

USER GUIDE

Tolomatic Motion Interface (TMI)

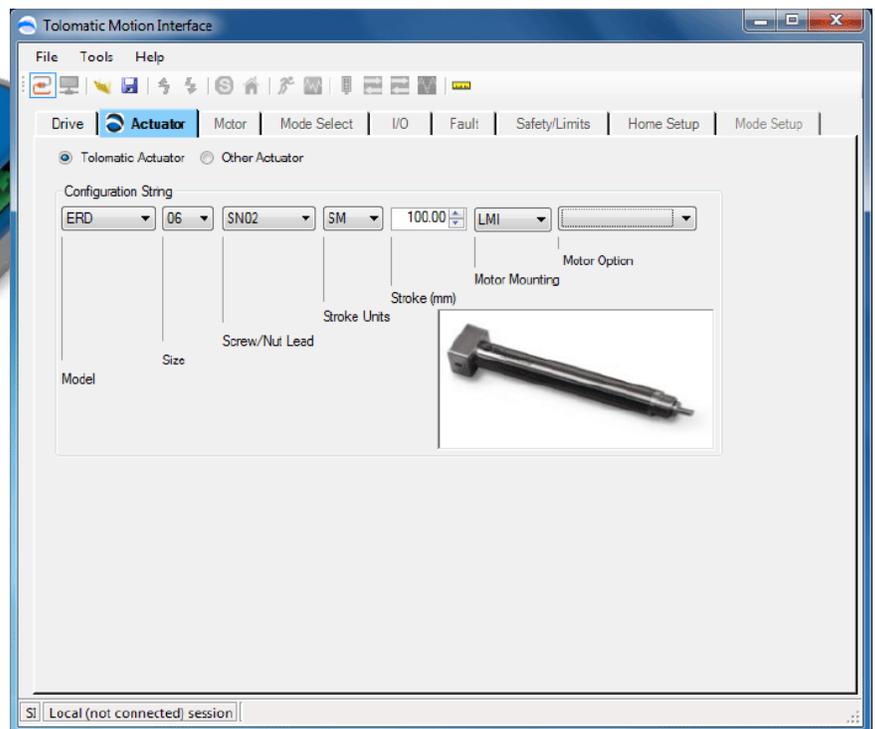
Stepper



Actuator Control Solutions for:

- ACS Stepper Drive/Controller/Motors
- ACS Servo Drive/Controller/Motors
- Tolomatic Electric Linear Actuators

Servo



DISCONTINUED Product Style, Size or Part no. This guide is for reference only. See 3604-4184 for current ACS Tolomatic Motion Interface (TMI) Guide

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1.1 The Tolomatic ACS Drive/Controller



NOTE:

It is important to identify the motor and corresponding ACS drive system (Stepper or Servo) being used!

Because the TMI software allows an offline connection that does not require the Tolomatic drive. This offline connection allows users to create, edit and save drive configuration files.

It is important to know which model Tolomatic ACS Drive/Controller you are programming. The stepper and servo units are the same size, color and externally are only different on the left panel. Use the part number on the label to confirm the Tolomatic ACS Drive/Controller you are programming.



Figure 1-1: Use the part number to identify the Tolomatic ACS Drive Controller you are programming

NOTE: Throughout this manual information that ONLY applies to Stepper Drives will be noted in grey box:

ACS Stepper Drive

ACS Stepper Drive

- Currently there are three ACS Stepper Drive/Controller choices:
- **#3604-9651** (ACST0324SD) - ACS Stepper Drive/Controller, Basic firmware 36043144SD.hex
 - **#3604-9654** (ACST0324ED) - ACS Stepper Drive/Controller, EtherNet/IP firmware 36043175ED.hex
 - **#3604-9655** (ACST0324MD) - ACS Stepper Drive/Controller, Modbus TCP firmware 36043176MD.hex

Information that ONLY applies to Servo Drives will be noted in light blue box:

ACS Servo Drive

ACS Servo Drive

- Currently there are three ACS Servo Drive/Controller choices:
- **#3604-9661** (ACSV2048UD) - ACS Servo Drive/Controller, Basic firmware 36043177.tol
 - **#3604-9662** (ACSV2048ED)- ACS Servo Drive/Controller, EtherNet/IP firmware 36043177.tol
 - **#3604-9663** (ACSV2048MD)- ACS Servo Drive/Controller, Modbus TCP firmware 36043177.tol

NOTE: They will collectively be referred to as ACS Drive throughout this guide

1: PRODUCT OVERVIEW

Some screens and instructions are different for the Stepper drive/controller than for the Servo drive/controller. The user guide indicates instructions that apply to Stepper only and instructions that apply to Servo only. If there is no indication, the information applies to all Tolomatic ACS Drive/Controllers.



NOTE:

It is important to identify the motor and corresponding ACS drive system (Stepper or Servo) being used!

Because the TMI software allows an offline connection that does not require the Tolomatic drive. This offline connection allows users to create, edit and save drive configuration files.

ACS Stepper Drive

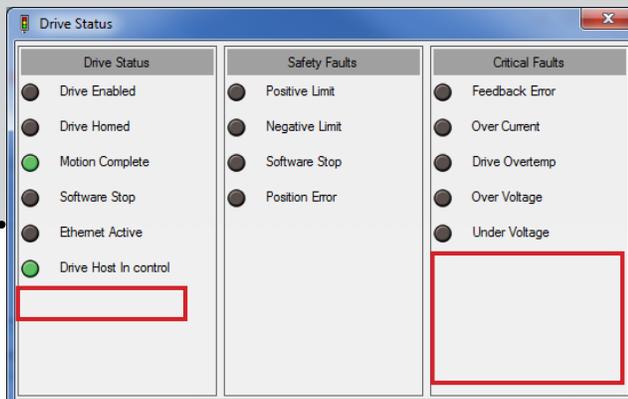


Figure 1-2: Example of Stepper Only information

ACS Servo Drive

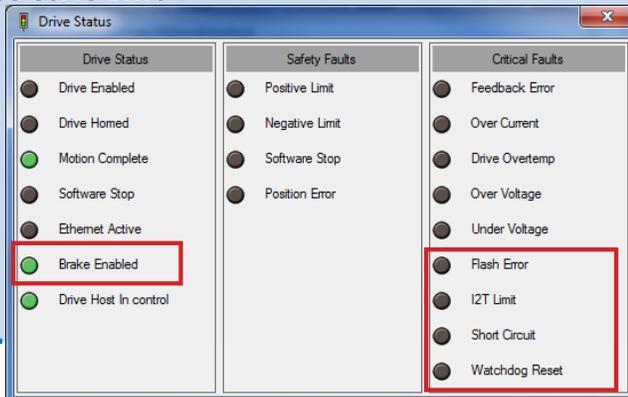


Figure 1-3: Example of Servo Only information

FOR EXAMPLE: The Tuning Filter Tool (Chapter 16) is only available for the Servo Drive. When the servo drive is connected to the computer the software will detect the drive and the Tuning Filter Tool will be available. Conversely, when connected to a Stepper Drive the Tuning Filter Tool will NOT be available.

2.1 Host Computer and Software System Requirements

The Tolomatic Motion Interface (TMI) is designed to work with a host PC with Windows® operating systems. Before installing the TMI software, be sure the host PC has the minimal host requirements indicated below.

2.1.1 Hardware Requirements

	HARDWARE	MINIMUM REQUIREMENT
	Processor	1 GHz
	RAM	512 MB
	Disk Space 32-Bit	600 MB
	Disk Space 64-Bit	1.5 GB
ACS Servo Drive	USB	1 USB Connection
ACS Stepper Drive	Serial* or USB	1 Serial Connection or 1 USB to Serial Adapter

Table 2-1: Hardware Requirements

*The ACS Stepper Drive requires a serial connection to the PC. Either through a USB serial adapter or plugging into a Com port on the PC.

2.1.2 Operating Systems Supported

The Tolomatic Motion Interface (TMI) is compatible with the following operating systems: Windows® 7, and Windows® 8.

For all platforms, it is recommended that you upgrade to the latest Windows Service Pack and critical updates from the Windows Update Web Site at <http://go.microsoft.com/fwlink/?LinkId=168461> to ensure the best compatibility and security.

The TMI software is not supported on IA-64-based (Itanium) systems.

3.1 Installation Instructions

3.1.1 Installing from the Tolomatic CD

1. Insert the software CD supplied by Tolomatic into the CD-ROM drive in your PC.
2. Follow the link on the displayed web page to install the latest software and view the manuals (requires internet connection)
3. If internet connection is not available, browse the CD and double-click the "**TolomaticMotionInterface[version].exe**" file to run the installer.
4. Follow the prompts to install the software.

The software will install a program launch icon in the Windows® Start menu at:
Start > All Programs > Tolomatic > TolomaticMotionInterface[version] > TolomaticMotionInterface

In the Start menu the program will start with a single click.

3.1.2 Downloading and Installing from the Tolomatic Web Site at www.tolomatic.com

The Tolomatic Motion Interface can be downloaded from the Tolomatic web site at www.tolomatic.com

1. To download, click on "**Resources**" in the navigation bar at top. Select "**Electric Linear Motion**" under "Select a product line below to view the available resources" by default the "Catalogs & Brochures" tab will open, select the tab: "**Software**" the current and archive ACS TMI software is available.
2. Select the TMI software and when prompted save the file to the programs folder on your hard drive.
3. Double-click the "**setup.exe**" file to run the installer.
4. Follow the prompts to install the software.

The software will install a program launch icon in the Windows® Start menu at:
Start > All Programs > Tolomatic > TolomaticMotionInterface[version] > TolomaticMotionInterface

In the Start menu the program will start with a single click.

4.1 Launching the TMI Software

1. To launch the software in the Windows® Start menu navigate to: **Start > All Programs > Tolomatic > TolomaticMotionInterface[version] > TolomaticMotionInterface**
2. When the TMI is launched for the first time, the software will automatically display the User Units dialog box (shown below, Figure 4-1) which defines the units displayed in the software. The user has two selections for linear actuator units: inches (US Linear) or mm (SI Linear).

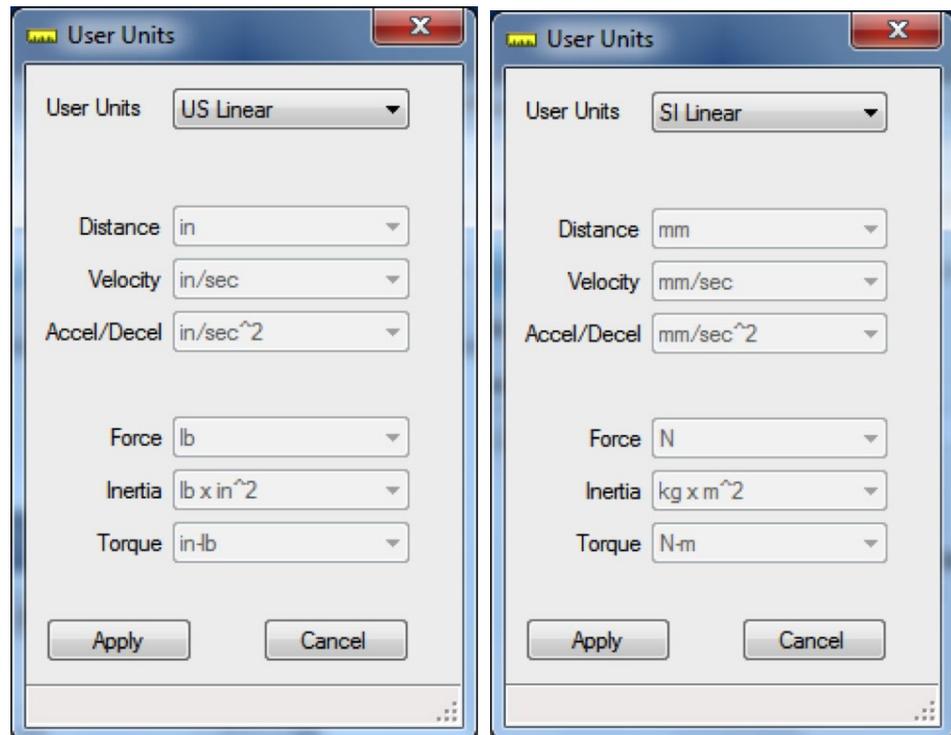


Figure 4-1: User Unit Dialog Box

3. The user must select the desired units and click Apply. Once the apply button is clicked TMI will no longer automatically display the User Units dialog box on application launch. To access the User Units dialog box click on the ruler icon in the tool bar at top. The units can be changed at any time and all displayed parameters in the software will be adjusted accordingly.

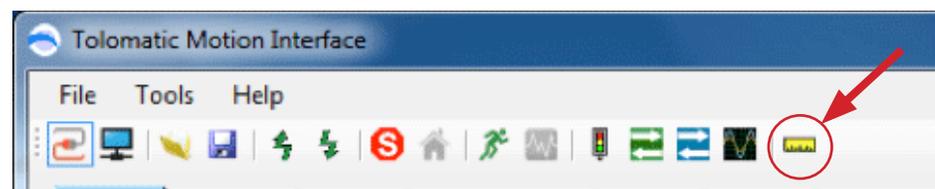


Figure 4-2: User Unit Tool Icon in menu

Establishing Communication 5

5.1 Establishing Communication with the Tolomatic ACS Drive



NOTE: The TMI software allows an offline connection that does not require the Tolomatic drive. This offline connection allows users to create, edit and save drive configuration files.



NOTE: Throughout this manual information that ONLY applies to Stepper Drives will be noted in grey box:

ACS Stepper Drive

Information that ONLY applies to Servo Drives will be noted in light blue box:

ACS Servo Drive

ACS Stepper Drive

For stepper drives the communications protocol used for configuration uses RS-232 cable.
or

ACS Servo Drive

For servo drives the communications protocol used for configuration uses USB cable.

1. After the User Units have been selected on initial startup, and from then on once the TMI is launched, the software will automatically default to the Drive tab shown in Figure 5-1 below.

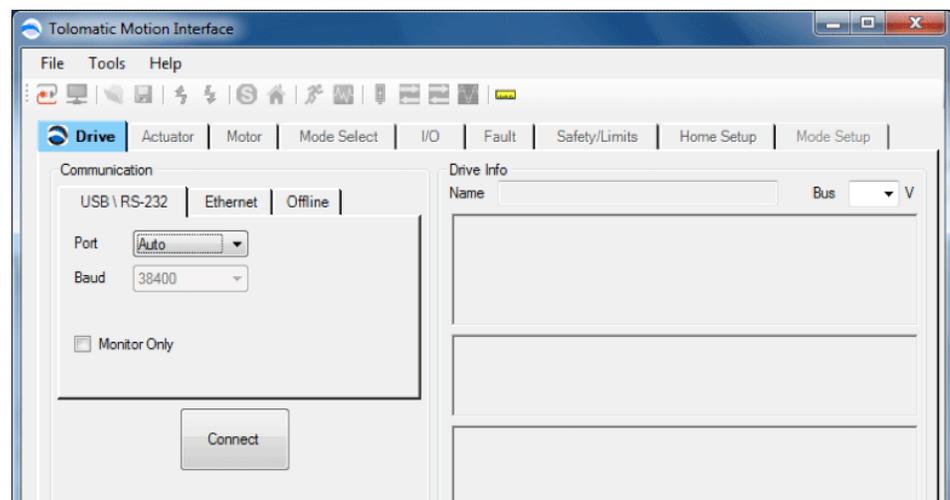


Figure 5-1: Drive Tab Showing ACS Drive Disconnected

2. When the 'Auto' option is selected for the port, TMI attempts to detect the presence of ACS servo or stepper drive on any of the COM ports available on the computer. The ACS drive must be powered on for communication with the PC in order for the discovery sequence to be successful. (If no ACS Drive is found, the status bar (at bottom) will display "Disconnected" and the text box will display "Unable to connect to ACS Drive" message.) The user may also select a specific port from the list of available COM ports. TMI will prompt you to install drivers if drivers are required to connect to the drive. For proper operation be sure that both the TMI software and associated drivers are up-to-date. Once successful communication is established, the TMI will remember that port for subsequent sessions. The Baud rate is set to 38400 and can not be changed.
3. Upon establishing communication with the ACS Drive, the TMI software reads all the current settings in the ACS Drive and updates the software interface accordingly. As shown in Figure 5-2, the ACS Drive information is displayed in several fields: Name of ACS Drive given by user; ACS Drive information including Model and Firmware Version; and a Photo of the Tolomatic ACS Drive

5: ESTABLISHING COMMUNICATIONS

product being configured (ACS Drive/Controller is pictured). If the ACS Drive has Network hardware the MAC address will also be displayed.

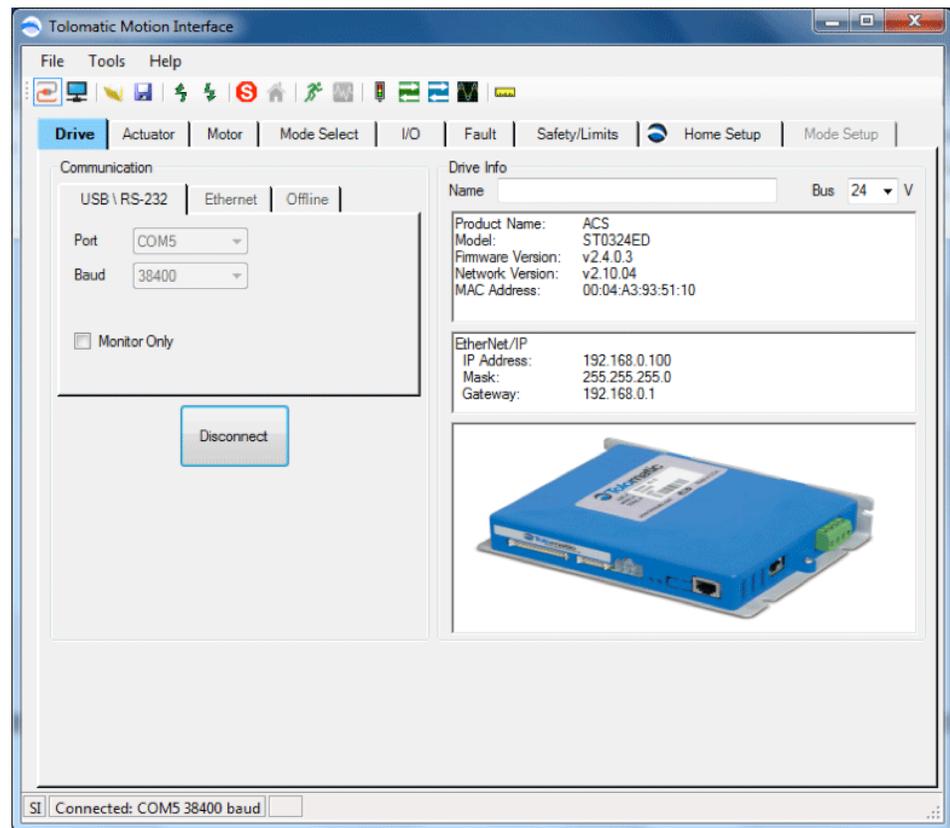


Figure 5-2: Drive Tab Showing ACS Drive Connected

4. The TMI software opens a Software Stop window shown in Figure 5-3. This Software Stop window is intended to be a software motion stop. If the user clicks on the stop button, the actuator will immediately stop. The Tolomatic ACS Drive will be disabled along with the output to the motor. For safety reasons this window is intended to always be on top of other windows.



Figure 5-3: Software Stop

5.2 Offline Connection

The TMI software supports an offline connection that allows the user to create, edit and save drive configuration files without the Tolomatic ACS Drive being present. This is a useful development and debug tool to create and analyze the drive configuration files.

With the Offline connection, all controls related to motion, tuning and enabling/disabling drive are disabled. The offline connection does not allow the user to simulate motion, debug logic, or tune servo motors.

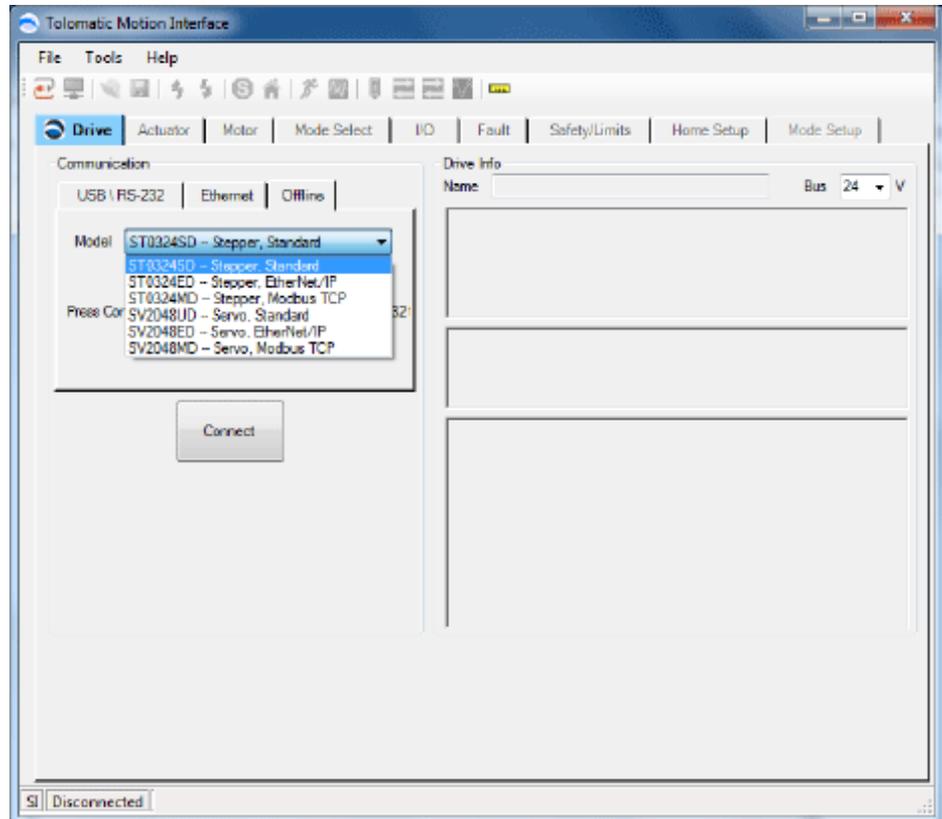


Figure 5-4: Offline connection

6.1 Navigating through the Tolomatic Motion Interface (TMI)

6.1.1 Setup Wizard Tabs

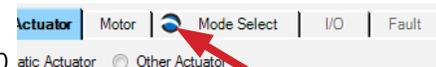
The TMI software for configuring the ACS Drive is designed as a setup wizard. It uses tabs, navigating from left to right through all the steps needed to configure the ACS Drive and create motion. As shown below, there are multiple tabs which are used in the setup process.

TMI Setup Wizard Navigation Tabs	
Drive	Establish communication and verify ACS Drive identification information such as model and firmware version.
Actuator	Configure a Tolomatic actuator or create a custom actuator in the “Other Actuator Catalog.”
Motor	Configure or view parameters of a Tolomatic motor or create a 3rd party motor file in the “Other Motor Catalog.”
Mode Select	Select the desired operating mode. Tolomatic ACS Drive products were designed to have dedicated operating modes to simplify the configuration and operation of the ACS Drive. Currently, there are four operating modes, depending on model: Index Move, Pneumatic, Analog Position and Network (<i>EtherNet/IP, ModbusTCP, Modbus RTU</i>)
I/O	Configure the functionality of the digital inputs and digital outputs of the ACS Drive. The TMI will automatically configure a suggested I/O map based on the selected operating mode.
Fault	Enable/disable faults, and configure the action taken for the displayed faults.
Safety/Limits	Configure safety parameters and motion limits such as: in position, position error, maximum velocity/accel/decel, current limit, software limits and zone bounds
Home Setup	Configure the homing routine parameters such as type, direction, velocity, force, and home on power-up.
Mode Setup	Setup the operating Mode selected in the Mode Setup tab. For example, in Index Move mode, the user configures move type, position, velocity, acceleration, deceleration and force for all the moves.

Table 6-1: TMI Setup Wizard Navigation Tabs

6.1.2 Tolomatic Logo

The TMI software uses the Tolomatic Logo to guide the user through the software in order to correctly configure all necessary parameters. Notice in the drawing above that the ACS Drive is connected, the Tolomatic logo has moved to the Actuator tab which is the next required step—configuring the actuator. The Drive tab remains highlighted in Blue which gives the user visual indication of the currently selected tab.



6.1.3 Tool Bar



Figure 6-1: Tolomatic Motion Interface (TMI) Tool Bar

The Tool Bar includes the following:



Drive Connect: Connect or disconnect communication to the ACS Drive.



Ethernet Setup (optional): Set up ACS Drive for Ethernet communication.



Open: Open a previously saved drive configuration file to setup all the parameters of the ACS Drive.



Save: Save all parameters to a drive configuration file for later use.



Restore Current Settings from Drive Flash: Read all parameters from drive flash memory into the TMI software.



Write Current Settings to Drive Flash: Write all parameters from the TMI software into the drive flash memory.



Software Stop: Disables ACS Drive and output to the motor



Home: Initiates a home routine



Motion Manager tool: Tool used to create simple moves such as absolute, incremental and jog. All motion profile parameters are adjustable through this tool.

ACS Servo Drive  **Tuning Filter tool:** Tool used to tune servo motors (advanced users)



Drive Status tool: Tool used to notify user of critical drive information such as Enable status, Home status, In Position status and Faults (see Section 20: Drive Status Tool).



Digital I/O tool: Tool used to view the status of the Digital Inputs and Digital Outputs (see Section 17: Digital I/O Tool).



Analog I/O tool: Tool used to view the status of the Analog Inputs and Analog Outputs (see Section 18 Analog I/O Tool).



4 Channel Software Oscilloscope: Tool used to view signals on the drive.



User Units tool: Tool to select application user units. At time of this release, units are selected in inches or millimeters.

6.1.4 Tool Tips

As the user moves the mouse over Tool Bar items, drive parameters or action buttons, the TMI will display a tool tip providing useful information about that item.

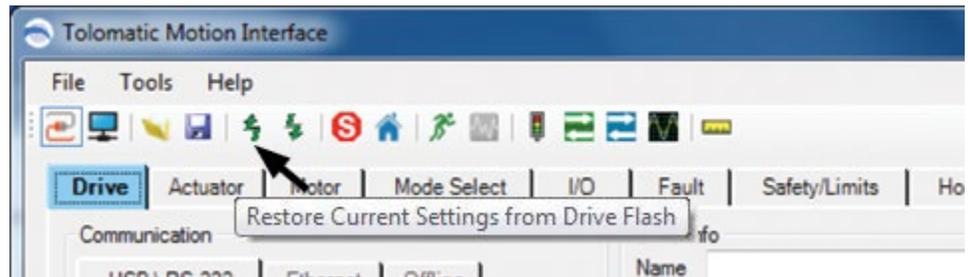


Figure 6-2: Tool Tips Display

Tool Tip Displays: Moving the mouse over a parameter field will activate the Tool Tips display and it will show the allowable range for that parameter. If a user attempts to enter a lower number than is allowed, the TMI software will automatically default to the minimum allowable value. If a user attempts to enter a higher number than is allowed, the TMI will automatically default to the maximum allowable value.

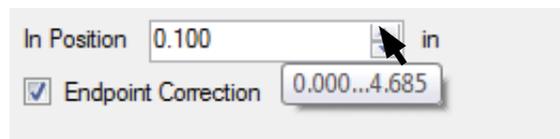


Figure 6-3: Parameter Range in Tool Tip Display

6.1.5 Parameter Entry

Red Parameter Field: The TMI will automatically shade any parameter field a red color if that parameter has not been configured (see Figure 6-4). This is a notice to the user that this parameter must be configured before continuing or creating motion.

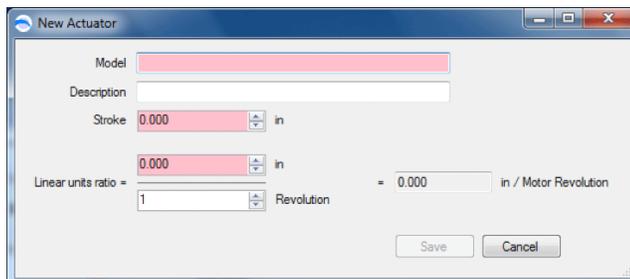


Figure 6-4: Red Parameter Fields

6.1.6 File Menu

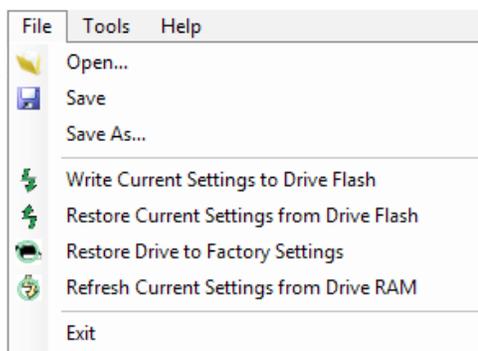


Figure 6-5: File Menu Options

NOTE: Executing any Open, Restore or Read operation will result in the TMI software automatically navigating to the Drive Tab and updating all parameters in TMI to the current drive settings.

File Menu Drop Down Descriptions	
Open	Open a drive configuration file to setup all the parameters of the ACS Drive.
Save	Saves all parameters to a drive configuration file. If user hasn't given a name to the file yet, a File Save window will be opened.
Save As	Opens a File Save window to allow user to select location and name of drive configuration file.
Write Current Settings to Drive Flash	Write all parameters from the TMI software into the drive flash memory.
Read Current Settings from Drive Flash	Read all parameters from drive flash memory into the drive's RAM and into the TMI software.
Restore Drive to Factory Settings	Restores all parameters in the ACS Drive flash and RAM memory to factory defaults.
Read Current Settings from Drive RAM	Reads all parameters in ACS Drive RAM into the TMI software (Performed automatically when communication is established)
Exit	Exits the application

Table 6-2: File Menu Drop Down Descriptions

6.1.7 Tools Menu

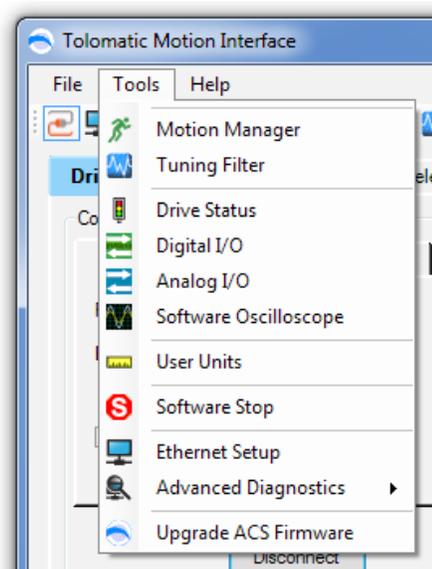


Figure 6-6: Tools Menu

Tools Menu Drop Down Descriptions	
Motion Manager	Used to create simple moves such as absolute, incremental and jog. All motion profile parameters are adjustable through the Motion Manager tool.
ACS Servo Drive Tuning Filter	Tool used to tune servo motors
Drive Status	Used to notify user of critical drive information such as Enable status, Home status, In Position status and Faults
Digital I/O	Used to view the status of the Digital Inputs and Digital Outputs.
Analog I/O	Used to view the status of the Analog Inputs and Analog Outputs.
4 Channel Software Oscilloscope	Software tool used to analyze drive parameters
User Units	Used to select application user units. At time of this release, units are selected in inches or millimeters.
Software Stop	Used to disable ACS Drive and output to the motor. This tool is automatically launched when the TMI software connects to the ACS Drive.
Ethernet Setup (optional)	Set up ACS Drive for Ethernet communication.
Advanced Diagnostics	Tools used for advanced diagnostics and troubleshooting.
Upgrade ACS Firmware	Used to upgrade the firmware for the ACS.

Table 6-3: Tools Menu Drop Down Descriptions

6.1.8 Help Menu

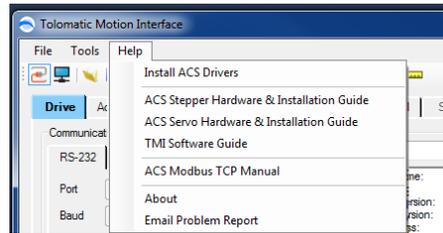


Figure 6-7: Help Menu Drop Down Options

Install ACS Drivers: Installs the drivers for the USB enabled ACS Drives.

ACS Stepper Hardware & Installation Guide: Launches a PDF of the manual with ACS Stepper Drive specifications, wiring diagrams, connector and cable information.

ACS Servo Hardware & Installation Guide: Launches a PDF of the manual with ACS Servo Drive specifications, wiring diagrams, connector and cable information.

Tolomatic Motion Interface (TMI) Software Guide: Launches a PDF of this manual.

ACS [Network Mode] Manual: Launches a drive specific PDF of the manual for supported network mode.

About: Indicates the current software version of the Tolomatic Motion Interface and the build date.

Email Problem Report: Launches local email application with log file attachments that can be sent to Tolomatic in the event of an issue.

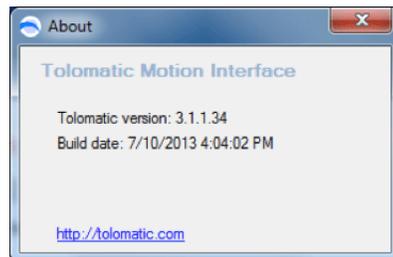


Figure 6-8: About Window

7.1 Using the Actuator Tab



NOTE: ALL

Tolomatic electric actuators can be selected from the model drop down menu.

The Actuator tab is used to configure a Tolomatic actuator or define a new actuator. The default selection of the radio button is Tolomatic Actuator.

7.1.1 Tolomatic Actuator Selection

1. Identify the actuator configuration string on the actuator. Enter Model, Size, Screw/Nut Lead, Stroke Units (either SM for mm, or SK for inches), length of Stroke in units specified, Motor Mount, and Motor option.



Figure 7-1: Configuration string on ERD actuator

2. When Model is configured, a photo of the actuator will be shown. (Note: ALL Tolomatic electric actuators can be selected from the model drop down menu.)



Figure 7-2: Configuring the Tolomatic Actuator Selection



NOTE: When complete configuration string is entered the Tolomatic logo will move to the next tab requiring attention.

3. Copy to Other Actuator: Creates a new actuator in the Other Actuator Selection based on the defined Tolomatic Actuator.

7.1.2 Other Actuator Selection

The Other Actuator Catalog allows a user to keep any number of Other Actuator models in the file for convenience and later reference.

1. If no Other Actuators have been created there will be no selections under the Models drop down. In this case, the user must click the New button at the bottom of the screen (see Figure 7-3).

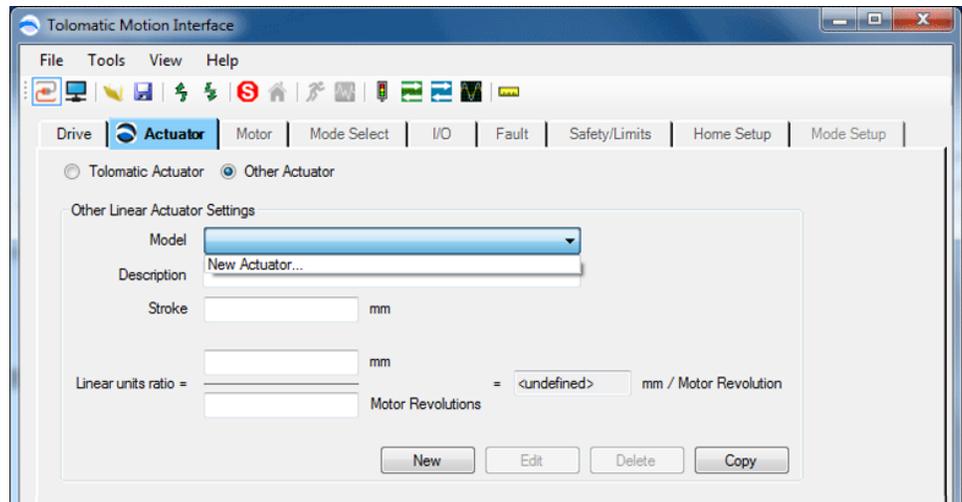


Figure 7-3: Selection of Other Actuators

2. Clicking the New button, will bring up a New Actuator dialog in which the user must enter critical information about the actuator (see figure 7-4)
3. Model field: Enter the name selected for the Other Actuator. It will remain red until the user enters a unique name that has not already been saved into the Other Actuator Catalog.
4. Description field: Enter a unique description of the Other Actuator, up to a 28 alpha-numeric character entry that is all uppercase. This field is optional.
5. Stroke field: Enter the stroke in the selected user units. There is no stroke limit for Other Actuators.

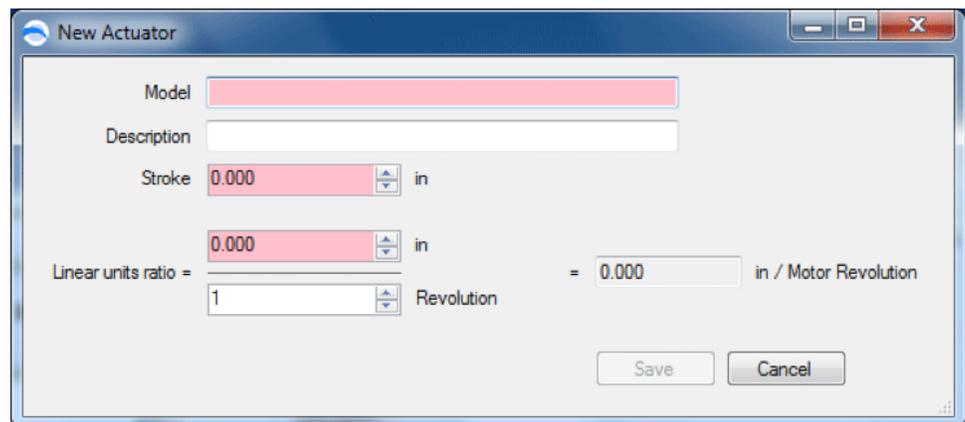


Figure 7-4: New Actuator Window

6. Linear Units Ratio field: These numerator and denominator entries are used to setup the ratio of rotary motor revolutions to linear distance in selected user

units per motor revolution. If there is a gearbox inline with the motor, this ratio must be taken into account and entered accordingly.

For example, if there is an Other Actuator with an 0.5" lead screw, then the Linear Units Ratio would look as in Figure 7-5 below. All the required fields have been entered properly and the parameters have been validated. This activates the Save button.

Figure 7-5: New Actuator Window Data Entry Complete

- Clicking the save button adds the New Actuator information to the Other Actuator catalog. The name of the new actuator is automatically added to the Model drop down for later reference.

Figure 7-6: Other Actuator Window with Multiple Model Drop Down Display

- Button descriptions:
 - New: Create new actuator
 - Edit: Edit existing actuator previously saved
 - Delete: Delete selected actuator
 - Copy: Create a new actuator based on selected existing actuator

8.1 Using the Motor Tab

The Motor tab is used to configure a Tolomatic motor or create a different motor in the Other Motor Catalog. The default selection of the radio button is Tolomatic Motor.

8.1.1 Tolomatic Motor Selection

1. Verify the correct Motor selection and settings are displayed.
2. All parameters except the Reverse Direction check box are automatically populated with those of the selected motor and are disabled from entry.
If the user wishes to select a different motor Model that is acceptable for the actuator chosen, then simply select a new motor from the Model drop down.
3. Depending on the actuator configuration or the actuator installation in the machine, the user may wish to reverse the direction of the motor's positive direction. Default positive motion direction is CW (clockwise) when viewed toward output shaft of motor. To change it to CCW (counter-clockwise), the Reverse Direction check box must be checked.

ACS Stepper Drive

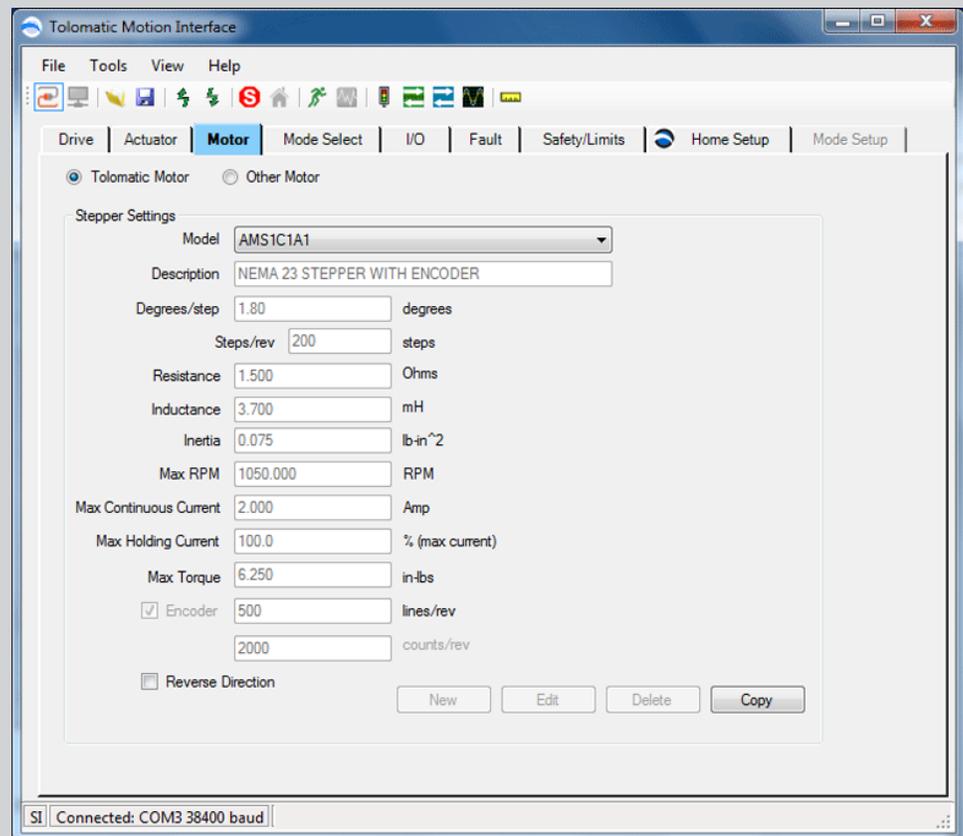


Figure 8-1: Motor Tab with Tolomatic Stepper Motor Selected

ACS Servo Drive

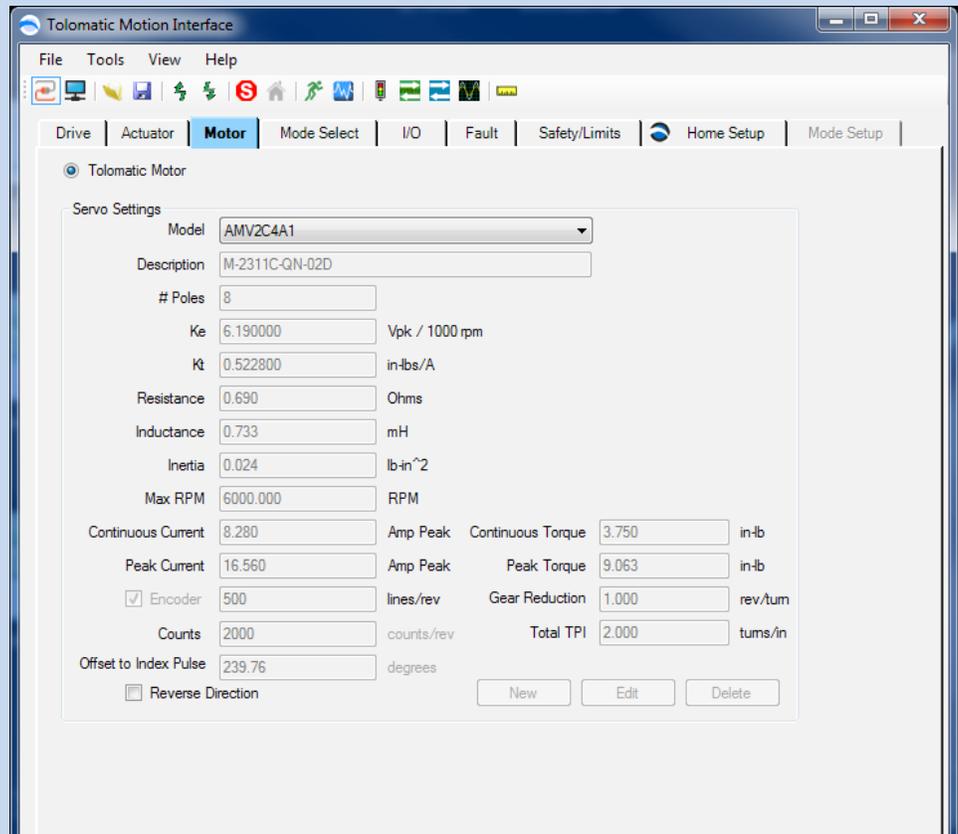


Figure 8-2: Motor Tab with Tolomatic Servo Motor Selected

NOTE: Servo does not currently support "Other Motor".

ACS Stepper Drive

8.1.2 Other Motor Selection

The Other Motor catalog allows a user to keep any number of motor models compatible with the ACS Drive in the file for convenience and later use. Selection of a motor other than one supplied by Tolomatic is done in a similar procedure as selecting an Other Actuator.

1. If no Other Motors have been created there will be no selections under the Models drop down (see Figure 8-3). In this case, the user must click the New button at the bottom of the screen.

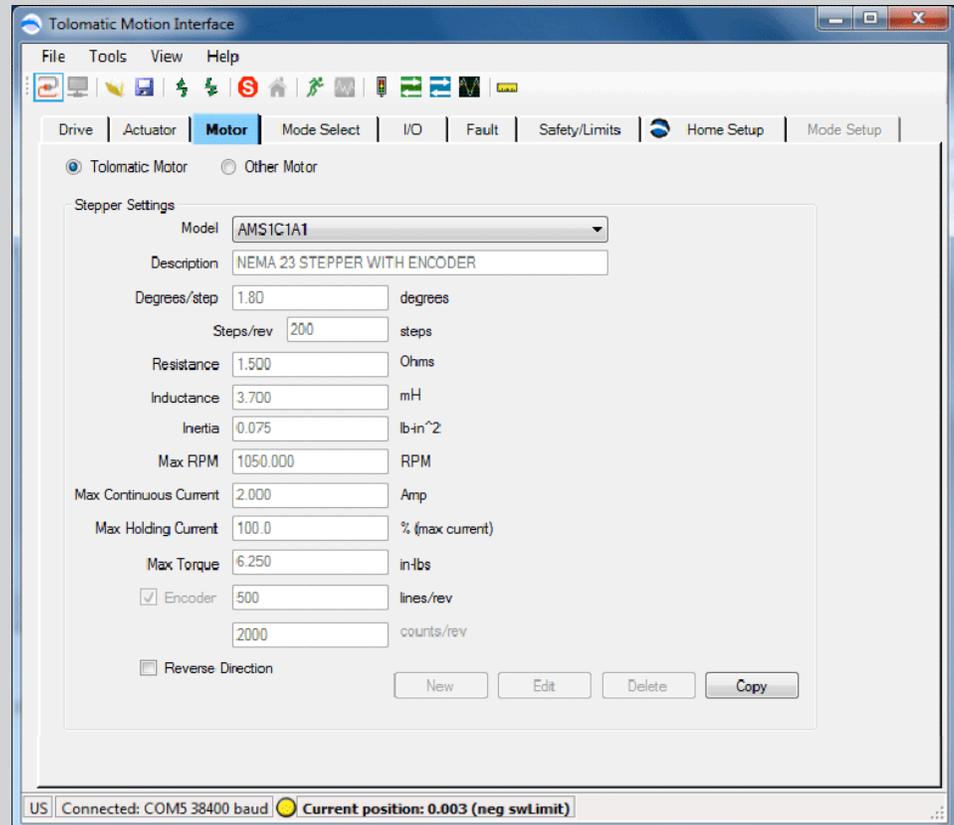


Figure 8-3: Other Motor with no Model Choices Available

2. Clicking the New button, will bring up a New Stepper Motor dialog box in which the user must enter the motor name, description (28 alpha-numeric characters in uppercase), and specifications. Once the information entered has been validated, the light red fields will disappear and the save button will become active.
3. Clicking the save button adds the New Motor information to the Other Motor catalog. The name of the new motor is automatically added to the Model drop down for later reference.
4. Depending on the actuator configuration or the actuator installation in the machine, the user may wish to reverse the direction of the motor's positive direction. When facing motor mounting end, default positive motion direction is CW (clockwise). To change it to CCW (counter-clockwise), the Reverse Direction check box must be checked.

ACS Stepper Drive

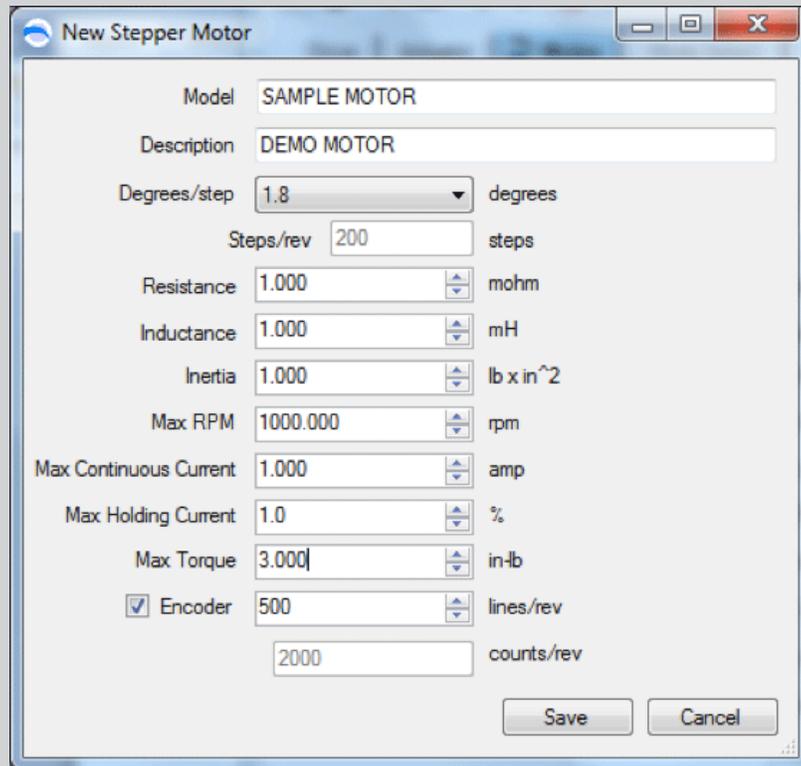


Figure 8-4: Edit Stepper Motor Window with Data Complete

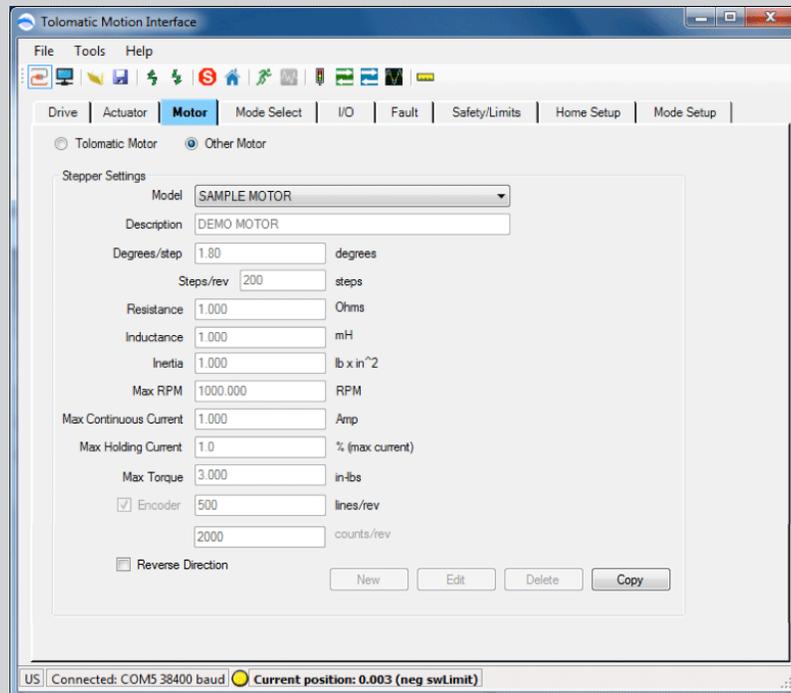


Figure 8-5: Other Motor Window with Model Added to Drop Down Display

5. Button descriptions: New: Create new actuator Edit: Edit existing actuator previously saved Delete: Delete selected actuator Copy: Create a new actuator based on selected existing actuator

9.1 Using the Mode Select Tab

ACS Stepper Drive



NOTE: The ACS stepper drive models and modes are as follows:

	ACS Model	Number	Mode
24V Stepper	ST0324SD	3604-9651	Index Move Analog Position Pneumatic Modbus RTU
	ST0324ED	3604-9654	Index Move Analog Position Pneumatic EtherNet/IP
	ST0324MD	3604-9655	Index Move Analog Position Pneumatic Modbus TCP

The software supports four different operating modes: Index Move, Analog Position, Pneumatic and Network. Network mode supports one of the following protocols: *Modbus RTU*, *EtherNet/IP* or *Modbus TCP*.

The **Index Move** mode supports 4, 8, and 16 move commands. These move commands can be configured to be Absolute, Incremental, Jog, Home or No Action moves. The motion profile can be independently set for each move. The motion profile includes velocity, acceleration, deceleration and force which is setup in the Mode Setup tab (see Section 14: Mode Setup Tab).

The **Analog Position** mode supports both voltage (0 to 10 VDC) and current (0 to 20 mA) on the analog input and analog output. The ACS Drive follows the analog input signal and commands the actuator position to a scaled position as distance/volt.

The **Pneumatic** mode is used to replace or mimic pneumatic cylinder/valve operation logic. With pneumatic mode there are four different selections: Spring, 2 Position (2 input), 3 Position (2 input) & 3 Position (3 input). These four pneumatic mode operations allow just about any pneumatic valve logic to be replaced with the ACS drive. Additionally, in pneumatic mode, the drive will automatically home the actuator upon power up based on the home setup configuration.

The **Network** mode supports one of the *Modbus RTU*, *EtherNet/IP* or *Modbus TCP* protocols. The ACS Drive can then accept commands to change motion profile, command infinite positions, monitor status and provide diagnostics.

ACS Servo Drive



NOTE: The ACS servo drive models and modes are as follows:

	ACS Model	Number	Mode
24V - 48V Servo	SV2048UD	3604-9661	Index Move Analog Position Pneumatic Modbus RTU
	SV2048ED	3604-9662	Index Move Analog Position Pneumatic EtherNet/IP
	SV2048MD	3604-9663	Index Move Analog Position Pneumatic Modbus TCP

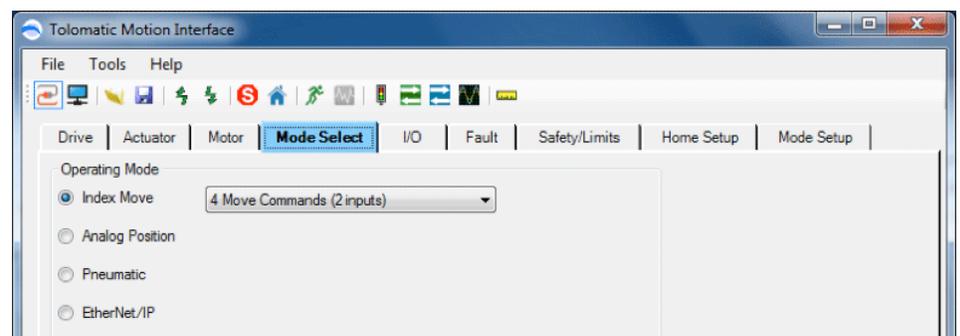


Figure 9-1: Mode Select Tab Window - Index default



NOTE: The TMI software will determine if ModBus RTU, EtherNet/IP or Modbus TCP is appropriate based on the connected ACS Drive and firmware version.

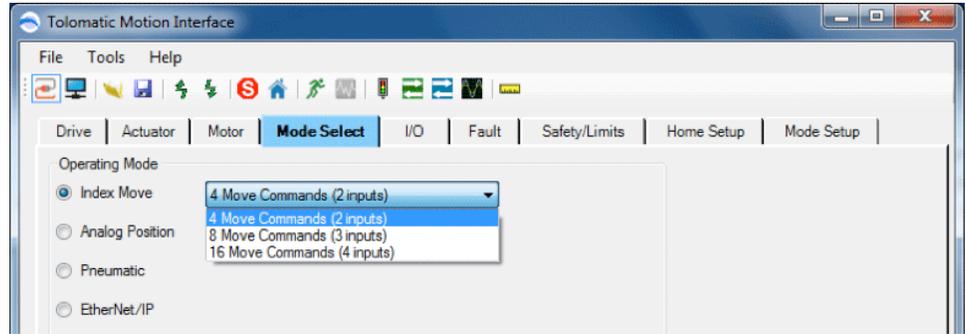


Figure 9-2: Mode Select Tab Window - Index drop-down

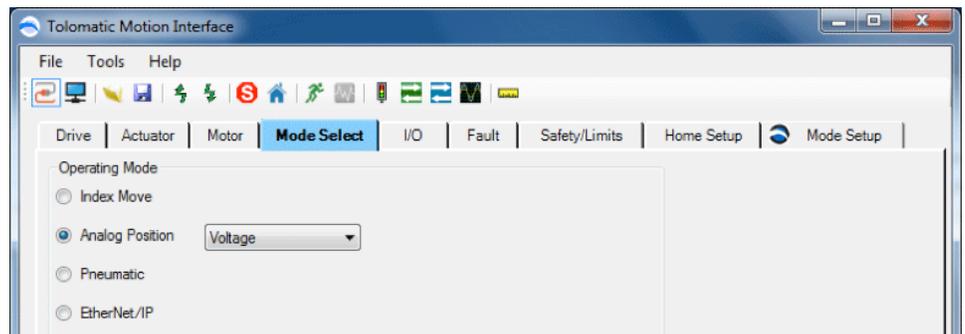


Figure 9-3: Mode Select Tab Window - Analog default

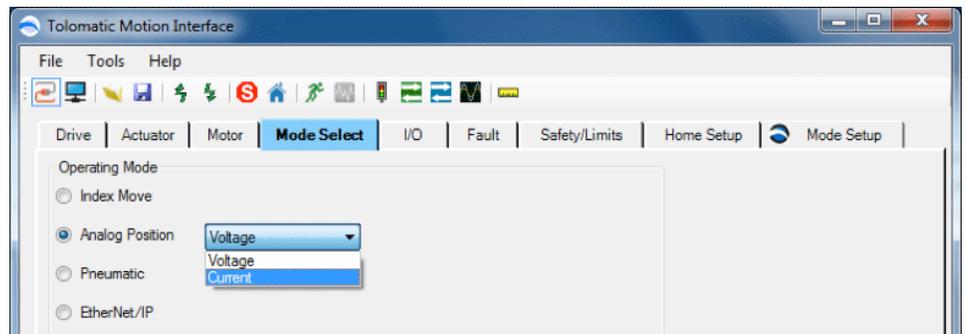


Figure 9-4: Mode Select Tab Window - Analog drop-down

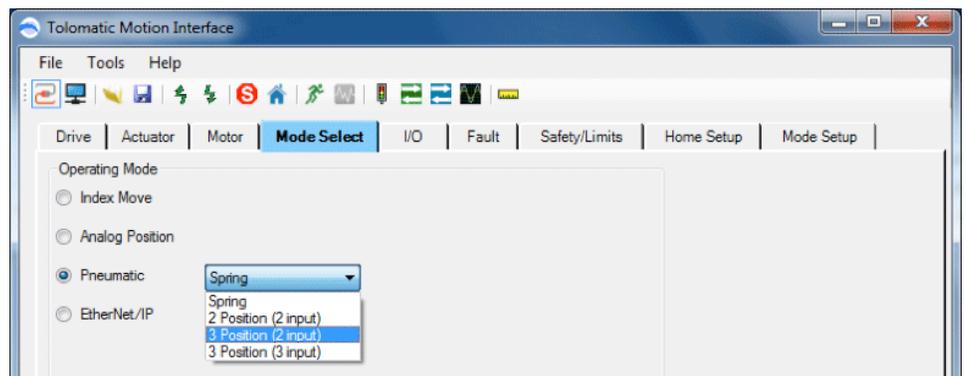


Figure 9-5: Mode Select Tab Window - Pneumatic drop-down



Figure 9-6: Mode Select Tab Window - Modbus RTU

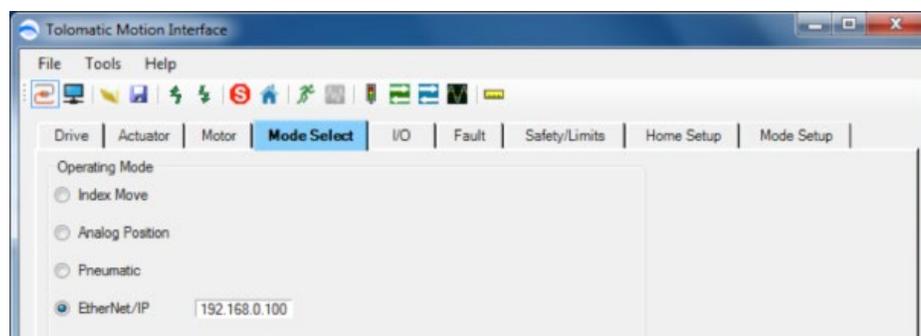


Figure 9-7: Mode Select Tab Window - EtherNet/IP

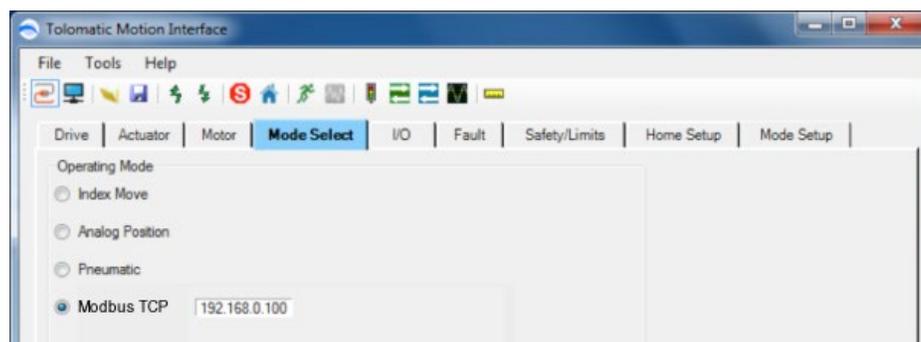


Figure 9-8: Mode Select Tab Window - Modbus TCP

10.1 Using the I/O Tab

The digital input and digital output functionality are configured using the I/O tab. Default I/O configurations are set up for the selected mode and are shown after the Digital Input and Output Command Tables in Figures 10-1 through 10-4.

10.1.1 Digital Inputs

Digital Input Functionality	
Enable	Enables or Disables the ACS Drive and power to the motor. NOTE: Faults configured to Disable Motor (see Section 11: Fault Tab) will require PLC or logic device to cycle level of Enable input to re-enable the ACS Drive. Cycling this input when there is no feedback device will clear the Home output.
Start Motion	Initiates the selected move command from the Move Select inputs.
Stop Motion	Stops move in progress with controlled deceleration.
Home	Initiates the homing routine setup in the Home Setup tab (see Section 13: Home Setup Tab).
Software-stop	Executes an immediate stop which either stops motion or disables ACS Drive depending on the fault configuration in the Fault tab (see Section 11: Fault Tab). While asserted it prevents further motion.
Move Select 1-4 Inputs	Selects move for execution based on Index Move mode (see Appendix 2 for Move Select Logic) or Pneumatic mode (see Appendix 3 for Move Select Logic)
Positive Limit Switch	Stops motion or disables the ACS Drive depending on the fault configuration in the Fault tab (see Section 11: Fault Tab).
Negative Limit Switch	Stops motion or disables the ACS Drive depending on the fault configuration in the Fault tab (see Section 11: Fault Tab).

Table 10-1: Descriptions of Digital Input Functionality

Refer to Appendix 1: I/O Timing Diagrams for Input Requirement, System Startup Timing, Jog Move Timing, Absolute and Incremental Moves, Timing and Move Timing Rules.

10.1.2 Digital Outputs

Digital Output Functionality	
Motion Complete	Signal to PLC or logic device indicating whether motion is in progress (off) or motion is complete (on).
Home Complete	Signal to PLC or logic device indicating whether ACS Drive/ motor combination is homed (on) or not homed (off). NOTE: When homing is in progress, the Home Complete output will be off.

Digital Output Functionality	
Fault	Signal to PLC or logic device indicating that a fault has occurred. The steps to reset the fault are different depending on the fault category (see section 11: Fault Tab) for a complete description of faults and recovery.
Zone (Optional)	Signal to PLC or logic device indicating that the position of the actuator is within the Zone Positive Bound and Zone Negative Bound setup in the Safety/Limits tab (see Section 12: Safety/Limits Tab).

Table 10-2: Descriptions of Digital Output Commands

Refer to Appendix 1: I/O Timing Diagrams for Input Requirement, System Startup Timing, Jog Move Timing, Absolute and Incremental Moves, Timing and Move Timing Rules.

Digital Input Control

TMI allows the user to adjust the digital debounce time from 0 to 500 milliseconds. (This control is not pictured)

10.1.3 Default Configurations for Operating Modes

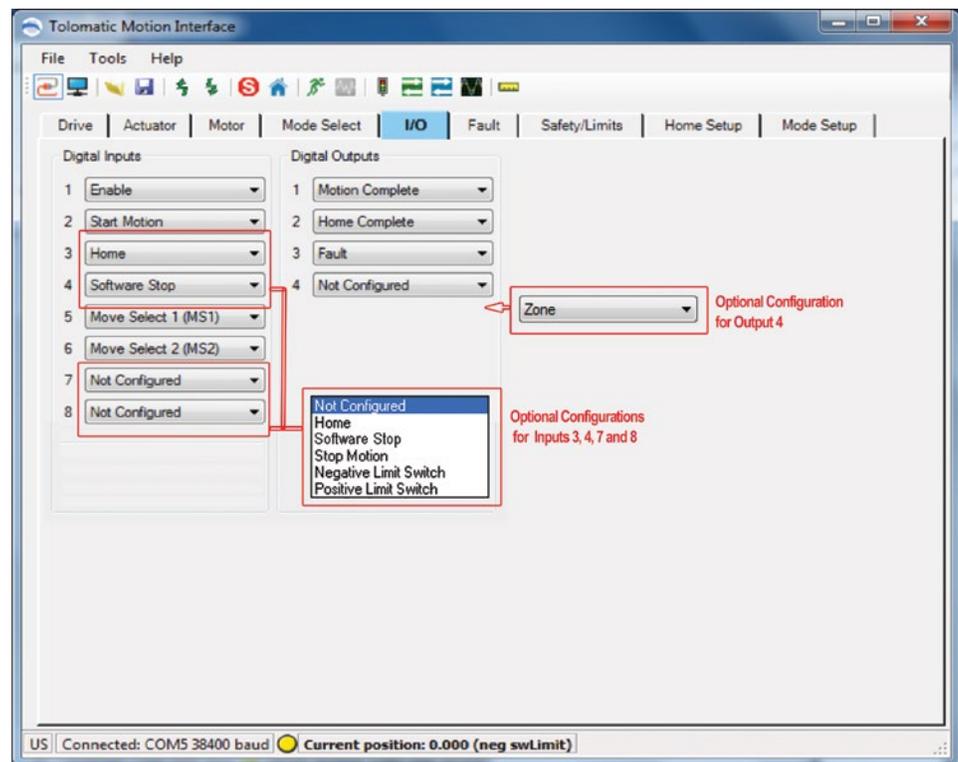


Figure 10-1: Default Configuration and Options for 4 Index Move Command

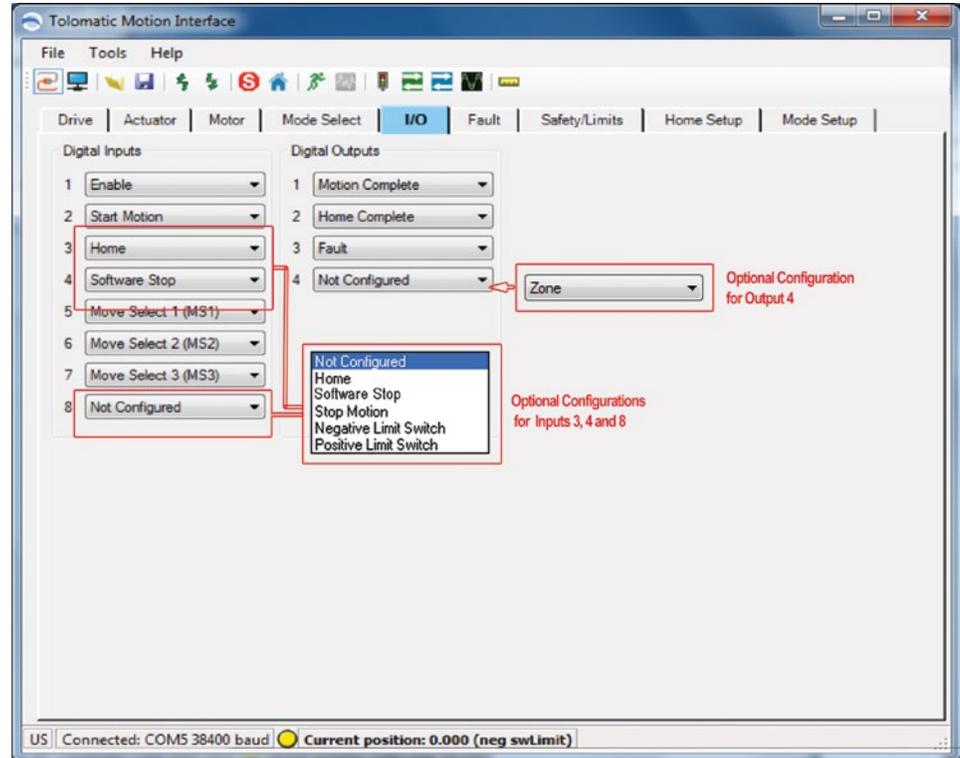


Figure 10-2: Default Configuration and Options for 8 Index Move Command

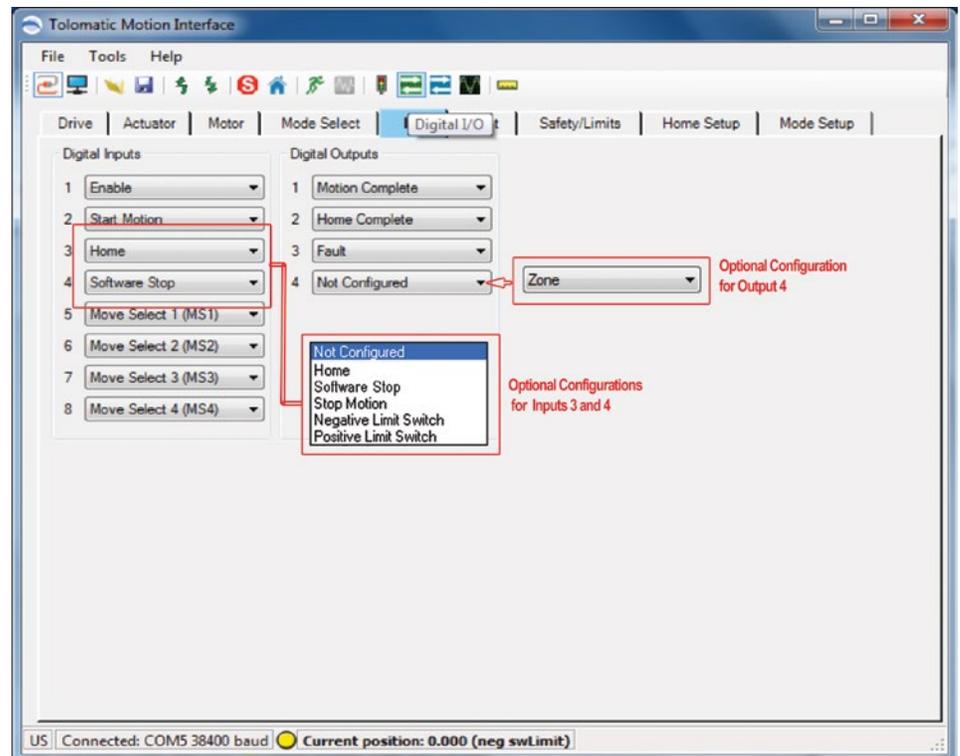


Figure 10-3: Default configuration and Options for 16 Index Move Command

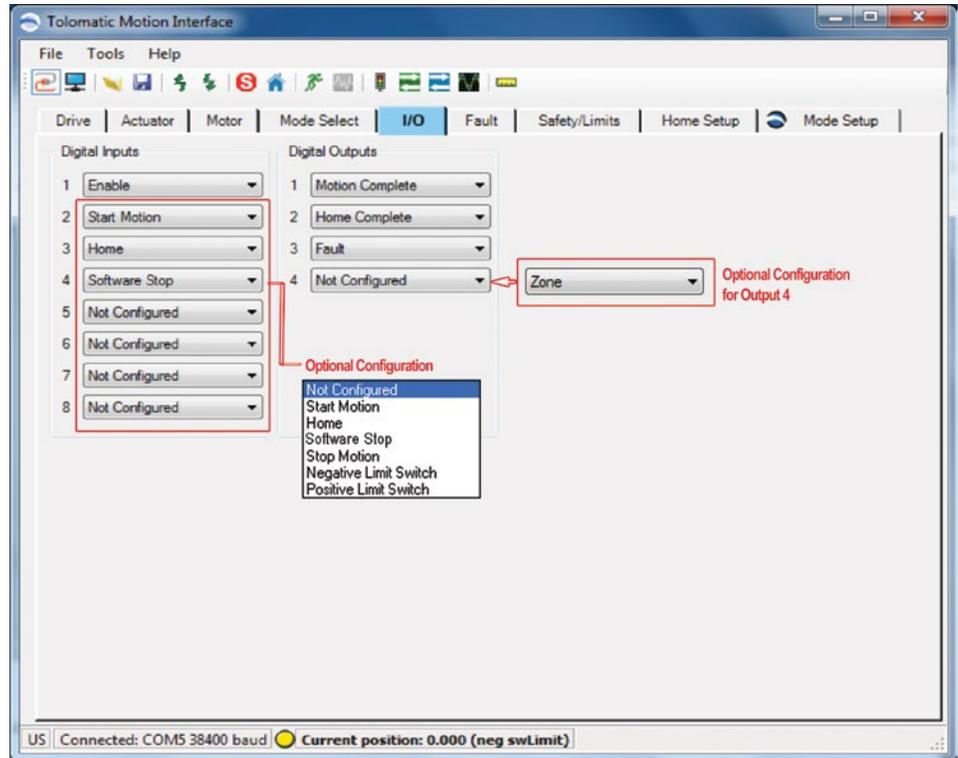


Figure 10-4: Default configuration and Options for Analog Position mode

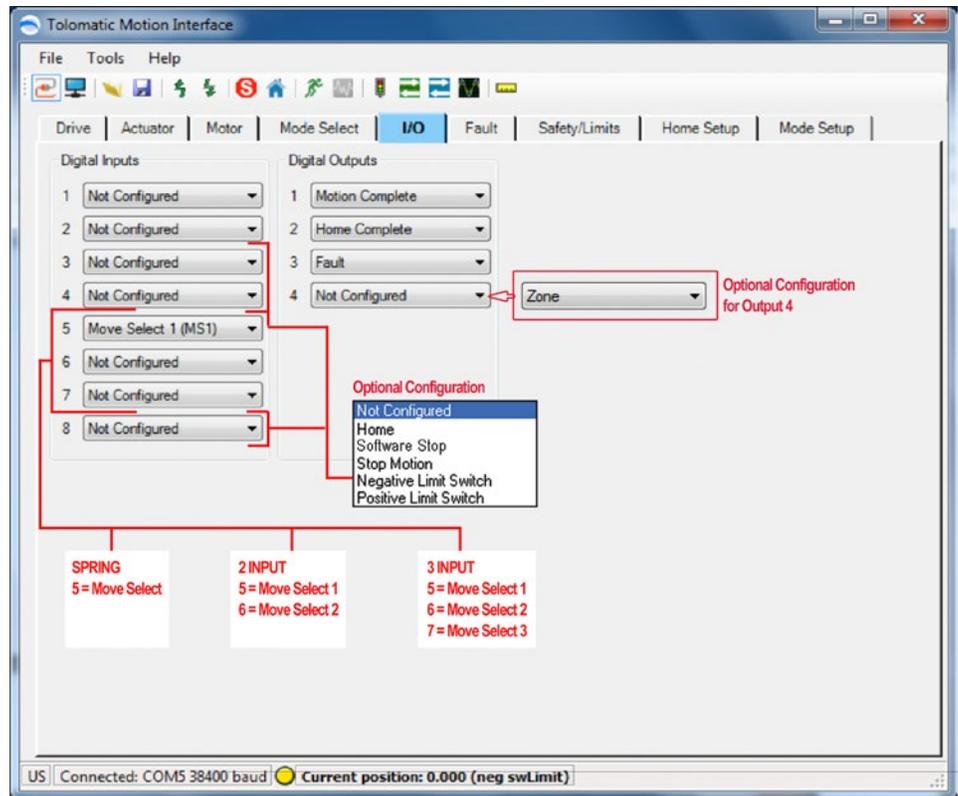


Figure 10-5: Default configuration and Options for Pneumatic mode

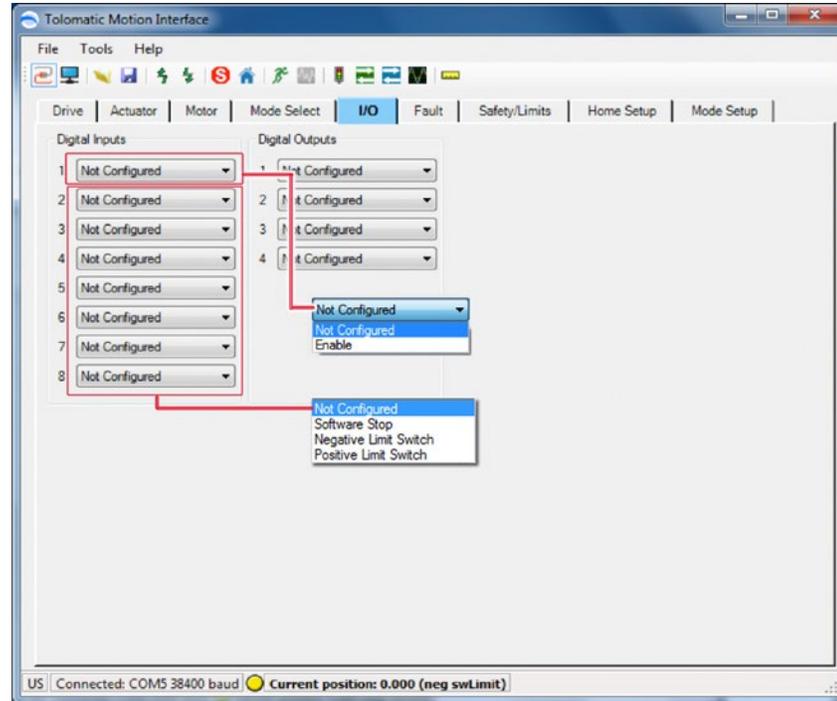


Figure 10-6: Default configuration and Options for Network modes (one of these protocols: Modbus RTU, EtherNet/IP or Modbus TCP)

10.1.4 Brake Output Configuration

For drives that support brake output, control of the output is configured on the I/O tab.

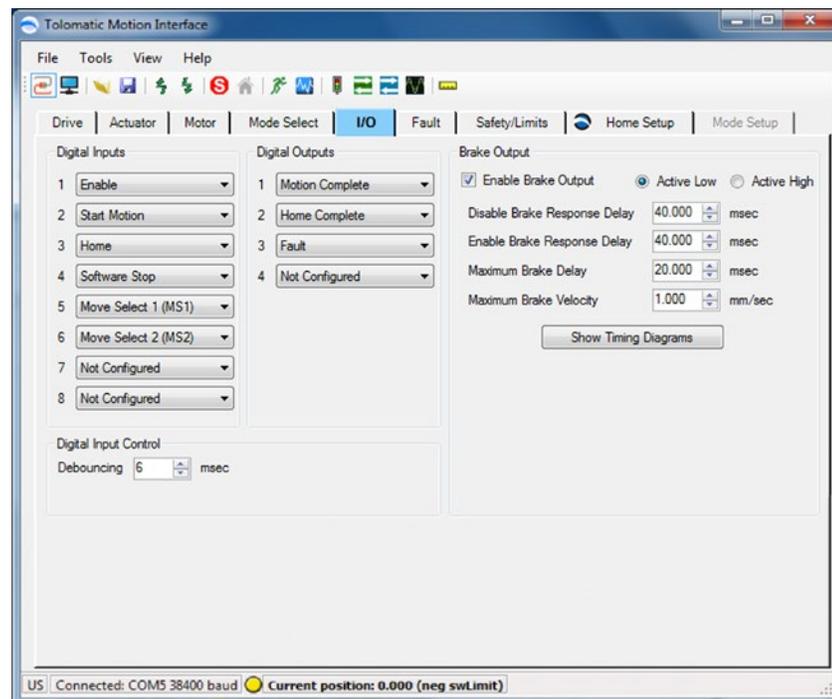


Figure 10-7: Brake Output enabled

Brake Output Functionality	
Enable Brake Output	Enables or disables the brake output subsystem
Active Low	Brake is applied when current is removed
Active High	Brake is applied when current is applied
Disable Brake Response Delay	Number between 0 and 1,000 milliseconds
Enable Brake Response Delay	Number between 0 and 1,000 milliseconds
Maximum Brake Delay	Number between 0 and 1,000 milliseconds
Maximum Brake Velocity	Number between 0 and 5 mm/sec.

Table 10-3: Descriptions of Brake Output Functionality

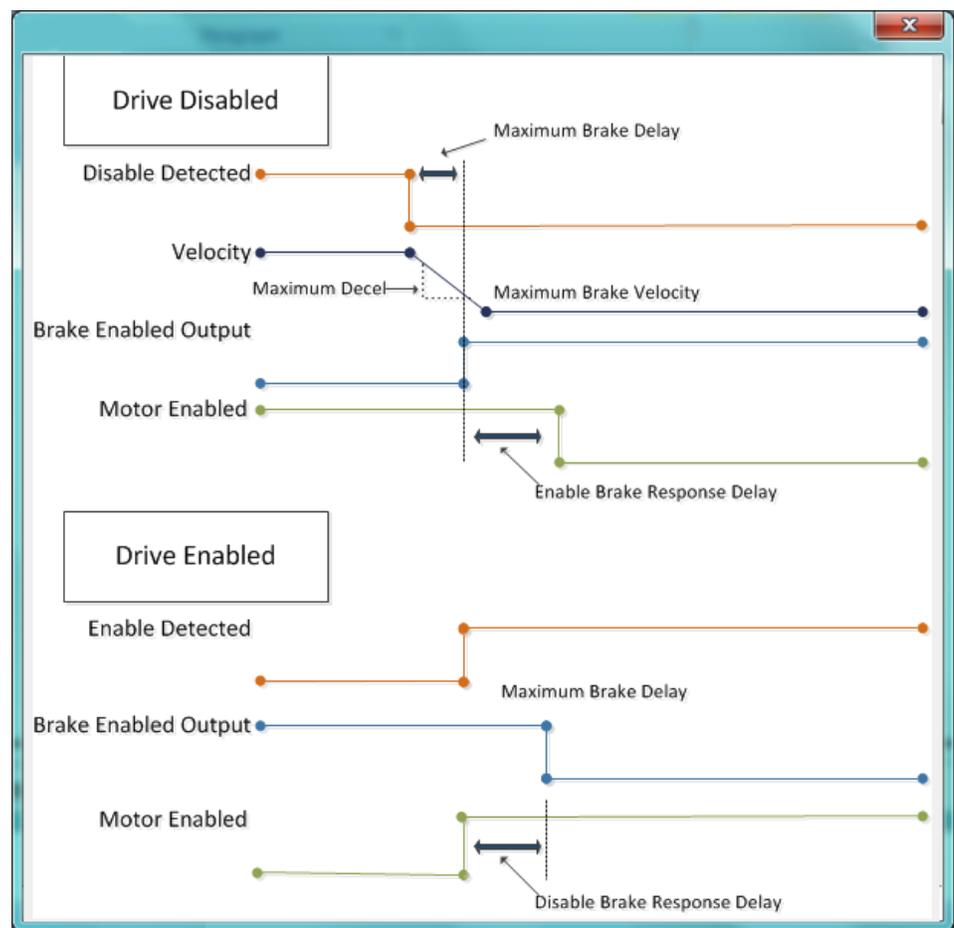


Figure 10-8: Brake Output timing

11.1 Using the Fault Tab

The Fault tab allows the user to configure how the drive responds to Safety Faults. The Critical Faults are always enabled and the configured response is to disable the motor. Critical Faults are listed for information only.

Each of the Safety Fault types has a check-box and a combobox (drop-down).

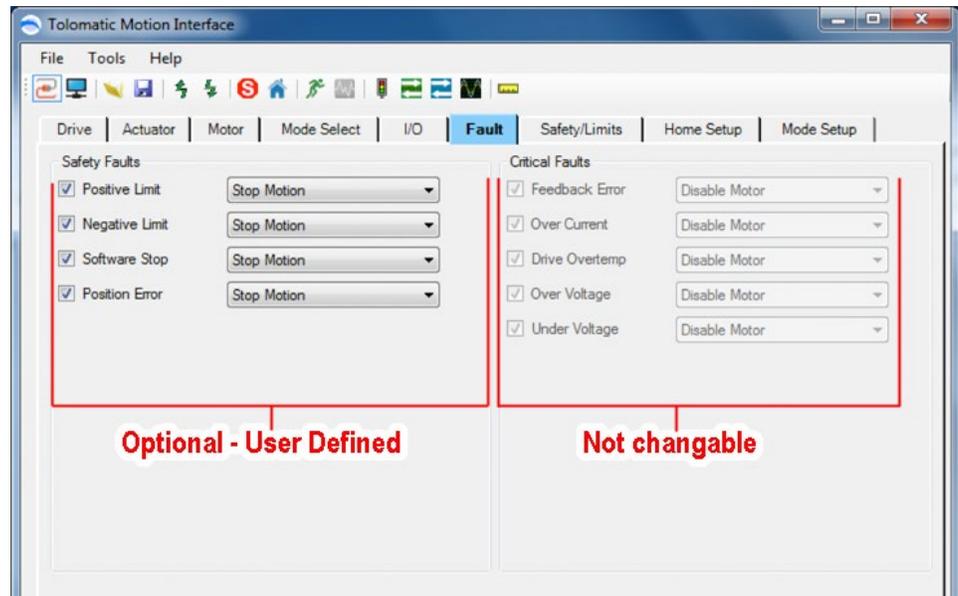


Figure 11-1: Safety Fault - user defined choices

Each available Safety Fault has 4 different user defined choices. (If greyed out no input is configured for that safety fault.) Safety Faults are assigned to physical digital inputs in the I/O tab. If that digital input is High, then the assigned Fault condition will occur.

NOTE: Maximum Decel is used in Safety Faults when either Stop Motion & Stop Motion (without Fault Output) is chosen. This allows a faster motion stop than Disable Motor. (See Chapter 12 Safety/Limits Tab)

Unchecked	Input will not cause a safety fault.
Checked, <i>Stop Motion</i>	Fault will result in current motion to stop at Maximum Decel value configured on the Safety/Limits tab, and the Fault digital output will be turned on. A subsequent motion command may automatically clear this fault.
Checked, <i>Disable Motor</i>	Fault will result in drive power to be cut. If a move is in progress, coasting may result. For a vertical application, the load may fall. The motor will remain disabled until the fault is cleared by an ACS Drive Disable/Enable cycle, or power cycle.
Checked, <i>Stop Motion (without Fault Output)</i>	Same as “Checked, <i>Stop Motion</i> ” except the Fault digital output will not be turned on.

Table 11-1: Safety Fault user defined choices

11.2 Fault Descriptions and Recovery

11.2.1 Safety Faults

Positive Limit Switch Enabled if a limit switch digital input is configured on the I/O tab.

Negative Limit Switch Enabled if a limit switch digital input is configured on the I/O tab.

Position Error safety fault is only enabled if the configured Motor has an encoder (configured on the Motor tab). Motion Limits must also be configured in the Safety Limits Tab.

Software Stop

These are optional, and if no associated digital input is configured (on the I/O tab), the check-box and combobox will be disabled.

NOTE: To clear faults that disable the motor; PLC needs to lower/raise the enable digital input, toggle the enable bit using Network or TMI user must press the Enable button on the motion manager.

Safety Faults Table	
Positive Limit Switch	Fault indicates positive limit has been reached. If <i>Stop Motion</i> is configured, the fault will clear on motion in the opposite direction. If <i>Disable Motor</i> is configured, the fault is cleared with <i>Disable/Enable</i> cycle.
Negative Limit Switch	Fault indicates negative limit has been reached. If <i>Stop Motion</i> is configured, the fault will clear on motion in the opposite direction. If <i>Disable Motor</i> is configured, the fault is cleared with <i>Disable/Enable</i> cycle.
Position Error	Requires motor with an encoder. Fault indicates current position is not within the specified Position Error distance (configured on the Safety/Limits tab) of the commanded position. If <i>Stop Motion</i> is configured, this fault will be automatically cleared on the next move. If <i>Disable Motor</i> is configured, the fault is cleared with <i>Disable/Enable</i> cycle.
Software Stop	Fault indicates the signal level on the digital input is high. If <i>Stop Motion</i> is configured it will be cleared once the software stop input is lowered. Motion will not be allowed until software stop has been cleared. If <i>Disable Motor</i> is configured the fault must be cleared by lowering software stop input, and cycle enable signal.

Table 11-2: Safety Faults Descriptions

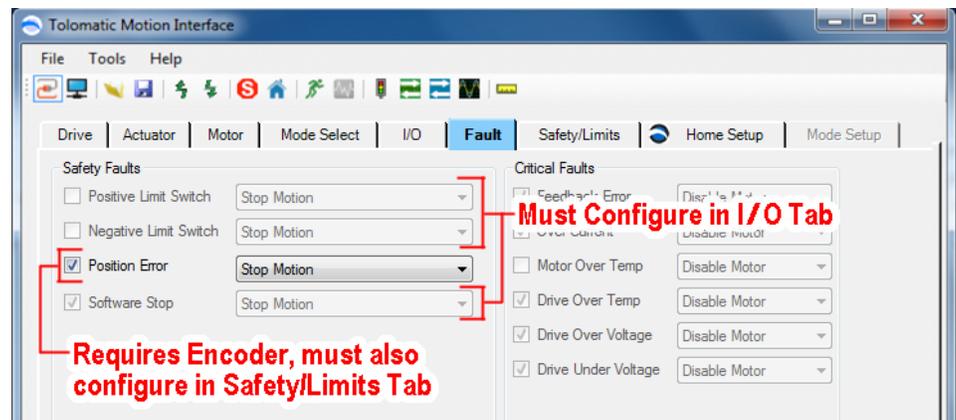


Figure 11-2: No associated digital input means Safety Fault cannot be configured and are displayed greyed out on Fault Tab

NOTE: To clear faults; PLC needs to lower/raise the enable digital input, enable bit using EtherNet/IP or TMI user must press the Enable button on the motion manager.

11.2.2 Critical Faults

All Critical Faults will disable the motor when they occur. To clear these faults, the fault condition cannot be present and the enable input line must be lowered and then raised to proceed with motion. Watchdog timeout must be cleared by power cycle only.

ACS Stepper Drive

Stepper Drive Critical Faults Table	
Feedback Error	Feedback device is malfunctioning.
Over Current	If a short circuit occurs from output to ground, this fault will be triggered.
Motor Over Temp	Not implemented in this release.
Drive Over Temp	Drive temperature is greater than the maximum allowed temperature (75°C).
Drive Over Voltage	Main power voltage exceeds the maximum voltage.
Drive Under Voltage	Main power voltage below the minimum voltage.

Table 11-3: Stepper Drive Critical Faults Descriptions

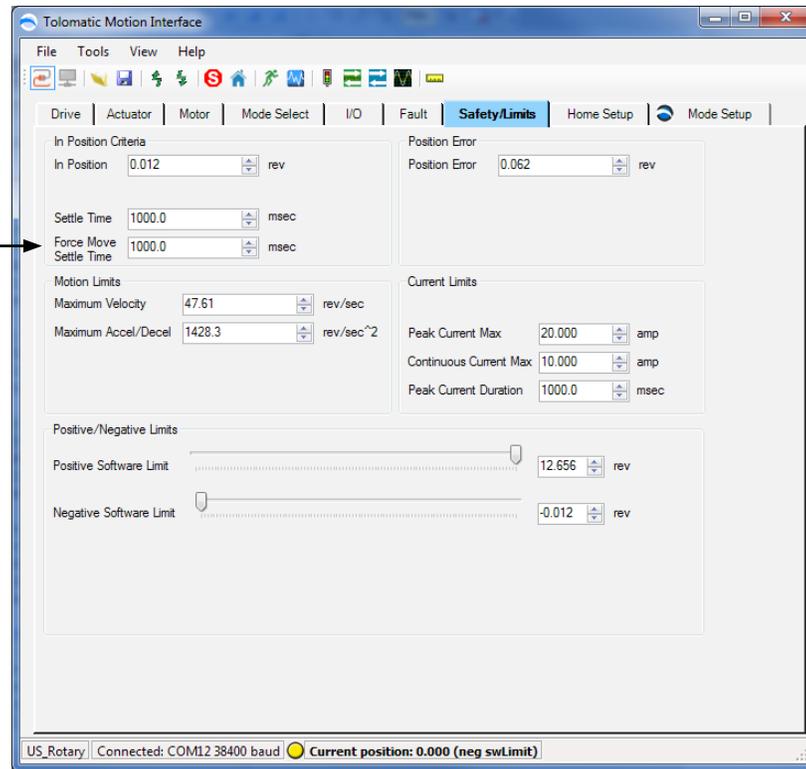
ACS Servo Drive

Servo Drive Critical Faults Table	
Feedback Error	Feedback device is malfunctioning OR disconnected when drive is enabled. (Power Cycle to Clear) or motor is overTemp
Over Current	Drive current is above safe level for the Drive hardware.
Drive Over Temperature	Drive temperature is greater than the maximum allowed temperature (75°C).
Drive Over Voltage	Main power voltage exceeds the maximum voltage. (75V)
Drive Under Voltage	Main power voltage below the minimum voltage. (9V)
Flash Error	Flash write failed. Flash version doesn't match.
I2T Limit	Drive power usage above maximum allowed.
Short Circuit	Motor phase shorted to ground. Internal motor short or phase short to ground.
Watchdog Timeout	Firmware stall, drive reset or drive power-cycled but voltage did not reach 0V. (Power Cycle to Clear)

Table 11-4: Servo Drive Critical Faults Descriptions

12.1 Using the Safety/Limits Tab

The Safety/Limits tab is used to configure Safety parameters, Motion Limits and setup such features as Endpoint Correction or Zone Output.



Force Move Settle Time

NOTE: Throughout this manual information that ONLY applies to Stepper Drives will be noted in grey box:

ACS Stepper Drive

Information that ONLY applies to Servo Drives will be noted in light blue box:

ACS Servo Drive

Figure 12-1: Safety/Limits Tab

12.1.1 In Position Criteria

In Position: This value defines the +/- window around the desired target position that is considered within position.

Settle Time: The amount of time the position is within the In Position Band before declaring Motion Complete.

ACS Stepper Drive

Endpoint Correction: When enabled, Endpoint Correction initiates one correcting move at the end of the initial move to correct any position error that is greater than the In Position value. At the end of the initial move, the distance of the corrected move will be the difference between Target Position and Actual Position. This correcting move will use the same motion profile parameters (velocity, accel, decel, force) as the initial move. Endpoint Correction is only available with stepper motors with encoders.

ACS Servo Drive

Force Move Settle Time: The amount of time after a specified force is reached before declaring Motion Complete.

12.1.2 Position Error

This value defines the +/- window around the commanded position that the actual position must be within or a Position Error fault will occur.

Position Error = Commanded Position – Actual Position.

The Position Error is continuously calculated throughout the entire move. Position Error is only available with motors with encoders. The Position Error setting must always be larger than the setting for the In Position parameter. If the Position Error setting is smaller than the In Position setting, the In Position parameter will turn red, indicating an invalid setting.

12.1.3 Eco Mode

Eco mode is intended to reduce motor current in the motion complete interval (dwell) by allowing a slight increase of position error. It is suggested to enable this feature when an I2T Fault occurs when the drive is not in motion, or if there is high drag in the mechanical system and the drive is near the I2T Limit.

Eco mode is a mode specially designed for instance where the dynamic loads on the actuator are lower than the stiction or drag of the mechanical system itself. In other words, if the drive is disabled, the load does not move from its current position.

In these high drag mechanical configurations, frictional drag may prevent position error from ever reaching 0. As the control loop error increases over time, it eventually breaks through the frictional drag and overshoots the target position. This process repeats and a scenario called “Position Hunting” occurs.

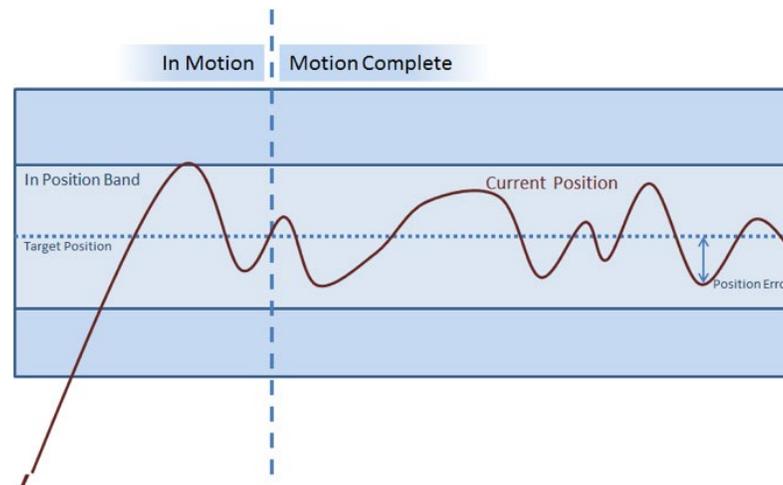


Figure 12-2: Position Hunting in a High Mechanical Drag System

While this hunting is occurring, current is increasing and, depending on the strength of the mechanical stiction of the system, integral error could be spooling up over the continuous current limits of the drive or motor. When the actual current is higher than the continuous current of the motor, an I2T fault can occur, which protects your motor and drive from overheating. If this is occurring, your actual output currents could well be approaching the peak limits of the drive or motor.

When Eco mode is enabled, motion is complete and the current position is within the In Position Band, the control loop does not attempt to correct position error. This allows the mechanical advantage of the system to hold the load while the drive monitors the position and intercedes when the current position falls outside of the In Position Band. This mode conserves power by stopping the Position Hunt.

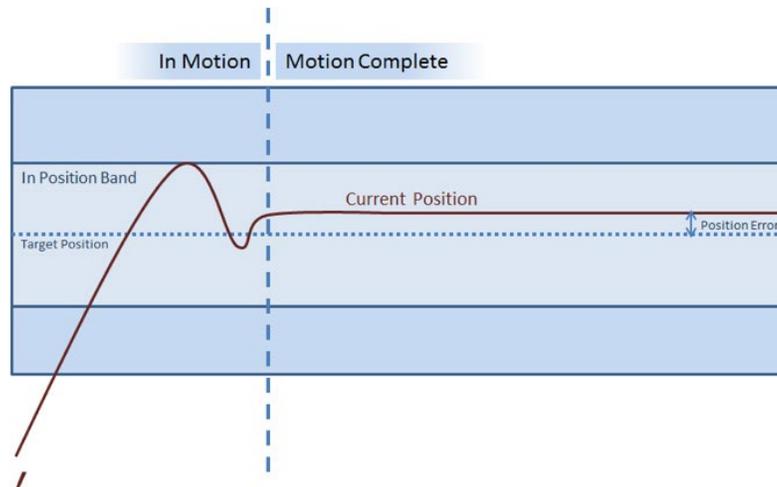


Figure 12-3: Eco Mode Enabled on a High Drag Mechanical System

While Eco mode is primarily used in systems with mechanical high drag, it also can be used in systems that do not have high drag, but wish to conserve power – at a cost of a slight position adjustment on motion complete. In these systems, the load pushes the Current Position outside of the In Position Band. The Control Loop then corrects the position using a scaling based on target position and the position error limit. As the current position approaches the position error limit the control gains increase. This negotiation results in a rapid equilibrium that conserves power.

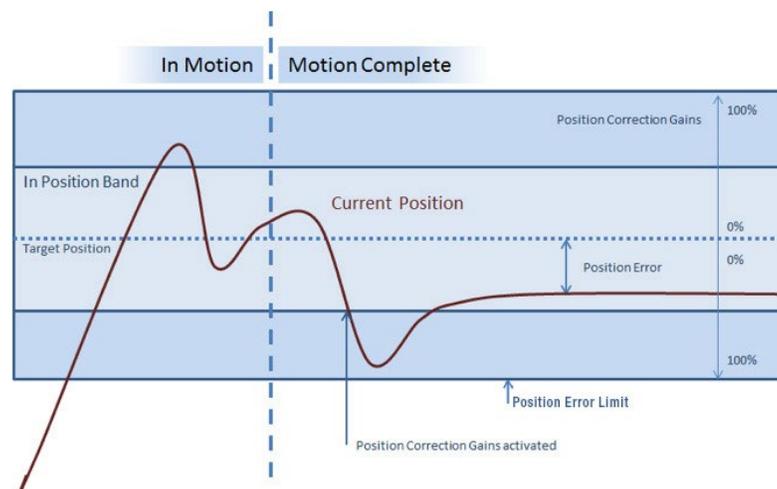


Figure 12-4: Eco Mode with Position reaching equilibrium

TIPS: 1) The smaller IN Position Band is the less effective ECO Mode, it will be reducing power during the motion complete interval.

2) Control gains are scaled at maximum 100% at the position error limit. To reduce position error when in motion complete interval, reduce position error limit value.

NOTE: Maximum Decel is used in Safety Faults when either Stop Motion & Stop Motion (without Fault Output) is chosen. This allows a faster motion stop than Disable Motor. (See Chapter 11 Fault Tab)

12.1.4 Motion Limits

Maximum Velocity: This value defines the maximum velocity that is allowed to be configured by the software and commanded by the ACS Drive. The TMI software will automatically cap any entered velocity value to the max setting. When the actuator & motor information is entered, the TMI software will automatically calculate the Maximum Velocity setting using the actuator max speed and motor max RPM. The ACS Drive ensures that no moves can be commanded with a velocity value higher than the max setting.

Maximum Accel/Decel: This value defines the maximum accelerations and decelerations that are allowed to be configured by the software and commanded by the ACS Drive. The TMI software will automatically cap any entered value to the maximum Accel/Decel setting. The maximum allowable Accel/Decel is 40 times the maximum allowable velocity. The ACS Drive ensures that no moves can be commanded with an acceleration or deceleration value higher than the value of the Maximum Accel/Decel parameter.

Note: If zero (0) velocity or accel/decel is entered, these parameters will turn red and the Tolomatic logo will appear on the Safety/Limits tab.

12.1.5 Current Limits

Peak Current Max: Instantaneous current the drive is allowed to supply to the motor. This corresponds to 100% force in a move.

ACS Servo Drive

Continuous Current Max: Maximum continuous current the drive is allowed to supply the motor.

Peak Current Duration: Maximum length of time the drive is allowed to supply Peak Current to the motor. This is used for the I2T Fault calculation.

ACS Stepper Drive

Holding Current: This value defines the current level (in percentage) to which the ACS Drive sets the output current to the motor when any move is complete. The ACS Drive maintains this current level to the motor until the next Move Command is executed. The default value for this parameter is 100%. This parameter can be used to conserve energy while the motor is at rest.

Peak Current Max: This value defines the maximum current applied to the motor for all moves. Force % for a move is scaled to this value for any defined Move Command in the Mode Setup Tab. The limits are automatically set by the motor selection and definition in the Motor Tab. The value cannot be set higher than the maximum rating of the motor/drive combination, but it can be reduced.

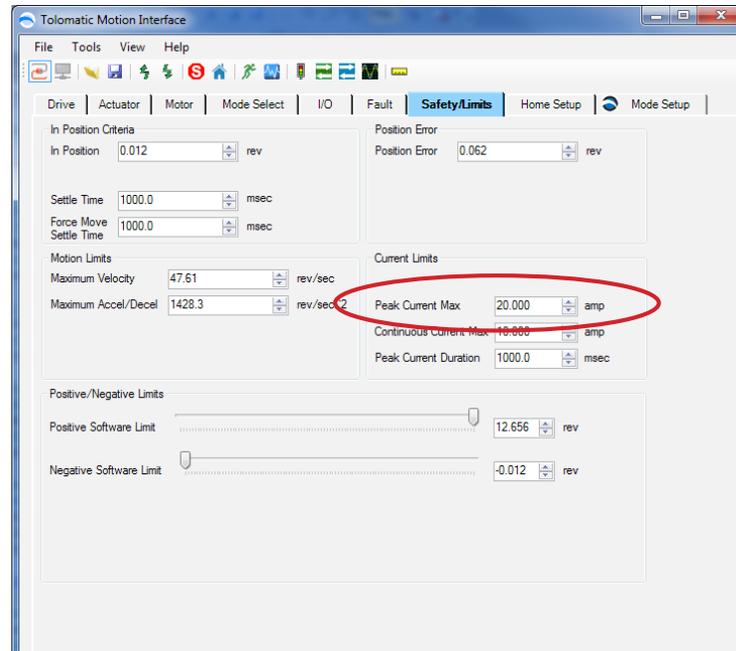


Figure 12-5: Peak Current Max.

ACS Servo Drive

Continuous Current Max (Servo Only): This value defines the maximum continuous current that can be applied to the motor/Drive combination.

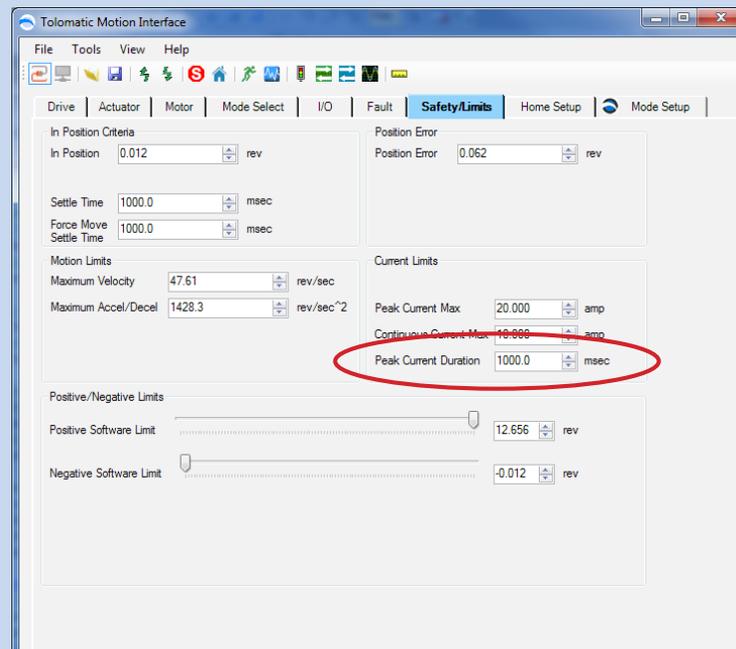


Figure 12-6: Continuous Current Max.

12.1.6 Positive/Negative Limits

Software Limits: There are two software limits, a *positive* and a *negative*. These software limits create a virtual position boundary for the motor/actuator system which the ACS Drive can not be commanded to exceed. The exception to this rule is for homing. A home command will ignore both software limits and will ignore limit switches if move to hard stop is selected. The TMI software will automatically cap any move to the positive software limit if the entered value is larger, or to the negative software limit if the entered value is smaller. The default values of the software limits are dependent upon the following homing sequences:

1. *Home to Hard-stop*

Negative home direction: Positive Software Limit = Stroke – Home Offset;
Negative Software Limit = - Home Offset

Positive home direction: Positive Software Limit = + Home Offset; Negative Software Limit = - Stroke + Home Offset

2. *Home to Limit Switch*

Negative Software Limit = - Stroke; Positive Software Limit = + Stroke

Note: The software limits must be changed to restrict motion bounds.

Zone Bounds: This feature is only visible if the Zone output is enabled on the I/O tab (see Section 10: I/O Tab). There are two zone bounds, a *positive* and a *negative*. These zone bounds define a virtual position window that is monitored at all times by the ACS Drive. When the actual position is greater than or equal to the Negative Bound Zone and less than the Positive Bound Zone, the Zone Output will be on. The TMI software has rules regarding these zones. The Zone Positive Bound is always smaller than the Positive Software Limit but larger than the Negative Software Limit. The Zone Negative Bound is always larger than the Negative Software Limit but smaller than the Positive Software Limit. The Zone Output feature does not interfere with motion. This feature can be used in a variety of applications to prevent a collision with another axis of motion or to initiate a process during a specific position range.

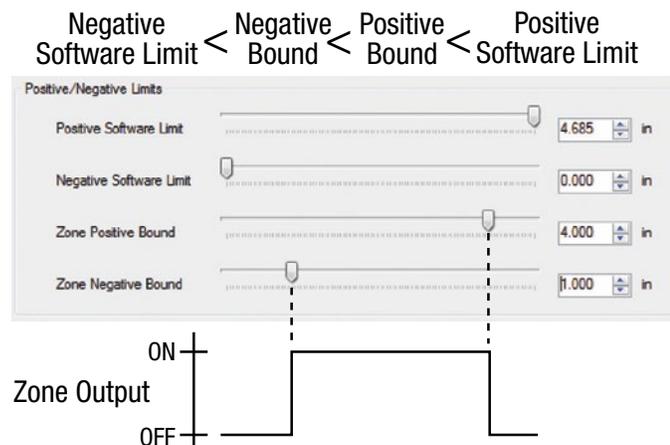


Figure 12-7: Zone Bounds Diagram

13.1 Using the Home Setup Tab

The Home Setup tab is used to configure the homing routine. Every home routine has a configurable motion profile (velocity, accel/decel, force), a choice of direction, and an option to home on power-up.

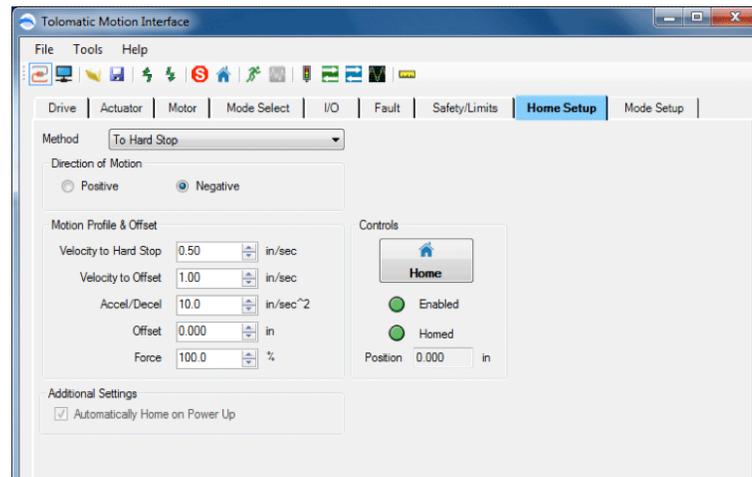


Figure 13-1: Home Setup Tab

Status Bar Indicators have been added to the status bar to indicate when a Fault condition exists (red light on the ACS drive flashing) or when the current actuator position is within the In Position criteria of the currently programmed software limit.

- Double-clicking on the Yellow indicator will navigate to the Safety/Limits tab so you can review the currently programmed Software Limits and In Position Criteria.
- Double-clicking on the Red indicator will display the Drive Status window.

13.1.1 Method of Homing

There are two different types of homing routines:

Homing To Hard Stop

1. **With encoder:** This home routine uses the encoder to detect position error to find the hard stop during home.

ACS Stepper Drive

2. **Without encoder:** This home routine initiates an incremental move the size of one stroke length. This ensures that the actuator will find the hard stop since there is no encoder to help detect it. Warning: Depending on where the actuator is positioned when homing begins, this routine may cause the motor/actuator to push against the hard stop for several seconds. This is not ideal for the mechanical system and may cause audible noise.

NOTE: To ensure repeatability it is best to home with relatively slow velocity (≤ 1 "/sec or 25 mm/sec) and relatively high accel/decel (> 40 "/sec² or 1000mm/sec²).

Homing to Limit Switch

The To Limit Switch homing routine is only available if the Positive or Negative Limit Switch is configured in the I/O tab (see Section 10: I/O Tab). This home routine uses either the positive or negative limit switch to find home position. The ACS Drive initiates an incremental move the size of one stroke length and stops motion when the limit switch input is activated.

 **NOTE:** To ensure repeatability it is best to home with relatively slow velocity ($\leq 1"/\text{sec}$ or $25 \text{ mm}/\text{sec}$) and relatively high accel/decel ($>40"/\text{sec}^2$ or $1000\text{mm}/\text{sec}^2$).

13.1.2 Direction of Motion

Positive or Negative: Depending on the setup of the motor in the Motor tab (see Section 8: Motor Tab), this selection will define the direction the motor/actuator system homes.

13.1.3 Motion Profile & Offset

Velocity to Hard Stop / Limit Switch: Velocity used in the initial move towards the hard stop or limit switch.

Velocity to Offset: Velocity used when reversing direction to the Offset.

Accel / Decel: Acceleration and Deceleration setting for all moves in the homing routine.

 **NOTE:** Tolomatic recommends a slow smooth homing Velocity/Accel. Fast homing to hard-stop can damage your actuator.

Offset: Distance to move away from either hard stop or limit switch in the opposite direction selected by Direction of Motion.

Force: Force % setting for all moves in the homing routine.

13.1.4 Controls

Home: Initiates the Home sequence.

Enabled and Homed: Status LEDs.

Position: Indicates current position in user units.

13.1.5 Additional Settings

Automatically Home on Power Up: This feature homes the system automatically when the ACS Drive unit is powered up.

 **NOTE:** The Enable input must be activated for the home routine to start.

 **NOTE:** This feature will not work when the ACS Drive is in Network mode.

STOP input: if during homing motion the STOP input is set, it will act like a 'home here'. It will decelerate at the homing deceleration value and then reset the position to 0.0 and show 'homed' status.

Software STOP input: if during homing the Software STOP input is set, it will stop the homing motion and declared 'unhomed' status. The same action will be taken if a fault occurs during homing.

 **NOTE:** Position is cleared to 0.0 at the hard-stop/limit switch, and again when finished the offset move.

The Mode Setup tab is used for configuring the selected mode in the Mode Select tab (see Section 9: Mode Select Tab).

14.1 Index Move Mode

With the Index Move mode, there are three different selections: 4, 8 & 16 Move Commands. If the ACS Drive has not been previously configured or it has been restored to factory defaults, the Move Commands will be configured with zero velocity, accel & decel to prevent any motion. The velocity, accel and decel fields will be highlighted in light indicating they are invalid settings (see table below).

The setup table used for the 4, 8 & 16 Move Commands mode has the following columns: Label, Move Type, Position, Velocity, Accel, Decel and Force. Each individual Move Command (rows) can have different, independent settings for each column.

Setup Table Move Definitions	
Label	Descriptive alpha-numeric “name” for each Move Command. Limited to 28 characters, all uppercase.
Move Type	<div data-bbox="532 961 651 1182" style="border: 1px solid gray; padding: 2px; width: fit-content;"> Move Type Absolute Absolute IncrPos IncrNeg JogPos JogNeg Home Force NoAction </div> <p>Drop down selection for the type of move for each Move Command. Valid selections are Absolute (default), IncrPos, IncrNeg, JogPos, JogNeg, Home and No Action. If an encoder is present, all moves are validated with the encoder feedback. If no encoder is present, the move is operated in open loop with no feedback.</p> <p>Absolute: Initiates an absolute move upon the Start Motion Input.</p> <p>IncrPos: Initiates an incremental move in the positive direction upon the Start Motion Input.</p> <p>IncrNeg: Initiates an incremental move in the negative direction upon the Start Motion Input.</p> <p>JogPos: Initiates a jog move in the positive direction when the Start Motion Input is active. When the Start Motion Input is not-active motion is stopped.</p> <p>JogNeg: Initiates a jog move in the negative direction when the Start Motion input is active. When the Start Motion input is not-active motion is stopped.</p> <p>Home: Initiates the homing sequence that is defined in the Home Setup tab. The position, velocity, accel/decel and force settings in that row will be disabled (not used) for this move type.</p> <p>No Action: Allows user to configure an unused move in the table in order to prevent unintended motion. If this move is executed, the ACS Drive will do nothing. The position, velocity, accel/decel and force settings in that row will be disabled (not used) for this move type.</p> <div style="border: 2px dashed blue; padding: 5px; margin-top: 10px;"> <p>ACS Servo Drive</p> <p>Force: Allows user to configure a push to force move upon start motion input. (see Force Move Settle Time, 12.1.1)</p> </div> <p>NOTE: See Start Motion Input (see Appendix 1: Timing Diagrams)</p>
Position	Move position value for either absolute or incremental moves. This field is not used in JogPos or JogNeg move types.
Velocity	Velocity value for all move types
Accel/Decel	Acceleration and Deceleration value for all move types
Force %	Force % value from 10 to 100% for all move types.

Table 14-1: Descriptions of Setup Table Move Definitions for 4, 8, and 16 Move Commands

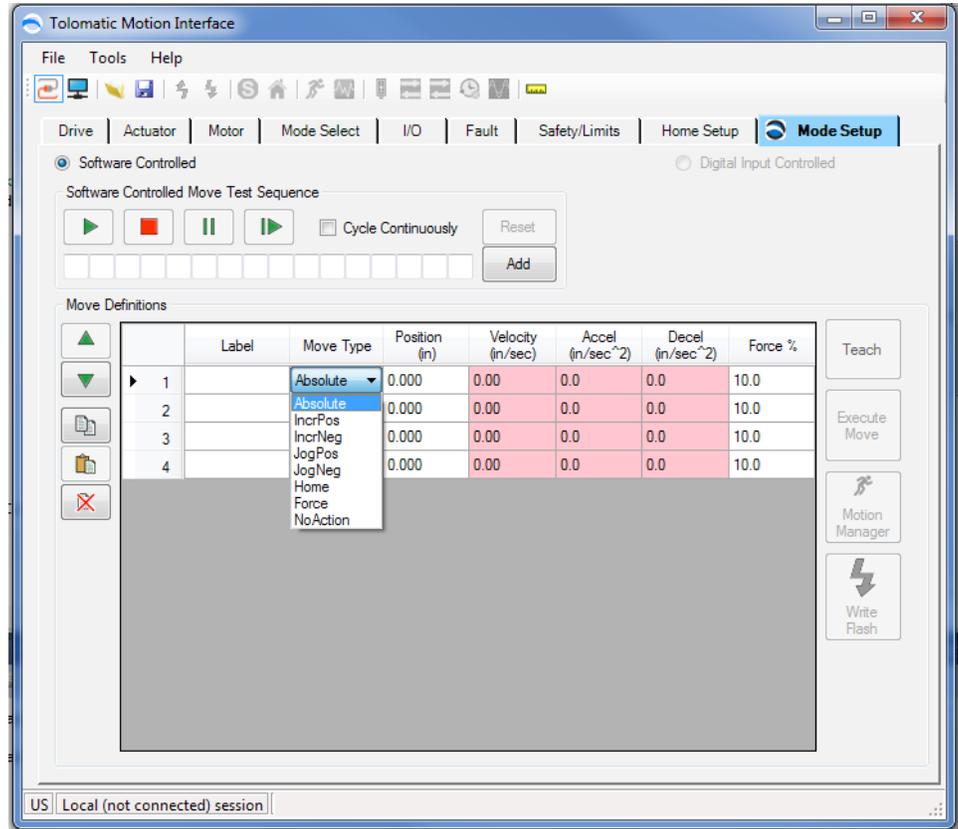


Figure 14-1: Mode Setup– 4 Move Commands, Not Configured

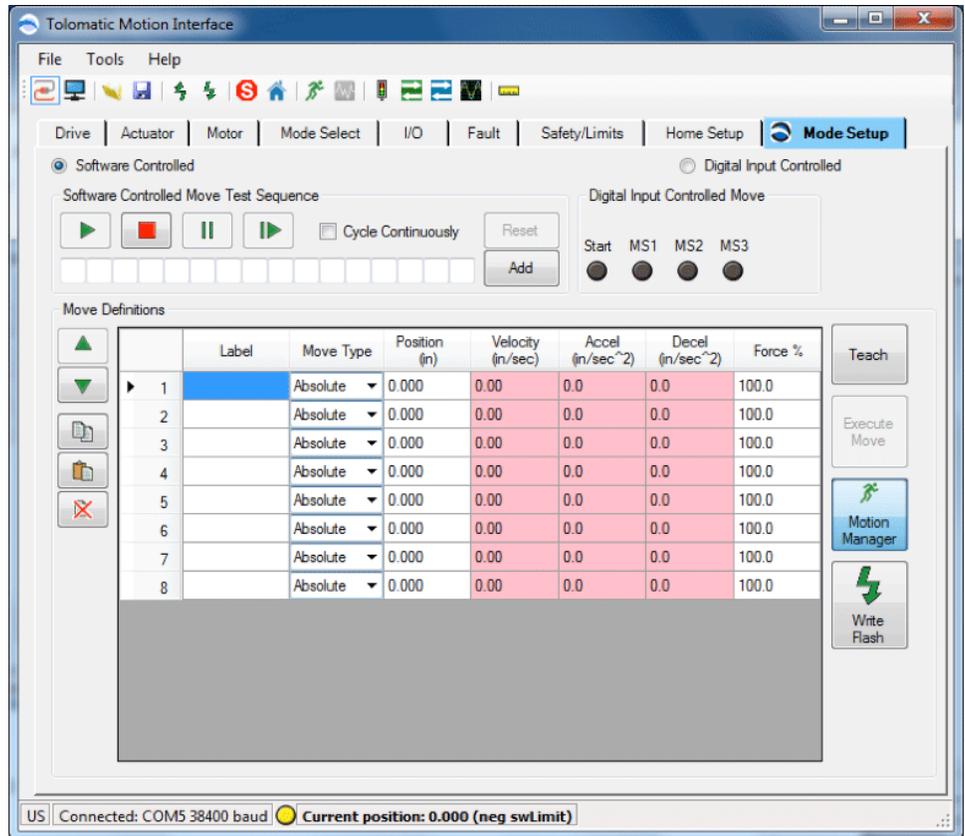


Figure 14-2: Mode Setup– 8 Move Commands, Not Configured

**NOTE:** The

software controlled MS# LEDs will light to indicate what digital input pattern corresponds to that row. Similarly, you can use the mouse to click and toggle the MS# LEDs On/Off and the row corresponding to that binary code will be selected.

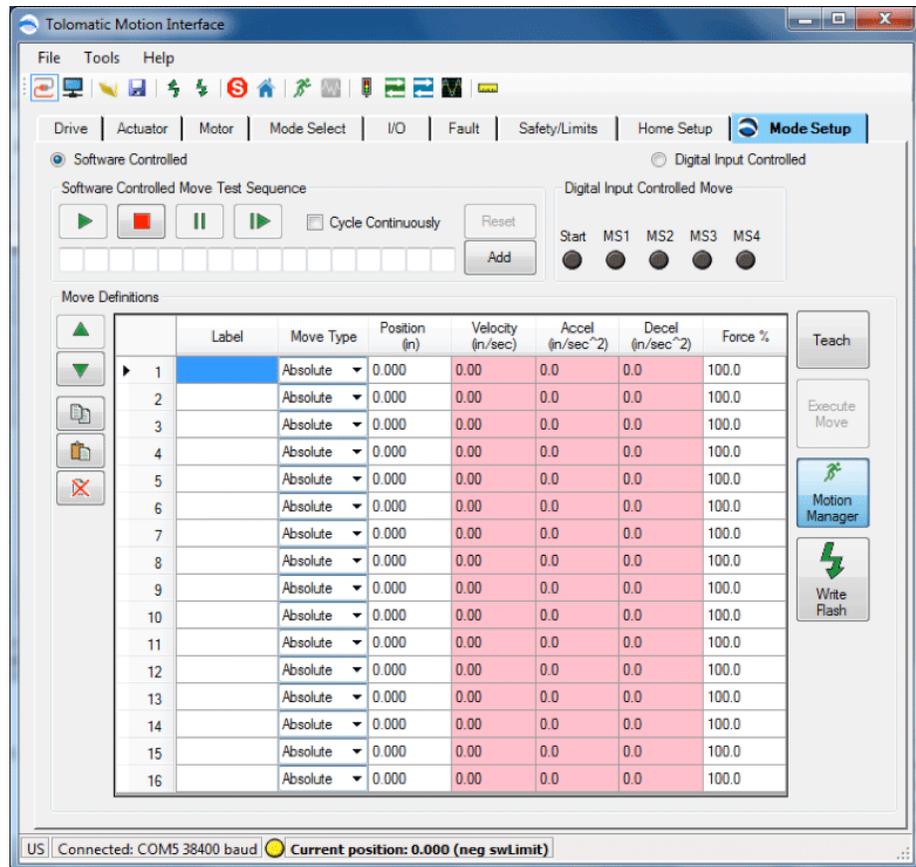


Figure 14-3: Mode Setup– 16 Move Commands, Not Configured



NOTE: Default Move Command velocities, acceleration, and deceleration are 0. If user does not configure a valid value for all motion parameters the TMI software and the ACS Drive will not allow that move to be executed.

For the move types of Home and No Action the fields for Position, Velocity, Accel, Decel and Force do not apply. They appear grey and are disabled for these move types.

With Home move type the parameters used in the homing routine are from the Home Setup tab. Using a Home move type in the Index Move table allows the user to free up an additional digital input.

The No Action move type is used to prevent unwanted moves from being commanded. If this type is configured, the controller will simply do nothing when it is commanded to move to that move number.

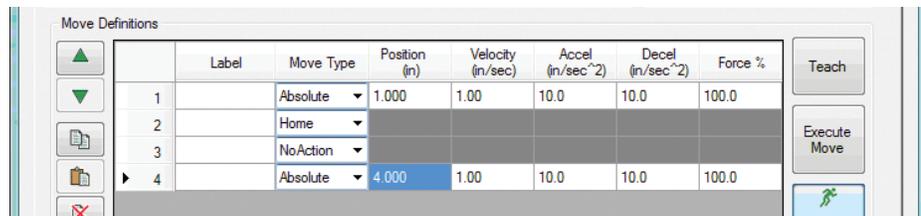


Figure 14-4: Mode Setup– The Home & No Action commands disable several fields.

14.1.2 Editing, Arranging and Testing Move Commands

Once all the Move Commands have been configured, there are several features in the Mode Setup screen for editing, arranging, or testing the configured Move Commands.



Move Row Up / Down: Move the Move Commands up and down one row at a time in the table.



Copy / Paste / Cut Row: Copy, Paste & Cut functionality for each row. Select the row and click button for desired functionality.



Teach: Teach all motion profile parameters (position, velocity, accel/ decel, force) from the Motion Manager (see Section 15: Motion Manager Tool) into the selected row in the table. If the selected row already has valid data, the TMI will prompt the user whether they want to overwrite it or not. If the ACS Drive is disabled (See Motion Manager) pressing teach will only update the position (not Velocity/Accel/Decel or Force). This is useful for manually positioning the actuator then teaching that position.



Execute Move: Clicking this button will execute or start the selected move in the table. The selected move is denoted by the move highlighted in blue with the black arrow on the left hand side. For Jog moves, the move is initiated while the Execute Move button is pressed and will stop when the Execute Move button is released.



Motion Manager: Opens and closes the Motion Manager tool (see Section 15: Motion Manager Tool)



Write Flash: Write Current Settings to Drive Flash: Write all parameters from the TMI software into the drive flash memory.



NOTE: Jog and No Action moves as well as empty boxes will be skipped when playing the sequence.

Software Controlled: When the TMI is in Software Control, all motion commands (Start Motion and Home inputs) from the I/O interface (PLC or logic controller) are ignored. In order to test the I/O logic with the PLC or logic controller, the user must select Digital Input Controlled.

While in Software Control, the user can test the moves by using the Software Controlled Move Test Sequence. This feature allows up to 16 Move Commands to be tested in any order. When in Software Controlled mode, the Move Select (MS#) LEDs in the Digital Input Controlled group box will echo the logic of the selected Move Command in the table. The Software Controlled mode feature has the following controls:

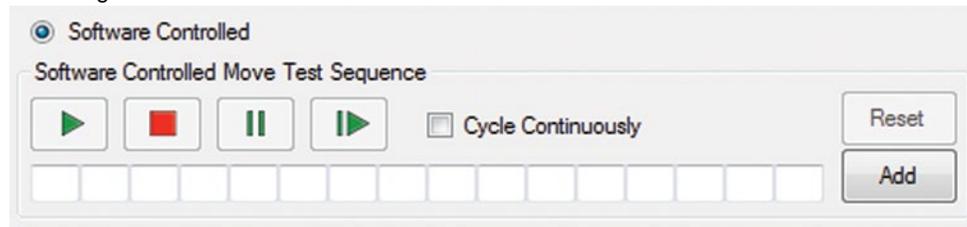


Figure 14-5: Software Controlled User Options

 **Add:** Click Add to add a Move Command to the next available position.

 **Reset:** Removes all Move Commands from the test sequence

 **Play:** Initiates the test sequence. All Move Commands in sequence will be executed once.

 **Stop:** Stops the test sequence.

 **Pause:** Pauses the test sequence on the highlighted move.

 **Step:** Steps through the test sequence one Move Command at a time.

Cycle Continuously

Cycle Continuously: When this feature is checked, the test sequence cycles continuously in an endless loop until the Stop or Pause button is clicked, the user switches to the Digital Input Controller, navigates to another tab, or communication is disconnected.

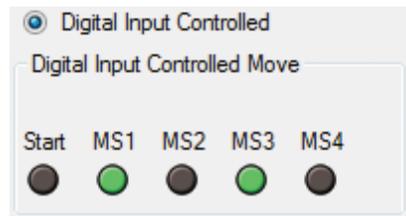
When the test sequence is in progress:

1. All other move controls in Mode Setup and Motion Manager will be disabled.
2. The currently executed move will be highlighted in blue in the table.

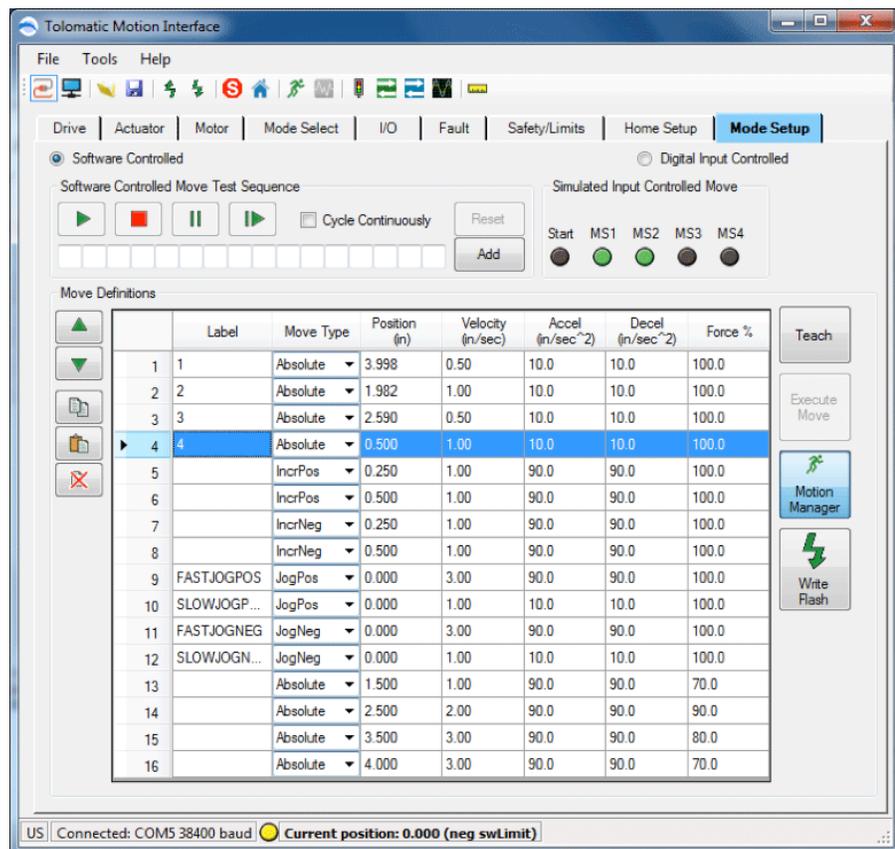
Move Delay: User settable dwell between test sequence moves. (Not Pictured)

Digital Input Controlled:

In order to test the I/O logic with the PLC or logic controller, the user must select Digital Input Controlled. When in this mode, all move buttons in the software are disabled and motion can only be initiated from the logic controller (PLC). The selected move from the Move Select inputs (see Section 10: I/O Tab) will be highlighted in blue in the table below. The Move Select (MS#) LEDs in the Digital Input Controlled group box will echo the logic of the Move Select inputs from the physical I/O interface. In this mode, the PLC or logic controller can select the desired move using the Move Select inputs and initiate motion using the Start Motion input (see Appendix 1: Timing Diagrams).

**Figure 14-6: Digital Input Controlled**

NOTE: When Software Controlled is selected the MS1 to MS4 “LEDs” will track the selected line in the Move Definitions table.

**Figure 14-7: Configured Mode Setup, 16 Move Command Mode**

ACS Servo Drive

14.1.3 FORCE Move Type

The FORCE move type is similar to the ABSOLUTE position move but with additional logic added to help with press at force applications. For safety of the user and equipment, the FORCE move is run as a position move in the way that it uses the position, velocity, and current control loops as opposed to other servo drives that only use the current loop for a force move. The advantage to using all three loops is to have control over the actuator speed; speed is not controllable with current loop only implementations. The current loop has a limiter at the input to limit the maximum current to the value of the move FORCE % as setup in each move's profile. A position command past the point of press may be desired to reach this desired force.

Important notes about the Force move behavior:

- The Force Move Settle Time is a timer that starts counting when the Force % has been reached, and ends when the Force Move Settle Time in milliseconds has passed. This timeout will set the motion complete output to ON and another move may be commanded. If the Force % has not been reached then the Force Move Settle Time starts when the move trajectory completes.
- It is recommended that the next move after a FORCE move that releases the press also be a Force move with the same Force %. This will ensure smooth force transitions and prevent unwanted jumps or spikes in force as well as prevent position error fault from triggering.
- Position error Fault is disabled during Force moves.
-  **WARNING: If a press move has reached its Force % and the load is suddenly removed, the actuator may accelerate quickly toward the commanded position at an un-regulated speed.** This is due to the large position error and the proportional integral gains trying to compensate for the error.

The following examples shows a force move where an actuator presses into a spring fixture until a force is achieved. The only difference between the two scope captures is the Force Move Settle Time.

	Label	Move Type	Position (mm)	Velocity (mm/sec)	Accel (mm/sec ²)	Decel (mm/sec ²)	Force %
1	PRESS	Force ▼	100.000	100.00	500.0	500.0	40.0
2	RELEASE	Force ▼	0.000	100.00	500.0	500.0	40.0

Figure 14-8: Entries for Force Move

ACS Servo Drive

Force Move Settle Time msec

Figure 14-9: Force Move Settle Time set to 100 msec

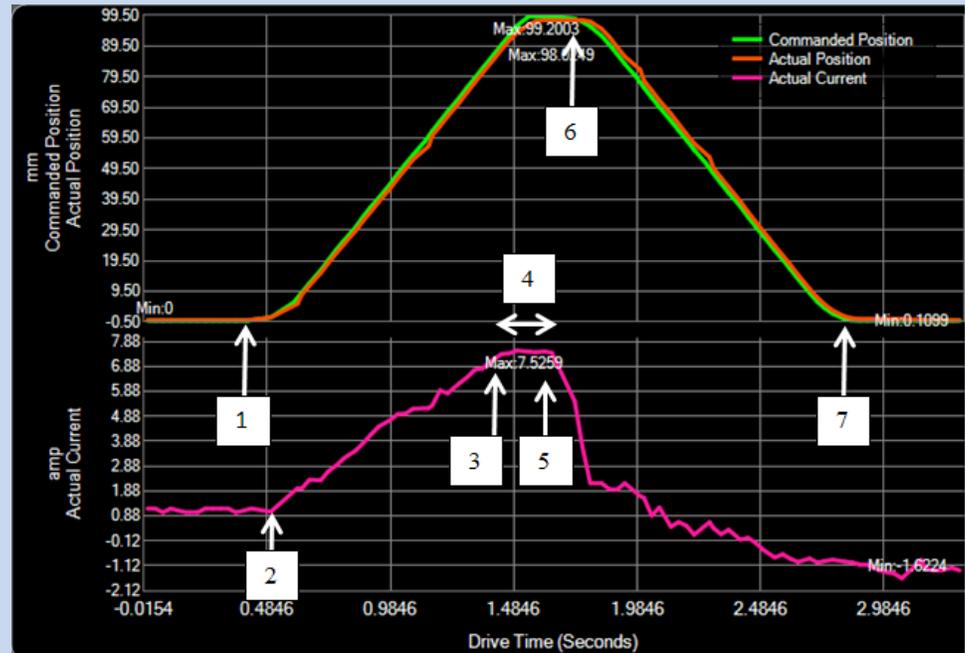


Figure 14-10: Resulting Motion Profile, 100 msec Settle Time

1. Force move begins (Press move)
2. Actuator begins compressing a spring
3. Actuator reaches Force % value, Force Move Settle Time timer begins
4. Force Move Settle Time
5. Motion Complete signaled
6. Start new Force move (Release move) to back off of the spring.
7. Move complete, motion complete will be signaled after Force Move Settle Time.

ACS Servo Drive

Force Move Settle Time msec

Figure 14-11: Force Move Settle Time set to 1000 msec

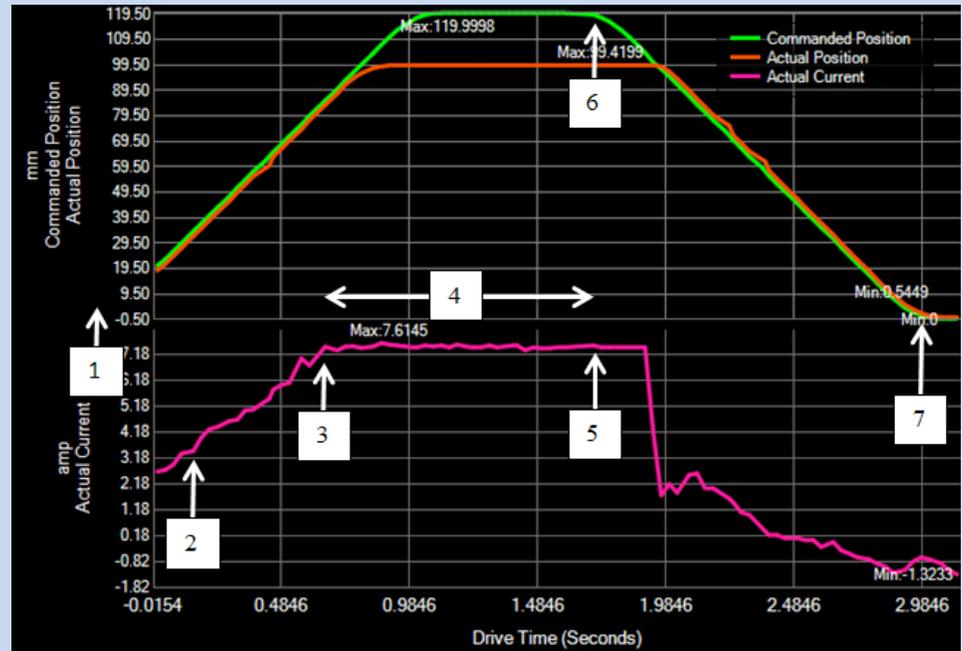


Figure 14-12: Resulting Motion Profile, 1000 msec Settle Time

1. Force move begins (Press move)
2. Actuator begins compressing a spring
3. Actuator reaches Force % value, Force Move Settle Time timer begins
4. Force Move Settle Time
5. Motion Complete signaled
6. Start New Force move (Release move) to back off of the spring.
7. Move complete, motion complete will be signaled after Force Move Settle Time.

14.2 Pneumatic Mode

Pneumatic mode is used to replace or mimic pneumatic cylinder/valve operation logic. With pneumatic mode, there are four different selections: Spring, 2 Position (2 input), 3 Position (2 input) & 3 Position (3 input). These four pneumatic mode operations allow just about any pneumatic valve logic to be replaced with the ACS drive. Additionally, in pneumatic mode, the drive will automatically home the actuator upon power up based on the home setup configuration.

 NOTE: The default configuration for Pneumatic Mode automatically enables drive upon power up. Because of this, the only way to clear a fault is to cycle power unless the enable input is configured to a digital input in the I/O tab.

The setup table used for pneumatic mode has the following columns:

Setup Table Move Definitions	
Label	Descriptive alpha-numeric “name” for each Move Command. Limited to 28 characters, all uppercase.
ACS Stepper Drive	Move Type Absolute: Initiates an absolute move upon change of Move Select bits. (STEPPER DRIVE: Pneumatic Mode only supports Absolute Moves)
ACS Servo Drive	Absolute: Initiates an absolute move upon change of Move Select bits. (SERVO DRIVE: Pneumatic Mode supports Absolute and Force Moves)
Position	Move position value for absolute moves. This field is not used in JogPos or JogNeg move types.
Velocity	Velocity value for all move types
Accel/Decel	Acceleration and Deceleration value for all move types
Force %	Force % value from 10 to 100% for all move types.

Table 14-2: Descriptions of Setup Table Move Definitions for Pneumatic Mode

 NOTE: Default Move Command velocities, acceleration, and deceleration are 0. If user does not configure a valid value for all motion parameters the TMI software and the ACS Drive will not allow that move to be executed.

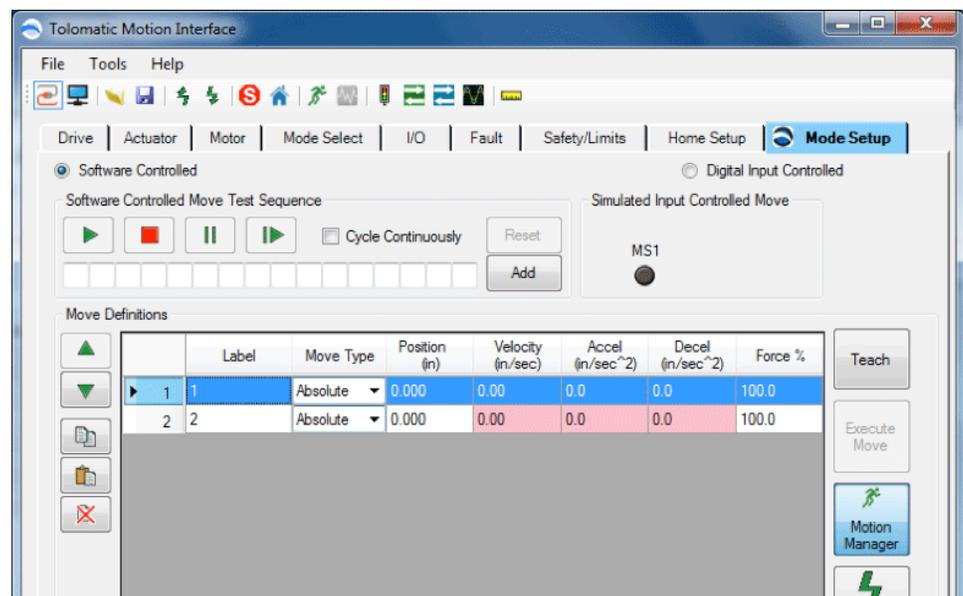


Figure 14-13: Pneumatic, Spring

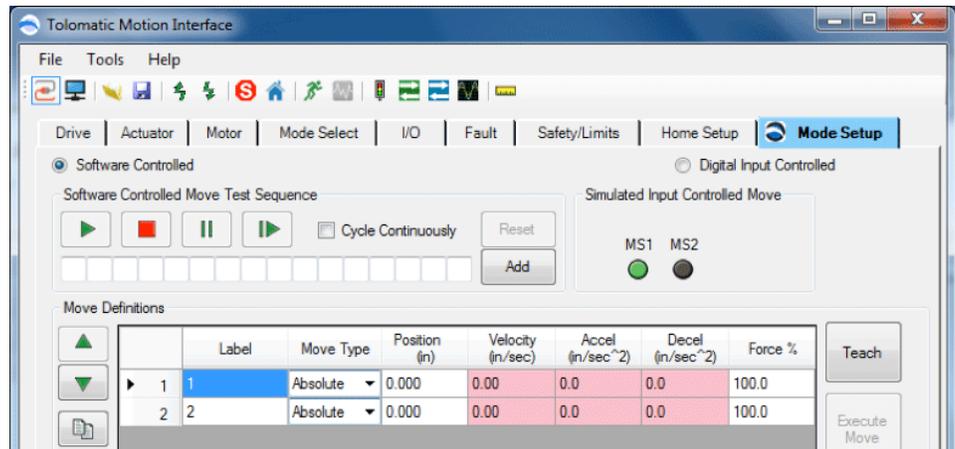


Figure 14-14: 2 Position (2 input)

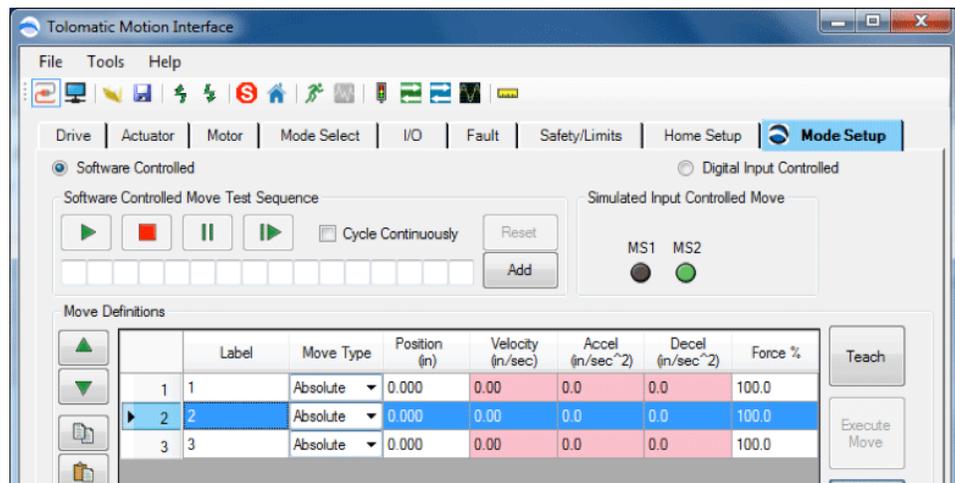


Figure 14-15: 3 Position (2 input)

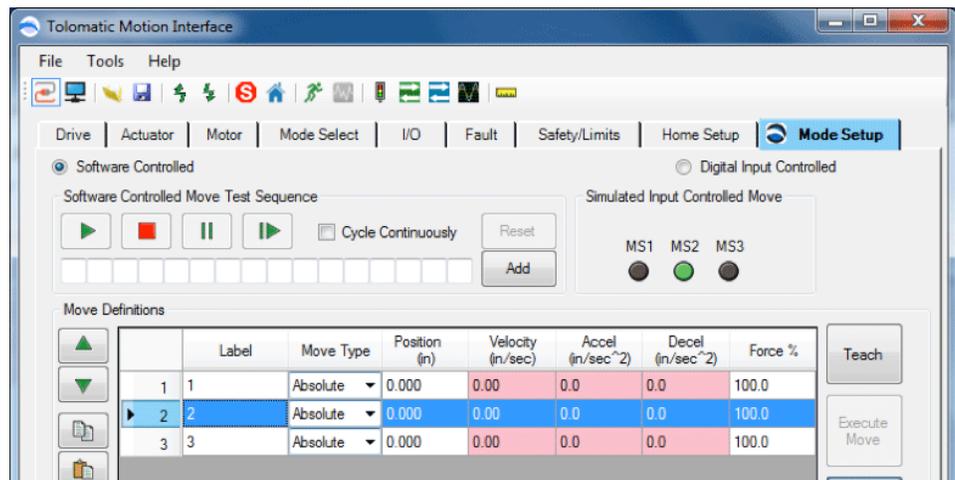


Figure 14-16: 3 Position (3 input)

Digital Input Controlled:

In order to test the I/O logic with the PLC or logic controller, the user must select Digital Input Controlled. When in this mode, all move buttons in the software are disabled and motion can only be initiated from the logic controller (PLC). The selected move from the Move Select inputs (see Section 10: I/O Tab) will be highlighted in blue in the table below. The Move Select (MS#) LEDs in the Digital Input Controlled group box will echo the logic of the Move Select inputs from the physical I/O interface. In this mode, the PLC or logic controller can select the desired move using the Move Select inputs and initiate motion using the Start Motion input (see Appendix 1: Timing Diagrams).

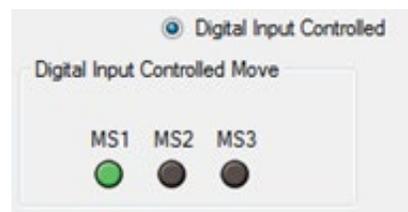


Figure 14-17: Digital Input Controlled

 **NOTE:** When Software Controlled is selected the MS1 to MS3 “LEDs” will track the selected line in the Move Definitions table.

14.3 Analog Position Mode

14.3.1 Configuring Analog Position Mode

Analog Position mode is used to equate an analog input voltage or current to position. The ACS Drive will convert the analog input to a scaled position range. If the ACS Drive has an analog output installed, the position of the encoder will be scaled to the analog output. If the ACS Drive has not been previously configured for Analog Position mode or has been restored to factory defaults, the Analog Position mode will be configured with zero Min/Max Position, Velocity, Accel/Decel to prevent any motion. The Min/Max Position, Velocity, Accel/Decel fields will be highlighted in light red indicating they are invalid settings (see Figure 14-18 below).

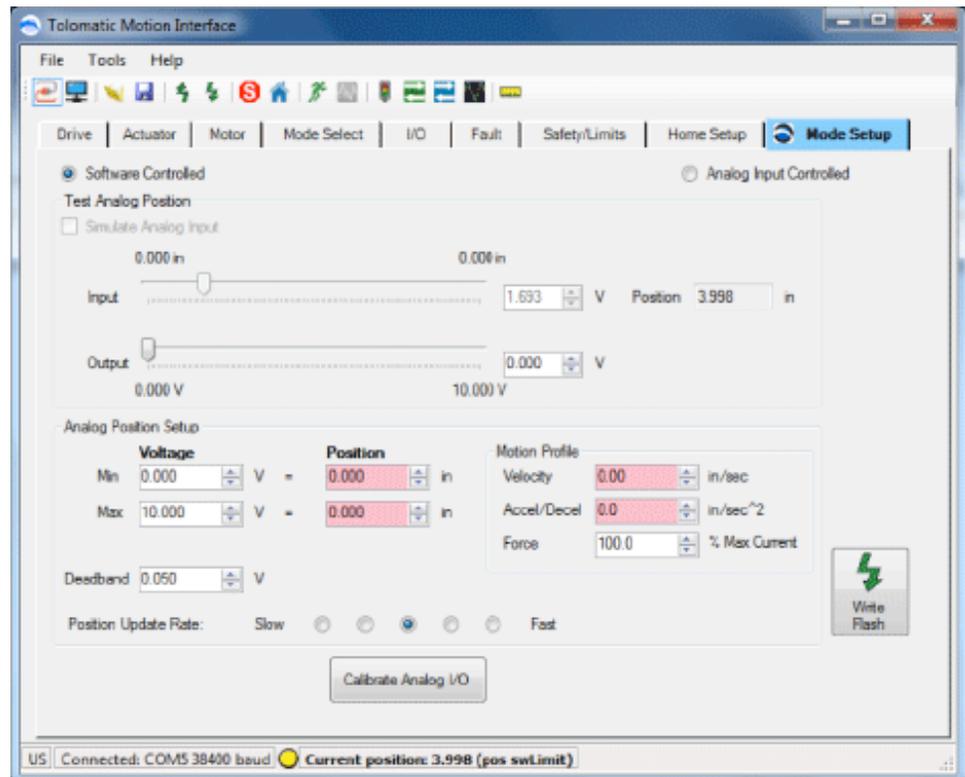


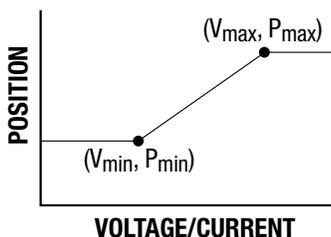
Figure 14-18: Default Analog Position Mode for Voltage

The mode setup for Analog Position mode has the following parameters that must be configured for proper operation.

Min/Max Voltage or Current: The range of Voltage is 0 to 10VDC and the range of Current is 0 to 20mA.

Min/Max Position: The configured positions that are equated to the Min/Max Voltage or Current setting. The ACS Drive will then linear interpolate the Analog Input and equate it to position based on the Min/Max Voltage or Current settings along with the Min/Max Position settings.

Velocity: Velocity value for any Analog Position move



Accel/Decel: Acceleration and deceleration value for any Analog Position move

Force: Force % value from 10 to 100% for any Analog Position move

Deadband: Plus / Minus window for Analog Input that is ignored or not used to create motion.

Position Update Rate: This setting adjusts the rate at which position commands are updated based on the changing Analog Input. A slower setting means the response of the system will not be as dynamic. A faster setting means the system will respond more quickly

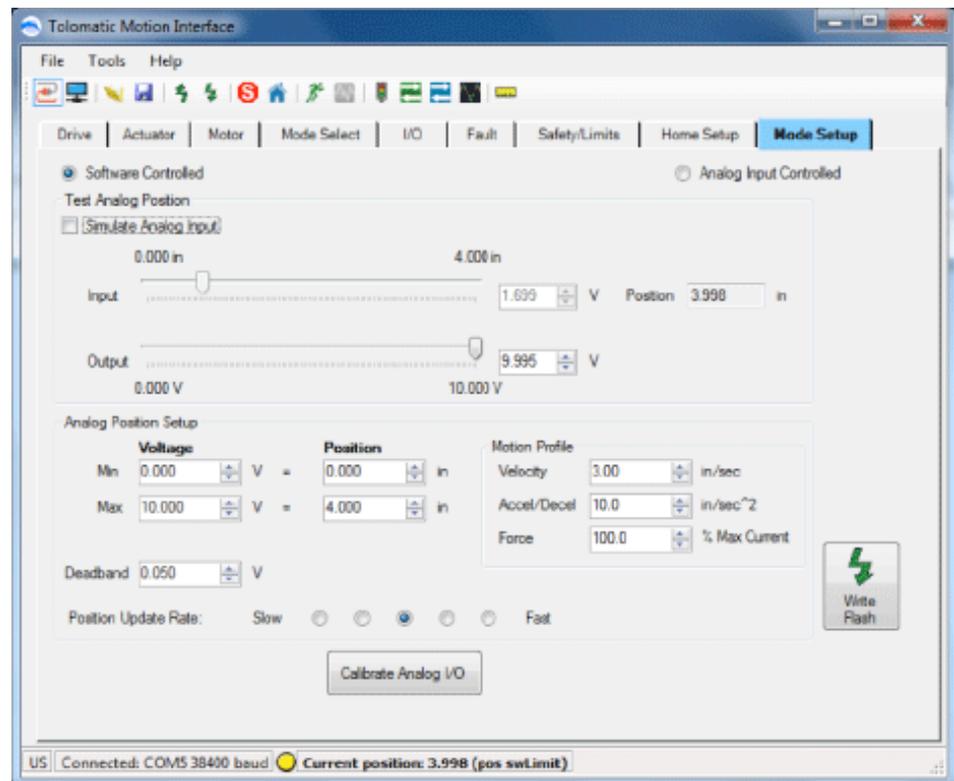


Figure 14-19: Settings for Analog Position mode for Voltage

Relationship between Analog Mode & Start Motion Input:

1. If Start Motion Input is configured in I/O Tab then user must set the Start Motion input ON to get motion. If Start Motion is configured and is set to OFF, user will not get motion after adjusting analog input.
2. In I/O Tab unmapping Start Motion input relieves the responsibility of setting Start Motion input to get motion using Analog input.



NOTE: If the Analog Output option is not installed, the Output slider will not be visible.



NOTE: If the motor doesn't have an encoder, the analog output will be forced

to 0 (volts or mA) and not used.



NOTE: In Analog mode Motion Select functions should not be mapped to digital inputs because they have no effect on the motion.

In the example above:

0 volts = 0 inch position

10 volts = 4 inch position

All moves will move with 3 inch/sec velocity, 10 inch/sec² accel/decel and 100% force.

14.3.2 Simulating the Analog Input

To simulate the analog input and test the logic setup for Analog Position mode, click on the Simulate Analog Input check-box. This will disable all the Analog Position Setup variables and the calibrate Analog I/O button because changes are not allowed when attempting motion. There are two sliders in the Test Analog Position box: one for an Input and one for the output. The Input is enabled and the user can change the values of the simulated analog input to create motion. The output slider should mimic the value of the analog output based on the actual position, if the motor has an encoder.

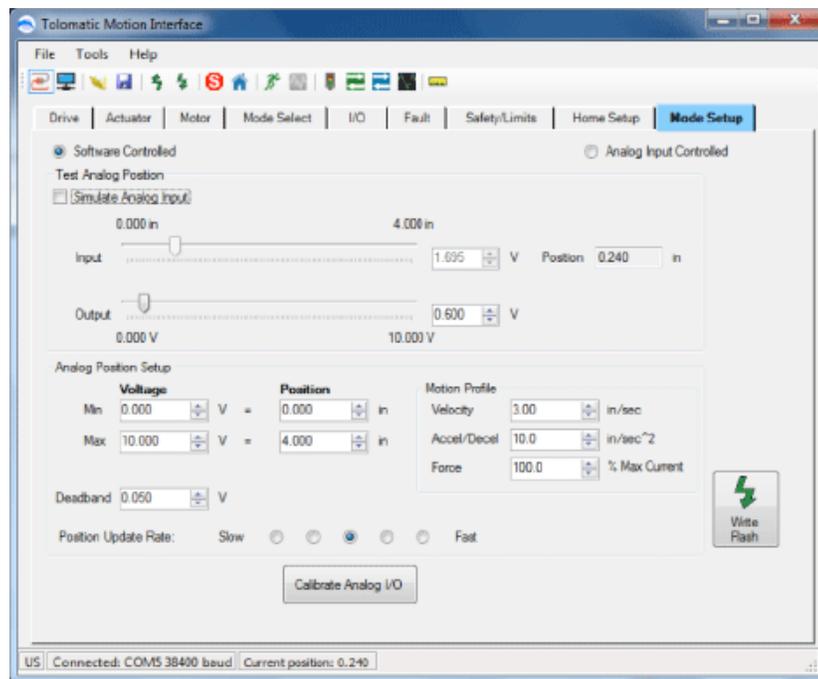


Figure 14-20: Simulating Analog Input



NOTE: When Simulate Analog Input is not checked, the output slider may be moved to manually change the analog output of the ACS drive.

14.3.3 Analog Input Controlled

Analog Input Controlled is used to test the logic of the Analog Position mode setup with actual external hardware such as a PLC. When the Analog Input Controlled button is pressed, the message below will be displayed.

WARNING: If “Yes” is selected, the user should expect motion as the ACS Drive will attempt to move in accordance with the Analog Position Setup.

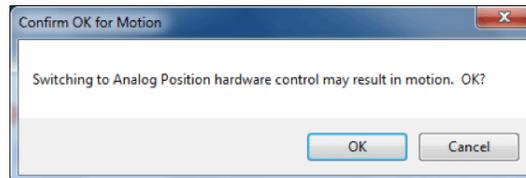


Figure 14-21: Confirm motion warning window

Once in this mode, the PLC or external Analog source can be used to test the system.

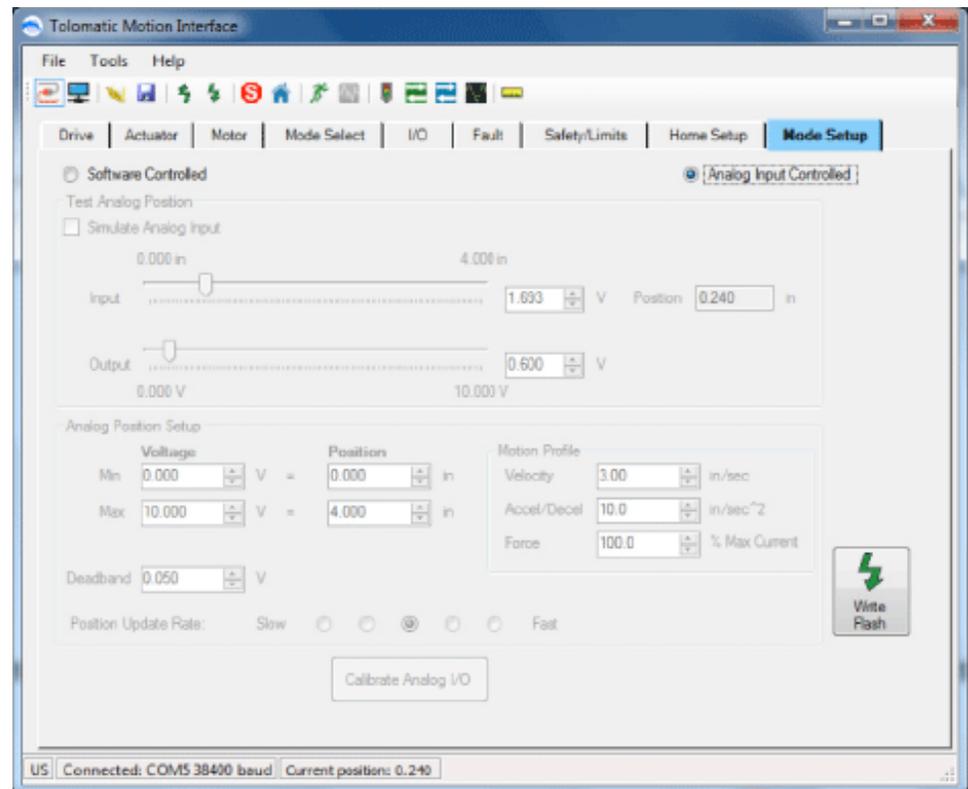


Figure 14-22: Analog Input Controlled

14.3.4 Calibrating Analog Input & Output

For advanced applications where positional accuracy is extremely important, the Analog I/O Calibration tool can be used to calibrate both the Analog Input and Output. Press the Calibrate Analog I/O tool from the Mode Setup screen to launch

the tool. Once in Analog I/O Calibration, the user can not navigate to any other screens in the Tolomatic Motion Interface (TMI). The user must click the Calibrate Analog I/O check box to enable the calibration process.

For analog input calibration, a voltage / current source and a meter (ohm / multi meter) will be required. Input a voltage or current to the ACS Drive and measure with the meter. Enter that value into the Measured Input field and press the associated Calibrate Min or Max button. For voltage, the recommended ranges are 1-4 volts for the Min voltage and 6-10 volts for the Max voltage. For current, the recommended ranges are 2-8 mA for the Min current and 12-20 mA for the Max current.

The analog input also has a software filter that is adjustable to give flexibility to the user on how dynamic the Analog Position control should be. With a filter setting more towards Min, the analog filter will do less filtering and the analog input signal will give the controller more raw data in which to respond. With a filter setting more towards Max, the analog filter will do more filtering causing the analog input signal to the controller to be smoother (less noisy).

For analog output calibration, a meter (ohm / multi meter) will be required. Enter a Min voltage or current (1 - 4 volts or 2 - 8mA) into the Test Output field press Test Min and then measure with the meter. Enter the measured value into the Measured Output field and press Calibrate Min button. Repeat procedure for Max voltage or current (6 - 10 volts or 12 - 20mA) and press the Calibrate Max button.

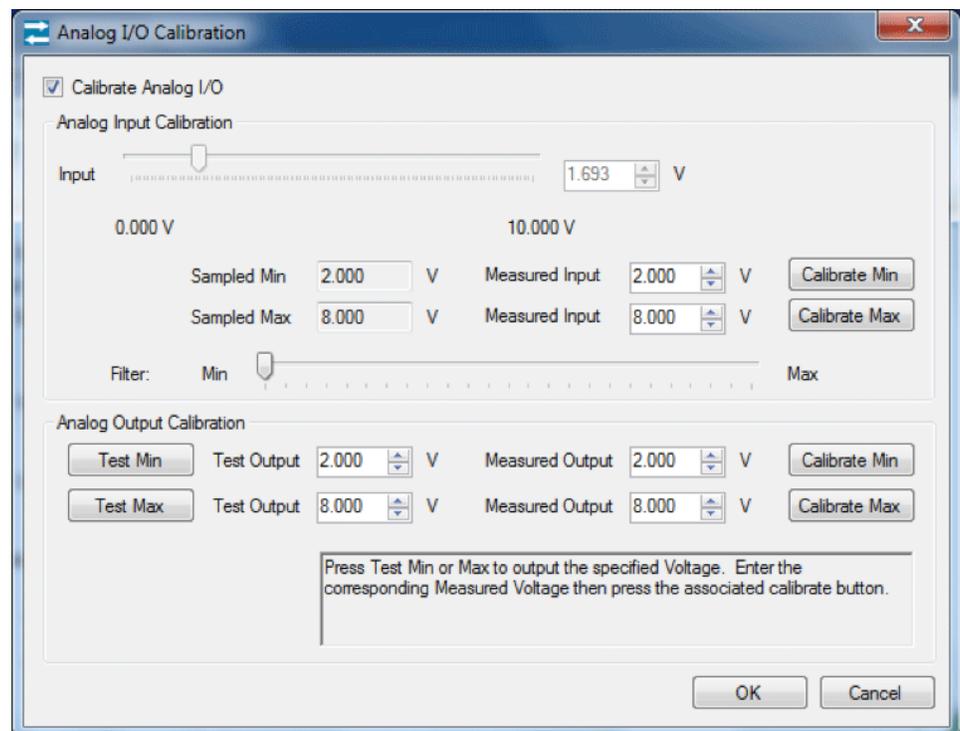


Figure 14-23: Sample of completed Analog I/O calibration

14.4 Network Mode (*Modbus RTU, EtherNet/IP & Modbus RTU*)



NOTE: The

TMI software will determine if *EtherNet/IP, Modbus TCPBus RTU* is appropriated based on the ACS unit connected.



NOTE: To setup

ACS drive for Network communication, the Ethernet port must be configured using the Ethernet Setup Tool. See Section 21 for details.

14.4.1 Using Network Mode

Once the ACS Drive has been configured for the desired Actuator and Motor, Network mode can be configured for control with *Modbus RTU, EtherNet/IP* or *Modbus TCP* protocol. Depending on the model ordered, the TMI software will only show either *Modbus RTU, EtherNet/IP* or *Modbus TCP* (also known as *Modbus TCP/IP, Modbus/TCP* or *Modbus-TCP*). In this section Network refers to *Modbus RTU, EtherNet/IP* or *Modbus TCP* protocols

When Mode Select is configured for Network operation, the Mode Setup tab will allow setup of up to 16 moves. The Network Move GroupBox displays the most recently commanded move. Please note that the Current Position is displayed instead of the Position from the move table or the position sent over the network. The reason for this is to be able to track the absolute position at all times. Move number 0 indicates a move commanded by the TMI Motion Manager or the Network connection.

When the TMI user presses the Network Controlled radio button, or whenever the *Modbus RTU* (or *EtherNet/IP Modbus TCP* or *Modbus RTU*) client commands a move the Host in control indicator (as seen on the Drive Status Tool) will turn off and the TMI controls will be disabled. This keeps the TMI user from changing parameter values while the *Modbus RTU, EtherNet/IP* or *Modbus TCP* client is commanding movement.



Figure 14-24: Modbus RTU Controlled

or



Figure 14-25: EtherNet/IP Controlled

or

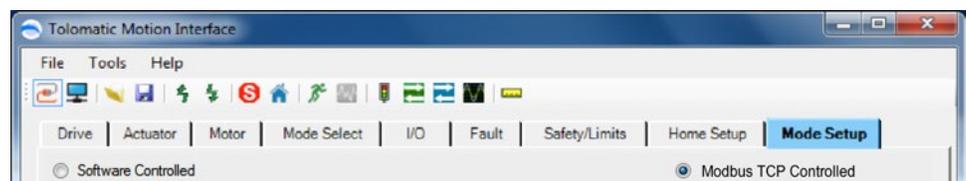


Figure 14-26: Modbus TCP Controlled

When Network is in control, the controls in the Mode Setup tab's Network Move GroupBox show the most recent move commanded by the *Modbus RTU, EtherNet/IP* or *Modbus TCP* client. Note that rather than displaying the commanded position, the Current Position is displayed.

To return control to the TMI host, either press the Software Controlled radio button, or select one of the tabs other than Mode Setup.

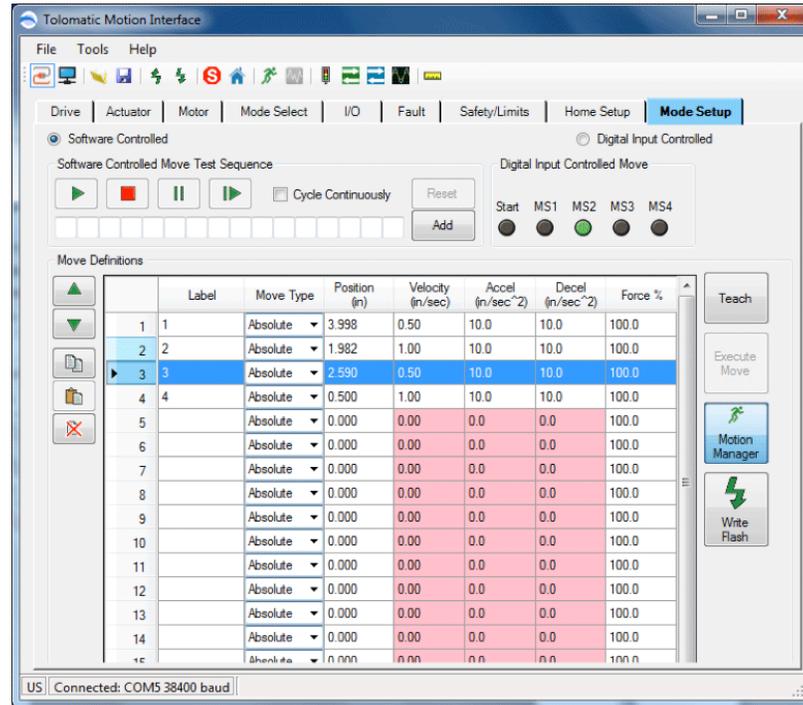


Figure 14-27: Software in control, last commanded move is highlighted.

The Host in control indicator on the Drive Status tool indicates whether TMI (the Host in this case) is in control.

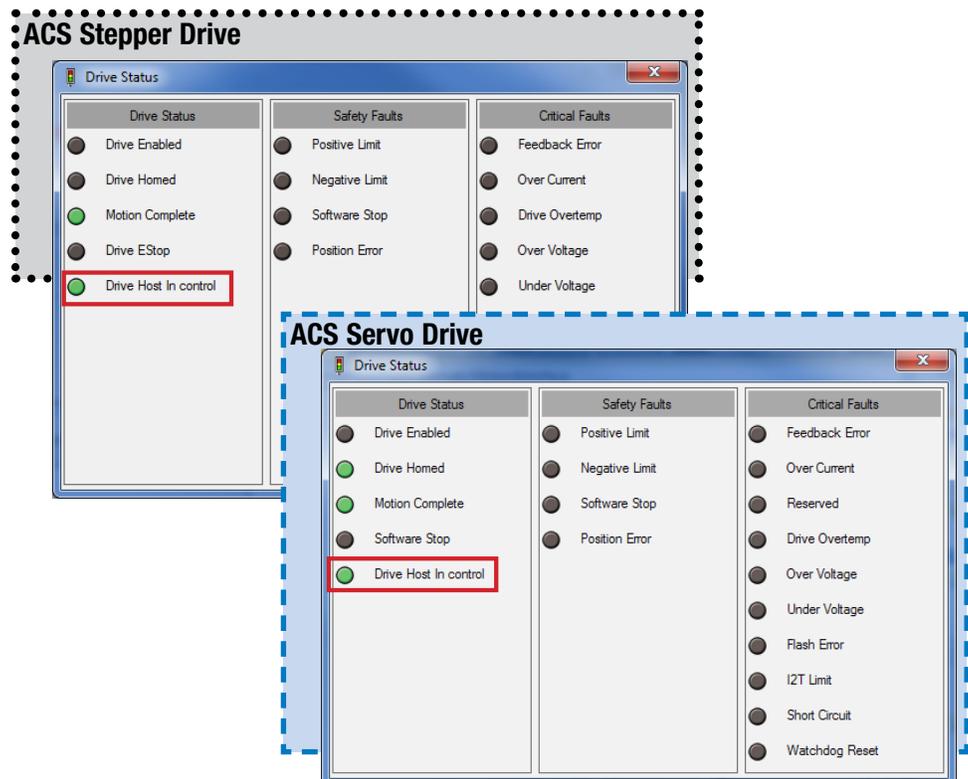


Figure 14-28: Drive Status tool indicates Software (Host) is in control.

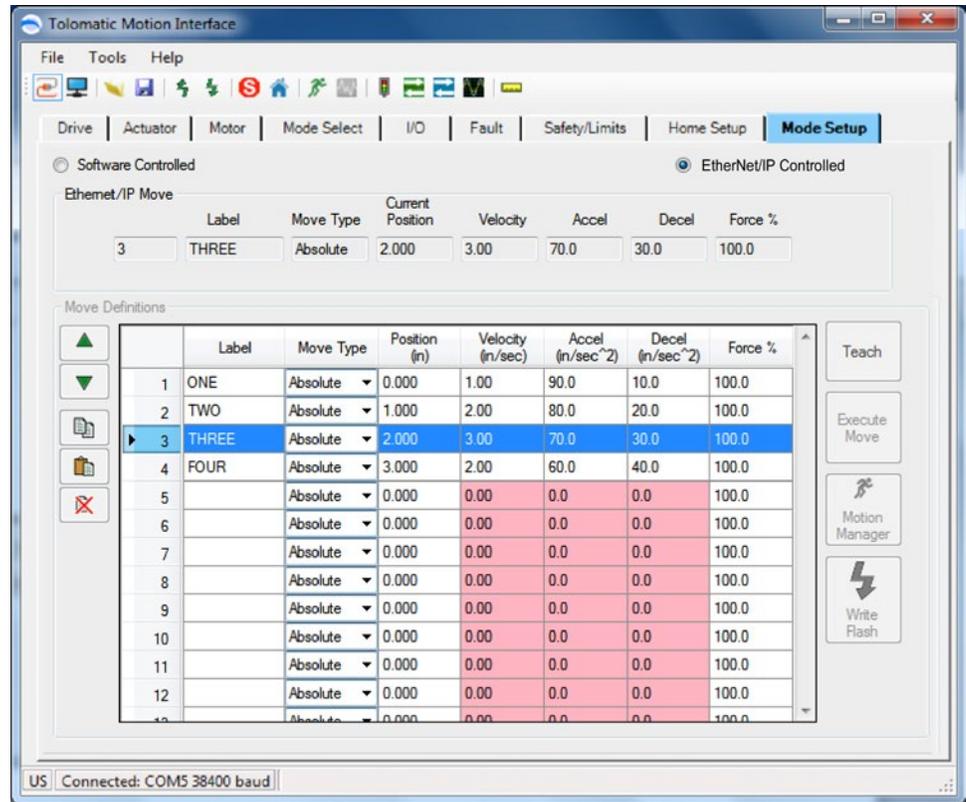


Figure 14-29 EtherNet/IP (or Modbus TCP, Modbus RTU) in control, last commanded move is highlighted.

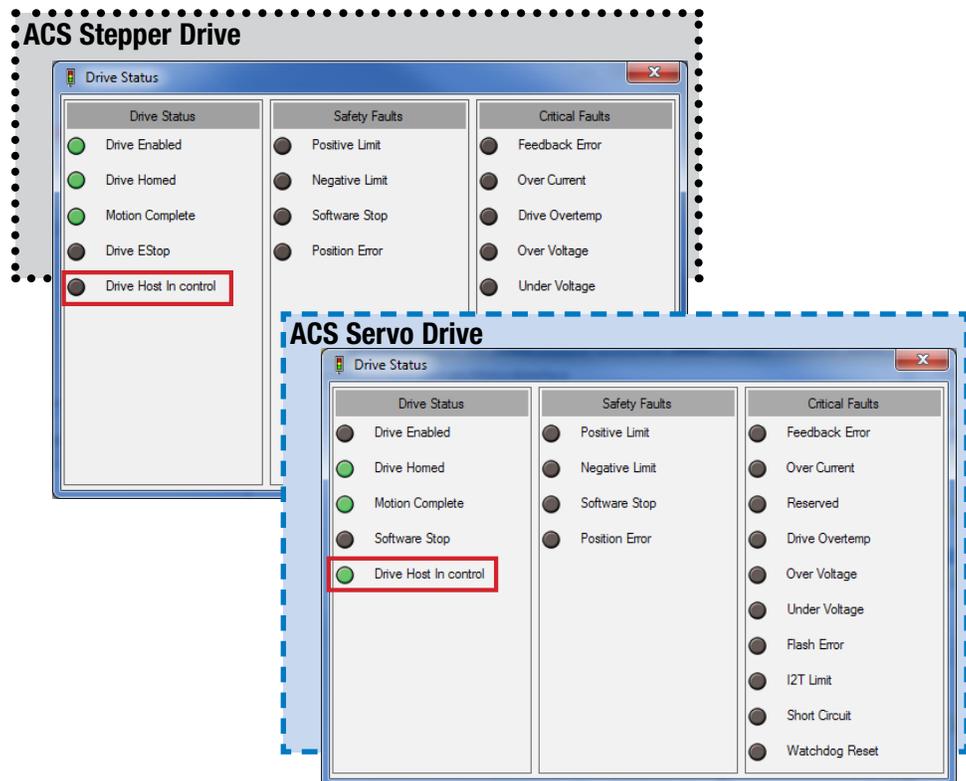


Figure 14-30: Drive Status tool indicates EtherNet/IP (or Modbus TCP, Modbus RTU) is in control.

Relationship between Network Mode (*Modbus RTU, EtherNet/IP or Modbus TCP*) & I/O:

When user selects Network Mode all digital inputs and digital outputs are set to "Not Configured". This way PLC or HMI can map any desired condition to them and set/reset digital output accordingly. When not configured, digital inputs don't have any effect. If user selects Network Mode and maps functions to digital outputs and digital inputs, they behave as follows:

Enable Digital Input is set to ON and Network command disables the ACS Drive, the ACS Drive remains enabled.

Enable Digital Input is set to OFF and Network command enables the ACS Drive, the ACS Drive becomes enabled

If Software-Stop Input is wired to digital input, configured in TMI and Software-Stop input is ON, the ACS Drive will not move even if motion is commanded over Network.



NOTE: In Network Mode motion select functions should not be mapped to digital inputs because they have no effect on the motion.



15.1 Using the Motion Manager

The Motion Manager allows the user to enable/disable the motor, home, and create simple motion commands (Absolute, Incremental, Jog). The Motion Manager is a can also be used for positioning in order to teach Moves into the Mode Setup table (see Section 14: Mode Setup Tab).

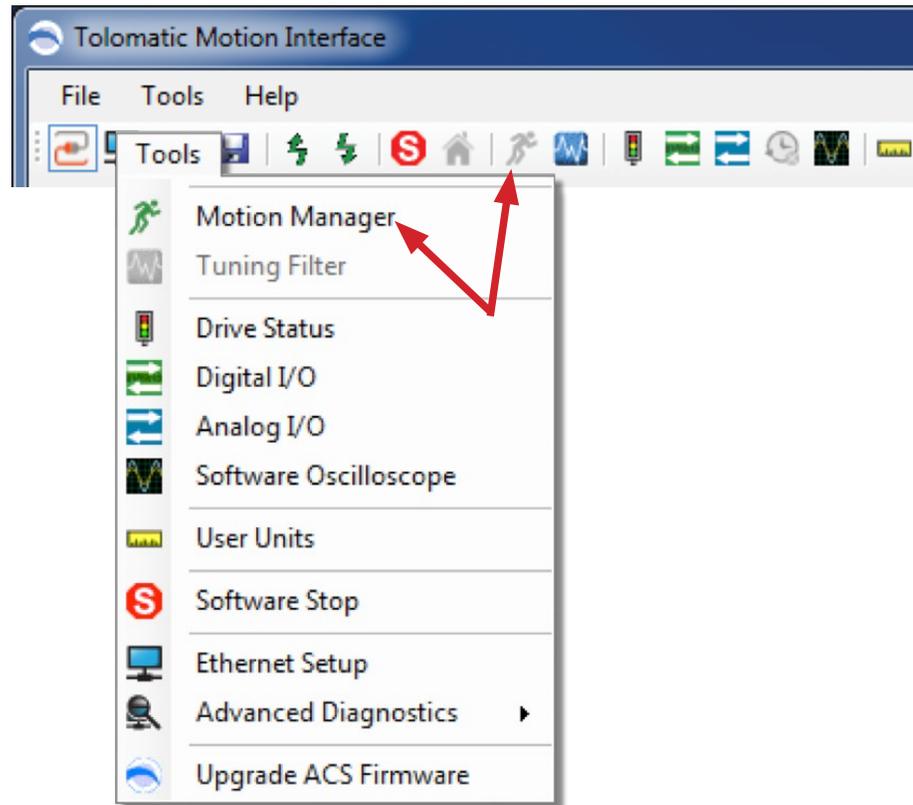


Figure 15-1: Launching the Motion Manager Tool

15.1.1 Controls

Enable/Disable: Enables or Disables drive and output to motor.

Home: Initiates Home sequence configured in Home Setup Tab.

Enabled, Homed, Motion Complete LEDs: Status LEDs.

15.1.2 Motion Profile

Position: Displays actual position from encoder or commanded position without encoder. Motion profile (Velocity, Accel, Decel, Force) per Jog, Absolute and Incremental moves in Motion Manager.

15.1.3 Jog

Jog Neg: Initiates a Jog Move with motion profile settings in a negative direction.

Jog Pos: Initiates a Jog Move with motion profile settings in a positive direction.

NOTE: Jog move will be initiated while Jog Neg or Jog Pos button is held down by mouse click. The jog move will stop when the mouse click is released.

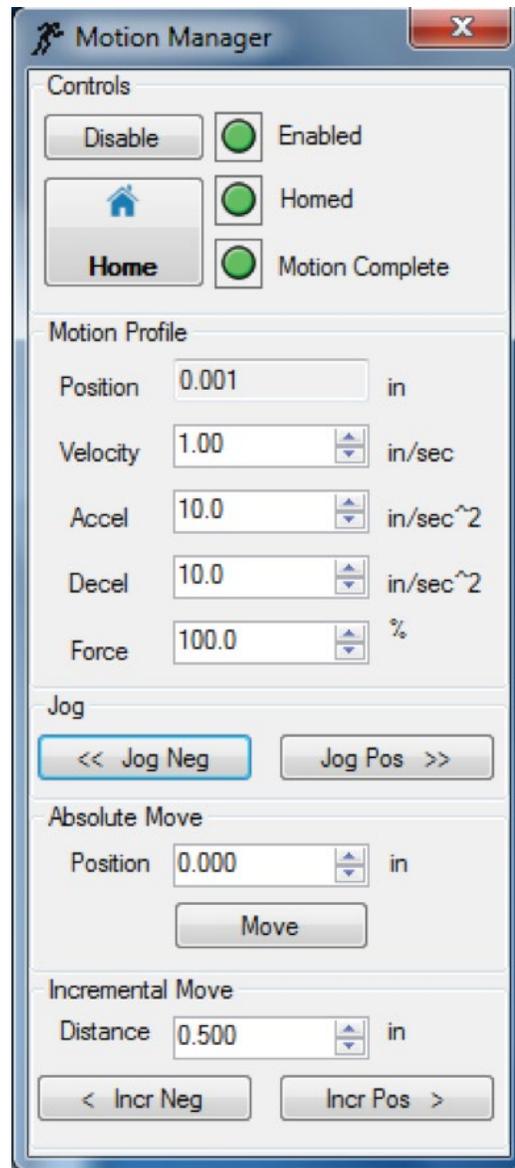


Figure 15-2: Motion Manager Panel

15.1.4 Absolute Move

Initiates an absolute move to entered position parameter with motion profile settings.

15.1.5 Incremental Move

Incr Neg: Initiates an incremental move the size of the entered distance parameter in a negative direction.

Incr Pos: Initiates an incremental move the size of the entered distance parameter in a positive direction.



Tuning a servo motor is an advanced procedure. Tolomatic standard motors have predetermined tuning values that should work for most applications. Tuning should be performed when more performance is required for the application or when a new motor is added. A basic understanding of PI (Proportional Integral) Control Loops is required for tuning.

The Servo Control Loop for Position Control is made up of three separate PI loops: Position, Velocity, and Current loops. These three control loops are cascaded, meaning that the output of one loop feeds into the input of the next loop. The position loop uses profile position from the trajectory generator and actual position from the feedback device to command velocity. The velocity loop uses the sum of commanded velocity from the position loop and profile velocity and compares it to actual velocity to generate a commanded current. This commanded current, along with the actual current, is used to control the PWM to the bridge circuit which in turns drives the servo motor.

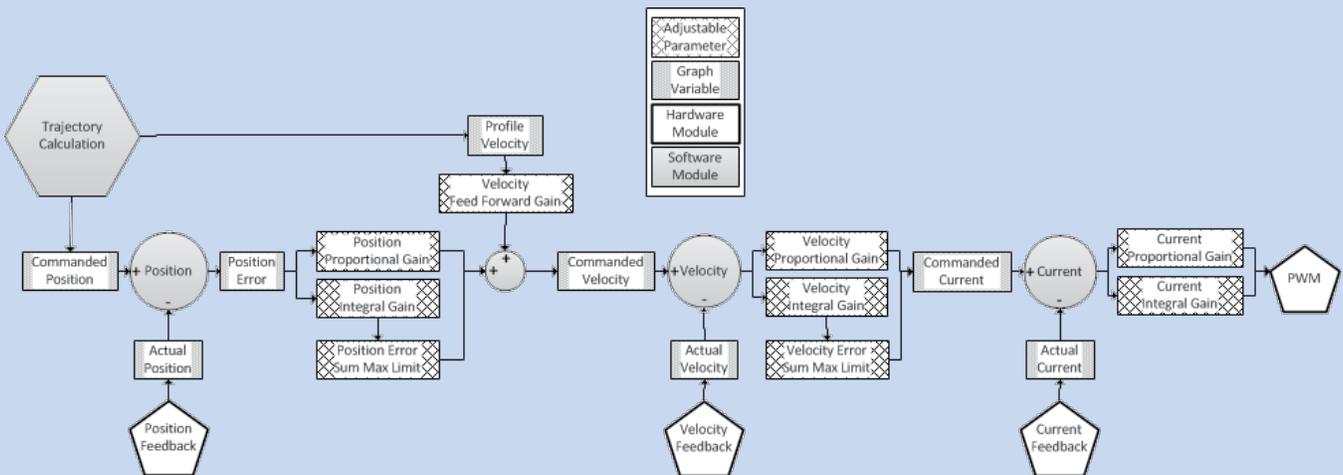


Figure 16-1: Control Loop

Each control loop corresponds to a set of tunable parameters in the Tuning Filter.



16.1 Tuning Filter Dialog

The Tuning Filter tool is broken into two distinct parts – the Parameter Adjustment pane, and the Graphing Pane. The parameters are adjusted in the left hand side of the window, and the effects can be observed on the right hand side of the window.

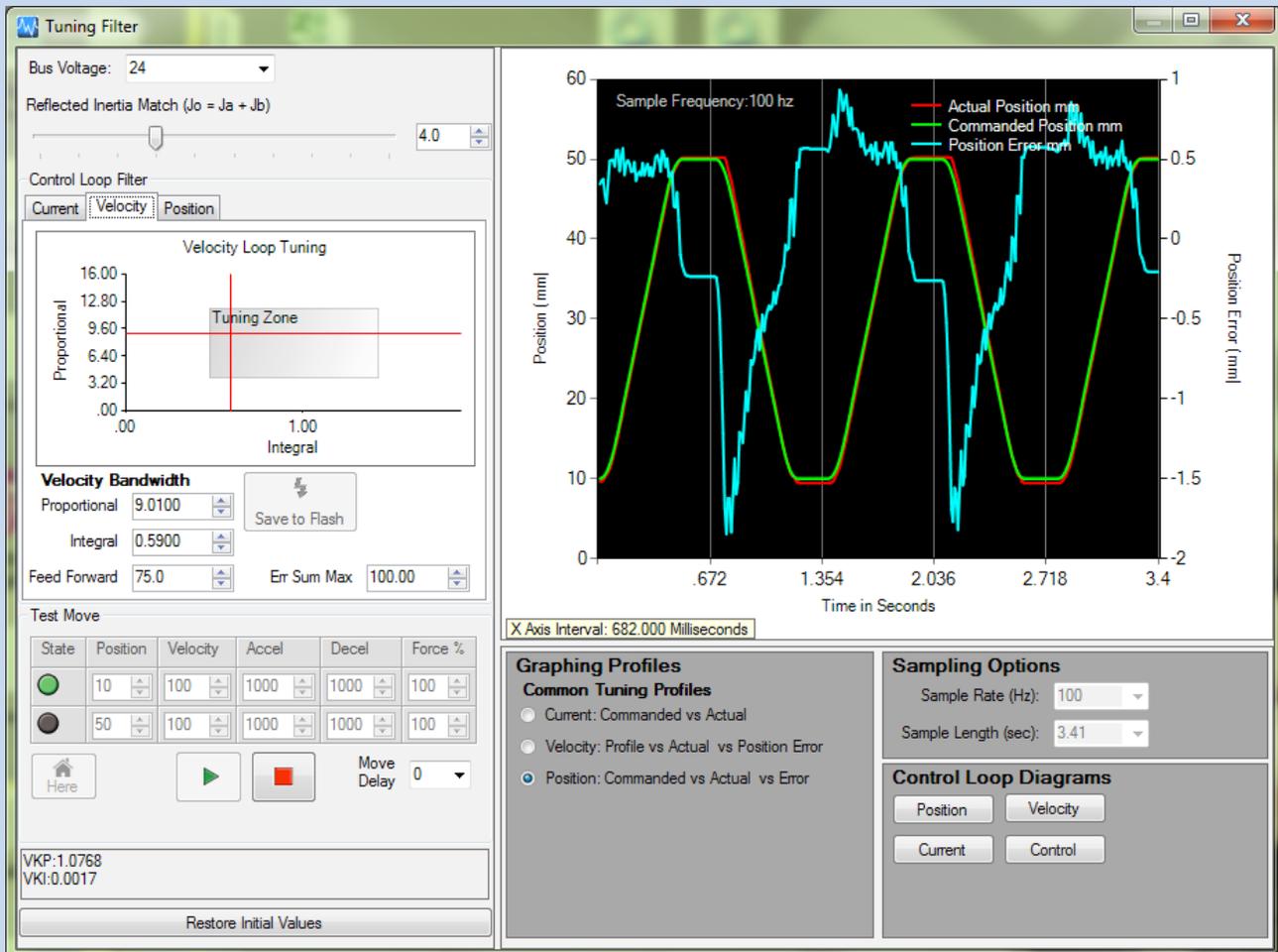


Figure 16-2: Tuning Filter Dialog

16.1.1 Parameter Adjustment Pane

- **Bus Voltage:** Bus voltage of the system, typically 24V or 48V. Note: This setting affects the calculation of current loop gains.
- **Reflected Inertia Match:** Inertia match of the system. Note: This setting affects the calculation of velocity loop gains.
- **Proportional Bandwidth:** Proportional bandwidth value for the given PI loop (Position, Velocity, Current) used to calculate proportional gain. The value can be changed using the numeric up/down box or by clicking on the graph.
- **Integral Bandwidth:** Integral bandwidth value for the given PI loop (Position, Velocity, Current) used to calculate integral gain. The value can be changed using the numeric up/down box or by clicking on the graph.
- **Feed Forward:** Percentage value that helps match commanded output to profile output. Typically used to smooth at the cost of precision



16: TUNING FILTER

- **Err Sum Max:** Percentage value that can be used to limit the amount of error calculated in the loop. Useful in limiting runaways and over corrections.
- **Save to Flash:** Saves the tuning settings of the specific loop to internal storage on the drive so that it can be maintained when the system power cycles
- **Test Move:** Configures the drive for a continuous sequenced position move between two points using the user defined settings. Current tuning inputs a square wave of specified force amplitude into the current loop instead of performing a position move. NOTE: Tuning uses relative positioning. Make sure that you are aware of your actuators position with relation to its stroke length before performing any moves to prevent a crash.
- **Home Here:** Declares home position value of 0.0 at the current position
- **Restore Initial Values:** Restores to the drive the initial tuning values saved when the tool was opened. Note that is not a restore to factory defaults. In order to do this, you should run the File->Restore Drive to Factory Settings command from the TMI menu

For the majority of setups, the user will only need to adjust the Bus Voltage and the Reflected Inertia Match slider. It is recommended that users do not modify the Current PI loop tuning parameters if using Tolomatic standard motors.

Advanced Option - Adjusting the Tuning Range Min/Max: If more range is desired, each bandwidth's combo box min/max can be adjusted by right clicking on that parameter's combo box, and selecting "Adjust Min/Max".

16.1.2 Graphing Pane

The graphing pane can display variables recorded during motion so the effects of changing tuning parameters can be seen. The drive supports a limited sized internal buffer for onboard sampling. The data is transferred after a move has completed.

- **Graphing Profiles:** Selectable outputs that can be graphed for analysis
- **Sample Rate:** Rate in Hertz at which parameters are sampled
- **Sample Length:** The total length of the sampling period, in seconds
- **Control Loop Diagrams:** Helpful diagrams that display the input and outputs of each PI loop



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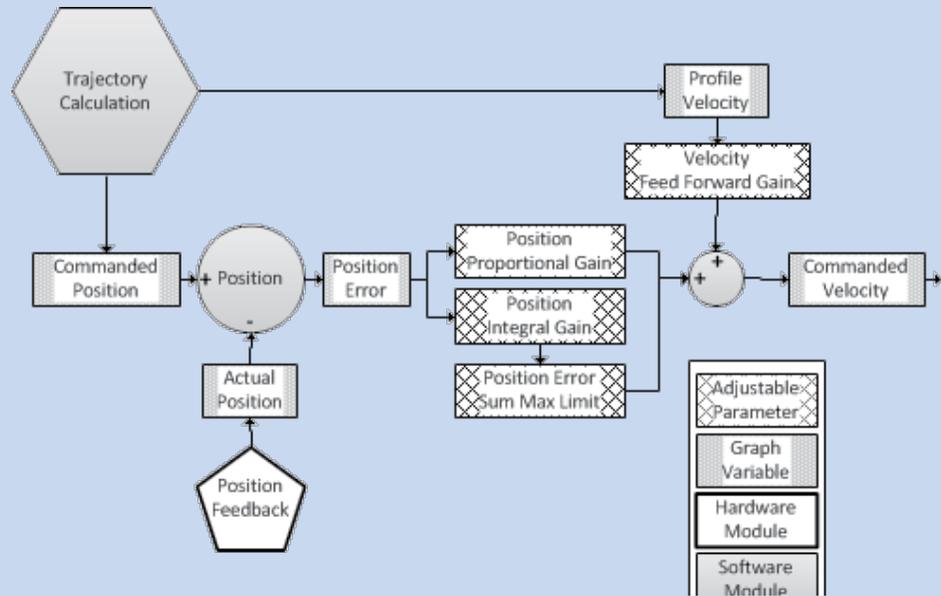


Figure 16-3: Position PID Loop

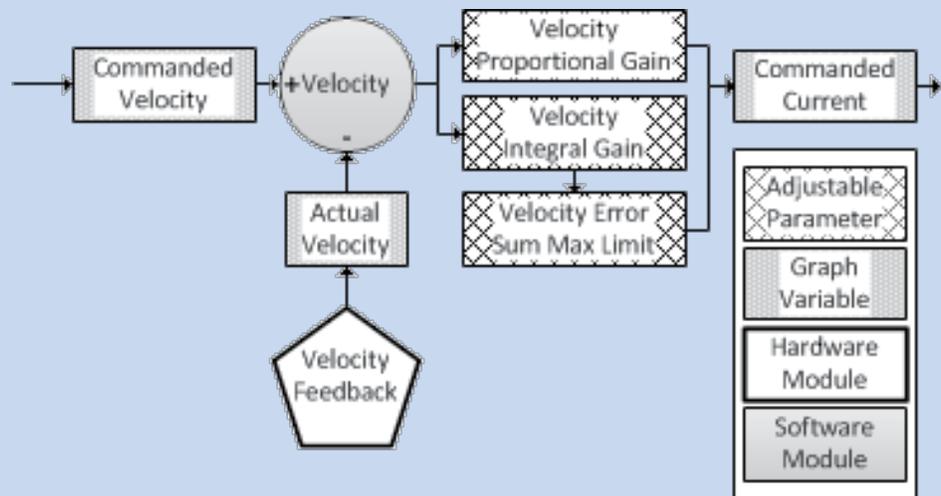


Figure 16-4: Velocity PID Loop

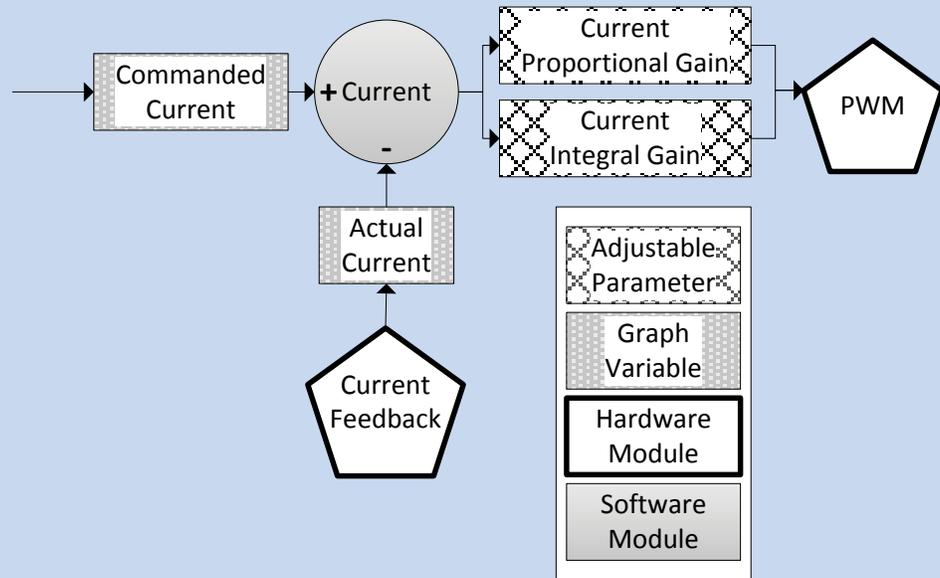


Figure 16-5: Current PID Loop

16.2 Gain Adjustments and Effects

The following section describes generally what each gain adjustment does with relation to motion using the Tuning Filter dialog.

16.2.1 Position Proportional

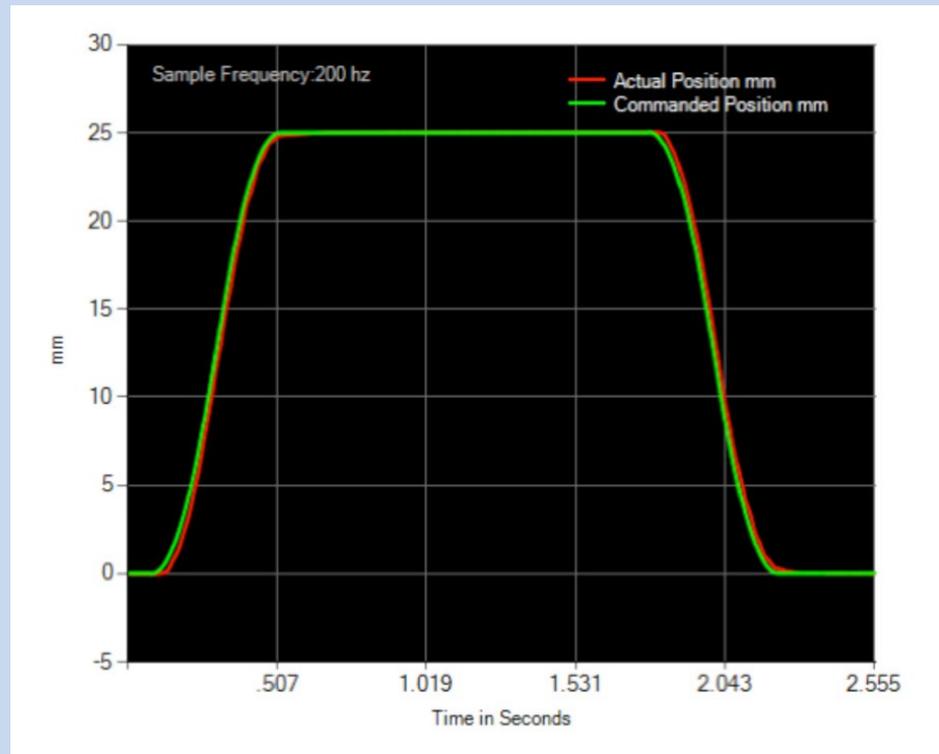


Figure 16-6 – Good Position Proportional Gain

A good position proportional gain setting should follow the position profile closely without much overshoot. This gain affects how quickly the control loop can follow a fast change in commanded position.

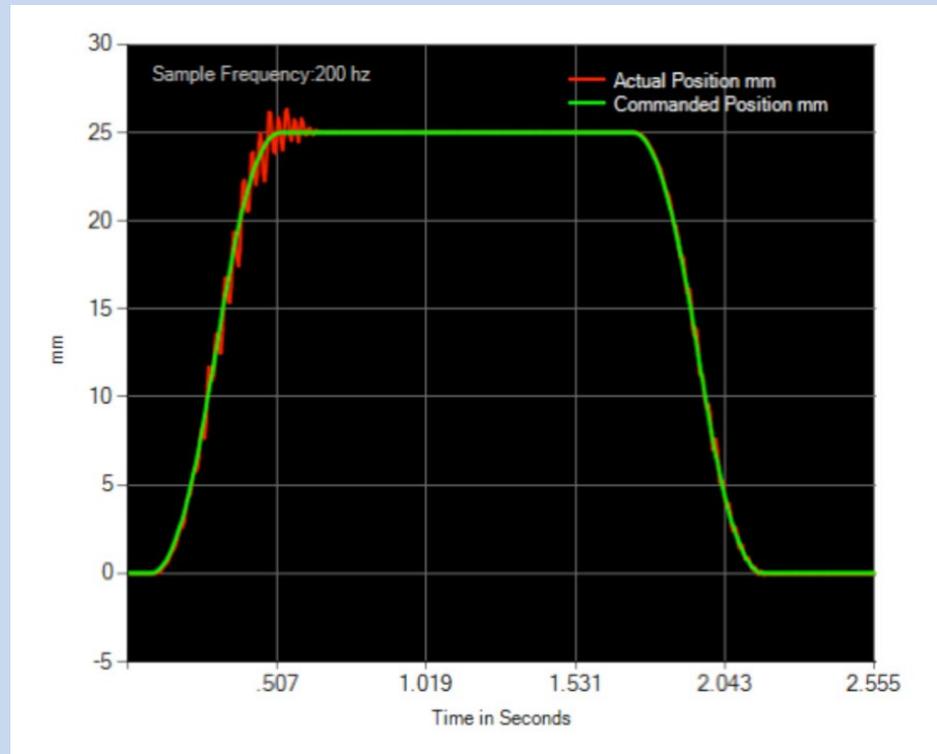


Figure 16-7: Position Proportional Gain - Too High: Oscillations

Figure 16-7: Generally the higher the proportional gain the faster the control loop can follow a fast change in the position command. A Position proportional gain too high can create oscillations and rough motion.

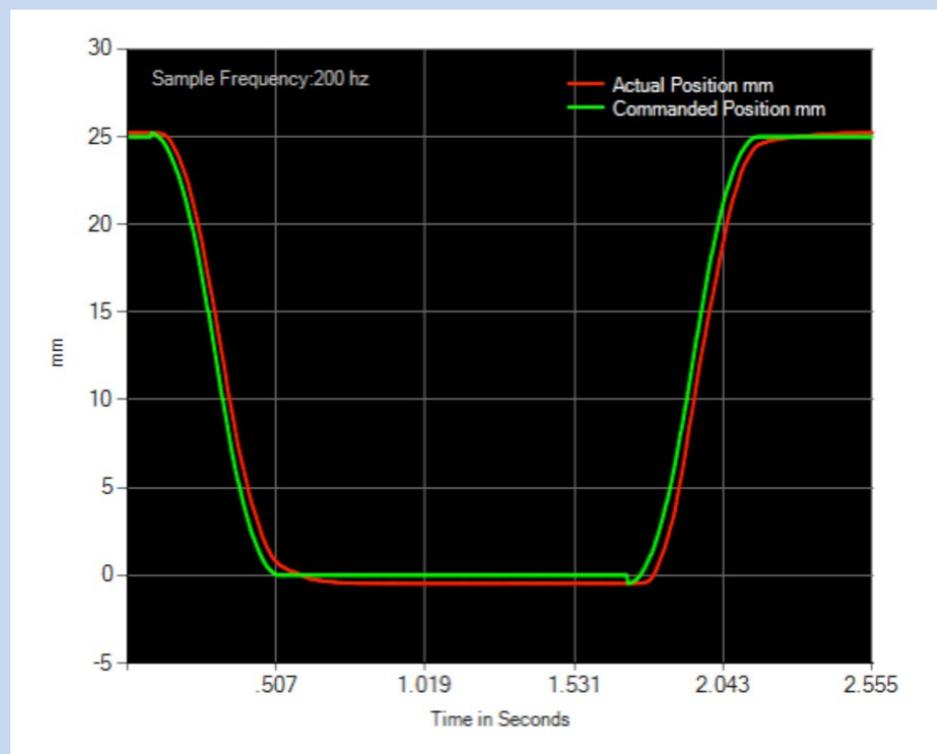


Figure 16-8: Position Proportional Gain - Too Low: Large Position Error

Figure 16-8: Position proportional gain too low can be sluggish and fall behind the



desired motion profile. Falling behind creates position error that can accumulate during the move and then take a while to wind down causing an overshoot of the desired position.

16.2.2 Position Integral

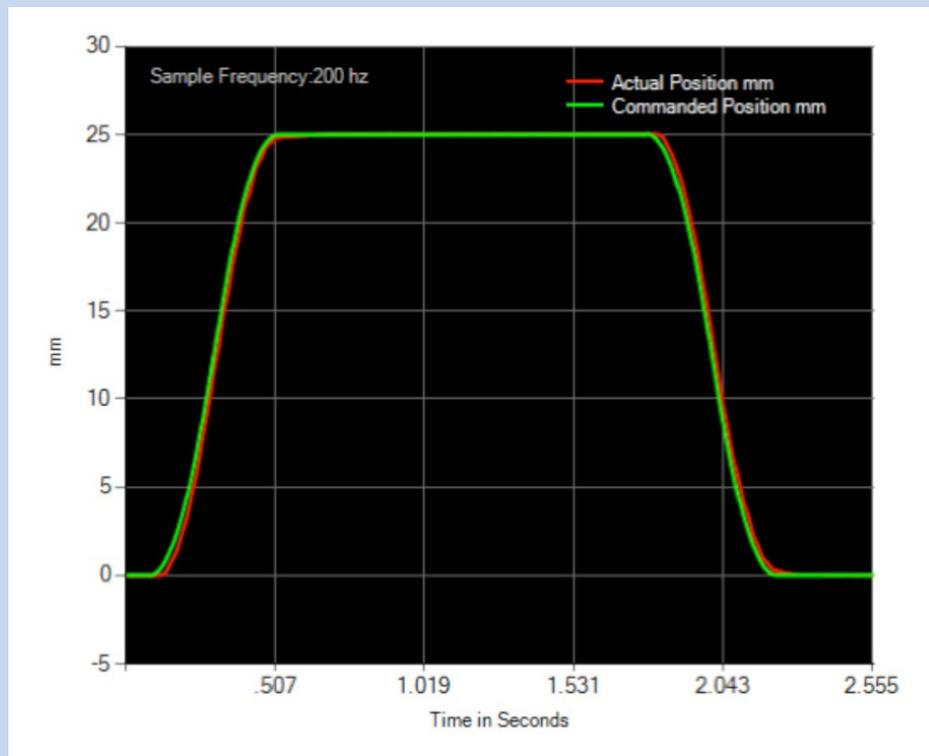


Figure 16-9: Good Position Integral Gain

Figure 16-9: A good position integral gain setting should follow the position profile closely without much overshoot and it should settle to a steady state position equal to the commanded position.

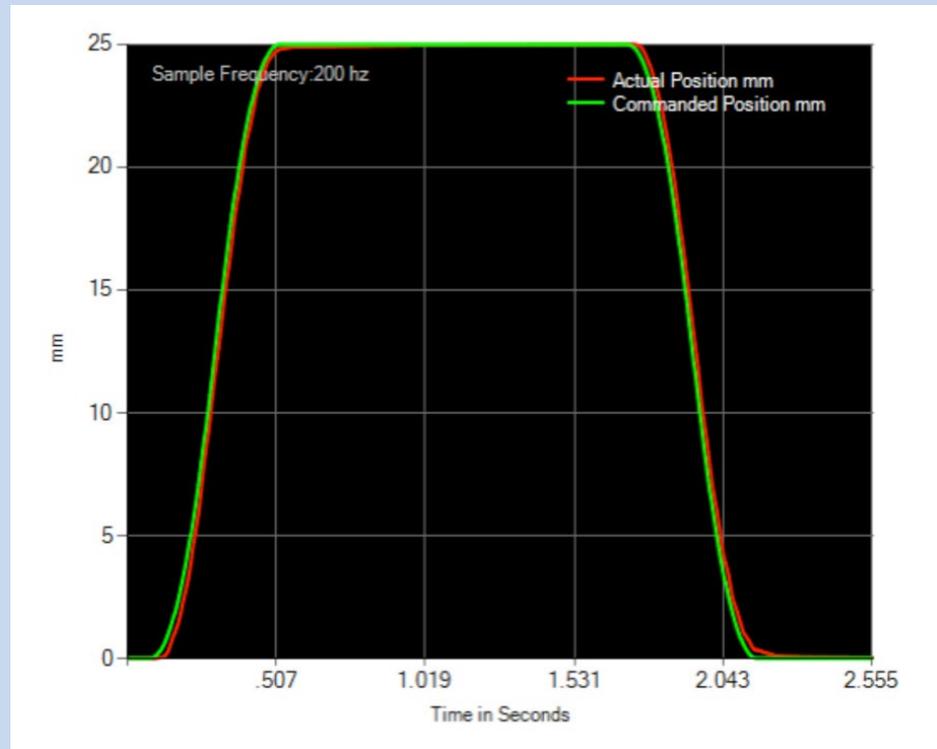


Figure 16-10: Position Integral Gain – Too Low: Slow steady-state response

Figure 16-10: A position integral gain set too low can increase position error during motion and slow the steady-state response of seeking the final position value.

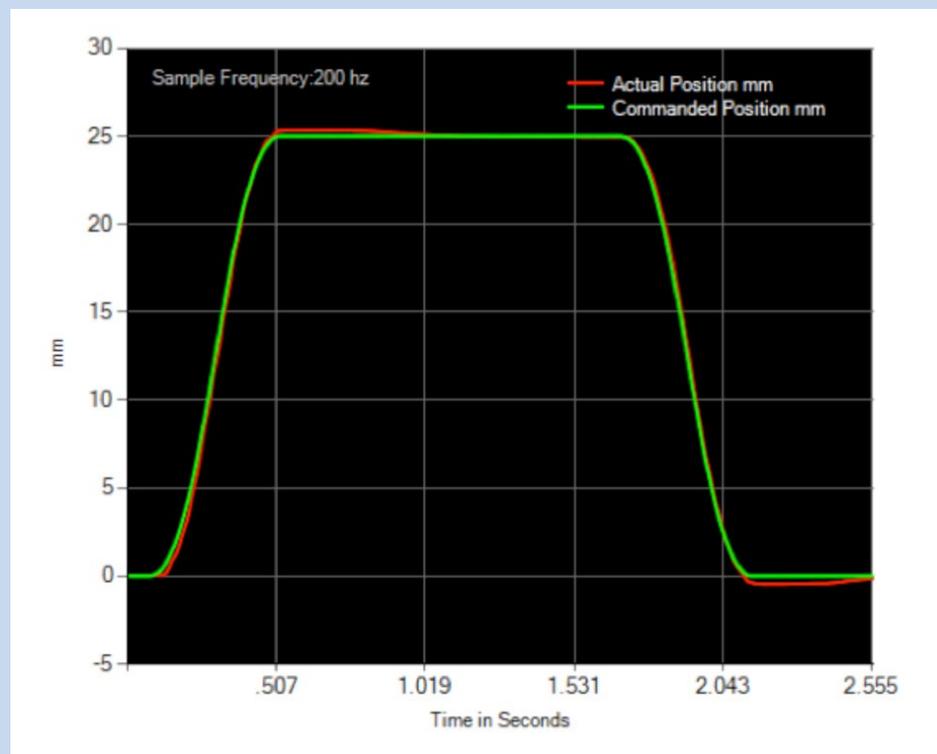


Figure 16-11: Position Integral Gain - Too High: Overshoot which gets corrected over time

Figure 16-11: A high position integral setting can accumulate error during the move and cause too much overshoot of the final position. Some overshoot oscillation can



occur also.

16.2.3 Velocity Proportional

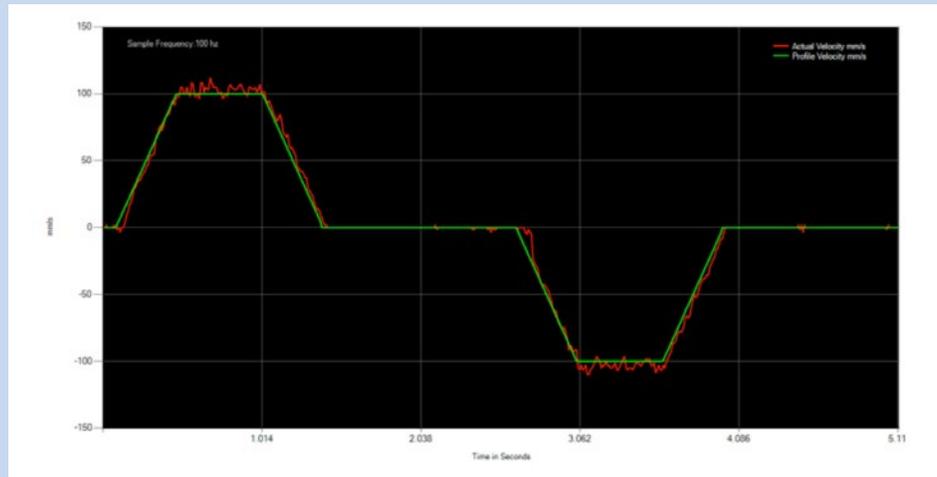


Figure 16-12: Good Velocity Proportional Gain

Figure 16-12: A good velocity proportional gain should create quick loop response to a fast change in velocity. Proportional gain will affect mainly the rising and falling slopes of the velocity profile.

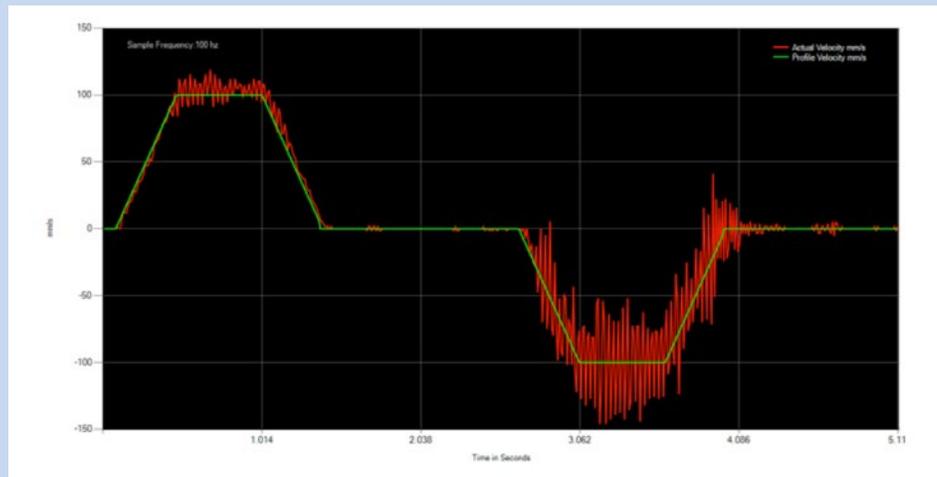


Figure 16-13: Velocity Proportional Gain - Too High: Large Oscillations in Velocity

Figure 16-13: Setting velocity proportional gain too high can result in large oscillations in velocity during a move.

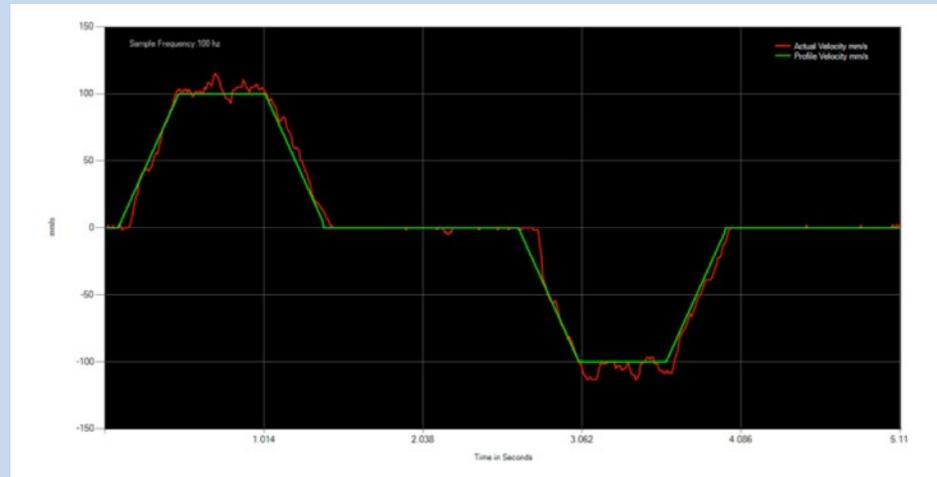


Figure 16-14: Velocity Proportional Gain - Too Low: Slow Velocity Response

Figure 16-14: Setting a velocity proportional gain too low can result in sluggish response to changes in velocity. It may not even reach the commanded velocity value.

16.2.4 Velocity Integral

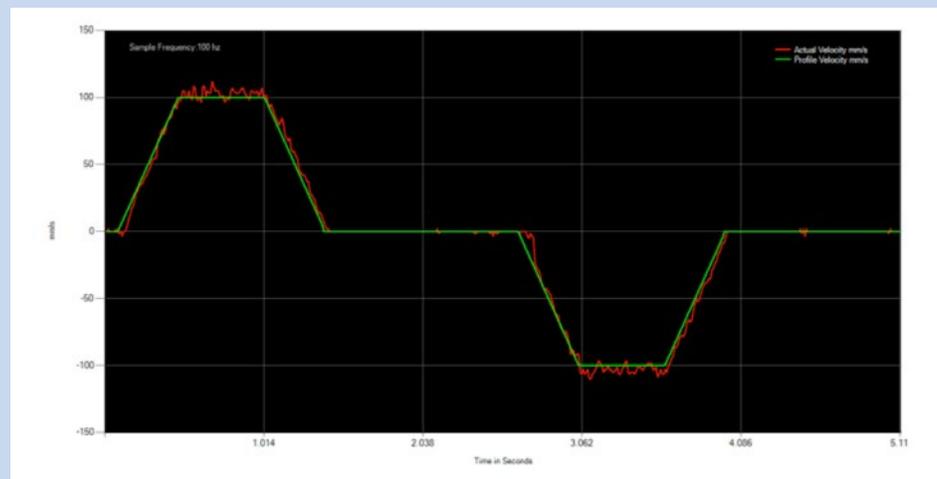


Figure 16-15: Good Velocity Integral Gain

Figure 16-15: A good velocity integral setting will help reduce the error in the constant velocity section of the velocity profile.



16: TUNING FILTER

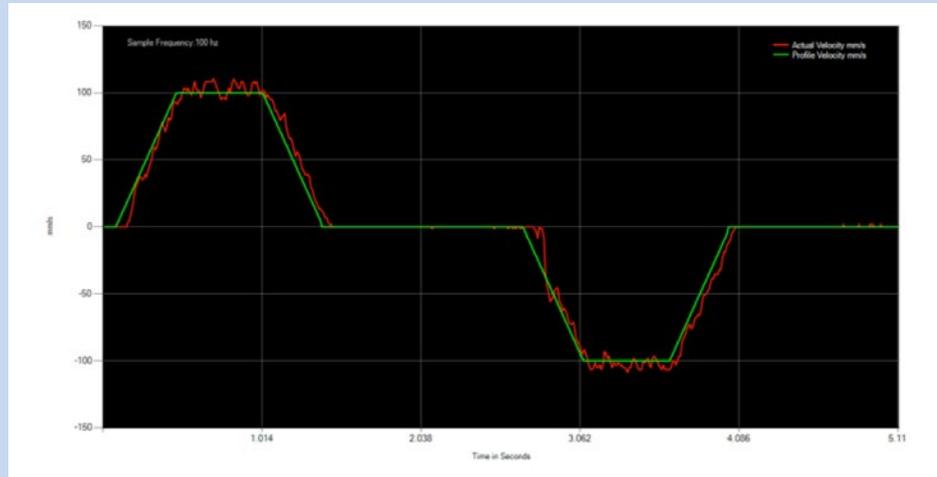


Figure 16-16: Velocity Integral Gain - Too High: Oscillations

Figure 16-16: Setting the velocity integral gain too high can cause oscillations in the constant velocity section of the velocity profile. It can increase the velocity overshoot.

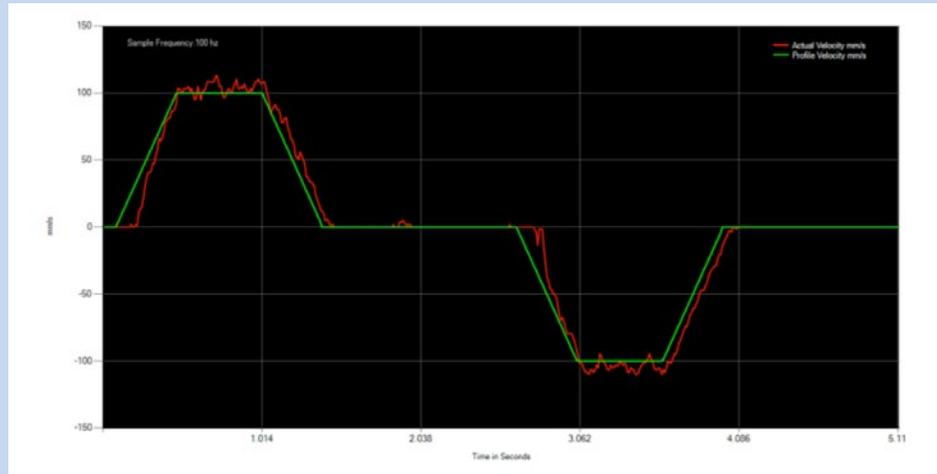


Figure 16-17: Velocity Integral Gain - Too Low: Steady-state velocity error

Figure 16-17: Too low of velocity integral gain will result in the loop not tracking to desired velocity resulting in steady-state velocity error.



16.2.5 Velocity Feed Forward

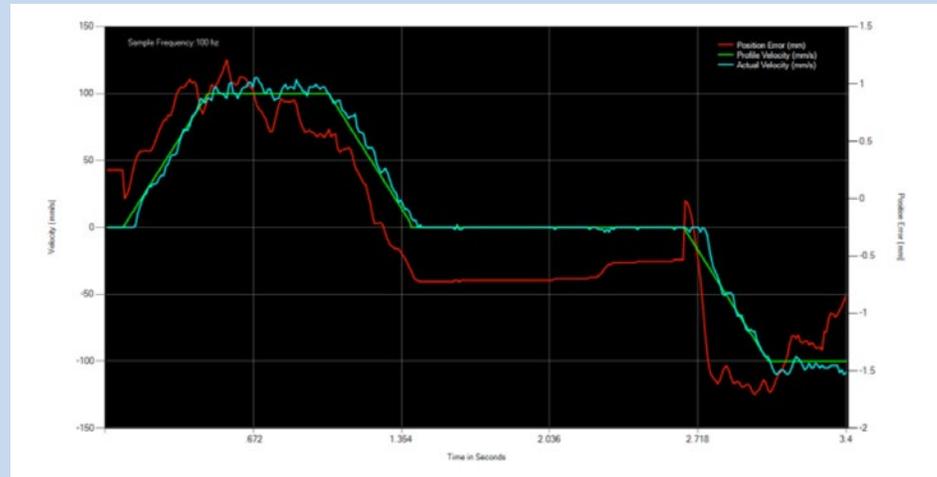


Figure 16-18: Default Velocity Feed Forward Gain (75%)

Figure 16-18: To increase performance and lessen the burden of control on the position loop, a velocity feed-forward (VFF) gain as an input to the velocity loop. Generally this value should not need to be adjusted much from the factory default setting.

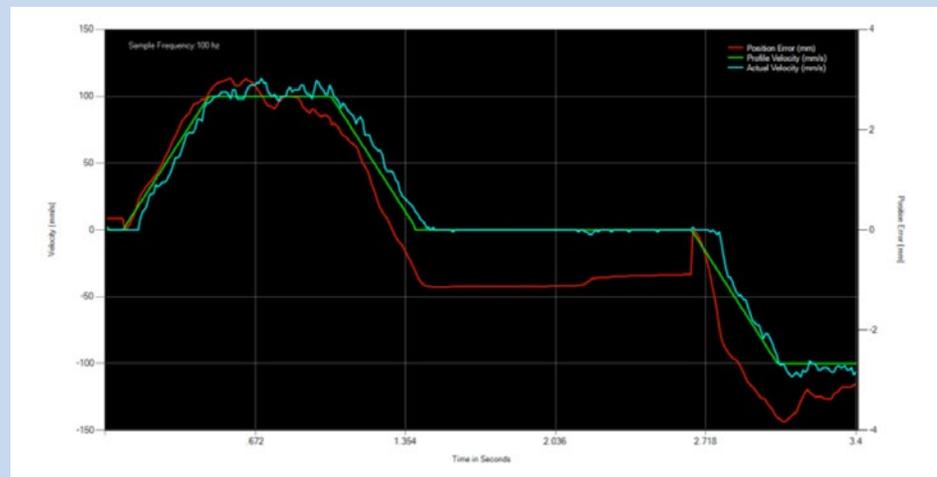


Figure 16-19: Velocity Feed Forward Gain (0%) - Higher Position error, higher velocity error

Figure 16-19: Decreasing the VFF gain or setting it to zero will cause the control response to be very sluggish. A higher position loop gain may be needed to get acceptable motion. The maximum velocity achievable may be reduced based on the position loop gains. Position and velocity error will increase.

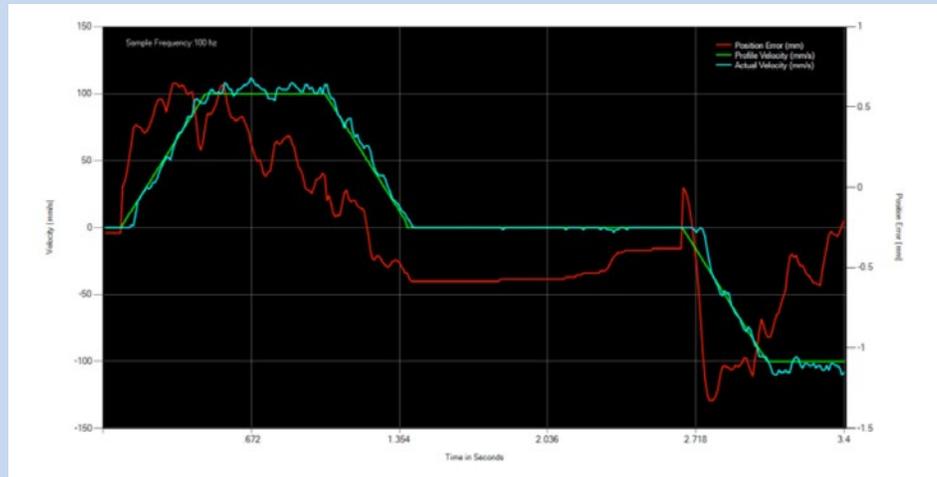


Figure 16-20: Modified Velocity Feed Forward Gain (100%) Low position and velocity error, causes overshoot

Figure 16-20: Too much VFF gain will cause velocity overshoot and possibly position overshoot.

16.2.6 Current Proportional

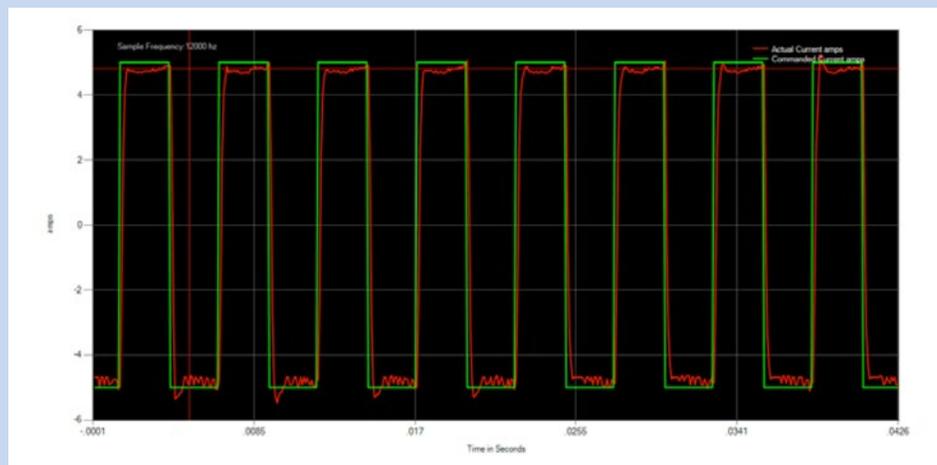


Figure 16-21 - Good Current Proportional Gain

Figure 16-21: A good current proportional gain setting will have a fast response to changes in current command.

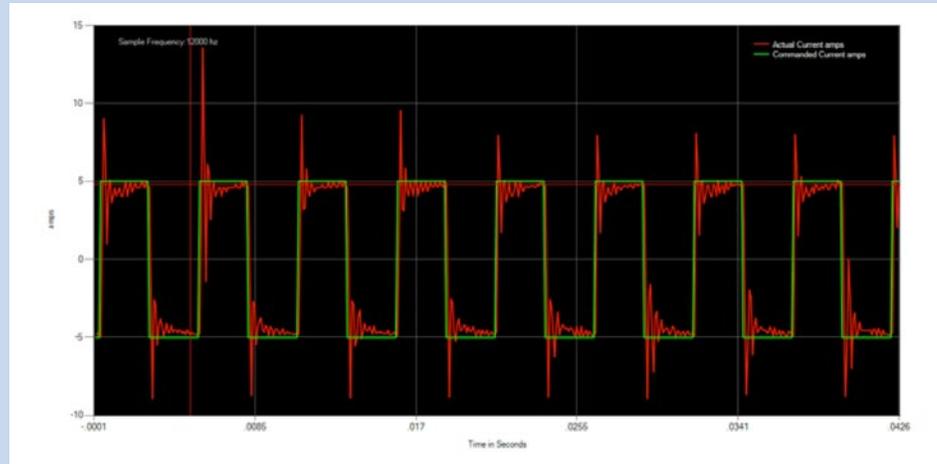


Figure 16-22: Current Proportional - Too High: Visible Oscillations

Figure 16-22: Setting the current proportional gain too high will cause high overshoot and oscillations in response to fast changes in current command.

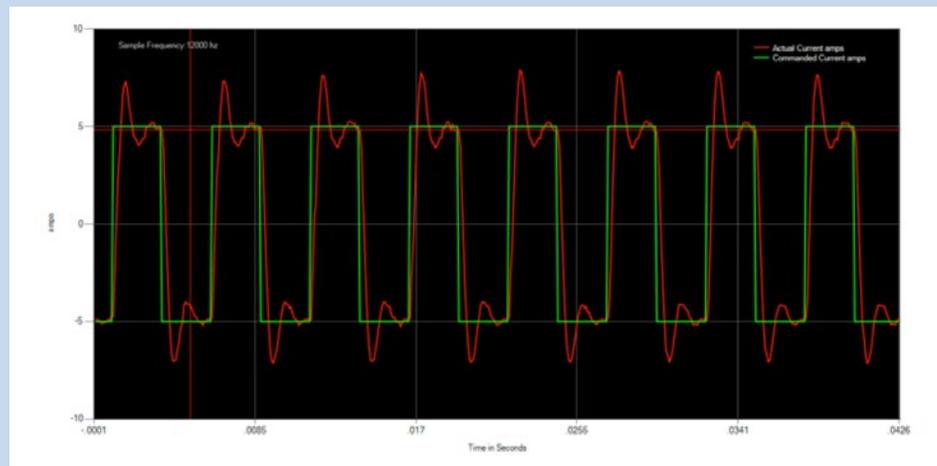


Figure 16-23: Current Proportional - Too Low: Sluggish Response

Figure 16-23: Setting current proportional gain too low will cause sluggish response to changes in current command.

16.2.7 Current Integral

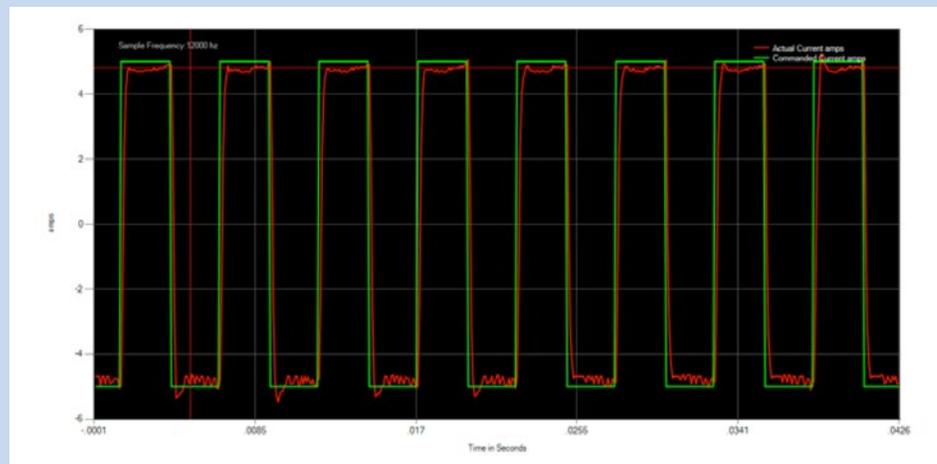


Figure 16-24: Good Current Integral



16: TUNING FILTER

Figure 16-24: Good current integral gain should reduce steady state current error.

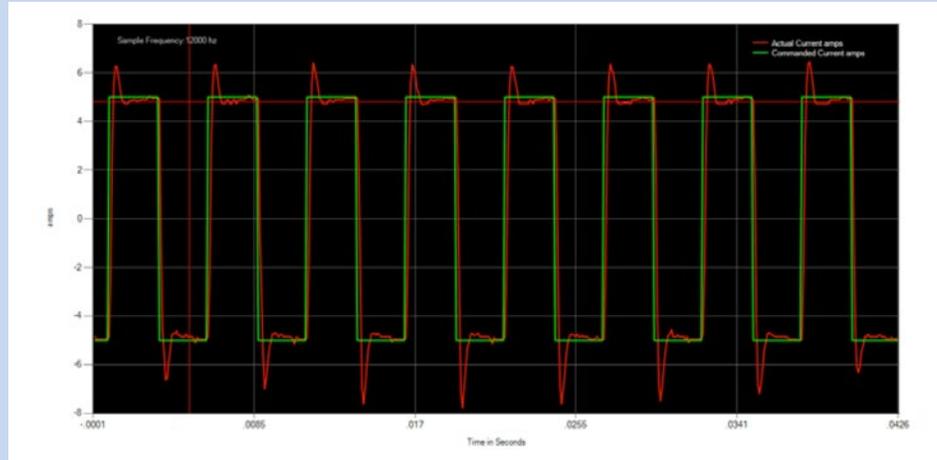


Figure 16-25: Bad Current Integral - Too High: Large Overshoot and oscillations

Figure 16-25: Too much current integral gain will cause large overshoot spikes in current and oscillations to occur

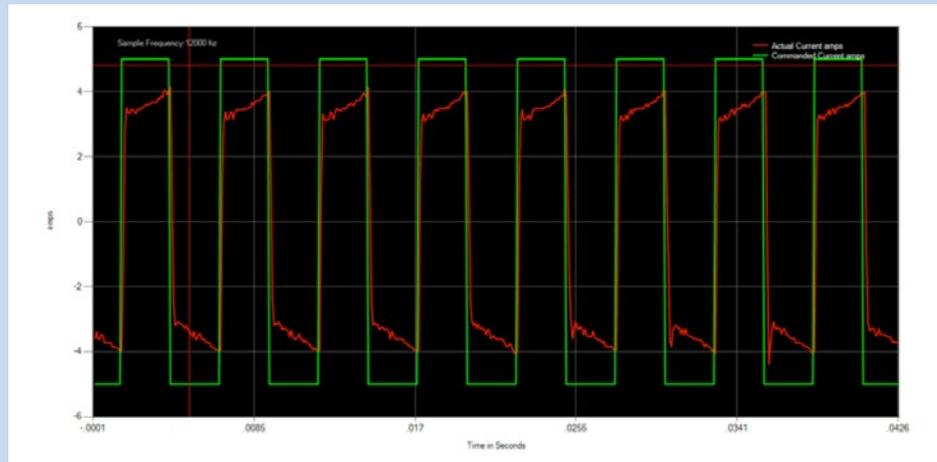


Figure 16-26: Bad Current Integral - Too Low: Actual not reaching commanded

Figure 16-26: Too little current integral gain will have large steady state current error.

16.2.8 Current Tuning

The user should not need to touch the current tuning gains for Tolomatic motors. However, if the need should arise, the following method can be used to tune the current loop.

Step 1: Set Integral Gain to 0, and set proportional gain to about 300





Step 2: Set Step force to 30% and start the Test Move

This will inject a 100 Hz commanded current square wave directly into the current loop to see how the control loop response to an ideal step input signal. The gains should be adjusted to make the actual current fit closely to the commanded current with little overshoot and steady-state error.

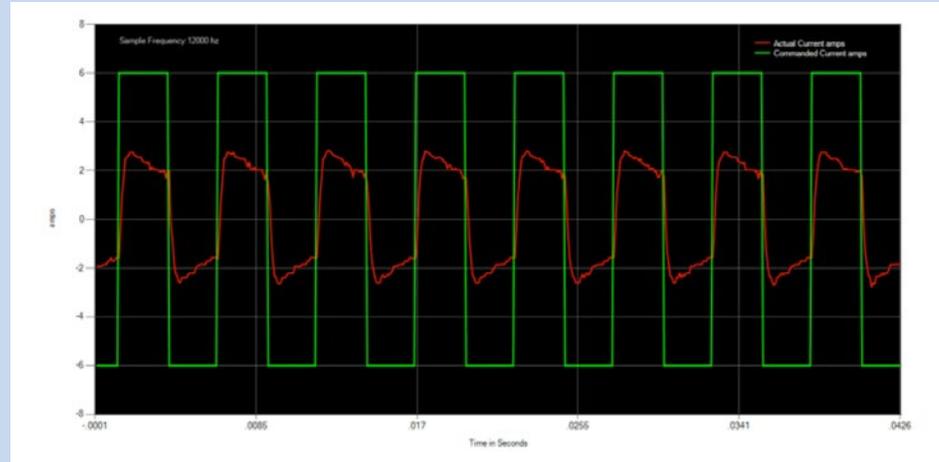


Figure 16-27: Current Loop Starting Point

Step 3: Increase Proportional Bandwidth until visible oscillations appear.

About 3-4 oscillation periods should be visible after the edge of the step input signal.

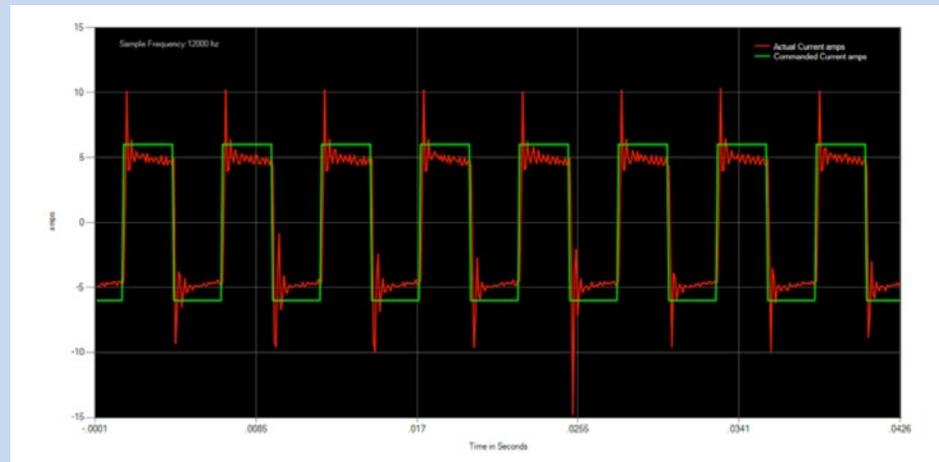


Figure 16-28: Current Loop Tuning - Proportional Bandwidth Oscillations

Step 4: Set Proportional Bandwidth to 40% of the oscillation bandwidth.

In our example, we saw oscillations at a bandwidth of 1931.18. $1931.18 \times .40 = 772.472$

Step 5: Increase Integral Bandwidth slowly until desired response is reached.

This starting point is as follows, with integral set at .01:



16: TUNING FILTER

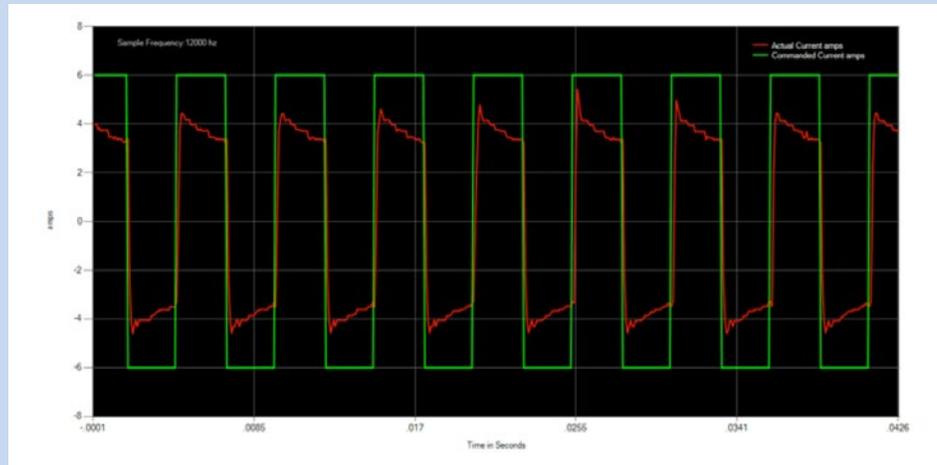


Figure 16-29: Current Loop Tuning - Integral Bandwidth @ .01

As you increase, the level of the signal will rise. Try to keep the overshoot under 10%.

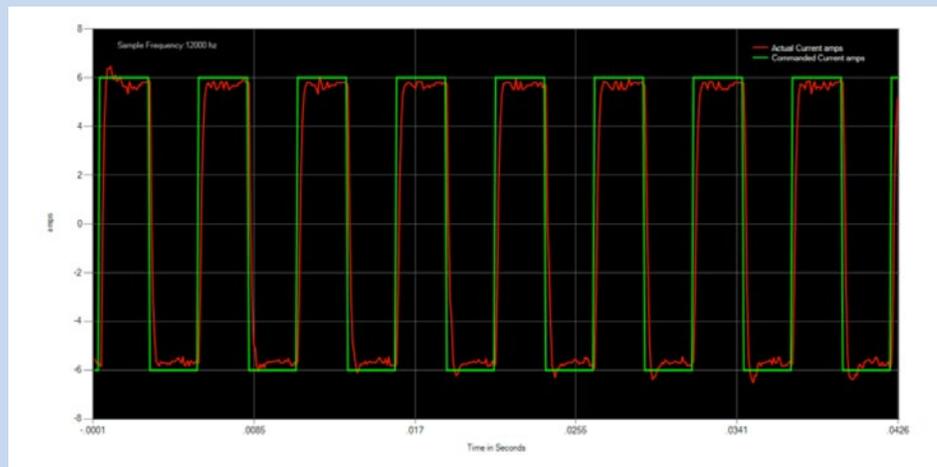


Figure 16-30: Current Loop Tuning - Integral Bandwidth @ 180



17.1 Using the Digital I/O Tool

The Digital I/O tool is launched from the Tools Menu in the TMI interface menu bar or the Tool Bar. This tool shows the current status of the physical I/O interface. The description of each input and output is dependent on the I/O configuration from the I/O Tab (see Section 10: I/O Tab)

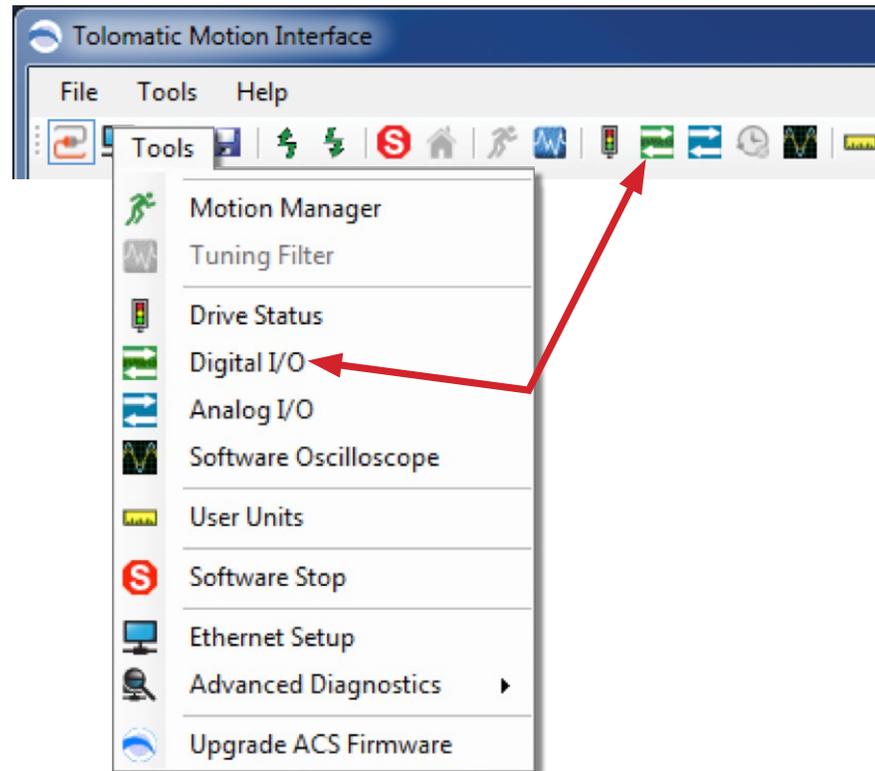


Figure 17-1: Launching the Digital I/O Tool

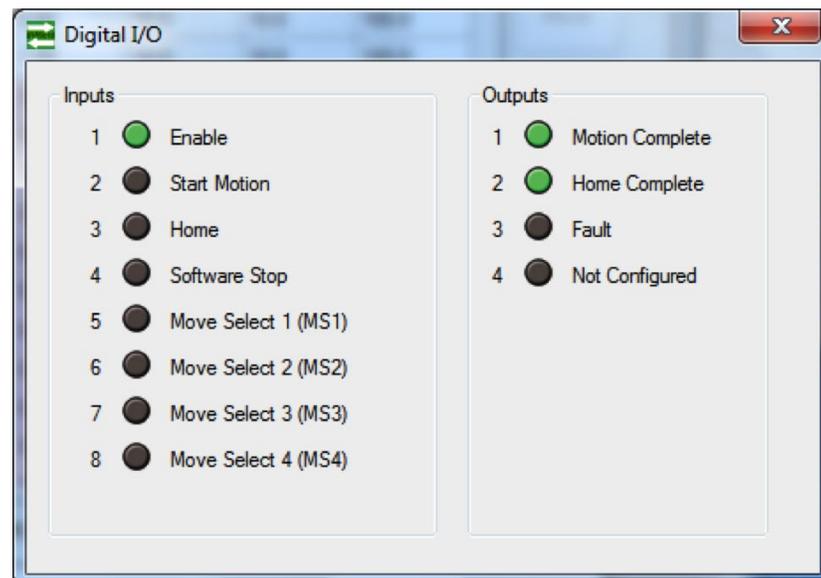
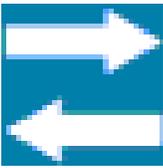


Figure 17-2: Digital I/O Tool



18.1 Using the Analog I/O Tool

The Analog I/O tool is launched from the Tools Menu in the TMI interface menu bar or the Tool Bar. This tool shows the current status of the physical Analog I/O interface. The units will be Volts or mAmps as determined by the Analog Position Settings (see Mode Select tab Section 9.1)

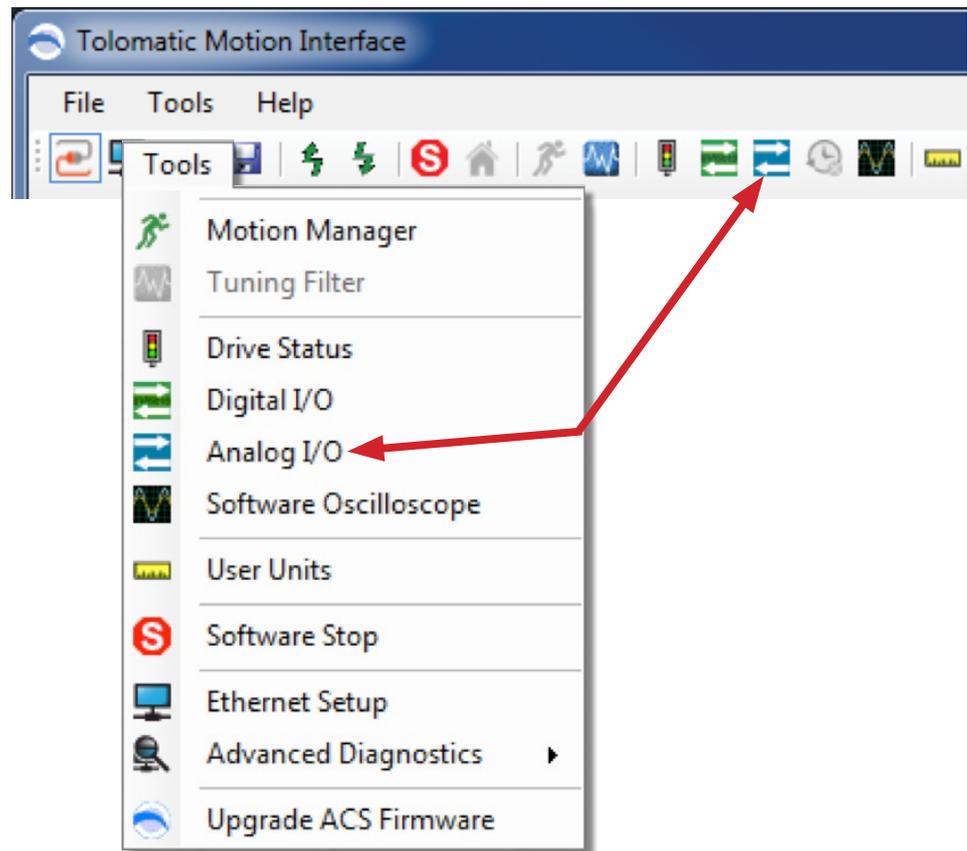


Figure 18-1: Launching the Analog I/O Tool

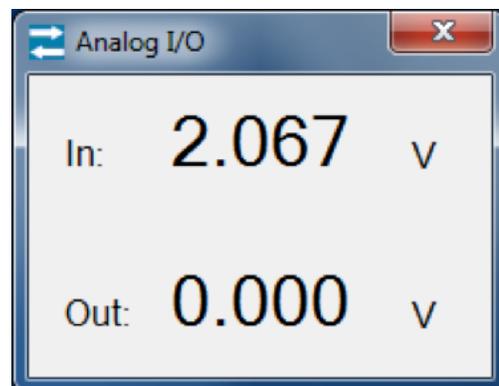
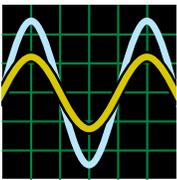
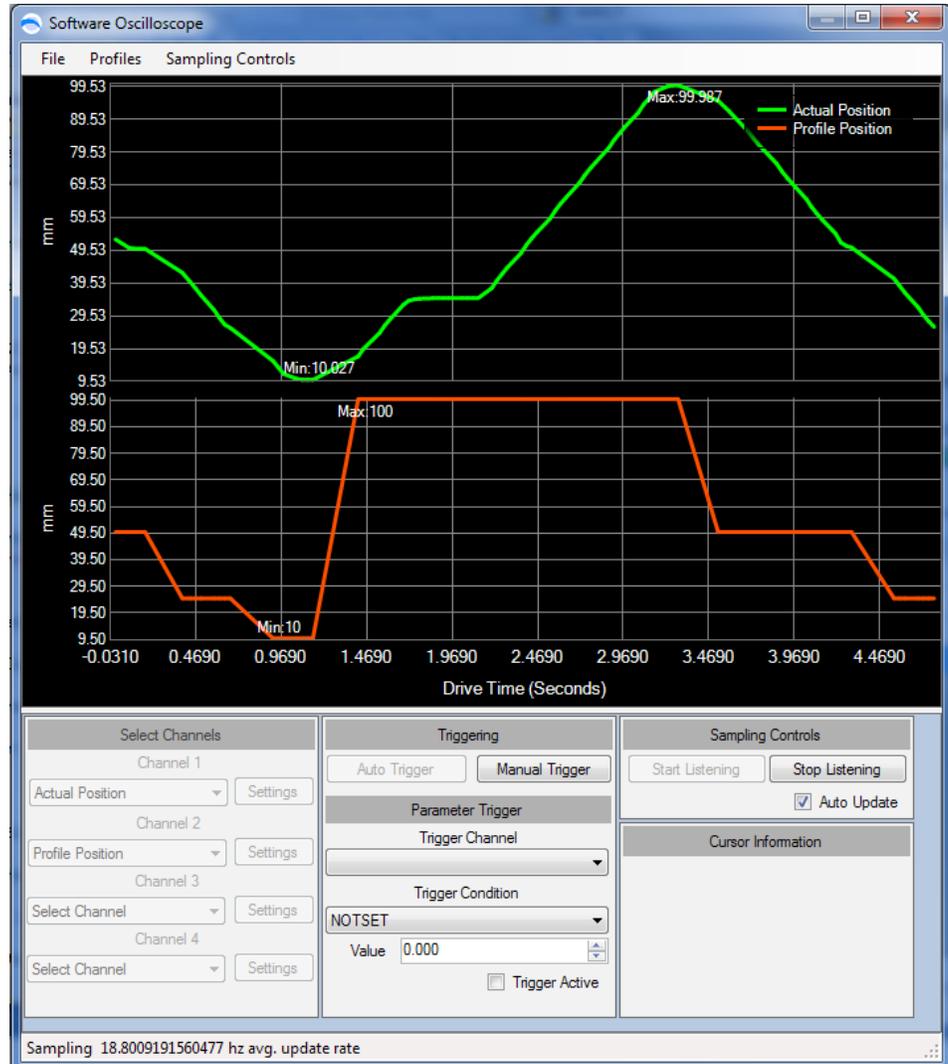


Figure 18-2: Analog I/O Tool



Software Oscilloscope 19

The Software Oscilloscope uses the serial communications interface to continuously poll user selected parameters. This tool is useful for live system debugging where a lower update rate is acceptable (~15-25ms).



19.1.1 Select Channels

- Channel 1-4: User selectable parameters (up to four) to display
- Channel Settings: Channel specific configuration items

19.1.2 Triggering

- Auto Trigger: Continuously polls the drive and automatically updates the graph as data arrives. Performs the same function as Auto Update + Start Listening
- Manual Trigger: When Listening, Manual Trigger triggers the start of a sample, and will display the data after the sampling has completed



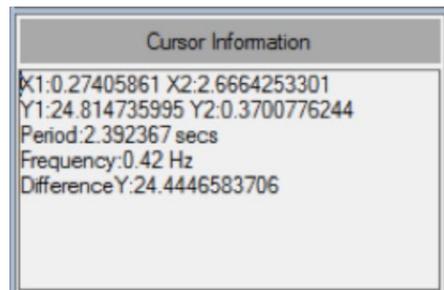
19.1.3 Parameter Trigger (Offline Sampling Only)

- Trigger Channel: The user selected channel to use as a trigger input
- Trigger Condition: A conditional statement to be used in conjunction with Trigger Channel and Trigger Condition Value. For instance if the Trigger Condition is “LESSTHAN”, sampling would occur when Trigger Channel is less than the Condition Value.
- Trigger Active: Activate the triggering condition

19.1.4 Sampling Controls

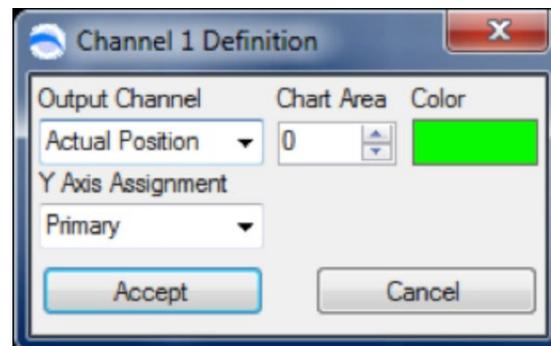
- Start Listening: Start polling the drive for the selected channels. Used in conjunction with Triggering. When a trigger is detected, the sampling queue fills and is displayed when the queue is filled
- Stop Listening: Stops the drive polling and prevents the currently displayed data from being overwritten
- Auto Update: When listening, the trigger condition will be constantly true, forcing the queue to be updated and graphed continuously

Cursor Information displays data to the user when the user clicks on two different places in a graph. This will display X and Y values as well as distance and time between the two mouse clicks.



19.2 Channel Definition Window

Accessible from the Channel Settings button



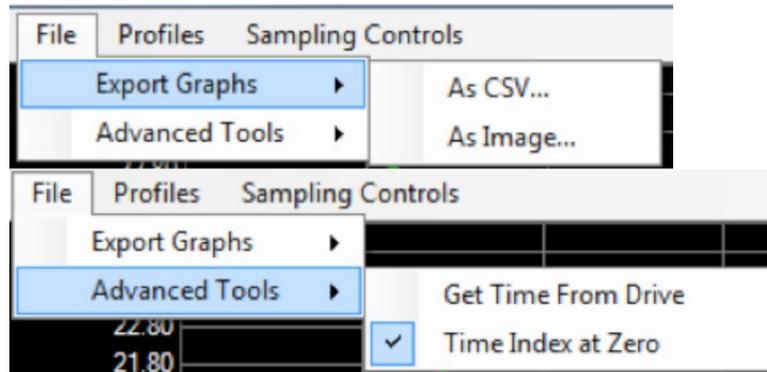
- Output Channel: Selected parameter for the channel
- Chart Area: Assignable to a specified chart area (0-3). It is possible to have multiple channels graphing to the same chart area



- Color: User definable channel color
- Y Axis Assignment: Useful for graphing multiple parameters that require different scaling
 - Primary: Left Y Axis
 - Secondary: Right Y Axis

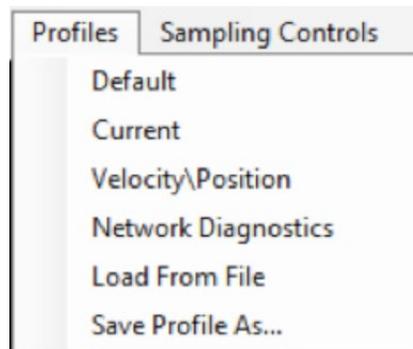
19.3 Menu Strip

19.3.1 File



- Export Graphs
 - As CSV: Exports the data displayed in a CSV format
 - As Image: Saves the graph as an image
- Advanced Tools
 - Get Time From Drive: Uses drive time instead of arrival time for sample timestamps
 - Time Index at Zero: Uses a zero based relative time index for graphing of the data instead of actual time

19.3.2 Profiles

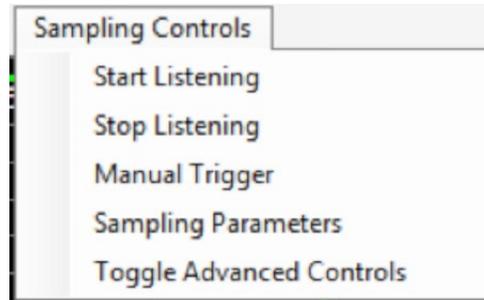


- Default: All available configured signals
- Current: Only Current related signals
- Velocity\Position: Only Velocity and Position signals
- Network Diagnostics: Special network specific signals



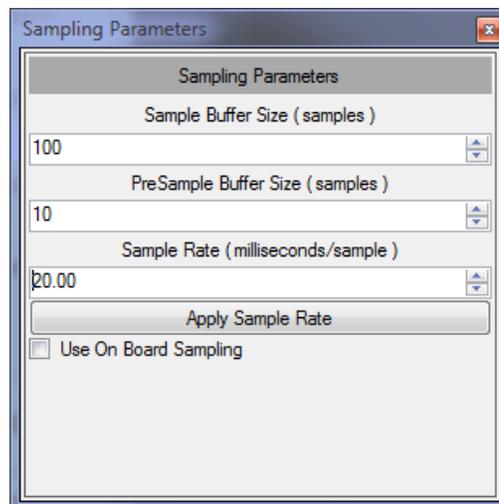
- Load From File: Load saved signals from a file
- Save Profile As...: Saves the currently loaded signal profile to disk

19.3.3 Sampling Controls



- Start Listening: Start polling the drive for the selected channels. Used in conjunction with Triggering. When a trigger is detected, the sampling queue fills and is displayed when the queue is filled
- Stop Listening: Stops the drive polling and prevents the currently displayed data from being overwritten
- Manual Trigger: When Listening, Manual Trigger triggers the start of a sample, and will display the data after the sampling has completed
- Sampling Parameters: Launch Sampling Parameters options window
- Toggle Advanced Controls: Hides/Shows the Controls frame at the bottom of the graph (enabling a larger graphing area)

19.3.4 Sampling Parameters Options Window



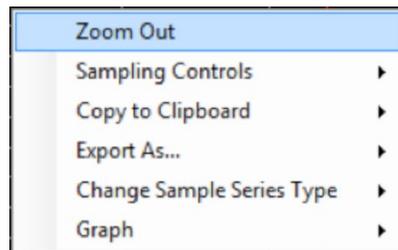
- Sample Buffer Size: Sample Size of the circular sampling buffer for each channel
- PreSample Buffer Size: Number of samples to save before a trigger occurs. In auto trigger mode, this is automatically set to 0



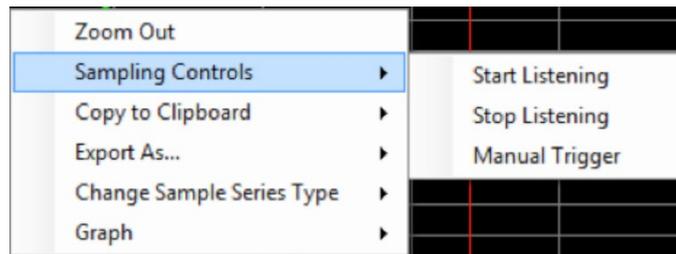
- Sample Rate: Best effort sampling poll rate from TMI to the drive. The sample rate may be slower based on transfer rates, number of channels being sampled, etc
- Apply Sample Rate: Applies the changes made to the Sampling Parameters
- Use On Board Sampling: Some drives provide on board sampling for higher sample rates. When available, this option will allow on board sampling and off board viewing. This option is only available if TMI is in control of motion.

19.4 Context Menu Strip (Right click on graph)

19.4.1 Zoom Out: Zooms out of the graph

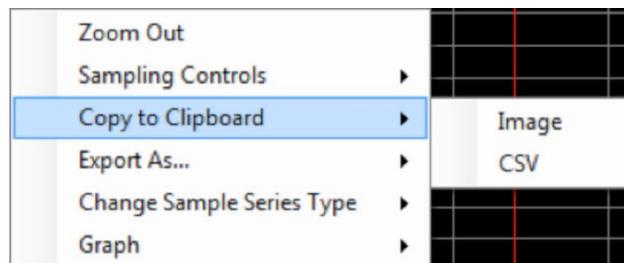


19.4.2 Sampling Controls



- Start Listening: : Start polling the drive for the selected channels. Used in conjunction with Triggering. When a trigger is detected, the sampling queue fills and is displayed when the queue is filled
- Stop Listening: Stops the drive polling and prevents the currently displayed data from being overwritten
- Manual Trigger: When Listening, Manual Trigger triggers the start of a sample, and will display the data after the sampling has completed

19.4.3 Copy to Clipboard



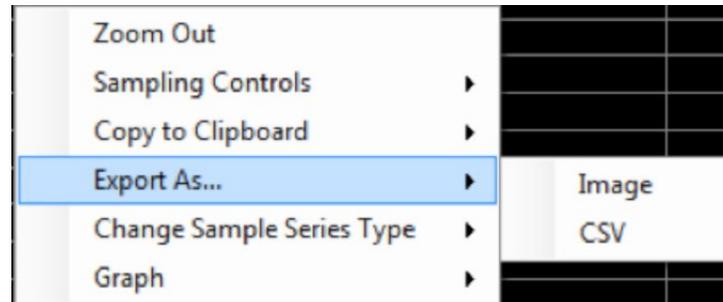
- Image: Copies the graph as an image to the clipboard so it can be pasted into external applications



19: SOFTWARE OSCILLOSCOPE

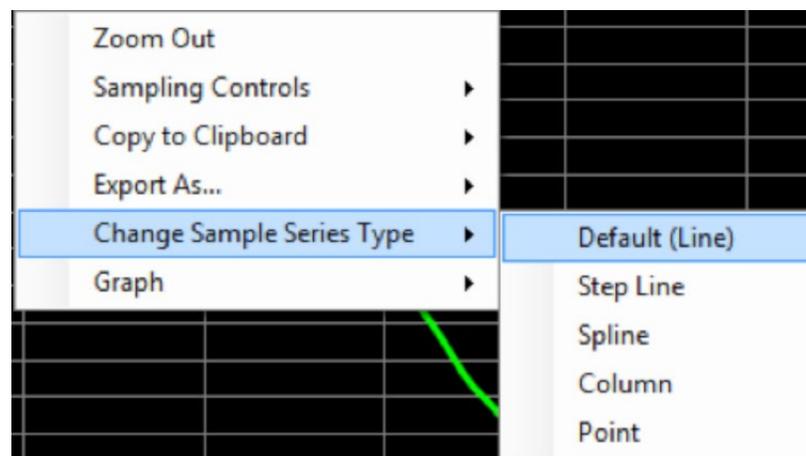
- CSV: Copies the data as CSV text into the clipboard so it can be pasted into external applications

19.4.4 Export As...

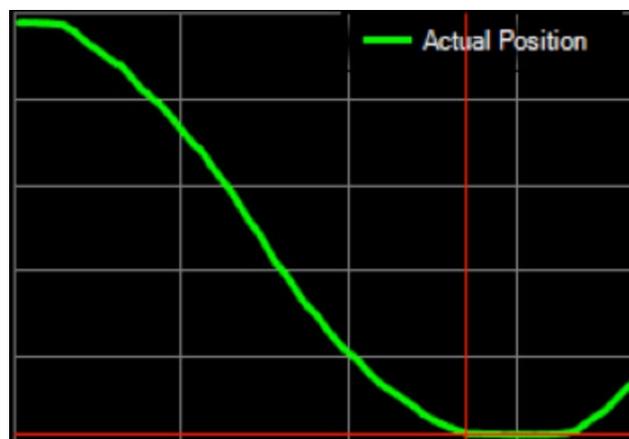


- Image: Saves the graph as an image
- CSV: Exports the data displayed in a CSV format

19.4.5 Change Sample Series Type



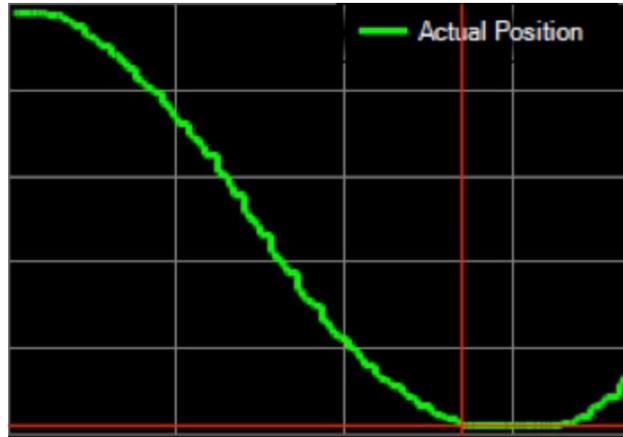
- Default (Line): Straight Line connecting sample to sample



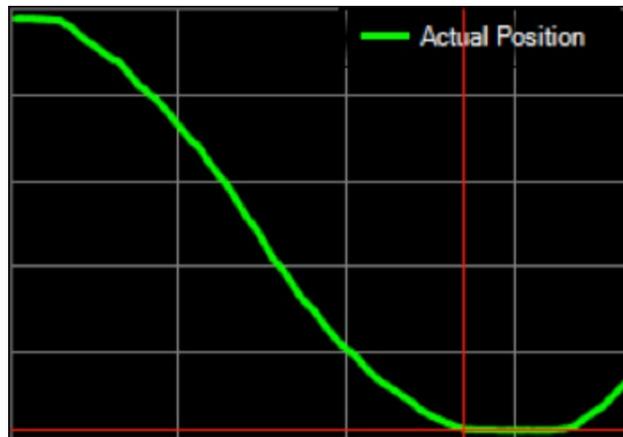


19: SOFTWARE OSCILLOSCOPE

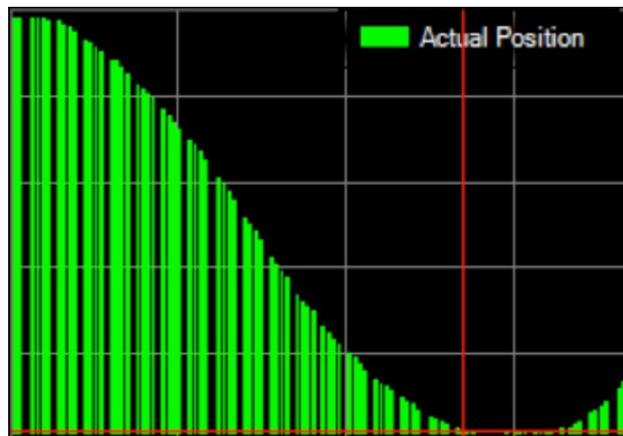
- Step Line: Step function between samples (Digital)



- Spline: Smoothing transitions between samples

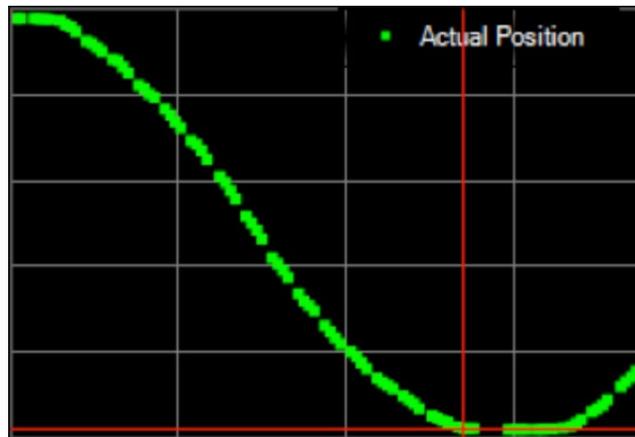


- Column: Each sample is represented by a column

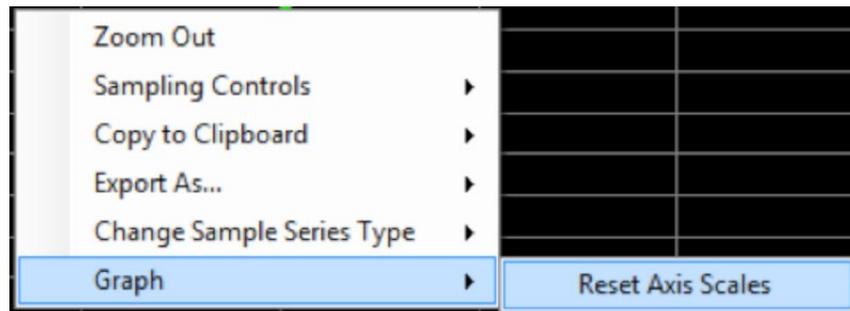




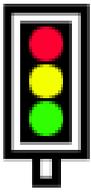
- Point: Each sample is represented by a point



19.4.6 Graph



- Reset Axis Scales: Forces the redrawing and auto-scaling of the axis scales for all of the graphs



20.1 Using the Drive Status Tool

The Drive Status Tool is launched from the Tools Menu in the TMI interface menu bar or the Tool Bar. This tool shows the current status of critical information about the drive.

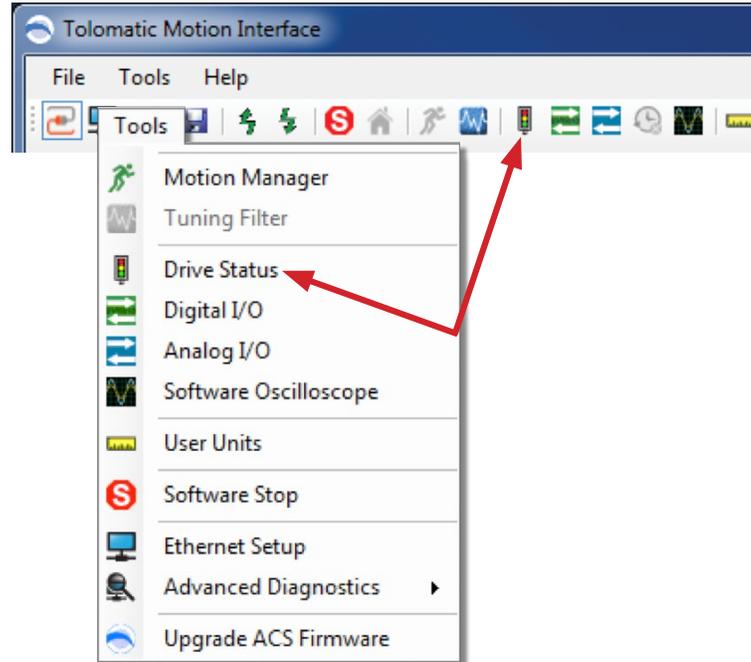


Figure 20-1: Launching the Drive Status Tool

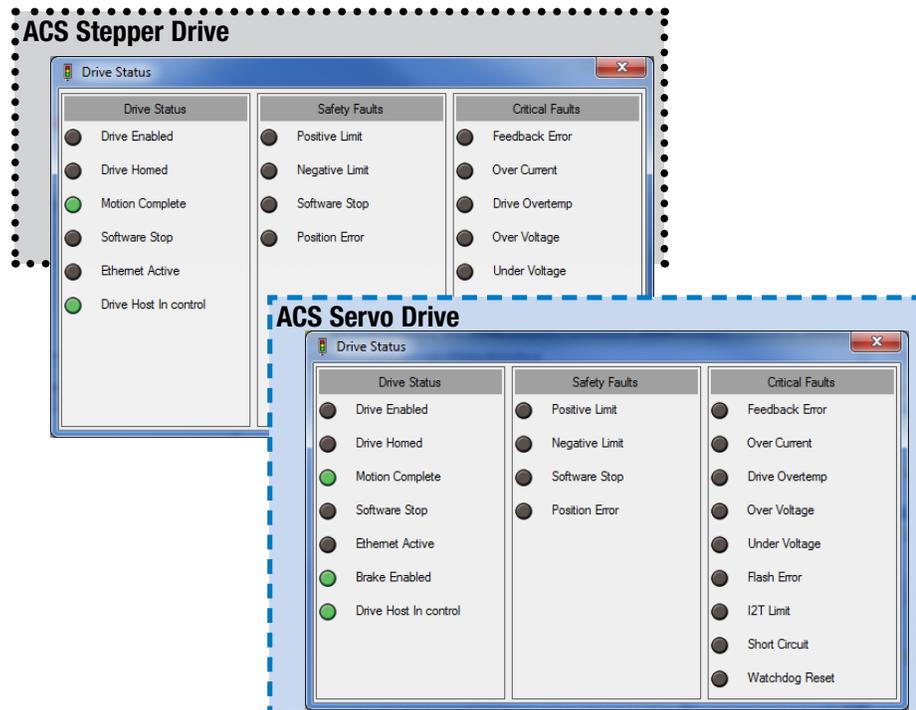


Figure 20-2: Drive Status Tool



21.1 Using the Ethernet Setup Tool

Choose the Tools -> Ethernet menu selection or press the Configure Ethernet button in the toolstrip.

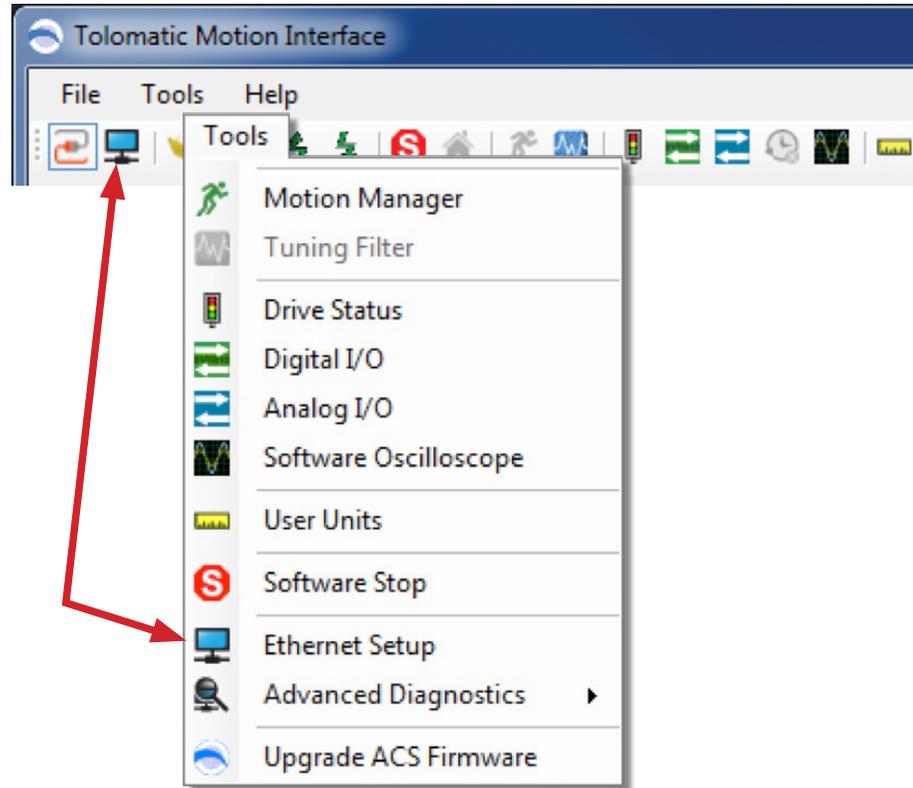


Figure 21-1: Launching the Ethernet Setup Tool

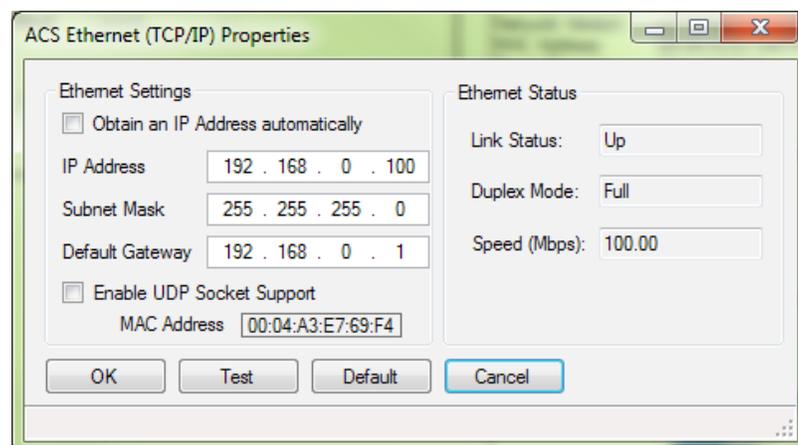


Figure 21-2: Ethernet setup tool

Enter the IP address, Subnet Mask and Default Gateway parameters for the network. (The values shown above are the factory default values for the ACS drive. Typically, at least the IP address and Default Gateway will need to be changed for the network.) Settings are downloaded when OK is pressed.



21 : ETHERNET SETUP TOOL

Feature	Description	Troubleshooting Tips
Obtain an IP Address automatically	Enables DHCP support on the drive, allowing a server to assign an IP address to the drive	
IP Address	IP Address of the drive	The ACS Drive supports Ping. Pinging the drive is a great way to verify that the drive is on the network.
Subnet Mask	Subnet Mask of the drive	
Default Gateway	Default Gateway of the drive	
Enable UDP Socket Support	Enables TMI to connect to drive over the network using port 7023 (ACS Servo Only)	Firewalls may automatically block Port 7023. Check with your network administrator if you are not able to connect over this port, but are able to ping the drive.
MAC Address	MAC Address of the drive	
Link Status	Current connection status of the drive (Up / Down)	If the Link Status reports Down, Ethernet communications will not function. Check physical connections, and verify lights on Ethernet ports are on.
Duplex Mode	Communications Duplex Mode (Full / Half)	For the Network Controlled modes (EIP and Modbus TCP), the drive is required to be in Full Duplex mode. If the drive is reporting Half duplex, errors are dropped connections are expected.
Speed	Communications Speed of the connection (10 Mbps or 100 Mbps)	
OK	Applies the settings and exits the tool	
Test	Initiates a Ping connection test to the drive	The PC and the drive must be configured and connected to the same network.
Default	Resets the Ethernet settings to the factory defaults	
Cancel	Exits the configuration tool	

Table 21-1: Ethernet connection troubleshooting tips

The test button can be used to initiate a ping test to the drive. The PC and the drive must be connected to the same network.

NOTE: An Ethernet cable must be connected from the PC to the ACS drive.

If the Test worked, a screen will pop-up showing similar results to the following.

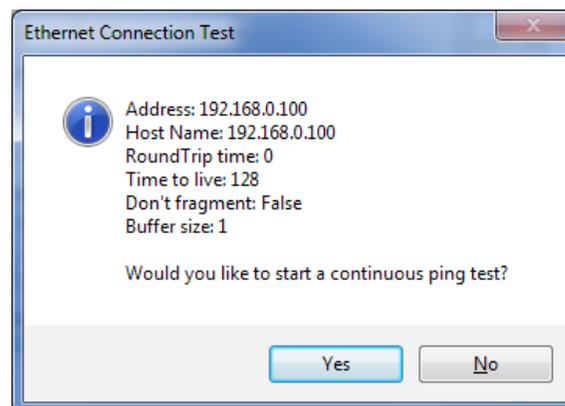


Figure 21-4: Testing verifies a successful Ethernet connection



21 : ETHERNET SETUP TOOL

If the Test didn't work (in this example, the Ethernet cable was unplugged from the ACS drive) an error dialog will be shown.

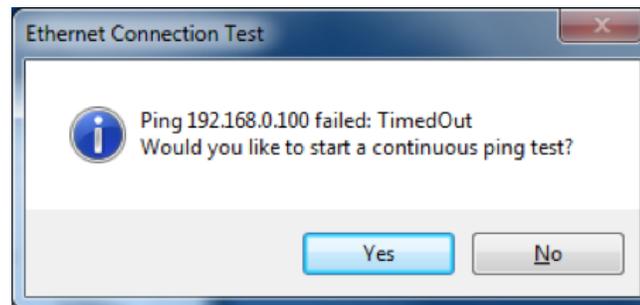


Figure 21-5: Testing indicates a failed attempt for Ethernet connection

A "Yes" response will open the Ping Test window that will continually ping the address and give you a visual online/comment state.



Figure 21-7: Ping Test failure and success

To configure the ACS drive for DHCP server in order to dynamically assign an IP Address:

- check the "Obtain an IP address automatically" check-box
- click OK on the ACS Internet Protocol (TCP/IP) Properties dialog
- click the Disconnect button on the TMI Drive tab (or press the Disconnect from Drive button on the toolstrip)
- click Yes when asked "Update drive flash memory?".
- cycle ACS drive power (turn off then turn on)
- press the Connect button on the TMI Drive tab (or press the Connect to Drive button on the toolstrip)

When the Ethernet configuration tool is opened, the status bar informs the status of the DHCP address configuration process. This is not dynamically updated. To see the current status, press Cancel (or OK), wait a bit, then open this tool again.

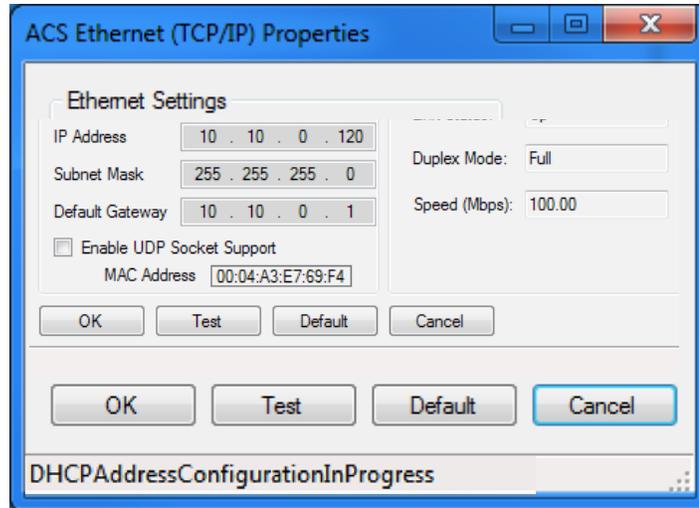


Figure 21-6: Obtaining an IP address automatically

If there is a problem and the ACS drive is unable to get an IP address from the DHCP server, the status bar will display the error message in the status bar.

When Ethernet configuration is complete, press OK.



22.1 Using Ethernet Advanced Diagnostics

When connected to Ethernet enabled ACS drives TMI will display Ethernet MIB Counters in Tools > Advanced Diagnostics Menu.

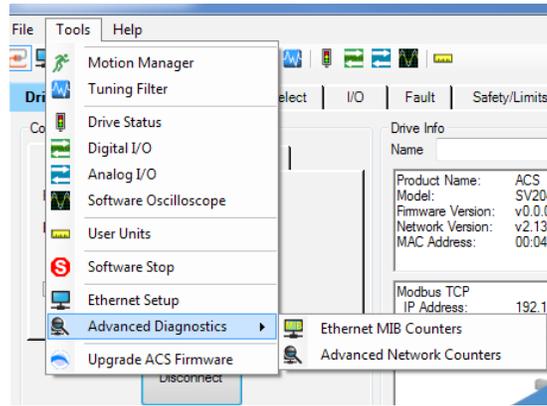


Figure 22-1: Advanced Diagnostics pull-down

Management Information Base (MIB) Counters

The ACS Drive provides 30 MIB counters per port. These counters are used to monitor the port activity for network management. Counters are polled every 10 seconds while the dialog box in Figure 22-2 is visible. When closed, polling stops. Pink highlighted text box indicates a problem reading the counter (this should rarely occur). Bold numbers indicate a change since previous poll. Use the box in the lower left corner to choose either Port 1 or Port 2: this corresponds to ACS Ethernet Port 1 and Port 2.

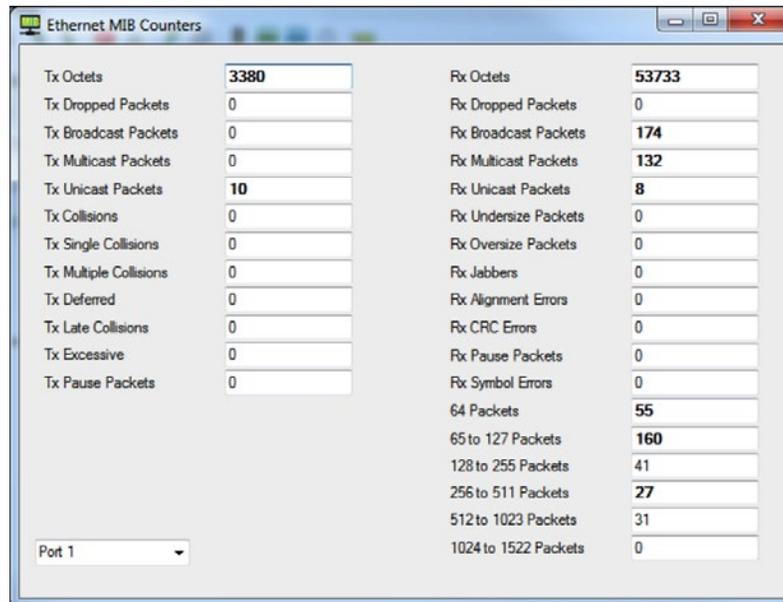


Figure 22-2: Ethernet MIB Counters



22 : ETHERNET ADVANCED DIAGNOSTICS

TMI LABEL	DESCRIPTION
TxOctets	Tx lo-priority good octet count including PAUSE packets
Tx Dropped Packets	TX packets dropped due to lack of resources
TxBroadcastPackets	Tx good broadcast packets (not including error broadcast or valid multicast packets)
TxMulticastPackets	Tx good multicast packets (not including error multicast or valid broadcast packets)
TxUnicastPackets	Tx good unicast packets
TxCollisions	Tx total collision, half duplex only
TxSingleCollisions	Successfully Tx frames on a port for which Tx is inhibited by exactly one collision
TxMultipleCollisions	Successfully Tx frames on a port for which Tx is inhibited by more than one collision
TxDeferred	Tx packets by a port for which the 1st Tx attempt is delayed due to the busy medium
TxLateCollisions	The number of times a collision is detected later than 512 bit-times into the Tx of a packet
TxExcessive	A count of frames for which Tx fails due to excessive collisions
TxPausePackets	Number of PAUSE frames transmitted by a port
RxOctets	Rx lo-priority (default) octet count including bad packets
Rx Dropped Packets	RX packets dropped due to lack of resources
RxBroadcastPackets	Rx good broadcast packets (not including error broadcast packets or valid multicast packets)
RxMulticastPackets	Rx good multicast packets (not including MAC control frames, error multicast packets or valid broadcast packets)
RxUnicastPackets	Rx good unicast packets
RxUndersizePackets	Rx undersize packets with good CRC
RxOversizePackets	Rx oversize packets with good CRC (max: 1536 or 1522 bytes)
RxJabbers	Rx packets longer than 1522 bytes with either CRC errors, alignment errors or symbol errors (depends on max packet size setting)
RxAlignmentErrors	Rx packets within (64, 1522) bytes with a non-integral number of bytes and a bad CRC (upper limit depends on max packet size setting)
RxCRCErrors	Rx packets within (64, 1522) bytes with an integral number of bytes and a bad CRC (upper limit depends on max packet size setting)
RxPausePackets	Number of PAUSE frames received by a port. Pause frame is qualified with EtherType (88-0xh), DA, control opcode (00-01), data length (64B min), and a valid CRC
RxSymbolErrors	Rx packets with invalid data symbol and legal packet size.
64Packets	Total Rx packets (bad packets included) that were 64 octets in length
65to127Packets	Total Rx packets (bad packets included) that were between 65 and 127 octets in length
128to255Packets	Total Rx packets (bad packets included) that were between 128 and 255 octets in length
256to511Packets	Total Rx packets (bad packets included) that were between 256 and 511 octets in length
512to1023Packets	Total Rx packets (bad packets included) that were between 512 and 1023 octets in length



TMI LABEL	DESCRIPTION
1024to1522Packets	Total Rx packets (bad packets included) that were between 1024 and 1522 octets in length (upper limit depends on max packet size setting)

Table 22-1: ACS Ethernet Drive MIB counters

Advanced Network Counters

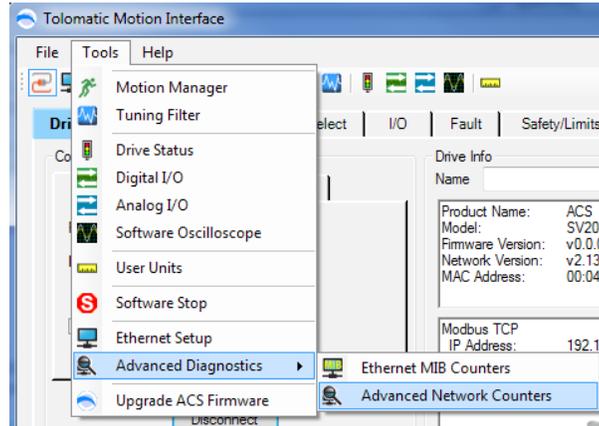


Figure 22-3: Menu selection of Advanced Network Counters

The ACS Drive provides extremely low level access to the network counters used by the network stack implemented in firmware. The Advanced Network Counters tool is an expert level tool designed specifically for deployment engineers troubleshooting network related issues. While the MIB Counters provide access to registers on the Ethernet Hardware directly, the Network Counters are maintained by the ACS Firmware.

Launching the tool from the Tools->Advanced Diagnostics->Advanced Network Counters will bring up the tool's interface.

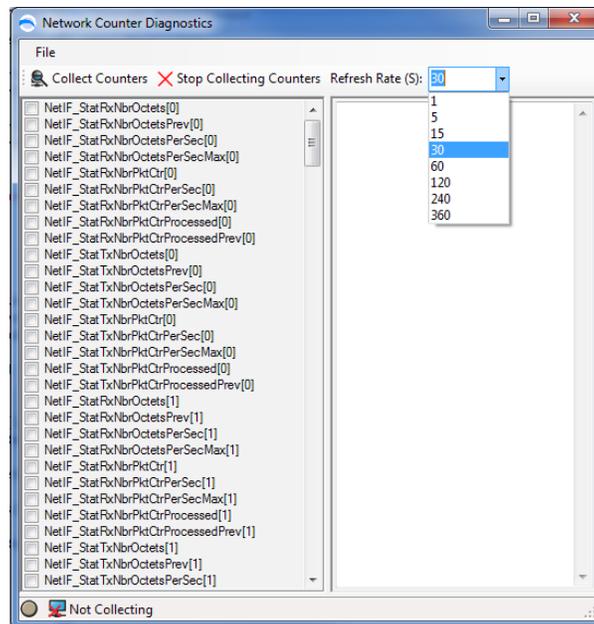


Figure 22-4: Advanced Network Counters Interface

The user can select an appropriate refresh rate based on the number of



22 : ETHERNET ADVANCED DIAGNOSTICS

counters selected. If only a few counters are selected, 1-5 second intervals can be maintained. However, the flexibility of the tool allows for an extremely high number of counters to be selected. Choose a slower refresh rate to increase the performance of the interface. Once the refresh rate (in seconds) is selected, click the "Collect Counters" button.

The counters will be polled at the Refresh Rate interval. As the values are collected, they will be displayed in a CSV format in the output window.

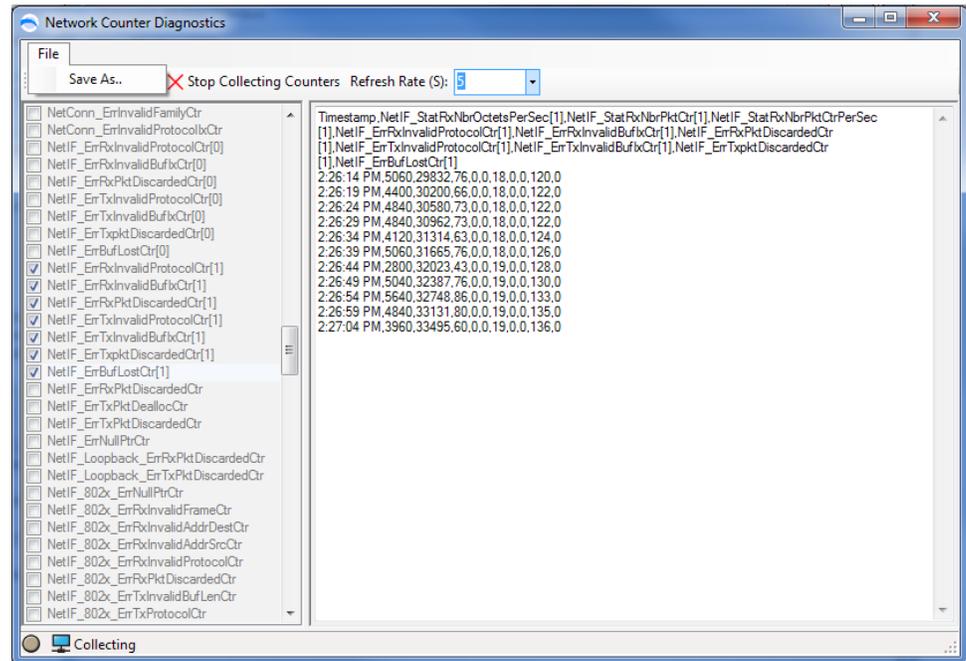


Figure 22-5: Result of "Collect Counters" selection

The user can then save the CSV output to a file using the File->Save As... option

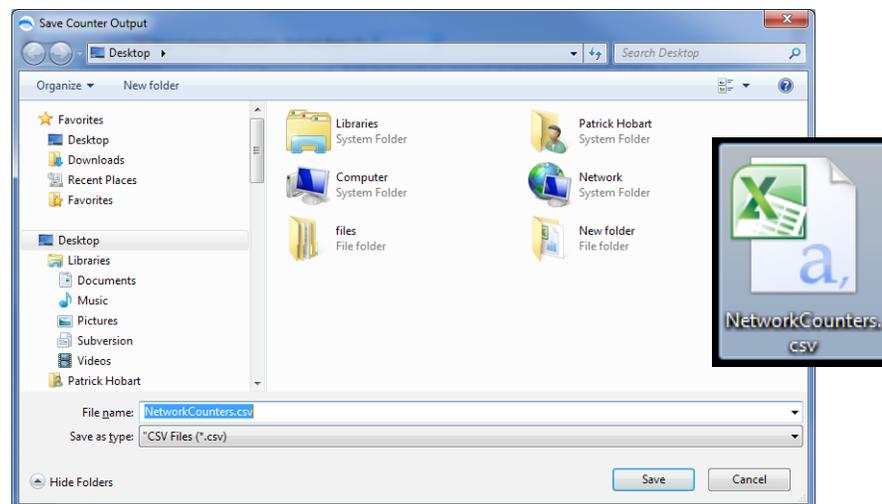


Figure 22-6: Save as .csv file for use in software like Excel



22: ETHERNET ADVANCED DIAGNOSTICS

The user can now import this file into a data analysis application (like Excel) and process the data.

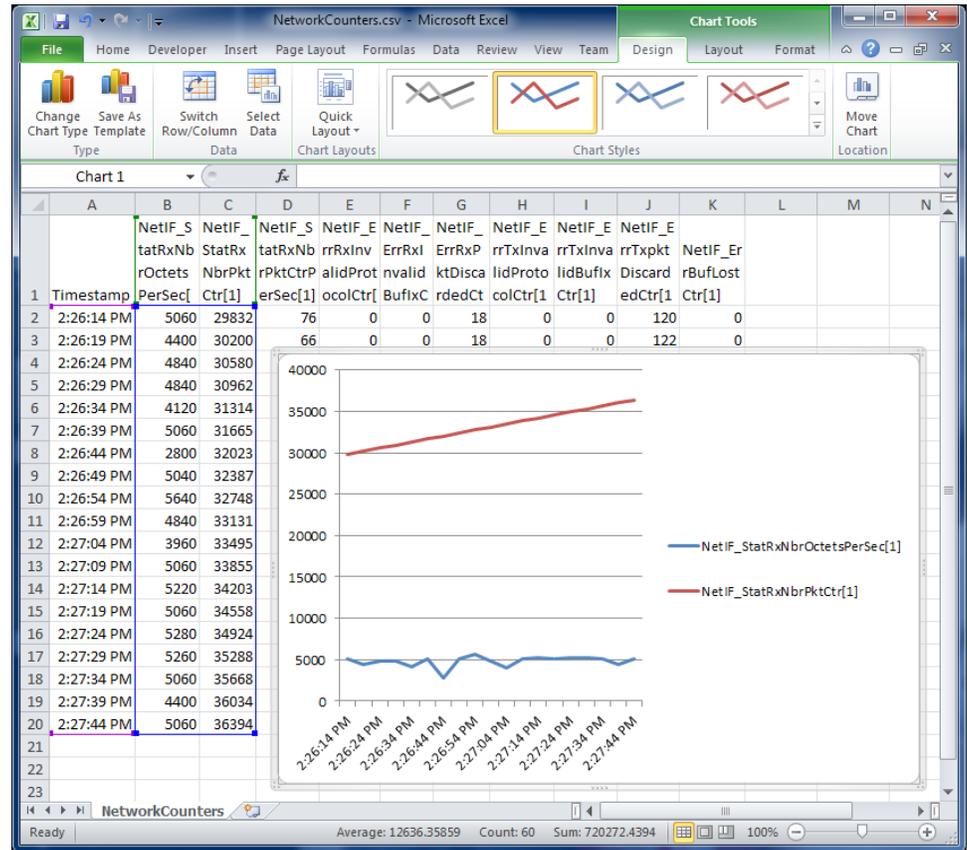


Figure 22-7: Result of "Collect Counters" graphed in MicroSoft Excel

Appendix 1: Index Move Mode - Move Select Logic

Index Move Mode - Move Select Logic Table

The three operating modes, 4/8/16 move commands, require digital inputs to select the desired move for execution. The digital inputs are called Move Select 1 through 4 (MS1-MS4) in the digital input map. To select the desired move command refer to the three logic tables below.

NOTE 1: MS# stands for Move Select #

NOTE 2: 1 = On; 0 = Off

4 Move Commands Mode Logic Table		
MOVE	MS1	MS2
1	0	0
2	1	0
3	0	1
4	1	1

Table A1-1: 4 Move Commands Mode Logic

8 Move Commands Mode Logic Table			
MOVE	MS1	MS2	MS3
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
7	0	1	1
8	1	1	1

Table A1-2: 8 Move Commands Mode Logic

Appendix 1: Index Move Mode - Move Select Logic

16 Move Commands Mode Logic Table				
MOVE	MS1	MS2	MS3	MS4
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Table A1-3: 16 Move Commands Mode Logic

Appendix 2: Pneumatic Mode - Move Select Logic

Pneumatic Mode - Move Select Logic Table

The pneumatic mode requires digital inputs to select the desired move for execution. The digital inputs are called Move Select 1 through Move Select 3 (MS1-MS3) in the digital input map. To select the desired move refer to the four logic tables below.

NOTE 1: MS# stands for Move Select #

NOTE 2: 1 = On; 0 = Off

2 Position (1 input) Table	
ACTION	MS1
Pos 1	0
Pos 2	1

Table A2-1: 2 Position (1 input) Mode Logic

2 Position (2 input) Table		
ACTION	MS1	MS2
Stop	0	0
Pos 1	1	0
Pos 2	0	1
Current Pos Command	1	1

Table A2-2: 2 Position (2 input) Mode Logic

3 Position (2 input) Table		
ACTION	MS1	MS2
Stop	0	0
Pos 1	1	0
Pos 2	0	1
Pos 3	1	1

Table A2-3: 3 Position (2 input) Mode Logic

Appendix 2: Pneumatic Mode - Move Select Logic

3 Position (3 input) Table			
ACTION	MS1	MS2	MS3
Stop	0	0	0
Pos 1	1	0	0
Pos 2	0	1	0
Pos 3	0	0	1
Current Pos Command	1	1	1
Current Pos Command	1	1	0
Current Pos Command	0	1	1
Current Pos Command	1	0	1

Table A2-4: 3 Position (3 input) Mode Logic

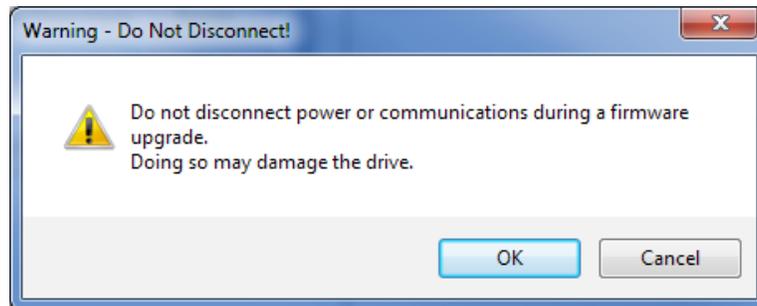


NOTE: If logic selects Current Pos Command, then the controller will continue to current commanded position. If already in position, no motion will occur.

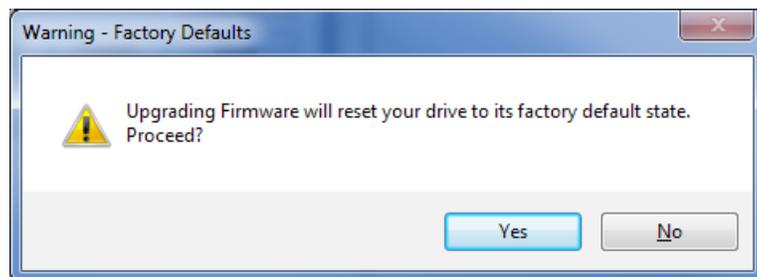
Appendix 3: Tolomatic Firmware Upgrade Tool

Tolomatic Firmware Upgrade Tool

⚠ SAFETY WARNING: Disconnect the drive from Ethernet, RS485, actuator, motor, encoder & brake before upgrading firmware. You should only have power and communications line (serial or USB) connected. Only use Tolomatic authorized firmware to upgrade your ACS drive. Running unauthorized firmware on the ACS drive will result in unexpected behavior.



⚠ WARNING: Do not disconnect the drive during the firmware upgrade upload. Doing so may damage the drive.



📄 NOTE: Because upgrading firmware will reset your drive to factory default state it is recommended that you backup your current ACS drive settings before upgrade.

A3.2.1 Installation Instructions

A3.2.1.1 Installing from the Tolomatic CD

1. Insert the software CD supplied by Tolomatic into the CD-ROM drive in your PC.
2. Follow the link on the displayed web page to install the latest software and view the manuals (requires internet connection)
3. If internet connection is not available, browse the CD and double-click the "**TolomaticMotionInterface[version].exe**" file to run the installer.
4. Follow the prompts to install the software. The installer automatically installs the Tolomatic Firmware Upgrade Tool and appropriate ACS Drive .hex files.

The software will install a program launch icon in the Windows® Start menu at:

Start > All Programs > Tolomatic > TolomaticMotionInterface[version] > TolomaticFirmwareUpgradeTool

In the Start menu the program will start with single click.

Appendix 3: Tolomatic Firmware Upgrade Tool

A3.2.1.2 Downloading and Installing from the Tolomatic Web Site at www.tolomatic.com

The Tolomatic Motion Interface can be downloaded from the Tolomatic web site at www.tolomatic.com/resources/index.cfm?catalog_id=1, click on the software tab.

1. To download, click on "**Resources**" in the navigation bar at top. Select "**Electric Linear Motion**" picture or text under the "**Select a Product Line...**" subhead. When on the "**Electric Linear Motion**" page the default tab is "**Catalogs & Brochures**" select the tab "**Software**" third from the left.

2. Select the "**Current Tolomatic Motion Interface v. _ _ _**" from the listing (it should be the first listing) and save the file when prompted to your hard drive.

3. Double-click the "**TolomaticMotionInterface.exe**" file to run the installer.

4. Follow the prompts to install the software. The installer automatically installs the Tolomatic Firmware Upgrade Tool and appropriate ACS Drive .hex files.

The software will install a program launch icon in the Windows® Start menu at:

**Start > All Programs > Tolomatic > TolomaticMotionInterface[version]
> TolomaticFirmwareUpgradeTool**

In the Start menu the program will start

A3.3.1 Saving Current Drive Settings

After successful firmware upgrade, the Tolomatic Firmware Upgrade Tool will restore the drive to factory settings appropriate to the new version of firmware, overwriting any user defined settings.



NOTE: This step is most useful if you want to **BACKUP** current ACS Drive settings before upgrading firmware. (Upgrading will force the ACS Drive to factory defaults) After upgrading firmware open TMI software and restore ACS Drive settings using the procedure outlined at right.

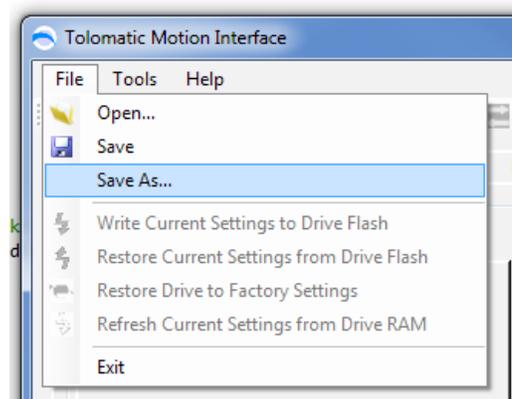


Figure A3-1: Using the Save As backup current ACS drive settings before upgrading firmware

If you run the Tolomatic Motion Interface, connect to the drive and select the **File->Save As** menu item, you can save the current drive settings to a file. The next time you run Tolomatic Motion Interface after upgrading the drive firmware, you can select **File->Open** and open this file. The parameter settings in the file will automatically be programmed into the Tolomatic drive.

Appendix 3: Tolomatic Firmware Upgrade Tool

ACS Stepper Drive



NOTE: Stepper Firmware uses .hex extension.

ACS Servo Drive



NOTE: Servo Firmware uses .tol extension.

A3.4.1 Launching the Upgrade Tool Software

1. Double-click the program icon on the desktop or in the Windows® Start menu at: **Start > All Programs > Tolomatic > TolomaticMotionInterface[version] > TolomaticFirmwareUpgradeTool** to launch the software.

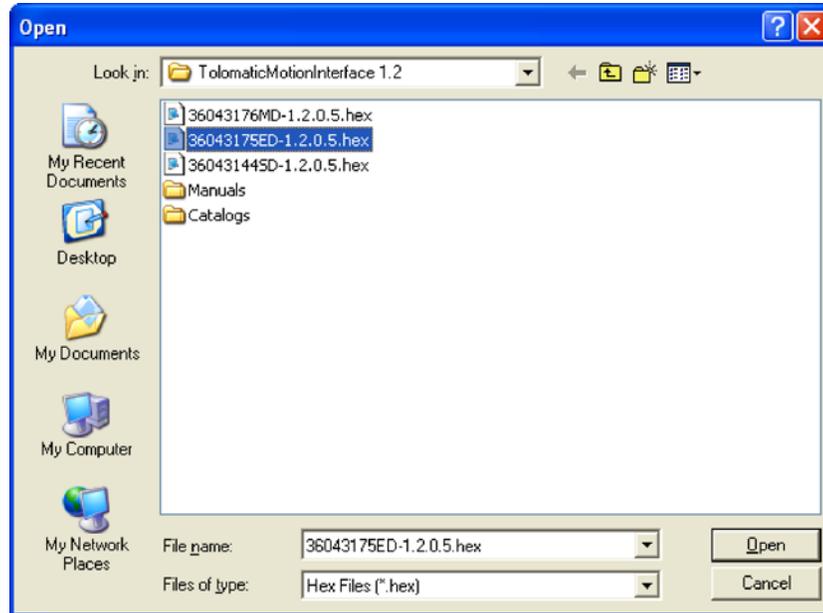


Figure A3-2: Select the correct version of the Firmware Upgrade Tool



NOTE: If user experiences a permissions error, try running TFUT as Administrator.

A3.5.1 User Interface Process

- As in TMI, setting COM Port to Auto will request TFUT to scan available ports looking for an ACS drive and automatically select that COM port. If the ACS drive does not have valid ACS firmware, the COM port must be selected manually.
- Status and progress messages are displayed in the read-only text box.
- Flash baud rates of 19200, 38400, 57600, 115200 (default) and 230400 are supported.
- A Show ACS Drive Info button is provided to query the Product Name, Model, Firmware Version, and Drive Name. This is useful in conjunction with COM Port: Auto. [Note that the ACS firmware always communicates at 38400 baud – the firmware flash speed is configurable] Auto should be used for USB updates for Servo.

Appendix 3: Tolomatic Firmware Upgrade Tool

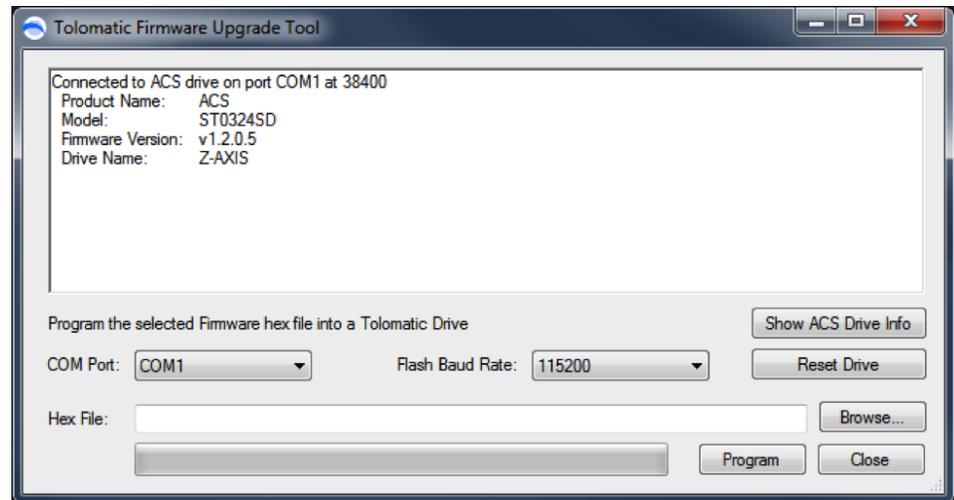


Figure A3-3 Connected to ACS Drive

- A Reset Drive button allows the ACS drive to be reset.
- If no Hex File is specified, pressing Program will run a connection test (useful for troubleshooting only)
- A progress bar shows how the firmware flashing process is progressing

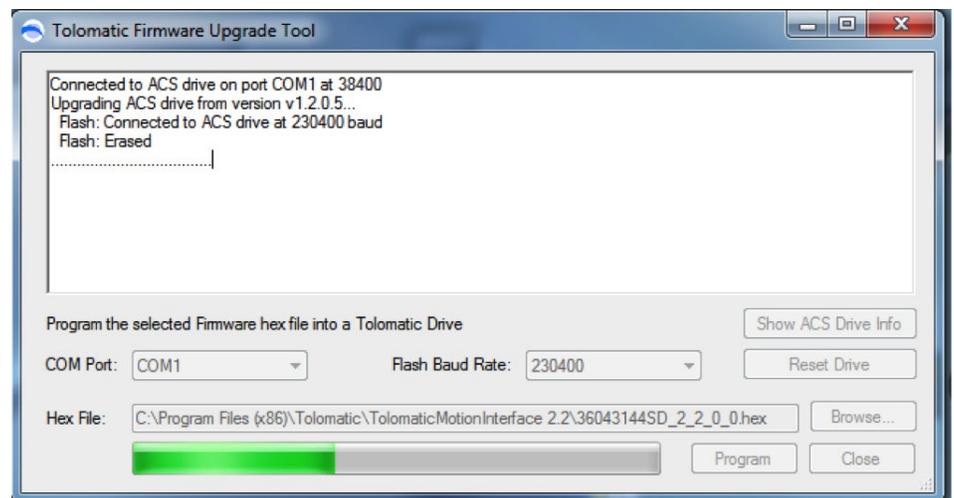


Figure A3-4: Firmware Flashing Progress

Appendix 3: Tolomatic Firmware Upgrade Tool

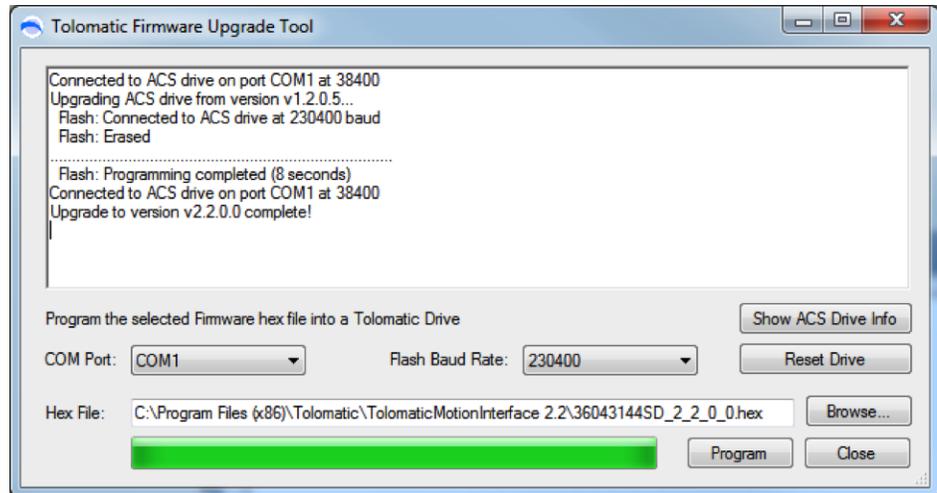


Figure A3-5: Firmware Flashing Complete

■ A3.6.1 TFUT Integrated with TMI

In addition to being available as a stand-alone tool, the Tolomatic Firmware Upgrade Tool (TFUT) is now available from TMI. Selecting this menu item will cause TMI to disconnect from the ACS drive (discarding any changes) and open a modal TFUT dialog.

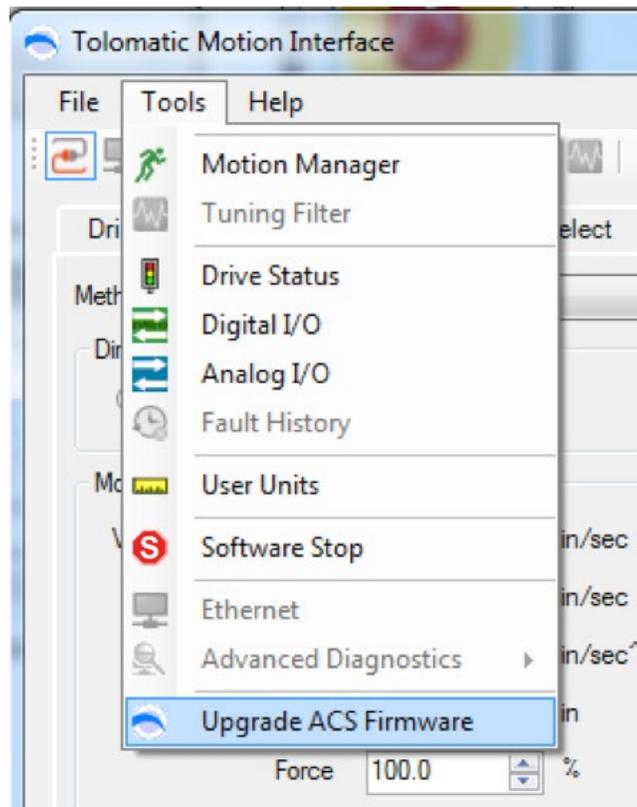


Figure A3-6: Upgrade Firmware through TMI



NOTE: Timing Diagrams are found in each Hardware & Installation Guide

[ACS Servo Hardware & Installation Guide #3604-4181](#)

[ACS Stepper Hardware & Installation Guide #3604-4173](#)

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