

user's manual

graphics terminal

26484

HEWLETT  PACKARD

Congratulations!

You have chosen Hewlett-Packard's new 2648A Graphics Terminal, another technological advance in reliable terminals. The terminal's flexibility, extensive features, and ease of operation can save you valuable time and computer resources in a wide range of applications.

This user's manual has been prepared to acquaint you with your terminal and to serve as an aid to achieving its optimum use. This manual tells you how to install and use the terminal. It should answer any questions you have about the actual use of the terminal. This manual also provides condensed reference information allowing you to use the terminal on-line (connected to a computer).

Detailed programming and accessory installation information is contained in the *HP 2648A Reference Manual*, 02648-90002. The *HP 2648A Service Manual*, 02648-90003 (ordered separately) provides information regarding troubleshooting, repair, and theory of operation.



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COMMUNICATIONS GROUP

TERMINAL CONTROL GROUP

DEVICE CONTROL AND SPECIAL FUNCTIONS GROUP

EDIT GROUP



GRAPHICS CONTROL GROUP

DISPLAY CONTROL GROUP

HP 2648A Graphics Terminal Keyboard

How to Use This Manual

This manual is written as an introduction to the terminal. It describes most of the terminal's features so that you can become familiar with its capabilities without worrying about all of the functional details. It mainly describes how to operate the terminal from the keyboard, leaving the detailed information and the description of program-driven features to the *Reference Manual*.

If you are already familiar with the HP 2640 series terminals, you need not read the entire manual. You can use the index at the back of the manual to locate answers to specific questions you may have.

This manual is made up of the following sections and appendix.

Section I – Introducing the HP 2648A. This section provides a general description of the terminal and briefly describes its capabilities.

Section II – Preparing Your Terminal For Use. This section explains how to identify terminal options and accessories. In addition it gives instructions for preparing your terminal for use.

Section III – The Keyboard. This section gives the location and describes the function of each of the major key groups.

Section IV – Using Your Terminal in Alphanumeric Mode. This section gives step-by-step examples of using the terminal in typical non-graphics operations. These operations can be performed without the need of peripheral devices (cartridge tapes or printer) or a computer system.

Section V – Using Your Terminal in Auto-plot Mode. This section describes how the terminal can automatically plot data that is entered into the display from the keyboard, from cartridge tape, or from a computer system.

Section VI – Using Your Terminal in Graphics Mode. This section describes how to use the various graphics features of the terminal, such as: rubber band line, graphics text, selective erase, zoom and pan, etc.

Section VII – Using Your Terminal in Compatibility Mode. This section describes how to use the terminal with industry compatible graphics software.

Section VIII – Using Your Terminal With Other Devices. This section provides step-by-step examples of how to use the terminal with optional cartridge tape units or a printer.

Section IX – Using Your Terminal With A Computer. This section explains how to setup and use the terminal with a computer system.

Section X – User Definable Function Keys. This section explains how to use the terminal's 8 special function keys and a soft RETURN key.

Section XI – Maintaining Your Terminal. This section gives instructions for cleaning the terminal and the optional cartridge tape units.

Section XII – In Case Of Difficulty. This section explains what to do if the terminal does not work properly. Included is a simple test that can be made to verify proper terminal operation.

Appendix. The appendix contains condensed programming information for all of the terminal's features.

Index. An index is provided for quick access to all information contained in the manual.

Terms Used In This Manual

A brief glossary of terms that you should know is given in the following table. Being familiar with these terms will help you to better understand the material presented in this manual.

ALPHANUMERIC CURSOR	The blinking underline on the display that tells you where the next character, or space, will occur: acts as a pointer.	DEVICE	The display, left or right tape unit, or optional printer.
ALPHANUMERIC MODE	Operating the terminal as a teletype-compatible terminal displaying the basic Roman character set (independent of the graphics capability of the terminal).	DEVICE CONTROL OPERATION	The process of rewinding tapes, finding files, marking files, skipping lines, moving printer paper, etc.
ALPHANUMERIC DISPLAY MEMORY	The storage area for the alphanumeric data which can be displayed as alphanumeric video.	END OF DATA	The point on the cartridge tape where you last recorded data.
ALPHANUMERIC VIDEO	The alphanumeric data stored in the alphanumeric display memory which is displayed on the screen.	EOT	"End Of Tape" — The point on the cartridge tape beyond which data cannot be recorded.
AUTO PLOT MODE	Using the terminal to automatically plot data (generate graphs) either offline (from tape) or from non-graphics software.	FILE	Usually consists of more than one record or line; may be thought of as a page in a book.
BOT	"Beginning of Tape" — The point to which the cartridge tape is rewind.	FILE MARK	A special record that you record on the cartridge tape to separate files.
COMPATIBILITY MODE	Operating the terminal with industry-compatible software to produce graphics.	FORM FEED	Moves the printer paper to the top of the next page.
CURSOR POSITION	The point on the display where the alphanumeric cursor or graphics cursor is positioned.	"FROM" DEVICE	The device that supplies the data in a data transfer. Also defined as the "source" device.
DATA TRANSFER OPERATION	The process of transferring (or copying) data from one device to another.	GRAPHICS CURSOR	The flickering crosshair on the display that tells you where the end point of a vector would be, if drawn manually or where the next character will appear if in graphics text mode. Operating the terminal to draw vectors and/or write graphics text.
		GRAPHICS MODE	
		GRAPHICS DISPLAY MEMORY	The storage area for the graphics data which can be displayed as graphics video.

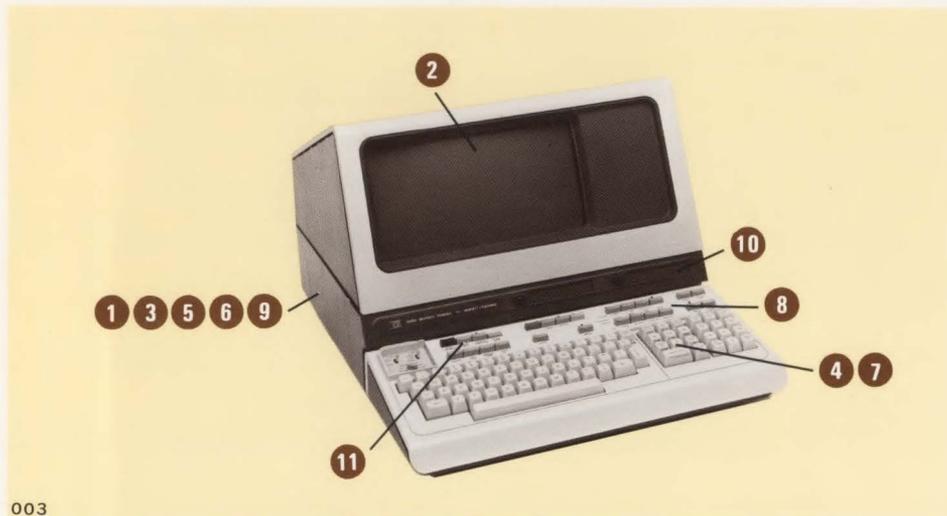
GRAPHICS VIDEO	The graphics data stored in the graphics display memory which is displayed on the screen.	REMOTE MODE	Operating the terminal with the aid of a computer system (that is, "on-line").
HP-IB	The interface bus that connects printers, plotters, etc., to the terminal.	RESOLUTION	The number of addressable or viewable dots on the horizontal and vertical axis of a graphics display.
LINE	A row of characters; may be thought of as a line of text in a book.	SCALING	The method of applying constants to the X- and Y-coordinates to enlarge or contract the picture along the axis specified by the magnitude of the constants.
LOAD POINT	The point on the cartridge tape where you can start recording data.	SELECTIVE ERASE	The ability to remove parts of a picture without interfering with the remaining portion or having to erase and redraw the complete picture with the new changes.
LOCAL MODE	Operating the terminal without the aid of a computer system (that is, "off-line").	"TO" DEVICE	The device that receives the alphanumeric data in an alphanumeric data transfer, also defined as the "destination" device.
PAGE	24 lines. (The amount of data that can be displayed on the screen at one time.)	VECTOR	A quantity that has magnitude and direction. In graphics it is a line segment whose length represents the magnitude and orientation represents direction.
PANNING	The process of continually bringing into view the parts of a picture that exceed the available display space. It is similar to watching the scenery pass while looking through the window of a moving vehicle.	VECTOR GENERATOR	A device that computes individual points (in the case of a digital generator) or individual end points (in the case of an analog generator) then passes the computed points to the deflection circuitry for presentation.
PEN POSITION	The starting point of a vector on the display.		
RASTER SCAN	The process of tracing out a picture on a display as a series of intensified points along horizontal lines.		
RECORD	A line of data. Records may be from 1 to 256 characters long.		
REFRESH RATE	The rate at which the display phosphor is re-excited in a CRT. This rate is normally set at a level that eliminates flicker.		



Introducing the 2648A _____ 1

The HP 2648A has many special features that make it both powerful and easy to use. Among these features are:

- Independent Graphics and Alphanumeric Memories
- Bright Display with Selective Erase
- Vector Generation
- Hardware Zoom and Pan
- Alphanumeric Text Composition within Graphics Memory
- Industry Code Compatibility
- Automatic Plotting
- Full Editing Capability/User Definable Keys
- Choice of Communications Capabilities
- Dual Mini Cartridge Mass Storage (Optional)
- Self-Test



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1 Independent Graphics and Alphanumeric Memories

The graphics memory, consisting of 32K bytes of RAM, stores a 360 by 720 dot pattern for the graphics image. The alphanumeric memory, consisting of 8K bytes of RAM (expandable to 12K bytes), stores the alphanumeric display.

2 Bright Display with Selective Erase

This raster scan display provides a 1,920 character capacity in 24 lines of up to 80 characters. The characters are formed by a 7x9 dot matrix. The bright display makes the characters and vectors easy to read in high ambient light. Selected portions of a picture can be modified without requiring a complete erase and redraw of the entire display.

3 Vector Generation

The graphics vectors are generated automatically by the terminal's hardware.

4 Hardware Zoom and Pan

The zoom and cursor control keys on the keyboard allow selected portions of the graphics display to be expanded up to 16 times. The complete display can be panned without re-drawing the graphics display memory.

5 Alphanumeric Text Composition Within Graphics Memory

Both the alphanumeric and graphics memories allow characters to be entered on the screen. In graphics mode, the characters may be either normal upright or italics. Also, the characters may be expanded to 8 different sizes and may be displayed in any one of four directions.

6 Industry Code Compatibility

The 2648A may be configured to be compatible with some existing graphics software. By physically setting a strap or by sending an escape sequence to the terminal, it may be possible to produce graphics input/output while under control of existing software.

7 Automatic Plotting

Your tabular data (entered either on the display, read from cartridge tape, or output from a computer system) can be plotted automatically without the aid of a plotting program. This feature does not require that you have a programming background to plot the data. Simply fill in a form resident in the 2648A, then press a key — the data is plotted on the display automatically.

8 Full Editing Capability/ User Definable Keys

Editing and computer time requirements can be significantly reduced by such features as:

- 8 user defined soft keys which can be used to produce any string of up to 80 characters with a single keystroke or to select a predefined program routine.
- Character insert and delete, line insert and delete, display clear.
- Roll up, roll down, next page, previous page.
- Cursor sensing, addressability, tabulation, margin setting, and positioning.

9 Choice of Communications Capability

You can operate character-by-character as a completely interactive terminal or on a block of data at a time. Information can be composed and edited locally, allowing you to verify and correct data before transmission to the computer.

The terminal operates at up to 9600 baud and offers asynchronous point-to-point data communications using an RS232C interface. Optional capabilities include asynchronous and synchronous polling for multipoint communications (allows multiple terminals to share communications resources), current loop, split input/output speed, and custom baud rates.

Connection to a computer can be direct or through a modem. In addition the terminal can be connected directly to a variety of printers to provide hard copy.

The  key on the keyboard can be programmed to provide additional communication codes.

10 Dual Mini Cartridge Mass Storage

Two optional tape drives which use the Mini Cartridge provide local data storage. This gives the terminal many powerful stand-alone capabilities. The shirt-pocket sized cartridges can hold up to 110,000 characters each (many hours worth of typing). In addition, up to over 6,000 characters can be stored in the display memory.

11 Self-Test

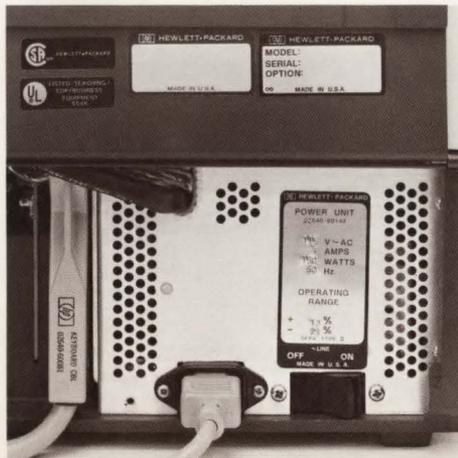
The terminal has been engineered for high reliability, ease of testing, and when needed, rapid repair. By using the  key you get a Go/No-Go indication of the terminal's operating condition.



Preparing your Terminal for Use

How To Identify Options and Accessories

Your terminal is delivered with the options and accessories that you requested. The options and accessories installed are specified on the Identification Labels found under the rear access cover. When you receive the terminal make sure that all of the items that were ordered are present. A list of options and accessories is given in the *Reference Manual*.



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When communicating with Hewlett-Packard regarding your terminal, use the Model, Serial, and Option numbers to insure quick identification by HP. Hewlett-Packard Sales and Service Offices are listed on page 10-14.

NOTE

If your terminal is already installed, you can proceed to "Turning Your Terminal On and Off".

Preparing the Terminal for Use

The terminal is designed to operate in a wide range of environments. It is self-contained with easy access to all operator controls so that normal installation does not require opening the unit.

NOTE

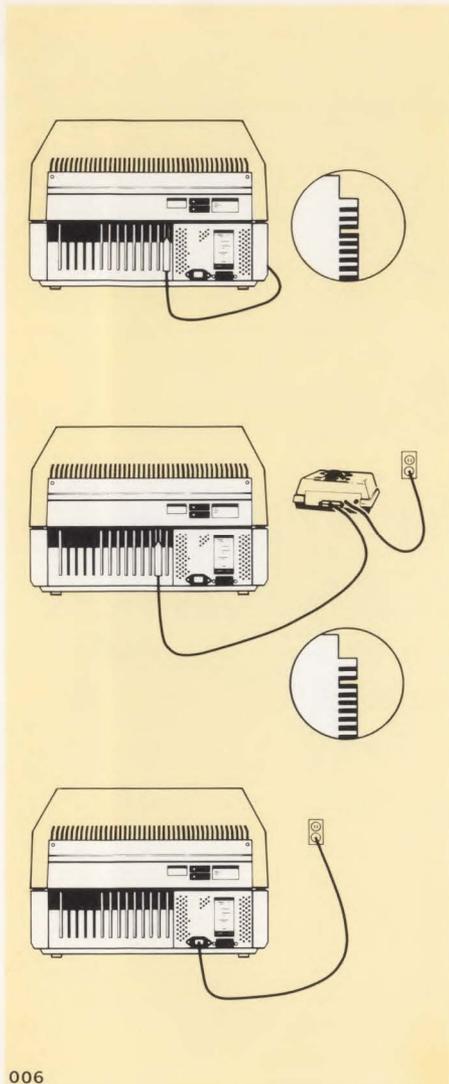
If you must open the unit for option or accessory installation, please refer to the *HP 2648A Reference Manual*, 02648-90002.

Simply complete the following steps for proper installation:

Step 1. Place the terminal on any convenient surface, except plush or spongy surfaces that might restrict air flow through the bottom vents; do not use typewriter pads, for example.



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Step 2. Raise the unit's hinged rear access cover (two rotating latches hold it in place) and connect the keyboard cable hood connector to the printed circuit card. The printed circuit card has been notched to match the cable connector.

NOTE

Card connectors have been notched to prevent erroneous connection. Minimal pressure is needed to make the connection.

Step 3. This step is only required when the terminal is to be used with a computer. Refer to the *Reference Manual* for additional information when installing multiple terminal networks.

Connect the proper interface cable hood connector to the communication interface. The card connector has been notched to match the hood connector. Connect the other end of the interface cable to your modem or computer.

Step 4. This step is required only when the terminal is connected to a printer by the Hewlett-Packard Interface Bus (HP-IB). Refer to the *Reference Manual* for configuring and installing the terminal in this type of network.

Connect the HP-IB Interface Adapter, part no. 02640-60215, to the interface card at the rear of the terminal. The card connector has been notched to match the adapter. Connect the HP-IB cable to the adapter. Connect the other end of the HP-IB cable to the HP-IB connector on the peripheral device.

Step 5. Put the power switch in the OFF position. Connect the power cord to the terminal power connector.

Step 6. MAKE SURE THAT YOUR VOLTAGE MATCHES THE TERMINAL'S REQUIREMENTS (either 115V or 230V, see the rear panel label). Plug the 3-prong power connector into your power outlet.

NOTE

For safety reasons a 3-prong grounded power outlet must always be used.

Turning the Terminal On and Off

ON

Step 1. When the terminal has been properly installed, set the **REMOTE** key to the up position (i.e. set for off-line operation).

Step 2. Set the Power Switch, located at the back of the terminal, to ON. After 15 seconds the terminal will be ready. The display and graphics/alphanumeric memories will be clear, the message **TERMINAL READY** will be displayed, the alphanumeric cursor will be blinking, all programmable functions will be OFF, the terminal will be in ASCII mode, and the left and right tape units (if installed) will be selected as the respective source and destination devices for data transfer operations.

Step 3. (Optional) You should also press the **TAPE TEST** key. If the terminal beeps and displays a test pattern similar to that shown on page 12-3, the terminal is working properly and is ready to use.

If the cursor or **TERMINAL READY** message does not appear or the **TAPE TEST** function does not work properly, set the Power Switch to OFF and perform the steps in "Preparing the Terminal for Use" on pages 2-1 and 2-2 again. Pay particular attention that the printed circuit cards are properly seated into their connectors. If the self



test still does not give the correct results, do not attempt to use the terminal until the malfunction has been corrected by a qualified service representative.

OFF

The terminal is turned OFF by setting the Power Switch at the back of the terminal to OFF.

Exercise 1

Display data on the screen and edit it. Sit down in front of the keyboard and type your name. Notice that the alphanumeric cursor moves across the screen as you type. This tells you where the next character will appear when you press the next key.

Alexander Hamilton_

NOTE

A list of display screen messages, along with their meaning and recovery procedure, is given on pages 12-6 thru 12-13. You may see one or more of these messages displayed while performing the demonstration.

Exercise 2

Draw a box around the text entered in exercise 1.

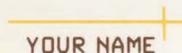
Step 1. Press the **G CURSOR** key, and move the graphics cursor (using the **←**, **↑**, **→**, **↓** keys on the graphics key pad) to the top-left portion of the text area.

+
YOUR NAME

Preparing your Terminal for Use

Step 2. Hold the **SHIFT** key down and press the **MOVE** key. (This effectively moves the "pen" to present position of the cursor.

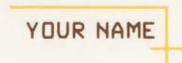
Step 3. Press and hold down the **SHIFT** key, then press the **RB LN** key. Move the cursor to the top-right portion of the text area.



YOUR NAME

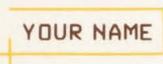
Step 4. Press **SHIFT** **DRAW** keys to draw a line from the previous point.

Step 5. Move the graphics cursor to the bottom-right portion of the text area, then press **SHIFT** **DRAW** keys.



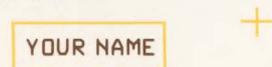
YOUR NAME

Step 6. Move the cursor to the bottom-left of the text area, then press **SHIFT** **DRAW** keys.



YOUR NAME

Step 7. Move the cursor to the top-left portion of the text area (the starting point), then press **SHIFT** **DRAW** keys to complete the box. You may move the cursor away from the text area, then press **SHIFT** **MOVE** keys to move the "rubber band line" starting point, or press **SHIFT** **RB LN** to turnoff "rubber band line".



YOUR NAME

Step 8. By pressing the **ROLL UP** and **ROLL DOWN** keys, you can see how the alphanumeric display memory is independent of the graphics display memory. (You may need to insert blank lines above your name on the display to provide room for the roll-up and roll-down functions to operate. To accomplish this, press **↶** to "home" the alphanumeric cursor, then press **INSERT LINE** a few times. Your name will move down on the display as you press **INSERT LINE**. The roll-up and roll-down functions should now operate.

Changing a Character. To change a character displayed on the screen in the alphanumeric memory, position the cursor under the character to be changed (using **←**, **→**, **↑**, **↓** keys in the Display Control group), then press the desired character key.

Further Editing. Editing text is further simplified by using the **INSERT LINE**, **DELETE LINE**, **INSERT CHAR**, **DELETE CHAR** keys. Explanations of these keys are given on page 3-5.

What To Do In Case of Difficulty

If the key or function you try does not work or an error message appears on the screen, refer to Section XII, "In Case of Difficulty". This section provides instructions for recovering from errors, testing the terminal, and getting help if the terminal requires services.

The Keyboard

Before learning to control devices and transfer data, you should become familiar with the keyboard. Figure 1, inside the manual front cover, shows the keyboard layout. The keyboard consists of the following functional groups:

- **Character Set Group.** This group of keys is similar to a standard typewriter keyboard. It is used for entering data into the terminal.
- **Graphics Control Group.** This group of keys controls the graphics cursor and additional graphics features.
- **Display Control Group.** The display group keys control the alphanumeric cursor position and the portion of display memory shown on the screen.
- **Edit Group.** Text can be easily changed using the insert and delete functions of the edit group.
- **Terminal Control Group.** This group is used to initialize the terminal, set an operating mode, or test the terminal.
- **Device Control and Special Function Group.** This group of keys controls the various input/output devices, data transfer operations, and other special functions that can be performed with the terminal.
- **Communications Group.** This set of switches is used to select communication parameters when the terminal is used with a computer.

The remainder of this section briefly describes each of the keyboard groups. Detailed descriptions of each of the keys are given later in the manual. You can use the index at the back of the manual to locate information on specific keys.



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Character Set Group

The alphabetic, numeric, and symbol keys are all located in the character set group. This is the largest group of keys on the keyboard. The basic character set is made up of 128 characters. This includes upper and lower case alphabetic characters, punctuation, and some commercial symbols. In addition, several non-displaying characters are also available. The non-displaying characters are used primarily for special applications. Refer to the *Reference Manual* for additional information on non-displaying characters.

The standard or base character set is indicated on the keys. The **SHIFT** key selects upper case or shifted characters and selects the graphics functions indicated on the front of the keycaps in the Graphics Control Group. The **BACK SPACE**, **RETURN**, and **TAB** keys are used in the same manner as on a typewriter. The **RETURN** key can be programmed locally to produce additional functions when operating with various computer systems (refer to Section IX).

Exercise 3

Try typing a few lines of text to get used to the keyboard. Remember this part of the terminal works very much like a typewriter. Note that by using the **BACK SPACE** key you can overwrite and change characters.

The **ESC** and **CNTRL** keys are used to provide additional character codes and to generate special control codes for various terminal operations. The use of the **ESC** and **CNTRL** keys are explained below.

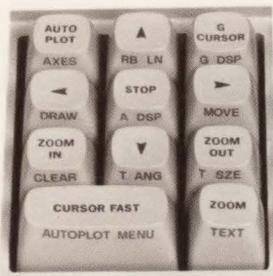
ESC Key Operations

The **ESC** key is also used to extend the operating functions of the terminal. Unlike the **CNTRL** key, the **ESC** key is pressed first, then released, before pressing any other keys. Some functions require only that one key be pressed following the **ESC** key to perform the function; while other functions require a sequence of character keys be pressed following the **ESC** key. *These sequences must always be terminated with an uppercase character, rather than a lowercase character, to tell the terminal that the sequence has ended.* All the escape code functions are listed in the *Programmer's Reference Table* in Appendix A.

CNTRL Key Operations

The **CNTRL** key can be used with the keys shown in the table below to extend the operating functions of the terminal. *Be sure to hold down the **CNTRL** key while pressing the other key.* The **CNTRL** key can be used also with @, A through Z, [, \,], ^ and _ to perform additional functions (refer to table A-1, page A-10).

KEYS PRESSED	FUNCTION PERFORMED
CNTL TAB or BACK SPACE	Back tabs to previous tab position.
CNTL CLEAR TAB	Clears all previously set tabs.
CNTL CLEAR DSPLY	Clears lines from cursor position to end of line.
CNTL NEXT PAGE	Presents special function key assignments on the display.
CNTL ↩	Cursor home down. Places cursor in next available line of display memory.
CNTL ←	Sets left margin.
CNTL →	Sets right margin.
CNTL TAPE TEST, f5, or f6	Conditions cartridge tape.
CNTL DISPLAY FUNCTIONS	Monitor mode. Displays all codes on data comm lines.
[] , CNTL , READ	Reads cartridge tape beyond end-of-data mark.
CNTL INSERT CHAR	Character wraparound mode. Characters inserted at cursor position will wraparound to next line after the line containing the cursor is filled.
CNTL DELETE CHAR	Delete character with wraparound from next line.
CNTL f1	Turns on display enhancement.
CNTL f2	Starts an unprotected field.
CNTL f3	Ends an unprotected field.
CNTL f4	Turns on Forms Mode.
CNTL f5	Turns off Forms Mode.
CNTL f6	Starts a Transmit Only field.
CNTL G CURSOR	Displays graphics cursor coordinates.
CNTL READ	When in Block Mode sends data to the computer from cartridge tape.



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Graphics Control Group

The Graphics Control Group controls the graphics display. Each key has two functions. Pressing a key alone executes the command labeled on top of the key. Pressing both the **SHIFT** key and one of the keys executes the command labeled on the *front* of the key. Functions that permanently alter the display, such as clear, have been made "shifted" to make their inadvertent use less likely.

If the terminal is in Display Functions Mode, an equivalent escape sequence will be generated in the *alphanumeric display memory* when you press one of the graphics control keys. The DRAW and MOVE functions will be executed on the graphics display. This function is useful for recording the graphics keystrokes that you used to generate the graphics display. (You should also use *Edit Mode* to ensure that you do not lose any of the keystrokes after the alphanumeric memory is full.)

Similarly, if keyboard strap A is out, the escape sequence will be transmitted to the host computer, but will not be executed unless "echoed". (For more information on terminal strapping, refer to the *Reference Manual*.)

The only graphics keys that "repeat" if held down for more than 0.5 seconds are those controlling zoom (**ZOOM IN** and **ZOOM OUT**) and the graphics cursor keys (**←**, **→**, **▲**, **▼**).

Unshifted Functions (Top Labels)

AUTO PLOT — Turns on the automatic plotting capability. If plotting from the display, autoplot will turn itself off when the last point is plotted. Otherwise, either the **STOP** key or a character key must be pressed to terminate autoplot. (See Section V.)

G CURSOR (Graphics Cursor) — Toggles the graphics cursor on and off. (See Section VI.)

▲, **←**, **▼**, **→** (Graphics Cursor Keys) — Move the graphics cursor. Two keys can be pressed simultaneously for diagonal motion. (See Section VI.)

CURSOR FAST — Speeds up the movement of the graphics cursor if pressed in conjunction with the cursor keys. The rate returns to normal when released. (See Section VI.)

ZOOM — Toggles zoom mode. The area about the graphics cursor is magnified by the amount set by the **ZOOM IN** / **ZOOM OUT** keys. Moving the graphics cursor changes the zoomed area (panning). (See Section VI.)

ZOOM IN — Increments the zoom magnification. (See Section VI.)

ZOOM OUT — Decrements the zoom magnification. (See Section VI.)

STOP — Turns autoplot and graphics text mode off. (See Sections V and VI.)

Shifted Functions (Front Labels — **SHIFT**)

AXES — Draws the axes, tic marks, and labels specified in the autoplot menu. (See Section V.)

AUTO PLOT MENU (Autoplot Menu) — Toggles the autoplot parameter menu on and off. (See Section V.)

RB LN (Rubberband Line) — Toggles the rubberband line on and off. This mode connects the current pen position with the graphics cursor. (See Section VI.)

G DSP (Graphics Display) — Toggles the graphics display on and off. When off it inhibits the graphics image without erasing it. (See Section VI.)

A DSP (Alphanumeric Display) — Toggles the alphanumeric display on and off. (See Section VI.)

CLEAR — Erases the graphics image memory. (See Section VI.)

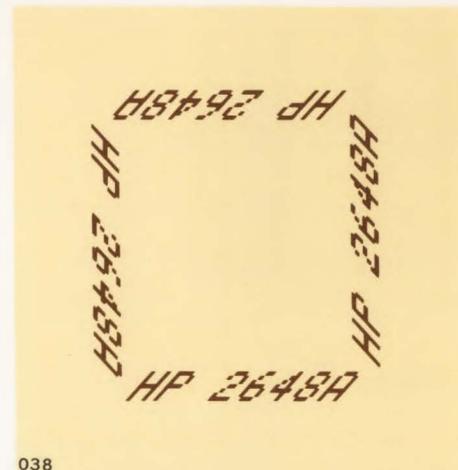
DRAW — Draws a vector from the current pen position to the graphics cursor. The current graphics cursor position becomes the new pen position. *The graphics cursor must be on.* (See Section VI.)

MOVE — Moves the pen to the graphics cursor without drawing a vector. *The graphics cursor must be on.* (See Section VI.)

TEXT — Selects the graphics image memory as the destination for all text. Characters entering from the keyboard, datacom, or tape are drawn as vectors in the graphics memory, using the current size and angle as specified by the **T SIZE** and **T ANG** keys. The drawing mode overwrites to allow for backspacing and typing of new characters. The graphics cursor indicates the position of the next character. Moving the graphics cursor with the graphics cursor control keys (**▲**, **◀**, **▶**, **▼**) resets the start-of-line point. The alphanumeric cursor keys are used to easily locate the text character positions for editing. The **STOP** key terminates this mode. (See Section VI.)

T SIZE (Text Size)— Increases the character size from 1 to 8x. The smallest character is a 5 by 7 matrix in a 7 by 10 cell. Increasing the size makes the dots bigger; the character is still drawn as a 5 by 7 matrix. (See Section VI.)

T ANG (Text Angle) — Sets the character orientation (multiples of 90 degrees) and turns slant on or off. (See Section VI.)



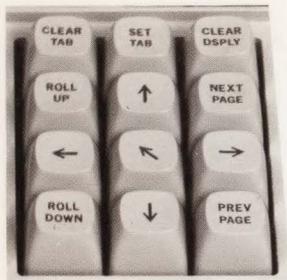
Exercise 4

Enter Graphics Text onto the screen.

Step 1. Move the graphics cursor to a convenient place on the screen. (If the cursor is not displayed, press **G CURSOR**.)

Step 2. Press **SHIFT** **TEXT**. Enter some data from the keyboard. Note that the **BACK SPACE**, **RETURN**, **AUTO LF**, and space bar operate in the same manner as alphanumeric mode.

The drawing mode can be set to *overwrite* existing characters or to *replace* existing characters. (See *Reference Manual*.)



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Display Control Group

The Display Control Group controls the display of the alphanumeric memory. The screen can show 24 lines of up to 80 characters each. This is called a "page". The terminal can hold multiple pages depending on the number and type of characters used in each line, and the amount of memory installed in your terminal. The 12 keys at the right of the keyboard are used to control the alphanumeric data shown on the screen. This group includes the **SET TAB** and **CLEAR TAB** keys which have the same function as on a typewriter.

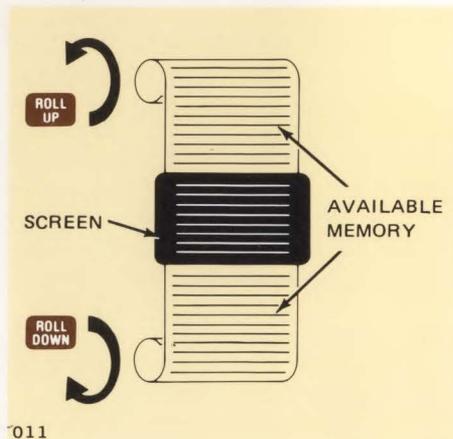
The display control group keys allow you to control the position of the alphanumeric cursor on the screen. They also allow you to "page" or scroll through the terminal's alphanumeric display memory in order to display characters that have rolled off the screen.

The terminal can store more characters than can be displayed on the screen. Depending on what memory options are installed in your terminal, you can store over 6 thousand characters. This is enough to completely fill three screens. The screen is used to look at one block or "page" of these characters at a time. Each page is made up of 24 lines of data.

When the screen has been filled (24 lines of data have been entered), the top line rolls off the screen. As you type each new line the display will roll up to make room for the new line. This continues until the alphanumeric memory is filled. At this point if you enter another line, one or more lines in memory will be lost to make room for the new line. Memory lock and edit mode operations (described later) will prevent lines of information from being lost.

The **ROLL UP** and **ROLL DOWN** keys allow you to move the screen (like a window) through memory, one line at a time.

The **NEXT PAGE** and **PREV PAGE** keys allow you to move the display 24 lines (a whole screen) forward or backward in alphanumeric display memory. When you press these keys the information presently displayed is replaced with the next (or previous) 24 lines of memory.



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Moving the Alphanumeric Cursor

You can move the alphanumeric cursor to any location on the screen with the **←**, **→**, **↑**, and **↓** keys. Each key stroke causes the cursor to step one position in the direction of the arrow on the key.

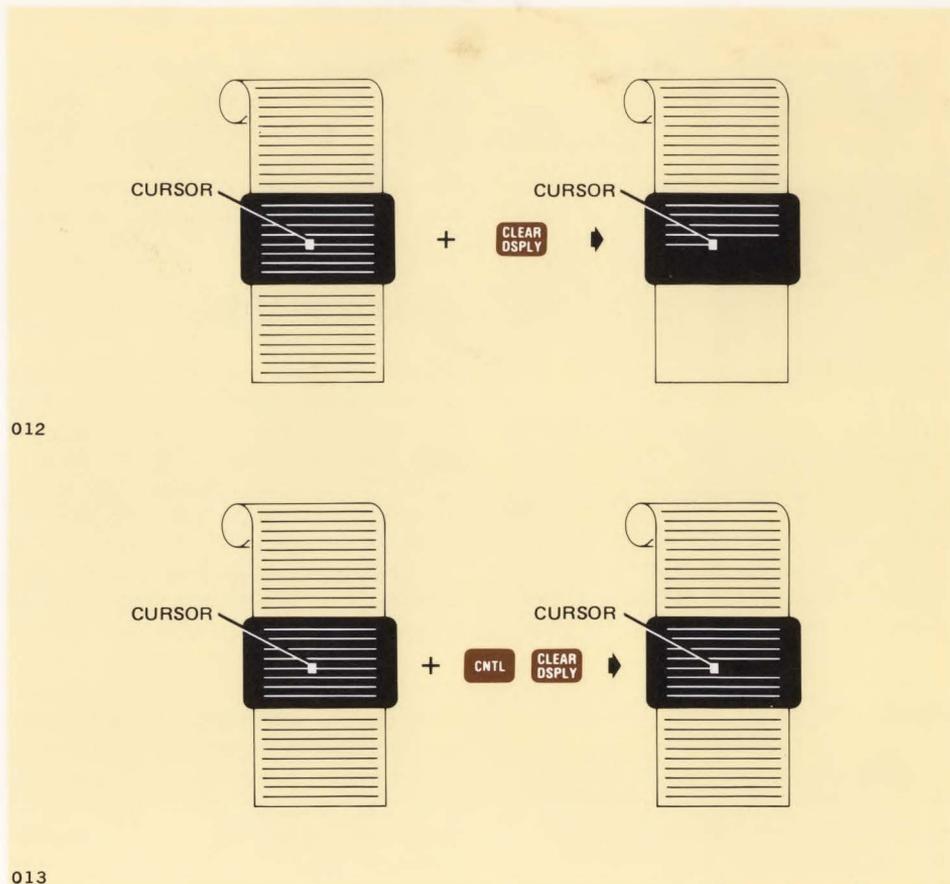
The **←** key “homes” the cursor to the left margin of the first line of alphanumeric display memory and displays the first page of memory. Holding the **CTRL** key down while pressing the **←** key will cause the cursor to be moved just beyond the end of memory data. This allows you to quickly move to the end of your data so that you can append additional lines.

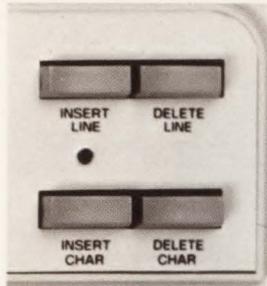
Clearing the Display

The **CLEAR DSPLY** key clears all of the alphanumeric display memory from the present position of the cursor to the end of memory. To clear all of memory, simply use the **←** key to return the cursor to the beginning of memory before using the **CLEAR DSPLY** key.

You can clear the portion of a line to the right of the cursor by holding the **CTRL** key down and pressing **CLEAR DSPLY**.

The operation of the **CLEAR DSPLY** key varies slightly when the terminal is in format mode (refer to the *Reference Manual*).





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Edit Group

The edit group (upper right portion of the keyboard) contains four keys that allow you to edit alphanumeric text or data on the screen. Note that some of the edit functions are disabled when the terminal is used in format mode. (Format mode is described later in the manual.) (These keys do not control graphics text or data.)

INSERT LINE

The **INSERT LINE** key causes the line containing the alphanumeric cursor and the remaining lines below to be rolled down leaving a blank line. The cursor is moved to the left margin of the blank line. This key is disabled when the terminal is in format mode.

DELETE LINE

The **DELETE LINE** key causes the line containing the alphanumeric cursor to be deleted. The line is deleted and the remaining lines below the cursor are rolled up to take its place. The cursor is moved to the left margin. This key is disabled when the terminal is in format mode.

INSERT CHARACTER

Normal. The **INSERT CHAR** key allows you to insert characters into a line without overwriting existing characters. When you press the **INSERT CHAR** key the indicator above the key lights. This indicates that you are in the insert character mode. When you want to return to the normal (overwrite) mode of character entry, press the key again. The light will go out, indicating that you have returned to normal operation.

When you are in the normal insert character mode, any characters that you type are inserted into the current line wherever the alphanumeric cursor is positioned. The remaining characters in the line are shifted to the right one column for each character entered. Characters shifted past the right margin are lost.

Wraparound. Using **CNTRL** **INSERT CHAR** will cause the Insert Character indicator to blink and will result in characters shifted past the right margin to be inserted at the left margin of the following line. If the next line is full, a new line will be inserted after the current line. To return to normal operation press **INSERT CHAR** again.

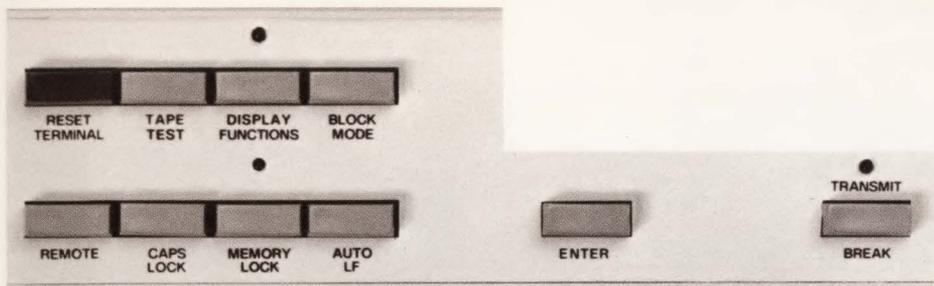
NOTE

The **INSERT CHAR** key may be used in conjunction with the **HOME** and **END** keys to perform additional functions. Refer to section 8.

DELETE CHARACTER

Normal. The **DELETE CHAR** key deletes the character at the alphanumeric cursor position. The remaining characters in the line to the right of the cursor (up to the right margin) are shifted left one column for each character deleted.

Wraparound. Using **CNTRL** **DELETE CHAR** will cause the character at the left margin of the next line to be moved to the right margin position of the current line.



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Terminal Control Group

The terminal control group keys are located in the upper left of the keyboard. These keys are used to select modes of operation, test the terminal, and to control such functions as capital character lock and automatic line feed.

RESET TERMINAL

Pressing the **RESET TERMINAL** key once results in a "soft reset" which unlocks the keyboard, stops device and communication operations and clears some control settings. Pressing the key twice in rapid succession (within 0.5 second) causes the terminal to be set to the initial power-on state: display and memory clear, cursor home, and programmable functions off. This key should not be used unless necessary (refer to Section XII, *In Case of Difficulty*).

TEST/TAPE TEST

The **TAPE TEST** key performs a diagnostic test of the terminal. If a failure is detected, an error message may be displayed. If no error is found, a standard test pattern is displayed. Section XII contains additional information on this key.

DISPLAY FUNCTIONS

When the **DISPLAY FUNCTIONS** key is depressed (indicator on), alphanumeric control functions typed at the keyboard or received from the computer are not executed. You can list programs or data which have escape or control codes in them without the terminal responding to the codes. Escape sequences and control codes are also displayed. The Self-Test pattern (page 12-4) shows these characters.

The graphics DRAW and MOVE functions will be executed and displayed.

Exercise 5: Draw a box using the graphics keys while Display Functions Mode is on.

Step 1. Press **RESET TERMINAL** twice rapidly (within 0.5 second) to initialize the terminal.

Step 2. Press **←**, **CLEAR DISPLAY**.

Step 3. Press **C CURSOR**. The graphics cursor will appear in the lower left-hand corner of the display.

Step 4. Move the graphics cursor to a more convenient position near the center of the display (using the **▲**, **▶**, **▼**, **◀** keys).

Step 5. Turn on Display Functions Mode by pressing **DISPLAY FUNCTIONS**.

Step 6. Press **SHIFT MOVE** (pen down) to start the first corner of the box. Move the cursor to another corner of the box, then press **SHIFT DRAW**, and so on. As you complete each side of the box with the **SHIFT DRAW** command, the equivalent escape sequence is shown in alphanumeric display memory.

Step 7. Be sure to turn off **DISPLAY FUNCTIONS** when you have completed the exercise.

```

⌘*pa213,213Z
⌘*pa213,213,382,213Z
⌘*pa382,213,382,109Z
⌘*pa382,109,213,109Z
⌘*pa213,109,213,213Z
    
```



Example:

Executing the escape sequences to move the alphanumeric cursor to the Home position, clear the display, turn on Memory Lock and type "Hello!" in Inverse Video. The sequence would appear on the display as:

```
HELLO!
```

With DISPLAY FUNCTIONS on, the same sequence would be displayed as:

```
⌘H⌘J⌘⌘⌘&dBHELLO!
```

REMOTE

The terminal can be set for Remote (on-line) operation by putting the **REMOTE** key in the down position. This puts the terminal in communication with a computer and changes the way some of the terminal's modes operate.

BLOCK MODE

The **BLOCK MODE** key can be used to switch the terminal to Block Mode. When the terminal is in Block Mode, typed data is displayed but not sent to the computer until requested by the computer or until after the **ENTER** key has been pressed and the computer has responded (remote key must be down). Otherwise, the terminal is in Character Mode and data is transmitted as typed. (See Block Mode, page 9-2.)

AUTO LF

The **AUTO LF** key causes Line Feed each time the **RETURN** key is pressed, provided a "R" is defined as part of the sequence. (See Section X.)

BREAK

The **BREAK** key can be used to interrupt the operation of the terminal's data communication function. Refer to the *Reference Manual* for additional information.

TRANSMIT Indicator

The TRANSMIT indicator will be on when a data link exists between the terminal and the computer. Refer to the *Reference Manual* for additional information.

ENTER

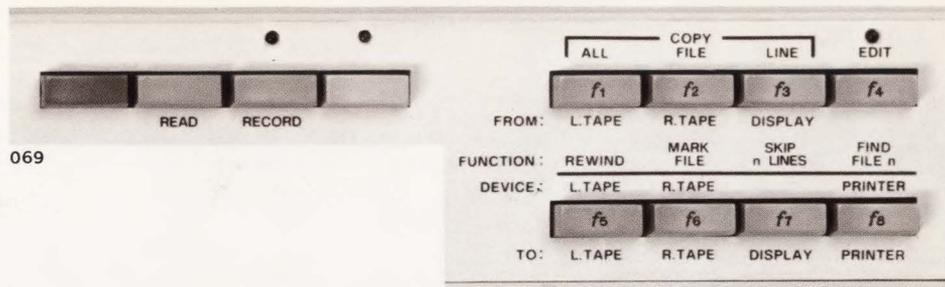
When the terminal is set for Remote (on-line), the **ENTER** key allows you to send blocks of data to a computer. The **ENTER** key functions differently depending on the character, block, format mode, and **REMOTE** key settings.

CAPS LOCK

The **CAPS LOCK** key locks all alphabetical keys to upper-case characters. The **@**, **[**, **]**, ****, and **^** keys are locked in unshifted mode. The remaining numeric/symbol keys operate normally. (The **CAPS LOCK** key restricts the keyboard to the first 96 characters of the ASCII character set.)

MEMORY LOCK

The **MEMORY LOCK** key has two functions, overflow protect and display lock. Overflow protect prevents data from being lost when the terminal's alphanumeric display memory is full. Display lock freezes data at the top of the screen. Entered data then rolls around the frozen data and into the terminal's alphanumeric display memory. This allows you to retain headings or instructions as you enter data. Refer to Section IV for a discussion of how to use MEMORY LOCK.



Device Control and Special Functions Group

f1 thru **f8** Special Function Keys

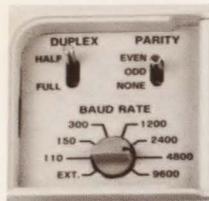
These eight keys perform multiple functions depending on whether the **GREEN**, **GOLD**, or **CNTRL** keys are also pressed.

Each special function key can be made to generate one or more characters (up to 80) whenever it is pressed. These character sequences can be defined to be for local use at the terminal, to be sent to a computer, or both. When the terminal is initialized (turned on or reset) these keys are assigned initial values (**␣ p** through **␣ w**).

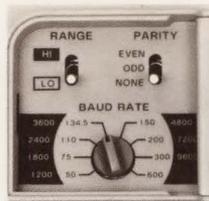
The character value of these keys can be changed from the keyboard, a cartridge tape, or the computer. They can be loaded with instructions for the terminal to perform a variety of operations such as formatting output (page numbering, form feeding, etc.) or multikey editing operations. A detailed description of how to assign character codes to these keys and some useful examples are given in Section X.

Green and Gold Key (Device Control) Operations

The **GREEN** and **GOLD** keys are used together with the special function keys to select the various device operations (labeled in green and gold on the keyboard). Device control functions are discussed in detail in Section VIII.



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Communications Group

The communications group (upper left portion of keyboard) contains three switches for controlling the operation of the terminal when it is used with a computer. The setting of these switches depends on the particular data communications option used.

DUPLEX

The DUPLEX switch selects whether or not the terminal should display characters as they are typed. In some cases the computer will "echo" the characters back to the terminal to indicate that it has received them correctly. When set to HALF, typed characters are displayed by the terminal and sent to the computer. Setting the switch to FULL prevents the characters from being displayed unless they are returned from the computer. This function is ignored when the terminal is in Block Mode. This switch is not present in some terminal configurations.

RANGE

Some terminal configurations use a baud rate range switch to select one of two ranges on the BAUD RATE switch.

PARITY

This switch selects whether even, odd, or no parity is supplied with each character sent to the computer. Parity is also used to determine if each character has been correctly received. If an error is detected a "■" may be displayed on the screen in place of the character.

BAUD RATE

The BAUD RATE switch selects the rate at which the terminal will send and receive data. The available rates are 110, 150, 300, 1200, 2400, 4800, or 9600 baud. This corresponds to 10, 15, 30, 120, 240, 480, or 960 characters per second. Operation above 2400 baud may require fill characters (refer to Section IX).

When set to the EXT position the terminal speed can be set by the computer or some other external source. Some terminal configurations use a baud rate scale switch to select alternate ranges on the BAUD RATE switch. Other configurations ignore the baud rate switch entirely.

Using Your Terminal in Alphanumeric Mode _____ 4

Alphanumeric Mode refers to operating the 2648A independent of the graphics capabilities. The Graphics Mode operations are discussed in Section VI.

The terminal can store over 6,000 characters and can be used without tapes or printers and without being connected to a computer. The terminal can be used alone when first learning to use it or when preparing blocks of data for later transmission to a computer. When used with cartridge tapes (described in Section VIII), the terminal becomes a complete stand-alone tool for data preparation.

We will use the terminal by itself to learn how to enter and correct data, use alternate character sets, and work with special forms. Once you have been introduced to the basic terminal, later sections will describe how to use the terminal with cartridge tapes, a printer, or a computer.

NOTE

The terminal uses a variety of messages to inform you of terminal status. A list of messages and the corresponding action that should be taken is given in Section XII.

Entering Data

One of the most important uses of the terminal is data entry. Data is entered using the keyboard. (Data can also be entered from a tape. See the discussion on tapes later in this manual.) The data can then be sent to a computer, saved on a tape, or listed on a printer.

Example: Enter the following name and date —

John Doe

June 1976

Correcting Data

If you make an error or wish to change an entry you have made, you can use any of the alphanumeric cursor or edit keys discussed earlier. For example, to add the middle initial T. to the entry in the previous example, move the cursor under the "D". Press the **INSERT CHAR** key and type "T." and a space. Press the **INSERT CHAR** key again to return to normal replace mode. (The indicator above the key should go out.)

Wraparound Functions

The **INSERT CHAR** and **DELETE CHAR** keys can be used in wraparound mode.

Insert Character With Wraparound

You can insert characters with wraparound by typing **CNTL** **INSERT CHAR**. This will cause the **INSERT CHAR** indicator to blink. While in this mode characters that overflow a line due to insertion are moved to the next line. Pressing **INSERT CHAR** returns the terminal to normal operation.

Example: Type **CTRL INSERT CHAR**. The indicator should blink. Type two or more lines of data. Move the cursor to the middle of the first line and type characters until the line is full. Add more characters and observe that they push characters from the end of the first line to the beginning of line two. If line two becomes full while the cursor is still in the first line, a blank line will be inserted between line one and two. The characters overflowing line one will then be entered on the new line.

Delete Character With Wraparound

When characters are deleted using **CTRL INSERT CHAR**, one character from the left margin of the next line is moved up to the right margin of the line containing the cursor. If the next line is blank, no wraparound is performed.

Techniques of Data Entry

In order to simplify data entry you can use tabs, margins, specially defined data fields, and data forms.

Tabs

Setting Tabs. To set a tab, move the cursor to the desired column and press **SET TAB**. Once a tab is set, the **TAB** key (located on the left of the keyboard) can be used to move the cursor to the next tab setting.

Using Tabs. Once tab positions have been set you can tab using the **TAB** key in the same manner that you would on a typewriter. You can even tab backwards to the previous tab position by typing **CTRL TAB**. When you are at the first tab position in a line and you backtab, the cursor moves to the last tab position in the previous line. Once the cursor has reached the first tab position in the first line of memory, no further backtabbing movement is made.

Clearing Tabs. You can clear individual tabs by moving the cursor to the tab position and pressing the **CLEAR TAB** key. All of the tabs can be cleared at once without having to position the cursor. Simply type **CTRL CLEAR TAB**.

Margins

You can set the left and right margins to make the entry of data easier. When the terminal is turned on or a full reset performed, the margins are set at columns 0 and 79. This gives a full 80 character line. You can define new margins as follows:

Left Margin — Move the cursor to the desired left margin setting. Type **CTRL <** (hold the **CTRL** key down while pressing **<**).

Right Margin — Move the cursor to the desired right margin setting. Type **CTRL >**.

The terminal will beep when you are eight characters from the right margin. When the right margin is reached, the cursor will move to the left margin of the next line.

The left margin cannot exceed the right margin. An invalid margin setting will not be accepted but will cause the terminal to beep.

Example: Set the margins for a 30 column page centered on the screen.

Move the cursor to column 25 and type **CTRL <**. Move the cursor to column 54 and type **CTRL >**. Place the cursor back at column 25 by pressing **RETURN** and begin typing.

```

column numbers      5 5
2 3 4             5 5
5 0 0             0 5

```

This is an example using margins to control data entry.

Margins are cleared or changed by setting new margins (or a full reset).

Moving Text Blocks

You can move blocks of text or data using

MEMORY LOCK

Example: In the following text, move the paragraphs into the proper order.

Initial order:

```

(Top of screen) 3. This is paragraph
                 3. It should be
                 last in the group.
                2. This is paragraph
                 2. It should be
                 second.
                1. This is paragraph
                 1. It should be
                 first.
                 (blank line)

```

Step 1. Press **RETURN**, **CLEAR DISPLAY** and type in the paragraphs as shown. Be sure to type **RETURN** following the last line.

Step 2. Position the cursor in the first line of paragraph 2.

Step 3. Turn on **MEMORY LOCK**.

Step 4. Use the **ROLL UP** key until the remaining paragraphs have rolled up under the cursor position and off the screen.

Step 5. Turn off **MEMORY LOCK**.

Step 6. Press **RETURN**.

The display should appear as follows:

```

(Top of screen) 2. This is paragraph
                 2. It should be
                 second.
                1. This is paragraph
                 1. It should be
                 first.
                3. This is paragraph
                 3. It should be
                 last in the group.

```

Step 7. Now move paragraph 1 by positioning the cursor in the first line of paragraph 1 and turning on **MEMORY LOCK**.

Step 8. Use the **ROLL UP** key until the cursor is in the first line of paragraph 3.

Step 9. Turn off **MEMORY LOCK** and press **RETURN**. The paragraphs should now be in order.

Note that if the data is not on the first page of memory, the **ROLL UP** key can be used instead of **RETURN** to view the newly ordered text.

Display Features

The terminal provides the following display features:

- **Display Enhancements** — Parts of the display can be half bright, underlined, blinking, or inverse video.
- **Alternate Character Sets** — The keyboard can be used to select characters from Math, Line Drawing, or other special character sets.
- **Protected Fields** — Data cannot be changed by the user and will not be sent to the computer.
- **Unprotected Fields** — Data can be entered and changed. Data will be sent to the computer.
- **Transmit Only Fields** — Displayed data will be sent to the computer but cannot normally be changed.
- **Data Checking** — Data can be checked to determine if it is numeric or alphabetic.

Using Your Terminal in Alphanumeric Mode

Forms can be created with these features to make data entry easier and reduce the chance of errors. The forms used are similar to paper forms except that they are displayed on the terminal screen. Forms are made by defining "fields" of one or more characters. Each character can be given one or more of the display features. Once a form is created, it can be stored in the computer (or on the optional tape cartridges) and displayed as needed.

The remainder of this section discusses briefly how forms are used. A complete discussion of forms and how they are used is contained in the *Reference Manual*.

Using Display Enhancements

NOTE

The graphics video will also be affected by display enhancements. Any graphics vectors or graphics text characters in the field of the Half Bright, Inverse Video, or Blinking will be affected by the enhancement.

The standard terminal can display data using inverse video (black on white). In addition, if your terminal has the 13231A Display Enhancement accessory you can also use half bright, underline, and blinking characters. Each character position on the screen can be displayed with various combinations of these features.

- **Half Bright** — characters are displayed a half intensity (grey).
- **Underline** — an underline is displayed below the normal character.
- **Inverse Video** — the screen is white and characters are black.
- **Blinking** — characters including the inverse video, underline, and half bright features blink.

The display enhancements are used by assigning one or more of them to a field. The selection sequence is **CTRL** **f1**, (enhancement character). The enhancement character (@, A through O) is used to select the combination of display enhancements to be assigned to the field. The following table lists the enhancement character for each of the combinations. The field is ended by selecting another enhancement, the end of the current line, or by **CTRL** **f1**, **@**.

	Enhancement Character															
	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Half-Bright									x	x	x	x	x	x	x	x
Underline					x	x	x	x					x	x	x	x
Inverse Video			x	x			x	x			x	x			x	x
Blinking	x		x		x		x		x		x		x		x	
End Enhancement	x															

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Example: Define columns 10 through 14 of line 5 to be inverse video and blinking.

Step 1. Position the cursor at column 10 in line 5.

Step 2. Type **CTRL** **f1**, **SHIFT** **C**.

Step 3. Move the cursor to column 15 in line 5.

Step 4. Type **CTRL** **f1**, **@** (this ends the enhancements). The field should be white.

Step 5. Type the word **TERMINAL** beginning in column 9 of line 5. It should appear as shown below. (If your terminal does not have the 13231A accessory installed the characters will not blink.)

```
      1      1
      0      5
      ↓      ↓
  T E R M I N A L
```

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Using Alternate Character Sets

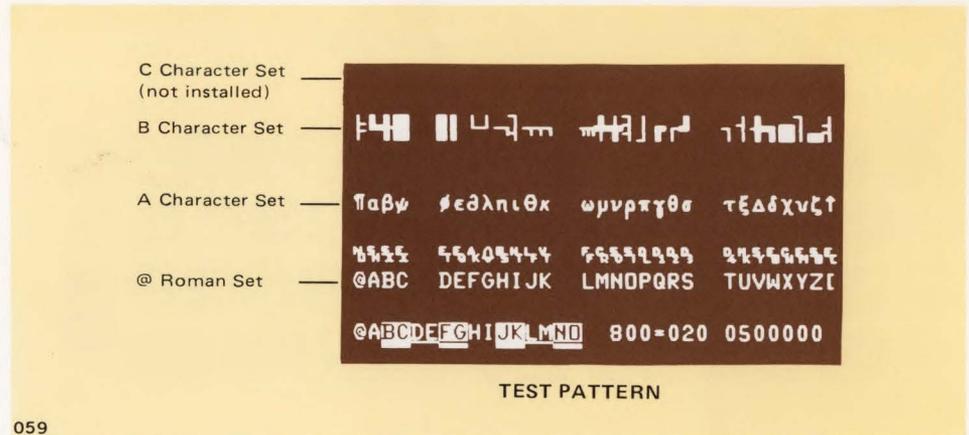
Your terminal can display up to four different character sets. Each character set can contain up to 128 characters or symbols. In addition to the Math, Line Drawing, and Large Character sets available as options, you can create character sets tailored for special applications. Contact your nearest Hewlett-Packard Sales Office for additional information on special character sets.

Switching from one character set to another can be done on a character-by-character basis. For example, a character from the Math Symbol Set can be displayed next to characters from the base set. This is done by defining one or more character positions in a line to be from alternate character sets. (Each group of characters can be thought of as a field.)

NOTE

The following discussion assumes that the Math and Line Drawing character sets are present and are installed as alternate sets A and B respectively and that the  key is down.

To use optional character sets, first select the character set to be used as the alternate. (With the terminal in its initial state, character set A is defined to be the alternate.) Type ,  followed by an , , , or  to select the desired alternate set. (To find out which character set corresponds to @, A, B, or C, generate the test pattern by pressing the  key.) This displays the order of the character sets as shown above.



Example: Define the Math Set as the alternate character set.

From the test pattern the Math Symbol Set is found to be the A alternate character set.

, , 

Once the alternate character set is defined, you can switch from the base to the alternate set by typing   (Hold the key down while you type .)

The terminal automatically returns to the base set at the end of a line. To return to the base set within a line, type  . (This means that you must type   again if your field of alternate characters extends onto the next line.)

To display $A\alpha B\beta$ type the following sequence:


The screen should display $A\alpha B\beta$.

$A\alpha B\beta$

Once a field has been defined as from the alternate set, the field moves with the display when the , , , and  keys are used. To change to a different alternate character set another ,  command must be typed.

Using Your Terminal in Alphanumeric Mode

The Math Set is useful for applications requiring the use of equations or formulas. The elements of the optional Math Symbol Set are shown below.



The Large Character Set allows you to create alphabetic characters that are three times the size of normal characters. The elements of the Large Character set are shown below.

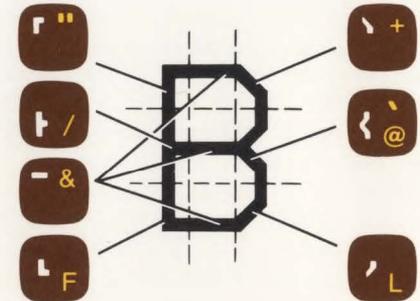


Example:

$$\iiint_0^{\infty} \Psi * \left[\frac{-h}{2\pi i} \frac{\partial \Psi}{\partial t} \right] dv = \iiint_0^{\infty} \Psi * E \Psi dv$$

020

Example:



Forms Mode (Format Mode)

In Forms Mode the terminal prevents you from overwriting or transmitting data in protected fields. Forms mode is normally entered under control of the computer or through commands recorded on a cartridge tape.

Protected Fields

Fields can be protected so that displayed data cannot be overwritten or sent to a computer. When the terminal is placed in "Forms Mode" (FORMAT Mode) all character positions on the screen are protected except those fields that have been specifically defined as "unprotected" or "transmit only".

Unprotected Fields

Data can be written into unprotected fields in the normal manner. After reaching the end of an unprotected field, the cursor moves to the beginning of the next unprotected field. The tab functions can be used to move from one unprotected field to the beginning of the next unprotected field. **CNTL** **TAB** causes the cursor to be positioned at the beginning of the previous unprotected field. Fields are defined as "unprotected" by using **CNTL** **f2** at the start of the field, **CNTL** **f3** or the end of the 80-character line is used to end the field.

FORM #1876

Vendor Name			Address		City	State	Zip	
PACIFIC TOOL INC			1273 CRESCENT WAY		SAN JOSE	CALIFORNIA	95131	
Voucher	Date	Units	Purchase And Assembly Details			Post Ref.	Cost	
07	16	1976	98	FINISHED STEEL CASTINGS			874738	65.88
03	19	1976	749	TAPE TRANSPORT BACKPLATES			875483	9753.88
02	28	1976	13	MILLED FLANGE ASSEMBLY			748563	877.44
		19						.
		19						.
HEWLETT-PACKARD			INITIATED BY: H.C. DOUGLAS			DATE: 04 14 1976		

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In the above figure only the shaded fields are unprotected or transmit only. Even if you move the cursor to a protected field and type a character the cursor will move to the nearest unprotected field before displaying the character.

Example: Define column 1 through 9 of line 3 as "unprotected".

Step 1. Position the cursor at column 1 in line 3.

Step 2. Type **CNTL** **f2**.

Step 3. Move the cursor to column 10 of line 3.

Step 4. Type **CNTL** **f3**.

Now try turning on Forms Mode (**CNTL** **f4**) and typing data. Note that data can only be entered into the unprotected field. (Remember to turn off Forms Mode with **CNTL** **f5**.)

Transmit Only Fields

It is often desirable to be able to return fixed data used as labels or headings to the computer. Transmit only fields are similar to protected fields except that they are sent to a computer along with the data that you enter. Normally data can only be entered in unprotected fields. But by manually positioning the cursor in the transmit only fields (using the cursor control keys), you can also enter data into transmit only fields. The tab functions skip over transmit only fields. After reaching the end of the transmit only field the cursor moves to the beginning of the next unprotected field. Fields are defined as "transmit only" by using **CTRL** **F6** at the beginning of the field, **CTRL** **F3** or the end of the 80-character line will end the field.

Example: Continue the previous example and define column 11 through 14 of line 3 as transmit only.

Step 1. Turn forms mode off (**CTRL** **F5**).

Step 2. Position the cursor at column 11 line 3.

Step 3. Type **CTRL** **F6**.

Step 4. Move the cursor to column 15 in line 3.

Step 5. Type **CTRL** **F3**.

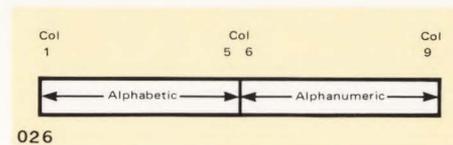
Position the cursor in column 0 and turn on Forms Mode (**CTRL** **F4**). Try typing data. Note that the cursor moves over the Transmit Only field without entering data.

Data Checking

While in Forms Mode the terminal can test data to make sure that it is numeric or alphabetic. If a field is defined as numeric and an alphabetic character is entered the terminal will beep and the keyboard will lock. This condition can be cleared by pressing **RETURN**. You can then continue entering data. Data checking fields are defined by beginning the field with one of the following sequences:

- ESC** , **6** — begin alphabetic field
- ESC** , **7** — begin numeric field
- ESC** , **8** — alphanumeric field

Example: Define columns 1 through 5 on line 4 to be alphabetic and columns 6 through 9 to be alphanumeric.



Step 1. Turn off forms mode (**CTRL** **F5**).

Step 2. Position the cursor at column 1 of line 4.

Step 3. Type **CTRL** **F2** to define the beginning of an unprotected field.

Step 4. Type **ESC** , **6** to define an alphabetic field.

Step 5. Move the cursor to column 6 of line 4.

Step 6. Type **ESC** , **8** to define normal alphanumeric data.

Step 7. Move the cursor to column 10 of line 4.

Step 8. Type **CTRL** **F3** to end the unprotected field.

Step 9. Turn on forms mode (**CTRL** **F4**).

Trying typing numeric characters in the alphabetic field the keyboard is locked, the terminal beeps, and the cursor remains under the invalid character. Press the **RETURN** key to unlock the keyboard. You can then make the correct entry.

The numeric character may be left in the alphabetic field by moving the cursor to the next character position using the cursor control keys. This has the effect of overriding the data check.



Using Your Terminal in Autoplot Mode



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Autoplot Mode allows you to plot tabular data into the graphics display memory while either on-line or off-line. This mode will produce immediate graphics output on the screen from:

- Any program that generates columns of tabular numerical data.
- Data stored on an optional cartridge tape.
- Data entered directly into the alphanumeric memory from the keyboard.

This mode is very useful in business environments where graphics was previously unavailable as being too hard to use, too costly to implement, and too time consuming to support. The example shown on page 5-3 illustrates the use of Autoplot Mode.

Basically, you must:

- Fill-in the Autoplot Menu (by pressing **SHIFT** **AUTO PLOT MENU**, and entering the parameters for the plot).
- Return to normal display by pressing **SHIFT** **AUTO PLOT MENU** again.
- Draw the axes (by pressing **SHIFT** **AXES**). (The data can be plotted without drawing the axes, but the plotted values would be difficult to interpret.)
- Plot the data (by pressing **AUTO PLOT**).

The information on the screen can be stored on cartridge tape and/or copied to a compatible printer. (Refer to section 8.)

The Autoplot Menu

Pressing **SHIFT** **AUTO PLOT MENU** selects the form shown on the next page. You enter the parameters for the plot by completing the specifications in the form. The form is divided into three parts: *Plot Specification*, *Axes Specification*, and *Plot Options*.

Once the menu is completed it can be recorded on tape for future use. (**RECORD**).

A. PLOT SPECIFICATION

The *Plot Specification* specifies the data parameters and type of line used for the plot. Items 1 through 3 specify the data format, item 4 selects the line type, and items 5 through 8 specify scale limits of the graph.

NOTE

To change any of the specifications that you have entered, move the cursor to the entry and retype the specification. You may use the **CLEAR DISPLAY** key to clear the specification containing the cursor from the cursor to the end of the specification.

AUTO PLOT

A. PLOT SPECIFICATION

1. NO. OF COLUMNS
2. X IS COLUMN
3. Y IS COLUMN
4. LINE TYPE (1-9)
5. MIN X
6. MAX X
7. MIN Y
8. MAX Y

B. AXES SPECIFICATION

1. UNITS BETWEEN X LABELS
2. UNITS BETWEEN X TICS
3. UNITS BETWEEN Y LABELS
4. UNITS BETWEEN Y TICS

C. PLOT OPTIONS

- | | |
|----------------|-------------------------|
| 1. SKIP FIRST | LINES OF TEXT
POINTS |
| 2. STOP AFTER | |
| 3. DRAW GRID? | |
| 4. FROM DSPLY? | |

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1. **NO. OF COLUMNS** — Specifies the number of columns used to contain the data. (In the example, on page 5-4, the number of columns is 5.)
2. **X IS COLUMN** — Specifies which column number will be used for the X values. (In the example on page 5-4, column 1 is used for the X values.)
3. **Y IS COLUMN** — Specifies which column number will be used for the Y values. (In the example on page 5-4, columns 2 through 5 are used in succession for each plot.)

4. **LINE TYPE (1-9)** — Specifies the type of line to be used to show the plotted data. The different line types allow you to distinguish between multiple plots on the same graph.

- | | |
|---------------|----------------------|
| 1 = _____ | 6 = - - - - - |
| 2 = - - - - - | 7 = - - - - - |
| 3 = - - - - - | 8 = - - - - - |
| 4 = - - - - - | 9 = · (POINT PLOT) · |
| 5 = ········· | |

5. **MIN X** — Specifies the minimum value to be assigned to the X-axis (the left side of the graph). (In the example on page 5-4, 1965 is the minimum value.)
6. **MAX X** — Specifies the maximum value to be assigned to the X-axis (the right side of the graph). (In the example on page 5-4, 1975 is the maximum value.)
7. **MIN Y** — Specifies the minimum value to be assigned to the Y-axis (the bottom of the graph). (In the example on page 5-4, 0 has been used as the minimum value.)
8. **MAX Y** — Specifies the maximum value to be assigned to the Y-axis (the top of the graph). (In the example on page 5-4, 100 has been used as the maximum value.)

B. AXES SPECIFICATION

The *Axes Specification* determines where the "tic" marks will appear on the graph and which tic marks will have labels (i.e., numeric values assigned to certain tic marks).

1. **UNITS BETWEEN X LABELS** — Specifies spacing between labels on the x-axis (e.g., for labels at 1965, 1966, 1967, etc. in the example, you specify "1" since you want a label at every tic mark).
2. **UNITS BETWEEN X TICS** — Specifies units between tic marks on the x-axis. (In the example on page 5-4, tic marks are desired at every point for the year.)
3. **UNITS BETWEEN Y LABELS** — Specifies spacing between labels on the y-axis. (In the example on page 5-4, you specify "10" for labels at 10, 20, 30, etc.)
4. **UNITS BETWEEN Y TICS** — Specifies units between tic marks on the y-axis (i.e., how many units each tic mark will represent). (In the example on page 5-4, tic marks are desired at every 5 units, therefore, you would specify "5".)

C. PLOT OPTIONS

The *Plot Options* specify optional parameters that can be entered to fit the particular plot situation.

1. **SKIP FIRST LINES OF TEXT** — If the data to be received has header lines (i.e., the first lines of data that do not contain plot values), you must specify how many lines to skip before accepting valid data. This feature need not be used if heading lines are alpha only.
2. **STOP AFTER POINTS** — If you do not want to plot all values in a column of data, you can specify how many points to plot before terminating.
3. **DRAW GRID?** — You can specify a grid pattern at the *label* points specified in the *Axes Specification* to make reading points in the center of the plot pattern easier. Enter a non-zero number in the space provided (any number will be interpreted as "yes").
4. **FROM DSPLY?** — If the data to be plotted is contained on the display, you must so specify by entering a non-zero number in the space provided (any number will be interpreted as "yes").

After all the necessary items in the menu have been completed, press   again to return to normal display.

Drawing the Axes

To draw the axes specified in the Autoplot Menu, press  . You may change the specifications and redraw the axes, if necessary.

Plotting the Data

To plot the source data, press . If the data is to be plotted from the display, position the alphanumeric cursor to the beginning of the first data column before pressing the  key.

Input Data Format

When autoplot is turned on ( key pressed), a scan is made for valid numerical values as characters are read from the display, cartridge tape, or on-line from the computer. The first found is assumed to be column one, the second column two, and so on until the limit specified by the user (NUMBER OF COLUMNS) is reached. Then, column one is assumed, and so on. As the columns designated X and Y are found, they are highlighted in inverse video, the values are scaled, and the data point is plotted.

Note that only the relative position in the data stream determines which column the terminal thinks a number is in, not the location on the screen. This means that extraneous alphabetic titles, blank lines, and text do not affect the autoplot scan. However, dates, page numbers, and the like, will be interpreted as belonging in data columns. Once autoplot is turned on, any numbers are assumed to be data. You must edit extraneous values out to prevent them from making erroneous plots. There are several ways to do this:

1. *Skip heading lines.* This *Autoplot Menu* parameter allows the user to specify a number of lines to be initially skipped before the autoplot scan starts. (However, you cannot use this in cases where there are heading numbers on every page.) *This function is not active when plotting from the display.*

2. *Plot from the display memory.* The normal alphanumeric display memory can be selected as the source of data. Once it contains the desired data, it can be edited using the local editing functions (Insert/Delete Character, Insert/Delete Line, etc.). All the desired data must fit in the available display memory when the inverse video enhancements are added as autoplot executes. Typically, 30 lines of data may be plotted.

3. *Edit with the Cartridge Tapes.* Record the data on tape, use edit mode to remove the extraneous values from the tape, then plot the data from the edited tape.

MULTIPLE PLOTS

Multiple plots can be made on the same set of axes by changing the appropriate data columns and running the data through as many times as necessary. (This was accomplished in the example that follows by changing the column number in "Y IS COLUMN" in the *Autoplot Menu*.) Different dot-dash patterns can be selected to differentiate the plots. When plotting from the display, reposition the cursor to the beginning of the data column and start autoplot.

XYZ WIDGET COMPANY				
EARNINGS BY PRODUCT LINE, 1965-1975				
YEAR	POLARIZERS	HELICAL CONVERTERS	AUTOMATIC MASHERS	TOTAL
1965	\$ 5.1	-0-	-0-	\$ 5.1
1966	9.3	-0-	-0-	9.3
1967	13.2	3.0	-0-	16.2
1968	16.9	5.9	-0-	22.8
1969	15.2	6.3	1.3	22.8
1970	19.7	10.1	4.5	34.3
1971	23.6	12.9	9.3	45.8
1972	15.2	16.8	12.7	44.7
1973	8.3	20.9	19.0	48.2
1974	-0-	27.5	22.4	49.9
1975	-0-	35.4	29.1	64.5

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EXAMPLE

This example will illustrate the use of Autoplot to make several plots of the data in display memory. The table above shows some typical financial data entered on the display. A plot of total sales, polarizers, mashers and converters versus year is desired.

1. *Fetch the Menu.* Typing   brings up the menu shown on page 5-2.

2. *Enter the Plot Specifications.*

- Specify the Data Columns.* There are five columns of data to be plotted; therefore, enter "5" in line A-1. To plot calendar time (first column) versus total sales (fifth column), enter "1" in line A-2 and "5" in line A-3. You may press   at any time to look at the data again while filling in the menu.
- Select the Line Type.* For the first plot, enter any value between 1 and 8 in line A-4. (Line type 9 is used for scattergrams.)

c. *Set the plot range.* X ranges from 1965 (line A-5) to 1975 (line A-6). Y actually ranges from 5.1 to 64.5, but the range specified is from 0 (line A-7) to 100 (line A-8) to allow plotting all data columns on the same graph. In general, the min and max values should be chosen as a reasonable range, not necessarily the actual min and max in the data column. (Exponential and floating point notation may be used.)

3. Select the Axes Specification (Tic Spacing).

a. *Tics are referenced from zero.* The value specified in lines B-2 and B-4 give the units represented between unlabeled tics. The x tic spacing of "1" places tics at 1965, 1966, . . . 1974, 1975. The y tic spacing of "5" puts tics at 0, 5, 10, . . . 90, 95, 100. To further illustrate, say that the range was -1 to 1, and the tic spacing was specified as 0.1. This would put tics at -1, -.9, . . . -.1, 0, .1, .2,9, 1.0. Here exponential and floating point notation can be used.

b. *Set the labeling interval.* The values in lines B-1 and B-3 are integers, and tell how many units separate labels. The units between x labels ("1") says to space labels one unit apart. The units between y labels ("10") says to space labels ten units apart. If a grid is specified (line C-3), the grid lines are always placed at the labels.

4. Select the Plot Options

a. *Skip first X lines of text.* Since this feature is not used when plotting from the display, we can leave this blank.

b. *Stop After X Points.* Since we are plotting all points in the data columns, we can leave this blank, also.

c. *Draw Grid?* Entering a non-zero integer specifies that we want a grid at the labeled tic marks.

d. *From Display?* Any non-zero numeric value tells the terminal to plot the data in the display memory. Otherwise, incoming data from the tape or datacomm is expected.

```

AUTO PLOT
A. PLOT SPECIFICATION
1. NO. OF COLUMNS 5
2. X IS COLUMN 1
3. Y IS COLUMN 5
4. LINE TYPE (1-9) 1
5. MIN X 1965
6. MAX X 1975
7. MIN Y 0
8. MAX Y 100

B. AXES SPECIFICATION
1. UNITS BETWEEN X LABELS 1
2. UNITS BETWEEN X TICS 1
3. UNITS BETWEEN Y LABELS 10
4. UNITS BETWEEN Y TICS 5

C. PLOT OPTIONS
1. SKIP FIRST LINES OF TEXT
2. STOP AFTER POINTS
3. DRAW GRID? 1
4. FROM DSPLY? 1
  
```

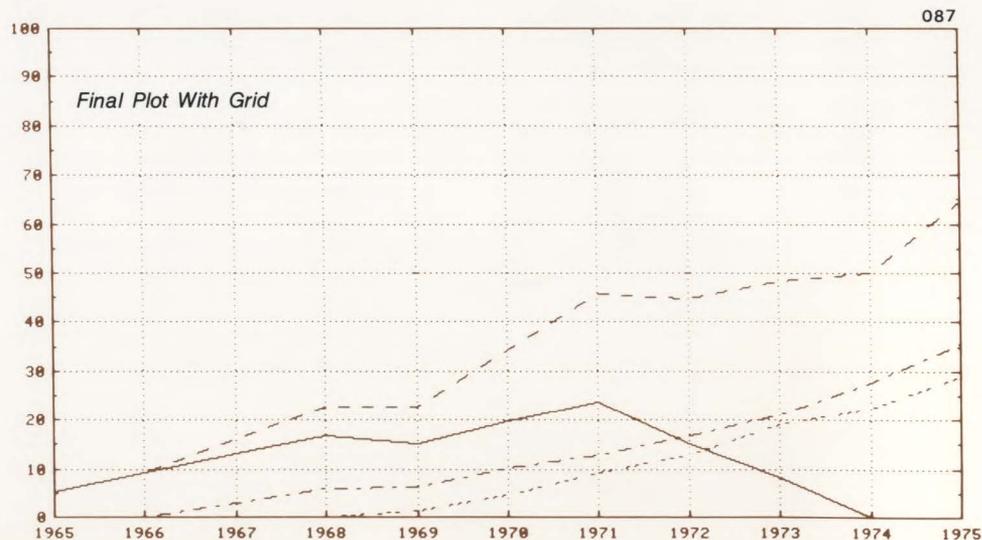
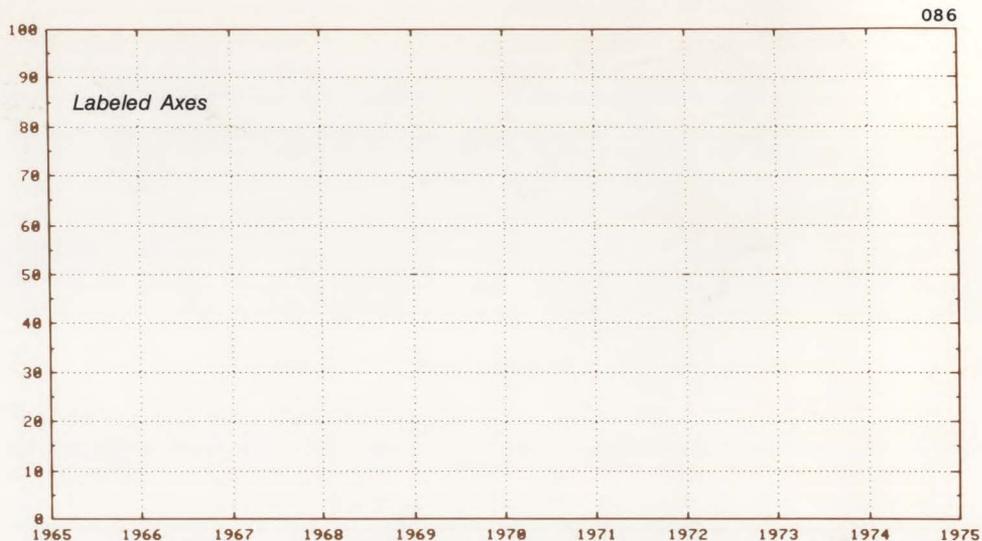
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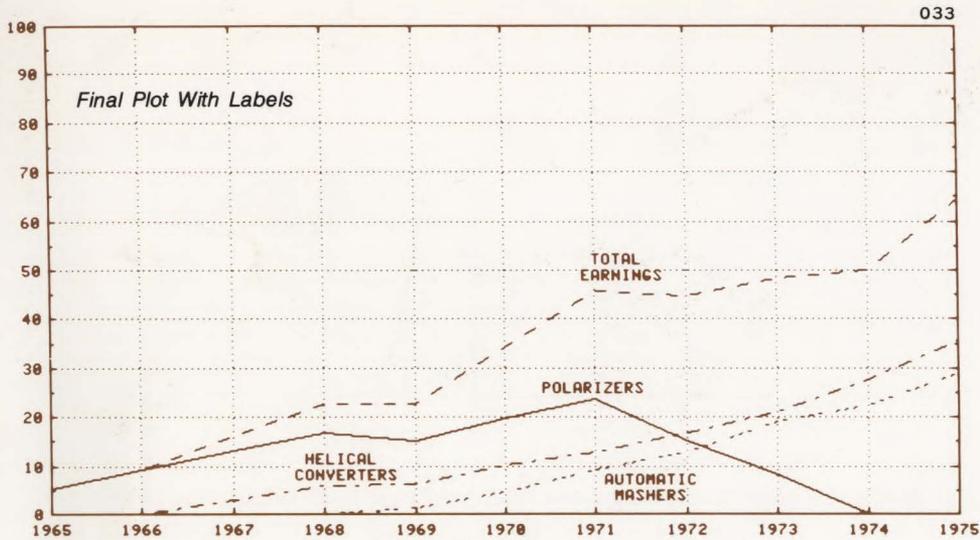
5. *Remove the Menu.* Pressing **SHIFT** **AUTO PLOT** **MENU** removes the menu and returns the normal display.

6. *Draw the Axes.* Pressing **SHIFT** **AXES** draws the axes, tics, labels, and grid (if specified in the menu) as shown on the next page.

7. *Plot the data.* Position the cursor at the beginning of the first line containing data and press **AUTO PLOT**. Since plot from display was selected, the cursor immediately moves through the data, picks out the X and Y fields, and plots the data.

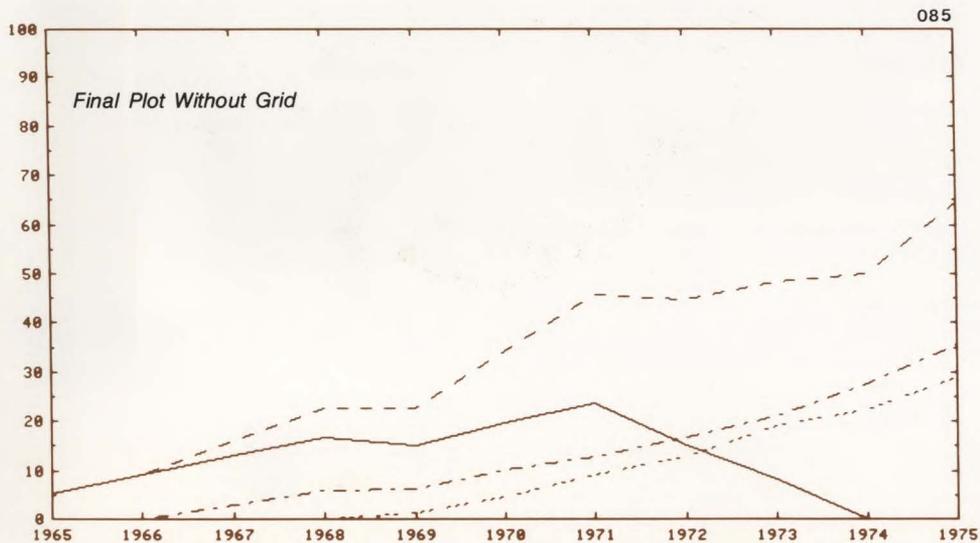
The total sales column has now been plotted. To plot the remaining data, as shown on the next page, it is necessary to run autoplot three more times. Only the Y IS COLUMN (line A-3) and the LINE TYPE (line A-4) fields in the menu need be changed. The cursor should be repositioned on the data columns.





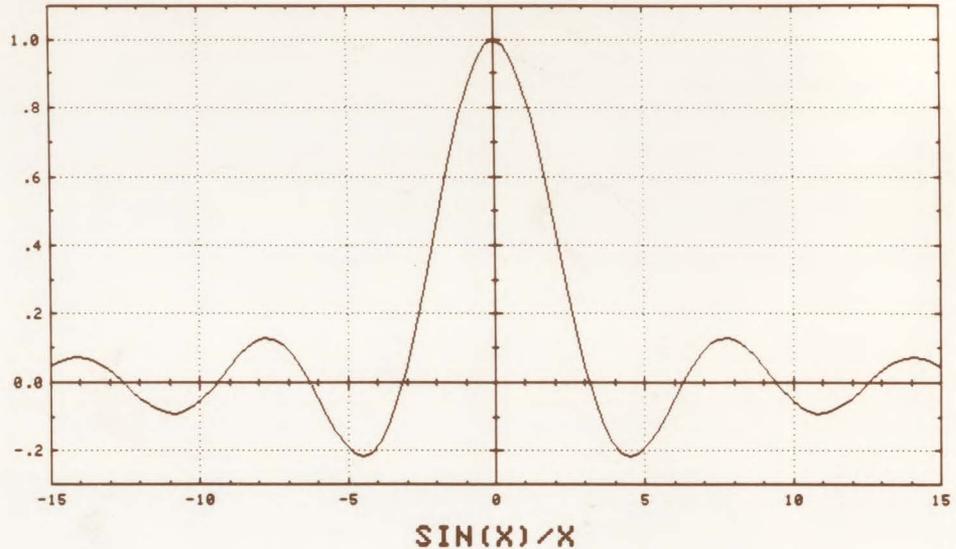
Labeling Plotted Data

After the data is plotted, the individual plot lines may be labeled using the Graphics Text Mode (refer to page 6-4).



Plotting From Data Comm or Cartridge Tape

To further illustrate the use of autoplot, assume that the data on page 5-4 is to be plotted as it arrives from the datacomm (or cartridge tape). The menu is loaded as before, with blanks or "0" entered in the FROM DSPLY field (line C-4). The **AUTO PLOT** key is pressed. To indicate that autoplot is active, the yellow LED above the gold key will blink. The proper command sequence to run the financial program is then entered. As the lines of data enter the terminal, they will be scanned and plotted. The **STOP** key then terminates autoplot. To plot all four columns, you can stop autoplot after each plot, change the menu, and rerun the program to plot the next column. Alternately, the computer can be programmed to change the menu and re-run the data.



Example:

This example shows a BASIC program (running in a remote computer), filled in menu, and plot for a $\sin X/X$ function.

>LIST

SINXPRDG

```
10 FOR X=-15 TO 15.1 STEP .3
20 PRINT X,SIN(X)/X
30 NEXT X
```

>

AUTO PLOT

A. PLOT SPECIFICATION

```
1. NO. OF COLUMNS 2
2. X IS COLUMN 1
3. Y IS COLUMN 2
4. LINE TYPE (1-9)
5. MIN X -15
6. MAX X 15
7. MIN Y -.3
8. MAX Y 1.1
```

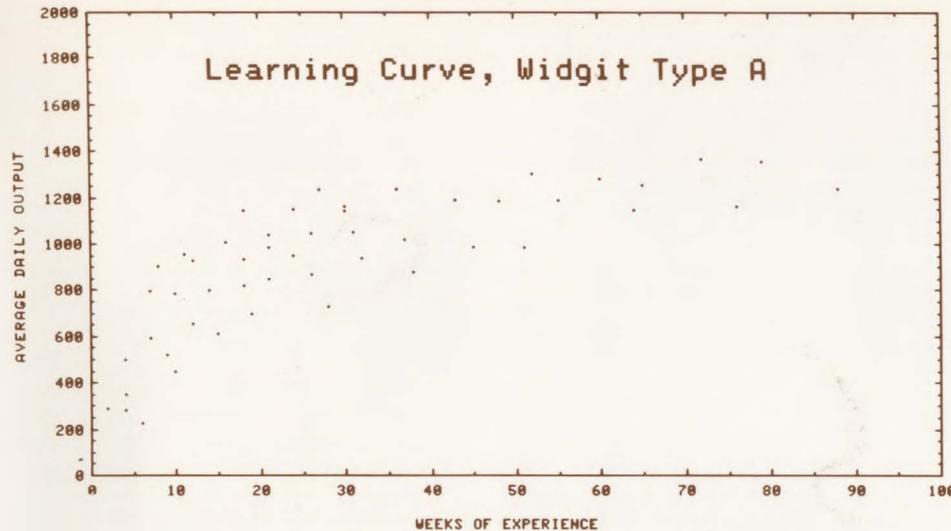
B. AXES SPECIFICATION

```
1. UNITS BETWEEN X LABELS 5
2. UNITS BETWEEN X TICS 1
3. UNITS BETWEEN Y LABELS .2
4. UNITS BETWEEN Y TICS .1
```

C. PLOT OPTIONS

```
1. SKIP FIRST
2. STOP AFTER
3. DRAW GRID? 1
4. FROM DSPLY?
```

LINES OF TEXT
POINTS



Scattergrams

You can generate scattergrams in Autoplot Mode by selecting line type 9. Each point is plotted as a dot on the display rather than being connected by a line from the previous point. The example shown plots average daily output versus weeks of experience in assembling a product "Widget Type A".

AUTO PLOT

A. PLOT SPECIFICATION

```

1. NO. OF COLUMNS 3
2. X IS COLUMN      2
3. Y IS COLUMN      3
4. LINE TYPE (1-9) 9
5. MIN X 0
6. MAX X 100
7. MIN Y 0
8. MAX Y 2000

```

B. AXES SPECIFICATION

```

1. UNITS BETWEEN X LABELS 10
2. UNITS BETWEEN X TICS   5
3. UNITS BETWEEN Y LABELS 200
4. UNITS BETWEEN Y TICS   50

```

C. PLOT OPTIONS

```

1. SKIP FIRST          LINES OF TEXT
2. STOP AFTER          POINTS
3. DRAW GRID?
4. FROM DSPLY? 1

```

Notes on Autoplot

- Keyboard entries are never plotted directly by autoplot. When autoplot is initially turned on, and no numbers have been plotted, any keyboard entry is ignored by the autoplot scanner. However, once the first point has been plotted, any keyboard entry terminates autoplot.
- When loading the menu, only numeric type characters are accepted, specifically, 0-9, +, -, ., and "E".
- The only functions that work when the menu is displayed are the alphanumeric cursor keys, home up, home down, tab, back tab, CR, LF, clear display, RECORD, and ENTER.
- Short fields in the menu indicate integer values only. The longer fields accept integer, floating point, and exponential notation.
- Calling up the menu turns off Autoplot Mode.
- To facilitate the plotting of financial data, "\$" and "," imbedded in numbers are ignored. In addition, trailing "-" or "+" signs, generated by some COBOL programs, are recognized.
- There are three error conditions. The first occurs if a maximum X or Y is less than or equal to the minimum. This is detected when the **AUTO PLOT** or **AXES** key is

pressed. The second occurs if more than 1000 tic marks (either X or Y) would be drawn. This condition is detected when **SHIFT** **AXES** is pressed. In either case, a message appears, similar to a cartridge tape message, which is cleared by pressing **RETURN**. The third occurs if more than 100 labeled tics are specified.

There may also be variations in labeling due to roundoff errors. These variations do not generate an error message and can usually be corrected by changing the MAX and MIN values in the plot specification.

8. When plotting from the display, a number cannot be broken across two separate lines, or it will be interpreted as two separate numbers. This is not the case when plotting from the datacomm or tape, since the autoplot scanner does not care where on the screen the characters are entered.
9. Numbers cannot be longer than 20 characters. If longer, the entire number will be scanned, but only the first 20 characters will be used. Accuracy is limited to five significant digits.
10. It is possible to force the autoplot scanner to plot selected pairs of data points by changing the number of columns. In the first example shown, if 10 columns, rather than 5, had been specified, then every other line of data would have been plotted.

Input Data	Result	Comments
123x456#78 9	→ 123 456 78 9	(non-numeric character delimits data)
123- 456	→ -123 456	(trailing - assumed)
123 -456	→ 123 -456	(- goes with second number)
-\$123,456	→ -123456	(\$ and , ignored)
\$123,456,\$789	→ 123456 789	(as expected)
- 123	→ 123	(can't have blanks after sign)
123E 02	→ 123 2	(can't have blanks between E and exponent)
123E+02	→ 123E02	(correct result)

11. Any non-numeric displayable character delimits a number. Carriage return also acts as a delimiter. Numbers imbedded in escape sequences will not be plotted (unless they are displayed using display functions). The following examples show how autoplot scans numeric strings. To avoid problems, put blanks around numbers to be sure of getting what you want.
12. The largest allowable number is approximately $1 \times 10^{+30}$. The smallest is approximately 1×10^{-30} .
13. When autoplot finds the proper X or Y column, it highlights the value in inverse video. This display enhancement uses display memory. If the memory is full before autoplotting, lines may be rolled off to make room for the inverse video codes.
14. Autoplot turns graphics text off. If autoplot is on, graphics text cannot be turned on. Data in the graphics memory cannot be scanned by autoplot.
15. Autoplot automatically changes the graphics text size, angle and slant, and the current drawing mode and line type.
16. The format for tic labels is determined by the value in the label spacing field (B-1 and B-3). If the value in the menu is an integer, the tic value is rounded to the nearest integer, and displayed without a decimal point. If the value has a decimal point, the tic value is rounded off to the same number of places as in the menu field. If the tic value is too small, less than .000001, or too large, greater than 9999999, exponential format is used for labeling.

Using Your Terminal in Graphics Mode



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Introducing Graphics Mode

The terminal's graphics capabilities can be controlled either from the keyboard's graphics keys or more extensively from escape sequences. The escape sequences may be entered locally from the keyboard; however, they are usually sent by computer program when the terminal is on-line.

Keyboard Control

The graphics keypad allows you to control the following functions (equivalent escape sequences are also given). *Autoplot Mode* and *Compatibility Mode* are graphics related, but they are discussed in Sections V and VII, respectively.

SHIFT CLEAR	$\text{Esc} * d A$	(clear graphics)
SHIFT G DSP	$\text{Esc} * d C$	(graphics video on)
	$\text{Esc} * d D$	(graphics video off)
SHIFT A DSP	$\text{Esc} * d E$	(alphanumeric video on)
	$\text{Esc} * d F$	(alphanumeric video off)
ZOOM	$\text{Esc} * d G$	(zoom on)
	$\text{Esc} * d H$	(zoom off)
ZOOM IN, ZOOM OUT	$\text{Esc} * d <parameter "1" thru "16"> I$	(set zoom size)
G CURSOR	$\text{Esc} * d K$	(graphics cursor on)
	$\text{Esc} * d L$	(graphics cursor off)
SHIFT RB LN	$\text{Esc} * d M$	(rubber band line on)
	$\text{Esc} * d N$	(rubber band line off)
← ↑ → ↓	$\text{Esc} * d <parameter> O$	(position cursor, absolute)
(no key equivalents)	$\text{Esc} * d <parameter> P$	(position cursor, incremental)
	$\text{Esc} * d Q$	(alphanumeric cursor on)
	$\text{Esc} * d R$	(alphanumeric cursor off)

Program Control

The escape sequences for the various graphics functions in addition to those above are given in the *Programmer's Reference Table* in Appendix A. The *Refer-*

ence Manual gives complete instructions for programming the terminal using escape sequences.

Display Control

Clear/Set Graphics Image Memory

The graphics image memory can be completely cleared (screen all black) or set (screen all white) independent of the alphanumeric display memory. **SHIFT** **CLEAR** will clear the display, and typing **ESC * d B** will set the display.

Graphics Video and Alphanumeric Video On/Off

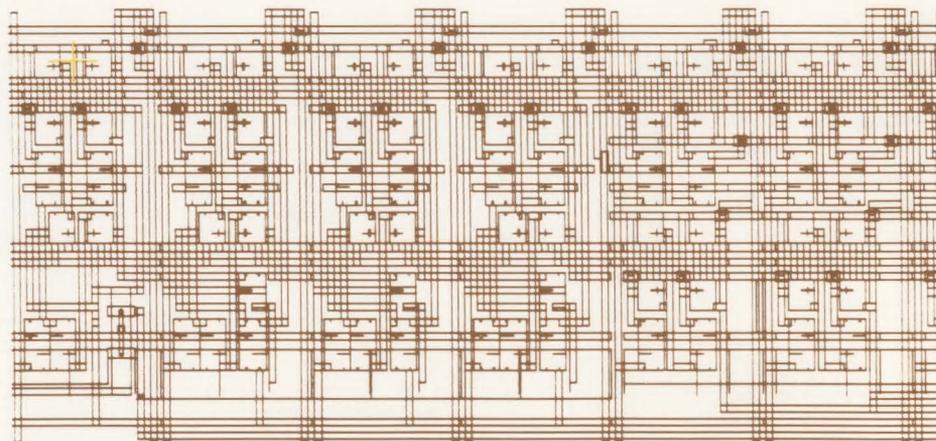
The graphics memory display can be turned on and off by **SHIFT** **G DSP**. The alphanumeric memory display can be turned on and off by **SHIFT** **A DSP**. Information stored in either is not lost when the other video is turned off. These keys allow either memory to be displayed; both may be on or off simultaneously.

Zoom On/Off

Any portion of the graphics display can be expanded from 1 to 16 times. **ZOOM IN** incrementally expands the display at the cursor position, while **ZOOM OUT** incrementally reduces the display at the cursor position. The **ZOOM** key will toggle between the normal 1:1 display and the expanded display size set by the **ZOOM IN**, **ZOOM OUT** keys. (Illustrations below and on the following page shown an IC mask at 1:1, the upper left corner magnified four times, and the same area magnified 11 times.

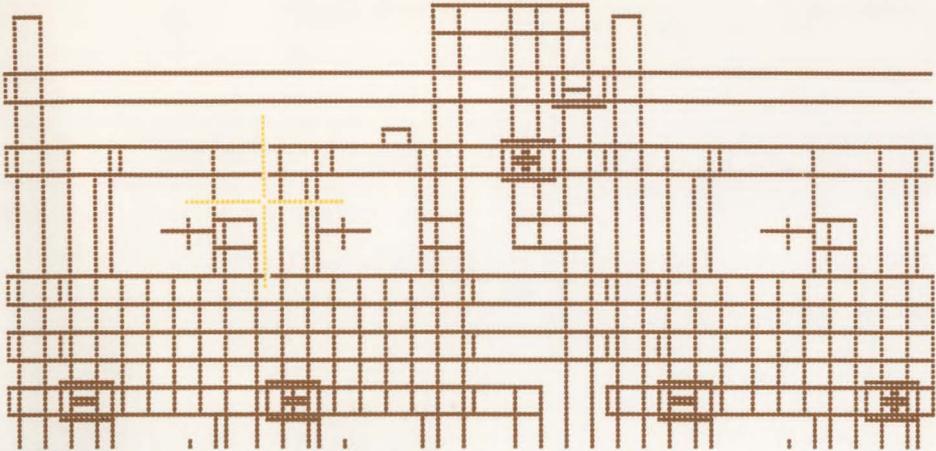
Panning

With the display expanded by the zoom keys, the graphics cursor control keys allow you to view any portion of the graphics display. When the cursor reaches the edge of the screen, a portion of the graphics display is moved into the screen viewing area. This allows you to "pan" throughout the entire graphics memory at any zoom size.



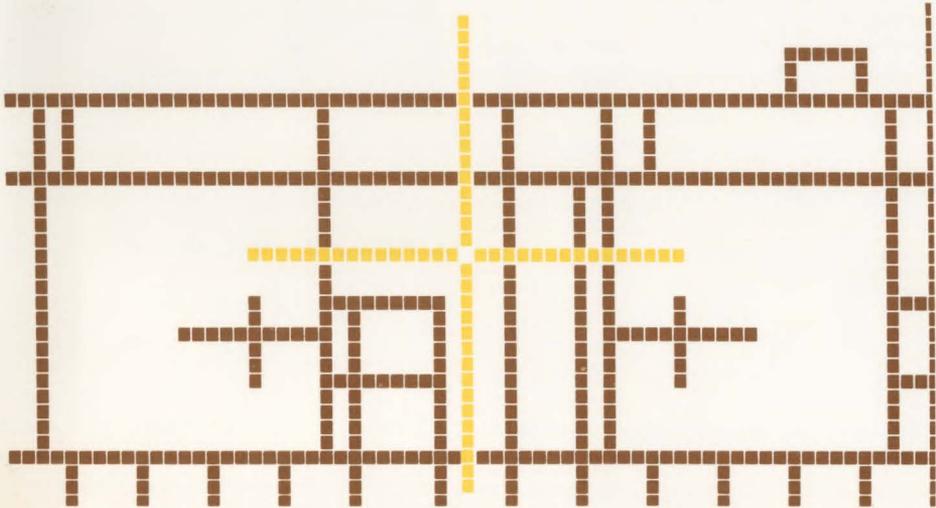
089

IC Mask At 1:1



090

Upper Left Corner Magnified 4 Times



091

Upper Left Corner Magnified 11 Times

Cursor Control

Alphanumeric Cursor

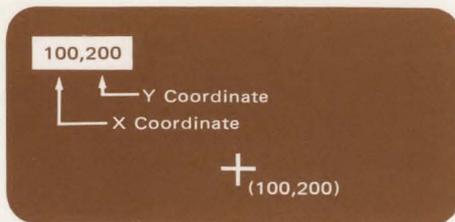
The alphanumeric cursor is turned on and off when the alphanumeric memory is turned on and off (**SHIFT** **A DSP**). However, by typing **ESC * d R** will turn off the cursor, and **ESC * d Q** will turn it on. This feature is useful for making hard copies of the display with the cursor off. The cursor is also turned on whenever the alphanumeric video is turned on.

Graphics Cursor

The graphics cursor may be turned on and off by **G CURSOR**. The cursor will not be displayed, however, if the graphics video is turned off. The cursor arrow keys on the keypad move the cursor to any position on the display. The **CURSOR FAST** key may be held down while pressing the cursor arrow keys to increase the cursor move speed. Any two cursor keys at right angles to each other may be held down simultaneously to move the cursor diagonally.

Graphics Cursor Position

You can find out the exact position of the graphics cursor at any time by **CTRL** **G CURSOR**. This will cause the cursor coordinates to be displayed in the upper left corner of the screen.



The display of cursor coordinates will remain when the graphics cursor keys (**←**, **↑**, **→**, **↓**) are used to move the cursor. The displayed coordinate values will change as the cursor is moved. This allows you to easily position the cursor to any predetermined point.

Once the cursor is correctly positioned simply press the **G CURSOR** key to return the normal display. You must return to the normal display to perform any of the graphics drawing functions (**MOVE**, **DRAW**, etc.).

Rubber Band Line

Rubber band line is toggled by **SHIFT** **RB LN**. The *rubber band line* feature allows you to "preview" lines before you draw them. The rubber band line is displayed from the current "pen" position to the graphics cursor. As you move the cursor, the line will stretch and contract like a rubber band from the current "pen" position.

"Pen" Control

To draw a vector from one point on the display to another, the "pen" must be moved to the beginning of the vector (**SHIFT** **MOVE** or **SHIFT** **DRAW**). The graphics cursor is then moved to the desired end point and the line is drawn (**SHIFT** **DRAW**).



Graphics Text Mode

The 96 displayable characters on the keycaps in the Character Set Group can also be entered into the graphics memory. The characters can be displayed either *upright* or *slanted* (like italics) in eight different sizes. Also, the text lines can be displayed at four different angles (90-degree increments).

Turning On Graphics Text Mode

Press **SHIFT** **TEXT** to turn on graphics text mode. Characters typed at the keyboard in local mode or received from the computer in remote mode will be displayed starting at the current cursor position. The current graphics cursor position will also define the left margin.

The keys used in graphics test mode are shown highlighted at the left. In addition to the normal 96-character keys, the **RETURN**, **BACK SPACE**, and **SHIFT** keys can be used. The **TAB** key functions like the alphanumeric cursor right (**→**) key. Editing keys (**INSERT LINE**, **DELETE LINE**, **INSERT CHAR**, **DELETE CHAR**) do not function in graphics memory.

Test Scale Factor

The size of the text characters is specified by typing **SHIFT** **T SIZE**. The message shown below will appear on the display, then you enter any number from "1" to "8" to specify the size of the characters. Pressing **RETURN** resumes the normal display.

Text Angle (90-Degree Increments) and Character Angle (Italics)

The text angle is specified by typing **SHIFT** **T ANG**. The message shown below will appear on the display, then you enter a number from "1" to "4" for the desired angle.

037

TEXT SIZE (1-8) 1 HP

TEXT SIZE (1-8) 2 HP

TEXT SIZE (1-8) 3 HP

TEXT SIZE (1-8) 4 HP

TEXT SIZE (1-8) 5 HP

TEXT SIZE (1-8) 6 HP

TEXT SIZE (1-8) 7 HP

TEXT SIZE (1-8) 8 HP

TEXT ANGLE (1-4) 3
SLANTED? (Y OR N) N

TEXT ANGLE (1-4) 4
SLANTED? (Y OR N) N

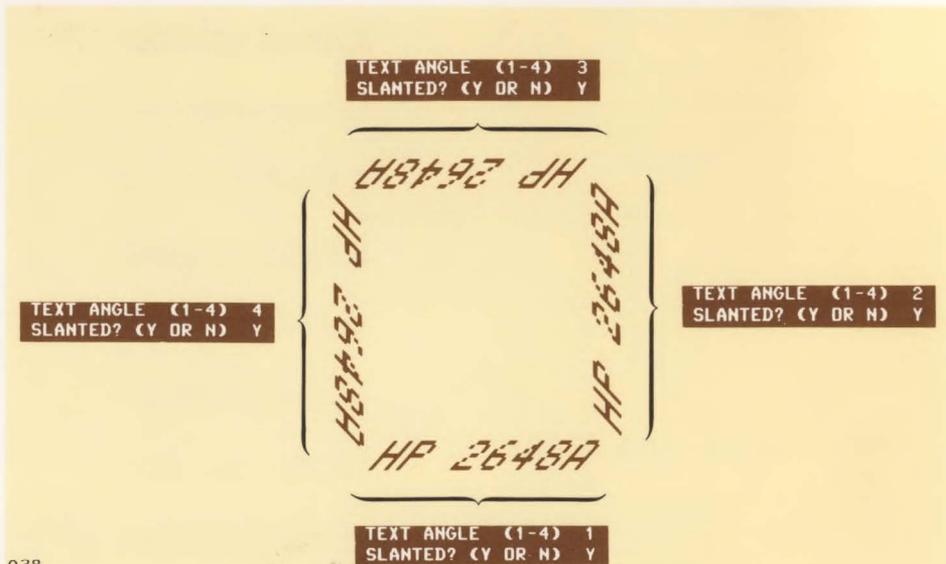
TEXT ANGLE (1-4) 2
SLANTED? (Y OR N) N

TEXT ANGLE (1-4) 1
SLANTED? (Y OR N) N

038

Normal (upright) and italic (slanted) characters are specified by typing "Y" (yes) or "N" (no) to the SLANTED? message.

Either parameter may be entered first, or only one of them entered when the message is displayed. Pressing the **RETURN** key resumes the normal display.



038

Justification (Left, Right, Center)

Text may be *left-justified* (normal, default), *center-justified*, or *right-justified* as shown at right.

NOTE

When using *center-justify* or *right-justify*, the line of text is not displayed until **RETURN** is pressed after typing the line.

Left-Justified:

Hewlett-Packard
1940 Homestead Road
Cupertino, California 95014

Center-Justified:

Hewlett-Packard
1940 Homestead Road
Cupertino, California 95014

Right-Justified:

Hewlett-Packard
1940 Homestead Road
Cupertino, California 95014

Also, the text/cursor relationship may be *bottom* (normal, default), *center*, or *top*. You must type escape codes from the keyboard to access these features. The list of escape codes are given at right and are shown in the illustrations.

Left Justify, cursor bottom	Esc * m 1 Q	Hewlett-Packard
Left Justify, cursor center	Esc * m 2 Q	Hewlett-Packard
Left Justify, cursor top	Esc * m 3 Q	Hewlett-Packard
Center Justify, cursor bottom	Esc * m 4 Q	Hewlett-Packard
Center Justify, cursor center	Esc * m 5 Q	Hewlett-Packard
Center Justify, cursor top	Esc * m 6 Q	Hewlett-Packard
Right Justify, cursor bottom	Esc * m 7 Q	Hewlett-Packard
Right Justify, cursor center	Esc * m 8 Q	Hewlett-Packard
Right Justify, cursor top	Esc * m 9 Q	Hewlett-Packard

Cursor Control

The *graphics cursor keys* control where the text will begin and provide a reference for the ,  cursor keys. If the graphics cursor is moved by the *graphics cursor control keys* after some text has been entered onto the display, a new reference point will be established.

The *alphanumeric cursor keys* move the graphics cursor in whole character spaces so that the cursor will be positioned correctly for editing the text already on the display, etc.

Therefore, use the graphics cursor keys to provide a starting reference point, then use the alphanumeric cursor keys, , ,  and space bar thereafter to ensure correct positioning.

Terminating Graphics Text Mode

When you have completed the graphics text, you may want to use the Alphanumeric Mode. Pressing the  key terminates the graphics text mode and allows alphanumeric text to be entered. You may have to press   to return the alphanumeric cursor to the display.

Erasing The Display

Pressing   will erase all graphics from the display.

NOTE

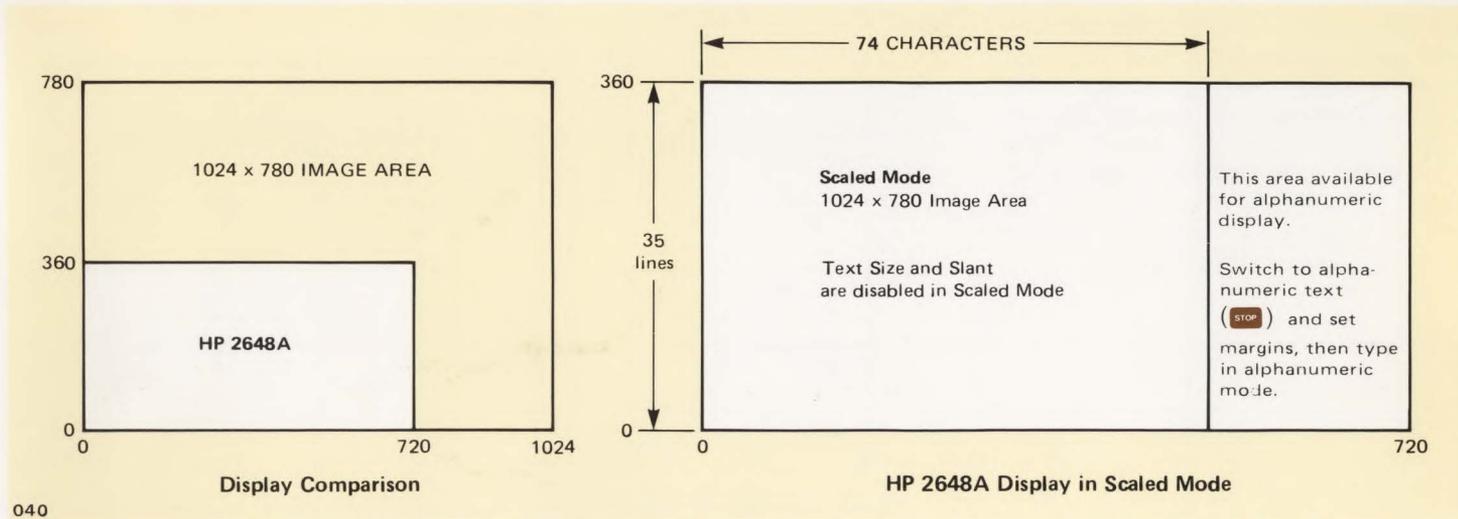
It is possible to enter graphics text into the graphics memory without seeing it on the display. Pressing   toggles the graphics display, and if the terminal is in the non-display mode, you may enter text without seeing it. Pressing the   keys again will display the text.

Also, the  key toggles the graphics cursor display. If the cursor is not displayed, you may still enter text onto the display. However, the cursor will not be shown, but the text will be. The graphics cursor keys will not move the graphics cursor when it is not displayed in graphics text mode. The alphanumeric cursor keys,  , and  will move the graphics cursor whether on or off in graphics text mode.

Copying Graphics Data

The contents of graphics memory may be copied to cartridge tape and compatible HP-IB printers. Also, graphics memory may be restored from cartridge tape. (Refer to section 8.)

Using Your Terminal in Compatibility Mode



Introduction

The 2648A may be compatible with graphics terminals with more addressable points. By configuring straps P and Q on the Keyboard Interface printed circuit assembly inside the terminal (either physically or programmatically), the 2648A enters *Compatibility Mode*. In this mode, either the input data is *scaled* to fit on the 2648's display, or a subset of the input data is selected for display (*unscaled*).

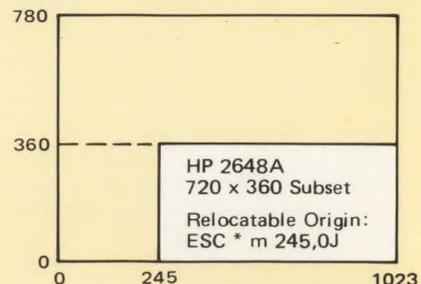
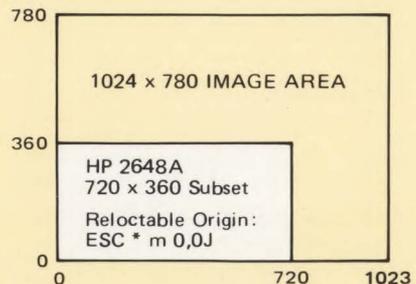
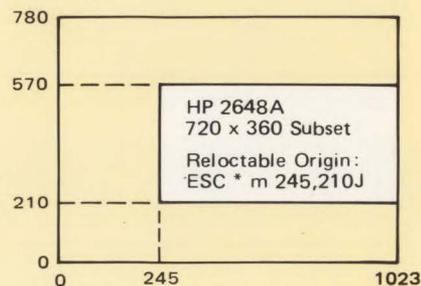
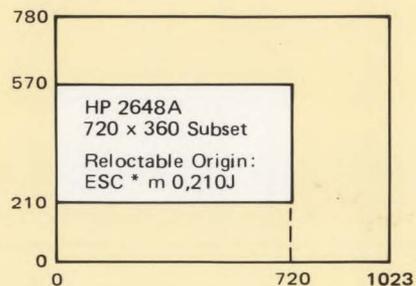
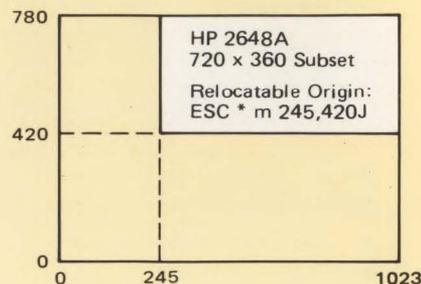
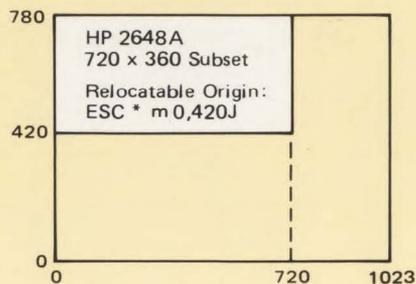
Scaling

Scaled mode reduces the 780×1024 images (by nearly one-half) to fit on the 2648 display. (The above figure shows the scaled image on the 2648A's screen.) Characters will also be *scaled*. To turn on *Scaled Mode*, set strap P open and strap

Q closed on the Keyboard I/F printed circuit assembly inside the terminal (refer to the *Reference Manual*). This can be done programmatically by sending an escape sequence ($\text{Esc} \& \text{S} \text{1} \text{p} \text{0} \text{q}$) from a computer program or locally from the terminal's keyboard (refer to the *Reference Manual*).

Using Your Terminal in Compatibility Mode

Unscaled mode displays a 720 × 360 subset of the 780 × 1024 display. Vectors going off screen are clipped. This mode allows full use of the 2648's resolution, but may require that you modify scaling statements in the user software in order to put the complete picture on the 2648 screen. (The 720 by 360 subset displayed can be varied by changing the *relocatable origin* – see illustration at right). To turn on *Unscaled Mode*, set strap P closed and strap Q open on the Keyboard I/F, or set them programmatically by typing `ESC & s 1 q 0 P` or sending this escape sequence by computer program.



*Changing the Relocatable Origin (ESC * m <x,y>J) on 2648's Display to Cover the Entire 780 x 1024 Display in Unscaled Mode*

Displaying Text

Text can be displayed in either the alphanumeric memory, or in the graphics memory. If graphics text mode is off (STOP), text will be sent to the alphanumeric memory. This is generally the most useful, as text can be scrolled, edited, erased, etc. without affecting the graphics image. Size and position of text is not important for program preparation, system interaction, etc. However, it is important for labels. So, if graphics text mode is on, text will go into the graphics memory, where size and position can be controlled. Graphics text can be turned on or off either locally (SHIFT TEXT, STOP) or through an escape sequence (refer to Appendix A).

Scaled Mode

When operating in *scaled mode*, the remainder of the screen can be used as a dialog area for alphanumeric text. When text is written into the graphics memory in *scaled mode*, the size and angle are fixed to allow for 35 lines of text, as in some graphics terminals. The main idea behind *scaled mode* is to allow the 2648 to run immediately with existing industry standard software with only minor software changes.

When text is diverted to the graphics memory, the graphics cursor is used as an alphanumeric cursor to designate where the next character will go. On some other terminals, there are separate alphanumeric and graphics cursors. In these terminals, the graphics cursor comes on when a response is expected from you. The graphics cursor in the 2648 is on continuously until turned off from the keyboard (SHIFT G CURSOR) or by computer program.

Unscaled Mode

Unscaled mode shows a 720 by 360 subset of the larger picture. The area this covers can be changed by modifying the value of the relocatable origin (and redrawing the picture). The relocatable origin is subtracted from all incoming coordinates in *unscaled mode*. If this is set to 0,0 (the default) the range $X = 0$ to 719, $Y = 0$ to 359 will be displayed. Setting the origin to 0, 360 would cover the area $X = 0$ to 719, $Y = 360$ to 719. *To display an area larger than 720 x 360, scaling statements in the program must be changed.* When characters are drawn in the graphics memory in *unscaled mode* the current size and angle are used. These can be changed locally (SHIFT T SIZE, SHIFT T ANG) or with escape sequences (refer to Appendix A). This gives the user the maximum flexibility when labeling.

In either case, vectors are drawn using the current line type and drawing mode, giving you the capability of drawing dotted and dashed lines, etc. if you change your program to send the additional escape sequences. In general, all of the features of the terminal are accessible in either *scaled* or *unscaled mode*.

To summarize, Compatibility mode is turned on by selecting either the scaled or unscaled mode. If graphics text mode is off, all text goes into the alphanumeric memory. If it is on, characters are drawn in the graphics memory. In *scaled mode*, such characters have fixed size and orientation. In *unscaled*, the size and angle can be changed.

Control Codes

The 2648A accepts the following control codes in Compatibility Mode:

<code>ESC S</code>	Read status and alpha cursor position
<code>ESC S ESC S</code>	Read graphics cursor position
<code>ESC S</code>	Read graphics cursor position when key struck
<code>ESC S</code>	Make hardcopy
<code>ESC F</code>	Clear screen
<code>ESC</code>	Go into graphics mode (draw vectors)
<code>ESC</code>	Go into alpha mode

ENQ/ACK Handshake Protocols

Since the ENQuiry/ACKnowledge handshake is disabled in Compatibility Mode, the baud rate may need to be lowered, or fill characters added, to prevent loss of data when running at high speeds (refer to the *Reference Manual*).

Strapping

The following escape sequences set firmware straps in the 2648A.

- **Set Graphic Input Terminator Strap**

`ESC * t <byte 1> A`

where byte 1 is:

- 0 = Carriage return only (Normal position)
- 1 = Carriage return and EOT
- 2 = No carriage return, no EOT

- **Set Page Full Break Strap**

`ESC * t <byte> B`

where byte 1 is:

- 0 = Out (normal position)
- 1 = In

- **Set Page Full Busy Strap**

`ESC * t <byte> C`

where byte 1 is:

- 0 = Out
- 1 = In (normal position)

The software package that controls some other graphics terminals may be used to control the 2648A; however, you should consider the following:

- The 2648A screen area is smaller than some graphics terminals; vectors that go off the visible screen do not wrap around. However, the 2648A has *Scaling Mode* which reduces the software-generated image to fit on the 2648A screen.
- Fill characters must be used to prevent losing data above 2400 baud.
- To prevent data overruns, a 2000-character buffer is allocated when strap P or Q is open (physically) on the Keyboard Interface PCA. *The buffer is not allocated if the straps are set by escape sequences.* Be sure to turn power off when setting the straps or perform a hard reset after setting the straps.

Terminal Strapping and Equivalent Escape Sequences Controlling Compatibility Mode

Function	Keyboard Interface Strapping	Escape Sequences
Turn Off Compatibility Mode	Strap P closed Strap Q open	<code>ESC & s 0p 0Q</code> (no parameters)
Turn On Scaled Mode	Strap P open Strap Q closed	<code>ESC & s 1p 0Q</code> (no parameters)
Turn On Unscaled Mode	Strap P closed Strap Q open	<code>ESC & s 1q 0P</code> (no parameters)

Using Your Terminal With Other Devices

This section describes how to use your terminal with the optional cartridge tape drives, optional printer, or HP-IB plotter/printers. (Additional information on how to control these devices from a computer is given in the *Reference Manual*.) You may want to fold out the keyboard illustration inside the manual front cover for reference while reading the discussion that follows.

NOTE

The terminal uses a variety of messages to inform you of terminal status. A list of messages and the corresponding action that should be taken is given in Section 12.

Selecting Devices ()

Data transfers from one device to another are made using the Device Control key group. The "devices" can be the display, left or right tape drives, or a printer. Data on the "FROM" device is sent to one or more "TO" devices. Some device operations (READ, RECORD) do not use both "FROM" and "TO" device assignments. (Refer to the specific operation for additional device information.)

When you power on the terminal or perform a full reset, the left tape is assigned as the "FROM" device and the right tape is assigned as the "TO" device.

You can change the "FROM" and "TO" assignments using the () key together with the function keys. The device assignments are labeled in gold below the keys. One of the first three function keys is used to select a single "FROM" device:



The bottom row of function keys and () key are used to select one or more "TO" devices:



When the () prefix key is pressed, the indicator above the key will light. This indicates that the terminal is performing a device selection. After you have completed the device selection, pressing any key (other than the () key, function keys, () key, or () keys) completes the selection process and the light goes out. The terminal will then perform the operation indicated by the key pressed. If the () key is pressed instead, the new device assignment will not be made. Once a de-

vice assignment has been made it will remain in effect until it is changed or a full reset is performed.

The () key is used to select the device (usually a printer) connected to the terminal by the Hewlett-Packard Interface Bus (HP-IB).

Example: Assign the left tape drive as the "FROM" device, and the display and printer as the "TO" devices.



Pressing () , f3 would now cause the next line of data on the right tape to be sent to both the screen and the printer.

You cannot use the same device for both "FROM" and "TO" assignments for copy or verify operations. If you do, you will get an error message on the screen when you try to perform the data transfer. (The error message can be cleared by pressing ().)

When the terminal is used in Remote Mode (on-line to a computer), device selections can be made by the computer program to prevent data loss. This can occur since data communications input is ignored during device selection.

Recording and Reading Data

You can store information for use at a later time by recording it on a cartridge tape. Then the data can be read or sent to a computer whenever it is convenient. Also, recorded data can be edited easily using the various operations described later in this section.

Recording Data

RECORD. Pressing **RECORD** copies data from the display (regardless of the "FROM" device assignment) to the "TO" devices. After the **RECORD** key is pressed, the cursor is "homed" and the entire contents of alphanumeric display memory is recorded.

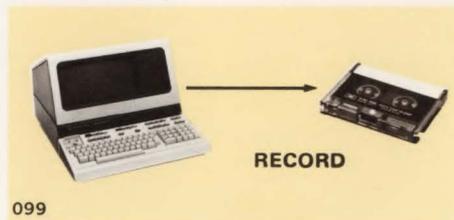
The function key assignments (Section X) and the autoplot parameters (Section V) can also be recorded on the "TO" devices. To record either information, display the menu and press **RECORD**. (Function key assignment menu is displayed by pressing **CTRL** **NEXT PAGE** simultaneously. Autoplot menu is displayed by pressing **SHIFT** **AUTOPLT MENU** simultaneously.)

The **RETURN** key can be used to stop the record operation. Refer to Section IX for remote operation.

Format Mode. When in Format Mode the **RECORD** key will only record data in "unprotected" or "transmit only" fields of the alphanumeric memory. (Refer to Section IV for a discussion of Format Mode and transmit only fields.) When the data has been recorded, a file mark is recorded, the cursor is homed, and the unprotected fields are cleared. This is useful when a single form is used with more than one set of data.

If a printer is the "TO" device, unprotected and transmit only data will appear exactly as shown on the screen. This allows you to use preprinted forms. The file mark at the end of the data will cause the printer to skip to the beginning of the next form.

If you record data in Format Mode and read it back in normal mode, the entry for each field will appear on a separate line.



Example: Type some data on the screen and then record it on the right tape.

Step 1. Press **←**, **CLEAR DSPLY**, and then type your name followed by **RETURN**.

Step 2. Insert a tape in the right slot. Be sure the tape is not protected.

Step 3. If the right tape is not assigned as the "TO" device, press **□**, **f6**.

Step 4. Press **RECORD** to store the screen data on the tape. The eject button on the right tape drive should blink as the data is recorded.

Step 5. Press **□**, **f5**, **f6** to rewind to the beginning of the tape.

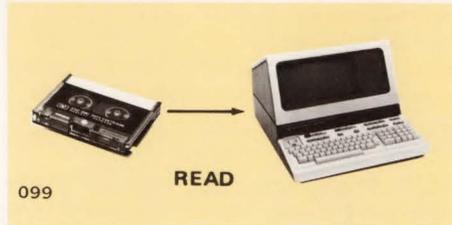
Step 6. You can now read the data back to the screen using the example under "Reading Data".

Reading Data

You can read data from the left or right tape using the **READ** key. Data will always be displayed on the screen, regardless of the "TO" device assignment.

READ. The **READ** key causes data to be read from the current position of the selected tape. The reading continues until a file mark or end-of-data mark is read. Data can be read from the beginning of a tape by rewinding the tape before pressing **READ**. Consecutive files can be read by pressing **READ** for each file. (Refer to COPY for other ways to read data.) The read operation can be stopped by pressing **RETURN**. Refer to Section IX for remote operation.

The data read from the tape will be read automatically into display memory. If nothing appears on the screen, the alphanumeric video may be turned off. Press **SHIFT** **A DSP** simultaneously to display the memory contents. If the screen is still blank, an empty display memory has been recorded on the tape.



Example: Display the data that you recorded in the previous example.

Step 1. Place a tape with recorded data in the right tape slot. Use the tape from the RECORD example.

Step 2. Press , **f2** to assign the right tape as the "FROM" device.

Step 3. Press **READ**. The data in the first file on the tape will be displayed. (Refer to FIND FILE for a description of how to find and display other files on the tape.)

Displaying data from a tape allows you to display prerecorded forms for formatted data entry. (Refer to Section IV for a discussion of forms.)

Appending Data

You can append data on a tape by finding the current end of data on the tape and then recording or copying data to that tape.

Example: Append data to the end of the right tape.

Step 1. Press , **f8**, **2**, **5**, **5**, **f6** to locate the end of data on the tape. The end of data message will appear on the screen.

Step 2. Press **RETURN** to clear the message.

Step 3. Select the tape as the "TO" device (if it is not already). Press , **f6**.

Step 4. You can now select a record or copy operation to add more data to the end of the tape.

Selecting Device Operations (■)

Most device operations (with the exception of READ and RECORD) are selected using the ■ prefix key followed by one or two of the function keys. The operations are printed in green above the function keys. The functions that can be selected in this way are:

- REWIND
- SKIP LINES
- MARK FILE
- FIND FILE
- COPY
- EDIT
- COMPARE
- REMAINING TAPE/FILE NUMBER
- WRITE/BACKSPACE/READ
- GRAPHICS TRANSFER

Operations that are not data transfers (REWIND, SKIP LINES, MARK FILE, and FIND FILE) require a device to be selected. The devices that can be selected are the left or right tape drive, or printer. This does not affect the "FROM"/"TO" device assignments.

REWIND

Pressing ■ **f5** causes the selected device to be rewound to its load point. This operation requires a device selection. If the previous operation recorded data on a tape,

an end-of-data mark is recorded at the current tape position before the tape is rewound. The end-of-data mark provides a reference point on the tape for appending data at a later time.

Tapes should always be rewound before they are removed from the terminal. This insures that only blank leader tape is exposed at the front of the cartridge.

You can select a printer for the REWIND operation. This will cause some printers to skip to the beginning of the next page (top-of-form).

Example: To rewind the left tape, press ■ , **f5** , **f5** .

SKIP n LINES

The ■ **f7** key causes the selected device to move forward or backward one or more lines. This operation requires a device selection. Press ■ , **f7** , followed by the number of lines to be skipped. When the number of lines is negative, and the selected device is a tape, the tape will be skipped backwards. (Printers ignore the sign of n.) If no value is entered for n, -1 will be used. A message indicating the operation and the number of lines to be skipped is displayed while the command is being defined.

File marks are counted as one line. If you are skipping backward and the last line skipped is a file mark, the tape will be moved forward so that it is positioned after the file mark. (To skip backwards over a file mark, a -2 could be used.) Additional information on files and file marks is contained in the *Reference Manual*.

Example: Skip the left tape forward 6 lines. Press ■ **f7** , **6** , **f5** .

Example: Skip backward 2 lines on the right tape. Press ■ , **f7** , **-** , **2** , **f6** .

MARK FILE

As you record data you may want to separate the data into files. This permits you to easily locate the data by file number after it is recorded on tape. "Marking" a file means recording a file mark at the end of a block of data. The file mark is recorded at the end of a file. You can then record additional data following the file mark and mark that file in the same way. For example, you could store two blocks of data on the same tape by recording the first block of data, writing a file mark, and then recording the second block of data. You could then address either block of data by using a FIND FILE operation. You can have up to 255 files on a tape, depending upon the length of the files.

When a cartridge tape is the selected device, the MARK FILE function causes a file mark to be placed at the current position on the tape. (If this is done in Edit Mode the file mark is placed on the tape immediately and ahead of the data still in display memory.) The file mark is used to separate one file from another.

When directed to a printer, the MARK FILE function causes some printers to skip to the beginning of the next page (top-of form).

Example: To write a file mark on the right tape, press **■**, **f6**, **f6**.

FIND FILE (Tapes Only)

Files of data recorded on a tape can be located with the FIND FILE command. This allows you to selectively read blocks of data that have been separated with file marks. (Refer to the MARK FILES command.)

The FIND FILE function causes the selected tape to be searched until the indicated file is found. If no value for n is given, -1 is assumed and the tape will be positioned at the beginning of the current file. The tape is positioned just before the indicated file and after the file mark for the previous file. Selection of this operation includes the device assignment.

Example: Find file 42 on the right tape. Press **■**, **f8**, **4**, **2**, **f6**.

You can skip the tape forward or backward n files (move three files, not find file three) by using a plus or minus sign (+ -) before the value for n.

Example: Move 7 files backwards on the left tape. Press **■**, **f8**, **-**, **7**, **f5**.

Once the tape has been positioned at the proper file, pressing **READ** will display the data in the file. You can also use this technique to selectively copy data from one tape to another or to a printer (see COPY).

Find End Of Data (Tapes Only). Since the maximum number of files that you can have on a tape is 255, you can locate the end of data on a tape by using 255 as the file number in a find file operation then press **READ**. The tape will be positioned just after the last data. You can then append data to a tape that already contains data.

Example: Position the right tape at the end of data. Press **■**, **f8**, **2**, **5**, **5**, **f6**.

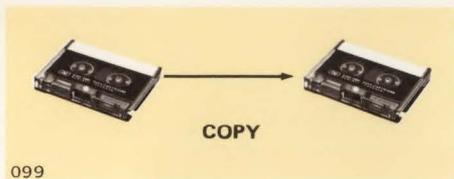
COPY

NOTE

Copy operations only apply to alphanumeric memory.

You can copy all of the data, a file, or a single line on the "FROM" device to one or more "TO" devices using **f1**, **f2**, or **f3** keys.

Copy All. Pressing **■**, **f1** will transfer all information from the "FROM" device to the "TO" device(s). File marks will also be copied. This is the easiest way to create backup tapes. If a tape is the "FROM" device, data will be copied from the present tape position to the end-of-data mark on the tape. If the display is the "FROM" device all data from the line containing the cursor to the end of display memory is copied. If a tape is the "TO" device, recording will begin at the tape's present position.



Example: Copy the left tape to the right tape.

Step 1. Insert the tape to be copied in the left tape slot. Insert another in the right tape slot. Be sure the right tape is not protected.

Step 2. Select the left tape as the "FROM" device and the right tape as to the "TO" device. Press , , .

Step 3. Select the Copy All operation. Press , . When both eject buttons stop blinking, the copy operation is complete.

Step 4. Rewind the right and left tapes. Press , , , , .

Copy File. Pressing , will copy a file from the "FROM" device to the "TO" device(s). When a tape is the "FROM" device, data is copied from the present tape position to end of the file (including the first file mark). When the display is the "FROM" device, data is copied from the present cursor position to the bottom of the screen. When the terminal is in Format Mode a Copy File from the display will copy all "unprotected" or "transmit only" data from the line containing the cursor to the end of display memory (the same as Copy All).

Copy Line. Pressing , will copy a single line of data from the "FROM" device to the "TO" device(s). If the display is the "FROM" device, the line containing the alphanumeric cursor is copied. Graphics video cannot be copied using the Copy Line function.

Example: Copy a single line of data from the current "FROM" device to the "TO" device. Press , .

EDIT

(This function applies to alphanumeric mode only.) Typing , causes the terminal to turn on Edit Mode (EDIT light goes on). In Edit Mode, when the terminal's alphanumeric memory is full and a

new line of data is entered, the top line in memory is automatically sent to the "TO" device(s) instead of being lost. This allows you to read data from one tape to the screen, edit the data, and then record it to the other tape or a printer. If a tape drive is selected as a "TO" device make sure that the cartridge is not protected (see page 8-8). While in Edit Mode you cannot change device selection.



NOTE

Edit Mode does not function when the key is down. Refer to the discussion on "Data Logging" in Section 9 for procedures to save data when the terminal is connected on-line to a computer.

READ. The **READ** key causes data from the "FROM" device to be transferred to the display. The read operation can be stopped by pressing **RETURN**. You can then edit the data from the keyboard before reading more data.

RECORD. At the end of the edit operation the **RECORD** key can be used to copy the remaining data on the screen to the "TO" device. The **RECORD** key transfers all of the data remaining in display memory to the "TO" device. If there is more data to be read from a tape assigned as the "FROM" device, the record operation will automatically begin transferring this remaining data (until a file mark is reached) directly to the "TO" device. When the RECORD operation is complete, the terminal will return to normal operation (Edit light will go out).

You can leave Edit mode at any time by pressing **ESC**, **f4** again. This will return the terminal to normal operation (the Edit light will go off). Any remaining data will not be copied to the "TO" device(s).

Example: Edit data on the left tape and record the new version on the right tape while making a printed copy of the new data.

Step 1. Select the devices. Press **ESC**, **f1**, **6**, **f8**

Step 2. Turn on Edit Mode. Press **ESC**, **f4**

Step 3. Press **READ**

Step 4. Press **RETURN** to stop the read operation in order to make corrections.

Step 5. After making the corrections, press **READ** to continue the reading operation.

Step 6. After the last correction is made, press **RECORD** to complete the data transfer to the right tape and printer.

COMPARE

Data on any two devices (except a printer) can be compared. The devices must be the "FROM" and "TO" devices. Data is compared beginning with the current record on each device. If one of the selected devices is the display the comparison starts at the beginning of the line containing the cursor. (If the terminal is in Format Mode the comparison begins with the first unprotected field). You can compare all of the data on a device, a file, or a single record using the following sequences:

- Compare All — **ESC**, **CTRL**, **f1**
- Compare File — **ESC**, **CTRL**, **f2**
- Compare Line — **ESC**, **CTRL**, **f3**

Example: Compare the first file on the left tape with the second file on the right tape.

Step 1. Position the tapes at the beginning of the proper files. Press **ESC**, **f8**, **1**, **f5**, **ESC**, **f8**, **2**, **f6**

Step 2. Press **ESC**, **f1**, **f5** to select the tapes for comparison.

Step 3. Press **ESC**, **CTRL**, **f2** to make the comparison.

Step 4. If the files do not contain exactly the same data a message will be displayed giving either the character (byte) or line (record) where the data varies and the comparison will stop. The message is cleared by pressing **RETURN**.

DIFFERENCE IN BYTE 33

DIFFERENCE LENGTH RECORDS, RECORD 4, FILE 1

If the data on the two tapes checked in the last example varied, the differing data could have been displayed as follows:

Step 1. Press **ESC**, **f7**, **f5**, **ESC**, **f7**, **f6** to position the tapes.

Step 2. Press **ESC**, **f1**, **f7**, **ESC**, **f1** and **ESC**, **f2**, **f3**, **ESC**, **f3** to display the data.

REMAINING TAPE

You can get an estimate of the amount of tape remaining on each cartridge as well as the current file positions by pressing , then the space bar. The information will be displayed in the following format:

```
FILE NUMBER  INCHES LEFT:  2 1045 ON LEFT DRIVE,
                   0 543 ON RIGHT DRIVE
```

One full line of data uses about 2 inches of tape. (The *Reference Manual* contains more detailed information on tape storage capacity.) The message can be cleared by pressing .

WRITE/BACKSPACE/READ (Tapes Only)

When the terminal is in Write/Backspace/Read Mode all tape write operations are verified. After each record is written, the tape is backspaced and read to make sure that the data is correct. If there is an error, the terminal attempts to write the data again up to 9 times. This process is time consuming and is not normally required.

Pressing ,  causes the Write/Backspace/Read check to be made during subsequent tape record operations. Normal operation is restored by pressing ,  or by a full reset.

Graphics Transfer

Graphics data (8-bit binary) can be copied from graphics memory to the cartridge tapes or a printer capable of receiving this type of data. (Refer to page 8-10.) Pressing , ,  copies the contents of graphics memory to the "TO" device(s). A file mark is not written after the data. Pressing , ,  copies the contents of the "FROM" device to graphics memory.

NOTE

A tape can store two displays of graphics data.

Example: Copy the contents of graphics memory to the right tape.

Step 1. Press ,  to select the right tape as the "TO" device.

Step 2. Press , ,  to start the copy operation. (The copy operation will take approximately 70 seconds.)

Example: Copy the contents of the graphics memory to the printer.

Step 1. Press ,  to select the printer connected on the HP-IB (Hewlett-Packard Interface Bus).

Step 2. Press , ,  to start the copy operation. (The copy operation will take approximately 60 seconds.)

Example: Copy the graphics data on the left tape to the graphics memory.

Step 1. Press ,  to select the left tape as the "FROM" device.

Step 2. Press , ,  to start the copy operation. (The copy operation will take approximately 70 seconds.)

Using Cartridge Tapes

The optional cartridge tape drives allow you to store data locally at your terminal. Tapes containing stored data can be removed for safe keeping or used in COPY or EDIT operations.

Inserting and Removing Tapes

Tape cartridges are easily inserted through the tape unit doors. The tape cartridge is inserted as shown below.

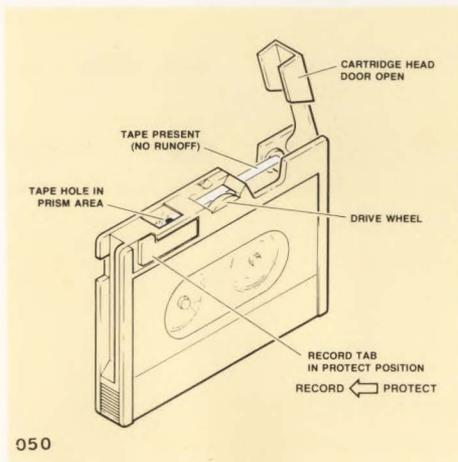


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Before removing a tape it should be re-wound. When a tape is rewound, its light goes out. You can use the light as a reminder when the light is on or blinking, do not remove the cartridge. Cartridges are removed by pressing the cartridge eject button.

Protecting Tapes

If you have data on a tape and want to protect it from being accidentally overwritten, move the tab marked RECORD at the rear of the cartridge in the opposite direction of the arrow. In order to record additional data on the tape it must have the tab in the record position. You can permanently protect the data by removing the tab from the cartridge. (The tab may be reinstalled when required for record operations.)



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If you attempt to write on a protected tape you will receive a PROTECTED TAPE message on the screen. Correct the problem by unprotecting the tape, typing **RETURN** and reselecting the operation.

Conditioning Tapes

"Conditioning" a tape means to run the tape forward to the end of the tape, reverse it, and run the tape backward to the beginning of the tape. This is done by inserting the tape cartridge to be conditioned, holding **CTRL** while pressing **TAPE TEST**, and then selecting **f5** or **f6**.

The eject button blinks during the conditioning process. When the light stops blinking, conditioning is complete.

Conditioning is necessary for smooth, continuous operation of the cartridge. Whenever a cartridge has been subjected to sudden environmental changes (such as being transported by air), you should condition the tape before use. Also, if the READ FAIL message occurs while reading a particular cartridge, it may be due to uneven tension on the tape. Conditioning restores proper tension, and the tape will operate smoothly. If READ FAIL messages still occur after conditioning, try cleaning the tape transport read-record head. Refer to Section 11 for cleaning procedures.

Testing the Tape Drives

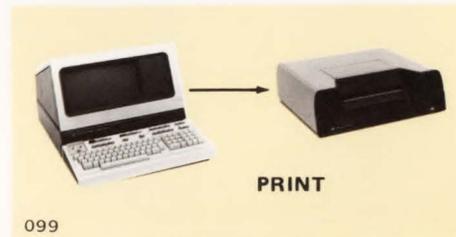
Pressing **TAPE TEST** performs a diagnostic test of the tape drives. Before using this function read the description of TAPE TEST in Section 12.

Using the Terminal with a Printer

The terminal can be used with a variety of printers to provide a "hard" or paper copy of data. In most operations the printer can be used in the same manner as one of the tape drives. Some operations, such as selecting the printer as a "FROM" device, cannot be performed for obvious reasons.

Printing Alphanumeric Data

If the printer has been selected as a "TO" device using the **PRINT** key, data can be printed using the RECORD, COPY, or EDIT operations.



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Example: Copy alphanumeric data from the display to the printer.

Step 1. Press , ,  to select the devices.

Step 2. Press ,  to print the data.

Controlling the Paper

The printer paper can be positioned by skipping lines. On some printers you can use a mark file or rewind operation to move the paper to the top-of-form.

Example: Move the paper to the top of form and then skip 3 lines.

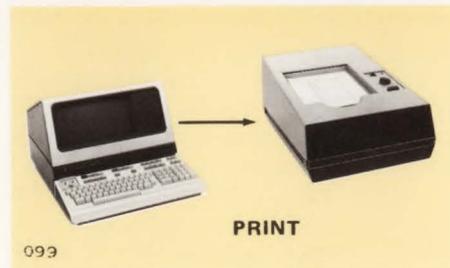
Step 1. Press , ,  to position the paper at the top of the paper form.

Step 2. Press , , ,  to move the paper up 3 lines.

Using the Terminal With a Video Hard Copy Unit

Graphics and alphanumeric video can be copied from the screen to a video hard copy unit. The keyboard can control sending the data to the copy unit if a 13232K accessory cable is used. If the 13232L cable (coax) is used, the print switch on the copy unit must be used.

If the 13232K accessory cable is used, the printer is selected as the "TO" device using the  key, then screen data is transferred to the hard copy unit using RECORD or COPY operations.



Example: Copy data from the display to the video hard copy unit.

Step 1. Press , ,  to select the devices.

Step 2. Press ,  to print the data.

Using the Terminal With the HP-IB Printers

Graphics data or alphanumeric data can be copied to a printer connected to the terminal by the HP-IB (Hewlett-Packard Interface Bus). The printers supported presently are the HP 7245A-001 Plotter Printer and the HP 2631G Printer.

Example: Copy the contents of graphics memory to the HP-IB printer.

Step 1. Press ,  to assign the printer as the "TO" device.

Step 2. Press , ,  to start the copy operation.

Example: Copy the graphics data stored on the right tape to the HP-IB printer.

Step 1. Press , ,  to assign the "FROM" and "TO" devices.

Step 2. Press ,  (ALL) or  (FILE) or  (LINE) to start the copy operation.

Example: Copy the alphanumeric data on the screen to the HP-IB printer.

Step 1. Press  .  .  to assign the "FROM" and "TO" devices.

Step 2. Press  .  (ALL) or  (FILE) or  (LINE).

Selecting HP-IB Addresses

When a transfer to a device on the HP-IB is initiated, the data is sent to the current "listen" address. The default value is 6. If the printer is not set for this address, the "listen" address must be changed to the printer address. This is accomplished as follows:

Press  .  . (listen address), .

When a transfer from a device on the HP-IB is initiated, the data is read from the current "talker" address. The "talker" address is set as follows:

Press  .  . (talker address), .



Using Your Terminal with a Computer

The terminal can be connected to a computer system either directly or through a modem. A variety of interface accessories are available depending on the type of connection desired. (Additional information on interfaces is contained in the *Reference Manual*.) The terminal accepts most industry-compatible communications codes (see Section VII) and therefore it can usually be connected to a system and driven by this software. Also, you may drive the terminal with its own graphics communications code to use more of the powerful features (refer to the *Reference Manual*).

Preparing the Terminal for Use On-Line

Very little must be done to use the terminal on-line. The proper interface should be installed, and the modem or direct line connected (this is normally already done). Make the settings listed in the following paragraphs.

Communication Settings

There are three switches in the communication group used to match the requirements of the computer that you will use. If you are using your terminal in a multipoint configuration, these switches will normally be preset and inaccessible. Additional information on communication settings is given in the *Reference Manual*.

BAUD RATE. This switch sets the speed at which data will be transferred. If you do not know the correct speed, use 300 for remote operation or 2400 for hardwire operation (where the terminal is directly connected to a computer). If data from the computer appears garbled it may mean that you should select a different baud rate.

PARITY. This switch selects the type of data checking to be used. If the “_” or “■” character appears on the screen, you may have selected the wrong parity.

DUPLEX. This switch is normally set to FULL. If no characters are displayed, switch to HALF.

RANGE. This switch replaces the DUPLEX switch on multipoint terminals. The RANGE switch is only present on terminals having the Multipoint option and is normally inaccessible. It allows you to select between speed ranges on the BAUD RATE switch.

Selecting Operating Modes

REMOTE. The **REMOTE** key must be down. This allows the terminal to send and receive data through its communication interface.

AUTO LF. Normally the **AUTO LF** key should be up.

CAPS LOCK. Leave the **CAPS LOCK** key down unless the system you are using accepts lower case characters.

Using Your Terminal with a Computer

BLOCK MODE. The **BLOCK MODE** key is used to select character-by-character or block transmission of data. When the key is up the terminal transmits characters to the computer as they are typed. This mode of operation is used for conversational exchanges with the computer system.

Example:

Computer **Please Type Your Company Name**

You type **HEWLETT-PACKARD**

Computer **What File Number Would You Like From The HEWLETT-PACKARD Library?**

You type **12345**

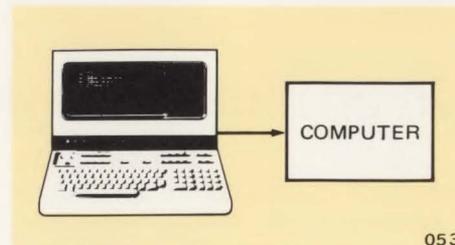
and so on . . .

When the **BLOCK MODE** key is down, characters are not sent as they are typed. Instead you can input information to the terminal and then edit it before sending it to the computer. The data is sent with the **ENTER** key. A portion of a line, a whole line, or even an entire screen of data can be sent at once. The size of the block of data sent depends on the setting of switches inside the terminal. (Refer to the *Reference Manual* for detailed information on the operation of Block Mode.)

Additional Settings

There are several more switch settings that can be made. These settings control such terminal features as compatibility mode, line wraparound, the number of characters to be sent in block mode, and character overstrike (Space Overwrite Latch). Setting of these switches is normally required only when the terminal is first installed. These switches are located inside the terminal. Instructions for setting these switches are contained in the *Reference Manual*.

If a modem is used it may be necessary to turn on the modem, make modem speed and parity settings, or dial a number. Baud rate, duplex, and parity settings should be the same values used for the terminal.



Sending Data to the Computer

Data can be sent to the computer from the terminal keyboard or from one of the cartridge tape drives.

From the Keyboard

When not in Block Mode, data entered from the keyboard is sent immediately to the computer automatically. If you are in Block Mode (**BLOCK MODE** key down) then the data is stored in the terminal until you press the **ENTER** key. Block mode and the **ENTER** key are often used with data entry forms. (Refer to Section IV).

From a Tape

Data can be read from a tape and sent to the computer. This allows you to prepare data ahead of time, off-line and then send the data later. In Character Mode ( key up), pressing  causes the next line of data on the "FROM" device to be sent to the computer. If the terminal is set for Block Mode ( key down) the terminal will not send data to the computer when the  key is pressed. In order to send data to the computer using the  key when in Block Mode, you must use  .

 only

Local: Copy file to display

Remote

Character: Read file to computer (handshake per G, H straps)

Block: Copy file to display (allows editing before sending data to computer via the ENTER key)

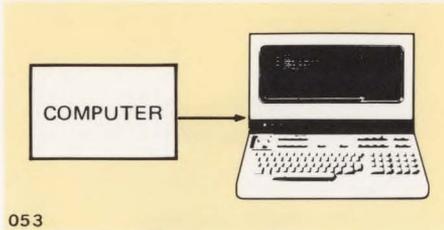
Local: Copy file to display

Remote

Character: Read file to computer (no handshake)

Block, Line: Read file to computer (handshake per G, H straps)

Block, Page: Read file to computer (no handshake)



From an HP-IB Device

Data may be read from an HP-IB device and sent to the computer. The data must be ASCII; no binary data is allowed. All records must be no longer than 256 bytes and end with a line feed character. The "TALKER" address must be set to the same value as the address switches on the device (see page 8-10). Also, the HP-IB device must be selected as the "FROM" device (press  ). In character mode ( key up), pressing  causes the next record on the HP-IB device to be sent to the computer.

Receiving Data From The Computer

To the Display

No special action is required to receive data from the computer. Data is normally displayed on the screen as it is received.

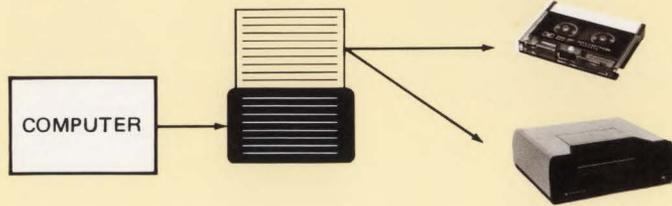
When operating at high data rates or when data is also being copied to a printer or other device it may be necessary to use "fill" or "pad" characters in the data to synchronize the terminal and computer. This will prevent possible data overruns. Detailed information on "fill" characters and other synchronization techniques are described in the *Reference Manual*.

To a Tape

The computer can be programmed to send data directly to the cartridge tapes (refer to the *Reference Manual*) or you can direct data to a tape from the keyboard by naming the tape unit as a "TO" device and then pressing the  key before the computer begins sending the data. The device assignment can be done at any time by pressing , , or . The  key should be pressed before the last response to the computer (typically before pressing ) but before data is received from the computer. (See Data Logging.)

To a Printer

Data received from the computer can be routed to a printer in the same manner as described for the cartridge tapes. (, ,  or   .) (See Data Logging.)



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To a Video Hard Copy Unit

Data received from the computer can be routed to a video hard copy unit by displaying the data on the screen, then copying the display by pressing the print switch on the hard copy unit. If a 13232K Accessory cable is used to connect the terminal to the hard copy unit, **f6**, **f8**, **RECORD** could be used.

To Several Devices

You can route data received from the computer to several devices by using more than one device in the device assignment operation. For example, **f6**, **f8** will cause the data to be routed to both the right tape and the printer when the **RECORD** key is pressed.

To an HP-IB Device

Data received from the computer may be sent to an HP-IB device (such as a plotter or printer). All records must be no longer than 256 bytes and end with a linefeed character. The "LISTEN" address must be set to the same values as the address switches on the device (see page 8-10). Also the HP-IB device must be selected as the "TO" device (press **f6**, **INSERT CHAR**). Press **RECORD** before pressing **RETURN** as the last response to the computer.

Data Logging

The terminal can be set to perform on-line data logging. This functions in a manner similar to Edit mode. Data received from the computer is displayed on the screen. When the terminal memory is full, data at

the top of memory is routed to the "TO" devices.

It may be necessary to use "fill" characters to prevent data overruns when operating at high data rates. See the discussion of "fill" characters on the previous page.

If both tape drives are selected as "TO" devices, data is written to the left tape first. When the left tape is full it is automatically rewound and data is routed to the right tape. If a new tape is inserted, all of the data in memory is recorded on the current "TO" tape before continuing. This insures that data from the computer will not be lost while the new tape is rewinding. (This occurs only when both tapes are selected as "TO" devices.)

Data logging is performed by first selecting "TO" devices, and then typing **f4**.

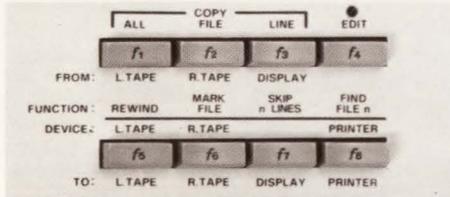
Data logging can only be done while the **REMOTE** key is down (On-Line operation). While performing data logging the **REMOTE** key is disabled and you cannot change "FROM" or "TO" device assignments.

In order to return to normal operation after the data logging is complete, type **f4** again.

The **RECORD** key can then be used to cause the current display to be logged to the "TO" devices. When the **RECORD** key is used, data beginning at the top of the screen (not memory) to the line above the current cursor position is sent to the "TO" devices. After the last line is transferred, the terminal beeps and normal data logging resumes. This is useful to clear the terminal's memory so that it can continue to store data while you are rewinding a tape. The terminal automatically performs this function when a new tape is inserted while performing data logging.



User Definable Soft Keys



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The terminal's 8 special function keys (f1 — f8) can be loaded with up to 80 characters each. These programmable keys are called "soft" keys. The data called by these keys can be defined to be for use locally at the terminal only, for transmission to a computer only, or to act in the same manner as data entered normally from the keyboard.

In addition, the RETURN key can also be assigned up to 80 characters. Normally, the "soft" RETURN key is used to provide a special line ending character for a computer system. More information on the soft RETURN key is contained in the *Reference Manual*.

NOTE

If the RETURN key is pressed while the function key assignment menu or the Autoplot menu is displayed, the carriage return function *only* will be performed regardless of its definition.

To load the keys or display the current key assignments press the CTRL key simultaneously with the NEXT PAGE key. This causes the current key assignments to be displayed in the following format:

f# type or CR type
string or string

where:

- "#" is the function key number (1-8)
- "type" is a T (Transmit, send to computer only), L (Local, use at terminal only), or N (Normal, use as keyboard input), and
- "string" is a group of up to 80 ASCII characters.

The labels f1 through f8 indicate the key; the character T, L, or N following the key label tells the terminal where to send the character string. The line below each key label contains the string of characters assigned to the key.

Whenever the terminal is turned on or the RESET TERMINAL key is pressed twice rapidly (full reset), the function keys will automatically be assigned default values of ϵp , ϵq , ϵr , ϵs , ϵt , ϵu , ϵv , and ϵw and are of type T. The RETURN key (CR) has the default value of CR (carriage return) and is of type N. Type CTRL NEXT PAGE to display the current key assignments. The screen should appear as shown. Press CTRL NEXT PAGE again to return the normal display.

	CR	N	
	CR		
KEY NUMBER 1	f1	T	TRANSMIT ONLY
	ϵp		CHARACTER STRING
	f2	T	
	ϵq		
	f3	T	
	ϵr		
	f4	T	
	ϵs		
	f5	T	
	ϵt		
	f6	T	
	ϵu		
	f7	T	
	ϵv		
	f8	T	
	ϵw		

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Using the Soft Keys

You can make changes to the values assigned to the soft keys at any time. Simply type **CNTL** **NEXT PAGE** to display the current key assignments and then type in the new values to be assigned. You can even enter control characters if you turn on **DISPLAY FUNCTIONS** before entering the characters. If you do, remember to turn off **DISPLAY FUNCTIONS** after completing the key assignments (or before using the BACKSPACE or alphanumeric cursor control keys **←** **→** **↑** **↓** to edit the soft key strings).

Exercise: Assign your company name and address to the **f1** key.

For example: ACME Co.
10 Star Rt.
New York, NY

Step 1. Type **CNTL** **NEXT PAGE**.

Step 2. Position the cursor for the **f1** key.

Step 3. Type **L** to indicate the string is for use at the terminal only.

Step 4. Turn on **DISPLAY FUNCTIONS** and put the **AUTO LF** key up.

Step 5. Type ACME Co. **RETURN** 10 Star Rt. **RETURN** New York, NY **RETURN**. The soft key display for **f1** should appear as follows:

```

f1 L
ACME Co. ␣ 10 Star Rt. ␣ New York, NY ␣
  
```

Step 6. Turn off **DISPLAY FUNCTIONS**.

Step 7. Turn on **AUTO LF**.

Step 8. Type **CNTL** **NEXT PAGE** to return to normal operation.

Step 9. Press **f1**.

Note that since the **AUTO LF** key is down, a linefeed is added following each **RETURN** when the **f1** key is pressed.

```

ACME Co.
10 Star Rt.
New York, NY
  
```

Storing the Soft Key Assignments

You can store the key assignments on tape by pressing **ENTER** while still in the key assignment mode. The function key assignments can be loaded from the tape by pressing **READ**. Do not include **LF** characters in function key assignments that are to be loaded on a tape (**AUTO LF** key should be up).

Example: Store the soft key assignments of the previous example on a tape.

Step 1. Perform steps 1 through 6 in the previous example.

Step 2. Place a tape in the right slot. Make sure that the tape is "unprotected" (the record tab is positioned in direction of the arrow).

Step 3. If the right tape is not assigned as the "TO" device, press **TO** **f6**.

Step 4. Press **ENTER**.

Step 5. Press **STOP**, **f6**, **f6**.

Step 6. Return to normal mode.

Step 7. Press **RESET TERMINAL** twice to clear the new key assignments.

Step 8. Type **CNTL** **NEXT PAGE** to show that the keys have the default values.

Step 9. Type **CNTL** **NEXT PAGE** and then **TO**, **f2**, **f7**, **READ** to load the keys from tape.

Step 10. Use **CNTL** **NEXT PAGE** to see that the new key values were stored.

Using the Definable Keys With A Computer

Besides holding often used text combinations the definable keys can be used to hold log-on and log-off messages for computer systems.

Example: A sample key assignment to log on to the Hewlett-Packard 2000 Computer System might be as follows:

```
f1 N
HEL-C500,PASWRD
```

A second key could be used to call and execute a library program:

```
f2 N
EXE-$TEST1
```

A third key could be used to log off of the system:

```
f3 N
BYE
```

Example: The soft keys could be used to generate graphics functions. A simple centered letter head with a trademark is shown below.

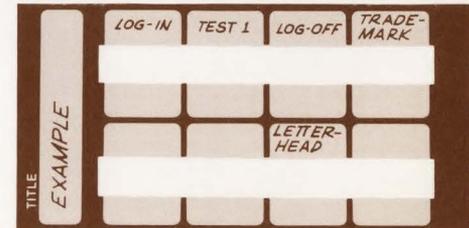


Acme Grain Co.
999 Wood Way
Field City, NY

```
f4 N
c*pha9,3 9,12 3,15 3,20 2,21 2,26 3,25 3,31 4,30 4,36 5,35 5,40 10,35Zc&f5E
f5 N
c*ph15,40 15,35 16,36 16,30 17,31 17,25 18,26 18,21 17,20 17,15 11,12 11,32c&f6E
f6 N
c*ph9,3a5,35 10,30 15,35a4,30 10,25 16,30a3,25 10,20 17,25a4,20 10,15 16,20aZ
f7 N
c*m350,300,50c*pa360,290Zc*dsAcme Grain Co. r999 Wood Way rField City, NY r c*dT
f8 N
```

Labeling the Function Keys

The terminal comes with 5 blank function key templates. These templates can be labeled with the functions assigned to the programmable keys. The template can be dropped over the function key group for easy reference.





Maintaining Your Terminal

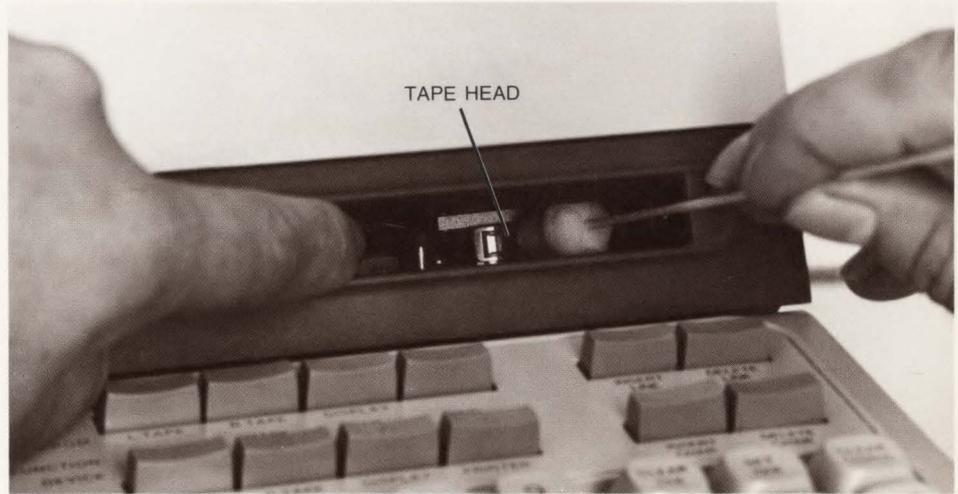
Cleaning the Screen and Keyboard

The screen and keyboard can be cleaned to remove dust or grease. First, lightly dust using a damp, lint-free cloth. The cloth should be just damp enough to pick up dust, not wet. Paper towels are fine. Avoid wiping dust or lint into the keyboard area.

Smudges and fingerprints can be removed using most conventional cleaners (such as "SNAP" glass and plastic cleaner manufactured by Mist Products Inc., 16 Watch Hill Rd., Croton-on-Hudson, N.Y. 10520). DO NOT use petroleum based cleaners such as lighter fluid or cleaners containing benzene, trichloroethylene, dilute ammonia, ammonia, or acetone. These could harm the plastic surfaces. Avoid spraying between the keys.

Cleaning the Tape Drive

The cartridge tape drives may develop a build up of oxide on the recording heads after extensive use. The oxide buildup occurs as a result of normal operation but may cause tape errors.



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The read-record heads on the tape drives should be cleaned every 50 hours of cartridge tape operation or when read problems occur. The head cleaning kit provided with the terminal contains all the necessary items. The procedure is as follows:

Step 1. Dip one of the swabs into the bottle of head cleaning solvent to saturate the swab.

Step 2. Hold the tape unit door open with your finger and clean the head with a back-and-forth motion of the swab (not an up-and-down motion). The head is the shiny surface at the right rear of the drive.

Step 3. Take a dry swab and wipe the head clean with a back-and-forth motion (not an up-and-down motion).



In Case of Difficulty

This section contains error recovery instructions, testing and troubleshooting information, a list of error messages, and a simple procedure for recovering from accidental end-of-data marks. Once you have determined that the terminal is not functioning properly procedures for requesting service are given at the end of the section under "How to Get Help".

Using RESET TERMINAL

It may be necessary to use the **RESET TERMINAL** key to clear error conditions. Since the **RESET TERMINAL** key has a major effect on terminal operation, it should not be used unless necessary. There are two types of reset, a soft reset and a full reset.

Soft Reset (Normal)

A normal reset is performed by pressing the **RESET TERMINAL** key once. This causes the following:

1. Any error messages present are cleared, the active display returned, and the keyboard unlocked.
2. If **DISPLAY FUNCTIONS** is enabled, it is turned off.
3. Incomplete device selections are cleared. (Previous selections are retained.)
4. If the terminal is performing an Auto-plot, operations are ended.
5. If graphics text is enabled, it remains enabled.
6. If the terminal is set for REMOTE, RECORD operations are ended.
7. Device operations (tape or printer) are stopped. If a tape drive was moving at the time the **RESET TERMINAL** key is pressed, the tape will be rewound. In addition, if the tape drive was recording data, an end-of-data mark will be recorded before the tape is rewound.
8. Current transmission of data stops. Data waiting to be sent to a computer is not sent. Partial messages from a computer are lost. The data communications facility is re-initialized.
9. All keyboard lights are turned on for 0.5 seconds. During the time the lights are on the **RESET TERMINAL** key can be pressed again to perform a full reset. After 0.5 seconds the lights are restored to their previous states (with the exception of DISPLAY FUNCTIONS, RECORD, and DEVICE SELECT indicators).

Full Reset

A full reset is performed by pressing the **RESET TERMINAL** key twice within 0.5 second (refer to soft reset). This has the same effect as turning power on. It completely re-initializes the entire terminal and should not be used unless necessary. A full reset causes the following:

1. The screen, graphics memory, and alphanumeric memory are cleared. The Autoplot Menu is cleared. All graphic functions, format mode, display functions, and all programmable functions including the function keys (**f1** — **f8**) are turned off or set to their default values.
2. Device assignments are set to their default values, tapes (if present) are rewound to their load point. (An end-of-data mark is not written.)

Operator Troubleshooting (SELF-TEST)

The self-tests tell you if the terminal is performing properly. The tests are made from the keyboard and do not require tools or even a computer. You should make the tests whenever you feel that the terminal is not working properly. If the terminal fails any of the tests, refer to "How to Get Help" at the end of this section.

There are three tests that can be made. The first, Terminal Test, checks out the terminal (excluding the tape drives) and is made by pressing the **TAPE TEST** key. This test can also be used to find out which options are installed and how the terminal jumpers are set. The Tape Test checks out the terminal and the tape drives. This test is made by pressing **TAPE TEST**. The Data Comm Test checks the terminal's data communication function. Instructions for the Data Comm Test are given in the *Reference Manual*.

Terminal Test

CAUTION

Terminal Test clears all data in the graphics memory. This data cannot be recovered.

You can test the terminal by pressing the **TAPE TEST** key. This is a GO/NO-GO check to see if the terminal is functioning properly. The Terminal Test cannot be performed if the terminal is in Edit mode. Pressing the **TAPE TEST** key causes the following:

- The keyboard lights are turned on. This indicates that the terminal's power supply, microprocessor, and indicators are functioning properly. The lights remain on until the test is completed.
- A test of the terminal's microcode is made, the display is turned off, and the terminal's alphanumeric display memory is tested.
- The bell is beeped, the display is turned back on, and all character sets contained in the terminal are displayed.
- A line of characters, @ABCDEFGHIJKLMNO, is displayed. If the Display Enhancement option is installed; then Underline, Half-Bright, and Blinking will be displayed (in Inverse Video) in all possible combinations in this line of characters.
- Fourteen bytes of status information are displayed and the keyboard indicators are turned off. The first seven bytes are the primary terminal status and the next seven bytes are the secondary terminal status. (Refer to the *Reference Manual* for an explanation of terminal status.)

- A graphics test is performed. The test checks both the vector generating function as well as the graphics memory. This is done by drawing a series of horizontal and vertical lines. In addition, a series of graphics characters is drawn at different sizes to test the graphics character generation function. If this test fails, a message indicating the failing component may be displayed. (Refer to the *Reference Manual* for additional information on the graphics test.) This test takes approximately 20 seconds.
- The terminal test pattern and status byte display is restored to the screen.

Generally, if the terminal beeps and the display shows a pattern similar to the ones below, then the terminal is functioning properly. The test pattern displayed will depend on which features are present in your terminal.

RESET TERMINAL must be pressed to resume operation if an error occurs during the test. When **RESET TERMINAL** is used to recover from a test error, the terminal will always perform a full reset. However, terminal operation will not be reliable if the Self Test failed.

NOTE

The test pattern cannot be recorded.

Tape Test

CAUTION

The tape test requires two unprotected tape cartridges. Make sure that the data on these tapes need not be saved.

The tape test is selected by pressing



A test is performed on the left tape unit.

1. A worst case data pattern ("%Z" repeated 128 times to form a 256 character record) is recorded on the tape cartridge.
2. The tape is backspaced over the record to the beginning of the test pattern.
3. The test pattern is read and verified.
4. A file mark is recorded and verified.

Two Terminal Tests are performed as described previously.

A test is performed on the right tape unit (same as the left tape unit).

A Terminal Test is performed.

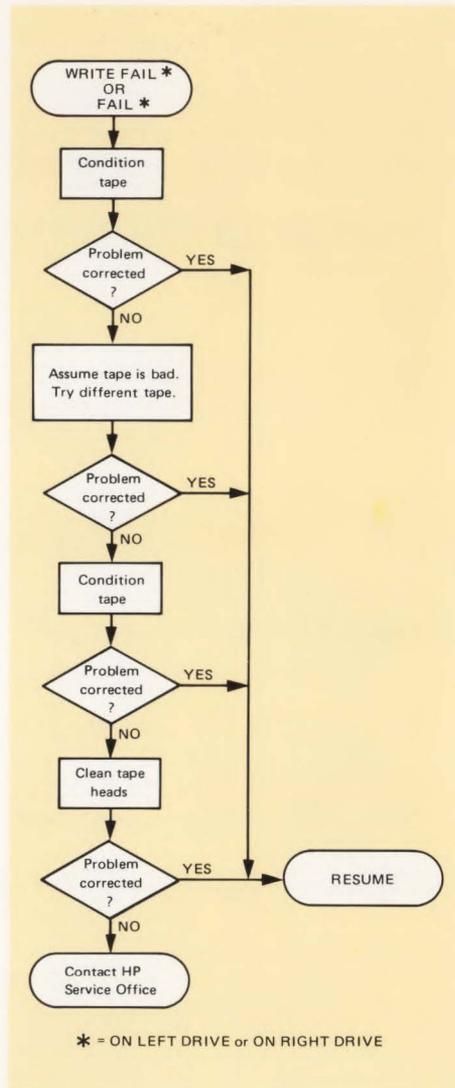
If a fault is detected during the Tape Test, the test will stop and one of the following error messages will be displayed:

NO TAPE, RUNOFF, DATA PROTECTED, FAIL, WRITE FAIL, STALL, or END OF TAPE

These messages are explained under "Messages". If the recovery procedure given does not correct the problem, or if the problem is not obvious, you can follow the supplemental tape test procedure that follows.

Tape Test Error Recovery Procedure

1. Obvious errors (e.g. NO TAPE, RUNOFF, DATA PROTECTED, END OF TAPE) — follow the procedure given under "MESSAGES".
2. STALL — If this message occurs frequently or consistently, contact your Hewlett-Packard service office.
3. WRITE FAIL, FAIL — Follow the procedures in the flowchart.
4. Errors not related to tape operation (ROM error, RAM error, etc.) refer to *Reference Manual*.



How to Recover from an Accidental End-Of-Data

If you accidentally cause an end-of-data mark to be written on your tape ahead of valid data, you will normally not be able to read the data.

You can recover all but about 10 lines of data lost at the point where the end-of-data mark was written. Use the following procedure:

Step 1. Place the tape with the end-of-data mark in the left tape drive and a new tape in the right drive.

Step 2. Press  ,  ,  .

Step 3. Press  ,  . This will copy all of the data up to the end-of-data mark.

Step 4. When the tape stops reading, press  until the END OF DATA message appears.

Step 5. Press  to clear the message. Press  ,  ,  . This moves the tape past the end-of-data mark.

Step 6. Copy the remaining data to the right tape by pressing  ,  .

Step 7. When the copy operation is complete, rewind the right tape. You can now restore the missing lines of data using the Edit function.

Messages

A variety of display messages inform you of terminal operating status, improper commands, or malfunctions. Messages appear in the upper left corner of the screen.

The following table gives an alphabetic list of terminal messages, their meaning, and any action that may be required.

- ① **ON LEFT DRIVE** or **ON RIGHT DRIVE**
- ② This message can also occur during a self test.  must be used to clear the error. In this case one press of  will cause a "full" reset.

How to Get Help

If you have performed the self-test and received an error message or if the test did not complete properly, the terminal is probably malfunctioning. At this point you can contact your nearest Hewlett-Packard service office. A list of service offices is given at the back of this section.

If you wish you can perform additional tests which may correct the malfunction. Procedures for these tests are given in the *Reference Manual*. These tests consist of a check of the terminal's assemblies and cables for loose connections and a test of the data communication function. The communication test helps isolate malfunctions when the terminal is used with a computer.

MESSAGE	MEANING	ACTION
abcde DATA COMM ERROR 0-5	An error occurred during the datacomm self test.	Refer to the <i>Reference Manual</i> .
ABORTED END OF TAPE ①	The physical end-of-tape has been reached. The tape drive has stopped to prevent runoff.	Remove the tape cartridge.
AUTO PLOT (Menu)	An Auto Plot Menu command has been entered from the keyboard.	Enter Autoplot parameters and then press   .
AUTO PLOT ERROR MAXIMUM X LESS THAN OR EQUAL TO MINIMUM AUTO PLOT ERROR MAXIMUM Y LESS THAN OR EQUAL TO MINIMUM AUTO PLOT ERROR TOO MANY X LABELS AUTO PLOT ERROR TOO MANY X TICS AUTO PLOT ERROR TOO MANY Y LABELS AUTO PLOT ERROR TOO MANY Y TICS	Improper data limits or too many labels or tic marks have been requested in the Autoplot Menu.	Press  and enter the appropriate new parameters.
BUFFER OVERFLOW	<ol style="list-style-type: none"> 1. If this message occurs when the terminal is turned on or reset, insufficient RAM memory is available for data communication buffer space. 2. An edit or data logging operation has found more than 256 characters (displayable or non-displayable) in a line of data. 	<p>Install additional memory or select a smaller buffer size. (See the <i>Reference Manual</i>.)</p> <p>Press  and shorten the top line in display memory.</p>
BUSY-WAITING ①	A tape operation is waiting for an earlier "unattended" tape operation to be completed.	No action required. The waiting operation can be aborted by pressing  .
CONFLICTING I/O	A data transfer operation (READ, RECORD, or COPY) has been requested while another transfer is in progress.	Press  . The current line of the initial transfer is completed and then both operations are aborted.

MESSAGE	MEANING	ACTION
DATA PROTECTED ①	A record operation was attempted on a "protected" tape. ②	Press RETURN . Remove the tape and move the RECORD tab in the direction of the arrow. If it is already in the "record" position, a malfunction has occurred. If the tab has been removed, reinstall it.
DIFFERENCE IN BYTE #, RECORD #, FILE #	This is the response to a compare operation. The location of the differing data is given in a format that depends on the type of compare requested.	Press RETURN . You can backspace on both tapes and then display the differing records.
DIFFERENT LENGTH RECORDS, RECORD #, FILE #	(Refer to "DIFFERENCE IN BYTE...")	(Refer to "DIFFERENCE IN BYTE...")
END OF DATA ①	The end of data has been detected while performing a READ, SKIP LINES, FIND FILE, or compare operation.	Press RETURN , then rewind the tape. If the message occurred during a compare operation refer to "DIFFERENCE IN BYTE...".
END OF FILE ①	(Refer to "DIFFERENCE IN BYTE...")	(Refer to "DIFFERENCE IN BYTE...")
END OF TAPE ①	The end of tape has been detected while performing a RECORD, COPY, SKIP LINES operation, or while performing a skip over end-of-data.	Press RETURN , then rewind the tape. ②
FAIL ①	A terminal malfunction has been detected during Tape Test.	Refer to Tape Test or the <i>Reference Manual</i> . RESET TERMINAL must be used to clear the error. This will perform a full reset of the terminal.
FILE MISSING ①	The specified file mark has been overwritten. The operation is ended.	Press RETURN .
FIND END OF DATA ①	The terminal is executing a find end-of-data command.	No action is required. The command can be aborted by pressing RETURN .
FIND FILE ±###	A FIND FILE command is being entered from the keyboard.	No action is required. The normal display will be automatically restored when the command begins to execute. The command can be aborted by pressing RETURN .

MESSAGE	MEANING	ACTION
FIND FILE ①	The terminal is executing a FIND FILE command sent from the computer.	No action is required. The command can be aborted by pressing RETURN .
"FROM" device = "TO" DEVICE	The same device has been selected as a "FROM" device and a "TO" device.	Press RETURN , then re-select devices.
GRAPHICS CURSOR # #	Gives the x,y coordinates of the present graphics cursor position.	Press RETURN or G CURSOR .
GRAPHICS SELF TEST ERROR MEMORY CHIP # #	An error has been detected during the graphics portion of the terminal self test.	Press RESET TERMINAL and refer to Self-Test in the <i>Reference Manual</i> .
HP-IB DOWN	The addressed HP-IB device is either busy or not working properly.	Press RETURN . Verify that the device is turned on, connected properly to the HP-IB, then try the attempted operation again.
INVALID - - SCALED MODE	An attempt has been made to change either the text size or angle while in the Scaled Compatibility Mode.	Press RETURN .
I/O ERROR n	An invalid device interrupt has occurred. The value "n" is the number of the device causing the interrupt. This may indicate that the 13261A accessory should be installed.	Install the accessory. If the accessory is already installed or if no devices that may have caused the message are connected to the terminal, a malfunction may have occurred.
LOADER	The terminal is loading a diagnostic program.	No action is required.
LOCATING LOAD POINT ①	The terminal is forward spacing to the load point on the indicated drive.	No action is required.
NO DEVICE DRIVER	An I/O operation has been attempted and the necessary accessory is not installed.	Install the required accessory.
NO TAPE ①	A tape cartridge is not present in the indicated drive. ②	Press RETURN . Insert tape in the selected drive. If a tape is already inserted, re-select devices and try the operation again. If the error message reappears, a malfunction has occurred.

MESSAGE	MEANING	ACTION
NO TEST	The terminal self test has been inhibited by a terminal strap setting or by an escape code sequence read from a tape.	Change the setting of the self test inhibit strap (refer to the <i>Reference Manual</i>).
PRINT FAIL	The printer did not respond properly. Either the printer is turned off, is not connected properly, or is out of paper.	Press RETURN . Check to make sure that the printer is properly connected to the terminal, is turned on, and has paper.
RAM ERROR . . .	A RAM error has been detected during self test.	Refer to the <i>Reference Manual</i> .
READ FAIL ❶	The terminal has tried to read a record on the indicated tape drive 10 times without success. ❷	Press RETURN . Try conditioning the tape, then try to read the record again. If you get another READ FAIL, try replacing the tape and running the tape test procedure. If you still get a READ FAIL, clean the tape drive heads. If the READ FAIL message is displayed again, a malfunction has occurred.
RETRY	The terminal is automatically rereading a record because of an error or is rewriting the record (Write-Backspace-Read Mode).	If several RETRY messages are displayed while reading data, consider conditioning the tape and cleaning the tape heads, or copy the data to another tape.
ROM ERROR . .	A ROM memory error has been detected during a self test.	Refer to the <i>Reference Manual</i> .
RUNOFF ❶	One of two conditions has occurred: 1. The tape has run off one of the spools in the indicated tape. You can check this by opening the small door opposite the RECORD tab on the tape cartridge to see if the tape is present. 2. One of the tape holes (used to monitor tape position) is present in the prism area.	Remove the tape cartridge and use another tape cartridge. If the data recorded on the runoff tape must be recovered, you can respool the tape using the procedure given in the <i>Reference Manual</i> . ❷ Remove the tape cartridge, and move the drive wheel to position the hole past the prism area. Reinsert the cartridge. ❷

MESSAGE	MEANING	ACTION
SKIP LINES ±##	A SKIP LINES command is being entered from the keyboard.	No action is required. The normal display will automatically be restored when the command is executed. The command can be aborted by pressing RETURN .
SKIP LINES ①	The terminal is executing a SKIP LINES command sent from the computer.	No action is required. The command can be aborted by pressing RETURN .
STALL ①	The current tape operation has stopped due to a malfunction or a bad tape.	Replace the tape. If the error message appears consistently, a malfunction has occurred. ②
TERMINAL READY	The terminal has just been turned on or a full (hard) RESET has occurred.	No action is required. The terminal is ready to use.
TEXT ANGLE (1-4) SLANTED? (Y or N)	A TEXT ANGLE command is being entered from the keyboard.	Select an angle and/or slant and press RETURN or SHIFT T ANGLE .
TEXT SIZE (1-8)	A TEXT SIZE COMMAND is being entered from the keyboard.	Select a text size and press RETURN or SHIFT T SIZE .
TOO MANY "FROM" DEVICES	More than one "FROM" device has been selected.	Press RETURN , then re-select the "FROM" and "TO" devices.
TOO MANY "TO" DEVICES	More than one "TO" device has been selected in a compare operation.	Press RETURN , then re-select the "FROM" and "TO" devices.
WRITE FAIL ①	The terminal has tried 10 times without success to write a record on the indicated drive while in Write-Backspace-Read Mode. ②	Replace the tape (see READ FAIL).

① ON LEFT DRIVE or ON RIGHT DRIVE

② This message can also occur during a self test. **RESET TERMINAL** must be used to clear the error. In this case one press of **RESET TERMINAL** will cause a "full" reset.

SALES & SERVICE OFFICES
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Pyrmble
New South Wales, 2073
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Pty. Ltd.
121 Wollongong Street
Fyshwick, A.C.T. 2609
Tel: 95-3733
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Teachers Union Building
495-499 Boundary Street
Spring Hill, 4000 Queensland
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Cable: 74766 SCHMC HX
Cable: SCHMIDTCO Hong Kong

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Tel: 7655
Cable: BLUESTAR
Blue Star Ltd.
7th & 8th Floor
Bhandari House
91 Nehru Place
New Delhi 110024
Tel: 534770 & 635166
Cable: BLUESTAR
Blue Star Ltd.
11/11A Magarath Road
Bangalore 560 025
Tel: 55668
Cable: BLUESTAR

Blue Star Ltd.
Meekshi Mandiran
xxx/178 Mahatma Gandhi Rd.
Cochin 582 016 Kerala
Tel: 32069, 32161, 32282
Cable: BLUESTAR
Blue Star Ltd.
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Sarojini Devi Road
Secunderabad 500 003
Tel: 70126, 70127
Cable: BLUEFROST
Tel: 459
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2/34 Kodambakkam High Road
Madras 600034
Tel: 82056
Cable: 041-379
Blue Star Ltd.
Nathraj Mansions
2nd Floor Bistupur
Jamshedpur 831 001
Tel: 7383
Cable: BLUESTAR
Tel: 240

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Jakarta
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Cable: BERCACON
BERCA Indonesia P. T.
63 J.L. Raya Gubeng
Surabaya
Tel: 44309
ISRAEL
Electronics & Engineering Div.
of Motorola Israel Ltd.
16, Kremnetskiy Street
P. O. Box 25016
Tel-Aviv
Tel: 03-389 73
Cable: BASTEL Tel-Aviv

JAPAN

Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Cable: BLUESTAR
Shibuya-ku, **Tokyo**
Tel: 03-370-2281/92
Cable: BLUESTAR
7th & 8th Floor
Bhandari House
91 Nehru Place
New Delhi 110024
Tel: 534770 & 635166
Cable: BLUESTAR
Tel: 07261 23-1641
Cable: BLUESTAR
Blue Star Ltd.
Tel: 5332-385 YHP OSAKA
Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
24 Kami Sasajima-cho
Nakamura-ku, **Nagoya**, 450
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Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
Yokohama 221
Tel: 045-312-1252
Cable: BLUESTAR
Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
105, 1-chrome, San-no-maru
Mito, Ibaragi 310
Tel: 0292-25-7470
Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho, 1-chrome
Atsugi, Kanagawa 243
Tel: 0462-24-0452
Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho, 1-chrome
Atsugi, Kanagawa 243
Tel: 0462-24-0452
Yokogawa-Hewlett-Packard Ltd.
Kimura Building
3rd Floor 20
2-chrome, Tsukuba
Kumagaya, Saitama 360
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KENYA

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Nairobi
Tel: 557726/556752
Cable: PROTON
Medical Only
International Aeradio(E.A.) Ltd.,
P. O. Box 19012
Nairobi Airport
Tel: 338055/56
Cable: 22201/22301
KOREA
Samsung Electronics Co., Ltd.
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MALAYSIA

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KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
ALPHANUMERIC DISPLAY CONTROL					
	ESC A	Cursor up		ESC 4	Set left margin
	ESC B	Cursor down		ESC 5	Set right margin
	ESC C	Cursor right		ESC J	Clear memory from cursor position to end of memory
	ESC D	Cursor left		ESC K	Clear line from the cursor to end of line
	BS (H ^c)	Cursor left one space		ESC S	Scroll the display up one line
	ESC F	Cursor home down		ESC T	Scroll the display down one line
---	ESC G	Cursor return		ESC U	Display the next 24 lines of memory
	ESC h	Cursor home (excluding transmit-only fields)		ESC V	Display the previous 24 lines of memory
---	ESC H	Home cursor (including transmit-only fields)		ESC & d	Turn on display enhance (see page 6)
	CR (M ^c)	Move cursor to left margin		ESC [	Start an unprotected field
---	LF (J ^c)	Move cursor down one line		ESC]	End an unprotected field or transmit-only field
	HT (I ^c) ESC I	Forward cursor to next tab position		ESC W (on)	Turn format mode on. Only unprotected fields can be modified.
OR	ESC i	Back tab		ESC X (off)	
	ESC 1	Set tab at the current cursor column		ESC {	Start transmit-only field
	ESC 2	Clear the tab at the current cursor column	---	ESC 6	Alphabetic only field
	ESC 3	Clear all tabs	---	ESC 7	Numeric only field
			---	ESC 8	Alphanumeric field

KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
EDITING			TERMINAL CONTROL GROUP		
INSERT LINE	ESC L	Insert a blank line	ESC	ESC (1 ^c)	Leads off an ASCII escape sequence
DELETE LINE	ESC M	Delete line containing cursor	CNTRL	---	Used to generate ASCII control codes and alternate key functions
DELETE CHAR	ESC P	Delete character at cursor	CAPS LOCK	ESC&k0C(off) ESC&k1C(on)	Upper-case alphabetical lock
CNTRL DELETE CHAR	ESC O	Delete character with wraparound from next line	MEMORY LOCK & indicator	ESC l (on) ESC m (off)	Memory overflow protect; display lock
INSERT CHAR & indicator	ESC Q (on) ESC R (off)	Insert succeeding inputs at cursor	AUTO LF	ESC&k0A(off) ESC&k1A(on)	Line Feed with each terminal carriage return
CNTRL INSERT CHAR	ESC N (on) ESC R (off)	Character Wraparound Mode. Insert succeeding inputs at cursor with wraparound to next line.	REMOTE	ESC&k0R(off) ESC&k1R(on)	Remote (on-line) operations; otherwise, off-line operation
ENTER , f4	---	Toggles EDIT mode	BLOCK MODE	ESC&k0B(off) ESC&k1B(on)	Block Mode: data displayed but not transmitted until requested; otherwise, terminal is in Character Mode and data transmitted as typed
			ENTER	---	Enables block transfers
			BREAK	---	Transmits BREAK signal to interrupt computer
			TRANSMIT indicator	---	Data link exists
			DISPLAY FUNCTIONS & indicator	ESC Y (on) ESC Z (off)	Control functions disabled and displayed
			CNTRL DISPLAY FUNCTIONS	ESC y (on) ESC Z (off)	Monitor Mode: display all codes received from data comm lines
			RESET TERMINAL	ESC g	(First press): frees the keyboard and clears I/O operations
			RESET TERMINAL	ESC E	(Second press): sets the terminal to power-on state
			ENTER	ESC x	Data Comm Self-Test
			TAPE TEST	ESC z	Terminal Self-Test (no tape test)

KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
ADDITIONAL FUNCTIONS			TERMINAL CONTROL		
----	ENQ (E ^c)	Enquiry from the computer	----	ESC & a <parameters>	Cursor addressing
----	ACK (F ^c)	Acknowledge — response to ENQ		Example: Cursor to 12th row 35th column (+, - for relative addressing) ⌘ & a 12r 35C	
----	BEL (G ^c)	Bell	----	ESC & b <parameters> or ESC & c <parameters>	HP diagnostics ONLY
----	ESC)	Define alternate character set: @, A, B, C		⌘ f , < @ through O >	Turn on display enhancement <enhancement>
----	SO (N ^c)	Turn on alternate character set			where: enhancements = @ through O
----	SI (O ^c)	Turn off alternate character set			
----	DC1 (Q ^c)	Block transfer trigger			
----	DC2 (R ^c)	Block transfer enable from terminal			
----	RS (⌘ ^c)	Record separator			
----	US (⌘ ^c)	Unit separator			
----	ESC @	Delay one second			
----	ESC ^	Cursor sensing (screen relative)			
----	ESC a	Cursor sensing (absolute)			
----	ESC b	Keyboard enable			
----	ESC c	Keyboard disable			
----	ESC d	Block transfer enable from computer (See DC2)			
----	ESC e	Fast binary read			
----	ESC f	Modem hang-up			
----	ESC j (on) ESC k (off)	Display user-defined soft keys			
----	ESC ^	Terminal status			
----	ESC ~	Extended status request			

	Enhancement Character															
	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Half-Bright									x	x	x	x	x	x	x	x
Under-line					x	x	x	x				x	x	x	x	
Inverse Video			x	x			x	x			x	x			x	x
Blinking		x		x		x		x		x		x		x		x
End Enhancement	x															

⌘ NEXT PAGE

KEY	CODE	FUNCTION
TERMINAL CONTROL (Cont.)		
---	ESC & f <parameters>	Define soft keys
where:	$\langle \text{parameters} \rangle = \left\{ \begin{array}{l} 0 \text{ (normal)} \\ 1 \text{ (local only)} \\ 2 \text{ (transmit only)} \end{array} \right\} a \{1-80\}l \langle \text{text string} \rangle$	
Example:	Assign the string "HELLO-MYACNT" to the f1 key. The key should function as normal keyboard input.	
	$\text{ESC} \& f 1 k 2 a 13 L \text{ HELLO-MYACNT}$	
---	ESC & f <key #>E	Execute the soft key. Key # = 0-8

KEY	DEFAULT	PROGRAMMABLE
RETURN	CR	
f1	ESC p to computer	
f2	ESC q to computer	
f3	ESC r to computer	
f4	ESC s to computer	Up to 80-character sequence for each key (local, transmit or both)
f5	ESC t to computer	
f6	ESC u to computer	
f7	ESC v to computer	
f8	ESC w to computer	

KEY	CODE	FUNCTION
---	ESC & g <parameters>	Simulate PA, PF keys (see <i>Reference Manual</i>)
---	ESC & k <parameters>	Define latching keys
where:	$\langle \text{parameter} \rangle = \left\{ \begin{array}{l} 0 \text{ (up)} \\ 1 \text{ (down)} \end{array} \right\} \left\{ \begin{array}{l} a \text{ (Auto LF)} \\ b \text{ (Block Mode)} \\ c \text{ (Caps Lock)} \\ r \text{ (Remote)} \end{array} \right.$	
Example:	Block Mode up Remote up Auto LF down Caps Lock down	
	$\text{ESC} \& k 1 a o b 1 c o r$	

DEVICE CONTROL			
ESC & p <parameters>			
f1	ESC & p 1S	Assigns LEFT TAPE as source device	
f2	ESC & p 2S	Assigns RIGHT TAPE as source device	
f3	ESC & p 3S	Assigns DISPLAY as source device	
f5	ESC & p 1D	Assigns LEFT TAPE as destination device	
f6	ESC & p 2D	Assigns RIGHT TAPE as destination device	
f7	ESC & p 3D	Assigns DISPLAY as destination device	
f8	ESC & p 4D	Assigns PRINTER as destination device	
INSERT CHAR	ESC & p 5D	Assigns PRINTER on HP-IB as destination device	
NOTE: One source and multiple destinations can be set up with the same sequence.			
Example:	$\text{ESC} \& p 1 s 3 d 4 D$		

KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
DEVICE CONTROL (Cont.)					
	f1	ESC & p xs xd M All files (current position) from source device are transferred to destination device		f8 . f5 ±n, or f6	ESC & p (±n)p 1u 2C or ESC & p (±n)p 2u 2C
	f2	ESC & p xs xd F One file (current position) from source device is transferred to destination device		CTRL f1 or f2 or f3	ESC & p1M Compare data between source and destination (All) ESC & p1F (File) ESC & p1B (Line)
	f3	ESC & p xs xd B One line (current position) from source device is transferred to destination device	CTRL READ	---	Read page without DC handshake
<p>NOTE: x is variable to indicate source and destination device codes. 1 = Left tape, 3 = Display, 5 = HP-IB device 2 = Right Tape, 4 = Printer</p> <p>Example: Copy all files from right tape to left tape and display. $\text{F} \text{c} \text{ & p } 2 \text{s } 1 \text{d } 3 \text{d } \text{M}$</p>					
	INSERT LINE	ESC & p 9C Turn off tape Write-Backspace-Read Mode		CTRL READ	---
	DELETE LINE	ESC & p 10C Turn on tape Write-Backspace-Read Mode		CTRL TAPE TEST f5 or f6	ESC & p 1u 4C Conditions left or right tape or ESC & p 2u 4C
	f5 . f5 or f6	ESC & p 1u 0C Rewinds LEFT TAPE ESC & p 2u 0C Rewinds RIGHT TAPE		f5 . INSERT CHAR	ESC & p 5u 0C Copy graphics memory to destination device
	f6 . f5 or f6	ESC & p 1u 5C Write a FILE MARK on LEFT TAPE ESC & p 2u 5C Write a FILE MARK on RIGHT TAPE		f6 . INSERT CHAR	ESC & p 5u 5C Copy from source device to graphics memory
	TAPE TEST	ESC & p 1u 7C Tests left tape unit ESC & p 2u 7C Tests right tape unit		f7 . INSERT CHAR address,	ESC & p 5u (address)p 1C Select HP-IB TALK address
	f7 . f5 ±n, or f6	ESC & p (±n)p 1u 1C Positions LEFT TAPE to a relative (±n) LINE ESC & p (±n)p 2u 1C Positions RIGHT TAPE to a relative (±n) LINE		f8 . INSERT CHAR address,	ESC & p 5u (address)p 2C Select HP-IB LISTEN address
			---		ESC & p 5u 3C Enable HP-IB timeout function.
			---		ESC & p 5u 4C Disable HP-IB timeout function.
			---		ESC & p 5u 7C Initialize HP-IB.
			---		ESC & p 5u <>p 6C Read byte count on HP-IB.
	SPACE BAR	---			Display file, inches remaining for each tape.

KEY CODE FUNCTION

DEVICE CONTROL (Cont.)

READ	---	In REMOTE, transfers data from source device to computer. In LOCAL, transfers one file from source device to DISPLAY.
RECORD	---	In REMOTE, transfers data from computer to destination device. In LOCAL, transfers one file from DISPLAY to destination device.
ENTER	---	In REMOTE, enables block transfers. In LOCAL, operates same as RECORD .
---	ESC & s <parameters>	Define strap settings

Example: Remove Q strap, install P strap. $\text{E} \text{c} \text{ \& } \text{s} \text{ 0q 1P}$

GRAPHICS CONTROL SEQUENCES

ESC * <control sequence>	NOTE
a = Autoplot	<i>All parameterized escape sequences must be terminated with an uppercase character.</i>
d = Display control	
l = Graphics text label	
m = Mode control	
p = Plot control	
s = Status	
t = Compatibility mode	

AUTO PLOT

ESC * a <parameters>

AUTO PLOT	a	Turn AUTO PLOT on.
AUTO PLOT or STOP	b	Turn AUTO PLOT off.
SHIFT AXES	c	Draw AUTO PLOT axes.
---	d	Clear AUTO PLOT menu.
SHIFT AUTO PLOT MENU	f	Turn AUTO PLOT menu on.

SHIFT AUTO PLOT MENU	g	Turn AUTO PLOT menu off.
---	<# of cols> h	Load # of cols.
---	<x col> i	Load x column #
---	<y col> j	Load y column #
---	<line type> k	Load line type (1-9)
---	<min x> l	Load minimum x value
---	<max x> m	Load maximum x value
---	<min y> n	Load minimum y value
---	<max y> o	Load maximum y value
---	<x labels> p	Load x label increment
---	<x tics> q	Load x tic increment
---	<y labels> r	Load y label increment
---	<y tics> s	Load y tic increment
---	<# of lines> t	Load heading lines to be skipped
---	<# of points> u	Load # of points to plot
---	<grid?> v	Load grid command (1/0)
---	<display?> w	Load display plot command (1/0)
---	z	NOP

AUTO PLOT

A. PLOT SPECIFICATION

1. NO. OF COLUMNS 2
2. X IS COLUMN 1
3. Y IS COLUMN 2
4. LINE TYPE (1-5)
5. MIN X -15
6. MAX X 15
7. MIN Y -.3
8. MAX Y 1.1

B. AXES SPECIFICATION

1. UNITS BETWEEN X LABELS 5
2. UNITS BETWEEN X TICS 1
3. UNITS BETWEEN Y LABELS .2
4. UNITS BETWEEN Y TICS .1

C. PLOT OPTIONS

1. SKIP FIRST LINES OF TEXT
2. STOP AFTER POINTS
3. DRAW GRID? 1
4. FROM DISPLAY?

Example: The following example programs the terminal to accept and plot 10 points (in the range 1 to 100) sent from the computer.

$\text{E} \text{c} * \text{a} \text{d} \text{2h} \text{1i} \text{2j} \text{1k} \text{1l} \text{100m} \text{1n} \text{100o} \text{20p} \text{10q} \text{20r} \text{10s} \text{10u} \text{1v} \text{0w} \text{c} \text{A}$

KEY	CODE	FUNCTION
DISPLAY CONTROL		
ESC * d <parameters>		
	a	Clear graphics memory
---	b	Set graphics memory
	c	Turn on graphics display
	d	Turn off graphics display
	e	Turn on alphanumeric display
	f	Turn off alphanumeric display
	g	Turn on zoom
	h	Turn off zoom
or	<size> i	Set zoom size (1-16)
---	<x,y> j	Set zoom position
	k	Turn on graphics cursor
	l	Turn off graphics cursor
	m	Turn on rubber band line
	n	Turn off rubber band line
---	<x,y> o	Move graphics cursor absolute
, , ,	<x,y> p	Move graphics cursor incremental

KEY	CODE	FUNCTION
---	q	Turn on alphanumeric cursor
---	r	Turn off alphanumeric cursor
	s	Turn on graphics text mode
	t	Turn off graphics text mode
---	z	NOP
<p>Example: Clear the graphics display, position the cursor at x=100, y=100, turn the cursor on, and zoom to 4 times.</p> <p>$\text{ESC} * d a 100,100 o k 4 i G$</p>		
GRAPHICS LABEL		
ESC * l <text label> <h, h', r, r', or f>		
<p>Example: Send the text "X=TIME, Y=TEMP"</p> <p>$\text{ESC} * l X=TIME, Y=TEMP h' r$</p>		
<p>Note: All parameterized escape sequences must be terminated with an uppercase character.</p>		

KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
VECTOR DRAWING MODE			PLOTTING COMMANDS		
ESC * m <parameters>			ESC * p <parameters>		
---	<mode>	a Select drawing mode (0-4)*	---	a	Lift the pen
---	<line type>	b Select line type (1-11)**	---	b	Lower the pen
---	<pattern>	c Define line pattern (1 byte)	---	c	Use graphics cursor as new point
---	<pattern>	d Define area shading pattern (8 bytes)	---	d	Draw a point at the current pen position and lift the pen
---	<x1,y1,x2,y2>	e Fill area, absolute	---	e	Set relocatable origin to the current pen position
---	<x1,y1,x2,y2>	f Fill area, relocatable	---	f	Data is ASCII absolute
---	<x,y>	j Set relocatable origin	---	g	Data is ASCII incremental
---		k Set relocatable origin to current pen position	---	h	Data is ASCII relocatable
---		l Set relocatable origin to graphics cursor position	---	i	Data is absolute
---			---	j	Data is short incremental
 	<size>	m Set graphics text size (1-8)	---	k	Data is incremental
 	<rotation>	n Set graphics text orientation (1-4)	---	l	Data is relocatable
 		o Turn on text slant	---	z	NOP
 		p Turn off text slant			
---	<1-9>	q Set graphics text origin			
---		r Set graphics defaults			
		z NOP			
* 0 (no effect), 1 (clear), 2 (set), 3 (complement), 4 (jam)			Example: Draw a box 25 units wide and 10 units high, beginning at x=100, y=50.		
** 1 (solid line) 5 (line #2) 9 (line #6)			␣ * p a f 100 50 g 25, 0 0, 10 -25, 0 0, -10Z		
2 (user line pattern) 6 (line #3) 10 (line #7)			NOTE: All parameterized escape sequences must be terminated with an uppercase character.		
3 (user area pattern) 7 (line #4) 11 (point plot)					
4 (line #1) 8 (line #5)					
Example: Select the set drawing mode, a graphics text size of 2 and slanted. Set the text to be center justified. ␣ * m 1 a 2m o 4Q					

KEY	CODE	FUNCTION	KEY	CODE	FUNCTION
GRAPHICS STATUS			COMPATIBILITY MODE		
ESC * s <parameter> ^			ESC * t <parameter>		
---	1	Read device I.D.	---	<0/1/2> a	Set grap (0=CR, 1=CR EOT, 2=none)
---	2	Read pen position	---	<0/1> b	Set Page Full Break strap (0=out, 1=in)
---	3	Read graphics cursor position	---	<0/1> c	Set Page Full Busy strap (0=out, 1=in)
---	4	Read cursor position and wait for key	---	z	NOP
---	5	Read display size	Keyboard Interface switches:		
---	6	Read graphics capabilities	P open = Scaled compatibility mode.		
---	7	Read graphics text status	Q open = Unscaled compatibility mode.		
---	8	Read zoom status	Example: Select a CR input terminator and set the Page Full Busy strap.		
---	9	Read relocatable origin	ESC * t 0a 1C		
---	10	Read reset status	NOTE: All parameterized escape sequences must be terminated with an up- percase character.		
---	11	Read area shading			
---	12	Read dynamics			
<p>Example: Read text status. ESC * s 7 ^ DC1</p> <p>NOTE: All parameterized escape sequences must be terminated with an up- percase character.</p>					

Programmer's Reference Table

BIT 7 6 5 4321	CONTROL (CNTL) CHARACTERS				DISPLAYABLE CHARACTERS				ESCAPE SENT FIRST							
	0 0 0	0 0 1	0 1 0	0 1 1	0 1 0	0 1 0	0 1 1	0 1 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1		
0000	@ NUL	0 DLE	P SP	16 DL	SP	0	@	P	'	p	SP	0	@	P	'	p
0001	A SOH	1 SH	Q DC1	17 D1	!	1	A	Q	a	q	!	1	A	Q	a	q
0010	B STX	2 SX	R DC2	18 D2	"	2	B	R	b	r	"	2	B	R	b	r
0011	C ETX	3 EX	S DC3	19 D3	#	3	C	S	c	s	#	3	C	S	c	s
0100	D EOT	4 ET	T DC4	20 D4	\$	4	D	T	d	t	\$	4	D	T	d	t
0101	E ENQ	5 EQ	U NAK	21 NK	%	5	E	U	e	u	%	5	E	U	e	u
0110	F ACK	6 AK	V SYN	22 SY	&	6	F	V	f	v	&	6	F	V	f	v
0111	G BEL	7 BELL	W ETB	23 EB	'	7	G	W	g	w	'	7	G	W	g	w
1000	H BS	8 BS	X CAN	24 CN	(	8	H	X	h	x	(	8	H	X	h	x
1001	I HT	9 HT	Y EM	25 EM	)	9	I	Y	i	y	)	9	I	Y	i	y
1010	J LF	10 LF	Z SUB	26 SB	*	:	J	Z	j	z	*	:	J	Z	j	z
1011	K VT	11 VT	[ESC	27 EC	+	;	K	[	k	{	+	;	K	[	k	{
1100	L FF	12 FF	\ FS	28 FS	,	<	L	\	l	!	,	<	L	\	l	!
1101	M CR	13 CR	] GS	29 GS	=	=	M	]	m	}	=	=	M	]	m	}
1110	N SO	14 SD	^ RS	30 RS	.	>	N	^	n	~	.	>	N	^	n	~
1111	O SI	15 SI	_ US	31 US	/	?	O	_	o	DEL	/	?	O	_	o	DEL

Example: J is bits 1001010; Control J is LF line feed; Escape (ESC) followed by J is CLEAR DISPLAY

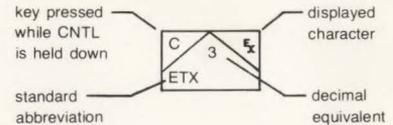
LEGEND

NOTES:

- LOWER CASE LETTER, LOWER CASE SYMBOL, AND CONTROL CHARACTER CODES ARE GENERATED BY STANDARD TERMINAL, BUT ASSOCIATED CHARACTERS ARE NOT DISPLAYED ON THE SCREEN. PRESS TAPE TEST KEY FOR DISPLAYABLE CHARACTER SET.
- SINGLE CHARACTER ESCAPE SEQUENCES AND CONTROL CODES NOT LISTED WITH A FUNCTION ARE NEITHER ACTED UPON NOR DISPLAYED.
- ESC H HOMES CURSOR INCLUDING TRANSMIT-ONLY FIELDS. ESC h HOMES CURSOR EXCLUDING TRANSMIT-ONLY FIELDS.

- | | |
|---------------------------------|---------------------------|
| k - ACKNOWLEDGE | E - END OF TEXT |
| Q - BELL | F - FORM FEED |
| B - BACKSPACE | FF - FILE SEPARATOR |
| C - CANCEL LINE | G - GROUP SEPARATOR |
| CR - CARRIAGE RETURN | H - HORIZONTAL TABULATION |
| DC1 - DEVICE CONTROL 1 | L - LINE FEED |
| DC2 - DEVICE CONTROL 2 | N - NEGATIVE ACKNOWLEDGE |
| DC3 - DEVICE CONTROL 3 | R - RECORD SEPARATOR |
| DC4 - DEVICE CONTROL 4 | S - SHIFT IN |
| DEL - DELETE | SH - SHIFT OUT |
| DL - DATA LINK ESCAPE | SP - SPACE |
| EM - END OF MEDIUM | SH - START OF HEADING |
| ENQ - ENQUIRY | ST - START OF TEXT |
| ET - END OF TRANSMISSION | S - SUBSTITUTE |
| ESC - ESCAPE | SY - SYNCHRONOUS IDLE |
| ETB - END OF TRANSMISSION BLOCK | U - UNIT SEPARATOR |
| | V - VERTICAL TABULATION |

Control Character Legend:



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