
Standard Commands

This chapter describes standard command procedures: how to enter commands from the host, the cursor, and the menu overlay.

Standard command procedures

Although the 9500 digitizer defines its operating parameters at power-up, you can override most of the default operating parameters. As drafting projects change, you can change the resolution of the tablet, the number of points per second transmitted to the host, you do not need to change switches on the Universal Formatter.

There are three sources for entering commands do not mix command sources.

- The terminal or host computer.
- The buttons on the 16 button cursor (limited command set).
- The pen or cursor, used in conjunction with the menu overlay.

For example, a command begun by the host must be finished by the host, not the tablet menu.

Some commands interact with others. For example, tablet resolution affects the increment command and the Universal Formatter commands. Baud rate, data rate, prompting and operating mode may all interact.

If a command requires a space character, an sp appears in the example. All other spaces in the commands are included only to make the command more legible.

Toggling a command turns the function off if it was on. It turns the function on, if it was off. Unless you are certain of the state of the function it is better to specify either ON or OFF.

Entering commands from the host

Command prefix

The host sends a command prefix before each command to alert the digitizer that a command is coming. The digitizer treats all characters between the command prefix and the next carriage return character as a command to follow. The default command prefix and the one used in all of the examples in this manual is ESC%. The command prefix may be changed if it interferes with other functions of the host. See Set Command Prefix, page 6-30.

You enter the commands by typing them on a dumb terminal or customizing a program on your host computer. Commands take effect immediately after the carriage return is entered. A command from the host follows this general format: ESC% h {h1} [h2] CR

Where:

Key	Description
ESC%	The command prefix. The ESC key followed by the % key.
n	An integer, (numeric variable).
h	An ASCII character to invoke the command.
[0|1]	0 or 1 sets the function to a definite state. No entry toggles the function.
{ }	Required variable of the command.
{n1 | n2}	One of the variables separated by the | character <i>must</i> be chosen.

[n1 | n2]	One of the variables separated by the | character <i>may</i> be chosen.
[]	Optional variable of the command.
CR	An ASCII carriage return character, HEX 0D.
<dpoint>	A digitized point on the tablet surface, indicates where you want the command to take effect.

Cursor commands

The 16 button cursor commands can be turned on or off at power up or by command. A listing of cursor commands starts on page 10-1.

The cursor may be used to send a limited number of commands to the tablet. The general format of the command follows:

F F h {h} [h] E

Where:

Key	Description
F F	The <i>F</i> button pressed twice is the command prefix.
h	The button code for the command.
n	An integer (numeric variable).
[0 | 1]	0 or 1 sets the function, or no entry toggles the current state.
{ }	Encloses required parameters of the command.

- [] Encloses optional parameter of the command.
- E The E button terminates the command string.

The command takes effect as soon as the E button is pressed. The cursor does not need to be on the tablet surface to send a command, but the cursor commands must be enabled. The 4 button cursor cannot be used for cursor commands. A summary of the 16 button cursor commands is on page 10-2.

Entering commands from the menu overlay

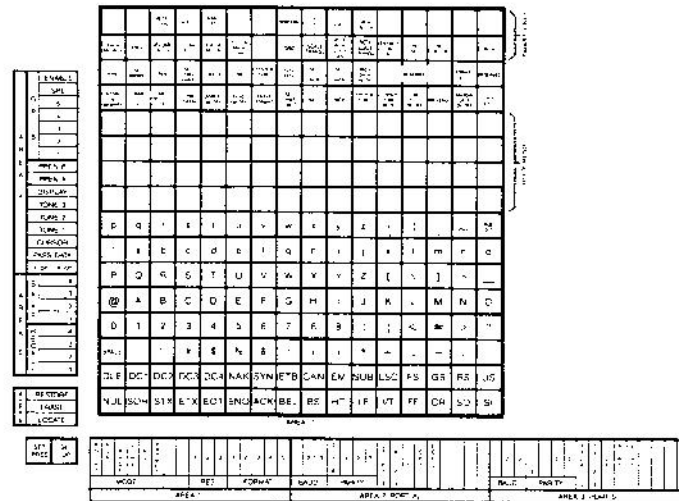


Figure 6-40: Tablet menus

The menus are a tablet surface device used for communicating with the 9500 system. You transmit data and issue commands by digitizing in a special menu area. The menu consists of two parts: the tablet region assigned to menu activity, and the mylar overlay sheet. Picking the labelled menu blocks sends com-

mands as if it were a keyboard. The command takes effect as soon as the CR (Carriage Return Block) is picked. A menu command follows this general format: A {h1} [h2] [h3] CR

Note: See page 4-13 for information on how to activate the large menu, (Area 7).

Where:

Key	Description
A	A function code block or blocks to invoke the command.
n	An integer.
h	An ASCII character.
[Ø | 1]	Ø or 1 sets the function to a definite state. No entry toggles the function.
{ }	Required variable of the command.
[]	Optional variable of the command.
{n1 | n2}	One of the variables separated by the | character <i>must</i> be chosen.
[n1 | n2]	One of the variables separated by the | character <i>may</i> be chosen.
CR	An ASCII carriage return character.
<dpoint>	A digitized point on the tablet's surface.

Picking the ESC% blocks from the menu does not activate any commands. The command prefix for the menu block is included in the function code block represented by A and cannot be changed.

Storing commands

Host: ESC% @ [n] COMMAND 1 @ COMMAND 2... CR
Menu: STORE IN MEMORY [n] COMMAND 1 @
COMMAND 2 ... CR

Description

*Any legal command
can be stored except
RESET.*

This command stores an alternate command string that automatically activates on power up, software reset, or upon request. Commands must be separated by an @ sign.

Parameters

Enter the commands as a string, preceding each command with the @ character. A maximum of 100 characters of format and set up commands can be stored in the non-volatile memory, not counting the ESC% command prefix.

Where n = 1 to 4. Same as in SAVE 1-4.

Example: To power up in format 4, with 30 lines per millimeter resolution, with two significant digits to the right of the decimal point, increment line mode active, and increment size of 0.1 millimeter. No other settings can be stored with the soft switches. From the host, send the command:

ESC % @ JM3Ø , 2 @ X3 @ Y3 @ IU CR

The setup parameters activate at the next power up, or as soon as the reset command, ESC % V R, is sent from the host.

From the menu, pick these blocks:

Menu: STORE IN MEMORY SYSTEM FUNC1 M 3 Ø ,
2 @ SET X INC 3 @ SET Y INC 3 @ INC U CR

The setup parameters activate at the next power up, or as soon as the SYSTEM FUNC 2 R blocks are picked to reset the tablet.

- ◆ **Caution:**
Do not enter the reset command, @VR or SYSTEM FUNC 2 R as part of the command string. It will create an unbreakable reset loop. The digitizer will need a service call to bring it back into operation.

Testing a command string

Entering the string without the first @ sign allows the string to execute immediately without being stored. If the string of commands performs correctly, re-enter it with the STORE IN MEMORY command.

Test the command string by entering:

ESC % J M 3 Ø , 2 @ X3 @ Y3 @ IU CR

Correcting errors

There is no provision for editing a command string once it has been entered. See section 7.

If you are entering the command string from a terminal, use the DEL or rubout key to erase errors before you store the command string with CR. If you discover the error after you have entered the command string, you must start over. Re-enter the entire

string, including the ESC % command prefix. The old string will be overwritten by the new string.

From the menu, pick the RUB OUT block once for each wrong block you picked. If you have already ended the command string with CR, you must re-enter the entire command string again.

The tablet has no way to display the command string that has been stored.

Enable/disable data from Ports A and B

Host: ESC% h [Ø | 1] CR
Menu: ENABLE/DISABLE I/O PORT [Ø | 1] CR
Cursor: FF h [Ø | 1] E

Description

Normal messages from the terminal to the host, or from the host to the terminal will pass through the digitizer whether the ports are disabled or not.

This command directs data output to the host port, to the terminal port, or to both ports.

Parameters

Where: h = A or B.
A Port A
B Port B

<i>Where:</i>	[Ø|1] = Ø, 1, or no entry.
Ø	Disabled port
1	Enabled port
No entry	Toggles current state

Example: To disable Port A, enter: ESC% A Ø CR.

To toggle Port B, enter: ESC% B CR.

Enable/disable data from display

Host: ESC% D [Ø|1] CR

Menu: DISPLAY ON/OFF [Ø|1] CR

Cursor: FF D [Ø|1] E

Description

The disable command freezes the coordinates. The enable command activates the coordinates.

Parameters

Ø	Disables display
1	Enables display
no entry	Toggles current state

Example: To enable data out to display, enter with the cursor: FF D 1 E.

Set communication parameters for RS-232 ports

Host: ESC% C [h1] n1 h2 n2 n3 CR

Menu: COM [h1] n1 h2 n2 n3 CR

Description

Sets communication parameters for RS-232 ports.

Parameters

Where: h1 = A, B, or no entry.
A Port A
B Port B
No entry Both ports

Where: n1 = baud rate

Ø	. . . . .	.19200
1	. . . . .	.9600
2	. . . . .	.4800
3	. . . . .	.2400
4	. . . . .	.1200
5	. . . . .	.600
6	. . . . .	.300
7	. . . . .	.150

Where: h2 = parity code letters: E, M, N, O, S.

E	Even
M	Mark
N	None
O	Odd
S	Space

Where: n2 = the number of data bits: 7 or 8.

Where: n3 = the number of stop bits: 1.

Example: To set the 9500 for Port A 1200 baud, even parity, 7 data bits, and 1 stop bit enter: ESC% C A 4 E 7 1 CR

Menu: COM PARAM A 4 E 7 1 CR

Set communication parameters for GPIB port

Host: ESC% CG {n1} , {n2} [h1] CR

Menu: COM CG {n1} , {n2} [h1] CR

Description

Sets communication parameters for GPIB.

Parameters

Where: n1 = a number from 0-30.

Where: n1 = 31, disables port.

Where: n2 = Ø, or serial poll disabled.
1, or serial poll enabled.

Where: h = EOS, end or identify, or
character h1.

Example: To set GPIB up from OR address 1, SPE, EOS on LF, enter: ESC% CG , 1 LF CR.

Disable/enable echo

Host: ESC% E [Ø|1|2|3] CR

Menu: ECHO ON/OFF [Ø|1|2|3] CR

Description

An echo command controls the communications ports transmissions.

Parameters

Where: [Ø|1|2|3] = Ø, 1, 2, 3, or no entry.

Ø	Disables echo Port B
1	Enables echo Port B
2	Disables echo Port A, RS-232
3	Enables echo Port A, RS 232
No entry	Toggles current state on Port B

Example: To disable echo to Port B, enter:

ESC% E Ø CR.

Defining a format for data output

Host: ESC% F {format command string} CR

Menu: ENTER FORMAT {FORMAT COMMAND STRING} CR

Description

The format command string consists of one or more subordinate formatting commands. These commands define the entire output format. The command string, including any operating commands, is limited to 100 characters.

Enter formatting commands in the same order as the desired output format. They may be separated by commas or spaces.

The subordinate formatting commands are considered part of a single storage command, and are not separated by @signs. The correct format reads: ESC% @ F TA MA ...CR.

A format may be stored with the ESC% @ prefix, or the STORE IN MEMORY menu block. You store a setup routine by entering the setup commands with the format command and its string of subordinate commands. When you save a format in memory, the format becomes active only when the tablet is reset. Do not store the reset command.

Parameter

Where: F = an ASCII character. For more information see the Universal Formatter section.

Set character constants

Host: ESC% G {h1} [h2...hn] CR
Menu: SET CHAR CONST {h1} [h2...hn] CR

Description

The ASCII characters that the tablet transmits to represent Tablet status (TA), Mode status (MA), Pen status (PA), Cursor status (CA), and position data, may be changed with this command. SET CHARACTER CONSTANTS affects the data output from the digitizer and the mode status character on the LCD display, but it doesn't affect the System status character of the LCD display. This command controls the value of status characters that are placed in a custom format or manipulated by logic commands. After entering the command, the new character will be transmitted

when that function occurs. For example, if you place a * in position 4, the digitizer transmits a * when it is in Point mode. You must re-enter all the characters preceding the character to be changed.

Parameters

Where: h1...hn = a position in a string of ASCII character constants. The characters must be entered in the following order:

h	Default	Function Tablet Character (TA)
1	A	Tablet status
h	Default	Function mode character (MA)
2	A	Answer flag (SMART only)
3	I	Increment mode
4	P	Point mode
5	U	Line mode
6	R	Run mode
7	T	Track mode
8	M	Menu mode
9	X	Out of active area
h	Default	Function Pen Character (PA)
10	U	Pen up (no button pressed)
11	D	Pen down (button pressed)
h	Default	Function Cursor Character (CA)
12	U	no buttons pressed
13	Ø	button Ø pressed
...		...
22	9	button 9 pressed
23	A	A pressed
...		...
28	F	F pressed

Table 6-5: Set character constants

Example: To change the line mode character to &, enter:
ESC% G A I P & CR.

Menu: SET CHAR A A I P & CR

Set operating modes

Description

Mode	Host Command	Cursor Command	Menu Blocks
Point	ESC % P CR	F F 3 E	Point CR
Run	ESC% R CR	F F 4 E	Run CR
Halt	ESC% H CR	F F 1 E	Halt CR
Track	ESC% T CR	F F 5 E	Track CR
Line	ESC% U CR	F F 6 E	Line CR
Increment Modes			
Run	ESC% IR CR	None	Incr R CR
Track	ESC% IT CR	F F 2 E	Incr T CR
Line	ESC% IU CR	None	Incr I CR

Table 6-6: Set operating modes

The operating and increment modes are changed by commands from the host, cursor, or menu. The previous table lists the commands according to mode and source.

The increment commands control the transmission of coordinates. In increment mode the cursor only selects increment track.

Set resolution

Host: ESC% J h n1 [,n2] CR

Menu: SYSTEM FUNC 1 h n1 , n2 CR

Description

The digitizer keeps track of the distance between the tablet origin and the cursor's position. This command determines the resolution of the coordinate data that is transmitted.

Parameters

Where: h = R or M.

R Inches

M Millimeters

Where: n1 = 1 to 2540 lines per inch or 1 to 100 lines per millimeter.

Where: n2 = 0 to 6, which denotes the offset for the decimal point in the displayed output field. If a zero is input for this number the decimal point will be located to the right of the right most digit.

Where: a "," separates the resolution digits from the offset digits in the command.

Example: The cursor is at a point five inches to the right (X) and 10 inches above (Y) the origin. The tablet is using Format 4, the Floating Point format, and 500 LPI.

Command	Output
ESC% J R 500 , Ø CR	2500, 5000, T M C CR
ESC% J R 500 , 1 CR	250.0, 500.0, T M C CR
ESC% J R 500 , 2 CR	25.00, 50.00, T M C CR
ESC% J R 500 , 3 CR	2.500, 5.000, T M C CR
ESC% J R 500 , 4 CR	.2500, .5000, T M C CR
ESC% J R 500 , 5 CR	.02500, .05000, T M C CR

Set origin

Host: ESC% J {h} CR

Menu: SYSTEM FUNC 1 {h} CR

Description

This command defines where on the tablet's active area the 0,0 coordinate origin locates.

Example: The origin is the place on the tablet where the X and Y position reads 0,0. The origin is the lower left corner of the active area. It may be relocated to any point of the tablet's surface. All X locations to the left of the origin are negative; all points to the right are positive. All Y locations below the origin are negative; all points above it are positive.

Moving the origin does not effect the active area or margins. Crossing from positive to negative regions or back again does not effect data output, only its polarity.

Parameters

Where: h = LL, LR, UL, UR, or C.

Key	Active Area
LL	Lower left corner
LR	Lower right corner
UL	Upper left corner
UR	Upper right corner
C	Center

Locate origin at next point digitized

Host: ESC% J O CR <d point>

Menu: SYSTEM FUNC 1 O CR <d point>

Description

Sets origin at the next <d point> you pick.

Parameters

If you want the new origin to be under a certain feature of a drawing, secure the drawing to the tablet surface first, then move the origin.

Set window opening

Host: ESC% J W CR <d point 1> <d point 2>

Menu: SYSTEM FUNC 1 W CR <d point 1> <d point 2>

Description

This command creates an active window on the tablet surface. The window may be any size up to the full active area size, or if data from the margin area is enabled, the window may be as large as the entire frame opening. Move the window by creating a new window. Cancelling the window restores the full active area.

Only one window exists at a time.

All the proximity indicators are triggered by the window edge as though it were the margin edge. This is useful if you want to align drawings with the axes of the tablet. Use the Aligning Media command on page 6-21.

Parameters

<d point 1> = The new point on the tablet surface for the lower left corner of the active area.

<d point 2> must be above and to the right of <d point 1>. The entire surface deactivates if <d point 2> is below or to the left of <d point 1>. If that happens, create a new window.

<d point 2> = The new point on the tablet surface for the upper right corner of the active area.

Cancel window

Host: ESC % J w CR

Menu: SYSTEM FUNC 1 w CR

Description

Clears current window and restores active area to the margins.

Aligning media

If you need to align a drawing with the axes of the tablet, follow these steps:

1. Place the media on the active area and visually align it with the edge of the tablet frame.
2. Fasten the lower left corner of the media securely to the tablet.
3. Select a line which is to be aligned with one of the axes. A line which extends the full height of the left side or width of the bottom of the media is best. The edge of the media may not be parallel with the line to be aligned. Do not use the edges.
4. Enter the CREATE WINDOW command.
5. For d point 1, pick a point on the selected line as far to the left as possible, for an X axis line, or as close to the bottom as possible, for a Y axis line. This establishes one corner of the window directly under one end of the line.

6. For d point 2, pick a point at the right end of the selected line and several inches above it for z axis alignment. Or pick a point at the top of the line and several inches to the right of it for Y axis alignment. The exact location isn't important, as long as it makes a window the full length of the selected line. At the free end of the selected line, move the cursor back and forth until you locate the spot where the out-of-proximity LED lights.
7. Keep the crosshairs or pen tip at the spot where the digitizer starts to transmit. Lift the cursor from the surface just enough to allow the media to move under it.
8. Move the unsecured corner of the sheet until the selected line is directly under the crosshairs or pen tip. You have aligned the line with the edge of the window, which in turn is aligned with the axes of the tablet.
9. Secure the remaining corners of the media.
10. Check the alignment. Does the out-of proximity LED light, or the output stop, as the transducer crosses the line? Check the ends of both lines you used to make sure the media didn't slip.
11. Either cancel the window, or make one large enough to surround the entire drawing.

Set buffer size

Host: ESC% J B {n} CR

Menu: SYSTEM FUNC 1 B {n} CR

Description

This command determines the buffer threshold before it accepts more coordinate pairs.

Parameters

Where: n = 0 to 127. The default setting is 64.

If the number of characters left in the output buffer is less than n then no new data is stored. This does not work with the Data Queue.

Set cursor functions

Host: ESC % K [n] CR

Menu: CURSOR FUNC ON/OFF [n] CR

Cursor: F F Ø E (disable only)

Description

When the cursor is disabled, it must be enabled by a command from the host or menu.

This command enables or disables the cursor from sending function commands to the digitizer.

Parameters

Where	n = Ø, 1, or no entry.
Ø	Disables cursor functions
1	Enables cursor functions
No entry	Toggles current state

Example: To disable cursor functions from cursor, enter: FF
Ø E

Set Line Feed

Host: ESC% L [n] CR

Menu: LINE FEED ON/OFF [n] CR

Description

This command determines Line Feed control for communications ports.

Parameters

<i>Where:</i>	n = Ø, 1, 2, 3, or no entry.
Ø	Disables port B
1	Enables port B
2	Disables port A
3	Enables port A
No entry	Toggles port B

Example: To disable line feed on Port B, enter:
ESC% L Ø CR.

Display host message

Host: ESC% M h1...hn CR
Menu: MESSAGE h1...hn CR

Description

This command sends messages to the optional LCD display from the host and menu. The cursor and the menu can also send messages to the host.

Parameters

Where: h1...hn = Characters of the message.
Where: h ≠ CR, @, RUB, or BS.

Place message characters from left to right across the display face. Old information remains on display unless your message length (including spaces) reaches 32 characters. Messages over 32 characters are shortened.

Following the message the display disables. The message remains on the display until the display is reenabled by the Enable/disable Output Port command, see page 6-9 or until another message is received.

Example: To center the message, System Fully Operational, on the display, enter:

is the space character on the LCD display.

ESC% M # # # # System # Fully # Operational # # #
CR

Message from the tablet menu to the host

Although there is no specific command when the menu is active you may send messages to the host by picking the blocks containing the characters of the message.

The message may contain up to 99 ASCII characters. If you make a mistake, use the RUB OUT block to erase it. The message echoes on the LCD display, if one is installed and active. The message transmits from all active ports as soon as the CR block is picked.

Message from the cursor to the host

Cursor: F h1...h99 {F|E}

Description

The 16 button cursor can send numbers to the host, which may be used as messages. The digitizer stops output when the F button is pressed. No data transmits until the E or F button is pressed to terminate the message. The message transmits from all active ports. A tone sounds confirming each pressed button, unless the tone has been disabled.

Parameters

Key	Character	Description
Ø-9	Ø-9	Numbers
A	-	Minus Sign
B	Rubout	Delete
C	,	Comma
D	.	Period or decimal point
E	CR	Ends message
F	.	Ends message

Table 6-7: Message from the cursor to the host

Margin data

Host: ESC% N [Ø|1] CR

Menu: MARGIN DATA [Ø|1] CR

Description

This command sends margin data out to the host. Under default conditions, no data transmits when the cursor moves into the margin. However, most of the margin is electronically functional and may be used.

The margin area has lower resolution and accuracy than the active area. Do not attempt to use it for high accuracy digitizing.

When margin data is enabled and the cursor is over the margin area, the Mode status character reads sx in the output format and on the LCD display. Also, the out-of-proximity LED (LED 4) on the cursor flashes even though the tablet is transmitting data.

Parameters

Where: [Ø|1] = Ø, 1, or no entry.

Ø	Enables margin
1	Disables margin
No entry	Toggles current state

Dataqueue

Dataqueue stores up to 16,000 characters in a first in, first out buffer for transmission to the host (Port A). The host starts and stops data transmission, receiving data points only when it is ready. When the queue fills, it loses any new points digitized. The tablet beeps to indicate that the queue is in overflow. X,Y coordinate pairs are not split, however, user messages may be split if sent while digitizing data and the queue becomes full.

Enable Dataqueue

Host: ESC% O h1 h2 CR

Menu: DATA QUEUE h1 h2 CR

Parameters:

Where: h1 = Start character.

Where: h2 = Stop character.

Where: h1 = @, CR, RUB, or BS.

Disable Dataqueue

Host: ESC% O CR

Menu: DATA QUEUE CR

Set prompt

Host: ESC% Q {h1} [h2] CR

Menu: SET PROMPT {h1} [h2] CR

Description

The prompt character is sent by the host to the digitizer, requesting transmission of a coordinate pair. The resend character is sent by the host to request retransmission of the last coordinate pair sent by the digitizer. When prompting is activated, the digitizer transmits one coordinate pair each time it receives a prompt character from the host

Parameters

All the normal operating mode requirements for transmitting must be satisfied and a prompt character received, before the digitizer transmits. The data rate limit also applies. The digitizer will not transmit data faster than the commanded maximum rate, even if prompting characters come in at a faster rate.

h1 and h2 must be different. H1 and h2 can be any ASCII characters except CR, BS, RUB, or @.

Where: h1 = the desired prompting character
Where: h2 = the optional resend character.

Example: To set up prompting mode using the ? for the prompt character and the * for the resend character, enter:

Host: ESC% Q ? * CR.

Menu: SET PROMPT ? * CR

Cancel prompt

Host: ESC% Q CR
Menu: SET PROMPT Q CR

Description

This command cancels prompt mode. The digitizer resumes normal operation in its current mode.

Example: To cancel prompting, enter:

Host: ESC % Q CR
Menu: SET PROMPT CR

Set command prefix

Host: ESC% S [h1] [h2] [h3] CR
Menu: SET COMD CHAR [h1] [h2] [h3] CR

Description

A command prefix signals the start of a digitizer command string. This command changes the default prefix from ESC% to one of your choice immediately upon entering the command.

Parameters

Where the prefix = 1 to 3 ASCII characters, and \backslash backspace (08 HEX), carriage return (0D HEX), rubout (7F HEX or DEL), and @ (40 HEX).

Where: h1 = The first command prefix character.

Avoid using a command prefix that can be accidentally entered if you bump the keyboard. Use keys that are on opposite ends of the keyboard or a prefix with an ESC.

Where: h2 = The second, optional command prefix character.
Where: h3 = the third optional command prefix character.

Example: To change the command prefix to the characters * \$ X, enter:

Host: ESC% S * \$ X CR
Menu: SET COMD CHAR * \$ X CR

Set cursor LED #2 and #3

Host: ESC% V {n} CR
Menu: SYSTEM FUNC 2 {n} CR

Description

This command controls the cursor's LED #2 and #3. LEDs #1 and #4 are under the tablet's control. LEDs #1 lights when a button is pressed. LED #4 lights when the cursor is off the active area.

Parameters

Where: n = 0, 1, 2, or 3.

0	LED #2 turns off
1	LED #2 turns on
2	LED #3 turns off
3	LED #3 turns on

Audible feedback

The 9500 uses two different sounds to indicate the status of your tablet. The lower tone sounds when a mistake occurs in command entry or message mode, or if the digitizer fails any of the power-up system tests. The higher tone sounds when a menu block is digitized, or when a cursor button is depressed in a command or message mode. It sounds on power-up to indicate that the 9500 is ready for operation. The ASCII BEL command, control G or 07 HEX, also generates this tone.

Clear the non-volatile memory

Host: ESC% V E CR

Menu: SYSTEM FUNC 2 E CR

Description

As soon as you reset the tablet the memory erases. No permanent damage to the memory results.

This command clears stored commands and soft switches. This command cannot be stored.

Host: ESC% V {h} CR

Menu: SYSTEM FUNC 2 {h} CR

Description

This command controls whether the tablet generates a sound when it receives an invalid command, a hardware error, or an inaccurate cursor function.

Parameters

Where: h = 4, 5, 8, 9, ;, or :

4	Beep sounds with first button down with output.
5	Beep does not sound with first button down with output.
8	Beep does not sound with a correct command.
9	Beep sounds with a correct command.
;	Beep does not sound with an invalid command.
:	Beep sounds with an invalid command.

Set large menu — see restore, erase, and locate

Host: ESC% V {h} CR <d point>

Menu: SYSTEM FUNC 2 {h} CR <d point>

Description

The large menu never activates at power-up. You enable it specifying its location. Then, use erase and restore commands as needed. The menu will reappear in the same spot on the tablet's surface.

This command performs the same functions as the three Small Fixed Menu blocks in Area 6.

Parameters

Where: h = L, M, or N.

L Locates Large Menu

M Erases Large Menu

N Restores Large Menu

Where: <d point> = Digitized point after the command sequence.

Reset K counter

Host: ESC% V K CR

Menu: SYSTEM FUNC 2 K CR

Description

The K counter begins at one each time the tablet powers up or receives the tablet reset command. The K counter counts each data point transmitted, up to 2^{24} (16,777,216).

This command resets the K counter.

Reset tablet

Host: ESC% V R CR

Menu: SYSTEM FUNC 2 R CR

Description

This command causes the tablet to reset.

Send tablet size

Host: ESC% V S CR

Menu: SYSTEM FUNC 2 S CR

Description

This command causes the tablet to transmit a data point, representing the upper right corner of the active area. The coordinates of the point represent the length of the axis multiplied by the current resolution and origin.

Set data rate

Host: ESC% W n CR

Menu: DATA RATE n CR

Description

This command determines the rate at which coordinate pairs are sent to the host. Due to RS-232 and GPIB baud rate limitations the digitizer may produce more data than can be accepted.

Parameters

The following table shows the maximum useable data rates for the seven 9500 baud rates, based on a 6 character format and a 10 bit frame.

Where: n = 0 to 100.

Baud Rate	Maximum Data Rate (points per second)
19200	100+
9600	100+
4800	80
2400	40
1200	20
600	10
300	5

Example: To set 100 pps, enter:
ESC% W 100 CR

Set X increment value

Host: ESC% X n CR
Menu: SET X INCR n CR
Cursor: FF 8 n E (sets X increment)

Description

This command sets the length of the minimum X increment distance before a new data point outputs. This command does not invoke the increment mode, it only sets the value.

Parameters

This is the minimum increment distance in the X direction. Where n = 0 to 65,535.

Example: You want the increment distance to be 0.1 inch. The current resolution is 20 LPI. Multiply the desired increment by the resolution to calculate the increment.

20 X 0.1 = 2 (enter this number in the increment command)

If the resolution is changed to 1000 LPI without changing the increment distance, the new increment distance would be two thousandths of an inch. To maintain the increment distance of 0.1 inch, enter (1000 X 0.1) or 100 lines as the new value.

Set Y increment value

Host: ESC% Y n CR

Menu: SET Y INCR n CR

Cursor: FF 9 n E (sets Y increment)

Description

This command sets the lengths of the minimum Y increment distance before a new data point outputs. This command does not invoke the increment mode, it only sets the value.

Parameters

This is the minimum increment distance in the Y direction.

Where: n = 0 to 65,535.

Set data proximity

Host: ESC% Z [Ø|1] CR

Menu: PROX DATA ON/OFF [Ø|1] CR

Description

This command allows the tablet to transmit coordinate data when the cursor is off the active area or in the margin. The X and Y data transmitted may be invalid when the cursor is out of proximity.

Parameters

<i>Where:</i>	[Ø|1] = Ø, 1, no entry.
Ø	Coordinate pairs transmitted whether or not the cursor is on or off the active area.
1	Coordinate pairs transmitted when the cursor is on the active area.
No entry	Toggles current state.

Change format

Host: ESC% ^ n CR

Menu: SELECT FORMAT n CR

Description

Changes operating formats.

Parameters

n = Ø to 31, (number of desired format).

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Universal Formatter

This chapter covers the Universal Formatter. To learn more about:

- Creating a custom format, see page 7-2.
- Defining an output format, see page 7-5.
- Exponential output, see page 7-10.
- Leading character override, see page 7-11.
- Exponential output, see page 7-14.
- Binary output commands, see page 7-16.
- Mixing output formats, see page 7-22.
- Bit manipulation of status characters, see page 7-25.
- Compound manipulations, see page 7-27.
- Indirect manipulation, see page 7-27.
- Conditional outputs, see page 7-29.
- Universal Formatter commands, see page 7-38.

Overview

The Universal Formatter allows you to create custom data output formats. Also, many of the 9500 Standard and SMART operating commands may be stored by the tablet as part of a set up routine that activates at power up. Commands stored by the Universal Formatter override the switch settings.

Storing a setup routine is not difficult. Creating a data output format, conditional data output, and bit manipulation of the status characters assumes that the user is familiar with digital logic and boolean algebra. In either case, plan the format or setup routine on paper before you enter it from the host or menu.

Creating a custom format: advanced users only

A format is entered by a host or menu command such as:

Host: ESC % F {format command string} CR

Menu: ENTER FORMAT {format command string} CR

Where F is the ASCII character.

The format command string consists of one or more subordinate formatting commands. In the rest of this discussion the word command refers to these subordinate commands. You define the entire output format with these commands. The tablet does not transmit any data that is not defined.

Formatting commands are entered in the same order as the desired output. They may be separated by commas or spaces, but the command string, including any operating commands, is limited to 100 characters. Spaces and commas are included in the following examples for clarity; they are not required.

The examples with each formatting command are intended to clarify only that command. Examples of useful command strings that produce the five 9500 output formats and others follows.

When you save a format in memory, the format will not become active until the tablet has been reset. Do not store the reset command.

Like set-up commands, a format may be stored with the ESC % @ prefix, or the STORE IN MEMORY block. If you are storing a set-up command too, the format command and its string of subordinate commands must be entered with the set-up commands.

The subordinate formatting commands are considered part of a single command for storage, and are not separated by @ signs:

enter this: ESC % @ F TA MA CR

not this: ESC % @ F @ TA @ MA.....CR

Types of output data

The Universal Formatter outputs the following data types: numeric data, ASCII data, and status data.

Numeric data

X Data - The position of the transducer on the X axis, expressed as lines. The raw number is controlled by the RESOLUTION command, see page 6-17.

Y Data - The position of the transducer on the Y axis, expressed as lines. The raw number is under the control of the RESOLUTION command, see page 6-17.

Z Data - The height or volume factor. If the SMART option is installed, Z data (height) may be entered as a calculation constant and output with the X and Y data. The tablet does not measure height directly.

K Count - The number of coordinate pairs transmitted since the last power-on or reset. The tablet counts up to 2^{24} then resets to zero and begins again with the next pair. You may also reset the counter with the ESC % V K command, see page 6-35.

ASCII data

ASCII characters inserted into the output data stream to transmit text.

Status data

The Status Data characters are transmitted when requested. They may be changed by the SET CHARACTER CONSTANTS command on page 6-13.

Tablet status	= Constant output.
Mode	= Operating mode.
Cursor status	= Buttons up, down, or no entry.
Pen status	= Buttons up or down.

Defining an output format

To define a format, first list the ASCII command for the data type, then the command for the output format or mathematical operation desired for that data type.

Numeric data

Numeric data may be output in integer, fixed point, exponential, decimal, or binary format. Any numeric data may be output in any format. A single data type may be output in more than one format. Different format types may be mixed in the command string.

Data Code	Description
X	X axis position data
Y	Y axis position data
Z	Z data for output (SMART only)
K	Number of data pairs transmitted since last reset

Format Code	Description
I or i	Integer output
F or f	Fixed point decimal output
E	Exponential output
B or b	Binary output

The X, Y, Z and K data types follow the same formatting rules. To assign a format to a data type, enter the ASCII character for the data type followed by the ASCII code for the output format and the characters that define the exact output.

For example, to output the X-axis coordinates in binary, the command would be XB, or Xb, followed by the modifiers for binary data that specify number of bits, byte width and bits per byte. Specific examples of each output are given in the following pages.

Integer

The integer format outputs numeric data as a whole number. This command interacts with the RESOLUTION command, (see page 6-17), and the resolution settings in the soft switches. Only the small i in the integer format uses resolution offset as the displacement. Also, if the resolution is >1280, it will add one character to the width.

The form of the command is Iw.d :

I	ASCII I (uppercase i)
w	maximum field width
.	ASCII "." to separate w from d
d	displacement

The **field width** is the maximum number of characters, digits or polarity signs, to be output. Data with more than the maximum number of characters will overflow the field. The digitizer outputs asterisks to indicate an overflow.

The default display condition fills the field with leading spaces if the output has fewer than the maximum number of digits. Negative numbers are preceded by a minus sign immediately to the left of the number, which uses one of the field spaces. Positive numbers do not have a plus sign. The LEADING CHARACTER OVERRIDE command, on page 7-12, changes the default style, as shown in the last two examples.

The **displacement** interacts with the offset of the **resolution** command. The resolution command accepts the number of counts, as an integer, from the digitizer and moves the decimal point to the **left** according to the offset number entered as part of the resolution command. The integer format moves the decimal point back to the **right**, according to the value of the displacement.

If the resolution command's offset is greater than the integer command's displacement, the digits that remain at the left of the decimal point will be truncated.

If the resolution offset is smaller than the integer displacement, the output will have trailing zeros.

If no significant digits are to the left of the decimal point, the format outputs a zero.

Example: The resolution is at 1000 LPI, with an offset of three. The X-axis position of the transducer is 10,583 lines away from the origin. The resolution command converts this to 10.583 inches. The examples below show the effect of various field widths and displacements on the final output.

Command	Output	Explanation
XI6.3	sp1Ø583	The displacement of three counteracted the offset of three. The five digit output leaves room for a leading space in the six-digit field.
Xi6.3	sp1Ø583	

<p>XI6.Ø Xi6.0</p>	<p>spspspsp1Ø spspspsp1Ø</p>	<p>There was no displacement to counteract the offset. The output truncated all the digits to the right of the decimal.</p>
<p>XI4.1 Xi4.1</p>	<p>sp1Ø5 ****</p>	<p>The displacement of 1 allows the digitizer to output the first number to the right of the decimal. The other two are truncated.</p>
<p>XI4.3 Xi4.3</p>	<p>* * * * ****</p>	<p>The displacement counteracts the offset, but the output of 10513 will not fit into a four-digit field width. The tablet outputs one * for each space of the field.</p>
<p>XI6.4 Xi6.4</p>	<p>1Ø583Ø sp1Ø583</p>	<p>The displacement is greater than the offset, resulting in a trailing zero.</p>

S5 XI6.Ø	+ØØØ1Ø	The output is the same as the second example. The Leading Character Override (see page 7-12) produces the leading zeros and a plus sign.
S5Xi6.0	+1Ø583	

Fixed Point

The Fixed Point Format expresses the output as a decimal number. Like Integer, Fixed Point is affected by the Resolution command and internal switch settings. Only the small f in the Fixed Point format uses resolution offset as displacement. If the resolution is >1280, it adds one more character to the width.

Where: the form of the command is Fw.d.

F	ASCII F
w	maximum field width
.	ASCII .
d	fixed point displacement

The **field width** is the maximum number of characters in the output, just as in the integer command. The decimal point is always present and takes up one of the character spaces.

The number of characters to the right of the decimal point is controlled by the Resolution offset. The fixed point **displacement** controls how many of those characters will be output.

The value entered for the displacement may range from zero to the field width minus one. If the displacement equals the offset, the number will be output unchanged. If the displacement is smaller than the offset, the excess characters will be truncated. If the displacement is greater than the offset, the output will have trailing zeros.

The polarity signs and leading zeros or spaces follow the same default rules as the integer format. They may be altered by the Leading Character Override command. See page 7-11.

Example: The resolution is at 1000 LPI, with an offset of three. The Y-axis position of the transducer is 15,725 lines from the origin. The resolution command converts this to 15725 inches. The examples show the effect of field width and displacement.

Command	Output	Explanation
YF6.3	15.725	The displacement equals the offset. The output is not altered.
Yf6.3	15.725	
YF4.3	* * * *	The field width is too small to display the number to the right of the decimal point, so the field overflows.
Yf4.3	****	

YF7.4 Yf7.4	15.7250 sp15.725	The displacement is greater than the offset. The output contains trailing zeros to fill up the allotted field width.
YF6.2 Yf6.2	sp15.72 15.725	The displacement of two truncates one digit to the right of the decimal. The field width of six leaves room for a leading sp.
S4 YF6.2 S4Yf6.2	+15.72 *****	The output is the same as the previous example, but the Leading Character Override was used to produce the leading plus sign.

Leading character override

The default output of the Integer and Fixed Point data formats has leading spaces to fill unused field width; does not show a plus sign; and places the minus sign immediately to the left of any negative number. This can be changed by placing a modifying command into the command string before the data type to be modified.

Data type commands follow the latest applicable modifier in the string.

When modifier commands are used anywhere in the command string any numeric data outputted in the unmodified (default) manner must be preceded by SØ, the modifier calling out the default conditions.

If all numeric data is to be modified in the same manner, a single modifier may be placed at the beginning of the command string.

Where: the default override command is Sn.

S ASCII "S"
n an ASCII numeral from Ø to 5,
 modifying the output as explained
 below.

n	Leading character	Minus sign	Plus sign	Example
Ø	spaces	after	none	sp-XXXX or spspXXXX
1	zeros	before	none	-ØXXXX or ØØXXXX
2	spaces	after	after	sp-XXXX or sp+XXXX
3	not used			
4	spaces	before	before	-spXXXX or +spXXXX
5	zeros	before	before	-ØXXXX or +ØXXXX

Table 7-8: Leading character override

Example: The resolution is at 1000 LPI, with an offset of three. The X-axis position of the transducer is 12,723 lines away from the origin. The resolution command converts this to 12.723 inches. The examples below show the effect of the default override on the output from an integer command. Fixed point would be modified in a similar fashion.

Because the presence and position of the polarity sign is also altered, each output is shown for positive and negative X values.

Unmodified (default) output

XI7.3	spsp12723 sp —12723	The five digit output leaves room for leading spaces in the seven-digit field.
--------------	------------------------	--

Modified outputs

Command	Output	Explanation
SØ XI7.3	spsp12723 sp— 12723	The SØ is the command to produce the default output.
S1XI7.3	ØØ12723 Ø—12723	S1 produces leading zeros and places the minus sign behind any zeros.
S2XI7.3	sp+12723 sp—12723	Plus and minus signs are behind leading spaces.
S4XI7.3	+sp12723 —sp12723	Plus and minus signs precede the leading spaces.

S5XI7.3

-Ø12723
+Ø12723

Plus and minus
signs precede the
leading zeros.

Exponential output

The exponential format outputs the data as a signed decimal fraction and an exponent according to the ANSI FORTRAN method of notating exponents.

For example, +14.863 would be output as +.14863E+Ø2; -2.250 would be output as -.2250E+Ø1. The sign of the number always precedes the decimal point.

Where: the form of the command is Ew.d.

E	ASCII E
w	field width
	ASCII .
d	mantissa width

The **field width** is the maximum number of characters in the output. The field width must exceed the desired mantissa width by at least six. The output must always include the sign of the mantissa, the leading decimal point, the ASCII E, the sign of the exponent, and the two digit exponent. In addition, at least one digit must be present in the mantissa for a minimum field width of seven.

If there isn't enough room in the field for the specified mantissa width and the six mandatory characters, the field fills with asterisks to indicate overflow.

If the mantissa width is smaller than the available space in the field width, the field contains leading zeros.

The raw numbers to be formatted can contain any number of significant digits. If the mantissa allows for more digits than are significant, the mantissa will contain trailing zeros. If the number has more significant digits than the mantissa allows, the excess digits are truncated.

The positive or negative output ranges from .922E+19 to .542E-19. Numbers smaller than this are expressed as zero, output as .000E-20.

Example: The resolution is at 1000 LPI, with an offset of three. The X-axis position of the transducer is 8,321 lines from the origin. The resolution command converts this to 8.321. The examples show the effect of field width and displacement

Command	Output	Explanation
XE10.4	+.8321E+02	The output fills the field completely.
XE11.5	+.83210E+02	There aren't enough significant digits to fill the specified mantissa width, resulting in a trailing zero.

XE10.5	*****	The field width is too small for a 5-digit mantissa and the six mandatory characters. It overflows.
XE7.2	+.83E+02	The output truncates the least significant digits to fit the output into the specified mantissa width of 2.
XE11.4	sp+.8321E+02	The specified mantissa width plus the required characters do not fill the field width, resulting in a leading sp.

Binary output commands

The binary output is only available on 9500 Standard systems.

Where: the form of the command is Bw.d or bw.d.

B	ASCII B or b
w	Bit count (1 to 24)
.	ASCII .
d	Data bit width (1-8)

The **bit count** is the total number of bits used in formatting the data. The data transmits as a two's complement binary number to preserve the polarity. If the bit count is too small to format the data, the least significant bits are truncated.

The **data bit width** is the number of data bits assigned to each 8-bit byte of the output. The data bits are loaded into the least significant side of each byte, filling the leftover bits with zeros. The formatter distributes the data bits evenly across the bytes, if possible. A bit count of 16 and data byte width of four produces four bytes with four data bits in each. A bit count of 16 and a data byte width of five produces four bytes, three with five data bits and one with one data bit.

If the command was **Bw.d**, the byte containing the most significant data bit transmits first. The similar command **bw.d** produces binary output with the byte containing the least significant bit transmitted first.

- ◆ **Caution:**
If you specify a data byte width of eight, the DATA BITS setting of the soft switches on the tablet's surface must also be set to eight or the board will truncate the most significant bit of each byte.

Examples:

Command: XB18.6

			MSB						
Byte one	Ø	Ø	X17	X16	X15	X14	X13	X12	
Byte two	Ø	Ø	X11	X10	X9	X8	X7	X6	
Byte three	Ø	Ø	X5	X4	X3	X2	X1	X0	
									LSB

Command: b18.6

								LSB
Byte one	Ø	Ø	X5	X4	X3	X2	X1	X0
Byte two	Ø	Ø	X11	X10	X9	X8	X7	X6
Byte three	Ø	Ø	X17	X16	X15	X14	X13	X12
			MSB					

The outputs are identical, except that the order of the bytes is inverted. Both outputs have 18 data bits divided into bytes with 6 data bits per byte.

Command YB12.5

								MSB
Byte one	Ø	Ø	Ø	Ø	Ø	Ø	Y11	Y10
Byte two	Ø	Ø	Ø	Y9	Y8	Y7	Y6	Y5
Byte three	Ø	Ø	Ø	Y4	Y3	Y2	Y1	Y0
								LSB

Command: Yb12.5

								LSB
Byte one	Ø	Ø	Ø	Y4	Y3	Y2	Y1	Y0
Byte two	Ø	Ø	Ø	Y9	Y8	Y7	Y6	Y5
Byte three	Ø	Ø	Ø	Ø	Ø	Ø	Y11	Y10
								MSB

This command has twelve data bits, with five data bits per byte. The number of bits wouldn't distribute evenly, so the formatter fills the remainder of the byte with zeros.

Binary bias

The Binary Bias command adds an offset value to the binary output of X, Y, Z, or K data. The output byte becomes the sum of the original data byte and the offset value. The bias is added to each byte of the data, regardless of the number of bytes.

The bias is added to the whole byte, regardless of the number of data bits designated for data within the byte. If the sum of the bias plus the data byte exceeds 255, the resulting byte will contain the value of the sum minus 256. No carry or borrow is passed between bytes.

Where: the form of the command is Bxx.

B	ASCII B
xx	the value of the bias (offset) as a two-digit hexadecimal number

Like the default override, the Binary Bias command precedes the data type command it is to modify. If you are outputting a mix of biased and unbiased data, the unbiased data must be given a bias of 00 Hex.

Example: To output a 1 as the most significant bit in the Y-axis data bytes as a flag to a program with unbiased X-axis data; both outputs are to contain 18 data bits in three bytes, enter this command:

B00 XB18.6 B80 YB18.6

X-data:

	MSB							
Byte one	0	0	X17	X16	X15	X14	X13	X12
Byte two	0	0	X11	X10	X9	X8	X7	X6
Byte three	0	0	X5	X4	X3	X2	X1	X0
								LSB

Y data before bias:

			MSB							
Byte one	Ø	Ø	Y17	Y16	Y15	Y14	Y13	Y12		
Byte two	Ø	Ø	Y11	Y10	Y9	Y8	Y7	Y6		
Byte three	Ø	Ø	Y5	Y4	Y3	Y2	Y1	Y0	LSB	

Bias value of 80 H added to each byte:

1 Ø Ø Ø Ø Ø Ø Ø

OUTPUT is biased Y data:

			MSB							
Byte one	1	Ø	Y17	Y16	Y15	Y14	Y13	Y12		
Byte two	1	Ø	Y11	Y10	Y9	Y8	Y7	Y6		
Byte three	1	Ø	Y5	Y4	Y3	Y2	Y1	Y0	LSB	

Formatting character strings

ASCII characters are output into the data stream in three ways.

1. Enclose the desired string in single (') or double quotes ("). The digitizer interprets ' or " as a string delimiter not a character.
2. To output a string that includes a quote, use the command:

Where: nH is an ASCII H.

h1 h2 ...hn = character string
n = number of characters in the string

3. ASCII control characters cannot be entered by the above methods. For example, if you insert a Carriage Return, the digitizer interprets it as the end of the command string. To enter control characters one at a time use the command: N x x.

Where: N is an ASCII N.

x x Hexadecimal value of the output character.

Character values between 80 and FF Hex (128 to 255 decimal) may repeat the standard ASCII character set, or may be used for special characters, depending on the host. Consult the host's technical manuals.

x x is the hexadecimal value of the control character to be output. For example, 0DH is the value of a carriage return. N0D will output a carriage return in the data string. N22 will produce a double quote ("). Turn to Appendix H for the ASCII chart.

Inserting control characters may have unexpected effects. Control Z (1A Hex) is used by many programs to indicate the end of a data file. Frequently, control C (03 Hex) indicates an exit this program command.

Remember that spaces are counted as characters and up to 50 characters may be output in a string.

Example: You are using exponential format for the X and Y data and want the digitizer to output an easy-to-read count of the number of data points that have been taken. Use the following format commands: XE12.5 YE12.5 N0D KI5.0" DATA POINTS HAVE BEEN TAKEN" N0D

The command KI5.0 produces the integer output.

The resulting output, after 3,573 data points would be: 3573 DATA POINTS HAVE BEEN TAKEN.

The message is on a separate line because of the carriage returns (the command NØD) on either side of the K-count. The quotes are not output.

To include the quotes in the above example, use the nH command:

3ØH" data points have been taken"

Mixing output formats

Output formats can be mixed because each data type is only affected by modifiers which apply to its type and are unaffected by a modifier for another type.

Example: the output resulting from the command string, S5 BA0 XB18.6 YI6.Ø KB1Ø.5 reads as follows:

The X-coordinate is a three-byte binary output, biased by AØH and transmits most significant byte first. Then, the tablet transmits an integer output with leading zeros and polarity signs for the Y coordinate. Finally a two-byte binary output, biased by ØH sends least significant byte first, transmits the K count. Each byte of the K-count has 5 data bits.

Status data

The status data (Tablet, Mode, Cursor, or Pen) may be output as ASCII, binary, complementary binary or hexadecimal. The desired output format is indicated by a character placed after the status data character.

Example: to output the cursor status character in ASCII, the command is CA. To output the Mode Status in Hexadecimal, the command is MH.

Data Code	Description
T	Tablet status, always an A. Included for compatibility with older models.
M	Operating Mode - denotes current operating mode.
C	Cursor status - tells which button on the cursor is currently depressed.
P	Pen status - tells if the stylus tip is up or down.

Output Format	Command
ASCII	A
Binary	B
Complementary	C (complemented binary)
Hexadecimal	H

The ASCII format outputs the default status data character or the character specified by the SET CHARACTER CONSTANTS command on page 6-14.

Binary output of status data produces the binary equivalent of the Hexadecimal output.

The complemented binary output produces the one's complement of the binary output.

The Hexadecimal output produces the two-character hexadecimal output shown in the table.

The ASCII default characters and the hexadecimal outputs are listed in the following table.

Character constants

Key	ASCII	HEX	Function/tablet character
1	A	00	Tablet status
Key	ASCII	HEX	Function/mode character
2	A	00	Answer/Display Flag (SMART units)
3	I	01	Increment modes
4	P	02	Point mode
5	U	03	Line mode
6	R	04	Run mode
7	T	05	Track mode
8	M	06	Menu active
9	X	07	Out of active area
Key	ASCII	HEX	Function/Pen Character
10	U	00	Pen up
11	D	FF	Pen down
Key	ASCII	HEX	Function/Pen Character
12	U	FF	All buttons up
13	Ø	00	Ø button pressed
14	1	01	1 button pressed
15	2	02	2 button pressed
16	3	03	3 button pressed
17	4	04	4 button pressed
18	5	05	5 button pressed
19	6	06	6 button pressed
20	7	07	7 button pressed
21	8	08	8 button pressed
22	9	09	9 button pressed
23	A	0A	A button pressed
24	B	0B	B button pressed
25	C	0C	C button pressed
25	D	0D	D button pressed
27	E	0E	E button pressed
28	F	0F	F button pressed

Table 7-9: Character constants

Bit manipulation of status characters

A status character may be ADDED, ORed, ANDed or XORed with a two-digit hexadecimal constant between 00 and FF. The bits of the status byte can also be rotated to the left or right from one to seven places. ASCII status characters can be manipulated. The output is the ASCII equivalent of the bit manipulation results.

Multiple manipulations can be performed on a status character. The formatter processes compound bit manipulation commands from left to right, performing each manipulation in the order it was entered.

Status characters can be changed, with the SET CHARACTER CONSTANTS command, see page 6-14. The bit manipulation is performed on the new status character.

Manipulation commands

Where +, —, ^, ~, and * are the ASCII characters and nn is the hexadecimal constant between 00 and FF.

If the sum of the ADD operation is greater than 255, the resulting output will be the sum minus 256.

ADD	+nn
SUB	—nn (subtracting by adding a negative number)
OR	^nn
XOR	~nn
AND	*nn

Where < and > are the ASCII characters and n is an ASCII character, from one to seven, representing the number of places the bits are to shift. Bits pushed out of the end of the byte come around to rest in the other end of the byte.

Left rotation <n
 Right rotation >n

Examples:

- CB +Ø1 Adds Ø1H to the binary output of the cursor.ØØØ1Ø11Ø becomes ØØØ1Ø111
- CA +Ø1 Adds Ø1H to the ASCII output of the cursorASCII "D" (44H) becomes "E"(45H)
- MB ^33 Boolean ORs the mode status character with 33HØ1Ø1ØØ1Ø (R, for run) becomes Ø111ØØ11
- CH~10 Boolean XORs the cursor status character with 10H FFH becomes EFH
- CA *Ø1 Boolean ANDs the cursor output with Ø1H ASCII "D" (44H) becomes NUL (ØØH)
- CB<3 Rotates the cursor status character output three places to the left. The bits move around into the least significant side of the byte.

Original output:

Ø Ø 1 1 Ø 1 1 Ø

After rotation:

1 Ø 1 1 Ø Ø Ø 1

Compound manipulations

CB<2^8Ø:	This rotates the binary cursor output two places to the left, then OR it with 8ØH before outputting the cursor data.							
Original cursor status byte:	Ø	Ø	Ø	C4	C3	C2	C1	CØ
Rotated cursor status byte, to be ORed with 8ØH:	Ø	C4	C3	C2	C1	CØ	Ø	Ø
8ØH:	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Final output:	1	C4	C3	C2	C1	CØ	Ø	Ø

Indirect manipulation

The status data can be ORed with the character occupying the designated position of the data stream. The results of this OR operation are output in the designated position instead of the original character. This is used in conjunction with the rotate command to combine, for example, the cursor status character with one of the bytes of X or Y data to produce more compact output. The status data character is not output by this command, it is only used as part of the OR expression.

The Ln command can be invoked only after the character in the data stream to be ORed has been formatted.

Where: the command is Ln.

- L The ASCII character L
- n An ASCII numeral indicating which position in the data stream is occupied by the character to be ORed with the designated status character.

Examples: Command YB12.5 CB<2 L1

Original Y data bytes:

							MSB		
Byte one	Ø	Ø	Ø	Ø	Ø	Ø	Y11	Y10	
Byte two	Ø	Ø	Ø	Y9	Y8	Y7	Y6	Y5	
Byte three	Ø	Ø	Ø	Y4	Y3	Y2	Y1	Y0	
									LSB

Original cursor status byte:

Ø Ø Ø C4 C3 C2 C1 CØ

Rotated cursor status byte, to be ORed with the first position in the data stream, which is the first byte of the Y data:

Ø C4 C3 C2 C1 CØ Ø Ø

Output, with cursor information and Y data combined in one byte:

								MSB	
Byte one	Ø	C4	C3	C2	C1	CØ	Y11	Y10	
Byte two	Ø	Ø	Ø	Y9	Y8	Y7	Y6	Y5	
Byte three	Ø	Ø	Ø	Y4	Y3	Y2	Y1	Y0	
									LSB

Conditional outputs

The conditional commands allow the output to change depending on the condition of the data and status characters.

The conditional expression is always placed in brackets. It contains the formatting commands that will be executed if the conditions are met. If the conditions are not met, the formatter skips the bracketed commands.

The formatter can be instructed to skip the commands following the brackets if the conditions are met. Placing the ASCII characters QF (quit format) inside the brackets instructs the formatter to skip the rest of the format commands if the conditions are met. The QF command may be placed after commands inside the brackets if you want them to be carried out before the format is terminated.

The formatter tests for equality or inequality. The equality test is met if the value of the test expression is equal to the specified hex value. The inequality test is met if the value of the test expression equals any number other than the specified hex value.

The test is a single-character comparison. If a multiple-character ASCII value or character string is presented, the value of the last character is used. If multiple-byte binary data is presented, the last byte of the binary expression will be used. If a manipulated status character is presented, the manipulation will be performed before the comparison is made.

Where Test Expression is the character string presented for comparison, the conditional commands take the general format:

Equality	Test Expression = xx (conditional commands)
Inequality	Test Expression # xx (conditional commands)
=	ASCII character for equality
#	ASCII character for inequality
xx	Two-digit hexadecimal value to compare to the test expression
{ and }	ASCII characters enclosing the commands to be executed if the test conditions are met

Example: If you want the K count and a message to be output each time you press cursor button 9, include the following command into the string of formatting commands: CA=39 {K15.0 "DATA POINTS HAVE BEEN TAKEN"}

CA puts the cursor output into ASCII, = checks for the equality, and 39 is the hexadecimal equivalent of an ASCII 9. When the cursor status character equals 9, the last character of the Hexadecimal number, the tablet will output the information in the brackets.

Repeating expressions

Any piece of a format may be repeated. The repeating expression may be any legal data type, status characters, ASCII text or conditional expressions. Only one repeating expression is allowed in a format.

The ASCII characters QR (quit repeat) are inserted into a conditional expression within a repeating expression to allow the repeating expression to be cancelled.

The K counter does not advance for each repetition. It only advances once for each formatting command. If X or Y data is within the repeating section of the format, the tablet will take a new position point for each repetition instead of outputting the same data over and over.

Where: the command has the general format:
Rn (repeating expression).

R	ASCII character
n	The number of times to repeat, from 1 to 255
(	ASCII character
Repeating expression	format commands to be repeated
)	ASCII character

Disable the linefeed before you begin a repeating format. The results of repeating formats are not predictable if the Line Feed is active.

Example: Assume the resolution is at 1000 LPI, with the offset of three, giving output in whole and thousandths of inches. Enter this command: K13.Ø R4 (S1"X" XI2.Ø "Y' YI2.Ø "I") "END" NØD

Explanation:

K13.Ø	The K-count, as an integer
R4 (	Repeat the next part of the output four times.
S1	Places leading zeros into the output
"X"	Outputs the letter X

XI2.Ø	X output as integer, two places, offset of zero. This will give output in whole inches only.
"Y"	Outputs the letter Y
YI5.ØY	Outputs as integer, two places, offset of zero, as in X.
"|"	Outputs | to mark the division between data points.
)	End of repeating section
END	Outputs the word END
NØD	Quoting a Carriage return into the output

Assume the first four data points were (4,5) (3,7) (6,12) and (8,2).

Output: Data Points	Output on CRT or To Host
4,5	ØØ1XØ4YØ5| The output for the next data point is added to the string.
3,7	ØØ1XØ4YØ5|XØ3YØ7|
6,12	ØØ1XØ4YØ5|XØ3YØ7|XØ6Y12|
8,2	ØØ1XØ4YØ5|XØ3YØ7|XØ6Y12| XØ8YØ2|END CR

Notice that the K count (the first three digits) doesn't increase with each data point. It increases with the fifth point as the tablet starts the format over.

Examples of useful output formats

The following examples clarify the development of an entire output format. The spaces in the outputs and formatter commands are for clarity only. An actual space would be represented by sp.

If the resolution is different, adjust the X and Y output commands.

Assuming that the resolution is set to 1000 LPI, with a default offset of three, the Universal Formatter commands read as follows:

ASCII output formats

9500 Format 4

Output: T M C XXXXX YYYYY CR
Command Ex. TA MA CA Xi5.3 Yi5.3 NØD

TA	Outputs the Tablet Status (always an A) in ASCII
MA	Outputs the Mode Status Character in ASCII
CA	Outputs the Cursor information in ASCII
Xi5.3	Outputs X data as a five-digit integer, with the .3 counteracting the offset from the resolution setting of the switches.
Yi5.3	Y data output

NØD Inserts a carriage return at the end of the data string

9500 Format 5

Output XXXXX, YYYYY, T M C CR
Command Ex. Xi5.3 ", " Yi5.3 ", " TA MA CA NØD

This is similar to Format 4, except for the inserted commas ", " after the X and Y data.

9500 Format 6

Output C P XXXXX YYYYY CR
Command Ex. CA PA Xi5.3 Yi5.3 NØD

Again, this is similar to Format 4, except for the Cursor and Pen Status characters.

9500 Format 7

Output sp XX.XXX, sp YY.YYY, T M C CR
Command Ex. Xf7.3 ", " Yf7.3 ", " TA MA CA NØD

Xf7.3 Gives an output field width of 7, with three of the digits that are to the right of the decimal (controlled by the RESOLUTION command) to be output.

, Inserts the commas

The sp does not have to be inserted. The default outputs for Fixed Point will insert a space if the data doesn't fill the field width. The largest number possible with this format and resolution has six digits. The field width is seven, which results in a leading space for the X and Y-data. You could use N2Ø XF6.3 ", " N2Ø YF6.3 to get the same results. N2Ø would insert a space by inserting the hexadecimal value of an ASCII space into the output.

Binary output

Example one: Binary outputs frequently use the status character's bit manipulation commands to compress the output. In this example, instead of separate bytes for the cursor and proximity information, they are combined into one byte. The output is the same as a CalComp 2000 binary. The 2000's cursor output is always one greater than the number of the button pushed – pressing button 2 produces an output of binary 3 – while the normal 9500 cursor output equals the button pushed. Adding 01H is easier than redefining the cursor output.

CalComp 2000 Binary Output:

Bit	7	6	5	4	3	2	1	0
Byte 1	0	1	C3	C2	C1	C0	0	0
Byte 2	0	0	X5	X4	X3	X2	X1	X0
Byte 3	0	0	X11	X10	X9	X8	X7	X6
Byte 4	0	0	Y5	Y4	Y3	Y2	Y1	Y0
Byte 5	0	0	Y11	Y10	Y9	Y8	Y7	Y6

Command	CB + 01 ^10<2 Xb12.6 Yb12.6
CB	Cursor status character, in binary
+01	ADD 01H to the cursor character
^10	OR it with 10H (this produces the 1 in bit 6 of byte 1)
<2	Shifts the bits of the first byte to the left 2 spaces
Xb12.6	X-data output in 12 data bits, six bits per byte, with the LEAST significant byte first
Yb12.6	Y-data output in 12 data bits, six bits per byte, with the LEAST significant byte first

Example two: In this commonly used high-resolution binary output, the cursor bits are combined with part of the X data bits to make up the first byte. The cursor information is first manipulated, then ORed with the X data.

Bit	7	6	5	4	3	2	1	Ø
Byte 1	1	C4	C3	C2	C1	CØ	X15	X14
Byte 2	Ø	X13	X12	X11	X1Ø	X9	X8	X7
Byte 3	Ø	X6	X5	X4	X3	X2	X1	XØ
Byte 4	Ø	Ø	Ø	Ø	Ø	Ø	Y15	Y14
Byte 5	Ø	Y13	Y12	Y11	Y1Ø	Y9	Y8	Y7
Byte 6	Ø	Y6	Y5	Y4	Y3	Y2	Y1	YØ

Command: XB16.7 YB16.7 CB=FF{*ØØ ^2Ø <2 L1 QF} ^3Ø <2 L1

XB16.7 16 bits for X-data, with 7 data bits per byte

YB16.7 16 bits for Y-data, with 7 data bits per byte

CB= Conditional statement, comparing cursor output with FF, which is produced when no buttons are pushed.

{ If no buttons are pressed, the tablet will output the following conditional format:

*ØØ AND FFH with ØØH, producing ØØH

^2Ø OR it with 2ØH, producing 2ØH

<2 Rotate it to the left two places, which places a 1 into bit 7 of byte one, for the leading zero.

L1	ORs it with the first character in the data stream, which has the most significant bits of the X data
QF	Quits the format
}	End of conditional output
^3Ø	If any button has been pressed, the tablet skips to this, ORing the cursor output with 3Ø
<2	Rotates to the left 2 places, which places a 1 into bit even as before, and also places a 1 into C4, the leading cursor bit (a leading 1 is in every cursor output of this format)
L1	ORs the results of ^3Ø <2 with the first character in the output, combining the cursor and X data.

Using Universal Formatter

The following are examples of how the Universal Formatter commands can generate standard formats.

- Format 0:** ESC% FS1Xi5.0','Yi5.0',C4+31NØD CR
- Format 1:** ESC% FS1CWXi5.0Yi5.0NØD CR
- Format 2:** ESC% F'@'C4+31S5Xi6.0Yi6.0NØD CR
- Format 4:** ESC% FSØTAMACAXi5.0Yi5.0NØD CR
- Format 5:** ESC% FSØXi5.0','Yi5.0',"TAMACANØD CR
- Format 6:** ESC% FSØCAPAXiF.0Yi5.0NØD, CR
- Format 7:** ESC% FSØXf7.0','Yf7.0',"TAMACANØD CR
- Format 8:** ESC%FS5Xf7.0','Yf7.0','CB+Ø1PR<5L17PR
<5L19D2',"TB+30NØD CR
- Format 9:** ESC% FS1C4+31Xi5.0' 'Yi5.0NØD CR
- Format 10:** ESC% FS1C4+31Xi5.0Yi5.0NØD CR
- Format 11:** ESC% FS1Xi5.0Yi5.0C4+31NØD CR
- Format 12:** ESC% FS1Xi5.0','Yi5.0','C4=FF(*FØ)+30NØD CR
- Format 14:** ESC% FS5Xi6.0','Yi6.0','C4=FF(*FØ)+3NØD CR
- Format 15:** ESC% FS5Xi6.0','Yi6.0','CB+Ø1PR<5L15PR
<5L17D2',"TB+30NØD CR
- Format 16:** ESC% FS5XF9.3','YF9.3','CB+Ø1PR
<5L21D2',"TB+30NØD CR
- Format 22:** ESC%Fp255XB16.7YB17.7XB17.24*Ø1<3L5PR
<5L5CG^20<2L2", CR
- Format 23:** ESC%FXB16.7YB17.7XB17.24*Ø1<3L4PR
<5L4CG^2ØL1 CR

Format 24: ESC%FXB16.7YB17.7XB17.24*01<3L4PR
<5L4CG^20L1 CR

Format 25: ESC%FC4+01*10>3^40PRL1C4+*0F<2L1X
b12.6Yb12.6 CR

Format 26: ESC%FC4+01*1F^80Xb14.7Yb14.7PR<6L1TB
<5L1 CR

Format 27: ESC%FXB16.7YB17.7XB17.24*01<3L4PR
<5L4C4+01^20<2L1 CR

Format 28: ESC%FC4+01<2^40PRL1C4+01>3*02L1Xb12.
6Yb12.6 CR

Format 30: ESC%FCB+01*07+98Xb14.7Yb14.7PR
<6L1TB<5L1 CR

Format 31: ESC%FTA-41<1^40PRL1CB+01Xb17.6Yb17.6CR