CHARACTERISTICS

Introduction

The characteristics are contained in two parts. The first part consists of an alphabetic listing. The alphabetic listing makes reference to the second part, which contains tabulated information.

The following conditions must be met before all characteristics can be considered valid:

The Terminal must have been adjusted at an ambient temperature between +20°C and +30°C.

It must be operating in an environment as specified under Environmental Specification.

Operation must be preceded by a warmup period of at least 20 minutes.

Specified power requirements must be met.

The specifications pertain principally to On Line operation as selected at the keyboard rocker switch, and should not be presumed applicable to Local operation. Refer to the Local operation specification for qualifying information.

The following tables are included immediately after the alphabetic listing of characteristics:

The characteristics included in the alphabetic listing are as follows:

Accessories
Address
Alpha Mode
Arming
Carriage Return
Character Effect on Terminal
Character Matrix
Character Size
Character Transmission in Alpha Mode
Character Transmission in Gin Mode
Character Type
Character Writing
Character Writing Suppression
Characters, Lower Case
Clock
Control Character
Control Character Sequence
Cursor, Alpha
Cursor, Crosshair
Data Transfer Rate
Display Measurement Unit
Display Size
Display Unit Specifications
Echoplex
Echoplex Suppression
Environmental Specifications
Gin Mode
Graph Mode
Graphic Address
Graph Mode Memory
Graph Mode Vector Drawing
Hard Copy Mode
Hold Status
Home Position
Interface Specification
Line, Alpha Mode
Line Feed
Line Length, Graphic
Local Operation
Margin, Horizontal
Minibus
Modes
Options, Equipment
Options, Strappable
Pagefull
Physical Characteristics
Point (Tekpoint)
Power Supply Specifications
Receive Rate
Resetting Gin to Alpha Mode
Resetting Graph to Alpha Mode
Resetting Home Position
Resetting Margin 1 to Margin 0
Space
Status Bits
Strappable Options
Tekpoint
Thumbwheels
Time, Character Writing
Time, Vector Drawing
Transmission, Alpha Mode
Transmission, Gin Mode
Transmission Rate
Vector Drawing Time
Vector Dynamic Geometry Error
Vector Length Error
View Mode

Alphabetic Listing

Accessories. See Table 2-14.

Address. A display position with reference to a grid of 1024 x 1024 points with 0, 0 being at the bottom left. Point density is nominally 54.5 points per cm (139 points per inch) horizontal or vertical with Terminal adjusted as outlined in the adjustment procedure.

Alpha Mode. A Terminal writing mode in which characters are written on the display screen. See Character Effect on Terminal and Table 2-2 for details.

Arming. Certain functions at the Terminal require a control sequence whose first character "arms" the Terminal, permitting the next character to perform a function other that what it would do if the Terminal were not armed. ESC is normally used as the arming command. The execution commands are listed under "Character Effect on Terminal". In addition, accessory devices may use other execution commands as explained in the accessory device instruction manual.

Carriage Return. Return of writing beam to the left or center margin (depending on effective margin position). Occurs on receipt of CR or ESC FF. Also occurs on receipt of LF if strapped on TC-1. Occurs automatically when beam spaces past 1023 address in Alpha Mode. Also caused by initializing or pressing PAGE or RESET key.

Character Effect on Terminal. Terminal recognizes all characters contained in ASCII code. During Alpha Mode all alphanumeric and graphic characters result in character writing and subsequent spacing except as follows: Low Case letters are written as upper case; Grave Accent (opening single quotation mark) is written as Commercial At; and Opening Brace is written as an Opening Bracket. Space causes spacing only. The 4010 does not respond to Vertical Line, Closing Brace, or Overline (Tilde). Rubout (DEL) is accepted and sent as a character, but does not cause a space or print. Control character and control character sequences are decoded and perform specific functions as shown in Table 2-1. Additional use of control characters or control character sequences may be made by accessory devices connected through circuit cards to Terminal minibus. Control characters or control character sequences are recognized during Graph Mode; all other data received in Graph Mode is accepted as a vector address as explained in Graph Mode.

Character Matrix. A five-by-seven dot pattern which creates characters by lighting specific combinations of the dots. Dot position is determined by modifying the X and/or Y position of the deflection beam through the pattern shown in Fig. 2-1. The matrix stops long enough in each position to turn the beam on to store a dot during character writing, or to display a non-storing dot during Alpha Mode cursor writing. The bottom-left dot in the matrix is determined by the X and Y register contents (address). However, the X and Y deviation from this point is independent of the register address. Matrix size is approximately 2.7 mm high x 1.8 mm wide (0.1 x 0.07 inch).

Character Size. Limits determined by character matrix, which is approximately 2.7 mm high x 1.8 mm wide.

Character Transmission in Alpha Mode. All ASCII characters except lower case, grave accent, opening brace, vertical line, and aproximate can be transmitted from the keyboard in response to a key, in response to a SHIFT and key combination, or in response to a CTRL SHIFT and key combination. ALT MODE key transmits the code for closing brace; RUBOUT sends the code for DEL. Bit 8 is sent as strapped at the keyboard (normally high), or as determined by the data communication interface in use. The minibus can accept any eight-bit combination from accessory units and transmit them to the computer.

Character Transmission in Gin Mode. A sequence of characters is transmitted to the computer in response to a control character sequence from the computer. See Gin Mode for details.

Character Type. If the Terminal is equipped with an alternate character set, it can be selected in accordance with the option setting as explained in Table 2-13.

Character Writing. The Terminal has writing capability for 63 ASCII characters as shown in Fig. 2-1. Character writing time is approximately 0.8 ms.

Character Writing Suppression. The character generator is suppressed in Gin and Graph modes. The Alpha cursor as well as alphanumeric characters are prevented from being written. The character generator becomes fully enabled when the Terminal is switched from Graph to Alpha Mode. It also becomes fully enabled when Gin Mode is ended by an ESC FF or CR command from the computer or by a PAGE or RESET command from the keyboard. However, when Gin Mode is ended by transmitting the address of the Alpha cursor or the crosshair intersect address, the character generator will not become fully enabled unless the CR is sent as a part of the address transmission, *AND IS ECHOED BACK* by the computer. If CR is not echoed back, the Terminal will be unable to write in Alpha Mode (even though the Alpha cursor appears) until one of the following is received by the Terminal: BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, VT from the computer, or PAGE, RESET, LOCAL, or MAKE COPY from the keyboard.

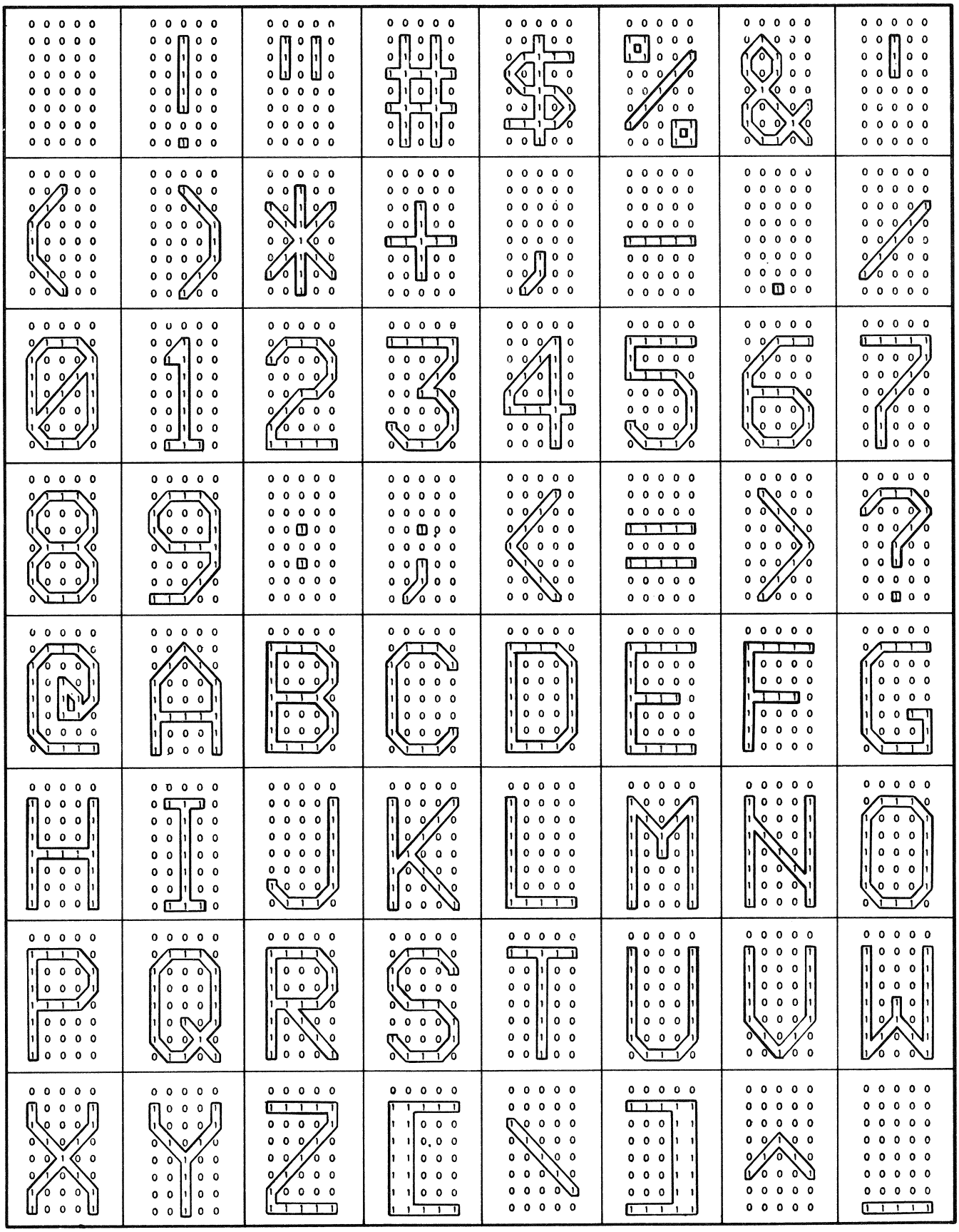


Fig. 2-1. Written Character Set.

Characters, Lower Case. Lower case ASCII characters are accepted and recognized as upper case characters during Alpha Mode. Lower case characters cannot be transmitted unless placed on the minibus by an accessory device, since the keyboard does not have lower case capability.

Clock. The Terminal operates on an internal 4.9 MHz clock. This and a 614 kHz derivation are available on the minibus.

Control Character. See Character Effect on Terminal.

Control Character Sequence. See Character Effect on Terminal.

Cursor, Alpha. Flickering, non-storing five-by-seven dot matrix which indicates position of writing beam. Occurs in Alpha Mode, during View condition. Position of lower-left corner of matrix is sent to computer in response to receipt of an ESC ENQ command sequence.

Cursor, Crosshair. Gin Mode non-storing cursor occurring in response to an ESC SUB command sequence. Cursor is caused by alternate cycling of the X and Y registers through each point, pausing at each point long enough to write the point with an intensity insufficient for storing it. The intersect point can be moved to any point within 0-1023 X and 0-780 Y by using the keyboard X and Y thumbwheels. The address of the intersect point is sent to the computer in response to an ESC ENQ from the computer or in response to entering a keyboard character. See Gin Mode for explanation of transmission.

Data Transfer Rate. Interface dependent; limited to approximately 12,000 words per minute (average of six characters per word).

Display Measurement Unit. Point. Equivalant to one increment of X or Y position register. Approximately 54.5 points per cm (139 per inch). 0.183 mm between center of points. 1024 X points addressable and viewable; 1024 Y points addressable, 780 Y points viewable (Terminal adjusted as outlined in adjustment procedure).

Display Multiplexer Option Strap. A strap (on the Motherboard) which can be removed for controlling the display with a Display Multiplexer card. A cable then connects between J35 and the Display Multiplexer card. This feature is not included in standard Motherboards numbered 670-1734-00.

Display Size. 19.1 cm horizontal by 14.3 cm vertical with its center within 6.35 mm of CRT faceplate center (7.5 x 5.625 inches centered within 0.25 inch).

Display Unit Specifications. Refer to Table 2-9.

Echoplex. Consists of executing data at the Terminal as the data is being sent to the computer. Can be caused by placing an $\overline{\text{ECHO}}$ command on the minibus, usually from the interface unit.

Echoplex Suppression. Over-rides the $\overline{\text{ECHO}}$ signal from the interface unit, inhibiting echoplex operation. Occurs automatically when the Terminal is in Gin Mode, permitting the coded position data to be sent to the computer without affecting the Terminal, despite condition of the $\overline{\text{ECHO}}$ signal. See Table 2-6 for additional details.

Environmental Specifications. See Table 2-12.

Gin Mode. An interactive graphic mode which permits the Terminal to send one of the following to the computer: Terminal status and the position of the bottom-left corner of the Alpha cursor; or the Terminal status and the Graph Mode beam position; or the position of the Gin Mode crosshair intersect point. The crosshair intersect point is controlled by the thumbwheels at the right on the keyboard. Note that moving the horizontal thumbwheel to either limit may remove the vertical line from the display and disable the vertical thumbwheel. Similarly, moving the vertical thumbwheel to the lower limit may remove the horizontal line from the display and disable the horizontal thumbwheel. The Terminal status and Alpha cursor position is sent if ESC ENQ is received while the Alpha cursor is being displayed. Terminal status and Graph Mode beam position is sent if ESC ENQ is received while in Graph Mode. Receipt of ESC SUB causes the crosshair cursor to be displayed. Its intersect point is then sent in response to an ESC ENQ from the computer or in response to the operator entering a keyboard character. A delay of at least 20 ms must occur between ESC SUB and ESC ENQ. See Table 2-6 for Gin Mode details.

Graph Mode. A graphic display mode which occurs upon receipt of GS. It permits the Terminal to accept data as addresses. Movement to the address can either be dark or can result in drawing a vector. See Tables 2-3, 2-4, and 2-5.

Graphic Address. A combination of X and Y register values which indicates a position on the display (X 0-1023, Y 0-780) or off the display (Y 780-1023). Address of bottom-left corner of display is 0X, 0Y; address of top-right corner of display is 1023X, 780Y. See Tables 2-4 and 2-5 for information about sending an address to the Terminal.

Graph Mode Memory. The ability of the Terminal to remember the first three bytes of the last graphic address when switched out of Graph Mode. The Terminal requires receipt of only the low X byte to return to its last Graph Mode address when switched back to Graph Mode.

Graph Mode Vector Drawing. See Table 2-4.

Hard Copy Mode. Permits copying of the Terminal Display by a Hard Copy Unit. Applicable to 4010-1, but not 4010. Mode is caused by $\overline{\text{READ}}$ from a Hard Copy Unit. $\overline{\text{TBUSY}}$ holds the Terminal busy during Hard Copy Mode. See Table 2-8.

Hold Status. A reduced intensity condition for the display unit. It occurs if the Terminal is inactive for approximately 90 seconds. The Terminal returns to View Status as soon as data is received or a keyboard character is entered.

Home Position. Top left corner of display unit in Alpha Mode, commanded by 0X, 767Y. Beam moves to that position upon initialization, and upon receiving ESC FF. It is also arrived at by entering PAGE or RESET at the keyboard.

Interface Specification. See documentation pertaining to specific interface unit.

Line, Alpha Mode. Consists of ⩾72 character spaces; lines are 22 points apart (approximately 4 mm or 0.16 inch) between identical reference points. 35 lines comprise the total display.

Line Feed. Moves writing beam down 22 points. This equals one line in Alpha Mode. Occurs upon receipt of LF or ESC FF. Occurs automatically when spacing past the end of a line.

Line Length, Graphic. Maximum line lengths within the quality display area are 18.75 cm (7.4 inch) horizontal, 14.3 cm (5.625 inch) vertical, 23.6 cm (9.29 inches) diagonal. (Values given are within the display quality area with the Terminal adjusted as outlined in the adjustment procedure.)

Local Operation. Off-line operation used principally for operator training, formatting of data, and equipment maintenance. It is selected by the LOCAL/LINE switch at the keyboard, and isolates the Terminal from the computer. See Table 2-7 for details.

Margin, Horizontal. Margin Ø is located at 0X; Margin 1 is located at 512X. Margins alternate automatically when line-feeding past the 35th line. Carriage return resets the beam to selected margin. ESC FF resets the Terminal to Margin Ø. Terminal also resets to Margin Ø in response to PAGE or RESET keys.

Minibus. Signals available at each of the board-edge connectors on the motherboard (except for Deflection Amp and Storage board connector). See Dictionary of Line Titles and Wire List in the Diagrams section for details.

Modes. Alpha (Alphanumeric), Graph (Graphic Display), Gin (Graphic Input), Hard Copy. See specific mode descriptions for details.

Options, Equipment. Options available for the 4010/4010-1 at the time of this printing include the Optional Data Communication Interface and a variety of TTY Port Interfaces. Also see Accessories.

Options, Strappable. See Table 2-13 for strappable options for the basic 4010/4010-1; see interface unit documentation for strap option information pertaining to interface units.

Pagefull. A condition occurring in Alpha Mode when line-feeding past the 35th line. It causes Margin 1 to occur (center of screen) if Margin Ø had been set, and vice-versa. Margin 1 can cause a terminal busy signal, if selected by option on TC-2.

Physical Characteristics. See Table 2-11.

Point (Tekpoint). The basic unit of measurement for Graph and Gin Modes. 1024X (0-1023) and 1024Y (0-1023) points addressable; 1024X and 780Y viewable. Point spacing is approximately 0.18 mm. (Approximately 54.5 points per cm.) (Terminal adjusted as outlined in the adjustment procedure.)

Power Supply Specifications. See Table 2-10.

Receive Rate. Capable of ⩾12,000 words per minute (average of six characters per word). Interface dependent.

Resetting Gin to Alpha Mode. Gin Mode is cancelled and Alpha Mode reset upon receipt of CR or ESC FF from the computer. Resets to Alpha (without transmitting to computer) in response to entering PAGE or RESET at the keyboard. Terminal also resets to Alpha Mode after completing Gin transmitting function. Refer to Table 2-6 for details.

Resetting Graph to Alpha Mode. Graph Mode is cancelled and Alpha Mode reset in response to US, CR or ESC FF from the computer. It can also be reset by entering PAGE or RESET at the keyboard.

Resetting Home Position. The Terminal display resets to home position (top-left of display) in response to ESC FF from the computer. It also resets to home position in response to an LF past line 35 if Margin 1 exists and the TC-1 option is set so that line feed causes carriage return. Home position also occurs when PAGE or RESET is entered at the keyboard.

Resetting Margin 1 to Margin Ø. Margin 1 (horizontal center of display) resets to Margin Ø (left edge of display) in response to ESC FF from the computer, or in response to an LF (line feed) past the 35th line. Margin Ø also occurs in response to PAGE or RESET entered at the keyboard.

Space. An Alpha Mode measurement made from a reference point in a character to the same reference point in a horizontally adjacent character. A space is equal to 14 Tekpoints, which equates to approximately 2.6 mm (0.1 inch). There are at least 72 spaces per line.

Status Bits. Bits transmitted in Gin Mode to denote the status of the Terminal. They are transmitted as part of a response to an ESC ENQ received while in Alpha or Graph Mode, and consist of the following:

Bit 8 = 1, Bit 7 = Ø, Bit 6 = 1.

Bit 5 = Hard Copy Unit status; 0 is intended to mean that the Hard Copy Unit is in working order, ready to accept a hard copy request. (With 4610 connected, it means that the 4610 Hard Copy Unit is connected and energized.)

Bit 4 = Vector Status indicator. A 1 indicates that the Terminal is set up to draw vectors.

Bit 3 = Graphic Mode indicator. A Ø indicates that a graphic mode exists. 1 indicates Alpha Mode.

Bit 2 = Margin Indicator. 1 indicates that Margin 1 exists. Ø indicates Margin Ø.

Bit 1 = Auxiliary device indicator. Ø indicates that some optional auxiliary unit is activated.

Strappable Options. Optional operating features which can be selected by connectors within the Terminal. See Table 2-13.

Tekpoint. A unit of measurement associated with TEKTRONIX Terminals. It consists of the distance between two adjacent points in the 1024 x 1024 grid provided by the X and Y registers. See Point.

Thumbwheels. Potentiometers located on the keyboard; used to position the crosshair cursor.

Time, Character Writing. Approximately 0.8 ms.

Time, Vector Drawing. Time required to draw a complete vector is approximately 2.6 ms.

Transmission, Alpha Mode. Data is transmitted as entered at the keyboard, or as placed on the minibus by other devices.

Transmission, Gin Mode. Data is transmitted as a series of bytes in response to an ESC ENQ from the computer, or in response to a keyboard character entered while the crosshair cursor is displayed. Refer to Table 2-6 for details.

Transmission Rate. Interface dependent. See documentation pertaining to the specific interface unit. Also see Data Transfer Rate.

Vector Drawing Time. 2.6 ms or less.

Vector Dynamic Geometry Error. Deviation from mean straight line does not exceed 1.5% worst case (45° line).

Vector Length Error. Does not exceed 1% of actual vector length.

View Mode. Normal intensity display. Occurs at all times except during copy making (Hard Copy Mode) and Hold Status.

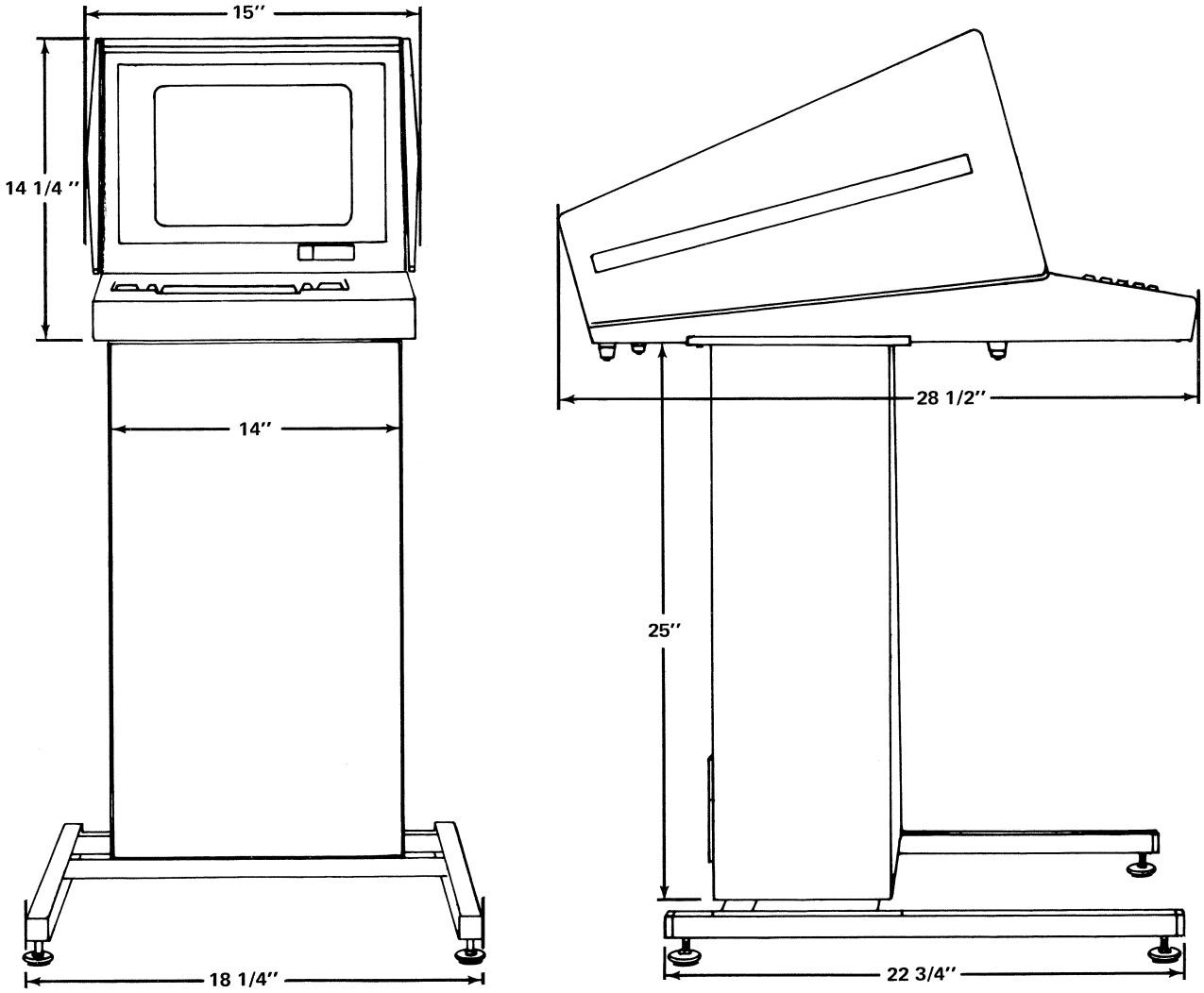


Fig. 2-2. Overall Dimensions.

TABLE 2-1

Control Character Effect on Terminal

ASCII	TTY	Effect
BEL	CONTROL G	A burst of 1200 hertz tone on the speaker. Makes Terminal go busy for approximately 200 ms. Sending a character or vector to the Terminal during the tone burst will terminate that burst.
BS	CONTROL H	Backspaces one space. Backspacing to the left of the margin will cause wraparound.
CR	RETURN or CONTROL M	Causes carriage return by clearing X register. Clears Gin and Graph. (If the crosshair is reset with CR, the resulting status of Y and Margin perform the Page Full function. With interfaces directly connected to the CPU, it is better to clear the cursor by sending ESC ENQ or ESC FF.)
ESC	CONTROL SHIFT K	First character of a special two-character sequence. (See ESC ENQ, ESC FF, ESC ETB, ESC SUB.) ESC raises LCE (B on the Minibus) which remains high until after the trailing edge of the next byte or activation of $\overline{\text{HOME}}$. Does not cause a response on $\overline{\text{TBUSY}}$.
ESC ENQ	CONTROL SHIFT K CONTROL E	Causes Terminal status and/or cursor position to be sent to CPU. Useful for remote diagnostics, in addition to graphic uses. Local copy is not generated. See explanation under Gin Mode. Activates echoplex suppression. If the $\overline{\text{CSTROBE}}$(s) generated does not cause a $\overline{\text{CBUSY}}$ response, TC will remain in Gin Mode. This would occur if ESC ENQ were struck while in LOCAL. Does not cause a response on $\overline{\text{TBUSY}}$.
ESC ETB	CONTROL SHIFT K CONTROL W	$\overline{\text{MAKE COPY}}$ is asserted.
ESC FF	CONTROL SHIFT K CONTROL L	Same as PAGE signal from keyboard. Erases screen. Resets X to 0. Resets Y to 1023. Y then counts down to 767 at 614 kHz. Resets Gin, Echoplex Suppression, Margin, and Graph.
ESC SUB	CONTROL SHIFT K CONTROL Z	Clears Graph. Starts crosshair cursor (which sets Gin). Activates Echoplex Suppression (see below). Does not cause a response on $\overline{\text{TBUSY}}$.
GS	CONTROL SHIFT M	Sets Terminal to Graph Mode; sets for dark vector. Does not cause a response on $\overline{\text{TBUSY}}$.
HT	CONTROL I	Spaces one space to right.
LF	CONTROL J	Y moves down one line (counts down by 22). If Y underflows, margin is complemented and Y counts down to 767. Strap on TC-1 can be set so that it also causes carriage return.
SI	CONTROL O	If strap on TC-1 is set for SI-SO, selects the normal Character Set (ROM A). Does not cause a response on $\overline{\text{TBUSY}}$.
SO	CONTROL N	If strap on TC-1 is set for SI-SO, selects the alternate character set (ROM B), if installed. Does not cause a response on $\overline{\text{TBUSY}}$.
US	CONTROL SHIFT O	Clears Terminal from Graphic Display Mode.
VT	CONTROL K	Y counts up by 22. If Y exceeds 767, Y will then count back down to 767.

TABLE 2-2

Alpha Mode Specification

Character Writing Area	19.1 cm x 14.3 cm (7.5 x 5.625 inches).
Character Writing Position	Indicated by pulsating cursor (5 x 7 dot matrix), 1.8 mm wide x 2.7 mm high (.07 x 0.1 inch).
Character Recognition	Complete ASCII code is recognized.
Character Writing	Lower case is written as upper case, providing 63 different printing characters.
Character Size	Written within limits of 5 x 7 dot matrix, restricting size of largest characters to 1.8 mm wide by 2.7 mm high.
Character Writing Time	Approximately 0.8 ms, providing at least 1200 characters per second.
Characters Per Line	At least 72.
Space	14 Tekpoints (equal to approximately 2.6 mm) between corresponding points in adjacent characters.
Number of Lines	35 lines.
Line Feed Spacing	22 Tekpoints (approximately 4 mm) between corresponding points on adjacent lines.
Carriage Return/Line Feed	Automatically occurs after character is written at end of line (74th character). Strap option can be set to cause carriage return to occur in response to programmed line feed.
Margin	Margin Ø (left edge) and Margin 1 (horizontal center) alternately occur when executing a line feed while at 35th line.
Rubout	Does not print or space.
Home	Top-left corner of display (0X, 767Y).
Pagefull	Occurs when line-feeding past 35th line with Margin Ø set.
Mode set by	Initialization; PAGE or RESET at keyboard; receipt of ESC FF or CR.
Writing Rate	⩾12,000 words per minute (average of 6 characters per word).
Cursor	Non-storing, pulsating 5 x 7 dot matrix.
Hold	Reduced intensity status which occurs in Alpha Mode only; occurs after approximately 90 seconds of inactivity.
View	Normal viewing status.

TABLE 2-3

Graph Mode Specification

Mode Function	Display graphic information.
Mode Commanded By	ASCII GS.
Mode Ended By	ASCII US, CR, ESC FF, ESC SUB, or keyboard entry of PAGE or RESET.
Basic Unit of Measurement	Point (Tekpoint).
Address Capability	1024X by 1024Y points.
Display Capability	1024X by 780Y points.
Display Address Orientation	0, 0 at bottom-left of display; 1023X, 780Y at top-right.
Display Area	19.1 cm by 14.3 cm (7.5 x 6.525 inches).
Vector Length Error	Does not exceed 1% of actual vector length.
Vector Writing Time	2.6 ms.
Vector Dynamic Geometry Error	Deviation from mean straight line does not exceed 1.5% worst case (45° line).
Display Scale Factor	Approximately 0.18 mm (.07 inch) point center to point center (approximately 54.5 points per cm or 139 points per inch).
Dark Vectors	First vector to follow a GS is unwritten. GS can be repeated at any time. Second vector following GS, and all subsequent vectors, are written.
Viewing Time	Indefinite—Hold Status is inhibited. (Terminal should not be kept in Graph Mode when not in use.)
Vector Drawing Commands	See Tables 2-4 and 2-5.
Wraparound	Enabled.
Margin	Disabled.
Graph Mode Memory	First three bytes of last Graph Mode address are remembered when the Terminal is switched out of Graph Mode. Terminal requires only the Low X byte to return to its last graphic address when switched back to Graph Mode.

TABLE 2-4

Graph Mode Vector Drawing

(1) GS Places the Terminal in Graph (Vector) Mode.

(2) The Terminal can be addressed to any position within 0-1023X and 0-1023Y as follows:

(A) Convert Y coordinate to ten binary digits; convert X coordinate to ten binary digits.

(B) Form a Hi Y byte by affixing 01 (as bits 7 and 6) to the 5 MSB of the ten digits of the Y coordinate.

(C) Form a Lo Y byte by affixing 11 (as bits 7 and 6) to the 5 LSB of the ten digits of the Y coordinate.

(D) Form a Hi X byte by affixing 01 (as bits 7 and 6) to the 5 MSB of the ten digits of the X coordinate.

(E) Form a Lo X byte by affixing 10 (as bits 7 and 6) to the 5 LSB of the ten digits of the X coordinate.

(F) Send the four bytes as formed in (B) through (E).

(3) The Lo X byte causes the beam to move to the new position. The first movement after a GS is unwritten (dark vector). Subsequent movement in response to a Lo X byte is written to form a vector. GS can be sent at any time to cause the next vector to be dark. (780Y-1023Y is outside the viewing area of the horizontally oriented display.)

(4) Address transmission can consist of all four bytes or can be shortened to 3, 2, or 1 byte(s). Omitted bytes are assumed to be correct as held in the Terminal. Table 2-5 specifies the minimum byte transmission which is required under all addressing situations.

(5) Hi Y, Lo Y, and Hi X bytes of the last address received are "remembered" by the Terminal if switched to Alpha or Gin Mode. The Terminal requires receipt of only the Low X command to return to its last address after being switched back to Graph Mode.

(6) Hold status is inhibited during Graph Mode.

TABLE 2-4 (cont)

(7) Graph Mode is ended by US, CR or ESC FF, which reset the Terminal to Alpha Mode. Graph Mode can also be ended by ESC SUB, which switches the Terminal to Gin Mode. PAGE and RESET from the keyboard also end Graph Mode, resetting Alpha Mode.

(8) TBUSY does not occur in response to Hi Y, Lo Y, Hi X.

TABLE 2-5

Bytes Required for Graphic Addressing

Bytes Which Change				Byte Transmission Required			
Hi Y	Lo Y	Hi X	Lo X	Hi Y	Lo Y	Hi X	Lo X
			#				#
		#			#	#	#
	#				#		#
#				#			#
		#	#		#	#	#
	#		#		#		#
#			#	#			#
	#	#			#	#	#
#		#		#	#	#	#
#	#			#	#		#
	#	#	#		#	#	#
#		#	#	#	#	#	#
#	#		#	#	#		#
#	#	#		#	#	#	#
#	#	#	#	#	#	#	#
Sending initial address				#	#	#	#
Returning to remembered address							#

TABLE 2-6

Gin Mode Specifications

<table>
<tr><td>Functions

Transmit Terminal Status and Alpha Cursor Position</td><td>With Alpha cursor displayed, the Terminal status, address of bottom-left corner of Alpha cursor, CR[1] and EOT[1] are transmitted to the computer in response to ESC ENQ from the computer. The Terminal automatically resets to full Alpha Mode upon completion of sending the following bytes if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression. Note that if CR is echoed, it resets the cursor to the left margin.
<table>
<tr><th>Byte</th><th>Item</th><th>Bit 7</th><th>Bit 6</th><th>Bits 5—1</th></tr>
<tr><td>1</td><td>Terminal Status</td><td>0</td><td>1</td><td>Status Bits</td></tr>
<tr><td>2</td><td>High bits of X address</td><td>0</td><td>1</td><td>5 MSB X</td></tr>
<tr><td>3</td><td>Low bits of X address</td><td>0</td><td>1</td><td>5 LSB X</td></tr>
<tr><td>4</td><td>High bits of Y address</td><td>0</td><td>1</td><td>5 MSB Y</td></tr>
<tr><td>5</td><td>Low bits of Y address</td><td>0</td><td>1</td><td>5 LSB Y</td></tr>
<tr><td>6</td><td>CR[1]</td><td>0</td><td>0</td><td>01101</td></tr>
<tr><td>7</td><td>EOT[1]</td><td>0</td><td>0</td><td>00100</td></tr>
</table></td></tr>
<tr><td>Transmit Terminal Status and Graph Mode Beam Position</td><td>If ESC ENQ is received while in Graph Mode, bytes 1 through 7 will be sent as explained above. Echoing of the bytes by the computer is not recommended because echoing of bytes 1 through 5 will affect the content of the Y memory latch, and echoing of CR will reset the Terminal to Alpha Mode.</td></tr>
<tr><td>Display Crosshair Cursor</td><td>ESC SUB from the computer turns the crosshair cursor on. (ESC SUB should not be entered at the keyboard.) This is a preparatory state for transmitting the address of the crosshair intersect point. The Terminal can be reset to Alpha Mode by ESC FF without causing it to transmit the crosshair intersect address. The Terminal can also be reset to Alpha Mode by a PAGE or RESET command entered at the keyboard, without transmitting the crosshair intersect address.</td></tr>
<tr><td>Transmit Crosshair Intersect Address

In Response to ESC ENQ</td><td>With crosshair cursor displayed, ESC ENQ from the computer causes transmission of bytes 2 through 7 as previously listed. The Terminal automatically returns to Alpha Mode upon completion of transmission if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression. A 20 ms delay must exist between ESC SUB and ESC ENQ.</td></tr>
<tr><td>In Response to Keyboard Character Entry</td><td>With crosshair cursor displayed, a keyboard character entry causes the Terminal to transmit the keyboard character, and then to transmit bytes 2 through 7 as previously listed. The Terminal automatically returns to Alpha Mode upon completion of transmission if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression.</td></tr>
</table>

[1] CR and EOT are optional, being dependent on straps on TC-2. EOT, or CR and EOT may be omitted. EOT cannot be sent without sending CR.

TABLE 2-6 (cont)

Address	
Basic Unit of Measurement	Point (Tekpoint).
Alpha Cursor	
Limits	0 to 1023X, 0 to 767Y, inclusive.
Transmission Accuracy	Actual address of lower left corner is transmitted. However, if Margin 1 exists (as indicated by Bit 2 of the status byte) and the X transmission is less than 512, the address is with respect to Margin 1 (center screen). The address must then be increased by 512 to determine its value with respect to Margin 0 (left edge of screen). Effectively, if the Margin bit is true, the most significant X bit (512 bit) must be considered to be true, regardless of how it was transmitted by the Terminal.
Crosshair Cursor	
Limits	4X to 1023X, 0Y to 780Y inclusive, except in Terminals containing TC-2 circuit cards numbered 670-1729-00, where it is 15X to 1023X, 0Y to 767Y, inclusive.
Controlled by	Horizontal and vertical thumbwheels at right on keyboard panel.
Transmission Accuracy	Within ±1 point of actual position of crosshair cursor intersect point.
Status Bits	Bit 8 = 1, Bit 7 = Ø, Bit 6 = 1.
	Bit 5 = Hard Copy Unit status; Ø is intended to mean that it is in working order, ready to accept a hard copy request. (With 4610, it indicates the Hard Copy Unit is connected and energized.)
	Bit 4 = Vector Mode indicator. 1 indicates that the Terminal is set to draw vectors.
	Bit 3 = Graph Mode indicator. Ø indicates that a graphic mode exists; 1 indicates Alpha Mode.
	Bit 2 = Margin indicator. 1 indicates that Margin 1 exists; Ø indicates Margin Ø.
	Bit 1 = Auxiliary device indicator. Ø indicates that some optional auxiliary device is activated.
Echoplex Suppression	Over-rides local echoing and disables character generator during Gin Mode. The receiving circuits automatically become enabled upon completion of transmission if CR is echoed by the computer. If CR is not echoed, the Terminal must be reset by BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, or VT from the computer, or by entering PAGE, RESET, LOCAL, or MAKE COPY at the keyboard. Resetting is not required in Graph Mode.
Byte Format	8 bits. In Terminals equipped with a Data Communication Interface 021-0065-00, bit 8 is determined by a strap on the keyboard which is factory-wired to 1 but may be changed to zero. In other interface units, bit 8 may be controlled by the keyboard strap or by the interface unit.

TABLE 2-7

Local Operation Specification

General	The Terminal is isolated from the computer.
Alpha Mode	Terminal accepts keyboard data as though it were coming from a computer, writing alphanumeric characters and executing control characters.
Gin Mode	Crosshair cursor can be obtained by entering a sequence consisting of CTRL SHIFT K and CTRL Z. The cursor is under full control of the thumbwheels. It will not disappear in response to character entry as it does when on-line. The Terminal can be reset to Alpha Mode by entering PAGE or RESET at the keyboard.
Graph Mode	Can be obtained by entering CTRL SHIFT M at the keyboard. Terminal will then write vectors in response to keyboard entries of graphic addresses as explained in Tables 2-3, 2-4, and 2-5. Obviously, the addresses must be converted to alphanumerics before knowing which keys send which address bytes. Low order Y bytes are limited to RUBOUT (DEL) and ALT (closing brace) since the keyboard does not have lower case capability. Dark vectors will follow any CTRL SHIFT M entries. The Terminal retains the ability to execute control characters.

TABLE 2-8

Hard Copy Mode Specification (4010-1 Only)

Function	Display is scanned by signals from the Hard Copy Unit, providing readout information to the Hard Copy Unit.
Initiated By	$\overline{\text{READ}}$ signal from Hard Copy Unit. ($\overline{\text{READ}}$ occurs in response to a Make Copy command from the keyboard, a Copy command from the Hard Copy Unit, or an ESC ETB sequence from the computer.)
Gin Cursor	Inhibited.
Alpha Cursor	Inhibited.
Hold Mode	Inhibited.
Display Unit	Under control of Hard Copy Unit.
Terminal Busy	Asserted.
Gin Mode Graphic Input	If commanded during Hard Copy Mode, the Gin transmission is delayed until copying is completed.

TABLE 2-9

Display Unit Specifications

Characteristics	Performance Requirements	Supplemental Information
Display Quality Area	7.5 inches horizontal by 5.625 inches, whose center is within 0.25 inch of the CRT faceplate center.	
Deflection Factors		
Center of Screen		Zero volts.
Edge of Screen		+5.0 volts left or down, −5.0 volts right or up.
Usable Storage Time		Up to one hour without permanent damage to the storage target. If a residual image is retained after a long viewing period, the target may be returned to normal condition by repeated erasures.
Line Straightness	Within 0.5% deviation from mean straight line (inside the specified display area).	
Geometry		
Orthogonality		$\leqslant 1^{\circ}$.
Parallelism	Within ±2%.	Condition for Test: Draw a rectangle on edge of specified area. Vertical line lengths should be within 2%, and horizontal line lengths should be within 2%.

TABLE 2-10

Power Supply Specifications

Characteristics	Performance Requirements		Supplemental Information
Line Voltage Ranges	110 V AC	220 V AC	
Low	100 V ±10%	200 V ±10%	
Medium	115 V ±10%	220 V ±10% 230 V ±10%	
High	120 V ±10%	240 V ±10%	
Power Consumption			192 watts maximum.
Line Frequency Range	48 to 440 Hz		
Fuses	2 A slo-blo for 110 V operation. 1.25 A slo-blo for 220 V operation.		

TABLE 2-11

Physical Characteristics

Finish	Metal and plastic painted cabinet.
Weight	Approximately 78 lbs. (shipping weight 87 lbs.).
Dimensions, Overall	See Fig. 2-2.
Height	About 41.5 inches.
Width	About 18.25 inches.
Length	About 28.5 inches.

TABLE 2-12

Environmental Specifications

Temperature	
Non-operating	–40°C to +65°C.
Operating	+10°C to +40°C.
Altitude	
Non-operating	To 50,000 feet.
Operating	To 15,000 feet.
Vibration (Non-operating)	Complete 4010: Not specified. Display Only: 10-50-10 c/s @ .015" total displacement. Pedestal Only: 10-55-10 c/s @ .015" total displacement.
Shock (Non-operating)	To 20 Gs, 1/2 sine, 11 ms duration.
Transportation	Meets National Safe Transit Committee type of test when packaged as shipped by factory.

TABLE 2-13

Strappable Options of Basic 4010/4010-1

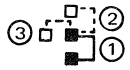
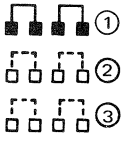
Feature	Location (see Fig. 2-3)	Choice	Effect
Character type (if alternate character memory is installed.	TC-1, 2nd row		1. Normal characters. 2. Alternate or normal character selection controlled by switch 2 on keyboard panel. 3. Alternate or normal character selection controlled by SO and SI control characters.
Line Feed Causes Carriage Return	TC-1, top row		1. Out. 2. In (LF causes carriage return).
Graphic Input Terminators	TC-2, top row		1. CR and EOT are automatically sent after address transmission in Gin Mode. 2. CR automatically follows address transmission in Gin Mode. 3. No CR or EOT sent after Gin address transmission.
PF BREAK	TC-2, 4th row		1. Out. 2. In (Page full makes 4010 busy).
Display Multiplexer Bypass Straps	Top-left on Motherboard	1. J35 connected to J36. 2. J35 connected to the Display Multiplexer card.	1. Normal. Display Multiplexer option card cannot control Terminal Screen. 2. Optional position. Terminal screen under control of installed Display Multiplexer card.

TABLE 2-14

Accessories for the 4010/4010-1

Item	Part No.
STANDARD ACCESSORIES	
Data Communication Interface	021-0065-00
Instruction Book	062-1445-00
4010/4010-1 User's Manual	070-1225-00
OPTIONAL ACCESSORIES	
4010/4010-1 Maintenance Manual	070-1183-01
Logic Extender Card	067-0653-00
Audio Recorder Card	018-0066-01
Motherboard Extender	018-0069-00
Display Multiplexer	018-0067-00
Copy Holder	016-0291-00
72-Pin Extender Card	067-0664-00
4010 Auxiliary Card	018-0065-00
Optional Data Communication Interface	021-0074-00
TTY Port Interface (Part number varies with type of installation)	021-XXX-XX

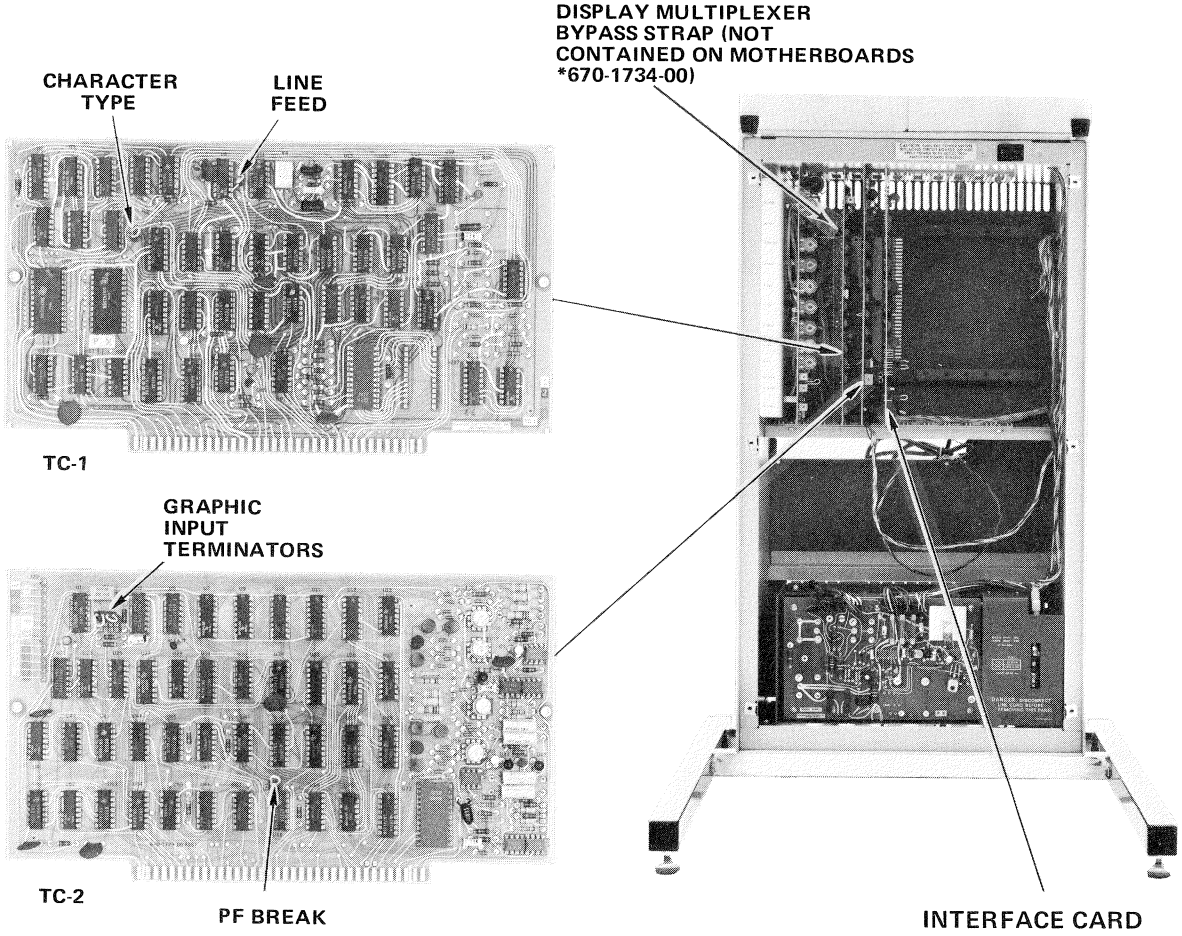


Fig. 2-3. Location of Strappable options. Additional Strappable Option information is given in Table 2-13. Locations of TC-1, TC-2, and the Interface are interchangeable.