

MMC-103

Series



3-Axis Piezo Motor Controller Quick Start Guide

Contents

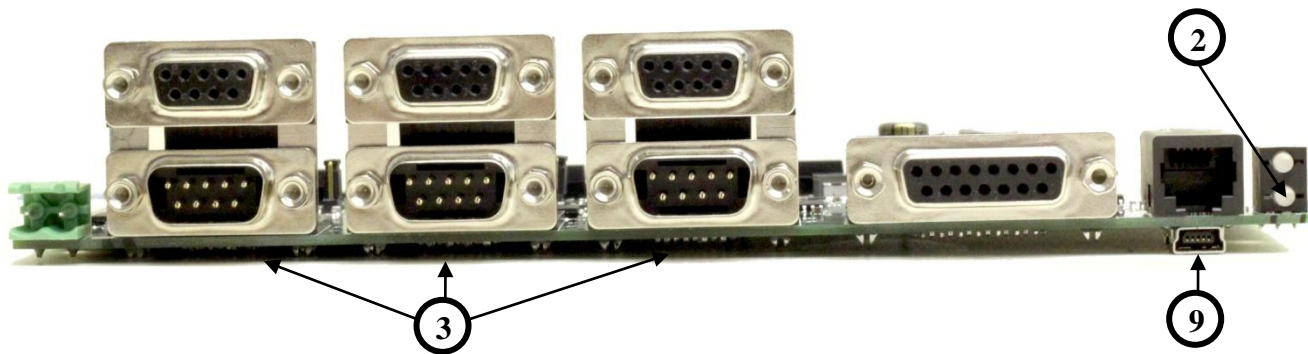
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1. Introduction

This document is meant to act as a quick start guide to be used to get the MMC-103 and accompanying stages connected and functional. For more information regarding programming and command set please refer to the full reference manual included on the MMC-103 CD supplied with your order.

1.1 Product Description

The MMC-103 is a high performance integrated piezo motor controller/driver designed to be used as a standalone three axis unit. The MMC-103 is capable of driving a piezo motor with a resolution as fine as 1 nm in open loop (motor dependent). The closed loop resolution is dependent on the resolution of the encoder (typically 1 nm).



1. LED Error Indicator 1
 - a. Red – An error has occurred
2. LED Addressing Indicator 2
 - a. Orange – Stage is Unaddressed
 - b. Green – Stage has an address and is ready
3. Encoder Input, Male D-Sub 9 Pin Connector
4. Motor 1, Female D-Sub 9-Pin Connector
5. Motor 2, Female D-Sub 9-Pin Connector
6. Motor 3, Female D-Sub 9-Pin Connector
7. Power Supply, +48VDC, Regulated
8. RS485 Intermodular Connector
9. USB Connector
10. I/O Connector

1.2 Features

- Integrated controller/driver for MICRONIX USA stick-slip piezo motors
- Integrated 3-Axis controller
- Open loop/closed loop operation
- Open loop resolution of less than 1 nm
- Closed loop resolution dependent on the encoder (typically 1 nm)
- A quad B, or sin/cos Analog encoder feedback
- USB 2.0 or RS-485 interface
- Windows GUI, and LabVIEW VI

1.3 Package Contents

If product is damaged or there are missing components, contact MICRONIX USA immediately. Do not discard product packaging in case of return shipment.

Package Contents:

- MMC-103 Controller
- Quick Start Guide
- Supplemental CD
- USB Cable

2. Quick Start Guide

2.1 Quick Start Guide Overview

The following Quick Start Guide is intended to provide a basic set-up of the MMC-103 in the least amount of time. The following paragraphs will provide a walkthrough of the steps needed to set-up the controller and verify that the system is working correctly.

Caution: In the case of custom and/or vacuum wiring this guide may not portray the wiring with which your system was supplied. Please consult the custom wiring diagram included with your custom/vacuum shipment.

1. Install Drivers

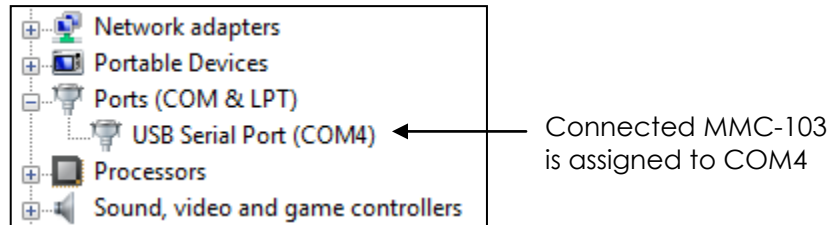
- a. To ensure correct communication between the module and PC, install the proper drivers onto the communicating computer prior to connecting the MMC-103.
- b. The drivers may be found on the supplemental installation CD or can be downloaded from:
<http://www.ftdichip.com/Drivers/VCP.htm>
- c. For more on how to properly install drivers, see the appropriate installation guide included on the supplemental CD or on the website above.

2. Connect Motion Devices
 - a. A single MMC-103 controller is capable of driving one piezo motor in either open or closed loop.
 - b. Connect the male D-sub 9-pin piezo motor cable to the Motor/Axis Input.
 - c. If applicable, connect the female D-sub 9-pin encoder adapter cable to the Encoder Input.
 - d. The other side of that cable to the interpolator module or encoder head.

3. Connect Module/Stack to PC
 - a. Use the supplied Mini USB to USB cable to connect the MMC-103 controller to the communicating PC. Only one USB cable is required per module/stack.

4. Power Up Controller
 - a. Connect the controller to a 48V, regulated power supply included in your order.
 - b. After power up, verify that the top LED(s) changes from Red to Orange to Green. This verifies that each axis is addressed and ready for communication.

5. Check COM Port
 - a. It is necessary to note the COM Port assigned to the MMC-103 when connecting to a PC.
 - i. In Windows Vista or Windows 7 Open the Device Manager:
 - 1 Windows Logo (in the bottom left corner by default)
 - 2 Control Panel
 - 3 Device Manager
 - ii. In Window Xp Open Device Manager:
 - 1 Start (in the bottom left corner by default)
 - 2 Control Panel
 - 3 System
 - 4 select the Hardware tab
 - 5 Click the device manager button
 - b. After powering up the controller (Step 4), note the USB Serial Port assigned. See the figure below showing a snapshot of the Device Manager window:



6. Continue to Quick Start MMC-103 Motion Controller Platform
 - a. The following section will help you get running with the MMC-103 Motion Controller Platform program.

2.2 Quick Start MMC-103 Motion Controller Platform

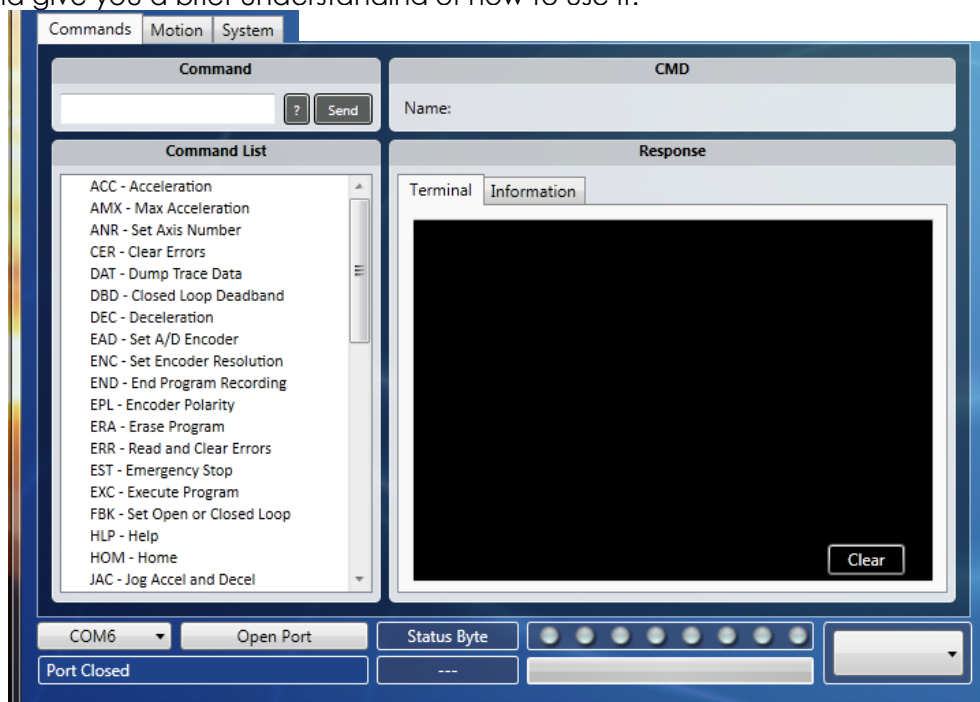
The MMC-103 MCP GUI can be used with the MMC-103 piezo controller. The following Quick Start Guide is intended to provide a basic set-up of the MMC-103 MCP program. The following paragraphs will provide a walkthrough of the steps needed to install the program and verify that the system is working correctly.

1. Pre-Installation
 - a. This guide assumes you have already run through the previous Quick Start guide and that the controller is on and connected to a Com port on your computer.
 - b. You will need the .NET Framework 4.0. If you are unsure if you have the .NET Framework 4.0 follow these steps.
 - Open the start menu (windows icon if using Vista).
 - Open the Control Panel
 - Open "Add or Remove Programs" ("Programs and Features" if using Vista)
 - Scroll through the list and find "Microsoft .NET Framework" If it is 4.0 skip to step-2. Otherwise continue with step c.

- c. To install the .NET Framework 4.0 you will need a connection to the internet.
 - Navigate to this site:
<http://www.microsoft.com/downloads/details.aspx?FamilyID=9cfb2d51-5ff4-4491-b0e5-b386f32c0992&displaylang=en>
 - Download and run the web installer
 - At the conclusion of this install you will be asked to restart your computer.
2. Install
 - a. To install the MMC-103 motion controller platform double click the setup.exe file on the supplied CD and follow the on screen instructions.
3. Run
 - a. The installer placed a start menu short-cut to the MMC-103 MCP program. Make sure that your MMC-103 is connected to your computer, powered on, and connected to a valid COM port as discussed in section 2.1
 - b. Open the start menu (or windows icon for vista)
 - c. Open the 'all programs' tab
 - d. Open the Micronix folder
 - e. Run the MMC-103 MCP program
 - For more on how to use the MCP program, there is a GUI Guide on the supplemental CD.

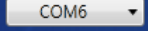
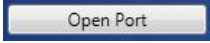
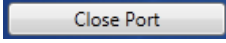


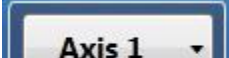
2.3 Using the MMC-103 Motion Controller Platform

In the Quick Start Guide Overview you connected your MMC-103 to your computer. In the Quick Start MMC-103 Motion Controller Platform you installed and ran the MMC-103 MCP software. This section will describe the capabilities of the MMC-103 MCP program and give you a brief understanding of how to use it.

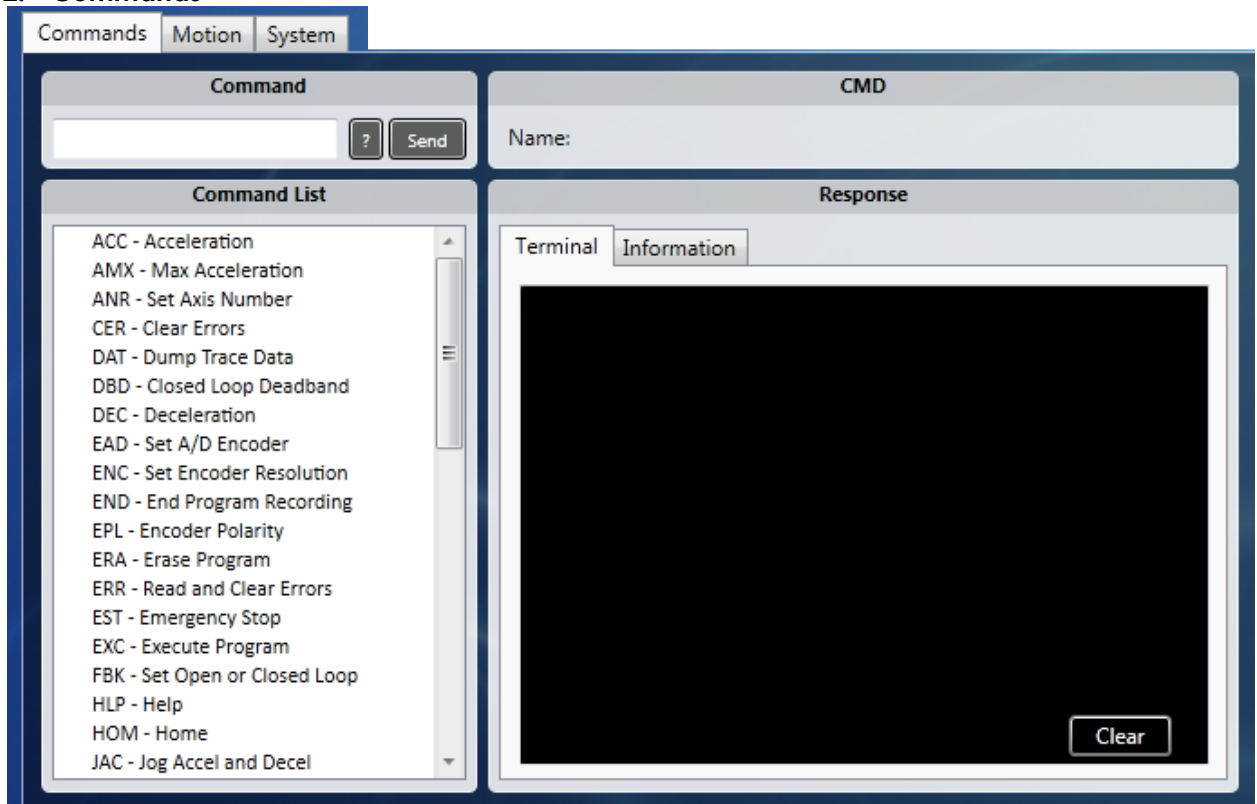


1. Port Control – The picture below depicts the program when the Port has been opened

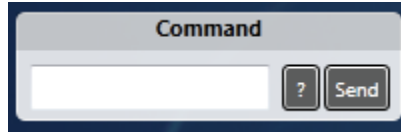




- a. Select the COM port associated with your MMC-103  as discussed in section 2.1, step 5.
- b. Click the Open Port button to connect to the MMC-103 
 - i. This button should change giving you the option to close the port 
- c. The Port field should change to indicate the Port is Open.   You will see the progress bar fill and the adjacent field change with information regarding the query process as the program initializes. You are now ready to start moving a stage with your MMC-103. For more information about this program see the MMC-103 MCP program guide.
- d. The Axis selector will allow you to switch control between different axes 

2. Commands

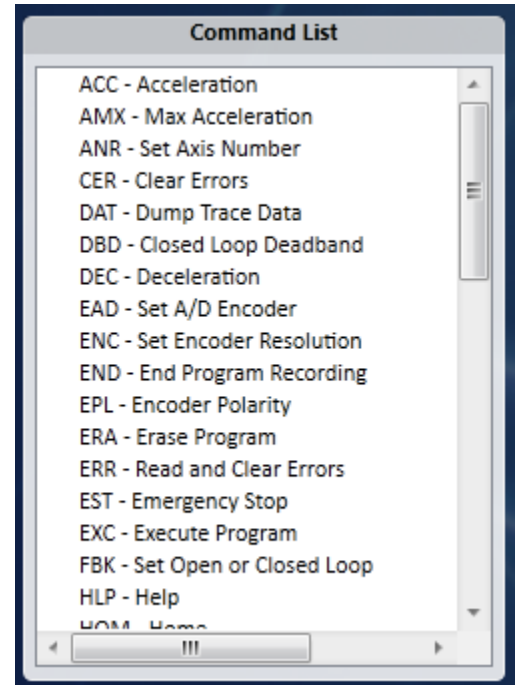


- a. **Command** – This field allows you to interface with your MMC-103 through manual terminal commands. For more about Commands see section 5 of the reference Manual.

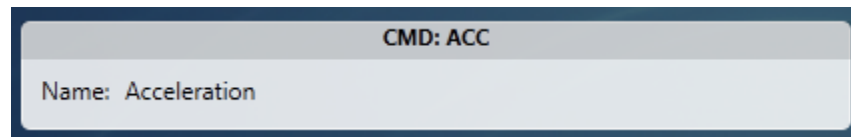


- i. Enter your command in the blank field
- ii.  This button appends a '?' on the end of the command making it a read function
- iii.  This button sends the command to the MMC-103

- b. **Command List** – This is a list of commands available to the MMC-103. Clicking any list item will send the 3 character command to the Command box with the preceding axis number.

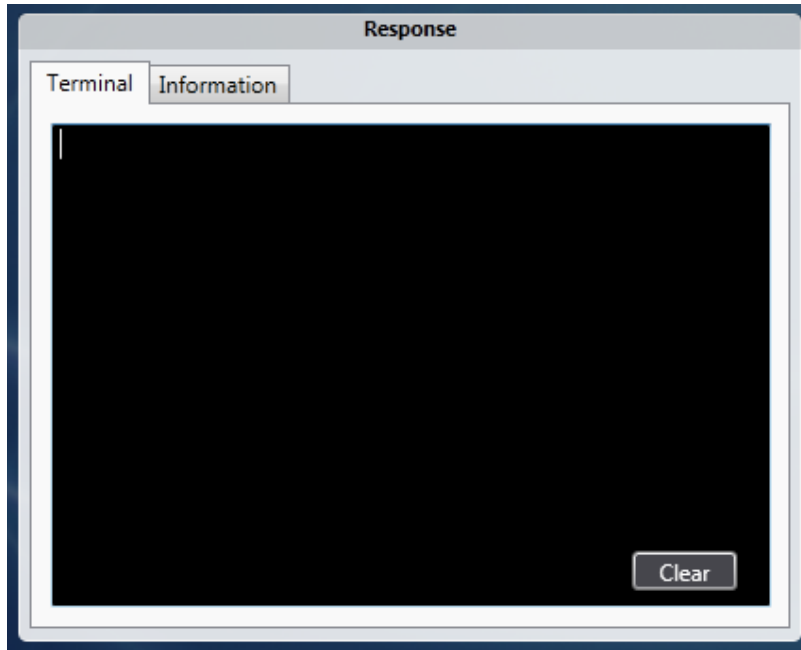


- c. **CMD** – This Field shows the 3 character command on top along with the associated full name

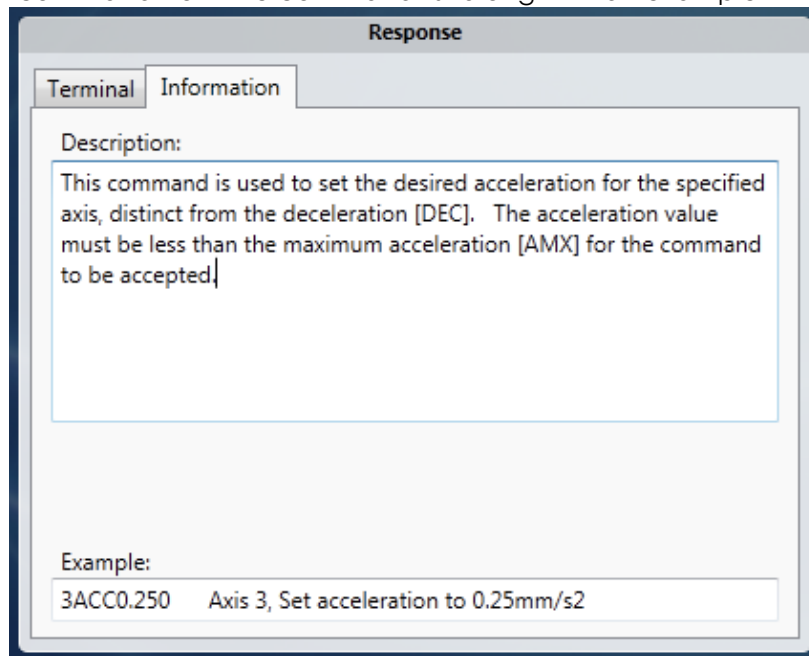


d. **Response**

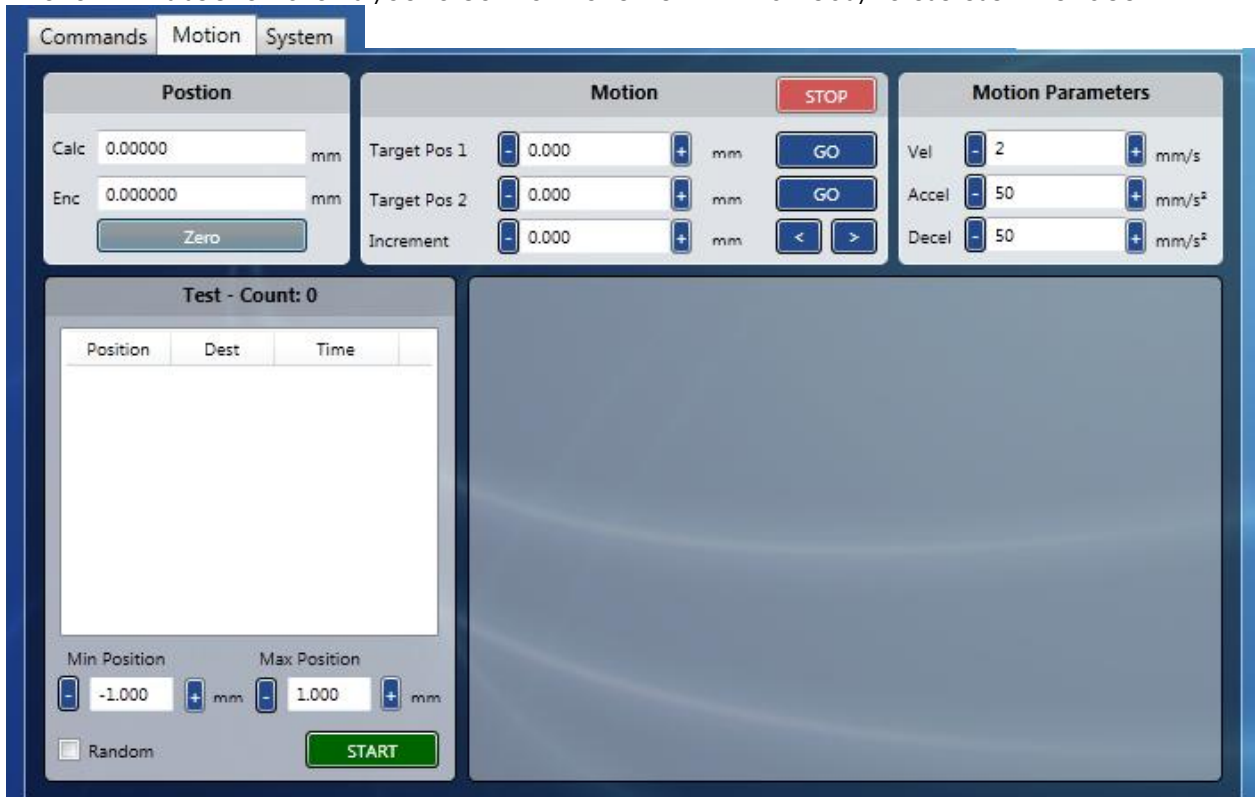
- i. Terminal – This field shows the responses from the MMC-103.
 - 1. The clear button will delete all entries in the Terminal



- ii. Information - This field will show some information about the selected command from the command list along with an example

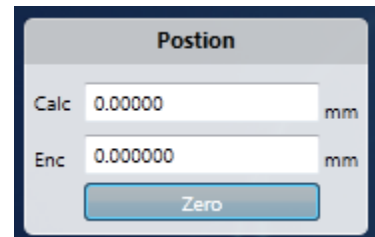


3. **Motion** – This section allows you to control movement with an easy to use user interface



a. **Position**

- i. **Zero** - This button will set the current position to zero for both the calculated and encoder reading.
- ii. **Cal** – This is the calculated position based on the number of steps taken (value in millimeters)
- iii. **Enc** – This is the position as read by the encoder assuming one is attached (value in millimeters)



b. **Motion** – This section allows you to control the movement of a stage attached to your MMC-103

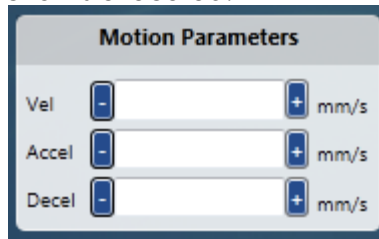
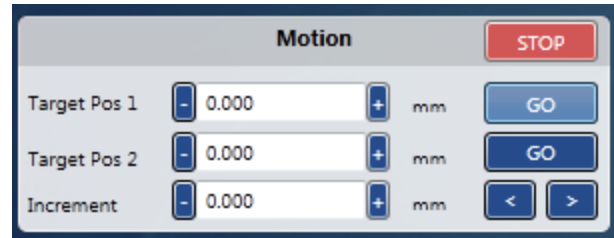
i. **Target Pos 1** – This field shows the target for an absolute move that will be executed upon pressing the adjacent 'GO' button

ii. **Target Pos 2** – This field shows the target for an absolute move that will be executed upon pressing the adjacent 'GO' button

iii. **Increment** – This field indicates the amount of displacement a relative move will travel upon pressing one of the adjacent '<','>' buttons.

iv. **STOP** – This button will execute an Emergency Stop Command.

c. **Motion Parameters** – This section dictates some parameters for how a movement function is executed.



i. **Vel** – This field indicates the controllers current set velocity

ii. **Accel** – This field indicates the controllers current set value for acceleration

iii. **Decel** – This field indicates the controllers current set value for deceleration

d. **Test**

i. **Max Position** – Set this value to the desired upper limit of travel

ii. **Min Position** - Set this value to the desired lower limit of travel

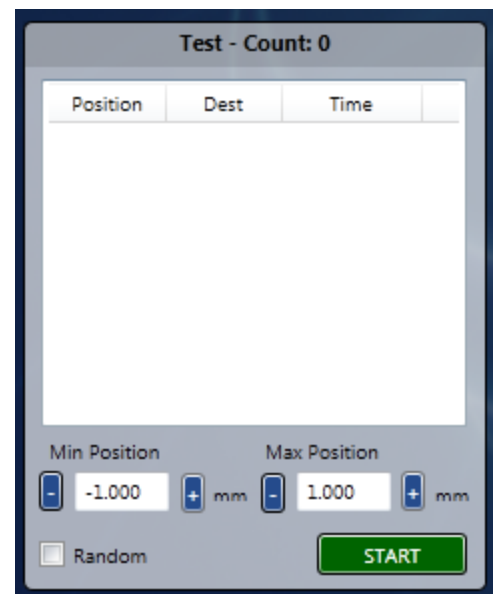
iii. **Random** – If set the controller will send random movements. If left unset, the stage will run from the Max Position to the Min Position as defined above.

iv. **START** – This will either execute the random movements between limits or the limit to limit run.

v. **Position** – This column is the start position for the move that is occurring.

vi. **Dest** – This column is the destination position for the move that is currently occurring.

vii. **Time** – This column indicates the time at which each move occurred.



4. System

The screenshot shows the 'System' tab of a control interface. It is divided into several sections:

- Axes:** Shows a tree view with 'MMC' expanded to 'MMC-100 - Axis: 1'.
- Axis 1 : Startup Parameters:** A table with columns 'Name' and 'Value'.

Name	Value
Firmware Version	1-04-017
Acceleration	100 mm/s ²
Max Acceleration	500 mm/s ²
Deceleration	100 mm/s ²
DeadBand Count	1 steps
DeadBand Timeout	0 sec
Encoder Resolution	0.005 um/cnt
Encoder Polarity	Normal Mode
Motor Polarity	Normal Mode
- Parameters:** A list of adjustable parameters with spinners:
 - Max Velocity: 17.060 mm/s
 - Max Acceleration: 500 mm/s²
 - Jog Acceleration: 250 mm/s²
 - + Travel Limit: 999,999 mm
 - Travel Limit: -999,999 mm
 - Step Resolution: 1200 steps/um
 - Enc Resolution: 0.005 um/cnt
- Encoder Polarity:** Radio buttons for 'Default' (selected) and 'Reverse'.
- Motor Polarity:** Radio buttons for 'Default' (selected) and 'Reverse'.
- Display Units:** Radio buttons for 'Linear' (selected) and 'Angular'.
- Axis:** A dropdown menu currently showing '0'.
- Run On Start:** A dropdown menu.
- Control:**
 - Loop: 'Open Loop' dropdown
 - Deadband: 1 cnt
 - Time Out: 0 sec
- PID Parameters:**
 - Kp: 0.500
 - Ki: 0.000
 - Kd: 0.000
- Errors:** A large empty area with a 'Clear' button.
- Buttons:** 'Store Parameters' (Save), 'Firmware' (1-04-017), and 'Request'.

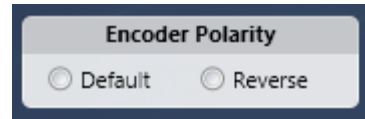
- a. **Axes** – This field will show the stages attached to the program along with associated axis number
- b. **Parameters** – Upon opening the port as discussed above, the MMC-103 MCP will populate the following fields.
 - i. **Max Velocity** – Maximum allowed Velocity
 - ii. **Max Acceleration** – Maximum Allowed Acceleration
 - iii. **Jog Acceleration** – Setting for Jog Acceleration
 - iv. **- Travel Limit** – The soft travel limit in the negative direction. The controller will not allow the stage to be moved outside this limit
 - v. **+ Travel Limit** – The soft travel limit in the positive direction. The controller will not allow the stage to be moved outside this limit
 - vi. **Step Resolution** – Steps per micron resolution
 - vii. **Enc Resolution** – Microns per encoder count

This inset shows the 'Axes' section of the interface, displaying a tree view with 'MMC' expanded to 'MMC-100 - Axis: 1'.

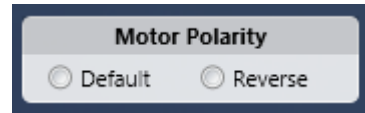
This inset shows the 'Parameters' section of the interface, displaying a list of adjustable parameters with spinners:

- Max Velocity: [] mm/s
- Max Acceleration: [] mm/s²
- Jog Acceleration: [] mm/s²
- Travel Limit: [] mm
- + Travel Limit: [] mm
- Step Resolution: [] steps/u
- Enc Resolution: [] u/count

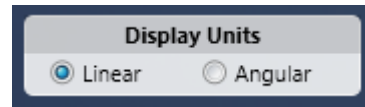
c. **Encoder Polarity** – This setting allows the user to flip positive and negative directions of the Encoder.



d. **Motor Polarity** – This setting allows the user to flip positive and negative directions of the Motor.



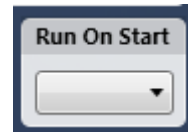
e. **Display Units** – This setting allows you to display linear units (mm) or rotary units (degrees).



f. **Axis** – This is a special command that needs to be unlocked in the settings menu on top. This field is associated with the ANR command and allows you to reset the axis number for the current selected axis.



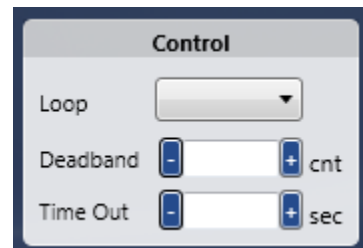
g. **Run On Start** – Here you can select which program you would like the stage to execute upon start up.



h. **Control** - This frame allows you to change options regarding feedback control

i. **Loop** – Here you can choose between 4 different modes of control

1. Open Loop – This mode will not read the encoder
2. Clean Open Loop – This mode will not read the encoder but does sound like a cleaner operation
3. Open Loop Close deceleration – This operation will run in open loop and then read from the encoder to correct its position.
4. Close Loop – This mode will constantly poll the encoder and make corrections to achieve the target trajectory.



ii. **Deadband** – This setting changes the amount of error the closed loop control mode will allow before trying to reposition.

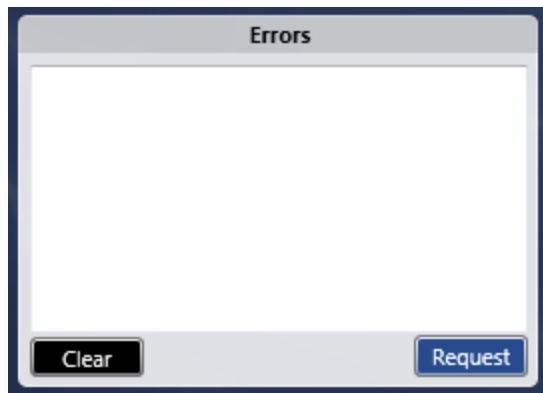
iii. **Time Out** – This setting allows you to change the amount of time a closed loop operation will search until it times out.

- i. **Startup Parameters** – This field will populate with the saved startup information for the selected axis

Axis 1 : Startup Parameters	
Name	Value
Firmware Version	1-04-29
Acceleration	100 mm/s ²
Max Acceleration	500 mm/s ²
Deceleration	100 mm/s ²
DeadBand Count	2 steps
DeadBand Timeout	0 sec
Encoder Resolution	0.002 um/cnt
Encoder Polarity	Reverse Mode
Motor Polarity	Normal Mode

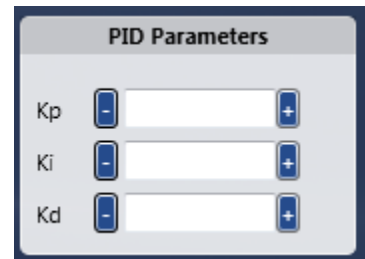
- j. **Error**

- i. **Clear** – This button will clear all error codes
- ii. **Request** – This button will dump all error codes to the above terminal

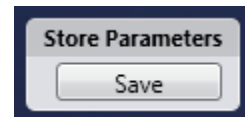


- k. **PID Parameters** - this field allows you to change the parameters for closed loop operation

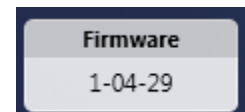
- i. **Kp** – Proportional Gain
- ii. **Ki** – Integral Gain
- iii. **Kd** – Differential Gain



- l. **Store Parameters** – This will allow you to save the settings you have entered as a file. This will allow you to restore these parameters in the future if necessary.





- m. **Firmware** – This Field indicates the Firmware version installed in the MMC-103 controller.





2.4 Functionality Quick-Start

Open Loop

If you have an open loop system (No Encoder), after opening the port from part 2.3-1 you can test movement by entering a value in the increment field and press either of the   buttons. Be sure that the value is within the confines of the travel limits. The stage should move and you should see the Calc field change.

Closed Loop

If you have a closed loop system (Attached Encoder), after opening the port from part 2.3-1, ensure that the controller is in closed loop on the system page (section 2.3-4h.). Then in the motion section enter a value in the increment field and press either of the   buttons. Be sure that the value is within the confines of the travel limits. The stage should move and you should see the Calc and Enc fields change and end at the same value.

3. Frequently Asked Questions

Why is my stage continuously running in one direction when set to closed loop (nFBK2, nFBK3)?

Most likely your encoder polarity is backwards. Use the nEPL? command to query the current setting and then if it is 1 send nEPL0 if it is 0 send nEPL1.

How do I get my settings like velocity, acceleration, and limits to remain when I power down the controller?

Use the nSAV command. This command writes all current settings to non-volatile RAM which will allow them to persist between power cycles. If you would like to revert to the factory settings simply use the nDEF command to revert the controller to its default parameters. (Note: to have these persist between power cycles don't forget to run the nSAV command)

What do the red and green LEDs mean?

The top LED (labeled 2 to the right) is an address indicator. At start up it will flash from Red (unaddressed) to orange (currently being addressed) to Green (addressed and ready for commands). The bottom LED is an error indicator. When an error occurs, the LED (labeled 1 to the right) will illuminate red. Use the nERR? command to read all errors. By default this LED will be off.

Why are the responses to my query commands coming back with garbage characters?

The communication bus for the MMC-103 is half-duplexed. It is important to ensure that you do not send commands when there are responses coming back from the MMC-103. Also, please ensure that the end of line character is a \r. If you sent \r\n a response will be sent at the same time as the \n is on the bus and will cause bus contention.