Smart Drive

Quick Reference Guide

Old Number SDQR 100

New Number MSM001H

SMART DRIVE QUICK REFERENCE
Rev 1.0.0

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1.0 ALPHABETIZED LIST OF COMMANDS & VARIABLES

The command and variable descriptions presented here are in alphabetical order and use the following conventions and format:

(COMMAND) This shadowed button gives the exact spelling of the command or variable and is followed by a brief description of what it does. The Smart Drive command processor is not case sensitive, so commands can be entered in upper- or lower-case letters.

If just the name of a variable is entered without specifying a new value, the Smart Drive will output the current setting of the variable, and Motion Link will display the value on the Motion Link screen.

TYPE: command, switch, variable, or factory variable. Switches and variables are further classified as read-only (r/o) or read/write (r/w). Factory variables, some of which are set when a TL file is loaded, are read-only.

Refer to section 3 for groupings of variables by type.

SYNTAX/RANGE: If the command/variable has required arguments, then the argument range is listed in angled brackets <>. If the command/variable has optional arguments, then the argument range is given in square brackets [ ]. If the command, variable or switch is not programmable (i.e., it is r/o), then the output range is specified in braces { }. If a command has different options, the options will be separated by a vertical bar to represent the logical OR, indicating that one of the options can be entered (for an example, see the ERR command). Refer to section 3 for a table showing the possible variable ranges.

OPMODES: (0-9). This specifies in which operational modes (opmodes) the command or variable can be used.

UNITS: specifies the units of a variable.

DEFAULT: specifies the default value and units of a variable.

DRIVE STATUS: “en” or “dis.” Indicates the drive status in which a command or variable may be used (en = enabled; dis = disabled; en/dis = either state).

EEPROM: “yes” or “no.” This specifies whether or not a variable can be stored in non-volatile memory (EEPROM). If a variable is stored in EEPROM, then it will be "remembered" by the Smart Drive if the drive is powered down and back up.

ABAUD indicates the status of the autobaud hardware jumper. Entering ABAUD will prompt the Smart Drive to return a value of 0 or 1, indicating the jumper's status.
TYPE: switch (r/o)
SYNTAX/RANGE: ABAUD {0,1}
0: Jumper out, use baud rate stored in BAUD variable.

1: Jumper in, AutoBAUD active.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

ACC sets the drive acceleration. ACC will only work when PROFMODE is non zero.
TYPE: variable (r/w)
SYNTAX/RANGE: ACC [1 to 100,000]
OPMODES: 0,1,4 to 9
UNITS: RPM/sec DEFAULT: 100,000 RPM/sec
DRIVE STATUS: en/dis EEPROM: yes

ACTIVE displays the drive status. This is the logical "AND" of the drive READY and the REMOTE input.
TYPE: switch (r/o)
SYNTAX/RANGE: ACTIVE {0,1}
0: READY = 0 (OFF) or REMOTE = 0 (OFF)
1: READY = 1 (ON) and REMOTE = 1 (ON)
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

ADDR displays the setting of the Address switch.
TYPE: variable (r/o)
SYNTAX/RANGE: ADDR {0-15}
0 = RS-232
1-15 = Multidrop address 1-9 and A-F respectively
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

AMPS displays the rated current of the drive amp.
TYPE: factory variable (r/o)
SYNTAX/RANGE: AMPS {0 to 55}
OPMODES: all
UNITS: amps DEFAULT: TL amps
DRIVE STATUS: en/dis EEPROM: no

ANDB sets the dead band of the analog velocity input signal. If the velocity input voltage is less than this value, then no velocity command signal is generated. This is useful in suppressing noise. The voltage range of this variable is 0-10V.
TYPE: variable (r/w)
SYNTAX/RANGE: ANDB [0 to 2047]
OPMODES: 1, 3, 9
UNITS: 10/2047 volts (4.88 mV) DEFAULT: 0 volts
DRIVE STATUS: en/dis EEPROM: yes

ANDG

enables/disables the analog input dual gain feature.

TYPE: switch (r/w)
SYNTAX/RANGE: ANDG [0,1]
0 = disable (gain stage 1:1)
1 = enable (gain stage 8:1)
OPMODES: 1, 3, 9
UNITS: n/a DEFAULT: 1
DRIVE STATUS: dis EEPROM: yes

ANIN

displays the value of the analog input used in analog velocity input mode of operation. This variable has a range of -16,384 to +16,383 corresponding to -10 to +10 VDC input.

TYPE: variable (r/o)
SYNTAX/RANGE: ANIN {-16384 to +16383}
OPMODES: 1, 3, 9
UNITS: 10/16384 volts (0.610 mV) DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

ANOFF

sets the bias velocity of the drive in the analog velocity input mode. This is used to compensate for the analog command signal (see ANIN) offset or drift.

TYPE: variable (r/w)
SYNTAX/RANGE: ANOFF [-16,384 to 16,383]
OPMODES: 1, 3, 9
UNITS: 10/16384 volts (0.610 mV) DEFAULT: 0 volts
DRIVE STATUS: en/dis EEPROM: yes

ANSLEW

sets the bandwidth (corner frequency) of the low pass filter of the analog input.

TYPE: variable (r/w)
SYNTAX/RANGE: ANSLEW [1 to 1000]
OPMODES: 1,3,9
UNITS: Hz DEFAULT : 1000
DRIVE STATUS: en/dis EEPROM: yes

ANZERO

is used to automatically zero the analog input. It may be necessary to execute this command a second time for higher accuracy.

TYPE: command
SYNTAX/RANGE: ANZERO
OPMODES: 1, 3, 9
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: dis EEPROM: n/a

BAUD

is used to set the communication baud rate between the Motion Link terminal and the Smart Drive when ABAUD = 0. This variable is set automatically whenever an autobaud sequence occurs.

TYPE: variable (r/w)
SYNTAX/RANGE: BAUD [<baud rate>]
<baud rate> = 19200, 9600, 4800, 2400, 1200, 600, 300
OPMODES: all

UNITS: baud DEFAULT: 9600 baud
DRIVE STATUS: en/dis EEPROM: yes

CCWLIM

displays the status of the travel limit in the counter clockwise direction (as seen from the shaft end). When the CCW travel limit is reached, the motor is inhibited from further travel in the CCW (counter-clockwise) direction.
TYPE: switch (r/o)
SYNTAX/RANGE: CCWLIM {0,1}
0: Indicates Counter-Clockwise travel limit not reached.
1: Indicates Counter-Clockwise travel limit reached.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

CWLIM

displays the status of the travel limit in the clockwise direction (as seen from the shaft end). When the CW travel limit is reached, the drive is inhibited from further travel in the CW (clockwise) direction.
TYPE: switch (r/o)
SYNTAX/RANGE: CWLIM {0,1}
0: Indicates Clockwise travel limit not reached.
1: Indicates Clockwise travel limit reached.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

DEC

sets the drive deceleration. DEC variable only works when PROFMODE is not set to zero.
TYPE: variable (r/w)
SYNTAX/RANGE: DEC [1 to 100,000]
OPMODES: 0,1,4 to 9
UNITS: RPM/sec DEFAULT: 100,000 RPM/sec
DRIVE STATUS: en/dis EEPROM: yes

DECSTOP

sets the drive deceleration that is used when a LIMIT switch (CCWLIM or CWLIM) is tripped.
TYPE: variable (r/w)
SYNTAX/RANGE: DECSTOP [1 to 100,000]
OPMODES: 0,1,4 to 9
UNITS: RPM/sec DEFAULT: 100,000 RPM/sec
DRIVE STATUS: en/dis EEPROM: yes

DEP

shortens the length of error messages for terminals with 40 column displays like that of the DEP01.
TYPE: switch (r/w)
SYNTAX/RANGE: DEP [0,1]
0 = long messages
1 = short messages
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

DIR

sets the direction of motion. The direction of motion determines which direction (CW or CCW) the motor shaft will rotate (as seen from the shaft end) when a positive velocity or position command is entered. A negative velocity or position command will cause rotation in the opposite direction.
TYPE: switch (r/w)
SYNTAX/RANGE: DIR [0,1]
0: Sets the positive motion to be counter-clockwise (CCW).
1: Sets the positive motion to be clockwise (CW) as seen
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: dis EEPROM: yes

DIS

disables the motor by cutting off the Smart Drive power stage. All of the control loops are bypassed when the Smart Drive is disabled, so no integral wind-up occurs.
TYPE: command
SYNTAX/RANGE: DIS
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

DUMP

dumps all of the Smart Drive variables to the serial port, causing them to be displayed on the Motion Link monitor or terminal. Entering "DUMP TL" will cause the Smart Drive to respond by transmitting the TL file to the serial port.
TYPE: command
SYNTAX/RANGE: DUMP [TL]
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

ECHO

enables/disables serial port character echo. If echo is enabled, commands typed in via Motion Link will be echoed (displayed) on the Motion Link monitor or terminal.
TYPE: switch (r/w)
SYNTAX/RANGE: ECHO [0,1] (0 = disable; 1 = enable)
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

EN

enables the Smart Drive power stage to supply power to the motor.
TYPE: command
SYNTAX/RANGE: EN
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: dis EEPROM: n/a

ENCLINES

sets the encoder counts per revolution of the motor shaft. When a resolver is used, the value of ENCLINES is set automatically.
TYPE: variable (r/w)

SYNTAX/RANGE: ENCLINES [<num lines>]
<num lines> = 8, 16, 32, 64, 128, 256, 512,
1024, 2048, 4096, 8192, 16384
OPMODES: all
UNITS: lines DEFAULT: 1024 lines
DRIVE STATUS: dis EEPROM: yes

ERR

displays the last fault detected by the Smart Drive. Note that simple Motion Link syntax errors and the like will not be stored and displayed; only faults are stored in the Error history file (refer to section 6 for the definitions of errors and faults). A time stamp in the format of days:hours:minutes is displayed along with each error, indicating the time at which the error occurred (refer to TRUN for more information).
TYPE: command
SYNTAX/RANGE: ERR [CLR | HIST | 1 to 100]
CLR: This clears error history buffer.
HIST: This lists the last 20 faults detected by the drive. The faults are displayed in order of occurrence with the first fault listed first and the most recent fault listed last.
1 to 100: This is used to display the error message associated with an error number. Each error/fault capable of being detected by the Smart Drive has a unique error number, and typing "ERR X" will cause the error message for Error #X to be displayed.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

FILTMODE

selects the filter type. The filter selected using this command will be applied to the torque command output to the motor. See also LPFHZ, NCHBW and NCHHZ.
TYPE: variable (r/w)
SYNTAX/RANGE: FILTMODE [<filter>]
<filter> 0: No filter selected
1: Low pass filter selected
2: Notch filter selected
OPMODES: all
UNITS: n/a DEFAULT: TL (usually 0)
DRIVE STATUS: en/dis EEPROM: yes

FOLD

indicates if the Smart Drive is in the foldback mode of operation.
TYPE: switch (r/o)
SYNTAX/RANGE: FOLD {0,1}
0: not in Foldback
1: in Foldback
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

GAINSHIFT

enables the Smart Drive to drive very high loads (up to 40:1 inertia mismatch).
TYPE: switch (r/w)
SYNTAX/RANGE: GAINSHIFT [0,1]
0: High gain mode not enabled

1: High gain mode enabled
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: dis EEPROM: yes

GEAR enables/disables electronic gearing.
TYPE: switch (r/w)
SYNTAX/RANGE: GEAR [0,1]
0: Gear mode not enabled
1: Gear mode enabled
OPMODES: 4 to 7, 9
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

GEARI specifies the number of teeth on the input "gear" for gear mode. This is also used to set "Span" in Opmode 9.
TYPE: variable (r/w)
SYNTAX/RANGE: GEARI [-SHORT to SHORT]
OPMODES: 4 to 7, 9
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

GEARO specifies the number of teeth on the output "gear" for gear mode. This is also used to set "Span" in Opmode 9.
TYPE: variable (r/w)
SYNTAX/RANGE: GEARO [1 to SHORT]
OPMODES: 4 to 7, 9
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

GICAP sets the Integrator Band in PI position loop. This is used to reduce the overshoot, although it tends to increase the following error during a move.
TYPE: variable (r/w)
SYNTAX/RANGE: GICAP [1 to 100]
OPMODES: 4 to 9
UNITS: n/a DEFAULT: 10
DRIVE STATUS: en/dis EEPROM: yes

GP is a tuning variable which sets the proportional gain for the Proportional Integral position control loop (PI position loop). This variable is set automatically when the TUNE command is used.
TYPE: variable (r/w)
SYNTAX/RANGE: GP [1 to 32,767]
OPMODES: 4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

GPI

is a tuning variable which sets the velocity integral gain for the Proportional Integral position control loop (PI position loop). This variable is set automatically when the TUNE command is used.
TYPE: variable (r/w)
SYNTAX/RANGE: GPI [1 to 32,767]
OPMODES: 4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

GV

is a tuning variable which sets the proportional gain for Proportional Integral (PI) velocity control loop. This variable is set automatically when the TUNE command is used.
TYPE: variable (r/w)
SYNTAX/RANGE: GV [50 to 32,767]
OPMODES: 1,2,4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

GVD

is a tuning variable which sets the velocity derivative gain for Proportional Integral velocity control loop (PID loop). This variable is not modified by the TUNE command.
TYPE: variable (r/w)
SYNTAX/RANGE: GVD [0 to 32,767]
OPMODES: 0,1
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

GVI

is a tuning variable which sets the velocity integral gain for Proportional Integral (PI) velocity control loop. This variable is set automatically when the TUNE command is used.
TYPE: variable (r/w)
SYNTAX/RANGE: GVI [0 to 32,767]
OPMODES: 1,2,4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

HVER

displays the hardware version number (Product # and Version #). If the Smart Drive returns a value of "0," then this indicates that this particular function is not supported.
TYPE: variable (r/o)
SYNTAX/RANGE: HVER
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: yes

I

prints the average current. The average current is expressed as a percentage of IMAX.
TYPE: variable (r/o)
SYNTAX/RANGE: I {0 to 100}
OPMODES: all
UNITS: % of IMAX DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

ILIM

sets the limit of the peak RMS current (short duration). ILIM is expressed as a percentage of IMAX.
TYPE: variable (r/w)
SYNTAX/RANGE: ILIM [0 to 100]
OPMODES: all
UNITS: % of IMAX DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

IMAX

displays the limit of the peak RMS current (short duration). This variable is expressed as a percentage of peak current (peak current = 2 x AMPS).
TYPE: factory variable (r/o)
SYNTAX/RANGE: IMAX {1 to 100}
OPMODES: all
UNITS: % of (2 x AMPS) DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

IMON

prints the instantaneous current. This variable is expressed as a percentage of IMAX.
TYPE: variable (r/o)
SYNTAX/RANGE: IMON {0 to 100}
OPMODES: all
UNITS: % of IMAX DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

INPOS

indicates if the commanded motion has reached its final position within the following error set in PEINPOS.
TYPE: switch (r/o)
SYNTAX/RANGE: INPOS {0,1}
0: Motor not in position.
1: Motor in position.
OPMODES: 8
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

J

is the Jog command. This command will cause the motor shaft to rotate at the specified jog speed (RPM).
TYPE: command
SYNTAX/RANGE: J [-VMAX to +VMAX]
OPMODES: 0
UNITS: RPM DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

K

is the Kill command. This command is the same as the disable (DIS) command.
TYPE: command
SYNTAX/RANGE: K
OPMODES: all
UNITS: n/a DEFAULT: n/a

DRIVE STATUS: en/dis EEPROM: n/a

KA is a feed-forward gain term applied to the acceleration component in Opmode 4 that helps reduce overshoot caused by the KF gain.
TYPE: variable (r/w)
SYNTAX/RANGE: KP [0 to 30]
OPMODES: 4
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

KF is a feed-forward gain term used in Opmodes 4 and 8. Increasing this term will improve the Smart Drive response, but it may also cause overshoot. If excessive overshoot occurs when using this term, try to minimize the overshoot by increasing KA or decreasing KP, GPI, or GP.
TYPE: variable (r/w)
SYNTAX/RANGE: KP [0 to 5]
OPMODES: 4, 8
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

KP is a tuning variable which sets the proportional gain for the PDF position loop. This variable can be changed using the TUNE command or can be set manually.
TYPE: variable (r/w)
SYNTAX/RANGE: KP [0 to 32,767]
OPMODES: 4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

KV is a tuning variable which sets the proportional gain for PDF velocity control loop (PDF loop). This variable can be changed using the TUNE command or can be set manually.
TYPE: variable (r/w)
SYNTAX/RANGE: KV [50 to 32,767]
OPMODES: 0,1,4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

KVI is a tuning variable which sets the Integral gain for the PDF velocity control loop (PDF loop). This variable can be changed using the TUNE command or can be set manually.
TYPE: variable (r/w)
SYNTAX/RANGE: KVI [50 to 32,767]
OPMODES: 0,1,4 to 9
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

LIMDIS is the travel limit enable/disable switch.
TYPE: switch (r/w)
SYNTAX/RANGE: LIMDIS [0 to 1]
0: Travel Limits active.

1: Travel Limits disabled.
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

LOAD

loads all the designated variables (those denoted EEPROM: yes) from the EEPROM to system RAM. This command is automatically executed on power-up.

Variables which can be saved in EEPROM are stored there whenever the SAVE command is executed. The next time the LOAD command is executed, the variable values from the most recent SAVE are reloaded into the system (see SAVE).
TYPE: command
SYNTAX/RANGE: LOAD
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: dis EEPROM: n/a

LPFHZ

sets the frequency cut off value for the low pass filter.
TYPE: variable (r/w)
SYNTAX/RANGE: LPFHZ [1 to 1000]
OPMODES: all
UNITS: Hz DEFAULT: TL (usu. 500 Hz)
DRIVE STATUS: en/dis EEPROM: yes

MA

Move Absolute: this command will move to the specified position at the specified speed. Motion could occur in either direction, depending upon the relationship between the starting position and the commanded position. The current position of the motor can be read using PFB.

The optional flag [in pos ack] enables the operator to direct the Smart Drive to indicate when the commanded move is completed. When this flag is set to 1, the Smart Drive, upon completion of the commanded move, will output an exclamation point (!) over the serial port.
TYPE: command
SYNTAX/RANGE: MA <position> <velocity> [in pos ack]
<position> -LONG to LONG
<velocity> 1 to VMAX
[in pos ack] 0 or 1 (optional)
in pos ack = 0: do not indicate when move is complete
in pos ack = 1: indicate when move is complete
OPMODES: 8
UNITS: counts (position) and RPM (velocity
DEFAULT: n/a
DRIVE STATUS: en EEPROM: n/a
EXAMPLES:
MA 10000 1000 (Move to absolute position 10,000 at a speed of 1,000 RPM)
MA -5000 100 1 (Move to absolute position -5000 at a speed of 100 RPM; transmit a (!) to the serial port when the move is completed)

MI

Move Incremental: this command will incrementally move the specified distance at the specified speed. A positive incremental move will occur in the direction determined by the variable DIR, and a negative incremental move will occur in the opposite direction.

The optional flag [in pos ack] enables the operator to direct the Smart Drive to indicate when the commanded move is completed. When this flag is set to 1, the Smart Drive, upon completion of the commanded move, will output an exclamation point (!) over the serial port.

TYPE: command
SYNTAX/RANGE: MA <pos> <vel> [in pos ack]
<pos> -LONG to LONG
<vel> 1 to VMAX
[in pos ack] 0 or 1 (optional)
in pos ack = 0: do not indicate when move is complete
in pos ack = 1: indicate when move is complete
OPMODES: 8
UNITS: counts (position) and RPM (velocity)
DEFAULT: n/a
DRIVE STATUS: en EEPROM: n/a
EXAMPLES:
MI 10000 1000 (move 10,000 counts in the positive direction at a speed of 1,000 RPM)
MI -10000 100 1 (move 10,000 counts in the negative direction at a speed of 100 RPM; transmit a (!) to the serial port when the move is completed)

MODESW

enables a mode switching function which allows the drive to be switched from Gear mode (opmodes 4-7) to Jog mode using the CWLIM and CCWLIM input lines as triggers. The function uses the variables X1 and X2 to specify jog velocity.

If MODESW is active, the Smart Drive is in opmode 4-7, and both the CWLIM and CCWLIM inputs are closed, then the drive operates as normal, in Gear mode. If one (or both) of the LIM switches is opened, this will cause the drive to switch to Jog mode (if MODESW = 1) and jog at one of two operator-entered velocities. The function works according to the following rules:

- Both inputs closed: operate in Gear mode
- CWLIM closed/CCWLIM open: jog at velocity X1
- CCWLIM closed/CWLIM open: jog at velocity X2
- Both inputs open: jog at velocity X1

IMPORTANT NOTE: For the function to work as specified, the operator must set LIMDIS=1. MODESW is reset to 0 whenever the opmode is changed.

TYPE: switch (r/w)
SYNTAX/RANGE: MODESW [0,1]
0: mode switching function deactivated
1: mode switching function activated
OPMODES: 4-7
UNITS: n/a DEFAULT: 0
DRIVE STATUS: dis EEPROM: yes

MOTOR

will display the TL number in use.

TYPE: factory variable (r/o)
SYNTAX/RANGE: MOTOR

OPMODES: all
UNITS: n/a DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

MRD

Move to R/D Position: this command causes the drive to move the motor shaft to a specified R/D converter position (in counts) at a specified speed. The direction of the move can also be explicitly commanded, or otherwise the motor will move in the direction of the shortest distance.

The optional flag [in pos ack] enables the operator to direct the Smart Drive to indicate when the commanded move is completed. When this flag is set to 1, the Smart Drive, upon completion of the commanded move, will output an exclamation point (!) over the serial port.

Note that in order to specify the [in pos ack] flag, the [direction] flag must also be specified; the [direction] flag, however, may be specified without specifying the [in pos ack] flag.

TYPE: command
SYNTAX/RANGE: MRD <pos> <vel> [direction] [in pos ack]
<pos> =0 to 4095 / 16,383 / 65,536 (RDRES = 12/14/16)
<vel> = 1 to VMAX
[direction] = 0 or 1 (optional; 0 = CCW, 1 = CW)
[in pos ack] = 0 or 1 (optional)
in pos ack = 0: do not indicate when move is complete
in pos ack = 1: indicate when move is complete
OPMODES: 8
UNITS: counts (position) and RPM (velocity)
DEFAULT: n/a
DRIVE STATUS: en EEPROM: n/a
EXAMPLES:

```
MI 3000 500     (MOVE to R/D position 3,000 in the
                 shortest direction from the current
                 position at a speed of 500 RPM)
MI 2000 1000 1  (MOVE to R/D position 2,000 in the CW
                 direction at a speed of 1,000 RPM)
MI 1000 100 0 1 (MOVE to R/D position 1,000 in the
                 CCW direction at a speed of 100 RPM;
                 transmit a (!) to the serial port when the
                 move is complete)
```

MSG

will suppress/enable the drive power-up message that is sent to the serial port and displayed on the Motion Link display.

TYPE: switch (r/w)
SYNTAX/RANGE: MSG [0,1]
0: Power-up message suppressed.
1: Power-up message not suppressed.
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

NCHBW

sets the bandwidth of the notch filter.

TYPE: variable (r/w)
SYNTAX/RANGE: NCHBW [1 to 200]
OPMODES: all
UNITS: Hz DEFAULT: TL

DRIVE STATUS: en/dis EEPROM: yes

NCHHZ

sets the center frequency of the notch filter.
TYPE: variable (r/w)
SYNTAX/RANGE: NCHHZ [1 to 500]
OPMODES: all
UNITS: Hz DEFAULT: TL (usu. 500 Hz)
DRIVE STATUS: en/dis EEPROM: yes

OPMODE

sets the operational mode of the drive.
TYPE: variable (r/w)
SYNTAX/RANGE: OPMODE [0 to 9]
0: Serial velocity mode
1: Analog velocity mode
2: Serial torque mode
3: Analog torque mode
4: Gear mode: A/B Quad input
5: Gear mode: CNT/DIR 1X (PULSE)
6: Gear mode: CNT/DIR 2X (EDGE)
7: Gear mode: UP/DN Counter input
8: Serial Position mode
9: Analog Position mode
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: dis EEPROM: yes

P

prints the value of the specified variable(s)/switch(es) on the monitor. Up to 20 variables can be displayed. The operator can specify the number of columns to be used to display each variable; the default number of columns is 12.
TYPE: command
SYNTAX/RANGE: P [<variable>] ....
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a
EXAMPLES:
P FILTMODE NCHBW (Print the filter mode and notch filter bandwidth, using 12 spaces/columns for each)

P PCMD 10 PDF 10 PE 10 (Print the listed variables, using 10 spaces/columns for each)

PCMD

prints the current commanded position.
TYPE: variable (r/o)
SYNTAX/RANGE: PCMD {-LONG to LONG}
OPMODES: 4 to 9
UNITS: counts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

PDF

is used to select the PDF (Pseudo Derivative Feedback) or PI (Proportional and Integral) control loop.

The PDF control loop has excellent load rejection capabilities and is suitable for applications requiring good speed regulation in the presence of load disturbances. The PI control loop is better suited for applications where a good command following capability is required, such as a master-slave application, but it tends to overshoot.

TYPE: switch (r/w)
SYNTAX/RANGE: PDF [0,1]
0: selects the PI loop
1: selects the PDF loop
OPMODES: 0,1,4 to 9
UNITS: n/a DEFAULT: TL (usually 1)
DRIVE STATUS: dis EEPROM: yes

PE

displays the current following error. If this value is greater than PEMAX, then the drive will be disabled.

TYPE: variable (r/o)
SYNTAX/RANGE: PE {0 to LONG}
OPMODES: 4 to 9
UNITS: Counts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

PEINPOS

sets the threshold position error. If PE is less than PEINPOS after a move, the INPOS switch is set, indicating that the drive is in position (see INPOS). If PE is greater than PEINPOS after a move, the INPOS switch is not set.

TYPE: variable (r/w)
SYNTAX/RANGE: PEINPOS [0 to 32,767]
OPMODES: 8
UNITS: counts DEFAULT: 100 counts
DRIVE STATUS: en/dis EEPROM: yes

PEMAX

sets the maximum allowable following error in pulse following mode. If the error exceeds this value, then the drive is disabled on fault. PEMAX = 0 disables this function.

TYPE: variable (r/w)
SYNTAX/RANGE: PEMAX [0 to 10,000,000]
OPMODES: 4 to 8
UNITS: counts DEFAULT: 0 counts
DRIVE STATUS: en/dis EEPROM: yes

PEXT

displays the accumulated position feedback from the external encoder. This variable is similar to PFB for the resolver feedback.

TYPE: variable (r/o)
SYNTAX/RANGE: PEXT {-LONG to LONG}
OPMODES: all
UNITS: counts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

PFB

displays the accumulated position feedback from the resolver. This variable can be used to change or reset the position feedback by entering a new value. PFB repre-sents the cumulative position due to total travel since power-up.
TYPE: variable (r/w)
SYNTAX/RANGE: PFB [-LONG to LONG]
OPMODES: all
UNITS: counts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

PLAY

will play back to the serial port the variable data that the PC-Scope Record command (RECORD) captured to memory (see the RECORD command for more information.
TYPE: command
SYNTAX/RANGE: PLAY
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

PRD

displays the current position output of the R/D converter. The maximum value of PRD is dependent upon the number of bits in the output of the R/D converter.
TYPE: variable (r/o)
SYNTAX/RANGE: PRD {0 to 4095 / 16,383 / 65,535)
(12-bit / 14-bit / 16-bit R/D)
OPMODES: all
UNITS: counts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

PROFMODE

sets the type of accel/decel profile to be used by the drive.
TYPE: variable (r/w)
SYNTAX/RANGE: PROFMODE [<curve>]
<curve> 0: No profile generation
1: Linear profile
2: Partial S-curve profile (Opmode 0,8)
3: Full S-curve profile (Opmode 0,8)
OPMODES: 0,1,4 to 8
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

PROMPT

enables/disables the prompt (-->) displayed on the Motion Link display.
TYPE: switch (r/w)
SYNTAX/RANGE: PROMPT [0,1] (0 = disabled; 1 = enabled)
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: yes

RDRES

sets the resolver resolution (# of bits).
TYPE: variable (r/w)

SYNTAX/RANGE: RDRES [<resolution>]
<resolution> = 12, 14, or 16 (4096, 16384, or 65536 counts/rev)
OPMODES: all
UNITS: bits DEFAULT: TL (usually 12)
DRIVE STATUS: dis EEPROM: yes

READY

indicates the status of the local drive Enable (EN). This may indicate that the drive is ready to be enabled, but will not take into account the status of the REMOTE input (see the ACTIVE command also).
TYPE: switch (r/o)
SYNTAX/RANGE: READY {0,1}
0: Drive not ready
1: Drive ready
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

RECORD

will capture real-time data to memory for later playback using the PLAY command. 256 data points are recorded for each of five variables: VCMD, VDES, VFB, TCMD, and IMON.

Timewise, the data points can be sampled at an integer multiple of every servo cycle. A servo cycle occurs every 500 microseconds (0.5 milliseconds), so the operator can specify that a data point be recorded every servo cycle, every 10th servo cycle, every 100th servo cycle, etc. The total recording time is therefore 256 times the recording interval selected by the operator. The recording interval (n) is the first of three parameters that can be specified with the RECORD command.

The three read-only switches RECDONE, RECING, and RECRDY can be used to track the progress of the RECORD command.

There are three options for initiating the recording sequence (using trigmode), as described below. One of the options is to begin recording when the velocity command (VCMD) exceeds an operator-defined trigger level (triglevel). If this option is selected, the trigger level, in RPM, must be specified.
TYPE: command
SYNTAX/RANGE: RECORD <n> <trigmode> <triglevel>
<n> Record data every nth servo cycle (.5 msecs)
<trigmode> 1 Upon start of move (VCMD > triglevel)
2 Upon any next command
3 Upon ABAUD input jumper
<triglevel> Defines the threshold value of VCMD in RPM that must be exceeded before recording will begin (trigmode 1)
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

RECDONE

indicates whether or not the Record command is done and data is available.
TYPE: switch (r/o)
0: Recording not done
1: Recording done, data ready
SYNTAX/RANGE: RECDONE {0,1}
OPMODES: all
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: no

RECING

indicates if data recording is in progress.

TYPE: switch (r/o)
0: Recording not in progress
1: Recording in progress
SYNTAX/RANGE: RECING
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: no

RECRDY

indicates that the Record command is waiting for a trigger to begin recording.

TYPE: switch (r/o)
0: Recording function not ready for trigger
1: Recording function ready and awaiting trigger
SYNTAX/RANGE: RECRDY
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: no

RELAY

gives the status of the Fault relay.

TYPE: switch (r/o)
SYNTAX/RANGE: RELAY {0,1}
0: Fault relay open (Fault present).
1: Fault relay closed (Normal--No Fault).
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

RELAYMODE

sets the Fault relay trigger condition.

TYPE: variable (r/w)
SYNTAX/RANGE: RELAYMODE [0, 1, 2, 3]
0: Fault relay drops when any fault condition exists.
1: Fault relay drops when any fault condition exists if the drive is Enabled.
2: relay closes (clears) automatically and LED clears when a fault clears to indicate that the fault disappeared (applicable only to unlatched faults, such as motor overspeed).
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

REMOTE

displays status of the Remote Enable input.

TYPE: switch (r/o)
SYNTAX/RANGE: REMOTE {0,1}
0: Remote input open.
1: Remote input closed.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

RSTVAR

resets all system variables and switches to their default states. Variables included in the TL file are not affected by this command. A complete system reset requires executing RSTVAR and then reloading the TL file. Refer to section 5 for more information on drive configuration and initialization.

TYPE: command
SYNTAX/RANGE: RSTVAR
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: dis EEPROM: n/a

S

will stop a jog or move command. The S command uses DEC to stop, but only if PROFMODE is non-zero. This command stops the drive, but the drive is still enabled. In Op-modes 2 & 3, the torque command is made 0. In Opmodes 1,4-7, & 9, the drive needs to be disabled and re-enabled to make the motor run again.

TYPE: command
SYNTAX/RANGE: S
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

SAT

indicates if the current loop command is greater than ILIM (i.e., the torque loop is saturated).

TYPE: switch (r/o)
SYNTAX/RANGE: SAT {0,1}
0: Current loop is not saturated.
1: Current loop is saturated.
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

SAVE

saves all the designated variables (those denoted EEPROM: yes) from system RAM to EEPROM. System RAM is cleared on power-loss. Variables which are saved to EEPROM can be reloaded into system RAM by executing a LOAD.

TYPE: command
SYNTAX/RANGE: SAVE
OPMODES: all
UNITS: n/a DEFAULT : n/a
DRIVE STATUS: en/dis EEPROM: n/a

SCRVTM

sets the duration of the s-curve profile in milliseconds (msec).

TYPE: variable (r/w)
SYNTAX/RANGE: SCRVTM [0 to 100,000]
OPMODES: 0, 8
UNITS: msec DEFAULT: 0 msec
DRIVE STATUS: en/dis EEPROM: yes

STATUS

will print 6 status bytes to the serial port: These bytes will be displayed on the Motion Link display as six hex (base 16) numbers, in the format: XX XX XX XX XX XX. The order of display is Byte1 - Byte2 - Byte3 - Byte4 - Byte5 - Byte6.

The following tables break the status bytes down bit by bit (bit 7 = MSB; bit 0 = LSB; n/u = not used). For all bits, 0=false and 1=true.

Status Byte 1: Hardware and Fault Status			
7	Under Voltage Fault (u)	3	Resolver Loss (r)
6	Over Voltage Fault (O)	2	+/-12v Analog Supply Fault (A)
5	Over Temp Fault (t)	1	Power Stage Enable
4	Power Stage Fault (P)	0	Remote (External) Enable

Status Byte 2: Software Fault Status			
7	n/u	3	Scale Overflow
6	n/u	2	Foldback bad
5	RAM Failed	1	Gear Overflow
4	Excessive Position Error	0	Overspeed

Status Byte 3: Mode_Flag2 (Opmode)			
7	n/u	3	n/u
6	n/u	2	n/u
5	n/u	1	Analog Position mode (opmode 9)
4	n/u	0	Serial Position mode (opmode 8)

Status Byte 4: Mode_Flag1 (Opmode)			
7	Up/Down Count Input mode (opmode 7)	3	Analog Torque mode (opmode 3)
6	Edge Counting Pulse/Dir mode (opmode 6)	2	Serial Torque mode (opmode 2)
5	Pulse Counting Pulse/Dir mode (opmode 5)	1	Analog Velocity mode (opmode 1)
4	A/B Quadrature Input mode (opmode 4)	0	Serial Velocity mode (opmode 0)

Status Byte 5: Drive and Motion Status Flags			
7	n/u	3	Saturated
6	DIR flag	2	In Foldback
5	Stopped	1	Active
4	In Position	0	Ready

Status Byte 6: Miscellaneous Status			
7	n/u	3	GEAR flag
6	Fault Relay Status (0=fault; 1=no fault)	2	LIMDIS flag
5	PDF (0=PI; 1=PDF)	1	CCW limit sw tripped
4	Zero Mode flag	0	CW limit sw tripped

STEP

generates a step input and records the response of the drive to the PC Scope memory. This memory can then be printed to the serial port with the PLAY command. This is useful for analyzing the time response of the drive.

The step input that is generated is in the form of a square wave which alternates between a non-zero velocity command and a velocity command of zero. The operator can specify the period of the square wave and the magnitude of the non-zero portion of the velocity command. The STEP command is halted by using the Stop (S), Kill (K), or Disable (DIS) command.

TYPE: command
SYNTAX/RANGE: STEP [<period>] [<magnitude>]
<period> 10 to 1000 millisec
<magnitude>10 to 1000 RPM
OPMODES: 0, 1
UNITS: milliseconds (period) and RPM (magnitude)
DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: n/a

EXAMPLE: STEP 100 1200

This will generate a velocity command of 1200 RPM for 50 milliseconds, a velocity command of zero for 50 milliseconds, and will repeat this cycle until the operator stops it using S, K, or DIS.

STOPPED

indicates whether or not the motor has finished a move command in Opmode 8.

TYPE: switch (r/o)
SYNTAX/RANGE: STOPPED {0,1}
0: the motor has not completed the last move command
1: the motor has completed the last move command
OPMODES: 8
UNITS: n/a DEFAULT: 1
DRIVE STATUS: en/dis EEPROM: no

T

prints the Absolute average torque.

TYPE: variable (r/o)
SYNTAX/RANGE: T {0 to 4095}
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: no

TCMD

displays the commanded torque (which is generally proportional to motor current). This variable can be viewed in any opmode but can only be set in opmodes 2 and 3.

TYPE: variable (r/w)
SYNTAX/RANGE: TCMD [-4096 to 4095]
OPMODES: 2, 3
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

TDAC

displays the value of the digital input to the torque D/A converter. This value is proportional to the current command to the motor.
TYPE: variable (r/o)
SYNTAX/RANGE: TDAC [-4096 to 4095]
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

THERM

displays the motor-over-temp flag status.
TYPE: switch (r/o)
SYNTAX/RANGE: THERM {0,1}
0: Motor not over temperature
1: Motor over temperature
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: no

THERMODE

sets the options for the Thermostat operation. If the motor exceeds temperature (THERM = 1), this variable defines the action that will be taken.
TYPE: variable (r/w)
SYNTAX/RANGE: THERMODE [0,1,2]
0: Disables the drive instantly and drops the fault relay.
1: Disables the drive after 2 minutes; drops the relay instantly.
2: Drops the Fault relay but does not disable the drive.
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: yes

TREF

sets the torque reference
TYPE: variable (r/w)
SYNTAX/RANGE: TREF [1 to 32,767]
OPMODES: 3
UNITS: 1/4096 Tmax DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

TRUN

displays the accumulated run time of the drive. The run time display format is: <days>:<hours>:<minutes>.
TYPE: variable (r/o)
SYNTAX/RANGE: TRUN
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: yes

TUNE

tunes the system for the given drive and load conditions. Often when the motor load is changed, tuning parameters need to be reset. This command tunes the drive and sets the values of the variables KV, KVI, GV, GVI, GP, and GPI.

The command requires two arguments (bandwidth and damping factor). Higher bandwidth produces faster response time. Lower damping factor reduces overshoot, but performance is noisier.
TYPE: command
SYNTAX/RANGE: TUNE <bw> <damping factor>
<bw> 5 to 100 Hz
<damping factor> 0: slightly overdamped
1: critically damped (normally used)
2: slightly underdamped
OPMODES: 0, 1, 4 to 9
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: n/a

V

displays the Average velocity as calculated from the resolver feedback. The velocity that is displayed is an average calculated over the most recent 8-millisecond time period.
TYPE: variable (r/o)
SYNTAX/RANGE: V [-VMAX to VMAX]
OPMODES: all
UNITS: RPM DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

VCMD

displays the velocity command to the drive. This value is the steady-state velocity that the drive is commanded to go to. For example, if the operator enters "J 100" in Opmode 0, then VCMD=100, regardless of what velocities the drive transitions through on its way to 100 RPM. In non-velocity modes, VCMD is the output of the position-loop portion of the servo loop.
TYPE: variable (r/o)
SYNTAX/RANGE: VCMD {-VMAX to VMAX}
OPMODES: all
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: no

VDES

displays the instantaneous commanded velocity to the drive. The source of this value is the velocity control loop, and this value can change as a motion profile is executed or the drive accelerates or decelerates. For example, if the operator enters "J 100" in Opmode 8, then VDES will change from 0 to 100 as the drive accelerates or decelerates to that speed.
TYPE: variable (r/o)
SYNTAX/RANGE: VDES {-VMAX to VMAX}
OPMODES: all
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: no

VE

displays the velocity error (VFB-VCMD).
TYPE: variable (r/o)
SYNTAX/RANGE: VE {-LONG to LONG}
OPMODES: all
UNITS: RPM DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

VER

displays the drive software version number.

TYPE: factory variable (r/o)
SYNTAX/RANGE: VER
OPMODES: all
UNITS: n/a DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

VEXT displays the instantaneous velocity feedback as calculated from the external encoder input channel. This assumes a 1024-line count encoder or a 4096 pulse-per-rev master. This variable is similar to VFB for the resolver feedback.
TYPE: variable (r/o)
SYNTAX/RANGE: VEXT {-VMAX to VMAX}
OPMODES: all
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: no

VFB displays the instantaneous velocity feedback of the motor as calculated from the resolver feedback.
TYPE: variable (r/o)
SYNTAX/RANGE: VFB {-VMAX to VMAX}
OPMODES: all
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: no

VMAX displays the drive's max allowable speed.
TYPE: factory variable (r/o)
SYNTAX/RANGE: VMAX {0 to 20,000}
OPMODES: all
UNITS: RPM DEFAULT: TL
DRIVE STATUS: en/dis EEPROM: yes

VOLTS displays the drive amplifier's rated voltage.
TYPE: factory variable (r/o)
SYNTAX/RANGE: VOLTS {0 to 480}
OPMODES: all
UNITS: volts DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

VOSPD sets the over speed trip limit of the motor. The drive is disabled when its velocity exceeds VOSPD. This is a TL variable is initially set to 20% above the rated motor speed, but it can be reduced during regular motor operation for protection.
TYPE: variable (r/w)
SYNTAX/RANGE: VOSPD [0 to (VMAX X 1.2)]
OPMODES: all
UNITS: RPM DEFAULT: TL
DRIVE STATUS: dis EEPROM: yes

VREF

sets the reference velocity in the analog velocity mode (opmode 1). For example, if VREF is 1.25 x VMAX, then 8 volts input equals maximum motor speed (VMAX).
TYPE: variable (r/w)
SYNTAX/RANGE: VREF [0 to LONG]
OPMODES: 1
UNITS: RPM DEFAULT: TL
DRIVE STATUS: dis EEPROM: yes

VX

displays the average external velocity as calculated from the external encoder input channel. This variable is similar to V for the resolver feedback.
TYPE: variable (r/o)
SYNTAX/RANGE: VX {0 to LONG}
OPMODES: 4 to 8
UNITS: RPM DEFAULT: n/a
DRIVE STATUS: en/dis EEPROM: no

X1

sets a jog velocity parameter that is used in conjunction with MODESW to specify operation in the Gear/Jog mode switching function. See also MODESW and X2.
TYPE: variable (r/w)
SYNTAX/RANGE: X1 [-VMAX to VMAX]
OPMODES: 4 to 7
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: yes

X2

sets a jog velocity parameter that is used in conjunction with MODESW to specify operation in the Gear/Jog mode switching function. See also MODESW and X1.
TYPE: variable (r/w)
SYNTAX/RANGE: X2 [-VMAX to VMAX]
OPMODES: 4 to 7
UNITS: RPM DEFAULT: 0 RPM
DRIVE STATUS: en/dis EEPROM: yes

ZERO

puts the drive in resolver zeroing mode. When the Zero mode is active, then only one winding is active.
TYPE: switch (r/w)
SYNTAX/RANGE: ZERO [0,1] (0 = not zero mode; 1 = zero mode)
OPMODES: all
UNITS: n/a DEFAULT: 0
DRIVE STATUS: en/dis EEPROM: no

2.0 TABLE OF COMMANDS

SMART DRIVE COMMANDS			
NAME	**DESCRIPTION**	**UNITS**	**RANGE**
ANZERO	Zero the Analog Input	n/a	n/a
DIS	Disable the Drive	n/a	n/a
DUMP	Dump the Variables to the Serial Port	n/a	n/a
DUMP TL	Dump the TL Variables to the Serial Port	n/a	n/a
EN	Enable the Drive	n/a	n/a
ERR	Display the Last Fault	n/a	n/a
ERR CLR	Clear the Fault Buffer	n/a	n/a
ERR HIST	Display Last 20 Faults	n/a	n/a
ERR #	Display the Error Message	n/a	1-100
J	Jog (Rotate) the Motor	rpm	-VMAX-+VMAX
K	Kill (Disable) the Drive	n/a	n/a
LOAD	Load EEPROM Variables	n/a	n/a
MA <pos><vel>	Move Absolute (pos, vel)	counts, rpm	Long, 1-VMAX
MI <pos><vel>	Move Incremental (pos,vel)	counts, rpm	Long, 1-VMAX
MRD <pos> <vel>	Move to R/D Position (pos, vel)	counts, rpm	0-4095, 1-VMAX
P<var><var	Print variables (up to 20)	n/a	n/a
PLAY	Play Recorded Data	n/a	n/a
RECORD	Record Data	n/a	n/a
RSTVAR	Reset Variables	n/a	n/a
S	Stop Motion	n/a	n/a
SAVE	Save EEPROM Variables	n/a	n/a
STEP	Record Step Command	n/a	n/a
TUNE <bw> <factor>	Tune the Drive With Specified Bandwidth and Damping Factors	Hz, n/a	5-100, 0-2

3.0 TABLES OF VARIABLES SORTED BY TYPE

DESCRIPTION OF VARIABLE RANGES	
VARIABLE	**VARIABLE RANGES**
Switch	0 or 1
Short>0	0 < x < 65,535 (integer values)
Short	-32,768 < x < 32,767 (integer values)
Long>0	0 < x < 4,294,967,295 (integer values)
Long	-2,147,483,648 < x < 2,147,483,647 (integer values)

READ/WRITE SWITCHES		
NAME	**DESCRIPTION**	**RANGE**
ANDG	Enable Analog Dual Gain	0,1
DEP	Enable 40 Character Error Messages	0,1
DIR	Direction; set to 1 if CW is positive	0,1
ECHO	Enable Serial Port Echo	0,1
GAINSHIFT	High Load Enable Switch	0,1
GEAR	Enable Gear Mode	0,1
LIMDIS	Limit Switch Disable	0,1
MODESW	Gear/Jog Mode Switching	0,1
MSG	Enable Power-up Message	0,1
PDF	Enable Pseudo-Derivative Feedback	0,1
PROMPT	Enable Prompt	0,1
ZERO	Enable Resolver Zeroing Mode	0,1

READ-ONLY SWITCHES		
NAME	**DESCRIPTION**	**RANGE**
ABAUD	AutoBAUD Status	0,1
ACTIVE	Monitor Drive Active	0,1
CCWLIM	CCW Travel Limit Reached	0,1
CWLIM	CW Travel Limit Reached	0,1
FOLD	Monitor Foldback Mode Status	0,1
INPOS	Motor in Position	0,1
READY	Local Drive Enable Status	0,1
RECDONE	Recording Done, Data Ready	0,1
RECING	Data Recording in Progress	0,1
RECRDY	Drive Ready to Record	0,1
RELAY	Fault Relay Status	0,1
REMOTE	Remote Enable Input Status	0,1
SAT	Current Loop Saturated	0,1
STOPPED	Commanded Motion Complete	0,1
THERM	Motor Over Temperature Flag	0,1

READ/WRITE VARIABLES			
NAME	**DESCRIPTION**	**UNITS**	**RANGE**
ACC	Acceleration	rpm/sec	1-100k
ANDB	Analog Dead Band	4.88 mV	0-2047
ANOFF	Analog Offset	0.610 mV	-16384-+16383
ANSLEW	Analog Input LPF BW	Hz	1-1000
BAUD	Serial Port Baud Rate	baud	300-19200
DEC	Profile Deceleration	rpm/sec	1-100k
DECSTOP	Limit SW Deceleration	rpm/sec	1-100k
ENCLINES	Encoder Input Lines	lines	8-16384
FILTMODE	Filter Mode	n/a	0-2
GEARI	Input Gear "Teeth"	n/a	Short
GEARO	Output Gear "Teeth"	n/a	Short
GICAP	Integrator Band	n/a	1-100
GP	PI Position Loop Proportional Gain	n/a	Short> 0
GPI	PI Position Loop Velocity Integral Gain	n/a	Short> 0
GV	PI Velocity Loop Proportional Gain	n/a	Short≥ 50
GVD	PI Velocity Loop Velocity Derivative Gain	n/a	Short≥ 0
GVI	PI Velocity Loop Velocity Integral Gain	n/a	Short≥ 0
ILIM	Current Limit	% IMAX	0-100

KA / KF	Feed-Forward Gains	n/a	0-30/0-5
KP	PDF Position Loop Proportional Gain	n/a	Short≥ 0
KV	PDF Velocity Loop Proportional Gain	n/a	Short≥ 50
KVI	PDF Velocity Loop Integral Gain	n/a	Short≥ 50
LPFHZ	Lowpass Filter Freq	Hz	1-1000
NCHBW	Notch Filter Frequency	Hz	1-200
NCHHZ	Notch Filter Bandwidth	Hz	1-500
OPMODE	Operational Mode	n/a	0-9
PEINPOS	Position Error Threshold	counts	Short≥ 0
PEMAX	Max Following Error	counts	0-10 million
PFB	Accumulated Resolver Position Feedback	counts	Long
PROFMODE	Profile Mode	n/a	0-3
RDRES	R/D Conv. Resolution	bits	12-16
RELAYMOE	Set Fault Relay Action	n/a	0-3
SCRVTM	S-Curve Time	msec	0-100k
TCMD	Torque Command	n/a	-4096-+4095
THERMODE	Thermostat Operation	n/a	0-2
TREF	Torque Reference	1/4096 x TMAX	Short> 0
VOSPD	Over Speed Trip Limit	rpm	0-(1.2 x VMAX)
VREF	Velocity Reference	rpm	Long≥ 0
X1 / X2	MODESW Velocity 1 / 2	rpm	±VMAX

READ-ONLY VARIABLES			
NAME	**DESCRIPTION**	**UNITS**	**RANGE**
ADDR	RS-485 Multidrop Addr	n/a	0-15
AMPS	Drive Rated Current	amps	0-55
ANIN	Analog Input (for -10V to +10V input range)	0.610 mV	-16384-+16383
HVER	Hardware Version #	n/a	n/a
I	Average Current Output	% of IMAX	0-100
IMAX	Peak RMS Current Limit	% of (2 x AMPS)	0-100
IMON	Instantaneous Current Output	% of IMAX	0-100
MOTOR	Motor Model/TL #	n/a	n/a
PCMD	Position Command	counts	Long
PE	Position Error	counts	Long>0
PEXT	Encoder Position Fdback	counts	Long
PRD	R/D Position Feedback	counts	0-4095
STATUS	Drive Status (6 Hex wds)	n/a	n/a
T	Average Torque Output	n/a	0-4095
TRUN	Accumulated Drive Run Time	dd:hh:mm	n/a
V	Ave Velocity (calculated from the resolver)	rpm	±VMAX
VCMD	Velocity Command	rpm	±VMAX
VDES	Desired Velocity	rpm	±VMAX
VE	Velocity Error	rpm	Long
VER	Firmware Version #	n/a	n/a
VEXT	Ave Velocity (calculated from the encoder)	rpm	±VMAX
VFB	Inst. Velocity Feedback	rpm	±VMAX
VMAX	Max Drive Speed	rpm	0-20,000
VOLTS	Rated Drive Voltage	volts	0-480
VX	Ave Velocity (calculated from the encoder)	rpm	±VMAX

FACTORY VARIABLES			
The following variables are internal variables and are not normally used or settable by customers. All of these variables may be viewed as read-only by the operator. These variables are set at the factory and program the Smart Drive for the particular motor it will be controlling. Many of these variables are initialized by loading the TL file.			
NAME	**DESCRIPTION**	**UNITS**	**RANGE**
A1-A16	Motor Commutation	n/a	0-255
ADEN	ACC/DEC Units Denominator	none	1-100,000
AMPS*	Drive Amps	I	0-55
ANGLD	Motor Commutation	n/a	0-2048
ANUM	ACC/DEC Units Numerator	none	1-100,000
FOLDD	Foldback Delay	sec/100	Short>0
FOLDR	Foldback Reset	sec/100	Short>0
FOLDT	Foldback Constant	sec/100	Short>0
ICONT	Continuous Current Rating	% of I peak	1-100
IDEN	Current Units Denominator	none	Long>0
IGAIN	Current Gain Factor	none	0-255
IMAX *	Maximum Current	I	0-100
IND	Reserved for future use		
INUM	Current Units Numerator	none	1-100,000
IZERO	Zeroing Current	% of peak	0-100
KC	Low Speed Adjust	none	0-255
MOTOR *	Motor Model Number	n/a	n/a
POLES	Motor Poles	Poles x 128	Short>0
VADVTBL	Angle Table Max	VEL	300-VMAX
VDEN	Velocity Units Denominator	none	1-100,000
VER*	Firmware Version #	n/a	n/a
VMAX*	Maximum Velocity	rpm	0-20,000
VNUM	Velocity Units Numerator	none	1-100,000
VOLTS*	Drive Voltage	Volts	0-480

* These variables are described in more detail in section 1.0.

4.0 COMMANDS & VARIABLES SORTED BY FUNCTION

DRIVE CONTROL AND STATUS	
EN, REMOTE	Drive Enable
DIS, K, S	Drive Disable/Kill/Stop
ACTIVE, READY, STATUS	Drive Status
RELAY, RELAYMODE	Fault Relay Configuration
THERM, THERMODE	Over Temp Configuration
OPMODE	Operational Mode
ZERO	Resolver Zeroing
ERR [HIST | CLR | 1-100]	Error Message Displays
TRUN	Drive Run Time

COMPENSATION / TUNING	
GP, GPI, GV, GVD, GVI	PI Compensation Gains
KC*, KP, KV, KVI	PDF Compensation Gains
KA, KF	Feed-Forward Gains
TUNE	Auto Compensation

COMMUNICATIONS	
\<address> (0-15)	Multidrop Axis Address
\\	Multidrop Hang-up Axis
*	Multidrop Broadcast All
ABAUD (0|1)	AutoBAUD Enable
ADDR (0-15)	Multidrop Address Variable
BAUD (300|600|...|19200)	Baud Rate Variable
DEP (0|1)	Enable 40 Column Error Msg
ECHO	Enable Character Echo
MSG	Enable Power-up Message and Error Messages
PROMPT	Disable System Prompts

MOTION CONTROL	
A1-A16*, ANGLD*	Motor Commutation Values
ACC, DEC, DECSTOP	Accel/Decel Values
ANUM*, ADEN*	Accel Units Numer/Denom
CCWLIM, CWLIM	Travel Limit Status Switches
DIR	Direction
FILTMODE	Filter Mode
GAINSHIFT	High Load Enable Switch
GEAR, GEARI, GEARO	Gear Variables
LPFHZ	Lowpass Filter Frequency
LIMDIS	Limit Switch Disable
MODESW	Gear/Jog Mode Switch Enable
NCHBW, NCHHZ	Notch Filter Bandwidth and Freq
OPMODE	Operational Mode
PDF	PDF/PI Select Switch
PROFMODE	Motion Profile Mode
SCRVTM	S-curve Time

* These variables are factory variables. Their values are set at the factory and are not programmable.

VARIABLE RECORDING / SETTING	
DUMP, DUMP TL	Dump Variables/TL Variables
LOAD, SAVE	EEPROM load/save
P <var> <var> ...	Print Variables
PLAY	Play Recorded Data
RECORD, STEP	Record Data
RECDONE, RECING, RECRDY	Recording Status Flags
RSTVAR	Reset Variables

ANALOG INPUT-RELATED	
ANDB, ANOFF, ANSLEW	Analog Deadband, Offset, Slew
ANDG	Analog Dual Gain Switch
ANIN	Analog Input Value
ANZERO	Zero Analog Input

MOTOR AND DRIVE PARAMETERS	
AMPS*, VOLTS*	Rated Drive Current and Voltage
ENCLINES, RDRES	Encoder/Resolver Parameters
HVER*, VER*	HW/SW Version Numbers
ICONT*, ILIM, IMAX*	Current Parameters
MOTOR*	Motor # / TL File
POLES*	Motor Poles
VMAX*	Maximum Motor Velocity

POSITION-RELATED	
ACC, DEC, DECSTOP	Profile Accel, Decel Values
CCWLIM, CWLIM, LIMDIS	Travel Limit Status, Disable
PEINPOS, INPOS	In-Position Threshold, Status
MA, MI, MRD	Move Absolute, Incremental, R/D
PCMD	Position Command
PE, PEMAX	Position Error and Threshold
PEXT, PFB	Position Feedback
PRD	R/D Position Feedback
S, STOPPED	Stop Command, Status Flag

VELOCITY-RELATED	
ACC, DEC, DECSTOP	Accel, Decel Values
J, S	Jog, Stop Commands
V, VEXT, VFB, VX	Velocity Feedback
VADVTBL*, VCMD, VDES	Velocity Command Parameters
VE	Velocity Error
VMAX*, VOSPD	Velocity Max and Overspeed
VREF	Velocity Reference
VNUM*, VDEN*	Velocity Units Numer/Denom
X1, X2	Gear/Jog MODESW Velocities

* These variables are factory variables. Their values are set at the factory and are not programmable.

CURRENT / TORQUE-RELATED	
AMPS*	Rated Drive Current
FOLD, FOLDD, FOLDR, FOLDT	Foldback Status Flag and Other Parameters
I, ICONT*, IGAIN*, ILIM, IMAX*, IZERO*	Current Limits and Parameters
INUM*, IDEN*	Current Units Numer/Denom
IMON	Current Monitor
SAT	Current Loop Saturated Flag
T, TCMD, TREF	Torque Cmd and Reference

SYSTEM UNITS			
NAME	**DESCRIPTION**	**UNITS**	**RANGE**
ADEN*	ACC/DEC Units Denominat	None	Long
ANUM*	ACC/DEC Units Numerator	None	Long
IDEN*	Current Units Denominator	None	Long
INUM*	Current Units Numerator	None	Long
VDEN*	Velocity Units Denominator	None	Long
VNUM*	Velocity Units Numerator	None	Long

* These variables are factory variables. Their values are set at the factory and are not programmable.

5.0 DRIVE INITIALIZATION & CONFIGURATION

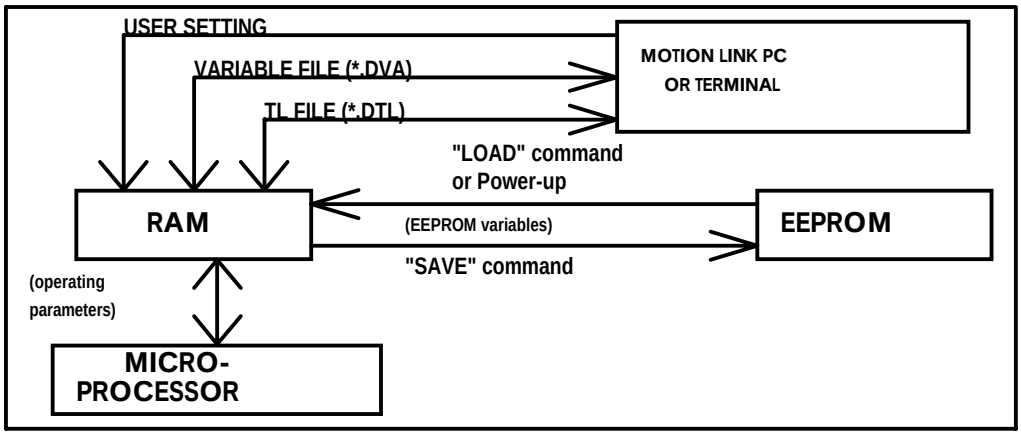
This section describes the different methods for setting system parameters and saving them. TL files, EEPROM variables, and Variable files are all discussed.

The Smart Drive is shipped with a TL file preloaded. A TL file "programs" the Smart Drive for the particular motor it will be controlling by automatically setting the values of system variables. During setup and operation, any changes that are made to variables are stored in dynamic system RAM and will be lost if the drive is powered down. If this occurs, the variables will revert back to their factory and TL-set values when the drive is powered up again.

Many of the Smart Drive variables, however, can be saved to system EEPROM, and they will not be lost when the drive is powered down and back up. The variables that can be saved in this fashion are listed in a table below and are denoted "EEPROM: yes" in the descriptions in section 1.

Therefore, the operator can make changes to system variables, execute a SAVE command, and any changes that have been made will be saved permanently, as long as the variable is an EEPROM variable. Once an operator has correctly configured a Smart Drive for its application, all variables can be saved, and none of the configuration information will be lost.

The Smart Drive also makes use of a Variable File (.DVA file name extension in DOS) which can be used to write system variables to disk. A Variable File includes variables that are not part of the EEPROM variables, so loading a Variable File into the drive will set some variables that loading from EEPROM will not affect.



The following procedures describe how to configure a drive, restore a drive to its factory configuration, and restore a drive to its custom configuration.

5.1 CONFIGURING A DRIVE

1. Set the Smart Drive up in its application. Perform any necessary tuning and variable changes as required for the application.
2. Execute a SAVE to save all EEPROM variables.
3. Save a Variable File (see Motion Link) to disk.

5.2 RESTORING FACTORY SETTINGS

1. Power-up the Smart Drive with the REMOTE switch in the OFF position.
2. Establish serial port communications. If the drive does not communicate, then try the AUTOBAUD procedure below.
3. At the prompt, type RSTVAR. This resets all the variables.
4. Load the TL file supplied with the drive.
5. Execute a SAVE command to save the values to EEPROM.
6. The drive is now in its factory-configured state.

5.3 RESTORING A CUSTOM CONFIGURATION

1. Execute the "Restoring Factory Settings" procedure above.
2. Load the Variable File that was saved as part of the "Configuring A Drive" procedure above.
3. The drive has now been restored to its customized settings for its particular application.

5.4 CHANGING AN EPROM

Note: the EPROM is different from the EEPROM. The EPROM contains the Smart Drive program, which may be updated to a new revision, requiring changing the EPROM. Follow this procedure when swapping an old EPROM for a new one.

1. Power off the Smart Drive and wait for few minutes until REGEN is discharged.
2. Wear a ground strap, and using a proper IC chip remover, remove the old EPROM.
3. Insert the new EPROM properly and make sure that all the pins are in the socket firmly.
4. Power-up the Smart drive with the REMOTE switch in OFF position.
5. Establish serial port communications. If it does not communicate then try the AUTOBAUD procedure below.
6. At the prompt, type RSTVAR, which resets all the variables.
7. Load the TL file supplied with the drive.
8. Execute a SAVE command to save the parameters.
9. Normal operation is now restored.

Note: The above procedure brings the drive to the factory known state. Any changes to parameters (such as the tune parameters) made with the old firmware are lost and need to be redone.

5.5 AUTOBAUD PROCEDURE

1. Power off the Smart Drive and wait for few minutes until REGEN is discharged.
2. Jumper the AUTOBAUD pins together on connector C3 (pins 7 to 8).
3. Turn the RS-485 multidrop address selector to "0".
4. Power-up the Smart Drive with the REMOTE switch OFF.
5. The Smart Drive's LED Status indicator should blink at an one second intervals.
   - If the readout does not blink, the check the AUTOBAUD jumper.
   - If the readout is not lit, then there is some other problem. Check that the EPROM has been inserted properly.
6. Press the Enter key repeatedly until the Smart Drive responds.

6a. The Smart Drive will automatically autobaud after 40 seconds if it does not respond to the Enter keys.

6b. If the Smart Drive still does not print any data to the screen but the LED Status readout has stopped flashing, then the ECHO and/or PROMPT flags may be turned off. Try typing "RSTVAR" terminated by an Enter key. This should initialize all communications variables to their proper state.

6c. If the Smart Drive still does not respond then check the following items:
   - the PC/Terminal *
   - the serial cable *
   - the multidrop address switch

6d. If the Smart Drive still does not respond, contact the factory.

* The PC/Terminal and the serial cable can be easily diagnosed with the following procedure:
- On the serial cable end that would plug into the Smart Drive, short pins 2 and 3 together.
- On the PC, run the Motion Link communications program.
- Now type characters on the PC/Terminal keyboard.
- You should see the characters that you type echo to the display.
- If you do not see any characters, then there is a problem with either the PC/Terminal or the serial cable.

VARIABLES STORED IN EEPROM		
NOTE: The settings of these variables are stored in EEPROM whenever the SAVE command is executed. The values in EEPROM are loaded into the system upon power-up and whenever the LOAD command is executed. Refer to the SAVE, LOAD, and RSTVAR commands for more information.		
ACC	GV	PDF
ANDB	GVD	PEINPOS
ANDG	GVI	PEMAX
ANSLEW	HVER	PROFMODE
DEC	ILIM	PROMPT
DECSTOP	IMAX	RDRES
DEP	KA	RELAYMODE
DIR	KF	THERMODE
ECHO	KP	TREF
FILTMODE	KV	TRUN
GAINSHIFT	KVI	VMAX
GEAR	LIMDIS	VOSPD
GEARI	LPFHZ	VREF
GEARO	MOTOR	X1
GICAP	MSG	X2
GP	NCHBW	
GPI	NCHHZ	

If the drive should ever need to be reconfigured, the proper method of doing so is to use the RSTVAR command to reset all variables to their default states, and to then reload the TL file. The following two tables give the effects of the RSTVAR command and list the variables that are assigned when a TL file is loaded.

DEFAULT VALUES ASSIGNED BY THE "RSTVAR" COMMAND		
ACC = 100,000	ENCLINES=1024	OPMODE = 1
ANDB = 0	GAINSHIFT = 0	PEINPOS = 100
ANDG = 1	GEAR = 1	PEMAX = 0
ANOFF = 0	GEARI = 1	PROMPT = 1
ANSLEW = 1000	GEARO = 1	PROFMODE = 0
DEC = 100,000	GICAP = 10	RELAYMODE=0
DECSTOP=100,000	IND = 0	SCRVTM = 0
DEP = 0	LIMDIS = 0	THERMODE = 0
DIR = 1	MSG = 1	TREF = 2048
ECHO = 1		ZERO = 0

VARIABLES LOADED FROM THE TL FILE (FILE NAME *.DTL)		
FACTORY VARIABLES		
AMPS	FOLDD	IGAIN
MOTOR	FOLDR	POLES
INUM	FOLDT	VMAX
IDEN	KC	VADVTBL
VNUM	IND	A1-A16
VDEN	IZERO	ANGLD
ANUM	IMAX	
ADEN	ICONT	
READ/WRITE VARIABLES		
RDRES	KVI	LPFHZ
VOSPD	KP	NCHBW
VREF	GV	NCHHZ
ILIM	GVI	FILTMODE
PDF	GP	
KV	GPI	

VARIABLES CONTAINED IN A VARIABLE FILE (FILE NAME *.DVA)		
ACC	GV	PEINPOS
ANDB	GVI	PEMAX
ANOFF	ILIM	PROFMODE
BAUD	KP	PROMPT
DEC	KV	RDRES
DIR	KVI	RELAYMODE
ECHO	LIMDIS	SCRVTM
FILTMODE	LPFHZ	THERMODE
GEAR	MSG	TREF
GEARI	NCHBW	VOSPD
GEARO	NCHHZ	VREF
GP	OPMODE	ZERO
GPI	PDF	

POWER-UP STATE OF THE SMART DRIVE SWITCHES		
OFF (= 0)		
RECING	THERM	ZERO
RECRDY		
ON (= 1)		
ANDG	RECDONE	STOPPED
REMEMBERED		
ABAUD	PDF	LIMDIS
ACTIVE	READY	DIR
CCWLIM	RELAY	ECHO
CWLIM	REMOTE	GEAR
FOLD	SAT	MSG
INPOS	DEP	PROMPT
MODESW	GAINSHIFT	
NOTE: The "REMEMBERED" switches include switches whose settings are loaded from EEPROM or are determined by hardware, by other switch settings, etc.		

6.0 ERRORS AND FAULTS

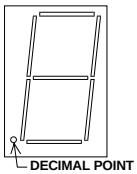
There are two types of errors detected by the Smart Drive.

1. Errors: non-fatal problems that do not require the drive to be shut down.
2. Faults: fatal problems that require the drive to be shut down by the software.

ERR COMMAND	
ERR	Print last fault detected
ERR <error number>	Print error message for error number
ERR HIST	Print Error History Buffer
ERR CLR	Clear Error History Buffer

SEVEN-SEGMENT LED DISPLAY	
DRIVE STATE	**DISPLAY APPEARANCE**
Power-up	Flashes a sequence of numbers that matches the motor number/TL file number in use.
Steady State (No Faults)	Displays the operational mode (opmode) of the drive (0-9). The only time the opmode number will flash is when autobauding is in progress.
Fatal Error (Fault)	Flashes a letter indicating the fault that was detected (see table below). In general, these faults will cause a latched drive disable.
Momentary Fault	Displays a character momentarily before returning to the steady state. C = Communications Error F = Drive is in Foldback mode

LED DISPLAY DECIMAL POINT	
DECIMAL POINT STATE	**DRIVE STATUS**
Steady OFF	No power to the motor
Steady ON	Drive enabled, power to the motor
Flashing	Drive enabled, power to the motor, but a safety feature has disabled the motor



SMART DRIVE LED'S	
FAULT	RED; indicates fault in regen. circuit when lit
OVERLOAD	YELLOW; indicates power supply regen. circuit is actively dumping power
BUS	GREEN; indicates high-voltage DC bus power is present on the drive

LIST OF FAULTS (FATAL)			
Err #	LED	Error/Fault Msg	Possible Cause
1	t	Drive Over Temp	overload, fan function, power stage
2	o	Bus Over Voltage	excessive decel rate
3	P	Power Stage Fault	power stage surge current
4	r	Resolver Loss	resolver connection
5	u	Bus Under Voltage	power line voltage
6	H	Motor Over Temp	motor overload
7	A	Analog Supply	+/- 12V power supply
8		not used	
9	i	RAM Test Failed	faulty RAM
10	J	Motor Over Speed	motor speed too high or accel overshoot
11	G	Gear Overflow	bad gear ratio creates an overflow
12	i	Foldback Bad	reload TL file
13	i	Engineering Unit Scale Overflow	calculations within the processor may have caused a computer error; reload TL file
14	y	Position Following Error	PEMAX too low or ACC too high
15	E	EEPROM Checksum Error	faulty EEPROM (non-volatile data storage)
16	e	EPROM Checksum Error	faulty EPROM (non-volatile code storage)

17	-	No Comp File	TL file not loaded
18	-	Resolver Over Spd	RDRES too high
19	y	Profile Failed	SCRVTM too high or ACC too low
	L	Limit SW Operated	motor has traveled beyond limits

LIST OF ERRORS (NON-FATAL)		
Err #	Error/Fault Message	Possible Cause
20	Unknown Command	undefined command or variable from serial port
21	not used	
22	Access Denied	variable is a factory variable
23	Drive Should be Inactive	drive is active
24	Drive Should be Active	drive is inactive
25	Value Out of Bound	variable value out of range
26	Negative # Not Allowed	variable must be ≥ 0
27	Not in Proper Mode	not in correct opmode for specified command
28	Bad Profile Generation	serial position loop
29	Drive in Motion	serial position loop
30	# of Parameters Incorrect	wrong # of parameters
33	Tune Failed	auto tuning failed
34	Bandwidth Out of Range	tuning BW parameter
35	Stability out of Range	tuning stability parameter
36	Not Programmable	variable is read-only
37	Analog Zeroing Failed	excessive noise or high signal level on analog input
38	Bad Profile	vel-to-acc ratio too high

7.0 SERIAL COMMUNICATIONS PROTOCOL

7.1 HOW TO CONTROL THE DRIVE

The user issues commands to and sets variables for the Smart Drive via a serial port. The other end of the serial port is hooked up to a PC running Motion Link software (DOS and Windows versions are available), a PC running a user's custom program, or a dumb terminal. Any of those three setups allows the user to utilize the PC or terminal to issue commands to the Smart Drive or to read and change variables in the Smart Drive.

The dumb terminal method is the simplest method of controlling the Smart Drive. Using Motion Link software for DOS provides additional capability through the use of menu commands. The most sophisticated way of controlling the Smart Drive is using Motion Link for Windows, which provides a robust set of dialog boxes for control functions and graphical presentations for data displays.

This section gives examples of the communications protocol between the Smart Drive and the terminal or PC. For simplicity's sake, this section assumes that a dumb terminal is being used to control the drive. In the following protocol definitions, special control codes are used. They are defined according to the table.

CONTROL CODE DEFINITIONS				
Name	**Symbol**	**Control**	**Hex**	**Decimal**
Bell	<Bell>	^F	07h	7
Line Feed	<Lf>	^J	0Ah	10
Carriage Return or Enter	<Cr>	^M	0Dh	13
Space	<Sp>	--	20h	32

Serial protocol is defined using the following protocol box format. The example in the table shows an enable (EN) command being issued to the Drive, with ECHO=1 and PROMPT=1. In this example, the Terminal transmits EN, the Drive echoes the EN, the Terminal transmits a carriage return, and the Drive responds with a carriage return, line feed, and the three-character prompt.

# Bytes	1	1	1	1	1	5
T->D	E		N		<Cr>	
D->T		E		N		<Cr> <Lf> -->

T->D = Terminal-to-Drive transmission
D->T = Drive-to-Terminal transmission

7.2 DRIVE-TO-TERMINAL COMMUNICATIONS

There are five items that the Drive will transmit to the Terminal:
1) echoes of characters entered from the terminal (see ECHO);
2) a prompt (see PROMPT);
3) variable values;
4) error messages; and
5) an in-position acknowledgment flag (refer to the MA/MI/MRD commands)

7.3 TERMINAL-TO-DRIVE COMMUNICATIONS

There are two items that the Terminal will transmit to the Drive:
1) commands
2) variables

7.4 FLAGS AFFECTING COMM PROTOCOL

There are four flags that affect the communications between the Drive and the Terminal. Refer to the descriptions of these flags for more information. The flags are: DEP, ECHO, MSG, and PROMPT.

7.5 ISSUING A COMMAND TO THE DRIVE

EXAMPLE 1: command the drive to jog at a speed of 100 RPM with ECHO=1 and PROMPT=1. Non-multidrop mode.

COMMAND: J 100

# Bytes	1	1	1	1	1	1	1	1	1	1	1	5
T->D	J		<Sp>		1		0		0		<Cr>	
D->T		J		<Sp>		1		0		0		<Cr> <Lf>-->

EXAMPLE 2: command the drive to move incrementally (MI) 1000 counts at a speed of 100 RPM with the <in pos ack> request. ECHO=1 and PROMPT=1. Multidrop mode, address = 8. Note the transmission of a backslash-8 at the beginning and the different prompt returned by the Drive. Also note that the backslash-8 is not echoed by the Drive.

COMMAND: \8MI 1000 100 1

# Bytes	1	1	1	1	1	1	1	1	1	1	1
T->D	\	8	M		I		<Sp>		1		0
D->T				M		I		<Sp>		1	

(continued)

# Bytes	1	1	1	1	1	1	1	1	1	1	1	1
T->D		0		0		<Sp>		1		0		0
D->T	0		0		0		<Sp>		1		1	

(continued)

# Bytes	1	1	1	1	1	1	5
T->D		<Sp>		1		<Cr>	
D->T	0		<Sp>		1		<Cr> <Lf> 8->

(later, after completion of move)

# Bytes	1
T->D	
D->T	!

7.6 REQUESTING A VARIABLE VALUE

EXAMPLE 3: request the value of PRD (which in this example is equal to 2057). ECHO=1 and PROMPT=1. Non-multidrop mode.

COMMAND: PRD

# Bytes	1	1	1	1	1	1	1	2
T->D	P		R		D		<Cr>	
D->T		P		R		D		<Cr> <Lf>

(continued)

# Bytes	4	5
T->D		
D->T	2057	<Cr> <Lf> -->

EXAMPLE 4: request the value of PFB (which in this example is equal to 12245). ECHO=0 and PROMPT=1. Multidrop mode, address = 7.

COMMAND: \7PFB

# Bytes	1	1	1	1	1	1	2
T->D	\	7	P	F	B	<Cr>	
D->T							<Cr> <Lf>

(continued)

# Bytes	5	5
T->D		
D->T	1224 5	<Cr> <Lf> 7->

7.7 SETTING A VARIABLE VALUE

EXAMPLE 5: set ACC = 1000. ECHO=1 and PROMPT=1. Non-multidrop mode.

COMMAND: ACC 1000

# Bytes	1	1	1	1	1	1	1	1	1	1
T->D	A		C		C		<Sp>		1	
D->T		A		C		C		<Sp>		1

(continued)

# Bytes	1	1	1	1	1	1	1	5
T->D	0		0		0		<Cr> >	
D->T		0		0		0		<Cr> <Lf> -->

EXAMPLE 6: set DEC = 800. ECHO=1 and PROMPT=1. Multidrop mode, address = 3.

COMMAND: \3DEC 800

# Bytes	1	1	1	1	1	1	1	1	1	1
T->D	\	3	D		E		C		<Sp>	
D->T				D		E		C		<Sp>

(continued)

# Bytes	1	1	1	1	1	1	1	5
T->D	8		0		0		<Cr> >	
D->T		8		0		0		<Cr> <Lf> 3->

7.8 ERROR MESSAGES

When the Smart Drive detects an error, the drive will output an error message over the serial port. There are two types of error messages:

1) command errors - these occur when an incorrect command is entered from the Terminal.
2) system errors - these occur when a system operational error is detected, such as an overtemperature detection.

The error message can be of two formats: long messages (DEP = 0) or short messages (DEP = 1). The following two examples illustrate one of each type of message.

Example 7: operator accidentally enters "JX 100" instead of "J 100." This is an example of a command error. DEP = 0, PROMPT = 1, no multi-drop.

# Bytes	1	1	1	3	1	8
T->D						
D->T	<Cr>	<Lf>	<Bell>	ERR	<Sp>	20

(continued)

# Bytes	5	1	2	1	10
T->D					
D->T	<Sp>	'	JX	'	<Sp>

(continued)

# Bytes	15	1	1	3
T->D				
D->T	Unknown Command	<Cr>	<Lf>	-->

Example 8: motor overtemperature fault occurs. This is an example of a system error. DEP=1, PROMPT=1, multidrop with address = 2.

# Bytes	1	1	22
T->D			
D->T	<Cr>	<Lf>	Motor Over Temperature

(continued)

# Bytes	1	1	3
T->D			
D->T	<Cr>	<Lf>	2->

8.0 SOFTWARE REVISION HISTORY

DATE	VER	ENHANCEMENTS
3-10-94	V1.0.0	Original release for beta customers
3-16-94	V1.0.1	1. GEAR switch now acts as clutch 2. ERR responds with last error. 3. VEXT and VX implemented. 4. PFB now programmable
3-20-94	V1.0.2	None
4-27-94	V1.0.3	1. New commands and variables: PLAY, STEP, PROFMODE 2
4-27-94	V1.1.0	1. ADDR and HVER implemented.

7-14-94	V1.2.0b4 V2.0.0b4	1. PEMAX=0 disables pos err check. 2. RDRES changed to read/write. 3. VMAX changed to read only. 4. RSTVAR command implemented. 5. NCHBW range increased to 1-200. 6. PBF changed to read/write. 7. Range of second parameter of STEP changed from 10-100 to 10-1000. 8. GEARI no longer depends on DIR. 9. GEARO range changed to 1-32767. 10. All scaling variable ranges (anum, aden, etc.) changed to 1-100,000. 11. TREF range changed to 1-32767. 12. VREF range changed to 1-100k. 13. ANDB range changed to 0-2048. 14. ANOFF range changed to (-16384) to (+16383). 15. ERR# range changed to 1-100. 16. IGAIN no longer takes 0 as value. 17. IND and MOTOR protected now. 18. RSTVAR now sets PEMAX to 0, not 32767. 19. PEMAX limited to 500,000. 20. VCMD can now go as high as 10 X VMAX. 21. RELAY1 now opens (=0) when a fault occurs (was reverse). 22. When speed reversal occurs, DEC is used before zero speed, and ACC is used after zero.

8-1-94	V1.2.0b5 and V2.0.0b5	1. GICAP, ANDG, and DEP added. 2. All tuning parameters made opmode independent. 3. CCWLIM / CWLIM made DIR and GEARI independent. 4. S command implemented in opmodes 2 and 3. 5. RSTVAR executed only when drive is disabled. 6. TCMD negative limit changed from -4096 to -4095. 7. ANDB check added to analog torque mode. 8. LPFHZ upper limit set to 1000.
8-1-94	V1.2.0b5 only	1. Notch filter and Command profiling no longer available in the Position Loop Modes.

DATE	VER	ENHANCEMENTS
	V1.2.0b 5 only (cont)	2. ANDB check for negative torque command added. 3. Fault relay opens on motor over temp fault now.
8-4-94	V2.0.0b 6	1. ANZERO implemented. 2. Fault relay opens on motor over temp fault now 3. ANDB consideration for negative torque command added
8-9-94	V2.0.0b 7	1. The ANDG switch default is set to 1 (dual gain enabled).
8-15-94	V2.0.0b 8	1. The STEP command is set valid only in opmodes 0 and 1. 2. Filter status (FILTMODE) not changed when switch to opmode 2 or 3 is made (previously, filters were turned off).
8-18-94	V2.0.0b 9	1. THERMODE 1 implemented. 2. When LIMDIS=1, if CWLIM/ CCWLIM triggers, then the decimal point is flashed if drive is enabled. 3. With DEP=1, faults are now registered (previously not true).
8-25-94	V2.0.0	1. Opmode 8: for triangle moves, lin- ear acc is carried out automatically even when S-curve is specified.
12-21-94	V2.1.0	1. Opmode 9 implemented. 2. ANSLEW implemented. 3. DECSTOP implemented. 4. Added: motor comp display on power-up, STOP command. 5. GAINSHIFT switch implemented. 6. Added GVD term to PID loop.

1-31-95	V2.2.0	1. Capability of broadcasting "!" character added to MA/MI moves.
3-23-95	V2.2.1	1. PRINT command changed so that it works when ECHO=0. 2. Encoder output marker pulse size reduced to 1/4 width.
4-26-95	V2.2.2	1. RELAYMODE 2 added. Other RELAYMODE's changed to match the description in this text. 2. STOP cmd added to STEP mode.
8-31-95	V2.2.3	1. Added four more encoder out res-olutions: 8196, 2048, 512, & 128. 2. ANDB, ANSLEW, and ANOFF are now saved to EEPROM. 3. ACC and DEC can now be changed any time. 4. ANSLEW works only in opmode 9. 5. ANSLEW default changed from 100 to 1000.
9-6-95	V2.2.4	1. Encoder marker pulse changed from 1/4 width to 1/2 width; now in phase with channel B pulse.
	V2.3.0	1. Added KA, KF, MRD, MODESW, X1, and X2