Overview

This command reference is a supplement to the Galil User Manual.

What is DMC code?

DMC (Digital Motion Controller) code is the programming language used for all Galil hardware. It is a high-level, interpreted language which is simple to learn and use, yet is surprisingly powerful. Actively developed and refined since 1983, DMC code provides functionality that is particularly well suited to motion control and PLC applications.

DMC code can be used manually from a terminal, programmatically from an external device or customer application, and can be fully embedded into a Galil controller's memory to leverage powerful "embedded-only" features and for stand-alone applications.

DMC code of course provides symbolic variables, arrays, and math support. The elegance of DMC coding is particularly evident when writing code for embedded applications. When running on the controller, the DMC language supports if-then-else conditionals, code branching, subroutines, a call stack (with parameter passing and local variable scope on some models), multi-threading, and automatic subroutines (i.e. event-driven programming).

DMC code runs on the Galil Real Time Operating System (RTOS) which is specifically designed for Galil hardware and for motion control.

The learning curve on DMC code is quite fast, usually less than one hour to basic motion, so called, "spinning motors". It is the fastest to learn, the easiest, the simplest, and one of the most flexible and powerful languages in the industry. Don't forget, Galil's Applications Support Team is available to assist you; from the most basic question to the most complicated needs.

Top Down: How is a Galil system normally structured?

However you want, there are three general approaches to Galil programming.
Embedded/Galil-centric Programming

In this approach, a host computer is only used during development to program the controller. The program is then downloaded and burned to non-volatile flash using the #AUTO automatic subroutine to indicate where code execution should start on boot-up. The Galil controller will now run "standalone," not requiring any intervention from the host. Note that for serial and Ethernet controllers, the standalone controller can still actively work with other controllers in a network, without host intervention.

PCI and other PC bus-based controllers support this approach, although still require the PCI bus for power.

GalilTools (GT) is provided as a programming environment for developing embedded applications.

Host-centric Programming

If a GUI or other frontend is desired to be run on a host, all development can be conducted on the host PC, with the architecture, operating system, and programming language of choice. In this approach, the controller receives every command from the host PC, nothing is running embedded. Many Galil firmware features are available to facilitate host-centric programming including mode-of-motion buffers, data logging buffers, asynchronous data record updates from the controller, PCI and UDP interrupt events, and more.

GalilTools (GT) is bundled with a programming library (API) for programming applications from a host. Many popular operating systems and languages are supported.

Hybrid Programming

Perhaps the most versatile approach to Galil system design, the Hybrid approach allows for both embedded code and host-side code to work in tandem. Typically an application is developed for embedded use in DMC code. The code incorporates all of the detail of an application but relies on the host to provide it data. Through variables, arrays, and other commands, the host is able to define the bounds of the embedded algorithms. The host plays a supervisory role, interrogating status, receiving asynchronous updates from the controller, starting and stopping threads, and so on. The controller takes care of the motion and I/O responsibilities based on its embedded program, and the controller's real time operating system (RTOS) ensures that the application won't suffer from indeterminacy which is common on general purpose PC operating systems (e.g. Microsoft Windows). Because the controller takes care of the details, the host is able to use its resources on other tasks, such as complicated number crunching or user interface.

It is noteworthy that Galil Standalone controllers (e.g. DMC-40x0, DMC-41x3, DMC-21x3, RIO-47xxx) can leverage the Ethernet to provide powerful modularity. Using any of the above three system approaches, multiple controllers can work in concert to achieve an application's requirements. Networked controllers also provide easy scalability. Need some more digital or analog I/O? Add an RIO. Need another axis of control? Add another DMC to the network. Both the Galil firmware and the Galil software libraries provide features which allow easy use of multiple controllers on an Ethernet network. RS232/422/485 networks are also possible.

Bottom Up: Anatomy of DMC code

Classification

DMC language can be broken up into the following general classifications

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Examples</th>
<th>Example Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit Notation Only</td>
<td>The command receives its arguments only by assignment with the &quot;=&quot; operator.</td>
<td>IHC=192,168,1,101&lt;1070&gt;2</td>
<td>Create a TCP connection on Ethernet handle C to a device at IP address 192.168.1.101 on port 1070</td>
</tr>
<tr>
<td>Implicit Notation Only</td>
<td>The command receives its arguments only by an implicit argument order.</td>
<td>IA 192,168,1,102</td>
<td>Set the local IP address to 192.168.1.102</td>
</tr>
<tr>
<td>Explicit &amp; Implicit</td>
<td>The command receives its arguments either by an explicit assignment using the &quot;=&quot; symbol, or an implicit argument order.</td>
<td>KPA=64;KPB=32;KPH=128 KP 64,32,,128</td>
<td>Assign the proportional constant (KP) of the PID filter to three different axes.</td>
</tr>
<tr>
<td>Accepts Axis Mask</td>
<td>The command receives its arguments as a string of valid axis names.</td>
<td>ST ADF</td>
<td>Stop (ST) axes A, D and F. Leave other axes running.</td>
</tr>
<tr>
<td>Two Letter Only</td>
<td>The command accepts no arguments</td>
<td>BN</td>
<td>Burn (BN) controller parameters to flash memory</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------</td>
<td>----</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Operator or Comparator</td>
<td>Operators take two arguments and produce a result. Comparators take two values and return a Boolean (1 or 0).</td>
<td>+,-,*,/ =,&lt;,&gt;,&lt;=,&gt;=,&lt;&gt;</td>
<td>Operators Comparators</td>
</tr>
<tr>
<td>@ Function</td>
<td>Starting with the @ character, these functions take one argument and perform a function, returning its result</td>
<td>@SIN, @ASIN @AN, @IN @RND, @FRAC, @COM</td>
<td>Trig functions Sine and ArcSine I/O functions Analog in and Digital in Numerical functions Round, Fractional Part, Bitwise compliment</td>
</tr>
<tr>
<td>Embedded Only</td>
<td>Not valid from the terminal, or from PC-side code, these commands are used in embedded DMC code only</td>
<td>IF, ELSE, ENDIF JS, JP EN, RE</td>
<td>IF Conditionals Jump commands End program, Return from Error</td>
</tr>
<tr>
<td>Operand</td>
<td>Operands hold values, and are not valid on their own. They can be used as arguments to commands, operators or comparators</td>
<td>_TPA _LFC _TC</td>
<td>Current position of axis A encoder Forward limit state on C axis Current Error code</td>
</tr>
<tr>
<td>Tripoint</td>
<td>Tripoints hold up a thread's execution (block) until a certain condition occurs. These are a special case of Embedded Only type commands.</td>
<td>WT 1000 AMA AI1</td>
<td>Wait 1000 ms Wait until axis A completes profiled motion Wait for input one to go high</td>
</tr>
<tr>
<td>Comment</td>
<td>Comments are used to document code.</td>
<td>This is a comment</td>
<td>There are three types of comments: REM, ', and NO</td>
</tr>
</tbody>
</table>

DMC code is case sensitive. All Galil commands are uppercase. User variables and arrays can be upper-case or lower case. Galil recommends that array and variable names contain at least one lower-case character to help distinguish them from commands.

**Explicit Notation**

These commands specify data using an axis designator followed by an equals sign. The * symbol can be used in place of the axis designator. The * defines data for all axes to be the same. For example:

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRB=1000</td>
<td>Sets B axis data at 1000</td>
</tr>
<tr>
<td>PR*=1000</td>
<td>Sets all axes to 1000</td>
</tr>
</tbody>
</table>

**Implicit Notation**

These commands require numerical arguments to be specified following the instruction. Values may be specified for any axis separately or any combination of axes. The comma delimiter indicates argument location. For commands that affect axes, the order of arguments is axis A first, followed by a comma, axis B next, followed by a comma, and so on. Omitting an argument will result in two consecutive commas and doesn't change that axis' current value. Examples of valid syntax are listed below.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC n</td>
<td>Specify argument for A axis only</td>
</tr>
<tr>
<td>AC n,n</td>
<td>Specify argument for A and B only</td>
</tr>
<tr>
<td>AC n,n</td>
<td>Specify argument for A and C only</td>
</tr>
<tr>
<td>AC n,n,n</td>
<td>Specify arguments for A,B,C,D axes</td>
</tr>
<tr>
<td>AC ,n,n,n</td>
<td>Specify arguments for B and E axis only</td>
</tr>
<tr>
<td>AC ,n,n,n</td>
<td>Specify arguments for E and F</td>
</tr>
</tbody>
</table>

Where n is replaced by actual values.

**Accepts Axis Mask**

These commands require the user to identify the specific axes to be affected. These commands are followed by uppercase X,Y,Z and W or A,B,C,D,E,
F,G and H. In DMC code, X,Y,Z,W and A,B,C,D are synonyms, respectively.

No commas are used and the order of axes is not important. When an argument is not required and is not given, the command is executed for all axes.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH A</td>
<td>Servo Here, A only</td>
</tr>
<tr>
<td>SH ABD</td>
<td>Servo Here, A,B and D axes</td>
</tr>
<tr>
<td>SH ACD</td>
<td>Servo Here, A,C and D axes</td>
</tr>
<tr>
<td>SH ABCD</td>
<td>Servo Here, A,B,C and D axes</td>
</tr>
<tr>
<td>SH XYZW</td>
<td>Identical to SH ABCD</td>
</tr>
<tr>
<td>SH BCAD</td>
<td>Servo Here, A,B,C and D axes</td>
</tr>
<tr>
<td>SH ADEG</td>
<td>Servo Here, A,D,E and G axes</td>
</tr>
<tr>
<td>SH H</td>
<td>Servo Here, H axis only</td>
</tr>
<tr>
<td>SH</td>
<td>Servo Here, all axes</td>
</tr>
</tbody>
</table>

**Two Letter Only**

These commands have no options or arguments. Some examples follow.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>Burn parameters</td>
</tr>
<tr>
<td>BV</td>
<td>Burn Variables</td>
</tr>
<tr>
<td>BP</td>
<td>Burn Programs</td>
</tr>
<tr>
<td>ID</td>
<td>Identify hardware config</td>
</tr>
<tr>
<td>LA</td>
<td>List arrays</td>
</tr>
</tbody>
</table>

**Operator or Comparator**

Operators and Comparators take two arguments and return one value. All comparison and operations occur left to right. That is, multiplication and addition have the same order-of-operation priority, and operations and comparisons are performed as encountered on a left to right search. Parenthesis should be used to indicate order of operation precedence. Some examples follow.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>var = 1 + 1</td>
<td>Variable var is assigned value 2</td>
</tr>
<tr>
<td>var = 2 + 1 * 3</td>
<td>Variable var is assigned value 9</td>
</tr>
<tr>
<td>var = 2 + (1 * 3)</td>
<td>Variable var is assigned value 5</td>
</tr>
<tr>
<td>IF ((a=b) &amp; (a=c))</td>
<td>Checks if a=b=c</td>
</tr>
<tr>
<td>IF (a=b=c)</td>
<td>Invalid syntax to check if a=b=c</td>
</tr>
<tr>
<td>var = (a=1)</td>
<td>var is assigned with Boolean value (true/false) based on comparison a=1</td>
</tr>
</tbody>
</table>

**@ Function**

At functions take one value or evaluated expression and return a result. Some examples follow.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>var = @SIN[90]</td>
<td>Variable var is assigned value 1. Sine of 90 degrees.</td>
</tr>
<tr>
<td>var = @ASIN[1]</td>
<td>Variable var is assigned value 90. Inverse Sine of 1</td>
</tr>
<tr>
<td>var = @IN[1]</td>
<td>Variable var is assigned 1 or 0, based on current state of digital input 1</td>
</tr>
<tr>
<td>var = @RND[1 + 0.6]</td>
<td>Variable var is assigned 2, 1.6 round to the nearest integer</td>
</tr>
</tbody>
</table>
Embedded Only

Embedded commands make sense only in the context of an embedded application. These commands include jumps, if-then-else syntax, subroutines, etc. Some examples follow.

<table>
<thead>
<tr>
<th>Valid Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#go</td>
<td>Labels can be called by name in order to jump code to specific lines</td>
</tr>
<tr>
<td>JP#go</td>
<td>Jump to line number indicated by #go label</td>
</tr>
<tr>
<td>#AUTO</td>
<td>Automatic subroutine. #AUTO is the entry point for execution on bootup. See entries starting with # for other automatic subroutines.</td>
</tr>
<tr>
<td>RI</td>
<td>Return from interrupt. This is the termination for certain automatic subroutines (event handlers)</td>
</tr>
<tr>
<td>IF (a=5);MG&quot;Five&quot;;ELSE;MG&quot;Not Five&quot;;ENDIF</td>
<td>If statement. ; can be replaced by carriage return for better readability</td>
</tr>
</tbody>
</table>

Automatic subroutines operate very similarly to event handlers in event-driven languages. When an event occurs, execution of code jumps to the automatic subroutine. Once the end of the automatic subroutine is reached, code execution continues where it left off.

Operand

Many commands have corresponding operands that can be used for interrogation or for use within mathematical or other expressions. Operands are not valid alone, and must be used inside a valid DMC code expression. For example, to print the value of the TIME operand the following command is issued.

```
:MG TIME
13779546.0000
:
```

To assign TIME to a variable and then print it, the following is used.

```
:var=TIME
:MG var
13909046.0000
:
```

All DMC codes starting with the underscore _ character are operands. The servo loop counter, TIME, is an operand without an underscore.

Variables and array elements act similarly to operands. Whereas operands are read-only, variables and array elements are read-write. Operands, variables, and array elements can be arguments to commands, are valid in mathematical expressions, and can be used in assignments to other variables and array elements.

Trippoints

The controller provides several commands that can be used to pause execution of code until certain conditions are met. Commands of this type are called "trippoints." Such trippoints may wait for an elapsed time, wait for a particular input, or in motion controllers wait for particular motion event to occur.

When a trippoint command is executed, the program halts execution of the next line of code until the status of the trippoint is cleared. Note that the trippoint only halts execution of the thread from which it is commanded while all other independent threads are unaffected. Additionally, if the trippoint is commanded from a subroutine, execution of the subroutine, as well as its calling thread, is halted.

Trippoints are intended for use only within embedded DMC code and should not be sent from a terminal or a host application program executing from a PC.

**Popular Trippoints**
<table>
<thead>
<tr>
<th>Trippoint</th>
<th>Short Description</th>
<th>Supported On</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT</td>
<td>wait for a time period (sleep)</td>
<td>All Galil Hardware</td>
</tr>
<tr>
<td>AI</td>
<td>wait for a digital input</td>
<td>All Galil Hardware</td>
</tr>
<tr>
<td>AM</td>
<td>after move</td>
<td>Motion Controllers</td>
</tr>
<tr>
<td>MC</td>
<td>motion complete, in position</td>
<td>Motion Controllers</td>
</tr>
<tr>
<td>AT</td>
<td>At time, time from reference</td>
<td>All Galil Hardware</td>
</tr>
<tr>
<td>AD</td>
<td>after distance</td>
<td>Motion Controllers</td>
</tr>
<tr>
<td>AS</td>
<td>At speed</td>
<td>Motion Controllers</td>
</tr>
<tr>
<td>AV</td>
<td>After Vector Distance</td>
<td>Motion Controllers</td>
</tr>
<tr>
<td>AA</td>
<td>After Analog</td>
<td>RIO-47xxx only</td>
</tr>
</tbody>
</table>

**Comments**

Comments are used to document code, and to disable lines of code while debugging. There are three ways to comment.

**REM**  REM stands for "Remark." When a line begins with the REM command, the entire line is stripped by Galil software before downloading to the controller. REM is NOT a recognized Galil command; it is a keyword recognized by Galil software as data that is to be skipped during program download. When program speed and code length are at a premium, use REM comments.

**NO**   NO stands for "No Operation." Lines beginning with NO are downloaded to the controller and incur a non-zero processing overhead as a result. If the developer desires the comments to stay in code so that uploaded code will still be notated, use NO or '. NO comments are not stripped when code is compressed by software.

' The single quote character is similar to NO. Lines beginning with ' are downloaded to the controller and incur a non-zero processing overhead as a result. If the developer desires the comments to stay in code so that uploaded code will still be notated, use NO or '. ' comments ARE stripped when code is compressed by software.

When commenting inline, NO and ' are valid when preceded by a ; character. REM is only valid as the start of a line. Some examples follow.

```
BG;' This is a comment. semicolon and ' precede, followed by spaces, and then the comment
ST;NO Same as above, except on compression, this data will remain, less spaces
REM This is a remark. It will not be downloaded to the controller by Galil software
NO This is an NO comment starting a line
NOTE This is also an NO comment
' This is a single quote comment starting a line
'PRX=1000;BGX;' This line of code has been disabled with a leading '
```

**Special characters ; and '**

; The semicolon is used to separate individual commands on a single line of embedded code or in a single interrogation from the host. When running multi-threaded, embedded code, all commands on a single line will be executed before the program counter switches to the next thread*. Using multiple commands on a single line therefore allows for increased thread priority.

* Certain commands such as trippoints will cause the program counter to continue to the next thread before a line has completed.

' On the RIO series of PLCs, the backtick (ascii 96) is a line continuation character. If a line of code passes the RIO's 40 character length limit, the ' character can be used to continue the line of code on the next line.

**Interrogation**

Most commands accept a question mark (?) as an argument. This argument causes the controller to return parameter information. Type the command followed by a ? for each axis requested. The syntax format is the same as the parameter arguments described above except '?' replaces the values.

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR ?</td>
<td>The controller will return the PR value for the A axis</td>
</tr>
<tr>
<td>PR ...,?</td>
<td>The controller will return the PR value for the D axis</td>
</tr>
</tbody>
</table>
### Data Types

#### Galil4.2

There is only one native data type in DMC language, the Galil4.2 format. Galil4.2 is a signed, fixed-point, decimal number with 4 bytes of integer and 2 bytes of fraction. Bit encoding of Galil4.2 is 2's complement.

Integer values range from -2,147,483,648 to 2,147,483,647

Fractional values range from 0.999985 to .000015 in increments of .000015 (one part in 65535). When working with very small fractional values, use the $ formatter to display the number in hex.

```plaintext
:v=1-$0.0001;'subtract the smallest fractional value
:v=1.0000
:v=?
:v=?{$1.4};'hex display has higher resolution
$0.FFFF
:v=v+$0.0001
:v=1.0000
:v=?{$1.4}
$1.0000
```

#### Strings

Galil "strings" are still variables in 4.2 format, with each byte printed as the ASCII representation of the number. Galil strings are max 6 characters. The left most character of a string is the most significant byte in the Galil4.2 number.

#### Boolean

A Boolean is represented in the Galil language as a Galil4.2 value. 0.0 is false. All other values are true.

```plaintext
:a=1
:b=2
:c=(a=b);'(a=b) returns a Galil Boolean
:LV
a= 1.0000
b= 2.0000
c= 0.0000
:a=2
:c=(a=b)
:LV
a= 2.0000
b= 2.0000
c= 1.0000
```

### Units of Distance

The units of distance in a Galil controller are either in "counts" or "steps". A count is a single unit of feedback, such as a quadrature count, an SSI or BiSS bit, or an Analog to Digital converter bit. Counts are typical with servos. Steps are used for stepper-type motors. Steps are open-loop units and refer to a single level transition sent to a stepper amplifier. In general for a unit of real distance, 1 step is NOT equal in distance to 1 count. See the "Stepper Position Maintenance Mode" in the user manual for more information.

Each axis of a Galil motion controller can be configured to control either a servo or a stepper. In this documentation, servo motors are generally assumed. Differences between functionality in stepper and servo operation are noted in each command. Where not explicitly noted otherwise, when using stepper motors, the unit "count" can be exchanged with the unit "step" (e.g. steps per second instead of counts per second).
Flash Memory

Each Galil controller has a flash memory provided for saving parameters and user data. The flash is divided into three sectors, Parameters, Variables and Arrays, and Program. Each sector has an associated burn command which burns the entire sector.

<table>
<thead>
<tr>
<th>Flash Sector</th>
<th>Data Storage</th>
<th>Burn Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>Stores the controller parameters such as PID filter coefficients, IP address, motion kinematic values, I/O configurations</td>
<td>BN</td>
</tr>
<tr>
<td>Variables and Array</td>
<td>Stores the currently allocated variable table (LV) and each of the arrays in the array table (LA)</td>
<td>BV</td>
</tr>
<tr>
<td>Program</td>
<td>Stores program currently downloaded on the controller</td>
<td>BP</td>
</tr>
</tbody>
</table>

Resetting the Controller to Factory Defaults

When a master reset occurs, the controller will reset all setup parameters to their default values and the non-volatile memory is cleared to the factory state. A master reset is executed by the command, `<ctrl R> <ctrl S> <Return>` OR by powering up or resetting the controller with the MRST jumper on.
Table of Contents

Info
Overview
- # - Label (subroutine)
  - #AMPERR - Amplifier error automatic subroutine
  - #AUTO - Subroutine to run automatically upon power up
  - #AUTOERR - EEPROM checksum error and Serial Encoder timeout error Automatic Subroutine
  - #CMDERR - Command error automatic subroutine
  - #COMINT - Communication interrupt automatic subroutine
  - #ININT - Input interrupt automatic subroutine
  - #LIMSWI - Limit switch automatic subroutine
  - #MCTIME - MC command timeout automatic subroutine
  - #POERR - Position error automatic subroutine
  - #SERERR - Serial Encoder Error Automatic Subroutine
  - #TCPERR - Ethernet communication error automatic subroutine
- $ - Hexadecimal
- & , | - Bitwise Logical Operators AND and OR
- (, ) - Parentheses (order of operations)
- ; - Semicolon (Command Delimiter)
- @ABS - Absolute value
- @ACOS - Inverse cosine
- @AN - Analog Input Query
- @ASIN - Inverse sine
- @ATAN - Inverse tangent
- @COM - Bitwise complement
- @COS - Cosine
- @FRAC - Fractional part
- @IN - Read digital input
- @INT - Integer part
- @OUT - Read digital output
- @RND - Round
- @SIN - Sine
- @SQR - Square Root
- [ , ] - Square Brackets (Array Index Operator)
- ^a, ^b, ^c, ^d, ^e, ^f, ^g, ^h - JS subroutine stack variable
- ^L^K - Lock program
- ^R^S - Master Reset
- ^R^V - Revision Information
- _GP - Gearing Phase Differential Operand
- _LF - Forward Limit Switch Operand
- _LR - Reverse Limit Switch Operand
- ~ - Variable Axis Designator
- +, -, *, /, % - Math Operators
- <, <=, >, >=, <> - Comparison Operators
- = - Equals (Assignment Operator)
- AB - Abort
- AC - Acceleration
- AD - After Distance
- AF - Analog Feedback Select
- AG - Amplifier Gain
- AI - After Input
- AL - Arm Latch
- AM - After Move
- AO - Analog Output
- AP - After Absolute Position
- AQ - Analog Input Configuration
- AR - After Relative Distance
- AS - At Speed
- AT - At Time
- AU - Set amplifier current loop
- AV - After Vector Distance
- AW - Amplifier Bandwidth
- BA - Brushless Axis
- BB - Brushless Phase Begins
- BC - Brushless Calibration
- BD - Brushless Degrees
- BG - Begin
- BI - Brushless Inputs
- BK - Breakpoint
- BL - Reverse Software Limit
- BM - Brushless Modulo
- BN - Burn
- BO - Brushless Offset
- BP - Burn Program
- BR - Brush Axis
- BS - Brushless Setup
- BT - Begin PVT Motion
- BV - Burn Variables and Array
- BW - Brake Wait
- BX - Sine Amp Initialization
- BZ - Brushless Zero
- CA - Coordinate Axes
- CB - Clear Bit
- CC - Configure Communications Port 2
- CD - Contour Data
- CE - Configure Encoder
- CF - Configure Unsolicited Messages Handle
- CI - Configure Communication Interrupt
- CM - Contour Mode
- CN - Configure
- CO - Configure Extended I/O
- CR - Circle
- CS - Clear Sequence
- CW - Copyright information Data Adjustment bit on off
- DA - Deallocate the Variables & Arrays
- DC - Deceleration
- DE - Dual (Auxiliary) Encoder Position
- DF - Dual Feedback (DV feedback swap)
- DH - DHCP Server Enable
- DL - Download
- DM - Dimension
- DP - Define Position
- DR - Configures I/O Data Record Update Rate
- DT - Delta Time
- DV - Dual Velocity (Dual Loop)
- EA - Choose ECAM master
- EB - Enable ECAM
- EC - ECAM Counter
- ED - Edit
- EG - ECAM go (engage)
- EI - Event Interrupts
- ELSE - Else function for use with IF conditional statement
- EM - Cam cycles (modulus)
- EN - End
- ENDIF - End of IF conditional statement
- EO - Echo
- EP - Cam table master interval and phase shift
- EQ - ECAM quit (disengage)
- ER - Error Limit
- ES - Ellipse Scale
- ET - Electronic cam table
- EW - ECAM Widen Segment
- EY - ECAM Cycle Count
- FA - Acceleration Feedforward
- FE - Find Edge
- FI - Find Index
- FL - Forward Software Limit
- FV - Velocity Feedforward
- GA - Master Axis for Gearing
- GD - Gear Distance
- GM - Gantry mode
- GR - Gear Ratio
- HM - Home
- HS - Handle Assignment Switch
- HV - Homing Velocity
- HX - Halt Execution
- IA - IP Address
- ID - Identify
- IF - IF conditional statement
- IH - Open IP Handle
- II - Input Interrupt
- IK - Block Ethernet ports
- IL - Integrator Limit
- IN - Input Variable
- IP - Increment Position
- IT - Independent Time Constant - Smoothing Function
- JG - Jog
- JP - Jump to Program Location
- JS - Jump to Subroutine
- KD - Derivative Constant
- KI - Integrator
- KP - Proportional Constant
- KS - Step Motor Smoothing
- LA - List Arrays
- LB - LCD Bias Contrast
- LC - Low Current Stepper Mode
- LD - Limit Disable
- LE - Linear Interpolation End
- LI - Linear Interpolation Distance
- LL - List Labels
- LM - Linear Interpolation Mode
- LS - List
- LU - LCD Update
- LV - List Variables
- LZ - Inhibit leading zeros
- MB - Modbus
- MC - Motion Complete
- MF - Forward Motion to Position
- MG - Message
- MO - Motor Off
- MR - Reverse Motion to Position
- MT - Motor Type
- MW - Modbus Wait
- NB - Notch Bandwidth
- NF - Notch Frequency
- NO' - No Operation
- NZ - Notch Zero
- OA - Off on encoder failure
- OB - Output Bit
- OC - Output Compare
- OE - Off-on-Error
- OF - Offset
- OP - Output Port
- OT - Off on encoder failure time
- OV - Off on encoder failure voltage
- P2CD - Serial port 2 code
- P2CH - Serial port 2 character
- P2NM - Serial port 2 number
- P2ST - Serial port 2 string
- PA - Position Absolute
- PF - Position Format
- PL - Pole
- PR - Position Relative
- PT - Position Tracking
- PV - PVT Data
- PW - Password
- QD - Download Array
- QH - Hall State
- QR - I O Data Record
- QS - Error Magnitude
- QU - Upload Array
- QZ - Return Data Record information
- RA - Record Array
- RC - Record
- RD - Record Data
- RE - Return from Error Routine
- REM - Remark
- RI - Return from Interrupt Routine
- RL - Report Latched Position
- RP - Reference Position
- RS - Reset
- SA - Send Command
- SB - Set Bit
- SC - Stop Code
- SD - Switch Deceleration
- SH - Servo Here
- SI - Configure the special Galil SSI feature
- SL - Single Step
- SM - Subnet Mask
- SP - Speed
- SS - Configure the special Galil BiSS feature
- ST - Stop
- SY - Serial encoder BiSS active level
- TA - Tell Amplifier error status
- TB - Tell Status Byte
- TC - Tell Error Code
- TD - Tell Dual Encoder
- TE - Tell Error
- TH - Tell Ethernet Handle
- TI - Tell Inputs
- TIME - Time Operand
- TK - Peak Torque Limit
- TL - Torque Limit
- TM - Update Time
- TN - Tangent
- TP - Tell Position
- TR - Trace
- TS - Tell Switches
- TT - Tell Torque
- TV - Tell Velocity
- TW - Timeout for IN Position (MC)
- TZ - Tell I O Configuration
- UI - User Interrupt
- UL - Upload
- VA - Vector Acceleration
- VD - Vector Deceleration
- VE - Vector Sequence End
- VF - Variable Format
- VM - Vector Mode
- VP - Vector Position
- VR - Vector Speed Ratio
- VS - Vector Speed
- VV - Vector Speed Variable
- WH - Which Handle
- WT - Wait
- XQ - Execute Program
- YA - Step Drive Resolution
- YB - Step Motor Resolution
- YC - Encoder Resolution
- YR - Error Correction
- YS - Stepper Position Maintenance Mode Enable, Status
- ZA - User Data Record Variables
- ZS - Zero Subroutine Stack
Galil Motion Control Command Reference

# Label (subroutine)

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The # operator denotes the name of a program label (for example #Move). Labels can be up to seven characters long and are often used to implement subroutines or loops. Labels are divided into (a) user defined (b) automatic subroutines. User defined labels can be printed with LL and the number of labels left available can be queried with MG_DL. The automatic subroutines include #CMDERR, #LIMSWI, #POSERR, #IINIT, #AUTO, #AUTOERR, and #MCTIME (no RIO).

A label can only be defined at the beginning of a new line.

There is a maximum of 510 labels available.

**Arguments**

#nnnnnnn where
nnnnnn is a label name up to seven characters. Uppercase or lowercase characters are valid.

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage and Default Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage</strong></td>
</tr>
<tr>
<td>While Moving (no RIO)</td>
</tr>
<tr>
<td>In a Program</td>
</tr>
<tr>
<td>Command Line</td>
</tr>
<tr>
<td>Controller Usage</td>
</tr>
<tr>
<td>Default Value</td>
</tr>
<tr>
<td>Default Format</td>
</tr>
</tbody>
</table>

**Related Commands**

LL - List labels
_DL - Labels available
JP - Jump statement
JS - Jump subroutine

**Examples:**

```
'A simple example of iteration. The loop will run 10 times
i=0;
#Loop;
i=i+1;
JP#Loop, i<10;_spin in #Loop until i >= 10
EN;'_End the subroutine or thread
```
#AMPERR

Amplifier error automatic subroutine

Full Description

#AMPERR is an automatic subroutine and is used to run code when a fault occurs on a Galil amplifier. See the TA command and individual amplifier information in the DMC-4xxx User Manual.

Other user code does not need to be running for #AMPERR to be raised.

When an external servo driver is used in an axes where the AMP-430x0 is also installed, the axis should be setup as a brushed motor (BR~a=1) otherwise the lack of hall inputs will cause an amplifier error.

Use RE to return from the AMPERR subroutine.

See the TA command for more information.

Arguments

N/A

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>controllers with integrated drives</td>
</tr>
</tbody>
</table>

Related Commands

TA - Tell amplifier status  
CN - Configure I/O  
OE - Off on error  
RE - Return from error

Examples:

'this code will run in the event of an amplifier error,  
'setting a digital output and notifying the operator.

#AMPERR

'set a digital bit to signal an amplifier error to peripheral hardware  
SB4

'send a message to the user  
MG"An amplifier error has occured"

'return from the AMPERR subroutine, restoring trippoints that were running  
RE1

detailed #AMPERR example. uses LCD to display amplifier error information and remains in #AMPERR
routine until the error is cleared.

#AMPERR
REM mask out axes that are in brushed mode for _TA1
mask=(_BRH*128)+(_BRG*64)+(_BRF*32)+(_BRE*16)+(_BRD*8)+(_BRC*4)+(_BRB*2)+_BRA
mask=@COM[mask]
mask=((_TA1&mask)&$0000FFFF)
LU0;'turn off auto update of LCD
REM amplifier error status on LCD
MG"A-ER TA0"(L1),_TA0(L2);WT2000
MG"A-ER TA1"(L1),mask(L2);WT2000
MG"A-ER TA2"(L1),_TA2(L2);WT2000
MG"A-ER TA3"(L1),_TA3(L2);WT2000
LU1;'turn on Automatic Axis Update of LCD
WT5000
REM the sum of the amperr bits should be 0 with no amplifier error
er=_TA0+mask+_TA2+_TA3
JP#AMPERR,er0
REM Notify user amperr has cleared
LU0
MG"AMPERR"(L1),"RESOLVED"(L2)
WT3000
LU1
RE
#AUTO

Subroutine to run automatically upon power up

**Full Description**

#AUTO defines code to run automatically when power is applied to the controller, or after the controller is reset. When no host software is used with the controller, #AUTO and the BP command are required to run an application program on the controller.

Upon controller startup, application code will automatically begin running in thread 0 at #AUTO.

Use EN to end the routine.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**

BP - Burn program
EN - End program
#AUTOERR - Automatic Subroutine for EEPROM error

**Examples:**

'On startup, this code will create a 50% duty cycle square wave on output 1 with a period of 1 second.

#AUTO;' Start on powerup
SB1;' Set bit 1
WT500;' Wait 500msec
CB1;' Clear bit 1
WT500;' Wait 500msec
JP#AUTO;' Jump back to #AUTO
#AUTOERR

EEPROM checksum error and Serial Encoder timeout error Automatic Subroutine

**Full Description**

**All firmware versions and controllers**

#AUTOERR will run code upon power up if data in the EEPROM has been corrupted. The EEPROM is considered corrupt if the checksum calculated on the bytes in the EEPROM do not match the checksum written to the EEPROM. The type of checksum error can be queried with _RS.

Use EN to end the routine.

**-SER firmware**

#AUTOERR will also run if the time to acquire serial position data exceeds 90% of the hardware sample loop. This type of error is very rare and should never occur in normal operation.

In the event of a serial position acquisition timeout, the following will occur:

a. The controller will reset
b. The controller servo loop will not run, TM will be set to zero
c. TC1 will return "143 TM timed out"
d. The automatic subroutine #AUTOERR will run, if present
   e. The Error output will be set.

When using serial encoders (SSI or BiSS), the #AUTOERR should follow these guidelines:

a. IF _TC=143 do not employ any trippoints in following code as the timer interrupt is suspended.
b. Serial encoders can be disabled with the commands SIn=0 or SSn=0 where n is the axis indicator ABCDEFG or H.
c. In order to re-enable the timer interrupt issue "TM m" where m is the servo update period in us (usually m=1000).

See code example below.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

_RS - Checksum error code operand
EN - End program

**Examples:**
Code detects a checksum error and notifies the user

```
#AUTOERR
MG"EEPROM ERROR ",_RS
EN
```

Distinguishing between a serial timeout condition and an EEPROM condition

```
#AUTOERR
IF _TC=143
REM BiSS or SSI timeout
REM No trippoints in this clause
REM Print message to DMC-4020 LCD
   LU0
   MG"BiSS"{L1}
   MG"Timeout"{L2}
   SSA=0
   SSB=0
ELSE
REM Checksum error
REM trippoints ok here
REM Print message to DMC-4020 LCD
   LU0
   MG"EEPROM:"{L1}
   MG(Z10.0)_RS{L2}
ENDIF
EN
```
#CMDERR

**Syntax:** Other  
**Operands:** none  
**Burn:** not burnable

**Command error automatic subroutine**

**Full Description**

#CMDERR is an automatic subroutine that runs code when a DMC code error occurs. Without #CMDERR defined, if an error (see TC command) occurs in an application program running on the Galil controller, the program (and all threads) will stop.

Use EN to end the routine.

#CMDERR will only run from errors generated within embedded DMC code.

In a single threaded application (Thread 0 only), the EN command in the #CMDERR routine will restart thread 0 where it left off.

In a multi-threaded application, the thread that has an error will be halted when a command error occurs. Thread 0 will be interrupted to run the #CMDERR routine but other threads will continue to run. In order to restart the thread that encountered the error, see the example in Chapter 7 of the User Manual and the _ED operand. Thread 0 does not need to be running in order for the #CMDERR routine to execute.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
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</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
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<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**

TC - Tell Error Code  
_ED - Last program line with an error  
EN - End program

**Examples:**

```
'This code will put the motion controller in Position Tracking mode.  
'Variable "target" is updated from the terminal or from a host program  
'to specify a new target.  #CMDERR is used to detect a bad target value.

#start
DPA=0;'   Define current position as zero
PTA=1;'   Turn on position tracking
target=0;' Initialize target variable
#track;'  Start tracking
PAA=target;' Track to current value of target
WT500;'   Wait 500 ms
JP#track;' Continue to track
' 
```
#CMDERR;' runs if an error occurs
JP#done, _TC<>6 ;' check that an out of range occurred (See TC)
MG"Value ",target," is out of range for Position Tracking"
    target=_PAA ;' reset target
#done
EN1 ;'return to tracking logic
#COMINT

Communication interrupt automatic subroutine

**Full Description**

#COMINT is an automatic subroutine which can be configured by the CI command to run either when any character is received, or when a carriage return is received over the com port. The auxiliary port is used if equipped.

#COMINT runs in thread 0, and an application must be running in thread 0 in order for #COMINT to be enabled. Code running in thread zero will be interrupted by the #COMINT subroutine. Use EN to end the routine.

NOTE: An application program must be executing for the automatic subroutine to function, which runs in thread 0. Use EN to end the routine.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

P2CD - Serial port 2 code  
P2CH - Serial port 2 character  
P2NM- Serial port 2 number  
P2ST - Serial port 2 string  
CI - Configure #COMINT  
CC - Configure serial port 2  
EN - End subroutine

**Examples:**

```plaintext
#A;                           'Program Label
 CC9600,0,1,0
  CI2;
  #Loop MG "Loop";
  WT 1000
  JF#Loop
  #COMINT MG "COMINT:" , P2CH{S1};
  EN1,1;
  ' 'print a message and the received character

  ' End this subroutine, re-arming trip points that
  were running and re-enabling the CI mask
```
#ININT

Full Description
#ININT is an automatic subroutine that runs upon a state transition of digital inputs 1 to 8 and is configured with II. #ININT runs in thread 0.

Arguments
N/A

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
</tbody>
</table>

Related Commands
II- Input interrupt
@IN - Read digital input
RI - Return from interrupt

Examples:

```
II1;       'arm digital input 1
EN;        'End thread zero
#
#ININT;    'Automatic sub. Runs on input event
MG"Inputs:",_TI0; 'Display status of inputs 1-8
WT100;     'Debounce input
RI;        'Return from interrupt
```
#LIMSWI

Limit switch automatic subroutine

### Full Description
Without #LIMSWI defined, the controller will effectively issue the STn on the axis when it's limit switch is tripped. With #LIMSWI defined, the axis is still stopped, and in addition, code is executed. #LIMSWI is most commonly used to turn the motor off when a limit switch is tripped (see example below). For #LIMSWI to run, the switch corresponding to the direction of motion must be tripped (forward limit switch for positive motion and negative limit switch for negative motion). #LIMSWI interrupts thread 0 when it runs.

Use RE to terminate the #LIMSWI subroutine.

### Arguments
N/A

### Operand Usage
N/A

### Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
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<tr>
<td>Command Line</td>
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</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
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<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands
- _LFn - State of forward limit switch
- _LRn - State of reverse limit switch

LD - Limit Disable

### Examples:

```plaintext
#Main        ; 'print a message every second
   MG "Main"
   WT1000
   JP#Main
EN

#LIMSWI ; 'runs when a limit switch is tripped
IF (_LFX = 0) | (_LRX = 0)
   MG "X"
   DCX=67107840
   STX
   AMX
   MOX
ELSE; IF (_LFY = 0) | (_LRY = 0)
   MG "Y"
   DCY=67107840
```
STY
AMY
MOY
ENDIF; ENDIF
REI
#MCTIME

MC command timeout automatic subroutine

**Full Description**

#MCTIME runs when the MC command is used to wait for motion to be complete, and the actual position TP does not reach or pass the target within the specified timeout TW.

Use RE to terminate the subroutine.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

MC - Wait for motion complete trip point
TW - MC timeout

**Examples:**

```plaintext
#BEGIN;
TWX=10000;.
PRX=100000;.
BGX;.
MCX;.
EN;.

#MCTIME;.
MG "X fell short";.
EN1;.
```

Begin main program
Set the time out to 1000 ms
Position relative
Begin motion
Motion Complete trip point
End main program

Motion Complete Subroutine
Send out a message
End subroutine
**#POSERR**

**Position error automatic subroutine**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The factory default behavior of the Galil controller upon a position error (_TEn > _ERn) is to do nothing more than drive the error signal low, turning on the red error LED. If OE is set to 1, the motor whose position error (TE) equals or exceeds its threshold (ER) will be turned off (MO). #POSERR can be used if the programmer wishes to run code upon a position error, for example to notify a host computer.

The #POSERR label causes the statements following to be automatically executed if error on any axis exceeds the error limit specified by ER. The error routine must be closed with the RE command. The RE command returns from the error subroutine to the main program.

Use RE to end the routine

#POSERR will also run when OE1 is set for an axes and that axis is also setup for encoder failure detection (see OA, OT, OV commands).

The automatic subroutine runs in thread 0. If thread 0 is running, it will jump to #POSERR when an error occurs. If thread 0 is not running, #POSERR will be started in thread 0.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
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<tbody>
<tr>
<td>While Moving</td>
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</tr>
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<tr>
<td>Command Line</td>
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<tr>
<td>Controller Usage</td>
<td>All</td>
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<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

OE - Off on error
TE - Tell error
ER - Error limit
RE - Return from error routine

**Examples:**

```
#main;
main program
,
JP #main
REM simple example of #POSERR
#POSERR
MG "#POSERR"
RE
```
REM example of #POSERR that checks for position error on each axis

#POSERR
~a=0;'  axis designator
IF ((_TE~a>_ER~a)&(_OE~a))
  MG "Position Error occured on ",~a(F1.0)," axis"
ENDIF
~a=~a+1
JP#POSERR,~a<_BV;' loop until axes have been checked
AI 1;'  wait until input 1 goes high (ex. safety switch)
SH
RE1;'  return to main program

REM #POSERR example for checking to see if encoder failure occured
REM The stop code will only update of the profiler is running at the time
REM the encoder failure is detected.

#POSERR
~a=0
#loop
IF _MO~a=1
  IF ((_TE~a<_ER~a)&(_OE~a)&(_OA~a))
    MG "possible encoder failure on ",~a(Z1.0)," axis"
  ENDIF
ENDIF
~a=~a+1
JP#loop,~a<_BV
AI1;'  wait for input 1 to go high
SH;'  enable all axes
RE
#SERERR

Serial Encoder Error Automatic Subroutine

**Full Description**

When equipped with hardware featuring the -BiSS encoder upgrade, #SERERR is an automatic subroutine which runs whenever there is a fault condition on the serial encoder. The following are the fault conditions which will cause #SERERR to interrupt.

### Serial Encoder Faults

<table>
<thead>
<tr>
<th>BiSS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder timeout (bit 0 of _SS)</td>
<td></td>
</tr>
<tr>
<td>CRC error (bit 1 of _SS)</td>
<td></td>
</tr>
<tr>
<td>Error bit* (bit 2 of _SS)</td>
<td></td>
</tr>
<tr>
<td>Warning bit* (bit 3 of _SS)</td>
<td></td>
</tr>
</tbody>
</table>

The active level of the Error and Warning bits for BiSS must be configured with SY.

For the encoder timeout condition, TC1 will also return "140 Serial encoder missing."

Return from this automatic sub with RE.

*Note: The encoder manufacturer may name the Error and Warning bits differently. Consult the encoder documentation for the naming convention.

Galil defines the Warning bit as the bit directly preceeding the CRC. The Error bit is defined as the bit directly preceeding the Warning bit. See table 1.

**Arguments**

N/A

**Operands**

N/A

**Usage**

*Usage and Default Details*

<table>
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<td>No</td>
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<td>Default Value</td>
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</tbody>
</table>

**Related Commands**

SS - Configure the special Galil BiSS feature
SY - Serial encoder BiSS active level

**Examples**

```
#SERERR
LU0
MG"SERERR"{L1}
MG_SSA(L2)
```
REM disable axis A
OEA=1; ERA=0
REM disable axis serial encoder
SSA=0
RE
#TCPERR

Ethernet communication error automatic subroutine

### Full Description

#TCPERR is an automatic subroutine which allows execution of code when an TCP error occurs.

The following error (see TC) occurs when a command such as MG "hello" {EA} is sent to a failed Ethernet connection:

123 TCP lost sync or timeout

This error means that the client on handle A did not respond with a TCP acknowledgement (for example because the Ethernet cable was disconnected). Handle A is closed in this case.

#TCPERR allows the application programmer to run code (for example to reestablish the connection) when error 123 occurs.

Use RE to terminate the subroutine.

Code does not need to be running in thread zero for #TCPERR to run.

### Arguments

N/A

### Operand Usage

N/A

### Usage

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</table>

### Related Commands

TC - Tell error code
_IA4 - Last dropped handle
MG - Print message
SA - Send ASCII command via Ethernet

### Examples:

```c
#L
  MG (EA) "L"
  WT1000
  JP#L
#TCPERR
  MG (P1) "TCPERR. Dropped handle", _IA4
  RE
  'NOTE: Use RE to end the routine
```
Full Description
The $ operator denotes that the following string is in hexadecimal notation.

Arguments
$nnnnnnnn.mmmm
n is up to eight hexadecimal digits (denoting 32 bits of integer)
m is up to four hexadecimal digits (denoting 16 bits of fraction)

Operand Usage
N/A

Usage

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Related Commands
+ - * / % - Multiply (shift left)
+ - * / % - Divide (shift right)
MG {8.4} - Print in hexadecimal

Examples:

```plaintext
x = $7fffffff.0000 ;'store 2147483647 in x
y = x & $0000ffff.0000 ;'store lower 16 bits of x in y
z = x & $ffff0000.0000 / $10000 ;'store upper 16 bits of x in z
```
& , |

Syntax: Operator or Comparator
Operands: none
Burn: not burnable

Bitwise Logical Operators AND and OR

Full Description
The operators & and | are typically used with IF, JP, and JS to perform conditional jumps; however, they can also be used to perform bitwise logical operations.

Arguments
n & m or n | m where
n and m are signed numbers in the range -2147483648 to 2147483647.
For IF, JP, and JS, n and m are typically the results of logical expressions such as (x > 2) & (y=8)

"&" is also used to pass a variable by reference in a JS call. See JS.

Operand Usage
N/A

Usage

Usage and Default Details

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Related Commands
@COM[n] - Bitwise complement
IF - If statement
JP - Jump statement
JS - Jump subroutine

Examples:

IF (x > 2) & (y = 4)
'x must be greater than 2 and y equal to 4
'for the message to print
MG "true"
ENDIF

:MG 1 | 2
  3.0000
:'Bitwise operation:  01 OR 10 is 11 = 3

Pass By Reference Example:

#main
test=5;
    a value to be passed by reference
global=8;
    a global variable
\texttt{JS#SUM(\&value,1,2,3,4,5,6,7);} \texttt{\textprime{} note first arg passed by reference}
\texttt{MG value;} \texttt{\textprime{} message out value after subroutine.}
\texttt{MG _JS;} \texttt{\textprime{} message out returned value}
\texttt{EN}
\texttt{\textprime{}}
\texttt{#SUM;} \texttt{\textprime{} (* ^a,^b,^c,^d,^e,^f,^g)}
\texttt{^a=^b+^c+^d+^e+^f+^g+global}
\texttt{EN,^a}
\texttt{\textprime{} notes-}
\texttt{\textprime{} do not use spaces when working with ^}
\texttt{\textprime{} If using global variables, they MUST be created before the subroutine is run}

Executed program from program2.dmc
36.0000
36.0000
Parentheses (order of operations)

Full Description
The parentheses denote the order of math and logical operations. Note that the controller DOES NOT OBEY STANDARD MATHEMATICAL OPERATOR PRECEDENCE. For example, multiplication is NOT evaluated before addition. Instead, the controller follows left-to-right precedence. Therefore, it is required to use parentheticals to ensure intended precedence.

Arguments
(n) where
n is a math (+ - * /) or logical (& |) expression

Operand Usage
N/A

Usage

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Related Commands
+ - * / - Math Operators
& | - Logical Operators

Examples:

:MG 1 + 2 * 3
   9.0000
:MG 1 + (2 * 3)
   7.0000
Semicolon (Command Delimiter)

Full Description

The semicolon operator allows multiple Galil commands to exist on a single line. It is used for the following three reasons:
(1) To put comments on the same line as the command (STX ; stop)
(2) To compress DMC programs to fit within the program line limit (Note: use a compression utility to do this. Do not program this way because it is hard to read.)
(3) To give higher priority to a thread. All commands on a line are executed before the thread scheduler switches to the next thread.

Arguments

n;n;n;n

where

n is a valid Galil command

Operand Usage

N/A

Usage

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Related Commands

NO - No Op, comment
' - comment

Examples:

SB1;WT500;CB1;'multiple commands separated by semicolons with a comment

#High;'       #High priority thread executes twice as fast as
  a = a + 1;  b = b + 1
JP#High

#Low;'        #Low when run in parallel
  c = c + 1
  d = d + 1
JP#Low
Absolute value

Full Description
Takes the absolute value of the given number. Returns the value if positive, and returns -1 times the value if negative.

Arguments
@ABS[n] where
  n is a signed number in the range -2147483647 to 2147483647

Operand Usage
N/A

Usage

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Related Commands
All math operators

Examples:
```
:MG @ABS[-2147483647]
2147483647.0000
```
@ACOS
Inverse cosine

Full Description
Returns in degrees the arc cosine of the given number.

Arguments
@ACOS[n] where
n is a signed number in the range -1 to 1.

Operand Usage
N/A

Usage

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Related Commands
@ASIN - Arc sine
@SIN - sine
@ATAN - Arc tangent
@COS - Cosine
@TAN - Tangent

Examples:

:MG @ACOS[-1]
 180.0000
:MG @ACOS[0]
 90.0000
:MG @ACOS[1]
 0.0001
@AN

Analog Input Query

**Full Description**
Returns the value of the given analog input in volts

**Arguments**
@AN[n] where n is the input number assigned to a particular analog input pin (1-8)

**Operand Usage**
N/A

**Usage**

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</table>

@AN[] is an operand, not a command. It can only be used as an argument to other commands and operators

**Related Commands**
AQ Analog Range

**Examples:**

```plaintext
:MG @AN[1] ;'print analog input 1
1.7883
:x = @AN[1] ;'assign analog input 1 to a variable
```
**@ASIN**

**Inverse sine**

### Full Description

Returns in degrees the arc sine of the given number.

### Arguments

@ASIN[n] where

- n is a signed number in the range -1 to 1.

### Operand Usage

N/A

### Usage

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### Related Commands

- @ACOS[n] - Arc cosine
- @SIN[n] - Sine
- @ATAN[n] - Arc tangent
- @COS[n] - Cosine
- @TAN[n] - Tangent

### Examples:

`:MG @ASIN[-1]
-90.0000`
`:MG @ASIN[0]
0.0000`
`:MG @ASIN[1]
90.0000`
@ATAN

Inverse tangent

Full Description
Returns in degrees the arc tangent of the given number.

Arguments
@ATAN[n]
n is a signed number in the range -2147483647 to 2147483647

Operands Usage
N/A

Usage

<table>
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Related Commands
@ASIN - Arc sine
@SIN - Sine
@ACOS - Arc cosine
@COS - Cosine
@TAN - Tangent

Examples:
:MG @ATAN[-10]
  -84.2894
:MG @ATAN[0]
  0.0000
:MG @ATAN[10]
  84.2894
@COM

Bitwise complement

Full Description
Performs the bitwise complement (NOT) operation to the given number.

Arguments
@COM[n] where
n is a signed integer in the range -2147483647 to 2147483647.
The integer is interpreted as a 32-bit field.

Operand Usage
N/A

Usage

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Related Commands
& | - Logical operators AND and OR

Examples:

:MG ($8.0) @COM[0]
$FFFFFFFF

:MG ($8.0) @COM[$FFFFFFFF]
$00000000
@COS

Cosine

Full Description
Returns the cosine of the given angle in degrees

Arguments
@COS[n] where
n is a signed number in degrees in the range of -32768 to 32767, with a fractional resolution of 16-bit.

Operand Usage
N/A

Usage

<table>
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Related Commands
@ASIN[n] - Arc sine
@SIN[n] - Sine
@ATAN[n] - Arc tangent
@ACOS[n] - Arc cosine
@TAN[n] - Tangent

Examples:

:MG @COS[0]
  1.0000
:MG @COS[90]
  0.0000
:MG @COS[180]
  -1.0000
:MG @COS[270]
  0.0000
:MG @COS[360]
  1.0000
@FRAC

Fractional part

Full Description
Returns the fractional part of the given number

Arguments
@FRAC[n], n is a signed number in the range -2147483648 to 2147483647.

Operand Usage
N/A

Usage
Usage and Default Detail

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Related Commands
@INT[n] - Integer part

Examples:

:MG @FRAC[1.2]
0.2000

:MG @FRAC[-2.4]
-0.4000
@IN

Read digital input

**Full Description**

Returns the value of the given digital input (either 0 or 1)

**Arguments**

@IN[n]

where

n is an unsigned integer in the range 1 to 96

**Operands Usage**

N/A

**Usage**

*Usage and Default Details*

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**Related Commands**

@AN[n] - Read analog input
@OUT[n] - Read digital output
SB - Set digital output bit
CB - Clear digital output bit
OF - Set analog output offset

**Examples:**

```plaintext
MG @IN[1]
:1.0000
x = @IN[1]
x = ?
:1.000  print digital input 1
```
Full Description
Returns the integer part of the given number. Note that the modulus operator can be implemented with @INT (see example below).

Arguments
@INT[n]

n is a signed number in the range -2147483648 to 2147483647.

Operand Usage
N/A

Usage

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Related Commands
@FRAC - Fractional part

Examples:

:MG @INT[1.2]
1.0000
:MG @INT[-2.4]
-2.0000

#AUTO;' modulus example
x = 10;' prepare arguments
y = 3
JS#mod;' call modulus
MG z;' print return value
EN

' subroutine: integer remainder of x/y (10 mod 3 = 1)
' arguments are x and y. Return is in z
#mod
z = x - (y * @INT[x/y])
EN
Read digital output

Full Description
Returns the value of the given digital output (either 0 or 1)

Arguments
@OUT[n] where

n is an unsigned integer in the range 1 to 80

Operand Usage
N/A

Usage

Usage and Default Details

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Related Commands
@AN[n] - Read analog input
@IN[n] - Read digital input
SB - Set digital output bit
CB - Clear digital output bit
OF - Set analog output offset

Examples:

MG @OUT[1] ;'print digital output 1
:1.0000
x = @OUT[1] ;'assign digital output 1 to a variable
**@RND**

**Syntax:** @ Function

**Operands:** none

**Burn:** not burnable

**Round**

**Full Description**
Rounds the given number to the nearest integer

**Arguments**
@RND[n]

n is a signed number in the range -2147483648 to 2147483647.

**Operand Usage**
N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

@INT[n] - Truncates to the nearest integer

**Examples:**

```plaintext
:MG @RND[1.2]
1.0000
:MG @RND[5.7]
6.0000
:MG @RND[-1.2]
-1.0000
:MG @RND[-5.7]
-6.0000
:MG @RND[5.5]
6.0000
:MG @RND[-5.5]
-5.0000
```
@SIN

Sine

Full Description
Returns the sine of the given angle in degrees

Arguments
@SIN[n] where
n is a signed number in degrees in the range of -32768 to 32767, with a fractional resolution of 16-bit.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
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</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
@ASIN[n] - Arc sine
@COS[n] - Cosine
@ATAN[n] - Arc tangent
@ACOS[n] - Arc cosine
@TAN[n] - Tangent

Examples:
:MG @SIN[0] 0.0000
:MG @SIN[90] 1.0000
:MG @SIN[180] 0.0000
:MG @SIN[270] -1.0000
:MG @SIN[360] 0.0000
@SQR

Square Root

Full Description
Takes the square root of the given number. If the number is negative, the absolute value is taken first.

Arguments
@SQR[n] where
n is a signed number in the range -2147483648 to 2147483647.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
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<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
@ABS[n] - Absolute value

Examples:

:MG @SQR[2]
1.4142

:MG @SQR[-2]
1.4142
Square Brackets (Array Index Operator)

Full Description

The square brackets are used to denote the array index for an array, or to denote an array name. (They are also used to designate the argument to a function, such as @ABS[n].)

Arguments

`mmmmmmmm[n]` where

- `mmmmmmmm` is the array name
- `n` is the array index and is an integer between 0 and 15999

When used in an array, `n=-1` returns the array length.

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
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<tr>
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<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

DM - Dimension Array
QU - Print/Upload Array

Examples:

```
DM A[50]        ;'define a 50 element array
A[0] = 3        ;'set first element to 3
MG A[0]         ;'print element 0

#array
DM A[5];'        ;define a 5 element array
A[0] = 3;'       ;'set first element to 3
MG "A[0]=",A[0];' ;'print element 0
len= A[-1];'     ;variable len now contains the length of array A[]
QU A[],0,len-1,1;MG"";' ;'print entire array
MG "A[] length=",len;'; display Variable len
EN
```

A[] length= 5
3, 4320, 216666, 217522, 607950
Full Description

Provides local subroutine access for up to 8 variables passed on the subroutine stack when using the JS (jump to subroutine) command. Passing values on the stack is advanced DMC programming, and is recommended for experienced DMC programmers familiar with the concept of passing arguments by value and by reference. See the JS command for a full explanation of passing stack variables.

Notes:
1. Passing parameters has no type checking, so it is important to exercise good programming style when passing parameters. See examples below for recommended syntax.
2. Do not use spaces in expressions containing ^.
3. Global variables MUST be assigned prior to any use in subroutines where variables are passed by reference.

Arguments

N/A

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx, DMC-18x6</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

MG - Message - & Pass by reference
JS - Jump to subroutine

Examples:

```plaintext
#Add
JS#SUM(1,2,3,4,5,6,7,8) ;' call subroutine, pass values
MG_JS ;' print return value
EN

#SUM ;NO(^a,^b,^c,^d,^e,^f,^g,^h) Sums the values ^a to ^h and returns the result
EN,(^a+^b+^c+^d+^e+^f+^g+^h) ;' return sum
EN

:Executed program from program1.dmc
36.0000
```

Note: For additional examples, see the "JS Subroutine Stack Variables (^a, ^b, ^c, ^d, ^e, ^f, ^g, ^h)" section in the DMC-40x0 User Manual.
Lock program

Full Description
<control>L<control>K locks user access to the application program. When locked, the ED, UL, LS, and TR commands will give privilege error #106. The application program will still run when locked.

The locked or unlocked state can be saved with a BN command. Upon master reset, the controller is unlocked. Once the program is unlocked, it will remain accessible until a lock command or a reset (with the locked condition burned in) occurs.

Arguments
<control>L<control>K password,n where
When n is 1, this command will lock the application program.
When n is 0, the program will be unlocked.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx, DMC-18x6, RIO-47xxx</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
PW - Password
ED - Edit program
UL - Upload program
LS - List program
TR - Trace program

Examples:
:PW test, test          Set password to "test"
:^L^K test, 1            Lock the program
:LS                      Attempt to list the program
?
:TC1                     106 Privilege violation


\(^R^S\)

**Syntax:** Two Letter Only  
**Operands:** none  
**Burn:** not burnable

**Master Reset**

**Full Description**
The Master Reset command resets the controller to factory default settings and erases EEPROM.  
A master reset can also be performed by installing a jumper at the location labeled MRST and resetting the board (power cycle or pressing the reset button). Remove the jumper after this procedure. 

Note: Sending a \(^R^S\) over an Ethernet connection will cause the IP address to be cleared from the controller and will result in a timeout.

**Arguments**

**Operand Usage**
N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
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</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Formula</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**
RS - Reset

**Examples:**
Example burns-in a non-default value for KP, does a standard reset with the RS command, then performs a master reset with \(^R^S\).

```
:KP?
6.00
:KP10
:BN
:RS

:KP?
10.00
:"R^S

:KP?
6.00
:
```
Revision Information

Full Description
The Revision Information command causes the controller to return the firmware revision information.

Arguments
N/A

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

| N/A |
Full Description

The _GP operand contains the value of the "phase differential"* accumulated on the most current change in the gearing ratio between the master and the slave axes. The value does not update if the distance over which the slave will engage is set to 0 with the GD command.

The operand is specified as: _GPn where n is the specified slave axis

* Phase Differential is a term that is used to describe the lead or lag between the master axis and the slave axis due to gradual gear shift. Pd=GR*Cm-Cs where Pd is the phase differential, GR is the gear ratio, Cm is the number of encoder counts the master axis moved, and Cs is the number of encoder counts the slave moved.

Arguments

N/A

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

GR - Gear Ratio
GA - Gear Axis

Examples:

`#A`  
GAY;'  
Sets the Y axis as the gearing master for the X axis.
'  
This axis does not have to be under servo control. In this example, the axis is connected to a conveyor operating open loop.

GD1000;'  
Set the distance that the master will travel to 1000 counts before the gearing is fully engaged for the X axis slave.

AI-1;'  
Wait for input 1 to go low. In this example, this input is representing a sensor that senses an object on a conveyor. This will trigger the controller to begin gearing and synchronize the master and slave axes together.

GR1;'  
Engage gearing between the master and slave

P1=_TPY;'  
Sets the current Y axis position to variable P1. This variable is used in the next command, because MF requires an absolute position.
MF,(P1+1000);'Wait for the Y axis (master) to move forward 1000 encoder counts so the gearing engagement period is complete. Then the phase difference can be adjusted for. Note this example assumes forward motion.

IP_GPX;' Increment the difference to bring the master/slave in position sync from the point that the GR1 command was issued.

EN;' End Program
Forward Limit Switch Operand

Full Description
The _LF operand contains the state of the forward limit for the specified axis. The operand is specified as: _LFn where n is the specified axis.

_\text{LF}_n = 1 \text{ when the limit switch state will allow motion in the positive direction.} 
_\text{LF}_n = 0 \text{ when the limit switch state will not allow motion in the positive direction.}

Note: This operand is not a direct readout of the digital input and is affected by the command CN.

<table>
<thead>
<tr>
<th>Values of _LFn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Digital Input activation</strong></td>
</tr>
<tr>
<td>On. Grounded for TTL, or sufficient activation current flowing for optos.</td>
</tr>
<tr>
<td>Off. Pullup for TTL, or insufficient activation current flowing for optos.</td>
</tr>
</tbody>
</table>

Arguments
N/A

Operand Usage
_\text{LF} is an operand

Usage

<table>
<thead>
<tr>
<th><strong>Usage and Default Details</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage</strong></td>
</tr>
<tr>
<td>While Moving</td>
</tr>
<tr>
<td>In a Program</td>
</tr>
<tr>
<td>Command Line</td>
</tr>
<tr>
<td>Controller Usage</td>
</tr>
<tr>
<td>Default Value</td>
</tr>
<tr>
<td>Default Format</td>
</tr>
</tbody>
</table>

Related Commands
_\text{LR} - Reverse Limit Switch Operand

Examples:

| MG _LFA Display the status of the A axis forward limit switch |

*See Connecting Hardware in User Manual for active/inactive state
Reverse Limit Switch Operand

Full Description

The _LR operand contains the state of the forward limit for the specified axis. The operand is specified as: _LRn where n is the specified axis.

_LRn = 1 when the limit switch state will allow motion in the reverse direction.
_LRn = 0 when the limit switch state will not allow motion in the reverse direction.

Note: This operand is not a direct readout of the digital input and is affected by the command CN.

<table>
<thead>
<tr>
<th>Values of _LRn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital input activation</td>
</tr>
<tr>
<td>On. Grounded for TTL, or sufficient activation current flowing for optos.</td>
</tr>
<tr>
<td>Off. Pullup for TTL, or insufficient activation current flowing for optos.</td>
</tr>
</tbody>
</table>

Arguments

N/A

Operand Usage

_LR is an operand

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
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<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Default Format</td>
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</tr>
</tbody>
</table>

Related Commands

_LF - Forward Limit Switch Operand

Examples:

MG _LRA Display the status of the A axis reverse limit switch

*See Connecting Hardware in User Manual for active/inactive state
### Variable Axis Designator

**Full Description**

The ~ is the variable axis designator. 8 axis variables are provided: ~a, ~b, ~c, ~d, ~e, ~f, ~g, and ~h. Each variable can be assigned an individual axis A, B, C, D, E, F, G, or H, a vector plane, or a virtual axis. Motion commands on the variable will then apply to the assigned axis.

**Arguments**

~n=m

n is a lowercase letter a through h

m is a positive integer or single character string, where

0 or "A" (quotes required) = X axis
1 or "B" = Y axis
2 or "C" = Z axis
3 or "D" = W axis
4 or "E" = E Axis
5 or "F" = F axis
6 or "G" = G axis
7 or "H" = H axis
8 or "S" = S coordinate system
9 or "T" = T coordinate system
10 or "N" = Virtual N axis
11 or "M" = Virtual M axis

**Operand Usage**

~n contains the axis number 0-11

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```
~a=2;~b=6;'  Sets ~a to 2(Z axis). Sets ~b to 6(G axis)
PR~a=1000;'  Relative position move 1000 counts on ~a variable (set as Z axis)
JG~b=9000;'  Set jog speed of ~b variable (set as G axis) to 9000 cts/sec
BG~a~b;'    Begin motion on ~a and ~b variables (Z and G)
```
### Math Operators

#### Full Description

The addition, subtraction, multiplication, division, and modulus (Accelera only) operators are binary operators (they take two arguments and return one value) used to perform mathematical operations on variables, constants, and operands.

Mathematical operations are calculated left to right rather than multiplication and division calculations performed prior to addition and subtraction. Example:

\[ 1 + 2 \times 3 = 9 \] (not 7)

It is recommended that parenthesis be used when more than one mathematical operation is combined in one command.

Example:

\[
var = ((10 \times 30) + (60 / 30));
\]

\[ var = 10 \times 30 + 60 / 30; \]

#### Arguments

\((n + m)\) or \((n - m)\) or \((n \times m)\) or \((n / m)\) or \((n \% m)\) where

- \(n\) and \(m\) are signed numbers in the range -2,147,483,648 to 2,147,483,647

#### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
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<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
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<tr>
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<td>Yes</td>
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<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
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<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Related Commands

() - Parenthesis

#### Examples:

```
:x = ((1+(2*3))/7)-2 ;'assign -1 to x
:MG 40 % 6 ;'integer remainder of 40 divided by 6
   4.0000
```
Comparison Operators

Full Description
The comparison operators are as follows:

- `<` less than
- `>` greater than
- `=` equals
- `<=` less than or equal
- `>=` greater than or equal
- `<>` not equals

These are used in conjunction with IF, JP, JS, ( ), & , and | to perform conditional jumps. The result of a comparison expression can also be printed with MG or assigned to a variable.

Arguments
(n < m) or (n > m) or (n = m) or (n <= m) or (n >= m) or (n <> m) where
  n and m are signed numbers in the range -2147483648 to 2147483647

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
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</tr>
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</tr>
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<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

- ( ) - Parentheses
- IF - If statement
- JP - Jump
- JS - Jump subroutine

Examples:

```plaintext
IF(x > 2) & (y = 4)
MG "true"
ENDIF ;'x must be greater than 2 and y equal to 4 for
; 'the message to print
```
Equals (Assignment Operator)

Full Description
The assignment operator is used for three reasons:
(1) to define and initialize a variable (x = 0) before it is used
(2) to assign a new value to a variable (x = 5)
(3) to print a variable or array element (x= which is equivalent to MG x). MG is the preferred method of printing.

Arguments
mmmmmmmm = n where
mmmmmmmm is a variable name and n is a signed number in the range -2147483648 to 2147483647

Operand Usage
N/A

Usage

<table>
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</tr>
<tr>
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<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
MG - Print Message

Examples:

:x=5
:x=
  5.0000
:MG x
  5.0000
:       ;'define and initialize x to 5
;print x two different ways
**AB**

**Syntax:** Implicit Notation Only

**Operands:** ABn

**Burn:** not burnable

**Full Description**

AB (Abort) stops a motion instantly without a controlled deceleration. If there is a program operating, AB also aborts the program unless a 1 argument is specified. The command, AB, will shut off the motors for any axis in which the off on error function is enabled (see command OE). AB aborts motion on all axes in motion and cannot stop individual axes.

**Arguments**

AB n where

n = 0  The controller aborts motion and program
n = 1  The controller aborts motion only

No argument will cause the controller to abort the motion and program

**Operand Usage**

_AB gives state of Abort Input, 1 inactive and 0 active.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

SH - Re-enables motor
OE - Specifies Off On Error

**Examples:**

```
AB  ;'Stops motion
OE 1,1,1,1  ;'Enable off on error
AB  ;'Shuts off motor command and stops motion
```
AC

Acceleration

Full Description
The Acceleration (AC) command sets the linear acceleration rate of the motors for independent moves, such as PR, PA and JG moves. The acceleration rate may be changed during motion. The DC command is used to specify the deceleration rate.

Arguments
AC n,n,n,n,n,n,n,n or ACA=n where
n is an unsigned number in the range 1024 to 1073740800. The parameters input will be rounded down to the nearest factor of 1024. The units of the parameters are counts per second squared.

n = ? Returns the acceleration value for the specified axes.

Operand Usage
_ACm contains the value of acceleration for the specified axis.
where m is the axis (ex MG _ACA)

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256000</td>
</tr>
<tr>
<td>Default Format</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Related Commands
DC - Specifies deceleration rate.
FA - Feedforward Acceleration
IT - Smoothing constant - S-curve

Examples:

AC 150000,200000,300000,400000 Set A-axis acceleration to 150000, B-axis to 200000 counts/sec2, the C axis to 300000 counts/sec2, and the D-axis to 400000 count/sec2.
AC ?,?,?,? Request the Acceleration
149504, 199680, 299008, 399360 Return Acceleration (resolution, 1024)
V=_ACB Assigns the B acceleration to the variable V

Hint: Specify realistic acceleration rates based on your physical system such as motor torque rating, loads, and amplifier current rating. Specifying an excessive acceleration will cause large following error during acceleration and the motor will not follow the commanded profile. The acceleration feedforward command FA will help minimize the error.
**AD**

**Syntax:** Explicit & Implicit & Trippoint

**Operands:** none

**Burn:** not burnable

---

**After Distance**

---

**Full Description**

The After Distance (AD) command is a trippoint used to control the timing of events. This command will hold up the execution of the following command until one of the following conditions have been met:

1. The commanded motor position crosses the specified relative distance from the start of the move.
2. The motion profiling on the axis is complete.
3. If in jog (JG) mode, the commanded motion is in the direction which moves away from the specified position.

The units of the command are quadrature counts. Only one axis may be specified at a time. AD can only be used when there's command motion on the axis.

If the direction of motion is reversed when in PT mode, the starting position for AD is reinitialized to the position at which the motor is reversed.

Note: AD command will be affected when the motion smoothing time constant, IT, is not 1. See IT command for further information.

Hint: The AD command is accurate to the number of counts that occur in $2 \times \text{TM}$ sec. Multiply your speed by $2 \times \text{TM}$ sec to obtain the maximum position error in counts. Remember AD measures incremental distance from start of move on one axis.

---

**Arguments**

AD n,n,n,n,n,n,n,n   or   ADA=n  where
n is an unsigned integers in the range 0 to 2,147,483,647 decimal.

Note: The AD command cannot have more than 1 argument.

---

**Operand Usage**

N/A

---

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

---

**Related Commands**

AV - After distance for vector moves
AP - After position trip point
AR - After relative distance trip point
MF - Motion Forward trip point
MR - Motion Reverse trip point

---

**Examples:**

```
#A;DP0,0;' Begin Program
PR 10000,20000;' Specify positions
BG;' Begin motion
AD 5000;' After A reaches 5000
MG "Halfway to A";TPA;' Send message
AD ,10000;' After B reaches 10000
```
MG "Halfway to B";TPB;' Send message
EN;' End Program
The Analog Feedback (AF) command is used to set an axis with analog feedback instead of digital feedback (quadrature/pulse + dir). The analog feedback is decoded by a 12-bit A/D converter. An option is available for 16-bits. The position and analog range is set using the AQ command. Note: AQ must be set prior to setting AF.

### Arguments

AF n,n,n,n,n,n or AFA=n where

- **n = 1** Enables analog feedback
- **n = 0** Disables analog feedback and switches to digital feedback
- **n = ?** Returns the state of analog feedback for the specified axes. 0 disabled, 1 enabled

For 1Vp-p Sinusoidal Encoder Input with ICM-42100 (-I100)

- **n = 5-12** indicates that the sinusoidal encoder input is to be used with 2^n interpolation counts per encoder cycle
- **n = 0** Disables Sinusoidal Interpolation and switches to digital feedback. Differential encoder inputs must be used when using digital encoders with the ICM-42100. Consult the factory for single-ended use.
- **n = ?** Returns the state of analog feedback for the specified axes
- **n = -1** When not using Analog feedback, a -1 provides that the analog hardware still be sampled in the servo interrupt. This provides evenly sampled data for both the data record and the RA/RD/RC function.

### Operand Usage

_AFx contains a "1" if analog feedback is enabled and "0" if not enabled for the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0,0,0,0 or -1,-1</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

- AQ - Analog Configuration
- CE - Configure Encoder
- MT - Motor Type

### Examples:

- **AF 1,0,0,1**    Analog feedback on A and D axis
- **V1 = _AFA**    Assign feedback type to variable
- **AF ?,?,?**    Interrogate feedback type
**AG**

**Amplifier Gain**

**Full Description**

The AG command sets the amplifier current/voltage gain for the AMP-430x0. 0 sets the lowest ratio or value while 2 sets the highest ratio. AG is stored in EEPROM by the BN command. The MT command must be issued prior to the AG command to set the proper range. The axis must be in the motor off state (MO) before new AG settings will take effect.

**Arguments**

AG n,n,n,n,n,n,n where

*AMP-43040*

<table>
<thead>
<tr>
<th>AG setting</th>
<th>Gain Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0</td>
<td>0.4 A/V</td>
</tr>
<tr>
<td>n = 1</td>
<td>0.7 A/V</td>
</tr>
<tr>
<td>n = 2</td>
<td>1 A/V</td>
</tr>
</tbody>
</table>

*AMP-43240*

<table>
<thead>
<tr>
<th>AG Setting</th>
<th>Gain Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0</td>
<td>0.5 A/V</td>
</tr>
<tr>
<td>n = 1</td>
<td>1 A/V</td>
</tr>
<tr>
<td>n = 2</td>
<td>2 A/V</td>
</tr>
</tbody>
</table>

*AMP-43540*

<table>
<thead>
<tr>
<th>AG setting</th>
<th>Gain Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0</td>
<td>0.4 A/V</td>
</tr>
<tr>
<td>n = 1</td>
<td>0.8 A/V</td>
</tr>
<tr>
<td>n = 2</td>
<td>1.6 A/V</td>
</tr>
</tbody>
</table>

*SDM-44140*

<table>
<thead>
<tr>
<th>AG setting</th>
<th>Gain Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0</td>
<td>0.5 A</td>
</tr>
<tr>
<td>n = 1</td>
<td>1.0 A</td>
</tr>
<tr>
<td>n = 2</td>
<td>2.0 A</td>
</tr>
<tr>
<td>n = 3</td>
<td>3.0 A</td>
</tr>
</tbody>
</table>

*SDM-44040*

<table>
<thead>
<tr>
<th>AG setting</th>
<th>Gain Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0</td>
<td>0.5 A</td>
</tr>
<tr>
<td>n = 1</td>
<td>0.75 A</td>
</tr>
<tr>
<td>n = 2</td>
<td>1.0 A</td>
</tr>
<tr>
<td>n = 3</td>
<td>1.4 A</td>
</tr>
</tbody>
</table>

n = ?    Returns the value of the amplifier gain

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
</table>

While Moving: No  
In a Program: Yes  
Command Line: Yes  
Controller Usage: DMC-4xxx-D30x0; DMC-4xxx-D4140; DMC-4xxx-D4040  
Default Value: 1,1,1,1,1,1,1  
Default Format: N/A  

Operand Usage

Related Commands
TA - Tell Amplifier Error  
AW - Amplifier Bandwidth

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>Set motor off</td>
</tr>
<tr>
<td>AG2,1</td>
<td>Sets the highest amplifier gain for A axis and medium gain for B axis on 430x0.</td>
</tr>
<tr>
<td>SH</td>
<td>Turn motor on</td>
</tr>
<tr>
<td>BN</td>
<td>Save AG setting to EEPROM</td>
</tr>
</tbody>
</table>
**AI**

**Syntax:** Implicit Notation Only

**Operands:** none

**Burn:** not burnable

### Full Description

The AI command is a trippoint used in motion programs to wait until after a specified input has changed state. This command can be configured such that the controller will wait until the input goes high or the input goes low.

**Hint:** The AI command actually halts execution until specified input is at desired logic level. Use the conditional Jump command (JP) or input interrupt (II) if you do not want the program sequence to halt.

### Arguments

**AI +/-n** where 

n is an integer between 1 and 96 and represents the input number. If n is positive, the controller will wait for the input to go high. If n is negative, it waits for n to go low.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Operand Usage

**Related Commands**

@IN[n] - Read Digital Input

II - Input interrupt

#ININT - Label for input interrupt

TI - Tell Inputs

### Examples:

```plaintext
#A;' Begin Program
AI 8;' Wait until input 8 is high
SP 10000;' Speed is 10000 counts/sec
AC 20000;' Acceleration is 20000 counts/sec2
PR 400;' Specify position
BGA;' Begin motion
EN;' End Program
```
**Full Description**

The AL command enables the latch function (high speed main or auxiliary position capture) of the controller. When the position latch is armed, the main or auxiliary encoder position will be captured upon a low going signal. Each axis has a position latch and can be activated through the general inputs:

- A axis latch     Input 1
- B axis latch     Input 2
- C axis latch     Input 3
- D axis latch     Input 4
- E axis latch     Input 9
- F axis latch     Input 10
- G axis latch     Input 11
- H axis latch     Input 12

The command RL returns the captured position for the specified axes. When interrogated the AL command will return a 1 if the latch for that axis is armed or a zero after the latch has occurred. The CN command can be used to change the polarity of the latch function.

The latch function is available on incremental quadrature encoder inputs only. For other position capture methods contact Galil.

**Arguments**

AL nnnnnnnn or AL n,n,n,n,n,n,n,n

where

- n can be A,B,C,D,E,F,G or H, specifying the main encoder for the axis to be latched
- n can be SA,SB,SC,SD,SE,SE,SF,SG or SH, specifying the auxiliary encoder.
- n can be TA,TB,TC,TD,TE,TF,TG or TH, specifying the main encoder is latched from the index pulse instead of a digital input.

**Operand Usage**

_ALn contains the state of the specified latch. 0 = not armed, 1 = armed.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

RL - Report Latch

**Examples:**

```plaintext
#A      ;'Program Label
ALB     ;'Arm B-axis latch
JG,50000        ;'Set up jog at 50000 counts/sec
BGB     ;'Begin the move
#LOOP   ;'Loop until latch has occurred
JP #LOOP,_ALB=1
RLB     ;'Transmit the latched position
```
The AM command is a trippoint used to control the timing of events. This command will hold up execution of the following commands until the current move on the specified axis or axes is completed. Any combination of axes or a motion sequence may be specified with the AM command. For example, AM AB waits for motion on both the A and B axis to be complete. AM with no parameter specifies that motion on all axes is complete.

Hint: AM is a very important command for controlling the timing between multiple move sequences. For example, if the A-axis is in the middle of a position relative move (PR) you cannot make a position absolute move (PAA, BGA) until the first move is complete. Use AMA to halt the program sequences until the first profiled motion is complete. AM tests for profile completion. The actual motor may still be moving. To halt program sequence until the actual physical motion has completed, use the MC command. Another method for testing motion complete is to check for the internal variable _BGn, being equal to zero (see BG command).

Arguments

AM nnnnnnnnnn where
n is A,B,C,D,E,F,G,H,S or T or any combination to specify the axis or sequence
No argument specifies to wait for after motion on all axes and / or sequences

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Operand Usage

_BGn contains a 0 if motion complete

Related Commands

BG - Begin Motion
MC - Motion Complete

Examples:

```
#MOVE;
PR 5000,5000,5000,5000; 'Position relative moves
BG A; 'Start the A-axis
AM A; 'After the move is complete on A,
BG B; 'Start the B-axis
AM B; 'After the move is complete on B,
BG C; 'Start the C-axis
AM C; 'After the move is complete on C
BG D; 'Start the D-axis
AM D; 'After the move is complete on D
EN; 'End of Program
```
AO

**Full Description**
The AO command sets the analog output voltage of Modbus Devices connected via Ethernet.

**Arguments**

AO m, n

where
m is the I/O number calculated using the following equations:
  m = (HandleNum*1000) + ((Module-1)*4) + (Bitnum-1)

HandleNum is the handle specifier from A to H.

Module is the position of the module in the rack from 1 to 16.

BitNum is the I/O point in the module from 1 to 4.
  n = the voltage which ranges from 9.99 to -9.99

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Operand Usage**

**Related Commands**

SB - Set Bit
CB - Clear Bit
MB - Modbus

**Examples:**
# After Absolute Position

**Full Description**

The After Position (AP) command is a trippoint used to control the timing of events. This command will hold up the execution of the following command until one of the following conditions have been met:

1. The actual motor position crosses the specified absolute position. When using a stepper motor, this condition is satisfied when the stepper position (as determined by the output buffer) has crossed the specified position. For further information see Chapter 6 of the User Manual "Stepper Motor Operation".
2. The motion profiling on the axis is complete.
3. The commanded motion is in the direction which moves away from the specified position.

The units of the command are quadrature counts. Only one axis may be specified at a time. AP can only be used when there's commanded motion on the axis.

**Arguments**

AP n,n,n,n,n,n,n,n or APA=n where

n is a signed integer in the range -2147483648 to 2147483647 decimal

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

While Moving | Yes | Default Value | ---
In a Program  | Yes | Default Format | ---
Command Line  | No  |
Controller Usage | ALL CONTROLLERS |

**Related Commands**

AR - Trippoint for relative distances
MF - Trippoint for forward motion

**Examples:**

```
#TEST ;'Program B
DP0 ;'Define zero
JG 1000 ;'Jog mode (speed of 1000 counts/sec)
BG A ;'Begin move
AP 2000 ;'After passing the position 2000
V1=_TPA ;'Assign V1 A position
MG "Position is", V1 ;'Print Message
ST ;'Stop
EN ;'End of Program
```
Hint: The accuracy of the AP command is the number of counts that occur in 2*TM sec. Multiply the speed by 2*TM sec to obtain the maximum error. AP tests for absolute position. Use the AD command to measure incremental distances.
**AQ**

**Syntax:** Implicit Notation Only

**Operands:** _AQ1, AQ2, AQ3, AQ4, AQ5, AQ6, AQ7, AQ8_

**Burn:** burnable with BN

## Analog Input Configuration

**Full Description**

The Analog Configuration (AQ) command is used to set the range of the analog inputs. There are 4 different ranges that each analog input may be assigned. Setting a negative range for inputs 1,3,5 or 7, configures those inputs as the differential input relative to input 2,4,6 and 8 respectively.

**Arguments**

AQn,m where

- n is an integer from 1-8 that represents the analog input channel
- m is an integer from 1-4 that designates the analog range

### AQ setting details

<table>
<thead>
<tr>
<th>m</th>
<th>Analog Range</th>
<th>Position Range (12 bit)</th>
<th>Position Range (16 bit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+/-5 V</td>
<td>-2048 to 2047</td>
<td>-32,768 to 32767</td>
</tr>
<tr>
<td>2</td>
<td>+/-10 V</td>
<td>-2048 to 2047</td>
<td>-32,768 to 32767</td>
</tr>
<tr>
<td>3</td>
<td>0-5 V</td>
<td>0 to 4095</td>
<td>0 to 65535</td>
</tr>
<tr>
<td>4</td>
<td>0-10 V</td>
<td>0 to 4095</td>
<td>0 to 65535</td>
</tr>
</tbody>
</table>

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (no RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx, DMC-21x3, RIO-47xxx</td>
</tr>
<tr>
<td>Default Value</td>
<td>n,2</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

**Operand Usage**

_AQn holds the range setting for that axis where n=1-8_

**Related Commands**

@AN[n] - Read Analog Input
AF - Analog Feedback

**Examples:**

- :AQ2,3 Specify analog input 2 as 0-5V
- :AQ1,-3 Specify analog input 1 as 0-5V and the differential input to analog input 2
- :MG_AQ2 3.0000
**AR**

### After Relative Distance

#### Full Description

The After Relative (AR) command is a trippoint used to control the timing of events. This command will hold up the execution of the following command until one of the following conditions have been met:

1. The commanded motor position crosses the specified relative distance from either the start of the move or the last AR or AD command. When using a stepper motor, this condition is satisfied when the stepper position (as determined by the output buffer) has crossed the specified Relative Position. For further information see Chapter 6 of the User Manual "Stepper Motor Operation".
2. The motion profiling on the axis is complete.
3. If in jog (JG) mode, the commanded motion is in the direction which moves away from the specified position.

If the direction of the motion is reversed when in position tracking mode (see PT command), the starting point for the trippoint is reinitialized to the point at which the motion reversed.

The units of the command are quadrature counts. Only one axis may be specified at a time. AR can only be used when there's commanded motion on the axis.

Note: AR will be affected when the motion smoothing time constant, IT, is not 1. See IT command for further information.

#### Arguments

AR \(n, n, n, n, n, n, n, n\) or ARA\(=n\) where
\(n\) is an unsigned integer in the range 0 to 2147483647 decimal.

#### Operand Usage

N/A

#### Usage

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Related Commands

AV - Trippoint for after vector position for coordinated moves
AP - Trippoint for after absolute position

#### Examples:

```
#A;DP 0,0,0,0  ;'Begin Program
JG 50000,,,7000 ;'Specify speeds
BG AD  ;'Begin motion
#B  ;'Label
AR 25000        ;'After passing 25000 counts of relative distance on A-axis
MG "Passed _A",_TPA ;'Send message on A-axis
JP #B  ;'Jump to Label #B
EN  ;'End Program
```

Hint: AR is used to specify incremental distance from last AR or AD command. Use AR if multiple position trippoints are needed in a single motion sequence.
**Syntax:** Accepts Axis Mask & Trippoint

**Operands:** none

**Burn:** not burnable

---

**At Speed**

---

**Full Description**

The AS command is a trippoint that occurs when the generated motion profile has reached the specified speed. This command will hold up execution of the following command until the commanded speed has been reached. The AS command will operate after either accelerating or decelerating. If the speed is not reached, the trippoint will be triggered after the speed begins diverging from the AS value.

**Arguments**

AS nnnnnnnnn where
n is A,B,C,D,E,F,G,H,S or T or any combination to specify the axis or sequence

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

While Moving  Yes Default Value  -
In a Program   Yes Default Format -
Command Line   No
Controller Usage ALL CONTROLLERS

**Related Commands**

**Examples:**

```
#SPEED ;'Program A
PR 100000 ;'Specify position
SP 10000  ;'Specify speed
BGA      ;'Begin A
ASA      ;'After speed is reached
MG "At Speed" ;'Print Message
EN       ;'End of Program
WARNING:
The AS command applies to a trapezoidal velocity profile only with linear acceleration. AS used with smoothing profiling will be inaccurate.
```

---

**WARNING:**

The AS command applies to a trapezoidal velocity profile only with linear acceleration. AS used with smoothing profiling will be inaccurate.
**Full Description**

The AT command is a tripoint which is used to hold up execution of the next command until after the specified time has elapsed. The time is measured with respect to a defined reference time. AT 0 establishes the initial reference. AT n specifies n msec from the reference. AT -n specifies n msec from the reference and establishes a new reference after the elapsed time period.

AT n,1 specifies n samples from the reference. This is useful when TM is lowered and faster application loop times are required.

**Arguments**

AT n,m where

\n
n is a signed, even integer in the range 0 to 2 Billion
n = 0 defines a reference time at current time
n > 0 specifies a wait time of n msec from the reference time
n < 0 specifies a wait time of n msec from the reference time and re-sets the reference time when the tripoint is satisfied.
m = 0 or ommitted specifies n to be in ms
m = 1 specifies n to be in samples

(AT -n is equivalent to AT n; AT <old reference +n>)

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>-</td>
</tr>
</tbody>
</table>

**Operand Usage**

**Related Commands**

TIME - Time Operand
TM - Update Time
WT - Wait

**Examples:**

```plaintext
' jog proportional to analog input example with AT in ms
'AT -n
#main0
AT0;'
set time reference for AT command
JG0;BGX;'
start Jog mode
gain=1
#atloop
jgspd=gain*@AN[1]
JG jgspd
AT-100;'
wait 100 ms from last time reference (last AT-n or AT0)
```
REM same functionality would be:
REM AT -100,0
REM -or-
REM AT 100,0;AT0
JP#atloop

' jog proportional to analog input example with AT in samples
' AT n,1
#main1
AT0;'                set time reference for AT command
JG0;BGX;'            start Jog mode
gain=1
#atloop
  jgspd=gain*@AN[1]
  JG jgspd
  AT -100,1;'         wait 100 samples from last time reference (AT0)
JP#atloop

The following commands are sent sequentially
AT 0    Establishes reference time 0 as current time
AT 50   Waits 50 msec from reference 0
AT 100  Waits 100 msec from reference 0
AT -150 Waits 150 msec from reference 0 and sets new reference at 150
AT 80   Waits 80 msec from new reference (total elapsed time is 230 msec)
AU

Set amplifier current loop

Full Description

AMP-43040

The AU command sets the amplifier current loop gain. The current loop is available in one of two settings (0 is default while 1 sets a higher current loop gain).

AU also sets the switching mode where available, Chopper vs. Inverter.

High current loop gain:

Use the higher current loop gain (AU 1 or 1.5) when the phase to phase inductance of the motor is > 5mH with a 24VDC supply, or if the inductance is > 10mH with a 48VDC supply.

Chopper Mode (AU 0.5 or 1.5):

The AMP-430x0 can be set to "chopper" mode. The chopper mode is in contrast to the normal inverter mode in which the amplifier sends PWM power to the motor of +/-Vs. In chopper mode, the amplifier sends a 0 to +Vs PWM to the motor when moving in the forward direction, and a 0 to -Vs PWM to the motor when moving in the negative direction.

Chopper mode should be used in 2 different scenarios

1 - The inductance of the motor is 200uH to 500uH
2 - The application requires a continuous operation at >= 4 Amps of continuous torque at a duty cycle of >= 50%.

Chopper mode is recommended for high duty-cycle and high current applications.

AMP-43540

The AU command sets the amplifier current loop gain for the AMP-43540. The optimal current loop gain setting is determined by the bus voltage supplied to the amplifier and the phase to phase inductance of the motor. The table in the Arguments section provides ideal AU settings for common bus voltages and phase to phase inductance.

Arguments

AU m,m,m,m,m,m,m,m or AU=m

where

m = ? Returns the value of the AU setting for the specified axis.

<table>
<thead>
<tr>
<th>Vsupply VDC</th>
<th>Inductance L (mH)</th>
<th>m =</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>L &lt; 1</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>1 &lt; L &lt; 2.3</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>2.3 &lt; L &lt; 4.2</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>4.2 &lt; L</td>
<td>4</td>
</tr>
<tr>
<td>48</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>L &lt; 2.4</td>
<td>1</td>
</tr>
<tr>
<td>48</td>
<td>2.4 &lt; L &lt; 4.2</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>4.2 &lt; L &lt; 7</td>
<td>3</td>
</tr>
<tr>
<td>48</td>
<td>7 &lt; L</td>
<td>4</td>
</tr>
</tbody>
</table>

AMP-43040

<table>
<thead>
<tr>
<th>Description</th>
<th>m =</th>
</tr>
</thead>
</table>
Operand Usage

_AUn Returns the AU setting for the axis specified by 'n'

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

TA - Tell Amplifier
AG - Amplifier Gain
AW - Amplifier Bandwidth
BX - Sine Amp Initialization

Examples:

AU1,0;' Sets X-axis to higher loop gain and Y-axis to normal loop gain
AUY=?;' Query Y-axis current loop gain
:0
MG_AUA;' Query A axis current loop gain
:1
The AV command is a trippoint, which is used to hold up execution of the next command during coordinated moves such as VP, CR or LI. This trippoint occurs when the path distance of a sequence reaches the specified value. The distance is measured from the start of a coordinated move sequence or from the last AV command. The units of the command are quadrature counts.

Arguments

AV s,t  where
s and t are unsigned integers in the range 0 to 2147483647 decimal. 's' represents the vector distance to be executed in the S coordinate system and 't' represents the vector distance to be executed in the T coordinate system.

Operand Usage

_AVs contains the vector distance from the start of the sequence in the S coordinate system and _AVt contains the vector distance from the start of the sequence in the T coordinate system.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

#MOVE;DP 0,0;' Label
CAT;' Specify the T coordinate system
LMAB;' Linear move for A,B
LI 1000,2000;' Specify distance
LI 2000,3000;' Specify distance
LE
BGT;' Begin motion in the T coordinate system
AV ,500;' After path distance = 500,
MG "Path>500"
TPAB;' Print position of A and B axes
EN;' End Program

Hint: Vector Distance is calculated as the square root of the sum of the squared distance for each axis in the linear or vector mode.
**Full Description**

The AW command accepts the drive voltage (volts) and motor inductance (millihenries) and uses the current loop gain setting (AU) as the default and then reports the calculated bandwidth. The user can check how the amplifier bandwidth is affected by changing the n parameter. The AU command uses the transfer function for the AMP-430x0 for the calculation of the bandwidth.

**Arguments**

\[ AWx = v, l, n \]

- \( x \): Axis designator
- \( v \): Drive voltage in Volts
- \( l \): Motor inductance in millihenries
- \( n \): optional current loop gain setting (1 or 0)

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-40x0/DMC-21x3 with AMP-430x0, AMP-205x0 or AMP-20440</td>
</tr>
<tr>
<td>Default Value</td>
<td>0, 0, 0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

TA - Tell Amplifier
AG - Amplifier Gain
BS - Brushless Setup

**Examples:**

\[ AWY=60,5,0 \]

Sets a 60 volt drive, motor with 5 millihenries inductance and normal current loop gain

: 4525.732

Is the bandwidth in hertz
BA

Brushless Axis

Full Description

Galil Sine Drive Use
For axes equipped with a Galil sine drive, BA is used to configure the axis for sinusoidal operation. In addition to BA, BM and BX or BZ must be used to initialize the drive commutation. When using a Galil sine drive, one axis of control is required for one axis of drive. This is in contrast to the paired behavior below.

Third-Party Sine Drives Requiring Dual Analog Inputs (Rare)
In rare cases, some third-party sinusoidal drives require two analog signals to perform commutation. In this case, the BA command configures the controller axes for sinusoidal commutation and reconfigures the controller to reflect the actual number of motors that can be controlled. In this configuration, each axis requires 2 motor command signals. The second motor command signals will always be associated with the highest axis on the controller. For example a 3 axis controller with A and C configured for sinusoidal commutation will require 5 command outputs (a 5 axis controller), where the second outputs for A and C will be the D and E axes respectively.

Arguments

BA xxxxxxxxxx
where
   n is A,B,C,D,E,F,G,H or any combination to specify the axis (axes) for this mode.

Galil Sine Drive Use
BAN removes all axes configured for use with the sine drive. Sine drives will be disabled.

Third-Party Sine Drives Requiring Dual Analog Inputs (Rare)
BA removes all axes configured for sinusoidal commutation.

Operand Usage

Galil Sine Drive Use
_BAn will contain a 1 if the BA command has been issued for that axis, or a 0 if it has not.

Third-Party Sine Drives Requiring Dual Analog Inputs (Rare)
_BAn indicates the axis number of the auxiliary DAC used for the second phase of the selected sinusoidal axis. The axis numbers start with zero for the A axis DAC. If the motor is configured as standard servo or stepper motor, _BAn contains 0.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Related Commands
BB - Brushless Phase Begins
BC - Brushless Commutation
BD - Brushless Degrees
BI - Brushless Inputs
BM - Brushless Modulo
BO - Brushless Offset
BS - Brushless Setup
BZ - Brushless Zero
BX - Sine Amp Initialization

Examples:

BAA;'  Configure axis A
**BB**

**Syntax:** Explicit & Implicit
**Operands:** _BBn
**Burn:** burnable with BN

**Brushless Phase Begins**

### Full Description

The BB function describes the position offset between the Hall transition point and = 0, for a sinusoidally commutated motor. This command must be saved in non-volatile memory to be effective upon reset.

### Arguments

**BB n,n,n,n,n,n,n,n or BBA=n**

where

n is a signed integer which represent the phase offset of the selected axes in degrees of the magnetic cycle. The range is +/-359.98. The resolution is 1/32 of a degree.

n = ? returns the hall offset for the specified axis.

### Operand Usage

_ _BBn contains the position offset between the Hall transition and = 0 for the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

BA - Brushless Axis  
BC - Brushless Commutation  
BD - Brushless Degrees  
BI - Brushless Inputs  
BM - Brushless Modulo  
BO - Brushless Offset  
BS - Brushless Setup  
BZ - Brushless Zero

Note: BB is only effective as part of the BC command or upon reset.

**Examples:**

| BB,30,,60 | The offsets for the Y and W axes are 30 and 60 respectively |
**BC**

**Brushless Calibration**

**Full Description**
The function BC monitors the status of the Hall sensors of a sinusoidally commutated motor, and resets the commutation phase upon detecting the first hall sensor. This procedure replaces the estimated commutation phase value with a more precise value determined by the hall sensors.

**Arguments**

\[
\text{BC nnnnnn} \quad \text{where}
\]

\[
n \text{is A,B,C,D,E,F,G or any combination to specify the axis}
\]

**Operand Usage**

_\text{BCn}\_ contains the state of the Hall sensor inputs. This value should be between 1 and 6. 0 and 7 are invalid hall states.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

BA - Brushless Axis
BB - Brushless Phase Begins
BD - Brushless Degrees
BI - Brushless Inputs
BM - Brushless Modulo
BO - Brushless Offset
BS - Brushless Setup
BZ - Brushless Zero

**Examples:**

```
REM Example for use with AMP-43650 or AMP-43540
#EX
BAA
BMA=2000
BIA=-1;'use hall sensor inputs on the Galil
BCA;'enable brushless calibration
bi=_BIA;'store hall state
JGA=500
BGA;'begin jog
#hall;JP#hall,_BIA<>bi;'wait for a hall transition
STA
MG"Commutation Complete"
EN
```
## BD

**Brushless Degrees**

### Full Description

This command sets the commutation phase of a sinusoidally commutated motor. When using hall effect sensors, a more accurate value for this parameter can be set by using the command, BC. This command should not be used except when the user is creating a specialized phase initialization procedure.

### Arguments

BD \( n,n,n,n,n,n,n \) or \( BDA=n \) where

\( n \) is an integer between 0 - 360.

\( n = ? \) Returns the current brushless motor angle (between 0-360)

### Operand Usage

- \_BDn contains the commutation phase of the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

- "BA" - Brushless Axis
- "BB" - Brushless Phase Begins
- "BC" - Brushless Commutation
- "BI" - Brushless Inputs
- "BM" - Brushless Modulo
- "BO" - Brushless Offset
- "BS" - Brushless Setup
- "BZ" - Brushless Zero

### Examples:
**BG**

**Full Description**

The BG command starts a motion on the specified axis or sequence.

**Arguments**

BG nnnnnnnnn where
n is A,B,C,D,E,F,G,H,S,T, M or N, or any combination to specify the axis or sequence

**Operand Usage**

_BGn contains a '0' if motion complete on the specified axis or coordinate system, otherwise contains a '1'.

**Usage**

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Examples:**

PR 2000,3000,,5000  Set up for a relative move
BG ABD  Start the A,B and D motors moving
HM  Set up for the homing
BGA  Start only the A-axis moving
JG 1000,4000  Set up for jog
BGY  Start only the B-axis moving
BSTATE=_BG Assign a 1 to BSTATE if the B-axis is performing a move
VP 1000,2000  Specify vector position
VS 20000  Specify vector velocity
BGS  Begin coordinated sequence
VMAB  Vector Mode
VP 4000,-1000  Specify vector position
VE  Vector End
FR ,,8000,5000  Specify C and D position
BGSCD  Begin sequence and C,D motion
MG _BGDisplays a 1 if motion occurring on coordinated system "S"

Hint: A BG command cannot be executed for any axis in which motion has not completed. Use the AM trippoint to wait for motion complete between moves. Determining when motion is complete can also
be accomplished by testing for the value of the operand _BGn.
Full Description
The command BI is used to define the inputs which are used when Hall sensors have been wired for sinusoidally commutated motors. These inputs can be the general use inputs (bits 1-8), the auxiliary encoder inputs (bits 81-96), or the extended I/O inputs (bits 17-48). The Hall sensors of each axis must be connected to consecutive input lines, for example: BI 3 indicates that inputs 3, 4 and 5 are used for halls sensors.

With the AMP-43540 or AMP-43650 the Hall A, Hall B and Hall C inputs on the Encoder connector may be specified by setting the BI command to -1.

Arguments
BI n,n,n,n,n,n,n or BIA=n where
n is an unsigned integer which represent the first digital input to be used for hall sensor input
n = 0 Clear the hall sensor configuration for the axis.
 n = -1 Specifies the controller to use the Hall inputs available on the AMP-43540 or AMP-43640.
 n = ? Returns the starting input used for Hall sensors for the specified axis.

Operand Usage
_BIn contains the starting input used for Hall sensors for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
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</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
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</table>

Related Commands
BA - Brushless Axis
BB - Brushless Phase Begins
BC - Brushless Commutation
BD - Brushless Degrees
BM - Brushless Modulo
BO - Brushless Offset
BS - Brushless Setup
BZ - Brushless Zero

Examples:

BI, 5;' The Hall sensor of the Y axis are on inputs 5, 6 and 7.
REM Example for use with AMP-43650 or AMP-43540
#EX
BAA
BMA=2000
BIA=-1;' use hall sensor inputs on the Galil
BCA;' enable brushless calibration
bi=_BIA;' store hall state
JGA=500
BGA;' begin jog
#hall;JP#hall,_BIA<>bi;' wait for a hall transition
STA
MG"Commutation Complete"
EN
**BK**

**Full Description**
For debugging. Causes the controller to pause execution of the given thread at the given program line number (which is not executed). All other threads continue running. Only one breakpoint may be armed at any time. After a breakpoint is encountered, a new breakpoint can be armed (to continue execution to the new breakpoint) or BK will resume program execution. The SL command can be used to single step from the breakpoint. The breakpoint can be armed before or during thread execution.

**Arguments**

\[
\text{BK } n,m \quad \text{where} \\
\begin{align*}
\text{n} & \text{ is an integer in the range 0 to 1999 which is the line number to stop at. } n \text{ must be a valid line number in the chosen thread.} \\
\text{m} & \text{ is an integer in the range 0 to 7. The thread.}
\end{align*}
\]

**Operand Usage**

BK will tell whether a breakpoint has been armed, whether it has been encountered, and the program line number of the breakpoint:

- LineNumber: breakpoint armed
- LineNumber: breakpoint encountered
- -2147483648: breakpoint not armed

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>of m 0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

- BK 3  
  Pause at line 3 (the 4th line) in thread 0
- BK 5  
  Continue to line 5
- SL    
  Execute the next line
- SL 3  
  Execute the next 3 lines
- BK    
  Resume normal execution
The BL command sets the reverse software limit. If this limit is exceeded during motion, motion on that axis will decelerate to a stop. Reverse motion beyond this limit is not permitted.

When the reverse software limit is activated, the automatic subroutine #LIMSWI will be executed if it is included in the program.

**Arguments**

BL n,n,n,n,n,n | n
where
n is a signed integer in the range -2147483648 to 2147483647. The reverse limit is activated at the position n-1. The units are in quadrature counts.

n = -2147483648  Turns off the reverse limit.
n = ?   Returns the reverse software limit for the specified axes.

**Operand Usage**

.BLn contains the value of the reverse software limit for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>-214783648</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position format</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

#TEST   Test Program
AC 1000000  Acceleration Rate
DC 1000000  Deceleration Rate
BL -15000   Set Reverse Limit
JG  -5000   Jog Reverse
BGA     Begin Motion
AMA     After Motion (limit occurred)
TPA     Tell Position
EN      End Program

*Hint:  Galil Controllers  also provide hardware limits.*
BM

**Brushless Modulo**

**Full Description**

The BM command defines the length of the magnetic cycle in encoder counts.

For rotary motors, it is recommended that the BM value be specified as the counts per revolution divided by the # of poll pairs.

\[
\text{cts}=4096; \quad \text{Counts per rev}
\]
\[
\text{pp}=3; \quad \text{Pole pairs}
\]
\[
\text{BMA}=\frac{\text{cts}}{\text{pp}}
\]

**Arguments**

BM \(n,n,n,n,n,n,n\) or BMA=\(n\) where

- \(n\) is a decimal value between 1 and 1000000 with a resolution of 1/10. This value can also be specified as a fraction with a resolution of 1/16.
- \(n = ?\) Returns the brushless module for the specified axis.

**Operand Usage**

_\_BMn_ indicates the cycle length in counts for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>2000</td>
</tr>
<tr>
<td>Default Format</td>
<td>4.2</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

- BM ,60000;' Set brushless modulo for B axis to be 60000
- BMWC=100000/3;' Set brushless modulo for C axis to be 100000/3 (33333.333)
- BM ,,,?;' Interrogate the Brushless Module for the D axis

**Note:** Changing the BM parameter causes an instant change in the commutation phase.
Full Description

The BN command saves controller parameters shown below in Flash EEPROM memory. This command typically takes 1 second to execute and must not be interrupted. The controller returns a : when the Burn is complete.

PARAMETERS SAVED DURING BURN:
AC  CE  GR  MT  SM
AF  CN  HV  NB  SP
AG  CO  IA  NF  TK
AQ  CW  IK  NZ  TL
AU  DC  IL  OA  TM
BA  DH  IT  OE  TR
BB  DV  KD  OF  VA
BI  EO  KI  OP  VD
BL  ER  KP  OT  VF
BM  FA  KS  OV  VS
BO  FL  LC  PF  YA
BR  FV  LD  PL  YB
BW  GA  LZ  PW  YC
CB  GM  MO  SB

Arguments
N/A

Operand Usage

_BN contains the serial number of the processor board.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

SB1;'   Set bit 1
CB2;'   Clear bit 2
CW1;'   Set data adjustment bit
BN;'    Burn all parameter states
BO

Brushless Offset

Full Description
The BO command sets a fixed offset on command signal outputs for sinusoidally commutated motors. This may be used to offset any bias in the amplifier, or can be used for phase initialization.

Arguments
BO n,n,n,n,n,n or BOA=n where
n specifies the voltage n is a signed number in the range -9.998 to +9.998 with a resolution of 0.0003.

n = ? Return the brushless offset for the specified axis.

Operand Usage
_BOn contains the offset voltage on the DAC for the specified axis.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands
BA
Brushless Axis
BB
Brushless Phase Begins
BC
Brushless Commutation
BD
Brushless Degrees
BI
Brushless Inputs
BM
Brushless Modulo
BS
Brushless Setup
BZ
Brushless Zero

Examples:
BO -2,,1 Generates the voltages -2 and 1 on the first DAC A, and the second DAC C of a sinusoidally commutated motor.
HINT: To assure that the output voltage equals the BO parameters, set the PID and OF parameters to zero.
Full Description
The BP command saves the application program in non-volatile EEPROM memory. This command typically takes up to 10 seconds to execute and must not be interrupted. The controller returns a : when the Burn is complete.

Arguments
None

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
BN
Burn Parameters
BV
Burn Variable

Examples:
**BR**

**Brush Axis**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>burnable with BN</td>
</tr>
</tbody>
</table>

**Full Description**

The BR command is used with internal Galil amplifiers to enable which axes will be set as brush-type servos or to configure the firmware to use external drives instead of the internal channel. The hall error bits cannot cause #AMPERR events if an axis is configured as brush-type. With BR1, the hall inputs are available for general use via the QH command.

**Trap Amps**

If an axis has Off-On-Error(OE) set to 1, an amplifier error will occur on an axis if there are no halls and BR is set to 0. Set BR to 1 to avoid an amplifier error state.

**Arguments**

\[ BR \ n\_1,\ n\_2,\ n\_3,\ n\_4,\ n\_5,\ n\_6,\ n\_7,\ n\_8 \]

where

- \( n = 0 \): Brushless servo axis
- \( n = 1 \): Brush-type servo axis
- \( n = ? \): Returns the value of the axis
- \( n = -1 \): External drive when equipped with an internal Galil sine drive

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0, 0, 0, 0, 0, 0, 0, 0</td>
</tr>
</tbody>
</table>

**Related Commands**

- OE - Off-On Error
- TA - Tell Amplifier
- QH - Hall State

**Examples:**

- BR 1,0,0;' Sets X-axis to brush-type, Y and Z to brushless
BS

Brushless Setup

Full Description
The command BS tests the wiring of a sinusoidally commutated brushless motor. If Hall sensors are connected, this command also tests the wiring of the Hall sensors. This function can only be performed with one axis at a time.
This command returns status information regarding the setup of brushless motors. The following information will be returned by the controller:
1. Correct wiring of the brushless motor phases.
2. An approximate value of the motor's magnetic cycle.
3. The value of the BB command (If hall sensors are used).
4. The results of the hall sensor wiring test (If hall sensors are used).
This command will turn the motor off when done and may be given when the motor is off.
Once the brushless motor is properly setup and the motor configuration has been saved in non-volatile memory, the BS command does not have to be re-issued. The configuration is saved by using the burn command, BN.
Note: In order to properly conduct the brushless setup, the motor must be allowed to move a minimum of one magnetic cycle in both directions.

Arguments
BSA= v, n where
v is a real number between 0 and 10. v represents the voltage level to be applied to each phase.
N is a positive integer between 100 or 1000. n represents the duration in milliseconds that voltage should be applied to the motor phases.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>200</td>
</tr>
</tbody>
</table>

Related Commands
BA - Brushless Axis
BB - Brushless Phase Begins
BC - Brushless Commutation
BD - Brushless Degrees
BI - Brushless Inputs
BM - Brushless Modulo
BO - Brushless Offset
BZ - Brushless Zero

Examples:
BSC = 2,900     Apply set up test to C axis with 2 volts for 900 millisecond on each step.
Note: When using Galil Windows software, the timeout must be set to a minimum of 10 seconds (timeout = 10000) when executing the BS command.
This allows the software to retrieve all messages returned from the controller.
BT

Begin PVT Motion

Full Description
The BT command begins PVT motion on the specified axes. All axes will begin at the same time. For more details on PVT mode see the user manual.

Arguments
BTnnnnnnn where n is A,B,C,D,E,F,G,H or any combination of axes

Operand Usage
_BTn contains the number of PV segments that have executed.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-40x0, DMC-18x6, and others via upgrade</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
PV - PVT Data
MF - Forward Motion to Position Trippoint
MR - Reverse Motion to Position Trippoint

Examples
:MG_BTX 0.0000
:PVX=100,200,100
:PVX=100,0,100
:PVX=0
:BTX
:MG_BTX 3.0000
Burn Variables and Array

Full Description
The BV command saves the controller variables and arrays in non-volatile EEPROM memory. This command typically takes up to 2 seconds to execute and must not be interrupted. The controller returns a : when the Burn is complete.

Arguments
None

Operand Usage
_BV returns the number of controller axes.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
"BP" - Burn Program
"BN" - Burn Parameters

Burn Program
Note 1: This command will store the ECAM table values in non-volatile EEPROM memory.
Note 2: This command may cause the Galil software to issue the following warning "A time-out occurred while waiting for a response from the controller". This warning is normal and is designed to warn the user when the controller does not respond to a command within the timeout period. This occurs because this command takes more time than the default timeout of 5 sec. The timeout can be changed in the Galil software but this warning does not affect the operation of the controller or software.

Examples:
**Full Description**

The BW command sets the delay between when the brake is turned on and when the amp is turned off. When the controller goes into a motor-off (MO) state, this is the time (in samples) between when the brake digital output changes state and when the amp enable digital output changes state. The brake is actuated immediately upon MO and the delay is to account for the time it takes for the brake to engage mechanically once it is energized electrically. The brake is released immediately upon SH.

Outputs 1-8 are used for Axes A-H, where output 1 is the brake for axis A and output 2 is the brake for axis B and so on.

Note: The Brake Wait does not apply when the motor is shut off due to OE1 (Off on Error). In this case (position error exceeded or Abort triggered) the motor off and brake output will be applied simultaneously.

**Arguments**

BW n,n,n,n,n,n,n

or BWA=n

where

n specifies the brake wait time in samples. n ranges from 1 to 32000

n = 0  Turns Brake Wait off

n = ?  Returns the brake wait time in msec for the specified axis.

**Operand Usage**

_BWn contains the brake wait time in samples for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

MO - Motor Off

SH - Servo Here

**Examples:**

BW100    Set brake delay to 100 ms (TM1000) for the X axis
THIS COMMAND IS STILL IN BETA. ITS IMPLEMENTATION IS SUBJECT TO CHANGE.

Full Description
The BX command is only valid with the AMP-43540 or the AMP-43640

An axis with a Galil sine amp powers up in MO state and SH will generate an error for that axis until it is initialized.

While the BX command is executing, communication to and from the controller will be halted. This may result in a timeout if the BX command is sent from the host*. Embedded code execution will also pause during BX operation.

If the BX command fails to initialize an axis, it will return an error code of 160. TC1 will return "160 BX Command Failure".

The BX uses a limited motion algorithm to determine the proper location of the motor within the magnetic cycle. It is expected to move no greater than 10 degrees of the magnetic cycle.

* The long timeout (-l) for GalilTools 1.5.0 has been increased to prevent a timeout while using the BX command.

Arguments

BX m,m,m,m,m,m,m,m,m,m,m,m or BX=m or BX<t
where
m is a real number from -4.998 to 4.999 representing the voltage used to initialize the axis.
A negative voltage will leave the amp on after the BX command, while a positive voltage will leave the amp in the MO state.

The time for the BX command to return will increase with the magnitude of m.
In most cases BX settings of larger than 3 are not required.

< t is an integer between 1 and 5000 and represents the final pulse duration of the BX command.
The last stage of the BX command will lock the motor into a 15 degree increment for 't' samples.

Operands

_BXn
contains 0 if n is not a Galil sine amp axis
contains 1 if n is an uninitialized sine amp axis
contains 3 if n is an initialized sine amp axis

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes (recommended)</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>t = 1000</td>
</tr>
</tbody>
</table>

Related Commands

BA - Brushless Axis
BM - Brushless Modulo

Examples
REM Simple Example
BAA
BMA=2000
BXA=-3
#bxa;JP#bxa,_BXA<>3
ENDIF

REM Detailed Example
#COM
~a=0;'0 = A axis, 1 = B axis . . .
BA~a;'enable brushless mode
BM~a=2000;'must be set per individual motor specifications
bx_i=0;'number of tries for the BX command
#COM_H
tc=0;'response from TC command if an error occurs
MO~a;'start in motor off state
#tv;JP#tv,_TV~a>500;'make sure axis is not moving
BX<1000;'set pulse duration to 1000 samples
BX~a=-3;'command the BX command
REM loop until BX passes or error occurs
#LOOP;JP#LOOP,((_BX~a<>3)&(tc=0))
REM try again if an error occurred and the number of tries < 5
JP#COM_H,((tc<>0)&(bx_i<5))
REM if the number of tries is < 5 then BX passed
REM else, try BZ command
IF (bx_i<5)
MG "Commutation complete"
ELSE
MG "BX failed to complete"
MG "attempting BZ command"
tc=0;BZ~a=-3
IF tc=0
MG "BZ command complete"
ELSE
MG "BZ command failed"
MG "check motor and encoder wiring"
MG "try setting CE 2 or swapping 2 motor leads"
ENDIF
ENDIF
EN

#CMDERR
tc=_TC
TC1
REM if 160 error, increase BX<t and try again
IF tc=160
MG "Retry BX"
bx_i=bx_i+1
BX<(bx_i*1000);'increase pulse time on failure
ENDIF
RE
Brushless Zero

Full Description
The BZ command is used for axes which are configured for sinusoidal commutation. This command drives the motor to zero magnetic phase and then sets the commutation phase to zero. This command may be given when the motor is off.

Arguments
\[
\text{BZ \ n,n,n,n,n,n,n \ or \ BZA = n \ or \ BZ < t \ where}
\]
- \( n \) is a real number between -4.998 and 4.998. The parameter \( n \) will set the voltage to be applied to the amplifier during the initialization. In order to be accurate, the BZ command voltage must be large enough to move the motor. If the argument is positive, when the BZ operation is complete, the motor will be left in the off state, MO. A negative value causes the motor to end up in the on state, SH.
- \( < t \) is an integer between 1 and 32767 and represents the settling time of the BZ function. The controller will wait \( t \) sec to update sufficient samples (sampling rate = 1000 sec by default) to settle the motor at the zero magnetic phase. The \( t \) parameter should be specified prior to issuing the BZ command.

Note: The BZ command causes instantaneous movement of the motor. It is recommended to start with small voltages and increase as needed
Note: Always use the Off On Error function (OE command) to avoid motor runaway whenever testing sinusoidal commutation.

Operand Usage
\( \_\text{BZn} \) contains the distance in encoder counts from the motor's current position and the position of commutation zero for the specified axis. This can be useful to command a motor to move to the commutation zero position for phase initialization.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>( n = 0, t = 1000 )</td>
</tr>
<tr>
<td>Default Format</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands
- BA - Brushless Axis
- BB - Brushless Phase Begins
- BC - Brushless Commutation
- BD - Brushless Degrees
- BI - Brushless Inputs
- BM - Brushless Modulo
- BO - Brushless Offset
- BS - Brushless Setup

Examples:
\[
\text{BZ, -3 \ Drive C axis to zero phase with 3 volt signal, and end with motor enabled.}
\]
CA

Coordinate Axes

Full Description
The CA command specifies the coordinate system to apply proceeding vector commands. The following commands apply to the active coordinate system as set by the CA command:

| CR | ES | LE | LI | LM |
| TN | VE | VM | VP |

Arguments
CAS or CAT where
CAS specifies that proceeding vector commands shall apply to the S coordinate system
CAT specifies that proceeding vector commands shall apply to the T coordinate system
CA ? returns a 0 if the S coordinate system is active and a 1 if the T coordinate system is active.

Operand Usage
_CA contains a 0 if the S coordinate system is active and a 1 if the T coordinate system is active.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>CAS</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
VP - Vector Position
VS - Vector Speed
VD - Vector Deceleration
VA - Vector Acceleration
VM - Vector Mode
VE - End Vector
BG - BGS - Begin Sequence

Examples:

<table>
<thead>
<tr>
<th>CAT</th>
<th>Specify T coordinate system</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMAB</td>
<td>Specify vector motion in the A and B plane</td>
</tr>
<tr>
<td>VS 10000</td>
<td>Specify vector speed</td>
</tr>
<tr>
<td>CR 1000,0,360</td>
<td>Generate circle with radius of 1000 counts, start at 0 degrees and complete one circle in counterclockwise direction.</td>
</tr>
<tr>
<td>VE</td>
<td>End Sequence</td>
</tr>
<tr>
<td>BGT</td>
<td>Start motion of T coordinate system</td>
</tr>
</tbody>
</table>
CB

Syntax: Implicit Notation Only
Operands: none
Burn: not burnable

Clear Bit

Full Description
The CB command clears a particular digital output, setting the output to logic 0. The CB and SB (Set Bit) instructions can be used to control the state of output lines.

CB can be used to clear the outputs of extended I/O which have been configured as outputs. See the CO command.

The CB command can also be used with modbus devices to clear remote outputs.

Arguments
CB n
where
n is an integer corresponding to a specific output on the controller to be cleared (set to 0).

When using Modbus devices, the I/O points of the modbus devices are calculated using the following formula:

\[ n = (\text{SlaveAddress} \times 10000) + (\text{HandleNum} \times 1000) + ((\text{Module} - 1) \times 4) + (\text{Bitnum} - 1) \]

Slave Address is used when the ModBus device has slave devices connected to it and specified as Addresses 0 to 255. Please note that the use of slave devices for modbus are very rare and this number will usually be 0.

HandleNum is the handle specifier from A to H.

Module is the position of the module in the rack from 1 to 16.

BitNum is the I/O point in the module from 1 to 4.

Operand Usage
N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

Related Commands
"SB" - Set Bit
"OB" - Output Bit
"OP" - Output Port

Examples:

| CB 7;\'         | Clear output bit 7 |
| CB 15;\'        | Clear output bit 15 (RIO and 5-8 axis controllers only) |
**Full Description**

The CC command configures baud rate, handshake, mode, and echo for the AUX SERIAL PORT, referred to as Port 2. This command must be given before using the MG, or CI commands with Port 2.

**Arguments**

\[
\text{CC } m,n,r,p
\]
where
- \( m \) - Baud rate \( 9600,19200, 38400, \text{ or } 115200 \)
- \( n \) - Handshake \( 0 \) for handshake off, \( 1 \) for handshake on
- \( r \) - Enabled \( 0 \) disabled, \( 1 \) enabled
- \( p \) - Echo \( 0 \) for echo off, \( 1 \) for echo on

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Related Commands**

CI - Configure Communication Interrupt

**Examples:**

\[\text{:CC 9600,0,0,0} \quad 9600 \text{ baud, no handshake, echo off.}\]
\[\text{:} \quad \text{Typical setting with TERM-P or TERM-H.}\]
**Full Description**

The CD command specifies the incremental position on contour axes. The units of the command are in encoder counts. This command is used only in the Contour Mode (CM). The incremental position will be executed over the time period specified by the command DT (ranging from 2 to 256 servo updates).

The = operator can be used to override the global DT time by transmitting the time in a CD with the position data.

**Arguments**

CD n,n,n,n,n,n,n,n = m or CDA=n where

- n is an integer in the range of +/-32767.
- m (optional) is an integer in the range 0 to 8 and overrides the global DT time for this interval
- n = m = 0 terminates the Contour Mode.
- m = 1 through 8 specifies the time interval (DT) of 2^m samples.

By default the sample period is 1 msec (set by the TM command); with m = 1, the time interval would be 2 msec.

Note 1: The command CD 0,0=0 would follow the last CD command in a sequence CD 0,0=0 is similar to VE & LE. Once reached in the buffer, CD 0,0 =0 will terminate the contour mode.

Note 2: The command CD0=0 will assign a variable CD0 the value of 0. In this case the user must have a space after CD in order to terminate the Contour Mode correctly. Example: CD 0=0 will terminate the contour mode for the X axis.

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Related Commands**

- CM - Contour Mode
- DT - Time Increment
- CS - Clear Sequence
  _CS is the Segment Counter_

**Examples:**

```plaintext
#CONTOUR;'                Program Label
CMAB;'                    Enter Contour Mode
DT 4;'                    Set time interval
CD 1000,2000;'            Specify data
CD 2000,4000;'            Next data
```
CD 0,0=0;'                End of Contour Buffer
#Wait;'                   Wait for all segments to process (buffer to empty)
WT 16,1;'                 wait for 1 DT time segment (2^4)
JP#Wait, _CM<>511         End Program
EN;'
**Configure Encoder**

**Full Description**

The CE command configures the encoder to quadrature type or pulse and direction type. It also allows inverting the polarity of the encoders which reverses the direction of the feedback. Note: When using a servo motor, changing the CE type can cause the motor to run away.

The configuration applies independently to the main axes encoders and the auxiliary encoders. When the MT command is configured for a stepper motor, the auxiliary encoder (used to count stepper pulses) will be forced to pulse and direction.

**Arguments**

CE n,n,n,n,n,n,n,n or CEA = n  
where  
n is an integer in the range of 0 to 15. Each integer is the sum of two integers M and N which configure the main and the auxiliary encoders.

**Configure Encoder Types**

<table>
<thead>
<tr>
<th>M argument</th>
<th>Main Encoder Type</th>
<th>N argument</th>
<th>Auxiliary Encoder Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal quadrature</td>
<td>0</td>
<td>Normal quadrature</td>
</tr>
<tr>
<td>1</td>
<td>Normal pulse and direction</td>
<td>4</td>
<td>Normal pulse and direction</td>
</tr>
<tr>
<td>2</td>
<td>Reversed quadrature</td>
<td>8</td>
<td>Reversed quadrature</td>
</tr>
<tr>
<td>3</td>
<td>Reversed pulse and direction</td>
<td>12</td>
<td>Reversed pulse and direction</td>
</tr>
</tbody>
</table>

For example: n = 10 implies M = 2 and N = 8, thus both encoders are reversed quadrature.

n = ?  Returns the value of the encoder configuration for the specified axes.

**Operand Usage**

_CEn contains the value of encoder type for the axis specified by 'n'.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related Commands**

"MT" - Specify motor type

**Examples:**

```plaintext
CE 0, 3, 6, 2  Configure encoders
CE ?,?,?,?,?  
:0,3,6,2  Interrogate configuration
V = _CEB
V = ?  
:3  Assign configuration to a variable
```

Note: When using pulse and direction encoders, the pulse signal is connected to CHA and the direction signal is connected to CHB.
CF
Configure Unsolicited Messages Handle

Full Description
Sets the port for unsolicited messages. By default, the controller will send unsolicited data to the main RS-232 or USB serial port. The CF command directs the controller to send unsolicited responses to the Main or Aux Serial Port (If equipped), or to an Ethernet handle.

An unsolicited message is data generated by the controller which is not in response to a command sent by the host. Examples of commands that will generate unsolicited messages follow. These commands are unsolicited only when in embedded code, NOT when sent from a host.

MG"Hello";' A message (MG)
TC1;' A command that returns a response
TP;' "
RPA;' "
var=?;' A variable interrogation
var=' "
thisIsAnError;' A dmc error will generate an error message

Arguments
CFn
where n is A through H for Ethernet handles 1 through 8, S for Main serial port, T for Aux serial port or I is to set to the port that issues the CF command.

The axis designator ~n can also be used.

Operands
_CF contains the decimal value of the ASCII letter where unsolicited messages are currently routed.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All Standalone Controllers</td>
</tr>
</tbody>
</table>

Default Value: S
Default Format: N/A

Related Commands
CW - Configures MSB of unsolicited messages
WH - What Handle
TH - Tell Handles

Examples
:CFI;' "Send to me"
'Sent from external hardware only, CFI directs
'unolicited traffic to the port that sent the command

When communicating over Ethernet, two Ethernet handles should be used:
1.) The first handle should be used for command-and-response traffic. This is the primary handle that the host uses to communicate to the controller.

2.) The second handle should be used for unsolicited traffic. This is the primary handle that the controller uses to asynchronously communicate to the host. Use CF to point unsolicited traffic to this handle.

It is NOT recommended to use one Ethernet handle for both command-and-response, and unsolicited messages.

GalilTools will by default establish a two handle connection when using Ethernet.

Demonstrates from GalilTools terminal that the main handle is separate from the unsolicited handle
192.168.1.3, RIO47102 Rev 1.0c, 1480, IHA IHB
:TH
CONTROLLER IP ADDRESS 192,168,1,3 ETHERNET ADDRESS 00-50-4C-28-05-C8
IHA TCP PORT 23 TO IP ADDRESS 192,168,1,100 PORT 2420
IHB UDP PORT 60007 TO IP ADDRESS 192,168,1,100 PORT 2421
IHC AVAILABLE
IHD AVAILABLE
IHE AVAILABLE
:WH
IHA
:'Main handle is A
:MG_CF
66.0000
:'Unsolicited handle. 66 is ASCII for "B"
:
Configure Communication Interrupt

Full Description

The CI command configures a program interrupt based on characters received on communications port 2, the AUX serial port (port 1 on DMC-21x2/3 & RIO). An interrupt causes program flow to jump to the #COMINT subroutine. If multiple program threads are used, the #COMINT subroutine runs in thread 0 and the remaining threads continue to run without interruption. The characters received can be accessed via the operands P2CH, P2ST, P2NM, P2CD (P1 on DMC-21x2/3 & RIO). For more, see Operator Data Entry Mode in the user manual.

Arguments

CI n, m (m on DMC-21x2/3 and RIO only)

- n = 0  Do not interrupt
- n = 1  Interrupt on carriage return
- n = 2  Interrupt on any character
- n = -1 Clear interrupt data buffer

RIO And DMC-21x2/3

- m = 0 Default, received serial port data is interpreted as Galil command, returning data to the port as a standard interpreted port.
- m = 1 Enable serial port for CI execution. Data received will not be interpreted as a command.

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>n = 0, m = 0</td>
</tr>
</tbody>
</table>

Related Commands

CC - Configure communications
IN - Communication input
MG - Message output

Examples:

:CI 1  Interrupt when the <enter> key is received on port 2
:CI 2  Interrupt on a single character received on Port 2
Contour Mode

**Full Description**
The Contour Mode is initiated by the instruction CM. This mode allows the generation of an arbitrary motion trajectory with any of the axes. The CD command specified a position increment, and the DT command specifies the time interval between subsequent increments.

Issuing the CM command will clear the contour buffer when contour mode is not running.

**Arguments**
CM \( nnnnnnnn \)
where
\( n \) is A,B,C,D,E,F,G,H or any combination to specify the axes for contour mode
\( n = ? \) Returns a 0 if the contour buffer is full and 511 if the contour buffer is empty.

**Operand Usage**
_CM contains a '0' if the contour buffer is full; otherwise it contains the number of available contour segments.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>All</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>Disabled</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**
CD - Contour Data
DT - Time Increment

**Examples:**
```
#Cont0,'
CM ABCD,'
DT 4,'
CD 200,350,-150,500,'
  ',',
CD 100,200,300,400,'
CD 0,0,0,0=0,'
#Wait;JP#Wait, _CM<>511,'
  ',
EN;'
  ',
#Cont1,'
CM ABC,'
DT 8,'
```
CD 100,100,100;' New position data
CD 100,100,100;' New position data
CD 0,0,0 =-1;' Pause countour buffer set DT to resume
CD 100,100,100;' New position data
CD 100,100,100;' New position data
CD 0,0,0,0=0;' Special syntax to terminate Contour mode
#Wait2;JP#Wait2, _CM<>511;'Spin on #Wait2 label until buffer is empty
'End of Contour Buffer/Sequence
EN
**Full Description**

The CN command configures the polarity of the limit switches, home switches, latch inputs, the selective abort function, and the program termination behaviour of the abort input.

**Arguments**

\[
\text{CN } m,n,o,p,q
\]

where

- **m**
  - 1: Limit switches active high
  - -1: Limit switches active low

- **n**
  - 1: HM will drive motor forward when Home input is high. See HM and FE commands.
  - -1: HM will drive motor backward when Home input is high. See HM and FE commands

- **o**
  - 1: Latch input is active high
  - -1: Latch input is active low

- **p**
  - 1: Configures inputs 5,6,7,8,13,14,15,16 as selective abort inputs for axes A,B,C,D,E,F,G, and H respectively. Will also trigger #POSERR automatic subroutine if program is running.
  - 0: Inputs 5,6,7,8,13,14,15,16 are configured as general use inputs

- **q**
  - 1: Abort input will not terminate program execution
  - 0: Abort input will terminate program execution

**Operand Usage**

- \_CN0: Contains the limit switch configuration
- \_CN1: Contains the home switch configuration
- \_CN2: Contains the latch input configuration
- \_CN3: Contains the state of the selective abort function (1 enabled, 0 disabled)
- \_CN4: Contains whether the abort input will terminate the program

**Usage**

- **Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>-1,-1,-1,0,0</td>
</tr>
<tr>
<td>Default Format</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**Related Commands**

- AL - Arm latch
- LD - Limit Switch Disable
Examples:

| CN 1,1 | Sets limit and home switches to active high |
| CN,, -1 | Sets input latch active low |
**Full Description**

The CO command configures which banks are inputs and which are outputs on the extended I/O.

The CO command configures which points are inputs and which are outputs on the extended I/O. The 32 extended I/O points of the controller can be configured in banks of 8. The extended I/O is denoted as bits 17-48 and banks 2-5.

**Arguments**

**CO n**

where

n is a decimal value which represents a binary number. Each bit of the binary number represents one bank of extended I/O. When set to 1, the corresponding bank is configured as an output.

The least significant bit represents bank 2 and the most significant bit represents bank 5. The decimal value can be calculated by the following formula.

\[ n = n_2 + 2^n_3 + 4^n_4 + 8^n_5 \]

where \( nx \) represents the bank. To configure a bank as outputs, substitute a one into that \( nx \) in the formula. If the \( nx \) value is a zero, then the bank of 8 I/O points will be configured as inputs. For example, if banks 3 and 4 are to be configured as outputs, CO 6 is issued.

**Operand Usage**

_\_CO returns the extended I/O configuration value.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related Commands**

CB - Clear Output Bit
SB - Set Output Bit
OP - Set Output Port
TI - Tell Inputs

**Examples:**

- `CO 15` Configure all points as outputs
- `CO 0` Configure all points as inputs
- `CO 1` Configures bank 2 as outputs on extended I/O
**CR**

Syntax: Implicit Notification Only

Operands: none

Burn: not burnable

---

**Circle**

**Full Description**

When using the vector mode (VM), the CR command specifies a 2-dimensional arc segment of radius r, starting at angle theta, and traversing over angle deltaTheta. A positive deltaTheta denotes counterclockwise traverse, negative deltaTheta denotes clockwise. The VE command must be used to denote the end of the motion sequence after all CR and VP segments are specified. The BG (Begin Sequence) command is used to start the motion sequence. Parameters r, theta, and deltaTheta must be specified in each CR. Radius units are in quadrature counts. Theta and deltaTheta have units of degrees. The parameters n and o are optional and describe the vector speeds that are attached to the motion segment.

A starting position of zero degrees denotes that the radius lies along a vector following the positive X axis, on a 2D Cartesian space:

```
VMXY
CR 1000,0,270
VE
BGS
EN
```

![Diagram of circle with vector speeds](image)

**Arguments**

**CR r, theta, deltaTheta < n > o**

where

- **r** is the circle radius and is an unsigned real number in the range 10 to 6000000
- **theta** is the circle starting angle in degrees and is a signed real number in the range 0 to +/-32000
- **deltaTheta** is the angle to traverse and is a signed real number in the range 0.0001 to +/-32000

Note: The product **r * deltaTheta** must be limited to +/-4.5x10^8

**n** specifies a vector speed to be taken into effect at the execution of the vector segment. **n** is an unsigned even integer between 0 and 22,000,000 for servo motor operation and between 0 and 6,000,000 for stepper motors.

**o** specifies a vector speed to be achieved at the end of the vector segment. **o** is an unsigned even integer between 0 and 8,000,000.

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Related Commands

- **VP** - Vector Position
- **VS** - Vector Speed
- **VD** - Vector Deceleration
- **VA** - Vector Acceleration
- **VM** - Vector Mode
- **VE** - End Vector
- **BG, BGS** - Begin Sequence

### Examples:

```plaintext
VMAB;'                Specify vector motion in the A and B plane
VS 1000;'             Specify vector speed
CR 1000,0,360;'       Generate circle with radius of 1000 counts, start at
                      '                          0 degrees and complete one circle in counterclockwise
                      '                          direction.
CR 1000,0,360 < 40000;' Generate circle with radius of 1000 counts, start
                      '                          at 0 degrees and complete one circle in counterclockwise
                      '                          direction and use a vector speed of 40000.
VE;'              End Sequence
BGS;'             Start motion
```
Clear Sequence

**Full Description**

The CS command will remove VP, CR or LI commands stored in a motion sequence for the S or T coordinate systems. After a sequence has been executed, the CS command is not necessary to put in a new sequence. This command is useful when you have incorrectly specified VP, CR or LI commands.

**Arguments**

CSS or CST where
S and/or T can be used to clear the sequence buffer for the "S" or "T" coordinate system.

**Operand Usage**

_CSn contains the segment number in the sequence specified by n, S or T. This operand is valid in the Linear mode, LM, Vector mode, VM

**Usage**

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

"CR" - Circular Interpolation Segment
"LI" - Linear Interpolation Segment
"LM" - Linear Interpolation Mode
"VM" - Vector Mode
"VP" - Vector Position

**Examples:**

```plaintext
#CLEAR ;'Label
CAT ;'Specify the T coordinate system vector points
VP 1000,2000 ;'Vector position
VP 4000,8000 ;'Vector position
CST ;'Clear vectors specified in T coordinate system
CAS ;'Specify the T coordinate system vector points
VP 1000,5000 ;'New vector
VP 8000,9000 ;'New vector
CSS ;'Clear vectors specified in S coordinate system
EN ;'End program
```
**Full Description**

The CW command will return the copyright information when the argument, n, is 0 or is omitted. Otherwise, the CW command is used as a communications enhancement for use by the Galil terminal software programs. When turned on, the most significant bit of unsolicited ASCII characters is set to 1. Unsolicited ASCII characters are characters that are returned from a program running on the controller (usually from the MG command). This command does not affect solicited characters, which are characters that are returned as a response to a command sent from a host PC (e.g. TP).

If using Galil drivers, CW will be automatically configured - the user should not change the CW settings.

**Arguments**

**CW n,m**

where

n is a number, either 0, 1 or 2:

0 or ? Causes the controller to return the copyright information
1 Causes the controller to set the MSB of unsolicited returned characters.
2 Causes the controller to not set the MSB of unsolicited characters.

m is 0 or 1 (optional)

0 Causes the controller to pause program execution when hardware handshaking disables character transmissions.
1 Causes the controller to continue program execution when hardware handshake disables character transmissions, output characters will be lost.

**Operand Usage**

_\_CW contains the value of the data adjustment bit. 1 =on, 2 = off

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**

CF - Configure Unsolicited Messages Handle

**Examples:**

```
CW1; '     Set CW to Galil Driver mode (MSB set on unsolicited characters)

'Note:    The CW command can cause garbled (non-ASCII) characters to be returned
'   by the controller when using third-party software. Use CW2.

CW2; '     Set CW to third-party device mode (normal ASCII on unsolicited characters)
```
**DA**

Deallocation of Variables & Arrays

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>DAn</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The DA command frees the array and/or variable memory space. In this command, more than one array or variable can be specified for memory deallocation. Different arrays and variables are separated by comma when specified in one command. The * argument deallocates all the variables, and * [0] deallocates all the arrays.

**Arguments**

DA c[],d,etc. where
- c[] - Defined array name
- d - Defined variable name
- * - Deallocates all the variables
- *[0] - Deallocates all the arrays

DA? Returns the number of arrays available.

**Operand Usage**

_ DA contains the total number of arrays available.

**Usage**

**Related Commands**

"DM" - Dimension Array

**Examples:**

| 'Cars' and 'Salesmen' are arrays, and 'Total' is a variable. |
| DM Cars[40],Salesmen[50] | Dimension 2 arrays |
| Total=70 | Assign 70 to the variable Total |
| DA Cars[0],Salesmen[0],Total | Deallocate the 2 arrays & variable |
| DA*[0] | Deallocate all arrays |
| DA *,*[0] | Deallocate all variables and all arrays |

NOTE: Since this command deallocates the spaces and compacts the array spaces in the memory, it is possible that execution of this command may take longer time than a standard command. Variables and arrays that are deallocated are not set to zero. A routine that writes zeros to the array and/or variables should be created if this is desired.
Deceleration

Full Description
The Deceleration command (DC) sets the linear deceleration rate of the motors for independent moves such as PR, PA and JG moves. The parameters will be rounded down to the nearest factor of 1024 and have units of counts per second squared.

Arguments
DC n,n,n,n,n,n,n,n or DCA=n where
n is an unsigned numbers in the range 1024 to 1073740800
n = ? Returns the deceleration value for the specified axes.

Operand Usage
_DCn contains the deceleration rate for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage and Default Details</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (The DC command can only be specified while in the jog mode)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256000</td>
</tr>
<tr>
<td>Default Format</td>
<td>(8.0 for 21x3, 18x2), (10.0 for 40x0, 18x6)</td>
</tr>
</tbody>
</table>

While Moving | Yes* |
In a Program | Default Value | 256000 |
Command Line | Yes |
Controller Usage | ALL CONTROLLERS |

* When moving, the DC command can only be specified while in the jog mode.

Related Commands
AC
Acceleration
PR
Position Relative
PA
Position Absolute
SP
Speed
JG
Jog
SD
Limit Switch Deceleration

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR 10000</td>
<td>Specify position</td>
</tr>
<tr>
<td>AC 2000000</td>
<td>Specify acceleration rate</td>
</tr>
<tr>
<td>DC 1000000</td>
<td>Specify deceleration rate</td>
</tr>
<tr>
<td>SP 5000</td>
<td>Specify slew speed</td>
</tr>
<tr>
<td>BG</td>
<td>Begin motion</td>
</tr>
</tbody>
</table>
Note: The DC command may be changed during the move in JG move, but not in PR or PA move.
Full Description
The DE command defines the position of the auxiliary encoders.

The DE command defines the encoder position when used with stepper motors.
Note: The auxiliary encoders are not available for the stepper axis or for any axis where output compare is active.

Arguments
DE n,n,n,n,n,n,n,n or DEA=n where
n is a signed integers in the range -2147483648 to 2147483647 decimal
n = ? returns the position of the auxiliary encoders for the specified axes.

Operand Usage
_DEn contains the current position of the specified auxiliary encoder.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0, 0, 0, 0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

Related Commands

Examples:
DE 0,100,200,400 Set the current auxiliary encoder position to 0,100,200,400 on A,B,C and D axes
DE?,?,?,?, Return auxiliary encoder positions
DualA=_DEA Assign auxiliary encoder position of A-axis to the variable DualA

Hint: Dual encoders are useful when you need an encoder on the motor and on the load. The encoder on the load is typically the auxiliary encoder and is used to verify the true load position. Any error in load position is used to correct the motor position.
Full Description

This command is used only by the DMC-4xxx with SSI or BiSS upgrades.

For users wishing to operate with SSI or BiSS in Dual Loop mode (DV), the DF command can be used to configure a load-side serial encoder and a motor-side incremental encoder with DV1. Wire the motor's incremental encoder per normal to the DMC-4xxx main encoder inputs. The load SSI encoder should be wired to the axis aux encoder lines:

<table>
<thead>
<tr>
<th>Nominal Signal Name</th>
<th>Signal Reassignment with SSI</th>
<th>Signal Reassignment with BiSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA+</td>
<td>Clock+</td>
<td>MA+</td>
</tr>
<tr>
<td>AA-</td>
<td>Clock-</td>
<td>MA-</td>
</tr>
<tr>
<td>AB+</td>
<td>Data+</td>
<td>SLO+</td>
</tr>
<tr>
<td>AB-</td>
<td>Data-</td>
<td>SLO-</td>
</tr>
</tbody>
</table>

Issue the configuration command (SI or SS) to setup the serial decoding for the axis aux encoder (e.g. SIn = 2, si1, si2, si3 <p >q). Verify proper serial encoder operation by moving the motor in non-dual loop mode and checking TDn. Disable the motor with MO and issue DFn=1 and DVn=1. The axis control law will now fragment the PID loop. P and I will be closed around the serial encoder. D will be closed around the motor encoder. The serial encoder can now be interrogated with TP (not TD), and the incremental encoder with TD (not TP).

In summary, DF will cause the main encoder register (TP) and aux encoder register (TD) to be swapped. This makes the wiring configuration compatible with the standard dual loop mode (DV).

Arguments

DF n,n,n,n,n,n,n where
n represents a Boolean (on or off) and is either 1 or 0.

Operands

_DFn contains the value (1 or 0) of the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands

DV - Dual Velocity (Dual Loop)
SI - Configure the special Galil SSI feature
SS - Configure the special Galil BiSS feature

Examples

```
MOX;
SIX=2,25,15,0<13>2;' Setup SSI encoder to fill the Aux encoder register
```
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF1;</td>
<td>Enable Dual Feedback Swap</td>
</tr>
<tr>
<td>DV1;</td>
<td>Enable Dual Loop mode</td>
</tr>
<tr>
<td>SHX;</td>
<td>Enable servo with new configuration</td>
</tr>
</tbody>
</table>
**DH**

**DHCP Server Enable**

**Full Description**

The DH command configures the DHCP or BOOT-P functionality on the controller for Server IP addressing.

**Arguments**

DH n  where  

n = 0 disables DHCP and enables BOOT-P  
n = 1 disables BOOT-P and enables DHCP  
n = ? returns the current state of the setting

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>1.0</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx / RIO-47xxx</td>
</tr>
<tr>
<td>Default Value</td>
<td>1.0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Operand Usage**

N/A

**Related Commands**

IA - IP Address

**Examples:**

DH 1  Sets the DHCP function on. IA assignment will no longer work. IP address cannot be burned. Controller will receive its IP address from the DHCP server on the network.  
DH 0  Sets the DHCP function off, and the Boot-P function on.
**DL**

**Download**

**Full Description**

The DL command transfers a data file from the host computer to the controller. Instructions in the file will be accepted as a data stream without line numbers. The file is terminated using <control> Z, <control> Q, <control> D, or \. DO NOT insert spaces before each command.

If no parameter is specified, downloading a data file will clear all programs in the controllers RAM. The data is entered beginning at line 0. If there are too many lines or too many characters per line, the controller will return a ?. To download a program after a label, specify the label name following DL. The argument # may be used with DL to append a file at the end of the program in RAM.

It is recommended to use the program download functions available through the GalilTools software and drivers rather than directly using the DL command.

**Arguments**

DL n  where  

n = no argument  Downloads program beginning at line 0. Erases programs in RAM.  
n = #Label  Begins download at line following #Label  
n = #  Begins download at end of program in RAM.

**Operand Usage**

When used as an operand, _DL gives the number of available labels (510 maximum)

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```
DL;     Begin download
#A;PR 4000;BGA Data
AMA;MG DONE Data
EN     Data
<control> Z End download
```
**DM**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>_DMn</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Dimension**

**Full Description**

The DM command defines a single-dimensional array with a name and n total elements. The first element of the defined array starts with element number 0 and the last element is at n-1.

**Arguments**

DM c[n]  where
- c is a array name of up to eight alphanumeric characters, starting with an alphabetic character.
- n is the number of array elements.

DM? returns the number of array elements available.

**Operand Usage**

_DM contains the available array space.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

"DA" - Deallocate Array

**Examples:**

```
DM Pets[5], Dogs[2], Cats[3]  Define dimension of arrays, pets with 5 elements; Dogs with 2 elements; Cats with 3 elements
DM Tests[1600]  Define dimension of array Tests with 1600 elements

:DM?
16000
:DM MyArray[1000]
:DM?
15000
'DMC-4xxx and 18x6 provide length of array with array[-1]
:MG "MyArray contains",MyArray[-1]," elements"
MyArray contains 1000.0000 elements
```


**Full Description**

The DP command sets the current motor position and current command positions to a user specified value. The units are in quadrature counts. This command will set both the TP and RP values.

The DP command sets the commanded reference position for axes configured as steppers. The units are in steps. Example: DP 0 this will set the registers for TD and RP to zero, but will not effect the TP register value.

**Arguments**

\[ \text{DP } n,n,n,n,n,n,n \text{ or } DPA=n \text{ where} \]

- \( n \) is a signed integer in the range \(-2147483648 \text{ to } 2147483647 \) decimal.
- \( n = ? \) Returns the current position of the motor for the specified axes.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0,0,0,0,0,0,0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format (PF)</td>
</tr>
</tbody>
</table>

**Operand Usage**

_\text{DPn}\_ contains the current position of the specified axis.

**Related Commands**

DE Define Aux Encoder
FI Find Index
FE Find Edge
HM Home
PF Position Format
RP Reference Position
TP Tell Encoder Position

**Examples:**

- \( \text{DP } 0,100,200,400 \)  Sets the current position of the A-axis to 0, the B-axis to 100, the C-axis to 200, and the D-axis to 400
- \( \text{DP } ,-50000 \) Sets the current position of B-axis to -50000. The B,C and D axes remain unchanged.
- \( \text{DP } ?,?,?,? \) Interrogate the position of A,B,C and D axis.
- \( \text{:0, -0050000, 200, 400} \) Returns all the motor positions
- \( \text{DP } ? \) Interrogate the position of A axis
- \( \text{:0} \) Returns the A-axis motor position

**Hint:** The DP command is useful to redefine the absolute position. For example, you can manually position the motor by hand using the Motor Off command, MO. Turn the servo motors back on with SH and then use DP0 to redefine the new position as your absolute zero.
**Syntax:** Implicit Notation Only  
**Operands:** DR  
**Burn:** not burnable

**Configures I O Data Record Update Rate**

**Full Description**

The controller creates a QR record and sends it periodically to a UDP Ethernet Handle.

**Arguments**

- **DR n, m**
  - *n* specifies the data update rate in samples between updates. When TM is set to the default of 1000, *n* specifies the data update rate in milliseconds. *n*=0 to turn it off, or *n* must be an integer in the range of 2 to 30,000.
  - *m* specifies the Ethernet handle on which to periodically send the Data Record. 0 is handle A, 1 is B, 7 is H. The handle must be UDP (not TCP).

**Operand Usage**

_**DR** contains the data record update rate._

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td></td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td></td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

**Related Commands**

- **QZ**  
  Sets format of data
- **QR**  
  Query a single data record

**Examples:**

```
:DR8,0
:G*×*****~*P*
_:~``*×*****~*P*
:_H*×*****~*P*
:_0*×*****~*P*
DR0

'Note: The data record is in a binary, non-printable format (the output above is normal when printing to the terminal)
**DT**

**Delta Time**

**Full Description**

The DT command sets the time interval for Contour Mode. Sending the DT command once will set the time interval for all contour data until a new DT command (or CDm=n) is sent.

**Arguments**

**DT n** where

- **n** is an integer in the range 0 to 8.
- **n = 1** through 8 specifies the time interval of $2^n$ samples.
- **n = -1** allows a pre-load of the contour buffer or to asynchronously pause the contour buffer. DT-1 during contour mode will pause the contour buffer (and commanded movement). A positive DT will resume contour mode from paused position of buffer.

By default the sample period is 1 msec (set by the TM command); with **n=1**, the time interval would be 2 msec

**n = ?** Returns the value for the time interval for contour mode.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Operand Usage**

_DT contains the value for the time interval for Contour Mode

**Related Commands**

CM - Contour Mode
CD - Contour Data

**Examples:**

```plaintext
:DT 4              Specifies time interval to be 16 msec (TM1000)
:DT 7              Specifies time interval to be 128 msec
```

REM basic contour example
#Cont0;'        Define label #Cont0
CM ABCD;'       Specify Contour Mode
DT 4;'          Specify time increment for contour
CD 200,350,-150,500;' Specify incremental positions on A,B,C and C axes
'                A-axis moves 200 counts B-axis moves 350 counts C-axis moves -150 counts C-axis moves 500 counts
CD 100,200,300,400 ;'    New position data
CD 0,0,0,0=0;'      End of Contour Buffer/Sequence
#WT;'             Wait for all segments to process (buffer to empty)
WT 16,1;'         wait for 1 DT time segment ($2^4$)
**REM contour example for pre-loading of contour buffer**

#Cont1;' Define label #Cont1
CM AB;' Specify Contour Mode
DT -1;' Pause Contour Mode to allow pre-load of buffer
CD 100,200;' Countour Data pre-loaded in buffer
CD 400,200;' Countour Data pre-loaded in buffer
CD 200,100;' Countour Data pre-loaded in buffer
CD 300,50;' Countour Data pre-loaded in buffer
AI -1;' Wait for Analog input 1 to go low
DT 8;' Set positive DT to start contour mode
CD 0,0,0,0=0;' End of Contour Buffer/Sequence
#Wait;' Wait for all segments to process (buffer to empty)
WT 16,1;' wait for 1 DT time segment (2^4)
JP#Wait, _CM<>511
EN;' End program
Full Description
The DV function changes the operation of the filter. It causes the KD (derivative) term to operate on the dual encoder instead of the main encoder. This results in improved stability in the cases where there is a backlash between the motor and the main encoder, and where the dual encoder is mounted on the motor.

When using Dual Loop mode with a large motor:load ratio and/or running at high velocities where low position error at speed is required, FV should be used to compensate for the derivative contribution from the higher resolution motor encoder.

The FV value is calculated by the equation:
\[ FV = \frac{KD}{4} \times \frac{\text{motor}}{\text{load}} \]

motor/load = effective motor to load ratio

For example:
KD = 200
motor encoder changes 5000 counts per 1000 counts of load encoder (motor/load = 5/1)
FV = \( \frac{200}{4} \times \frac{5}{1} \) = 250

Arguments
DV n,n,n,n,n,n,n,n or DVX=n where
n = 0 Disables the dual loop mode.
n = 1 Enables the dual loop mode.

Operand Usage
_DVn contains the state of dual velocity mode for specified axis. 0 = disabled, 1 = enabled.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
KD - Damping constant
FV - Velocity feedforward

Examples:
DV 1,1,1,1 Enables dual loop on all axes
DV 0 Disables DV on A axis
DV,,1,1 Enables dual loop on C axis and D axis. Other axes remain unchanged.
DV 1,0,1,0 Enables dual loop on A and C axis. Disables dual loop on B and D axis.
MG_DVA Returns state of dual velocity mode for A axis

Hint: The DV command is useful in backlash and resonance compensation.
The EA command selects the master axis for the electronic cam mode. Any axis may be chosen.

**Arguments**

EA n  where  
n is one of the axis specified as A,B,C,D,E,F,G, H, M or N

**Operand Usage**

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

"EB " - Enable ECAM  
"EC " - Set ECAM table index  
"EG " - Engage ECAM  
"EM " - Specify ECAM cycle  
"EP" - Specify ECAM table intervals & staring point  
"EQ " - Disengage ECAM  
"ET " - ECAM table

**Examples:**

| EAB  | Select B as a master for ECAM |
EB

Enable ECAM

Full Description
The EB function enables or disables the cam mode. In this mode, the starting position of the master axis is specified within the cycle. When the EB command is given, the master axis is modularized.

Arguments
EB n   where
n = 1    Starts ECAM mode
n = 0    Stops ECAM mode.
n = ?    Returns 0 if ECAM is disabled and a 1 if enabled.

Operand Usage
_EB contains the state of Ecam mode. 0 = disabled, 1 = enabled

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Related Commands
"EA" - Choose ECAM master
"EC " - Set ECAM table index
"EG " - Engage ECAM
"EM " - Specify ECAM cycle
"EP" - Specify ECAM table intervals & staring point
"EQ " - Disengage ECAM
"ET " - ECAM table

Examples:

| EB1     | Starts ECAM mode |
| EB0     | Stops ECAM mode  |
| B = _EB | Return status of cam mode |
**Full Description**

The EC function sets the index into the ECAM table. This command is only useful when entering ECAM table values without index values and is most useful when sending commands in binary. See the command, ET.

**Arguments**

EC n  
where  
n is an integer between 0 and 256.  
n = ?  Returns the current value of the index into the ECAM table.

**Operand Usage**

_EC contains the current value of the index into the ECAM table.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

"EA" - Choose ECAM master  
"EB " - Enable ECAM  
"EG " - Engage ECAM  
"EM " - Specify ECAM cycle  
"EP " - Specify ECAM table intervals & starting point  
"EQ " - Disengage ECAM  
"ET " - ECAM table

**Examples:**

EC0  Set ECAM index to 0  
ET 200,400  Set first ECAM table entries to 200,400  
ET 400,800  Set second ECAM table entries to 400,800
**Full Description**

Using Telnet style interface (not Galil Software). The ED command puts the controller into the Edit subsystem. In the Edit subsystem, programs can be created, changed, or destroyed. The commands in the Edit subsystem are:

- `<cntrl>D` Deletes a line
- `<cntrl>I` Inserts a line before the current one
- `<cntrl>P` Displays the previous line
- `<cntrl>Q` Exits the Edit subsystem
- `<return>` Saves a line

**Arguments**

ED n  where

n specifies the line number to begin editing. The default line number is the last line of program space with commands.

**Operand Usage**

_ED contains the line number of the last line to have an error.
_ED1 contains the number of the thread where the error occurred (for multitasking).
_ED4 when evaluated in an embedded code thread, this operand will contain the thread id of the calling thread. This is useful for DMC code to determine which thread it is running in. See example below.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

DL - Download
UL - Upload

**Examples:**

```plaintext
ED
0 #START
1 PR 2000
2 BGA
3 SLKJ Bad line
4 EN
5 #CMDERR Routine which occurs upon a command error
6 V=_ED
7 MG "An error has occurred" {n}
8 MG "In line", V{F3.0}
9 ST
10 ZS0
11 EN
```
Hint: Remember to quit the Edit Mode prior to executing or listing a program.

'Using _ED4
XQ#id,1
XQ#id,2
XQ#id,3
XQ#id,4
XQ#id,5
XQ#id,6
XQ#id,7
#id
MG(Z10.0)"This message is from thread",_ED4
EN

' Returns...
' :XQ
' This message is from thread 1
' This message is from thread 2
' This message is from thread 3
' This message is from thread 4
' This message is from thread 5
' This message is from thread 6
' This message is from thread 7
' This message is from thread 0
**Full Description**

The EG command engages an ECAM slave axis at a specified position of the master. If a value is specified outside of the master's range, the slave will engage immediately. Once a slave motor is engaged, its position is redefined to fit within the cycle.

**Arguments**

\[ EG \, n,n,n,n,n,n,n,n \text{ or } EGA=n \]

where

- \( n \) is the ECAM master position at which the ECAM slave axis must be engaged.
- \( n=\? \) Returns 1 if specified axis is engaged and 0 if disengaged.

**Operand Usage**

-_EGn contains ECAM status for specified axis. 0 = axis is not engaged, 1 = axis is engaged.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

"EA" - Choose ECAM master
"EB " - Enable ECAM
"EC " - Set ECAM table index
"EM " - Specify ECAM cycle
"EP " - Specify ECAM table intervals & starting point
"EQ " - Disengage ECAM
"ET " - ECAM table

**Examples:**

1. **EG 700,1300**   Engages the A and B axes at the master position 700 and 1300 respectively.
2. **B = _EGB**       Return the status of B axis, 1 if engaged

Note: This command is not a trippoint. This command will not hold the execution of the program flow. If the execution needs to be held until master position is reached, use MF or MR command.
EI

Event Interrupts

Full Description

EI enables interrupts for the predefined event conditions in the table below. When a condition (e.g. Axis A profiled motion complete) occurs after EI is armed, a particular status byte value (e.g. $D0 or 208) is delivered to the host PC along with the interrupt.

Interrupts are issued as automatically dispatched UDP packets. GalilTools version 1.2.1.0 or newer required for software support.

The UDP packet can contain up to 16 individual status bytes and is framed as follows

<table>
<thead>
<tr>
<th>Format</th>
<th>Header (Fixed Byte)</th>
<th>Status Byte (1-16 bytes)</th>
<th>Payload Byte Count (0x03 - 0x12) [Includes header and footer in count]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>0x01</td>
<td>0xD0F1DBE1</td>
<td>0x06</td>
</tr>
<tr>
<td>Example Decoded</td>
<td>Interrupt Packet Indicator</td>
<td>Axis A Profiled Motion Complete; User Interrupt 1; Application Program Stopped; Digital Input 1 is low</td>
<td>6 bytes in payload</td>
</tr>
</tbody>
</table>

Arguments

EI m,n,h

m is a 16-bit integer mask between 0 and 65535 and is used to select the interrupt condition(s) to be used. 0 (the default) means "don't interrupt" and clears the queue when issued. The * conditions must be re-enabled with EI after each occurrence.

Interrupt Bytes

<table>
<thead>
<tr>
<th>bit</th>
<th>m=2^bit Hex (decimal)</th>
<th>Status Byte Hex (decimal)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$0001 (1)</td>
<td>$D0 (208)</td>
<td>Axis A profiled motion complete _BGA = 0</td>
</tr>
<tr>
<td>1</td>
<td>$0002 (2)</td>
<td>$D1 (209)</td>
<td>Axis B profiled motion complete _BGB = 0</td>
</tr>
<tr>
<td>2</td>
<td>$0004 (4)</td>
<td>$D2 (210)</td>
<td>Axis C profiled motion complete _BGC = 0</td>
</tr>
<tr>
<td>3</td>
<td>$0008 (8)</td>
<td>$D3 (211)</td>
<td>Axis D profiled motion complete _BGD = 0</td>
</tr>
<tr>
<td>4</td>
<td>$0010 (16)</td>
<td>$D4 (212)</td>
<td>Axis E profiled motion complete _BGE = 0</td>
</tr>
<tr>
<td>5</td>
<td>$0020 (32)</td>
<td>$D5 (213)</td>
<td>Axis F profiled motion complete _BGF = 0</td>
</tr>
<tr>
<td>6</td>
<td>$0040 (64)</td>
<td>$D6 (214)</td>
<td>Axis G profiled motion complete _BGG = 0</td>
</tr>
<tr>
<td>7</td>
<td>$0080 (128)</td>
<td>$D7 (215)</td>
<td>Axis H profiled motion complete _BGH = 0</td>
</tr>
<tr>
<td>8</td>
<td>$0100 (256)</td>
<td>$D8 (216)</td>
<td>All axes profiled motion complete _BGI = 0</td>
</tr>
<tr>
<td>9</td>
<td>$0200 (512)</td>
<td>$C8 (200)</td>
<td>Excess position error _TEn &gt;= _ERn*</td>
</tr>
<tr>
<td>10</td>
<td>$0400 (1024)</td>
<td>$C0 (192)</td>
<td>Limit switch _LFn = 0* Must be profiling motion in direction of activated limit switch for interrupt to occur.</td>
</tr>
<tr>
<td>11</td>
<td>$0800 (2048)</td>
<td>$D9 (217)</td>
<td>Watchdog timer (PCI only, no 40x0)</td>
</tr>
<tr>
<td>12</td>
<td>$1000 (4096)</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>$2000 (8192)</td>
<td>$DB (219)</td>
<td>Application program stopped _XQn = -1</td>
</tr>
<tr>
<td>14</td>
<td>$4000 (16384)</td>
<td>$DA (218)</td>
<td>PC command done, colon response sent (PCI only, no 40x0)</td>
</tr>
<tr>
<td>15</td>
<td>$8000 (32768)</td>
<td>$E1-$E8 (225-232)</td>
<td>Digital input(s) 1-8 low (use n for mask)*</td>
</tr>
</tbody>
</table>

n is an 8-bit integer mask between 0 and 255 and is used to select the specific digital input(s) if bit 15 of m is set (indicating that digital inputs are to be used for interrupting). Bit 15 of m must be set for the n mask to be used.

Input Interrupts
<table>
<thead>
<tr>
<th>bit</th>
<th>n=2^bit hex (decimal)</th>
<th>Status Byte hex (decimal)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$01 (1)</td>
<td>$E1 (225)</td>
<td>Digital input 1 is low @IN[1] = 0*</td>
</tr>
<tr>
<td>1</td>
<td>$02 (2)</td>
<td>$E2 (226)</td>
<td>Digital input 2 is low @IN[2] = 0*</td>
</tr>
<tr>
<td>2</td>
<td>$04 (4)</td>
<td>$E3 (227)</td>
<td>Digital input 3 is low @IN[3] = 0*</td>
</tr>
<tr>
<td>3</td>
<td>$08 (8)</td>
<td>$E4 (228)</td>
<td>Digital input 4 is low @IN[4] = 0*</td>
</tr>
<tr>
<td>4</td>
<td>$10 (16)</td>
<td>$E5 (229)</td>
<td>Digital input 5 is low @IN[5] = 0*</td>
</tr>
<tr>
<td>5</td>
<td>$20 (32)</td>
<td>$E6 (230)</td>
<td>Digital input 6 is low @IN[6] = 0*</td>
</tr>
<tr>
<td>6</td>
<td>$40 (64)</td>
<td>$E7 (231)</td>
<td>Digital input 7 is low @IN[7] = 0*</td>
</tr>
<tr>
<td>7</td>
<td>$80 (128)</td>
<td>$E8 (232)</td>
<td>Digital input 8 is low @IN[8] = 0*</td>
</tr>
</tbody>
</table>

h is 0-7 or -1 and indicates the preconfigured UDP handle where interrupts should be sent. 0-7 indicates handles A-H, respectively. If the handle specified by h is not UDP or not initialized, an error will occur (TC1). A -1 disables the interrupt dispatch. GalilTools software will auto configure h, allowing the user to ignore its use in most cases.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0,0 for PCI 0,0,-1 for Ethernet</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Operand Usage**

_EI_ contains the interrupt mask m

**Related Commands**

UI - User interrupt

**Examples:**

1. Interrupt when motion is complete on all axes OR if a limit switch is hit:
   From the table, enable bits 8 and 10.  m = 256 + 1024 = 1280
   EI 1280
2. Interrupt when digital input 3 is low.  Enable bit 15 of m and bit 2 of n.
   EI 32768,4
ELSE

Else function for use with IF conditional statement

Full Description

The ELSE command is an optional part of an IF conditional statement. The ELSE command must occur after an IF command and it has no arguments. It allows for the execution of a command only when the argument of the IF command evaluates False. If the argument of the IF command evaluates false, the controller will skip commands until the ELSE command. If the argument for the IF command evaluates true, the controller will execute the commands between the IF and ELSE command.

Arguments

ELSE

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

ENDIF - End of IF conditional Statement

Examples:

```
#A
IF (@IN[1]=0)   ;'IF conditional statement based on ;'input 1
IF (@IN[2]=0)   ;'2nd IF conditional statement ;'executed if 1st IF conditional true
MG "INPUT 1 AND INPUT 2 ARE ACTIVE"     ;'Message to be executed if 2nd IF ;'conditional is true
ELSE    ;'ELSE command for 2nd IF conditional ;'statement
MG "ONLY INPUT 1 IS ACTIVE"     ;'Message to be executed if 2nd IF ;'conditional is false
ENDIF   ;'End of 2nd conditional statement
ELSE    ;'ELSE command for 1st IF conditional ;'statement
MG "ONLY INPUT 2 IS ACTIVE"     ;'Message to be executed if 1st IF ;'conditional statement is false
ENDIF   ;'End of 1st conditional statement
EN
```
**EM**

**Cam cycles (modulus)**

### Full Description

The EM command is part of the ECAM mode. It is used to define the change in position over one complete cycle of the master. The field for the master axis is the cycle of the master position. For the slaves, the field defines the net change in one cycle. If a slave will return to its original position at the end of the cycle, the change is zero. If the change is negative, specify the absolute value.

### Arguments

\[ \text{EM } n,n,n,n,n,n,n \]  
or  
\[ \text{EMA}=n \]

- \( n \) is a positive integer in the range between 1 and 8,388,607 for the master axis and between 1 and 2,147,483,647 for a slave axis.

### Operand Usage

- \( _\text{EMn} \) contains the cycle of the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

- "EA" - Choose ECAM master
- "EB" - Enable ECAM
- "EC" - Set ECAM table index
- "EG" - Engage ECAM
- "EP" - Specify ECAM table intervals & starting point
- "EQ" - Disengage ECAM
- "ET" - ECAM table

### Examples:

- **EAC** Select C axis as master for ECAM.
- **EM 0,3000,2000** Define the changes in A and B to be 0 and 3000 respectively. Define master cycle as 2000.
- \( V = _\text{EMA} \) Return cycle of A
Full Description
The EN command is used to designate the end of a program or subroutine. If a subroutine was called by the JS command, the EN command ends the subroutine and returns program flow to the point just after the JS command.

Note: Instead of EN, use the RE command to end the error subroutine and limit subroutine. Use the RI command to end the input interrupt subroutine.

A return parameter can be specified to EN from a subroutine to return a value from the subroutine to the calling stack.

The EN command is used to end the automatic subroutines #MCTIME #COMINT and #CMDERR.

When the EN command is used to terminate the #COMINT communications interrupt subroutine, there are 2 arguments. The first determines whether trippoints will be restored upon completion of the subroutine, and the second determines whether the communication will be re-enabled.

Arguments
EN m, n, r where
m = 0: Return from subroutine without restoring trippoint
m = 1: Return from subroutine and restore trippoint
n = 0: Return from #COMINT without restoring CI interrupt trigger
n = 1: Return from #COMINT and restore CI interrupt trigger
r = anyvalue: Return a value from a subroutine, accessible to the calling stack in JS

Note 1: The default value for the argument is 0.

Note 2: The arguments will specify how the #COMINT routine handles trippoints. Trippoints cause a program to wait for a particular event. The AM command, for example, waits for motion on all axes to complete. If the #COMINT subroutine is executed due to a communication interrupt while the program is waiting for a trippoint, the #COMINT can end and continue to wait for the trippoint, or clear the trippoint and continue executing the program at the command just after the trippoint.

Note 3: Use the RE command to return from the interrupt handling subroutines #LIMSWI and #POSERR. Use the RI command to return from the #ININT subroutine.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>m=0, n=0, r=0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Operand Usage
N/A

Related Commands
RE - Return from error subroutine
RI - Return from interrupt subroutine

Examples:
#A;
PR 500;
BGA;
AMA;
EN;

Program A
Move A axis forward 500 counts
Begin motion
Pause the program until the A axis completes the motion
End of Program
ENDIF

End of IF conditional statement

Full Description

The ENDIF command is used to designate the end of an IF conditional statement. An IF conditional statement is formed by the combination of an IF and ENDIF command. An ENDIF command must always be executed for every IF command that has been executed. It is recommended that the user not include jump commands inside IF conditional statements since this causes re-direction of command execution. In this case, the command interpreter may not execute an ENDIF command.

Arguments

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Operand Usage

Related Commands

IF - Command to begin IF conditional statement
ELSE - Optional command to be used only after IF command
JP - Jump command
JS - Jump to subroutine command

Examples:

```c
#A
IF (@IN[1]=0);' IF conditional statement based on input 1
' IF (@IN[2]=0);' 2nd IF conditional statement
' MG "INPUT 1 AND INPUT 2 ARE ACTIVE";' Message to be executed if 2nd IF
' conditional is true
' ELSE;' ELSE command for 2nd IF conditional statement
' MG "ONLY INPUT 1 IS ACTIVE";' Message to be executed if 2nd IF
' conditional is false
' ENDIF;' End of 2nd conditional statement
ELSE;' ELSE command for 1st IF conditional statement
' MG "ONLY INPUT 2 IS ACTIVE";' Message to be executed if 1st IF
' conditional statement is false
' ENDIF;' End of 1st conditional statement
EN```
**EO**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands</td>
<td>EO</td>
</tr>
<tr>
<td>Burn</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Echo**

**Full Description**

The EO command turns the echo on or off. If the echo is off, characters input over the bus will not be echoed back.

Serial only, no Ethernet.

**Arguments**

EO n

- **n = 0** 0 turns echo off
- **n = 1** 1 turns echo on.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value (PCI-based controllers)</td>
<td>0</td>
</tr>
<tr>
<td>Default Value (Stand Alone controllers)</td>
<td>1 (Galil software will set EO 0 upon connection)</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Operand Usage**

_EO contains the state of the echo; 0 is off, 1 is on_

**Related Commands**

**Examples:**

- EO 0  Turns echo off
- EO 1  Turns echo on
Full Description
The EP command defines the ECAM table intervals and offset. The offset is the master position of the first ECAM table entry. The interval is the difference of the master position between 2 consecutive table entries. This command effectively defines the size of the ECAM table. The parameter 'm' is the interval and 'n' is the starting point. Up to 257 points may be specified.

The offset parameter 'n' can also be used to instantaneously phase shift the graph of the slave position verses the master position. This can be used to make on-the-fly corrections to the slaves. See application note #2502 for more details.

http://www.galilmc.com/support/application-notes.php

Arguments
EP m,n  where
m is the master interval and is a positive integer in the range between 1 and 32,767 master counts. m cannot be changed while ECAM is running.
m = ?  Returns the value of the interval, m.
n is the phase shift and is an integer between -2,147,483,648 and 2,147,483,647 master counts. n can be changed while ECAM is running.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256,0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Operand Usage
_EP contains the value of the interval m.

Related Commands
EA - Choose ECAM master
EB - Enable ECAM
EC - Set ECAM table index
EG - Engage ECAM
EM - Specify ECAM cycle
EQ - Disengage ECAM
ET - ECAM table

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP 20</td>
<td>Sets the cam master points to 0,20,40 . . .</td>
</tr>
<tr>
<td>D = _EP</td>
<td>Set the variable D equal to the ECAM internal master interval</td>
</tr>
<tr>
<td>EP,100</td>
<td>Phase shift all slaves by 100 master counts</td>
</tr>
</tbody>
</table>
Full Description
The EQ command disengages an electronic cam slave axis at the specified master position. Separate points can be specified for each axis. If a value is specified outside of the master's range, the slave will disengage immediately.

Arguments
EQ n,n,n,n,n,n,n,n or EQA=n where
n is the master positions at which the axes are to be disengaged.

n = ? Returns 1 if engage command issued and axis is waiting to engage, 2 if disengage command issued and axis is waiting to disengage, and 0 if ECAM engaged or disengaged.

Operand Usage
_EQn contains 1 if engage command issued and axis is waiting to engage, 2 if disengage command issued and axis is waiting to disengage, and 0 if ECAM engaged or disengaged.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
EA - Choose ECAM master
EB - Enable ECAM
EC - Set ECAM table index
EG - Engage ECAM
EM - Specify ECAM cycle
EP - Specify ECAM table intervals & staring point
ET - ECAM table

Examples:
EQ 300,700 Disengages the A and B motors at master positions 300 and 700 respectively.
Note: This command is not a trippoint. This command will not hold the execution of the program flow. If the execution needs to be held until master position is reached, use MF or MR command.
Full Description
The ER command sets the magnitude of the position errors for each axis that will trigger an error condition. When the limit is exceeded, the Error output will go low (true) and the controller's red light will be turned on. If the Off On Error (OE1) command is active, the motors will be disabled. For debugging purposes, ER0 and ER-1 can be used to turn the red LED on and off.

Arguments
ER n,n,n,n,n,n,n or ERA=n where
n is an unsigned number in the range 1 to 2147483647 which represents the error limit in encoder counts. A value of -1 will disable the position error limit for the specified axis.

n = ? Returns the value of the Error limit for the specified axis.

Operand Usage
_ERN contains the value of the Error limit for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>16384</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

Related Commands
OE - Off-On Error
#POERROR - Automatic Error Subroutine

Examples:
ER 200,300,400,600 Set the A-axis error limit to 200, the B-axis error limit to 300, the C-axis error limit to 400, and the D-axis error limit to 600.
ER ,1000 Sets the B-axis error limit to 1000, leave the A-axis error limit unchanged.
ER ?,?,?,? Return A, B, C and D values
200, 100, 400, 600
ER ? Return A value
200
V1=_ERA Assigns V1 value of ERA
V1= Returns V1
: 200

Hint: The error limit specified by ER should be high enough as not to be reached during normal operation. Examples of exceeding the error limit would be a mechanical jam, or a fault in a system component such as encoder or amplifier.
Full Description

The ES command divides the resolution of one of the axes in a vector mode (VM). This function allows for the generation of circular motion when encoder resolutions differ. It also allows for the generation of an ellipse instead of a circle. The command has two parameters, m and n. The arguments, m and n apply to the axes designated by the command VM. When m>n, the resolution of the first axis, x, will be multiplied by the ratio m/n. When m<n, the resolution of the second axis, y, will be multiplied by n/m. The resolution change applies for the purpose of generating the VP and CR commands, effectively changing the axis with the lower resolution to match the higher resolution. The ES command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

Arguments

ES m,n   where
m and n are positive integers in the range between 1 and 65,535.

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1.1</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

VM - Vector Mode
CR - Circle move
VP - Vector position

Examples:

VMAB; ES3,4      Scale B resolution by 4/3
VMCA; ES2,3      Scale A resolution by 3/2
VMAC; ES3,2      Scale A Resolution by 3/2

Note: ES must be issued after VM.
ET

Electronic cam table

Full Description
The ET command sets the ECAM table entries for the slave axes. The values of the master axes are not required. The slave entry (n) is the position of the slave axes when the master is at the point (m i) + o, where i is the interval and o is the offset as determined by the EP command.

Arguments
ET[m] = n,n,n,n,n,n,n,n

where
m is an integer between 0 and 256
n is an integer in the range between -2,147,438,648, and 2,147,438,647.

n=? Returns the slave position for the specified point.
The value m can be left out of the command if the index count has been set using the command, EC. In this mode, each ET command will automatically increment the index count by 1.

Operand Usage

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
EA - Choose ECAM master
EB - Enable ECAM
EC - Set ECAM table index
EG - Engage ECAM
EM - Specify ECAM cycle
EP - Specify ECAM table intervals & staring point
EQ - Disengage ECAM

Examples:
ET[0]=0,,0 Specifies the position of the slave axes A and C to be synchronized with the starting point of the master.
ET[1]=1200,,400 Specifies the position of the slave axes A and C to be synchronized with the second point of the master.
EC0 Set the table index value to 0, the first element in the table
ET 0,,0 Specifies the position of the slave axes A and C to be synchronized with the starting point of the master.
ET 1200,,400 Specifies the position of the slave axes A and C to be synchronized with the second point of the master.
**EW**

**ECAM Widen Segment**

**Full Description**

The EW command allows widening the length of one or two ECAM segments beyond the width specified by EP. For ECAM tables with one or two long linear sections, this allows placing more points in the curved sections of the table.

There are only two widened segments, and if used they are common for all ECAM axes. Remember that the widened segment lengths must be taken into account when determining the modulus (EM) for the master. The segments chosen should not be the first or last segments, or consecutive segments.

**Arguments**

EW \(m_1=n_1, m_2=n_2\) where

- \(m_1\) is the index of the first widened segment. \(m_1\) is a positive integer between 1 and 255.
- \(n_1\) is the length of the first widened segment in master counts. \(n_1\) is an integer between 1 and 2,147,483,647.
- \(m_2\) is the index of the second widened segment. \(m_2\) is a positive integer between 3 and 255.
- \(n_2\) is the length of the second widened segment in master counts. \(n_2\) is an integer between 1 and 2,147,483,647.

If \(m_1\) or \(m_2\) is set to -1, there is no widened segment. The segment number \(m_2\) must be greater than \(m_1\), and \(m_2\) may not be used unless \(m_1\) is used.

**Operand Usage**

- \(_{EW0}\) contains \(m_1\), the index of the first widened segment.
- \(_{EW1}\) contains \(n_1\), the length of the first widened segment.
- \(_{EW2}\) contains \(m_2\), the index of the second widened segment.
- \(_{EW3}\) contains \(n_2\), the length of the second widened segment.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>-1, 0, -1, 0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

- EP - ECAM master positions
- EA - Choose ECAM master
- EB - Enable ECAM
- EC - Set ECAM table index
- EG - Engage ECAM Slave
- EM - Specify ECAM cycle
- EQ - Disengage ECAM Slave
- ET - ECAM table

**Examples:**

EW 41=688  : 'Widen segment 41 to 688 master counts
EW 41=688, 124=688 : 'Widen segments 41 and 124 to 688 master counts
EY

ECAM Cycle Count

Full Description
Sets or gets the ECAM cycle count. This is the number of times that the ECAM axes have exceeded their modulus as defined by the EM command. EY will increment by one each time the master exceeds its modulus in the positive direction, and EY will decrement by one each time the master exceeds its modulus in the negative direction. EY can be used to calculate the absolute position of an axis with the following equation:

Absolute position = EY * EM + TP

Arguments
EY n
n is a signed integer in the range -2147483648 to 2147483647 decimal.
n = ? returns the current cycle count.

Operand Usage
_EY returns the current cycle count

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
EM - ECAM modulus

Examples:

MG _EY * _EMY + _TPY;'
print absolute position of master (Y)
**Full Description**

The FA command sets the acceleration feedforward coefficient. This coefficient, when scaled by the acceleration, adds a torque bias voltage during the acceleration phase and subtracts the bias during the deceleration phase of a motion.

The Feedforward Bias product is limited to 10 Volts. FA operates when commanding motion with PA, PR and JG.

Note: If the feedforward coefficient is changed during a move, then the change will not take effect until the next move.

Acceleration Feedforward Bias = \( FA \times AC \times (1.5 \times 10^{-7}) \times ((TM/1000)^2) \)

Deceleration Feedforward Bias = \( FA \times DC \times (1.5 \times 10^{-7}) \times ((TM/1000)^2) \)

**Arguments**

\( FA \ n,n,n,n,n,n,n \) or \( FAS=n \) where

\( n \) is an unsigned number in the range 0 to 8191 decimal with a resolution of 0.25.

\( n = ? \) Returns the value of the feedforward acceleration coefficient for the specified axis.

**Operand Usage**

\_FAn contains the value of the feedforward acceleration coefficient for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>4.2</td>
</tr>
</tbody>
</table>

**Related Commands**

FV - Velocity feedforward

**Examples:**

Set feedforward coefficient to 10 for the A-axis and 15 for the B-axis. The effective bias will be 0.75V for A and 2.25V for B.

\[AC\] 500000,1000000

\[FA\] 10,15

\[FA\] ?,? Return A and B values

10, 15
**FE**

**Find Edge**

### Full Description

The FE command moves a motor until a transition is seen on the homing input for that axis. The direction of motion depends on the initial state of the homing input (use the CN command to configure the polarity of the home input). Once the transition is detected, the motor decelerates to a stop. This command is useful for creating your own homing sequences.

Hint: Find Edge only searches for a change in state on the Home Input. Use FI (Find Index) to search for the encoder index. Use HM (Home) to search for both the Home input and the Index. Remember to specify BG after each of these commands.

### Arguments

**FE** nnnnnnnn  
where  
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes  
No argument specifies all axes.

### Operand Usage

N/A

### Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

FI - Find Index  
HM - Home  
BG - Begin  
AC - Acceleration Rate  
DC - Deceleration Rate  
SP - Speed for search

### Examples:

```
:FE     Set find edge mode  
:BG     Begin all axes  
:FEA    Only find edge on A  
:BGA    
:FEB    Only find edge on B  
:BGB    
:FECD   Find edge on C and D  
:BGCD
```
**Full Description**

The FI and BG commands move the motor until an encoder index pulse is detected. The controller looks for a transition from low to high. There are 2 stages to the FI command. The first stage jogs the motor at the speed and direction of the JG command until a transition is detected on the index line. When the transition is detected, the position is latched and the motor will decelerate to a stop. In the second stage, the motor will reverse direction and move to the latched position of the index pulse at the speed set by the HV command. At the conclusion of FI, the position is defined as zero.

**Arguments**

FI nnnnnnnn where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or sequence
No argument specifies all axes.

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

FE - Find Edge
HM - Home
BG - Begin
AC - Acceleration
DC - Deceleration
JG - Jog

HV - Homing Velocity

**Examples:**

```plaintext
#HOME;'           Home Routine
JG 500;'           Set speed and forward direction
FIA;'              Find index
BGA;'              Begin motion
AMA;'              After motion
MG "FOUND INDEX";' Print message
EN
```

Hint: Find Index only searches for a change in state on the Index. Use FE to search for the Home. Use HM (Home) to search for both the Home input and the Index. Remember to specify BG after each of these commands.
Forward Software Limit

**Full Description**

The FL command sets the forward software position limit. If this limit is exceeded during motion, motion on that axis will decelerate to a stop. Forward motion beyond this limit is not permitted. The forward limit is activated at one count past the set value. The forward limit is disabled at 2147483647. The units are in quadrature counts.

When the forward software limit is activated, the automatic subroutine #LIMSWI will be executed if it is included in the program.

**Arguments**

**FL n,n,n,n,n,n,n,n or FLA=n**

where

n is a signed integers in the range -2147483648 to 2147483647, n represents the absolute position of axis.

- \( n = 2147483647 \)  turns off the forward limit
- \( n = ? \)  Returns the value of the forward limit switch for the specified axis.

**Operand Usage**

_\_FLn contains the value of the forward software limit for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>2147483647</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

BL - Reverse Limit
PF - Position Formatting

**Examples:**

```
:FL 150000   Set forward limit to 150000 counts on the A-axis
:

#TEST;
AC 1000000;
DC 1000000;
FL 15000;
JG 5000;
BGA;
AMA;
TPA;
EN;
```
'Hint: Galil controllers also provide hardware limits.
Full Description

The FV command sets the velocity feedforward coefficient, or returns the previously set value. This coefficient generates an output bias signal in proportions to the commanded velocity.

Velocity feedforward bias = \( FV \times (\text{Velocity [cts/s]} \times 1.22 \times 10^{-6} \times (\text{TM}/1000)) \)

FV operates when commanding motion with PA, PR, JG, VM, LM, PVT Mode and CM. For example, if \( FV=10 \) and the velocity is 200,000 count/s, the velocity feedforward bias equals 2.44 volts.

Arguments

\( FV \ n,n,n,n,n,n,n \) or \( FVA=n \) where

\( n \) is an unsigned numbers in the range 0 to 8191 decimal

\( n = ? \) Returns the feedforward velocity for the specified axis.

Operand Usage

\_FVn contains the feedforward velocity for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Related Commands

FA - Acceleration Feedforward

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( :FV \ 10,20 )</td>
<td>Set feedforward coefficients to 10 and 20 for A and B respectively</td>
</tr>
<tr>
<td>( :JG \ 30000,80000 )</td>
<td>This produces 0.366 volts for A and 1.95 volts for B.</td>
</tr>
<tr>
<td>( :FV \ ?,? ) 10,20</td>
<td>Return the A and B values.</td>
</tr>
</tbody>
</table>
GA

Master Axis for Gearing

Full Description
The GA command specifies the master axes for electronic gearing. Multiple masters for gearing may be specified. The masters may be the main encoder input, auxiliary encoder input, or the commanded position of any axis. The master may also be the commanded vector move in a coordinated motion of LM or VM type. When the master is a simple axis, it may move in any direction and the slave follows. When the master is a commanded vector move, the vector move is considered positive and the slave will move forward if the gear ratio is positive, and backward if the gear ratio is negative. The slave axes and ratios are specified with the GR command and gearing is turned off by the command GR0.

When the geared motors must be coupled "strongly" to the master, use the gantry mode GM.

When gearing is used in a gantry application, gearing off of the commanded position is recommended.

Arguments
GA n,n,n,n,n,n,n,n or GAA=n where
n can be A,B,C,D,E,F,G, H, M or N. The value of n is used to set the specified main encoder axis as the gearing master and M and N represents the virtual axes. The slave axis is specified by the position of the argument. The first position of the argument corresponds to the 'A' axis, the second position corresponds to the 'B' axis, etc. A comma must be used in place of an argument if the corresponding axes will not be a slave.

n can be CA,CB,CC,CD,CE,CF,CG or CH. The value of x is used to set the commanded position of the specified axis as the gearing master.

n can be S or T. S and T are used to specify the vector motion of the coordinated system, S or T, as the gearing master.

n can be DA,DB,DC,DD,DE,DF,DG or DH. The value of n is used to set the specified auxiliary encoder axis as the gearing master.

n=? returns the GA setting

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
GR - Gear Ratio
GM - Gantry Mode

Examples:
REM setup gearing where B axis is master for A and C axes.
#GEAR
MOB;'              Turn off servo to B motor
GAB,,B;           Specify master axis as B
GR .25,,-5;       Specify A and C gear ratios
SHB;'             Enable B axis
PRB=1000;BGB;'    Move B axis 1000 counts
'                A axis will be commanded to move 250 counts positive
REM imaginary axis example
#imag
GAC=N;'  set the imaginary N axis as the master of the C axis
GRC=2.5;'  set the gear ratio for the C axis as 1
PRN=1000;BGN;'  Move N axis 1000 counts
'  C axis will be commanded to move 2500 counts positive
EN;'  End Program
**GD**

**Gear Distance**

**Full Description**
The GD command sets the distance of the master axis over which the specified slave will be engaged, disengaged or changed to a new gear setting. The distance is entered as an absolute value, the motion of the master may be in either direction. If the distance is set to 0, then the gearing will engage instantly.

**Arguments**
GD n,n,n,n,n,n,n

N is an integer in the range 0 to 32767, the units are in encoder counts
n = 0 will result in the conventional method of instant gear change
n = ? will return the value that is set for the appropriate axis

**Operand Usage**
_GDn contains the distance the master axis will travel for the specified slave axis to fully engage, disengage, or change ratios.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>(1.0 for 18x2 &amp; 21x3) (5.0 for 18x6 &amp; 4xxx)</td>
</tr>
</tbody>
</table>

**Related Commands**
_GP - Gearing Phase Differential
GR - Gear Ratio
GA - Gear Axis

**Examples:**

```
#A
GA,X      ;'Sets the X axis as the gearing master for the Y axis
GD,5000   ;'Set distance over which gearing is engaged to 5000 counts of the master axis.
JG5000    ;'Set the X axis jog speed to 5000 cts/sec
BGX       ;'Begin motion on the X axis
ASX       ;'Wait until X axis reaches the set speed of 5000 counts/sec
GR,1      ;'Engage gearing on the Y axis with a ratio of 1:1, the
           ;'distance to fully engage gearing will be 5000 counts of the master axis
WT1000    ;'Wait 1 second
GR,3      ;'Set the gear ratio to three.  The ratio will be changed
           ;'over the distance set by the GD command
WT1000    ;'Wait 1 second
GR,0      ;'Disengage the gearing between the Y axis slave and the
           ;'master.  The gearing will be disengaged over the number of
           ;'counts of the master specified with the GD command above
EN        ;'End program
```
**GM**

**Syntax:** Explicit & Implicit  
**Operands:** _GMn_  
**Burn:** not burnable

**Gantry mode**

**Full Description**
The GM command specifies the axes in which the gearing function is performed in the Gantry mode. In this mode, the gearing will not be stopped by the ST command or by limit switches. Only GR0 will stop the gearing in this mode.

**Arguments**
GM n,n,n,n,n,n,n,n or GMA=n where  
n = 0  Disables gantry mode function  
n = 1  Enables the gantry mode  
n = ?  Returns the state of gantry mode for the specified axis: 0 gantry mode disabled, 1 gantry mode enabled

**Operand Usage**

_GMn_ contains the state of gantry mode for the specified axis: 0 gantry mode disabled, 1 gantry mode enabled

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

GR - Gear Ratio  
GA - Gear Axes

**Examples:**

GM 1,1,1,1  
GM 0  
GM ,,1,1  
GM 1,0,1,0  

Hint: The GM command is useful for driving heavy load on both sides (Gantry Style).
GR

Gear Ratio

Full Description

GR specifies the Gear Ratios for the geared axes in the electronic gearing mode. The master axis is defined by the GA command. The gear ratio may be different for each geared axis. The master can go in both directions. A gear ratio of 0 disables gearing for each axis. A limit switch also disables the gearing unless gantry mode has been enabled (see GM command).

When the geared motors must be coupled "strongly" to the master, use the gantry mode GM.

Arguments

GR n,n,n,n,n,n,n,n or GRA=n where
n is a signed numbers in the range +/-127, with a fractional resolution of 1/65536.

n = 0    Disables gearing
n = ?    Returns the value of the gear ratio for the specified axis.

Operand Usage

_GRn contains the value of the gear ratio for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Related Commands

GA - Master Axis for Gearing
GM - Gantry Mode

Examples:

REM setup gearing where B axis is master for A and C axes.
#GEAR
MOB;'    Turn off servo to B motor
GAB,,B;' Specify master axis as B
GR .25,-5;' Specify A and C gear ratios
SHB;'   Enable B axis
PRB=1000;BGB;' Move B axis 1000 counts
'   A axis will be commanded to move 250 counts positive
'   C axis will be commanded to move 5000 counts negative (-5000)
EN;'   End program
<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Accepts Axis Mask</th>
<th>Operands:</th>
<th>HMn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burn:</td>
<td>not burnable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Full Description

The HM command performs a three-stage homing sequence for servo systems and two stage sequence for stepper motor operation.

For servo motor operation: During first stage of the homing sequence, the motor moves at the user programmed speed until detecting a transition on the homing input for that axis. The direction for this first stage is determined by the initial state of the homing input. Once the homing input changes state, the motor decelerates to a stop. The state of the homing input can be configured using the CN command.

At the second stage, the motor change directions and slowly approach the transition again at the speed set with the HV command. When the transition is detected, the motor is stopped instantaneously.

At the third stage, the motor moves forward at the speed set with the HV command until it detects an index pulse from the encoder. It latches to this point and defines it as position 0.

For stepper mode operation, the sequence consists of the first two stages. The frequency of the motion in stage 2 is set with the HV command.

### Arguments

HM nnnnnnnnn  
where

n is A,B,C,D,E,F,G, or H, or any combination to specify the axis. No argument homes all axes.

### Operand Usage

_HMn contains the state of the home switch for the specified axis

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Related Commands

CN - Configure Home  
FI - Find Index Only  
FE - Find Home Only  
HV - Homing velocity

### Examples:

```
HM      Set Homing Mode for all axes  
BG      Home all axes  
BGA     Home only the A-axis  
RGB     Home only the B-axis  
BGC     Home only the C-axis  
BDG     Home only the D-axis  

Hint:  You can create your own custom homing sequence by using the FE (Find Home Sensor only) and FI (Find Index only) commands.
```
**HS**

**Syntax:** Explicit Notation Only

**Operands:** none

**Burn:** not burnable

### Handle Assignment Switch

**Full Description**

The HS command is used to switch the handle assignments between two handles. Handles are opened when a connection is established by an external client (TCP or UDP), or when a handle is assigned explicitly with the IH command. Should those assignments need modifications, the HS command allows the handles to be reassigned.

A handle encapsulates the following 4 pieces of information:
1. Local IP address (same for all handles)
2. Remote IP address
3. Local Port
4. Remote Port

Handles are used as a pointer to the network socket in commands such as SAh, MBh, {Eh}, and IHh where h is the handle letter.

**Arguments**

HSh=i where
- h is the first handle of the switch (A through H, S).
- i is the second handle of the switch (A through H, S)
- S is used to represent the current handle executing the command.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Operand Usage**

N/A

**Related Commands**

IH- IP Handle

**Examples:**

HSC=D   Connection for handle C is assigned to handle D. Connection for handle D is assigned to handle C.

HSS=E   Executing handle connection is assigned to handle E. Connection for handle E is assigned to executing handle.
Homing Velocity

**Full Description**
Sets the slew speed for the FI final move to the index and all but the first stage of HM.

**Arguments**

Syntax: $HV n,n,n,n,n,n,n,n$ or $HVA=n$

- $n$ is an unsigned even number in the range 0 to 22,000,000 for servo motors. The units are encoder counts per second.
- OR
- $n$ is an unsigned number in the range 0 to 6,000,000 for stepper motors
- $n = ?$ Returns the speed for the specified axis.

**Operand Usage**

$_HVn$ contains the homing speed for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

HM - Home
FI - Find index

**Examples:**

```plaintext
HVX=1000       ;'set homing speed
HMX            ;'home to home switch then index
BGX            ;'begin motion
AMX            ;'wait for motion complete
EN              ;'end program
```
Full Description

The HX command halts the execution of any program that is running.

Arguments

HXn where
n is an integer in the range of 0 to 7 and indicates the thread number.

Operand Usage

When used as an operand, _HXn contains the running status of thread n with:
0 Thread not running
1 Thread is running
2 Thread has stopped at trippoint

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>n=0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

XQ - Execute program
HX - Stop all threads of motion

Examples:

XQ #A  Execute program #A, thread zero
XQ #B,3 Execute program #B, thread three
HX0    Halt thread zero
HX3    Halt thread three
### IA

**Syntax:** Implicit Notation Only  
**Operands:** _IA0, _IA1, _IA2, _IA3, _IA4, _IA5  
**Burn:** burnable with BN

---

**IP Address**

---

**Full Description**

The IA command assigns the controller's IP address.*

The IA command may also be used to specify the TCP time out.

Setting the IP address over Ethernet to a new value will cause an immediate disconnect. Reconnect to the controller on the new IP address and issue a BN to save the new value to flash.

Since it assigns an IP address to the controller, communication with the controller via Ethernet cannot be accomplished until after the address has been assigned. *

* The controller defaults to DHCP and will receive an IP address from a DHCP server if present. To manually set an IP address over the serial connection, send DH0 to disable DHCP prior to setting the new IP address with IA.

**Arguments**

**IA ip0,ip1,ip2, ip3 or IA n or IA<t**

where  
ip0, ip1, ip2, ip3 are 1 byte numbers separated by commas and represent the individual fields of the IP address. 
n is the IP address for the controller which is specified as an integer representing the signed 32 bit number (two's complement). 
<t specifies the time in update samples between TCP retries. 1<= t <= 2,147,483,647 up to 5 retries occur. (TCP/IP connection only)

>u specifies the multicast IP address where u is an integer between 0 and 63. (UDP/IP connection only)

IA? will return the IP address of the controller

**Operand Usage**

- _IA0 contains the IP address representing a 32 bit signed number (Two's complement)  
- _IA1 contains the value for t (retry time)  
- _IA2 contains the number of available handles  
- _IA3 contains the number of the handle using this operand where the number is 0 to 7. 0 represents handle A, 1 handle B, etc.  
- _IA4 contains the number of the handle that lost communication last, contains A-1 on reset to indicate no handles lost  
- _IA5 returns autonegotiation Ethernet speed. Returns 10 for 10-Base T and returns 100 for 100-Base T, it will return -1 if there is no physical link

The IP address can be derived using _IA0:

- **a** = @INT[(_IA0 & ($FF000000)) / $1000000] & $FF  
- **b** = @INT[(_IA0 & ($00FF0000)) / $10000]  
- **c** = @INT[(_IA0 & ($0000FF00)) / $100]  
- **d** = @INT[(_IA0 & ($000000FF))]  

IP address = a.b.c.d

---

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (no RIO)</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Controller Usage

**Default Value**: \( n=0, t=250 \)

**Default Format**: -

### Related Commands

**IH** - Internet Handle

**DH** - DHCP Server Enable

### Examples:

```
:IA 151,12,53,89   Assigns the controller with the address 151.12.53.89
:IA 2534159705     Assigns the controller with the address 151.12.53.89
:IA < 500           Sets the timeout value to 500msec
```
### Full Description

**DMC-40x0**

The ID command is used to query the controller for the accessories that are attached. It will respond with the type of communications board followed by the amplifier for axes 1-4 and then axes 5-8 if any are attached. The following are example responses to the ID command and a description of each line.

#### Example ID

```
:ID
DMC400016 bit adc option rev 0
Connector J3= Communications Board CMB-41012 3.3 volt i/o rev 0
Connector J1= 42100 Sine rev 1
Connector P1= Stepper Amplifier Board AMP-44040 rev 0
Connector P2= Servo Amplifier Board AMP-43020 500 watt rev 1
:
```

#### Example ID

```
:ID
DMC4000 rev 0
Connector J3= Communications Board CMB-41012 3.3 volt i/o rev 0
Connector J1= 42000 SSI rev 0
```

**Description of response**

DMC4000[bits] rev 0

where

- [bits] - '16 bit adc option' if -16bit option ordered
  - No string returned here indicates standard 12 bit analog input

Connector J3= Communications Board CMB-41012 [IO type] rev 0

where

- [IO type] - '3.3 volt i/o' for standard 3.3V extended IO
  - '5 volt i/o' for -5V option ordered

Connector J1/J2= [icm type] [encoder] rev 0

where

- J1 = A-D axes
- J2 = E-H axes. No string is output for J2 on a 1-4 axis controller
- [icm type] - specifies the ICM model number used.
  - '42000' is the -I000 option
  - '42100' is the -I100 option
  - '42200' is the -I200 option
- [encoder] - specifies the encoder option available on this ICM
  - 'Sine' indicates sin/cos encoder support
  - 'SSI' indicates SSI encoder support
'Biss option' indicates BiSS encoder support
An empty string after the = sign indicates that it is a standard ICM with no additional encoder option.

Connector P1/P2= [drive type] Amplifier Board [model] rev 0
where
P1 = A-D axes
P2 = E-H axes. No string is shown for P2 on a 1-4 axis controller
[drive type] - specifies the drive available on this set of 4 axes
  'Servo' indicates standard servo drives
  'Stepper' indicates stepper drive
  'Sine' indicates sinusoidally commutated servo drives
[model] - specifies the ordered drive option for that set of 4 axes
  'AMP-43040 500 watt' for -D3040 option
  'AMP-43020 500 watt' for -D3020 option
  'AMP-43140 1 A' for -D3140 option
  'AMP-44040' for -D4040 option
  'AMP-44140' for -D4140 option
  'AMP-43540' for sine drive option
If no string is displayed, then that indicates that no drive is present for that set of 4 axes

Note that the rev number at the end of each line of the ID command indicates the hardware revision of that board.
Newer board revisions will have a higher revision value.

Arguments
N/A

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

;ID
Connector J3= Communications Board CMB-41012 3.3 volt i/o
Connector P1= Stepper Amplifier Board AMP-44040
Connector P2= Stepper Amplifier Board AMP-44040
Full Description
The IF command is used in conjunction with an ENDIF command to form an IF conditional statement. The arguments consist of one or more conditional statements and each condition must be enclosed with parenthesis (). If the conditional statement(s) evaluates true, the command interpreter will continue executing commands which follow the IF command. If the conditional statement evaluates false, the controller will ignore commands until the associated ENDIF command OR an ELSE command occurs in the program.

Each condition must be placed in parenthesis for proper evaluation by the controller.
Example:

```
IF((var0=1)&&(var1=2));' valid IF statement
MG "GOOD"
ENDIF

IF var0=1&var1=2;' invalid IF statement
MG "BAD"
ENDIF

IF (var0=1&var1=2);' invalid IF statement
MG "BAD"
ENDIF
```

Arguments
IF (condition) where
Conditions are tested with the following logical operators:
< less than or equal to
> greater than
= equal to
<= less than or equal to
>= greater than or equal to
<> not equal

Note 1: Bit wise operators | and & can be used to evaluate multiple conditions.

Note 2: A true condition = 1 and an false condition = 0.

Usage
```
<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>
```

Operand Usage
Related Commands
ELSE - Optional command to be used only after IF command
ENDIF - End of IF conditional Statement
JS - Jump to subroutine
JP - Jump to label

Examples:

```plaintext
#A
IF (_TEA<1000);'  IF conditional statement based on a motor position
   MG "Motor is within 1000 counts of zero";' Message to be executed for true
ENDIF;'           End of IF conditional statement
EN;'             End Program

#input
IF (@IN[1]=0);'          IF conditional statement based on input 1
   MG "Input 1 is Low";'   Message to be executed if "IF" statement is true
ENDIF;'                  End of IF conditional statement
EN

#var
v1=@AN[1]*5;'            some calculation for variable v1
IF((v1>25)&(@IN[4]=1));' Conditions based on V1 variable and input 4 status
   MG "Conditions met";' Message to be executed if "IF" statement is true
ENDIF;'                  End of IF statement
EN

REM The conditions of an if statement can be simplified with the fact that
REM a true condition = 1 and a false condition = 0.
#true
v1=1
IF v1
   MG "True v1=",,v1
ENDIF
#false
v1=0
IF v1
   'if statement evaluates false
ELSE
   MG "False v1=",,0
ENDIF
EN
```
**IH**

**Open IP Handle**

**Full Description**

The IH command is used when the controller is operated as a master (also known as a client). This command opens a handle and connects to a slave (server).

To open a handle, the user must specify:

1. The IP address of the slave
2. The type of session: TCP/IP or UDP/IP
3. The port number of the slave. This number is not necessary if the slave device does not require a specific port value. If not specified, the board will specify the port value as 1000.

Each controller (DMC) may have 8 handles open at any given time. The handles are denoted with A,B,C,D,E,F,G, or H.

**Arguments**

IHh= ip0,ip1,ip2,ip3 <p >q
IHh=n <p >q
IHh= >r

where

h is the handle
ip0,ip1,ip2,ip3 are integers between 0 and 255 and represent the individual fields of the IP address. These values must be separated by commas.

n is a signed integer between -2147483648 and 2147483647. This value is the 32 bit IP address and can be used instead of specifying the 4 address fields.

<p specifies the port number of the slave where p is an integer between 0 and 65535. This value is not required for opening a handle.

>q specifies the connection type where q is 0 for no connection, 1 for UDP and 2 for TCP

IHS => r closes the handle that sent the command; where r = -1 for UDP/IP, or r = -2 for TCP/IP, or -3 for either

IHT => r closes all handles except for the one sending the command; where r = -1 UDP, or r = -2 TCP, or -3 for either

>r specifies that the connection be terminated and the handle be freed, where r is -1 for UDP, -2 for TCP/IP, or -3 for TCP/IP Reset

IHh=? returns the IP address as 4 1-byte numbers

**Operand Usage**

_\_IH\_0\_ contains the IP address as a 32 bit number
_\_IH\_1\_ contains the slave port number
_\_IH\_2\_ contains a 0 if the handle is free
contains a 1 if it is for a UDP slave
contains a 2 if it is for a TCP slave
contains a -1 if it is for a UDP master
contains a -2 if it is for a TCP master
contains a -5 while attempting to establish a UDP handle
contains a -6 while attempting to establish a TCP/IP handle

_\_IH\_3\_ contains a 0 if the ARP was successful
contains a 1 if it has failed or is still in progress

_\_IH\_4\_ contains a 1 if the master controller is waiting for acknowledgment from the slave after issuing a command.
contains a 2 if the master controller received a colon from the slave after issuing a command.
contains a 3 if the master controller received a question mark from the slave after issuing a command.
contains a 4 if the master controller timed-out while waiting for a response from the slave after issuing a command.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0.0,0.0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

IA Internet Address

**Examples:**

```
IHA=251,29,51,1;    ' Open handle A at IP address 251.29.51.1, TCP is used as default
IHA= -2095238399;    ' Open handle A at IP address 251.29.51.1

'Note:  When the IH command is given, the controller initializes an ARP on the slave device before
'opening a handle.  This operation can cause a small time delay before the controller responds.
```
Full Description

The II command enables the input interrupt function for the specified inputs. By default, input interrupts are configured for activation with a logic "0" but can be configured for activation with a logic "1" signal.

If any of the specified inputs are activated during program execution, the program will jump to the subroutine with label #ININT. Any trippoints set by the program will be cleared but can be re-enabled by the proper termination of the interrupt subroutine using RI. The RI command is used to return from the #ININT routine.

Arguments

II m,n,o,p
where
m is an integer between 0 and 8 decimal. 0 disables interrupt. The value of m specifies the lowest input to be used for the input interrupt. When the 2nd argument, n, is omitted, only the input specified by m will be enabled.

n is an integer between 2 and 8. This argument is optional and is used with m to specify a range of values for input interrupts. For example, II 2,4 specifies interrupts occurring for Input 2, Input 3 and Input 4.

o is an integer between 1 and 255. Using this argument is an alternative to specifying an input range with m,n. If m and n are specified, o will be ignored. The argument o is an integer value and represents a binary number. For example, if o = 15, the binary equivalent is 00001111 where the bottom 4 bits are 1 (bit 0 through bit 3) and the top 4 bits are 0 (bit 4 through bit 7). Each bit represents an interrupt to be enabled - bit0 for interrupt 1, bit 1 for interrupt 2, etc. If o=15, the inputs 1,2,3 and 4 would be enabled.

p is an integer between 1 and 255. The argument p is used to specify inputs that will be activated with a logic "1". This argument is an integer value and represents a binary number. This binary number is used to logically "AND" with the inputs which have been specified by the parameters m and n or the parameter o. For example, if m=1 and n=4, the inputs 1,2,3 and 4 have been activated. If the value for p is 2 (the binary equivalent of 2 is 00000010), input 2 will be activated by a logic '1' and inputs 1,3, and 4 will be activated with a logic "0".

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands

#ININT - Interrupt Subroutine
AI - Trippoint for input
RI - Return from Interrupt

Examples:

```
#A;'                        Program A
II 1;';                      Specify interrupt on input 1
JG 5000;BGA;'                Specify jog and begin motion on A axis
```
#LOOP;JP #LOOP;'  Loop to keep thread zero active, only necessary on Ecnono (21x3/18x2)
EN;'  End Program
#ININT;'  Interrupt subroutine
STA;MG "INTERRUPT";AMA;'  Stop A, print message, wait for motion to complete
A11;'  Check for interrupt clear
BGA;'  Begin motion
R10;'  Return to main program, don't re-enable tripoints
IK

Block Ethernet ports

Full Description
A Galil Ethernet controller simultaneously operates as a server (listening for Ethernet connections from a client) and a client (able to create connections to a server). The IK command blocks clients from connecting to the controller on incoming ports lower than 1000 except for ports 0, 23, 68, and 502.

Arguments
IKn  where
n = 0 allows controller to receive Ethernet packets on any port
n = 1 blocks controller from receiving Ethernet packets on all ports lower than 1000 except those mentioned in the Full Description above.
n = ? queries controller for value of IK

Operand Usage
IK can not be used as an operand.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>Ethernet Only</td>
</tr>
<tr>
<td>Default Value</td>
<td>0 (DMC21x3/2)</td>
</tr>
<tr>
<td>Default Value</td>
<td>1 (DMC4xxx/RIO)</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
TH- Tell Handles
IH - Open new Ethernet handle

Examples

:IK1  Blocks undesirable port communication
:IK0  Allows all Ethernet ports to be used

: 
**Full Description**

The IL command limits the effect of the integrator function in the filter to a certain voltage. For example, IL 2 limits the output of the integrator of the A-axis to the +/-2 Volt range.

A negative parameter also freezes the effect of the integrator during the move. For example, IL -3 limits the integrator output to +/-3V. If, at the start of the motion, the integrator output is 1.6 Volts, that level will be maintained through the move. Note, however, that the KD and KP terms remain active in any case.

**Arguments**

IL n,n,n,n,n,n,n,n or ILA=n where

n is a number in the range -10 to 10 Volts with a resolution of 0.0003.

n = ? Returns the value of the integrator limit for the specified axis.

**Operand Usage**

_ILn contains the value of the integrator limit for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>9.9982</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

KI - Integrator

**Examples:**

KI 2,3,5,8  Integrator constants
IL 3,2,7,2  Integrator limits
IL ?  Returns the A-axis limit
3.0000
**Input Variable**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The IN command allows a variable to be input from a keyboard. When the IN command is executed in a program, the prompt message is displayed. The operator then enters the variable value followed by a carriage return. The entered value is assigned to the specified variable name. The IN command holds up execution of following commands in a program until a carriage return or semicolon is detected. If no value is given prior to a semicolon or carriage return, the previous variable value is kept. Input Interrupts, Error Interrupts and Limit Switch Interrupts will still be active. The IN command may only be used in thread 0.

The IN command can only be used with a serial connection to the controller.

**Arguments**

IN "m",n          where
   m is prompt message
   n is the variable name

The total number of characters for n and m must be less than 80 characters.

Note: Do not include a space between the comma at the end of the input message and the variable name.

**Operand Usage**

N/A

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

N/A

**Examples:**

Operator specifies length of material to be cut in inches and speed in inches/sec (2 pitch lead screw, 2000 counts/rev encoder).

```plaintext
#A;'                     Program A
IN "Enter Speed(in/sec)",V1;'   Prompt operator for speed
IN "Enter Length(in)",V2;'     Prompt for length
V3=V1*4000;'                Convert units to counts/sec
V4=V2*4000;'                Convert units to counts
SP V3;'                    Speed command
PR V4;'                    Position command
BGA;'                      Begin motion
AMA;'                      Wait for motion complete
MG "MOVE DONE";'           Print Message
EN;'                      End Program
```
Increment Position

Full Description
The IP command allows for a change in the command position while the motor is moving. This command does not require a BG. The command has three effects depending on the motion being executed. The units of this are quadrature.

Case 1: Motor is standing still
An IP a,b,c,d command is equivalent to a PR a,b,c,d and BG command. The motor will move to the specified position at the requested slew speed and acceleration.

Case 2: Motor is moving towards a position as specified by PR, PA, or IP.
An IP command will cause the motor to move to a new position target, which is the old target plus the specified increment. The incremental position must be in the same direction as the existing motion.

Case 3: Motor is in the Jog Mode
An IP command will cause the motor to instantly try to servo to a position which is the current instantaneous position plus the specified increment position. The SP and AC parameters have no effect. This command is useful when synchronizing 2 axes in which one of the axis' speed is indeterminate due to a variable diameter pulley.

Warning: When the mode is in jog mode, an IP will create an instantaneous position error. In this mode, the IP should only be used to make small incremental position movements.

Arguments
IP n,n,n,n,n,n,n,n or IPA=n
where
n is a signed numbers in the range -2147483648 to 2147483647 decimal.
n = ? Returns the current position of the specified axis.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>(7.0 on 18x2 &amp; 21x3) (PF on 18x6 &amp; 4xxx)</td>
</tr>
</tbody>
</table>

Related Commands
PF - Position Formatting

Examples:

| IP 50  | 50 counts with set acceleration and speed |
The IT command filters the acceleration and deceleration functions of independent moves such as JG, PR, PA to produce a smooth velocity profile. The resulting profile, known as smoothing, has continuous acceleration and results in reduced mechanical vibrations. IT sets the bandwidth of the filter where 1 means no filtering and 0.004 means maximum filtering. Note that the filtering results in longer motion time. The use of IT will not effect the trippoints AR and AD. The trippoints AR & AD monitor the profile prior to the IT filter and therefore can be satisfied before the actual distance has been reached if IT is NOT 1.

Arguments

IT n,n,n,n,n,n,n,n or ITA=n where
n is a positive numbers in the range between 0.004 and 1.0 with a resolution of 1/256.
n = ?  Returns the value of the independent time constant for the specified axis.

Operand Usage

_ITn contains the value of the independent time constant for the specified 'n' axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Related Commands

PR - Position relative
PA - Position absolute
JG - Jog
VM - Vector mode
LM - Linear Interpolation Mode

Examples:

IT 0.8, 0.6, 0.9, 0.1  Set independent time constants for a,b,c,d axes
IT ?  Return independent time constant for A-axis
:0.8
### Full Description

The JG command sets the jog mode and the jog slew speed of the axes.

### Arguments

\[ JG \, n,n,n,n,n,n,n \quad \text{or} \quad JGA=n \]

where

\( n \) is a signed even integer in the range 0 to +/-22,000,000. The units of this are counts/second. (Use \( JGN = n \) or \( JGM = n \) for the virtual axes)

For stepper motor operation, the maximum value is 6,000,000 steps/second

\( n = ? \) Returns the absolute value of the jog speed for the specified axis.

When ordered with the ICM-42100:

\( n \) is a signed even integer in the range of 0 to +/- 50,000,000. The units are interpolated encoder counts per second.

### Operand Usage

\( _JGn \) contains the absolute value of the jog speed for the specified axis.

### Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>25000</td>
</tr>
</tbody>
</table>

### Related Commands

- BG - Begin
- DC - Deceleration
- TV - Tell Velocity
- ST - Stop
- AC - Acceleration
- IP - Increment Position

### Examples:
Jump to Program Location

Full Description
The JP command causes a jump to a program location on a specified condition. The program location may be any program line number or label. The condition is a conditional statement which uses a logical operator such as equal to or less than. A jump is taken if the specified condition is true. Multiple conditions can be used in a single jump statement. The conditional statements are combined in pairs using the operands "&" and "|". The "&" operand between any two conditions, requires that both statements must be true for the combined statement to be true. The "|" operand between any two conditions, requires that only one statement be true for the combined statement to be true.

Example:
Each condition must be placed in parenthesis for proper evaluation by the controller.

Example:
JP#a,(var0=1)&(var1=2));' valid conditional jump
JP#a, var0=1&var1=2;'      invalid conditional jump

Arguments

JP destination,condition

where
destination is a label, integer, or variable and is defined as the line number where code shall jump if condition is true.

c-condition is an optional conditional statement using a logical operator

The logical operators are:
< less than
> greater than
= equal to
<= less than or equal to
>= greater than or equal to
<> not equal to

Operands

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

JS - Jump to Subroutine
IF - If conditional statement
ELSE - Else function for use with IF conditional statement
ENDIF - End of IF conditional statement
Examples:

<table>
<thead>
<tr>
<th>JP #POS1, (V1&lt;5); '</th>
<th>Jump to label #POS1 if variable V1 is less than 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP #A, ((V7*V8)=0);</td>
<td>Jump to #A if V7 times V8 equals 0</td>
</tr>
<tr>
<td>JP #B, (@IN[1]=9);</td>
<td>Jump to #B if input 1 = 1</td>
</tr>
<tr>
<td>JP #C;</td>
<td>Jump to #C unconditionally</td>
</tr>
</tbody>
</table>
### Full Description

#### Basic Usage

The JS command will change the sequential order of execution of commands in a program. If the jump is taken, program execution will continue at the line specified by the destination parameter, which can be either a line number or label. The line number of the JS command is saved and after the next EN command is encountered (End of subroutine), program execution will continue with the instruction following the JS command. There can be a JS command within a subroutine, up to 16 deep.

Multiple conditions can be used in a single jump statement. The conditional statements are combined in pairs using the operands "&" and "|". The "&" operand between any two conditions, requires that both statements must be true for the combined statement to be true. The "|" operand between any two conditions, requires that only one statement be true for the combined statement to be true. Note: Each condition must be placed in parenthesis for proper evaluation by the controller.

A jump is taken if the specified condition is true.

Each condition must be placed in parenthesis for proper evaluation by the controller.

Example:

- `JS#A,(var0=1)&(var1=2);` valid conditional jump
- `JS#A,var0=1&var1=2;` invalid conditional jump

#### Passing Values on the Stack

Up to 8 parameters can be passed on the subroutine stack. One value can be returned from a subroutine. More return values are possible with pass by reference and array passing.

Using subroutine stacks and passing parameters in a subroutine has many advantages including:

1. Code flexibility/reuse. A single subroutine can be written and called many times and from various locations in code. The stack "remembers" where to return when completed. This is opposite from a "blind jump" (JP).
2. Variable Scope/Local variables. A subroutine can run with a protected variable space. Local variables exist only in the extent of the subroutine, and no external thread or stack level can access local variables. Local variables can be used for counters, indices, and other helper variables. "a - ^h must be used for local variables. Other variable names remain global.
3. Each thread has its own stack, therefore subroutines are reentrant. In other words, multiple threads can be running the same subroutine simultaneously at various stack depths.
4. Support for recursion. Although the subroutine stack is only 16 deep, recursion is possible. A stack depth of 16 is sufficient for many recursive tasks. E.G. recursing axes, handles, and thread status.
5. Parameter passing. A calling command can explicitly specify the inputs to a subroutine. The subroutine can pass one value back to the calling command. More returns are possible with pass by reference and array passing.

#### Arguments

Variables may be passed by value or by reference. If passed by value, a copy is made in the subroutine stack, leaving the original variable unchangeable. If passed by reference, the original variable's value will be changed when the subroutine writes to its local variable. This is similar, but not exactly analogous to a C pointer.

A variable passed by reference is automatically dereferenced; the variable pointer is not exposed to the user. Following the C syntax, a by-reference pass is accomplished with the ampersand (&) in the invoking call. When passing a variable by reference, do not allocate any new variables in the called subroutine.

Arrays can be passed in the stack, though only by reference. No "&" is used when passing arrays, by-reference is assumed. To pass an array, use its name in quotations. Arrays to be passed must have names that are 6 characters or less.

The number of elements in an array is returned by reading index -1, e.g. array[-1].

To return a value on the stack, write the value in the EN command upon ending the subroutine.
JS destination (param1,param2,...,param8), condition

where

destination is a label, integer, or variable and is defined as the line number where code shall jump if condition is true.

param1 - param8 are optional parameters to pass to the subroutine's stack, referenced from within the subroutine as ^a-^h, respectively.

condition is an optional conditional statement using a logical operator

The logical operators are:

< less than or equal to
> greater than
= equal to
<= less than or equal to
>= greater than or equal to
<> not equal

Operand Usage

_JS used after JS is called, this operand contains the returned value of the subroutine called by JS

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

Related Commands

& , | - Bitwise Logical Operators AND and OR
EN - End
<,>,=,<,>,=,<> - Comparison Operators

^a, ^b, ^c, ^d, ^e, ^f, ^g, ^h - JS subroutine stack variable

Examples:

JS #SQUARE,(V1<5);' Jump to subroutine #SQUARE if V1 is less than 5
JS #LOOP,(V1<>0);' Jump to #LOOP if V1 is not equal to 0
JS #A;' Jump to subroutine #A (unconditionally)

Advanced Usage Examples

#ADD
JS#SUM(1,2,3,4,5,6,7,8);' Call subroutine, pass values
MG_JS;' Print return value, will print 36.0000
EN

#SUM;' Sums values passed to it. Expects 8 numbers
EN,,^a+^b+^c+^d+^e+^f+^g+^h;' Return the sum

'Dimension two arrays
DM array1[10]
DM array2[100]
'Zero the contents of each array
JS#ZeroAry("array1", 0)
JS#ZeroAry("array2", 0)
EN

'Zero the contents of an array
#ZeroAry;(^a array,^b starting index)
^a[^b]=0
^b=(^b+1)
JP#ZeroAry,(^b < ^a[-1])
EN

i=1;' Counter
#loop
  offset=#spell+i;' Calculate offset
  JS offset;' Jump to offset
  i=i+1;' Increment Counter
  JP#loop,i<=3;' Loop through 3 states
EN

  #spell;' Subroutine containing various words
  MG"One";EN;' Prints "One" if this line is called (i=1)
  MG"Two";EN;' Prints "Two" if this line is called (i=2)
  MG"Three";EN;' Prints "Three" if this line is called (i=3)

REM Controller responds with:
REM One
REM Two
REM Three
KD

Derivative Constant

Full Description
KD designates the derivative constant in the control filter. The filter transfer function is
\[ D(z) = KP + KD(z-1)/z + KIz/2 (z-1) \]
For further details on the filter see the section Theory of Operation.

Arguments
KD n,n,n,n,n,n,n,n or KDX=n where
n is an unsigned numbers in the range 0 to 4095.875 with a resolution of 1/8.
n = ? Returns the value of the derivative constant for the specified axis.

Operand Usage
KDn contains the value of the derivative constant for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>64</td>
</tr>
<tr>
<td>Default Format</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Related Commands
KI - Integrator
KP - Proportional

Examples:
KD 100,200,300,400.25 Specify KD
KD ?,?,?,? Return KD
:100.00, 200.00, 300.00, 400.25
Note: KD now has four time more resolution as prior controllers, and thus for the same value is four times less effective.
Full Description

The KI command sets the integral gain of the control loop. It fits in the control equation as follows:
\[ D(z) = KP + KD(z-1)/z + KI z/2(z-1) \]
The integrator term will reduce the position error at rest to zero.

Arguments

KI n,n,n,n,n,n,n or KIA=n where
n is an unsigned numbers in the range 0 to 255 with a resolution of 0.001.
n = ? Returns the value for the specified axis.

Operand Usage

_KIn contains the value of the integral gain for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>(4.0 for 18x2 &amp; 21x3), (4.4 for 18x6, 4xxx &amp; RIO)</td>
</tr>
</tbody>
</table>

Related Commands

KP - Proportional Constant
KD - Derivative Constant
IL - Integrator Limit

Examples:

KI 12,14,16,20 Specify a,b,c,d-axis integral
KI 7 Specify a-axis only
KI ,,8 Specify c-axis only
KI ?,?,?,? Return A,B,C,D
:7, 14, 8, 20 KI values
**Proportional Constant**

**Full Description**

KP designates the proportional constant in the controller filter. The filter transfer function is

\[ D(z) = KP + KD(z-1)/z + KI \frac{z}{2(z-1)} \]

For further details see the section Theory of Operation in the User's Manual.

**Arguments**

KP n,n,n,n,n,n,n,n or KPA=n where

n is an unsigned numbers in the range 0 to 1023.875 with a resolution of 1/8.

n = ? Returns the value of the proportional constant for the specified axis.

**Operand Usage**

_KPn contains the value of the proportional constant for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage and Default Details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage</strong></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>6</td>
</tr>
<tr>
<td>Default Format</td>
<td>4.2</td>
</tr>
</tbody>
</table>

**Related Commands**

KD - Derivative Constant
KI - Integrator Constant
IL - Integrator Limit

**Examples:**

KP 12,14,16,20 Specify a,b,c,d-axis proportional
KP 7 Specify a-axis only
KP ,,8 Specify c-axis only
KP ?,?,?,? Return A,B,C,D
:7, 14, 8, 20 KP values
Galil Motion Control Command Reference

KS

Step Motor Smoothing

Syntax: Explicit & Implicit
Operands: _KSn
Burn: burnable with BN

Full Description

The KS parameter sets the amount of smoothing of stepper motor pulses. This is most useful when operating in full or half step mode. Larger values of KS provide greater smoothness. This parameter will also increase the motion time by 3KS sampling periods. KS adds a single pole low pass filter onto the output of the motion profiler.

Note: KS will cause a delay in the generation of output steps.

Arguments

KS n,n,n,n,n,n,n,n or KSA=n where
n is a positive number in the range between 0.25 and 64 with a resolution of 1/32.
n = ? Returns the value of the smoothing constant for the specified axis.

Operand Usage

_KSn contains the value of the stepper motor smoothing constant for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td></td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Default Value 2.000</td>
</tr>
<tr>
<td>In a Program</td>
<td>Default Format 2.3</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>ALL CONTROLLERS</td>
</tr>
</tbody>
</table>

Related Commands

MT - Motor Type

Examples:

KS 2, 4, 8 Specify a,b,c axes
KS 5 Specify a-axis only
KS ,,15 Specify c-axis only

Hint: KS is valid for step motor only.
**LA**

**Syntax:** Two Letter Only  
**Operands:** none  
**Burn:** not burnable  

**List Arrays**

**Full Description**

The LA command returns a list of all arrays in memory. The listing will be in alphabetical order. The size of each array will be included next to each array name in square brackets.

**Arguments**

None

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

LL - List Labels  
LS - List Program  
LV - List Variable

**Examples:**

```
: LA  
CA [10]  
LA [5]  
NY [25]  
VA [17]  
```
LB

LCD Bias Contrast

Full Description
Sets the Bias contrast on the LCD.

Arguments
LBn where
n is an integer between 0 and 15 where 0 is least contrast and 15 is greatest contrast. A negative value turns the optional backlight on.

Operand Usage
LB contains setting of the LB command

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Related Commands
MG - Message {Lx}
LU - LCD Update

Examples:

LB0    Set the LCD Bias Contrast to minimum
LB15   Set the LCD Bias Contrast to maximum
LB-8   Set the LCD Bias Contrast to default and turn on backlight (backlight is an optional enhancement)
LC

Low Current Stepper Mode

Full Description
The LC command causes the amp enable line for the specified axes to toggle (disabling the stepper drive) when the respective axes stops (profiler holding position). Each axis is handled individually. This will reduce current consumption, but there will be no holding torque at rest. The MT command must be issued prior to the LC command.

The user can set a time interval to wait after the profile has finished the move before the amp enable line is removed.

Using a Galil SDM drive with LC
When using an integrated Galil stepper drive LC may leverage a hardware feature providing for a fraction of the total holding torque to be used at rest. Sending LC0;MO may be necessary to shut off all current to the SDM in the "motor off" (MO) state. Consult the user manual for the SDM to be used for further details.

Arguments

<table>
<thead>
<tr>
<th>LC n,n,n,n,n,n,n,n where</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 0  Normal (stepper drive always on)</td>
</tr>
<tr>
<td>n = 1  Low current stepper mode</td>
</tr>
<tr>
<td>n = ?  Returns whether the axis is in low current stepper mode</td>
</tr>
</tbody>
</table>

n can also be an integer between 1 and 32767 specifying the number of samples to wait between the end of the move and when the amp enable line toggles

Operand Usage

_LCn contains the low current setting.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands
MT - Motor Type

Examples:

MTZ=2  Specify stepper mode for the z axis
LCZ=1  Specify low current mode for the z axis
**LD**

**Limit Disable**

**Full Description**
Disables limit switches. Soft limits BL and FL are still in effect. This feature should be used to gain additional digital inputs if limit switches are not used, or if there is a noise problem which causes limit switch conditions even though no limit switches are connected.

**Arguments**

LD n,n,n,n,n,n,n,n or LDA=n where

- n = 0  enabled (default)
- n = 1  forward limit disabled
- n = 2  reverse limit disabled
- n = 3  both disabled
- n =?  returns the current setting

**Operand Usage**

_LDn contains the current value

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

_LFX - State of forward limit
_LRX - State of reverse limit
SC - Stop code
BL - Backward soft limit
FL - Forward soft limit

**Examples:**

LDX=1  Disable the forward limit switch on the X axis
**LE**

**Syntax:** Two Letter Only  
**Operands:** _LEn  
**Burn:** not burnable

---

**Linear Interpolation End**

---

**Full Description**

**LE**  
Signifies the end of a linear interpolation sequence. It follows the last LI specification in a linear sequence. After the LE specification, the controller issues commands to decelerate the motors to a stop. The VE command is interchangeable with the LE command.  
The LE command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

**Arguments**

n = ?  
Returns the total move length in encoder counts for the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

**Operand Usage**

_LEn contains the total vector move length in encoder counts.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>PF</td>
</tr>
</tbody>
</table>

**Related Commands**

LI - Linear Distance  
BG - BGS Begin Sequence  
LM - Linear Interpolation Mode  
PF - Position Formatting  
VA - Vector Acceleration  
VD - Vector Deceleration  
VS - Vector Speed

**Examples:**

| CAS     | Specify S coordinated motion system  
| LM CD   | Specify linear interpolation mode for C and D axes  
| LI ,,100,200 | Specify linear distance  
| LE      | End linear move  
| BGS     | Begin motion |
Linear Interpolation Distance

Full Description
The LI command specifies the incremental distance of travel for each axis in the Linear Interpolation (LM) mode. LI parameters are relative distances given with respect to the current axis positions. Up to 511 LI segments may be given ahead of the Begin Sequence (BGS) command. Additional LI commands may be sent during motion when the controller sequence buffer frees additional space for new vector segments. The Linear End (LE) command must be given after the last LI segment in a sequence. LE tells the controller to decelerate to a stop at the last LI command. It is the responsibility of the user to keep enough LI segments in the controller's sequence buffer to ensure continuous motion.

LM Returns the available spaces for LI segments that can be sent to the buffer. 511 returned means the buffer is empty and 511 LI segments can be sent. A zero means the buffer is full and no additional segments can be sent. It should be noted that the controller computes the vector speed based on the axes specified in the LM mode. For example, LM ABC designates linear interpolation for the A,B and C axes. The speed of these axes will be computed from:

\[ V = \sqrt{A^2 + B^2 + C^2} \]

where
V is the vector speed
A, B and C are the speed of the A,B and C axes

If the LI command specifies only A and B, the speed of C will still be used in the vector calculations. The controller always uses the axis specifications from LM, not LI, to compute the speed.

The LI command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

Arguments

LI n,n,n,n,n,n,n <o >p or LIA=n

where
n is a signed integer in the range -8,388,607 to 8,388,607 and represents the incremental move distance (at least one n must be non-zero).
o specifies a vector speed to be taken into effect at the execution of the linear segment. o is an unsigned even integer between 0 and 22,000,000 for servo motor operation and between 0 and 6,000,000 for stepper motors.
p specifies a vector speed to be achieved at the end of the linear segment. Based on vector accel and decal rates, p is an unsigned even integer between 0 and 22,000,000 for servos, and between 0 and 6,000,000 for steppers.

Operand Usage
N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

Related Commands
LE - Linear end
BG - BGS Begin sequence
LM - Linear Interpolation Mode
CS - Clear Sequence
VS - Vector Speed
VA - Vector Acceleration
VD - Vector Deceleration

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM ABC;</td>
<td>Specify linear interpolation mode</td>
</tr>
<tr>
<td>LI 1000,2000,3000;</td>
<td>Specify distance</td>
</tr>
<tr>
<td>LE;</td>
<td>Last segment</td>
</tr>
<tr>
<td>BGS;</td>
<td>Begin sequence</td>
</tr>
</tbody>
</table>
**LL**

**List Labels**

**Full Description**
The LL command returns a listing of all of the program labels in memory and their associated line numbers. The listing will be in alphabetical order.

**Arguments**
None

**Operand Usage**
N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**
LA - List Arrays
LS - List Program
LV - List Variables

**Examples:**

```
: LL
# FIVE=5
# FOUR=4
# ONE=1
# THREE=3
# TWO=2
```
**LM**

**Linear Interpolation Mode**

**Full Description**
The LM command specifies the linear interpolation mode and specifies the axes for linear interpolation. Any set of 1 thru 8 axes may be used for linear interpolation. LI commands are used to specify the travel distances for linear interpolation. The LE command specifies the end of the linear interpolation sequence. Several LI commands may be given as long as the controller sequence buffer has room for additional segments. Once the LM command has been given, it does not need to be given again unless the VM command has been used.

The LM command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

**Arguments**

LM nnnnnnnnnnn

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

n = ? Returns the number of spaces available in the sequence buffer for additional LI commands.

**Operand Usage**

_LMn contains the number of spaces available in the sequence buffer for the 'n' coordinate system, S or T.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

LE - Linear Interpolation End
LI - Linear Interpolation Distance
VA - Vector Acceleration
VS - Vector Speed
VD - Vector Deceleration
AV - After Vector Distance
CS - Clear Sequence

**Examples:**

LM ABCD;' Specify linear interpolation mode
VS 10000; VA 100000;VD 1000000;' Specify vector speed, acceleration and deceleration
LI 100,200,300,400;' Specify linear distance
LI 200,300,400,500;' Specify linear distance
LE; BGS;' Last vector, then begin motion
**Full Description**

The LS command returns a listing of the programs in memory.

**Arguments**

LS n,m where

n and m are valid numbers from 0 to 1999, or labels. n is the first line to be listed, m is the last.

n is an integer in the range of 0 to 1999 or a label in the program memory. n is used to specify the first line to be listed.

m is an integer in the range of 1 to 1999 or a label on the program memory. m is used to specify the last line to be listed.

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0, Last Line (for DMC)</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

LA - List Arrays
LL - List Labels
LV - List Variables

**Examples:**

```plaintext
:LS #A,6           List program starting at #A through line 6
2 #A
3 PR 500
4 BGA
5 AM
6 WT 200

Hint: Remember to quit the Edit Mode <cntrl> Q prior to giving the LS command. (DOS)
```
**Full Description**

Turns the automatic axes status update on the LCD on or off.

**Arguments**

\[ LUn \]

where

- \( n = 0 \) Turns off the automatic update of the LCD with the axis status.
- \( n = 1 \) Sets the LCD in an automatic update mode with the axes status shown below.

The LCD displays the following pattern:

\[
\begin{array}{cccccccc}
A & B & C & D & E & F & G & H \\
\end{array}
\]

\[
\begin{array}{cccccccc}
m & m & m & m & m & m & m & m \\
\end{array}
\]

*where \( m \) is the axis status for axes ABCDEFGH and is*

<table>
<thead>
<tr>
<th>Axis Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Idle</td>
</tr>
<tr>
<td>i</td>
<td>Low power Idle</td>
</tr>
<tr>
<td>O</td>
<td>Motor Off</td>
</tr>
<tr>
<td>M</td>
<td>Motion - Axis Running in independent mode</td>
</tr>
<tr>
<td>E</td>
<td>Error - Positions Error exceeded TEn&gt;ERn</td>
</tr>
<tr>
<td>S</td>
<td>Stop - Stopped from ST command</td>
</tr>
<tr>
<td>L</td>
<td>Limit - Decelerating or stopped by a limit switch</td>
</tr>
<tr>
<td>A</td>
<td>Abort - Stopped by abort</td>
</tr>
<tr>
<td>V</td>
<td>Vector - Running in Vector or Linear Interpolation Mode</td>
</tr>
<tr>
<td>C</td>
<td>Contour - Running in Contour Mode</td>
</tr>
<tr>
<td>P</td>
<td>PVT - Running in PVT mode</td>
</tr>
<tr>
<td>H</td>
<td>Homing - Running in a Homing Routine</td>
</tr>
<tr>
<td>e</td>
<td>ECAM - Running in ECAM mode</td>
</tr>
<tr>
<td>F</td>
<td>Fault - Amplifier Fault</td>
</tr>
<tr>
<td>T</td>
<td>Stall - Stepper Position Maintenance Mode Stall Detected</td>
</tr>
</tbody>
</table>

**Operand Usage**

\[ _LU \] contains the setting of the LU command

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4000</td>
</tr>
</tbody>
</table>
Related Commands

MG - Message {Lx}
LB - LCD Bias Contrast
SC - Stop Code

Examples:

LU0     Turn the LCD update off
MG"DMC-40x0" {L1}       Send DMC-40x0 to line 1 of the LCD screen
MG"Galil MC" {L2}       Send Galil MC to line 2 of the LCD screen
LU1     Set the LCD to automatically update the LCD screen with the axis status
LV

List Variables

Full Description
The LV command returns a listing of all of the program variables in memory. The listing will be in alphabetical order.

Arguments
None

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>VF (for 18x6 &amp; 4xxx)</td>
</tr>
</tbody>
</table>

Related Commands
LA - List Arrays
LS - List Program
LL - List Labels

Examples:

```
: LV
APPLE = 60.0000
BOY   = 25.0000
ZEBRA = 37.0000
```
The LZ command is used for formatting the values returned from interrogation commands or interrogation of variables and arrays. By enabling the LZ function, all leading zeros of returned values will be removed.

Arguments
LZ n
where
n = 1  Removes leading zeros
n = 0  Does not remove leading zeros.
n = ?  Returns the state of the LZ function. '0' does not remove and '1' removes zeros

Operand Usage
_LZ contains the state of the LZ function. '0' is disabled and '1' is enabled.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Details</td>
<td>1</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

LZ 0  Disable the LZ function
TPA   Interrogate the controller for current position of A axis
:0000021645.0000  Value returned by the controller
VAR1=  Request value of variable "VAR1" (previously set to 10)
:0000000010.0000  Value of variable returned by controller
LZ1   Enable LZ function
TPA   Interrogate the controller for current position of A axis
:21645.0000  Value returned by the controller
VAR1=  Request value of variable "VAR1" (previously set to 10)
:10.0000  Value of variable returned by controller
**Full Description**

The MB command is used to communicate with I/O devices using the first two levels of the Modbus protocol. The format of the command varies depending on each function code. The function code -1 designates that the first level of Modbus is used (creates raw packets and receives raw data). The other codes are the 10 major function codes of the second level.

Modbus support is for TCP/IP.

Note: For those command formats that have "addr", this is the slave address. The slave address may be designated or defaulted to the device handle letter.

Note: All the formats contain an h parameter. This designates the connection handle letter (A thru H).

Note: Port 502 must be used in the Ethernet handle. See the IH command for more info on how to open a handle with a specific port number.

### Level 2 Modbus Function Codes

<table>
<thead>
<tr>
<th>Function Code</th>
<th>Modbus Definition</th>
<th>Slaved Galil Description (RIO only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Read Coil Status (Read Bits)</td>
<td>Read Digital Outputs (RIO only)</td>
</tr>
<tr>
<td>02</td>
<td>Read Input Status (Read Bits)</td>
<td>Read Digital Inputs (RIO only)</td>
</tr>
<tr>
<td>03</td>
<td>Read Holding Registers (Read Words)</td>
<td>Read Analog Inputs (RIO only)</td>
</tr>
<tr>
<td>04</td>
<td>Read Input Registers (Read Words)</td>
<td>Read Analog Outputs (RIO only)</td>
</tr>
<tr>
<td>05</td>
<td>Force Single Coil (Write One Bit)</td>
<td>Write Digital Output (RIO only)</td>
</tr>
<tr>
<td>06</td>
<td>Preset Single Register (Write One Word)</td>
<td>Write Digital Outputs (RIO only)</td>
</tr>
<tr>
<td>07</td>
<td>Read Exception Status (Read Error Code)</td>
<td>Read Digital Outputs (RIO only)</td>
</tr>
<tr>
<td>15</td>
<td>Force Multiple Coils (Write Multiple Bits)</td>
<td>Write Digital Outputs (RIO only)</td>
</tr>
<tr>
<td>16</td>
<td>Preset Multiple Registers (Write Words)</td>
<td>Write Analog Outputs (RIO only)</td>
</tr>
<tr>
<td>17</td>
<td>Report Slave ID</td>
<td></td>
</tr>
</tbody>
</table>

### Arguments

**MBh= addr, 1, m, n, array[]** where

- h is the handle letter
- addr is the unit ID
- 1 is the function code 1, Read Coil Status
- m is the address of the first coil
- n is the quantity of coils
- array[] is the name of the array whose first element will store the response

**MBh= addr, 2, m, n, array[]** where

- h is the handle letter
- addr is the unit ID
- 2 is the function code 2, Read Input Status
- m is the address of the first coil
- n is the quantity of coils
- array[] is the name of the array whose first element will store the response

**MBh= addr, 3, m, n, array[]** where

- h is the handle letter
- addr is the unit ID
- 3 is the function code 3, Read Holding Registers
- m is the address of the first Register
- n is the quantity of registers
- array[] is the name of the array that will store the resulting register data; 2-byte per element
MBh= addr, 4, m, n, array[] where
   h is the handle letter
   addr is the unit ID
   4 is the function code 4, Read Input Registers
   m is the address of the first Register
   n is the quantity of registers
   array[] is the name of the array that will store the resulting register data; 2-byte per element

MBh= addr, 5, m, n where
   h is the handle letter
   addr is the unit ID
   5 is the function code 5, Force Single Coil
   m is the address of the coil
   n is a value of 0 or 1 to turn the coil off or on

MBh= addr, 6, m, n where
   h is the handle letter
   addr is the unit ID
   6 is the function code 6, Preset Single Register
   m is register address
   n is a 16-bit value

MBh= addr, 7, m, n, array[] where
   h is the handle letter
   addr is the unit ID
   7 is the function code 7, Read Exception Status
   m is the address of the first Register
   n is the quantity of registers
   array[] is the name of the array where the response will be stored in the first element

MBh= addr, 15, m, n, array[] where
   h is the handle letter
   addr is the unit ID
   15 is the function code 15, Write Multiple Coils
   m is the address of the first register
   n is the quantity of registers
   array[] is the name of the array that will store the desired register data; 2-byte per element

MBh= addr, 16, m, n, array[] where
   h is the handle letter
   addr is the unit ID
   16 is the function code 16, Write Multiple Registers
   m is the address of the first Register
   n is the quantity of registers
   array[] is the name of the array that will store the desired register data; 2-byte per element

MBh = addr, 17, array[] where
   h is the handle letter
   addr is the unit ID
   17 is the function code 17, Report Slave ID
   array[] is where the returned data is stored
   (not supported on RIO)

**Raw Modbus Packet Send**

MBh= -1, len, array[] where
   h is the handle letter
   len is the number of bytes in the array,
   array[] is the array containing the outgoing data with a dimension of at least len

Note: each element of array[] may contain only one byte, and array[] must contain the entire modbus packet, including transaction identifiers, protocol identifiers, length field, modbus function code, and data specific to that function code.

**Operand Usage**
Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

IA - IP Address
MW - Modbus Wait

Examples:
Galil Motion Control Command Reference

MC

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Accepts Axis Mask &amp; Trippoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

Motion Complete

**Full Description**
The MC command is a trippoint used to control the timing of events. This command will hold up execution of the following commands until the current move on the specified axis or axes is completed and the encoder reaches or passes the specified position. Any combination of axes may be specified with the MC command. For example, MC AB waits for motion on both the A and B axis to be complete. MC with no parameter specifies that motion on all axes should complete before code continues. The command TW sets the timeout to declare an error if the encoder is not in position within the specified time. If a timeout occurs, the trippoint will clear and the stopcode will be set to 99. An application program will jump to the special label #MCTIME, if present.

When used in stepper mode, the controller will hold up execution of the proceeding commands until the controller has generated the same number of steps as specified in the commanded position. The actual number of steps that have been generated can be monitored by using the interrogation command TD.

Note: The MC command is recommended when operating with stepper motors in lieu of AM since the generation of step pulses can be delayed due to the stepper motor smoothing function, KS. In this case, the MC command would only be satisfied after all steps are generated.

**Arguments**

MC nnnnnnnn

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

MC with no axis mask specifies that motion on all axes should complete before code continues

**Operand Usage**

N/A

**Usage**

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Related Commands**

BG - Begin
AM - After Move
TW - Timeout

**Examples:**

```
#MOVE,'
TW 1000,1000,'
PR2000',4000,'
BG AB,'
MC AB,'
MG "DONE"'
EN,'

#MCTIME,'
MG "Motion Timeout"'
```

Program MOVE
Set motion complete timeout to one second per axis
Independent Move on A and B axis
Start the B axis
After the move is complete on T coordinate system,
Print message
End of Program
Motion Complete timeout Subroutine
Print failure message
| SC;' | Print stop codes |
| RE1;' | End subroutine |
**Syntax:**

Explicit & Implicit & Trippoint

**Operands:**

none

**Burn:**

not burnable

---

# Forward Motion to Position

## Full Description

The MF command is a trippoint used to control the timing of events. This command will hold up the execution of the following command until the specified motor moves forward and crosses the position specified*. The units of the command are in quadrature counts. Only one axis may be specified at a time. The MF command only requires an encoder and does not require that the axis be under servo control.

* When using a stepper motor, this condition is satisfied when the stepper position (as determined by the output buffer) has crossed the specified Forward Motion Position. For further information see Chapter 6 of the User Manual "Stepper Motor Operation".

Hint: The accuracy of the MF command is the number of counts that occur in 2*TM sec. Multiply the speed by 2*TM sec to obtain the maximum error. MF tests for absolute position. The MF command can also be used when the specified motor is driven independently by an external device.

## Arguments

MF n,n,n,n,n,n,n,n or MFA=n where

n is a signed integer in the range 2147483648 to 2147483647 decimal

## Operand Usage

N/A

## Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Related Commands

AR - Trippoint for after Relative Distances
AP - Trippoint for after Absolute Position
MR - Reverse Motion to Position Trippoint

## Examples:

```
#TEST;
DP0;
JG 1000;
BG A;
MF 2000;
V1=_TPA;
MG "Position is", V1;
ST;
EN;
```

Program Test
Define zero
Jog mode (speed of 1000 counts/sec)
Begin move
After passing the position 2000
Assign V1 A position
Print Message
Stop
End of Program
**MG**

**Syntax:** Implicit Notation Only  
**Operands:** none  
**Burn:** not burnable

---

**Message**

---

**Full Description**

The MG command can be used in two ways:

1.) From a host PC "MG val" will return the value, where val is an operand, string, variable, or number, including mathematical expressions. This is known as a solicited command, because the host sends the command and expects a response.

```
:MG TIME
  261928200.0000
:variable = 10
:MG variable + 5
  15.0000
:MG _TI0
  255.0000
:MG "Foo"
  Foo
```

2.) From embedded DMC code, the MG command will send an unsolicited, asynchronous message from the controller to the host. This can be used to alert an operator, send instructions or return a variable value. This is known as an unsolicited command because the host is not expecting it; the DMC code sends the data when the MG command is executed in embedded code.

The CW command controls the ASCII format of all unsolicited messages.

```
#POSERR
  MG "Warning, position error exceeded"
RE
```

Messages sent from within embedded code can go to any of the Ethernet handles, or serial ports. See CF to set the routing of the message.

**Arguments**

**MG "m", \{^n\}, V**

where

"m" is a text string including alphanumeric characters (up to 76 characters)  
\{"^n\} is an ASCII character specified by the value n  
V is a value, variable name, operand, array element, or mathematical expression

Multiple strings, variables, and ASCII characters may be used, each must be separated by a comma.

**Formatters**

\{Fm.n\} Display variable in decimal format with m digits to left of decimal, and n to the right.  
\{Zm.n\} Same as \{Fm.n\} but suppresses leading zeros.  
\{Sm.n\} Display variable in hexadecimal format with m digits to left of decimal, and n to the right.  
\{Sn\} Display variable as a string of length n where n is 1 through 6  
\{N\} Suppress carriage return line feed (\r\n) at the end of the message.

Formatters can be placed before or after each argument in MG.

**Message Routing**

Messages are routed based upon the CF setting. MG can override the global CF setting.

\{Ex\} Sends the message out the Ethernet handle x, where x is A,B,C,D,E,F,G or H  
\{Pn\} Sends the message out the Serial port n, where n is 1 or 2 denoting Main or Auxilary (where equipped).
Routing options should be placed at the beginning of the message, right after MG.

**Printing to the LCD**

\{Lx\} Sends the message to the LCD, where x is 1 or 2 for the top or bottom line of the LCD. The message cannot be more than 8 characters when sent to the LCD screen; excess characters will not be shown.

The LU command must be set to 0 for user messages sent to the LCD to appear.

When outputting to the LCD using multiple variables, use \{L1\} and \{L2\} before the variable in order to direct it to a specific line number. See Example Below.

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Related Commands**

CF - Configure Unsolicited Messages Handle

**Examples**

'Message command displays ASCII string
MG "Good Morning"

'Displays the string with the content of variable 'Total' in format of 4 digits before and 2 digits after the decimal point.
MG "The Answer is", Total \{F4.2\}

Message command sends any ASCII character
MG \{^13\}, \{^10\}, \{^48\}, \{^055\}
'displays carriage return, line feed, and the characters 0 and 7.

CFA;' Messages configured to go out Ethernet handle A
MG\{EB\}var;' Override CF and send the value of variable var to B handle

'printing to the LCD screen
LU0
cr=1
rpm=1432
MG\{L1\}"CT SPD","{L2}\{F1.0\}ct,"\{F4.0\}rpm
EN
**Full Description**

The MO command shuts off the control algorithm. The controller will continue to monitor the motor position. To turn the motor back on use the Servo Here command (SH).

**Arguments**

MO nnnnnnnnn where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes.
No argument specifies all axes.

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

_MOn contains the state of the motor for the specified axis.

**Related Commands**

SH
Servo Here

**Examples:**

- MO Turn off all motors
- MOA Turn off the A motor. Leave the other motors unchanged
- MOB Turn off the B motor. Leave the other motors unchanged
- MOCA Turn off the C and A motors. Leave the other motors unchanged
- SH Turn all motors on
- Bob=_MOA Sets Bob equal to the A-axis servo status
- Bob= Return value of Bob. If 1, in motor off mode, If 0, in servo mode
- Hint: The MO command is useful for positioning the motors by hand. Turn them back on with the SH command.
MR

Reverse Motion to Position

Full Description
The MR command is a trippoint used to control the timing of events. This command will hold up the execution of the following command until the specified motor moves backward and crosses the position specified*. The units of the command are in quadrature counts. Only one axis may be specified at a time. The MR command only requires an encoder and does not require that the axis be under servo control.
* When using a stepper motor, this condition is satisfied when the stepper position (as determined by the output buffer) has crossed the specified Reverse Motion Position. For further information see Chapter 6 of the User Manual "Stepper Motor Operation".

Hint: The accuracy of the MR command is the number of counts that occur in 2*TM sec. Multiply the speed by 2*TM sec to obtain the maximum error. MR tests for absolute position. The MR command can also be used when the specified motor is driven independently by an external device.

Arguments
MR n,n,n,n,n,n,n,n or MRA=n where
n is a signed integers in the range 2147483648 to 2147483647 decimal

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
AD - Trippoint for Relative Distances
AP - Trippoint for after Absolute Position
MF - Forward Motion to Position Trippoint

Examples:

```
#TEST;' Program Test
DP0,'
JG -1000;' Jog mode (speed of 1000 counts/sec)
BG A,'
MR -3000;' After passing the position -3000
V1=_TPA,'
MG "Position is", V1;' Print Message
ST,'
EN;'
```

End of Program
Full Description

The MT command selects the type of the motor and the polarity of the drive signal. Motor types include standard servomotors, which require a voltage in the range of +/- 10 Volts, and step motors, which require pulse and direction signals. The polarity reversal inverts the analog signals for servomotors, and inverts logic level of the pulse train, for step motors.

Arguments

MT n,n,n,n,n,n,n,n or MTA=n where
n = 1 Specifies Servo motor
n = -1 Specifies Servo motor with reversed polarity
n = 1.5 Specifies PWM/Sign servo drive
n = -1.5 Specifies PWM/Sign servo drive with reversed polarity
n = -2 Specifies Step motor with active high step pulses
n = 2 Specifies Step motor with active low step pulses
n = -2.5 Specifies Step motor with reversed direction and active high step pulses
n = 2.5 Specifies Step motor with reversed direction and active low step pulses
n = ? Returns the value of the motor type for the specified axis.

Operand Usage

_MTn contains the value of the motor type for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1,1,1,1</td>
</tr>
<tr>
<td>Default Format</td>
<td>1 (18x2 &amp; 21x3), 1.1 (18x6 &amp; 4xxx)</td>
</tr>
</tbody>
</table>

Related Commands

CE - Configure encoder type

Examples:

| MT 1,-1,2,2 | Configure a as servo, b as reverse servo, c and d as steppers |
| MT ?,,?     | Interrogate motor type                                      |
| V=_MTA      | Assign motor type to variable                               |
**MW**

**Modbus Wait**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>_MW, _MW1</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

Enabling the MW command causes the controller to hold up execution of the program after sending a Modbus command until a response from the Modbus device has been received. If the response is never received, then the #TCPERR subroutine will be triggered and an error code of 123 will occur on _TC.

**Arguments**

MWn  
where  

n = 0  Disables the Modbus Wait function  
n = 1  Enables the Modbus Wait function

**Operand Usage**

MW? contains the state of the Modbus Wait.  
 Melania _MW contains returned function code  
 Melania _MW1 contains returned error code

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1 (0 on 21x3)</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

MB - Modbus

**Examples:**

- MW1  Enables Modbus Wait  
- SB1001  Set Bit 1 on Modbus Handle A  
- CB1001  Clear Bit 1 on Modbus Handle A
Full Description

The NB command sets real part of the notch poles

Arguments

NB n,n,n,n,n,n,n,n or NBA=n where

n is ranges from 0 Hz to

Operand Usage

_NBn contains the value of the notch bandwidth for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0.5</td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

Default Value
- While Moving: Yes
- In a Program: Yes
- Command Line: Yes
- Controller Usage: ALL CONTROLLERS

Related Commands

NF - Notch Filter
NZ - Notch Zeros

Examples:

_NB = 10          Sets the real part of the notch pole to 10/2 Hz
notch = _NB       Sets the variable "notch" equal to the notch bandwidth value for the A axis
NF

Notch Frequency

**Full Description**
The NF command sets the frequency of the notch filter, which is placed in series with the PID compensation.

**Arguments**
NF n,n,n,n,n,n,n,n or NFA=n where
n ranges from 1 Hz to 1 / (4 * TM) Hz, where TM is the update rate (default TM is 1000).
n = ? Returns the value of the Notch filter for the specified axis.

**Operand Usage**
_NFn contains the value of notch filter for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Examples:**

| NF, 20            | Sets the notch frequency of B axis to 20 Hz |

**Related Commands**
NB - Notch bandwidth
NZ - Notch Zero
**Full Description**
The NO or an apostrophe (') command performs no action in a sequence, but can be used as a comment in a program. This helps to document a program.

**Arguments**
NO m  where
m is any group of letters and numbers
up to 77 characters can follow the NO command

**Operand Usage**
_NO returns a bit field indicating which threads are running. For example, 0 means no threads are running, 1 means only thread 0 is running, 3 means threads 0 and 1 are running, and 255 means all 8 threads are running).

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```plaintext
#A    ;'Program A
NO    ;'No Operation
NO    ;'No Operation
NO This Program        ;'No Operation
NO Does Absolutely     ;'No Operation
NO Nothing             ;'No Operation
EN     ;'End of Program
```
### Notch Zero

**Full Description**

The NZ command sets the real part of the notch zero.

**Arguments**

NZ n,n,n,n,n,n,n,n, or NZA=n where

- n is ranges from 1 Hz to 1 / (16 * update period)
- update period = TM/(10^6)
- n = ? Returns the value of the Notch filter zero for the specified axis.

#### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0.5</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Operand Usage**

NZn contains the value of the Notch filter zero for the specified axis.

**Related Commands**

NB - Notch Bandwidth
NF - Notch Filter

**Examples:**

- \( \text{NZA} = 10 \) Sets the real part of the notch pole to 10/2 Hz
OA

Off on encoder failure

Full Description

Turns on or off encoder failure detection. The controller can detect a failure on either or both channels of the encoder. This is accomplished by checking on whether motion of at least 4 counts is detected whenever the torque exceeds a preset level (OV) for a specified time (OT). Note that for this function to work properly it is necessary to have a non-zero value for KI.

The OA command works like the OE command: if OA is set to 1 and an encoder failure occurs, the axis goes into the motor off (MO) state and the stop code (SC) is set to 12. The encoder failure detection will shut the motor off regardless of profiling status, but the stop code is not updated unless the axis is executing a profiled move at the time of the detection of the encoder failure.

If included in the application program and OE is set to 1 for the particular axis, #POSERR will run when an encoder failure is detected.

Arguments

OAn,n,n,n,n,n,n where
n is 0 or 1 with 1 enabling this feature.
? returns the last value set

Operand Usage

_OAn contains the OA value for the specified axis.

Usage

Usage and Default Detail

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx, DMC-18x6</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Related Commands

OT - Off on encoder failure time
OV - Off on encoder failure voltage

Examples:

```
#setup
OTX=10;'  Set time to 10 milliseconds
OVX=5;'   Set voltage to 5
OAX=1;'   Enable encoder detection feature
EN

REM #POSERR example for checking to see if encoder failure occured
REM The stop code will only update of the profilier is running at the time
REM the encoder failure is detected.
#POSERR
~a=0
#loop
IF _MO~a=1
```
IF ((_TE-a<_ER-a)&(_OE-a)&(_OA-a))
    MG "possible encoder failure on ",-a(Z1.0)," axis"
ENDIF
ENDIF
~a=~a+1
JP#loop,-a<_BV
AI1;" wait for input 1 to go high
SH;" enable all axes
RE
Full Description
The OB n, logical expression command defines output bit n as either 0 or 1 depending on the result from the logical expression. Any non-zero value of the expression results in a one on the output.

Arguments
OB n, expression where
n denotes the output bit
expression is any valid logical expression, variable or array element.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

| OB 1, POS=1           | If POS 1 is non-zero, Bit 1 is high. |
|                       | If POS 1 is zero, Bit 1 is low       |
| OB 2, @IN[1]&@IN[2]   | If Input 1 and Input 2 are both high, then Output 2 is set high |
| OB 3, COUNT[1]        | If the element 1 in the array is zero, clear bit 3 |
| OB N, COUNT[1]        | If element 1 in the array is zero, clear bit N |
Full Description
The OC command sets up the Output Compare feature, also known as Pulse on Position. Each set of 4 axes, ABCD and EFGH, has one digital output which can be configured to pulse on a specified axis absolute encoder position, and optionally on a delta encoder change after that. These operations are known as one-shot and circular compare, respectively.

One-Shot Compare: The output compare signal will go low, and stay low at a specified absolute encoder position.

Circular Compare: After the one-shot, the circular compare can be configured to pulse low at a relative delta thereafter.

This function cannot be used with any axis configured for a step motor and the auxiliary encoder of the corresponding axis cannot be used while using this function. The OC function requires that the main encoder and auxiliary encoders be configured exactly the same (see the command, CE). For example: CE 0, CE 5, CE 10, CE 15.

OC only requires an encoder, and is independent of axis tuning, and motion profiling.

For circular compare, the output is a low-going pulse with a duration of approximately 250 nanoseconds.

Arguments
\[ \text{OC} x = m, n \]
where
\[ x = \text{A,B,C,D,E,F,G,H} \] specifies which main encoder input to be used. For 5-8 axis controllers, two OC functions can work simultaneously, one on axes A,B,C or D and the other on E,F,G or H.

\[ m \rightarrow \text{Absolute position for first pulse. Integer between -2,147,483,648 and 2,147,483,647. The beginning pulse position must be within 65535 counts of the current axis positions when the OC command is executed.} \]

\[ n \rightarrow \text{Incremental distance between pulses. Integer between -65535 and 65535} \]

- 0 one shot when moving in the forward direction
- -65536 one shot when moving in the reverse direction

\[ \text{OCA} = 0 \] will disable the Circular Compare function on axes A-D.
\[ \text{OCE} = 0 \] will disable the Circular Compare function on axes E-H.

The sign of the second parameter, \( n \), will designate the expected direction of motion for the output compare function. When moving in the opposite direction, output compare pulses will occur at the incremental distance of 65536-\(|n|\) where \(|n|\) is the absolute value of \( n \).

Operand Usage
\[_\text{OC} \] contains the state of the OC function
\[ _\text{OC} = 0 : \] OC function has been enabled but not generated any pulses.
\[ _\text{OC} = 1: \] OC function not enabled or has generated the first output pulse.
(on a 5-8 axis controller, \( _\text{OC} \) is a logical AND of axes A-D and E-H)

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Related Commands
AL - Arm Latch
RL - Report Latched Position
CE - Configure Encoder

Examples:

```
OCA=300,100;  ' Select A encoder as position sensor. First pulse at 300.
'          Following pulses at 400, 500, 600 ...
```

Output compare can be used to create raster scans. By using circular compare on one axis, followed by an index move on a perpendicular axis, raster patterns are easily made. The following image shows a rastered "dot matrix" type image easily created with output compare and a laser on a two dimensional stage.

---

### OE

**Syntax:** Explicit & Implicit

**Operands:** OEn

**Burn:** burnable with BN

#### Off-on-Error

**Full Description**

The OE command causes the controller to shut off the motor command if a position error exceeds the limit specified by the ER command, an abort occurs from either the abort input or on AB command, or an amplifier error occurs based on the description of the TA command. See the TA command for conditions of an amplifier fault.

If an error or axis-specific abort is detected on an axis, and the motion was executing an independent move, only that axis will be shut off. If the motion is a part of coordinated mode of the types VM, LM or CM, all participating axes will be stopped.

When internal servo amplifiers are installed that can drive brushless motors, such as the AMP-43040 (-D3040), or the AMP-20540, and an axis is driven with an external amplifier, the axis should be setup as a brushed motor (BR1). Otherwise the controller will detect the amplifier as having a hall error and shut down the motor if OE is set to nonzero.

#### Arguments

```
OE n,n,n,n,n,n,n,n,n or OEA=n
```

- **n = 0** Disables the Off On Error function.
- **n = 1** Motor shut off (MO) by position error (TE > ER) or abort input
- **n = 2** Motor shut off (MO) by hardware limit switch
- **n = 3** Motor shut off (MO) either by position error (TE > ER), hardware limit switch, or abort input
- **n <>0** Motor is shut off (MO) by an amplifier error (TA)

#### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

---

Operand Usage

_OEn contains the status of the off on error function for the specified axis.

Related Commands

AB - Abort
ER - Error limit
SH - Servo Here
#POSERR - Error Subroutine
TA - Tell Amplifier Error

#LIMSWI - Limit switch automatic subroutine

Examples:

| :OE 1,1,1,1  | Enable OE on all axes        |
| :OE 0        | Disable OE on A-axis; other axes remain unchanged |
| :OE ,,1,1    | Enable OE on C-axis and D-axis; other axes remain unchanged |
| :OE 1,0,1,0  | Enable OE on A and C-axis; Disable OE on B and D axis |
|             |                                 |
**OF**

**Offset**

**Full Description**

The OF command sets a bias voltage in the motor command output or returns a previously set value. This can be used to counteract gravity or an offset in an amplifier.

**Arguments**

OF n,n,n,n,n,n,n,n or OFA=n where 
n is a signed number in the range -9.998 to 9.998 volts with resolution of 0.0003. 
n = ? Returns the offset for the specified axis.

**Operand Usage**

_OFn contains the offset for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4 (1.0 for 18x2)</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

- OF 1,-2,3,5 Set A-axis offset to 1, the B-axis offset to -2, the C-axis to 3, and the D-axis to 5
- OF -3 Set A-axis offset to -3 Leave other axes unchanged
- OF ,0 Set B-axis offset to 0 Leave other axes unchanged
- OF ?,?,?,? Return offsets :-3.0000,0.0000,3.0000,5.0000
- OF ? Return A offset :-3.0000
- OF ,? Return B offset :0.0000
OP

Output Port

Full Description
The OP command sends data to the output ports of the controller. Arguments to the OP command are bit patterns (decimal or hex) to set entire banks (bytes) of digital outputs. Use SB, CB or OB to set bits individually.

Arguments

**OP m,a,b,c,d**

where

- m is an integer in the range 0 to 65535 decimal, or $0000$ to $FFFFFF$ hexadecimal. (0 to 255 for 4 axes or less). m is the decimal representation of the general output bits. Output 1 through output 8 for controllers with 4 axes or less. Outputs 1 through output 16 for controller with 5 or more axes.

- a,b,c,d represent the extended I/O (where available) in consecutive groups of 16 bits, (values from 0 to 65535). Bit patterns for I/O banks which are configured as inputs have no affect on the bank.

- m,a,b,c or d = ? returns the current value of the applicable argument.

The following table describes the arguments used to set the state of outputs.

<table>
<thead>
<tr>
<th>Argument</th>
<th>Examples</th>
<th>Banks</th>
<th>Bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>Set all: OP255;OP$FF</td>
<td>0</td>
<td>1-8</td>
<td>General Outputs (1-4 axes controllers)</td>
</tr>
<tr>
<td>m</td>
<td>Set all: OP65535;OP$FFFF</td>
<td>0,1</td>
<td>1-16</td>
<td>General Outputs (5-8 axes controllers)</td>
</tr>
<tr>
<td>a</td>
<td>Clear all: OP0;OP$0000</td>
<td>2,3</td>
<td>17-32</td>
<td>Extended I/O</td>
</tr>
<tr>
<td>b</td>
<td>Alternating on/off: OP43690;OP$AAAA</td>
<td>4,5</td>
<td>33-48</td>
<td>Extended I/O</td>
</tr>
<tr>
<td>c</td>
<td>Set High Byte: OP65280;OP$FF00</td>
<td>6,7</td>
<td>49-64</td>
<td>Extended I/O</td>
</tr>
<tr>
<td>d</td>
<td>Set Low Byte: OP255;OP$00FF</td>
<td>8,9</td>
<td>65-80</td>
<td>Extended I/O</td>
</tr>
</tbody>
</table>

The DMC-40x0 comes equipped with 32 bits of extended I/O standard (banks 2-5).

Operand Usage

- _OP0 contains the value of the first argument, m
- _OP1 contains the value of the first argument, a
- _OP2 contains the value of the first argument, b
- _OP3 contains the value of the first argument, c
- _OP4 contains the value of the first argument, d

Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>
Related Commands

SB - Set output bit
CB - Clear output bit
OB - Output Byte

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP 0</td>
<td>Clear Output Port -- all bits</td>
</tr>
<tr>
<td>OP $85</td>
<td>Set outputs 1,3,8; clear the others</td>
</tr>
<tr>
<td>MG _OP0</td>
<td>Returns the first parameter &quot;m&quot;</td>
</tr>
</tbody>
</table>
### OT

Off on encoder failure time

#### Full Description
Sets the time in samples (milliseconds for TM1000) that the controller will wait for motion after the OV threshold has been exceeded. The controller can detect a failure on either or both channels of the encoder. This is accomplished by checking on whether motion of at least 4 counts is detected whenever the torque exceeds a preset level (OV) for a specified time (OT). Note that for this function to work properly it is necessary to have a non-zero value for KI.

#### Arguments
OT \( n,n,n,n,n,n,n \) where
\( n \) is the number of samples between 2 and 32000
? returns the last value set

#### Operand Usage
_\( _{\text{OT}} \)\( n \) contains the OT value for the specified axis.

#### Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-40x0, DMC-18x6</td>
</tr>
<tr>
<td>Default Value</td>
<td>30</td>
</tr>
<tr>
<td>Default Format</td>
<td>5.0</td>
</tr>
</tbody>
</table>

#### Related Commands
OA - Off on encoder failure
OV - Off on encoder failure voltage

#### Examples:
```
#setup
OTX=10;'  Set time to 10 milliseconds
OVX=5;'   Set voltage to 5
OAX=1;'   Enable encoder detection feature
EN
```
Galil Motion Control Command Reference

**OV**

Off on encoder failure voltage

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Explicit &amp; Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td><em>OV_n</em></td>
</tr>
<tr>
<td>Burn:</td>
<td>burnable with BN</td>
</tr>
</tbody>
</table>

**Full Description**

Sets the threshold voltage for detecting an encoder failure. The controller can detect a failure on either or both channels of the encoder. This is accomplished by checking on whether motion of at least 4 counts is detected whenever the torque exceeds a preset level (OV) for a specified time (OT). Note that for this function to work properly it is necessary to have a non-zero value for KI.

The default value for OV is approximately .95 volts. The value should be high enough to guarantee that the motor would overcome any static friction. If it is too low, there will be false triggering of the error condition. The OV value may not be higher than the TL value.

**Arguments**

OV n,n,n,n,n,n,n where

where n is a positive voltage between 0.001 and 9.9 volts.

? returns the last value set

**Operand Usage**

OVn contains the OV value for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0.9438</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

OA - Off on encoder failure
OT - Off on encoder failure time

**Examples:**

```bash
#setup
OTX=10;'
OVX=5;'
OAX=1;'
EN
```

Set time to 10 milliseconds
Set voltage to 5
Enable encoder detection feature
P2CD

Serial port 2 code

Full Description
P2CD returns the status of the auxiliary serial port (port 2)

Arguments
Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
P2CH - Serial port 2 character
P2NM - Serial port 2 number
P2ST - Serial port 2 string
CI - Configure #COMINT
CC - Configure serial port 2
#COMINT - Communication interrupt automatic subroutine

Examples:

```
:R
DMC2240 Rev 1.0
:R
:CC 9600,0,0,0
:MG "TEST" (P2);'       send a message to the hand terminal
:MG P2CD;'
:MG P2CD;'
:MG P2CD;'
```
P2CH

Serial port 2 character

Full Description

P2CH returns the last character sent to the auxiliary serial port (port 2)

Arguments

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

P2CD - Serial port 2 code
P2NM - Serial port 2 number
P2ST - Serial port 2 string
CI - Configure #COMINT
CC - Configure serial port 2
#COMINT - Communication interrupt automatic subroutine

Examples:

:^R^V
DMC2240 Rev 1.0o
:^R^S
:CC 9600,0,0,0
:MG "TEST" (P2) ;'send a message to the hand terminal
:MG P2CH (S1) ;'the 6 button was pushed on the hand terminal
6

:
P2NM

Serial port 2 number

Syntax: Operand Only
Operands: P2NM
Burn: not burnable

Full Description

P2NM returns the last number (followed by carriage return) sent to auxiliary serial port (port 2).

Converts from ASCII (e.g. "1234") to binary so that a number can be stored into a variable and math can be performed on it. Numbers from -2147483648 to 2147483647 can be processed.

Arguments

Operand Usage
N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

P2CD - Serial port 2 code
P2CH - Serial port 2 character
P2ST - Serial port 2 string
Cl - Configure #COMINT
CC - Configure serial port 2
#COMINT - Communication interrupt automatic subroutine

Examples:

:^R^V
DMC2240 Rev 1.00
:^R^S
:CC 9600,0,0,0
:MG "TEST" {P2} ;'send a message to the hand terminal
:x = P2NM ;'the 1, 2, 3, <enter> buttons were pushed
:MG x
123.0000
:

P2ST

Serial port 2 string

Full Description
P2ST returns the last string (followed by carriage return) sent to auxiliary serial port (port 2)
NO MORE THAN SIX CHARACTERS CAN BE ACCESSED.

Arguments

Operand Usage
N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
P2CD - Serial port 2 code
P2CH - Serial port 2 character
P2NM - Serial port 2 number
CI - Configure #COMINT
CC - Configure serial port 2
#COMINT - Communication interrupt automatic subroutine

Examples:
:CC 9600,0,1,0
:MG "TEST" (P2) ;'send a message to the hand terminal
:MG P2ST (S3) ;'the characters ABC were entered
    ABC
**PA**

**Position Absolute**

**Full Description**

The PA command sets the end target of the Position Absolute Mode of Motion. The position is referenced to the absolute zero.

**Arguments**

**PA n,n,n,n,n,n,n,n or PAA=n**

where

n is a signed integer in the range -2147483647 to 2147483648 decimal. Units are in encoder counts.

\( n = ? \) Returns the commanded position at which motion stopped.

**Operand Usage**

_\_PAn contains the last commanded position at which motion stopped.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

PR - Position relative  
SP - Speed  
AC - Acceleration  
DC - Deceleration  
BG - Begin

**Examples:**

```
:PA 400,-600,500,200  
A-axis will go to 400 counts  
B-axis will go to -600 counts  
C-axis will go to 500 counts  
D-axis will go to 200 counts  
:BG  
Execute Motion  
:PA ?,?,?,?  
400, -600, 500, 200  
Returns the current commanded position after motion has completed  
:PA 700  
A-axis will go to 700 on the next move while the  
B,C and D-axis will travel the previously set relative distance  
if the preceding move was a PR move, or will not move if the  
preceding move was a PA move.  
:BG
```
**Full Description**

The PF command allows the user to format the position numbers such as those returned by TP. The number of digits of integers and the number of digits of fractions can be selected with this command. An extra digit for sign and a digit for decimal point will be added to the total number of digits. If PF is negative, the format will be hexadecimal and a dollar sign will precede the characters. Hex numbers are displayed as 2's complement with the first bit used to signify the sign.

If a number exceeds the format, the number will be displayed as the maximum possible positive or negative number (i.e. 999.99, -999, $8000 or $7FF). The PF command can be used to format values returned from the following commands:

- BL ?
- LE ?
- DE ?
- PA ?
- DP ?
- PR ?
- EM ?
- TN ?
- FL ?
- VE ?
- IP ?
- TE
- TP

**Arguments**

PF m.n  

Where

m is an integer between -8 and 10 which represents the number of places preceding the decimal point. A negative sign for m specifies hexadecimal representation.

n is an integer between 0 and 4 which represent the number of places after the decimal point.

n = ?  Returns the value of m.

**Operand Usage**

_PF contains the value of the position format parameter.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>10.0</td>
</tr>
<tr>
<td>Default Format</td>
<td>2.1 (10.0 for 18x2)</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```
TPX     Tell position of X
:0      Default format
PF 5.2  Change format to 5 digits of integers and 2 of fractions
TPX     Tell Position
:21.00
PF-5.2  New format. Change format to hexadecimal
TPX     Tell Position
:00015.00  Report in hex
```
Full Description

The PL command adds a low-pass filter in series with the PID compensation.

The crossover frequency can be entered directly as an argument to PL. The minimum frequency for pole placement is 1 Hz. and the maximum is 1/(4*TM).

To maintain compatibility with earlier versions, a value less than 1 may be specified using the following formula.

The digital transfer function of the filter is (1 - n) / (Z - n) and the equivalent continuous filter is A/(S+A) where A is the filter cutoff frequency: A=(1/T) ln (1 / n) rad/sec and T is the sample time.

To convert from the desired crossover (-3 dB) frequency in Hertz to the value given to PL, use the following formula:

\[ n = e^{-T \cdot f_c \cdot 2\pi} \]

where:
- \( n \) is the argument given to PL
- \( T \) is the controller's servo loop sample time in seconds (TM divided by 1,000,000)
- \( f_c \) is the crossover frequency in Hertz

Example: \( f_c=36\text{Hz} \hspace{1em} \text{TM}=1000 \hspace{1em} n=e^{(-0.001\cdot36\cdot2\cdot\pi)}=0.8 \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>( f_c ) (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Infinite (off)</td>
</tr>
<tr>
<td>0.2</td>
<td>256</td>
</tr>
<tr>
<td>0.4</td>
<td>145</td>
</tr>
<tr>
<td>0.6</td>
<td>81</td>
</tr>
<tr>
<td>0.8</td>
<td>36</td>
</tr>
<tr>
<td>0.999</td>
<td>0</td>
</tr>
</tbody>
</table>

Arguments

**PL n,n,n,n,n,n,n,n or PLA=n**

Frequency Argument

\( n \) is a positive integer in the range of 1 to Fmax and corresponds to the crossover frequency that the poll will create.

Fmax is given by 1/(4*TM)

Calculated Poll Argument (deprecated)

\( n \) is a positive number in the range 0 to 0.9999.

\( n = ? \) Returns the value of the pole filter for the specified axis.

Operand Usage

_\PLn_ contains the value of the pole filter for the specified axis.

Usage

*Usage and Default Details*
<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0.0</td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

### Related Commands

- KD - Derivative
- KP - Proportional
- KI - Integral Gain

### Examples:

- Set A-axis Pole to 0.95, B-axis to 0.9, C-axis to 0.8, D-axis pole to 0.822
  ```plaintext
  PL .95,.9,.8,.822
  : 
  ```

- Query all Pole values
  ```plaintext
  PL ?,?,?,?
  :0.9527,0.8997,0.7994,0.8244
  ```

- Return A Pole only
  ```plaintext
  PL?
  :0.9527
  ```
Full Description

The PR command sets the incremental distance and direction of the next move. The move is referenced with respect to the current position.

Arguments

PR n,n,n,n,n,n,n,n or PRA=n

where

n is a signed integer in the range -2147483648 to 2147483647 decimal. Units are in encoder counts

n = ? Returns the current incremental distance for the specified axis.

Operand Usage

_PRn contains the current incremental distance for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

Related Commands

AC - Acceleration
BG - Begin
DC - Deceleration
IP - Increment Position
PA - Position Absolute
PF - Position Formatting
SP - Speed

Examples:

PR 100,200,300,400 On the next move the A-axis will go 100 counts,
BG the B-axis will go to 200 counts forward, C-axis will go 300 counts and the D-axis will go 400 counts.
PR ?,?,?,? Return relative distances
:100, 200, 300
PR 500 Set the relative distance for the A axis to 500
BG The A-axis will go 500 counts on the next move while the B-axis will go its previously set relative distance.
Full Description

The PT command will place the controller in the position tracking mode. In this mode, the controller will allow the user to issue absolute position commands on the fly. The motion profile is trapezoidal with the parameters controlled by acceleration, deceleration, and speed (AD, DC, SP). The absolute position may be specified such that the axes will begin motion, continue in the same direction, reverse directions, or decelerate to a stop. When an axis is in the PT mode the ST command will exit the mode. The PA command is used to give the controller an absolute position target. Motion commands other than PA are not supported in this mode.

The BG command is not used to start the PT mode. The AM and MC trip points are not valid in this mode. It is recommended to use MF and MR as trip points with this command, as they allow the user to specify both the absolute position, and the direction. The AP trip point may also be used.

Arguments

PT n,n,n,n,n,n,n,n

where
n=0 or 1 where 1 designates the controller is in the special mode.
n=? returns the current setting

Operand Usage

_PTn contains the set state of position tracking, 1 or 0

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Related Commands

AC - Acceleration
DC - Deceleration
PA - Position Absolute
SP - Speed

Examples:

#A
  PT1,1,1,1;'
  '
#LOOP;' Create label #LOOP in a program. This small program will
  ' update the absolute position at 100 Hz. Note that the
  ' user must update the variables V1, V2, V3 and V4 from the
  ' host PC, or another thread operating on the controller.
  '
PA V1,V2,V3,V4;' Command XYZW axes to move to absolute positions. Motion
  ' begins when the command is processed. BG is not used
to begin motion in this mode. In this example, it is assumed that the user is updating the variables at a specified rate. The controller will update the new target position every 10 milliseconds (WT10).

WT10;' Wait 10 milliseconds
JP#LOOP;' Repeat by jumping back to label LOOP
PV

Full Description
The PV command is used to enter PVT data into the PVT buffer by specifying the target position, velocity, and delta time. For more details on PVT mode of motion see the user manual.

Arguments
PVa=p,v,t where

a specifies the axis
p is the relative target position specified in counts. -44,000,000 <= p <= 44,000,000.
v is the target velocity specified in counts per second. -22,000,000 <= v <= 22,000,000. Integer values only for p and v
t is the time to achieve target position and velocity. t is in even samples 2 <= t <= 2048. If t=0 then the PVT mode is exited. If t = -1 the PVT buffer is cleared. t is in samples and sample time is defined by TM (With a default TM of 1000, 1024 samples is 1 second). If t is omitted then the previous value is used.

Operand Usage
_PPVa contains the number of spaces available in the PV buffer for the specified axis. Each axis has a 255 segment PV buffer

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-4xxx, DMC-18x6, others via upgrade</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
BT - Begin PVT Motion
MF - Forward Motion to Position Trippoint
MR - Reverse Motion to Position Trippoint

Examples

<table>
<thead>
<tr>
<th>Desired X/Y Trajectory</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Position (relative/absolute)</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>0/0</td>
</tr>
<tr>
<td>100/100</td>
</tr>
<tr>
<td>200/300</td>
</tr>
<tr>
<td>300/600</td>
</tr>
</tbody>
</table>

DP0,0;' Define zero position
PVX=100,200,256;' Command X axis to move 100 counts reaching an ending speed of 200c/s in 256 samples
PVY=-50,500,100;'  Command Y axis to move -50 counts reaching an ending speed of 500c/s in 100 samples
PVY=-100,-100,510;' Command Y axis to move -100 counts reaching an ending speed of -100c/s in 510 samples
PVX=200,200,50;'  Command X axis to move 200 counts reaching an ending speed of 200c/s in 50 samples
PVX=300,0,50;'    Command X axis to move 300 counts reaching an ending speed of 0c/s in 50 samples
PVY=300,0,50;'    Command Y axis to move 300 counts reaching an ending speed of 0c/s in 50 samples
PVY=,,0;'        Exit PVT mode on Y axis
PVX=,,0;'        Exit PVT mode on X axis
    '            When the PVT mode is exited, the axis will be in the "SH" state
    '            (assuming position error is not exceeded, etc)
BTXY;'            Begin PVT on X and Y axis
AMXY;'            Trip point will block until PVT motion on X AND Y is complete
EN;'            End program
**Password**

**Full Description**
The password can be set with the command PW password,password where the password can be up to 8 alphanumeric characters. The default value after master reset is a null string. The password can only be changed when the controller is in the unlocked state (^L^K). The password is burnable but cannot be interrogated. If you forget the password you must master reset the controller to gain access.

**Arguments**

PW n,n  
where  
n is a string from 0 to 8 characters in length

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes (No for 40x0)</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>&quot;&quot; (null string)</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

<control>L<control>K - Lock/Unlock
ED - Edit program
UL - Upload program
LS - List program
TR - Trace program

**Examples:**

:PWtest,test Set password to "test"
:^L^K test,1 Lock the program
:ED Attempt to edit program
**Full Description**

The QD command transfers array data from the host computer to the controller. QD array[], start, end requires that the array name be specified along with the index of the first element of the array and the index of the last element of the array. The array elements can be separated by a comma (, ) or by <CR> <LF>. The downloaded array is terminated by a \.

It is recommended to use the array download functions available through the GalilTools software and drivers rather than directly using the QD command.

**Arguments**

QD array[], start, end  where  
array[] is valid array name  
start is index of first element of array (default=0)  
end is index of last element of array (default = size-1)

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>start=0, end=size-1</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A (Position Format for 18x2)</td>
</tr>
</tbody>
</table>

**Related Commands**

QU - Upload array

**Examples**

:QD array[]  Download values to array  
1,2,3,4,5\:  
:QU array[],0,4,1  Upload the array  
1.0000, 2.0000, 3.0000, 4.0000, 5.0000  
:QD array[],2,4  Download a subset  
9,8,7\:  
:QU array[],0,4,1  
1.0000, 2.0000, 9.0000, 8.0000, 7.0000

Hint: This log is from Hyperterm, a non-Galil software.
Full Description
The QH command transmits the state of the Hall sensor inputs. The value is decimal and represents an 8 bit value.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>Undefined (set to 0)</td>
</tr>
<tr>
<td>06</td>
<td>Undefined (set to 0)</td>
</tr>
<tr>
<td>05</td>
<td>Undefined (set to 0)</td>
</tr>
<tr>
<td>04</td>
<td>Undefined (set to 0)</td>
</tr>
<tr>
<td>03</td>
<td>Undefined (set to 0)</td>
</tr>
<tr>
<td>02</td>
<td>Hall C State</td>
</tr>
<tr>
<td>01</td>
<td>Hall B State</td>
</tr>
<tr>
<td>00</td>
<td>Hall A State</td>
</tr>
</tbody>
</table>

When using the AMP-43540 and AMP-43640, the BA command must be issued before QH will report the hall state status.

Arguments
QHn returns the Hall sensor input byte where
n=A, B, C, D, E, F, G, H

Usage
While Moving: Yes
In a Program: Yes
Command Line: Yes
Controller Usage: DMC-40x0-D430x0

Operand Usage
_QHn Contains the state of the Hall sensor inputs

Related Commands
PA
Position Absolute
BS
Brushless Setup
EXAMPLE:
QHY
:6 Hall inputs B and C active on Y axis

QR

Examples:
Full Description

The QR command causes the controller to return a record of information regarding controller status. This status information includes 4 bytes of header information and specific blocks of information as specified by the command arguments. The details of the status information is described in Chapter 4 of the user's manual.

Arguments

QR nnnnnnnnnn where
n is A,B,C,D,E,F,G,H,S,T, or I or any combination to specify the axis, axes, sequence, or I/O status
S and T represent the S and T coordinated motion planes
I represents the status of the I/O

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

QZ - Return DMA / Data Record information
Note: The Galil windows terminal will not display the results of the QR command since the results are in binary format.

Examples:
**QS**

**Error Magnitude**

**Syntax:** Accepts Axis Mask

**Operands:** QSn

**Burn:** not burnable

**Full Description**

The QS command reports the magnitude of error, in step counts, for axes in Stepper Position Maintenance mode. A step count is directly proportional to the resolution of the step drive.

The result of QS is modularized so that result is never greater than 1/2 the revolution of the stepper motor. Largest possible QS result = 0.5*YA*YB

**Arguments**

QS nnnnnnn or QSn = ? where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

**Operand Usage**

_QSn contains the error magnitude in drive step counts for the given axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

YA - Step Drive Resolution
YB - Step Motor Resolution
YC - Encoder Resolution
YR - Error Correction
YS - Stepper Position Maintenance Mode Enable, Status

**Examples:**

1. For an SDM-44140 microstepping drive, query the error of B axis:
   
   :QSB=?
   
   :253 This shows 253 step counts of error. The SDM-44140 resolution is 64 microsteps per full motor step, nearly four full motor steps of error.

2. Query the value of all axes:
   
   :QS
   
   :0,253,0,0,0,0,0,0 Response shows all axes error values
Upload Array

Full Description
The QU command transfers array data from the controller to a host computer. The QU requires that the array name be specified along with the first element of the array and last element of the array. The uploaded array will be followed by a <control>Z as an end of text marker.

The GalilTools array upload functions can be used to upload array data in .csv format.

Arguments
QU array[],start,end,delim where
"array[]" is a valid array name
"start" is the first element of the array (default=0)
"end" is the last element of the array (default = last element)
"delim" specifies the character used to delimit the array elements. If delim is 1, then the array elements will be separated by a comma. Otherwise, the elements will be separated by a carriage return.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

Related Commands
QD - Download array

Examples
:DM array[5]
:QU array[],0,4,1
:0.0000, 0.0000, 0.0000, 0.0000, 0.0000
:array[0]=9
:array[1]=1
:QU array[],0,4,1
:9.0000, 1.0000, 0.0000, 0.0000, 0.0000
:array[0]=?
 9.0000

Dimension Array
Upload Array
Set value
Alternative method to return just one array value
**QZ**

**Return Data Record information**

**Full Description**

The QZ command is an interrogation command that returns information regarding data record transfers. The controller's response to this command will be the return of 4 integers separated by commas. The four fields represent the following:

- First field returns the number of axes.
- Second field returns the number of bytes to be transferred for general status
- Third field returns the number bytes to be transferred for coordinated move status
- Fourth field returns the number of bytes to be transferred for axis specific information

**Arguments**

QZ

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

DR

Ethernet data record update rate

RA

**Examples:**
**RA**

**Record Array**

**Full Description**
The RA command selects one through eight arrays for automatic data capture. The selected arrays must be dimensioned by the DM command. The data to be captured is specified by the RD command and time interval by the RC command.

**Arguments**

RA n[],m[],o[],p[],q[],r[],s[],t[]

where
n,m,o,p,q,r,s, and t are dimensioned arrays as defined by DM command. The square brackets are empty, [].

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

DM - Dimension Array
RD - Record Data
RC - Record Interval

**Examples:**

```
#Record;'   Label
DM POS[100];' Define array
RA POS[];'   Specify Record Mode
RD _TPA;'    Specify data type for record
RC 1;'      Begin recording at 2 msec intervals
PR 1000;BG;' Start motion
EN;'        End
```

**Hint:** The record array mode is useful for recording the real-time motor position during motion. The data is automatically captured in the background and does not interrupt the program sequencer. The record mode can also be used for a teach or learn of a motion path.

**GalilTools:** The GalilTools Realtime scope can often be used as an alternative to record array.
Galil Motion Control Command Reference

**RC**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>RC</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
<tr>
<td>Record</td>
<td></td>
</tr>
</tbody>
</table>

**Full Description**

The RC command begins recording for the Automatic Record Array Mode (RA). RC 0 stops recording.

Firmware Note: Do not allocate or deallocate arrays (DM, DA) while the Automatic Record Array Mode is running.

GalilTools Note: Do not download arrays from GalilTools, or call the arrayDownload() or arrayDownloadFile() functions while automatic record array mode is running.

**Arguments**

**RC n,m**

where

n is an integer 1 thru 8 and specifies $2^n$ samples between records. RC 0 stops recording.

m is optional and specifies the number of records to be recorded. If m is not specified, the array bounds will be used. A negative number for m causes circular recording over array addresses 0 to m-1.

$n = ?$ Returns status of recording. '1' if recording, '0' if not recording.

Note: The address for the array element for the next recording can be interrogated with _RD.

**Operand Usage**

_RC contains status of recording. '1' if recording, '0' if not recording.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related Commands**

DM - Dimension Array
RD - Record Data
RA - Record Array Mode

**Examples:**

```c
#RECORD;
DM Torque[1000];
RA Torque[];
RD _TTA;
RC 2;
JG 1000;BG;
#A;JP #A, _RC=1;
MG "DONE RECORDING";
EN;
```

Record label
Define Array
Specify Array to record data
Specify Data Type
Begin recording and set 4 msec between records
Begin motion
Loop until done
Print message
End program
**Record Data**

**Full Description**
The RD command specifies the data type to be captured for the Record Array (RA) mode. The command type includes:

**Data sources for automatic record mode**

<table>
<thead>
<tr>
<th>Source name (where 'n' is the axis specifier, A-H)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>Time in servo sample as read by the TIME command</td>
</tr>
<tr>
<td>_AFn</td>
<td>Analog Input Value (+32767 to -32768). The analog inputs are limited to those which correspond to an axis on the controller.</td>
</tr>
<tr>
<td>_DEn</td>
<td>2nd encoder</td>
</tr>
<tr>
<td>_TPn</td>
<td>Position</td>
</tr>
<tr>
<td>_TEn</td>
<td>Position error</td>
</tr>
<tr>
<td>_RPn</td>
<td>Commanded Position (_SHn also valid)</td>
</tr>
<tr>
<td>_RLn</td>
<td>Latched Position</td>
</tr>
<tr>
<td>_TI</td>
<td>Input States</td>
</tr>
<tr>
<td>_OP</td>
<td>Output State</td>
</tr>
<tr>
<td>_TSn</td>
<td>Switches, only 0-4 bits valid</td>
</tr>
<tr>
<td>_SCn</td>
<td>Stop code</td>
</tr>
<tr>
<td>_TTn</td>
<td>Tell torque (Note: the values recorded for torque are in the range of +/- 32767 where 0 is 0 torque, -32767 is -10 volt command output, and +32767 is +10 volt.</td>
</tr>
<tr>
<td>_TVn</td>
<td>Filtered velocity. (Note: will be 65 times greater than TV command)</td>
</tr>
<tr>
<td>_TDn</td>
<td>Stepper Position</td>
</tr>
</tbody>
</table>

**Arguments**

RD m1, m2, m3, m4, m5, m6, m7, m8

where

the arguments are the data sources to be captured using the record array feature. The order is important. Each data type corresponds with the array specified in the RA command.

**Operand Usage**

_RD contains the address for the next array element for recording.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Related Commands
RA - Record Array
RC - Record Interval
DM - Dimension Array

Examples
DM ERRORA[50],ERRORB[50];
RA ERRORA[],ERRORB[];
RD _TEA,_TEB;
RC1;
JG 1000;BG;

GalilTools: The GalilTools Realtime scope can often be used as an alternative to record array.
The `RE` command is used to end the following error automatic subroutines:

- `#POSERR`
- `#LIMSWI`
- `#TCPERR`
- `#AMPERR` (if equipped with internal amplifiers)
- `#SERERR` (if equipped with -SER firmware)

An `RE` at the end of these routines causes a return to the main program. Care should be taken to ensure the error conditions no longer are present to avoid re-entering the subroutines.

Trippoint states can be preserved or cleared with `RE1` or `RE0`, respectively.

A motion trippoint like MF or MR requires the axis to be actively profiling in order to be restored with the `RE1` command.

To avoid returning to the main program on an interrupt, use the `ZS` command to zero the subroutine stack.

### Arguments

**RE n**

where

- `n = 1` Restores state of trippoint
- `n = 0` Clears the interrupted trippoint
- no argument clears the interrupted trippoint

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

### Related Commands

- `#AMPERR` - Amplifier error automatic subroutine
- `#SERERR` - Serial Encoder Error Automatic Subroutine
- `#TCPERR` - Ethernet communication error automatic subroutine
- `#POSERR` - Position error automatic subroutine
- `#LIMSWI` - Limit switch automatic subroutine
Examples:

REM dummy loop
#A
JP #A
EN

#POSERR;' Begin Error Handling Subroutine
MG "ERROR";' Print message
SB1;' Set output bit 1
RE;' Return to main program and clear trippoint
REM

Full Description
REM is used for comments. The REM statement is NOT a controller command. Rather, it is recognized by Galil PC software, which strips away the REM lines before downloading the DMC file to the controller. REM differs from NO (or ') in the following ways:
1. NO (or ') comments are downloaded to the controller and REM comments aren't
2. NO (or ') comments take up execution time and REM comments don't; therefore, REM should be used for code that needs to run fast.
3. REM comments cannot be recovered when uploading a program but NO (or ') comments are recovered. Thus the uploaded program is less readable with REM.
4. NO (or ') comments take up program line space and REM lines don't.
5. REM comments must be the first and only thing on a line, whereas NO (or ') can be used to place comments to the right of code (after a semicolon) on the same line

NO (or ') should be used instead of REM unless speed or program space is an issue.

Arguments
REM n

where
n is a text string comment

Operand Usage
N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

NO (' apostrophe also accepted) - No operation (comment)

Examples:
**RI**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Embedded Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>none</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Return from Interrupt Routine**

**Full Description**

The RI command is used to end the interrupt subroutine beginning with the label #ININT. An RI at the end of this routine causes a return to the main program. The RI command also re-enables input interrupts. If the program sequencer was interrupted while waiting for a trippoint, such as WT, RI1 restores the trippoint on the return to the program. A motion trippoint such as MF or MR requires the axis to be actively profiling in order to be restored with RI1. RI0 clears the trippoint. To avoid returning to the main program on an interrupt, use the command ZS to zero the subroutine stack. This turns the jump subroutine into a jump only.

**Arguments**

RI n

where

- n = 0  Clears the interrupted trippoint
- n = 1  Restores state of trippoint
- no argument clears the interrupted trippoint

**Operand Usage**

N/A

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

#ININT - Input interrupt subroutine
II - Enable input interrupts

**Examples:**

```
#A;II1;JP #A;EN ;'Program label
#ININT ;'Begin interrupt subroutine
MG "INPUT INTERRUPT" ;'Print Message
SB 1 ;'Set output line 1
RI 1 ;'Return to the main program and restore trippoint
```
**Full Description**

The RL command will return the last position captured by the latch. The latch must first be armed by the AL command and then a 0 must occur on the appropriate input. Each axis uses a specific general input for the latch input:

- X (A) axis latch Input 1
- Y (B) axis latch Input 2
- Z (C) axis latch Input 3
- W (D) axis latch Input 4
- E axis latch Input 9
- F axis latch Input 10
- G axis latch Input 11
- H axis latch Input 12

The armed state of the latch can be configured using the CN command.

Note: The Latch Function works with the main encoder. When working with a stepper motor without an encoder, the latch can be used to capture the stepper position. To do this, place a wire from the controller Step (PWM) output into the main encoder input, channel A+. Connect the Direction (sign) output into the channel B+ input. Configure the main encoder for Step/Direction using the CE command. The latch will now capture the stepper position based on the pulses generated by the controller.

**Arguments**

\[
\text{RL nnnnnnnnnn} \\
\text{where} \\
\text{n is X,Y,Z,W,A,B,C,D,E,F,G or H or any combination to specify the axis or axes}
\]

**Operand Usage**

_\text{RLn} contains the latched position of the specified axis._

**RELATED COMMAND:**

AL - Arm Latch

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

- \text{JG ,5000} Set up to jog the B-axis
- \text{BGB} Begin jog
- \text{ALB} Arm the B latch; assume that after about 2 seconds, input goes low
- \text{RLB} Report the latch
  
  :10000
**Full Description**

The RP command returns the commanded reference position of the motor(s).

**Arguments**

RP nnnnnnnnnn

where

n is A,B,C,D,E,F,G,H or N, or any combination to specify the axis or axes.

**Operand Usage**

\_RPn contains the commanded reference position for the specified axis.

**RELATED COMMAND:**

TP

Tell Position

Note: The relationship between RP, TP and TE: TEA equals the difference between the reference position, RPA, and the actual position, TPA.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

Assume that ABC and D axes are commanded to be at the positions 200, -10, 0, -110 respectively. The returned units are in quadrature counts.
**Full Description**

The RS command resets the state of the processor to its power-on condition. The previously saved state of the hardware, along with parameter values and saved program, are restored.

RS-1 Soft master reset. Restores factory defaults without erasing EEPROM. To restore saved EEPROM settings use RS with no arguments.

**Arguments**

N/A

**Operand Usage**

_RS returns the state of the processor on its last power-up condition. The value returned is the decimal equivalent of the 4 bit binary value shown below.

- Bit 3 For master reset error
- Bit 2 For program checksum error
- Bit 1 For parameter checksum error
- Bit 0 For variable checksum error

At startup the controller operating system verifies the firmware sector. If there is a checksum error in firmware, it is not loaded and the controller will boot to monitor mode.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td></td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td></td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

In a Program No
Can be Interrogated Yes
Used as an Operand Yes

**Related Commands**

`^R^S` - Master Reset

**Examples:**

```
RS      Reset the hardware
```
Full Description
SA sends a command, and optionally receives a response, from one controller to another via Ethernet.

Important Notes
1. SA is non-blocking. A wait (e.g. WT10) must occur between successive calls to SA.
2. SA is not valid over a handle configured for Modbus (port 502).
3. When writing multi-threaded DMC code, send all traffic from only one thread or use individual handles (IH) for each individual thread.
4. The Galil that establishes the connection and issues the SA command is called the master. The Galil that receives the connection and answers the SA is the slave. For both controllers in a connection to be both masters and slaves, open two Ethernet handles. Each of the controllers is a master over one of the handles, and a slave on the other.

Arguments
SAh=arg
SAh=arg, arg, arg, arg, arg, arg, arg, arg,
where
h is the handle being used to send commands to the slave controller.
arg is a number, controller operand, variable, mathematical function, or string. The range for numeric values is 4 bytes of integer followed by two bytes of fraction.
Strings are encapsulated by quotations.
Typical usage would have the first argument as a string such as "KI" and the subsequent arguments as the arguments to the command: Example SAF="KI", 1, 2 would send the command: KI1,2
There is a 78 character maximum payload length for the SA command.

Operand Usage
_SAhn gives the value of the response to the command sent with an SA command. The h value represents the handle A thru H and the n value represents the specific field returned from the controller (0-7). If the specific field is not used, the operand will be -2^31.

Usage
Usage and Default Details
<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**
IH - Open IP Handle

**Examples:**

```plaintext
#A
IH=10,0,0,12;' Configures handle A to be connected to a controller with IP 10.0.0.12
#B;JP#B,_,_IHA2<>-2;' Wait for connection
SAA="KI", 1, 2 ;' Sends the command to handle A (slave controller):  KI 1,2
WT10
SAA="TE";' Sends the command to handle A (slave controller):  TE
WT10
MG_SAA0;' Display the content of the operand_SAA (first response to ;'TE command)
MG_SAA1;' Display the content of the operand_SAA (2nd response to TE ;'command)
SAA="TEMP=",16;' Sets variable temp equal to 16 on handle A controller
EN;' End Program
```
**Full Description**

The SB command sets a particular digital output, setting the output to logic 1. The SB and CB (Clear Bit) instructions can be used to control the state of output lines.

SB can be used to set the outputs of extended I/O which have been configured as outputs. See the CO command.

The SB command can also be used with modbus devices to toggle remote outputs.

**Arguments**

**SB n**

where

n is an integer which represents a specific controller output bit to be set high.

When using Modbus devices, the I/O points of the modbus devices are calculated using the following formula:

\[ n = (\text{SlaveAddress} \times 10000) + (\text{HandleNum} \times 1000) + ((\text{Module}-1) \times 4) + (\text{Bitnum}-1) \]

Slave Address is used when the ModBus device has slave devices connected to it and specified as Addresses 0 to 255. Please note that the use of slave devices for modbus are very rare and this number will usually be 0.

HandleNum is the handle specifier from A to H.

Module is the position of the module in the rack from 1 to 16.

BitNum is the I/O point in the module from 1 to 4.

**Operand Usage**

N/A

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
</tbody>
</table>

**Related Commands**

CB - Clear Bit
OB - Output Bit
OP - Output Port

**Examples:**

- SB 5;' Set digital output 5
- SB 1;' Set digital output 1
- CB 5;' Clear digital output 5
CB 1;' Clear digital output 1
Stop Code

Full Description
The Stop Code command returns a number indicating why a motor has stopped. The controller responds with a number interpreted as follows:

**Stop Code Table**

<table>
<thead>
<tr>
<th>Stop Code Number</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Motors are running, independent mode</td>
</tr>
<tr>
<td>1</td>
<td>Motors decelerating or stopped at commanded independent position</td>
</tr>
<tr>
<td>2</td>
<td>Decelerating or stopped by FWD limit switch or soft limit FL</td>
</tr>
<tr>
<td>3</td>
<td>Decelerating or stopped by REV limit switch or soft limit BL</td>
</tr>
<tr>
<td>4</td>
<td>Decelerating or stopped by Stop Command (ST)</td>
</tr>
<tr>
<td>6</td>
<td>Stopped by Abort input</td>
</tr>
<tr>
<td>7</td>
<td>Stopped by Abort command (AB)</td>
</tr>
<tr>
<td>8</td>
<td>Decelerating or stopped by Off on Error (OE1)</td>
</tr>
<tr>
<td>9</td>
<td>Stopped after finding edge (FE)</td>
</tr>
<tr>
<td>10</td>
<td>Stopped after homing (HM) or Find Index (FI)</td>
</tr>
<tr>
<td>11</td>
<td>Stopped by selective abort input</td>
</tr>
<tr>
<td>12</td>
<td>Decelerating or stopped by encoder failure (OA1) (DMC-40x0/18x6)</td>
</tr>
<tr>
<td>15</td>
<td>Amplifier Fault (DMC-40x0)</td>
</tr>
<tr>
<td>16</td>
<td>Stepper position maintenance error</td>
</tr>
<tr>
<td>30</td>
<td>Running in PVT mode</td>
</tr>
<tr>
<td>31</td>
<td>PVT mode completed normally</td>
</tr>
<tr>
<td>32</td>
<td>PVT mode exited because buffer is empty</td>
</tr>
<tr>
<td>50</td>
<td>Contour Running</td>
</tr>
<tr>
<td>51</td>
<td>Contour Stop</td>
</tr>
<tr>
<td>99</td>
<td>MC timeout</td>
</tr>
<tr>
<td>100</td>
<td>Motors are running, Vector Sequence</td>
</tr>
<tr>
<td>101</td>
<td>Motors stopped at commanded vector</td>
</tr>
</tbody>
</table>

Arguments

**SC nnnnnnnnnn**

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

Operand Usage

_SCn contains the value of the stop code for the specified axis.

Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (no RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Related Commands**

LU LCD Update

**Examples:**

`Tom = _SCD` Assign the Stop Code of D to variable Tom
Switch Deceleration

Full Description
The Limit Switch Deceleration command (SD) sets the linear deceleration rate of the motors when a limit switch has been reached. The parameters will be rounded down to the nearest factor of 1024 and have units of counts per second squared.

Arguments
SD n,n,n,n,n,n,n

SDA=n

where
n is an unsigned numbers in the range 1024 to 1073740800
n = ? Returns the deceleration value for the specified axes.

Operand Usage
_SDn contains the deceleration rate for the specified axis.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256000</td>
</tr>
</tbody>
</table>

Related Commands
AC - Acceleration
DC - Deceleration
PR - Position Relative
PA - Position Absolute
SP - Speed

Examples:
- PR 10000 Specify position
- AC 2000000 Specify acceleration rate
- DC 1000000 Specify deceleration rate
- SD 5000000 Specify Limit Switch Deceleration Rate
- SP 5000 Specify slew speed

Note: The SD command may be changed during the move in JG move, but not in PR or PA move.
Full Description

The SH commands tells the controller to use the current motor position as the command position and to enable servo control here. This command can be useful when the position of a motor has been manually adjusted following a motor off (MO) command.

Arguments

SH nnnnnnnnnn

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

Operand Usage

N/A

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

MO - Motor-off

Examples:

SH  Servo A,B,C,D motors
SHA Only servo the A motor, the B,C and D motors remain in its previous state.
SHB Servo the B motor; leave the A,C and D motors unchanged
SHC Servo the C motor; leave the A,B and D motors unchanged
SHD Servo the D motor; leave the A,B and C motors unchanged

Note: The SH command changes the coordinate system. Therefore, all position commands given prior to SH, must be repeated. Otherwise, the controller produces incorrect motion.
SYNTAX: Explicit Notation Only
Operands: none
Burn: burnable with BN

Configure the special Galil SSI feature

**Full Description**
Synchronous Serial Interface (SSI) allows for serial transmission of absolute position data (either binary or Gray code) from the encoder based on a timed clock pulse train from the controller. Connection between the controller and encoder is based on two signal lines, clock and data, which are usually differential for increased noise immunity. For each sequential clock pulse of the controller, the encoder transmits one data bit from shift registers on the encoder.

There are two items required when connecting an SSI encoder to a DMC-40x0: special SSI firmware and the controller -SSI option.

Clocking in SSI data has a timing overhead which may be non-negligible. In the event that clocking in data may have a negative effect on servo performance (e.g. using multiple encoders with a lowered TM sample rate) the controller will respond with an error mode. See #AUTOERR for more information. This error mode is very rare, and is expected to occur only in development.

**Arguments**

\[ SIn = si0, si1, si2, si3 <p >q \]

where

- \( n \) = The axis designator (XYZW or ABCDEFGH). Each axis must be set individually
- \( si0 = 0 \) is for NO SSI, \( 1 \) is for SSI to replace MAIN encoder data. \( 2 \) is for SSI to replace AUX encoder data
- \( si1 = \) Total # of Bits of SSI. A positive number designates No Rollover. A negative number will cause the controller to act as an incremental encoder, allowing the encoder to count past the max value of the encoder. (Note: when the controller is powered down, the rollover values are lost)
- \( si2 = \) # of Single Turn Bits
- \( si3 = \) # of Status Bits (ie: Error Bits)
  - Positive # designates status bits as trailing the SSI data
  - Negative # designates status bits as leading the SSI data
- \( p \) is an integer in the range of 4-26 and indicates the clock frequency given the following formula
  \[ \text{SSI Clock Freq} = \frac{CLK}{2*(p+1)} \]
  \( CLK = 20\text{Mhz} \)
- \( q = 1 \) For Binary encoding, \( 2 \) for Gray Code

\[ SIn=? \] Returns the configuration parameters (where \( n \) is the axis)

See Application Note 2438 for more information, and a Clock frequency table.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>( SIn=0 )</td>
</tr>
</tbody>
</table>

SSI Hardware Upgrade Required

**Related Commands**
TP - Tell Position
TD - Tell Dual Encoder
SS - Configure the special Galil BiSS feature

#AUTOERR - EEPROM checksum error and Serial Encoder timeout error Automatic Subroutine

DF - Dual Feedback (DV feedback swap)

Examples

SIA=1,25,25,0<10>1;' Encoder on axis A replaces main encoder (TP), 25 bits total, all single turn, no status

SIA=0;' Disable SSI on axis A
**SL**

**Single Step**

**Full Description**
The SL command is for debugging purposes. Single Step through the program after execution has paused at a breakpoint (BK). Optional argument allows user to specify the number of lines to execute before pausing again. The BK command resumes normal program execution.

**Arguments**

**SL n**

where

n is an integer representing the number of lines to execute before pausing again

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1</td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

**Related Commands**

BK - Breakpoint
TR - Trace

**Examples:**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BK 3</td>
<td>Pause at line 3 (the 4th line) in thread 0</td>
</tr>
<tr>
<td>BK 5</td>
<td>Continue to line 5</td>
</tr>
<tr>
<td>SL</td>
<td>Execute the next line</td>
</tr>
<tr>
<td>SL 3</td>
<td>Execute the next 3 lines</td>
</tr>
<tr>
<td>BK</td>
<td>Resume normal execution</td>
</tr>
</tbody>
</table>
Full Description

The SM command assigns a subnet mask to the controller. All packets sent to the controller whose source IP address is not on the subnet will be ignored by the controller. For example, for SM 255, 255, 0, 0 and IA 10, 0, 51, 1, only packets from IP addresses of the form 10.0.xxx.xxx will be accepted.

Arguments

SM sm0, sm1, sm2, sm3 or SM n

where

sm0, sm1, sm2, sm3 are 1 byte numbers (0 to 255) separated by commas and represent the individual fields of the subnet mask.
n is the subnet mask for the controller, which is specified as an integer representing the signed 32 bit number (two's complement).

SM? will return the subnet mask of the controller

Operand Usage

_SM0 contains the subnet mask representing a 32 bit signed number (Two's complement)

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td>SM 0, 0, 0, 0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

IH - Internet Handle
IA - IP address

Examples:

| SM 255, 255, 255, 255 | Ignore all incoming Ethernet packets |
| SM 0, 0, 0, 0         | Process all incoming Ethernet packets |
**SP**

### Full Description

The SP command sets the slew speed of any or all axes for independent moves.

Note: Negative values will be interpreted as the absolute value.

### Arguments

**SP n,n,n,n,n,n,n,n or SPA=n**

where  
\( n \) is an unsigned even number in the range 0 to 22,000,000 for servo motors. The units are encoder counts per second.

OR  
\( n \) is an unsigned number in the range 0 to 6,000,000 for stepper motors

\( n = ? \)    Returns the speed for the specified axis.

When ordered with the ICM-42100:

\( n \) is an unsigned even number in the range of 0 to 50,000,000. The units are interpolated encoder counts per second.

### Operand Usage

_\_SPn_ contains the speed for the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>25000</td>
</tr>
</tbody>
</table>

### Related Commands

AC - Acceleration  
DC - Deceleration  
PA - Position Absolute  
PR - Position Relative  
BG - Begin

### Examples:

:PR 2000,3000,4000,5000    Specify a,b,c,d parameter  
:SP 5000,6000,7000,8000    Specify a,b,c,d speeds  
:BG                         Begin motion of all axes  
:AM C                       After C motion is complete

Note: For vector moves, use the vector speed command (VS) to change the speed.  
SP is not a "mode" of motion like JOG (JG).  
Note: 2 is the minimum non-zero speed.
SS

Configure the special Galil BiSS feature

Full Description

BiSS is an open source digital interface for sensors and actuators. BiSS is hardware compatible to the industrial standard SSI (Serial Synchronous Interface). It allows serial transmission of absolute position data from BiSS encoders based on a master clock signal from the controller.

Communication between the controller and encoder is based on two signal lines, clock (MA) and data (SLO), which are differential for increased noise immunity and transmission length.

The standard Galil BiSS implementation is C-mode (unidirectional). Contact Galil for other modes.

There are two items required when connecting a BiSS encoder to a DMC-40x0: special BiSS firmware and a hardware upgrade on the controller's internal ICM board. When ordering a new controller with the -BISS option, both requirements will be loaded at the factory.

Clocking in BiSS data has a timing overhead which may be non-negligible. In the event that clocking in data may have a negative effect on servo performance (e.g. using multiple encoders with a lowered TM sample rate) the controller will respond with an error mode. See #AUTOERR for more information. This error mode is very rare, and is expected to occur only in development.

Arguments

SSn = ss0, ss1, ss2, ss3 < p

where

n = The axis designator (XYZ or W or ABCDEFG or H). Each axis must be set individually.

ss0 = 0 is for NO BiSS, 1 is for BiSS to replace MAIN encoder data (TP). 2 is for BiSS to replace AUX encoder data (TD).

ss1 = number of single-turn bits. A positive number designates true, absolute, single-turn decoding. A negative number will cause the controller to internally simulate a multi-turn encoder by counting past the single-turn max/min. This is typically used for a rotary, single-turn encoder to prevent an instantaneous change in position error when the single-turn bits roll over. When the controller loses power, the internal multi-turn state is lost.

ss2 = number of bits before E (error bit). This includes multi-turn bits + single-turn bits + zero padding bits. See Table 1.

ss3 = number of bits after error bit. See Table 1.

p = clock frequency argument. See Table 2.

SSn=? Returns the configuration parameters

<table>
<thead>
<tr>
<th>Bit sequence:</th>
<th>T-2</th>
<th>T-1 (Delay)</th>
<th>T0</th>
<th>T1... T12</th>
<th>T13... T22</th>
<th>T23... T26</th>
<th>T27</th>
<th>T28</th>
<th>T29... T34</th>
<th>T35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data (Data/SLO line):</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>M11... M0</td>
<td>S9... S0</td>
<td>0</td>
<td>E</td>
<td>W</td>
<td>C5... C0</td>
<td>MCD</td>
</tr>
<tr>
<td>Data Description:</td>
<td>Idle</td>
<td>Encoder acquiring</td>
<td>Start Bit</td>
<td>Multi-turn data</td>
<td>Single-turn data</td>
<td>Zero padding</td>
<td>Error Bit</td>
<td>Warning Bit</td>
<td>CRC</td>
<td>Multi-Cycle Data</td>
</tr>
<tr>
<td>SS command details:</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>ss1=10</td>
<td>ss3=4</td>
<td>ss2=26, E bit read in _SSn</td>
<td>W read in _SSn</td>
<td>CRC valid bit read in _SSn</td>
<td>Ignored by default</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. SS Example for Hengstler 12 bit MT 10 bit ST

`BiSS setup command for the Hengstler 12 bit MT 10 bit ST
'Data will be available in TP and for servo feedback
SSA=1,10,26,4<13`
BiSS clock (MA) frequency is set with the p argument and has the following form:
MA freq= $\frac{20 \text{ MHz}}{2 \times (p+1)}$

20 MHz frequency is hardware dependent with a range of 18Mhz to 26Mhz. Contact Galil if tolerances must be tighter for a particular application (this is rare).

### Table 2. Popular Master Clock Frequencies (MA)

<table>
<thead>
<tr>
<th>p argument</th>
<th>Clock Frequency (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2000</td>
</tr>
<tr>
<td>8</td>
<td>1111</td>
</tr>
<tr>
<td>10</td>
<td>909</td>
</tr>
<tr>
<td>12</td>
<td>769</td>
</tr>
<tr>
<td>13</td>
<td>714</td>
</tr>
<tr>
<td>24</td>
<td>400</td>
</tr>
<tr>
<td>26</td>
<td>370</td>
</tr>
</tbody>
</table>

### Operands

(SSn) Returns 4 bits of axis status data where n is the axis ABCDEFG or H. #SERERR is an automatic sub which will run in the event of an encoder problem. See SY for setting up the active high/low status of bits 2 and 3.

### SSN Bit Map

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>Bit Meaning</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No timeout = 0, timeout occurred = 1</td>
<td>The BiSS decoding hardware will timeout if the encoder doesn't set the start bit within 30uS</td>
</tr>
<tr>
<td>1</td>
<td>CRC valid = 0, invalid = 1</td>
<td>BiSS employs a Cyclic Redundancy Check to verify data after transmission</td>
</tr>
<tr>
<td>2</td>
<td>Error bit* (active state set with SY)</td>
<td>When SY is set correctly, this bit should be low when there is no active warning. Consult the encoder documentation for the Warning bit definition</td>
</tr>
<tr>
<td>3</td>
<td>Warning bit* (active state set with SY)</td>
<td>When SY is set correctly, this bit should be low when there is no active alarm/error. Consult the encoder documentation for the Alarm bit definition</td>
</tr>
</tbody>
</table>

*Note: The encoder manufacturer may name the Error and Warning bits differently. Consult the encoder documentation for the naming convention.

Galil defines the Warning bit as the bit directly preceeding the CRC. The Error bit is defined as the bit directly preceeding the Warning bit. See table 1.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>SSn=0</td>
</tr>
</tbody>
</table>

### Related Commands

TP - Tell Position
TD - Tell Dual Encoder
SI - Configure the special Galil SSI feature
SY - Serial encoder BiSS active level
#SERERR - Serial Encoder Error Automatic Subroutine
DF - Dual Feedback (DV feedback swap)
#AUTOERR - EEPROM checksum error and Serial Encoder timeout error Automatic Subroutine

DF - Dual Feedback (DV feedback swap)
Examples

- Configuration for 26 bit Renishaw Resolute single-turn encoder
  SYA=0; 'Warning and Alarm bits are active low
  SSA=1,26,27,0<14
  'The 27 includes the Resolute single leading zero bit

- Configuration for 36 bit Hengstler multi-turn encoder
  SYA=3; 'Warning and Alarm bits are active high
  SSB=1,19,36,5<14
  '19 bits single turn, 12 bits multi turn, 5 zero padding bits
The ST command stops motion on the specified axis. Motors will come to a decelerated stop. If ST is sent from the host without an axis specification, program execution will stop in addition to motion.

Arguments

ST nnnnnnnnnn
where
n is A,B,C,D,E,F,G,H,M,N,S or T or any combination to specify the axis or sequence. If the specific axis or sequence is specified, program execution will not stop.
No argument will stop motion on all axes.

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands
BG - Begin Motion
AB - Abort Motion
DC - Deceleration rate

Examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST A</td>
<td>Stop A-axis motion</td>
</tr>
<tr>
<td>ST S</td>
<td>Stop coordinated sequence</td>
</tr>
<tr>
<td>ST ABCD</td>
<td>Stop A,B,C,D motion</td>
</tr>
<tr>
<td>ST</td>
<td>Stop ABCD motion</td>
</tr>
<tr>
<td>ST SCD</td>
<td>Stop coordinated AB sequence, and C and D motion</td>
</tr>
</tbody>
</table>

Hint: Use the after motion complete command, AM, to wait for motion to be stopped.
**SY**

Serial encoder BiSS active level

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Explicit &amp; Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>SYn</td>
</tr>
<tr>
<td>Burn:</td>
<td>burnable with BN</td>
</tr>
</tbody>
</table>

**Full Description**

This command is used to designate the active level of the Error and Warning bits when using the Galil BiSS upgrade. The BiSS protocol defines two bits which can be used by the encoder to signal various events. The encoder manufacturer dictates the high/low active state of both of these bits. Consult your encoder documentation for details.

The SY mask should be set appropriately to ensure that the #SERERR automatic subroutine will run when the bits are active, and that the _SSn operand reports the fault state of the encoder correctly.

**Example of Warning and Alarm/Error bit use**

Quoted from Renishaw Data Sheet L-9709-9005-03-A

**Error (1 bit)**

The error bit is active low: "1" indicates that the transmitted position information has been verified by the readhead's internal safety checking algorithm and is correct; "0" indicates that the internal check has failed and the position information should not be trusted. The error bit is also set to "0" if the temperature exceeds the maximum specification for the product.

**Warning (1 bit)**

The warning bit is active low: "0" indicates that the encoder scale (and/or reading window) should be cleaned. Note that the warning bit is not an indication of the trustworthiness of the position data. Only the error bit should be used for this purpose.

**Arguments**

SY m,m,m,m,m,m,m,m or SYn=m

where

m specifies the axis Error and Warning active high/low configuration according to the following table.

<table>
<thead>
<tr>
<th>SY &quot;m&quot; argument</th>
<th>Warning Bit</th>
<th>Error Bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Active Low</td>
<td>Active Low</td>
</tr>
<tr>
<td>1</td>
<td>Active Low</td>
<td>Active High</td>
</tr>
<tr>
<td>2</td>
<td>Active High</td>
<td>Active Low</td>
</tr>
<tr>
<td>3 (default)</td>
<td>Active High</td>
<td>Active High</td>
</tr>
</tbody>
</table>

**Operands**

_SYn contains the current state of the SY setting

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Default Value: 3

Related Commands
- SS - Configure the special Galil BiSS feature
- #SERERR - Serial Encoder Error Automatic Subroutine

Examples

```
'configure SY for Renishaw Resolute encoder
SYA=0
```
**TA**

Tell Amplifier error status

**Full Description**

The command returns the amplifier error status. The value is decimal and represents an 8 bit value. Bit 7 is most significant bit, 0 is least.

**Tell Amplifier Error Bit Definition**

<table>
<thead>
<tr>
<th>BIT #:</th>
<th>STATUS:</th>
<th>STATUS:</th>
<th>STATUS:</th>
<th>STATUS:</th>
<th>BIT #</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Under Voltage (E-H Axes) **</td>
<td>Hall Error H Axis *</td>
<td>Peak Current H Axis</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Over Temperature (E-H Axes) **</td>
<td>Hall Error G Axis *</td>
<td>Peak Current G Axis</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Over Voltage (E-H Axes) *</td>
<td>Hall Error F Axis *</td>
<td>Peak Current F Axis</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Over Current (E-H Axes) ***</td>
<td>Hall Error E Axis *</td>
<td>Peak Current EAxis</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Under Voltage (A-D Axes) **</td>
<td>Hall Error D Axis *</td>
<td>Peak Current DAxis</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Over Temperature (A-D Axes) *</td>
<td>Hall Error C Axis *</td>
<td>Peak Current CAxis</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>Over Voltage (A-D Axes)</td>
<td>Hall Error B Axis *</td>
<td>Peak Current BAxis</td>
<td>ELO Active (E-H Axes) ****</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>Over Current (A-D Axes) ***</td>
<td>Hall Error A Axis *</td>
<td>Peak Current AAxis</td>
<td>ELO Active (A-D Axes) ****</td>
<td>0</td>
</tr>
</tbody>
</table>

* Valid for AMP-43040 (-D3040)
** Valid for AMP-43040 (-D3040) & SDM-44140 (-D4140)
*** Valid for AMP-43040 (-D3040) & Valid for SDM-44140 (-D4140) & Valid for SDM-44040 (-D4040)
**** Valid for AMP-43040 (-D3040) & Valid for AMP-43140 (-D3140) & Valid for SDM-44140 (-D4140) & Valid for SDM-44040 (-D4040)

Hint: If your Brushed-type servo motor is disabling and TA1 shows a hall error, try using the BR command to set that axis as a Brushed axis, causing the controller to ignore invalid Hall states.

**Arguments**

`TA n`

returns the amplifier error status where n is 0,1, or 3

**Operand Usage**

_`TAm`_ Contains the Amplifier error status. m = 0,1,2, or 3

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>DMC-40x0 with -D30x0, -D4040, -D4140; DMC-21x3 with AMP-204x0, AMP-205x0, or SDM 206x0</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Related Commands**

#AMPERR - Amplifier Error Automatic Subroutine
BR - Brush Axis Configuration
QH - Hall State

Examples:

| TA1       | :5       | Hall Error for Axis A and C |
Tell Status Byte

Full Description

The TB command returns status information from the controller as a decimal number. Each bit of the status byte denotes the following condition when the bit is set (high):

<table>
<thead>
<tr>
<th>BIT</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7</td>
<td>Executing application program</td>
</tr>
<tr>
<td>Bit 6</td>
<td>N/A</td>
</tr>
<tr>
<td>Bit 5</td>
<td>Contouring</td>
</tr>
<tr>
<td>Bit 4</td>
<td>Executing error or limit switch routine</td>
</tr>
<tr>
<td>Bit 3</td>
<td>Input interrupt enabled</td>
</tr>
<tr>
<td>Bit 2</td>
<td>Executing input interrupt routine</td>
</tr>
<tr>
<td>Bit 1</td>
<td>N/A</td>
</tr>
<tr>
<td>Bit 0</td>
<td>Echo on</td>
</tr>
</tbody>
</table>

Arguments

TB ?
returns the status byte

Operand Usage

_TB Contains the status byte

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

<table>
<thead>
<tr>
<th>TB?</th>
<th>:65</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data Record Active and Echo is on (26 + 20 = 64 + 1 = 65)</td>
</tr>
</tbody>
</table>
**TC**

**Tell Error Code**

**Full Description**

The TC command returns a number between 1 and 255. This number is a code that reflects why a command was not accepted by the controller. This command is useful when the controller halts execution of a program or when the response to a command is a question mark. After TC has been read, the error code is set to zero.

TC1 will return the error code, along with a human-readable description of the code.

### Tell Code List

<table>
<thead>
<tr>
<th>Tell Code Number</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unrecognized command</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Command only valid from program</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Command not valid in program</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Operand error</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Input buffer full</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Number out of range</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Command not valid while running</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>8</td>
<td>Command not valid while not running</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>9</td>
<td>Variable error</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Empty program line or undefined label</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Invalid label or line number</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Subroutine more than 16 deep</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>JG only valid when running in jog mode</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>14</td>
<td>EEPROM check sum error</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>EEPROM write error</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>IP incorrect sign during position move or IP given during forced deceleration</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>17</td>
<td>ED, BN and DL not valid while program running</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Command not valid when contouring</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>19</td>
<td>Application strand already executing</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Begin not valid with motor off</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>21</td>
<td>Begin not valid while running</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>22</td>
<td>Begin not possible due to Limit Switch</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>24</td>
<td>Begin not valid because no sequence defined (no RIO)</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Variable not given in IN command</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>S operand not valid</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>29</td>
<td>Not valid during coordinated move</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>30</td>
<td>Sequencet Segment Too Short</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>31</td>
<td>Total move distance in a sequence &gt; 2 billion</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>32</td>
<td>Segment buffer full</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>33</td>
<td>VP or CR commands cannot be mixed with LI commands</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>39</td>
<td>No time specified</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>41</td>
<td>Contouring record range error</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Note</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>42</td>
<td>Contour data being sent too slowly</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>46</td>
<td>Gear axis both master and follower</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>50</td>
<td>Not enough fields</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Question mark not valid</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Missing &quot; or string too long</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Error in {}</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Question mark part of string</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Missing [ or []</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Array index invalid or out of range</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>Bad function or array</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Bad command response (i.e. _GNX)</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Mismatched parentheses</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Download error - line too long or too many lines</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Duplicate or bad label</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Too many labels</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>IF statement without ENDIF</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>IN command must have a comma</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Array space full</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Too many arrays or variables</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>IN only valid in thread #0</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Record mode already running</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>No array or source specified</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Undefined Array</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Not a valid number</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Too many elements</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Only A B C D valid operand</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>96</td>
<td>SM jumper needs to be installed for stepper motor operation (no Accelera, no RIO)</td>
<td></td>
</tr>
<tr>
<td>97</td>
<td>Bad Binary Command Format</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>Binary Commands not valid in application program</td>
<td></td>
</tr>
<tr>
<td>99</td>
<td>Bad binary command number</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Not valid when running ECAM</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>101</td>
<td>Improper index into ET</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>102</td>
<td>No master axis defined for ECAM</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>103</td>
<td>Master axis modulus greater than 256 EP value</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>104</td>
<td>Not valid when axis performing ECAM</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>105</td>
<td>EBI command must be given first</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>106</td>
<td>Privilege Violation</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>110</td>
<td>No hall effect sensors detected</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>111</td>
<td>Must be made brushless by BA command</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>112</td>
<td>BZ command timeout</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>113</td>
<td>No movement in BZ command</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>114</td>
<td>BZ command runaway</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>118</td>
<td>Controller has GL1600 not GL1800</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>119</td>
<td>Not valid for axis configured as stepper</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>120</td>
<td>Bad Ethernet transmit</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>TC n</td>
<td>Description</td>
<td>Valid for</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>121</td>
<td>Bad Ethernet packet received</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>122</td>
<td>Ethernet input buffer overrun</td>
<td>DMC-21x3 only</td>
</tr>
<tr>
<td>123</td>
<td>TCP lost sync</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>124</td>
<td>Ethernet handle already in use</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>125</td>
<td>No ARP response from IP address</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>126</td>
<td>Closed Ethernet handle</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>127</td>
<td>Illegal Modbus function code</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>128</td>
<td>IP address not valid</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>130</td>
<td>Remote IO command error</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>131</td>
<td>Serial Port Timeout</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>132</td>
<td>Analog inputs not present</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>133</td>
<td>Command not valid when locked / Handle must be UDP</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>134</td>
<td>All motors must be in MO for this command</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>135</td>
<td>Motor must be in MO</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>136</td>
<td>Invalid Password</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>137</td>
<td>Invalid lock setting</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>138</td>
<td>Passwords not identical</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>140</td>
<td>serial encoder missing</td>
<td>Valid for BiSS support</td>
</tr>
<tr>
<td>141</td>
<td>Incorrect ICM Configuration</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>TM timed out</td>
<td>Valid on SER firmware (SSI and BiSS)</td>
</tr>
<tr>
<td>160</td>
<td>BX failure</td>
<td>Valid on SINE firmware</td>
</tr>
<tr>
<td>161</td>
<td>Sine amp axis not initialized</td>
<td>Valid on SINE firmware</td>
</tr>
</tbody>
</table>

**Arguments**

TC n

where

n = 0  Returns numerical code only
n = 1  Returns numerical code and human-readable message
n = ?  Returns the error code

**Operand Usage**

_TC contains the value of the error code.

**Usage**

Usage Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes (No RIO)</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Not in a program</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

<table>
<thead>
<tr>
<th>TC n</th>
<th>Description</th>
<th>Valid for</th>
</tr>
</thead>
<tbody>
<tr>
<td>121</td>
<td>Bad Ethernet packet received</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>122</td>
<td>Ethernet input buffer overrun</td>
<td>DMC-21x3 only</td>
</tr>
<tr>
<td>123</td>
<td>TCP lost sync</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>124</td>
<td>Ethernet handle already in use</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>125</td>
<td>No ARP response from IP address</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>126</td>
<td>Closed Ethernet handle</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>127</td>
<td>Illegal Modbus function code</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>128</td>
<td>IP address not valid</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>130</td>
<td>Remote IO command error</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>131</td>
<td>Serial Port Timeout</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>132</td>
<td>Analog inputs not present</td>
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</tr>
<tr>
<td>133</td>
<td>Command not valid when locked / Handle must be UDP</td>
<td>not valid for PCI</td>
</tr>
<tr>
<td>134</td>
<td>All motors must be in MO for this command</td>
<td>not valid for RIO</td>
</tr>
<tr>
<td>135</td>
<td>Motor must be in MO</td>
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<td>136</td>
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</tr>
<tr>
<td>137</td>
<td>Invalid lock setting</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>138</td>
<td>Passwords not identical</td>
<td>not valid for Econo, Optima</td>
</tr>
<tr>
<td>140</td>
<td>serial encoder missing</td>
<td>Valid for BiSS support</td>
</tr>
<tr>
<td>141</td>
<td>Incorrect ICM Configuration</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>TM timed out</td>
<td>Valid on SER firmware (SSI and BiSS)</td>
</tr>
<tr>
<td>160</td>
<td>BX failure</td>
<td>Valid on SINE firmware</td>
</tr>
<tr>
<td>161</td>
<td>Sine amp axis not initialized</td>
<td>Valid on SINE firmware</td>
</tr>
</tbody>
</table>
:GF3   Bad command
?TC1   Tell error code
1      Unrecognized command
Galil Motion Control Command Reference

TD

Tell Dual Encoder

**Full Description**
The TD command returns the current position of the dual (auxiliary) encoder(s). Auxiliary encoders are not available for stepper axes or for the axis where output compare is used.
When operating with stepper motors, the TD command returns the number of counts that have been output by the controller.

**Arguments**

```
TD nnnnnnnnnn
```

where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes
No argument will provide the dual encoder position for all axes

**Operand Usage**

_TDn_ contains value of dual encoder register.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

DE - Dual Encoder

**Examples:**

```
:TD     Return A,B,C,D Dual encoders
200, -10, 0, -110
TDA     Return the A motor Dual encoder
200
DUAL=_TDA     Assign the variable, DUAL, the value of TDA
```
**TE**

**Tell Error**

**Full Description**

The TE command returns the current position error of the motor(s). The range of possible error is 2147483647. The Tell Error command is not valid for step motors since they operate open-loop.

**Arguments**

TE nnnnnnnnnnn

where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes
No argument will provide the position error for all axes

**Operand Usage**

_TEn contains the current position error value for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**

OE - Off On Error
ER - Error Limit
#POSERR - Error Subroutine
PF - Position Formatting

**Examples:**

<table>
<thead>
<tr>
<th>TE</th>
<th>Return all position errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>:5, -2, 0, 6</td>
<td></td>
</tr>
</tbody>
</table>

TEA      | Return the A motor position error |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>:5</td>
<td></td>
</tr>
</tbody>
</table>

TEB      | Return the B motor position error |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>:2</td>
<td></td>
</tr>
</tbody>
</table>

Error = _TEA   | Sets the variable, Error, with the A-axis position error |
**Hint:** Under normal operating conditions with servo control, the position error should be small. The position error is typically largest during acceleration.
**Tell Ethernet Handle**

**Full Description**

The TH command returns a list of data pertaining to the Galil's Ethernet connection. This list begins with the IP address and Ethernet address (physical address), followed by the status of each handle indicating connection type and IP address.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (no RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>Ethernet Only</td>
</tr>
<tr>
<td>Default Value</td>
<td>-</td>
</tr>
<tr>
<td>Default Format</td>
<td>-</td>
</tr>
</tbody>
</table>

**Related Commands**

HS - Handle Swap
IA - IP address
IH - Internet Handle
WH - Which Handle

**Examples:**

```
:TH
CONTROLLER IP ADDRESS 10,51,0,87 ETHERNET ADDRESS 00-50-4C-08-01-1F
IHA TCP PORT 1050 TO IP ADDRESS 10,51,0,89 PORT 1000
IHB TCP PORT 1061 TO IP ADDRESS 10,51,0,89 PORT 1001
IHC TCP PORT 1012 TO IP ADDRESS 10,51,0,93 PORT 1002
IHD TCP PORT 1023 TO IP ADDRESS 10,51,0,93 PORT 1003
IHE TCP PORT 1034 TO IP ADDRESS 10,51,0,101 PORT 1004
IHF TCP PORT 1045 TO IP ADDRESS 10,51,0,101 PORT 1005
IHG AVAILABLE
IHH AVAILABLE
```
Tell Inputs

Full Description
The TI command returns the state of the inputs including the extended I/O configured as inputs. The value returned by this command is decimal and represents an 8 bit value (decimal value ranges from 0 to 255). Each bit represents one input where the LSB is the lowest input number and the MSB is the highest input bit.

Arguments

TIn
where
n = 0  Return Input Status for Inputs 1 through 8
n = 1  Return Input Status for Inputs 9 through 16 (Applies only to controllers with more than 4 axes)
n = 10 Return Input Status for Inputs 81 through 88 (auxiliary encoder inputs)
n = 11 Return Input Status for Inputs 89 through 96 (auxiliary encoder inputs)

no argument will return the Input Status for Inputs 1 through 8

n = ? returns the Input Status for Inputs 1 through 8

n = 2 through 5 see note 2 (These arguments only apply when using extended I/O configured as inputs)
where n represents the extended inputs ranging from (8*n)+1 through (8*(n+1))

Operand Usage
_TIn contains the status byte of the input block specified by 'n'. Note that the operand can be masked to return only specified bit information - see section on Bit-wise operations.

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

@IN - Read digital input
CO - Configure Extended I/O

Examples:

| :TI1 | Tell input state on bank 1 |
| :8   | Bit 3 is high, others low |
| :TI0 | All inputs on bank 0 low   |
| :Input =_TI1 | Sets the variable, Input, with the TI1 value |
| :Input=?  | 8:0000 |

**TIME**

**Time Operand**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Operand Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>TIME</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The TIME operand returns the value of the internal free running, real time clock. The returned value represents the number of servo loop updates and is based on the TM command. The default value for the TM command is 1000. With this update rate, the operand TIME will increase by 1 count every update of approximately 1000usec. Note that a value of 1000 for the update rate (TM command) will actually set an update rate of 976 microseconds. Thus the value returned by the TIME operand will be off by 2.4% of the actual time.

The clock is reset to 0 with a standard reset or a master reset.

The keyword, TIME, does not require an underscore "_" as does the other operands.

**Arguments**

N/A

**Operand Usage**

N/A

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td></td>
</tr>
<tr>
<td>Default Format</td>
<td></td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```plaintext
MG TIME Display the value of the internal clock
```
Full Description
The TK command sets the peak torque limit on the motor command output and TL sets the continuous torque limit. When the average torque is below TL, the motor command signal can go up to the TK (Peak Torque) for a short amount of time (approx 1000 samples from 0V to TK value). If TK is set lower than TL, then TL is the maximum command output under all circumstances.

Arguments

TK n,n,n,n,n,n,n

TKA=n
where
n is an unsigned number in the range of 0 to 9.99 volts
n=0 disables the peak torque limit
n=? returns the value of the peak torque limit for the specified axis.

Operand Usage

_TKn contains the value of the peak torque limit for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Related Commands

TL - Torque Limit

Examples:

| TLA=7       | Limit A-axis to a 7 volt average torque output |
| TKA=9.99    | Limit A-axis to a 9.99 volt peak torque output |
**Full Description**

The TL command sets the limit on the motor command output. For example, TL of 5 limits the motor command output to 5 volts. Maximum output of the motor command is 9.998 volts.

**Arguments**

TL n,n,n,n,n,n,n

TLA=n

where

n is an unsigned numbers in the range 0 to 9.998 volts with resolution of 0.0003 volts

n = ? Returns the value of the torque limit for the specified axis.

**Operand Usage**

_TLn_ contains the value of the torque limit for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>9.998</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

- TL 1,5,9,7.5  Limit A-axis to 1 volt. Limit B-axis to 5 volts. Limit C-axis to 9 volts. Limit D-axis to 7.5 volts.
- TL ?,?,?,? Return limits
  :1.0000,5.0000,9.0000, 7.5000
- TL ? Return A-axis limit
  :1.0000
The TM command sets the sampling period of the control loop. A zero or negative number turns off the servo loop. The units of this command are microseconds.

**Full Description**

**Arguments**

**TM** *n*

where

Default Firmware. Using the normal firmware the minimum sample times (*n*) are the following:

- Accelera Controllers with 1-2 axes: 62.5 usec
- Accelera Controllers with 3-4 axes: 125 usec
- Accelera Controllers with 5-6 axes: 156.25 usec
- Accelera Controllers with 7-8 axes: 187.5 usec

Fast Firmware. Using the fast firmware the minimum sample times (*n*) are the following:

- Accelera Controllers with 1-2 axes: 31.25 usec
- Accelera Controllers with 3-4 axes: 62.5 usec
- Accelera Controllers with 5-6 axes: 93.75 usec
- Accelera Controllers with 7-8 axes: 125 usec

Limitations: In the Fast firmware mode the following functions are disabled:

- TD, DV, TK, NB, NZ, NF, second field of EI, Gearing, CAM, PL, Analog Feedback, Steppers, Trippoints in all but threads 0 and 1, Data Record and TV.

Maximum value for *n* is 1000 usec.

Resolution of *n* is 31.25 usec.

*n* = ? returns the value of the sample time.

**Operand Usage**

_/TM_ contains the value of the sample time.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

TM -1000 Turn off internal clock
TM 2000 Set sample rate to 2000 msec
TM 1000 Return to default sample rate
**Full Description**

The TN m,n command describes the tangent axis to the coordinated motion path. m is the scale factor in counts/degree of the tangent axis. n is the absolute position of the tangent axis where the tangent axis is aligned with zero degrees in the coordinated motion plane. The tangent axis is specified with the VMnmp command where p is the tangent axis. The tangent function is useful for cutting applications where a cutting tool must remain tangent to the part.

**Arguments**

**TN m,n**

where

m is the scale factor in counts/degree, in the range between -127 and 127 with a fractional resolution of 0.004

- m = ? Returns the first position value for the tangent axis (same as _TN).
- When operating with stepper motors, m is the scale factor in steps / degree

n is the absolute position at which the tangent angle is zero, in the range between -8388608 to 8388607.

**Operands**

_\_TNn (where n = S or T) contains the first position value for the tangent axis in the specified vector plane. This allows the user to correctly position the tangent axis before the motion begins. Note, _\_TNn will change based upon the vector path described in the VM declaration. See the example below.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

VM - Vector mode
CR - Circle Command
VP - Vector Position

**Examples**

Use a 2D table with a tangent cutting blade to cut a half circle. Ensure that the blade is oriented before turning on the saw. The saw is activated with output 1.
#EXAMPLE
VM XYZ;' Z axis is tangent
VSS=500;' Set vector speed
m=1000/360;' Z axis encoder is 1000 counts per full revolution
n=0;' When TPZ=0, blade is oriented to cut along X axis
TN m,n;' Set these tangent characteristics
CR 1000,0,180;' Profile a circle with radius 1000 counts,
' starting at 0 degrees
' and spanning 180 degrees
VE;' End the vector path
MG_TN;' Print the calculated initial tangent entry point (250)
PAZ=_TN;' Profile a move to orient the Z axis to begin
BGZ;' Move the blade into place
AMZ;' Wait until the blade motion is done
SB1;' Turn on the saw
WT1000;' Wait for saw to spin up
BGS;' Begin vector motion, saw will stay tangent
AMS;' Wait for the cut to complete
CB0;' Turn off the saw
MG "ALL DONE";' Print a message
EN
TP

Tell Position

**Full Description**
The TP command returns the current position of the motor(s).

**Arguments**

TP nnnnnnnnnn

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

**Operand Usage**

_ TPx contains the current position value for the specified axis.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

**Related Commands**
PF - Position Formatting

**Examples:**

Assume the A-axis is at the position 200 (decimal), the B-axis is at the position -10 (decimal), the C-axis is at position 0, and the D-axis is at -110 (decimal). The returned parameter units are in quadrature counts.

TP Return A,B,C,D positions
:200,-10,0,-110

TPA Return the A motor position
:200

TPB Return the B motor position
:-10

PF-6.0 Change to hex format
TP Return A,B,C,D in hex
:0000C8,FFFFF6,000000,FFFF93

Position =_TPA Assign the variable, Position, the value of TPA
The TR command causes each instruction in a program to be sent out the communications port prior to execution. TR1 enables this function and TR0 disables it. The trace command is useful in debugging programs.

### Arguments

**TR n, m**

where

- **n = 0** Disables the trace function
- **n = 1** Enables the trace function

**m** is an integer between 0 and 255 and designates which threads to trace. A bit is set per thread. Thread 0=1, Thread 1=2, Thread 2=4 ... Thread 7 =128. The default is 255 (all threads)

The least significant bit represents thread 0 and the most significant bit represents thread 7. The decimal value can be calculated by the following formula:

\[ n = n_0 + 2^n_1 + 4^n_2 + 8^n_3 + 16^n_4 + 32^n_5 + 64^n_6 + 128^n_7 \]

where \( n_x \) represents the thread. To turn tracing on for a thread, substitute a one into that \( n_x \) in the formula. If the \( n_x \) value is a zero, then tracing will be off for that thread.

For example, if threads 3 and 4 are to be traced, TR24 is issued.

Omitting \( m \) traces all threads.

### Operand Usage

N/A

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

### Related Commands

CF - Configure port for unsolicited messages

### Examples:

```
:TR
:LS
0 MGTIME
1 WT1000
2 JP0
3
:TR
18003461.0000
18004461.0000
```
18005461.0000
:TR1
:
2 JP0
0 MGTIME
18006461.0000
1 WT1000
2 JP0
0 MGTIME
18007461.0000
1 WT1000
:TR0
:
18008461.0000
18009461.0000
:ST
:
**Full Description**

TS returns status information of the Home switch, Forward Limit switch, Reverse Limit switch, error conditions, motion condition and motor state. The value returned by this command is decimal and represents an 8 bit value (decimal value ranges from 0 to 255). Each bit represents the following status information:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7</td>
<td>Axis in motion if high</td>
</tr>
<tr>
<td>Bit 6</td>
<td>Axis error exceeds error limit if high</td>
</tr>
<tr>
<td>Bit 5</td>
<td>A motor off if high</td>
</tr>
<tr>
<td>Bit 4</td>
<td>Undefined</td>
</tr>
<tr>
<td>Bit 3</td>
<td>Forward Limit Switch Status inactive if high</td>
</tr>
<tr>
<td>Bit 2</td>
<td>Reverse Limit Switch Status inactive if high</td>
</tr>
<tr>
<td>Bit 1</td>
<td>Home A Switch Status</td>
</tr>
<tr>
<td>Bit 0</td>
<td>Latched</td>
</tr>
</tbody>
</table>

Note: For active high or active low configuration (CN command), the limit switch bits are '1' when the switch is inactive and '0' when active.

**Arguments**

`TS nnnnnnnnnn`

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

No argument will provide the status for all axes

**Operand Usage**

_TSn contains the current status of the switches.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```c
V1=_TSB Assigns value of TSB to the variable V1
V1=     Interrogate value of variable V1
:15     Decimal value corresponding to bit pattern 00001111
Y axis not in motion (bit 7 - has a value of 0)
Y axis error limit not exceeded (bit 6 has a value of 0)
Y axis motor is on (bit 5 has a value of 0)
Y axis forward limit is inactive (bit 3 has a value of 1)
Y axis reverse limit is inactive (bit 2 has a value of 1)
Y axis home switch is high (bit 1 has a value of 1)
```
Y axis latch is not armed (bit 0 has a value of 1)
TT

Tell Torque

Full Description
The TT command reports the value of the analog output signal, which is a number between -9.998 and 9.998 volts.

Arguments

TT nnnnnnnnnnn
where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes
No argument will provide the torque for all axes

Operand Usage

_TTn contains the value of the torque for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Related Commands

TL - Torque Limit

Examples:

V1=_TTA Assigns value of TTA to variable, V1
TTA Report torque on A
:-0.2843 Torque is -.2843 volts
Tell Velocity

**Full Description**
The `TV` command returns the actual velocity of the axes in units of encoder count/s. The value returned includes the sign.

The `TV` command is computed using a special averaging filter (over approximately 0.25 sec for TM1000). Therefore, `TV` will return average velocity, not instantaneous velocity.

**Arguments**

```
TV nnnnnnnnnnn
```

where

- `n` is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

No argument will provide the velocity for all axes.

**Operand Usage**

`_TVn` contains the value of the velocity for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>8.0</td>
</tr>
</tbody>
</table>

**Related Commands**

- SP - Speed
- AC - Acceleration
- DC - Deceleration
- TM - Update Time

**Examples:**

```
:vela=_TVA       Assigns value of A-axis velocity to the variable VELA
:TVA             Returns the A-axis velocity
0003420
```
TW

Timeout for IN Position (MC)

Full Description

Arguments

TW n,n,n,n,n,n,n

TWA=n

n specifies the timeout in msec. n ranges from 0 to 32767 msec
n = -1    Disables the timeout.
n = ?    Returns the timeout in msec for the MC command for the specified axis.

Operand Usage

_TWn contains the timeout for the MC command for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>32766</td>
</tr>
<tr>
<td>Default Format</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Related Commands

MC - Motion Complete trippoint
#MCTIME - Motion Complete Timeout Automatic Subroutine

Examples:
TZ

Tell I/O Configuration

Full Description
The TZ command is used to request the I/O status. This is returned to the user as a text string.

Arguments
N/A

Operand Usage
N/A

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Related Commands
TI - Tell Inputs
SB/CB - Set/Clear output bits
OP - Output port
CO - Configure I/O

Examples:

:TZ
BLOCK 0 (8-1) dedicated as input - value 255 (1111_1111)
BLOCK 0 (8-1) dedicated as output - value 0 (0000_0000)
BLOCK 2 (24-17) configured as input - value 255 (1111_1111)
BLOCK 3 (32-25) configured as input - value 255 (1111_1111)
BLOCK 4 (40-33) configured as input - value 255 (1111_1111)
BLOCK 5 (48-41) configured as input - value 255 (1111_1111)
BLOCK 6 (56-49) configured as input - value 255 (1111_1111)
BLOCK 10 (88-81) dedicated as input - value 255 (1111_1111)
UI

Full Description
UI pushes a user-defined status byte into the EI queue. UI can generate 16 different status bytes, $F0 to $FF (240-255), corresponding to UI0 to UI15. When the UI command (e.g. UI5) is executed, the status byte value (e.g. $F5 or 245) is queued up for transmission to the host, along with any other interrupts. The UDP interrupt packet dispatch may be delayed. If immediate packet dispatch is required, use the message command (MG) to send a unique message to the host software.
EI,h must be set to a valid UDP port (set by the host, not the DMC code, is recommended) before any interrupt packet will be dispatched.

Arguments

UI n
where
n is an integer between 0 and 15 corresponding to status bytes $F0 to $FF (240-255).

<table>
<thead>
<tr>
<th>STATUS BYTE</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F0 (240)</td>
<td>UI or UI0 was executed</td>
</tr>
<tr>
<td>$F1 (241)</td>
<td>UI1 was executed</td>
</tr>
<tr>
<td>$F2 (242)</td>
<td>UI2 was executed</td>
</tr>
<tr>
<td>$F3 (243)</td>
<td>UI3 was executed</td>
</tr>
<tr>
<td>$F4 (244)</td>
<td>UI4 was executed</td>
</tr>
<tr>
<td>$F5 (245)</td>
<td>UI5 was executed</td>
</tr>
<tr>
<td>$F6 (246)</td>
<td>UI6 was executed</td>
</tr>
<tr>
<td>$F7 (247)</td>
<td>UI7 was executed</td>
</tr>
<tr>
<td>$F8 (248)</td>
<td>UI8 was executed</td>
</tr>
<tr>
<td>$F9 (249)</td>
<td>UI9 was executed</td>
</tr>
<tr>
<td>$FA (250)</td>
<td>UI10 was executed</td>
</tr>
<tr>
<td>$FB (251)</td>
<td>UI11 was executed</td>
</tr>
<tr>
<td>$FC (252)</td>
<td>UI12 was executed</td>
</tr>
<tr>
<td>$FD (253)</td>
<td>UI13 was executed</td>
</tr>
<tr>
<td>$FE (254)</td>
<td>UI14 was executed</td>
</tr>
<tr>
<td>$FF (255)</td>
<td>UI15 was executed</td>
</tr>
</tbody>
</table>

Operand Usage
N/A

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>All</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Related Commands
EI - Event interrupts
MG - Message
Examples:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>JG 5000</td>
<td>Jog at 5000 counts/s</td>
</tr>
<tr>
<td>BGA</td>
<td>Begin motion</td>
</tr>
<tr>
<td>ASA</td>
<td>Wait for at speed</td>
</tr>
<tr>
<td>UI 1</td>
<td>Cause an interrupt with status byte $F1$ (241)</td>
</tr>
</tbody>
</table>
Full Description
The UL command transfers data from the controller to a host computer. Programs are sent without line numbers. The Uploaded program will be followed by a <control>Z as an end of text marker.

Arguments
None

Operand Usage
When used as an operand, _UL gives the number of available variables. The number of available variables is 510.

RELATED COMMAND:
DL
Download

Usage
Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

Examples:

UL;  Begin upload
#A   Line 0
NO This is an Example   Line 1
NO Program            Line 2
EN                 Line 3
<cntrl>Z       Terminator
VA

Vector Acceleration

Full Description
The VA command sets the acceleration rate of the vector in a coordinated motion sequence.

Arguments

VA s,t
where
s and t are unsigned integers in the range 1024 to 1073740800. s represents the vector acceleration for the S coordinate system and t represents the vector acceleration for the T coordinate system. The parameter input will be rounded down to the nearest factor of 1024. The units of the parameter is counts per second squared.

s = ? Returns the value of the vector acceleration for the S coordinate plane.
t = ? Returns the value of the vector acceleration for the T coordinate plane.

Operand Usage

_VAx contains the value of the vector acceleration for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256000 (10.0 for 18x6 &amp; 40x0)</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format</td>
</tr>
</tbody>
</table>

Related Commands

VS - Vector Speed
VP - Vector Position
VE - End Vector
CR - Circle
VM - Vector Mode
BG - Begin Sequence
VD - Vector Deceleration
IT - Smoothing constant - S-curve

Examples:

VA 1024 Set vector acceleration to 1024 counts/sec2
VA ? Return vector acceleration
:1024
VA 20000 Set vector acceleration
VA ? :19456 Return vector acceleration
ACCEL=_VA Assign variable, ACCEL, the value of VA
**Full Description**

The VD command sets the deceleration rate of the vector in a coordinated motion sequence.

**Arguments**

VD s,t

where

s and t are unsigned integers in the range 1024 to 1073740800. s represents the vector deceleration for the S coordinate system and t represents the vector acceleration for the T coordinate system. The parameter input will be rounded down to the nearest factor of 1024. The units of the parameter is counts per second squared.

\[ s = ? \] Returns the value of the vector deceleration for the S coordinate plane.

\[ t = ? \] Returns the value of the vector deceleration for the T coordinate plane.

**Operand Usage**

VDn contains the value of the vector deceleration for the specified coordinate system, S or T.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>256000</td>
</tr>
<tr>
<td>Default Format</td>
<td>Position Format (10.0 for 18x6 &amp; 40x0)</td>
</tr>
</tbody>
</table>

**Related Commands**

VA - Vector Acceleration  
VS - Vector Speed  
VP - Vector Position  
CR - Circle  
VE - Vector End  
VM - Vector Mode  
BG - Begin Sequence  
IT - Smoothing constant - S-curve

**Examples:**

```
#VECTOR ;'Vector Program Label
VMAB ;'Specify plane of motion
VA10000000 ;'Vector Acceleration
VD 5000000 ;'Vector Deceleration
VS 2000 ;'Vector Speed
VP 10000, 20000 ;'Vector Position
VE ;'End Vector
BGS ;'Begin Sequence
AMS ;'Wait for Vector sequence to complete
```
EN  ; 'End Program
**Full Description**

VE is required to specify the end segment of a coordinated move sequence. VE would follow the final VP or CR command in a sequence. VE is equivalent to the LE command.

The VE command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

**Arguments**

**VE n**

No argument specifies the end of a vector sequence.

n = ?      Returns the length of the vector in counts.

**Operand Usage**

_VE_n contains the length of the vector in counts for the specified coordinate system, S or T.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>N/A</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Related Commands**

VM - Vector Mode
VS - Vector Speed
VA - Vector Acceleration
VD - Vector Deceleration
CR - Circle
VP - Vector Position
BG - Begin Sequence
CS - Clear Sequence

**Examples:**

```
#A      ;'Program Label
VM AB   ;'Vector move in AB
VP 1000,2000    ;'Linear segment
CR 0,90,180     ;'Arc segment
VP 0,0  ;'Linear segment
VE      ;'End sequence
BGS     ;'Begin motion
AMS     ;'Wait for VE to execute in buffer
EN      ;'End program
```
VF

Variable Format

**Full Description**
The VF command formats the number of digits to be displayed when interrogating the controller or RIO board. If a number exceeds the format, the number will be displayed as the maximum possible positive or negative number (i.e. 999.99, -999, $8000 or $7FF).

**Arguments**

`VF m.n`
where
m and n are unsigned numbers in the range 0<m<10 and 0<n<4.

m represents the number of digits before the decimal point. A negative m specifies hexadecimal format. When in hexadecimal, the string will be preceded by a $ and Hex numbers are displayed as 2's complement with the first bit used to signify the sign.

n represents the number of digits after the decimal point.

m = ? Returns the value of the format for variables and arrays.

**Operand Usage**

_VF contains the value of the format for variables and arrays.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Default Value</td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>Default Format</td>
<td>2.1</td>
<td></td>
</tr>
</tbody>
</table>

**Related Commands**

PF - Position Format

**Examples:**

| VF 5.3 | Sets 5 digits of integers and 3 digits after the decimal point |
| VF 8.0 | Sets 8 digits of integers and no fractions                  |
| VF -4.0| Specify hexadecimal format with 4 bytes to the left of the decimal |
VM

Full Description
The VM command specifies the coordinated motion mode and the plane of motion. This mode may be specified for motion on any set of two axes. The motion is specified by the instructions VP and CR, which specify linear and circular segments. Up to 511 segments may be given before the Begin Sequence (BGS or BGT) command. Additional segments may be given during the motion when the buffer frees additional spaces for new segments. It is the responsibility of the user to keep enough motion segments in the buffer to ensure continuous motion.

The Vector End (VE) command must be given after the last segment. This allows the controller to properly decelerate.

The VM command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

Arguments

VM nmp
where
n and m specify plane of vector motion and can be any two axes. Vector Motion can be specified for one axis by specifying 2nd parameter, m, as N. Specifying one axis is useful for obtaining sinusoidal motion on 1 axis.
p is the tangent axis and can be specified as any axis except the imaginary M and N axes. A value of N for the parameter, p, turns off tangent function.

Operand Usage

_VMn contains instantaneous commanded vector velocity for the specified coordinate system, S or T.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>AB</td>
</tr>
</tbody>
</table>

Related Commands
CR - Circle
VP - Vector Mode
VE - Vector End
BG - Begin Sequence

Examples:

#A ;'Program Label
VM AB ;'Specify motion plane
VP 1000,2000 ;'Specify vector position 1000,2000
VP 2000,4000 ;'Specify vector position 2000,4000
CR 1000,0,360 ;'Specify arc
VE ;'Vector end
BGS ;'Begin motion sequence
AMS ;'Wait for vector motion to complete
EN ;'End Program
Hint: The first vector in a coordinated motion sequence defines the origin for that sequence. All other vectors in the sequence are defined by their endpoints with respect to the start of the move sequence.
VP

Vector Position

Full Description
The VP command defines the target coordinates of a straight line segment in a 2 axis motion sequence which have been selected by the VM command. The units are in quadrature counts, and are a function of the elliptical scale factor set using the command ES. For three or more axes linear interpolation, use the LI command. The VP command will apply to the selected coordinate system, S or T. To select the coordinate system, use the command CAS or CAT.

Arguments
VP n,m < o > p
where
n and m are signed integers in the range -2147483648 to 2147483647 The length of each segment must be limited to 8388607. The values for n and m will specify a coordinate system from the beginning of the sequence.

o specifies a vector speed to be taken into effect at the execution of the vector segment. o is an unsigned even integer between 2 and 22,000,000 for servo motor operation and between 2 and 6,000,000 for stepper motors (o is in units of counts per sample).

p specifies a vector speed to be achieved at the end of the vector segment. p is an unsigned even integer between 2 and 22,000,000 (p is in units of counts per sample).

Operand Usage
_VPa where a=ABCDEFGH for the axis and contains the absolute coordinate of the axes at the last intersection along the sequence. For example, during the first motion segment, this instruction returns the coordinate at the start of the sequence. The use as an operand is valid in the linear mode, LM, and in the Vector mode, VM.

example: _VPA for the the A axis

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>-</td>
</tr>
<tr>
<td>Default Format</td>
<td>-</td>
</tr>
</tbody>
</table>

Related Commands
VM - Vector Mode
VE - Vector End
BG - Begin Sequence
IT - Vector smoothing

Examples
#A;' Program Label
VM AB;' Specify motion plane
VP 1000,2000 ;'Specify vector position 1000,2000
VP 2000,4000;' Specify vector position 2000,4000
CR 1000,0,360;'Specify arc
VE;'     Vector end
BGS;'     Begin motion sequence
AMS;'     Wait for vector motion to complete
EN;'      End Program

REM VP n,m <o> p
REM 'o' and 'p' are in counts/sample rather than counts/second as the VS command.
REM this means that when TM <> 1000, commanded speed for VS will be different than
REM values for 'o' and 'p'
REM To get counts/second for 'o' and 'p', divide them by a ratio of 1000/_TM
REM
REM #vs and #vsop result in the same profile
#vs
TM 250
VMXY
VS 100000
VA 2560000
VD 2560000
VP 20000,20000
VE
BGS
AMS
EN
'
#vsop
TM 250
VMXY
n=1000/_TM
'VS 100000
VA 2560000
VD 2560000
VP 20000,20000<(100000/n)
VE
BGS
AMS
EN

Hint: The first vector in a coordinated motion sequence defines the origin for that sequence. All other vectors in the sequence are defined by their endpoints with respect to the start of the move sequence.
VR

Vector Speed Ratio

Full Description

The VR sets a ratio to be used as a multiplier of the current vector speed. The vector speed can be set by the command VS or the operators < and > used with CR, VP and LI commands. VR takes effect immediately and will ratio all the following vector speed commands. VR doesn't ratio acceleration or deceleration, but the change in speed is accomplished by accelerating or decelerating at the rate specified by VA and VD.

Arguments

VR s,t

where

s and t are between 0 and 10 with a resolution of .0001. The value specified by s is the vector ratio to apply to the S coordinate system and t is the value to apply to the T coordinate system.

s = ? Returns the value of the vector speed ratio for the S coordinate plane.

t = ? Returns the value of the vector speed ratio for the T coordinate plane.

Operand Usage

_ VRn contains the vector speed ratio of the specified coordinate system, S or T.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>1</td>
</tr>
<tr>
<td>Default Format</td>
<td>2.4</td>
</tr>
</tbody>
</table>

While Moving | Yes | Default Value | 1
In a Program | Yes | Default Format | 2.4
Command Line | Yes | Controller Usage | ALL CONTROLLERS

Related Commands

VS - Vector Speed

Examples:

#A ;'Vector Program
VMAB ;'Vector Mode
VP 1000,2000 ;'Vector Position
CR 1000,0,360 ;'Specify Arc
VE ;'End Sequence
VS 2000 ;'Vector Speed
BGS ;'Begin Sequence
AMS ;'After Motion
JP#A ;'Repeat Move
### VS

**Vector Speed**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Implicit Notation Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands</td>
<td>_VSn</td>
</tr>
<tr>
<td>Burn</td>
<td>burnable with BN</td>
</tr>
</tbody>
</table>

#### Full Description

The VS command specifies the speed of the vector in a coordinated motion sequence in either the LM or VM modes. VS may be changed during motion. Vector Speed can be calculated by taking the square root of the sum of the squared values of speed for each axis specified for vector or linear interpolated motion.

#### Arguments

**VS s,t**

where

$s$ and $t$ are unsigned even numbers in the range 2 to 22,000,000 for servo motors and 2 to 6,000,000 for stepper motors. $s$ is the speed to apply to the S coordinate system and $t$ is the speed to apply to the T coordinate system. The units are counts per second.

$s = ?$  Returns the value of the vector speed for the S coordinate plane.

$t = ?$  Returns the value of the vector speed for the T coordinate plane.

#### Operand Usage

_VSn contains the vector speed of the specified coordinate system, S or T

#### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>25000</td>
</tr>
</tbody>
</table>

#### Related Commands

VA - Vector Acceleration
VP - Vector Position
CR - Circle
LM - Linear Interpolation
VM - Vector Mode
BG - Begin Sequence
VE - Vector End

#### Examples:


**VV**

**Vector Speed Variable**

**Full Description**

The VV command sets the speed of the vector variable in a coordinated motion sequence in either the LM or VM modes. VV may be changed during motion.

The VV command is used to set the "<" vector speed variable argument for segments that exist in the vector buffer. By defining a vector segment begin speed as a negative 1 (i.e. ":-1"), the controller will utilize the current vector variable speed as the segment is profiled from the buffer.

This is useful when vector segments exist in the buffer that use the ":<" and ":>" speed indicators for specific segment and corner speed control and the host needs to be able to dynamically change the nominal return operating speed.

The vector variable is supported for VP, CR and LI segments.

**Arguments**

**VVS=n or VVT=n**

where,

n specifies the speed as an unsigned even number in the range 2 to 22,000,000 for servo motors and 2 to 6,000,000 for stepper motors. VVS is the speed to apply to the S coordinate system and VVT is the speed to apply to the T coordinate system. The units are in counts per second.

VVS=? Returns the value of the vector speed variable for the S coordinate plane.

VVT=? Returns the value of the vector speed variable for the T coordinate plane.

**Operand Usage**

_VVn contains the vector speed variable of the specified coordinate system (n= S or T)

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related Commands**

VA - Vector Acceleration
VD - Vector Deceleration
VP - Vector Position Segment
CR - Circular Interpolation Segment
LI - Linear Interpolation Segment
VM - Vector Mode
LM - Linear Interpolation Mode

**Examples:**

| :VVS= 20000 | Define vector speed variable to 20000 for the S coordinate system |
| VP1000,2000<-1>100 | Define vector speed variable for specific segment. |
| :VVS=? | |
| :20000 | |
| : | |
Full Description
The WH command is used to identify the handle from which the command was received. The command returns IHA through IHH to indicate on which handle the command was executed.

The command returns RS232 if using serial communication.

Arguments
None

Operand Usage
_WH contains the numeric representation of the handle from which the command was received.
Handles A through H are indicated by the value 0-7, while a-l indicates the serial port.

Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>No</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Related Commands
HS - Handle Swap
IA - IP address
IH - Internet Handle
TH -Tell Handles

Examples:

\:WH Request incoming handle identification
\:IH Command received from handle C
\:
**WT**

**Wait**

### Full Description

The WT command is a trippoint used to time events. When this command is executed, the controller will wait for the number of milliseconds specified before executing the next command.

If \( m = 1 \) for \( WT_n,m \) then the controller will wait for the number of samples specified before executing the next command.

### Arguments

**WT \( n,m \)**

where

- \( n \) is an unsigned integer in the range 0 to 2000000000 (2 Billion)

where

- \( n \) is an unsigned, even integer in the range 0 to 2 Billion
- \( m = 0 \) or omitted specifies \( n \) to be in ms
- \( m = 1 \) specifies \( n \) to be in samples

### Operand Usage

N/A

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In A Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>ALL</td>
</tr>
<tr>
<td>Default Value</td>
<td>-</td>
</tr>
<tr>
<td>Default Format</td>
<td>-</td>
</tr>
</tbody>
</table>

### Related Commands

- AT - At Time
- TIME - Time Operand
- TM - Update Time

### Examples:

REM 10 seconds after a move is complete, turn on a relay for 2 seconds

```
#A;      'Program A
PR 50000; 'Position relative move
BGA;     'Begin the move
AMA;     'After the move is over
WT 10000; 'Wait 10 seconds
SB 1;    'Turn on relay (set output 1)
WT 2000; 'Wait 2 seconds
CB1;     'Turn off relay (clear output 1)
```
EN; 'End Program
Full Description
The XQ command begins execution of a program residing in the program memory of the controller. Execution will start at the label or line number specified. Up to 8 programs may be executed with the controller.

Arguments

**XQ #A,n**

**XQm,n**

where

A is a program name of up to seven characters.

m is a line number

n is an integer representing the thread number for multitasking

n is an integer in the range of 0 to 7.

NOTE: The arguments for the command, XQ, are optional. If no arguments are given, the first program in memory will be executed as thread 0.

Operand Usage

_XQn contains the current line number of execution for thread n, and -1 if thread n is not running.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Related Commands

HX - Halt execution

Examples:

XQ #APPLE,0  Start execution at label APPLE, thread zero
XQ #DATA,2   Start execution at label DATA, thread two
XQ 0         Start execution at line 0

Hint: For DOS users, don't forget to quit the edit mode first before executing a program!
**Full Description**

The YA command specifies the resolution of the step drive, in step counts per full motor step, for Stepper Position Maintenance mode.

**Arguments**

**YA m,m,m,m,m,m,m,m**

\[ \text{YAn} = m \]

where

- \( n \) is \( A,B,C,D,E,F,G \) or \( H \) or any combination to specify the axis or axes.
- \( m \) is 0 to 9999 which represents the drive resolution in step counts per full motor step.

For the SDM-44040, \( m \) is 1, 2, 4, or 16 for full, half, 1/4 and 1/16 step drive resolution, respectively. YA actually sets the configurable hardware step drive resolution for the SDM-44040.

For the SDM-44140, set \( m \) to 64 when using stepper position maintenance mode. The 44140 step drive is fixed at 64 step counts per full motor step and is not modifiable with the YA command.

**Operand Usage**

\_YAn contains the resolution for the specified axis.

**Usage**

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>2</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

- QS - Error Magnitude
- YS - Stepper Position Maintenance Mode Enable, Status
- YB - Step Motor Resolution
- YC - Encoder Resolution
- YR - Error Correction

**Examples:**

1. Set the step drive resolution for the SDM-44140 Microstepping Drive:
   
   YA 64,64,64,64

2. Query the D axis value:

   MG_YAD

   :64.0000  Response shows D axis step drive resolution
**Full Description**

The YB command specifies the resolution of the step motor, in full steps per full revolution, for Stepper Position Maintenance mode.

**Arguments**

\[
\text{YB m,m,m,m,m,m,m,m,m}
\]

\[
\text{YBn} = m
\]

where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes.

m is 0 to 9999 which represents the motor resolution in full steps per revolution.

**Operands Usage**

_YBn_ contains the stepmotor resolution for the specified axis.

**Usage**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>200</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Related Commands**

QS - Error Magnitude
YS - Stepper Position Maintenance Mode Enable, Status
YA - Step Drive Resolution
YC - Encoder Resolution
YR - Error Correction

**Examples:**

1. Set the step motor resolution of the A axis for a 1.8\(^\circ\) step motor:
   
   \[\text{YBA}=200\]

2. Query the A axis value:
   
   \[\text{YBA}=?\]
   
   :200 Response shows A axis step motor resolution
YC

Encoder Resolution

Full Description
The YC command specifies the resolution of the encoder, in counts per revolution, for Stepper Position Maintenance mode.

Arguments
YC m,m,m,m,m,m,m

YCn = m

where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes.
m is 0 to 32766 which represents the encoder resolution in counts per revolution.

Operand Usage
_YCn contains the encoder resolution for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
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<tr>
<td>While Moving</td>
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<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>4000</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
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</table>

Related Commands
QS - Error Magnitude
YS - Stepper Position Maintenance Mode Enable, Status
YA - Step Drive Resolution
YB - Step Motor Resolution
YR - Error Correction

Examples:
1. Set the encoder resolution of the D axis for a 4000 count/rev encoder:
   YC,,,4000
2. Query the D axis value:
   YCD=?
   :4000 Response shows D axis encoder resolution
**YR**

**Error Correction**

**Syntax:** Explicit & Implicit  
**Operands:** none  
**Burn:** not burnable

**Full Description**  
The YR command allows the user to correct for position error in Stepper Position Maintenance mode. This correction acts like an IP command, moving the axis or axes the specified quantity of step counts. YR will typically be used in conjunction with QS.

**Arguments**

YR m,m,m,m,m,m,m,m  
YRn = m  
where  
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes.  
m is a magnitude in step counts.

**Operand Usage**  
None

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>No</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related Commands**

QS - Error Magnitude  
YA - Step Drive Resolution  
YB - Step Motor Resolution  
YR - Error Correction  
YS - Stepper Position Maintenance Mode Enable, Status

**Examples:**

1. Query the error of the B axis:  
   :QS B=?  
   :253  
   This shows 253 step counts of error  
   Correct for the error:  
   :YRB=_QS B  
   The motor moves _QS step counts to correct for the error, and YS is set back to 1
YS

Stepper Position Maintenance Mode Enable, Status

Full Description
The YS command enables and disables the Stepper Position Maintenance Mode function. YS also reacts to excessive position error condition as defined by the QS command.

Arguments

YS m,m,m,m,m,m,m,m

YSn = m
where
n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes.
m = 0    SPM Mode Disable
m = 1    Enable SPM Mode, Clear trippoint and QS error
m = 2    Error condition occurred

Operand Usage

_YSn contains the status of the mode for the specified axis.

Usage

Usage and Default Details

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
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</tr>
<tr>
<td>Default Format</td>
<td>1.4</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
</tbody>
</table>

Related Commands
QS - Error Magnitude
YA - Step Drive Resolution
YB - Step Motor Resolution
YC - Encoder Resolution
YR - Error Correction

Examples:

1. Enable the mode:
   YSH=1
2. Query the value:
   YS*=
   :0,0,0,0,0,0,1    Response shows H axis is enabled
### Full Description

ZA sets the user variables in the data record. The eight user variables (one per axis) are automatically sent as part of the status record from the controller to the host computer. These variables provide a method for specific controller information to be passed to the host automatically.

### Arguments

\[ ZA \, n,n,n,n,n,n,n \]

\[ ZA=n \]

where

- \( n \) is an integer and can be a number, controller operand, variable, mathematical function, or string. The range for numeric values is 4 bytes of integer (-2,147,483,648 to +2,147,483,647). The maximum number of characters for a string is 4 characters. Strings are identified by quotations.
- \( n = ? \) returns the current value

### Operand Usage

\[ _ZAn \] contains the current value for the specified axis.

### Usage

**Usage and Default Details**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>Yes</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>10.0</td>
</tr>
</tbody>
</table>

### Related Commands

- DR - Data Record update rate
- QR - Query Data Record
- QZ - Data Record format

### Examples:

```csharp
#Thread
ZAX=MyVar;  'constantly update ZA
JP#Thread
```
**ZS**

**Zero Subroutine Stack**

<table>
<thead>
<tr>
<th>Syntax:</th>
<th>Explicit &amp; Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operands:</td>
<td>ZSn</td>
</tr>
<tr>
<td>Burn:</td>
<td>not burnable</td>
</tr>
</tbody>
</table>

**Full Description**

The ZS command is only valid in an application program and is used to avoid returning from an interrupt (either input or error). ZS alone returns the stack to its original condition. ZS1 adjusts the stack to eliminate one return. This turns the jump to subroutine into a jump. Do not use RI (Return from Interrupt) when using ZS. To re-enable interrupts, you must use II command again.

The status of the stack can be interrogated with the operand _ZSn - see operand usage below.

**Arguments**

ZS n

where

- n = 0     Returns stack to original condition
- n = 1     Eliminates one return on stack

**Operand Usage**

_ZSn contains the stack level for the specified thread where n = 0 to 7.

The response, an integer between zero and sixteen, indicates zero for beginning condition and sixteen for the deepest value.

**Usage**

*Usage and Default Details*

<table>
<thead>
<tr>
<th>Usage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>While Moving (No RIO)</td>
<td>Yes</td>
</tr>
<tr>
<td>In a Program</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Line</td>
<td>No</td>
</tr>
<tr>
<td>Controller Usage</td>
<td>All</td>
</tr>
<tr>
<td>Default Value</td>
<td>0</td>
</tr>
<tr>
<td>Default Format</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Related Commands**

**Examples:**

```
#A;'           Main Program
III;'          Input Interrupt on 1
#B;JP #B;EN ;' Loop
#ININT;'       Input Interrupt
MG"INTERRUPT";'Print message
S=_ZS;'       Interrogate stack
S=?;'         Print stack
ZS;'          Zero stack
S=_ZS;'       Interrogate stack
S=?;'         Print stack
EN;'           End
```