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MA6445-SW

StepperBASIC Programming Reference Manual

for use with 6x45 Microstep Indexer

Rev 1

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1 Conventions

Introduction

This chapter contains a summary of conventions used with Pacific Scientific StepperBASIC™. Topics covered are:

- Variable names
- Characters
- Operators used in programming
- Constants
- Notation conventions
- StepperBASIC instruction types
- Getting started
- Programming
- Error messages

1.1 Variable Names

Introduction

Variables are *used with BASIC functions and statements for general programming tasks*. There are three basic types of variables:

- INTEGER
- FLOAT
- FLAG

Variable names are the values acted upon by functions. The variables are pre-defined or user-defined.

Note: *Variable names are not case sensitive.*

Type of Variable	Characteristic
Integer	4 byte 2's complement
Float	4 byte IEEE single precision
Flag	single bit flag

These three types of variables are organized into two groups:

- Global - meanings and usage defined by Real Time Software
- User - available for user-defined purposes

All three types occur in both groups. Unlike standard BASIC, Pacific Scientific StepperBASIC variable names are pre-defined.

Note: *No variable names other than pre-defined names may be used. Arrays may not be used.*

Examples

Type of Variable	Pre-defined Names
Integer	INT1, INT2, INT3, ..., INT32
Floating point	FLT1, FLT2, FLT3, ..., FLT32
Flag	FLG1, FLG2, FLG3, ..., FLG8

Global variables

Global variables are used to communicate with Real Time Software. The Real Time Software is that part of the software which directly controls the motion of the motor. Values of global variables can be set to control the operation of the motor when used in conjunction with other commands such as the `CALL` command. Other global variables report the current status of various aspects of motor operation.

Some Global variables are **Read-Only**. This means that the value of these variables cannot be changed by the user directly. For instance, the variable named `INPUTS` is the current state of discrete inputs. This value can be printed or used in an expression, but a new value cannot be assigned to `INPUTS` by a Pacific Scientific StepperBASIC program. The only way to change the value of `INPUTS` is to actually change the voltage level at the connector pins used for the discrete inputs.

Note: *Global variables are treated the same as user variables within expressions and programs.*

1.2 Characters

Along with Pacific Scientific StepperBASIC instructions, alphabetic and numeric characters are used in creating programs.

Alphabetic Any alphabetic character is legal in StepperBASIC. Program instructions are not case sensitive. Alpha characters may be typed in either upper or lower case. StepperBASIC processes all text in upper case after compilation. The drive does not recognize case when the text is part of a string, that is text bracketed by quotes for printout or display.

Numeric The digits 0 through 9 are legal for use in StepperBASIC.

Character	Name	Example
	Space	PRINT “Hello”, “ ”, FLT1
=	Equal sign of assignment symbol	FLT1 = VELOCITY
+	Plus sign	INT1 = INT2 + 3
-	Minus sign	INT1 = RUN.SPEED - 100
∗	Asterisk or multiplication symbol	FLT1 = 6.28 * FLT3
/	Slash or division symbol	FLT1 = INDEX.DIST/4096
< >	Not equal	IF VELOCITY < > 0 GOTO 100
<	Less than	IF VELOCITY < 100 GOTO 10
>	Greater than	IF POSITION > 0 GOTO 10
(	Open parenthesis	INT1 = 3 * (INT2 ∗ INT3)
)	Closed parenthesis	
,	Comma	PRINT FLT1, FLT2
;	Semicolon	PRINT “No line feed”;
”	Quote	
.	Period, dot or decimal point	ACCEL.RATE = 10
‘	Single quote	‘This is a comment

1.3 Operators Used in Programming

Introduction

The operators used by StepperBASIC are *arithmetic*, *relational* and *logical*, and are evaluated in that order of precedence. However, operations within parentheses are performed first. Inside the parentheses the usual order of precedence occurs.

Arithmetic

The arithmetic operators are:

Arithmetic Operator	Description of Operation	Example
- (one variable)	Negation of value	-3
∗, /	Multiplication/Division	4.21∗3, 10.5/2
+ , - (two variables)	Addition/Subtraction	27 + 8, 19 -2

Note: *When multiple arithmetic operators are used in an expression, they are performed in the order of precedence given in the table; that is, multiplication is performed before addition, and so on. Also, integer division is not supported.*

Example

Precedence may be altered by the use of parentheses. For example:

```
INT1 = 2 + 3 ∗ 5
```

will assign the value 17 (2 + 15) to the variable `INT1`. The statement:

```
INT1 = (2 + 3) ∗ 5
```

will assign the value 25 (5 ∗ 5) to the variable `INT1`.

Relational

Relational operators are used in `IF-THEN-ELSE`, `WHILE-WEND`, and `FOR-NEXT` statements. The result of a comparison of two values with these relational operators is recorded by Pacific Scientific StepperBASIC as either true or false. The relational operators are:

Relational Operator	Description of Operation	Example
=	Equality	10 IF INT1 = 9 THEN 20
< >	Inequality	50 IF FLT1 < > 9 THEN 15
<	Less than	30 IF INT2 < 151 THEN 100
>	Greater than	10 IF FLT1 > INT2 THEN 20
< =	Less than or equal to	10 IF FLT1 < = INT2 THEN 20
> =	Greater than or equal to	10 IF INT3 > = INT5 THEN 20

Note: *Arithmetic operators are performed before relational operators in an executing program line. Relational operators are performed in the order of precedence shown in the table.*

Logical

Logical operators are used in IF-THEN-ELSE, WHILE-WEND, and FOR-NEXT statements. The logical operators are:

Logical Operator	Description of Operation	Example
NOT	Condition must not be true	NOT FLG1
AND	Both conditions must be true	FLG2 AND (INT2 = 5)
OR	Either or both conditions must be true	FLG1 OR DIR
XOR	Either but **not** both conditions must be true	FLG5 XOR FLG6

Note: *Logical operators are performed in the order of precedence given in the table. Arithmetic operators are evaluated before relational operators.*

1.4 Constants

Introduction

Two types of constants may be used with Pacific Scientific StepperBASIC:

- String constants
- Numeric constants

String

These constants are used with PRINT and INPUT statements. A string constant is a sequence of alphanumeric characters enclosed within quotation marks.

Example

“Hello There”

“3.14159”

Numeric These constants are used in numeric expressions, in assignment statements and in print statements. There are two types of numeric constants:

- integer
- float

Integer Numbers with no values to the right of the decimal point.

Float Numbers with values to the right of the decimal point.

1.5 Notation Conventions

The following notation conventions are used in this manual when explaining StepperBASIC™ language use.

Notation	Named	Indicates
<return>	“return” surrounded by angle brackets	the user should press the carriage return key on the keyboard
[ ]	square brackets	the entry within the brackets is optional
...	three dots	the entry may be repeated multiple times
CAPS	capital letters (upper case)	entries which must be entered exactly as shown
lc	lower case letters	user-supplied information
Caps/lc	bold typeface capital and lower case letters	information sent to the terminal screen
/	slash (preceding a computer command)	a global command or an address command within a global command
:	colon	separation between multiple commands entered on the same line
^ C	control C	stops operation of program
/ ^ C	slash, control C	a global control C (used to stop all programs in all controllers)

1.6 StepperBASIC™ Instruction Types

Introduction

Pacific Scientific StepperBASIC consists of programming statements or functions, and arithmetic operations permitted in the BASIC programming language. A complete list of these instructions is given in Section 4, "Quick Reference," of this manual.

Statements

Statements are of two types, *BASIC* and *StepperBASIC*:

- *BASIC* statements control the flow of instructions within a program. They direct the execution of functions, for example comparing function results and going to specific points in the program based on the comparison, prompting for input, printing results of functions, and so on. An example of a BASIC statement is:

  ```
  GOTO 100
  ```

- *Pacific Scientific StepperBASIC* statements control the motion of the motor in real time. Motion statements command the motor to move at constant velocity, to move at a specified position, etc. An example of a Pacific Scientific StepperBASIC statement is:

  ```
  GO.ABS
  ```

Commands

Commands normally operate on the program currently residing in the controller's memory and are not normally used within a program. In general, if a command is used in a program the command will operate properly but the program will be stopped. For example, if the `LIST` command appears in a program, the program will stop operating and list the program. An example of a command is:

```
DELETE 120 - 300
```

Functions

BASIC functions perform a computation and return a value that can be used in arithmetic expressions. For example, BASIC functions convert decimal numbers to integers and convert an ASCII code to its equivalent screen display character. An example of a function is:

```
INT1 = INKEY( )
```

Pre-defined variable types

Variables are *the values acted upon by functions*, or as the result of arithmetic operations. Variables can be further categorized as Read/Write (R/W) or Read Only (R/O). Pre-defined variables are reserved for use with specific Pacific Scientific functions. These pre-defined variables are either:

- *Floating points* — numbers with values to the right of the decimal place. Used with functions that require decimal numbers, for example the `VELOCITY` variable contains the motor speed in revolutions-per-minute.

or

- *Integers* — integers used with functions that require integers, for example the number of steps to move the motor. Some pre-defined variables are read-only, that is they cannot be altered from the keyboard or by the program. The `INPUTS` variable, for instance, is dependent solely on the state of the programmable inputs at the connector interface and cannot be altered from the keyboard.

Parameters

The 6x45 Indexer/Drive contain a large number of pre-defined parameters which specify constraints on motion control and mode control functions. Parameters are functionally analogous to variables except once set, they typically remain constant.

1.7 Interface Requirements

Terminal types: You can select two types of interface terminal for controlling the unit.

Display-only

A display-only “dumb” terminal allows you to type programs and commands, but will not save programs externally (the program can be saved in the drive memory).

Note: *The T-10C terminal, available from Pacific Scientific, is a display-only terminal that allows you to enter values and run downloaded programs.*

Computer

A computer terminal allows you to save and work on programs externally from the controller. In addition, you can use utilities such as the PacCom Toolkit for editing programs, downloading programs, and terminal emulation. An example of this type of terminal is an IBM AT PC.

Terminal requirements

The requirements for the terminal are:

- RS-232, RS-485, or RS-422 serial communication on board
- 9600 baud transmission rate

1.7.1 Setting Up Communications

Introduction

This section covers downloading programs and terminal emulation using the communications utilities in the PacCom Toolkit.

PacCom installation procedure

1. With power disconnected from the unit, verify that the power and earth ground connections to J1 are correctly installed.
2. Disconnect the 9-pin connector from J7 to ensure that the enable input is disconnected.
3. Set up the PC for terminal emulation:

a. Turn On the computer.

b. Load MS-DOS boot up.

Note: User keyboard entries are indicated in boldface, and individual key presses, such as <enter>, are in brackets. Prompts and selections displayed in the StepperBASIC program are enclosed in quotes.

c. Insert the PacCom^{TM} diskette in the A drive, then type **A:<enter>** to select drive A.

4. Load PacCom, version 3.1 or higher. For further information, refer to the PacCom Software Toolkit Instruction Manual.

a. Type **paccom <enter>**. The Main Menu is displayed.

b. Press **<enter>** at “Select Hardware.”

c. Use the arrows to move to “5645.”

Note: *This selection is also appropriate for the 6x45.*

d. Press **<enter>**.

e. Use arrows to move to “Terminal Emulator”, then press **<enter>**.

5. Power up the unit per the RS-232 or RS-422/RS-485 procedure.

Power up procedure - RS-232

Perform the following procedure for single units controlled from the terminal under RS-232.

1. Apply power to the controller.
2. Verify that the POWER status indicator on the drive front panel is On.
3. Verify that the PC display shows the following (versions higher than 2.3 are acceptable):

```
Pacific Scientific
Charlestown, MA
StepperBASIC Version X.X
Copyright © 1988. 1991
OK
Program Loaded Properly
Variables Loaded into RAM
```

Pack Function Executing ...

Pack Function Done.

where (X.X) is the Version Number

6. Verify operation by typing the following:

   `RUN.SPEED = 10` **<enter>**

   `DIR = 0` **<enter>**

   `GO.VEL` **<enter>**

   The motor rotates slowly (10 RPM) in the clockwise direction.

7. Stop motor motion by pressing the **<Ctrl>** and **<c>** keys.

   Continue testing and programming as appropriate for your application.

8. Press the **<Ctrl><e>** keys to return to the PacCom Main Menu for access to other PacCom tools.

   Upon successful completion of these procedures, the unit is ready to be programmed.

Power up procedure - RS-422/RS-485

Perform the following procedure for multiple unit control under RS-422/RS-485. Follow the steps outlined here to log onto and test each indexer/drive individually.

1. Apply power to all indexer/drives.
2. Verify that the POWER status indicator on each drive front panel is On. No cursor or message is displayed on the PC screen when operating under RS-422/RS-485.
3. Type **/x <enter>** with the address for the first unit for log on in the x position.

   For example, to log on to a drive with address 1, type **/ 1 <enter>**.

   Note: *Unique addresses must be set for each unit on the bus. If incorrect or duplicate addresses are set, erratic performance will occur. Refer to Section 3.2, "Setting Up Serial Addresses Using Switch S2", in the Installation Manual to set addresses.*

4. The OK prompt is displayed. If you do not see this prompt, check:

   - that you set a unique address
   - that you logged on to a valid address
   - that the serial cable is properly installed
   - the PacCom steps used in setting up the PC

Caution

Do not continue with this procedure until proper serial link communication has been established.

5. Make sure that the Enable input J7-5 is open and plug the 9-pin connector cable into J7.

6. Enable the drive by connecting Enable J7-5 to ground. **Be ready to disconnect the Enable from ground quickly if there is unwanted motion or excessive noise from the motor.**

7. Verify operation by typing the following:

   `RUN.SPEED = 10` **<enter>**

   `DIR = 0` **<enter>**

   `GO.VEL` **<enter>**

   The motor rotates slowly (10 RPM) in the clockwise direction.

8. Stop motor motion by pressing **<Ctrl> <c>** .

9. Repeat steps 3 to 8 for the other indexer/drives in your installation.

10. Press **<Ctrl> <e>** to return to the PacCom Main Menu.

    Upon successful completion of these procedures, the indexer/drive is ready to be programmed.

1.8 Programming

Introduction

The Pacific Scientific 6x45 Indexer/Drives control motor velocity and position. The user interacts with the controller via a computer or a standard “dumb” terminal. The computer or terminal is connected to the controller by one of two serial communications ports:

- RS-232
- RS-485

Using the computer or terminal, they user may “talk” to the controller by:

- entering BASIC commands via a programming language (StepperBASIC) similar to standard “BASIC” computer programming language.
- executing a StepperBASIC program stored in the memory of the controller by typing `RUN` <return>.

Note: *The controller can hold only one program and has no file system.*

1.8.1 Programming Modes

Mode types

StepperBASIC operates in one of two possible modes, *Immediate* or *Program*.

Immediate

In the immediate mode, statements and commands are executed when you press <enter> at the end of a line. Results are displayed immediately, but the instructions cannot be recalled or stored after they have been used. Use this mode when storing a program is not needed; for instance, during installation you would type `GO.VEL` <enter> to check the motor for excessive vibration. The motor runs at default velocity until you type `STOP` <enter>.

Program

The program mode is the program writing and running mode of the indexer/drive. This mode requires StepperBASIC instructions preceded by line numbers. To run the program you must enter the `RUN` command. Programs created are savable and can be recalled for repeated use.

1.8.2 Program Memory and Filing

Introduction

The drive has two types of memory, *RAM* and *non-volatile battery-backed RAM*. The unit operates out of RAM; non-volatile battery-backed RAM is used for storage (`SAVE` and `SAVEVAR`) or program retrieval (`LOAD` and `LOADVAR`):

RAM memory

The drive uses RAM memory for programming and running in the direct mode. This memory is *volatile*, that is, it is only available when the unit has power, and it is lost if power is removed from the system.

12K (12000 bytes) of memory is available for programming.

Non-volatile battery-backed RAM

The drive uses non-volatile battery-backed RAM memory for program storage. This memory is *non-volatile*, meaning that it is retained if power is removed from the drive.

12K (12000 bytes) of memory is available for storage.

Note: *As an alternative, you may choose to upload to PacCom for storage (if using a computer for terminal emulation).*

1.8.3 Writing and Editing Programs in StepperBASIC

Line format

StepperBASIC programs are comprised of lines of instructions, each starting with a line number and ending when <enter> is pressed. Line numbers are usually in increments of 10 (10, 20, 30, and so on), to allow you to insert lines that may have been overlooked without renumbering all subsequent lines:

Example

```
20   RUN.SPEED = 200 <enter>

30   ACCEL.RATE = 1000 <enter>

40   PRINT INT1 <enter>

50   IF INT1 = 6 THEN 90 <enter>

.
```

Rules

Start each line with a number followed by a space.

Use numbers from 1 to 65500

Do not type more than 132 characters on a line.

Multiple statements

Multiple instructions may be put on a single line. For ease in reading, you may separate each instruction by a colon (:), although this is not required. The program will run faster and take less memory with no colons. All instructions on the line will be executed with the same line number.

An example of program line syntax is as follows:

line number statement [[:statement] ...] <return>

Program lines may not be preceded by the global command prefix "/". Thus, there can be no global edits.

If the following line is typed:

```
/2 INT1=1 : PRINT INT1
```

a new line 2 will not be added to the program of each controller. Rather, the following will occur:

- Unit 2 will be logged on and all others will be logged off
- The local variable "INT1" of the controller with address 2 will be assigned the value of 1
- The value of the variable "INT1" will be printed immediately

Typing in PacCom

Type your program as if you are typing on a word processor, then download the program to the drive using the download utility provided by PacCom.

After a change is made to the program while in PacCom editor, the program must be saved each time.

Note: *While in the PacCom editor mode, there will be no syntax checking. Syntax checking is only done when downloading the program to the drive.*

1.8.4 Writing and Editing Programs Using the Screen Editor

Line format

StepperBASIC programs are comprised of lines of instructions, each starting with a line number and ending when <enter> is pressed. Line numbers are usually in increments of 10 (10, 20, 30, and so on), to allow you to insert lines that may have been overlooked without renumbering all subsequent lines:

Example

```
20 RUN.SPEED = 200 <enter>

30 ACCEL.RATE = 1000 <enter>

40 PRINT INT1 <enter>

50 IF INT1 = 6 THEN 90 <enter>
```

Rules

Start each line with a number followed by a space. Or use the AUTO command to automatically display the next line number each time you press <enter> when typing in the lines of your program.

Use numbers from 1 to 65500

Do not type more than 132 characters on a line.

Editing

Once a program has been entered, it may be edited in one of the following ways:

- a new line may be added to the program
- an existing line may be modified
- an existing line may be deleted

New lines

The line number must be legal and at least one non-blank character must follow the line number in the line.

Existing line (modifying)

If a line number that already exists in the program is typed, the existing line is replaced with the text of the newly entered line when <return> is entered.

Existing line (deleting)

If you type the line number of the line to be deleted with no characters following the number, that line will be deleted when <return> is pressed.

To delete an entire program, type:

`NEW` <return>.

Note: *`NEW` will clear memory prior to entering a new program.*

1.8.5 Program Header

To insure that variables previously programmed do not affect current program, initialize all variables at the start of each program. This shuts off any forgotten variables that may affect the current program.

For example, if the Stall Jump Go To Line variable was not set to zero in memory as follows:

```
STALL.JUMP = 1000
```

The variables would still try to jump to a line 1000 upon a stall. If the current program does not have a line 1000, the program stops execution upon a stall and displays an error message.

Procedure

1. Type the following immediate mode “header” before the program:

```
STEPSIZE = 1
MIN.SPEED = 100
GEARING = 0
ENABLE = 1
RMT.START = 2
PWR.ON.ENABLE = 1
PWR.ON.OUTPUTS = 255
PREDEF.INP = 0 : PREDEF.OUT = 0
POS.CHK1.OUT = 0 : POS.CHK2.OUT = 0 :
  POS.CHK3.OUT = 0
OUTPUTS = 255
CW.OT.ON = 0 : CCW.OT.ON = 0
CLR.SCAN1 : CLR.SCAN2
```

```
HOME.ACTIVE = 1
HMPOS.OFFSET = 0
ACCEL.RATE = 1000
MAX.DECEL = 10000
STALL.STOP = 0
STALL.JUMP = 0
POS.VERIFY.JUMP = 0
```

2. Type in your program, programming variables as needed.
3. When through with the program, type the `SAVEVAR` command to save the correct variables and type the `SAVE` command to save the final version of your program to memory in case power is cycled.

Other variables

Other variables need not be included in this header because they are covered as follows:

`CCW.OT, CCW.OT.JUMP, CW.OT, CW.OT.JUMP` — Covered by `CW(CCW).OT.ON`

`DIR, RUN.SPEED` — Must be set up as needed before `GO.VEL` or `SEEK.HOME`

`ENCODER, RATIO` — Covered by `GEARING = 0`

`INDEX.DIST` — Must be set up as needed before `GO.INCR`

`JOG.SPEED` — Covered by `PREDEF.INP = 0`

`POS.CHKn` — Covered by `POS.CHKx.OUT = 0`

`SKn.JUMP, SKn.OUTPUT, SKn.STOP, SKn.TRIGGER`— Covered by `CLEAR.SKn`

`TARGET.POS` — Must be set up as needed before `GO.ABS`

`WAIT.TIME` — Must be set up as needed before `PAUSE`

1.9 Error Messages

Introduction

There are three types of errors:

- syntax
- runtime
- system

Errors are displayed on the terminal screen indicating the type of error and the error code. All possible errors are listed in the tables below.

1.9.1 Syntax Errors

Introduction

A syntax error is an error in the syntax of an entered command. Syntax errors may appear on the screen when a program is being entered or when a program is running.

Error Code #	Error	Explanation
1	Command terminator	Not used.
2	Command missing	Program line does not begin with a valid BASIC statement or command.
3	Number missing	BASIC was expecting a number.
4	Invalid list	Not used.
5	Statement not entered	BASIC was expecting a statement.
6	Assignment not entered	BASIC was expecting an equal (=) sign.
7	THEN not entered	The “THEN” of an IF-THEN-ELSE statement was omitted.

Error Code #	Error	Explanation
8	TO not entered	The “TO” of a FOR-NEXT statement was omitted.
9	Variable not entered	A variable was omitted.
10	Close parenthesis not entered	A closed parenthesis “)” was omitted.
11	Open parenthesis not entered	An open parenthesis “(” was omitted.
12	Invalid factor	BASIC was expecting a constant, variable, function, “(” or NOT.
13	Unknown identifier	Not used.
14	Quote not entered	A quote (”) was omitted.
15	Digit not entered	A number contains a character which is not a digit.
16	Comma or semicolon not entered	A comma (,) or semicolon (;) was omitted.
20	Error in WHEN statement	Syntax of WHEN statement is incorrect.

1.9.2 Runtime Errors

Introduction A runtime error is an error that occurs during program execution. Coded runtime errors and their causes are:

Error code #	Error	Explanation
1	Stack overflow	Too many operations caused the size of the stack to overflow the amount of available memory.
2	Divide by 0	You may not divide by zero.
3	Exceeding FOR-NEXT	Too many FOR-NEXT loops are nested.
4	No matching NEXT	A "FOR" statement has no matching "NEXT" statement.
5	No matching FOR	A "NEXT" statement has no matching "FOR" statement.
6	Exceeded WHILE nest	Too many WHILE-WEND loops are nested.
7	No matching WEND	A "WHILE" statement has no matching "WEND" statement.
8	No matching WHILE	A "WEND" statement has no matching "WHILE".
9	No line to go to	A "GOTO" or "GOSUB" cannot find the line number to which to go.
10	Exceeded GOSUB nest	Too many GOSUB-RETURNs are nested.
11	No matching GOSUB	A "RETURN" is encountered before a GOSUB.
12	S-Curve Error	This is a profile generator error.
13	Registration overrun	Registration re-triggers before registration GOSUB completes execution.

1.9.3 System Errors

Introduction

A system error is a serious error which can only be fixed by changes to the software system. Coded system errors are as follows:

Error Code #	Error	Explanation
1	Line without a line number	There is no line number associated with the line. Thus, the integrity of the program is lost.
2	Invalid token	A token cannot be converted back into a known symbol while attempting to list a program.
3	No more program memory	The program cannot be fit into the available memory.
4	Renumber table overflow	Occurs during a "RENUM" command. The temporary number table size is exceeded.
5	GOTO table overflow	Occurs when a program is running and the GOTO table overflows. The GOTO table is used to store line number positions so they only have to be looked up once.

2 Using StepperBASIC Functions

In this chapter

This chapter provides an in-depth description of how to perform certain actions using StepperBASIC. These include the following:

- Scan functions
- Homing routines
- Overtravel limits
- `POSITION` check function
- Position verification and correction function
- Stall detection function
- Using the `WHEN` statement
- Electronic gearing
- Making the motor move
- Registration functionality

2.1 Scan Functions

Introduction

The purpose of the SCAN functions is to allow you to specify an action to be taken when a given discrete input condition is satisfied. The specified input condition is tested every millisecond and the specified action is performed immediately as soon as the condition is satisfied.

Similar functionality can be performed by an `IF...THEN` statement in your Pacific Scientific StepperBASIC program. However, using a `SCAN` function has two key advantages:

1. The SCAN response will be much faster than the `IF...THEN` response because the SCAN condition is tested every millisecond and the SCAN action is performed as soon as the condition is satisfied.
2. When the SCAN function is used, there is no need to have a program loop that regularly tests the specified condition. Once the SCAN function is set up and turned on, the SCAN condition will be automatically tested every millisecond until the SCAN function is turned OFF.

2.1.1 Setting the SCAN Trigger Condition

The SCAN input condition, which is also referred to as the SCAN Trigger Condition, is specified using the variable SKn.TRIGGER. The first digit of `SKn.TRIGGER` specifies which one of the sixteen discrete inputs the SCAN is checking. The second digit of `SKn.TRIGGER` specifies whether the SCAN condition is satisfied when the input is equal to zero or whether the SCAN condition is satisfied when the input is equal to 1.

For example:

```
SKn.TRIGGER = 51
```

sets the SCAN condition as input 5 (INP5) being equal to 1.

2.1.2 Setting the SCAN Output Action

There are three actions which can be performed when the SCAN Trigger Condition is satisfied. Any combination of these actions can be specified. The four available output actions are:

1. Turn a specified output ON or OFF. This action is specified using the variable `SKn.OUTPUT`.
2. Stop the motor. This action is specified by setting the variable `SKn.STOP` to 1. If `SKn.STOP` is set to zero, the motor will not be stopped when the SCAN Trigger Condition is satisfied.
3. Jump to a specified line of the StepperBASIC program. This action is specified using the variable `SKn.JUMP`. If `SKn.JUMP` is set to zero, then the StepperBASIC program will not be affected when the SCAN Trigger Condition is satisfied. If `SKn.JUMP` is set to a non-zero value the program will commence execution at the instruction specified by the `SKn.JUMP` program line.

Note: *Use of the SCAN jump (`SKn.JUMP`) functions may absolutely require the execution of the `RESET.STACK` statement to ensure internal program control is restored if the SCAN input has been triggered during execution of a subroutine or looping construct.*

2.1.3 Enabling and Disabling SCANs

SCAN functions are enabled or disabled as follows:

- The SCAN function is enabled by executing `SET.SCANn.`
- The SCAN function is disabled by executing `CLR.SCANn`.

Example

As an example, suppose you have an End of Travel Limit Switch. If this switch is activated, then all motion must stop, an output must be turned on and a message must be displayed on the screen of the terminal. The following segment will perform this function:

```
10    SK1.TRIGGER = 10
20    SK1.STOP = 1
30    SK1.JUMP = 2000
40    SK1.OUTPUT = 11
50    SET.SCAN1
.
.
.
2000 PRINT “End of Travel Limit Switch activated”
2010 IF INP1 = 0 THEN 2010
2020 GOTO 100
```

Line 10 specifies the SCAN trigger condition as input 1 going to a low voltage.

Line 20 specifies that the motor will stop when the SCAN condition is satisfied.

Line 40 specifies that Output 1 will be turned Off when the Scan condition is satisfied.

Line 50 enables the SCAN function.

Line 2000 prints a message on the terminal screen. This message will be displayed when the SCAN condition is satisfied.

Line 2010 waits until 1 goes to a high voltage before proceeding to line 2020.

Line 2020 jumps to line 100 which should be a program restart routine in this example.

2.2 Homing Routines

Pacific Scientific StepperBASIC is an absolute positioning system. It maintains a position counter (POS.COMMAND) and is capable of moving the motor shaft to any absolute position. The position counter has a range of approximately -32,000 revolutions to +32,000 revolutions of the motor shaft.

Electrical home

The position at which the position counter (POS.COMMAND) equals zero is called the electrical home position. The electrical home position can be established by executing the SEEK.HOME function. After the SEEK.HOME function is performed, the motor will be at the electrical home position and POS.COMMAND will be zero. All absolute positions will then be referenced to this electrical home position.

Note: *Refer to Section 2.9, "Making the Motor Move", for more information on SEEK.HOME.*

At any point, you may move to the electrical home position by executing the GO.HOME function. This function is exactly equivalent to setting TARGET.POS to zero and executing the GO.ABS (go to absolute position) function.

2.3 Using the Software Overtravel Limit Function

Introduction

The software overtravel limit function is used to prevent the motor from traveling outside pre-defined limits. Two independent overtravel limits may be specified, one for limiting travel in the clockwise direction and the other for limiting travel in the counterclockwise direction.

Note: *Either one or both or these limits may be enabled at any time.*

Overtravel limit exceeded

If either the clockwise and/or the counterclockwise overtravel limit function is enabled the internal software constantly checks the motor position and compares it to the overtravel limits. If the motor position exceeds the overtravel limit (and that overtravel limit is enabled) then the controller will decelerate the motor to a stop and will prevent further motion in the direction for which the limit was exceeded.

In addition, a program line number may be specified for each of the two limits. If a program line number is specified then the program will jump to that line when the corresponding overtravel limit is exceeded. This allows you to write a recovery routine for an overtravel error.

2.3.1 Setting up the Software Overtravel Function

To use the overtravel limit function set up the following variables:

VARIABLE	DESCRIPTION
`CW.OT`	Specifies the maximum clockwise position
`CW.OT.ON`	Specifies whether or not the clockwise overtravel checking is enabled
`CW.OT.JUMP`	Specifies the line number to be jumped to when the clockwise overtravel limit is exceeded
`CCW.OT`	Specifies the maximum counterclockwise position
`CCW.OT.ON`	Specifies whether or not the counterclockwise overtravel checking is enabled
`CCW.OT.JUMP`	Specifies the line number to be jumped to when the counterclockwise overtravel limit is exceeded

Note: *If you do not want the program to jump to a new line number when the overtravel limit is exceeded, then you must set the jump destination (`CW.OT.JUMP` or `CCW.OT.JUMP`) equal to zero.*

OT.ERROR

Note: The variable *OT.ERROR is set by the internal software to reflect the status of the overtravel function. OT.ERROR always has one of the following values:*

VALUE	DESCRIPTION
0	No overtravel detected
1	Clockwise overtravel detected
2	Counterclockwise overtravel detected

Example

```
10   POS.COMMAND = 0
20   CW.OT = 100000
30   CW.OT.JUMP = 200
40   CW.OT.ON = 1
50   CCW.OT = -100000
60   CCW.OT.JUMP = 300
70   CCW.OT.ON = 1
80   DIR = 0
90   STEPSIZE = 25
100 MIN.SPEED = 25
110 ACCEL.RATE = 5000
120 RUN.SPEED = 100
130 GO.VEL
140 GOTO 110
.
.
.
200 PRINT “Clockwise Overtravel”
210 DIR = 1
215 GO.VEL
220 GOTO 110
300 PRINT “Counterclockwise Overtravel”
310 DIR = 0
315 GO.VEL
320 GOTO 110
```

Explanation

This example sets up a clockwise overtravel limit of 100000 microsteps and a counterclockwise overtravel limit of -100000 microsteps. The example sets the clockwise jump line number to 200 and sets the counterclockwise jump line number to 300. The two limit checks are turned on and the motor is commanded to turn at 100 rpm in the clockwise direction.

When the clockwise overtravel limit is exceeded the motor will decelerate to a stop and the program will transfer control to line 200. At line 200 a message is printed, the motor direction is reversed and control is passed back to line 110.

When the counterclockwise overtravel limit is exceeded the motor will decelerate to a stop and the program will transfer control to line 300. At line 300 a message is printed, the motor direction is reversed and control is passed back to line 110.

This process will continue until the program is aborted.

2.4 Using the Position Check Function

Introduction

The position check function is used to allow the internal software to automatically turn On (set to 0) or turn Off (set to 1) an output discrete (`OUT1`, `OUT2` and/or `OUT3`) based upon the motor's position.

Note: *Up to three position check functions may be defined at any time.*

When a position check function has been defined, the internal software checks the motor position every 2.048 msec and either turns On or turns Off the appropriate discrete output depending upon whether the motor position is greater than or less than the specified check position.

Three independent position checks

To set up the position check function, two variables must be specified for each of the three position checks which may be defined.

VARIABLE	DESCRIPTION	
POS.CHKn	Specifies the position check value	
POS.CHKn.OUT	Specifies whether or not position check is enabled and if enabled, whether Output n (OUTn) is to be turned On or Off. POS.CHKn.OUT may be set to one of three values:	
	0	Position check n is disabled
	10	OUTn = 0 if the motor position is greater than POS.CHKn
		OUTn = 1 if the motor position is less than POS.CHKn
	11	OUTn = 1 if the motor position is greater than POS.CHKn
		OUTn = 0 if the motor position is less than POS.CHKn

The value of n can be 1, 2 or 3.

Note: *Once a position check has been enabled by setting POS.CHKn.OUT (where n's value is 1, 2, or 3) equal to 10 or 11 the corresponding output cannot be changed by the program (e.g. OUTn = 1) until that position check has been disabled.*

Example

```
10    POS.COMMAND = 0
20    POS.CHK1 = -5000
30    POS.CHK2 = 0
40    POS.CHK3 = 5000
50    POS.CHK1.OUT = 10
60    POS.CHK2.OUT = 11
70    POS.CHK3.OUT = 10
80    TARGET.POS = -10000
90    GO.ABS
100   TARGET.POS = 10000
110   GO.ABS
120   GOTO 80
```

Line 10 defines the current position as home.

Lines 20 through 40 set position check 1 to -5000, position check 2 to 0 and position check 3 to 5000.

Lines 50 through 70 turn On all position checks and specify the output states.

Lines 80 through 120 command the motor to move from -10000 to +10000 continuously.

2.5 Using the Position Verification and Correction Function

Introduction

For incremental and absolute moves, Pacific Scientific StepperBASIC compares incremental distance traveled by the encoder to the distance commanded on the motor shaft.

Setting up for Position Verification

There are five variables associated with the Position Verification. These are:

VARIABLE	DESCRIPTION
POS.VERIFY.TIME	User defined variable which specifies the amount of wait time in milliseconds after the positioning move is finished before it looks at the encoder position. This will allow for any ringing to settle.
POS.VERIFY.CORRECTION	A read only variable that gives the difference between the rotor position and the position command in number of microsteps, **NOT ENCODER COUNTS**. It is to be used as the correction distance.
POS.VERIFY.ERROR	This is a flag that is tripped when the rotor error between the rotor position and the commanded position is greater than that allowed by the POS.VERIFY.DEADBAND.
POS.VERIFY.DEADBAND	Is the allowable error in microsteps (± this number) in a system. If the error between the commanded position and the position measured by the encoder exceeds this value, the POS.VERIFY.ERROR flag will be tripped.
POS.VERIFY.JUMP	Causes the program to jump to a new line when the POS.VERIFY.DEADBAND is exceeded. This will allow the correction to be made based upon the commands at the line jumped to.

Related Commands

VARIABLE	DESCRIPTION
ENCODER	Should be set to the number of PPR (pulses per revolution) of your encoder.
STEP.DIR.INPUT	Set up the encoder port for an encoder or step and direction inputs from another control. **Note:** *If STEP.DIR.INPUT = 1 for accepting step and direction inputs,* ***ENCODER*** *needs to be set to Stepsize * 50.*
IN.POSITION	Flag controlled by the internal software that indicates when the motor is in position. This flag is set by the internal software to 1 or 0. It will be set to 1 when the following conditions are true: * Motor commanded to be stopped (the last move is completed). * POS.VERIFY.DEADBAND has not been exceeded.

Example

```
10 STEPSIZE = 25
20 MIN.SPEED = 5
30 RUN.SPEED = 1000
40 ACCEL.RATE = 5000
50 ENCODER = 1250
60 INDEX.DIST = 20000
70 POS.VERIFY.TIME = 200
80 POS.VERIFY.DEADBAND = 10
90 POS.VERIFY.JUMP = 1000
100 POS.COMMAND = 0
110 ENCDR.POS = 0
120 GO.INCR
130 IF MOVING THEN 130
140 GOTO 2000
```

```
1000 PRINT “I AM CORRECTING”
1010 INDEX.DIST = POS.VERIFY.CORRECTION
1020 GO.INCR
1030 IF MOVING THEN 1030
1040 IF POS.VERIFY.ERROR THEN 1010 ELSE 2000
2000 PRINT “FINAL POSITION IS  ” POS.COMMAND
2010 PRINT “FINAL ENCODER POSITION IS ” ENCDR.POS
2020 END
```

Explanation

Line 10 sets the software stepsize variable (both software and hardware stepsize should be the same).

Line 20 sets the start/stop speed to 5 rpm.

Line 30 sets the run speed to 1000 rpm.

Line 40 sets the acceleration rate to 5000 rpm/sec.

Line 50 sets the encoder variable to 1250 ppr.

Line 60 sets an incremental move of 20000 microsteps (4 revs).

Line 70 sets a wait time of 200 msec before reading the encoder position.

Line 80 sets the maximum microstep difference allowed for measured encoder counts versus commanded microsteps counts to 10 counts.

Line 90 moves the program execution to line 1000 when the POS.VERIFY.ERROR is tripped.

Line 100 sets the position counter to 0 (zero).

Line 110 sets the encoder counter to 0 (zero).

Line 120 initiates an incremental move.

Line 130 holds the program executions until the move is completed.

Line 140 causes the program to jump to line 2000.

Explanation (cont'd)

Line 1000 will print "I AM CORRECTING" if the error had exceeded the `POS.VERIFY.DEADBAND` limit set in line 80.

Line 1010 sets an incremental correction move equal to the `POS.VERIFY.CORRECTION` variable.

Line 1020 initiates the incremental correction move.

Line 1030 holds the program as long as the move is not completed.

Line 1040 checks if there is a position error after the correction move has been completed and if there is an error it will correct again otherwise it will force the execution of the program to go to line 2000.

Line 2000 will print the final encoder position after the motor rotation has stopped.

Line 2010 will terminate the program execution.

2.6 Stall Detection Function

Introduction

The Stall Detection Command, detects a stall condition based upon the users allowable difference between the motor commanded position and the actual rotor position. The encoder could be in/on the motor or the load axis.

Setting Up For Stall Detection

There are four variables associated with the Stall Detection function:

VARIABLE	DESCRIPTION
STALL.DEADBAND	Sets the maximum step difference allowed between the commanded and measured steps (commanded position versus rotor or encoder counts).
STALL.STOP	Stops the motor at the rate set by MAX.DECEL when a stall is detected (the STALL.ERROR FLAG = 1, tripped).
STALL.ERROR	Flag controlled by the internal software that indicates a stall has occurred (the STALL.DEADBAND variable had exceeded). It is reset back to zero at the start of the next move.
STALL.JUMP	A variable that moves the program execution to a new line when STALL.ERROR is tripped (stall occurs).

Related instructions

VARIABLE	DESCRIPTION
MAX.DECEL	A variable that sets the maximum deceleration rate in rpm/sec at which the motor will decelerate to stop.

The encoder position and the position command are sampled at 8 msec intervals. The value at each sample is compared to the last sample only. If the difference is larger than the STALL.DEADBAND value, STALL.ERROR will be set to 1.

Due to the 8 msec sample rate and since the error does not accumulate, there are limitations in the size of the STALL.DEADBAND.

Maximum

The following equation is used to calculate the maximum deadband allowed as a function of rotor speed.

Maximum `STALL.DEADBAND` = 8 * RPM * (#step/rev)/60000

Note: *If a larger value is used, the indexer will not detect a stall condition.*

Minimum

The minimum value for the stall deadband can be calculated using the following equation:

Minimum `STALL.DEADBAND` = 4 * STEPSIZE

In general stepper motors will lose 4 full steps at once when they stall. The above equation will allow 4 full steps of error before a stall is being detected.

Example

```
 10 STEPSIZE = 25
 20 MIN.SPEED = 5
 30 ACCEL.RATE = 1000
 40 MAX.DECEL = 1000
 50 RUN.SPEED = 800
 60 INDEX.DIST = 75000
 70 ENCODER = 1250
 80 STALL.DEADBAND = 100
 90 STALL.JUMP = 1000
100 STALL.STOP = 1
110 POS.COMMAND = 0
120 ENCDR.POS = 0
130 GO.INCR
140 IF MOVING THEN 140
150 GOTO 110
1000 PRINT “ MOTOR STALLED ”CINT (ENCDR.POS) “
STEPS FROM START.”
1010 END
```

Explanation

Line 10 sets the software stepsize variable to 25.

Line 20 through 50 sets the move profile parameters.

Line 60 sets an incremental move to 75000 steps (15 revs).

Line 70 sets the encoder to 1250 ppr.

Line 80 sets the allowable error to 100.

Line 90 will force the program to jump to line 1000 and start executing if a stall is detected (`STALL.ERROR` = 1).

Line 100 will cause the motor to stop using the `DECEL.RATE` of 1000 rpm/sec if a stall is detected (`STALL.ERROR` = 1).

Line 110 and 120 will reset the position command and the encoder counters to zero (0).

Line 130 will initiate the incremental move.

Line 140 will hold the program until the motion is completed.

Line 150 will take the program back to line 110.

Line 1000 will print MOTOR STALLED XXXXXX STEPS FROM START, if a stall is detected (`STALL.ERROR` = 1).

2.7 Using the WHEN Statement

The WHEN statement is used to get extremely fast response to certain input conditions. When the Pacific Scientific StepperBASIC program encounters a WHEN statement, it tests the specified condition every 1.024 msec and as soon as the condition is satisfied, the specified output action is initiated.

When the StepperBASIC program encounters a WHEN statement, the program will not proceed to the next line of the program until the WHEN condition is satisfied. When the WHEN condition is satisfied and the specified action has been performed, the WHEN statement is complete. In order to execute this function again you must execute another WHEN statement.

For example, if you desire the motor to rotate at 1000 RPM until Input 3 is pulled low (INP3 = 0) at which point the motor is to be decelerated to 500 RPM, you use the following program:

```
10   RUN.SPEED = 1000
20   GO.VEL
30   RUN.SPEED = 500
40   WHEN INP3 = 0, GO.VEL
```

In this example, line 40 causes Input 3 to be checked every 1.024 msec. As soon as Input 3 is seen to be low (INP3 = 0) the program will execute a GO.VEL (go at velocity) move.

The syntax for using the WHEN statement is:

```
 [line number] WHEN condition, action
```

Condition

The condition specifies what condition must be satisfied before the action is performed. The condition may be any one of the following:

- Checking for an input to be equal to 0 or 1.
- Checking for the position command to be greater than or less than some value.
- Checking for the position to be greater than or less than some value.
- Checking for the Encoder position to be greater than or less than some value.

Action

The action specifies what operation is to be taken when the condition is satisfied. The action may be any one of the following:

- Setting an Output equal to 0 or 1.
- Setting RATIO equal to a new value.
- Turning GEARING ON/OFF
- Turning REG.FUNC ON/OFF
- Performing any one of the following functions:

GO.ABS

GO.INCR

PAUSE

SEEK.HOME

GO.HOME

GO.VEL

UPD.MOVE

STOP.MOTION

- Allowing program execution to continue to the next instruction (with no action performed).

On the 1.024 msec sample that the WHEN condition is satisfied and the action is performed the values of POS.COMMAND, and ENCDR.POS are stored in the variables WHENPCMD, and WHEN.ENCPOS respectively. The values of these variables may be used for even greater synchronization.

The following list is a sampling of some possible WHEN statements:

```
50   WHEN INP1 = 1, GO.VEL
60   WHEN INP3 = 0, OUT4 = 1
100  WHEN POS.COMMAND < INT6, STOP.MOTION
320  WHEN ENCDR.POS > INT3, GO.INCR
360  WHEN INP6 = 1, RATIO = FLT4
870  WHEN POSITION > 40960, CONTINUE
900  WHEN REG.FLAG, OUT2 = 1
950  WHEN INP5, REG.FUNC = 1
```

Example

The following program is an example of using the WHEN statement. This program executes an incremental move as soon as INP3 goes low. It then waits for INP3 to go high again. When INP3 goes high, the program goes back to waiting for INP3 to go low so that it can perform another incremental move.

The response time from INP3 going low to the motor motion starting will be approximately 1 msec.

```
10   INDEX.DIST = 40960
20   WHEN INP3 = 0, GO.INCR
30   WHEN INP3 = 1, CONTINUE
40   GOTO 20
```

2.8 Electronic Gearing

Introduction

Electronic gearing allows you to control the movement of the motor shaft from an external source. Gearing usually is done with encoder inputs. However, it can be performed using Step/Dir inputs also.

To use electronic gearing, you must provide an external encoder or differential Step/Dir source. This external source is used as a master reference for electronic gearing must provide differential, line driver type outputs in quadrature form. The receiver IC is an SN75175.

The encoder inputs must be wired up as follows:

Encoder Signal	**Pin Number**
CHA (STEP)	J11-2
$\overline{\text{CHA}}$ ($\overline{\text{STEP}}$)	J11-3
CHB (DIR)	J11-4
$\overline{\text{CHB}}$ ($\overline{\text{DIR}}$)	J11-5
Encoder +5V	J11-8
Encoder GND	J11-9

Note: *An external power supply may be used to power up the encoder. If this is done then the power supply ground must be connected to J11-9.*

That also applies if a differential Step/Dir source was used as a "MASTER", then a GND (common) from this source must be connected to J11-9.

Encoder position

When an external reference (source) has been connected the encoder position variable (`ENCDR.POS`) is updated by the internal software every 1.024 msec. The value of the encoder position is contained in the variable `ENCDR.POS`. This variable continues to be updated even if electronic gearing is turned off.

Setting the electronic gear ratio

The variable `RATIO` is used to specify the electronic gear ratio.

VARIABLE	**DESCRIPTION**
RATIO	Specifies the electronic gear ratio in terms of motor shaft to encoder (Step @ Dir) shaft movement. The line count of the master encoder must be specified in order to use the `RATIO` variable.

Note: *The actual gear ratio will be specified by the most recently specified value.*

Related instructions

VARIABLE	DESCRIPTION
STEPSIZE	Step size must be >= 5 for gearing.
STEP.DIR.INPUT	Set up the encoder port to see an encoder or step @ direction inputs.
ENCODER	Should be set to the number of PPR of the installed encoder.

Turning electronic gearing ON and OFF

- Bi-directional electronic gearing is enabled by setting GEARING = 1.
- Electronic gearing is disabled by setting GEARING = 0.
- Electronic gearing, in the clockwise direction only, is enabled by setting GEARING = 2.
- Electronic gearing, in the counterclockwise direction only, is enabled by setting GEARING = 3.

Note: *The STOP.MOTION instruction will not stop the motor motion resulting from gearing. Therefore, turn gearing off (GEARING = 0) before stopping motion.*

- The variable MOVING does not recognize moving caused by GEARING.
- If directional limits are set, gearing motion in the allowed direction occurs only when the master encoder returns to the point where it originally reversed direction.
- Other motion commands could result in motion in the disabled gearing direction.
- The variable (read only) VELOCITY will return the actual speed at which the motor is running.

Note: *The minimum step size required is 5.*

Example

```
10 STEPSIZE = 25
20 STEP.DIR.INPUT = 0
30 ENCODER = 1250
40 RATIO = 2
50 GEARING = 1
60 WHEN INP1 = 1, CONTINUE
70 GEARING = 0
```

Line 10 sets the step size to 25 (both hardware and software should be the same settings).

Line 20 configure J6 inputs for encoder type signal.

Line 30 the installed encoder provides a 1250 PPR (5000 quadrature counts per rev).

Line 40 sets 2 motor shaft turns per encoder shaft revolution.

Line 50 Turn gearing ON.

Line 60 Holds the program at this line until input 1 goes high.

Line 70 Turns OFF gearing.

Using the STEP and DIR Outputs

The controller's STEP @ DIR out (J11), generates differential signals as long as there is motion in progress.

These output signals can be used to drive two other controllers. The two controllers (slaves) will follow the master's exact profile (speed and direction).

These output signals are fed back to the same controller (J10) when registration functionality is required. Refer to Section 2.10, “Registration Functionality” for additional information.

2.9 Making the Motor Move

Introduction

There are six different statements which you can use to make the motor move:

- `GO.VEL`
- `GO.INCR`
- `GO.ABS`
- `GO.HOME`
- `SEEK.HOME`
- `GEARING`

Each of these provides a different type of movement, described as follows. The instruction `GEARING` is covered in Section 2.8, “Electronic Gearing”

Program execution

These instructions, except for `SEEK.HOME`, do not wait for completion before continuing to the next line. For example, after a `GO.INCR` is encountered, the program immediately goes to the next line even though the move is still executing.

(The `SEEK.HOME` function waits for completion of the move before the program continues to the next line.)

Common variables

Common variables for motion instructions are as follows. Specific instructions are given in the appropriate instruction section.

1. `ENABLE` = 1. Also, enable the hardware, pulling the Enable input low. If not done, motion instructions are ignored.
2. `RUN.SPEED` will determine the motor speed.
3. `ACCEL.RATE` (and optionally `DECEL.RATE`) will determine the acceleration rate and the deceleration rate.
4. `MIN.SPEED` sets the initial velocity step
5. `STEPSIZE` sets the amount of rotation per input step (Both hardware and software should be the same)

Note: *`RUN.SPEED`, `ACCEL.RATE`, and `MIN.SPEED` are not required for `GEARING`.*

`RUN.SPEED` and `ACCEL.RATE` can be changed while a move is in progress using `UPD.MOVE` (Update Move).

Stopping the motor

There are several ways to stop the motor after a motion statement has been executed.

- Wait for the motion to be completed.

Note: *This does not apply to the `GO.VEL` statement.*

- Type <Ctrl><C> .
- Pull the Remote Stop input low
  (J8-5 with `PREDEF.INP13 = 1`)
- Remove the `ENABLE` input from the control

Note: *This will disable the motor current and torque but may not cease motion.*

- Execute a `STOP.MOTION` statement.

Note: *Either LIMIT(-) (J8-3) with `PREDEF.INP11` = 1) or LIMIT (+) (J8-2) with `PREDEF.INP10` = 1) inputs pulled low.*

The program stops the motor if:

- A scan triggers and a scan stop is active (SKn.STOP = 1) .
- A software overtravel has occurred.
- A stall occurs causing a STALL.STOP.

Continuous motion

CONTINUOUS.MOTION enables motion to proceed continuously over multiple motion instructions.

2.9.1 Descriptions of Motion Statements

GO.VEL

This statement causes the motor to move at the specified run speed (RUN.SPEED). The direction of rotation is specified by the DIR variable as follows:

Value	Functionality
DIR = 0	Motor rotates clockwise
DIR = 1	Motor rotates counterclockwise

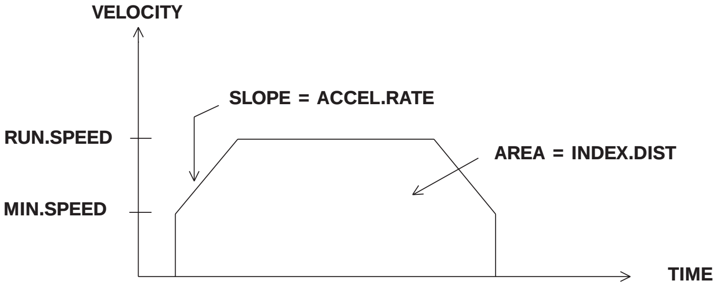
After the GO.VEL statement has been executed, the motor will continue to rotate at the specified RUN.SPEED until one of the STOP conditions described above occurs or until another GO.VEL statement is executed.

If another GO.VEL statement is executed, then motor will accelerate (or decelerate) to the new value of RUN.SPEED. If the new value of RUN.SPEED is zero, the motor will decelerate to a stop and the GO.VEL move will be complete.

Note: *If you terminate the GO.VEL move by setting RUN.SPEED equal to zero and executing a GO.VEL statement than you must set RUN.SPEED equal to a non-zero value before attempting to execute another motion statement.*

GO.INCR

This statement causes the motor to rotate a specified amount (INDEX.DIST). The software uses a trapezoidal velocity profile to rotate the motor. The acceleration rate is specified by ACCEL.RATE and the slew speed is specified by RUN.SPEED and MIN.SPEED sets the initial velocity step.



Direction

The direction of rotation is determined by the sign of INDEX.DIST:

Value	Functionality
INDEX.DIST > 0	Motor rotates clockwise
INDEX.DIST < 0	Motor rotates counterclockwise

GO.ABS

This statement causes the motor to move to an absolute position. This absolute position is specified by the variable `TARGET.POS`. The absolute position is relative to the HOME position (i.e. the place where `POS.COMMAND` = 0).

The direction of motor rotation is determined by the value of `TARGET.POS` and the current value of `POS.COMMAND`.

Value	Functionality
TARGET.POS > POS.COMMAND	Motor rotates clockwise
TARGET.POS < POS.COMMAND	Motor rotates counterclockwise

The `GO.HOME` statement is exactly equivalent to:

```
TARGET.POS = 0 : GO.ABS
```

GO.HOME

This statement moves the motor to the zero, home position (electrical home where `POS.COMMAND` = 0).

Direction

Direction of motor rotation is specified by the current value of `POS.COMMAND` relative to 0 (zero):

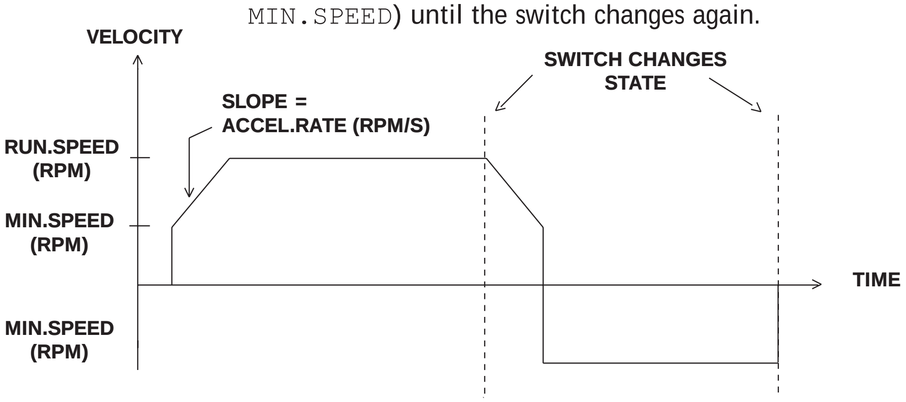
Value	Functionality
POS.COMMAND > 0	Motion goes in negative direction to 0 (zero)
POS.COMMAND < 0	Motion goes in positive direction to 0 (zero)

SEEK.HOME

This statement causes the motor to move to mechanical home position, as defined by an external limit switch connected to J8-8.

Upon initiation, the following steps occur:

1. The motor moves as specified by `DIR` (direction), `RUN.SPEED`, `ACCEL.RATE`.
2. When the switch is found, it changes state (the variable `HOME.ACTIVE` should be set to correspond to the desired state change).
3. The motor decelerates to a stop.
4. Direction reverses and the motor moves slowly (defined by `MIN.SPEED`) until the switch changes again.



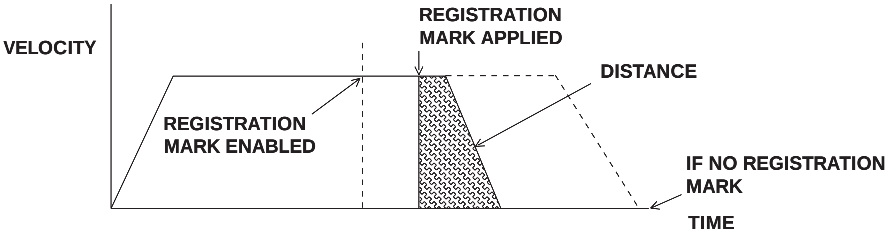
5. Motion is stopped. This position is defined as mechanical home. If no offset is programmed (see following), this position is also defined as electrical home (where `POS.COMMAND = 0`).

If an offset is needed, you can program `HMPOS.OFFSET` to add an additional incremental move when the mechanical home position is reached. This position is electrical home (`POS.COMMAND = 0`).

2.10 Registration Functionality

Introduction

In motion control terms, registration provides the ability to execute a preset move with reference to an external event while the motor is executing another move. This is done by executing a long move which would, under normal conditions, cause the index to go beyond the registration mark. As the move proceeds, the sensor detects the presence of the registration mark. It then aborts the current move and, without stopping, begins the Registration Move to the precise position.



Setting up for registration

To utilize the 6x45 registration functionality, attach the differential registration signal to J11-6 and J11-7 (CHZ and $\overline{\text{CHZ}}$). If the source of registration signal does not provide differential TTL levels, refer to “Connecting to Registration Input” on the following page. The registration function will trigger when the Z input goes negative relative to the $\overline{\text{Z}}$ input. Also, connect the STEP and DIR outputs to the STEP and DIR inputs (refer to Wiring the controller).

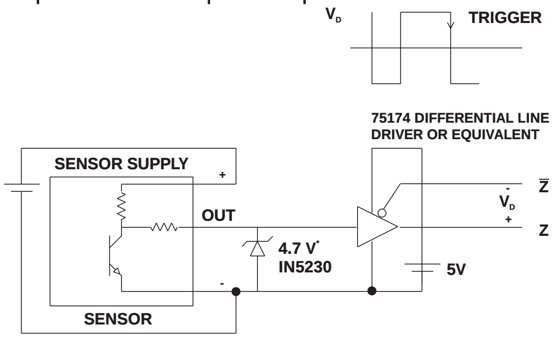
Wiring the Controller

The table below shows wiring connections for 6x45 indexers:

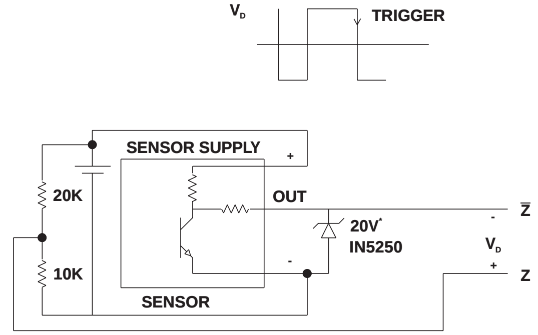
J11	J10
pin 2	pin 1
pin 3	pin 2
pin 4	pin 3
pin 5	pin 4

Connecting to Registration Input

The registration inputs, Z and $\overline{Z}$, on the stepper indexers connect to a different line receiver. It is necessary to apply a voltage across the receiver having one polarity in the active state and the opposite polarity in the inactive state. If the source is a single-ended device such as a proximity or photo sensor, one of the circuits shown below should be used to provide the required input:



*ZENER REQUIRED IF SUPPLY VOLTAGE GREATER THAN 20 Vdc



*ZENER REQUIRED IF SUPPLY VOLTAGE GREATER THAN 20 Vdc

Note: *The return used for the sensor source should be connected to the controller's return at a single point.*

Related instructions

There are six variables associated with the REG.FUNC function. They are:

<table>
<tr><th>VARIABLE</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>STEP.DIR.INPUT</td><td colspan="2">This variable must be set = 1. It will configure J11 to a STEP and DIR input.</td></tr>
<tr><td>STEPSIZE</td><td colspan="2">Both software and hardware setup should be the same (1, 2, 5, 25 or 125).</td></tr>
<tr><td rowspan="7">ENCODER</td><td colspan="2">Based upon the designated STEPSIZE, the ENCODER variable setting should be as follows:</td></tr>
<tr><td>STEPSIZE</td><td>ENCODER</td></tr>
<tr><td>1</td><td>50</td></tr>
<tr><td>2</td><td>100</td></tr>
<tr><td>5</td><td>250</td></tr>
<tr><td>25</td><td>1250</td></tr>
<tr><td>125</td><td>6250</td></tr>
<tr><td>REG.DIST</td><td colspan="2">The distance that is moved automatically after the Registration input is applied (REG.FLAG = 1 and REG.FUNC = 1). It will perform a move like the GO.INCR but with microsecond response to the input.</td></tr>
<tr><td>REG.FUNC</td><td colspan="2">Setting up this variable = 1 will enable(activate) the registration function and it will allow for a registration move set up the REG.DIST to be performed if a registration input was applied (REG.FLAG = 1). Setting up this variable = 0 will disable the registration function and no registration distance will be performed even if a registration input was applied.</td></tr>
<tr><td>REG.FLAG</td><td colspan="2">Flag indicates the status of the registration input.
REG.FLAG = 1 —-Input has triggered
REG.FLAG = 0 —- Input has not triggered
This flag can be cleared in two ways:
1) Setting REG.FLAG = 0
2) Setting REG.FUNC = 1</td></tr>
</table>

Example

```
10   STEPSIZE = 25
20   ENCODER = 1250
30   MIN.SPEED = 5
40   ACCEL.RATE = 5000
50   RUN.SPEED = 750
60   REG.DIST = 15000
70   INDEX.DIST = 25000
80   GO.INCR
90   REG.FUNC = 1
100 IF MOVING THEN 100
110 GOTO 80
```

Line 10 sets the software step size to 25 (the hardware step size switch should be the same).

Line 20 sets the encoder variable to 1250 ppr.

Line 30 through 50 set the motion parameters.

Line 60 sets registration distance of 3 revs.

Line 70 and 80 perform an incremental move of 5 revs.

Line 90 enables the registration function to automatically move a registration distance once the registration input is triggered (`REG.FLAG` = 1).

Line 100 holds the program until the move is completed.

Line 110 forces the program to go to line 80.

3 StepperBASIC Instructions

Introduction

This section is an alphabetical reference to StepperBASIC instructions:

- commands
- functions
- parameters
- statements
- variables

The name and type of each instruction is listed at the top of the page. The instruction is then described based on the following categories:

Purpose: The purpose of the instruction

Syntax: The complete notation of the instruction

Related instructions: Other StepperBASIC commands that are similar to this particular instruction

Programming guidelines: Pertinent information about the instruction and its use in StepperBASIC

Program segment: Possible use of the instruction in a program

ABS

function

Purpose

The Absolute Value function, `ABS(x)`, converts the associated value to an absolute value. If the value is negative, it is converted to a positive value. If the value is positive, it is not changed.

Syntax

```
ABS(x)
```

Programming guidelines

Enter the argument (the value) in parentheses immediately following the term ABS.

Program segment

Program line

```
10     INT1 = -1000
20     PRINT ABS(INT1)
RUN    <enter>
```

Program prints “1000".

ACCEL.RATE

parameter

(integer)

Purpose `ACCEL.RATE` (Acceleration Rate) sets the rate at which the motor will accelerate/decelerate to change speed.

> **IMPORTANT NOTE**
>
> The value of this variable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

```
ACCEL.RATE = x
```

where x is the desired acceleration rate in RPM/sec and it depends on step size with range and resolution as follows:

Range

Stepsize	Range
1	17.46 to 1,000,000 RPM/sec
2	17.46 to 1,000,000 RPM/sec
5	6.98 to 1,000,000 RPM/sec
25	5.59 to 1,000,000 RPM/sec
125	2.24 to 1,000,000 RPM/sec

Note: *Below these values,* `ACCEL.RATE` is set to 0.

Resolution

Stepsize	Resolution
1	4.6 RPM
2	4.6 RPM
5	1.8 RPM
25	1.5 RPM
125	0.58 RPM

Default x = 1000

ACCEL.RATE (continued)

Related instructions

MAX.DECEL — alternative deceleration rate for special condition stopping.

DECEL.RATE — deceleration rate when DCL.TRACK.ACL disable.

DCL.TRACK.ACL — enables same deceleration rate as acceleration.

GO.ABS — causes the motor to move to the position specified by TARGET.POS.

GO.HOME — moves the motor shaft to the electrical home position.

GO.INCR — moves the motor shaft an incremental index from the current position.

GO.VEL — moves the motor shaft at constant speed.

RUN.SPEED — sets the commanded velocity in RPM.

UPD.MOVE — updates the commanded motion (currently in progress) using specified ACCEL.RATE, DECEL.RATE and RUN.SPEED.

Programming guidelines

- Program variable whenever there is a change in the rate of motion, including negative motion.
- If ACCEL.RATE = 0 and a move is initiated, the motor runs at MIN.SPEED.
- Set the ACCEL.RATE parameter prior to issuing any motion command statement.
- ACCEL.RATE can be updated using the UPD.MOVE statement.

Program segment

<u>Program line</u>

```
10      'Set stepsize equal to 25
20      STEPSIZE = 25
30      RUN.SPEED = 300
40      'Set an incremental move of 25000 microsteps
50      INDEX.DIST = 25000
60      GO.INCR
```

AUTO
command

Purpose

AUTO automatically generates program line numbers, presenting a new line number after each program line is added.

Syntax

```
AUTO[ line number [ , increment ] ]
```

Related instructions

RENUM — renumbers program lines.

Programming guidelines

If the new line number does not appear, the previous line was not successfully added to the program because of a syntax error. Retype the line number and instruction correctly to remedy this.

The AUTO command stays in effect until the user types:

<Cntl><c>

or until a line typed in by the user contains a syntax error.

Program segment

Program line

```
AUTO 100, 50 <enter>
```

Generates line numbers 100, 150, 200, ...

```
AUTO <enter>
```

Generates line numbers 10, 20, 30, ...

CCW.OT

parameter

(integer)

Purpose

`CCW.OT` (Counterclockwise Overtravel) sets the counterclockwise software overtravel limit in motor steps.

When the counterclockwise overtravel variable is turned On (`CCW.OT.ON` = 1) and the set distance is surpassed, the motor decelerates to a stop and further counterclockwise motion is prevented. An error code is generated and an overtravel jump occurs if programmed.

Note: *Please refer to Section 2.3, "Setting Up Overtravel Function", for additional information.*

Syntax

```
CCW.OT = x
```

Stepsize	**Steps**
1	-33,554,432 ≤ x ≤ 33,554,431
2	-67,108,864 ≤ x ≤ 67,108,863
5	-67,108,864 ≤ x ≤ 67,108,863
25	-268,435,456 ≤ x ≤ 268,435,455
125	-536,870,912 ≤ x ≤ 536,870,911

Default x = 0

Related instructions

`CCW.OT.JUMP` — sets the line number destination if overtravel exceeded.

`CCW.OT.ON` — turns on counterclockwise overtravel checking.

`OT.ERROR` — displays value for the appropriate direction if an overtravel error occurs.

See also corresponding clockwise variables, `CW.OT`, `CW.OT.ON` and `CW.OT.JUMP`.

CCW.OT (continued)

Programming guidelines

1. Set CCW.OT to the desired distance in motor position. This distance is based on POS.COMMAND = 0.
2. Program CCW.JUMP for a line number destination if desired.
3. Program CCW.OT.ON = 1 to turn On overtravel checking.

Program segment

Program line

```
10     PREDEF.INP = 0
20     ENABLE = 1
30     STEPSIZE = 25
40     MIN.SPEED = 100
50     RUN.SPEED = 1000
60     ACCEL.RATE = 1000
70     POS.COMMAND = 0
80     CW.OT = 25000
90     CCW.OT = -25000
100    CW.OT.ON = 1
110    CCW.OT.ON = 1
120    CW.OT.JUMP = 1000
130    CCW.OT.JUMP = 1000
140    GO.VEL
150    WHILE MOVING : WEND
160    PRINT “ERROR”
170    END
1000   PRINT “CW & CCW OT JUMP OK”
1010   PRINT “OT.ERROR = ”; OT.ERROR
1020   DIR = NOT DIR
1030   GOTO 80
RUN    <enter>
```

The motor oscillates between position + 25000 and -25000.

CCW.OT.JUMP

parameter

(integer)

Purpose

CCW.OT.JUMP (Counterclockwise Overtravel Error Jump Location) specifies the jump location for counterclockwise overtravel errors.

If CCW.OT.JUMP is equal to zero, the program will not jump when a counterclockwise overtravel occurs.

Note: *Refer to Section 2.3, "Setting Up the Software Overtravel Function", for additional information.*

Syntax

```
CCW.OT.JUMP = x
```

where x is the line number of counterclockwise overtravel error handler.

CCW.OT.JUMP = 0 prevents the program from jumping when a counterclockwise overtravel error occurs.

Default

x = 0

Related instructions

CCW.OT — sets the counterclockwise software overtravel limit

CCW.OT.ON —turns On/Off counterclockwise overtravel checking

OT.ERROR — displays value for the appropriate direction if an overtravel error occurs.

See also corresponding clockwise variables, CW.OT and CW.OT.ON.

Programming guidelines

1. Program CCW.OT.ON = 1 to turn On overtravel checking.
2. Set CCW.OT to the desired distance in motor position. This distance is based on POS.COMMAND.

CCW.OT.ON

Variable

(Integer)

Purpose

CCW.OT.ON (CounterclockwiseOvertravel Check Enable) works with CCW.OT and CCW.OT.JUMP to turn On the counterclockwise software overtravel limit function.

CCW.OT.ON specifies whether the counterclockwise overtravel checking is turned On or Off. You can set CCW.OT.ON to 0 or 1.

Note: *Please refer to Section 2.3,"Setting Up Overtravel Function", foradditional information.*

Syntax

CCW.OT.ON = 1 Turns counterclockwise overtravel check On

CCW.OT.ON = 0 Turns counterclockwise overtravel check Off

Related instructions

CCW.OT.JUMP — sets theline number destination of overtravel exceeded.

CCW.OT — counterclockwise software overtravel limit.

OT.ERROR — displays value for the appropriate direction if an overtravel error occurs.

See also corresponding clockwise variables, CW.OT, CW.OT.ON, and CW.OT.JUMP.

Programming guidelines

1. Set CCW.OT to the desired distance in motor position. This distance is based on POS.COMMAND = 0.
2. Program CCW.JUMP for a line number destination, if desired.
3. Program CCW.OT.ON = 1 to turn overtravel checking On.

CHR ( )

function

Purpose

CHR converts an ASCII code to its equivalent character

Syntax

```
CHR (n)
```

Related instructions

INKEY — returns the key or control code corresponding to a key pressed or control entered from the keyboard.

Programming guidelines

n is a value from 0 to 255.

Refer to Appendix A, “ASCII Codes”, for a table of ASCII values.

Program segment

Program line

```
10     PRINT CHR (66)
RUN    <enter>
```

The upper case letter B will be printed.

CINT
function

Purpose

The convert to integer function, `CINT(x)`, converts x to an integer by rounding the fractional portion. If the fractional portion is greater than 0.5, x is rounded up to the next integer; if less than 0.5, x is rounded down to the existing integer portion.

Syntax

```
CINT (x)
```

Range

-32,768 to 332,767

Related instructions

`INT` — converts a constant or variable into the largest integer that is less than or equal to x.

Program segment

Program line

```
PRINT CINT (45.67)
```

The value 46 will be printed

```
PRINT CINT (-12.11)
```

The value -12 will be printed

```
PRINT CINT (VELOCITY)
```

The value 1000 will be printed if the motor is moving at 1000 RPM

CLEAR

command

Purpose

`CLEAR` is an immediate mode instruction that sets `FLGn`, `FLTn`, and `INTn` variables to 0.

Note: *`CLEAR`* does not affect program text or global variables.

Syntax

```
CLEAR
```

Related instructions

`FLGn` — flag variable cleared by `CLEAR`.

`FLTn` — float variable cleared by `CLEAR`.

`INTn` — integer variable cleared by `CLEAR`.

Programming guidelines

Program `CLEAR` from immediate mode to set all user-specified variables in RAM to 0. Variables in the program are not affected.

CLR.SCANn

statement

Purpose

`CLR.SCANn` (Clear Scan 1 or 2) turns Off scan 1 or scan 2.

Note: *Refer to Section 2.1, "Enabling and Disabling SCANs" for additional information.*

Syntax

`CLR.SCANn`

where n = 1 or 2

Related instructions

`SET.SCANn` — activates scan 1 or scan 2.

`SKn.JUMP` — sets the jump line number.

`SKn.TRIGGER` — sets the scan trigger input.

`SKn.OUTPUT` — sets an output action.

`SKn.GOSUB` — sets the gosub line number.

`SKn.STOP` — stops the motor using `MAX.DECEL` value.

Programming guidelines

- Program `CLR.SCANn` at the point in the program where you wish to turn the scan off.
- To turn the scan On again, program `SET.SCANn`.
- Refer to `SET.SCANn` for scan information.

CLR.SCANn (continued)

Program segment

Program line

```
5      ‘Set scan to occur when input 2 goes to low voltage.
10     SK1.TRIGGER = 20
15     ‘Stop motor when scan input seen.
20     SK1.STOP = 1
25     ‘Do not jump.
30     SK1.JUMP = 0
35     ‘Turn output 1 On when scan input seen.
40     SK1.OUTPUT = 11
45     ‘Begin checking for scan input.
50     SET.SCAN1
55     ‘Turn motor at 1000 RPM.
60     RUN.SPEED = 1000
65     ‘Perform motion.
70     GO.VEL
75     ‘Wait for 5 seconds.
80     WAIT.TIME = 5
85     ‘Pause.
90     PAUSE
95     ‘Turn Off scan 1.
100    CLR.SCAN1
RUN    <enter>
```

Scan1 looks for input 2 going low. Scan1 will be active for only five seconds after motor starts to move.

CONT

command

Purpose

CONT (Continue after Stop) is an immediate mode instruction that causes resumption of a program interrupted by a STOP command.

Using CONT with STOP is an effective tool for testing and debugging programs.

Syntax

```
CONT
```

Related instructions

STOP — causes program interrupt used with CONT.

Note: *Do not confuse the instruction* CONTINUE, used with WHEN, with CONT.

Programming guidelines

Program CONT from immediate mode whenever a program is interrupted using the STOP command.

Note: *Do not change the program interrupted by* STOP. Program execution will be incorrect if a STOP interrupted program is altered. You may, however, change variables in immediate mode during an active STOP command.

CONT (continued)

Program segment

Program Line

```
90      ‘The program stops.
100     STOP
110     ‘Program resumes from here when CONT programmed.
120     PRINT “Program”
        .
        .
        .
```

`RUN` When the program runs, it completes up to line 100 and prints “Break in line 100". You may now enter instructions in immediate mode, including variable changes.

`CONT` Program execution continues from line 110.

CONTINUOUS.MOTION

variable

(integer)

Purpose

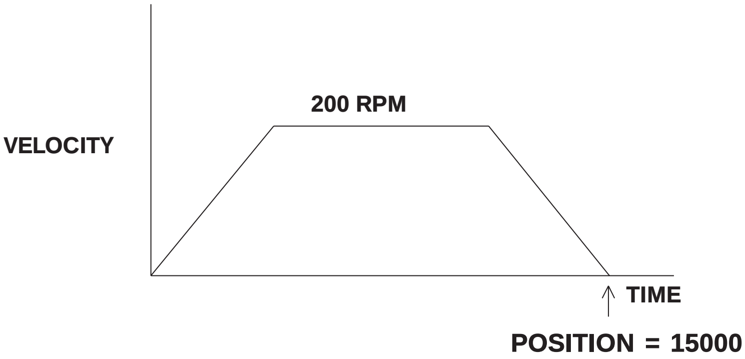
CONTINUOUS.MOTION enables motion to proceed continuously over multiple motion instructions. Motion does not stop when new motion instructions are encountered; instead, motion continues with the parameters of the new motion instruction.

If CONTINUOUS.MOTION is not enabled, motion stops after each motion instruction.

When enabled

When enabled (CONTINUOUS.MOTION = 1), the following program segment results in one continuous move to a position one turn beyond the absolute position of 10000.

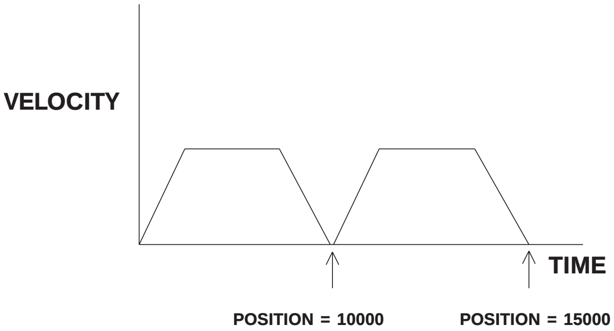
```
10 CONTINUOUS.MOTION = 1
20 POS.COMMAND = 0
30 TARGET.POS = 10000
40 INDEX.DIST = 5000
50 RUN.SPEED = 200
60 GO.ABS
70 GO.INCR
```



CONTINUOUS.MOTION (continued)

When disabled

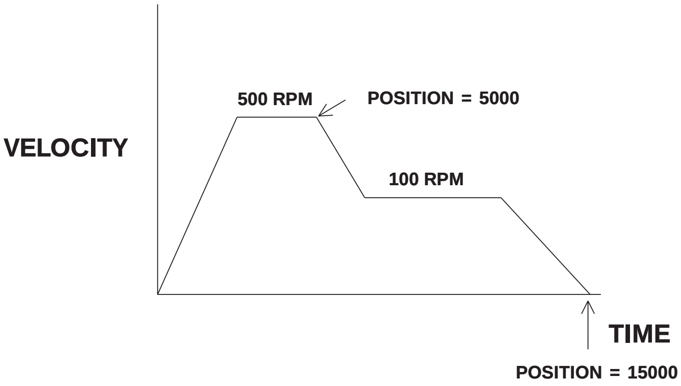
If line 10 had not enabled Continuous Motion (CONTINUOUS.MOTION = 0), two distinct moves would occur:



Changing variables

If new motion variables are programmed following existing motion instructions, these new variables become effective as soon as a new motion instruction is encountered. For example, the following program segment generates the motion profile shown:

```
10 CONTINUOUS.MOTION = 1
20 POS.COMMAND = 0
30 TARGET.POS = 10000
40 RUN.SPEED = 500
50 GO.VEL
60 RUN.SPEED = 100
70 WHEN POS.COMMAND > 5000, GO.ABS
```



Used with Update Move

Continuous Motion must be enabled when using Update Move (UPD.MOVE).

Syntax

```
CONTINUOUS.MOTION = x
```

Value

x = 0 to disallow Continuous Motion. Once a move is in process, the move must complete and motion stop before other moves may initiate.

x = 1 to specify Continuous Motion when new variables and UPD.MOVE encountered.

Default

x = 0

Related instructions

UPD.MOVE — immediately update the current move in process with new variables.

Programming guidelines

Set CONTINUOUS.MOTION = 1 to specify Continuous Motion.

Note: *Any relevant variables that the program encounters while the motion profile is in process will be implemented for the remainder of the profile.*

Program segment

Program line

```
90     'Specify continuous motion.
100    CONTINUOUS.MOTION = 1
110    RUN.SPEED = 2000
120    INDEX.DIST = 100000
130    GO.INCR
140    GO.INCR
RUN    <enter>
```

Single move of 200,000 steps will be performed without any stopping.

CW.OT

parameter

(integer)

Purpose

CW.OT (Clockwise overtravel) sets the clockwise software overtravel limit in motor steps.

When the clockwise overtravel variable is turned On (CW.OT.ON = 1) and the set distance is surpassed, the motor decelerates to a stop and further clockwise motion is prevented. An error code is generated and an overtravel jump occurs if programmed.

Note: *Refer to Section 2.3, "Setting Up the Software Overtravel Function" for additional information.*

Syntax

```
CW.OT = x
```

Range

Stepsize	**Steps**
1	-33,554,432 ≤ x ≤ 33,554,431
2	-67,108,864 ≤ x ≤ 67,108,863
5	-67,108,864 ≤ x ≤ 67,108,863
25	-268,435,456 ≤ x ≤ 268,435,455
125	-536,870,912 ≤ x ≤ 536,870,911

Default

x = 0

Related instructions

CW.OT.JUMP — sets the line number destination if overtravel exceeded.

CW.OT.ON — turns on clockwise overtravel checking.

OT.ERROR — displays value for the appropriate direction if an overtravel error occurs.

See also corresponding clockwise variables, CCW.OT, CCW.OT.ON and CCW.OT.JUMP.

Programming guidelines

1. Set CW.OT to the desired distance in motor position. This distance is based on POSITION = 0.
2. Program CW.JUMP for a line number destination if desired.
3. Program CW.OT.ON = 1 to turn On overtravel checking.

CW.OT.JUMP

parameter

(integer)

Purpose

CW.OT.JUMP (Clockwise Overtravel Error Jump) sets the line the program jumps to upon an overtravel error.

This variable works with CW.OT and CW.OT.ON to implement the clockwise software overtravel limit function.

If you set CW.OT.JUMP equal to zero then the program will not jump when a clockwise overtravel occurs.

Note: *Refer to Section 2.3, "Setting Up the Software Overtravel Function" for more information.*

Syntax

```
CW.OT.JUMP = x
```

Value	x = line number of clockwise overtravel error handler
	x = 0 to prevent jumping upon a clockwise overtravel error
Default	x = 0

Related instructions

CCW.OT — counterclockwise overtravel limit.

CCW.OT.ON — turns On counterclockwise overtravel checking

CW.OT.ON — turns On clockwise overtravel checking.

CW.OT — clockwise overtravel limit.

OT.ERROR — displays value for appropriate direction if overtravel occurs.

Programming guidelines

1. Program CW.OT.ON = 1 to turn ON overtravel checking.
2. Set CW.OT to desired distance in motor position. This distance is based on POS.COMMAND = 0.

CW.OT.ON

parameter

(integer)

Purpose

CW.OT.ON (Clockwise Overtravel Check Enable) specifies whether the clockwise overtravel checking is turned On or Off. You can set CW.OT.ON to 0 or 1.

Note: *Refer to Section 2.3, "Setting Up Software Overtravel Function" for additional information.*

Syntax

CW.OT.ON = 1 Turns Clockwise Overtravel Enable On

CW.OT.ON = 0 Turns Clockwise Overtravel Enable Off

Related instructions

CW.OT.JUMP — sets the line number destination of overtravel exceeded.

CW.OT — clockwise software overtravel limit.

OT.ERROR — displays value for the appropriate direction if an overtravel error occurs.

See also corresponding clockwise variables, CCW.OT, CCW.OT.ON, and CCW.OT.JUMP.

Programming guidelines

1. Set CW.OT to the desired distance in motor position. This distance is based on POS.COMMAND = 0.
2. Program CW.JUMP for a line number destination if desired.
3. Program CW.OT.ON = 1 to turn overtravel checking On.

DCL.TRACK.ACL

variable

(integer)

Purpose DCL.TRACK.ACL (Deceleration Tracks Acceleration) enables the acceleration rate equal to the deceleration rate. If disabled, deceleration is a separate value to be set using DECEL.RATE.

Syntax `DCL.TRACK.ACL = x`

Value x = 0 to turn OFF Deceleration Tracks Acceleration to use DECEL.RATE.

x = 1 to turn ON Deceleration Tracks Acceleration. The program uses the acceleration rate to decelerate.

Note: *DCL.TRACK.ACL* is automatically turned Off when a DECEL.RATE is specified.

Default x = 1

Related instructions

DECEL.RATE — sets the deceleration rate for motion.

ACCEL.RATE — sets the acceleration rate when speed is increased.

Program segment

Program line

```
90     ‘Disable deceleration track acceleration.
100    DCL.TRACK.ACL = 0
110    ACCEL.RATE = 1000000
120    DECEL.RATE = 1000
130    RUN.SPEED = 10000
140    INDEX.DIST = 10000
150    GO.INCR
RUN    <enter>
```

Line 100 disables deceleration track acceleration when line 150 is encountered. Trapezoidal move profile is performed with deceleration rate different from acceleration.

DECEL.RATE

parameter

(integer)

Purpose DECEL.RATE (Deceleration Rate) sets the deceleration performed at the end of a move.

Syntax

```
DECEL.RATE = x
```

where x is the desired deceleration rate in RPM/ sec.

Stepsize	Range
1	17.46 to 1,000,000 RPM/sec
2	17.46 to 1,000,000 RPM/sec
5	6.98 to 1,000,000 RPM/sec
25	5.59 to 1,000,000 RPM/sec
125	2.24 to 1,000,000 RPM/sec

Stepsize	Resolution
1	4.6 RPM/sec
2	4.6 RPM/sec
5	1.8 RPM/sec
25	1.5 RPM/sec
125	0.58 RPM/sec

Default x = 1000

Related instructions DCL.TRACK.ACL — specifies deceleration rate different than acceleration.

DECEL.RATE (continued)

Programming guidelines

Specify `DCL.TRACK.ACL = 0` then set `DECEL.RATE` to the desired value.

To switch from deceleration at `DECEL.RATE` to deceleration at the acceleration rate, program `DCL.TRACK.ACL = 1`.

Program segment

Program line

```
90      'Disables deceleration tracks acceleration.
100     DCL.TRACK.ACL = 0
110     ACCEL.RATE = 1000000
120     DECEL.RATE = 1000
130     RUN.SPEED = 10000
140     INDEX.DIST = 10000
150     GO.INCR
RUN     <enter>
```

Line 100 disables deceleration track acceleration when line 150 is encountered. Trapezoidal move profile is performed with deceleration rate different from acceleration.

DELETE

command

Purpose

`DELETE` removes one or more lines from a program.

Syntax

```
DELETE [ line number1 ] - [ line number 2 ]
```

Where line number1 designates the first line number to be deleted and line number2 designates the last line number to be deleted.

Note: *A line may also be deleted by typing the line number followed by <Return>.*

Example program

Program line

```
DELETE
```

This results in an error message because no line number was specified.

```
DELETE 25
```

Deletes line 25 from the program.

```
DELETE 20-50
```

Deletes lines 20 through 50 from the program.

```
DELETE -50
```

Deletes all lines from the beginning of the program through line 50.

DIR

parameter

(integer)

Purpose

DIR (Direction) sets the direction the motor turns when a GO.VEL or SEEK.HOME function is executed.

The step counter (POS.COMMAND) increases with moves in the set direction and decreases with moves in the opposite direction.

Note: *Refer to Section 2.9, "Description of Motion Statements" for additional information.*

> **IMPORTANT NOTE:**
>
> The value of this valuable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

`DIR = x`

Value

x = 0 rotation is *clockwise* when looking at the motor shaft end-first

x = 1 rotation is *counterclockwise* when looking at the motor shaft end-first

Default

x = 0

Related instructions

GO.VEL — moves the motor shaft at a constant speed

POS.COMMAND — displays steps and can also be set to a value.

RUN.SPEED — sets the commanded velocity

SEEK.HOME — causes the motor to find its home position based upon a limit switch connected to INP16.

Programming guidelines

Note: *DIR does not define direction for the GO.INCR motion function. The sign of INDEX.DIST defines direction for this function.*

DIR (continued)

Program segment

Program line

```
10     DIR = 0
20     SEEK.HOME
30     DIR = NOT DIR
40     RUN.SPEED = 250
50     GO.VEL
```

Lines 10 and 20 determine the clockwise direction for rotation to find the home position.

Lines 30 through 50 determine the rotation move in constant speed of 250 RPM in the counterclockwise direction.

ENABLE

parameter

(integer)

Purpose ENABLE allows or prevents power flow to the motor.

Syntax ENABLE = x

Value x = 0 to disable the drive

x = 1 to enable the drive

Default x = 1

Related instructions

PWR.ON.ENABLE — automatically enables the drive upon power up.

ENABLED — displays drive enable state.

FAULTCODE — indicates if the controller is faulted.

Programming guidelines

To enable, that is, allow power to flow to the motor, verify that the following conditions are all true:

1. Drive is not faulted.
2. Enable input J10-5 connected to I/O RTN.
3. ENABLE variable set to 1.

If any of these conditions is false, power will not flow into the motor. Therefore, when conditions 1 and 2 are true, the ENABLE variable may be used to control whether or not power flows into the motor.

Note: *When the controller is turned on, the* ENABLE *variable is set equal to the value* PWR.ON.ENABLE.

ENABLED

variable

(integer)

(read only)

Purpose

`ENABLED` indicates whether controller is enabled.

Syntax

```
x = ENABLED
```

0 = controller disabled

1 = controller enabled

Related instructions

`ENABLE` — variable to enable drive in program.

`FAULTCODE` — indicates if the controller has faulted.

Programming guidelines

To enable, that is, allow power to flow to the motor, verify that the following conditions are all true:

1. Drive is not faulted.
2. Enable input J10-5 connected to I/O RTN.
3. `ENABLE` variable programmed.

ENCDR.POS

variable

(integer)

Purpose

ENCDR.POS (Encoder Position) displays encoder position. For example, with a 1024 line encoder, each increment of ENCDR.POS is equal to 1/4096 of a revolution of the encoder shaft.

Note: *Refer to Sections 2.5, 2.6, 2.8, and 2.10 for additional information.*

Syntax

```
x = ENCDR.POS
```

Value

x = ± 2,147,483,647 encoder line count

Related instructions

ENCODER — sets the line count of the master encoder.

STEP.DIR.INPUT — specifies encoder or step/direction input.

ENC.FREQ — displays encoder frequency.

Programming guidelines

- Install an incremental quadrature encoder with differential line driver-type outputs on the master motor. Refer to Section 2.5.5, "J11 Encoder/Step and Direction Input Connection" in the Installation Manual.
- Install the encoder input from the master and verify that it is set to the correct ENCODER line count.
- ENCDR.POS can also be used when the J11 Encoder Interface is converted for step and direction input. Refer to STEP.DIR.INPUT.

Note: *The maximum encoder frequency is 500 KHz.*

ENC.FREQ

variable

(float)

(read only)

Purpose

ENC.FREQ (Encoder Frequency) displays the encoder frequency in pulses per second.

Syntax

```
x = ENC.FREQ
```

Maximum frequency

500 KHz

Related instructions

STEP.DIR.INPUT — specifies encoder or step/direction input.

ENCODER — sets the line count of the master encoder.

Programming guidelines

The value returned is a floating point variable. To convert the value to an integer, use CINT.

ENC.FREQ is updated every 160 msec and represents the average frequency over the preceding 160 msec interval.

Program segment

Program line

```
10     ENCODER = 1024
20     PRINT ″ENC.FREQ = ″ CINT (ENC.FREQ)
```

Assuming the master encoder is moving at a rate of 3000 RPM, the output for this program will be:

```
ENC.FREQ = 204800
```

Note: *ENC.FREQ* = (ENCODER x Speed (RPM) x 4) / 60

ENCODER

parameter

(integer)

Purpose

`ENCODER` specifies the number of line counts per revolution for the installed encoder. This variable must be specified if using electronic gearing, position verification and correction, stall detection, and registration function.

Note: *An incremental quadrature encoder with differential line driver type outputs must be used. Refer to Sections 2.5, 2.6, 2.8 and 2.10 for additional information.*

> **IMPORTANT NOTE:**
>
> The value of this valuable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

```
ENCODER = x
```

Range	x = 200 to 10000
Default	x = 1000

Related instructions

`GEARING` — turns On or Off electronic gearing.

`RATIO` — the electronic gearing ratio of motor shaft movement to encoder shaft movement using encoder line count.

`STEP.DIR.INPUT` — selects quadrature encoder or step and direction inputs J11.

ENCODER (continued)

Program segment

Program line

```
5    ‘Installed encoder is 500 lines per revolution
10   ENCODER = 500
15   ‘Ratio is 0.5 for a half turn of the motor shaft per encoder
     revolution
20   RATIO = 0.5
25   ‘Turn On electronic gearing
30   GEARING = 1
```

END
statement

Purpose

END terminates the execution of a program

Syntax

```
END
```

Programming guidelines

This statement may be used anywhere in a program to cause the program to terminate and stop the motor. This statement may be used as the last line of the program.

Note: *An error will not occur if the* END statement is not used.

The CONT command will not work after execution of an END statement it will, however, continue following a STOP statement.

To restart the program following an END statement, the RUN command must be used.

Related instructions

STOP — Stops program and motion.

CONT — causes the program to continue after a STOP command is encountered.

FAULTCODE

variable

(integer)

Purpose

FAULTCODE flags general drive or microprocessor fault occurrence. This code occurs whenever the PROCESSOR FAULT LED is lit.

Syntax

```
x = FAULTCODE
```

Value

x = 0 displayed if no fault present or is entered to clear fault code after source of faulting has been removed

x = 1 displayed if drive faulted

x = 2 displayed if an error occurred while loading the program fromthe NVRAM to RAM.

x = 3 displayed if an error occurred while loading the variables from the NVRAM to RAM.

Programming guidelines

- Program a fault code in an expression to detect faults that occur during operation.
- If fault occurs, reset FAULTCODE by programming FAULTCODE = 0. If a drive fault occurred, cycle power only. If the fault recurs, troubleshoot as follows:

1. Check correct connections to motor. See Section 2.5.1 in the Installation Manual.

2. Check for voltage drops in line voltage. Voltage must be at 120 volts ± 20%.

For further help, contact Pacific Scientific Application Engineering at (978) 988-9800 from 8 am to 5 pm Eastern Standard Time, or contact your Pacific Scientific distributor.

FLGn

variable

Purpose

FLGn (Flag variables 1 to 8) are flag, that is 0 or 1, variables you define as part of your program.

Syntax

```
FLGn = x
```

Range

x = 0 or 1

Default

FLGn = 0

Related instructions

FLTn — thirty-two floating point user-defined variables.

INTn —thirty-two integer user-defined variables.

CLEAR — clears FLGn, FLTn, and INTn variables in immediate mode.

Programming guidelines

Set the individual variable to 0 or 1 as required.

Note: *Flags are not saved in NVRAM by* SAVEVAR. If you cycle power you will loose the state of the FLG variables.

Program segment

Program line

```
100   FLG7 = 1
```

Flag 7 is 1.

```
    .
    .
    .
1000  IF FLG7 = 1 THEN STOP.MOTION
```

Stop motor if flag 7 is 1.

FLTn

variable

(float)

Purpose

`FLTn` (Floating point variables 1 to 32) are decimal variables you define as part of your program.

Syntax `FLTn = x where n = 1 to 32`

Range	± 3 x 10^{-39} to ± 1.7 x 10^{38}
Default	`FLTn` = 0
Resolution	IEEE Single Precision Floating Point

Related instructions

`FLGn` — eight flag (0 to 1) user-defined variables.

`INTn` — thirty-two integer user-defined variables.

`CLEAR` — clears `FLGn`, `FLTn`, and `INTn` variables in immediate mode.

`SAVEVAR` — FLT1...FLT32 are saved in NVRAM memory.

Programming guidelines

Set the individual variable equal to a floating value within the range.

Program segment

Program line

```
.
.
100   RATIO = FLT9 + FLT3
```

Set ratio equal to sum of float variable 9 and 3.

```
.
.
```

FOR...NEXT
statement

Purpose

FOR...NEXT allows a series of statements to be executed in a loop a given number of times.

Syntax

```
FOR  variable start value TO end value  [STEP increment]
.
.
.
NEXT = [variable]
```

Programming guidelines

An integer or floating point is used as a counter. The first expression is the initial value of the counter variable, and the second expression is the final value of the counter variable. The program lines following the FOR statement are executed until the corresponding NEXT statement is encountered. Then the counter variable is incremented (or decremented if STEP is negative) by STEP. The BASIC interpreter software checks to see if the counter variable is greater than (or less than) the final value. If the value of the counter variable is not greater than (not less than) the final value, the BASIC interpreter software executes the statement following the FOR statement and the loop is repeated.

If the variable is greater (smaller) than the final value, execution continues with the statement following the NEXT statement.

Note: *If* STEP is not specified, the default value of +1 is assumed.

FOR ... NEXT (continued)

If STEP is negative, the final value of the counter is less than the initial value. The variable is decreased by the value of STEP each time through the loop, and the loop is executed until the variable is less than the final value. The body of the loop is skipped if the initial value times the sign of the step is greater than the final value times the sign of the step.

The NEXT statement can optionally include the name of the control variable used in the FOR statement. FOR loops can be nested up to a limit of eight. Each NEXT statement encountered at runtime must correspond to the most recently encountered FOR statement. The value of the expression is evaluated prior to the start of loop execution. Changing any variable used in the expressions within the loop will not affect the number of loops performed. The final expression is evaluated before the initial value expression.

Program segment

Program line

```
20     FOR INT1 = 2 to 5
30     PRINT INT1;
40     NEXT
RUN <return>
```

FREE
command

Purpose

`FREE` displays the number of free bytes of program memory.

Syntax

```
FREE
```

Programming guidelines

When writing a program of several hundred lines, check the size of the program periodically to ensure that it does not exceed the 12K byte size of NVRAM.

Program segment

Program line

```
FREE
```

Screen displays 500 bytes used, 11500 bytes free.

```
OK
```

GEARING

parameter

(integer)

Purpose

`GEARING` turns electronic gearing on or off and sets allowed direction of motion. Electronic gearing slaves the motion of the controller’s motor to a master encoder signal.

Note: *Refer to Section 2.8, “Electronic Gearing”, for more information.*

Syntax

```
GEARING = x
```

Value

Value	Description
x = 0	Gearing is Off
x = 1	Gearing is On
x = 2	Follow clockwise master encoder inputs only
x = 3	Follow counterclockwise master encoder inputs only

Default x = 0

Related instructions

`ENCODER` — sets the line count of the master encoder.

`RATIO`— the electronic gearing ratio of motor shaft movement to encoder shaft movement using encoder line count.

`ENCDR.POS` — displays the encoder position.

`STEPSIZE` — sets the full or microstep rate for the drive.

`STEP.DIR.INPUT` — specifies encoder or step/direction input.

GEARING (continued)

Programming guidelines

- STEPSIZE must be ≥ 5 for gearing.

Note: *Gearing usually is done with encoder inputs. However, it can be performed using Step/Dir inputs also. Refer to* STEP.DIR.INPUT.

- Install an encoder input from the master and verify that it is set to the correct ENCODER line count. Refer to Section 2.5.5, "J11 Encoder/Step and Direction Input Connection" in the Installation Manual.
- Specify RATIO before programming GEARING.

Note: *Turn Off gearing before stopping motion. The instruction* STOP.MOTION will not stop motor motion resulting from gearing.

- The variable MOVING does not recognize moving caused by GEARING.
- If directional limits are set, gearing motion in the allowed direction occurs only when the master encoder returns to the point where it originally reversed direction.

Note: *Other motion commands could result in motion in the disabled gearing direction.*

Program segment

Program line

```
5       'Installed encoder is 500 lines per revolution.
10      ENCODER = 500
15      'Ratio is 0.5 for a half turn of the motor shaft per encoder
        revolution.
20      RATIO = 0.5
25      'Sets GEARING equal to the value of INP1 (J9-2) If INP1 is
        zero then electronic gearing is turned Off (GEARING = 0); if
        INP1 is one then electronic gearing is turned On (GEARING =
        1).
30      WHILE (1)
35      GEARING = INP1
40      'Monitor INP1 continually.
45      WEND
```

GO.ABS

statement

Purpose

GO.ABS (Go Absolute) moves the motor shaft to the position specified by TARGET.POS. This position is based on a zero position at electrical home.

The motor speed follows a trapezoidal velocity profile as specified by ACCEL.RATE and RUN.SPEED, with deceleration equal to the acceleration rate. Direction of travel depends on current position and target position only (DIR has no effect).

Note: *The program does not wait for* GO.ABS completion. After the program initiates this move it immediately goes to the next instruction.

If CONTINUOUS.MOTION is enabled, you may perform multiple motion instructions with no stop between moves.

Variables may be changed during a move using UPD.MOVE.

Note: *Refer to Section 2.9, "Making the Motion Move", for more information.*

Syntax

```
GO.ABS
```

Related instructions

MIN.SPEED — sets the start/stop speed for making the move

RUN.SPEED — run speed for the move.

ACCEL.RATE — acceleration rate for the move.

DECEL.RATE — deceleration rate for the move.

TARGET.POS — target position for GO.ABS.

CONTINUOUS.MOTION — enables multiple motion instructions with no stop between moves.

UPD.MOVE — update current move in process with new variables.

GO.ABS (continued)

Programming guidelines

- Set appropriate RUN.SPEED, MIN.SPEED, ACCEL.RATE, DECEL.RATE, and TARGET.POS variables.
- Enable CONTINUOUS.MOTION for multiple motion instructions.
- Program parameter changes during a move using UPD.MOVE.

Program segment

Program line

```
5       ‘Set run speed to 1,000 RPM.
10      RUN.SPEED = 1000
15      ‘Set acceleration rate to 1,000 RPM / second.
20      ACCEL.RATE = 1000
25      ‘Set deceleration rate to 100,000 RPM/second.
30      DECEL.RATE = 100000
35      ‘Set target position to 10000 steps from the electrical home
        position.
40      TARGET.POS = 10000
45      ‘Move motor to target position.
50      GO.ABS
55      ‘Hold execution of program to line 60 until move is completed.
60      WHILE MOVING : WEND
```

GO.HOME

statement

Purpose

GO.HOME moves the motor to the electrical home position. This moves the motor shaft to home without sensing the home switch (position determined previously with SEEK.HOME).

The motor speed follows a trapezoidal velocity profile as specified by ACCEL.RATE, RUN.SPEED, and DECEL.RATE.

Note: *The program does not wait for* GO.HOME completion. After the program initiates this move it immediately goes to the next instruction.

GO.HOME performs the same action as setting TARGET.POS to zero and executing a GO.ABS function.

If CONTINUOUS.MOTION is enabled, you may perform multiple motion instructions with no stop between moves.

Note: *Refer to Section 2.9, "Homing Routine", for additional information.*

Syntax

```
GO.HOME
```

Related instructions

MIN.SPEED — sets the start/stop speed for making the move.

RUN.SPEED — run speed for the move.

ACCEL.RATE — acceleration rate for the move.

DECEL.RATE — deceleration rate for the move.

TARGET.POS — target position for GO.ABS.

POS.COMMAND — redefines the current absolute position to be the specified absolute position.

SEEK.HOME — causes homing routine using mechanical switch.

HMPOS.OFFSET — determines offset from mechanical home to establish electrical home.

CONTINUOUS.MOTION — enables multiple motion instructions with no stop between moves.

GO.HOME (continued)

Programming guidelines

- Set appropriate RUN.SPEED, MIN.SPEED, ACCEL.RATE, DECEL.RATE, and TARGET.POS variables.
- Enable CONTINUOUS.MOTION for multiple motion functions.
- Program parameter changes during a move using UPD.MOVE.

Program segment

Program line

```
5       ‘Set run speed to 1000 RPM
10      RUN.SPEED = 1000
15      ‘Set acceleration rate to 1,000 RPM/second.
20      ACCEL.RATE = 1000
25      ‘Go to the electrical home position.
30      GO.HOME
35      ‘Hold program execution at line 40 until move completes.
40      WHILE MOVING : WEND
```

GO.INCR

statement

Purpose

GO.INCR (Go Incremental) moves the motor shaft an incremental distance.

Distance, as specified in INDEX.DIST, may be positive or negative. The motor speed follows a trapezoidal velocity profile as specified by ACCEL.RATE, RUN.SPEED, and DECEL.RATE.

Note: *The program does not wait for motion completion. After the program initiates this move it immediately goes to the next instruction.*

If CONTINUOUS.MOTION is enabled, you may perform multiple motion instructions with no stop between moves.

Parameters may be changed during a move using UPD.MOVE.

Note: *Refer to Section 2.9, "Making the Motor Move", for additional information.*

Syntax

```
GO.INCR
```

Related instructions

MIN.SPEED — sets the start/stop speed for making the move

RUN.SPEED — run speed for the move.

ACCEL.RATE — acceleration rate for the move.

DECEL.RATE — deceleration rate for the move.

INDEX.DIST — index distance for each move cycle.

CONTINUOUS.MOTION — enables multiple motion instructions with no stop between moves.

UPD.MOVE — updates current move in process with new variables.

Programming guidelines

Set appropriate RUN.SPEED, MIN.SPEED, ACCEL.RATE, and DECEL.RATE variables.

Note: *Set direction of the motor using* INDEX.DIST. Positive values move clockwise and negative values move counterclockwise. Direction is not affected by DIR.

Enable CONTINUOUS.MOTION for multiple motion functions.

Program parameter changes during a move using UPD.MOVE.

Program segment

Program line

```
5       ‘Set acceleration rate to 100,000 RPM /second.
10      ACCEL.RATE = 100000
15      ‘Set run speed to 1,000 RPM.
20      RUN.SPEED = 1000
25      ‘Set the incremental index distance to 25,000 steps.
30      INDEX.DIST = 25000
35      ‘Perform index distance move.
40      GO.INCR
```

GOSUB...RETURN

statement

Purpose

GOSUB...RETURN (Go to subroutine) branches program execution to a subroutine, executes it, and returns..

Syntax

```
GOSUB line number
.
.
.
RETURN
```

Programming guidelines

- Subroutines may be located anywhere in the program. They may be nested to a limit of 8; i.e. up to 8 GOSUBs can be executed without an intervening RETURN statement. An attempt to exceed the nesting limit will result in a run-time error.
- To test a subroutine without running the rest of the program, issue a RUN command with the starting line number of the subroutines as the line number parameter. When the RETURN statement of the subroutine is executed, BASIC will return to immediate mode, with the error message “RETURN without GOSUB”.

Caution

*Do Not use **GOSUB...RETURN** in immediate mode. The program may not execute correctly if this is done.*

Program segment

Program line

```
10     PRINT “BEGINNING”
20     GOSUB 100
30     PRINT “ENDING”
40     END
100    PRINT “THIS IS THE SUBROUTINE”
110    RETURN
RUN    <enter>
```

The screen displays:

```
BEGINNING
THIS IS THE SUBROUTINE
ENDING
```

GOTO

statement

Purpose

GOTO causes software to jump to a specific line number and continue executing.

Syntax

```
GOTO line number
```

Programming guidelines

The GOTO statement should only be used where necessary. It is good programming practice to use structured control statements (FOR...NEXT, IF...THEN...ELSE, WHILE...WEND) instead of GOTO statements because a program with many GOTO statements is difficult to read and debug.

GOTO is a simple statement used to change the flow of program execution. If the GOTO statement is used to start execution after the program has stopped, the user should ensure that the nesting levels of subroutines, FOR ...NEXT loops, are not altered.

Program segment

Program line

```
10     INT1 = 1
15     'Execution leaves off here.
20     GOTO 65
.
.
.
65     'Execution continues here.
70     RUN.SPEED = 100
.
.
.
110    PRINT INT1
```

GO.VEL

statement

Purpose

GO.VEL (Go Velocity) moves the motor shaft at a constant speed.

The motor accelerates and reaches maximum speed as specified by ACCEL.RATE and RUN.SPEED, with direction determined by DIR. Stop motion by:

- Programming STOP.MOTION for deceleration at rate set by MAX.DECEL.
- Applying a Stop Motion input for deceleration at rate set by MAX.DECEL.
- Programming RUN.SPEED = 0 for deceleration at rate set by DECEL.RATE (or ACCEL.RATE if DECEL.RATE not set).

Note: *After the program initiates a* GO.VEL it immediately goes to the next instruction.

If CONTINUOUS.MOTION is specified, you may perform multiple motion instructions with no stop between moves.

Variables may be changed during a move using UPD.MOVE.

Note: *Refer to Section 2.9,* "*Making the Motor Move" for more information.*

Syntax

```
GO.VEL
```

GO.VEL (continued)

Related instructions

RUN.SPEED — run speed for the move.

ACCEL.RATE — acceleration rate for the move.

MAX.DECEL — maximum deceleration rate to stop motion.

DECEL.RATE — deceleration rate for the move if RUN.SPEED = 0 set to stop move.

MIN.SPEED — minimum speed for application.

STOP.MOTION — stops motor motion using deceleration rate specified by MAX.DECEL.

CONTINUOUS.MOTION — enables multiple motion instructions with no stop between moves.

UPD.MOVE — updates current move in process with new variables.

Programming guidelines

- Set appropriate RUN.SPEED, MIN.SPEED, ACCEL.RATE, and MAX.DECEL variables.
- Change the RUN.SPEED variables in the lines following GO.VEL to change the run speed accordingly.
- Set direction using DIR.

Program segment

Program line

```
5       ‘Set minimum speed for application
10      MIN.SPEED = 25
15      ‘Set acceleration rate to 100,000 RPM /second.
20      ACCEL.RATE = 100000
25      ‘Set run speed to 1,000 RPM.
30      RUN.SPEED = 1000
35      ‘Go to RUN.SPEED velocity.
40      GO.VEL
45      ‘Stop motion with input 1.
50      WHEN INP7 = 0, STOP.MOTION
```

HMPOS.OFFSET

parameter

(integer)

Purpose

HMPOS.OFFSET (Home Position Offset) is the offset distance from the mechanical home position.

When the SEEK.HOME homing function is performed, the motor moves to mechanical home position as designated by the home switch connected to input J8-8. The motor then moves the HMPOS.OFFSET distance away from the home switch. This final position, known as *electrical home*, is set to zero in the POS.COMMAND counter to provide the zero reference home for further moves.

IMPORTANT NOTE:

The value of this variable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

```
HMPOS.OFFSET = x
```

Value	x = - 4,096,000 to + 4,096,000 steps (direction relative to POS.COMMAND)
Default	x = 0

Related instructions

SEEK.HOME — causes homing routine using mechanical switch.

PRINT POS.COMMAND — displays current step position.

Programming guidelines

- Connect limit switch for homing to J8-8.
- Program SEEK.HOME to perform the homing with the home position offset.
- Save HMPOS.OFFSET in NVRAM, if desired, using SAVEVAR.

HOME.ACTIVE

parameter

(integer)

Purpose

HOME.ACTIVE matches the software to the mechanical home switch used for SEEK.HOME:

- If HOME.ACTIVE = 0, the home (mechanical) switch opens at the home position, opening J8-8 from ground.
- The home switch is closed (pulled low) when the mechanical switch contact is not in position.
- If HOME.ACTIVE = 1, the home (mechanical) switch closes at the home position, connecting J8-8 to ground (pulled low).

The home switch is open when the mechanical switch contact is not in position.

Note: *Refer to Section 2.9.1, "Descriptions of Motion Statements" for additional information.*

IMPORTANT NOTE:

The value of this variable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

```
HOME.ACTIVE = x
```

Value	x = 0 if switch normally closed, triggering open
	x = 1 if switch normally open, triggering closed
Default	x = 0

Related instructions

GO.HOME — moves the motor to electrical home position

SEEK.HOME — causes homing routine using mechanical switch.

HMPOS.OFFSET — sets additional move necessary for offset.

IF...THEN...ELSE

statement

Purpose

IF...THEN ... ELSE statements control program execution based on the evaluation of logical expressions. The IF...THEN...ELSE decision structure permits the execution of program statements or allows branching to other parts of the program based on the evaluation of the expression.

Syntax

IF expression THEN statement [ELSE statement]

IF expression GOTO line number [ELSE line number]

The ELSE clause must be on the same line as the IF–THEN statement

Note: *A statement can be any Pacific Scientific StepperBASIC statement or any series of StepperBASIC statements separated by colons.*

Programming guidelines

- If the expression is TRUE (not zero), the statement following the THEN is executed, otherwise, the statement following the ELSE is executed, if specified.
- If no ELSE is used, then the statement following the IF–THEN is executed.
- The "GOTO" syntax is also used as a short form of "THEN GOTO". If the number of ELSE clauses do not match the number of IF statements, each ELSE is matched with the closest unmatched THEN or GOTO statement.

Note: *IF...THEN...ELSE* statements may be nested up to a limit of eight.

Program segment

Program line

```
400   IF INT4 > INT7 GOSUB 1000 ELSE GOSUB 2000
1000  PRINT "INT4 > INT7"
1010  RETURN
2000  PRINT "INT4 <= INT7"
2010  RETURN
```

INDEX.DIST

parameter

(integer)

Purpose

`INDEX.DIST` sets the distance the motor rotates during each index when a `GO.INCR` function is performed.

Note: *Refer to Section 2.9.1, "Descriptions of Motion Statements" for additional information.*

> **IMPORTANT NOTE:**
>
> The value of this variable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

`INDEX.DIST = ± x` where positive values move clockwise and negative values move counterclockwise.

Stepsize	Range
1	-33,554-432 ≤ x ≤ 33,554,431
2	-67,108,864 ≤ x ≤ 67,108,863
5	-67,108,864 ≤ x ≤ 67,108,863
25	-268,435,456 ≤ x ≤ 268,435,455
125	-536,870,912 ≤ x ≤ 536,870,911

Default x = 5,000

Related instructions

`GO.INCR` — performs an incremental move from the current position.

Programming guidelines

- Specify `INDEX.DIST` prior to issuing a `GO.INCR` command.

INKEY

function

Purpose

`INKEY` returns the key or control code corresponding to a key pressed or control entered from the keyboard. This function is useful to control program flow based on key presses, such as "Y" or "N".

Syntax

```
x = INKEY ()
```

Value

Refer to Appendix A, "ASCII Codes", for an ASCII code table of values.

Related instructions

`CHR (x)` — Converts an ASCII code to its equivalent character.

Programming guidelines

`INKEY ( )` returns a string character.

If no character is pending in the serial buffer, a null string (length zero) is returned.

If several characters are pending, only the first is returned.

Once a character is read from the buffer, it is removed from the buffer.

Use this instruction to control program flow, as shown in the example.

The control characters <Ctrl><s>, <Ctrl><q>, and <Ctrl><c> are not returned by `INKEY ( )`.

INKEY (continued)

Program segment

Program line

```
5      ‘Test integer 1 four times.
10     FOR INT1 = 1 TO 4
15     INT2 = 0
20     WHILE INT2 = 0
25     ‘Read zero, or a character when entered.
30     INT2 = INKEY ()
35     ‘Loop until a character is entered.
40     WEND
45     ‘Print value.
50     PRINT “Your key value is”; INT2
60     NEXT
RUN    <enter>
```

The program prints:

```
Your key value is 97
Your key value is 98
Your key value is 99
Your key value is 100
```

INPn

variable

(integer)

(read only)

Purpose

`INPn` (Inputs 1 to 16) displays the state of a specific discrete input. This is a read-only variable determined by the voltage level applied to the input pin.

Syntax

`x = INPn`

Value

x = 0 to read specific input On (pulled low)

x = 1 to read specific input Off (open circuit/high)

Default

x = 1

Related instructions

`INPUTS` — allows you to read all 16 inputs in a word.

`PREDEF.INPn` — pre-defines input 10 to 15 functionality as follows:

Input	Functionality	Input	Functionality
Input 10	Limit+	Input 13	Stop
Input 11	Limit-	Input 14	Jog+
Input 12	Start	Input 15	Jog-

Note: *Home switch (input 16) is automatically pre-defined if a* `SEEK.HOME` is active.

INPn (continued)

Programming guidelines

0 — indicates logic low input (ON)

1 — indicates logic high input (OFF).

Note: *This is a read only variable and can not be set by the software.*

Program segment

<u>Program line</u>

```
10     MIN.SPEED = 50
20     ACCEL.RATE = 5000
30     RUN.SPEED = 300
40     WHEN INP1 = 0, GO.VEL
```

When input 1 is switched On, perform a Go Velocity move.

IN.POSITION

variable

(integer)

(read only)

Purpose

IN.POSITION indicates whether or not the motor is considered to be "in position". IN.POSITION is always either 1 (true) or 0 (false). **This variable is only valid when StepperBASIC is configured to use Position Verification. Before using this variable, please refer to Section 2.5, "Using the Position Verification and Correction Function." If StepperBASIC is not configured to use Position Verification, then IN.POSITION will always be 0 (False).**

The internal software automatically sets the IN.POSITION flag equal to 1 when the following two conditions are met:

- The last commanded move is complete
- POS.VERIFY.DEADBAND is not exceeded

If either of these conditions are not satisfied then the internal software will automatically set the IN.POSITION flag equal to 0.

Syntax

```
x = IN.POSITION
```

Value x = 0 or 1

Related instructions

POS.VERIFY.CORRECTION — returns the number of steps difference for the position verification error.

POS.VERIFY.DEADBAND — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a position verification error is triggered.

POS.VERIFY.ERROR — indicates that a position verification error has occurred.

POS.VERIFY.JUMP — jumps to program line number upon position verification error.

POS.VERIFY.TIME — setting time for encoder reading.

IN.POSITION (continued)

Program segment

Program line

```
10     POS.VERIFY.DEADBAND = 10
20     POS.VERIFY.TIME = 100
30     GO.INCR
40     IF MOVING THEN 40
50     IF NOT IN.POSITION THEN PRINT “ERROR”
60     PRINT POS.VERIFY.CORRECTION
```

INPUT

statement

Purpose

INPUT enables the program to prompt you for numeric input to a running program.

Syntax

```
INPUT [ ; ] [ “ prompt ” ; ] variable
```

Value

A semicolon after the INPUT statement keeps the cursor on the same line after the instruction is executed.

A semicolon after the prompt causes a question mark followed by a space to be displayed. If a comma is used rather than a semicolon, no question mark is displayed.

Related instructions

INKEY — enables the program to prompt for alphabetic or special characters.

Programming guidelines

Only integer, float, or flag variables of numeric data types (no alphabetic characters) are allowed as input.

If you are using RS-422 or RS-485 multi-unit configuration and the drive specified for INPUT is not logged On, INPUT is automatically set to zero.

If the drive is logged On, then the variable is set per the value entered at the terminal.

Note: *Refer to Appendix B, “INPUT Statement” for additional information.*

Program segment

Program line

```
10     INPUT INT1
20     PRINT “ You entered ” ; INT1
RUN    <enter>
```

Program prompts for INT1. If you press 3 <enter> the program prints “You entered 3".

INPUTS

variable

(integer)

(read only)

Purpose `INPUTS` displays the state of the 16 inputs. This is a read only variable determined by the voltage levels applied to the discrete input pins.

Syntax `x = INPUTS`

Range 0 to 65535

Default 65535 (inputs disconnected/high or all inputs Off)

Value where x is a decimal value corresponding to the sum of the weighted inputs as described by:

INPUTS = (32768 * INP16) + (16384 * INP15) + (8192 * INP14)

+ (4096 * INP13) + (2048 * INP12) + (1024 * INP11)

+ (512 * INP10) + (256 * INP9) + (128 * INP8)

+ (64 * INP7) + (32 * INP6) + (16 * INP5) + (8 * INP4)

+ (4 * INP3) + (2 * INP2) + (1 * INP1)

where `INPn` = State of input as indicated by:

`INPn` = 1 = OFF (high)

`INPn` = 0 = ON (low)

Related instructions

`INPn` — reads input signals for individual outputs.

`PREDEF.INP10,...,15` — specifies the functionality of discrete inputs 10 to 15.

INPUTS (continued)

Programming guidelines

If the individual inputs are connected such that:

Instruction	Value	Instruction	Value	Instruction	**Value**
INP16	0	INP10	1	INP4	1
INP15	0	INP9	0	INP3	0
INP14	0	INP8	1	INP2	1
INP13	0	INP7	0	INP1	0
INP12	1	INP6	1		
INP11	0	INP5	0		

Then `INPUTS` will equal:

(2048 * 1) + (1024 * 0) + (512 * 1) + (256 * 0) + (128 * 1)

+ (64 * 0) + (32 * 1) + (16 * 0) + (8 * 1) + (4 * 0) + (2 * 1)

+ (1 * 0)

or `INPUTS` = 2730

If the individual `INPUTS` are configured as follows:

Instruction	Value	Instruction	**Value**	**Instruction**	**Value**
INP16	0	INP10	0	INP4	0
INP15	0	INP9	1	INP3	1
INP14	0	INP8	0	INP2	0
INP13	0	INP7	1	INP1	1
INP12	0	INP6	0		
INP11	1	INP5	1		

Then INPUTS will equal :

(2048 * 0) + (1024 * 1) + (512 * 0) + (256 * 1) + (128 * 0)

+ (64 * 1) + (32 * 0) + (16 * 1) + (8 * 0) + (4 * 1) + (2 * 0)

+ (1 * 1)

or INPUTS = 1365

INT ( )

function

Purpose: INT(x) (Convert to Largest Integer) truncates an expression to a whole number.

Syntax: INT (x)

Related instructions

CINT — converts x to an integer by rounding the fractional portion.

FLTn — decimal (floating point) variables you define as part of your program.

INTn — integer variables defined as part of the program.

Program segment

Program line

```
10    PRINT INT (99.89)
```

Prints the value 99.

```
10    PRINT INT (-12.11)
```

Prints the value -13.

INTn
variable
(integer)

Purpose

INTn (integers 1 to 32) are integer variables you define as part of your program.

IMPORTANT NOTE:

The value of this variable is saved in NVRAM when the SAVEVAR command is executed.

Syntax

```
INTn
```

where n equals 1 to 32

Range

x = ± 2,147,483,648

Related instructions

FLGn — eight flag (0 or 1) user-defined variables.

FLTn — thirty-two floating point (value to right of decimal) user-defined variables.

CLEAR — clears FLGn, FLTn, and INTn variables in immediate mode.

SAVEVAR — saves INTn to NVRAM memory.

JOG.SPEED

variable

(float)

Purpose

`JOG.SPEED` sets the speed the motor rotates when jogging.

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
JOG.SPEED = x
```

Stepsize	Range
1	MIN.SPEED to 18,750.00 RPM
2	MIN.SPEED to 18,750.00 RPM
5	MIN.SPEED to 7,500.00 RPM
25	MIN.SPEED to 6,000.00 RPM
125	MIN.SPEED to 2,399.99 RPM

Programming guidelines

- The motor will jog clockwise when no program is being run if the JOG + discrete input (J8-6) is connected to I/O RTN. The motor will jog counterclockwise when no program is being run if the JOG - discrete input (J8-7) is connected to I/O RTN.

Note: *The jog inputs are not active when a Pacific Scientific StepperBASIC program is running* `PREDEF.INP14 = 0` (JOG+) or `PREDEF.INP15 = 0` (JOG-).

LIST
command

Purpose

LIST displays a complete program or part of a program on the terminal screen.

Syntax

```
LIST [line number] - [line number]
```

Programming guidelines

The LIST command displays the program lines in a standardized output format. Extra spaces or tabs (except for character constants) will be stripped out. Keywords and expressions are separated by a single space, as shown in the examples of syntax in this document. To temporarily stop the output of the LIST command on the terminal, use <Ctrl><s>. Use <Ctrl><q> to resume the listing.

Program segment

Program line

```
LIST
```

Lists all lines of the program.

```
LIST 20
```

Lists only line 20.

```
LIST 50 -
```

Lists all lines from 50 to the end of the program.

```
LIST -60
```

Lists all lines from the beginning of the program to line 60.

```
LIST 20 - 70
```

Lists all lines from 20 to 70.

LOAD

command

Purpose

LOAD copies the program stored in NVRAM into RAM in order to execute the program or to edit the program.

Note: *This command does not load variables.*

Syntax

```
LOAD
```

Related instructions

LOADVAR — copies stored values for global variables

SAVE — saves program in RAM to NVRAM.

SAVEVAR — stores the values of parameters into NVRAM so they will be saved when the controller is turned off.

Programming guidelines

The LOAD command can be used to restore the program to the most recently saved version. The program stored in NVRAM is automatically transferred into RAM when you turn on the controller.

LOADVAR

command

Purpose

LOADVAR copies stored values for the global variables from NVRAM into RAM.

Syntax

LOADVAR — loads variables into RAM.

Loaded Variables

ACCEL.RATE	
DIR	MAX.DECEL
ENCODER	MIN.SPEED
FLT1, ..., FLT32	PREDEF.INP10,..., PREDEF.INP15
HMPOS.OFFSET	PWR.ON.ENABLE
HOME.ACTIVE	RMT.START
INDEX.DIST	RUN.SPEED
INT1, ... INT32	STEPSIZE
JOG.SPEED	WAIT.TIME

Related Instructions

SAVE — saves program from RAM to NVRAM

SAVEVAR — saves variables from RAM to NVRAM

LOAD — loads program from NVRAM to RAM

LOADVAR (continued)

Programming guidelines

Use `LOADVAR` to restore the values of the global variables to a set of previously stored values. This may be done in preparation for running a program.

When you turn on the controller, the values of the variables stored in NVRAM are automatically transferred to RAM. If an error is encountered during this transfer, factory default parameters are loaded.

Program segment

Program line

```
LOADVAR
```

Variables loaded into RAM

MAX.DECEL

parameter

(integer)

Purpose

MAX.DECEL (Maximum Deceleration) sets the maximum rate at which the motor decelerates under any of the following conditions:

- STOP.MOTION instruction is executed
- STOP instruction is executed
- Remote Stop (J8-5) input is activated
- <Ctrl><c> is typed on the keyboard
- SCAN1 is satisfied and SK1.STOP is set to 1
- SCAN2 is satisfied and SK2.STOP is set to 1
- STALL.STOP occurs

You can set this value to a high rate for emergency stops and use a lower value for ACCEL.RATE if your application requires it.

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
MAX.DECEL = x
```

Value	x = 5 to 1,000,000 RPM/second
Default	x = 100,000

Related instructions

STOP.MOTION — stops motion while allowing program execution.

SKn.STOP —stops motion when a scan is triggered.

STOP — stops motion and interrupts the program.

Programming guidelines

- Do not set to a value below 5 RPM/second. The motor will not stop if MAX.DECEL is set to zero (0).

MIN.SPEED

parameter

(float)

Purpose `MIN.SPEED` (Minimum Speed) sets the minimum speed used in making any move. It is commonly referred to as the Start/Stop Speed.

Note: *Refer to Section 2.9, "Making the Motor Move" for additional information.*

IMPORTANT NOTE

The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax `MIN.SPEED = x`

Stepsize	**Range**
1	4.6 to 1,171.8 RPM
2	1.8 to 1,171.8 RPM
5	1.8 to 468.7 RPM
25	1.5 to 375.0 RPM
125	0.58 to 150.0 RPM

Default x = lowest value of range for selected step size.

Programming guidelines Save `MIN.SPEED` in NVRAM, if desired, using SAVEVAR.

MOVING

variable

(integer)

(read only)

Purpose

`MOVING` is read only display that is equal to 1 when the motor is moving.

Syntax

```
x = MOVING
```

Value

x = 0 if the motor is not moving

x = 1 if the motor is moving

Related instructions

`PREDEF.OUT` — defines output 12 to output a low signal when the motor is moving.

Programming guidelines

Program `MOVING` to display the current moving status for use in an expression.

Note: `MOVING` displays 0 during all stops in motion, including commanded stops that you may not be able to see. These stops may not be visually perceptible; however, `MOVING` displays 0 during the stop interval.

MOVING (continued)

Program segment

Program line

```
10     RUN.SPEED = 200
20     INDEX.DIST = 25000
30     GO.INCR
35     WHILE MOVING
40     PRINT ”I am moving”
50     WEND
60     PRINT ”I have stopped moving”
```

Line 30 will execute an incremental move.

Line 50 will cause the program to go to line 40 as long as the move is not completed and print “I am moving”.

Line 60 will print “I have stopped moving” after the move is completed.

NEW

command

Purpose

`NEW` clears the program memory and sets the value of all user variables in RAM to zero. This command does not affect the program or the variables stored in NVRAM.

Syntax

```
NEW <enter>
```

Related instruction

`LOAD` — copies program stored in NVRAM into RAM

`SAVE` — saves program in RAM into NVRAM

Programming guidelines

`NEW` is usually used to remove a program from memory before entering a new program. The `NEW` command erases any program lines in RAM, and sets all user variables to 0 (as when you use the command `CLEAR`). No change is made to the NVRAM memory. Trace mode is turned off if it was on (as when you use the command `TROFF`). To intentionally clear the program and the stored variables, use `NEW` followed by `SAVE`.

Program segment

<u>Program line</u>

```
NEW
```

The screen displays “OK”.

Program memory in RAM is now cleared and all user variables are set to zero.

OT.ERROR

variable

(integer)

(read only)

Purpose

`OT.ERROR` indicates when either of the software over travel limits is exceeded.

Note: *Refer to Section 2.3.1, "Setting Up the Software Over travel Function" for additional information.*

Syntax

```
OT.ERROR = x
```

x = 0 for no over travel error

x = 1 for clockwise over travel error

x = 2 for counterclockwise over travel error

Note: `OT.ERROR` is only set when the appropriate (clockwise or counterclockwise) checking is turned on.

Related instructions

`CCW.OT` — sets the counterclockwise software over travel limit.

`CCW.OT.ON` — turns on counterclockwise over travel limit.

`CCW.OT.JUMP` — specifies the jump location for counterclockwise over travel errors.

`CW.OT` — sets the clockwise software over travel limit.

`CW.OT.ON` — turns on clockwise over travel checking.

`CW.OT.JUMP` — specifies the jump location for clockwise over travel errors.

OUTn

parameter

(integer)

Purpose

`OUTn` (Outputs 1 to 12) sets the state of a specific discrete output.

Syntax

```
OUT1 = x
```

Value

`OUTn` = 0 for specific outputs (1 to 12) to be On (pulled low)

`OUTn` = 1 for specific outputs (1 to 12) to be Off (open circuit)

Default

x = 1

Related instructions

`OUTPUTS` — allows you to set a group of outputs.

`PREDEF.OUT` — pre-defines output 12 for motor moving.

`POS.CHKn.OUT` — sets outputs 1 to 3 based on position.

`PWR.ON.OUTPUTS` — specifies the state of the outputs when the controller is powered up.

Programming guidelines

- Set the individual variable equal to 0 to output a 0 to turn On the output or to 1 (to output a 1) to turn an output OFF.

Note: *Outputs 1 to 3 are also controlled by* `POS.CHKn.OUT`.

OUTPUTS

parameter

(integer)

Purpose

OUTPUTS specifies the state of the 12 outputs.

Syntax

OUTPUTS = x

Range

0 to 4095

Default

4095

Value

where x is a decimal value corresponding to the sum of the weighted outputs as described by:

OUTPUTS = (2048 * OUT12) + (1024 * OUT11) + (512 * OUT10)
+ (256 * OUT9) + (128 * OUT8) + (64 * OUT7)
+ (32 * OUT6) + (16 * OUT5) + (8 * OUT4)
+ (4 * OUT3) + (2 * OUT2) + (1 * OUT1)

where OUTn = State of output as indicated by:

OUTn = 1 = OFF (high)

OUTn = 0 = ON (low)

Related instructions

OUT1,...,12 — outputs low signals for individual outputs.

PREDEF.OUT — pre-defines output 12 for motor moving.

PWR.ON.OUTPUT — specifies the state of the outputs when the controller is powered up.

OUTPUTS (continued)

Programming guidelines

If the individual outputs are configured such that:

Instruction	Value	Instruction	Value
OUT12	1	OUT6	1
OUT11	0	OUT5	0
OUT10	1	OUT4	1
OUT9	0	OUT3	0
OUT8	1	OUT2	1
OUT7	0	OUT1	0

Then `OUTPUTS` will be equal:

(2048 * 1) + (1024 * 0) + (512 * 1) + (256 * 0) + (128 * 1)

+ (64 * 0) + (32 * 1) + (16 * 0)+ (8 * 1) + (4 * 0) + (2 * 1)

+ (1 * 0)

or `OUTPUTS` = 2730

If the individual outputs are configured as follows:

Instruction	Value	Instruction	Value
OUT12	0	OUT6	0
OUT11	1	OUT5	1
OUT10	0	OUT4	0
OUT9	1	OUT3	1
OUT8	0	OUT2	0
OUT7	1	OUT1	1

Then `OUTPUTS` will equal:

(2048 * 0) + (1024 * 1) + (512 * 0) + (256 * 1) + (128 * 0)

+ (64 * 1) + (32 * 0) + (8 * 0) + (4 * 1) + (2 * 0) + (1 * 1)

or `OUTPUTS` = 1365

OUTPUTS (continued)

For example: Set the variable equal to the sum of the x values for Off (high) outputs.

- Outputs 1 to 8 Off (high): `OUTPUTS` = 255

(128 * 1) + (64 * 1) + (32 * 1) + (16 * 1) + (8 * 1)

+ (4 * 1) + (2 * 1)+ (1 * 1)

- All outputs On (low): `OUTPUTS` = 0

(2048 * 0) + (1024 * 0) + (512 * 0) + (256 * 0)

+ (128 * 0) + (64 * 0) + (32 * 0) + (16 * 0) + (8 * 0)

+ (4 * 0) + (2 * 0) + (1 * 0)

- Output 5 Off (all others On): `OUTPUTS` = 16

(2048 * 0) + (1024 * 0) + (512 * 0) + (256 * 0)

+ (128 * 0) + (64 * 0) + (32 * 0) + (16 * 1) + (8 * 0)

+ (4 * 0) + (2 * 0)+ (1 * 0)

PACK

command

Purpose

PACK speeds up program execution by generating the GOTO table before the program executes.

The PACK command goes through the Pacific Scientific StepperBASIC program and puts an entry in the GOTO table for every GOTO, GOSUB, and IF–THEN–ELSE statement. This allows the program to execute faster because this table does not need to be generated as the program runs.

Syntax

```
PACK
```

Programming guidelines

The PACK command is automatically executed when the controller is turned On. For maximum program speed, the PACK function should be executed before the program is run if the program has been changed since the last time the program was executed.

PAUSE

statement

Purpose

PAUSE causes the program to pause the amount of time specified by the WAIT.TIME variable. The motion of the motor is not affected. The Remote Stop hardware input remains active while the program is paused. Typing <Ctrl><c> on the keyboard will also abort the program when the program is paused.

Syntax

```
PAUSE
```

Related instructions

WAIT.TIME — sets time for pause.

Programming guidelines

The PAUSE function can be used in place of software loops (e.g. FOR...NEXT) for precise control of timing.

Program segment

Program line

```
10    WAIT.TIME = 0.5
20    WHILE INP1 = 1 : WEND
30    PAUSE
40    GO.INCR
```

This program looks at INP1 (J9-2) and waits until this input is zero (connected to I/O RTN). The program pauses for 0.5 second and then performs an incremental move.

POS.CHKn

parameter

(integer)

Purpose

POS.CHKn (Position Check trigger 1, 2, or 3) specifies the position at which outputs 1, 2, and 3 are switched to the polarity designated by the POS.CHKn.OUT parameter. Position check function as a programmable limit switch output.

Note: *Refer to Section 2.4, "Using the Position Check Function" for additional information.*

Syntax

```
POS.CHKn = x
```

where n = 1, 2, or 3

Value	x is any valid arithmetic expression
Range	-134,217,728 to 134,217,727
Default	x = 0

Related instructions

POS.CHKn.OUT — defines output when POS.CHKn exceeded.

Programming guidelines

Program POS.CHKn.OUT to enable the POS.CHKn.

Refer to POS.CHKn.OUT for more information.

Note: *Make sure to program* POS.CHKn after establishing electrical home with SEEK.HOME or POS.COMMAND. POS.CHKn is an absolute position variables that is changed when electronic home is changed.

POS.CHKn.OUT

variable

(integer)

Purpose

`POS.CHKn.OUT` (Position Check Output Specifier) is used in conjunction with `POS.CHKn` to implement Position Check n. Position Check functions as a programmable limit switch output.

Note: *Refer to Section 2.4, "Using the Position Check Function", for additional information.*

`POS.CHKn.OUT` can be set to one of three values:

Value	Description
0	Position check n disabled
10	Position check n enabled
	If (`POSITION` >= `POS.CHKn`) then `OUTn` = 0
	If (`POSITION` < `POS.CHKn`) then `OUTn` = 1
11	Position check n enabled
	If (`POSITION` >= `POS.CHKn`) then `OUTn` = 1
	If (`POSITION` < `POS.CHKn`) then `OUTn` = 0

Syntax

```
POS.CHKn.OUT = 0
POS.CHKn.OUT = 10
POS.CHKn.OUT = 11
```

Default x = 0

Related instructions

`POS.CHKn` — position to trigger `POS.CHKn.OUT`.

Programming guidelines

- OUT1 to OUT3 (Outputs 1 to 3) cannot be programmed if the outputs are enabled using POS.CHK1.OUT to POS.CHK3.OUT.
- Set the POS.CHKn position before programming POS.CHKn.OUT.

Program segment

Program line

```
10     POS.COMMAND = 0
20     POS.CHK1.OUT = 10
30     POS.CHK1 = 10 * 5000
40     DIR = 0
50     GO.VEL
```

This program will cause OUT1 to be 1 until the motor rotates 10 revolutions if the Indexer is configured for STEPSIZE = 25. At that point, OUT1 will be set to 0.

POS.COMMAND

variable

(integer)

Purpose

POS.COMMAND (Position Command) is a read or write position counter that allows you to:

- Display and use the current step position to perform absolute distance calculations.
- Redefine the current position, or the electrical home position.

Note : *Refer to Section 2.2, "Homing Routines", for additional information.*

Syntax

```
POS.COMMAND = x
```

Stepsize	POS.COMMAND Value
1	-33,554,432 to 33,554,431
2	-67,108,864 to 67,108,863
5	-67,108,864 to 67,108,863
25	-268,435,456 to 268,435,455
125	536,870,912 to 536,870,911

Related instructions

GO.HOME — moves the motor to POS.COMMAND = 0 (electrical home position).

SEEK.HOME — causes homing routine using mechanical switch, then sets POS.COMMAND= 0.

DIR — sets direction for POS.COMMAND increase.

WHENPCMD — specifies the motor position when the WHEN condition is satisfied.

Programming guidelines

Note: *Do not change* `POS.COMMAND` after `CCW.OT`, `CW.OT`, `TARGET.POS`, or `POS.CHKn` have been programmed. These absolute position variables change value if the electrical home position is changed.

Program segment

Program line

```
10     POS.COMMAND = 0
20     INDEX.DIST = 1000
30     GO.INCR
40     WHILE MOVING : WEND
50     IF  (POS.COMMAND  <>  INDEX.DIST)  THEN  PRINT
       “ERROR”
60     END
```

This program redefines the current position to zero and checks that the correct distance is traveled.

POS.VERIFY.CORRECTION

parameter

(integer)

(read only)

Purpose

POS.VERIFY.CORRECTION displays the number of motor steps required to complete a move that had a position verification error. You may program a move using this correction to insure that lost steps are made up.

Note: *Refer to Section 2.5, "Using the Position Verification and Correction Function" for additional information.*

Syntax

```
x steps = POS.VERIFY.CORRECTION
```

Related instructions

POS.VERIFY.DEADBAND — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a position verification error is triggered.

POS.VERIFY.ERROR — indicates that a position verification error has occurred.

POS.VERIFY.JUMP — jumps to program line number upon position verification error.

POS.VERIFY.TIME — settling time for encoder reading.

IN.POSITION — indicates when step position is reached.

STEP.DIR.INPUT — selects quadrature encoder or step and direction inputs to J11 (pin 2, 3, 4, 5).

Programming guidelines

- Install an encoder and verify that it is set to the correct ENCODER line count.
- Make sure STEPSIZE is correct.
- Use GO.ABS, GO.INCR, or GO.HOME for moves. Position verification does not work with other move instructions.

POS.VERIFY.DEADBAND

parameter

(integer)

Purpose

POS.VERIFY.DEADBAND sets the maximum step difference allowed for measured versus commanded steps (encoder versus step counts).

At the end of an absolute or incremental move, the measured versus commanded difference is checked against the deadband variable. If the deadband is exceeded, POS.VERIFY.ERROR, POS.VERIFY.CORRECTION, and any programmed position verify variables are activated.

Note: *Refer to Section 2.5,* "Using the Position Verification and Correction Function" for additional information.

Syntax

`POS.VERIFY.DEADBAND = x`

Range x = 0 to 4,294,967,296 steps (microsteps)

Default x = 0

Related instructions

POS.VERIFY.CORRECTION — returns the number of steps difference for the position verification error.

POS.VERIFY.ERROR — indicates that a position error has occurred.

POS.VERIFY.JUMP — jumps to program line number when position error occurs.

POS.VERIFY.TIME — settling time for encoder reading.

IN.POSITION — indicates when step position is reached.

STEP.DIR.INPUT — selects quadrature encoder or step and direction inputs to J11.

POS.VERIFY.DEADBAND (continued)

Programming guidelines

Note: *Due to the inherent limitations of a mechanical system, the encoder may lead or lag the motor by 1 full motor step. Account for this by entering a* `POS.VERIFY.DEADBAND` of at least 2 full steps (or corresponding microsteps).

- Install an encoder and verify that it is set to the correct `ENCODER` line count.
- Use `GO.ABS` ,`GO.INCR` or `GO.HOME` for moves. Position verification does not work with other move instructions.
- Make sure `STEPSIZE` is correct.

Note: *If you change step size, convert the deadband by multiplying by the corresponding factor. For example, if you go from full step to 25 microstep and the deadband was 4, program a new deadband of 100 (that is, 4 x 25).*

- Set `STEP.DIR.INPUT = 0` if using quadrature inputs to the J11 encoder interface.

POS.VERIFY.ERROR

variable

(integer)

(read only)

Purpose

POS.VERIFY.ERROR indicates an unacceptable mismatch of commanded versus measured steps for a move. This error display is triggered when the POS.VERIFY.DEADBAND limit is exceeded.

Note: *Refer to Section 2.5, "Using the Position Verification and Correction Function" for additional information.*

Syntax

0 (no error) or 1 (error occurred) = POS.VERIFY.ERROR

Related instructions

POS.VERIFY.CORRECTION — returns the number of steps difference for the position error.

POS.VERIFY.DEADBAND —sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a position verification error is triggered.

POS.VERIFY.JUMP — jumps to program line number upon position verification error.

POS.VERIFY.TIME — settling time for encoder reading.

IN.POSITION — indicates when step position is reached.

STEP.DIR.INPUT — selects quadrature encoder or step and direction inputs J11.

POS.VERIFY.ERROR (continued)

Programming guidelines

- The position verification error is only operational for 1 move. It is cleared upon the next move.
- Install an encoder and verify that it is set to the correct `ENCODER` line count.
- Make sure `STEPSIZE` is correct.
- Use `GO.ABS`, `GO.INCR` , or `GO.HOME` for moves. Position verification does not work with other move instructions.
- Set `STEP.DIR.INPUT = 0` if using quadrature inputs to the J11 encoder interface.

POS.VERIFY.JUMP

parameter

(integer)

Purpose

`POS.VERIFY.JUMP` moves program execution to specified line when a position verification error occurs.

Note: *Refer to Section 2.5, "Using the Position Verification and Correction Function" for additional information.*

Syntax

`POS.VERIFY.JUMP = x`

Range

x = the desired line number to jump to

x = 0 for no jump

Default

x = 0

Related instructions

`POS.VERIFY.CORRECTION` — returns the number of steps difference for the position error.

`POS.VERIFY.DEADBAND` — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a position verification error is triggered.

`POS.VERIFY.ERROR` — indicates that a position verification error has occurred.

`POS.VERIFY.TIME` — settling time for encoder reading.

`IN.POSITION` — indicates when step position is reached.

`STEP.DIR.INPUT` — selects quadrature encoder or step and direction inputs to J11.

POS.VERIFY.JUMP (continued)

Programming guidelines

- Install an encoder and verify that it is set to the correct `ENCODER` line count.
- Make sure `STEPSIZE` is correct.
- Use `GO.ABS`, `GO.INCR` or `GO.HOME` for moves. Position verification does not work with other move instructions.
- Set `STEP.DIR.INPUT` = 0 if using quadrature inputs to the J11 encoder interface.

POS.VERIFY.TIME

parameter

(integer)

Purpose

`POS.VERIFY.TIME` establishes a settling time for the encoder reading. If a value is not set, you may see position verification errors.

Note: *Refer to Section 2.5, "Using the Position Verification and Correction Function" for additional information.*

Syntax

`POS.VERIFY.TIME = x`

Range	x = 0 to 65,536 milliseconds
Default	x = 0

Related instructions

`POS.VERIFY.CORRECTION` — returns the number of steps difference for the position error.

`POS.VERIFY.DEADBAND` — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a position verification error is triggered.

`POS.VERIFY.ERROR` — indicates that a position verification error has occurred.

`POS.VERIFY.JUMP` — jumps to program line number upon position verification error.

Programming guidelines

- Install an encoder and verify that it is set to the correct `ENCODER` line count.
- Make sure `STEPSIZE` is correct.
- Use `GO.ABS`, `GO.INCR` or `GO.HOME` for moves. Position verification does not work with other move instructions.
- Set `STEP.DIR.INPUT = 0` if using quadrature inputs to the J11 encoder interface.

PREDEF.INPn

parameter

(integer)

Purpose

PREDEF.INPn (Pre-defined Input n) and PREDEF.INP (Pre-defined Inputs) enable pre-defined functionality for discrete inputs INP10 to INP15:

PREDEF.INPn specifies functionality for an individual input n.

PREDEF.INP specifies functionality for all inputs

IMPORTANT NOTE

The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
PREDEF.INPn = x
```

Value

PREDEF.INPn = 0 for each individual input (n = 10 to 15) to disable pre-defined functionality (enable the discrete input functionality) for the input.

PREDEF.INPn = 1 for each individual input (10 to 15) to enable pre-defined functionality as follows:

Input	Function
PREDEF.INP10	Limit Clockwise
PREDEF.INP11	Limit Counterclockwise
PREDEF.INP12	Remote Start
PREDEF.INP13	Remote Stop
PREDEF.INP14	Jog Clockwise
PREDEF.INP15	Jog Counterclockwise

Default

PREDEF.INPn = 0 for inputs 10 to 15

PREDEF.INPn (continued)

Syntax `PREDEF.INPn = y`

Range $0 \leq y \leq 63$

Default 63

Value

Input	Function
PREDEF.INP10	Limit Clockwise
PREDEF.INP11	Limit Counterclockwise
PREDEF.INP12	Remote Start
PREDEF.INP13	Remote Stop
PREDEF.INP14	Jog Clockwise
PREDEF.INP15	Jog Counterclockwise

where y is the decimal corresponding sum of the weighted `PREDEF.INP` as described by:

```
PREDEF.INP = (32 * PREDEF.INP15) + (16 * PREDEF.INP14)
             + (8 * PREDEF.INP13) + (4 * PREDEF.INP12)
             + (2 * PREDEF.INP11) + (1 * PREDEF.INP10)
```

Related instructions

`INPn` — displays the state of individual inputs.

`INPUTS` — displays the state of the inputs as a binary-coded decimal value corresponding to the sum of the binary number of the inputs.

Programming guidelines

Individual - Set the desired input equal to 1 to enable the input for the predefined functionality.

Group - Set the variable equal to the sum of the inputs of the BCD equivalencies to enable predefined functionality for that group of variables.

PREDEF.INP (continued)

For example:

All inputs pre-defined:. . . . . PREDEF.INP = 63
(32 *1) + (16 * 1) + (8 * 1) + (4 * 1) + (2 * 1) + (1 * 1)

Inputs 10 and 11 only pre-defined: . . PREDEF.INP = 3
(32 *0) + (16 * 0) + (8 * 0) + (4 * 0) + (2 * 1) + (1 * 1)

No inputs pre-defined: . . . . PREDEF.INP = 0
(32 *0) + (16 * 0) + (8 * 0) + (4 * 0) + (2 * 0) + (1 * 0)

All inputs pre-defined except input 15: . PREDEF.INP = 31
(32 * 0) + (16 * 1) + (8 * 1) + (4 * 1) + (2 * 1) + (1 * 1)

When through, execute the SAVEVAR command to store the variable in NVRAM.

Refer to section 2.5.4 “J9 and J8 Discrete Input/Output Connection” in the Installation Manual for information on the pre-defined inputs.

Program segment

Program line

```
PREDEF.INP10 = 1
```

Limit (+) functionality enabled.

```
PREDEF.INP10 = 0
```

Limit (+) functionality disabled.

```
PREDEF.INP = 0
```

No inputs predefined.

```
PREDEF.INP = 5
```

Inputs 10 and 12 predefined for Limit (+) and Remote Start.

PREDEF.OUT

parameter

(integer)

Purpose

PREDEF.OUT (Pre-defined Output 12) specifies that output 12 is active (low) whenever the motor is moving.

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
PREDEF.OUT = x
```

Value

x = 0 for output 12 not pre-defined for moving

x = 1 for output 12 pre-defined for moving

Default

x = 0

Related instructions

MOVING — displays a value of 1 when the motor is moving.

Programming guidelines

Set PREDEF.OUT equal to 1 for a low output from output 12 when the motor is moving.

Refer to section 2.5.4, “J9 and J8 Discrete Input/Output Connection” in the Installation Manual for information on output 12 pre-defined for moving.

PRINT

statement

Purpose

PRINT displays output on the terminal screen while the program is running.

Syntax

```
PRINT expression [[,;] expression ][ ; ]
```

Expressions can be:

- Variables
- Calculations with numeric variables and constants
- String constants enclosed in quotes

Programming guidelines

Pacific Scientific StepperBASIC defines zones of 13 characters which can be used to produce output in columns.

- If a list of expressions is separated by commas (,) or spaces ( ) , each subsequent expression is printed in the next available Zone.
- If a list of expressions is separated by semicolons (;) the Zones are ignored and consecutive expressions are printed in the next character space.
- If the PRINT statement ends with a comma or a semicolon, the carriage return/line feed at the end of the screen output is suppressed.

Program segment

Program line

```
10     INT1 = 25
20     PRINT ”The total is ”; INT1; ”this shift”
RUN    <enter>
```

This program segment prints ”The total is 25 this shift”.

PWR.ON.ENABLE

variable

Purpose

PWR.ON.ENABLE specifies the value of ENABLE when the controller is turned on.

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
PWR.ON.ENABLE = x
```

Value

x = 0 or 1

Related instructions

ENABLE — allows or prevents power flow to the motor.

Programming guidelines

If you want the ENABLE flag to be equal to 1 when the controller is turned on, set PWR.ON.ENABLE equal to 1 and execute a SAVEVAR command. When the controller is turned on after this, ENABLE will automatically be set to 1. If the controller is not faulted and the ENABLE input (J10-5) is pulled low, then power will be allowed to flow to the motor.

If you want the ENABLE flag to be equal to 0 when the controller is turned on, set PWR.ON.ENABLE equal to 0 and execute a SAVEVAR command. When the controller is turned on, ENABLE will automatically be set to 0.

Note: *To enable the controller,* ENABLE must be set to 1. There must be no faults present and the hardware enable input must be asserted.

PWR.ON.OUTPUTS

variable

Purpose `PWR.ON.OUTPUTS` (power on outputs) specifies the state of the outputs when the controller is powered up.

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax `PWR.ON.OUTPUTS = x`

Range 0 to 4095

Default 4095

Value where x is a decimal value corresponding to the sum weighted outputs as described by:

```
PWR.ON.OUTPUTS = (2048 * OUT12) + (1024 * OUT11)
                 + (512 * 1) + (256 * OUT9) + (128 * OUT8)
                 + (64 * OUT7) + (32 * OUT6) + (16 * OUT5)
                 + (8 * OUT4) + (4 * OUT3) + (2 * OUT2)
                 + (1 * OUT1)
```

where `OUTn` = State of output as indicated by:

`OUTn` = 1 = OFF (high)

`OUTn` = 0 = ON (low)

PWR.ON.OUTPUTS (continued)

Programming guidelines

If the individual outputs are configured such that:

Instruction	Value	Instruction	Value
OUT12	1	OUT6	1
OUT11	0	OUT5	0
OUT10	1	OUT4	1
OUT9	0	OUT3	0
OUT8	1	OUT2	1
OUT7	0	OUT1	0

Then `PWR.ON.OUTPUTS` will be equal:

(2048 * 1) + (1024 * 0) + (512 * 1) + (256 * 0) + (128 * 1)
+ (64 * 0) + (32 * 1) + (16 * 0) + (8 * 1) + (4 * 0)
+ (2 * 1) + (1 * 0)

or `PWR.ON.OUTPUTS` = 2730

If the individual outputs are configured as follows:

Instruction	Value	Instruction	Value
OUT12	0	OUT6	0
OUT11	1	OUT5	1
OUT10	0	OUT4	0
OUT9	1	OUT3	1
OUT8	0	OUT2	0
OUT7	1	OUT1	1

Then `PWR.ON OUTPUTS` will be equal:

(2048 * 0) + (1024 * 1) + (512 * 0) + (256 * 1) + (128 * 0)
+ (64 * 1) + (32 * 0) + (16 * 1) + (8 * 0) + (4 * 1)
+ (2 * 0) + (1 * 1)

or `PWR.ON.OUTPUTS` = 1365

PWR.ON.OUTPUTS (continued)

Set the variable equal to the sum of the x values to turn Off (high) the desired outputs. For example:

- All outputs Off (high):`PWR.ON.OUTPUTS` = 4095
- All outputs On (low):`PWR.ON.OUTPUTS` = 0
- Output 5 Off (all others On):`PWR.ON.OUTPUTS` = 16
- Output 5 and 12 Off (all others On) `PWR.ON.OUTPUTS` = 16

When through, execute the `SAVEVAR` command to store the variable in NVRAM.

Warning

For approximately 1/2 second after power is applied to the unit, a hardware reset pulse forces all outputs to the On (low) state. Hence, all outputs sink current for approximately 1/2 second. At the end of this reset pulse, the outputs are set to the state defined by the ***P R.ON.OUTPUTS*** *variable.*

Make sure that any external machine logic takes this into account.

QRY

command/statement

Purpose QRY (Query) lists the current values of parameter and status instructions. The values may be the default values (preset at the factory) or the currently programmed values.

The parameters and status instructions listed are shown with default values if appropriate.

Parameters

Parameter	Default	Parameter	Default
ACCEL.RATE	1000	MIN.SPEED	1.465
DIR	0	PREDEF.INP	63
ENCODER	1000	PREDEF.OUT	0
FLT1,...,FLT8	as set	PWR.ON.ENABLE	1
HMPOS.OFFSET	0	PWR.ON.OUTPUTS	0
HOME.ACTIVE	0	RMT.START	0
INDEX.DIST	5000	RUN.SPEED	1000
INT1,...,INT8	as set	STEPSIZE	25
JOG.SPEED	1000	WAIT.TIME	1
MAX.DECEL	100000		

Status display

Status Display	Default	Status Display	Default
ENABLE	1	OUTPUTS	0
ENABLED	0	POS.COMMAND	0
ENCDR.POS	1	STEP.DIR.INPUT	0
FAULTCODE	0	TARGET.POS	0
INPUTS	65535		

QRY (continued)

Syntax

```
QRY
```

Related instructions

`QRY.PRM` — displays parameters values only.

`QRY.STAT` — displays current status values only.

Programming guidelines

Use `QRY` after programming `SAVEVAR` to check the values of the parameters saved and to check current status values.

Program segment

Program line

```
QRY <enter>
```

QRY.PRM

command/statement

Purpose

QRY.PRM (Query Parameters) lists the current values of parameter instructions. The values may be the default values (preset at the factory) or the currently programmed values.

The parameters shown are listed with default values.

Parameters

Parameter	Default	Parameter	Default
ACCEL.RATE	1000	MAX.DECEL	100000
DIR	0	MIN.SPEED	1.465
ENCODER	1000	PREDEF.INP	63
FLT1,...,FLT8	as set	PREDEF.OUT	0
GO.FUNC	0	PWR.ON.ENABLE	1
HMPOS.OFFSET	0	PWR.ON.OUTPUTS	0
HOME.ACTIVE	0	RMT.START	0
INDEX.DIST	5000	RUN.SPEED	1000
INT1,...,INT8	as set	STEPSIZE	25
JOG.SPEED	1000	WAIT.TIME	1

Syntax

```
QRY.PRM
```

Related instructions

QRY — displays parameters and current status values.

QRY.STAT — displays current status values only.

Programming guidelines

Use QRY.PRM after programming SAVEVAR to check the values of the parameters saved.

Program segment

Program line

```
QRY.PRM <enter>
```

QRY.STAT

command/statement

Purpose

QRY.STAT (Query Status) lists the current values of status instructions. The values may be the default values (preset at the factory) or the currently programmed values.

The status instructions listed are shown with default values.

Status display

Status Display	Default	Status Display	Default
ENABLE	1	OUTPUTS	0
ENABLED	0	POS.COMMAND	0
ENCDR.POS	1	STEP.DIR.INPUT	0
FAULTCODE	0	TARGET.POS	0
INPUTS	65535		

Syntax

```
QRY.STAT
```

Related instructions

QRY — displays parameters and status values.

QRY.PRM — displays parameters values only.

Programming guidelines

Use QRY.STAT to check current drive status. The values displayed are not saved in SAVEVAR.

Program segment

Program line

```
QRY.STAT  <enter>
```

RATIO

parameter

(float)

Purpose

RATIO sets a ratio between an external encoder, or step and direction source, and the motor shaft for electronic gearing motion.

Note: *Refer to Section 2.8, "Electronic Gearing" for additional information.*

> **IMPORTANT NOTE**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
RATIO = ± x
```

Range x = ± 0.000001 to 100

Default x = 1

Related instructions

GEARING — turns electronic gearing On or Off .

ENCODER — sets the line count of the master encoder.

STEP.DIR.INPUT — specifies encoder or step/direction input.

Programming guidelines

- For an encoder input, install an encoder input from the master and verify that it is set to the correct ENCODER line count.
- A negative value for RATIO causes motion opposite to the encoder shaft.
- For step and direction inputs, use Step/Dir signals at the J11 encoder interface.

RATIO (continued)

Program segment

Program line

```
10     RATIO = 0.1
20     ENCODER = 1000
30     GEARING = 1
```

GEARING is On. The motor follows the external encoder.

This program specifies that the motor shaft will turn 0.1 revolution for each encoder shaft revolution.. The installed encoder is 1000 lines per revolution.

REG.DIST

parameter

(integer)

Purpose

`REG.DIST` (Registration Distance) is the distance that is moved automatically when a Registration input is applied. This function, specified with `REG.FUNC` performs a move like a `GO.INCR` but with microsecond response to the input.

Note: *Refer to Section 2.10, "Registration Functionality" for additional information.*

Syntax

`REG.DIST = x`

Value

x = -134,217,728 to 134,217,727

Default

x = 0

Related instructions

`ENCODER` — sets the line count of the master encoder

`REG.ENCPOS` — encoder position when Registration input triggers.

`REG.FLAG` — flag to indicate that Registration input is triggered.

`REG.FUNC` — specifier to perform `REG.DIST` index move when Registration input triggers.

`STEP.DIR.INPUT` — specifies encoder or step/direction input.

Programming guidelines

Attach differential Registration inputs to J11-6 (CH Z), and J11-7 (CH $\overline{Z}$).

Program `REG.FUNC` = 1 to specify allowing `REG.DIST`.

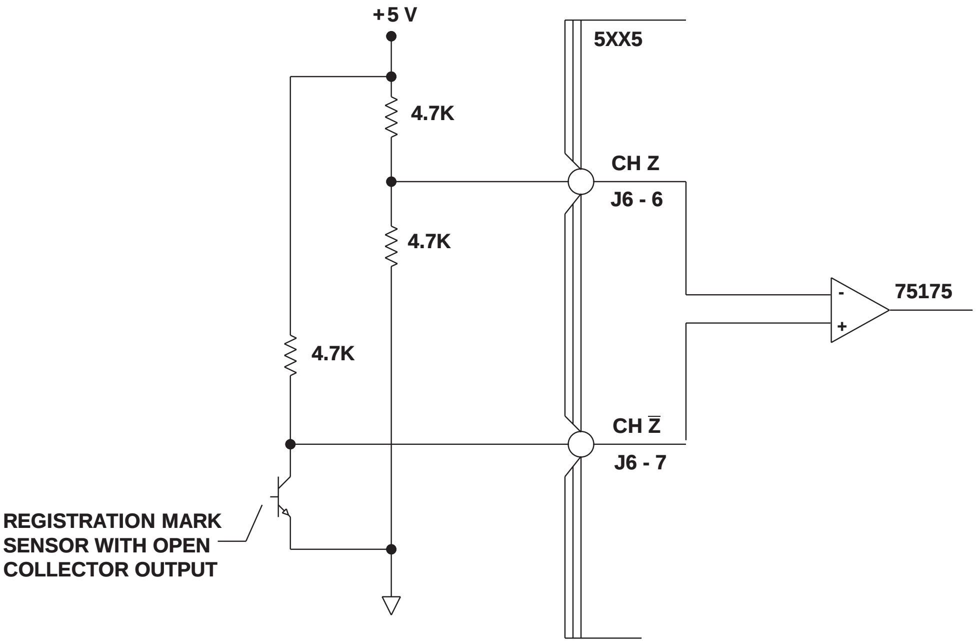
Refer to `REG.FUNC` for more information.

Note: *Set* `STEP.DIR.INPUT` = 1 and `ENCODER = STEPSIZE *` 50

REG.DIST (continued)

Registration input connection

The following is a schematic diagram of the input connections for J11-6 and J11-7.



Note: *Registration mark handling is not operational if electronic gearing is in use. The controller must be in motion and executing a motion command to perform the registration distance.*

REG.ENCPOS

variable

(integer)

(read only)

Purpose

REG.ENCPOS (Registration Encoder Position) specifies the encoder position when Registration input triggers.

Note: *Refer to Section 2.10, "Registration Functionality" for additional information.*

Syntax

REG.ENCPOS

Range

-2,147,483,648 to 2,147,483,647 encoder quadrature counts.

Related instructions

ENCODER — sets the line count of the master encoder

REG.DIST — distance moved upon Registration input.

REG.FLAG — flag to indicate that Registration input is triggered.

REG.FUNC — specifier to perform REG.DIST index move when Registration input triggers.

STEP.DIR.INPUT — specifies encoder or step/direction input.

Programming guidelines

Attach differential Registration inputs to J11-6 (CH Z) and J11-7 (CH $\overline{\text{Z}}$).

Registration input connection

Please refer to REG.DIST for a schematic diagram of the input connections for J11-6 and J11-7 and REG.FUNC for more information.

Note: *Registration mark handling is not operational if electronic gearing is in use. The controller must be in motion and executing a motion command to perform the registration distance.*

REG.FLAG

variable

(integer)

Purpose

`REG.FLAG` (Registration Flag) indicates that the Registration input has triggered.

Note: *Refer to Section 2.10, “Registration Functionality” for additional information.*

Syntax

```
x = REG.FLAG
```

Value	x = 1 indicates a Registration input triggered
Default	x = 0

Related instructions

`ENCODER` — sets the line count of the master encoder

`REG.DIST` — distance moved upon Registration input.

`REG.ENCPOS` — encoder position when Registration input triggers.

`REG.FUNC` — specifier to perform `REG.DIST` index move when Registration input triggers.

`STEP.DIR.INPUT` — specifies encoder or step/direction input.

REG.FLAG (continued)

Programming guidelines

Attach differential Registration inputs to J11-6 (CH Z) and J11-7 (CH $\overline{Z}$).

To clear the flag, set `REG.FLAG` = 0

Note: *`REG.FLAG`* is automatically cleared by `REG.FUNC` = 1.

Program `REG.DIST` for the appropriate distance after specifying `REG.FUNC` = 1.

Refer to `REG.FUNC` for more information.

Note: *Registration mark handling is not operational if electronic gearing is in use. The controller must be in motion and executing a motion command to perform the registration distance.*

Registration input connection

Please refer to `REG.DIST` for a schematic diagram of the input connections for J11-6 and J11-7.

REG.FUNC

parameter

(integer)

Purpose

REG.FUNC (Registration Functionality) specifies whether REG.DIST is the distance that is moved automatically when a Registration input is applied. This function performs a move like a GO.INCR, but with microsecond response to the input.

Note: *Refer to Section 2.10, "Registration Functionality" for additional information.*

Syntax

`REG.FUNC = x`

x = 1 to allow REG.DIST move upon Registration trigger.

x = 0 to disallow REG.DIST move upon Registration trigger.

Default

x = 0

Related instruction

ENCODER — sets the line count of the master encoder

REG.DIST — distance moved upon Registration input.

REG.ENCPOS — encoder position when Registration input triggers.

REG.FLAG — flag to indicate that Registration input triggered.

STEP.DIR.INPUT — specifies encoder or step/direction input.

REG.FUNC (continued)

Programming guidelines

Attach differential Registration inputs to J6-6 (CH Z), and J6-7 (CH $\overline{Z}$).

Set `REG.FUNC = 1`.(`REG.FLAG` is now cleared).

Any motion command in process is terminated upon a Registration input.

Note: *Registration mark handling is not operational if electronic gearing is in use. The controller must be in motion and executing a motion command to perform the registration distance.*

Registration input connection

Please refer to `REG.DIST` for a schematic diagram of the input connections for J11-6 and J11-7.

REM or ‘

statement

Purpose

REM (Remark) enables you to include explanatory remarks or comments in the program.

The text of the REM statement is **not** stored into the RAM. All comments are stored as REM only; the content is not stored. The REM statement is provided so that programs downloaded from other computers may contain comments. A REM may appear anywhere within the line and anything following the REM is treated as a comment. Comments may also appear at the end of any program line, by the use of the apostrophe (‘). These will be converted to REM and stored as above. Since the line number for a Remark statement is stored in RAM, GOTO and GOSUB statements may jump to these line numbers.

Syntax

```
REM [text of comment]
or
‘ [text of comment]
```

Program segment

Program line

```
10      REM Beginning of loop program
15      WHILE (1)
20      REM now do the loop
25      ‘ Loop 5 times
30      FOR I = 1 to 5
40      PRINT  I
50      NEXT
60      WEND
```

RENUM
command

Purpose

RENUM renumbers program lines.

Note: *This is an immediate mode command.*

Syntax

RENUM [[new number] [, [existing number] [, increment]]]

‘New number’ is the first line number to be used in the new sequence; the default is 10. ‘Existing number’ is the number of the line where you want the renumbering to begin. The default is the first line of the program. ‘Increment’ is the increment to be used with the new sequence; default is 10. RENUM changes all line number references in GOTO, GOSUB, THEN, and ELSE statements.

Programming guidelines

Note: *RENUM* does not affect SKn.JUMP program line numbers. Change these line numbers manually after performing RENUM.

Program segment

Program line

```
6      GOSUB 41
9      GOSUB 27
11     GOSUB 93
12     END
27     PRINT “SUBROUTINE A”
28     RETURN
41     PRINT “SUBROUTINE B”
42     RETURN
93     PRINT “SUBROUTINE C”
95     RETURN
RENUM
LIST
```

RESET.STACK

statement

Purpose

RESET.STACK clears the StepperBASIC internal stack so that the program may be restarted from within a subroutine call or after jumping out of a WHILE...WEND or FOR...NEXT loop.

Syntax

```
RESET.STACK
```

Programming guidelines

RESET.STACK permits the re-initialization of the controller's internal stack to allow program flow to be re-directed after aborting execution. of a subroutine, WHILE...WEND loop or FOR...NEXT loop. These program control mechanisms all require use of the internal stack.

Use of the SCAN jump (SKn.JUMP) functions require the execution of the RESET.STACK statement to ensure internal program control is restored if the SCAN input has been triggered during execution of a subroutine or looping construct.

Program segment

Program line

```
100    PRINT ”Program Restarted”
110    SK1.TRIGGER = 10
120    SK1.JUMP = 500
130    SET.SCAN1
140    FOR INT1 = 1 to 100
.
.
.
500    PRINT ”SCAN1 Triggered”
510    RESET.STACK
520     GO TO 100
```

RETURN

statement

Purpose

RETURN ends a subroutine and sends control to the instruction following the most recent GOSUB statement executed.

Syntax

```
RETURN
```

Related instructions

GOSUB...RETURN — statement to branch to and execute a subroutine.

Programming guidelines

Program a RETURN at the end of the subroutine to send execution to the line following the most recent GOSUB executed.

```
10     GOSUB 1000
  .
  .
  .

1000   PRINT ”PRINT VELOCITY” VELOCITY
1010   RETURN
```

RMT.START

parameter

(integer)

Purpose RMT.START defines Remote Start input J8-4 to:

- Power up in immediate mode and initiate a GO command upon a high-to-low transition at the Remote Start input.
- Power up in immediate mode and initiate a RUN command upon a high-to-low transition at the Remote Start input.
- Power up running the program, and after program completion, initiate a RUN command upon a high-to-low transition at the Remote Start input.

Note: *Pre-defined input 12 must be set to 1 for J8-4 to function as Remote Start.*

IMPORTANT NOTE

The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax `RMT.START = x`

Value

Value of RMT.START	Functionality
0	To power up in immediate mode and initiate a GO command upon input
1	To power up in immediate mode and initiate a RUN command upon input
2	To power up running the program and, when through, initiate a RUN command upon input

Default x = 0

Related instructions

GO — initiates motion as defined by GO.VEL, GO.ABS or GO.INCR.

PREDEF.INPn — specifies the functionality of discrete inputs 10 to 15.

Programming guidelines

- Set PREDEF.INP12 = 1 to define input 1 for Remote Start.
- Set RMT.START to the desired value for motion function emulation.
- Save RMT.START in NVRAM, if desired, using SAVEVAR.

RUN

command

Purpose

RUN executes all or part of the program in RAM.

The RUN command is used to begin executing the program. If no line number is specified, the program begins executing at the lowest line number in the program.

Syntax

RUN

RUN [line number] where 'line number' is the line number at which you want to start the program.

Program segment

Program line

```
10    PRINT " LINE NUMBER 10"
20    PRINT "LINE NUMBER 20"
```

Example 1

```
RUN <enter>
```

```
LINE NUMBER 10
LINE NUMBER 20
```

Program execution starts at the first line.

Example 2

```
RUN 20 <enter>
```

```
LINE NUMBER 20
```

Program execution starts at line 20.

RUN.SPEED

parameter

(float)

Purpose

RUN.SPEED sets the maximum speed used in making an incremental or absolute move. It is also used to set the velocity for a GO.VEL command.

Note: *Refer to Section 2.9, "Making the Motor Move" for additional information.*

IMPORTANT NOTE

The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
RUN.SPEED = x
```

Stepsize	Range
1	0.01 to 18,750.00 RPM
2	0.01 to 18,750.00 RPM
5	0.01 to 7,500.00 RPM
25	0.01 to 6,000.00 RPM
125	0.01 to 2,399.99 RPM

Note: *If the* MIN.SPEED value is *higher than the* RUN.SPEED value, the drive will default to the MIN.SPEED value.

Refer to MIN.SPEED for range information.

Default

x = 1000

RUN.SPEED (continued)

Related instructions

`DIR` — specifies the direction of a `GO.VEL` command.

`GO.ABS` — moves motor to target position.

`GO.INCR` — moves motor an index distance.

`GO.VEL` — moves motor at constant velocity.

`MIN.SPEED` — sets the minimum speed used in making a move.

Programming guidelines

Specify `RUN.SPEED` prior to issuing motion commands.

SAVE
command

Purpose

SAVE saves the program from RAM in NVRAM so that the program is not lost when power is removed.

Syntax

```
SAVE
```

Related instructions

SAVEVAR — saves specified variable to NVRAM.

LOAD — copies saved program from NVRAM to RAM.

LOADVAR — transfers saved variables from NVRAM to RAM.

NEW — clears the program memory

Programming guidelines

- Complete programs are saved. Portions of a program cannot be designated to be saved.
- Recover the program from NVRAM using the LOAD command or by cycling power.
- SAVE can be used as an instruction within a program, if desired. It will not stop program execution.

Program segment

Program line

```
SAVE
OK
```

Program Saved in NVRAM.

The program is now saved in NVRAM. When you turn the drive off the program will remain in NVRAM. When the controller is turned back on, the saved program will be loaded into RAM automatically.

SAVEVAR

command/statement

Purpose

SAVEVAR saves an INTn or FLTn variable or a complete group of variables from RAM to NVRAM memory. This is done so that the variable or group of variables is not lost when power is removed.

Syntax

```
SAVEVAR (INTn or FLTn)
```

SAVEVAR with no variable specified for group of variables

Allowed variables

The variables that can be saved are as follows. If no variable is specified after SAVEVAR, all of these variables are saved.

```
ACCEL.RATE          MAX.DECEL
DIR                 MIN.SPEED
ENCODER             PREDEF.INP
FLT1,...,FLT32      PREDEF.OUT
HMPOS.OFFSET        PWR.ON.ENABLE
HOME.ACTIVE         PWR.ON.OUTPUTS
INDEX.DIST          RMT.START
INT1,...,INT32      RUN.SPEED
JOG.SPEED           STEPSIZE
                    WAIT.TIME
```

Related instructions

SAVE — saves program from RAM to NVRAM.

LOADVAR — transfers variables from NVRAM to RAM.

LOAD — copies the program stored in NVRAM into RAM in order to execute or edit the program.

Programming guidelines

- For an INTn or FLTn, program the variable name, in parentheses, only. Do not include its assigned value.

Note: *You must set the new variable value separately, preceding* SAVEVAR (INTn or FLTn).

- Program SAVEVAR with no specified variable to save all allowed variables.
- Check saved variables using QRY.PRM.
- The SAVEVAR command can be executed from within a program.
- To insure that variables from previous programs do not affect the current program, initialize all variables at the start of each program as described in Section 1.8.5, "Program Header to Initialize Variables".

Program segment

<u>Program line</u>

```
10     INT6 = 100
20     SAVEVAR (INT6)
```

Set integer 6 to 100.

Save value in integer 6 to non-volatile memory -when the unit is power cycled, the saved value is loaded into RAM as the current variable.

SEEK.HOME

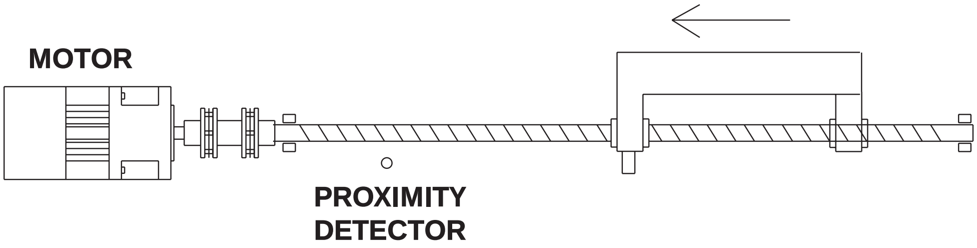
statement

Purpose

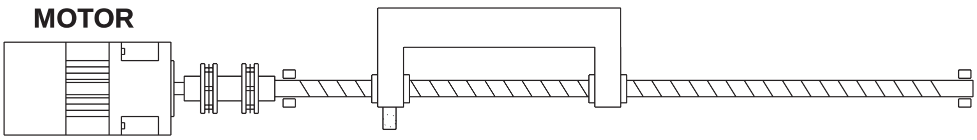
SEEK.HOME moves the motor to search for a mechanical limit switch. When the switch is encountered, the motor homes in and stops on the exact switch position. This position, *defined as electrical home*, is set to zero in the POS.COMMAND counter to provide the zero reference home for further motion.

The sequence of events, illustrated by a linear motion slide drive, is as follows:

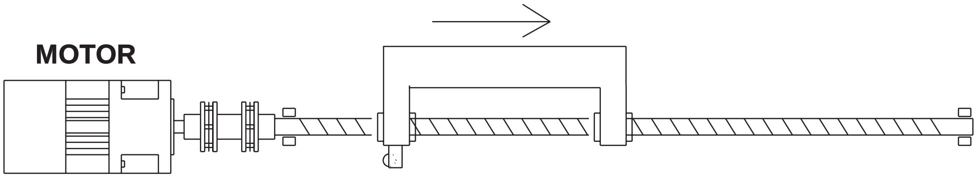
1. Motor moves toward limit switch based on direction specified by DIR and speed specified by RUN.SPEED.



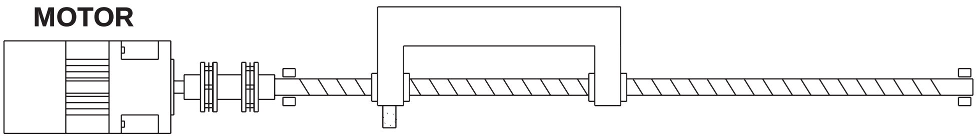
2. When the limit switch is triggered, input J8-8 changes state and the motor stops. (HOME.ACTIVE specifies the polarity of the limit switch). At this point the motor has overshot the edge of the limit switch.



3. The motor reverses direction and moves slowly, as specified by `MIN.SPEED`, toward the edge of the limit switch (the motor went beyond the switch in step 2).



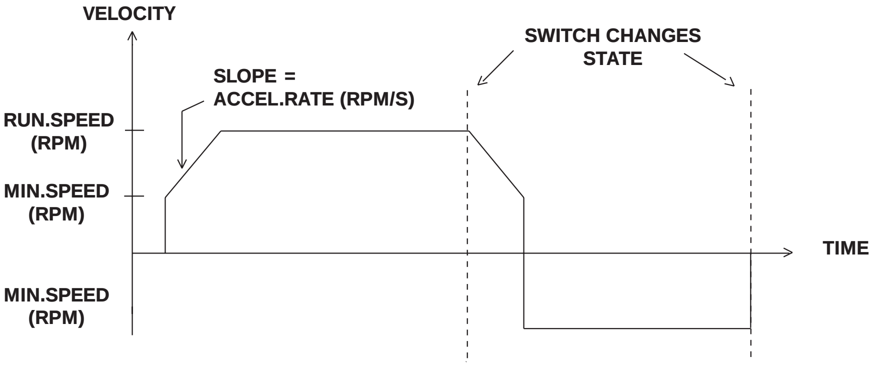
4. The switch triggers again, and the motor immediately stops and establishes this position as the mechanical home position, the `POS.COMMAND` counter is set to zero. In this case, the mechanical home position is equal to the electrical home position.



5. If you defined an offset using `HMPOS.OFFSET`, an additional move is performed, and electrical home is established at this new position. In this case, mechanical home is not equal to electrical home.

SEEK.HOME (continued)

Homing velocity profile



Note: *Refer to Section 2.2, "Homing Routines", and Section 2.9, "Making the Motor Move" for additional information.*

Syntax

```
SEEK.HOME
```

Related instructions

`HOME.ACTIVE` — matches mechanical switch triggering polarity to software.

`DIR` — sets the direction the motor moves during initial move for `SEEK.HOME`.

`RUN.SPEED` — sets the speed the motor moves during initial move to find limit switch.

`MIN.SPEED` — sets the low speed used after the motor changes direction when the switch is found the first time.

`POS.COMMAND` — displays current step position.

`HMPOS.OFFSET` — determines additional move necessary for offset.

`GO.HOME` — moves the motor to electrical home position.

`CW.OT` and `CCW.OT` — limits motion if initial `SEEK.HOME` motion is in wrong direction.

SEEK.HOME (continued)

Programming guidelines

- Connect the mechanical switch for homing to J8-8.
- Set DIR to 0 or 1 for clockwise or counterclockwise rotation to move toward the limit switch.
- Set HOME.ACTIVE to 0 or 1 to set the software to look for an open or closed input, respectively, when the switch triggers.
- If desired, set CW.OT or CCW.OT travel limits.
- If desired, set an offset from the mechanical position using HMPOS.OFFSET.
- SEEK.HOME holds program execution on the current line until function completion.

Program segment

Program line

```
5     'Sets the minimum motor speed.
10    MIN.SPEED = 100
15    'Sets the acceleration rate at 40,000 RPM/s.
20    ACCEL.RATE = 40000
25    'Sets the run speed to 200 RPM.
30    RUN.SPEED = 200
35    'Sets the SEEK.HOME function to interpret the home position as input J5-8 closed.
40    HOME.ACTIVE = 1
45    'Sets the direction of rotation counterclockwise (when looking at the motor shaft end-first) so that the motor moves the elevator towards the home switch.
50    DIR = 1
55    'Perform the homing function.
60    SEEK.HOME
```

SET.SCANn

statement

Purpose

SET.SCANn (set scan 1 or 2) activates the scan function to respond to trigger inputs. When the input occurs, the current program line completes, and if programmed, any or all of the following occur:

- Jump to another program line
- Move to a subroutine
- Stop motion
- Output a signal

Two inputs can be checked for scanning, using SET.SCAN1 and SET.SCAN2.

Performing a scan function is similar to checking an input in an IF...THEN loop statement, but the function has the added advantages of:

- Faster response because input is checked every millisecond.
- Elimination of a program loop to check the input. The scan function runs "transparently" while the other program instructions execute. Once a scan is set up and turned On, it checks for the trigger input continuously until turned Off.

Note: *Refer to Section 2.1.3, "Enabling and Disabling SCANs" for additional information.*

Syntax

SET.SCANn where n = 1 or 2

Related instructions

The predefined variables used with SET.SCANn are:

SKn.ENCPOS — records encoder position when scan triggers.

SKn.TRIGGER — sets the scan trigger input.

SKn.JUMP — sets the jump line number.

SKn.OUTPUT — sets an output action.

SKn.STOP — stops the motor.

CLR.SCANn — turns off scanning.

Programming guidelines

Follow these guidelines for effective programming of the set scan function:

Warning

Do not use a scan for an emergency stop to prevent personal injury. Use a hard-wired switch connected to the power source for an emergency stop.

Note: *If both Scan 1 and Scan 2 are triggered at the same time (within the same millisecond), only one of the scans will trigger.*

Procedure

1. Set up the `SKn.TRIGGER` for the input to trigger the scan.
2. Set `SKn.STOP`, `SKn.JUMP`, `SKn.OUTPUT`, to stop, jump, and output as desired.
3. Set the `SET.SCANn`.
4. To turn Off a scan, program a `CLR.SCANn`.

Multiple set scans for repeated triggering

The `SET.SCANn` instruction works for one scan only, triggering when the designated input is seen, but not more times if the input is seen again.

To repeatedly use a scan input in your program, make sure that your program repeats or loops to the `SET.SCANn` function.

For example, in the program segment:

```
    .
    .
60  SK1.TRIGGER = 30
70  SK1.JUMP = 500
80  SET.SCAN1
90  GO.INCR
100 IF MOVING PRINT “Moving”
110 PAUSE.
    .
    .
500 PRINT “Program interrupted”
510 PAUSE
520 GOTO 80
```

SET.SCANn (continued)

A low input 3 applied after line 80 will trigger the scan. However, when the program loops back to line 90 a second time, a repeat application of input 3 will not cause the scan to occur again.

Making the line 520 GOTO statement go to line 80 to revisit the scan would enable the scan to be used repeatedly.

Stack overflow errors may occur if you have a GOSUB...RETURN or WHILE...WEND statement in a program so that a scan could trigger within either of these loops.

Program segment

Program line

```
5       'Set scan to occur when input 1 goes to low voltage (INP1 = 0)
10      SK1.TRIGGER = 10
15      'Stop motor when scan input seen
20      SK1.STOP = 1
25      'Jump to line 2000 when scan input seen..
30      SK1.JUMP = 2000
35      'Turn output 1 On when scan input seen.
40      SK1.OUTPUT = 11
45      'Begin checking for scan input.
50      SET.SCAN1
    .
    .
1995    'Print message when scan input seen.
2000    PRINT "End of travel limit switch has
        activated"
2005    'Wait until input 1 goes high before proceeding.
2010    IF INP1 = 0 THEN 2010
2015    'Repeat the program.
2020    GOTO 50
```

Skn.ENCPOS

variable

(integer)

(read only)

Purpose

`SKn.ENCPOS` records the encoder position when a SCAN1 or SCAN2 is triggered. `SKn.ENCPOS` is equivalent to an `ENCDR.POS` at the scan trigger point.

Note: *Refer to Section 2.1, "Scan Functions", for additional information.*

Syntax

`SKn.ENCPOS`

where n = 1 or 2

Range

-2,147,483,648 to 2,147,483,648

Related instructions

`SET.SCANn` — activates SCAN1 or SCAN2.

`SKn.TRIGGER` — sets the scan trigger input.

`SKn.JUMP` — sets the jump line number.

`SKn.OUTPUT` — sets an output action.

`SKn.POS` — reads the motor position.

`SKn.STOP` — stops the motor.

`CLR.SCANn` — turns off scanning.

SKn.JUMP

parameter

(integer)

Purpose

`SKn.JUMP` (Scan Jump 1 or 2) sets a program line destination to jump to when a scan is triggered.

`SK1.JUMP` and `SK2.JUMP` are the respective scan 1 or scan 2 jump variables.

Note: *Refer to Section 2.1, "Scan Functions" for additional information.*

Syntax

`SKn.JUMP = x`

Value

x = the desired line number destination

x = 0 for no jump

Range

x = 0 to 65,536

Related instructions

`SET.SCANn` — activates scan 1 or scan 2.

`SKn.TRIGGER` — sets the scan trigger input.

`SKn.OUTPUT` — sets an output action.

`SKn.STOP` — stops the motor.

`CLR.SCANn` — turns off scanning.

`SKn.ENCPOS` — records encoder position when scan triggers.

`RESET.STACK` — clears the internal stack so that the program may be restarted.

SKn.JUMP (continued)

Programming guidelines

Program `SKn.JUMP` = x for the line number at the desired location.

Note: *When a scan is triggered, the program line that is executing completes before the jump occurs.*

Set up `SKn.JUMP` = 0 if no jump is desired.

If there is a possibility that the SCAN trigger will occur while a subroutine, `FOR...NEXT` or `WHILE...WEND` loop is executing, it is extremely important that a `RESET.STACK` instruction is executed to insure the internal program control is maintained. This should be executed either on or shortly after the instruction at the jump destination.

Refer to `SET.SCANn` for scan information and an example program.

SKn.OUTPUT

parameter

(integer)

Purpose

SKn.OUTPUT specifies which of the programmable outputs is to be turned On or turned Off when the corresponding scan condition is satisfied.

The first digit of SKn.OUTPUT specifies which of the programmable outputs will be affected when the Scan condition is satisfied. The first digit can be from 1 to 8, corresponding to OUT1 through OUT8.

The second digit specifies whether the output will be turned ON(0) or turned OFF(1).

If you do not want any of the outputs affected when the Scan condition is satisfied, you must set SKn.OUTPUT equal to 0.

Note: *Refer to Section 2.1, "Scan Functions" for additional information.*

Syntax SKn.OUTPUT = x,y where n = 1 or 2

Range x = 1 to 12 (# of output), y = 0 (low,ON) or 1 (high,OFF)

Value	Scan Output Action
0	Scan output action disabled
10	OUT1 turned On when Scan condition satisfied
11	OUT1 turned Off when Scan condition satisfied
20	OUT 2 turned On when Scan condition satisfied
21	OUT2 turned Off when Scan condition satisfied
30	OUT3 turned On when Scan condition satisfied
31	OUT3 turned Off when Scan condition satisfied

Note: *The same conditions apply for values through 120 and 121.*

Related instructions

`SET.SCANn` — activates scan 1 or scan 2.

`SKn.JUMP` — sets the jump line number.

`SKn.TRIGGER` — sets the scan trigger input.

`SKn.ENCPOS` — records encoder position when scan triggers.

`SKn.STOP` — stops the motor.

`CLR.SCAN` — turns off scanning.

SKn.STATUS

variable

(integer)

(read only)

Purpose `SKn.STATUS` indicates the status of the SCAN function.

Note: *Refer to Section 2.1, "Scan Functions" for additional information.*

Syntax `SKn.STATUS = x` where n = 1 or 2

Range x = 0, 1 or 2

Value of SKn.STATUS	Interpretation
0	Scan function is not active. Value after executing `CLR.SCANn` statement.
1	Scan function is active but not triggered. Value after executing `SET.SCANn` statement, but before triggering occurs.
2	Scan function has been triggered.

Default x = 0

Related instructions

`SET.SCANn` — activates scan 1 or scan 2.

`SKn.JUMP` — sets the jump line number.

`SKn.TRIGGER` — sets the scan trigger input.

`SKn.ENCPOS` — records encoder position when scan triggers.

`SKn.STOP` — stops the motor.

`CLR.SCAN` — turns off scanning.

SKn.STOP

parameter

(integer)

Purpose

SKn.STOP is set to 1 to stop motion when a scan is triggered. The deceleration rate is set by MAX.DECEL. SK1.STOP and SK2.STOP are the respective scan 1/scan 2 stop motion variables.

Note: *Refer to Section 2.1.2, "Setting the Scan Output Action" for additional information.*

Syntax

```
SKn.STOP = x
```

Value

x = 1 to stop motion
x = 0 to turn Off scan stop motion

Related instructions

SET.SCANn — activates scan 1 or scan 2.

SKn.JUMP — sets the jump line number.

SKn.TRIGGER — sets the scan trigger input.

SKn.OUTPUT — sets an output action.

CLR.SCANn — turns off scanning.

MAX.DECEL — sets the deceleration rate for special stopping conditions.

SKn.ENCPOS — records encoder position when scan triggers.

Programming guidelines

Program SKn.STOP = 1 to stop motion when the scan triggers.

Note: *When a scan is triggered, motion is stopped immediately. The program line that is executing when the scan triggers does not complete.*

Set up SKn.STOP = 0 to disable scan stop motion so that motion will continue when the scan triggers.

Refer to SET.SCANn for scan information and an example program.

SKn.TRIGGER

variable

(integer)

Purpose

`SKn.TRIGGER` specifies the scan triggers condition. Two independent scans are available and both may be activated at the same time.

The first digit of `SKn.TRIGGER` specifies which of the programmable inputs will be affected when the Scan condition is satisfied. The first digit can be from 1 to 8, corresponding to `INP1` through `INP8`.

The second digit specifies whether the input will be checked against 0 or checked against 1.

Note: *Refer to Section 2.1.1, "Setting the SCAN trigger Condition" for additional information.*

Syntax

```
SKn.TRIGGER = x,y
```

where n = 1 or 2

Range

x = 1 to 16 (# of input), y =0 (low,ON) or 1 (high,OFF)

Value	Scan Condition
10	INP1 equals 0
11	INP1 equals 1
20	INP2 equals 0
21	INP2 equals 1
30	INP3 equals 0
31	INP3 equals 1

Note: *The same conditions apply for values through 160 and 161.*

Default

x = 0

SKn.TRIGGER (continued)

Related instructions

SET.SCANn — activates scan 1 or scan 2.

SKn.JUMP — sets the jump line number.

SKn.OUTPUT — sets an output action.

SKn.ENCPOS — records encoder position when scan triggers.

SKn.STOP — stops the motor.

CLR.SCANn — turns off scanning.

Programming guidelines

Set up the SKn.TRIGGER before the other scan instructions.

Note: *SKn.TRIGGER* checks for an input state, not for a transition to a state. This means that the input must be set to the appropriate Off state after the SET.SCANn has triggered. If, for instance, you perform a scan triggering it with the correct input, then clear the scan. Upon reprogramming another SET.SCANn you will immediately trigger the scan. If this is not desired, make sure to set the input Off before repeating the SET.SCANn.

Refer to SET.SCANn for scan information and an example program.

/ (Slash)

command

Purpose

This command is used for two things:

- To log on to a specific controller when using the RS-485 serial link to communicate with the controllers.
- A prefix for global commands when using the RS-485 serial link to communicate with the controllers.

Is used when there are two or more 6x45 units connected in parallel to the same terminal, using the RS-485 serial port of each unit. A set of switches on the 6x45 specifies the address of the 6x45; an address of 31 is taken to mean this is a single module configuration. Commands can be given either to all units connected (Global commands), or can be directed to just one unit (Address specify).

Global Command

All commands which can be used in immediate mode are allowed to be specified after the / character. Every 6x45 will react to the command just as it would in single unit mode, with the exception that there will be no output produced to the terminal (in order to prevent multiple access to a shared hardware signal line). Commands whose only purpose is to produce output (such as `LIST`) will do nothing.

Address Specify

The / character followed by the unit number sets the address as the only unit to respond to immediate mode commands. Once received, the addressed unit is the only one to react to or respond to commands received. The address specification remains in effect until another address specification is given. Address specifications may be temporarily overridden with a Global command. This command can be given even to units running programs, in order to stop a single unit. See the `INPUT` and `PRINT` statements for additional notes about using multiple units.

Syntax

```
/n <Return>
```

where ‘n’ is the address of the controller that you want to log on to.

```
 /x <Return>
```

where ‘x’ is a global command that is to be executed by every controller connected to the RS-485 serial link.

Program segment

Program line

```
/STOP
```

Tell all units to stop motion

```
/GO.VEL
```

Tell all units to begin motion

```
/^C
```

(Global control-c) All units abort motion

```
/3
```

Set address to unit 3

```
/2:LIST
```

Set address to unit 2, and list program of unit 2

STALL.DEADBAND

parameter

(integer)

Purpose

STALL.DEADBAND sets the maximum step difference allowed between commanded and measured steps (step counts versus encoder counts).

During a move, this difference is checked against the deadband variable. Exceeding this value, interpreted as a stall, activates any programmed stall variables.

Note: *Refer to Section 2.6, "Stall Detection Function" for additional information.*

Syntax

```
STALL.DEADBAND = x
```

Range	x = 0 to 4,294,967,296 full or microsteps
Default	x = 0

Related instructions

STALL.STOP — stops the motor when the deadband is exceeded.

STALL.JUMP — jumps to program line number when deadband is exceeded.

STALL.ERROR — indicates that a stall has occurred when deadband is exceeded.

MAX.DECEL — sets the maximum deceleration rate

Programming guidelines

- Install an encoder and verify that it is set to the correct ENCODER line count.
- Make sure STEPSIZE is correct. (Both hardware and software)

If you change step size, convert the deadband by multiplying by the corresponding factor. For example, if you go from full step to 25 microstep and the deadband was 4, program a new deadband of 100 (4 x 25).

- Program stall stop, jump, or error as desired.

Note: *STALL.DEADBAND* may be exceeded even without a stall. Due to the inherent limitations of a mechanical system, the motor may lead or lag the encoder by up to 2 full motor steps. Account for this by entering a STALL.DEADBAND of at least 4 full steps (or corresponding microsteps).

Program segment

Program line

```
10     STEPSIZE = 1
20     STEP.DIR.INPUT = 0
30     ENCODER = 1000
40     STALL.DEADBAND = 10
50     STALL.JUMP = 100
60     STALL.STOP = 1
70     GO.VEL
80     IF MOVING THEN 80
100    PRINT “STALL HAS OCCURRED”
110    PRINT “MOTOR SHOULD HAVE STOPPED”
120    END
```

STALL.ERROR

variable

(integer)

(read only)

Purpose

STALL.ERROR indicates that a stall has occurred.

Note: *Refer to Section 2.6, "Stall Detection Function" for additional information.*

Syntax

```
x = STALL.ERROR
```

where x = 0 (no stall)

x = 1 (stall occurred)

Related instructions

STALL.DEADBAND = range — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a stall is triggered

STALL.JUMP = line number — jumps to program line number upon stall

STALL.STOP = flag — stops the motor when stall occurs

Programming guidelines

- Stall error is only operational for 1 move. It is cleared upon the next move.
- Install an encoder and verify that it is set to the correct ENCODER line count
- Make sure STEPSIZE is correct (Both hardware and software)

STALL.JUMP

parameter

(integer)

Purpose

`STALL.JUMP` moves program execution to a specified line in the program when a stall occurs.

Note: *Refer to Section 2.6, "Stall Detection Function" for additional information.*

Syntax

```
STALL.JUMP = x
```

x = the desired line number

x = 0 for no jump

Range

x = 0

Related instructions

`STALL.DEADBAND` — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a stall is triggered.

`STALL.ERROR` — indicates that a stall has occurred.

`STALL.STOP` — stops the motor when stall occurs.

Programming guidelines

- Install an encoder and verify that it is set to the correct `ENCODER` line count.
- Make sure `STEPSIZE` is correct. (Both hardware and software)

STALL.STOP

parameter

(integer)

Purpose

STALL.STOP stops the motor at a rate set by MAX.DECEL when a stall occurs.

Note: *Refer to Section 2.6, "Stall Detection Function" for additional information.*

Syntax

STALL.STOP

Value

x = 0 (Off) Disables the stop on STALL triggered.

x = 1 (On) Enables the stop on STALL triggered.

Default

x = 0

Related instructions

STALL.DEADBAND — sets the maximum allowed difference in motor steps (microsteps) between encoder and pulse counts that can occur before a stall is triggered.

STALL.ERROR — indicates that a stall has occurred.

STALL.JUMP — sets the jump line number.

MAX.DECEL — maximum deceleration rate used for STALL.STOP.

Programming guidelines

- Install an encoder and verify that it is set to the correct ENCODER line count.
- Make sure STEPSIZE is correct. (Both hardware and software)

STALL.STOP (continued)

Program segment

Program line

```
10     STEPSIZE = 1
20     STEP.DIR.INPUT = 0
30     ENCODER = 1000
40     STALL.DEADBAND = 10
50     STALL.JUMP = 100
60     STALL.STOP = 1
70     GO.VEL
80     IF MOVING THEN 80
100    PRINT “STALL HAS OCCURRED”
110    PRINT “MOTOR SHOULD HAVE STOPPED”
120    END
```

STEP.DIR.INPUT

parameter

(integer)

Purpose

STEP.DIR.INPUT (Step/Direction Input) determines whether connector J11 is configured as an encoder input or as a step and direction input. When configured as a step/direction input, the drive functions as a follower under electronic gearing.

Note: *Refer to Sections 2.5, 2.6, 2.8, and 2.10 for additional information.*

Syntax

STEP.DIR.INPUT = x

Value

x = 0 results in connector pins J11-2 to J11-5 being quadrature encoder inputs for A, $\overline{A}$, B, and $\overline{B}$.

x = 1 results in connector pins J11-2 to J11-5 being step, $\overline{\text{step}}$, direction and $\overline{\text{direction}}$ signals for external control.

Default

x = 0

Related instructions

STEPSIZE — full or microstep rate for the drive.

ENCODER — sets the line count of the master encoder.

Programming guidelines

To use STEP.DIR.INPUT specified for step and direction for Electronic Gearing:

1. Set STEP.DIR.INPUT = 1 to configure J11 for step and direction input.
2. Connect the step and direction inputs at the J11 interface. Refer to Section 2.5.5, “J11 Encoder/Step and Direction”.

3. Set ENCODER as follows:

   ENCODER = # steps (or microsteps) per revolution/4

   where the number of steps or microsteps per revolution refers to the incoming step and direction inputs at the J11 encoder interface.

Stepsize	Encoder
1	50
2	100
5	250
25	1250
125	6250

4. Program GEARING and associated instructions as desired (refer to GEARING).

STEPSIZE

parameter

(integer)

Purpose

STEPSIZE sets the microstep rate assumed for the associated drive. The stepsize for the drive is determined by the DIP switch located on the top of the 6x45.

IMPORTANT NOTE:

The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
STEPSIZE = x
```

Value	**Stepsize**
1	Full step
2	Half step
5	1/5 step
25	1/25 step
125	1/125 step

Default

x = 25

Related instructions

GEARING —turns On or Off electronic or uni-directional electronic gearing.

Note: *STEPSIZE* must be > = 5 for Gearing.

STEPSIZE (continued)

Programming guidelines

Note: *Changing* STEPSIZE will automatically change values of RUN.SPEED, ACCEL.RATE, etc. Check these values and reprogram if desired.

1. Set the Step Size for the drive from the DIP switch (refer to section 3.1.1, “Step Size” in the Installation Manual).
2. Program the STEPSIZE.
3. Program a SAVEVAR.
4. Cycle power.

Save STEPSIZE to NVRAM, if desired.

Caution

*Changing **STEPSIZE** without performing the above procedure will cause unpredictable results.*

STOP

statement

Purpose

STOP stops motion and interrupts the program. The program continues when CONT is programmed.

Using STOP with CONT is an effective tool for testing and debugging programs.

Syntax

```
STOP
```

Related instructions

CONT — causes program to continue from STOP line.

STOP.MOTION — stops motion while allowing program execution.

END — stops the program while allowing motion to continue.

Programming guidelines

Program a line with STOP wherever you wish to have the program stop so you can program in immediate mode and abort any commanded motion, except GEARING.

A <Ctrl><c> entered from the terminal while the program is running has the same effect as a STOP statement encountered within the program.

Note: *Do not change the program interrupted by* STOP. Program execution will be incorrect if a STOP interrupted program is altered. You may, however, change variables in immediate mode during an active STOP command.

STOP.MOTION

statement

Purpose

STOP.MOTION stops motor motion while allowing continued program execution. Deceleration is as specified by the MAX.DECEL variable.

Syntax

```
STOP.MOTION
```

Related instructions

STOP — stops motion and interrupts the program.

MAX.DECEL — specifies the rate of deceleration for STOP.MOTION and other special stopping conditions.

Programming guidelines

Program a line with STOP.MOTION wherever you wish to stop the motor while continuing the program.

Program segment

Program line

```
 5      ‘Set run speed to 1,000 RPM.
10      RUN.SPEED = 1000
15      ‘Set acceleration rate to 10,000 RPM/second.
20      ACCEL.RATE = 10000
25      ‘Set deceleration rate to 1,000,000 RPM/second.
30      MAX.DECEL = 1000000
35      ‘Start motor.
40      GO.VEL
45      ‘If input 1 is low then go to line 55. Otherwise, go back to line 50.
50      IF INP1 = 1 THEN 50
55      ‘Stop the motor.
60      STOP.MOTION
```

TARGET.POS

parameter

(integer)

Purpose

`TARGET.POS` (Target Position) sets the target position that is the destination when a `GO.ABS` function is called.

The target position is the absolute position relative to the electrical home position.

Note: *Refer to Section 2.9.1, "Description of Motion Statements" for additional information.*

> **IMPORTANT NOTE:**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
TARGET.POS = x
```

Stepsize	Range
1	-33,554,432 ≤ x ≤ 33,554,431
2	-67,108,864 ≤ x ≤ 67,108,863
5	-67,108,864 ≤ x ≤ 67,108,863
25	-268,435,456 ≤ x ≤ 268,435,455
125	-536,870,912 ≤ x ≤ 536,870,911

Related instructions

`POS.COMMAND` — displays or redefines position.

`STEPSIZE` — full or microstep rate for the drive.

`SEEK.HOME` — causes homing routine using mechanical switch.

`GO.ABS` — moves motor shaft to position specified by `TARGET.POS`.

`GO.HOME` — moves motor shaft to electrical home.

`MOVING` — flag turned on when the motor is moving.

TARGET.POS (continued)

Programming guidelines

Note: *Do not program a new value for* POS.COMMAND after TARGET.POS has been programmed. Target Position is an absolute position variable based on the existing POS.COMMAND position.

Program segment

Program line

```
10     STEPSIZE = 25
20     MIN.SPEED = 25
30     ACCEL.RATE = 500
40     RUN.SPEED = 1000
50     POS.COMMAND = 0
60     TARGET.POS = 100000
70     GO.ABS
80     IF MOVING THEN 80
90     IF (POS.COMMAND <> TARGET.POS) THEN 200
100    END
200    PRINT “ERROR”
210    END
```

This program will set the target for motion to 100,000 microsteps, and then move to target position.

TIME

variable

(float)

Purpose

TIME is a continually running internal software timer that counts from 0 to 67.10886 seconds.

If you enter a value for TIME, the timer resets to continue from this new time. For example, when TIME = 2 is executed, the timer resets to the 2 second point before continuing to count up to 67.10886 seconds, go to zero, and repeat the cycle.

Syntax

```
TIME = xx.xxx
```

Range

0 to 67.10886 seconds, timer updated every 1.024 msec

Default

x = 0

Programming guidelines

- Set TIME equal to a value that represents the starting time for the count.
- To get an accurate reading of the time of a given event, such as a switch closing, set a floating point variable equal to TIME and then PRINT that variable. Do this because the PRINT statement takes a relatively long time to execute.
- To time events longer than 67.10886 seconds, use a counter to count the number of times the timer resets.

Program division of the desired time by 67.10886 for the number of timer resets. Then, determine the remainder. Using these values, program the desired motion for the appropriate number of time intervals plus the remainder.

Program segment

Program line

```
10     IF INP1 = 1 THEN 10
20     TIME = 0
30     IF INP1 = 0 THEN 30
40     FLT1 = TIME
50     PRINT FLT1
```

This program waits until input 1 is equal to zero (connected to I/O RTN). It then measures the length of time that the input remains connected to I/O RTN. The program then displays this on the terminal screen.

TRON and TROFF

command

Purpose

To enable or disable tracing of the executing program lines for use in debugging your program.

`TRON` stands for **TR**ace **ON**.

`TROFF` stands for **TR**ace **OFF**.

Syntax

`TRON` to enable tracing

or

`TROFF` to disable tracing

Programming guidelines

`TRON` enables the printing of each program line as that line is executed by the BASIC interpreter software. This is useful when you are trying to find out if your program is working properly. `TROFF` disables the trace. The lines that are printed when executing a program after a `TRON` command appear just as they would in a `LIST` command. Tracing is disabled when you first turn on the controller. Tracing is also disabled when you execute a `NEW` Command.

Note: *Tracing will slow down program execution time.*

Program segment

Program line

```
TRON
5      PRINT “BEGINNING NOW”
15     Print “ENDING NOW”
20     END
RUN    <enter>
TROFF
```

This program turns tracing on and then prints ”Beginning Now”. The program then prints ”Ending Now” before turning tracing off.

UPD.MOVE

statement

Purpose

UPD.MOVE updates a move in process with new variables. This allows you to change motion "on the fly" without having to stop motion and restart the motion function again with new variables.

Syntax

UPD.MOVE

Related instructions

ACCEL.RATE — limits the maximum commanded acceleration rate.

CONTINUOUS.MOTION — specifies continuous motion allowing variable changing without stopping the move.

DCL.TRACK.ACL — specifies that the acceleration rate is equal to the deceleration rate.

DECEL.RATE — limits the maximum commanded deceleration rate.

DIR — sets the direction the motor turns when a GO.VEL or a SEEK.HOME function is executed.

RUN.SPEED — sets the commanded velocity.

Programming guidelines

Set CONTINUOUS.MOTION = 1 to specify continuous motion, then implement continuous motion with UPD.MOVE.

Move functions that are updated with UPD.MOVE are GO.ABS, GO.HOME, GO.INCR, and GO.VEL

Update desired ACCEL.RATE, DECEL.RATE, RUN.SPEED, and DIR (for GO.VEL moves only).

DCL.TRACK.ACL must be equal to zero to set DECEL.RATE independently.

UPD.MOVE (continued)

Program segment

Program line

```
110     CONTINUOUS.MOTION = 1
120     POS.COMMAND = 0
130     RUN.SPEED = 2000
140     INDEX.DIST = 100000
150     GO.INCR
160     RUN.SPEED = 100
170     WHEN POSITION > 5000, UPD.MOVE
```

This program waits until the position is greater than 5000, then updates move causing the run speed to drop to 100 RPM.

VELOCITY

variable

(float)

(read only)

Purpose

`VELOCITY` indicates the actual speed at which the motor shaft is running averaged over a 128 msec interval. This is a read only variable.

Syntax

```
x = VELOCITY
```

Stepsize	**Range**
1	0.01 to 18,750.00 RPM
2	0.01 to 18,750.00 RPM
5	0.01 to 7,500.00 RPM
25	0.01 to 6,000.00 RPM
125	0.01 to 2,399.99 RPM

Related instructions

`RUN.SPEED` — Programmed speed realistically represented by `VELOCITY`.

VELOCITY (continued)

Program segment

Program line

```
10     STEPSIZE = 1
20     RUN.SPEED = 1000
30     MIN.SPEED = 50
40     ACCEL.RATE = 1000
50     DIR = 0
60     GO.VEL
70     WAIT.TIME = 5 : PAUSE
80     IF (RUN.SPEED - VELOCITY) * 100 > 1 THEN 90
       ELSE 80
90     PRINT “VELOCITY FOLLOWING ERROR”
```

This program checks mismatch between RUN.SPEED and VELOCITY. If greater than 1%, print error message.

VER
command

Purpose

`VER` is an immediate mode instruction that displays the version number of the software.

Syntax

```
VER <enter>
```

Program segment

```
VER <enter>
```

Returns :

```
Pacific Scientific
Charlestown, MA
StepperBASIC Version X.X
Copyright © 1988. 1991 (YYYY)
OK
```

where x.x is the version number

and YYYY is the version check sum no.

WAIT.TIME

parameter

(float)

Purpose

WAIT.TIME sets the amount of time in seconds that the program pauses when the PAUSE statement is executed.

> **IMPORTANT NOTE:**
>
> The value of this variable is stored in NVRAM when the SAVEVAR command is executed.

Syntax

```
WAIT.TIME = x
```

Range

x = 0.001 to 67.10886 seconds

Default

x = 1

Related instructions

PAUSE — causes the program to wait as specified by WAIT.TIME

Program segment

Program line

```
10    WAIT.TIME = 0.5
20    IF INP1 = 1 THEN 20
30    PAUSE
40    GO.INCR
```

This program looks at INP1 (J9-2) and waits until this input is zero (connected to I/O RTN). The program pauses for 0.5 second and then performs an incremental move.

WHEN

statement

Purpose

WHEN is used for very fast output responses to certain input conditions.

You specify the condition and action. Upon encountering the WHEN, program execution waits until the defined condition is satisfied. Then the program immediately executes the action and continues with the next line of the program.

The WHEN statement provides latching of several variables when the WHEN condition is satisfied. These variables are: WHEN.ENCPOS, WHENPCMD.

The software checks for the defined condition every 1.024 millisecond and performs the action within 1.024 millisecond of condition satisfaction.

Note: *Refer to Section 2.7,* "*Using the* WHEN Statement" for additional information.

Syntax

```
WHEN condition, action
```

The condition must be:

- INPn = 1 or 0
- POS.COMMAND > value
- POS.COMMAND < value
- ENCDR.POS > value
- ENCDR.POS < value

The action must be:

- OUTn = 1 or 0
- RATIO = value
- Any of the following:

  GEARING

  GO.ABS

  GO.HOME

  GO.INCR

  GO.VEL

  PAUSE

  REG.FUNC

  SEEK.HOME

  STOP.MOTION
- CONTINUE (CONTINUE allows program execution to continue at the next program line.
- UPD.MOVE

Related instructions

WHEN.ENCPOS — specifies the encoder position (ENCPOS) latched when the WHEN condition is satisfied.

WHENPCMD — specifies the motor position command (POS.COMMAND) latched when the WHEN condition is satisfied.

Programming guidelines

Program the WHEN statement followed by the valid condition and action separated by a comma.

WHEN.ENCPOS

variable

(integer)

(read only)

Purpose

WHEN.ENCPOS (When Encoder Position) records the encoder position at the time the WHEN statement becomes true. This value is checked for at 1.024 millisecond time intervals.

Syntax

```
x = WHEN.ENCPOS
```

Value

x is -2,147,483,648 to 2,147,483,647 external encoder counts.

Related instructions

WHEN — provides fast response to certain input conditions

ENCDR.POS — provides the encoder position

Program segment

Program line

```
10    ‘Latch encoder position when input 6 goes low
20    WHEN INP6 = 0, OUT6 = 0
30    PRINT “WHEN Encoder position is ” WHEN.ENCPOS
```

WHENPCMD

variable

(integer)

(read only)

Purpose

WHENPCMD (When Position Command) specifies the motor position when the WHEN condition is satisfied.

Syntax

```
x = WHENPCMD
```

Related instructions

POS.COMMAND — contains the current position command.

WHEN — provides fast response to certain input conditions

Program segment

Program line

```
10      'Latch encoder position when input 1 goes low
20      WHEN INP1 = 0, CONTINUE
30      PRINT "WHEN POS.COMMAND IS" WHENPCMD
```

WHILE...WEND

statement

Purpose

WHILE...WEND tells the program to execute a series of statements as long as an expression after the WHILE statement is true.

If the expression is true, then the loop statements between WHILE and WEND are executed. The expression is evaluated again and if the expression is still true, then the loop statements are executed again. This continues until the expression is no longer true. If the expression is not true, then the BASIC interpreter software executes the statement immediately following the WEND statement.

Syntax

```
WHILE expression
.
(loop statements)
.
WEND
```

expression is any numeric or boolean expression

Programming guidelines

WHILE...WEND loops may be nested, up to a limit of 8. Each WEND is matched to the most recent WHILE. Unmatched WHILE or WEND statements cause run-time errors.

WHILE ... WEND (continued)

Program segment

Program line

```
10     INT1 = 3
20     WHILE INT1 > 1
30     PRINT ”INT1 =” INT1
40     INT1 = INT1 - 1
50     WEND
60     END
RUN    <enter>
```

This program will print out the following:

```
INT1 = 3
INT1 = 2
```

4 Quick Reference

Introduction

This section contains commands, functions, parameters, statements and variables for Pacific Scientific StepperBASIC™. Below is a summary of the list of instructions.

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SKn.TRIGGER	parameter (integer)		3-150

Name	Type	Default Value	Page #
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STALL.JUMP	parameter (integer)		3-157
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Appendix A ASCII Codes

ASCII Code Result			ASCII Code Result		ASCII Code Result		ASCII Code Result	
0	^ @	NUL	32		64	@	96	‘
1	^ A	SOH	33	!	65	A	97	a
2	^ B	STX	34	\	66	B	98	b
3	^ C	ETX	35	#	67	C	99	c
4	^ D	EOT	36	$	68	D	100	d
5	^ E	ENQ	37	%	69	E	101	e
6	^ F	ACK	38	&	70	F	102	f
7	^ G	BEL	39	‘	71	G	103	g
8	^ H	BS	40	(	72	H	104	h
9	^ I	HT	41	)	73	I	105	i
10	^ J	LF	42	*	74	J	106	j
11	^ K	VT	43	+	75	K	107	k
12	^ L	FF	44	,	76	L	108	l
13	^ M	CR	45	-	77	M	109	m
14	^ N	SO	46	.	78	N	110	n
15	^ O	SI	47	/	79	O	111	o
16	^ P	DLE	48	0	80	P	112	p
17	^ Q	DC1	49	1	81	Q	113	q
18	^ R	DC2	50	2	82	R	114	r
19	^ S	DC3	51	3	83	S	115	s
20	^ T	DC4	52	4	84	T	116	t
21	^ U	NAK	53	5	85	U	117	u
22	^ V	SYN	54	6	86	V	118	v
23	^ W	ETB	55	7	87	W	119	w
24	^ X	CAN	56	8	88	X	120	x
25	^ Y	EM	57	9	89	Y	121	y
26	^ Z	SUB	58	:	90	Z	122	z
27	^ [	ESC	59	;	91	[	123	{
28	^ \	FS	60	<	92	\	124	|
29	^]	GS	61	=	93	]	125	}
30	^ ^	RS	62	>	94	^	126	~
31	^ _	US	63	?	95	_	127	

Appendix B INPUT Statement

Introduction

This appendix is intended to provide additional information on the `INPUT` statement.

INPUT statement execution

When a StepperBASIC program executes the `INPUT` statement, the following sequence of events occur:

1. The character input buffer of the 6x45 controller is cleared.
2. a. If there is no user-defined prompt (within “ ”), the controller will transmit a question mark followed by a space (?_).

   b. If there is a user-defined prompt string, the prompt is transmitted followed by a question mark and a space.

   c. If the prompt string is followed by a comma instead of a semi-colon, the prompt is transmitted but the question mark is suppressed.
3. Numeric Data Characters received by the controller are placed in the input character buffer. They are also echoed back (transmitted by the controller) one at a time after they are received.

Note: *Line feeds received by the 6x45 are ignored.*

4. Step 3 is repeated until a carriage return is transmitted to the 6x45.
5. When a carriage return is transmitted to the 6x45, the numeric input data is terminated. After its reception the 6x45 transmits a line feed followed by a carriage return, unless a semicolon appears just after `INPUT`, in which case the line feed and carriage return are suppressed.
6. If the numeric response is a valid numeric value, then the input data is placed in the specified variable. Otherwise, the `INPUT` process is repeated from Step 1.

Variations of INPUT statement options

Note: *"?_" in these examples represents a question mark followed by a blank space. The underscore character "_" is used to illustrate the blank space. In all instances, characters received by the 6x45 will be echoed (transmitted) after they are received.*

These `INPUT` statements will cause the 6x45 to transmit a line feed followed by a carriage return, after a carriage return is received by the controller, to terminate the input data string.

```
10 INPUT INT1
will transmit the prompt:      ?_
20 INPUT “Please Enter INT1" ; INT1
will transmit the prompt: Please Enter INT1?_
30 INPUT “Please Enter INT1" , INT1
will transmit the prompt: Please Enter INT1_
```

These `INPUT` statements will suppress the 6x45's transmission of a line feed and carriage return, after a carriage return is received by the controller, to terminate the input data string.

```
40 INPUT ; INT1
will transmit the prompt:      ?_
50 INPUT ; “Please Enter INT1" ; INT1
will transmit the prompt: Please Enter INT1?_
60 INPUT ; “Please Enter INT1" , INT1
will transmit the prompt: Please Enter INT1_
```

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