CDS-3310

COMMAND REFERENCE

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By Galil Motion Control, Inc.

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ARRAYS	
DA	deallocate
_DA	arrays left
DM	define
_DM	space left
LA	list
QD	print/download
QU	upload
RA	record
RC	begin
_RC	recording?
RD	data
_RD	address
[ ]	index

COMMUNICATE	
CF	unsolicited
CI	interrupt
CW	copyright
EO	echo
HS	handle switch
IA	IP address
IH	open handle
IN	user input
LO	lockout handle
LZ	leading zeros
MB	modbus
MG	message
MW	modbus wait
P1CD	port 2 code
P1CH	character
P1NM	number
P1ST	string
PF	position format
QR	query record
QZ	record info
SA	send command
_SA	response
SM	subnet mask
TH	tell handles
VF	variable format
WH	which handle
_WH	numeric
#COMINT;EN1,1	
#TCPERR; RE	

CONTOUR	
CD	data
CM	axes
_CM	buffer full
DT	delta time
WC	wait for buffer

CONTROL	
DV	dual loop
FA	accel feedfwd
FV	speed feedfwd
IL	integrator limit
KD	d gain
KI	i gain
KP	p gain
MO	motor off
_MO	motor off?
NB	notch width
NF	notch frequency
NZ	notch zero
OF	offset
PL	low pass
SH	servo here
TE	tell error
TK	peak torque
TL	torque limit
TM	sample time
TT	tell torque

DISTRIBUTED	
HA	axes
HC	configure
HQ	query controllers
HW	response wait
ZA	slave variable 1
ZB	slave variable 2

EEPROM	
^R^S	master reset
BN	burn
BP	burn program
BV	burn variables
RS	reset

ERRORS	
AB	abort
_AB	abort input
BL	reverse soft limit
_ED	program line
_ED1	thread
ER	maximum TE
FL	forward soft limit
_LF	forward limit
_LR	reverse limit
OE	off on error
SC	stop code
TC	tell code
#AMPERR; RE1	
#CMDERR; EN1	
#LIMSWI; RE1	
#POSERR; RE1	

FEEDBACK	
AF	analog feedback
AL	arm latch
_AL	latch occurred?
CE	configure
MT	motor type
OC	output compare
_OC	first pulse?
RL	read latch
_RL	latch position
TD	tell dual
TP	tell position
TV	tell velocity

GEAR	
GA	axes
GD	distance
GM	gantry mode
_GP	phase
GR	ratio

HOME	
DE	define dual
DP	define position
FE	find home only
FI	find index only
HM	home
_HM	home input

INFO	
_BN	serial number
_BV	axes
^R^V	firmware rev
TF	tell FPGA rev

I/O	
@AN[x]	analog in
@IN[x]	digital in
@OUT[x]	digital out
AI	wait for input
AO	set analog out
CB	clear digital out
CN	configure
CO	extended I/O
II	input interrupt
OB	output bit
OP	output port
OQ	set 7007 port
OS	add outputs
SB	set digital out
TI	tell input byte
TS	tell switches
TZ	tell Ethernet I/O
#ININT; RI1	

MATH	
@ABS[x]	|x|
@ACOS[x]	arccos
@ASIN[x]	arcsin
@ATAN[x]	arctan
@COM[x]	bit not
@COS[x]	cosine
@FRAC[x]	fraction
@INT[x]	integer
@RND[x]	round
@SIN[x]	sine
@SQR[x]	x^0.5
@TAN[x]	tangent
+	add
-	subtract
*	multiply
/	divide
( )	parenthesis
&	and
|	or
$	hexadecimal
<	less than
>	greater than
=	assign / equal
<=	less or equal
>=	greater or equal
<>	not equal

MOTION	
AC	acceleration
BG	begin
_BG	in motion?
DC	deceleration
IP	increment position
IT	s curve
JG	jog
PA	position absolute
_PA	last target
PR	position relative
PT	position tracking
_PR	relative target
RP	desired position
SP	speed
ST	stop

MOTION WAIT	
AD	distance (RP)
AM	complete (RP)
AP	position (TP)
AR	distance (RP)
AS	at speed (SP)
MC	complete (TP)
MF	forward (TP)
MR	reverse (TP)
TW	MC timeout
#MCTIME; EN1	

PROGRAM	
BK	breakpoint
DL	download
_DL	labels left
ED	edit
ELSE	if else
EN	end
ENDIF	if endif
HX	halt thread
IF	conditional
JP	for/while loop
JS	jump subroutine
LL	list labels
LS	list
LV	list variables
NO (')	comment
RE	return error
REM	fast comment
RI	return interrupt
SL	single step
TB	tell status byte
TR	debug trace
UL	upload
_UL	variables left
XQ	execute
_XQ	current line #
ZS	zero stack
_ZS	stack level
#AUTO; EN	
#AUTOERR; EN	
;	command delimiter
#	subroutine

TIME	
AT	wait reference
TIME	clock
WT	wait

AMPLIFIER	
AG	gain
AU	current loop
AW	bandwidth
BR	brush motor
BS	brushless setup
QH	query halls
TA	tell errors

TABLE OF CONTENTS

Overview

This command reference is a supplement to the Galil User Manual. For proper controller operation, consult the User Manual. This command reference describes commands for the Galil CDS-3310 motion controller. Commands are listed in alphabetical order.

Command Descriptions

Each executable instruction is listed in alphabetical order. The two-letter Opcode for each instruction is placed in the upper left corner. Below the opcode is a description of the command and required arguments.

Axes Arguments

Some commands require the user to identify the specific axes to be affected. These commands are followed by uppercase X,Y,Z, W or A,B,C,D,E,F,G and H. No commas are needed and the order of axes is not important. Do not insert any spaces prior to any command. For example, STX; AMX is invalid because there is a space after the semicolon. When an argument is not required and is not given, the command is executed for all axes.

Valid syntax

SH A	Servo Here, A only
SH ABD	Servo Here, A,B and D axes
SH ACD	Servo Here, A,C and D axes
SH ABCD	Servo Here, A,B, C and D axes
SH BCAD	Servo Here, A,B,C and D axes
SH ADEG	Servo Here, A,D,E and G axes
SH H	Servo Here, H axis only
SH	Servo Here, all axes

Parameter Arguments

Some commands require numerical arguments to be specified following the instruction. In the argument description, these commands are followed by lower case n,n,n,n,n,n,n,n, where the letter, n, represents the value. Values may be specified for any axis separately or any combination of axes. The argument for each axis is separated by commas. Examples of valid syntax are listed below.

Valid syntax

AC n	Specify argument for a axis only
AC n,n	Specify argument for a and b only
AC n,,n	Specify argument for a and c only

AC n,n,n,n	Specify arguments for a,b,c,d axes
AC n,n,n,n	Specify arguments for a,b,c,d
AC ,n,,,n	Specify arguments for b and e axis only
AC ,,,n,n	Specify arguments for e and f

Where n is replaced by actual values.

Direct Command Arguments

An alternative method for specifying data is to set data for individual axes 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:

PRB=1000	Sets B axis data at 1000
PR*=1000	Sets all axes to 1000

Interrogation

Most commands accept a question mark (?) as an argument. This argument causes the controller to return parameter information listed in the command description. 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.

PR ?	Returns the PR value for the A axis
PR ,,,?	Returns the PR value for the D axis
PR ?,?,?,?	Returns the PR value for the A,B,C and D axes
PR ,,,,,,,?	Returns the PR value for the H axis
PR*=?	returns the PR value for all axes

Operand Usage

Most commands have a corresponding operand that can be used for interrogation. The Operand Usage description provides proper syntax and the value returned by the operand. Operands must be used inside of valid DMC expressions. For example, to display the value of an operand, the user could use the command:

MG ‘operand’

All of the command operands begin with the underscore character (_). For example, the value of the current position on the A axis can be assigned to the variable ‘V’ with the command:

V=_TPA

Usage Description

The Usage description specifies the restrictions on proper command usage. The following provides an explanation of the command information provided:

"While Moving":

Describes whether the command is valid while the controller is performing a motion.

"In a program":

Describes whether the command may be used as part of a user-defined program.

"Command Line":

Describes whether the command may be used as a direct command.

Default Description

In the command description, the DEFAULT section provides the default values for controller setup parameters. These parameters can be changed and the new values can be saved in the controller's non-volatile memory by using the command, BN. If the setup parameters are not saved in non-volatile memory, the default values will automatically reset when the system is reset. A reset occurs when the power is turned off and on, when the reset button is pushed, or the command, RS, is given.

The default format describes the format for numerical values which are returned when the command is interrogated. The format value represents the number of digits before and after the decimal point.

Resetting the Controller to Factory Default

When a master reset occurs, the controller will always 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.

For example, the command KD is used to set the Derivative Constant for each axis. The default value for the derivative constant is 64. If this parameter is not set by using the command, KD, the controller will automatically set this value to 64 for each axis. If the Derivative Constant is changed but not saved in non-volatile memory, the default value of 64 will be used if the controller is reset or upon power up of the controller. If this value is set and saved in non-volatile memory, it will be restored upon reset until a master reset is given to the controller.

Trippoints

The controller provides several “trippoints” commands that can be used to wait for a condition to be met. Such conditions include: the completion of a specific motion, waiting for a certain position to be reached, or simply waiting for a certain amount of time to elapse.

When a program is executing on the controller, each program line is executed sequentially. However, 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 the main thread, is halted.

Since trippoint commands are used as program flow instructions during a running program, they should not be implemented directly from the command line of the terminal. Sending a trippoint command directly from the command line might cause an interruption in communications between the host PC and the controller until the trippoint is cleared.

The following table lists the available trippoint commands:

AD	after distance
AI	after input
AM	after move
AP	after absolute position
AR	after relative position
AS	at speed
AT	at time relative to a reference time
MC	motion complete and “in position”
MF	after motion forward
MR	after motion reverse
WC	wait for contour data to complete
WT	wait for time

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AB

FUNCTION: Abort

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	---
Default Format	---

OPERAND USAGE:

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

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
#A	Label - Start of program
JG 20000	Specify jog speed on X-axis
BGX	Begin jog on X-axis
WT 5000	Wait 5000 msec
AB1	Stop motion without aborting program
WT 5000	Wait 5000 milliseconds
SH	Servo Here
JP #A	Jump to Label A
EN	End of the routine

Hint: *Remember to use the parameter 1 following AB if you only want the motion to be aborted. Otherwise, your application program will also be aborted.*

AC

FUNCTION: Acceleration

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 numbers in the range 1024 to 67107840. 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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	25600
Default Format	8.0

OPERAND USAGE:

_ACx contains the value of acceleration for the specified axis.

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/sec^2, the C axis to 300000 counts/sec^2, and the D-axis to 400000 count/sec^2.
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

FUNCTION: After Distance

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.

If the direction of the motion is reversed when in position tracking (PT) or job (JG) mode, 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.

AD can only be used when there's commanded motion on the axis.

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

ARGUMENTS: AD n,n,n,n,n,n,n,n or ADA=n where

n is an unsigned integers in the range 0 to 2147483647 decimal.

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

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

RELATED COMMANDS:

"AP"	After position trip point
"AR"	After relative distance trip point
"MF"	Motion Forward trip point
"MR"	Motion Reverse trip point

EXAMPLES:

#A;DP0,0,0,0	Begin Program
PR 10000,20000,30000,40000	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
AD ,,15000	After C reaches 15000
MG "Halfway to C";TPC	Send message
AD ,,,20000	After D reaches 20000
MG "Halfway to D";TPD	Send message
EN	End Program

Hint: *The AD command is accurate to the number of counts that occur in 2 msec. Multiply your speed by 2 msec to obtain the maximum position error in counts. Remember AD measures incremental distance from start of move on one axis.*

AF

FUNCTION: Analog Feedback

DESCRIPTION:

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 where an input voltage of 5 volts is decoded as a position of 4095 counts and a voltage of 0 volts corresponds to a position of 0 counts.

When using the analog feedback mode analog input 1 is used.

ARGUMENTS: AF n,n,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

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0,0,0,0
Default Format	-

OPERAND USAGE:

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

RELATED COMMANDS:

"MT"	Motor Type
"CE"	Configure Encoder

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

FUNCTION: Amplifier Gain

DESCRIPTION:

The AG command sets the amplifier current/voltage gain to one of three levels. 0 sets the lowest ratio while 2 sets the highest ratio. The controller must be in the motor off state.

ARGUMENTS: AG n,n,n,n,n,n,n,n where

n = 0 0.4 A/V
n = 1 0.7 A/V
n = 2 1.0 A/V
n = ? Returns the value of the amplifier gain

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1, 1, 1, 1, 1, 1, 1, 1
Default Format	-

RELATED COMMANDS:

"TA"	Tell Amplifier
"AW"	Amplifier Bandwidth
"BS"	Brushless Setup

EXAMPLE:

MO	Turn motor off
AG2,1	Sets the highest amplifier gain for A axis and medium gain for B axis

AI

FUNCTION: After Input

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.

ARGUMENTS: AI +/-n where

n is an integer between 1 and 82 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:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

RELATED COMMANDS:

@IN[n]	Function to read input 1 through 82
"II"	Input interrupt
#ININT	Label for input interrupt

EXAMPLES:

#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
BG A	Begin motion
EN	End Program

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.*

AL

FUNCTION: Arm Latch

DESCRIPTION:

The AL command enables the latching 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 digital input 1.

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.

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. The value of n is used to specify main encoder for the specified axis to be latched

n can be SA,SB,SC,SD,SE,SF,SG or SH. The value of n is used to specify the auxiliary encoder for the specified axis to be latched

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.0

OPERAND USAGE:

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

RELATED COMMANDS:

"RL"	Report Latch

EXAMPLES:

#START	Start program
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
EN	End of program

AM

FUNCTION: After Move

DESCRIPTION:

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.

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:

While Moving	Yes
In a Program	Yes
Command Line	Yes*

DEFAULTS:

Default Value	0
Default Format	1.0

*Invalid from command line on Ethernet controllers

RELATED COMMANDS:

"BG"	_BGn contains a 0 if motion complete
"MC (Binary C9)"	Motion Complete

EXAMPLES:

#MOVE	Program 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

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 motion is complete. AM tests for profile completion. The actual motor may still be moving. To halt program sequence until the actual motion is complete, 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).*

AO

FUNCTION: Analog Out

DESCRIPTION:

The AO command sets the analog output voltage of either the CDS-3310 local analog output or of a Modbus Devices connected via Ethernet.

ARGUMENTS: AO m, n where

m is the I/O number calculated using the following equations:

m = 1 for the local analog output (J3 pin 19)

m = (HandleNum * 100) + Bitnum for a distributed slave controller

m = (HandleNum * 1000) + Bitnum for an IOC-7007

m = (SlaveAddress*10000) + (HandleNum*1000) + ((Module-1)*4) + (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 F.

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:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	---
Default Format	---

OPERAND USAGE:

_AO contains the value of the analog output.

RELATED COMMANDS:

"SB"	Set Bit
“CB"	Clear Bit

EXAMPLES:

AO 1, 5

AP

FUNCTION: After Absolute Position

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.
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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	---
Default Format	---

RELATED COMMANDS:

"AD"	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 msec. Multiply the speed by 2 msec to obtain the maximum error. AP tests for absolute position. Use the AD command to measure incremental distances.*

AR

FUNCTION: After Relative Distance

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.
2. The motion profiling on the axis is complete.

If the direction of the motion is reversed when in position tracking (PT) or job (JG) mode, 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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"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.*

AS

FUNCTION: At Speed

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

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

EXAMPLES:

#SPEED	Program A
PR 100000	Specify position
SP 10000	Specify speed
BG A	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.*

AT

FUNCTION: At Time

DESCRIPTION:

The AT command is a trippoint 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.

ARGUMENTS: AT n where

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 trippoint is satisfied.

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-

EXAMPLES:

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

FUNCTION: Set amplifier current loop

DESCRIPTION:

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

ARGUMENTS: AU n,n,n,n,n,n,n,n where
n = 0 for normal current loop gain
= 1 for higher current loop gain

USAGE:		**DEFAULTS:**	
While Moving	No	Default Value	0
In a Program	Yes	Default Format	-
Command Line	Yes		

RELATED COMMANDS:

"TA"	Tell Amplifier
"AG"	Amplifier Gain
"BS"	Brushless Setup
"AW"	Amplifier Bandwidth

EXAMPLE:

AU1,0	Sets X-axis to higher loop gain and Y-axis to normal loop gain
AUY=?	Query Y-axis current loop gain
:0	Y-axis normal current loop gain

Note: *Unless the motor has more than 5 mH of inductance with a 24V supply, or 10 mH of inductance with a 48 volts supply, the normal current loop bandwidth option should be chosen.*

AW

FUNCTION: Amplifier Bandwidth

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.

ARGUMENTS: AWx = v, l, n where
x = Axis designator
v = Drive voltage in Volts
l = Motor inductance in millihenries
n = optional current loop gain setting (1 or 0)

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0, 0, 0
Default Format	--

RELATED COMMANDS:

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

EXAMPLE:

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

BG

FUNCTION: Begin

DESCRIPTION:

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

ARGUMENTS: BG nnnnnnnnnn where

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-

OPERAND USAGE:

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

RELATED COMMANDS:

"AM"	After motion complete
"ST"	Stop Motion

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=_BGB	Assign a 1 to BSTATE if the B-axis is performing a move

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.*

BK

FUNCTION: Breakpoint

DESCRIPTION:

The BK command is 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: BK n,m where

n is an integer in the range 0 to 999 which is the line number to stop at. n must be a valid line number in the chosen thread.

m is an integer in the range 0 to 7. The thread.

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value of m	0

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

RELATED COMMANDS:

"SL"	Single Step
"TR"	Trace

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

BL

FUNCTION: Reverse Software Limit

DESCRIPTION:

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 and a program is executing. See User's Manual, Automatic Subroutine.

ARGUMENTS: BL n,n,n,n,n,n,n,n or BLA=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 = -214783648 Turns off the reverse limit.

n = ? Returns the reverse software limit for the specified axes.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-214783648
Default Format	PF

OPERAND USAGE:

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

RELATED COMMANDS:

"FL"	Forward Limit
"PF"	Position Formatting

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.*

BN

FUNCTION: Burn

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	DC	IA	NZ	TK
AF	DV	IL	OE	TL
AG	EO	IT	OF	TM
AU	ER	KD	OP	TR
BL	FA	KI	OS	VF
BR	FL	KP	PF	
BW	FV	LZ	PL	
CE	GA	MO	PT	
CN	GM	MT	SB	
CO	GR	NB	SM	
CW	HA	NF	SP	

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

OPERAND USAGE:

_BN contains the serial number of the controller.

RELATED COMMANDS:

"BP"	Burn Program
"BV"	Burn Variables

EXAMPLES:

KD 100	Set damping term for A axis
KP 10	Set proportional gain term for A axis
KI 1	Set integral gain term for A axis
AC 200000	Set acceleration
DC 150000	Set deceleration rate
SP 10000	Set speed
MT -1	Set motor type for A axis to be type '-1', reversed polarity servo motor
MO	Turn motor off
BN	Burn parameters; may take up to 15 seconds

BP

FUNCTION: Burn Program

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

USAGE:

While Moving	No
In a Program	No
Not in a Program	Yes

DEFAULTS:

Default Value	---

RELATED COMMANDS:

"BN"	Burn Parameters
"BV"	Burn Variable

Note: 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.

BR

FUNCTION: Brush Axis

DESCRIPTION:

The BR command is used to enable which axis will be set as brush-type servo. The hall error bits are not set in the TA value when an axis is configured as brush-type. The hall inputs are available for general use via the QH command.

ARGUMENTS: BR n,n,n,n,n,n,n,n where
n = 0 Brushless servo axis
n = 1 Brush-type servo axis
n = ? Returns the value of the axis

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0, 0, 0, 0, 0, 0, 0, 0
Default Format	--

RELATED COMMANDS:

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

EXAMPLE:

BR1,0,0	Sets X-axis to brush-type, Y and Z to brushless

BS

FUNCTION: Brushless Setup

DESCRIPTION:

The command BS tests the wiring of a brushless motor. 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. 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 set up the BS command does not have to be re-issued.

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.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value of V	0
Default Value of n	200

EXAMPLES:

BSA = 2,900	Apply set up test to A axis with 2 volts for 900 millisecond on each step.

Note 1: *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.*

Note 2: *The BS command performs an algorithm that verifies the correct motor phase wiring. If incorrect, the command will recommend the correct motor phase wiring.*

Example: BSY=

: *Wire A to terminal B, wire B to terminal A*

BV

FUNCTION: Burn Variables & Arrays

DESCRIPTION::

The BV command saves the controller variables 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

USAGE:

While Moving	Yes
In a Program	Yes
Not in a Program	Yes

DEFAULTS:

Default Value	---

OPERAND USAGE:

_BV returns the number of controller axes.

RELATED COMMANDS:

"BP" Burn Program

***Note 1**: This command will store array 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.*

BW

FUNCTION: Brake Wait

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.

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,n or BWA=n where

n specifies the brake wait time in samples. n ranges from 0 to 32000

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	

OPERAND USAGE:

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

RELATED COMMANDS:

"MO"	Motor Off
"SH"	Servo Here

EXAMPLES:

BW100	Set brake delay to 100 ms (TM1000)

CB

FUNCTION: Clear Bit

DESCRIPTION:

The CB command sets the specified output bit low. CB can be used to clear the outputs of extended I/O which have been configured as outputs.

ARGUMENTS: CB n where

n is an integer corresponding to a specific output on the controller to be cleared (set to 0). The first output on the controller is denoted as output 1.

n = (HandleNum * 100) + Bitnum for a distributed slave controller

n = (HandleNum * 1000) + Bitnum for an IOC-7007

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

n = (SlaveAddress*10000) + (HandleNum*1000) + ((Module-1)*4) + (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 F.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"SB"	Set Bit
"OB"	Output Bit
"OP"	Define output port (byte-wise).

EXAMPLES:

CB 7	Clear output bit 7

CD

FUNCTION: Contour Data

DESCRIPTION:

The CD command specifies the incremental position for all 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)

ARGUMENTS: CD n,n,n,n,n,n,n,n or CDA=n where

n is an integer in the range of +/-32762.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"CM"	Contour Mode
"WC"	Wait for Contour
"DT"	Time Increment

EXAMPLES:

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
WC	Wait for complete
CD 100,200,300,400	New position data
WC	Wait for complete
DT0	Stop Contour
CD 0,0,0,0	Exit Mode

Note: The user must include a comma for each axis not present. For instance, CM CD; CD,,500,300.

CE

FUNCTION: Configure Encoder

DESCRIPTION:

The CE command configures the encoder to the quadrature type or the 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, the motor will run away. The configuration applies independently to the main axes encoders and the auxiliary encoders.

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. The values of M and N are

m =	Main encoder type	n =	Auxiliary encoder type
0	Normal quadrature	0	Normal quadrature
1	Normal pulse and direction	4	Normal pulse and direction
2	Reversed quadrature	8	Reversed quadrature
3	Reversed pulse and direction	12	Reversed pulse and direction

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	2.0

OPERAND USAGE:

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

RELATED COMMANDS:

"MT" Specify motor type

EXAMPLES:

CE 0, 3, 6, 2	Configure encoders
CE ?,?,?,?	Interrogate configuration
V = _CEA	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

FUNCTION: Configure

DESCRIPTION:

Sets the default port for unsolicited messages. By default, the controller will send unsolicited responses to the main RS-232 serial port. The CF command allows the user to send unsolicited responses to the Main Serial Port, or Handles A-H.

ARGUMENTS: CF n where

n is A thru H for Ethernet handles 1 thru 8, S for Main serial port or I is to set to the port that issues the CF command.

USAGE:

While Moving	Yes	Default Value	S
In a Program	Yes	Default Format	-----
Command Line	Yes		

OPERAND USAGE:

_CF contains the decimal value of the ASCII letter.

RELATED COMMANDS:

"CW"	Configures MSB of unsolicited messages
"WH"	What Handle
"TH"	Tell Handles

CI

FUNCTION: Configure Communication Interrupt

DESCRIPTION:

The CI command configures a program interrupt based on characters received on the serial port. 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 internal variables P1CH, P1ST, P1NM, P1CD. For more, see Operator Data Entry Mode in chapter 7 of the user manual.

ARGUMENTS: CI n, m

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

PARAMETER	EXPLANATION
m = 0	Serial port interprets Galil commands (normal)
m = 1	Operator Data Entry Mode. Serial port DOES NOT interpret Galil commands. Rather, it behaves like the AUX port on DMC-2000, 2100, and 2200 controllers.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	n = 0, m = 0
Default Format	-

RELATED COMMANDS:

"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
CI 2, 1	Interrupt on a single character received on the serial port

CM

FUNCTION: Contour Mode

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 the position increment, and the DT command specifies the time interval.

The command, CM?, can be used to check the status of the Contour Buffer. A value of 1 returned from the command CM? indicates that the Contour Buffer is full. A value of 0 indicates that the Contour Buffer is empty.

ARGUMENTS: CM nnnnnnnnnn where

n is A,B,C,D,E,F,G or any combination to specify the axis (axes) for contour mode

n = ? Returns a 1 if the contour buffer is full and 0 if the contour buffer is empty.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	2.0

OPERAND USAGE:

_CM contains a '0' if the contour buffer is empty, otherwise contains a '1'.

RELATED COMMANDS:

"CD"	Contour Data
"WC"	Wait for Contour
"DT"	Time Increment

EXAMPLES:

V=_CM;V=	Return contour buffer status
CM?	Return contour buffer status
CM AC	Specify A,C axes for Contour Mode

CN

FUNCTION: Configure

DESCRIPTION:

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

ARGUMENTS: CN m,n,o,p,q where

m,n,o are integers with values 1 or -1.

q is an integer, 0 or 1.

m =	1	Limit switches active high
	-1	Limit switches active low
n =	1	Home switch configured to drive motor in forward direction when input is high. See HM and FE commands.
	-1	Home switch configured to drive motor in reverse direction when input is high. See HM and FE commands
o =	1	Latch input is active high
	-1	Latch input is active low
p =	0	Reserved
q =	1	Abort input will not terminate program execution
	0	Abort input will terminate program execution

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-1,-1,-1,0, 0
Default Format	2.0

OPERAND USAGE:

_CN0 Contains the limit switch configuration
_CN1 Contains the home switch configuration
_CN2 Contains the latch input configuration
_CN4 Contains the configuration of program execution upon hard abort input

RELATED COMMANDS:

"AL" Arm latch

EXAMPLES:

CN 1,1	Sets limit and home switches to active high
CN,, -1	Sets input latch active low

CO

FUNCTION: Configure Extended I/O

DESCRIPTION:

The CO command configures the extended I/O (DB-28040).

The 40 extended I/O points of the controller can be configured in banks of 8. The extended I/O is denoted as bits 17-56 and banks 2-6.

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 9. The decimal value can be calculated by the following formula.

$n = n_2 + 2*n_3 + 4*n_4 + 8*n_5 + 16* n_6$

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-

OPERAND USAGE:

_CO returns the extended I/O configuration value.

RELATED COMMANDS:

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

EXAMPLES:

CO 255	Configure all points as outputs
CO 0	Configure all points as inputs
CO 1	Configures bank 2 to outputs on extended I/O

Hint: *See user manual appendix for more information on the DB-28040.*

CW

FUNCTION: Copyright information / Data Adjustment bit on/off

DESCRIPTION:

The CW command has two uses: (1) to return copyright information; (2) to set the MSB of unsolicited ASCII characters (unsolicited characters are those returned from the controller without being directly queried from the PC).

ARGUMENTS: CW n where

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	2, 0
Default Format	-----

OPERAND USAGE:

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

Note: *The CW command can cause unreadable characters to be returned by the controller. The default state of the controller CW2; however, the Galil Servo Design Kit and terminal software sets CW1 for internal usage. If the controller is reset while the Galil software is running, the CW command could be reset to the default value, and it may be necessary to re-enable CW1. The CW command status can be stored in EEPROM with BN.*

DA

FUNCTION: Deallocate the Variables & Arrays

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 de-allocation. 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[0],variable-name where

c[0] = Defined array name

variable-name = Defined variable name

* - Deallocates all the variables

*[0] - Deallocates all the arrays

DA? Returns the number of arrays available on the controller.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	------
Default Format	------

OPERAND USAGE:

_DA contains the total number of arrays available. For example, before any arrays have been defined, the operand _DA is 30. If one array is defined, the operand _DA will return 29.

RELATED COMMANDS:

"DM" Dimension Array

EXAMPLES: 'Cars' and 'Sales' are arrays and 'Total' is a variable.

DM Cars[400],Sales[50]	Dimension 2 arrays
Total=70	Assign 70 to the variable Total
DA Cars[0],Sales[0],Total	Deallocate the 2 arrays & variables
DA*[]	Deallocate all arrays
DA *,*[]	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 2 ms.*

DC

FUNCTION: Deceleration

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 67107840

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

USAGE:

While Moving	Yes*
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	256000
Default Format	8.0

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

OPERAND USAGE:

_DCn contains the deceleration rate for the specified axis.

RELATED COMMANDS:

"AC"	Acceleration
"PR"	Position Relative
“PA”	Position Absolute
“SP"	Speed
"JG"	Jog

EXAMPLES:

PR 10000	Specify position
AC 2000000	Specify acceleration rate
DC 1000000	Specify deceleration rate
SP 5000	Specify slew speed
BG	Begin motion

Note: *The DC command may be changed during the move in JG move, but not in PR or PA move.*

DE

FUNCTION: Dual (Auxiliary) Encoder Position

DESCRIPTION:

The DE command defines the position of the auxiliary encoders.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0,0,0,0
Default Format	PF

OPERAND USAGE:

_DEn contains the current position of the specified auxiliary encoder.

RELATED COMMANDS:

"DP"	Define main encoder position
"TD"	Tell Dual Encoder position

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.*

DL

FUNCTION: Download

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.

Using Galil DOS Terminal 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: 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.

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	---
Default Format	---

OPERAND USAGE:

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

RELATED COMMANDS:

"UL" Upload

EXAMPLES:

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

DM

FUNCTION: Dimension

DESCRIPTION:

The DM command defines a single dimensional array with a name and the number of elements in the array. 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 name of up to eight characters, starting with an uppercase alphabetic character. n specifies the size of the array (number of array elements).

n = ? Returns the number of array elements available.

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	---
In a Program	Yes	Default Format	---
Command Line	Yes		

OPERAND USAGE:

_DM contains the available array space. For example, before any arrays have been defined, the operand _DM will return 8000. If an array of 100 elements is defined, the operand _DM will return 7900.

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

DP

FUNCTION: Define Position

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.

ARGUMENTS: DP n,n,n,n,n,n,n,n or DPA=n where

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

n = ? Returns the current position of the motor for the specified axes.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0,0,0,0
Default Format	PF

OPERAND USAGE:

_DPn contains the current position of the specified axis.

RELATED COMMANDS:

"PF" Position Formatting

EXAMPLES:

: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
:DP ,-50000	Sets the current position of B-axis to -50000. The B,C and D axes remain unchanged.
:DP ?,?,?,?	Interrogate the position of A,B,C and D axis.
0, -50000, 200, 400	Returns all the motor positions
:DP ?	Interrogate the position of A axis
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.*

DT

FUNCTION: Delta Time

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 is sent. 2^n milliseconds is the time interval. (Followed by CD0 command).

ARGUMENTS: DT n where

n is an integer in the range 0 to 8.

n=0 terminates the Contour Mode.

n=1 through 8 specifies the time interval of 2^n samples.

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:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.0

OPERAND USAGE:

_DT contains the value for the time interval for Contour Mode

RELATED COMMANDS:

"CM"	Contour Mode
"CD"	Contour Data
"WC"	Wait for next data

EXAMPLES:

DT 4	Specifies time interval to be 16 msec
DT 7	Specifies time interval to be 128 msec
#CONTOUR	Begin
CMAB	Enter Contour Mode
DT 4	Set time interval
CD 1000,2000	Specify data
WC	Wait for contour
CD 2000,4000	New data
WC	Wait
DT0	Stop contour
CD0	Exit Contour Mode
EN	End

DV

FUNCTION: Dual Velocity (Dual Loop)

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.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-----

OPERAND USAGE:

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

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.*

EA

FUNCTION: Choose ECAM master

DESCRIPTION:

The EA command selects the master axis for the electronic cam mode. The controller defaults to setting the auxiliary encoder as the master axis.

ARGUMENTS: EA x where

x is the axis specified as X or N. X designates the auxiliary encoder as the master, while N designates the imaginary axis N as the master.

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Controller Usage	**DMC-1425**	

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:

EAN	Select N as a master for ECAM

EB

FUNCTION: Enable ECAM

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 cam mode and n = 0 stops cam mode.

EB? Returns a 0 if ECAM is disabled and 1 if enable.

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Can be Interrogated	Yes	
Used as an Operand	Yes	
Controller Usage	**ALL**	

OPERAND USAGE:

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

RELATED COMMANDS:

EM	Specify Ecam Cycle
EP	CAM table intervals & starting point

EXAMPLES:

EB1	Starts ECAM mode
EB0	Stops ECAM mode
B = _EB	Assigns status of cam mode to variable “B”

EC

FUNCTION: ECAM Counter

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.

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Controller Usage	**ALL**	

OPERAND USAGE:

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

RELATED COMMANDS:

EA	Choose ECAM master
EB	Enable ECAM
EG	Engage ECAM
	Specify ECAM cycle
EP	Specify ECAM table intervals & staring 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

ED

FUNCTION: Edit

DESCRIPTION:

Using Galil DOS Terminal 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

Using Galil Windows Terminal Software: The ED command causes the Windows terminal software to open the terminal editor.

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).

EXAMPLES:

```
ED
000 #START
001 PR 2000
002 BGA
003 slkj                          Bad line
004 EN
005 #CMDERR                       Routine which occurs upon a command error
006 V=_ED
007 MG "An error has occurred" {n}
008 MG "In line", V{F3.0}
009 ST
010 ZS0
011 EN
XQ_ED2                            Retry instruction that included error
XQ_ED3                            Execute next instruction
```

Hint: *Remember to quit the Edit Mode prior to executing or listing a program.*

EG

FUNCTION: ECAM go (engage)

DESCRIPTION:

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

ARGUMENTS: EG n where

n is the master position at which the slave axis must be engaged.

"?" returns 1 if specified axis is engaged and 0 if disengaged

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Can be Interrogated	No	
Used as an Operand	Yes	
Controller Usage	**ALL**	

OPERAND USAGE:

_EG contains ECAM status . 0 = axis is not engaged, 1 = axis is engaged.

RELATED COMMANDS:

EB	Enable Ecam
EQ	Ecam quit

EXAMPLES:

EG 700	Engages axes at master position 700.
MG_EG	Return the status of the 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*.

ELSE

FUNCTION: Else function for use with IF conditional statement

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value
Default Format

RELATED COMMANDS:

"ENDIF"	End of IF conditional Statement

EXAMPLES:

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

EM

FUNCTION: Cam cycles

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 slave, 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: EM n,m where

n - change in slave axis, between 1 and 2147483647

m - change in master encoder, between 1 and 8388607.

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Can be Interrogated	No	
Used as an Operand	Yes	
Controller Usage	**ALL**	

OPERAND USAGE:

_EM contains the cam cycle modulus of the motor..

RELATED COMMANDS:

EP	CAM table intervals & starting point
ET	Electronic CAM table
EB	Enable Ecam

EXAMPLES:

EM 0,2000	Define the changes in the motor to be 0. Define master cycle as 2000.
V = _EM	Assigns motor cam cycle distance to variable “V”

EN

FUNCTION: End

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.

The EN command is used to end the automatic subroutines #MCTIME, #CMDERR, and #COMINT. When the EN command is used to terminate the #COMINT communications interrupt subroutine, there are two arguments; the first determines whether trippoints will be restored upon completion of the subroutine and the second determines whether the communication interrupt will be re-enabled.

ARGUMENTS: EN m, n where

m = 0: Return from subroutine without restoring trippoint

m = 1: Return from subroutine and restore trippoint

n = 0: Return from #COMINT without restoring interrupt

n = 1: Return from communications interrupt #COMINT and restore interrupt

Note1: The default values for the arguments are 0. For example EN,1 and EN0,1 have the same effect.

Note2: 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 by continue to wait for the trippoint, or clear the trippoint and continue executing the program at the command just after the trippoint. .

Note3: 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:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	m=0, n=0
Default Format	

RELATED COMMANDS:

"RE"	Return from error subroutine
"RI"	Return from interrupt subroutine

EXAMPLES:

#A	Program A
PR 500	Move A axis forward 500 counts
BGA	Pause the program until the A axis completes the motion
AMA	Move A axis forward 1000 counts
PR 1000	Set another Position Relative move
BGA	Begin motion
EN	End of Program

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

ENDIF

FUNCTION: End of IF conditional statement

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: ENDIF

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

RELATED COMMANDS:

IK"IF"	Command to begin IF conditional statement
"EG " Optional command to be used only after IF command	
"JP"	Jump command

"JS" Jump to subroutine command**EXAMPLES:**

IF (@IN[1]=0)	IF conditional statement based on input 1
MG " INPUT 1 IS ACTIVE"	Message to be executed if "IF" conditional is true
ENDIF	End of conditional statement

EO

FUNCTION: Echo

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 where

n = 0 0 turns echo off

n = 1 1 turns echo on.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.0

OPERAND USAGE:

_EO contains the value of the echo setting

EXAMPLES:

EO 0	Turns echo off
EO 1	Turns echo on

EP

FUNCTION: Cam table master interval and phase shift

DESCRIPTION:

The EP command defines the ECAM table master interval and phase shift. The interval m is the difference in master position between table entries. The phase shift n instantaneously moves the graph of slave position versus master position left (negative) or right (positive) and is used to make on-the-fly corrections to the slaves. Up to 257 points may be specified.

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. m can be changed while ECAM is running.

USAGE:

While Moving	Yes	Default Value	256,0
In a Program	Yes	Default Format	
Command Line	Yes		
Can be Interrogated	Yes		
Used as an Operand	Yes (m only)		
Controller Usage	**ALL**		

OPERAND USAGE:

_EP contains the value of the interval m.

RELATED COMMANDS:

EB	Enable Ecam
EG	Engage Ecam
EM	Specify Ecam Cycle
EQ	Ecam quit
ET	Electronic CAM table

EXAMPLES:

EP 20	Sets the cam master points to 0,20,40 . . .
D =_EP	Set the variable D equal to the ECAM internal master interval
EP,100	Phase shift all slaves by 100 master counts

EQ

FUNCTION: ECAM quit (disengage)

DESCRIPTION:

The EQ command disengages an electronic cam slave axis at the specified master position. If a value is specified outside of the master's range, the slave will disengage immediately.

ARGUMENTS: EQ n where

n is the master position at which the axis is to be disengaged.

"?" contains a 1 if engage command issued and slave is waiting to engage, 2 if disengage command issued and slave is waiting to disengage, and 0 if ECAM engaged or disengaged.

USAGE:

While Moving	Yes	Default Value	--
In a Program	Yes	Default Format	--
Command Line	Yes		
Can be Interrogated	Yes		
Used as an Operand	Yes		
Controller Usage	**ALL**		

OPERAND USAGE:

_EQ contains 1 if engage command issued and slave is waiting to engage, 2 if disengage command issued and slave is waiting to disengage, and 0 if ECAM engaged or disengaged.

RELATED COMMANDS:

EB	Enable Ecam
EG	Engage Ecam
EM	Specify Ecam Cycle
EP	CAM table intervals & starting point
ET	Electronic CAM table

EXAMPLES:

EQ 300	Disengages the motor at master position 300.

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.*

ER

FUNCTION: Error Limit

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). If the Off On Error (OE1) command is active, the motors will be disabled.

ARGUMENTS: ER n,n,n,n,n,n,n,n or ERA=n where

n is an unsigned numbers in the range 1 to 32767 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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	16384
Default Format	PF

OPERAND USAGE:

_ERn contains the value of the Error limit for the specified axis.

RELATED COMMANDS:

"OE"	Off-On Error
#POSERR	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.*

ET

FUNCTION: Electronic cam table

DESCRIPTION:

The ET command sets the ECAM table entries for the slave axis. The values of the master are not required. The slave entry (n) is the position of the slave when the master is at the point (n ∗ i) + o, where i is the interval and o is the offset as determined by the EP command.

ARGUMENTS: ET [n] = m where

n is an integer between 0 and 256

m is an integer in the range between -2,147,438,648, and 2,147,438,647

USAGE:

While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	
Can be Interrogated	No	
Used as an Operand	No	
Controller Usage	**ALL**	

RELATED COMMANDS:

EB	Enable Ecam
EG	Engage Ecam
EM	Specify Ecam Cycle
EP	Specify Ecam intervals and starting point
EQ	Ecam quit

EXAMPLES:

ET [7] = 1000	Specifies the position of the slave that must be synchronized with the eighth increment of the master.

FA

FUNCTION: Acceleration Feedforward

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.

Acceleration Feedforward Bias = $FA \cdot AC \cdot 1.5 \cdot 10^{-7}$

Deceleration Feedforward Bias = $FA \cdot DC \cdot 1.5 \cdot 10^{-7}$

The Feedforward Bias product is limited to 10 Volts. FA operates when commanding motion with PA, PR and JG.

ARGUMENTS: FA n,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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	4.2

OPERAND USAGE:

_FAn contains the value of the feedforward acceleration coefficient for the specified axis.

RELATED COMMANDS:

"FV" Velocity feedforward

EXAMPLES:

AC 500000,1000000	Set feedforward coefficient to 10 for the A-axis
FA 10,15	and 15 for the B-axis. The effective bias will be 0.75V for A and 2.25V for B.
FA ?,?	Return A and B values
10.00, 15.00	

Note: *If the feedforward coefficient is changed during a move, then the change will not take effect until the next move.*

FE

FUNCTION: Find Edge

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.

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.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value
Default Format

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	

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.*

FI

FUNCTION: Find Index

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. When the transition is detected, motion stops and the position is defined as zero. To improve accuracy, the speed during the search should be specified as 500 counts/s or less. The FI command is useful in custom homing sequences. The direction of motion is specified by the sign of the JG command.

ARGUMENTS: FI nnnnnnnnnn 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.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	
Default Format	

RELATED COMMANDS:

"FE"	Find Edge
"HM"	Home
"BG"	Begin
"AC"	Acceleration Rate
"DC"	Deceleration Rate
"SP"	Search Speed

EXAMPLES:

#HOME	Home Routine
JG 500	Set speed and forward direction
FIA	Find index
BGA	Begin motion
AMA	After motion
MG "FOUND INDEX"	

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.*

FL

FUNCTION: Forward Software Limit

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 A+1, B+1, C+1, D+1. The forward limit is disabled at 2147483647. The units are in counts.

When the forward software limit is activated, the automatic subroutine #LIMSWI will be executed if it is included in the program and a program is executing. See User's Manual, Automatic Subroutine.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	2147483647
Default Format	PF

OPERAND USAGE:

_FLn contains the value of the forward software limit for the specified axis.

RELATED COMMANDS:

"BL"	Reverse Limit
"PF"	Position Formatting

EXAMPLES:

FL 150000	Set forward limit to 150000 counts on the A-axis
#TEST	Test Program
AC 1000000	Acceleration Rate
DC 1000000	Deceleration Rate
FL 15000	Forward Limit
JG 5000	Jog Forward
BGA	Begin
AMA	After Limit
TPA	Tell Position
EN	End

Hint: *Galil controllers also provide hardware limits.*

FV

FUNCTION: Velocity Feedforward

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 = $1.22 \cdot 10^{-6} \cdot FV \cdot$ Velocity [in cts/s].

FV operates when commanding motion with PA, PR, JG, 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,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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	3.0

OPERAND USAGE:

_FVn contains the feedforward velocity for the specified axis.

RELATED COMMANDS:

"FA" Acceleration feedforward

EXAMPLES:

:FV 10,20	Set feedforward coefficients to 10 and 20 for A and B respectively
:JG 30000,80000	This produces 0.366 volts for A and 1.95 volts for B.
:FV ?,?	Return the A and B values.
10, 20	

GA

FUNCTION: Master Axis for Gearing

DESCRIPTION:

The GA command specifies the auxiliary encoder as the master for electronic gearing. The slave ratio is specified with the GR command and gearing is turned off by the command GR0.

ARGUMENTS: GA n or GAA=n where

n can be DA or N. The value of n is used to set the auxiliary encoder axis as the gearing master and N represents the virtual axis.

n=? returns the GA setting

USAGE:		**DEFAULTS:**
While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	

RELATED COMMANDS:

"GR" Gear Ratio

EXAMPLES:

#GEAR	Gear program
GADA	Specify auxiliary encoder as master
GR 1	Specify ratio

GD

FUNCTION: Gear Distance

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 where

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:		**DEFAULTS:**	
While Moving	Yes	Default Value	0
In a Program	Yes	Default Format	1.0
Command Line	Yes		

RELATED COMMANDS:

"_GP"	Gearing Phase Differential
"GR"	Gear Ratio
"GA"	Gear Axis

EXAMPLES:

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 job speed to 5000 cts/sec
BGX	Begin motion on the X axis
ASX	Wait until X axis reaches the set speed of 5000 cts/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 the master specified with the GD command above.

_GP*

FUNCTION: Gearing Phase Differential Operand (Keyword)

DESCRIPTION:

The _GP operand contains the value of the "phase differential"[1] 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.

[1]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.

RELATED COMMANDS:

"GR"	Gear Ratio
"GA"	Gear Axis

EXAMPLES: The following example illustrates how _GP can be used to achieve exact synchronization.

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.

GR

FUNCTION: Gear Ratio

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.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	3.4

OPERAND USAGE:

_GRn contains the value of the gear ratio for the specified axis.

RELATED COMMANDS:

"GA" Master Axis

EXAMPLES:

```
#GEAR
MOB              Turn off servo to B motor
GAB,,B           Specify master axis as B
GR .25,,-5       Specify A and C gear ratios
EN               End program
```

Now when the B motor is rotated by hand, the A will rotate at 1/4th the speed and C will rotate 5 times the speed in the opposite direction.

HA

FUNCTION: Handle Assignment

DESCRIPTION:

The HA command establishes the axis order for the slave controllers in a distributed system. This command must be executed in order for the HC command to configure and assign the slaves with the proper IP addresses within the distributed system. The arguments given to the command are the serial numbers of the slave controllers in the system. If you do not know the serial numbers of the controllers in your system, you may query them by issuing the HQ command to the master controller.

ARGUMENTS: HA n,n,n,n,n,n,n where

n represents the serial numbers of the slave controllers in the system. The system may have a total of 8 axes.

USAGE:		**DEFAULTS:**
While Moving	Yes	
In a Program	Yes	
Command Line	Yes	

OPERAND USAGE:

_HAn contains the serial number of the appropriate slave where n may range from 0 to 6.

RELATED COMMANDS:

"IA"	Internet Address
"HC"	Handle Configuration
"HQ"	Handle Query

EXAMPLES:

HA 5522,5533	The controller with serial number 5522 will be the Y axis and the controller with serial number 5533 will be the Z axis.

HC

FUNCTION: Handle Configuration

DESCRIPTION:

The HC command configures and establishes communications for a master/slave system. The command is executed on the master controller and addresses all slaves in the system. After the HC command is initiated, the master responds to the slave BOOTP requests and assigns corresponding IP addresses in the order assigned by the HA command. The master then opens handles and initiates the slave update packets.

The IP address for the master controller must be established with the IA command or DMCNet software prior to the HC command being issued. The slave controllers should not be assigned IP addresses (or their addresses must be assigned as discussed in the user manual).

ARGUMENTS: HCa,b,c where

a is the total number of axes in the system

b is the slave update interval in milliseconds.

c is the communication protocol for the slave communications

1 = UDP (1 handle used)

2 = TCP/IP (2 handles used)

3 = TCP/IP used for Command Handle, UDP used for slave update Handle

Note: If modes 2 or 3 are used, a maximum of 4 slaves is allowed

HC? Returns the present setting of the HC command

USAGE:		**DEFAULTS:**
While Moving	Yes	
In a Program	Yes	
Command Line	Yes	

OPERAND USAGE:

_HC contains a 1 if the handle configuration is in progress

contains a 2 if the handle configuration has completed successfully

contains a 0 if the handle configuration failed or has not been issued

RELATED COMMANDS:

"IA"	Internet Address
"HA"	Handle Assignment
"HQ"	Handle Query

EXAMPLES:

#AUTO	program that will automatically run when controller is powered up
HA 5522,5533	The controller with serial number 5522 will Y and the controller with serial number 5533 will be Z.
HC 3,250, 2	configures a 3 axis system with a 250 msec update rate
#LOOP;JP#LOOP,_HC<>2	wait for successful connection before continuing execution of code.

***Hint**: Use a #LOOP; JP#LOOP,_HC<>2 when issuing the HC command in a program to allow enough time for slaves to be configured before executing any other commands.*

HM

FUNCTION: Home

DESCRIPTION:

The HM command performs a three-stage homing sequence.

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. When the transition is detected, the motor is stopped instantaneously..

At the third stage, the motor slowly moves forward until it detects an index pulse from the encoder. It stops at this point and defines it as position 0.

USAGE:		**DEFAULTS:**
While Moving	No	Default Value
In a Program	Yes	Default Format
Command Line	Yes	

OPERAND USAGE:

_HMn contains the state of the home switch for the specified axis

RELATED COMMANDS:

"CN"	Configure Home
"FI"	Find Index Only
"FE"	Find Home Only

EXAMPLES:

HM	Set Homing Mode for all axes
BG	Home all axes
BGA	Home only the A-axis
BGB	Home only the B-axis
BGC	Home only the C-axis
BGD	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.*

HQ

FUNCTION: Handle Query

DESCRIPTION:

The HQ command queries the network for controllers that are issuing BOOTP packets and those assigned valid slave IP addresses. Only motion controllers without IP addresses will be issuing BOOTP packets. To see the results of the command, issue the HQ? after the command has completed executing. It may be necessary to wait 5-10 seconds for HQ to complete. This command must be issued to the master controller.

The IP address for the master controller must be established with the IA command or DMCNet software prior to the HQ command being issued.

ARGUMENTS: HQ

HQ? returns the controllers found without IP addresses (or with valid slave IP addresses) in the format a,b,c where

a = controller type 1 for motion controllers and 255 for the IOC-7007

b = number of motion axes available

c = the serial number of the controller

If the HQ command has not completed execution, HQ? returns "1"

USAGE:		**DEFAULTS:**
While Moving	Yes	
In a Program	Yes	
Command Line	Yes	

RELATED COMMANDS:

"IA"	Internet Address
"HC"	Handle Configuration
"HA"	Handle Assignment

EXAMPLES:

HQ	Queries the network for controllers without IP addresses issuing Boot-P packets.
HQ?	Returns the results of the HQ command. The results contain serial numbers along with the number of axes available on each controller. It may be required to wait 5-10 seconds for the HQ process to complete.

HS

FUNCTION: Handle Assignment Switch

DESCRIPTION:

The HS command is used to switch the handle assignments between two handles. Handles are assigned by the controller when the handles are opened with the HC command, or are assigned explicitly with the IH command. Should those assignments need modifications, the HS command allows the handles to be reassigned.

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:

While Moving	Yes	Default Value	-----
In a Program	Yes	Default Format	-----
Command Line	Yes		

RELATED COMMANDS:

"IH" Internet 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.

HW

FUNCTION: Handle response wait

DESCRIPTION:

This command is used to set the master to wait on responses from the slave for each command sent. With this command enabled, the master controller will wait until the slave responds to a command before sending the colon or ? to the host. If an error is generated on the slaves, the master will indicate the error with a ? to the host. With this command disabled, the master controller will immediately acknowledge a command sent to the slave and will not wait for the slave to respond to the command.

If an error is generated on a slave while in the HW1 mode, the master will respond with a "?". Issuing the TC on the master will respond with the error code from the slave.

Issuing TCA through TCH will respond with the text of the error from the slave on a specified handle.

_TCA through _TCH will respond with the error code from the slave on a specified handle.

ARGUMENTS: HWn where

n = 0 turns handle response wait off

n = 1 turns handle response wait on

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1
Default Format	--

OPERAND USAGE:

_HW contains the current value of the handle response wait parameter.

EXAMPLES:

HW1	Turn on handle response wait
HW0	Turn off handle response wait

HX

FUNCTION: Halt Execution

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	n = 0
Default Format	

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

RELATED COMMANDS:

"XQ"	Execute program
"ST"	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

FUNCTION: IP Address

DESCRIPTION:

The IA command assigns the controller with an IP address.

The IA command may also be used to specify the time out value. This is only applicable when using the TCP/IP protocol.

The IA command can only be used via RS-232. Since it assigns an IP address to the controller, communication with the controller via internet cannot be accomplished until after the address has been assigned.

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. (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

USAGE:

While Moving	No
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	n = 0, t=250
Default Format	

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 5. 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 auto negotiation Ethernet speed of 10 for 10 Base T and 100 for 100 Base T

RELATED COMMANDS:

"IH"	Internet Handle
"SM"	Subnet Mask

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

IF

FUNCTION: IF conditional statement

DESCRIPTION:

The IF command is used in conjunction with an ENDIF command to form an IF conditional statement. The arguments are 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.

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

Bit wise operators | and & can be used to evaluate multiple conditions.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"EG "	
Optional command to be used only after IF command	"ENDIF"

End of IF conditional Statement**EXAMPLES:**

IF (_TEA<1000)	IF conditional statement based on A motor position
MG "Motor is within 1000 counts of zero"	Message to be executed if “IF” conditional statement is true
ENDIF	End of IF conditional statement

IH

FUNCTION: Open Internet Handle

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.

Each controller may have 8 handles open at any given time. They are designated by the letters A through H. 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 controller will specify the port value as 1000.

ARGUMENTS: IHh= ip0,ip1,ip2,ip3 <p >q **or** IHh=n <p >q **or** IHh= >r where

h is the handle, specified as A,B,C,D,E, F, G, or H

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 2147483648. This value is the 32 bit IP address and can be used instead of specifying the 4 address fields.

IHS => r closes the handle that sent the command; where r = -1 for UDP/IP, or r = -2 for TCP/IP.

IHT => r closes all handles except for the one sending the command; where r = -1 UDP, or r = -2 TCP.

<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

>r specifies that the connection be terminated and the handle be freed, where r is -1 for UDP and -2 for TCP/IP

"?" returns the IP address as 4 1-byte numbers

OPERAND USAGE:

_IHh0 contains the IP address as a 32 bit number

_IHh1 contains the slave port number

_IHh2 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

_IHh3 contains a 0 if the ARP was successful

contains a 1 if it has failed or is still in progress

_IHh4 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:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-----
Default Format	-----

RELATED COMMANDS:

"IA"	Internet Address
"SA"	Send Command

EXAMPLES:

IHA=251,29,51,1	Open handle A at IP address 251.29.51.1
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.

II

FUNCTION: Input Interrupt

DESCRIPTION:

The II command enables the 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".

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	
Default Format	3.0 (mask only)

RELATED COMMANDS:

"RI"	Return from Interrupt
#ININT	Interrupt Subroutine
"AI"	Trippoint for input

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
EN	End Program

#ININT	Interrupt subroutine
STA;MG "INTERRUPT";AMA	Stop A, print message, wait for motion to complete
#CLEAR;JP#CLEAR,@IN[1]=0	Check for interrupt clear
BGA	Begin motion
RI0	Return to main program, don't re-enable trippoints

IK

FUNCTION: Block Ethernet ports

DESCRIPTION:

The IK command blocks the controller from receiving packets on Ethernet ports lower than 1000 except for ports 0, 23, 68, and 502.

ARGUMENTS: IK n 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	N/A

OPERAND USAGE:

_IK can not be used as an operand.

RELATED COMMANDS:

TH	Tell Handles
IH	Open new Ethernet Handle

EXAMPLES:

IK1	Blocks undesirable port communication
IK0	Allows all Ethernet ports to be used

IL

FUNCTION: Integrator Limit

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	9.9982
Default Format	1.4

OPERAND USAGE:

_ILn contains the value of the integrator limit for the specified axis.

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	

IN

FUNCTION: Input Variable

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.

NOTE: THE IN COMMAND WORKS ONLY WITH THE SERIAL PORT.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	-----
Default Format	PF

EXAMPLES: Operator specifies length of material to be cut in inches and speed in inches/sec (2 pitch lead screw, 2000 counts/rev encoder).

#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

IP

FUNCTION: Increment Position

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	
Default Format	7.0

RELATED COMMANDS:

"PF" Position Formatting

EXAMPLES:

IP 50	50 counts with set acceleration and speed
#CORRECT	Label
AC 100000	Set acceleration
JG 10000;BGA	Jog at 10000 counts/sec rate
WT 1000	Wait 1000 msec
IP 10	Move the motor 10 counts instantaneously
STA	Stop Motion

IT

FUNCTION: Independent Time Constant - Smoothing Function

DESCRIPTION:

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1
Default Format	1.4

OPERAND USAGE:

_ITn contains the value of the independent time constant for the specified 'n' axis.

RELATED COMMANDS:

PA	Position Absolute
PR	Position Relative

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
0.8000	

.

JG

FUNCTION: Jog

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,n or JGA=n where

n is a signed even integer in the range 0 to +/-12,000,000 decimal. The units of this are counts/second. (Use JGN=n for virtual axis)

n = ? Returns the absolute value of the jog speed for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	25000
Default Format	PF

OPERAND USAGE:

_JGn contains the absolute value of the jog speed for the specified axis.

RELATED COMMANDS:

"BG"	Begin
"ST"	Stop
"AC"	Acceleration
"DC"	Deceleration
"IP"	Increment Position
"TV"	Tell Velocity

EXAMPLES:

JG 100,500,2000,5000	Set for jog mode with a slew speed of 100 counts/sec for the A-axis, 500 counts/sec for the B-axis, 2000 counts/sec for the C-axis, and 5000 counts/sec for D-axis.
BG	Begin Motion
JG ,,-2000	Change the C-axis to slew in the negative direction at -2000 counts/sec.

Note: *JG2 is the minimum non-zero speed.*

JP

FUNCTION: Jump to Program Location

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. *Note: Each condition must be placed in parenthesis for proper evaluation by the controller.*

ARGUMENTS: JP location,condition where

location is a program line number or label

condition is a 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value
Default Format

RELATED COMMANDS:

"JS"	Jump to Subroutine
"IF"	If conditional statement
"EG "	
Else function for use with IF conditional statement	"ENDIF" End of IF conditional statement

EXAMPLES:

JP #POS1,V1<5	Jump to label #POS1 if variable V1 is less than 5
JP #A,V7*V8=0	Jump to #A if V7 times V8 equals 0
JP #B	Jump to #B (no condition)

Hint: *JP is similar to an IF, THEN command. Text to the right of the comma is the condition that must be met for a jump to occur. The destination is the specified label before the comma.*

JS

FUNCTION: Jump to Subroutine

DESCRIPTION:

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.

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.*

Note: Subroutines may be nested 16 deep in the controller.

A jump is taken if the specified condition is true. Conditions are tested with logical operators. The logical operators are:

< less than or equal to	<= less than or equal to
> greater than	>= greater than or equal to
= equal to	<> not equal

ARGUMENTS: JS destination, condition where

destination is a line number or label

condition is a conditional statement using a logical operator

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value
Default Format

RELATED COMMANDS:

"EM " End

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 (no condition)

KD

FUNCTION: Derivative Constant

DESCRIPTION:

KD designates the derivative constant in the control filter. The filter transfer function is

$D(z) = 4 \cdot KP + 4 \cdot KD(z-1)/z + KIz/2\ (z-1)$

For further details on the filter see the section Theory of Operation in the user manual.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	64
Default Format	4.2

OPERAND USAGE:

_KDn contains the value of the derivative constant for the specified axis.

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	

KI

FUNCTION: Integrator

DESCRIPTION:

The KI command sets the integral gain of the control loop. It fits in the control equation as follows:

$D(z) = 4 \cdot KP + 4 \cdot KD(z-1)/z + KI\ z/2(z-1)$

The integrator term will reduce the position error at rest to zero.

ARGUMENTS: KI n,n,n,n,n,n,n,n or KIA=n where

n is an unsigned numbers in the range 0 to 2047.875 with a resolution of 1/128.

n = ? Returns the value of the derivative constant for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	4.3

OPERAND USAGE:

_KIn contains the value of the integral gain for the specified axis.

RELATED COMMANDS:

"KP"	Proportional Constant
"KI"	Integrator
"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
7.000, 14.000, 8.000, 20.000	KI values

KP

FUNCTION: Proportional Constant

DESCRIPTION:

KP designates the proportional constant in the controller filter. The filter transfer function is

$$D(z) = 4 \cdot KP + 4 \cdot KD(z-1)/z + KI\ z/2(z-1)$$

For further details see the section Theory of Operation in the user 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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	6
Default Format	4.2

OPERAND USAGE:

_KPn contains the value of the proportional constant for the specified axis.

RELATED COMMANDS:

"KP"	Proportional Constant
"KI"	Integrator
"IL"	Integrator Limit

LA

FUNCTION: List Arrays

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"LL"	List Labels
"LS"	List Program
"LV"	List Variable

EXAMPLES:

```
: LA
CA [10]
LA [5]
NY [25]
VA [17]
```

_LF

FUNCTION: Forward Limit Switch Operand (Keyword)

DESCRIPTION:

The _LF operand contains the state of the forward limit switch for the specified axis.

The operand is specified as: _LFn where n is the specified axis.

Note: This operand is affected by the configuration of the limit switches set by the command CN:

For CN -1:

_LFn = 1 when the limit switch input is inactive*

_LFn = 0 when the limit switch input is active*

For CN 1:

_LFn = 0 when the limit switch input is inactive*

_LFn = 1 when the limit switch input is active*

* The term “active” refers to the condition when at least 1ma of current is flowing through the input circuitry. The input circuitry can be configured to sink or source current to become active. See Chapter 3 in the user manual for further details.

EXAMPLES:

MG _LF A	Display the status of the A axis forward limit switch

LL

FUNCTION: List Labels

DESCRIPTION:

The LL command returns a listing of all of the program labels in memory. The listing will be in alphabetical order. The line number where the label is defined is included in the listing.

ARGUMENTS: None

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"LA"	List Arrays
"LS"	List Program
"LV"	List Variables

EXAMPLES:

```
: LL
# FIVE=5
# FOUR=4
# ONE=1
# THREE=3
# TWO=2
```

LO

FUNCTION: Lockout

DESCRIPTION:

The lockout command is used to lockout a particular handle or serial port. This function ignores all data received on the specified communication channel.

ARGUMENTS: LO h,n where

h is the handle, A thru H, or the letter S for the serial port. This identifies the communication channel to be locked out.

n = 1 or no argument to enable the lockout.

n = -1 to remove the lockout.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	--
Default Format	--

OPERAND USAGE:

_LOh contains the state of the lockout for Handle A-H or S

RELATED COMMANDS:

"IH"	Set Internet Handles
"SA"	Send Command to Slave

EXAMPLES:

LOS	Lockout information received from the serial port
WT10000	Wait 10 seconds
LOS,-1	Re-enable the serial port

_LR

FUNCTION: Reverse Limit Switch Operand (Keyword)

DESCRIPTION:

The _LR operand contains the state of the reverse limit switch for the specified axis.

The operand is specified as: _LRn where n is the specified axis.

Note: This operand is affected by the configuration of the limit switches set by the command CN:

For CN -1:

_LRn = 1 when the limit switch input is inactive*

_LRn = 0 when the limit switch input is active*

For CN 1:

_LRn = 0 when the limit switch input is inactive*

_LRn = 1 when the limit switch input is active*

* The term “active” refers to the condition when at least 1ma of current is flowing through the input circuitry. The input circuitry can be configured to sink or source current to become active. See Chapter 3 in the user manual for further details.

EXAMPLES:

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

LS

FUNCTION: List Program

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 999, or labels. n is the first line to be listed, m is the last.

n is an integer in the range of 0 to 999 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 999 or a label on the program memory. m is used to specify the last line to be listed.

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	0, Last Line
Default Format	-

RELATED COMMANDS:

"LA"	List Arrays
"LL"	List Labels
"LV"	List Variables

EXAMPLES:

```
: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.*

LV

FUNCTION: List Variables

DESCRIPTION:

The LV command returns a listing of all of the program variables in memory. The listing will be in alphabetical order.

ARGUMENTS: None

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"LA"	List Arrays
"LS"	List Program
"LL"	List Labels

EXAMPLES:

```
: LV
APPLE  = 60.0000
BOY    = 25.0000
ZEBRA = 37.0000
```

LZ

FUNCTION: Leading Zeros

DESCRIPTION:

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1
Default Format	-

OPERAND USAGE:

_LZ contains the state of the LZ function. '0' is disabled and '1' is enabled.

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

MB

FUNCTION: Modbus

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 that the controller supports.

FUNCTION CODE	DEFINITION
01	Read Coil Status (Read Bits)
02	Read Input Status (Read Bits)
03	Read Holding Registers (Read Words)
04	Read Input Registers (Read Words)
05	Force Single Coil (Write One Bit)
06	Preset Single Register (Write One Word)
07	Read Exception Status (Read Error Code)
15	Force Multiple Coils (Write Multiple Bits)
16	Preset Multiple Registers (Write Words)
17	Report Slave ID

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 number.

Note: All the formats contain an h parameter. This designates the connection handle number (A thru F).

ARGUMENTS:

MBh = -1, len, array[] where

len is the number of the bytes

Array[] is the name of array containing data

MBh = addr, 1, m, n, array[] where

m is the starting bit number

n is the number of bits

array[] of which the first element will hold result

MBh = addr, 2, m, n, array[] where

m is the starting bit number

n is the number of bits

array[] of which the first element will hold result

MBh = addr, 3, m, n, array[] where

m is the starting register number

n is the number of registers

array[] will hold the response

MBh = addr, 4, m, n, array[] where

m is the starting register number

n is the number of registers

array[] will hold the response

MBh = addr, 5, m, n where

m is the starting bit number

n is 0 or 1 and represents the coil set to off or on.

MBh = addr, 6, m, n where

m is the register number

n is the 16 bit value

MBh = addr, 7, array[] where

array[] is where the returned data is stored (one byte per element)

MBh = addr, 15, m, n, array[] where

m is the starting bit number

n is the number of bits

array[] contains the data (one byte per element)

MBh = addr, 16, m, n, array[] where

m is the starting register number

n is the number of registers

array[] contains the data (one 16 bit word per element)

MBh = addr, 17, array[] where

array[] is where the returned data is stored

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

MC

FUNCTION: Motion Complete - "In Position"

DESCRIPTION:

The MC command is a trippoint used to control the timing of events for PR or PA moves. 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 is complete. 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, the stop code will be set to 99, and the application program will jump to the special label #MCTIME.

ARGUMENTS: MC 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 that motion on all axes is complete.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"BG"	Begin
"AM"	After Move
"TW"	Timeout

EXAMPLES:

#MOVE	Program MOVE
PR2000,4000	Independent Move on A and B axis
BG AB	Start the B-axis
MC AB	After the move is complete
MG "DONE"; TP	Print message
EN	End of Program

Hint: *MC can be used to verify that the actual motion has been completed.*

MF

FUNCTION: Forward Motion to Position

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.

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

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

RELATED COMMANDS:

"AD"	Trippoint for after Relative Distances
"AP"	Trippoint for after Absolute Position

EXAMPLES:

#TEST	Program B
DP0	Define zero
JG 1000	Jog mode (speed of 1000 counts/sec)
BG A	Begin move
MF 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 MF command is the number of counts that occur in 2 msec. Multiply the speed by 2 msec 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.*

MG

FUNCTION: Message

DESCRIPTION:

The MG command sends data out the serial port or Ethernet handle. This can be used to alert an operator, send instructions, or return a variable value.

ARGUMENTS: MG "m", {^n}, V {Fm.n or $m,n} {N} {Pn} where

"m" is a text message including letters, numbers, symbols or <ctrl>G (up to 72 characters).

{^n} is an ASCII character specified by the value n

{Ex} for Ethernet and 'x' specifies the Ethernet handle (A,B,C,D,E,F,G or H).

V is a variable name or array element where the following formats can be used:

{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 the leading zeros.

{$m.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.

{P1} Directs output to main serial port

Note: Multiple text, variables, and ASCII characters may be used, each must be separated by a comma.

Note: The order of arguments is not important.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	Variable Format

EXAMPLES:

Case 1: Message command displays ASCII strings

MG "Good Morning" Displays the string

Case 2: Message command displays variables or arrays

MG "The Answer is", Total {F4.2} Displays the string with the content of variable TOTAL in local format of 4 digits before and 2 digits after the decimal point.

Case 3: Message command sends any ASCII characters to the port.

MG {^13}, {^10}, {^48}, {^055} displays carriage return and the characters 0 and 7.

MO

FUNCTION: Motor Off

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). MO also turns on the brake BW milliseconds before turning the motor off.

ARGUMENTS: MO nnnnnnnnnn 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.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.0

OPERAND USAGE:

_MOn contains the state of the motor for the specified axis.

RELATED COMMANDS:

"SH"	Servo Here
"BW"	Brake Wait

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

FUNCTION: Reverse Motion to Position

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.

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

USAGE:		**DEFAULTS:**
While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	

RELATED COMMANDS:

"AD"	Trippoint for Relative Distances
"AP"	Trippoint for after Absolute Position

EXAMPLES:

#TEST	Program B
DP0	Define zero
JG -1000	Jog mode (speed of 1000 counts/sec)
BG A	Begin move
MR -3000	After passing the position -3000
V1=_TPA	Assign V1 A position
MG "Position is", V1	Print Message
ST	Stop
EN	End of Program

Hint: *The accuracy of the MR command is the number of counts that occur in 2 msec. Multiply the speed by 2 msec 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.*

MT

FUNCTION: Motor Type

DESCRIPTION:

The MT command selects the polarity of the drive signal.

ARGUMENTS: MT n,n,n,n,n,n,n,n or MTA=n where

n = 1	Specifies Servo motor with normal polarity
n = -1	Specifies Servo motor with reversed polarity
n = ?	Returns the value of the motor type for the specified axis.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1,1,1,1
Default Format	1

OPERAND USAGE:

_MTn contains the value of the motor type for the specified axis.

RELATED COMMANDS:

"CE"	Configure encoder type

EXAMPLES:

MT 1,-1	Configure a as servo, b as reverse servo
MT ?,?	Interrogate motor type
V=_MTA	Assign motor type to variable

MU

FUNCTION: Multicast Address

DESCRIPTION:

The MU command sets the controller's mutlicast address

ARGUMENTS: MU n0,n1,n2,n3

n0 = Integer from 0 – 255	Sets the first field of the multicast address
n1 = Integer from 0 – 255	Sets the second field of the multicast address
n2 = Integer from 0 – 255	Sets the third field of the multicast address
n3 = Integer from 0 – 255	Sets the fourth field of the multicast address

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0,0,0,0

OPERAND USAGE:

_MU contains the 32-bit multicast address number in two's complement.

MU ? returns the current multicast address setting in 4 byte format

RELATED COMMANDS:

IA	IP address

EXAMPLES:

```
:MU 239,255,19,57
:MU ?
 239, 255, 019, 057
:MG _MU
 -268496071.0000
:MG _MU{$8.0}
$EFFF1339
:
```

MW

FUNCTION: Modbus Wait

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.0

OPERAND USAGE:

MW? contains the state of the Modbus Wait.

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

Hint: *The MW command ensures that the command that was sent to the Modbus device was successfully received before continuing program execution. This prevents the controller from sending multiple commands to the same Modbus device before it has a chance to execute them.*

NB

FUNCTION: Notch Bandwidth

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 ranges from 0 Hz to $\frac{1}{(16 \cdot TM)}$

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0.5
Default Format	

OPERAND USAGE:

_NBn contains the value of the notch bandwidth for the specified axis.

RELATED COMMANDS:

"NF"	Notch Filter
"NZ"	Notch Zeros

EXAMPLES:

_NBA = 10	Sets the real part of the notch pole to 10/2 Hz
NOTCH = _NBA	Sets the variable "NOTCH" equal to the notch bandwidth value for the A axis

NF

FUNCTION: Notch Frequency

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 $\frac{1}{(4 \cdot TM)}$ where TM is the update rate (default TM is 1 msec).

n = ? Returns the value of the Notch filter for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	

OPERAND USAGE:

_NFn contains the value of notch filter for the specified axis.

RELATED COMMANDS:

"NB"	Notch bandwidth
"NZ"	Notch Zero

EXAMPLES:

NF, 20	Sets the notch frequency of B axis to 20 Hz

NO (‘ apostrophe also accepted)

FUNCTION: No Operation

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value
Default Format

EXAMPLES:

#A	Program A
NO	No Operation
NO This Program	No Operation
NO Does Absolutely	No Operation
NO Nothing	No Operation
EN	End of Program

NZ

FUNCTION: Notch Zero

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 $\frac{1}{(16 \cdot TM)}$

n = ? Returns the value of the Notch filter zero for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0.5
Default Format	

OPERAND USAGE:

_NZn contains the value of the Notch filter zero for the specified axis.

RELATED COMMANDS:

"NB"	Notch Bandwidth
"NF"	Notch Filter

EXAMPLES:

NZA = 10	Sets the real part of the notch pole to 10/2 Hz

OB

FUNCTION: Output Bit

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, *expressio*n where

n denotes the output bit

n = (HandleNum * 100) + Bitnum for a distributed slave controller

n = (HandleNum * 1000) + Bitnum for an IOC-7007

expression is any valid logical expression, variable or array element.

USAGE:		**DEFAULTS:**
While Moving	Yes	Default Value
In a Program	Yes	Default Format
Command Line	Yes	

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

OC

FUNCTION: Output Compare

DESCRIPTION:

The OC command allows the generation of output pulses based on the main encoder position. For circular compare, the output is a low-going pulse with a duration of approximately 600 nanoseconds and is available at the output compare signal (CMP). For one shot, the output goes low until OC is called again.

The auxiliary encoder can not be used while using this function.

Note: 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.

ARGUMENTS: OCx = m, n where

x = A,B,C,D,E,F,G H specifies which encoder input to be used.

m = Absolute position for first pulse. Integer between $-2 \cdot 10^9$ and $2 \cdot 10^9$

n = Incremental distance between pulses. Integer between -65535 and 65535, 0 one shot.

n = 0 One shot when moving in the forward direction

n = -65536 = One shot when moving in the reverse direction

Notes:

OCx = 0 will disable the Circular Compare function

The sign of the 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.

When changing to CEx=2, if the original command was OCx=m,n and the starting position was _TPx, the new command is OCx=2*_TPx-m,-n. For pulses to occur under CEx=2, the following conditions must be met:

m>_TPx and n > 0 for negative moves (e.g. JGx=-1000)

m<_TPx and n < 0 for positive moves (e.g. JGx=1000)

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

OPERAND USAGE:

_OC contains the state of the OC function

_OC = 0 : OC function has been enabled but not generated any pulses.

_OC = 1: OC function not enabled or has generated the first output pulse.

EXAMPLES:

OCA=300,100	Select A encoder as position sensor. First pulse at 300. Following pulses at 400, 500…

OE

FUNCTION: Off-on-Error

DESCRIPTION:

The OE command causes the controller to shut off the motor 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 (overcurrent, overvoltage, undervoltage, hall) occurs.

If an abort or an error is detected on an axis, and the motion was executing an independent move, only that axis will be shut off.

ARGUMENTS: OE n,n,n,n,n,n,n,n or OEA=n where

n = 0	Disables the Off-On-Error function.
n = 1	Enables the Off-On-Error function.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	---

OPERAND USAGE:

_OEn contains the status of the off-on-error function for the specified axis. 0 = off, 1 = on

RELATED COMMANDS:

"AB"	Abort
"ER"	Error limit
"SH"	Servo Here
#POSERR	Error Subroutine
"TA"	Tell Amplifier Error

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

Hint: *The OE command is useful for preventing system damage due to excessive error.*

OF

FUNCTION: Offset

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	1.4

OPERAND USAGE:

_OFn contains the offset for the specified axis.

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

FUNCTION: Output Port

DESCRIPTION:

The OP command sends data to the output ports of the controller. You can use the output port to control external switches and relays.

ARGUMENTS: OP m,a,b,c,d where

m is an integer in the range 0 to 65535 decimal, or $0000 to $FFFF hexadecimal. m is the decimal representation of the general output bits for Output 1 through output 14.

a,b,c,d represent the extended I/O in consecutive groups of 16 bits, (values from 0 to 65535). Arguments which are given for I/O points which are configured as inputs will be ignored. The following table describes the arguments used to set the state of outputs.

Arguments	Blocks	Bits	Description
m	0	1-8	General Outputs
	1	9-14	General Outputs
a	2,3	17-32	Extended I/O
b	4,5	33-48	Extended I/O
c	6,7	49-64	Extended I/O
d	8,9	65-80	Extended I/O

n = ? returns the value of the argument, where n is any of the above arguments.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	3.0

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

RELATED COMMANDS:

"SB"	Set output bit
"CB"	Clear output bit
"OB"	Output bit

EXAMPLES:

OP 0	Clear Output Port -- all bits
OP $85	Set outputs 1,3,8; clear the others
MG _OP0	Returns the first parameter "m"
MG _OP1	Returns the second parameter "a"

OQ

FUNCTION: Output Data

DESCRIPTION:

The OQ command writes data to an entire IOM module of an IOC-7007 controller.

ARGUMENTS: OQ a,b where

a is an integer representing the handle and slot number of the output module. This integer is calculated as follows:

a = (HandleNum * 1000) + SlotNum where

HandleNum is the number associated with the handle specifier for the particular IOC-7007. 1 for handle A, 2 for handle B, etc.

SlotNum is the number associated with the slot location of the IOM output to be set, 0 – 6.

b is an integer representing the data to be written to the particular IOC-7007 output slot. The data written will depend on the IOM module in each particular slot and whether they have 8 or 16 outputs.

IOM-70208	b = 0 – 255
IOM-70308	b = 0 - 255
IOM-70404	b = 0 – 15

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	--

OPERAND USAGE:

_OQa where a is the HandleNum and SlotNum as calculated above, contains the value of the output data at the specified location.

RELATED COMMANDS:

SB	Set output bit
CB	Clear output bit

EXAMPLES:

OQ 6001,128	6001 represents handle F, slot 1 of the IOC-7007. 128 is the data written, which will set bit 7 of the specified IOM module.
OQ 4003,0	4003 represents handle D, slot 3 of the IOC-7007. 0 is the data written, which will clear all outputs of the specified IOM module.

OS

FUNCTION: Output Setting

DESCRIPTION:

The OS command increases the number of digital outputs from 10 up to 13. It configures one or more of the following dedicated digital outputs as general-purpose digital outputs 11-13: Error/Amp Enable, Output Compare, and Brake. These outputs can be programmed with SB and CB. For the brake, SB turns the MOSFET on.

Error/Amp Enable (J3 pin 2)	Output Compare (J3 pin 23)	Brake (J3 pin 32)
General output 11	General Output 12	General Output 13

ARGUMENTS: OS n,m where

n is a decimal value that can be calculated by the following formula:

$n = 4*n_{11} + 8*n_{12} +16* n_{13}$

where n_x represents the output. To configure an output as a general purpose output, substitute a one into that n_x in the formula. If the n_x value is a zero, then the output will take on its normal purpose (Error/Amp Enable, Output Compare, or Brake). For example, if the user wishes to sacrifice the output compare and brake outputs to gain two additional digital outputs, OS 24 is issued.

m is 0 or 1. 0 indicates J3 pin 2 is an amplifier enable digital output. 1 indicates J3 pin 2 is an error digital output

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0,0
Default Format	-

OPERAND USAGE:

_OS returns the output setting value.

_OS1 returns 0 if J3 pin 2 is an amplifier enable digital output and returns 1 if J3 pin 2 is an error digital output.

RELATED COMMANDS:

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

EXAMPLES:

```
OS 28              ;'Configure Error/Amp Enable, Output Compare, and Brake as general outputs
SB11;SB12;SB13     ;'Set the outputs

OS 0               ;'Configure Error/Amp Enable, Output Compare, and Brake as normal

OS 8               ;'Configure the output compare as a general output
SB12               ;'Set the output compare
```

PA

FUNCTION: Position Absolute

DESCRIPTION:

The PA command will set the final destination of each axis. 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 integers in the range -2147483647 to 2147483648 decimal. Units are in encoder counts.

n = ? Returns the commanded position at which motion stopped.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	PF

OPERAND USAGE:

_PAn contains the last commanded position at which motion stopped.

RELATED COMMANDS:

"PR"	Position relative
"SP "	Speed
"AC"	Acceleration
"DC"	Deceleration
"BG"	Begin
"PF"	Position Formatting

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;AM	Execute Motion and Wait for Motion Complete
:PA ?,?,?,?	Returns the current commanded position after motion has completed
400, -600, 500, 200	
:BG	Start the move
:PA 700	A-axis will go to 700 on the next move while the
:BG	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.

PF

FUNCTION: Position Format

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 minus, 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 ?	PA ?
DE ?	PR ?
DP ?	TE
FL ?	RL
IP ?	RP
TP	TD

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	10.0
Default Format	2.1

OPERAND USAGE:

_PF contains the value of 'm' position format parameter.

EXAMPLES:

:TPX	Tell position of X
21	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

PL

FUNCTION: Pole

DESCRIPTION:

The PL command adds a low-pass filter in series with the PID compensation. The digital transfer function of the filter is (1 - P) / (Z - P) and the equivalent continuous filter is A/ (S + A) where A is the filter crossover 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 = 36Hz TM = 1000 $n = e^{-0.001 \cdot 36 \cdot 2\pi} = 0.8$

n	0	0.2	0.4	0.6	0.8	0.999
F_c (Hz)	∞ (off)	256	145	81	36	0

ARGUMENTS: PL n,n,n,n,n,n,n,n or PLA=n where

n is a positive number in the range 0 to 0.9999.

n = ? Returns the value of the pole filter for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Not in a Program	Yes

DEFAULTS:

Default Value	0.0
Default Format	0.4

OPERAND USAGE:

_PLn contains the value of the pole filter for the specified axis.

RELATED COMMANDS:

"KD"	Derivative
"KP"	Proportional
"KI"	Integral Gain

EXAMPLES:

PL .95,.9,.8,.822	Set A-axis Pole to 0.95, B-axis to 0.9, C-axis to 0.8, D-axis pole to 0.822
PL ?,?,?,?	Return all Poles
0.9527,0.8997,0.7994,0.8244	
PL?	Return A Pole only
0.9527	
PL?	Return B Pole only
0.8997	

PR

FUNCTION: Position Relative

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.

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	PF

OPERAND USAGE:

_PRn contains the current incremental distance for the specified axis.

RELATED COMMANDS:

"PA "	Position Absolute
"BG"	Begin
"AC"	Acceleration
"DC"	Deceleration
“SP "	Speed
"IP"	Increment Position
"PF"	Position Formatting

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.

PT

FUNCTION: Position Tracking

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 this special mode, the ST command will exit the mode. Hitting a limit switch will also exit this 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.

ARGUMENTS: PT n,n,n,n,n,n,n,n

n = 0 or 1 where 1 designates the controller is in the special mode

n = ? returns the current setting

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	0

RELATED COMMANDS:

"PA "	Position Absolute
"AC"	Acceleration
"DC"	Deceleration
"SP "	Speed

EXAMPLE:

PT1,1,1,1	Enable the position tracking mode for axes X, Y, Z and W
#A	Create label A 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.
PAV1,V2,V3,V4	Command XYZW axes to move to absolute positions. Motion begins when the command is processed. BG is not required 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#A	Repeat by jumping back to label A

Special Notes: 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. _BG and the AP trip point may also be used.

QD

FUNCTION: Download Array

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 backslash \.

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)

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	start=0, end=size-1
Default Format	-

RELATED COMMANDS:

"QU" Upload array

HINT:

Using non-Galil terminal software, the command can be used in the following manner:

1. Set the timeout to 0
2. Send the command QD

3a. Use the send file command to send the data file.

OR

3b. Enter data manually from the terminal. End the data entry with the character '\'

QH

FUNCTION: Hall State

DESCRIPTION:

The QH command transmits the state of the Hall sensor inputs. The value is decimal and represents an 8 bit value.

Bit	Status
07	Undefined (set to 0)
06	Undefined (set to 0)
05	Undefined (set to 0)
04	Undefined (set to 0)
03	Undefined (set to 0)
02	Hall C State
01	Hall B State
00	Hall A State

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

DEFAULTS:

Default Value	0
Default Format	-

OPERAND USAGE:

_QHn Contains the state of the Hall sensor inputs

RELATED COMMANDS:

"BS" Brushless setup

EXAMPLE:

```
QHY
:6          Hall inputs B and C active on Y axis
```

QR

FUNCTION: Data Record

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 or I or any combination to specify the axis, axes, sequence, or I/O status

I represents the status of the I/O

Chapter 4 of the users manual provides the definition of the data record information.

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

Note: The Galil windows terminal will not display the results of the QR command since the results are in binary format.

QU

FUNCTION: Upload Array

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.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	PF

RELATED COMMANDS:

"QD"	Download Array

QZ

FUNCTION: Return Data Record information

DESCRIPTION:

The QZ command is an interrogation command that returns information regarding the Data Record. The controller's response is four 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 is reserved

Fourth field returns the number of bytes to be transferred for axis specified information

ARGUMENTS: QZ

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	

RELATED COMMANDS:

"QR" Data Record update rate

RA

FUNCTION: Record Array

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 [] RA n[],m[],o[],p[],q[],r[],s[],t[] where

n,m,o and p are dimensioned arrays as defined by DM command. The [] contain nothing.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

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.*

RC

FUNCTION: Record

DESCRIPTION:

The RC command begins recording for the Automatic Record Array Mode (RA). RC 0 stops recording .

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 DM number will be used. A negative number for m causes circular recording over array addresses 0 to m-1. The address for the array element for the next recording can be interrogated with _RD.

n = ? Returns status of recording. '1' if recording, '0' if not recording.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

OPERAND USAGE:

_RC contains status of recording. '1' if recording, '0' if not recording.

RELATED COMMANDS:

"DM"	Dimension Array
"RD"	Record Data

EXAMPLES:

#RECORD	Record
DM Torque[1000]	Define Array
RA Torque[]	Specify Record Mode
RD _TTA	Specify Data Type
RC 2	Begin recording and set 4 msec between records
JG 1000;BG	Begin motion
#A;JP #A,_RC=1	Loop until done
MG "DONE RECORDING"	Print message
EN	End program

RD

FUNCTION: Record Data

DESCRIPTION:

The RD command specifies the data type to be captured for the Record Array (RA) mode. The command type includes:

_TTn	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.
_DEn	2nd encoder
_TPn	Position
_TEn	Position error
_RPn	Commanded position
_RL	Latched position
_AFn	Analog input value (+32767 to -32768). Analog inputs can be read up to the number of axes.
_TI	Inputs
_OP	Outputs
_TS	Switches, only 0-4 bits valid
_SCn	Stop code
_TVn	Filtered velocity (Note: will be 65 times greater than TV command)

where 'n' is the axis specifier. In the case of CDS-3310, there is only one axis, A.

ARGUMENTS: RD m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_8 where

the arguments are data types to be captured using the record Array feature. The order is important. Each data type corresponds with the array specified in the RA command.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

OPERAND USAGE:

_RD contains the address for the next array element for recording.

RELATED COMMANDS:

"RA"	Record Array
"RC"	Record Interval
"DM"	Dimension Array

EXAMPLES:

DM ERRORA[50],ERRORB[50]	Define array
RA ERRORA[],ERRORB[ ]	Specify record mode
RD _TEA,_TEB	Specify data type
RC1	Begin record
JG 1000;BG	Begin motion

RE

FUNCTION: Return from Error Routine

DESCRIPTION:

The RE command is used to end a position error handling subroutine or limit switch handling subroutine. The error handling subroutine begins with the #POSERR label. The limit switch handling subroutine begins with the #LIMSWI. An RE at the end of these routines causes a return to the main program. Care should be taken to be sure the error or limit switch conditions no longer occur to avoid re-entering the subroutines. If the program sequencer was waiting for a trippoint to occur, prior to the error interrupt, the trippoint condition is preserved on the return to the program if RE1 is used. A motion trippoint like MF or MR Requires the axis to be actively profiling in order to be restored with the RE1 command. RE0 clears the trippoint. To avoid returning to the main program on an interrupt, use the ZS command to zero the subroutine stack.

ARGUMENTS: RE n where

n = 0	Clears the interrupted trippoint
n = 1	Restores state of trippoint
no argument	clears the interrupted trippoint

USAGE:

While Moving	No
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

#POSERR	Error Subroutine
#LIMSWI	Limit Subroutine

EXAMPLES:

#A;JP #A;EN	Label for main program
#POSERR	Begin Error Handling Subroutine
MG "ERROR"	Print message
SB1	Set output bit 1
RE	Return to main program and clear trippoint

Hint: *An applications program must be executing for the #LIMSWI and #POSERR subroutines to function.*

RI

FUNCTION: Return from Interrupt Routine

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 like MF or MR requires the axis to be actively profiling in order to be restored with the RI1 command. 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

USAGE:

While Moving	No
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	-
Default Format	-

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

Hint: *An applications program must be executing for the #ININT subroutine to function.*

RL

FUNCTION: Report Latched Position

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 state change must occur on the latch digital input.

The armed state of the latch can be configured using the CN command.

Note: The Latch Function only works with the main (not auxiliary) encoder.

ARGUMENTS: RL nnnnnnnnnn where

n can be X,Y,Z,W,A,B,C,D,E,F,G or H or any combination to specify the main encoder axis or axes

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	PF

OPERAND USAGE:

_RLn contains the latched position of the specified axis.

RELATED COMMAND:

"AL"	Arm Latch

EXAMPLES:

JG ,5000	Set up to jog the B-axis
BGB	Begin jog
ALB	Arm the B latch; assume that after about 2 seconds, input goes low
RLB	Report the latch
10000	

RP

FUNCTION: Reference Position

DESCRIPTION:

This 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	PF

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.

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.

:PF 7	Position format of 7
0	
:RP	
200, -10, 0, -110	Return A,B,C,D reference positions
RPA	
200	Return the A motor reference position
RPB	
-10	Return the B motor reference position
PF-6.0	Change to hex format
RP	
$0000C8,$FFFFF6,$000000,$FFFF93	Return A,B,C,D in hex
Position =_RPA	Assign the variable, Position, the value of RPA

RS

FUNCTION: Reset

DESCRIPTION:

The RS command resets the state of the processor to its power-on condition. The previously saved state of the controller, along with parameter values, and saved sequences are restored.

The RS-1 command resets the state of the processor to its factory default without modifying the EEPROM.

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-

OPERAND USAGE:

_RS contains the power up error status

Bit	Error Condition
Bit 3	Master Reset error
Bit 2	Program checksum error
Bit 1	Parameter checksum error
Bit 0	Variable checksum error

<control>R<control>S

FUNCTION: Master Reset

DESCRIPTION:

This command resets the controller to factory default settings and erases EEPROM.

A master reset can also be performed by installing a jumper on the controller at the location labeled MRST and resetting the controller (power cycle or pressing the reset button). Remove the jumper after this procedure.

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	No	Default Format	-
Command Line	Yes		

Note: A master reset is not supported on the Ethernet connection. Any attempt will hang up the host.

<control>R<control>V

FUNCTION: Revision Information

DESCRIPTION:

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

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

SA

FUNCTION: Send command

DESCRIPTION:

SA sends a command from one controller to another via Ethernet. Any command can be sent to a distributed slave controller and will be interpreted by the slave as a "local" command. Some commands are only "local" commands and must be sent with the SA command.

NOTE: A wait statement (e.g. WT5) must be inserted between successive calls to SA.

ARGUMENTS: SAh=arg or 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 (2^{31}) followed by two bytes of fraction (+/- 2,147,483,647.9999). The maximum number of characters for a string is 38 characters. Strings are identified 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-----
Default Format	-----

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.

RELATED COMMAND:

"MG"	Display messages
IH"IH"	Opens handle

EXAMPLES:

IHA=10,0,0,12	Configures handle A to be connected to a controller with the IP address 10.0.0.12
#L;JP#L,_IHA2<>-2	Wait for connection
SAA="KI", 1, 2	Sends the command to handle A (slave controller): KI 1,2
WT5	
SAA="TE"	Sends the command to handle A (slave controller): TE
WT5	
MG_SAA0	Display the content of the operand _SAA (first response to TE command)
: 132	
MG_SAA1	Display the content of the operand _SAA (2^{nd} response to TE command)
: 12	
SAA="TEMP=",16	Sets variable temp equal to 16 on handle A controller

***Note**: The SA command does not wait for a response from the slave controller before continuing code execution. Therefore, a WTxx is required between two SA commands or between an SA command and*

querying the response using _SAHn. There is a 38 character maximum string length for the SA command. It is helpful for timing to keep the SA command query as short as possible.

SB

FUNCTION: Set Bit

DESCRIPTION:

The SB command sets one of the output bits.

ARGUMENTS: SB n where

n is an integer which represents a specific controller output bit to be set high (output = 1).

n = (HandleNum * 100) + Bitnum for a distributed slave controller

n = (HandleNum * 1000) + Bitnum for an IOC-7007

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

n = (SlaveAddress*10000) + (HandleNum*1000) + ((Module-1)*4) + (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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMAND

"CB" Clear Bit

EXAMPLES:

SB 5	Set output line 5
SB 1	Set output line 1

SC

FUNCTION: Stop Code

DESCRIPTION:

The SC command allows the user to determine why a motor stops. The controller responds with the stop code as follows:

CODE	MEANING	CODE	MEANING
0	Motors are running, independent mode	9	Stopped after Finding Edge (FE)
1	Motors decelerating or stopped at commanded independent position	10	Stopped after homing (HM)
2	Decelerating or stopped by FWD limit switch or soft limit FL	11	Stopped by Selective Abort Input
3	Decelerating or stopped by REV limit switch or soft limit BL	50	Contour running
4	Decelerating or stopped by Stop Command (ST)	51	Contour Stop
6	Stopped by Abort input	99	MC timeout
7	Stopped by Abort command (AB)		
8	Decelerating or stopped by Off-on-Error (OE1)		

ARGUMENTS: SC nnnnnnnnnn where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	3.0

OPERAND USAGE:

_SCn contains the value of the stop code for the specified axis.

EXAMPLES:

Tom =_SCD	Assign the Stop Code of D to variable Tom

SH

FUNCTION: Servo Here

DESCRIPTION:

The SH commands tells the controller to use the current motor position as the commanded 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. SH also turns off the brake.

ARGUMENTS: SH nnnnnnnnnn where

n is A,B,C,D,E,F,G or H or any combination to specify the axis or axes

USAGE:

While Moving	No
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

“MO”	Motor-off
"BW"	Brake Wait

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

SL

FUNCTION: Single Step

DESCRIPTION:

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

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	1

RELATED COMMANDS:

"BK"	Breakpoint
"TR"	Trace

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

SM

FUNCTION: Subnet Mask

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	SM 0, 0, 0, 0
Default Format	

OPERAND USAGE:

_SM0 contains the IP address representing a 32 bit signed number (Two's complement)

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

FUNCTION: Speed

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 integer in the range 0 to 12,000,000 for servo motors. The units are encoder counts per second.

n = ? Returns the speed for the specified axis.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	25000
Default Format	8.0

OPERAND USAGE:

_SPn contains the speed for the specified axis.

RELATED COMMANDS:

"AC"	Acceleration
"DC"	Deceleration
"PA "	Position Absolute
"PR"	Position Relation
"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**: SP2 is the minimum non-zero speed*

ST

FUNCTION: Stop

DESCRIPTION:

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 nnnnnnnnn where

n is A,B,C,D,E,F,G,H,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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"BG"	Begin Motion
"AB"	Abort Motion
"DC"	Deceleration rate

EXAMPLES:

ST A	Stop A-axis motion
ST ABCD	Stop A,B,C,D motion
ST	Stop all axes motion and program execution

Hint: *Use the after motion complete command, AM, to wait for motion to be stopped.*

TA

FUNCTION: Tell Amplifier error status

DESCRIPTION:

The command transmits the amplifier error status. The value is decimal and represents an 8 bit value.

TA0		TA1		TA2		TA3	
Bit #	**STATUS**	**Bit #**	**STATUS**	**Bit #**	**STATUS**	**Bit #**	**STATUS**
Bit 3	Under Voltage	Bit 3	0	Bit 3	0	Bit 3	0
Bit 2	0	Bit 2	0	Bit 2	0	Bit 2	0
Bit 1	Over Voltage	Bit 1	0	Bit 1	0	Bit 1	0
Bit 0	Over Current	Bit 0	Hall Error A Axis	Bit 0	Peak Current A-Axis	Bit 0	ELO Active

ARGUMENTS: TA n returns the amplifier error status where n is 0,1,2, or 3

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	1.0

OPERAND USAGE:

_TAn Contains the Amplifier error status

RELATED COMMANDS:

"BR"	Brush Axis Configuration
"QH"	Hall State

EXAMPLE:

```
TA1
:1                    Hall Error
```

TB

FUNCTION: Tell Status Byte

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):

BIT	STATUS
Bit 7	Executing application program
Bit 6	Reserved
Bit 5	Contouring
Bit 4	Executing error or limit switch routine
Bit 3	Input interrupt enabled
Bit 2	Executing input interrupt routine
Bit 1	N/A
Bit 0	Echo on

ARGUMENTS:

TB ? returns the status byte

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	3.0

OPERAND USAGE:

_TB Contains the status byte

EXAMPLES:

65 Executing program and Echo is on ($2^6 + 2^0 = 64 + 1 = 65$)

TC

FUNCTION: Tell Error Code

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 at a command or when the response to a command is a question mark. The TC command will provide the user with a diagnostic tool. After TC has been read, the error code is set to zero.

ARGUMENTS: TC n where

n = 0 Returns code only

n = 1 Returns code and message

n = ? Returns the error code

No argument will provide the error code for all axes

CODE	EXPLANATION	CODE	EXPLANATION
1	Unrecognized command	58	Bad command response (i.e._GNX)
2	Command only valid from program	59	Mismatched parentheses
3	Command not valid in program	60	Download error - line too long or too many lines
4	Operand error	61	Duplicate or bad label
5	Input buffer full	62	Too many labels
6	Number out of range	63	IF statement without ENDIF
7	Command not valid while running	65	IN command must have a comma
8	Command not valid when not running	66	Array space full
9	Variable error	67	Too many arrays or variables
10	Empty program line or undefined label	71	IN only valid in task #0
11	Invalid label or line number	80	Record mode already running
12	Subroutine more than 16 deep	81	No array or source specified
13	JG only valid when running in jog mode	82	Undefined Array
14	EEPROM check sum error	83	Not a valid number
15	EEPROM write error	84	Too many elements
16	IP incorrect sign during position move or IP given during forced deceleration	90	Only A B C D valid operand
17	ED and DL not valid while program running	97	Bad Binary Command Format
18	Command not valid when contouring	98	Binary Commands not valid in application program
19	Application strand already executing	99	Bad binary command number
20	Begin not valid with motor off	110	No hall effect sensors detected
21	Begin not valid while running	120	Bad Ethernet transmit
22	Begin not possible due to Limit Switch	121	Bad Ethernet packet received
24	Begin not valid because no sequence defined	122	Ethernet input buffer overrun

25	Variable not given in IN command	123	TCP lost sync
31	Total move distance in a sequence > 2 billion	124	Ethernet handle already in use
41	Contouring record range error	125	No ARP response from IP address
42	Contour data being sent too slowly	126	Closed Ethernet Handle
46	Gear axis both master and follower	127	Illegal Modbus Function Code
50	Not enough fields	128	IP address not valid
51	Question mark not valid	129	HC already executed
52	Missing " or string too long	130	Illegal IOC command
53	Error in {}	131	Timeout On Serial Port
54	Question mark part of string	132	Analog inputs not present
55	Missing [or []	134	All motors must be in MO for this command
56	Array index invalid or out of range	135	Motor must be in MO
57	Bad function or array	141	Incorrect Xilinx configuration

USAGE:

While Moving	Yes
In a Program	Yes
Not in a Program	Yes

DEFAULTS:

Default Value	---
Default Format	3.0

USAGE:

_TC contains the error code

EXAMPLES:

:GF32	Bad command
?TC	Tell error code
001	Unrecognized command

TD

FUNCTION: Tell Dual Encoder

DESCRIPTION::

This command returns the current position of the dual (auxiliary) encoder. The auxiliary encoder is not available when the output compare is used.

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

USAGE:

While Moving	Yes
In a Program	Yes
Not in a Program	Yes

DEFAULTS:

Default Value	0
Default Format	PF

OPERAND USAGE:

_Ten contains value of dual encoder register.

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

FUNCTION: Tell Error

DESCRIPTION::

Returns the current position error of the motor(s). The range of possible error is -2147483648 to 2147483647.

ARGUMENTS: TE nnnnnnnnn 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

USAGE:

While Moving	Yes
In a Program	Yes
Not in a Program	Yes

DEFAULTS:

Default Value	0
Default Format	PF

OPERAND USAGE:

_TEn contains the current position error value for the specified axis.

RELATED COMMANDS:

"OE"	Off On Error
"ER"	Error Limit
#POSERR	Error Subroutine
"PF"	Position Formatting

EXAMPLES:

TE	Return all position errors
5, -2, 0, 6	
TEA	Return the A motor position error
5	
TEB	Return the B motor position error
-2	
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.*

TF

FUNCTION: Tell FPGA Version

DESCRIPTION:

The TF command returns a value representing the Xilinx FPGA version.

ARGUMENTS: none

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	3.0

EXAMPLES:

```
:TF                          ;'Query the FPGA version
 0
```

TH

FUNCTION: Tell Handle Status

DESCRIPTION:

The TH command is used to request the controllers' handle status. Data returned from this command indicates the IP address and Ethernet address of the current controller. This data is followed by the status of each handle indicating connection type and IP address.

ARGUMENTS: None

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-----
Default Format	-----

RELATED COMMANDS:

"IH"	Internet Handle
"WH"	Which Handle

EXAMPLES:

:TH Tell current handle configuration

CONTROLLER IP ADDRESS 10,51,0,87 ETHERNET ADDRESS 00-50-4C-18-01-1F

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

TI

FUNCTION: Tell Inputs

DESCRIPTION:

This 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 14

n = 2 through 9 [see note 1]

where n represents the extended inputs ranging from (8*n)+1 through (8*(n+1))

n = 10 Return Input Status for Inputs 81 through 82 (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 = (HandleNum * 100) + Locknut for a distributed slave controller

n = (HandleNum * 1000) + Locknut for an IOC-7007

[note 1] These arguments only apply when using extended I/O configured as inputs

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	3.0

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.

EXAMPLES:

TI	
08	Input 4 is high, others low
TI	
00	All inputs low
Input =_TI	Sets the variable, Input, with the TI value
TI	
255	All inputs high

TIME

FUNCTION: Time Operand (Keyword)

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.

EXAMPLES:

MG TIME	Display the value of the internal clock

TK

FUNCTION: Peak Torque Limit

DESPCRITION:

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. 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,n or 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.

USAGE:

While Moving	Yes	Default Value	0
In a Program	Yes	Default Format	1.4
Command Line	Yes		

OPERAND USAGE:

_TKn contains the value of the peak torque limit for the specified axis.

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

TL

FUNCTION: Continuous Torque Limit

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. If the AG is set to 2, then TL will be set to 7.

ARGUMENTS: TL n,n,n,n,n,n,n,n or 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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	9.998
Default Format	1.4

OPERAND USAGE:

_TLn contains the value of the torque limit for the specified axis.

EXAMPLES:

TL 1,5,9,7.5	Limit A-axis to 1volt 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	

TM

FUNCTION: Update Time

DESCRIPTION:

The TM command sets the sampling period of the control loop. Changing the sampling period will uncalibrate the speed and acceleration parameters. A negative number turns off the servo loop. The units of this command are μsec.

NOTE: THIS COMMAND SHOULD ONLY BE USED FOR A ONE-AXIS SYSTEM

ARGUMENTS: TM n where

n is an integer in the range 250 to 20000 decimal with resolution of 125 microseconds.

With normal firmware: Using the normal firmware the minimum sample times are the following:

Controllers with 1-2 axes	250 μsec
Controllers with 3-4 axes	375 μsec
Controllers with 5-6 axes	500 μsec
Controllers with 7-8 axes	625 μsec

n = ? returns the value of the sample time.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	1000
Default Format	4.0

OPERAND USAGE:

_TM contains the value of the sample time.

EXAMPLES:

TM -1000	Turn off internal clock
TM 2000	Set sample rate to 2 msec (This will cut all speeds in half and all acceleration in fourths)
TM 1000	Return to default sample rate

TP

FUNCTION: Tell Position

DESCRIPTION:

This 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	PF

OPERAND USAGE:

_TPx contains the current position value for the specified axis.

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.

:PF 7	Position format of 7
:LZ0	Add leading zeros
:TP	Return A,B,C,D positions
0000200,-0000010,0000000,-0000110	
TPA	Return the A motor position
0000200	
TPB	Return the B motor position
-0000010	
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

TR

FUNCTION: Trace

DESCRIPTION:

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 where

n = 0 Disables the trace function

n = 1 Enables the trace function

No argument disables the trace function

RELATED COMMANDS:

"CF"	Configure port for unsolicited messages
"CW2"	Data Adjustment Bit

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	TR0
Default Format	--

TS

FUNCTION: Tell Switches

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:

Bit	Status
Bit 7	Axis in motion if high
Bit 6	Axis error exceeds error limit if high
Bit 5	A motor off if high
Bit 4	Undefined
Bit 3	Forward Limit Switch Status inactive if high
Bit 2	Reverse Limit Switch Status inactive if high
Bit 1	Home A Switch Status
Bit 0	Latched

Note: For active high or active low configuration (CN command), these 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	3.0

OPERAND USAGE:

_TS contains the current status of the switches.

EXAMPLES:

V1=_TSB	Assigns value of TSB to the variable V1
V1=	Interrogate value of variable V1
015 (returned value)	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

FUNCTION: Tell Torque

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 nnnnnnnnn 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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	1.4

OPERAND USAGE:

_TTn contains the value of the torque for the specified axis.

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

TV

FUNCTION: Tell Velocity

DESCRIPTION:

The TV command returns the actual velocity of the axes in units of encoder count/s. The value returned includes the sign.

ARGUMENTS: TV 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 auxiliary encoder position for all axes.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	7.0

OPERAND USAGE:

_TVn contains the value of the velocity for the specified axis.

EXAMPLES:

VELA=_TVA	Assigns value of A-axis velocity to the variable VELA
TVA	Returns the A-axis velocity
3420	

Note: *The TV command is computed using a special averaging filter (over approximately .25 sec). Therefore, TV will return average velocity, not instantaneous velocity.*

TW

FUNCTION: Timeout for IN-Position (MC)

DESCRIPTION:

The TW command sets the timeout in msec to declare an error if the MC command is active and the motor is not at or beyond the actual position within n msec after the completion of the motion profile. If a timeout occurs, then the MC trippoint will clear and the stop code will be set to 99. An application program will jump to the special label #MCTIME. The RE command should be used to return from the #MCTIME subroutine.

ARGUMENTS: TW n,n,n,n,n,n,n,n or TWA=n where

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	32766
Default Format	5.0

OPERAND USAGE:

_TWn contains the timeout in msec for the MC command for the specified axis.

RELATED COMMANDS:

"MC" Motion Complete trippoint

TZ

FUNCTION: Tell I/O Status

DESCRIPTION:

The TZ command is used to request the I/O status. This is returned to the user as a text string.

ARGUMENTS: TZ or TZh where

h is the handle, specified as A,B,C,D,E, F, G, or H

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-----
Default Format	-----

RELATED COMMANDS:

TI	Tell Inputs
SB/CB	Set/Clear output bits
OP	Output port
CO	Configure I/O

EXAMPLES:

```
:TZ
Block 0000000000 (0000000008-0000000001) dedicated as input - value 255 (1111_1111)
Block 000 (008-001) dedicated as output - value 000 (0000_0000)
Block 001 (014-009) dedicated as output - value 000 (00_0000)
Block 010 (082-081) dedicated as input - value 002 (10)
:
```

UL

FUNCTION: Upload

DESCRIPTION:

The UL command transfers data from the controller to a host computer through port 1. Programs are sent without line numbers. The Uploaded program will be followed by a <control>Z or a \ as an end of text marker.

ARGUMENTS: None

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	0
Default Format	-

OPERAND USAGE:

When used as an operand, _UL gives the number of available variables. The number of available variables is 254.

RELATED COMMAND:

"DL" Download

EXAMPLES:

UL;	Begin upload
#A	Line 0
NO This is an Example	Line 1
NO Program	Line 2
EN	Line 3
<cntrl>Z	Terminator

VF

FUNCTION: Variable Format

DESCRIPTION:

The VF command formats the number of digits to be displayed when interrogating the controller.

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	10.4
Default Format	2.1

OPERAND USAGE:

_VF contains the value of the format for variables and arrays.

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

WC

FUNCTION: Wait for Contour Data

DESCRIPTION:

The WC command acts as a flag in the Contour Mode. After this command is executed, the controller does not receive any new data until the internal contour data buffer is ready to accept new commands. This command prevents the contour data from overwriting on itself in the contour data buffer.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	-
Default Format	-

RELATED COMMANDS:

"CM"	Contour Mode
"CD"	Contour Data
"DT"	Contour Time

EXAMPLES:

CM ABCD	Specify contour mode
DT 4	Specify time increment for contour
CD 200,350,-150,500	Specify incremental position on A,B,C and D. A-axis moves 200 counts B-axis moves 300 counts C-axis moves -150 counts D-axis moves 500 counts
WC	Wait for contour data to complete
CD 100,200,300,400	
WC	Wait for contour data to complete
DT 0	Stop contour
CD 0,0,0,0	Exit mode

WH

FUNCTION: Which Handle

DESCRIPTION:

The WH command is used to identify the handle in which the command is executed. The command returns IHA through IHH to indicate on which handle the command was executed. The command returns RS232 if communicating serially.

ARGUMENTS: None

USAGE:

While Moving	Yes
In a Program	No
Command Line	Yes

DEFAULTS:

Default Value	-----
Default Format	-----

RELATED COMMANDS:

"TH" Tell Handle

OPERAND USAGE:

_WH contains the numeric representation of the handle in which a command is executed. Handles A through H are indicated by the value 0-7, while a-1 indicates the serial port.

EXAMPLES:

:WH	Request handle identification
IHC	Command executed in handle C
:WH	Request handle identification
RS232	Command executed in RS232 port

WT

FUNCTION: Wait

DESCRIPTION:

The WT command is a trippoint used to time events. After this command is executed, the controller will wait for the number of samples specified before executing the next command. If the TM command has not been used to change the sample rate from 1 msec, then the units of the Wait command are milliseconds.

ARGUMENTS: WT n where

n is an integer in the range 0 to 2 Billion decimal

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	-
In a Program	Yes	Default Format	-
Command Line	Yes		

EXAMPLES: Assume that 10 seconds after a move is over a relay must be closed.

#A	Program A
PR 50000	Position relative move
BGA	Begin the move
AMA	After the move is over
WT 10000	Wait 10 seconds
SB 0	Turn on relay
EN	End Program

Hint: *To achieve longer wait intervals, just stack multiple WT commands.*

XQ

FUNCTION: Execute Program

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.

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value of n:	0
Default Format	-

OPERAND USAGE:

_XQn contains the current line number of execution for thread n, and -1 if thread n is not running.

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: *Don't forget to quit the edit mode first before executing a program!*

ZA

FUNCTION: User Network Variable 1

DESCRIPTION:

ZA sets the first user variable on a slave controller for use with a distributed control system. The two user variables (ZA and ZB) are automatically sent as part of the status record from the slave controller to the master controller. These variables provide a method for specific slave information to be passed to the master automatically.

ARGUMENTS: 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 user network variable value on a slave

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	Yes

DEFAULTS:

Default Value	--
Default Format	--

OPERAND USAGE:

_ZAa is called on the master controller and contains the user variable defined by the slave controller on axis a set with the ZA command. a is global axis A,B,C,D,E,F,G or H.

RELATED COMMANDS:

"ZB"	Set second user network variable

EXAMPLES:

ZA 2343	Sets the first user variable to a number (2343). This is called on the slave controller Call _ZAa on the master controller to retrieve the value.

ZB

FUNCTION: User Network Variable 2

DESCRIPTION:

ZB sets the second user variable on a slave controller for use with a distributed control system. The two user variables (ZA and ZB) are automatically sent as part of the status record from the slave controller to the master controller. These variables provide a method for specific slave information to be passed to the master automatically.

ARGUMENTS: ZB 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 user network variable value on a slave

USAGE:		**DEFAULTS:**	
While Moving	Yes	Default Value	--
In a Program	Yes	Default Format	--
Command Line	Yes		

OPERAND USAGE:

_ZBa is called on the master controller and contains the user variable defined by the slave controller on axis a set with the ZB command. a is global axis A,B,C,D,E,F,G or H.

RELATED COMMANDS:

"ZA"	Set first user network variable

EXAMPLES:

ZB 2343	Sets the first user variable to a number (2343). This is called on the slave controller. Call _ZBa on the master controller to retrieve the value.

ZS

FUNCTION: Zero Subroutine Stack

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

USAGE:

While Moving	Yes
In a Program	Yes
Command Line	No

DEFAULTS:

Default Value	0
Default Format	3.0

OPERAND USAGE:

_ZSn contains the stack level for the specified thread where n = 0,1,2 or 3. Note: n can also be specified using A (thread 0), B(thread1), C(thread2) or D(thread3) .

EXAMPLES:

II1	Input Interrupt on 1
#A;JP #A;EN	Main program
#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

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