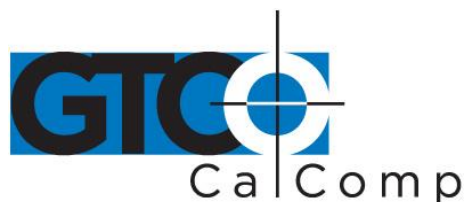


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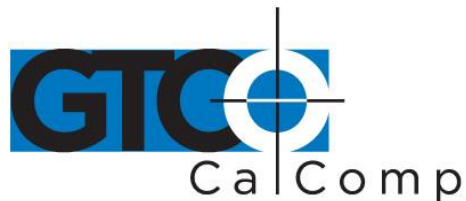
MM™ II 1201 GRAPHICS TABLET USER'S GUIDE

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Chapter 1: What is the MM II and How Does It Work?

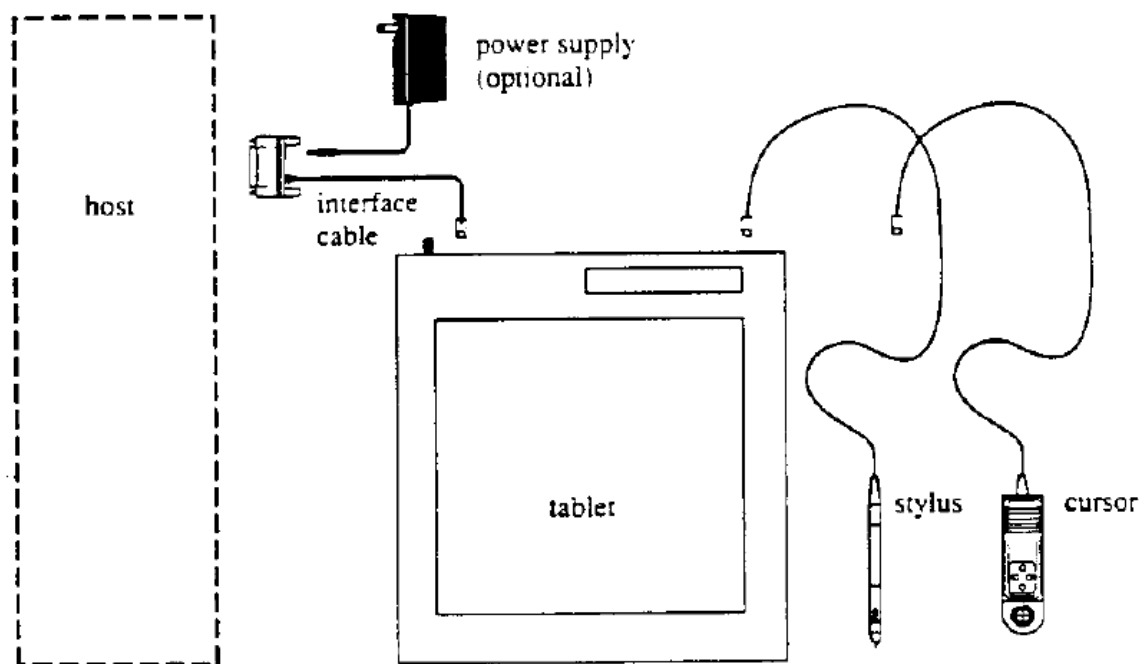
Section A - What is the MM II?

The MM II is a graphics tablet that acts as an input device. It allows for the translation of graphic information into digital, suitable for computer manipulation.

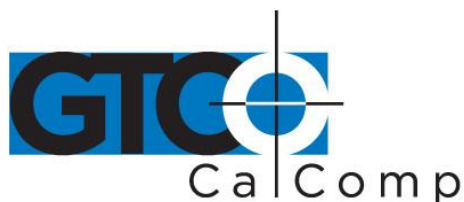
- Steering a computer screen pointer
- Selecting locations on menus
- Drawing and tracing

The components required for a functional MM II are:

- Tablet
- Stylus or cursor
- Interface cable
- Power source



The tablet is similar to a drawing board. The stylus and cursor are handheld devices that are used for pointing or drawing on the tablet. The interface cable connects the graphics tablet to the host (computer).



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Section B: How the MM II Works

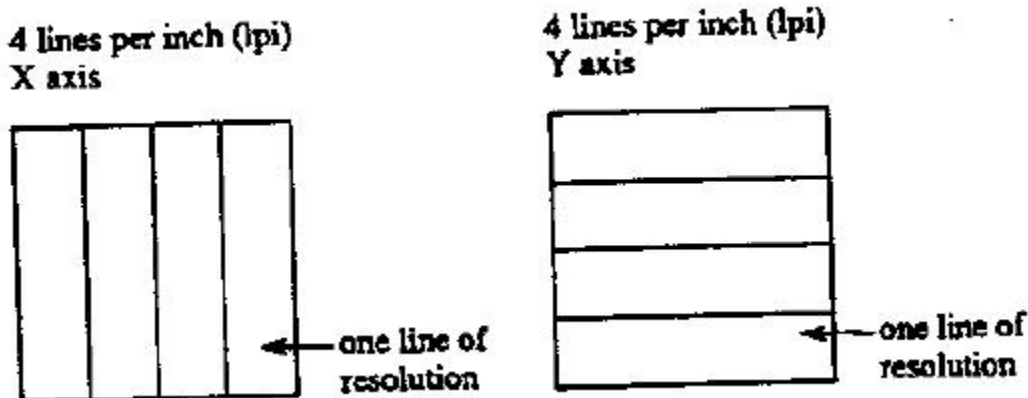
MM II translates the stylus/cursor position on the tablet into digital information and communicates it to the host. The stylus/cursor position is expressed as an X, Y coordinate pair. One coordinate pair is a report.

Valid reports can only be collected when the stylus/cursor is in the tablet's active area and in proximity:

- Active area is an 11.7 inch square area inside the groove on the tablet surface.
- Proximity is the maximum distance above the active area that the stylus/cursor can be held and report a valid position. It's approximately $\frac{1}{2}$ inches, which means the stylus/cursor and tablet do not need to be in direct contact with each other to issue reports. There still can be up to a $\frac{1}{2}$ inch of material (drawings, photos, etc.) between the tablet and stylus/cursor, allowing it to issue reports.

The active area and proximity, in effect, establish a three-dimensional volume within which the stylus/cursor can issue valid reports. Reports issued from outside of this volume are **out-of-prox** and, therefore, do not represent the current position of the stylus/cursor.

Reports are measured in counts of resolution. **Resolution** is the fineness of detail that the tablet can distinguish. It's expressed in lines per inch (lpi) or lines per millimeter (lpmm). This is slightly misleading, however. Resolution should be expressed in "bands per ..." or "lanes per ..." because these lines have perceivable width at lower resolution settings.

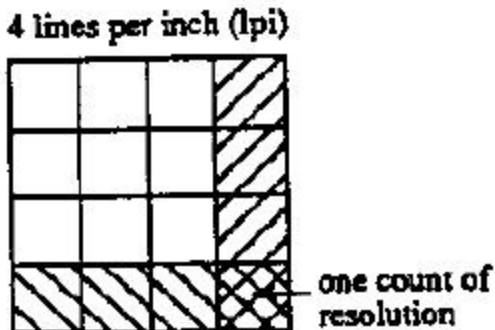


The higher the resolution, e.g. 100 lpi or 200 lpi, the narrower the bands of resolution become. Eventually, the bands become so narrow that they are easier to conceptualize as **lines** of no measurable width.

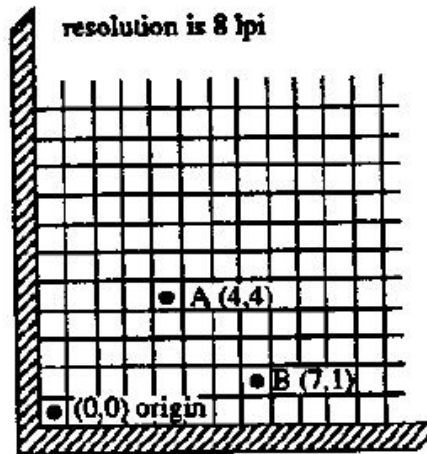
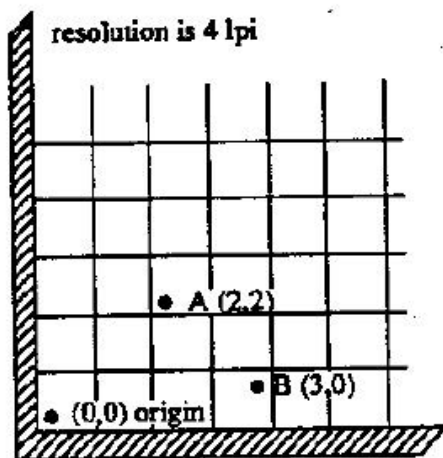


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As previously stated, reports are measured in counts of resolution. As shown below, each square is one count of resolution. The tablet reports the same coordinates for any point within the square.

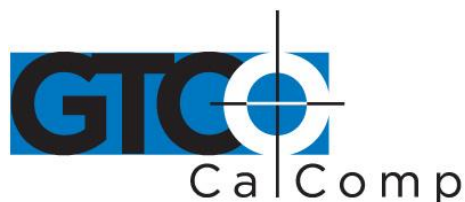


With different resolution settings, you can receive different reports for the same tablet location. In the illustration below, points A and B are the same physical locations on the tablet, but their coordinates are different because of the resolution setting.



points	absolute coordinates	relative coordinates
A	(2,2)	
B	(3,0)	(1,-2)

points	absolute coordinates	relative coordinates
A	(4,4)	
B	(7,1)	(3,-3)



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Reports are in absolute or relative coordinates. **Absolute coordinates** are coordinates measured from the tablet's origin (0, 0). **Relative coordinates** are measured relative to the last report location. In the illustration above, point B is issued after point A. Therefore, in relative coordinates, point B is measured relative to point A.

The tablet defaults to absolute coordinates. However, you can change to relative coordinates with the Relative Coordinates command, described in Chapter 4.

Section C - Commands: Controlling the Tablet's Operation

Control the MM II's operating characteristics, functions and diagnostics with commands from the host. This book represents the commands in ASCII. For convenience, an ASCII conversion chart appears in **Appendix C**.

The tablet accepts commands from the host at any rate, except as follows:

- After turning on the tablet or issue the Reset command, wait approximately ten milliseconds before sending commands.
- Commands that require a tablet response: If you send a command to the tablet that requires a response, the tablet does so within two milliseconds. Wait until the host receives the entire response before issuing another command to the tablet.

Section D: Alternative Configurations

The tablet is already set up to operate with a certain:

- Baud rate: 9600 or Autobaud
- Report format: binary or ASCII BCD
- Parity: odd parity or no parity

The standard setup is 9600 baud, binary report format and odd parity. Your unit may be different.

Change the setup by altering the hardware or with commands from the host. Appendix B tells you how to change the hardware. Chapter 4 describes the commands. Read the passages and select the method most appropriate for the situation. Note that the tablet defaults to the hardware setup each time you turn on the tablet or send the reset command.



Chapter 2: Assembly and Installation

The MM II package should include the following:

- Tablet
- Stylus or cursor
- Interface cable
- Power supply (optional)
- Document clips
- MM II+ Graphics Tablet User's Guide

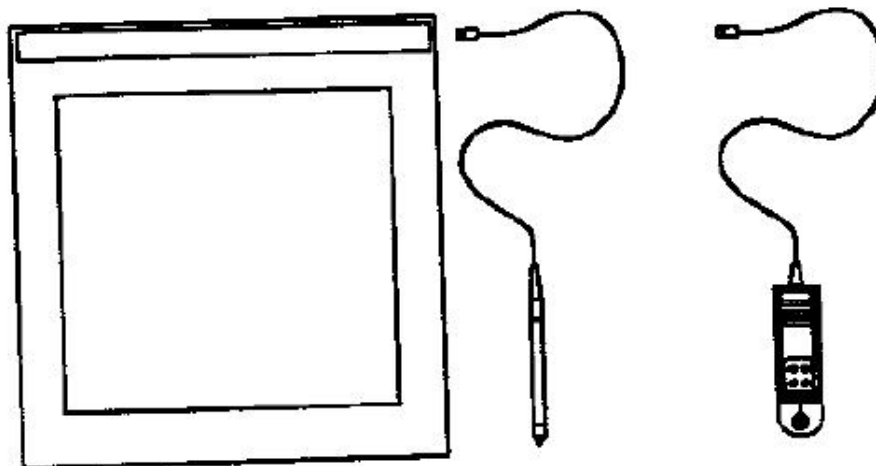
To assemble and install MM II:

1. Connect the stylus/cursor to the tablet.
2. Attach the tablet to the host and power source.
3. Turn on the tablet.
4. Attach the document clips. (Optional)

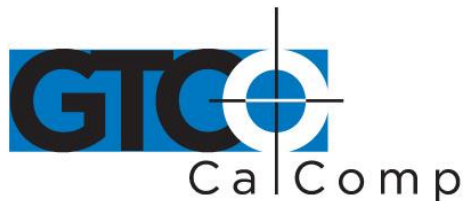
NOTE: Always have the computer and tablet power off when attaching or detaching any part of the MM II. If the power is on, nothing serious happens to the MM II, but it could have the potential to corrupt the file being worked on or cause the computer to malfunction.

Installing MM II Graphics Tablet

1. **Plug the stylus/cursor into the modular socket on the right-hand edge of the tablet.**

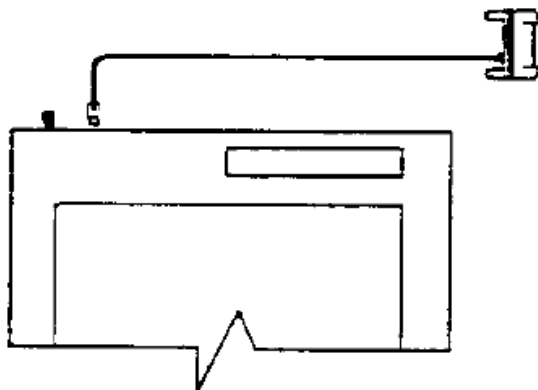


The cursor and stylus are interchangeable.



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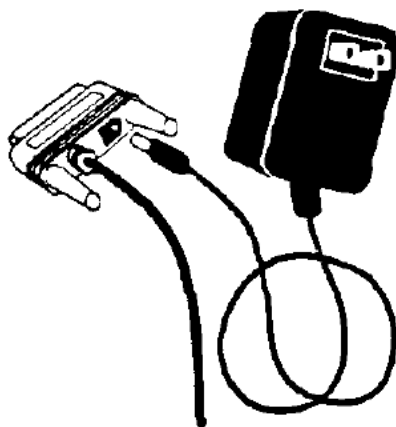
2. Connect the tablet to the host and power source. Plug the interface cable modular connector into the socket at the top left edge of the tablet.



Plug the interface cable 25-pin D connector into the host communications port.

The tablet can obtain power from the computer or MM II power supply. **Never power the tablet from both simultaneously. Pin 9 and the power supply socket are connected inside the 25-pin D connector. Therefore, power applied to one, also exists on the other. Ensure that nothing is attached to the source not in use.**

- Power from the host must supply +12 VDC at 250 mA, less than 50 mV ripple, +/- 10% regulation and a rise time less than 100 milliseconds. Once the tablet is connected to the computer, installation is complete.
- Power from the MM II power supply and plug the barrel connector into the interface cable D connector.



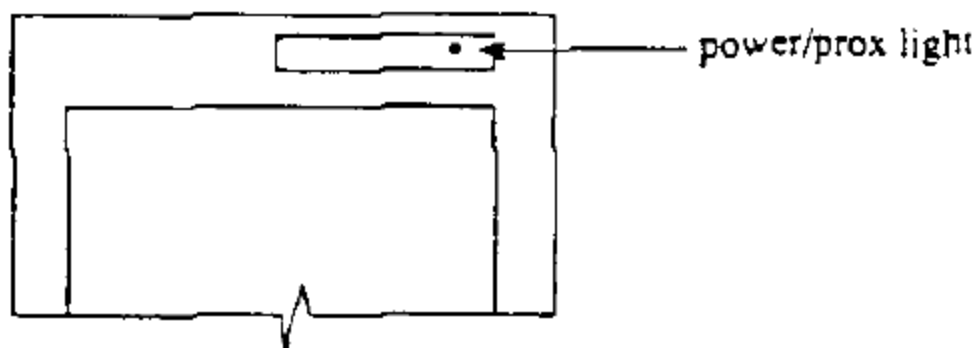


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Plug the power supply into a standard electrical outlet. Use only an MM II power supply. Substituting a different power supply could permanently damage the tablet.

3. Turn the tablet on.

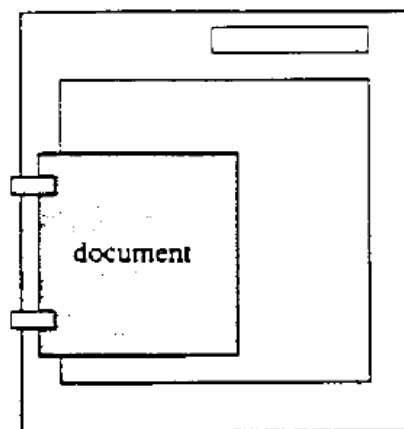
on/off switch



The power light/prox light serves two purposes. First, it notifies that the tablet is on and receiving power. Second, it is a proximity indicator. The light remains lit when the stylus/cursor is in-prox. It blinks when the stylus/cursor is out-of-prox. If the light blinks when the stylus/cursor is in-prox, one of two problems exists. Either, the stylus/cursor is not connected to the tablet, or it is malfunctioning. (Service information appears in Chapter 8.)

4. Attach the document clips. (Optional)

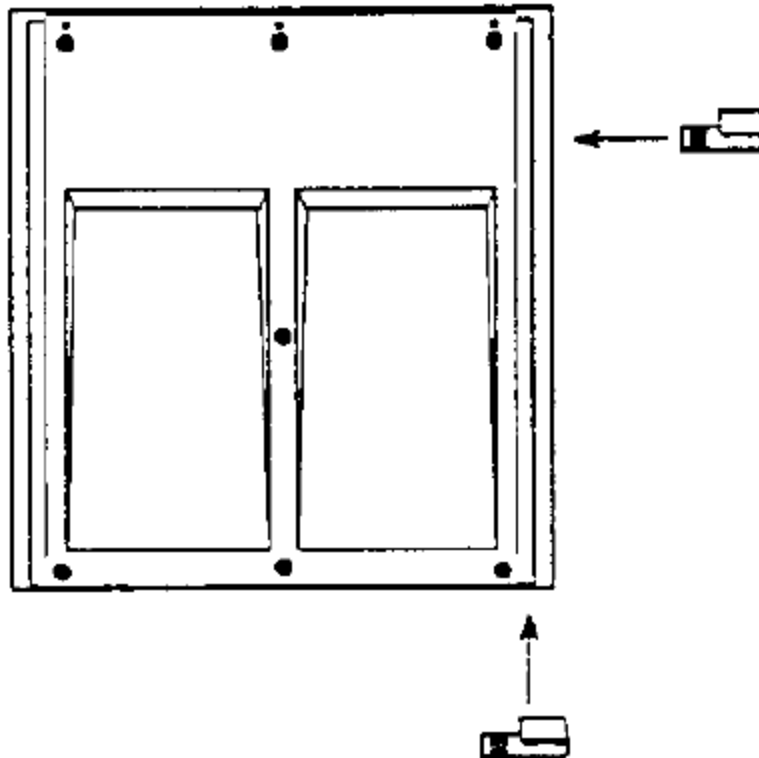
MM II comes with document clips. These are to steady documents on the tablet.





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The clips attach to rails on the tablet underside. To attach them, push them straight on or slide them up from the bottom.



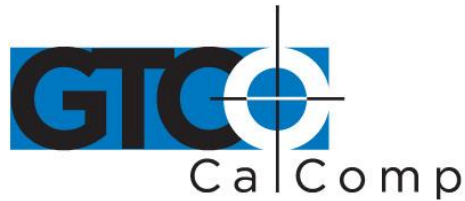
Position the clips where they're comfortably out of the way. To remove the clips, slide them to the bottom of the tablet.

Chapter 3: Interfacing with the Host

For successful communication between MM II and its host, they must have the same hardware interface, baud rate, communications protocol and report format.

Section A: Hardware Interface

The hardware interface consists of one cable terminated with a 25-pin male D connector. (If the computer requires a different connector, contact your GTCO CalComp by Turning Technologies representative for information about adapters.)



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The interface accommodates RS-232C and TTL. (Do not use both at the same time.)

RS-232C – CITTL Interface: 25-Pin D Connector Pin Assignments

Pin	Wire Name	Description
1	GND	Protective, frame ground
2	TXD	Transmits data to host (RS-232C only)
3	RXD	Receives data from host (RS-232C or TTL)
7	signal ground	Return for data
9	+12 VDC	Power to tablet from host
11	TXD	Transmits data to host (TTL only)

Pin 9 is for powering the tablet from the host. The host must supply a +12 VDC at 250 mA, less than 50 mV ripple, +/-10% regulation and a rise time less than 100 milliseconds.

CAUTION:

- Never power the tablet from the power supply and host simultaneously.
- Pin 9 and the power supply socket are connected inside the 25-pin D connector. Therefore, power applied to one, also exists on the other. Ensure that nothing is attached to the source not in use.

RS-232C Interface

The RS-232C lines are configured as DTE (Data Terminal Equipment). The signal levels comply with standard signal levels for data transmission:

RS-232C Signal Levels

RS-232C Interface	Interchange Voltage	+3V to +12V
	-3V to -12V	
Binary states	1	0
Signal condition	Mark	Space

NOTE: The source is the *EIA Standard RS-232C: Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange*, by the Engineering Department of the Electronic Industries Association (Washington, D.C.: EIA, 1969).



TTL Interface

The computer port must provide full duplex, asynchronous, serial communications. The signal levels for data transmission are:

TTL Signal Levels

TTL Interface	Interchange Voltage 0V to 0.8V	+2.4V to +5V
Binary states	1	0
Signal condition	Mark	Space

Section B: Baud Rate

The MM II is available with 9600 baud or Autobaud. The standard setting is 9600 baud, unless Autobaud is specifically ordered.

Autobaud automatically matches the tablet baud rate to the host baud rate. The tablet supports 75 to 19,200 baud. After turning on the tablet, the first character it must receive from the host is an ASCII space, <SP>. The tablet uses this to identify the host baud rate and to set its own accordingly.

Section C: Communication Protocols

The MM II communication protocols are:

- Number of start bits: 1
- Number of data bits: 8
- Number of stop bits: 1
- Parity: odd or none. (The standard product has odd parity.) To change the parity setting, refer to **Changing the Tablet Setup** in Chapter 1.

Section D: Report Formats

The MM II has one of the following report formats:

- Binary
- ASCII BCD

To change the format, refer to **Changing the Tablet Setup** in Chapter 1. The reports are in counts of resolution and not in inches or millimeters.



Binary Report Format

Binary Format for Absolute Coordinates

MSB							LSB	Transmission Sequence
7	6	5	4	3	2	1	0	
PH	PR	T	Sx	Sy	Fc	Fb	Fa	1st byte
0	X6	X5	X4	X3	X2	X1	X0	2nd byte
0	X13	X12	X11	X10	X9	X8	X7	3rd byte
0	Y6	Y5	Y4	Y3	Y2	Y1	Y0	4th byte
0	Y13	Y12	Y11	Y10	Y9	Y8	Y7	5th byte

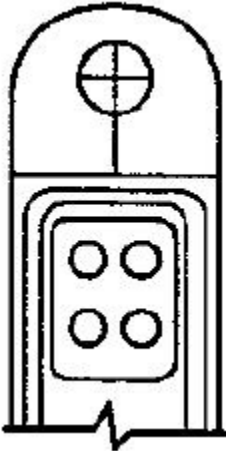
Binary Format for Relative Coordinates

MSB							LSB	Transmission Sequence
7	6	5	4	3	2	1	0	
PH	PR	T	Sx	Sy	Fc	Fb	Fa	1st byte
0	X6	X5	X4	X3	X2	X1	X0	2nd byte
0	Y6	Y5	Y4	Y3	Y2	Y1	Y0	3rd byte

**Key:**

- LSB is the least significant bit. MSB is the most significant bit.
- Fa, Fb and Fc are the flag bits. They identify the status of the stylus and cursor buttons:

Stylus Buttons	Cursor Buttons	Fc	Fb	Fa
none pressed	none pressed	0	0	0
tip button pressed	1 pressed	0	0	1
barrel button pressed	2 pressed	0	1	0
tip and barrel pressed	3 pressed	0	1	1
	4 pressed	1	0	0
	1+2	0	1	1
	1+3	1	0	0
	1+4	1	0	1
	2+3	1	0	1
	2+4	1	1	0
	1+2+3	1	1	0
	1+2+4	1	1	1
	2+3+4	1	1	1
	1+2+3+4	1	1	1



- S_x and S_y are the X and Y coordinate signs. 1 is positive and 0 is negative. In absolute coordinates, the sign is always positive. In relative coordinates, the sign can be positive or negative.
- T is the Tablet Identifier. Your choice of 1 or 0. Command controlled.
- PR is the proximity bit. 0 is in-prox and 1 is out-of-prox.
- PH is the phasing bit, which is always 1.
- $X_0, X_1, \text{etc.}$ and $Y_0, Y_1, \text{etc.}$ are the X and Y coordinate bits.

ASCII BCD Report Format

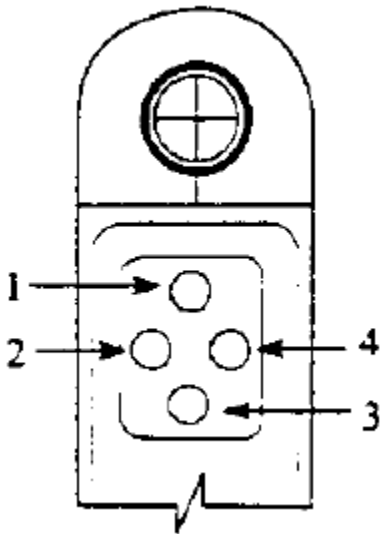
The ASCII BCD format depends on the coordinate system and resolution:

Resolution	Absolute Coordinates	Relative Coordinates
1 to 508 lpi (20 lpmm)	XXXX, YYYY, F<CR><LF>	S0XXX, S0YYY, F<CR><LF>
1000 lpi or 40 lpmm	XXXXX, YYYYY, F<CR><LF>	S00XXX, S00YYY, F<CR><LF>

**Key:**

- X is an X coordinate digit, where each digit is an ASCII character from 0 to 9
- “,” is an ASCII comma
- Y is a Y coordinate digit, where each digit is an ASCII character from 0 to 9
- F is the stylus and cursor flag character, identifying the button status:

Stylus Buttons	Cursor Buttons	F
none pressed	none pressed	0
tip button pressed	1 pressed	1
barrel button pressed	2 pressed	2
tip and barrel pressed	3 pressed	3
	4 pressed	4
	1+2	3
	1+3	4
	1+4	5
	2+3	5
	2+4	6
	1+2+3	6
	1+2+4	7
	2+3+4	7
	1+2+3+4	7



- <CR> is an ASCII carriage return character.
- <LF> is an ASCII line feed character.

Chapter 4: Operating Characteristics and Functions

MM II includes a variety of operating characteristics and functions that can be controlled with commands from the host. For example, define:

- Report flow
- Tablet resolution
- Tablet origin location

The tablet accepts commands from the host at any rate, except in a few situations. These are listed in Chapter 1, Section C, **Commands: Controlling the Tablet's Operation**.

So that the MM II is operable upon arrival at your facility, it is set to predefined default settings. The unit defaults to these settings each time you turn on the tablet or issue the Reset command. A summary of the defaults appear in the Reset command section and in **Appendix D**.



Section A: Controlling the Report Flow

The primary functions that control the report flow are Point, Remote Request, Stream and Switch Stream modes. The secondary functions are Report Rate, Increment Mode and Axis Update.

- Reports have a proximity bit.
- Each report has flag bits. These bits identify the stylus/cursor buttons that were activated when the report was issued.

Point Mode

ASCII command: B

In Point Mode, the graphics tablet issues one report when pressing a stylus/cursor button. If the stylus/cursor is out-of-prox, the last valid report is issued for each button press.

Remote Request Mode

ASCII mode command: D
ASCII trigger command: P

In Remote Request Mode, the tablet 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. After initiating Remote Request Mode, the tablet issues the report resulting from the first trigger within ten milliseconds.

Issue reports with the trigger even if the MM is in **Point**, **Stream** or **Switch Stream** modes. However, the reverse is not true: pressing a stylus/cursor button when the MM is in Remote Request Mode does not issue a report.

When the stylus/cursor is out-of-prox, the tablet issues the last valid report each time it receives a trigger.



Stream Mode

ASCII command: @

In Stream Mode, the graphics tablet issues reports continuously, whether a stylus/cursor button is pressed or not. The Report Rate, described below, controls the number of reports issued per second.

If the stylus/cursor is out-of-prox and no buttons have been pressed, the last valid report is transmitted three times. If a button is pressed, the last valid report is issued continuously.

Switch Stream Mode

ASCII command: A

In Switch Stream Mode, the graphics tablet issues report continuously while pressing a stylus/cursor button. The Report Rate, described below, controls the number of reports issued per second.

If the stylus/cursor is out-of-prox when pressing a button, the last in-prox scanned report is issued continuously.

Report Rate

	ASCII command
Report Rate equal to:	
Maximum throughput	Q
Maximum throughput +2	R
Maximum throughput +8	S
Maximum throughput +32	T

The Report Rate function is an adjunct to Stream and Switch Stream modes. Use Report Rate to define the number of reports the tablet issues each second. Maximum throughput is the default.



Maximum Report Throughput

Baud Rate	Binary Report Format Absolute Coordinates (reports per second)	Binary Report Format Relative Coordinates (reports per second)	ASCII BCD* Report Format (reports per second)
19,200	166	200	94
9600	116	157	55
4800	70	102	30
2400	39	60	16
1200	20	33	8
600	10.6	17	4
300	5.4	8.4	2
150	3.7	4.1	1

*Approximate rates. Throughput can vary with coordinate system and resolution setting.

Increment Mode

Command Sequence: <mode command><increment value>

ASCII mode command	I
ASCII increment value	SP to z

Increment mode is an adjunct to **Remote Request**, **Stream** and **Switch Stream** modes. It is useful for reducing redundant data output.

In Increment Mode, the tablet sends a report only when the stylus/cursor has traveled a minimum distance in the X or Y direction. This minimum distance is the increment. It applies to both axes and is measured in counts (of resolution). Its limits are 0 to 95 counts.

NOTE: When using **Increment Mode**, we recommend using a resolution setting of 50 lpi or higher.

How Increment Mode Works

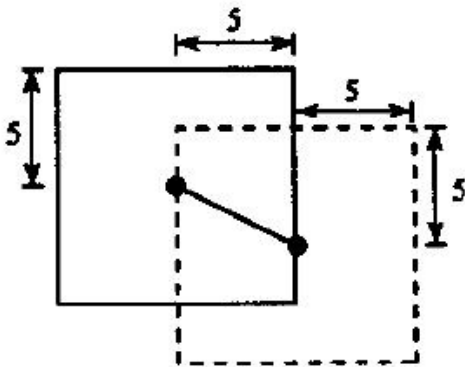
The last report issued becomes the center of an imaginary square. The square's sides measure twice the increment value. The stylus/cursor can move anywhere inside the imaginary square without the tablet issuing a report. When the stylus/cursor touches the



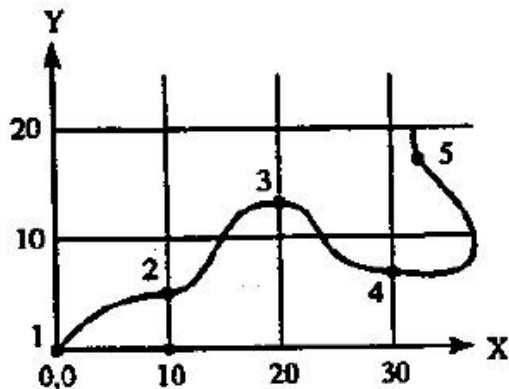
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square, the increment is met and the tablet transmits a report. This point becomes the center of a new imaginary square. The process repeats.

The following illustration shows the imaginary square created around a report point. The increment is five.



The following example shows the reports issued as the stylus/cursor travels across the tablet. The increment is ten. We have assumed that the first point collected is the origin (0, 0).





The points issued are:

Point	Report	Description
1	(0,0)	First point collected in Increment Mode.
2	(10,5)	The increment is met along the X axis. The tablet reports the actual Y location.
No point is transmitted between points 2 and 3 because the stylus/cursor did not move ten counts in either the X or Y direction.		
3	(20,13)	The increment is met along the X axis. The tablet reports the actual Y location.
4	(30,7)	The increment is met along the X axis. The tablet reports the actual Y location.
5	(32,17)	The increment is met along the Y axis. The tablet reports the actual X location.

How to Use Increment Mode

Send the mode command and then the increment value. The increment value is in counts (of resolution) and can be a decimal whole number from 0 to 95. (The default is zero.) Add 32 (decimal), a required offset, to the desired increment and then convert the sum into your preferred number base. For example, if the desired increment value is 10 (decimal),

<i>desired increment</i>	+32	= increment value in decimal	= increment value in hexadecimal	= increment value in ASCII
10	+32	= 42 decimal	= 2A hexadecimal	= ASCII

To disable Increment Mode, set the increment to zero with the ASCII space character (SP).

The length of a count can vary depending on the resolution and measurement system the tablet is using. Therefore, the increment length can vary:



Resolution	Measurement System	Increment Value (in Counts)	Length of One Count	Increment Length
50 lpi	U.S.	5	0.02 inches	0.1 inches
200 lpi	U.S.	5	0.005 inches	0.025 inches

Checking the Increment

You can confirm the increment setting with the **zi** command. Refer to **Z Commands** later in this chapter for additional information.

Combining Increment Mode with Other Modes

- **Point Mode** and **Increment Mode**: Invalid combination as Point Mode overrides Increment Mode.
- **Remote Request Mode** and **Increment Mode**: When the tablet receives a (Remote Request) trigger from the host, it issues a report. If the increment has not been met when the tablet receives this trigger, the tablet reissues the last report. If the increment has been met when the tablet receives this trigger, the tablet advises an updated report.
- **Stream Mode** and **Increment Mode**: The tablet issues a report only when the increment is met. It can issue reports up to the established Report Rate. Also, pressing a stylus/cursor button reissues the last valid report twice, once when the button is pressed and then again when it's released. (The difference between these reports is the button flag. The flag is set when the button is pressed. It is zero when the button is released.)
- **Switch Stream Mode** and **Increment Mode**: If the increment has not been met, the tablet issues one report when a button is pressed. If the increment has been met and a button is pressed, the tablet can issue reports up to the established Report Rate.

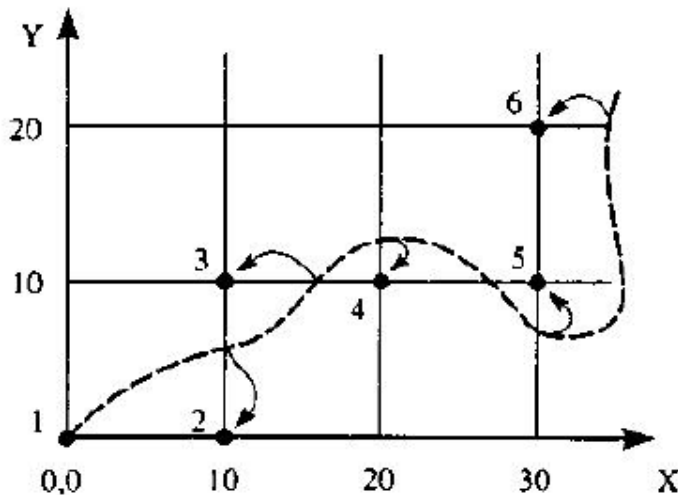


Axis Update Mode

Command Sequence: <mode command><update value>

	ASCII command
mode command	G
update value	<SP> to z

Axis Update Mode is an adjunct to Remote Request, Stream and Switch Stream modes, particularly useful if using a grid on the tablet and you want reports sectioning the grid intersection points.



The points issued are:

Point	Report	Description
1	(0,0)	Reference point, the first point collected in Axis Update Mode.
2	(10,0)	X update was met. Y was not. Last Y value repeated.
3	(10,10)	Y update was met. X was not. Last X value repeated.
4	(20,10)	X update was met. Y was not. Last Y value repeated.
No	point is	issued between points 4 and 5 because the same report is not issued consecutively.
5	(30,10)	X update was met. Y was not. Last Y value repeated.
6	(30,20)	Y update was met. X was not. Last X value repeated.



How to Use Axis Update Mode

Before sending the mode command, place the stylus/cursor on the tablet at one of your desired grid intersection points. Send the mode command, then the update value. The update value is in counts (of resolution) and can be a decimal whole number from 0 to 95. (The default is zero.) Add 32 (decimal), a required offset, to the desired update value and convert the sum into your preferred number base. For example, if the desired update value is 10 (decimal).

<i>desired increment</i>	+32	= increment value in decimal	= increment value in hexadecimal	= increment value in ASCII
10	+32	= 42 decimal	= 2A hexadecimal	= ASCII

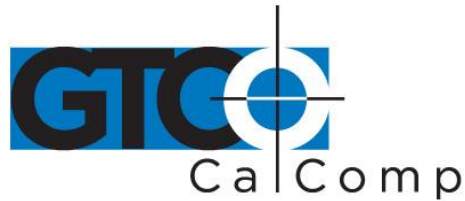
To disable Axis Update Mode, set the update to zero with the ASCII space character <SP>.

As mentioned above, the update value is in counts. The length of a count can vary depending on the resolution and measurement system the tablet is using. Therefore, the update length can vary. For example:

Resolution	Measurement System	Update Value (in Counts)	Length of One Count	Update Length
50 lpi	US	5	0.02 inches	0.1 inches
200 lpi	US	5	0.005 inches	0.025 inches

Combining Axis Update Mode with Other Modes

- Point Mode and Axis Update Mode: Invalid combination. Point Mode overrides Axis Update Mode.
- Remote Request Mode and Axis Update Mode: When the tablet receives a (Remote Request) trigger from the host, it issues a report. If the update has not been met when the tablet receives this trigger, the tablet reissues the last report. If the update has been met when the tablet receives this trigger, the tablet issues an updated report.
- Stream Mode and Axis Update Mode: The tablet issues a report when the update is met. It can issue reports up to the established Report Rate. Also, when pressing a



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stylus/cursor button, the tablet reissues the last valid report twice, once the button is pressed and again when it is released. (The difference between these reports is the button flag. The flag is set when the button is pressed. It is zero when the button is released.)

- Switch Stream Mode and Axis Update Mode: If the update has not been met, the tablet issues one report when a button is pressed. If the update has been met and a button is pressed, the tablet can issue reports up to the established Report Rate.

Section B: Setting the Resolution

Resolution is the fineness of detail that the tablet can distinguish. Resolution is expressed in lines per inch (lpi) or lines per millimeter (lpmm). (A detailed definition of resolution appears in Chapter 1.) Two resolution functions are available, Predefined Resolution and Definable Resolution.

Each time the tablet is turned on or issues the Reset command, the tablet defaults to a resolution of 200 lpi.

Resolution, Predefined

	ASCII command
Resolution setting of:	
1 lpi	l (lowercase L)
2 lpi	n
4 lpi	p
100 lpi	d
200 lpi	e
10 lpmm (254 lpi)	f
400 lpi	g
500 lpi	h
20 lpmm (508 lpi)	i
1000 lpi	j
40 lpmm (1016 lpi)	q

Use these commands to set the tablet to one of the predefined resolutions listed above.



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Resolution, Definable (Set X, Y Scale)

Command Sequence: <command><X low byte><X high byte><Y low byte><Y high byte>

	ASCII	Hex
command	r	72
X axis resolution, low byte	—	00 to FF
X axis resolution, high byte	—	00 to 17
Y axis resolution, low byte	—	00 to FF
Y axis resolution, high byte	—	00 to 17

The purpose of the **Definable Resolution** function is to let you match the tablet resolution to the resolution of another two-dimensional device, e.g. a computer screen. With Definable Resolution:

- Define the resolution of each tablet axis, independent of one another.
- Clarify the resolution to be any value from 1 to 508 lpi.

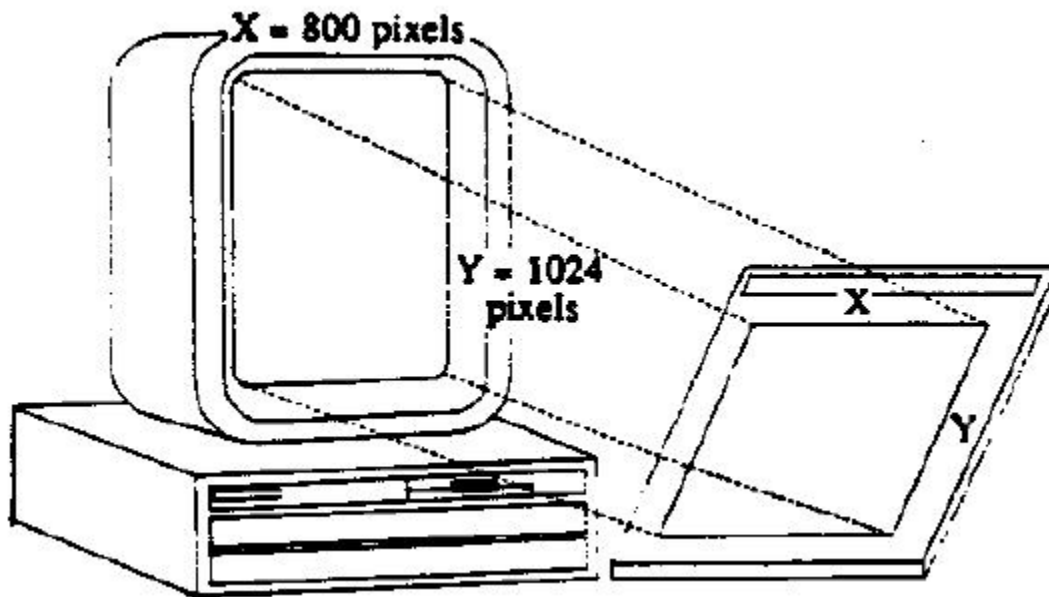
Here's how to use Definable Resolution:

1. Determine the resolution that's desired for the entire length of the (tablet) axis:

- If the other device's resolution is expressed in "units per...", such as 37 lines per inch, multiply that number by the tablet axis length. Example: *other device's resolution x length of tablet axis = desired axis resolution*

37 lpi x 11.7 inches = 432.9 = rounded to 433 ... is the desired axis resolution

- The other device may have a resolution expressed as the overall axis values, such as 800 by 1024 pixels.



In this case, ensure the length of the corresponding tablet axis divides evenly into the other device's resolution. If it does not, the tablet truncates the resolution value to a whole number.

Example: Matching the MM II to a vertical (portrait) screen with a resolution of 800 (X) by 1024 (Y) pixels:

Other Device's Resolution / Tablet Axis Length

800 pixels / 11.7 inches = 68.37 ... X axis

1024 pixels / 12.7 inches = 87.52 ... Y axis

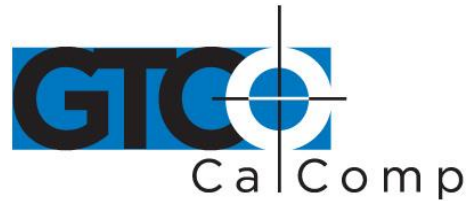
The tablet would truncate these values to 68 and 87. Therefore, round them high to 69 and 88. (This ensures that the entire screen is addressable from the tablet.) Multiply the rounded values by the tablet axis length to derive the desired resolution for the overall axis.

69 x 11.7 inches = 807.3 ... is the desired X axis resolution

88 x 11.7 inches = 1030 ... is the desired Y axis resolution

- Convert the desired axis resolution to a hexadecimal number.

Example: 808 decimal = 328 hexadecimal



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1030 decimal = 406 hexadecimal

If the number is less from four digits, pack the left side with zeros. For example, 328 becomes 0328; 406 becomes 0406.

Separate the hexadecimal number into two 2-digit parts, the most significant byte (high byte) and the least significant byte (low byte).

Example:

0328 = 03 high byte 28 low byte

0406 = 04 high byte 06 low byte

3. You're now ready to send the Definable Resolution command sequence to the tablet. In the example of 800 by 1024 portrait screen, the command sequence is:

Command	X Low Byte	X High Byte	Y Low Byte	Y High Byte
72	28	03	06	04

NOTE: To change the resolution of only one axis, send zeros as the other axis's resolution.

4. To verify the new resolution settings, use the Send Configuration command.

Section C: Other Functions

Absolute and Relative Coordinates (Delta Mode)

	ASCII command
relative coordinates	E
absolute coordinates	F

These commands change the tablet's coordinate system. Absolute coordinates are measured from the tablet's origin (0,0). Relative coordinates are measured **relative to** the last report location. (Refer to Chapter 1 for details.)

The tablet defaults to absolute coordinates.



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When updating to relative coordinates, the lower left corner of the tablet becomes the active area origin. Stylus/cursor movement up and to the right is positive. Movement down and to the left is negative. (You can change the origin location to the upper left corner with the Origin command. Stylus/cursor movement down and to the right is positive; up and to the left is negative.)

Also, when the tablet is using relative coordinates, reports issued out-of-prox are zero.

Origin

ASCII command	
Origin location:	
Upper Left	b
Lower Left	c

Use the Origin command to define the location of the tablet's origin (0, 0). It can be the lower or upper left corner of the active area. The default is the lower left.

When the origin is in the upper left corner, Y coordinates are positive, not negative. This departure from the standard Cartesian coordinate system is to aid in the compatibility between the MM II and terminals with a screen origin in the upper left corner.

Reset (to Defaults)

ASCII command:	NUL
-----------------------	------------

Use **Reset** to run the Self-Test diagnostic function and returns the MM to the defaults:

- Axis Update: 0, Axis Update Mode off
- Coordinate system: absolute
- Increment: 0, Increment Mode off
- Origin: lower left corner



- Report Mode: Switch Stream
- Report Rate: maximum throughput
- Resolution: 500 lpi
- Tablet Identifier: 0

After the tablet receives the Reset command, there is a ten millisecond delay before it is ready to receive further data from the host.

Send Configuration

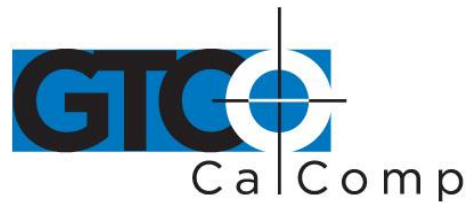
ASCII command: a

Send Configuration issues a report to the host that identifies the resolution of each axis. The report format is one of the following:

MSB	7	6	5	4	3	2	1	LSB	0	Transmission Sequence
1	PR	T	1	1	Fc	Fb	Fa			Flag byte
0	b6	b5	b4	b3	b2	b1	b0			X low byte
0	b13	b12	b11	b10	b9	b8	b7			X high byte
0	b6	b5	b4	b3	b2	b1	b0			Y low byte
0	b13	b12	b11	b10	b9	b8	b7			Y high byte

Key:

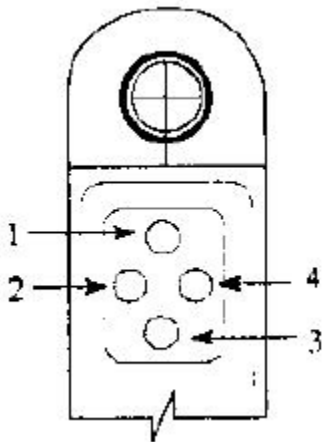
- LSB is the least significant bit. MSB is the most significant bit.



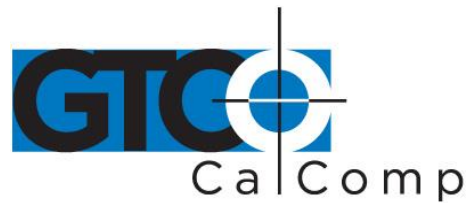
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- Fa, Fb and Fc are the flag bits. They identify the status of the stylus and cursor buttons:

Stylus Buttons	Cursor Buttons	Fc	Fb	Fa
none pressed	none pressed	0	0	0
tip button pressed	1 pressed	0	0	1
barrel button pressed	2 pressed	0	1	0
tip and barrel pressed	3 pressed	0	1	1
	4 pressed	1	0	0
	1+2	0	1	1
	1+3	1	0	0
	1+4	1	0	1
	2+3	1	0	1
	2+4	1	1	0
	1+2+3	1	1	0
	1+2+4	1	1	1
	2+3+4	1	1	1
	1+2+3+4	1	1	1



- T is the Tablet Identifier, which is 1 or 0.
- PR is the proximity bit. 0 is in-prox. 1 is out-of-prox.
- b0 through b13 is the maximum X or Y value at the set resolution.



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The configuration report does not express the resolution in lines per inch or lines per millimeter. Rather, the resolution is expressed as the total number of counts over the length of the axis.

Example: Resolution setting is 200 lpi. The X and Y axes are 11.7 inches long. Therefore, the resolution is 2340 for each axis. The Send Configuration report is:

MSB							LSB	Transmission Sequence
7	6	5	4	3	2	1	0	
1	0	0	1	1	0	0	0	Flag byte
0	0	1	0	0	1	0	0	X low byte
0	0	0	1	0	0	1	0	X high byte
0	0	1	0	0	1	0	0	Y low byte
0	0	0	1	0	0	1	0	Y high byte

Tablet Identifier

	ASCII command
Tablet Identifier equal to:	
zero	0 (zero)
one	1

Use this command to set a bit in the binary report format to a one or a zero. This can be helpful in a dual-tablet configuration to distinguish between the reports coming from one tablet versus the other.



Transmission Control

	ASCII command
Stop Transmission (XOFF)	<DC3>
Resume Transmission (XON)	<DC1>

The **Stop Transmission** and **Resume Transmission** commands act as software gates, controlling data transmission from the MM II to the host. These commands control the data flow, regardless of the report collection mode (Stream, Point, etc.). Stop Transmission and Resume Transmission are equivalents of the protocols XOFF and XON.

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

While on standby, the tablet can buffer up to ten commands, which it executes after receiving the Resume Transmission command.

If a Stop Transmission is issued while data is being transmitted, no data is lost. The MM II severs the data transmission at the end of the byte. When a Resume Transmission command is issued, the tablet resumes operation.

NOTE: The Reset command does not cancel the Stop Transmission command.

Z Commands

	ASCII command
Autobaud	z<SP><SP>
ASCII BCD report format	za
binary report format	zb
8 data bits, no parity	z8
8 data bits, odd parity	z9
increment confirmation	zi
firmware identification	z?
stylus/cursor identification	zl



The z commands include a variety of functions. Some can be used to override the set up jumpers inside the tablet. To void a z command, send the Reset command or repower the tablet.

- Autobaud: Command overrides set up jumper AA. It changes the default baud rate to Autobaud, described in Chapter 2. The character <SP> is an ASCII space.

After issuing z<SP>, ensure that the host port is set to the baud rate you want. Only then can you issue the second <SP>. The tablet responds with an ASCII <ACK> at the new baud rate.

- ASCII BCD report format: Command overrides set up jumper AB. It causes the tablet to use the ASCII BCD report format.
- Binary report format: Command overrides set up jumper AB. It causes the tablet to use the binary report format/
- 8 data bits, no parity: Command overrides set up jumper AC. It programs the UART to use an 8-bit frame: 8 data bits, odd parity. After the command is executed, the tablet responds with an ASCII <ACK>.
- 8 data bits, odd parity: Command overrides set up jumper AC. It programs the UART to use a 9-bit frame: 8 data bits, odd parity. After the command is executed, the tablet responds with an ASCII <ACK>.
- Increment confirmation: Command lets you confirm the current Increment Mode value. The tablet transmits two ASCII hexadecimal characters followed by an ASCII carriage return: XX<CR>.
- Firmware identification: Command sends a character string to the host that identifies the tablet firmware version. The string is:

MM2 12x12 Tablet by Summagraphics Firmware Version x.xx<CR>
 where x.xx is the firmware version and <CR> is an ASCII carriage return.



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- Transducer identification: Command sends a character string to the host that identifies which transducer (stylus or cursor) is attached to the tablet. The string is one of the following:

CSR4<CR>	Four button cursor
CSR16<CR>	16-button cursor
STYLUS<CR>	Stylus

Section D: Reserved Commands

Do not use the ASCII commands zh, zd or zf or their equivalents. They are reserved for factory use. If a reserved command is issued by mistake, clear it by repowering the tablet.



Chapter 5: Guidelines for Writing a Device Driver

For the computer to make use of the data being sent to it from the tablet, the software (system or application) must contain a tablet device driver. The driver needs to be written for your specific MM II configuration.

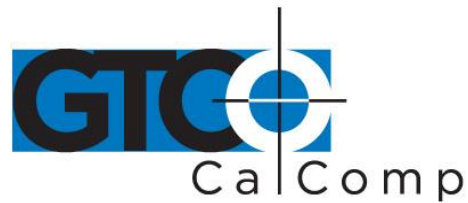
The device driver is a program that collects and decodes the tablet data.

The driver usually sits between the application and serial interface. The driver should be able to:

- Receive reports and status information from the tablet via the serial interface
- Transmit data to the application
- Present high level commands from the application that control the tablet

A typical driver consists of four major parts:

- **Configure Host and Tablet**
 - Structure the host communications port (port address, baud rate, etc.)
 - Shape the tablet (resolution, report mode, etc.)
- **Report Collection – Interrupt Routines**
 - Assemble the report: collect the report's data bytes into an array
 - Check for errors
- **Process Reports from the Tablet**
 - Decode the report
 - Filter reports, if required by the application
 - Notify the application, if applicable, that a report is ready to be issued to the application
- **Process Errors**
 - Parity errors
 - Short report errors after time-out
 - Long report errors
 - Missing report errors after time-out
 - Host buffer full errors (automatic XON/XOFF support)

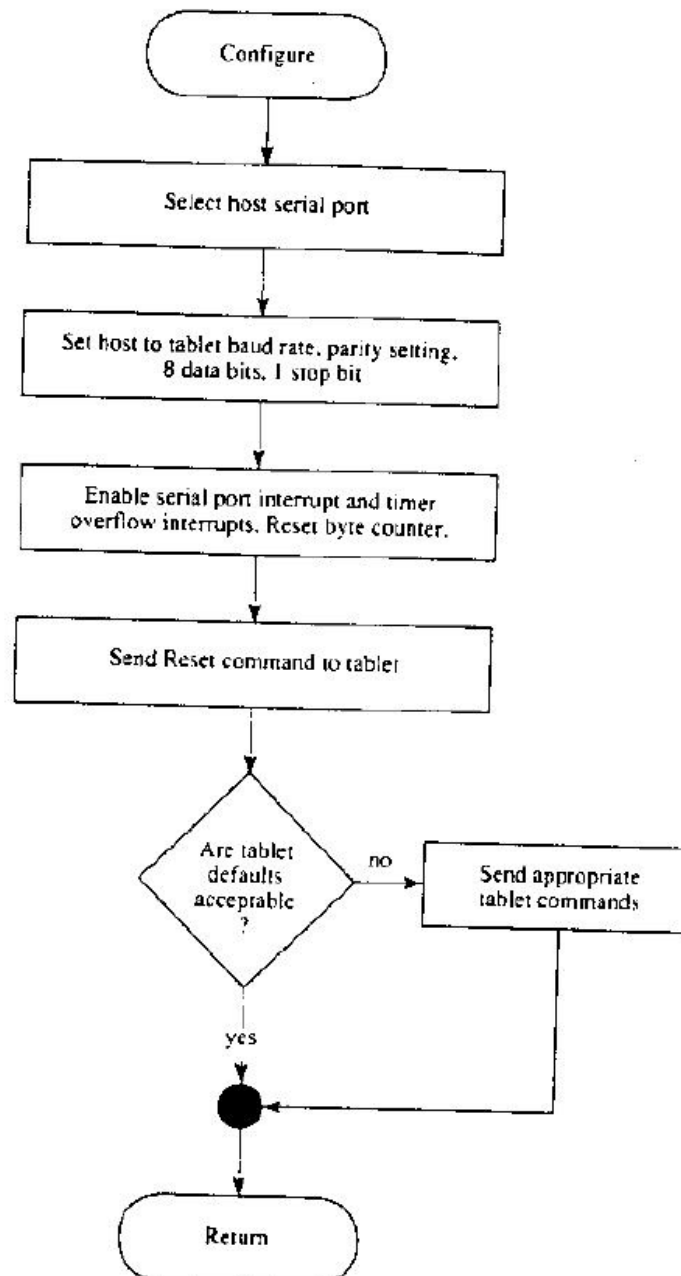


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The following flowcharts are for a MM II in the Bit Pad One configuration.

Configure Host and Tablet

- Structure the host communications port (port address, baud rate, etc.)
- Shape the tablet (resolution, report mode, etc.)

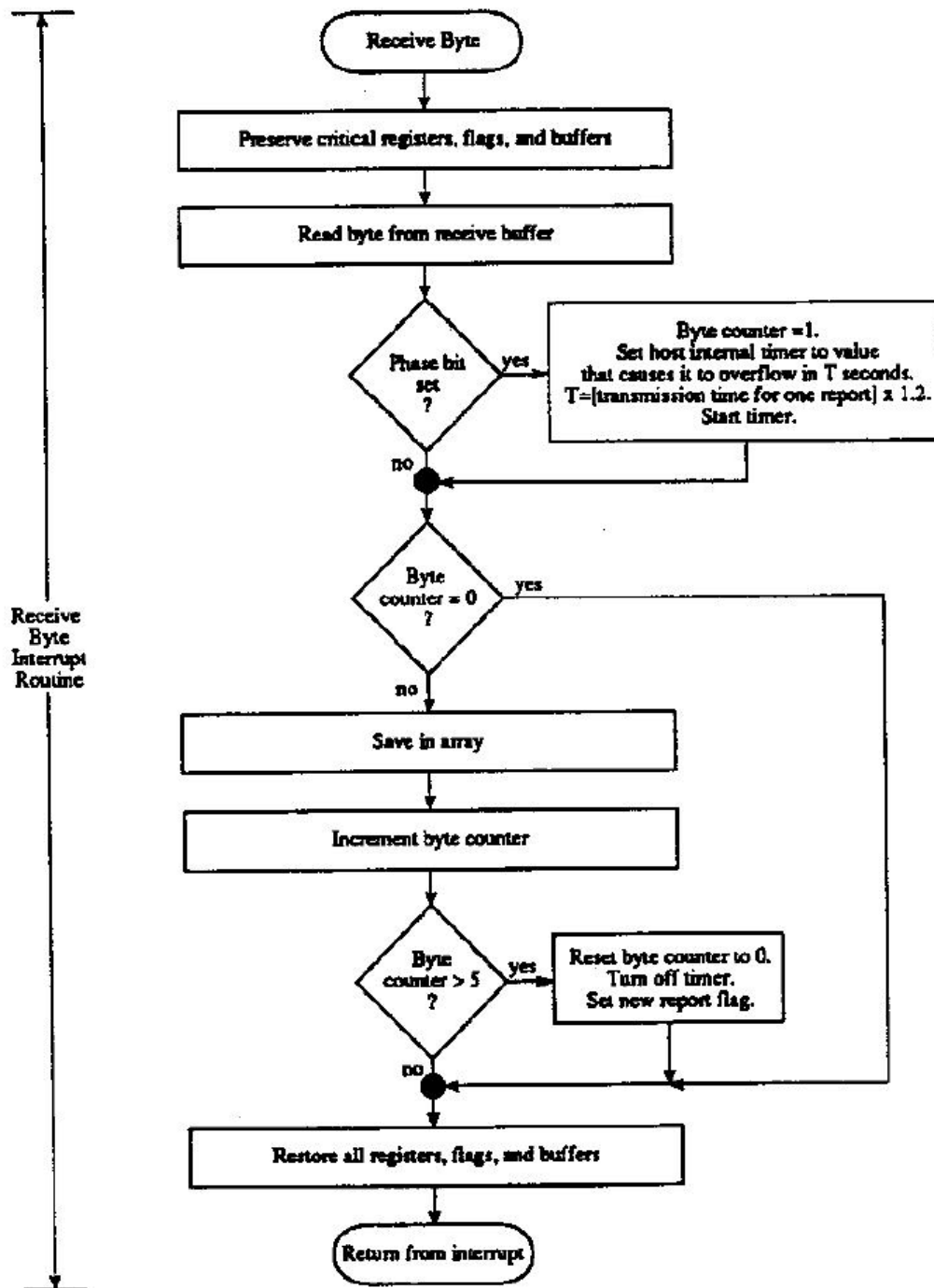




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Report Collection – Interrupt Routines

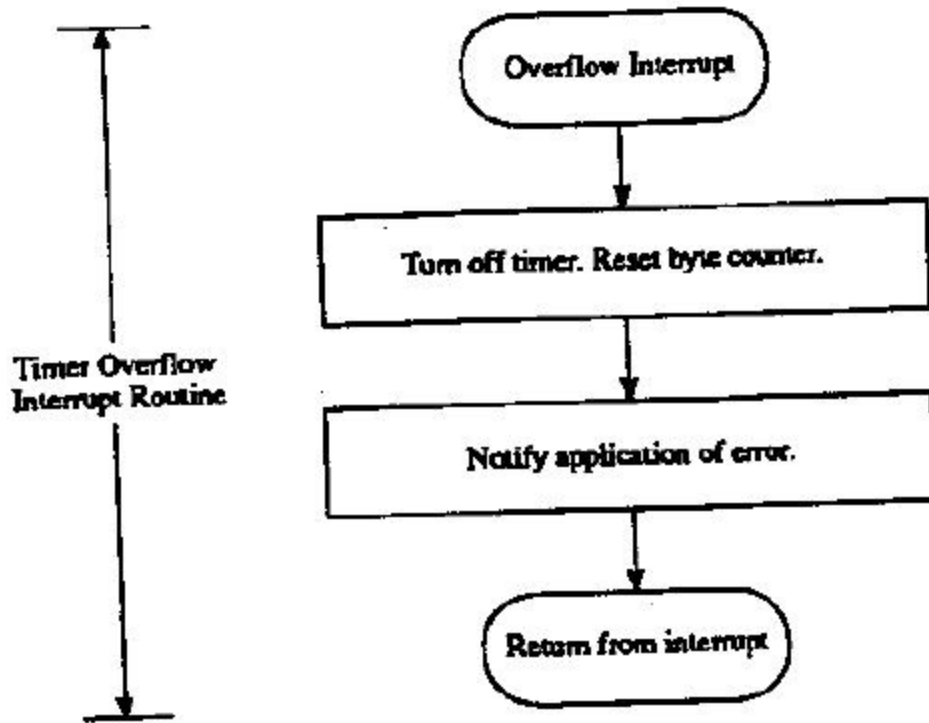
- Assemble the report: collect the report's data bytes into an array
- Check for errors





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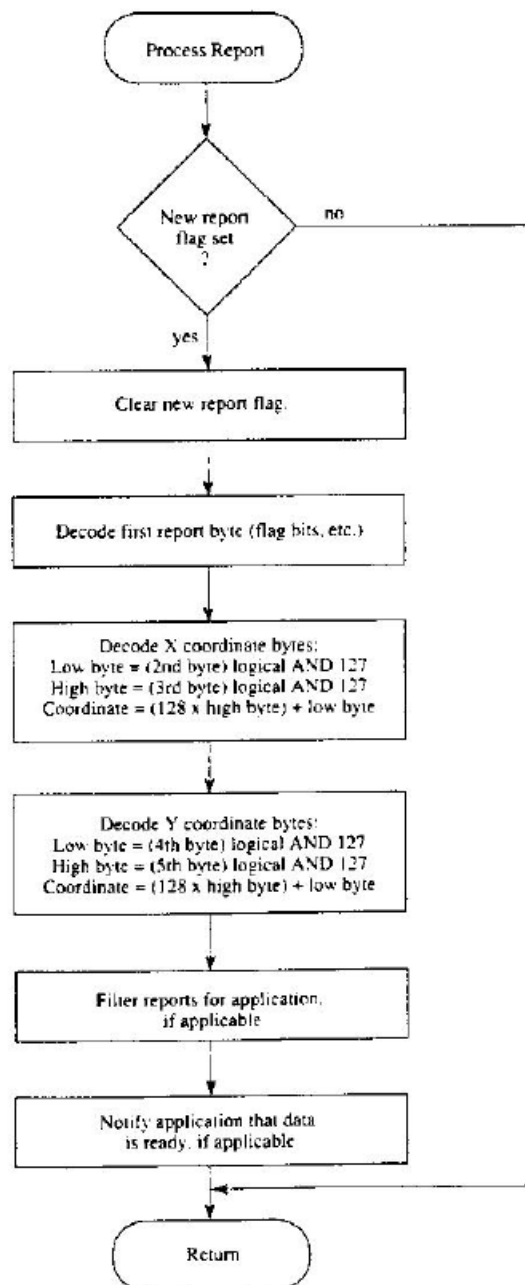
Cont.





Process Reports from the Tablet

- Decode the report
- Filter reports, if required by the application
- Notify the application, if applicable, that a report is ready to be issued to the application





Chapter 6: Using the MM II

Follow these guidelines to maximize usage of the MM II.

- You can tape things down to the tablet, including pictures and drawings. Tape does not affect the tablet. You can even stack materials up to ½ inch high between the tablet and stylus/cursor.
- After turning on the tablet, wait until it stops calibrating before starting an application that uses it.
- Keep the stylus/cursor in the active area of the tablet and in proximity. Please note when the stylus/cursor is in proximity, the tablet power light is on. When the stylus/cursor is out-of-prox, the power light blinks.
- Stylus or cursor - which to use? For freehand drawing, the stylus tends to feel more natural. For tracing, the cursor provides the user with more control and precise sighting. Also, the cursor has multiple buttons, to which can assign specific functions.
- The cursor and stylus are interchangeable. However, before changing from one to the other, turn off the tablet. (This allows the tablet's internal software to re-initialize for each device.)
- Stylus: The stylus has a switch inside the barrel. To activate the switch, press the stylus tip or button.
- Cursor is most accurate when held parallel with the tablet surface. To activate a cursor button, press it.
- When you turn off the computer, turn off the tablet.
- The unit is affected by conductive materials. Do not trace through metal or metallized paper. Do not use metal objects, such as rulers, on the tablet. However, with the cursor, you can trace through some conductive materials, such as X-rays or drawings in pencil or conductive ink.



Chapter 7: Checking the Graphics Tablet

Section A: Power (and Proximity) Light

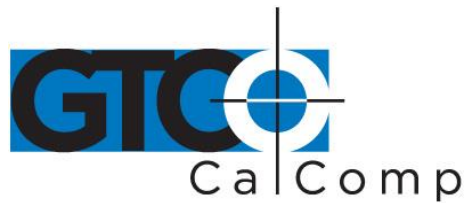
The power light on the tablet serves two purposes. First, it notifies when the tablet is on and receiving power. Second, it is a proximity indicator. The light remains lit when the stylus/cursor is in-prox. It blinks when the stylus/cursor is out-of-prox. If the light blinks when the stylus/cursor is in-prox, then the tablet is malfunctioning. Turn it off for an estimated 10-20 seconds and then turn it back on.

Section B: A Quick Functional Check

Here is a quick functional check that you can perform. Its purpose is to ensure that the interface is working and that all parts of the tablet active area are being read by the stylus/cursor.

1. Connect the tablet to a "dumb" terminal. The terminal must be set up to communicate in full duplex at 9600 baud. If the unit is a Bit Pad One or Two configurations, the terminal's data protocol must be a 9-bit frame: odd parity and eight data bits.
2. On the terminal, enter the command string: **zA@**. The tablet is now in **Stream Mode** sending reports in an ASCII format.
3. Starting at the lower left corner of the tablet, run the stylus/cursor across the tablet's active area. You should see reports on the terminal in the following ASCII format: **XXXX, YYYY, F**. XXXX, YYYY are the X and Y coordinates. F is the stylus/cursor flag:

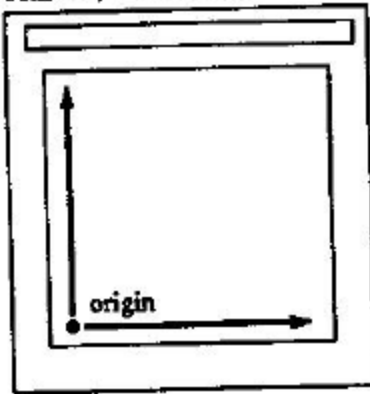
Stylus Buttons	Cursor Buttons	F
not pressed	none pressed	0
tip button pressed	1 pressed	1
barrel button pressed	2 pressed	2
tip and barrel pressed	3 pressed	3
	4 pressed	4



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The X and Y coordinates should increase as you slide the stylus/cursor up and right, as shown below.

When stylus/cursor moves vertically, X is constant, Y increases.



When stylus/cursor moves horizontally, Y is constant, X increases.

Section C: Diagnostic Functions

Code Check

ASCII command: **x**

Code Check identifies the tablet's firmware version. It does this by issuing a number called the checksum, to the host. Each firmware version has a unique checksum.

We recommend that you record the checksum when the unit first arrives and periodically thereafter. The checksum should always be the same. A change indicates a change in the firmware.

The checksum is in a six byte format: **.#HHHH**

HHHH is a hexadecimal number in ASCII. This is the format, regardless of the report format being used by the tablet.



Echo

ASCII command: k

Use Echo to ensure that the interface between the tablet and host is operating correctly. The tablet echoes (retransmits) characters back to the host that were sent from the host. The tablet echoes the characters, one by one, as it receives them. If the interface is working properly, the sent character matches the echoed character.

Note that character sequences are passed through, not acted upon by the tablet. Therefore, remote commands issued while Echo is in effect are ignored by the tablet. To abort the Echo function, issue the Reset command or repower the tablet.

Self-Test

ASCII command: t

Self-Test checks the following:

- Analog circuitry
- Stylus/cursor status
- Digital circuitry

The tablet performs self-test evaluations each time it is turned on and each time the Reset or Self-Test command is issued. The test results are stored in the tablet. You can access them with the Send Test Results command.

Send Test Results

ASCII command: w

Send Test Results transmits the most recent Self-Test results to the host. The results are transmitted as one byte:



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

- A** Analog circuitry test; pass = 1, fail = 0
- C** Stylus/cursor connection and coil test; pass = 1, fail = 0
- D** Digital circuitry test; pass = 1, fail = 0
- PR** Stylus/cursor proximity; in-prox = 1, stylus/cursor out-of-prox = 0
- T** Total test result (based on A,C and D); pass = 1, fail = 0

If the test result is a Hex 8FH or 87H, the tablet passed the tests. Another result means that the tablet failed.



Chapter 8: Operating Environment, Care and Service

Section A: Operating Environment

Operate the MM II within these temperature and humidity 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

Extremes in environment can cause degradation of operation. Be careful as extreme temperatures can occur in some rather surprising places – atop a TV set, in direct sunlight or in a car on a hot or cold day.

Section B: Service

You should have no problems with the MM II. However, if a problem arises, try one or more of the following:

- Check the hardware connections.
- Ensure that the computer is working.
- If possible, perform the tests described in Chapter 7.
- If applicable, check that the device driver is installed in your system or application software.
- Turn off the computer and tablet. Then turn them on again.

If the tablet continues to malfunction, contact our Customer Service Department at:

GTCO CalComp by Turning Technologies
14557 N. 82nd Street
Scottsdale, AZ 85260

Toll-Free Number: 1.866.746.3015



When contacting Customer Service, please have ready the unit serial number. The serial number is located on the bottom of the tablet. If it is necessary to return the unit, Customer Service will give you a Return Authorization Number. Write this number on the outside of the package and on all accompanying paperwork.

NOTE: Please do not ship equipment to GTCO CalComp by Turning Technologies without obtaining instructions and a Return Authorization Number from the Customer Service Department.

Section C: Care and Cleaning

The MM II requires minimal care and cleaning. However, the following guidelines are important:

- Disconnect the unit from its power source before cleaning.
- Using a soft, damp (not wet), lint-free cloth, wipe the case clean with a mild detergent solution.
- Never disassemble any part of the MM II, except to change the stylus refill.
- Never immerse in liquid.
- Never bang it around or drop it.
- Never scratch or mar the tablet.
- Cursor: The transparent part of the cursor that encases the cross hair is called the paddle. The top surface of the paddle is covered by a special film. It is important to protect the paddle and film. Do not scratch, mar or separate. To clean the paddle, wipe with a lint-free cloth dampened with water. Do not use spray cleaner or any other type of cleaner or solvent.

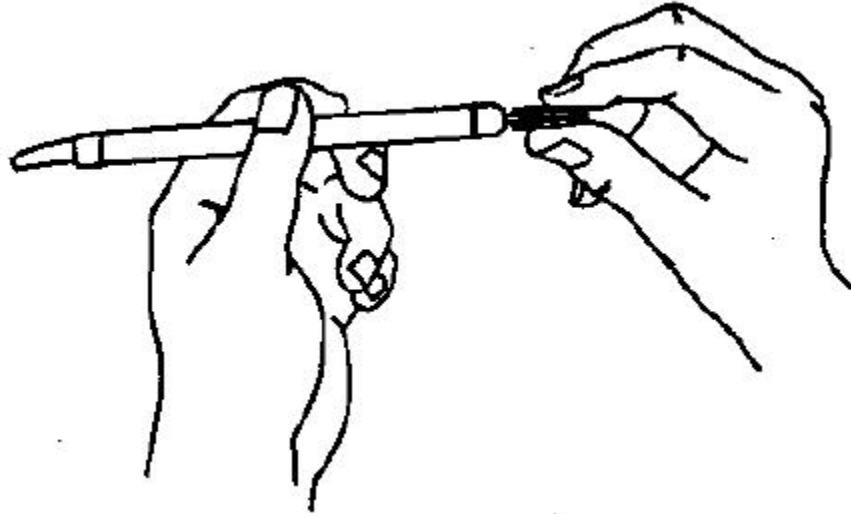
NOTE: Do not plug MM II connectors into foreign objects. Do not plug foreign objects into the MM II. Doing so would produce unpredictable results and could destroy the tablet.



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Section D: Changing the Stylus Refill

To change the stylus refill, unscrew the cap and pull the refill straight out.



Insert the new refill until it is firmly seated.



Appendix A Specifications

Physical Description

Approximate physical dimensions:

Width	16 inches (406 mm)
Length	17 inches (432 mm)
Maximum Height	1.3 inches (33 mm)
Weight	7 lbs. (3.2 kg) maximum

Power Supply Specifications

The MM II power supply is specified as:

- Input: 120 VAC +7%, -13%, 58 to 62 Hz
- Output: 5 VDC at 225 mA, less than 50 mV ripple, +/-5% regulation, rise time less than 100 milliseconds

Operating Specifications

Standard Accuracy: +/-0.025 inches (1.27 mm) or better

Accuracy is how closely a point's actual location is determined.

Active Area: 11.7 inches by 11.7 inches (287 mm by 287 mm) approximately

The area of the tablet that senses the stylus/cursor location and where valid reports are obtained.

Jitter: Stylus or cursor: +/-1 count of resolution

Jitter is the different in values collected by the graphics tablet for the same point (for example, 200, 201 and 202). Jitter can be caused by electrical noise from environmental sources or from the tablet's analog-to-digital conversion circuitry. Noise affects the signal that identifies a point. Jitter is measured as one unit of the resolution.

Proximity: 0.5 inches (12.7 mm) approximately

Proximity is the maximum distance the stylus/cursor can be held above the active area and report a valid position.

Resolution: Up to 1016 lpi (40 lpmm)

Resolution is the "fineness" of detail that the tablet can distinguish. Resolution is expressed in lines per inch (lpi) or lines per millimeter (lpmm).



Appendix B Changing the Set Up Jumpers

This appendix describes how to change the set up jumpers inside the tablet that control certain operational defaults:

- Baud rate: 9600 or Autobaud
- Report format: binary or ASCII BCD
- Parity: odd or none

Caution: Performing the procedure described in this appendix is done at your own risk. We take no responsibility for any damage that could occur.

An alternative to changing the jumpers is to use the Z commands, described in Chapter 4.

In brief, to change the set up jumpers:

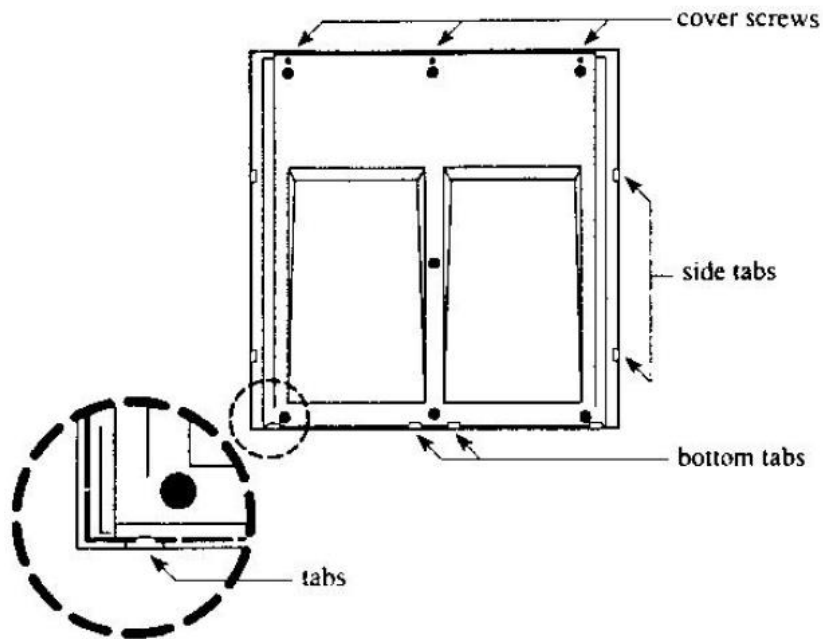
1. Disassemble the tablet.
2. Change the jumper caps.
3. Reassemble the tablet.

Disassembling the Tablet

1. Ensure the tablet is turned off and all cables are removed.
2. Turn the tablet upside-down on a clean, smooth surface that will not mar it. The bottom cover should be facing you.
3. Using a Phillips head screwdriver, remove the three cover screws. (A magnetic screwdriver is helpful because the screws are recessed.) Lay the screws aside.

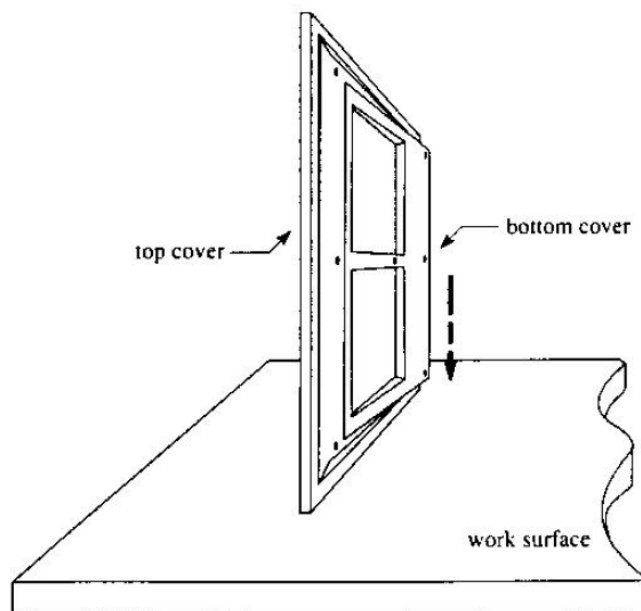


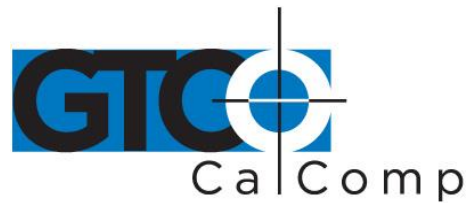
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Notice that the bottom and top covers are held together by tabs on the bottom cover.

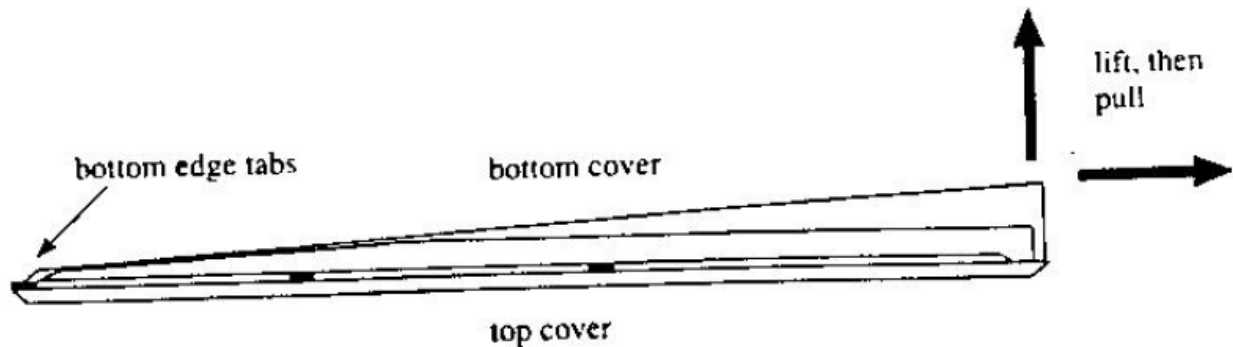
4. Turn the tablet on its side. Tap it gently against the work surface. This shifts the bottom cover enough to loosen the tabs from their slots at the upper edge.





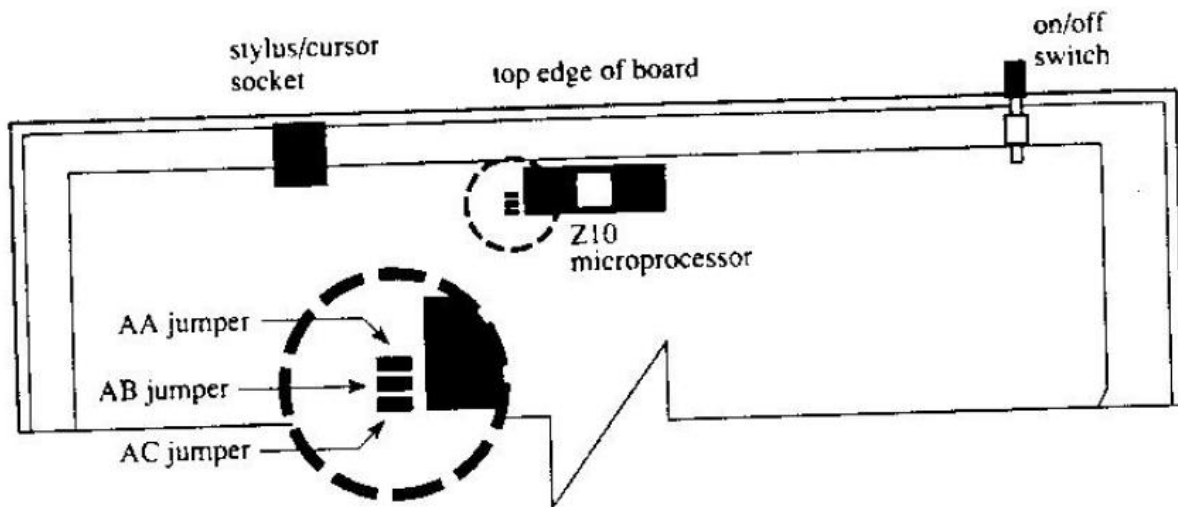
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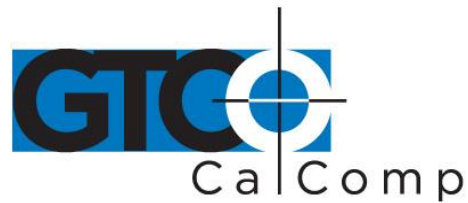
5. Lay the tablet upside down on the work surface. Grasp the side of the tablet that is still held together. Flex the top cover away from the tabs until they snap loose. Do the same at the bottom edge.



When the bottom cover is free, remove and set aside. The printed circuit board is now visible. Do not remove the board from the cover. It protects delicate shielding below.

6. The jumper locations are shown here:





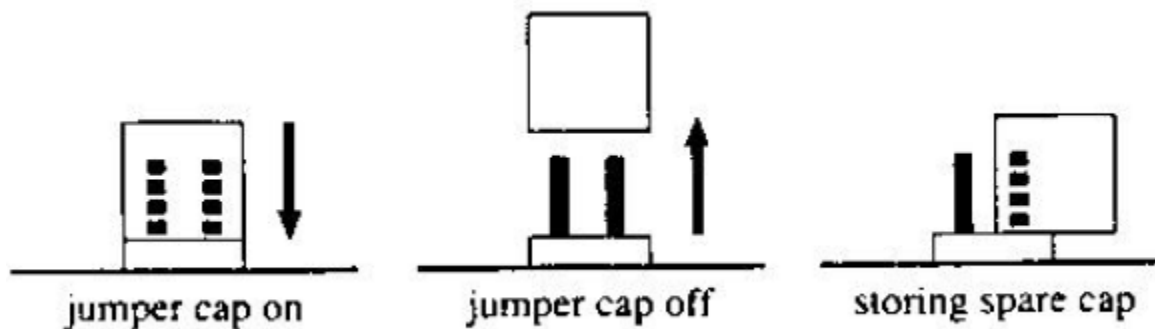
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Changing Jumpers

Change the jumper caps as you wish.

Configuration	Board Label	Jumper
9600 baud	AA	attached
Autobaud	AA	removed
binary report format	AB	attached
ASCII BCD report format	AB	removed
8 data bits, odd parity	AC	attached
8 data bits, no parity	AC	removed

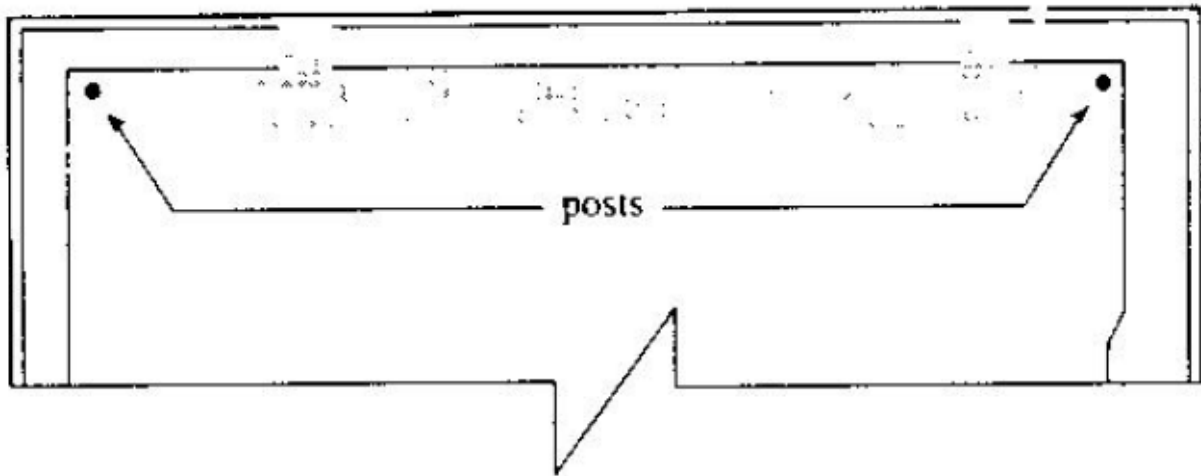
The jumper caps are black plastic sleeves, open at two ends. To remove a cap, pull straight up. To attach a cap, push straight down onto the two jumper pins. Both ends of the cap are the same, so it does not matter which way you attach it.



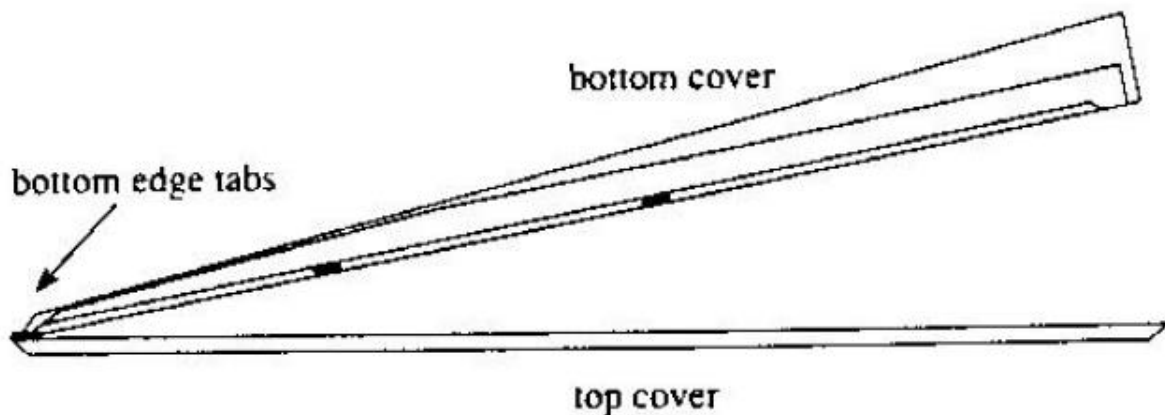


Reassembling the Tablet

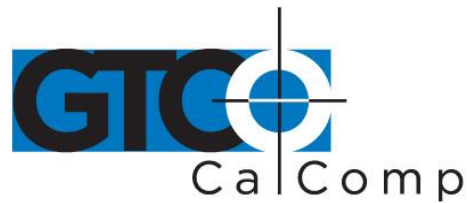
1. Ensure that the printed circuit board has not shifted or lifted out of position. It should be held gently in place by the two posts at the top edge.



2. Hold the bottom cover upside-down over the top cover. Slide the bottom edge of the bottom cover into the top cover so that the tabs fit into the slots.



3. Snap the bottom cover down against the top cover. The bottom and side tabs should be seated in the slots.
4. Replace the three cover screws. Gently tighten, but do not over tighten. Too much pressure can strip the screw threads. Ensure that there is no gap between the top and bottom covers.



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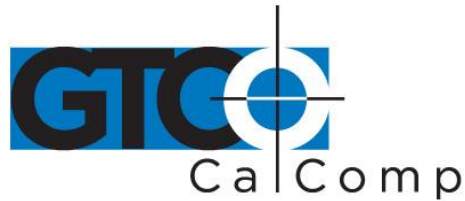
Appendix C ASCII Conversion Chart

Decimal	Binary 7 6 5 4 3 2 1 0	Octal	Hex	ASCII Character	Control Function or Character Description
0	00000000	000	00	NUL	Null
1	00000001	001	01	SOH	Start of Heading
2	00000010	002	02	STX	Start of Text
3	00000011	003	03	ETX	End of Text
4	00000100	004	04	EOT	End of Transmission
5	00000101	005	05	ENQ	Enquiry
6	00000110	006	06	ACK	Acknowledge
7	00000111	007	07	BEL	Bell
8	00001000	010	08	BS	Backspace
9	00001001	011	09	HT	Horizontal Tab
10	00001010	012	0A	LF or NL	Line Feed or New Line
11	00001011	013	0B	VT	Vertical Tab
12	00001100	014	0C	FF	Form Feed
13	00001101	015	0D	CR or RT	Carriage Return
14	00001110	016	0E	SO	Shift Out
15	00001111	017	0F	SI	Shift In
16	00010000	020	10	DLE	Data Link Escape
17	00010001	021	11	DC1	Device Control 1
18	00010010	022	12	DC2	Device Control 2
19	00010011	023	13	DC3	Device Control 3
20	00010100	024	14	DC4	Device Control 4
21	00010101	025	15	NAK	Negative Acknowledge
22	00010110	026	16	SYN	Synchronous Idle
23	00010111	027	17	ETB	End Transmission Block
24	00011000	030	18	CAN	Cancel
25	00011001	031	19	EM	End of Medium
26	00011010	032	1A	SUB	Substitute
27	00011011	033	1B	ESC	Escape
28	00011100	034	1C	FS	File Separator
29	00011101	035	1D	GS	Group Separator
30	00011110	036	1E	RS	Record Separator
31	00011111	037	1F	US	Unit Separator
32	00100000	040	20	SP	Space
33	00100001	041	21	!	Exclamation Point
34	00100010	042	22	"	Double Quote
35	00100011	043	23	#	Number or Pound
36	00100100	044	24	\$	Dollar
37	00100101	045	25	%	Percent
38	00100110	046	26	&	Ampersand
39	00100111	047	27	'	Apostrophe
40	00101000	050	28	(Left Parenthesis
41	00101001	051	29)	Right Parenthesis
42	00101010	052	2A	*	Asterisk
43	00101011	053	2B	+	Plus or Addition



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	Binary 7 6 5 4 3 2 1 0	Octal	Hex	ASCII Character	Control Function or Character Description	Decimal
44	00101100	054	2C	,	Comma	
45	00101101	055	2D	-	Hyphen	
46	00101110	056	2E	.	Period	
47	00101111	057	2F	/	Slash	
48	00110000	060	30	0		
49	00110001	061	31	1		
50	00110010	062	32	2		
51	00110011	063	33	3		
52	00110100	064	34	4		
53	00110101	065	35	5		
54	00110110	066	36	6		
55	00110111	067	37	7		
56	00111000	070	38	8		
57	00111001	071	39	9		
58	00111010	072	3A	:	Colon	
59	00111011	073	3B	;	Semicolon	
60	00111100	074	3C	<	Less Than	
61	00111101	075	3D	=	Equals	
62	00111110	076	3E	>	Greater Than	
63	00111111	077	3F	?	Question Mark	
64	01000000	100	40	@	Commercial At	
65	01000001	101	41	A		
66	01000010	102	42	B		
67	01000011	103	43	C		
68	01000100	104	44	D		
69	01000101	105	45	E		
70	01000110	106	46	F		
71	01000111	107	47	G		
72	01001000	110	48	H		
73	01001001	111	49	I		
74	01001010	112	4A	J		
75	01001011	113	4B	K		
76	01001100	114	4C	L		
77	01001101	115	4D	M		
78	01001110	116	4E	N		
79	01001111	117	4F	O		
80	01010000	120	50	P		
81	01010001	121	51	Q		
82	01010010	122	52	R		
83	01010011	123	53	S		
84	01010100	124	54	T		
85	01010101	125	55	U		
86	01010110	126	56	V		
87	01010111	127	57	W		
88	01011000	130	58	X		
89	01011001	131	59	Y		



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	Binary	Octal	Hex	ASCII	Control Function or	Decimal
	76543210			Character	Character Description	
90	01011010	132	5A	Z		
91	01011011	133	5B	[Left Square Bracket	
92	01011100	134	5C	\	Back Slash	
93	01011101	135	5D]	Right Square Bracket	
94	01011110	136	5E	^	Circumflex	
95	01011111	137	5F	_	Underscore	
96	01100000	140	60	"	Left Single Quote	
97	01100001	141	61	a		
98	01100010	142	62	b		
99	01100011	143	63	c		
100	01100100	144	64	d		
101	01100101	145	65	e		
102	01100110	146	66	f		
103	01100111	147	67	g		
104	01101000	150	68	h		
105	01101001	151	69	i		
106	01101010	152	6A	j		
107	01101011	153	6B	k		
108	01101100	154	6C	l		
109	01101101	155	6D	m		
110	01101110	156	6E	n		
111	01101111	157	6F	o		
112	01110000	160	70	p		
113	01110001	161	71	q		
114	01110010	162	72	r		
115	01110011	163	73	s		
116	01110100	164	74	t		
117	01110101	165	75	u		
118	01110110	166	76	v		
119	01110111	167	77	w		
120	01111000	170	78	x		
121	01111001	171	79	y		
122	01111010	172	7A	z		
123	01111011	173	7B	{	Left Curved Bracket	
124	01111100	174	7C		Vertical Line	
125	01111101	175	7D	}	Right Curved Bracket	
126	01111110	176	7E	~	Tilde	
127	01111111	177	7F	DEL	Delete (rubout)	



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Appendix D Quick Reference of Commands and Defaults

Command Summary

Command	ASCII	Command	ASCII
Autobaud	<SP>	Resolution, Predefined:	
Axis Update Mode: command	G	1 lpi	l (lowercase L)
value	<SP> to z	2 lpi	n
Code Check	x (lowercase X)	4 lpi	p
Coordinate system: absolute	F	100 lpi	d
relative	E	200 lpi	c
Echo	k	10 lpm (254 lpi)	f
Increment Mode: mode command	I	400 lpi	g
increment value	<SP> to z	500 lpi	h
Origin: upper left	b	20 lpm (508 lpi)	i
lower left	c	1000 lpi	j
Report Modes: Point Mode	B	40 lpm (1016 lpi)	q
Remote Request Mode: mode command	D	Resume Transmission (XON)	<DC1>
trigger command	P	Self Test	t
Stream Mode	@	Send Test Results	w
Switch Stream Mode	A	Send Configuration	a
Report Rate: maximum + 32	T	Stop Transmission (XOFF)	<DC3>
maximum + 8	S	Tablet Identifier:	
maximum + 2	R	zero	0 (zero)
maximum	Q	one	1
Reset	<NUL>	Z commands:	
Resolution, Definable: command	r	Autobaud	z<SP><SP>
X axis resol., low byte	Hex 00 to FF	ASCII BCD report format	za
X axis resol., high byte	Hex 00 to 17	binary report format	zb
Y axis resol., low byte	Hex 00 to FF	8 data bits, no parity	z8
Y axis resol., high byte	Hex 00 to 17	8 data bits, odd parity	z9
		increment confirmation	zi
		firmware identification	z?
		transducer identification	zt
		Reserved commands: Do not use the commands	
		<i>zh, zd, or zf.</i>	

**Defaults**

Axis Update	0, Axis Update Mode off
Coordinate System	Absolute
Increment	0, Increment Mode off
Origin	Lower left corner
Report Mode	Switch Stream
Report Rate	Maximum throughput
Resolution	500 lpi
Tablet Identifier	0

Standard Product Configuration

Baud Rate	9600
Report Format	Binary
Parity	Odd



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