MMC-10

Series

Modular Motion Control System

Reference Manual

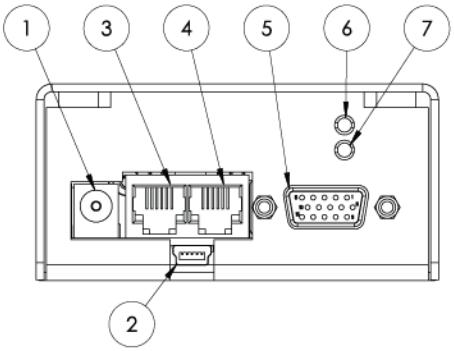
Contents

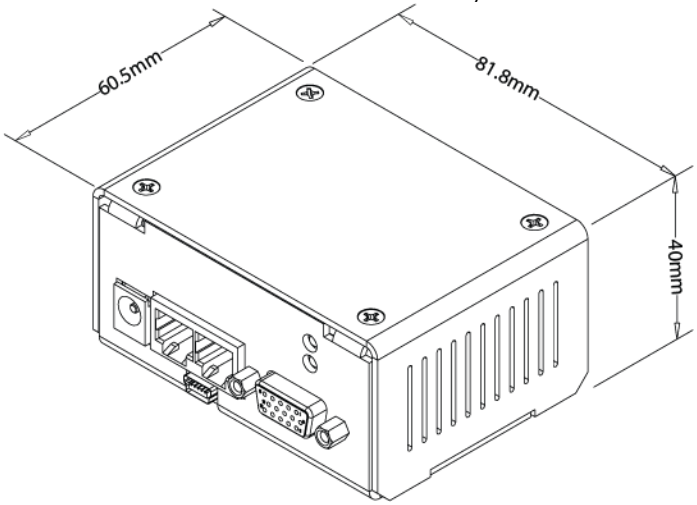
1. Introduction

This document is a quick start guide to be used to get the MMC-10 and accompanying stages connected and functional.

1.1 Product Description

The MMC-10 is a low cost two phase piezo motor controller/driver designed to be used as a standalone single axis unit or interconnected for multi-axis functionality.





1. 12V to 36V DC in (24V Nominal, peak current draw 0.5A)
2. USB Connector
3. Intermodular/RS-485 Input
4. Intermodular/RS-485 Output
5. Motor/Encoder
6. LED Addressing Indicator 2
    a. Orange – Stage is Unaddressed
    b. Green – Stage has an address and is ready
7. LED Error Indicator 1
    a. Red – An error has occurred

1.2 Features

- Integrated controller/driver for MICRONIX USA stick-slip piezo motors
- Ultra-compact design
- Open loop/closed loop operation
- Closed loop resolution dependent on the encoder

2. Quick Start

2.1 Inventory

We will begin the setup process by making sure all the components we will need are accounted for. With every MMC-10 controller, the following should be included:

Package Contents:

1. MMC-10 Controller
2. 24V Power Supply
3. Power Cable
4. 6' USB Cable
5. User Manual
6. Supplemental CD
7. RJ-11 Daisy Chain Cable (Optional)

2.2 *Quick Start: Connecting Your Motion Device.*

Now that we have confirmed we have everything we need; we can get the controller and stages set up.

1. Connect MMC-10 to Motion Devices:
   Each stage to be used with an MMC-10 will have a male DSUB15 HD connector attached to it. Plug this into the motor/encoder plug on the MMC-10 unit. This connector will connect the motor to the drive circuitry of the controller, and on closed loop stages will additionally serve to relay the encoder data back to the controller (Pinout available in manual appendix).

2. Connect MMC-10 to Computer:
   Connect the mini USB connector on the MMC-10 unit to your pc using the included 6' USB cable.

3. (Optional) Connect MMC-10 units together
   The MMC-10 has both an in and an out jack for RS-485 communication. This jack also distributes power and is responsible for addressing in situations where the auto address function is used. Connect the output of one MMC-10 to the input of another to daisy chain multiple MMC-10 controllers together, sharing power and a communication bus (Pinout available in manual appendix). Axes will be addressed in the order they are connected, a unit who's "in" jack is connected to another units "out" jack will have an address one higher than the unit it is daisy chained to, starting with 1.

4. Connect MMC-10 to Power
   Now that everything is connected, power on the device by plugging in the 24V power supply. At this point, the upper LED should be lit green.

2.3 *Getting Your Target PC Ready*

There are a number of ways to control Micronix controllers, but let's start by setting up the Micronix MCP user interface on your PC.

1. Install
   a. To install the Micronix motion controller platform double click the setup.exe file on the supplied CD or downloaded from http://www.micronixusa.com/motion/support/softwares.cfm and follow the on screen instructions.
   b. If the on-screen instructions do not take you all the way through the installation process, see the Troubleshooting section on page 15 of this manual.

2. Run
   a. Open the start menu (Windows 7/Vista) or the Start screen (Windows 8/10)
   b. Open the 'all programs' tab (Windows 7/Vista) or use the down arrow to navigate to the Apps screen (Windows 8/10)
   c. Open the Micronix folder (Windows 7/Vista) or navigate to the Micronix section of the Apps screen by scrolling sideways (Windows 8/10)
   d. Run the Micronix MCP program.

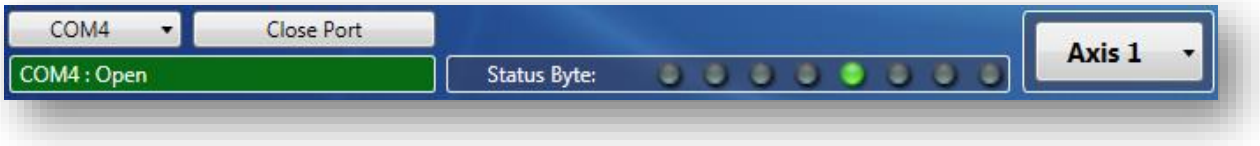
Micronix MCP GUI

2.4 *Quick Start: Using the Micronix Motion Controller Platform*

Now that we have connected a stage to a controller, and a controller to a PC, it's time to tie it all together. Your PC should automatically recognize the device plugged into it (your controller) as a com port with the following specs:

By default, Micronix devices will appear as "COM 4". If this com port is already occupied, it will appear as the next available com port. If there is uncertainty about which COM port your Micronix device is occupying, or if you are unable to communicate with your Micronix device via com port, skip to the troubleshooting section on page 15 of this manual for help resolving this issue.

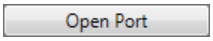
With a com port identified, it is time to connect to the MMC-10 using the Micronix MCP program installed in section 2.2.

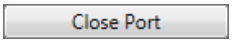


Port Control section of Micronix MCP software

1. Port Control

a. Select the COM port associated with your MMC-10 device 

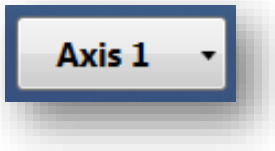
b. Click the Open Port button to connect to the MMC-10 

   i. This button should change giving you the option to close the port 

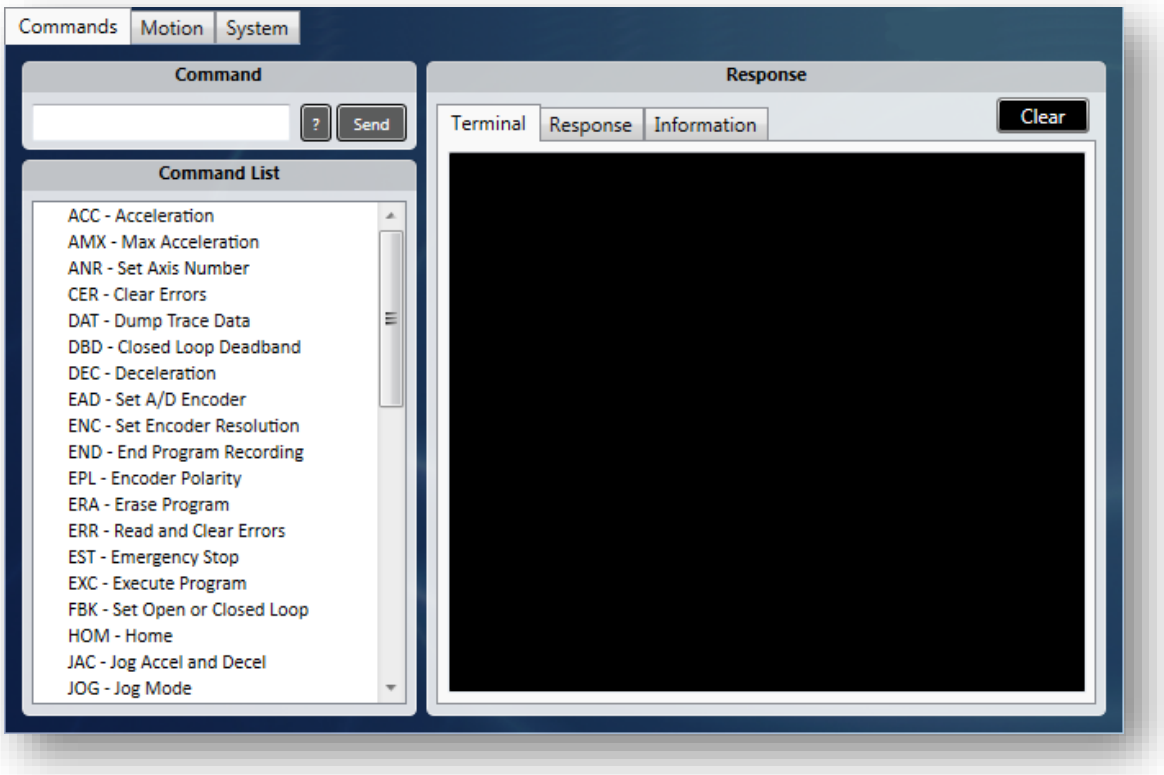
c. The Port field should change to indicate the Port is Open.


d. 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-10.

e. The Axis selector will allow you to switch control between different axes, if multiple axes are being used.

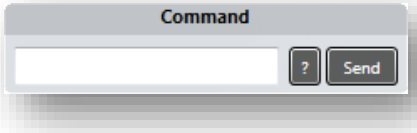


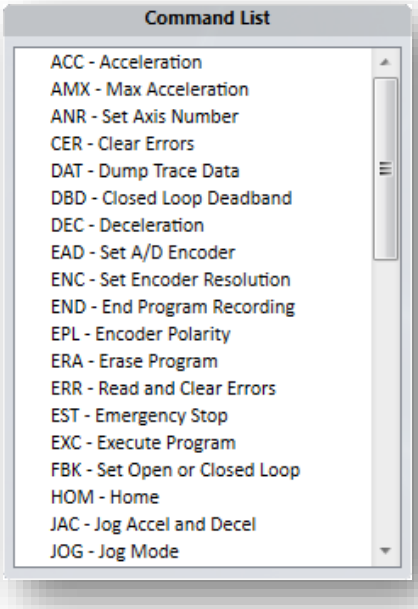
2. Commands



Terminal section of Micronix MCP software

a. **Command** – This field allows you to interface with your MMC-10 through manual terminal commands. For more about Commands see section 7 of the reference Manual.





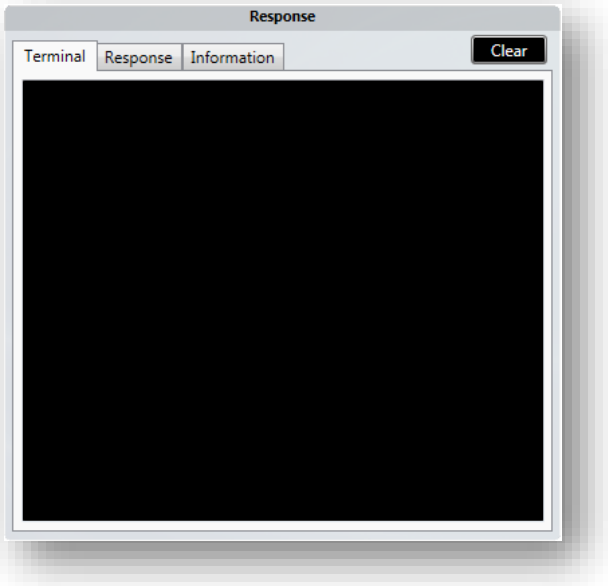
   i. Enter your command in the blank field
   ii.  This button appends a '?' on the end of the command making it a read function
   iii.  This button sends the command to the MMC-10

b. **Command List** – This is a list of commands available to the MMC-10. Clicking any list item will send the 3 character command to the Command box with the preceding axis number.

c. **Response**

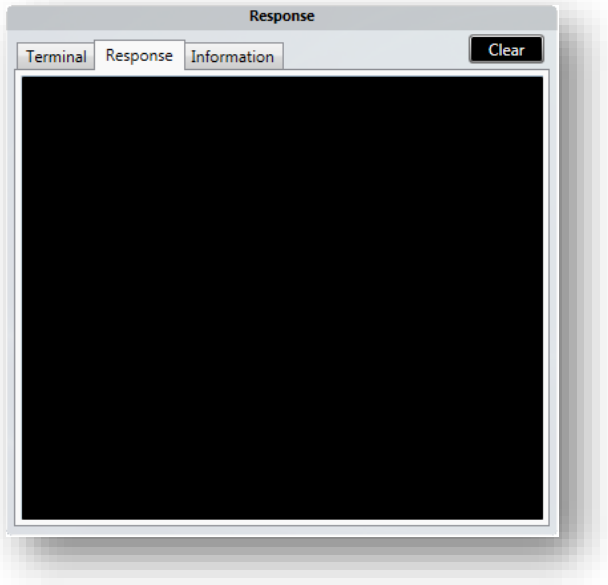
i. Terminal – This field shows the responses from the MMC-10.

1. The clear button will delete all entries in the Terminal



ii. Response – Responses to user queries are displayed here.

1. The clear button will delete all entries in the Response terminal.

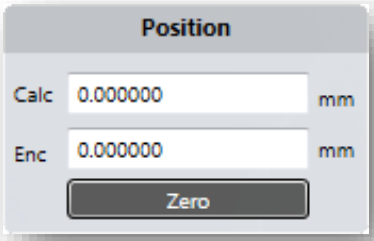


iii. Information - This field will show some information about the selected command from the command list along with an example

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

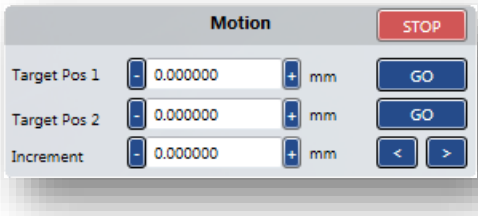
Motion section of Micronix MCP software

a. **Position**



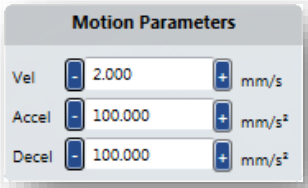
i. **Zero** - This button will set the current position to zero for both the calculated and encoder reading.
ii. **Calc** – This is the calculated position based on the number of steps taken (value in millimeters)
iii. **Enc** – This is the position as read by the encoder assuming one is attached (value in millimeters). If no encoder is attached, this value reads 0.000000.

b. **Motion** – This section allows you to control the movement of a stage attached to your MMC-10



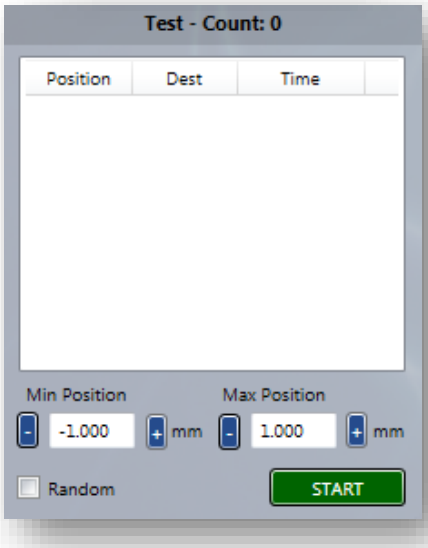
i. **Target Pos 1** – This field shows the target for an absolute move that will be executed upon pressing the adjacent 'GO' button
ii. **Target Pos 2** – This field shows the target for an absolute move that will be executed upon pressing the adjacent 'GO' button
iii. **Increment** – This field indicates 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.



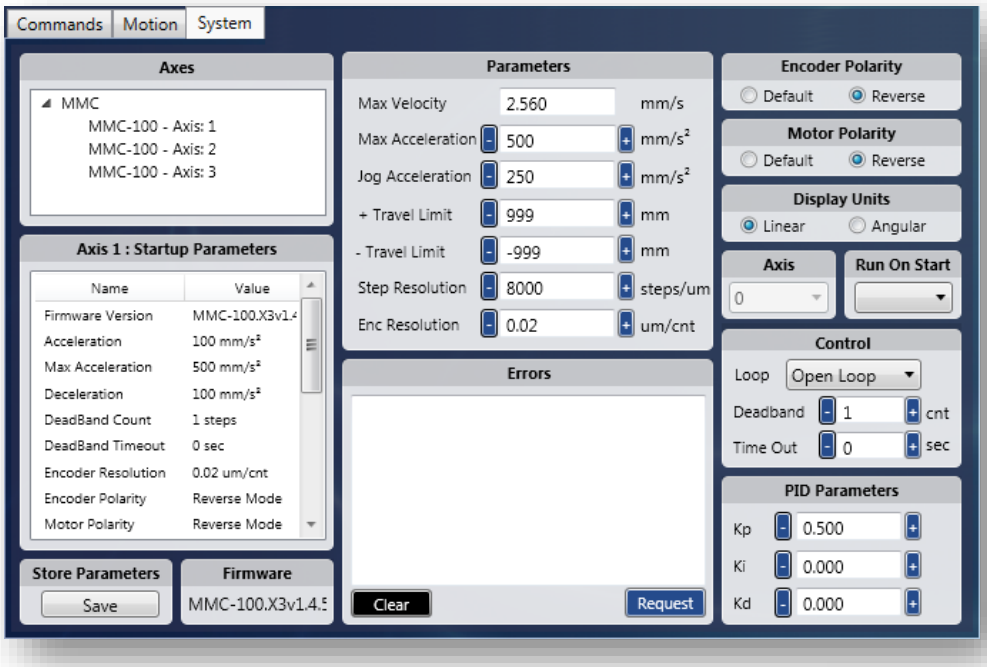
i. **Vel** – This field indicates the controllers current set velocity
ii. **Accel** – This field indicates the controllers current set value for acceleration
iii. **Decel** – This field indicates the controllers current set value for deceleration

d. **Test**

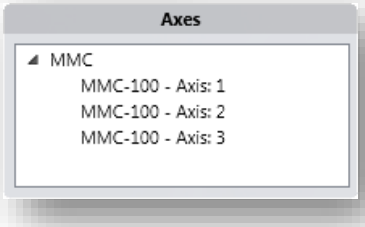


i. **Max Position** – Set this value to the desired upper limit of travel
ii. **Min Position** - Set this value to the desired lower limit of travel
iii. **Random** – If set the controller will send random movements. If left unset, the stage will run from the Max Position to the Min Position as defined 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

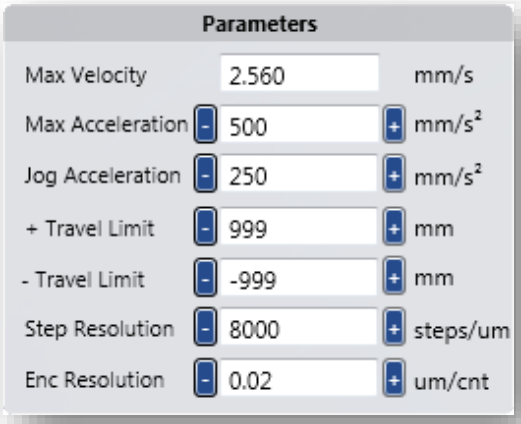


System section of Micronix MCP software



b. **Axes** – This field will show the stages attached to the program along with associated axis number

c. **Parameters** – Upon opening the port as discussed above, the MMC-10 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

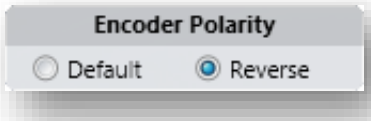
iv. **– Travel Limit** – The soft travel limit in the negative direction. The controller will not allow the stage to be moved outside this limit

v. **+ Travel Limit** – The soft travel limit in the positive direction. The controller will not allow the stage to be moved outside this limit

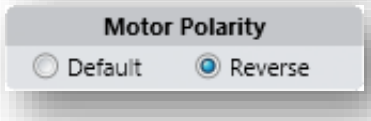
vi. **Step Resolution** – Steps per micron resolution

vii. **Enc Resolution** – Microns per encoder count

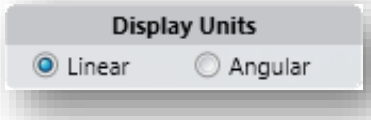
d. **Encoder Polarity** – This setting allows the user to flip positive and negative directions for the Encoder.



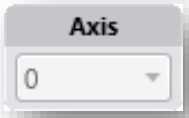
e. **Motor Polarity** – This setting allows the user to flip positive and negative directions for the Motor.



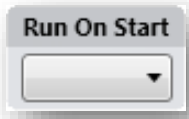
f. **Display Units** – This setting allows switching between linear units (mm) and rotary units (degrees).



g. **Axis** – This is a special command that needs to be unlocked in the settings menu (Settings Menu -> Advanced Tab -> Unlock Axis Select). This field is associated with the ANR command and allows you to reset the axis number for the current selected axis.

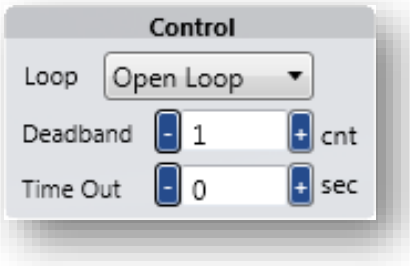


h. **Run On Start** – Here you can select which program you would like the stage to execute upon start up. For more on internal programs, see page 20 of this manual.

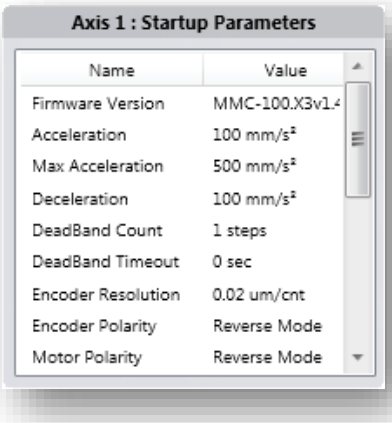


i. **Control** - This frame allows you to change options regarding feedback control

   i. **Loop** – Here you can choose between 4 different modes of control
      1. Open Loop – This mode does not take encoder position into account.
      2. Clean Open Loop – This mode also does not take encoder position into account but maintains a consistent pitch.
      3. Open Loop Close deceleration – This operation will run in clean open loop mode and then read from the encoder to correct its position at the end of travel (Not a constant velocity move).
      4. Close Loop – This mode will constantly poll the encoder and make corrections to achieve the target trajectory (Constant velocity).



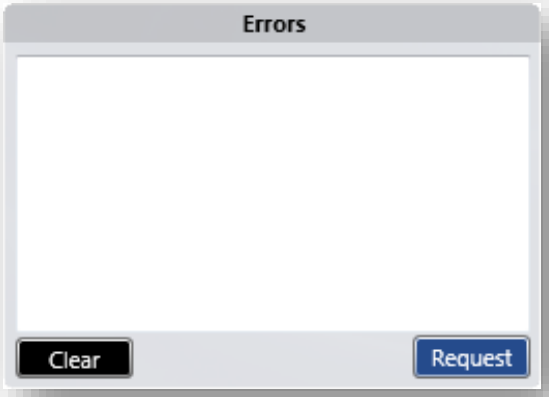
ii. **Deadband** – This setting changes the amount of error the closed loop control mode will allow before trying to reposition.
iii. **Time Out** – This setting allows you to change the amount of time a closed loop operation will search until it times out.



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

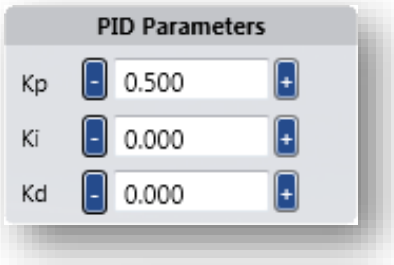
k. **Error**

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

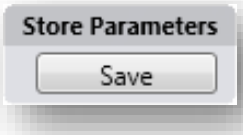


l. **PID Parameters** - this field allows you to change the parameters for closed loop operation

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



m. **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.



n. **Firmware** – This Field indicates the Firmware version installed in the MMC-10 controller

2.5 Motion With and Without Encoders

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 is an address indicator. At startup 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 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-10 is half-duplexed. It is important to ensure that you do not send commands when there are responses coming back from the MMC-10. 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.

4. Trouble Shooting

Difficulty Installing the Micronix Motion Control Platform
To run the Micronix MCP software, you will need the .NET Framework 4.0 or higher to already be installed on the target computer. If the target computer has Windows 7 or later installed and is current on all updates, .NET 4.0 should already be installed. If the target computer does not have .NET 4.0 or you are unsure if the target computer has the .NET Framework 4.0, follow these steps:

a. Navigate to the support section of the Micronix Website at http://www.micronixusa.com/motion/support/softwares.cfm
b. Download the file labeled DOT_NET Installation.
c. Run the application and follow the on screen instructions.
d. Return to section 2.2 and follow instructions. If you are still encountering problems, contact Micronix support.

My MMC-10 is not being recognized as a com port by my system.
In some cases, due to a variety of factors, controllers will not be recognized as Com ports. Here are steps to take to resolve this issue.

1. Make sure the device is powered on and the top LED is lit green. If the top LED is not lit green, or if power is connected but no LEDs are lit, contact Micronix support.

2. Make sure the USB port the controller is plugged in to is functional. Try to plug the MMC-10 into another USB port, or if using a USB hub try plugging the unit directly into the PC USB port. Try another device like a thumb drive in the USB port and make sure it connects.

3. If the controller is powered on and plugged in to a functional USB port, but is still not being recognized, try installing the Com Port drivers located at
http://www.micronixusa.com/motion/support/softwares.cfm
and restarting your computer. If this does not solve the problem, please contact Micronix Support.

4. If the com port is recognized, but the Micronix Motion Control Platform is unable to communicate with it, double check the setting of the port. To do this, open the control panel in Microsoft windows and navigate to the device manager. Locate the com port associated with the MMC unit (if there are multiple com ports open, unplug and replug the unit and look for the com port that responds). Right click the com port associated with the MMC unit and select "Properties" from the menu that appears. On the "Port Settings" tab, make sure the following values are set.

Software Parameter	Setting
Baud Rate	38400
Data Bits	8
Stop Bits	1
Parity	No
Handshake	No

Difficulty Identifying the Correct Com Port
In some cases, in which a large number of com ports are being used or com ports are tied up by the system, it may be difficult to identify which com port is associated with which device. The Micronix MCP programs drop down menu will display the most recently connected com port on the bottom of the list. As such, an easy way to identify a device is to power cycle it, it should now be the last listed com port.

5. Technical Information

5.1 MMC-10 Specifications

Parameter	Description
Motor Type	Stick-slip piezo motors
Interface	USB 2.0 compliant/RS-485
Commands	ASCII Commands
Trajectory Mode	Trapezoidal velocity profile
Servo Clock	10 kHz

* Each axis requires 0.5A at peak usage. A up the individual axis power requirements to determine the power supply amperage requirement.

5.2 Serial Port Setup

Below are the virtual RS-232 configuration settings necessary for correct communication setup:

Software Parameter	Setting
Data Bits	8
Stop Bits	1
Parity	No
Handshake	No
Baud rate	38400

5.3 RJ11 RS485 Bus

The RS485 Intermodular RJ11 connector connects directly to the same Serial bus as the FTDI interface above. In addition to being an RS-485 line, this connector also distributes power and is responsible for addressing in situations where the auto address function is being used. MMC-10 units can be connected in a daisy chain fashion, with the RS-485 Out of one unit plugging in to the RS-485 In of the next unit as shown in section 2.3 of this manual. When daisy chaining, keep in mind that each unit has a peak current draw of 0.5A, so the number of daisy chained units is limited by the current rating of the power supply being used.

6. Operation

6.1 Axis Addressing

Auto Addressing is the default method of assigning axis numbers on start up. Controllers are automatically assigned axis numbers on every power up, starting with axis 1 and increasing consecutively until reaching axis 99.

Manual axis numbers may be assigned to a unique controller using the ANR Command. This overrides Auto Addressing, as the controller stores the axis number until reassigned or reset back to Auto Addressing. In the case of having a mix of manually assigned and auto addressed controllers, the Auto Addressed axis numbers increase consecutively after each manually assigned axis in the stack. For example; in a stack of 5 controllers with the third controller manually assigned to axis 10, the axis numbers will read: 1, 2, 10, 11, 12

If two controllers are accidentally assigned the same axis number, use a global command to reset all controllers back to Auto Addressing.

6.2 Feedback Control

The MMC-10 has four different movement modes of operation. When executing a move command, the controller will drive a stage differently when set to different modes. The FBK command is used to switch between these modes.

The first mode (nFBK0) is a traditional Open Loop. It follows a standard trapezoidal velocity characteristic. It bases the transition between acceleration, constant velocity and deceleration on the resolution settings (nREZx) or the distance it travels in one pulse. This is entirely theoretical and does not guarantee a set trajectory or end point.

The second mode (nFBK1) is also open loop, however this one does not follow the standard trapezoidal velocity set by the user. Instead, it rounds off the velocity to an even number of servo clocks per transition. This causes the motor to sound much cleaner than the previous mode. However, it does sacrifice accuracy.

The third mode (nFBK2) is a version of closed loop; meaning it takes position data from an attached encoder and uses it to ensure that it stops at the desired position. In this mode the controller runs in the second open loop mode (nFBK1) until it reaches the deceleration point. At this point it constantly reads from encoder and corrects its position to arrive at the correct position. This, unlike the first two modes can guarantee position within the specified deadband (DBN Command). However, this mode cannot guarantee a known trajectory.

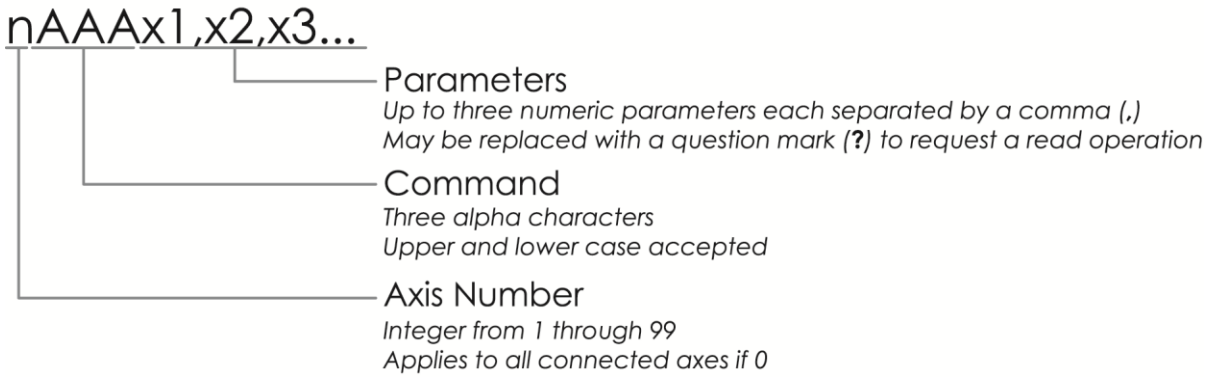
The fourth mode (nFBK3) is a more traditional closed loop. The controller will constantly try to achieve an ideal trapezoidal velocity characteristic. Like the previous mode it too can guarantee position final within the specified deadband.

6.3 MLN, MLP, and User Defined References

The move to limit negative (MLN) and moves to limit positive (MLP) commands both require the attached stage to have an encoder and will move the stage to end of travel in their respective directions. The orientation of positive versus negative limits can be changed using the limit direction (LDR) command. In addition, a user created reference point can be created by moving to a limit, moving out of said limit the desired amount, and then using the zero (ZRO) command to set both the calculated and encoder positions to the value 0.000000mm. To return to this reference point, the user need only use the move to absolute (MVA) command and move to the location 0.000000mm. See Programming Example 3 of the Internal Programming section of this manual (Page 91) for detailed instructions on creating a routine that runs on startup and automatically creates this reference point.

7. Commands

7.1 Command Line Syntax



There are three components to every command prompt. The first is the "Axis Number" which designates which controller, or axis, will receive the command. If the "Axis Number" is 0, then the command will be sent globally to all connected controllers. It is possible to connect up to 99 controllers; therefore the "Axis Number" will be an integer value from 0 through 99.
The second component is the "Command", which is always comprised of three letters. Each command is outlined, along with its corresponding parameters, in the *Command Description* section 5.9 of this manual.

The third and final component is the "Parameter". This portion is command dependent, meaning that the parameter value will change depending on the specific requirements of the "Command". Where applicable, a question mark (?) may be substituted to initiate a read operation which will return information regarding the particular command. There may be up to three separate parameters for a particular command, each parameter value is separated by a comma (,).

All white space (blank spaces) are ignored in the command format. The following are examples of equivalent commands:

```
4TRM13,45
4 TRM 13, 45
```

7.2 Command Line Format

Commands are first executed in the order that they are input, then line by line. This means that two commands on the same line are executed significantly closer to each other than if they were on two separate lines. Each command is separated by a semicolon (;) and every command line ends in a terminator (EX: carriage return). The following is an example of a command line entry:

```
1MVR16;3MVR12        | Axis 1, Move 16 mm [16 degrees]; Axis 3, Move 12 mm [12 degrees]
```

Using multiple commands on the same command line allows for synchronization of different commands to different axes. Up to 8 commands are allowed per command line.

Only one read operation is allowed per line. The controller will not send information unless requested to do so by a read operation.

7.3 Global Commands

Some commands have the option of being called globally. This means that you can send the same command to all available axes. To do this, replace the axis number of a global command with a '0'. For example; 0ACC 50 will set the acceleration of all available axes to 50 mm/s^2 [degrees/s^2].

7.4 Multiple Parameters

When dealing with a command that has multiple parameters, it is possible to change a single parameter by omitting numbers for the parameters that will remain unchanged. For example; 4PID,,3 will only change the third parameter to a new value, "3".

7.5 Synchronous Move

It is possible to execute multiple motions at the same time by setting up and executing a synchronous move. To set up a synchronous move, use the MSA and MSR commands. These commands can be written on the same command line (up to 8 allowed) or on separate lines followed by a line terminator. To execute the move, use the RUN command on the proceeding command line followed by a line terminator. For example;

```
1MSA4;2MSA4;3MSA4   | Axis 1, Move 4mm;  Axis 2, Move 4mm;  Axis 3 Move 4mm
0RUN                | Run Synchronous Move
```

Or

```
1MSA4               | Axis 1, Move 4mm
2MSA4               | Axis 2, Move 4mm
3MSA4               | Axis 3 Move 4mm
0RUN                | Run Synchronous Move
```

7.6 Internal Programming

A program may be used to save time when repeatedly using a sequence of commands. Each controller or axis must be programmed individually; however, multiple controllers may execute the same program at the same time. For a more detailed look at the internal programming features of the MMC-10, see the appendix of this manual.

7.7 Terminating Characters

When communicating with the controller, it is necessary to note the terminating characters involved in transmitting and receiving data. To send data to the controller, enter the desired commands in the command line followed by the new line and carriage return terminating characters [\n\r], or just the carriage return terminating character [\r]. When receiving, each line of data will be followed by the new line terminating character [\n] and the final line will end in the new line and carriage return terminating characters [\n\r]. The Hexadecimal value for new line [\n] is 0X0A and for carriage return [\r] is 0X0D. The following is an example of data transmission:

1VEL0.005 \n\r | Axis 1, Set velocity to .005 mm/s [degrees/s^2] [New line, Carriage Return]

7.8 Summary of Commands

Command	Description	During Motion		Real-time		Program		Global		Page
		Set	Read	Set	Read	Set	Read	Set	Read	
ACC	Acceleration		✓	✓	✓	✓		✓		16
AMX	Maximum Allowable Acceleration		✓	✓	✓			✓		17
ANR	Set Axis Number		✓	✓	✓			✓*		18
CER	Clear Errors			✓				✓		19
DAT	Dump Trace Data				✓					20
DBD	Closed Loop Deadband		✓	✓	✓			✓		21
DEC	Deceleration		✓	✓	✓	✓		✓		22
DEF	Restore Factory Defaults			✓						23
EAD	Set Analog or Digital Encoder		✓	✓	✓			✓		24
ENC	Select Encoder Resolution		✓	✓	✓			✓		25
END	End Program Recording			✓		✓				26
EPL	Encoder Polarity		✓	✓	✓			✓		27
ERA	Erase Program			✓						28
ERR	Read and Clear Errors		✓		✓					29
EST	Emergency Stop	✓		✓		✓		✓		30
EXC	Execute Program			✓				✓		31
FBK	Set Open or Closed Loop Mode		✓	✓	✓					32
FMR	Upload Firmware			✓						33
HCG	Home Configuration		✓	✓	✓	✓		✓		34
HOM	Home		✓	✓	✓	✓		✓		35
IOD	IO Pin Definition			✓						36
IOF	IO Function			✓						37
JAC	Jog Acceleration and Deceleration		✓	✓	✓			✓		38
JOG	Jog Mode	✓		✓						39
LDR	Limit Switch Direction			✓						40
LCG	Limit Configuration		✓	✓	✓			✓		41
LIM	Limit Status		✓		✓					42
LST	Program List			✓						43
LPL	Limit Switch Polarity		✓	✓	✓					44
MLN	Move to Negative Limit			✓		✓		✓		45
MLP	Move to Positive Limit			✓		✓		✓		46
MOT	Toggle Motor On/Off		✓	✓	✓			✓		47
MPL	Motor Polarity		✓	✓	✓			✓		48
MSA	Synchronous Move – Absolute			✓				✓		49
MSR	Synchronous Move – Relative			✓				✓		50
MVA	Move Absolute			✓		✓		✓		51
MVR	Move Relative			✓		✓		✓		52
PGL	Loop Program		✓	✓	✓			✓		53
PGM	Begin Program Recording		✓	✓	✓					54

Continued…

Command	Description	During Motion		Real-time		Program		Global		Page
		Set	Read	Set	Read	Set	Read	Set	Read	
PGS	Run Program At Start-Up			✓	✓			✓		55
PID	Set Feedback Constants		✓	✓	✓					56
POS	Position		✓		✓					57
REZ	Set Resolution		✓	✓	✓			✓		58
RST	Perform Soft Reset			✓				✓		59
RUN	Start Synchronous move			✓				✓		60
SAV	Save Axis Settings			✓				✓		61
STA	Status Byte		✓		✓					62
STP	Stop Motion	✓		✓		✓		✓		63
SVP	Save Startup Position		✓	✓	✓	✓		✓		64
SYN	Sync					✓		✓		65
TLN	Negative Soft Limit Position		✓	✓	✓	✓		✓		66
TLP	Positive Soft Limit Position		✓	✓	✓	✓		✓		67
TRA	Perform Trace		✓	✓	✓	✓		✓		68
VEL	Velocity	✓	✓	✓	✓	✓		✓		69
VER	Firmware Version		✓		✓					70
VMX	Max. Allowable Velocity		✓		✓					71
VRT	Encoder Velocity		✓		✓					72
WST	Wait For Stop					✓				73
WSY	Wait For Sync					✓		✓		74
WTM	Wait For Time Period					✓				75
ZRO	Zero Position			✓		✓		✓		76
ZZZ	Take Axis Offline			✓				✓		77

∗ see ANR command page 18 for more info

7.9 Command Descriptions

ACC Acceleration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the desired acceleration for the specified axis, distinct from the deceleration [DEC]. The acceleration value must be less than the maximum acceleration [AMX] for the command to be accepted.
Returns:	A read operation returns the acceleration value in mm/s^2 for the specified axis.
Syntax:	nACCx – Standard syntax nACC? – Read acceleration value 0ACCx –All axes set acceleration value Error [#]: ACC? – Read operation with missing axis number [27] nACC – Missing acceleration parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Acceleration ? – Read acceleration value
Parameter Range:	n – 0 to 99 x – 000.001 to AMX (500.000 mm/s^2 [$degrees/s^2$])
Related Commands:	DEC, VEL, JAC, AMX
Example:	`3ACC0.250` |Axis 3, Set acceleration to 0.25mm/s^2 [$degrees/s^2$] – `4ACC?` |Axis 4, Read acceleration value

AMX Maximum Allowable Acceleration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to set the maximum allowable acceleration for the specified axis.
Returns:	A read operation returns the maximum allowable acceleration value in mm/s^2 for the specified axis.
Syntax:	nAMXx – Standard syntax nAMX? – Read maximum allowable acceleration value 0AMXx – All axes set maximum allowable acceleration value Error [#]: AMX? – Read operation with missing axis number [27] nAMX – Missing maximum acceleration parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Maximum acceleration ? – Read maximum allowable acceleration value
Parameter Range:	n – 0 to 99 x – 000.001 to 500.000 mm/s^2 [degrees/s^2]
Related Commands:	DEC, VEL, JAC, VMX, ACC
Example:	`2AMX1.500` |Axis 2, Set max acceleration to 1.500 mm/s^2 [degrees/s^2] `6AMX?` |Axis 6, Read max acceleration value

ANR Set Axis Number

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓*	

Command Description:	This command is used to override Auto Addressing by manually assigning an axis number to a controller. Auto Addressing is the default method of assigning axis numbers on power up and may be reassigned to an axis by substituting a "0" for the parameter value. Simultaneous axis swapping is possible by using multiple ANR commands on the same command line. A save [SAV] followed by a controller reset [RST] is required for changes to take effect. If wo or more axes in the same stack have the same address, bus contention will occur causing invalid controller response and erratic behavior (including inaccessible axes). To correct this, issue the commands 0ANR0, then 0SAV, followed by 0RST to restore default auto addressing. ∗This command can be called globally by specifying a '0' for the axis number; however it will only work if the new axis number parameter is set to '0' for auto-addressing.
Returns:	A read operation returns the following axis number values for the specified axis: 0 – Auto Addressing assigned (default) 1-99 – Manually assigned, axis number displayed
Syntax:	nANRx – Standard syntax nANR? – Read axis number value Error [#]: ANR? – Read operation with missing axis number [27] nANR – Missing new axis number parameter [28] ANRx – Missing axis number [30]
Parameter Description:	n[int] – Axis number x[int] – New axis number, 0 for Auto Addressing ? – Read axis number value
Parameter Range:	n – 0 to 99 x – 0 to 99
Related Commands:	RST
Example:	`5ANR1;1ANR5` Set to axis 1; – Simultaneous axis swapping: Axis 5, Axis 1, Set to axis 5 `4ANR0` However it will remain axis 4 until the MMC-100 is reset – Axis 4 Set to Auto Addressing.

CER

Clear Errors

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to clear all error messages without reading them.
Returns:	A read operation cannot be used with this command.
Syntax:	nCER – Standard syntax 0CER – All axes clear error messages
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	ERR
Example:	`1CER` | Axis 1, clear error messages – `0CER` | All axes, clear error messages

DAT

Dump Trace Data

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
			✓				

Command Description:	This command is used to read trace data from a specified axis initially recorded by the trace command [TRA]. The retrieved trace data set is dumped from the controller, consequently allowing the data to be retrieved only once.
Returns:	A read operation returns the trace data values for the specified axis in the following format: [Theoretical Position (Encoder Counts)],[Actual Position(Encoder Counts)], [DAC Value], [Not Used]
Syntax:	nDAT? – Read trace data values Error [#]: DAT? – Read operation with missing axis number [27] nDAT – Missing read operation parameter [28]
Parameter Description:	n[int] – Axis number ? – Read trace data values
Parameter Range:	n – 1 to 99
Related Commands:	TRA
Example:	`11DAT?` |Axis 11, Read trace data values

DBD Closed Loop Deadband

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to set the acceptable deadband and deadband timeout values. Deadband refers to the number of encoder counts (±) from the target that is considered acceptable. If the parameter (x1) is set to "0", the controller will continuously oscillate around the target. Deadband timeout refers to the amount of time that the controller will try to move into the deadband area. If the parameter (x2) is set to "0", the controller will seek continuously.
Returns:	A read operation returns the deadband and deadband timeout values for the specified axis.
Syntax:	nDBDx1,x2 – Standard syntax nDBD? – Read deadband and deadband timeout values 0DBDx1,x2 – All axes set deadband and deadband timeout values Error [#]: DBD? – Read operation with missing axis number [27] nDBD – Missing deadband and deadband timeout parameter values [28]
Parameter Description:	n[int] – Axis number x1[int] – Deadband x2[float] – Deadband timeout ? – Read deadband and deadband timeout values
Parameter Range:	n – 0 to 99 x1 – Encoder dependent, 0 for continuous, Encoder Counts x2 – Encoder dependent, 0 for infinite, Seconds (default 0)
Related Commands:	ENC, EPL
Example:	`1DBD10,1` | Axis 1, Set deadband to 10 encoder counts & deadband timeout to 1 second – `4DBD5,0` | Axis 4, Set deadband to 5 encoder counts & deadband timeout to infinite

DEC Deceleration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the desired deceleration for the specified axis, distinct from the acceleration [ACC]. The deceleration value must be less than the maximum acceleration value [AMX] for the command to be accepted.
Returns:	A read operation returns the deceleration value in mm/s^2 for the specified axis.
Syntax:	nDECx – Standard syntax nDEC? – Read deceleration value 0DECn – All axes set deceleration value Error [#]: DEC? – Read operation with missing axis number [27] nDEC – Missing deceleration parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Deceleration ? – Read deceleration value
Parameter Range:	n – 0 to 99 x – 000.001 to AMX (500.000 mm/s^2) [degrees/s^2]
Related Commands:	ACC, AMX, VEL
Example:	`2DEC1.25` |Axis 2, Set deceleration to 1.25 mm/s^2 [degrees/s^2] – `7DEC?` |Axis 7, Read deceleration value

DEF

Restore Factory Defaults

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓					

Command Description:	This command restores the factory default parameters.
Returns:	A read operation is not available with this command.
Syntax:	nDEF – Standard syntax Error [#]: DEF – Missing axis number [30]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	SAV
Example:	`1DEF` |Axis 1, set all default parameters

EAD

Set Analog or Digital Encoder

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to specify whether the encoder signal for a specified axis is analog or digital.
Returns:	A read operation returns the following encoder mode values for the specified axis: 0 – Digital 1 – Analog
Syntax:	nEADx – Standard syntax nEAD? – Read encoder mode value 0EADx – All axes set encoder value Error [#]: xEAD – Missing encoder mode parameter [28] EAD? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number x[int] – Encoder mode ? – Read encoder mode value
Parameter Range:	n – 0 to 99 x – 0 for digital, 1 for analog
Related Commands:	ENC
Example:	`9EAD0` |Axis 9, Set encoder to digital input

ENC Set Encoder Resolution

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to set the desired encoder resolution for the specified axis. When a digital encoder is connected, encoder resolution is determined by the encoder itself and the ENC setting will need to reflect this value. Analog encoder resolution is set by the controller.
Returns:	A read operation returns the encoder resolution value for the specified axis.
Syntax:	nENCx – Standard syntax nENC? – Read encoder resolution value 0ENCx – All axes execute encoder resolution value Error [#]: ENC? – Read operation with missing axis number [27] nENC – Missing encoder resolution parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Encoder resolution ? – Read encoder resolution value
Parameter Range:	n – 0 to 99 x – 0.001 to 999.999 µm/count (milli-degrees/count)
Related Commands:	EAD
Example:	`2ENC10` Axis 2, Set encoder resolution to 10 microns/count (10 milli- degrees/count)

END

End Program Recording

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓			

Command Description:	This command is used to exit out of program recording mode, which is initiated by the PGM command. The END command must be placed separately on the last line of the program sequence. The resulting program is saved upon exit for later use.
Returns:	A read operation is not available with this command.
Syntax:	nEND – Standard syntax Error [#]: END – Missing axis number [30]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	REC, EXC, PGM
Example:	*1PGM* |Axis 1, Begin program recording *1VEL1;1ACC.5* |Axis 1, Set velocity value to 1 mm/s; Axis 1, Set acceleration value to 0.5 mm/s^2 [degrees/s^2] 1END |Axis 1, End program recording

EPL

Encoder Polarity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to switch the encoder signal polarity for the specified axis, which determines the physical direction of travel that the stage reads as positive (by default, moving away from where the wires enter the base of the stage is positive). NOTE: EPL, MPL and LDR must all be changed together to maintain proper functionality, changing one of these values without changing the rest will result in improper stage behavior.
Returns:	A read operation returns the following encoder polarity values for the specified axis: 0 – Normal operation 1 – Reverse operation
Syntax:	nEPLx – Standard syntax nEPL? – Read encoder polarity value 0EPLx – All axes execute encoder polarity value Error [#]: EPL? – Read operation with missing axis number [27] nEPL – Missing encoder polarity parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Encoder polarity ? – Read encoder polarity value
Parameter Range:	n – 0 to 99 x – 0 for normal operation, 1 for reverse operation
Related Commands:	DBD
Example:	`13EPL0` |Axis 13, Set encoder polarity to normal operation – `6EPL1` |Axis 6, Set encoder polarity to reverse operation

ERA Erase Program

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓					

Command Description:	This command is used to erase a specified program from an axis. Before recording a program, use the LST command to see what program numbers are available for that axis. There are 16 program numbers available allowing up to 16 programs to be stored. An existing program cannot be overwritten and must be erased first. Therefore, use this command to erase the specified program and make space for a new one.
Returns:	A read operation is not available with this command.
Syntax:	nERAx – Standard syntax Error [#]: ERAx – Missing axis number [30] nERA– Missing program number parameter [28]
Parameter Description:	n[int] – Axis number x[int] – Program number to be erased
Parameter Range:	n – 1 to 99 x – 1 to 16
Related Commands:	LST
Example:	`5ERA4` |Axis 8, Erase program 4

ERR

Read and Clear Errors

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description:	This command is used to read and clear any pending error messages.
Returns:	A read operation returns a list of error messages for the specified axis in the following format. “AAA” signifies the specific command name that the error corresponds to. Error Number – Description [AAA]
Syntax:	nERR? – Standard syntax Error [#]: ERR? – Read operation with missing axis number [123]
Parameter Description:	n[int] – Axis number ? – Read error messages
Parameter Range:	n – 1 to 99
Related Commands:	None
Example:	`3ERR?` | Axis 3, Read error messages

EST

Emergency Stop

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
✓		✓		✓		✓	

Command Description:	This command is used to stop a specific axis or all connected axes simultaneously in case of an emergency. The controller executes the largest possible deceleration.
Returns:	A read operation is not available with this command.
Syntax:	nEST – Standard syntax 0EST – All axes execute emergency stop
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	STP
Example:	8EST |Axis 8, Emergency stop – 0EST |All axes, Emergency stop

EXC Execute Program

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to execute a specified program for one or multiple axes. If executing a program globally, all connected axes should have individual programs stored under the specified program number prior to execution.
Returns:	A read operation is not available with this command.
Syntax:	nEXCx – Standard syntax 0EXCx – All axes execute program Error [#]: nEXC – Missing program number parameter [123]
Parameter Description:	n[int] – Axis number x[float] – Program number to be executed
Parameter Range:	n – 0 to 99 x – 1 to 64
Related Commands:	PGM
Example:	`4EXC5` |Axis 4, Execute program 5 – `0EXC2` |All axes, Execute program 2

FBK

Set Open or Closed Loop Mode

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓				

Command Description:	This command is used to select the feedback mode of the controller. See section 4.2 for more details
Returns:	A read operation returns the following loop mode values for the specified axis: 1. – Open Loop [default] 2. – Clean Open Loop 3. – Clean Open Loop Movement, Closed Loop deceleration 4. – Closed Loop
Syntax:	nFBKx– Standard syntax nFBK? – Read encoder mode value Error [#]: FBKx – Missing axis number [30] FBK? – Read operation with missing axis number [27] nFBK – Missing closed/open loop parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Open/closed loop mode ? – Read encoder mode value
Parameter Range:	n – 1 to 99 x – 0 for open loop mode, 1 for clean sounding open loop mode, 2 for open loop with closed loop deceleration, 3 closed loop
Related Commands:	ENC, EAD, EPL, DBD
Example:	`2FBK3` |Axis 2, Set closed loop mode

HCG Home Configuration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to select the direction of motion when the Home [HOM] command is initialized.
Returns:	A read operation returns the current direction setting: 0 – Home starts in the direction of the negative limit 1 – Home starts in the direction of the positive limit
Syntax:	nHCGx – Standard syntax 0HCGx – All axes set direction nHCG? – Read direction setting Error [#]: HCG? – Read operation with missing axis number [27] nHCG – Missing direction setting [28]
Parameter Description:	n[int] – Axis number x [int] – Set direction of motion.
Parameter Range:	n – 0 to 99 x – 0 for setting motion in the direction of the negative limit 1 for setting motion in the direction of the positive limit
Related Commands:	HOM
Example:	`3HCG0` | Axis 3, Set initial direction of Home command towards the negative limit – `0HCG1` | All Axes, Set initial direction of Home command towards the positive limit

HOM Home

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to find the home position for a specified axis. An error will occur if there is no encoder signal at the time of execution. Home is configured using the HCG command. This command will jog the stage until it reaches the limit configured with the HCG command. It will then acquire the home position by looking for the index. This command blocks all communication over the serial port during motion.
Returns:	A read parameter returns the following calibration values for the specified axis: 0 – Not calibrated to home position 1 – Calibrated to home position
Syntax:	nHOM – Standard syntax nHOM? – Returns 1 if homed since last startup otherwise returns 0 0HOM – All axes execute home position Error [#]: HOM? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	HCG
Example:	`1HOM` |Axis 1, Move to home position

IOD

Set IO Definition

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓					

Command Description:	This command is used to select Input or Output for one of the IO pins on the 8-Pin Din connector.
Returns:	A read operation is not available with this command.
Syntax:	nIODx1,x2 – Standard syntax nIOD? – Read encoder mode value Error [#]: IODx1,x2 – Missing axis number [30] IOD? – Read operation with missing axis number [27] nIOD – Missing closed/open loop parameter [28]
Parameter Description:	n[int] – Axis number x1[int] – IO Pin x2[int] – Input/ Output ? – Read encoder mode value
Parameter Range:	n – 1 to 99 x1 – 1 – IO1 (output only) 2 – IO2 3 – IO3 4 – IO4 x2 – 0 – Output 1 - Input
Related Commands:	IOF
Example:	`2IOD2,1` |Axis 2, Set IO2 to an Input

IOF

Set IO Function

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓					

Command Description:	This command is used to select the function of an IO pin.
Returns:	A read operation is not available with this command.
Syntax:	nIOFx1,x2 – Standard syntax nIOF? – Read encoder mode value Error [#]: IOFx1,x2 – Missing axis number [30] IOF? – Read operation with missing axis number [27] nIOF – Missing closed/open loop parameter [28]
Parameter Description:	n [int] – Axis number x1[int] – IO Pin x2 [int] – IO Function ? – Read encoder mode value
Parameter Range:	n – 1 to 99 x1 – 1 – IO1 2 – IO2 3 – IO3 4 – IO4 x2 – 0 – No function 1 – Trace data acquisition on trigger 2 – Output pulse trigger when in position 3 – Output level when in position
Related Commands:	IOD
Example:	`2IOF2,1` |Axis 2, Set IO2 to data logging trigger

JAC — Jog Acceleration and Deceleration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to set the desired value for the jog acceleration and deceleration for a specified axis. The controller will not allow for JAC values that are greater than AMX.
Returns:	A read operation returns the jog acceleration and deceleration value in mm/s^2 for the specified axis.
Syntax:	nJACx – Standard syntax 0JACx – All axes execute acceleration value nJAC? – Read acceleration value Error [#]: JAC? – Read operation with missing axis number [27] nJAC – Missing acceleration parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Acceleration ? – Read acceleration value
Parameter Range:	n – 0 to 99 x – .001 to 500.000 mm/s^2 [degrees/s^2]
Related Commands:	ACC, DEC, AMX
Example:	`4JAC0.1` | Axis 4, Set jog acceleration & deceleration to 0.1 mm/s^2 [degrees/s^2]

JOG Jog Mode

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
✓		✓					

Command Description:	This command is used to jog a specific axis, or move continuously in a direction with no target position. The jog velocity is a percentage of the maximum velocity and may be changed on-the-fly by sending another JOG command during motion.
Returns:	A read operation is not available with this command.
Syntax:	nJOGx – Standard syntax Error [#]: JOGx – Missing axis number [30] nJOG – Missing velocity parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Velocity
Parameter Range:	n – 1 to 99 x – 0 to ±100.000 % (of maximum velocity)
Related Commands:	JAC
Example:	4JOG10 |Axis 4, Jog at 10% maximum velocity 2JOG-50 |Axis 2, Jog in the negative direction at 50% maximum velocity

LCG

Limit Configuration

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command selects how the stage will detect it's end limits, using a limit switch or using the encoder to detect a hard stop.
Returns:	A read operation returns the selected limit type.
Syntax:	nLCGx – Standard syntax Error(s): LCGx – Missing axis number [30] nLCG – Missing program number parameter [28]
Parameter Description:	n[int] – Axis number x[int] – 0 – ignore [default] 1– active
Parameter Range:	n – 1 to 99 x – 0 – ignore [default] 1 – Home and MLN/MLP use Soft Limits 2 – Limits Switches Enabled 3 – Home and MLN.MLP use Soft Limits and Limit Switches enabled
Related Commands:	LPL
Example:	`1LCG1` |Axis 1, set limit switches active

LDR

Positive/ Negative Limit Location

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	Determines orientation of Positive limit, and negative limit. NOTE: EPL, MPL and LDR must all be changed together to maintain proper functionality, changing one of these values without changing the rest will result in improper stage behavior.
Returns:	A read operation returns the following limit direction values for the specified axis: 0 – Normal orientation 1 – Reverse orientation
Syntax:	nLDRx – Standard syntax nLDR? – Read velocity value 0LDRx – Missing axis number, all axes set limit direction Error [#]: LDR? – Read operation with missing axis number [27] nLDR – Missing limit parameter [28]
Parameter Description:	n[int] – Axis number x[int] – limit direction value ? – Read limit direction value
Parameter Range:	n – 0 to 99 x – 0 or 1
Related Commands:	
Example:	`1LDR1` |Axis 1, set to reverse orientation – `5LDR?` |Axis 5, Read limit switch orientation

LIM

Limit Status

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓		✓		✓

Command Description:	Returns the status of both limit switches in the form LSP, LSN. This is useful for limit switch configuration.
Returns:	A read operation returns current limit status for the specified axis.
Syntax:	nLIM? – Standard syntax Error [#]: LIM? – Read operation with missing axis number [123]
Parameter Description:	n[int] – Axis number ? – Read limit switches
Parameter Range:	n – 1 to 99
Related Commands:	None
Example:	`6LIM?` | Axis 6, read current limit status

LST

Program List

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
			✓				

Command Description:	This command is used to display the individual commands entered by the user to create the specified program. NOTE: Commands are returned sequentially and individually, which means in the Micronix GUI they will be listed from bottom (first returned) to top (last returned).
Returns:	A read operation returns the program table for the specified axis.
Syntax:	nLST? – Standard syntax Error [#]: 1LST? – Read Not Available For This Command [38]
Parameter Description:	n[int] – Axis number x[int] – Program# to be read
Parameter Range:	n – 1 to 99 x – 1 to 16
Related Commands:	None
Example:	`6LST1` | Axis 6, return program 1 list of commands

LPL

Limit Switch Polarity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓				

Command Description:	This command sets whether the limit switch inputs are active high[1] or low[0]
Returns:	A read operation returns the limit polarity value.
Syntax:	nLPLx – Standard syntax Error(s): LPLx – Missing axis number [30] nLPL – Missing program number parameter [28]
Parameter Description:	n[int] – Axis number x – 0 –Active Low – 1 – Active High
Parameter Range:	n – 1 to 99 x – 0 – active low [default] 1– active high
Related Commands:	LCG
Example:	`6LPL1` | Axis 5, limit switches set to active high

MLN Move to Negative Limit

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓		✓	

Command Description:	This command initiates a move to the negative limit position. Upon reaching the negative hard limit the controller will then move the stage back from the hard limit and stop. If hard stop detection using the encoder (LCG0) is active, an error will occur if there is no encoder signal at the time of execution.
Returns:	A read operation is not available with this command.
Syntax:	nMLN – Standard syntax 0MLN – All axes execute move to negative limit position Error [#]: MLN – Missing axis number [30]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	MLP, LCG
Example:	`8MLN` | Axis 8, Move to negative limit position – `0MLN` | All Axes, Move to negative limit position

MLP Move to Positive Limit

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓		✓	

Command Description:	This command initiates a move to the positive limit position. Upon reaching the positive hard limit the controller will then move the stage back from the hard limit and stop. If hard stop detection using the encoder (LCG0) is active, an error will occur if there is no encoder signal at the time of execution.
Returns:	A read operation is not available with this command.
Syntax:	nMLP – Standard syntax 0MLP – All axes execute move to positive limit position Error [#]: MLP – Missing axis number [30]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	MLN, LCG
Example:	`1MLP` |Axis 1, Move to positive limit position – `0MLP` |All Axes, Move to positive limit position

MOT Toggle Motor Off/On

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to turn the motor current flow "Off" or "On" for a specified axis. Turning the motor current off will cause the piezo to relax and the stage will shift slightly.
Returns:	A read operation returns the following motor current off/on values for the specified axis: 0 – Motor current is off 1 – Motor current is on
Syntax:	nMOTx – Standard syntax nMOT? – Read motor current off/on value 0MOTx – All axes set motor value Error [#]: MOT? – Read operation with missing axis number [27] xMOT – Missing motor off/on parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Motor current off/on ? – Read motor current off/on value
Parameter Range:	n – 0 to 99 x – 0 for motor current off 1 for motor current on
Related Commands:	None
Example:	`1MOT0` |Axis1, Set motor current to off

MPL Toggle Motor Polarity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command set the motor polarity for the specified axis. If the theoretical positive direction is away from the motor, changing this setting will make the theoretical positive direction towards the motor. NOTE: EPL, MPL and LDR must all be changed together to maintain proper functionality, changing one of these values without changing the rest will result in improper stage behavior.
Returns:	A read operation returns the current motor polarity setting for the specified axis.
Syntax:	nMPLx – Standard syntax nMPL? – Read motor current off/on value 0MPLx – All axes set motor value Error [#]: MPL? – Read operation with missing axis number [27] nMPL – Missing motor off/on parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Motor Polarity setting ? – Read motor current off/on value
Parameter Range:	n – 0 to 99 x – 0 Normal 1 Reverse
Related Commands:	MVR
Example:	`1MPL0` |Axis1, To normal Polarity

MSA Synchronous Move - Absolute

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to set up a synchronous move to an absolute position. This command is most useful when coordinating motion to an absolute position between 2 or more axes and requires a RUN command on a separate line to execute the synchronous move. An error will occur if the commanded position is outside of the soft limits.
Returns:	A read operation is not available with this command.
Syntax:	nMSAx – Standard syntax 0MSAx – All axes execute synchronous move Error [#]: nMSA – Missing absolute position parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Absolute position
Parameter Range:	n – 0 to 99 x – -999.999999 to 999.999999 mm (degrees)
Related Commands:	RUN, MSR
Example:	`1MSA10;2MSA10` |Axis 1, Move to absolute position: 10 mm[degrees]; Axis 2, Move to absolute position: 10 mm [degrees] `0RUN` |All axes, Execute synchronous move - `0MSA5` |All axes, Move to absolute position: 5 mm [degrees] `0RUN` |All axes, Execute synchronous move

MSR Synchronous Move – Relative

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to set up a synchronous move to a position relative to the current position. This command is most useful when coordinating relative positions between 2 or more axes and requires a RUN command on a separate line to execute the synchronous move. An error will occur if the commanded increment will cause the stage to travel outside of the set soft limits.
Returns:	A read operation is not available with this command.
Syntax:	nMSRx – Standard syntax 0MSAx – All axes execute synchronous move Error [#]: nMSA – Missing relative position parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Relative position
Parameter Range:	n – 0 to 99 x – ± 0.000001 to 999.999999 mm (degrees)
Related Commands:	RUN, MSA
Example:	`4MSR.1;5MSR.5 0.5` |Axis 4, Move 0.1 mm [degrees]; Axis 5, Move 0.5 mm [degrees] `0RUN` |Execute synchronous move `0MSR0.01` |All axes, Move 0.01 mm [degrees] `0RUN` |All axes, execute synchronous move

MVA Move Absolute

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓		✓	

Command Description:	This command is used to initiate an instantaneous move to an absolute position for a specified axis. An error will occur if the commanded position is outside of the soft limits.
Returns:	A read operation is not available with this command.
Syntax:	nMVAx – Standard syntax 0MVAx – All axes execute instantaneous move Error(s): nMVA – Missing absolute position parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Absolute position
Parameter Range:	n – 0 to 99 x – -999.999999 to +999.999999 mm (degrees)
Related Commands:	MVR, WFS
Example:	`4MVA14.5` |Axis 4, Move to absolute position: 14.5 mm [degrees] – `0MVA5.5` |All axes, Move to absolute position: 5.5 mm [degrees]

MVR Move Relative

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓		✓	

Command Description:	This command is used to initiate an instantaneous move to a relative position for a specified axis. An error will occur if the commanded increment will cause the stage to travel outside of the set soft limits.
Returns:	A read operation is not available with this command.
Syntax:	nMVRx – Standard syntax 0MVRx – All axes execute command. Error(s): nMVR – Missing relative position parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Relative position
Parameter Range:	n – 0 to 99 x – ± 0.000001 to ± 999.999999 mm [degrees]
Related Commands:	MVR, WFS
Example:	`6MVR10` |Axis 6, Move 10 mm [degrees] – `0MVR.89` |All axes, Move 0.89 mm [degrees]

PGL Loop Program

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓			✓	

Command Description:	This command is used to change the number of times a program will execute. If the program loop setting is 0, any program that is executed will run in a continuous loop. It can be combined with the PGS command to run a program continuously on startup. To disable program looping, set PGL to 1. A looping program can be stopped at any time by sending the STP or EST commands. This version of the command available in firmware version 1.4.53 and up. Prior versions have an on/off PGL setting 1/0.
Returns:	A read operation returns the program loop setting for the specified axis.
Syntax:	nPGLx – Standard syntax Error(s): PGLx – Missing axis number [30] nPGL – Missing program number parameter [28]
Parameter Description:	n[int] – Axis number x[int] – loop flag parameter
Parameter Range:	n – 1 to 99 x – 0 – Loop indefinitely 1 – Don't Loop 2 to 999999 – number of times an executed command will repeated
Related Commands:	PGS, STP
Example:	`1PGL0` |Axis 1, Run program 1 continuously `1PGL5` |Axis 1, Run program 5 times

PGM Begin Program Recording

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓				

Command Description:	This command is used to enter program recording mode for a specified axis. The program being recorded must use a unique program number or else the program will be ignored. Us the PGM? command to check program number availability and use the ERA command to erase any previously recorded programs. Each program has a size limit of 4Kb.
Returns:	A read operation in not available for this command
Syntax:	nPGMx – Standard syntax nPGM? – Read a binary representation of written program numbers If programs 1 and 2 are written it will return 3 If programs 1 and 4 are written it will return 9 If only program 1 is written it will return 1 If only program 3 is written it will return 4 Error(s): PGMx – Missing axis number [30] nPGM – Missing program number parameter [28]
Parameter Description:	n[int] – Axis number x[int] – Program number to be recorded
Parameter Range:	n – 1 to 99 x – 1 to 16
Related Commands:	END, EXC, LST, ERA
Example:	`1PGM3` |Axis 1, Begin recording program. Save program as program 3

PGS Run Program At Start-Up

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓	✓			✓	

Command Description:
This command is used to set a program to run immediately on start-up. Only one program per axis can run on start up.

Returns:
A read operation returns a value for the specified axis in the format below:
0 – No program set to run
1-16 – Program set to run on start-up

Syntax:
nPGSx – Standard syntax
0PGSx – Missing axis number, all axes set program to run on start-up
nPGS? – Read program(s) set to run on start-up

Error [#]:
PGS? – Read operation with missing axis number [27]
nPGS – Missing program set to run on start-up parameter [28]

Parameter Description:
n[int] – Axis number
x[float] – Program set to run on start-up
? – Return number of program set to run on startup.

Parameter Range:
n – 0 to 99
x – 0 - No program
1 to 16- Specific program set to run on start-up

Related Commands:
LST, PGM

Example:

```
6PGS5          | Axis 6, set program 5 to run on start-up
–
0PGS16         | All axes, set program 16 to run on start-up
–
3PGS?          | Axis 3, Read program to run on start-up
–
3PGS0          | Axis 3, Set no program to run on start-up
```

PID Set Feedback Constants

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓				

Command Description:	This command is used to set the encoder feedback gain constants for a specified controller.
Returns:	A read operation returns the encoder feedback constant values for the specified axis.
Syntax:	nPIDx1,x2,x3 – Standard syntax nPID? – Read encoder feedback constant values Error(s): PIDx1,x2,x3 – Missing axis number [30] PID? – Read operation with missing axis number [27] nPID – Missing encoder feedback constant parameters [28]
Parameter Description:	n[int] – Axis number x1[float] – K_p (proportional constant) x2[float] – K_i (integral constant, stepper only) x3 [float] – K_d (derivative constant, stepper only) ? – Read encoder feedback constants and values
Parameter Range:	n – 1 to 99 x1 – 0.000 to 2.000 x2 – 0.000 to 2.000 x3 – 0.000 to 2.000
Related Commands:	FBK, ENC, POS
Example:	`5PID.02,.04,.05` | Axis 5, Set encoder feedback constants to 0.02, 0.04 and 0.05, respectively – `2PID.03,,` | Axis 2, Set encoder feedback constant K_p to 0.03, other constants remain unchanged – `4PID,,.07` | Axis 4, Set encoder feedback constant K_d to 0.07, other constants remain unchanged

POS Position

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description:	This command is used to read the position information from the specified axis controller
Returns:	A read operation returns the position values in mm for the specified axis in the following format: [Theoretical position in mm, Encoder position in mm] [Theoretical position in degrees, Encoder position in degrees]
Syntax:	nPOS? – Standard syntax Error(s): POS? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number ? – Read position values
Parameter Range:	n – 1 to 99
Related Commands:	MVR
Example:	`4POS?` | Axis 4, Read position values

REZ Set Resolution

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓				

Command Description:	This command is used to set the DAC (digital to analog converter) steps per micron resolution for the specified axis.
Returns:	A read operation returns the resolution value in steps per micron for the specified axis.
Syntax:	nREZx – Standard syntax nREZ? – Read steps per micron resolution value Error(s): REZ? – Read operation with missing axis number [27] REZx – Missing axis number [30] nREZ – Missing steps per micron resolution parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Steps per micron resolution (steps/mili-degrees) (default is 8,000) ? – Read steps per micron resolution value (steps/milli-degrees)
Parameter Range:	n – 1 to 99 x – 0 to 999999 DAC steps per micron (steps/milli-degrees)
Related Commands:	None
Example:	`9REZ25` | Axis 9, Set resolution to 25 steps/micron [steps/milli-degrees] - `3REZ?` | Axis 3, Read steps/micron [steps/degrees] resolution value

RST

Perform Soft Reset

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to perform a soft reset of the specified axis. Unsaved settings will be lost. In a multi axis stack, if only one axis is restarted using this command and ANR is set to 0, that axis will address as "1", even if another axis is already addressed as "1" causing an axis to become unresponsive. To correct this, restart all axes.
Returns:	A read operation cannot be used with this command.
Syntax:	nRST – Standard syntax 0RST – All axes execute soft reset
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	None
Example:	`8RST` | Axis 8, execute soft reset

RUN

Start Synchronous Move

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to start a global synchronous move previously set up by using the MSA or MSR commands.
Returns:	A read operation cannot be used with this command.
Syntax:	RUN – Standard syntax
Parameter Description:	-
Parameter Range:	-
Related Commands:	MSA, MSR
Example:	`3MSR5;4MSR5` | Axis 3, setup 5 mm[degrees] move; Axis 4, setup 5 mm [degrees] move `0RUN` | All axes, Execute synchronous moves

SAV

Save Axis Settings

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓				✓	

Command Description:	This command is used to save all settings for the specified axis. This allows an axis to be configured on power up.
Returns:	A read operation cannot be used with this command.
Syntax:	nSAV – Standard syntax 0SAV – All axes save settings
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	None
Example:	16SAV | Axis 16, save settings

STA

Status Byte

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description: This command is used to check the status register for a specified axis.

Returns: A read operation will return an integer from 0 to 255 describing the status of the axis. The byte must be decoded in binary to determine the value of each bit.

Bit	7	6	5	4	3	2	1	0
Name	ERR	ACC	CNST	DEC	STP	PGM	PLS	NLS

Note: Bits 2, 1 and 0 are unused

Bit 7: 1 – One or more errors have occurred. Use ERR? Or CER to clear.
0 – No Errors have occurred.

Bit 6: 1 – Currently in Acceleration phase of motion.
0 – Not in Acceleration phase of motion.

Bit 5: 1 – Currently in Constant Velocity phase of motion.
0 – Not in Constant Velocity phase of motion.

Bit 4: 1 – Currently in Deceleration phase of motion.
0 – Not in Deceleration phase of motion.

Bit 3: 1 – Stage has stopped. (In Closed Loop Stage, is in the deadband)
0 – Stage is moving. (In Closed Loop, Stage is out of deadband)

Bit 2: 1 – A Program is currently running
0 – No program is running

Bit 1: 1 – Positive Switch is Activated
0 – Positive Switch is not Activated

Bit 0: 1 – Negative Switch is Activated
0 – Negative Switch is not Activated

Syntax: nSTA? – Standard syntax

Error(s):
STA? – Read operation with missing axis number [27]
nSTA – Missing read operation parameter [28]

Parameter Description: n[int] – Axis number
? – Read status register

Parameter Range: n – 1 to 99

Related Commands: None

Example: `6STA?` | Axis 6, Read status register

STP

Stop Motion

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
✓		✓				✓	

Command Description:	This command is used to stop motion for a specified axis.
Returns:	A read operation cannot be used with this command.
Syntax:	nSTP – Standard syntax 0STP– All axes execute stop
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	EST, DEC
Example:	`8STP` | Axis 8, execute stop

SVP

Save Startup Position

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the startup position. Default is 0. This setting does not require the SAV command to save it into memory. It also does not change with a DEF command. To reset the Startup position to the default, send nSVP0.
Returns:	A read operation returns the Startup position setting for the specified axis.
Syntax:	nSVP – Standard syntax 0SVP – Missing axis number, command accepted as standard syntax
Parameter Description:	n[int] – Axis number x[float] – Startup Position mm ? – Read Startup Position
Parameter Range:	n – 0 to 99 x – TLN (-999.999999mm) to TLP(999.999999mm)
Related Commands:	None
Example:	`4SVP` | Set current position to Startup position `2SVP2.3` | Set startup position to 2.3mm

SYN

Sync

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
				✓		✓	

Command Description:	This command is used in a program together with the wait for sync [WSY] command in order to synchronize motion between multiple axes.
Returns:	A read operation cannot be used with this command.
Syntax:	nSYN – Standard syntax 0SYN – Missing axis number, command accepted as standard syntax
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 0 to 99
Related Commands:	WSY
Example:	`4SYN` | Send sync to axis 4

TLN Negative Soft Limit Position

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the desired negative soft limit position, using absolute position, for the specified axis. The negative soft limit position value must be less than the positive soft limit position value [TLP] for the command to be accepted.
Returns:	A read operation returns the negative soft limit position value.
Syntax:	nTLNx – Standard syntax nTLN? – Read negative soft limit position value 0TLNx – All axes set limit position value nTLN – Set current position to negative limit Error(s): TLN? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number x[float] – Negative soft limit position ? – Read negative soft limit position
Parameter Range:	n – 0 to 99 x – -999.999999 to TLP mm [degrees]
Related Commands:	TLP
Example:	`2TLN0.005` | Axis 2, Set negative soft limit position to 0.005 mm [degrees] – `6TLN?` | Axis 6, Read negative soft limit position value – `1TLN` | Axis 1 Set the negative limit to the current position

TLP

Positive Soft limit Position

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the desired positive soft limit position, using absolute position, for the specified axis. The positive soft limit position value must be greater than the negative soft limit position value [TLN] for the command to be accepted.
Returns:	A read operation returns the positive soft limit position value for the specified axis.
Syntax:	nTLPx – Standard syntax nTLP? – Read positive soft limit position value 0TLPx – All axes set limit position value nTLN – Set current position to negative limit Error(s): TLP? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number x[float] – Positive soft limit position ? – Read positive soft limit position
Parameter Range:	n – 0 to 99 x – TLN to + 999.999999 mm [degrees]
Related Commands:	TLN
Example:	`4TLP10.005` | Axis 2, Set positive soft limit position to 10.005 mm [degrees] – `9TLP?` | Axis 9, Read positive soft limit position value – `1TLP` | Axis 1 Set the positive limit to the current position

TRA

Perform Trace

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓	✓	✓	✓		✓	

Command Description:	This command is used to execute a trace of the specified axis. In lieu of the trace beginning at value stored in x3, a TTL logic pulse to an IO pin [IOF] [IOD] can be used to trigger the trace function from an external source.
Returns:	A read operation returns the position samples taken for the specified axis.
Syntax:	nTRAx1,x2,x3 – Standard syntax nTRA? – Read position values 0TLPx1,x2,x3 – All axes execute trace Error(s): TRA? – Read operation with missing axis number [27] nTRA – Missing parameters [28]
Parameter Description:	n[int] – Axis number x1[int] – Number of samples taken (default is 1000) x2[int] – 10kHz /Sampling frequency (default is 1) x3[float] – Trace starting position (default is immediate) ? – Read number of position samples collected
Parameter Range:	n – 0 to 99 x1 – 1 to 9000 x2 – 1 to 1000 Servo clocks per cycle x3 – 000.000001 to 999.999999 mm [degrees]
Related Commands:	DAT, IOF, IOD
Example:	`5TRA5,10,1` | Axis 5, execute trace with 5 samples at a sampling frequency of 1kHz starting at a position of 1 mm [degrees] `3TRA2000,,` | Axis 3, execute trace with 2000 samples at a sampling frequency of 10kHz starting at the current position

VEL Velocity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
✓	✓	✓	✓	✓		✓	

Command Description:	This command is used to set the desired velocity for the specified axis. The velocity may be changed on-the-fly by sending another VEL command during motion. The velocity value should be lower than the maximum allowable velocity [VMX] for the command to be accepted.
Returns:	A read operation returns the velocity value in mm/s for the specified axis.
Syntax:	nVELx – Standard syntax nVEL? – Read velocity value 0VELx – Missing axis number, all axes set velocity Error [#]: VEL? – Read operation with missing axis number [27] nVEL – Missing velocity parameter [28]
Parameter Description:	n[int] – Axis number x[float] – Velocity value ? – Read velocity value
Parameter Range:	n – 0 to 99 x – 000.001 to VMX (999.999 mm/s) [degrees/s]
Related Commands:	VMX, REZ
Example:	`1VEL.25` |Axis 1, Set velocity to 0.25mm/s [degrees/s] – `5VEL?` |Axis 5, Read velocity value

VER Firmware Version

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description:	This command is used to check the firmware version for the specified axis.
Returns:	A read operation returns the firmware version for the specified axis.
Syntax:	nVER? – Standard syntax Error(s): VER? – Read operation with missing axis number [27] nVER – Missing read operation parameter [28]
Parameter Description:	n[int] – Axis number ? – Read firmware version
Parameter Range:	n – 1 to 99
Related Commands:	None
Example:	`11VER?` | Axis 11, Read firmware version

VMX Maximum Allowable Velocity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description:	This command is used to read the maximum allowable velocity for a specific axis. This value is calculated based on the steps per micron parameter in the REZ command.
Returns:	A read operation returns the maximum allowable velocity value in mm/s for the specified axis.
Syntax:	nVMX? – Read maximum allowable velocity value Error [#]: VMX? – Read operation with missing axis number [27] nVMX – Missing read operation parameter [123]
Parameter Description:	n[int] – Axis number ? – Read maximum allowable velocity value
Parameter Range:	n – 1 to 99
Related Commands:	REZ, VEL
Example:	4VMX? |Axis 4, Read maximum allowable velocity value

VRT Encoder Velocity

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
	✓		✓				

Command Description:	This command returns the actual velocity calculated from the encoder.
Returns:	A read operation returns the encoder velocity in mm/s.
Syntax:	nVRT? – Standard syntax Error [#]: VRT? – Read operation with missing axis number [27]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	POS
Example:	`5VRT?` |Axis 5, Read encoder velocity

WST Wait For Stop

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
				✓			

Command Description:	This command is used in a program to wait until motion is completed to begin executing the next command.
Returns:	A read operation cannot be used with this command.
Syntax:	nWST – Standard syntax WST – Missing axis number, command accepted as standard syntax
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	PGM
Example:	`7WST` | Axis 7, Wait for motion to stop before executing next command

WSY Wait For Sync

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
				✓		✓	

Command Description:	This command is used in a program together with the sync [SYN] command in order to synchronize motion between multiple axes.
Returns:	A read operation cannot be used with this command.
Syntax:	nWSY – Standard syntax WSY – Missing axis number, command accepted as standard syntax
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	SYN
Example:	`1WSY` | Axis 1, Wait until sync command is received before executing next command

WTM Wait For Time Period

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
				✓			

Command Description:	This command is used in a program to wait for a specified period of time before executing the next command.
Returns:	A read operation cannot be used with this command.
Syntax:	nWTMx – Standard syntax WSTx – Missing axis number, command accepted as standard syntax
Parameter Description:	n[int] – Axis number x[int] – Time
Parameter Range:	n – 1 to 99 x – 0 to 999999 milliseconds
Related Commands:	PGM
Example:	`2WTM42` | Axis 2, Wait for 42 milliseconds before executing next command

ZRO Zero Position

During Motion		Real-time		Program		Global	
Set	Read	Set	Read	Set	Read	Set	Read
		✓		✓		✓	

Command Description:	This command is used to set the absolute zero position for the specified axis.
Returns:	A read operation cannot be used with this command.
Syntax:	nZRO – Standard syntax Error [#]: ZRO – Missing axis number [123]
Parameter Description:	n[int] – Axis number
Parameter Range:	n – 1 to 99
Related Commands:	None
Example:	`1ZRO` | Axis 1, set current position as absolute zero

Error Messages

Error Number	Name	Description
10	Receive Buffer Overrun	The Receive Buffer has reached or exceeded maximum capacity.
11	Motor Disabled	The command that triggered this error was trying to move the servo while it was disabled.
12	No Encoder Detected	The command that triggered this error was trying to access encoder data when no encoder was attached.
13	Index Not Found	The controller moved across the full range of motion and did not find an index.
14	Home Requires Encoder	The HOM command requires an encoder signal.
15	Move Limit Requires Encoder	The MLN and MLP commands require an encoder signal.
20	Command is Read Only	The command that triggered this error only supports read operations. The command must be followed by a question mark to be accepted. Ex: XXX?
21	One Read Operation Per Line	Multiple read operations on the same command line. Only one read operation is allowed per line, even if addressed to separate axes.
22	Too Many Commands On Line	The maximum number of allowed commands per command line has been exceeded. No more than 8 commands are allowed on a single command line.
23	Line Character Limit Exceeded	The maximum number of characters per command line has been exceeded. Each line has an 80 character limit.
24	Missing Axis Number	The controller could not find an axis number or the beginning of an instruction. Check the beginning of the command for erroneous characters.
25	Malformed Command	The controller could not find a 3-letter instruction in the input. Check to ensure that each instruction in the line has exactly 3 letters referring to a command.

26	Invalid Command	The 3-letter instruction entered is not a valid command. Ensure that the 3-letter instruction is a recognizable command.
27	Global Read Operation Request	A read request for a command was entered without an axis number. A read request cannot be used in a global context.
28	Invalid Parameter Type	1. The parameter entered does not correspond to the type of number that the instruction requires. For example, the command may expect an integer value, therefore sending a floating point value will trigger this error. 2. The allowable precision for a parameter has been exceeded. For example, velocity can be specified with a precision of 0.001 mm/sec. If a more precise velocity value of 0.0001 mm/sec is entered, this error will be triggered. Refer to the command pages for the type of parameter that each command expects.
29	Invalid Character in Parameter	There is an alpha character in a parameter that should be a numeric character.
30	Command Cannot Be Used In Global Context	The command entered must be addressed to a specific axis number. Not all commands can be used in a global context. Check the specific command page or the table of commands for more info.
31	Parameter Out Of Bounds	The parameter is out of bounds. The current state of the controller will not allow this parameter to be used. Check the command page for more information.
32	Incorrect Jog Velocity Request	The jog velocity can only be changed during motion by using a new JOG command. If the VEL command is used to change the velocity, this error will be triggered. The VEL command can only be used to change velocity during motion initiated by the move commands [MVR, MVA, MSR, MSA].
33	Not In Jog Mode	Sending a JOG command during motion initiated by a move command will trigger this error. To initiate Jog Mode, the controller should be at stand-still. To change velocity during a move, use the VEL command.
34	Trace Already In Progress	This error is triggered when a new trace command is received after a trace is already in progress. Trace settings may be modified only if the trace hasn't started recording data. Otherwise, wait until the trace has finished before modifying the trace settings.
35	Trace Did Not Complete	An error occurred while recording trace data. Try the operation again.

36	Command Cannot Be Executed During Motion	Only certain commands can be executed when motion is in progress. Check the command pages for information on individual commands.
37	Move Outside Soft Limits	If a requested move will take the controller outside of the preset travel limits, then the command will not be executed.
38	Read Not Available For This Command	This error is triggered by a read request from a command that does not support a read operation.
39	Program Number Out of Range	The number entered for the program number was either less than 1 or greater than 16.
40	Program Size Limit Exceeded	The program has exceeded the character limit of 4 Kb.
41	Program failed to Record	Error in recording program. Erase program and try operation again.
42	End Command Must Be on its Own Line	The End command used to end a program must be on a separate line from all other instructions.
43	Failed to Read Program	An error occurred while trying to read a program. Try the Operation again.
44	Command Only Valid Within Program	The command that triggered this error is only suitable for use within a program.
45	Program Already Exists	A program already exists for the indicated program parameter. The program must be erased with the ERA command before being written again.
46	Program Doesn't Exist	The indicated program does not exist. This error can occur when you try to execute a program number that has not had a program assigned to it.
47	Read Operations Not Allowed Inside Program	Read Operations are not permitted in programs.
48	Command Not Allowed While Program in Progress	The command that triggered this error was given while a program was executing.
50	Limit Activated	Motion in the direction of the activated limit switch is disallowed if limit switches are enabled.

51	End of Travel Limit	The requested move will take the controller outside of its valid travel range, therefore the move is disallowed.
52	Home In Progress	A Home or a Move To Limit Procedure is in progress. Motion commands are disallowed during this time. A STP or EST command can be used to terminate the Home, and then a motion command can be sent.
53	IO Function Already In Use	The I/O Function in question is already assigned to another I/O pin. Some Functions can only be assigned to one pin at a time. See the documentation for each function for more details.
55	Limits Are Not Configured Properly	Both Limit Switches are active, so motion is disallowed in both directions. Most likely the LPL (Limit Polarity command) setting should be switched.
80	Command Not Available in this Version	The command entered is not supported in this version of the firmware.
81	Analog Encoder Not Available In this Version	The current version of firmware installed does not support Analog Encoders.

8. Pin Outs

8.1.1 Power Pin-Out

Pin	Description
1	+24V
2	GND

8.1.2 Motor/Encoder Pin-Out

Pin	Description
1	Motor Phase 1
2	Motor Phase 2
3	N/C
4	N/C
5	Motor GND
6	Limit Switch +
7	Limit Switch -
8	A+
9	B+
10	Index+
11	+5V
12	Signal GND
13	A-
14	B-
15	Index-

8.1.3 RS-485 Input

Pin	Description
1	+24VDC
2	24V GND
3	RS485 A
4	RS485 B
5	ID In
6	RS485 GND

8.1.4 RS-485 Output

Pin	Description
1	+24VDC
2	24V GND
3	RS485 A
4	RS485 B
5	ID Out
6	RS485 GND