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Compumotor

Model 4000 Controller
X Command Language
Reference Guide

Compumotor Division
Parker Hannifin Corporation
p/n 88-011004-01 E

Parker

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User Guide Change Summary

The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 88-011004-01**E**, supersedes version 88-011004-01**D** .

When a user guide is updated, the new or changed text is differentiated with a change bar in the right margin (this paragraph is an example).

The entire user guide has been changed according to the new Compumotor user guide styles, format, and illustration standards. Technical changes are summarized below.

The following commands have been added to support Compumotor absolute encoders (AR-C and AL-C).

DCR (Define C Axis Resolution)
DP (Define Path)
DPA (Define Path Absolute)
DPI (Define Path Incremental)
DPL (Define Path Local Coordinates)
DPO (Define Path Segment Outputs)
DPR (Define P Axis Ratio)
DPW (Define Path Work Coordinates)

ENDP (End Path Definition)

GP (Execute Path)
GSEG (Start Segment Move)

ID (X Center Data)

LINE (Define Line Segment)

OCW (Center Specified CW Arc Segment)
OCCW (Center Specified CCW Arc Segment)

PDEL (Delete Path)
PR (Absolute Position Report)

RCW (Radius Specified CW Arc Segment
RCCW (Radius Specified CCW Arc Segment)

RD (Radius Data)

XD (X Axis Data)
XLD (Local X Coordinate Data)
XWD (Work X Coordinate Data)

YD (Y Axis Data)
YLD (Local Y Coordinate Data)
YWD (Work Y Coordinate Data)

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Command Listing

A (Acceleration)
ABS (Enable Absolute Encoders)
AD (Deceleration)
AP (Path Acceleration)
ADP (Path Deceleration)
AVS (Velocity Scale Acceleration)

B (Buffer Status)
BSEG (Define Start Segment)

C (Continue)
CG (Correction Gain)
CR (Carriage Return)

D (Distance)
DB (Dead Band)
DCR (Define C Axis Resolution)
DP (Define Path)
DPA (Define Path Absolute)
DPI (Define Path Incremental)
DPL (Define Path Local Coordinates)
DPO (Define Path Segment Outputs)
DPR (Define P Axis Ratio)
DPW (Define Path Work Coordinates)
DTR (Disable Trigger Interrupt)
DW (Dead Band Window)

ENDP (End Path Definition)
ESEG (Define Endinbg Segment)
ETR (Enable Trigger Interrupt)
ER (Encoder Resolution)

FR (Encoder Functions Report)
FSA (Set to Incremental/Absolute Mode)
FSB (Set Indexer to Motor/Encoder Mode)
FSC (Enable/Disable Position Maintenance)
FSD (Stop on Stall)

G (Go)
GA (Go Home Acceleration)
GH (Go Home)
GL (Go Linear)
GP (Execute Path)
GSEG (Start Segment Move)

H± (Set Direction)
^H (Delete)

ID (X Center Data)

J (Enable/Disable Joystick)
JA (Joystick Acceleration)
JAD (Joystick Deceleration)
JCDB (Joystick Center Deadband)
JD (Y Center Data)
JEDB (Joystick End Deadband)
JDH (Define Joysel High Channel)
JDL (Define Joysel Low Channel)
JVH (Joystick High Velocity)
JVL (Joystick Low Velocity)
JZ (Joystick Zero)

K (Kill)

L (Loop)
LA (Limit Acceleration)
LINE (Define Line Segment)

MC (Mode Continuous)
MSEG (Start Middle Segment)
MN (Mode Normal)
MR (Select Motor Resolution)
MV (Maximum Correction Velocity)

N (End of Loop)

O (Output)
OCW (Center Specified CW Arc Segment)
OCCW (Center Specified CCW Arc Segment)
OR (Report Status of Functional Setup)
OS (Function Setup Report)
OSA (Invert Encoder Direction)
OSB (Backup to Home Switch)
OSC (Define Active State of Home Switch)
OSD (Enable Encoder Z Channel Input)
OSE (Enable/Disable Stall Detect)
OSG (Final Homing Direction)
OSH (Reference Edge of Home Switch)

P (Incremental Position Report)
PD (Position Definition)
PDEL (Delete Path)
PR (Absolute Position Report)
PS (Pause)
PX (Report Encoder Absolute Position)
PZ (Position Zero)

Q (Quit Buffer)

R (Request Controller Status)
RA (Limit Switch Status Report)
RB (Report Loop, Pause, Shutdown, Trigger Status Request)
RC (Report Closed Loop and Go Home Status)
RCW (Radius Specified CW Arc Segment
RCCW (Radius Specified CCW Arc Segment)
RD (Radius Data)
RE (Resume)
REG (Define Registration Move)
RI (Simulate Trigger Interrupt)
RV (Revision Level)

S (Stop)
SR (Special Status Request)
SSF (Select Velocity Range)
SSG (Clear/Save Command Buffer on LImit)
SSH (Clear/Save Command Buffer on Stop)
ST (Shutdown)

T (Time)
TR (Wait for Trigger)
TS (Trigger Input Status)

U (Pause and Wait for Continue)
UR (Scale Factor Status)
US (Set Distance Scale Factor)

V (Velocity)
VP (Path Velocity)
VS (Set Start/Stop Velocity)
VSE (Velocity Scale Enable)
VSH (Velocity Scale Source High)
VSL (Velocity Scale Source Low)

W3 (Hexadecimal Position Report)

XD (X Axis Data)
XLD (Local X Coordinate Data)
XWD (Work X Coordinate Data)

Y (Stop Loop)
YD (Y Axis Data)
YLD (Local Y Coordinate Data)
YWD (Work Y Coordinate Data)

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X Series Command Language

This User Guide contains definitions of the X Series language commands that you may use with the Model 4000 Controller. The X command language is useful for interactive operation of the individual axes in an independent manner. It is possible, but not advisable, to operate the X command language while a Model 4000 statement program is running.

The X command language is intended to allow use of the four axes as though they were four individual controllers tied through a daisy chained serial link. There are no global commands.

Access to the X command language is gained by typing a / and a carriage return at the Model 4000 prompt on either port. Either port may be used, which makes it possible to have both ports in X Command Language mode at the same time. In this case all responses to X command requests will be sent to port 2, regardless of which port originated the request. After the slash is entered, the Model 4000 stops sending prompts, and merely echos the received characters. X commands must be all capital letters and are delimited with a space or carriage return. To return to the standard Model 4000 prompt, type a ; and a carriage return.

Contouring with X Command Language

The basic concepts of contouring are presented, as well as statement examples to illustrate these concepts. It is important to read that description before expecting to understand how to use contouring with the X command language. This text will discuss programming issues that are unique to the use of X command language contouring, as well as give X command language examples of the topics discussed in in the **Model 4000 User Guide**.

Path Definition

When using X command language, the commands which compose a path definition will generally be stored in a host computer file. This is the equivalent to Model 4000 statement program storage. The X command language path segment definition commands are compiled as segments in the order in which they are received. Just as with the Model 4000 **PATH** statements, this must be the order in which they are intended to be executed. Paths defined with the X command language are specified by a number between 1 and 100 instead of a name. Just as the **PATH DEF** statement specifies the path name and the participating axes, the X command used to start the definition of a path specifies the axes and also contains a number for the path. When all the path setup and segment definition commands have been sent, the End Path Definition (**ENDP**) command tells the Model 4000 that the path definition is complete. This command finishes the compilation of the path. This enables the path to be executed, but does not execute it. The Execute Path (**GP**) command actually executes the path.

The Model 4000 holds the parameters it needs for certain commands in temporary registers before and during the execution of the command. These commands are those needed to define a line or arc segment and those needed to locate the *Work* and *Local* coordinate systems. When using the Model 4000 statements, the data for these registers is contained in the statement. When using the X command language, these data registers must be filled before the corresponding command is entered. The data registers (the X commands which fill them) and the segment types or commands which use them are as follows:

Data register	X command	Segments or Commands
X data	XDnnnnn	LINE,RCW,RCCW,OCW,OCCW
Y data	YDnnnnn	LINE,RCW,RCCW,OCW,OCCW
radius data	RDnnnnn	RCW,RCCW
X center data	IDnnnnn	OCW,OCCW
Y center data	JDnnnnn	OCW,OCCW
X local coordinate	XLDnnnn	DPL
Y local coordinate	YLDnnnn	DPL
X work coordinate	XWDnnnn	DPW
Y work coordinate	YWDnnnn	DPW

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Examples of X Language in Contouring

The descriptions and examples that follow illustrate the general use of X commands in defining and executing a path. The section is presented in a step by step manner, in order to illustrate the order of commands and describe what is happening with each group of commands.

In the following example, storage space is made available for the definition of path #3 by first deleting path #1 and path #2. The Define Path (**DP**) command begins the definition of the path #3. The X and Y axes are specified to be axes 4 and 2. The path includes the C axis to be axis 1, with a resolution of 100,000 steps. It also includes the P axis to be axis 3, with a ratio of P axis travel to path travel specified as 2.5. The radius tolerance may be specified individually for each arc, simply by using an **RTOL** command before each arc specification. In this example and in all subsequent arc specifications the radius tolerance is specified to be 10 steps. The example below also illustrates the specification of velocity, acceleration, and deceleration.

Example

Command	Description
PDEL1	Delete path 1
PDEL2	Delete path 2
DP3,4213	Begin path definition 3
DCR100000	Define C axis resolution
DPR2.5	Define P axis ratio
RTOL10	Specifiy radius tolerance 10 steps
VP5	Path velocity 5 rps
AP50	Path acceleration 50 rps^2
ADP100	Path deceleration 100 rps^2

The path itself consists of line and arc segments, which are specified by their endpoint locations. These endpoint coordinates may be specified incrementally, or as absolute positions. The absolute positions may be assumed by the Model 4000 to be one of two coordinate systems. These are the *Work* coordinate system, and the *Local* coordinate system. Path 3 consists of a line specified in the *Work* coordinate system, followed by an **RCCW**, specified in a *Local* coordinate system, and followed with an **OCW**, specified in the original *Work* coordinate system. Note that the *Work* coordinate system location is only specified once, using the Work Coordinate Data (**XWD**) and Work Y Coordinate Data (**YWD**) commands.

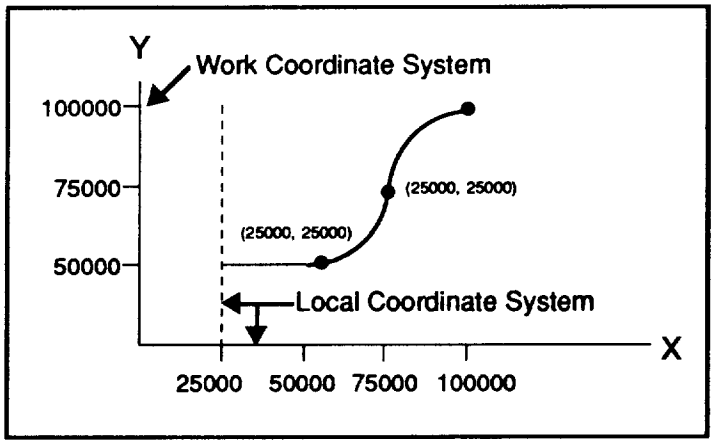


Figure 1-1. Work and Local Coordinate System Example

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Example

Command	Description
DPA	Use absolute positioning
XWD25000	Specify WORK X coordinate
YWD50000	Specify WORK Y coordinate
DPW	Use WORK coordinate system
XD50000	Specify X endpoint
YD50000	Specify Y endpoint
LINE	Create LINE segment
XLD25000	Specify LOCAL X coordinate
YLD25000	Specify LOCAL Y coordinate
DPL	Use LOCAL coordinate system
XD50000	Specify X endpoint
YD50000	Specify Y endpoint
RD25000	Specify radius of RCCW
RCCW	Create RCCW arc
DPW	Return to previous WORK coordinate system
XD100000	Specify X endpoint
YD100000	Specify Y endpoint
ID25000	Specify X relative center point
JD0	Specify Y relative center point
OCW	Create OCW arc

For this example, assume that the three segments above are unique to path #3, but that all paths finish with a special short line segment. The length of the segment is always the same, but its location will vary from path to path. It is programmed in incremental coordinates, so that the ending position is not needed. This segment also has POB output 2# low for the duration of the segment. After the path #3 definition is finished, the host computer may execute the path repeatedly without re-definition.

Example

Command	Description
DPI	Use incremental coordinates
XD25000	Incremental X endpoint
YD0	Incremental Y endpoint
DPOX0XX	Segment sets POB 2 low during execution
LINE	Create the LINE segment
ENDP	Finish definition of path 3
GP3	Execute path 3
GP3	Execute path 3 again immediately

Path Statements and X Command Summary

The following list of statements and X commands is intended to provide a summary of all the **PATH** statements followed by the corresponding X command strings. If the statement has no corresponding X command, the letters N/A appear. The statements are listed in an order which represents the way they would be found in a Model 4000 program. Each statement provides one example of syntax, and is accompanied by a very brief comment. Each statement is described in greater detail in **Model 4000 Controller User Guide**.

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```
UNIT PATH POS 25000                          'X, Y, and R steps/unit
    N/A
UNIT PATH VEL 25000                          'Path steps/sec per vel unit
    N/A
UNIT PATH ACCEL 25000
    N/A                                      'Path steps/sec^2 per accel unit
VEL PATH 5                                   'Path velocity in PATH VEL units
    VP5                                      'Path velocity in rps
ACCEL PATH 100                               'Path accel in PATH ACCEL units
    AP100                                    'Path accel in rps^2
DECEL PATH 200                               'Path decel in PATH DECEL units
    ADP200                                   'Path decel in rps^2
PATH UNCOMP CONTOUR2                         'Remove compiled CONTOUR2
    PDEL2                                    'Delete path 2
PATH COMPILE CONTOUR1                        'Compile CONTOUR1 (not execute)
    N/A
PATH EXECUTE CONTOUR1                        'Execute compiled path CONTOUR1
    GP1                                      'Execute path 1
PATH DEF CONTOUR1  2 1 4 3                   'Start CONTOUR1 definition
    DP1,2143                                 'Start path 1 definition
PATH C_RES 125000                            'Specify C axis resolution
    DCR125000                                'Specify C axis resolution
PATH P_RATIO 2.5                             'Specify P axis ratio
    DPR2.5                                   'Specify P axis ratio
PATH RAD_TOL .001                            'Radius tolerance in PATH POS units
    RTOL10                                   'Radius tolerance 10 steps
PATH XY MINC                                 'Program in incremental coordinates
    DPI                                      'Program in incremental coordinates
PATH XY MABS                                 'Program in absolute coordinates
    DPA                                      'Program in absolute coordinates
PATH XY WORK  10  50                         'Specify WORK coordinate system
    XWD10000 YWD50000 DPW                    'Specify WORK coordinate system
PATH XY LOCAL 5   3
    XLD5000 YLD3000 PDL                      'Specify LOCAL coordinate system
PATH ONLY IF COMPILING                       'Start of conditional block
    N/A
PATH ONLY ENDIF                              'End of conditional block
    N/A
PATH ONLY IF EXECUTING                       'Start of conditional block
    N/A
PATH POB 0011                                'POB bit pattern for next segment
    DPO0011                                  'POB bit pattern for next segment
PATH LINE 4 7                                'Line segment to (4,7)
    XD4000 YD7000 LINE                       'Line segment to (4000,7000)
PATH RCCW  9 12 5                            'CCW arc to (9,12) radius 5
    XD9000 YD12000 RD5000 RCCW               " " (9000,12000) " 5000
PATH RCW 4 7 5                               'CW arc to (4,7) radius 5
    XD4000 YD7000 RD5000 RCW                 'CW arc to (4000,7000) radius 5000
PATH OCCW 9 12 4 12
    XD9000 YD12000 ID4000 JD12000 ' " " " (9000,12000) " (4000,12000)
                                             'CCW arc to (9,12) center (4,12)
PATH OCW 4 7 4 12                            'CW arc to (4,7) center (4,12)
    XD4000 YD7000 ID4000 JD12000             " " " (4000,7000) " (4000,12000)
PATH END                                     'End of CONTOUR1 definition
    ENDP                                     'End of path 1 definition
```

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Description of Format

①A ②Motion	③Acceleration			④VALID Software Version A2
⑤SYNTAX <a>An	⑥UNITS n = rps	⑦RANGE 0.001 to 999.999	⑧DEFAULT 100	⑨ATTRIBUTES Buffered
⑩EXECUTION TIME		⑪SEE ALSO D, V, G		
⑫RESPONSE TO aA IS *An				

① *Mnemonic Code* — This box contains the command's mnemonic code and the command type. The command types are described below.

② *Type* — This portion of the box contains the command's type. The four command types are listed below.

Set-Up — Setup commands define setup conditions for the application. Setup commands include the following types of commands:

- ❑ Homing (Go home acceleration and velocity, etc.)
- ❑ Input/Output (Limits, scan time, in-position time, etc.)
- ❑ Tuning (Servo or position tracking)
- ❑ General (Set switches, return to factory settings, etc.)

Programming — Programming commands affect programming and program flow. For example, trigger, output, all sequence commands, quote, time delays, pause and continue, enable and front-panel, loop and end loop, line feed, carriage return, and backspace.

Status — Status commands respond (report back) with information.

Motion — Motion commands affect motor motion (i.e., accelerate, velocity, distance, go home, stop, direction, mode, etc.

③ *Full Name* — This field contains the full command name.

④ *Valid Revision Level* — This field contains the revision history of the command. It includes the revision of software when the command was added or modified. If the revision level of the software you are using is equal to or greater than the revision level listed in this field, you are using the proper version of the software.

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

- a This indicates that a device address must accompany the command. Only the device specified by this parameter receives and executes the command. If this parameter, or any other parameter appears within brackets <a>, it is optional.
- n This represents an integer. You may use an integer to specify a variety of values (acceleration, velocity, etc.).
- s This represents a sign character (+ or -). This variable allows you to specify direction (CCW or CW) or a positive or negative value.
- x This represents a function parameter. Some commands (like the **RS** and the **QS** commands) have multiple functions You can specify which function you want to use (i.e., **A**, **B**, **C**, **D**, etc.) by entering the appropriate letter in this field. The valid options are discussed in the individual command descriptions

⑥ ***Units*** — This field describes what unit of measurement the parameter in the command syntax represents.

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

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

⑨ ***Attributes*** — This box indicates if the command is ***immediate*** or ***buffered.*** The system executes immediate commands as soon as it receives them. Buffered commands are executed in the order that they are received with other buffered commands.

⑩ ***Execution Time*** — The execution time is the span of time that passes from the moment you issue a command to the moment the system begins to execute it.

⑪ ***See Also*** — Commands that are related or similar to the command described are listed here.

⑫ ***Response*** — A sample status command is given (next to **RESPONSE TO**) and the system response is shown. *This box will only be provided if the system provides a response to the command. If no response is provided, this box will not be included with the description.*

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Alphabetical Command List

A Motion	Acceleration			VALID Software Version A2
SYNTAX <a>An	**UNITS** n = rps^2	**RANGE** 0.001 to 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** D, V, G		

Description

The Acceleration (A) command specifies the acceleration rate to be used upon executing the next Go (G) command. The acceleration remains set until you change it. You do not need to reissue this command for subsequent G commands. Accelerations outside the valid range will cause the acceleration to remain in previous valid A setting.

Example

Command	Description
MN	Sets to Normal mode(preset moves)
A5	Sets acceleration to 5 rps^2
V1Ø	Sets velocity to 10 rps
D1ØØØØ	Sets distance to 10,000 steps
G	Executes the move (Go)

ABS Set-Up	Initialize Absolute Encoders			VALID Software Version C3
SYNTAX <a>ABSxxxx	**UNITS** x = axis participation	**RANGE** x = 0 – no encoder x = 1 – encoder	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <4mS		**SEE ALSO** ER, FSB1		
RESPONSE TO aABSxxxx **IS** yyyy (yyyy should match xxxx)				

Description

The ABS command causes the Model 4000 to search the absolute encoder inputs of all four axes to determine which axes have absolute encoders attached. The four digits following the ABS command indicate the initialization command for axes 1-4. A 1 is used to inform the Model 4000 that an absolute encoder is attached and should be initialized. A 0 is used to inform the Model 4000 that no absolute encoder is to be initialized for that axis. For user specified axes which have absolute encoders attached, the encoder position is read and the rollover boundaries are determined. For a discussion of rollover boundaries and possible detection responses refer to the **Model 4000 User Guide**.

The Model 4000 will respond to the ABS command with a four digit string, for axes 1 through 4, indicating which axes have an initialized absolute encoder. A 1 is used to respond that an absolute encoder has been initialized for that axis. A 0 is used to indicate that no absolute encoder has been initialized for that axis. The response pattern to the ABS command should match its parameter pattern. A response pattern which does not match indicates that one or more axes did not initialize absolute encoders as specified. The ABS command is not axis specific and will affect all axes which have an absolute encoder attached. When programming in X command language, the ABS command must be issued in order for the Model 4000 to detect the presence of the absolute encoders.

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Example

Command	Description
ER32768	Specify encoder resolution
ABS1Ø11	Initialize absolute encoders on Axes 1, 3, and 4
1Ø11	Response to ABS command
FSB1	Switch to encoder step mode
D32768	Specify a one revolution move
G	Execute the move (Go)

AD Motion	**Deceleration**			**VALID** Software Version A2
SYNTAX <a>ADn	**UNITS** n = rps^2	**RANGE** 0.001 to 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** D, V, G, A		

Description

The Deceleration (**AD**) command specifies the deceleration rate to be used upon finishing the next Go (**G**) command or Stop (**S**) command. The deceleration remains set until you change it. You do not need to reissue this command for subsequent **G** commands. Deceleration outside the valid range causes the deceleration to remain in previous valid **AD** setting.

The deceleration will follow the acceleration given with the **A** command until an **AD** command is given. After that, deceleration will cease to track acceleration and must be changed with the **AD** command.

Example

Command	Description
MN	Sets to Normal mode(preset moves)
AD5	Sets deceleration to 5 rps^2
V1Ø	Sets velocity to 10 rps
D1ØØØØ	Sets distance to 10,000 steps
G	Executes the move (Go)

AP Motion	**Path Acceleration**			**VALID** Software Version A2
SYNTAX <a>APn	**UNITS** n = rps^2	**RANGE** 0.001 to 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** VP, GP, ADP		

Description

The Path Acceleration (**AP**) command specifies the path acceleration to be used in linearly interpolated moves, and in the Model 4000 contouring option. In linearly interpolated moves, a path may involve one to four axis, each with its own distance of travel. In contouring paths, only the X and Y axis are included in the calculation of the path.

For both types of moves, the path acceleration refers to the acceleration experienced by the load as motion gains speed along the path. For linearly interpolated moves, the acceleration of each individual axis is dependent on the distance it contributes to the total path travelled by the load. In contouring paths, the acceleration of each individual axis is dependent on the direction of travel in the X-Y plane.

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Example

Command	Description
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

ADP Motion	**Path Deceleration**			**VALID** Software Version A2
SYNTAX <a>ADPn	**UNITS** n = rps^2	**RANGE** 0.001 to 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** VP, GP, AP		

Description

The Path Deceleration (ADP) command specifies the path deceleration to be used in linearly interpolated moves, and in the Model 4000 contouring option. In linearly interpolated moves, a path may involve one to four axis, each with its own distance of travel. In contouring paths, only the X and Y axis are included in the calculation of the path.

For both types of moves, the path deceleration refers to the deceleration experienced by the load as motion slows along the path. For linearly interpolated moves, the deceleration of each individual axis is dependent on the distance it contributes to the total path travelled by the load. In contouring paths, the deceleration of each individual axis is dependent on the direction of travel in the X-Y plane.

Example

Command	Description
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

AVS Set-Up	**Velocity Scale Acceleration**			**VALID** Software Version B2
SYNTAX AVSn	**UNITS** n = %/sec	**RANGE** 0 - 50000	**DEFAULT** 1000	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO**		

Description

The Velocity Scale (AVS) command specifies the maximum velocity scale acceleration in terms of percentage per second. This feature allows the user to prevent rapid motor deceleration due to a sudden change in the commanded velocity scale percentage. Because the maximum value for velocity scaling is 100% and the update rate is 2mS, the maximum value of velocity scale acceleration is 50,000%/sec.

Example

Command	Description
VSL4	Set velocity scale source to low
VSH3	Set velocity scale source to high
AVS1000	Set velocity scale acceleration to 1000%/sec
VSE1	Enable velocity scaling

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B Status	Buffer Status			VALID Software Version A2
SYNTAX aB	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO**		
RESPONSE TO aB **IS** *R (more than 32 bytes free) or *B (less than 32 bytes free)				

Description

The Buffer Status (B) command will report the status of the command buffer. If the command buffer is empty or has less than 32 bytes left, the controller will respond with a ***R**.

The command buffer is 1,000 bytes long for each axis. A ***B**[cr] response will be issued if less than 32 bytes of the command buffer is free.

- *R = More than 32 bytes of the buffer is free
- *B = Less than 32 bytes of the buffer is free

This command is commonly used when a long series of commands will be loaded remotely. If the buffer size is exceeded, the extra commands will not be received by the controller.

Example

Command	Response
1B	*R More than 32 bytes of the buffer is free

BSEG Motion	Define Starting Segment			VALID Software Version B2
SYNTAX <a>BSEGn	**UNITS** n = steps	**RANGE** 1 - 999999999	**DEFAULT** No segment definition	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** MSEG, ESEG, GSEG		

Description

The **BSEG** command defines the first complex move segment. The parameter is the distance the axis should travel during the first segment.

The acceleration, mode, velocity, and deceleration used for the segment definition are those currently in effect when the **BSEG** command is executed.

The **BSEG** command may be followed by zero to three **MSEG MID** commands, but must be followed by a **ESEG** command.

Example

Command	Description
A50	Sets first segment acceleration to 50 rps^2
AD20	Sets first segment deceleration to 20 rps^2
V5	Sets first segment velocity to 5 rps
BSEG5ØØØØ	Sets first segment move to 50,000 steps
V10	Sets middle segment velocity to 10 rps
MSEG1ØØØØØ	Sets middle segment move to 100,000 steps
V1	Sets last segment velocity to 1rps
ESEG25ØØØ	Sets last segment move to 25,000 steps
BSEG-	Start segment move in the negative direction.

The total distance traveled in this move is negative 175,000 steps.

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C Programming	Continue			VALID Software Version A2
SYNTAX aC	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** PS, V		

Description

The Continue (C) command ends a pause state. It enables your controller to continue executing buffered commands. After you initiate a pause with the Pause (PS) command or the Pause and Wait for Continue (U) command, you can clear it with a Continue command. This command is useful when you want to transmit a string of commands before you actually need to execute them.

Examples

Command	Description
PS	Pause and wait for a continue
MC	Set to Continuous mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
G	Executes the move (Go)
T1Ø	Waits 10 seconds after the move
VØ	Sets velocity to zero
G	Decelerates the motor to zero velocity
C	Starts executing commands in buffer

CG Set-Up	Correction Gain			VALID Software Version A2
SYNTAX aCGn	**UNITS** n = rps	**RANGE** 0.001 - maximum velocity	**DEFAULT** 0.01	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** FSB, FSC, DB		

Description

This command allows you to set the Position Maintenance (FSC1) correction gain expressed in rps/encoder step error. If you enable the position maintenance function while the controller's axis is in encoder step mode, the controller will set a correction velocity that is equal to the gain factor times the number of encoder steps of position error measured.

If you choose a value that is larger than the default, the motor will correct position errors more quickly, but the chance of overshooting and oscillation will increase. The opposite of this is true (i.e., if you choose a value less than the default, position errors will not be corrected as quickly, but overshooting and oscillation will decrease). The optimal value is determined empirically.

The maximum velocity is equal to the maximum velocity allowed for a given motor. Refer to the Motor Resolution (MR) command.

Examples

Command	Description
CG.01	Set correction gain to 0.01rps/encoder step

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CR Programming	Carriage Return			VALID Software Version A2
SYNTAX aCR	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO**		

Description

The Carriage Return (CR) command determines when the controller has reached a particular point in the execution buffer. When the controller reaches this command in the buffer, it responds by issuing a carriage return (ASCII 13) over its interface back to the host computer. If you place the CR command after a Go (G) command, it will indicate when a move is complete. If you place the CR command after a Trigger (TR) command, it will indicate when the trigger condition is met.

Examples

Command	Description
MPA	Sets to Absolute Position mode
A5	Sets acceleration to 5rps^2
V5	Sets velocity to 5 rps
D5ØØØ	Sets distance to 5,000 steps
G	Executes the move (Go)
CR	Sends a carriage return

D Motion	Distance			VALID Software Version A2
SYNTAX aDn	**UNITS** n = steps	**RANGE** 0 - 99,999,999	**DEFAULT** 25,000	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** SS		

Description

The Distance (D) command defines either the number of steps the motor will move or the absolute position it will seek after a Go (G) command is entered. In incremental mode (FSAØ), the value set with the D command will be the distance (in steps) the motor will travel on all subsequent Go (G) commands.

In absolute mode (FSA1), the distance moved by the motor will be the difference between the current motor position and the position (referenced to the zero position) set with the D command The Distance (D) command has no effect on Continuous Moves (MC).

Examples

Command	Description
MN	Sets to Normal mode (preset)
A5	Sets acceleration to 5rps^2
V1Ø	Sets velocity to 10 rps
D5ØØØØ	Sets distance to 50,000 steps
G	Executes the move (Go)

The motor will travel 50,000 steps in the CW direction after the Go command is issued.

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DB Setup	Deadband			VALID Software Version A2
SYNTAX <a>DBn	UNITS None	RANGE n = ±999999999	DEFAULT 0	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO FS, CG		

Description

This command specifies a positioning range (in encoder steps) that the motor may not exceed after completing a move. If the motor's position is closer to the desired position than the number specified, no position maintenance correction will be performed. If the motor's position is not within the allowable range, position maintenance is performed (if enabled by the enable position maintenance [**FSC1**] command). The purpose of the **DB** command is to prevent the motor from searching for a set position when it is within an allowable dead band range.

Example

Command	Description
DB1ØØ	Sets deadband to 100 steps.

DCR Set-up	Define C Axis Resolution			VALID Software Version C2
SYNTAX <a>DCRn	UNITS n = steps	RANGE ± 0 - 99,999,999	DEFAULT 25,000	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DP, GP		

Description

The Define C Axis Resolution (**DCR**) command is used to specify the C axis resolution in the Model 4000's contouring option. The C axis will keep an angular position which changes linearly with the direction of travel implied by X and Y. This allows the C axis to control an object which must stay tangent (or normal) to the direction of travel.

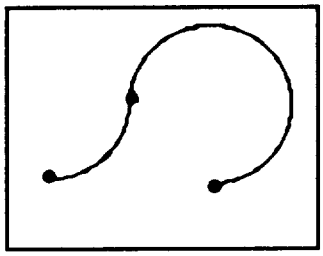
The C axis resolution is the number of motor steps in 360 degrees of arc. C axis resolution does not necessarily equal the number of steps per revolution of the motor, but if the motor directly drove the rotating piece, then these numbers would be the same.

The **DCR** command may be given at any time during a path definition, but the last **DCR** command issued within a path definition will specify the C axis resolution for the entire path. A negative value for the C axis resolution causes rotation in the negative direction as the angle in the X-Y plane gets larger.

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Example

Command	Description
DCR4000	Specify C axis resolution
DPI	Use incremental endpoints
XD25000	Specify incremental X endpoint position
YD25000	Specify incremental Y endpoint position
RD25000	Specify radius arc <180°
DPO1001	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-25000	New incremental Y endpoint, X unchanged
RD-25000	Same radius arc >180°
DPO1100	Output pattern during second arc
RCW	Three quarter circle CW arc



DP Motion	**Define Path**			**VALID** Software Version C2
SYNTAX <a>DPnn<n> <a>DPn,xy<e><e>	**UNITS** n = path # x = x axis# y = y axis# c = c axis# p = p axis#	**RANGE** 1 - 100 x,y,c,p=0-4	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** DPA, DPI, ENDP, GP		

Description

The Define Path (DP) command begins the definition and compilation of an individual path for the Model 4000's contouring option. The parameter in the DP syntax is the path number. Up to 100 paths may exist in their compiled form at one time. The four numbers following the comma specify the X, Y, C, and P axes respectively. The X and Y axes must be specified, but the C and P axes are optional.

If an axis number of zero is specified for C or P, it signifies that the C or P axis is not included in that path definition. The axis specification for the entire path is done with this command, and may not be changed within a path definition.

Example

Command	Description
PDEL24	Delete path #24
DP12,2103	Begin definition of path #12
DPR2.5	P axis to path ratio = 2.5
•	
•	Multiple segment definitions
•	
ENDP	End of path #12 definition
GP12	Execute path #12

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DPA Motion	Define Path Absolute			VALID Software Version C2
SYNTAX <a>DPA	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DPI, DP, ENDP, GP, DPL, DPW		

Description

The Define Path Absolute (**DPA**) command is used in the Model 4000's contouring option to indicate that subsequent segment endpoints are specified in absolute coordinates. Segment endpoint position specifications may be either absolute with respect to user defined coordinate system, or incremental, relative to the start of each individual segment. At any point along a path definition, coordinates may be switched from incremental to absolute.

The coordinate system may be either the *work* coordinate system (see **DPW**), or the *local* coordinate system (see **DPL**).

Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

DPI Motion	Define Path Incremental			VALID Software Version C2
SYNTAX <a>DPI	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DPA, DP, ENDP, GP		

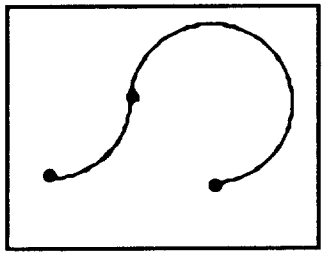
Description

The Define Path Incremental (**DPI**) command is used in the Model 4000's contouring option to indicate that subsequent segment endpoints are specified in incremental coordinates. Segment endpoint position specifications may be either absolute with respect to user defined coordinate system, or incremental, relative to the start of each individual segment. At any point along a path definition, coordinates may be switched from absolute to incremental. When the **DPI** command is received, the X-Y coordinate system is ignored, and endpoint specifications are interpreted as incremental data.

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Example

Command	Description
DCR4000	Specify C axis resolution
DPI	Use incremental endpoints
XD250000	Specify incremental X endpoint position
YD250000	Specify incremental Y endpoint position
RD250000	Specify radius arc <180°
DPO1001	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-250000	New incremental Y endpoint, X unchanged
RD-250000	Same radius arc >180°
DPO1100	Output pattern during second arc
RCW	Three quarter circle CW arc



DPL Motion	**Define Path Local Coordinates**			**VALID** Software Version C2
SYNTAX <a>DPL	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** DPW, DP, ENDP, GP, XLD, YLD		

Description

The **DPL** command is used in the Model 4000's contouring option to specify use of the local coordinate system. The Model 4000 allows endpoints to be specified as absolute positions, and these positions may either be in the Work or the Local coordinate system. Programming may switch between Local and Work coordinates before any segment or group of segments. When switching to Local coordinates, the starting coordinates of the next segment in the Local coordinate system must be specified with the **XLD** and **YLD** commands.

Example

Command	Description
XLD150000	Specify X data, local coordinate
YLD0	Specify Y data, local coordinate
DPL	Specify local coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP50	Set next segments path acceleration to 50rps^2
ADP100	Set next segments path deceleration to 100rps^2
XD250000	Specify X endpoint position
YD250000	Specify Y endpoint position
LINE	Create 45° angle line segment

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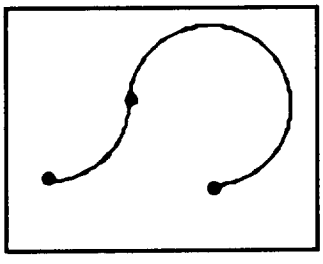
DPO Programming	Define Path Segment Outputs			VALID Software Version C2
SYNTAX <a>DPOn	**UNITS** n = off/on or no change	**RANGE** 0, 1, X	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** RCW, RCCW, OCW, OCCW		

Description

The Define Path Segment Outputs (DPO) command is used in the Model 4000's contouring option to specify the POB output pattern which is to be applied to the POB outputs at the beginning of the next segment and remain throughout that segment. The DPO command may be issued before any segment definition command, and will affect all subsequent segments until a new DPO command is issued. A DPO command will not take affect if there is no segment definition command following it. To change the POB outputs at the end of a path, the standard output (O) command must be used. These segment defined POB output patterns are stored as part of the compiled path definition. These outputs will change state at some time in the range of 1.5 mS before the beginning of the segment to 0.5 mS after the beginning of the segment. The POB outputs may not be controlled more precisely than this, because the Model 4000 updates its record of path position every 2 milliseconds.

Example

Command	Description
DCR4ØØØ	Specify C axis resolution
DPI	Use incremental endpoints
XD25ØØØ	Specify incremental X endpoint position
YD25ØØØ	Specify incremental Y endpoint position
RD25ØØØ	Specify radius arc <180°
DPO1ØØ1	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-25ØØØ	New incremental Y endpoint, X unchanged
RD-25ØØØ	Same radius arc >180°
DPO11ØØ	Output pattern during second arc
RCW	Three quarter circle CW arc



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DPR Set-up	Define P Axis Ratio			VALID Software Version C2
SYNTAX <a>DPRn	UNITS n = ratio	RANGE ±.0001 - 1000	DEFAULT 1.0	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DP, GP		

Description

The Define P Axis Ratio (DPR) command is used to specify the P axis to path travel ratio in the Model 4000's contouring option. The P axis will keep a position which is proportional to the distance traveled along the X-Y path as the path is executed. This allows the P axis to act as the Z axis in helical interpolation or to control the motion of any object which moves with distance and velocity proportional to the path. The DPR command may be given at any time during a path definition, but the last DPR command issued within a path definition will specify the P axis travel to path travel ratio for the entire path. A negative value for the P axis ratio simply causes rotation in the negative direction as path travel in the X-Y plane gets larger.

Example

Command	Description
PDEL24	Delete path #24
DP12,2103	Begin definition of path #12
DPR2.5	P axis to path ratio = 2.5
.	Multiple segment definitions
.	
.	
ENDP	End of path #12 definition
GP12	Execute path #12

DPW Motion	Define Path Work Coordinates			VALID Software Version C2
SYNTAX <a>DPW	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DPL, DP, ENDP, GP, XWD, YWD		

Description

The DPW command is used in the Model 4000's contouring option to specify use of the work coordinate system. The Model 4000 allows endpoints to be specified as absolute positions, and these positions may either be in the work or the local coordinate system. Programming may switch between Local and Work coordinates before any segment or group of segments. When switching to Work coordinates, the starting coordinates of the next segment in the Work coordinate system may be specified with the XWD and YWD commands for the purpose of shifting the Work coordinate system. If the XWD and YWD commands are not given, the Work coordinate system is used, but not shifted.

Example

Command	Description
XWD150000	Specify X data, work coordinate
YWD0	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP50	Set next segments path acceleration to 50rps^2
ADP100	Set next segments path deceleration to 100rps^2
XD25000	Specify X endpoint position
YD25000	Specify Y endpoint position
LINE	Create 45° angle line segment

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DTR Setup	Disable Trigger Interrupt			VALID Software Version B2
SYNTAX <a>DTRn	**UNITS** n = trigger number	**RANGE** 1-4	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** ETR, REG, RI		

Description

The Disable Trigger Interrupt (DTR) command prevents the specified trigger input from causing a registration move to occur. The registration move interrupts whatever current move was in progress and performs the registration move. The registration move is defined by the Define Registration Move (REG) command.

The value of n can be from 1 to 4 and defines which trigger input is disabled from causing registration moves. When not enabled, the trigger inputs will not cause a registration move even if the inputs are active.

The default value is that registration moves are disabled.

Example

Command	Description
A5Ø	Sets acceleration to 50 rps^2
AD2Ø	Sets deceleration to 20 rps^2
V1Ø	Sets velocity to 10 rps
REG1,1ØØØØØ	Sets move to 100,000 steps from TRIG1 input
ETR1	Enable TRIG1 registration for this axis
G	Execute the move (Go)
RI1	Simulate Trigger #1 input
DTR1	Disable Trigger #1 registration

DW Set-Up	Deadband Window			VALID Software Version A2
SYNTAX aDWn	**UNITS** n = steps	**RANGE** 0 - 99,999,999	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** FS		

Description

This command specifies a backlash deadband in motor steps. The backlash deadband compensates for mechanical systems with backlash and allows you to use the stall detect function. The controller does not check for a stall at the beginning of a new move until the number of motor steps sent exceeds the number specified with the DW command. This command is most useful when the encoder is mounted on the load.

This command is different from the Deadband (DB) command. DW is used for stall detection, and the DB command is used to indicate that the encoder is within the deadband (DB) range.

Example

Command	Description
DW1ØØ	Set deadband to 100 steps

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ENDP Motion	End Path Definition			VALID Software Version C2
SYNTAX <a>ENDP	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DP, DPA, DPI, GP		

Description

The End Path Definition (**ENDP**) command is used in the Model 4000's contouring option to specify the end of the current path definition. The path definition is started with the **DP** command, and remains under definition as segments are added. The **ENDP** command tells the Model 4000 that the previous segment was the last segment, and that motion is to stop at the end of that segment. Only one path may be under definition at a time. If one path is currently under definition, the **ENDP** command must be issued before another path may be defined.

Example

Command	Description
PDEL24	Delete path #24
DP12,21Ø3	Begin definition of path #12
DPR2.5	P axis to path ratio = 2.5
•	
•	Multiple segment definitions
•	
ENDP	End of path #12 definition
GP12	Execute path #12

ER Set-Up	Encoder Resolution			VALID Software Version A2
SYNTAX a**ER**n	UNITS n = encoder counts	RANGE 0 - 200,000	DEFAULT 4,000	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO FS, DW		

Description

This command defines the number of encoder counts per one revolution of the motor. The number of lines on an encoder should be multiplied by four to arrive at the correct **ER** value per revolution of the motor. In other words, one line of an encoder will produce four encoder steps.

A 4:1 ratio of motor steps to encoder steps or a 16:1 ratio of motor steps, encoder lines are necessary for proper closed loop operation. If a lower ratio is used it may be difficult to tune the position maintenance (Servoing) feature of your controller.

Example

Command	Description
ER4ØØØ	Sets encoder resolution to 4,000 steps

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ESEG Motion	Define Ending Segment			VALID Software Version B2
SYNTAX <a>ESEGn	UNITS n = steps	RANGE 1-999999999	DEFAULT No segment definition	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO MSEG, BSEG, GSEG		

Description

The Define Ending Segment (**ESEG**) command defines the final complex move segment. The parameter is the distance the axis should travel during the final segment. The acceleration, mode, velocity, and deceleration used for the segment definition are those currently in effect when the **ESEG** command is executed.

The **ESEG** command must be issued before a segmented move can take place.

Example

Command	Description
A50	Sets first segment acceleration to 50 rps^2
AD20	Sets first segment deceleration to 20 rps^2
V5	Sets first segment velocity to 5 rps
BSEG5ØØØØ	Sets first segment move to 50,000 steps
V10	Sets middle segment velocity to 10 rps
MSEG1ØØØØØ	Sets middle segment move to 100,000 steps
V1	Sets last segment velocity to 1rps
ESEG25ØØØ	Sets last segment move to 25,000 steps
GSEG-	Start segment move in the negative direction.

ETR Setup	Enable Trigger Interrupt			VALID Software Version B2
SYNTAX <a>ETRn	UNITS n = trigger number	RANGE 1-4	DEFAULT None	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO DTR, REG, RI		

Description

The Enable Trigger Interrupt (**ETR**)command allows the specified trigger input to cause a registration move to occur. The registration move interrupts whatever current move was in progress and performs the registration move. The registration move is defined by the Define Registration Move (**REG**) command.

The value of n can be from 1 to 4 and defines which trigger input is enabled to cause registration moves. When not enabled, the trigger inputs will not cause a registration move even if the inputs are active.

The default value is that registration moves are disabled.

Example

Command	Description
A50	Sets acceleration to 50 rps^2
AD20	Sets deceleration to 20 rps^2
V1Ø	Sets velocity to 10 rps
REG1,1ØØØØØ	Sets move to 100,000 steps from trigger #1
ETR1	Enable Trigger 1 registration for this axis
G	Execute the move (Go)
RI1	Simulate Trigger #1 input
DTR1	Disable Trigger #1 registration

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FR Status	Encoder Functions Report			VALID Software Version A2
SYNTAX aFR	UNITS n = status function	RANGE 0 - 255	DEFAULT 0	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO The FS commands		
RESPONSE TO aFR IS *Ø or *1 for each encoder function (A - D)				

Description

This command allows you to request the status of functions set by **FS** commands. The response contains one ASCII digit per function set by the **FS** command, each of which is a zero or a one. The digits correspond to the functions, left to right, A through H. The digit **1** corresponds to a **FS** function that is being turned on. A **Ø** corresponds to an **FS** command that is being turned off.

A Incremental= OFF (Ø), Absolute = ON (1). Defines the move distances (**D**) as either incremental from current position, or as absolute referenced to the absolute zero position).

B Motor Step mode = OFF (Ø), Encoder Step mode = ON (1). Defines the distance (D) parameter in units of motor steps or encoder steps.

C Position Maintenance Ø = OFF, 1 = ON. Enables position maintenance. This will cause the controller to servo the motor to the desired position if not in the correct position at the end of a move, or, if the motor is forced out of position while at rest.

D Terminate move on Stall Detect Ø = OFF, 1 = ON. Instructs the controller to abort any move if a stall is detected.

Example

Command	Response
1FR	*11ØØØØØØ

The controller is in Absolute Encoder Step mode with all other **FS** encoder functions turned off.

FSA Set-Up	Set to Incremental/Absolute Mode			VALID Software Version A2
SYNTAX aFSAn	UNITS n = function ON or OFF	RANGE 0 - 1	DEFAULT 0	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO PZ, PR, PD		

Description

This command sets the controller to perform its moves in either absolute or incremental positioning mode.

- **FSAØ:** Incremental mode
- **FSA1:** Absolute mode

In Incremental mode (**FSA1**), all moves are made with respect to the position at the beginning of the move. This mode is useful for repeating moves of the same distance.

In Absolute mode (**FSA1**), all moves are made with respect to the absolute zero position. The absolute zero position is set to zero when you power up the controller or execute the Position Zero (**PZ**) command.

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Example

Command	Description
FSA1	Sets to Absolute mode
PZ	Resets the absolute counter to zero
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25000	Moves motor to absolute position 25,000
G	Executes the move (Go)
D50000	Move motor to absolute position 50,000
G	Executes the move (Go)

FSB Set-Up	**Set to Motor/Encoder Step Mode**			**VALID** Software Version A2
SYNTAX aFSBn	**UNITS** n = function on or off	**RANGE** 0 or 1	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** ER, D		

Description

This command sets up the controller to perform moves in either motor steps or encoder steps.

- ❑ FSB0: Motor steps
- ❑ FSB1: Encoder steps

In Motor Step mode, the distance command (D) defines moves in motor steps.

In Encoder Step mode, the distance command defines moves in encoder steps. You must set up the controller for the correct encoder resolution The Encoder Resolution (ER) command is used to define the encoder resolution.

Enabling Encoder Step mode does not guarantee that your moves will position to the exact encoder step commanded. Position maintenance (FSC) must be enabled to activate closed loop servoing.

Example

Command	Description
ER4000	Sets encoder resolution to 4,000 steps
FSB1	Sets to Encoder Step mode
A5	Sets acceleration to 5rps^2
V5	Sets velocity to 5 rps
D4000	Sets distance to 4,000 encoder steps
G	Executes the move (Go)

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FSC Set-Up	**Enable/Disable Position Maintenance**			**VALID** Software Version A2
SYNTAX aFSCn	**UNITS** n = function on or off	**RANGE** 0 or 1	**DEFAULT** n = 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** FSB, ER, DB		

Description This command enables and disables the position maintenance function.

- ❑ **FSC1** Enable Position Maintenance
- ❑ **FSCØ** Disable Position Maintenance

Enabling position maintenance will cause the controller to servo the motor until the correct encoder position is achieved, or until the encoder position falls within the deadband region defined with the **DB** command. This occurs at the end of a move (if the final position is incorrect) or any time the controller senses a change in position while the motor is at zero velocity. You must have an encoder connected, and set the controller in Encoder Step mode in order to enable position maintenance.

Position maintenance will be temporarily suspended automatically if a stall is detected while position maintenance is in progress. The function will remain suspended but enabled, and position maintenance will resume when the next move is complete.

Example

Command	Description
ER2ØØØ	Sets encoder resolution to 2,000
FSB1	Sets to Encoder Step mode
FSC1	Enables position maintenance

FSD Set-Up	**Stop on Stall**			**VALID** Software Version A2
SYNTAX aFSDn	**UNITS** n = function on or off	**RANGE** 0 or 1	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** SS, DW, ER, OSE		

Description Entering **FSDØ** will cause the controller to attempt to finish the move when a stall is detected, even if the load is jammed.

Entering **FSD1** will cause the controller to stop the move in progress when a stall is detected. The move is stopped immediately; no deceleration. This command is only valid if stall detection has been enabled. It will have no effect otherwise.

Example

Command	Description
DW1ØØ	Sets deadband to 100 steps
ER4ØØØ	Sets encoder resolution to 4,000 steps/rev
OSE1	Enables stall detect
FSD1	Enables stop on stall

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G Motion	Go			VALID Software Version A2
SYNTAX aG	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO S, MN, MC, A, V, D		

Description

The Go (G) command instructs the motor to make a move using motion parameters that you have previously entered. You do not have to re-enter Acceleration (A), Velocity (V), Distance (D), or Mode Normal (MN) orMode Continuous (MC) commands with each Go (G) command. In the Incremental Preset mode (FSA1), a Go (G) command will initiate the steps you specified with the D command. A Go (G) command in the Absolute Preset mode (FSA1) will not cause motion unless you change the distance (D command) first.

In the Continuous mode (MC), you only need to enter the Acceleration (G) and Velocity (G) commands prior to the Go (G) command. The system ignores the Distance (D) command in this mode.

No motor motion will occur until you enter the Go (G) command in both the Normal (MN) and Continuous (MC) modes.

If motion does not occur with the Go (G) command, an activated end-of-travel limit switch may be on. Check the limit switches.

Example

Command	Description
MN	Sets to Normal mode (preset)
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25000	Sets distance to 25,000 steps
G	Executes the move (Go)
A1	Sets acceleration to 1 rps^2
G	Executes the move (Go)

GA Motion	Go Home Acceleration			VALID Software Version A2
SYNTAX aGAnnnnnnn	UNITS n = rps^2	RANGE 0.001 - 999.999	DEFAULT 10	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO GH, A		

Description

The Go Home Acceleration (GA) command sets the linear acceleration value that the motor will use during any subsequent Go Home (GH) moves.

Example

Command	Description
GA5	Sets go home acceleration to 5 rps^2
GH-5	The motor moves in the negative direction (CCW) at 5 rps^2 and looks for the home limit input to go active

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GH Motion	Go Home			VALID Software Version A2
SYNTAX aGHn	UNITS n = rps	RANGE 0 - 20.00	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO RC, GH		

Description

The Go Home (GH) command instructs the controller to search for the home position. When Enable Encoder Z Channel Input (OSDØ) is issued, the controller looks only at the Home Limit input. It will define Home as the position where the Home Limit signal changed state at the edge selected with the Reference Edge of Home Switch (OSH) command (usually via a load activated switch).

The process is the same when OSD1 is issued except the controller also looks for the Z Channel input as well as the home limit input to be active at the same time. This means that the Z channel pulse must be *enveloped* by the active region of the home limit input. When both are active the controller defines that position as the home position.

The controller will reverse direction if an end-of-travel limit is activated while searching for home. However, if a second end-of-travel limit is encountered in the new direction the go home procedure will stop and the operation will be aborted. The RC command will indicate if the GH operation was successful.

After the GH command is issued, the motor will run in the direction and velocity specified. The motor will keep running until it passes the selected edge of the home switch. It will then decelerate and reverse direction. On final approach it will creep toward the home switch edge at 0.1rps.

Example

Command	Description
GH-2Ø	The motor moves in the negative direction at 20rps and looks for the home limit input to go active

GL Motion	Go Linear			VALID Software Version B2
SYNTAX <a>GLnnnn	UNITS n = #axes	RANGE 1-4	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO AP, VP, ADP		

Description

The Go Linear (GL) command tells the Model 4000 to begin a linearly interpolated move on one or more axes. Linearly interpolated moves are preset moves on one or more axes in which the axes are started and ended simultaneously. In linearly interpolated moves, a path may involve one to four axis, each with its own distance of travel. The velocity, acceleration, and deceleration of each individual axis is dependent on the distance it contributes to the total path travelled by the load.

The distance travelled and the mode used by each axis is that specified by the most recent D, FSA, and FSB commands on those axes.

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Example

Command	Description
AP5Ø	Set path acceleration to 50rps²
ADP1ØØ	Set path deceleration to00rps²
VP8	Set path velocity to 8rps
1D1ØØØ	Axis 1 moves 1000 steps
3D4ØØØ	Axis 3 moves 4000 steps
4D7ØØØ	Axis 4 moves 7000 steps
GL134	Start axes 1, 3, and 4 on the linearly interpolated move

GP Motion	Execute Path			VALID Software Version C2
SYNTAX <a>GPn	UNITS n = path #	RANGE 1-100	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO DP, DPA, DPI, ENDP		

Description

The Execute Path (GP) command is used in the Model 4000's contouring option to start execution of a previously compiled (defined) path. All the required information about the path whose number is specified in the GP command has already been stored by the path definition commands. If any axes included in the specified path are not ready, the path will not be executed. An axis is not ready if it is shutdown, moving in mode continuous, or in joystick mode. When path execution begins, all included axes become busy until path execution is finished. The GP command may be issued on any axis, even if that axis is not included in the path.

Example

Command	Description
PDEL24	Delete path #24
DP12,21Ø3	Begin definition of path #12
DPR2.5	P axis to path ratio = 2.5
•	
•	Multiple segment definitions
•	
ENDP	End of path #12 definition
GP12	Execute path #12

GSEG Motion	Start Segmented Move			VALID Software Version B2
SYNTAX <a>GSEGs	UNITS s = direction	RANGE + or -	DEFAULT +	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO MSEG, BSEG, ESEG		

Description

The Start Segmented Move (GSEG) command starts the previously, defined segmented move. The segmented move must be previously defined with a BSEG command, between zero and three MSEG commands, and an ESEG command. If its definition is not complete, no motion will take place. If the definition is complete, GSEG or GSEG+ will start the move in the positive direction, and GSEG- will start the move in the negative direction.

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Example

Command	Description
A50	Sets first segment acceleration to 50 rps^2
AD20	Sets first segment deceleration to 20 rps^2
V5	Sets first segment velocity to 5 rps
BSEG5ØØØØ	Sets first segment move to 50,000 steps
V10	Sets middle segment velocity to 10 rps
MSEG1ØØØØØ	Sets middle segment move to 100,000 steps
V1	Sets last segment velocity to 1rps
ESEG25ØØØ	Sets last segment move to 25,000 steps
GSEG-	Start segment move in the negative direction.

H Motion	**Set Direction**			**VALID** Software Version A
SYNTAX aH*s*	**UNITS** s = direction	**RANGE** + or - (or none)	**DEFAULT** +	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** D		

Description

The Set Direction (**H**) command changes or defines the direction of the next move. This command does not effect moves already in progress.

- H+ sets move to CW direction
- H- sets move to CCW direction
- H changes direction from the previous setting

In preset moves, a distance (**D**) command entered after the set direction (**H**) command overrides the direction set by the **H** command. In continuous mode(**MC**) only the set direction (**H**) command can set the direction of motion.

Example

Command	Description
MN	Sets to Normal mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 steps
G	Executes the move (Go) in + direction
H	Reverses direction
G	Executes the move (Go) in - direction
C	Sets to Continuous mode
+	Sets direction to + direction
G	Moves continuously in + direction

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^H Programming	Backspace			VALID Software Version A2
SYNTAX a^H	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO		

Description

This command allows you to delete the last character that you entered. The ^H command will not prevent execution of any command which has already been delimited with a space or carriage return (CR). A new character may be entered at that position to replace the existing character. (^H indicates that the Ctrl key is held down when the H key is pressed.) This command prompts the controller to backup one character in the command buffer, regardless of what appears on the terminal. On some terminals, the Ctrl and the left arrow (←) keys produce the same character.

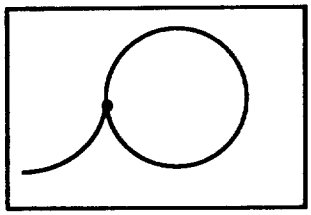
ID Motion	X Center Data			VALID Software VersionC2
SYNTAX <a>IDn	UNITS n = steps	RANGE ± 0 - 99,999,999	DEFAULT 0	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO YD, XD, JD, OCCW, OCW		

Description

The X Center Data (ID) command is used in the Model 4000's contouring option to specify the X center coordinate data required for Center Specified Arc Segments (OCW, OCCW). The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as ID, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement. Center position specifications are always incremental, relative to the start of the arc segment.

Example

Command	Description
DPI	Use incremental endpoints
XD25000	X incremental endpoint
YD25000	Y incremental endpoint
ID0	Y incremental center point
JD25000	Y incremental center point
OCCW	CCW arc makes quarter circle
XD0	X incremental endpoint
YD0	Y incremental endpoint
ID25000	X incremental center point
JD0	Y incremental center point
OCW	CW arc makes complete circle



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J Set-Up	**Enable/Disable Joystick**			**VALID** Software Version B2
SYNTAX <a>Jn	**UNITS** n = function 1 (enables)	**RANGE** Ø (disables)	**DEFAULT** JØ = J1 =	**ATTRIBUTES** Immediate Buffered
EXECUTION TIME <15 ms		**SEE ALSO** JCDB, JEDB, JZ, JDL, JDH, JA, JAD, JVH, JVL		

Description

This command allows you to enter and exit the joystick mode.

- ❑ **JØ** Disable Joystick Mode
- ❑ **J1** Enable Joystick Mode

When you enter the Joystick mode (**J1**), the command clears the buffer before entering the mode. The joystick is slew-rate limited by the last joystick acceleration command when accelerating, and by the last joystick deceleration command when decelerating. The channel assignment for individual axes are done with the Define Joysel Low Channel (**JDL**) and Define Joysel High Channel (**JDH**) commands. Axes 1 through 4 default to channels 1 through 4. In Joystick mode, the last joystick acceleration and velocity rates that you specify will be used to determine that axis' maximum velocity with full deflection and how rapidly the motor will track the joystick movements. High velocities will result in coarse velocity resolution. Compumotor recommends that you set the acceleration rate high to follow the joystick's movement as stiffly as possible.

When Joystick mode is enabled, the joystick voltage must be within deadband (or changed to be within deadband) before motion will occur. For instance, if the joystick is at full deflection when joystick is enabled, it must be moved to within deadband before motion will be allowed.

Example

Command	Description
1J1	Enter Joystick mode on axis #1
2J1	Enter Joystick mode on axis #2

JA Set-Up	**Joystick Acceleration**			**VALID** Software Version B2
SYNTAX <a>JAn	**UNITS** n = rps^2	**RANGE** 0.3 - 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** J1, JØ, JVH, JVL, JAD		

Description

The Joystick Acceleration (**JA**) command specifies the joystick for each axis. This limits the rate at which the motor will accelerate in response to a change in joystick position. If the value is set lower than the speed with which a change in position can be made, a delayed response to the position will be noticed.

Example

Command	Description
1JA100	Set joystick acceleration to 100 on axis #1
2JAD200	Set joystick deceleration to 200 on axis #2
3JVL2	Set joystick low velocity to 2 rps on axis #3
4JVH15	Set joystick high velocity to 15 on axis #4
J1	Enter Joystick mode on axis #1

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JAD Set-Up	Joystick Deceleration			VALID Software Version B2
SYNTAX <a>JADn	**UNITS** n = rps^2	**RANGE** 0.3 - 999.999	**DEFAULT** 100	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** J1, J0, JVH, JVL, JA		

Description

The Joystick Deceleration (JAD) command specifies the joystick acceleration deceleration for each axis. This limits the rate at which the motor will accelerate in response to a change in joystick position. If the value is set lower than the speed with which a change in position can be made, a delayed response to the position will be noticed.

Example

Command	Description
JA100	Set maximum joystick acceleration to 100 on axis #1
2JAD200	Set maximum joystick deceleration to 200 on axis #2
JVL2	Set low joystick velocity to 2 on axis #1
JVH15	Set high joystick velocity to 15 on axis #1
2J1	Enter joystick mode on axis #2

JCDB Set-Up	Joystick Center Deadband			VALID Software Version B2
SYNTAX JCDBn,v	**UNITS** v = volts n = channel	**RANGE** 0 - 1.24 1 - 4	**DEFAULT** v = 0.1	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** JEDB, JZ, JDL, JDH		

Description

The Joystick Center Deadband (JCDB) command sets the range of voltage about the center voltage point which will command no motion in Joystick mode. This command is useful if the joystick does not return to the same resting position. The value entered can be a constant or a variable. The value must be between 0V and 1.24V. The entire voltage range at the center point which commands no motion is equal to twice the value entered.

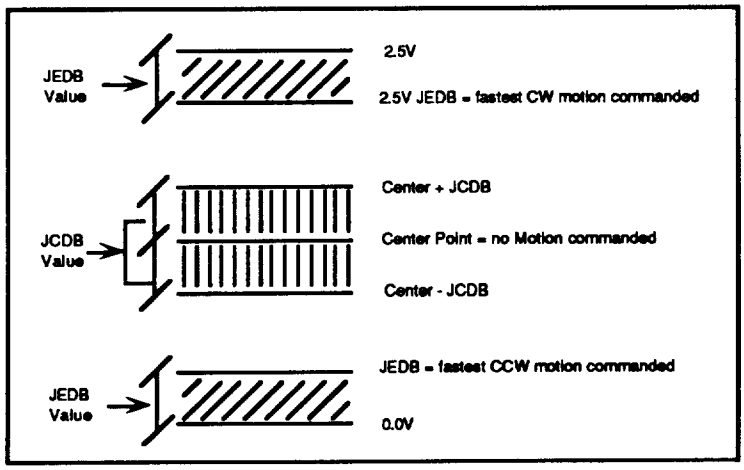


Figure 1-1. JCDB Example

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Example

Command	Description
1JDL1	Sets Joysel Low Channel to Axis #1
4JDH3	Sets Joysel High Channel to Axis #4
JZ1,1.25	Set center voltage to 1.25V on channel #1
JCDB1,.1	Set center deadband to ±0.1V on channel #1
JEDB1,.1	Set end deadband to 0.1V on channel #1
JEDB2,.5	Set end deacband to 0.5 on channel #2

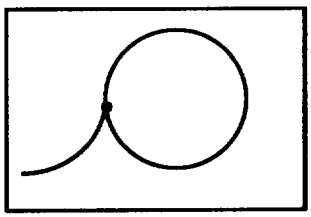
JD Motion	Y Center Data			VALID Software Version C2
SYNTAX <a>JDn	**UNITS** n = steps	**RANGE** ± 0 - 99,999,999	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** YD, XD, ID, OCCW, OCW		

Description

The Y Center Data (JD) command is used in the Model 4000's contouring option to specify the Y center coordinate data required for center specified arc segments (OCW, OCCW). The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as JD, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement. Center position specifications are always incremental, relative to the start of the arc segment.

Example

Command	Description
DPI	Use incremental endpoints
XD25ØØØ	X incremental endpoint
YD25ØØØ	Y incremental endpoint
IDØ	Y incremental center point
JD25ØØØ	Y incremental center point
OCCW	CCW arc makes quarter circle
XDØ	X incremental endpoint
YDØ	Y incremental endpoint
ID25ØØØ	X incremental center point
JDØ	Y incremental center point
OCW	CW arc makes complete circle



JEDB Set-Up	Joystick End Deadband			VALID Software Version B2
SYNTAX <a>JEDBn	**UNITS** v = volts n = channel	**RANGE** 0 - 1.24 1 - 4	**DEFAULT** v = 0.1	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** JCDB, JZ, JDL, JDH		

Description

The Joystick End Deadband (JCEB) command is used to determine the minimum and maximum voltages for the full range of analog input. This is used for both joystick and velocity scaling.

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This command is useful if your joystick does not reach either limit of the voltage range (0V or 2.5V). This statement reduces the range to fit the voltage range for that joystick. When an analog input is used for velocity scaling, this command defines the range of voltage used to command the velocity scaling percentage. Refer to Figure 4-1.

Example

Command	Description
1JDL1	Sets Joysel Low Channel to Axis #1
2JDH3	Sets Joysel High Channel to Axis #2
JZ1,1.25	Set center voltage to 1.25V on channel #1
JCDB4,.1	Set center deadband to ±0.1V on channel #4
JEDB3,.1	Set end deadband to 0.1V on channel #3

JDH Set-Up	**Define Joysel High Channel**			**VALID** Software Version B2
SYNTAX <a>JDHn	**UNITS** n = channel	**RANGE** 0 - 4 0 = off	**DEFAULT** channel # axis #	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** JEDB, JZ, JDL		

Description

The Define Joysel High Channel (JDH) command defines which analog input controls which axis, when the joystick select input is high (current not flowing), and when in joystick mode.

The four analog inputs are referenced as CH1-CH4. If you enter the OFF option (0) for an axis, that axis cannot be controlled by any analog input when the joystick mode is selected. One analog input can control more than one axis, depending on how it is configured.

The default for this statement is axis 1-4 are controlled by analog input channels 1-4, respectively.

Example

Command	Description
1JDL1	Sets Joysel Low Channel to Axis #2
4JDH3	Sets Joysel High Channel to Axis #4
JZ1,1.25	Set center voltage to 1.25V
JCDB1,.1	Set center deadband to ±0.1V
JEDB1,.1	Set end deadband to 0.1V

JDL Set-Up	**Define Joysel Low Channel**			**VALID** Software Version B2
SYNTAX <a>JDLn	**UNITS** n = channel 0 = off	**RANGE** 0 - 4 = axis #	**DEFAULT** channel #	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** JEDB, JCDB, JZ, JDH		

Description

The Define Joysel Low Channel (JDL) command defines which analog input controls which axis, when the joystick select input is low (current flowing), and when in joystick mode.

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The four analog inputs are referenced as CH1-CH4. If you enter the off (0) option for an axis, that axis cannot be controlled by any analog input when the Joystick mode is selected. One analog input can control more than one axis, depending on how it is configured.

The default for this statement is axis 1-4 are controlled by analog input channels 1-4, respectively.

Example

Command	Description
1JDL1	Sets Joysel Low Channel to Axis #1
4JDH3	Sets Joysel High Channel to Axis #2
JZ1,1.25	Set center voltage to 1.25V
JCDB1,.1	Set center deadband to ±0.1V
JEDB1,.1	Set end deadband to 0.1V

JVH Motion	**Joystick High Velocity**			**VALID** Software Version B2
SYNTAX JVHn	**UNITS** n = rps	**RANGE** motor resolution dependent	**DEFAULT** 0.2	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** JEDB, JCDB, JZ, JDL, JDH		

Description The Joystick High Velocity (JVH) command sets the velocity a joystick move may achieve when the joystick velocity range input is high.

Example

Command	Description
JA1ØØ	Set maximum joystick acceleration on channel #1
2JAD2ØØ	Set maximum joystick deceleration on channel #2
JVL2	Set low joystick velocity to 2 on channel #1
JVH15	Set high joystick velocity to 15 on channel #1
J1	Enter Joystick mode on axis #1

JVL Motion	**Joystick Low Velocity**			**VALID** Software Version B2
SYNTAX JVLn	**UNITS** n = rps	**RANGE** motor resolution dependent	**DEFAULT** 0.2	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** JEDB, JCDB, JZ, JDL, JDH		

Description The Joystick Low Velocity (JVL) command sets the velocity a joystick move may achieve when the joystick velocity range input is low.

Example

Command	Description
3JA1ØØ	Set joystick acceleration to 100rps, channel #3
2JAD2ØØ	Set joystick decelerationto 200rps, channel #2
1JVL2	Set joystick low velocity to 2 on channel 1
2JVH15	Set joystick high velocity to 15 on channel 2
4J1	Enter Joystick mode on axis #4

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JZ Set-Up	Joystick Zero			VALID Software Version B2
SYNTAX JZn,v	UNITS v = volts n = channel	RANGE 0 - 2.4 1-4	DEFAULT v = 1.25	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO JCDB, JEDB, JDL, JDH		

Description

The Joystick Zero (JZ) command defines the voltage level of an analog input that commands no motion for the joystick axis.

The voltage value can be a constant, or the AUTOREAD option. If a constant is used, the value must be between 0.15V and 2.4V. The maximum resolution is hundredths of a volt. If the AUTOREAD option is chosen, the analog input voltage is read at the time the statement is executed. This voltage is set as the center value.

The AUTOREAD option is selected by omitting the comma and voltage specification following the channel number in the JZ command.

Example

Command	Description
1JDL1	Sets Joysel Low Channel to Axis #1
1JDH3	Sets Joysel High Channel to Axis #4
JZ1,1.25	Set center voltage to 1.25V for channel #1
JZ2	Read analog channel 2 and set joystick zero to current value
JCDB1,.1	Set center deadband to ±0.1V on channel #1
JEDB1,.1	Set end deadband to 0.1V on channel #1

K Motion	Kill			VALID Software Version A2
SYNTAX aK	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO S		

Description

The Kill (K) command is an emergency stop command and should only be used as such. This command causes indexing to cease immediately. There is no deceleration of the motor. If Kill causes the motor to slip (i.e., large loads at high speed), the load could be driven past limit switches and cause damage to the mechanism and possibly to the operation.

In addition to stopping the motor, the K command will terminate a loop, end a time delay, clear the command buffer, end a wait on trigger, and end a pause.

Example

Command	Description
A5	Sets acceleration to 5 rps^2
V2	Sets velocity to 2 rps
MC	Sets to Continuous mode
G	Executes the move (Go)
.	
.	
.	
K	Stops the motor instantly

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L Programming	Loop			VALID Software Version A2
SYNTAX aLn	**UNITS** n = # of loops	**RANGE** 0 - 65,535	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** Y, N, U, C		

Description

When you combine the Loop (L) command with the end-of-loop (N) command, all of the commands between L and N will be repeated the number of times indicated by n. The L command, without a value specified for n, or with a Ø, will create an infinite loop.

The end-of-loop command prompts the controller to proceed with further commands after the designated number of loops have been executed. The stop loop (Y) command will end execution of the loop. The immediate pause (U) command allows you to temporarily halt loop execution. You can use the continue (C) command to resume loop execution.

Nested loops are allowed up to 16 levels deep.

Example

Command	Description
L5	Loops 5 times
A5	Sets acceleration to 5 rps^2
V1Ø	Sets velocity to 10 rps
D1ØØØØ	Sets distance to 10,000 steps
G	Executes the move (Go)
N	End loop

LA Set-Up	Limit Acceleration			VALID Software Version A2
SYNTAX aLAn	**UNITS** n = rps^2	**RANGE** 1- 999.99	**DEFAULT** 99.000	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** A, LD		

Description

The Limit Acceleration (LA) command allows you to define the deceleration rate that should be used when an end-of-travel limit is encountered. This command is useful if you do not want an abrupt stop upon encountering a limit. However, you should be careful to specify a deceleration rate that will stop the load before it can do any damage. Normally, limit switches are placed so that the motor has room to safely decelerate the load.

Example

Command	Description
LA5Ø	The motor decelerates at 50 rps^2 when it encounters an end-of-travel limit.

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LD Set-Up	Limit Disable			VALID Software Version A2
SYNTAX aLDn	**UNITS** n = limits	**RANGE** 0 - 3	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** RA		

Description

The Limit Disable (LD) command allows you to enable or disable the end-of-travel limit switch protection. The LDØ condition does not allow the motor to run without properly installing the limit inputs. If you want motion without wiring the limits, you must issue the LD3 command.

- ❑ Enable CCW and CW limits — n = 0 (Default)
- ❑ Disable CW limits — n = 1
- ❑ Disable CCW limits — n = 2
- ❑ Disable CCW and CW limits — n = 3

Example

Command	Description
1LDØ	Enables CW and CCW limits.
LD3	Disables CW and CCW limits.

LINE Motion	Define Line Segment			VALID Software Version C2
SYNTAX <a>LINE	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME 25ms		**SEE ALSO** YD, XD		

Description

The Define Line Segment (LINE) command is used in the Model 4000's contouring option to finish the specification of a line segment. It does not initiate motion of the line. The placement, length, and orientation of the line is completely specified by the endpoint of the line segment and the endpoint of the previous segment. Segment endpoint position specifications may be either absolute with respect to the user defined coordinate system, or incremental, relative to the start of each individual segment.

When the LINE command is received, the X-Y endpoint position is established with most recent X and Y data given in the X Axis Data (XD) and Y Axis Data (YD) commands.

Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

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MC Motion	Mode Continuous			VALID Software Version A2
SYNTAX aMC	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO MN, A, V, TR, T		

Description The Mode Continuous (MC) command causes subsequent moves to ignore any distance parameter and move continuously. You can clear the MC command with the Mode Normal (MN) command.

The indexer uses the Acceleration (A) and Velocity (V) commands to reach continuous velocity. Using the Time Delay (T), Trigger (TR), and Velocity (V) commands, you can achieve basic velocity profiling.

Example

Command	Description
MC	Sets to Continuous mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
G	Executes the move (Go)

The motor turns at 5 rps until it is halted by the Stop (S) command, Kill (K) command, a limit switch, or by a new velocity specification.

MN Motion	Mode Normal			VALID Software Version A2
SYNTAX aMN	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO MC, D, A, V		

Description The Mode Normal (MN) command sets the positioning mode to preset. In Mode Normal, the motor will move the distance specified with the distance (D) command. To define the complete move profile, you must define Acceleration (A), Velocity (V), and the Distance (D). The MN command is used to change the mode of operation from Mode Continuous (MC) to preset mode.

Example

Command	Description
MN	Set to Normal mode (preset)
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
D1ØØØ	Set distance to 1,000 steps
G	Executes the move (Go)

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MR Set-Up	Motor Resolution			VALID Software Version A2
SYNTAX aMRn	UNITS n = rps	RANGE 0 - 20	DEFAULT 10	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO A, V, ER, SSF		

Description The Motor Resolution (MR) command sets the number of steps per units. This command allows the controller to control drives of different resolutions while maintaining the commanded acceleration and velocity.

Example

Command	Description
MN	Set to Normal mode (preset)
MRØ1	Set motor resolution to 400 steps per rev
A5	Set Acceleration to 5 rps^2
V1Ø	Set Velocity to 10 rps
D8ØØ	Set distance of move to 800 steps
G	Executes the move (Go)

A 400 step per revolution motor/drive will turn 800 steps (two units) CW at an acceleration of 10 rps^2 and a velocity of 10 rps after the G command.

If this same command set is sent to a motor/drive with a resolution of 4,000, then the motor will still turn 800 steps (1/5 of a unit). However, the actual acceleration would only be 0.5 rps^2 and the actual velocity would only be 1 rps.

In summary, the controller resolution and motor/drive resolution must match in order to get the commanded velocity and acceleration. This command does not effect the distance.

		High Range				Low Range			
MR	Resol-ution	rps	Max Frequency of step signal, KHz	VEL increment Hz	Min. pulse width µsec	RPS	Max Frequency of step signal, KHz	VEL increment Hz	Min. pulse width µsec
00	200	250	50	1.526	10	25	5	.1526	100
01	400	125	50	1.526	10	12.5	5	.1526	100
02	800	62.5	50	1.526	10	6.25	5	.1526	100
03	1000	100	100	3.052	5	10	10	.3052	50
04	2000	50	100	3.052	5	5	10	.3052	50
05	4000	125	500	15.259	1	12.5	50	1.5259	10
06	5000	100	500	15.259	1	10	50	1.5259	10
07	500	100	50	1.526	10	10	5	.1526	100
08	10000	50.0	500	15.259	1	5	50	1.5259	10
9	21600	23	496.8	15.259	1	2.3	49.68	1.5259	10
10	25000	20	500	15.259	1	2.0	50	1.5259	10
11	25400	19.5	495.79	15.259	1	19	49.57	1.5259	10
12	36000	13.8	496.8	15.259	1	13	49.68	1.5259	10
13	50000	10	500	15.259	1	1	50	1.5259	10
14	50800	9.8	497.84	15.259	1	.9	49.78	1.5259	10
15	4096	122.0	499.7	15.259	1	12.2	49.9	1.5259	10
16	12800	39	499	15.259	1	3.9	49.9	1.5259	10
17	25600	19.5	499.2	15.259	1	19	49.82	1.5259	10
18	12500	40	500	15.259	1	4	50	1.5259	10
19	16384	30.0	491.52	15.259	1	3	49.15	1.5259	10
20	20000	25	500	15.259	1	2.5	50	1.5259	10

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MSEG Motion	Start Middle Segment			VALID Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>MSEGn	n = steps	1-99999999	No segment definition	Buffered
EXECUTION TIME <2mS		**SEE ALSO** BSEG, BSEG, ESEG		

Description

The **MSEG** statement defines second, third or fourth segments of a complex move. The parameter is the distance the axis should travel during this segment.

The acceleration, velocity, and deceleration used for the segment definition are those currently in effect when the Define Starting Segment (**BSEG**) command is executed.

There can be as many as three **SMEG** commands. After you have entered the number of **MSEG** commands you desire, you must enter a End Segment (**ESEG**) command.

Example

Command	Description
A50	Sets first segment acceleration to 50 rps^2
AD20	Sets first segment deceleration to 20 rps^2
V5	Sets first segment velocity to 5 rps
BSEG5ØØØØ	Sets first segment move to 50,000 steps
V10	Sets middle segment velocity to 10 rps
MSEG1ØØØØØ	Sets middle segment move to 100,000 steps
V1	Sets last segment velocity to 1rps
ESEG25ØØØ	Sets last segment move to 25,000 steps
GSEG-	Start segment move in the negative direction.

MV Set-Up	Maximum Correction Velocity			VALID Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aMVn	n = rps	0 - max. vel	0.2	Buffered
EXECUTION TIME <2mS		**SEE ALSO** CG, FS, ER, MR		

Description

If the motor is running with the encoder feedback, and the Position Maintenance function (**FSC1**)is on, this command will specify the maximum velocity for correction moves.

Maximum velocity is equal to the maximum velocity allowed for a given motor. Refer to the Motor resolution (**MR**) command.

Example

Command	Description
MN	Set to Mode normal (preset moves)
MV2	Set the maximum correction velocity to 2 rps
FSB1	Set motion in encoder mode
FSC1	Set position maintenance on

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N Programming	End Of Loop			VALID Software Version A2
SYNTAX aN	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** L, PS, C, Y		

Description This command marks the end of loop. You can use this command in conjunction with the Loop (L) command. All buffered commands that you enter between the L and N commands are executed as many times as the number that you enter following the L command. You may nest loops 16 levels deep.

Example

Command	Description
PS	Pause and wait for continue
MN	Sets to Normal mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D1ØØØØ	Sets move distance to 10,000 steps
L5	Loops the following commands five times
G	Executes the move (Go)
N	Ends the loop
C	Clears pause and executes all commands in the buffer

O Programming	Output			VALID Software Version A2
SYNTAX aOn	**UNITS** n = OFF or ON	**RANGE** 0, 1, or X	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** SS		

Description The Output (O) command turns the programmable output bits on and off. This is used for signaling remote controllers, turning on LED's, or sounding whistles. The output can indicate that the motor is in position, about to begin its move, or is at constant velocity, etc. Outputs 1 - 4 are specified left to right respectively. Unspecified outputs remain unchanged. On refers to a TTL low.

- 0 = OFF
- 1 = ON
- x = No Change

Example

Command	Description
A5	Set acceleration to 15 rps^2
V5	Sets velocity to 5 rps
D2ØØØØ	Set move distance to 20,000 steps
OØ1	Set programmable output 1 off and output 2 on
G	Executes the move (Go)
OØØ	Turn off outputs 1 and 2—outputs 3 and 4 are not affected

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OCW Motion	Center Specified CW Arc Segment			VALID Software Version C2
SYNTAX <a>OCW	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME 80ms		**SEE ALSO** XD, YD, RD, OCCW, ID, JD		

Description

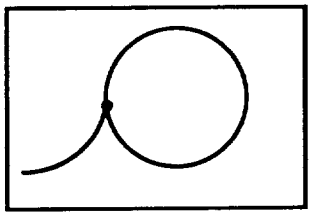
The Center Specified CW Arc Segment (OCW) command is used in the Model 4000's contouring option to finish the specification of an center specified CW arc segment. It does not initiate motion of the arc. The placement, length, radius of curvature, and orientation of the arc is completely specified by the endpoint and center specifications of the arc segment and the endpoint of the previous segment. The direction of rotation in the X-Y plane will be CW.

Segment endpoint position specifications may be either absolute with respect to user defined segment start coordinates, or incremental, relative to the start of each individual segment.

Center position specifications are always incremental, relative to the start of the arc segment. When the OCW command is received, the X-Y endpoint position is established with most recent X and Y data given in the X Axis Data (XD) and Y Axis Data (YD) commands, and the X-Y center position is established with most recent X and Y data given in the X Center Data (ID) and Y Center Data (JD) commands.

Example

Command	Description
DPI	Use incremental endpoints
XD25ØØØ	X incremental endpoint
YD25ØØØ	Y incremental endpoint
IDØ	Y incremental center point
JD25ØØØ	Y incremental center point
OCCW	CCW arc makes quarter circle
XDØ	X incremental endpoint
YDØ	Y incremental endpoint
ID25ØØØ	X incremental center point
JDØ	Y incremental center point
OCW	CW arc makes complete circle



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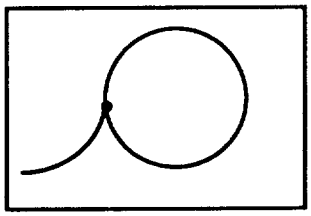
OCCW Motion	**Center Specified CCW Arc Segment**			**VALID** Software Version C2
SYNTAX <a>OCCW	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME 80ms		**SEE ALSO** XD, YD, ID, JD, OCW		

Description

The Center Specified CCW Arc Segment (OCCW) command is used in the Model 4000's contouring option to finish the specification of an center specified CCW arc segment. It does not initiate motion of the arc. The placement, length, radius of curvature, and orientation of the arc is completely specified by the endpoint and center specifications of the arc segment and the endpoint of the previous segment. The direction of rotation in the X-Y plane will be CCW. Segment endpoint position specifications may be either absolute with respect to user defined segment start coordinates, or incremental, relative to the start of each individual segment. Center position specifications are always incremental, relative to the start of the arc segment. When the OCCW command is received, the X-Y endpoint position is established with most recent X and Y data given in the X Axis Data (XD) and Y Axis Data (YD) commands, and the X-Y center position is established with most recent X and Y data given in the X Center Data (ID) and Y Center Data (JD) commands.

Example

Command	Description
DPI	Use incremental endpoints
XD25ØØØ	X incremental endpoint
YD25ØØØ	Y incremental endpoint
IDØ	Y incremental center point
JD25ØØØ	Y incremental center point
OCCW	CCW arc makes quarter circle
XDØ	X incremental endpoint
YDØ	Y incremental endpoint
ID25ØØØ	X incremental center point
JDØ	Y incremental center point
OCW	CW arc makes complete circle



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OR Status	Status Report of Function Setup (OS Commands)			VALID Software Version B2
SYNTAX aOR	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** OS Commands		
RESPONSE TO aOR **IS** nnnnnnnn				

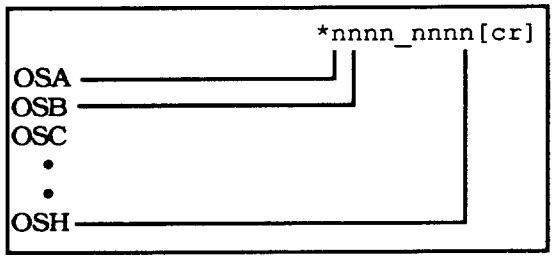
Description This command reports which software switches have been set by the OS commands. The reply is eight digits. This command reports OSA through OSH setup status in binary format.

Example

Command	Response
1OR	*ØØØØ1ØØØ Enable stall detection

OS Status	Function Setup Report			VALID Software Version B2
SYNTAX <a>OS	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered Savable in Sequence
EXECUTION TIME <2mS		**SEE ALSO** OSB, OSC, OSD, OSE, OSG, OSH		
RESPONSE TO aOS **IS** *OSnnnn_nnnn				

Description Reports the status of OS command (OSA-OSH) settings.



OSA Set-Up	Invert Encoder Direction			VALID Software Version B2
SYNTAX <a>OSAn	**UNITS** n = steps	**RANGE** 0, 1	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO**		

Description

- OSA1–Inverts the up/down count direction of encoder steps
- OSAØ–Returns the up/down count direction of encoder steps to factory setting

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Entering Invert Encoder Direction (**OSA1**) inverts the up/down count direction of the encoder. This command causes the motor to expect encoder pulses back in the opposite direction of the motor pulses being sent out. This is useful if the encoder is attached the load and is turning in the opposite direction of the motor due to the mechanical configuration of the system.

Entering **OSAØ** will change the up/down count of the encoder back to normal if it has been inverted with the **OSA1** command.

Example

Command	Description
OSA1	Inverts direction of encoder step count

OSB Set-Up	**Backup to Home Switch**			**VALID** Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>OSBn	n = mode	Ø or 1	1	Buffered
EXECUTION TIME <2mS		**SEE ALSO** GH, OSC, OSD, OSG, OSH, OS		

Description

- OSBØ—Do not back up to home switch
- OSB1—Back up to home switch

If you do not enable the function, the Model 4000 will consider the motor at home at the end of deceleration after encountering the active edge of the home region. If you enable this function, the Model 4000 will decelerate the motor to a stop after reaching the active edge of the home region, and then move the motor in the opposite direction of the initial go home move until the active edge of the home region is encountered. The Model 4000 will then consider the motor at home. This occurs regardless of whether or not the home input is active at the end of the deceleration of the initial go home move.

OSC Set-Up	**Define Active State of Home Switch**			**VALID** Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>OSCn	n = mode	Ø or 1	1	Buffered
EXECUTION TIME <2mS		**SEE ALSO** GH, OS, OSB, OSD, OSG, OSH		

Description

- OSCØ–Active state of home input is a low signal level
- OSC1–Active state of home input is a high signal level

This command sets the active state of the home input. It enables you to use either a normally closed or a normally open switch for homing. **OSCØ** requires a low-level signal to activate the home limit input.

OSC1 requires a high-level signal to activate the home limit input.

Example

Command	Description
OSC1	Sets home input's active state to a high state

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OSD Set-Up	Enable Encoder Z Channel Input			VALID Software Version B2
SYNTAX <a>OSDn	**UNITS** n = mode	**RANGE** Ø or 1	**DEFAULT** Ø	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** OSB, OSC, OSG, OSH		

Description

- ❑ OSDØ–Disable Z channel function during home
- ❑ OSD1–Recognizes Z channel after encountering the home

The Z channel is used (in conjunction with a load activated switch connected to home limit) to determine the home position. The switch determines the home region. The Z channel determines the exact position in that region that will be used as the home reference.

Example

Command	Description
OSDØ	Disable Z channel function

OSE Set-Up	Enable/Disable Stall Detect			VALID Software Version B2
SYNTAX <a>OSEn	**UNITS** n = mode	**RANGE** 0, 1	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** ER, DW		

Description

- ❑ OSEØ–Disable Stall Detect function
- ❑ OSE1–Enable Stall Detect function

This command detects stall conditions. After you enable stall detection, you may use the Stop on Stall (FSD1) function.

It is necessary to define the Deadband Window (DW) command and the Encoder Resolution (ER) command before this feature will operate properly. Stall Detection is only possible when an encoder is being used.

Example

Command	Description
DW1ØØØ	Set deadband window to 1,000 steps
ER2ØØØ	Set encoder resolution to 2,000 steps
OSE1	Enable stall detection
FSD1	Stop motor movement if stall detected.

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OSG Set-Up	Final Homing Direction			VALID Software Version B2
SYNTAX <a>OSGn	UNITS n = mode	RANGE Ø or 1	DEFAULT Ø	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO OSH		

Description

- OSGØ–Sets the final home approach direction to be CW
- OSG1–Sets the final home approach direction to be CCW

This enables you to approach home from any direction yet stop at home repeatedly in the same edge of the switch.

OSH Set-Up	Reference Edge of Home Switch			VALID Software Version B2
SYNTAX <a>OSHn	UNITS n = mode	RANGE Ø or 1	DEFAULT 1	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO OSG		

Description

- OSHØ Selects the CW side of the Home signal as the "edge" on which the final approach will stop
- OSH1 Selects the CCW side of the home signal as the "edge" on which the final approach will stop

The CW edge of the home switch is defined as the first switch transition seen by the Model 4000 when traveling off of the CW limit in the CCW direction. If n = 1, the CCW edge of the home switch will be referenced as the home position. The CCW edge of the home switch is defined as the first switch transition seen by the Model 4000 when traveling off of the CCW limit in the CW direction.

P Status	Incremental Position Report			VALID Software Version A2
SYNTAX a P	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO PR		
RESPONSE TO aPRn IS *snnnnnnnnnn (s = +/-, nnnnnnnnnn = 0 - 99,999,999)				

Description

The Incremental Position Report (P) command reports the incremental distance traveled during the last move in decimal format. The command reports positions as an 8 digit number preceded by sign (+/-), and followed by a carriage return. If the controller is in the encoder mode, the report is in encoder steps. If the controller is in motor mode, the report is in motor steps.

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Example

Command	Description
MN	Set to Normal mode
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D25ØØØ	Set move distance to 25,000 steps
G	Executes the move (Go)
1P	Request Position
+25ØØØ	Response from the controller

PD Status	Position Definition			VALID Software Version A2
SYNTAX aPD	**UNITS** n = steps	**RANGE** 0 - ±99999999	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** PR, FSA, FSB		

Description

The Position Definition (PD) command defines the current absolute position of the motor or the encoder. In Motor Step mode (FSBØ) the PD command will define the current motor step position to be the absolute position entered, but leave the encoder step position unchanged. In Encoder Step mode (FSB1), the PD command will define the current encoder step position to be the absolute position given, but leaves the motor step position unchanged.

Example

Command	Response	Description
PD25000		Define position
1PR	+25000	Report position
PD1234		Define new position
1PR	+1234	Report Position

In the above example, the absolute position reported by the Absolute Position Report (PR) command changed, even though no motion took place.

PDEL Motion	Delete Path			VALID Software Version C2
SYNTAX <a>PDELn	**UNITS** n = path #	**RANGE** 1 - 100	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** DP, DPA, DPI, ENDP, GP		

Description

The Delete Path (PDEL) command is used in the Model 4000's contouring option to delete a previously compiled (defined) path. Paths defined with the X command language are specified by a number between 1 and 100. All 100 individual paths may be defined and compiled, as long as the sum of all the segments of all the paths does not exceed 500. If the Model 4000 application requires more than 100 paths, or requires multiple paths whose combined segment count exceeds 500, then an existing path compilation must be deleted to make room for a new path compilation. Re-defining an existing path name or path number will automatically delete the existing path compilation with that number. The ability to delete and re-define paths allows hundreds of path definitions, even though only 100 may exist in the pre-compiled form at one time.

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Example

Command	Description
PDEL24	Delete path #24
DP12,21Ø3	Begin definition of path #12
DPR2.5	P axis to path ratio = 2.5
•	
•	Multiple segment definitions
•	
ENDP	End of path #12 definition
GP12	Execute path #12

PR Status	Absolute Position Report			VALID Software Version C2
SYNTAX aPR	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** W, MN, PZ, D, PX		
RESPONSE TO aPRn **IS** *snnnnnnnnnn (s = +/-, nnnnnnnnnn = 0 - 99,999,999)				

Description

The Absolute Position Report (PB) command reports motor position with respect to power-up position. The absolute position counter can track up to ±99,999,999 steps. If the counter is overrun in the Relative Position mode (by running the motor continuously for 24 hours at 20 rps), the absolute position will be invalid.

If in the Encoder mode, position will be reported in encoder steps. It represents the setpoint, on commanded position. The actual position may vary slightly due to vibrations of the encoder. For the actual position, use the Report Encoder Absolute Position (PX) command. If you are in motor mode, position will be reported in motor steps. In preset mode, response to this command will be reported after the move is done. In continuous mode, the response to this command will be reported after the motor reaches constant velocity.

The Position Report (PR) command responds with the cumulative position of the motor in respect to the zero position. The zero position can be defined by the position of the motor after a Position Zero (PZ) command is issued.

This command can only respond when the motor is not being commanded to move. Should you need relative positional information when the motor is moving, see the Report Position Relative to Start of Current Move (W) command.

Example

Command	Description
PZ	Resets the cumulative counter to zero
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D5ØØØ	Sets move distance to 5,000 units
G	Executes the move (Go)
1PR	Request absolute position report.
	Response *+00005000

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PS Programming	Pause			VALID Software Version A2
SYNTAX aPS	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** C, U, SSB		

Description

This command pauses execution of a command string or sequence following the Pause (PS) command until the controller receives a Continue (C) command. This command is useful if you need to enter a complete string of commands before you can execute your other commands.

This command is useful for interactive tests and synchronizing multiple indexes that have long command strings.

Example

Command	Description
PS	Pause and wait for continue
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets move distance to 25,000 steps
G	Executes the move (Go)
T.2	Delays the move for 2 sec
	Executes the move (Go)
C	Continues execution

When the controller receives the C command, the motor moves 25,000 steps twice with a 2-second delay between moves.

PX Set-Up	Report Encoder Absolute Position			VALID Software Version A2
SYNTAX aPX	**UNITS** n = steps	**RANGE** None	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** W1, W3, PR		
RESPONSE TO aPRn **IS** *snnnnnnnnnn (s = +/-, nnnnnnnnnn = 0 - 99,999,999)				

Description

This command returns a decimal value indicating the absolute position of the incremental encoder. The absolute position is based on the zero position. The zero position is established when you power up the system. The zero position can also be established by issuing a Position Zero (PZ) command. Whether in Motor Step mode or Encoder Step mode, the position is reported in encoder steps. This report may deviate slightly from the commanded position due to vibration of the encoder.

This command is useful in the following situations:

- Encoder setup
- Closing the loop with the host by comparing the encoder's actual position to the commanded position

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Example

Command	Description
MN	Set to Normal mode (Preset)
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D2ØØØØ	Sets move distance to 20,000 units
G	Executes the move (Go)
1PX	Report encoder position (*+00020000)

PZ Set-Up	Position Zero			VALID Software Version A2
SYNTAX aPZ	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Buffered
EXECUTION TIME <2mS		SEE ALSO MN, PR, D, PX, PD, FSA		

Description

This command sets the absolute position counter to zero. When your controller powers up, the absolute counter sets to zero. After moving the motor, the PZ command is used to reset the absolute counter to zero. This command zeros both the motor step position and the encoder step position.

In Absolute Mode (FSA1), all the moves will be made with respect to the absolute counter.

Example

Command	Description
PZ	Sets the absolute counter to zero
FSA1	Set to Absolute mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØ	Sets move distance to 2,500 steps
G	Executes the move (Go)
1PR	Reports Absolute Position (Response = *+00002500)
PZ	Sets the absolute counter to zero
1PR	Reports absolute position (Response = *+00000000)

Q Motion	Quit Buffer			VALID Software Version A2
SYNTAX aQ	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO K, S		

Description

This command allows the currently executing buffered command to be completed, but will cause all the remaining buffered commands already in the command to be dropped. It is similar to the Stop (S) and Kill (K) commands, except the currently executing command will be completed.

Example

Command	Description
A10	Set acceleration to 10rps^2
V5	Set velocity to 5rps
D25000	Sets distance to 25,000 steps
G	Executes the move (Go)
D50000	Set the next move distance to 50,000 steps
G	Buffer the Go (G) command
Q	Quit the buffer

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R Status	Request Controller Status			VALID Software Version A2
SYNTAX aR	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** RA, RB, RC		
RESPONSE TO aR **IS** *x (x = R, B, S, or C)				

Description

You can use the this command to display the controller's general status. Possible responses are:

Response	Definition
*R	Ready
*S	Ready, Attention Needed
*B	Busy
*C	Busy, Attention Needed

When the controller is prepared to accept another command, the following conditions will cause a response that indicates the controller is busy:

- Performing a preset move
- Accelerating/decelerating during a continuous move
- A time delay is in progress (T command).
- Paused (PS) waiting on a Trigger (TR)
- In Jog mode
- Going Home
- Executing a loop

The following conditions will cause a response that indicates an error exists.

- A feedback error condition exits
- Go home failed
- Limit has been encountered

When the response indicates that attention is required, more details on the error condition are available by using the **RA**, **RB**, or **RC** commands.

Compumotor recommends that you refrain from using this command in tight polling loops. Use of the **R** command in the situations may result in microprocessor over load. Time delays can alleviate this problem. Do not use this command to determine if a move is complete. Use it after the move is complete to determine if there other errors or faults exist. Use a buffered status request command or a programmable output to indicate move completion.

Example

Command	Response
R	*R

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RA Status	Limit Switch Status Report			VALID Software Version A2
SYNTAX aRA	UNITS None	RANGE None	DEFAULT None	ATTRIBUTES Immediate
EXECUTION TIME <2mS		SEE ALSO R, RB		
RESPONSE TO aRA IS *x (x = @ - N, see explanation below)				

Description

The Limit Switch Status Report (**RA**) command provides the status of the end-of-travel limits during the last move as well as the present condition. This is done by responding with one of 15 characters representing the conditions listed below.

Response Character	Last Move Terminated By: *CW Limit*	*CCW Limit*	Current Move Limited By *CW Limit*	*CCW Limit*
*@	NO	NO	NO	NO
*A	YES	NO	NO	NO
*B	NO	YES	NO	NO
*C	YES	YES	NO	NO
*D	NO	NO	YES	NO
*E	YES	NO	YES	NO
*F	NO	YES	YES	NO
*G	YES	YES	YES	NO
*H	NO	NO	NO	YES
*I	YES	NO	NO	YES
*J	NO	YES	NO	YES
*K	YES	YES	NO	YES
*L	NO	NO	YES	YES
*M	YES	NO	YES	YES
*N	NO	YES	YES	YES

The **RA** command is useful when the motor will not move in either or both directions. The report back will indicate whether or not the last move was terminated by one or both end-of-travel limits.

Example

Command	Response
1RA	*@

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RB Status	**Report Loop, Pause, Shutdown Trigger Status Request**			**VALID** Software Version A2
SYNTAX aRB	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** R, RA, TR, PS, L ST		
RESPONSE TO aRB **IS** *x (x = @ - O, see explanation below)				

Description

The Report Loop, Pause, Shutdown, Trigger Status Request (**RB**) command provides the status of the command buffer if it is presently executing a Loop (**L**) or a Shutdown (**ST**) command. It will also indicate if a Pause (**PS**) command is being executed or if a Trigger (**TR**) condition is presently being waited on.

The controller responds with one of 15 different characters, each of which represents one of the conditions listed below.

Response Character	Loop Active	Pause Active	Shutdown Active	Trigger Active
*@	NO	NO	NO	NO
*A	YES	NO	NO	NO
*B	NO	YES	NO	NO
*C	YES	YES	NO	NO
*D	NO	NO	YES	NO
*E	YES	NO	YES	NO
*F	NO	YES	YES	NO
*G	YES	YES	YES	NO
*H	NO	NO	NO	YES
*I	YES	NO	NO	YES
*J	NO	YES	NO	YES
*K	YES	YES	NO	YES
*L	NO	NO	YES	YES
*M	YES	NO	YES	YES
*N	NO	YES	YES	YES

This command is useful to determine the present status of the execution buffer. Especially when execution is delayed or the response is unclear.

Example

Command	Description
1RB	*A After using 1RB, response came back as *A. This means that the controller is currently executing a loop.

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RC Status	Report Closed Loop and Go Home Status			VALID Software Version A2
SYNTAX aRC	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** R, RA, RB		
RESPONSE TO aRC **IS** *x (x = @ - C, see explanation below)				

Description

The Report Closed Loop And Go Home Status (RC) command responds with a character representing the conditions listed on the RC Response Table below. The four conditions which make up each response are described in more detail:

- Homing Function Failure. In this condition, the controller has encountered both end-of-travel limits or one of several possible Stop commands or conditions. Go home motion was concluded, but not at Home.
- Stall (only valid when using encoder feedback). In this condition, the controller has detected a deviation between motor and encoder position larger than one pole of the motor while running, or a deviation larger than one pole of the motor plus the backlash parameter following a direction change.

Character	Detected	Unsuccessful
*@	NO	NO
*A	YES	NO
*B	NO	YES
*C	YES	YES

Example

Command	Description
1RC	*C After issuing 1RC, response came back as *C. This means that while attempting last move, controller detected a stall.

RCW Motion	Radius Specified CW Arc Segment			VALID Software Version C2
SYNTAX <a>RCW	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME 50ms		**SEE ALSO** XD, YD, RD, RCCW		

Description

The Radius Specified CW Arc Segment (RCW) command is used in the Model 4000's contouring option to finish the specification of an radius specified CW arc segment. It does not initiate motion of the arc. The placement, length, radius of curvature, and orientation of the arc is completely specified by the endpoint and radius specifications of the arc segment and the endpoint of the previous segment. The direction of rotation in the X-Y plane will be CW.

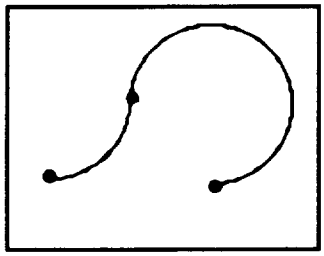
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Segment endpoint position specifications may be either absolute with respect to user defined segment start coordinates, or incremental, relative to the start of each individual segment.

Radius specifications are signed values. A positive radius specifies an arc which is 180 degrees or less. A negative radius specifies and arc which is 180 degrees or more. When the **RCW** command is received, the X-Y endpoint position is established with most recent X and Y data given in the X Axis Data (**XD**) and Y Axis Data (**YD**) commands, and the radius sign and magnitude is established with most recent data given in the Radius Data (**RD**) command.

Example

Command	Description
DCR4000	Specify C axis resolution
DPI	Use incremental endpoints
XD25000	Specify incremental X endpoint position
YD25000	Specify incremental Y endpoint position
RD25000	Specify radius arc <180°
DPO1001	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-25000	New incremental Y endpoint, X unchanged
RD-25000	Same radius arc >180°
DPO1100	Output pattern during second arc
RCW	Three quarter circle CW arc



RCCW Motion	Radius Specified CCW Arc Segment			VALID Software Version C2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>RCCW	None	None	None	Buffered
EXECUTION TIME 50ms		**SEE ALSO** XD, YD, RD, RCW		

Description

The Radius Specified CCW Arc Segment (**RCCW**) command is used in the Model 4000's contouring option to finish the specification of an radius specified CCW arc segment. It does not initiate motion of the arc. The placement, length, radius of curvature, and orientation of the arc is completely specified by the endpoint and radius specifications of the arc segment and the endpoint of the previous segment. The direction of rotation in the X-Y plane will be CW.

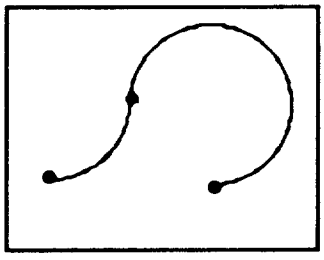
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Segment endpoint position specifications may be either absolute with respect to user defined segment start coordinates, or incremental, relative to the start of each individual segment.

Radius specifications are signed values. A positive radius specifies an arc which is 180 degrees or less. A negative radius specifies and arc which is 180 degrees or more. When the **RCCW** command is received, the X-Y endpoint position is established with most recent X and Y data given in the X Axis Data (**XD**) and Y Axis Data (**YD**) commands, and the radius sign and magnitude is established with most recent data given in the Radius Data (**RD**) command.

Example

Command	Description
DCR4ØØØ	Specify C axis resolution
DPI	Use incremental endpoints
XD25ØØØ	Specify incremental X endpoint position
YD25ØØØ	Specify incremental Y endpoint position
RD25ØØØ	Specify radius arc <180°
DPO1ØØ1	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-25ØØØ	New incremental Y endpoint, X unchanged
RD-25ØØØ	Same radius arc >180°
DPO11ØØ	Output pattern during second arc
RCW	Three quarter circle CW arc



RD Motion	**Radius Data**			**VALID** Software Version C2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>RDn	n = steps	0 - 99,999,999	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** XD, YD		

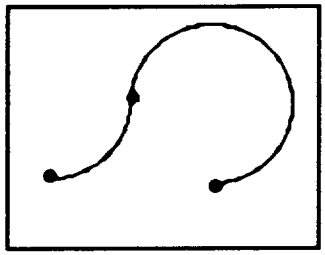
Description

The Radius Data (**RD**) command is used in the Model 4000's contouring option to specify the data required for radius specified arc segments (**RCW**, **RCCW**). The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as **RD**, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement. Radius specifications are signed values. A positive radius specifies an arc which is 180 degrees or less. A negative radius specifies and arc which is 180 degrees or more.

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Example

Command	Description
DCR4ØØØ	Specify C axis resolution
DPI	Use incremental endpoints
XD25ØØØ	Specify incremental X endpoint position
YD25ØØØ	Specify incremental Y endpoint position
RD25ØØØ	Specify radius arc <180°
DPO1ØØ1	Output pattern during first arc
RCCW	CCW arc makes quarter circle
YD-25ØØØ	New incremental Y endpoint, X unchanged
RD-25ØØØ	Same radius arc >180°
DPO11ØØ	Output pattern during second arc
RCW	Three quarter circle CW arc



RE Motion	**Resume**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aG aRE	None	None	None	Buffered
EXECUTION TIME <2mS		**SEE ALSO** S, MN, MC, A, V, D, G, GH		

Description

The Resume (RE) command instructs the motor to complete a move which had been stopped with the Stop (S) command. It uses motion parameters that you have previously entered. You do not have to re-enter Acceleration (A), Velocity (V), Distance (D), or the current mode (MN or MC) commands. In the Incremental Preset mode (FSAØ), a Resume (RE) command will finish the steps you specified with the D command.

A Resume (RE) command in the Absolute Preset mode (FSA1) will finish the move to the previously specified position.

If a segmented move or a registration move is stopped with the (S) command, Resume (RE) will finish the remaining distance to be traveled by either of these move types. If a contouring move is stopped with the Stop (S) command, the Resume (RE) command will finish the remainder of the path.

In the Continuous Mode (MC) and after a go home move which has been stopped, the move is simply re-initiated, just as if another Go (G) command or Go Home (GH) has been given.

If motion does not occur with the Resume (RE) command , an activated end-of-travel limit switch may be on. Check the limit switches.

Example

Command	Description
MN	Sets to Normal mode (preset)
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 steps
G	Executes the move (Go)
S	Stop the move
RE	Finish the move

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REG Motion	Define Registration Move			VALID Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aREGn,x	n = trig x = steps	n = 1-4 x = 1-999999999	None	Buffered
EXECUTION TIME <2mS		**SEE ALSO** ETR, DTR, RI		

Description

The **REG** command defines the distance to travel when a registration input becomes active. The parameter n specifies the registration input that will cause motion on that axis. The value of n can be 1 -4.

The acceleration, mode, velocity, and deceleration used for the segment definitions are those currently in effect when the **REG** command is executed.

Any of the four registration inputs can occur on a single axis while a move is in progress. Subsequent registration inputs can interrupt a registration move already in progress. A registration input will generate a registration move if all the following conditions are met.

① The **REG** command has been executed for the registration input.

② 100 ms have past from the time the last registration move was started (this is to debounce the input) This input has gone from active to inactive.

③ The registration input has become active again.

Example

Command	Description
A50	Sets acceleration to 50 rps^2
AD20	Sets deceleration to 20 rps^2
V1Ø	Sets velocity to 10 rps
REG1,1ØØØØØ	Sets move to 100,000 steps from trigger #1
ETR1	Enable TRIG1 registration for this axis
G	Execute the move (Go)
RI1	Simulate Trigger #1 input
DTR1	Disable Trigger #1 registration

RI Motion	Simulate Trigger Interrupt			VALID Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>RIn	n = Trigger #	1-4	None	Immediate
EXECUTION TIME 5mS		**SEE ALSO** ETR, DTR, REG		

Description

The **RI** command may be used to simulate a momentarily active trigger. The simulate trigger number is specified with the **RI** command. This command functions exactly as an activated trigger, except that the **RI** command reads the current position with a repeatability of 5 mSec, as a trigger input reads its position with a repeatability of 200 mS. Even though the trigger is not used with the **RI** command, it must be enabled via the Enable Trigger Inputs (**ETR**) command in order for the **RI** command to simulate that trigger.

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Example

Command	Description
A50	Sets acceleration to 50 rps^2
AD20	Sets deceleration to 20 rps^2
V1Ø	Sets velocity to 10 rps
REG1,1ØØØØØ	Sets move to 100,000 steps from trigger #1
ETR1	Enable TRIG1 registration for this axis
G	Execute the move (Go)
RI1	Simulate Trigger #1 input
DTR1	Disable Trigger #1 registration

RV Status	**Revision Level**			**VALID** Software Version A2
SYNTAX aRV	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO**		
RESPONSE TO aRV **IS** *nn-nnnnnn-nn-x (n = 0 - 9 x = A - Z)				

Description

The Revision (RV) command provides the software part number and its revision level. The response is in the form shown below:

```
*92-010871-01<A2>[cr]
part number revision level
```

The part number identifies which product the software is written for, as well as any special features that the software may include.

Example

Command	Response
1RV	*92-010871-01A2

The product is identified by 92-010871. The revision level is identified by Ø1A2.

S Motion	**Stop**			**VALID** Software Version A2
SYNTAX aS	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** K, SSH, AD, RE		

Description

This command decelerates the motor to a stop using the last defined Deceleration (AD) command. This command normally clears any remaining commands in the command buffer, unless prevented from doing so by the Save Command Buffer On Stop (SSH1) command. When the SSH1 command is executed, the S command stops only the current move and goes on to the next command in the buffer. Any move which has been stopped with the S command may be resumed with the RE command.

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Example

Command	Description
MC	Sets to Continuous mode
A1	Sets acceleration to 1 rps^2
V1Ø	Sets velocity to 10 rps
G	Executes the move (Go)
AD5	Sets deceleration to 5 rps^2
S	Stops motor (motor comes to 0 rps at a deceleration rate of 5 rps)

SSF Set-Up	**Select Velocity Range**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aSSFn	n = mode	0 = high 1 = low	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** SR, MR		

Description This command selects the velocity range to be used for subsequent moves. SSFØ selects the high velocity range and SSF1 selects the low velocity range. The high velocity range is the default range, and allows maximum speed from the motor. The low range allows finer velocity resolution at low speeds. The velocity ranges are dependent on motor resolution. For a complete list, refer to the MR command.

Example

Command	Description
SSF1	Set low velocity range
V.ØØØ1	Set velocity to .0001 rps

SSG Set-Up	**Clear/Save Command Buffer on Limit**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aSSGn	n = mode	0 or 1	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** LD		

Description

- ❑ SSG1 Saves command buffer when a limit is reached
- ❑ SSGØ Clears command buffer when a limit is reached (executes commands currently in buffer after aborting the move that reached the limit)

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In most cases, it is desirable that upon activating an end-of-travel limit input, all motion should cease until the problem causing the over-travel is rectified. This will be assured if all commands pending execution in the command buffer are cleared when hitting a limit. This is the case if **SSGØ** is specified. If **SSG1** is specified and a limit is activated, the current move is aborted, but the remaining commands in the buffer continue to be executed.

Example

Command	Description
SSG1	Save buffer on limit
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
D25ØØØ	Set distance to 25,000 steps
G	Executes the move (Go)
O11	Turn on outputs 1 and 2

SSH Set-Up	**Clear/Save Command Buffer on Stop**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aSSHn	n = mode	0 or 1	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** LD, SS		

Description

- SSHØ—Clears command buffer on stop
- SSH1—Saves command buffer on stop

In Normal Operation (**SSHØ**) the Stop (**S**) command or a dedicated stop input will cause any commands in the command buffer to be cleared. If you select the Save Command Buffer On Stop (**SSH1**) command, a remote stop input or Stop (**S**) command will only stop execution of a move in progress. It will not stop execution of any commands that remain in the buffer.

Example

Command	Description
SSHØ	Clears command buffer on stop
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 units
L5Ø	Loop 50 times
G	Executes the move (Go)
T.5	Pauses the motor 500 msec
N	Ends loop
S	Stops motion

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ST Programming	Shutdown			VALID Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aSTn	n = mode	0 or 1	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** OFF, ON		

Description

The Shutdown (**ST1**) command rapidly decreases the motor current to zero. The system ignores move commands that you issue after the **ST1** command. Torque on the motor is not maintained after you issue the **ST1** command. The fault light on the front panel goes on to indicate that the motor is shut down.

The **STØ** command rapidly increases the motor current to normal. Once you restore the current, you can execute moves.

This command is useful for reducing motor heating and allows you to manually position the load. This command affects the shutdown output on the motor drive connector. Motor drives which have a shutdown input will be disabled with the **ST1** command.

Example

Command	Description
ST1	Commands the drive to de-energize the motor

T Programming	Time			VALID Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aTn	n = seconds	0.01 - 999.99	None	Buffered
EXECUTION TIME <2mS		**SEE ALSO** None		

Description

The Time (**T**) command causes the controller to wait the number of seconds that you specify before it executes the next command in the buffer. This command is useful whenever you need to delay the motor's actions.

Example 1

Command	Description
MN	Sets to Normal mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 steps
T1Ø	Pauses motor movement 10 seconds
G	Executes the move (Go)
T5	Pauses the motor for 5 seconds after the move ends
G	Executes the move (Go)

You may use this command in Continuous mode to generate different move profiles, or to program different acceleration and deceleration rates (provided strict positional repeatability is not needed).

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Example 2

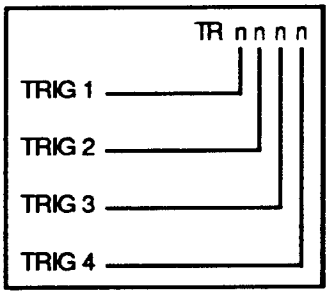
Command	Description
MC	Sets to Continuous mode
A5	Sets acceleration to 5 rps^2
V6	Sets velocity to 6 rps
G	Ramps motor to 6 rps (Go)
T3	Runs at 6 rps for 3 seconds
A1	Sets acceleration to 1 rps^2
VØ	Sets velocity to 0 rps
G	Stops motor at reduced acceleration rate

TR Programming	**Wait for Trigger**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aTRnnnnn	n = input	Ø, 1, or X (see below)	None	Buffered
EXECUTION TIME <2mS		**SEE ALSO** SS, TS		

Description

You can use triggers to synchronize controller operations with external events. You can also use them to implement a handshaking function with other devices. The three characters that are used for the variable (n) are listed below:

Ø = Input grounded (OFF)
1 = Input opened (ON)
X = Don't care (ON or OFF)



When TR command is used in a buffer, the controller will get to this command and wait until the input pattern is matched before going on to the next command.

Example

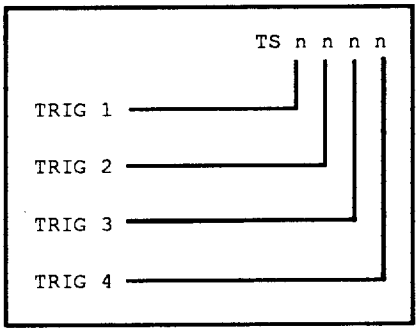
Command	Description
TRØ1XX	Wait for TRIG#1 to be inactive and TRIG#2 to be active
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 steps
G	Executes the move (Go)

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TS Status	Trigger Input Status			VALID Software Version A2
SYNTAX aTS	**UNITS** n = input	**RANGE** Ø, 1, or X (X = don't care)	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** TR		

Description The Trigger Input Status (TS) command retrieves the status of the trigger inputs.

n= 1 (Input is ON, open to ground)
n = Ø (Input is OFF, closed to ground)
n = X = don't care



Since the TS command is immediate, the host controller can determine the status of the trigger inputs at any time, even during execution of other commands. You can use this command to make sure that your trigger pattern is met, when you have issued the Trigger (TR) command.

Example

Command	Response
1TS	*1Ø1Ø

U Programming	Pause and Wait for Continue			VALID Software Version A2
SYNTAX aU	**UNITS** None	**RANGE** None	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** PS, C, SSB		

Description This command causes the controller to complete the move in progress, then wait until it receives a Continue (C) to resume processing. Since the buffer is saved, the controller continues to execute the program (at the point where it was interrupted). The controller continues processing when it receives the C command. This command is typically used to stop a machine while it is unattended.

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Example

Command	Description
MN	Sets to Normal mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
LØ	Loops indefinitely
D256ØØ	Sets distance to 25,600 steps
G	Executes the move (G)
T1Ø	Waits 10 seconds after the move
N	Ends loop
U	Pause and wait for continue.

This command string pauses at the point where the U command is entered. A Continue (C) command causes execution to resume at the point where it was paused. In this example, the loop stops at the end of a move, and resumes when the controller receives the C command.

UR Status	**Scale Factor Status**			**VALID** Software Version A2
SYNTAX aUR	**UNITS** n = steps	**RANGE** 001 - 255	**DEFAULT** None	**ATTRIBUTES** Immediate
EXECUTION TIME <2mS		**SEE ALSO** US		
RESPONSE TO aUR **IS** *x (x = @ - N, see explanation below)				

Description

Reports the current scale factor setting using the Set Distance Scale Factor (US) command. The actual number of steps sent to the motor drive during a preset move will be the current distance parameter setting multiplied by this scale factor.

Example

Command	Description
MN	Sets to Continuous mode
A1Ø	Sets acceleration to 10 rps^2
V5	Sets velocity to 5 rps
US2Ø	Sets scale factor to 20
1UR	Response: *Ø2Ø
D2ØØØØ	Sets distance to 20,000 steps
G	Executes the move (Go)

US Set-Up	**Set Distance Scale Factor**			**VALID** Software Version A2
SYNTAX a USn	**UNITS** n = steps	**RANGE** 1 to 255	**DEFAULT** 1	**ATTRIBUTES** Buffered,
EXECUTION TIME <2mS		**SEE ALSO** UR		

Description

This command allows you to set the distance scale factor. Any distance value set with the Distance (D) command will be multiplied by the value set by US command. This value will remain valid until the controller is reset or a new US value is defined.

If 200 steps will yield a 0.001 inch linear movement, then you can issue a US200 command and program distance in 0.001 inch increments.

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Example

Command	Description
MN	Sets to Continuous mode
A1Ø	Sets acceleration to 10 rps^2
V5	Sets velocity to 5 rps
US2ØØ	Sets scale factor to 200 steps
D1ØØØØ	Sets distance to 10,000 units
G	Executes the move (Go)

V Motion	**Velocity**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aVn	n = rps	motor resolution dependent	0.2	Buffered
EXECUTION TIME <2mS		**SEE ALSO** A, D, G, MR		

Description

The Velocity (V) command defines the maximum speed at which the motor will run when given the Go (G) command. The actual speed of the motor or output frequency of the controller will vary, depending on the motor drive resolution. The following formula is used to determine the output frequency of the controller:

Frequency = (V) * (Motor Resolution) in steps/rev

The top speed of the motor drive is limited by the motor type. Entering a velocity higher than the top speed of a motor drive system will cause the motor to stall and may cause the drive to fault.

Example

Command	Description
MC	Sets to Continuous mode
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
G	Executes the move (Go)

VP Motion	**Path Velocity**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>VPn	n = rps	motor resolution dependent	0.2	Buffered
EXECUTION TIME <2mS		**SEE ALSO** AP, GP, ADP, GL		

Description

The VP command specifies the path velocity to be used in linearly interpolated moves, and in the Model 4000 contouring option. In linearly interpolated moves, a path may involve one to four axis, each with its own distance of travel. In contouring paths, only the X and Y axis are included in the calculation of the path. For both types of moves, the path velocity refers to the velocity of the load as motion proceeds along the path. For linearly interpolated moves, the velocity of each individual axis is dependent on the distance it contributes to the total path travelled by the load. In contouring paths, the velocity of each individual axis is dependent on the direction of travel in the X-Y plane.

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Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

VS Motion	Set Start/Stop Velocity			VALID Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
aVS	n = pulses per rev.	0.001 - max. vel	0.2	Buffered
EXECUTION TIME <2mS		**SEE ALSO** V, MR		

Description

This command is most useful with with low resolution drives (200, 400 or 1,000 pulses per revolution). This is the minimum velocity employed by any MN or MC moves. The motor will jump immediately to VS value before ramping to a V value. It is typically used to prevent full step motor from stalling at resonance point. If VS value is greater than the V value for a move, the V value will be used regardless of the VS command. (It will move up to V value immediately.)

The maximum velocity is equal to the maximum velocity allowed for a given motor. Refer to the Motor Resolution (MR) command.

Example

Command	Description
MRØ	Sets motor resolution select to 200 parts per rev
MC	Sets mode continuous
VS1	Start/Stop velocity set to 1 rps
V5	Sets velocity to 5 rps
A2Ø	Sets acceleration to 10 rps^2
G	Executes the move (Go)

VSE Set-Up	Velocity Scale Enable			VALID Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
VSEn	n = percent	0 = off 1 = on	0	Immediate
EXECUTION TIME <2mS		**SEE ALSO** VSL, VSH, AVS		

Description

The VSE command allows velocity scaling to be used in some parts of the program and not in others. When velocity scaling is enabled, the state of the joystick select input and the definitions for VSH, VSL will determine the source of the velocity scaling percentage.

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When velocity scaling is enabled, the velocity on all axes will be continuously scaled by the percentage defined by the **VSL** and **VSH** commands. The update rate is once every 2 milliseconds.

When velocity scaling is not enabled, the velocity on all axes is just as specified by the move statements.

Example

Command	Description
VSL4	Set velocity scaling source low on axis #1.
VSH3	Set velocity scaling source high on axis #1.
AVS1ØØØ	Maximum velocity scale acceleration is 1000%/sec
VSE1	Enable velocity scaling

VSH Set-Up	**Velocity Scale Source High**			**VALID** Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
VSHn	n = channel	0 = off 1 = on	0	Immediate
EXECUTION TIME <2mS		**SEE ALSO** VSL, VSH, AVS		

Description

The **VSH** command defines the source used for velocity scaling when the joystick select input is high (current not flowing), and velocity scaling is enabled.

The four analog inputs are referred to as CH1-CH4. If one of these channels is given as the source and velocity scaling is enabled, then all velocities will be scaled as a percentage of full scale. The percentage is a function of the voltage present on that channel and the end deadband defined for that channel. The percentage can be expressed as below:

Percentage = (V_in - end _db) / (2.5 Volts - 2 * end_db).
where : V_in is the input voltage
end_db is the user define end deadband voltage.

If the **OFF** option is selected, all velocities will be full scale (100%) when the joystick select input is high.

The default for this statement is **OFF**.

Example

Command	Description
2VSL4	Set velocity scaling source low on axis #2.
3VSH3	Set velocity scaling source high on axis #3.
AVS1ØØØ	Maximum velocity scale acceleration is 1000%/second
VSE1	Enable velocity scaling

VSL Set-Up	**Velocity Scale Source Low**			**VALID** Software Version B2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
VSLn	n = channel	0 = off 1 = on	0	Immediate
EXECUTION TIME <2mS		**SEE ALSO** VSL, VSH, AVS		

Description

The **VSL** command defines the source used for velocity scaling when the joystick select input is low (current flowing), and velocity scaling is enabled.

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The four analog inputs are referred to as CH1-CH4. If one of these channels is given as the source and velocity scaling is enabled, then all velocities will scaled as a percentage of full scale. The percentage is a function of the voltage present on that channel and the end deadband defined for that channel. See **JCEB** command. The percentage can be expressed as below:

Percentage = (V_in - end _db) / (2.5 Volts - 2 * end_db).
where : V_in is the input voltage
end_db is the user define end deadband voltage.

If the **OFF** option is selected, all velocities will be full scale (100%) when the joystick select input is low.

The default for this statement is **OFF**.

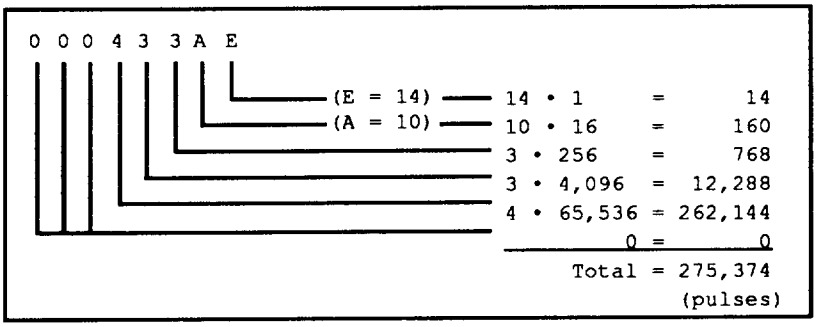
Example

Command	Description
VSL4	Set velocity scaling source low on axis #1.
VSH3	Set velocity scaling source high on axis #1.
AVS1000	Maximum velocity scale acceleration is 1000%/second
VSE1	Enable velocity scaling

W3 Status	**Hexadecimal Position Report**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>**W3**	None	None	None	Immediate
EXECUTION TIME <2mS		**SEE ALSO** W1, PR		
RESPONSE TO a**W3** **IS** nnnnnnnn				

Description

The **W3** command provides an immediate hexadecimal character position report in two's complement format. The position response indicates motor position relative to the current move. The response is an 8-digit ASCII hexadecimal number. If the response was ***000433AE**, the decimal value would be:



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If the first digit of the response is F, the response represents a *two's complement* negative number (i.e., Fnnnnnnnn). To interpret a negative number (starting with Fnnnnnnnn) using the binary approach, follow the steps below:

① Convert the hexadecimal response to binary form.
② Complement the binary number
③ Add 1 to the binary result
④ Convert the binary result to decimal value with a minus sign placed ahead of the decimal value

Example

Command	Description
1W3	*FFFFA19C

XD Motion	X Axis Data			VALID Software Version C2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>XDn	n = steps	± 0 - 99,999,999	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** YD, RD		

Description

The XD command is used in the Model 4000's contouring option to specify the X endpoint coordinate data required for line and arc segments. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as XD , before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

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XLD Motion	Local X Coordinate Data			VALID Software VersionC2
SYNTAX <a>XLDn	**UNITS** n = steps	**RANGE** ± 0 - 99,999,999	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** YLD, DPL, DPA		

Description

The **XLD** command is used in the Model 4000's contouring option to specify the local X coordinate data required for subsequent segment definition in the local coordinate system. This command places the X coordinate value of the Local coordinate system at the beginning of the next segment. This command must be used before the **DPL** command is given. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as **XLD**, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

Example

Command	Description
XLD150000	Specify X data, local coordinate
YLD0	Specify Y data, local coordinate
DPL	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP50	Set next segments path acceleration to 50rps^2
ADP100	Set next segments path deceleration to 100rps^2
XD250000	Specify X endpoint position
YD250000	Specify Y endpoint position
LINE	Create 45° angle line segment

XWD Motion	Work X Coordinate Data			VALID Software Version C2
SYNTAX <a>XWDn	**UNITS** n = steps	**RANGE** ± 0 - 99,999,999	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** YWD, DPW, DPA		

Description

The **XWD** command is used in the Model 4000's contouring option to specify the work X coordinate data required for subsequent segment definition in the work coordinate system. This command places the X coordinate value of the Work coordinate system at the beginning of the next segment. This command may be used before the **DPW** command is given for the purpose of shifting the Work coordinate system. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as **XWD** , before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

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Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

Y Programming	**Stop Loop**			**VALID** Software Version A2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>Y	None	None	None	Immediate
EXECUTION TIME <2mS		**SEE ALSO** L, N		

Description

The Stop Loop (Y) command takes you out of inner loop when the loop completes its current pass. This command does not halt processing of the commands in the loop until the controller processes reach the last command of the current loop. At that time, the controller executes the command that follows the End Loop (N) command.

Example

Command	Description
L	Loops indefinitely
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D25ØØØ	Sets distance to 25,000 steps
T2	Waits 2 seconds
G	Executes the move (Go)
N	Ends loop
Y	Stops loop

YD Motion	**Y Axis Data**			**VALID** Software Version C2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>YDn	n = steps	± 0 - 99,999,999	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** XD, RD		

Description

The YD command is used in the Model 4000's contouring option to specify the Y endpoint coordinate data required for line and arc segments, and the Y start point coordinate required for the DPA command. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as YD, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

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Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

YLD Motion	**Local Y Coordinate Data**			**VALID** Software Version C2
SYNTAX	**UNITS**	**RANGE**	**DEFAULT**	**ATTRIBUTES**
<a>YLDn	n = steps	± 0 - 99,999,999	0	Buffered
EXECUTION TIME <2mS		**SEE ALSO** XLD, DPL, DPA		

Description

The YLD command is used in the Model 4000's contouring option to specify the local Y coordinate data required for subsequent segment definition in the local coordinate system. This command places the Y coordinate value of the Local coordinate system at the beginning of the next segment. This command must be used before the DPL command is given. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as YLD, before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

Example

Command	Description
XLD15ØØØØ	Specify X data, local coordinate
YLDØ	Specify Y data, local coordinate
DPL	Specify Local coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

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YWD Motion	Work Y Coordinate Data			VALID Software Version C2
SYNTAX <a>YWDn	**UNITS** n = steps	**RANGE** ± 0 - 99,999,999	**DEFAULT** 0	**ATTRIBUTES** Buffered
EXECUTION TIME <2mS		**SEE ALSO** XWD, DPW, DPA		

Description

The **YWD** command is used in the Model 4000's contouring option to specify the work Y coordinate data required for subsequent segment definition in the work coordinate system. This command places the Y coordinate value of the work coordinate system at the beginning of the next segment. This command may be used before the **DPW** command is given for the purpose of shifting the work coordinate system. The Model 4000 holds the parameters it needs to define a segment or execute a command in temporary registers before and during the execution of the command. When using the X command language, these data registers must be filled with individual parameter data commands, such as **YWD** , before the corresponding path specification command is entered. When using the Model 4000 statements, the data for these registers is contained in the statement.

Example

Command	Description
XWD15ØØØØ	Specify X data, work coordinate
YWDØ	Specify Y data, work coordinate
DPW	Specify Work coordinate system
DP	Use absolute endpoints
VP5	Set next segments path velocity to 5rps
AP5Ø	Set next segments path acceleration to 50rps^2
ADP1ØØ	Set next segments path deceleration to 100rps^2
XD25ØØØ	Specify X endpoint position
YD25ØØØ	Specify Y endpoint position
LINE	Create 45° angle line segment

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