Parker
Automation

p/n 88-019933-01 A

Gemini GV6K and Gemini GT6K Command Reference

Effective: October 1, 2001

INFNC OUTFNC C LS TSKAX GO WHILE
TDIR LIMFNC A HELP OUT IF
D PS ONIN PCOMP
TRGFN LH WHEN ELSE
TPE GOBUF SFB
WAIT DEF END PRUN
STARTP RESET VARB
ERASE DEL VAR
TASF ENCCNT JOY JOG VARS MC
MA FOLEN TOUT DRFEN
HOM READ TIO
ERROR FOLMAS DRES ERES
TSTAT STRGTE TSSF
GOWHEN TFSF CMDDIR DATSIZ
TIN GOTO
SOFFS V TREV S K TINOF

IMPORTANT

User Information

⚠ WARNING ⚠

Gem6K Series products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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Technical Assistance ⇨ *Contact your local automation technology center (ATC) or distributor,* ***or ...***

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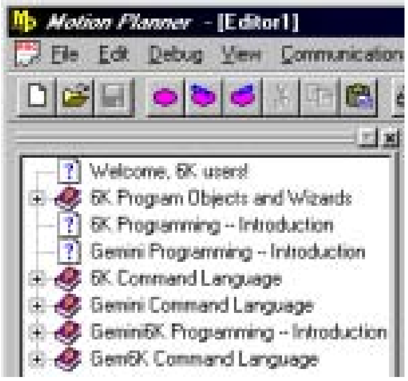
Introduction

Purpose of this Document

This document is a reference for all the Gem6K Series commands. To gain a full understanding of how the Gem6K Series commands are used together to implement specific features, refer to the *Gem6K Series Programmer's Guide* (p/n 88-019934-01). For hardware-related information (e.g., electrical wiring connections, specifications, tuning, etc.), refer to the *Gem6K Series Hardware Installation Guide* (p/n 88-019932-01). Information on the Gem6K communications server (COM6SRVR) is provided in the *Communications Server Programmer's Reference.*

NOTE

The contents of this document are available from the Motion Planner help system. To access the help system, use the Info window (right), or press the F1 key.


Motion Planner - [Editor1]
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6K Programming -- Introduction
Gemini Programming -- Introduction
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Description of Format

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INEN **Input Enable**

			Product	**Rev**
4.	Type	`Inputs or Program Debug Tools`	GT6K	6.0
5.	Syntax	`<!><B>INEN<d><d><d>...<d>`	GV6K	6.0
6.	Units	`d = 0, 1, E, or X`		
7.	Range	`0 = off, 1 = on, E = enable, X = don't care`		
8.	Default	`E`		
9.	Response	`INEN: *INENEEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE`		
10.	See Also	`[IN], INFNC, INLVL, INPLC, INSTW, TIN, TIO`		

Item Number **Description**

1. **Mnemonic Code**: This field contains the command's mnemonic code. If the command is in brackets (e.g., `[ IN ]`), it is an operator that must be used within the syntax of another command (e.g., `IN` may be used in a conditional expression like `IF(IN.3=b1)`).

2. **Full Name**: This field contains the command's full name.

3. **Valid Product & Revision**: This field lists the Gem6K Series products and the revision of each product when this command was incorporated or modified per the description. If the command does not apply to that particular product, the **Rev** is specified as “n/a”.

   You can use the `TREV` command to determine which product revision you are using. For example, if the `TREV` response is `*TREV92-016740-01-6.0`, the product revision is 6.0.

4. **Type**: This field contains the command’s type.

5. **Syntax**: The proper syntax for the command is shown here. The specific parameters associated with the command are also shown. Definitions of the parameters are described in the *Syntax* sections below.

6. **Units**: This field describes what unit of measurement the parameter (b, d, `i`, `r`, or `t`) in the command syntax represents.

7. **Range**: This is the range of valid values that you can specify for an argument (or any other parameter specified).

8. **Default**: The default setting for the command is shown in this field. A command will perform its function with the default setting if you do not provide a value.

9. **Response**: Some commands allow you to check the status of the command. In the example above, entering the `INEN` command by itself, you will receive the response `*INENEEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE` (response indicates all inputs are enabled). The example responses provided are based on the default error level, Error Level 4, established with the `ERRLVL4` command.

10. **See Also**: Commands related or similar to the command described are listed here.

Syntax – Letters and Symbols

The command descriptions provided within this manual use alphabetic letters and ASCII symbols within the **Syntax** description (see example below) to represent different parameter requirements.

INEN Input Enable

			Product	Rev
	Type	`Inputs or Program Debug Tools`	GT6K	6.0
→	Syntax	`<!><%><B>INEN<d><d><d>...<d>`	GV6K	6.0
	Units	`d = 0, 1, E, or X`		
	Range	`0 = off, 1 = on, E = enable, X = don't care`		
	Default	`E`		
	Response	`INEN: *INENEEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE`		
	See Also	`[IN], INFNC, INLVL, INPLC, INSTW, TIN, TIO`		

Letter/Symbol **Description**

a_ ....Represents an address specifier, numeric value from 0 to 99. An address specifier is required if multiple Gem6K drives are connected in a daisy-chain or multi-drop configuration; in fact, leaving off the address specifier will cause parameter assignment commands to affect all units and response/transfer commands to request information from all units at the same time (multiple units transmitting characters at one time will garble the communication). To assign unique unit addresses to multiple drives, refer to the `ADDR` command.

B ....Represents the number of the product's I/O brick. External I/O bricks are represented by numbers 1 through n (to connect external I/O bricks, refer to the *Installation Guide*). On-board I/O are address at brick location zero (Ø). If the brick identifier is omitted from the command, the controller assumes the command is supposed to affect the onboard I/O.

b * ....Represents the values `1`, `0`, `X` or `x`; does not require field separator between values.

c ....Represents a character (A to Z, or a to z)

d ....Represents the values `1`, `0`, `X` or `x`, `E` or `e` ; does not require field separator between values. `E` or `e` enables a specific command field. `X` or `x` leaves the specific command field unchanged or ignored. In the `ANIEN` command, the "d" symbol may also represent a real numeric value.

`i` ....Represents a numeric value that cannot contain a decimal point (integer values only). The numeric range varies by command. Field separator required.

`r` ....Represents a numeric value that may contain a decimal point, but is not required to have a decimal point. The numeric range varies by command. Field separator required.

`t` ....Represents a string of alpha numeric characters from 1 to 6 characters in length. The string must start with a alpha character.

`!` ....Represents an immediate command. Changes a buffered command to an immediate command. Immediate commands are processed immediately, even before previously entered buffered commands.

`%` ....(Multitasking Only) Represents a task identifier. To address the command to a specific task, prefix the command with "`i%`", where "`i`" is the task number. For example, the `4%CUT` command uses task #4 to execute the program called "`CUT`".

`,` ....Represents a field separator. Commands with the symbol `r` or `i` in their Syntax description require field separators. Commands with the symbol b or d in their Syntax description **do not** require field separators (but they may be included). See *General Guidelines* table below.

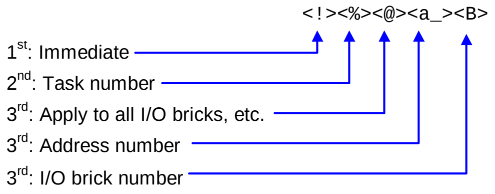
`@` ....Represents a global specifier, where only one field need be entered. Applicable to all commands with multiple command fields. (e.g., `@OUT1` sets output #1 on for all I/O bricks).

`< >` ......Indicates that the item contained within the `< >` is optional, not required by that command. NOTE: Do not confuse with `<cr>`, `<sp>`, and `<lf>`, which refer to the ASCII characters corresponding to a carriage return, space, and line feed, respectively.

`[ ]` ......Indicates that the command between the `[ ]` must be used in conjunction with another command, and cannot be used by itself.

* The ASCII character b can also be used within a command to precede a binary number. When the b is used in this context, it is not to be replaced with a `0`, `1`, `X`, or `x`. Examples are assignments such as `VARB1=b10001`, and comparisons such as `IF(3IN=b1001X1)`.

Order of Precedence for Command Prefix Characters (from left to right):



`<!><%><@><a_><B>`

1st: Immediate

2nd: Task number

3rd: Apply to all I/O bricks, etc.

3rd: Address number

3rd: I/O brick number

Syntax – General Guidelines

Guideline Topic	Guideline	Examples

Command Delimiters (`<cr>`, `<lf>`, and `:`)	All commands must be separated by a delimiter. A carriage return is the most commonly used. The colon (`:`)allows you to place multiple commands on one line of code.	Set acceleration to 10 rev/sec/sec:
		`A10<cr>`
		`A10<lf>`
		`A10: V25 : D25000 : GO<cr>`

Neutral Characters (`<sp>` and `<tab>`)	Using neutral characters anywhere within a command will not affect the command.	Set velocity to 10 rps: `V<sp>10<cr>`

Case Sensitivity	There is no case sensitivity. Use upper or lower case letters within commands.	Initiate motion:
		`GO1`
		`go1`

Comment Delimiter (;)	All text between a comment delimiter and a command delimiter is considered *program comments*.	Add a comment to the command: `V10<tab> ;set velocity`
Field Separator (`,`)	Commands with the symbol `r` or `i` in their Syntax description require field separators.	Display variable #1 on the RP240 at the current cursor location with 3 characters displayed to the left of the decimal, 2 to the right of the decimal, and the sign: `DVAR1,3,2,1`
	Commands with the symbol b or d in their Syntax description **do not** require field separators (but they may be included).	Enable error checking for hard limits and drive faults: `ERROR0101`
Global Command Identifier (@)	When you wish to set the command value equal on all outputs, add the `@` symbol at the beginning of the command (enter only the value for one command field).	Set the digital outputs (#1 & #2) active on all digital outputs (onboard and external): `@OUT11`
	The `@` symbol is also useful for checking the status of all inputs or outputs on all I/O bricks.	Check the status of all digital outputs (onboard, and on external I/O bricks): `@OUT`

Bit Select Operator (`.`)	The bit select operator allows you to affect one or more binary bits without having to enter all the preceding bits in the command.
	Syntax for setup commands:
	`[command name].[bit #]-[binary value]`
	Syntax for conditional expressions:
	`[command name].[bit #]=[binary value]`
		Enable error-checking bit #9:
		`ERROR.9-1`
		Enable error-check bits #9-12:
		`ERROR.9-1,1,1,1`
		IF statement based on value of axis status bit #12 for axis #1:
		`IF(1AS.12=b1)`

Left-to-right Math	All mathematical operations assume left-to-right precedence.	`VAR1=5+3*2` Result: Variable 1 is assigned the value of 16 (8*2), not 11 (5+6).
Binary and Hexadecimal Values	When making assignments with or comparisons against binary or hexadecimal values, you must precede the binary value with the letter “b” or “B”, and the hex value with “h” or “H”. In the binary syntax, an “x” simply means the status of that bit is ignored.	Binary: `IF(IN=b1x01)` ↑ Hexadecimal: `IF(IN=h7F)` ↑

Multi-tasking Task Identifier (%)	Use the `%` command prefix to identify the command with a specific task.	Launch the “`move1`” program in Task 1:
		`1%move1`
		Check the error status for Task 3:
		`3%TER`
		Check the system status for Task 3:
		`3%TSS`

NOTE: The command line is limited to 80 characters (excluding spaces).

Syntax – Command Value Substitutions

Many commands can substitute one or more of its command field values with one of these substitution items (demonstrated in the programming example below):

VAR .... Places current value of the numeric variable in the corresponding field of the command.
VARB........... Uses the value of the binary variable to establish all the fields in the command.
VARI........... Places current value of the integer variable in the corresponding field of the command.
READ........... Information is requested at the time the command is executed.
DREAD .... Reads the RP240's numeric keypad into the corresponding field of the command.
DREADF...... Reads the RP240's function keypad into the corresponding field of the command.
TW .... Places the current value set on the thumbwheels in the corresponding field of the command.
DAT .... Places the current value of the data program (DATP) in the corresponding field of the command.

Programming Example: *(NOTE: The substitution item must be enclosed in parentheses.)*

```
VAR1=15          ; Set variable 1 to 15
A(VAR1)          ; Set acceleration to 15
VARB1=b101XX     ; Set binary variable 1 to 101XX (bits 4 & 5 not affected)
OUT(VARB1)       ; Turn on ouputs 1 & 3, turn off output 2, don't change outputs 4 &
                    5.
VARS1="Enter Velocity" ; Set string variable 1 to the message "Enter Velocity"
V(READ1)         ; Read in the velocity, output variable string 1 as the prompting
                    message
                 ; 1. Operator sees "ENTER VELOCITY" displayed on the screen.
                 ; 2. Operator enters velocity prefixed by !' (e.g., !'20).
HOMV(TW1)        ; Read in the home velocity from thumbwheel set 1
HOMVF(DAT1)      ; Read home final velocity from data program 1.
VARI1=2*3        ; Set integer variable 1 to 6 (2 multiplied by 3)
D(VARI2)         ; Set the distance equal to the value of
                 ; integer variable 2.
```

Rule of Thumb

Not all of the commands allow command field substitutions. In general, commands with a binary command field (<b> in the syntax) will accept the VARB substitution. Commands with a real or integer command field (<r> or <i> in the syntax) will accept VAR, VARI, READ, DREAD, DREADF, TW or DAT.

Programming Interface Tools

Motion Planner™, a graphical programming interface, is provided as a tool for programming your Gem6K drive. These are the functions provided:

- Configuration (motor selection, tuning, motor matching and damping, etc.)
- Terminal emulation for sending commands and checking drive status
- Program editor for developing program files to send to the drive
- Downloading and uploading program and operating system files to/from the drive

Motion Planner runs on the Windows 95, Windows 98 and Windows NT operating systems.

Motion Planner is installed from the "Motion Planner" CD which is included in your Gem6k drive shipment (unless you ordered the -NK option).

Communications Server: Also available on the Motion Planner CD is the Communications Server (COM6SRVR.EXE). COM6SRVR.EXE is a 32-bit OLE automation server that allows you to add Gem6K (as well as Gemini and 6K) communication capability to your custom applications created with programming languages such as Visual Basic, Visual C++, and Delphi. The Motion Planner installation program installs COM6SRVR.EXE in the Motion Planner directory. Details on the Communication Server functions are provided in the *COM6SRVR Communications Server User Guide*.

NOTE

The Gem6K commands described in this document can be used only with Motion Planner or the COM6SRVR Communications Server.

Using Motion Planner with a Gem6K Drive

Motion Planner is a programming interface for the Gemini product family, as well as the 6K product family. Motion Planner runs on the Windows 95, Windows 98 and Windows NT operating systems. Below are instructions on how to use Motion Planner with your Gem6K.

Installing Motion Planner:

System Requirements:

- IBM-compatible PC with a Pentium 166 MHz or higher processor.
- Operating system: Microsoft Windows 95, Microsoft Windows NT Workstation 4.0, or Microsoft Windows 98.
- 32MB RAM.
- Hard disk space: 16MB minimum.
- PCI VGA with 800 x 600 resolution or higher.
- CD-ROM drive or internet access for installation.
- Mouse or pointing device.
- RS-232C serial port for using serial RS-232C communications.

Insert the Motion Planner CD in your CD-ROM player. The installation program automatically launches and displays this dialog:

Updating the Drive's Operating System:

Gem6K drives are digital motor drives that run under an internal software operating system. The operating system was loaded into your drive during the manufacturing process, and under ordinary circumstances you will not need to update your drive's operating system. However, because Compumotor continues to add enhancements and address software bugs, you may want to upgrade the operating system. You may obtain a new operating system file from the Compumotor web site, or from Technical Support (see phone numbers on the inside cover of this manual).

Web Site Download:

The operating system file is located in the software download section of the *Compumotor Online* web site (http://www.compumotor.com). The file name is in this format: GEM_*n*_*nn*.ops. For example, the operating system file for version 1.50 is called GEM_1_50.ops. Download the file to the Motion Planner directory on your hard drive.

Update Procedure:

1. Using the Gem6K's RS-232 connector (COM 2), connect to your computer's RS-232 serial communication port (see instructions in the *Hardware Installation Guide*).
   NOTE: You can download the operating system to only one drive unit at a time and you must use RS-232 communication (no daisy chains).
   NOTE: You must use the Gem6K's RS-232 connector (COM 2), not the RS-232/485 connector (COM 1).
2. Launch Motion Planner.
3. In the Default Communications Settings dialog box, select your Gem6K drive and select the serial port to which the drive is connected, then click "OK".
4. Click on the Terminal tab to expose the terminal emulator.
5. From the **Communications** pull-down menu, select **Download OS**. When presented with the **Locate Gem6K Operating System** dialog, locate the operating system file and click the **Open** button. This initiates the download to the drive and displays the download status dialog.
6. When the download is completed successfully, Motion Planner displays a confirmation message. Also, the drive automatically resets itself and displays the `TREV` response in the terminal emulator window. Check the `TREV` report to verify that the proper operating system revision is now in the drive (e.g., the response "`*TREV-GV-L3E_D1.05_F1.00`" indicates that the drive is using OS revision 1.05, denoted by "`D1.05`").

NOTE: If the download is interrupted or corrupted, the drive will flash the left LED (red) until a valid operating system is downloaded.

Programmable I/O Bit Patterns

The Gem6K has programmable inputs and outputs. The total number of onboard inputs and outputs (analog inputs, digital inputs and digital outputs) is fixed. The total number of expansion inputs and outputs depends on your configuration of expansion I/O bricks.

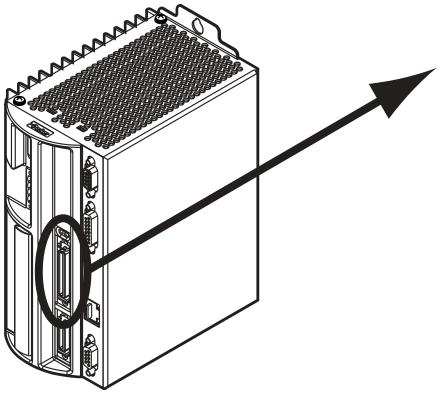
These programmable I/O are represented by binary bit patterns, and it is the bit pattern that you reference when programming and checking the status of specific inputs and outputs. The bit pattern is referenced 1 to *n*, from left to right.

- Onboard I/O. For example, the status command to check all onboard inputs is `TIN`.
  An example response is: `*TIN0100_0`.
  Bit 1 — Bit 5
- Expansion I/O. For example, the status command to check all digital inputs on I/O brick 2 is `2TIN`.
  An example response is: `*2TIN0010_0110_1100_0000_XXXX_XXXX_XXXX_XXXX`.
  I/O Brick 2 — Bit 1 — Bit 32

Onboard I/O

I/O	Location	Programming	Status Report, Assignment
Limit Inputs	"DRIVE I/O" connector	`LIMFNC`, `LIMEN`, `LIMLVL`	`TLIM`, `LIM`
Inputs (digital)	"DRIVE I/O" connector	`INFNC`, `INLVL`, `INEN`, `ONIN`, `INPLC`, `INSTW`	`TIN`, `IN`
Outputs (digital)	"DRIVE I/O" connector	`OUT`, `OUTFNC`, `OUTLVL`, `OUTEN`, `OUTALL`, `OUTPLC`, `OUTTW`, `POUT`	`TOUT`, `[OUT]`

Limit Inputs ("DRIVE I/O" connector)



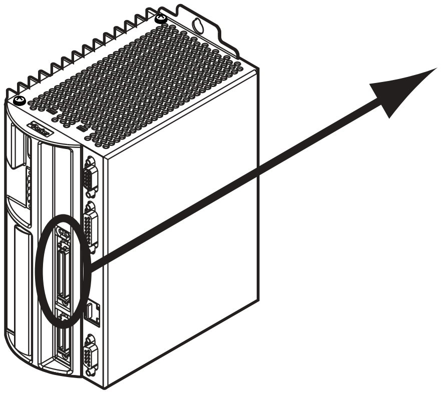
Input bit pattern for `LIM`, `TLIM`, `LIMEN`, `LIMFNC`, and `LIMLVL`:

Bit #	Pin #	Function *
1	28	Positive end-of-travel limit
2	29	Negative end-of-travel limit
3	31	Home limit

* The functions listed are the factory default functions; other functions may be assigned with the `LIMFNC` command.

Sample response to `TLIM` (limit inputs status) command:
`*TLIM110`

Inputs ("DRIVE I/O" connector)



Input bit pattern for TIN, IN, INFNC, INLVL, INEN, INPLC, INSTW, and ONIN:

Bit #	Pin #	Function *
1	37	Input 1 (if assigned, TRIG-A)
2	38	Input 2 (if assigned, TRIG-B)
3	39	Input 3
4	34	Input 4
5	35	Input 5 (if assigned, TRIG-M)

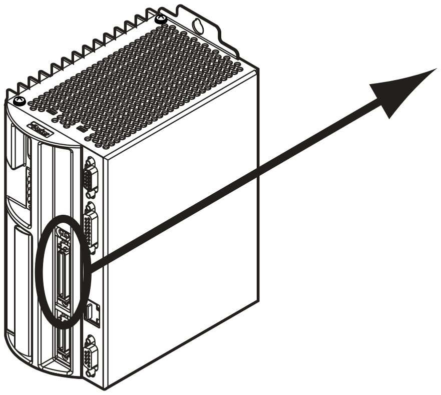
* If the input is assigned the "trigger interrupt" function with the INFNCi-H command:

TRIG-A must be on Input 1
TRIG-B must be on Input 2
TRIG-M must be on input 5

Sample response to TIN (input status) command:

```
*TIN0010_1
```

Outputs ("DRIVE I/O" connector)



Output bit pattern for TOUT, [OUT], OUT, OUTFNC, OUTLVL, OUTEN, OUTALL, OUTPLC, OUTTW, POUT:

Bit #	Pin #	Function
1	41	Output 1.
2	43	Output 2.
3	45	Output 3.
4	46	Output 4.
5	48	Output 5.
6	49	Output 6.
7	Relay	Output 7.

Sample response to TOUT (onboard outputs status) command:

```
*TOUT0000_000
```

Expansion I/O Bricks

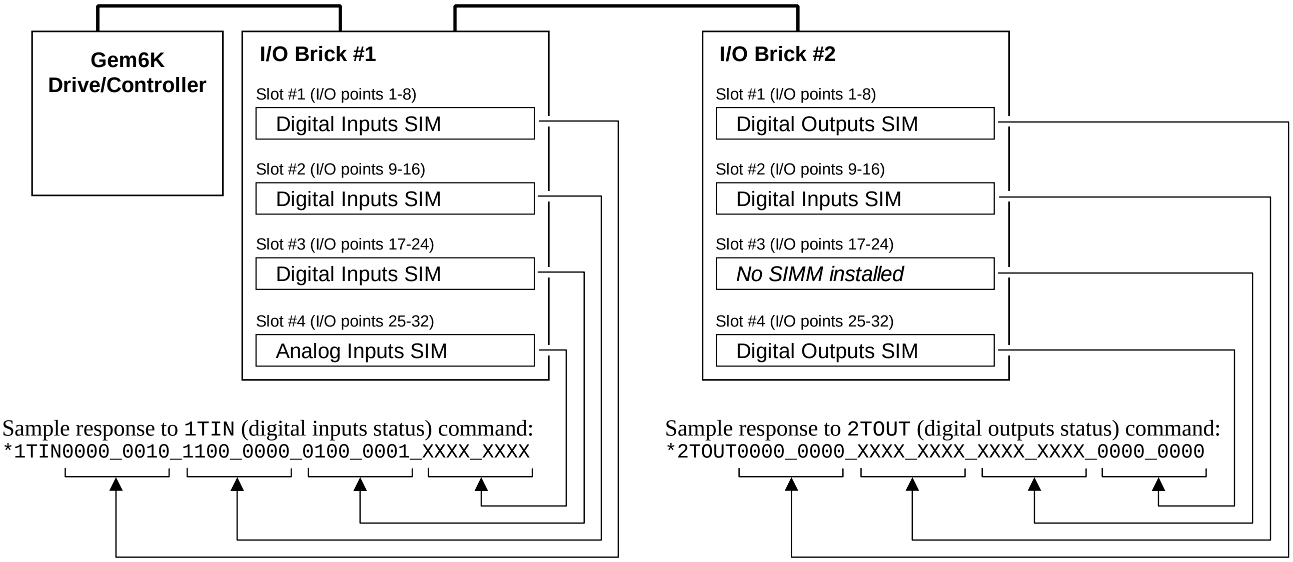
The Gem6K allows you to expand your system I/O by connecting up to eight I/O bricks (see *Installation Guide* for connections). Expansion I/O bricks may be ordered separately (referred to as the "EVM32"). Each I/O brick can hold from 1 to 4 of these I/O SIM modules in any combination:

SIM Type	Programming	Status Report, Assignment
Digital Inputs SIM (8 inputs)	INFNC, INLVL, INEN, ONIN, INPLC, INSTW	TIN, IN, TIO
Digital Outputs SIM (8 outputs)	OUT, OUTFNC, OUTLVL, OUTEN, OUTALL, OUTPLC, OUTTW, POUT	TOUT, [OUT], TIO
Analog Inputs SIM (8 inputs)	• Enable/Disable: ANIEN. • Voltage range: ANIRNG. • Joystick setup: JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYZ. • Following master source: ANIMAS, FOLMAS	• Voltage: TANI, ANI, TIO
Analog Outputs SIM (8 outputs)	ANO	TANO, [ANO], TIO

Each I/O brick has a unique "brick address", denoted with the "<B>" symbol in the command syntax. The I/O bricks are connected in series to the "EXPANSION I/O" connector on the Gem6K. The 1st I/O brick has address #1, the next brick has address #2, and so on. (**NOTE**: If you leave out the brick address in the command, the Gem6K will assume you are addressing the command to the onboard I/O.) Each I/O brick has 32 I/O addresses, referenced as absolute I/O point locations:

- SIM slot 1 = I/O points 1-8
- SIM slot 2 = I/O points 9-16
- SIM slot 3 = I/O points 17-24
- SIM slot 4 = I/O points 25-32

Example:



Sample response to 1TIN (digital inputs status) command:

```
*1TIN0000_0010_1100_0000_0100_0001_XXXX_XXXX
```

Sample response to 2TOUT (digital outputs status) command:

```
*2TOUT0000_0000_XXXX_XXXX_XXXX_XXXX_0000_0000
```

The TIO command identifies the connected I/O bricks (and installed SIMs), including the status of each I/O point:

```
  *BRICK 1:  SIM Type          Status      Function
        1-8: DIGITAL INPUTS    0000_0000   AAAA_AAAA
       9-16: DIGITAL INPUTS    0000_0000   AAAA_AAAA
      17-24: DIGITAL INPUTS    0000_0000   AAAA_AAAA
      25-32: ANALOG INPUTS     0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000

  *BRICK 2:  SIM Type          Status      Function
        1-8: DIGITAL OUTPUTS   0000_0000   AAAA_AAAA  -- SINKING
       9-16: DIGITAL INPUTS    0000_0000   AAAA_AAAA
      17-24: NO SIM PRESENT
      25-32: DIGITAL OUTPUTS   0000_0000   AAAA_AAAA  -- SOURCING
```

Programming Error Messages

Depending on the error level setting (set with the ERRLVL command), when a programming error is created, the Gem6K will respond with an error message and/or an error prompt. A list of all possible error messages is provided in a table below. The default error prompt is a question mark (?), but you can change it with the ERRBAD command if you wish.

At error level 4 (ERRLVL4—the factory default setting) the Gem6K responds with both the error message and the error prompt. At error level 3 (ERRLVL3), the Gem6K responds with only the error prompt.

Error Response	Possible Cause
ACCESS DENIED	Program security feature enabled, but the *program access input* (INFNCi-Q or LIMFNCi-Q) is not activated.
ALREADY DEFINED FOR THUMBWHEELS	Attempting to assign an I/O function to an I/O that is already defined as a thumbwheel I/O.
ALTERNATIVE TASK NOT ALLOWED	Attempting to execute a LOCK command directed to another task.
AXES NOT READY	Compiled Profile path compilation error.
COMMAND NOT IMPLEMENTED	Command is not applicable to the Gem6K Series product.
COMMAND NOT ALLOWED IN PROGRAM	Command is not allowed inside a program definition (between DEF and END).
COMMAND/DRIVE MISMATCH	The command is not appropriate to the type of drive being used (e.g., attempting to execute a servo tuning command on a stepper axis)
ERROR: MOTION ENDS IN NON-ZERO VELOCITY	Compiled Motion: The last GOBUF segment within a PLOOP/PLN loop does not end at zero velocity, or there is no final GOBUF segment placed outside the loop.
FOLMAS NOT SPECIFIED	No FOLMAS for the axis is currently specified. It will occur if FMCNEW, FSHFC, or FSHFD commands are executed and no FOLMASØ command was executed, or FOLMAS0 was executed.
INCORRECT AXIS	Axis specified is incorrect.
INCORRECT BRICK NUMBER	Attempted to execute a command that addresses an I/O brick that is not connected to your Gem6K controller.
INCORRECT DATA	Incorrect command syntax. Following: Velocity (V), acceleration (A) or deceleration (AD) command is zero (used by FSHFC & FSHFD).
INPUT(S) NOT DEFINED AS JOYSTICK INPUT	Attempted to execute JOYCDB, JOYCTR, JOYEDB, or JOYZ before executing JOYAXH to assign the analog input.
INSUFFICIENT MEMORY	Not enough memory for the user program or compiled profile segments. This may be remedied by reallocating memory (see MEMORY command description).
INVALID COMMAND	Command is invalid because of existing conditions

Programming Error Messages *(continued)*

Error Response	Possible Cause
INVALID CONDITIONS FOR COMMAND	System not ready for command (e.g., LN command issued before the L command). Following (these conditions can cause an error during Following): • The FOLMD value is too small to achieve the preset distance and still remain within the FOLRN/FOLRD ratio. • A phase shift cannot be performed: FSHFD .... Error if already shifting or performing other time based move. FSHFC .... Error if currently executing a FSHFD move, or if currently executing another FSHFC move in the opposite direction. • The FOLEN1 command was given while a profile was suspended by a GOWHEN.
INVALID CONDITIONS FOR S_CURVE ACCELERATION—FIELD *n*	Average (AA) acceleration or deceleration command (e.g., AA, ADA, HOMAA, HOMADA, etc.) with a range that violates the equation ½A ≤ AA ≤ A (A is the max. accel or decel command—e.g., A, AD, HOMA, HOMAD, etc.)
INVALID DATA	Data for a command is out of range. Following (these conditions can cause an error during Following): • The parameter supplied with the command is valid. FFILT Error if: smooth number is not 0-4 FMCLEN .. Error if: master steps > 999999999 or negative FMCP ...... Error if: master steps > 999999999 or < -999999999 FOLMD .... Error if: master steps > 999999999 or negative FOLRD .... Error if: master steps > 999999999 or negative FOLRN .... Error if: follower steps > 999999999 or negative FSHFC .... Error if: number is not 0-3 FSHFD .... Error if: follower steps > 999999999 or < -999999999 GOWHEN .. Error if: position > 999999999 or < -999999999 WAIT ...... Error if: position > 999999999 or < -999999999 • Error if a GO command is given in the preset positioning mode (MCØ) and: FOLRN = zero FOLMD = zero, or too small (see Following chapter in the *Programmer's Guide*)
INVALID FOLMAS SPECIFIED	Following: An illegal master was specified in FOLMAS. A follower may never use its own commanded position or feedback source as its master.
INVALID RATIO	Following: Error if the FOLRN:FOLRD ratio after scaling is > 127 when a GO is executed.
INVALID TASK IDENTIFIER	Attempting to launch a PEXE or EXE command into the supervisor task (task 0).
LABEL ALREADY DEFINED	Defining a program or label with an existing program name or label name.
MASTER SLAVE DISTANCE MISMATCH	Attempting a preset Following move with a FOLMD value that is too small.
MAXIMUM COMMAND LENGTH EXCEEDED	Command exceeds the maximum number of characters.
MAXIMUM COUNTS PER SECOND EXCEEDED	Velocity value is greater than 1,600,000 counts/sec.
MOTION IN PROGRESS	Attempting to execute a command not allowed during motion (see Restricted Commands During Motion section in the *Programmer's Guide*.) Following: The FOLEN1 command was given while that follower was moving in a non-Following mode.
NEST LEVEL TOO DEEP	IFs, REPEATs, WHILEs, or GOSUBs nested greater than 16 levels (for each type).

Programming Error Messages *(continued)*

Error Response	Possible Cause
`NO MOTION IN PROGRESS`	Attempting to execute a command that requires motion, but motion is not in progress.
`NO PATH SEGMENTS DEFINED`	Compiled Profile compilation error.
`NO PROGRAM BEING DEFINED`	`END` command issued before a `DEF` command.
`NOT ALLOWED IN PATH`	Compiled Profile path compilation error.
`NOT VALID DURING FOLLOWING MOTION`	A `GO` command was given while moving in the Following mode (`FOLEN1`) and while in the preset positioning mode (`MCØ`).
`NOT VALID DURING RAMP`	A `GO` command was given while moving in a Following ramp and while in the continuous positioning mode (`MC1`). Following status (`FS`) bit #3 will be set to 1. A `FOLEN` command was given during one of these conditions: • During a shift (`FSHFC` or `FSHFD`) • During a change in ratio (`FOLRN`/`FOLRD`) • During deceleration to a stop
`OUTPUT USED AS OUTFNC`	Attempting to change an output that is not an `OUTFNCi-A` output.
`PROFILE ALREADY MOVING`	Compiled Profile compilation error.
`PROFILE NOT COMPILED`	Attempting to execute a profile that has not been compiled.
`STRING ALREADY DEFINED`	A string (program name or label) with the specified name already exists.
`STRING IS A COMMAND`	Defining a program or label that is a command or a variant of a command.
`UNDEFINED LABEL`	Command issued to product is not a command or program name.
`WARNING: POINTER HAS WRAPPED AROUND TO DATA POINT 1`	During the process of writing data (`DATTCH`) or recalling data (`DAT`), the pointer reached the last data element in the program and automatically wrapped around to the first datum in the program.
`WARNING: ENABLE INPUT INACTIVE`	**ENABLE** input is no longer connected to ground (**GND**).
`WARNING: DEFINED WITH ANOTHER TW/PLC`	Duplicate I/O in multiple thumbwheel definitions.

Identifying Bad Commands

To facilitate program debugging, the Transfer Command Error (`TCMDER`) command allows you to transfer the first command that the controller detects as an error. This is especially useful if you receive an error message when running or downloading a program, because it catches and remembers the command that caused the error.

Using Motion Planner: If you are typing the command in a live terminal emulator session, the controller will detect the bad command and respond with an error message, followed by the `ERRBAD` error prompt (`?`). If the bad command was detected on download, the bad command is reported automatically (see example below).

NOTE: If you are not using Motion Planner, you'll have to type in the `TCMDER` command at the error prompt to display the bad command.

Once a command error has occurred, the command and its fields are stored and system status bit #11 (reported in the `TSSF`, `TSS` and `SS` commands) is set to `1`. The status bit remains set until the `TCMDER` command is issued.

Example Error Scenario:

1. In Motion Planner's program editor, create and save a program with a programming error:

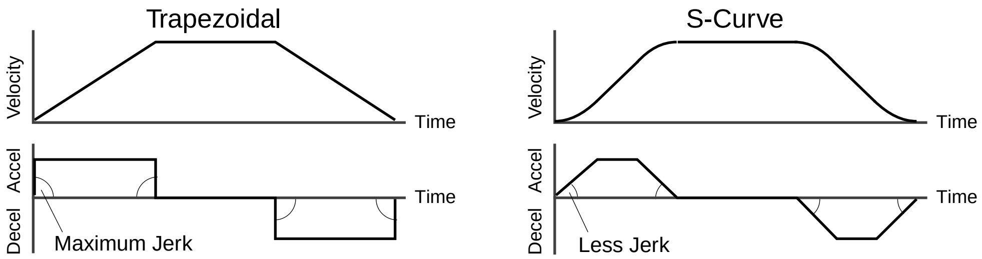
```
DEL badprg    ; Delete a program before defining and downloading
DEF badprg    ; Begin definition of program called badprg
MA1           ; Select the absolute preset positioning mode
A25           ; Set acceleration
AD11          ; Set deceleration
V5            ; Set velocity
VAR1=0        ; Set variable #1 equal to zero
GO1           ; Initiate move
IF(VAR1<)16   ; MISTYPED IF STATEMENT - should be typed as "IF(VAR1<16)"
VAR1=VAR1+1   ; If variable #1 is less than 16, increment the counter by 1
NIF           ; End IF statement
END           ; End programming of program called badprg
```

2. Using Motion Planner's terminal emulator, download the program to the Gem6K Series product. Notice that an error response identifies the bad command as an "`INCORRECT DATA`" item and displays it:

```
> *NO ERRORS
*INCORRECT DATA
> *IF(VAR1<)16
```

S-Curve Acceleration/Deceleration Profiling

The Gem6K allows you to perform *S-curve* move profiles, in addition to the usual trapezoidal profiles. S-curve profiling provides smoother motion control by reducing the *jerk* (rate of change) in acceleration and deceleration portions of the move profile (see drawing below). Because S-curve profiling reduces jerk, it improves position tracking performance, especially in linear interpolation applications.



S-Curve Programming Requirements

To program an S-curve profile, you must use the *average accel/decel* commands provided in the Gem6K programming language. For every maximum accel/decel command (e.g., A, AD, HOMA, HOMAD, JOGA, JOGAD, etc.) there is an *average* command for S-curve profiling (see table below).

Maximum Accel/Decel Commands:		**Average ("S-Curve") Accel/Decel Commands:**	
Command	**Function**	**Command**	**Function**
A	Acceleration	AA	Average Acceleration
AD	Deceleration	ADA	Average Deceleration
HOMA	Home Acceleration	HOMAA	Average Home Acceleration
HOMAD	Home Deceleration	HOMADA	Average Home Deceleration
JOGA	Jog Acceleration	JOGAA	Average Jog Acceleration
JOGAD	Jog Deceleration	JOGADA	Average Jog Deceleration
JOYA	Joystick Acceleration	JOYAA	Average Joystick Acceleration
JOYAD	Joystick Deceleration	JOYADA	Average Joystick Deceleration
LHAD	Hard Limit Deceleration	LHADA	Average Hard Limit Deceleration
LSAD	Soft Limit Deceleration	LSADA	Average Soft Limit Deceleration

Determining the S-Curve Characteristics

The command values for average accel/decel (AA, ADA, etc.) and maximum accel/decel (A, AD, etc.) determine the characteristics of the S-curve. To smooth the accel/decel ramps, you must enter average accel/decel command values that satisfy the equation $\boxed{\frac{1}{2} A \leq AA < A}$, where A represents maximum accel/decel and AA represents average accel/decel. Given this requirement, the following conditions are possible:

Acceleration Setting	Profiling Condition
AA > ½ A, but AA < A	S-curve profile with a variable period of constant acceleration. Increasing the AA value above the pure S-curve level (AA > ½ A), the time required to reach the target velocity and the target distance is decreased. However, increasing AA also increases jerk.
AA = ½ A	*Pure S-curve* (no period of constant acceleration—smoothest motion).
AA = A	Trapezoidal profile (but can be changed to an S-curve by specifying a new AA value less than A).
AA < ½ A; or AA > A	When you issue the `GO` command, the move will not be executed and an error message, `*INVALID CONDITIONS FOR S_CURVE ACCELERATION—FIELD` *n*, will be displayed.
AA = zero	S-curve profiling is disabled. Trapezoidal profiling is enabled. AA tracks A. (*Track* means the command's value will match the other command's value and will continue to match whatever the other command's value is set to.) However, if you enter an average decel command (e.g., `ADA`, `HOMADA`, etc.) equal to zero, you will receive the "`INVALID DATA-FIELD n`" error.
AA ≠ zero and AA ≠ A	S-curve profiling is enabled **only for standard moves.** All subsequent standard moves for that axis must comply with this equation: ½ A ≤ AA < A.
AA > ½ A	Average accel/decel is raised above the pure S-curve level; this decreases the time required to reach the target velocity and distance. However, increasing AA also increases jerk. After increasing AA, you can reduce jerk by increasing A, but be aware that increasing A requires a greater torque to achieve the commanded velocity at the mid-point of the acceleration profile.
No AA value ever entered	Profile will default to trapezoidal. AA tracks A.

If you never change the A or AA deceleration commands, AA deceleration will track AA acceleration. However, once you change A deceleration, AA deceleration will no longer track changes in AA acceleration. For example, if you never change the `AD` or `ADA` command values, `ADA` will track the `AA` command value. But once you change `AD`, the `ADA` command value will no longer track the changes in the `AA` command value.

Calculating Move Times. The calculation for determining S-curve average accel and decel move times is as follows (*calculation method identical for S-curve and trapezoidal moves*):

$$\text{Time} = \frac{\text{Velocity}}{A_{\text{avg}}} \quad \text{or} \quad \text{Time} = \sqrt{\frac{2 * \text{Distance}}{A_{\text{avg}}}}$$

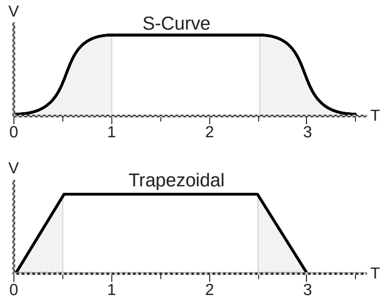
Scaling affects the AA average acceleration (`AA`, `ADA`, etc.) the same as it does for the A maximum acceleration (`A`, `AD`, etc.). See page 19 for details on scaling.

NOTE: Equations for calculating jerk are provided on page 17.

Programming Example *(see move profile drawings below)*

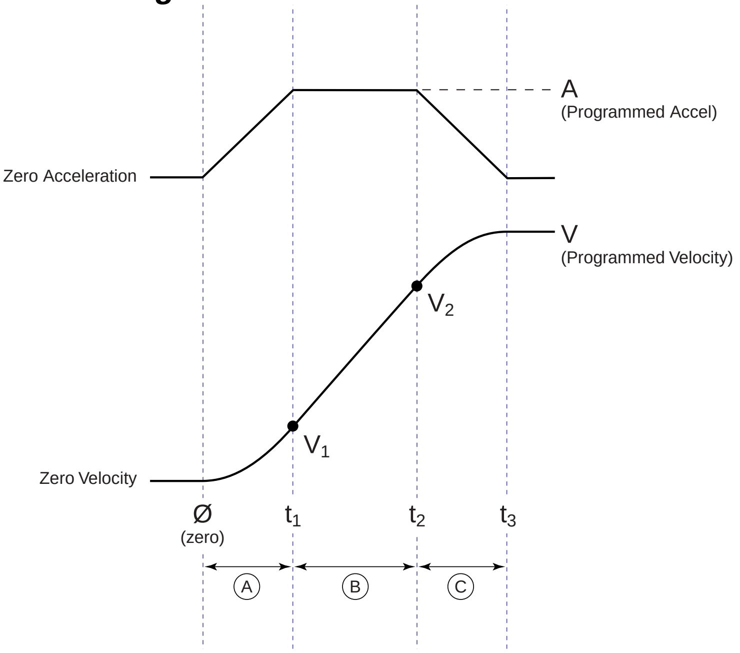
```
; In this example, prog1 executes a pure S-curve and takes 1 second
; to reach a velocity of 5 rps; prog2 executes a trapezoidal profile
; and takes 0.5 seconds to reach a velocity of 5 rps.
SCALE0    ; Disable scaling
DEL Prog1 ; Delete program called prog1
DEF Prog1 ; Begin definition of prog1
MA0       ; Select incremental positioning mode
D40000    ; Set distance to 40,000
A10       ; Set max. accel to 10 revs/sec/sec
AA5       ; Set avg. accel to 5 revs/sec/sec
AD10      ; Set max. decel to 10 revs/sec/sec
ADA5      ; Set avg. decel to 5 revs/sec/sec
V5        ; Set velocity to 5 revs/sec
GO1       ; Execute motion
END       ; End definition of prog1

DEL Prog2 ; Delete program called prog2
DEF Prog2 ; Begin definition of prog2
MA0       ; Select incremental positioning mode
D40000    ; Set distance to 40,000
A10       ; Set max. accel to 10 revs/sec/sec
AA10      ; Set avg. accel to 10 revs/sec/sec
AD10      ; Set max. decel to 10 revs/sec/sec
ADA10     ; Set avg. decel to 10 rev/sec/sec
V5        ; Set velocity to 5 revs/sec
GO1       ; Execute motion
END       ; End definition of program #2
```



Move profiles

Calculating Jerk



Rules of Motion:

$$\text{Jerk} = \frac{da}{dt}$$

$$a = \frac{dv}{dt}$$

$$v = \frac{dx}{dt} \quad (x = \text{distance})$$

Assuming the accel profile starts when the load is at zero velocity and the ramp to the programmed velocity is not compromised:

$$\textbf{Jerk} = J_A = \frac{A^2 * AA}{V\,(A-AA)}$$

A = programmed acceleration (A, AD, HOMAD, etc.)

AA = average acceleration (AA, ADA, HOMAA, etc.)

V = programmed velocity (V, HOMV, etc.)

$$t_1 = \frac{A}{J_A}$$

$$t_2 = \frac{V}{AA} - \frac{A}{J_A}$$

$$t_3 = \frac{V}{AA}$$

NOTE: $t_3 - t_2 = t_1$

$$V_1 = \frac{J_A * t_1^2}{2} = \frac{A^2}{2 * J_A}$$

$$V_2 = V - \frac{A^2}{2 * J_A}$$

a (t) = acceleration at time t
v (t) = velocity at time t
d (t) = distance at time t

Ⓐ $t_1 \geq t \geq Ø$

$$a\,(t) = J_A * t$$

$$v\,(t) = \frac{J_A * t^2}{2}$$

$$d\,(t) = \frac{J_A * t^3}{6}$$

Ⓑ $t_2 \geq t > t_1$

$$a\,(t) = A$$

$$v\,(t) = \frac{A^2}{2J_A} + A * (t - t_1)$$

$$d\,(t) = \frac{J_A * t_1^3}{6} + \left(\frac{A * (t - t_1)^2}{2}\right) + \left(V_1 * (t - t_1)\right)$$

Ⓒ $t_3 \geq t > t_2$

$$a\,(t) = A - (J_A * (t - t_2))$$

$$v\,(t) = V - \left(\frac{J_A * (t_3 - t)^2}{2}\right)$$

$$d\,(t) = \frac{V^2}{2AA} + \left(\frac{J_A\,(t_3 - t)^3}{6}\right) - \left(V * (t_3 - t)\right)$$

Starting at a Non-Zero Velocity: If starting the acceleration profile with a non-zero initial velocity, the move comprises two components: a constant velocity component, and an s-curve component. Typically, the change of velocity should be used in the S-curve calculations. Thus, in the calculations above, you would substitute “(V_F - V_O)” for “V” (V_F = final velocity, V_O = initial velocity). This is shown in the jerk equation (right).

$$\textbf{Jerk} = J_A = \frac{A^2 * AA}{(V_F - V_O)\,(A-AA)}$$

Units of Measure and Scaling

Units of Measure without Scaling

Scaling is disabled (SCALEØ) as the factory default condition:

- Stepper axes: All distance values entered are in commanded counts (sometimes referred to as *motor steps*), and all acceleration, deceleration and velocity values entered are internally multiplied by the DRES command value.
- Servo axes:

	Units of Measure
Motion Attribute	**Encoder or Resolver**
Accel/Decel	Revs/sec/sec *
Velocity	Revs/sec *
Distance	Counts **

* All accel/decel & velocity values are internally multiplied by the ERES command value.

** Distance is measured in the counts received from the feedback device.

What is Scaling?

Scaling allows you to program acceleration, deceleration, velocity, and position values in units of measure that are appropriate for your application. The SCALE command is used to enable or disable scaling (SCALE1 to enable, SCALEØ to disable). The motion type(s) you are using in your application determines which scale factor commands you need to configure:

Type of Motion	Accel/Decel Scaling	Velocity Scaling	Distance Scaling
Standard Point-to-Point Motion	SCLA	SCLV	SCLD
Following	SCLA	SCLV	SCLD for follower distances SCLMAS for master distances

When Should I Define Scaling Factors?

Scaling calculations are performed when a program is defined or downloaded. Consequently, you must enable scaling (SCALE1) and define the scaling factors (SCLD, SCLA, SCLV, SCLMAS) *prior* to defining (DEF), uploading (TPROG), or running (RUN) the program. **NOTE**: All scaling settings (SCALE, SCLA, SCLD, SCLV and SCLMAS) are automatically saved in the Gem6K's battery-backed RAM.

RECOMMENDED: Place the scaling commands at the beginning of your program file, *before* the location of any defined programs. This ensures that the motion parameters in subsequent programs in your program file are scaled correctly. When you use Motion Planner's scaling setup wizard, the scaling commands are automatically placed in the appropriate location in your program file.

ALTERNATIVE: Scaling factors could be defined via a terminal emulator ***just before*** defining or downloading a program. Because scaling command values are saved in battery-backed RAM (remembered after you issue a RESET command or cycle power to the Gem6K), all subsequent program definitions and downloads will be scaled correctly.

NOTES

- Scaling commands are not allowed in a program. If there are scaling commands in a program, the Gem6K will report an error message ("COMMAND NOT ALLOWED IN PROGRAM") when the program is downloaded.
- If you intend to upload a program with scaled motion parameters, be sure to use Motion Planner. Motion Planner automatically uploads the scaling parameters and places them at the beginning of the program file containing the uploaded program from the Gem6K. This ensures correct scaling when the program file is later downloaded.

*Acceleration & Deceleration Scaling (*SCLA*)*

Stepper Axes: If scaling is enabled (SCALE1), all accel/decel values entered are internally multiplied by the acceleration scaling factor to convert user units/sec/sec to commanded counts/sec/sec. The scaled values are always in reference in commanded counts, regardless of the existence of an encoder.

Servo Axes: If scaling is enabled (SCALE1), all accel/decel values entered are internally multiplied by the acceleration scaling factor to convert user units/sec/sec to encoder or resolver counts/sec/sec.

All accel/decel commands (e.g., A, AA, AD, HOMA, HOMAD, JOGA, etc.) are multiplied by the SCLA command value.

As the accel/decel scaling factor (SCLA) changes, the resolution of the accel and decel values and the number of positions to the right of the decimal point also change (see table at right). An accel/decel value with greater resolution than allowed will be truncated (e.g., if scaling is set to SCLA1Ø, the A9.9999 command would be truncated to A9.9).

SCLA value **(counts/unit/unit)**	**Decimal Places**
1 - 9	0
10 - 99	1
100 - 999	2
1000 - 9999	3
10000 - 99999	4
100000 - 999999	5

The following equations can help you determine the range of acceleration and deceleration values.

Axis Type	**Min. Accel or Decel (resolution)**	**Max. Accel or Decel**
Stepper	$\frac{0.001 * \text{DRES}}{\text{SCLA}}$	$\frac{999.9999 * \text{DRES}}{\text{SCLA}}$
Servo	Encoder Feedback: $\frac{0.001 * \text{ERES}}{\text{SCLA}}$	Encoder Feedback: $\frac{999.9999 * \text{ERES}}{\text{SCLA}}$

*Velocity Scaling (*SCLV*)*

Stepper Axes: If scaling is enabled (SCALE1), all velocity values entered are internally multiplied by the velocity scaling factor to convert user units/sec to commanded counts/sec. The scaled values are always in reference to commanded counts (sometimes referred to as “motor steps”).

Servo Axes: If scaling is enabled (SCALE1), all velocity values entered are internally multiplied by the velocity scaling factor to convert user units/sec to encoder or resolver counts/sec.

All velocity commands (e.g., V, HOMV, HOMVF, JOGVH, JOGVL, etc.) are multiplied by the SCLV command value.

As the velocity scaling factor (SCLV) changes, the velocity command's range and its decimal places also change (see table below). A velocity value with greater resolution than allowed will be truncated. For example, if scaling is set to SCLV10, the V9.9999 command would be truncated to V9.9.

SCLV Value **(counts/unit)**	**Velocity Resolution (units/sec)**	**Decimal Places**
1 - 9	1	0
10 - 99	0.1	1
100 - 999	0.01	2
1000 - 9999	0.001	3
10000 - 99999	0.0001	4
100000 - 999999	0.00001	5

Use the following table to determine the maximum velocity for your product type.

Max. Velocity for Stepper Axes	Max. Velocity for Servo Axes
50 revs/sec	200 revs/sec

NOTE: These velocity limitations are hardware based. Make sure the velocity scaling value used with the desired velocity (V command) does not exceed these velocities. The Gem6K will generate an error message if you try to exceed these maximums. The maximum servo velocity may also be limited when using encoder feedback, depending on the encoder resolution `used. Refer to the *Gem6K Hardware Installation Guide* for the maximum encoder input frequency.

*Distance Scaling (*SCLD *and* SCLMAS*)*

Stepper Axes: If scaling is enabled (SCALE1), all distance values entered are internally multiplied by the distance scaling factor to convert user units to commanded counts ("motor steps").

Servo Axes: If scaling is enabled (SCALE1), all distance values entered are internally multiplied by the distance scaling factor to convert user units to encoder or analog input counts.

All standard motion distance commands (e.g., D, PSET, REG, SMPER, STRGTD) and are multiplied by the SCLD command value. The only exception is for master distance values (see table below):

Scaling for Following Motion: The SCLD command defines the follower axis distance scale factor, and the SCLMAS command defines the master's distance scale factor. The Following-related commands that are affected by SCLD and SCLMAS are listed in the table below.

Commands Affected by Master Scaling (SCLMAS)
FMCLEN: *Master Cycle Length*
FMCP: *Master Cycle Position Offset*
FOLMD: *Master Distance*
FOLRD: *Follower-to-Master Ratio (Denominator)*
GOWHEN: *Conditional GO* (left-hand variable is PMAS)
TPMAS & [PMAS]: *Position of Master Axis*
TVMAS & [VMAS]: *Velocity of Master Axis*

Commands Affected by Follower Scaling (SCLD)
FOLRN: *Follower-to-Master Ratio (Numerator)*
FGADV: *Geared Advance*
FSHFD: *Preset Phase Shift*
GOWHEN: *Conditional GO* (left-hand variable ≠ PMAS)
TPSHF & [PSHF]: *Net Position Shift of Follower*
TPSLV & [PSLV]: *Position of Follower Axis*

As the SCLD or SCLMAS scaling factor changes, the distance command's range and its decimal places also change (see table below). A distance value with greater resolution than allowed will be truncated. For example, if scaling is set to SCLD4000, the D105.2776 command would be truncated to D105.277.

SCLD or SCLMAS **Value (counts/unit)**	**Distance Resolution (units)**	**Distance Range * (units)**	**Decimal Places**
1 - 9	1.0	0 - ±999999999	0
10 - 99	0.10	0.0 - ±99999999.9	1
100 - 999	0.010	0.00 - ±9999999.99	2
1000 - 9999	0.0010	0.000 - ±999999.999	3
10000 - 99999	0.00010	0.0000 - ±99999.9999	4
100000 - 999999	0.00001	0.00000 - ±9999.99999	5

NOTE **FRACTIONAL STEP TRUNCATION** **NOTE**

If you are operating in the incremental mode (MAØ), or specifying master distance values with FOLMD, when the distance scaling factor (SCLD or SCLMAS) and the distance value are multiplied, a fraction of one step may be left over. This fraction is truncated when the distance value is used in the move algorithm. This truncation error can accumulate over a period of time, when performing incremental moves continuously in the same direction. To eliminate this truncation problem, set SCLD or SCLMAS to 1, or a multiple of 10.

Scaling Example — Steppers (GT6K)

We configure for a 25,000 step/rev system attached to 5-pitch leadscrew. The user wants to program motion parameters in inches; therefore the scale factor calculation is: 25,000 steps/rev x 5 revs/inch = 125,000 steps/inch. For instance, with a scale factor of 125,000, the operator could enter a move distance value of 2.000 and the controller would send out 250,000 pulses, corresponding to two inches of travel.

```
SCALE1               ; Enable scaling
DRES25000            ; Set drive resolution to 25,000 steps/rev
SCLD125000           ; Allow user to enter distance in inches
SCLV125000           ; Allow user to enter velocity in inches/sec
SCLA125000           ; Allow entering accel/decel in inches/sec/sec
DRESET               ; Reset the drive so the DRES value is accepted
```

Scaling Example — Servos (GV6K)

We configure for a 4,000 count/rev servo motor/drive system (using a 1000-line encoder) attached to a 5-pitch leadscrew. The user wants to position in inches; therefore, the scale factor calculation is 4,000 counts/rev x 5 revs/inch = 20,000 counts/inch.

```
SFB1             ; Select encoder feedback
ERES4000         ; Set encoder resolution to 4000 steps/rev (post quadrature)
SCALE1           ; Enable scaling
SCLD20000        ; Allow user to enter distance values in inches
SCLV20000        ; Allow user to enter velocity values in inches/sec
SCLA20000        ; Allow user to enter accel/decel values in inches/sec/sec
DRESET           ; Reset the drive so the DRES value is accepted
```

Scaling Example — Following

Typically, the master and follower scale factors are programmed so that master and follower units are the same, but this is not required. Consider the scenario below as an example.

The master is a 1000-line encoder (4000 counts/rev post-quadrature) mounted to a 50 teeth/rev pulley attached to a 10 teeth/inch conveyor belt, resulting in 80 counts/tooth (4000 counts/50 teeth = 80 counts/tooth). To program in inches, you would set up the master scaling factor with the `SCLMAS800` command (80 counts/tooth ∗ 10 teeth/inch = 800 counts/inch).

The follower is a servo motor with position feedback from a 1000-line encoder (4000 counts/rev). The motor is mounted to a 4-pitch (4 revs/inch) leadscrew. Thus, to program in inches, you would set up the follower scaling factor with the `SCLD16000` command (4000 counts/rev ∗ 4 revs/inch = 16000 counts/inch).

```
SCALE1      ; Enable scaling
SCLMAS800   ; Master scaling (80 counts/tooth * 10 teeth/inch = 800 counts/inch)
SCLD16000   ; Follower scaling (4000 counts/rev * 4 revs/inch = 16000 counts/inch)
```

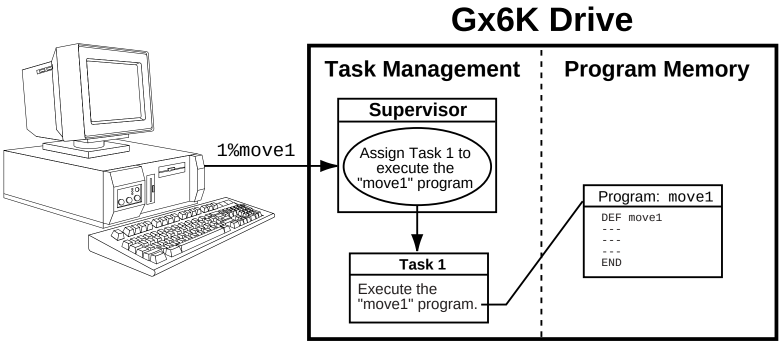
Special Programming Characters

% Task Identifier

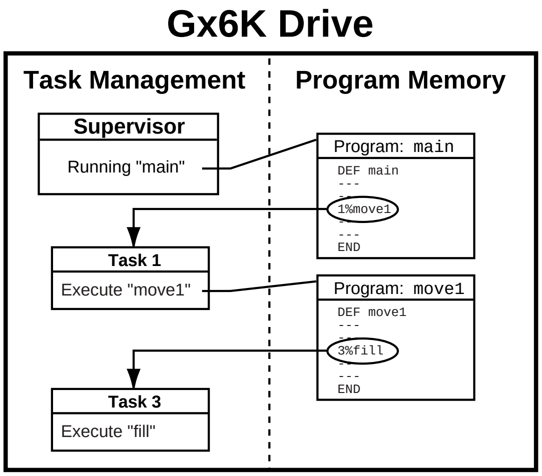
Type	`Multi-Tasking`
Syntax	`<a_>i%<command>`
Units	`i = task number`
Range	`1-10`
Default	`1`
Response	`n/a`
See Also	`LOCK, [SWAP], [TASK], TSKAX, TSKTRN, TSWAP, TTASK`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the Task Identifier (`%`) prefix to specify that the associated command will affect the indicated task number. For most simple multi-tasking applications, the `%` prefix is used to start a program running in a specific task. For example, the drawing on the right illustrates how the `1%move1` command starts the program called “`move1`” in task 1 (specified with the `1%` prefix).



Because the % prefix specifies the task number that the associated command will affect, new tasks can be started from within other tasks, as shown in the drawing on the right.



Within a program in a task, it is not necessary to use the % prefix unless trying to initiate a program or command in a different task. For example, if the `fill` program running in task 3 executes a `COMEXC1` command, only task 3 is placed into `COMEXC1` mode. If the `fill` program running in task 3 also executes a `2%PS` command, task 3 executes the command, but the program being executed in task 2 is paused, not task 3.

How the Task Supervisor Works: The "Task Supervisor" (also referred to as Task Ø) is the main program execution environment. It contains the command buffer and parser. Immediate commands and commands executed from the communications buffer are implicitly directed to affect the supervisor unless explicitly directed to a task with the % prefix. Only the supervisor executes buffered commands from the communications buffer. If the supervisor is executing a program, incoming commands will be buffered, not executed. If the supervisor is not executing a program, it will execute commands from the input command buffer, even if the other tasks are executing programs. If a command in the command buffer has a task prefix, it is still executed by the supervisor, but affects the task specified by the prefix.

[!] mmediate Command Identifier

Type	`Operator (Other)`
Syntax	`<a_>!<command>`
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	`COMEXC`

Product	Rev
GT6K	6.0
GV6K	6.0

The Immediate Command Identifier (`!`) changes a buffered command into an immediate command. All immediate commands are processed immediately, even before previously entered buffered commands.

All Gem6K commands are buffered.

The commands that use the `!` identifier are identified in the **Syntax** portion of the command description.

NOTE
A command with the `!` prefix cannot be stored in a program.

[@] Global Command Identifier

Type	`Operator (Other)`
Syntax	`@<command><field1>`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`ANIEN, ANIRNG, INEN, INLVL, OUT, OUTALL, OUTEN, OUTLVL, TANI, TANO, TIN, TIO, TOUT`

Product	Rev
GT6K	6.0
GV6K	6.0

The Global Command Identifier (`@`) is used to set the value of all fields to the value entered only in the first field. For example, `@OUT1` sets output #1 on for all I/O bricks. If you have any doubts about which commands can use the `@` symbol, refer to the **Syntax** portion of the command description.

; Begin Comment

Type	`Operator (Other)`
Syntax	`;<this is a comment>`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`None`

Product	Rev
GT6K	6.0
GV6K	6.0

The Begin Comment (`;`) command is used to comment application programs. The comment begins with a semicolon (`;`) and is terminated by a command delimiter. The comment is not stored in a program. An example of using the comment delimiter is as follows:

```
DEF pick ; Begin definition of program pick<cr>
```

$ Label Declaration

Type	`Operator (Other)`
Syntax	`<a_><!>$<t>`
Units	`t = text name`
Range	`Text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`DEF, DEL, END, GOSUB, GOTO, JUMP, RUN, TLABEL`

Product	Rev
GT6K	6.0
GV6K	6.0

The Label Declaration (`$`) command defines the current location as the label specified. A label consists of 6 or fewer alpha-numeric characters and must start with an alpha-character, not a number. Labels can only be defined within a program or subroutine. The `GOTO`, `GOSUB` or `JUMP` commands can be used to branch to a label. The `RUN` command can also be used to start executing statements at a label. The label cannot be deleted by a `DEL` command. However, when the program that contains the label is deleted, all labels contained within the program will be deleted.

NOTE: The maximum number of labels possible is 600.

A label declaration cannot consist of any of the following characters:
`!`, _, #, $, %, ^, &, *, `(`, `)`, `+`, `-`, `{`, `}`, `\`, `|`, `"`, `:`, `;`, `'`, `<`, `>`, `,`, `.`, `?`, `/`, `=`

NOTE: A label cannot have the same name as a Gem6K command. For example, `$A` and `$A123` are illegal labels.

Example

```
DEF pick          ; Begin definition of program called pick
GO1               ; Initiate motion
IF(VAR1=5)        ; If variable 1 = 5 then do commands between IF and ELSE,
                  ; otherwise commands between ELSE and NIF
GOTO pick1        ; Goto label pick1
ELSE              ; Else part of IF command
GOTO pick2        ; Goto label pick2
NIF               ; End IF command
$pick1            ; Label declaration for pick1
TAS               ; Report axis status
BREAK             ; Break out of current subroutine or program
$pick2            ; Label declaration for pick2
TPC               ; Report commanded position
END               ; End program definition
RUN pick          ; Execute program named pick
```

## [#] Step Through a Program

Type	Operator (Other)	**Product**	**Rev**
Syntax	<a_>!#<i>		
Units	i = number of commands to execute from the buffer	GT6K	6.0
Range	i = 1 - 200	GV6K	6.0
Default	1		
Response	n/a		
See Also	DEF, HELP, STEP, TRACE, TRANS		

This command controls the execution of a program or sequence when the single step mode is enabled (STEP1). Each time you enter the !#<i> command followed by a delimiter, i commands in the sequence buffer will be executed. A !# followed by a delimiter will cause one command to be executed.

Single step mode can be advantageous when trying to debug a program.

Example:

```
DEF tst           ; Begin definition of program named tst
V1                ; Set velocity to 1 unit/sec
A10               ; Set acceleration to 10 units/sec/sec
D1                ; Set distance to 1 unit
GO1               ; Initiate motion
OUT11X1           ; Turn on on-board programmable outputs 1, 2, and 4,
                  ; leave 3 unchanged
END               ; End program definition
STEP1             ; Enable single step mode
RUN tst           ; Execute program named tst
```

NOTE: After entering the command RUN no action will occur because single step mode has been enabled. Single step operation is as follows:

```
!#2               ; First 2 commands in the program tst are executed,
                  ; commands to be executed are V1 and A10.
!#                ; Execute 1 command from program; command to execute is D1
!#1               ; Execute 1 command from program; command to be executed is GO1
!#2               ; Execute 2 commands from program; commands to be executed are
                  ; OUT11X1 and END
```

'　Enter Interactive Data

Type	`Operator (Other)`
Syntax	`!'<numeric data>`
Units	`Numeric data is command-dependent`
Range	`Numeric data is command-dependent`
Default	`n/a`
Response	`n/a`
See Also	`[ READ ], VARI, VARS`

Product	Rev
GT6K	6.0
GV6K	6.0

To enter data interactively, two operations must occur. First, numeric information must be requested. Requesting the numeric information is accomplished with the `VARx=READy` command. The `x` specifies the numeric variable to place the data into, and the `y` specifies the string variable to transmit before the data is entered. Numeric information can also be requested by placing the `READ` command in place of a command argument (e.g., `A(READ1),12.52,(READ2),5.62`). After the data has been requested, a numeric response must be provided. The numeric response must be preceded by the interactive data specifier (`!'`) and followed by a delimiter (<cr> or <lf>).

Command processing will pause while waiting for data.

Example:

```
VARS1="Enter the count > "  ; Set string variable 1 equal to the message
VAR5=READ1        ; Transmit string variable 1, and wait for numeric data in the
                  ; form of !'<data>. Once numeric data has been received, place
                  ; it in numeric variable 5
!'65.12           ; Variable 5 will receive the value 65.12
```

[.]　Bit Select

Type	`Operator (Other)`
Syntax	`<command>.i`
Units	`i = bit number`
Range	`Command-dependent`
Default	`None`
Response	`n/a`
See Also	`[ AS ], [ ER ], ERROR, [ IN ], INEN, INLVL, [ INO ], INTHW, LIMLVL, [ MOV ], ONIN, ONUS, OUT, OUTEN, OUTLVL, POUT, [ SS ], TAS, TER, TIN, TINO, TIO , TOUT, TSS, TUS, [ US ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The Bit Select (`.`) operator specifies which bit to select. The primary purpose of this command is to let the user specify a specific bit (or range), instead of having to type in an entire bit string.

When using the bit operator in a comparison, the bit operator must always come to the left of the comparison. For example, the command `IF(AS.12=b1)` is legal, but `IF(b1=AS.12)` is illegal.

Command Shortcut Examples (affect only one binary bit location)**:**

- Activate outputs at I/O location Brick 3, I/O point 9: `3OUT.9=1`
- Enable analog input at I/O location Brick 2, I/O point 2: `2ANIEN.2=E`
- Enable error-checking bit 6 for task 3: `3%ERROR.6=1`

Example:

```
VARB2=ER.12       ; Error status bit 12 assigned to binary variable 2
VARB2             ; Response (if bit 12 is set to 1):
                  ; *VARB2=XXXX_XXXX_XXX1_XXXX_XXXX_XXXX_XXXX_XXXX
2OUT.5=1          ; Activate the output at location Brick 2, I/O point 5
```

["] Begin and End String

Type	`Operator (Other)`
Syntax	`"<message>" (see below for possibilities)`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`DWRITE, VARS, WRITE, WRVARS`

Product	Rev
GT6K	6.0
GV6K	6.0

There are three commands that deal with string variables, or messages. The first of these commands is the `VARS` command. This command sets a string variable equal to a specific message (e.g., `VARS1="Enter part count"`). The message must be placed in quotes for it to be recognized. The same can be said for the `WRITE` and `DWRITE` commands. Their messages must also be placed in quotes (e.g., `WRITE"Today is the first day of the rest of your life"`).

Syntax possibilities: `VARSn="<message>"` where `n` equals the string variable number
`WRITE"<message>"`
`DWRITE"<message>"`

There are three ASCII characters that cannot be used within the quotes (`:`, `"`, and `;`). These characters can be specified in the string by using the backslash character (\) in combination with the ASCII decimal value for the character. For example, if you wanted to display the message `"WHY ASK WHY"` in quotes, you would use the following syntax: `WRITE"\34WHY ASK WHY\34"`.

An ASCII table is provided in Appendix B. Common characters and their ASCII equivalent value:

Character	Description	ASCII Decimal Value
`<lf>`	Line Feed	10
`<cr>`	Carriage Return	13
`"`	Quote	34
`:`	Colon	58
`;`	Semi-colon	59
`\`	Backslash	92 (cannot be used with `DWRITE`)

[\ ] ASCII Character Designator

Type	`Operator (Other)`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`VARS, WRITE, WRVARS`

Product	Rev
GT6K	6.0
GV6K	6.0

The ASCII Character Designator (\) operator is used to place a character in a string that is normally not represented by a keyboard character. The (\) operator can be used within the `VARS` or the `WRITE` commands. The syntax for the (\) operator is as follows:

`WRITE"\<i>"`, Where `<i>` is the ASCII decimal equivalent of the character to be placed in the string.

`VARS1="\<i>"`, Where `<i>` is the ASCII decimal equivalent of the character to be placed in the string.

There are three ASCII characters that cannot be used within the quotes (`:`, `;`, and `"`). These characters must be specified in the string by using the backslash character (\) in combination with the ASCII decimal value for the character.

An ASCII table is provided in Appendix B. Common characters and their ASCII equivalent value:

Character	Description	ASCII Decimal Value
`<lf>`	Line Feed	10
`<cr>`	Carriage Return	13
"	Quote	34
:	Colon	58
;	Semi-colon	59
\	Backslash	92

Example:

```
WRITE"cd\92GEM6K\13\10"     ;Displays: cd\GEM6K<cr><lf>
```

[=] Assignment or Equivalence

Type	`Operator (Mathematical or Relational)`	
Syntax	`See below`	
Units	`n/a`	
Range	`n/a`	
Default	`n/a`	
Response	`n/a`	
See Also	`[ > ], [ >= ], [ < ], [ <= ], [ <> ], [ AND ], IF, [ OR ], UNTIL, VAR, VARB, VARI, VARS, WAIT, WHILE`	

Product	Rev
GT6K	6.0
GV6K	6.0

The assignment or equivalence operator (=) is used to either assign a value to a variable, or compare two values and/or variables. The (=) operator is limited to 1 assignment operation per line. It is acceptable to state `VAR1=25`, but it is unacceptable to state `VAR1=25=VAR2`.

More than 1 equivalence operator can be used in a command; however, the total number of relational operators used in a line is limited by the command length limitation (80 characters), not the number of relational operators (e.g., the command `IF(VAR1=1 AND VAR2=4 AND VAR3=4)` is a legal command).

When (=) is used as an assignment operator, it can be used with these commands: `VAR`, `VARI`, `VARB`, `VARS`. When (=) is used as an equivalence operator, it can be used with these commands: `IF`, `WHILE`, `UNTIL`, `WAIT`.

[>] Greater Than

Type	`Operator (Relational)`	
Syntax	`See below`	
Units	`n/a`	
Range	`n/a`	
Default	`n/a`	
Response	`n/a`	
See Also	`[ = ], [ >= ], [ < ], [ <= ], [ <> ], [ AND ], IF, [ OR ], UNTIL, WAIT, WHILE`	

Product	Rev
GT6K	6.0
GV6K	6.0

The greater than (>) operator is used to compare two values. If the value on the left of the operator is greater than the value on the right of the operator, then the expression is *TRUE*. If the value on the left is less than or equal to the value on the right of the operator, then the expression is *FALSE*. The greater than operator (>) can only be used to compare two values.

More than one (>) operator can be used within a single command; however, the total command length is limited to 80 characters.

The (>) operator can be used in conjunction with the `IF`, `WHILE`, `UNTIL`, and `WAIT` commands.

Examples of valid commands are `IF(VAR1>1)` and `WHILE(VAR1>1 AND VAR2>3)`. An example of an invalid command is `IF(5>VAR1>1)`.

[>=] Greater Than or Equal

Type	`Operator (Relational)`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ = ], [ > ], [ < ], [ <= ], [ <> ], [ AND ], IF, [ OR ], UNTIL, WAIT, WHILE`

Product	Rev
GT6K	6.0
GV6K	6.0

The greater than or equal (>=) operator is used to compare two values. If the value on the left of the operator is greater than or equal to the value on the right of the operator, then the expression is *TRUE*. If the value on the left is less than the value on the right of the operator, then the expression is *FALSE*. The greater than or equal operator (>=) can only be used to compare two values.

More than one (>=) operator can be used within a single command; however, the total command length is limited to 80 characters.

The (>=) operator can be used in conjunction with the `IF`, `WHILE`, `UNTIL`, and `WAIT` commands.

Examples of valid commands are `IF(VAR1>=1)` and `WHILE(VAR1>=1 AND VAR2>=3)`. An example of an invalid command is `IF(5>VAR1>=1)`.

[<] Less Than

Type	`Operator (Relational)`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ = ], [ > ], [ >= ], [ <= ], [ <> ], [ AND ], IF, [ OR ], UNTIL, WAIT, WHILE`

Product	Rev
GT6K	6.0
GV6K	6.0

The less than (<) operator is used to compare two values. If the value on the left of the operator is less than the value on the right of the operator, then the expression is *TRUE*. If the value on the left is greater than or equal to the value on the right of the operator, then the expression is *FALSE*. The less than operator (<) can only be used to compare two values.

More than one (<) operator can be used within a single command; however, the total command length is limited to 80 characters.

The (<) operator can be used in conjunction with the `IF`, `WHILE`, `UNTIL`, and `WAIT` commands.

Examples of valid commands are `IF(VAR1<1)` and `WHILE(VAR1<1 AND VAR2<3)`. An example of an invalid command is `IF(1<VAR1<54)`.

[<=] Less Than or Equal

Type	`Operator (Relational)`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ = ], [ > ], [ < ], [ >= ], [ <> ], [ AND ], IF, [ OR ], UNTIL, WAIT, WHILE`

Product	Rev
GT6K	6.0
GV6K	6.0

The less than or equal (<=) operator is used to compare two values. If the value on the left of the operator is less than or equal to the value on the right of the operator, then the expression is *TRUE*. If the value on the left is greater than the value on the right of the operator, then the expression is *FALSE*. The less than or equal operator (<=) can only be used to compare two values.

More than one (<=) operator can be used within a single command; however, the total command length is limited to 80 characters.

The (<=) operator can be used in conjunction with the `IF`, `WHILE`, `UNTIL`, and `WAIT` commands.

Examples of valid commands are `IF(VAR1<=1)` and `WHILE(VAR1<=1 AND VAR2<=3)`. An example of an invalid command is `IF(1<VAR1<=54)`.

[<>] Not Equal

		Product	Rev
Type	`Operator (Relational)`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`[ = ], [ >= ], [ < ], [ <= ], [ AND ], IF, [ OR ], UNTIL, WAIT, WHILE`		

The not equal (<>) operator is used to compare two values. If the value on the left of the operator is not equal to the value on the right of the operator, then the expression is *TRUE*. If the value on the left is equal to the value on the right of the operator, then the expression is *FALSE*. The not equal operator (<>) can only be used to compare two values.

More than one (<>) operator can be used within a single command; however, the total command length is limited to 80 characters.

The (<>) operator can be used in conjunction with the `IF`, `WHILE`, `UNTIL`, and `WAIT` commands.

Examples of valid commands are `IF(VAR1<>1)` and `WHILE(VAR1<>1 AND VAR2<=3)`. An example of an invalid command is `IF(1<VAR1<>54)`.

[( )] Operation Priority Level

		Product	Rev
Type	`Operator (Mathematical)`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`[ = ], [ - ], [ * ], [ / ], [ SQRT ], VAR, VARI`		

The Operation Priority Level operator determines which operation to do first in a mathematical expression. For example, if you want to add 5 to 6 times 3, you can specify `VAR1=6*3+5` or `VAR1=5 + (6*3)`.

More than one set of parentheses can be used in a mathematical expression; however, they cannot be nested.

Example of valid command: `VAR1=(VAR2 * 3) * (3 + VAR4)`

[+] Addition

Type	Operator (Mathematical)
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [( )], [-], [*], [/], [SQRT], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The addition (+) operator adds the value on the left of the operator to the value on the right of the operator. The addition operator can only be used in conjunction with the VAR, VARI and VARB commands.

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (( )) operators can be used; however, they cannot be nested.

Examples of valid commands:

```
VAR1=1+2+3+4+5+6+7+8+9
VAR2=VAR1+1+(5*3)
VARB1=b1101 + b11001
```

[–] Subtraction

Type	Operator (Mathematical)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [( )], [+], [*], [/], [SQRT], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The subtraction (-) operator subtracts the value to the right of the operator from the value to the left of the operator. The subtraction operator can only be used in conjunction with the VAR, VARI and VARB commands.

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (( )) operators can be used; however, they cannot be nested.

Examples of valid command s:

```
VAR1=1-2-3-4-5-6-7-8-9
VAR2=VAR1-1+(5*3)
VARB1=b111101 - b11001
```

[*] Multiplication

Type	Operator (Mathematical)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [( )], [+], [-], [/], [SQRT], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The multiplication (*) operator multiplies the value to the right of the operator with the value to the left of the operator. The multiplication operator can only be used in conjunction with the VAR, VARI and VARB commands. (Values assigned to VARI variables are truncated to integer values.)

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (( )) operators can be used; however, they cannot be nested.

Examples of valid commands:

```
VAR1=1*2*3*4*5*6*7*8*9
VAR2=VAR1-1+(5*3)
VARB1=b111101 * b11001
```

[/] Division

Type	Operator (Mathematical)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [()], [+], [-], [*], [SQRT], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The division (/) operator divides the value to the left of the operator by the value on the right of the operator. The result of the division is specified to five decimal places (VARI integer variables are truncated). The division operator can only be used in conjunction with the VAR, VARI and VARB commands.

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (()) operators can be used; however, they cannot be nested.

Examples of valid commands:

```
VAR1=1/2/3/4/5/6/7/8/9
VAR2=VAR1-1/(5*3)
VARB1=b111101 / b11001
```

DIVISION BY ZERO IS NOT ALLOWED.

[&] Boolean And

Type	Operator (Bitwise)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [|], [~], [^], [<<],[>>], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The Boolean And (&) operator performs a logical AND on the two values to the left and right of the operator when used with the VAR or VARI command. The Boolean And (&) performs a bitwise AND on the two values to the left and right of the operator when used with the VARB command.

For a logical AND (using VAR or VARI), the possible combinations are as follows:

positive number & positive number	= 1
positive number & zero or a negative number	= 0
zero or negative number & positive number	= 0
zero or negative number & zero or negative number	= 0

Example: VAR1=5 & -1
Result: VAR1=0

For a bitwise AND (using VARB), the value on the left side of the & operator has each of its bits ANDed with the corresponding bit of the value on the right side of the operator. Each bit comparison will be composed of 9 possible combinations:

```
1 & 1 = 1          X & X = X
1 & 0 = 0          1 & X = X
0 & 1 = 0          X & 1 = X
0 & 0 = 0          0 & X = 0
                   X & 0 = 0
```

Example: VARB1=b0000 1000 & b1000 1011 1
Response to VARB1 is *VARB1=0000_1000_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX

Example: VARB1=h32FD & h23
Response to VARB1 is *VARB1=0100_0100_0000_0000_0000_0000_0000_0000

Example: VARB1=h23 & b1101
Response to VARB1 is *VARB1=0100_XX00_0000_0000_0000_0000_0000_0000

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (()) operators can be used; however, they cannot be nested.

[|] Boolean Inclusive Or

Type	Operator (Bitwise)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [&], [~], [^], [<<], [>>], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The Boolean Inclusive Or (|) operator performs a logical OR on the two values to the left and right of the operator when used with the VAR or VARI command. The Boolean Inclusive Or (|) performs a bitwise OR on the two values to the left and right of the operator when used with the VARB command.

For a logical OR (using VAR or VARI), the possible combinations are as follows:

positive number | positive number = 1
positive number | zero or a negative number = 1
zero or negative number | positive number = 1
zero or negative number | zero or negative number = 0

Example: VAR1=5 | -1
Result: VAR1=1

For a bitwise OR (using VARB), the value on the left side of the | operator has each of its bits *ORed* with the corresponding bit of the value on the right side of the operator. Each bit comparison will be composed of 9 possible combinations:

```
1 | 1 = 1          X | X = 1
1 | 0 = 1          1 | X = 1
0 | 1 = 1          X | 1 = 1
0 | 0 = 0          0 | X = X
                   X | 0 = X
```

Example: VARB1=b1001 01X1 XX11 | b1000 1011 10
Response to VARB1 is *VARB1=1001_1111_1X11_XXXX_XXXX_XXXX_XXXX_XXXX

Example: VARB1=h1234 | hFAD31
Response to VARB1 is *VARB1=1111_0101_1111_1110_1000_0000_0000_0000

Example: VARB1=h23 | b1101 001X 001X 1X11
Response to VARB1 is *VARB1=1101_111X_001X_1X11_XXXX_XXXX_XXXX_XXXX

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (( )) operators can be used; however, they cannot be nested.

[^] Boolean Exclusive Or

Type	Operator (Bitwise)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [&], [~], [|], [<<], [>>], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The Boolean Exclusive Or (^) operator performs a logical exclusive OR on the two values to the left and right of the operator when used with the VAR or VARI command. The Boolean Exclusive Or (^) performs a bitwise exclusive OR on the two values to the left and right of the operator when used with the VARB command.

For a logical exclusive OR (using VAR or VARI), the possible combinations are as follows:

positive number ^ positive number	=	0
positive number ^ zero or a negative number	=	1
zero or negative number ^ positive number	=	1
zero or negative number ^ zero or negative number	=	0

Example: VAR1=5 ^ -1
Result: VAR1=1

For a bitwise exclusive OR (using VARB), the value on the left side of the ^ operator has each of its bits exclusive *ORed* with the corresponding bit of the value on the right side of the operator. Each bit comparison will be composed of 9 possible combinations:

1 ^ 1 = 0
1 ^ 0 = 1
0 ^ 1 = 1
0 ^ 0 = 0

X ^ X = X
1 ^ X = X
X ^ 1 = X
0 ^ X = X
X ^ 0 = X

Example: VARB1=b0000 1111 XXX1 ^ b10XX 10XX 10XX
Response to VARB1 is *VARB1=10XX_01XX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX

Example: VARB1=h32FD ^ h6A
Response to VARB1 is *VARB1=1010_0001_1111_1011_0000_0000_0000_0000

Example: VARB1=h7FFF ^ b1101 1111 0000 1101
Response to VARB1 is *VARB1=0011_0000_1111_0010_XXXX_XXXX_XXXX_XXXX

The total command length must be less than 80 characters. The order of precedence is **left to right**. The Operation Priority Level (( )) operators can be used; however, they cannot be nested.

[~()] Boolean Not

Type	Operator (Bitwise)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [&], [^], [|], [<<], [>>], VAR, VARI, VARB

Product	**Rev**
GT6K	6.0
GV6K	6.0

The Boolean Not (~) operator performs a logical NOT on the value immediately to its right when used with the VAR or VARI command. The Boolean NOT (~) performs a bitwise NOT on the value immediately to its right when used with the VARB command. Parentheses (( )) are required.

For a logical NOT (using VAR or VARI), the possible combinations are as follows:

~ (positive number)	=	0
~ (zero or a negative number)	=	1

Example: VAR1=~(5) ; Result: VAR1=0
Example: VAR1=~(-1) ; Result: VAR1=1

For a bitwise NOT (using VARB), each bit is *NOTed*.

Example: VARB1=~(b0000 1000 1XX1)
Response to VARB1 is *VARB1=1111_0111_0XX0_XXXX_XXXX_XXXX_XXXX_XXXX

Example: VARB1=~(h32FD)
Response to VARB1 is *VARB1=0011_1011_0000_0100_1111_1111_1111_1111

The total command length must be less than 80 characters. The order of precedence is **left to right**.

The Boolean Not (~) operator also has one additional use. It can be used to change the sign of the distance (D) command. For example, if the distance has the value *D+25000, by issuing D~ the new value for distance would be *D-25000.

[<<] Shift from R to L (Bit 32 to Bit 1)

Type	Operator (Bitwise
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [&], [^], [|], [~], [>>], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The Shift R to L (<<) operator shifts a binary value from right to left (reducing its value) the number of bits specified. Zeros are shifted into the most significant bit locations. The number of bits to shift by is specified with the value immediately to the right of the (<<) operator, 32 maximum. The number of places to shift must be specified in either binary or hexadecimal format. (*The bits in the binary variable are displayed from 1 to 32, left to right, and shifting from right to left causes bits to be shifted from 32 to 1.*)

Example: VARB1=b0000 1000 1XX1 << b01
Response to VARB1 is *VARB1=0010_001X_X1XX_XXXX_XXXX_XXXX_XXX_XX00

Example: VARB1=b1111 0000 1111 << b001
Response to VARB1 is *VARB1=0000_1111_XXXX_XXXX_XXXX_XXXX_XXXX_0000

Example: VARB1= h0000 E3 << hA
Response to VARB1 is *VARB1=0000_0001_1111_0000_0000_0000_0000_0000

The total command length must be less than 80 characters. The order of precedence is **left to right**.

[>>] Shift from L to R (Bit 1 to Bit 32)

Type	Operator (Bitwise)
Syntax	See Below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [&], [^], [|], [~], [<<], VAR, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The Shift L to R (>>) operator shifts a binary value from left to right (increasing its value) the number of bits specified. Zeros are shifted into the least significant bit locations. The number of bits to shift by is specified with the value immediately to the right of the (>>) operator, 32 maximum. The number of places to shift must be specified in either binary or hexadecimal format. (*The bits in the binary variable are displayed from 1 to 32, left to right, and shifting from left to right causes bits to be shifted from 1 to 32.*)

Example: VARB1=b0000 1000 1XX1 >> b01
Response to VARB1 is *VARB1=0000_0010_001X_X1XX_XXXX_XXXX_XXXX_XXXX

Example: VARB1=b1111 0000 1111 >> b001
Response to VARB1 is *VARB1=0000_1111_0000_1111_XXXX_XXXX_XXXX_XXXX

Example: VARB1= h45FA2 >> h4
Response to VARB1 is *VARB1=0000_0010_1010_1111_0101_0100_0000_0000

The total command length must be less than 80 characters. The order of precedence is **left to right**.

[Send Response to Both Communication Ports

Type	`Communication Interface`	**Product**	**Rev**
Syntax	`<a_><!> [ <command><field1>`	GT6K	6.0
Units	`n/a`	GV6K	6.0
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`BOT, PORT, ], ECHO, EOL, EOT, LOCK`		

The Send Response to All Ports ([ ) command is used to send the response from the command which follows it to both communication ports. If a syntax error occurs, an error message will be sent to both communication ports.

NOTE: COM1 refers to the “RS-232/485” or “ETHERNET” connector, and COM2 refers to the “RS-232” connector.

Example:

```
[TER        ;Transfer TER Status to both communication ports
```

] Send Response to Alternate Communication Port

Type	`Communication Interface`	**Product**	**Rev**
Syntax	`<a_><!> ] <command><field1>`	GT6K	6.0
Units	`n/a`	GV6K	6.0
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`BOT, PORT, [, ECHO, EOL, EOT, LOCK`		

The Send Response to Alternate Port ( ]) command is used to send the response from the command which follows it to the alternate port from the one selected. If a report back is requested from port COM1, the response will be sent out port COM2, and vice-versa. If a command is in a stored program, the report will be sent out the alternate port from the one selected by the `PORT` command. If a syntax error occurs an error message will be sent to the alternate port from the one selected.

NOTE: COM1 refers to the “RS-232/485” or “ETHERNET” connector, and COM2 refers to the “RS-232” connector.

Example:

```
; **********************************************************************
; In this example, we place the "]TAS" statement in a program so that
; we can select the port (in this case, "PORT1" selects COM1) as a
; reference. Otherwise, executing "]TAS" outside of a program sends
; the response to whatever port you are not communicating through.
; **********************************************************************
DEF COM       ; Begin definition of program called "COM"
PORT1         ; Select COM1
TER           ; Transfer TER Status to port COM1
]TAS          ; Transfer TAS Status to port COM2
END           ; End program definition
```

Command Descriptions

A Acceleration

Type	`Motion`
Syntax	`<a_><!>A<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 – 9999.9999`
Default	`10.0000`
Response	`A:    *A10.0000`
See Also	`[ A ], AA, AD, ADA, DRES, ERES, GO, MC, SCALE, SCLA, TSTAT, DMEPIT, IF, VARI, WAIT`

Product	Rev
GT6K	6.0
GV6K	6.0

The Acceleration (`A`) command specifies the acceleration rate to be used upon executing the next `GO` command.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The acceleration remains set until you change it with a subsequent acceleration command. Accelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid acceleration is entered the previous acceleration value is retained.

If the Deceleration (`AD`) command has not been entered, the acceleration (`A`) command will set the deceleration rate. Once the deceleration (`AD`) command has been entered, the acceleration (`A`) command no longer affects deceleration.

ON-THE-FLY CHANGES: You can change acceleration *on the fly* (while motion is in progress) in two ways. One way is to send an immediate acceleration command (`!A`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered acceleration command (`A`) followed by a buffered go command (`GO`).

Example:

```
SCALE1                  ; Enable scaling
SCLA25000               ; Set the acceleration scaling factor for to
                        ; 25000 counts/unit
SCLV25000               ; Set the velocity scaling factor to 25000 counts/unit
SCLD1                   ; Set the distance scaling factor 1 count/unit
DEL proga               ; Delete program called proga
DEF proga               ; Begin definition of program called proga
MA0                     ; Incremental positioning mode
MC0                     ; Preset positioning mode
A10                     ; Set the acceleration to 10 units/sec/sec
V1                      ; Set the velocity to 1 units/sec
D100000                 ; Set the distance to 100000 units
GO1                     ; Initiate motion
END                     ; End definition of program called proga
```

[A] Acceleration Assignment

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`units/sec/sec`
Range	`0.0001 – 9999.9999`
Default	`n/a`
Response	`n/a`
See Also	`A, AA, AD, ADA, DRES, ERES, GO, SCALE, SCLA`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The acceleration assignment command is used to compare the programmed acceleration value to another value or variable, or to assign the current programmed acceleration to a variable.

Syntax: `VARn=A`, where `n` is the variable number, or `A` can be used in an expression such as `IF(A<25000)`. The (`A`) value used in any comparison, or in any assignment statement is the programmed (`A`) value.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example:

```
IF(A<25000)       ; If the acceleration is less than 25000 units/sec/sec,
                  ; then do the statements between the IF and NIF
VAR1=A*2          ; Variable 1 = acceleration times 2
A(VAR1)           ; Set the acceleration to the value of variable 1
NIF               ; End the IF statement
```

AA Average Acceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>AA<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0, or 0.0001 – 9999.9999`

Default	`10.00 (Default is a constant accel ramp, where AA tracks A.`
	`S-curve accel is achieved when AA is changed independent of A.`
	`To restore a constant accel ramp and tracking, set AA = 0.)`

Response	`AA:    *AA10.0000`
See Also	`A, AD, ADA, SCALE, SCLA, DMEPIT`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `AA` command allows you to specify the average acceleration for an S-curve motion profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling affects the average acceleration (`AA`) the same as it does for the maximum acceleration (`A`). Refer to page 16 for details on scaling.

ON-THE-FLY CHANGES: You can change acceleration *on the fly* (while motion is in progress) in two ways. One way is to send an immediate acceleration command (`!AA`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered acceleration command (`AA`) followed by a buffered go command (`GO`).

Example:

```
; In this example, prog1 executes a pure S-curve and takes 1 second
; to reach a velocity of 5 rps; prog2 executes a trapezoidal profile
; and takes 0.5 seconds to reach a velocity of 5 rps.
SCALE0            ; Disable scaling
DEL Prog1         ; Delete program called prog1
DEF Prog1         ; Begin definition of prog1
MA0               ; Select incremental positioning mode
D40000            ; Set distance to 40,000 positive-direction counts
A10               ; Set max. accel to 10 revs/sec/sec
AA5               ; Set avg. accel to 5 revs/sec/sec
AD10              ; Set max. decel to 10 revs/sec/sec
```

```
ADA5              ; Set avg. decel to 5 revs/sec/sec
V5                ; Set velocity to 5 revs/sec
GO1               ; Execute motion
END               ; End definition of prog1

DEL Prog2         ; Delete program called prog2
DEF Prog2         ; Begin definition of prog2
MA0               ; Select incremental positioning mode
D40000            ; Set distance to 40,000 positive-direction counts
A10               ; Set max. accel to 10 revs/sec/sec
AA10              ; Set avg. accel to 10 revs/sec/sec
AD10              ; Set max. decel to 10 revs/sec/sec
ADA10             ; Set avg. decel to 10 rev/sec/sec
V5                ; Set velocity to 5 revs/sec
GO1               ; Execute motion
END               ; End definition of program #2
```

AD Deceleration

Type	`Motion`
Syntax	`<a_><!>AD<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0, or 0.0001 – 9999.9999`
Default	`10.0000 (by default, AD tracks A until AD is changed independent of A; to restore tracking, set AD = 0)`
Response	`AD:    *AD10.0000`
See Also	`[ A ], A, AA, ADA, DMEPIT, DRES, ERES, GO, IF, LHAD, LSAD, MC, VARI, SCALE, SCLA, TSTAT, WAIT`

Product	Rev
GT6K	6.0
GV6K	6.0

The `AD` command specifies the deceleration rate to be used upon executing the next go (`GO`) command.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The deceleration remains set until you change it with a subsequent deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

If the deceleration (`AD`) command has not been entered, the acceleration (`A`) command will set the deceleration rate. Once the deceleration (`AD`) command has been entered, the acceleration (`A`) command no longer affects deceleration. If the `AD` command is set to zero (`ADØ`), then the deceleration will once again track whatever the `A` command is set to.

ON-THE-FLY CHANGES: You can change deceleration *on the fly* (while motion is in progress) in two ways. One way is to send an immediate deceleration command (`!AD`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered deceleration command (`AD`) followed by a buffered go command (`GO`).

Example:

```
SCALE1               ; Enable scaling
SCLA25000            ; Set the acceleration scaling factor to 25000 counts/unit
SCLV25000            ; Set the velocity scaling factor to 25000 counts/unit
SCLD1                ; Set the distance scaling factor to 1 count/unit
DEL proga            ; Delete program called proga
DEF proga            ; Begin definition of program called proga
MA0                  ; Incremental positioning mode
MC0                  ; Preset positioning mode
A10                  ; Set the acceleration to 10 units/sec/sec
AD1                  ; Set the deceleration to 1 units/sec/sec
V1                   ; Set the velocity to 1 units/sec
D100000              ; Set the distance to 100000 units
GO1                  ; Initiate motion
END                  ; End definition of program called proga
```

[AD]   Deceleration Assignment

Type	`Assignment` or `Comparison`
Syntax	`See below`

Units	`units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0, or 0.0001 – 9999.9999`
Default	`n/a`
Response	`n/a`
See Also	`[A], A, AA, AD, ADA, DRES, ERES, GO, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The deceleration assignment command is used to compare the programmed deceleration value to another value or variable, or to assign the current programmed deceleration to a variable.

Syntax: `VARn=AD` where `n` is the variable number, or `[AD]` can be used in an expression such as `IF(AD<25ØØØ)`. The (`AD`) value used in any comparison, or in any assignment statement is the programmed (`AD`) value.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example:

```
IF(AD<25000)     ; If the deceleration is less than 25000 units/sec/sec,
                 ; then do the statements between the IF and NIF
VAR1=AD*2        ; Variable 1 = deceleration times 2
AD(VAR1)         ; Set the deceleration to the value of variable 1
NIF              ; End the IF statement
```

ADA   Average Deceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>ADA<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 – 9999.9999`
Default	`10.00 (By default, ADA tracks AA until ADA is changed independent of AA. To restore tracking, set AD = 0.)`
Response	`ADA:   *ADA10.0000`
See Also	`A, AA, AD, DMEPIT, LHADA, LSADA, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `ADA` command allows you to specify the average deceleration for an S-curve motion profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling affects the average deceleration (`ADA`) the same as it does for the maximum deceleration (`AD`). Refer to page 16 for details on scaling.

ON-THE-FLY CHANGES: You can change deceleration *on the fly* (while motion is in progress) in two ways. One way is to send an immediate deceleration command (`!ADA`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered deceleration command (`ADA`) followed by a buffered go command (`GO`).

Example: (refer to the AA command description)

ADDR Multiple Unit Auto-Address

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_><!>ADDR<i>	GT6K	6.0
Units	i = unit number	GV6K	6.0
Range	0 to 99		
Default	0		
Response	ADDR: *ADDR0		
See Also	BAUD, E, PORT		

The ADDR command automatically configures unit addresses for a daisy-chain or multi-drop. The factory default address for a Gem6K drive is address zero (0). The ADDR command allows up to 99 units on a chain to be uniquely addressed. After unique addresses are established, you can address commands to specific units by prefixing the commands with the unit's address followed by an underscore (e.g., 2_TAS checks the status on unit #2).

The ADDR value is stored in non-volatile memory.

RS-232C Daisy Chain:

Sending ADDRi to the first unit in the chain sets its address to be (i). The first unit in turn transmits ADDR(i + 1) to the next unit to set its address to (i + 1). This continues down the daisy chain until the last unit of (n) daisy-chained units has its address set to (i + n - 1).

NOTE: ADDR configures only the first unit in the chain.

RS-485 Multi-Drop:

To use the ADDR command, you must address each unit individually before it is connected on the multi drop. For example, given that each product is shipped configured with address zero, you could set up a 4-unit multi-drop with the commands below, and then connect them in a multi drop:

1. Connect the unit that is to be unit #1 and transmit the Ø_ADDR1 command to it.
2. Connect the unit that is to be unit #2 and transmit the Ø_ADDR2 command to it.
3. Connect the unit that is to be unit #3 and transmit the Ø_ADDR3 command to it.
4. Connect the unit that is to be unit #4 and transmit the Ø_ADDR4 command to it.

If you need to replace a unit in the multi drop, send the Ø_ADDRi command to it, where "i" is the address you wish the new unit to have.

To send a Gem6K command from the master unit to a specific unit in the multi-drop, prefix the command with the unit address and an underscore (e.g., 3_OUTØ turns off output #1 on unit #3). The master unit (if it is not a Gem6K product) may receive data from a multi-drop unit.

For more information on controlling multiple Gem6K Series controller/drives in an RS-232 daisy-chain or RS-485 multi-drop, refer to the *Programmer's Guide*.

Example:

```
ADDR1          ; Set the address of the first unit in the daisy-chain to 1.
               ; Subsequent units in the chain are automatically numbered
               ; 2, 3, 4, 5, and so on, in their order in the chain.
```

[AND] And

Type	Operator (logical)	**Product**	**Rev**
Syntax	See below	GT6K	6.0
Units	n/a	GV6K	6.0
Range	n/a		
Default	n/a		
Response	n/a		
See Also	IF, [NOT], [OR], REPEAT, UNTIL, WAIT, WHILE		

The AND command is used in conjunction with the program flow control commands (IF, REPEAT, UNTIL, WHILE, WAIT). The AND command logically links two events. If each of the two events are true, and are linked with an AND command, then the whole statement is true. This fact is best illustrated by example.

Example 1: `IF(VAR1>Ø AND VAR2<3) : TPME : NIF`

If variable 1 = 1 and variable 2 = 1, then the expression within the IF statement is true, and the commands between the IF and the NIF will be executed.

Example 2: `WHILE(VAR1=1 AND VAR2=2) : TPME : NWHILE`

If variable 1 = 1 and variable 2 = 1, then the expression within the WHILE statement is false, and the commands between the WHILE and the NWHILE will not be executed.

To evaluate an expression (Expression 1 AND Expression 2 = Result) to determine if the whole expression is true, use the following rules:

TRUE AND TRUE = TRUE
TRUE AND FALSE = FALSE
FALSE AND TRUE = FALSE
FALSE AND FALSE = FALSE

[ANI] Analog Input Value

Type	Assignment or comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	ANIRNG, TANI

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the ANI operator to assign the voltage level present at an analog input (ANI) to a variable, or to make a comparison against another value. The ANI value is measured in volts.

The ANI value is derived from the voltage applied to the corresponding analog input and ground. The analog value is determined from a 12-bit analog-to-digital converter. Under the default ANI voltage range, set with ANIRNG, the range of the ANI operator is -10.000VDC to +10.000VDC (see ANIRNG command for optional voltage ranges).

Syntax: VARn=<B>ANI.i where "n" is the variable number, "<B>" is the number of the I/O brick, and "i" is the I/O brick address where the analog input resides; or ANI can be used in an expression such as IF(1ANI.2=2.3). If no brick identifier (<B>) is provided, it defaults to brick "0", the onboard analog input. To understand the I/O brick addressing convention, refer to page 8.

Example:

```
VAR1=ANI.1        ; Voltage value at onboard analog input is assigned
                  ; to variable 1
VAR2=3ANI.2       ; Voltage value at analog input 2 on I/O brick 3 is assigned
                  ; to variable 2
IF(1ANI.1<8.2)    ; If voltage value at analog input 1 on brick 1 < 8.2V, do the
                  ; commands between the IF statement and the NIF statement.
TREV              ; Transfer revision level
NIF               ; End if statement
```

ANIEN

Analog Input Enable

Type	`Inputs`

Syntax	`To enable only:   <a_><!><@><B>ANIEN<.i>=<E>`
	`To override only: <a_><!><@><B>ANIEN<.i>=<r>`

Units	`B = I/O brick number`
	`i = input location on I/O brick “B”`
	`E = Enable`
	`r = volts`

Range	`B = 0-8`
	`i = 1-32 (dependent on I/O brick configuration)`
	`r = -10.000 to +10.000 (voltage override value)`

Default	`E (enabled)`

Response	`2ANIEN:  *2ANIENx,x,x,x,x,x,x,x    (SIM slot 1)`
	`                x,x,x,x,x,x,x,x    (SIM slot 2)`
	`                E,E,E,E,E,E,E,E    (SIM slot 3)`
	`                x,x,x,x,x,x,x,x    (SIM slot 4)`

See Also	`[ ANI ], ANIMAS, ANIRNG, FOLMAS, TANI, TIO`

Product	Rev
GT6K	6.0
GV6K	6.0

The `ANIEN` command enables or disables specific analog inputs on expansion I/O bricks. The default state for each input is the enabled condition. `ANIEN` can also be used to set analog inputs to specific override voltage levels. To disable an analog input, set an override voltage of 0.

NOTE: The onboard analog input (`ANI.1`) is always enabled, and is not affected by the `ANIEN` command.

Performance: The rate at which the drive samples each analog input depends on how many are enabled on the SIM; each enabled analog input adds 2 ms to the sample rate for all analog inputs on the SIM. For example, if 4 of the 8 analog inputs on a SIM are enabled, the sample rate for any specific input on the same SIM is 8 ms (4 inputs x 2 ms). Disabling input channels increases the performance of the remaining channels; this is important if an input channel is to be used as a Following source (`ANIMAS` and `FOLMAS` selection).

Example:

```
1ANIEN.9=E,E       ; Enable the 1st & 2nd analog input in SIM slot 2
                   ; (I/O locations 9 & 10) on I/O brick 1.
1ANIEN.11=2.4      ; Override the 3rd analog input in SIM slot 2 (I/O location 11)
                   ; on I/O brick 1 with a voltage of 2.4 volts.
2ANIEN             ; Check status of analog inputs on I/O brick 2. As an example,
                   ; a response of *2ANIENx,x,x,x,x,x,x,x
                                         x,x,x,x,x,x,x,x
                                         E,E,E,E,E,E,E,E
                                         x,x,x,x,x,x,x,x
                   ; indicates that an analog input SIM is installed in slot 3 of
                   ; I/O brick 2 and all eight channels are enabled ("E").
```

ANIMAS

Assign Analog Inputs as Following Master

Type	`Following`
Syntax	`<a_><!>ANIMAS<B-i>`

Units	`B = I/O brick number`
	`i = input location on I/O brick “B”`

Range	`B = 0-8`
	`i = 1-32 (dependent on I/O brick configuration)`

Default	`0-0  (No assignment)`
Response	`ANIMAS:  *ANIMAS1-1`
See Also	`ANIEN, FOLMAS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `ANIMAS` command assigns an analog input channel to a specific Following master for use when an ANI master is selected with the `FOLMAS` command. The `ANIMAS` command only has an effect if an analog input Following master is selected with a subsequent `FOLMAS` command (`ANIMAS` command must be issued before the `FOLMAS` command).

Example:

```
ANIMAS4-17          ; Select the first analog input channel in SIM slot 3
                    ; (I/O location 17) of I/O brick 4 to be used for master
FOLMAS12            ; Define axis 1 to be follower of the analog input
                    ; selected for master
```

ANIRNG Analog Input Voltage Range

Type	`Drive Configuration`
Syntax	`<a_><!><@><B>ANIRNG<.i><=i>`

Units	`B = I/O brick number`
	`1st i = input location on I/O brick "B"`
	`2nd i = voltage range selector number`

Range	`B = 0-8`
	`1st i = 1-32 (dependent on I/O brick configuration)`
	`2nd i = 1 (0 to +5VDC),`
	`2 (-5 to +5VDC),`
	`3 (0 to +10VDC), or`
	`4 (-10 to +10VDC)`

Default	`4 (range is set to -10 to +10VDC)`

Response	`2ANIRNG:    *2ANIRNGx,x,x,x,x,x,x,x`
	`4,4,4,4,4,4,4,4`
	`x,x,x,x,x,x,x,x`
	`x,x,x,x,x,x,x,x`
	`2ANIRNG.9:  *4`

See Also	`[ ANI ], ANIEN, JOYCDB, JOYCTR, JOYEDB, SCLA, SCLV, TANI, TIO,`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `ANIRNG` command to select voltage ranges for specific analog inputs on the expansion I/O bricks connected to your Gem6K. The default range for all analog inputs is –10VDC to +10VDC.

NOTE: The onboard analog input (`ANI.1`) is fixed at –10VDC to +10VDC, and is not affected by the `ANIRNG` command.

Be aware that changing the analog input voltage range affects these settings:

`ANIRNG` Setting	Voltage Range	Counts/volt resolution
1	0 to +5VDC	819
2	-5 to +5VDC	410
3	0 to +10VDC	410
4	-10 to +10VDC	205

Example

```
2ANIRNG.9=3         ; For the 1st analog input on SIM2 of I/O brick 2, select a voltage
                    ; range of 0 to +10VDC
```

ANO Set Analog Output Voltage

Type	`Output`
Syntax	`<a_><!><B>ANO<.i>=<r>`

Units	`B = I/O brick number`
	`i = input/output location on brick "B"`
	`r = volts`

Range	`B = 1-8 (depending on I/O brick configuration)`
	`i = 1-32 (depending on I/O brick configuration)`
	`r = -10.00 to +10.00 (or 0 to 4095 in PLC mode)`

Default	`0.0`
Response	`n/a`
See Also	`[ ANO ], DMONAS, DMONAV, DMONBS, DMONBV, TANO, TIO`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `ANO` command to assign a voltage of an analog output associated with an analog output SIM.

NOTE: See the `DMONxx` commands for information on controlling the onboard analog monitors.

Performance: Each analog output channel is updated once every 16ms (2ms per analog output channel). Each DAC has 10-bit granularity, giving approximately 20 mV/bit over the 20 volt range.

PLC Mode: When commanding an analog output using PLC mode, the raw DAC value must be used. To calculate what value to program, use the following formula or table:

`ANO` Value = (Vout + 10) x 4095 / 20

Vout	DAC Value
-10V	0
-5V	1024
0V	2048
+5V	3071
+10V	4095

Example

```
1ANO.9=8.5          ; Command 8.5 volts on analog output 9, I/O brick 1
                    ; (analog output SIM must be present in slot 2 of I/O brick 1)
```

[ANO] Analog Output Voltage Assignment

Type	`Outputs; Assignment or Comparison`
Syntax	`See below`
Units	`Voltage`
Range	`-10.00VDC to +10.00VDC`
Default	`n/a`
Response	`n/a`
See Also	`ANO, TANO, TIO`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `ANO` operand to assign the voltage level present at one of the analog outputs to a variable, or to make a comparison against another value.

The `ANO` value is derived from the voltage applied to the corresponding analog output and ground. The analog value is determined from a 10-bit digital-to-analog converter and the value set with the `ANO` command. The range of the `ANO` operand is -10.00VDC to +10.00VDC.

Syntax: `VARn=<B>ANO.i` where "n" is the variable number, "`<B>`" is the number of the I/O brick, and "`i`" is I/O brick address where the analog output resides; or `ANO` can be used in an expression such as `IF(1ANO.2=2.3)`. If no brick identifier (`<B>`) is provided, it defaults to 1. To understand the I/O brick addressing convention, refer to page 8.

PLC Mode: When assigning or comparing an analog output value in PLC mode, the raw DAC value must be used. To calculate what this value will be, use the following formula or table:

`ANO` Value = (Vout + 10) x 4095 / 20

Vout	DAC Value
-10V	0
-5V	1024
0V	2048
+5V	3071
+10V	4095

Example:

```
IF(1ANO.9>8.5)      ; If the commanded analog output is greater than 8.5
  WRITE"HIGH"       ; write warning to screen
  NIF
IF(1ANO.9<-8.5)     ; If the commanded analog output is less than -8.5
  WRITE"LOW"        ; write warning to screen
  NIF
```

[AS] Axis Status

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ ASX ], ESTALL, GOBUF, GOWHEN, INDUST, SMPER, TAS, TASF, TRGFN, TSTAT, VARB`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `AS` operator to assign the axis status bits to a binary variable, or to make a comparison against a binary or hexadecimal value.

To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value that the axis status is being compared against. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value that the axis status is being compared against. The hexadecimal value itself must only contain the letters A through F, and the numbers Ø through 9. The function of each axis status bit is shown below.

Bit # (left to right)	**Function** (1 = Yes; Ø = No)	**GT6K**	**GV6K**	**To Clear This Bit:**
1	Motion is commanded. (CAUTION: This bit could be cleared even while the motor is still “moving” – e.g., due to end-of-move settling.)	X	X	----------
2	Negative/positive-direction (1 = negative, Ø = positive).	X	X	----------
3	Accelerating (commanded acceleration only – `TACC`). This bit does not indicate commanded deceleration (bit is set to 0 during decel); to check if the axis is decelerating, the state of `TAS` bits 1, 3 and 4 should be: `TAS1x00`.	X	X	----------
4	At commanded velocity (`TVEL`).	X	X	----------
5	Home Successful (`HOM`) (YES/NO)	X	X	----------
6	Absolute/Incremental (`MA`) position mode selected. (1 = `MA1`, Ø = `MA0`)	X	X	----------
7	Continuous/Preset (`MC`) position mode selected. (1 = `MC1`, Ø = `MC0`)	X	X	----------
8	Jog Mode selected (`JOG`) (1 = `JOG1`, Ø = `JOG0`)	--	--	----------
9	Joystick Mode selected (`JOY`) (1 = `JOY1`, Ø = `JOY0`)	--	--	----------
10	RESERVED	--	--	----------
11	Position Maintenance Mode	X	--	----------
12	Stall detected (`ESTALL`)	X	--	----------
13	Drive shut down. **NOTE**: If operating in the `FLTDSB1` mode, a shutdown (`DRIVE0` or open the Enable input interlock) will cause a “fault condition” – see note * below.	X	X	`DRIVE1`
14 *	Drive Faults occurred. Check the `TASX` response to identify which fault(s) occurred.	X	X	`DRIVE1`
15	Positive-direction hardware limit hit. This is not a “fault condition”.	X	X	`LHØ` or `GO` in opposite direction.
16	Negative-direction hardware limit hit. This is not a “fault condition”.	X	X	`LHØ` or `GO` in opposite direction.
17	Positive-direction Software Limit (`LSPOS`) Hit.	X	X	`LSØ` or `GO` in opposite direction.
18	Negative-direction Software Limit (`LSNEG`) Hit.	X	X	`LSØ` or `GO` in opposite direction.
19	Position Error	X	--	---------

20	RESERVED	--	--	---------
21	RESERVED	--	--	---------
22	RESERVED	--	--	---------
23 *	Position error exceeded (SMPER).	--	X	DRIVE1
24	In Target Zone (defined with STRGTD & STRGTV). This bit is set only after the *successful completion* of a move (if STRGTD and STRGTV criteria have been satisfied). This bit is usable even if the Target Zone mode is not enabled (STRGTE0).	--	X	GO1
25	Target Zone Timeout occurred (STRGTT).	--	X	GV6K: GO1
26	Change in motion is suspended pending GOWHEN (YES/NO). This bit is cleared if the GOWHEN condition is true, or if STOP (!S) or KILL (!K or ^K) is executed	X	X	(see description)
27	RESERVED	--	--	---------
28	Registration move initiated by trigger since last GO command. This bit is cleared with the next GO command.	X	X	GO1
29	GOWHEN error occurred. The input state or the position relationship specified in a GOWHEN command was already true when the subsequent GO, FGADV, FSHFC or FSHFD command was executed.	X	X	---------
30	Pre-emptive (OTF) GO or Registration profile not possible	X	X	GO1
31	Compiled GOBUF profile is executing.	X	X	---------
32	RESERVED	--	--	---------

* **FAULT CONDITIONS**: If one or more of these conditions exist, the drive automatically disables (DRIVE0), it activates any output configured as a fault output, and it opens the dry contact relay (labeled “RELAY COM” and “RELAY N.O.”) on the 4 pin removable connector.

Syntax: VARBn=AS where n is the binary variable number, or AS can be used in an expression such as IF(AS=b11Ø1), or IF(AS=h7F). If it is desired to assign only one bit of the axis status value to a binary variable, instead of all 32, the bit select (.) operator can be used. The bit select operator, in conjunction with the bit number, is used to specify a specific axis status bit (e.g., VARB1=AS.12 assigns status bit 12 to binary variable 1).

Example:

```
VARB1=AS                ; Axis status assigned to binary variable 1
VARB2=AS.12             ; Status bit 12 assigned to binary variable 2
VARB2                   ; Response, if bit 12 is set to 1, is
                        ; "*VARB2=XXXX_XXXX_XXX1_XXXX_XXXX_XXXX_XXXX_XXXX"
IF(AS=b111011X11)       ; If the axis status contains 1's for
                        ; bits 1,2,3,5,6,8,and 9, and a 0 for bit location 4,
                        ; do the IF statement
TREV                    ; Transfer revision level
NIF                     ; End if statement
IF(AS=h7F00)            ; If the axis status contains 1's for
                        ; bits 1,2,3,5,6,7,and 8, and 0's for every other bit
                        ; location, do the IF statement
TREV                    ; Transfer revision level
NIF                     ; End if statement
```

[ASX]   Extended Axis Status

Type   Assignment or Comparison

Syntax   See below

Units   n/a

Range   n/a

Default   n/a

Response   n/a

See Also   [AS], DSTALL, ESTALL, TASX, TASXF, TAS, TASF, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

The ASX command is used to assign the axis status bits to a binary variable, or to make a comparison against a binary or hexadecimal value.

To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value that the axis status is being compared against. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value that the axis status is being compared against. The hexadecimal value itself must only contain the letters A through F, and the numbers Ø through 9.

Bit #	**Function** (1 = Yes; Ø = No)	GT6K	GV6K	To Clear This Status Bit:
1 *	Motor temperature fault (hardware switch in the motor).	--	X	DRIVE1
2 *	Low voltage fault	X	X	DRIVE1
3 *	Drive over-temperature fault (hardware thermal sensor in drive).	X	X	DRIVE1
4	RESERVED	--	--	----------
5 *	Resolver failed.	--	X	RESET or cycle power
6	RESERVED	--	--	----------
7 *	Motor configuration error occurred (checked on power up). Use TCS to ascertain the cause of the error. This is a fault condition which causes a drive shutdown (DRIVE0).	X	X	Resolve error condition (see TCS) and issue RESET or DRESET or cycle power
8	RESERVED	--	--	----------
9 *	Velocity error limit (SMVER value) has been exceeded.	--	X	DRIVE1
10 *	Bridge fault (hardware signal from the bridge)	X	X	RESET or DRESET or cycle power
11 *	Bridge temperature fault (this is a software control).	--	X	DRIVE1
12 *	Over-voltage.	--	X	RESET or DRESET or cycle power
13-16	RESERVED	--	--	----------
17	Stall detected (DSTALL or ESTALL)	X	--	DRIVE1
18	Override mode was invoked. (See DMVLIM command.)	X	X	DCLRLR or RESET or DRESET or cycle power
19	Bridge is in foldback mode.	--	X	DCLRLR or RESET or DRESET or cycle power
20	Power Dissipation Circuit has been active – not applicable to GV6K-U3, GV6K-U6, and GV6K-U12 drives	X	X	DCLRLR or RESET or cycle power
21 *	Bad Hall state detected. (Use THALL for diagnostics.)	--	X	RESET or cycle power
22 *	Unrecognized hardware — consult factory	X	X	RESET or cycle power
23 *	User Fault input activated (INFNCi-F)	X	X	Deactivate the input
24	Keep Alive active (User supplied +24VDC)	X	X	----------
25	Power dissipation circuit fault (excessive power dissipation)	X	X	DRIVE1
26	RESERVED	--	--	----------
27	RESERVED	--	--	----------
28	Motor configuration warning resulting from trying to run the motor beyond acceptable limits. Use TCS to ascertain the cause of the warning.	X	X	Resolve error condition (see TCS) and issue RESET or DRESET or cycle power
29 *	ORES failure (encoder output or step & direction output exceeds the maximum output frequency).	X	X	DRIVE1
30 *	Motor Thermal model fault.	--	X	Let the motor cool, then issue DRIVE1.
31	Commanded torque/force is at limit (TTRQ = DMTLIM).	--	X	DCLRLR or RESET or DRESET or cycle power
32	RESERVED	--	--	---------

* **FAULT CONDITIONS**: If one or more of these conditions exist, the drive automatically disables (DRIVE0), it activates any output configured as a fault output, and it opens the dry contact relay (labeled "RELAY COM" and "RELAY N.O.") on the 4 pin removable connector.

Syntax: VARBn=ASX where n is the binary variable number, or ASX can be used in an expression such as IF(ASX=b11ØØ), or IF(ASX=h7Ø). If it is desired to assign only one bit of the axis status value to a binary variable, instead of all 32, the bit select (.) operator can be used. The bit select, in conjunction with the bit number, is used to specify a specific axis status bit (e.g., VARB1=ASX.3 assigns status bit 3 to binary variable 1).

Example:

```
VARB1=ASX              ; Extended Axis status assigned to binary variable 1
VARB2=ASX.3            ; Extended Axis status bit 3 assigned to binary variable 2
VARB2                  ; Response if bit 3 is set to 1:
                       ; "*VARB2=XX1X_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX"
IF(ASX=b101XXXXX)      ; If the extended axis status contains 1's
                       ; for bits 1 and 3, and a 0 for bit location 2, do the
                       ; IF statement
TREV                   ; Transfer revision level
NIF                    ; End if statement
```

[ATAN()] Arc Tangent

Type	`Operator (Trigonometric)`
Syntax	`VARi=ATAN(r)`
Units	`r = real number`
Range	`0.00000 to ±999,999,999`
Default	`none`
Response	`n/a`
See Also	`[=], [COS], [PI], RADIAN, [SIN], [TAN], VAR`

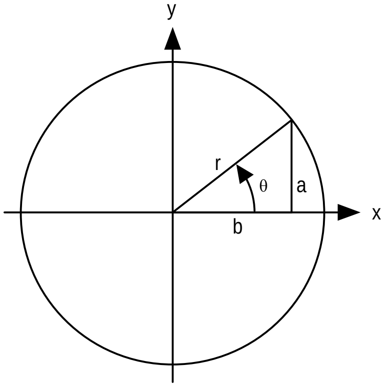
Product	Rev
GT6K	6.0
GV6K	6.0

The `ATAN` operator is used to calculate the inverse tangent of a real number. If “a” and “b” are coordinates of a point on a circle of radius “r”, then the angle of measure “θ” can be defined by the equation:

$$\theta = \arctan\frac{a}{b}\ .$$

The result of the `ATAN` command will either be in degrees or radians, depending on the `RADIAN` command.

To convert radians to degrees, use the formula: 360° = 2π radians.



$$\sin\theta = \frac{a}{r}$$

$$\cos\theta = \frac{b}{r}$$

$$\tan\theta = \frac{a}{b}$$

Syntax: `VARi=ATAN(r)` where `i` is the variable number and `r` is a real number value. Parentheses (`()`) must be used with the `ATAN` command. **The result will be specified to 2 decimal places in either radians or degrees.**

Example:

```
RADIAN1              ; Enable radian mode
VAR1=ATAN(0.75)      ; Set variable 1 equal to the inverse tangent of 0.75 radians
```

BAUD Baud Rate

Type	`Communication Interface`
Syntax	`BAUD<i>`
Units	`i = Baud rate`
Range	`i = 1200, 2400, 4800, 9600, 19200, 38400, or 115200 (COM2 only)`
Default	`9600`
Response	`BAUD     *BAUD9600`
See Also	`ADDR, E, PORT`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: The baud rate for the “RS-232/485” (COM1) serial port is fixed at 9600 baud, and is not adjustable by the `BAUD` command.

`BAUD` establishes the baud rate for the “RS-232” (COM2) serial port, as selected by the last `PORT` command. The default is 9600 baud (`BAUD9600`). The `BAUD` setting is automatically saved in battery backed RAM. **NOTE**: Changing the baud rate for the “RS-232” port will result in a loss of communication until the baud rate of the terminal is changed accordingly.

Example:

```
PORT2            ; Select COM2 ("RS-232") port
BAUD38400        ; Set the baud rate for COM2 to 38400 baud
```

BOT Beginning of Transmission Characters

Type	Communication Interface
Syntax	<!>BOT<i>,<i>,<i>
Units	n/a
Range	i = 0 – 256
Default	0,0,0
Response	BOT: *BOT0,0,0
See Also	EOT, ERROK, ERRBAD, PORT, DRPCHK, EOL,], [

Product	Rev
GT6K	6.0
GV6K	6.0

The BOT command designates the characters to be placed at the beginning of every response. Up to 3 characters can be placed before the first line of a multi-line response, or before all single-line responses. The characters are designated with their ASCII equivalent. For example, a carriage return is ASCII 13, a line feed is ASCII 10, a Ctrl-Z is ASCII 26, and no terminating character is designated with a zero.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

For a more complete list of ASCII Equivalents, refer to the ASCII Table in Appendix B.

Example:

```
BOT13,10,26      ; Place a carriage return, line feed, and Ctrl-Z before
                 ; the first line of a multi-line response, and before
                 ; all single line responses
```

BP Set a Program Break Point

Type	Program Flow Control or Program Debug Tool
Syntax	<a_><!>BP<i>
Units	i = break point number
Range	1 – 32
Default	n/a
Response	n/a
See Also	BREAK, C, HALT, K, S, [SS], TSS

Product	Rev
GT6K	6.0
GV6K	6.0

The BP command allows the programmer to set a place in the program where command processing will halt and a message will be transmitted to the PC. There are 32 break points available, BP1 to BP32, all transmitting the message *BREAKPOINT NUMBER x<cr> where x is the break point number.

After halting at a break point, command processing can be resumed by issuing a continue (!C) command.

The break point command is useful for stopping a program at specific locations in order to test status for debugging or other purposes.

Example:

```
DEF prog1        ; Begin definition of program named prog1
D50000           ; Set distance to 50000 units
MA1              ; Absolute mode
GO1              ; Initiate motion
IF(PC>40000)     ; Compare commanded position to 40000
BP1              ; If the motor position is > 40000 units, set break point #1
NIF              ; End IF statement
D80000           ; Set distance to 80000 units
GO1              ; Initiate motion
BP2              ; Set break point #2
END              ; End program definition
RUN prog1        ; Execute program prog1
```

If the IF statement evaluates true, the message *BREAKPOINT NUMBER 1 will be transferred out. A !C command must be issued before processing will continue. Once processing has continued, the second break point command will be encountered, again the message `*BREAKPOINT NUMBER 2` will be transferred out, and processing of commands will pause until a second `!C` command is received.

BREAK Terminate Program Execution

Type	`Program Flow Control`
Syntax	`<a_><!>BREAK`
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	`BP, C, GOSUB, HALT, K, S`

Product	Rev
GT6K	6.0
GV6K	6.0

The `BREAK` command terminates program execution when processed. This command allows the user to terminate a program based upon a condition, or at any other particular point in the program where it is necessary to end the program. If the program terminated was called from another program, control will be passed to the calling program. This command is useful when debugging a program.

To terminate all program processing, use the `HALT` command.

Example:

```
DEF prog1         ; Define a program called prog1
GO1               ; Initiate motion
GOSUB prog2       ; Gosub to subroutine named prog2
GO1               ; Initiate motion
END               ; End program definition
DEF prog2         ; Define a program called prog2
D5                ; Change distance
IF(IN=b1X0)       ; IF condition is: status of input 1 is active (1)
                  ; and input 3 is inactive (0)
BREAK             ; If condition is true break out of program
ELSE              ; Else part of if condition
TPE               ; If condition does not come true, transfer position of encoder
NIF               ; End If statement
END               ; End program definition
RUN prog1         ; Execute program prog1
;
; Upon completion of motion, subroutine prog2 is called. If inputs 1 and 3
; are in the correct state when the subroutine is entered, the subroutine
; will be terminated and returned to prog1, where motion will be initiated.
```

C Continue Command Execution

Type	`Program Flow Control`
Syntax	`<a_>!C`
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	`BP, COMEXR, COMEXS, INFNC, PS, S`

Product	Rev
GT6K	6.0
GV6K	6.0

The Continue (`!C`) command ends a pause state (`PS`), a break point (`BP`) condition, or a stopped (`S`) condition. When the Gem6K is in a paused state or at a break point, no commands from the command buffer are executed. All immediate commands, however, are still processed. By sending a `!C` command, command processing will resume, starting with the first command after the `PS` command or the `BP` command. If a stop (`S`) command has been issued, motion and command processing can be resumed by issuing a `!C` command, only if `COMEXS` has been enabled.

Example:

```
PS                ; Stop execution of command buffer until !C command
MA0               ; Select incremental positioning mode
D10000            ; Set distance to 10000 counts
GO1               ; Initiate motion
```

No buffered commands after the PS command will be executed until a !C command is received.

```
!C                ; Restart execution of command buffer
DEF prog1         ; Begin definition of program named prog1
D50000            ; Set distance to 50000 units
MA0               ; Select incremental positioning mode
GO1               ; Initiate motion
IF(VAR1>6)        ; Compare VAR1>6
BP1               ; If the motor position is > 50000 units, set break point #1
NIF               ; End IF statement
GO1               ; Initiate motion
BP2               ; Set break point #2
END               ; End program definition
RUN prog1         ; Execute program prog1
```

If the IF statement evaluates true, the message BREAKPOINT NUMBER 1 will be transferred out. A !C command must be issued before processing will continue. Once processing has continued, the second break point command will be encountered, the message BREAKPOINT NUMBER 2 will be transferred out, and processing of commands will pause until a second !C command is received.

```
COMEXS1           ; Enable command processing on stop
D50000            ; Set distance to 50000 units
GO1               ; Initiate motion
!S                ; Stop motion
```

When the Gem6K drive processes the !S command, motion will be stopped. If the desired distance has not been reached, motion can be resumed by issuing the !C command. If motion and command processing are to stop, a Kill (!K) command can be issued.

CERRLG Clear the Error Log

Type	Error Handling
Syntax	<a_><!>CERRLG
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	TAS, TASX, TDHRS, TDTEMP, TERRLG, TMTEMP

Product	Rev
GT6K	6.0
GV6K	6.0

The CERRLG command erases the stored contents of the error log. Clearing the error log is a helpful diagnostic tool; it allows you to start the diagnostic process when the error log is in a known state so that you can check the error log in response to subsequent events.

The error log is updated every time an event occurs, as selected by the ERRORL command. The TERRLG command displays the last ten error conditions that the drive has experienced, as recorded in these status registers:

- TAS (axis status binary report)
- TASX (extended axis status binary report)
- TDHRS (number of hours since the drive was powered up or RESET)
- TDTEMP (measured temperature of the drive in centigrade)
- TMTEMP (estimated temperature of the motor in centigrade for GV6K only; GT6K always reports zero)

COMEXC Continuous Command Processing Mode

Type	`Command Buffer Control`
Syntax	`<a_><!>COMEXC<b>`
Units	`b = 0 or 1`
Range	`0 = Disable, 1 = Enable`
Default	`0`
Response	`COMEXC: *COMEXC0`
See Also	`[ ! ], A, AA, AD, ADA, COMEXL, COMEXS, D, ERRORP, FOLRD, FOLRN, GO, GOWHEN, MA, MC, V`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use COMEXC to enable or disable Continuous Command Execution Mode. Under default operation (COMEXC0), when a motion command is received, command processing is temporarily paused until the motion is complete. In continuous command execution mode (COMEXC1), however, command processing continues while motion is taking place. **NOTE**: Command processing will be slower and some motion parameters cannot be changed while motion is in progress; for a complete list of motion parameters that cannot be changed while motion is in progress, refer to the Restricted Commands During Motion section in Chapter 1 of the *Programmer's Guide*.

The Continuous Command Processing Mode is useful in the following situations:

- When trying to check the status of inputs while the Gem6K is commanding motion.
- Performing calculations ahead of time, possibly decreasing cycle time.
- Executing buffered on-the-fly acceleration (A, AA), and deceleration (AD, ADA), distance (D), positioning mode (MA & MC), Following ratio (FOLRD & FOLRN), and velocity (V) changes. (The buffered A, AA, AD, ADA, D, FOLRD, FOLRN, MA, MC, or V change can be executed only with a buffered Go (GO) command.) For more information about on-the-fly motion changes, refer to the *Programmer's Guide*.
- Pre-processing the next move while the current move is in progress (see CAUTION note below). This reduces the processing time for the subsequent move to only a few microseconds.

CAUTION: Avoid Executing Moves Prematurely

With continuous command execution enabled (COMEXC1), if you wish motion to stop before executing the subsequent move, place a WAIT(AS.1=bØ) statement before the subsequent GO command. If you wish to ensure the load settles adequately before the next move, use the WAIT(AS.24=b1) command instead (this requires you to define end-of-move settling criteria — see STRGTE command or the *Target Zone* section in the *Programmer's Guide* for details).

Example:

```
DEL Prog1        ; Delete program called Prog1
DEF Prog1        ; Begin definition of program called Prog1
COMEXC1          ; Enable continuous command execution mode
L50              ; Loop 50 times
D50000           ; Set distance to 50000 counts
GO1              ; Initiate motion
; Normally at this point, the Gem6K drive would wait for the motion to complete
; before processing the next command. However, with continuous command execution
; enabled (COMEXC1), processing will continue with the statements that follow.
IF(IN.1=b1)      ; Check for input #1 becoming active
OUT.3-1          ; If it does, turn on output #3
ELSE             ;
OUT.1-1          ; If input #1 is not on, turn on output #1
NIF
WAIT(AS.1=b0)    ; Wait for no commanded motion
LN               ; End loop
COMEXC0          ; Disable continuous command mode
END              ; End definition of program
```

On-the-fly Velocity, Acceleration and Deceleration Change Example:

```
DEF vsteps       ; Begin definition of program vsteps
COMEXC1          ; Enable continuous command execution mode
MC1              ; Set mode to continuous
A10              ; Set acceleration to 10 rev/sec/sec
V1               ; Set velocity to 1 rps
GO1              ; Initiate move
WAIT(VEL=1)      ; Wait for motor to reach continuous velocity
T3               ; Time delay of 3 seconds
A50              ; Set acceleration to 50 rev/sec/sec
V10              ; Set velocity to 10 rps
GO1              ; Initiate move
T5               ; Time delay of 5 seconds
S1               ; Initiate stop of move
WAIT(MOV=b0)     ; Wait for motion to completely stop
COMEXC0          ; Disable continuous command execution mode
END              ; End definition of program vsteps
```

COMEXL Continue Execution on Limit

Type	`Command Buffer Control`
Syntax	`<a_><!>COMEXL<b>`
Units	`b = 0 or 1`
Range	`0 = Disable, 1 = Enable`
Default	`0`
Response	`COMEXL:  *COMEXL0`
See Also	`COMEXC, COMEXS, ERROR, LH, LIMLVL, LS`

Product	Rev
GT6K	6.0
GV6K	6.0

`COMEXL` determines whether the command buffer will be saved upon hitting a hardware end-of-travel limit (`LH`), or a soft limit (`LS`). If save command buffer on limit is enabled (`COMEXL1`), then all commands following the command currently being executed will remain in the command buffer when a limit is hit. If save command buffer on limit is disabled (`COMEXLØ`), then every command in the buffer will be discarded, and program execution will be terminated.

Example:

```
COMEXL1          ; Save the command buffer if the limit is hit.
```

COMEXR Continue Motion on Pause/Continue Input

Type	`Command Buffer Control`
Syntax	`<a_><!>COMEXR<b>`
Units	`b = 0 or 1`
Range	`0 = disable, 1 = enable`
Default	`0`
Response	`COMEXR:  *COMEXR0`
See Also	`C, COMEXS, INFNC`

Product	Rev
GT6K	6.0
GV6K	6.0

The `COMEXR` command determines the functionality of programmable inputs defined as pause/continue inputs with the `INFNCi-E` command. When the input is activated, the command being processed will be allowed to finish executing.

`COMEXRØ`: Upon receiving a pause input, only program execution is paused; any motion in progress will continue to its predetermined destination. Releasing the pause input or issuing a `!C` command will resume program execution.

`COMEXR1`: Upon receiving a pause input, both motion and program execution will be paused; the motion stop function is used to halt motion. *After motion stops*, you can release the pause input or issue a `!C` command to resume motion and program execution.

Example:

```
COMEXR1          ; Allow both motion and program execution to be paused upon
                 ; receiving a pause input
2INFNC1-E        ; Define input 1 on I/O brick 2 as a pause/continue input
```

COMEXS   Continue Execution on Stop

		Product	**Rev**
Type	`Command Buffer Control`	GT6K	6.0
Syntax	`<a_><!>COMEXS<i>`	GV6K	6.0
Units	`i = function identifier`		
Range	`0, 1, or 2`		
Default	`0`		
Response	`COMEXS: *COMEXS0`		
See Also	`COMEXC, COMEXL, COMEXR, INFNC, S`		

The `COMEXS` command determines the impact on motion, program execution, and the command buffer when the Gem6K receives a Stop command (`S`, `!S`, `S1`, or `!S1`) or an external Stop input (an input assigned a stop function with `INFNCi-D`).

`COMEXS0`: Under factory default conditions (`COMEXS0`), when the Gem6K receives a stop command (`S`, `!S`, `S1`, or `!S1`) or a stop input (`INFNCi-D`), the following will happen:

- Motion decelerates to a stop, using the present `AD` and `ADA` deceleration values. The motion profile cannot be resumed.
- All commands in the Gem6K's command buffer are discarded.
- Program execution is terminated.

`COMEXS1`: Using the `COMEXS1` mode, the Gem6K allows more flexibility in responding to stop conditions, depending on the stop method (see table below).

Stop Method	What Stops?		**Resume Motion Profile**. (Allow resume with a `!C` command or a resume input *)	**Resume Program**. (Allow resume with a `!C` command or a resume input *)	**Save Command Buffer**. (Save the commands that were in the command buffer when the stop was commanded)
	Motion	Program			
`!S` or `S`	Yes	Yes	Yes	Yes	Yes
`!S1` or `S1`	Yes	No	No	No	Yes
Stop input	Yes	No	No	No	Yes
Pause input * (if `COMEXR1`)	Yes	Yes	Yes	Yes	Yes
Pause input * (if `COMEXR0`)	No	Yes	No	Yes	Yes

* A *Pause* input is an input configured with the `INFNCi-E` command command. This is also the *Resume* input that can be used to resume motion and program execution after motion is stopped.

`COMEXS2`: Using the `COMEXS2` mode, the Gem6K responds as it does in the `COMEXS0` mode, with the exception that you can still use the program-select inputs to select programs (`INSELP` value is retained). The program-select input functions are: BCD select (`INFNCi-B`), and one-to-one select (`INFNCi-P`). For further details on program selection with inputs, refer to `INFNC` and `INSELP`.

[COS()] Cosine

Type Operator (Trigonometric)
Syntax COS(r) (see below)
Units r = radians or degrees (depending on RADIAN command)
Range r = 0.00000 - ±17500
Default n/a
Response n/a
See Also [ATAN], [PI], RADIAN, [SIN], [TAN], VAR

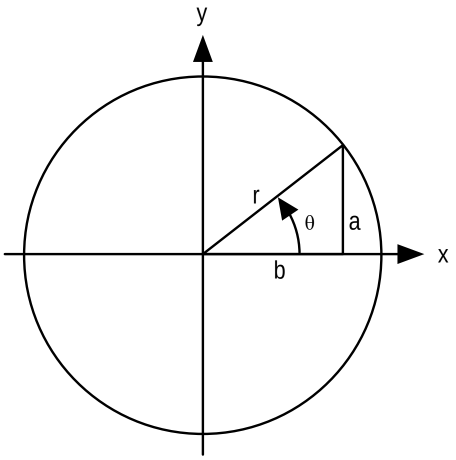
Product	Rev
GT6K	6.0
GV6K	6.0

Use this operator to calculate the cosine of a number given in radians or degrees (see RADIAN command). If “a” and “b” are coordinates of a point on a circle of radius “r”, then the angle of measure “θ” can be defined by the equation:

$\cos\theta = \frac{b}{r}$ (see illustration at right)

If a value is given in radians and a conversion is needed to degrees, or vice-versa, use the formula:

360° = 2π radians.

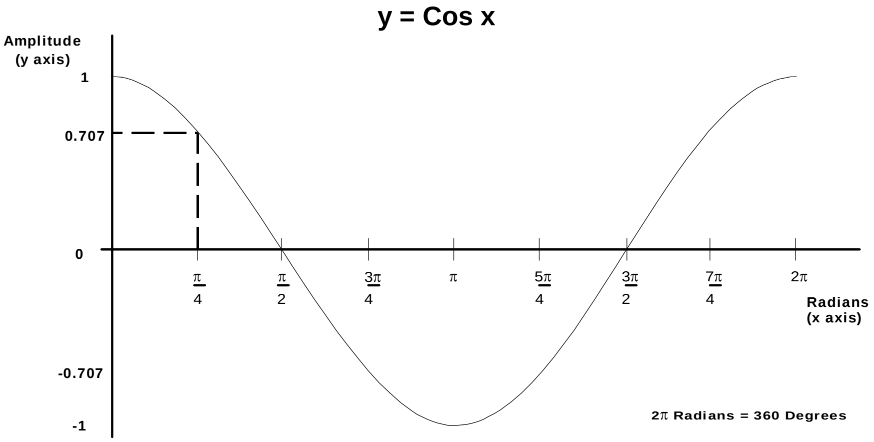


$\sin\theta = \frac{a}{r}$

$\cos\theta = \frac{b}{r}$

$\tan\theta = \frac{a}{b}$

The graph to the right shows the amplitude of **y** on the unit circle for different values of **x**.



Syntax: VARi=COS(r) where i is the variable number and r is a value in either radians or degrees depending on the RADIAN command. Parentheses (()) must be placed around the COS operand. **The result will be specified to 5 decimal places.**

Example:

```
VAR1=5 * COS(PI/4)     ; Set variable 1 equal to 5 times the cosine of
                       ; π divided by 4
```

D Distance

Type	`Motion`
Syntax	`<a_><!>D<r>`
Units	`r = distance units (scalable by SCLD)`
Range	`±999,999,999.99999`
Default	`4000`
Response	`D:   *D+4000`
See Also	`[ D ], DMEPIT, DRES, ERES, GO, IF, MA, MC, PSET, SCLD, TSTAT, VARI, WAIT`

Product	Rev
GT6K	6.0
GV6K	6.0

The Distance (`D`) command defines either the number of units the motor will move or the absolute position it will seek after a `GO` command. In the incremental mode (`MAØ`), the distance value represents the total number of units you wish the motor to move. In the absolute mode (`MA1`) the distance value represents the absolute position the motor will end up at; the actual distance traveled will vary depending on the absolute position of the motor before the move is initiated.

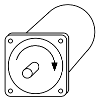
In the incremental mode (`MAØ`), you can specify a negative distance by placing a dash or hyphen (-) in front of the distance value (e.g., `D-10000`). Otherwise, the direction is considered positive. You can change direction without changing the distance value by using the `+`, `-`, or `~` operators (e.g. `D+`, or `D-`, or `D~`); the tilde (~) is a means of toggling the direction.

The distance remains set until you change it with a subsequent distance command. Distances outside the valid range are flagged as an error, returning the message `*INVALID DATA-FIELD x`, where `x` is the field number.

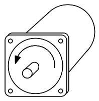
UNITS OF MEASURE and **SCALING**: refer to page 16.

ON-THE-FLY CHANGES: You can change distance *on the fly* (while motion is in progress) in two ways. One way is to send an immediate distance command (`!D`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered distance command (`D`) followed by a buffered go command (`GO`).

Direction of Motion for Rotary Motors:
Positive distance values (e.g., `D20000`) represent clockwise motion and negative values (e.g., `D-20000`) represent counter-clockwise motion. This assumes you connected the motor (and feedback device for servos) according to the *Hardware Installation Guide* instructions.



Clockwise (positive counts)



Counter-clockwise (negative counts)

Example:

```
SCALE1          ; Enable scaling
SCLA25000       ; Set the acceleration scaling factor for to 25000 steps/unit
SCLV25000       ; Set the velocity scaling factor to 25000 steps/unit
SCLD1           ; Set the distance scaling factor to 1 step/unit
DEL proga       ; Delete program called proga
DEF proga       ; Begin definition of program called proga
MA0             ; Incremental positioning mode
MC0             ; Preset positioning mode
A10             ; Set the acceleration to 10 units/sec/sec
AD1             ; Set the deceleration to 1 units/sec/sec
V1              ; Set the velocity to 1 units/sec
D100000         ; Set the distance to 100000 units
GO1             ; Initiate motion
END             ; End definition of program called proga
```

[D] Distance Assignment

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`distance units (scalable by SCLD)`
Range	`±999,999,999.99999`
Default	`n/a`
Response	`n/a`
See Also	`D, GO, MA, MC, PSET, SCLD`

Product	Rev
GT6K	6.0
GV6K	6.0

The distance assignment (`D`) command is used to compare the programmed distance value to another value or variable, or to assign the current programmed distance to a variable.

Syntax: `VARn=D` where `n` is the variable number, or `[D]` can be used in an expression such as `IF(D<25ØØØ)`. The `D` value used in any comparison, or in any assignment statement is the programmed `D` value. If the actual position information is required, refer to the `PC` command for steppers, or the `PE` command for servos.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example:

```
IF(D<25000)       ; If the programmed distance is less than 25000 units,
                  ; then do the statements between the IF and NIF
VAR1=D*2          ; Variable 1 = programmed distance times 2
D(VAR1)           ; Set the distance to the value of variable 1
NIF               ; End the IF statement
```

DABSD Enable ABS Damping

Type	`Drive Configuration`
Syntax	`<a_><!>DABSD<b>`
Units	`b = enable bit`
Range	`0 (disable) or 1 (enable)`
Default	`0 (disabled)`
Response	`DABSD:    *DABSD1`
See Also	`DACTDP, DDAMPA, DELVIS`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `DABSD` command enables or disables the ABS damping function. ABS is a damping technique designed for use at very low to zero speed. ABS damping requires no additional user setup or configuration. When enabled (`DABSD1`), ABS damping takes precedence over electronic viscosity (`DELVIS`) at speeds less than approximately 0.2 revs/sec (motor dependent). ABS damping can be disabled during acceleration with the `DDAMPA0` command (`DDAMPA0` is the factory default setting).

GT6K Damping Features: The GT6K drive provides damping features that reduce vibration, increase low-speed smoothness, and decrease load settling time. (A procedure for configuring damping settings is provided in the Configuration chapter of the *Hardware Installation Guide*.)

Command	Damping Function	Velocity *	Default	Related Parameters *
DABSD	ABS Damping. Load-independent damping at extreme low speeds. This feature targets applications that require minimal zero-speed settling (e.g., pick-and-place applications).	0 to 0.2 revs/sec **	Disabled	DMTRES, DMTIND
DELVIS	Electronic Viscosity. This feature targets applications that require reduced low-speed velocity ripple and increased smoothness, as well as aggressive low-speed damping. (NOTE: If ABS Damping is enabled, it overrides electronic viscosity in the 0-0.2 rev/sec velocity range.) Start with DELVIS set to zero, and increase until the required performance is achieved.	0 to 3 revs/sec **	Disabled	DMTJ, DMTSTT, DPOLE, DMTIC, DMTIND, LJRAT
DACTDP	Active Damping. This feature targets applications that require high accelerations, fast settling at commanded speed, mechanical vibration rejection, and highly stable (non-resonant) motion. Start configuration with a low DACTDP value, as highly aggressive damping can lead to mechanical failure.	> 3 revs/sec	Enabled, gain = 4	DMTJ, DMTIND, DMTSTT, LJRAT
DDAMPA	Damping During Acceleration. When enabled, ABS Damping and Electronic Viscosity are allowed to function at accel and decel rates greater than 50 revs/sec/sec. If your application requires more responsive acceleration and deceleration (full motor torque) above 50 revs/sec/sec, you can disable this feature; but be aware that doing so increases jerk in your mechanical system.	Affects damping at accelerations > 50 revs/sec/sec	Disabled	n/a

* These features are based on motor and load parameters that you set up with the configuration utility in Motion Planner (see page 6). *For optimum damping performance, accurate motor and load parameters are required.* **NOTE**: If you select a Parker motor with the configuration utility, all of the motor parameters (excluding LJRAT, which sets the load-to-rotor ratio) are automatically set accordingly.

** Actual transition velocity is based on motor and load parameters, and is therefore application dependent.

DACTDP Active Damping

Type	Drive Configuration
Syntax	<a_><!>DACTDP<i>
Units	i = gain
Range	0-40; 0 disables active damping
Default	4
Response	DACTDP *DACTDP0
See Also	DABSD, DELVIS, DMTR, LJRAT

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The DACTDP command controls the gain of the Active Damping function for a specific motor and load. Active damping works at speeds greater than 3 revolutions per second.

NOTE: To be fully effective, the active damping function requires that you first set the system inertia ratio (LJRAT) and configure your motor parameters. Motor parameters are automatically configured when you select a Parker motor with the DMTR command (if you are not using a Parker motor you must individually configure each command listed in the DMTR command description). **With a setting of DACTDP20**, the nominal gains (calculated based on LJRAT and the motor parameters) give the best performance over the entire speed range, but you may adjust the DACTDP setting further as your application warrants.

An overview of the GT6K's damping features is provided in the DABSD command description

[DAT] Data Assignment

Type	Data Storage
Syntax	DATi
Units	i = data program #
Range	1-50
Default	n/a
Response	n/a
See Also	DATA, [DATP], DATPTR, DATRST, DATTCH

Product	Rev
GT6K	6.0
GV6K	6.0

The DAT command recalls data from the data program (DATP). The data is loaded into a command field, or into a variable (VAR). As the data is loaded, the internal data pointer to the DATP data increments and points to the next datum for the next DAT command.

Syntax: VARn=DATi where "n" is the variable number, and "i" is the data program number, or DAT can be used as a command argument such as A(DAT1)

If the data is to be loaded into a command field, the DAT command must be placed within parentheses (e.g., AD(DAT2)). If the data is loaded into a variable, parentheses are not required. (e.g., VAR1=DAT2). Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by <r>) or an integer value (denoted by <i>), you can use the DAT substitution (e.g., HOMV(DAT1)).

The DAT command cannot be used in an expression, such as IF(DAT2 < 5) or VAR1=1 + DAT3.

Example: Refer to the Reset Data Pointer (DATRST) command example.

DATA Data Statement

Type	Data Storage
Syntax	<a_><!>DATA=<r>,<r>,<r>,<r>
Units	r = data value
Range	±999,999,999.99999999
Default	n/a
Response	n/a
See Also	[DAT], [DATP], DATPTR, DATRST, DATTCH, MEMORY

Product	Rev
GT6K	6.0
GV6K	6.0

The DATA command is used only in the data programs (DATP) to identify the data statements. The DATA command is followed by an equal sign (=), and a maximum of four data values. The maximum number of data statements is limited only by the amount of memory available.

Example: Refer to the Reset Data Pointer (DATRST) command example.

[DATP] Data Program

Type	Data Storage
Syntax	DATPi
Units	i = data program number
Range	1-50
Default	n/a
Response	n/a
See Also	[DAT], DATA, DATPTR, DATRST, DATSIZ, DATTCH, MEMORY

Product	Rev
GT6K	6.0
GV6K	6.0

DATP is not a command, but is the name of the program that is the default for storing data. Fifty such data programs can be created, DATP1 - DATP5Ø. The program is defined with the DEF command, just as any other program would be, but only the DATA and END commands are allowed within the program definition. DATPi will contain the array of data to be recalled by the DATi command. Upon completion of the definition, the internal data pointer is pointing to the first datum in the data program.

Example:

```
DEF DATP5             ; Define data program 5
DATA=1,2,3,4          ; Enter data
DATA=5.62,6.52,7.12,8.47     ; Enter data
END                   ; End program definition
A(DAT5)               ; Load data from data program 5 and store in axis acceleration.
                      ; Axis acceleration = 1
V(DAT5)               ; Load data from data program 5 and store in axis velocity.
                      ; Axis velocity = 2
D(DAT5)               ; Load data from data program 5 and store in axis distance.
                      ; Axis distance = 3
A(DAT5)               ; Load data from data program 5 and store in axis acceleration.
                      ; Axis acceleration = 4
A(DAT5)               ; Load data from data program 5 and store in axis acceleration.
                      ; Axis acceleration = 5.62
```

DATPTR Set Data Pointer

Type	`Data Storage`
Syntax	`<a_><!>DATPTRi,i,i`
Units	`n/a`

Range	`1st i = program # 1 to 50`
	`2nd i = data element # 1 to 6500`
	`3rd i = increment setting of 1 to 100`

Default	`1,1,1`
Response	`n/a`
See Also	`[ DAT ], DATA, [ DATP ], DATSIZ, DATTCH, [ DPTR ], TDPTR`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `DATPTR` command moves the internal data pointer to a specific data element in the specified data program (`DATPi`). This command also establishes the number of data elements by which the pointer increments after writing each data element from a `DATTCH` command, or after recalling a data element with the `DAT` command.

The data program selected with the first integer in the `DATPTR` command becomes the active data program. Subsequent `DATTCH`, `TDPTR`, and `DPTR` commands will reference the active data program. You can use the `TDPTR` command to ascertain the current active data program, as well as the current location of the data pointer and the increment setting (see `TDPTR` command description for details).

The `DPTR` command can be used to compare the current pointer location (the number of the data element to which the data pointer is pointing) against another value or variable, or to assign the pointer location number to a variable.

As an example, suppose data program #1 (`DATP1`) is configured to hold 15 data elements (`DATSIZ1,15`), the data pointer is configured to start at the first data element and increment 1 data element after every `DATTCH` value is stored (`DATPTR1,1,1`), and the values of numeric variables #1 through #4 are already assigned (`VAR1=2`, `VAR2=4`, `VAR3=8`, `VAR4=64`). If you then enter the `DATTCH1,2,3,4` command, the values of `VAR1` through `VAR4` will be assigned respectively to the first four data elements in the data program and the pointer will stop at data element #5. The response to the `TPROG DATP1` command would be as depicted below (the text is highlighted to illustrate the location of the data pointer after the `DATTCH1,2,3,4` command is executed). The response to the `TDPTR` command would be `*TDPTR1,5,1`.

```
*DATA=2.0,4.0,8.0,64.0
*DATA=0.0,0.0,0.0,0.0
*DATA=0.0,0.0,0.0,0.0
*DATA=0.0,0.0,0.0
```

Once you have stored (taught) the variables to the data program, you can use the `DATPTR` command to point to the data elements and then use the `DAT` data assignment command to read the stored variables to your motion program.

During the process of writing data (`DATTCH`) or recalling data (`DAT`), if the pointer reaches the last data element in the program, it automatically wraps around to the first datum in the program and a warning message is displayed (`*WARNING: POINTER HAS WRAPPED AROUND TO DATA POINT 1`). This warning will not interrupt command execution.

Example: (See Also: DATSIZ command)

```
DEL DATP5          ; Delete data program #5 (DATP5)
DEF DATP5          ; Define data program #5 (DATP5)
DATA=1,2,3,4       ; Enter data
DATA=5.62,6.52,7.12,8.47     ; Enter data
END                ; End program definition
A(DAT5)            ; Load data from DATP5 and store in axis acceleration.
                   ; Axis acceleration = 1
V(DAT5)            ; Load data from DATP5 and store in axis velocity.
                   ; Axis velocity = 2
D(DAT5)            ; Load data from DATP5 and store in axis distance.
                   ; Axis distance = 3
DATPTR5,1,1        ; Set the data pointer to datum 1 in DATP5; increment the
                   ; pointer by one after each DAT command
A(DAT5)            ; Load data from DATP5 and store in axis acceleration.
                   ; Axis acceleration = 1
A(DAT5)            ; Load data from DATP5 and store in axis acceleration.
                   ; Axis acceleration = 2
```

DATRST Reset Data Pointer

Type	`Data Storage`
Syntax	`<a_><!>DATRST<i>,<i>`
Units	`n/a`
Range	`1st i = program # 1 to 50, 2nd i = data element # 1 to 6500`
Default	`n/a`
Response	`n/a`
See Also	`[ DAT ], DATA, [ DATP ]`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `DATRST` command sets the internal data pointer to a specific data element in a data program (`DATP<i>`). As data is recalled from a data program with the `DAT` command, the pointer automatically increments to the next data element. If the pointer reaches the end of the program, it automatically wraps around to the first data element in the program. `DATRST` allows the pointer to be set to any location within the data program (`DATP`).

Example:

```
DEF DATP5          ; Define data program 5
DATA=1,2,3,4       ; Enter data
DATA=5.62,6.52,7.12,8.47     ; Enter data
END                ; End program definition
A(DAT5)            ; Load data from data program 5 and store in axis acceleration.
                   ; Axis acceleration = 1
V(DAT5)            ; Load data from data program 5 and store in axis velocity.
                   ; Axis velocity = 2
D(DAT5)            ; Load data from data program 5 and store in axis distance.
                   ; Axis distance = 3
DATRST5,1          ; Set the data pointer to datum 1 in data program 5
A(DAT5)            ; Load data from data program 5 and store in axis acceleration.
                   ; Axis acceleration = 1
A(DAT5)            ; Load data from data program 5 and store in axis acceleration.
                   ; Axis acceleration = 2
```

DATSIZ Data Program Size

Type	`Data Storage`
Syntax	`<a_><!>DATSIZi<,i>`
Units	`n/a`

Range	`1st i = program # 0 - 50 (0 = disable)`
	`2nd i = data element # 1 - 6500`

Default	`0,1`
Response	`n/a`
See Also	`[ DAT ], DATPTR, [ DATP ], DATTCH`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DATSIZ` command creates a new data program (`DATP`) and establishes the number of data elements the data program contains.

The `DATSIZ` command syntax is `DATSIZi<,i>`. The first integer (`i`) represents the number of the data program (1 - 50). You can create up to 50 separate data programs. The data program is automatically given a specific program name (`DATPi`). If the program number `Ø` is selected, then the `DATTCH` command is disabled. Before creating a new data program, be sure to delete the existing data program that has the same name. For example, if you wish to create data program #5 with the `DATSIZ5,144` command and `DATP5` already exists, first delete `DATP5` with the `DEL DATP5` command and then issue the `DATSIZ5,144` command.

The second integer represents the total number of data elements (up to 6,500) you want in the data program. Upon issuing the `DATSIZ` command, the data program is created with all the data elements initialized with a value of zero. (The `DATSIZ` command is equivalent to creating a `DATP` program and filling it with `DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø` commands up to the size indicated in the second integer.)

Each data statement, which contains four data elements, uses 43 bytes of memory. This amount of memory is subtracted from the memory allocated for user programs (see `MEMORY` command). Use the `TDIR` command to determine the amount of remaining memory for user program storage.

The data program has a tabular structure, where the data elements are stored 4 to a line. Each line of data elements is called a *data statement*. Each element is numbered in sequential order from left to right (1 - 4) and top to bottom (1 - 4, 5 - 8, 9 - 12, etc.). You can use the `TPROG DATPi` command ("`i`" represents the number of the data program) to display all the data elements of the data program. For example, if you issue the `DATSIZ1,13` command, data program #1 (called `DATP1`) is created with 13 data elements initialized to zero. The response to the `TPROG DATP1` command is depicted below. Each line (*data statement*) begins with `DATA=`, and each data element is separated with a comma.

```
*DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø
*DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø
*DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø
*DATA=Ø.Ø
```

The `DATSIZ`, `DATTCH`, and `DAT` commands will typically be used as a teach mode in this manner:

1. Issue the `DATSIZ` command to create (or recall) the data program.
2. Store variable data (e.g., position, acceleration, velocity, etc.) to numeric variables (`VAR`).
3. Use `DATTCH` commands to store the data from the numeric variables into the data program. You can use the data pointer (`DATPTR`) command to select any data element in the data program, and to determine the number by which the pointer increments after each value from the `DATTCH` command is stored. *NOTE: If the `DATTCH` command is issued without having issued the `DATSIZ` command, an error will result.*
4. Use the `DAT` commands to read the stored data from the data program into the variable parameters of your motion program. You can use the `DATPTR` command to select any data element in the data program, and to determine the number by which the pointer increments after each `DAT` command.

Any use of the `DATTCH` and `DAT` commands will reference the current active data program (`DATP`) specified by the first integer of the last `DATSIZ` or `DATPTR` command. If you want to use the `DATSIZ` command to recall a data program, **and not create one**, specify only the first integer and not the second integer. For example, DATSIZ7 recalls data program #7 (DATP7) as the active data program.

Example:

```
DEL DATP5         ; Delete existing data program #5 (DATP5)
DATSIZ5,200       ; Create data program #5 (DATP5) with 200 data elements
DEF TEACH         ; Begin definition of program called TEACH
COMEXC0           ; Disable continuous command execution mode
MA1               ; Enable the absolute positioning mode
HOM1              ; Home (absolute position counter set to zero after homing)
DATPTR5,1,1       ; Set data pointer to data element #1 in DATP5, and increment the
                  ; pointer by one element after every DATTCH value or DAT command
REPEAT            ; Set up a loop for teaching the positions
JOY1              ; Enable joystick mode so that you can start moving the
                  ; axis into position with the joystick. Command processing stops
                  ; here until you activate IN.2 to disable the
                  ; joystick mode and execute the rest of the commands in the
                  ; repeat/until loop (assign the motor positions to the variables and
                  ; then store the positions from the variables to the data program).
VAR1=1PM          ; Store the current position in variable #1
DATTCH1           ; Store variable #1 into consecutive data elements
WAIT(IN.2=b0)     ; Wait for the "joystick release" input to be de-activated
UNTIL(DPTR=1)     ; Repeat loop until the data pointer wraps around to data element #1
HOM1              ; Home (absolute position counter set to zero after homing)
DATPTR5,1,1       ; Set data pointer to data element #1, read one data element at a time
REPEAT            ; Set up a repeat/until loop to read all data elements
D(DAT5)           ; Read position data from the data program to the distance command
GO1               ; Make the move to the positions that were taught
T.2               ; Wait 0.2 seconds
UNTIL(DPTR=1)     ; Repeat loop until the data pointer wraps around to data element #1
END               ; End definition of program called TEACH
```

DATTCH Data Teach

Type	Data Storage
Syntax	<a_><!>DATTCHi<,i,i,i>
Units	i = number of a numeric variable
Range	i = 1-225
Default	n/a
Response	n/a
See Also	[DAT], [DATP],DATPTR, DATSIZ, DATTCH, VAR

Product	Rev
GT6K	6.0
GV6K	6.0

The Data Teach (DATTCH) command stores the values from the specified numeric variables (VAR) into the **currently active data program** (i.e., the data program specified with the last DATSIZ or DATPTR command). The value that is in the specified variable at the time the DATTCH command is executed is the value that is stored in the data program.

If the DATTCH command is issued without having first issued the DATSIZ command, an error will result. If a zero is entered in the first integer of the DATSIZ command (e.g., DATSIZØ), the DATTCH command is disabled.

As indicated by the number of integers in the syntax, the maximum number of variables that can be stored in the data program per DATTCH command is 4. The variables are stored in the data program, starting at the current location of the data pointer. The data pointer's position can be moved to any data element in any data program by use of the DATPTR command. After each successive DATTCH value is stored, the data pointer will increment by the number specified in the third integer of the DATPTR command. Any data element in the data program can be edited by setting the data pointer to that element and then issuing the DATTCH command.

As an example, suppose data program #1 (DATP1) is configured to hold 15 data elements (DATSIZ1,15), the data pointer is configured to start at the first data element and increment 1 data element after every DATTCH value is stored (DATPTR1,1,1), and the values of numeric variables #1 through #4 are already assigned (VAR1=2, VAR2=4, VAR3=8, VAR4=64). If you then enter the DATTCH1,2,3,4 command, the values of VAR1 through VAR4 will be assigned respectively to the first four data elements in the data program and the pointer will stop at data element #5. The response to the TPROG DATP1 command would be as follows (the text is highlighted to illustrate the location of the data pointer after the DATTCH1,2,3,4 command is executed).

```
*DATA=2.Ø,4.Ø,8.Ø,64.Ø
*DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø
*DATA=Ø.Ø,Ø.Ø,Ø.Ø,Ø.Ø
*DATA=Ø.Ø,Ø.Ø,Ø.Ø
```

Example: Refer to the DATSIZ command**.**

DAUTOS Auto Current Standby

Type	Drive Configuration
Syntax	<a_><!>DAUTOS<r>
Units	r = percent reduction of motor current
Range	0.00-99.99 : ±0.01
Default	0.00 (no current reduction)
Response	DAUTOS *DAUTOS0
See Also	

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The DAUTOS command allows you to let the motor cool when it is not moving. When automatic current standby is set to a value other than 0.00 (default), the motor current will be reduced by that percentage when the drive has not issued a motion command for one second. Full commanded current is restored upon the first motion command that the drive issues.

WARNING: Motor torque is reduced when the motor current is reduced. Applications with vertical loads or loads that require holding torque at zero speed should not use this feature.

DCLEAR Clear Display

Type	Display (RP240) Interface
Syntax	<a_><!>DCLEARi
Units	n/a
Range	i = 0 (clear all lines), 1 (clear line 1), or 2 (clear line 2)
Default	n/a
Response	n/a
See Also	DLED, DPASS, DPCUR, DSTP, DVAR, DVARB, DVARI, DWRITE

Product	**Rev**
GT6K	6.0
GV6K	6.0

The Clear Display (DCLEAR) command clears lines (as specified with i) of the RP240 display. After clearing a line, the cursor will be reset to the beginning of that line (or to the beginning of line 1 if all lines are cleared).

DCLRLR Clear the Latched Status Register Bits

Type	Drive Configuration
Syntax	<a_><!>DCLRLR
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	DMODE, DMTLIM, DMVLIM, DIFOLD, TASX, TTRQ

Product	**Rev**
GT6K	6.0
GV6K	6.0

TASX status register bits 18, 19, 20 and 31 (see descriptions below) indicate conditions in which drive protective software has engaged, but drive operation continues. These status bits remain set (*latched*), regardless of whether the conditions persist, and are cleared with the DCLRLR command or when you issue a RESET or DRESET command, cycle power, or activate the Reset input.

TASX bit 18 Commanded Velocity Exceeds DMVLIM Limit (GV6K and GT6K):
Bit 18 is set when the velocity demand from the internal Gem6K control loops exceeds the limits set by the DMVLIM command. The Gem6K drive responds to this condition by invoking the “Override Mode,” in which the drive software clamps the maximum allowable velocity command to the value set by DMVLIM. The Override Mode feature is applicable to the Gem6K drive in all operating modes (DMODE).

TASX bit 19 Bridge is in Foldback Mode (GV6K only):
When a GV6K drive produces more than its rated continuous current, a software algorithm determines on an ongoing basis the amount of power being delivered by the drive to the motor. When this value exceeds the safe threshold for the drive, the drive either goes into Foldback Mode or faults, depending on the DIFOLD command. For motion profiles that push the limits of the drive’s capabilities, the drive might go into Foldback Mode for a short period of time. Bit 19 stays latched, however, so that the user can determine that foldback occurred.

TASX bit 20 Power Dissipation Circuit Active (GV6K and GT6K):
When a Gem6K drive attempts to slow a motor down, the stored energy in the motor and load must be absorbed by the drive. This regenerative energy will increase the bus voltage in the drive until either a regenerative power dissipation circuit dissipates the energy or a drive over-voltage fault (reported in TASX bit 13) occurs. In all GT6K drives, the GV6K-L3, GV6K-H20 and GV6K-H40, internal regenerative power dissipation circuitry is provided to dissipate this energy; when this circuitry is activated, TASX bit 20 is set and latched. In the GV6K-U3, GV6K-U6, and GV6K-U12 drives, the external ‘Gemini Power Dissipation Module’ or ‘GPDM’ option can be used to dissipate this energy — TASX bit 20 does not get set for these drives.

TASX bit 31 Commanding Maximum Torque/Force (GV6K):
When the GV6K’s commanded torque/force reaches the limit set by DMTLIM (TTRQ = DMTLIM), TAS bit #31 is set. This is not considered a fault condition.

DDAMPA Damping During Acceleration/Deceleration

Type	Drive Configuration
Syntax	<a_><!>DDAMPA<b>
Units	b = enable bit
Range	0 (disable damping) or 1 (enable damping)
Default	0 disabled)
Response	DDAMPA: *DDAMPA1
See Also	DABSD, DELVIS

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

When Damping During Acceleration is enabled (DDAMPA1), ABS damping (DABSD) and Electronic Viscosity (DELVIS) function normally.

If your application requires more responsive acceleration and deceleration, you can disable Damping During Accel/Decel with the DDAMPA0 command (DDAMPA0 is the factory default setting). This disables ABS damping and Electronic Viscosity during acceleration and deceleration rates greater than 50 revs/sec/sec when the commanded speed exceeds 0.03 revs/sec.

Be aware that the DDAMPA0 mode allows increased jerk in your mechanical system.

An overview of the GT6K’s damping features is provided in the DABSD command descripition.

DEF Begin Program/Subroutine Definition

Type	`Program or Subroutine Definition`
Syntax	`<a_><!>DEF<t>`
Units	`t = alpha text string (name of a program)`
Range	`text string of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`$, DEL, END, ERASE, GOBUF, GOSUB, GOTO, MEMORY, PCOMP, PLCP, PRUN, RUN, [ SS ], TDIR, TMEM, TPROG, TSS, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DEF` command is the beginning of a program or subroutine definition. The syntax for the command is `DEF` followed by 6 or fewer alpha-numeric characters. The first character may not be a number. Refer to the `MEMORY` command description for information on program size restriction and total number of programs possible per product.

All programs are stored in a binary fashion within the Gem6K. A program transferred back out (`TPROG`) after it has been defined (`DEF`), may not look identical to the program defined. However, the program is functionally identical.

NOTE

When defining a program and the memory limitation is exceeded, an error message will be generated, and bit 11 of the system status register will be set (`SS` or `TSS`). The program will be stored up to the point where the memory limitation was exceeded.

There is no actual difference in the definition of, or execution of a program versus the definition, or execution of a subroutine. Both a program and a subroutine are defined as the set of commands between a `DEF<t>` and an `END` command. If an invalid program/subroutine name is entered, an error message will be generated. An invalid program/subroutine name is any name that is also a current command. (An example of an invalid name would be `DEFhom1`, because it is impossible for the operating system to distinguish the `hom1` subroutine call from the `HOM1` go home command.). A subroutine/program definition cannot be assigned the name "`CLR`" and cannot contain any of the following characters:
`!`, –, #, $, %, ^, &, *, `(`, `)`, +, `-`, _, =, {, }, \, `|`, `"`, `:`, `;`, `'`, <, >, `,`, `.`, ?, `/`.

The `RUN` command can be used to start executing a program/subroutine. The program name by itself can also be used to start executing a program/subroutine. A compiled motion profile must be compiled with the `PCOMP` command before it can be executed with the `PRUN` command; and a compiled PLC (`PLCP`) program must be compiled with `PCOMP` before it can be executed with the `SCANP` or `PRUN` command.

The `GOTO` and `GOSUB` commands can be used within a program/subroutine to go to another program/subroutine.

NOTE: Program, compiled profile, or subroutine names must be deleted (`DEL`) before they can be redefined.

Example:

```
DEL pick          ; Delete program named pick
DEF pick          ; Begin definition of program named pick
GO1               ; Initiate motion
END               ; End program definition
RUN pick          ; Execute program pick
```

DEL Delete a Program/Subroutine

Type	`Program or Subroutine Definition`	**Product**	**Rev**
Syntax	`<a_><!>DEL<t>`	GT6K	6.0
Units	`t = alpha text string (name of a program)`	GV6K	6.0
Range	`text string of 6 characters or less`		
Default	`n/a`		
Response	`n/a`		
See Also	`$, DEF, END, ERASE, GOSUB, GOTO, RUN`		

The Delete a Program/Subroutine (`DEL`) command removes a program or subroutine definition. The syntax for the command is `DEL` followed by 6 or fewer alpha-numeric characters. To delete all programs refer to the `ERASE` command. The `DEL` command can be placed inside a program (e.g., to delete a `DATP` program).

To edit an existing program, you must first delete it. The `DEL` command will not delete a label (`$`).

Example:

```
DEF pick          ; Begin definition of program named pick
GO1               ; Initiate motion
END               ; End program definition
RUN pick          ; Execute program pick
DEL pick          ; Deletes program named pick
```

DELVIS Electronic Viscosity

Type	`Drive Configuration`	**Product**	**Rev**
Syntax	`<a_><!>DELVIS<i>`	GT6K	6.0
Units	`i = gain`	GV6K	n/a
Range	`0-7  (0 disables Electronic Viscosity)`		
Default	`0 (disabled)`	(applicable only to stepper axes)	
Response	`DELVIS   *DELVIS0`		
See Also	`DACTDP, DABSD, DDAMPA, DMTR, LJRAT`		

When the `DELVIS` command is set to a non-zero value (`DELVIS1` through `DELVIS7`), Electronic Viscosity is invoked at speeds below 3 revs/sec. Electronic Viscosity is superseded by the ABS damping function (enabled with the `DABSD1` command) at speeds below approximately 0.2 revs/sec.

If Damping During Acceleration is disabled (`DDAMPA0`), Electronic Viscosity is disabled during accelerations greater than 50 revs/sec/sec (`DDAMPA0` is the factory default setting).

An overview of the GT6K's damping features is provided in the `DABSD` command descripition.

NOTE: To be fully effective, the electronic viscosity function requires that you first set the system inertia ratio (`LJRAT`) and configure your motor parameters. Motor parameters are automatically configured when you select a Parker motor with the configuration tool in Motion Planner (if you are not using a Parker motor you must individually configure each command listed in the `DMTR` command description). With a setting of `DELVIS5`, the nominal gains (calculated based on `LJRAT` and the motor parameters) give the best performance over the entire speed range, but you may adjust the `DELVIS` setting further as your application warrants.

DHALL Disable Hall Sensor Checking

Type	Drive Configuration
Syntax	<a_><!>DHALL<i>
Units	i = control option #
Range	0 (Enable Hall Error Checking) 1 (Disable Hall Error Checking)
Default	0
Response	DHALL: *DHALL0
See Also	SHALL, THALL, TASX

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: When issued, this command takes effect immediately.

Encoder Motors (with SFB1): The DHALL command controls whether or not the Hall error checking routines are invoked once the Gemini drive determines a valid absolute position of the motor at initialization.

These error routines include checks:

1. to see if all three Hall sensors are reporting valid states (000 and 111 are ***not*** valid).
2. to see if the Hall state signal order is correct for either positive (clockwise) or negative (counter clockwise) motion. The Hall state order is 6, 2, 3, 1, 5, 4, 6, 2, 3, 1, 5, 4, 6 (and so on) for a motor turning in the positive direction.
3. to see if the encoder reports a position that is within +/- 90 electrical degrees from the Hall sensor reading.

If any or all of these three conditions are not met for more than 40 consecutive samples, the drive will fault with BIT21 of TASX set.

NOTE: At start up, the Hall signals are used to determine the initial position of the rotor with an accuracy of +/- 30 electrical degrees regardless of how DHALL is set. Once the motor begins to rotate and after it passes through another valid Hall state, the motor commutation sequence switches over to using the encoder only and therefore no longer requires the use of the Hall sensors. At this point a check is made to see if DHALL is set to 0 (Hall checking on) or 1 (Hall checking off.)

For a complete description on how to troubleshoot Hall sensors, especially for non-Compumotor motors, refer to the *Hardware Installation Guide* section on using non-Compumotor motors.

Resolver Motors (with SFB4): If you use a resolver motor, DHALL is not applicable.

DIBW Current Loop Bandwidth

Type	Tuning
Syntax	<a_><!>DIBW<i>
Units	i = Hz
Range	0-5000 (motor dependent)
Default	0 (DIBW of 0 results in motor configuration error)
Response	DIBW: *DIBW1000
See Also	DMTLIM, DMTSCL, DMVLIM, DNOTAF, DNOTAQ, DNOTLD, DNOTLG, DPBW, SGIRAT, TASX, TCS, TGAIN, TSGSET

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes –32259 to TCS, and shuts down the drive (DRIVE0).

The DIBW command sets the bandwidth of the current loop, in hertz. The drive current will be progressively less responsive to inputs or disturbances above this frequency. Fast, short moves may require higher settings, while systems with mechanical resonance may require lower settings, or the use of filters (see DNOTAF, DNOTAQ, DNOTBF, DNOTBQ, DNOTLD, DNOTLG).

Low current loop bandwidth can limit the bandwidth and stiffness that can be attained in the velocity and position loops. High bandwidths can emphasize resonance and system noise, add to heating of both motor and drive, and increase acoustic noise produced by the motor.

NOTE: Attempting to set this value too low for the selected motor will result in a motor configuration error. This will set TASX bit #7 and write error -32259 in the TCS configuration status register.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (DIBW is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

DIFOLD Current Foldback Enable

Type	Drive Configuration
Syntax	<a_><!>DIFOLD<b>
Units	b = enable bit
Range	0 (disable) or 1 (enable)
Default	0
Response	DIFOLD: *DIFOLD0
See Also	

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

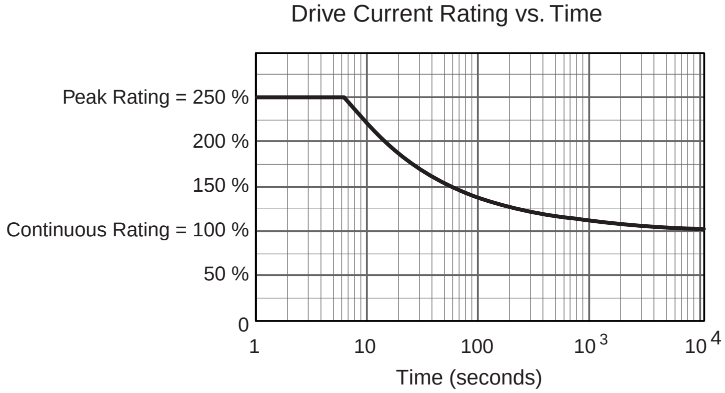
The DIFOLD command enables (1) or disables (0) the drive's current foldback protection feature. The current foldback feature reduces the drive's continuous current output by 20% when sustained current has the potential to overheat the drive.

Each drive has the following specifications. Note that current ratings are for the *drive*, not for the *motor*.

	Units	GV6K-L3	GV6K-U3	GV6K-U6	GV6K-U12	GV6K-H20	GV6K-H40
Drive Continuous Current Rating (100%)	amps *	3	3	6	12	20	40
Drive Peak Current Rating**	amps *	7.5	7.5	15	30	50	100
Maximum Time at Peak Current Rating	seconds	6	6	6	6	6	6

* peak of the sinewave
** peak rating is 250% of continuous rating

If your drive is operating above its continuous rating, use the figure below to predict the number of seconds until foldback will occur. For example, the figure shows that at the drive's peak current rating (250% of continuous), foldback will occur after six seconds.



DIGN Current Loop Gain

Type	`Tuning`
Syntax	`<a_><!>DIGNc<r>`

Units	`c = gain identifier letter (required);`
	`r = gain value`

Range	`c = A, B, C, or D;`
	`DIGNA, DIGNB, DIGNC : r = 0.000 to 15.000 : ±0.001`
	`DIGND               : r = 0.000 to 1.000 : ±0.001`

Default	`r = 0.000  (DIGNc of 0 results in motor config. warning)`
Response	`DIGNA:    *DIGNA2.306`
See Also	`DMTR, TASX, TCS`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration warning with `TASX` bit 28, and writes a value to the `TCS` register (46 for `DIGNA`, 47 for `DIGNB`, 48 for `DIGNC`, or 49 for `DIGND`).

Use the `DIGN` command to set values for the gain terms in the stepper current loop, which optimizes drive performance for a specific motor.

Setting `DIGN` values for Non-Parker Motors:

NOTES

- The drive must be disabled (`DRIVE0`) before making any changes to the `DIGN` values.
- When making changes to `DIGNA`, `DIGNB` and `DIGNC` values, the ratio between the values must remain constant. That is, multiply or divide all three gain values by the same amount.
- Increasing the `DIGN` values can improve system performance; however, setting an excessive `DIGN` value will cause the motor to “sing” (emit a high-pitched squeal or screech) when it is at rest and to heat unnecessarily

Calculating initial values * : $\texttt{DIGNA} = \frac{\text{Inductance (in mH)}}{2}$

`DIGNB` = `DIGNA` * 0.0896

`DIGNC` = `DIGNA` * 0.3578

`DIGND` = 0.98 (*this value will not be changed again*)

* If these initial values cause the motor to “sing,” immediately disable the drive (`DRIVE0`) and lower `DIGNA`, `DIGNB` and `DIGNC` by the same factor; repeat as necessary.

If motor performance is not as high as expected, increase `DIGNA`, `DIGNB` and `DIGNC` by the same factor (keeping the initial ratio) until system performance is acceptable.

For additional assistance in determining `DIGNc` values for your motor, please consult the factory.

DJOG Enable RP240 Jog Mode

Type	`Display (RP240) Interface`
Syntax	`<a><!>DJOG<b>`
Units	`b = 0 or 1`
Range	`0 = disable, 1 = enable`
Default	`0`
Response	`DJOG:    *DJOG0`
See Also	`JOG, JOGA, JOGAA, JOGAD, JOGADA, JOGVH, JOGVL`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DJOG` command allows you to branch into the RP240 front panel jog mode from within your user-defined program, adjust the position of the axis, and then return to program execution.

The `DJOG1` command enables the RP240 jog mode. Once the RP240 jog mode is enabled, you can use the RP240 arrow keys to jog the axis. Unlike the `JOG` command, command processing is suspended after the `DJOG1` command is issued. Jogging acceleration and deceleration are performed with the parameters set with the Jog Acceleration (`JOGA`) and Jog Deceleration (`JOGAD`) commands. Jogging velocities are set with the Jog Velocity High (`JOGVH`) and the Jog Velocity Low (`JOGVL`) commands. Once in the RP240 Jog Mode, you can switch between low and high jog velocities, and you can also modify the two jog velocities using the RP240's **EDIT** key.

To disable the RP240 jog mode, press the **MENU RECALL** key or issue the immediate `!DJOGØ` command. Upon exiting the RP240 jog mode, the RP240's display is cleared.

To have the jog mode continually enabled during program execution, you must use jog inputs and the `JOG` command.

[DKEY] Value of RP240 Key

Type	`Display (RP240) Interface; Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`DCLEAR, DPCUR, [ DREAD ], DREADF, DREADI, DVAR, DWRITE`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `DKEY` operator allows you to read the current state of the RP240 key-pad and use it in comparison commands (e.g., `IF`, `WHILE`, etc.) or variable assignments. **NOTE**: If two or more keys are pressed simultaneously, `DKEY` will report -1.

Syntax: `VARn=DKEY` where "n" is the variable number,
or `DKEY` can be used in an expression such as `IF(DKEY=-1)`

The value reported by the `DKEY` command is defined by the following table:

Value of DKEY	Key currently active
-1	None or multiple keys
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	.
11	+/-
12	C/E
13	ENTER
14	Menu Recall
15	STOP
16	PAUSE
17	CONTINUE
21	F1
22	F2
23	F3
24	F4
25	F5
26	F6

DLED Turn RP240 Display LEDs On/Off

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DLED<b><b><b><b><b><b><b><b>`
Units	`n/a`
Range	`b = 0 (off) or 1 (on)`
Default	`n/a`
Response	`DLED:    *DLED1101_0001`
See Also	`DCLEAR, DPASS, DPCUR, DSTP, DVAR, DVARB, DVARI, DWRITE`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DLED` command controls the state of the 8 programmable LEDs on the RP240. *It is legal to substitute a binary variable (VARB) for the `DLED` command.*

Example:

```
DLED11XXXX01     ; Turn on LEDs 1, 2, and 8; turn off LED 7; leave LEDs 3,4,5,
                 ; and 6 unchanged
VARB1=b10101010  ; Set bits 1, 3, 5 & 7 low, and bits 2, 4, 6, & 8 high
DLED(VARB1)      ; Turn on LEDs 1, 3, 5 & 7; turn off LEDs 2, 4, 6, & 8
```

DMEPIT Motor Electrical Pitch

Type	`Motor (Linear only)`
Syntax	`<a_><!>DMEPIT<r>` (does not take effect until RESET, DRESET or cycle power)
Units	`r = millimeters`
Range	`0 to 327.68 : ±0.01`
Default	`0`
Response	`DMEPIT:   *DMEPIT40.00`
See Also	`D, DRES, ERES`

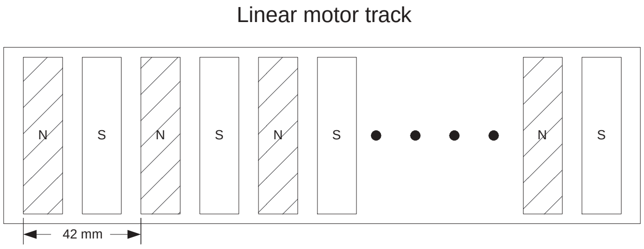
Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command is only applicable if you use the Motion Planner Setup Wizard, which uses the `DMEPIT` value to convert linear units to rotary units before downloading commands to the drive. The drive *always* expects rotary units. If you are *not* using the Motion Planner Setup Wizard, this command is not applicable, and you must convert your linear units to rotary units.

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker linear servo motor, this command is set to 0 and assumes a rotary motor. Refer to `DMTR` for a list of auto-configured commands. For more information on linear motion, see the *Programmer's Guide*.

The `DMEPIT` command sets the electrical pitch of the magnets for use with permanent magnet brushless linear motors. The `DMEPIT` value is required to convert between linear units and rotary units. The electrical pitch can equated to one revolution in a rotary motor. Mechanically, the definition of the electrical pitch is the linear distance between two magnets comprising a full magnetic cycle. The illustration shows an example of an electrical pitch of 42mm (`DMEPIT42`).



Definition of DMEPIT (Electrical Pitch)

For all rotary motors, `DMEPIT` is set to zero.

Converting Between Rotary and Linear Values

The Gem6K drive operates in rotary units; therefore, it expects to receive commands in rotary units and reports operating conditions in rotary units. The setup wizard in Motion Planner (page 6) makes it easy to perform the setup in linear units. The setup wizard automatically converts your setup parameters (in linear units) to the appropriate Gem6K code in rotary units. You then download the generated code/file to the drive. If you are communicating to the Gem6K over a live serial link, you must convert certain command values from linear to rotary units before you send them to the drive. Likewise, when you query the drive for certain conditions, or if you upload the configuration file from the drive, the command values are reported in rotary units.

Use the following table as a guide.

Command/Parameter	To convert rotary to linear, multiply by:	To convert linear to rotary, multiply by:
DMTKE (motor voltage constant)	$\frac{60}{\texttt{DMEPIT}}$	$\frac{\texttt{DMEPIT}}{60}$
DMTW (motor rated speed) DMVLIM (velocity limit) SMVER (max. allowable velocity error) TACC (display commanded accel) TVEL (display commanded velocity) TVELA (display actual velocity) TVE (display velocity error) Velocity & Accel/Decel (e.g., V, A, AD)	$\frac{\texttt{DMEPIT}}{1000}$	$\frac{1000}{\texttt{DMEPIT}}$
DMTD (motor damping) DMTJ (motor/forcer mass) LDAMP (load damping)	$\frac{(2 \bullet \pi \bullet 1000)^2}{(\texttt{DMEPIT})^2}$	$\frac{(\texttt{DMEPIT})^2}{(2 \bullet \pi \bullet 1000)^2}$
DMTLIM (force limit) DMTSCL (force scaling)	$\frac{2 \bullet \pi \bullet 1000}{\texttt{DMEPIT}}$	$\frac{\texttt{DMEPIT}}{2 \bullet \pi \bullet 1000}$

If you are constructing your own motor data files, use the formulas from the table below. The key conversion parameter is *r* and is defined as:

$$r = \frac{DMEPIT\,(mm)}{2\pi \cdot 1000}$$

	Linear Motor	Convert to rotary units
General Motion Equation	$F = Ma + Dv$	$T = J\alpha + B\omega$
Position	$x = m$	$\theta = \frac{x}{r} = radians$
Velocity	$v = \frac{m}{\sec}$	$\omega = \frac{v}{r} = \frac{radians}{\sec}$
Acceleration	$a = \frac{m}{\sec^2}$	$\alpha = \frac{a}{r} = \frac{radians}{\sec^2}$
Force / Torque	$F = N$	$T = F \cdot r = Nm$
Mass / Inertia	$M = kg$	$J = m \cdot r^2 = kgm^2$
Damping	$D = \frac{N}{\frac{m}{\sec}}$	$B = D \cdot r^2 = \frac{Nm}{\frac{radians}{\sec}}$
Flux constant	$K_{e\_linear} = \frac{V_{peak,\phi-\phi}}{\frac{m}{\sec}}$	$K_e = r \cdot K_{e\_Linear} \cdot \frac{2\pi 1000}{60} = \frac{V_{peak,\phi-\phi}}{krpm}$

DMODE Drive Control Mode

		Product	Rev
Type	`Drive Configuration`	GT6K	6.0
Syntax	`<a_><!>DMODE<i>`	GV6K	6.0
Units	`i = control mode setting`		
Range	`1-17 (see table below)`		
Default	`12`		
Response	`DMODE: *DMODE12`		
See Also	`DRES, SRSET`		

Use the `DMODE` command to select the drive control mode for your Gem6K drive. Refer to the table below for drive mode descriptions and drive compatibility.

DMODE	Mode	Description	GT6K	GV6K
1 – 10	RESERVED	----------------	--	--
11	Feedback Alignment Mode	(requires a resolver card to be installed) This mode allows you to automatically set the resolver offset angle with the SRSET command.	--	X
12	Controller/Drive — **default for GT6K & GV6K drives**	Programmed motion using internal trajectory generator.	X	X
13	Autorun	Rotates the motor at 1 rps/mps. Current is reduced by 10%. Refer also to the *Hardware Installation Guide*.	X	X
14	RESERVED	----------------	--	--
15	Torque/Force Tuning Mode	10 Hz step input of 25% rated motor current for torque/force mode tuning. *	--	X
16	Velocity Tuning Mode	1 Hz ±2 rps/mps step velocity command for velocity mode tuning. *	--	X
17	Position Tuning Mode	1 Hz ± 1/4 rev/epitch step position command for position mode tuning. *	--	X

* Refer to the servo tuning procedures in the *Hardware Installation Guide* for details.

DMONAS Analog Monitor Output A — Scaling

		Product	Rev
Type	`Outputs`	GT6K	6.0
Syntax	`<a_><!>DMONAS<i>`	GV6K	6.0
Units	`i = scale percentage (%)`		
Range	`-2000 to 2000`		
Default	`100 (no scaling)`		
Response	`DMONAS: *DMONAS100`		
See Also	`DMONAV, DMONBS, DMONBV`		

The `DMONAS` command sets the amount by which the variable selected with the `DMONAV` command is scaled. For example, `DMONAS200` doubles the amplitude of the selected output signal. The maximum scaled output voltage is approximately ±10V.

Monitor waveform clipping will occur if `DMONAS` scaling results in an output greater than ±10V.

DMONAV Analog Monitor Output A — Variable

			Product	Rev
Type	`Outputs`		GT6K	6.0
Syntax	`<a_><!>DMONAV<i>`		GV6K	6.0
Units	`i = variable number`			
Range	`0-24 (0 = turn off output)`			
Default	`0 (turn off output)`			
Response	`DMONAV:   *DMONAV0`			
See Also	`DMEPIT, DMONAS, DMONBS, DMONBV`			

The DMONAV command selects the function (or signal) that will be presented at the 8-bit DAC "Analog Out A" terminal (pin 21 on the DRIVE I/O connector).

Number	Name	Description	GT6K	GV6K
0	Unused / Turn off output	No output function selected	X	X
1	Motor Temperature	(TMTEMP) Estimated motor winding temperature based on a second-order thermal model (see the *Hardware Installation Guide* for details). Normalized to ±10 volts equals ±250 °C.		X
2	Drive Temperature	(TDTEMP) Measured internal drive temperature. Normalized to ±10 volts equals ±250 °C.	X	X
3	Position Error	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch, regardless of the DMONAS setting): • Rotary motors: ±10V = ±1 rev (based on TPER ÷ ERES) • Linear motors: ±10V = ±1 epitch (based on TPER ÷ DMEPIT)		X
4	Velocity Setpoint	(TVEL) User commanded velocity. Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).	X	X
5	Estimated Actual Velocity	(TVELA) Output of velocity estimator, based on encoder or resolver data. Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).		X
6	Acceleration Setpoint	(TACC) User commanded acceleration.	X	X
7	Torque/Force Setpoint	(TTRQ) User commanded torque/force.		X
8	Actual Torque/Force	(TTRQA) Calculated torque/force based on measured motor current and motor Ke (DMTKE). Scaled as a % of DMTSCL.		X
9	Velocity Error	(TVE) Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).		X
10	Phase A Commanded Current	Instantaneous commanded current for phase A (Volts per Amp). *	X	
11	Phase A Actual Current	Instantaneous measured current for phase A (Volts per Amp). *	X	X

Number	Name	Description	GT6K	GV6K
13	Phase B Actual Current	Instantaneous measured current for phase B (Volts per Amp). *	X	X
14	RESERVED			
15	RESERVED			
16	d-axis Commanded Current	Commanded direct-axis current (usually 0). This current does not produce torque/force. *		X
17	d-axis Actual Current	Estimated direct-axis current from coordinate-conversion software. Based on measured phase currents. *		X
18	q-axis Commanded Current	Commanded quadrature-axis current. This current is proportional to commanded torque/force. *		X
19	q-axis Actual Current	Estimated quadrature-axis current from coordinate-conversion software. Based on measured phase currents. This current is proportional to actual torque/force. *		X
20	Phase A Applied Voltage Duty Cycle	A voltage representation of the PWM duty cycle for Phase A.	X	
21	Phase B Applied Voltage Duty Cycle	A voltage representation of the PWM duty cycle for Phase B.	X	
22	RESERVED			
23	Position Setpoint	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch (epitch), regardless of the `DMONAS` setting): • Rotary motors: ±10V = ±1 rev (based on `TPC` ÷ `ERES`) • Linear motors: ±10V = ±1 epitch (based on `TPC` ÷ `DMEPIT`)		X
24	Actual Position	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch, regardless of the `DMONAS` setting): • Rotary motors: ±10V = ±1 rev (based on `TPE` ÷ `ERES`) • Linear motors: ±10V = ±1 epitch (based on `TPE` ÷ `DMEPIT`)		X

* The nominal Volts per Amp scaling is drive dependent, and is shown below:

Stepper Drive	Nominal (V/A) Current Scaling
GT6K-L5	1.432
GT6K-L8	0.882

Servo Drive	Nominal (V/A) Current Scaling
GV6K-L3	0.615
GV6K-U3	0.615
GV6K-U6	0.308
GV6K-U12	0.205
GV6K-H20	0.123
GV6K-H40	0.062

DMONBS Analog Monitor Output B — Scaling

Type	`Outputs`
Syntax	`<a_><!>DMONBS<i>`
Units	`i = scale percentage (%)`
Range	`-2000 to 2000`
Default	`100 (no scaling)`
Response	`DMONBS:   *DMONBS100`
See Also	`DMONAS, DMONAV, DMONBV`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DMONBS` command sets the amount by which the variable selected with the `DMONBV` command is scaled. The maximum scaled output voltage is ±10V.

Monitor waveform clipping will occur if `DMONBS` scaling results in an output greater than ±10V.

DMONBV Analog Monitor Output B — Variable

Type	`Outputs`
Syntax	`<a_><!>DMONBV<i>`
Units	`i = variable number`
Range	`0-24 (0 = turn off output)`
Default	`0 (turn off output)`
Response	`DMONBV:   *DMONBV0`
See Also	`DMONAS, DMONAV , DMONBS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DMONBV` command selects the function (or signal) that will be presented at the 8-bit DAC "Analog Out B" terminal (pin 22 on the DRIVE I/O connector).

Number	Name	Description	GT6K	GV6K
0	Unused / Turn off output	No output function selected	X	X
1	Motor Temperature	(`TMTEMP`) Estimated motor winding temperature based on a second-order thermal model (see the *Hardware Installation Guide* for details). Normalized to ±10 volts equals ±250 °C.		X
2	Drive Temperature	(`TDTEMP`) Measured internal drive temperature. Normalized to ±10 volts equals ±250 °C.	X	X
3	Position Error	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch, regardless of the `DMONAS` setting): • Rotary motors: ±10V = ±1 rev (based on `TPER` ÷ `ERES`) • Linear motors: ±10V = ±1 epitch (based on `TPER` ÷ `DMEPIT`)		X
4	Velocity Setpoint	(`TVEL`) User commanded velocity. Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).	X	X
5	Estimated Actual Velocity	(`TVELA`) Output of velocity estimator, based on encoder or resolver data. Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).		X
6	Acceleration Setpoint	(`TACC`) User commanded acceleration.	X	X
7	Torque/Force Setpoint	(`TTRQ`) User commanded torque/force.		X
8	Actual Torque/Force	(`TTRQA`) Calculated torque/force based on measured motor current and motor Ke (`DMTKE`). Scaled as a % of `DMTSCL`.		X
9	Velocity Error	(`TVE`) Normalized to ±10 volts equals ±200 revs/sec (rotary) or ±8.4 meters/sec (linear).		X
10	Phase A Commanded Current	Instantaneous commanded current for phase A (Volts per Amp). *	X	
11	Phase A Actual Current	Instantaneous measured current for phase A (Volts per Amp). *	X	X
12	Phase B Commanded Current	Instantaneous commanded current for phase B (Volts per Amp). *	X	
13	Phase B Actual Current	Instantaneous measured current for phase B (Volts per Amp). *	X	X
14	RESERVED			
15	RESERVED			
16	d-axis Commanded Current	Commanded direct-axis current (usually 0). This current does not produce torque/force. *		X
17	d-axis Actual Current	Estimated direct-axis current from coordinate-conversion software. Based on measured phase currents. *		X
18	q-axis Commanded Current	Commanded quadrature-axis current. This current is proportional to commanded torque/force. *		X
19	q-axis Actual Current	Estimated quadrature-axis current from coordinate-conversion software. Based on measured phase currents. This current is proportional to actual torque/force. *		X
20	Phase A Applied Voltage Duty Cycle	A voltage representation of the PWM duty cycle for Phase A.	X	
21	Phase B Applied Voltage Duty Cycle	A voltage representation of the PWM duty cycle for Phase B.	X	
22	RESERVED			

(Continued on next page)

Number	Name	Description	GT6K	GV6K
23	Position Setpoint	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch (epitch), regardless of the `DMONAS` setting): • Rotary motors: ±10V = ±1 rev (based on `TPC` ÷ `ERES`) • Linear motors: ±10V = ±1 epitch (based on `TPC` ÷ `DMEPIT`)		X
24	Actual Position	This value is normalized as follows (value clips at ±1 rev or ±1 electrical pitch, regardless of the `DMONAS` setting): • Rotary motors: ±10V = ±1 rev (based on `TPE` ÷ `ERES`) • Linear motors: ±10V = ±1 epitch (based on `TPE` ÷ `DMEPIT`)		X

* The nominal Volts per Amp scaling is drive dependent, and is shown below:

Stepper Drive	Nominal (V/A) Current Scaling
GT6K-L5	1.432
GT6K-L8	0.882

Servo Drive	Nominal (V/A) Current Scaling
GV6K-L3	0.615
GV6K-U3	0.615
GV6K-U6	0.308
GV6K-U12	0.205
GV6K-H20	0.123
GV6K-H40	0.062

DMTAMB Motor Ambient Temperature

Type	`Motor`
Syntax	`<a_><!>DMTAMB<r>`
Units	`r = Degrees Celsius`
Range	`-50.0 to 250.0 : ±0.1`
Default	`40.0`
Response	`DMTAMB:   *DMTAMB40.0`
See Also	`DMTMAX, DMTRWC, DMTTCM, DMTTCW, TASX`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DMTAMB` command sets the motor ambient temperature used by the software motor thermal model. The `DMTAMB` value, in conjunction with the motor thermal time constant (`DMTTCM`), the motor winding time constant (`DMTTCW`), the motor thermal resistance (`DMTRWC`) and the continuous motor current (`DMTIC`), is used in a real-time estimation of the motor winding temperature. When the winding temperature exceeds `DMTMAX`, the drive faults and `TASX` bit #30 is set.

NOTE: If you cycle power, or issue a `RESET` or `DRESET` command, the drive resets its motor thermal model (in internal software). Be aware that your motor's winding temperature may still be high.

DMTD Motor Damping

Type	`Motor`
Syntax	`<a_><!>DMTD<r>     (does not take effect until RESET, DRESET or cycle power)`

Units	`Rotary motor: r = Nm/rad/sec`
	`Linear motor: r = N/meter/sec`

Range	`Rotary motor: 0.000000 to 0.010000 : ±0.000001`
	`Linear motor: DMEPIT (electrical pitch) dependent`

Default	`0.000000`
Response	`DMTD:    *DMTD0.002000`
See Also	`DMTR, LDAMP`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

The `DMTD` command specifies the damping of the motor itself. This includes both magnetic losses and bearing losses. (The load damping is specified with the `LDAMP` command.)

DMTIC Continuous Current

			Product	Rev
Type	`Motor`		GT6K	6.0
Syntax	`<a_><!>DMTIC<r>`		GV6K	6.0
Units	`r = Amps-RMS`			
Range	`0.00 to 100.00 : ±0.01`			
Default	`0.00  (DMTIC of 0 results in motor configuration warning)`			
Response	`DMTIC:    *DMTIC6.50`			
See Also	`DMTICD, TASX, TCS, TDICNT`			

GV6K Only: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.
GT6K Only: This command takes effect immediately.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration warning with `TASX` bit 28, and writes 40 to `TCS`.

The `DMTIC` command sets the continuous operating current for a motor. For a servo drive operating a rotary motor continuously at this current, the internal winding temperature will reach 125°C with a specified heatsink (see the *Gemini Motor Reference Manual* for heatsink dimensions) in a 40°C ambient. For linear servo motors, the winding will reach 90°C in a 25°C ambient.

The continuous current of a motor that is designed to provide a long service life depends on many factors. Among them are motor ambient temperature, the degree of heatsinking provided by the motor mounting surface, and airflow over the motor. In a stepper, the continuous current is flowing in the motor continuously. In a servo, the continuous current is used in calculations to protect the motor from thermal damage, and has no immediate effect on performance.

Example:
```
DMTIC5       ; Set the motor current to 5 amps rms (equates to 7.07 amps peak)
```

DMTICD Continuous Current Derating

			Product	Rev
Type	`Motor`		GT6K	n/a
Syntax	`<a_><!>DMTICD<i>  (does not take effect until RESET, DRESET or cycle power)`		GV6K	6.0
Units	`i = percent derating at rated speed`		(applicable only to servo axes)	
Range	`0.00 to 100.00 : ±0.01`			
Default	`0.00    (DMTICD of 0 results in no current derating)`			
Response	`DMTICD:   *DMTICD5`			
See Also	`DMTIC, DMTIP, DMTW`			

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.)

The DMTICD command sets the percentage current derating at rated speed (DMTW). This value sets the extent to which continuous current must be reduced at speed to compensate velocity-related losses in the motor.

For example, DMTICD3 sets the motor's continuous current derating to 3% (or 97% of continuous value DMTIC) at the motor's rated speed (DMTW). At half this speed, it will be reduced 1.5%.

DMTIND Motor Inductance

Type	Motor
Syntax	<a_><!>DMTIND<r> (does not take effect until RESET, DRESET or cycle power)
Units	r = mH
Range	0.0 to 200.0 : ±0.1
Default	0.0 (DMTIND of 0 results in motor config. error)
Response	DMTIND *DMTIND10
See Also	DMTLMN, DMTLMX, DMTR, TASX, TCS

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes a value of -32726 to the TCS register, and shuts down the drive (DRIVE0).

The DMTIND command sets the motor phase inductance for stepper motors only (servo motor inductance is set with DMTLMN and DMTLMX). The motor inductance entered is the motor phase inductance you measure across one phase at the motor terminals of the drive. The inductance value is the "small signal inductance" as measured by a hand-held or bench-top inductance meter at 1 KHz.

A procedure for configuring motor inductance (for non-Parker motors) is provided in the *Configuration* chapter of the *Hardware Installation Guide*.

DMTIP Peak Current

Type	Motor
Syntax	<a_><!>DMTIP<r>
Units	r = Amps-RMS
Range	0.00 to 128.00 : ±0.01
Default	0.00 (DMTIP of 0 results in motor config. warning)
Response	DMTIP: *DMTIP7.50
See Also	DMTIC, DMTICD, DMTLIM, DMTR, TASX, TCS, TDIMAX

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration warning with TASX bit 28, and a value of 51 is written to the TCS configuration status register.

The DMTIP command sets a limit that the commanded current cannot exceed. This is typically set to three times the motor's continuous current rating (DMTIC) or less.

If DMTIP is set higher than the full-scale value calculated by DMTLIM (torque/force limit) the new DMTIP value will be ignored (but not overwritten), the configuration warning (TASX bit #28) will be set, a value of 51 is written to the TCS configuration status register, and the full-scale DMTLIM value will be used internally. The configuration warning is cleared with the RESET or DRESET command or by cycling power to the drive.

If the DMTIP value exceeds the drive's maximum output current (TDIMAX), the DMTIP value will be ignored and the maximum allowable value will be used (see table below).

	Units	GV6K-L3	GV6K-U3	GV6K-U6	GV6K-U12	GV6K-H20	GV6K-H40
Maximum Current Rating	amps *	7.5	7.5	15	30	50	100

* peak of the sinewave

Note that the values in TDIMAX are amps (peak of the sine wave) and the value for DMTIP is in amps (rms). They are related by:

$$I_{rms} = \frac{I_{peak\ of\ the\ sine\ wave}}{\sqrt{2}}$$

DMTJ Motor Rotor Inertia / Forcer Mass

Type	Motor
Syntax	<a_><!>DMTJ<r> (does not take effect until RESET, DRESET or cycle power)
Units	Rotary motor: r = kgm^2 * 10^{-6} Linear motor: r = kg
Range	Rotary motor: 0.000 to 1000000.000 : ±0.001 Linear motor: DMEPIT (electrical pitch) dependent
Default	0.000 (DMTJ of 0 results in motor config. error)
Response	DMTJ: *DMTJ200.600
See Also	DMTR, TASX, TCS

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes a value of -32710 to the TCS register, and shuts down the drive (DRIVE0).

The DMTJ command sets the motor rotor inertia for rotary motors, or the forcer mass for linear motors.

DMTKE Motor Ke

Type	Motor
Syntax	<a_><!>DMTKE<r> (does not take effect until RESET, DRESET or cycle power)
Units	Rotary motor: r = volts (0-peak)/krpm (measured line-to-line) Linear motor: r = volts (0-peak)/meter/sec (measured line-to-line)
Range	Rotary motor: 0.0 to 400.0 : ±0.1 Linear motor: DMEPIT (electrical pitch) dependent
Default	0.0 (DMTKE of 0 results in motor config. error)
Response	DMTKE: *DMTKE15.0
See Also	DMEPIT, DMONAV, DMONBV, DMTSCL, DMTR, TASX, TCS

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration error with `TASX` bit 7, writes a value of -32727 to the `TCS` register, and shuts down the drive (`DRIVE0`).

The `DMTKE` command specifies the motor voltage constant (Ke). This defaults to the nominal Ke of the motor selected with the `DMTR` command.

The motor's torque/force constant (Kt) is derived from the motor's voltage constant (Ke) by the following relationship:

Rotary motors:

$$Kt(Nm/A^*) = \frac{3\sqrt{3}}{200\pi} * Ke(Volts^*/krpm)$$

* peak value

Linear motors:

$$Kt(N/A^*) = \frac{3\sqrt{3}}{200\pi} * Ke(Volts^*/(meter/\sec))$$

* peak value

NOTE: The Gem6K requires values in rotary units. Motion Planner does these conversions for you when you use the Setup Wizard. If you do not use the Setup Wizard, you must convert your linear units to rotary units. See the `DMEPIT` command for information on conversion.

DMTLIM Torque/Force Limit

Type	`System`
Syntax	`<a_><!>DMTLIM<r>`

Units	`Rotary motor: r = Nm`
	`Linear motor: r = N`

Range	`Rotary motor: 0.0 to 500.0 (motor/drive dependent) : ±0.1`
	`Linear motor: DMEPIT (electrical pitch) dependent`

Default	`0`
Response	`DMTLIM:   *DMTLIM10.5`
See Also	`DCLRLR, DMEPIT, DMODE, DMTIP, DMTKE, DMTR, DMTSCL, TASX, TGAIN, TSGSET, TTRQ, TTRQA`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. Refer to `DMTR` for a list of auto-configured commands.

The `DMTLIM` command sets a maximum torque/force limit for the system. Requests for higher torque/force will be clamped to this value. This command will default automatically to a value appropriate to the motor selection (`DMTR`) and the GV6K drive you are using, and no changes are required in many cases.

If your mechanical system has torque/force limitations (due, for example, to the limitations of a coupler or belt), you can use this command to limit system torque/force without affecting system scaling or gains.

During initial tuning, this command can be used to limit the torque/force produced if the system becomes unstable.This reduces the rate of motor heating, allows more reaction time for the person tuning the system, and lessens chances of damage to the mechanical system.

When the GV6K's commanded torque/force reaches the limit set by `DMTLIM` (`TTRQ` = `DMTLIM`), `TASX` bit #31 is set. `TASX` bit #31 remains set until you clear it with the `DCLRLR` command, cycle power, or issue a `RESET` or `DRESET`. This is not considered a fault condition.

If `DMTLIM` is set higher than the value allowed by the motor's peak current times the motor's Kt, or the drive's peak current times the motor's Kt (whichever is lower), the new `DMTLIM` value will be ignored (but not overwritten), the status warning bit #28 in TASX will be set, and the maximum internal value will be used. This warning is cleared with the RESET or DRESET command or by cycling power to the drive.

The motor's torque/force constant (Kt) is derived from the motor's voltage constant (Ke, which is set by the DMTKE command) by the following relationship (note: *Ke* is set with the DMTKE command):

Rotary motors: $$Kt(Nm / A^{*}) = \frac{3\sqrt{3}}{200\pi} * Ke(Volts^{*} / krpm)$$

* peak value

Linear motors: $$Kt(N / A^{*}) = \frac{3\sqrt{3}}{200\pi} * Ke(Volts^{*} /(meter / \sec))$$

* peak value

NOTE: The Gem6K requires values in rotary units. Motion Planner does these conversions for you when you use the Setup Wizard. If you do not use the Setup Wizard, you must convert your linear units to rotary units. See the DMEPIT command for information on conversion.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (DMTLIM is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

DMTLMN Minimum Motor Inductance

Type	Motor
Syntax	<a_><!>DMTLMN<r> (does not take effect until RESET, DRESET or cycle power)
Units	r = mH (measured line-to-line)
Range	0.1 to 200.0 (motor dependent) : ±0.1
Default	0.0 (DMTLMN of 0 results in motor config. error)
Response	DMTLMN: *DMTLMN10.0
See Also	DMTLMX, DMTR, TASX, TCS

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes a value of -32715 to the TCS register, and shuts down the drive (DRIVE0).

The DMTLMN command specifies the minimum value of motor inductance. This will usually differ from the nominal nameplate value because actual inductance is usually position dependent.

If DMTLMN value is less than the "Lmin" value (see table below), the drive will fault (motor configuration error is reported in TASX bit #7).

	Units	GV6K-L3	GV6K-U3	GV6K-U6	GV6K-U12	GV6K-H20	GV6K-H40
Lmin (min. phase-phase inductance)	mH	0.5	5.0	5.0	5.0	5.0	5.0

DMTLMX Maximum Motor Inductance

Type	`Motor`
Syntax	`<a_><!>DMTLMX<r>  (does not take effect until RESET, DRESET or cycle power)`
Units	`r = mH (measured line-to-line)`
Range	`0.1 to 200.0 (motor dependent) : ±0.1`
Default	`0.0  (DMTLMX of 0 results in motor config. error)`
Response	`DMTLMX:   *DMTLMX10.0`
See Also	`DMTLMN, DMTR, TASX, TCS`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6) . If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration error with `TASX` bit 7, writes a value of -32714 to the `TCS` register, and shuts down the drive (`DRIVE0`).

The `DMTLMX` command specifies the maximum value of motor inductance. This will usually differ from the nominal nameplate value since actual inductance is usually position dependent.

DMTMAX Maximum Motor Winding Temperature

Type	`Motor`
Syntax	`<a_><!>DMTMAX<r>`
Units	`r = Degrees Celsius`
Range	`-50.0 to 250.0 : ±0.1`
Default	`125.0`
Response	`DMTMAX:   *DMTMAX125.0`
See Also	`DMTAMB, DMTIC, DMTRWC, DMTTCM, DMTTCW, TASX`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

The `DMTMAX` command sets the maximum motor winding temperature allowed. The `DMTMAX` value, in conjunction with the motor thermal time constant (`DMTTCM`), the motor winding time constant (`DMTTCW`), the motor thermal resistance (`DMTRWC`) and the continuous motor current (`DMTIC`), is used in a real-time estimation of the motor winding temperature. When the winding temperature exceeds `DMTMAX`, the drive faults and `TASX` bit #30 is set.

NOTE: If you cycle power, or issue a `RESET` or `DRESET` command, the drive resets its motor thermal model (in internal software). Be aware that your motor's winding temperature may still be high.

DMTR Identify (and Load) Motor

Type	`Drive Configuration`
Syntax	`<a_><!>DMTR<i>`
Units	`i = Parker motor identification number`
Range	`0-3000 (0 = non-Parker motor; 1-3000 = Parker motor)`
Default	`-1 (motor config. Parameters are not configured)`
Response	`DMTR:     *DMTR50`
See Also	`(see parameter table below), DRIVE, RESET, RFS, TASX, TCS`

Product	Rev
GT6K	6.0
GV6K	6.0

The purpose of the `DMTR` command is to record and report the identification number of the Parker motor you selected in the setup tool in Motion Planner (see page 6).

When you select a specific Parker motor using the Motion Planner setup tool, the `DMTR` setting and various motor parameters (see list below) are automatically configured for the associated motor and saved in a configuration file. After you download the configuration file to the Gem6K drive, you must cycle drive power, or issue a `RESET` or `DRESET` command for the `DMTR` and all the motor parameter commands to take effect. (**NOTE**: If you do not select a Parker motor, the default setting, `DMTR-1`, is used and you must set all relevant motor parameters manually.) Avoid using the `DMTR` command to change the motor number, because the new `DMTR` value may not represent the actual motor parameters that are currently loaded in the drive. Instead, use the Motion Planner setup tool to change the motor number.

Stepper Motor Data Parameters	
`DIGNA`	Current Loop Gain A
`DIGNB`	Current Loop Gain B
`DIGNC`	Current Loop Gain C
`DIGND`	Current Loop Gain D
`DMTIC`	Continuous Current
`DMTIND`	Motor Inductance
`DMTJ`	Motor Rotor Inertia
`DMTRES`	Motor Winding Resistance
`DMTSTT`	Motor Static Torque
`DMVLIM`	Velocity Limit
`DPOLE`	Number of Motor Pole Pairs

Servo Motor Data Parameters			
`DIBW`	Current Loop Bandwidth	`DMTSCL`	Torque/Force Scaling
`DMEPIT`	Motor Electrical Pitch	`DMTTCM`	Motor Thermal Time Constant
`DMTD`	Motor Damping	`DMTTCW`	Motor Winding Time Constant
`DMTIC`	Continuous Current	`DMTW`	Motor Rated Speed
`DMTICD`	Continuous Current Derating	`DMVLIM`	Velocity Limit
`DMTIP`	Peak Current	`DPBW`	Position Loop Bandwidth
`DMTJ`	Motor Rotor Inertia	`DPOLE`	Number of Motor Pole Pairs
`DMTKE`	Motor Ke	`DRES`	Drive Resolution
`DMTLIM`	Torque/Force Limit	`ERES`	Encoder Resolution
`DMTLMN`	Minimum Motor Inductance	`ORES`	Encoder Output Resolution
`DMTLMX`	Maximum Motor Inductance	`SFB`	Feedback Source Selection
`DMTMAX`	Maximum Motor Winding Temp.	`SRSET`	Resolver Offset Angle
`DMTRES`	Motor Winding Resistance		
`DMTRWC`	Motor Winding Thermal Resistance		

Although these command values are auto-configured when you select a Parker motor (using the setup tool in Motion Planner), you may individually set the command values with the respective configuration command.

Motor Configuration Error

For many of the above motor parameters, if they are not configured (i.e., a command is left at its factory default value, or an `RFS` command is executed) when the Gem6K drive is powered up, a motor configuration “error” or “warning” is reported in `TASX` bit #7 or bit #28 (an “error” also disables the drive – `DRIVE0`). To resolve the error or warning condition, you must select a Parker motor with Motion Planner (or configure each motor parameter command with a value other than zero – using a Gem6K terminal emulator), download the resulting configuration information and then cycle power, or issue the `RESET` or `DRESET` command.

Updating the motor data table. The motor information for the parameters list above is located in a file named “GEM_motors.mtr” and is used by Motion Planner to configure the Gem6K drive. Updates to this file are maintained on the Compumotor web site (http://www.compumotor.com) — search for “GEM_motors.mtr”. If you need to update the information, download the latest motor table file. If you are using Motion Planner, place the updated file in the Motion Planner directory (default location is \Program Files\Compumotor\Motion Planner).

DMTRES Motor Winding Resistance

Type	`Motor`
Syntax	`<a_><!>DMTRES<r>` (`does not take effect until RESET, DRESET or cycle power`)
Units	`r = Ohm (measured line-to-line)`
Range	`0.00 to 50.00 : ±0.01`
Default	`0.00 (DMTRES of 0 results in motor config. error)`
Response	`DMTRES: *DMTRES7.50`
See Also	`DMTR, TASX, TCS`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration error with `TASX` bit 7, writes a value of -32725 to the `TCS` register, and shuts down the drive (`DRIVE0`).

The `DMTRES` command sets the motor winding resistance. This resistance value is measured at 25 °C at the drive end of the motor cable (motor cable included). For steppers, this resistance is a phase resistance measured at terminals A+ to A-, or B+ to B-. For servos, this resistance is the phase-to-phase resistance measured at termnals U to V, V to W, or W to U.

NOTE: Disconnect the motor cable from the drive before attempting to make this measurement. For best accuracy, and to avoid injury, this measurement must be made with the motor cable disconnected from the drive.

DMTRWC Motor Winding Thermal Resistance

Type	`Motor`
Syntax	`<a_><!>DMTRWC<r>` (`does not take effect until RESET, DRESET or cycle power`)
Units	`r = Degrees Celsius/Watt (°C/W)`
Range	`0.00 to 50.00 : ±0.01`
Default	`0.00`
Response	`DMTRWC: *DMTRWC23.60`
See Also	`DMTR, DMTTCM, DMTTCW, TASX, TCS`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

`DMTRWC` specifies the temperature rise of the motor winding above motor case temperature per watt of winding power dissipation. Motor heatsinking does not affect this value. See the `DMTMAX` command for more information on how the drive estimates motor temperature.

DMTSCL Torque/Force Scaling

Type	`Drive Configuration`
Syntax	`<a_><!>DMTSCL<r>`

Units	`Rotary motor: r = Nm`
	`Linear motor: r = N`

Range	`Rotary motor: 0.0 to 500.0 (motor/drive dependent) : ±0.1`
	`Linear motor: DMEPIT (electrical pitch) dependent`

Default	`0`
Response	`DMTSCL:   *DMTSCL20.0`
See Also	`DMEPIT, DMONAV, DMONBV, DMTKE, DMTLIM, TTRQ, TTRQA`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

The `DMTSCL` command scales the torque/force (`TTRQ` and `TTRQA`). Motion Planner's configuration utility will set the `DMTSCL` value according to the Parker motor you select. If you use a non-Parker motor, set the full-scale `DMTSCL` value according to the peak torque/force your motor can produce (in newton-meters for rotary motors, or newtons for linear motors.

`DMTLIM` may limit torque/force to less than this full-scale value.

NOTE: The Gem6K requires values in rotary units. Motion Planner does these conversions for you when you use the Setup Wizard. If you do not use the Setup Wizard, you must convert your linear units to rotary units. See the `DMEPIT` command for information on conversion.

DMTSTT Motor Static Torque

Type	`Drive Configuration`
Syntax	`<a_><!>DMTSTT<i> (does not take effect until RESET, DRESET or cycle power)`
Units	`i = oz-in`
Range	`0 to 5000`
Default	`0   (DMTSTT of 0 results in motor config. error)`
Response	`DMTSTT   *DMTSTT410`
See Also	`DMTR, TASX, TCS`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if `RFS` is executed), the drive reports a motor configuration error with `TASX` bit 7, writes a value of -32729 to the `TCS` register, and shuts down the drive (`DRIVE0`).

The `DMTSTT` command sets the motor static torque. The motor static torque is the motor holding torque measured in the "one phase on" condition. The "one phase on" condition is measured with the peak motor current in one phase.

DMTTCM Motor Thermal Time Constant

			Product	Rev
Type	`Motor`		GT6K	n/a
Syntax	`<a_><!>DMTTCM<r>` (does not take effect until RESET, DRESET or cycle power)		GV6K	6.0
Units	`r = minutes`		(applicable only to servo axes)	
Range	`0.0 to 300.0 : ±0.1`			
Default	`0.0`			
Response	`DMTTCM: *DMTTCM30.4`			
See Also	`DMTR, DMTTCW`			

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

The `DMTTCM` command specifies the thermal time constant of the motor and its mounting. This value is used to help protect the motor from thermal damage. It describes the length of time the motor takes to reach 63% of it's final temperature, given constant power. Note that motor mounting will affect this.

Continuous current ratings and published time constants for Parker motors are specified when mounted to a 10" x 10" x ¼" aluminum plate in 25 °C free air. If your mounting surface provides heatsinking or thermal mass significantly different than this, a different value may be appropriate to your application. Note also that the time constant of the motor winding itself (`DMTTCW`) is much faster than this; therefore, the rise in winding temperature will initially be much faster than `DMTTCM` would suggest.

DMTTCW Motor Winding Time Constant

			Product	Rev
Type	`Motor`		GT6K	n/a
Syntax	`<a_><!>DMTTCW<r>` (does not take effect until RESET, DRESET or cycle power)		GV6K	6.0
Units	`r = minutes`		(applicable only to servo axes)	
Range	`0.00 to 100.00 : ±0.01`			
Default	`0.00`			
Response	`DMTTCW: *DMTTCW28.40`			
See Also	`DMTMAX, DMTR, DMTTCM, DMTRWC`			

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

The `DMTTCW` command specifies the time constant of the motor winding alone. This is the time for the winding to reach 63% of it's final temperature rise above the rest of the motor, given constant power. Note that this is NOT the time constant usually specified in motor data sheets (see `DMTTCM`); the `DMTTCW` value is typically much faster.

DMTW Motor Rated Speed

Type	Motor
Syntax	<a_><!>DMTW<r> (does not take effect until RESET, DRESET or cycle power)
Units	Rotary motor: r = revs/sec Linear motor: r = meters/sec
Range	Rotary motor: 0.0 to 200.0 : ±0.1 Linear motor: DMEPIT (electrical pitch) dependent
Default	0.0 (DMTW of 0 results in motor config. error)
Response	DMTW: *DMTW150.0
See Also	DMEPIT, DMTICD, DMTR, TASX, TCS

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to DMTR for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes a value of -32718 to the TCS register, and shuts down the drive (DRIVE0).

The DMTW command specifies the rated speed of the motor. This is the lesser of:

- (rotary motor) The motor mechanical limit of 7500 RPM (125 rps)
- (rotary motor) The encoder limit of 6000 rpm (100 rps) for a 1000-line encoder
- Linear motor speed limitations include encoder resolution and track length.
- The corner of the continuous speed/torque or speed/force curve (the point where the continuous torque/force breaks downward).

The DMTW value is used in conjunction with DMTICD to protect the motor from thermal damage.

NOTE: The Gem6K requires values in rotary units. Motion Planner does these conversions for you when you use the Setup Wizard. If you do not use the Setup Wizard, you must convert your linear units to rotary units. See the DMEPIT command for information on conversion.

DMVLIM Velocity Limit

Type	System
Syntax	<a_><!>DMVLIM<r>
Units	Rotary motor: r = revs/sec Linear motor: r = meters/sec
Range	Rotary motor: GT6K: 0.000000 to 60.000000 : ±0.000001 GV6K: 0.000000 to 200.000000 : ±0.000001 Linear motor: DMEPIT (electrical pitch) dependent
Default	GT6K: 50.000000 GV6K: 200.000000
Response	DMVLIM: *DMVLIM50.000000
See Also	DCLRLR, DMODE, DMTR, SGVRAT, TASX, TGAIN, TSGSET

Product	Rev
GT6K	6.0
GV6K	6.0

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. Refer to DMTR for a list of auto-configured commands.

The DMVLIM command sets a limit that commanded velocity cannot exceed, without affecting gains or scaling. This is typically used to protect parts of the mechanical system.

In controller/drive mode (DMODE12), DMVLIM clamps the command to the specified value.

If the velocity demand from the internal Gem6K control loops exceeds the limits set by DMVLIM, then TASX bit 18 will be set. The Gem6k responds to this condition by invoking the “Override Mode,” in which the drive software clamps the maximum allowable velocity command to the value set by DMVLIM. Bit 18 stays latched until a DCLRLR, RESET or DRESET is issued.

Changes to the DMVLIM command are not allowed while motion is in progress.

NOTE: The Gem6K requires values in rotary units. Motion Planner does these conversions for you when you use the Setup Wizard. If you do not use the Setup Wizard, you must convert your linear units to rotary units. See the DMEPIT command for information on conversion.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (DMVLIM is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

DNOTAD Notch Filter A Depth

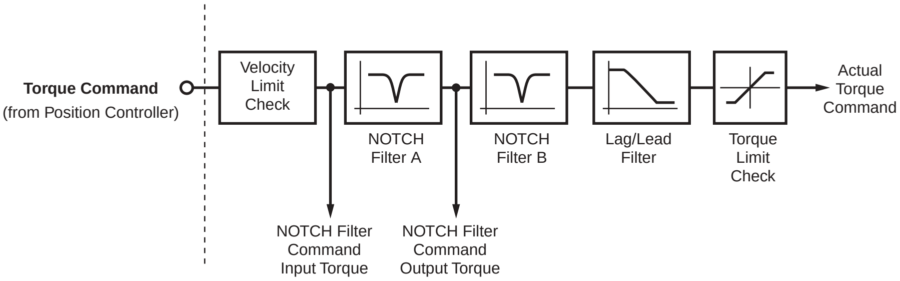
Type	Tuning
Syntax	<a_><!>DNOTAD<i>
Units	n/a
Range	0.0000 - 1.0000
Default	0.0000 (depth is zero)
Response	DNOTAD: *DNOTAD.5
See Also	DMODE, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG, DPBW, TGAIN, TSGSET

Product	Rev
GT6K	n/a
GV6K	6.0

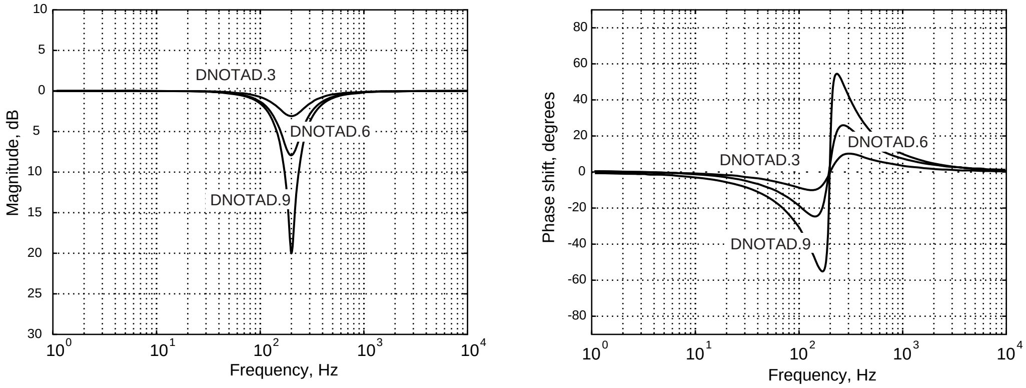
(applicable only to servo axes)

The DNOTAD command sets the depth for the commanded torque/force notch filter A. Setting this to 0 disables the filter. This command is useful in adjusting the maximum allowable attenuation and phase shift through the filter. The deeper the notch depth, the more attenuation and phase shift. In general, the notch depth is increased until the resonance is diminished. Increasing the depth further might increase the phase shift to an unacceptable level and decrease the overall system performance.

There are two cascaded notch filters labeled “A” and “B”. Both filters operate in exactly the same way. The diagram below shows the topology of these filters.



The graphs below illustrate the transfer function for the magnitude and phase of the notch filter command output torque/force vs. the notch filter command input torque/force. In this example, the notch depths are set to .3, .6, and .9 (DNOTAD.3, DNOTAD.6, DNOTAD.9). The notch center frequency is set to 200 Hz (DNOTAF200) and the “Q” is set to 1 (DNOTAQ1).



These filters operate in all `DMODE` settings, except Autorun (`DMODE13`) and Torque/Force Tuning mode (`DMODE15`).

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTAD` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTAF Notch Filter A Frequency

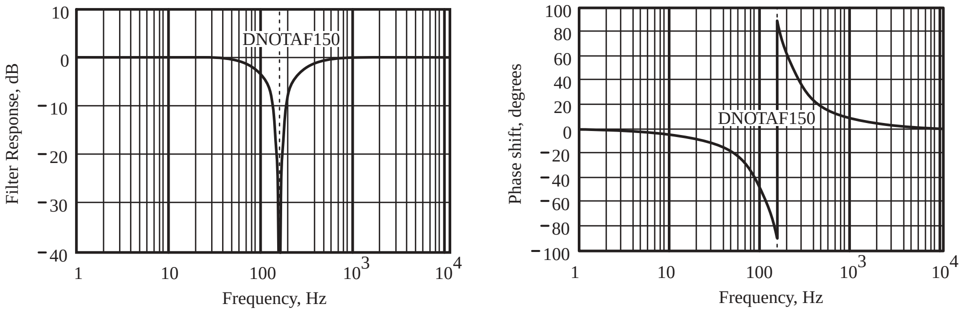
Type	`Tuning`
Syntax	`<a_><!>DNOTAF<i>`
Units	`i = Hz`
Range	`0 (disable), or 60-1000`
Default	`0 (filter is disabled)`
Response	`DNOTAF:   *DNOTAF200`
See Also	`DNOTAD, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG, TASX, TCS, TGAIN, TSGSET`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTAF` command sets the center frequency for the commanded torque/force notch filter A. Setting this to 0 disables the filter. If setting a value results in an internal calculation error, the last valid value is used, `TASX` bit #28 is set, and a value of 551 is written to the `TCS` register.

There are two cascaded notch filters labeled “A” and “B”. Both filters operate in exactly the same way. The graphs below illustrate the transfer function (magnitude and phase) of the input commanded torque/force vs. the output commanded torque/force. In this example, the notch frequency is set to 150 Hz (`DNOTAF150`) and the “Q” is set to 1 (`DNOTAQ1`).



These filters operate in all `DMODE` settings, except Autorun (`DMODE13`) and Torque/Force Tuning mode (`DMODE15`).

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTAF` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTAQ Notch Filter A Quality Factor

Type	`Tuning`
Syntax	`<a_><!>DNOTAQ<r>`
Units	`r = quality factor`
Range	`0.5 to 2.5`
Default	`1`
Response	`DNOTAQ:   *DNOTAQ1.5`
See Also	`DNOTAD, DNOTAF, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTAQ` command sets the quality factor (Q) for notch filter A. For a description of the filter's transfer function characteristics, refer to the `DNOTAF` command description.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTAQ` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTBD Notch Filter B Depth

Type	`Tuning`
Syntax	`<a_><!>DNOTBD<i>`
Units	`n/a`
Range	`0.0000 - 1.0000`
Default	`0.0000 (depth is zero)`
Response	`DNOTBD:   *DNOTBD.5`
See Also	`DNOTAD, DNOTAF, DNOTAQ, DNOTBF, DNOTBQ, DNOTLD, DNOTLG, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTBD` command sets the depth for the commanded torque/force notch filter B. Refer to `DNOTAD` for a complete description of the notch filter depth.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTBD` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTBF Notch Filter B Frequency

Type	`Tuning`
Syntax	`<a_><!>DNOTBF<i>`
Units	`i = Hz`
Range	`0 (disable), or 60-1000`
Default	`0 (filter is disabled)`
Response	`DNOTBF:   *DNOTBF200`
See Also	`DNOTAD, DNOTAF, DNOTAQ , DNOTBD, DNOTBQ, DNOTLD, DNOTLG, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTBF` command sets the center frequency for notch filter B. Setting this to 0 disables the filter. For a description of the filter's transfer function characteristics, refer to the `DNOTAF` command description.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTBF` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTBQ Notch Filter B Quality Factor

Type	`Tuning`
Syntax	`<a_><!>DNOTBQ<r>`
Units	`r = quality factor`
Range	`0.5 to 2.5`
Default	`1`
Response	`DNOTBQ: *DNOTBQ1.5`
See Also	`DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTLD, DNOTLG, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTBQ` command sets the quality factor (Q) for notch filter B. For a description of the filter's transfer function characteristics, refer to the `DNOTAF` command description.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTBQ` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTLD Notch Lead Filter Break Frequency

Type	`Tuning`
Syntax	`<a_><!>DNOTLD<i>`
Units	`i = Hz`
Range	`0 (disable), or 80-1000`
Default	`0 (filter is disabled)`
Response	`DNOTLD: *DNOTLD200`
See Also	`DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTLG, TASX, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

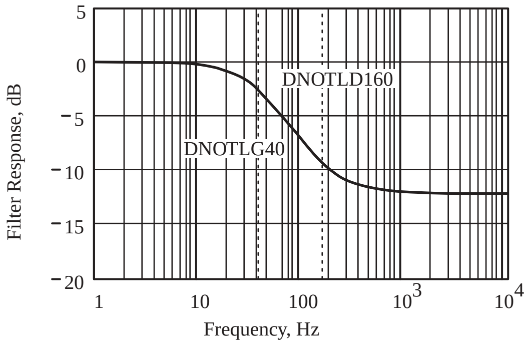
(applicable only to servo axes)

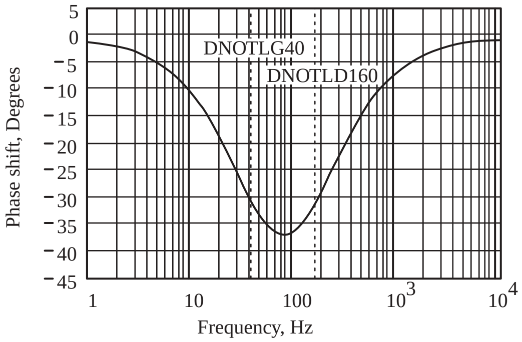
The `DNOTLD` command sets the break frequency of the lead filter. This filter cannot be used alone, but must be used in conjunction with the `DNOTLG` lag filter. The `DNOTLG` lag filter must be configured before the `DNOTLD` lead filter is configured.

The `DNOTLD` value must be less than or equal to 4 times the `DNOTLG` (notch lag frequency) value; otherwise, the new `DNOTLD` value will be ignored (but not overwritten), the configuration warning bit (`TASX` bit #28) will be set, and the last valid `DNOTLD` value will be used internally.

This filter operates in all `DMODE` settings, except Autorun (`DMODE13`) and Torque/Force Tuning mode (`DMODE15`).

In the graphs below, the transfer function is shown relating the internal commanded torque/force vs. the user commanded torque/force. In this example, the lag frequency was set first to 40 Hz (`DNOTLG40`) and then the lead filter was set to 160 Hz (`DNOTLD`).





Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTLD` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DNOTLG Notch Lag Filter Break Frequency

Type	`Tuning`
Syntax	`<a_><!>DNOTLG<i>`
Units	`i = Hz`
Range	`0 (disable), or 20-1000`
Default	`0 (filter is disabled)`
Response	`DNOTLG:   *DNOTLG400`
See Also	`DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, TGAIN, TSGSET`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `DNOTLG` command sets the break frequency of the lag filter. This filter can be used alone, or in conjunction with lead filter (`DNOTLD`) to improve the phase response of the notch filters. In this case, the lag value (`DNOTLG`) must be greater than or equal to ¼ of the lead value (`DNOTLD`), but not greater than the `DNOTLD` value.

If `DNOTLG` is lower than ¼ the value of `DNOTLD`, the new `DNOTLG` value will be ignored (but not overwritten), the configuration warning bit (`TASX` bit #28) will be set, and the last valid `DNOTLG` value will be used internally.

This filter operates in all `DMODE` settings, except Autorun (`DMODE13`) and Torque/Force Tuning mode (`DMODE15`).

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`DNOTLG` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

DPASS Change RP240 Password

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DPASS<i>`
Units	`i = integer of up to 4 characters`
Range	`1 - 9999`
Default	`For the Gx6K: DPASS6000`
Response	`DPASS:   * DPASS6000`
See Also	`DCLEAR, DLED, DPCUR, DSTP, DVAR, DVARB, DVARI, DWRITE`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `DPASS` command changes the RP240 password. If the default password is not changed by the user, then there will be no password protection.

Example:

```
DPASS1234        ; New password = 1234
```

DPBW Position Loop Bandwidth

Type	`Tuning`
Syntax	`<a_><!>DPBW<r>`
Units	`r = Hz`
Range	`1.00 to 100.00 : ±0.01`
Default	`5.00`
Response	`DPBW:    *DPBW10.00`
See Also	`DIBW, DMTR, SGPRAT, LJRAT, TGAIN, TSGSET`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. Refer to `DMTR` for a list of auto-configured commands.

The DPBW command sets the bandwidth of the position loop. Higher values will increase responsiveness and dynamic stiffness. Excessive position loop bandwidth can result in reduced stability, causing long settling times; this is particularly true in applications with resonant mechanics.

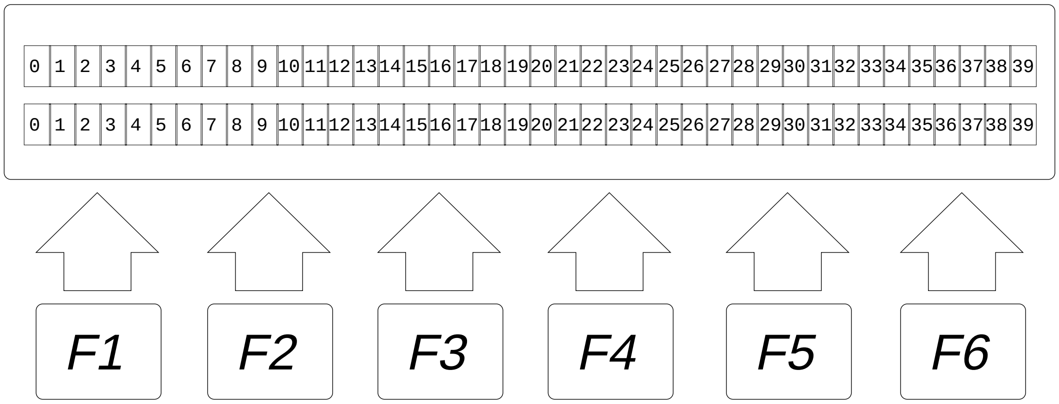
Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (DPBW is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

DPCUR Position Cursor

Type	Display (RP240) Interface	**Product**	**Rev**
Syntax	<a_><!>DPCURi,i	GT6K	6.0
Units	1st i = line number, 2nd i = column	GV6K	6.0
Range	line number = 1 or 2; column = 0 - 39		
Default	n/a		
Response	n/a		
See Also	DCLEAR, DLED, DPASS, DREADI, DSTP, DVAR, DVARI, DVARB, DWRITE		

The DPCUR command changes the location of the cursor on the RP240 display. The RP240 lines are numbered from top to bottom, 1 to 2. The columns are numbered left to right, 0 to 39.



Example:

```
DPCUR2,15          ; Position cursor on line 2, column 15
```

DPHBAL Phase Balance

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_><!>DPHBAL<r>	GT6K	6.0
Units	r = percent of (peak) nominal commanded current	GV6K	n/a
Range	90.0 to 110.0 : ±0.1		
Default	100.0	(applicable only to stepper axes)	
Response	DPHBAL: *DPHBAL100.0		
See Also	DPHOFA, DPHOFB, DWAVEF		

The DPHBAL command adjusts the current amplitude of phase B with respect to phase A.

A procedure for configuring Phase Balance is provided in the *Configuration* chapter of the *Hardware Installation Guide*.

Example:

```
DPHBAL110          ; sets the current amplitude of phase B to 110%
                   ; of the current in phase A.
```

DPHOFA Phase A Current Offset

Type	`Drive Configuration`
Syntax	`<a_><!>DPHOFA<r>`
Units	`r = no units`
Range	`-10.000 to 10.000 : ±0.001`
Default	`0.000`
Response	`DPHOFA:   *DPHOFA5.000`
See Also	`DPHBAL, DPHOFB, DWAVEF`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `DPHOFA` command adjusts the current offset of phase A.

A procedure for configuring phase offset is provided in the *Configuration* chapter of the *Hardware Installation Guide*.

DPHOFB Phase B Current Offset

Type	`Drive Configuration`
Syntax	`<a_><!>DPHOFB<r>`
Units	`r = no units`
Range	`-10.000 to 10.000 : ±0.001`
Default	`0.000`
Response	`DPHOFB:   *DPHOFB5.000`
See Also	`DPHBAL, DPHOFA, DWAVEF`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `DPHOFB` command adjusts the current offset of phase B.

A procedure for configuring phase offset is provided in the *Configuration* chapter of the *Hardware Installation Guide*.

DPOLE Number of Motor Pole Pairs

Type	`Motor`
Syntax	`<a_><!>DPOLE<i>  (does not take effect until RESET, DRESET or cycle power)`
Units	`i = pole pairs`
Range	`1-200`
Default	`0   (DPOLE of 0 results in motor config. error)`
Response	`DPOLE:   *DPOLE50`
See Also	`DMTR, TASX, TCS`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.) If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with TASX bit 7, writes a value of -32723 to the TCS register, and shuts down the drive (`DRIVE0`).

The `DPOLE` command sets the number of motor pole pairs. The number of pole pairs is defined as the number of poles (P), divided by 2 (or, P/2). The electrical frequency of the current (ω_e) is related to the mechanical speed (ω_m) of the motor by the pole pairs. The equation (right) shows this relationship.

$$\omega_e = \left(\frac{P}{2}\right) * \omega_m$$

NOTES:

- A 1.8^o step motor will have 50 pole pairs, a 0.9^o step motor will have 100 pole pairs.
- All linear motors, regardless of the number of stator poles, are considered to be one pole pair (`DPOLE1`) machines.

[DPTR] Data Pointer Location

Type	`Data Storage; Assignment or Comparison`
Syntax	see below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	`[ DAT ], DATA, [ DATP ], DATPTR, DATSIZ, TDPTR`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DPTR` command can be used to compare the current pointer location (the number of the data element to which the data pointer is pointing) against another value or numeric variable, or to assign the pointer location number to a variable. The current data pointer location is referenced to the current active data program specified in the first integer of the last `DATSIZ` or `DATPTR` command.

Syntax: `VARn=DPTR` where "n" is the variable number,
or `DPTR` can be used in an expression such as `IF(DPTR=1)`

Example:

```
DATSIZ4,200      ; Create data program called DATP4 with 200 data elements
DATPTR4,20,2     ; Set the data pointer to data element #20 in DATP4 and set the
                 ; increment to 2 (DATP4 becomes the current active data program)
VAR1=DPTR        ; Assign the number of the pointer location in DATP4 to numeric
                 ; variable #1
VAR1             ; Response is *VAR1=20. Indicates that the data pointer is
                 ; pointing to data element #20.
```

DPWM Drive PWM Frequency

Type	`Drive Configuration`
Syntax	`<a_><!>DPWM <i>` (does not take effect until RESET, DRESET or cycle power)
Units	kHz
Range	0, 8, 16, 20 or 40
Default	0 (use the drive's default frequency): GV6K-U3, GV6K-U6, GV6K-U12, GV6K-H20, GV6K-H40: 8 KHz GV6K-L3: 40 KHz
Response	DPWM8
See Also	

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a `RESET` or `DRESET` command.

Use the `DPWM` command to select the drive's PWM frequency. This value is the internal PWM frequency as seen at the motor windings; the motor ripple current is twice this frequency. In general, for a given drive power level, the higher the switching frequency, the lower the motor ripple current heating and the lower both the peak and continuous current ratings.

The table below lists the drive's continuous current and peak current ratings for different PWM frequencies.

		CONTINUOUS CURRENT				PEAK CURRENT			
Drive	**Input Voltage**	**DPWM8**	**DPWM16**	**DPWM20**	**DPWM40**	**DPWM8**	**DPWM16**	**DPWM20**	**DPWM40**
GV6K-L3	120VAC, 1 phase	n/a	n/a	n/a	3.0A	n/a	n/a	n/a	7.5A
GV6K-U3*	240VAC, 1 phase	3.0A	n/a	n/a	n/a	7.5A	n/a	n/a	n/a
GV6K-U6*	240VAC, 1 phase	6.0A	4.5A	3.6A	n/a	15.0A	11.2A	9.0A	n/a
GV6K-U12*	240VAC, 1 phase	12.0A	9.0A	7.2A	n/a	20.0A	22.5A	18.0A	n/a
GV6K-H20	240VAC, 1 phase	16.0A	13.0A	11.0A	n/a	50.0A	32.5A	27.5A	n/a
GV6K-H20	240VAC, 3 phase	20.0A	13.0A	11.0A	n/a	50.0A	32.5A	27.5A	n/a
GV6K-H40	240VAC, 1 phase	23.1A	23.1A	22.0A	n/a	100.0A	65.0A	55.0A	n/a
GV6K-H40	240VAC, 3 phase	40.0A	26.0A	22.0A	n/a	100.0A	65.0A	55.0A	n/a

* Current Ratings are the same for 120VAC operation

Note: All currents are peak of the sine wave values

[DREAD] Read RP240 Data

		Product	Rev
Type	`Display (RP240) Interface`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`[ DREADF ], DREADI, DVAR, DWRITE, [ SS ], TSS, VAR`		

The `DREAD` command allows you to store numeric data entered from the RP240's keypad into a variable. As the user presses RP240 numeric keys, the data will be displayed on the RP240 starting at the location equal to the current cursor location + 1 (for a sign bit):

`VAR1=DREAD`	Wait for RP240 numeric entry (terminated with the **ENTER** key), then set `VAR1` equal to that value.

Additionally the `DREAD` command can be used as a variable assignment within another command that is expecting numeric data (Rule of Thumb: If the command syntax shows that the command field requires a real number (denoted by `<r>`) or an integer value (denoted by `<i>`), you can use the `DREAD` substitution.):

`A(DREAD)`	Wait for RP240 numeric entry (terminated with the **ENTER** key), then set acceleration equal to that value.

The `DREAD` command cannot be used in an expression such as `VAR5=4+DREAD` or `IF(DREAD=1)`.

[DREADF] Read RP240 Function Key

		Product	Rev
Type	`Display (RP240) Interface`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`[ DREAD ], DREADI, DVAR, DWRITE, [ SS ], TSS, VAR, VARI`		

The `DREADF` command allows you to store numeric data entered from an RP240 function key into a variable. Function key 1 (**F1**) = 1, **F2** = 2, etc., and **MENU RECALL** (**F0**) = 0.

Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by `<r>`) or an integer value (denoted by `<i>`), you can use the `DREADF` substitution (e.g., `V(DREADF)`).

Example:

```
VAR1=DREADF      ; Wait for RP240 function key entry, then set VAR1 equal to that value
IF(VAR1=5)       ; If function key 5 was hit then ...
GO1              ; Start motion
NIF              ; End if statement
```

DREADI RP240 Data Read Immediate Mode

		Product	Rev
Type	`Display (RP240) Interface`	GT6K	6.0
Syntax	`<a_><!>DREADI<b>`	GV6K	6.0
Units	`n/a`		
Range	`1 (enable) or 0 (disable)`		
Default	`0`		
Response	`DREADI: *DREADI0`		
See Also	`DPCUR, [ DREAD ], [ DREADF ], VAR, VARI`		

The `DREADI1` command allows continual numeric or function key data entry from the RP240 (when used in conjunction with the `DREAD` and/or `DREADF` commands). In this immediate mode, program execution is not paused (waiting for data entry) when a `DREAD` or `DREADF` command is encountered.

NOTES

- While in the Data Read Immediate Mode (`DREADI1`), data is read into `VAR` and `VARI` variables only (e.g., `A(DREAD)` or `V(DREAD)` substitutions are not valid).
- This feature is not designed to be used in conjunction with the RP240's standard menus (see *Programmer's Guide* for menu structure); the **RUN** and **JOG** menus will disable the `DREADI` mode.
- After the RP240's ENTER key is pressed (to enter numeric data), the value is displayed on the RP240 display at the 1,30 location (showing 10 significant digits).
- Do not assign the same variable to read numeric data **and** function key data—pick only one.

Simple Numeric Data Entry (example):

```
VAR1=25000         ; Initialize variable #1
DCLEAR0            ; Clear entire RP240 display
DWRITE"ENTER VALUE > " ; Send message to RP240 display starting at location 1,0
DREADI1            ; Enable RP240 data read immediate mode
VAR1=DREAD         ; Set variable #1 (VAR1) to receive data entered on the RP240.
                   ; Current VAR1 data will be displayed at cursor location 1,30
                   ; (fixed). New data will be displayed at current cursor location
                   ; as defined by the previous DCLEAR, DWRITE and DPCUR commands—
                   ; this is the home cursor location for subsequent data entries.
L77                ; Start loop of 77 repetitions
D(VAR1)            ; Set distance equal to the current (last entered) RP240 data
GO1                ; Initiate move
LN                 ; End loop
DREADI0            ; Exit RP240 data read immediate mode
; As the loop is running, the user may enter in a new distance value
; (which must be terminated with the ENTER key) via the RP240 numeric keypad.
; The numeric keystrokes cause the digits to be displayed on the RP240
; starting at the home cursor location (see VAR1=DREAD description in the
; example above). When the ENTER key is pressed, the variable is updated;
; the most significant 10 digits (total, including sign & decimal point
; if appropriate) of this variable are displayed at cursor location 1,30;
; and then the data entry field (starting at home) is cleared.
; The Gem6K drive is ready to accept new data.
```

Numeric Data & Function Key Entry (example):

```
VAR1=25000         ; Initialize variable #1
VAR2=1             ; Initialize variable #2
DCLEAR0            ; Clear the RP240 display
DPCUR2,0           ; Place RP240 cursor on line 2, column 0 (bottom left corner of
                   ; display)
DWRITE" SLOW FAST"     ; Send message to RP240 display starting at location 2,0
DPCUR1,0           ; Place RP240 cursor on line 1, column 0 (top left corner)
DWRITE"ENTER VALUE > "  ; Send message to RP240 display starting at location 1,0
DREADI1            ; Enable RP240 data read immediate mode
VAR1=DREAD         ; Set variable #1 (VAR1) to receive numeric data entered on the
                   ; RP240's keypad
VAR2=DREADF        ; Set VAR2 to receive RP240 function key input
L                  ; Begin loop
```

```
IF(VAR2=1)       ; If function key 1 was last pressed, do the IF statement
                 ; (slow velocity)
V3.6             ; Set velocity to 3.6 units per second
NIF              ; End IF statement
IF(VAR2=2)       ; If function key 2 was last pressed, do the IF statement
                 ; (fast velocity)
V6.4             ; Set velocity to 6.4 units per second
NIF              ; End IF statement
D(VAR1)          ; Set distance equal to the current (last entered) RP240 numeric
                 ; data
GO1              ; Initiate the move
LN               ; End loop
; As the loop is running, the user may enter in a new distance value and/or
; choose between two different preset velocities. The display does not change
; when a function key is pressed.
```

Multiple Numeric Data Entry (example):

```
VAR2=0           ; Initialize variable #2 (VAR2)
VAR3=99          ; Initialize variable #3 (VAR3)
VAR4=10          ; Initialize variable #4 (VAR4)
VAR5=25000       ; Initialize variable #5 (VAR5)
DCLEAR0          ; Clear the entire RP240 display
DPCUR2,0         ; Place RP240 cursor on line 2, column 0 (bottom left corner)
DWRITE" ACCEL VEL DIST"  ; Send message to RP240 display starting at location 2,0
DREADI1          ; Enable RP240 data read immediate mode
VAR2=DREADF      ; VAR2 will capture function key entries (0 - 6)
L                ; Begin loop
IF(VAR2<>0)      ; If a new function key is pressed, do the following code:
DCLEAR1          ; Clear line one of the RP240 display (top line)
IF(VAR2=1)       ; If function key 1 is pressed, do the IF statement
                 ; (input acceleration)
DWRITE"ENTER ACCEL VALUE>" ; Send message to RP240 display starting at location 1,0
VAR3=DREAD       ; Set VAR3 equal to the numeric data entered on the RP240's keypad
NIF              ; End IF statement
IF(VAR2=2)       ; If function key 2 is pressed, do the IF statement (input velocity)
DWRITE"ENTER VEL VALUE>" ; Send message to RP240 display starting at location 1,0
VAR4=DREAD       ; Set VAR4 equal to the numeric data entered on the RP240's keypad
NIF              ; End IF statement
IF(VAR2=3)       ; If function key 3 is pressed, do the IF statement (input distance)
DWRITE"ENTER DIST VALUE>" ; Send message to RP240 display starting at location 1,0
VAR5=DREAD       ; Set VAR5 equal to the numeric data entered on the RP240's keypad
NIF              ; End IF statement
VAR2=0           ; Prohibit repeated execution of this code
VAR2=DREADF      ; Re-enable VAR2 to capture new function key entry
NIF              ; End IF statement
A(VAR3)          ; Set acceleration equal to the numeric value of VAR3
V(VAR4)          ; Set velocity equal to the numeric value of VAR4
D(VAR5)          ; Set distance equal to the numeric value of VAR5
GO1              ; Initiate the move
LN               ; End loop
; As the loop is running, the user may select among the three variables he wants
; to enter data into. These three variables correspond with acceleration,
; velocity, and distance. Each time the function key variable changes from 0
; (to 1, 2 or 3), then a new message is displayed and the VARi=DREAD command
; will put the current value of that variable in location 1,30 (upper right hand
; corner of the display). For example, the user can choose VEL (F2) and then
; repeatedly change VAR4 by entering a value on the RP240 numeric keypad and
; pressing the ENTER key. Each time through the loop, the VAR4 data is loaded
; into the V command.
```

DRES Drive Resolution

Type	`Drive Configuration`
Syntax	`<a_><!>DRES<i>`
Units	`i = counts/rev`
Range	`200-128000`
Default	`25000`
Response	`DRES:   *DRES25000`
See Also	`DMEPIT, DMODE, DRIVE, ERES, SCALE, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the DRES command to set the Gem6K's resolution appropriately for your application. This resolution determines how many distinct positions the drive will command the motor to travel within one revolution.

Example:

```
DRES25000        ; Set drive resolution to 25000 counts/rev
```

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

DRESET Drive Reset

Type	`Communication Interface`
Syntax	`<a_><!>DRESET`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`DRESET: (no response; parameters listed below are reset)`
See Also	`RESET, RFS, TASX`

Product	Rev
GT6K	6.0
GV6K	6.0

The DRESET command performs a limited "software" reset of the parameters listed below. Unlike the RESET command, which affects the drive the same as cycling power or activating the hardware Reset input, the DRESET command affects only the parameters below.

Resolution Commands

DRES
ERES
ORES

Status Registers (certain bits cleared by DRESET)

ASX   TASX   TASXF

Motor Configuration Parameters

DMEPIT
DMTD
DMTIC
DMTICD
DMTIND
DMTJ
DMTKE
DMTLMN
DMTLMX
DMTR
DMTRES
DMTRWC
DMTSTT
DMTTCM
DMTTCW
DMTW
DPOLE
DPWM
SFB
SHALL

NOTE: The DRESET command does not disconnect an Ethernet connection.
The DRESET command does not clear the ERRORP assignment or run the STARTP program.

DRIVE Drive Enable

Type	`Drive Configuration`
Syntax	`<a_><!>DRIVE<b>`
Units	`n/a`
Range	`b = 0 (disable), 1 (enable)`
Default	`0 (disable)`
Response	`DRIVE    *DRIVE1`
See Also	`[ AS ], [ ASX ], ESK, FLTDSB, KDRIVE, TAS, TASX, TER`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `DRIVE` command to enable or disable (shut down) the drive. By default, the drive is disabled (`DRIVE0`) upon power up. The enable input (pin 1 on the 50 pin `DRIVE I/O` connector) must be connected to ground before a `DRIVE1` will enable the drive.

If the Disable Drive on Kill (`KDRIVE`) mode is enabled, the drive will be disabled in the event of a kill command or kill input.

NOTE: The `DRIVE0` command will not de-energize a motor drive during motion.
`DRIVE1` sets the commanded position (`TPC`) equal to the actual position (`TPE`).

The conditions below automatically disable the drive (`DRIVE0`), activate any outputs you have configured as "fault" outputs, and open the dry contact relay ("RELAY N.O."):

- Certain axis "fault" conditions – refer to the status bits denoted with an asterisk (*) in the `TAS` and `TASX` descriptions.
- If operating in the `FLTDSB1` mode and the drive received a `DRIVE0` command or the hardware enable input interlock was opened.

Example:

```
DRIVE1           ; Enable the drive
```

DRPCHK RP240 Check

Type	`Communication Interface; Display (RP240) Interface`
Syntax	`<a_><!>DRPCHK<i>`
Units	`n/a`
Range	`0-3`
Default	`0 for port COM1 and COM2 (PORT command setting determines which COM port's DRPCHK setting is checked)`
Response	`DRPCHK   *DRPCHK0`
See Also	`LOCK, PORT, XONOFF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DRPCHK` command is used to indicate whether a port is to be used with an RP240 or for Gem6K language commands. The `DRPCHK` command affects the COM port selected with the last `PORT` command. The `DRPCHK` command value is automatically saved in battery-backed RAM.

NOTE: COM1 is the connector labeled "RS-232/485" and COM2 is the connector labeled "RS-232."

`DRPCHKØ`......... The serial port will be used for Gem6K language commands. This is the default setting for COM1 and COM2. Power-up messages appear on all ports set to `DRPCHKØ`.

`DRPCHK1`......... A check for the presence of an RP240 will be performed at power-up/reset. If an RP240 is present and energized, the Gem6K will initialize the RP240. If an RP240 is not present, the port may be used for Gem6K language commands. Note that RP240 commands will be sent at power-up and reset.

`DRPCHK2`......... A status check for the presence of an RP240 will be periodically performed (every 5-6 seconds). If an RP240 is plugged in and energized, the Gem6K will initialize the RP240.

Press F6 on the RP240 periodically until the Gem6K recognizes the RP240. (The RP240 indicates that it has been recognized by beeping when F6 is pressed.)

DRPCHK3......... A status check for the presence of an RP240 will be performed at power-up/reset. If an RP240 is present, the Gem6K will initialize the RP240. If an RP240 is not present, no commands except DWRITE will have any effect for that port and the COM port will ignore received characters.

Each port has its own DRPCHK value, but only one may be set to DRPCHK2 or DRPCHK3 at any time.

Default values are used until DRPCHK is set for the first time. DRPCHK values are automatically saved in non-volatile memory. They do not change until you set new values or issue an RFS command. It may be advisable to include the DRPCHK command in your start-up program to ensure that it powers up in the correct setting for your current application.

DSTALL Drive Stall Detect Sensitivity

Type	Drive Configuration
Syntax	<a_><!>DSTALL<i>
Units	i = sensitivity level selection
Range	0-50 (0 disables the stall detect function)
Default	0 (disabled)
Response	DSTALL: *DSTALL20
See Also	ERROR, ESK, ESTALL, KDRIVE, TAS, TASX, TER

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The DSTALL command sets the sensitivity of the *Drive Stall Detection* function. An encoder is not required for this function. (An encoder is required for *Encoder Stall Detection*; refer to the ESTALL command.)

A setting of 0 disables the drive stall detect function. Stall "sensitivity" is an empirical metric; therefore, you must iteratively try different settings to identify the sensitivity setting that works best for your application.

When a Drive Stall is detected, the GT6K responds as follows:

- The stall is reported with Extended Axis Status bit #17 (reported with TASX, TASXF, and ASX).
- If error-checking bit #1 is enabled (ERROR.1-1):
  - The stall is reported with Error Status bit #1 (reported with TER, TERF, and ER).
  - The GT6K branches to the assigned ERRORP program.
- If the Kill-on-Stall feature is enabled (ESK1), the GT6K immediately stops pulses from being sent to the motor. If Disable Drive on Kill is enabled (KDRIVE1) it disables the drive.

Example:

```
SCALE0          ; Disable scaling
DEL proga       ; Delete program called proga
DEF proga       ; Begin definition of program called proga
DSTALL20        ; Enable drive stall detect, with sensitivity of 20
ESK1            ; Enable kill on stall
MA0             ; Incremental positioning mode
MC0             ; Preset positioning mode
A10             ; Set the acceleration to 10 units/sec/sec
V1              ; Set the velocity to 1 unit/sec
D100000         ; Set the distance to 100000 units
GO1             ; Initiate motion
                ; The motor will move 100000 commanded counts (4 revs)
                ; (If, at any time during the move the drive detects a stall,
                ; a stall condition will be flagged, and motion will stop.)
END             ; End definition of proga
```

DSTP Enable/Disable RP240 Stop Key

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DSTP<b>`
Units	`b = enable bit`
Range	`b = 1 (enable) or 0 (disable)`
Default	`1 (enable)`
Response	`DSTP     *DSTP1`
See Also	`DLED, [ DREAD ], [ DREADF ]`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `DSTP` command to enable or disable the stop key on the RP240 panel.

DVAR Display Variable on RP240

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DVARi,<i>,<i>,<i>`
Units	`See below`
Range	`n/a`
Default	`See below`
Response	`n/a`
See Also	`[ DREAD ], [ DREADF ], DVARB, DVARI, DWRITE, VAR`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `DVAR` command to display a numeric variable on the RP240's LCD at the current cursor location:

1st `i` = Variable number [Range 1-225]

2nd `i` = Number of whole digits displayed (left of decimal point) [Range 0-9]

3rd `i` = Number of fractional digits displayed (right of decimal point) [Range 0-8]

4th `i` = Sign bit: 0 = no sign displayed, 1 = display + or -

Example:

```
VAR2=542.14      ; Assign the value 542.14 to variable #2
DVAR2,6,3,1      ; Display variable #2 as +000542.140
DVAR2,3,1,0      ; Display variable #2 as 542.1
DVAR2,3,,1       ; Display variable #2 as +542
```

DVARB Display Binary Variable on RP240

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DVARBi,<i>`
Units	`See below`
Range	`n/a`
Default	`See below`
Response	`n/a`
See Also	`DVAR, DVARI, DWRITE, VARB`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `DVARB` command to display a binary variable on the RP240's LCD at the current cursor location:

1st `i` = Variable number [Range 1-125]

2nd `i` = Number of bits displayed [Range 1-32]

Example

```
VARB2=b11001X11  ; Assign the value 11001X11 to binary variable #2
DVARB2,6         ; Display binary variable #2 as 1100_1X
DVARB2,3         ; Display binary variable #2 as 110
DVARB2,1         ; Display binary variable #2 as 1
```

DVARI Display Integer Variable on RP240

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DVARIi,<i>,<i>`
Units	`See below`
Range	`n/a`
Default	`See below`
Response	`n/a`
See Also	`DVAR, DVARB, DWRITE, VARI`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `DVARI` command to display an integer variable on the RP240's LCD at the current cursor location:

1st i = Variable number [Range 1-225]
2nd i = Number of whole digits displayed [Range 0-9]
3rd i = Sign bit: 0=no sign displayed, 1=display + or - sign

Example

```
VARI2=542        ; Assign the value 542 to integer variable #2
DVARI2,6,1       ; Display integer variable #2 as +000542
DVARI2,3,1       ; Display integer variable #2 as =+542
```

DWAVEF Waveform

Type	`Drive Configuration`
Syntax	`<a_><!>DWAVEF<r>`
Units	`r = percent 3rd harmonic`
Range	`-20.00 to 10.00 : ±0.01`
Default	`-4.00 (-4% 3rd harmonic injection)`
Response	`DWAVEF   *DWAVEF-4`
See Also	`DPHBAL, DPHOFA, DPHOFB`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `DWAVEF` command sets the percentage of 3rd harmonic included in the commanded motor current waveform. A procedure for configuring the waveform is provided in the *Hardware Installation Guide*; refer to the section entitled *Motor Control Settings*.

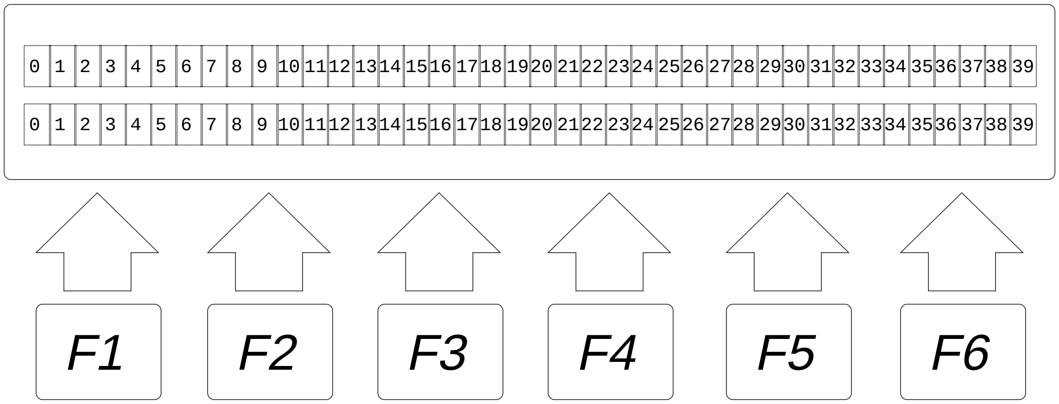
DWRITE Write Text on RP240

Type	`Display (RP240) Interface`
Syntax	`<a_><!>DWRITE"message"`
Units	`n/a`
Range	`Message can be ≤ 80 characters (may not use characters ", \, * or :)`
Default	`See below`
Response	`n/a`
See Also	`DCLEAR, DLED, DPASS, DPCUR, DVAR, DVARB, DVARI, PORT`

Product	Rev
GT6K	6.0
GV6K	6.0

The `DWRITE` command displays a message on the RP240's LCD starting at the current cursor location. A message is a character string of up to 80 characters in length. The characters within the string may be any characters except quote (`"`), backslash (\), asterisk (`*`),colon (`:`), and tilde (~). Strings that have lower-case letters will be converted to upper case prior to display (see example).

The following graphic shows the location of the RP240's two-line, 40-character display. It also shows the characters in relation to the function keys.



HINT: If you do not have an RP240 and wish to send (only) characters out the serial port to another serial device, you may use this command. Place a backslash (\) before non-alphanumeric characters. Example: `DWRITE"HOMING SUCCESSFUL\13"` = send message plus <CR>

Example:

```
DCLEAR0                        ; Clear RP240 display
DPCUR1,12                      ; Move cursor to line 1, column 12
DWRITE"Enter Number of Parts"  ; RP240 will display: ENTER NUMBER OF PARTS
VAR1=DREAD                     ; RP240 waiting for data entry
```

E Enable Communication

Type	`Communication Interface`
Syntax	`<a_><!>E<b>`
Units	`b = enable bit`
Range	`b = 0 (serial communication off) or 1 (serial communication on)`
Default	`b = 1`
Response	`0_E:     *E1`
See Also	`ADDR, BAUD, DRPCHK, ECHO, LOCK, PORT, XONOFF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `E` command allows you to enable and disable serial ports on the Gem6K drive. To enable all units in the RS-232 daisy-chain or RS-485 multi-drop at one time, you can use the `E1` command. The `PORT` command determines which COM port is affected by the `E` command.

Example:

```
PORT1            ; Next command affects the COM1 serial port on the Gem6K
0_E1             ; Enable serial port for unit with device address 0
```

ECHO Communication Echo Enable

Type	`Communication Interface`
Syntax	`<a_><!>ECHO<b>`
Units	`b = enable bit`

Range	`b = 0 (disable), 1 (enable), 2 (echo through other COM port),`
	`3 (echo through both COM ports), or X (don't change)`

Default	`1`
Response	`ECHO:    *ECHO0`
See Also	`], [, BAUD, EOL, EOT, ERRLVL, PORT, [ SS ], TSS`

Product	Rev
GT6K	6.0
GV6K	6.0

The Communication Echo Enable (`ECHO`) command enables command echo. *Lower-case letters are converted to upper case and then echoed.* When echo is enabled, commands are echoed character by character.

In a terminal emulator mode, you may not see the echoed characters on your display when issuing commands that have a response, because the echoed characters may be overwritten by the response.

The PORT command determines which COM port is affected by the ECHO command.

The purpose of the ECHO2 and ECHO3 options is to accommodate an RS-485 multi-drop configuration in which a host computer communicates to the "master" Gem6K drive over RS-232 (COM2 port) and the master Gem6K drive communicates over RS-485 (COM1 port) to the rest of the units on the multi-drop. For this configuration, the echo setup should be configured by sending to the master the following commands executed in the order shown. In this example, it is assumed that the master's device address is set to 1. Hence, each command is prefixed with "1_" to address only the master unit.

1_PORT1....... Subsequent command affects COM1, the RS-485 port
1_ECHO2....... Echo characters back through the other port, COM2
1_PORT2....... Subsequent command affects COM2, the RS-232 port
1_ECHO3....... Echo characters back through both ports, COM1 and COM2

ELSE Else Condition of IF Statement

Type	Program Flow Control	**Product**	**Rev**
Syntax	<a_><!>ELSE	GT6K	6.0
Units	n/a	GV6K	6.0
Range	n/a		
Default	n/a		
Response	n/a		
See Also	IF, NIF		

ELSE is used in conjunction with the IF and NIF commands to provide conditional branching. If the expression contained within the parentheses of the IF command evaluates true, then the commands between the IF and the ELSE are executed, and the commands after the ELSE until the NIF are ignored. If the expression evaluates false, the commands between the ELSE and the NIF are executed and the commands between IF and ELSE are ignored. The ELSE command is **optional** and does not have to be included in the IF statement. IF( )...ELSE...NIF commands can be nested up to 16 levels deep.

Programming order: IF(expression) ...commands... ELSE ...commands... NIF

Example:

```
IF(IN.1=b1)       ; Specify condition: if onboard input #1 is on
T5                ; If condition evaluates true, wait 5 seconds
ELSE              ; Else part of IF condition
TPE               ; If condition does not evaluate true transfer encoder position
NIF               ; End IF statement
```

ENCCNT Encoder Count Reference Enable

Type	Encoder; Drive Configuration	**Product**	**Rev**
Syntax	<a_><!>ENCCNT<b>	GT6K	6.0
Units	b = enable bit	GV6K	n/a
Range	0 (reference the commanded position), 1 (reference the encoder position) or X (don't change)		
Default	0 (reference the commanded position)	(applicable only to stepper axes)	
Response	ENCCNT *ENCCNT0		
See Also	ESTALL, INFNC, LIMFNC, OUTP, [PCC], [PCE], [PCME], [PE], TPCC, TPCE, TPCME, TPE, TVELA, [VELA]		

Use ENCCNT to configure a GT6K to reference either the encoder position or the commanded position when capturing the position (see INFNCi-H) and checking the encoder position (PE and TPE). When checking the actual velocity (VELA and TVELA), ENCCNT determines whether the velocity, in units of revs/sec, is derived with the encoder resolution (ERES) or the drive resolution (DRES). The default setting (ENCCNT0) references the commanded position.

NOTES:
- ENCCNT must be enabled (ENCCNT1) before encoder stall detect (ESTALL) can be used.
- When operating in ENCCNT1 mode, the encoder position (PCE, PE, TPCE, TPE) is always measured in encoder counts and is not scaled, regardless of SCALE and SCLD.

Example:

```
INFNC1-H      ; Configure trigger A as a position capture input
ENCCNT1       ; Capture encoder position when trigger A is activated,
```

END End Program or Subroutine Definition

Type	Program or Subroutine Definition
Syntax	<a_><!>END
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	$, DEF, DEL, ERASE, GOBUF, GOSUB, GOTO, RUN, PRUN

Product	Rev
GT6K	6.0
GV6K	6.0

The END command marks the ending point of a program or subroutine definition. All commands between the DEF and the END statement will be considered in a program or subroutine.

Example:

```
DEL pick          ; Delete program named pick
DEF pick          ; Begin definition of program named pick
GO1               ; Initiate motion
END               ; End program definition
pick              ; Execute program named pick
```

EOL End of Line Terminating Characters

Type	Communication Interface
Syntax	<!>EOL<i>,<i>,<i>
Units	n/a
Range	i = 0 – 256
Default	13,10,0
Response	EOL: *EOL13,10,0
See Also	], [, BOT, EOT, ERRLVL, PORT, WRITE, XONOFF

Product	Rev
GT6K	6.0
GV6K	6.0

The EOL command designates the characters to be placed at the end of each line, but not the last line, in a multi-line response. The last line of a multi-line response has the EOT characters. Up to 3 characters can be placed at the end of each line. The characters are designated with their ASCII equivalent (no character that has a value of zero [Ø] will be output). For example, a carriage return is ASCII 13, a line feed is ASCII 10, and no terminating character is designated with a zero.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

The PORT command determines which COM port is affected by the EOL command.

NOTE: Although you may issue a single command, like TERRLG, each line of the response will have the EOL characters. The last line in the response will have the EOT characters. If the response is only one line long, the EOT characters will be placed after the response, not the EOL characters.

Character	ASCII Equivalent
Line Feed	10
Carriage Return	13

For a more complete list of ASCII Equivalents, refer to the ASCII Table in Appendix B.

Example:

```
EOL13,0,0         ; Place a carriage return after each line of a response
```

EOT End of Transmission Characters

Type	`Communication Interface`
Syntax	`<!>EOT<i>,<i>,<i>`
Units	`n/a`
Range	`i = 0 – 256`
Default	`13,0,0`
Response	`EOT:     *EOT13,0,0`
See Also	`], [, BOT, EOL, ERRLVL, PORT, WRITE`

Product	Rev
GT6K	6.0
GV6K	6.0

The `EOT` command designates the characters to be placed at the end of every response. Up to 3 characters can be placed after the last line of a multi-line response, or after all single-line responses. The characters are designated with their ASCII equivalent (no character that has a value of zero [Ø] will be output). For example, a carriage return is ASCII 13, a line feed is ASCII 10, and no terminating character is designated with a zero.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

The `PORT` command determines which COM port is affected by the `EOT` command.

NOTE: Although you may issue a single command, like `TERRLG`, each line of the response will have the `EOL` characters. The last line in the response will have the `EOT` characters. If the response is only one line long, the `EOT` characters will be placed after the response, not the `EOL` characters.

Character	ASCII Equivalent
Line Feed	10
Carriage Return	13

For a more complete list of ASCII Equivalents, refer to the ASCII Table in Appendix B.

Example:

```
EOT13,10,0     ; Place a carriage return and a line feed after the last line
               ; of a multi-line response, and after all single line responses
```

[ER] Error Status

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ ASX ], DSTALL, ERROR, ERRORP, ESTALL, GOWHEN, INFNC, K, LH, LIMFNC, LS, S, SMPER, STRGTT, TASX, TER, TERF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `ER` command is used to assign the error status bits to a binary variable, or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=<i%>ER` where `n` is the binary variable number, or `ER` can be used in an expression such as `IF(ER=b11Ø1)`, or `IF(ER=h7F)`.

The bit select operator (`.`), in conjunction with the bit number, can be used to specify a specific error bit. Examples: `VARB1=ER.2` assigns error bit 2 to binary variable 1; `IF(ER.2=b1)` is a conditional statement that is true if error bit 2 is set to 1.

The specific error-checking bits must be enabled by the Error-Checking Enable (`ERROR`) command before the `ER` command will provide an error response — see programming example below.

MULTI-TASKING

If you are operating multiple tasks, be aware that you must enable error conditions (ERROR) and specify an error program (ERRORP) for each task (e.g., 2%ERROR.2-1 and 2%ERRORP FIX for Task 2). Each task has its own error status register (reported with ER, TER, and TERF).

The function of each error status bit is shown below.

Bit #	**Function** (1 = Yes; Ø = No)
1*	Stall Detected: Functions when stall detection has been enabled (ESTALL or DSTALL), and ESK1 is set.
2	Hard Limit Hit: Functions when hard limits are enabled (LH).
3	Soft Limit Hit: Functions when soft limits are enabled (LS).
4	Drive Fault: Detected only if the drive is enabled (DRIVE1).
5	RESERVED (see note at end of table; refer to ERROR command)
6	Kill Input: When an input is defined as a Kill input (INFNCi-C), and that input becomes active.
7	User Fault Input: When an input is defined as a User Fault input (INFNCi-F), and that input becomes active.
8	Stop Input: When an input is defined as a Stop input (INFNCi-D), and that input becomes active.
9	Enable input is activated (not grounded).
10	Pre-emptive (on-the-fly) GO or registration move profile not possible.
11 **	Target Zone Settling Timeout Period (set with the STRGTT command) is exceeded.
12 **	Maximum Position Error (set with the SMPER command) is exceeded.
13	RESERVED
14	Position relationship in GOWHEN already true when GO, FSHFC, or FSHFD was executed.
15	RESERVED
16	Bad command detected (bit is cleared with TCMDER command).
17	RESERVED
18	Cable to an expansion I/O brick is disconnected, or power to the I/O brick is lost; error is cleared by reconnecting the I/O brick and issuing the ERROR.18-0 command and then the ERROR.18-1 command. (Multi-tasking: This condition also kills all tasks.)
19	RESERVED
20	RESERVED
21	RESERVED
22	RESERVED
23	Ethernet Client connection error.
24	Ethernet Client polling error.
25-32	RESERVED

* Stepper axes only
** Servo axes only

NOTE: When error bit 5 (Commanded Kill or Stop) of the ERROR command is enabled (ERROR.5-1), a Stop (!S) or a Kill (!K or <ctrl>K) command will cause the drive to GOSUB or GOTO to the error program (ERRORP). Within the error program the cause of the error will need to be determined. The ER or TER command can be used to determine the cause of the error. If none of the error status bits are set, the cause of the error is a commanded kill or a commanded stop. The reason for not setting a bit on this error condition is that there is no way to clear the error condition upon leaving the error program.

Example:

```
ERROR111101101       ; Enable error-checking bits 1-4, 6, 7, and 9
VARB1=ER             ; Error status assigned to binary variable 1
VARB2=ER.4           ; Error status bit 4 assigned to binary variable 2
VARB2                ; Response if bit 4 is set to 1:
                     ; *VARB2=XXX1_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX
IF(ER=b1110X11X1)    ; If the error status contains 1's for bit locations 1, 2, 3,
                     ; 6, 7, and 9, and a 0 for bit location 4, do the IF statement
TREV                 ; Transfer revision level
NIF                  ; End if statement
IF(ER=hF600)         ; If the error status contains 1's for bit locations 1, 2, 3,
                     ; 4, 6, and 7, and 0's for every other bit location, do the
                     ; IF statement
TREV                 ; Transfer revision level
NIF                  ; End if statement
```

ERASE Erase All Programs

		Product	Rev
Type	Subroutine or Program Definition	GT6K	6.0
Syntax	<a_><!>ERASE	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	n/a		
See Also	[DATP], DEF, DEL, RESET, RFS		

The ERASE command deletes all programs created with the DEF command, including all data programs (DATP). If you do not want to erase all the programs, you can use the DEL command to selectively delete programs. See the RESET command to determine which values are reset to factory defaults.

ERES Encoder Resolution

		Product	Rev
Type	Encoder Configuration	GT6K	6.0
Syntax	<a_><!>ERES<i>>:(does not take effect until RESET, DRESET or cycle power)	GV6K	6.0
Units	Rotary motor: i = counts/rev Linear motor: i = counts/electrical pitch		
Range	0 – 65535 (stepper axes); 200 - 1073741823 (servo axes)		
Default	4000 (If SFB4, the default is 4096 counts/rev.)		
Response	ERES: *ERES4000		
See Also	DMEPIT, DMTR, DRES, ESTALL, ORES, SFB, SMPER, TPE, TPER, TSTAT		

Use the ERES command to establish the encoder or resolver resolution (post quadrature) in counts/rev or counts/electrical pitch. (To set a linear motor's electrical pitch, refer to the DMEPIT command).

Stepper Axes: The ERES command establishes the number of encoder counts received for a move equal to the distance set in the drive resolution (DRES) command. If the motor/drive resolution equals 25000 steps/rev, and a 1 revolution move is performed (with scaling (SCALE) disabled), the number of encoder counts received back would be the encoder resolution value (ERES). A standard 1000-line per revolution encoder gives 4000 counts post-quadrature. If the encoder is coupled to the back of a motor, the ERES value will be 4000. This value, along with the drive resolution value (DRES) are important for the motion algorithm to correctly interpret move distances, move velocities, and move accelerations.

Servo Axes: The servo system's resolution is determined by the resolution of the encoder used with the servo motor. The ERES command establishes the number of counts (post quadrature), per unit of travel. For example, Compumotor's SM and NeoMetric Series motors with the "E" encoder option use 1,000-line encoders, and therefore have a 4,000 count/rev post-quadrature resolution (requires ERES4ØØØ). If the encoder is mounted directly to the motor, then to ensure that the motor will move according to the programmed distance and velocity, the GV6K's resolution (ERES value) must match the encoder's resolution.

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

AUTO-SETUP for GV6K Drives only: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter (if SFB1) or this command is set to 4096 counts/rev (if SFB4). Refer to DMTR for a list of auto-configured commands.

Resolutions for Compumotor Encoders:

Stepper axes:

- -RE, -RC, -EC, and -E Series Encoders ....`ERES4000`
- -HJ Series Encoders ....`ERES2048`

Servo axes:

- BE Series Servo Motors ....BExxxxJ-xxxx: `ERES8000`
- SM, N or J Series Servo Motors................SM/N/JxxxxD-xxxx: `ERES2000`
  SM/N/JxxxxE-xxxx: `ERES4000`
- G Series Servo Motors ....GxxxxK-xxxx: `ERES8192`
- Resolution for Parker-supplied resolvers ..`SFB4`: `ERES4096` (BE, SM, N, J and G Series motors)

Daedal Positioning Tables (encoder options):

- -E2..`ERES42000`
- -E3..`ERES84000`
- -E4..`ERES420000`
- -E5..`ERES8400`
- For linear servo motors, use the following equation to determine the proper `ERES`, based on both the encoder resolution and the motor's electrical (or magnetic) pitch (`DMEPIT`).

$$ERES = \frac{DMEPIT\ \ (mm)}{Encoder\_resolution\ \ \left({}^{mm}\!/_{count}\right)}$$

Example: Linear encoder resolution (post quad) is 1 μm and the electrical pitch is 42mm (`DMEPIT42`). `ERES` is calculated as:

$$ERES = \frac{42\ \ (mm)}{1 \cdot 10^{-3}\ \left({}^{mm}\!/_{count}\right)} = 42000$$

Dynaserv (stepper or servo):

- DR10xxB ....`ERES507904`
- DR1xxxE...`ERES614400`
- DR1xxxA ....`ERES819200`
- DR5xxxB ....`ERES278528`
- DR5xxxA ....`ERES425894`
- DM10xxB ....`ERES655360`
- DM1xxxA ....`ERES1024000`
- DM1004x ....`ERES655360`

Example (for stepper axis):

```
SCALE0           ; Disable scaling
DEL proga        ; Delete program called proga
DEF proga        ; Begin definition of program called proga
DRES25000        ; Motor/drive resolution set to 25000 steps/rev
                 ; (DRES is used for stepper axes only)
ERES4000         ; Encoder resolution set to 4000 post-quadrature counts/rev
                 ; (encoder is for stall detection only)
ESTALL1          ; Enable encoder stall detection
MA0              ; Incremental mode
MC0              ; Preset mode
A10              ; Set the acceleration to 10 units/sec/sec
V1               ; Set the velocity to 1 unit/sec
D100000          ; Set the distance to 100000 units
GO1              ; Initiate motion
                 ; Axis will move 100,000 commanded counts (4 revs)
END              ; End definition of proga
```

ERRBAD Error Prompt

		Product	Rev
Type	`Communication Interface`	GT6K	6.0
Syntax	`<!>ERRBAD<i>,<i>,<i>,<i>`	GV6K	6.0
Units	`n/a`		
Range	`i = 0 – 256`		
Default	`13,10,63,32`		
Response	`ERRBAD: *ERRBAD13,10,63,32`		
See Also	`BOT, EOT, ERRDEF, ERRLVL, ERROK, PORT, TCMDER`		

The ERRBAD command designates the characters to be placed into the output buffer after an erroneous command has been entered. Up to 4 characters can be placed in the output buffer. These characters serve as a prompt for the next command. The characters are designated with their ASCII equivalent. For example, a carriage return is ASCII 13, a line feed is ASCII 10, a question mark is ASCII 63, a space is ASCII 32, and no terminating character is designated with a zero. For a more complete list of ASCII equivalents, refer to the ASCII Table in Appendix B.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

The PORT command determines which COM port is affected by the ERRBAD command.

Example:

```
ERRBAD13,0,0,0   ; Place a carriage return only in the output buffer after
                 ; processing an erroneous command
```

ERRDEF Program Definition Prompt

		Product	Rev
Type	`Communication Interface`	GT6K	6.0
Syntax	`<!>ERRDEF<i>,<i>,<i>,<i>`	GV6K	6.0
Units	`n/a`		
Range	`i = 0 - 256`		
Default	`13,10,45,32`		
Response	`ERRDEF: *ERRDEF13,10,45,32`		
See Also	`BOT, END, EOT, ERRBAD, ERRLVL, ERROK, PORT, XONOFF`		

The ERRDEF command designates the characters to be placed into the output buffer after a DEF has been entered. Up to 4 characters can be placed in the output buffer. These characters will continue to be placed into the output buffer after each command, until the END command is processed. The characters are designated with their ASCII equivalent. For example, a carriage return is ASCII 13, a line feed is ASCII 10, a hyphen is ASCII 45, a space is ASCII 32, and no terminating character is designated with a zero. For a more complete list of ASCII equivalents, refer to the ASCII Table in Appendix B.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

The PORT command determines which COM port is affected by the ERRDEF command.

Example:

```
ERRDEF13,0,0,0   ; Place a carriage return only in the output buffer after each
                 ; command in the program definition
```

ERRLVL Error Detection Level

		Product	Rev
Type	`Error Handling`	GT6K	6.0
Syntax	`<a_><!>ERRLVL<i>`	GV6K	6.0
Units	`i - error level settings`		
Range	`i = 0, 1, 2, 3, or 4`		

Default	`4 if COM port is set up for RS-232C;`
	`0 if COM port is set up for RS-485`		

Response	`ERRLVL: *ERRLVL4`		
See Also	`BOT, EOL, EOT, ERRBAD, ERRDEF, ERROK, PORT`		

The ERRLVL command has options which allow you to include or exclude certain elements of the response from the Gem6K (see table below). The PORT command determines which COM port is affected by the ERRLVL command.

Overview:

- **When you enter or send a command:**
  Under factory default conditions (error detection level 4, selected with the ERRLVL4 command), after you type a command and press the ENTER key, or send a command via the COM6SRVR communications server, the Gem6K responds as follows:
  - If an error is **not** detected, the ERROK characters are transmitted. The default ERROK transmission characters are (in order of transmission): carriage return, line feed, “>” prompt, and space.
  - If an error is detected, the following is transmitted (in this order):
    1. BOT (beginning of transmission) characters. The default BOT transmission is no characters.
    2. Carriage return
    3. Line feed
    4. Asterisk (*)
    5. Error message (if there is one corresponding to the error) — see list on page 11.
    6. EOT (end of transmission) characters. The default EOT transmission is a carriage return.
    7. ERRBAD characters. The default ERRBAD transmission characters are (in order of transmission): carriage return, line feed, “?” prompt, and space.

- **Soliciting information and checking responses:**
  In each command description, there is a “Response” field that identifies the potential response(s) given when the command is executed. For example, parameter-based commands may be executed without parameters to report the current configuration; *transfer* commands may be executed to report certain status conditions. Under factory default conditions (ERRLVL4), and if no error is detected, the response characters are transmitted in the following order:
    1. BOT (beginning of transmission) characters. The default BOT transmission is no characters.
    2. Asterisk (*) immediately preceding the response text.
    3. Response text.
    4. EOT (end of transmission) characters. The default EOT transmission is a carriage return. If the response comprises more than one line (e.g., TASF has a multi-line response), the EOL (end of line) characters are placed at the end of each line, except for the last line—EOT characters are always placed at the end of the last line. The default EOL characters are carriage return and line feed.
    5. ERROK characters. Default characters are: carriage return, line feed, “>” prompt, and space.

Customizing the Gem6K response:

Using the factory default error level, ERRLVL4, the Gem6K uses all available response characters. The ERRLVL command has additional options which allow you to include or exclude certain elements of the response (refer also to the table below):

- BOT, EOL, and EOT characters (these characters are always transmitted when no error is detected).
- An asterisk (*), transmitted at the beginning of each line of the Gem6K's response (e.g., *ERRLVL4).
- The query or status command that was entered (echoed back as a confirmation). For example, to check the error level setting, type in the ERRLVL command with no parameters; the Gem6K responds with *ERRLVL4 if it is set to error level 4.
- ERROK character(s) transmitted when no error is detected, and whenever you press the ENTER key.
- ERRBAD character(s) transmitted when an error is detected. Default is the "?" character.
- Error message (see page 11).

	Characters when no error is detected						Characters when an error is detected				
	BOT	EOT	EOL	*	Command	ERROK	BOT	EOT	EOL	ERRBAD	Error Msg.
ERRLVL4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ERRLVL3	✓	✓	✓	✓	✓	✓				✓	
ERRLVL2	✓	✓	✓	✓	✓						
ERRLVL1	✓	✓	✓	✓							
ERRLVL0 *	✓	✓	✓								

Example:

The examples below show the Gem6K's response to the TAS status command under all five ERRLVL settings. The factory default BOT, EOT, EOL, and ERROK characters (noted above) are used. The printed characters are shown in **bold text**, and the non-printing characters are represented as follows:

- Carriage return ...... <cr>
- Line feed .... <lf>
- Space .... <sp>

◆ ERRLVL4 and ERRLVL3 (no difference between these two settings):

```
*TAS0000_0000_0000_1000_0000_0001_0000_0000<cr><lf>
*    0000_0000_0000_1000_0000_0001_0000_0000<cr>
<cr><lf>
> <sp>
```

◆ ERRLVL2:

```
*TAS0000_0000_0000_1000_0000_0001_0000_0000<cr><lf>
*    0000_0000_0000_1000_0000_0001_0000_0000<cr>
```

◆ ERRLVL1:

```
*0000_0000_0000_1000_0000_0001_0000_0000<cr><lf>
*0000_0000_0000_1000_0000_0001_0000_0000<cr>
```

◆ ERRLVL0:

```
0000_0000_0000_1000_0000_0001_0000_0000<cr><lf>
0000_0000_0000_1000_0000_0001_0000_0000<cr>
```

ERROK Good Prompt

Type	Communication Interface
Syntax	<a_><!>ERROK<i>,<i>,<i>,<i>
Units	n/a
Range	i = 0 - 256
Default	13,10,62,32
Response	ERROK: *ERROK13,10,62,32
See Also	ERRBAD, ERRDEF, ERRLVL, PORT, XONOFF

Product	Rev
GT6K	6.0
GV6K	6.0

The ERROK command designates the characters to be placed into the output buffer after a command has been entered correctly. Up to 4 characters can be placed in the output buffer. These characters serve as a prompt for the next command. The characters are designated with their ASCII equivalent. For example, a carriage return is ASCII 13, a line feed is ASCII 10, a greater than symbol is ASCII 62, a space is ASCII 32, and no terminating character is designated with a zero. For a more complete list of ASCII equivalents, refer to the ASCII Table in Appendix B.

The ERROK characters are not transmitted when you send an immediate command (e.g., !TPE) to the product (or task) while it is executing a program.

NOTE: ASCII 256 transmits nothing. ASCII 256 transmits a null ASCII zero character, which is typically used to create a null terminated string in a C language.

The PORT command determines which COM port is affected by the ERROK command.

Example:

```
ERROK13,0,0,0    ; Place a carriage return only in the output buffer after
                 ; processing a valid command
```

ERROR Error-Checking Enable

Type	Error Handling
Syntax	<a_><!><%>ERROR<b><b>...<b><b> (32 bits)
Units	n/a
Range	b = 0 (disable), 1 (enable), or X (don't change)
Default	0
Response	ERROR: *ERROR0000_0000_0000_0000_0000_0000_0000_0000
	bit 1 ↑ ↑ bit 32
See Also	[ASX], DSTALL, [ER], ERRORL, ERRORP, ESTALL, GOWHEN, INFNC, K, KIOEN, LH, LS, S, TASX, TER, TRGFN

Product	Rev
GT6K	6.0
GV6K	6.0

When an error-checking bit is enabled (ERROR11...11), the operating system will respond to a specific execution error by doing a GOSUB or a GOTO to the error program assigned with the ERRORP command (see table below). Each bit corresponds to a different error condition. To enable or disable a specific bit, the syntax is ERROR.n-b, where “n” is the error bit number and “b” is either 1 to enable or Ø to disable.

MULTI-TASKING

If you are operating multiple tasks, be aware that you must enable error conditions (ERROR) and specify an error program (ERRORP) for each task (e.g., 2%ERROR.2-1 and 2%ERRORP FIX for Task 2). Each task has its own error status register (reported with ER, TER, and TERF).

Bit #	**Function** (Error bits 13, 15, 17, 19 – 22, and 25 – 32 are reserved.)	**Branch Type**
1*	Stall Detected: Functions when stall detection is enabled with ESTALL (encoder stall detection) or DSTALL (drive stall detection), and Kill on Stall is enabled (ESK1).	GOSUB
2	Hard Limit Hit: When an input is defined as an end-of-travel input (LIMFNCi-R or INFNCi-R; LIMFNCi-S or INFNCi-S), and that input becomes active. Hard limits must be enabled (LH3).	GOTO if COMEXLØ; GOSUB if COMEXL1
3	Soft Limit Hit: Functions when soft limits are enabled (LS3).	GOTO if COMEXLØ; GOSUB if COMEXL1
4	Drive Fault: Detected only if the drive is enabled (DRIVE1).	GOTO

5	Commanded Kill or Commanded Stop (a K, !K, <ctrl>K, S, or !S command is sent).
	NOTE
	If you want the program to stop, you must issue the !HALT command.
		!K = GOTO;
		!S = GOTO if COMEXSØ;
		!S = GOSUB if COMEXS1, but need !C

6	Kill Input: When an input is defined as a KILL input (INFNCi-C), and that input becomes active.	GOTO
7	User Fault Input: When an input is defined as a user fault input (INFNCi-F), and that input becomes active.	GOTO
8	Stop Input: When an input is defined as a stop input (INFNCi-D), and that input becomes active.	GOTO
9	Enable input is activated (not grounded). See also TINO bit #6.	GOTO
10	Pre-emptive (on-the-fly) GO or registration move profile not possible at the time of attempted execution.	GOSUB
11 **	Target Zone Settling Timeout Period (set with the STRGTT command) is exceeded.	GOSUB
12 **	Maximum Position Error (set with the SMPER command) is exceeded.	GOSUB
14	GOWHEN condition already true when a subsequent GO, FSHFC, or FSHFD command is executed.	GOSUB
16	Bad command detected (bit is cleared with TCMDER command).	GOSUB
18	Cable to an expansion I/O brick is disconnected, or power to the I/O brick is lost; error is cleared by reconnecting the I/O brick (or restore power to the I/O brick) and issuing the ERROR.18-0 command and then the ERROR.18-1 command. (Multi-tasking: This condition also kills all tasks.)	GOTO if KIOEN1 GOSUB if KIOENØ
23	Ethernet Client connection error.	GOSUB
24	Ethernet Client polling error.	GOSUB

* Stepper axes only; ** Servo axes only

Example: Refer to the Error Program Assignment (ERRORP) command example.

ERRORL Error Log Selection

		Product	**Rev**
Type	Error Handling	GT6K	6.0
Syntax	<a_><!><%>ERRORL<b><b>...<b><b> (32 bits)	GV6K	6.0
Units	n/a		
Range	b = 0 (disable), 1 (enable), or X (don't change)		
Default	0		

Response
```
ERRORL:  *ERRORL0000_0000_0000_0000_0000_0000_0000_0000
         bit 1 ─┘                                    └─ bit
32
```

See Also [ASX],CERRLG, DSTALL, [ER], ERROR, ESTALL, GOWHEN, INFNC, K, KIOEN, LH, LS, S, TASX, TER, TERF, TERRLG, TRGFN

Use the ERRORL command to choose the conditions that will be included in the error log. When an error log bit is enabled (ERRORL11...11), the operating system will respond to a specific execution error by making an entry in the error log. Each bit corresponds to a different error condition (see table below). To enable or disable a specific bit, the syntax is ERRORL.n-b, where "n" is the error bit number and "b" is either 1 to enable or Ø to disable.

Use the TERRLG command to view the error log. Use the CERRLG command to clear the error log.

NOTE: After an error event occurs and the drive updates the error log, bits may still be recorded in TAS or TASX for another 120 milliseconds. To find all possible causes of an error event, examine TAS and TASX in addition to viewing the error log.

Bit #	Function
1*	Stall Detected: Functions when stall detection is enabled with ESTALL (encoder stall detection) or DSTALL (drive stall detection), and Kill on Stall is enabled (ESK1).
2	Hard Limit Hit: When an input is defined as an end-of-travel input (LIMFNCi-R or INFNCi-R; LIMFNCi-S or INFNCi-S), and that input becomes active. Hard limits must be enabled (LH3).
3	Soft Limit Hit: Functions when soft limits are enabled (LS3).
4	Drive Fault: Detected only if the drive is enabled (DRIVE1).
5	RESERVED
6	RESERVED
7	User Fault Input: When an input is defined as a user fault input (INFNCi-F), and that input becomes active.
8	RESERVED
9	RESERVED
10	Pre-emptive (on-the-fly) GO or registration move profile not possible at the time of attempted execution.
11 **	Target Zone Settling Timeout Period (set with the STRGTT command) is exceeded.
12 **	Maximum Position Error (set with the SMPER command) is exceeded.
13	RESERVED
14	GOWHEN condition already true when a subsequent GO, FSHFC, or FSHFD command is executed.
15-32	RESERVED

* Stepper axes only; ** Servo axes only

NOTE: ERRORL bits 5, 6, 8, 9, 13, 15 – 32 are reserved.

ERRORP Error Program Assignment

Type	Error Handling
Syntax	<a_><!><%>ERRORP<t>
Units	t = text (name of error program)
Range	Text name of 6 characters or less
Default	n/a
Response	ERRORP: *ERRORPerr1
See Also	[ER], ERRLVL, ERROR, TER

Product	Rev
GT6K	6.0
GV6K	6.0

Using the ERRORP command, you can assign any previously defined program as the error program. For example, to assign a previously defined program named CRASH as the error program, enter the ERRORP CRASH command. If you later decide not to have an error program, issue the ERRORP CLR command; after the ERRORP CLR command, no error program will be called until you assign a new one.

The purpose of the error program is to provide a programmed response to certain error conditions (see table below) that may occur during the operation of your system. Programmed responses typically include actions such as shutting down the drive, activating or de-activating outputs, etc. To detect and respond to the error conditions, the corresponding error-checking bit(s) must be enabled with the ERROR command (refer to the *ERROR Bit #* column in the table below). It is the programmer's responsibility to determine the cause of the error, and take action based on the error. The error condition can be determined using the ER evaluation in an IF statement (e.g., IF(ER=b1ØX)). An error program set-up example is provided in the *Programmer's Guide*.

When an error condition occurs and the associated error-checking bit has been enabled with the ERROR command, the Gem6K will branch to the error program. Depending on the error condition, the branch may be either a GOTO or GOSUB. If the error condition calls for a GOSUB, then after the ERRORP program is executed, program control returns to the point at which the error occurred. If you do not want to return to the point at which the error occurred, you can use the HALT command to end program execution or you can use the GOTO command to go to a different program. If the error condition calls for a GOTO, there is no way to return to the point at which the error occurred.

MULTI-TASKING

If you are operating multiple tasks, be aware that you must enable error conditions (ERROR) and specify an error program (ERRORP) for each task (e.g., 2%ERROR.2-1 and 2%ERRORP FIX for Task 2). Each task has its own error status register (reported with ER, TER, and TERF).

The ERRORP assignment is not saved in battery-backed RAM. To ensure that the ERRORP assignment is retained when you cycle power or issue a RESET command, put the ERRORP command in the *startup* program assigned with the STARTP command.

WHEN TO BRANCH

If you wish the branch to the error program to occur at the time the error condition is detected, use the continuous command execution mode (COMEXC1). Otherwise, the branch will not occur until motion has stopped.

Canceling the Branch to the Error Program: The error program will be continuously called/repeated until you cancel the branch to the error program. (This is true for all cases except error condition #9, enable input activated, in which case the error program is called only once.) There are three ways to cancel the branch:

- Disable the error-checking bit with the ERROR.n-0 command, where "n" is the number of the error-checking bit you wish to disable. For example, to disable error checking for the kill input activation (bit #6), issue the ERROR.6-0 command. To re-enable the error-checking bit, issue the ERROR.n-1 command.
- Delete the program assigned as the ERRORP program (DEL <name of program>).
- Satisfy the *How to Remedy the Error* requirement identified in the table below.

NOTE

In addition to canceling the branch to the error program, you must also remedy the cause of the error; otherwise, the error program will be called again when you resume operation. Refer to the *How to Remedy the Error* column in the table below for details.

ERROR Bit #	Cause of the Error	Branch Type to ERRORP	How to Remedy the Error
1	Stepper axes only: Stall detected (Stall Detection and Kill On Stall must be enabled first—see ESTALL or DSTALL, respectively—and ESK1 enabled)	Gosub	Issue a GO command.
2	Hard Limit Hit. An input defined as an end-of-travel input (LIMFNC or INFNC) became active. Hard limits must be enabled (see LH).	If COMEXLØ, then Goto; If COMEXL1, then Gosub	Change direction & issue GO command; or issue LHØ.
3	Soft Limit Hit (soft limits must be enabled first—see LS)	If COMEXLØ, then Goto; If COMEXL1, then Gosub	Change direction & issue GO command; or issue LSØ.
4	Drive Fault (Detected only if drive enabled – DRIVE1).	Goto	Check the cause with TASX, remedy the fault condition, then issue a DRIVE1 command.

5	Commanded Stop or Kill (whenever a K, !K, <ctrl>K, S, or !S command is sent) — See "Commanded Kill or Stop" note below.	If !K, then Goto;
		If !S & COMEXSØ, then Goto;
		If !S & COMEXS1, then Gosub, but need !C
			No fault condition is present—there is no error to clear
			If you want the program to stop, you must issue the !HALT command.

6	Kill Input Activated (see INFNCi-C)	Goto	Deactivate the kill input.
7	User Fault Input Activated (see INFNCi-F)	Goto	Deactivate the user fault input, or disable it by assigning it a different INFNC function.
8	Stop Input Activated (see INFNCi-D)	Goto	Deactivate the stop input, or disable it by assigning it a different INFNC function.
9	Enable input not grounded	Goto	Re-ground the enable input, and issue a DRIVE1 command.
10	Pre-emptive (on-the-fly) GO or registration move profile not possible at the time of attempted execution.	Gosub	Issue another GO command.
11	GV6K Only: Target Zone Timeout (STRGTT value has been exceeded).	Gosub	Issue these commands in this order: STRGTEØ, DØ, GO, STRGTE1
12	GV6K Only: Exceeded Max. Allowable Position Error (set with the SMPER command).	Gosub	Issue a DRIVE1 command. Verify that feedback device is working properly.
14	GOWHEN condition already true when GO, FSHFC, or FSHFD executed.	Goto	Issue another GOWHEN command; or issue a !K command and check the program logic (use the TRACE and STEP features if necessary).
16	Bad command detected.	Gosub	Issue the TCMDER command.
18	Expansion I/O brick disconnected, or lost power. (Multi-tasking: This condition also kills all tasks.)	Goto if KIOEN1 Gosub if KIOEN0	Reconnect I/O brick or restore power. Then issue ERROR.18-0 and then ERROR.18-1.
23	Ethernet Client connection error.	Gosub	Clear the error bit (ERROR.23-0), then re-establish the Ethernet connection, and then issue ERROR.23-1.
24	Ethernet Client polling failed.	Gosub	Clear the error bit (ERROR.24-0), then re-establish the Ethernet connection, and then issue ERROR.24-1.

Reserved Bits: Bits 13, 15, 17, 19-22, and 25-32 are reserved.

Branching Types: If the error condition calls for a GOSUB, then after the ERRORP program is executed, program control returns to the point at which the error occurred. If you do not want to return to the point at which the error occurred, you can use the HALT command to end program execution or you can use the GOTO command to go to a different program. If the error condition calls for a GOTO, there is no way to return to the point at which the error occurred.

Commanded Kill or Stop: When ERROR bit 5 is enabled (ERROR.5-1), a Stop (S or !S) or a Kill (K, !K or <ctrl>K) command will cause the Gem6K to branch to the error program. Note, however, that this error condition does not set an error bit (ER), because there is no way to clear the error condition upon leaving the error program. Therefore, you should use the IF(ER=b00000000000000000000000000000000) statement in your error program to determine if the cause of the error was a commanded kill or stop (i.e., if no error bits are set).

Example:

```
DEF err1      ; Define error program err1
IF(ER=b01)    ; If the error is a hard limit, send a message & stop program execution
WRITE"Hard Limit Hit"  ; Write Hard Limit Hit message
HALT          ; Terminate program execution
NIF           ; End IF statement
IF(ER=b0X1)   ; If error is soft limit, back off soft limit, reset position, & continue
D~            ; Change direction in preparation to back off the soft limit
D1            ; Set distance to 1 step (just far enough to back off the soft limit)
GO1           ; Initiate the 1-step move to back off the soft limit
PSET0         ; Reset the position to zero
NIF           ; End IF statement
END           ; End definition of error program err1
ERRORP err1   ; Set error program to err1. Branch to err1 upon hitting a hard or soft limit
ERROR01100000 ; Set error condition bits to look for hard limit or a soft limit
```

ESDB Stall Backlash Deadband

Type	`Encoder Configuration`
Syntax	`<a_><!>ESDB<i>`
Units	`i = motor steps`
Range	`0 - 99,999,999`
Default	`0`
Response	`ESDB:    *ESDB0`
See Also	`[ AS ], DRES, ERES, ESK, ESTALL, TAS`

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `ESDB` command establishes the number of motor steps that a move will travel after a change in direction before stall detection is initiated. If there is no change in direction, the stall backlash deadband value will not be used to determine if there is a stall condition. To use the stall backlash deadband, encoder-based stall detection (`ESTALL`) must be enabled.

A stall condition will be recorded by bit 12 of the axis status register. The `TAS` command can be used to get the axis status response.

Example: Refer to the enable stall detect (`ESTALL`) command example.

ESK Kill on Stall

Type	`Encoder Configuration`
Syntax	`<a_><!>ESK<b>`
Units	`b = enable bit`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`ESK:    *ESK0`
See Also	`DRES, DRIVE, DSTALL, ERES, ESDB, ESTALL, TAS, TASX, TER`

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `ESK` command enables/disables the Kill-on-Stall feature. With Kill-on-Stall enabled, if the Gem6K detects an encoder stall (`ESTALL`) or a drive stall (`DSTALL`), it will immediately stops pulses from being sent to the motor. Stall detection must be enabled (with the `ESTALL` command or the `DSTALL` command) before the `ESK` command will have any affect.

For further details and programming examples on *Encoder Stall Detection*, refer to `ESTALL`.
For further details and programming examples on *Drive Stall Detection*, refer to `DSTALL`.

ESTALL Encoder-Based Stall Detection

Type	`Encoder Configuration`
Syntax	`<a_><!>ESTALL<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`ESTALL: *ESTALL0`
See Also	`[ AS ], DRES, DSTALL, ENCCNT, [ ER ], ERES, ESDB, ESK, TAS, TER`

Product	Rev
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `ESTALL` command determines if encoder-based stall conditions will be checked. (For information about *Drive Stall Detection*; which does not require an encoder, refer to the `DSTALL` command.)

NOTE: Encoder count reference must be enabled (`ENCCNT1`) before encoder stall detect (`ESTALL`) can be used.

A stall condition will occur if the actual number of encoder counts received is less than expected for each motor step output segment. The number of encoder counts expected is determined by dividing the encoder resolution (`ERES`) by 100. The motor step output segment is determined by dividing the drive resolution (`DRES`) by 50.

For example, given an encoder resolution (`ERES`) of 4000 and a drive resolution (`DRES`) of 25000, the number of encoder counts expected for each motor step output segment = $\frac{4000}{100} = 40$. The motor step output segment = $\frac{25000}{50} = 500$. Therefore, during a move, after every 500 motor steps are sent out, the drive checks to see if it received 40 encoder counts. If it did, then everything is O.K. If not, then a stall condition exists.

To accurately detect a stall, the drive resolution (`DRES`) and the encoder resolution (`ERES`) must be properly set.

When a stall is detected, the GT6K responds as follows:

- The stall is reported with Axis Status bit #12 (reported with `TAS`, `TASF`, and `AS`).
- The stall is reported with Extended Axis Status bit #17 (reported with `TASX`, `TASXF`, and `ASX`).
- If error-checking bit #1 is enabled (`ERROR.1-1`):
  - The stall is reported with Error Status bit #1 (reported with `TER`, `TERF`, and `ER`).
  - The GT6K branches to the assigned `ERRORP` program.
- If the Kill-on-Stall feature is enabled (`ESK1`), the GT6K immediately stops pulses from being sent to the motor. If Disable Drive on Kill is enabled (`KDRIVE1`) it disables the drive.

Example:

```
SCALE0           ; Disable scaling
DEL proga        ; Delete program called proga
DEF proga        ; Begin definition of program called proga
DRES25000        ; Drive resolution set to 25000 steps/rev
ERES4000         ; Encoder resolution is 4000 post-quadrature counts/rev
ESDB10           ; Stall backlash set to 10 commanded counts
ENCCNT1          ; Enable encoder count reference mode
ESTALL1          ; Enable stall detection
ESK1             ; Enable kill on stall
MA0              ; Incremental positioning mode
MC0              ; Preset positioning mode
A10              ; Set the acceleration to 10 units/sec/sec
V1               ; Set the velocity to 1 unit/sec
D100000          ; Set the distance to 100000 units
GO1              ; Initiate motion
                 ; The motor will move 100000 commanded counts (4 revs)
                 ; (If, at any time during the move the actual encoder count falls
                 ; behind, a stall condition will be flagged, and motion will stop.)
END              ; End definition of proga
```

EXE Execute a Program From a Compiled Program

		Product	Rev
Type	`PLC Scan Program`	GT6K	6.0
Syntax	`i%EXEt`	GV6K	6.0

Units	`i = Task Number`
	`t = Program Name (6 characters or less)`		

Range	`i = 1-10`		
Default	`n/a`		
Response	`n/a`		
See Also	`INSELP, PCOMP, PEXE, PLCP, SCANP`		

Use the EXE command to start a standard (non-compiled) program from within a compiled PLCP program. The EXE command specifies the name of the program, and the task in which it will be launched. The program named in the EXE command need not be defined at the time the PLCP program is compiled; however, the program must be defined before the SCANP or PRUN is issued. If no task number is assigned with a % prefix, then the task in which the PLCP program is compiled (PCOMP) will be the task that runs the program. Note, however, that the EXE program cannot be executed in the Task Supervisor (task 0).

When a PLCP program performs an EXE command, SS bit 28 ("PROGRAM PENDING") will be set in the task specified by EXE command. When background task swapping allows the program to actually start running, SS.28 will be cleared and SS bit 3 ("PROGRAM EXECUTING") will be set. If a PLCP program performs an EXE command with either of these bits set, the new program will not run, and SS bit 32 ("EXE FAILED") will be set. SS.32 will be cleared upon the next successful EXE directed to that task. Because the PLCP program ignores the EXE command if a currently running program is detected within the specified task, the EXE command can only be used to initiate a new program if the task is not already running a program.

Like the INSELP command, the program launched by the EXE command will not interrupt a currently running program, nor will it interrupt a WAIT or T command.

CAUTION: Using the SCANP command to run a PLCP program in Scan mode will cause the PLCP program to execute as often as every system update period (2 ms). An EXE command used within a PLCP program running in Scan mode could therefore attempt to launch a program in the specified task as often as every 2 ms. This may not allow enough time for the program launched in the specified task by the EXE command to complete before the same EXE command is issued again. As stated, the PLCP program will ignore the EXE command if a currently running program is detected, so timing must be considered when launching programs with the EXE command.

To execute a compiled program from within a compiled PLCP program, use the PEXE command.

Example:

```
DEF PLCP1        ; Define PLC program PLCP1
IF(IN.1=b1)      ; If input 1 is active
3%EXE PROG1      ; Launch program PROG1 in Task 3
ELSE
2%EXE PROG2      ; Otherwise launch program PROG2 in Task 2
NIF
END

PCOMP PLCP1      ; Compile PLCP1
SCANP PLCP1      ; Scan with program PLCP1
```

[FB] Value of Current Feedback Device

Type	`Servo; Assignment or Comparison`
Syntax	`See below`
Units	`See below`
Range	`See below`
Default	`n/a`
Response	`n/a`
See Also	`GOWHEN, [ PE ], PSET, SCALE, SCLD, SFB, TFB,`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `FB` operator to assign the value of the selected feedback device to a variable or to make a comparison. Depending on the configuration of the `SFB` command, the feedback device could be an encoder or a resolver.

If you issue a `PSET` command, the feedback device position value will be offset by the `PSET` command value.

If scaling is **not** enabled, the position values returned will be encoder or resolver counts. If scaling is enabled (`SCALE1`), the encoder or resolver values will be scaled by the `SCLD` value. For more information on scaling, refer to page 16.

Syntax: `VARn=FB` where `n` is the variable number, or `FB` can be used in an expression such as `IF(FB<6)`.

Example:

```
SFB1              ; Feedback is encoder
VAR6=FB           ; Assign position (scalable) of encoder to variable #6
IF(FB<500)        ; If position (scalable) of encoder is less than 500,
                  ; do the commands following the IF statement until the NIF command
VAR4=FB+1000      ; Set variable #4 equal to current position of encoder plus 1,000
NIF               ; End of IF statement
```

FFILT Following Filter

Type	`Following`	
Syntax	`<a_><!>FFILT<i>`	
Units	`i = filtering level`	
Range	`i = 0, 1, 2, 3, or 4`	
Default	`0`	
Response	`FFILT`	`*FFILT0`
See Also	`FMAXA, FMAXV, FPPEN`	

Product	Rev
GT6K	6.0
GV6K	6.0

The `FFILT` command specifies the bandwidth of the low pass filter applied to the measurements of master position. This command is to be used in these situations:

- Measurement of master position is contaminated by either electrical noise (when analog input is the master) or mechanical vibration.
- Measurement noise is minimal, but the motion that occurs on the master input is oscillatory. In this case, using the filter can prevent the oscillatory signal from propagating into the follower axis (i.e., ensuring smoother motion on the follower axis).

The table below shows how the value of the `FFILT` command specifies the low pass filter's bandwidth:

`FFILT` Setting	Low pass Filter Bandwidth
0	∞ (no filtering) – *default setting*
1	120 Hz
2	80 Hz
3	50 Hz
4	20 Hz

Example:

```
FFILT1         ; Set filtering bandwidth to 120 Hz
```

FGADV Following Geared Advance

Type	Following
Syntax	<a_><!>FGADV<r>
Units	r = advance distance (scalable)
Range	0.00000-999,999,999 (scalable with SCLD)
Default	n/a
Response	n/a
See Also	FOLMD, FOLRD, FOLRN, [FS], FSHFD, GOWHEN, SCLD, TFS

Product	Rev
GT6K	6.0
GV6K	6.0

The FGADV command provides the ability to superimpose an advance or retard on Following motion. This is the same ability provided by the FSHFD command, except that the superimposed motion is also geared to master motion. The FGADV command has the positive or negative "advance" distance as a parameter, but it initiates motion instead of simply setting up the distance. The shape of the superimposed profile is determined by the FOLMD, FOLRN, and FOLRD commands (just as a normal preset Following move).

The FGADV command profile may be delayed with the GOWHEN command.

A FGADV move may be performed only while the conditions below exist (Following status bit #23, reported with the FS, TFS, and TFSF commands, indicates that it is "OK to do FGADV move"):

- Master is specified with a FOLMAS command
- Following is enabled with the FOLEN command
- The follower axis is either not moving, or moving at constant ratio in continuous mode (MC1)

A FGADV move may not be performed:

- During a preset (MC0) move
- In a compiled profile or program

Following Status (FS, TFS, and TFSF) bit #24 reports if a "FGADV move is underway".

Example:

```
COMEXC1             ; All command processing during motion
FOLRN25             ; Set numerator of follower-to-master Following ratio
FOLRD10             ; Set denominator of follower-to-master Following ratio
FOLMD1000           ; Set master distance to 1000 units
MC1                 ; Enable continuous positioning mode
D+                  ; Set direction to positive
FOLEN1              ; Enable Following
GO                  ; Ramp up to a 2.5 to 1 ratio over 1000 master distance units
FOLMD500            ; Set master distance to 500 units
FOLRN13             ; Superimposed ratio will be 1.3 (added to 2.5 = 3.8 total)
WAIT(FS.23=B1)      ; Wait for OK to do geared advance
                    ; (in this case, ramp is complete)
FGAVD400            ; Advance the follower axis 400 counts over a distance
                    ; of 500 master counts
WAIT (FS.23=B1)     ; Wait for OK to do geared advance
                    ; (in this case, FGADV400 superimposed profile is complete)
FGADV-400           ; Retard the follower axis 400 counts over a distance of
                    ; 500 master counts (2.5 - 1.3 = 1.2 net ratio)
```

FLTDSB Fault on Drive Disable (DRIVE0)

Type	Drive Configuration
Syntax	<a_><!>FLTDSB<b>
Units	b = enable bit
Range	0 (disable) or 1 (enable)
Default	1
Response	FLTDSB: *FLTDSB1
See Also	DRIVE, TAS, TASX, TER

Product	Rev
GT6K	6.0
GV6K	6.0

Use the FLTDSB command to enable/disable the Fault on Drive Disable mode. If Fault on Drive Disable is enabled (FLTDSB1 – the default setting), and the drive is disabled via the DRIVE0 command or the "Enable" input (pin 1 on the DRIVE I/O connector), any output configured as a fault output is activated and the dry contact relay (labeled "RELAY COM" and "RELAY N.O." on the 4-pin removable connector) is opened.

FMAXA Follower Axis Maximum Acceleration

Type	`Following`
Syntax	`<a_><!>FMAXA<r>`
Units	`r = units/sec/sec`
Range	`r = 0.00001 - 39,999,998 (scalable with SCLA)`
Default	`0.00 (no limit imposed)`
Response	`FMAXA    *FMAXA0.0000`
See Also	`[ FS ], FFILT, FMAXV, FPPEN, SCLA, TFS, TFSF`

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `FMAXA` command sets the maximum acceleration for follower axes. The `FMAXA` command is scaled by the `SCLA` parameter.

As part of a ramp to new ratio, or simply following an accelerating master at constant ratio, a follower may be required to accelerate. If the required acceleration is larger than `FMAXA`, the follower will begin falling behind its commanded position. The Gem6K drive will attempt to make up this position error as soon as the commanded accel falls below `FMAXA`. In controlling stepper motors, the Gem6K adds an error correction velocity to that implied by the commanded ratio.

As with `FMAXV`, `FMAXA` should be determined and defined early in the development stage of an application to prevent any damage to the load on the follower axis when unexpectedly high accelerations are commanded. The torque available from the follower motor will also be a determining factor in this parameter in order to prevent motor stalls.

Following status bit #26 (see `TAS`, `TASF`, `FS`) is set while `FMAXA` or `FMAXV` is limiting the present Following profile.

Example:

```
FMAXA75      ;Set maximum follower acceleration to 75 user units.
```

FMAXV Follower Axis Maximum Velocity

Type	`Following`
Syntax	`<a_><!>FMAXV<r>`
Units	`r = units/sec (scalable with SCLV)`
Range	`r = 0.000000-1600000.000000`
Default	`0.00 (no limit imposed)`
Response	`FMAXV    *FMAXV0.0000`
See Also	`[ FS ], FFILT, FMAXA, FPPEN, SCLV, TFS, TFSF`

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable only to stepper axes)

The `FMAXV` command sets the maximum velocity at which follower axes may travel. The `FMAXV` command accepts numeric variables (`VAR`) as an argument and is scaled by the `SCLV` parameter.

Normally in a Following application, the follower velocities will be known based on the normal speed of the master and the commanded Following ratios (`FOLRN` and `FOLRD`). In some cases, however, the master speed may be higher than normal, the follower may be commanded to perform a shift move, or some other event may occur which will cause the follower to travel at a velocity higher than expected. In these cases, the Gem6K drive will increase the speed of the follower as necessary to perform the required move, but only up to the `FMAXV` value.

If the commanded speed is higher than `FMAXV`, the follower axis will start falling behind its commanded position. The Gem6K drive will attempt to make up this position error as soon as the commanded speed falls below `FMAXV`. In controlling stepper motors, the Gem6K automatically adds an error correction velocity to that implied by the commanded ratio.

The `FMAXV` value should be determined and defined early in the development stage of an application to prevent any damage to the load on the follower axis when unexpectedly high velocities are commanded.

Following status bit #26 (see `TAS`, `TASF`, `FS`) is set while `FMAXA` or `FMAXV` is limiting the present Following profile.

Example:

```
FMAXV15          ;Set the follower maximum velocity to 15 user units
```

FMCLEN Master Cycle Length

		Product	Rev
Type	Following	GT6K	6.0
Syntax	<a_><!>FMCLEN<r>	GV6K	6.0
Units	r = master distance units (scalable)		
Range	r = 0-999,999,999 (scalable with SCLMAS)		
Default	0		
Response	FMCLEN *FMCLEN0		
See Also	FMCNEW, FMCP, FOLEN, [FS], GOWHEN, [PMAS], SCLMAS, TFS, TPMAS, WAIT		

The FMCLEN command defines the length of the master cycle in user units. This value is scaled by the SCLMAS parameter. Numeric variables (VAR) can be used with this command. The initial value for FMCLEN is zero (FMCLENØ), which means that the default master cycle length is the maximum internal size (4,294,967,296).

The concept of a master cycle may be useful when moves or other events must be initiated at certain master positions in a repetitive cycle. By specifying a master cycle length, periodic actions may be programmed in a loop or with subroutines which refer to cycle positions, even if the master runs continuously. You can program the Gem6K drive to suspend program operation or delay moves until specified master cycle positions. The master cycle length, FMCLEN, should be defined before the functions which wait for periodic master cycle positions are used. An axis need not be in Following mode (FOLEN1) to utilize the concept of a master cycle. However, **master positions will not be measured until a master has been assigned with the FOLMAS command.**

Example (refer also to FOLEN example #2)**:**

```
SCLMAS4000          ; Set the master scale factor to 4000
FMCLEN3             ; Set master cycle length to 3 user units
```

FMCNEW Restart Master Cycle Counting

		Product	Rev
Type	Following	GT6K	6.0
Syntax	<a_><!>FMCNEW<b>	GV6K	6.0
Units	n/a		
Range	b = 0 (do not restart) or 1 (restart immediately)		
Default	n/a		
Response	n/a		
See Also	FMCLEN, FMCP, GOWHEN, [NMCY], [PMAS], TPMAS, TRGFN, WAIT		

The FMCNEW1 command restarts master cycle counting. This sets the master cycle position (PMAS) to the value most recently specified with FMCP, and sets the master cycle number (NMCY) to zero. The master cycle position and the master cycle number are set immediately, and program flow continues normally.

The function of the FMCNEW1 command can be initiated with a trigger input by specifying a TRGFNcx1 command. If the FMCNEW1 command is used, master cycle counting is restarted immediately; if TRGFNcx1 is used, the Gem6K drive will record the instruction to set the master cycle position when the specified trigger occurs. In this case, the master cycle counting is restarted when the specified trigger is activated, even though commands continue to execute and the master cycle counting continues.

FMCNEWØ or FMCNEW1 will remove the status of master cycle restart pending a trigger input (TRGFNcx1). In the case of FMCNEWØ, no restart will occur, and the specified trigger will not cause a new cycle restart.

A new cycle automatically occurs (i.e., the master cycle position is set to zero, not the FMCP value), when the master cycle length (FMCLEN) is reached, even if no FMCNEW command has been executed.

Example:

```
TPMAS             ; Display master position: response is *TPMAS12.2
FMCNEW1           ; Start new master cycle
TPMAS             ; Display master position: response is *0
```

FMCP Initial Master Cycle Position

Type	`Following`	**Product**	**Rev**
Syntax	`<a_><!>FMCP<r>`	GT6K	6.0
Units	`r = master position in scalable steps`	GV6K	6.0
Range	`r = ±999,999,999 (scalable with SCLMAS)`		
Default	`0`		
Response	`FMCP    *FMCP+0`		
See Also	`FMCNEW, FOLMAS, [ FS ], GOWHEN, SCLMAS, TFS, WAIT`		

The `FMCP` command defines the initial master cycle position in user units. The initial master cycle position is assigned as the current master cycle position each time master cycle counting is restarted with the `FMCNEW` or `TRGFNcx1` command. This value is scaled by the `SCLMAS` parameter. Numeric variables (`VAR`) can be used with this command. The default value for `FMCP` is zero (`FMCPØ`), which means that the master cycle position will be zero when master cycle counting is restarted (see `FMCNEW`).

The concept of an initial master cycle position may be useful if new master cycle position counting must be restarted at a master position which is different from what needs to be considered the “zero position” of a periodic cycle. The initial position defined with `FMCP` applies to the first cycle only. When a master cycle is complete, the master cycle position rolls over to zero. A negative value would be used if some master travel were desired before master cycle position was zero. A positive value would be used if it was necessary to enter the first master cycle at a position greater than zero.

For example, suppose `FMCLEN` was set to 20 and `FMCP` was set to 7. When master cycle position counting is restarted, either via `FMCNEW1` or the specified trigger (`TRGFNcx1`), the initial master cycle position will be 7. Rollover will occur after the master travels 13 more units, and the master cycle position would go to zero.

Example:

```
FMCP-2           ; Set the initial master cycle position to -2
```

FOLEN Following Mode Enable

Type	`Following`	**Product**	**Rev**
Syntax	`<a_><!>FOLEN<b>`	GT6K	6.0
Units	`n/a`	GV6K	6.0
Range	`b = 0 (disable) or 1 (enable)`		
Default	`0`		
Response	`FOLEN:   *FOLEN0`		
See Also	`FGADV, FOLK, FOLMAS, FOLRD, FOLRN, FOLRNF, [ FS ], FSHFC, FSHFD, GOWHEN, JOG, JOY, TFS`		

The `FOLEN` command indicates whether subsequent moves on the specified axes will be following a master (`FOLEN1`) or normal time-based moves (`FOLEN0`). The term *Following mode* means that `FOLEN1` has been given, and that the motion of the follower is dependent on the motion of the master at all times. If `FOLEN0` is given, the motion of the master is still monitored, but the motion of the follower is independent of the master.

To move in the Following mode, the master must be previously specified with the `FOLMAS` command.

Enabling the Following mode (`FOLEN1`) will set the net position shift value (reported by `TPSHF` and `PSHF`) to zero. This is true even if the follower is already in Following mode.

S-Curve profiling is not operational during Following moves.

RESTRICTIONS ON USING `FOLEN`

The `FOLEN` command may not be executed during certain conditions (results in the error message “`NOT VALID DURING RAMP`”).

- You may not enable Following (`FOLEN1`) on an axis that is in motion, waiting for a `GOWHEN` condition, or operating in the Joystick mode (`JOY1`) or Jog mode (`JOG1`).
- You may not disable Following (`FOLEN0`) on an axis that is in motion (unless moving at ratio in continuous mode, `MC1`, and not shifting) or waiting for a `GOWHEN` condition.

FOLEN Examples

Example #1:

The Gem6K drive is controlling a rotary motor, the master is a 1000-line incremental encoder mounted on the back of an externally controlled motor, and programming units are to be revs/second (rps).

Stepper Products:

The follower will start ramping to a ratio of 1:1 when trigger #1 (TRG-1A) goes active. This means the actual step ratio of follower to master is 25000 to 4000, or 6.25 follower steps for every master. After 25 master revolutions, the follower will decelerate to a 0.5:1 ratio (3.125 follower steps for every master). After a total of 75 master revolutions, the follower will ramp to zero ratio (i.e., stop) and repeat the cycle when trigger #1 is activated. All ramps to new ratios, including zero ratio, take place over one master revolution.

Scaling Set Up: (prior to defining program)

```
SCALE1           ; Enable scaling
SCLD25000        ; Set follower distance scale factor to 25,000 steps/rev
                 ; (assumes a resolution of 25,000 steps/rev)
SCLMAS4000       ; Set master scale factor to 4000 steps/rev
```

Servo Products:

The follower will start ramping to a ratio of 1:1 when trigger #1 (TRG-1A) goes active. This means the actual step ratio of follower to master is 4000 to 4000, or 1 follower steps for every master. After 25 master revolutions, the follower will decelerate to a 0.5:1 ratio (0.5 follower steps for every master). After a total of 75 master revolutions, the follower will ramp to zero ratio (i.e., stop) and repeat the cycle when trigger #1 is activated. All ramps to new ratios, including zero ratio, take place over one master revolution.

Scaling Set Up: (prior to defining program)

```
SCALE1           ; Enable scaling
SCLD4000         ; Set follower distance scale factor to 4,000 steps/rev
                 ; (assumes an encoder resolution of 4,000 steps/rev)
SCLMAS4000       ; Set master scale factor to 4000 steps/rev
```

The application program is defined as follows:

```
DEL FOLTST     ; Delete program called FOLTST
DEF FOLTST     ; Begin definition of program called FOLTST
INFNC1-H       ; Set input #1 (TRG-1A) to be "trigger interrupt" (used with GOWHEN later)
COMEXC1        ; Select continuous command processing mode
MC1            ; Select continuous positioning mode
FOLMAS1        ; Assign master encoder input as master
FOLMD1         ; Follower should change ratios over 1 master revolution
FMCLEN100      ; Set master cycle length to 100 revs
FOLRD1         ; Set follower-to-master Following ratio denominator to 1
               ; (applies to all subsequent FOLRN commands)
FOLEN1         ; Enable Following
D+             ; Set motion to the positive- direction
$STRMV         ; Label to repeat move
TRGFNA1        ; Suspend execution of next move until trigger (TRG-1A) is active
TRGFNAx1       ; Begin new master cycle (counter at 0) when trigger (TRG-1A) is active
FOLRN1         ; Set follower-to-master Following ratio numerator to 1 (ratio set to 1:1)
GO1            ; Start continuous Following move (when TRG-1A is active)
WAIT(AS.26=b0 AND FS.4=b1) ; Wait for profile to actually start
                           ; (when TRG-1A is active) and be at ratio
GOWHEN(PMAS>=25)  ; Suspend execution of next move until master position >= 25
FOLRN0.5       ; Set Following ratio numerator to 0.5 (ratio set to 0.5:1)
GO1            ; Initiate new move according to new Following ratio
               ; (when master position >= 25)
WAIT(AS.26=b0 AND FS.4=b1)  ; Wait for profile to actually start
                            ; (when master position >= 25) and be at ratio
GOWHEN(PMAS>=75)  ; Suspend execution of next move until master position >= 75
FOLRN0         ; Set Following ratio numerator to zero
               ; (ratio causes follower to ramp to stop)
GO1            ; Initiate new move with new Following ratio (when master pos. >= 75)
WAIT(AS.26=b0 AND FS.1=b0)  ; Wait for profile to actually start
               ; (when master position >= 75) and the follower is not moving
JUMP STRMV     ; Repeat the cycle
END            ; End of program
```

Example #2:

Stepper Axes:

The master is an encoder mounted to gearing on a conveyor line. The gearing results in 16,000 encoder steps per conveyor inch. The follower, controlled by the Gem6K, is a 25,000 step/rev microstepper on a 36" long, 4-pitch leadscrew. The follower waits for the product to be sensed on the conveyor, accelerates to a 1-to-1 ratio, waits for a safe location to actuate the stamping equipment, then applies an inked stamp to the product at the correct location. After the stamp is placed, the follower quickly moves back to the starting position and waits for the next product. Note that this example illustrates how the `WAIT` command can be used to wait for master cycle positions in order to coordinate motion.

Scaling Set Up: (prior to defining program)

```
SCALE1          ; Enable scaling
SCLA100000      ; Set accel scaling: 100,000 steps/inch
SCLV100000      ; Set velocity scaling: 100,000 steps/inch
SCLD100000      ; Set follower distance scaling: 100,000 steps/inch
SCLMAS16000     ; Set master scale factor to 16000 steps/inch to program in inches
```

Servo Axes:

The master is an encoder mounted to gearing on a conveyor line. The gearing results in 16,000 encoder steps per conveyor inch. The follower is a 4,000 step/rev servo on a 36" long, 4-pitch leadscrew. The follower waits for the product to be sensed on the conveyor, accelerates to a 1-to-1 ratio, waits for a safe location to actuate the stamping equipment, then applies an inked stamp to the product at the correct location. After the stamp is placed, the follower quickly moves back to the starting position and waits for the next product. Note that this example illustrates how the `WAIT` command can be used to wait for master cycle positions in order to coordinate motion.

Scaling Set Up: (prior to defining program)

```
SCALE1          ; Enable scaling
SCLA16000       ; Set accel scaling: 16,000 steps/inch
SCLV16000       ; Set velocity scaling: 16,000 steps/inch
SCLD16000       ; Set follower distance scaling: 16,000 steps/inch
SCLMAS16000     ; Set master scale factor to 16,000 steps/inch to program in inches
```

The application program is defined as follows:

```
DEF STAMPR           ; Begin definition of program called STAMPR
COMEXS1              ; Continue command execution after Stop
COMEXC1              ; Continue command execution during motion
SCALE1               ; Enable parameter scaling
1OUTFNC1-A           ; Configure onboard output #1 as a general-purpose prog. output
1INFNC2-H            ; Define TRG-1B as trigger interrupt (use as GOWHEN input)
A10                  ; Acceleration = 10 inches/sec/sec
V5                   ; Velocity = 5 inches/sec (non-Following moves)
MA1                  ; Enable absolute positioning mode
FOLMAS1              ; Assign Master encoder input as master
FOLRN1               ; Set follower-to-master Following ratio numerator to 1
FOLRD1               ; Set follower-to-master Following ratio denominator to 1 (ratio is 1:1)
FOLMD1               ; Accel the follower over 1 master inch for Following moves
FMCLEN40             ; Master cycle length is 40 inches
$INKON               ; Label to repeat inking process
FOLEN1               ; Enable Following on axis #1
1TRGFNBx1            ; Begin new master cycle when TRG-1B goes active
                     ; (product sensed on conveyor)
1TRGFNB1             ; Start next move when TRG-1B is active
D+                   ; Set to positive-direction
MC1                  ; Select continuous positioning mode
GO1                  ; Start continuous follower move on trigger #2
WAIT(PMAS>=10.5)      ; Wait until master position is 10.5 inches - this is when the
                       ; stamping device can be actuated without mechanical damage
                       ; to the leadscrew assembly
1OUT.1-1             ; Turn on actuator (output #1) to place ink stamp on product
T.1                  ; Wait for the ink stamp to be pressed in place by a
                     ; stationary stamper
1OUT.1-0             ; Turn off actuator (output #1)
S1                   ; Stop follower move
WAIT(1AS.1=b0)       ; Wait until the axis is not moving
FOLEN0               ; Disable Following
D0                   ; Set distance (position) to zero
```

```
MC0                ; Select preset positioning mode
GO1                ; Move back to zero (the home position)
WAIT(MOV=b0)       ; Wait until the axis is not moving
JUMP INKON         ; Begin cycle again on trigger #2
END                ; End of program
```

FOLK Following Kill

Type	`Following`
Syntax	`<a_><!>FOLK<b>`
Units	`n/a`
Range	`b= 0 (disable) or 1 (enable)`
Default	`0`
Response	`FOLK     *FOLK0`
See Also	`DRIVE, [ ER ], ERROR, FOLEN, FOLRD, FOLRN, FOLMAS, FOLMD, FSHFC, FSHFD, INFNC, K, [ PSHF ], SMPER, TER`

Product	Rev
GT6K	6.0
GV6K	6.0

Under default operation (`FOLK0`), certain error conditions (i.e., drive fault input active, or max. position error limit exceeded) will cause the Gem6K to disable the drive and kill the Following profile (follower's commanded position loses synchronization with the master).

If you enable Following Kill (`FOLK1`), these error conditions will still disable the drive, but will not kill the Following profile. Because the Following profile is still running, the drive keeps track of what the follower's position should be in the Following trajectory. To resume Following operation, resolve the error condition (drive fault, excessive position error), enable the drive (`DRIVE1`), and command the drive to impose a shift to compensate for the lapse/shift that occurred while the drive was disabled and the follower was not moving. To impose the shift, assign the negative of the internally monitored shift value (`PSHF`) to a variable (e.g., `VAR1 = -1 * PSHF`) and command the shift using a variable substitution in the `FSHFD` command (e.g., `FSHFD(VAR1)`).

The `FOLK` command only preserves Following profiles; normal velocity-based profiles will be killed regardless of the `FOLK` command.

FOLMAS Assignment of Master to Follower

Type	`Following`
Syntax	`<a_><!>FOLMAS<±ii >`

Units	`1st i = master #;`
	`2nd i = master count source;`
	`± sets direction of master counts relative to direction of actual master count source`

Range	`1st i = 1-8 if 2nd i = 8; otherwise 1st i = 1`
	`2nd i = 1 (encoder),`
	`2 (analog input),`
	`4 (commanded position),`
	`5 (internal count source),`
	`6 (internal sine wave source),`
	`7 (RESERVED), or`
	`8 (VARI variable).`
	`NOTE: "1", by itself, selects the master encoder.`
	`"0", by itself, disables the axis from being a follower`

Default	`+0 (disable from being a follower axis)`
Response	`FOLMAS   *FOLMAS+0`
See Also	`ANIMAS, FGADV, FOLEN, FOLK, FOLMD, FOLRD, FOLRN, FOLRNF, [ FS ], FVMACC, FVMFRQ, SINAMP, SINANG, SINGO, TFS`

Product	Rev
GT6K	6.0
GV6K	6.0

Use `FOLMAS` to assign or un-assign a master to a follower axis. The data field (`±ii`) configures the axis as a follower following the specified master count source:

Exceptions to the syntax:

- If a one (`1`) is placed in the data field (`±ii`), the axis will follow the counts from the Master Encoder (the separate encoder labeled "MASTER ENCODER").
- If a zero (`Ø`) is placed in the data field (`±ii`), the axis becomes a normal non-Following axis.

Following a Virtual Master. There are two "Virtual Master" options (an internal count source and an internal sine wave) for applications that require the synchronization features of Following, but have no external master. For a detailed description of virtual master features, see *Virtual Master* in the *Programmer's Guide*.

- Master Source Option 5 (e.g., FOLMAS±15) selects the internal count source as master. The frequency and acceleration of the internal count source are established with the FVMACC and FVMFRQ commands, respectively.
- Master Source Option 6 (e.g., FOLMAS±16) selects the internal sine wave as master. The angle and amplitude of the sine wave are established with the SINANG and SINAMP commands, respectively. To start and stop the internal sine wave generator, use the SINGO command.

Following an Integer Variable (Option 8: syntax is FOLMASn8). This option allows an axis to follow the integer variable (VARI) specified with "n"; that is, VARIn. The range for "n" is 1-8 (VARI1 – VARI8). For example, FOLMAS48 assigns the axis to follow VARI4.

This option is particularly useful in conjunction with the INVARI (Map Inputs to a VARI Variable) feature. INVARI continuously updates a specified VARI variable with the value of a specified group of digital inputs, allowing the axis to follow a binary input pattern. Another useful way to update the value of the VARI variable is to calculate its value in a PLCP program (launched with the SCANP command).

The INVARI and SCANP options for updating VARI are good choices, because both are performed every system update, thus facilitating smooth Following motion. It is also possible to use an extra task (multi-tasking) to calculate VARI values, but the resulting updates will not be as fast (not perfectly periodic); consequently, Follow motion will be less smooth.

If scaling is enabled (SCALE1), the measurement of the master is scaled by the SCLMAS value. For more information on scaling, refer to page 16 or to the SCLMAS command description.

NOTES

- A follower axis cannot use its own feedback device or commanded position as the master input.
- Before you can use an analog input as a master count source, you must first use the ANIMAS command to assign the analog input to a master axis number. Then you can use the FOLMAS command to assign the analog input as a master counting source for the follower axis.

As an example, the FOLMAS+1 command sets up these parameters:

- Follower axis #1 is set up as follows (+1): the master encoder is assigned as the master to follower axis #1. The positive sign bit indicates that master counts will count in the same direction as the master encoder.

NOTE

The FOLMAS command configures an axis to be a follower, but *does not* automatically enable Following. To enable Following use the FOLEN1 command. To enable follower motion, enable Following (FOLEN1), issue a ratio (FOLRN and FOLRD), and issue the GO command.

As soon as the master is specified with the FOLMAS command, a continuously updated relationship is maintained between the follower's position and the master's position. Also, master velocity is continuously measured.

There are several applications in which a minus sign in the FOLMAS command is used. A minus sign should be used whenever the master is moving in the desired positive direction and yet the Gem6K drive actually perceives the master to be moving in the negative direction. For example, this can occur when the master input device is mounted on the opposite side of a conveyor. Putting a minus sign in front of the master parameter specification in the FOLMAS command causes the incoming master signal to be negated before it is used by the follower. The term *master count* refers to the count after negation, if any.

For preset follower moves, the direction the follower travels depends on the mode of operation (absolute or incremental) and the commanded position. However, once a preset follower move is commanded, it will only start moving if the master is moving in the positive direction. This is true no matter the commanded direction of the follower move.

For continuous follower moves, the master count direction has a different effect. If the commanded move is positive in direction and the master is counting up, the actual follower travel direction will be positive. If the commanded move is positive in direction and the master is counting down, the actual follower travel direction will be negative. Similar cases exist for follower moves commanded in the negative direction.

Example: (refer to the FOLEN examples)

FOLMD Master Distance

Type	Following
Syntax	<a_><!>FOLMD<r>
Units	r = distance in counts
Range	0 - 999,999,999 (scalable by SCLMAS)
Default	0
Response	FOLMD *FOLMD0
See Also	ANIMAS, FGADV, FOLEN, FOLK, FOLRN, FOLRNF, FOLRD, MC, [PMAS], SCLMAS, TPMAS

Product	**Rev**
GT6K	6.0
GV6K	6.0

If a follower is in continuous positioning mode (MC1), FOLMD is the master distance over which acceleration or deceleration from the current ratio to the new ratio takes place. Or, if a follower is in preset positioning mode (MCØ), the FOLMD command indicates the master distance over which the next preset move will take place.

If scaling is enabled (SCALE1), the FOLMD value is specified in user units and is scaled by the SCLMAS parameter (for more detail on scaling, refer to page 16 or to the SCLMAS command description). Numeric variables (VAR) can be used with this command (e.g., FOLMD(VAR6)).

By carefully specifying accurate master distances for each ramp of a follower's move profile, a precise position relationship between master and follower will be maintained during all phases of the profile. The *Master and Follower Distance Calculation* section in the *Following* chapter of the *Programmer's Guide* discusses the relationship between ratio changes and the corresponding master and follower distances.

HINT*:* If a follower is in continuous mode (MC1) and the master is starting from rest, setting FOLMD to Ø will ensure precise tracking of the master's acceleration ramp.

Examples: (refer also to the FOLEN examples)

```
SCALE1           ; Enable parameter scaling
SCLMAS4000       ; Master scale factor is 4000 steps/rev
SCLD4000         ; Follower scale factor is 4000 steps/rev
DEL progx        ; Delete program called progx
DEF progx        ; Begin definition of program called progx
FOLMAS1          ; Master encoder is the master
FOLMD0           ; Assign Following acceleration distance to 0 master revs
                 ; (i.e., instantaneous)
FOLRN1           ; Set follower-to-master Following ratio numerator to 1
FOLRD1           ; Set follower-to-master Following ratio denominator to 1
                 ; Ratio set to 1:1
FOLEN1           ; Enable Following
D-               ; Set direction to opposite direction of the master
GO1              ; Begin following master. If the master is not moving, follower
                 ; will remain at rest until master moves, at which time the
                 ; follower will track the master precisely, but in the opposite
                 ; direction as the master.
END              ; End definition of progx
```

FOLRD Denominator of Follower-to-Master Ratio

Type	`Following`
Syntax	`<a_><!>FOLRD<r>`
Units	`r = master distance in counts`
Range	`r = 1.00000 - 999,999,999 (scalable by SCLMAS)`
Default	`1`
Response	`FOLRD    *FOLRD1`
See Also	`COMEXC, FGADV, FOLEN, FOLK, FOLMAS, FOLRN, FOLRNF, SCLMAS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `FOLRD` command establishes the denominator of a ratio between follower and master travel. (Ratios are always specified as positive, similar to velocity.) For a preset move (`MCØ`), it is the maximum allowed ratio, and for a continuous move (`MC1`), it is the final ratio reached by the follower. The actual follower direction will depend on commanded moves (`D+` or `D-`) and master direction.

If no `FOLRD` parameter is specified, it is assumed to be 1.

If scaling is enabled (`SCALE1`), the `FOLRD` value is scaled by the `SCLMAS` value. For more detail on scaling, refer to page 16 or to the `SCLMAS` command description.

Numeric variables (`VAR`) can be used with this command for master parameters (e.g., `FOLRD(VAR5)`).

Each time `FOLRN` or `FOLRD` are given, the Gem6K drive divides the scaled numerator and denominator to calculate the ratio, but round-off errors are eliminated by measuring both master and follower over a large distance. After scaling, the maximum magnitude of the ratio is 127 follower steps for every master step.

ON-THE-FLY CHANGES: You can change Following ratio *on the fly* (while motion is in progress) in two ways. One way is to send an immediate command (`!FOLRD`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered command (`FOLRD`) followed by a buffered go command (`GO`).

Example: (refer also to the `FOLEN` examples)

```
SCLD25000         ; Set follower scaling factor to 25,000
SCLMAS4000        ; Set master scaling factor to 4,000
SCALE1            ; Enable scaling
FOLRN5            ; Set ratio numerator to 5 (5 * 25,000 = 125,000)
FOLRD3            ; Set ratio denominator to 3 (3 * 4,000 = 12,000)
                  ; (Resulting ratio is 125 follower steps to every 12 master steps.)
```

FOLRN Numerator of Follower-to-Master Ratio

Type	`Following`
Syntax	`<a_><!>FOLRN<r>`
Units	`r = follower distance in steps`
Range	`r = 0.00000 – 999,999,999.99999 (scalable by SCLD)`
Default	`1`
Response	`FOLRN    *FOLRN1`
See Also	`FGADV, FOLEN, FOLK, FOLMAS, FOLRNF, FOLRD, SCLD`

Product	Rev
GT6K	6.0
GV6K	6.0

The `FOLRN` command establishes the numerator of a ratio between follower and master travel. (Ratios are always specified as positive, similar to velocity.) For a preset move (`MCØ`), it is the maximum allowed ratio, and for a continuous move (`MC1`), it is the final ratio reached by the follower. The actual follower direction will depend on commanded moves (`D+` or `D-`) and master direction.

If no `FOLRN` parameter is specified, it is assumed to be 1.

If scaling is enabled (`SCALE1`), the `FOLRN` value is scaled by the `SCLD` value. For more detail on scaling, refer to page 16 or to the `SCLD` command description.

Numeric variables (`VAR`) can be used with this command for follower parameters (e.g., `FOLRN(VAR2)`).

Each time FOLRN or FOLRD are given, the Gem6K drive divides the scaled numerator and denominator to calculate the ratio, but round-off errors are eliminated by measuring both master and follower over a large distance. After scaling, the maximum magnitude of the ratio is 127 follower steps for every master step.

ON-THE-FLY CHANGES: You can change Following ratio *on the fly* (while motion is in progress) in two ways. One way is to send an immediate command (!FOLRN) followed by an immediate go command (!GO). The other way is to enable the continuous command execution mode (COMEXC1) and execute a buffered command (FOLRN) followed by a buffered go command (GO).

Example: refer to the FOLRD and FOLEN examples

FOLRNF Numerator of Final Follower-to-Master Ratio, Preset Moves

Type	Following; Compiled Motion
Syntax	<a_><!>FOLRNF<r>
Units	r = follower distance in steps
Range	0.00000
Default	0
Response	FOLRNF *FOLRNF0
See Also	FGADV, FOLEN, FOLRD, FOLRN, FOLMD, SCLD

Product	**Rev**
GT6K	6.0
GV6K	6.0

The FOLRNF command establishes the numerator of the final ratio between follower and master travel. (Ratios are always specified as positive, similar to velocity.) The FOLRNF command designates that the motor will move the load the distance designated in a preset GOBUF segment, completing the move at a final ratio of zero. FOLRNF applies only to the first subsequent GOBUF, which marks an intermediate "end of move" within a following profile. FOLRNF is used only in conjunction with the GOBUF command. Normal preset GO moves always finish with zero FOLRNF.

If scaling is enabled (SCALE1), the FOLRNF value is scaled by the SCLD value. For more detail on scaling, refer to page 16 or to the SCLD command description.

NOTE: The only allowable value for FOLRNF is Ø, and it may only be used with compiled preset Following moves (a non-zero FOLRNF value will result in an immediate error message). FOLRNF is allowed for a segment only if the starting ratio is also zero (i.e., it must be the first segment, or the previous segment must have ended in zero ratio).

With compiled preset Following moves where FOLRNF has not been given, the final ratio is given with FOLRN, and the shape of the intermediate profile will be constrained to be within the starting and ending ratios.

For more information on using the FOLRNF command, refer to *Compiled Following Profiles* in the *Custom Profiling* chapter in the *Programmer's Guide*.

FPPEN Master Position Prediction Enable

Type	Following
Syntax	<a_><!>FPPEN<b>
Units	n/a
Range	b = 0 (disable) or 1 (enable)
Default	1
Response	FPPEN *FPPEN1
See Also	[FS], TFS

Product	**Rev**
GT6K	6.0
GV6K	6.0

The FPPEN command enables or disables Master Position Prediction in the Gem6K drive Following algorithm. Master Position Prediction is enabled by default, but can be disabled as desired with the FPPENØ command.

The Gem6K drive measures master position once per *position sample period* and calculates a corresponding follower commanded position. This calculation, and achieving the subsequent follower commanded position, requires 2 sample periods (4 milliseconds).

Enabling Master Position Prediction (FPPEN1) eliminates any lag in follower position which would be dependent on master speed. It may be desirable to disable Master Position Prediction (FPPENØ) when maximum follower smoothness is important and minor phase delays can be accommodated. A detailed discussion of Master Position Prediction is given in the *Following* chapter of the *Programmer's Guide.*

Example:

```
FPPEN1          ; Enable Master Position Prediction.
```

[FS] Following Status

Type Following; Assignment or Comparison
Syntax See below
Units n/a
Range n/a
Default n/a
Response n/a

See Also FGADV, FMAXA, FMAXV, FMCLEN, FMCP, FOLEN, FOLMAS, FPPEN, FSHFC, FSHFD, MC, [NMCY], [PMAS], TFS, TFSF, VARB

Product	**Rev**
GT6K	6.0
GV6K	6.0

The FS command is used to assign the Following status bits to a binary variable, or to make a comparison against a binary or hexadecimal value. The function of each status bit is shown below.

Bit Assignment (left to right)	**Function** (YES = 1; NO = Ø)	
1	Follower in Ratio Move	A Following move is in progress.
2	Ratio is Negative	The current ratio is negative (i.e., the follower counts are counting in the opposite direction from the master counts).
3	Follower Ratio Changing	The follower is ramping from one ratio to another (including a ramp to or from zero ratio).
4	Follower At Ratio	The follower is at constant non-zero ratio.
* 5	FOLMAS Active	A master is specified with the FOLMAS command.
* 6	FOLEN Active	Following has been enabled with the FOLEN command.
* 7	Master is Moving	The specified master is currently in motion.
8	Master Dir Neg	The current master direction is negative. (bit must be cleared to allow Following move in preset mode–MCØ).
9	OK to Shift	Conditions are valid to issue shift commands (FSHFD or FSHFC).
10	Shifting now	A shift move is in progress.
11	Shift is Continuous	An FSHFC-based shift move is in progress.
12	Shift Dir is Neg	The direction of the shift move in progress is negative.
13	Master Cyc Trig Pend	A master cycle restart is pending the occurrence of the specified trigger.
14	Mas Cyc Len Given	A non-zero master cycle length has been specified with the FMCLEN command.
15	Master Cyc Pos Neg	The current master cycle position (PMAS) is negative. This could be caused by a negative initial master cycle position (FMCP), or if the master is moving in the negative direction.
16	Master Cyc Num > 0	The master position (PMAS) has exceeded the master cycle length (FMCLEN) at least once, causing the master cycle number (NMCY) to increment.
17	Mas Pos Prediction On	Master position prediction has been enabled (FPPEN).
18	Master Filtering On	A non-zero value for master position filtering (FFILT) is in effect.
19	RESERVED	
20	RESERVED	

(continued on next page)

21	RESERVED	
22	RESERVED	
23	OK to do FGADV move	OK to do Geared Advance move (master assigned with FOLMAS, Following enabled with FOLEN, and follower axis is either not moving, or moving at constant ratio in continuous mode).
24	FGADV move underway	Geared Advance move profile is in progress.
25	RESERVED	
26	FMAXA/FMAXV limited	The present Following move profile is being limited by FMAXA or FMAXV.
27-32	RESERVED	

* All these conditions must be true before Following motion will occur.

Syntax: VARBn=FS where n is the binary variable number, or FS can be used in an expression such as IF(FS=b11Ø1), or IF(FS=h7F).

To make a comparison against a binary value, place the letter b (b or B) in front of the value that the Following status is being compared against. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value that the Following status is being compared against. The hexadecimal value itself must only contain the letters A through F, and the numbers Ø through 9.

If you wish to assign only one bit of the Following status to a binary variable, instead of all 32, use the bit select (.) operator. The bit select, in conjunction with the bit number, is used to specify a specific Following status bit (e.g., VARB1=FS.12 assigns status bit 12 to binary variable 1).

Example:

```
VARB1=FS         ; Following status assigned to binary variable 1
VARB2=1FS.12     ; Following status bit 12 assigned to binary variable 2
VARB2            ; Response if bit 12 is set to 1 should be:
                 ; *VARB2=XXXX_XXXX_XXX1_XXXX_XXXX_XXXX_XXXX_XXXX
IF(FS=b111011X11)  ; If the Following status contains 1's for bit locations
                 ; 1, 2, 3, 5, 6, 8, and 9, and a 0 for bit location 4,
                 ; do the IF statement
TREV             ; Transfer revision level
NIF              ; End if statement
IF(FS=h7F00)     ; If the Following status contains 1's for bits 1,
                 ; 2, 3, 5, 6, 7, and 8, and 0's for every other bit location,
                 ; do the IF statement
TREV             ; Transfer revision level
NIF              ; End if statement
```

FSHFC Continuous Shift

Type	Following
Syntax	<a_><!>FSHFC<i>
Units	i = shift feature to implement
Range	i = 0 (stop), 1 (positive-direction), 2 (negative-direction), or 3 (kill)
Default	n/a
Response	n/a
See Also	FGADV, FOLEN, FOLK, FOLRN, FOLRNF, FOLRD, [FS], FSHFD, MC, [PSHF], TFS, TPSHF

Product	Rev
GT6K	6.0
GV6K	6.0

The FSHFC command allows time-based follower moves to be superimposed on continuous Following moves. This results in a *shift* (change in phase) between the master position and the follower position. Continuous shift moves in the positive- or negative-direction may be commanded only while the follower is in the Following mode (FOLEN1).

Steppers only: An FSHFC move may be performed only when the follower is in the continuous positioning mode (MC1) and performing a Following move at a constant ratio.

The most recently commanded velocity (V) and acceleration (A) for the follower axis will determine the speed at which the FSHFC move takes place. The velocity and direction of the FSHFC shift is independently superimposed on whatever velocity and direction results from the ratio and motion of the master. The FSHFC shift is not a change in ratio; rather, it is a velocity added to a ratio. The velocity commanded is added to the present speed at which the follower is moving, up to the velocity limit of the product. For example, assume a follower is traveling at 1 rps in the positive direction while following a master. If a FSHFC move is commanded in the positive direction at 2 rps, the follower's actual velocity (after acceleration) will be 3 rps.

The FSHFC parameters stop (Ø) and kill (3) can be used to halt a continuous FSHFC move (positive-direction or negative-direction). The example below shows how to stop a FSHFC continuous move.

An FSHFC move may be needed to adjust the relative follower position on the fly during the continuous Following move. For example, suppose an operator is visually inspecting the follower's motion with respect to the master. If he notices that the master and follower are out of synchronization, it may be desirable to have an interrupt programmed (e.g., activated with a push-button switch) that will allow the operator to advance or retard the follower at a superimposed correction speed until the operator chooses to have the follower start tracking the master again. The example below shows this.

FSHFC Example:

Assume all scale factors and set-up parameters have been entered for the master and follower. In this example, the follower is continually following the master at a 1:1 ratio. If the operator notices some misalignment between master and follower, he can press 1 of 2 pushbuttons (connected to onboard trigger inputs #1 and #2, which are also referred to as TRG-1A and TRG-1B) to shift the follower in the positive- or negative-direction at 0.1 user scaled units until the button is released. After the adjustment, the program continues on as before.

Example:

```
DEF SHIFT        ; Begin definition of program called SHIFT
V.1              ; Add or subtract 0.1 user scaled units from the follower velocity
                 ; when shifting
COMEXS1          ; Continue command execution after stop
COMEXC1          ; Continue command execution during motion
FOLMAS1          ; Master encoder input is the master
FOLRN1           ; Set follower-to-master Following ratio numerator to 1
FOLRD1           ; Set follower-to-master Following ratio denominator to 1
                 ; (ratio set to 1:1)
FOLEN1           ; Enable Following mode
D+               ; Set to positive-direction
MC1              ; Select continuous positioning mode
GO1              ; Start following master continuously
VARB1=b10        ; Define onboard input pattern #1 and assign to VARB1
VARB2=b01        ; Define onboard input pattern #2 and assign to VARB2
$TESTIN          ; Define label called TESTIN
IF(IN=VARB1)     ; IF statement (if onboard input #1 is activated, do the jump)
  JUMP SHIFTP    ; Jump to shift follower in the positive-direction when pattern 1
                 ; active
  NIF            ; End of IF statement
IF(IN=VARB2)     ; IF statement (if onboard input #2 is activated, do the jump)
  JUMP SHIFTN    ; Jump to shift follower in the negative-direction when pattern 2
                 ; active
  NIF            ; End of IF statement
JUMP TESTIN      ; Return to main program loop
$SHIFTP          ; Define label called SHIFTP (subroutine to shift in the
                 ; positive direction)
FSHFC1           ; Start continuous follower shift move in positive-direction
WAIT(IN.1=b0)    ; Continue shift until onboard input #1 is deactivated
FSHFC0           ; Stop shift move
JUMP TESTIN      ; Return to main program loop
$SHIFTN          ; Define label called SHIFTN (subroutine to shift in the
                 ; negative-direction)
FSHFC2           ; Start continuous follower shift move in the negative-direction
WAIT(IN.2=b0)    ; Continue shift until onboard input #2 is deactivated
FSHFC0           ; Stop shift move
JUMP TESTIN      ; Return to main program loop
END              ; End definition of program called SHIFT
```

FSHFD Preset Shift

		Product	Rev
Type	Following	GT6K	6.0
Syntax	<a_><!>FSHFD<r>	GV6K	6.0
Units	r = shift distance		
Range	r = 0.00000 - 999,999,999 (scalable with SCLD)		
Default	n/a		
Response	n/a		
See Also	FGADV, FOLEN, FOLK, FOLRN, FOLRNF, FOLRD, [FS], FSHFC, MC, ONCOND, [PSHF], SCLD, TFS, TPSHF		

The FSHFD command allows time-based follower moves to be superimposed on continuous Following moves. This results in a *shift* (change in phase, or registration) between the master position and the follower position. Preset shift moves of defined or variable distances, may be commanded only while the follower is in the Following mode (FOLEN1). The FSHFD distance is scaled by the SCLD value of scaling is enabled (SCALE1).

The most recently commanded velocity (V) and acceleration (A) for the follower axis will determine the speed at which the FSHFD move takes place. The velocity and direction of the FSHFD shift is independently superimposed on whatever velocity and direction results from the ratio and motion of the master.

The FSHFC parameters stop (Ø) and kill (3) can be used to halt an FSHFD.

It should be noted that FSHFD is similar in execution to GO. The entire preset distance shift, or ramp-to-shift velocity, must finish before the Gem6K drive proceeds to the next command.

The FSHFD shift is not a change in ratio; rather, it is a velocity added to a ratio. The velocity commanded will be added to the present speed at which the follower is moving, up to the velocity limit of the product. For example, assume a follower is traveling at 1 rps in the positive direction while following a master. If a FSHFD move is commanded in the positive direction at 2 rps, the follower's actual velocity (after acceleration) will be 3 rps.

An FSHFD move may be needed to adjust the follower position on the fly because of a load condition which changes during the continuous Following move. For example, suppose an operator is visually inspecting the follower's motion with respect to the master. If the operator notices that the master and follower are out of synchronization, it may be desirable to have an input programmed (e.g., activated with a push-button switch) that will allow the operator to advance or retard the follower a fixed distance, and then let the follower resume tracking the master. The example below illustrates this.

FSHFD Example:

Assume all scale factors and set-up parameters have been entered for the master and follower. In this example, the follower is continually following the master at a 1:1 ratio. If the operator notices some misalignment between master and follower, he can press 1 of 2 pushbuttons (connected to onboard trigger inputs #1 and #2, which are also referred to as TRG-1A and TRG-1B) to advance or retard the follower a fixed distance of 200 steps. After the adjustment, the follower resumes tracking the master as before.

Example:

```
DEF PSHIFT       ; Begin definition of program called PSHIFT
COMEXS1          ; Continue command execution after stop
COMEXC1          ; Continue command execution during motion
FOLMAS1          ; Master encoder input is the master for axis 1
FOLRN1           ; Set follower-to-master Following ratio numerator to 1
FOLRD1           ; Set follower-to-master Following ratio denominator to 1
                 ; (ratio set to 1:1)
FOLEN1           ; Enable Following mode
```

```
D+               ; Set direction to positive
MC1              ; Select continuous positioning mode
GO1              ; Start following master continuously
VARB1=b10        ; Define input pattern #1 and assign to VARB
VARB2=b01        ; Define input pattern #2 and assign to VARB
$TESTIN          ; Define label called TESTIN
IF(IN=VARB1)     ; IF statement (if onboard input #1 is activated, do the jump)
  JUMP SHIFTP    ; Jump to shift follower in positive-direction when pattern 1 active
  NIF            ; End of IF statement
IF(IN=VARB2)     ; IF statement (if onboard input #2 is activated, do the jump)
  JUMP SHIFTN    ; Jump to shift follower in negative-direction when pattern 2 active
  NIF            ; End of IF statement
JUMP TESTIN      ; Return to main program loop
$SHIFTP          ; Define label called SHIFTP (subroutine to shift in the
                 ; positive direction)
FSHFD200         ; Start preset follower shift move of 200 steps in positive direction
WAIT(FS.10=b0)   ; Wait for shift to finish
JUMP TESTIN      ; Return to main program loop
$SHIFTN          ; Define label called SHIFTN (subroutine to shift in the
                 ; negative direction)
FSHFD-2ØØ        ; Start preset follower shift move of 200 steps in the negative
                 ; direction
WAIT(FS.10=b0)   ; Wait for shift to finish
JUMP TESTIN      ; Return to main program loop
END              ; End definition of program called PSHIFT
```

FVMACC Virtual Master Count Acceleration

		Product	Rev
Type	Following	GT6K	6.0
Syntax	<a_><!>FVMACC<i>	GV6K	6.0
Units	i = count acceleration in counts/sec/sec		
Range	0-999,999,999		
Default	0		
Response	FVMACC *FVMACC+0		
See Also	FOLMAS, FVMFRQ, SINAMP, SINANG, SINGO		

Use the FVMACC command to define the rate at which the virtual master internal count frequency may change. This command allows smooth changes in master velocity and direction.

FVMFRQ Virtual Master Count Frequency

		Product	Rev
Type	Following	GT6K	6.0
Syntax	<a_><!> FVMFRQ<i>	GV6K	6.0
Units	i = count frequency in counts/sec		
Range	±1,000,000		
Default	+0		
Response	FVMFRQ *FVMFRQ+0		
See Also	FOLMAS, FVMACC, SINAMP, SINANG, SINGO		

Use the FVMFRQ command to define the virtual master count frequency. The “virtual master” is an internal count source, intended to mimic the counts which might be received on an external encoder port. Just as may be encountered with an external encoder, this count source may speed up, slow down, stop, or count backwards.

The count source has a variable count frequency, defined by the user. The count source is always enabled, counting at the signed rate specified by this command. To start and stop the count source, specify non-zero or zero values, respectively, for the FVMFRQ command.

The rate at which the count frequency may change is specified in counts per second per second with the FVMACC command, allowing smooth changes in master velocity and direction.

GO Initiate Motion

		Product	Rev
Type	`Motion`	GT6K	6.0
Syntax	`<a_><!>GO<b>`	GV6K	6.0
Units	`n/a`		
Range	`b = 1 (go); or blank`		
Default	`1`		
Response	`GO:` `No response; instead, motion is initiated`		
See Also	`A, AA, AD, ADA, COMEXC, D, GOBUF, GOWHEN, K, LH, LS, MA, MC, PSET, S ,SCLA, SCLD, SCLV, SSV, TAS, TEST, V`		

The `GO` command instructs the motor to make a move using motion parameters that have been previously entered. Several commands affect the motion that will occur when a `GO` is received: `A`, `AA`, `AD`, `ADA`, `D`, `V`, `LH`, `LS`, `MA`, and `MC`.

The `GO1` command and the `GO` command both start motion.

If motion does not occur after a `GO` command has been issued, check `TAS` bits 15-18 to ascertain if the hardware or software end-of-travel limits have been encountered.

On-The-Fly (Pre-emptive `GO`) Motion Profiling

While motion is in progress (regardless of the positioning mode), you can change these motion parameters “on-the-fly” (OTF) to affect a new profile:

- Acceleration (`A`) — S-curve acceleration is not supported in OTF motion changes
- Deceleration (`AD`) — S-curve acceleration is not supported in OTF motion changes
- Velocity (`V`)
- Distance (`D`)
- Preset or Continuous Positioning Mode Selection (`MC`)
- Incremental or Absolute Positioning Mode Selection (`MA`)
- Following Ratio Numerator and Denominator (`FOLRN` and `FOLRD`, respectively)

The motion parameters can be changed by sending the respective command (e.g., `A`, `V`, `D`, `MC`, etc.) followed by the `GO` command. If the continuous command execution mode is enabled (`COMEXC1`), you can execute buffered commands; otherwise, you must prefix each command with an immediate command identifier (e.g., `!A`, `!V`, `!D`, `!MC`, etc., followed by `!GO`). The new `GO` command pre-empts the motion profile in progress with a new profile based on the new motion parameter(s).

For more information, refer to the *Custom Profiling* section in the *Programmer's Guide*.

Example:

```
SCALE1                ; Enable scaling
SCLA25000             ; Set the accel. scale factor to 25000 steps/unit
SCLV25000             ; Set the velocity scale factor to 25000 steps/unit
SCLD1                 ; Set the distance scaling factor to 1 step/unit
DEL proga             ; Delete program called proga
DEF proga             ; Begin definition of program called proga
MA0                   ; Incremental positioning mode
MC0                   ; Preset positioning mode
A10                   ; Set the acceleration to 10 units/sec/sec
V1                    ; Set the velocity to 1 units/
D100000               ; Set the distance to 100000 units
GO1                   ; Initiate motion
END                   ; End definition of proga
```

GOBUF Store a Motion Segment in Compiled Memory

		Product	Rev
Type	Compiled Motion	GT6K	6.0
Syntax	<a_><!>GOBUF<b>	GV6K	6.0
Units	n/a		
Range	b = 0 (don't go) or 1 (go)		
Default	1		
Response	n/a		
See Also	[AS], DEF, END, [ER], FOLRNF, MC, MEMORY, PCOMP, PEXE, POUTn, PRUN, PUCOMP, PLOOP, PLN, [SS], TAS, TER, TSS, VF, (Compiled Motion overview in *Custom Profiling* in the *Programmer's Guide*.)		

The GOBUF command creates a motion segment as part of a profile and places it in a segment of compiled memory, to be executed after all previous GOBUF motion segments have been executed. When a GOBUF command is executed, the distance from the new D command is added to the profile's current goal position as soon as the GOBUF command is executed, thus extending the overall move distance of the profile under construction.

GOBUF is not a stand-alone command; it can only be executed within compiled programs, using the PCOMP and PRUN commands.

Each GOBUF motion segment may have its own distance to travel, velocity, acceleration and deceleration. The end of a preset segment (MCØ) is determined by the distance or position specified; a compiled MCØ GOBUF motion segment is finished when the "D" goal is reached. The end of a continuous motion (MC1) segment is determined by the ratio or velocity specified; a compiled MC1 GOBUF motion segment is finished when the velocity or ratio goal is reached. If either a preset segment or continuous segment is followed by a compiled GOWHEN command, motion will continue at the last velocity until the GOWHEN condition becomes true, and the next segment begins.

The GOBUF command is not allowed during absolute positioning mode (MA1).

Starting velocity of a GOBUF segment

Every GOBUF motion segment will start at a velocity equal to the previous segment's end velocity. If the previous GOBUF segment uses the VFØ command, then it will end at zero velocity; otherwise, the end velocity will be equal to the goal velocity (V) of the previous segment.

Ending velocity of a GOBUF segment

Preset Positioning Mode (MCØ)

A preset motion segment starts at the previous motion segment's end velocity, attempts to reach the goal velocity (V) with the programmed acceleration and deceleration (A and AD) values, and is considered completed when the distance (D) goal is reached.

In non-Following motion (FOLENØ), the last preset GOBUF segment always ends at zero velocity, but if you wish the velocity between intermediate GOBUF segments to end at zero velocity, use the VFØ command. In Following mode (FOLEN1), the last preset GOBUF segment will end with the last-specified goal velocity, but if you wish the velocity between intermediate GOBUF segments to end at zero velocity, use the FOLRNF command.

Each GOBUF will build a motion segment that, by default, becomes known as the last segment in the profile. The last motion segment in a profile must end at zero velocity. If using pre-compiled loops (PLOOP) and the loop is closed after the last GOBUF segment (PLN occurs after the last GOBUF), then the unit will not consider the last GOBUF as a final motion segment since it can link to either the first segment of the loop or the next segment after the loop. If the conditions are such that the last motion segment is within a loop and does not end at zero velocity, then an error is generated (TSS/SS bit #31 is set) at compile time (PCOMP), and the profile remains un-compiled.

Continuous Positioning Mode (MC1)

A continuous segment starts at the previous motion segment's end velocity, and is considered complete when it reaches the goal velocity (V) at the programmed accel (A) or decel (AD) values.

You may use a mode continuous (MC1) non-zero velocity segment as the last motion segment in a profile (no error will result). The axis will continue traveling at the goal velocity.

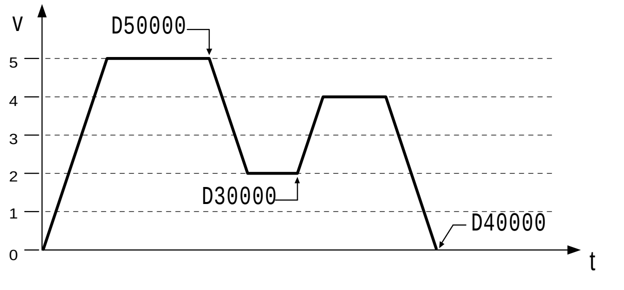
NOTE: Each GOBUF motion segment can consume from 2-8 memory segments of compiled memory. If there is no more space left in compiled memory, a compilation error will result.

Example:

```
DEF simple   ; Begin definition of program
MC0          ; Preset positioning mode
D50000       ; Distance is 50000
A10          ; Acceleration is 10
AD10         ; Deceleration is 10
V5           ; Velocity is 5
GOBUF1       ; 1st motion segment
D30000       ; Distance is 30000
V2           ; Velocity is 2
GOBUF1       ; 2nd motion segment
D40000       ; Distance is 40000
V4           ; Velocity is 4
GOBUF1       ; 3rd motion segment
END          ; End program definition

PCOMP simple ; Compile simple
PRUN simple  ; Run simple
```

The resulting profile from this program:



GOSUB Call a Subroutine

Type	`Program; Subroutine Definition; Program Flow Control`
Syntax	`<a_><!>GOSUB<t>`
Units	`t = text (name of program/subroutine)`
Range	`Text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`$, BREAK, DEF, DEL, END, ERASE, GOTO, JUMP, RUN`

Product	Rev
GT6K	6.0
GV6K	6.0

The `GOSUB` command branches to the corresponding program/subroutine name when executed. A subroutine name consists of 6 or fewer alpha-numeric characters. The subroutine that the `GOSUB` initiates will return control to the line after the `GOSUB`, when the subroutine completes operation. If an invalid subroutine name is entered, no branch will occur, and processing will continue with the line after the `GOSUB`.

If you do not want to use the `GOSUB` command before the subroutine name (`GOSUBsubname`), you can simply use the subroutine name without the `GOSUB` attached to it (`subname`).

If a subroutine is executed, and a `BREAK` command is received, the subroutine will return control to the calling program or subroutine immediately.

Up to 16 levels of subroutine calls can be made without receiving an error.

Example:

```
DEF prog1         ; Begin definition of program prog1 to be used as a subroutine
COMEXC0           ; Disable continuous command processing mode
A10               ; Set acceleration to 10 revs/sec/sec
V1                ; Set velocity to 1 rev/sec
D4000             ; Set distance to 4000 counts
L10               ; Loop 10 times
GO1               ; Initiate motion
GOSUB prog2       ; GOSUB to program prog2 as a subroutine
LN                ; End loop
END               ; End subroutine definition of program proga
DEF prog2         ; Begin definition of program prog2
OUT1              ; Turn on output #1
T1                ; Time delay of 1 second
OUT0              ; Turn off output #1
END               ; End subroutine definition of program prog2
RUN prog1         ; Execute program prog1
; After program prog1 is initiated, and the first move of 4000 counts is complete, a
; GOSUB will occur causing the execution of program prog2. After program prog2
; finishes, control will be passed back to program prog1, to the command immediately
; following the GOSUB.
```

GOTO Goto a Program or Label

Type	Program; Subroutine Definition; Program Flow Control
Syntax	<!>GOTO<t>
Units	t = text (name of program/label)
Range	Text name of 6 characters or less
Default	n/a
Response	n/a
See Also	$, DEF, DEL, END, GOSUB, IF, JUMP, L, LN, NIF, NWHILE, REPEAT, RUN, UNTIL, WHILE

Product	Rev
GT6K	6.0
GV6K	6.0

The GOTO command branches to the corresponding program name or label when executed. A program or label name consists of 6 or fewer alpha-numeric characters. The program or label that the GOTO initiates will **not** return control to the line after the GOTO when the program completes operation—instead, the program will end. This holds true unless the subroutine in which the GOTO resides was called by another program; in this case, the END in the GOTO program will initiate a return to the calling program.

If an invalid program or label name is entered, the GOTO will be ignored, and processing will continue with the line after the GOTO.

CAUTION

Use caution when performing a GOTO between IF & NIF, or L & LN, or REPEAT & UNTIL, or WHILE & NWHILE. Branching to a different location within the same program will cause the next IF, L, REPEAT or WHILE statement to be nested within the previous IF, L, REPEAT or WHILE statement unless a NIF, LN, UNTIL or NWHILE command has already been encountered. If you wish to avoid this nesting situation, use the JUMP command instead of the GOTO command.

Example:

```
DEF pick          ; Begin definition of subroutine named pick
D-5000            ; Set distance to -5000
GO1               ; Initiate motion
END               ; End subroutine definition
DEF place         ; Begin definition of subroutine named place
GOTO pick         ; Goto to subroutine named pick
D+5000            ; Set distance to +5000
GO1               ; Initiate motion
END               ; End subroutine definition
place             ; Execute program named place
; After the GOTO command, the D+5000 and GO1 commands will not be executed because a
; GOTO was issued. If a GOSUB was used instead of the GOTO statement, control would
; have been returned to the line after the GOSUB.
```

GOWHEN Conditional Go

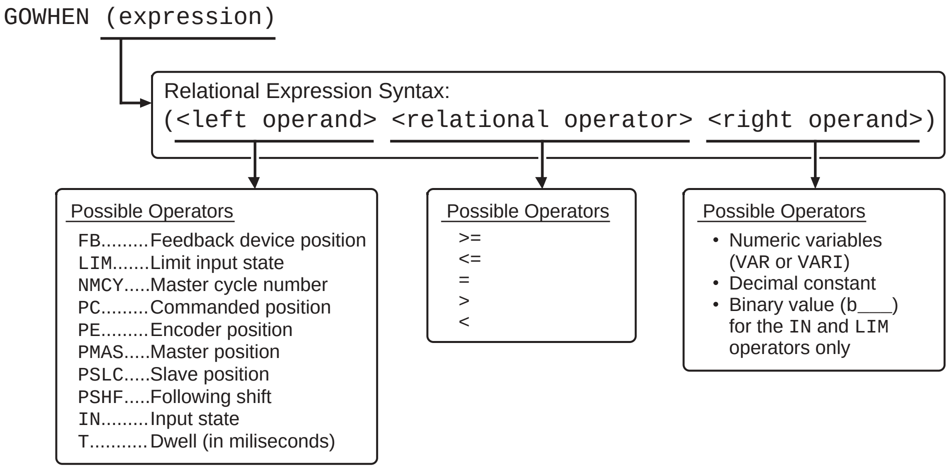
Type	Motion
Syntax	<a_><!>GOWHEN(expression)
Units	n/a
Range	Up to 80 characters (including parentheses)
Default	n/a
Response	n/a
See Also	[AS], COMEXC, [ER], ERROR, ERRORP, [FB], FGADV, FSHFC, FSHFD, GO, [IN], [LIM], [NMCY], [PC], [PE], [PMAS], [PSHF], [PSLV], T, TAS, TER, TRGFN, WAIT

Product	Rev
GT6K	6.0
GV6K	6.0

Use the GOWHEN command to synchronize a motion profile of an axis with a specified position count (commanded, feedback device, motor, master, follower, Following shift), input status, dwell (time delay), or master cycle number on that axis. Command processing does not wait for the GOWHEN conditions (relational expressions) to become true during the GOWHEN command. Rather, the motion from the subsequent start-motion command (GO, FGADV, FSHFC, and FSHFD) will be suspended until the condition becomes true.

Start-motion type commands that **cannot** be synchronized using the GOWHEN command are: HOM, JOG, JOY, and PRUN. A preset GO command that is already in motion can start a new profile using the GOWHEN and GO sequence of commands. Continuous moves (MC1) already in progress can change to a new velocity based upon the GOWHEN and GO sequence. Both preset and continuous moves can be started from rest with the GOWHEN and GO sequence.

GOWHEN Syntax:



GOWHEN (expression)

Relational Expression Syntax:
(<left operand> <relational operator> <right operand>)

Possible Operators
FB.........Feedback device position
LIM.......Limit input state
NMCY.....Master cycle number
PC.........Commanded position
PE.........Encoder position
PMAS.....Master position
PSLC.....Slave position
PSHF.....Following shift
IN.........Input state
T...........Dwell (in miliseconds)

Possible Operators
>=
<=
=
>
<

Possible Operators
- Numeric variables (VAR or VARI)
- Decimal constant
- Binary value (b____) for the IN and LIM operators only

EXAMPLES

```
GOWHEN (PE>40000)   ; suspend next GO until encoder position > 40000
GOWHEN (IN.4=b1)    ; suspend next GO until onboard input #4 is activated (b1)
GOWHEN (PMAS>255)   ; suspend next GO until the master has
                    ; traveled 255 master distance units
```

SCALING

If scaling is enabled (SCALE1), the right-hand operand is multiplied by SCLD if the left-hand operand is FB, PC, PE, PSLV, or PSHF. The right-hand operand is multiplied by the SCLMAS value if the left-hand operand is PMAS. The SCLD or SCLMAS values used correlate to the axis specified with the variable (e.g., a GOWHEN expression with PE scales the encoder position by the SCLD value specified).

GOWHEN Status:

Axis Status — Bit #26: Bit #26 is set when motion has been commanded by a GO, FGADV, FSHFC, or FSHFD command, but the change in motion is suspended due to a pending GOWHEN condition. This status bit is cleared when the GOWHEN condition is true or when a stop (!S) or kill (!K or ^K) command is executed. A GOWHEN command can be cleared using an axis-specific S or K command (e.g., !S1 or !K1).

AS.26 .....Assignment & comparison operator — use in a conditional expression (see AS).
TASF........Full text description of each status bit. (see "Gowhen is Pending" line item)
TAS ....Binary report of each status bit (bits 1-32 from left to right). See bit #26.

Axis Status — Bit #29: Bit #29 is set if the input state or position relationship specified in the GOWHEN command is already true when the subsequent GO, FGADV, FSHFC, or FSHFD command is issued. To clear this error condition, issue another GOWHEN command; or issue a !K command and check the program logic (use the TRACE and STEP features if necessary).

AS.29 .....Assignment & comparison operator — use in a conditional expression (see AS).
TASF........Full text description of each status bit. (see "Gowhen error" line item)
TAS ....Binary report of each status bit (bits 1-32 from left to right). See bit #29.

Error Status — Bit #14: Bit #14 is set if the input state or position relationship specified in the GOWHEN command is already true when the GO, FGADV, FSHFC, or FSHFD command is issued. The error status is monitored and reported only if you enable error-checking bit #14 with the ERROR command (e.g., ERROR.14-1). NOTE: When the error occurs, the drive will branch to the error program (assigned with the ERRORP command). To clear this error condition, issue another GOWHEN command; or issue a !K command and check the program logic (use the TRACE and STEP features if necessary).

ER.14..... Assignment & comparison operator — use in a conditional expression (see AS).
TERF....... Full text description of each status bit. (see "Gowhen condition true" line item)
TER .... Binary report of each status bit (bits 1-32 from left to right). See bit #14.

GOWHEN ... on a Trigger Input: Use aTRGFNc1

If you wish motion to be triggered with a trigger input, use the TRGFNc1 command. The TRGFNc1 command executes in the same manner as the GOWHEN command, except that motion is executed when the specified trigger input (c) is activated. For more information, refer to the TRGFN command description.

GOWHEN vs. WAIT:

A WAIT will cause program flow to halt (except for execution of immediate commands) until the condition specified is satisfied. Common uses for this function include delaying subsequent I/O activation until the master has achieved a required position or an object has been sensed.

By contrast, a GOWHEN will suspend the motion profile until the specified condition is met. It does **not** affect program flow. If you wish motion to be triggered with a trigger input, use the TRGFNc1 command. The TRGFNc1 command executes in the same manner as the GOWHEN command, except that motion is executed when the specified trigger input (c) is activated (see TRGFN command description for details). In addition, GOWHEN expressions are limited to the operands listed above; WAIT can use additional operands such as FS (Following status) and VMAS (velocity of master).

Factors Affecting GOWHEN Execution:

If a second GOWHEN command is executed **before** a start-motion command (GO, FGADV, FSHFC, or FSHFD), then the first GOWHEN is over-written by the second GOWHEN command. (GOWHEN commands are not nested.) An error is not generated when a GOWHEN command is over-written by another GOWHEN.

While waiting for a GOWHEN condition to be met **and** a start-motion command **has** been issued, if a second GOWHEN command is encountered, then the first sequence is disabled and another start-motion command is needed to re-arm the second GOWHEN sequence.

A new GOWHEN command must be issued for each start-motion command (GO, FGADV, FSHFC, or FSHFD). That is, once a GOWHEN condition is met and the motion command is executed, subsequent motion commands will not be affected by the same GOWHEN command.

If the GOWHEN and start-motion commands are issued, the motion profile is delayed until the GOWHEN condition is met. If a second start-motion command is encountered, the second start-motion command will override the GOWHEN command and start motion. If this override situation is not desired, it can be avoided by using a WAIT condition between the first start-motion command and the second start-motion command.

It is probable that the GOWHEN command, the GO command, and the GOWHEN condition becoming true may be separated in time, and by other commands. Situations may arise, or commands may be given which make the GOWHEN invalid or inappropriate. In these cases, the GOWHEN condition is cleared, and any motion pending the GOWHEN condition becoming true is canceled. These situations include execution of the JOG, JOY, HOM, PRUN, and DRIVEØ commands, as well motion being stopped due to hard or soft limits, a drive fault, an immediate stop (!S), or an immediate kill (!K or ^K).

`GOWHEN` in Compiled Motion: When used in a compiled program, a `GOWHEN` will pause the profile in progress (motion continues at constant velocity) until the `GOWHEN` condition evaluates true. When executing a compiled Following profile, the `GOWHEN` is ignored on the reverse Following path (i.e., when the master is moving in the opposite direction of that which is specified in the `FOLMAS` command). A compiled `GOWHEN` may require up to 4 segments of compiled memory storage.

Example:

In the example below, the axis must start motion when input 3 becomes active. While input 3 is off, the program must be monitoring inputs and serving other system requirements, so a `WAIT` statement cannot be used; instead, a `GOWHEN` and `GO` sequence will delay the profile of the axis.

```
SCALE1           ; Enable scaling
SCLV25000        ; Set velocity scaling factor
SCLD10000        ; Set distance scaling factor
DEL proga        ; Delete program called proga
DEF proga        ; Begin definition of program called proga
MC0              ; Set to preset move mode
D20              ; Set distance end-point
COMEXC1          ; Enable continuous command execution mode
V1               ; Set velocity
A100             ; Set acceleration
GOWHEN(IN.3=B1)  ; Delay profile. When the expression is true
                 ; (input 3 is active), allow the axis to start motion
GO1              ; Command axis to move. Axis will not start until
                 ; conditions in the GOWHEN statement are true.
                 ; Command processing does not wait, so other system
                 ; functions may be performed.
END              ; End definition of program
```

HALT Terminate Program Execution

Type	`Program Flow Control`
Syntax	`<!>HALT`
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	`BP, BREAK, C, ELSE, IF, K, NIF, NWHILE, PS, REPEAT, S, T, UNTIL, WAIT, WHILE`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HALT` command terminates program execution when processed. This command allows the user to terminate command processing at any point in a program. The programmer may want processing to stop because of an error condition, an input, a variable, or just after a specific motion has been accomplished. This command is useful when debugging a program.

Example:

```
DEF prog1        ; Define a program called prog1
GO1              ; Initiate motion
GOSUB prog2      ; Gosub to subroutine named prog2
GO1              ; Initiate motion again
END              ; End program definition
DEF prog2        ; Define a program called prog2
GO1              ; Initiate motion
IF(IN=b1X0)      ; If onboard input 1 is active (1), and input 3 is inactive (0)
HALT             ; If condition is true break out of program
ELSE             ; Else part of if condition
TPE              ; If condition does not come true transfer position of the encoder
NIF              ; End If statement
END              ; End program definition
RUN prog1        ; Execute program prog2
;
; Upon completion of motion, subroutine prog2 is called.
; If inputs 1 and 3 are in the correct state after the motion is complete,
; program processing will be terminated. In other words, all commands waiting
; to be parsed in the program buffer will be eliminated.
; **** Note: There will not be a return to prog1.
```

HELP Technical Support

		Product	Rev
Type	`Program Debug Tool`	GT6K	6.0
Syntax	`<!>HELP`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`See description below`		
See Also	`None`		

The (`HELP`) command provides the telephone numbers for technical support.

HOM Go Home

		Product	Rev
Type	`Homing`	GT6K	6.0
Syntax	`<a_><!>HOM<b>`	GV6K	6.0
Units	`n/a`		
Range	`b = 0 (home in positive direction), 1 (home in negative direction), or X (do not home)`		
Default	`X`		
Response	`n/a`		
See Also	`[ AS ], HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMEDG, HOMV, HOMVF, HOMZ, PSET, TAS, TIN, TLIM`		

The `HOM` command instructs the Gem6K drive to search for the home position in the direction specified by the command. If an end-of-travel limit is activated while searching for the home limit, the drive will reverse direction and search for home in the opposite direction. However, if a second end-of-travel limit is encountered, after the change of direction, the homing operation will be aborted.

The status of the homing operation is provided by bit 5 of the axis status register (refer to the `TAS` or `AS` command). *When the homing operation is successfully completed, the absolute position register is set to zero (equivalent to `PSETØ`).*

NOTE

Pause and resume functions are not recommended during the homing operation. A Pause command or input will pause the homing motion; however, when the subsequent Resume command or input occurs, motion will resume at the beginning of the homing motion sequence.

The homing operation has several parameters that determine the homing algorithm:

- Home acceleration (`HOMA` and `HOMAA`)
- Home deceleration (`HOMAD` and `HOMADA`)
- Home velocity (`HOMV`)
- Final home velocity (`HOMVF`)
- Home reference edge (`HOMEDG`)
- Backup to home (`HOMBAC`)
- Final home direction (`HOMDF`)
- Home to encoder Z-channel (`HOMZ`)

For more information on homing, including sample scenarios, refer to the *Homing* section of the *Programmer's Guide*.

Example:

```
SCALE1          ; Enable scaling
SCLA25000       ; Set accel. Scaling to 25000 steps/unit/unit;
SCLV25000       ; Set vel. Scaling to 25000 steps/unit;
SCLD1           ; Set distance scaling factor to 1 step/unit
DEL Homrdy      ; Delete program called Homrdy
DEF Homrdy      ; Begin definition of program called Homrdy
MA0             ; Incremental mode
MC0             ; Preset mode
HOMA10          ; Set home acceleration to 10 units/sec/sec
HOMAD20         ; Set home deceleration to 20 units/sec/sec
HOMBAC1         ; Enable backup to home switch
HOMEDG0         ; Stop on the positive-direction edge of the home switch
HOMDF0          ; Set final home direction to positive
HOMZ0           ; Disable homing to encoder Z-channel
HOMV1           ; Set home velocity to 1 units/sec
HOMVF.1         ; Sets home final velocity to 0.1 units/sec
HOM0            ; Execute go home in positive-direction
END             ; End definition of Homrdy
```

HOMA Home Acceleration

Type	`Homing`
Syntax	`<a_><!>HOMA<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 – 9999.9999`
Default	`10.0000`
Response	`HOMA:    *HOMA10.0000`
See Also	`DMEPIT, HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMEDG, HOMV, HOMVF, HOMZ, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMA` command specifies the acceleration rate to be used upon executing the next go home (`HOM`) command.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The homing acceleration remains set until you change it with a subsequent homing acceleration command. Homing accelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid homing acceleration is entered the previous homing acceleration value is retained.

If the home deceleration (`HOMAD`) command has not been entered, the home acceleration (`HOMA`) command will set the home deceleration rate. Once the home deceleration (`HOMAD`) command has been entered, the home acceleration (`HOMA`) command no longer affects home deceleration.

Example: Refer to the go home (`HOM`) command example.

HOMAA Homing Average Acceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>HOMAA<r >`
Units	`r = units/sec/sec`
Range	`0, or 0.0001 – 9999.9999`
Default	`10.00 (Default is a constant accel ramp, where HOMAA tracks HOMA. S-curve accel is achieved when HOMAA is changed independent of HOMA. To restore a constant accel ramp and tracking, set HOMAA = 0.)`
Response	`HOMAA:   *HOMAA10.0000`
See Also	`A, AD, ADA, HOM, HOMA, HOMAA, HOMAD, HOMADA, , HOMBAC, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMAA` command allows you to specify the average acceleration for an S-curve homing profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling (`SCLA`) affects `HOMAA` the same as it does for `HOMA`. Refer to page 16 for details on scaling.

Example:

```
SCALE0             ; Disable scaling
DEL proge          ; Delete program called proge
DEF proge          ; Begin definition of program called proge
MA0                ; Select incremental positioning mode
HOMA10             ; Set homing max. accel to 10 rev/sec/sec
HOMAA5             ; Set homing avg. accel to 5 rev/sec/sec
HOMAD10            ; Set homing max. decel to 10 rev/sec/sec
HOMADA5            ; Set homing avg. decel to 5 rev/sec/sec
HOM1               ; Execute a pure S-curve homing move in the negative-direction
END                ; End definition of program
```

HOMAD Home Deceleration

Type	`Homing`
Syntax	`<a_><!>HOMAD<r>`
Units	`r = units/sec/sec`
Range	`0, or 0.0001 – 9999.9999`
Default	`10.0000 (by default, HOMAD tracks HOMA until HOMAD is changed independent of HOMA; to restore tracking, set HOMAD = 0)`
Response	`HOMAD:   *HOMAD10.0000`
See Also	`HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMEDG, HOMDF, HOMV, HOMVF, HOMZ, [ LIM ], LIMEN, LIMLVL, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMAD` command specifies the deceleration rate to be used upon executing the next go home (`HOM`) command.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The home deceleration remains set until you change it with a subsequent home deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

If the `HOMAD` command has not been entered, the home acceleration (`HOMA`) command will set the deceleration rate. Once the `HOMAD` command has been entered, the home acceleration (`HOMA`) command no longer affects home deceleration. If the `HOMAD` command is set to zero (`HOMADØ`), then the homing deceleration will once again track whatever the `HOMA` command is set to.

Example: Refer to the go home (`HOM`) command example.

HOMADA Homing Average Deceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>HOMADA<r>`
Units	`r = units/sec/sec`
Range	`0.0001 – 9999.9999`
Default	`10.00 (By default, HOMADA tracks HOMAA until HOMADA is changed independent of HOMAA. To restore tracking, set HOMAD = 0.)`
Response	`HOMADA:    *HOMADA10.0000`
See Also	`A, AD, HOM, HOMA, HOMAA, HOMAD, HOMADA???, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMADA` command allows you to specify the average deceleration for an S-curve homing profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling (`SCLA`) affects `HOMADA` the same as it does for `HOMAD`. Refer to page 16 for details on scaling.

Example: Refer to the Homing Average Acceleration (`HOMAA`) command example.

HOMBAC Home Backup Enable

Type	`Homing`
Syntax	`<a_><!>HOMBAC<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`HOMBAC:  *HOMBAC0`
See Also	`HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMDF, HOMEDG, HOMV, HOMVF, HOMZ`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMBAC` command enables or disables the backup to home switch function. When this function is enabled, the motor will decelerate to a stop after encountering the active edge of the home region, and then move the motor in the opposite direction at the home final velocity (`HOMVF`) until the active edge of the home region is encountered. This motion will occur regardless of whether or not the home input is active at the end of the deceleration of the initial go home move.

Example: Refer to the go home (`HOM`) command example.

HOMDF Home Final Direction

Type	`Homing`
Syntax	`<a_><!>HOMDF<b>`
Units	`n/a`
Range	`b = 0 (positive-direction) or 1 (negative-direction)`
Default	`0`
Response	`HOMDF:   *HOMDF0`
See Also	`HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMEDG, HOMV, HOMVF, HOMZ`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMDF` command specifies the direction to be traveling when the home algorithm does its final approach. This command is operational when backup to home (`HOMBAC`) is enabled, or when homing to an encoder Z channel (`HOMZ`).

Example: Refer to the go home (`HOM`) command example.

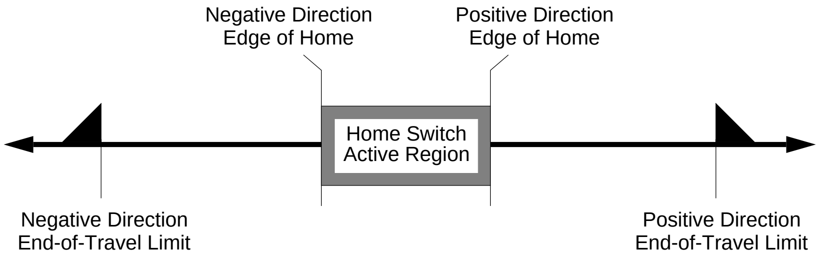
HOMEDG Home Reference Edge

Type	Homing
Syntax	`<a_><!>HOMEDG<b>`
Units	n/a
Range	b = 0 (positive-direction edge) or 1 (negative-direction edge
Default	0
Response	HOMEDG: *HOMEDG0
See Also	HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMV, HOMVF, HOMZ, INFNC, INLVL

Product	Rev
GT6K	6.0
GV6K	6.0

The HOMEDG command specifies which edge of the home switch the homing operation will consider as its final destination.

As illustrated below, the positive-direction edge of the home switch is defined as the first switch transition seen by the Gem6K when traveling off of the positive-direction end-of-travel limit in the negative direction. The negative-direction edge of the home switch is defined as the first switch transition seen by the Gem6K when traveling off of the negative-direction end-of-travel limit in the positive-direction. This command is operational when backup to home (HOMBAC) is enabled.



Example: Refer to the go home (HOM) command example.

HOMV Home Velocity

Type	Homing
Syntax	`<a_><!>HOMV<r>`
Units	r = units/sec (scalable with SCLV) (linear motors: see DMEPIT for linear/rotary conversion)
Range	Stepper Axes: 0.0000-60.0000 (after conversion to revs/sec) Servo Axes: 0.0000-200.0000 (after conversion to revs/sec; if ERES > 10,000, maximum = 2,000,000/ERES)
Default	1.0000
Response	HOMV: *HOMV1.0000
See Also	DMEPIT, HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMEDG, HOMVF, HOMZ, SCALE, SCLV

Product	Rev
GT6K	6.0
GV6K	6.0

The HOMV command specifies the velocity to use when the home algorithm begins its initial go home (HOM) move. The velocity remains set until you change it with a subsequent home velocity command. Velocities outside the valid range are flagged as an error, with a message *INVALID DATA-FIELD x, where x is the field number. When an invalid velocity is entered the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the go home (HOM) command example.

HOMVF Home Final Velocity

Type	`Homing`
Syntax	`<a_><!>HOMVF<r>`

Units	`r = units/sec (scalable with SCLV)`
	`(linear motors: see DMEPIT linear/rotary conversion)`

Range	`Stepper Axes: 0.0000-60.0000  (after conversion to revs/sec)`
	`Servo Axes:   0.0000-200.0000 (after conversion to revs/sec;`
	`if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`0.1000`
Response	`HOMVF:   *HOMVF0.1000`
See Also	`DMEPIT, HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMEDG, HOMV, HOMZ, SCALE, SCLV`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMVF` command specifies the velocity to use when the home algorithm does its final approach. This command is only operational when backup to home (`HOMBAC`) is enabled, or when homing to an encoder Z channel (`HOMZ`).

The velocity remains set until you change it with a subsequent home final velocity command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered, the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the go home (`HOM`) command example.

HOMZ Home to Encoder Z-channel Enable

Type	`Homing`
Syntax	`<a_><!>HOMZ<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`HOMZ:    *HOMZ0`
See Also	`[ ASX ], HOM, HOMA, HOMAA, HOMAD, HOMADA, HOMBAC, HOMDF, HOMEDG, HOMV, HOMVF, INFNC, INLVL, TASX`

Product	Rev
GT6K	6.0
GV6K	6.0

The `HOMZ` command enables homing to an encoder z-channel after the initial home input has gone active. NOTE: The home limit input is required to go active prior to homing to the Z channel. The state of the Z-channel is reported with bit 6 of the `ASX` and `TASX` register.

Example: Refer to the go home (`HOM`) command example.

IF( ) IF Statement

Type	`Program Flow Control or Conditional Branching`
Syntax	`<a_><!>IF(expression)`
Units	`n/a`
Range	`Up to 80 characters (including parentheses)`
Default	`n/a`
Response	`n/a`
See Also	`ELSE, NIF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `IF` command is used in conjunction with the `ELSE` and `NIF` commands to provide conditional branching. If the expression contained within the parenthesis of the `IF` command evaluates true, then the commands between the `IF` and the `NIF` are executed. If the expression evaluates false, the commands between the IF and the NIF are ignored, and command processing continues with the first command following the NIF.

When the ELSE command is used in conjunction with the IF command, true IF evaluations cause the commands between the IF and ELSE commands to be executed, and the commands after the ELSE until the NIF are ignored. False IF evaluations cause commands between the ELSE and the NIF to be executed, and the commands between the IF and the ELSE are ignored. The ELSE command is optional and does not have to be included in the IF statement.

The IF( ).. ELSE .. NIF structure can be nested up to 16 levels deep.

NOTE: Be careful about performing a GOTO between IF and NIF. Branching to a different location within the same program will cause the next IF statement encountered to be nested within the previous IF statement, unless a NIF command has already been encountered.

IF statement programming order: IF(expression)...commands...NIF
or
IF(expression)...commands...ELSE...commands...NIF

All logical operators (AND, OR, NOT), and all relational operators (=, >, >=, <, <=, <>) can be used within the IF expression. There is no limit on the number of logical operators, or on the number of relational operators allowed within a single IF expression. The limiting factor for the IF expression is the command length. **The total character count for the IF command and expression cannot exceed 80 characters.** (e.g., If you add up the letters in the IF command and the letters within the ( ) expression, including the parenthesis and excluding each space, this count must be less than or equal to 80.)

All assignment operators (A, AD, AS, ASX, D, ER, IN, MOV, OUT, PC, PCE, PCM, PE, PER, PMAS, SEG, SS, TIM, US, V, VEL, VELA, etc.) can be used within the IF expression.

Multiple parentheses may not be used within the IF command.

Example:

```
IF(IN=b1X0 AND VAR1=1)        ; If input 1 is ON, input 3 is OFF, and
                              ; variable 1 equals 1, then the IF statement evaluates
                              ; true, so commands between this statement and NIF
                              ; are executed
  TREV                        ; Transfer revision level
  NIF                         ; End IF statement
IF(A<5000 AND PC>50000)       ; If the acceleration is less than 5000, and
                              ; the commanded position is greater than
                              ; 50000, then do the IF statement. Note: The
                              ; acceleration value used is programmed acceleration,
                              ; not actual.
  VAR1=VAR1+1                 ; Increment variable 1
  NIF                         ; End if statement
IF(VEL<123 OR VEL>156)        ; If the current velocity is less than 123
                              ; or if it is greater than 156, then do the commands
                              ; following the IF statement
  WRITE"Something's Wrong\13" ; Put message Something's Wrong<cr> in output buffer
  NIF                         ; End if statement
IF(OUT=b110X1 AND VAR1<=13)   ; If outputs 1, 2 and 5 are ON, output 3 is
                              ; off and variable 1 is less than or equal to 13,
                              ; then set variable 1 equal to variable 1 plus 1,
                              ; else set variable 1 equal to variable 1 minus 1
  VAR1=VAR1+1
  ELSE
  VAR1=VAR1-1
  NIF                         ; End IF statement
```

IN Virtual Input Override

Type	`Inputs`	**Product**	**Rev**
Syntax	`<a_><!><B>IN<=xx>`	GT6K	6.0

Units	`B = I/O brick number`
	`xx = 32-bit data operand (see list below)`
		GV6K	6.0

Range	`B = 1-8`		
Default	`n/a`		
Response	`n/a`		
See Also	`[ IN ], INDEB, INEN, INFNC, INPLC, INSTW, TIN, TIO`		

The `IN` command allows you to substitute almost any 32-bit data parameter as a virtual input brick of 32 inputs. The virtual inputs behave similarly to real inputs in that they are affected by `INEN` and `INLVL`, and they affect `INFNC`, `INPLC`, `INSTW`, `INDUST`, `ONIN`, and `GOWHEN(<B>IN=b<bbbb>)` commands. Unlike real inputs, virtual inputs are not affected by the `INDEB` debounce setting.

The data operands allowed for virtual input assignments are listed below (integer values are converted to binary):

`A`	Acceleration	`NMCY`	Master cycle number	`SWAP`	Task swap assignment
`AD`	Deceleration	`OUT`	Output status	`TASK`	Task number
`ANI`	Analog input voltage	`PC`	Commanded position	`TIM`	Timer value
`ANO`	Analog output voltage	`PCC`	Captured command pos.	`TRIG`	Trigger interrupt status
`AS`	Axis status	`PCE`	Captured encoder pos.	`US`	User-defined status
`ASX`	Extended axis status	`PCME`	Captured master enc. pos.	`V`	Velocity
`D`	Distance	`PE`	Encoder position	`VARI`	Integer variable
`DKEY`	RP240 keypad value	`PER`	Position error	`VARB`	Binary variable
`ER`	Error status	`PMAS`	Position of Master	`VEL`	Commanded velocity
`FB`	Feedback device pos.	`PME`	Master encoder pos.	`VELA`	Actual velocity
`FS`	Following status	`PSHF`	Net position shift	`VMAS`	Velocity of the master
`IN`	Input status	`PSLV`	Follower pos. command		
`INO`	Enable input status	`SC`	Controller status		
`LIM`	Limit input status	`SCAN`	PLC scan time		
`MOV`	Axis moving status	`SEG`	Free segment buffers		
		`SS`	System status		

NOTE: A virtual input can only be defined for I/O bricks that are not connected on the serial I/O network (remember that up to 8 I/O bricks are allowed). For example, if your Gem6K unit has two I/O bricks, you can designate I/O bricks 3-8 as virtual I/O bricks.

Virtual inputs provide programming input functionality for data or external events (see operand list above) that are not ordinarily represented by inputs.

For example, suppose a PLC is sending binary data via the `VARB1` command to the Gem6K. If the binary state of `VARB1` is assigned to input brick 2 (`2IN=VARB1`), the Gem6K can respond based on programmable input functions set up with the `INFNC` command.

```
2TIN              ; Brick 2 is not connected; therefore, the Gem6K will
                  ; respond with an error message: "*INCORRECT I/O BRICK"
2IN=VARB1         ; Map the binary state of VARB1 to be the
                  ; input state of "virtual" input brick 2 (2IN)
VARB1=b10100000   ; Change "virtual" input brick 2IN to a new VARB1 value
2TIN              ; Check the input status. The response will be:
                  ; "*2IN1010_0000_0000_0000_0000_0000_0000_0000"
```

[IN] Input Status

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`GOWHEN, IN, INFNC, [ LIM ], ONIN, TIN, VARB`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `IN` operator to assign the input value to a binary variable (`VARB`), or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=<B>IN` where “`n`” is the binary variable number and “`<B>`” is the number of the I/O brick where the input resides (not required if addressing inputs on the Gem6K’s DRIVE I/O connector), or `IN` can be used in an expression such as `IF(2IN=b11Ø1)`, or `IF(2IN=h7F)`. To assign only one input value to a binary variable, instead of all the inputs, the bit select (`.`) operator can be used. For example, `VARB1=2IN.10` assigns the binary state of input 10 (2nd pin on SIM 2) on I/O brick 2 to binary variable 1.

The function of the inputs is established with the `INFNC` command (although the `IN` operator looks at any trigger or external digital input, regardless of its assigned function from the `INFNC` command).

Example:

```
VARB1=3IN           ; Input status on I/O brick 3 assigned to binary variable 1
VARB2=2IN.12        ; Input bit 12 on I/O brick 2 assigned to binary variable 2
VARB2               ; Response if bit 12 is set to 1:
                    ; *VARB2=XXXX_XXXX_XXX1_XXXX_XXXX_XXXX_XXXX_XXXX
IF(1IN=b111011X11)  ; If the input status contains 1's for inputs 1,2,3,5,6,8,& 9,
                    ; and 0 for input 4 on I/O brick 1, do the commands
                    ; following the IF statement
TREV                ; Transfer revision level
NIF                 ; End IF statement
IF(2IN=hEF00)       ; If the input status contains 1's for I/O brick 2's inputs
                    ; 1,2,3,5,6,7,& 8, and 0's for every other input, do the
                    ; commands following the IF statement
TREV                ; Transfer revision level
NIF                 ; End IF statement
```

INDEB Input Debounce Time

Type	`Input`
Syntax	`<a_><!><B>INDEB<i>`
Units	`i = time in milliseconds (ms)`
Range	`i = 2-250`
Default	`4`
Response	`INDEB:   *INDEB4`
See Also	`INFNC, INLVL, LIMFNC, RE, REG, TIN, TLIM, TRGFN, TRGLOT`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INDEB` command governs the debounce time for the onboard inputs on the DRIVE I/O connector, or inputs on a specified I/O brick. The debounce time is the period of time that the input must be held in a certain state before the drive recognizes it. This directly affects the rate at which the inputs can change state and be recognized. The default setting is 4 ms.

Exception for Trigger Inputs: For inputs that are assigned the “Trigger Interrupt” function (`INFNCi-H`), the debounce is instead governed by the `TRGLOT` setting. The `TRGLOT` setting applies to all inputs defined as “Trigger Interrupt” inputs. The `TRGLOT` debounce time is the time required between a trigger's initial active transition and its secondary active transition. This allows rapid recognition of a trigger, but prevents subsequent bouncing of the input from causing a false position capture. The default setting is 24 ms.

Limit Inputs. The limit inputs found on the DRIVE I/O connector are not normally debounced; however, if a limit is assigned a different function with the `LIMFNC` command (other than `LIMFNCi-R`, `LIMFNCi-S`, or `LIMFNCi-T`), the input is debounced using the `INDEB` setting for the onboard inputs. If a general-purpose input is assigned a limit input function (`INFNCi-R`, `INFNCi-S`, or `INFNCi-T`), the input will not be debounced.

Example:

```
INDEB6          ; Assign all onboard inputs a debounce time of 6 ms (inputs
                ; assigned as triggers with INFNCi-H will not be debounced)
2INDEB10        ; Assign inputs on I/O brick 2 a debounce time of 10 ms
1INDEB12        ; Assign inputs on I/O brick 1 a debounce time of 12 ms
```

INDUSE Enable/Disable User Status

Type	`Drive Configuration`
Syntax	`<a_><!>INDUSE<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`INDUSE:  *INDUSE0`
See Also	`INDUST, ONUS, TUS, [ US ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INDUSE` command enables the `INDUST` command updates. When this command is not enabled, the user status bits (`INDUST`) can be defined; however, they will not be updated in the `US` or the `TUS` commands until `INDUSE` is enabled.

Example:

```
INDUSE1         ; Enable user status
```

INDUST User Status Definition

		Product	Rev
Type	`Drive Configuration`	GT6K	6.0
Syntax	`<a_><!><B>INDUST<i><-<i><c>>`	GV6K	6.0
Units	`See description below`		
Range	`1st i = 1 - 16; 2nd i = 1 - 32; c = A through S`		
Default	`See description below`		

Response	`INDUST:  *INDUST1-1A AXIS 1 STATUS - STATUS OFF`
	`(...repeated for all 16 user status bits...)`
	`*INDUST16-16A AXIS 1 STATUS - STATUS OFF`
	`INDUST1: *INDUST1-1A AXIS 1 STATUS - STATUS OFF`		

See Also	`[ AS ], [ ASX ], [ IN ], INDUSE, ONUS, [ SS ], TAS, TASX, TIN, TSS, TUS, [ US ]`		

The INDUST command establishes the user status bit function. Each bit can correspond to an axis status bit, a system status bit, an input, an interrupt bit, or an extended axis status bit. The default for each user status bit is as follows:

Default for the Gem6K product (first two AS status bits):

Bits 1-16 = first 16 bits of axis status (AS)

The purpose of this command is to allow the user to create his or her own meaningful status word. It allows the user to place certain status information in the order they prefer.

The syntax <B>INDUST<i><-<i><c>> is described as follows:

- First <i> corresponds to the user status bit being defined (16 maximum).
- Second <i> corresponds to the bit of the axis status (AS), the system status (SS), the input status (IN), or the extended axis status (ASX).
- The <c> defines what status to use:

<c> Value	Function	<c> Value	Function
A	Use axis status (AS)	K	RESERVED
B - H	RESERVED	L	Use extended axis status (ASX)
I	Use system status (SS) *	M - S	RESERVED
J	Use input status (IN) **		

* If you are using multitasking, the “I” value requires you to prefix the INDUST command with the task identifier (e.g., 2%INDUST6-2I assigns system status bit 2 for task 2 to user status bit 6). If no task prefix is given, the system status for task zero is used by default.

** The “J” value requires you to prefix the INDUST command with the I/O brick identifier (e.g., 2INDUST14-4J assigns the status of I/O point on I/O brick 2 to user status bit 14). If no brick prefix is given, the onboard inputs are referenced by default. Refer to page 8 to fully understand the I/O bit patterns and use of the brick identifier.

Example

```
INDUSE1          ; Enable user status
INDUST1-5A       ; User status bit 1 defined as axis status bit 5
INDUST2-3A       ; User status bit 2 defined as axis status bit 3
3INDUST3-5J      ; User status bit 3 defined as input 5 on I/O brick 3
2%INDUST16-2I    ; User status bit 16 defined as system status bit 2 for task 2
```

INEN Input Enable

Type	Input or Program Debug Tool
Syntax	`<a_><!><@><B>INEN<d><d>...<d>    (one <d> for each input)`
Units	n/a

Range	`d = 0 (disable, leave off), 1 (disable, leave on),`
	`E (enable), or X (don't change)`

Default	E

Response	`INEN:    *INENEEEE_E`
	`1INEN:   *1INENEEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE`
	`1INEN.3  *E`

See Also	ERROR, IN, [IN], INFNC, INLVL, INPLC, INSTW, KIOEN, LH, LIMEN, TIN, TIO, TSTAT

Product	Rev
GT6K	6.0
GV6K	6.0

The `INEN` command allows you to simulate the activation of specific general-purpose inputs or external digital inputs (without actually wiring the inputs) by disabling them and setting them to a specific level (ON or OFF).

The default `INEN` condition is enabled (`E`), requiring external wiring to exercise the input's respective `INFNC` function.

Using Inputs on Expansion I/O Bricks: If the I/O brick is disconnected or if it loses power, the drive will perform a kill (all tasks) and set error bit #18 (see `ERROR`). (If you disable the "Kill on I/O Disconnect" mode with `KIOENØ`, the Gem6K will not perform the kill.) The drive will remember the brick configuration (volatile memory) in effect at the time the disconnection occurred. When you reconnect the I/O brick, the drive checks to see if anything changed (SIM by SIM) from the state when it was disconnected. If an existing SIM slot is changed (different SIM, vacant SIM slot, or jumper setting), the drive will set the SIM to factory default `INEN` and `OUTLVL` settings. If a new SIM is installed where there was none before, the new SIM is auto-configured to factory defaults.

Example: `INEN1` disables input 1 but leaves it in the ON state (the `TIN` command will show input 1 as active). `INENØ` disables input 1 but leaves it in the OFF (inactive) state. To re-enable input 1, issue the `INENE` command.

`INEN` has no effect on ...

- Inputs when they are configured as "trigger interrupt" inputs with the `INFNCi-H` command. This includes position capture and registration functions.
- Inputs configured as "end-of-travel limit" inputs with the `INFNCi-R` or `INFNCi-S` commands. Instead, use the `LH` command.

Input bit assignments for the `INEN` command vary by external I/O brick configuration. The input bit patterns for general-purpose inputs and external I/O bricks are explained on page 8 of this document.

Example:

```
DEF tester          ; Begin definition of program tester
WHILE(IN=b11X10)    ; While inputs 1, 2, and 4 are active, and input 5 is not
                    ; active, execute the statements between the WHILE & NWHILE
GO1                 ; Initiate motion
NWHILE              ; End WHILE statement
END                 ; End definition of program tester
INEN11X10           ; Disable inputs 1,2,4, & 5, and set inputs 1, 2 & 4 in
                    ; the active state, and input 5 in the inactive state
RUN tester          ; Initiate program tester
!INEN00000          ; Disable onboard inputs 1,2,3,4, & 5, and leave them in the
                    ; inactive state
INENeeeee           ; Re-enable inputs 1 through 5
```

INFNC Input Function

Type	`Input`
Syntax	`<a_><!><B>INFNC<i>-<<a>c>`

Units	`i = input #,`
	`a = program # for function P;`
	`c = function identifier letter`

Range	`i = 1-32 (I/O brick dependent — see page 8);`
	`c = A-T`

Default	`All inputs set to A (general-purpose)`

Response	`INFNC:   (input function and status of general-purpose inputs)`
	`1INFNC:  (input function and status of I/O brick 1 inputs)`
	`1INFNC1: *1INFNC1-A NO FUNCTION - STATUS OFF`

See Also	`COMEXR, COMEXS, ENCCNT, [ ER ], ERROR, [ IN ], INDEB, INEN, INLVL, INPLC, INSELP, INSTW, INTHW, JOY, JOYAXH, JOYVH, JOYVL, K, KDRIVE, LH, LIMFNC, PSET, [ SS ], TER, TIN, TIO, TRGFN, TRGLOT, [ TRIG ], TSS, TSTAT, TTRIG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INFNC` command defines the function of each individual input, where *`i`* is the input bit number, or the program number for the case of input function P, and *`c`* is the function. A limit of 32 inputs may be assigned `INFNC` functions; this excludes functions `A` ("general-purpose") and `H` ("trigger interrupt").

Input Debounce. Using the Input Debounce Time (`INDEB`) command, you can change the input debounce time for all general-purpose inputs. The debounce is the period of time that the input must be held in a certain state before the Gem6K recognizes it. This directly affects the rate at which the inputs can change state and be recognized. Inputs that are assigned the "Trigger Interrupt" function (`INFNCi-H`), are instead debounced by the `TRGLOT` value. Inputs defined as limit inputs (`INFNCi-R`, `INFNCi-S`, or `INFNCi-T`), will not be debounced.

Input bit assignments vary. The input bit patterns for onboard and external I/O bricks are explained on page 8 of this document.

Input Scan Rate. The programmable inputs are scanned once per *system update* (2 milliseconds).

Multitasking. If the `INFNC` command does not include the task identifier (`%`) prefix, the function affects the task that executes the `INFNC` command. The functions that may be directed to a task with `%` are: `C`, `D`, `E`, `F`, and `P` (e.g., `2%INFNC3-F` assigns onboard input 3 as a user fault input for task 2). Multiple tasks may share the same input, but the input may only be assigned one function.

Identifier **Function Description**

A **General Purpose Input.** Normal input, used with the `IN` assignment

B **BCD Program Select.** BCD input assignment to programs, lowest numbered input is least significant bit (LSB). BCD values for inputs are as follows:

	BCD Value
Least Significant Bit Value	1
.	2
.	4
.	8
.	10
.	20
.	40
.	80
Most Significant Bit Value	100

Note: If fewer inputs than shown above are defined to be Program Select Inputs, then the highest input number defined as a Program Select Input is the most significant bit.

An input defined as a BCD Program Select Input will not function until the `INSELP` command has been enabled.

Identifier **Function Description**

C **Kill.** Kills motion and halts all command processing (refer to K and KDRIVE command descriptions for further details on the *kill* function). This is an edge detection function and is not intended to inhibit motion. To inhibit motion, use the Pause/Resume function (INFNCi-E). When enabled with the ERROR command, bit #6 of the TER and ER commands will report the kill status.

D **Stop.** Stops motion. If COMEXS is set to zero (COMEXSØ), program execution will be terminated. If COMEXS is set to 1 (COMEXS1), command processing will continue. With COMEXS set to 2 (COMEXS2), program execution is terminated, but the INSELP value is retained. Motion deceleration during the stop is controlled by the AD & ADA commands. If error bit #8 is enabled (e.g., ERROR.8-1), activating a Stop input will set the error bit and cause a branch to the ERRORP program. Activating a Stop input does not return a prompt to the terminal.

E **Pause/Continue.** If COMEXR is disabled (COMEXRØ), then only command execution pauses, not motion. With COMEXR enabled (COMEXR1), both command and motion execution are paused. After motion stops, you can release the input or issue a continue (!C) command to resume command processing (and motion in COMEXR1 mode).

F **User Fault.** Refer to the ERROR command. If error bit #7 is enabled (e.g., ERROR.7-1), activating a User Fault input will set the error bit and cause a branch to the ERRORP program. **CAUTION**: Activating the user fault input sends a !K command to the drive, “killing” motion (refer to the K command description for ramifications).

G **Reserved**

H **Trigger Interrupt** - This function can only be assigned to the general-purpose inputs on the DRIVE I/O connector, as specified below:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

A “Trigger Interrupt” input can be used for these purposes:

- **Position Capture**. You can assign up to two trigger inputs, referred to as “TRIG-A” and “TRIG-B. If assigned, TRIG-A must be on onboard input #1 (pin 37). TRIG-B must be on onboard input #2 (pin 38). These inputs are located on the 25-pin DRIVE I/O connector. To assign TRIG-A and TRIG-B, use the INFNC1-H and INFNC2-H commands, respectively.

  When assigned the Trigger Interrupt function, activating the input performs a *hardware capture* of axis position. If the axis is used as a follower in Following, activating the trigger also performs an *interpolated capture* of the associated master axis position.

  You can assign an additional “Master Trigger”, referred to as “TRIG-M”. If assigned, TRIG-M must be on onboard input #5 (pin 35). TRIG-M may be used to perform a hardware capture of the “MASTER ENCODER” (the encoder connected to the “Master Encoder” connector), as well as axis position (encoder position on servo axes; commanded or encoder position for steppers, depending on the ENCCNT setting). To assign trigger interrupt input TRIG-M to input #5, use the INFNC5-H command.

  When a Trigger Interrupt input is activated, the drive captures the relevant positions and stores them in registers that are available at the next system update (2 ms) through the use of these transfer and assignment/comparison commands:

Captured Information	Transfer	Assignment/Comparison	Offset *	Scale Factor **
Commanded position	TPCC	PCC	PSET	SCLD
Encoder position	TPCE	PCE	PSET or PESET	SCLD
Master encoder position	TPCME	PCME	PMESET	SCLMAS
Master cycle position	TPCMS	PCMS	PSET	SCLMAS

* Captured values are offset by any existing PSET or PMESET offset.

** If scaling is enabled, the captured position is scaled by SCLD or SCLMAS.

More about Trigger Interrupt function on next page …

Identifier Function Description

H (con't.) *Continued from previous page (Trigger Interrupt function):*

NOTES ABOUT POSITION CAPTURE:

- Hardware Capture: The encoder position is captured within ± 1 encoder count. The commanded position capture accuracy is ± 1 count.
- Interpolated Capture: There is a time delay of up to 50 µs between activating the trigger interrupt input and capturing the position; therefore, the accuracy of the captured position is equal to 50 µs multiplied by the velocity of the axis at the time the input was activated.
- Servo vs. Stepper. The nature of the axis position captured with a Trigger Interrupt input may be different, depending on whether the drive is a servo (GV6K) or stepper GT6K. For servo axes, both the commanded and encoder position for the axis are captured. For stepper axes, if the `ENCCNT` command is set to `ENCCNT0` (default condition), only the commanded position is captured. If `ENCCNT1` mode is enabled, only the encoder position is captured.

- **Registration**. (see `RE` description for details)
- **Special trigger functions** defined with the `TRGFN` command (see `TRGFN` for details).

NOTES ABOUT TRIGGER INTERRUPT INPUTS:

- When an input is assigned the "Trigger Interrupt" function, the debounce is governed by the `TRGLOT` command setting (default is 24 ms). The `TRGLOT` setting overrides the existing `INDEB` setting for only the inputs that are assigned the "Trigger Interrupt" function.
- When an input is assigned the "Trigger Interrupt" function, the input cannot be affected by the input enable (`INEN`) command.
- Trigger Interrupt Status: Use the `TTRIG` and `TRIG` commands to ascertain if a trigger interrupt input has been activated. `TTRIG` displays the status as a binary report, and `TRIG` is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an `IF` statement). The `TTRIG`/`TRIG` bits are cleared when the respective captured position is read (see table above).

I **Alarm Event** - Will cause the Gem6K drive to set an Alarm Event in the Communications Server over the Ethernet interface. You must first enable the Alarm checking bit for this input-driven alarm (`INTHW.23-1`). For details on using alarms, refer to the *Programmer's Guide*.

J **JOG positive-direction** - Will jog the axis in a positive direction. The `JOG` command must be enabled for this function to work.

K **JOG negative-direction.** Will jog the axis in a negative direction. The `JOG` command must be enabled for this function to work.

L **JOG Speed Select.** Selects the high or low velocity range while jogging. If the input is active, the high jog velocity range will be selected.

M **Joystick Release.** Signals the drive to end joystick operation and resume program execution with the next statement in your program. When the input is open (high), the joystick mode is disabled (joystick mode can be enabled only if the input is closed, and only with the `JOY` command). When the input is closed (low), joystick mode can be enabled with the `JOY` command. The process of using Joystick mode is:

1. Assign the "Joystick Release" input function to a programmable input.
2. At the appropriate place in the program, enable joystick control of motion (with the `JOY` command). (Joystick mode cannot be enabled unless the "Joystick Release" input is closed.) When the `JOY` command enables joystick mode, program execution stops (assuming the Continuous Command Execution Mode is disabled with the `COMEXCØ` command).
3. Use the joystick to move the axis as required.
4. When you are finished using the joystick, open the "Joystick Release" input to disable the joystick mode. This allows program execution to resume with the next statement after the initial `JOY` command that started the joystick mode.

N **Reserved**

Identifier	Function Description
O	**Joystick Velocity Select.** Allows you to select the velocity for joystick motion. The JOYVH and JOYVL commands establish two joystick velocities. Opening the Velocity Select input (input is high) selects the JOYVH configuration. Closing the Velocity Select input (input is low) selects the JOYVL configuration. The JOYVL velocity could be used to quickly move to a location, the JOYVH velocity could be used for low-speed accurate positioning. NOTE: When this input is not connected, joystick motion always uses the JOYVH velocity setting.
aP	**Program Select.** One to one correspondence for input vs. program number. The program number comes from the TDIR command. The number specified before the program name is the number to specify within this input definition. For example, in the 2INFNC1-3P command, 3 is the program number. An input defined as a Program Select Input will not function until the INSELP command has been enabled.
Q	**Program Security.** Issuing the INFNCi-Q command enables the *Program Security* feature and assigns the *Program Access* function to the specified programmable input. The program security feature denies you access to the DEF, DEL, ERASE, MEMORY, INFNC and LIMFNC commands until you activate the program access input. Being denied access to these commands effectively restricts altering the user memory allocation. If you try to use these commands when program security is active (program access input is not activated), you will receive the error message *ACCESS DENIED. *The INFNCi-Q command is not saved in battery-backed RAM, so you may want to put it in the start-up program (STARTP).* For example, once you issue the 3INFNC12-Q command, the input on the 4th pin on SIM2 (I/O point 12) of I/O brick 3 is assigned the program access function and access to the DEF, DEL, ERASE, MEMORY, INFNC, and LIMFNC commands will be denied until you activate the input. To regain access to these commands without the use of the program access input, you must issue the INEN command to disable the program security input, make the required user memory changes, and then issue the INEN command to re-enable the input. For example, if input 3 on brick 2 is assigned as the Program Security input, use 2INEN.3=1 to disable the input and leave it activated, make the necessary user memory changes, and then use 2INEN.3=E to re-enable the input.
R	**End-of-Travel Limit, Positive Direction.** This assigns the positive direction end-of-travel limit input function. For example, INFNC1-R assigns the "Positive EOT limit" function to general-purpose input #1. “Positive direction” correlates to motion in the positive-counting direction as reported with TPE and TPC. **REMEMBER**: Once an input is assigned a limit function, it is no longer debounced (INDEB has no effect), and it must be enabled/disabled with the LH command instead of the INEN command.
S	**End-of-Travel Limit, Negative Direction.** This assigns the negative direction end-of-travel limit input function. For example, INFNC2-S assigns the "Negative EOT limit" function to general-purpose input #2. “Negative direction” correlates to motion in the negative-counting direction as reported with TPE and TPC. **REMEMBER**: Once an input is assigned a limit function, it is no longer debounced (INDEB has no effect), and it must be enabled/disabled with the LH command instead of the INEN command.
T	**Home Limit.** This assigns the home limit input function. For example, INFNC3-T assigns the "Home limit" function to general-purpose input #3. **REMEMBER**: Once an input is assigned a limit function, it is no longer debounced. For more information on homing, refer to the HOM command and the Homing section in the *Programmer’s Guide*.

Example:

```
3INFNC1-D        ; Input at I/O point #1 on brick 3 is defined to be a stop input
```

INLVL Input Active Level

Type	`Input`
Syntax	`<a_><!><@><B>INLVL<b><b>...<b><b`
Units	`n/a`
Range	`b = 0 (active low), 1 (active high, or X (don’t change))`
Default	`0`

Response	`INLVL:     *INLVL0000_0`
	`1INLVL:    *1INLVL0000_0000_0000_0000_0000_0000_0000_0000`
	`1INLVL.3:  *0 (active low)`

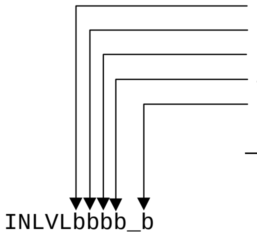
See Also	`INDEB, INEN, INFNC, INPLC, INSTW, TIN, TIO`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INLVL` command defines the active state of the general-purpose inputs on the DRIVE I/O connector, and on external I/O bricks. Example: `INLVL11000` sets the active level for onboard inputs 1 & 2 to active high, all other onboard inputs are set to active low.

`INLVL` bit assignments for inputs on the DRIVE I/O connector (bits are numbered 1-5 from left to right):

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)



Active Level Relationships (inputs on the DRIVE I/O connector):

Active Level	Sinking/Sourcing *	Switch	`TIN` and `IN` status
`INLVL0` (active low)	Sourcing	Closed (connected to ground)	`1`
`INLVL0` (active low)	Sourcing	Open	`0`
`INLVL1` (active high)	Sourcing	Closed (connected to ground)	`0`
`INLVL1` (active high)	Sourcing	Open	`1`
`INLVL0` (active low)	Sinking	Closed (connected to +V)	`0`
`INLVL0` (active low)	Sinking	Open	`1`
`INLVL1` (active high)	Sinking	Closed (connected to +V)	`1`
`INLVL1` (active high)	Sinking	Open	`0`

* The inputs are factory configured to source current. If you wish the inputs to sink current, connect the pull-up terminals (pins 27 and 33) on the **DRIVE I/O** connector to ground (see the *Hardware Installation Guide* for wiring instructions). Pin 27 is the pull up for limit inputs 1-3, and pin 33 is the pull up for general-purpose inputs 1-5.

Active Level Relationships (external SIM8-IN-EVM32 inputs on an EVM32 I/O brick):

Active Level *	Jumper Selection *	Switch	Voltage at Input	LED	`IN`/`TIN`/`TIO` Report
`INLVL0` (active low)	Position 3 (sourcing)	Open	≥ 2/3 of V+	On	`0`
`INLVL0` (active low)	Position 3 (sourcing)	Closed	< 1/3 of V+	Off	`1`
`INLVL1` (active high)	Position 3 (sourcing)	Open	≥ 2/3 of V+	On	`1`
`INLVL1` (active high)	Position 3 (sourcing)	Closed	< 1/3 of V+	Off	`0`
`INLVL0` (active low)	Position 1 (sinking)	Open	< 1/3 of V+	Off	`1`
`INLVL0` (active low)	Position 1 (sinking)	Closed	≥ 2/3 of V+	On	`0`
`INLVL1` (active high)	Position 1 (sinking)	Open	< 1/3 of V+	Off	`0`
`INLVL1` (active high)	Position 1 (sinking)	Closed	≥ 2/3 of V+	On	`1`

* Factory default: `INLVL0` (active low) and jumper in position 3 (sourcing). Move jumper to position 1 for sinking.

Example:

```
2INLVL0101       ; Set active level for these inputs on I/O brick 2:
                 ; inputs 1 & 3 are active low, inputs 2 & 4 are active high.
```

[INO] Other Input Status

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`[ IN ], [ LIM ], TINO, TINOF`

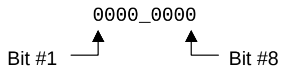
Product	Rev
GT6K	6.0
GV6K	6.0

Use the `INO` command to assign an other input value to a binary variable, or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=INO` where n is the binary variable number
or `[ INO ]` can be used in an expression such as `IF(INO=b11Ø1)`, or `IF(INO=hØ2)`

There are 8 other inputs available for assignment or comparison. To assign only one bit (one specific input) value to a binary variable, instead of all 8, use the bit select (`.`) operator . For example, `VARB1=INO.6` assigns the status of the `ENABLE` input to binary variable 1.

Format for binary assignment:



Bit	Function	Location
1-5	RESERVED	
6	Enable input (1 = OK for motion)	DRIVE I/O connector
7-8	RESERVED	

Example:

```
VARB2=INO.6        ; ENABLE input status assigned to binary variable 2
VARB2              ; Response if bit 6 is set to 1: *VARB2=XXXX_X1XX
IF(INO.6=b1)       ; If ENABLE input status is 1 (OK for motion), do the commands
                   ; following the  IF statement until the NIF statement
TREV               ; Transfer revision level
NIF                ; End if statement
```

INPLC Establish PLC Data Inputs

Type	`Input`
Syntax	`<a_><!><B>INPLC<i>,<i-i>,<i>,<i>`
Units	`See below`
Range	`See below`
Default	`1,0—0,0,0`

Response	`INPLC1:  *INPLC1,0-0,0,0`
	`1INPLC1: *1`

See Also	`INEN, INFNC, INLVL, INSTW, OUTPLC, [ TW ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INPLC` command, in combination with the `OUTPLC` command, configures the inputs and outputs to read data from a parallel I/O device such as a PLC (Programmable Logic Controller), or a passive thumbwheel module. The actual data transfer occurs with the `TW` command. Refer to the `TW` command for a description of the data transfer process.

The INPLC command has four fields (<i>,<i-i>,<i>,<i>):

Data Field	Description
Field 1: <i>	**Set #**: There are 4 possible INPLC sets (1-4). This field identifies which set to use.
Field 2: <i-i>	**Input #s**: Data is read into the Gem6K through programmable inputs on expansion I/O bricks. This field identifies the inputs to be used with the TW command. The first number is the first input, and the second number is the last input. The inputs must be consecutive. The number of inputs should be 8, because two BCD digits are read per data strobe. You must use inputs on an expansion I/O brick. Refer to page 8 for help in identifying which input bits are available to place in this field.
Field 3: <i>	**Sign Input #**: This field identifies which input is designated to provide sign information. A zero specified in the command field specifies no sign information. An active signal on the input designated as the sign input indicates a negative data entry.
Field 4: <i>	**Data Valid Input #**: This field identifies which input is designated to be the data valid handshake input. A zero in this field indicates that there will be no data valid handshake input used. When an input is specified as a data valid, the input must be active in order for data to be read. If the input is not active, data will not be read until the signal becomes active.

To disable a specific PLC set, enter INPLCn,Ø-Ø,Ø,Ø where n is the PLC set (1-4).

Example:

```
1INPLC2,1-8,9,10   ; Set INPLC set 2 as BCD digits on inputs 1-8 on I/O brick 1,
                   ; with input 9 as the sign bit, and input 10 as the data valid
1OUTPLC2,1-4,5,50  ; Set OUTPLC set 2 as output strobes on outputs 1-4 on I/O
                   ; brick 1, with output 5 as the output enable bit, and
                   ; strobe time of 50 milliseconds
A(TW6)             ; Read data into acceleration using INPLC set 2 and
                   ; OUTPLC set 2 as the data configuration
```

INSELP — Select Program Enable

Type	Input
Syntax	<a_><!>INSELP<i>,<i>
Units	See below
Range	1st i = 0, 1, or 2; 2nd i = 0 – 5000
Default	0,0
Response	INSELP: *INSELP0,0
See Also	COMEXS, INEN, INFNC, INLVL, INPLC, INSTW, [SS], TDIR, TSS

Product	Rev
GT6K	6.0
GV6K	6.0

The INSELP command enables program selection by inputs. In addition, the command establishes the strobe time for the inputs, and whether programs are selected on a one-to-one basis (INFNCi-iP) or on a BCD basis (INFNCi-B). When programs are selected on a one-to-one basis, each input defined with the INFNCi-iP command will run a specific program upon activation. When programs are selected by BCD values, each input defined by the INFNCi-B command will contribute to the BCD value, which corresponds to the program number. The program number is derived from the order in which the programs were defined (DEF). The first program defined is program #1, the second defined is program #2, etc. To verify which program number corresponds to each program, use the TDIR command. The number in front of the program name is the program number.

First i = Enable or disable function (Ø = Disable, 1 and 2 = Enable). Use INFNCi-B inputs if i = 1; use INFNCi-iP inputs if i = 2, to select program.

Second i = Strobe Time in milliseconds for inputs used to select program. The input must be active at the end of the strobe time for it to be recognized as a valid selection. The inputs are scanned once per *system update* (2 milliseconds).

The Kill (`!K`) command releases this mode, in addition to `INSELPØ`. The Stop (`!S`) command or an input defined as a stop input (`INFNCi-D`) will also release this mode, as long as `COMEXS` has been disabled.

Example:

```
2INFNC1-1P      ; Input #1 on I/O brick 2 defined to select program #1
2INFNC2-2P      ; Input #2 on I/O brick 2 defined to select program #2
2INFNC3-7P      ; Input #3 on I/O brick 2 defined to select program #7
INSELP2,50      ; Enable continuous scan of inputs to select a program to run
```

INSTW Establish Thumbwheel Data Inputs

Type	`Input`
Syntax	`<a_><!><B>INSTW<i>,<i-i>,<i>`
Units	See below
Range	See below
Default	`1,0–0,0`

Response	`INSTW1:  *INSTW1,0-0,0`
	`1INSTW1: *1INSTW1,0-0,0`

See Also	`INEN, INFNC, INLVL, INPLC, OUTTW, [ SS ], TSS, [ TW ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The `INSTW` command, in combination with the `OUTTW` command, configures the inputs and outputs to read data from an active thumbwheel device. The actual data transfer occurs with the `TW` command. Refer to the `TW` command for a description of the data transfer process.

The `INSTW` command has three fields (`<i>,<i-i>,<i>`):

Data Field	Description
Field 1: `<i>`	**Set #**: There are 4 possible `INSTW` sets (1-4). This field identifies which set to use.
Field 2: `<i-i>`	**Input #s**: Data is read into the Gem6K through the programmable inputs. This field identifies the inputs to be used with the `TW` command. The first number is the first input, and the second number is the last input. The inputs must be consecutive. The number of inputs should be compatible to the thumbwheel device. Refer to page 8 for help in identifying which input bits are available to place in this field.
Field 3: `<i>`	**Sign Input #**: This field identifies which input is designated to provide sign information. A zero specified in the command field specifies no sign information. An active signal on the input designated as the sign input indicates a negative data entry.

To disable a specific thumbwheel set, enter `INSTWn,Ø-Ø,Ø` where `n` is the thumbwheel set (1-4).

Example:

```
3INSTW2,1-4,5      ; Set INSTW set 2 as BCD digits on inputs 1-4 on I/O brick 3,
                   ; with input 5 as the sign bit
2OUTTW2,1-3,4,50   ; Set OUTTW set 2 as output strobes on outputs 1-3 on I/O
                   ; brick 2, with output 4 as the output enable bit, and
                   ; strobe time of 50 milliseconds
A(TW2)             ; Read data into acceleration using INSTW set 2
                   ; and OUTTW set 2 as the data configuration
```

INTHW Check for Alarm Events

Type	`Alarm Event`
Syntax	`<a_><!>INTHW<b><b>...<b><b>` (one b for each of 32 interrupts)
Units	`n/a`
Range	`b = 0 (disable), 1 (enable), or X (don't change)`
Default	`0`
Response	`INTHW:   *INTHW0000_0000_0000_0000_0000_0000_0000_0000`
See Also	`[ ER ], INFNC, INTSW, LIMFNC, TER, TIMINT`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `INTHW` command to determine which conditions will cause an alarm event in the Gem6K Communications Server (this requires an Ethernet interface to the Gem6K). The alarm bit in the Gem6K is cleared as soon as the alarm occurs, but the status of the alarm remains available, through the

Communications Server, to be checked by client applications. For details on using alarms, refer to the *Programmer's Guide*.

The table below lists the potential alarm conditions. Any number of the conditions may be enabled.

```
Format for INTHW:     bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb
               Bit #1 ┘                                    └ Bit #32
```

To enable a specific interrupt, place a 1 in the corresponding bit location (b) in the `INTHWbb....bbb` command. To disable a specific interrupt bit, place a `Ø` in the corresponding bit location.

NOTE: A specific interrupt bit can also be enabled by specifying the bit and the state of the bit (`Ø` = Disable, `1` = Enable). For example, the command `INTHW.25-1` enables bit 25, whereas `INTHW.25-Ø` disables bit 25.

Bit #	Function *
1	Software (forced) Alarm #1
2	Software (forced) Alarm #2
3	Software (forced) Alarm #3
4	Software (forced) Alarm #4
5	Software (forced) Alarm #5
6	Software (forced) Alarm #6
7	Software (forced) Alarm #7
8	Software (forced) Alarm #8
9	Software (forced) Alarm #9
10	Software (forced) Alarm #10
11	Software (forced) Alarm #11
12	Software (forced) Alarm #12
13	Command Buffer Full
14	ENABLE input Activated
15	Program Complete
16	Drive Fault

Bit #	Function
17	Reserved
18	Reserved
19	Limit Hit - hard or soft limit
20	Stall Detected (stepper) or Position Error (servo)
21	Timer (`TIMINT`)
22	Ethernet Failure - caused by `RESET` or by `ER.22` condition (also causes the COM6SRVR to display an alert dialog)
23	Input - any of the inputs defined by `INFNCi-I`
24	Command Error
25	Motion Complete
26	Reserved
27	Reserved
28	Reserved
29	Reserved
30	Reserved
31	Reserved
32	Reserved

* Bits 1-12: software alarms are forced with the `INTSW` command.

INTSW Force an Alarm Event

Type	`Alarm Event`
Syntax	`<a_><!>INTSW<i>`
Units	`i = alarm event condition # (see list in INTHW)`
Range	`i = 1-12`
Default	`n/a`
Response	`n/a`
See Also	`INTHW`

Product	Rev
GT6K	6.0
GV6K	6.0

This command forces a specific alarm event. The alarm events are available in the Communications Server (over the Ethernet interface), and a client application can read the Communications Server's "fast status" (alarm event) register to ascertain when certain conditions have occurred. 12 different software alarms are available (see table in `INTHW` command description). By forcing an alarm condition, you can customize the program to generate specific alarms at predefined places in your program.

The specific alarm event cannot be forced until the corresponding enable bit is set with the `INTHW` command. For example, before you can force alarm event bit #3 (`INTSW3`), you must first enable the Gem6K to check the state of alarm event bit #3 (`INTHW.3-1`).

The client application must determine the cause of the forced alarm event. This is accomplished by polling the Communication Server's "fast status" register for the alarm information. Once the register has been read for a client application, the alarm conditions are automatically cleared in the Communications Server. For more information on the alarms and using the fast status register, refer to the *Programmer's Guide*.

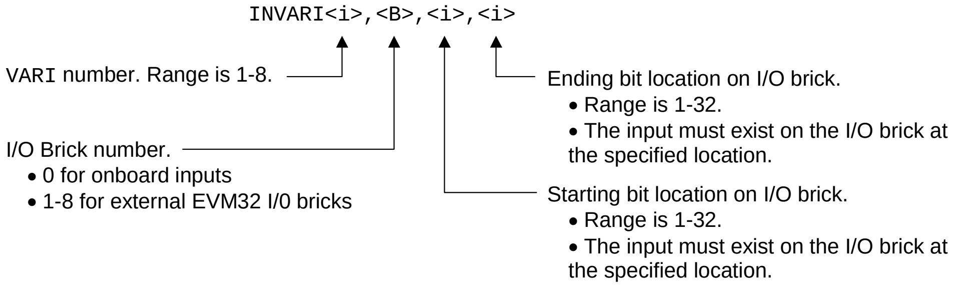
Example:

```
INTHW1           ; Enable alarm event bit #1
A20              ; Set acceleration to 20 units/sec/sec
V2               ; Set velocity to 2 units/sec
D25000           ; Set move distance to 25000 units
GO1              ; Initiate motion
INTSW1           ; Force alarm event bit #1 as soon as the move is finished
; ***************************************************************************
; * Note: After the alarm occurs, it is the client application program's    *
; * responsibility to examine the communication server's fast status        *
; * register to determine the cause of the alarm.                           *
; ***************************************************************************
```

INVARI Map Inputs to Integer Variable

		Product	Rev
Type	`Variables`	GT6K	6.0
Syntax	`<a_><!>INVARI<i>,<B>,<i>,<i>`	GV6K	6.0
Units	`See below`		
Range	`See below`		
Default	`n/a`		
Response	`INVARI:  *INVARI1,1,1,12`		
See Also	`INDEB, INEN, INLVL, VARI`		

The `INVARI` command allows a selected group of contiguous inputs to be interpreted as a binary number and continuously assigned to the selected integer variable (`VARI`). The inputs are specified by I/O brick number, starting bit number, and ending bit number. All inputs to be mapped to a `VARI` must be contiguous and on the same I/O brick. These inputs are read and masked internally, then shifted such that the starting bit is the low-order bit of the resulting binary value. A change in the starting bit input will always result in a change of ±1 in the resulting `VARI`, even if the starting bit number is not 1.



`INVARI<i>,<B>,<i>,<i>`

`VARI` number. Range is 1-8.

I/O Brick number.
- 0 for onboard inputs
- 1-8 for external EVM32 I/0 bricks

Ending bit location on I/O brick.
- Range is 1-32.
- The input must exist on the I/O brick at the specified location.

Starting bit location on I/O brick.
- Range is 1-32.
- The input must exist on the I/O brick at the specified location.

The Gem6K inputs are read every 2 milliseconds, modified by `INLVL` and `INEN`, and debounced with the time specified in `INDEB`. The inputs specified by `INVARI` are monitored after they are modified by `INLVL` and `INEN`, but before the debounce. Thus, the `VARI` variable specified by the `INVARI` command will be updated every 2 milliseconds.

The `VARI` variables are not updated with inputs unless the `INVARI` is issued with valid values for starting and ending bits. If the specified input bit does not exist onboard or on the I/O brick, an error message ("`*INVALID DATA`") will result.

Specifying bit 0 for both starting and ending bit disables the `INVARI` mapping (`INVARI<i>,<b>,0,0`).

Example:

A following application requires an axis to follow a master source that has position information presented as a 12-bit binary number on digital outputs. An external I/O brick with two 8-bit digital input SIMs is used to read the 12 bits of the source. The source is wired to bits 1-12.

```
DEF SETUP
INVARI4,1,1,12       ; VARI4 reflects bits 1-12 of brick 1
FOLMAS48             ; Axis follows VARI4
FOLEN1               ; Enable Following mode.
END
```

Test: (Assert bits 2 and 3)

```
>VARI4
*VARI4=+6
>TPMAS
*TPMAS+6
```

JOG Jog Mode Enable

Type	`Jog`
Syntax	`<a_><!>JOG<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`JOG:     *JOG0`
See Also	`DJOG, JOGA, JOGAA, JOGAD, JOGADA, JOGVH, JOGVL, INFNC`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOG1` command enables jog mode. Once jog mode has been enabled, the jog inputs can be used to produce motion. The inputs that will be used as jog inputs are determined by the `INFNC` command. Once the jog inputs have been enabled, they will remain enabled, and able to jog at any time while the motor is *in position*. Or in other words, as long as the motor is not moving the jog inputs will be active.

After processing the `JOG1` command, command processing does not stop and wait for the jog mode to be disabled (`JOGØ`). Instead, the jog inputs are enabled and command processing continues with the first command after the `JOG1` command.

WARNING
If a jog input is active when jog mode is enabled, motion will occur.

To disable jog mode, issue the `JOGØ` command at any point in the program.

NOTE: If you are using an RP240 operator panel, you can enable the RP240 Jog Mode with the `DJOG1` command and use the RP240's arrow keys to jog the axis. To disable the RP240 Jog Mode, use the `!DJOGØ` command or press the RP240's **MENU RECALL** button.

Example:

```
1INFNC1-L          ; Input #1 on I/O brick 1 defined as jog velocity select input
1INFNC2-J          ; Input #2 on I/O brick 1 defined as jog positive-direction input
1INFNC3-K          ; Input #3 on I/O brick 1 defined as jog negative-direction input
JOGA100            ; Jog acceleration set to 100 units/sec/sec
JOGAD200           ; Jog deceleration set to 200 units/sec/sec
JOGVH10            ; The velocity when the jog velocity select input is high is
                   ; 10 units/sec
JOGVL1             ; The velocity when the jog velocity select input is low is
                   ; 1 units/sec
JOG1               ; Enable jog mode. When an input occurs on input 2 or input 3,
                   ; the motor will move at the appropriate jog velocity until
                   ; the input is released
WAIT(1IN.4=b1)     ; Wait for input #4 on I/O brick 1 to become active.
                   ; Input #4 is being used as a signal to disable jog mode.
JOG0               ; Disable jog mode
```

JOGA Jog Acceleration

Type	Jog
Syntax	<a_><!>JOGA<r>
Units	r = units/sec/sec
Range	0.00001 - 39,999,998 (depending on the scaling factor)
Default	10.0000
Response	JOGA: *JOGA10.0000
See Also	DJOG, JOG, JOGAA, JOGAD, JOGADA, JOGVH, JOGVL, INFNC, SCALE, SCLA

Product	Rev
GT6K	6.0
GV6K	6.0

The JOGA command specifies the acceleration to be used upon receiving a jog input.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The jog acceleration remains set until you change it with a subsequent jog acceleration command. Accelerations outside the valid range are flagged as an error, with a message *INVALID DATA-FIELD x, where x is the field number. When an invalid acceleration is entered the previous acceleration value is retained.

If the jog deceleration (JOGAD) command has not been entered, the jog acceleration (JOGA) command will also set the jog deceleration rate. Once the jog deceleration (JOGAD) command has been entered, the jog acceleration (JOGA) command no longer affects jog deceleration.

Example: Refer to the jog mode enable (JOG) command example.

JOGAA Jogging Average Acceleration

Type	Jog; Motion (S-Curve)
Syntax	<a_><!>JOGAA<r>
Units	r = units/sec/sec
Range	0.00001 - 39,999,998 (depending on the scaling factor)
Default	10.00 (Default is a constant accel ramp, where JOGAA tracks JOGA. S-curve accel is achieved when JOGAA is changed independent of JOGA. To restore a constant accel ramp and tracking, set JOGAA = 0.)
Response	JOGAA: *JOGAA10.0000
See Also	A, ADA, JOG, JOGA, JOGAD, JOGADA, SCALE, SCLA

Product	Rev
GT6K	6.0
GV6K	6.0

The JOGAA command allows you to specify the average acceleration for an S-curve jogging profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling (SCLA) affects JOGAA the same as it does for JOGA. Refer to page 16 for details on scaling.

Example:

```
JOGA10              ; Sets the maximum jogging acceleration
JOGAA5              ; Sets the average jogging acceleration
```

JOGAD Jog Deceleration

Type	Jog
Syntax	`<a_><!>JOGAD<r>`
Units	r = units/sec/sec
Range	0.00001 - 39,999,998 (depending on the scaling factor)
Default	10.0000 (by default, JOGAD tracks JOGA until JOGAD is changed independent of JOGA; to restore tracking, set JOGAD = 0)
Response	JOGAD: *JOGAD10.0000
See Also	DJOG, JOG, JOGA, JOGAA, JOGADA, JOGVH, JOGVL, INFNC, SCALE, SCLA

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOGAD` command specifies the deceleration to be used when a jog input is released.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The jog deceleration remains set until you change it with a subsequent jog deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

If the jog deceleration (`JOGAD`) command has not been entered, the jog acceleration (`JOGA`) command will also set the jog deceleration rate. Once the jog deceleration (`JOGAD`) command has been entered, the jog acceleration (`JOGA`) command no longer affects jog deceleration. If `JOGAD` is set to zero (`JOGADØ`), then the jog deceleration will once again track whatever the `JOGA` command is set to.

Example: Refer to the jog mode enable (`JOG`) command example.

JOGADA Jogging Average Deceleration

Type	Jog; Motion (S-Curve)
Syntax	`<a_><!>JOGADA<r>`
Units	r = units/sec/sec
Range	0.00001 - 39,999,998 (depending on the scaling factor)
Default	10.00 (By default, JOGADA tracks JOGAA until JOGADA is changed independent of JOGAA. To restore tracking, set JOGAD = 0.)
Response	JOGADA: *JOGADA10.0000
See Also	A, AD, JOG, JOGA, JOGAA, JOGAD, SCALE, SCLA

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOGADA` command allows you to specify the average deceleration for an S-curve jogging profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Scaling (`SCLA`) affects `JOGADA` the same as it does for `JOGAD`. Refer to page 16 for details on scaling.

Example:

```
JOGAD10         ; Sets the maximum jog deceleration
JOGADA5         ; Sets the average jog deceleration
```

JOGVH Jog Velocity High

Type	`Jog`
Syntax	`<a_><!>JOGVH<r>`
Units	`r = units/sec (scalable with SCLV)`

Range	`Stepper Axes: 0.0000-60.0000  (after conversion to revs/sec)`
	`Servo Axes:   0.0000-200.0000 (after conversion to revs/sec;`
	`if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`10.0000`
Response	`JOGVH:   *JOGVH10.0000`
See Also	`DJOG, JOG, JOGA, JOGAA, JOGAD, JOGADA, JOGVL, INFNC , SCALE, SCLV`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOGVH` command specifies the velocity to be used upon receiving a jog input with the jog velocity select input active (*ON*).

The jog high velocity remains set until you change it with a subsequent jog high velocity command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the jog mode enable (`JOG`) command example.

JOGVL Jog Velocity Low

Type	`Jog`
Syntax	`<a_><!>JOGVL<r>`
Units	`r = units/sec (scalable with SCLV)`

Range	`Stepper Axes: 0.0000-60.0000  (after conversion to revs/sec)`
	`Servo Axes:   0.0000-200.0000 (after conversion to revs/sec;`
	`if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`0.5000`
Response	`JOGVL:   *JOGVL0.50000`
See Also	`DJOG, JOG, JOGA, JOGAA, JOGAD, JOGADA, JOGVH, INFNC , SCALE, SCLV`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOGVL` command specifies the velocity to be used upon receiving a jog input with the jog velocity select input low, or *OFF*. The velocity remains set until you change it with a subsequent jog velocity low command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the jog mode enable (`JOG`) command example.

JOY Joystick Mode Enable

		Product	Rev
Type	`Joystick`	GT6K	6.0
Syntax	`<a_><!>JOY<b>`	GV6K	6.0
Units	`n/a`		
Range	`b = 0 (disable) or 1 (enable)`		
Default	`0`		
Response	`JOY: *JOY0`		
See Also	`ANIRNG, [ AS ], COMEXC, INFNC, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYVL, JOYZ, TAS, TIN`		

The Gem6K drive supports joystick operation with digital inputs and analog inputs.

To Set Up Joystick Operation (refer also to the example code below):

1. Select the required digital inputs and analog inputs required for joystick operation. Connect the joystick as instructed in the *Hardware Installation Guide*.
2. Assign the appropriate input functions to the digital inputs used for the joystick's operation:
   - Release Input: `INFNCi-M`
   - Velocity Select Input: `INFNCi-O`
3. (optional) Use the `ANIRNG` command to select the voltage range for the analog input you will use. The default range is -10VDC to +10VDC (other options are 0 to +5V, -5 to +5V, and 0 to +10V).
4. Assign analog input, using:
   - `JOYAXH`: Standard analog input-to-axis assignment.
5. Define the joystick motion parameters:
   - Max. Velocity when Velocity Select input switch is open/high (`JOYVH` command). If the Velocity Select input is not used, joystick motion always uses the `JOYVH` velocity.
   - Max. Velocity when Velocity Select input switch is closed/low (`JOYVL` command).
   - Accel (`JOYA` command).
   - Accel for s-curve profiling (`JOYAA` command).
   - Decel (`JOYAD` command).
   - Decel for s-curve profiling (`JOYADA` command).
6. Define the usable voltage zone for your joystick:
   (make sure you have first assigned the analog inputs – see step 4 above)
   - End Deadband (`JOYEDB`): Defines the voltage offset (from the -10V & +10V endpoints) at which max. velocity occurs. Default is 0.1V, maxing voltage at -9.9V and +9.9V.
   - Center Voltage (`JOYCTR` or `JOYZ`): Defines the voltage when the joystick is at rest to be the zero-velocity center. Default `JOYCTR` setting is 0V.
   - Center Deadband (`JOYCDB`): Defines the zero-velocity range on either side of the Center Voltage. Default is 0.1V, setting the zero-velocity range at -0.1V to +0.1V.
7. To jog the axis:
   a. In your program, enable Joystick Operation with the `JOY` command (Joystick Release input must be closed in order to enable joystick mode). When the `JOY` command enables joystick mode, program execution stops (assuming the Continuous Command Execution Mode is disabled with the `COMEXCØ` command).
   b. Move the load with the joystick.
   c. When you are finished, open the Joystick Release input to disable joystick mode. This allows program execution to resume with the next statement after the initial `JOY` command that started the joystick mode.

Programming Example (refer also to the illustration below):

Application Requirements:

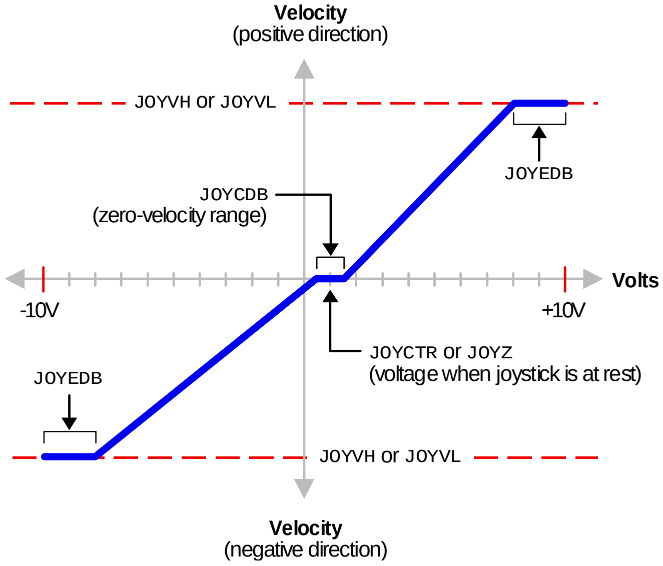
This example represents a typical joystick application in which a high-velocity range is required to move to a region, then a low-velocity range is required for a fine search. After the search is completed it is necessary to record the load position, then move to the next region. A digital input can be used to indicate that the position should be read. The Joystick Release input is used to exit the joystick mode and continue with the motion program.

Hardware Configuration:

- An analog input SIM is installed in the 3rd slot of I/O brick 1. The eight analog inputs (1-8) are addressed as input numbers 17-24 on the I/O brick. Analog input 17 will control the axis.
- A digital input SIM is installed in the 1st slot of I/O brick 1. The eight digital inputs (1-8) are addressed as input numbers 1-8 on the I/O brick. Digital input 6 will be used for the Joystick Release function, and input 7 will be used for the Joystick Velocity Select input. Input 8 will be used to indicate that the position should be read.

Setup Code (the drawing below shows the usable voltage configuration):

```
1INFNC6-M          ; Assign Joystick Release function to brick 1, input 6
1INFNC7-O          ; Assign Joystick Velocity Select function to brick 1, input 7
JOYAXH1-17         ; Assign analog input 17 to control the axis
JOYVH10            ; Max. velocity is 10 units/sec when the Velocity Select
                   ; input switch (1IN.7) is open (high)
JOYVL1             ; Max. velocity is 1 unit/sec when the Velocity Select
                   ; input switch (1IN.7) is closed (low)
JOYA100            ; Set joystick accel to 100 units/sec/sec
JOYAD100           ; Set joystick decel to 100 units/sec/sec
;**** COMMANDS TO SET UP USABLE VOLTAGE: **********
1JOYCTR.17=+1.0    ; Set center voltage for analog input 17 to+1.0V. The +1.0V value
                   ; was ascertained by checking the voltage of the input (with
                   ; the 1TANI.17 command) when the joystick was at rest
1JOYCDB.17=0.5     ; Set center deadband to compensate for the fact that
                   ; when the joystick is at rest, the voltage received on
                   ; the analog input may fluctuate +/- 0.5V on either
                   ; side of the +1.0V center.
1JOYEDB.17=2.0     ; Set end deadband to compensate for the fact that the
                   ; joystick can produce only -8.0V to +8.0V.
;***************************************************
JOY1               ; Enable joystick mode
```



JOYA Joystick Acceleration

Type	`Joystick`
Syntax	`<a_><!>JOYA<r>`
Units	`r = units/sec/sec`
Range	`0.3 – 9999.9999`
Default	`10.0000`
Response	`JOYA:   *JOYA10.0000`
See Also	`JOY, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYVL, JOYZ, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYA` command specifies the acceleration to be used during joystick mode.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The joystick acceleration remains set until you change it with a subsequent joystick acceleration command. Accelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid acceleration is entered the previous acceleration value is retained.

If the joystick deceleration (`JOYAD`) command has not been entered, the joystick acceleration (`JOYA`) command will also set the joystick deceleration rate. Once the joystick deceleration (`JOYAD`) command has been entered, the joystick acceleration (`JOYA`) command no longer affects joystick deceleration.

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYAA Joystick Average Acceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>JOYAA<r>`
Units	`r = units/sec/sec`
Range	`0, or 0.3 – 9999.9999`
Default	`10.00 (Default is a constant accel ramp, where JOYAA tracks JOYA. S-curve accel is achieved when JOYAA is changed independent of JOYA. To restore a constant accel ramp and tracking, set JOYAA = 0.)`
Response	`JOYAA:   *JOYAA10.0000`
See Also	`AA, AD, JOY, JOYA, JOYAD, JOYADA, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYAA` command allows you to specify the average acceleration for an S-curve joystick profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Accelerating Scaling (`SCLA`) affects `JOYAA` the same as it does for `JOYA`. Refer to page 16 for details on scaling.

Example:

```
JOYA10            ; Set the maximum joystick acceleration
JOYAA5            ; Set the average joystick acceleration
```

JOYAD Joystick Deceleration

Type	`Joystick`
Syntax	`<a_><!>JOYAD<r>`
Units	`r = units/sec/sec`
Range	`0, or 0.3 – 9999.9999`
Default	`10.0000 (by default, JOYAD tracks JOYA until JOYAD is changed independent of JOYA; to restore tracking, set JOYAD = 0)`
Response	`JOYAD:   *JOYAD10.0000`
See Also	`JOY, JOYA, JOYAA, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYVL, JOYZ, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYAD` command specifies the deceleration to be used during the joystick mode.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The joystick deceleration remains set until you change it with a subsequent joystick deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where x is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

If the joystick deceleration (`JOYAD`) command has not been entered, the joystick acceleration (`JOYA`) command will also set the joystick deceleration rate. Once the joystick deceleration (`JOYAD`) command has been entered, the joystick acceleration (`JOYA`) command no longer affects joystick deceleration. If `JOYAD` is set to zero (`JOYADØ`), then the joystick deceleration will once again track whatever the `JOYA` command is set to.

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYADA Joystick Average Deceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>JOYADA<r>`
Units	`r = units/sec/sec`
Range	`0.3 – 9999.9999`
Default	`10.00 (By default, JOYADA tracks JOYAA until JOYADA is changed independent of JOYAA. To restore tracking, set JOYAD = 0.)`
Response	`JOYADA:  *JOYADA10.0000`
See Also	`A, AD, JOY, JOYA, JOYAA, JOYAD, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYADA` command allows you to specify the average deceleration for an S-curve joystick profile. S-curve profiling provides smoother motion control by reducing the rate of change in acceleration and deceleration; this accel/decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Acceleration Scaling (`SCLA`) affects `JOYADA` the same as it does for `JOYAD`. Refer to page 16 for details on scaling.

Example:

```
JOYAD10         ; Sets the maximum joystick deceleration
JOYADA5         ; Sets the average joystick deceleration
```

JOYAXH Joystick Analog Channel High

Type	`Joystick`
Syntax	`<a_><!>JOYAXH<B-i>`

Units	`B = I/O brick number`
	`i = Location of the analog input on I/O brick (see page 8)`

Range	`B = 1-8`
	`i = 1-32`

Default	`0-0`
Response	`JOYAXH:  *JOYAXH1-1`
See Also	`ANIRNG, [ IN ], INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYVL, JOYZ, TIN, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYAXH` command specifies the analog input that will control the axis while Joystick Mode is enabled.

To understand how specific I/O points are addressed on the I/O bricks, refer to page 8.

NOTE: If you install an analog input SIM on an external I/O brick, use the `ANIRNG` command to select the voltage range for the external 12-bit analog inputs you will use. The default range is -10VDC to +10VDC (other options are 0 to +5V, -5 to +5V, and 0 to +10V). The onboard analog input on the DRIVE I/O connector is not affected by the `ANIRNG` command.

**`Example:** Refer to the joystick mode enable (`JOY`) command example.

JOYCDB Joystick Center Deadband

Type	`Joystick`
Syntax	`<a_><!><B>JOYCDB<.i><=r>`

Units	`i = I/O location for the analog input on brick B (see page 8)`
	`r = volts`

Range	`i = 1-32`
	`r = 0.00 - 10.00 (depending on ANIRNG setting)`

Default	`0.1`
Response	`1JOYCDB.1  *1JOYCDB.1=0.1`
See Also	`ANIRNG, INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCTR, JOYEDB, JOYVH, JOYVL, JOYZ`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYCDB` command defines, for the specified analog input, the zero-velocity range on either side of the Center Voltage established with the `JOYCTR` command or the `JOYZ` command. The default setting is 0.1V, which sets the zero-velocity range at -0.1V to +0.1V (assuming the default `JOYCTR` default of 0.0V is used). **NOTE**: Executing the `JOYCDB` command before the `JOYAXH` command will cause an error (“`INPUT(S) NOT DEFINED AS JOYSTICK INPUT`”).

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYCTR Joystick Center

Type	`Joystick`
Syntax	`<a_><!><B>JOYCTR<.i><=r>`

Units	`i = I/O location for the analog input on brick B (see page 8)`
	`r = volts`

Range	`i = 1-32`
	`r = -10.00 - +10.00 (depending on ANIRNG setting)`

Default	`0.00`
Response	`1JOYCTR.1  *1JOYCTR.1=0.00`
See Also	`ANIRNG, INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYEDB, JOYVH, JOYVL, JOYZ`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYCTR` command defines, for the specified analog input(s), the voltage to be considered as the zero-velocity center (usually associated with leaving the joystick in the resting position). Default is 0V. The zero-velocity range about the center is determined by the `JOYCDB` command. As an alternative to the `JOYCTR` command, you could use the `JOYZ` command. **NOTE**: Executing the `JOYCTR` command before the `JOYAXH` command will cause an error (“`INPUT(S) NOT DEFINED AS JOYSTICK INPUT`”).

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYEDB Joystick End Deadband

Type	`Joystick`
Syntax	`<a_><!><B>JOYEDB<.i><=r>`

Units	`i = I/O location for the analog input on brick B (see page 8)`
	`r = volts`

Range	`i = 1-32`
	`r = 0.00 - 10.00 (depending on ANIRNG setting)`

Default	`0.1`
Response	`1JOYEDB.1   *1JOYCTR.1=0.1`
See Also	`ANIRNG, INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYVH, JOYVL, JOYZ`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYEDB` command defines, for the specified analog input, the voltage offset (from the -10V & +10V endpoints) at which maximum velocity occurs. This command is useful if your joystick does not reach either limit of the voltage range (-10.00V to+10.00V). The default setting is 0.1V, creating a maximum voltage range of -9.9V to +9.9V. **NOTE**: Executing the `JOYEDB` command before the `JOYAXH` command will cause an error (“`INPUT(S) NOT DEFINED AS JOYSTICK INPUT`”).

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYVH Joystick Velocity — Velocity Select Input High

Type	`Joystick`
Syntax	`<a_><!>JOYVH<r>`
Units	`r = units/sec`

Range	`Stepper Axes: 0.004-60.0000  (after conversion to revs/sec)`
	`Servo Axes:   0.004-200.0000 (after conversion to revs/sec; if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`0.5000`
Response	`JOYVH:   *JOYVH0.5000`
See Also	`[ IN ], INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYCDB, JOYCTR, JOYEDB, JOYVL, JOYZ, SCALE, SCLV, TIN, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYVH` command specifies the maximum velocity that can be obtained at full deflection during joystick mode, with the Joystick Velocity Select input open (high). The Joystick Velocity Select input function is defined with the `INFNCi-O` command. If the Velocity Select input is not used, joystick motion always uses the `JOYVH` velocity.

The joystick velocity must be entered prior to entering joystick mode (`JOY`). The joystick velocity high remains set until you change it with a subsequent `JOYVH` command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYVL Joystick Velocity — Velocity Select Input Low

Type	`Joystick`
Syntax	`<a_><!>JOYVL<r>`
Units	`r = units/sec`

Range	`Stepper Axes: 0.004-60.0000 (after conversion to revs/sec)`
	`Servo Axes: 0.004-200.0000 (after conversion to revs/sec; if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`0.2000`
Response	`JOYVL: *JOYVL0.2000`
See Also	`[ IN ], INFNC, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYZ, SCALE, SCLV, TIN, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYVL` command specifies the maximum velocity that can be obtained at full deflection during joystick mode, with the Joystick Velocity Select input closed (low). The Joystick Velocity Select input function is defined with the `INFNCi-O` command. If the Velocity Select input is not used, joystick motion always uses the `JOYVH` velocity.

The joystick velocity must be entered prior to entering joystick mode (`JOY`). The joystick velocity low remains set until you change it with a subsequent `JOYVL` command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered the previous velocity value is retained.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example: Refer to the joystick mode enable (`JOY`) command example.

JOYZ Joystick Zero

Type	`Joystick`

Syntax	`<a_><!><B>JOYZ<.i><=b>`
	`(multiple inputs per brick may be configured at one time)`

Units	`B = I/O brick number`
	`i = Location of the analog input on I/O brick (see page 8)`
	`b = enable bit`

Range	`B = 1-8`
	`i = 1-32`
	`b = 0 (don't zero) or 1 (zero), or X (don't change)`

Default	`n/a`
Response	`n/a`
See Also	`ANIRNG, JOY, JOYA, JOYAA, JOYAD, JOYADA, JOYAXH, JOYCDB, JOYCTR, JOYEDB, JOYVH, JOYVL`

Product	Rev
GT6K	6.0
GV6K	6.0

The `JOYZ` command defines the voltage when the joystick is at rest to be the zero-velocity center. Simply leave the joystick in its resting position and issue a `JOYZ` command to define the current voltage of the respective analog inputs as the zero-velocity center. The zero-velocity range about the center is determined by the `JOYCDB` command.

The `JOYZ` command is an alternative to using the `JOYCTR` command.

Example:

```
1INFNC7-M          ; Assign Joystick Release function to brick 1, input 7
1INFNC8-O          ; Assign Joystick Velocity Select function to brick 1, input 8
JOYAXH1-17         ; Assign analog input 17 to control the axis
JOYVH10            ; Max. velocity is 10 units/sec when the Velocity Select
                   ; input (1IN.8) is high (sinking current)
JOYVL1             ; Max. velocity is 1 unit/sec when the Velocity Select
                   ; input (1IN.8) is low (not sinking current)
JOYA100            ; Set joystick accel to 100 units/sec/sec
JOYAD100           ; Set joystick decel to 100 units/sec/sec
;**** COMMANDS TO SET UP USABLE VOLTAGE: **********
1JOYZ.17=1         ; This command is executed while the joystick is at rest. It
                   ; sets the current voltage on analog input 17 as the
                   ; zero-velocity center.
```

```
1JOYCDB.17=0.5     ; Set center deadband to compensate for the fact that
                   ; when the joystick is at rest, the voltage received on
                   ; the analog input may fluctuate +/- 0.5V on either
                   ; side of the zero-velocity center established with JOYZ.
1JOYEDB.17=2.0     ; Set end deadband to compensate for the fact that the
                   ; joystick can produce only -8.0V to +8.0V.
;**************************************************
JOY1               ; Enable joystick mode
```

JUMP   Jump to a Program or Label (and do not return)

Type	`Program or Subroutine Definition or Program Flow Control`
Syntax	`<a_><!>JUMP<t>`
Units	`t = text (name of program/label)`
Range	`Text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`$, DEF, DEL, END, GOSUB, GOTO, IF, L, LN, NIF, NWHILE, REPEAT, RUN, UNTIL, WHILE`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `JUMP` command branches to the corresponding program name or label when executed. A program or label name consists of 6 or fewer alpha-numeric characters.

All nested `IF`s, `WHILE`s, and `REPEAT`s, loops, and subroutines are cleared; thus, the program or label that the `JUMP` initiates will **not** return control to the line after the `JUMP`, when the program completes operation. Instead, the program will end.

If an invalid program or label name is entered, the `JUMP` will be ignored, and processing will continue with the line after the `JUMP`.

Example

```
; ************************************************************************
; * In this example, the program bottom is executed and calls the top   *
; * subroutine. The top subroutine then initiates motion (GO1) and      *
; * jumps to the program called middle to turn on output #2. Then,      *
; * because the JUMP command cleared the top subroutine, program        *
; * execution is terminated instead of returning to the bottom program. *
; ************************************************************************
DEL top          ; Delete program top
DEF top          ; Begin definition program top
GO1              ; Initiate motion
JUMP middle      ; Jump to program middle
END              ; End subroutine definition
DEL middle       ; Delete program middle
DEF middle       ; Begin definition of program middle
OUTx1            ; Turn on output #2
END              ; End program definition
DEL bottom       ; Delete program bottom
DEF bottom       ; Begin definition of program bottom
GOSUB top        ; Gosub to program top
GO1              ; Initiate motion
END              ; End subroutine definition
RUN bottom       ; Execute program bottom
```

K Kill Motion

Type	`Motion`
Syntax	`<a_><!>K<b>`
Units	`n/a`
Range	`b = 0 (don't kill) or 1 (kill)`
Default	`n/a`
Response	`!K   No response, instead motion is killed`
See Also	`FOLK, GO, <CTRL>K, KDRIVE, LHAD, LHADA, S, SCANP, TAS`

Product	Rev
GT6K	6.0
GV6K	6.0

The Kill Motion (`K`) command instructs the drive to stop motion. Two types of Kill are available:

- Kill motion only: `K1` (buffered) or `!K1` (immediate).
- Kill motion and terminate program: `!K` (immediate), `K` (buffered), <CTRL>K
  Additional methods include: activate a kill input (`INFNCi-C`), activate a user fault input (`INFNCi-F`), or open the Enable input connection.

When a kill is initiated, motion is stopped at the rate set with the `LHADA` and `LHAD` commands.

If you want the drive to be disabled upon executing a Kill command, enable the *Disable Drive on Kill* mode with the `KDRIVE1` command. **CAUTION**: In the `KDRIVE1` mode, a Kill command or Kill input immediately shuts down the drive, allowing the load to *free wheel* to a stop.

If the axis is involved in a PLC Scan (initiated with `SCANP`), a `K` command will clear the scan.

Example:

```
A2                  ; Set acceleration to 2 units/sec/sec
AD2                 ; Set deceleration to 2 units/sec/sec
V1                  ; Set velocity to 1 units/
D10                 ; Set distance to 10 units
GO1                 ; Initiate motion -- motion begins.
                    ; After a short period the Kill command is sent.
!K                  ; Kill motion (stop at the LHADA/LHAD decel)
```

<CTRL>K Kill Motion

Type	`Motion`
Syntax	`<CTRL>K`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`<CTRL>K: No response, instead motion is killed`
See Also	`GO, K, KDRIVE, LHAD, LHADA, S`

Product	Rev
GT6K	6.0
GV6K	6.0

The Kill Motion (`<ctrl>K`) command instructs the Gem6K to stop motion and terminate program execution. In essence, the `<ctrl>K` command is an immediate kill (`!K`) command.

Motion is stopped at the rate set with the `LHADA` and `LHAD` commands. If the *Disable Drive on Kill* mode is enabled with the `KDRIVE1` command, a `<ctrl>K` command immediately shuts down the drive, allowing the load to *free wheel* to a stop.

Example:

```
A2                  ; Set acceleration to 2 units/sec/sec
AD2                 ; Set deceleration to 2 units/sec/sec
V1                  ; Set velocity to 1 units/
D10                 ; Set distance to 10 units
GO1                 ; Initiate motion -- motion begins.
                    ; After a short period the Kill command is sent.
<CTRL>K             ; Kill motion (stop at the LHADA/LHAD deceleration)
```

KDRIVE Disable Drive on Kill

			Product	Rev
Type	`Drive Configuration`		GT6K	6.0
Syntax	`<a_><!>KDRIVE<b>`		GV6K	6.0
Units	`b = enable bit`			
Range	`0 (disable) or 1 (enable)`			
Default	`0`			
Response	`KDRIVE:  *KDRIVE0`			
See Also	`DRIVE, INFNC, K, <ctrl>K`			

If you enable the Disable Drive on Kill function (`KDRIVE1`), then when a kill command (`K`, `!K`, or `<ctrl>K`) is processed or a kill input (`INFNCi-C`) is activated, the drive will be disabled immediately. **CAUTION**: This cuts all control to the motor and allows the load to freewheel to a stop.

To re-enable the drive, issue the `DRIVE1` command.

If you leave the `KDRIVE` command in its default state (`Ø`, disabled), the kill function behaves in its normal manner, leaving the drive enabled.

Example:

```
KDRIVE1          ; Disable the drive when a kill occurs
K                ; Kill is performed and drive is disabled
```

KIOEN Kill on EVM32 Disconnect

			Product	Rev
Type	`Drive Configuration; Inputs; Outputs`		GT6K	6.0
Syntax	`<a_><!>KIOEN<b>`		GV6K	6.0
Units	`n/a`			
Range	`b = 0 (disable) or 1 (enable)`			
Default	`0`			
Response	`KIOEN:   *KIOEN0`			
See Also	`ERROR, TER, TIO`			

The `KIOEN` command allows you to control the functionality of the Gem6K when an *EVM32 I/O failure* has been detected (cause could be cable disconnection, or loss of power on the EVM32 I/O brick). The options are as follows:

- `KIOEN0` (factory default): The Gem6K will not perform a kill. **(SEE WARNING NOTE BELOW)**
- `KIOEN1`: The Gem6K will perform a kill (all motion and program execution on all tasks) if an EVM32 I/O failure is detected.

Regardless of the state of the `KIOEN` command, you can enable error bit 18 (`ERROR.18-1`) and use an error program to respond to an EVM32 I/O failure. Note that when operating in the `KIOEN0` mode (factory default), the branch to the error program is a GOSUB, but in `KIOEN1` mode the branch is a GOTO.

WARNING

If you use the factory default `KIOEN0` mode (no kill if EVM32 I/O failure), bear in mind that when an EVM32 I/O failure occurs, the state of any external conditions becomes unknown to the Gem6K drive. For example, if an input on brick 2 is defined as a hardware end-of-travel limit, and if brick 2 loses power or is disconnected from the Gem6K, the Gem6K will never see a state change on the limit.

The `KIOEN0` mode is designed for use during system setup (for example, if you will be connecting and disconnecting I/O bricks in the process of wiring and programming your system).

Therefore, to help prevent damage to equipment and serious injury to personnel, we recommend enabling this feature (`KIOEN1`) during normal operation of your motion control system.

L Loop

Type	`Loops; Program Flow Control`
Syntax	`<a_><!>L<i>`
Units	`i = number of times to loop`
Range	`0-999,999,999  (0 = infinite loop)`
Default	`0`
Response	`L:  No response; instead, this has the same function as L0`
See Also	`C, COMEXS, LN, LX, PLN, PLOOP, PS, S`

Product	Rev
GT6K	6.0
GV6K	6.0

When you combine the Loop (`L`) command with the end of loop (`LN`) command, all of the commands between `L` and `LN` will be repeated the number of times specified by `L<i>`. If `<i>` = `0`, or if no argument is specified, all the commands between `L` and `LN` will be repeated indefinitely. The loop can be stopped by issuing a Terminate Loop (`!LX`) command, an immediate Kill (`!K`) command, or an immediate Halt (`!HALT`) command.

The loop can be paused by issuing an immediate Pause (`!PS`) command or a Stop (`!S`) command, but only in the COMEXS1 mode. The loop can then be resumed with the immediate Continue (`!C`) command.

You may nest loops up to 16 levels deep.

NOTE: Be careful about performing a `GOTO` between the `L` and `LN` commands. Branching to a different location within the same program will cause the next loop encountered to be nested within the previous loop, unless an `LN` command has already been encountered.

Example:

```
DEL flash        ; Delete program flash
DEF flash        ; Begin definition of program flash
L5               ; Repeat the commands between L and LN five times
A20              ; Set acceleration to 20 revs/sec
D8300            ; Set distance to 8300 counts
WAIT(AS.1=b0)    ; Wait until no motion is commanded
OUTxxx1          ; Turn on output #4
T.75             ; Dwell for 0.75 seconds
OUTxxx0          ; Turn off output #4
T.75             ; Dwell for 0.75 seconds
LN               ; End loop
END              ; End definition
```

LDAMP Load Damping

Type	`System`
Syntax	`<a_><!>LDAMP<r>`

Units	`Rotary motor: r = Nm/rad/sec`
	`Linear motor: r = N/meter/sec`

Range	`Rotary motor: 0.0000 to 1.0000 : ±0.0001`
	`Linear motor: DMEPIT (electrical pitch) dependent`

Default	`0.0000`
Response	`LDAMP:    *LDAMP0.2000`
See Also	`DMTD, SGPRAT, SGVRAT, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `LDAMP` command specifies the damping provided by the mechanical load only, not including the motor itself (which is specified by `DMTD`).

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`LDAMP` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

LH Hardware End-of-Travel Limit — Enable Checking

		Product	Rev
Type	`Limit (End-of-Travel); Drive Configuration`	GT6K	6.0
Syntax	`<a_><!>LH<i>`	GV6K	6.0
Units	`n/a`		

Range	`i = 0 (disable both), 1 (disable positive-direction),`
	`2 (disable negative-direction), or 3 (enable both)`		

Default	3		
Response	`LH:     *LH3`		
See Also	`[ AS ], [ ER ], DRIVE, ERROR, INDEB, INFNC, INLVL, LHAD, LHADA, [ LIM ], LIMEN, LIMFNC, LIMLVL, LS, LSAD, LSADA, LSNEG, LSPOS, TAS, TER, TLIM, TSTAT`		

Use the `LH` command to enable or disable either or both end-of-travel limit inputs.

Disable negative-direction limit; Disable positive-direction limit:	`LH0`
Enable negative-direction limit; Disable positive-direction limit:	`LH1`
Disable negative-direction limit; Enable positive-direction limit:	`LH2`
Enable negative-direction limit; Enable positive-direction limit:	`LH3`

The “end-of-travel limit” functions are assigned with the `LIMFNC` command to the onboard limit inputs on the DRIVE I/O connector; or with the `INFNC` command to onboard or external inputs. The factory default `LIMFNC` assignments on the DRIVE I/O connector are as follows (but any of the three limit inputs, five general purpose inputs or inputs on external I/O bricks could be re-assigned as end-of-travel inputs):

Limit #	Pin #	GT6K & GV6K Function (`LIMFNC` default)
1	28	`LIMFNC1-R` (Positive end-of-travel limit)
2	29	`LIMFNC2-S` (Negative end-of-travel limit)
3	31	`LIMFNC3-T` (Home limit)

The `LH` command is required to enable checking the state of the end-of-travel limits (i.e., `LIMFNCi-R`, or `LIMFNCi-S`); for example, `LH3` is required to detect the occurrence of the hardware limit activation, as reported with axis status bits 15 and 16 (see `TASF`, `TAS`, `AS`). The default `LH` condition is enabled (`LH3`).

With limits disabled, motion will not be restricted. When a specific limit is enabled (positive- or negative-direction), and the limit wiring for the enabled limit is a physical open circuit, motion will be restricted (assuming the default active level of `LIMLVLØ`). The `LIMLVL` command controls the active level of the limit inputs.

If an “end-of-travel limit” input is redefined with a different function (i.e., not `LIMFNCi-R` or `LIMFNCi-S`), it is no longer controlled by the `LH` command. Instead, use the `LIMEN` command.

NOTE

If a hardware limit is encountered while limits are enabled, motion must occur in the opposite direction; then you can make a move in the original direction. If limits are disabled (`LH0`), you are free to make a move in either direction. When a hardware limit is encountered, the drive sets `TAS` bit 15 or 16, as well as `TER` bit 2. To clear these status bits, you can execute a `GO` in the opposite direction or disable the limits with the `LH0` command.

Example:

```
LH3              ; Enable limits
LHAD100          ; Set hard limit decel to 100 units/sec/sec
A10              ; Set acceleration to 10 units/sec/sec
V1               ; Set velocity to 1 unit/sec
D100000          ; Set distance to 100000 units
GO1              ; Initiate motion
```

LHAD Hard Limit Deceleration

Type	`Limit (End-of-Travel)`
Syntax	`<a_><!>LHAD<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 - 9999.9999`
Default	`100.0000`
Response	`LHAD:    *LHAD100.0000`
See Also	`AD, DMEPIT, DRES, INFNC, INLVL, K, [ LIM ], LIMEN, LIMFNC, LIMLVL, LH, LHADA, LS, LSAD, LSADA, LSNEG, LSPOS, SCALE, SCLA, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LHAD` command determines the value at which to decelerate after a hardware end-of-travel limit has been hit.

The "end-of-travel limit" functions are assigned with the `LIMFNC` command to the onboard limit inputs on the DRIVE I/O connector; or with the `INFNC` command to onboard or external inputs. The factory default `LIMFNC` assignments on the DRIVE I/O connector are as follows (but any of the three limit inputs, five general purpose inputs or inputs on external I/O bricks could be re-assigned as end-of-travel inputs):

Limit #	Pin #	GT6K & GV6K Function (`LIMFNC` default)
1	28	`LIMFNC1-R` (Positive end-of-travel limit)
2	29	`LIMFNC2-S` (Negative end-of-travel limit)
3	31	`LIMFNC3-T` (Home limit)

UNITS OF MEASURE and **SCALING**: refer to page 16.

When a drive fault, a Kill command (`K`, `!K`, or `^K`), or a Kill input (`INFNCi-C`) occurs, motion is stopped at the rate set with the `LHAD` and `LHADA` commands. However, if the *Disable Drive on Kill* mode is enabled (`KDRIVE1`), the drive is immediately shut down upon a Kill command or Kill input and allows the motor/load to *freewheel* to a stop without a controlled deceleration.

The hard limit deceleration remains set until you change it with a subsequent hard limit deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

Example: Refer to the hard limit enable (`LH`) command example.

LHADA Hard Limit Average Deceleration

Type	`Motion (S-Curve)`
Syntax	`<a_><!>LHADA<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 - 9999.9999`
Default	`100.000 (Default is a constant decel ramp, where LHADA tracks LHAD. S-curve decel is achieved when LHADA is changed independent of LHAD. To restore a constant decel ramp and tracking, set AA = 0.)`
Response	`LHADA:    *LHADA100.0000`
See Also	`AD, ADA, INFNC, K, LHAD, LIMFNC, LIMLVL, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LHADA` command allows you to specify the average deceleration for an S-curve deceleration profile when a hardware end-of-travel limit is hit.

The "end-of-travel limit" functions are assigned with the `LIMFNC` command to the onboard limit inputs on the DRIVE I/O connector; or with the `INFNC` command to onboard or external inputs. The factory default `LIMFNC` assignments on the DRIVE I/O connector are as follows (but any of the three limit inputs, five general purpose inputs or inputs on external I/O bricks could be re-assigned as end-of-travel inputs):

Limit #	Pin #	GT6K & GV6K Function (LIMFNC default)
1	28	LIMFNC1-R (Positive end-of-travel limit)
2	29	LIMFNC2-S (Negative end-of-travel limit)
3	31	LIMFNC3-T (Home limit)

Acceleration scaling (SCLA) affects LHADA the same as it does for LHAD. Refer to page 16 for details on scaling.

S-curve profiling provides smoother motion control by reducing the rate of change in deceleration; this decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Example:

```
LHAD10     ; Set the maximum deceleration to 10 units/sec/sec
LHADA5     ; Set the average deceleration to 5 units/sec/sec
```

[LIM]   Limit Status

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[IN], INDEB, INFNC, LH, LIMEN, LIMFNC, LIMLVL, TLIM

Product	Rev
GT6K	6.0
GV6K	6.0

The LIM operator is used to assign the limit status bits to a binary variable, or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

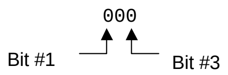
LIM does not depict the status of onboard inputs or external digital inputs assigned an end-of-travel or home limit function (INFNCi-R, INFNCi-S, or INFNCi-T). For such inputs, you must use the IN operator.

Syntax: VARBn=LIM where n is the binary variable number,
or LIM can be used in an expression such as IF(LIM=b1XX), or IF(LIM=h7)

The LIM value is the debounced version of the limits status (debounced with the ØINDEB value). Axis status (AS) bits 15 and 16 reports the non-debounced version of the end-of-travel limits.

There are 3 limit inputs: positive-direction, negative-direction, and home end-of-travel limits. Each is available for assignment or comparison. If it is desired to assign only one limit input value to a binary variable, instead of the status of all the limit inputs, the bit select (.) operator can be used. The bit select, in conjunction with the limit input number, is used to specify a specific limit input. For example, VARB1=LIM.3 assigns limit input 3 (home limit) to binary variable 1.

Format for binary assignment:



LIM bit	Function
1	Positive-direction Limit
2	Negative-direction Limit
3	Home Limit

Example:

```
IF(LIM=b11X)     ; If both end of travel limit inputs are active, then
                 ; do the statements between the IF and NIF
TLIM             ; Transfer limit status
NIF              ; End IF statement
```

LIMEN Limit Input Enable

Type	`Inputs; Program Debug Tool`
Syntax	`<a_><!>LIMEN<d><d><d>`
Units	`n/a`

Range	`d = 0 (disable, leave off), 1 (disable, leave on),`
	`E (enable), or X (don't change)`

Default	`E`

Response	`LIMEN:   *LIMENEEE`
	`LIMEN.3  *E`

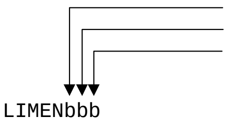
See Also	`INEN, LH, [ LIM ], LIMFNC, LIMLVL, TIO, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LIMEN` command allows you to simulate the activation of specific limit inputs (without actually wiring the inputs to the drive) by disabling them and setting them to a specific level (ON or OFF). This is useful for testing and debugging your program (see program example below). `LIMEN` may only be used for onboard limit inputs (found on the "DRIVE I/O" connector), not for onboard or external digital inputs. The default state is enabled (`E`), requiring external wiring to exercise their respective `LIMFNC` functions.

`LIMEN` response for limits on the DRIVE I/O connector (bits are numbered 1-3 from left to right):

Limit #	Pin #	GT6K & GV6K Function (`LIMFNC` default)
1	28	`LIMFNC1-R` (Positive end-of-travel limit)
2	29	`LIMFNC2-S` (Negative end-of-travel limit)
3	31	`LIMFNC3-T` (Home limit)



The `LH` command is required to enable checking the state of the end-of-travel limits (i.e., `LIMFNCi-R`, or `LIMFNCi-S`); for example, `LH3` is required to detect the occurrence of the hardware limit activation, as reported with axis status bits 15 and 16 (see `TASF`, `TAS`, `AS`). The default `LH` condition is enabled (`LH3`).

The input bit patterns for onboard and external I/O bricks are explained on page 8 of this document.

Example:

```
DEL tsting          ; Delete program called "tsting"
DEF tsting          ; Begin definition of program called "tsting"
LIMFNC3-E           ; Define hardware end-of-travel limit #3 (normally defined
                    ; as the home end-of-travel limit) as a "pause/resume" input.
COMEXR1             ; Activating the pause/resume input will pause command and
                    ; motion execution, de-activating the pause/resume input
                    ; will resume command and motion execution.
MC1                 ; Set the axis to continuous motion profiling mode
A15                 ; Set acceleration to 15 units/sec/sec
AD5                 ; Set deceleration to 5 units/sec/sec
V4                  ; Set velocity to 4 revs/sec
GO1                 ; Initiate continuous motion
END                 ; End definition of program called "tsting"
; While this program is running and motion is in progress, you can send
; immediate LIMEN commands to simulate the function of the "pause/resume"
; input as follows:
;   1. Start the program by sending the RUN TSTING command to the drive.
;      The axis will start moving, using a continuous motion profile.
;   2. Send the !LIMEN.3=1 command to the drive. This disables the
;      "pause/resume" input but simulates its activation. Motion and
;      program execution will pause.
;   3. Send the !LIMEN.3=0 command to the drive. This disables the
;      "pause/resume" input but simulates its de-activation. Motion and
;      program execution will resume.
;   4. Send the !LIMEN.3=E command to the drive. This re-enables the
;      "pause/resume" input for normal operation with an external switch
;      or sensor.
;   5. To stop this experiment, send the !K command to the drive.
;      This "kills" program execution and motion.
```

LIMFNC Input Function for Limit Inputs

Type	`Inputs; Limits (end of travel); Homing`
Syntax	`<a_><!>LIMFNC<i>-<<a>c>`

Units	`i = input # on the "DRIVE I/O" connector (see page 8);`
	`a = program # for function P;`
	`c = function identifier letter`

Range	`i = 1-3;`
	`c = A-T`

Default	`(pre-assigned limits and home function -- see below)`

Response	`LIMFNC: *LIMFNC1-A NO FUNCTION - STATUS OFF`
	`(repeated for all onboard limit inputs)`

See Also	`COMEXR, COMEXS, [ ER ], ERROR, INDEB, INFNC, INPLC, INSELP, INSTW, INTHW, JOY, JOYAXH, JOYVH, JOYVL, K, KDRIVE, LH, [ LIM ], LIMEN, LIMFNC, LIMLVL, PSET, [ SS ], TER, TIN, TRGFN, TRGLOT, [ TRIG ], TSS, TSTAT, TTRIG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LIMFNC` command defines the function of each individual limit input found on the "DRIVE I/O" connector. The factory default configuration is that each dedicated hardware end-of-travel and home limit is assigned to its respective `LIMFNC` function. That is, positive limit is assigned to `LIMFNC1-R`, negative limit is assigned to `LIMFNC2-S`, home limit is assigned to `LIMFNC3-T`.

Input debounce. By default, the limit inputs are assigned their respective end-of-travel or home `LIMFNC` functions (`R`, `S` or `T`). These limit functions are not debounced, but the hardware status (see `TLIM` and `LIM`) is debounced with the Input Debounce Time (`INDEB`) command setting for I/O brick zero (default is 4 ms). The `INDEB` debounce is the period of time that the input must be held in a certain state before the drive recognizes it. This directly affects the rate at which the inputs can change state and be recognized. When a limit input is assigned a function other than its respective end-of-travel or home `LIMFNC` function (`R`, `S` or `T`), it is debounced the `INDEB` setting for I/O brick zero (default is 4 ms). If a limit is once again returned to its respective `LIMFNC` function, the debounce is removed.

Input scan rate: The limit inputs are scanned once per *system update* (2 milliseconds).

Enabling & disabling inputs. Limit inputs assigned an end-of-travel input function (functions `R` or `S` described below) are enabled/disabled with the `LH` command — the default is enabled. Limit input functions may be overridden with the `LIMEN` command — the default is enabled (no override).

Multitasking. If the `LIMFNC` command does not include the task identifier (`%`) prefix, the function affects the task that executes the `LIMFNC` command. The functions that may be directed to a task with `%` are: `C`, `D`, `E`, `F`, and `P` (e.g., `2%LIMFNC3-F` assigns limit input 3 as a user fault input for task 2). Multiple tasks may share the same input, but the input may only be assigned one function.

Identifier	Function Description
A	**No special function** (general-purpose input)**.** Status can be used with the `LIM` assignment/comparison operator.
B	**BCD Program Select.** BCD input assignment to programs, lowest numbered input is least significant bit (LSB). BCD values for inputs are as follows:

	BCD Value
Least Significant Bit Value	1
.	2
Most Significant Bit Value	4

Note: If fewer inputs than shown above are defined to be Program Select Inputs, then the highest input number defined as a Program Select Input is the most significant bit.

An input defined as a BCD Program Select Input will not function until the `INSELP` command has been enabled.

Identifier **Function Description**

C **Kill.** Kills motion and halts all command processing (refer to `K` and `KDRIVE` command descriptions for further details on the *kill* function). This is an edge detection function and is not intended to inhibit motion. To inhibit motion, use the Pause/Resume function (`LIMFNCi-E`). When enabled with the `ERROR` command, bit #6 of the `TER` and `ER` commands will report the kill status.

D **Stop.** Stops motion. If `COMEXS` is set to zero (`COMEXSØ`), program execution will be terminated. If `COMEXS` is set to 1 (`COMEXS1`), command processing will continue. With `COMEXS` set to 2 (`COMEXS2`), program execution is terminated, but the `INSELP` value is retained. Motion deceleration during the stop is controlled by the `AD` & `ADA` commands. If error bit #8 is enabled (e.g., `ERROR.8-1`), activating a Stop input will set the error bit and cause a branch to the `ERRORP` program.

E **Pause/Continue.** If `COMEXR` is disabled (`COMEXRØ`), then only command execution pauses, not motion. With `COMEXR` enabled (`COMEXR1`), both command and motion execution are paused. After motion stops, you can release the input or issue a continue (`!C`) command to resume command processing (and motion in `COMEXR1` mode).

F **User Fault.** Refer to the `ERROR` command. If error bit #7 is enabled (e.g., `ERROR.7-1`), activating a User Fault input will set the error bit and cause a branch to the `ERRORP` program. **CAUTION**: Activating the user fault input sends an `!K` command to the drive, “killing” motion (refer to the `K` command description for ramifications).

G,H **Reserved**

I **Alarm Event** - Will cause the drive to set an Alarm Event in the Communications Server over the Ethernet interface. You must first enable the Alarm checking bit for this input-driven alarm (`INTHW.23-1`). For details on using alarms, refer to the *Programmer's Guide*.

J **JOG positive-direction** - Will jog the axis in a positive-direction. The `JOG` command must be enabled for this function to work.

K **JOG negative-direction.** Will jog the axis in a negative-direction. The `JOG` command must be enabled for this function to work.

L **JOG Speed Select.** Selects the high or low velocity range while jogging. If the input is active, the high jog velocity range will be selected.

M **Joystick Release.** Signals the drive to end joystick operation and resume program execution with the next statement in your program. When the input is open (high), the joystick mode is disabled (joystick mode can be enabled only if the input is closed, and only with the `JOY` command). When the input is closed (low), joystick mode can be enabled with the `JOY` command. The process of using Joystick mode is:

1. Assign the "Joystick Release" input function to a programmable input.
2. At the appropriate place in the program, enable joystick control of motion (with the `JOY` command). (Joystick mode cannot be enabled unless the "Joystick Release" input is closed.) When the `JOY` command enables joystick mode, program execution stops (assuming the Continuous Command Execution Mode is disabled with the `COMEXCØ` command).
3. Use the joystick to move the axis as required.
4. When you are finished using the joystick, open the "Joystick Release" input to disable the joystick mode. This allows program execution to resume with the next statement after the initial `JOY` command that started the joystick mode.

N **Reserved**

Identifier **Function Description**

O **Joystick Velocity Select.** Allows you to select the velocity for joystick motion. The JOYVH and JOYVL commands establish two joystick velocities. Opening the Velocity Select input (input is high) selects the JOYVH configuration. Closing the Velocity Select input (input is low) selects the JOYVL configuration. The JOYVL velocity could be used to quickly move to a location, the JOYVH velocity could be used for low-speed accurate positioning. NOTE: When this input is not connected, joystick motion always uses the JOYVH velocity setting.

aP **Program Select.** One to one correspondence for input vs. program number. The program number comes from the TDIR command. The number specified before the program name is the number to specify within this input definition. For example, in the LIMFNC1-3P command, 3 is the program number. An input defined as a Program Select Input will not function until the INSELP command has been enabled.

Q **Program Security.** Issuing the LIMFNCi-Q command enables the *Program Security* feature and assigns the *Program Access* function to the specified programmable input.

The program security feature denies you access to the DEF, DEL, ERASE, MEMORY, LIMFNC, and INFNC commands until you activate the program access input. Being denied access to these commands effectively restricts altering the user memory allocation. If you try to use these commands when program security is active (program access input is not activated), you will receive the error message *ACCESS DENIED. *The LIMFNCi-Q command is not saved in battery-backed RAM, so you may want to put it in the start-up program (STARTP).*

For example, once you issue the LIMFNC1-Q command, limit input 3 is assigned the program access function and access to the DEF, DEL, ERASE, MEMORY, LIMFNC, and INFNC commands will be denied until you activate the input.

To regain access to these commands without the use of the program access input, you must issue the LIMEN command to disable the program security input, make the required user memory changes, and then issue the LIMEN command to re-enable the input. For example, if limit input 3 is assigned as the Program Security input, use LIMEN.3=1 to disable the input and leave it activated, make the necessary user memory changes, and then use LIMEN.3=E to re-enable the input.

Limit Function Assignments: The end-of-travel and home limit functions listed below (R, S & T) can only be assigned to their respective inputs (which is the factory default configuration). For example, limit input functions R, S & T must be assigned to limit inputs 1-3, respectively. If you attempt any other permutation of LIMFNC assignment of functions R, S & T, the drive will respond with the error message "INVALID LIMFNC COMBINATION".

R **End-of-Travel Limit, Positive Direction**. This is the factory default function for limit input 1 found on the "DRIVE I/O" connector. If an onboard input or a digital input on an external I/O brick is assigned this function (e.g. 2INFNC1-R), then change the limit input's function to something else (e.g., change LIMFNC1-R to LIMFNC1-A). This end-of-travel limit input function is not debounced.

S **End-of-Travel Limit, Negative Direction.** This is the factory default function for limit input 2 found on the "DRIVE I/O" connector. If an onboard input or a digital input on an external I/O brick is assigned this function (e.g. 2INFNC2-S), then change the limit input's function to something else (e.g., change LIMFNC2-S to LIMFNC2-A). This end-of-travel limit input function is not debounced.

T **Home Limit.** This is the factory default function for limit input 3 found on the "DRIVE I/O" connector. If an onboard input or a digital input on an external I/O brick is assigned this function (e.g. 2INFNC3-T), then change the limit input's function to something else (e.g., change LIMFNC3-T to LIMFNC3-A). This home limit input function is not debounced.

Example:

```
LIMFNC1-D        ; Redefine the positive EOT input (limit input #1)
                 ; to be a stop input
```

LIMLVL Hardware Limit Input Active Level

Type	`Limit (End-of-Travel and Homing)`
Syntax	`<a_><!>LIMLVL<b><b><b>`
Units	`n/a`

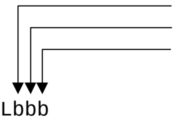
Range	`b = 0 (active low: requires n.c. EOT switch & n.o. home switch),`
	`    1 (active high: requires n.o. EOT switch & n.c. home switch),`
	`or  X (don't care)`

Default	`0`
Response	`LIMLVL:  *LIMLVL000`
See Also	`[ AS ], LH, LIMEN, [ LIM ], LIMFNC, HOM, TAS, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `LIMLVL` command to define the active state the end-of-travel and home limits (found on the "DRIVE I/O" connector). The default state is active low.

Command syntax for limits on the DRIVE I/O connector (bits are numbered 1-3 from left to right):



Limit #	Pin #	GT6K & GV6K Function (`LIMFNC` default)
1	28	`LIMFNC1-R` (Positive end-of-travel limit)
2	29	`LIMFNC2-S` (Negative end-of-travel limit)
3	31	`LIMFNC3-T` (Home limit)

Active Level Setting	Required Switch Type *	State	`LIM`/`TLIM` Report
Active low (`LIMLVL0`) *This is the default setting.*	End-of-travel limit: N.C. Home limit: N.O.	**Grounded** — sinking current (device driving the input is on)	1 (no limit hit)
		Not Grounded — not sinking current (device driving the input is off)	0 (FAULT: limit hit)
Active high (`LIMLVL1`)	End-of-travel limit: N.O. Home limit: N.C.	**Grounded** — sinking current (device driving the input is on)	0 (FAULT: limit hit)
		Not Grounded — not sinking current (device driving the input is off)	1 (no limit hit)

* Compumotor recommends that all end-of-travel limit switches be normally-closed, because with normally-closed limit switches the drive detects a limit fault condition (and stops or inhibits motion) when the switch contact is open or if the wiring to the switch is broken.

Axis Status (`AS`, `TAS`, and `TASF`) bits 15 and 16 indicate when a hardware end-of-travel limit has been activated (i.e., invoking the "inhibit motion" function).

Wiring instructions and specifications for the limit inputs are provided in the *Hardware Installation Guide*.

LJRAT System Load-to-Rotor/Forcer Inertia/Mass Ratio

Type	`System`
Syntax	`<a_><!>LJRAT<r>`

Units	`Rotary motor: r = ratio of load inertia to motor rotor inertia`
	`Linear motor: r = ratio of load mass to forcer mass`

Range	`0.0 - 100.0`
Default	`0.0`
Response	`LJRAT:   *LJRAT4`
See Also	`DACTDP, DELVIS, TGAIN, TSGSET`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LJRAT` command sets the system's load-to-rotor inertia ratio (rotary motors) or load-to-forcer mass ratio (linear motors). The ratio is expressed in the following equation:

Rotary Motors:

`LJRAT` = load inertia / motor rotor inertia

(Total system inertia = load inertia + motor rotor inertia)

Linear Motors:

`LJRAT` = load mass / forcer mass

(Total system mass = load mass + forcer mass)

NOTE: `LJRAT` must be set in order for the Electronic Viscosity (`DELVIS`) and Active Damping (`DACTDP`) features to function properly.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide*.
- Check the values of all active gains (`LJRAT` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

LN End of Loop

Type	`Loops or Program Flow Control`
Syntax	`<a_><!>LN`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`No response; used in conjunction with the L command`
See Also	`L, LX`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LN` command marks the end of a loop. You must use this command in conjunction with the Loop (`L`) command. All buffered commands that you enter between the `L` and `LN` commands are executed as many times as the number that you enter following the `L` command. You may nest loops up to 16 levels deep.
NOTE: Be careful about performing a `GOTO` between the `L` and `LN` commands. Branching to a different location within the same program will cause the next loop encountered to be nested within the previous loop, unless an `LN` command has already been encountered.

Example:

```
L5           ; Repeat the commands between L and LN five times
GO1          ; Start motion
LN           ; End loop
```

LOCK Lock Resource to Task

Type	`Multi-tasking`
Syntax	`<a_><!>LOCK<i,i>`

Units	`1st i = resource number`
	`2nd i = 1 (lock the resource) or 0 (unlock the resource)`

Range	`1st i = 1 (COM1 port), 2 (COM2 port),`
	`or 3 (task swapping)`
	`2nd i = 1 (lock the resource) or 0 (unlock the resource)`

Default	`0 (= not locked)`
Response	`LOCK      (see example below)`
See Also	`[ , ], DRPCHK, E, PORT, TSKTRN`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `LOCK` command to make a resource available only to the specified task. The `LOCK`-able resources are:

- COM1 — the “RS-232/485” communication port or the “ETHERNET” communication port
- COM2 — the “RS-232” communication port
- Task Swapping — When task swapping is locked to a specific task, statements in all other tasks will not be executed until task swapping is again unlocked.

To check the `LOCK` status of all available resources, enter the `LOCK` command without field value. Below is an example response:

```
*LOCK1,0 COM PORT 1     - UNLOCKED
*LOCK2,0 COM PORT 2     - UNLOCKED
*LOCK3,0 TASK SWAPPING - UNLOCKED
```

See the *Programmer’s Guide* for more information about using the `LOCK` command with multi-tasking.

NOTES

- If one task attempts to lock a resource in a different task (e.g., if Task1 attempts to execute the `2%LOCK1,1` command), the drive will respond with an error message (“`ALTERNATE TASK NOT ALLOWED`“).
- If task “A” attempts to lock a resource that is already locked to task “B”, command processing in task “A” will pause on the `LOCK` command, and SS bit 26 or 27 will be set (“`SUSPENDED ON COMn`“). When task “B” unlocks the resource, task “A” will be able to lock the resource and continue processing.
- If task “A” attempts to lock task swapping while any other task has locked a resource, command processing in task “A” will pause on the `LOCK` command, and SS bit 24 will be set (“`SUSPENDED ON SWAP`“). When all other tasks release locks on all other resources (COM1, COM2), task “A” will be able to lock task swapping and continue processing.
- A resource may be locked by a task only while that task is executing a program. If program execution is terminated for any reason (e.g., stop, kill, limit, fault, or just reaching the `END` of a program), all resources locked by that task will become unlocked.

Example:

```
LOCK1,1           ; Ensure exclusive COM1 access for the task executing
                  ; this program
WRITE"travel is"  ; First part of output string
WRVAR1            ; Numeric value of travel
WRITE"inches.”    ; Finish complete string
LOCK1,0           ; Allow other tasks access to COM1
```

LS Soft Limit Enable

Type	`Limit (End-of-Travel)`
Syntax	`<a_><!>LS<i>`
Units	`n/a`
Range	`i = 0 (disable both), 1 (disable positive-direction), 2 (disable negative-direction) or 3 (enable both)`
Default	`0`
Response	`LS:    *LS0`
See Also	`[ AS ], [ ER ], LH, LSAD, LSADA, LSNEG, LSPOS, PSET, TAS, TER, TSTAT`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `LS` command determines the status of the programmable soft move distance limits. With soft limits disabled, motion will not be restricted. After a soft limit absolute position has been programmed (`LSPOS` and `LSNEG`), and the soft limit is enabled (`LS`), a move will be restricted upon reaching the programmed soft limit absolute position. The rate at which motion is decelerated to a stop upon reaching a soft limit is determined by the `LSAD` and `LSADA` commands.

Disable negative- and positive-direction soft limits	`i` = `0`
Enable negative-direction, disable positive-direction soft limit	`i` = `1`
Enable positive-direction, disable negative-direction soft limit	`i` = `2`
Enable negative- and positive-direction soft limits	`i` = `3`

NOTE: The Gem6K drive maintains an absolute count, even though you may be programming in the incremental mode (`MAØ`). The soft limits will also function in preset mode (`MCØ`) or continuous mode (`MC1`). The soft limit position references the commanded position (`TPC`), <u>not</u> the position as measured by a feedback device, such as an encoder (`TPE`).

NOTE

If a soft limit is encountered while limits are enabled, motion must occur in the opposite direction before a move in the original direction is allowed. You cannot use the `PSET` command to clear the soft limit condition. If limits are disabled, you are free to make a move in either direction.

Example

```
LSPOS500000           ; Set soft limit positive-direction absolute position to be
                      ; 500000 units (Soft limits are always absolute)
LSNEG-500000          ; Set soft limit negative-direction absolute position to
                      ; be -500000 units (Soft limits are always absolute)
LS3                   ; Enable both soft limits
LSAD100               ; Set soft limit decel to 100 units/sec/sec
PSET0                 ; Set absolute position to 0
A10                   ; Set accel to 10 units/sec/sec
V1                    ; Set velocity to 1 unit/sec
D100000               ; Set distance to 100000 units
GO1                   ; Initiate motion
```

LSAD Soft Limit Deceleration

Type	`Limit (End-of-Travel)`
Syntax	`<a_><!>LSAD<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 – 9999.9999`
Default	`100.0000`
Response	`LSAD:    *LSAD100.0000`
See Also	`DMEPIT, DRES, LHAD, LS, LSADA, LSNEG, LSPOS, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LSAD` command determines the value at which to decelerate after a programmed soft limit (`LSPOS` or `LSNEG`) has been hit.

UNITS OF MEASURE and **SCALING**: refer to page 16.

The soft limit deceleration remains set until you change it with a subsequent soft limit deceleration command. Decelerations outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid deceleration is entered the previous deceleration value is retained.

Example: Refer to the soft limit enable (`LS`) command example.

LSADA Soft Limit Average Deceleration

Type	`Motion (S-Curve); Limit (End-of-Travel)`
Syntax	`<a_><!>LSADA<r>`

Units	`r = units/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0001 – 9999.9999`
Default	`100.0000 (Default is a constant decel ramp, where LSADA tracks LSAD. S-curve decel is achieved when LSADA is changed independent of LSAD. To restore a constant decel ramp and tracking, set AA = 0.)`
Response	`LSADA:   *LSADA100.0000`
See Also	`AD, ADA, LS, DMEPIT, LHADA, LS, LSAD, SCALE, SCLA`

Product	Rev
GT6K	6.0
GV6K	6.0

The `LSADA` command allows you to specify the average deceleration for an S-curve deceleration profile when a soft limit is hit. S-curve profiling provides smoother motion control by reducing the rate of change in deceleration; this decel rate of change is known as *jerk*. Refer to page 15 for details on S-curve profiling.

Acceleration scaling (`SCLA`) affects `LSADA` the same as it does for `LSAD`. Refer to page 16 for details on scaling.

Example:

```
LSAD10             ; Set the maximum deceleration to 10 units/sec/sec
LSADA5             ; Set the average deceleration to 5 units/sec/sec
```

LSNEG Soft Limit Negative Travel Range

Type	Limit (End-of-Travel)
Syntax	<a_><!>LSNEG<r>
Units	r = units of distance
Range	-999,999,999 to +999,999,999 (after conversion to steps)
Default	+0
Response	LSNEG: *LSNEG+0
See Also	LS, LSAD, LSADA, LSPOS, PSET, SCALE, SCLD

Product	Rev
GT6K	6.0
GV6K	6.0

The LSNEG command specifies the distance in absolute units where motion will be restricted when traveling in a negative-travel direction. The reference position used to determine absolute position is set to zero upon power-up, and can be reset using the PSET command. **Be sure to set the LSPOS value greater than the LSNEG value.**

The LSNEG value remains set until you change it with a subsequent LSNEG command.

All soft limit values entered are in absolute distance counts. If scaling is enabled (SCALE1), LSNEG is internally multiplied by the distance scale factor (SCLD). The soft limit position references the commanded position (TPC), not the position as measured by a feedback device, such as an encoder (TPE).

Example: Refer to the soft limit enable (LS) command example.

LSPOS Soft Limit Positive Travel Range

Type	Limit (End-of-Travel)
Syntax	<a_><!>LSPOS<r>
Units	r = units of distance
Range	-999,999,999 to +999,999,999 (after conversion to steps)
Default	+0
Response	LSPOS: *LSPOS+0
See Also	LS, LSAD, LSADA, LSNEG, PSET, SCALE, SCLD

Product	Rev
GT6K	6.0
GV6K	6.0

The LSPOS command specifies the distance in absolute units where motion will be restricted when traveling in a positive-travel direction. The reference position used to determine absolute position is set to zero upon power-up, and can be reset using the PSET command. **Be sure to set the LSPOS value greater than the LSNEG value.**

The LSPOS value remains set until you change it with a subsequent LSPOS command.

All soft limit values entered are in absolute distance counts. If scaling is enabled (SCALE1), LSPOS is internally multiplied by the distance scale factor (SCLD). The soft limit position references the commanded position (TPC), not the position as measured by a feedback device, such as an encoder (TPE).

Example: Refer to the soft limit enable (LS) command example.

LX Terminate Loop

Type	Loops; Program Flow Control
Syntax	<a_><!>LX
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	L, LN, PLN, PLOOP

Product	Rev
GT6K	6.0
GV6K	6.0

The LX command terminates the current loop in progress. This command does not halt processing of the commands in the loop until the last command in the current loop iteration is executed. At this point, the loop is terminated. If there are nested loops, only the inner most loop is terminated.

This command can be used externally to terminate the loop only if it is preceded by the immediate command specifier (`!LX`). If the immediate command specifier is not used, the command will have no effect on a loop in progress. An example of where the buffered Terminate Loop command (`LX`) might be used is provided below.

Example:

```
; *******************************************************************
; This program will make the move specified by the GO1 command
; indefinitely until input 2 goes high, at which point, an LX will
; be issued, terminating the loop.
; *******************************************************************
L0                ; Repeat the commands between L and LN infinitely, or until
                  ; a Terminate Loop (LX) command is received
GO1               ; Start motion
IF(IN=bX1)        ; If input 2 goes high, execute all
                  ; statements between IF and NIF
LX                ; Terminate loop
NIF               ; End IF statement
LN                ; End loop
```

MA — Absolute/Incremental Mode Enable

Type	`Motion`
Syntax	`<a_><!>MA<b>`
Units	`n/a`
Range	`b = 0 (incremental mode) or 1 (absolute mode)`
Default	`0`
Response	`MA:    *MA0`
See Also	`COMEXC, D, GO, PSET`

Product	Rev
GT6K	6.0
GV6K	6.0

The `MA` command specifies whether the subsequent motion will be made with respect to current position (incremental mode) or with respect to an absolute zero position (absolute mode).

In incremental mode (`MAØ`), all moves are made with respect to the position at the beginning of the move. This mode is useful for repeating moves of the same distance.

In absolute mode (`MA1`), all moves are made with respect to the absolute zero position. The absolute zero position is equal to zero upon power up, and can be redefined with the `PSET` command. An internal counter keeps track of absolute position.

ON-THE-FLY CHANGES: You can change positioning modes *on the fly* (while motion is in progress) in two ways. One way is to send an immediate command (`!MA`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered command (`MA`) followed by a buffered go command (`GO`).

Example:

```
PSET0     ; Set the present position to be absolute position zero
MA1       ; Enable absolute positioning mode
A2        ; Set acceleration to 2 revs/sec/sec
AD7       ; Set deceleration to 7 revs/sec/sec
V1        ; Set velocity to 1 rev/sec
D4000     ; Set the setpoint distance to absolute position 4000
GO1       ; Start motion: (move 4000 counts in the positive direction)
D2000     ; Set the setpoint distance to absolute position 2000
GO1       ; Start motion: (move 2000 counts in the negative direction)
D8000     ; Set the setpoint distance to absolute position 8000
GO1       ; Start motion: (move 6000 counts in the positive direction)
MA0       ; Enable incremental positioning mode
D4000     ; Set incremental distance to 4000 counts, positive direction
GO1       ; Start motion: (move 4000 counts in the positive direction
          ; and finish at absolute position 12000)
GO1       ; Start motion again: (move 4000 counts in the positive direction
          ; and finish at absolute position 16000)
```

MC Preset/Continuous Mode Enable

Type	`Motion`
Syntax	`<a_><!>MC<b>`
Units	`n/a`
Range	`b = 0 (preset mode) or 1 (continuous mode)`
Default	`0`
Response	`MC:    *MC0`
See Also	`A, AD, COMEXC, COMEXS, D, FOLMD, [ FS ], FSHFC, FSHFD, GO, GOBUF, K, MA, PSET, S, TFS, V`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `MC` command causes subsequent moves to go a specified distance (`MCØ`), or a specified velocity (`MC1`).

In the Preset Mode (`MCØ`), all moves will go a specific distance. The actual distance traveled is specified by the `D`, `SCLD`, and `MA` commands.

In the Continuous Mode (`MC1`), all moves will go to a specific velocity with the Distance (`D`) command establishing the direction (`D+` or `D-`). The actual velocity will be determined by the `V` and `SCLV` commands, or the `V` and `DRES` commands.

Motion will stop with an immediate Stop (`!S`) command, an immediate Kill (`!K`) command, or by specifying a velocity of zero followed by a `GO` command. Motion can also be stopped with a buffered Stop (`S`) or Kill (`K`) command if the continuous command processing mode (`COMEXC`) is enabled.

ON-THE-FLY CHANGES: You can change positioning modes *on the fly* (while motion is in progress) in two ways. One way is to send an immediate command (`!MC`) followed by an immediate go command (`!GO`). The other way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered command (`MC`) followed by a buffered go command (`GO`).

Example:

```
DEL demo          ; Delete program demo
DEF demo          ; Begin definition of program demo
COMEXC0           ; Disable continuous command processing mode
MA0               ; Enable incremental positioning mode
MC0               ; Enable preset positioning mode
A20               ; Set acceleration to 20 revs/sec/sec
AD7               ; Set deceleration to 7 revs/sec/sec
V2                ; Set velocity to 2 revs/sec
D10000            ; Set distance to 10,000 counts
GO1               ; Initiate motion (move 10,000 counts in positive direction)
COMEXC1           ; Enable continuous command processing mode
MC1               ; Enable continuous positioning mode
A12               ; Set acceleration to 12 revs/sec/sec
AD8               ; Set deceleration to 8 revs/sec/sec
V5                ; Set velocity to 5 revs/sec
GO1               ; Initiate motion (travel at a velocity of 5 revs/sec)
T5                ; Wait 5 seconds
V9                ; Set velocity to 9 revs/sec (when the next GO is executed)
GO1               ; Change to the new velocity of 9 revs/sec
T2                ; Wait 2 seconds
V0                ; Set velocity to zero
GO1               ; Go to zero velocity
WAIT(AS.1=b0)     ; Wait until no motion is commanded
COMEXC0           ; Disable continuous command processing mode
END               ; End definition of program demo
```

MEMORY Partition User Memory

Type	`Drive Configuration`
Syntax	`<a_><!>MEMORY<i>,<i>`

Units	`i = bytes of memory (use even number only)`
	`1st <i> = partition for “Programs”`
	`2nd <i> = partition for “Compiled Profiles”`

Range	`(see table below)`
Default	`(see table below)`
Response	`MEMORY: *MEMORY150000,150000`
See Also	`[ DATP ], DEF, GOBUF, PCOMP, PLCP, [ SEG ], [ SS ], TDIR, TMEM, TSEG, TSS`

Product	Rev
GT6K	6.0
GV6K	6.0

The Gem6K’s memory has two partitions: one for storing *programs* and one for storing *compiled profiles & PLC programs*. The allocation of memory to these two areas is controlled with the `MEMORY` command.

“Programs” vs. ”Compiled Profiles & Programs”

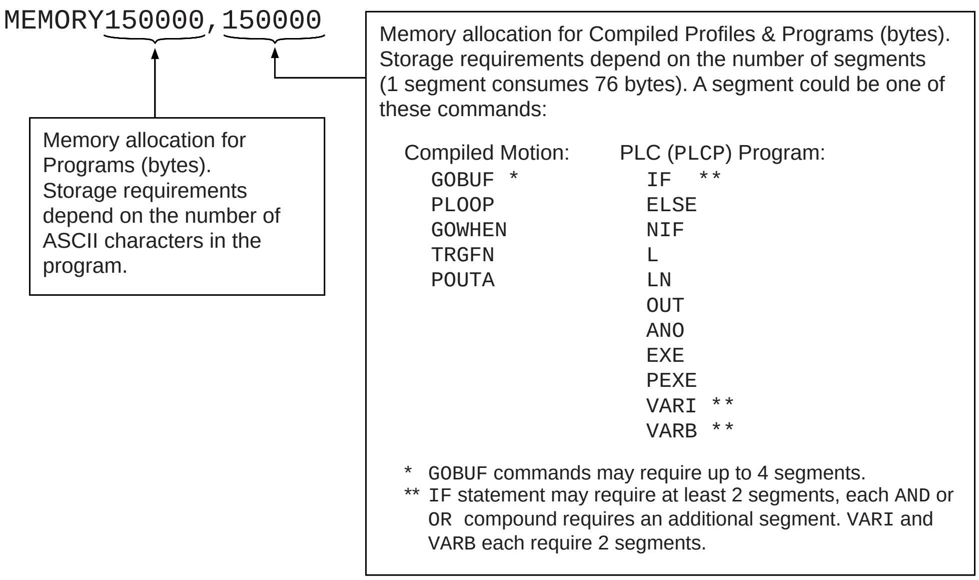
Programs are defined with the `DEF` and `END` commands, as demonstrated in the “Program Development Scenario” in the *Programmer's Guide*.

Compiled Profiles & PLC Programs are defined like programs (using the `DEF` and `END` commands), but are compiled with the `PCOMP` command and executed with the `PRUN` command (but `PLCP` programs are usually executed with `SCANP`). Compiled profiles/programs could be a *profile* (a series of `GOBUF` commands), or a *PLC program* (for PLC Scan Mode).

Programs intended to be compiled are stored in program memory. After they are compiled with the `PCOMP` command, they remain in program memory and the *segments* (see diagram below) from the compiled program are stored in compiled memory. The `TDIR` report indicates which programs are compiled as compiled profiles (“`COMPILED AS A PATH`”) and which programs are compiled as PLC programs (“`COMPILED AS A PLC PROGRAM`”) .

For more information on compiled profiles (Compiled Motion Profiling), and PLC Scan Mode, refer to the *Programmer's Guide*.

`MEMORY` Syntax:



`MEMORY150000,150000`

Memory allocation for Programs (bytes). Storage requirements depend on the number of ASCII characters in the program.

Memory allocation for Compiled Profiles & Programs (bytes). Storage requirements depend on the number of segments (1 segment consumes 76 bytes). A segment could be one of these commands:

Compiled Motion:	PLC (`PLCP`) Program:
`GOBUF *`	`IF **`
`PLOOP`	`ELSE`
`GOWHEN`	`NIF`
`TRGFN`	`L`
`POUTA`	`LN`
	`OUT`
	`ANO`
	`EXE`
	`PEXE`
	`VARI **`
	`VARB **`

* `GOBUF` commands may require up to 4 segments.
** `IF` statement may require at least 2 segments, each `AND` or `OR` compound requires an additional segment. `VARI` and `VARB` each require 2 segments.

Allocation Defaults and Limits:

The following table identifies memory allocation defaults and limits for the Gem6K drive. When specifying the memory allocation, use only even numbers. The minimum storage capacity for one partition area (program or compiled) is 1,000 bytes.

Feature	Gem6K
Total memory (bytes)	300,000
Default allocation (program,compiled)	150000,150000
Maximum allocation for programs	299000,1000
Maximum allocation for compiled profiles/programs	1000,299000
Max. # of programs	400
Max. # of labels	600
Max. # of compiled profiles	300
Max. # of compiled profile segments	2069
Max. # of numeric variables	225
Max. # of integer variables	225
Max. # of string variables	25
Max. # of binary variables	125

When teaching variable data to a data program (DATP), be aware that the memory required for each data statement of four data points (43 bytes) is taken from the memory allocation for program storage.

CAUTION

Issuing a memory allocation command (e.g., MEMORY200000,100000) will erase all existing programs and compiled segments. However, issuing the MEMORY command by itself (e.g., type MEMORY <cr> by itself to request the status of how the memory is allocated) will not affect existing programs or compiled segments.

Checking Memory Status:

To find out what programs reside in your drive's memory, and how much of the available memory is allocated for programs and compiled profile segments, issue the TDIR command (see example response below). Entering the TMEM command or the MEMORY command (without parameters) will also report the available memory for programs and compiled profile segments.

Sample response to TDIR command:

```
*1 - SETUP USES 345 BYTES
*2 - PIKPRT USES 333 BYTES
*14322 OF 150000 BYTES (98%) PROGRAM MEMORY REMAINING
*1973 OF 1973 SEGMENTS (100%) COMPILED MEMORY REMAINING
```

Two system status bits (reported with the TSS, TSSF and SS commands) are available to check when compiled profile segment storage is 75% full or 100% full. System status bit #29 is set when segment storage reaches 75% of capacity; bit #30 indicates when segment storage is 100% full.

Example:

```
MEMORY200000,100000     ; Set aside 200,000 bytes for program storage,
                        ; 100,000 bytes for compiled profile segments
```

MEPOL Master Encoder Polarity

Type	Encoder; Following; Drive Configuration
Syntax	<a_><!>MEPOL<b>
Units	b = polarity bit
Range	b = 0 (normal polarity), 1 (reverse polarity), or X (don’t care)
Default	0
Response	MEPOL: *MEPOL0
See Also	[PCME], [PCMS], [PMAS], [PME], PMESET, TPCME, TPME, TPCMS, TPMAS

Product	Rev
GT6K	6.0
GV6K	6.0

Use the MEPOL command to reverse the counting direction (polarity) of the Master Encoder input (the encoder connector labeled “Master Encoder”). This allows you to reverse the counting direction without having to change the actual wiring to the encoder input.

Immediately after issuing the MEPOL command, the master encoder will start counting in the opposite direction (including all master encoder position registers).

The MEPOL command is automatically saved in non-volatile RAM.

MESND Master Encoder Step and Direction Mode

Type	Encoder; Counter; Following
Syntax	<a_><!>MESND<b>
Units	b = enable bit
Range	b = 0 (quadrature signal), 1 (step & direction), or X (don’t care)
Default	0
Response	MESND: *MESND0
See Also	[PME], TPME

Product	Rev
GT6K	6.0
GV6K	6.0

Use the MESND command to specify the functionality of the Master Encoder input.

MESND0........(default setting) accept a quadrature signal from the master encoder.

MESND1........Accept step and direction signals. The count is registered on a positive edge of a transition for a signal measured on encoder channel A+ and A- connections. The direction of the count is specified by the signal on encoder channel B+ and B- connections. Therefore, you should connect your step and direction input device as follows: Connect Step+ to A+, Step- to A-, Direction+ to B+, and Direction- to B-.

[MOV] Axis Moving Status

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[AS], GO, TAS

Product	Rev
GT6K	6.0
GV6K	6.0

The MOV command is used to assign the moving status to a binary variable, or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

The axis moving status is also reported with bit #1 of the TAS, TASF and AS commands

Syntax: VARBn=MOV where n is the binary variable number,
or MOV can be used in an expression such as IF(MOV=b1), or IF(MOV=h1)

If the axis is in motion, the bit will be a one (1). If the axis is not in motion, the bit will be a zero (Ø).

Example:

```
COMEXC1             ; Enable continuous command processing mode
COMEXS1             ; Save command buffer on stop
MC1                 ; Enable continuous mode
A2                  ; Set acceleration to 2 units/sec/sec
AD2                 ; Set deceleration to 2 units/sec/sec
V1                  ; Set velocity to 1 units/sec
GO1                 ; Initiate motion
T5                  ; Wait 5 seconds
S1                  ; Stop motion
WAIT(MOV=b0)        ; Wait for motion to come to a halt
COMEXC0             ; Disable continuous command processing mode
```

NIF End IF Statement

Type	Program Flow Control or Conditional Branching	**Product**	**Rev**
Syntax	<a_><!>NIF	GT6K	6.0
Units	n/a	GV6K	6.0
Range	n/a		
Default	n/a		
Response	No response when used in conjunction with the IF command		
See Also	ELSE, IF		

The NIF command is used in conjunction with the IF and ELSE commands to provide conditional program flow. If the expression contained within the parentheses of the IF command evaluates true, then the commands between the IF and the ELSE are executed, and the commands between the ELSE and the NIF are ignored. If the expression evaluates false, the commands between the ELSE and the NIF are executed, and the commands between IF and ELSE are ignored. The ELSE command is optional and does not have to be included in the IF statement.

Programming order: IF(expression) ...commands... NIF
or
IF(expression) ...commands... ELSE ...commands... NIF

NOTE: Be careful about performing a GOTO between IF and NIF. Branching to a different location within the same program will cause the next IF statement encountered to be nested within the previous IF statement, unless a NIF command has already been encountered.

Example:

```
IF(IN=b1X0)     ; If input 1 is ON and input 3 is OFF (IF statement evaluates
                ; true), run program #13. If the IF statement evaluates false,
                ; turn on output #3.
  PROG13        ; Run program #13
  ELSE          ; If the IF condition evaluates false, execute the subsequent
                ; commands until the NIF.
  OUTxx1        ; Turn on output #3
  NIF           ; End IF statement
```

[NMCY] Master Cycle Number

		Product	Rev
Type	Following; Assignment or Comparison	GT6K	6.0
Syntax	See below	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	n/a		
See Also	FMCLEN, FMCNEW, FMCP, [FS], [PMAS], TFS, TNMCY, TRGFN		

The NMCY command is used to assign the current master cycle number to a numeric variable, or to make a comparison against another value. The master must be assigned first (FOLMAS command) before this command will be useful. For a complete discussion of master cycles, refer to the Following chapter in the *Programmer's Guide.*

The value represents the current cycle number, not the position of the master (or the follower). The master cycle number is set to zero when master cycle counting is restarted, and is incremented each time a master cycle finishes (i.e., rollover occurs). It will often correspond to the number of complete parts in a production run. This value may be used for subsequent decision making, or simply recording the cycle number corresponding to some other event.

Syntax: VARn=NMCY where “n” is the variable number, or NMCY can be used in an expression such as IF(NMCY>=5).

Example:

```
IF(NMCY>500)       ; If the master has moved through 500 cycles ...
WRITE"500 cycles have occurred"  ; Send string to serial port
NIF                ; End of IF statement
VAR12=NMCY         ; Set VAR12 to equal the number of cycles that have occurred on
                   ; the master
```

[NOT] Not

		Product	Rev
Type	Operator (Logical)	GT6K	6.0
Syntax	See below	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	n/a		
See Also	[AND], IF, NWHILE, [OR], REPEAT, UNTIL, WAIT, WHILE		

The NOT operator is used in conjunction with the program flow control commands (IF, REPEAT..UNTIL, WHILE..NWHILE, WAIT). The NOT operator complements a logical expression. If an expression is true, the NOT operator will make the expression false. If an expression is false, the NOT operator will make the expression true. This is illustrated by the following examples:

If variable #1 equals 1, then the following is a true statement: IF(VAR1<3)
By using the NOT operator, the same statement becomes false: IF (NOT VAR1<3)
If variable #2 equals 2, then the following statement is false: WHILE(VAR2=3)
By using the NOT operator, the same statement becomes true: WHILE (NOT VAR2=3)

To evaluate an expression (NOT Expression) to determine if the expression is true, use the following rule:

NOT TRUE = FALSE
NOT FALSE = TRUE

In the following example, variable #1 is displayed, then is incremented by 1 as long as VAR1 is not equal to 10.

Example:

```
VAR1=1              ; Set variable 1 equal to 1
WHILE(NOT VAR1=10)  ; Compare variable 1 to 10, and logically not the expression
WRVAR1              ; Write out variable 1
VAR1=VAR1 + 1       ; Set variable 1 to increment 1 by 1
NWHILE              ; End WHILE statement
```

NTADDR Ethernet IP Address

Type	`Communication Interface`
Syntax	`NTADDR<i,i,i,i>`
Units	`i,i,i,i = IP address (commas are used in place of periods)`
Range	`i = 0-255`
Default	`192,168,10,30 (network address is 192.168.10.30)`
Response	`NTADDR: *192,168,10,30`
See Also	`TNTMAC`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `NTADDR` command to change the Gem6K drive's IP address (e.g., to correct an IP address conflict). **NOTE**: The Gem6K drive needs to be reset (cycle power or issue `RESET` command) in order for the new address to take effect.

The `NTADDR` setting is automatically saved in battery backed RAM.

NTFEN Ethernet Communication Enable

Type	`Communication Interface`
Syntax	`NTFEN<b>`
Units	`b = Ethernet enable bit`

Range	`0 (disabled),`
	`1 (enabled for Windows 95/98, no File Sharing, closed network),`
	`2 (enabled – recommended for most Ethernet configurations)`

Default	`0 (Ethernet communication is disabled)`
Response	`NTFEN: *0`
See Also	`NTADDR, NTMASK, TNT, TNTMAC`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `NTFEN` command to enable or disable Ethernet communication. The factory default configuration is that Ethernet communication is disabled (`NTFEN0`). To enable Ethernet communication, you must connect to the Gem6K's "RS-232" serial port (COM2) and send the `NTFEN` command which is appropriate for your Ethernet configuration (see options below). Then you can communicate over the Ethernet connection.

Options:

`NTFEN0`: Use `NTFEN0` to disable Ethernet communication.

`NTFEN1`: `NTFEN1` is primarily intended for use with Windows 95/98 with no File Sharing and a closed network.

`NTFEN2`: `NTFEN2` is recommended as the standard Ethernet communication mode, even if you are using a closed network and no file sharing. `NTFEN2` is especially useful if you are using Windows NT, or Windows 95/98 with File Sharing and/or an open network.
NOTE: When using `NTFEN2`, you must also follow the ARP -S Static Mapping procedure (see *Programmer's Guide*).

NOTE: You can communicate to <u>either</u> the "ETHERNET" port <u>or</u> the "RS-232/485" port at one time.

The `NTFEN` setting is automatically saved in battery backed RAM. Thus, if you cycle power, Ethernet communication will still be enabled.

If the Ethernet connection fails, the Gem6K will set error status bit #22 (see `ER`, `TER`, and `TERF`) if error-checking bit #22 is enabled with the `ERROR` command. Also, if this error occurs, the Gem6K will branch to the `ERRORP` program.

NTMASK Ethernet Network Mask

Type	`Communication Interface`
Syntax	`NTMASK<i,i,i,i>`
Units	`i,i,i,i = mask`
Range	`i = 0-255`
Default	`255,255,255,0`
Response	`NTMASK:  *255,255,255,0`
See Also	`NTADDR, TNTMAC`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `NTMASK` command to configure the Gem6K drive's network mask. **NOTE**: The Gem6K drive needs to be reset (cycle power or issue `RESET` command) in order for the new network mask to take effect.

The `NTMASK` setting is automatically saved in battery backed RAM.

NTSFS Ethernet Send Fast Status Packet

Type	`Communication Interface`
Syntax	`NTSFS`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`NTFEN`

Product	Rev
GT6K	6.0
GV6K	6.0

The `NTSFS` command allows a Gem6K program to send a *Fast Status packet*, as needed, from the Gem6K drive to a PC application (COM6SRVR). In a typical application, a PC may be controlling a machine and using the COM6SRVR's *Variable Packets* to send variables and "job" instructions to the Gem6K. When the job is complete, the Gem6K could execute the `NTSFS` command to send a Fast Status packet back to the PC, thus indicating that the job was completed. Using the VarI and VarB elements of the Fast Status packet allows the Gem6K to communicate that the job was completed satisfactorily or that a specific error caused the job to fail.

For details on using Fast Status and COM6SRVR, refer to the *Communication Server Programmer's Reference*.

NWHILE End WHILE Statement

Type	`Program Flow Control or Conditional Branching`
Syntax	`<a_><!>NWHILE`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`No response when used in conjunction with the WHILE command`
See Also	`WHILE`

Product	Rev
GT6K	6.0
GV6K	6.0

The `WHILE` command, in conjunction with the `NWHILE` command, provide a means of conditional program flow. The `WHILE` command marks the beginning of the conditional statement, the `NWHILE` command marks the end. If the expression contained within the parenthesis of the `WHILE` command evaluates true, then the commands between the `WHILE` and `NWHILE` are executed, and continue to execute as long as the expression evaluates true. If the expression evaluates false, then program execution jumps to the first command after the `NWHILE`.

Up to 16 levels of `WHILE` .... `NWHILE` commands may be nested.

NOTE: Be careful about performing a `GOTO` between `WHILE` and `NWHILE`. Branching to a different location within the same program will cause the next `WHILE` statement encountered to be nested within the previous `WHILE` statement, unless an `NWHILE` command has already been encountered.

Programming order: `WHILE(expression) ...commands... NWHILE`

Example:

```
WHILE(IN=b1X0)     ; While input 1 = 1, input 3 = 0, execute commands between WHILE & NWHILE
T5                 ; Wait 5 seconds
TPE                ; Transfer position of encoder
NWHILE             ; End WHILE statement
```

ONCOND On Condition Enable

Type	On Condition (Program Interrupt)
Syntax	<a_><!><%>ONCOND<b><b><b><b>
Units	n/a
Range	b = 0 (disable), 1 (enable) or X (don't change)
Default	0
Response	ONCOND: *ONCOND0000
See Also	FSHFD, ONIN, ONP, ONUS, ONVARA, ONVARB, [SS], TSS

Product	Rev
GT6K	6.0
GV6K	6.0

The ONCOND command enables the ONIN, ONUS, ONVARA, and ONVARB commands. When enabled, the expressions specified in the ONIN, ONUS, ONVARA, and ONVARB commands will be continuously evaluated. If any of the expressions ever evaluate true, a GOSUB will be made to the ONP program/subroutine.

ONP, ONIN, ONUS, ONVARA, and ONVARB should be defined before enabling the On Condition. If ONP is not defined first, the error message *UNDEFINED LABEL will appear.

ONCONDbbbb: First b = ONIN Enable
Second b = ONUS Enable
Third b = ONVARA Enable
Fourth b = ONVARB Enable

When ON conditions WILL NOT interrupt immediately: These are situations in which an ON condition does not immediately interrupt the program in progress. However, the fact that the ON condition evaluated true is retained, and when the condition listed below is no longer preventing the interrupt, the interrupt will occur.

- While a WAIT statement is in progress
- While a time delay (T) is in progress
- While a program is being defined (DEF)
- While a pause (PS) is in progress
- While a data read (DREAD, DREADF, or READ) is in progress
- While motion is in progress due to GO, GOWHEN, HOM, JOY, JOG, or PRUN and the continuous command execution mode is disabled (COMEXCØ).

Multi-Tasking: Each task has it own ONP Program and its own set of On conditions.

Example:

```
DEF bigmov         ; Define program bigmov
D20                ; Sets move distance to 20 units
GO1                ; Initiate motion
END                ; End program definition
ONP bigmov         ; Set ON program to bigmov
2ONINxxx1          ; When input #4 on I/O brick 2 is activated,
                   ; GOSUB to the ONP program
ONCOND1000         ; Enable ONIN condition
;  Now that the ONP program named bigmov is defined, if input #4 becomes
;  active during normal program operation, the program will GOSUB to the
;  ONP program (bigmov).
```

ONIN On an Input Condition Gosub

		Product	Rev
Type	`On Condition (Program Interrupt)`	GT6K	6.0
Syntax	`<a_!><%><@><B>ONIN<b><b><b>...<b><b>`	GV6K	6.0
Units	`n/a`		
Range	`b = 0 (disable), 1 (enable) or X (don't care)`		
Default	`X`		

Response	`ONIN:    *ONINXXXX_X`
	`1ONIN:   *1ONINXXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX`		

See Also	`INFNC, ONCOND, ONP, TIN`		

The `ONIN` command specifies the input bit pattern which will cause a branch to the ON program (`ONP`). If the input pattern occurs, a GOSUB is performed. The subroutine or program that the GOSUB branches to is selected with the ON program (`ONP`) command.

The number of external inputs available varies by the configuration of I/O bricks used. Refer to page 8 for details.

The `ONIN` command must be enabled using the `ONCOND` command before any branching will occur. Once a branch to the `ONP` program occurs, the `ONIN` command will not call the `ONP` program while the `ONP` program is executing, eliminating the possibility of recursive calls. After returning from the `ONP` program, the input pattern specified by the `ONIN` command must evaluate false before another branch to the `ONP` program, resulting from the `ONIN` inputs, will be allowed.

Multi-Tasking: Each task has it own `ONP` Program and its own set of On conditions. Only 1 `ONIN` condition is allowed per task. Therefore, only one I/O brick can be referenced in an `ONIN` condition for a specific task.

Example:

```
DEF bigmov       ; Define program bigmov
D20              ; Set move distance to 20 units
GO1              ; Initiate motion
END              ; End program definition
ONP bigmov       ; Set ON program to bigmov
2ONINxxx11xx1    ; When inputs 4, 5, and 8 on I/O brick 2 are activated,
                 ; GOSUB to the ONP program
ONCOND1000       ; Enable ONIN condition
;
; Now that the ONP program named bigmov is defined, if inputs 4, 5, and 8 on
; I/O brick 2 become active during normal program operation, the program will
; GOSUB to the ONP program (bigmov).
```

ONP On Condition Program Assignment

		Product	Rev
Type	`On Condition (Program Interrupt)`	GT6K	6.0
Syntax	`<a_><!><%>ONP<t>`	GV6K	6.0
Units	`t = text (name of On Condition program)`		
Range	`text name of 6 characters or less`		
Default	`n/a`		
Response	`ONP:    *ONP bigmov`		
See Also	`DEF, END, ONCOND, ONIN, ONUS, ONVARA, ONVARB`		

The `ONP` command assigns the program to which programming will GOSUB when an ON condition is met. The program must be defined (`DEF`) previous to the execution of the `ONP` command. The `ONP` command must be specified before enabling the ON conditions (`ONCOND`). If `ONP` is not defined first, the error message `*UNDEFINED LABEL` will appear.

To unassign the program as the ON condition program, issue the `ONP CLR` command. Deleting the program with the `DEL` command will accomplish the same thing.

Within the `ONP` program, the programmer is responsible for checking which ON condition caused the branch, if multiple ON conditions (`ONCOND`) have been enabled. Once a branch to the `ONP` program occurs, the ONP program will not be called again until after it has finished executing. After returning from the ONP program, the condition that caused the branch must evaluate false before another branch to the ONP program will be allowed.

Multi-Tasking: Each task has it own ONP Program and its own set of On conditions.

Example:

```
DEF bigmov       ; Define program bigmov
D20              ; Sets move distance to 20 units
GO1              ; Initiate motion
END              ; End program definition
ONP bigmov       ; Set ON program to bigmov
2ONIN.4-1        ; When input #4 on I/O brick 2 is activated,
                 ; GOSUB to the ONP program
ONCOND1000       ; Enable ONIN condition
;
; Now that the ONP program named bigmov is defined, if input #4 becomes
; active during normal program operation, the program will GOSUB to
; the ONP program (bigmov).
```

ONUS On a User Status Condition Gosub

Type	On Condition (Program Interrupt)
Syntax	<a_><!><%>ONUS<b><b><b>...<b><b> (16 bits)
Units	n/a
Range	b = 0 (disable), 1 (enable) or X (don't care)
Default	0
Response	ONUS: *ONUS0000_0000_0000_0000
See Also	INDUSE, INDUST, ONCOND, ONP

Product	Rev
GT6K	6.0
GV6K	6.0

The ONUS command specifies the user status bit pattern, defined using the INDUST command, which will cause a branch to the ON program (ONP). If the bit pattern occurs, a GOSUB is performed. The subroutine or program that the GOSUB branches to is selected by the ON program (ONP) command.

The ONUS command must be enabled using the ONCOND command before any branching will occur. Once a branch to the ONP program occurs, ONUS command will not call the ONP program while the ONP program is executing, eliminating the possibility of recursive calls. After returning from the ONP program, the user status bit pattern specified by the ONUS command must evaluate false before another branch to the ONP program, resulting from the ONUS status bits, will be allowed.

Multi-Tasking: Each task has it own ONP Program and its own set of On conditions.

Example:

```
INDUSE1          ; Enable user status
INDUST1-5A       ; User status bit 1 defined as axis status bit 5
INDUST2-3A       ; User status bit 2 defined as axis status bit 3
3INDUST3-5J      ; User status bit 3 defined as input 5 on I/O brick 3
INDUST4-14A      ; User status bit 4 defined as axis status bit 14
2%INDUST16-2I    ; User status bit 16 defined as system status bit 2 for task 2
DEF bigmov       ; Define program bigmov
D20              ; Sets move distance to 20 units
GO1              ; Initiate motion
END              ; End program definition
ONP bigmov       ; Set ON program to bigmov
ONUSxxx1         ; On user status bit #4 (axis status bit 14) GOSUB to
                 ; the ONP program
ONCOND0100       ; Enable ONUS condition
```

ONVARA On Variable 1 Condition Gosub

Type	`On Condition (Program Interrupt)`
Syntax	`<a_!><%>ONVARA<i,i,i>`
Units	`See below`
Range	`±999,999,999.99999999`
Default	`+0.0,+0.0,+0.0`
Response	`ONVARA:  *ONVARA+0.0,+0.0,+0.0`
See Also	`ONCOND, ONP, ONVARB, VAR, VARI`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `ONVARA` command specifies the low and high values which will cause a branch to the ON program (`ONP`). If the value of variable 1 is less than or equal to the first `i`, or greater than or equal to the second `i`, a GOSUB is performed. The subroutine or program that the GOSUB branches to is selected by the ON program (`ONP`) command. If the third field is non-zero, integer variables (`VARI`) are used for the comparison.

The `ONVARA` command must be enabled using the `ONCOND` command before any branching will occur. Once a branch to the `ONP` program occurs, the `ONVARA` command will not call the `ONP` program while the `ONP` program is executing, eliminating the possibility of recursive calls. After returning from the `ONP` program, variable 1 must be reset to a value within the low and high values before another branch to the `ONP` program, resulting from the value of variable 1, will be allowed.

Multi-Tasking: Each task has it own `ONP` Program and its own set of On conditions.

Example:

```
DEF bigmov       ; Define program bigmov
D20              ; Sets move distance to 20 units
GO1              ; Initiate motion
END              ; End program definition
ONP bigmov       ; Set ON program to bigmov
ONVARA0,12       ; On VAR1 <= 0, or VAR1 >= 12 GOSUB to ONP program
ONCOND0010       ; Enable ONVARA condition
```

ONVARB On Variable 2 Condition Gosub

Type	`On Condition (Program Interrupt)`
Syntax	`<a_><!><%>ONVARB<i,i,i>`
Units	`See below`
Range	`±999,999,999.99999999`
Default	`+0.0,+0.0,+0.0`
Response	`ONVARB:  *ONVARB+0.0,+0.0,+0.0`
See Also	`ONCOND, ONP, ONVARA, VAR, VARI`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `ONVARB` command specifies the low and high values which will cause a branch to the ON program (`ONP`). If the value of variable 2 is less than or equal to the first `i`, or greater than or equal to the second `i`, a GOSUB is performed. The subroutine or program that the GOSUB branches to is selected by the ON program (`ONP`) command. If the third field is non-zero, integer variables (`VARI`) are used for the comparison.

The `ONVARB` command must be enabled using the `ONCOND` command before any branching will occur. Once a branch to the `ONP` program occurs, the `ONVARB` command will not call the `ONP` program while the `ONP` program is executing, eliminating the possibility of recursive calls. After returning from the `ONP` program, variable 2 must be reset to a value within the low and high values before another branch to the `ONP` program, resulting from the value of variable 1, will be allowed.

Multi-Tasking: Each task has it own `ONP` Program and its own set of On conditions.

Example:

```
DEF bigmov       ; Define program bigmov
D20              ; Sets move distance to 20 units
GO1              ; Initiate motion
END              ; End program definition
ONP bigmov       ; Set ON program to bigmov
ONVARB0,12       ; On VAR2 <= 0, or VAR2 >= 12 GOSUB to ONP program
ONCOND0001       ; Enable ONVARB condition
```

[OR] Or

		Product	Rev
Type	Operator (Logical)	GT6K	6.0
Syntax	See below	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	n/a		
See Also	[AND], IF, [NOT], NWHILE, REPEAT, UNTIL, WAIT, WHILE		

Use the OR command as a logical operator in a program flow control command (IF, REPEAT, UNTIL, WHILE, NWHILE, WAIT). The OR command logically links two expressions. If either of the two expressions are true, and are linked with an OR command, then the whole statement is true. This is illustrated by the following examples.

If VAR1=1 and VAR2=1 then, even though variable 2 is not greater than 3, this is a true statement: IF(VAR1>0 OR VAR2>3). This statement would not be true: IF(VAR1<>1 OR VAR2=2).

To evaluate an expression (Expression 1 OR Expression 2 = Result) to determine if the whole expression is true, use the following rule:

TRUE OR TRUE = TRUE
TRUE OR FALSE = TRUE
FALSE OR TRUE = TRUE
FALSE OR FALSE = FALSE

Example:

```
VAR1=1                    ; Set variable 1 equal to 1
IF(VAR1=1 OR IN=b1XXX)    ; Compare variable 1 to 1, and check for input #1
                          ; to be active
WRITE"FIRST EXAMPLE"      ; If either condition is true, write out FIRST EXAMPLE
NIF                       ; End IF statement
```

ORES Resolution of Step & Direction Output (GT6K) or Encoder Output (GV6K)

		Product	Rev
Type	Drive Configuration; Outputs		
Syntax	<a_><!>ORES<i> (does not take effect until RESET, DRESET or cycle power)	GT6K GV6K	6.0 6.0
Units	Rotary motors: i = counts/rev Linear motors: i = counts/electrical pitch		
Range	GT6K: 200 - 128000; 0 to disable GV6K: 200 - 1073741823; 0 to disable		
Default	GT6K: 0 GV6K: 4000		
Response	ORES *ORES4000		
See Also	DMEPIT, DMTR, DRES, ERES, TASX, TER, TPC, TPE		

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

AUTO-SETUP for GV6K Drives: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero and you will have to manually set this parameter. Refer to DMTR for a list of auto-configured commands.

NOTE: ORES0 disables this output function.

GT6K: The ORES command sets the resolution of the auxiliary step & direction output (pins 14-17 on the DRIVE I/O connector).

GV6K: The ORES command sets the resolution of the encoder output (pins 14-19 on the DRIVE I/O connector).

Maximum Frequency

The Maximum output frequency (post quadrature) of the hardware generating the ORES functionality is 2.5 MHz. If the maximum output frequency is exceeded, the drive will fault (causes a DRIVE0 and sets TASX bit #29). The following equation dictates the maximum allowable ORES value for a given maximum motor velocity:

$$\texttt{ORES} \leq \frac{2500000}{\text{Maximum Velocity}}$$

For example, if a rotary application requires a maximum velocity of 100 revs/sec, the maximum ORES value would be ORES25000.

Maximum Frequency in Bypass Mode (GV6K only): When ORES = ERES, the encoder bypass mode is activated, which allows the native encoder counts to pass directly through the drive. The maximum encoder frequency in encoder bypass is 2.0 MHz pre-quadrature (8 MHz post-quadrature). For resolver motors, the native resolution of the R/D converter (4096 counts/rev post quadrature) is passed through directly.

Refer to the *Hardware Installation Guide* for specifications and installation instructions for the encoder output.

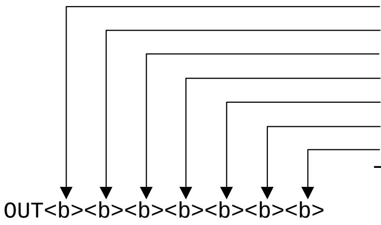
OUT Output State

Type	`Outputs`
Syntax	`<a_><!><@><B>OUT<b><b><b>...<b><b><b>`
Units	`n/a`
Range	`b = 0 (off), 1 (on) or X (don't change`
Default	`0`
Response	`n/a`
See Also	`OUTALL, OUTEN, OUTFNC, OUTLVL, OUTP, TIO, TOUT`

Product	Rev
GT6K	6.0
GV6K	6.0

You can use the OUT command to turn on/off one or more of the digital outputs on the DRIVE I/O connector, as well as the relay output (labeled "RELAY COM" and "RELAY N.O.") on the 4-pin removable connector.

Output #	Pin #	GT6K & GV6K Function (OUTFNC default)
1	41	OUTFNC1-A (General-purpose)
2	43	OUTFNC2-A (General-purpose)
3	45	OUTFNC3-A (General-purpose)
4	46	OUTFNC4-A (General-purpose)
5	48	OUTFNC5-A (General-purpose)
6	49	OUTFNC6-A (General-purpose)
7	Relay	OUTFNC7-F (Fault)



You may also use the OUT command to control outputs on external I/O bricks.

NOTE: You may use OUT to control only the outputs defined as "general-purpose" outputs with the OUTFNCi-A command. If you attempt to change the state of an output that is not defined as general-purpose output, the drive will respond with an error message ("OUTPUT BIT USED AS OUTFNC") and the OUT command will not be executed (but command processing will continue)

The number of external outputs varies by the configuration of I/O bricks used. Refer to page 8 for details.

If you wish to affect only one output, instead of all outputs, use the bit select (.) operator followed by the number of the specific output. For example, OUT.5-1 turns on output #5.

Onboard Outputs (on the "DRIVE I/O" connector) — **Relationships**:

Relationships:

OUTLVL **Setting**	OUT **State ***	**Current**	TOUT **status**
OUTLVL0 (default)	OUT1	Sinking current	1
OUTLVL0	OUT0	No current flow	0
OUTLVL1	OUT1	No current flow	1
OUTLVL1	OUT0	Sinking current	0

* The output is "active" when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Expansion I/O Outputs (on an EVM32) — **Interrelationships**:

Output Type	OUTLVL **Setting**	OUT **State ***	**Current**	OUT/TOUT **status**	**LED**
NPN (sinking)	OUTLVL0 (default)	OUT1	Sinking current	1	ON
NPN	OUTLVL0 (default)	OUT0	No current flow	0	OFF
NPN	OUTLVL1	OUT1	No current flow	1	OFF
NPN	OUTLVL1	OUT0	Sinking current	0	ON
PNP (sourcing)	OUTLVL0	OUT1	No current flow	1	OFF
PNP	OUTLVL0	OUT0	Sourcing current	0	ON
PNP	OUTLVL1 (default)	OUT1	Sourcing current	1	ON
PNP	OUTLVL1 (default)	OUT0	No current flow	0	OFF
Reed Relay	OUTLVL0 (default)	OUT1	Sinking (closed)	1	ON
Reed Relay	OUTLVL0 (default)	OUT0	No flow (open)	0	OFF
Reed Relay	OUTLVL1	OUT1	No flow (open)	1	OFF
Reed Relay	OUTLVL1	OUT0	Sinking (closed)	0	ON

* The output is "active" when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Example:

```
OUTFNC1-A         ; Define output #1 as a general-purpose output
OUTFNC2-A         ; Define output #2 as a general-purpose output
OUT11             ; Turn on outputs 1 & 2
OUT.2-0           ; Turn off output 2
1OUT.9-1          ; Turn on output 9 (the 1st I/O point on SIM2) on I/O brick 1
```

[OUT] Output Status

Type Assignment or Comparison
Syntax See below
Units n/a
Range b = 0 (off), 1 (on) or X (don't change)
Default 0
Response n/a
See Also OUTALL, OUTEN, OUTFNC, OUTLVL, TIO, TOUT, VARB

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the OUT operator to assign the output states to a binary variable (VARB), or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: VARBn=<B>OUT where "n" is the binary variable number and "<B>" is the number of the I/O brick where the output resides (not required if addressing the onboard outputs), or OUT can be used in an expression such as IF(2OUT=b11Ø1), or IF(1OUT=h7F)

The number of external outputs varies by I/O bricks used. See page 8 for details.

The function of the outputs is established with the OUTFNC command (although the OUT operator looks at all outputs regardless of their assigned function from the OUTFNC command). If it is desired to assign only one output value to a binary variable, instead of all outputs, the bit select (.) operator can be used, followed by the number of the specific output. For example, VARB1=2OUT.12 assigns output 12 (the 4th I/O point on SIM2) on I/O brick 2 to binary variable 1.

Onboard Outputs (on the "DRIVE I/O" connector) — **Relationships**:

Relationships:

OUTLVL **Setting**	OUT **State ***	**Current**	TOUT **status**
OUTLVL0 (default)	OUT1	Sinking current	1
OUTLVL0	OUT0	No current flow	0
OUTLVL1	OUT1	No current flow	1
OUTLVL1	OUT0	Sinking current	0

* The output is "active" when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Expansion I/O Outputs (on an EVM32) — **Interrelationships**:

Output Type	OUTLVL **Setting**	OUT **State ***	**Current**	OUT/TOUT **status**	**LED**
NPN (sinking)	OUTLVL0 (default)	OUT1	Sinking current	1	ON
NPN	OUTLVL0 (default)	OUT0	No current flow	0	OFF
NPN	OUTLVL1	OUT1	No current flow	1	OFF
NPN	OUTLVL1	OUT0	Sinking current	0	ON
PNP (sourcing)	OUTLVL0	OUT1	No current flow	1	OFF
PNP	OUTLVL0	OUT0	Sourcing current	0	ON
PNP	OUTLVL1 (default)	OUT1	Sourcing current	1	ON
PNP	OUTLVL1 (default)	OUT0	No current flow	0	OFF
Reed Relay	OUTLVL0 (default)	OUT1	Sinking (closed)	1	ON
Reed Relay	OUTLVL0 (default)	OUT0	No flow (open)	0	OFF
Reed Relay	OUTLVL1	OUT1	No flow (open)	1	OFF
Reed Relay	OUTLVL1	OUT0	Sinking (closed)	0	ON

* The output is "active" when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Example:

```
VARB1=OUT                 ; Output status assigned to binary variable 1
VARB2=OUT.4               ; On-board output bit 4 assigned to binary variable 2
VARB2                     ; Response if bit 4 is set to 1:
                          ; *VARB2=XXX1_XXX
IF(OUT=b110X1)            ; If the output status contains 1's for outputs 1, 2, & 5,
                          ; and a 0 for output 4, do the IF statement
TREV                      ; Transfer revision level
NIF                       ; End IF statement
```

OUTALL   Output State for Multiple Outputs

Type	Output
Syntax	<a_><!><@><B>OUTALL<i>,<i>,<b>
Units	1st i = beginning number of output range 2nd i = ending number of output range b = enable/disable bit
Range	1st i = 1 to *n* (*n* is max. number of outputs available) 2nd i = First i to *n* b = 0 (off) or 1 (on)
Default	0
Response	n/a
See Also	OUT, OUTEN, OUTFNC, OUTLVL, TIO, TOUT

Product	**Rev**
GT6K	6.0
GV6K	6.0

The OUTALL command turns a range of output bits on and off. You may use this command to control any contiguous range of the onboard outputs, as well as any outputs on external I/O bricks, as long as all outputs in the range are defined as OUTFNCi-A (general-purpose) outputs. If you attempt to change the state of an output that is not defined as OUTFNCi-A, the drive will respond with an error message ("OUTPUT BIT USED AS OUTFNC") and the OUTALL command will not be executed (but command processing will continue).

The number of external outputs varies by configuration of I/O bricks used. Refer to page 8 for details.

Example:

```
OUTALL1,4,1       ; Turn on on-board outputs 1-4
2OUTALL3,8,1      ; On I/O brick 2, turn on outputs at I/O locations 3-8
                  ; (I/O pins 3-8 on SIM1)
```

OUTBD Brake Output Delay

Type	`Output`
Syntax	`<a_><!>OUTBD<i>`
Units	`milliseconds`
Range	`0 - 1000`
Default	`0`
Response	`OUTBD:     *OUTBD250`
See Also	`DRIVE, OUTFNC`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `OUTBD` command specifies the amount of time that the fault output (`OUTFNCn-F`) will remain asserted after current is applied to the motor windings with the `DRIVE1` command. This allows torque to build up in the motor while the fault output is still high. This is important in vertical applications, where the motor must be able to support the load before the brake is released.

OUTEN Output Enable

Type	`Output` or `Program Debug Tool`
Syntax	`<a_><!><@><B>OUTEN<d><d><d><d>...    (one <d> for each input)`
Units	`n/a`

Range	`d = 0 (Disable output function and turn output off)`
	`d = 1 (Disable output function and turn output on)`
	`d = E (Enable output function)`
	`d = X (don't change)`

Default	`E`

Response	`OUTEN:   *OUTENEEEE_EEE (onboard outputs)`
	`1OUTEN:  *1OUTENEEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE_EEEE`
	`1OUTEN.3 *E`

See Also	`OUT, OUTFNC, OUTLVL, TIO, TOUT, TSTAT`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `OUTEN` command to disable any of the outputs from their configured function and set them on or off. This command is used for troubleshooting and initial start-up testing. It allows you to simulate output operations by bypassing the configured output function.

The `OUTEN` command has no effect on onboard outputs when they are configured as output-on-position outputs with the `OUTFNCi-H` command.

The number of external outputs varies by configuration of I/O bricks used. Refer to page 8 for details.

Example:

```
; This allows the user to test if the fault output is working,
; without the inconvenience of trying to force a fault.
1OUTFNC1-B        ; Define output #1 on I/O brick 1 as axis moving/not moving
1OUTFNC2-A        ; Define output #2 on I/O brick 1 as programmable
1OUTFNC3-A        ; Define output #3 on I/O brick 1 as programmable
1OUTFNC4-A        ; Define output #4 on I/O brick 1 as programmable
1OUTFNC5-F        ; Define output #5 on I/O brick 1 as fault output
1OUTENxxxx1       ; Disable programmed function of output #5 on I/O brick 1
                  ; and turn it on
```

OUTFNC Output Function

Type	`Output`
Syntax	`<a_><!><B>OUTFNC<i>-<c>`
Units	`i = output #, c = function identifier (letter)`

Range	`i = 1-32 (I/O brick dependent — see page 8)`
	`c = A-H`

Default	`(see table below)`

Response	`OUTFNC:   (function and status of onboard outputs)`
	`1OUTFNC:  (function and status of outputs on I/O brick 1)`
	`1OUTFNC1: *1OUTFNC1-A PROGRAMMABLE OUTPUT - STATUS OFF`

See Also	`OUT, OUTEN, OUTLVL, OUTP, OUTPLC, OUTTW, POUT, SMPER, TIO, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

Default Function Assignments: outputs on the DRIVE I/O connector, as well as the relay output (labeled "RELAY COM" and "RELAY N.O.") on the 4-pin removable connector.

Output #	Pin #	GT6K & GV6K Function (OUTFNC default)
1	41	OUTFNC1-A (General-purpose)
2	43	OUTFNC2-A (General-purpose)
3	45	OUTFNC3-A (General-purpose)
4	46	OUTFNC4-A (General-purpose)
5	48	OUTFNC5-A (General-purpose)
6	49	OUTFNC6-A (General-purpose)
7	Relay	OUTFNC7-F (Fault)

Use the OUTFNC command to define the function for each output. A limit of 32 outputs may be assigned OUTFNC functions; this excludes A ("general-purpose") function.

Output bit assignments vary by product. The number of external outputs varies by configuration of I/O bricks used. Refer to page 8 for details.

Output Scan Rate: The programmable outputs are scanned once per *system update* (2 milliseconds).

Multitasking. If the OUTFNC command does not include the task identifier (%) prefix, the function affects the task that executes the OUTFNC command. Only function "C" may be directed to a specific task with the % prefix (e.g., 2%OUTFNC3-C assigns onboard output 3 as a program-in-progress output for task 2). Multiple tasks may share the same output, but the output may only be assigned one function.

Identifier	Function Description
A	**General-Purpose Output**: A *General Purpose* output is a standard output. Turn on or off with the OUT, POUTA, or OUTALL commands to affect external processes. To view the state of the outputs, use the TOUT command. To use the state of the outputs as a basis for conditional branching or looping statements (IF, REPEAT, WHILE, etc.), use the [OUT] command.
B	**Moving/Not Moving**: Output activates when the axis is moving. As soon as the move is completed, the output will change to the opposite state. Servo Axes: With the target zone mode enabled (STRGTE1), the output will not change state until the move completion criteria set with the STRGTD and STRGTV commands have been met. In this manner, the output functions as an *In Position* output.
C	**Program in Progress**: Output activates when a program is being executed. After the program is finished, the output's state is reversed.
D	**End-of-Travel Limit Encountered**: Output activates when a hard or soft end-of-travel limit has been encountered. When a limit is encountered, you will not be able to move the motor in that same direction until you clear the limit by changing direction (D) and issuing a GO command. (An alternative is to disable the limits with the LH0 command, but this is recommended only if the motor is not coupled to the load.)

E **Stall Indicator** (GT6K only): Output activates when a stall is detected. To detect an encoder stall, you must first connect an encoder and enable stall detection with the ESTALL1 command. To detect a drive stall (no encoder required),you must enable drive stall detection with the DSTALL1 command. For details refer to the *Programmer's Guide*.

F **Fault Indicator**: Output activates when one or more of these fault conditions exist:

- A *User Fault* input becomes active. The user fault input is a general-purpose input defined as a user fault input with the INFNCi-F command.
- The drive was shut down (DRIVE0) or the Enable input was opened (reported with TAS bit #13), but only if the "fault on drive disable" function is enabled with FLTDSB1.
- Drive fault(s) occurred (TAS bit 14 is set).
- Other drive and motor fault conditions – refer to the status bits denoted with an asterisk (*) in the TAS and TASX descriptions.

G **Position Error Exceeds Max. Limit** (GV6K Only): Output activates when the maximum allowable position error, as defined with the SMPER command, is exceeded. The position error (TPER) is defined as the difference between the commanded position (TPC) and the actual position as measured by the feedback device. When the maximum position error is exceeded (usually due to instability or loss of position feedback from the feedback device), the drive is shut down and TER (error status) bit #12 and TAS (axis status) bit #23 are set. If the SMPER command is set to zero (SMPER0), the position error will not be monitored; thus, the *Position Error* output function will not be usable.

H **Output On Position**: Output activates when the axis is at a specified position (servo axes can use encoder position only; stepper axes can use commanded position or encoder position, depending on the ENCCNT setting for that axis). Output On Position function parameters are configured with the OUTPA command. Applicable only to onboard output #1 (pin #41on the "**DRIVE I/O**" connector).

Example:

```
1OUTFNC1-3B      ; Define output #1 on I/O brick 1 as moving/not moving output
1OUTFNC2-D       ; Define output #2 on I/O brick 1 to go active when any of
                 ; the limits are hit
```

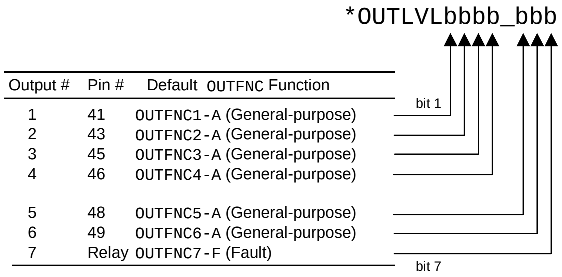
OUTLVL Output Active Level

Type	Outputs
Syntax	<a_><!><@><B>OUTLVL<b><b><b>...<b><b><b>
Units	n/a
Range	b = 0 (active low), 1 (active high) or X (don't change)
Default	Onboard outputs: 0 Expansion I/O outputs: 0 for NPN outputs, 1 for PNP outputs
Response	OUTLVL: *OUTLVL0000_000 (onboard outputs) 1OUTLVL: *1OUTLVL0000_0000_0000_0000_0000_0000_0000_0000 1OUTLVL.3 *0
See Also	KIOEN, OUT, OUTEN, OUTFNC, OUTP, OUTPLC, OUTTW, POUT, TOUT

Product	Rev
GT6K	6.0
GV6K	6.0

The OUTLVL command defines the active state of each programmable output. The factory default state is active low for the digital outputs on the DRIVE I/O connector, and normally open for the relay output (labeled "RELAY COM" and "RELAY N.O.") on the 4-pin removable connector.

OUTLVL bit assignments (bits are numbered 1-7 from left to right):



Output #	Pin #	Default OUTFNC Function
1	41	OUTFNC1-A (General-purpose)
2	43	OUTFNC2-A (General-purpose)
3	45	OUTFNC3-A (General-purpose)
4	46	OUTFNC4-A (General-purpose)
5	48	OUTFNC5-A (General-purpose)
6	49	OUTFNC6-A (General-purpose)
7	Relay	OUTFNC7-F (Fault)

NOTE: The OUTLVL setting is NOT saved in battery-backed RAM; therefore, on power up or reset, the OUTLVL setting will default to the factory default setting (thus, the OUTLVL command is a good candidate for inclusion in your STARTP program).

The number of external outputs varies by the configuration of I/O bricks used. Refer to page 8 for details.

Onboard Outputs

Relationships:

OUTLVL Setting	OUT State *	Current	TOUT status
OUTLVL0 (default)	OUT1	Sinking current	1
OUTLVL0	OUT0	No current flow	0
OUTLVL1	OUT1	No current flow	1
OUTLVL1	OUT0	Sinking current	0

* The output is “active” when it is commanded by the OUT command (for example, OUTxx1 activates output #3).

Outputs on Expansion I/O Bricks:

- Sinking vs. Sourcing Outputs. On power up, the Gem6K drive auto-detects the type of output SIM installed on each external I/O brick, and automatically changes the OUTLVL setting accordingly. If sinking (NPN) outputs or Reed Relay outputs are detected, OUTLVL is set to active low (OUTLVL0); if sourcing (PNP) outputs are detected, OUTLVL is set to active high (OUTLVL1).
- Disconnect I/O Brick. If the I/O brick is disconnected (or if it loses power), the drive will perform a kill (all tasks) and set error bit #18. (If you disable the “Kill on I/O Disconnect” mode with KIOENØ, the Gem6K will not perform the kill.) The drive will remember the brick configuration (volatile memory) in effect at the time the disconnection occurred. When you reconnect the I/O brick, the drive checks to see if anything changed (SIM by SIM) from the state when it was disconnected. If an existing SIM slot is changed (different SIM, vacant SIM slot, or jumper setting), the drive will set the SIM to factory default INEN and OUTLVL settings. If a new SIM is installed where there was none before, the new SIM is auto-configured to factory defaults.
- Relationships:

Output Type	OUTLVL Setting	OUT State *	Current	OUT/TOUT status	LED
NPN (sinking)	OUTLVL0 (default)	OUT1	Sinking current	1	ON
NPN	OUTLVL0 (default)	OUT0	No current flow	0	OFF
NPN	OUTLVL1	OUT1	No current flow	1	OFF
NPN	OUTLVL1	OUT0	Sinking current	0	ON
PNP (sourcing)	OUTLVL0	OUT1	No current flow	1	OFF
PNP	OUTLVL0	OUT0	Sourcing current	0	ON
PNP	OUTLVL1 (default)	OUT1	Sourcing current	1	ON
PNP	OUTLVL1 (default)	OUT0	No current flow	0	OFF
Reed Relay	OUTLVL0 (default)	OUT1	Sinking (closed)	1	ON
Reed Relay	OUTLVL0 (default)	OUT0	No flow (open)	0	OFF
Reed Relay	OUTLVL1	OUT1	No flow (open)	1	OFF
Reed Relay	OUTLVL1	OUT0	Sinking (closed)	0	ON

* The output is “active” when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Example:

```
OUTLVL1x0   ; Configure onboard output 1 to be active high, output 2 unchanged,
            ; and output 3 as active low
```

OUTPA Output on Position

Type	Output
Syntax	<!>OUTPA<b>,<b>,<r>,<i>

Units	1st & 2nd b = enable/modal bits;
	r = scalable distance
	i = time (ms)

Range	1st b = 1 (enable output on position) or 0 (disable)
	2nd b = 1 (incremental position) or 0 (absolute position)
	r = -2,147,483,648 to +2,147,483,647
	i = 0-65535

Default	0,0,0,0
Response	OUTPA: *OUTPA0,0,+0,0
See Also	ENCCNT, [OUT], OUT, OUTFNC, PSET, SFB

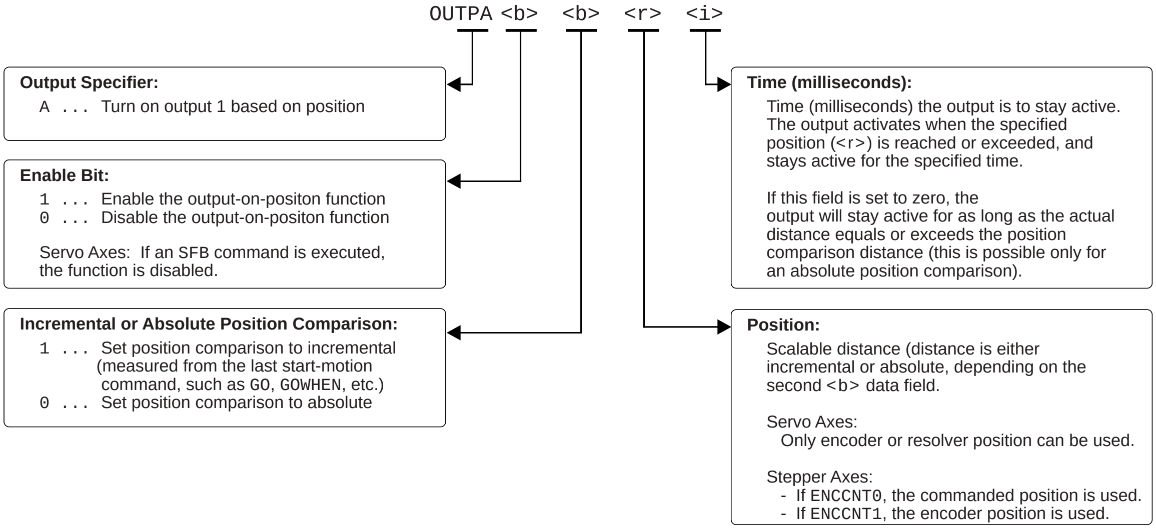
Product	Rev
GT6K	6.0
GV6K	6.0

Use the OUTPA command to configure onboard output #1 (pin #41 on the **DRIVE I/O** connector) to activate based on the specified position of the axis. The position referenced is dependent upon whether the axis is a servo or stepper:

- **GV6K Servo**: The referenced position is the feedback position.
- **GT6K Stepper**: The referenced position depends on the ENCCNT setting at the time the OUTPA command is executed. If ENCCNT0 (factory default), the commanded position is used, if ENCCNT1, the encoder position is used.

To use the OUTPA command, you must first use the OUTFNC1-H command to configure onboard output #1 to function as an *output on position* output. Refer to the programming example below.

Syntax:



OUTPA <b> <b> <r> <i>

Output Specifier:
A ... Turn on output 1 based on position

Enable Bit:
1 ... Enable the output-on-positon function
0 ... Disable the output-on-positon function

Servo Axes: If an SFB command is executed, the function is disabled.

Incremental or Absolute Position Comparison:
1 ... Set position comparison to incremental (measured from the last start-motion command, such as GO, GOWHEN, etc.)
0 ... Set position comparison to absolute

Time (milliseconds):
Time (milliseconds) the output is to stay active. The output activates when the specified position (<r>) is reached or exceeded, and stays active for the specified time.

If this field is set to zero, the output will stay active for as long as the actual distance equals or exceeds the position comparison distance (this is possible only for an absolute position comparison).

Position:
Scalable distance (distance is either incremental or absolute, depending on the second <b> data field.

Servo Axes:
Only encoder or resolver position can be used.

Stepper Axes:
- If ENCCNT0, the commanded position is used.
- If ENCCNT1, the encoder position is used.

NOTE

The output activates only during motion; therefore, issuing a PSET command to set the absolute position counter to activate the output on position will not turn on the output until the next motion occurs.

Example (servo axes)**:**

```
SFB1                  ; Select encoder feedback
OUTFNC1-H             ; Set onboard output #1 as an "output on position" output
OUTPA1,0,+50000,50    ; Turn on onboard output #1 for 50 ms when the encoder
                      ; position is > or = absolute position +50,000
```

OUTPLC Establish PLC Strobe Outputs

Type	Output
Syntax	<a_><!>OUTPLC<i>,<i-i>,<i>,<i>
Units	See below
Range	See below
Default	1,0-0,0,0
Response	OUTPLC1: *0-0,0,0 (onboard outputs referenced)
See Also	INPLC, OUT, OUTEN, OUTFNC, OUTLVL, OUTTW, [TW]

Product	Rev
GT6K	6.0
GV6K	6.0

The OUTPLC command with its corresponding INPLC command configures the applicable inputs and outputs to read data from a parallel I/O device such as a PLC (Programmable Logic Controller), or a passive thumbwheel module. The actual data transfer occurs with the TW command. Refer to the TW command for a description of the data transfer process.

The OUTPLC command has four fields (<i>,<i-i>,<i>,<i>):

Data Field	Description
Field 1: <i>	**Set #**: There are 4 possible OUTPLC sets (1-4). This field identifies which set to use.
Field 2: <i-i>	**Strobe Output #s**: Data reads with the TW command are strobed by the outputs selected in this field. The first number is the first output, and the second number is the last output. The outputs must be consecutive. The number of outputs should equal half the number of the maximum number of BCD digits required. If 6 digits are being read, then three outputs are needed as each output strobe selects two BCD digits. Refer to page 8 for help in identifying which output bits are available to place in this field.
Field 3: <i>	TW **Command Pending**: This field identifies an output that becomes active on a TW command and then turns off on completion of the TW command. This output can signal a device that a TW command is pending. A zero in this field will not activate any output.
Field 4: <i>	**Strobe Time**: This field identifies the length of time an output will stay active in order to read the BCD digits. The strobe time (in milliseconds) should be greater than the PLC scan time, if a PLC is being used, or set greater than the minimal debounce time if using thumbwheels. Range = 1 - 5000 milliseconds.

To disable a specific PLC set, enter OUTPLCn,Ø-Ø,Ø,Ø where n is the PLC set (1-4).

Example:

```
1INPLC2,1-8,9,10    ; Set INPLC set 2 as BCD digits on inputs 1-8 on I/O brick 1,
                    ; with input 9 as the sign bit, and input 10 as the data valid bit
OUTPLC2,1-4,5,50    ; Set OUTPLC set 2 as output strobes on onboard outputs 1-4,
                    ; with output 5 as the command pending bit, and strobe time
                    ; of 50 milliseconds
A(TW6)              ; Read data into acceleration using INPLC set 2
                    ; and OUTPLC set 2 as the data configuration
```

OUTTW Establish Thumbwheel Strobe Outputs

Type	Output
Syntax	<a_><!><B>OUTTW<i>,<i-i>,<i>,<i>
Units	See below
Range	See below
Default	1,0-0,0,0
Response	OUTTW1: *0-0,0,0 (onboard outputs referenced)
See Also	INSTW, OUT, OUTEN, OUTFNC, OUTLVL, OUTPLC, [TW]

Product	Rev
GT6K	6.0
GV6K	6.0

The OUTTW command with its corresponding INSTW command configure the applicable inputs and outputs to read data from an active thumbwheel device. The actual data transfer occurs with the TW command. Refer to the TW command for a description of the data transfer process.

The OUTTW command has four fields (<i>,<i-i>,<i>,<i>):

Data Field	Description
Field 1: `<i>`	**Set #**: There are 4 possible `OUTTW` sets (1-4). This field identifies which set to use.
Field 2: `<i-i>`	**Strobe Output #s**: Data reads with the `TW` command are strobed by the outputs selected in this field. The first number is the first output, and the second number is the last output. The outputs must be consecutive. The number of outputs should be compatible to the thumbwheel device. Refer to page 8 for help in identifying which output bits are available to place in this field.
Field 3: `<i>`	**Thumbwheel Enable Output**: This field identifies an output that becomes active on a `TW` command and then turns off on completion of the `TW` command. This output can enable a thumbwheel module to respond, thus allowing multiple thumbwheels to be wired to the inputs and outputs. A zero in this field will not activate any output.
Field 4: `<i>`	**Strobe Time**: This field identifies the length of time an output will stay active to read the BCD digits. The strobe time (in milliseconds) should be set to a minimal debounce time. Range = 1-5000 milliseconds.

Example:

```
INSTW2,1-4,5        ; Set INSTW set 2 as BCD digits on onboard inputs 1-4, with
                    ; input 5 as the sign bit
OUTTW2,1-3,4,50     ; Set OUTTW set 2 as output strobes on onboard outputs 1-3,
                    ; with onboard output 4 as the output enable bit, and
                    ; strobe time of 50 milliseconds
A(TW2)              ; Read data into acceleration using INSTW set 2 and
                    ; OUTTW set 2 as the data configuration
```

[PC] Position Commanded

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`ERES, [ FB ], GOWHEN, [ PCC ], [ PE ], [ PER ], PSET, SCALE, SCLD, SMPER, TAS, TFB, TPC, TPCC, TPE, TPER`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `PC` operator to assign the current *commanded position* (scalable by `SCLD`) to a variable, or to make a comparison against another value. If you issue a `PSET` command, the commanded position value will be offset by the `PSET` command value.

Servo Axes: The `PC` value is measured in encoder or resolver counts. The commanded position (`PC`) and the actual position (`FB`) are used in the control algorithm to calculate the position error (`PC - FB` = `PER`) and thereby determine the corrective control signal.

Stepper Axes: The `PC` value is measured in commanded counts (“motor counts”).

UNITS OF MEASURE and **SCALING**: refer to page 16.

Syntax: `VARn=PC` where “n” is the variable number; or `PC` can be used in an expression such as `IF(PC>5Ø).`

Example:

```
VAR1=PC           ; Commanded position is assigned to variable 1
IF(PC<50)         ; If the commanded position is <50, do the IF statement
VAR2=PC+500       ; Commanded position plus 500 is assigned to variable 2
NIF               ; End IF statement
```

[PCC] Captured Commanded Position

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	ENCCNT, INFNC, [PC], [PCMS], PSET, SCALE, SCLD, SFB, [TRIG], TRGLOT, TPC, TPCC, TTRIG

Product	Rev
GT6K	6.0
GV6K	6.0

Use the PCC operator to assign the captured commanded position to a variable, or to make a comparison against another value.

Syntax: VARn=PCCc where "n" is the variable number, and "c" designates trigger A or B, or M for the **MASTER TRIG** input; or PCC can be used in an expression such as IF(PCCB>2345Ø).

General-purpose inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The commanded position can be captured only by an input that is defined as a "trigger interrupt" input with the INFNCi-H command (see INFNC for details). When a "trigger interrupt" input is activated, the commanded position is captured and the position is available through the use of the PCC operator and the TPCC display command.

Note for Stepper Axes: By default, stepper axes capture only the commanded position. However, if the axis has Encoder Capture Mode enabled with the ENCCNT command, only the encoder position is captured.

Position Capture Status, Longevity of Captured Position: Use the TTRIG and TRIG commands to ascertain if a trigger interrupt input has been activated. TTRIG displays the status as a binary report, and TRIG is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an IF statement). Once the captured commanded position value is assigned/compared with the PCC operator, the TTRIG/TRIG status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The commanded position capture accuracy is ±1 count.

Scaling and Position Offset: If scaling is enabled (SCALE1), the commanded position is scaled by the distance scaling factor (SCLD). If scaling is not enabled (SCALEØ), the value assigned will be actual commanded counts. If you issue a PSET (establish absolute position reference) command, any previously captured commanded positions will be offset by the PSET command value.

Example:

```
INFNC1-H          ; Assign input 1 as TRIG-A input
VAR1=PCCA         ; Assign captured commanded position to variable 1
                  ; (position was captured when trigger input TRIG-A became active)
IF(PCCA<40)       ; If the captured commanded position is less than 40, do the
                  ; IF statement
VAR2=PCCA+10      ; Add 10 to the captured commanded position (captured when
                  ; trigger input TRIG-A became active) and assign the sum to
                  ; variable #2
NIF               ; End IF statement
```

[PCE] Position of Captured Encoder

Type	`Assignment or Comparison`
Syntax	`See below`
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	ENCCNT, INFNC, [PCMS], [PE], PSET, SCALE, SCLD, SFB, TPCE, [TRIG], TRGLOT, TTRIG

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the PCE operator to assign the captured encoder position to a variable, or to make a comparison against another value.

Syntax: VARn=PCEc where "n" is the variable number, and "c" designates trigger A or B, or M for the **MASTER TRIG** input; or PCE can be used in an expression such as IF(PCEB>2345Ø).

Inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The encoder position can be captured only by an input that is defined as a "trigger interrupt" input with the INFNCi-H command (see INFNC command). When a "trigger interrupt" input is activated, the encoder position is captured and the position is available through the use of the PCE operator and the TPCE display command. **Stepper Axes**: By default, stepper axes capture only the commanded position. To capture the encoder position, the axis must be in the Encoder Capture Mode (see ENCCNT command).

Position Capture Status, Longevity of Captured Position: Use the TTRIG and TRIG commands to ascertain if a trigger interrupt input has been activated. TTRIG displays the status as a binary report, and TRIG is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an IF statement). Once the captured encoder position value is assigned/compared with the PCE operator, the TTRIG/TRIG status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The encoder position capture accuracy is ±1 encoder count.

Scaling and Position Offset: If scaling is enabled (SCALE1), the encoder position is scaled by the distance scaling factor (SCLD). If scaling is not enabled (SCALEØ), the value assigned will be actual encoder counts. (**NOTE**: When using a stepper axis operating in ENCCNT1 mode, the PCE value is always encoder counts and is never scaled by SCLD.) If you issue a PSET (establish absolute position reference) command, any previously captured encoder positions will be offset by the PSET command value.

Example:

```
INFNC1-H          ; Assign trigger input TRIG-A as trigger interrupt input
VAR1=PCEA         ; Assign captured encoder position to variable 1
                  ; (position was captured when trigger input TRIG-A became active)
IF(PCEA<4000)     ; If the captured encoder position is less than 4000,
                  ; do the IF statement
VAR2=PCEA+10      ; Add 10 to the captured encoder position
                  ; (captured when trigger input TRIG-A became active) and
                  ; assign the sum to variable #2
NIF               ; End IF statement
```

[PCME] Position of Captured Master Encoder

		Product	Rev
Type	`Assignment` or `Comparison`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`INFNC, MEPOL, MESND, [ PME ], [ PCMS ], PMECLR, PMESET, TPCME, TPME, TPCMS`		

Use the `PCME` operator to assign the captured master encoder position to a variable, or to make a comparison against another value. The master encoder is connected to the connector labeled “Master Encoder.”

> **Syntax**: `VARn=PCME` where “`n`” is the variable number; or `PCME` can be used in an expression such as `IF(PCME>2345Ø)`.

Inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The master encoder position can be captured only by the Master Trigger input (input #5), and only when that input is defined as a “trigger interrupt” input with the `INFNC5-H` command (see `INFNC` command). When the “trigger interrupt” input is activated (active edge), the master encoder position is captured and the position is available through the use of the `PCME` operator and the `TPCME` display command.

Position Capture Status, Longevity of Captured Position: Use the `TTRIG` and `TRIG` commands to ascertain if a trigger interrupt input has been activated. `TTRIG` displays the status as a binary report, and `TRIG` is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an `IF` statement). Once the captured master encoder position value is assigned/compared with the `PCME` operator, `TTRIG`/`TRIG` status bit #5 is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the master trigger input.

Position Capture Accuracy: The master encoder position capture accuracy is ±1 encoder count.

Scaling and Position Offset: The `PCME` value is always in master encoder counts; it is never scaled. If you issue a `PMESET` (establish absolute position reference) command, any previously captured master encoder positions will be offset by the `PMESET` command value.

Example:

```
INFNC5-H          ; Assign input #5 as master trigger input (TRIG-M) for the
                  ; master encoder
VAR1=PCME         ; Assign captured master encoder position to variable 1
                  ; (position was captured when master trigger became active)
IF(PCME<4000)     ; If the captured master encoder position
                  ; (captured when master trigger input became active) is
                  ; less than 4000, do the IF statement
VAR2=PCME+10      ; Add 10 to the captured master encoder position
                  ; (captured when master trigger input became active) and
                  ; assign the sum to variable #2
NIF               ; End IF statement
```

[PCMS] Captured Master Cycle Position

		Product	Rev
Type	Assignment or Comparison	GT6K	6.0
Syntax	See below	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	n/a		
See Also	ENCCNT, FOLMAS, INFNC, [PCC], [PCE], [PE], PSET, SCALE, SCLMAS, SFB, TPCMS, [TRIG], TRGLOT, TTRIG		

Use the PCMS operator to assign the captured master cycle position for a follower axis to a variable, or to make a comparison against another value.

PCMS (like PMAS) is unique among position assignment variables, because its value rolls over to zero each time the entire master cycle length (FMCLEN) has been traveled. Thus, the captured PCMS value is essentially a snap-shot of the position relative to the master cycle at the time of the capture.

The master must be assigned first (FOLMAS command) before this operator will be useful.

Syntax: VARn=PCMSc where "n" is the variable number, and "c" designates trigger A or B for the axis, or M for the **MASTER TRIG** input (see table below); or PCMS can be used in an expression such as IF(PCMSB>2311).

General-purpose inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The master cycle position can be captured only by an input that is defined as "trigger interrupt" input with the INFNCi-H command (see INFNC command). When a "trigger interrupt" input is activated, the master cycle position of the axis is captured and the position is available through the use of the PCMS operator and the TPCMS display command.

Position Capture Status, Longevity of Captured Position: Use the TTRIG and TRIG commands to ascertain if a trigger interrupt input has been activated. TTRIG displays the status as a binary report, and TRIG is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an IF statement). Once the captured master cycle position value is assigned/compared with the PCMS operator, the TTRIG/TRIG status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The master cycle position is interpolated; the capture accuracy is 50 µs multiplied by the velocity of the axis at the time the trigger input was activated.

Scaling and Position Offset: If scaling is enabled (SCALE1), the master source position is scaled by the distance scaling factor (SCLMAS). If scaling is not enabled (SCALEØ), the value assigned will be actual counts from the commanded or encoder master source as selected with the FOLMAS command. If you issue a PSET (establish absolute position reference) command, any previously captured master cycle positions will be offset by the PSET command value.

PCOMP Compile a Profile or Program

		Product	Rev
Type	`Compiled Motion; PLC Program`	GT6K	6.0
Syntax	`<a_><!>PCOMP<t>`	GV6K	6.0
Units	`t = text (name of program/path)`		
Range	`Text name of 6 characters or less`		
Default	`n/a`		
Response	`n/a`		
See Also	`DEF, DRES, END, GOBUF, GOWHEN, MEMORY, PEXE, PLOOP, PLCP, PLN, POUTn, PRUN, SCLD, PUCOMP, SCANP, [ SEG ], [ SS ], TDIR, TMEM, TRGFN, TSEG, TSS`		

Use the PCOMP command to compile GOBUF profiles compile PLCP programs for PLC Scan Mode. (For additional detail on compiled motion, refer to the Custom Profiling chapter in the *Programmer's Guide*.)

"Programs" vs. "Compiled Profiles & Programs":

- Programs are defined with the DEF and END commands, as demonstrated in the Program Development Scenario in the *Programmer's Guide*.
- Compiled Profiles are defined like programs (using the DEF and END commands), but are compiled with the PCOMP command and executed with the PRUN command. A compiled profile could be a series of GOBUF commands.
- Compiled PLC programs are defined with DEF PLCPi and END, compiled with PCOMP, and are normally executed in the PLC Scan Mode with the SCANP.

Compiling and Storing Compiled Programs:

The Gem6K's memory has two partitions: one for storing programs ("program" memory) and one for storing profiles & program segments compiled with the PCOMP command ("compiled" memory). The allocation of memory to these two areas is controlled with the MEMORY command.

Programs intended to be compiled are stored in program memory. After they are compiled with the PCOMP command, they remain in program memory and the segments (see segment command list below) from the compiled profile are stored in compiled memory.

- Compiled Motion segments: GOBUF, PLOOP, GOWHEN, TRGFN, POUTA
- PLC Program segments: IF, ELSE, NIF, L, LN, OUT, EXE, PEXE, VARI, VARB

The TDIR command uses "COMPILED AS A PATH" to denote the programs compiled as a compiled profile, and "COMPILED AS A PLC PROGRAM" to denote the programs compiled as a PLC programs. TDIR also reports the amount of program storage available, as does the TSEG command. System status bit #29 indicates that compiled memory is 75% full, and system status bit #30 indicates that compiled memory is completely full. (Use TSSF, TSS and SS to work with system status bits.)

If a compile (PCOMP) fails, system status bit #31 (see TSSF, TSS and SS) will be set. This status bit is cleared on power-up, reset, or after a successful compile. Possible causes for a failed compile are:

- Errors in profile design (e.g., change direction while at non-zero velocity; distance and velocity equate to < 1 count/system update; preset move profile ends in non-zero velocity).
- Profile will cause a Following error (see TFSF, TFS and [FS] commands).
- Out of memory (see system status bit #30).
- Axis already in motion at the time of a PCOMP command.
- Loop programming errors (e.g., no matching PLOOP or PLN; more than four embedded PLOOP/END loops).
- PLCP program contains invalid commands or command parameters.

Conditions That Require a Re-Compile (Compiled Motion only):

- If it is desired to change a compiled path's velocity, acceleration, or deceleration, the values must be changed and then the path must be re-compiled.
- If the scaling factors are changed, the program must be downloaded again.
- Compiled Motion ONLY: After compiling (PCOMP) and running (PRUN) a compiled profile, the profile segments will be deleted from compiled memory if you cycle power or issue a RESET command.

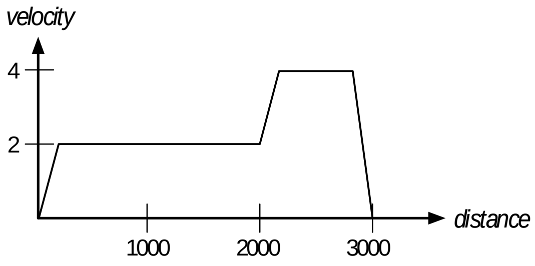
COMPILED MOTION

When using compiled loops (`PLOOP` and `PLN`), the last segment within the loop must end at zero velocity or there must be a final `GOBUF` segment placed outside the loop. Otherwise an error will result when the profile is compiled. The error is "`ERROR: MOTION ENDS IN NON-ZERO VELOCITY`".

PLC PROGRAM EXAMPLE: see `PLCP` command description.

COMPILED MOTION EXAMPLE (see profile below)

```
DEF prog2         ; Begin definition of program named prog2
A10               ; Set A, V, and D values
V2
D2000
GOBUF1            ; First segment of motion
V4                ; New A, V, and D values
AD50
D1000
GOBUF1            ; Second segment
END               ; End definition of prog2
PCOMP prog2       ; Compile prog2
PRUN prog2        ; Execute prog2
```



[PE] Position of Encoder

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`Encoder counts, or scaled by SCLD`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`ENCCNT, [ FB ], GOWHEN, INFNC, [ PC ], [ PCE ], [ PER ], PESET, PSET, SCALE, SCLD, SFB, TFB, TPE`

Product	Rev
GT6K	6.0
GV6K	6.0

The `PE` operator is used to assign one of the encoder register values to a variable, or to make a comparison against another value.

Stepper axes: If the `ENCCNT1` mode is enabled `PE` reports the encoder position, but in `ENCCNT0` mode (the factory default setting) the `PE` report represents the commanded position. **NOTE**: When operating in `ENCCNT1` mode, the `PE` value is always encoder counts and is never scaled by `SCLD`.

UNITS OF MEASURE and **SCALING**: refer to page 16 or to the `SCLD` command.

If you issue a `PSET` command, the encoder position value will be offset by the `PSET` command value. If you are using a stepper axis in the `ENCCNT1` mode, use the `PESET` command instead.

Syntax: `VARn=PE` where "n" is the variable number, or `PE` can be used in an expression such as `IF(PE>2345Ø)`.

Example:

```
VAR1=PE           ; Encoder position is assigned to variable 1
IF(PE<4000)       ; If the encoder position is less than 4000,
                  ; do the IF statement
VAR2=PE+4000      ; Encoder position plus 4000 is assigned
                  ; to variable 2
```

```
NIF                 ; End IF statement
```

[PER] Position Error

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	DRES, ERES, SCLD, SFB, SMPER, TAS, TPER, TPE, TPC

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The PER operator is used to assign the current position error to a variable, or to make a comparison against another value. The value assigned to the variable or the value against which the comparison is made is measured in feedback device counts and is scaled by the distance scaling factor (SCLD), if scaling is enabled with the SCALE1 command.

The position error is the difference between the commanded position and the actual position read by the feedback device. This error is calculated every sample period and can be displayed at any time using the TPER command.

Syntax: VARn=PER where "n" is the variable number, or PER can be used in an expression such as IF(0PER>5Ø).

Example:

```
VAR1=PER            ; Position error is assigned to variable 1
IF(PER>2000)        ; If the position error is >2000 encoder counts,
                    ; do the IF statement (enable output #4)
OUTXXX1             ; Enable onboard output #4
NIF                 ; End IF statement
```

PESET Encoder Absolute Position Reference - Stepper Axes

Type	Motion
Syntax	<a_><!>PESET<r>
Units	r = units (absolute position of encoder)
Range	±999,999,999.99999
Default	n/a
Response	n/a
See Also	ENCCNT, INFNC, [PCE], [PE], PMESET, PSET, SCALE, SCLD, TPCE, TPE

Product	**Rev**
GT6K	6.0
GV6K	n/a

(applicable to stepper axes only)

Use the PESET command to offset the current encoder absolute position to establish an *absolute position reference* for the encoder reports (TPE, PE, TPCE, PCE). All PESET values entered are in encoder steps, scalable by the SCLD value if scaling is enabled.

NOTE: If you issue a PESET command, any previously captured encoder positions (INFNCi-H or LIMFNCi-H function) will be offset by the PESET value.

Example:

```
ENCCNT1             ; Place axis in the encoder count referencing mode
PESET0              ; Set absolute position to zero
TPE                 ; Display the new position. The new encoder position
                    ; report should be: *TPE0
PESET1000           ; Set absolute position to 1000 units
TPE                 ; Display the new position. The new encoder position
                    ; report should be: *TPE1000
```

PEXE Execute a Compiled Program

Type	`PLC Mode Compiled Program Execution`
Syntax	`i%PEXEt`

Units	`i = Task Number`
	`t = Program Name (6 characters or less)`

Range	`i = 1-10`
Default	`n/a`
Response	`n/a`
See Also	`EXE, GOBUF, PCOMP, PLCP, SCANP`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `PEXE` command to start a compiled `PLCP` program, or compiled `GOBUF` profile from within a compiled `PLCP` program. The `PEXE` command specifies the name of the compiled program, and the task in which it will be launched. The program named in the `PEXE` command need not be defined or compiled at the time the `PLCP` program is compiled; however, the program must be defined and compiled before the `SCANP` or `PRUN` is issued. If no task number is assigned with a `%` prefix, then the task in which the `PLCP` program is compiled (`PCOMP`) will be the task that runs the compiled program. Note, however, that the `PEXE` program cannot be executed in the Task Supervisor (task 0).

The `PLCP` program will ignore the `PEXE` command if a currently running program is detected within the specified task; therefore, the `PEXE` command can essentially only be used to initiate a new task with the program it is launching. Like the `INSELP` command, the program launched by the `PEXE` command will not interrupt a currently running program, nor will it interrupt a `WAIT` or `T` command. Also, if launching a `GOBUF` profile, the `PEXE` will not interrupt motion already in progress.

CAUTION: Using the `SCANP` command to run a `PLCP` program in Scan mode will cause the `PLCP` program to execute as often as every system update period (2 ms). A `PEXE` command used within a `PLCP` program running in Scan mode could therefore attempt to launch a program in the specified task as often as every 2 ms. This may not allow enough time for the program launched in the specified task by the `PEXE` command to complete before the same `PEXE` command is issued again. As stated, the `PLCP` program will ignore the `PEXE` command if a currently running program is detected or motion is in progress, so timing must be considered when launching programs with the `PEXE` command.

To execute a non-compiled program from within a compiled `PLCP` program, use the `EXE` command.

Example:

```
DEF PLCP1          ; Define PLC program PLCP1
1%PEXE PLCP2       ; Launch compiled program PLCP2 in task 1
END
DEF PLCP2          ; Define PLC program PLCP2
OUT(VARB1)         ; Modify outputs
END
PCOMP PLCP1        ; Compile PLCP1
PCOMP PLCP2        ; Compile PLCP2
SCANP PLCP1        ; Scan with program PLCP1
VARB1=h0000        ; Set VARB1
TOUT               ; Check outputs (response is *TOUT0000_000)
VARB1=b1010        ; Reassign VARB1
TOUT               ; Check outputs again (response is *TOUT1010_000)
```

[PI] PI (π)

Type	Operator (Trigonometric)
Syntax	See examples below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[=], [+], [-], [*], [/], [&], [|], [^], [~], [ATAN], [COS], IF, [SIN], [SQRT], [TAN], VAR

Product	Rev
GT6K	6.0
GV6K	6.0

The (`PI`) command is assigned the value 3.14159265. There are 2π radians in 360°. This command is useful for doing trigonometric functions in radian units (`RADIAN` command).

Example:

```
VAR1=PI          ; 3.14159265 is assigned to variable 1
VAR2=2 * PI      ; 2 pi is assigned to variable 2
```

PLCP Compiled PLC Program

Type	PLC Scan Program
Syntax	<a_><!>PLCPi
Units	i = number of PLC program
Range	1-99
Default	n/a
Response	n/a
See Also	ANO, [ANO], BREAK, DEF, ELSE, EXE, HALT, IF, L, LN, MEMORY, NIF, OUT, PCOMP, PEXE, PRUN, PUCOMP, [SC], [SCAN], SCANP, TIMST, TIMSTP, TSC, TSCAN, VARI, VARB

Product	Rev
GT6K	6.0
GV6K	6.0

`PLCP` is not a command; it is used to identify a PLCP program to be defined (e.g., `DEF PLCP2`), compiled (e.g., `PCOMP PLCP2`), and executed (e.g., `SCANP PLCP2` or `PRUN PLCP2`). Up to 99 PLCP programs may be defined, identified as `PLCP1`, `PLCP2`, `PLCP3`, and so on. The purpose of PLCP programs is to facilitate fast I/O scanning. The process of creating and executing a PLCP program is:

1. Define the PLCP program (`DEF PLCPi` statement, followed by commands from the list below, followed by `END`). Only these commands are allowed in a PLCP program:
   - `IF`, `ELSE`, and `NIF` (conditional branching) — see note below for limitations
   - `L` and `LN` (loops)
   - `HALT`:
     - If the PLCP program is executed with `SCANP`, `HALT` will terminate the current PLCP program and kill the `SCANP` mode.
     - If the PLCP program is executed with `PRUN`, `HALT` will stop the PLCP program (and the program that executed the `PRUN` statement) running in that task.
   - `BREAK`:
     - If the PLCP program is executed with `SCANP`, `BREAK` will end only the current scan loop. At the next 2-millsecond update, the scan will restart at the first line of the PLCP program.
     - If the PLCP program is executed with `PRUN`, `BREAK` will stop the PLCP program and execution will continue in the program from which the `PRUN` was executed (resuming at the command immediately following the `PRUN` command).
   - `TIMST` and `TIMSTP` (start and stop the timer)
   - `OUT` (turn on a digital output)
   - `ANO` (set an analog output voltage – requires an extended I/O brick with on an analog output SIM)
   - `EXE` (execute a program in a specific task — e.g., `2%EXE MOVE`)
   - `PEXE` (execute a compiled program in a specific task — e.g., `3%PEXE PLCP4`)
   - `VARI` (integer variables).
   - `VARB` (binary variables). Bitwise operations are limited to Boolean And (`&`), Boolean Inclusive Or (`|`), and Boolean Exclusive Or (`^`).

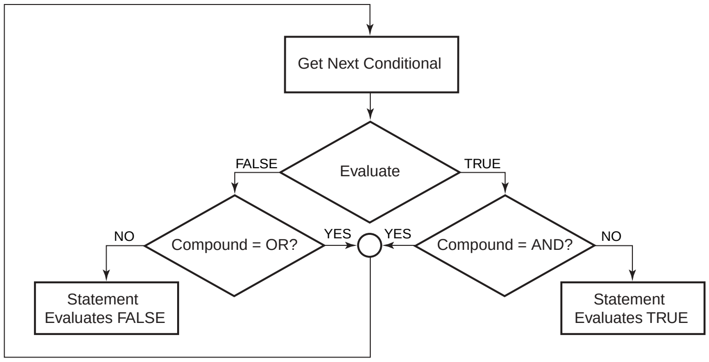
2. Compile the PLCP program (`PCOMP PLCPi`). A compiled program runs much faster than a standard program.
3. Execute the PLCP program (`SCANP PLCPi`). When the PLCP program is launched with the `SCANP` command, it is executed in the "PLC Scan Mode". The advantage of the PLC Scan Mode is that the PLCP program is executed within a dedicated 0.5 ms time slot during every 2 ms system update period. This gives the PLCP program faster throughput for monitoring and manipulating I/O. *For more information on how the PLCP program is executed with* `SCANP`*, refer to the* `SCANP` *command description.*

   An alternative execution method is to use the `PRUN` command (`PRUN PLCPi`). This method is similar to the `SCANP PLCPi` method, but will only run through the PLCP program once.

Memory Requirements: Most commands allowed in a PLCP program consume one segment of compiled memory after the program is compiled with `PCOMP`; the exceptions are `VARI` and `VARB` (each consume 2 segments) and `IF` statements. Each `IF` conditional evaluation compounded with either an `AND` or an `OR` operator consumes an additional segment (e.g., `IF(IN.1=b1 AND AS.1=b0)` consumes three segments of compiled memory). The number of compounds is limited only by the memory available.

Conditional Expressions:

- Order of Evaluation. Because only one level of parenthesis is allowed, the order of evaluation of `IF` conditionals is from left to right. Refer to the flowchart for the evaluation logic.
- Conditional expressions in a PLC program use the non-scaled integer ("raw") operand values. Examples of the "raw" operand values are:
  - The `PE` operator reports encoder counts not scaled by `SCLD` and not scaled by `ERES`.
  - The `ANI` operator reports ADC counts from an analog input. Assuming the default `ANIRNG4` setting (+/-10V voltage range), 205 ADC counts = 1 volt.
  - The `ANO` operator reports DAC counts commanded to an analog output. The range is 0-4095 counts over the –10 to +10V range. The calculation is: `ANO` value = (Vout + 10) x 4095 / 20.



The only operands that are not allowed are: `SIN`, `COS`, `TAN`, `ATAN`, `VCVT`, `SQRT`, `VAR`, `TW`, `READ`, `DREAD`, `DREADF`, `DAT`, `DPTR`, and `PI`.

Programming Example: Refer to the example in the `SCANP` command description.

PLN — End of Loop, Compiled Motion

Type	`Compiled Motion`
Syntax	`<a_>PLN`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`No response; instead ends loop for compiled motion`
See Also	`GOBUF, PCOMP, PLOOP, PRUN, PUCOMP`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `PLN` command to specify the end of a compiled motion profile loop, as initiated with the `PLOOP` command.

Programming Example: see `PLOOP`.

PLOOP Beginning of Loop, Compiled Motion

Type	`Compiled Motion`
Syntax	`<a_>PLOOP<i>`
Units	`i = number of times to loop`
Range	`0-2,147,483,647` (2^{31}`-1`) `0 = infinite loop`
Default	`n/a`
Response	`No response; instead starts loop for compiled motion`
See Also	`GOBUF, PCOMP, PLN, PRUN, PUCOMP`

Product	Rev
GT6K	6.0
GV6K	6.0

The `PLOOP` command specifies the beginning of a profile loop. All subsequent segments defined between the `PLOOP` and `PLN` commands are included within that loop. The `PLOOP` value specifies the number of loops to be executed. If that number is a zero or blank, then the loop will be executed infinitely. The `PLOOP` command can be nested up to four levels deep within a program.

When using compiled loops (`PLOOP` and `PLN`), the last segment within the loop must end at zero velocity or there must be a final `GOBUF` segment placed outside (after) the loop. Otherwise, an error will result when the profile is compiled. The error is "`ERROR: MOTION ENDS IN NON-ZERO VELOCITY`".

The `PLOOP` command will consume one segment of compiled space.

Example:

```
DEF prog1         ; Begin definition of prog1
V1                ; Set velocity to 1 unit/sec
D1000             ; Set distance to 1000 units
GOBUF1            ; Segment of motion sent to buffer

PLOOP3            ; Start loop of the subsequent move profile

V10               ; Set velocity to 10 units/sec
D25000            ; Set distance to 25000 units
GOBUF1            ; First segment within loop sent to buffer

V2                ; Set velocity to 2 units/sec
D1000             ; Set distance to 1000 units
GOBUF1            ; Second segment of motion within loop sent to buffer

V1                ; Set velocity to 1 unit/sec
D25000            ; Set distance to 25000 units
GOBUF1            ; Third segment within loop sent to buffer

PLN1              ; Close loop

V.5               ; Set velocity to 0.5 units/sec
D100              ; Set distance to 100 units
GOBUF1            ; Segment of motion sent to buffer (outside loop)

END               ; End definition of prog1

PCOMP prog1       ; Compile prog1
PRUN prog1        ; Execute prog1
```

[PMAS] Current Master Cycle Position

Type	`Following and Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`FMCNEW, FMCP, FOLMAS, FOLMD, [ FS ], GOWHEN, [ PCMS ], SCALE, SCLMAS, TPMAS, TFS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `PMAS` operator is used to assign the master position register value to a variable, or to make a comparison against another value. This value may be used for subsequent decision making, or for recording the cycle position corresponding to some other event.

PMAS is unique among position assignment variables, because its value rolls over to zero each time the entire master cycle length (FMCLEN value) has been traveled. If it is desired to WAIT or GOWHEN on a master cycle position of the next master cycle, one master cycle length (value of FMCLEN) should be added to the master cycle position specified in the argument. This allows commands that sequence follower events through a master cycle to be placed in a loop. The WAIT or GOWHEN command at the top of the loop could execute, even though the actual master travel had not finished the previous cycle. This is done to allow a PMAS value which is equal to the master cycle length to be specified and reliably detected. When using PMAS with IF, UNTIL, or WHILE arguments, the instantaneous PMAS value is used. Be careful to avoid specifying PMAS values that are nearly equal to the master cycle length (FMCLEN), because rollover may occur before a PMAS sample is read.

The master must be assigned first (FOLMAS command) before this command will be useful.

If scaling is enabled (SCALE1), the PMAS value is scaled by the master scaling factor (SCLMAS). If scaling is disabled (SCALEØ), the PMAS value is in counts.

Syntax: VARn=PMAS where “n” is the variable number; or PMAS can be used in an expression such as IF(PMAS>2345Ø).

Example: (refer also to FOLEN example #2)

```
IF(PMAS>4.3)      ; If the master has traveled more than 4.3 master user units
                  ; then do the IF statement
OUT.2=b1          ; Set onboard output #2 to 1
NIF               ; End of IF statement
VAR14=PMAS        ; Set VAR14 to the master cycle position
```

[PME] Position of Master Encoder

Type	Assignment or Comparison
Syntax	See below
Units	Master Encoder counts
Range	n/a
Default	n/a
Response	n/a
See Also	MEPOL, MESND, [PCME], [PE], PMECLR, PMESET, TPCME, TPME

Product	Rev
GT6K	6.0
GV6K	6.0

Use the PME operator to assign the current master encoder position to a variable, or to make a comparison against another value. The master encoder is connected to the connector labeled “Master Encoder”. If you issue a PMESET command, the encoder position value will be offset by the PMESET command value. The PME value is always in encoder counts, it is never scaled.

Syntax: VARn=PME where “n” is the variable number, or PME can be used in an expression such as IF(PME>16ØØØ).

Example:

```
VAR1=PME          ; Master encoder position is assigned to variable 1
IF(PME<4000)      ; If the master encoder count is less than 4000,
                  ; do the IF statement
VAR2=PME+4000     ; Master encoder position plus 4000 is assigned to variable 2
NIF               ; End IF statement
```

PMECLR Clear Master Encoder Absolute Position Reference

Type	`Motion`
Syntax	`<a_><!>PMECLR<r>`
Units	`r = master encoder counts (not scalable)`
Range	`±999,999,999.99999`
Default	`n/a`
Response	`n/a`
See Also	`MEPOL, MESND, [ PCME ], [ PME ], PMESET, PSET, TPCME, TPME`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `PMECLR` command to remove any offset on the master encoder position reports (offset to master encoder position is established with the `PMESET` command).

Example:

```
TPME            ; Report master encoder position. For the sake of this example,
                ; let's say the response is *TPME10000 (master encoder is at
                ; absolute position 10,000).
PMESET20000     ; Change relative position of master encoder with offset
TPME            ; Report new master encoder position with offset. New position
                ; response should now be: *TPME20000 (what was considered
                ; position 10,000 is now considered position 20,000).
PMECLR          ; Clear any offset applied to the master encoder position
TPME            ; Report master encoder position with no offsets.
                ; Response should be: *TPME10000.
```

PMESET Establish Master Encoder Absolute Position Reference

Type	`Motion`
Syntax	`<a_><!>PMESET<r>`
Units	`r = master encoder counts (not scalable)`
Range	`±999,999,999.99999`
Default	`n/a`
Response	`n/a`
See Also	`MEPOL, MESND, [ PCME ], [ PME ], PMECLR, PSET, TPCME, TPME`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `PMESET` command to offset the current absolute position of the master encoder (connected to the connector labeled “Master Encoder”) to establish an *absolute position reference*. To remove the offset, issue the `PMECLR` command.

All `PMESET` values entered are in master encoder counts; this value is never scaled.

Example:

```
TPME            ; Report master encoder position. For the sake of this example,
                ; let's say the response is *TPME10000 (master encoder is at
                ; absolute position 10,000).
PMESET20000     ; Change relative position of master encoder with offset
TPME            ; Report new master encoder position with offset. New position
                ; response should now be: *TPME20000 (what was considered
                ; position 10,000 is now considered position 20,000).
PMECLR          ; Clear any offset applied to the master encoder position
TPME            ; Report master encoder position with no offsets.
                ; Response should be: *TPME10000.
```

PORT Designate Destination Communication ("COM") Port

Type	`Communication Interface`
Syntax	`<a_><!>PORT<i>`
Units	`i = port number`

Range	`0 (set to active port), 1 (COM1), or 2 (COM2)`
	`NOTE: "COM1" is the "RS-232/485" or "ETHERNET" connector.`
	`"COM2" is the "RS-232" connector.`

Default	`1`
Response	`PORT: *PORT1`
See Also	`], [, BOT, DRPCHK, E, EOL, EOT, ERRDEF, ERRLVL, ERROK, ERRBAD, LOCK, [READ], WRITE, XONOFF`

Product	Rev
GT6K	6.0
GV6K	6.0

The PORT command is used to determine which COM port is affected by the DRPCHK, E, ECHO, BOT, EOL, EOT, ERROK, ERRBAD, ERRDEF, ERRLVL, and XONOFF commands. It also specifies the port to which responses and prompts from stored programs should be sent.

The PORT command also selects the target port through which the WRITE and READ commands transmit ASCII text strings. The DWRITE command (as well as all other RP240 commands) will affect the RP240 regardless of the PORT command setting. If no RP240 is detected, the commands are sent to the COM2 port. DWRITE text strings are always terminated with a carriage return.

You can use the PORT0 command to set the PORT value to the port through which the command was received. For example, if your computer is connected to the RS-232/485 port (COM1) and you send the PORT0 command, the PORT value will be changed to PORT1 and all subsequent communication commands will affect the COM1 port.

Example (The PORT command can be used to designate EOT parameters for both ports. Assume that port COM1 is being used to communicate to the Gem6K drive.)

```
PORT1           ; Select COM1 for EOT setup
EOT45,49,10     ; EOT for COM1 is -1<lf>
TPE             ; Send "Transfer Position of Encoder" response to COM1
                ; using EOT 45,49,10
PORT2           ; Select COM2 for EOT setup
EOT45,50,10     ; EOT for COM2 is -2<lf>
TPC             ; Send "Transfer Commanded Position" response to COM2
                ; using EOT 45,50,10
```

Example (The PORT command specifies both port setups and response destinations in a stored program.)

```
DEF qwe         ; Begin definition of qwe
PORT1
EOT45,49,10     ; EOT for COM1 is -1<lf>
TPE             ; Send "Transfer Position of Encoder" response to COM1
                ; using EOT 45,49,10
PORT2
EOT45,50,10     ; EOT for COM2 is -2<lf>
TPC             ; Send "Transfer Commanded Position" response to COM2
                ; using EOT 45,50,10
END             ; End definition of qwe
```

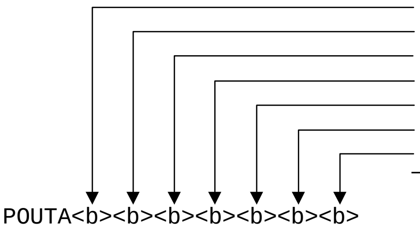
POUTA Compiled Output

Type	`Compiled Motion; Outputs`
Syntax	`<a_><!><B>POUTA<b><b><b><b>...`
Units	`b = enable bit for specific outputs (see page 8)`
Range	`b = 0 (off), 1 (on), or X (don't change)`
Default	`0`
Response	`n/a`
See Also	`GOBUF, OUT, OUTEN, OUTFNC, OUTLVL, PCOMP, PRUN, PUCOMP`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the POUTA command to control outputs during Compiled Motion. The outputs that can be controlled are the digital outputs on the DRIVE I/O connector, the relay output (labeled "RELAY COM" and "RELAY N.O.") on the 4-pin removable connector, and any outputs on external I/O bricks. Refer to page 8 to understand how to address the outputs (onboard and on optional expansion I/O bricks) available on the Gem6K.

Output #	Pin #	GT6K & GV6K Function (OUTFNC default)
1	41	OUTFNC1-A (General-purpose)
2	43	OUTFNC2-A (General-purpose)
3	45	OUTFNC3-A (General-purpose)
4	46	OUTFNC4-A (General-purpose)
5	48	OUTFNC5-A (General-purpose)
6	49	OUTFNC6-A (General-purpose)
7	Relay	OUTFNC7-F (Fault)



NOTE: You may use POUTA to control only the outputs defined as "general-purpose" outputs with the OUTFNCi-A command. If you attempt to change the state of an output that is not defined as a general-purpose output, the drive will respond with an error message ("OUTPUT BIT USED AS OUTFNC") and the POUTA command will not be executed (but command processing will continue).

If you wish to set only one output value, instead of all outputs, use the bit select (.) operator, followed by the number of the specific output. For example, 2POUTA.12-1 turns on only output 12 on I/O brick 2.

The POUTA command consumes one segment of compiled memory.

The programmable outputs are sampled once per "system update" (2 ms).

Example:

```
OUTFNC3-A       ; Default output function for onboard output 3
OUTFNC6-A       ; Default output function for onboard output 6
DEF P1          ; Define program P1
D1000           ; Set distance to travel
GOBUF1          ; Motion segment
POUTA.3-1       ; Turn on output 3 when the axis travels 1000 counts
D2000           ; New distance commanded
GOBUF1          ; Motion segment
POUTA.3-0       ; When the axis travels 2000 additional counts,
POUTA.6-1       ; turn off output 3 and turn on output 6
D1000           ; New distance commanded
GOBUF1          ; Motion segment
POUTA.6-0       ; Turn off output 6 when the axis travels 1000 additional counts
END             ; End program definition

PCOMP P1        ; Compiled program P1
PRUN P1         ; Execute program P1
```

When executing a Compiled Following profile, the POUTA statement is always executed as programmed. Therefore, in order to make sure an output is on for a given motion segment no matter what direction the master is traveling, you should use two POUTA statements (see example below).

```
POUTA.3-0       ; Turn off onboard output 3 - master going backwards
POUTA.3-1       ; Turn on onboard output 3 - master going forwards
GOBUF1          ; Motion segments for axis 1
POUTA.3-1       ; Turn on onboard output 3 for axis 1 - master going backwards
POUTA.3-0       ; Turn off onboard output 3 for axis 1 - master going forwards
```

If you desire to "pulse" an output (turn on for a given amount of time), then use the POUTA command along with the GOWHEN(T=n) command. For example:

```
POUTA.3-1       ; Turn on output 3
GOWHEN(T=120)   ; Wait for 120 milliseconds
POUTA.3-0       ; Turn off output 3
```

PRUN Run a Compiled Profile

Type	`Compiled Motion; PLC Program`
Syntax	`<a_><!>PRUN<t>`
Units	`t = text (name of path program)`
Range	`text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`COMEXC, DEF, END, PCOMP, PUCOMP, GOBUF, PLCP, PLOOP, PLN, SCANP`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the PRUN command to start execution of a previously compiled program (a GOBUF profile, or a PLCP program). All the required information about the program or path whose name is specified in the PRUN command has already been stored by the definition commands (DEF and END) and compiled by the PCOMP command.

Executing GOBUF profiles: If the axis is not ready, a GOBUF profile will not be executed. An axis is not ready if it is shutdown, moving, or in joystick mode. When execution of a pre-compiled program begins, the axis becomes busy until motion has completed.

Executing PLC programs: When using PRUN to execute a PLCP program, the PLCP program is run only once (as opposed to invoking a continual scan loop when executing PLCP programs with the SCANP command).

COMEXC1 mode must be enabled in order for command processing to continue once a motion invoking command has been initiated with PRUN. If you use the PRUN command within a program while in COMEXC1 mode, it functions as a GO and returns control back to the original program after the embedded program's motion is started (control is returned to the first command immediately following the PRUN command). If in COMEXCØ mode, command processing will not continue until the motion invoking command has completed its movement.

Example:

```
DEL prog1     ; Delete prog1
DEF prog1     ; Define prog1
MC0           ; Preset positioning mode
D50000        ; Distance is 50000
A10           ; Acceleration is 10 revs/sec/sec
AD10          ; Deceleration is 10 revs/sec/sec
V5            ; Velocity is 5 revs/sec
GOBUF1        ; 1st motion segment
D30000        ; Distance is 30000
V2            ; Velocity is 2 revs/sec
GOBUF1        ; 2nd motion segment
END           ; End definition of prog1
PCOMP prog1   ; Compile prog1
PRUN prog1    ; Execute prog1
```

PS Pause Program Execution

Type	`Program Flow Control`
Syntax	`<a_><!>PS`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`C, COMEXR, COMEXS, K, S, [ SS ], TSS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The PS command pauses execution of commands in the command buffer. If a PS command is executed, no commands after the PS will be executed until a !C command is received. However, additional commands may still be placed in the command buffer.

The PS command does not pause motion. In order for motion to be paused, the S and the COMEXS commands should be used.

Example:

```
PS                ; Stop execution of command buffer until !C command
MA0               ; Select incremental positioning mode
D10000            ; Set distance to 10000 units
GO1               ; Initiate motion
; *********************************************************************
; * NOTE:                                                             *
; * No commands after the PS command will be executed until a !C      *
; * command is received.                                              *
; *********************************************************************
```

PSET Establish Absolute Position

Product	Rev
GT6K	6.0
GV6K	6.0

Type Motion
Syntax `<a_><!>PSET<r>`
Units `r = units (absolute position)`
Range `±999,999,999.99999`
Default `n/a`
Response `n/a`

See Also `D, [ FB ], GO, HOM, INFNC, MA, MC, [ PC ], [ PCC ], [ PCE ], [ PCMS ], [ PE ], PESET, PMESET, SCALE, SCLD, SFB, TFB, TPC, TPCC, TPCE, TPCMS, TPE`

Use the `PSET` command to offset the current absolute position to establish an *absolute position reference*. To remove the offset, issue the `PSET CLR` command. All `PSET` values entered are in steps, unless scaling is enabled (`SCALE1`), in which case (`PSET`) is multiplied by the distance scale factor (`SCLD`).

Steppers – without scaling: The `PSET` command will define the present commanded position to be the absolute position entered. To set an encoder absolute position, use the `PESET` command.

Servos – without scaling: The `PSET` command defines a new absolute position reference. If the drive is enabled (`DRIVE1`), the present commanded position is used as the reference point. If the drive is disabled (`DRIVE0`), the present feedback device position (selected with the `SFB` command) is used as the reference point.

SERVO AXES

The `PSET` offset value is specific only to the feedback source selected with the last `SFB` command.

If your application requires switching between feedback sources, then you must select the feedback source with the appropriate `SFB` command and issue a `PSET` value specific to that feedback source. (Each feedback source can have a separate offset.)

NOTE: If you issue a `PSET` command, any previously captured positions (`INFNCi-H` function) will be offset by the `PSET` value.

If a software end-of-travel limit has been hit, the `PSET` command will not remove the error condition. The error condition is removed by commanding motion in the opposite direction.

Example:

```
PSET0             ; Wherever the present actual or commanded position happens to be,
                  ; consider that position to have an absolute position of zero.
```

[PSHF] Net Position Shift

Type	`Following; Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`FOLEN, FOLMAS, FSHFC, FSHFD, SCALE, SCLD, TPSHF`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `PSHF` operator is used to assign to a numeric variable the value of the net (absolute) follower axis position shift that has occurred since that last `FOLEN1` command. The position value will be the sum of all shifts performed on that axis, including decelerations due to limits, kill, or stop. The shift value is set to zero each time a new `FOLEN1` command or a `FOLMAS` command (with a value other than zero) is issued.

If scaling is enabled (`SCALE1`), the `PSHF` value is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled, the value is in commanded counts.

Syntax: `VARn=PSHF` where "n" is the variable number, or `PSHF` can be used in an expression such as `IF(PSHF>2345Ø)`.

Example:

```
IF(PSHF>4.3)     ; If the follower axis has shifted more than 4.3 user units in the
                 ; positive direction, then do the IF statement
OUT.2=b1         ; Turn on onboard output #2
NIF              ; End of IF statement
VAR14=PSHF       ; Set VAR14 to the follower axis’s position shift
```

[PSLV] Current Commanded Position of Follower Axis

Type	`Following; Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`FMCNEW, FMCP, SCLD, SCALE, TPSLV`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `PSLV` operator to assign the follower axis commanded position register value to a variable, or to make a comparison against another value.

If scaling is enabled (`SCALE1`), the `PSLV` value is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled, the value is in commanded counts.

Syntax: `VARn=PSLV` where "n" is the variable number, or `PSLV` can be used in an expression such as `IF(PSLV>2345Ø)`.

Example:

```
IF(PSLV>4.3)     ; If the follower axis has traveled more than 4.3 user units then
                 ; do the IF statement
OUT.2=b1         ; Turn on onboard output #2
NIF              ; End of IF statement
VAR14=PSLV       ; Set VAR14 to the follower axis's position
```

PUCOMP Un-Compile a Compiled Profile

Type	`Compiled Motion; PLC Program`
Syntax	`<a_><!>PUCOMP<t>`
Units	`t = text (name of program)`
Range	`Text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`DEF, END, GOBUF, MEMORY, PCOMP, PLCP, PRUN, SCANP, TDIR, TMEM, TSEG, GOBUF, PLOOP, PLN`

Product	Rev
GT6K	6.0
GV6K	6.0

The `PUCOMP` command is used to delete a previously compiled (`PCOMP`) program from the compiled memory. The `PUCOMP` command does not delete the program from program memory.

Example:

```
PUCOMP prog1    ; Delete compiled motion segments for prog1
DEL prog1       ; Delete prog1
DEF prog1       ; Begin definition of path named prog1
A50             ; Set acceleration to 50
V10             ; Set velocity to 10
D100000         ; Set D to 100000
GOBUF1
;  *********************************************
;  *  Add multiple GOBUF segment               *
;  *  definitions in this                      *
;  *  portion of the                           *
;  *  program                                  *
;  *********************************************
END             ; End definition of prog1
PCOMP prog1     ; Compile prog1
PRUN prog1      ; Execute prog1
```

RADIAN Radian Enable

Type	`Operators (Trigonometric)`
Syntax	`<a_><!>RADIAN<b>`
Units	`n/a`
Range	`b = 0 (Disable), 1 (Enable) or X (don't care)`
Default	`0`
Response	`RADIAN: *RADIAN0`
See Also	`[ ATAN ], [ COS ], [ PI ], [ SIN ], [ TAN ], VAR`

Product	Rev
GT6K	6.0
GV6K	6.0

This operator is used to switch between radians and degrees. The command `RADIAN1` specifies units in radians for `SIN`, `COS`, `TAN`, and `ATAN`. The command `RADIANØ` specifies units in degrees for `SIN`, `COS`, `TAN`, and `ATAN`.

If a value is given in radians and a conversion is needed to degrees, use the formula: 360° = 2π radians.

Example:

```
RADIAN1         ; Set trigonometric functions to radian mode
```

RE Registration Enable

Type	`Registration`
Syntax	`<a_><!>RE<b>`
Units	`b = 0 (disable), 1 (enable)`
Range	`n/a`
Default	`0`
Response	`RE:   *RE0`
See Also	`[ AS ], COMEXC, [ ER ], INFNC, [ PCC ], [ PCE ], [ PCMS ], REG, REGLOD, REGSS, TAS, TER, TPCC, TPCE, TPCMS, TRGLOT, [ TRIG ], TTRIG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `RE` command enables the registration feature. When a registration input (an input assigned the "Trigger Interrupt" function with the `INFNCi-H` command) is activated, the motion profile currently being executed is replaced by a *registration profile* with its own distance (`REG`), acceleration (`A` & `AA`), deceleration (`AD` & `ADA`), and velocity (`V`) values. The registration move may interrupt any preset (`MC0`), continuous (`MC1`), or registration move in progress.

The registration move does not alter the rest of the program being executed when registration occurs, nor does it affect commands being executed in the background if the Gem6K is operating in the continuous command execution mode (`COMEXC1`).

Registration moves will not be executed while the motor is not performing a move, while in the joystick mode (`JOY1`), or while decelerating due to a stop, kill, soft limit, or hard limit.

How to Set up a Registration Move

1. Use the `INFNC1-H` or `INFNC2-H` command to configure onboard input 1 or 2 as a trigger input (TRIG A or TRIG B, respectively). TRIG M, the MASTER TRIGGER, may not be used for registration.
2. Specify the distance of the registration move with the `REG` command. For servo axes, the distance refers to the encoder position. For stepper axes, the distance refers to commanded position.
3. Enable the registration function with the `RE1` command. Registration is performed only when there is a non-zero distance specified by the `REG` command.

   NOTE: The registration move is executed using the `A`, `AA`, `AD`, `ADA`, and `V` values that were in effect when the `REG` command was entered.

Registration Move Accuracy (see also Registration Move Status below)

The accuracy of the registration move distance specified with the `REG` command is ±1 count (servo axes: encoder count; stepper axes: commanded count)

RULE OF THUMB: To prevent position overshoot, make sure the `REG` distance is greater than 4 ms multiplied by the incoming velocity.

The lapse between activating the registration input and commencing the registration move (this does not affect the move accuracy) is less than one position sample period (2 ms).

The `REG` distance will be scaled by the distance scale factor (`SCLD` value) if scaling is enabled (`SCALE1`). See page 16 for details on scaling.

Preventing Unwanted Registration Moves (methods)

- Registration Input Debounce: By default, the registration inputs are debounced for 24 ms before another input on the same trigger is recognized. (The debounce time is the time required between an input's initial active transition and its secondary active transition.) If your application requires a shorter debounce time, you can change it with the `TRGLOT` command.
- Registration Single-Shot: The `REGSS` command allows you to program the Gem6K drive to ignore any registration commands after the first registration move has been initiated. Refer to the `REGSS` command description for further details and an application example.

- Registration Lockout Distance: The REGLOD command specifies what distance an axis must travel before any input assigned as a registration input will be recognized. Refer to the REGLOD command description for further details and an application example.

Registration Move Status & Error Handling

Axis Status — Bit #28: This status bit is set when a registration move has been initiated by the registration input. This status bit is cleared with the next GO command.

AS.28 ...... Assignment & comparison operator — use in a conditional expression (e.g., WAIT(AS.28=b1)).
TASF .... Full text description of each status bit. (see "Reg Move Commanded" line item)
TAS .... Binary report of each status bit (bits 1-32 from left to right). See bit #28.

Axis Status — Bit #30: If, when the registration input is activated, the registration move profile cannot be performed with the specified motion parameters, the Gem6K drive will kill the move in progress and set axis status bit #30. This status bit is cleared with the next GO command.

AS.30 ...... Assignment & comparison operator — use in a conditional expression.
TASF .... Full text description of each status bit. (see "Preset Move Overshot" line item)
TAS .... Binary report of each status bit (bits 1-32 from left to right). See bit #30.

Input Status — Bits #1-5: Check the status of the assigned input to ascertain if it has been activated. The status reports the present state of the input.

IN.n .... Comparison operand for IF and WAIT conditional expressions (e.g., IF(IN.2=b1)).
TIN .... Binary report of each status bit (bits 1-5 from left to right).

Error Status — Bit #10: This status bit may be set if axis status bit #30 is set. The error status is monitored and reported only if you enable error-checking bit #10 with the ERROR command (e.g., ERROR.10-1). NOTE: When the error occurs, the Gem6K will branch to the error program (assigned with the ERRORP command). This status bit is cleared with the next GO command.

ER.10 ...... Assignment & comparison operator — use in a conditional expression (e.g., IF(ER.10=b1)).
TERF .... Full text description of each status bit. (see "Profile Impossible" line item)
TER .... Binary report of each status bit (bits 1-32 from left to right). See bit #10.

Trigger Status — Bits #1-5: Trigger status bits are set when a registration move has been initiated by trigger inputs A or B. This also indicates that the position has been captured. As soon as the captured information is transferred or assigned/compared, the respective trigger status bit is cleared (set to Ø).

TRIG .... Assignment & comparison operator — use in a conditional expression.
TTRIG ...... Binary report of each status bit (bits 1-5). From left to right the bits represent trigger A and B (the 5th bit is master trigger M, the "MASTER TRIG" input terminal, which may not be used for registration) — see page 8.

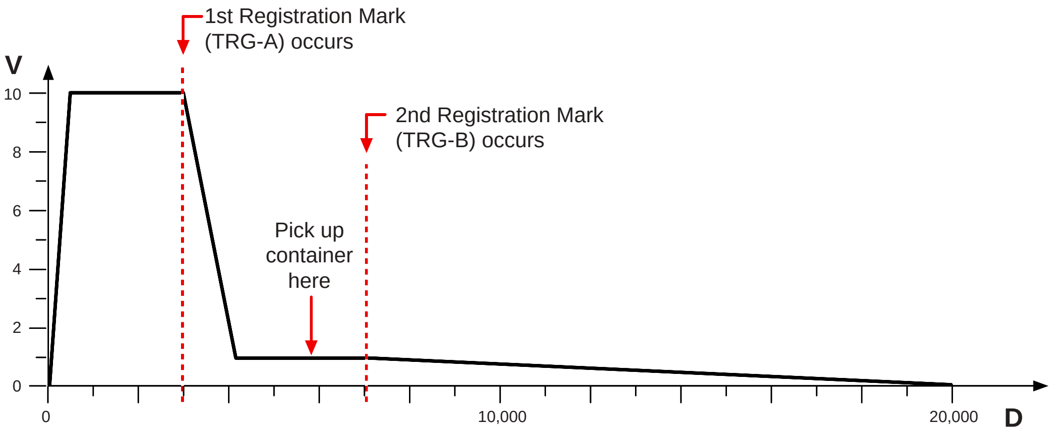
Example:

In this example, two-tiered registration is achieved. While the axis is executing its 50,000-unit move, Trigger A is activated and executes registration move A to slow the load's movement. An open container of volatile liquid is then placed on the conveyor belt. After picking up the liquid and while registration move A is still in progress, Trigger B is activated and executes registration move B to slow the load to a gentle stop.

```
DEL REGI1     ; Delete program (assume program already resides in memory)
DEF REGI1     ; Begin program definition
INFNC1-H      ; Define input 1 as trigger A
INFNC2-H      ; Define input 2 as trigger B
A20           ; Set acceleration on to 20 units/sec/sec
AD40          ; Set deceleration on to 40 units/sec/sec
V1            ; Set velocity to 1 unit/sec
REGA4000      ; Set trigger A's registration distance to 4000 units
              ; (registration A move will use the A, AD, & V values above)
A5            ; Set acceleration to 5 units/sec/sec
AD2           ; Set deceleration to 2 units/sec/sec
V.5           ; Set velocity to 0.5 units/sec
REGB13000     ; Set trigger B's registration distance to 13,000 units
              ; (registration B move will use the A, AD, & V values above)
```

```
RE1           ; Enable registration
A50           ; Set acceleration to 50 units/sec/sec
AD50          ; Set deceleration to 50 units/sec/sec
V10           ; Set velocity to 10 unit/sec
D50000        ; Set distance to 50000 units
GO1           ; Initiate motion
END           ; End program definition
```

Registration Profile:



[READ] Read a Value

		Product	Rev
Type	`Communication Interface or Assignment`		
Syntax	`... READi ... (See below)`	GT6K	6.0
Units	`i = string variable number`	GV6K	6.0
Range	`1-50`		
Default	`n/a`		
Response	`n/a`		
See Also	`', PORT, [ SS ], TSS, VAR, VARS, WRITE`		

The `READ` command provides the user with an efficient way of storing numeric data read from the input buffer into a variable. The `READ` command can be used as part of a numeric variable assignment statement (e.g., `VAR1=READ1`) or in another command (`A(READ1)`). However, the `READ` command cannot be used in an expression such as `VAR5=1+READ1` or `IF(READ1=1)`.

Syntax: `VARx=READi` where `x` is the variable number and `i` is the string variable to be sent out to prompt the user for the numeric information.

Syntax: `Command(READi)` where `Command` is any command that has a separate field (e.g., `A`, `AD`, `V`, `D`, etc.), and `i` is the string variable number.

The number attached to the end of the `READ` command corresponds to the string variable to be sent out the Ethernet port or the RS-232 or RS-485 port, at the time this command is executed. The Gem6K drive will then wait for numeric data to be sent to its input buffer. **The numeric data must be preceded with an immediate command identifier and a single quote (`!'`).** The information read in can be either integer or real, and must be terminated by a command delimiter (`:`, `<cr>`, `<lf>`).

Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by `<r>`) or an integer value (denoted by `<i>`), you can use the `READ` substitution (e.g., `V(READ1)`).

Example:

```
VARS1="Enter the count >"   ; Place message in string variable #1
VAR2=READ1                  ; Prompt with string variable #1, and read data
                            ; into variable #2
;
```

```
; The drive will send this message (string variable #1) to the screen:
;                   "Enter the count >"
; The user must enter the numeric data preceded by the characters !'.
; For example, !'82.5 assigns the value 82.5 to numeric variable 2
```

REG Registration Distance

Type	Registration
Syntax	<a_><!>REGc<r>
Units	c = letter of trigger input (A or B) r = distance units (scalable by the SCLD value) servo axes: always encoder or resolver counts stepper axes: commanded counts
Range	r = 0.00000 to 999,999,999 (after conversion to steps)
Default	0 (do not make a registration move)
Response	REG: *REG0
See Also	[AS], INFNC, [ER], [PCC], [PCE], [PCMS], RE, REGLOD, REGSS, SCALE, SCLD, [SS], TAS, TER, TPCE, TRGLOT, [TRIG], TTRIG

Product	Rev
GT6K	6.0
GV6K	6.0

The REG command specifies the distance to travel after receiving a registration input (trigger A or B). For example, REGA4000 sets up a 4000-count registration move to be initiated trigger A is activated.

Servo Axes: REG value always represents encoder or resolver counts.

Stepper Axes: REG value represents commanded counts.

NOTE: The registration move is executed using the A, AA, AD, ADA, and V values that were in effect when the REG command was entered. To see an example, refer to the programming sample in the RE command description.

RULE OF THUMB: To prevent position overshoot, make sure the REG distance is greater than 4 ms multiplied by the incoming velocity.

The registration distance remains set until you change it with a subsequent REG command. Registration distances outside the valid range are flagged as an error, returning the message *INVALID DATA-FIELD x, where x is the field number.

The REG distance will be scaled by the distance scale factor (SCLD value) if scaling is enabled (SCALE1). See page 16 for details on scaling.

UNITS OF MEASURE and **SCALING**: refer to page 16.

For additional details on Registration (including programming examples), refer to the RE command description and to the Registration section in the *Programmer's Guide*.

REGLOD Registration Lock-Out Distance

Type	Registration
Syntax	<a_><!>REGLOD<r>
Units	r = distance units (scalable by SCLD)
Range	0.00000 to +999,999,999.99999
Default	0
Response	REGLOD: *REGLOD0
See Also	INFNC, RE, REG, REGSS, SCLD, TRGLOT

Product	Rev
GT6K	6.0
GV6K	6.0

The REGLOD command specifies the distance to travel before a registration input will be recognized. If scaling is enabled (SCALE1), the lock-out distance is scaled by the SCLD value.

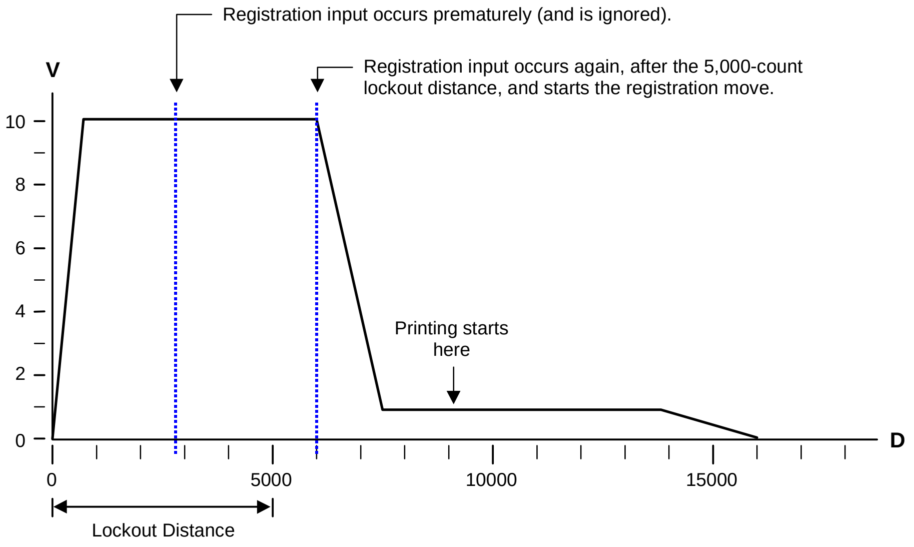
Stepper axes: The lock-out distance is measured incrementally from the start of motion to the commanded position.

Servo axes: The lock-out distance is measured incrementally from the start of motion to the actual position (as measured by the position feedback device), not the commanded position.

Example:
A print wheel uses registration to initiate each print cycle. From the beginning of motion, the Gem6K should ignore all registration marks before traveling 5000 counts.

```
DEL reg1          ; Delete program reg1
DEF reg1          ; Begin program definition
INFNC1-H          ; Define input #1 as a "trigger interrupt" input (TRG-A)
A40               ; Set acceleration to 40 revs/sec/sec
AD5               ; Set deceleration to 5 revs/sec/sec
V1                ; Set velocity to 1 rev/sec
REGA10000         ; Set registration distance to 10,000 counts
                  ; (registration move will use the A, AD, & V values above)
REGLOD5000        ; Set registration lockout distance to 5000 counts
RE1               ; Enable registration
A50               ; Set acceleration to 50 revs/sec/sec
AD50              ; Set deceleration to 50 revs/sec/sec
V10               ; Set velocity to 10 revs/sec
D50000            ; Set distance to 50000 counts
GO1               ; Initiate motion
END               ; End program definition
```

Registration Profile:



REGSS Registration Single-Shot

Type	`Registration`
Syntax	`<a_><!>REGSS<b>`
Units	`n/a`
Range	`b=0 (Disable) or 1 (Enable)`
Default	`0`
Response	`REGSS:      *REGSS0`
See Also	`RE, REG, REGLOD`

Product	**Rev**
GT6K	6.0
GV6K	6.0

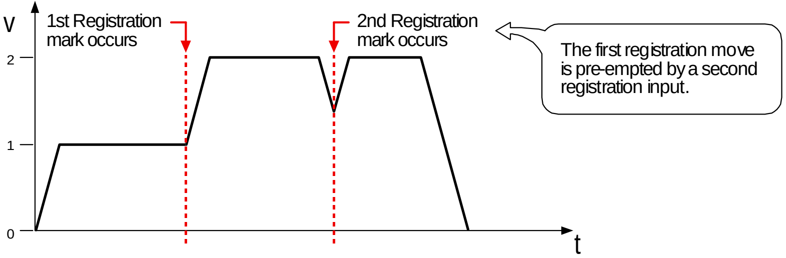
The `REGSS` command sets the registration such that only one registration move will take place. This allows the user to prevent any other trigger from interrupting the registration move in progress. A `GO` command will reset the "one shot" condition.

Example – Senario A :

A user has a line of material with randomly spaced registration marks. It is known that the first mark must initiate a registration move, and that each registration move cannot be interrupted or the end product will be destroyed. Since the distance between marks is random, it is impossible to predict if a second registration mark will occur before the first registration move has finished.

```
DEL REGI2a       ; Delete program (in case program already resides in memory)
DEF REGI2a       ; Begin program definition
INFNC1-H         ; Define input #1 as a "trigger interrupt" input (TRG-A)
RE1              ; Enable registration
V2               ; Set registration move to a velocity of 2 rps
AD.5             ; a deceleration of 0.5 rev/sec/sec
REGA20000        ; and a distance of 20000 steps
MC1              ; Start a mode continuous
V1               ; move at a velocity of 1 rps
GO1              ; Initiate motion
END              ; End program definition
```

Registration Profile:

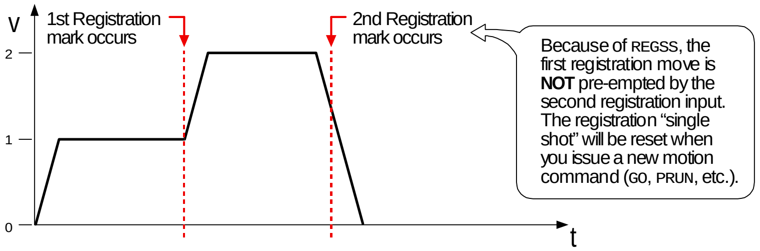


The first registration move is pre-empted by a second registration input.

Example – Scenario B (introducing “single-shot” registration):
In order to stop the second registration from occurring, REGSS can be used:

```
DEL REGI2b       ; Delete program (in case program already resides in memory)
DEF REGI2b       ; Begin program definition
INFNC1-H         ; Define input #1 as a "trigger interrupt" input (TRG-A)
RE1              ; Enable registration
V2               ; Set registration move to a velocity of 2 rps
REGA20000        ; and a distance of 20000 steps
REGSS1           ; Enable registration single shot mode
MC1              ; Start a mode continuous
V1               ; move at a velocity of 1 rps
GO1              ; Initiate motion
END              ; End program definition
```

Registration Profile:



Because of REGSS, the first registration move is **NOT** pre-empted by the second registration input. The registration “single shot” will be reset when you issue a new motion command (GO, PRUN, etc.).

REPEAT Repeat Statement

		Product	Rev
Type	`Program Flow Control or Conditional Branching`	GT6K	6.0
Syntax	`<a_><!>REPEAT`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`JUMP, UNTIL`		

The REPEAT command, in conjunction with the UNTIL command, provide a means of conditional program flow. The REPEAT command marks the beginning of the conditional statement. The commands between the REPEAT and the UNTIL command are executed at least once. Upon reaching the UNTIL command, the expression contained within the UNTIL command is evaluated. If the expression is false, the program flow is redirected to the first command after the REPEAT command. If the expression is true, the first command after the UNTIL command is executed.

Up to 16 levels of REPEAT ... UNTIL( ) commands may be nested.

NOTE: Be careful about performing a GOTO between REPEAT and UNTIL. Branching to a different location within the same program will cause the next REPEAT statement encountered to be nested within the previous REPEAT statement, unless an UNTIL command has already been encountered. The JUMP command should be used in this case.

All logical operators (AND, OR, NOT), and all relational operators (=, >, >=, <, <=, <>) can be used within the UNTIL expression. There is no limit on the number of logical operators, or on the number of relational operators allowed within a single UNTIL expression.

The limiting factor for the UNTIL expression is the command length. The total character count for the UNTIL command and expression cannot exceed 80 characters. For example, if you add all the letters in the UNTIL command and the letters within the () expression, including the parentheses and excluding the spaces, this count must be less than or equal to 80.

All assignment operators (A, AD, AS, D, ER, IN, INO, MOV, OUT, PC, PCE, PCME, PCMS, PE, PER, SS, TIM, US, V, VEL, etc.) can be used within the UNTIL() expression.

Example:

```
REPEAT          ; Beginning of REPEAT ... UNTIL( ) loop
GO1             ; Initiate motion
VAR1=VAR1+1     ; Increment variable 1 by 1
UNTIL(VAR1=12)  ; Repeat loop until variable 1 = 12
```

RESET Reset

		Product	Rev
Type	`Communication Interface`	GT6K	6.0
Syntax	`<a_><!>RESET`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`RESET:   (power-up message is displayed)`		
See Also	`DRESET, RFS, STARTP, TAS, TASX, TSTAT, TREV`		

The RESET command affects the Gem6K drive the same as cycling power, or activating the hardware Reset input (pin 3 on the DRIVE I/O connector). The drive's programs, variables, scaling parameters, and motor configuration parameters are retained in non-volatile memory; however, all previously entered command values (not saved in programs or variables) will be reset to factory default values.

NOTE: After sending the RESET or !RESET command to the Gem6K, you must wait until you see the power-up message before communicating with the Gem6K.

CAUTION: The RESET command will disconnect an Ethernet connection. (See DRESET for a command that resets certain parameters, without disconnecting an Ethernet connection.)

RFS Return to Factory Settings

Type	Drive Configuration
Syntax	<a_><!>RFS
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	ERROK, RESET, TDHRS, TREV

Product	Rev
GT6K	6.0
GV6K	6.0

The RFS command returns all settings to factory default, with the exception of the ERROK prompt and the TDHRS value. All stored programs and profiles are deleted. A RESET command is automatically issued following this command; therefore, no prompt will be returned.

When is the RFS event finished? The RFS process can take several seconds. When RFS is finished, the drive transmits the power-up message.

Recommendation: When you complete the drive configuration procedure in Motion Planner (see page 6), be sure to save the configuration file and program files to your PC's hard drive for safe keeping. If, after executing the RFS command, you need to restore the previous configuration or stored programs, re-download the configuration file and program files to your drive (REMEMBER: You must reset the drive to invoke new configuration settings).

RUN Begin Executing a Program

Type	Program or Subroutine Definition
Syntax	<a_><!>RUN<t>
Units	t = text (name of program)
Range	Text name of 6 characters or less
Default	n/a
Response	n/a
See Also	$, DEF, DEL, END, GOSUB, GOTO

Product	Rev
GT6K	6.0
GV6K	6.0

The RUN command executes a program defined with the DEF command. A program name consists of 6 or fewer alpha-numeric characters. The RUN command can be used inside a program or subroutine. The program can also be run by specifying the name of the program without the RUN command. The RUN command functions similarly to a GOSUB command in that control returns to the original program when the called program finishes.

Example:

```
DEF pick         ; Begin definition of program named pick
GO1              ; Initiate motion
END              ; End program definition
RUN pick         ; Executes program named pick
pick             ; Executes program named pick
```

S Stop Motion

		Product	Rev
Type	Motion	GT6K	6.0
Syntax	<a_><!>S<b>	GV6K	6.0
Units	n/a		
Range	b = 0 (do not stop) or 1 (stop)		
Default	1		
Response	!S: No response, instead motion is stopped.		
See Also	C, COMEXC, COMEXS, GO, K		

The Stop (S) command instructs the motor to stop motion. The S command will bring the axis to rest using the last deceleration values (AD and ADA) entered.

NOTE

Since all commands are buffered, the next command does not begin until the previous command has finished. This is important because if you place a Stop (S) command after a Go (GO) command in a program, the Stop command will have no effect. For the Stop command to have an effect within a program, continuous command processing mode must be enabled (COMEXC1). If the Stop (S) command is to be used external to the program, the immediate command identifier must be used (!S or !S1).

Effect of COMEXS:

COMEXS0: Under factory default conditions (COMEXS0), when the Gem6K receives a stop command (S, !S, S1, or !S1) or a stop input (input assigned a stop function with INFNCi-D), the following will happen:

- Motion decelerates to a stop, using the present AD and ADA deceleration values. The motion profile cannot be resumed.
- All commands in the Gem6K's command buffer are discarded.
- Program execution is terminated and cannot be resumed.

COMEXS1: Using the COMEXS1 mode, the Gem6K allows more flexibility in responding to stop conditions, depending on the stop method (see table below).

Stop Method	What Stops? Motion	 Program	**Resume Motion Profile**. (Allow resume with a !C command or a resume input *)	**Resume Program**. (Allow resume with a !C command or a resume input *)	**Save Command Buffer**. (Save the commands that were in the command buffer when the stop was commanded)
!S or S	Yes	Yes	Yes	Yes	Yes
!S1 or S1	Yes	No	No	No	Yes
Stop input	Yes	No	No	No	Yes
Pause input * (if COMEXR1)	Yes	Yes	Yes	Yes	Yes
Pause input * (if COMEXR0)	No	Yes	No	Yes	Yes

* A *Pause* input is an input configured with the INFNCi-E command. This is also the *Resume* input that can be used to resume motion and program execution after a stop.

COMEXS2: Using the COMEXS2 mode, the Gem6K responds as it does in the COMEXS0 mode, with the exception that you can still use the program-select inputs to select programs (INSELP value is retained). The program-select input functions are: BCD select (INFNCi-B), and one-to-one select (INFNCi-P). For further details on program selection with inputs, refer to INFNC and INSELP.

Example:

```
GO1       ; Initiate motion
!S        ; Stop motion (must use "!S" to stop motion in progress)
```

[SC] Status Assignment/Comparison

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`SCANP, TSC, TSCF, VARB`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `SC` operator to assign the drive status bits to a binary variable (`VARB`) or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, 0, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers 0 through 9.

Syntax: `VARBn=SC` where "n" is the binary variable number, or `SC` can be used in an expression such as `IF(SC=b0010)`, or `IF(SC=h7F)`. If it is desired to assign only one bit of the drive status value to a binary variable, instead of all 32, the bit select (`.`) operator can be used. For example, `VARB1=SC.3` assigns drive status bit #3 to binary variable 1: `*VARB1=XX0X_XXXX_XXXX_XXXX_XXXX_XXXX_XXX_XXXX`.

The function of each drive status bit is shown below.

Bit #	**Function** (1 = Yes; Ø = No)
1	RESERVED
2	RESERVED
3	A PLC program is being executed in Scan Mode (`SCANP`).
4	RESERVED
5	RESERVED
6	RESERVED
7	RESERVED
8-32	RESERVED

SCALE Enable/Disable Scale Factors

Type	`Scaling`
Syntax	`<a_><!>SCALE<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`SCALE:   *SCALE0`
See Also	`DRES, ERES, SCLA, SCLD, SCLMAS, SCLV, SFB, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: All scaling settings (`SCALE`, `SCLA`, `SCLD`, `SCLV` and `SCLMAS`) are automatically saved in the Gem6K's battery-backed RAM.

Scaling allows you to program acceleration, deceleration, velocity, and position values in units of measure that are appropriate for your application. The `SCALE` command is used to enable or disable scaling (`SCALE1` to enable, `SCALEØ` to disable). When scaling is enabled (`SCALE1`), all entered data is multiplied by the appropriate scale factor:

Type of Motion	Accel/Decel Scaling	Velocity Scaling	Distance Scaling
Standard Point-to-Point Motion	`SCLA`	`SCLV`	`SCLD`
Following	`SCLA`	`SCLV`	`SCLD` for follower distances `SCLMAS` for master distances

When Should I Define Scaling Factors?

Scaling calculations are performed when a program is defined or downloaded. Consequently, you must enable scaling (SCALE1) and define the scaling factors (SCLD, SCLA, SCLV, SCLMAS) *prior* to defining (DEF), uploading (TPROG), or running (RUN or PRUN) the program.

> RECOMMENDATION: Place the scaling commands at the beginning of your program file, *before* the location of any defined programs. This ensures that the motion parameters in subsequent programs in your program file are scaled correctly. When you use Motion Planner's scaling setup wizard, the scaling commands are automatically placed in the appropriate location in your program file.
>
> ALTERNATIVE: Scaling factors could be defined via a terminal emulator ***just before*** defining or downloading a program. Because scaling command values are saved in battery-backed RAM (remembered after you issue a RESET command or cycle power to the Gem6K product), all subsequent program definitions and downloads will be scaled correctly.
>
> **RESTRICTIONS**: Scaling commands are not allowed in a program. If there are scaling commands in a program, the drive will report an error message ("COMMAND NOT ALLOWED IN PROGRAM") when the program is downloaded. If you intend to upload a program with scaled motion parameters, be sure to use Motion Planner. Motion Planner automatically uploads the scaling parameters and places them at the beginning of the program file containing the uploaded program from the drive. This assures correct scaling when the program file is later downloaded.

Units of Measure without Scaling (Scaling is disabled (SCALEØ) as the factory default condition):

- Stepper axes: All distance values entered are in commanded counts (sometimes referred to as *motor steps*), and all acceleration, deceleration and velocity values entered are internally multiplied by the DRES command value.
- Servo axes:

	Units of Measure
Motion Attribute	**Encoder**
Accel/Decel	Revs/sec/sec *
Velocity	Revs/sec *
Distance	Counts **

* All accel/decel & velocity values are internally multiplied by the ERES command value.
** Distance is measured in the counts received from the feedback device.

SCALING EXAMPLES: Refer to page 16.

[SCAN] PLC Scan Runtime

Type	PLC Scan Program; Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	PLCP, SCANP, TSCAN

Product	Rev
GT6K	6.0
GV6K	6.0

Use the SCAN operand to assign the PLCP runtime (the duration it took the last PLCP program scan to complete) to a variable, or to make a comparison against another value. A compiled PLCP program is launched into Scan mode using the SCANP command. During each 2 ms update, the PLCP program is scanned until 30 segments have been executed. If the PLCP program takes more than 30 segments to complete, the program will be paused and then resumed at the next 2 ms system update. The SCAN value is in multiples of the 2 ms system update period.

Example:

```
   SCANP PLCP1   ; Start execution of compiled PLCP program 1 in Scan mode
   VARI1=SCAN    ; Assign the duration of the last scan to integer variable VARI1
```

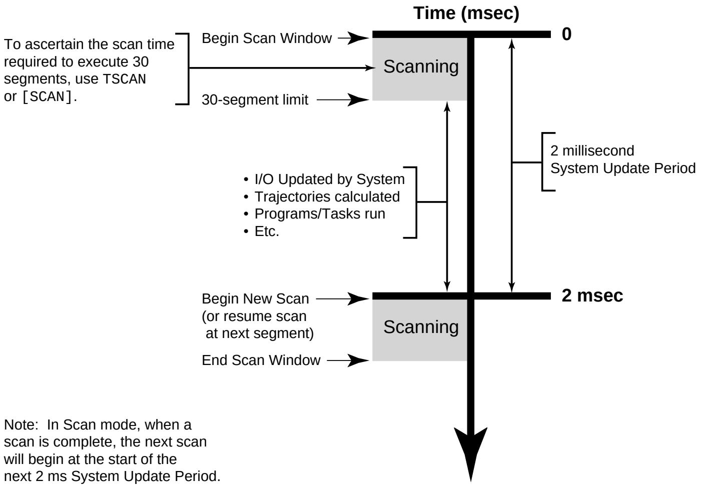
SCANP Scan Compiled PLCP Program

Type	`PLC Scan Program`
Syntax	`<a_><!>SCANP<t>`
Units	`t = text (name of the PLCP program, or CLR)`
Range	`t = PLCPi, where i is the number of the desired PLCP program, or t = CLR (to clear or stop the scan function)`
Default	`n/a`
Response	`n/a`
See Also	`PLCP, PCOMP, PRUN, PUCOMP, [ SC ], [ SCAN ], TSC, TSCAN`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `SCANP` command to initiate scanning a specific compiled PLCP program (`PLCPi`). For example, `SCANP PLCP3` initiates scanning the program defined as `PLCP3` (defined with `DEF PLCP3`) and compiled (`PCOMP PLCP3`).

The PLCP program is scanned/executed at the beginning of the 2 ms update period. The scan will stop after 30 segments have been executed and resume at the next 2 ms update. PLCP programs, when compiled, are comprised of a linked list of PLC segments. During a scan, each segment is counted until the total number of segments executed exceeds 30.


Time (msec)
0
To ascertain the scan time required to execute 30 segments, use TSCAN or [SCAN].
Begin Scan Window
Scanning
30-segment limit
2 millisecond System Update Period
• I/O Updated by System
• Trajectories calculated
• Programs/Tasks run
• Etc.
Begin New Scan (or resume scan at next segment)
2 msec
Scanning
End Scan Window

Note: In Scan mode, when a scan is complete, the next scan will begin at the start of the next 2 ms System Update Period.

If the 30-segment limit occurs while executing a multi-segment statement, then that statement will finish no matter how many segments it executes. For example, if 29 segments have executed, then the next segment will cause the scan to pause until the next 2 ms update. If that next statement is `VARI1=1PE`, which executes 2 segments, then `VARI1=1PE` will complete its operations before pausing the scan.

To check how much time (in 2 ms increments) the last scan took to complete, issue the `TSCAN` command or use the `SCAN` operator. For example, if the last PLCP program took 3 system updates (2 ms each) to scan, then `TSCAN` would report `*TSCAN6`, indicating that it took 6 ms to complete the scan. Each pass, if taking the same path through the conditional branches (`IF` statements), will always report the same `TSCAN` value.

Controller Status bit #3 is set when a PLCP program is being executed in Scan Mode. To check the controller status, use `SC`, `TSC`, or `TSCF`.

Launching programs external to the scan: Using the `EXE` command or the `PEXE` command, a scan program can launch another program in a specified task. `EXE` launches a standard, non-compiled program; `PEXE` launches a compiled program.

Stopping the scan: The scan program can be stopped in several ways:

- Send the `!K` command to the Gem6K.
- Clear the scan program by issuing a `SCANP CLR` command.
- Placing a `HALT` or `BREAK` command in the PLCP program:
  - `HALT` terminates the current PLCP program scan and kills the `SCANP` mode.
  - `BREAK` will end only the current scan loop. At the next 2-millsecond update, the scan will restart at the first line of the PLCP program.

Timing the PLCP program outputs: It is not possible to control where the PLCP program will pause if the scan takes more than the allowed time. This means that there can be a time lag of several update periods before the outputs, analog outputs, and/or variables affected by the PLCP program are updated. The order in which the scan takes place should be considered when creating PLCP programs to minimize the effects of such a lag. One way to avoid the lag is to create a binary variable as a temporary holding place for the desired output states. The last commands before the `END` statement of the PLCP program can set the outputs according to the final status of the variable, such that all output states are written at the same time, just as the scan completes. This method is demonstrated in the example program below.

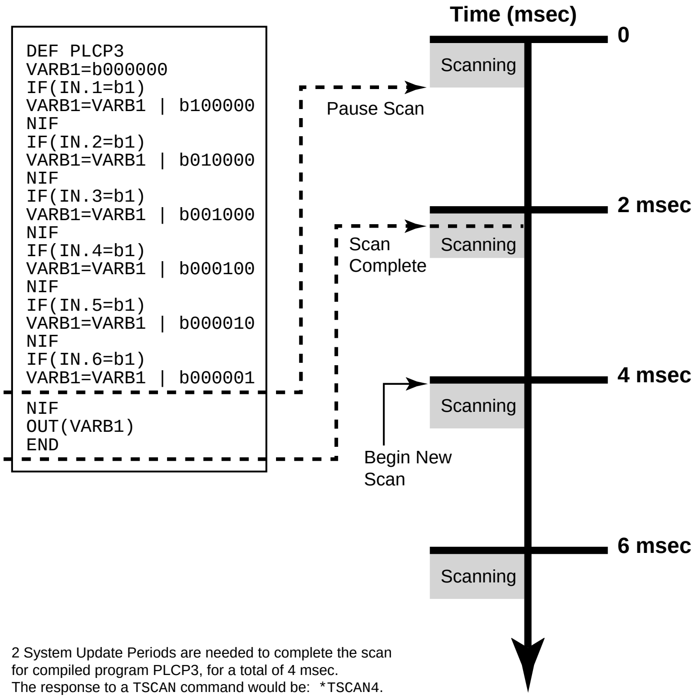
For more information on defining a PLC program, refer to the `PLCP` *command description.*

Example:

```
DEF PLCP3
; Binary states of outputs 1-6 are represented by VARB1 bit 1-6.
; Outputs 1-6 are set at the end of the program.
VARB1=b000000             ; Initialize binary variable 1
IF(IN.1=b1)               ; If Input 1 is ON, turn Output 1 ON
VARB1=VARB1 | b100000     ; Set binary bit for output 1 only to ON
NIF
IF(IN.2=b1)               ; If Input 2 is ON, turn Output 2 ON
VARB1=VARB1 | b010000     ; Set binary bit for output 2 only to ON
NIF
IF(IN.3=b1)               ; If Input 3 is ON, turn Output 3 ON
VARB1=VARB1 | b001000     ; Set binary bit for output 3 only to ON
NIF
IF(IN.4=b1)               ; If Input 4 is ON, turn Output 4 ON
VARB1=VARB1 | b000100     ; Set binary bit for output 4 only to ON
NIF
IF(IN.5=b1)               ; If Input 5 is ON, turn Output 5 ON
VARB1=VARB1 | b000010     ; Set binary bit for output 5 only to ON
NIF
IF(IN.6=b1)               ; If Input 6 is ON, turn Output 6 ON
VARB1=VARB1 | b000001     ; Set binary bit for output 6 only to ON
NIF
OUT(VARB1)                ; Turn on appropriate outputs
END

PCOMP PLCP3               ; Compile program PLCP3

SCANP PLCP3               ; Run compiled program PLCP3 in Scan mode
                          ; The diagram below illustrates the scan.
```



```
DEF PLCP3
VARB1=b000000
IF(IN.1=b1)
VARB1=VARB1 | b100000
NIF
IF(IN.2=b1)
VARB1=VARB1 | b010000
NIF
IF(IN.3=b1)
VARB1=VARB1 | b001000
NIF
IF(IN.4=b1)
VARB1=VARB1 | b000100
NIF
IF(IN.5=b1)
VARB1=VARB1 | b000010
NIF
IF(IN.6=b1)
VARB1=VARB1 | b000001
NIF
OUT(VARB1)
END
```

2 System Update Periods are needed to complete the scan
for compiled program PLCP3, for a total of 4 msec.
The response to a TSCAN command would be: `*TSCAN4`.

SCLA Acceleration Scale Factor

Type	`Scaling`
Syntax	`<a_><!>SCLA<i>`
Units	`i = counts/unit`
Range	`1 - 999,999`

Default	`4000`
	`(Servos auto-detect based on SFB: 4000 if encoder, 4096 if resolver)`

Response	`SCLA:   *SCLA4000`
See Also	`ANIRNG, FMAXA, SCALE, SCLD, SCLMAS, SCLV, SFB, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: All scaling settings (SCALE, SCLA, SCLD, SCLV and SCLMAS) are automatically saved in the Gem6K's battery-backed RAM.

When scaling is enabled (SCALE1), all point-to-point acceleration values (A, AA, HOMA, HOMAA, JOGA, JOGAA, JOYA, JOYAA) and deceleration values (AD, ADA, LHAD, LHADA, LSAD, LSADA, HOMAD, HOMADA, JOGAD, JOGADA, JOYAD, JOYADA) are multiplied by the Acceleration Scale Factor (SCLA) command. Since the units are counts/unit, and all the acceleration values are in units/sec/sec, all accelerations will thus be internally represented as counts/sec/sec.

Stepper axes: If scaling is enabled (SCALE1), the entered accel and decel values are internally multiplied by the acceleration scaling factor (SCLA) to convert user units/sec/sec to commanded counts/sec/sec (sometimes referred to as "motor steps"/sec/sec).

If scaling is disabled (SCALEØ), all accel and decel values are entered in commanded revs/sec/sec; these values are internally multiplied by the drive resolution (DRES) value to obtain accel and decel values in commanded counts/sec/sec for the motion trajectory calculations.

Servo axes: If scaling is enabled (SCALE1), the entered accel and decel values are internally multiplied by the acceleration scaling factor (SCLA) to convert user units/sec/sec to encoder counts/sec/sec.

If scaling is disabled (SCALEØ), all accel and decel values are entered in encoder revs/sec/sec; encoder values are internally multiplied by the encoder resolution (ERES) value to obtain accel and decel values in counts/sec/sec for the motion trajectory calculations.

As the acceleration scaling factor (SCLA) changes, the resolution of the acceleration and deceleration values and the number of positions to the right of the decimal point also change (see table at right). An acceleration value with greater resolution than allowed will be truncated. For example, if scaling is set to SCLA1Ø, the A9.9999 command would be truncated to A9.9.

SCLA **(counts/unit)**	**Decimal Places**
1 - 9	0
10 - 99	1
100 - 999	2
1000 - 9999	3
10000 - 99999	4
100000 - 999999	5

The following equations can help you determine the range of acceleration and deceleration values.

Axis Type	Min. Accel or Decel (resolution)	Max. Accel or Decel
GT6K Stepper	$\frac{0.001 * \mathrm{DRES}}{\mathrm{SCLA}}$	$\frac{999.9999 * \mathrm{DRES}}{\mathrm{SCLA}}$
GV6K Servo	Encoder Feedback: $\frac{0.001 * \mathrm{ERES}}{\mathrm{SCLA}}$	Encoder Feedback: $\frac{999.9999 * \mathrm{ERES}}{\mathrm{SCLA}}$

MORE ABOUT SCALING

For additional details on scaling, including scaling examples, refer to page 16.

SCLD Distance Scale Factor

Type	`Scaling`
Syntax	`<a_><!>SCLD<i>`
Units	`i = counts/unit`
Range	`1 - 999,999`
Default	`1`
Response	`SCLD:   *SCLD1`
See Also	`[ ANI ], D, [ FB ], FOLRN, FSHFD, [ PC ], [ PCC ], [ PCE ], [ PCMS ], [ PE ], [ PER ], PSET, [ PSHF ], [ PSLV ], REG, REGLOD, SCALE, SCLA, SCLV, SCLMAS, SFB, SMPER, TANI, TFB, TPC, TPCC, TPCE, TPCMS, TPE, TPER, TPSHF, TPSLV, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: All scaling settings (SCALE, SCLA, SCLD, SCLV and SCLMAS) are automatically saved in the Gem6K's battery-backed RAM.

If scaling is enabled (SCALE1), the Gem6K internally multiplies certain commands (see list below) by the Distance Scale Factor (SCLD) value.

Standard Motion

D
PESET
PSET
REG
REGLOD
SMPER
STRGTD
[ANI]
[FB]
[PC]
[PCC]
[PCE]
[PE]
[PER]

TANI
TFB
TPC
TPCC
TPCE
TPE
TPER

Following (Follower Axis only)

FOLRN
FSHFD
[PCMS]
[PSHF]
[PSLV]
TPCMS
TPSHF
TPSLV

Since the SCLD units are in terms of counts/unit, all distances will thus be internally represented in counts. For instance, if your distance scaling factor is 10000 (SCLD10000) and you enter a distance of 75 (D75), the actual distance moved will be 750,000 counts. (10000 x 75 = 750,000 counts)

This command is useful for allowing the user to specify distances in any unit. For example, if the user had a 25000 step/revolution drive and wanted distance units in terms of revolutions, then SCLD should be set to 25000, and scaling should be enabled (SCALE1).

As the distance scaling factor (SCLD) changes, the resolution of all distance commands and the number of positions to the right of the decimal point also change (see table below). A distance value with greater resolution than allowed will be truncated (e.g., if scaling is set to SCLD25ØØØ, the D1.99999 command would be truncated to D1.9999).

SCLD (counts/unit)	Distance Resolution (units)	Distance Range (units)	Decimal Places
1 - 9	1	0 - ±999,999,999	0
10 - 99	0.1	0.0 - ±99,999,999.9	1
100 - 999	0.01	0.00 - ±9,999,999.99	2
1000 - 9999	0.001	0.000 - ±999,999.999	3
10000 - 99999	0.0001	0.0000 - ±99,999.9999	4
100000 - 999999	0.00001	0.00000 - ±9999.99999	5

FRACTIONAL STEP TRUNCATION

If you are operating in the preset positioning mode (MCØ), when the distance scaling factor (SCLD) and the distance value are multiplied, a fraction of one step may possibly be left over. This fraction is truncated when the distance value is used in the move algorithm. This truncation error can accumulate over a period of time, when performing incremental moves continuously in the same direction. To eliminate this truncation problem, set the distance scale factor (SCLD) to 1, or a multiple of 10.

More about scaling, including scaling examples, refer to page 16.

SCLMAS Master Scale Factor

Type	Following; Scaling
Syntax	<a_><!>SCLMAS<i>
Units	i = scaling factor
Range	i = 1 - 999999
Default	1
Response	SCLMAS *SCLMAS1
See Also	FMCLEN, FMCP, FOLEN, FOLMD, FOLRD, FOLRN, GOWHEN, [PCMS], [PMAS], SCALE, SCLD, TPMAS, TPCMS

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: All scaling settings (SCALE, SCLA, SCLD, SCLV and SCLMAS) are automatically saved in the Gem6K's battery-backed RAM.

The SCLMAS command internally multiplies all Following master values by the specified scale factor value. Since the SCLMAS units are in terms of counts/unit, all distances will thus be internally represented in counts. For instance, if your master scaling factor is 10000 (SCLMAS10000) and you enter a master parameter of 75 (e.g., FOLMD75), the internal value will be 750,000 counts. (10000 x 75 =750,000)

NOTE: The SCLMAS command will not take effect unless scaling is enabled (SCALE1).

This command allows you to specify distances in any unit. For example, if you had a 4000 step/revolution encoder as the master and wanted master units in terms of revolutions, then SCLMAS should be set to 4000.

As the master scaling factor (SCLMAS) changes, the resolution of all master parameter values and the number of positions to the right of the decimal point also change (see table below). A master parameter value with greater resolution than allowed will be truncated (e.g., if scaling is set to SCLD4000, the FOLMD1.9999 command would be truncated to FOLMD1.999).

SCLMAS (counts/unit)	Master Resolution (units)	Master Range (units)	Decimal Places
1 - 9	1	0 - ±999,999,999	0
10 - 99	0.1	0.0 - ±99,999,999.9	1
100 - 999	0.01	0.00 - ±9,999,999.99	2
1000 - 9999	0.001	0.000 - ±999,999.999	3
10000 - 99999	0.0001	0.0000 - ±99,999.9999	4
100000 - 999999	0.00001	0.00000 - ±9999.99999	5

FRACTIONAL STEP TRUNCATION

If you are specifying master distance values (FOLMD), when the master scaling factor (SCLMAS) and the distance value are multiplied, a fraction of one count may possibly be left over. This fraction is truncated when the distance value is used in the move algorithm. This truncation error can accumulate when performing several moves over the specified master distance. To eliminate this truncation problem, set the master scale factor (SCLMAS) to 1, or a multiple of 10.

Example: (refer also to the FOLEN examples, and page 16)
The commands below are a subset of the set-up parameters for an application in which the axis is following the Master encoder input at a 1-to-1 ratio.

```
SCALE1          ; Enable parameter scaling
SCLA25000       ; Set follower acceleration scale factor to 25000
SCLV25000       ; Set follower velocity scale factor to 25000
SCLD25000       ; Set follower distance scale factor to 25000
SCLMAS4000      ; Set master scale factor to 4000
FOLMAS1         ; Axis 1 using Master encoder input as master
FOLRN1          ; Set follower-to-master Following ratio numerator to 1
                ; (scaled by SCLD)
FOLRD1          ; Set follower-to-master Following ratio denominator to 1.
                ; This sets the ratio to 1:1 (scaled the SCLMAS).
                ; The actual ratio in counts = 25000 to 4000 = 6.25 follower
                ; axis counts per master count.
```

SCLV Velocity Scale Factor

Type	`Scaling`
Syntax	`<a_><!>SCLV<i>`
Units	`i = counts/unit`
Range	`1 - 999,999`

Default	`4000`
	`(Servos auto-detect based on SFB: 4000 if encoder, 4096 if resolver)`

Response	`SCLV: *SCLV4000`
See Also	`ANIRNG, FMAXV, HOMV, HOMVF, JOGVH, JOGVL, JOYVH, JOYVL, SCALE, SCLA, SCLD, SFB, TSTAT, V`

Product	Rev
GT6K	6.0
GV6K	6.0

NOTE: All scaling settings (SCALE, SCLA, SCLD, SCLV and SCLMAS) are automatically saved in the Gem6K's battery-backed RAM.

When scaling is enabled (SCALE1), all velocity values (HOMV, HOMVF, JOGVH, JOGVL, JOYVH, JOYVL, V) are multiplied by the Velocity Scale Factor (SCLV) command. Since the units are counts/unit, all velocities will thus be internally represented in counts/sec.

Steppers: If scaling is enabled (SCALE1), the entered velocity values are internally multiplied by SCLV to convert user units/sec to commanded counts/sec.

If scaling is disabled (SCALEØ), all velocity values are entered in commanded revs/sec; these values are internally multiplied by the drive resolution (DRES) value to obtain velocity values in commanded counts/sec for the motion trajectory calculations.

Servos: If scaling is enabled (SCALE1), the entered velocity values are internally multiplied by SCLV to convert user units/sec to encoder counts/sec.

If scaling is disabled (SCALEØ), all velocity values are entered in encoder revs/sec; encoder values are internally multiplied by the encoder resolution (ERES) value to obtain velocity values in counts/sec for the motion trajectory calculations.

As the velocity scaling factor (SCLV) changes, the resolution of the velocity commands and the number of positions to the right of the decimal point also change (see table below). A velocity value with greater resolution than allowed will be truncated. For example, if scaling is set to SCLV1Ø, the V1.9999 command would be truncated to V1.9.

SCLV **(steps/unit)**	**Velocity Resolution (units/sec)**	**Decimal Places**
1 - 9	1	0
10 - 99	0.1	1
100 - 999	0.01	2
1000 - 9999	0.001	3
10000 - 99999	0.0001	4
100000 - 999999	0.00001	5

MORE ABOUT SCALING

For additional details on scaling, including scaling examples, refer to page 16.

[SEG] Number of Free Segment Buffers

		Product	Rev
Type	`Compiled Motion; Assignment or Comparison`	GT6K	6.0
Syntax	`See below`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`n/a`		
See Also	`MEMORY, [SS], TDIR, TMEM, TSEG, TSS`		

Use the `SEG` operator to assign the number of free memory segment buffers in *compiled memory* to a variable (`VAR`), or to make a comparison against another value. “Compiled memory” is the partition of the Gem6K’s non-volatile memory that stores compiled profiles & PLC programs. Compiled profiles/programs could be a *motion profile* (a series of `GOBUF` commands), or a *PLC program* (for PLC Scan Mode).

System status bit (see `TSSF`, `TSS`, and `SS`) 29 is set when the compiled memory is 75% full, and bit 30 is set if the compiled memory is 100% full.

Syntax: `VARn=SEG` where “`n`” is the variable number,
or `SEG` can be used in an expression such as `IF(SEG=1)`

SFB Select Servo Feedback Source

		Product	Rev
Type	`Drive Configuration`	GT6K	n/a
Syntax	`<a_>SFB<i>`	GV6K	6.0
Units	`i = feedback source identifier`		
Range	`i = 1 (encoder), or 4 (resolver)`	(applicable only to servo axes)	
Default	`1`		
Response	`SFB    *SFB1`		
See Also	`ERES, SRSET, TPE`		

> **AUTO-SETUP**: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to 1. You may have to manually set this parameter. (Refer to `DMTR` for a list of auto-configured commands.)

Use the `SFB` command to select the servo feedback source to be used. The options are:

Options	Physical Location	Measurement*	Resolution Command
1—Encoder	**MOTOR FEEDBACK** connector only	Encoder counts	ERES (default is 4000 counts/rev)
4—Resolver	**MOTOR FEEDBACK** connector (GV6K must have Resolver option)	Resolver counts	ERES (fixed at 4096 counts/rev)

***** With scaling enabled (`SCALE1`), feedback is scaled by the `SCLD` value.

SGAF Acceleration Feedforward Gain

Type	`Tuning`
Syntax	`<a_><!>SGAF<i>`
Units	`i = percent`
Range	`0 – 500`
Default	`100`
Response	`SGAF:    *SGAF100`
See Also	`DMTJ, LJRAT, SFB, SGENB, SGSET, SGVF, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

Use the `SGAF` command to set the gain for the acceleration feedforward term in the servo control algorithm. Introducing acceleration feedforward control improves *position tracking performance* when the system is commanded to accelerate or decelerate. Acceleration feedforward control does not affect the servo system's stability, nor does it have any effect at constant velocity.

The `SGAF` value is multiplied by the *commanded acceleration* calculated by the GV6K's move profile routine to produce an estimated torque command that is added to the servo control signal. The value is normalized to the current setting of both the motor inertia and load inertia ratio (`DMTJ` and `LJRAT`, respectively) as shown in the equation below.

$$\text{Estimated acceleration torque} = \underbrace{\text{DMTJ}\ \left(1+\text{LJRAT}\right)}_{\text{SGAF}\ \ \text{value}=100\%}\cdot\text{acceleration command}$$

Setting `SGAF` to 100% will theoretically produce zero following error during the acceleration and deceleration part of a move profile. This assumes that the drive or motor are not being current limited, the values for inertia are accurate and the models used for analysis are correct. You can adjust the value of `SGAF` from zero to as high as 5 times or 500% (`SGAF500`) of the theoretical value. For example, `SGAF200` sets the acceleration feedforward to 200% of theoretical value.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (`SGAF` is one of many servo gains): use `TGAIN`.
- Creating and invoking gain sets: see `SGSET`, `SGENB`, `TGAIN`, `TSGSET`.

SGENB Enable a Servo Gain Set

Type	`Tuning`
Syntax	`<a_><!>SGENB<i>`
Units	`i = gain set identification number (see SGSET command)`
Range	`1 – 3`
Default	`n/a`
Response	`n/a`
See Also	`SFB, SGAF, SGSET, SGVF, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`SGENB` allows you to enable one of the three gain sets. The gain sets are established with the `SGSET` command. A gain set can be enabled during motion at any specified point in the profile, or when not in motion. For example, you could use one set of gain parameters for the constant velocity portion of the profile, and when you approach the target position a different set of gains can be enabled.

Gain Set Elements:

- DIBW (current loop bandwidth)
- DMTLIM (torque/force limit)
- DMVLIM (velocity limit)
- DNOTAD (notch filter A depth)
- DNOTAF (notch filter A frequency)
- DNOTAQ (notch filter A quality factor)
- DNOTBD (notch filter B depth)
- DNOTBF (notch filter B frequency)
- DNOTBQ (notch filter A quality factor)
- DNOTLD (notch lead filter break frequency)
- DNOTLG (notch lag filter break frequency)
- DPBW (position loop bandwidth)
- LDAMP (load damping)
- LJRAT (load-to-rotor inertia ratio or load-to-force mass ratio)
- SGAF (acceleration feedforward gain)
- SGINTE (integrator enable)
- SGIRAT (current damping ratio)
- SGPRAT (position loop ratio)
- SGPSIG (velocity/position bandwidth ratio)
- SGVF (velocity feedforward gain)
- SGVRAT (velocity damping ratio)

For help with servo tuning procedures, refer to the *Hardware Installation Guide* or to the Motion Planner help system.

Example:

```
SGVF5           ; Set the velocity feedforward gain
SGAF1           ; Set the acceleration feedforward gain
SGSET3          ; Assign SGVF & SGAF gains to servo gain set #3
SGVF9           ; Set the velocity feedforward gain
SGAF18          ; Set the acceleration feedforward gain
SGSET1          ; Assign SGAF & SGVF gains to servo gain set #1
SGENB1          ; Enable gain set #1 to be in effect
TSGSET3         ; Display the value for all gains in gain set #3.
                ; (see sample response in TSGSET command description)
```

SGINTE Integrator Enable

Type	Tuning
Syntax	<a_><!>SGINTE<b>
Units	b = enable bit
Range	0 (disable) or 1 (enable) or 2 (enable only at end of move)
Default	1 (enabled)
Response	SGINTE: *SGINTE1
See Also	LDAMP, SGPRAT, SGVRAT, TGAIN, TSGSET

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The SGINTE command enables/disables the integrator in the velocity and position loops. When enabled (the default), the integrator progressively reduces the velocity error in proportion to how long the error has persisted. This helps to reduce the effects of load friction on performance. This effect is most noticeable when a constant velocity is commanded for a significant period of time.

Because position error causes the generation of a corrective velocity command, the integrator also reduces steady-state position error to zero, and will result in more accurate final positioning in applications where friction is present. If you use the SGINTE2 setting, the integrator will be disabled during the move, and will be enabled only at the end of the move.

In some situations, the integrator can reduce stability, especially if there is high stiction (non-linear friction). In this case, a limit-cycle can result. This will typically take the form of a square-wave oscillation around the final position. (Most other causes of instability result in nearly sinusoidal oscillations.) In such cases, disabling the integrator can improve performance.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGINTE is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

SGIRAT Current Damping Ratio

Type	Tuning
Syntax	<a_><!>SGIRAT<r>
Units	r = ratio
Range	0.500 to 2.000 : ±0.001
Default	1.000
Response	SGIRAT: *SGIRAT.775
See Also	DIBW, SGPSIG, SGPRAT, SGVRAT, TGAIN, TSGSET

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The SGIRAT command sets the damping ratio (Zeta) of the current loop. Higher values produce a more stable current loop response. Lower values provide faster current response but increase current overshoot.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGIRAT is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

SGPRAT Position Damping Ratio

Type	Tuning
Syntax	<a_><!>SGPRAT<r>
Units	r = ratio
Range	0.500 to 2.000 : ±0.001
Default	1.000
Response	SGPRAT: *SGPRAT.542
See Also	DPBW, LDAMP, LJRAT, SGIRAT, SGPSIG, SGVRAT, TGAIN, TSGSET

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The SGPRAT command sets the damping ratio (Zeta) of the position loop. Higher values produce a more stable position loop. Lower values provide faster position response but increase position overshoot.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGPRAT is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

SGPSIG Velocity/Position Bandwidth Ratio

Type	Tuning
Syntax	<a_><!>SGPSIG<r>
Units	r = ratio
Range	0.100 to 2.000 : ±0.001
Default	1.000
Response	SGPSIG: *SGPSIG1.250
See Also	DMODE, DPBW, SGIRAT, SGPRAT, SGVRAT, TGAIN, TSGSET

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The SGPSIG command sets the ratio (frequency spread) between the internal velocity loop bandwidth and the position loop bandwidth (DPBW). When operating in one of the position modes (see list below), the velocity loop bandwidth will track position loop bandwidth adjustments, with the ratio set by SGPSIG.

Position modes are DMODE12 and DMODE17 (see DMODE for descriptions).

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGPSIG is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

SGSET Save a Servo Gain Set

Type	`Tuning`
Syntax	`<a_><!>SGSET<i>`
Units	`i = gain set identification number`
Range	`1-3`
Default	`n/a`
Response	`n/a`
See Also	`SFB, SGAF, SGENB, SGVF, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `SGSET` command saves the presently active gain values (see list below) as a set of gains. Up to three sets of gains can be saved. Any gain set can be displayed using the `TSGSET` command. To report the presently active gain values, enter the `TGAIN` command.

Any gain set can be enabled with the `SGENB` command during motion at any specified point in the profile, or when not in motion. For example, you could use one set of gain parameters for the constant velocity portion of the profile, and when you approach the target position a different set of gains can be enabled.

Gain Set Elements:

- `DIBW` (current loop bandwidth)
- `DMTLIM` (torque/force limit)
- `DMVLIM` (velocity limit)
- `DNOTAD` (notch filter A depth)
- `DNOTAF` (notch filter A frequency)
- `DNOTAQ` (notch filter A quality factor)
- `DNOTBD` (notch filter B depth)
- `DNOTBF` (notch filter B frequency)
- `DNOTBQ` (notch filter A quality factor)
- `DNOTLD` (notch lead filter break frequency)
- `DNOTLG` (notch lag filter break frequency)
- `DPBW` (position loop bandwidth)
- `LDAMP` (load damping)
- `LJRAT` (load-to-rotor inertia ratio or load-to-force mass ratio)
- `SGAF` (acceleration feedforward gain)
- `SGINTE` (integrator enable)
- `SGIRAT` (current damping ratio)
- `SGPRAT` (position loop ratio)
- `SGPSIG` (velocity/position bandwidth ratio)
- `SGVF` (velocity feedforward gain)
- `SGVRAT` (velocity damping ratio)

For help with servo tuning procedures, refer to the *Hardware Installation Guide* or to the Motion Planner help system.

Example:

```
SGVF5            ; Set the velocity feedforward gain
SGAF1            ; Set the acceleration feedforward gain
SGSET3           ; Assign SGVF & SGAF gains to servo gain set #3
SGVF9            ; Set the velocity feedforward gain
SGAF18           ; Set the acceleration feedforward gain
SGSET1           ; Assign SGAF & SGVF gains to servo gain set #1
SGENB1           ; Enable gain set #1 to be in effect
TSGSET3          ; Display the value for all gains in gain set #3.
                 ; (see sample response in TSGSET command description)
```

SGVF Velocity Feedforward Gain

Type	`Tuning`
Syntax	`<a_><!>SGVF<i>`
Units	`i = percent`
Range	`0 – 500`
Default	`100`
Response	`SGVF:    *SGVF100`
See Also	`DMTD, LDAMP, SFB, SGAF, SGENB, SGSET, TGAIN, TSGSET`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

Use the `SGVF` command to set the velocity feedforward gain. Velocity feedforward control improves *position tracking performance* when the system is commanded to move at constant velocity. The velocity tracking error is mainly attributed to viscous friction.

The `SGVF` value is multiplied by the *commanded velocity* calculated by the GV6K's move profile routine to produce an estimated torque command that gets added to the servo control signal. The value is normalized to the current setting of both the motor and load viscous damping terms (DMTD and LDAMP, respectively) as shown in the equation below.

$$\text{Estimated velocity torque} = \underbrace{(\text{DMTD} + \text{LDAMP})}_{\text{SGVF value}=100\%} \cdot \text{velocity command}$$

Setting SGVF to 100% will theoretically produce zero following error during the constant velocity portion of a move profile. This assumes that the drive or motor are not being current limited, the values for viscous damping are accurate and the models used for analysis are correct. You can adjust the value of SGVF from zero to as high as 5 times or 500% (SGVF500) of the theoretical value.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGVF is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

Example:

```
SGVF200          ; Set velocity feedforward to 200% of theoretical value
```

SGVRAT Velocity Damping Ratio

Type	Tuning
Syntax	<a_><!>SGVRAT<r>
Units	r = ratio
Range	0.500 to 2.000 : ±0.001
Default	1.000
Response	SGVRAT: *SGVRAT.224
See Also	LDAMP, LJRAT, SGIRAT, SGPSIG, SGPRAT, SGSET, TGAIN, TSGSET

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The SGVRAT command sets the damping ratio (Zeta) of the velocity loop. Higher values produce a more stable velocity loop. Lower values provide faster velocity response but increase velocity overshoot.

Working with servo gains.

- Servo tuning process: refer to the *Hardware Installation Guide* or to the Motion Planner help system.
- Check the values of all active gains (SGVRAT is one of many servo gains): use TGAIN.
- Creating and invoking gain sets: see SGSET, SGENB, TGAIN, TSGSET.

SHALL Hall Sensor Inversion

Type	Drive Configuration
Syntax	<a_><!>SHALL<i> (does not take effect until RESET, DRESET or cycle power)
Units	i = control option #
Range	0 (do not invert) 1 (invert)
Default	0
Response	SHALL: *SHALL0
See Also	THALL

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

NOTE: This command does not take effect until you cycle power to the drive, or issue a RESET or DRESET command.

Encoder Motors (with SFB1): The SHALL command controls the logic sense of the Hall sensors. To invert the sensors, use the SHALL1 command. To check the present value of the Hall sensors, use the THALL command.

For a complete description on how to troubleshoot Hall sensors, especially for non-Compumotor motors, refer to the *Hardware Installation Guide* section on using non-Compumotor motors.

Resolver Motors (with SFB4): If you use a resolver motor, SHALL is not applicable.

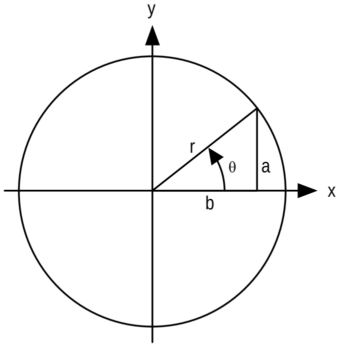
[SIN( )] Sine

Type	Operator (Trigonometric)
Syntax	... SIN(r) (See below)
Units	r = value in radian or degrees based on RADIAN command
Range	±17500.0000000 radians
Default	n/a
Response	n/a
See Also	[ATAN], [COS], [PI], RADIAN, [TAN], VAR

Product	Rev
GT6K	6.0
GV6K	6.0

This operator is used to calculate the sine of a number given in radians or degrees (see the RADIAN command). If "a" and "b" are coordinates of a point on a circle of radius "r", then the angle of measure "θ" can be defined by the equation: $\text{sine } \theta = \frac{a}{r}$

If a value is given in radians and a conversion is needed to degrees, use the formula: 360° = 2π radians.

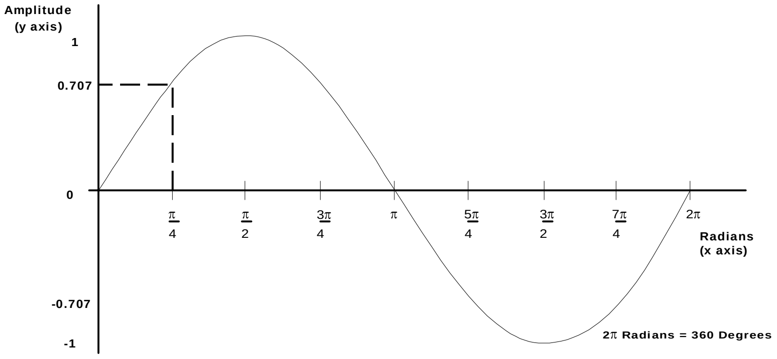


$$\sin \theta = \frac{a}{r}$$

$$\cos \theta = \frac{b}{r}$$

$$\tan \theta = \frac{a}{b}$$

The graph on the right shows the amplitude of **y** on the unit circle for different values of **x**.



Syntax: VARx=SIN(r) where "x" is the numeric variable number and "r" is a value provided in either degrees or radians based on the RADIAN command. Parentheses (( )) must be placed around the SIN operand. The result will be specified to 5 decimal places.

Example:

```
RADIAN1
VAR1=5 * SIN(PI/4)    ; Set variable 1 equal to 5 times the sine of Pi divided by 4
```

SINAMP Virtual Master Sine Wave Amplitude

Type	Following
Syntax	<a_><!>SINAMP<i>
Units	i = amplitude
Range	0-8192 (max. peak to peak is 16384)
Default	0
Response	SINAMP: *SINAMP0
See Also	FOLMAS, FVMACC, FVMFRQ, SINANG, SINGO

Product	Rev
GT6K	6.0
GV6K	6.0

Use the SINAMP command to define the amplitude of the internal sine wave when it has been designated as the virtual master. By designating the internal sine wave as a master, the user may produce a sinusoidally oscillating motion, with control of the phase, amplitude, and center of oscillation.

The SINAMP command allows a change in follower amplitude without changing the center of oscillation. It affects the sine wave immediately, without any built-in ramp in amplitude. If a gentle change in amplitude is desired, write a user program which repeatedly issues the command with small changes in value until the desired value is reached.

The peak-to-peak amplitude of a virtual master sine wave is twice the value specified with the SINAMP command.

SINANG Virtual Master Sine Wave Angle

Type	Following
Syntax	<a_><!>SINANG<r>
Units	degrees
Range	0.0-360.0
Default	0
Response	SINANG: *SINANG0
See Also	FOLMAS, FVMACC, FVMFRQ, SINAMP, SINGO

Product	Rev
GT6K	6.0
GV6K	6.0

The SINANG command is used to define the phase angle when the internal sine wave is designated as the virtual master. By designating the internal sine wave as a master, the user may produce a sinusoidally oscillating motion, with control of the phase, amplitude, and center of oscillation.

The internal sine wave uses the variable count frequency command (FVMFRQ) to increase or decrease the angle from which the sine is calculated. Each count of the count frequency changes the angle by one-tenth (0.1) of a degree. For example, a FVMFRQ value of 3600 would create an angular frequency of 3600 tenths of degrees per second, or 1 cycle per second. When used as a source for the sine wave, the maximum value for FVMFRQ is 144000. This results in a maximum of 40 Hz angular frequency. Frequencies higher than this are not allowed because they may be subject to aliasing.

SINGO Virtual Master - Initiate Internal Sine Wave

Type	Following
Syntax	<a_><!>SINGO<b>
Units	n/a
Range	b = 1 (restart sine wave from previous angle & amplitude) or 0 (stop sine wave)
Default	0
Response	SINGO *SINGO0
See Also	FOLMAS, FVMACC, FVMFRQ, SINAMP, SINANG

Product	Rev
GT6K	6.0
GV6K	6.0

The SINGO command is used to restart the internal sine wave from zero degrees. By designating the internal sine wave as a master, the user may produce a sinusoidally oscillating motion, with control of the phase, amplitude, and center of oscillation.

The SINGO command with a “0” parameter abruptly stops the sine wave, without changing its current magnitude. Using the SINGO command with a “1” parameter abruptly starts the sine wave, also without changing its current magnitude. To gently pause the follower output, change the FVMFRQ value to zero with a moderate FVMACC value; to resume the follower output, restore the original FVMFRQ value.

The SINGO command with a “1” parameter always starts at the previous angle, which may not be the desired start of oscillation. The SINANG command will instantly change the angle and corresponding sine of the angle. This represents an abrupt change in master position. If the follower axis is still following when this occurs, there will be an abrupt change in commanded follower position. To start the follower properly, move the follower to the desired start position first (using MC0, D, GO), then issue SINANG, then MC1, GO1, and finally SINGO.

SMPER Maximum Allowable Position Error

Type	Servo
Syntax	<a_><!>SMPER<r>
Units	r = feedback device counts (scalable with SCLD)
Range	0-200,000,000 (after conversion to steps) (0 = do not monitor position error condition)
Default	4000
Response	SMPER: *SMPER4000
See Also	[AS], [ER], ERES, ERROR, ERRORP, SCALE, SCLD, SFB, TANI, TAS, TER, TERRLG, TFB, TPC, TPE, TPER

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

SMPER determines the maximum position error (in feedback device counts) allowed before an error condition occurs. The position error is the difference between the commanded position and the actual position as read by the feedback device. When the position error exceeds the value entered by the SMPER command, an error condition is latched (see TAS or AS bit #23 and TER bit #12) and the drive faults (issues a shutdown – DRIVE0) The DRIVE1 command re-enables the drive, clears TAS bit #23 and TER bit #12, and sets the commanded position (TPC) equal to the actual feedback device position (TPE). Incremental devices will be zeroed. The position error is monitored once per system update period.

CAUTION: If the SMPER value is set to zero (SMPERØ), the position error condition is not monitored, allowing the position error to accumulate without causing a fault.

You can enable ERROR command bit #12 to continually check for the position error condition, and when it occurs to branch to a programmed response defined in the ERRORP program. You can check the status of this error condition with the TAS, AS, TER, and ER commands. You can check the actual position error with the TPER and PER commands.

If scaling is enabled (SCALE1), the SMPER value is multiplied by the SCLD value.

Example:

```
ERES4000                    ; Set feedback resolution to 4000 counts/rev
SMPER4000                   ; Set maximum allowable position error to 1 rev before
                            ; a fault condition will occur.
```

SMVER Maximum Allowable Velocity Error

Type	Drive Configuration
Syntax	<a_><!>SMVER<r>
Units	r = feedback device revs/sec (linear motors: see DMEPIT for linear/rotary conversion)
Range	0.000000 to 200.000000 : ±0.000001
Default	0.000000 (do not monitor velocity error condition)
Response	SMVER: *SMVER10.000000
See Also	DMEPIT, TASX, TVE, TVEL, TVELA

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

SMVER determines the maximum velocity error allowed before an error condition occurs. The velocity error is the difference between the commanded velocity (TVEL) and estimated actual velocity (TVELA). If the error exceeds this value, a fault will result in which the drive is shut down (DRIVE0) and TASX bit #9 is set. The DRIVE1 command re-enables the drive, clears TASX bit #9, and sets TVEL equal to TVELA.

You can check the actual velocity error with the TVE command.

If the SMVER value is set to zero (SMVER0), the velocity error condition is not monitored, allowing the velocity error to accumulate without causing a fault.

[SQRT()]   Square Root

Type	Operator (Mathematical)	**Product**	**Rev**
Syntax	See below	GT6K	6.0
Units	n/a	GV6K	6.0
Range	n/a		
Default	n/a		
Response	n/a		
See Also	[=], [+], [-], [*],[/], VAR		

This operator takes the square root of a value. The result, if multiplied by itself, will *approximately equal* the original value (the difference is attributed to round-off error). The resulting value has 3 decimal places.

Syntax: VARn=SQRT(expression) where “n” is the variable number, and the expression can be a number or a mathematical expression. The SQRT of a negative number is not allowed. Parentheses (()) must be placed around the SQRT operand.

Example:

```
VAR1=SQRT(25)    ; Set variable 1 equal to the square root of 25 (result = 5)
```

SRSET   Resolver Offset Angle

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_><!>SRSET<r>	GT6K	n/a
Units	r = angle in degrees	GV6K	6.0
Range	-180.0 to +180.0 : ±0.1 (no value = use auto align if in DMODE11)	(applicable only to servo axes)	
Default	0		
Response	SRSET: (returns the calculated value only if in DMODE11)		
See Also	DMODE, SFB, TSROFF		

AUTO-SETUP: This command is automatically set according to the Parker motor selected with the configuration utility in Motion Planner (see page 6). If you did not use the configuration utility or are not using a Parker Motor, this command is set to zero. (Refer to DMTR for a list of auto-configured commands.)

The SRSET value becomes the new resolver offset angle. When no value is specified, and the drive is in DMODE11 (feedback alignment mode), then a routine is executed to automatically set the resolver angle. **WARNING**: Motion (less than 1 rev) will occur when you initiate the auto alignment mode. To ascertain the actual offset angle, use the TSROFF command.

The SRSET value is saved in non-volatile memory.

[SS]   System Status

Type	Assignment or Comparison	**Product**	**Rev**
Syntax	See below	GT6K	6.0
Units	n/a	GV6K	6.0
Range	n/a		
Default	n/a		
Response	n/a		
See Also	IF, TCMDER, TRGFN, [TRIG], TTRIG, TSS, TSSF, TSTAT, VARB		

Use the SS operator to assign the system status bits to a binary variable (VARB), or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=<i%>SS` where "n" is the binary variable number, or `SS` can be used in an expression such as `IF(SS=b11Ø1)`, or `IF(SS=h7F)`. **NOTE**: If you are using multi-tasking, be aware that each task has its own system status register. If you wish to check the system status of an external task (a task other than the task that is executing the `SS` operator), then you must prefix the `SS` operator to address the targeted task (e.g., `2%SS` for the system status of Task 2).

The function of each system status bit is shown below.

BIT (Left to Right)	**Function** (1 = yes, Ø = no)	**BIT** (Left to Right)	**Function** (1 = yes, Ø = no)
1	System Ready	17	Loading Thumbwheel Data (TW)
2	RESERVED	18	External Program Select Mode (INSELP)
3	Executing a Program (see EXE)	19	Dwell in Progress (T command)
4	Immediate Command (set if last command was immediate)	20	Waiting for RP240 Data—DREAD or DREADF
5	In ASCII Mode	21	RP240 Connected — current PORT setting only
6	In Echo Mode — current PORT setting only	22	Non-volatile Memory Error
7	Defining a Program	23	GV6K: Servo data gathering transmission in progress: GT6K: Reserved
8	In Trace Mode	24	Suspended on Swap (see LOCK)
9	In Step Mode	25	RESERVED
10	In Translation Mode	26	Suspended on COM1 (see LOCK)
11	Command Error Occurred (bit is cleared when TCMDER is issued)	26	Suspended on COM2 (see LOCK)
12	Break Point Active (BP)	28	Program Pending (see EXE command)
13	Pause Active	29	Compiled memory is 75% full
14	Wait Active (WAIT)	30	Compiled memory is 100% full
15	Monitoring On Condition (ONCOND)	31 *	Compile operation failed (PCOMP) **
16	Waiting for Data (READ)	32	EXE Failed (see EXE command)

* Bit #31: failed PCOMP compile is cleared on power up, RESET, or after successful compile. Possible causes include:

- Errors in profile design (e.g., change direction while at non-zero velocity; distance & velocity equate to < 1 count per system update; preset move profile ends in non-zero velocity)
- Profile will cause a Following error (see TFSF, TFS, or FS command descriptions)
- Out of memory (see SS bit #30)
- Axis already in motion at the time of the PCOMP command
- Loop programming errors (e.g., no matching PLOOP or PLN; more than 4 embedded PLOOP/END loops)
- PLCP program contains invalid commands.

If it is desired to assign only one bit of the system status value to a binary variable, instead of all 32, the bit select (`.`) operator can be used. For example, `VARB1=SS.12` assigns system status bit 12 to binary variable 1: `*VARB1=XXXX_XXXX_XXXØ_XXXX_XXXX_XXXX_XXXX_XXXX`.

Example:

```
VARB1=SS             ; System status assigned to binary variable 1
IF(SS=b111011X11)    ; If the system status contains 1s in bit locations 1, 2, 3,
                     ; 5, 6, 8, & 9, and a 0 in bit location 4, do the IF
                     ; statement
IF(SS=h7F00)         ; If the system status contains 1s in bit locations 1, 2, 3,
                     ; 5, 6, 7, & 8, and 0s in every other bit location, do the IF
                     ; statement
NIF                  ; End of second IF statement
NIF                  ; End of first IF statement
```

STARTP Start-Up Program

Type	Program Definition
Syntax	<a_><!>STARTP<t>
Units	t = text (name of program)
Range	Text name of 6 characters or less
Default	n/a
Response	STARTP: *STARTP MAIN
See Also	DEF, RESET, SCALE

Product	Rev
GT6K	6.0
GV6K	6.0

The STARTP command assigns an existing program to be executed automatically when the Gem6K drive is powered up or reset. A reset may be invoked by sending the RESET command, or activating the hardware Reset input (pin 3 on the DRIVE I/O connector). For example, STARTP MAIN assigns program MAIN (previously defined with DEF MAIN) as the startup program.

If the program that is identified as the STARTP program is deleted with the DEL command, the STARTP assignment is automatically cleared. If you wish to prevent the STARTP program from being executed, without having to delete the assigned program, issue the STARTP CLR command.

Example:

```
DEL WakeUp       ; Delete program WakeUp
DEF WakeUp       ; Begin definition of program WakeUp
INFNC1-B         ; Assign input #1 as a BCD program select input
INFNC2-B         ; Assign input #2 as a BCD program select input
INFNC3-B         ; Assign input #3 as a BCD program select input
END              ; End program definition
STARTP WakeUp    ; Assign program WakeUp as the startup program
STARTP CLR       ; Clears the program WakeUp from its assignment as the
                 ; start-up program
DEL WakeUp       ; Deletes the program WakeUp and clears the STARTP command
                 ; (no power-up program will be executed)
```

STEP Single Step Mode Enable

Type	Program Debug Tool
Syntax	<a_><!>STEP<b>
Units	n/a
Range	b = 0 (disable), 1 (enable) or X (don't care)
Default	0
Response	STEP: *STEP0
See Also	[#], BP, [SS], TRACE, TRACEP, TRANS, TSS

Product	Rev
GT6K	6.0
GV6K	6.0

The STEP command enables single command step mode. Single step mode is used for stepping through a defined (DEF) program. To execute single step mode:

1. Define a program (DEF)
2. Enable single step mode (STEP1)
3. Enable trace mode (TRACE1)
4. Run the program (RUN)
5. Use the immediate pound (!#) to step through the program

Each step (!#) command will initiate the next command to be processed.

Example:

```
DEF tester       ; Begin definition of program named tester
V1               ; Set velocity to 1 unit/sec
                 ; (Note: This command will not be executed until a !# sign
                 ; is received.)
A10              ; Set acceleration to 10 units/sec/sec
D1               ; Set distance to 1 unit
GO1              ; Initiate motion
OUT11X1          ; Turn on outputs 1, 2, and 4, leave 3 unchanged
```

```
END              ; End program definition
STEP1            ; Enable single step mode
RUN tester       ; Execute program named tester
; **************************************************************************
; * At this point no action will occur because single step mode          *
; * has been enabled.  Here's how to execute commands:                    *
; *  !#2  (Execute 1st 2 commands in the program: V1 & A10)               *
; *  !#   (Execute 1 command: command to be executed is D1)               *
; *  !#1  (Execute 1 command: command to be executed is GO1)              *
; *  !#2  (Execute 2 commands: commands to be executed are OUT11X1 & END)  *
; **************************************************************************
```

STRGTD Target Distance Zone

Type	`Servo`
Syntax	`<a_><!>STRGTD<r>`
Units	`r = distance units (scalable with SCLD)`
Range	`0-999,999,999.99999`
Default	`50`
Response	`STRGTD:  *STRGTD50`
See Also	`[ AS ], SCLD, STRGTE, STRGTT, STRGTV, TAS, TSTLT`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`STRGTD` sets the target distance zone used in the Target Zone Settling Mode. The target distance zone is a range of positions around the desired endpoint that the load must be within before motion is considered complete. If scaling is enabled (`SCALE1`), the `STRGTD` value is multiplied by the distance scale factor (`SCLD`).

When using the Target Zone Settling Mode, the load's actual position and actual velocity must be within the *target zone* (that is, within the distance zone defined by `STRGTD` and within the velocity zone defined by `STRGTV`) before motion can be determined complete. Axis status bit #24 (see `TASF`, `TAS`, or `AS`) indicates when the axis is within the zone specified with `STRGTD` and `STRGTV`; this status bit is usable even if the Target Zone Mode is not enabled (`STRGTE0`).

If the load does not settle into the target zone before the timeout period set by `STRGTT`, the Gem6K drive detects an error (see `TASF`, `TAS`, or `AS` bit #25, and `TER` bit #11). If this error occurs, you can prevent subsequent command and/or move execution by enabling bit #11 in the `ERROR` command to continually check for this error condition, and when it occurs to branch to a programmed response defined in the `ERRORP` program. (Refer to the `ERRORP` command description for an example of using an error program.)

For more information on target zone operation, refer to the Programmer's Guide.

Example (see `STRGTE`):

STRGTE Enable Target Zone Settling Mode

Type	`Servo`
Syntax	`<a_><!>STRGTE<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`STRGTE:   *STRGTE0`
See Also	`COMEXC, ERROR, STRGTD, STRGTT, STRGTV, TAS, TER, TSTLT`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`STRGTE` enables or disables the Target Zone Settling Mode. When using the target zone settling criterion, the load's actual position (`TPE`) and actual velocity (`TVELA`) must be within the *target zone* (that is, within the position zone defined by `STRGTD` and within the velocity zone defined by `STRGTV`) before motion can be determined complete. Axis status bit #24 (see `TASF`, `TAS`, or `AS`) indicates when the axis is within the zone specified with STRGTD and STRGTV; this status bit is usable even if the Target Zone Mode is not enabled (STRGTE0).

If the load does not settle into the target zone before the timeout period set by STRGTT, the Gem6K drive detects an error (see TASF, TAS, or AS bit #25, and TER bit #11). If this error occurs, you can prevent subsequent command and/or move execution by enabling bit #11 in the ERROR command to continually check for this error condition, and when it occurs to branch to a programmed response defined in the ERRORP program. (Refer to the ERRORP command description for an example of using an error program.)

For more information on target zone operation, refer to the Programmer's Guide.

Example:

```
STRGTD5                 ; Sets the distance target zone to +/-5 units
STRGTV.01               ; Sets the velocity target zone to <= 0.01 units/sec
STRGTT10                ; Sets the timeout period to 10 milliseconds
STRGTE1                 ; Enables the target zone criteria
;
; Given these target zone commands, a move with a distance of, for example,
; 8,000 units (D8000) must end up between position 7,995 and 8,005 and settle
; to <=0.01 units/sec within 10 ms after the commanded profile is complete.
```

STRGTT Target Settling Timeout Period

Type	Servo
Syntax	<a_><!>STRGTT<i>
Units	i = milliseconds
Range	0-5000
Default	1000
Response	STRGTT: *STRGTT1000
See Also	[AS], [ER], ERROR, ERRORP, STRGTD, STRGTE, STRGTV, TAS, TER, TSTLT

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

STRGTT sets the maximum time allowed for the load to settle within the defined target zone; exceeding this time period will generate an error condition.This command is useful only if Target Zone Settling Mode is enabled with the STRGTE command.

When using the Target Zone Settling Mode, the load's actual position (TPE) and actual velocity (TVELA) must be within the *target zone* (that is, within the distance zone defined by STRGTD and within the velocity zone defined by STRGTV) before motion can be determined complete. Axis status bit #24 (see TASF, TAS, or AS) indicates when the axis is within the zone specified with STRGTD and STRGTV; this status bit is usable even if the Target Zone Mode is not enabled (STRGTE0).

If the load does not settle into the target zone before the timeout period set by STRGTT, the Gem6K drive detects an error (see TASF, TAS, or AS bit #25, and TER bit #11). If this error occurs, you can prevent subsequent command and/or move execution by enabling bit #11 in the ERROR command to continually check for this error condition, and when it occurs to branch to a programmed response defined in the ERRORP program. (Refer to the ERRORP command description for an example of using an error program.)

For more information on target zone operation, refer to the Programmer's Guide.

Example (see STRGTE):

STRGTV Target Velocity Zone

Type	`Servo`
Syntax	`<a_><!>STRGTV<r>`

Units	`r = units/sec (scalable by SCLV)`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`0.0000-200.0000`
Default	`1.00000`
Response	`STRGTV:   *STRGTV1.0000`
See Also	`[ AS ], DMEPIT, ERROR, ERRORP, SCLV, STRGTD, STRGTE, STRGTT, TAS, TER, TSTLT`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`STRGTV` sets the target velocity zone for use in the Target Zone Settling Mode. The target velocity zone is a velocity range that the load must be within before motion is considered complete. If scaling (`SCALE`) is enabled, the `STRGTV` value is multiplied by the velocity scale factor (`SCLV`).

When using the Target Zone Mode, the load's actual position and actual velocity must be within the *target zone* (that is, within the distance zone defined by `STRGTD` and less than or equal to the velocity defined by `STRGTV`) before motion can be determined complete. Axis status bit #24 (see `TASF`, `TAS`, or `AS`) indicates when the axis is within the zone specified with `STRGTD` and `STRGTV`; this bit is usable even if the Target Zone Mode is not enabled (`STRGTE0`).

If the load does not settle into the target zone before the timeout period set by `STRGTT`, the Gem6K drive detects an error (see `TASF`, `TAS`, or `AS` bit #25, and `TER` bit #11). If this error occurs, you can prevent subsequent command and/or move execution by enabling bit #11 in the `ERROR` command to continually check for this error condition, and when it occurs to branch to a programmed response defined in the `ERRORP` program. (Refer to the `ERRORP` command description for an example of using an error program.)

For more information on target zone operation, refer to the Programmer's Guide.

Example (see `STRGTE`):

[SWAP] Task Swap Assignment

Type	`Assignment or Comparison; Multi-Tasking`
Syntax	`See Below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`%, [ SS ], TTASK, TSWAP, TSKTRN, TSKAX, TSS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `SWAP` command allows a binary bit pattern indicating the tasks that are currently active to be assigned to a binary variable, or evaluated in a conditional statement such as `IF` or `WAIT`. This is useful for ascertaining which tasks have any activity. To ascertain exactly what activity a specific task has at a given time, use the system status commands (`SS` or `TSS`).

`SWAP`'s binary 10-bit pattern represents tasks 1-10, from left to right. A "`1`" indicates that the task is active, and a "`0`" indicates that the task is inactive. The "Task Supervisor", represented by task Ø, is always active and is therefore not included in the `SWAP` and `TSWAP` status.

Syntax: `VARBn=SWAP` where "`n`" is the binary variable number, or `SWAP` can be used in an expression such as `IF(SWAP=b1001000000)` or `IF(SWAP.3=b1)` or `IF(SWAP=h7F0)`.

To check the status of only one task, you may use the bit select (`.`) operator. For example, `VARB1=SWAP.2` assigns the binary state of Task2 to binary variable 1; or `WAIT(SWAP.2=b1)` establishes a wait condition that evaluates true when Task2 becomes active.

T Time Delay

Type	`Program Flow Control`
Syntax	`<a_><!>T<r>`
Units	`r = seconds`
Range	`0.001-999.999`
Default	`n/a`
Response	`n/a`
See Also	`GOWHEN, PS, [ SS ], [ TIM ], TTIM, TSS, WAIT`

Product	Rev
GT6K	6.0
GV6K	6.0

The Time Delay (`T`) command pauses command processing for **r** seconds before continuing command execution. Once the elapsed time has expired, the command after the `T` command will be executed.

The minimum resolution of the `T` command is 2 milliseconds (ms). Although you can enter time delays that are not multiples of 2 ms, the time delay will be rounded up to the next multiple of 2 ms. For example, `T.005` produces a 6 ms time delay.

`VARI` variables may be substituted for the `T` command value (e.g., `T(VARI5)`).

Example:

```
T5                ; Wait 5 seconds before executing TPE command
TPE               ; Transfer position of encoder to the terminal
```

TACC Transfer Commanded Acceleration

Type	`Transfer`
Syntax	`<a_><!>TACC`

Units	`revs/sec/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`n/a`
Default	`n/a`
Response	`TACC:     *TACC100`
See Also	`A, AD, DMEPIT, HOMA, LHAD, LSAD, TVEL`

Product	Rev
GT6K	6.0
GV6K	6.0

`TACC` reports the commanded acceleration.

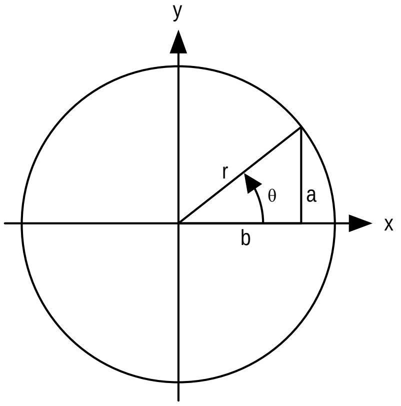
[TAN( )] Tangent

Type	Operator (Trigonometric)
Syntax	... TAN(r) (See below)
Units	r = radians or degrees depending on RADIAN command
Range	±17500.0000000 radians
Default	n/a
Response	n/a
See Also	[ATAN], [COS], [PI], RADIAN, [SIN], VAR

Product	Rev
GT6K	6.0
GV6K	6.0

The TAN operator is used to calculate the tangent of a number given in radians or degrees (see the RADIAN command). If "a" and "b" are coordinates of a point on a circle of radius "r", then the angle of measure "θ" can be defined by the equation:

$$\tan\theta = \frac{a}{b}$$



$$\sin\theta = \frac{a}{r}$$

$$\cos\theta = \frac{b}{r}$$

$$\tan\theta = \frac{a}{b}$$

If a value is given in radians and a conversion is needed to degrees, use the following formula: 360° = 2π radians.

Syntax: VARx=TAN(r), where x is the numeric variable number and r is a value in either radians or degrees depending on the RADIAN command. Parentheses (( )) must be placed around the TAN operand. The result will be specified to 5 decimal places.

Example:

```
VAR1=5 * TAN(PI/4)   ; Set variable 1 = 5 times the tangent of Pi divided by 4
```

TANI Transfer Analog Input Voltage

Type	Transfer
Syntax	<a_><!><@><B>TANI<.i>

Units	B = I/O brick
	i = location on I/O brick

Range	i = 1-32
Default	n/a
Response	1TANI *1TANIx,x,x,x,x,x,x,x +5.802,-4.663,-4.972, +6.023,+2.126,+2.223, ... x,x,x,x,x,x,x,x x,x,x,x,x,x,x,x 1TANI.10 *-4.663
See Also	ANIRNG, [ANI], [FB], TFB,

Product	Rev
GT6K	6.0
GV6K	6.0

The TANI command returns the voltage level present at the ANI analog inputs. The value reported with the TANI command is measured in volts.

If you omit the brick number, the value of the onboard analog input (ANI.1) will be reported. To determine the analog value from a specific input on an external I/O brick, use the bit select operator (.). For example, to check the voltage of the 2nd analog input on the 3rd SIM (I/O location 18) of I/O brick 2, use the 2TANI.18 command. To understand more about the location of I/O points on external I/O bricks, see page 8.

The TANI value is derived from the voltage applied to the corresponding analog input and ground. The analog value is determined from a 12-bit analog-to-digital converter (ADC). Under the default ANI voltage range, set with ANIRNG, the range of the ANI operator is -10.000VDC to +10.000VDC (see ANIRNG command for optional voltage ranges).

TANO Transfer Analog Output Value

Type	`Transfer`
Syntax	`<a_><!><@><B>TANO.i`

Units	`B = I/O brick number`
	`i = input/output location on brick “B”`

Range	`B = 1-8 (depending on I/O brick configuration)`
	`i = 1-32 (depending on I/O brick configuration)`

Default	`n/a`
Response	`1TANO.9: *1TANO.9=0.00`
See Also	`[ ANO ], ANO, TIO`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the TANO command to report the value of an analog output channel.

Example:

```
>1TANO.9    ; Report the commanded analog output voltage at bit 9 of I/O brick 1.
*1TANO.9=0.00
```

TAS Transfer Axis Status

Type	`Transfer`
Syntax	`<a_><!>TAS<.i>`
Units	`i = bit location for the axis (See below)`
Range	`1-32`
Default	`n/a`

Response	`TAS:     *TAS0000_0000_0000_0000_0000_0000_0000_0000`
	`bit 1 ─↑ ↑─ bit 32`
	`TAS.5:   *0 (bit 5 of status register)`

See Also	`[ AS ], [ ASX ], DSTALL, ESTALL, GOBUF, GOWHEN, HOM, JOG, JOY, MA, MC, SMPER, STRGTD, STRGTE, STRGTT, STRGTV, TASF, TASX, TSTAT`

Product	Rev
GT6K	6.0
GV6K	6.0

The TAS command returns the current status of the axis.

FULL-TEXT STATUS REPORT AVAILABLE

The TAS status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the TASF command description.

Bit # (left to right)	**Function** (1 = Yes; Ø = No)	**GT6K**	**GV6K**	**To Clear This Bit:**
1	Motion is <u>commanded</u>. (CAUTION: This bit could be cleared even while the motor is still “moving” – e.g., due to end-of-move settling.)	X	X	----------
2	Negative/positive-direction (1 = negative, Ø = positive).	X	X	----------
3	Accelerating (commanded acceleration only – TACC). This bit does not indicate commanded deceleration (bit is set to 0 during decel); to check if the axis is decelerating, the state of TAS bits 1, 3 and 4 should be: TAS1x00.	X	X	----------
4	At commanded velocity (TVEL).	X	X	----------
5	Home Successful (HOM) (YES/NO)	X	X	----------
6	Absolute/Incremental (MA) position mode selected. (1 = MA1, Ø = MA0)	X	X	----------
7	Continuous/Preset (MC) position mode selected. (1 = MC1, Ø = MC0)	X	X	----------
8	Jog Mode selected (JOG) (1 = JOG1, Ø = JOG0)	--	--	----------

9	Joystick Mode selected (JOY) (1 = JOY1, Ø = JOY0)	--	--	----------
10	RESERVED	--	--	----------
11	Position Maintenance Mode	X	--	----------
12	Stall Detected (ESTALL)	X	--	----------
13	Drive shut down. **NOTE**: If operating in the FLTDSB1 mode, a shutdown (DRIVE0 or open the Enable input interlock) will cause a "fault condition" – see note * below.	X	X	DRIVE1
14 *	Drive Faults occurred. Check the TASX response to identify which fault(s) occurred.	X	X	DRIVE1
15	Positive-direction hardware limit hit. This is <u>not</u> a "fault condition".	X	X	LHØ or GO in opposite direction.
16	Negative-direction hardware limit hit. This is <u>not</u> a "fault condition".	X	X	LHØ or GO in opposite direction.
17	Positive-direction Software Limit (LSPOS) Hit.	X	X	LSØ or GO in opposite direction.
18	Negative-direction Software Limit (LSNEG) Hit.	X	X	LSØ or GO in opposite direction.
19	Position Error	X	--	---------
20	RESERVED	--	--	---------
21	RESERVED	--	--	---------
22	RESERVED	--	--	---------
23 *	Position error exceeded (SMPER).	--	X	DRIVE1
24	In Target Zone (defined with STRGTD & STRGTV). This bit is set only after the *successful completion* of a move (if STRGTD and STRGTV criteria have been satisfied). This bit is usable even if the Target Zone mode is not enabled (STRGTE0).	--	X	GO1
25	Target Zone Timeout occurred (STRGTT).	--	X	GO1
26	Change in motion is suspended pending GOWHEN (YES/NO). This bit is cleared if the GOWHEN condition is true, or if STOP (!S) or KILL (!K or ^K) is executed	X	X	(see description)
27	RESERVED	--	--	---------
28	Registration move initiated by trigger since last GO command. This bit is cleared with the next GO command.	X	X	GO1
29	GOWHEN error occurred. The input state or the position relationship specified in a GOWHEN command was already true when the subsequent GO, FGADV, FSHFC or FSHFD command was executed.	X	X	---------
30	Pre-emptive (OTF) GO or Registration profile not possible	X	X	GO1
31	Compiled GOBUF profile is executing.	X	X	---------
32	RESERVED	--	--	---------

* **FAULT CONDITIONS**: If one or more of these conditions exist, the drive automatically disables (DRIVE0), it activates any output configured as a fault output, and it opens the dry contact relay (labeled "RELAY COM" and "RELAY N.O.") on the 4 pin removable connector.

TASF Transfer Axis Status (full-text report)

Type	Transfer
Syntax	<a_><!>TASF
Units	n/a
Range	n/a
Default	n/a
Response	TASF: (see example below)
See Also	[AS], [ASX], DSTALL, ESTALL, GOBUF, GOWHEN, HOM, JOG, JOY, MA, MC, SMPER, STRGTD, STRGTE, STRGTT, STRGTV, TAS, TASX, TSTAT

Product	**Rev**
GT6K	6.0
GV6K	6.0

The TASF command returns a text-based status report. This is an alternative to the binary report (TAS). Example TASF response:

```
*TASF                AXIS #
*                      1
*Moving                NO
*Direction NEG         NO
*Accelerating          NO
*At Velocity           NO
*
*Home successful       NO
*Mode Absolute         NO
*Mode Continuous       NO
*Jog Mode              NO
*
*Joystick Mode         NO
*RESERVED              NO
*Position Maint Mode   NO  (RESERVED for GV6K)
*Stall Detected        NO  (RESERVED for GV6K)
*
*Drive Shutdown        NO
*Drive Faulted         NO
*POS Hard Limit Hit    NO
*NEG Hard Limit Hit    NO
*
*POS Sftwr Limit Hit   NO
*NEG Sftwr Limit Hit   NO
*Within Deadband       NO  (RESERVED for GV6K)
*RESERVED              NO
*
*RESERVED              NO
*RESERVED              NO
*Pos Error Exceeded    NO  (RESERVED for GT6K)
*In Target Zone        YES (RESERVED for GT6K)
*
*Target Zone Timeout   NO  (RESERVED for GT6K)
*Gowhen is Pending     NO
*RESERVED              NO
*Reg Move Commanded    NO
*
*Gowhen Error          NO
*Preset Move Overshot  NO
*Executing Profile     NO
```

[TASK] Task Number Assignment

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`The TASK value is the number of the controlling task.`
Range	`0-10`
Default	`n/a`
Response	`n/a`
See Also	`%, TTASK, VAR, VARI`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TASK` operator allows the program itself to determine which task is executing it. The current task number `TASK` may be assigned to a numeric or integer variable or evaluated in a conditional statement, such as `IF` or `WAIT`.

Syntax: `VARn=TASK` or `VARIn=TASK` where “n” is the variable number; or `TASK` can be used in an expression, such as `IF(TASK=3)`.

The `TASK` operator allows a single program to be used as a subroutine called from programs running in all tasks, yet this routine could contain sections of statements which are executed by some tasks and not others. The example below demonstrates statements used to execute different `WAIT`-for-input conditions, depending on the task that is executing the program.

Example:

```
IF (TASK=1)      ; Check if this program is operating in task 1
WAIT(1IN.3=B1)   ; If in task 1, wait for input at location 3 on I/O brick 1
NIF

IF(TASK=2)       ; Check if this program is operating in task 2
WAIT(2IN.11=B1)  ; If in task 2, wait for input at location 11 on I/O brick 2
NIF
```

TASX Transfer Extended Axis Status

Type	`Transfer`
Syntax	`<a_><!>TASX<.i>`
Units	`i = bit location for the axis (See below)`
Range	`1-32`
Default	`n/a`
Response	see below
See Also	`[AS], [ASX],DCLRLR, DRIVE, DSTALL, [ER], TAS, TASXF, TER`

Response:

```
TASX:    *1TASX0000_0000_0000_0000_0000_0000_0000_0000
      bit 1 ─┘                                    └─ bit 32
TASX.5:  *0 (bit 5 of status register)
```

Product	Rev
GT6K	6.0
GV6K	6.0

The `TASX` command reports axis status conditions.

FULL-TEXT STATUS REPORT AVAILABLE

The TASX status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the TASXF command description.

Bit #	**Function** (1 = Yes; Ø = No)	GT6K	GV6K	To Clear This Status Bit:
1 *	Motor temperature fault (hardware switch in the motor).	X	X	DRIVE1
2 *	Low voltage fault	X	X	DRIVE1
3 *	Drive over-temperature fault (hardware thermal sensor in drive).	X	X	DRIVE1
4	RESERVED	--	--	----------
5 *	Resolver failure.	--	X	RESET or cycle power
6	RESERVED	--	--	----------
7 *	Motor configuration error occurred (checked on power up). Use TCS to ascertain the cause of the error. This is a fault condition which causes a drive shutdown (DRIVE0).	X	X	Resolve error condition (see TCS) and issue RESET or DRESET or cycle power
8	RESERVED	--	--	----------
9 *	Velocity error limit (SMVER value) has been exceeded.	--	X	DRIVE1
10 *	Bridge fault (hardware signal from the bridge)	X	X	RESET or DRESET or cycle power
11 *	Bridge temperature fault (this is a software control).	--	X	DRIVE1
12 *	Over-voltage.	--	X	RESET or DRESET or cycle power
13-16	RESERVED	--	--	----------
17	Stall detected (DSTALL or ESTALL)	X	--	DRIVE1
18	Override mode was invoked. (See DMVLIM command.)	X	X	DCLRLR or RESET or DRESET or cycle power
19	Bridge is in foldback mode.	--	X	DCLRLR or RESET or DRESET or cycle power
20	Power Dissipation Circuit has been active – not applicable to GV6K-U3, GV6K-U6, and GV6K-U12 drives	X	X	DCLRLR or RESET or cycle power
21 *	Bad Hall state detected. (Use THALL for diagnostics.)	--	X	RESET or cycle power
22 *	Unrecognized hardware — consult factory	X	X	RESET or cycle power
23 *	User Fault input activated (INFNCi-F)	X	X	Deactivate the input
24	Keep Alive active (User supplied +24VDC)	X	X	----------
25	Power dissipation circuit fault (excessive power dissipation)	X	X	DRIVE1
26	RESERVED	--	--	----------
27	RESERVED	--	--	----------
28	Motor configuration warning resulting from trying to run the motor beyond acceptable limits. Use TCS to ascertain the cause of the warning.	X	X	Resolve error condition (see TCS) and issue RESET or DRESET or cycle power
29 *	ORES failure (encoder output or step & direction output exceeds the maximum output frequency).	X	X	DRIVE1
30 *	Motor Thermal model fault.	--	X	Let the motor cool, then issue DRIVE1.
31	Commanded torque/force is at limit (TTRQ = DMTLIM).	--	X	DCLRLR or RESET or DRESET or cycle power
32	RESERVED	--	--	---------

* **FAULT CONDITIONS**: If one or more of these conditions exist, the drive automatically disables (DRIVE0), it activates any output configured as a fault output, and it opens the dry contact relay (labeled “RELAY COM” and “RELAY N.O.”) on the 4 pin removable connector.

TASXF Transfer Extended Axis Status, (full-text report)

		Product	Rev
Type	`Transfer`	GT6K	6.0
Syntax	`<a_><!>TASXF`	GV6K	6.0
Units	`n/a`		
Range	`n/a`		
Default	`n/a`		
Response	`TASXF: (see example below)`		
See Also	`[AS], [ASX], DSTALL, [ER], TAS, TASX, TER`		

The TASXF command returns a text-based status report. This is an alternative to the binary report (TASX). Example TASXF response:

```
*TASXF                  AXIS #
*                        1
*Motor Fault             NO
*Low-voltage             NO
*Over-temperature        NO
*RESERVED                NO
*
*Resolver Failure        NO  (RESERVED for GT6K)
*RESERVED                NO
*Motor Config Error      NO
*RESERVED                NO
*
*SMVER Exceeded          NO  (RESERVED for GT6K)
*Bridge Fault            NO
*Bridge Temp Fault       NO  (RESERVED for GT6K)
*Over-voltage            NO  (RESERVED for GT6K)
*
*RESERVED                NO
*RESERVED                NO
*RESERVED                NO
*RESERVED                NO
*
*Drive Stall Detected    NO  (RESERVED for GV6K)
*Override Mode Active    NO
*Bridge in Foldback      NO  (RESERVED for GT6K)
*Power Dissip Active     NO
*
*Bad Hall State          NO  (RESERVED for GT6K)
*Unrecognized Hardware   NO
*User Fault              NO
*Keep Alive Active       NO
*
*Power Dissipat Fault    NO
*RESERVED                NO
*RESERVED                NO
*Motor Config Warning    NO
*
*ORES Failure            NO
*Motor Thermal Fault     NO  (RESERVED for GT6K)
*Torque at Limit         NO  (RESERVED for GT6K)
*RESERVED                NO
```

TCMDER Transfer Command Error

		Product	Rev
Type	Transfer or Program Debug Tool	GT6K	6.0
Syntax	`<a_><!>TCMDER`	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	`TCMDER: *(incorrect command)`		
See Also	ERRBAD, [SS], TSS		

For program debugging, use TCMDER to transfer the command that the drive detects as an error. This is especially useful if you receive an error message when running or downloading a program, because it catches and remembers the **first** command that caused the error.

When the bad command is detected, the drive sends an error message to the screen, followed by the ERRBAD error prompt (?). To determine which command is in error, enter the TCMDER command and the drive will display the command, including all its command fields, if any.

Once a command error has occurred, the command and its fields are stored and system status bit #11 (reported in the TSSF, TSS, and SS commands) is set to 1. The status bit remains set until the TCMDER command is issued.

Example:

```
DEL badprg          ; Delete program called badprg
DEF badprg          ; Begin definition of program called badprg
MA1                 ; Select the absolute preset positioning mode
A25                 ; Set acceleration
AD11                ; Set deceleration
V5                  ; Set velocity
VAR1=0              ; Set variable #1 equal to zero
GO1                 ; Initiate move
IF(VAR1<)16         ; Mistyped IF statement—should be typed as: IF(VAR1<16)
VAR1=VAR1+1         ; If variable #1 is less than 16, increment the counter by 1
NIF                 ; End IF statement
END                 ; End programming of program called badprg
RUN badprg          ; Run the program called badprg
                    ; (this will cause an error --see comment box below)
; ***********************************************************************
; * 1. When you run the badprg program, you should see this error      *
; *    message on your screen: "*INCORRECT DATA"  (this error message  *
; *    indicates incorrect command syntax).                            *
; * 2. Type "TCMDER" and press enter.  This queries the drive to       *
; *    display the command that caused the error.  In this case, the   *
; *    response will be "*IF(VAR1<)16".                                *
; ***********************************************************************
```

TCS Transfer Configuration Status

Type	`Transfer`	**Product**	**Rev**
Syntax	`<a_><!>TCS`	GT6K	6.0
Units	`Fault/Warning code (see table below)`	GV6K	6.0
Range	`n/a`		
Default	`n/a`		
Response	`TCS:      *TCS46`		
See Also	`DMTR, TASX`		

TASX bit #7 is set when a motor configuration error occurs. TASX bit #28 is set when a motor configuration warning occurs. An error causes the drive to be shut down (DRIVE0). A warning means the drive attempted to control the motor outside of safe operating limits (in this case, the maximum safe configuration value is used). To help ascertain the cause of the error or warning, the TCS command reports any existing configuration error or warning conditions (refer to the table below).

NOTE: TCS reports only one code. If there is more than one error or warning condition present, **errors will overwrite warnings**. Therefore, to resolve multiple error or warning conditions:

1. Resolve the known error.
2. Cycle power to the drive, issue a RESET command, or activate the Reset input.
3. If another error condition presents itself (e.g., the drive will not enable), check for subsequent errors with the TCS command.

Code	Fault / Warning	Drive Type	Condition	Method to clear	TASX Bit Set
-32228	Fault	GV6K	ERES ≠ 4096 during SFB4	Change ERES to 4096 (ERES4096).	Bit 7
-32238	Fault	GV6K	Internal position loop gains ≤ 0.	Increase one or all of the following: DPBW, SGPRAT, SGPSIG. Recheck DMTKE, DMTJ, LJRAT, DMTD, LDAMP.	Bit 7
-32248	Fault	GV6K	Internal velocity loop gains ≤ 0.	Increase SGVRAT. Recheck DMTKE, DMTJ, LJRAT, DMTD, DVBW, LDAMP.	Bit 7
-32259	Fault	GV6K	Internal current loop gains < 0.	Increase DIBW and/or re-check DMTRES, DMTLMN, DMTLMX and SGIRAT.	Bit 7
-32367	Fault	GT6K	Drive resolution (DRES) is too low for the number of motor pole pairs.	Increase DRES value to be at least 4 x DPOLE.	Bit 7
-32710	Fault	Both	DMTJ = 0	Enter non zero value.	Bit 7
-32714	Fault	GV6K	DMTLMX = 0	Enter non zero value.	Bit 7
-32715	Fault	GV6K	DMTLMN = 0	Enter non zero value.	Bit 7
-32718	Fault	GV6K	DMTW = 0	Enter non zero value.	Bit 7
-32723	Fault	Both	DPOLE = 0	Enter non zero value.	Bit 7
-32725	Fault	Both	DMTRES = 0	Enter non zero value.	Bit 7
-32726	Fault	GT6K	DMTIND = 0	Enter non zero value.	Bit 7
-32727	Fault	GV6K	DMTKE = 0	Enter non zero value.	Bit 7
-32729	Fault	GT6K	DMTSTT = 0	Enter non zero value.	Bit 7
40	Warning	Both	DMTIC = 0	Enter non zero value.	Bit 28
46	Warning	GT6K	DIGNA = 0	Enter non zero value.	Bit 28
47	Warning	GT6K	DIGNB = 0	Enter non zero value.	Bit 28
48	Warning	GT6K	DIGNC = 0	Enter non zero value.	Bit 28
49	Warning	GT6K	DIGND = 0	Enter non zero value.	Bit 28
51	Warning	GV6K	DMTIP = 0	Enter non zero value.	Bit 28

Code	Fault / Warning	Drive Type	Condition	Method to clear	TASX **Bit Set**
400	Warning	Both	`DMTIC` is too high for power level of drive. The drive's continuous current rating is used instead.	Is drive sized properly? Lower `DMTIC`.	Bit 28
500	Warning	GV6K	`DMTLIM` is too high for the drive's peak current rating.	Lower `DMTLIM` and/or recheck `DMTKE`.	Bit 28
503	Warning	GV6K	`DMTIP` is set too high. Drive is set to maximum value.	Is drive sized properly? Lower `DMTIP`.	Bit 28
551	Warning	GV6K	Notch filter calculation error.	Check `DNOTAF`, `DNOTBF`, `DNOTAQ`, `DNOTBQ`.	Bit 28
560	Warning	GV6K	Lead frequency (`DNOTLD`) < 20 Hz. The last good value is used. (0 = disable)	Increase `DNOTLD`.	Bit 28
561	Warning	GV6K	Lead frequency (`DNOTLD`) > 4 times the lag frequency (`DNOTLG`). The last good value is used. (0 = disable)	Lower `DNOTLD` or turn off Lead Filter (`DNOTLD` = 0).	Bit 28

TDHRS Transfer Operating Hours

			Product	Rev
Type	`Transfer`			
Syntax	`<a_><!>TDHRS`		GT6K	6.0
Units	`Lifetime operating hours (resolution is ¼ or 0.25 hours)`		GV6K	6.0
Range	`Hour counter rolls over at 16384.00 hours`			
Default	`n/a`			
Response	`TDHRS:    *TDHRS16.5`			
See Also	`RESET, TERRLG`			

The `TDHRS` command reports the lifetime number of hours (to the nearest ¼ hour) that the Gem6K drive has had power applied.

NOTE: The hour count rolls over at 16,384.00 hours.

TDICNT Transfer Continuous Current Rating

			Product	Rev
Type	`Transfer`			
Syntax	`<a_><!>TDICNT`		GT6K	6.0
Units	`Amps peak`		GV6K	6.0
Range	`n/a`			
Default	`n/a`			
Response	`TDICNT: *TDICNT10`			
See Also	`DMTIC, DMTIP, TDIMAX`			

The `TDICNT` command reports the continuous current rating of the drive in amps peak. Note that most other current-related parameters (e.g., `DMTIC`, `DMTIP`) are in amps RMS.

TDIMAX Transfer Maximum Current Rating

Type	`Transfer`
Syntax	`<a_><!>TDIMAX`
Units	`Amps peak`
Range	`n/a`
Default	`n/a`
Response	`TDIMAX:   *TDIMAX10`
See Also	`DMTIP, DMTIP, TDICNT`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to
servo axes)

The `TDIMAX` command reports the maximum current rating of the drive in amps peak.

Note that most other current-related parameters (e.g., `DMTIC`, `DMTIP`) are in amps RMS.

TDIR Transfer Program Directory

Type	`Transfer`
Syntax	`<a_><!>TDIR`
Units	`n/a`
Range	`n/a`
Default	`n/a`

Response	`TDIR: *NO PROGRAMS DEFINED`
	`*150000 OF 150000 BYTES (100%) PROGRAM MEMORY REMAINING`
	`*1973 of 1973 SEGMENTS (100%) COMPILED MEMORY REMAINING`

See Also	`DEF, INFNC, MEMORY, PLCP, [ SEG ] TMEM, TSEG`

Product	**Rev**
GT6K	6.0
GV6K	6.0

`TDIR` returns the names of all the programs and subroutines defined with the `DEF` command, and the amount of memory each consumes. The format of the response is as follows:

```
*1 - PROG1 USES 345 BYTES
*2 - PROG2 USES 333 BYTES
*14322 OF 15ØØØØ BYTES (98%) PROGRAM MEMORY REMAINING
*1973 of 1973 SEGMENTS (1ØØ%) COMPILED MEMORY REMAINING
```

(In the above example, `PROG1` and `PROG2` are names of programs.)

The number in front of the program name is the number to use when defining specific inputs (`INFNC`) to correspond to a specific program (function `P` of `INFNC`), or when programs are selected via BCD (function `B` of `INFNC`).

If the program is intended to be a compiled profile and has been successfully compiled (`PCOMP`), then the line item for a compiled `GOBUF` program is amended with "`COMPILED AS A PATH`", and the line item for a compiled PLCP program is "`COMPILED AS A PLC PROGRAM`."

TDPTR Transfer Data Pointer Status

Type	`Data Storage`
Syntax	`<a_><!>TDPTR`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TDPTR    *TDPTR1,1,1`
See Also	`DATPTR, DATSIZ, [ DPTR ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TDPTR` command responds with a 3-integer status report (`i,i,i`). The first integer is the number of the current active data program (the program number specified with the last `DATSIZ` or `DATPTR` command). The second integer is the location number of the data element to which the data pointer is currently pointing. The third integer is the increment set with the last `DATPTR` command.

The `DPTR` command can be used to compare the current pointer location against another value or variable, or to assign the pointer location number to a variable.

Example

```
DATSIZ4,200        ; Create data program called DATP4 with 200 data elements
DATPTR4,20,2       ; Set the data pointer to data element #20 in DATP4 and set the
                   ; increment to 2 (DATP4 becomes the current active data program)
TDPTR              ; Response is *TDPTR4,20,2. Indicates that the data pointer is
                   ; pointing to data element #20 in data program #4 (DATP4),
                   ; and the increment setting is 2.
```

TDTEMP Transfer Drive Temperature

Type	`Transfer`
Syntax	`<a_><!>TDTEMP`
Units	`Degrees C`
Range	`n/a`
Default	`n/a`
Response	`TDTEMP:   *TDTEMP50`
See Also	`DMONAV, DMONBV, TERRLG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TDTEMP` reports the measured temperature (internal) of the drive.

TDVBUS Transfer Bus Voltage

Type	`Transfer`
Syntax	`<a_><!>TDVBUS`
Units	`Volts`
Range	`n/a`
Default	`n/a`
Response	`TDVBUS:   *TDVBUS170`
See Also	

Product	Rev
GT6K	6.0
GV6K	6.0

GT6K: `TDVBUS` reports the currently measured bus voltage of the drive.
GV6K: `TDVBUS` reports the nominal DC bus voltage (see calculation below) when the drive is first powered up.

$$169\text{V } (= \sqrt{2} * 120) \quad \text{or} \quad 339\text{V } (= \sqrt{2} * 240)$$

TER Transfer Error Status

		Product	Rev
Type	`Transfer`	GT6K	6.0
Syntax	`<a_><!><%>TER<.i>`	GV6K	6.0
Units	`i = specific error status bit (specific to the task)`		
Range	`1-32`		
Default	`n/a`		

Response
```
TER:      *TER0000_0000_0000_0000_0000_0000_0000_0000
      bit 1 ─┘                                   └── bit 32
TER.4:    *0 (bit 4 of error status register for Task 0)
```

See Also `[ ASX ], DSTALL, [ ER ], ERROR, ERRORP, ESTALL, GOWHEN, INFNC, LH, LIMFNC, LS, SMPER, STRGTT, TASX, TCMDER, TERF`

The `TER` command returns the status of the 32 error bits. There is one error status register per Task. The `TER` status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the `TERF` command description.

NOTES

- The specific error bits must be enabled by the Error Enable (`ERROR`) command before the `TER` command will provide the correct status of the error conditions.
- Multi-tasking: If you are using multi-tasking, be aware that each task has its own error status register. Therefore, to check a specific task's error status, you must prefix the `TER` command with the task identifier (e.g., `2%TER` to check error status for Task 2). If no task identifier is given, the `TER` response is for the task supervisor (Task 0).

The function of each error status bit is shown below.

Bit # (left to right)	**Function** (1 = Yes; Ø = No)	**GT6K**	**GV6K**	**To Clear This Bit:**
1	Stall detected: Functions when stall detection has been enabled (`ESTALL` or `DSTALL`), and Kill on Stall is enabled (`ESK1`).	X	--	`GO`
2	Hardware end-of-travel limit hit. This condition is detectable only when the limits are enabled (`LH3`).	X	X	`LHØ` or `GO` in opposite direction.
3	Software end-of-travel limit hit. This condition is detectable only when the limits are enabled (`LS3`).	X	X	`LSØ` or `GO` in opposite direction.
4	Drive fault: Detected only if the drive is enabled (`DRIVE`).	X	X	Varies with Fault – refer to `TASX`
5	RESERVED (see note at end of table; refer to `ERROR` command)	X	X	---------
6	Kill input activated. An input defined as a Kill input (`INFNCi-C`) was activated.	X	X	Deactivate input
7	User Fault input activated. Input must be assigned the user fault function (`INFNCi-F`).	X	X	Deactivate input
8	Stop input activated. An input defined as a Stop input (`INFNCi-D`) was activated.	X	X	Deactivate input
9	Enable input is not grounded.	X	X	Ground the Enable Input
10	Pre-emptive (on-the-fly) `GO` or registration move profile not possible.	X	X	Issue another `GO` command
11	Target Zone Settling Timeout Period (set with the `STRGTT` command) is exceeded.	--	X	`STRGTE0 : D0 : GO : STRGTE1`
12	Maximum position error (set with the `SMPER` command) is exceeded.	--	X	`DRIVE1`
13	RESERVED	--	--	---------
14	`GOWHEN` condition already true when a subsequent `GO, FSHFC,` or `FSHFD` is executed.	X	X	---------
15	RESERVED	--	--	RESERVED
16	Bad command detected	--	X	`TCMDER`

17	RESERVED	--	--	RESERVED
18	Cable to an expansion I/O brick is disconnected, or power to the I/O brick is lost. (Multi-tasking: This condition also kills all tasks.)	X	X	Reconnect I/O brick, issue `ERROR.18-0`, then `ERROR.18-1`
19	RESERVED	--	--	---------
20	RESERVED	--	--	---------
21	RESERVED	--	--	---------
22	RESERVED	--	--	---------
23	Ethernet Client connection error.	X	X	Clear error bit (`ERROR.23-0`), then re-establish Ethernet connection, and issue `ERROR.23-1`
24	Ethernet Client polling error.	X	X	Clear error bit (`ERROR.24-0`), then re-establish Ethernet connection, and issue `ERROR.24-1`
25-32	RESERVED	--	--	---------

Error Handling: Each `TER` status bit has a corresponding error-checking bit that can be enabled with the `ERROR` command. If an error-checking bit is enabled and the error occurs, the Gem6K drive will branch to the "error program," which is assigned with the `ERRORP` command. For additional details on handling errors, refer to the `ERROR` and `ERRORP` command descriptions, and the *Error Handling* section in the *Programmer's Guide*.

NOTE: When error bit 5 (Commanded Kill or Stop) of the `ERROR` command is enabled (`ERROR.5-1`), a Stop (`!S`) or a Kill (`!K` or `<ctrl>K`) command will cause the drive to GOSUB or GOTO to the error program (`ERRORP`). Within the error program the cause of the error will need to be determined. The `TER` command can be used to determine the cause of the error. If none of the error status bits are set, the cause of the error is a commanded kill or a commanded stop. The reason for not setting a bit on this error condition is that there is no way to clear the error condition upon leaving the error program.

TERF Transfer Error Status (full-text report)

Type	Transfer
Syntax	<a_><!><%>TERF
Units	n/a
Range	n/a
Default	n/a
Response	TERF: (see example below)
See Also	[ASX], DSTALL, [ER], ERROR, ERRORP, ESTALL, GOWHEN, INFNC, LH, LS, SMPER, STRGTT, TASX, TCMDER, TER

Product	Rev
GT6K	6.0
GV6K	6.0

The TERF command returns a text-based status report. This is an alternative to the binary report (TER). Example TERF response:

```
*TERF
*Stall Detected      NO
*Hard Limit Hit      NO
*Soft Limit Hit      NO
*Drive Fault Active  NO
*
*RESERVED            NO
*Kill Input Active   NO
*User Fault Input    NO
*Stop Input Asserted NO
*
*Enable Input Open   NO
*Profile Impossible  NO
*Target Zone Timeout NO
*Max Position Error  NO
*
*RESERVED            NO
*GOWHEN cond true    NO
*RESERVED            NO
*Bad command         NO
*
*RESERVED            NO
*I/O Brick Failure   NO
*RESERVED            NO
*RESERVED            NO
*
*RESERVED            NO
*RESERVED            NO
*Client Connect Err  NO
*Client Polling Err  NO
```

TERRLG Transfer Error Log

Type	Transfer
Syntax	<a_><!>TERRLG
Units	n/a
Range	n/a
Default	n/a
Response	TERRLG: *TAS0000_0000_0000_0000_0000_0000_0000_0000 *TASX0000_0000_0000_0000_0000_0000_0000_0000 *TDHRS104.5 *TDTEMP45 *TMTEMP100
See Also	CERRLG, ERRORL, TAS, TASX, TDHRS, TDTEMP, TMTEMP

Product	Rev
GT6K	6.0
GV6K	6.0

The error log is updated every time an event occurs, as selected by the ERRORL command. The TERRLG command displays the last ten error conditions, most recent at the top, which the drive has experienced, as recorded in these status registers:

- TAS (axis status binary report)
- TASX (extended axis status binary report)
- TDHRS (number of lifetime hours the drive has been powered)
- TDTEMP (temperature of the drive in degrees centigrade)
- TMTEMP (temperature of the motor in degrees centigrade – GV6K only)

NOTE: After an error event occurs and the drive updates the error log, bits may still be recorded in TAS or TASX for another 120 milliseconds. To find all possible causes of an error event, examine TAS and TASX in addition to viewing the error log.

The CERRLG command erases the stored contents of the error log. Clearing the error log is a helpful diagnostic tool; it allows you to start the diagnostic process when the error log is in a known state so that you can check the error log in response to subsequent events.

NOTE: TERRLG may not be stored in a program.

TEX Transfer Program Execution Status

Type	Transfer
Syntax	<a_><!><%>TEX
Units	n/a
Range	n/a
Default	n/a
Response	!TEX: *PROGRAM NOT EXECUTING
See Also	DEF

Product	Rev
GT6K	6.0
GV6K	6.0

The TEX command reports the status of any programs in progress (in the specified task). If using multi-tasking, you must prefix the TEX with the task you want to check (e.g., 2%TEX).

If the program PAUL was in progress (in task 0), and within that program a loop was in progress, the response to !TEX could look like the following: *PROGRAM=PAUL COMMAND=LN LOOP COUNT=12

TFB Transfer Position of Selected Feedback Device

Type	`Transfer`
Syntax	`<a_><!>TFB`
Units	`Response is position of the selected feedback device`
Range	`n/a`
Default	`n/a`
Response	`TFB    *TFB+0`
See Also	`[ FB ], [ PE ], PSET, SCALE, SCLD, SFB, TPCE, TPE`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

Use the `TFB` command to return the value of the feedback source selected with the `SFB` command. If you do not change the default `SFB` selection, the response will indicate the encoder position.

If scaling is **not** enabled, the position values returned will be counts. If scaling is enabled (`SCALE1`), the values will be scaled by the `SCLD` value.

If you issue a `PSET` command, the feedback device position value will be offset by the `PSET` command value.

Example:

```
SFB1          ; Select encoder feedback
TFB           ; Report encoder's position.
              ; Sample response is *TFB2.436
```

TFS Transfer Following Status

Type	`Following; Transfer`
Syntax	`<a_><!>TFS`
Units	`n/a`
Range	`n/a`
Default	`n/a`

Product	Rev
GT6K	6.0
GV6K	6.0

Response

```
TFS       *TFS0000_0000_0000_0000_0000_0000_0000_0000
      bit 1 ─┘                                       └─ bit 32
```

See Also `FGADV, FMAXA, FMAXV, FMCLEN, FMCP, FOLEN, FOLMAS, FPPEN, [ FS ], FSHFC, FSHFD, MC, [ NMCY ], [ PMAS ], TFSF`

The `TFS` command returns the current Following status. The response for `TFS` is as follows**:**

FULL-TEXT STATUS REPORT AVAILABLE

The `TFS` status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the `TFSF` command description.

Bit Assignment (left to right)	**Function** (YES = 1; NO = Ø)	
1	Follower in Ratio Move	A Following move is in progress.
2	Ratio is Negative	The current ratio is negative (i.e., the follower counts are counting in the opposite direction from the master counts).
3	Follower Ratio Changing	The follower is ramping from one ratio to another (including a ramp to or from zero ratio).
4	Follower At Ratio	The follower is at constant non-zero ratio.

Bits 1-4 indicate the status of Following motion. They mimic the meaning and organization of Axis Status (TAS & AS) bits 1-4, except that each bit indicates the current state of the ratio, rather than the current state of the velocity.

* 5	`FOLMAS` Active	A master is specified with the `FOLMAS` command.

* 6	FOLEN Active	Following has been enabled with the FOLEN command.
* 7	Master is Moving	The specified master is currently in motion.
8	Master Dir Neg	The current master direction is negative. (bit must be cleared to allow Following move in preset mode–MCØ).

Bits 5-8 indicate the status required for Following motion (i.e., a master must be assigned, Following must be enabled, the master must be moving, and for many features, the master direction must be positive).

Unless the master is a commanded position of another axis, it is likely that minor vibration of the master will cause bits 7-8 to toggle on and off, even if the master is nominally “at rest”. These bits are meant primarily as a quick diagnosis for the absence of master motion, or master motion in the wrong direction. Many features require positive master counting to work properly.

9	OK to Shift	Conditions are valid to issue shift commands (FSHFD or FSHFC).
10	Shifting now	A shift move is in progress.
11	Shift is Continuous	An FSHFC-based shift move is in progress.
12	Shift Dir is Neg	The direction of the shift move in progress is negative.

Bits 9-12 indicate the shift status of the follower. Shifting is super-imposed motion, but if viewed alone, can have its own status. In other words, bits 10-12 describe only the shifting portion of motion.

13	Master Cyc Trig Pend	A master cycle restart is pending the occurrence of the specified trigger.
14	Mas Cyc Len Given	A non-zero master cycle length has been specified with the FMCLEN command.
15	Master Cyc Pos Neg	The current master cycle position (PMAS) is negative. This could be caused by a negative initial master cycle position (FMCP), or if the master is moving in the negative direction.
16	Master Cyc Num > 0	The master position (PMAS) has exceeded the master cycle length (FMCLEN) at least once, causing the master cycle number (NMCY) to increment.

Bits 13-16 indicate the status of master cycle counting. If a Following application is taking advantage of master cycle counting, these bits provide a quick summary of some important master cycle information.

17	Mas Pos Prediction On	Master position prediction has been enabled (FPPEN).
18	Mas Filtering On	A non-zero value for master position filtering (FFILT) is in effect.
19	RESERVED	
20	RESERVED	

Bits 17-18 indicate the status of master position measurement features.

21	RESERVED	
22	RESERVED	
23	OK to do FGADV move	OK to do Geared Advance move (master assigned with FOLMAS, Following enabled with FOLEN, and follower axis is either not moving, or moving at constant ratio in continuous mode).
24	FGADV move underway	Geared Advance move profile is in progress.

Bits 23-24 indicate the status of geared advance features.

25	RESERVED	
26	FMAXA/FMAXV limited	The present Following move profile is being limited by FMAXA or FMAXV.
27-32	RESERVED	

* All these conditions must be true before Following motion will occur.

TFSF Transfer Following Status (full-text report)

Type	`Following; Transfer`
Syntax	`<a_><!>TFSF`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TFSF:   (see example below)`
See Also	`FGADV, FMAXA, FMAXV, FMCLEN, FMCP, FOLEN, FOLMAS, FPPEN, [ FS ], FSHFC, FSHFD, MC, [ NMCY ], [ PMAS ], TFS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TFSF` command returns a text-based status report. This is an alternative to the binary report (`TFS`).

Example `TFSF` response:

```
*TFSF                    AXIS #
*                        1
*Follower in Ratio Move NO
*Ratio is Negative       NO
*Followr Ratio Changing NO
*Follower At Ratio       NO
*
*FOLMAS Active           NO
*FOLEN Active            NO
*Master is Moving        NO
*Master Dir Neg          NO
*
*OK to Shift             NO
*Shifting now            NO
*Shift is Continuous     NO
*Shift Dir is Neg        NO
*
*Master Cyc Trig Arm     NO
*Mas Cyc Len Given       NO
*Master Cyc Pos Neg      NO
*Master Cyc Num > 0      NO
*
*Pos Prediction On       YES
*Master Filtering On     NO
*Performing FRC move     NO
*RESERVED                NO
*
*Master Window given     NO
*Inside Master Window    NO
*OK to do FGADV move     NO
*FGADV move underway     NO
*
*RESERVED                NO
*FMAXA/FMAXV limited     NO
*RESERVED                NO
```

TGAIN Transfer Active Gains

Type	`Transfer`
Syntax	`<a_><!>TGAIN`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`(list of all gain values)`
See Also	`SGENB, SGSET, TSGSET, (see list below)`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

This command allows you to display the value of each of the gains presently in effect (see list below). Each time an individual gain is entered, the `TGAIN` register is updated accordingly. When a gain set is enabled with the `SGENB` command, the present value of each gain is set to the values saved in that particular gain set.

- `DIBW` (current loop bandwidth)
- `DMTLIM` (torque/force limit)
- `DMVLIM` (velocity limit)
- `DNOTAD` (notch filter A depth)
- `DNOTAF` (notch filter A frequency)
- `DNOTAQ` (notch filter A quality factor)
- `DNOTBD` (notch filter B depth)
- `DNOTBF` (notch filter B frequency)
- `DNOTBQ` (notch filter A quality factor)
- `DNOTLD` (notch lead filter break frequency)
- `DNOTLG` (notch lag filter break frequency)
- `DPBW` (position loop bandwidth)
- `LDAMP` (load damping)
- `LJRAT` (load-to-rotor inertia ratio or load-to-force mass ratio)
- `SGAF` (acceleration feedforward gain)
- `SGINTE` (integrator enable)
- `SGIRAT` (current damping ratio)
- `SGPRAT` (position loop ratio)
- `SGPSIG` (velocity/position bandwidth ratio)
- `SGVF` (velocity feedforward gain)
- `SGVRAT` (velocity damping ratio)

THALL Transfer Hall Sensor Values

Type	`Transfer`
Syntax	`<a_><!>THALL`
Units	`n/a`
Range	`1-6 (0 or 7 is a fault condition – see TASX bit #21)`
Default	`n/a`
Response	`THALL:    *THALL6`
See Also	`SHALL, TASX`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

Encoder Motors (with `SFB1`): The `THALL` command reports the present Hall sensor value. There are six distinct Hall states, from 1 to 6. Rotating the motor shaft clockwise, the Hall state order should be `6`, `2`, `3`, `1`, `5`, `4`, `6`, `2`, `3`, `1`, `5`, `4`, `6` (and so on).

`THALL` values `0` and `7` are invalid and will fault the drive and set `TASX` bit #21 (in case of this fault, check the Hall wiring or grounding/noise conditions).

For a complete description on how to troubleshoot Hall sensors, especially for non-Compumotor motors, refer to the *Hardware Installation Guide* section on using non-Compumotor motors.

Resolver Motors (with `SFB4`): If you use a resolver motor, `THALL` will always report a value of 7.

[TIM] Current Timer Value

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`Milliseconds`
Range	`Maximum count is 999,999,999 (approx. 11 days, 13 hours)`
Default	`n/a`
Response	`n/a`
See Also	`TIMINT, TIMST, TIMSTP, TTIM`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TIM` command is used to assign the timer value to a variable, or to make a comparison against another value. The value returned is in milliseconds.

Syntax: `VARx=<n%>TIM` where `x` is a numeric variable number, or `TIM` can be used in an expression such as `IF(TIM<2400)`. Multi-tasking: If addressing the timer of a specific task, include the `n%` prefix.

Example:

```
VAR1=TIM          ; Timer value is assigned to variable 1
IF(TIM<1000)      ; If timer value is < 1000 milliseconds, do the IF statement
VAR1=TIM + 10     ; Timer value plus 10 assigned to variable 1
NIF               ; End IF statement
```

TIMINT Timer Value to Cause Alarm Event

Type	`Timer; Alarm Event`
Syntax	`<a_><!>TIMINT<b>,<i>`
Units	`i = milliseconds`

Range	`b = 0 (reset and start) or 1 (stop)`
	`i = 0 - 999,999,999`

Default	`0,0`
Response	`TIMINT:  *TIMINT0,0`
See Also	`INTHW, [ TIM ], TIMST, TIMSTP, TTIM`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TIMINT` command sets the timer value upon which the Gem6K drive will trigger an Alarm Event. The time value at which the alarm event will occur is specified by the second field in the command.

NOTES

- To use `TIMINT`, you must first issue the `INTHW.21-1` command to enable checking for the alarm event.
- When using multi-tasking, this feature only works with the timer for Task zero.

The `TIMINT` command also determines if the timer is to be stopped when the value is reached, or if the timer is to be reset and started again. If the timer is to be stopped upon reaching the alarm value, a one should be specified for the first field. If the timer is to be reset and restarted upon reaching the alarm value, a zero should be specified for the first field. By specifying a zero in the first field, an alarm will occur repeatedly.

Example:

```
INTHW.21-1        ; Enable checking for the timer-driven alarm event
TIMINT1,10000     ; Trigger alarm once after 10000 ms, do not restart the timer
TIMST0            ; Reset and start timer
```

TIMST Start Timer

Type	Timer
Syntax	<a_><!>TIMST<b><r>

Units	b = Enable bit
	r = time (milliseconds) if b = 0, task # if b = 1

Range	b = 0 (reset and start) or 1 (start from previous TIMSTP)
	r = absolute time 0-999,999,999 if b = 0,
	or r = task # 0-10 if b = 1

Default	0
Response	TIMST: No response, acts as if TIMST1 command was issued
See Also	[TIM], TIMINT, TIMSTP, TTIM

Product	Rev
GT6K	6.0
GV6K	6.0

The TIMST command is used to start the timer.

- If TIMST0, you can start the timer at a specific time in milliseconds (e.g., TIMST0,500).
- If TIMST1, you can resume the timer (after stopping it with the TIMSTP command) with the value of the time of the specified task (e.g., TIMST1,3).

The timer resolution is 2 ms. The delay for executing TIMST and TIMSTP in combination is 4-6 ms.

If the timer is started and allowed to roll over the maximum timer count of 999,999,999 milliseconds (11 days, 13 hours, 46 minutes, 39.999 seconds), the timer will be stopped, and the value will be frozen at the maximum value.

Multi-Tasking: Each task has its own timer.

Example:

```
TIMST0          ; Reset and start timer
GO1             ; Initiate motion
TIMSTP          ; Stop timer
TTIM            ; Transfer time required for move
```

TIMSTP Stop Timer

Type	Timer
Syntax	<a_><!><%>TIMSTP
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	[TIM], TIMINT, TIMST, TTIM

Product	Rev
GT6K	6.0
GV6K	6.0

The TIMSTP command stops the timer. This command in conjunction with the start timer (TIMST) command, provides a timer that can be used to time internal or external events.

The timer resolution is 2 ms. The delay for executing TIMST and TIMSTP in combination is 4-6 ms.

Multi-Tasking: Each task has its own timer.

Example:

```
TIMST0          ; Reset and start timer
GO1             ; Initiate motion
TIMSTP          ; Stop timer
TTIM            ; Transfer time required for move
```

TIN Transfer Input Status

Type	`Transfer`
Syntax	`<a_><!><@><B>TIN<.i>`
Units	`i = input number on the specified I/O brick (B) — see page 8`
Range	`1-32 (dependent on I/O brick and options installed)`
Default	`n/a`

Response	`TIN:     *0000_0 (onboard inputs)`
	`1TIN     *0000_0000_0000_0000_0000_0000_0000_0000`
	`1TIN.4:  *1 (status of I/O point 4 on I/O brick 1)`

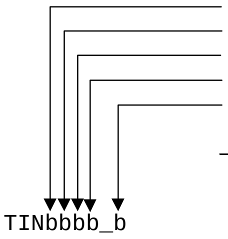
See Also	`IN, [ IN ], INFNC, INLVL, TINO, TLIM`

Product	Rev
GT6K	6.0
GV6K	6.0

The TIN command returns the status (active or inactive) of the digital inputs on the DRIVE I/O connector and the programmable inputs on external I/O bricks. The inputs are numbered 1 to *n* from left to right (*n* is the maximum number of I/O points on the I/O brick— refer to page 8 for details.)

If the status of a specific input is required, use the bit select operator (.). For example, 1TIN.9 reports the status of the 1st I/O point on the 2nd SIM of I/O brick 1.

TIN response for inputs on the DRIVE I/O connector (bits are numbered 1-5 from left to right):



Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

Input State Relationships (inputs on the DRIVE I/O connector):

Active Level	Sinking/Sourcing *	Switch	IN/TIN/TIO Report
INLVL0 (active low)	Sourcing	Closed (connected to ground)	1
INLVL0 (active low)	Sourcing	Open	0
INLVL1 (active high)	Sourcing	Closed (connected to ground)	0
INLVL1 (active high)	Sourcing	Open	1
INLVL0 (active low)	Sinking	Closed (connected to +V)	0
INLVL0 (active low)	Sinking	Open	1
INLVL1 (active high)	Sinking	Closed (connected to +V)	1
INLVL1 (active high)	Sinking	Open	0

* The inputs are factory configured to source current. If you wish the inputs to sink current, connect the pull-up terminals (pins 27 and 33) on the **DRIVE I/O** connector to ground (see the *Hardware Installation Guide* for wiring instructions). Pin 27 is the pull up for limit inputs 1-3, and pin 33 is the pull up for general-purpose inputs 1-5.

Input State Relationships (external SIM8-IN-EVM32 inputs on an EVM32 I/O brick):

Active Level *	Jumper Selection *	Switch	Voltage at Input	LED	IN/TIN/TIO Report
INLVL0 (active low)	Position 3 (sourcing)	Open	≥ 2/3 of V+	On	0
INLVL0 (active low)	Position 3 (sourcing)	Closed	< 1/3 of V+	Off	1
INLVL1 (active high)	Position 3 (sourcing)	Open	≥ 2/3 of V+	On	1
INLVL1 (active high)	Position 3 (sourcing)	Closed	< 1/3 of V+	Off	0
INLVL0 (active low)	Position 1 (sinking)	Open	< 1/3 of V+	Off	1
INLVL0 (active low)	Position 1 (sinking)	Closed	≥ 2/3 of V+	On	0
INLVL1 (active high)	Position 1 (sinking)	Open	< 1/3 of V+	Off	0
INLVL1 (active high)	Position 1 (sinking)	Closed	≥ 2/3 of V+	On	1

* Factory default: INLVL0 (active low) and jumper in position 3 (sourcing). Move jumper to position 1 for sinking.

TINO Transfer Other Input Status

Type	`Transfer`
Syntax	`<a_><!>TINO<.i>`
Units	`(bit #6 = ENABLE input. 1 = OK for motion)`
Range	`n/a`
Default	`n/a`

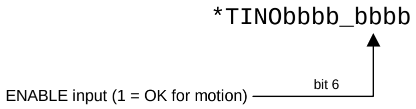
Response	`TINO:    *TINO0000_0100`
	`TINO.6:  *1 (status of input number 6 – ENABLE input)`

See Also	`[ INO ], TINOF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TINO` command returns the status of the Enable input (bit #6). This bit is set (`1`) when the input is grounded and motion is allowable. All other `TINO` status bits (1-5 and 7-8) are not used and are always cleared (`0`). The Enable input is located at pin #1 on the DRIVE I/O connector.

`TINO` response (bits are numbered 1-8 from left to right):



FULL-TEXT STATUS REPORT AVAILABLE

The `TINO` status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the `TINOF` command description.

TINOF Transfer Other Input Status (full-text report)

Type	`Transfer`
Syntax	`<a_><!>TINOF`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TINOF:   (see example below)`
See Also	`[ INO ], TINO`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TINOF` command returns a text-based status report. This is an alternative to the binary report (`TINO`).

Example response:

```
*TINOF
*Enable input OK    YES
```

TIO Transfer Current Expansion I/O Status

Type	`Transfer`
Syntax	`<a_><!><@><B>TIO`
Units	`B = I/O brick number`
Range	`1-8`
Default	`n/a`
Response	`(see example below)`
See Also	`IN, KIOEN, TANO, TIN, TINO, TOUT, TANI`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TIO` command displays the status of the current I/O configuration for the drive's expansion I/O bricks. If an I/O brick is not connected, it will not be included in the status report. Onboard I/O is not reported.

The I/O bricks are connected in series to the "EXPANSION I/O" connector (see the *Hardware Installation Guide* for instructions). The 1st I/O brick in the series (closest to the Gem6K drive) is `BRICK 1`. The next is `BRICK 2`, and so on.

Each I/O brick has 4 SIM slots and can hold from 1 to 4 I/O SIM modules. A SIM slot may hold a digital input SIM, a digital output SIM, an analog input SIM, or an analog output SIM. Each SIM provides 8 inputs or outputs; therefore, each I/O brick has 32 I/O addresses, referenced as absolute I/O point locations:

- SIM slot 1 = I/O points 1-8
- SIM slot 2 = I/O points 9-16
- SIM slot 3 = I/O points 17-24
- SIM slot 4 = I/O points 25-32

The TIO response for each I/O brick is separated into four lines, one for each SIM. I/O points 1-8 represent SIM #1, 9-16 represents SIM #2, 17-24 represents SIM #3, and 25-32 represents SIM #4. When digital outputs are detected, the report also indicates the type (NPN outputs are SINKING, PNP outputs are SOURCING). When digital inputs and digital or relay outputs are detected, TIO displays the present hardware state and programmed function (INFNC for inputs and OUTFNC for outputs). When analog inputs are detected, TIO reports the voltage present on each input. When analog outputs are detected, TIO reports the voltage commanded on each output.

Example TIO responses (in this example, 2 I/O bricks are connected to the drive):

```
>TIO
*BRICK 1:  SIM Type         Status      Function
      1-8: DIGITAL INPUTS   0000_0000   AAAA_AAAA
     9-16: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    17-24: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    25-32: ANALOG INPUTS    0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
*BRICK 2:  SIM Type         Status      Function
      1-8: DIGITAL OUTPUTS  0000_0000   AAAA_AAAA  -- SINKING
     9-16: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    17-24: NO SIM PRESENT
    25-32: DIGITAL OUTPUTS  0000_0000   AAAA_AAAA  -- SOURCING

>1TIO
*BRICK 1:  SIM Type         Status      Function
      1-8: DIGITAL INPUTS   0000_0000   AAAA_AAAA
     9-16: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    17-24: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    25-32: ANALOG INPUTS    0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000

>2TIO
*BRICK 2:  SIM Type         Status      Function
      1-8: DIGITAL OUTPUTS  0000_0000   AAAA_AAAA  -- SINKING
     9-16: DIGITAL INPUTS   0000_0000   AAAA_AAAA
    17-24: NO SIM PRESENT
    25-32: DIGITAL OUTPUTS  0000_0000   AAAA_AAAA  -- SOURCING
```

TLABEL Transfer Labels

Type	Transfer
Syntax	<a_><!>TLABEL
Units	n/a
Range	n/a
Default	n/a
Response	TLABEL: *NO LABELS DEFINED
See Also	$

Product	Rev
GT6K	6.0
GV6K	6.0

The TLABEL command returns the names of all the labels defined with the $ command.

The response to a TLABEL command if the labels call and open are defined in a program named prog1 is as follows:

```
*CALL DEFINED IN PROGRAM PROG1
*OPEN DEFINED IN PROGRAM PROG1
```

TLIM Transfer Limits

Type	`Transfer`
Syntax	`<!><a>TLIM<.i>`
Units	`i = limit input number`
Range	`System configuration dependant`
Default	`n/a`

Response	`TLIM:    *TLIM110`
	`TLIM.2:  *0 (status of negative-direction limit)`

See Also	`HOM, INDEB, INFNC, [ LIM ], LIMFNC, LIMLVL, TAS, TASF, TIN`

Product	Rev
GT6K	6.0
GV6K	6.0

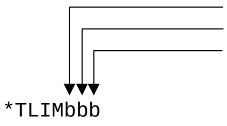
The `TLIM` command returns the current hardware state of the limit inputs located on the "DRIVE I/O" connector. This command reports the state of the limit inputs, regardless of their assigned function with the `LIMFNC` command. There are 3 limit inputs. To determine if an end-of-travel limit has been hit, refer to the `TAS` or `TASF` command response, bits 15 through 18.

This command does not report the status of onboard or external inputs configured as limit inputs with the `INFNC` command. For status on such inputs, refer to the `TIN` command.

The `TLIM` value is the debounced version of the limits status (debounced with the `ØINDEB` value). Axis status (`TAS`) bits 15 and 16 reports the non-debounced version of the end-of-travel limits.

`TLIM` response for limits on the DRIVE I/O connector (bits are numbered 1-3 from left to right):

Limit #	Pin #	GT6K & GV6K Function (`LIMFNC` default)
1	28	`LIMFNC1-R` (Positive end-of-travel limit)
2	29	`LIMFNC2-S` (Negative end-of-travel limit)
3	31	`LIMFNC3-T` (Home limit)



Input State Relationships:

Active Level Setting	Required Switch Type *	State	`LIM`/`TLIM` Report
Active low (`LIMLVL0`) *This is the default setting.*	End-of-travel limit: N.C. Home limit: N.O.	**Grounded** — sinking current (device driving the input is on)	1 (no limit hit)
		Not Grounded — not sinking current (device driving the input is off)	0 (FAULT: limit hit)
Active high (`LIMLVL1`)	End-of-travel limit: N.O. Home limit: N.C.	**Grounded** — sinking current (device driving the input is on)	0 (FAULT: limit hit)
		Not Grounded — not sinking current (device driving the input is off)	1 (no limit hit)

* Compumotor recommends that all end-of-travel limit switches be normally-closed, because with normally-closed limit switches the drive detects a limit fault condition (and stops or inhibits motion) when the switch contact is open or if the wiring to the switch is broken.

TMEM Transfer Memory Usage

Type	`Transfer`
Syntax	`<a_><!>TMEM`
Units	`n/a`
Range	`n/a`
Default	`n/a`

Response	`TMEM: *150000 OF 150000 BYTES (100%) PROGRAM MEMORY REMAINING`
	`      *1973 OF 1973 SEGMENTS (100%) COMPILED MEMORY REMAINING`

See Also	`DEF, MEMORY, PCOMP, [ SEG ], TDIR, TSEG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TMEM` command returns the amount of available memory for storing programs and for storing compiled profile path segments. A path segment is one element of a compiled profile path. The amount of memory available can be modified with the `MEMORY` command. As programs are defined (`DEF`) and paths are compiled (`PCOMP`), the amount of memory available decreases.

TMTEMP Transfer Motor Temperature

Type	`Transfer`
Syntax	`<a_><!>TMTEMP`
Units	`Degrees C`
Range	`n/a`
Default	`n/a`
Response	`TMTEMP:   *TMTEMP45`
See Also	`DMONAV, DMONBV, DMTRWC, DMTTCM, DMTTCW, TASX, TERRLG`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `TMTEMP` reports the predicted temperature of the motor winding for Parker motors. The temperature is estimated using the winding and motor time constants, the rated continuous current, and the winding thermal resistance. The motor will fault (reported with `TASX` bit 30) at an estimated winding temperature of 125°C, assuming the ambient temperature is 40°C.

If you are using a non-Parker motor, the `TMTEMP` value depends on parameters you supply for `DMTRWC`, `DMTTCM` and `DMTTCW`.

TNMCY Transfer Master Cycle Number

Type	`Following; Transfer`
Syntax	`<a_><!>TNMCY`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TNMCY    *TNMCY0`
See Also	`FMCLEN, FMCNEW, [ FS ], TRGFN, TFS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TNMCY` command displays the current master cycle number. The value represents the current cycle number, not the position of the master (or the follower). The master cycle number is set to zero when master cycle counting is restarted, and is incremented each time a master cycle finishes (i.e., rollover occurs). It will often correspond to the number of complete parts in a production run. This value may be used for subsequent decision making, or simply recording the cycle number corresponding to some other event.

The master must be assigned first (`FOLMAS` command) before this command will be useful.

For a complete discussion of master cycles, please refer to the Following chapter in the *Programmer's Guide.*

TNT Transfer Ethernet Status

Type	`Transfer`
Syntax	`<a_><!>TNT`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TNT:   (see sample response below)`
See Also	`NTADDR, NTFEN, TNTMAC`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TNT` command reports the current Ethernet conditions (see sample response below).

```
*GEM6K ETHERNET STATUS
*Ethernet enabled: NTFEN2
*GEM6K IP address: 172.20.34.156
*GEM6K Network Mask: 255.255.255.0
*GEM6K Ethernet address: 0-144-85-0-0-1 (decimal)
*GEM6K Ethernet address: 0-90-55-0-0-1 (hex)
*GEM6K Ethernet connected
```

How to interpret the status report

- **Ethernet enabled (`NTFEN`):** `NTFEN2` is recommended as the standard Ethernet communication mode, even if you are using a closed network and no file sharing. `NTFEN2` is especially helpful if you are using Windows NT, or Windows 95/98 with File Sharing and/or an open network. **NOTE**: When using `NTFEN2`, you must also follow the ARP -S Static Mapping procedure (refer to the instructions in the *Programmer's Guide*).
- **GEM6K IP address:**
  This is the IP address that you specified (`NTADDR` command) in the configuration process (refer to the *Programmer's Guide*)
- **GEM6K Network Mask:**
  This is the network mask that you specified (`NTMASK` command) in the configuration process.
- **GEM6K Ethernet address:**
  This is the Ethernet "MAC" address that is given to the Gem6K unit at the factory.
- **GEM6K Ethernet connected/not connected:**
  Ethernet is "Connected" if the Ethernet hardware connection is good and your PC is communicating to the Gem6K over a valid Communication Server/Motion Planner connection.

Error Status: If the Ethernet connection fails, the Gem6K will set error status bit #22 (see `ER`, `TER`, and `TERF`) if error-checking bit #22 is enabled with the `ERROR` command. Also, if this error occurs, the Gem6K will branch to the `ERRORP` program.

TNTMAC Transfer Ethernet Address

Type	`Transfer; Communications Interface`
Syntax	`<a_><!>TNTMAC`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TMAC: *0,144,85,0,0,1`
See Also	`NTADDR, NTFEN, NTMASK`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TNTMAC` command reports the Gem6K's Ethernet address.

TOUT Transfer Output Status

Type	`Transfer`
Syntax	`<a_><!><@><B>TOUT<.i>`
Units	`i = input number on the specified I/O brick (B) — see page 8`
Range	`1-32 (dependent on I/O brick and options installed)`
Default	`n/a`

Response	`TOUT:     *0000_000 (onboard outputs)`
	`1TOUT     *0000_0000_0000_0000_0000_0000_0000_0000`
	`1TOUT.4:  *1 (status of I/O point 4 on I/O brick 1)`

See Also	`OUT, OUTFNC, OUTLVL, TAS, TASX, TIN, TINO, TIO`

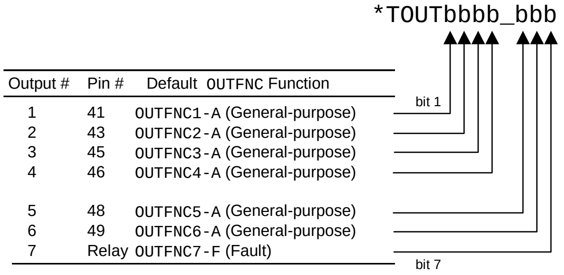
Product	Rev
GT6K	6.0
GV6K	6.0

The `TOUT` command returns the present status (active or inactive) of the outputs on the DRIVE I/O connector, the dry contact relay output (labeled "RELAY COM" and "RELAY N.O.") on the 4-pin removable connector, and the programmable outputs on external I/O bricks. The outputs are numbered 1 to *n* from left to right (*n* is the maximum number of I/O points on the I/O brick— refer to page 8 for details.)

If the status of a specific output is required, use the bit select operator (`.`). For example, `1TOUT.9` reports the status of the 1st I/O point on the 2nd SIM of I/O brick 1.

TOUT response for the outputs on the DRIVE I/O connector and the relay (bits are numbered 1-7 from left to right):

GT6K & GV6K:



Output #	Pin #	Default OUTFNC Function
1	41	OUTFNC1-A (General-purpose)
2	43	OUTFNC2-A (General-purpose)
3	45	OUTFNC3-A (General-purpose)
4	46	OUTFNC4-A (General-purpose)
5	48	OUTFNC5-A (General-purpose)
6	49	OUTFNC6-A (General-purpose)
7	Relay	OUTFNC7-F (Fault)

Output State Relationships (outputs on the DRIVE I/O connector):

OUTLVL Setting	OUT State *	Current	OUT/TOUT status
OUTLVL0 (default)	OUT1	Sinking current	1
OUTLVL0	OUT0	No current flow	0
OUTLVL1	OUT1	No current flow	1
OUTLVL1	OUT0	Sinking current	0

* The output is “active” when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

Output State Relationships (external outputs on an EVM32 I/O brick):

Output Type	OUTLVL Setting	OUT State *	Current	OUT/TOUT status	LED
NPN (sinking)	OUTLVL0 (default)	OUT1	Sinking current	1	ON
NPN	OUTLVL0 (default)	OUT0	No current flow	0	OFF
NPN	OUTLVL1	OUT1	No current flow	1	OFF
NPN	OUTLVL1	OUT0	Sinking current	0	ON
PNP (sourcing)	OUTLVL0	OUT1	No current flow	1	OFF
PNP	OUTLVL0	OUT0	Sourcing current	0	ON
PNP	OUTLVL1 (default)	OUT1	Sourcing current	1	ON
PNP	OUTLVL1 (default)	OUT0	No current flow	0	OFF

* The output is “active” when it is commanded by the OUT, OUTP, or POUT command (for example, OUTxx1 activates output #3).

TPC Transfer Position Commanded

		Product	Rev
Type	Transfer	GT6K	6.0
Syntax	<a_><!>TPC	GV6K	6.0
Units	Reported value represents distance units (scalable by SCLD)		
Range	Range of the reported value is ±2,147,483,648		
Default	n/a		
Response	TPC: *TPC+0		
See Also	DRES, ERES, [PC], [PCC], PSET, SCALE, SCLD, SMPER, TAS, TFB, TPCC, TPER		

Use the TPC command to display the *commanded position*. The TPC value is scaled by the distance scaling factor (SCLD) if scaling is enabled with the SCALE1 command.

If you issue a PSET command, the commanded position value will be offset by the PSET command value.

GT6K: The reported value is measured in commanded counts (“motor counts”).

GV6K: The reported TPC value is measured in feedback device counts (resolution set with ERES). The commanded position (TPC) and the actual position (TPE) are used in the position error calculation (TPC - TPE = TPER).

Example (GV6K only):

```
TPC                 ; Display the commanded position. Example is *TPC4000 (setpoint
                    ; displayed in counts)
TPE                 ; Display the actual position. Example is *TPE4004 (actual
                    ; position displayed in counts)
TPER                ; Display position error. Example is *TPER-4 (error displayed
                    ; in counts)
```

TPCC Transfer Captured Commanded Position

Type	`Transfer`
Syntax	`<a_><!>TPCCc`

Units	`c = trigger input letter (A, B or M)`
	`(Reported value is commanded counts, scalable by SCLD)`

Range	`n/a`
Default	`n/a`
Response	`TPCCA:   *TPCCA+0`
See Also	`ENCCNT, INFNC, [ PC ], [ PCC ], [ PCMS ], PSET, SCALE, SCLD, SFB, TFB, TPC, [ TRIG ], TRGLOT, TTRIG`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `TPCC` command to display the current captured commanded position, captured with the specific "trigger interrupt" input—A, B, or M.

General-purpose inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The commanded position can be captured only by an input that is defined as a "trigger interrupt" input with the `INFNCi-H` command (see `INFNC` for details). When a "trigger interrupt" input is activated, the commanded position is captured and the position is available through the use of the `PCC` operator and the `TPCC` display command.

GT6K: By default, the GT6K captures only the commanded position. However, if the drive has Encoder Capture Mode enabled with the `ENCCNT` command, only the encoder position is captured.

Position Capture Status, Longevity of Captured Position: Use the `TTRIG` and `TRIG` commands to ascertain if a trigger interrupt input has been activated. `TTRIG` displays the status as a binary report, and `TRIG` is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an `IF` statement). Once the captured commanded position value is displayed with the `TPCC` command, the `TTRIG`/`TRIG` status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The commanded position capture accuracy is ±1 count.

Scaling and Position Offset: If scaling is enabled (`SCALE1`), the commanded position is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled (`SCALEØ`), the value reported will be actual commanded counts. If you issue a `PSET` (establish absolute position reference) command, any previously captured commanded positions will be offset by the `PSET` command value.

Example:

```
TPCCA      ; Report the captured command position, which was captured
           ; when trigger A (TRG-A) was activated
TPCCB      ; Report captured command position, which was captured
           ; when trigger B (TRG-B) was activated
TPCCM      ; Report captured command position, which was captured
           ; when the master trigger (TRG-M) was activated
```

TPCE Transfer Position of Captured Encoder

Type	`Transfer`
Syntax	`<a_><!>TPCEc`

Units	`c = trigger input letter (A, B or M)`
	`(Reported value represents encoder counts, scalable by SCLD)`

Range	`n/a`
Default	`n/a`
Response	`TPCEA:   *TPCEA+0`
See Also	`ENCCNT, INFNC, [ PCE ], PESET, PSET, SCALE, SCLD, SFB, TPE`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `TPCE` command to display the current captured encoder position, from the time of the last trigger interrupt.

General-purpose inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The encoder position can be captured only by an input that is defined as a “trigger interrupt” input with the `INFNCi-H` command (see `INFNC` command). When a “trigger interrupt” input is activated, the encoder position is captured and the position is available through the use of the `PCE` operator and the `TPCE` display command.

GT6K: By default, the GT6K captures only the commanded position. To capture the encoder position, the axis must be in the Encoder Capture Mode (see `ENCCNT` command).

Position Capture Status, Longevity of Captured Position: Use the `TTRIG` and `TRIG` commands to ascertain if a trigger interrupt input has been activated. `TTRIG` displays the status as a binary report, and `TRIG` is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an `IF` statement). Once the captured encoder position value is reported with the `TPCE` command, the `TTRIG`/`TRIG` status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The encoder position capture accuracy is ±1 encoder count.

Scaling and Position Offset: If scaling is enabled (`SCALE1`), the encoder position is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled (`SCALEØ`), the value reported will be actual encoder counts. If you issue a `PSET` (establish absolute position reference) command, any previously captured encoder positions will be offset by the `PSET` command value.

Example:

```
TPCEA      ; Report captured encoder position, which was captured
           ; when trigger A (TRG-A) was activated
TPCEB      ; Report captured encoder position, which was captured
           ; when trigger B (TRG-B) was activated
TPCEM      ; Report captured encoder position, which was captured
           ; when the master trigger (TRG-M) was activated
```

TPCME Transfer Captured Master Encoder Position

Type	`Transfer`
Syntax	`<a_><!>TPCME`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TPCME    *TPCME+0`
See Also	`INFNC, MEPOL, MESND, [ PME ], [ PCME ], [ PCMS ], PMECLR, PMESET, TPME, TPCMS`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `TPCME` command to display the current captured master encoder position. The master encoder is connected to the connector labeled “Master Encoder.”

> **Syntax**: `VARn=PCME` where `n` is the variable number; or `PCME` can be used in an expression such as `IF(PCME>2345Ø)`.

About Position Capture: The master encoder position can be captured only by the Master Trigger input (input #5), and only when that input is defined as a “trigger interrupt” input with the `INFNC5-H` command (see `INFNC` command). When the “trigger interrupt” input is activated (active edge), the master encoder position is captured and the position is available through the use of the `PCME` operator and the `TPCME` display command.

Position Capture Status, Longevity of Captured Position: Use the `TTRIG` and `TRIG` commands to ascertain if a trigger interrupt input has been activated. `TTRIG` displays the status as a binary report, and `TRIG` is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an `IF` statement). Once the captured master encoder position value is displayed with the `TPCME` command, `TTRIG`/`TRIG` status bit #5 is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the master trigger input.

Position Capture Accuracy: The master encoder position capture accuracy is ±1 encoder count.

Scaling and Position Offset: The `TPCME` value is always in master encoder counts; it is never scaled. If you issue a `PMESET` (establish absolute position reference) command, any previously captured master encoder positions will be offset by the `PMESET` command value.

TPCMS Transfer Captured Master Cycle Position

Type	`Transfer`
Syntax	`<a_><!>TPCMSc`

Units	`c = trigger input letter (A, B or M)`
	`(Reported value represents master counts, scalable by SCLMAS)`

Range	`n/a`
Default	`n/a`
Response	`TPCMSA    *TPCMSA+0`
See Also	`ENCCNT, FOLMAS, INFNC, [ PCMS ], PSET, SCALE, SCLMAS, SFB, TPCME, [ TRIG ], TRGLOT, TTRIG`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TPCMS` command transfers the captured position of the master within its current master cycle.

`TPCMS` (and `TPMAS`) is unique among position transfers, because its value rolls over to zero each time the entire master cycle length (`FMCLEN`) has been traveled. Thus, the captured `TPCMS` value is essentially a snap-shot of the position relative to the master cycle at the time of the capture.

The master must be assigned first (`FOLMAS` command) before this command will be useful.

For a complete discussion of master cycles, refer to the Following chapter in the *Programmer’s Guide*.

General-purpose inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (INFNC default)
1	37	INFNC1-A (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	INFNC2-A (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	INFNC3-A (General-purpose)
4	34	INFNC4-A (General-purpose)
5	35	INFNC5-A (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

About Position Capture: The master cycle position can be captured only by a trigger input that is defined as "trigger interrupt" input with the INFNCi-H command (see INFNC command). When a "trigger interrupt" input is activated, the master cycle position of the dedicated axis is captured and the position is available through the use of the PCMS operator and the TPCMS display command.

Position Capture Status, Longevity of Captured Position: Use the TTRIG and TRIG commands to ascertain if a trigger interrupt input has been activated. TTRIG displays the status as a binary report, and TRIG is an assignment/comparison operator for using the status information in a conditional expression (e.g., in an IF statement). Once the captured master cycle position value is reported with the TPCMS command, the TTRIG/TRIG status bit for that trigger input is cleared; but the position information remains available until it is overwritten by a subsequent position capture from the same trigger input.

Position Capture Accuracy: The master cycle position is interpolated; the capture accuracy is 50 µs multiplied by the velocity of the axis at the time the trigger input was activated.

Scaling and Position Offset: If scaling is enabled (SCALE1), the master cycle position is scaled by the distance scaling factor (SCLMAS). If scaling is not enabled (SCALEØ), the value assigned will be actual counts from the commanded or encoder master source as selected with the FOLMAS command. If you issue a PSET (establish absolute position reference) command, any previously captured master cycle positions will be offset by the PSET command value.

TPE Transfer Position of Encoder/Resolver

		Product	Rev
Type	Transfer	GT6K	6.0
Syntax	<a_><!>TPE	GV6K	6.0
Units	Encoder or resolver counts, or scaled by SCLD		
Range	n/a		
Default	n/a		
Response	TPE: *TPE+0		
See Also	ENCCNT, ERES, [FB], [PE], PESET, PSET, SCALE, SCLD, SFB, TFB, TPC, TPER		

GV6K: The TPE command reports the present feedback device position, based on the encoder/resolver resolution (ERES).

GT6K: If the ENCCNT1 mode is enabled TPE reports the encoder position, but in ENCCNT0 mode (the factory default setting) the TPE report represents the commanded position.

UNITS OF MEASURE and **SCALING**: refer to page 16 or to the SCLD command.

If you issue a PSET command, the encoder position value will be offset by the PSET command value. If you are using a stepper axis in the ENCCNT1 mode, use the PESET command instead.

The position error calculation is: TPER = TPC – TPE.

TPER Transfer Position Error

Type	Transfers
Syntax	<a_><!>TPER
Units	Reported value represents distance units (scalable by SCLD)
Range	Range of the reported value is ±2,147,483,648
Default	n/a
Response	TPER: *TPER+0
See Also	ENCCNT, DMODE, DMONAV, DMONBV, DRES, ERES, [FB], [PC], [PE], [PER], SFB, SMPER, TANI, TAS, TFB, TPE, TPC

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The TPER command reports the present position error. The error is reported in feedback device counts and is based on the encoder/resolver resolution (ERES). It is scaled by the distance scaling factor (SCLD), if scaling is enabled with the SCALE1 command.

The position error is the difference between the commanded position and the actual position read by the feedback device. (TPER = TPC - TPE).

The position error is calculated every sample period.

Example:

```
TPC             ; Display the commanded position. Example is: *TPC4000
TPE             ; Display the actual position.    Example is: *TPE4004
TPER            ; Display position error.         Example is: *TPER-4
```

TPMAS Transfer Current Master Cycle Position

Type	Following; Transfer
Syntax	<a_><!>TPMAS
Units	Reported value represents master counts, scalable by SCLMAS.
Range	n/a
Default	n/a
Response	TPMAS *TPMAS0
See Also	FMCLEN, FMCNEW, FMCP, FOLMAS, FOLMD, [FS], MEPOL, [NMCY], [PMAS], SCALE, SCLMAS, TFS

Product	Rev
GT6K	6.0
GV6K	6.0

The TPMAS command transfers the current position of the master within its current master cycle. **The master must be assigned first (FOLMAS command) before this command will be useful.**

TPMAS is unique among position transfers, because master cycle position rolls over to zero each time the entire master cycle length (FMCLEN value) has been traveled.

If scaling is enabled (SCALE1), the value returned is scaled by the master scaling factor (SCLMAS). If scaling is disabled (SCALEØ), the value returned is in master counts (encoder/resolver counts, commanded counts, or analog input counts).

For a complete discussion of master cycles, refer to the Following chapter in the *Programmer's Guide*.

TPME Transfer Position of Master Encoder

Type	Transfer
Syntax	<a_><!>TPME
Units	Reported value represents master encoder counts.
Range	n/a
Default	n/a
Response	TPME *TPME+0
See Also	MEPOL, MESND, [PCME], [PE], [PME], PMECLR, PMESET, TPCME

Product	Rev
GT6K	6.0
GV6K	6.0

Use the TPME command to display the current master encoder position. The master encoder is connected to the connector labeled “Master Encoder”. If you issue a PMESET command, the master encoder position value will be offset by the PMESET command value. The TPME value is always in encoder counts, it is never scaled.

TPRA Transfer Absolute Resolver Position

Type	`Transfer`
Syntax	`<a_><!>TPRA`
Units	`counts`
Range	`0 – (ERES-1)`
Default	`n/a`
Response	`TPRA:    *TPRA145`
See Also	`ERES, SFB`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`TPRA` returns the actual resolver reading. For resolver drives, the command will be valid even if encoder feedback has been selected with the `SFB` command. For servo drives without resolver feedback, this command will always return 0.

TPROG Transfer Program Contents

Type	`Transfer`
Syntax	`<a_><!>TPROG<t>`
Units	`t = text (name of program)`
Range	`Text name of 6 characters or less`
Default	`n/a`
Response	`n/a`
See Also	`DEF, TDIR, TMEM`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TPROG` command displays the contents of the program specified. If there is no such program, the drive responds with the error message: `*INVALID DATA`. To see which programs have been created, use the `TDIR` command.

TPSHF Transfer Net Position Shift

Type	`Following; Transfer`
Syntax	`<a_><!>TPSHF`
Units	`(Reported value represents commanded counts, scalable by SCLD)`
Range	`n/a`
Default	`n/a`
Response	`TPSHF    *TPSHF+0`
See Also	`FMCNEW, FMCP, FOLEN, FSHFC, FSHFD, [ PSHF ], SCALE, SCLD`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TPSHF` command transfers the net (absolute) follower axis position shift that has occurred since that last `FOLEN1` command. The position returned will be the sum of all shifts performed on that axis, including decelerations due to limits, kill, or stop. The shift value is set to zero each time a new `FOLEN1` command or a `FOLMAS` command (with a value other than zero) is issued.

If scaling is enabled (`SCALE1`), the `PSHF` value is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled, the value is in commanded counts.

TPSLV Transfer Current Commanded Position of Follower Axis

Type	`Following; Transfer`
Syntax	`<a_><!>TPSLV`
Units	`(Reported value represents commanded counts, scalable by SCLD)`
Range	`n/a`
Default	`n/a`
Response	`TPSLV    *TPSLV+0`
See Also	`FMCNEW, FMCP, [ PSLV ], SCALE, SCLD`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TPSLV` command transfers the current commanded position of the follower axis. The master must be assigned first (`FOLMAS` command) before this command will be useful.

If scaling is enabled (`SCALE1`), the `PSLV` value is scaled by the distance scaling factor (`SCLD`). If scaling is not enabled, the value is in commanded counts.

TRACE Program Trace Mode Enable

Type	`Program Debug Tool`
Syntax	`<a_><!>TRACE<b>`
Units	`n/a`
Range	`b = 0 (disable) or 1 (enable)`
Default	`0`
Response	`TRACE:   *TRACE0`
See Also	`[, ], [ # ], PORT, [ SS ], STEP, TRACEP, TRANS, TSS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TRACE` command enables program trace mode. When in program trace mode, all commands executed are transferred out the Ethernet, RS-232 or RS-485 port, and the program from which the command came is identified.

Example:

```
DEL prog1          ; Delete program prog1
DEF prog1          ; Begin definition of program prog1
L                  ; Begin loop
  IF(IN.3=b1)      ; If input #3 is activated ...
  JUMP prog2       ; Jump to program prog2
  ELSE             ; If input #3 is not activated, continue with loop
  MC0              ; Select preset positioning mode
  MA0              ; Select incremental positioning mode
  A45              ; Set acceleration to 45 revs/sec/sec
  AD20             ; Set deceleration to 20 revs/sec/sec
  V7               ; Set velocity to 7 revs/sec
  GO1              ; Initiate motion
  NIF
LN                 ; End loop
END                ; End definition of program

DEL prog2          ; Delete program prog2
DEF prog2          ; Begin definition of prog2
K1                 ; Kill motion only
TERRLG             ; Display the error log
END                ; End definition of program

TRACE1             ; Enable trace mode
RUN prog1          ; Run program prog1
```

After enabling the trace mode, executing `RUN prog1` places the following information in the output buffer: (assume input #3 is not activated)

```
*L
*IF(IN.3=b1)
*ELSE
*MC0
*MA0
*A45
```

(continues)

TRACEP Program Flow Mode Enable

Type	Program Debug Tool
Syntax	<a_><!>TRACEP<b>
Units	n/a
Range	b = 0 (disable), 1 (enable) or X (don't care)
Default	0
Response	TRACEP: *TRACEP0
See Also	TRACE

Product	Rev
GT6K	6.0
GV6K	6.0

The TRACEP command provides a debug tool to monitor the entry and exit of programs and their associated nest-levels.

Example:

```
DEF PICK1
GOSUB PICK2
GOTO PICK3
END

DEF PICK2
GOSUB PICK4
END

DEF PICK3
END

DEF PICK 4
END

>TRACEP1
>PICK1
*INITIATE PROGRAM:   PICK1   NEST=1
*INITIATE PROGRAM:   PICK2   NEST=2
*INITIATE PROGRAM:   PICK4   NEST=3
*END:            PROGRAM NOW:      PICK2   NEST=2
*END:            PROGRAM NOW:      PICK1   NEST=1
*INITIATE PROGRAM:   PICK3   NEST=1
*END:            PROGRAM EXECUTION TERMINATED
```

TRANS Translation Mode Enable

Type	Program Debug Tool
Syntax	<a_><!>TRANS<b>
Units	n/a
Range	b = 0 (disable), 1 (enable) or X (don't care)
Default	0
Response	TRANS: *TRANS0
See Also	[#], [SS], STEP, TSS

Product	Rev
GT6K	6.0
GV6K	6.0

The TRANS command enables the program translation mode, in which all commands processed by the Gem6K drive are echoed back in their binary format (hex representation of the binary equivalent), and are not executed. The first byte (first two characters) of the response represents the command's memory requirement. The remaining bytes represent the actual command.

Example:

```
TRANS1           ; Enable translation mode
A10              ; Translate acceleration command A10. Response displayed
                 ; is: 07 01 00 00 01 86 A0. Note that 07 hex represents a command
                 ; memory requirement of 19 bytes.
GO1              ; Translate initiate motion command GO1. Response displayed
                 ; is: 04 07 03 01.   Note that 04 hex represents a
; command memory requirement of 4 bytes.
```

TREV Transfer Revision Level

Type	Transfer
Syntax	<a_><!>TREV
Units	n/a
Range	n/a
Default	n/a
Response	TREV: *TREV92-016740-01-5.3.25 GEM6K GV6K-L3E D0.11 F1.3 (response varies by product)
See Also	RESET, RFS

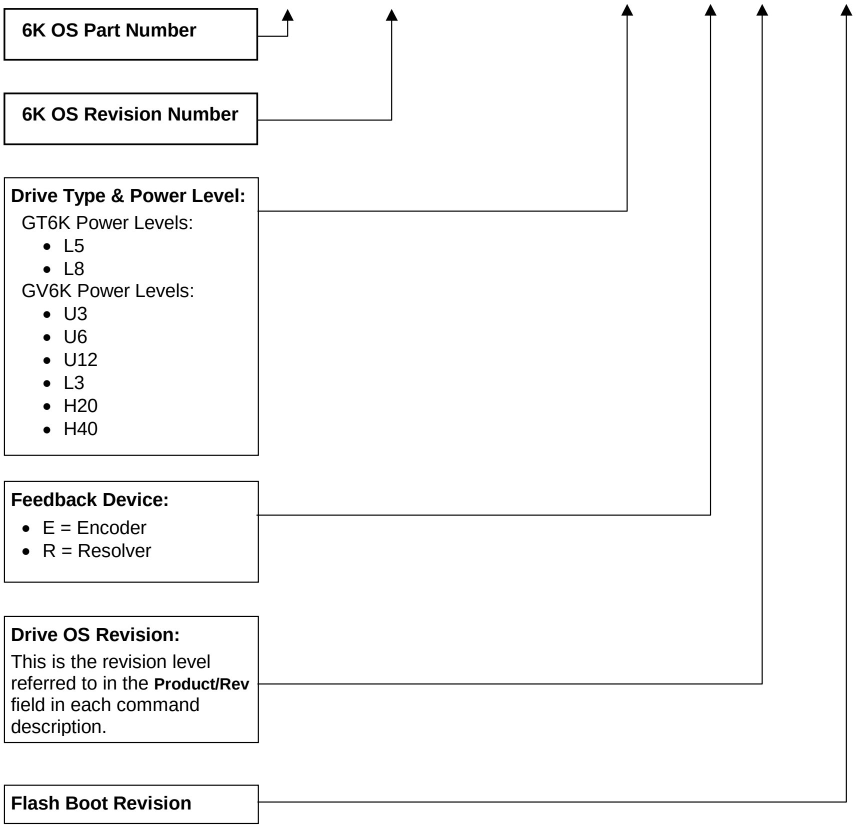
Product	Rev
GT6K	6.0
GV6K	6.0

The Transfer Revision Level (TREV) command reports the following information:

- 6K operating system part number
- 6K operating system revision number
- Drive type
- Drive power level
- Feedback device (for GV6K only)
- Drive operating system
- Flash boot revision (for hardware identification only)

Example Response:

```
*TREV92-016740-01-5.3.25 GEM6K GV6K-L3E D0.11 F1.3
```



6K OS Part Number

6K OS Revision Number

Drive Type & Power Level:
GT6K Power Levels:
- L5
- L8

GV6K Power Levels:
- U3
- U6
- U12
- L3
- H20
- H40

Feedback Device:
- E = Encoder
- R = Resolver

Drive OS Revision:
This is the revision level referred to in the **Product/Rev** field in each command description.

Flash Boot Revision

To update your drive operating system: The operating system file is located in the software download section of the *Compumotor Online* web site (http://www.compumotor.com). Download the file to your hard drive and follow the relevant download procedure:

- Motion Planner users: refer to page 6.
- Communications Server (COM6SRVR.EXE) users: use the SendOS method described on page 6.

TRGFN Trigger Functions

Type	`Inputs; Following; Motion`
Syntax	`<a_><!>TRGFNcbb`
Units	`c = trigger input letter` 1st `b = bit to select Conditional GO (GOWHEN) function` 2nd `b = bit to select Start New Master Cycle (FMCNEW) function`

Range	`c = A, B, or M (M is master trigger, “TRG-M”)`
	`b = 0 (disable function), 1 (enable function),`
	`or X (leave unchanged)`

Default	`c = A; b = 0`
Response	`TRGFN    *TRGFNA00`

See Also	`[ AS ], ERROR, ERRORP, FMCNEW, GOWHEN, INFNC, [ SS ], TAS,`
	`TRGLOT, TSS, [ TRIG ], TTRIG`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `TRGFN` command to assign certain command functions to the trigger inputs on the DRIVE I/O connector:

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)

NOTE

The input used in this command must first be defined as a *Trigger Interrupt* input with the `INFNCi-H` command.

- “**Conditional GO**” Function (`TRGFNc1x`): Suspend execution of the next start-motion command until the specified trigger input goes active. Start-motion commands are:
  - `GO` (standard command to begin motion)
  - `FGADV` (begin geared advance – for Following motion)
  - `FSHFC` (begin continuous shift – for Following motion)
  - `FSHFD` (begin preset shift – for Following motion)

  Axis status bit #26 (reported with `TASF`, `TAS`, or `AS`) is set to one (`1`) when there is a pending “Conditional GO” condition initiated by a `TRGFN` command; this bit is cleared when the trigger is activated or when a stop command (`S`) or a kill command (`K`) is issued. If you need execution to be triggered by other factors (e.g., input state, master position, encoder position, etc.) use the `GOWHEN` command.

- “**New Master Cycle**” Function (`TRGFNcx1`): This is equivalent to executing the `FMCNEW` command. When the specified trigger input goes active, the drive begins a new Following master cycle. For more information on master cycles, refer to the Following chapter in the *Programmer’s Guide*.

These trigger functions are cleared once the function is complete. To use the trigger to perform another conditional Go or begin a new master cycle, the `TRGFN` command must be given again.

`TRGFN` in Compiled Motion: When used in a compiled program, a `TRGFNc1x` (conditional `GO` function) command will pause the profile in progress (motion continues at constant velocity) until the trigger is activated to execute the next move profile. When used in a compiled profile, the TRGFN command consumes one segment of compiled memory. When used in a compiled Following profile, the TRGFN command is ignored on the reverse Following profile (i.e., when the master is moving in the opposite direction of that specified in the FOLMAS command).

Trigger Interrupt Status: The status of a trigger interrupt event is reported with the TTRIG and TRIG commands.

Example: (refer also to the FOLEN examples)

```
TRGFNBx1           ; When trigger B goes active, a new master cycle will begin
TRGFNB1x           ; When trigger B goes active, execute the move
                   ; commanded with the GO command.
GO1                ; The move is commanded, but will not execute until
                   ; trigger B goes active.
```

TRGLOT Trigger Interrupt Lockout Time

Type	Input
Syntax	<a_><!>TRGLOT<I>
Units	i = time in milliseconds
Range	0-250
Default	24
Response	TRGLOT: *TRGLOT24
See Also	INDEB, INFNC, RE, REG, TIN, TRGFN, [TRIG], TTRIG

Product	**Rev**
GT6K	6.0
GV6K	6.0

The TRGLOT command configures the amount of time in which a “trigger interrupt” input (all inputs configured with the INFNCi-H command) is disabled between its initial active transition and its secondary active transition. This allows rapid recognition of a trigger interrupt input, but prevents subsequent bouncing of the input from causing a false position capture, registration move, or TRGFN event. The lockout time affects only those inputs configured as H (trigger interrupt) with the INFNCi-H command during those interrupt actions (registration, position capture, etc.).

The TRGLOT setting overrides the existing INDEB setting for only the inputs that are assigned the “Trigger Interrupt” function with the INFNCi-H command (see INFNC for details).

Example:

```
INFNC1-H          ; Assign input #1 as a "trigger interrupt" input
TRGLOT40          ; Set lockout time for all "trigger interrupt" inputs
                  ; to be 40 milliseconds
```

[TRIG] Trigger Interrupt Status

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	INFNC, [PCC], [PCE], [PCME], [PCMS], TAS, TPCC, TPCE, TPCME, TPCMS, TRGFN, TRGLOT, TTRIG

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the TRIG operator to assign the Trigger Interrupt status bits to a binary variable (VARB), or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=TRIG` where "n" is the binary variable number, or `TRIG` can be used in an expression such as `IF(TRIG=b11Ø1)`, or `IF(TRIG=h7F)`

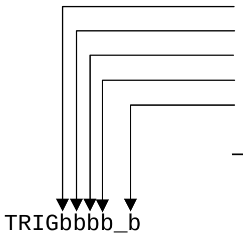
Each Trigger Interrupt status bit indicates whether a "trigger interrupt" input has been activated to capture a position, initiate a registration move, or execute a `TRGFN` function. "Trigger Interrupt" inputs are onboard inputs that have been assigned the trigger interrupt function with the `INFNCi-H` command.

Each `TTRIG` bit is cleared when the captured position value is read with the `PCC`, `PCE`, `PCME`, `PCMS`, `TPCC`, `TPCE`, `TPCME`, or `TPCMS` commands, but the position information is still available from the respective register until it is overwritten by a subsequent position capture by the same trigger input.

The function of each status bit is shown in the table below (bits are numbered from left to right). A bit that is set ("`1`") indicates the trigger interrupt has occurred, a "`0`" indicates no trigger interrupt.

`TRIG` bit assignments for inputs on the DRIVE I/O connector (bits are numbered 1-5 from left to right):

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)



TSC Transfer Controller Status

Type	`Transfer`
Syntax	`<a_><!>TSC<.i>`
Units	`i = drive status bit number`
Range	`1-32`
Default	`n/a`

Response	`TSC:     *TSC0000_0000_0000_0000_0000_0000_0000_0000`
	`TSC.1:   *0`

See Also	`[ SC ], SCANP, TSCF`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TSC` command provides a binary report of the current "Controller Status" register. If you would like a more descriptive text-based report, use the `TSCF` command.

```
*TSCbbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb
```

Bit 1 Bit 32

Bit #	**Function** (1 = Yes; Ø = No)
1	RESERVED
2	RESERVED
3	A PLC program is being executed in Scan Mode (`SCANP`).
4-32	RESERVED

TSCF Transfer Controller Status (full-text report)

Type	`Transfer`
Syntax	`<a_><!>TSCF`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TSCF:    (see example below)`
See Also	`[ SC ], SCANP, TSC`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TSCF` command provides a full-text report of the current “Controller Status” register. This is an alternative to the binary report (`TSC`).

Example `TSCF` response:

```
*TSCF
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*SCANP Running         NO          Reserved              NO
*Reserved              NO          Reserved              NO
*
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
*Reserved              NO          Reserved              NO
```

TSCAN Transfer Scan Time of PLCP Program

Type	`Transfer; PLC Scan Program`
Syntax	`<a_><!>TSCAN`
Units	`Response is in increments of 2 milliseconds`
Range	`2 ms - unlimited`
Default	`n/a`
Response	`TSCAN    *TSCAN4    (4 ms corresponds to 2 system updates)`
See Also	`EXE, PLCP, SCANP`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TSCAN` command reports the duration it takes the last PLCP program to be scanned completely. A compiled PLCP program is launched into Scan mode using the `SCANP` command. During each 2 ms system update, the PLCP program is scanned an allotted 0.5 ms window. If the PLCP program requires more than 0.5 ms to be scanned, the program will be paused and then resumed at the next system update. The value reported by the `TSCAN` command is in multiples of the 2 ms system update period.

Example:

```
SCANP PLCP1       ; Start execution of compiled PLCP program PLCP1 in Scan mode
TSCAN             ; Report the duration of the scan program in multiples of the
                  ; 2 millisecond system update period. An example response might
                  ; be *TSCAN4 (indicates that 2 system update periods, a total of
                  ; 4 milliseconds was required to scan the last PLCP program).
```

TSEG Transfer Number of Free Segment Buffers

Type	`Compiled Motion;  Transfer`
Syntax	`<a_><!>TSEG`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TSEG:    *TSEG258`
See Also	`MEMORY, TDIR, TMEM, [SEG], [SS], TSS, TSSF`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TSEG` command returns the number of free segment buffers in compiled memory.

System status bit (see `TSSF`, `TSS`, and `SS`) 29 is set when the compiled memory is 75% full, and bit 30 is set if the compiled memory is 100% full.

TSGSET Transfer Servo Gain Set

Type	`Transfer`
Syntax	`<a_><!>TSGSETi`
Units	`i = gain set identification number (see SGSET command)`
Range	`1-3`
Default	`n/a`
Response	`(reports all gains in the specified set)`
See Also	`SFB, SGAF, SGENB, SGSET, SGVF, TGAIN`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

This command allows you to display any of the 3 gain sets that you saved with the `SGSET` command. Up to 3 gain sets can be saved with the `SGSET` command. Each gain set contains these gain parameters:

- `DIBW` (current loop bandwidth)
- `DMTLIM` (torque/force limit)
- `DMVLIM` (velocity limit)
- `DNOTAD` (notch filter A depth)
- `DNOTAF` (notch filter A frequency)
- `DNOTAQ` (notch filter A quality factor)
- `DNOTBD` (notch filter B depth)
- `DNOTBF` (notch filter B frequency)
- `DNOTBQ` (notch filter A quality factor)
- `DNOTLD` (notch lead filter break frequency)
- `DNOTLG` (notch lag filter break frequency)
- `DPBW` (position loop bandwidth)
- `LDAMP` (load damping)
- `LJRAT` (load-to-rotor inertia ratio or load-to-force mass ratio)
- `SGAF` (acceleration feedforward gain)
- `SGINTE` (integrator enable)
- `SGIRAT` (current damping ratio)
- `SGPRAT` (position loop ratio)
- `SGPSIG` (velocity/position bandwidth ratio)
- `SGVF` (velocity feedforward gain)
- `SGVRAT` (velocity damping ratio)

NOTE: To report the present gain values in effect, use the `TGAIN` command.

TSKAX Task Axis

Type	`Multi-Tasking`
Syntax	`i%TSKAX<a>`

Units	`i = task number`
	`a = 0 or 1`

Range	`For i: 0-10`
	`For <a>:1 or 0`

Default	`a = 1`
Response	`TSKAX:   *TSKAX1`
See Also	`%, TTASK, [ TASK ], TSWAP, [ SWAP ], TSKTRN`

Product	Rev
GT6K	6.0
GV6K	6.0

The Task Axis command (`TSKAX`) allows you to specify whether or not a task is associated with motion.

The default condition in multi-tasking (`TSKAX1`) is that each task is associated with motion. This means, for example, that when the load hits an end-of travel limit, program execution will be killed within that task, and in all other tasks associated with motion.

Use the TSKAX0 command to eliminate altogether a task's association with motion. This would be appropriate for a task that is not involved in motion control, but may control I/O or start other tasks.

Example:

```
DEF main          ; Begin definition of program called "main"
1%TSKAX1          ; Associate Task1 with motion
2%TSKAX0          ; Make Task2 independent of motion
1%move1           ; Execute stored program "move1" in Task1
2%inout           ; Execute stored program "inout" in Task2
END
```

TSKTRN Task Turns Before Swapping

Type	Multi-Tasking
Syntax	i_1%TSKTRNi_2
Units	i_1 = task number i_2 = number of turns before task swap
Range	i_1 = 0-10 i_2 = 0-10,000
Default	i_1 = 0 i_2 = 1
Response	TSKTRN: *TSKTRN1
See Also	%, LOCK, TTASK, [TASK], TSWAP, [SWAP], TSKAX

Product	Rev
GT6K	6.0
GV6K	6.0

Use the TSKTRN command to set the relative amount of processing time a task will get. Under default multi-tasking operation, all active tasks have an equal share of processing time; that is, each task executes one "turn" and then "swaps" control to the next active task. (A "turn" is the execution of a command, or a portion of a complex command such as those for math and trig operators.)

For example, if Task2 issued a TSKTRN6 command, while the other tasks stayed at TSKTRN1, Task2 would execute 6 commands (or portions of long commands) before relinquishing control to another task.

The TSKTRN value for a task may be changed at any time, allowing a task to increase its weight for an isolated section of program commands.

TSROFF Transfer Resolver Offset Angle

Type	Transfer
Syntax	<a_><!>TSROFF
Units	angle offset, in degrees
Range	-180.0 to +180.0
Default	n/a
Response	TSROFF: *TSROFF-90.0
See Also	DMODE, SRSET

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

Use the TSROFF command to ascertain the actual resolver offset angle. SRSET sets the resolver offset angle. When a non-zero value is specified for SRSET, it becomes the new offset angle. When no value is specified, and the drive is in DMODE11 (feedback alignment mode), then a routine is executed to automatically set the resolver angle.

TSS Transfer System Status

Type	`Transfer`
Syntax	`<a_><!><%>TSS<.i>`
Units	`i = system status bit number`
Range	`1-32`
Default	`n/a`

Response	`TSS:     *TSS1000_1000_0000_0000_0000_0000_0000_0000`
	`TSS.1:   *1 (status of Task 0 status bit #1—system is ready)`

See Also	`PORT, TAS, TCMDER, TRGFN, TSSF, TSTAT, [ TRIG ], TTRIG`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The TSS command provides information on the 32 system status bits. The TSS status command reports a binary bit report. If you would like to see a more descriptive text-based report, use the TSSF command description.

Response for TSS (b can equal Ø, 1, X, or x):

```
*TSSbbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb
    ^                                     ^
  Bit #1                               Bit #32
```

MULTI-TASKING

If you are using multi-tasking, be aware that each task has its own system status register. Therefore, to check a specific task's system status, you must prefix the TSS command with the task identifier (e.g., 2%TSS to check system status for Task 2). If no task identifier is given, the TSS response is for the task supervisor (Task 0).

BIT (Left to Right)	**Function** (1 = yes, Ø = no)	**BIT** (Left to Right)	**Function** (1 = yes, Ø = no)
1	System Ready (powered up and ready to receive commands)	17	Loading Thumbwheel Data ([TW])
2	Reserved	18	External Program Select Mode is enabled (INSELP1)
3	Executing a Program (see EXE)	19	Dwell in Progress (T command)
4	Immediate Command (set if last command was immediate)	20	Waiting for RP240 Data—[DREAD] or [DREADF]
5	In ASCII Mode	21	RP240 Connected— current PORT setting only
6	In Echo Mode (ECHO1)— current PORT setting only	22	Non-volatile Memory Error
7	Defining a Program	23	GV6K: Servo data gathering transmission in progress; GT6K: Reserved
8	In Trace Mode (TRACE1)	24	Suspended on Swap (see LOCK command)
9	In Step Mode (STEP1)	25	Reserved
10	In Translation Mode (must use fast status area to see)	26	Suspended on COM1 (see LOCK command)
11	Command Error Occurred (bit is cleared when TCMDER is issued)	27	Suspended on COM2 (see LOCK command)
12	Break Point Active (BP)	28	Program Pending (see EXE command)
13	Pause is Active (PS command or pause input, INFNCi-E)	29	Compiled memory is 75% full
14	Wait is in progress (WAIT)	30	Compiled memory is 100% full
15	Monitoring On Condition (ONCOND)	31 *	Compile operation failed (PCOMP)
16	Waiting for Data (READ)	32	EXE Failed (see EXE command)

* Bit #31: failed PCOMP compile is cleared on power up, RESET, or after successful compile. Possible causes include:

- Errors in profile design (e.g., change direction while at non-zero velocity; distance & velocity equate to < 1 count per system update; preset move profile ends in non-zero velocity)
- Profile will cause a Following error (see TFSF, TFS, or FS command descriptions)
- Out of memory (see TSS bit #30)
- Axis already in motion at the time of the PCOMP command
- Loop programming errors (e.g., no matching PLOOP or PLN; more than 4 embedded PLOOP/PLN loops)
- PLCP program contains invalid commands.

TSSF Transfer System Status (full-text report)

Type	Transfer
Syntax	<a_><!><%>TSSF
Units	n/a
Range	n/a
Default	n/a
Response	TSSF: (see example below)
See Also	PORT, [SS], TAS, TCMDER, TRGFN, TSS, TSTAT

Product	**Rev**
GT6K	6.0
GV6K	6.0

The TSSF command returns a text-based status report. This is an alternative to the binary report (TSS).

MULTI-TASKING

If you are using multi-tasking, be aware that each task has its own system status register. Therefore, to check a specific task's system status, you must prefix the TSSF command with the task identifier (e.g., 2%TSSF to check system status for Task 2). If no task identifier is given, the TSSF response is for the task supervisor (Task 0).

Example TSSF response:

```
*TSSF
*System Ready        YES     Thumbwhl Data Load  NO
*RESERVED            NO      Ext Prog Sel Mode   NO
*Program Executing   NO      Time Command        NO
*Immediate Comm Last NO      Waiting RP240 Data  NO
*
*ASCII Mode          YES     RP240 Connected     NO
*Echo Mode           YES     Memory Error        NO
*Defining a Program  NO      Servo Data Transfer NO (RESERVED for GT6K)
*Trace Mode          NO      Suspended on Swap   NO
*
*Step Mode           NO      RESERVED            NO
*FS Translate Mode   NO      Suspended on COM1   NO
*Command Error       NO      Suspended on COM2   NO
*Break Point Active  NO      Program Pending     NO
*
*Pause Active        NO      Comp Mem Near Full  NO
*Wait Active         NO      Compiled Mem Full   NO
*Checking On Conds   NO      Compile Error       NO
*Waiting for Data    NO      EXE Failed          NO
```

TSTAT Transfer Statistics

Type	`Transfer`
Syntax	`<a_><!>TSTAT`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TSTAT: (See below)`
See Also	`NTADDR, TAS, TDIR, TER, TFB, TIN, TIO, TOUT, TPC, TPE, TREV, TSWAP, TSS, TTIM, TUS, TVEL`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The following is an example (**NOTE:** The response for each Gem6K Series product will vary slightly.):

```
*GEM6K Revision: 92-XXXXXX-01-5.3  GEM6K GV6K-U6E D0.11 F1.62
*Ethernet address: xxxxxxxxxx;  IP address: 192.168.10.30
*Power-up program assignment (STARTP):
*ENABLE input OK: Yes
*Drive status (DRIVE): 0
*Encoder resolution (ERES): 4000
*Hard Limit enable: LH3
*Soft Limit enable: LS0
*Current Motion Attributes:
*  Scaling enabled (SCALE1): 0
*  Acceleration scaler (SCLA): 4000
*  Distance scaler: 1
*  Velocity scaler: 4000
*  Commanded position (TPC): +0
*  A10.0000
*  AA10.0000
*  AD10.0000
*  ADA10.0000
*  V1.0000
*  D+4000
*I/O Status:
*  Onboard limit inputs:
*    Hardware state (TLIM):   110
*  Expansion I/O bricks: See TIO response
*Axis Status (see TASF for full text report):
*  Axis 1 (1TAS): 0010_0000_0000_1000_0000_0001_0000_0000
*System Status (This is Task 0 if using multi-tasking):
*5 Programs Defined; Scale Enable 0
*System Status:   1000_1100_0000_0000_0000_0100_0000_0000
```

TSTLT Transfer Settling Time

Type	`Transfer`
Syntax	`<a_><!>TSTLT`
Units	`Reported value represents milliseconds`
Range	`n/a`
Default	`n/a`
Response	`TSTLT: *TSTLT502`
See Also	`STRGTD, STRGTE, STRGTT, STRGTV`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

`TSTLT` allows you to display the actual time it took the last move to settle into the target zone (that is, within the distance zone defined by `STRGTD` and less than or equal to the velocity defined by `STRGTV`). The reported value represents milliseconds. **This command is usable whether or not the Target Zone Settling Mode is enabled with the `STRGTE` command.**

For more information on target zone operation, refer to the *Programmer's Guide*.

TSWAP Transfer Current Active Tasks

Type	`Transfer`
Syntax	`<!>TSWAP`
Units	`n/a`

Range	`Binary response status of tasks (0 = inactive, 1 = active).`
	`10-bit pattern represents tasks 1-10 from left to right.`

Default	`n/a`

Response	`TSWAP:    *TSWAP1001_0000_00  (tasks 1 and 4 are active)`
	`TSWAP.3:  *0  (task 3 is inactive)`

See Also	`%, [ SS ], [ TASK ],, TSS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TSWAP` command reports a binary bit pattern indicating the tasks that are currently active. Note that `TSWAP` only indicates if a task is active; to ascertain exactly what activity the task has at a given time, use the system status (`SS` or `TSS` commands).

`TSWAP`'s binary 10-bit pattern represents tasks 1-10, from left to right. A "`1`" indicates that the task is active, and a "`0`" indicates that the task is inactive. To check the status of only one task, you may use the bit select (`.`) operator. For example, `TSWAP.3` checks the status of Task 3 only.

The "Task Supervisor", represented by task Ø, is always active and is therefore not included in the `SWAP` and `TSWAP` status.

TTASK Transfer Task Number

Type	`Transfer`
Syntax	`<!>TTASK`
Units	`Reported value is the number of the controlling task.`
Range	`0-10`
Default	`n/a`
Response	`TTASK:   *TTASK2  (Task 2 executed the TTASK command)`
See Also	`%, [ TASK ]`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `TTASK` command to the display the task number of the task which executed the command. This could be used for diagnostic purposes, as a way to indicate which task is executing a given section of program.

TTIM Transfer Timer

Type	`Transfer`
Syntax	`<a_><!><%>TTIM`
Units	`Reported value represents milliseconds`
Range	`Maximum count is 999,999,999 (approx. 11 days, 13 hours)`
Default	`n/a`
Response	`TTIM:    *TTIM64000`
See Also	`T, [ TIM ], TIMINT, TIMST, TIMSTP`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TTIM` command returns the current value of the timer in milliseconds. The timer is started with the `TIMST` command, and stopped with the `TIMSTP` command.

Multi-Tasking: Each task has its own timer.

TTRIG Transfer Trigger Interrupt Status

Type	`Transfer, Inputs`
Syntax	`<a><!>TTRIG`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`TTRIG    *TTRIG0000_0`
See Also	`INFNC, [ PCC ], [ PCE ], [ PCME ], [ PCMS ], TAS, TPCC, TPCE, TPCME, TPCMS, TRGFN, TRGLOT, [ TRIG ]`

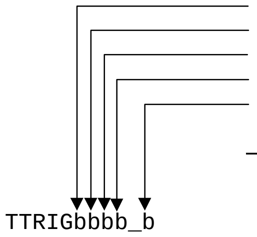
Product	Rev
GT6K	6.0
GV6K	6.0

Use the `TTRIG` command to check whether a "trigger interrupt" input has been activated to capture a position, initiate a registration move, or execute a `TRGFN` function. "Trigger Interrupt" inputs are onboard inputs that have been assigned the trigger interrupt function with the `INFNCi-H` command.

Each `TTRIG` bit is cleared when the captured position value is read with the `PCC`, `PCE`, `PCME`, `PCMS`, `TPCC`, `TPCE`, `TPCME`, or `TPCMS` commands, but the position information is still available from the respective register until it is overwritten by a subsequent position capture by the same trigger input.

`TTRIG` bit assignments for inputs on the DRIVE I/O connector are shown below (bits are numbered 1-5 from left to right). A bit that is set ("`1`") indicates the trigger interrupt has occurred, a "`0`" indicates no trigger interrupt.

Input #	Pin #	GT6K & GV6K Function (`INFNC` default)
1	37	`INFNC1-A` (General-purpose. If assigned, TRG-A must be on Input #1)
2	38	`INFNC2-A` (General-purpose. If assigned, TRG-B must be on Input #2)
3	39	`INFNC3-A` (General-purpose)
4	34	`INFNC4-A` (General-purpose)
5	35	`INFNC5-A` (General-purpose. If assigned, MASTER TRIGGER must be on Input #5)



Example

```
COMEXC1                     ; Continuous command execution
INFNC1-H                    ; Define input 1 as trigger A
REGA10000                   ; Registration move on trigger A event
WAIT(TRIG.1=B1)             ; Wait for trigger A event to occur
WRITE"TRIGGER A OCCURRED"   ; Display message
TTRIG                       ; Get report back (display to monitor)
                            ; response should be: *TTRIG1000_0
```

TTRQ Transfer Commanded Torque/Force

Type	`Transfer`
Syntax	`<a_><!>TTRQ`
Units	`percent of the DMTSCL value`
Range	`-100.00% to +100.00% : ±0.01`
Default	`n/a`
Response	`TTRQ:    *TTRQ50.00`
See Also	`DMODE, DMONAV, DMONBV, DMTLIM, DMTSCL, TTRQ`

Product	Rev
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

In Autorun mode (`DMODE13`) and Torque/Force Tuning mode (`DMODE15`), `TTRQ` = 0. In all other `DMODE` modes, `TTRQ` reports the actual internal torque/force setpoint as a percentage of `DMTSCL`. Several commands may limit the maximum value of `TTRQ`. These commands include `DMTLIM`, `DMVLIM`, `DMTIC`, `DMTIP`, `TDICNT`, `TDIMAX`.

TTRQA Transfer Actual Torque/Force

Type	`Transfer`
Syntax	`<a_><!>TTRQA`
Units	`percent of full-scale torque/force set by DMTSCL command`
Range	`-100.00% to +100.00% : ±0.01`
Default	`n/a`
Response	`TTRQA:    *TTRQA55`
See Also	`DMONAV, DMONBV, DMTKE, DMTLIM, DMTSCL, TTRQ`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `TTRQA` command reports the calculated torque/force, based on q-axis current and the motor's Ke, as a percentage of the full-scale torque/force set by `DMTSCL` command.

TUS Transfer User Status

Type	`Transfer`
Syntax	`<a_><!>TUS<.i>`
Units	`i = user status bit number`
Range	`1 - 16`
Default	`n/a`

Response	`TUS:     *TUS1111_0000_1111_0000`
	`TUS.4:   *1 (user status bit 4 is reported)`

See Also	`INDUSE, INDUST, [ US ]`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `TUS` command returns the current bit pattern for the user status word. All 16 bits of the user status word are defined with the `INDUST` command. Each bit can correspond to an axis status bit, a system status bit, or an input.

Example:

```
INDUSE1            ; Enable user status
INDUST1-5A         ; User status bit 1 defined as axis status bit 5
INDUST2-3A         ; User status bit 2 defined as axis status bit 3
3INDUST3-5J        ; User status bit 3 defined as input 5 on I/O brick 3
2%INDUST16-2I      ; User status bit 16 defined as system status bit 2 for task 2
TUS                ; Return the state of the user status word
```

TVE Transfer Velocity Error

Type	`Transfer`
Syntax	`<a_><!>TVE`

Units	`Revs/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`-200 to 200`
Default	`n/a`
Response	`TVE:     *TVE3`
See Also	`DMEPIT, DMONAV, DMONBV, DMVLIM, SMVER, TVEL, TVELA, V`

Product	**Rev**
GT6K	n/a
GV6K	6.0

(applicable only to servo axes)

The `TVE` command reports velocity error in revs/sec (rotary) or meters/sec (linear). The velocity error is the difference between the commanded velocity (`TVEL`) and estimated actual velocity (`TVELA`).

The maximum allowable velocity error limit is established with the `SMVER` command.

TVEL Transfer Current Commanded Velocity

Type	`Transfer`
Syntax	`<a_><!>TVEL`

Units	`Reported value is in units/sec (scalable by SCLV)`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`n/a`
Default	`n/a`
Response	`TVEL:    *TVEL23.3450`

See Also	`DMEPIT, DMONAV, DMONBV, DMVLIM, ERES, SCALE, SCLV, TVELA, V,`
	`[ VEL ]`

Product	Rev
GT6K	6.0
GV6K	6.0

The `TVEL` command reports the internal commanded velocity. It is not the programmed velocity (`V`), and is limited by `DMVLIM`. The sign determines the direction of motion. If scaling is enabled (`SCALE1`), the `TVEL` value is scaled by the velocity scaling factor (`SCLV`).

Stepper Axes: If scaling is disabled (`SCALEØ`), the value is measured in revolutions/sec (actual velocity in commanded counts/sec divided by the drive resolution `DRES` value).

Servo Axes: If scaling is disabled (`SCALEØ`), the value is measured in encoder revs/sec or resolver revs/sec.

TVELA Transfer Current Actual Velocity

Type	`Transfer`
Syntax	`<a_><!>TVELA`

Units	`Reported value is in units/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

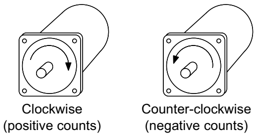
Range	`n/a`
Default	`n/a`
Response	`TVELA:   *TVELA+1.55`

See Also	`DMEPIT, DMONAV, DMONBV, DMVLIM, SCALE, SCLV, SFB, TVEL, V,`
	`[ VEL ], [ VELA ]`

Product	Rev
GT6K	6.0
GV6K	6.0

For servos, the `TVELA` command reports the velocity as derived from the feedback device. The sign determines the direction of motion.

Rotary Motors:
Positive values represent clockwise motion and negative values represent counter-clockwise motion (assuming you connected the feedback device according to instructions in the *Hardware Installation Guide*).



You can use the `TVELA` command at all times; therefore, even if no motion is being commanded, `TVELA` will still report a non-zero value as it detects the servoing action.

Units of Measure:

GT6K Steppers: The value reported by steppers is the `TVEL` value, ***not*** velocity derived from the feedback device. If scaling is disabled (`SCALEØ`), the value is measured in revolutions/sec (actual velocity in commanded counts/sec divided by the drive resolution `DRES` value).

GV6K Servos: If scaling is enabled (`SCALE1`), the velocity value will be scaled by the velocity scaling factor (`SCLV`). If scaling is not enabled (`SCALEØ`), the value returned will be in encoder revs/sec or resolver revs/sec.

Example:

```
TVELA            ; Reports the current actual velocity; since no motion is
                 ; commanded, the servoing velocities are reported.
                 ; Example response is:  *TVELA+0.0097
```

TVMAS Transfer Current Master Velocity

		Product	Rev
Type	Following and Transfer	GT6K	6.0
Syntax	<a_><!>TVMAS	GV6K	6.0
Units	n/a		
Range	n/a		
Default	n/a		
Response	TVMAS *TVMAS+0		
See Also	FFILT, FOLMAS, SCALE, SCLMAS, V, [VMAS]		

The TVMAS command transfers the current velocity of the master. The master must be assigned first (FOLMAS command) before this command will be useful.

The precision of the reported TVMAS value is dependent upon the FFILT filter value (details are provided in the "Master Position Filtering" section in the Following chapter of the *Programmer's Guide.*

If scaling is enabled (SCALE1), the value returned is scaled by the master scaling factor (SCLMAS). If scaling is disabled (SCALE0), the value returned is in counts/sec.

[TW] Thumbwheel Assignment

		Product	Rev
Type	Assignment or Comparison	GT6K	6.0
Syntax	TWi (See below for examples)	GV6K	6.0
Units	i = sets used by INPLC, INSTW, OUTPLC and OUTTW		
Range	1-8		
Default	n/a		
Response	n/a		
See Also	INPLC, INSTW, OUTPLC, OUTTW, [SS], TSS		

The TW command, executed from within another command, reads data from a parallel device and loads it into the command field the TW command is occupying. Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by <r>) or and integer value (denoted by <i>), you can use the TW substitution (e.g., V(TW)).

The value of the TW command designates which input and output set to use. TW values 1-4 correspond to INSTW and OUTTW sets 1 - 4, respectively. TW values 5-8 correspond to INPLC and OUTPLC sets 1 - 4, respectively.

The TW command can be used as a variable assignment (VAR1=TW2) or in another command (e.g., A(TW2)). However, the TW command cannot be used in an expression such as VAR4=1 + TW2 or IF(TW2<8).

For more information on interfacing thumbwheels, refer to the *Programmer's Guide*

Example:

```
INSTW2,1-4,5        ; Set INSTW set 2 as BCD digits on onboard inputs 1-4, with
                    ; input 5 as the sign bit
OUTTW2,1-3,4,50     ; Set OUTTW set 2 as output strobes on onboard outputs 1-3,
                    ; with output 4 as the output enable bit, and strobe time
                    ; of 50 milliseconds
A(TW2)              ; Read data into acceleration using INSTW set 2 and
                    ; OUTTW set 2 as the data configuration
```

UNTIL( ) Until Part of Repeat Statement

Type	`Program Flow Control`
Syntax	`<a_><!>UNTIL(expression)`
Units	`n/a`
Range	`Up to 80 characters (including parentheses)`
Default	`n/a`
Response	`n/a`
See Also	`JUMP, REPEAT`

Product	Rev
GT6K	6.0
GV6K	6.0

The `UNTIL()` command, in conjunction with the `REPEAT` command, provide a means of conditional program flow. The `REPEAT` command marks the beginning of the conditional statement. The commands between the `REPEAT` and the `UNTIL` command are executed at least once. Upon reaching the `UNTIL` command, the expression contained within the `UNTIL` command is evaluated. If the expression is false, the program flow is redirected to the first command after the `REPEAT` command. If the expression is true, the first command after the `UNTIL` command is executed.

Up to 16 levels of `REPEAT ... UNTIL()` commands may be nested.

NOTE: Be careful about performing a `GOTO` between `REPEAT` and `UNTIL`. Branching to a different location within the same program will cause the next `REPEAT` statement encountered to be nested within the previous `REPEAT` statement, unless an `UNTIL` command has already been encountered. The `JUMP` command should be used in this case.

All logical operators (`AND`, `OR`, `NOT`), and all relational operators (=, >, >=, <, <=, <>) can be used within the `UNTIL` expression. There is no limit on the number of logical operators, or on the number of relational operators allowed within a single `UNTIL` expression.

The limiting factor for the `UNTIL` expression is the command length. The total character count for the `UNTIL` command and expression cannot exceed 80 characters. For example, if you add all the letters in the `UNTIL` command and the letters within the `()` expression, including the parentheses and excluding the spaces, this count must be less than or equal to 80.

All assignment operators (`A`, `AD`, `ANI`, `AS`, `D`, `DPTR`, `ER`, `IN`, `INO`, `MOV`, `OUT`, `PC`, `PCC`, `PCE`, `PCMS`, `PE`, `PER`, `SS`, `TIM`, `US`, `V`, `VEL`, etc.) can be used within the `UNTIL` expression.

Example:

```
REPEAT           ; Beginning of REPEAT ... UNTIL( ) loop
GO1              ; Initiate motion
IF(IN=b1X0)      ; IF condition: if onboard input 1 = 1, input 3 = Ø
VAR1=VAR1+1      ; If condition comes true increment variable 1 by 1
ELSE             ; Else part of IF condition
TPE              ; If condition does not come true transfer position of encoder
NIF              ; End IF statement
UNTIL(VAR1=12)   ; Repeat loop until variable 1 = 12
```

[US] User Status

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`INDUSE, INDUST, TUS`

Product	Rev
GT6K	6.0
GV6K	6.0

The User Status (`US`) operator is used to assign the user status bits to a binary variable, or to make a comparison against a binary or hexadecimal value. To make a comparison against a binary value, the letter b (b or B) must be placed in front of the value. The binary value itself must only contain ones, zeros, or Xs (1, Ø, X, x). To make a comparison against a hexadecimal value, the letter h (h or H) must be placed in front of the value. The hexadecimal value itself must only contain the letters A through F, or the numbers Ø through 9.

Syntax: `VARBn=US` where "n" is the binary variable number,
or `US` can be used in an expression such as `IF(US=b11Ø1)`, or `IF(US=h7)`

All 16 bits of the user status word are defined with the `INDUST` command. Each bit can correspond to an axis status bit, a system status bit, or an input.

You can use the bit select (`.`) operator to assign only one bit of the user status value to a binary variable, instead of all 16. For example, `VARB1=US.12` assigns user status bit 12 to binary variable 1.

Example:

```
VARB1=US           ; User status assigned to binary variable 1
VARB2=US.12        ; User status bit 12 assigned to binary variable 2
VARB2              ; Response, if bit 12 is set to 1, will be:
                   ;    *VARB2=XXXX_XXXX_XXX1_XXXX_XXXX_XXXX_XXXX_XXXX
IF(US=b111011X11)  ; If the user status contains 1's in bit locations
                   ; 1, 2, 3, 5, 6, 8, and 9, and a 0 in bit location 4,
                   ; do the IF statement
  TREV             ; Transfer revision level
ELSE               ; Else
  IF(US=h7F00)     ; If the user status contains 1's in bit locations
                   ; 1, 2, 3, 5, 6, 7, and 8, and 0's in every other bit
                   ; location, do the IF statement
    TSTAT          ; Transfer statistics
  NIF              ; End of second IF statement
NIF                ; End of first IF statement
```

V Velocity

Type	`Motion`
Syntax	`<a_><!>V<r>`

Units	`r = units/sec`
	`(linear motors: see DMEPIT for linear/rotary conversion)`

Range	`Stepper Axes:0.0000-60.0000  (after conversion to revs/sec)`
	`Servo Axes:  0.0000-200.0000 (after conversion to revs/sec;`
	`if ERES > 10,000, maximum = 2,000,000/ERES)`

Default	`1.0000`
Response	`V:   *V1.0000`
See Also	`DMEPIT, GO, MC, SCALE, SCLV, TSTAT, TVEL, TVELA, [ V ], [ VEL ], [ VELA ], VF`

Product	Rev
GT6K	6.0
GV6K	6.0

The Velocity (`V`) command defines the speed at which the motor will run when given a `GO` command. The motor will attempt to accelerate at a predefined acceleration rate (`A`), before reaching the velocity specified (`V`).

The velocity remains set until you change it with a subsequent velocity command. Velocities outside the valid range are flagged as an error, with a message `*INVALID DATA-FIELD x`, where `x` is the field number. When an invalid velocity is entered the previous velocity value is retained.

The `V` command value may be used in variable (`VARI`) assignments, and in `IF` and `WAIT` conditional statements. In addition, `VARI` variables may be substituted for the `V` command value.

UNITS OF MEASURE and **SCALING**: refer to page 16.

ON-THE-FLY CHANGES: While running in the continuous mode (`MC1`), you can change velocity *on the fly* (while motion is in progress) in two ways. One way is to send an immediate velocity command (`!V`) followed by an immediate go command (`!GO`). The other, and more common, way is to enable the continuous command execution mode (`COMEXC1`) and execute a buffered velocity command (`V`) followed by a buffered go command (`GO`).

Example:

```
SCALE1                 ; Enable scaling
SCLA25000              ; Set the acceleration scaling factor to
                       ; 25000 counts/unit/unit
SCLV25000              ; Set the velocity scaling factor to 25000 counts/unit
SCLD1                  ; Set the distance scaling factor to 1 count/unit
DEL proge              ; Delete program called proge
DEF proge              ; Begin definition of program called proge
MA0                    ; Incremental positioning mode
MC0                    ; Preset positioning mode
A10                    ; Set the acceleration to 10 units/sec/sec
V1                     ; Set the velocity to 1 units/sec
D100000                ; Set the distance to 100000 units
GO1                    ; Initiate motion
END                    ; End definition of proge
```

[V] Velocity (Programmed) Assignment

Type	Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	GO, SCALE, SCLV, V, [VEL]

Product	Rev
GT6K	6.0
GV6K	6.0

The velocity assignment operator (V) is used to compare the programmed velocity value to another value or variable, or to assign the current programmed velocity to a variable.

Syntax: VARn=V where "n" is the variable number, or V can be used in an expression such as IF(V<25)

The (V) value used in any comparison, or in any assignment statement is the programmed (V) value. If the actual velocity information is required, refer to the VEL or VELA command.

UNITS OF MEASURE and **SCALING**: refer to page 16.

Example:

```
IF(V<25)          ; If the programmed velocity is less than 25
                  ; units/sec, then do the statements between the IF and NIF
VAR1=V*2          ; Variable 1 = programmed velocity times 2
V(VAR1)           ; Set the velocity to the value of variable 1
NIF               ; End the IF statement
```

VAR Numeric Variable Assignment

Type	Variable
Syntax	<a_><!>VAR<i><=r>

Units	i = variable number
	r = number or expression

Range	i = 1-225
	r = ±999,999,999.99999999

Default	n/a
Response	VAR1: *VAR1=+0.0
See Also	DVAR, VARB, VARCLR, VARI, VCVT, VARS, WRVAR

Product	Rev
GT6K	6.0
GV6K	6.0

Numeric variables can be used to store any real number value, with a range from -999,999,999.99999999 to +999,999,999.99999999. The information is assigned to the variable with the equal sign (e.g., VAR1=32.3).

All variables (numeric [VAR], integer [VARI], binary [VARB], and string [VARS]) are automatically stored in battery-backed RAM.

Variables are also used in conjunction with mathematical (=, +, -, *, /, SQRT), trigonometric (ATAN, COS, PI, SIN, TAN), and bitwise operators (&, |, ^, ~). For example, VAR1=(3+4-7*4/4+3-2/1.5)*3.

Each variable expression must be less than 80 characters in length, including the VAR1= part of the expression.

Numeric data can also be read into a variable, through the use of the READ , DAT, or TW commands (e.g., VAR1=READ1).

All variables can be used within commands that require a real or integer value. For example, the A command requires real values for acceleration; therefore, the command A(VAR1) is legal. Indirect variable assignments are also legal; (e.g., VAR(VAR1)=5 or VAR(VAR2)=VAR(VAR4)).

Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by <r>) or an integer value (denoted by <i>), you can use the VAR substitution.

Example:

```
VAR1=2*PI                ; Set Variable 1 to 2 pi
D(VAR2)                  ; Set the distance value equal to variable 2
```

Indirect Variables: Numeric variables can be used indirectly. Only one level of indirection is possible (e.g., VAR(VAR(VARn)) is not a legal command). The example below shows how indirect variables are used to clear 50 variables (from 1 to 50).

Example:

```
VAR51 = 1                ; Set Variable 51 to 1
REPEAT                   ; Begin repeat/until loop
VAR(VAR51) = 0           ; Clear variables (e.g., if VAR51 = 8,
                         ; then VAR(VAR51)=0 is equivalent to VAR8=0)
VAR51 = VAR51 + 1        ; Increment counter
UNTIL (VAR51 = 51)       ; End repeat/until loop
```

VARB Binary Variable Assignment

Type	Variable
Syntax	<a_><!>VARB<i><=bb...bbb> (32 bits) bit select syntax: VARB<i>.<bit #>-<b>
Units	i = variable number

Range	i = 1-125
	b = 0, 1, X, or x

Default	n/a
Response	VARB1: *VARB1=XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX
See Also	DVARB, PLCP, VAR, VARI, VARCLR, VARS, VCVT, WRVARB

Product	**Rev**
GT6K	6.0
GV6K	6.0

Binary variables can be used to store any 32-bit or less binary value. The 32-bit binary value must be in the form of 32 ones, zeros, or Xs. The information is assigned to the binary variable with the equal sign.

All variables (numeric [VAR], integer [VARI], binary [VARB], and string [VARS]) are automatically stored in battery-backed RAM.

Example: VARB1=b1111ØØØØ1111XXXX1111ØØØØxxxx1111

Notice that the letter "b" is required. The "b" signifies binary: 1's, Ø's, and X's only.

Example: VARB1.14-1

This is a shortcut to change only the state of VARB1 bit #14 to "1".

Example: VARB1=h7F4356A3

Notice that the letter "h" is required. The "h" signifies hexadecimal: Ø-9, A-F only.

Binary variables are also used in conjunction with bitwise operators (&, |, ^, and ~).
Example:VARB1=VARB2 | VARB3 & b1111ØØØØ11ØØ1

The expression must be less than 80 characters in length, including the (VARB1=b or VARB1=h) part of the expression.

NOTE: When assigning a binary variable, any bit set to “x” remains “x” until set to “1” or “0”. Any bit that is unspecified is set to “x”.

All binary variables can be used to set bits for commands that require at least 4 bits of binary information. For example, the OUT command requires more than 4 bits of binary information; therefore, the command OUT(VARB1) is legal.

Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a binary value (denoted by <b>), you can use the VARB substitution.

Example:
```
VARB1=b1110 & hA    ; Binary variable 1 is set to binary 1110 bitwise
                    ; "AND"ed with hexadecimal A
VARB1=IN.7          ; State of onboard input bit 7 assigned to binary variable 1
OUT(VARB2)          ; State of all onboard outputs assigned by binary variable 2
```

VARCLR Variable Clear

Type	Variable
Syntax	<a_><!>VARCLR
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	DVAR, DVARI, DVARB, VAR, VARB, VARI, VARS

Product	Rev
GT6K	6.0
GV6K	6.0

VARCLR resets all numeric variables (VAR), integer variables (VARI), binary variables (VARB), and string variables (VARS) to their factory default values:

Numeric (VAR) variables are set to 0.0
Integer (VARI) variables are set to 0
Binary (VARB) variables are set to bxxxx_xxxx_xxxx_xxxx_xxxx_xxxx_xxxx_xxxx
String (VARS) variables are set to ""

VARI Integer Variable Assignment

Type	Variable
Syntax	<a_><!>VARI<i><=i>
Units	1st i = variable number 2nd i = integer number
Range	1st i = 1-225 2nd i = -2,147,483,647 to +2,147,483,647
Default	n/a
Response	VARI1: *VARI1=+Ø
See Also	DVARI, INVARI, VARB, VAR, VARCLR, VCVT, WRVARI

Product	Rev
GT6K	6.0
GV6K	6.0

Integer variables can be used to store integer number values, with a range from -2,147,483,647 to +2,147,483,647. The information is assigned to the variable with the equal sign (e.g., VARI1=32).

All variables (numeric [VAR], binary [VARB], integer [VARI], and string [VARS]) are automatically stored in battery-backed RAM.

Integer variables can be used with mathematical (=, +, -, *, /) and bitwise operators (&, |, ^, ~). For example, VARI1=(3+4-7*4/4+3-2/2)*3. Numeric (VAR) and integer (VARI) variables can be mixed in the mathematical expressions. The results, if fractional, are truncated. **NOTE**: VARI cannot be used with trigonometric operators (ATAN, COS, PI, SIN, TAN) and square root (SQRT).

Each variable expression must be less than 80 characters in length, including the VARI1= part of the expression.

Numeric data can also be read into a variable, through the use of the READ, DAT, or TW commands (e.g., VARI1=READ1). Setting an integer variable to a real number results in a truncation.

All integer variables can be used within commands that require a real or integer value. For example, the A command requires real values for acceleration; therefore, the command A(VARI1) is legal. Indirect variable assignments are also legal; (e.g., VARI(VARI1)=5 or VARI(VARI2)=VARI(VARI4)).

Integer variables should be used whenever possible to allow faster math operation than numeric variables (VAR).

Mapping inputs to a VARI variable: It is possible to map the binary value of a group of inputs to an integer variable. For details, refer o the INVARI command.

Rule of Thumb for command value substitutions: If the command syntax shows that the command field requires a real number (denoted by <r>) or an integer value (denoted by <i>, you can use the VARI substitution.

Example:

```
VARI1=2*3            ; Set Variable 1 to 6
D(VARI2)             ; Set the distance value equal to integer variable 2
```

Indirect Variables: Integer variables can be used indirectly. Only one level of indirection is possible (e.g., VARI(VARI(VARIn)) is not a legal command). The example below shows how indirect variables are used to clear 50 variables (from 1 to 50).

Example:

```
VARI51 = 1           ; Set Integer Variable 51 to 1
REPEAT               ; Begin repeat/until loop
VARI(VARI51) = 0     ; Clear variables (e.g., if VARI51 = 8, then
                     ; VARI(VARI51)=0 is equivalent to VARI8=0)
VARI51 = VARI51 + 1  ; Increment counter
UNTIL (VARI51 = 51)
```

VARS String Variable Assignment

		Product	Rev
Type	Variable	GT6K	6.0
Syntax	<a_><!>VARS<i><="message">	GV6K	6.0

Units	i = variable number
	message = text string		

Range	i = 1-25
	Message = up to 50 characters		

Default	n/a		
Response	VARS1: *VARS1="HI JOHN"		
See Also	', [\ ], EOT, [READ], VAR, VARB, VARCLR, VARI, WRITE, WRVARS		

String variables can be assigned a character string up to 50 characters long. The characters within the string can be any character except the quote ("), the semicolon (;), and the colon (:). The backslash character (\) immediately followed by a number is okay.

All variables (numeric [VAR], integer [VARI], binary [VARB], and string [VARS]) are automatically stored in battery-backed RAM.

To place specific control characters that are not directly available on the keyboard within a character string, use the backslash character (\), followed by the control character's ASCII decimal equivalent. Multiple control characters can be sent.

For example, to set the string for variable #1 equal to `HI MOM<cr>`, use the command `VARS1="HI MOM\13"` where `\13` corresponds to the carriage return character.

Common characters and their ASCII equivalent value:

Character	Description	ASCII Decimal Value
`<lf>`	Line Feed	10
`<cr>`	Carriage Return	13
`"`	Quote	34
`:`	Colon	58
`;`	Semi-colon	59
`\`	Backslash	92

You can copy one `VARS` to another `VARS`. `VARSn=VARSm` may be used, as well as variable substitution for "`n`" or "`m`".

Example:

```
VARS1="Enter velocity >"     ; Assign a message to string variable #1
VAR2=READ1                   ; Transmit string variable 1, and wait for numeric
                             ; data entered in the format of !'<data>.
                             ; Once numeric data is received, place it in
                             ; numeric variable 2.
                             ; Example of data entry is to type "!'10.0", which
                             ; will assign numeric variable 2 the value 10.00
```

VCVT Variable Type Conversion

			Product	Rev
Type	`Operator (Mathematical)`		GT6K	6.0
Syntax	`See below`		GV6K	6.0
Units	`n/a`			
Range	`n/a`			
Default	`n/a`			
Response	`n/a`			
See Also	`VAR, VARB, VARI`			

Using `VCVT` operator, you can convert numeric (`VAR` or `VARI`) values to binary (`VARB`) values, and vice versa. The operation is a signed operation as the binary value is interpreted as a two's complement number, with the least significant bit (LSB) on the left and the most significant bit (MSB) on the right. A *don't care* (`X`) in a binary value will be interpreted as a zero (`Ø`).

If the mathematical statement's result is a numeric value, then `VCVT` converts binary values to numeric values. If the statement's result is a binary value, then `VCVT` converts numeric values to binary values.

You can also convert real (`VAR`) values to integer (`VARI`) values (real values are truncated in the process).

NOTE: Numeric variables (`VAR`) have insufficient range to convert a full 32-bit binary variable (`VARB`). For example, executing the `VARB1=h00000004` command and then the `VAR1=VCVT(VARB1)` command yields an `INVALID DATA` error.

Numeric-to-Binary Conversion:

```
VARB1=-5              ; Set numeric variable value = -5
VARB1=VCVT(VAR1)      ; Convert the numeric value to a binary value and
                      ; store in VARB1
VARB1                 ; Display value of VARB1.  The response should be:
                      ;    *VARB1=1101_1111_1111_1111_1111_1111_1111_1111

VAR1=25               ; Set numeric variable value = 25
VARB1=VCVT(VAR1)      ; Convert the numeric value to a binary value and
                      ; store in VARB1
VARB1                 ; Display value of VARB1.  The response should be:
                      ;    *VARB1=1001_1000_0000_0000_0000_0000_0000_0000
```

Binary-to-Numeric Conversion:

```
VARB1=b0010_0110_0000_0000_0000_0000_0000_0000  ; Set binary variable = +100.0
VAR1=VCVT(VARB1)       ; Convert the binary value to a numeric value
VAR1                   ; *VAR1=+100.0
```

[VEL] Velocity (Commanded) Assignment

			Product	**Rev**
Type	`Assignment or Comparison`		GT6K	6.0
Syntax	`See below`		GV6K	6.0
Units	`n/a`			
Range	`n/a`			
Default	`n/a`			
Response	`n/a`			
See Also	`SCALE, SCLV, SFB, TVEL, TVELA, V, [ V ], VELA`			

Use the VEL operator to compare the current *commanded* velocity to another value or variable, or to assign the current commanded velocity to a variable. The velocity value used in any comparison, or in any assignment statement, is the current commanded velocity value, not the *programmed* velocity (V) or the actual velocity as measured from the feedback device (VELA).

Syntax: VARn=VEL where "n" is the variable number, or VEL can be used in an expression such as IF(VEL>4).

The VEL value represents the current commanded velocity. It is not the programmed velocity (V). If scaling is enabled (SCALE1), the VEL value is scaled by the velocity scaling factor (SCLV).

GT6K Steppers: If scaling is disabled (SCALEØ), the value is measured in revolutions/sec (actual velocity in commanded counts/sec divided by the drive resolution DRES value).

GV6K Servos: If scaling is disabled (SCALEØ), the value is measured in encoder revs/sec or resolver revs/sec.

Example:

```
IF(VEL<25)         ; If the current velocity is less than 25 units/sec,
                   ; then do the statements between the IF and NIF
  VAR1=V*2         ; Variable 1 = programmed velocity times 2
NIF                ; End the IF statement
```

[VELA] Velocity (Actual) Assignment

Type	`Assignment or Comparison`
Syntax	`See below`
Units	`n/a`
Range	`n/a`
Default	`n/a`
Response	`n/a`
See Also	`ERES, SCLV, TVEL, TVELA, [V], V, [VEL]`

Product	Rev
GT6K	6.0
GV6K	6.0

The VELA operator is used to compare the current *actual* velocity (as derived from the feedback device) to another value or variable, or to assign the current velocity to a variable. If the programmed velocity information is required, refer to the [V] operator; if the current commanded velocity information is required, refer to the [VEL] operator.

The sign determines the direction of motion. You can use the VELA operator at all times; therefore, even if no motion is being commanded, TVELA will still report a non-zero value as it detects the servoing action.

Syntax: VARn=VELA where "n" is the variable number, or VELA can be used in an expression such as IF(VELA>4).

Units of Measure:

GT6K Steppers: The velocity is always revs/sec (actual velocity in counts/sec multiplied by the ERES value if in ENCCNT1 mode, or multiplied by DRES if in ENCCNT0 mode).

GV6K Servos: If scaling is enabled (SCALE1), the velocity value will be scaled by the velocity scaling factor (SCLV). If scaling is not enabled (SCALEØ), the value returned will be in encoder revs/sec or resolver revs/sec.

Example:

```
IF(VELA<25)     ; If the current velocity is less than 25 units/sec,
                ; then do the statements between IF and NIF
  VAR1=V*2      ; Variable 1 = programmed velocity times 2
NIF             ; End the IF statement
```

VF Final Velocity

Type	`Compiled Motion`
Syntax	`<a_><!>VF<r>`
Units	`n/a`
Range	`0 (non-zero values result in error message)`
Default	`0`
Response	`n/a`
See Also	`FOLRN, FOLRD, FOLMAS, FOLMD, GOBUF, SCLD, FOLEN, V`

Product	Rev
GT6K	6.0
GV6K	6.0

The VF command designates that the motor will move the load the programmed distance in a preset GOBUF segment, completing the move at a final speed of zero. VF applies only to the next (subsequent) GOBUF, which marks an intermediate "end of move" within a profile. VF is used only in conjunction with the GOBUF command. Normal preset GO moves always finish with zero velocity.

The VF command remains in effect for the affected axis until a GOBUF is executed on that axis, or until you issue a RESET command.

Any non-zero value that is entered for VF will result in an immediate error message.

[VMAS] Current Master Velocity

Type	Following; Assignment or Comparison
Syntax	See below
Units	n/a
Range	n/a
Default	n/a
Response	n/a
See Also	FFILT, FMCNEW, FMCP, FOLMAS, FOLMD, SCALE, SCLMAS, TVMAS

Product	Rev
GT6K	6.0
GV6K	6.0

The VMAS command is used to assign the master velocity value to a variable, or to make a comparison against another value. <u>The master must be assigned first (FOLMAS command) before this command will be useful.</u>

Syntax: VARn=VMAS where "n" is the variable number, or VMAS can be used in an expression such as IF(VMAS>1Ø).

The precision of the VMAS value is dependent upon the FFILT filter value.

If scaling is enabled (SCALE1), the velocity value is scaled by the master scaling factor (SCLMAS). If scaling is disabled (SCALEØ), the velocity value is in counts/sec.

Example:

```
IF(VMAS>4.3)      ; If the master is traveling at more than
                  ; 4.3 user units/sec then do the IF statement
  OUT.4=b1        ; Set onboard output #4 to 1
NIF               ; End of IF statement
VAR14=VMAS        ; Set VAR14 to master velocity
```

WAIT( ) Wait for a Specific Condition

Type	Program Flow Control
Syntax	<a_><!>WAIT(expression)
Units	n/a
Range	Up to 80 characters (including parentheses)
Default	n/a
Response	n/a
See Also	FMCLEN, FMCNEW, FMCP, GOWHEN, IF, NWHILE, REPEAT, [SS], T, TSS, UNTIL, WHILE

Product	Rev
GT6K	6.0
GV6K	6.0

The WAIT command is used to wait for a specific expression to evaluate true. No commands, except for immediate commands (a command preceded with !), after the WAIT command will be processed until the expression contained within the parentheses of the WAIT command evaluates true. The COMEXC command has no effect on the WAIT command. When a wait condition is pending, system status (TSS) bit #14 is set.

All logical operators (AND, OR, NOT), and all relational operators (=, >, >=, <, <=, <>) can be used within the WAIT( ) expression. There is no limit on the number of logical operators, or on the number of relational operators allowed within a single WAIT( ) expression.

The limiting factor for the WAIT( ) expression is the command length. The total character count for the WAIT( ) command and expression cannot exceed 80 characters. For example, if you add all the letters in the WAIT command and the letters within the ( ) expression, including the parenthesis and excluding the spaces, this count must be less than or equal to 80.

All assignment operators (A, AD, AS, D, ER, IN, INO, MOV, OUT, PC, PCE, PCMS, PE, PER, SS, TIM, US, V, VEL, etc.) can be used within the WAIT( ) expression.

Example:

```
MC1             ; Mode continuous
COMEXC1         ; Enable continuous command mode
GO1             ; Initiate motion
WAIT(IN=b1)     ; Wait for input 1 to be active
S1              ; Stop motion
WAIT(MOV=b0)    ; Wait for motion complete
COMEXC0         ; Disable continuous command execution mode
```

WHILE( ) WHILE Statement

Type	`Program Flow Control; Conditional Branching`
Syntax	`<a_><!>WHILE(expression)`
Units	`n/a`
Range	`Up to 80 characters (including parentheses)`
Default	`n/a`
Response	`n/a`
See Also	`IF, JUMP, NWHILE, REPEAT, UNTIL, WAIT`

Product	**Rev**
GT6K	6.0
GV6K	6.0

The `WHILE` command, in conjunction with the `NWHILE` command, provide a means of conditional program flow. The `WHILE` command marks the beginning of the conditional statement, the `NWHILE` command marks the end. If the expression contained within the parenthesis of the `WHILE` command evaluates true, then the commands between the `WHILE` and `NWHILE` are executed, and continue to execute as long as the expression evaluates true. If the expression evaluates false, then program execution jumps to the first command after the `NWHILE`. Up to 16 levels of `WHILE ... NWHILE` commands may be nested.

Programming order: `WHILE(expression) ...commands... NWHILE`

NOTE: Be careful about performing a `GOTO` between `WHILE` and `NWHILE`. Branching to a different location within the same program will cause the next `WHILE` statement encountered to be nested within the previous `WHILE` statement, unless a `NWHILE` command has already been encountered. The `JUMP` command should be used in this situation.

All logical operators (`AND`, `OR`, `NOT`), and all relational operators (=, >, >=, <, <=, <>) can be used within the `WHILE()` expression. There is no limit on the number of logical operators, or on the number of relational operators allowed within a single `WHILE()` expression.

The limiting factor for the `WHILE()` expression is the command length. The total character count for the `WHILE()` command and expression cannot exceed 80 characters. For example, if you add all the letters in the `WHILE` command and the letters within the `()` expression, including the parenthesis and excluding the spaces, this count must be less than or equal to 80.

All assignment operators (`A`, `AD`, `AS`, `D`, `ER`, `IN`, `INO`, `MOV`, `OUT`, `PC`, `PCE`, `PCMS`, `PE`, `PER`, `SS`, `TIM`, `US`, `V`, `VEL`, etc.) can be used within the `WHILE()` expression.

Example:

```
WHILE(IN=b1X0)   ; While onboard input 1 = 1, input 3 = Ø,
                 ; execute commands between WHILE and NWHILE
T5               ; Wait 5 seconds
TPE              ; Transfer position of all encoders
NWHILE           ; End WHILE statement
WHILE(1ANV<2.3)  ; While analog channel 1's voltage is less than 2.3 volts,
                 ; execute commands between WHILE and NWHILE
TPC              ; Transfer commanded position
NWHILE           ; End WHILE statement
```

WRITE Write a Message

Type	`Communication Interface`
Syntax	`<a_><!>WRITE"<message>"`
Units	`n/a`
Range	`Up to 69 characters (may not use ", ; or :)`

Default	`Messages are written to COM1 by default`
	`NOTE: “COM1” is the “RS-232/485” or “ETHERNET” connector.`
	`“COM2” is the “RS-232” connector.`

Response	`WRITE"message":    message`
See Also	`[ \ ], EOT, PORT, [ READ ], VARS, WRVAR, WRVARB, WRVARS`

Product	Rev
GT6K	6.0
GV6K	6.0

The `WRITE` command provides an efficient way of transmitting message strings to the Ethernet port and the RS-232 or RS-485 ports. These messages can then be used by the operating program. The `EOT` command characters will be transmitted after the message.

Each message can be assigned a character string up to 69 characters long. The characters within the string can be any character except the quote (`"`), the colon (`:`), and the asterisk (`*`).

To place specific control characters that are not directly available on the keyboard within the character string, use the backslash character (`\`), followed by the control character’s ASCII decimal equivalent. Multiple control characters can be sent. For example, to set the message equal to `HI MOM<cr>`, use the command `WRITE"HI MOM\13"` where `\13` corresponds to the carriage return character. Common characters and their ASCII equivalent values are listed below:

Character	Description	ASCII Decimal Value
`<lf>`	Line Feed	10
`<cr>`	Carriage Return	13
`"`	Quote	34
`:`	Colon	58
`;`	Semi-colon	59
`\`	Backslash	92

NOTE: All text strings are transmitted in UPPER CASE. If you must transmit lower-case strings, use the ASCII decimal equivalent for each character (see ASCII table in Appendix B). For example, `WRITE"\106\117\110\107"` will transmit the text string “`junk`” in lower-case letters.

NOTE: Upon power up or after a reset, by default the `WRITE` command writes messages to COM1. See the `PORT` command for instructions on writing messages to COM2. If you want to automatically write messages to COM2 after power up or a reset, consider putting the `PORT` command in your `STARTP` program. See the `STARTP` command for more information.

Example:

```
WRITE"It's a wonderful life!"    ; Send the message "IT'S A WONDERFUL LIFE!"
```

WRVAR Write a Numeric Variable

Type	`Communication Interface`
Syntax	`<a_><!>WRVAR<i>`
Units	`i = variable number`
Range	`i = 1-225`
Default	`n/a`
Response	`WRVAR1:  +0.0`
See Also	`EOT, [ READ ], VAR, WRITE, WRVARB, WRVARI, WRVARS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `WRVAR` command to transfer a specific numeric variable (`VAR`) to the Ethernet port and the RS-232C or RS-485 ports. Only the value and the `EOT` command characters are transmitted.

Example:

```
VAR1=100          ; Set variable 1 equal to 100
WRVAR1            ; Transmit variable 1 (the value +100.0 is transmitted)
```

WRVARB Write a Binary Variable

Type	`Communication Interface`
Syntax	`<a_><!>WRVARB<i>`
Units	`i = variable number`
Range	`i = 1-125`
Default	`n/a`
Response	`WRVARB1: XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX`
See Also	`EOT, [ READ ], VARB, WRITE, WRVAR, WRVARI, WRVARS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `WRVARB` command to transfer a specific binary variable (`VARB`) to the Ethernet port and the RS-232C or RS-485 ports. Only the binary value and the `EOT` command characters are transmitted.

Example:

```
VARB1=b1101       ; Set binary variable 1 to 1101
WRVARB1           ; Transmit binary variable 1
                  ; (value transmitted =1101_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX)
```

WRVARI Write an Integer Variable

Type	`Communication Interface`
Syntax	`<a_><!>WRVARI<i><=i>`
Units	1st `i = variable number` 2nd `i = integer number`
Range	1st `i = 1-225` 2nd `i = -2,147,483,647 to +2,147,483,647`
Default	`n/a`
Response	`WRVARI1: +0`
See Also	`EOT, [ READ ], VARI, WRITE, WRVAR, WRVARB, WRVARS`

Product	**Rev**
GT6K	6.0
GV6K	6.0

Use the `WRVARI` command to transfer a specific integer variable (`VARI`) to the Ethernet port and the RS-232C or RS-485 ports. Only the integer value and the `EOT` command characters are transmitted.

Integer variables should be used whenever possible to allow faster math operation than numeric variables (`VAR`).

Example:

```
VARI1=100         ; Set integer variable 1 equal to 100
WRVARI1           ; Transmit integer variable 1 (the value +100 is transmitted)
```

WRVARS Write a String Variable

Type	`Communication Interface`
Syntax	`<a_><!>WRVARS<i>`
Units	`i = variable number`
Range	`i = 1-25`
Default	`n/a`
Response	`WRVARS1:   No response until a string is placed in VARS1`
See Also	`EOT, [ READ ], VARS, WRITE, WRVAR , WRVARB, WRVARI`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `WRVARS` command to transfer a specific string variable (`VARS`) to the Ethernet port and the RS-232C or RS-485 ports. Only the string and the `EOT` command characters are transmitted.

NOTE: All text strings are transmitted in UPPER CASE. If you must transmit lower-case strings, use the ASCII decimal equivalent for each character (see ASCII table in Appendix B). For example, if you entered `VARS1="\106\117\110\107"`, the `WRVARS1` command will transmit the text string “`junk`” in lower-case letters.

Example:

```
VARS1="John L"    ; Set string variable 1 = "John L"
WRVARS1           ; Transmit string variable 1 (string "JOHN L" is transmitted)
```

XONOFF Enable/Disable XON / XOFF

Type	`Communication Interface`
Syntax	`<a_><!>XONOFF<b>`
Units	`b = enable bit`
Range	`0 (disable) or 1 (enable)`
Default	`1 for COM1, 0 for COM2 (PORT command setting determines which COM port’s XONOFF setting is checked)`
Response	`XONOFF   *XONOFF1`
See Also	`], [, BOT, DRPCHK, E, EOT, ERRBAD, ERROK, LOCK, PORT`

Product	Rev
GT6K	6.0
GV6K	6.0

Use the `XONOFF` command to enable or disable XON/XOFF (ASCII handshaking).

`XONOFF1` enables XON/XOFF, which allows the Gem6K to recognize ASCII handshaking control characters. When XON/XOFF is enabled, ASCII 17 or ^`Q` is a signal to start sending characters; ASCII 19 or ^`S` is a signal to stop sending characters. `XONOFFØ` disables XON/XOFF.

The `PORT` command determines which COM port is affected by the `XONOFF` command. Each port will track its `XON/XOFF` values

RS-485 Multi-drop: If you are using RS-485 multi-drop, disable XON/XOFF by executing the `PORT1` command followed by the `XONOFFØ` command.

NOTE: COM1 is the “RS-232/485” or “ETHERNET” connector; COM2 is the “RS-232” connector.

Appendix A: Gem6K Command List

(Firmware Revision 6.0)

Command	Description
%	Task Identifier
[!]	Immediate Command Identifier
[@]	Global Command Identifier
;	Begin Comment
$	Label Declaration
[#]	Step Through a Program
'	Enter Interactive Data
[.]	Bit Select
["]	Begin and End String
[\ ]	ASCII Character Designator
[=]	Assignment or Equivalence
[>]	Greater Than
[>=]	Greater Than or Equal
[<]	Less Than
[<=]	Less Than or Equal
[<>]	Not Equal
[( )]	Operation Priority Level
[+]	Addition
[-]	Subtraction
[*]	Multiplication
[/]	Division
[&]	Boolean And
[|]	Boolean Inclusive Or
[^]	Boolean Exclusive Or
[~( )]	Boolean Not
[<<]	Shift from Right to Left (bit 32 to bit 1)
[>>]	Shift from Left to Right (bit 1 to bit 32)
[	Send Response to Both COM Ports
]	Send Response to Alternate COM Port
A	Acceleration
[A]	Acceleration [operator]
AA	Acceleration, S-curve
AD	Deceleration
[AD]	Deceleration [operator]
ADA	Deceleration, S-curve
ADDR	Auto-Address Multiple Serial Units
[AND]	And [operator]
[ANI]	Analog Input Voltage [operator]
ANIEN	Analog Input Enable
ANIMAS	Assign Analog Input as Master
ANIRNG	Analog Input Voltage Range

Command	Description
ANO	Set Analog Output Voltage Value
[ANO]	Analog Output Voltage Value [operator]
[AS]	Axis Status [operator]
[ASX]	Axis Status, Extended [operator]
[ATAN( )]	Arc Tangent [operator]
BAUD	Baud Rate
BOT	Beginning of Transmission Characters
BP	Set a Program Break Point
BREAK	Terminate Program Execution
C	Continue Command Execution
CERRLG	Clear Error Log
COMEXC	Continuous Command Processing Mode
COMEXL	Continue Execution on End-of-Travel Limit
COMEXR	Continue Motion on Pause/Continue Input
COMEXS	Continue Execution on Stop
[COS( )]	Cosine [operator]
D	Distance
[D]	Distance [operator]
DABSD	Enable ABS Damping
DACTDP	Active Damping
[DAT]	Data Assignment [operator]
DATA	Data Statement
[DATP]	Data Program
DATPTR	Set Data Pointer
DATRST	Reset Data Pointer
DATSIZ	Data Program Size
DATTCH	Data Teach
DAUTOS	Auto Current Standby
DCLEAR	Clear RP240 Display
DCLRLR	Clear Latched Status Register Bits
DDAMPA	Damping During Acceleration/Deceleration
DEF	Begin Definition of Program
DEL	Delete Program
DELVIS	Electronic Viscosity
DIBW	Current Loop Bandwidth
DIFOLD	Current Foldback Enable
DIGN	Current Loop Gain
DJOG	Enable RP240 Jog Mode
[DKEY]	Value of RP240 Key
DLED	Turn RP240 LEDs ON/OFF
DMEPIT	Motor Electrical Pitch

Command	Description
DMODE	Drive Control Mode
DMONAS	Analog Monitor Output A – Scaling
DMONAV	Analog Monitor Output A – Variable
DMONBS	Analog Monitor Output B – Scaling
DMONBV	Analog Monitor Output B – Variable
DMTAMB	Motor Ambient Temperature
DMTD	Motor Damping
DMTIC	Continuous Current
DMTICD	Continuous Current Derating
DMTIND	Motor Inductance
DMTIP	Peak Current
DMTJ	Motor Rotor Inertia / Forcer Mass
DMTKE	Motor Ke
DMTLIM	Torque/Force Limit
DMTLMN	Minimum Motor Inductance
DMTLMX	Maximum Motor Inductance
DMTMAX	Maximum Motor Winding Temperature
DMTR	Identify (and Load) Motor
DMTRES	Motor Winding Resistance
DMTRWC	Motor Winding Thermal Resistance
DMTSCL	Torque/Force Scaling
DMTSTT	Motor Static Torque
DMTTCM	Motor Thermal Time Constant
DMTTCW	Motor Winding Time Constant
DMTW	Motor Rated Speed
DMVLIM	Velocity Limit
DNOTAD	Notch Filter A Depth
DNOTAF	Notch Filter A Frequency
DNOTAQ	Notch Filter A Quality Factor
DNOTBD	Notch Filter B Depth
DNOTBF	Notch Filter B Frequency
DNOTBQ	Notch Filter B Quality Factor
DNOTLD	Notch Lead Filter Break Frequency
DNOTLG	Notch Lag Filter Break Frequency
DPASS	Change RP240 Password
DPBW	Position Loop Bandwidth
DPCUR	Position RP240 Display Cursor
DPHBAL	Phase Balance
DPHOFA	Phase A Current Offset
DPHOFB	Phase B Current Offset
DPOLE	Number of Motor Pole Pairs
[DPTR]	Data Pointer Location [operator]
DPWM	Drive PWM Frequency
[DREAD]	Read RP240 Numeric Data [operator]
[DREADF]	Read RP240 Function Key [operator]
DREADI	RP240 Data Read, Immediate Mode
DRES	Drive Resolution
DRESET	Drive Reset
DRIVE	Drive Enable/Disable
DRPCHK	RP240 COM Port Check
DSTALL	Enable/Disable Drive Stall Detection
DSTP	Enable/Disable RP240 Stop Key
DVAR	Display Numeric Variable on RP240
DVARB	Display Binary Variable on RP240
DVARI	Display Integer Variable on RP240
DWAVEF	Waveform
DWRITE	Write Text to RP240
E	Enable Serial Communication
ECHO	Enable Communication Echo
ELSE	Else Condition of IF Statement
ENCCNT	Encoder Count Reference Enable
END	End Definition of Program
EOL	End-of-Line Termination Characters
EOT	End-of-Transmission Characters
[ER]	Error Status [operator]
ERASE	Erase All Programs
ERES	Encoder Resolution
ERRBAD	Error Prompt Characters
ERRDEF	Program Definition Prompt Characters
ERRLVL	Error Detection Level
ERROK	Good Prompt Characters
ERROR	Enable Error Checking
ERRORL	Error Log Selection
ERRORP	Assign an Error Program
ESDB	Stall Backlash Deadband
ESK	Kill on Stall
ESTALL	Enable Encoder Stall Detection
EXE	Execute Program from a Compiled Program
[FB]	Value of Feedback Device [operator]
FFILT	Following Filter
FGADV	Following Geared Advance
FLTDSB	Fault on Drive Disable (DRIVE0)
FMAXA	Follower Axis Maximum Acceleration
FMAXV	Follower Axis Maximum Velocity
FMCLEN	Master Cycle Length
FMCNEW	Restart Master Cycle Counting
FMCP	Initial Master Cycle Position
FOLEN	Enable Following Mode
FOLK	Following Kill, Limitations
FOLMAS	Assignment of Master to Follower
FOLMD	Master Distance
FOLRD	Denominator of Follower-to-Master Ratio
FOLRN	Numerator of Follower-to-Master Ratio
FOLRNF	Numerator of Final Follower-to-Master Ratio
FPPEN	Enable Master Position Prediction
[FS]	Following Status [operator]
FSHFC	Continuous Shift
FSHFD	Preset Shift
FVMACC	Virtual Master Count Acceleration
FVMFRQ	Virtual Master Count Frequency
GO	Initiate Motion
GOBUF	Store a Compiled Motion Segment
GOSUB	Call a Subroutine
GOTO	Go To a Program or Label
GOWHEN	Conditional Go
HALT	Terminate Program Execution
HELP	Technical Support Phone Numbers
HOM	Initiate Homing Operation
HOMA	Homing Acceleration
HOMAA	Homing Acceleration, S-curve
HOMAD	Homing Deceleration
HOMADA	Homing Deceleration, S-curve
HOMBAC	Backup to Home
HOMDF	Homing Final Direction
HOMEDG	Home Reference Edge
HOMV	Homing Velocity
HOMVF	Homing Velocity, Final Approach
HOMZ	Home to Encoder Z Channel
IF()	IF Statement
IN	Virtual Input Override

Command	Description
[IN]	Input Status [operator]
INDEB	Input Debounce Time
INDUSE	Enable User Status
INDUST	User Status Definition
INEN	Enable Specific Inputs
INFNC	Input Function Assignment
INLVL	Input Active Level
[INO]	Other Inputs (Enable Input) Status [operator]
INPLC	Establish PLC Data Inputs
INSELP	Enable Program Selection via Inputs
INSTW	Establish Thumbwheel Data Inputs
INTHW	Enable Checking for Alarm Events
INTSW	Force an Alarm Event
INVARI	Map Inputs to Integer Variable
JOG	Enable Jog Mode
JOGA	Jog Acceleration
JOGAA	Jog Acceleration, S-curve
JOGAD	Jog Deceleration
JOGADA	Jog Deceleration, S-curve
JOGVH	Jog Velocity, High
JOGVL	Jog Velocity, Low
JOY	Enable Joystick Mode
JOYA	Joystick Acceleration
JOYAA	Joystick Acceleration, S-curve
JOYAD	Joystick Deceleration
JOYADA	Joystick Deceleration, S-curve
JOYAXH	Joystick Analog Channel, High
JOYCDB	Joystick Center Deadband
JOYCTR	Joystick Center
JOYEDB	Joystick End Deadband
JOYVH	Joystick Velocity, High
JOYVL	Joystick Velocity, Low
JOYZ	Joystick Zero (Center)
JUMP	Jump to Program or Label (No Return)
K	Kill Motion
<ctrl>K	Kill Motion
KDRIVE	Disable Drive on Kill
KIOEN	Kill on EVM32 Disconnect
L	Loop
LDAMP	Load Damping
LH	Enable Hardware End-of-Travel Limits
LHAD	Hardware EOT Limits Deceleration
LHADA	Hardware EOT Limits Decel, S-curve
[LIM]	Hardware EOT & Home Limit Inputs, Status
LIMEN	Limit Input Enable
LIMFNC	Limit Input Function Assignment
LIMLVL	Hardware EOT & Home Inputs, Active Level
LJRAT	Load-to-Rotor/Forcer Inertia/Mass Ratio
LN	End of Loop
LOCK	Lock Resource to a Task
LS	Enable Software End-of-Travel Limits
LSAD	Software EOT Limits, Deceleration
LSADA	Software EOT Limits Decel, S-curve
LSNEG	Negative-Direction Software EOT Limit
LSPOS	Positive-Direction Software EOT Limit
LX	Terminate Loop
MA	Enable Absolute/Incremental Positioning
MC	Enable Continuous/Preset Positioning
MEMORY	Partition Product Memory
MEPOL	Master Encoder Polarity

Command	Description
MESND	Master Encoder Step & Direction Mode
[MOV]	Axis Moving Status [operator]
NIF	End IF Statement
[NMCY]	Master Cycle Number Status [operator]
[NOT]	Not [operator]
NTADDR	Set IP Address
NTCONN	Network Connect
NTFEN	Ethernet Communication Enable
NTID	Network Sharing Unit ID for Peer-to-Peer
NTIO	Network I/O Configuration
NTIP	Network IP Address
NTMASK	Ethernet Network Mask
NTMPRB	Network Map Binary Variables for Reading
NTMPRI	Network Map Integer Variables for Reading
NTMPWB	Network Map Binary Variable for Writing
NTMPWI	Network Map Integer Variable for Writing
NTPOLL	Network Polling Rate
NTRATE	Network Sharing Rate for Peer-to-Peer
[NTS]	Network Status
NTSELP	Network Select Program Enable
NTSFS	Ethernet Send Fast Status Packet
NTWRIT	Network (Ethernet) ASCII Write
NWHILE	End of WHILE Statement
ONCOND	Enable Program Interrupt (“On”) Conditions
ONIN	On an Input Condition GOSUB
ONP	On Condition Program Assignment
ONUS	On a User Status Condition GOSUB
ONVARA	On Numeric Variable 1 Condition GOSUB
ONVARB	On Numeric Variable 2 Condition GOSUB
[OR]	Or [operator]
ORES	Output Resolution
OUT	Activate Programmable Outputs
[OUT]	Programmable Outputs Status [operator]
OUTALL	Activate Programmable Outputs, Range
OUTBD	Brake Output Delay
OUTEN	Disable Programmable Outputs
OUTFNC	Programmable Output Function Assignment
OUTLVL	Programmable Output Active Level
OUTPA	Output on Position
OUTPLC	Establish PLC Strobe Outputs
OUTTW	Establish Thumbwheel Strobe Outputs
[PC]	Position Commanded [operator]
[PCC]	Captured Commanded Position [operator]
[PCE]	Position of Captured Encoder [operator]
[PCME]	Position of Captured Master Encoder [operator]
[PCMS]	Position of Captured Master Cycle [operator]
PCOMP	Compile a Profile or Program
[PE]	Position of Encoder [operator]
[PER]	Position Error [operator]
PESET	Set Encoder Absolute Position (steppers)
PEXE	Execute a Compiled Program
[PI]	Pi (π) [operator]
PLCP	Compiled PLC Program
PLN	End of Loop, Compiled Motion
PLOOP	Start of Loop, Compiled Motion
[PMAS]	Current Master Cycle Position [operator]
[PME]	Position of Master Encoder [operator]
PMECLR	Clear Master Encoder Absolute Position
PMESET	Set Master Encoder Absolute Position
PORT	Designate Destination COM Port

Command	Description
POUTA	Compiled Output (Compiled Motion)
PRUN	Run a Compiled Profile
PS	Pause Program Execution
PSET	Establish Absolute Position Reference
[PSHF]	Net Position Shift Status [operator]
[PSLV]	Commanded Follower Position [operator]
PUCOMP	Un-Compile a Compiled Profile
RADIAN	Specify Units in Radians or Degrees
RE	Enable Registration
[READ]	Read a Value
REG	Registration Distance
REGLOD	Registration Lockout Distance
REGSS	Registration Single-Shot
REPEAT	REPEAT Statement
RESET	Reset the Gem6K Drive
RFS	Return to Factory Settings
RUN	Begin Executing a Program
S	Stop Motion
[SC]	Controller Status [operator]
SCALE	Enable Scaling Factors
[SCAN]	PLC Scan Runtime [operator]
SCANP	Scan a Compiled PLC Program
SCLA	Acceleration Scale Factor
SCLD	Distance Scale Factor
SCLMAS	Master Axis Scale Factor
SCLV	Velocity Scale Factor
[SEG]	Number of Free Segment Buffers [operator]
SFB	Select Servo Feedback Source
SGAF	Gain – Acceleration Feedforward
SGENB	Enable a Servo Gain Set
SGINTE	Integrator Enable
SGIRAT	Current Damping Ratio
SGPRAT	Position Damping Ratio
SGPSIG	Velocity/Position Bandwidth Ratio
SGSET	Save a Servo Gain Set
SGVF	Gain – Velocity Feedforward
SGVRAT	Velocity Damping Ratio
SHALL	Hall Sensor Inversion
[SIN( )]	Sine [operator]
SINAMP	Virtual Master Sine Wave Amplitude
SINANG	Virtual Master Sine Wave Angle
SINGO	Virtual Master - Start Internal Sine Wave
SMPER	Maximum Allowable Position Error
SMVER	Maximum Allowable Velocity Error
[SQRT]	Square Root [operator]
SRSET	Resolver Offset Angle
[SS]	System Status [operator]
STARTP	Start-up Program
STEP	Enable Single Step Mode
STRGTD	Target Zone Distance
STRGTE	Enable Target Zone Mode
STRGTT	Target Zone Timeout Period
STRGTV	Target Zone Velocity
[SWAP]	Task Swap Assignment [operator]
T	Time Delay
TACC	Transfer Commanded Acceleration
[TAN( )]	Tangent [operator]
TANI	Transfer ANI Analog Input Voltage
TANO	Transfer Analog Output Voltage
TAS	Transfer Axis Status
TASF	Transfer Axis Status (full-text report)
[TASK]	Task Number Assignment [operator]
TASX	Transfer Axis Status, Extended
TASXF	Transfer Axis Status, Extended (full-text)
TCMDER	Transfer Command Error
TCS	Transfer Configuration Status
TDHRS	Transfer Operating Hours
TDICNT	Transfer Continuous Current Rating
TDIMAX	Transfer Maximum Current Rating
TDIR	Transfer Program Directory
TDPTR	Transfer Data Pointer Status
TDTEMP	Transfer Drive Temperature
TDVBUS	Transfer Bus Voltage
TER	Transfer Error Status
TERF	Transfer Error Status (full-text report)
TERRLG	Transfer Error Log
TEX	Transfer Program Execution Status
TFB	Transfer Position of Feedback Devices
TFS	Transfer Following Status
TFSF	Transfer Following Status (full-test report)
TGAIN	Transfer Servo Gains
THALL	Transfer Hall Sensor Values
[TIM]	Current Timer Value [operator]
TIMINT	Timer Value to Cause an Alarm Event
TIMST	Start Timer
TIMSTP	Stop Timer
TIN	Transfer Programmable Input Status
TINO	Transfer Other Input Status
TINOF	Transfer Other Input Status (full-text report)
TIO	Transfer Expansion I/O Status
TLABEL	Transfer Labels
TLIM	Transfer Hardware Limit Status
TMEM	Transfer Memory Usage
TMTEMP	Transfer Motor Temperature
TNMCY	Transfer Master Cycle Number
TNT	Transfer Ethernet Status
TNTMAC	Transfer Ethernet Address
TNTS	Transfer Network Status
TNTSF	Transfer Network Status (full-text report)
TOUT	Transfer Programmable Output Status
TPC	Transfer Commanded Position
TPCC	Transfer Captured Commanded Position
TPCE	Transfer Position of Captured Encoder
TPCME	Transfer Position of Captured Master Encoder
TPCMS	Transfer Position of Captured Master Cycle
TPE	Transfer Position of Encoder
TPER	Transfer Position Error
TPMAS	Transfer Position of Master (current cycle)
TPME	Transfer Position of Master Encoder
TPRA	Transfer Absolute Resolver Position
TPROG	Transfer Program Contents
TPSHF	Transfer Net Position Shift
TPSLV	Transfer Commanded Position of Follower
TRACE	Enable Program Trace Mode
TRACEP	Enable Program Flow Mode
TRANS	Enable Translation Mode
TREV	Transfer Revision Level
TRGFN	Trigger Functions
TRGLOT	Trigger Interrupt Lockout Time
[TRIG]	Trigger Interrupt Status [operator]

Command	Description	Command	Description
TSC	Transfer Controller Status		
TSCAN	Transfer Scan Time of PLC Program		
TSCF	Transfer Controller Status (full-text report)		
TSEG	Transfer Number of Free Segment Buffers		
TSGSET	Transfer Servo Gain Set		
TSKAX	Task Axis Association for Multi-Tasking		
TSKTRN	Task Turns Before Swapping		
TSROFF	Transfer Resolver Offset Angle		
TSS	Transfer System Status		
TSSF	Transfer System Status (full-text report)		
TSTAT	Transfer Drive Statistics		
TSTLT	Transfer Settling Time		
TSWAP	Transfer Currently Active Tasks		
TTASK	Transfer Task Number		
TTIM	Transfer Timer Value		
TTRIG	Transfer Trigger Interrupt Status		
TTRQ	Transfer Commanded Torque/Force		
TTRQA	Transfer Actual Torque/Force		
TUS	Transfer User Status		
TVE	Transfer Velocity Error		
TVEL	Transfer Current Commanded Velocity		
TVELA	Transfer Current Actual Velocity		
TVMAS	Transfer Current Master Velocity		
[TW]	Thumbwheel Assignment [operator]		
UNTIL()	Until Part of REPEAT Statement		
[US]	User Status [operator]		
V	Velocity		
[V]	Velocity [operator]		
VAR	Numeric Variable Assignment		
VARB	Binary Variable Assignment		
VARCLR	Clear All Variables		
VARI	Integer Variable Assignment		
VARS	String Variable Assignment		
VARSHI	Shared Input Variable for Peer-to-Peer		
VARSHO	Shared Output Variable for Peer-to-Peer		
VCVT()	Variable Type Conversion		
[VEL]	Commanded Velocity Assignment [operator]		
[VELA]	Actual Velocity Assignment [operator]		
VF	Final Velocity		
[VMAS]	Velocity of Master [operator]		
WAIT()	Wait for a Specific Condition		
WHILE()	WHILE Statement		
WRITE	Write a Message		
WRVAR	Write a Numeric Variable		
WRVARB	Write a Binary Variable		
WRVARI	Write a Integer Variable		
WRVARS	Write a String Variable		
XONOFF	Enable XON/XOFF ASCII Handshaking		
[\ANI]	Network Analog Input Voltage Status		
\ANO	Network Analog Output		
[\ANO]	Network Analog Output Status		
[\IN]	Network Digital Input Status		
\OUT	Network Digital Output		
[\OUT]	Network Digital Output Status		
\TANI	Transfer Network Analog Input Status		
\TANO	Transfer Network Analog Output Status		
\TIN	Transfer Network Digital Input Status		
\TIO	Transfer Ethernet I/O Status		
\TOUT	Transfer Network Digital Output Status		

Appendix B: ASCII Table

DEC	HEX	CHAR
0	00	NUL
1	01	SOH
2	02	STX
3	03	EXT
4	04	EOT
5	05	ENQ
6	06	ACK
7	07	BEL
8	08	BS
9	09	HT
10	0A	LF
11	0B	VT
12	0C	FF
13	0D	CR
14	0E	SO
15	0F	S1
16	10	DLE
17	11	XON
18	12	DC2
19	13	XOFF
20	14	DC4
21	15	NAK
22	16	SYN
23	17	ETB
24	18	CAN
25	19	EM
26	1A	SUB
27	1B	ESC
28	1C	FS
29	1D	GS
30	1E	RSt
31	1F	US
32	20	SPACE
33	21	!
34	22	"
35	23	#
36	24	$
37	25	%
38	26	&
39	27	`
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	∅
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	_
96	60	'
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
100	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}

DEC	HEX	CHAR
126	7E	~
127	7F	DEL
128	80	Ç
129	81	ü
130	82	é
131	83	â
132	84	ä
133	85	à
134	86	å
135	87	ç
136	88	ê
137	89	ë
138	8A	è
139	8B	ï
140	8C	î
141	8D	ì
142	8E	Ä
143	8F	Å
144	90	É
145	91	æ
146	92	Æ
147	93	ô
148	94	î
149	95	ò
150	96	û
151	97	ù
152	98	ÿ
153	99	Ö
154	9A	Ü
155	9B	¢
156	9C	£
157	9D	¥
158	9E	Pt
159	9F	ƒ
160	A0	á
161	A1	í
162	A2	ó
163	A3	ú
164	A4	ñ
165	A5	Ñ
166	A6	ª
167	A7	º
168	A8	¿
169	A9	⌐
170	AA	¬
171	AB	½

DEC	HEX	CHAR
172	AC	¼
173	AD	¡
174	AE	«
175	AF	»
176	B0	░
177	B1	▒
178	B2	▓
179	B3	¦
180	B4	┤
181	B5	╡
182	B6	╢
183	B7	╖
184	B8	╕
185	B9	╣
186	BA	║
187	BB	╗
188	BC	╝
189	BD	╜
190	BE	╛
191	BF	┐
192	C0	└
193	C1	┴
194	C2	┬
195	C3	├
196	C4	–
197	C5	†
198	C6	╞
199	C7	╟
200	C8	╚
201	C9	╔
202	CA	╩
203	CB	╦
204	CC	╠
205	CD	=
206	CE	╬
207	CF	╧
208	D0	╨
209	D1	╤
210	D2	╥
211	D3	╙

DEC	HEX	CHAR
212	D4	╘
213	D5	╒
214	D6	╓
215	D7	╫
216	D8	╪
217	D9	┘
218	DA	┌
219	DB	█
220	DC	▄
221	DD	▌
222	DE	▐
223	DF	▀
224	E0	α
225	E1	β
226	E2	Γ
227	E3	π
228	E4	Σ
229	E5	σ
230	E6	∝
231	E7	τ
232	E8	Φ
233	E9	θ
234	EA	Ω
235	EB	δ
236	EC	∞
237	ED	∅
238	EE	∈
239	EF	∩
240	F0	≡
241	F1	±
242	F2	≥
243	F3	≤
244	F4	Ï
245	F5	|
246	F6	÷
247	F7	≈
248	F8	°
249	F9	•
250	FA	·
251	FB	√
252	FC	η
253	FD	2
254	FE	●
255	FF	

Index