APPENDIX D
DIGITIZING TABLET SPECIFICATION

D.1 GENERAL DESCRIPTION

This Appendix provides the specifications that define the characteristics of a digitizing tablet system interfacing with a VAXstation II/GPX workstation. The digitizing tablet system consists of a 27.5 cm (11 in) square digitizing tablet, a 4-button puck, a 2-button stylus, and a 5-foot power/signal cable, as shown in Figure D-1.

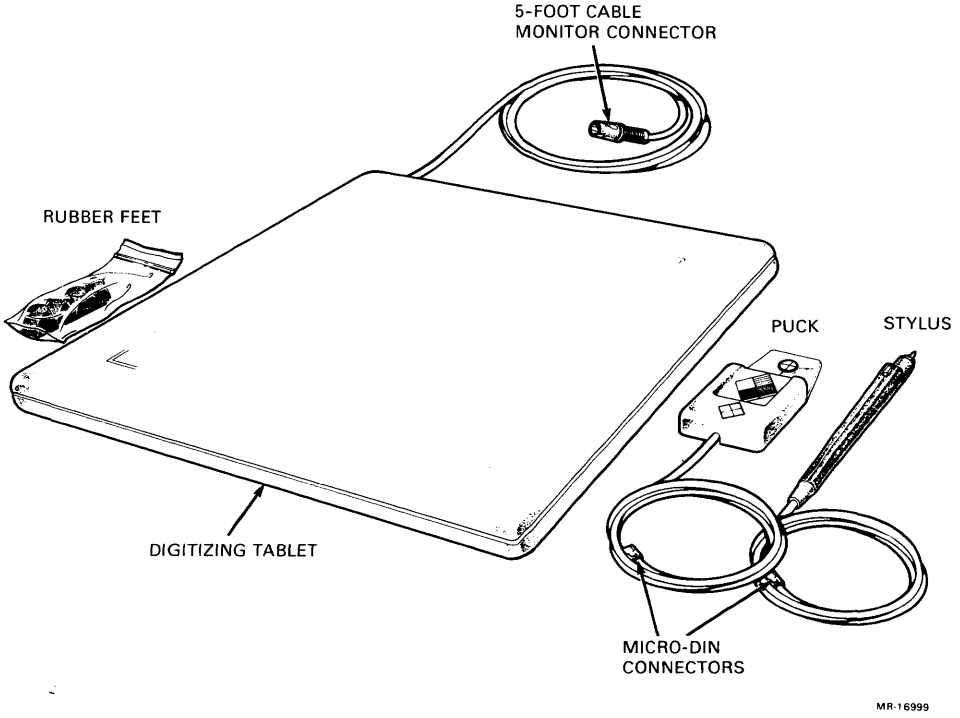

Figure D-1 Digitizing Tablet

The digitizing tablet is a computer input device that sends X-Y coordinates to a computer in order to indicate the position of a stylus or puck on the tablet's surface. The tablet has a resolution of 0.0125 cm (0.005 in) or 200 counts/in. The active area of the tablet is 27.5 cm (11 in) square. The 4-button puck and the 2-button stylus pen use the same connector at the rear of the tablet, with only one connected at any given time. The tablet cable is supplied with a 7-pin micro-DIN type connector (male), which is assigned the signals listed in Table D-1. A 5-foot, 5-conductor, flexible signal/power cable connects the tablet to the MicroVAX workstation system. Figure D-2 shows the tablet cable connector numbering scheme.

Table D-1 Tablet Cable Connector Signal Assignments

Connector Pin	Signal Assignment
1	GND
2	TXD (serial out from tablet)
3	RXD (serial into tablet)
4	Not used
5	Not used
6	+12 V
7	Device present (connected to pin 1)
Shell	Protective ground (ESD shield)

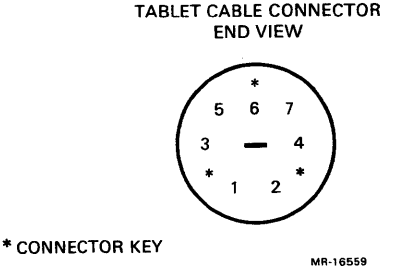

Figure D-2 Tablet Cable Connector Numbering Scheme

D.2 ELECTRICAL SPECIFICATIONS (POWER RATING)

The electrical requirements of the tablet are +12 Vdc +/-10% at less than 300 mA.

D.3 COMMUNICATION SPECIFICATIONS

D.3.1 Serial Interface

The tablet communicates with its host via an asynchronous, full-duplex, serial interface at 4800 baud (+/- 2%) and 9600 baud (+/- 2%). Bytes are framed by one start bit and one stop bit. The data byte contains 8 bits of data and 1 parity bit (odd parity). The default baud rate is 4800 bits/s.

D.3.2 Electrical Signals

The tablet transmits and receives RS-232-C-compatible signals as follows.

```
Transmit: Space = +5 V to +12 V,  mark = -4 V to -12 V
Receive:  Space = +3 V to +12 V,  mark = -3 V to -12 V
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Output from the tablet is capable of driving a load of 3000 ohms to ground.

D.3.3 Tablet Position Report

The tablet transmits a 5-byte position report format as shown in Figure D-3.

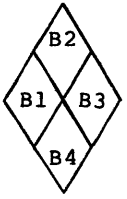
In explanation of Figure D-3:

Bit 7 = Start of frame synchronization

Puck:

B1 = Button #1: 0 = up, 1 = down
B2 = Button #2: 0 = up, 1 = down
B3 = Button #3: 0 = up, 1 = down
B4 = Button #4: 0 = up, 1 = down

Puck
Button Layout



Stylus:

B1 = Barrel button: 0 = up, 1 = down
B2 = Tip button: 0 = up, 1 = down
PR = Proximity: 0 = in proximity,
1 = out of proximity

X0-X11 = X coordinate bits; X0 is LSB, binary format.
Y0-Y11 = Y coordinate bits; Y0 is LSB, binary format.

BYTE	BIT 7	6	5	4	3	2	1	0
1	1	1	0	B4	B3	B2	B1	PR
2	0	0	X5	X4	X3	X2	X1	X0
3	0	0	X11	X10	X9	X8	X7	X6
4	0	0	Y5	Y4	Y3	Y2	Y1	Y0
5	0	0	Y11	Y10	Y9	Y8	Y7	Y6

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Figure D-3 Tablet Position Report Binary Format

D.4 TABLET OPERATION AND COMMANDS

D.4.1 Report Rate

The tablet report rate is software-selectable by host command. Report rates are 55, 72, and 120 reports/s. In order to transmit 120 reports/s, the baud rate must be increased to 9600 bits/s. The default or power-up report rate is 55 reports/s. Report rate is selected by sending the following ASCII characters.

K	(4B hex)	Sampling rate of 55 reports/s
L	(4C hex)	Sampling rate of 72 reports/s
M	(4D hex)	Sampling rate of 120 reports/s

D.4.2 Baud Rate Command

The default baud rate of the tablet is 4800 bits/s. The baud rate is changed to 9600 bits/s by sending the ASCII character B (42 hex) to the tablet. Upon receiving this command, the tablet completes any report in progress, change baud rate, and switches to request point mode.

The tablet is switched back to the default baud rate by sending a BREAK (minimum of two character times) or by requesting a self-test of the tablet. Both these commands invoke the self-test and return all functions to the default conditions.

D.4.3 Request Point Mode

Request point mode allows the host to select when a coordinate pair is to be sent. This mode is selected by sending the ASCII character D (44 hex). A coordinate pair is requested by sending the ASCII character P (50 hex) to the tablet. The P command also switches the tablet to request point mode. If the request is made while the stylus or puck is not in proximity with the tablet, the last valid coordinate pair is transmitted without the off-proximity flag being set. Upon completion of power-up or self-test, the tablet is placed in this mode.

D.4.4 Incremental Stream Mode

In incremental stream mode, the tablet generates a report when the puck or stylus is moved more than 0.0125 cm (0.005 in). Reports continue while the puck is in motion. A report is also generated upon button depression or release. Incremental stream is selected by sending the ASCII character R (52 hex) to the tablet.

D.4.5 Self-Test

Upon command from the host computer or upon tablet power-up, the tablet automatically checks its internal logic circuits, and transmits a 2-byte identification code, plus a 2-byte code describing the health of the electronics and firmware.

A 4-byte self-test report is transmitted at power-up, as shown in Figure D-4. Each report contains the absolute X and Y positions of the puck or stylus from the origin of the tablet. The origin of the tablet is the bottom left corner of the active area. The first byte of the report indicates which button is pressed.

07	06	05	04	03	02	01	00	BIT NUMBER
1	0	1	0	R3	R2	R1	R0	BYTE 1
0	M2	M1	M0	0	0	1	0	BYTE 2
0	E6	E5	E4	E3	E2	E1	E0	BYTE 3
0	0	0	B4	B3	B2	B1	PR	BYTE 4

KEY:
BIT 7 = FRAME SYNCHRONIZATION
R3-R0 = REVISION NUMBER
M2-M0 = MANUFACTURING LOCATION ID
E6-E0 = ERROR CODE
B4-B1 = BUTTON CODE
PR = PROXIMITY

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Figure D-4 Four-Byte Self-Test Report Format

The four bytes are explained below.

Byte 1, Firmware ID: A0 (hex) for initial release.

Byte 2, Hardware ID: A single-byte code for manufacturing and device identification, as formatted in Figure D-5.

Manufacturing location ID code assignments are reserved for Digital's future definition.

Device ID code assignments:
0010 - Indicates mouse data
0100 - Indicates tablet data

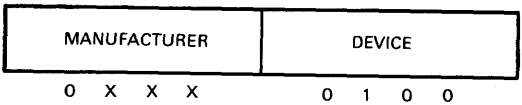

Figure D-5 ID Code Format

Byte 3, Hardware: Status — This byte states the health of the tablet's circuitry. Codes of 20 (hex) or greater are considered to be fatal hardware problems, codes less than 20 (hex) are successful. This byte will be one of the following codes.

3E (hex) - RAM or ROM checksum error
3A (hex) - Analog or digital error
3D (hex) - Button down error

13 (hex) - No puck or stylus connected
11 (hex) - Stylus is connected
00 (hex) - Self-test passed

Byte 4, Button Code: or Zero — The code is the same as the first byte of the 5-byte code of the tablet position report. It indicates which buttons are down, if any. Bits 6 and 7 of this byte are 0s.

The self-test command leaves the tablet in the reset or power-up state. When a self-test command is issued, it is invalid to send any data to the tablet until the last byte of the self-test report is received. The tablet ignores any data received during self-test.

The host commands for self-test are the ASCII character T (54 hex) or a BREAK (minimum of two character times).

D.4.6 Default Conditions

Upon completion of power-up or after a self-test command, the tablet is placed in the following state.

- Request point mode
- Baud rate of 4800 bits/s
- Report rate of 55 reports/s

D.4.7 Report Synchronization

Multibyte reports are atomic (the bytes of the report are sent in sequence without interruption). Bit 7 of the first byte of a multibyte report is a 1, and can be used for software synchronization. Bit 7 of the succeeding bytes of a multibyte report are always 0s.

When a command is received, the tablet completes the current report transmission before executing the new command.

D.4.8 Recovery from Invalid Commands

The tablet ignores invalid commands.

D.4.9 Summary of Digitizing Tablet Commands

Table D-2 lists the commands that can be executed using the digitizing tablet. All tablet commands are single-byte, printable ASCII characters.

Table D-2 Summary of Tablet Commands

ASCII	Hex	Function
BREAK		Invoke self-test
B	42	Change baud rate to 9600
D	44	Request point mode command
K	4B	Set sampling rate to 55
L	4C	Set sampling rate to 72
M	4D	Set sampling rate to 120
P	50	Position request command
R	52	Incremental stream
T	54	Invoke self-test
Zx	5A XX	Digital's reserved functions for testing or quality control, completed within 1 s. The previous tablet state is not disturbed.

D.5 PERFORMANCE SPECIFICATIONS

D.5.1 Resolution

The resolution of the tablet is 0.0125 cm (0.005 in) or 200 counts/in in any direction.

D.5.2 Accuracy

The tablet does not produce outputs in error by more than +/- 5 counts of the position report's LSB.

D.5.3 Spurious Outputs

The tablet avoids reporting movements of 1 LSB or when reporting has been disabled. Picking the puck or stylus straight up from the tablet surface does not report movement of more than 10 counts of resolution. When the puck or the stylus is not in the proximity of the tablet, positional reports to the host are suppressed.

D.5.4 Response Time

The tablet processes all valid commands (except self-test and vendor-reserved commands) within 100 ms. Within 500 ms, the tablet must respond to a self-test command. The tablet completes its power-up self-test within 1 s after stable power.

D.5.5 Initialization

A sample initialization for the tablet is as follows.

1. Initialize the host's serial port for the mouse/tablet to 4800 baud data format (8 data, odd parity, 1 stop bit).

2. Request that the tablet do a self-test and identification sequence by sending ASCII T (54 hex) to the tablet.

   If the tablet driver switches the baud rate to 9600 baud, the break character should also be used (break followed by an ASCII T). This prevents the tablet's staying at the higher baud rate if the system is reset. Care must be taken when switching to the higher baud rate.

3. The tablet replies with the self-test and identification sequence. Device identification should be checked for device type, along with any error report. If self-test was successful, go to step 5.

4. If self-test report was not received within 1 s:

   - Check that the tablet is correctly attached.
   - If no response is received, the tablet is either defective or alien.

5. The system now should set the tablet to the proper operating mode. Default set-up is for prompt mode.

D.6 ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE RANGE

Operating	+10°C to +40°C (+50°F to +104°F)
Nonoperating	-40°C to +66°C (-40°F to +150.8°F)

HUMIDITY

Operating	10% to 90% relative humidity, noncondensing, with a maximum wet bulb temperature of 28°C (82.4°F) and a minimum dew point of 2°C (35.6°F).
Nonoperating	5% to 95% with a maximum wet bulb temperature of 46°C (82.8°F).

ALTITUDE

Operating	2.4 km (8,000 ft) maximum for 4 hours minimum.
Nonoperating (packaged)	9.1 km (30,000 ft) maximum for 1 hour minimum.