Part No. 414a-UM-00

# USERS MANUAL
## CIT-414a
## VIDEO TERMINAL

CIE TERMINALS
A C.ITOH ELECTRONICS COMPANY

P.N.414A-UM-00

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TEK
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## INTRODUCTION

The CIT-414a is a state-of-the-art multifunction video alphanumeric character attribute and graphics display terminal with a detachable keyboard. The CIT-414a allows the user to communicate with a host computer via the keyboard and display screen. The CIT-414a can be interfaced with a variety of computer systems and peripheral devices.

The terminal operates in one of two modes; ANSI, or Graphic. In ANSI mode the CIT-414a is compatible with American National Institute (ANSI) programming standards. From ANSI mode the CIT-414a can be placed in the VT-52 mode and is compatible with DEC VT-52 control sequences. In graphics mode the CIT-414a emulates most of the features of the Tektronix graphics primitives 4010/4014/4016 terminals. In addition the CIT-414a has a versatile, powerful native graphics mode that can be used independently or in conjunction with the Tektronix mode of operation.

Standard features include a full and half duplex communication channel with an RS-232-C/20mA current loop communication interface, and a full duplex auxiliary port.

Other useful features supplied as standard with the CIT-414a terminal are:

* Cursor can be static or blinking.
* Video can be normal or reverse.
* Separate keypad for numeric input.
* Power-on self-test diagnostics to assure successful start-up operation and to assist in troubleshooting.

## DOCUMENTATION

In addition to this manual a maintenance manual for the terminal can be ordered from the CIE Terminals documentation center. The part number for the maintenance manual is 414-MM-00.

## HOW TO USE THIS MANUAL

This manual is divided into five parts:

### PART I-INSTALLATION

This part provides the information needed to locate and install the terminal in a working environment. It also includes the information necessary to interface the terminal with a host computer and/or auxiliary devices including a printer.

**PART II-OPERATION**

This part provides operator information on the operation of the terminal. This includes the operation of the keyboard and functions controlled from the keyboard.

**PART III-SETUP MODE**

This part contains a description of the setup mode features and provides information on how to select and retain terminal parameters set in the setup mode.

**PART IV-PROGRAMMING**

This part provides programmer information on the escape sequences and control codes generated and recognized by the CIT-414a terminal in both the ANSI and graphics modes of terminal operation.

**PART V-SPECIFICATIONS**

This part provides the specifications of the CIT-414a terminal.

## PART I-INSTALLATION

This part describes the installation procedures for the CIT-414a. A brief description of the terminal configuration and factory default condition is provided.

Also provided in this section is information on how to connect the terminal to a host computer and or an auxiliary device including a printer.

## INSTALLATION

### Locating The Terminal

Locate the CIT-414a in a working environment which conforms to the environmental operating specifications outlined in Part V. The operational reliability of the CIT-414a requires the operator to adhere to the following guidelines:

1. Locate the CIT-414a so that there is free air flow through top and bottom air vents.

2. Do not cover the CIT-414a air vents.

3. Do not locate the CIT-414a where it is exposed to sunlight or intense heat.

### Electrical Hookup

To connect keyboard plug keyboard cable connector into jack located at lower right corner of the terminal.

The terminal has been set to the AC power source as specified. however to ensure proper operation the AC power setting should be checked. If the setting requires changing proceed as follows. If the setting is correct, go to step 4.

**CAUTION**

*DO NOT ATTEMPT TO OPERATE THE CIT-414a WITH AN INCORRECT AC VOLTAGE OR DAMAGE TO THE CIT-414A CAN OCCUR*

1. Remove the two phillips screws on protective cover of AC line switch.

2. Remove cover and set slide switch to value of AC line voltage.

3. Install protective cover and two screws removed in step 1.

4. Connect AC cord to AC receptacle at rear of video terminal. Plug AC cord into desired AC outlet.

## TERMINAL CHECKOUT

Place the power ON/OFF switch located on the rear of the terminal shown in figure 1-1, to the on position. The terminal should respond with a beep tone, a pause of about 3 seconds, and a second beep of equal length. If the second beep is of the same duration as the first and no message appears on the screen, your unit has successfully completed self-test and is ready for connection to a host computer and terminal SET-UP procedures. Refer to Part III SET-UP modes, for more information about configuring the terminal for a specific application.

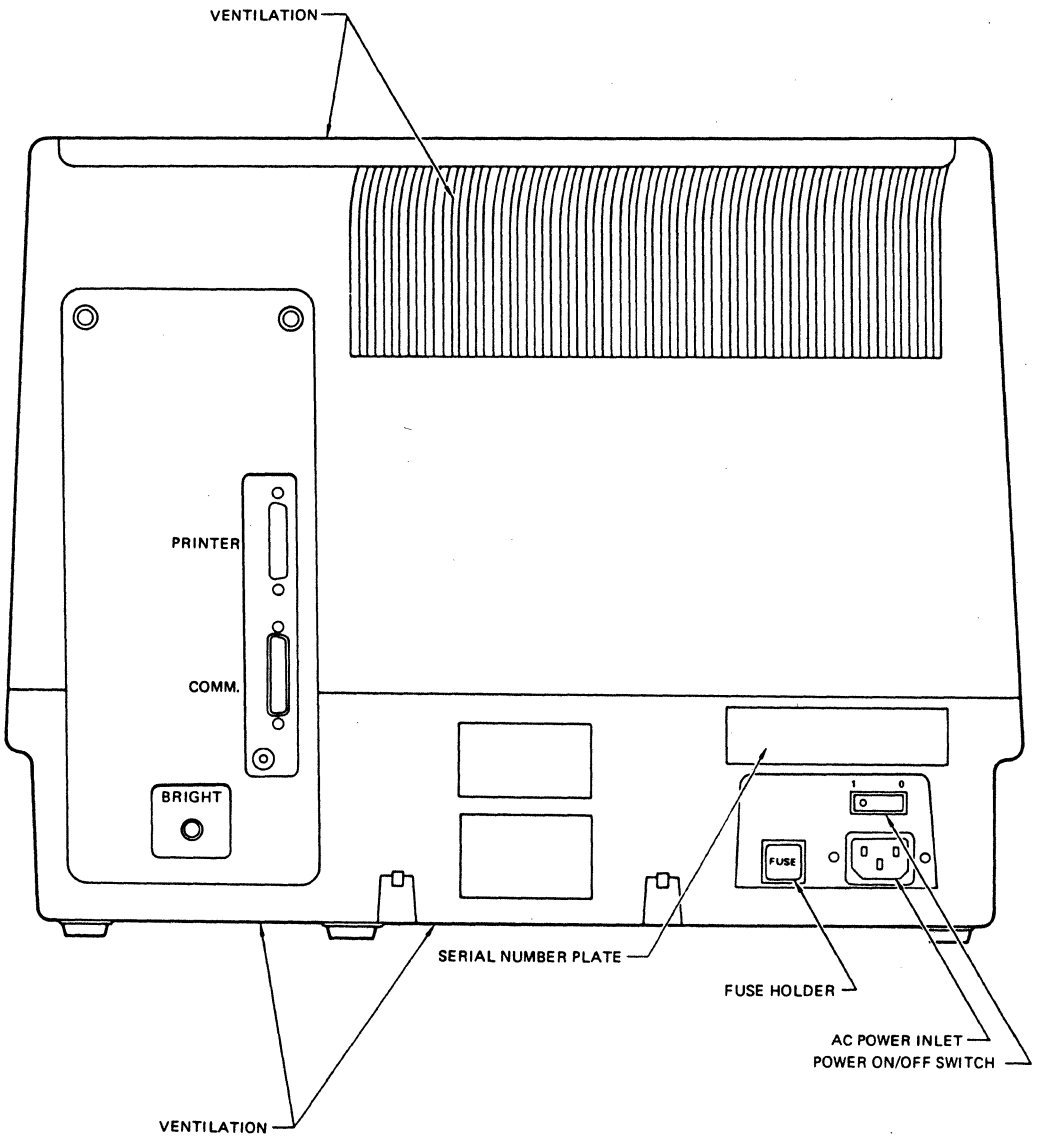



FIGURE 1-1. CIT-414a CONNECTORS AND CONTROLS

If the beep tone is not heard or the second beep tone is longer than the first (about twice as long), the CIT-414a diagnostics have detected a fault condition. After the CRT has warmed up, a message will appear in the upper left corner of the display giving more information about the problem. See Part III of this manual that covers self-test for more information about any possible problems. If a fault condition cannot be cleared contact your local service representative for corrective action.

**Terminal Operating Configuration**

The operating configuration of the terminal can be set by the operator through the keyboard or by the host with control sequences by altering individual parameter control bits in SET-UP mode. The SET-UP parameters may be permanently stored in NVR memory (parameters are not lost during a power failure). Standard default conditions are programmed into the NVR memory at the factory. The default conditions are used at initial power on and can also be recalled by the operator.

Section III provides a complete description of the SET-UP modes, the respective displays, factory default values, as well their operation and the procedures for either permanently saving operator selected SET-UP parameters or restoring factory default conditions.

**INTERFACING**

In the standard system configuration the CIT-414a is interfaced with the host via the bidirectional communication port according to EIA RS-232-C. The terminal also provides a bidirectional auxiliary port. This port is RS-232-C compatible and is designed to support a variety of peripheral devices. Refer to figure 1-1 for the location of the communication and auxiliary port connectors.

The male D connector labeled COMM, is used for host communication. The female D connector, labeled PRINTER, is used for peripheral device communication. Table 1-1 provides the RS-232-C pin assignments for the COMM connector. Table 1-2 provides the pin assignments for the auxiliary port. The D connector pin locations are shown in figures 1-2 and 1-3.

Communication parameters, (e.g. baud rates, parity, etc.),are selected in the SET-UP mode. Refer to Part III.

TABLE 1-1. COMMUNICATION PORT D CONNECTOR PIN ASSIGNMENTS

| PIN | MNEMONIC | FUNCTION | NOTES |
|---|---|---|---|
| 1 | PGND | Protective ground | Chassis ground |
| 2 | TXD | EIA Transmit Data | Serial data from the terminal |
| 3 | RXD | EIA Receive Data | Serial data into the terminal |
| 4 | RTS | Request to Send | Always asserted if disabled in SET-UP C mode. Asserted if terminal has data to transmit |
| 5 | CTS | Clear to Send | Ignored if disabled in SET-UP C mode. Must be asserted externally for data transmission to proceed. |
| 6 | DSR | Data Set Ready | Always ignored |
| 7 | GND | Signal Ground | Reference and Chassis ground |
| 8 | CD | Carrier Detect | Always ignored |
| 9 | | NC | Not used |
| 10 | | NC | Not used |
| 11 | SPDS | Speed Select | Always asserted |
| 12 | SI | Speed Indicator | Always Ignored |
| 13 | | NC | Not used |
| 14 | | NC | Not used |
| 15 | | NC | Not used |
| 16 | | NC | Not used |
| 17 | | NC | Not used |
| 18 | | NC | Not used |
| 19 | SPDS | Speed Select | Always asserted |
| 20 | DTR | Data Terminal Ready | Asserted except for 3.5 seconds after a SHIFT BREAK is entered at keyboard. |
| 21 | | NC | Not used |
| 22 | | Ring Indicator | Always ignored |
| 23 | SPDS | Speed Select | Always asserted |
| 24 | | NC | Not used |
| 25 | | NC | Not used |

TABLE 1-2. AUXILIARY PORT D CONNECTOR PIN ASSIGNMENTS

| PIN | MNEMONIC | FUNCTION | NOTES |
|---|---|---|---|
| 1 | PGND | Protective ground | Chassis ground |
| 2 | RXD | Receive Data | Serial data into the terminal |
| 3 | TXD | Transmit Data | Serial data from the terminal |
| 4 | | NC | Not used |
| 5 | | NC | Not used |
| 6 | | NC | Not used |
| 7 | GND | Signal Ground | Reference and Chassis ground |
| 8 | | NC | Not used |
| 9 | | NC | Not used |
| 10 | | NC | Not used |
| 11 | | NC | Not used |
| 12 | | NC | Not used |
| 13 | | NC | Not used |
| 14 | | NC | Not used |
| 15 | | NC | Not used |
| 16 | | NC | Not used |
| 17 | | NC | Not used |
| 18 | | NC | Not used |
| 19 | | NC | Not used |
| 20 | CTS | Clear to Send | Terminal will not send unless this signal is asserted |
| 21 | | NC | Not used |
| 22 | | NC | Not used |
| 23 | | NC | Not used |
| 24 | | NC | Not used |
| 25 | | NC | Not used |

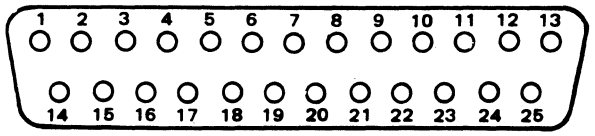



FIGURE 2-3. MALE D CONNECTOR PIN LOCATIONS

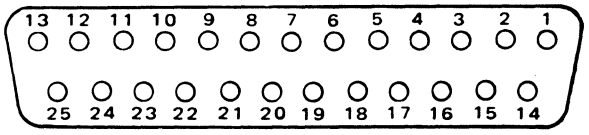



FIGURE 2-4. FEMALE D CONNECTOR PIN LOCATIONS

## PROTOCOL

The communications protocol may be enabled or disabled through SET-UP parameters which can be stored in the terminal NVR memory. The terminal is able to control bidirectional data flow through XON/XOFF protocol.

With auto XON/XOFF enabled, the terminal automatically monitors the condition of the receive data buffer. In the event the terminal is receiving data at a rate faster than it is able to process, (e.g. assume a concurrent print mode utilized with a slow printer), data soon begins to back up in the buffer. When the buffer is almost full, the terminal automatically transmits an XOFF code, to request that the host suspend transmission of data. While the host data is halted, the terminal continues to remove data from the buffer. When buffer capacity has been sufficiently reduced, the terminal automatically issues an XON command to the host, requesting that data transmission be resumed. In this manner the terminal is able to monitor and control the data input to ensure no loss of data.

The transmit protocol is the reverse of the description above and governs the terminals ability to transmit data. The terminal recognizes an incoming XOFF command and halts data transmission until receipt of a subsequent XON command. In the conversational mode, the terminal accepts data from the keyboard after an XOFF is received until the transmit buffer becomes full. At this time the terminal sounds the alarm for each subsequent keystroke to indicate that the data is being discarded.

The bidirectional auxiliary port is a powerful extension of the printer output port found on some terminals and may be used as a simple output port to drive a local printer. In this mode the terminal can accept VT100 and VT52 printer commands. Additional support for this mode is provided by a single wire READY/BUSY handshake protocol which may be used instead of (or in addition to) the XON/XOFF protocol. For more sophisticated applications, the port may be used for both input and output and may be interchanged with the main port in many applications. Data may be directed from the keyboard to either the communications port or the auxiliary port, from the communications port to either the display or the auxiliary port or both, and from the auxiliary port to either the display or communication port or both. To provide even greater flexibility, these paths may all be selected and controlled by either the keyboard or the host system.

The receive data protocol for the auxiliary port controls the rate of data flow with either XON/XOFF or READY/BUSY handshake protocol. The XON/XOFF commands function exactly as described for the communications port. However, the READY/BUSY (CTS) signal (pin 20 of the auxiliary port connector) is internally pulled high, asserting this signal to the terminal unless it is pulled low by an external connection.

The transmit protocol for the auxiliary port is XON/XOFF and functions exactly as for the communications port.

## CARE AND MAINTENANCE

With the exception of occasional dusting or cleaning, the CIT-414a should require very little care or maintenance.

The terminal should be cleaned with a dry, lint-free cloth, when required. If the CRT screen or the plastic case need cleaning, remove the AC power cord first to prevent any accidents. Clean the terminal with a cloth dampened with a mild detergent solution. Avoid the use of strong solvent cleaners or detergents which may damage the plastic surfaces.

## PART II-OPERATION

This part contains operator information on the keyboard and operating modes of the CIT-414a terminal.

## KEYBOARD DESCRIPTION

Functionally there are four types of keys and indicators on the keyboard, refer to figure 2-1. The basic types include:

1. Standard typewriter alphanumeric keys including symbols and keyboard function keys.

2. Terminal control and function keys.

3. A calculator type numeric keypad with special function control keys.

4. Seven LED indicators consisting of three status indicators and four special function indicators.

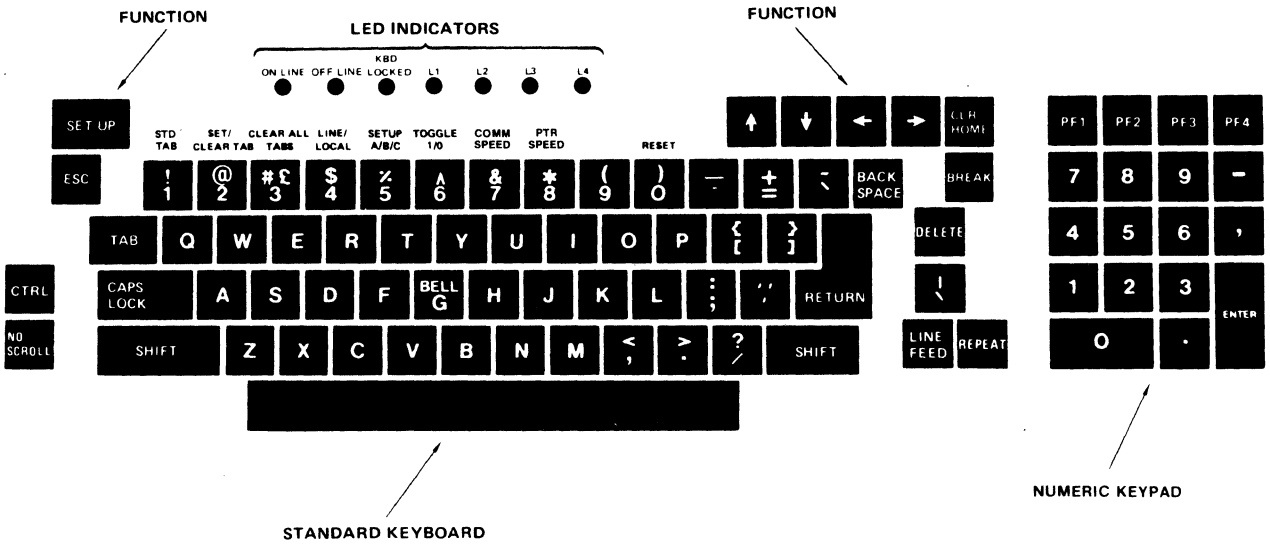



Figure 2-1. CIT-414a Keyboard

## Standard Keys

The standard keys of the keyboard in conjunction with the SHIFT and/or CAPS LOCK keys provide all the upper and lowercase letters, numerals, and symbols found in a standard ANSI typewriter layout, refer to figure 2-2. The function keys; BACK-SPACE, TAB, RETURN, and space bar correspond to similar key functions on a standard typewriter. The lower case letters, numerals, and symbols marked on the lower half of the key caps are produced directly by pressing the key. The uppercase letters and symbols marked on the upper half of the keys are produced by depressing the SHIFT key and the desired key simultaneously. The CAPS LOCK provides the same function as the SHIFT key, however the CAPS LOCK key will lock in the down position when pressed one time, and must be pressed a second time to release. The CAPS LOCK key functions only with alphabetic uppercase characters.

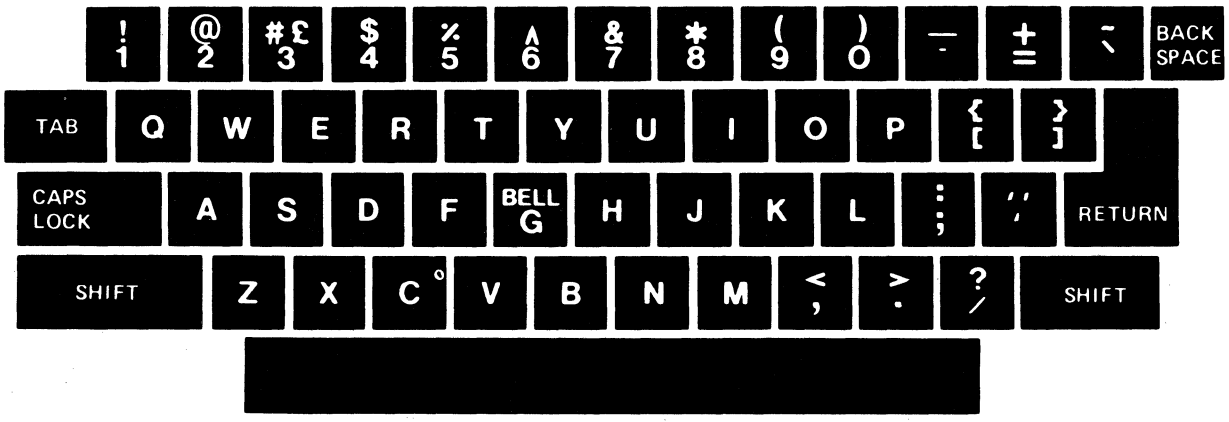



Figure 2-2. CIT-414a Standard Keyboard Keys

## Terminal Control And Function Keys

The keys shown in figure 2-3 are used to set up and control terminal functions. Function keys are used in conjunction with the SHIFT and CTRL keys in order to perform a terminal function. Control keys are used individually. All control and function keys generate ASCII compatible codes. Table 2-1 provides a description of the control functions available.

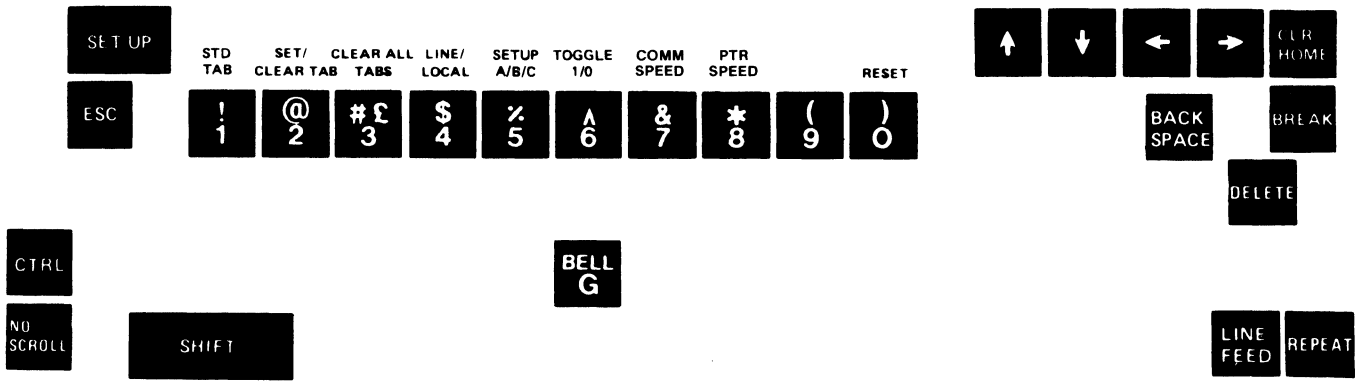



Figure 2-3. Terminal Control and Function Keys

TABLE 2-1. TERMINAL CONTROL AND FUNCTION KEYS

| KEY | DESCRIPTION |
|---|---|
| SET UP | When pressed the terminal enters SET-UP A mode. When pressed a second time the terminal exits the SET-UP modes. |
| ↑ ↓ | Out of SET-UP mode, these keys move the cursor up ↑ or down ↓ . |
| ← → | These keys move the cursor left < or right > . In or out of SET-UP mode. |
| ESC | This key when pressed generates a code which introduces a sequence of key actions that constitute an escape command. |
| 1 | In SET-UP mode this key when pressed places a tab stop at every eight column. |
| 2 | In SET-UP A mode this key when pressed will cause a tab stop to be set or cleared (see SET-UP A mode). |
| 3 | In SET-UP mode this key when pressed clears all the horizontal tabs set. |
| 4 | In the SET-UP mode, this key when pressed toggles the terminal mode from ON LINE to LOCAL or from LOCAL to ON LINE. |

| | |
|---|---|
| 5 | In the SET-UP mode this key when pressed toggles the terminal between SET-UP modes A and B. |
| 6 | In SET-UP mode, this key is used to turn a selectable feature on or off. |
| 7 | In SET-UP mode, this key steps the comm port speed settings in the ascending order. |
| 8 | In SET-UP mode, this key steps the printer port settings in ascending order. |
| 9 | In SET-UP mode this key when pressed steps the terminal mode through the ANSI, VT52, Tek 4014, and native modes. |
| 0 | IN SET-UP mode this key when pressed initiates a reset sequence. |
| DELETE | When pressed transmits a delete code to the host computer. |
| CTRL | This key is used with other keys to generate special function codes. |
| NO SCROLL | During data transmission, pressing this key stops the flow of data to, or from the host computer, (XOFF is generated). Pressing this key a second time restarts data transmission from the point at which it was stopped, (XON is generated). |
| SHIFT | This key is used with other keys to generate special function codes or uppercase letters and symbols. |
| LINE FEED | When pressed generates a line feed code to the host. |
| REPEAT | Pressing this key simultaneously with any display character key causes the terminal to display the character repeatedly. This key functions independently of the AUTO REPEAT function. |
| CLR HOME | When pressed, the cursor is moved to the Home position (upper left corner of screen). No programming codes are sent to peripheral equipment when this key is pressed. |
| CTRL and CLR HOME | Clears Tektronix Alpha, graphic, and native mode screen then homes cursor. |
| SHIFT and CLR HOME | Homes the cursor and clears the screen in ANSI or VT52 mode. |
| BREAK | When pressed transmits a 300 msec break signal. Not active in local mode. |

| | |
|---|---|
| SHIFT and BREAK | Sends a 3.5 second signal break. Data Terminal Ready (Pin 20 COMM connector) is placed in a deasserted state for the duration of the break. Not active in local mode. |
| CTRL and BREAK | Sends the stored answerback message to the active I/O channel. |
| CTRL and BELL G | Causes a bell code to be generated. |
| CTRL & S | Save current SET-UP parameters in NVR. |
| CTRL & R | Recall last-saved SET-UP parameters to NVR. |
| CTRL & D | Recall factory default parameters. |
| CTRL & A | Define answerback message, refer to part III. |
| SHIFT & ENTER | Sends contents of current screen, either ANSI or graphics, to auxiliary port. |
| CTRL & ENTER | Toggles the AUTO PRINT mode. |

Keyboard Cursor Control.

The four arrow keys ↑, ↓, ←, → move the cursor up, down, left and right respectively. Cursor movements by any of these four keys is limited to the current cursor line, for the left and right arrows and the current cursor column for the up and down functions. No scrolling or data loss can be caused by these keys.

The CLEAR/HOME key causes the cursor to move to the home location of the screen. When passed in conjunction with the shift key, the cursor will be homed and all data erased from the screen.

The BACKSPACE key moves the cursor one position to the left, until the cursor reaches the first column of the current line.

The RETURN key causes the cursor to move directly to column zero of the current cursor line. If the terminal has the 'newline mode' enabled (SET-UP B mode), the return will be converted to a carriage return-line feed sequence which will position the cursor to column zero of the next sequential line, this function will cause a destructive scroll to occur if executed on line 24.

The LINEFEED key will cause the cursor to move down one line while maintaining its current column, (on reaching line 24 destructive scrolling will be invoked). Cursor styles (blinking, static), are selectable via the SET-UP modes.

## Numeric Keypad

The Numeric Keypad, (see figure 2-4), adds versatility and convenience to the CIT-414a and is made up of 18 keys grouped in a rectangle and located to the right of the Main Keypad. The Auxiliary Keypad consists of 18 keys: 0 through 9, MINUS, COMMA, decimal point (PERIOD), ENTER, and four Special Function keys designated PF1, PF2, PF3, and PF4. The Numeric Keyboard permits single key transmission of various special control sequences and direct input of decimal data. The various single or multiple key sequences generated by the Auxiliary Keypad in the various operating configurations are described below and listed in part IV.

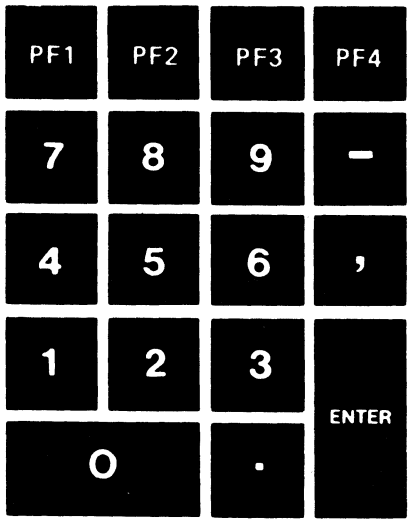



Figure 2-4. CIT-414a Numeric Keypad

### Normal Keypad Numeric Mode.

In Normal Keypad Numeric Mode operation (such as following power-up or a terminal Reset operation), the numerals and punctuation keys perform identical functions as the keys in the Main Keyboard; ENTER performs the same as RETURN (except that ENTER is not affected by Newline mode and does not function with Auto Repeat), and the four Special Function Keys generate two or three character control sequences. The escape sequences generated by the Special Function Keys are often used by a Host computer to support special software functions.

### Numeric Keypad Application Modes.

In other modes of operation, the Numeric Keypad may be configured (via control sequences) to transmit ANSI compatible multiple key sequences in place of the normal keypad functions. These Application Mode key sequences allow special user software such as text editors to distinguish an additional 18 key codes and to assign direct commands to them for efficient user control.

**Keyboard Indicators**

The CIT-414a keyboard indicators (refer to figure 2-5) provide CIT-414 status information. Table 2-2 provides a functional description of the CIT-414a indicators.

L1 thru L4 are used for user special applications.

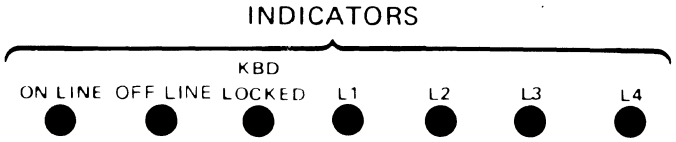



Figure 2-5. CIT-414a Keyboard Indicators

TABLE 2-2. Keyboard Indicator Functions

| Indicator | Function |
|---|---|
| ON LINE | When on, indicates that the CIT-414a is ON LINE and ready to communicate with the Host Computer. The ON LINE indicator blinks if the CIT-414a is set for ON LINE operation and has sent an XOFF to the host computer, temporarily suspending transmission. |
| OFF LINE (LOCAL) | When on, indicates that the CIT-414a is off line. Communication with the host computer is suspended. |
| KBD LOCKED | When on, indicates that the keyboard is locked (functionally off). Data from the host computer is still received and displayed on the screen. However, data cannot be transmitted to the host computer from the keyboard. The keyboard can be unlocked by entering and exiting the SET-UP mode. |
| L1 thru L4 | Available for any user application. LED's are set and cleared by ANSI command codes. |

## GRAPHIC MODES

The CIT-414a graphic modes enable the terminal to emulate most of the software features of the Tektronix 4010/4014/4016 terminals. In addition the terminal also provides a NATIVE graphics mode which provides graphic features unique to CIT terminals.

### Tektronix Mode

In Tektronix 4010/4014/4016 mode (hereafter referred to as the TEK mode) there are four modes of operation:

1. Alphanumeric (alpha) mode
2. Graphic Plot (graph) mode
3. Graphic Input (gin) mode
4. Hard Copy (print) mode

The terminals operation while in the Tek mode consists basically of writing characters, drawing lines (vectors), or executing control characters. Characters are written in alpha mode; vectors are drawn in graph mode; control characters are executed in either of these modes. Data can also be transmitted from the terminal in these modes.

In the gin mode crosshair information is transmitted to the host. In the hard copy mode data is transmitted to the printer.

LOCAL AND ONLINE OPERATION

In order to utilize the graphic features of the CIT-414a, the terminal must be connected to a host computer with the applicable Tektronix (or compatible) software. However for purposes of familiarization with the terminal capabilities, the CIT-414a can be placed in the LOCAL (offline) mode and escape or control sequences may be entered at the keyboard.

## TEK ALPHA MODE

In the TEK alpha mode the terminal displays printing characters as entered at the keyboard. The characters displayed can be either ASCII or APL characters. An alpha cursor, similar to a small underline, is displayed on the screen to indicate the active position. The display screen allows up to 34 lines of standard size characters. Three other sizes are also available. There are left and right margins with automatic carriage return and line feed at the right margin. The home position is the first line, first character position in the upper lefthand corner of the display.

The TEK alpha mode can entered from the keyboard when the terminal is in the local mode by keying in ESC1 while the terminal is in the ANSI mode. The terminal can also be configured in SET-UP mode to automatically enter the TEK alpha mode when the terminal is powered up. Refer to part III of this manual.

## TEK ALPHA MODE CONTROL FUNCTIONS

Table 2-3 provides the a listing of the keyboard control codes recognized by the terminal in the graphics mode of operation. In the simulated on line mode codes are not transmitted to the host but are executed at the terminal. In the normal on line mode codes are transmitted to the host and/or received from the host.

TABLE 2-3. TEK ALPHA MODE CONTROL FUNCTIONS

| KEY | FUNCTION |
|---|---|
| CTRL & H | When pressed generates a backspace. |
| LINE FEED | When pressed generates a line feed code. |
| SPACE BAR | When pressed generates a space code. |
| RETURN | When pressed generates a carriage return code. |
| CTRL & I | When pressed generates a space code, same as pressing space bar. |
| CTRL & K | When pressed generates a vertical tab (VT) code. |
| CTRL & G | When pressed generates a bell code. |
| ESC & CTRL & L | When pressed clears the display and homes the cursor. This function corresponds to the TEKTRONIX PAGE key. |
| ESC & CTRL & N | When pressed exits ASCII alpha mode and enters APL alpha mode. |
| ESC & CTRL & O | Exits APL alpha mode and enters ASCII alpha mode. |
| ESC 8 | Selects largest size alpha display character. |
| ESC 9 | Selects second largest size alpha display character. |
| ESC : | Selects third largest size alpha display character. |
| ESC ; | Selects smallest size alpha display character. |
| CTRL & CLR | Clears the APL screen. |
| CTRL & ] | Enter graphic plot mode. |

## GRAPHIC PLOT MODE

In the graphic plot mode written or unwritten vectors of any length (including zero length) can be executed. In this mode the terminal has 1024 addressable points on each axis. Only 780 of these points on the Y axis are used on the viewable screen area. When the terminal emulates a Tektronix 4014 terminal with option 34, the addressable points are increased to 4096 on each axis, with 3120 of the Y axis points used on the viewable screen area. The addressable points are obtained by sending data in groups of four bytes. Each four character sequence representing a specific point. Normally graphic information is sent from the host for display on the terminal. Refer to part IV for a description of programming considerations. The graphic plot mode can be entered when the terminal is in the Tek mode by entering CTRL] at the keyboard.

## GRAPHIC INPUT (GIN) MODE

The terminal emulates the Tektronix graphic input (GIN) mode using the cursor positioning keys on the terminal keyboard to position the crosshair cursor. The GIN mode operations are interactive in that they involve a computer request for information and the terminals response to the request. Programming considerations for the GIN mode are described in section IV. The following is a description of the various GIN mode operations.

The crosshair cursor is displayed when the terminal receives an ESC SUB from the host. While in the local or simulated online mode the crosshair cursor can be displayed by entering ESC CTRL Z at the keyboard. However this is recommended only for purposes of testing or familiarization of GIN mode operation. If an illegal command is entered while in the simulated online mode, a terminal malfunction may occur which requires a reset of the terminal.

### Transmission of terminal status and alpha mode cursor position

An ESC ENQ request from the host when the terminal is in the alpha mode results in transmission of the terminal status and the address of the bottom left corner of the alpha cursor. The terminal responds automatically and the operation is not noticeable to the operator.

### Transmission of crosshair cursor intersect address

An ESC SUB from the host causes the terminal to display a crosshair cursor. A subsequent ESC ENQ from the host requests the crosshair cursor intersect address. The terminal responds automatically and the crosshair cursor is cleared from the display.

### Transmission of crosshair cursor intersect address in response to keyboard request

An ESC SUB from the host results in the crosshair cursor display. The crosshair cursor can be positioned with the cursor positioning keys. When a character is entered at the keyboard, the terminal

transmits the character code to the host and also the crosshair intersect address. This is also followed by a CR or CR and EOT if selected at the terminal. Refer to part IV for details. The crosshair cursor is then cleared from the display.

Termination of the GIN mode

The GIN mode is exited when the terminal has transmitted the GIN mode information requested.

**Native Mode**

The native mode provides additional graphics capability beyond that provided with Tektronix emulation. Highlights are:

1. Unique vector format specification (X1, Y1. (X2, Y2.) (X3, Y3.)...etc. where X and Y are readable integers that specify the address of the vector end points.

2. Relative addressing of vectors.

3. Relocatable origin.

4. Magnification of vector image (smaller or larger).

5. Box drawing.

6. Arc drawing.

The native mode is set up for 4096 horizontal by 3120 vertical addressable dots mapped to 670 by 500 real visible dot resolution. The origin is located in the upper left corner, and may be relocated anywhere on the 670 X 500 visible screen. The x value increases to the right and y increases up.

Once in the native graphics mode, any number followed by a comma (,) will make that number an X coordinate; any number followed by a period (.) will make that number a Y coordinate. These coordinates will be the end point of the line. The left parenthesis ' (' copies the end point coordinate to be the beginning of the line so that new end points can be specified, and the right parenthesis ')' causes the line to be displayed.

## PART III-CIT-414a SET-UP MODES

The CIT-414a utilizes special Non-Volatile memory (NVR) to remember individual feature selections, settings, and parameters even after power has been removed. The user may choose to set features either temporarily (not saved after power is turned off) or permanently (until changed by the user).

The CIT-414a has two SET-UP modes, A and B. SET-UP A mode is entered by pressing the SET-UP key. SET-UP mode B is entered by pressing the 5 key (labeled SET-UP A/B/C on the keyboard indicator panel). The SET-UP mode may be exited by pressing SET-UP. SET-UP A Mode is used to set or reset individual TAB STOPS. SET-UP B Mode controls parity, word length, protocol, and graphic mode features. The Printer (auxiliary) Port is also configured in SET-UP B Mode for baud rates, parity, word length, and selection of line terminator character.

When the CIT-414a is placed in the SET-UP mode, the contents of the display are stored. Each SET-UP mode display shows special information used to select and set the various special features of the terminal and only certain keys are active, refer to part II. Upon exiting SET-UP Mode, the SET-UP display is cleared and the original screen data is scrolled to its original position.

## COMMON SET-UP MODE FEATURES

Several features are common to both SET-UP modes. These are:

1. Terminal baud rate
2. Printer baud rate
3. Terminal mode
4. Terminal reset
5. Recall default parameters
6. Save operator set parameters
7. Recall operator set parameters
8. Set answerback message
9. Select printer interface
10. Select online or local(offline)mode

**Terminal and printer baud rates.**

To change the terminal baud rate press the 7 key. Pressing this key once advances the display to the next higher speed. Repeat until desired speed is displayed. To change printer speed, press the 8 key the transmission speed steps to next higher baud rate. Repeat until the desired speed is displayed.

**Terminal mode.**

The terminal mode can be changed in any set-up mode by pressing the 9 key. Pressing this key will step the terminal mode from ANSI through VT52, native, 4014 and back to ANSI.

**Resetting the terminal.**

The CIT-414a may be reinitialized to its power-up state by entering any SET-UP mode and pressing the numeral 0 key which is labeled RESET on the Indicator Panel. This operation will: (1) exit SET-UP Mode, (2) run the basic Self-Test Diagnostics (causing the Display to be busy for several seconds while the tests run), (3) clear the Display, (4) perform a Recall operation to restore the parameters currently saved in NVR (replacing any temporarily set parameters), and reset all modes that may have been set by the user (such as character set selection, Keypad Application mode, etc.).

**Factory Default Parameters.**

A set of factory established set-up parameters are permanently stored within the terminal. These values are used when the terminal is first turned on. The terminal can be configured to these default values by placing the terminal in any set-up mode and pressing the CTRL and D keys simultaneously.

**SET-UP Mode SAVE and RECALL Operations.**

Any changes made in any SET-UP mode are temporary until permanently stored in memory with a SAVE operation. Temporary changes are lost if power is removed, the terminal is reset, or a RECALL operation is performed.

SET-UP mode save operation.

Control conditions are stored in Non-Volatile Ram Memory (NVR) on a permanent basis by entering any SET-UP mode and pressing CTRL and S. When all the new data has been successfully transferred to the NVR, a beep occurs and the keyboard is unlocked. With the new SET-UP parameters now stored in NVR the operator may exit SET-UP. DO NOT TURN OFF THE POWER WHILE A SAVE OPERATION IS IN PROGRESS!

SET-UP mode recall operation.

The user stored permanent SET-UP conditions are automatically restored whenever the terminal is turned on or reset. In addition, a special RECALL operation may be performed to reinstate permanently

stored control conditions by entering any SET-UP mode and pressing CTRL simultaneously with R. The operation is completed within two seconds. The terminal is now operating with the user selected permanent SET-UP control conditions.

**Answerback message.**

The answerback feature enables the terminal to identify itself to the host. The answerback message is entered by the operator while in SET-UP B mode. The message is sent to the host either automatically when the hosts requests identity or by pressing the CTRL and BREAK keys simultaneously. To set the answerback message proceed as follows:

1. Place the terminal in the SET-UP B mode.

2. Press CTRL and A keys simultaneously.

3. Verify that <A=> appears on the screen.

4. Type delimiter character.

NOTE

*Delimiter can be any character not used as part of the answerback message.*

5. Type the answerback message which can be up to 19 characters long, including spaces and control characters.

NOTE

*Control characters are displayed in their ASCII format. The host computer solicits a stored answerback message (if present) by using an ASCII ENQ code.*

6. Type same delimiter character entered in step 4.

NOTE

*If an error is made in entering answerback message, type delimiter and go back to step 2.*

Once entered the answerback message is temporarily stored. A SAVE operation must be performed to permanently store the message.

**Printer Selection.**

The type printer that is interfaced with the terminal can be specified in any of the set-up modes. The terminal can be configured for a C.ITOH 8510, DEC LA100, or EPSOM MX80 type printer. To select the printer the terminal must be in the a set-up mode. To the left of of the CPU BAUD RATE is displayed the current printer selection. By pressing the CTRL and P keys simultaneously the printer selection is changed. The selected printer type can be permanently saved by performing a save operation.

**LOCAL vs ON LINE Operation.**

LOCAL (OFF LINE) versus ON LINE operation is selected from any SET-UP mode by pressing the numeral 4 key which is labeled LINE/LOCAL on the Indicator Panel. Each time this key is pressed in SET-UP mode, the current mode is toggled to the other and the new status is indicated by either a lit ON LINE or LOCAL (OFF LINE) indicator. In LOCAL mode, keyboard data is sent directly to the display, no interaction with the COMM Port occurs, and signal DTR is unasserted. In ON LINE mode, Keyboard data is transmitted to the COMM Port (and possibly to the Display or Auxiliary Port, depending upon user choice of Full or Half Duplex and status of the Auxiliary Port). ON LINE mode must be selected to communicate with a Host computer. LOCAL mode is used for test and familiarization purposes.

## CIT-414a SET-UP MODE OPERATION

### SET-UP A Mode.

SET-UP A Mode is entered by pressing the "SET-UP" key. In this mode the Display shows in ruler fashion the locations of all the currently set TAB STOP positions. Each available column is numbered in repeating groups of 1 through 0 for easy location of the TAB STOPS.

Tabs are automatically set at every eight column (standard tabs) by pressing the 1 key (STD TAB). The tab stops are individually set or reset utilizing the tab set/clear (2) key. Position the cursor over the tab position desired and press the 2 key. All tabs can be cleared by pressing the 3 key. The SET-UP A mode is exited by pressing the SET-UP key.

### SET-UP B Mode.

The SET-UP B mode is entered from the SET-UP A mode by pressing the 5 key (SET-UP) A/B/C mode. To exit the SET-UP B mode press the SET-UP key.

Setting/Resetting Set-up Mode Bits. SET-UP Mode B shows several groups of up to four bits each, that are referenced by Group numbers beginning with the left-most group. Individual control conditions are represented by a 1 or 0. In the SET-UP B mode there are ten groups of control conditions labeled 1 through 9. Individual bits may be toggled by placing the cursor under the desired bit using the LEFT ARROW, RIGHT ARROW, TAB, BACKSPACE, RETURN or SPACE keys and pressing the numeral 6 key (labeled Toggle I/O on the Indicator Panel). The purpose of each bit is shown by individual messages that are displayed as the cursor is positioned under each bit.

**CIT-414a SETUP B**

**0** 1101 **1** 0000 **2** 0110 **3** 1000 **4** 0001 **5** 1000 **6** 0000 **7** 1110 **8** 0001 **9** 0000

**ANSI** **6510** **CPU BAUD 9600** **AUX BAUD 9600**

FIGURE 3-1. SET-UP B DISPLAY

## SET-UP B Mode Control Condition Options

**FIELD 0**

1101

**KEYCLICKS:** 1=ON, 0=OFF (DEFAULT=1)

When ON, an audible keyclick is generated when a key is pressed.

**MARGIN BELL:** 1=ON, 0=OFF (DEFAULT=0)

When ON, a beep tone occurs when the cursor is eight columns away from the end of the display. When ON, this control condition is active in any screen width display mode.

**CURSOR TYPE:** 1=BLINKING, 0=STATIC (DEFAULT=1)

Cursor constant or blinking may be selected.

**AUTO REPEAT:** 1=ON, 0=OFF (DEFAULT=1)

When ON, if a key is held down for 0.5 sec or longer the character of that key is repeated until key is released.

**FIELD 1**

0000

**CRT SAVER:** 1=ON, 0=OFF (DEFAULT=0)

When ON, the screen intensity slowly diminishes over a ten minute period of inactivity. The brightness returns to normal when either data is received or a key is pressed.

**MONITOR MODE:** 1=ON, 0=OFF (DEFAULT=0)

When ON, control codes and characters are displayed but not executed. The hex code for each of the received characters and codes are displayed on the left side of the screen. At the right side of the screen the control codes are displayed as an ASCII character but are offset by 40 hex. For example an ESC code is displayed on the left as 1B hex and on the right as [. Non control characters are displayed on the right and their ASCII code is displayed on the left side. Up to 16 characters can be displayed on one line.

**NEWLINE:** 1=ON, 0=OFF (DEFAULT=0)

When ON, pressing the RETURN key automatically generates a carriage return and linefeed. A carriage return from the host computer is automatically interpreted as a carriage return and linefeed. If the host computer automatically sends carriage return and linefeed codes then New line should be OFF.

**AUTO WRAP:** 1=ON, 0=OFF (DEFAULT=0)

When ON, causes an automatic return and linefeed. When the cursor is at the end of the display line the CIT-414a will automatically begin displaying data in column 1 of the next line down.

**FIELD 2**

0110

**INVERSE VIDEO:** 0=OFF, 1=ON (DEFAULT=OFF)

Screen background can be either dark (OFF=normal) or light (ON=inverse).

**CHARACTER SET:** 1=US, 0=UK (DEFAULT=US)

When the US character set is selected the display character set consists of the standard US character set. When the UK character set is selected the display character set consists of the British character set.

**TERMINAL MODE:** 1=ANSI MODE, 0=VT52 MODE (DEFAULT=ANSI MODE)

When ANSI mode is selected, American National Standards Institute (ANSI) programming control sequences are recognized and executed by the terminal. When VT52 mode is selected the terminal recognizes and executes DEC VT52 control sequences.

**LOCAL ECHO:** 1=ON, 0=OFF (DEFAULT=OFF)

When local echo is on the terminal is a half duplex mode. Keyboard entries are displayed on the screen as well as sent to the host. When off, the terminal is in a full duplex mode. Keyboard entries are sent to the host and displayed only when sent back to the terminal by the host.

**FIELD 3**

1000

**CPU PARITY:** 1=EVEN, 0=ODD (DEFAULT=ODD)

When parity is enabled, this option selects even or odd parity to be set on transmission from the terminal or checked on reception of data from the host.

**CPU PARITY:** 1=ON, 0=OFF (DEFAULT=OFF)

When ON, parity is set during transmission and checked during reception. Used in accordance with host computer communication configuration. Error characters are displayed when parity error is detected.

**INCOMING XOFF:** 1=ENABLED, 0=IGNORED (DEFAULT=IGNORED)

When set to ignore, the CIT-414a continues transmitting data to the host computer (prevents keyboard lockout). An XOFF sent by the host computer is ignored by the CIT-414a.

**CPU XON/XOFF:** 1=ENABLED, 0=DISABLED (DEFAULT=ENABLED)

When ENABLED, ON LINE transmission to the CIT-414a is controlled by the CIT-414a. When data cannot be displayed as quickly as it is received the CIT-414a generates an XOFF. The XOFF inhibits transmissions from the host computer. The CIT-414A generates an XON when received data can be displayed. The XON allows the host computer to resume transmission. XON/XOFF does not function when the CIT-414a is in the LOCAL (OFF LINE) mode.

**FIELD 4**

0001

**BREAK:** 1=ENABLED, 0=DISABLED (DEFAULT=ENABLED)

This feature selects or disables the BREAK function, refer to part II operation for a description and use of the BREAK function.

**CPU PARITY BIT:** 0=SPACE, 1=MARK (DEFAULT=SPACE)

When parity is disabled, the parity bit can be selected as either a MARK or SPACE for all data transmissions.

**CPU STOP BITS:** 1=2 STOP BITS, 0=1 STOP BIT (DEFAULT=1 BIT)

Either 1 or 2 stop bits can be selected.

**CPU DATA BITS:** 1=7 DATA BITS, 0=8 DATA BITS (DEFAULT=8 BITS)

The user may select 7- or 8-bit data words for serial transmission. Selection of word length is dependent on host computer communication configuration.

**FIELD 5**

1000

**AUX DATA BITS:** 1=7 DATA BITS, 0=8 DATA BITS (DEFAULT=8 BITS)

The user may select 7- or 8-bit data words for serial transmission from the auxiliary port. Selection of word length is dependent on host computer communication configuration.

**AUX PARITY:** 1=EVEN, 0=ODD (DEFAULT=ODD)

Selects either EVEN or ODD parity when parity is enabled for the auxiliary port.

**AUX PARITY:** 1=ON, 0=OFF (DEFAULT=OFF)

Enables(ON) or disables(OFF) parity for the auxiliary port. When enabled parity is set on transmission and checked on reception of data.

**AUX HANDSHAKE:** 1=XON/XOFF, 0=DSR (DEFAULT=XON/XOFF)

Selects either XON/XOFF or DSR as the protocol for the auxiliary port.

**FIELD 6**

0000

**PRINT REGION:** 1=PAGE, 0=SCROLL (DEFAULT=SCROLL)

Selects the entire screen or only the scrolling region to be output to the auxiliary port on a print operation.

**PRINT TERM:** 1=FORM FEED, 0=NONE (DEFAULT=NONE)

Selects either a form feed as the print terminator or no print terminator character is selected.

**AUX PARITY BIT:** 1=MARK, 0=SPACE (DEFAULT=SPACE)

When parity is disabled, the parity bit can be selected as either a MARK or SPACE for all data transmissions to the auxiliary port.

**AUX STOP BITS:** 1=2 STOP BITS,0=1 STOP BIT (DEFAULT=1 STOP BIT)

Either 1 or 2 stop bits can be selected for the auxiliary port.

**FIELD 7**

1110

**EOT AFTER CR:** 1=SENT, 0=NOT SENT (DEFAULT=NOT SENT)

If GIN data is terminated it may use C/R, or C/R followed by EOT.

**GIN MODE TERMINATOR:** 1=CR, 0=NO TERM (DEFAULT=NO TERM)

GIN mode data transmitted from the CIT-414a can either be not terminated or terminated with C/R.

**AUTO TEK SCREEN CLEAR:** 1=ENABLED, 0=DISABLED (DEFAULT=ENABLE)

When enabled the display screen is cleared when Tektronix graphics mode is entered. Auto Tek mode entry must be ON. See next entry.

**AUTO TEK ENTRY:** 1=ON, 0=OFF (DEFAULT=ON)

When ON, Tektronix graphics mode is entered by GS command. Refer to TEktronix mode entry in part IV of this manual.

**FIELD 8**

0001

**TEK CHAR SET:** 1=STANDARD, 0=APL (DEFAULT=STANDARD)

Selects standard character set or APL character set when terminal is placed in Tektronix graphics mode.

**TEK AUTO LF:** 1=ON, 0=OFF (DEFAULT=OFF)

When ON a LF is generated when a CR is received in Tektronix graphics mode.

**PAGE FULL BREAK:** 1=ON, 0=OFF (DEFAULT=OFF)

If ON, a BREAK is issued and the display is erased when a FULL condition is encountered in Tektronix Alpha mode.

**TEK MARGIN:** 1=TWO TEK MARGINS, 0=ONE TEK MARGIN (DEFAULT=ONE)

If ONE MARGIN is enabled, the Tektronix Alpha mode will use Margin 1 (the left side of the screen) as a margin. If TWO MARGINS is enabled, the Tektronix Alpha mode will use Margin 2 (the left side and center of the screen) as margins.

**FIELD 9**

0000

(NOT USED)

**ATTRIBUTES:** 1=ALL=REV VIDEO, 0=REV VIDEO ONLY (DEFAULT=0)

This setup mode feature alters the operation of the video attribute escape sequence refer to part V programmer data for a description of the control sequence.

# PART IV-PROGRAMMING DATA

## GENERAL

This section provides the programming sequences and character codes generated and recognized by the CIT-414a Graphics terminal in the ANSI and graphics modes of operation.

The terminal provides three basic functions. First, the terminal serves as an input device for information to the host computer and/or a peripheral device. Information is input by the operator at the keyboard. Second, it serves as an output device for information from the host computer and/or peripheral device. Information received from the host computer or peripheral device can be displayed on the screen. Third, the terminal operates as an interface between the host computer and peripheral device.

## KEYBOARD GENERATED CODES

The keyboard generates ASCII codes for transmission to the host computer. The codes are standard 7-bit or 8-bit bytes and are normally transmitted immediately when a key is pressed, the codes are transmitted in the order in which the keys were pressed. Pressing three keys causes two codes to be transmitted first, and the third code is transmitted when one of the first two keys is released. Note the keyboard contains four type of keys as described in part II.

## Keyboard Generated Standard ASCII Characters

The standard (printing) characters generated by the terminal keyboard are shown in table 4-1 together with the special characters SPACE and DELETE. Note that all of these characters have an upper case function that is produced by simultaneously depressing SHIFT with the desired key.

TABLE 4-1. KEYBOARD GENERATED ASCII CHARACTER CODES

| CHARACTER | CODE | CHARACTER | CODE | CHARACTER | CODE |
|---|---|---|---|---|---|
| (space) | 040 | ? | 077 | ` | 140 |
| ! | 041 | @ | 100 | a | 141 |
| " | 042 | A | 101 | b | 142 |
| # | 043 | B | 102 | c | 143 |
| $ | 044 | C | 103 | d | 144 |
| % | 045 | D | 104 | e | 145 |
| & | 046 | E | 105 | f | 146 |
| ' | 047 | F | 106 | g | 147 |
| ( | 050 | G | 107 | h | 150 |
| ) | 051 | H | 110 | i | 151 |
| * | 052 | I | 111 | j | 152 |
| + | 053 | J | 112 | k | 153 |
| , | 054 | K | 113 | l | 154 |
| - | 055 | L | 114 | m | 155 |
| . | 056 | M | 115 | n | 156 |
| / | 057 | N | 116 | o | 157 |
| 0 | 060 | O | 117 | p | 160 |
| 1 | 061 | P | 120 | q | 161 |
| 2 | 062 | Q | 121 | r | 162 |
| 3 | 063 | R | 122 | s | 163 |
| 4 | 064 | S | 123 | t | 164 |
| 5 | 065 | T | 124 | u | 165 |
| 6 | 066 | U | 125 | v | 166 |
| 7 | 067 | V | 126 | w | 167 |
| 8 | 070 | W | 127 | x | 170 |
| 9 | 071 | X | 130 | y | 171 |
| : | 072 | Y | 131 | z | 172 |
| ; | 073 | Z | 132 | { | 173 |
| < | 074 | [ | 133 | \| | 174 |
| = | 075 | ^ | 134 | } | 175 |
| > | 076 | _ | 135 | ~ | 176 |
| | | | | (delete) | 177 |

## Keyboard Generated ASCII Control Codes

The control characters (octal values 000 through 037) can all be generated by depressing CTRL simultaneously with the appropriate key chosen from among the standard characters. These control codes are listed in table 4-2 together with their octal codes and ASCII mnemonics.

TABLE 4-2. KEYBOARD GENERATED ASCII CONTROL CODES

| KEY | CODE | MNEMONIC | KEY | CODE | MNEMONIC | KEY | CODE | MNEMONIC |
|---|---|---|---|---|---|---|---|---|
| SPACE | 000 | NUL | L | 014 | FF | X | 030 | CAN |
| A | 001 | SOH | M | 015 | CR | Y | 031 | EM |
| B | 002 | STX | N | 016 | SO | Z | 032 | SUB |
| C | 003 | ETX | O | 017 | SI | [ | 033 | ESC |
| D | 004 | EOT | P | 020 | DEL | \ | 034 | FS |
| E | 005 | ENQ | Q | 021 | DC1 | ] | 035 | GS |
| F | 006 | ACK | R | 022 | DC2 | ~ | 036 | RS |
| G | 007 | BEL | S | 023 | DC3 | ? | 037 | US |
| H | 010 | BS | T | 024 | DC4 | | | |
| I | 011 | HT | U | 025 | NAK | | | |
| J | 012 | LF | V | 026 | SYN | | | |
| K | 013 | VT | W | 027 | ETB | | | |

## Keyboard Function Key Control Codes

For user convenience and by convention, several of the control character codes may also be generated directly by simply pressing certain dedicated keys. Table 4-3 lists these function key control characters together with their octal values and functions. Note that all of these characters are also available with the use of the CTRL key and the standard keys.

A common feature of these function keys in particular and control characters in general is that the codes generated by them, if echoed by a host device or encountered in LOCAL mode, typically result in some terminal action that does not display any characters. Other classes of typical function keys not listed here are SET-UP, REPEAT, CLEAR/HOME, BREAK, etc., that are not single character control codes are described in section III.

TABLE 4-3. FUNCTION KEY CONTROL CODES

| KEY | CODE | FUNCTION |
|---|---|---|
| BACKSPACE | 010 | Backspace function |
| TAB | 011 | Tab function |
| LINEFEED | 012 | line feed |
| RETURN | 015 | Carriage return delimiter |
| ESC | 033 | Escape sequence delimiter |
| SPACE BAR | 040 | Space function |

## Cursor Keys

The four keys which control cursor movement generate control sequences which are transmitted to the host. When the host sends the signals back, the corresponding cursor action occurs. Table 4-4 lists the escape sequences echoed from a host when the terminal is online and a cursor key is pressed. Refer to CURSOR CONTROL SEQUENCES in this section for generating these sequences from a host program.

TABLE 4-4. CURSOR KEY GENERATED CONTROL SEQUENCES

| CURSOR KEY | ANSI MODE | | VT52 MODE |
|---|---|---|---|
| | KEY MODE RESET | KEY MODE SET | |
| UP | ESC[A | ESCOA | ESCA |
| DOWN | ESC[B | ESCOB | ESCB |
| RIGHT | ESC[C | ESCOC | ESCC |
| LEFT | ESC[D | ESCOD | ESCD |

## Numeric Keypad

The numeric keypad generates codes for numerals, decimal point, minus sign, and comma. The ENTER key transmits the same code as the RETURN key. The codes are the same as the codes generated by the corresponding key on the main keyboard.

If the host must distinguish between the numeric keypad and the main keyboard, the terminal can be placed in a keypad application mode by the host. In the keypad application mode the keys transmit control sequences which can be used by the host as user defined functions. Table 4-5 lists the code sequences generated in the keypad numeric/application modes for both ANSI and VT52 modes of operation.

In either ANSI or VT52 mode, control sequences must be used to put the terminal into either the keypad application mode or the keypad normal mode. To enter the keypad HEX mode (in VT52 mode) requires setting bit 3 of group one in SET-UP C mode. In ANSI mode, the keypad HEX mode may be invoked by either a command from the host or by setting bit 3 of group one in SET-UP C mode.

TABLE 4-5. NUMERIC KEYPAD GENERATED CODES

| KEY | ANSI NORMAL MODE | ANSI APPLICATION MODE | VT52 NORMAL MODE | VT52 APPLICATION MODE |
|---|---|---|---|---|
| 0 | 0 | ESC O p | 0 | ESC ? p |
| 1 | 1 | ESC O q | 1 | ESC ? q |
| 2 | 2 | ESC O r | 2 | ESC ? r |
| 3 | 3 | ESC O s | 3 | ESC ? s |
| 4 | 4 | ESC O t | 4 | ESC ? t |
| 5 | 5 | ESC O u | 5 | ESC ? u |
| 6 | 6 | ESC O v | 6 | ESC ? v |
| 7 | 7 | ESC O w | 7 | ESC ? w |
| 8 | 8 | ESC O x | 8 | ESC ? x |
| 9 | 9 | ESC O y | 9 | ESC ? y |
| PF1 | ESC O P | ESC O P | ESC P | ESC P |
| PF2 | ESC O Q | ESC O Q | ESC Q | ESC Q |
| PF3 | ESC O R | ESC O R | ESC R | ESC R |
| PF4 | ESC O S | ESC O S | ESC S | ESC S |
| MINUS | MINUS | ESC O m | MINUS | ESC ? m |
| COMMA | COMMA | ESC O l | COMMA | ESC ? l |
| PERIOD | PERIOD | ESC O n | PERIOD | ESC ? n |
| ENTER | RETURN | ESC O M | RETURN | ESC ? M |

## GRAPHICS CHARACTER SET

When the graphics character set is selected, the graphics for ASCII codes 137 through 176 represent the graphics character set. Table 4-6 gives the replacement graphics. Refer to appendix B for dot matrix configurations.

**Table 4-6. The Graphics Character Set**

| Octal Code | Standard Character | Graphics Character | Octal Code | Standard Character | Graphics Character |
|---|---|---|---|---|---|
| 137 | – | Blank | 157 | o | – Horizontal line (Scan 1) |
| 140 | \ | ♦ Diamond | 160 | p | – Horizontal line (Scan 3) |
| 141 | a | ▒ Checkerboard | 161 | q | – Horizontal line (Scan 5) |
| 142 | b | $^{H}_{T}$ Horizontal tab | 162 | r | – Horizontal line (Scan 7) |
| 143 | c | $^{F}_{F}$ Form Feed | 163 | s | – Horizontal line (Scan 9) |
| 144 | d | $^{C}_{R}$ Carriage return | 164 | t | ├ Left "T" |
| 145 | e | $^{L}_{F}$ Line feed | 165 | u | ┤ Right "T" |
| 146 | f | ° Degree symbol | 166 | v | ┴ Bottom "T" |
| 147 | g | ± Plus/minus | 167 | w | ┬ Top "T" |
| 150 | h | $^{N}_{L}$ New Line | 170 | x | \| Vertical Bar |
| 151 | i | $^{V}_{T}$ Vertical tab | 171 | y | ≤ Less than or equal to |
| 152 | j | ┘ Lower-right corner | 172 | z | ≥ Greater than or equal to |
| 153 | k | ┐ Upper-right corner | 173 | { | π Pi |
| 154 | l | ┌ Upper-left corner | 174 | \| | ≠ Not equal to |
| 155 | m | └ Lower-left corner | 175 | } | £ UK pound sign |
| 156 | n | + Crossing lines | 176 | ~ | · Centered dot |

## CONTROL SEQUENCES

The CIT-414a recognizes and executes control sequences in both the ANSI and graphics modes of operation. In ANSI mode the terminal is software compatible with American National Standards Institute (ANSI) standards contained in documents X3.41-1974 and X3.64-1977. When the terminal is in the VT52 mode, the terminal recognizes and executes DEC VT52 control sequences.

In Graphics mode the terminal is compatible with Tektronix 4010/4014/4016 programming sequences. In the NATIVE graphics mode the terminal recognizes CIT private programming sequences. In the following text the control sequences are divided according to these modes of operation.

## ANSI MODE CONTROL SEQUENCES

The basic elements of an ANSI mode control sequences are defined as follows:

Control Sequence Introducer(CSI)-An escape sequence which introduces an expanded set of control functions by allowing an alternate interpretation of a string of characters which follow it.

Parameter-A string of decimal digits representing a single value(i.e. a decimal number). Leading zeros are ignored. The decimal digits are sent in the ASCII representation, 0(octal 60) through 9(octal 71). Parameter also means the value so represented.

Numeric Parameter-A parameter that represents a number, designated by Pn.

Selective Parameter-A parameter that selects one function from a group of functions, designated by Ps. In general, a control sequence with multiple selective parameters has the same effect as multiple control sequences each with one selective parameter, e.g., CSI Psa;Psb;Psc F acts identically to CSI Psa F CSI Psb F CSI Psc F.

Parameter String-A string of parameters separated by a semicolon (octal 73).

Default-The value assumed for the argument to a function when no value is specified, or if a value of 0 is given.

Final Character-The character which terminates an escape or control sequence.

The CIT-414a control sequences defined here are valid in the ANSI mode of operation. Unless otherwise noted, actions described are taken in response to receipt of the indicated control sequence. Parameters are either numeric (Pn) or selective (Ps). If a location in the list is left blank or specified as 0 the default is used.

## CURSOR CONTROL SEQUENCES

The terminal supports a variety of powerful cursor commands that position the cursor, scroll the display up and down, and select a variety of cursor styles.

### Relative Cursor Positioning

| | |
|---|---|
| Move cursor up | ESC[PnA |
| Move cursor down | ESC[PnB |
| Move cursor right(forward) | ESC[PnC |
| Move cursor left(backward) | ESC[PnD |

Pn is the number of rows or columns to move the cursor. The default value is 1. If no value for Pn is entered, the cursor will move by one row or column as appropriate. When the cursor reaches any margin(left,right,top,or bottom) it will stop there.

### Direct Cursor Positioning

| | |
|---|---|
| Position cursor | ESC[Pn;PnH<br>or<br>ESC[Pn;Pnf |

Directly positions cursor at location given. The first Pn specifies row number and the second Pn specifies column number where the cursor is to be positioned. Default values are each 1.

### Scroll Direction

| | |
|---|---|
| Index | ESCD |
| Reverse index | ESCM |

Index moves the cursor down one line without changing column position. Reverse index moves the cursor up one line. These moves cause scrolling when top or bottom margins are encountered.

### Save and Restore Cursor and Attributes

| | |
|---|---|
| Save cursor and attributes | ESC7 |
| Restore cursor and attributes | ESC8 |

Saves cursor position, type, and attributes so they may later be restored.

### New Line

| | |
|---|---|
| New line | ESCE |

Moves cursor to the first position on the next line down. Causes display to scroll when the bottom margin is encountered.

## ERASE CONTROL SEQUENCES

The CIT-414a supports a variety of erase commands that can erase from the cursor to the beginning or end of the current line or entire display or scrolling region. A second group of erase commands can erase a rectangular window spanning a single line (or column) or the entire display.

### Erase Within Display

| | |
|---|---|
| Erase within display | ESC[PsJ |
| From cursor to end of display | Ps=0 |
| From start of display to cursor | 1 |
| Entire display | 2 |

The default value is 0. If no value is entered the display is erased from the cursor to the end of the screen. If the appropriate bit is set in SET-UP C mode, the display is erased only to the appropriate margin instead of the display limit.

### Erase Within Line

| | |
|---|---|
| Erase within line | ESC[PsK |
| From cursor to end of line | Ps=0 |
| From start of line to cursor | 1 |
| Entire line | 2 |

The default value is 0. If no value is entered line is erased from cursor to end of line.

## VIDEO ATTRIBUTES COMMANDS

| | |
|---|---|
| Set video attributes | ESC[Psm |
| Normal/none | Ps=0 |
| Reverse video* | 1 |
| Reverse video* | 4 |
| Reverse video* | 5 |
| Reverse video | 7 |

*The operation of these parameter values is determined in SET-UP B.

The default value is 0. If no value is entered all characters received will be normal video with no other attributes set. The current attribute settings apply to all succeeding characters displayed until new attributes are set.

## SCROLLING COMMANDS

These commands affect the size of the scrolling region and the rate at which smooth scrolling occurs.

| | |
|---|---|
| Set scrolling region | ESC[Pn;Pnr |

The first parameter value is top margin and the second is bottom margin. Default is the entire screen. The topmost line designation is 1.

## TABS

Tab stops may be individually set or cleared at the current cursor position, cleared altogether, or added to every eighth column (DEC standard).

| | |
|---|---|
| Set tab at current column | ESCH |
| Set/clear tab | ESC[Psg |
| Clear tab at current cursor | Ps=0 |
| Clear all tabs | 3 |

The default value is 0. If no value is entered the tab is cleared at the current cursor column position.

## LED CONTROL

This sequence allows the user to individually set(turn on) or collectively reset(turn off) the programmable LED indicators L1 through L4.

| | |
|---|---|
| Set/reset LED | ESC[Pnq |

LED number Pn is turned on. The default value is 0. If no value or 0 is entered, all the LEDs are turned off.

## MODES

The CIT-414a has a variety of features that offer the user a choice of one of two states at any one time. These two state features are called modes and have a set or reset state. The set or reset condition of the mode either enables or disables a feature and in some modes selects one of two possible operating modes of the feature.

NOTE

*The final character for the reset is a lower case alpha L.*

Keyboard Lock mode

| | |
|---|---|
| Set keyboard locked | ESC[2h |
| Reset Keyboard locked | ESC[2l |

This mode can be set from either the host when online or the keyboard when offline. However this mode can only be reset by the host and the terminal must be online.

Insert mode

| | |
|---|---|
| Set insert mode | ESC[4h |
| reset replace mode | ESC[4l |

When insert mode is set, characters are added to the displayed line at the cursor position with remaining characters shifted right. Any characters shifted into the margin area are lost. When reset added characters replace the character at the cursor position.

Form Feed mode

| | |
|---|---|
| Set form feed | ESC[?18h |
| Reset form feed | ESC[?18l |

When set, the form feed (FF) character is selected as the print termination character. When reset there is no print termination character.

Print Extent mode

| | |
|---|---|
| Set extent mode | ESC[?19h |
| Reset extent mode | ESC[?19l |

When set the entire screen is printed during a print screen operation. When reset only the scrolling region is printed.

Local Echo mode

| | |
|---|---|
| Set local echo off | ESC[12h |
| Reset local on | ESC[12l |

When set the terminal is effectively in a full duplex mode. When reset the terminal is placed in a half duplex mode.

Newline mode

| | |
|---|---|
| Set newline mode | ESC[20h |
| Reset to line feed mode | ESC[20l |

When newline mode is in the set state and line feed is received the active position is moved to the first position on the next line and the return key generates a carriage return followed by a line feed each time it is pressed. When newline mode is reset and a line feed is received the active position is moved to the next line but stays in the same column position.

Cursor key application mode

| | |
|---|---|
| Set cursor key application mode | ESC[?1h |
| Reset cursor key application mode | ESC[?1l |

This mode is effective only when the terminal is in ANSI mode (i.e., ESC[?2h has been sent). With cursor key application mode set, the four cursor control keys send special user interpretable functions such as ESCOA. If cursor key application mode is reset the function keys will send ANSI cursor control commands such as ESC[A. Refer to table 4-4.

ANSI/VT52 modes

| | |
|---|---|
| Set to ANSI mode(from VT52) | ESC< |
| Reset to VT52 mode | ESC[?2l |

In set state only ANSI compatible sequences are recognized. In reset state only VT52 sequences are recognized.

Reverse/Normal Screen mode

| | |
|---|---|
| Set to reverse screen mode | ESC[?5h |
| Reset to normal screen mode | ESC[?5l |

In set state screen will be reversed showing dark characters on light background. In reset state screen will show light characters on a dark background. These conditions may be locally reversed under the cursor or where character attributes are other than normal.

Cursor origin mode

| | |
|---|---|
| Set cursor origin mode | ESC[?6h |
| Reset cursor origin mode | ESC[?6l |

In set state the cursor home position is the upper left character position within set margins and screen addresses are relative to that position. In reset state the cursor home position is the upper left character position of the display regardless of the margin settings.

Auto wraparound mode

| | |
|---|---|
| Set auto wraparound mode | ESC[?7h |
| Reset auto wraparound mode | ESC[?7l |

In set state any characters received when cursor is at the right margin are moved to the start of the next line. A scroll is performed if necessary and allowed. In the reset state, any characters received when the cursor is at the right margin replace any characters at that position.

Auto repeat mode

| | |
|---|---|
| Set auto repeat mode | ESC[?8h |
| Reset auto repeat mode | ESC[?8l |

In set state any key (except SET-UP,ESC, NO SCROLL, TAB, RETURN, and CTRL with any key) when held down for more than 1/2 second will repeat at the rate of about 30 characters per second. In the reset state no keys will repeat. This mode does not affect the operation of the repeat key.

Numeric keypad application mode

| | |
|---|---|
| Set keypad to application mode | ESC= |
| Reset keypad to numeric mode | ESC> |

In application mode the numeric keypad will transmit the appropriate ANSI or VT52 mode control sequences as selected. When reset the numeric keypad is in the normal mode.

**RESET TERMINAL**

| | |
|---|---|
| Reinitialize terminal | ESCc |

The terminal is cleared and is reset to fixed SET-UP parameter values. This function will take several seconds to occur and XON-XOFF is not supported during this operation.

**EDITING**

| | |
|---|---|
| Delete Character | ESC[PnP |

Deletes number of characters specified by Pn, starting with the character at the cursor position and subsequent characters to the right of cursor. Remaining characters are shifted right the number of characters removed. The corresponding number of spaces are added at the right end of the line

| | |
|---|---|
| Delete Line | ESC[PnM |

Deletes number of lines specified by Pn, starting with line at cursor position and subsequent lines below. Remaining lines are shifted up and replaced with lines containing all spaces.

| | |
|---|---|
| Insert Line | ESC[PnL |

Inserts number of lines specified by Pn at cursor location. All lines below cursor are moved down corresponding number of rows. All lines moved into bottom margin are lost.

## SCREEN ALIGNMENT

| | |
|---|---|
| Fill screen with E's | ESC#8 |

This control sequence fills the display with the uppercase E character. This sequence is used primarily for alignment and test procedures.

## REPORTS

A report is a character sequence sent to the host resulting from receipt of a request sequence to the terminal from the host asking for terminal parameters and status.

Request for terminal status

| | |
|---|---|
| Request | ESC[5n |
| Response terminal OK | ESC[n<br>or<br>ESC[0n |
| Response terminal not OK | ESC[3n |

Request for cursor position

| | |
|---|---|
| Request | ESC[6n |
| Response | ESC[Pl;PcR<br>Pl=Row<br>Pc=Column |

Request for device attributes

| | |
|---|---|
| Request | ESC[c<br>or<br>ESC[0c |
| Response | ESC[?6c |

## DESIGNATE CHARACTER SET

G0 character set

| | |
|---|---|
| UK character set | ESC(A |
| ASCII character set | ESC(B |
| Graphics character set | ESC(0 |

G1 character set

| | |
|---|---|
| UK character set | ESC)A |
| ASCII character set | ESC)B |
| Graphics character set | ESC)0 |

The G0 character set is selected by performing a shift in (SI), CTRL O. The G1 character set is selected by performing a shift out (SO), CTRL N.

## PRINT COMMANDS

Auto print mode

| | |
|---|---|
| Enter auto print mode | ESC[?5i |
| Exit auto print mode | ESC[?4i |

Print controller mode

| | |
|---|---|
| Enter print controller mode | ESC[5i |
| Exit print controller mode | ESC[4i |
| Print screen | ESC[i<br>or<br>ESC[0i |
| Print cursor line | ESC[?1i |

## SELF-TEST DIAGNOSTICS

These ANSI-only commands perform a variety of diagnostic self-tests in the CIT-414a. Note that if continuous testing is selected, control of the terminal can only be regained if an error is detected or by placing Power OFF and back ON.

Self test ESC[2;1y

where "Ps" is a parameter chosen for the desired test(s) as follows:

| Function Tested | Parameter |
|---|---|
| Same as power up | 1 |
| ROM | |
| NVR | |
| RAM | |

## SUMMARY OF ANSI CONTROL SEQUENCES

Table 4-7 is a summary of valid CIT-414a ANSI mode control and escape sequences. Default values are given in parentheses at the end of each line.

TABLE 4-7. SUMMARY OF ANSI MODE CONTROL SEQUENCES

| SEQUENCE | FUNCTION |
|---|---|
| ESC#8 | Fill screen with uppercase E's |
| ESC(A | Designate UK character set as G0 |
| ESC(B | Designate ASCII character set as G0 |
| ESC(0 | Designate graphics character set as G0 |
| ESC)A | Designate UK character set as G1 |
| ESC)B | Designate ASCII character set as G1 |
| ESC)0 | Designate graphics character set as G1 |
| ESC7 | Save cursor and attributes |
| ESC8 | Restore cursor and attributes |
| ESC= | Set numeric keypad application mode |
| ESC> | Set numeric keypad normal mode |
| ESCD | Move cursor down one line |
| ESCE | Move cursor to first character position next line down |
| ESCH | Set tab at current cursor position (column) |
| ESCM | Move cursor up one line |
| ESCc | Reset terminal to initial state |
| ESC[PnA | Move cursor up Pn lines (1) |
| ESC[PnB | Move cursor down Pn lines (1) |
| ESC[PnC | Move cursor forward(right) Pn places (1) |
| ESC[PnD | Move cursor back(left) Pn places (1) |
| ESC[Pn;PnH | Position cursor to Pn row, Pn column (1) |
| ESC[0J | Erase from cursor to end of display |
| ESC[1J | Erase from beginning of display to cursor |
| ESC[2J | Erase entire display |
| ESC[0K | Erase from cursor to end of line |
| ESC[1K | Erase from beginning of line to cursor |
| ESC[2K | Erase entire line |
| ESC[PnL | Insert Pn lines |
| ESC[PnM | Delete Pn lines |
| ESC[PnP | Delete Pn characters |
| ESC[c OR ESC[0c | Report device attributes, response is ESC[?6c |
| ESC[Pn;Pnf | Same as ESC[Pn;PnH (1,1) |
| ESC[0g | Clear tab at cursor column position (0) |
| ESC[3g | Clear all tab stops |
| ESC[2h | Set keyboard locked |
| ESC[4h | Set insert mode |
| ESC[12h | Set local echo off |
| ESC[20h | Set newline mode |
| ESC[2l | Reset keyboard locked |
| ESC[4l | Reset insert mode |
| ESC[12l | Reset local echo on |
| ESC[20l | Reset to line feed from new line mode |
| ESC[?1h | Set cursor key application mode |
| ESC[?5h | Set reverse screen mode |

TABLE 4-7. SUMMARY OF ANSI MODE CONTROL SEQUENCES(CONT)

| SEQUENCE | FUNCTION |
|---|---|
| ESC[?6h | Set origin mode |
| ESC[?7h | Set auto wraparound mode |
| ESC[?8h | Set auto repeat mode |
| ESC[?18h | Print form feed on |
| ESC[?19h | Print extent full screen |
| ESC[?1i | Print cursor line |
| ESC[?4i | Exit auto print mode |
| ESC[?5i | Enter auto print mode |
| ESC[i or ESC[0i | Print screen |
| ESC[4i | Exit print controller mode |
| ESC[5i | Enter print controller mode |
| ESC[?1l | Reset cursor key application mode |
| ESC[?2l | Reset to VT52 mode |
| ESC[?5l | Reset to normal screen mode |
| ESC[?6l | Reset to cursor origin mode |
| ESC[?7l | Reset auto wraparound mode |
| ESC[?8l | Reset auto repeat mode |
| ESC[?18l | Print form feed off |
| ESC[?19l | Print extent scrolling region |
| ESC[?15n | Request for printer status, response is:<br>ESC[?10n Printer ready<br>ESC[?11n Printer not ready<br>ESC[?13n No printer |
| ESC[0m | Select normal graphic rendition, visual with no attributes (0) |
| ESC[7m | Select reverse video characters (background and foreground reversed) |
| ESC[5n | Report terminal status, response is:<br>ESC[0n Terminal is OK<br>ESC[3n Terminal is not OK |
| ESC[6n | Report cursor position,response is:<br>ESC[Pl,PcR Pl=line,Pc=column |
| ESC[0q | Turn off all LEDs (0) |
| ESC[Pnq | Turn on LED Pn (1 thru 4) |
| ESC[RT;RBr | Set scrolling region at top row (RT) and bottom row (RB)(default is entire screen) |
| ESC[2;1y | Invoke power-up diagnostic test |
| ESC[2;2y | Invoke dual port loop back test |
| ESC[2;4y | Invoke EIA loop back test |
| ESC[2;Psy | Invoke specified test |

## VT52 MODE CONTROL SEQUENCES

The CIT-414a control sequences defined here are valid in the VT52 mode of operation. Unless otherwise noted actions described are taken in response to receipt of the indicated control sequence.

### Cursor control sequences

| | |
|---|---|
| Move cursor up | ESCA |
| Move cursor down | ESCB |
| Move cursor right | ESCC |
| Move cursor left | ESCD |

The cursor is moved one row, up or down, or one column, left or right, as specified. Cursor will not move beyond margin limits.

### Move cursor home

| | |
|---|---|
| Home cursor | ESCH |

The cursor is moved to the home position at the upper left corner of the display.

### Position cursor

| | |
|---|---|
| Move cursor | ESCYrc |

Position cursor to specified row (r) and column (c). Row and column values are sent in ASCII code plus octal 37. For example, row 2 is octal 41 (37+2).

### Erase control

| | |
|---|---|
| Erase to end of line | ESCK |
| Erase to end of page | ESCJ |

### Graphics mode

| | |
|---|---|
| Enter special graphics mode | ESCF |
| Exit special graphics mode | ESCG |

### Keypad application mode

| | |
|---|---|
| Enter keypad application mode | ESC= |
| Exit keypad application mode | ESC> |

### Print commands

| | |
|---|---|
| Print cursor line | ESCV |
| Enter print controller mode | ESCW |
| Exit print controller mode | ESCX |
| Print screen | ESC] |
| Exit auto print mode | ESC_ |
| Enter auto print mode | ESC^ |

Scroll

| | |
|---|---|
| Reverse line feed | ESC: |

Moves the cursor up one row in the same column. If cursor is at the top margin, a scroll down is performed.

ANSI mode

| | |
|---|---|
| Enter ANSI mode | ESC< |

Request identity

| | |
|---|---|
| Identify terminal type | ESCZ |
| Transmit identifier sequence | ESC/Z |

SUMMARY OF VT52 CONTROL SEQUENCES

Table 4-8 is a summary of valid CIT-414a VT52 mode control sequences.

TABLE 4-8. SUMMARY OF VT52 MODE CONTROL SEQUENCES

| SEQUENCE | ACTION |
|---|---|
| ESC< | Enter ANSI mode from VT52 mode |
| ESC= | Enter alternate keypad mode |
| ESC> | Exit alternate keypad mode |
| ESCA | Move cursor up one row |
| ESCB | Move cursor down one row |
| ESCC | Move cursor right one column |
| ESCD | Move cursor left one column |
| ESCF | Enter special graphics mode |
| ESCG | Exit special graphics mode |
| ESCH | Move cursor to home position |
| ESCI | Reverse line feed |
| ESCJ | Erase to end of page |
| ESCK | Erase to end of line |
| ESCU | Enter concurrent auxiliary mode |
| ESCV | Print cursor line |
| ESCW | Enter print controller mode |
| ESCX | Exit print controller mode |
| ESCY | Direct cursor addressing |
| ESCZ | Identify terminal type |
| ESC] | Print screen |
| ESC_ | Exit auto print mode |
| ESC^ | Enter auto print mode |

## GRAPHICS MODE

### Alpha Mode

The alpha mode is entered automatically when TEK mode is selected with ESC1 from the ANSI mode. Once in TEK graphic plot mode alpha mode is selected by; program command CR, program command sequence ESC FF, program command US (except in GIN mode), or keyboard command ESC CTRL L.

Display Formatting

Display formatting is controlled by the following:

ESC FF selects home and erases the display

CR returns the cursor to the left margin; it may also cause line feed if selected in SET-UP mode.

LF causes a line feed

HT causes the cursor to move right one space

BS causes the cursor to move left one space

VT causes the cursor to move up one line

Automatic commands

The home position is selected automatically when the mode is initialized. The largest character size is also selected.

Line feed and carriage return occur after entering a writing character or a space in the last character position on any line. This feature is selected in SET-UP mode.

A line feed (automatic or program command) past the bottom line causes a change between margin 1 and margin 2 as selected in SET-UP mode.

Graphic character size

The available character sizes and the control sequences used to select them are listed in table 4-8.

TABLE 4-8. ALPHA CHARACTER SIZES

| CHARACTERS PER LINE | LINES PER PAGE | CHARACTERS PER DISPLAY | CONTROL SEQUENCE |
|---|---|---|---|
| 74 | 35 | 2590 | ESC8 |
| 81 | 38 | 3078 | ESC9 |
| 121 | 58 | 7018 | ESC: |
| 133 | 64 | 8512 | ESC; |

## Graphic Plot Mode

The graphic plot mode is entered by the program control command GS. The following definitions apply to this mode of operation as described in this section.

VECTOR WRITING RATE-More than 10,000 pixels per second.

ADDRESS-An address is any point within the 1024Y by 1024X capability of the terminals beam positioning registers. In the standard format Y axes addresses higher than 779Y fall outside the screens specified display area. Figure 4-1 illustrates the display format.

COMPLETE ADDRESS-A complete graphic address consists of four data bytes; Hi Y, Lo Y, HI X and Lo X which are received in this order.

SHORTENED ADDRESS-Addresses may sometimes be reduced to one, two or three bytes, but must always contain a Lo X byte. Refer to the graph mode memory description.

VIEWABLE ADDRESS-Any point within the 780Y by 1024X grid quality display area can be seen.

VECTOR SET-UP TIME-The time required to receive and establish the vector address, exclusive of vector writing time.

VECTOR EXECUTION-This is accomplished only upon receipt of the LO X byte.

DARK VECTOR-A dark vector is an unwritten vector, which always occurs upon execution of the first vector to be received after a GS command.

WRITTEN VECTOR-normally, the second and any subsequent address received after a GS command results in a written vector. However, if the first vector following a GS is preceded by a BEL, the first vector is also written.

POINT WRITING-A point can be written by executing a GS and then executing the same address twice. The second address command requires only the Lo X byte.

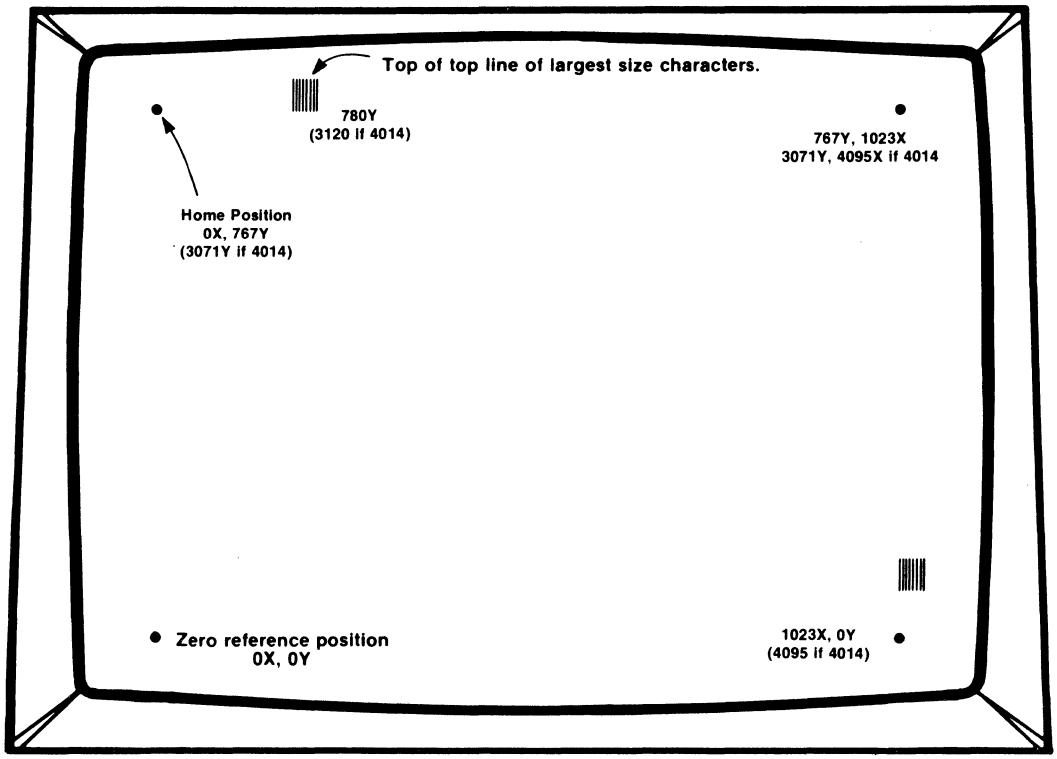



FIGURE 4-1. DISPLAY FORMAT

## GRAPH MODE TERMINATION

The graph mode can be terminated (exited) by any of the following program commands:

ESC FF-This command erases the display, homes the cursor, and selects the alpha mode.

CR-This command selects the alpha mode and sets the cursor to margin 1 if a vector has been executed while in the graph mode.

US-This command selects the alpha mode and leaves the cursor at the last graph mode position.

RS-This command selects the incremental plot mode.

FS-This selects the point plot mode.

## GRAPH MODE KEYBOARD COMMANDS

These command sequences when entered at the keyboard perform the following functions:

ESC CTRL L-This sequence selects the TEK alpha mode, homes the cursor, and clears the display.

ESC DEL-This sequence selects the alpha mode and homes the alpha cursor. The terminal graphics circuits are also initialized.

## DISPLAY BEAM ADDRESSING

In the graph mode the beam ic positioned to an X,Y coordinate by sending to the terminal the coordinates for that point. Each X and Y coordinate is sent to the terminal in the form of a high (Hi) and low (Lo) order byte. The HI order byte is formed from the five most significant bits (MSB) of the binary equivalent for that X or Y point. The Lo order byte is formed from the five least significant (LSB) bits. As an example consider the following:

| COORDINATE | BINARY EQUIVALENT | HI Y BYTE | LO Y BYTE | HI X BYTE | LO X BYTE |
|---|---|---|---|---|---|
| 205Y | 0011001101 | 00110 | 01101 | | |
| 148X | 0010010100 | | | 00100 | 10100 |

The ASCII equivalent for the bytes can be determined from the coordinate conversion charts in appendix C. In the above example the Hi Lo coordinates for point 205Y are the ASCII characters & and m, while for point 148X they are $ and T.

## GRAPH MODE MEMORY

Three of the bytes (Hi Y, Lo Y, and Hi X) are stored by the terminal when received. Once received by the terminal they are not required in subsequent transmissions unless their value has changed. In particular they do not have to be reloaded when the terminal is reset to alpha mode. This feature may be used to advantage when displaying mixed graphics and alphanumerics. However, if one of the stored bytes changes, that byte plus at least one of the other bytes are required. The requirements are as follows:

When Hi Y changes HI Y and Lo X byte must be sent

When Lo Y changes Lo Y and Lo X byte must be sent

When Hi X changes Hi x, Lo Y and Lo X must be sent

When Lo X changes only the Lo X byte must be sent

## GIN MODE CONTROL SEQUENCES

TRANSMIT ALPHA CURSOR ADDRESS

ESQ ENQ-When the terminal receives this control sequence in alpha mode, it responds with the following:

1. Terminal status byte
2. 4-byte address of the lower left corner of the alpha cursor.
3. CR (if selected)
4. EOT (if selected and cannot be sent without CR)

The terminal returns to the alpha mode after completing the transmission. This sequence is ignored in the graphic plot mode. Figure 4-3 depicts the response by the terminal to an ESC ENQ.

CAUTION

*ESC CTRL Z IS ILLEGAL IN SIMULATED ON LINE MODE. USE OF THIS SEQUENCE MAY RESULT IN TERMINAL MALFUNCTION AND THE TERMINAL MUST BE RESET.*

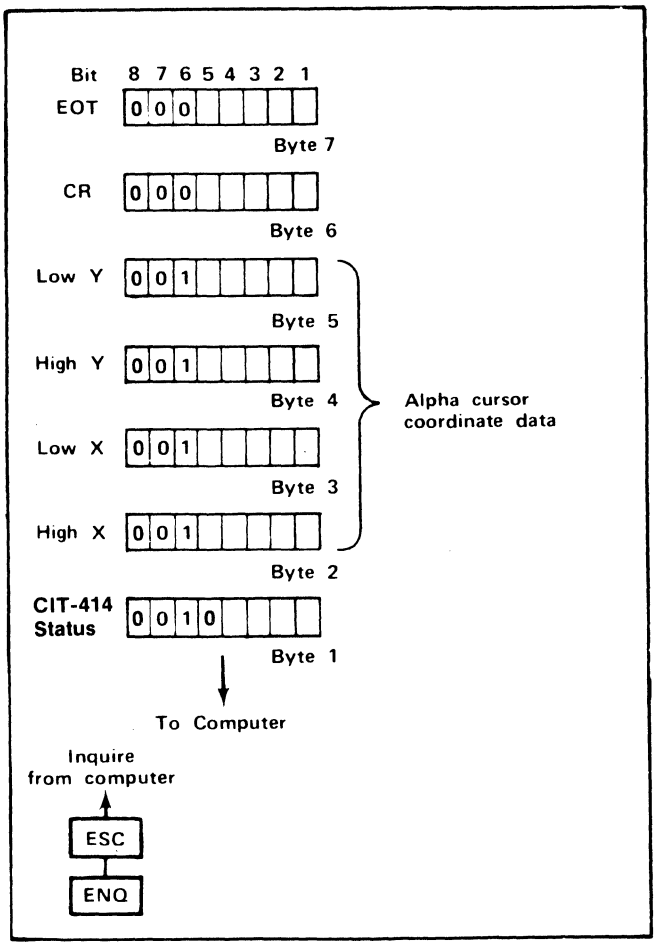



FIGURE 4-2. RESPONSE TO ESC ENQ.

## DISPLAY CROSSHAIR CURSOR

ESC SUB-When the terminal receives this control sequence, the crosshair cursor is displayed. The crosshair cursor can be positioned with the keyboard cursor positioning keys. This control sequence should not be entered at the keyboard while the terminal is in the online mode.

## TRANSMIT CROSSHAIR CURSOR ADDRESS

ESC ENQ-When the terminal receives this control sequence and the crosshair cursor is displayed, it responds with the following:

1. The 4-byte address of the crosshair cursor intersect point

2. CR (if selected)

3. EOT (if selected and cannot be sent without CR)

The terminal returns to the alpha mode after completing the transmission. A 20 ms delay must occur between ESC SUB and ESC ENQ. Figure 4-3 depicts the format to the host in response to an inquiry which consists of ESC SUB, a 20 ms delay and ESC ENQ.

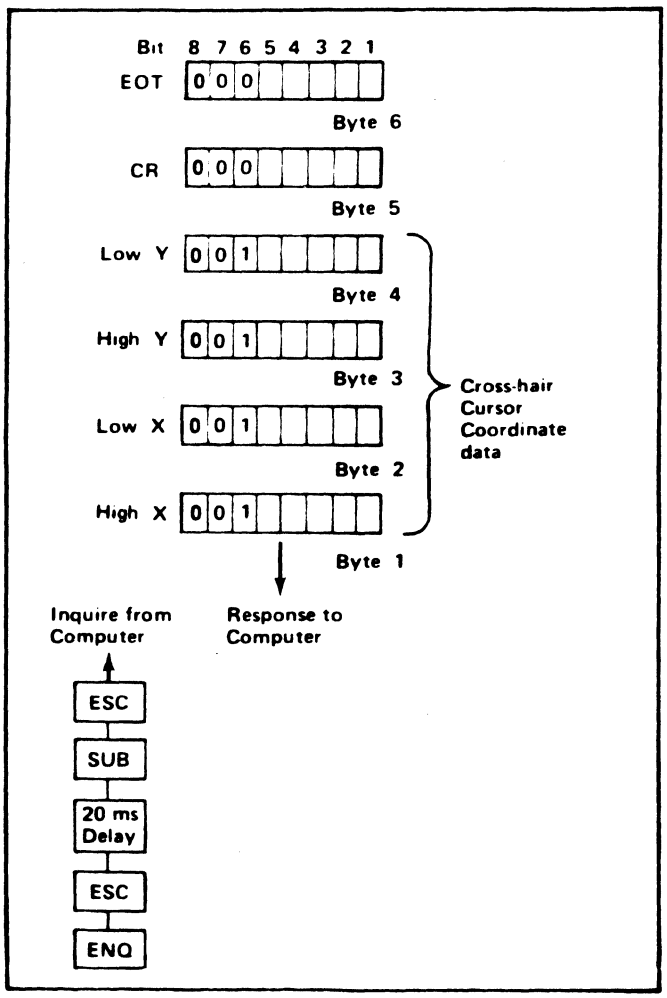



FIGURE 4-3. TRANSMIT CROSSHAIR CURSOR ADDRESS RESPONSE

Keyboard transmission of crosshair cursor address

The crosshair cursor address is also transmitted if a character is entered at the keyboard after an ESC SUB sequence has been received.

When the crosshair cursor appears on the screen following an ESC SUB, the operator may position the crosshair cursor. A character entered at the keyboard results in transmission of that character followed by the 4-byte address of the crosshair cursor intersect point. A CR if selected is sent along with the EOT if selected. An EOT cannot be sent without a CR.

The terminal returns to the alpha mode after completing the transmission. Figure 4-4 depicts the format to the host when transmission is initiated by the operator.

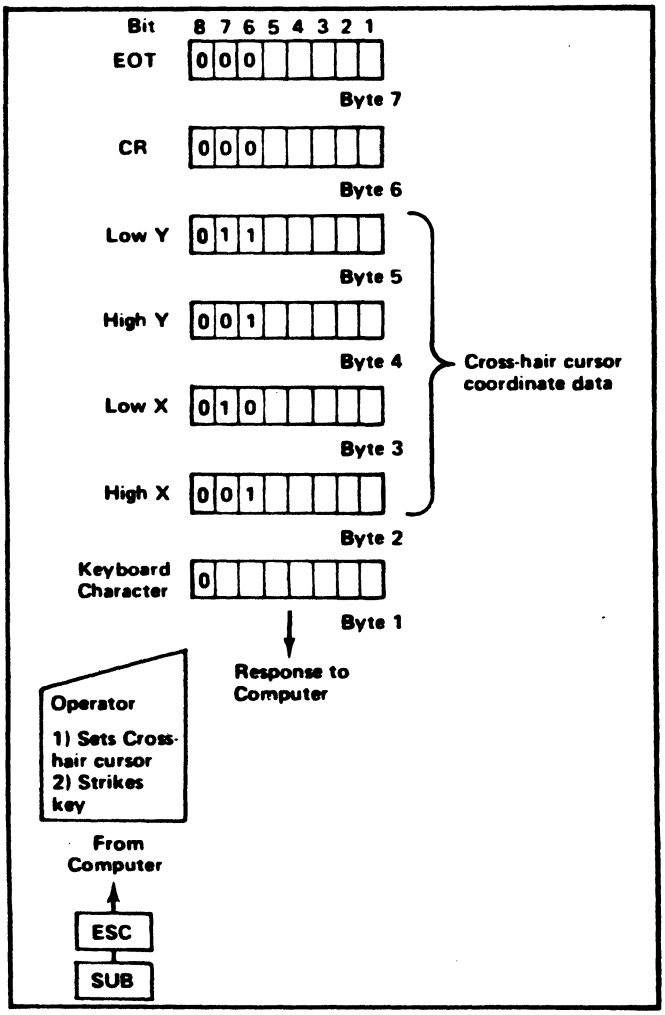



FIGURE 4-4. OPERATOR INITIATED RESPONSE TO ESC SUB

## BYPASS CONDITION

The terminal is in a bypass condition whenever it is in the GIN mode. In the bypass condition the terminal will not display any GIN mode data or echoed GIN mode data. The bypass condition is cleared when the GIN mode is terminated and the character generator is reset.

The GIN mode is terminated when the GIN mode data has been transmitted to the host and CR is the last character in the GIN mode data string and is echoed. A CR places the terminal in the alpha mode and may leave the terminal in margin 1 or margin 2 status. GIN mode data echoed back to the terminal may affect the graph mode circuits, the operating mode, or writing beam position.

It can also be terminated, while the crosshair cursor is displayed, by a CR or ESC FF sequence. This terminates the GIN mode and places the terminal in the alpha mode without transmitting GIN mode data to the host. However, the CR may place the terminal in margin 1 or margin 2 status and an ESC FF will clear the display. An alternative would be to send an ESC ENQ from the host and ignore the subsequent GIN mode data transmission.

The following control sequences also clear the GIN mode and reset the character generator clearing the bypass mode:

BEL
CR
ESC ETB
ESC
FF
LF
US
SI

All these controls except BEL, ESC ETB, and US affect the display or position of the alpha cursor.

The GIN mode can also be terminated by the operator by entering an ESC CTRL L or CTRL CLEAR at the keyboard. This also resets the character generator clearing the bypass condition.

STATUS BYTE

The status byte is defined as follows:

| | |
|---|---|
| Bit 8 | Always 0 |
| Bit 7 | Always 0 |
| Bit 6 | Always 1 |
| Bit 5 | Always 0 |
| Bit 4 | Vector bit; 1 indicates graph mode |
| Bit 3 | Graph mode bit; 0 indicates graph mode |
| Bit 2 | Margin bit; 1 indicates that margin 2 exists. With margin 2 in effect, the most significant X bit (512) of the alpha cursor address must be considered to be true (1), regardless of how it was transmitted. The cursor is therefore on the right half of the screen. If the transmitted address is less than 512, and margin 2 exists, the X value must be increased by 512 to indicate beam position with respect to the left edge of the screen (X=0 position). |
| Bit 1 | Always 0 |

## Graphic Mode Features

The following features are also available in the graphics mode:

1. 4096 addressable points
2. Vector line formats
3. Incremental plot mode
4. Point plot mode

### 4096 point addressability

This feature allows graph mode addressing on a 4096 by 4096 matrix (4096X by 3120Y viewable). This increases the resolution by a factor of four over the normal mode. This address resolution requires that two additional bits to be added to each axis address (12 bits); therefore an extra byte must be inserted in the vector address string. 4096 addressability is upwards and downwards compatible with 1024 (10 bit) software (4010, 4012, and 4013), and vice-versa. Refer to programming.

To establish an address in the addressable point grid of 4096X by 4096Y, 12 bits of Y data (24 bits total) must be transmitted to the terminal. This necessitates the use of an extra 7-bit byte in the vector address. The transmission order is shown in table 4-10, which also shows the byte content.

The extra byte need not be sent but the low order Y byte must always be sent if the extra byte is sent. The rules for shortened address transmission only change if the extra byte changes; then send the extra byte, low Y, and low X bytes.

TABLE 4-10. VECTOR ADDRESS DATA STRING

| BYTE NAME | 7-BIT ASCII CHARACTERS | | |
|---|---|---|---|
| | TAG BITS | | ADDRESS BITS |
| High order Y | 0 | 1 | 5 MSB of Y address |
| Extra byte | 1 | 1 | * Y2 Y1 X2 X1 |
| LOW ORDER Y | 1 | 1 | 5 INTERMEDIATE BITS OF Y ADDRESS |
| HIGH ORDER X | 0 | 1 | 5 MSB OF X ADDRESS |
| LOW ORDER X | 1 | 0 | 5 INTERMEDIATE BITS OF X ADDRESS |

* Note that bits 7 and 6 of the extra byte must be ones. Bit 5 can be used to set margin 1. Bits 4 and 3 contain the two least significant bits of the 12-bit y address, and bits 2 and 1 contain the two least significant bits of the 12-bit X address.

### Vector line formats

Vectors can be plotted as either dotted, dot-dash, short dash, or long dash lines. The vector line type is selected by the control sequence ESC and a specific ASCII character.

Vector types (continuous, dotted, short-dash, long-dash, dot-dash) are dependent on the last control sequence received. GS sets the graph mode, but the next control sequence of ESC plus a lower case character code determines the vector type. This information is provided in tables 4-11 and 4-12. All vector writing starts at the beginning of the longest written element of the vector pattern; i.e., the dot-dash pattern always starts at the beginning of the dash.

TABLE 4-11. BEAM AND VECTOR SEQUENCES

| ASCII CHARACTER | APL CHARACTER | DECIMAL | FUNCTION |
|---|---|---|---|
| ESC | ESC | 96 | Normal vectors or alpha mode |
| ESCa | ESCA | 97 | Dotted line vectors |
| ESCb | ESCB | 98 | Dot dash vectors |
| ESCc | ESCC | 99 | Short dash vectors |
| ESCd | ESCD | 100 | Long dash vectors |
| ESCh | ESCH | 104 | Normal vectors or alpha |

TABLE 4-12. FUNCTION VERSES BIT CONFIGURATION FOR VECTOR TYPE

| DESIRED FUNCTION | REQUIRED BIT CONFIGURATION | | | | | | |
|---|---|---|---|---|---|---|---|
| | B7 | B6 | B5 | B4 | B3 | B2 | B1 |
| Normal vectors | 1 | 1 | | | 0 | 0 | 0 |
| Dotted vectors | 1 | 1 | | | 0 | 0 | 1 |
| Dot dash vectors | 1 | 1 | | | 0 | 1 | 0 |
| Short dash vectors | 1 | 1 | | | 0 | 1 | 1 |
| Long dash vectors | 1 | 1 | | | 1 | 0 | 0 |

Point plot mode

When the terminal receives the point plot command FS the terminal plots (writes) the end point of the vector. The received data is identical to standard vector plots.

To enter point plot mode, send the ASCII control character FS. The keyboard equivalent is CTRL \. Data format is identical to normal graphic input. The only difference is that just the end point (* addressed point) is drawn. Point plot mode can only be entered from the alpha or graph mode. Thus if a graphic mode other than the standard graph mode has previously been selected, the terminal will have to be returned to alpha before point plot can be selected.

Incremental plot mode

When the terminal receives the RS control character, the character following this code determines whether the beam is turned on or off. The next character determines the direction in which the writing beam moves. Incremental plot uses relative addressing (one 7-bit byte addresses a point).

The terminal plots in one point in this mode. The ASCII control character RS selects this mode. The character that follows RS must be a write command-beam off or beam on. The write command is followed by an increment command. The write status does not change until a different write command is received. If desired, the display beam can be addressed to the desired starting point in graph vector mode; then placed in incremental plot mode by RS. The ASCII characters shown in table 4-13 would result in the indicated action when received in incremental plot mode. Once the write condition is set (beam off or beam on), subsequent directional movement bytes have bits 5 and 6 at zero.

TABLE 4-13. INCREMENTAL PLOT MODE CHARACTERS

| CHARACTER | | | BITS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | DECIMAL | APL | 7 | 6 | 5 | 4 | 3 | 2 | 1 | INDICATED ACTION |
| SP | 32 | SP | 0 | 1 | 0 | 0 | 0 | 0 | 0 | BEAM OFF(PEN UP) |
| P | 80 | * | 1 | 0 | 1 | 0 | 0 | 0 | 0 | BEAM ON(PEN DOWN) |
| D | 68 | ⌊ | 1 | 0 | 0 | 0 | 1 | 0 | 0 | N↑ |
| E | 69 | ∈ | 1 | 0 | 0 | 0 | 1 | 0 | 1 | NE↗ |
| A | 65 | ∝ | 1 | 0 | 0 | 0 | 0 | 0 | 1 | E→ |
| I | 73 | ⌊ | 1 | 0 | 0 | 1 | 0 | 0 | 1 | SE↘ |
| H | 72 | △ | 1 | 0 | 0 | 1 | 0 | 0 | 0 | S↓ |
| J | 74 | ○ | 1 | 0 | 0 | 1 | 0 | 1 | 0 | SW↙ |
| B | 66 | ⊥ | 1 | 0 | 0 | 0 | 0 | 1 | 0 | W← |
| F | 70 | _ | 1 | 0 | 0 | 0 | 0 | 1 | 1 | NW↖ |

ONCE THE WRITE CONDITION IS SET (BEAM OFF OR BEAM ON), SUBSEQUENT DIRECTIONAL MOVEMENT BYTES HAVE BITS 6 AND 5 AT ZERO.

## NATIVE MODE

The native mode provides additional graphics capability beyond that provided with Tektronix emulation. Highlights are:

1. Unique vector format specification (X1, Y1. (X2, Y2.) (X3, Y3.)...etc. where X and Y are readable integers that specify the address of the vector end points.

2. Relative addressing of vectors.

3. Relocatable origin.

4. Magnification of vector image (smaller or larger).

5. Box drawing.

6. Arc drawing.

For example, once in the native graphics mode, a vector is drawn by specifying the beginning and end address of the vector:

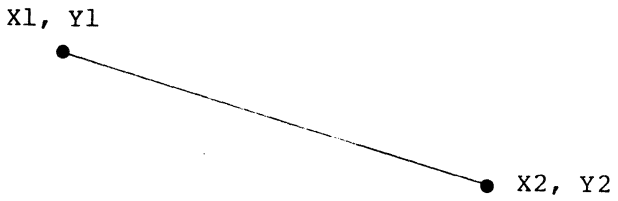
| | |
|---|---|
| 100, | Establishes X address 100. |
| 100. | Establishes Y address 100. |
| ( | Makes last specified X and Y values the beginning of the line. (The beginning and end of the line are now the same.) |
| 400, | Establishes the end of line as X address 400. |
| 400. | Establishes the end of line as Y address 400. |
| ) | Draws the line between 100,100 and 400,400. |

The native mode is set up for 4096 horizontal by 3120 vertical addressable dots mapped to 670 by 500 real visible dot resolution. The origin is located in the upper left corner, and may be relocated anywhere on the 670 X 500 visible screen. The x value increases to the right and y increases downward.

Once in the native graphics mode, any number followed by a comma (,) will make that number an X coordinate; any number followed by a period (.) will make that number a Y coordinate. These coordinates will be the end point of the line. The left parenthesis ' (' copies the end point coordinate to be the beginning of the line so that new end points can be specified, and the right parenthesis ')' causes the line to be displayed. As an example:

X1, Y1. (X2, Y2.)

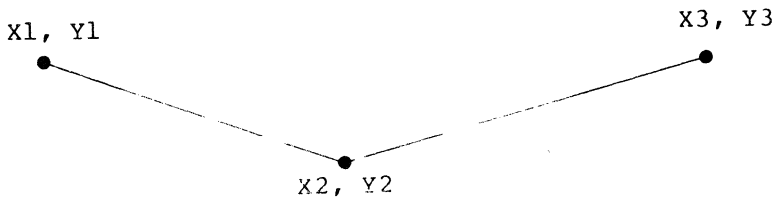
Is a standard format for drawing a line between X1, Y1, and X2, Y2. (X1, Y1, X2, Y2 are integer numbers representing the beginning and end of a line):




To continue this line to X3, Y3, all that is required is to send:

(X3, Y3.)

The result would be:



Notice that the commands sent were X1, Y1. (X2, Y2.) (X3, Y3.)

This is identical to using the standard format (however, more characters are required):

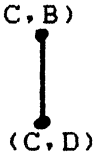
```
X1, Y1.  (X2, Y2.)
X2, Y2. (X3, Y3.)
```

Both methods accomplish the same results.

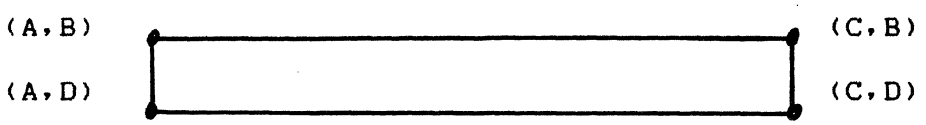
Other useful examples are given below:

Horizontal line: (A, B.(C,)

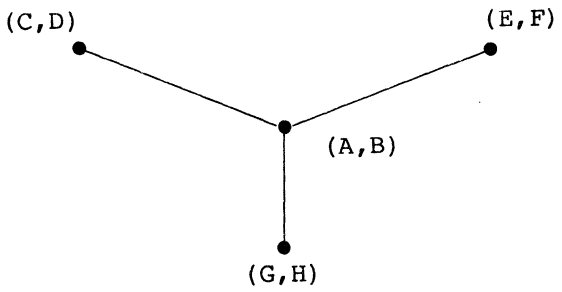

Vertical line: (C,B.(D.)




Rectangle: (A, B.(C,)(D.) (A,) (B.)




Radials: (A, B.(C,D.) E.F.)G, H.)




Single dot: (A,B.( ) (A,B)

**Native Mode Commands**

The native mode is strictly an alternate graphic mode to the 4014 graphics mode. There are no character sets. The control codes that are started with an ESC character are identical to those in the normal Tektronix modes. Single character control codes are completely different. The following is a list of the native mode single character control codes: (ESC= Escape, ^=CTRL)

| | |
|---|---|
| ESC0 | Enters native mode. |
| FF | Clear screen (^L). Note that this clear screen does not exit the graphics mode. (ESC FF does.) |
| GS | Switch to Tektronix graphics mode (^]). |
| US | Switch to Tektronix alpha mode. (^-). |
| * | Switch to Tektronix alpha mode. |
| 0-9 | Enter number.<br>The accumulator is multiplied by 10 and the new number is added to it. When any control code uses the data in the accumulator, it is automatically cleared back to a value of 0. |
| | Enter x value.<br>The contents of the accumulator are copied into the top of the x stack and the accumulator is cleared to 0. If a minus sign had been entered, the value is negated first. If an R had been entered, then the value is added to the previous value on the top of the x stack before being stored back onto the stack. |
| | Enter y value.<br>Same as, above except for the y stack. |
| | Negate accumulator contents.<br>The minus sign may precede a number or be sent anytime prior to sending a numeric terminator. |
| R | Flag for relative value.<br>The relative value flag is tested when the contents of the accumulator are about to be stored somewhere. If the flag is set, the old value in the 'somewhere' is added to the value from the accumulator and the result is stored |

back into the 'somewhere'. For example, to draw continuous vectors incrementally the next position by 100 dots for both x or y:

| | |
|---|---|
| ESC 0 | Enters native mode. |
| ^L | Clears screen. |
| 100, 500. | Specifies starting point. |
| (100R, 100 R.) | Adds 100 to X and Y and draws a line. |
| (100R,-100 R.) | Adds 100 to X and subtracts 100 from Y and draws a line. |
| (100R, 100 R.) | Adds both X and Y and draws a line. |

NOTE

*The above is different from absolute addressing where each end point address must be specified.*

; Set x origin.

The value in the accumulator is used to set the x origin. When anything is drawn (including characters in Tek modes), the calculated x position is added to the x origin before being used to address the screen for storage. A value of 100 in the accumulator will therefore move anything drawn over by 100 physical dots to the right. Note that the origin translation is applied last and is therefore in physical screen units (670 dots horizontally).

: Set y origin.

Same as; above except for y. The y axis is physically 500 dots high.

W Set write mode. (Where n = 0 to 2).

Uses the value in the accumulator to select one of 3 writing modes. A value of 0 will select the "OR" mode which has the effect of overlaying lines and characters. A value of 1 will select the "XOR" mode which will cause the existing dots to be reversed when a new dot is written over them. This allows a line to be drawn and then redrawn to erase it and leave all the other dots unchanged. A value of 2 will set the "CLEAR" mode which causes the dots to be written black, i.e. erased. Any other value will be taken as a value or 0.

( Push x, y stack.

Causes the values in the top locations of the x and y stack to be copied down to the bottom of their respective stacks. The top and bottom of the stacks have different significance when drawing lines and shapes.

X Set x gain.

Stores the accumulator value into the x gain register. The gain is biased by a factor of 256 and can be calculated by multiplying the desired gain factor by 256 to get the value to be placed in the accumulator. This means that a gain of 2 (magnifying by a factor of 2) would be entered as 512. Note that the gain stays set even when exiting back to TEK modes. The gain always is relative to the nominal image size so that a gain of 2 will double the size of a line drawn in native mode and will double the size of a line drawn in TEK mode even though the lines would be specified differently and with different aspect ratios. Again of 0 is the same as a gain of 1.

Y Set y gain.

Same as X above except for y gain.

) Draw line.

Draws a vector from the starting point specified by the values at the bottom of the x and y stacks to the ending point specified by the values at the top of the x and y stack.

] Don't draw line.

Same as ) command above except the line is not drawn. Has the effect of positioning the beam to the end point of the line that is not drawn. This is useful for positioning the alpha cursor before entering the TEK alpha mode.

B Draw box.

Draws a rectangular box using the x values in the x stack as the width coordinates and the y values in the y stack as the height coordinates. The coordinates do not have to be entered in any particular order. Boxes are easily drawn using the native vector mode. Instead of using the right parenthesis command, use B for a terminator to draw the box. For example:

```
ESC 0                 Enters native graphics mode
100,100.(500,500.     Specifies corners of box
B                     Draws box
^L                    Clears screen
)                     Draws diagonal line
B                     Draws box
*                     Enters TEK alpha mode
```

L Set arc length.

Stores the accumulator contents into the arc length register. The arc length is specified as a fraction of a full circle times 256. For example, a full circle would have an arc length of 256 (or 0 or some integral multiple of 256) while a half circle would have an arc length of 128. If the arc length is known in degrees, the value in the accumulator should be set to 256 times the number of degrees divided by 360. See the following parameters (I, ) for additional information.

I Set arc increment.

Stores the accumulator contents into the arc increment register. The arcs are generated by a succession of line segments which are chords of the true arc. Normally, the line segments have to traverse an arc length of 4 (which means a full circle is approximated by 64 short line segments). The arc increment is the same as the arc length of these line segments. For example, if the arc increment value was set to 32, then the circle would be approximated by 8 line segments thus producing a regular octagon. A square would have an arc increment of 64 while a triangle would have an arc increment of 85. Note that if the arc increment specified does not exactly close to the arc increment that was specified with L above, then the remainder of the arc is approximated by line segments with length=1.

}

Draw arc.

An arc with center of curvature equal to the x and y values at the bottom of the x and y stacks and a starting point equal to the values at the top of the x and y stacks is drawn using line segments of the specified (by I above) arc length (increment) for that portion of a full circle specified by L above. For example, to draw a circle with a radius 100 and centered around x=500 and y=500, the following sequence would be used:

(500,500.(600,500.0I0L}

Note that the increment is specified as 0 but the minimum (except for automatic arc completion) increment is 4 and that is what would be used. Also, the increment and length do not have to be specified every time if they are already at the desired values. Assuming this, and using relative entry to specify the radius more directly the circle could also have been drawn by:

(500,500.(100,}

Concentric circles could be drawn at 100 point radius intervals by:

(500,500.(100R,}100R,}100R,}

which would draw 3 circles all centered around 500,500 with radii of 100, 200, and 300.

V

Turn graphics video on/off.

If the accumulator value is 0, graphics video is turned off. If the accumulator value is non-zero, the graphics video will be turned back on. Also, drawing any dot/line/shape will turn the graphics video back on. Entering TEK mode will turn graphics video back on also.

F

Fill area.

Fills from the present physical screen location to the boundaries of the plot by complementing all dots (white dots become black, black dots become white). Boundaries are defined by pixels that are complements of the beginning pixel. For example, if a rectangle were drawn and any pixel within the rectangle was then addressed (followed by an F), the rectangle would fill with white dots from the addressed pixel out to the sides of the rectangle. Multiple area fills can not be done with large number of return area fills at one time.

# APPENDIX A
# ANSI DEFINITIONS

This appendix provides definitions of ANSI terms as they relate to the information contained in this document and the CIT-414A terminal. For further definitions of ANSI terms refer to ANSI documents X3/TR-1-77, X3.4-1977, X3.41-1974 and X3.64-1979.

**active position.** The character position in a visual display that is ti image the graphic symbol representing the next graphic or control character for which a graphic representation is required.

**control character.** A character whose occurrence in a particular context initiates, modifies, or stops a control function.

**control function.** An action that affects the recording, processing, transmission, or interpretation of data.

**control sequence.** A sequence of characters that is used for control purposes to perform a control function. It begins with a Control Sequence Introducer (CSI) control character and may contain a parameter string.

**Control Sequence Introducer(CSI).** A control character (in 8 bits) or an Escape sequence (in 7 bits) that provides supplementary controls and that is itself a prefix affecting the interpretation of a limited number of contiguous bit combinations.

**control string.** A string of characters that is used to perform a control function and is delimited by an opening and closing delimiter control.

**cursor.** A visual representation of the active position.

**default.** A function-dependent value that is assumed when no explicit value is specified.

**designate.** To identify a set of characters that are to be represented, in some cases immediately and in others on the occurrence of a further control function, in a prescribed manner.

**Editor function.** A control that affects the layout or positioning of previously entered or received information in a character imaging device (for example, a printing or cathode ray tube device) and is intended to be interpreted and executed without remaining in the data stream.

**Escape character(ESC).** A control character that provides supplementary characters (code extension) and is itself a prefix affecting the interpretation of a limited number of contiguous bit combinations.

**Escape sequence.** A sequence of characters that is used for control purposes to perform a control function and whose first character is the Escape (ESC) control character.

**Final character.** A character whose bit combination terminates an escape sequence or control sequence.

**line.** A set of adjacent character positions in a visual display that have the same vertical position.

**mode.** A state of a device, or other sender or recipient, that affects the interpretation of received information, the operation of the sender or recipient, or the format of the transmitted information.

**numeric parameter.** A string of bit combinations that represents a number.

**parameter.**
(1) A string of one or more bit combinations representing a single value.
(2) The value so represented.

**parameter string.** A string of bit combinations that represent one or more parameter values.

**scroll.** An action whereby all of the graphic symbols of a visual display are moved in a specified direction.

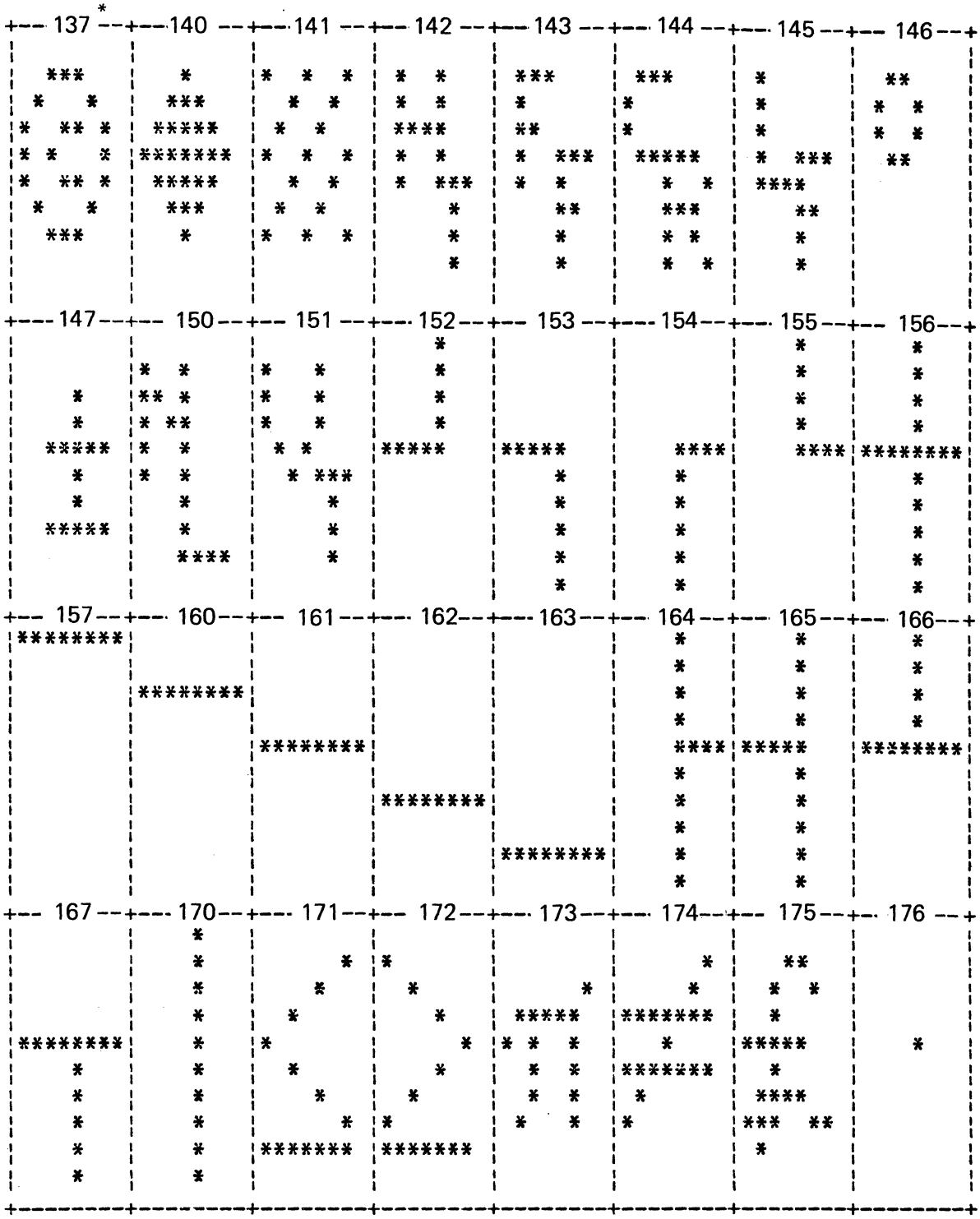
**selective parameter.** A string of bit combinations that selects a subfunction from a specified list of subfunctions.

**string delimiter.** A control that begins or ends a string of characters in a data stream.

APPENDIX B

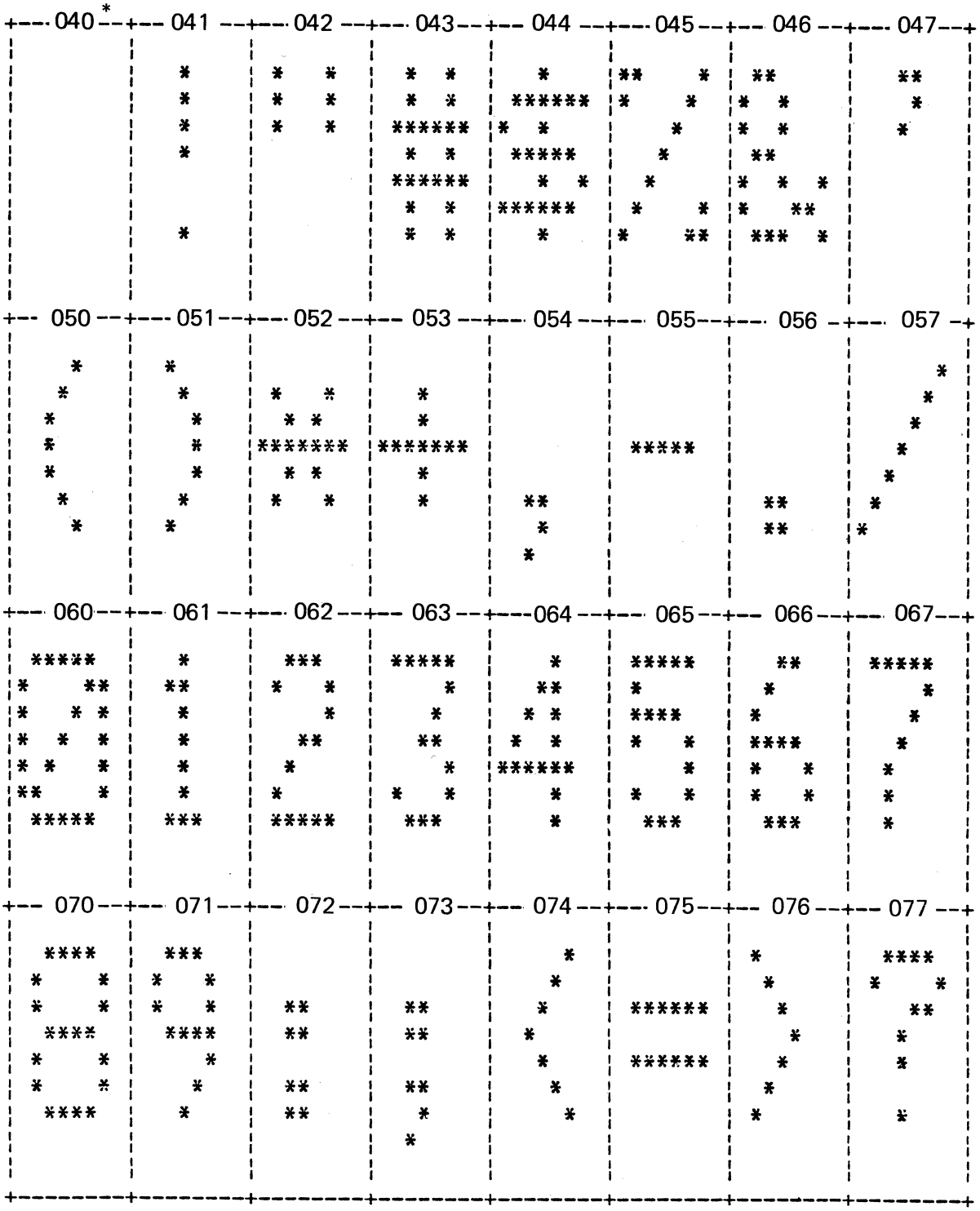
# DOT MATRIX CONFIGURATIONS

## GRAPHICS CHARACTER SET



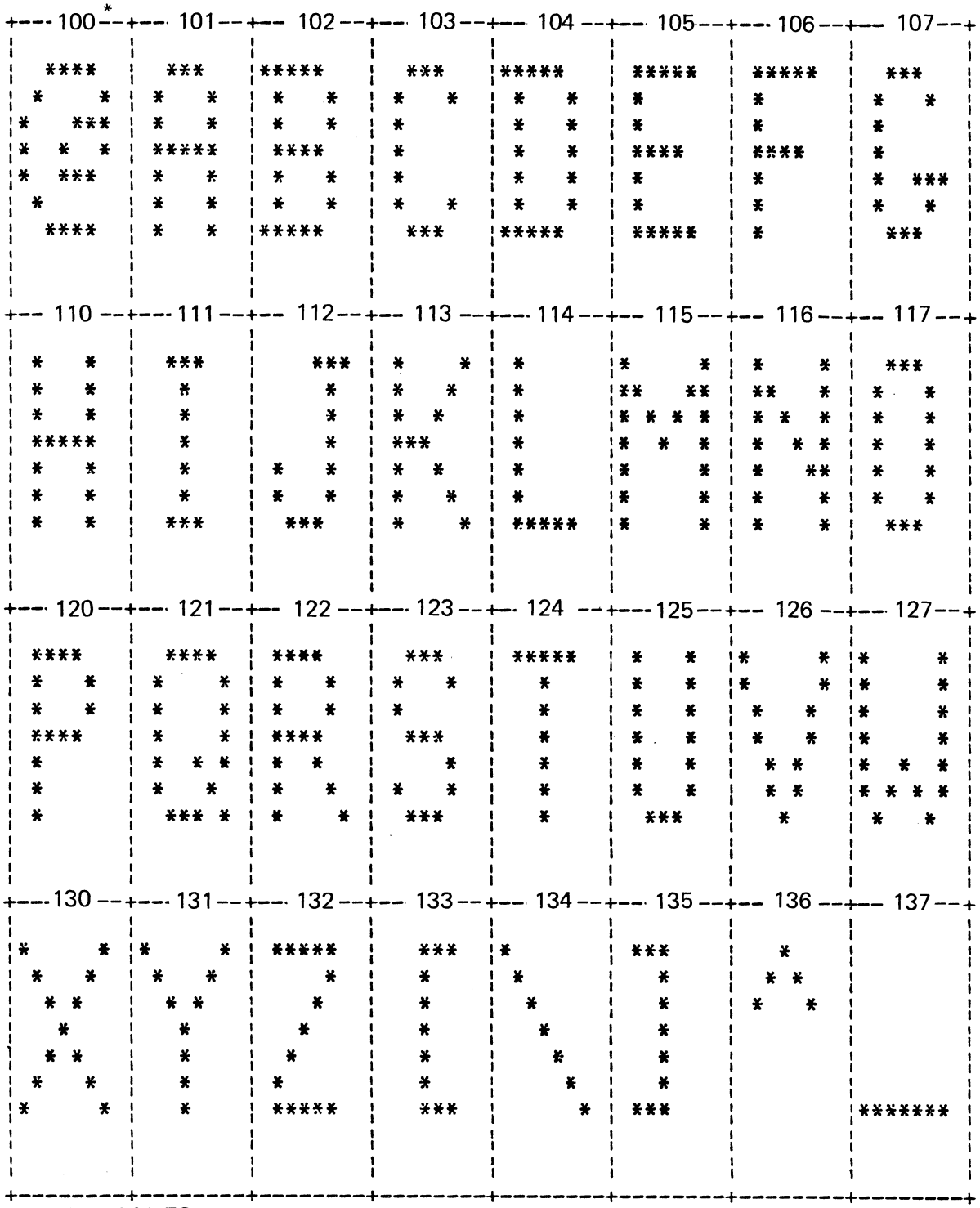

*OCTAL CODES

# ASCII CHARACTER SET



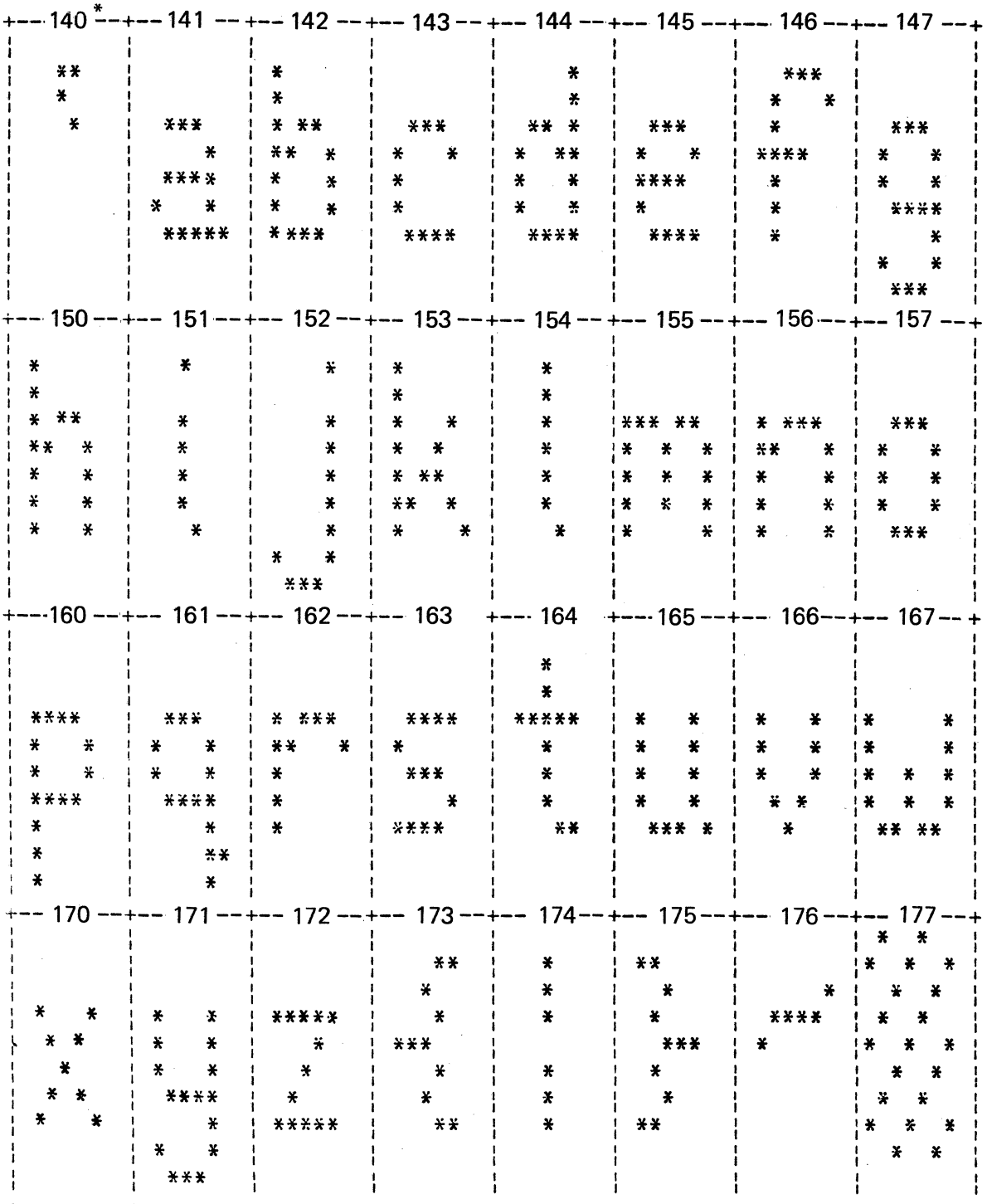

*OCTAL CODES

ASCII CHARACTER SET (Cont'd)




*OCTAL CODES

## ASCII CHARACTER SET (Cont'd)




*OCTAL CODES

# APPENDIX C
# COORDINATE CONVERSION CHART

Graphic plotting information is sent from the computer in a 4-byte sequence containing High and Low order Y, and High and low order X. Each byte contains the two tag bits plus 5 binary bits. Each byte thus encodes to an ASCII character.

To obtain the 4 ASCII characters for each addressable point on the display, use the instructions as outlined in Figure C-1 and the conversion chart Part 1 thru 4. With X=0 and Y=31 as an example of a desired coordinate display, Figure C-1 shows the process of selecting the 4 bytes from the conversion Chart Part 1. The chart is useful for determining the ASCII encoding of a coordinate when it is not convenient to use a computer subroutine.

## INSTRUCTIONS FOR USE OF COORDINATE CONVERSION CHART

1. Find coordinate value in chart.

2. Follow column to bottom of chart to find decimal value or ASCII character which represents the High Y or High X byte.

3. Go to the right of the row containing the coordinate value to find the Low Y or go to the left to find the Low X byte.

   For example:

   200Y, 48X = 38 104 33 80 in decimal
   & h ! P in ASCII

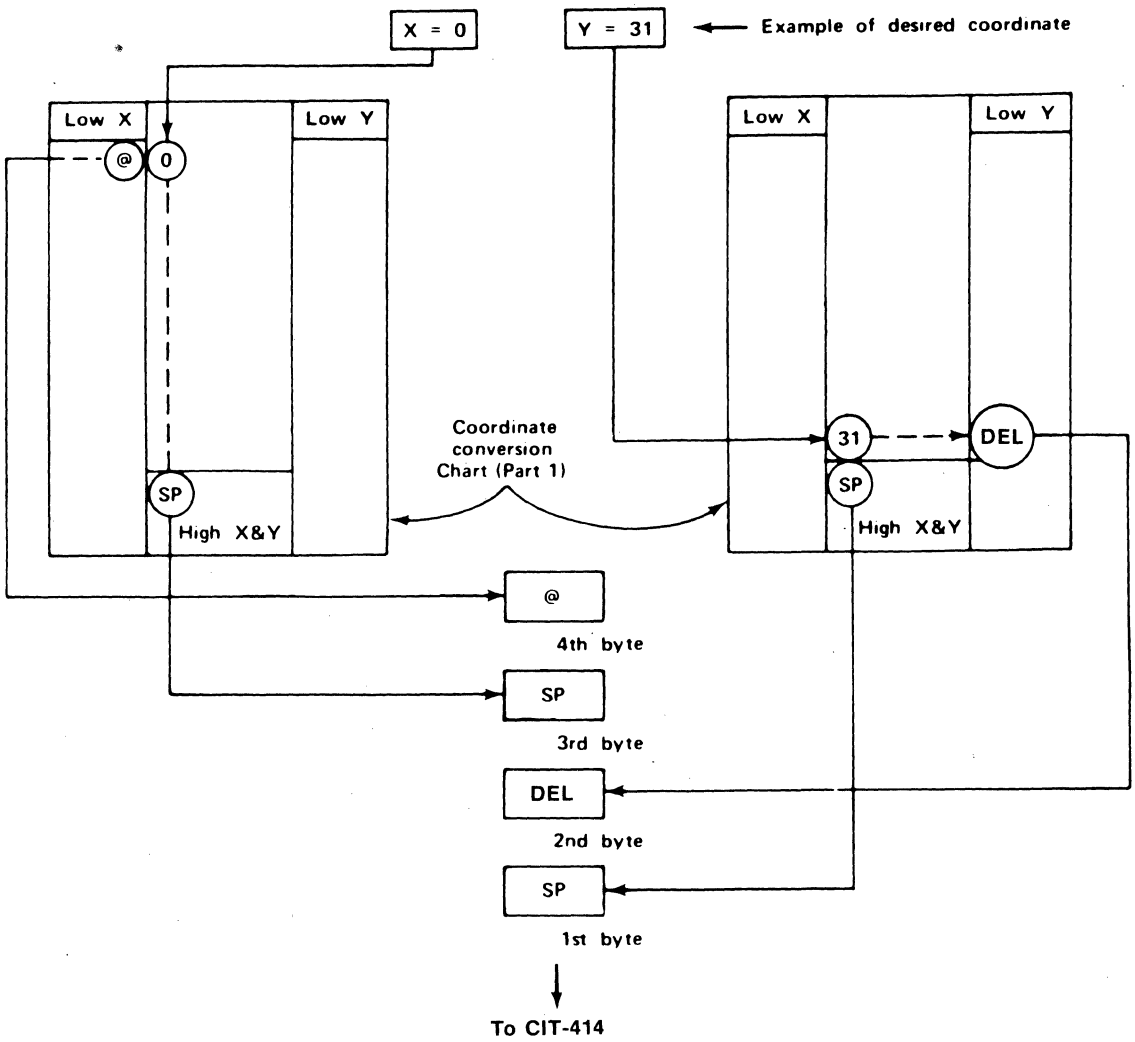



Figure C-1. Coordinate Conversion Example

# COORDINATE CONVERSION CHART I

| Low Order X ASCII | DEC. | X or Y Coordinate | | | | | | | | Low Order Y DEC. | ASCII |
|---|---|---|---|---|---|---|---|---|---|---|---|
| @ | 64 | 0 | 32 | 64 | 96 | 128 | 160 | 192 | 224 | 96 | ` |
| A | 65 | 1 | 33 | 65 | 97 | 129 | 161 | 193 | 225 | 97 | a |
| B | 66 | 2 | 34 | 66 | 98 | 130 | 162 | 194 | 226 | 98 | b |
| C | 67 | 3 | 35 | 67 | 99 | 131 | 163 | 195 | 227 | 99 | c |
| D | 68 | 4 | 36 | 68 | 100 | 132 | 164 | 196 | 228 | 100 | d |
| E | 69 | 5 | 37 | 69 | 101 | 133 | 165 | 197 | 229 | 101 | e |
| F | 70 | 6 | 38 | 70 | 102 | 134 | 166 | 198 | 230 | 102 | f |
| G | 71 | 7 | 39 | 71 | 103 | 135 | 167 | 199 | 231 | 103 | g |
| H | 72 | 8 | 40 | 72 | 104 | 136 | 168 | 200 | 232 | 104 | h |
| I | 73 | 9 | 41 | 73 | 105 | 137 | 169 | 201 | 233 | 105 | i |
| J | 74 | 10 | 42 | 74 | 106 | 138 | 170 | 202 | 234 | 106 | j |
| K | 75 | 11 | 43 | 75 | 107 | 139 | 171 | 203 | 235 | 107 | k |
| L | 76 | 12 | 44 | 76 | 108 | 140 | 172 | 204 | 236 | 108 | l |
| M | 77 | 13 | 45 | 77 | 109 | 141 | 173 | 205 | 237 | 109 | m |
| N | 78 | 14 | 46 | 78 | 110 | 142 | 174 | 206 | 238 | 110 | n |
| O | 79 | 15 | 47 | 79 | 111 | 143 | 175 | 207 | 239 | 111 | o |
| P | 80 | 16 | 48 | 80 | 112 | 144 | 176 | 208 | 240 | 112 | p |
| Q | 81 | 17 | 49 | 81 | 113 | 145 | 477 | 209 | 241 | 113 | q |
| R | 82 | 18 | 50 | 82 | 114 | 146 | 478 | 210 | 242 | 114 | r |
| S | 83 | 19 | 51 | 83 | 115 | 147 | 479 | 211 | 243 | 115 | s |
| T | 84 | 20 | 52 | 84 | 116 | 148 | 480 | 212 | 244 | 116 | t |
| U | 85 | 21 | 53 | 85 | 117 | 149 | 481 | 213 | 245 | 117 | u |
| V | 86 | 22 | 54 | 86 | 118 | 150 | 482 | 214 | 246 | 118 | v |
| W | 87 | 23 | 55 | 87 | 119 | 150 | 483 | 215 | 247 | 119 | w |
| X | 88 | 24 | 56 | 88 | 120 | 151 | 484 | 216 | 248 | 120 | x |
| Y | 89 | 25 | 57 | 89 | 121 | 153 | 185 | 217 | 249 | 121 | y |
| Z | 90 | 26 | 58 | 90 | 122 | 154 | 186 | 218 | 250 | 122 | z |
| [ | 91 | 27 | 59 | 91 | 123 | 155 | 187 | 219 | 251 | 123 | { |
| \ | 92 | 28 | 60 | 92 | 124 | 156 | 188 | 220 | 252 | 124 | ¦ |
| ] | 93 | 29 | 61 | 93 | 125 | 157 | 189 | 221 | 253 | 125 | } |
| ^ | 94 | 30 | 62 | 94 | 126 | 158 | 190 | 222 | 254 | 126 | ~ |
| _ | 95 | 31 | 63 | 95 | 127 | 159 | 191 | 223 | 255 | 127 | |

| DECIMAL | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
|---|---|---|---|---|---|---|---|---|
| ASCII | SP | ! | " | # | $ | % | & | ' |

High Order X & Y

# COORDINATE CONVERSION CHART II

| Low Order X ASCII | DEC. | X or Y Coordinate | | | | | | | | Low Order Y DEC. | ASCII |
|---|---|---|---|---|---|---|---|---|---|---|---|
| @ | 64 | 256 | 288 | 320 | 352 | 384 | 416 | 448 | 480 | 96 | ` |
| A | 65 | 257 | 289 | 321 | 353 | 385 | 417 | 449 | 481 | 97 | a |
| B | 66 | 258 | 290 | 322 | 354 | 386 | 418 | 450 | 482 | 98 | b |
| C | 67 | 259 | 291 | 323 | 355 | 387 | 419 | 451 | 483 | 99 | c |
| D | 68 | 260 | 292 | 324 | 356 | 388 | 420 | 452 | 484 | 100 | d |
| E | 69 | 261 | 293 | 325 | 357 | 389 | 421 | 453 | 485 | 101 | e |
| F | 70 | 262 | 294 | 326 | 358 | 390 | 422 | 454 | 486 | 102 | f |
| G | 71 | 263 | 295 | 327 | 359 | 391 | 423 | 455 | 487 | 103 | g |
| H | 72 | 264 | 296 | 328 | 360 | 392 | 424 | 456 | 488 | 104 | h |
| I | 73 | 265 | 297 | 329 | 361 | 393 | 425 | 457 | 489 | 105 | i |
| J | 74 | 266 | 298 | 330 | 362 | 394 | 426 | 458 | 490 | 106 | j |
| K | 75 | 267 | 299 | 331 | 363 | 395 | 427 | 459 | 491 | 107 | k |
| L | 76 | 268 | 300 | 332 | 364 | 396 | 428 | 460 | 492 | 108 | l |
| M | 77 | 269 | 301 | 333 | 365 | 397 | 429 | 461 | 493 | 109 | m |
| N | 78 | 270 | 302 | 334 | 366 | 398 | 430 | 462 | 494 | 110 | n |
| O | 79 | 271 | 303 | 335 | 367 | 399 | 431 | 463 | 495 | 111 | o |
| P | 80 | 272 | 304 | 336 | 368 | 400 | 432 | 464 | 496 | 112 | p |
| Q | 81 | 273 | 305 | 337 | 369 | 401 | 433 | 465 | 497 | 113 | q |
| R | 82 | 274 | 306 | 338 | 370 | 402 | 434 | 466 | 498 | 114 | r |
| S | 83 | 275 | 307 | 339 | 371 | 403 | 435 | 467 | 499 | 115 | s |
| T | 84 | 276 | 308 | 340 | 372 | 404 | 436 | 468 | 500 | 116 | t |
| U | 85 | 277 | 309 | 341 | 373 | 405 | 437 | 469 | 501 | 117 | u |
| V | 86 | 278 | 310 | 342 | 374 | 406 | 438 | 470 | 502 | 118 | v |
| W | 87 | 279 | 311 | 343 | 375 | 407 | 439 | 471 | 503 | 119 | w |
| X | 88 | 280 | 312 | 344 | 376 | 408 | 440 | 472 | 504 | 120 | x |
| Y | 89 | 281 | 313 | 345 | 377 | 409 | 441 | 473 | 505 | 121 | y |
| Z | 90 | 282 | 314 | 346 | 378 | 410 | 442 | 474 | 506 | 122 | z |
| [ | 91 | 283 | 315 | 347 | 379 | 411 | 443 | 475 | 507 | 123 | { |
| \ | 92 | 284 | 316 | 348 | 380 | 412 | 444 | 476 | 508 | 124 | ¦ |
| ] | 93 | 285 | 317 | 349 | 381 | 413 | 445 | 477 | 509 | 125 | } |
| ^ | 94 | 286 | 318 | 350 | 382 | 414 | 446 | 478 | 510 | 126 | ~ |
| _ | 95 | 287 | 319 | 351 | 383 | 415 | 447 | 479 | 511 | 127 | |
| DECIMAL | | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | | |
| ASCII | | (P | ) | * | + | , | - | . | / | | |

High Order X & Y

# COORDINATE CONVERSION CHART III

| Low Order X ASCII | DEC. | X or Y Coordinate | | | | | | | | Low Order Y DEC. | ASCII |
|---|---|---|---|---|---|---|---|---|---|---|---|
| @ | 64 | 512 | 544 | 576 | 608 | 640 | 672 | 704 | 736 | 96 | ` |
| A | 65 | 513 | 545 | 577 | 609 | 641 | 673 | 705 | 737 | 97 | a |
| B | 66 | 514 | 546 | 578 | 610 | 642 | 674 | 706 | 738 | 98 | b |
| C | 67 | 515 | 547 | 579 | 611 | 643 | 675 | 707 | 739 | 99 | c |
| D | 68 | 516 | 548 | 580 | 612 | 644 | 676 | 708 | 740 | 100 | d |
| E | 69 | 517 | 549 | 581 | 613 | 645 | 677 | 709 | 741 | 101 | e |
| F | 70 | 518 | 550 | 582 | 614 | 646 | 678 | 710 | 742 | 102 | f |
| G | 71 | 519 | 551 | 583 | 615 | 647 | 679 | 711 | 743 | 103 | g |
| H | 72 | 520 | 552 | 584 | 616 | 648 | 680 | 712 | 744 | 104 | h |
| I | 73 | 521 | 553 | 585 | 617 | 649 | 681 | 713 | 745 | 105 | i |
| J | 74 | 522 | 554 | 586 | 618 | 650 | 682 | 714 | 746 | 106 | j |
| K | 75 | 523 | 555 | 587 | 619 | 651 | 683 | 715 | 747 | 107 | k |
| L | 76 | 524 | 556 | 588 | 620 | 652 | 684 | 716 | 748 | 108 | l |
| M | 77 | 525 | 557 | 589 | 621 | 653 | 685 | 717 | 749 | 109 | m |
| N | 78 | 526 | 558 | 590 | 622 | 654 | 686 | 718 | 750 | 110 | n |
| O | 79 | 527 | 559 | 591 | 623 | 655 | 687 | 719 | 751 | 111 | o |
| P | 80 | 528 | 560 | 592 | 624 | 656 | 688 | 720 | 752 | 112 | p |
| Q | 81 | 529 | 561 | 593 | 625 | 657 | 689 | 721 | 753 | 113 | q |
| R | 82 | 530 | 562 | 594 | 626 | 658 | 690 | 722 | 754 | 114 | r |
| S | 83 | 531 | 563 | 595 | 627 | 659 | 691 | 723 | 755 | 115 | s |
| T | 84 | 532 | 564 | 596 | 628 | 660 | 692 | 724 | 756 | 116 | t |
| U | 85 | 533 | 565 | 597 | 629 | 661 | 693 | 725 | 757 | 117 | u |
| V | 86 | 534 | 566 | 598 | 630 | 662 | 694 | 726 | 758 | 118 | v |
| W | 87 | 535 | 567 | 599 | 631 | 663 | 695 | 727 | 759 | 119 | w |
| X | 88 | 536 | 568 | 600 | 632 | 664 | 696 | 728 | 760 | 120 | x |
| Y | 89 | 537 | 569 | 601 | 633 | 665 | 697 | 729 | 761 | 121 | y |
| Z | 90 | 538 | 570 | 602 | 634 | 666 | 698 | 730 | 762 | 122 | z |
| [ | 91 | 549 | 571 | 603 | 635 | 667 | 699 | 731 | 763 | 123 | { |
| \ | 92 | 540 | 572 | 604 | 636 | 668 | 700 | 732 | 764 | 124 | ¦ |
| ] | 93 | 541 | 573 | 605 | 637 | 669 | 701 | 733 | 765 | 125 | } |
| ^ | 94 | 542 | 574 | 606 | 638 | 670 | 702 | 734 | 766 | 126 | ~ |
| _ | 95 | 543 | 575 | 607 | 639 | 671 | 703 | 735 | 767 | 127 | |
| DECIMAL | | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | | |
| ASCII | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |

High Order X & Y

# COORDINATE CONVERSION CHART IV

| Low Order X ASCII | DEC. | X or Y Coordinate | | | | | | | | Low Order Y DEC. | ASCII |
|---|---|---|---|---|---|---|---|---|---|---|---|
| @ | 64 | 768 | 800 | 832 | 864 | 896 | 928 | 960 | 992 | 96 | ` |
| A | 65 | 769 | 801 | 833 | 865 | 897 | 929 | 961 | 993 | 97 | a |
| B | 66 | 770 | 802 | 834 | 866 | 898 | 930 | 962 | 994 | 98 | b |
| C | 67 | 771 | 803 | 835 | 867 | 899 | 931 | 963 | 995 | 99 | c |
| D | 68 | 772 | 804 | 836 | 868 | 900 | 932 | 964 | 996 | 100 | d |
| E | 69 | 773 | 805 | 837 | 869 | 901 | 933 | 965 | 997 | 101 | e |
| F | 70 | 774 | 806 | 838 | 870 | 902 | 934 | 966 | 998 | 102 | f |
| G | 71 | 775 | 807 | 839 | 871 | 903 | 935 | 967 | 999 | 103 | g |
| H | 72 | 776 | 808 | 840 | 872 | 904 | 936 | 968 | 1000 | 104 | h |
| I | 73 | 777 | 809 | 841 | 873 | 905 | 937 | 969 | 1001 | 105 | i |
| J | 74 | 778 | 810 | 842 | 874 | 906 | 938 | 970 | 1002 | 106 | j |
| K | 75 | 779 | 811 | 843 | 875 | 907 | 939 | 971 | 1003 | 107 | k |
| L | 76 | 780 | 812 | 844 | 876 | 908 | 940 | 972 | 1004 | 108 | l |
| M | 77 | 781 | 813 | 845 | 877 | 909 | 941 | 973 | 1005 | 109 | m |
| N | 78 | 782 | 814 | 846 | 878 | 910 | 942 | 974 | 1006 | 110 | n |
| O | 79 | 783 | 815 | 847 | 879 | 911 | 943 | 975 | 1007 | 111 | o |
| P | 80 | 784 | 816 | 848 | 880 | 912 | 944 | 976 | 1008 | 112 | p |
| Q | 81 | 785 | 817 | 849 | 881 | 913 | 945 | 977 | 1009 | 113 | q |
| R | 82 | 786 | 818 | 850 | 882 | 914 | 946 | 978 | 1010 | 114 | r |
| S | 83 | 787 | 819 | 851 | 883 | 915 | 947 | 979 | 1011 | 115 | s |
| T | 84 | 788 | 820 | 852 | 884 | 916 | 948 | 980 | 1012 | 116 | t |
| U | 85 | 789 | 821 | 853 | 885 | 917 | 949 | 981 | 1013 | 117 | u |
| V | 86 | 790 | 822 | 854 | 886 | 918 | 950 | 982 | 1014 | 118 | v |
| W | 87 | 791 | 823 | 855 | 887 | 919 | 951 | 983 | 1015 | 119 | w |
| X | 88 | 792 | 824 | 856 | 888 | 920 | 952 | 984 | 1016 | 120 | x |
| Y | 89 | 793 | 825 | 857 | 889 | 921 | 953 | 985 | 1017 | 121 | y |
| Z | 90 | 794 | 826 | 858 | 890 | 922 | 954 | 986 | 1018 | 122 | z |
| [ | 91 | 795 | 827 | 859 | 891 | 923 | 955 | 987 | 1019 | 123 | { |
| \ | 92 | 796 | 828 | 860 | 892 | 924 | 956 | 988 | 1020 | 124 | ¦ |
| ] | 93 | 797 | 829 | 861 | 893 | 925 | 957 | 989 | 1021 | 125 | } |
| ^ | 94 | 798 | 830 | 862 | 894 | 926 | 958 | 990 | 1022 | 126 | ~ |
| _ | 95 | 799 | 831 | 863 | 895 | 927 | 959 | 991 | 1023 | 127 | |

| DECIMAL | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
|---|---|---|---|---|---|---|---|---|
| ASCII | 8 | 9 | : | ; | < | = | > | ? |

High Order X & Y

ASCII CODE CHART

| B I T S B7 B6 B5 / B4 B3 B2 B1 | ø ø ø | ø ø 1 | ø 1 ø | ø 1 1 | 1 ø ø | 1 ø 1 | 1 1 ø | 1 1 1 |
|---|---|---|---|---|---|---|---|---|
| | CONTROL | | HIGH X & Y GRAPHIC INPUT | | LOW X | | LOW Y | |
| ø ø ø ø | NUL ø | DLE 16 | SP 32 | ø 48 | @ 64 | P 8ø | ` 96 | p 112 |
| ø ø ø 1 | SOH 1 | DC1 17 | ! 33 | 1 49 | A 65 | Q 81 | a 97 | q 113 |
| ø ø 1 ø | STX 2 | DC2 18 | " 34 | 2 50 | B 66 | R 82 | b 98 | r 114 |
| ø ø 1 1 | ETX 3 | DC3 19 | # 35 | 3 51 | C 67 | S 83 | c 99 | s 115 |
| ø 1 ø ø | EOT 4 | DC4 2ø | $ 36 | 4 52 | D 68 | T 84 | d 1øø | t 116 |
| ø 1 ø 1 | ENQ 5 | NAK 21 | % 37 | 5 53 | E 69 | U 85 | e 1ø1 | u 117 |
| ø 1 1 ø | ACK 6 | SYN 22 | & 38 | 6 54 | F 7ø | V 86 | f 1ø2 | v 118 |
| ø 1 1 1 | BEL 7 BELL | ETB 23 | ' 39 | 7 55 | G 71 | W 87 | g 1ø3 | w 119 |
| 1 ø ø ø | BS 8 BACK SPACE | CAN 24 | ( 40 | 8 56 | H 72 | X 88 | h 1ø4 | x 12ø |
| 1 ø ø 1 | HT 9 | EM 25 | ) 41 | 9 57 | I 73 | Y 89 | i 1ø5 | y 121 |
| 1 ø 1 ø | LF 1ø | SUB 26 | * 42 | : 58 | J 74 | Z 9ø | j 1ø6 | z 122 |
| 1 ø 1 1 | VT 11 | ESC 27 | + 43 | ; 59 | K 75 | [ 91 | k 1ø7 | { 123 |
| 1 1 ø ø | FF 12 | FS 28 | , 44 | < 60 | L 76 | \ 92 | l 1ø8 | ¦ 124 |
| 1 1 ø 1 | CR 13 RETURN | GS 29 | - 45 | = 61 | M 77 | ] 93 | m 1ø9 | } 125 |
| 1 1 1 ø | SO 14 | RS 3ø | . 46 | > 62 | N 78 | ^ 94 | n 11ø | ~ 126 |
| 1 1 1 1 | SI 15 | US 31 | / 47 | ? 63 | O 79 | _ 95 | o 111 | RUBOUT (DEL) 127 |

CIE TERMINALS

A C.ITOH ELECTRONICS COMPANY