MM 1812 DIGITIZER
(BIT PAD VERSION)

Technical Reference

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Radio Frequency Interference (RFI)

The MM 1812 digitizer ("the Equipment") generates and uses radio frequencies. If not properly installed and used in strict accordance with Summagraphics's instructions, the Equipment may cause interference with radio or television reception. The Equipment has been tested and found to perform within the Class B limits for a computing device according to the specifications in Subpart J, Part 15 of the Federal Communications Commission (FCC) Rules, designed to provide reasonable protection against such interference in a residential installation.

Only Summagraphics's accessories and options sold for use with this Equipment may be used.

Summagraphics Corporation is not responsible for radio or television interference caused by unauthorized modification of the Equipment.

Compliance with Class B specifications does not guarantee that interference will not occur in a particular installation. If it does occur, one or more of the following measures could remedy the problem:

- Re-orient the radio or television receiving antenna.

- Move the Equipment away from the radio or television.

- Plug the Equipment and the radio or television into separate outlets so that they are on different branch circuits.

If necessary, consult the radio or television dealer or an experienced technician. In addition, the booklet "How to Identify and Resolve Radio-TV Interference Problems" may be helpful. This booklet was prepared by the FCC and is available from the U.S. Government Printing Office, Washington, D.C. 20402, U.S.A., Stock No. 004-000-00345-4.

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TABLES

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CHAPTER 1 - HOW TO USE THIS BOOK

This book's purpose is to provide all the information you need to successfully integrate the MM 1812 into your system. This includes:

- set-up,
- operation,
- testing, and
- installation and care.

If you're new to digitizers or to the MM 1812, read all of this book. Many aspects of the MM 1812 are interrelated and interdependent. An overall understanding of the product before you start is very helpful.

If you're an "old hand" to the MM 1812, the many tables and summaries will let you quickly skim for the information you require. Of special note are Appendices C and D. Appendix C highlights differences between the MM 1812 digitizer and the previous Bit Pad I and Bit Pad Two (MM 1103) digitizers. Appendix D summarizes the MM's commands and default operating characteristics.

CHAPTER 2 — AN OVERVIEW OF THE MM 1812

The MM 1812 is a digitizer. A digitizer is an input device that
translates each location selected by the stylus or cursor into X,Y coor-
dinates, information suitable for a digital device, e.g. a computer or a
computer terminal.

The MM 1812 is a valuable tool in many applications. Use it, for exam-
ple, to:

- steer a cursor on a computer terminal;
- pick locations on a menu; and
- draw or trace maps and drawings.

The sections that follow describe the parts of the MM 1812 and how it
operates.

SECTION A – PARTS
====================

For the MM 1812 digitizer to be functional you need:

- a tablet,
- a cursor or stylus,
- an interface cable, and
- a power source.

Your sales representative can tell you which parts are included in the
standard package, and which are purchasable options.

The following illustration shows a typical MM 1812 configuration:
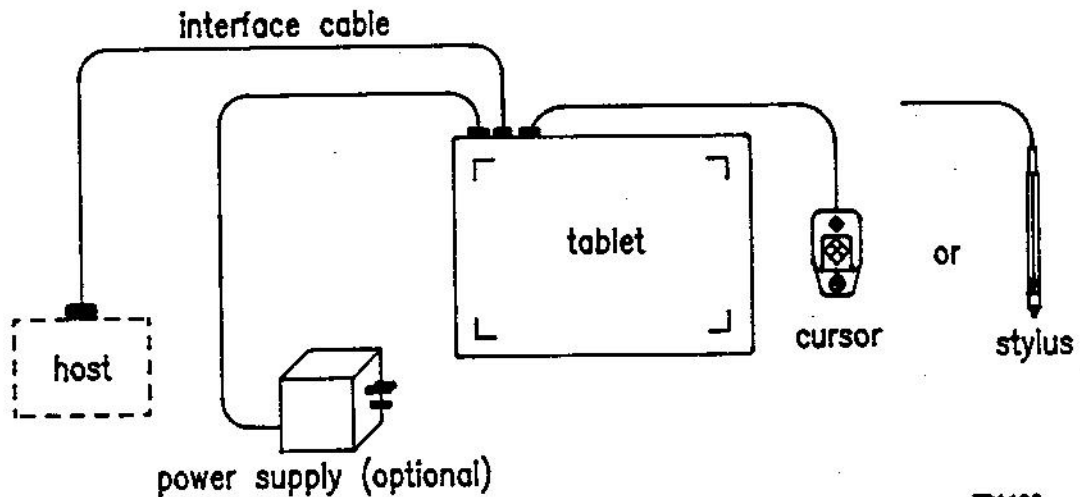
TP1190

Figure 2-1 MM 1812 Digitizer – Typical Configuration

TABLET

The tablet is a flat surface like a small drawing board. Built into the tablet case is a flip-out stand. Without the stand, the tablet sits at a 2-degree slope; when rotated outward, the stand elevates the tablet to a ten-degree slope.

CURSOR

The cursor is a puck-like hand-held device. Use it with the tablet to locate points. A cursor has a cross hair for precisely sighting the points. Cursors are available with three or four buttons. The cursor is most accurate when you hold it parallel to the tablet surface.

3 — button cursor   4 — button cursor

raised
dimples

TP1182
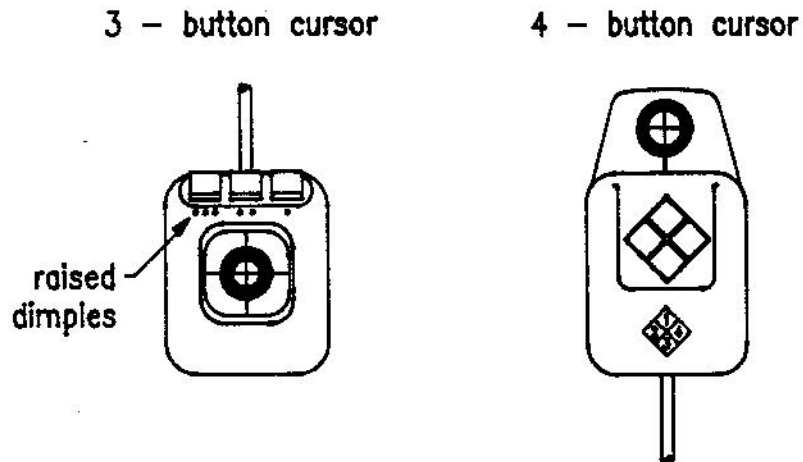
Figure 2-2 Cursors

STYLUS

The stylus is a pen-like hand-held device. Use it with the tablet to locate points. Two styli are available. One stylus has an internal button only. To activate it, press the stylus tip. The other has two buttons: one on the barrel and one inside. Activate the internal button by pressing the stylus tip. Activate the barrel button by pressing it.

The stylus is most accurate when you hold it perpendicular to the tablet surface.

stylus

barrel
button (optional)

tip button
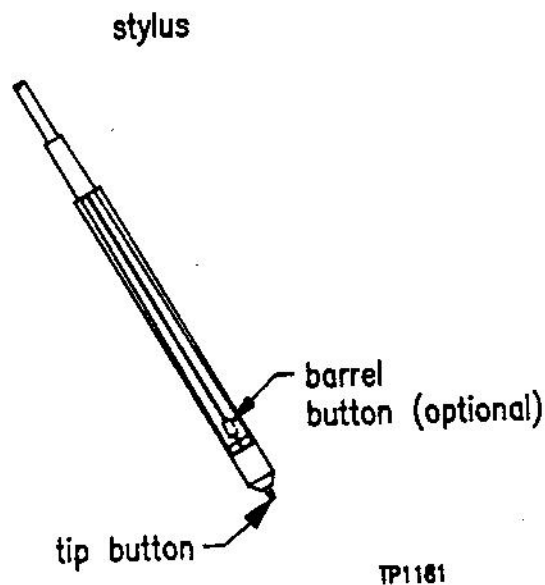
TP1161

Figure 2-3 Stylus

INTERFACE CABLE

The interface cable is the cable and connector assembly that connects the digitizer to the host.

POWER SOURCE

The MM's power source can be our external power supply or your host. Powering the MM from the host requires a hardware modification, which must be specified when ordered. Refer to Chapter 5, Section D for details.

SECTION B - OPERATION
==========================

The MM 1812 translates the position of the stylus or cursor on the ta-
blet into digital information. It then communicates that digital infor-
mation to the host. The host is usually a computer or computer termi-
nal. The MM 1812 expresses the stylus or cursor position as an X,Y
coordinate pair. One coordinate pair is a report.

Reports can only be collected when the stylus or cursor is in the
tablet's active area and in proximity. The active area is the area on
the tablet surface in which stylus or cursor positions can be identi-
fied. The corner marks approximate its location, as shown below:
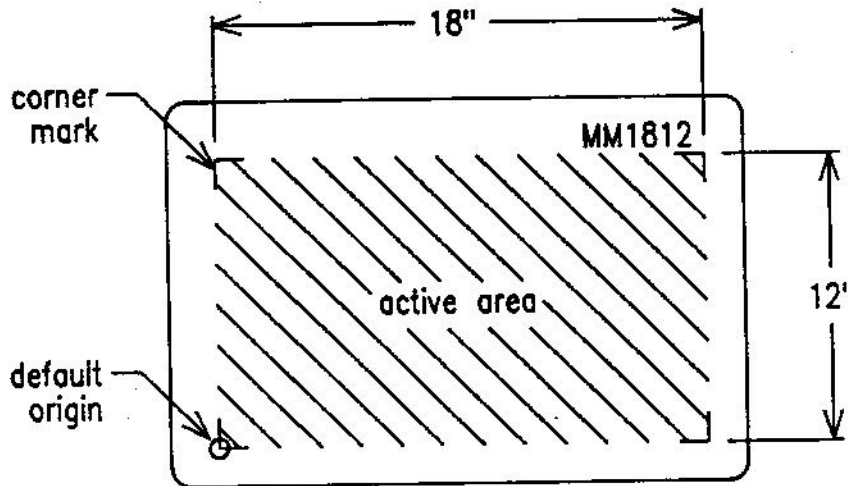
TP1191

Figure 2-4 The Active Area

Proximity is the maximum distance above the active area that the stylus
or cursor can be held and report a valid position. Together, the active
area and proximity establish a three-dimensional volume within which the
stylus or cursor can issue valid reports. Reports issued from outside
of this volume are out of proximity (out-of-prox) and, therefore, do not
represent the current position of the stylus or cursor.

Reports are in absolute or relative coordinates, expressed in counts (of
resolution). The following figure illustrates the concepts of absolute
versus relative coordinates, resolution, and counts of resolution:

one
resolution count

active
area

origin

resolution = 4 lpi

one
resolution count

active
area

origin
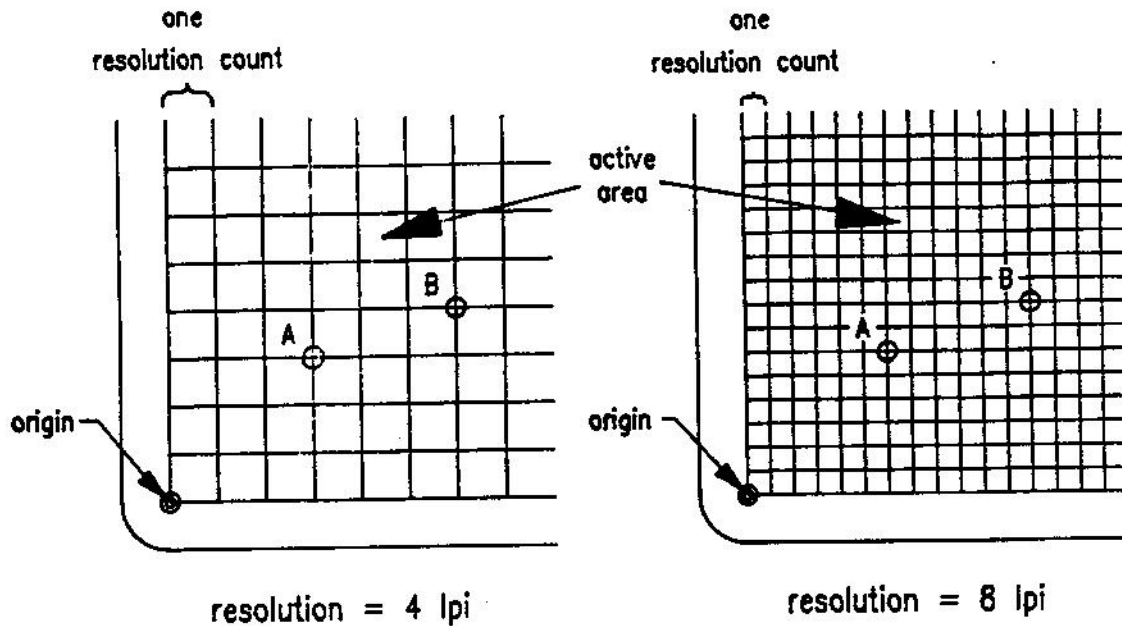
resolution = 8 lpi

points	absolute coordinates	relative coordinates
A	(3,3)	(3,3)
B	(6,4)	(3,1)

Example I

points	absolute coordinates	relative coordinates
A	(6,6)	(6,6)
B	(12,8)	(6,2)

Example II

TP1071

Figure 2-5   Absolute Versus Relative Coordinates, Resolution, and
Counts of Resolution

Absolute coordinates are coordinates measured from the tablet's origin
(0,0). Relative coordinates are measured "relative to" the last report
location. In Figure 2-5, point B is reported after point A. Therefore,
point B in relative coordinates is reported as relative to point A.

Resolution is the smallest distance or movement that the digitizer can
distinguish. Resolution is a measure of precision and is expressed in
lines per inch (lpi) or lines per millimeter (lpmm).

Counts of resolution is a unit of measure: one count is the distance
between two lines of resolution. In Figure 2-5, points A and B are in
the same physical locations, but their coordinates are different. This
is because the resolution in Example I is 4 lpi, and the resolution in
Example II is 8 lpi.

Absolute Coordinates and Relative Coordinates are two of the many
operating characteristics. Other operating characteristics govern when
reports

are issued; how fast they are issued; and the tablet resolution.

The operating characteristics can be set by commands from the host or by switches. The switches, slide or rocker, are grouped in banks of eight per DIP switch. The DIP switches, located on the printed circuit board, are easily accessible at the top underside of the tablet. See Chapter 5, Section B.

The digitizer's configuration parameters are established by switch settings. These parameters specify the data communications, such as CTS handshaking and baud rate, and the data format.

So that the MM 1812 is operable upon arrival at your facility, the switches are set at the factory. The factory settings appear in Appendix D, "Quick Reference Sheet of Commands and Settings" at the rear of this book.

SECTION C - CONFIGURATION PARAMETERS
==

For successful communication between an MM 1812 and its host, the
hardware interface and configuration parameters must be compatible. The
hardware interface is RS-232-C. The configuration parameters are:

- proximity transmission
- remote control
- baud rate, parity and stop bits
- CTS handshaking
- report format and cursor output codes
- hardware interface

This chapter describes the alternatives available for each of the confi-
guration parameters. The parameters are switch-selective.

Appendix D, "Quick Reference Sheet of Commands and Switch Settings",
summarizes the switch settings and the defaults that the factory normal-
ly uses.

PROXIMITY TRANSMISSION

The MM 1812 can be configured to:

- transmit reports only when the cursor or stylus is in
  proximity; or

- transmit reports regardless of whether the cursor or stylus
  is in or out of proximity.

If the digitizer is configured the second way, reports issued from out-
of-prox reflect that state with a special bit or character. Reports in
the binary format have a bit assigned to report the proximity status.
Reports in the ASCII BCD format use the cursor/stylus flag character to
identify an out-of-prox report.

REMOTE CONTROL

When remote control is enabled, the digitizer is receptive to commands
from the host. For a complete list of commands, see Appendix D.

When remote control is disabled, the MM 1812 only responds to the following commands:

ASCII Command	Function
T	remote request trigger
NUL	Reset
XOFF	Stop Transmission
XON	Start Transmission
ENQ	Send Configuration
SP (space)	no operation
CR	no operation

BAUD RATE, PARITY and STOP BITS

Baud rate is the number of bits transmitted each second between host and peripheral MM 1812 or peripheral and host. The available baud rates are 110, 150, 300, 1200, 2400, 4800, 9600, and 19200.

Parity and stop bits must be set for compatibility between peripheral and host.

CTS HANDSHAKING

The MM 1812 supports CTS (Clear To Send) handshaking, a hardware governed method of communications control. The MM 1812 is configured as a DTE (Data Terminal Equipment). Therefore, RTS (Request to Send) and DTR (Data Terminal Ready) are always asserted.

CTS at the digitizer is always enabled. If the CTS enable switch is on and no connection is made to the CTS pin, the digitizer will still transmit data. If a connection is made to the CTS pin and CTS is not asserted, the digitizer is inhibited from sending reports.

If the switch is set to disable CTS handshaking, the digitizer ignores the CTS line.

HARDWARE INTERFACE

The MM 1812 has an RS-232-C interface. It is full duplex. See Chapter 5, Section D for the pin assignments and signal levels.

CHAPTER 3 - OPERATING CHARACTERISTICS AND FUNCTIONS

The MM 1812 has a variety of operating characteristics and functions that control:

- the report flow -- when and how fast;
- the digitizer resolution;
- the digitizer origin location; etc.

In this chapter, Sections A and B describe the command and report formats. Section C covers the state of the digitizer after power up or reset. The final sections of this chapter discuss the remote commands that set up these characteristics, how to combine characteristics, and other functions.

SECTION A - COMMAND FORMAT

==============================

When sending commands to the MM 1812, all commands are single ASCII characters.

We recommend that you use only the commands described in this book. This is because future releases of the MM 1812 may use commands currently unassigned. If you do use an unassigned command, the MM ignores it.

All commands are one byte long. The MM command buffer can hold 16 bytes; therefore, up to 16 commands can be sent to the MM in quick succession.

SECTION B - REPORT FORMAT AND CURSOR OUTPUT CODES
==

Two report formats are available, binary and ASCII BCD.

(To users of other Summagraphics data tablets or digitizers: The formats described here are specific to the MM 1812, the Bit Pad Two (MM 1103) and the Bit Pad One. Other Summagraphics products have similarly named formats, but their content may be different.)

Regardless of format, reports are in counts of resolution, not in inches or millimeters. (Counts of resolution is described in Chapter 2.)

Within the report format:

- you can opt to have parity enabled or not;
- if parity is enabled, it can be even or odd;
- you can select the number of stop bits to be one or two; and
- you have two cursor output codes to choose from.

The MM 1812 is configured at the factory in the ASCII BCD report format with parity enabled (set for even parity), two stop bits, and cursor output A code.

MM 1812 BINARY FORMAT

Binary Format is a five-byte format. This means that five bytes are transmitted for each coordinate pair.

The binary format content is different for reports issued when the digitizer uses Absolute Coordinates versus Relative Coordinates. Absolute Coordinates use 12 bits per coordinate. Relative Coordinates use 11 bits and one sign bit per coordinate.

Table 3-1
MM 1812 Binary Report Format

MSB 7	6	5	4	3	2	1	LSB Ø	Transmission Sequence
P	PH	Fd	Fc	Fb	Fa	Ø	PR	1st byte
P	Ø	X5	X4	X3	X2	X1	XØ	2nd byte
P	Ø	X11	X1Ø	X9	X8	X7	X6	3rd byte
P	Ø	Y5	Y4	Y3	Y2	Y1	YØ	4th byte
P	Ø	Y11	Y1Ø	Y9	Y8	Y7	Y6	5th byte

Key to Table 3-1:

LSB = least significant bit
MSB = most significant bit
PR   = proximity, Ø when in proximity and 1 when out-
       of-prox
Fa-Fd = flag bits, identifying the stylus or cursor
        button being pressed. The cursor output codes
        are switch-selective and the cursor buttons are
        not additive:

Stylus Buttons	Output Code Fd Fc Fb Fa
none	Ø Ø Ø Ø
tip	Ø Ø Ø 1
barrel	Ø Ø 1 Ø
tip & barrel	Ø Ø 1 1

3-button Cursor *Buttons	4-button Cursor Buttons	Output A Code Fd Fc Fb Fa	Output B Code Fd Fc Fb Fa
none	none	Ø Ø Ø Ø	Ø Ø Ø Ø
1	1	Ø Ø Ø 1	Ø Ø Ø 1
2	2	Ø Ø 1 Ø	Ø Ø 1 Ø
---	3	Ø 1 Ø Ø	Ø Ø 1 1
3	4	1 Ø Ø Ø	Ø 1 Ø Ø

        * On the 3-button cursor, the buttons are dist-
          inguished by raised dimples, rather than by
          numbered labels. In the table above, 1 corres-
          ponds to one dimple; 2 to two dimples, etc.

PH   = phasing bit, which is always 1
P   = parity bit
XØ to X11
   and
YØ to Y11 = X and Y coordinate bits.

        Note: X11 and Y11 are the sign bits when using
        Relative Coordinates. The bit is Ø for a positive
        coordinate and 1 for a negative coordinate. Furthermore,
        the coordinate, when negative in value, is expressed
        in the two's complement form.

<u>MM 1812 ASCII BCD FORMAT</u>

When the digitizer issues Absolute Coordinates, the ASCII BCD report
format is:

    XXXX,YYYY,F<CR>   or   XXXX,YYYY,F<CR><LF>

When the digitizer issues Relative Coordinates, the ASCII BCD report
format is:

    SXXX,SYYY,F<CR>   or   SXXX,SYYY,F<CR><LF>

As shown in the above formats, the terminator can be a carriage return
(<CR>) or a carriage return and a line feed (<CR><LF>). This is switch-
selective.

Key:
S = coordinate sign, for a Relative Coordinate only.
   For a positive coordinate, the character can be
   0 through 9. For a negative coordinate, the
   character is a minus sign (-).
X = a digit of the X coordinate, where each digit is an
   ASCII character, 0 through 9
, = the delineator character, an ASCII comma
Y = a digit of the Y coordinate, where each digit is an
   ASCII character, 0 through 9
F = flag character, identifying the stylus or cursor
   button being pressed. The cursor output codes are
   switch-selective and the cursor buttons are not additive:

Stylus Buttons	Output Code	3-button Cursor *Buttons	4-button Cursor Buttons	Output Code A	Output Code B
none	0				
tip	1	none	none	0	0
barrel	2	1	1	1	1
tip & barrel	3	2	2	2	2
out-of-prox	9	——	3	4	3
		3	4	8	4
		out-of-prox		9	9

Note: The character 9 is in the cursor/stylus flag position
   when a report is issued from out-of-prox.

* Note: On the 3-button cursor, the buttons are distinguished by raised
   dimples, rather than by numbered labels. In the table above,
   1 corresponds to one dimple; 2 to two dimples, etc.

<CR> = ASCII carriage return
<LF> = ASCII line feed

SECTION C - RESET AND POWER UP

Each time you power up or reset the MM 1812, all operating characteristics return to their default switch settings.

You can reset the digitizer by issuing the Reset command or by pressing the Reset switch. The Reset command and switch are described in Section F, of this chapter. The location of the Reset switch is described in Chapter 5, Section B, "Configuring the MM 1812 Digitizer".)

From the time the MM is powered up or reset, there is a 10 millisecond delay before the MM is ready to receive commands from the host.

SECTION D - OPERATING CHARACTERISTICS AND COMMANDS
===

The MM 1812 has a variety of operating characteristics and functions. The operating characteristics control the report flow, report content, digitizer resolution, etc.

Set the MM 1812's operating characteristics either remotely with commands from the host or internally with switches inside the digitizer. The table below outlines the selector methods available:

Table 3-2
Operating Characteristics and Function Control

OPERATING CHARACTERISTICS AND FUNCTIONS	CONTROLLED BY	
	SWITCH	COMMAND
Stream Mode	yes	yes
Switch Stream Mode	yes	yes
Stream/Switch Stream	yes	yes
Resolution	yes	yes
Increment Mode and Value	yes	yes
Remote Request Mode	yes	yes
Point Mode	yes	yes
Absolute/Relative Coordinates	yes	yes
Send Configuration	no	yes
Self Test	no	yes
Start/Stop Transmission	no	yes
Reset	yes	yes
NOP (no operation)	no	yes
Send Code Check	no	yes

SECTION E - CONTROLLING THE REPORT FLOW
==

The operating characteristics that control the report flow are the re-
port collection modes and the modifier.

The report collection modes are:

- Point Mode,
- Stream Mode,
- Switch Stream Mode and
- Remote Request Mode.

The modifier is

- Increment Mode

Increment Mode is called a modifier because you use it to "modify" the
behavior of the report collection modes.

The final sections of this chapter describe the report collection modes
and modifier, as well as the effects of combining them. For easy refer-
ence, the commands appear in ASCII and hexadecimal. (Appendix A, "ASCII
Conversion Chart," also provides the binary, decimal, and octal conver-
sions.)

Note: Settings for Stream Mode and Switch Stream Mode also set
       the report rate.

Point Mode

Command:

	ASCII	Hex
command	P	50

Switch Setting:

DIP #	Switch	Setting
1	3	off
	4	on

In Point Mode, the MM 1812 issues one report each time a cursor or stylus button is pressed.

Stream Mode

mode and rate	ASCII	Hex	DIP # 1		Switch Settings:		
			mode		rate		
			3	4	6	7	8
Stream at 2 rps	H	48	on	off	off	off	off
Stream at 4 rps	I	49	on	off	off	off	on
Stream at 10 rps	J	4A	on	off	off	on	off
Stream at 20 rps	K	4B	on	off	off	on	on
Stream at 40 rps	L	4C	on	off	on	off	off
Stream at 70 rps	M	4D	on	off	on	off	on
Stream at 100 rps	N	4E	on	off	on	on	off
Stream at maximum rps	O	4F	on	off	on	on	on

In Stream Mode, the MM 1812 continuously issues reports. It is not necessary to press a stylus or cursor button.

A single command selects both Stream Mode and a Report Rate.

The Report Rate is the number of reports the digitizer issues each second. Note that Report Rate settings are approximate and for Binary Format only.

If the cursor or stylus is moved out of proximity and no buttons are pressed, the last valid report is transmitted continuously or transmission stops depending upon the setting of the transmit always or transmit only-in-prox DIP switch. If the report format is binary, the MM 1812 sets the proximity bit to one, indicating that the cursor or stylus is out of proximity. If the report format is ASCII BCD, the flag value is set to 9.

Hint: To eliminate redundant reports when the stylus or cursor is stationary, use Stream Mode together with Increment Mode.

Switch Stream Mode

Command:			DIP #1			Switch settings:		
				mode		rate		
mode and rate	ASCII	Hex	3	4	6	7	8
Switch Stream at 2 rps	@	40	on	on	off	off	off
Switch Stream at 4 rps	A	41	on	on	off	off	on
Switch Stream at 10 rps	B	42	on	on	off	on	off
Switch Stream at 20 rps	C	43	on	on	off	on	on
Switch Stream at 40 rps	D	44	on	on	on	off	off
Switch Stream at 70 rps	E	45	on	on	on	off	on
Switch Stream at 100 rps	F	46	on	on	on	on	off
Switch Stream at maximum rps	G	47	on	on	on	on	on

In Switch Stream Mode, the MM 1812 continuously issues reports while you press a stylus or cursor button.

A single character selects both Switch Stream Mode and a Report Rate.

The Report Rate is the number of reports the digitizer issues each second. Note that the Report Rate settings are approximate for Binary Format only.

If the cursor or stylus is moved out of proximity and a button is pressed, the last valid report is transmitted continuously or transmission stops depending upon the setting of the transmit always or transmit only-in-prox DIP switch. If the report format is in binary, the MM 1812 sets the proximity bit to one, indicating that the cursor or stylus is out of proximity. If the report format is ASCII BCD, the flag has a value of 9.

Hint: To eliminate redundant reports when the stylus or cursor is stationary, use Switch Stream Mode together with Increment Mode.

Remote Request Mode

Command:

	ASCII	Hex
mode command	S	53
trigger command	T	54

Switch Setting:

DIP #	Switch	Setting
1	3	off
	4	off

In Remote Request Mode, the MM 1812 issues one report each time the host sends a trigger command. Issue the mode command once. Thereafter, send only a trigger command for each report.

You can solicit reports with the trigger when the MM 1812 is in Point, Stream or Switch Stream Mode. Simply issue the trigger command. Note that pressing a cursor or stylus button, when the MM 1812 is in Remote Request Mode, doesn't issue a report. However, if a trigger command is issued at the same time that you are pressing a button, the report transmitted from the digitizer includes the value of the cursor or stylus flag pressed.

After Remote Request Mode is initiated, the MM 1812 takes between one and ten milliseconds to issue the report resulting from the trigger command. Reports can be issued up to the maximum Report Rate available for the set baud rate and report format.

Stop Mode

Stop Mode was a mode used by the Bit Pad One. The MM 1812 has replaced it with the Remote Request Mode. Since these modes are not exactly alike, read the section on Remote Request Mode.

<u>MODIFIER</u>

<u>Increment Mode</u>

Command: Switch Settings:

	ASCII	Hex
Increment equals:		
Ø (disable)	a	61
1	b	62
2	c	63
3	d	64
4	e	65
5	f	66
10	g	67
20	h	68

Increment Mode and Value: DIP #2

	Switch Setting		
	3	4	5
Ø	off	off	off
1	off	off	on
2	off	on	off
3	off	on	on
4	on	off	off
5	on	off	on
10	on	on	off
20	on	on	on

In Increment Mode, the MM 1812 sends a report only when the cursor or stylus has traveled a minimum distance in the X or Y direction. This minimum distance is the increment. The increment is defined by you and applies to both axes. Because redundant reports are not sent to the host, Increment Mode is useful in reducing data output.

Here is a description of how Increment Mode works: The last report issued becomes the center of an imaginary square, whose sides are twice the increment value. The cursor can move anywhere inside the imaginary square without a report being issued. As soon as the increment is satisfied along either axis, the MM 1812 transmits the actual X and Y coordinates of the point. The new point becomes the center of a new, imaginary square.

When Increment and Stream Modes are enabled, and the cursor/stylus button is pressed between incremental values, the MM 1812 repeats the last valid report twice. When the button is pressed, a coordinate pair is transmitted with the value of the flag contained in the report equal to the button pressed. When the button is released, the same report is transmitted again however, the value of the flags contained in the report is equal to zero.

Example: Figure 3-1 illustrates operation in this mode. Part A shows the imaginary square created around each report point; the increment is five. Part B shows the reports issued as the cursor or stylus travels across the tablet; the increment is 10.

Part A   Part B
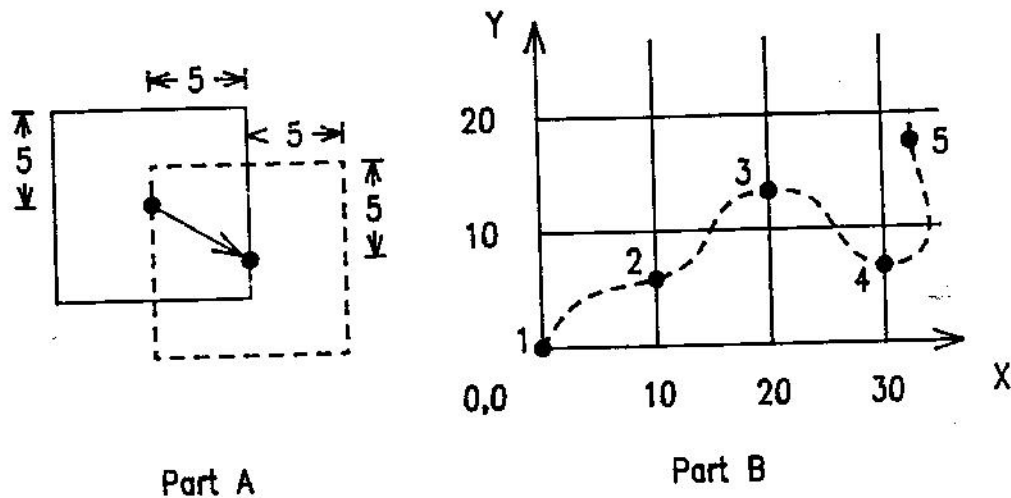
TP1210

Figure 3-1 Increment Mode Example

The five points issued in part B are numbered in order.

Point		Report	Description
1	=	(0,0)	
2	=	(10,5)	Only X is satisfied. The actual value of Y is transmitted.

No point is transmitted between points 2 and 3 because the cursor or stylus did not move 10 resolution counts in either the X or the Y direction.

3	=	(20,13)	The increment is satisfied from the last point along the X axis, only; the MM 1812 issues the new report.
4	=	(30,7)	The increment is satisfied from the last point along the X axis, only; the MM 1812 issues the new report.
5	=	(32,17)	The increment is satisfied from the last point along the Y axis, only; the MM 1812 issues the new report.

What Happens When You Combine Report Collection Modes and a Modifier

This section describes some of the effects of combining primary modes and a modifier.

- When operating in Remote Request Mode, the MM 1812 does not issue reports in response to buttons being pressed.

- The MM 1812 issues reports in response to pressing buttons or remote requests when the digitizer is in Point, Stream, or Switch Stream Mode.

- When the digitizer is in Stream, Switch Stream or Point Mode with Increment Mode enabled and you press a button, the last coordinate pair that satisfies the increment is reported.

- When both Stream Mode and Increment Mode are enabled, and you press a button, the MM 1812 repeats the last valid report twice: once when you press the button and again when you release it.

- When the digitizer is in Stream Mode or Switch Stream Mode and Increment Mode is enabled, reports are issued as follows:

    - A report cannot be issued until the increment has been satisfied.

    - If the increment has been exceeded and the Report Rate mandates that a report be issued, the last coordinate pair that satisfies the increment is reported.

- When the digitizer is in Point and Increment Modes, reports are issued as follows:

    - If a button is pressed, but the increment has not been met, the last coordinate pair that satisfies the increment is reported.

    - If the increment has been exceeded and a button is pressed, the last coordinate pair that satisfies the increment is reported.

- When the digitizer is in Remote Request and Increment Modes, regardless of whether the increment has been satisfied or not, the actual position of the stylus or cursor, when the digitizer receives the remote trigger, is the reported position.

- If Point Mode or Remote Request Mode is set by switch, rather than by command, the Report Rate, also set by switch, is valid.

Consequently, the Report Rate, if set by DIP switches, has priority over buttons or remote triggers.

REPORT CONTENT

Command:

Switch Settings:

	ASCII	Hex
Absolute Coordinates	Q	51
Relative Coordinates	R	52

DIP #	Switch #	Setting
1	5	off
1	5	on

The MM 1812 issues report points as Absolute Coordinates or Relative Coordinates. Absolute Coordinates are measured relative to the digitizer origin. Relative Coordinates are measured relative to the last issued report.

Absolute Coordinates are measured relative to the origin which is fixed in the lower left corner. The origin on the MM 1812 digitizer with Bit Pad Format is not relocatable.
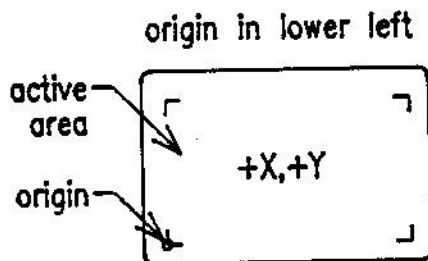
Figure 3-2 Absolute Coordinates Depend on Origin Location

Absolute reports issued from out-of-prox are repeats of the last valid coordinate pair. Relative Coordinates issued from out-of-prox have a value of zero.

Note: When reports are in Binary Format and the digitizer is issuing Absolute Coordinates, the maximum reportable value is 4095. Reports larger than this are reported as the maximum value (4095). Higher resolutions can be used; however, the active area shrinks accordingly. the following table specifies the maximum length of each active area's axis from the tablet origin for resolutions higher than 200 lpi.

Binary Format

Resolution Setting	Maximum Axis Length
254 lpi, 10 lpmm	16.122 inches
400 lpi	10.24 inches
500 lpi	8.19 inches
508 lpi, 20 lpmm	8.06 inches
1000 lpi	4.095 inches

When reports are in ASCII format and the digitizer is issuing Absolute Coordinates, the maximum reportable value is 9999. Reports larger than this are reported as the maximum value (9999). Resolutions which cause the maximum value to go beyond 9999 can be used; however the active area shrinks accordingly.

The 1000 lpi resolution is the only resolution that can not be used over the entire active area of the digitizer when using ASCII format.

The MM 1812 digitizer issues Relative Coordinates which are measured "relative to" the last issued report, not the tablet origin.

Relative Coordinates can have positive or negative values.

Reports issued while the cursor or stylus is out-of-prox are zero.

Because relative coordinates are measured relative to the last issued report, the coordinate values vary depending on that report's location, as shown below:
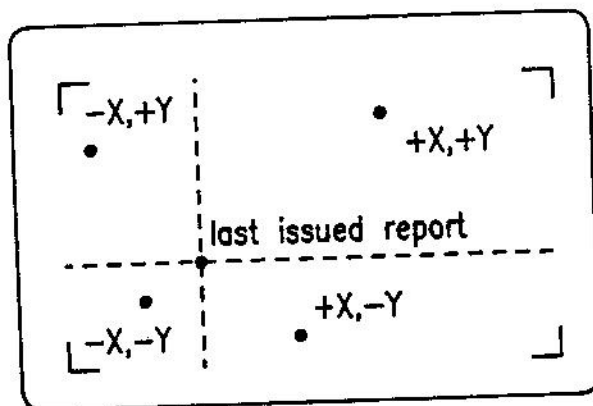
TP1193

Figure 3-3 Relative Coordinates Depend on Last Issued Report

Note: When the digitizer issues Relative Coordinates, the maximum negative coordinate that can be reported is restricted. In binary format, the maximum reportable value is 2047. In the ASCII BCD format, the maximum reportable value is 9999 in the positive direction and 999 in the negative direction. Reports larger than these values are reported as the maximum value. (Positive coordinates are not restricted.)

The effect is a restriction of the maximum "delta" between reported points. The "delta" is the distance from the last report to the current report. The maximum delta varies, depending on the digitizer's resolution setting. The relationship is quantified in the table below:

Resolution Setting	Max. Negative Delta ASCII BCD Format (in inches)	Max. Delta Binary Format (in inches)	Max. Positive Delta ASCII BCD Format (in inches)
100	9.9	no restriction	no restriction
127	7.87	no restriction	no restriction
200	4.99	no restriction	no restriction
254	3.93	8.06	no restriction
400	2.5	5.12	no restriction
500	1.99	4.09	no restriction
508	1.97	4.03	no restriction
1000	0.999	2.047	9.9

RESOLUTION

Command: Switch Setting:

	ASCII	Hex
Resolution of:		
100 lpi	i	69
127 lpi (5 lpmm)	j	6A
200 lpi	k	6B
254 lpi (10 lpmm)	l	6C
400 lpi	m	6D
500 lpi	n	6E
508 lpi (20 lpmm)	o	6F
1000 lpi	p	70

Resolution: DIP #2

	Switch Setting		
	6	7	8
100 lpi	off	off	off
127 lpi (5 lpmm)	off	off	on
200 lpi	off	on	off
254 lpi (10 lpmm)	off	on	on
400 lpi	on	off	off
500 lpi	on	off	on
508 lpi (20 lpmm)	on	on	off
1000 lpi	on	on	on

Resolution is the smallest distance or movement that the digitizer can distinguish. Resolution is a measure of precision and is expressed in lines per inch (lpi) or lines per millimeter (lpmm).

Note: The data format and the coordinate mode both play a role in which resolutions are valid for the entire tablet. Refer to the previous sections on Absolute and Relative Coordinates for further information.

SEND CONFIGURATION

Command:

	ASCII	Hex
command	s	73
or		
	ENQ	Ø5

Switch Setting:

DIP #	Switch	Setting
	NONE	

Use the Send Configuration command to send a report to the host that identifies the digitizer model and its version of software. The output looks like this:

BP1812__TABLET__by_Summagraphics_Firmware_Version_n.n<CR><LF>

where the underlines are spaces (_ is a single space, __ is a double space); n.n is the version number; and the carriage return or line feed is transmitted according to the setting of the switch controlling the transmission of <CR>'s and <LF>'s.

TRANSMISSION CONTROL

Command: Switch Setting:

	ASCII	Hex
Stop Transmission	XOFF	13
Start Transmission	XON	11

DIP #	Switch	Setting
	NONE	

The Start Transmission and Stop Transmission commands act as gates, allowing reports to be sent or not sent from the MM 1812 to the host. These commands control data flow, regardless of the report mode. (Stop Transmission and Start Transmission are equivalents of the transmission protocols XOFF and XON.)

Stop Transmission places the digitizer on standby. It is useful for systems that do not use the digitizer constantly. End the standby state by sending the Start Transmission command.

If a report is interrupted by Stop Transmission, no data is lost. The report is severed at the end of the byte. When the Start Transmission command is issued, the next byte in that report is sent, intact. To avoid corrupted data when using Binary Format, the host software should not look for a phasing bit at the beginning of resumed transmission.

The digitizer responds to all other commands, such as a command to change the resolution, while it is on standby. If the Reset command is issued while the digitizer is on standby, the digitizer honors the Reset command, and retracts the XOFF state while resetting the tablet.

Note: This differs from the way Bit Pad Two operates.
      If Bit Pad Two is reset in the XOFF state, the digitizer
      resets but the XOFF state is not retracted.

RESET

Command: Switch Setting:

	ASCII	Hex
command	NUL	00

DIP #	Switch	Setting
A Reset switch is located under the tablet at the top of the tablet		

Use the Reset command to return the operating characteristics to their current switch settings.

The factory-set defaults are:

    report mode   =   Stream
    coordinate system   =   absolute
    Report Rate   =   100 rps
    increment   =   0
    resolution   =   200 lpi

After a Reset is issued, there is a 10 millisecond delay before the MM 1812 is ready to receive information from the host.

For a complete list of default settings, see Appendix D.

NOP (NO OPERATION)

Command:

	ASCII	Hex
command	SP	20
or		
	CR	0D

Switch Setting:

DIP #	Switch	Setting
NONE		

The digitizer performs no operation (NOP) when either of these commands is issued to it. These commands or characters can be used as a pad between command sequences, e.g. between XON and XOFF.

CHAPTER 4 - GUIDELINES FOR WRITING A SOFTWARE DRIVER

If the MM 1812 is connected to a computer, rather than to a terminal, the computer must have a driver for the MM 1812. The driver is a software subroutine that collects and decodes the reports for use by another (master) program. This section provides some guidelines, in the form of flowcharts, for writing a driver.

The flowcharts are for an MM 1812 using the binary report format. The steps are general for any set of operating characteristics. Figure 4-1 is a flowchart of the overall driver. Figures 4-2 and 4-3 are subroutine details.

Note: In the context of these charts, "normalize" means to combine the two coordinate bytes into the format required by your master program.

start

data input
(Detail B)

validate to see
if first byte
is data

valid
data byte
?

no

yes

decode first byte
for proximity

decode first byte
for flag

3

3

Relative
Mode
?

no

yes

decode sign of
X coordinate

normalize bytes
2 and 3 for
x coordinate

decode sign of
Y coordinate

normalize bytes
4 and 5 for
y coordinate

normalize bytes
2 and 3 for
x coordinate

normalize bytes
4 and 5 for
y coordinate

return

TP1113

Figure 4-2 Detail A: Get and Decode Reports Subroutine

```
          ┌─────────────┐                          ╭─────╮
          │    start    │                          │  2  │
          └──────┬──────┘                          ╰──┬──╯
                 │                            ┌────────┼────────┐
                 │                            │     ▼──┴──▼      │
                 ▼                            │  ┌─────────────┐ │
          ┌─────────────┐                     │  │    check    │ │
          │ load counter│                     │  │   status    │ │
          │             │                     │  │  register   │ │
          │  with five  │                     │  └──────┬──────┘ │
          └──────┬──────┘                     │         ▼        │
                 │                            │       ╱─────╲     │
                 │                            │      ╱ byte  ╲    │    no
                 ▼                            │     ╱available ╲──┘──────┐
              ╱─────╲                         │     ╲    ?    ╱          │
             ╱   in  ╲        no              │      ╲───────╱           │
            ╱ Remote  ╲──────────────┐        │         │ yes            │
            ╲ Request ╱              │        │         ▼                │
             ╲ Mode  ╱               │        │   ╱─────────────╲        │
              ╲  ?  ╱                │        │  ╱  read byte from╲      │
               ╲───╱                 │        │ ╱  communications  ╲     │
                 │ yes               │        │ ╲      port        ╱     │
                 ▼                   │        │  ╲─────────────────╱     │
          ╱─────────────╲            │        │         │                │
         ╱ send  trigger ╲           │        │         ▼                │
        ╱                 ╲          │        │  ┌─────────────┐         │
        ╲    command      ╱          │        │  │    store    │         │
         ╲───────────────╱           │        │  │    byte     │         │
                 │                   │        │  └──────┬──────┘         │
                 │◄──────────────────┘        │         ▼                │
                 ▼                            │  ┌─────────────┐         │
              ╭─────╮                         │  │  decrement  │         │
              │  2  │                         │  │   counter   │         │
              ╰─────╯                         │  └──────┬──────┘         │
                                              │         ▼                │
                                     no       │      ╱─────╲             │
                                    ┌─────────┘     ╱counter ╲           │
                                    │              ╱   = 0    ╲          │
                                    └──────────────╲    ?     ╱          │
                                                    ╲───────╱            │
                                                       │ yes             │
                                                       ▼                 │
                                                ┌─────────────┐          │
                                                │   return    │          │
                                                └─────────────┘          │
```
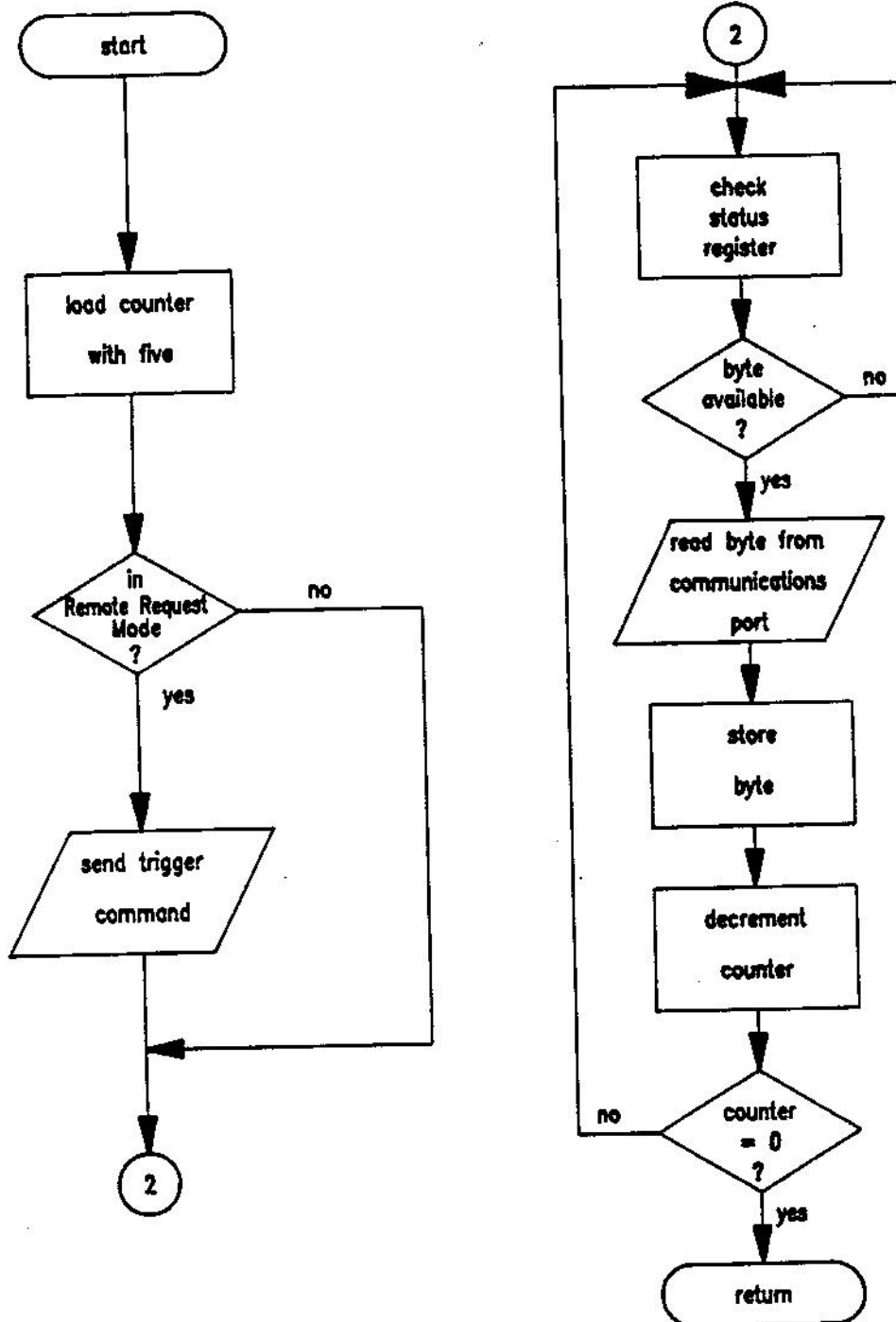
TP1114

Figure 4-3 Detail B: Data Input Subroutine

CHAPTER 5 — INSTALLING AND CARING FOR THE MM 1812

This chapter provides information on:

- the recommended operating environment for the MM;
- unpacking and installing the MM;
- caring for and cleaning the MM; and
- whom to contact for service.

SECTION A - TEMPERATURE AND HUMIDITY REQUIREMENTS
==

Extremes in temperature and humidity can degrade the MM's operation. Therefore, operate it within these ranges:

    +45 degrees to +110 degrees Fahrenheit
    +7 degrees to +43 degrees Celsius
    8% to 80% relative humidity, non-condensing

Acceptable non-operating conditions are:

    -45 degrees to +145 degrees Fahrenheit
    -43 degrees to +63 degrees Celsius
    8% to 80% relative humidity, non-condensing

SECTION B - ASSEMBLY AND INSTALLATION
=====================================

Unpack the MM 1812. The package should include a tablet and this book,
"MM 1812 Digitizer Bit Pad Version - Technical Reference". Other con-
tents may include a:.

- cursor and/or stylus
- interface cable
- power supply
- power cable (for international power supplies only)

Briefly stated, the steps for assembling and installing the MM 1812 are
as follows:

1. Configuring the MM 1812 digitizer.
2. Adjusting the tilt.
3. Attaching the stylus holder, if applicable.
4. Connecting the stylus or cursor.
5. Interfacing the digitizer to the host.
6. Connecting the digitizer to the power source.

Detailed instructions for each of these steps follow.

CONFIGURING THE MM 1812 DIGITIZER

The MM is configured at the factory to default specifications, (as listed in Appendix D).

If, however, you want to change the configuration, you can do so by changing the settings on the DIP switches located on the underside of the tablet.
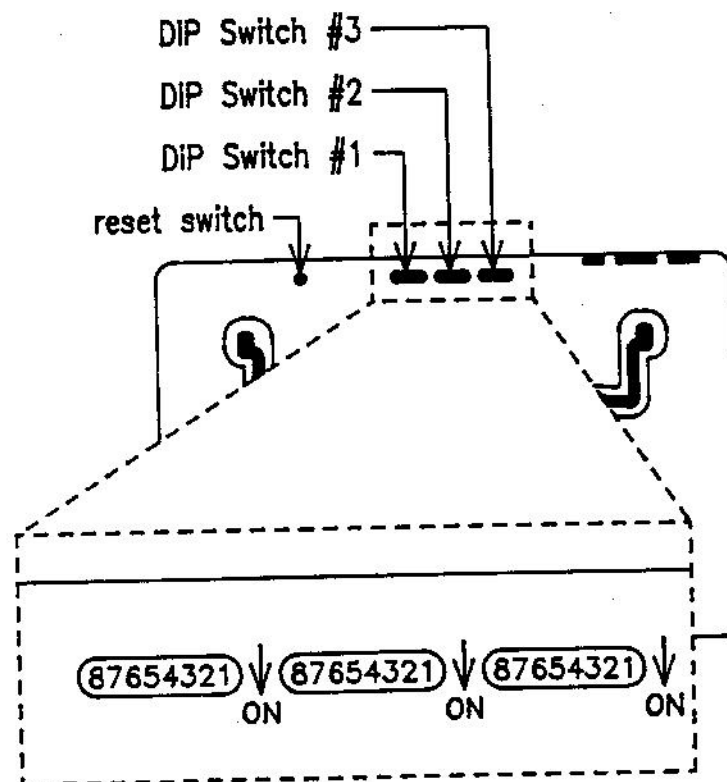
Figure 5-1 DIP Switches and Reset Switch Locations

The switches are rocker or slide switches, grouped in banks of eight switches per DIP switch. The On and Off positions are shown in Figure 5-1. To set a rocker switch, press down on the side next to the desired position, or slide the switch to correct position. Use a pointed instrument. Do not, however, use a pencil or another instrument that could deposit residue, e.g. graphite or ink, on the switch. This could cause the switch to malfunction.

Whenever you change the switch settings, re-power the MM or press the Reset switch. This re-initializes the MM in the new configuration.

The Reset switch is inside the hole, to the left of the DIP switches.

ADJUSTING THE TILT

You can use the digitizer with or without raising it on the flip-out stand. Without using the stand, the digitizer surface lies at two degrees slope. With the stand rotated outward, the digitizer surface is sloped at ten degrees.
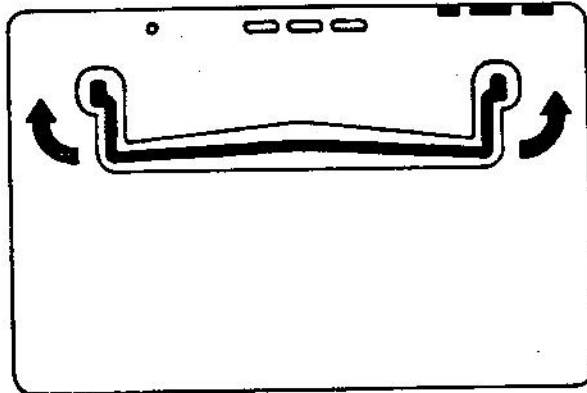
TP1195

Figure 5-2   Flip-out Stand

ATTACHING THE STYLUS HOLDER

If you have a stylus, you'll find the stylus holder to be a very handy item. It keeps the stylus from getting in your way when not in use.

To attach the stylus holder, remove the protective paper from the adhesive tape. Position the holder anywhere along the digitizer edge within five inches from the digitizer top, as shown below:
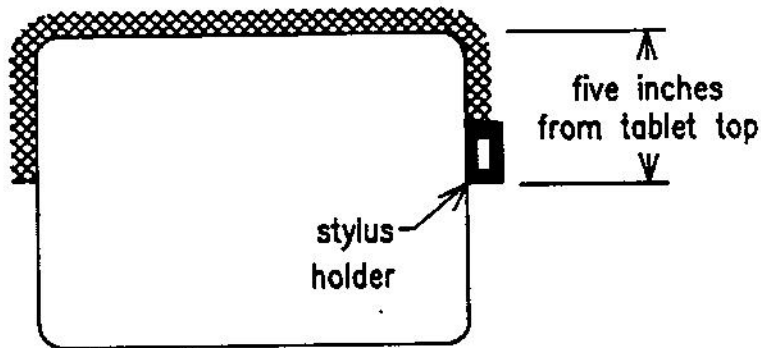
TP1196

Figure 5-3   Acceptable Stylus Holder Locations

Press the tape side of the holder to the digitizer back.

To use the holder, simply insert the stylus tip into the holder opening.

CONNECTING THE STYLUS OR CURSOR

Plug the stylus or cursor into the phone-type jack, located at the digitizer's upper left edge.

You can interchange the stylus and cursor, but first, power down the MM.

SECTION C - INTERFACING THE DIGITIZER TO THE HOST
==

The MM 1812 has an RS-232-C interface, which complies with the EIA
(Electronic Industries Association) RS-232-C standard.

The MM supports CTS (Clear To Send) handshaking, a hardware-governed
method of communications control. The MM is configured as DTE (Data
Terminal Equipment). The RTS (Request To Send) and DTR (Data Terminal
Ready) lines are always asserted.

SIGNAL LEVELS

The table below specifies the signal levels for data transmissions:

Table 5-1
RS-232-C Data Signal Levels

| RS-232-C Interface | Interchange Voltage | |
	−3V to −12V	+3V to +12V
Binary states	1	Ø
Signal condition	Mark	Space

The RS-232-C interface is terminated with a 25-pin female D connector
located on the tablet's top edge:

cursor/stylus socket   RS-232-C interface cable connector   power supply cable connector
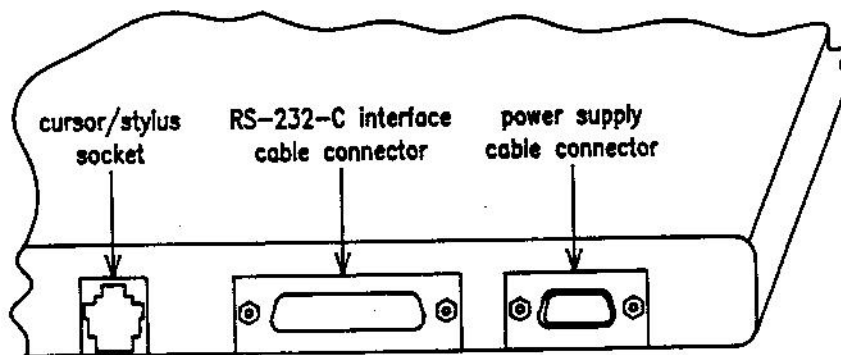
TP1197

Figure 5-4   RS-232-C Interface - Connector Location

Your interface cable must have a 25-pin male D connector. To lock the
connectors together, the cable connector must have screws that mate with
the MM's screwlock sleeves.

To comply with the FCC EMI shielding requirements, the host's interface connector must have a metal shroud, grounded to the system chassis.

CONNECTOR PIN ASSIGNMENTS

The table below identifies the pin assignments of the MM's RS-232-C connector:

Table 5-2
RS-232-C Connector - Pin Assignments

Pin	Wire Name	Transmission Flow	Description
1	shield		protective, frame ground, connector's metal shroud
2	TXD	MM >>> host	transmits data from MM 1812 to host
3	RXD	MM <<< host	receives commands from host to MM 1812
4	RTS	MM >>> host	Request To Send*
5	CTS	MM <<< host	Clear To Send**
7	signal ground		return for serial data
20	DTR	MM >>> host	Data Terminal Ready*

* Note: Request To Send and Data Terminal Ready are always asserted. These control signals are connected to +12 VDC through a 3300 ohm resistor.

** Note: The Clear To Send control signal is enabled internal to the tablet. It is connected to the +12 VDC through a 3300 ohm resistor. The tablet can transmit data if the CTS enable switch is on and no connection is made to pin #5 (CTS control signal input).

BAUD RATE

The baud rate is the number of bits transmitted each second between host and peripheral (MM 1812) or peripheral and host.

The MM is configured at the factory to the fixed baud rate setting (9600). You can change the baud rate configuration by setting DIP switch #3, positions 6, 7 and 8. (See Section B of this chapter for instructions on locating and setting the DIP switches.)

SECTION D - CONNECTING THE DIGITIZER TO THE POWER SOURCE
===

You can power the MM 1812 from an external power supply or from the host
via the interface cable. This latter configuration must be specified in
the original purchase.

Since the MM 1812 passed the FCC certification tests using the Summa-
graphics power supply, if you use a power supply or interface cables
other than the ones we provide for the MM 1812, the FCC certification
and other safety and regulatory certifications are void.

POWERING FROM THE SUMMAGRAPHICS EXTERNAL POWER SUPPLY

If you are using the external power supply, plug the power supply cable
into the MM's smaller 9-pin D connector.
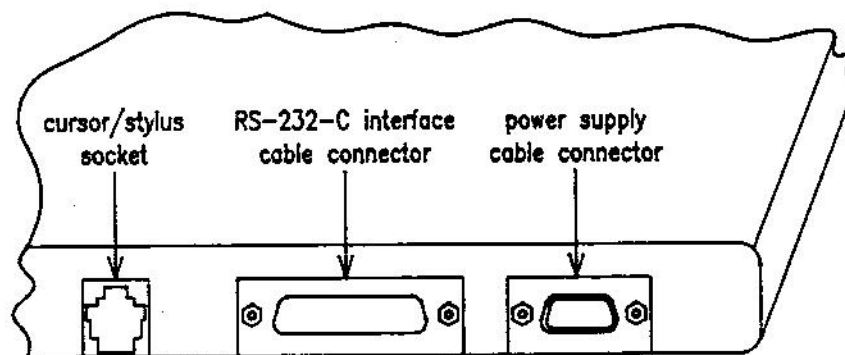
TP1187

Figure 5-5   Power Supply Connector Location

Next, plug the power supply into an electrical outlet. (For interna-
tional power supplies, use our plug adapter cable between the power sup-
ply and the electrical outlet.)

POWERING FROM OTHER SOURCES

If you are powering the MM from the host via the interface cable:

CAUTION

Ensure that the external power supply is connected to either
the 25-pin D connector or the 9-pin D connector, not both.
Connecting power to both ports could damage the MM, the power
supply, and the host. If power is supplied through the 25-pin
RS-232-C port on a digitizer that also has the 9-pin D connec-
tor, note that power is present at the 9-pin connector. In
this situation, DO NOT TOUCH THE 9-PIN CONNECTOR WITH YOUR
FINGERS OR ANY METAL OBJECT.

Plug the interface cable into the appropriate connector on the MM. To lock the connectors together, the cable connector must have screws that mate with the MM's screwlock sleeves.

When the MM's RS-232-C connector is configured for power, the pin assignments are as follows:

Table 5-3
RS-232-C Connector with Power-
Pin Assignments

Pin	Wire Name	Transmission Flow	Description
1	shield		protective, frame ground, connector's metal shroud
2	TXD	MM >>> host	transmits data from MM 1812 to host
3	RXD	MM <<< host	receives commands from host to MM 1812
4	RTS	MM >>> host	Request To Send, asserted
5	CTS	MM <<< host	Clear To Send
7	signal ground		return for serial data and power ground
9	power	MM <<< host	+12 VDC
10	power*	MM <<< host	-12 VDC (for RS-232-C)
15	power*	MM <<< host	-12 VDC (for RS-232-C)
20	DTR	MM >>> host	Data Terminal Ready, asserted

An MM with an RS-232-C interface requires +12 VDC +/- 5% (ripple and noise at +/- 0.5% or better) at 0.300A and -12 VDC with +/- 10% regulation at 0.03A. The -12V power source must be able to operate down to 0.003 A and remain regulated to +/- 10%.

* Note: -12 V power is required on pin 10 or pin 15, not both. On digitizers that do not require -12V, do not apply power to these pins.

Pin assignments for the 9-pin connector, when configured to supply power to the digitizer, are as follows:

Table 5-4
9-Pin Connector with Power-
Pin Assignments

Pin	Wire Name	Description
6	power*	-12 VDC
7	GND	ground for power
1	shield	protective, frame ground
9	power	+12 VDC

* CAUTION: On tablets which require the +12V only for
operation, this pin is not connected.

An MM with an RS-232-C interface requires +12 VDC +/- 5% (ripple and noise at +/- 0.5% or better) at 0.300A and -12 VDC with +/- 10% regulation at 0.03 A. The -12V power source must be able to operate down to 0.003A and remain regulated to +/- 10%.

SECTION E – CHANGING THE STYLUS REFILL

If you have a stylus, to change the stylus refill, twist and pull the cap out. Pull the refill out. (Don't remove the metal guide-ring inside the cap. It keeps the refill in place.) Replace the refill, then the cap.
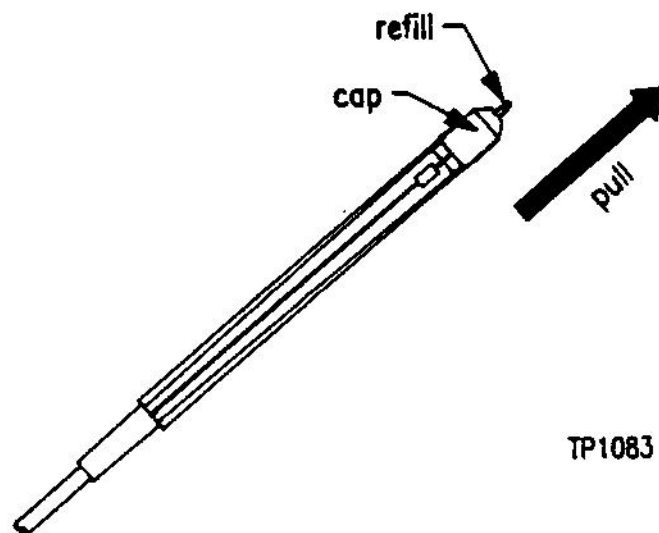
Figure 5-6 Changing the Stylus Refill

SECTION F - CARE AND CLEANING
==============================

Avoid sharply banging or dropping any part of the MM 1812 or its accessories.

Never immerse them in liquid.

Disconnect the digitizer from its power source before cleaning it.

The digitizer surface is made of plastic. To clean it, use only a cotton flannel cloth with mild detergent and water. Never use a hydrocarbon cleaner (acetone) or an abrasive cloth. These mar the digitizer finish.

SECTION G - TECHNICAL SUPPORT AND SERVICE

In Countries Other than the U.S.A. and Canada

Contact your local Summagraphics representative for technical support and service.

In the U.S.A. or Canada

For technical support and service, contact Summagraphics Corporation at this address:

Customer Service Department
Summagraphics Corporation
60 Silvermine Road
Seymour, CT 06483

For Canadian or U.S.A. residents, except Connecticut, call
toll free: (800) 243-9388

For Connecticut residents, call (203) 881-5400

If you return a Microgrid for repair, a Return Authorization Number must be on the outside of the package and on all accompanying paperwork. Obtain a Return Authorization Number from Summagraphics' Customer Service Department. Please have ready the tablet serial number and the purchase order number when you call. This will speed along the repair of your unit.

DO NOT SHIP ANY EQUIPMENT TO SUMMAGRAPHICS WITHOUT A RETURN AUTHORIZATION NUMBER.

COUNTRIES OTHER THAN THE U.S.A. OR CANADA

Contact your local Summagraphics representative for technical support and service.

CHAPTER 6 - CHECKING THE DIGITIZER

This chapter describes methods of checking your MM 1812. They include:

- a functional check;
- the Self Test function; and
- the Code Check function;

Section D covers some simple toubleshooting you can do before deciding you need technical assistance from Summagraphics.

SECTION A - A QUICK FUNCTIONAL CHECK
==

You can perform a quick, functional check of the digitizer by connecting
the MM 1812 to a terminal and moving the cursor or stylus across the
digitizer's active area. The MM 1812 must be in ASCII BCD format in
order for the coordinates to be displayed on the terminal. If the MM
1812 is working properly, the X and Y values increase as you slide the
cursor or stylus from the digitizer origin toward the end of the axis.
This is depicted in the following illustration, where the origin is lo-
cated at the lower left corner:
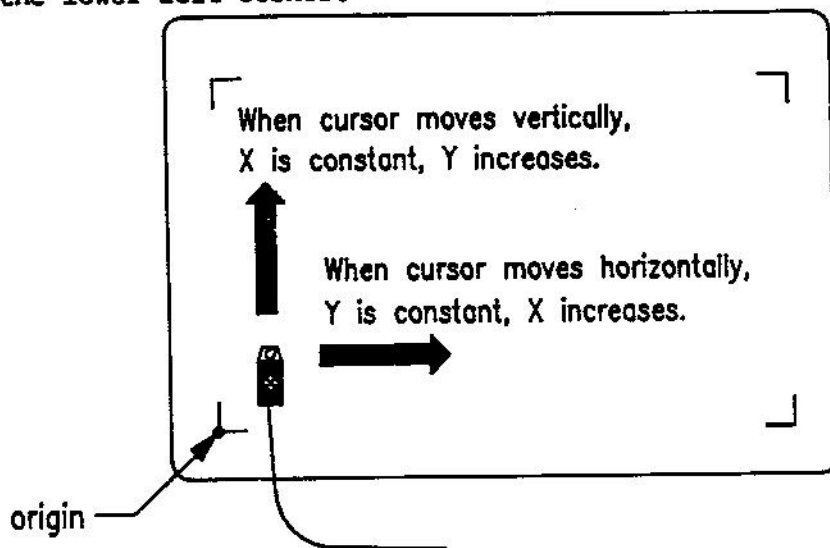
Figure 6-1 Quick Functional Check of the MM 1812 Digitizer

Note: For this check, remember to set the terminal parameters
       (e.g. Baud Rate, Parity, Stop Bits and cabling) to match those
       of the digitizer. The tablet format must be ASCII BCD.

SECTION B - SELF TEST, DIAGNOSTIC FUNCTION

Command: Switch Setting:

	ASCII	Hex
command	t	74

DIP #	Switch	Setting
	NONE	

Use the Self Test command to perform tests on the digitizer and cursor
or stylus. Self Test checks:

- the analog circuitry;
- the cursor or stylus connection, operation,
  and location; and
- the digital circuitry and ROM code
  validity test.

After the test is performed, the results are sent to the host. The results are transmitted in one byte in the following format:

Table 6-1
Output Format of Self Test Function

MSB 7	6	5	4	3	2	1	LSB 0
P	T	0	0	PR	D	C	A

A = analog circuitry test   pass = 1
                                                     fail = 0

C = cursor/stylus connection   pass = 1
      and cursor/stylus coil   fail = 0
      operation test

D = digital circuitry test   pass = 1
      and ROM code validity test   fail = 0

PR = cursor/stylus   on = 1
      on/off tablet   off = 0

T = total test result (This result   pass = 1
      is based only on the results of   fail = 0
      tests A, C, and D.)

P = parity

Note: In order for the Self Test to function correctly,
       the cursor must be on the digitizer surface,
       within the active area markings.

If the Self Test output byte is an ASCII O, the digitizer passed the diagnostic tests. (An O indicates that the stylus/cursor is in proximity and that it is connected to the tablet. Any other character denotes a problem). Check to be sure the stylus/cursor is plugged in correctly and is on the digitizer surface within the active area. If the problem continues, call your Summagraphics representative or Summagraphics' Customer Service department.

SECTION C - CODE CHECK

Command:

	ASCII	Hex
command	x	78

Switch Setting:

DIP #	Switch #	Setting
	NONE	

Use the Code Check function to identify:

- the firmware version that the MM is using; and
- weather changes have occurred in the firmware
  since it was installed.

The Code Check sends this information to the host as a number, called the checksum, The checksum uniquely identifies firmware.

When your MM first arrives, record the checksum. Each time you perform a Code Check, the checksum should be the same. A change in the checksum means something is faulty with the MM.

The checksum is in the following six-byte format:

    .#HHHH

where H is a hexadecimal character (Ø through 9 and A through F) in ASCII code. The checksum is in this format, regardless of the format being used for reports.

SECTION D - IN CASE OF FAILURE

If the MM fails to operate or fails any of the tests, follow these steps:

1. Power down the MM.
2. Check that the power cable and the data (RS-232-C) cable are both firmly attached.
3. Make sure the cursor/stylus cable is plugged in correctly.
4. Ensure that the host is working properly. This includes verification that the terminal's parameters match those of the digitizer, e. g. Baud Rate, Parity and Stop Bits.
5. Power up the MM.
6. Perform the test functions again and check the results.

If the MM 1812 is still malfunctioning, contact Summagraphics' Customer Service department or your Summagraphics representative. Addresses and phone numbers appear in Chapter 5, Section G.

APPENDIX A - ASCII CONVERSION CHART

Decimal	Binary 7 6 5 4 3 2 1 0	Octal	Hex	ASCII Character	Control Function or Character Description
0	0 0 0 0 0 0 0 0	000	00	NUL	Null
1	0 0 0 0 0 0 0 1	001	01	SOH	Start of Heading
2	0 0 0 0 0 0 1 0	002	02	STX	Start of Text
3	0 0 0 0 0 0 1 1	003	03	ETX	End of Text
4	0 0 0 0 0 1 0 0	004	04	EOT	End of Transmission
5	0 0 0 0 0 1 0 1	005	05	ENQ	Enquiry
6	0 0 0 0 0 1 1 0	006	06	ACK	Acknowledge
7	0 0 0 0 0 1 1 1	007	07	BEL	Bell
8	0 0 0 0 1 0 0 0	010	08	BS	Backspace
9	0 0 0 0 1 0 0 1	011	09	HT	Horizontal Tab
10	0 0 0 0 1 0 1 0	012	0A	LF or NL	Line Feed or New Line
11	0 0 0 0 1 0 1 1	013	0B	VT	Vertical Tab
12	0 0 0 0 1 1 0 0	014	0C	FF	Form Feed
13	0 0 0 0 1 1 0 1	015	0D	CR or RT	Carriage Return
14	0 0 0 0 1 1 1 0	016	0E	SO	Shift Out
15	0 0 0 0 1 1 1 1	017	0F	SI	Shift In
16	0 0 0 1 0 0 0 0	020	10	DLE	Data Link Escape
17	0 0 0 1 0 0 0 1	021	11	DC1	Device Control 1
18	0 0 0 1 0 0 1 0	022	12	DC2	Device Control 2
19	0 0 0 1 0 0 1 1	023	13	DC3	Device Control 3
20	0 0 0 1 0 1 0 0	024	14	DC4	Device Control 4
21	0 0 0 1 0 1 0 1	025	15	NAK	Negative Acknowledge
22	0 0 0 1 0 1 1 0	026	16	SYN	Synchronous Idle
23	0 0 0 1 0 1 1 1	027	17	ETB	End Transmission Block
24	0 0 0 1 1 0 0 0	030	18	CAN	Cancel
25	0 0 0 1 1 0 0 1	031	19	EM	End of Medium
26	0 0 0 1 1 0 1 0	032	1A	SUB	Substitute
27	0 0 0 1 1 0 1 1	033	1B	ESC	Escape
28	0 0 0 1 1 1 0 0	034	1C	FS	File Separator
29	0 0 0 1 1 1 0 1	035	1D	GS	Group Separator
30	0 0 0 1 1 1 1 0	036	1E	RS	Record Separator
31	0 0 0 1 1 1 1 1	037	1F	US	Unit Separator
32	0 0 1 0 0 0 0 0	040	20	SP	Space
33	0 0 1 0 0 0 0 1	041	21	!	Exclamation Point
34	0 0 1 0 0 0 1 0	042	22	"	Double Quote
35	0 0 1 0 0 0 1 1	043	23	#	Number or Pound
36	0 0 1 0 0 1 0 0	044	24	$	Dollar
37	0 0 1 0 0 1 0 1	045	25	%	Percent
38	0 0 1 0 0 1 1 0	046	26	&	Ampersand
39	0 0 1 0 0 1 1 1	047	27	'	Apostrophe, Right Single Quote
40	0 0 1 0 1 0 0 0	050	28	(	Left Parenthesis
41	0 0 1 0 1 0 0 1	051	29	)	Right Parenthesis

Decimal	Binary 7 6 5 4 3 2 1 0	Octal	Hex	ASCII Character	Control Function or Character Description
42	0 0 1 0 1 0 1 0	052	2A	*	Asterisk
43	0 0 1 0 1 0 1 1	053	2B	+	Plus or Addition
44	0 0 1 0 1 1 0 0	054	2C	,	Comma
45	0 0 1 0 1 1 0 1	055	2D	−	Hyphen
46	0 0 1 0 1 1 1 0	056	2E	.	Period
47	0 0 1 0 1 1 1 1	057	2F	/	Slash
48	0 0 1 1 0 0 0 0	060	30	0	
49	0 0 1 1 0 0 0 1	061	31	1	
50	0 0 1 1 0 0 1 0	062	32	2	
51	0 0 1 1 0 0 1 1	063	33	3	
52	0 0 1 1 0 1 0 0	064	34	4	
53	0 0 1 1 0 1 0 1	065	35	5	
54	0 0 1 1 0 1 1 0	066	36	6	
55	0 0 1 1 0 1 1 1	067	37	7	
56	0 0 1 1 1 0 0 0	070	38	8	
57	0 0 1 1 1 0 0 1	071	39	9	
58	0 0 1 1 1 0 1 0	072	3A	:	Colon
59	0 0 1 1 1 0 1 1	073	3B	;	Semicolon
60	0 0 1 1 1 1 0 0	074	3C	<	Less Than
61	0 0 1 1 1 1 0 1	075	3D	=	Equals
62	0 0 1 1 1 1 1 0	076	3E	>	Greater Than
63	0 0 1 1 1 1 1 1	077	3F	?	Question Mark
64	0 1 0 0 0 0 0 0	100	40	@	Commercial At
65	0 1 0 0 0 0 0 1	101	41	A	
66	0 1 0 0 0 0 1 0	102	42	B	
67	0 1 0 0 0 0 1 1	103	43	C	
68	0 1 0 0 0 1 0 0	104	44	D	
69	0 1 0 0 0 1 0 1	105	45	E	
70	0 1 0 0 0 1 1 0	106	46	F	
71	0 1 0 0 0 1 1 1	107	47	G	
72	0 1 0 0 1 0 0 0	110	48	H	
73	0 1 0 0 1 0 0 1	111	49	I	
74	0 1 0 0 1 0 1 0	112	4A	J	
75	0 1 0 0 1 0 1 1	113	4B	K	
76	0 1 0 0 1 1 0 0	114	4C	L	
77	0 1 0 0 1 1 0 1	115	4D	M	
78	0 1 0 0 1 1 1 0	116	4E	N	
79	0 1 0 0 1 1 1 1	117	4F	O	
80	0 1 0 1 0 0 0 0	120	50	P	
81	0 1 0 1 0 0 0 1	121	51	Q	
82	0 1 0 1 0 0 1 0	122	52	R	
83	0 1 0 1 0 0 1 1	123	53	S	
84	0 1 0 1 0 1 0 0	124	54	T	

(cont.)

Decimal	Binary 7 6 5 4 3 2 1 0	Octal	Hex	ASCII Character	Control Function or Character Description
85	0 1 0 1 0 1 0 1	125	55	U	
86	0 1 0 1 0 1 1 0	126	56	V	
87	0 1 0 1 0 1 1 1	127	57	W	
88	0 1 0 1 1 0 0 0	130	58	X	
89	0 1 0 1 1 0 0 1	131	59	Y	
90	0 1 0 1 1 0 1 0	132	5A	Z	
91	0 1 0 1 1 0 1 1	133	5B	[	Left Square Bracket
92	0 1 0 1 1 1 0 0	134	5C	\	Back Slash
93	0 1 0 1 1 1 0 1	135	5D	]	Right Square Bracket
94	0 1 0 1 1 1 1 0	136	5E	^	Circumflex
95	0 1 0 1 1 1 1 1	137	5F	_	Underscore
96	0 1 1 0 0 0 0 0	140	60	`	Left Single Quote
97	0 1 1 0 0 0 0 1	141	61	a	
98	0 1 1 0 0 0 1 0	142	62	b	
99	0 1 1 0 0 0 1 1	143	63	c	
100	0 1 1 0 0 1 0 0	144	64	d	
101	0 1 1 0 0 1 0 1	145	65	e	
102	0 1 1 0 0 1 1 0	146	66	f	
103	0 1 1 0 0 1 1 1	147	67	g	
104	0 1 1 0 1 0 0 0	150	68	h	
105	0 1 1 0 1 0 0 1	151	69	i	
106	0 1 1 0 1 0 1 0	152	6A	j	
107	0 1 1 0 1 0 1 1	153	6B	k	
108	0 1 1 0 1 1 0 0	154	6C	l	
109	0 1 1 0 1 1 0 1	155	6D	m	
110	0 1 1 0 1 1 1 0	156	6E	n	
111	0 1 1 0 1 1 1 1	157	6F	o	
112	0 1 1 1 0 0 0 0	160	70	p	
113	0 1 1 1 0 0 0 1	161	71	q	
114	0 1 1 1 0 0 1 0	162	72	r	
115	0 1 1 1 0 0 1 1	163	73	s	
116	0 1 1 1 0 1 0 0	164	74	t	
117	0 1 1 1 0 1 0 1	165	75	u	
118	0 1 1 1 0 1 1 0	166	76	v	
119	0 1 1 1 0 1 1 1	167	77	w	
120	0 1 1 1 1 0 0 0	170	78	x	
121	0 1 1 1 1 0 0 1	171	79	y	
122	0 1 1 1 1 0 1 0	172	7A	z	
123	0 1 1 1 1 0 1 1	173	7B	{	Left Curved Bracket
124	0 1 1 1 1 1 0 0	174	7C			Vertical Line
125	0 1 1 1 1 1 0 1	175	7D	}	Right Curved Bracket
126	0 1 1 1 1 1 1 0	176	7E	~	Tilde
127	0 1 1 1 1 1 1 1	177	7F	DEL	Delete (rubout)

APPENDIX B - SPECIFICATIONS

PHYSICAL DESCRIPTION

Overall Dimensions			Active Area (nominal)	Weight
Vertical	Horizontal	*Thickness		
17.0" 431.8mm	22.5" 571.5mm	0.75" 19.1mm	12" x 18" 294mm x 441mm	max. 7 lbs. max. 3.2 kg

* Note: 1.75 " (44.5 mm) including the wedge

POWER SUPPLIES (OPTIONAL)

U.S.A.:   102V to 132V, 58Hz to 62Hz, NEMA 5-15P plug

International: 197V to 264V, 48Hz to 52Hz, I.E.C. Universal power
                 receptacle

Japan: 90V to 110V, 42Hz to 62Hz, NEMA 1-15P plug

OPERATING SPECIFICATIONS

An MM 1812 performs to the specifications appearing below. We use the word "typical" to describe accuracy and proximity. Typical means the unit, when at 25 degrees Celsius, performs to that specification over more than 90 percent of the active area. A slight degradation occurs at the extreme edges and corners of the active area.

The following specifications are to aid your understanding and use of the product. For detailed specifications, refer to the Summagraphics engineering specification.

Accuracy .... +/- 0.025" (.625mm) typical cursor

Accuracy is how closely a point's actual location is determined. It is measured when the cursor is on the tablet's surface.

Cursor Eccentricity .... +/-0.005" (.125mm) or better

Cursor eccentricity is how much the electrical center varies from the cross hair center as the cursor is rotated through 360 degrees.

Jitter .... cursor: +/-1 count at 1000 lpi
                                     stylus: +/-2 counts at 1000 lpi

Jitter is the difference in values collected by the digitizer for the same point (for example, 5.999, 6.000, 6.001). Jitter can be caused by electrical noise from environmental sources or from the digitizer's analog to digital conversion circuitry. Noise affects the signal that identifies a point.

Proximity .... 0.5" (12.7mm) typical for cursor
                                    0.3" (7.6 mm) typical for stylus

Proximity is the maximum distance the cursor or stylus can be held above the active area and report the position of the stylus or cursor.

Repeatability .... +/- 0.010" (.250mm) or better
                                     (for cursor only)

Repeatability is how closely you receive the same coordinates from the tablet when repeatedly locating the point. Repeatability takes temperature range and jitter into consideration.

Note: Repeatability for the stylus is similar, but is difficult
to measure since the stylus does not have crosshairs.

APPENDIX C - COMPARISON BETWEEN MM 1812 VERSION AND PREVIOUS
DIGITIZERS IN THE BIT PAD TWO (MM 1103) SERIES

HOW THE MM 1812 BIT PAD FORMAT IS DIFFERENT FROM THE BIT PAD TWO

When the digitizer is placed on standby using the XOFF (CTRL S)
command, it resumes normal operation with either a reset (NUL or
CTRL SP [space]) or XON (CTRL Q) command. There is only one
difference between the two: when a reset command is received, the
digitizer returns to its defaults; when an XON command is re-
ceived, the digitizer retains all remotely set parameters.

The Bit Pad Two only exits from an XOFF state when an XON in is-
sued, not a reset command.

When a cursor is out-of-prox during a Self Test (t), nonprintable
control code (ASCII STX-start of text) is transmitted. The Bit
Pad Two, under the same conditions, transmits an ASCII G.

The MM 1812 has a 1000 lpi resolution switch setting available,
the Bit Pad Two does not.

The MM 1812 has a 1000 lpi resolution command (p) available, the
Bit Pad Two does not.

The MM 1812 has a Check Code command (x) available, the Bit Pad
Two does not.

HOW THE MM 1812 BIT PAD FORMAT IS DIFFERENT FROM THE BIT PAD ONE

The MM 1812 is a second generation digitizer. It is, with some minor exceptions, a plug replacement for the Bit Pad One.

As an improved version of its predecessor, dissimilarities do exist. For example, the MM 1812 uses more advanced hardware and a different technology.

Some noteworthy exceptions are that the MM 1812:

- does not require biasing: pulling a magnet over the tablet.

- report formats, binary and ASCII BCD, include a bit or character identifying whether the stylus/cursor is in or out of proximity.

- offers more operating characteristics to choose from, such as Relative Mode.

- maximum baud rate is 19.2 K.

- offers only one type of hardware interface which is RS-232-C.

- does not have a Stop Mode, as such. Instead, it offers two alternatives, XOFF and Remote Mode. Note that the command previously used by the Bit Pad One to initiate Stop Mode is now the command for Remote Request Mode.

- offers Remote Request Mode and a Remote Trigger command. This function did not exist in Bit Pad One but was synthesized by sending a Stream Mode command immediately followed by a Stop command.

APPENDIX D - QUICK REFERENCE SHEET OF COMMANDS AND SWITCH SETTINGS

COMMAND	ASCII	HEX	COMMAND	ASCII	HEX
Switch Stream 2 rps	@	40	Increment:		
Switch Stream 4 rps	A	41	0 (disable)	a	61
Switch Stream 10 rps	B	42	1	b	62
Switch Stream 20 rps	C	43	2	c	63
Switch Stream 40 rps	D	44	3	d	64
Switch Stream 70 rps	E	45	4	e	65
Switch Stream 100 rps	F	46	5	f	66
Switch Stream maximum	G	47	10	g	67
Stream 2 rps	H	48	20	h	68
Stream 4 rps	I	49	Resolution:		
Stream 10 rps	J	4A	100 lpi	i	69
Stream 20 rps	K	4B	127 lpi (5 lpmm)	j	6A
Stream 40 rps	L	4C	200 lpi	k	6B
Stream 70 rps	M	4D	254 lpi (10 lpmm)	l	6C
Stream 100 rps	N	4E	400 lpi	m	6D
Stream maximum	O	4F	500 lpi	n	6E
Point Mode	P	50	508 lpi (20 lpmm)	o	6F
Remote Request			1000 lpi	p	70
mode	S	53	Send Configuration	s	73
trigger	T*	54	Send Configuration	ENQ*	05
Relative Coordinate	R	52	Self Test	t	74
Absolute Coordinate	Q	51	Stop Transmission	XOFF*	13
NOP (no operation)	CR*	0D	Start Transmission	XON*	11
NOP (no operation)	SP*	20	Reset	NUL*	00
			Check Code	x	78

Note: * Active even when remote control switch
(DIP switch #1, position #1) is off.

DIP Switch 1

Operating Characteristics and Configuration Parameters	Factory Setting	Switches and Settings							
		1	2	3	4	5	6	7	8
remote control:									
enable	X	on							
disable		off							
proximity transmission:									
always transmit	X		on						
only when in proximity			off						
stream:									
enable	X			on					
disable				off					
switch:									
enable	X				on				
disable					off				
coordinate content:									
Absolute Coordinate	X					off			
Relative Coordinate						on			
Report Rate of:									
2 rps							off	off	off
4 rps							off	off	on
10 rps							off	on	off
20 rps							off	on	on
40 rps							on	off	off
70 rps							on	off	on
100 rps	X						on	on	off
maximum rps							on	on	on

DIP Switch 2

Operating Characteristics and Configuration Parameters	Factory Setting	Switches and Settings							
		1	2	3	4	5	6	7	8
report format:									
ASCII BCD	X	on							
binary		off							
ASCII report terminator:									
CR LF	X		on						
CR			off						
increment setting:									
0	X			off	off	off			
1				off	off	on			
2				off	on	off			
3				off	on	on			
4				on	off	off			
5				on	off	on			
10				on	on	off			
20				on	on	on			
resolution setting:									
100 lpi							off	off	off
127 lpi or 5 lpmm							off	off	on
200 lpi	X						off	on	off
254 lpi or 10 lpmm							off	on	on
400 lpi							on	off	off
500 lpi							on	off	on
508 lpi or 20 lpmm							on	on	off
1000 lpi							on	on	on

DIP Switch 3

Operating Characteristics and Configuration Parameters	Factory Setting	Switches and Settings							
		1	2	3	4	5	6	7	8
parity:									
enable	X	on							
disable		off							
enabled parity setting:									
odd			on						
even	X		off						
number of stop bits:									
two	X			on					
one				off					
CTS handshake:									
enable	X				on				
disable					off				
cursor output code:									
output A	X					on			
output B						off			
baud rate:									
110							off	off	off
150							off	off	on
300							off	on	off
1200							off	on	on
2400							on	off	off
4800							on	off	on
9600	X						on	on	off
19200							on	on	on

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