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4024

COMPUTER DISPLAY TERMINAL

OPERATOR'S MANUAL

TEKTRONIX®

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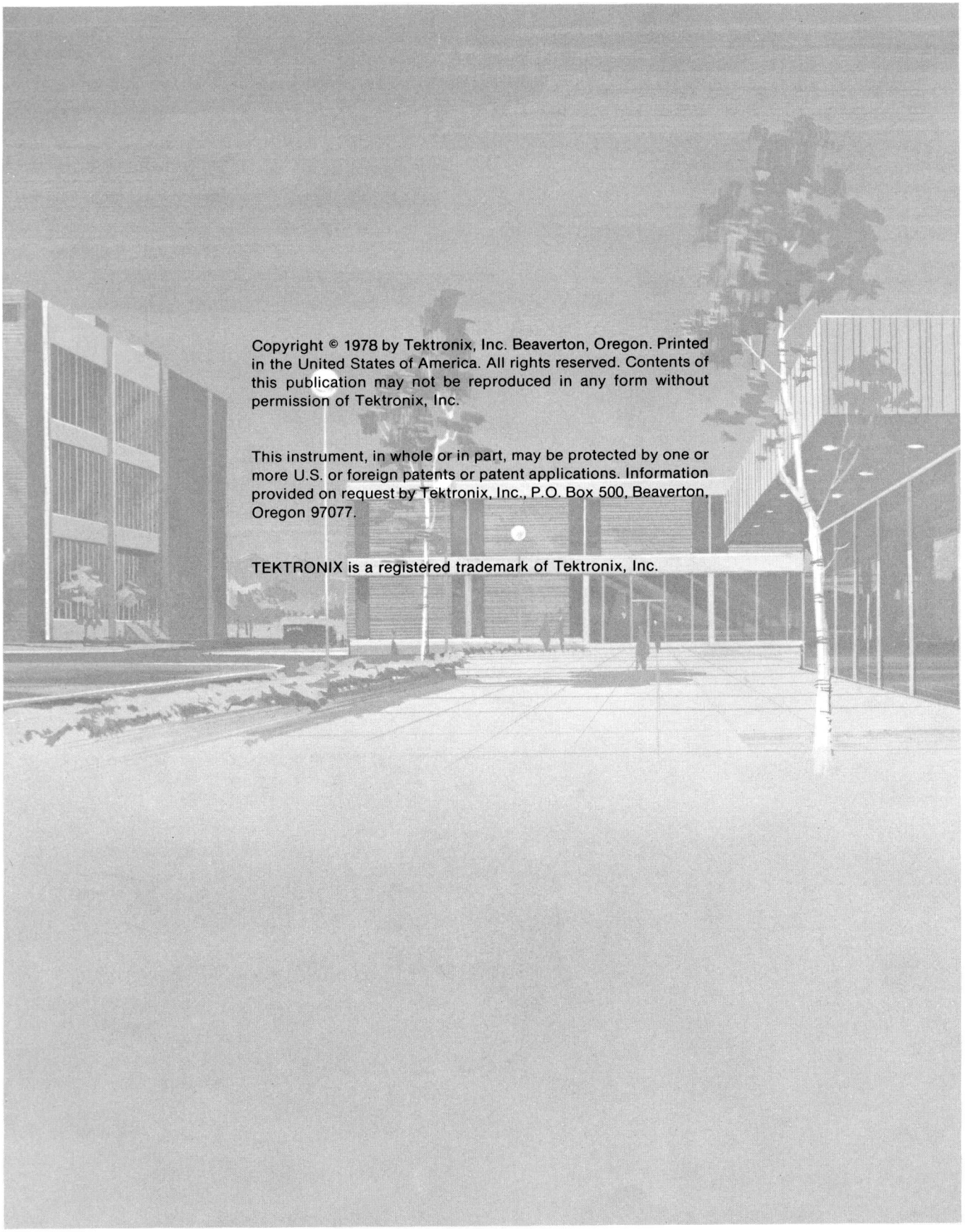

PRODUCT 4024 Computer Display Terminal

This manual supports the following versions of this product: B010100 and up

MANUAL REVISION STATUS

REV.	DATE	DESCRIPTION
@	1/78	Original Issue

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Fig. 1-1. 4024 Computer Display Terminal.

Section 1

INTRODUCTION

This manual provides an introduction to the TEKTRONIX 4024 Computer Display Terminal. It includes descriptions of the keyboard, the "workspace" and "monitor" areas of memory, and those commands which may be needed by a data entry or data retrieval operator. For a complete description of all the commands, see the Programmer's Reference Manual.

Appendix A gives examples of all the commands, including those not described in this manual.

THE 4024

The TEKTRONIX 4024 Computer Display Terminal (Fig. 1-1) is an instrument that enables people to exchange information with computers. Inputs to the computer can be made by typing on the Terminal's keyboard, and data from the computer can be displayed on the Terminal's television-like screen.

The 4024 has the following features:

- *Buffered text.* Can hold a line of text (as many as 80 characters), allowing the line to be edited before being sent to the computer.
- *Local editing.* Can hold text in a workspace, where it can be edited before being sent to the computer.
- *Forms.* Holds forms in a workspace and allows the operator or the computer to fill in the blanks.
- *Enhanced Background.* Can display parts of the text in its workspace with a background that is brighter than usual.
- *Definable keys.* Learns new definitions for most of the keys of its keyboard. The operator or the computer can assign any character or string of characters to a key. Thereafter, whenever that key is pressed, the 4024 interprets it as the defined character or string of characters. Commands, as well as text strings, may be included in these key definitions.

- *Repeating keys.* Repeats any character when that character's key is depressed for longer than 1/2 second. Most function keys also repeat: of the 86 keys, 78 have the repeating feature.

- *Split screen.* Divides the screen into two areas when told to do so by the operator or the computer. The upper part of the screen displays the workspace, a scratchpad area for editing text or filling out forms. The lower part of the screen displays the monitor, where messages to and from the computer may be displayed without overwriting the text in the workspace.

- *Scrolling.* Scrolls text on the screen up and down. Text scrolled off the screen is not lost, but is saved as long as memory is available to hold it.

- *Self test.* When the 4024 is turned on, it checks its memory and displays an error message if it has a memory defect. When commanded to do so, the 4024 can also check its firmware and display checksums and samples of all its characters.

- *Remote programmability.* Changes its settings under computer control. Uses "English-language" commands, rather than non-printing control characters; this simplifies sending commands from the computer.

- *Detached keyboard.* Has a detached keyboard, which may be placed where convenient for the operator.

These additional capabilities are available as options:

- *Additional display memory.*

- *Printed hard copies.* Prints copies on a TEKTRONIX 4642 Line Printer.

- *Rulings.* Draws vertical or horizontal single or double lines on forms in the workspace.

- *Current loop interface.* Communicates with other devices using a 20 mA current loop, rather than the standard RS-232 interface.

- *Polling Interface.* Can be used in a polling environment, as one of several display stations communicating with the host computer through a polling controller.

SPECIFICATIONS

Appendix D of this manual lists the 4024's specifications. Some of the more important specifications are:

- Transmission/reception speed of up to 9600 baud. The following baud rates may be selected by internal straps: 75,110, 150, 300, 600, 1200, 2400, 4800, and 9600 baud.
- Thirty-four lines of display, each holding up to 80 characters.
- Size of display memory: 4096 characters; may be expanded to 8192, 16384, or 32,768 characters (Options 20, 21, and 22).

ACCESSORIES

The following standard accessories are provided with each 4024:

1	Operator's Manual	070-2438-00
1	Large (1x2) blank keycap	366-1748-00
1	Large (1x2) keycap cover	200-2163-00
4	Small (1x1) blank keycaps	366-1749-00
4	Small (1x1) keycap covers	200-2164-00
6	Keyboard overlays	334-3290-00

These optional accessories are also available:

Programmer's Reference Manual	~~061-1551-00~~ 070-2402-00
Reference Card	070-2437-01 02
Service Manual	061-1523-00
Keyboard overlay	334-3290-00
Large (1x2) blank keycap	366-1748-00

Large (1x2) keycap cover	200-2163-00
Small (1x1) blank keycap	366-1749-00
Small (1x1) keycap cover	200-2164-00

THE SPLIT SCREEN: MONITOR AND WORKSPACE

You can divide the 4024's display into two different work areas, or *scrolls* of memory (Fig. 1-2). The bottom part of the screen displays the *monitor* scroll, while the top part displays the *workspace* scroll.

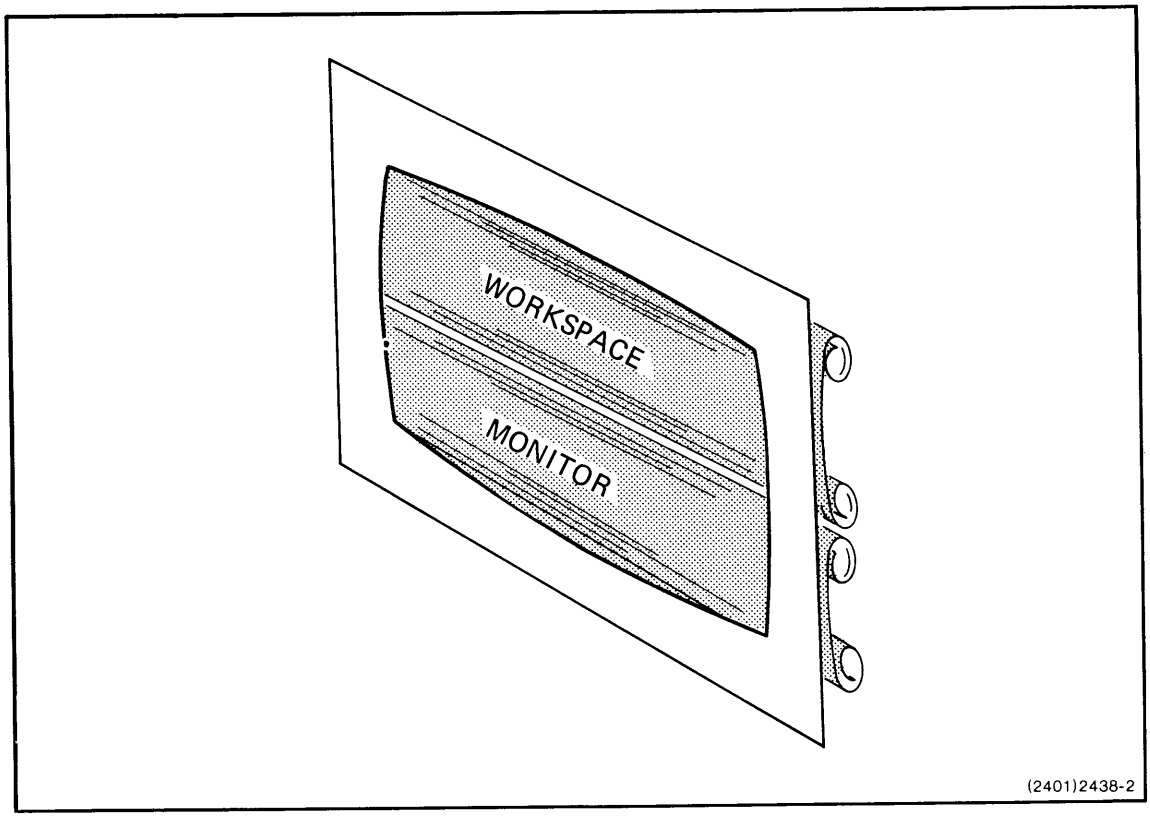


Fig. 1-2. The Split Screen: Workspace and Monitor Scrolls.

Text from the keyboard or the host computer can be directed to either scroll. When the keyboard types into the monitor, the cursor (an underline serving as a position marker) appears in the monitor. Likewise, when the keyboard types into the workspace, the cursor appears in the workspace.

Each scroll has a specific use. The workspace can hold text while it is being edited, or it can hold forms that are being filled out. The monitor provides a separate display area where messages to and from the computer may be displayed without interfering with the text in the workspace.

Monitor

Text typed into the monitor is sent to the computer. When logging in on a time-sharing system, you would have both the keyboard and the computer send text to the monitor. (The monitor would then act like the roll of paper coming out of a teletypewriter.)

Workspace

Text typed into the workspace is stored there and is not automatically sent to the computer. This lets you add or delete characters or lines with the special editing keys. When the text is as you like it, you can send the entire workspace contents to the computer.

The workspace can also hold a *form* whose blanks either you or the computer can fill in. With the 4024 in *form fillout mode,* you can fill in some or all of the form's blanks and then send the contents of those blanks to the computer.

Scrolling

Each scroll can hold more text than is visible on the screen. Special scrolling keys allow you to roll the workspace and monitor scrolls up and down. When the keyboard types into the workspace (cursor in the workspace), the scrolling keys move the workspace scroll; when the keyboard types into the monitor, the scrolling keys affect the monitor scroll.

HOW THE 4024 MIGHT BE USED

The following example shows one way the 4024 might be used. If you wish, you may skip this example and go on to Section 2.

In our example, let's assume that you work for the XYZ Company, which keeps a mailing list of its customers. Your job is to keep the list up-to-date by adding new names to the list, or by changing the entries when customers change their addresses. The list is kept in a disc file in the company's main computer. You use the 4024 to communicate with the computer.

Dialing Up the Computer

Before you can make changes to the mailing list, you must first establish communication with the computer. You turn on the 4024 and place a telephone call using a special data telephone[1]. When the computer answers the phone, it puts an audio tone on the line. You then press a button on the data telephone to connect the 4024 to the computer.

At this point, the 4024 behaves like an ordinary teletypewriter. Whenever you type a character on the keyboard, the 4024 sends that character to the computer. The computer acknowledges that it has received the character by sending it back to the 4024. (This is called *echoing* the character). The echoed character is displayed on the 4024's screen[2].

Logging In

Now you must establish your authority to use the computer. You type a "login" message on the keyboard. The computer responds by asking for your password. If the password you type is correct, the computer sends a message acknowledging that you have "logged in" and have access to the computer.

Initialization

Now you must gain access to the computer program that handles the mailing list. To do this, you type an instruction to the computer to run that program. The computer *initializes* the 4024 (sends a series of commands which prepare the 4024 for the task to come). These commands cause the 4024 to display a form on its screen (Fig. 1-3) and to direct characters typed on the keyboard into the blanks of that form. Also, the commands give special meanings to some of the keys:

- The SEND key is set to send what you have typed in the blanks of the form.
- Function Key 1 is set so that pressing it tells the computer to open a new entry in the mailing list.

---

[1] In the XYZ Company, the computer is connected to its terminals over the ordinary telephone lines, and you must dial up the computer's telephone number in order to use it. This is not the case in all companies. In some computer installations, the terminals are always connected to the computer.

[2] This example assumes that the XYZ Company uses *full duplex, remote echo* data communication. It is possible to use the 4024 in other ways , such as *local echo*, in which the 4024 displays each character as it sends it to the computer, and the computer does not echo the character back to the 4024.

- Function Key 2 is set so that pressing it makes the computer delete a mailing list entry.

- Function Key 3 is set so that pressing it tells the computer to stop running its "mailing list maintenance" program and log you off the computer.

At this point, you place an overlay around Function Keys 1 through 4. The overlay holds labels describing the functions of the keys.

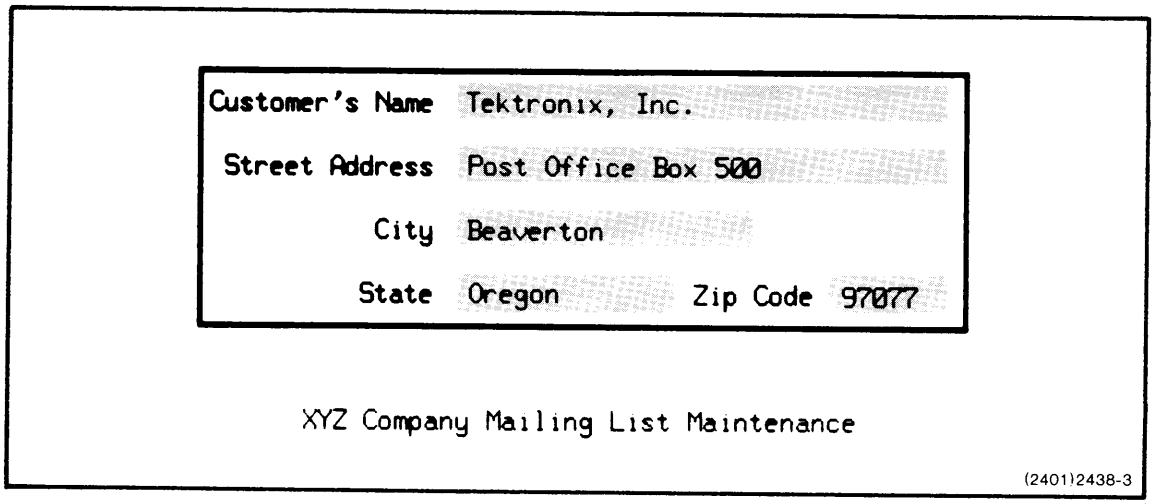


Fig. 1-3. Example of a form displayed on the 4024's screen.

Retrieving a Record From the Host Computer

To retrieve a record from the computer's file, you type the customer's name in the first blank of the form and press the SEND key. The 4024 sends the name to the computer. The computer finds the customer's record and sends it back to the 4024, filling in the other blanks in the form displayed on the screen.

Changing a Record

Once the record is received, any (or all) of the information can be changed, and new information can be added. Suppose that you have a new street address for that customer. By pressing the TAB key, you move through the form to the blank that holds the street address. You then type in the new address and press SEND again.

When you press SEND, the 4024 sends the computer only the part of the form that changed. That is, it sends the new street address, but does not repeat the customer's name, city, state, etc. When the computer receives the new street address, it corrects its mailing list.

After pressing SEND, you can erase the contents of the form (by pressing the ERASE key) and type in the next customer's name. You need not wait for the 4024 to finish sending the last customer's address.

Logging Off

When done making changes to the mailing list, you "log off" from the computer. In this example, you press Function Key 3. The computer then erases the 4024's screen and proceeds to log you off. As it does so, it sends a "logoff" message, which the 4024 displays for you to see.

You then end the call to the computer by replacing the handset in the special data telephone.

Section 2

OPERATOR CONTROLS

This section introduces you to the keys of the 4024's keyboard and to its other switches and controls. Exercises are included to help you become familiar with the 4024.

NOTE

Do Exercise 3 before doing any of the exercises which follow it. (Exercise 3 sets the 4024 so that you can practice on it without accidentally communicating with the computer.)

Should you put down this manual, be sure to do Exercise 3 before resuming your reading and doing any more exercises.

TURNING POWER ON

The POWER Switch

The POWER switch is on the right side of the 4024's cabinet (Fig. 2-1); it has an internal lamp which lights when power is on.

When power is first applied, the 4024 tests certain parts of its memory. Should the test reveal a failure, a RAM ERROR message will appear on the screen. (If that occurs, call your Tektronix Service Center.)

CAUTION

Never turn the 4024 on, and then immediately turn it off; doing so can destroy the display screen's phosphor. After turning the unit on, wait at least one minute before turning it off again.

Do not place papers, books, etc. on the 4024's cabinet. Be especially careful not to cover the slits in the cabinet cover. These slits are needed to ventilate the 4024's internal components.

MASTER RESET Button

The MASTER RESET button (next to the POWER switch) resets the 4024 to its "power up" condition; pressing it is like turning the 4024 off and then on again.

CAUTION

If the 4024 contains information you wish to keep, do not operate the POWER switch or the MASTER RESET button. Doing so destroys any text or programmable key definitions you may have stored in the 4024.

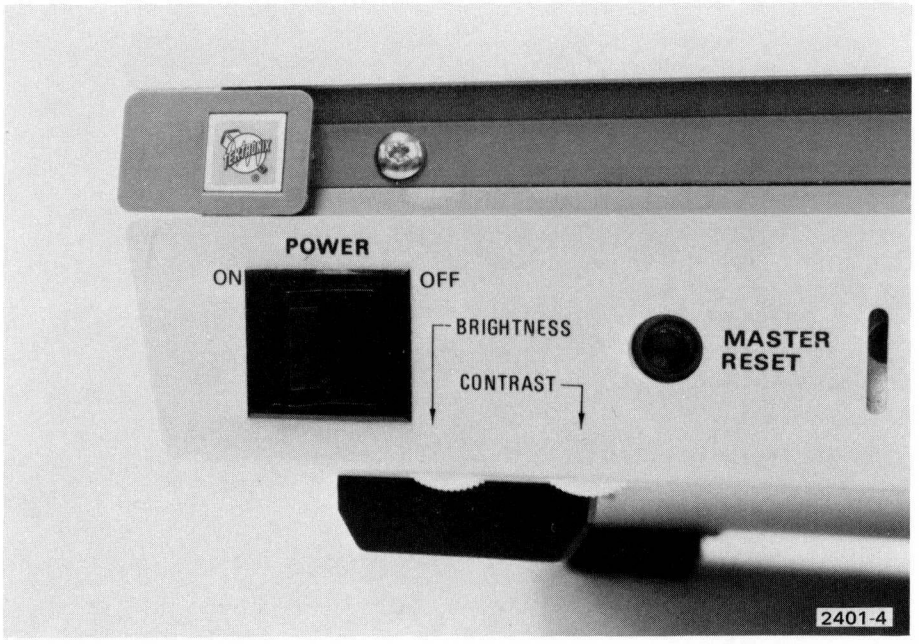
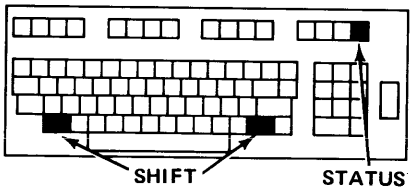
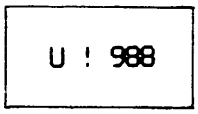


Fig. 2-1. POWER, MASTER RESET, BRIGHTNESS and CONTRAST controls.

NOTE

In this manual, expressions such as "press SHIFT-STATUS," or "press CTRL-G" mean "while holding down the SHIFT key, press the STATUS key," or "while holding down the CTRL key, press the G key."





STATUS MESSAGE

Exercise 1

Turn on the POWER switch; its green light should turn on. After a delay of about 15 seconds, a cursor (underline) will appear in the upper left corner of the screen.

(Should a RESET message appear, consult Section 4 of this manual.)

Press SHIFT-STATUS; the *status message* should appear on the screen. (Do not touch any other keyboard keys yet, as you may inadvertently send data to the computer.)

Press the MASTER RESET button. The screen will erase and the cursor will appear in the upper left corner of the screen, just as it did when you first applied power.

After applying power or pressing MASTER RESET, there is a delay of about 15 seconds before the cursor appears. During this time, the 4024 is testing its memory. Should the test reveal that essential settings like baud rate and parity have been forgotten, a RESET message will appear. (In that case, refer to Section 4.)

Should a RAM ERROR message appear, call your Tektronix Service Center; there is a defect in the 4024's memory.

The BRIGHTNESS and CONTRAST Controls

The BRIGHTNESS and CONTRAST controls are located near the POWER switch (Fig. 2-1). They function like the brightness and contrast controls of a television set: BRIGHTNESS adjusts the background brightness of the display, and CONTRAST adjusts the degree of contrast between the light and dark parts of the display.

Exercise 2

Press SHIFT-STATUS. The status message will appear on the screen. (Do not touch any other keys yet; doing so may send data to the computer.) Experiment with the BRIGHTNESS and CONTRAST controls, adjusting them until the display pleases you.

HOW TO AVOID TALKING TO THE COMPUTER

It is sometimes possible to "confuse" a computer by sending improper data to it. The following discussion shows how to prevent this, by directing text from the keyboard to the 4024's internal workspace rather than to the computer.

If your terminal is always connected directly to the computer (constantly *on line*), use the following procedure to avoid talking to the computer:

1. Press SHIFT-STATUS. The 4024 will display the status message. Notice the second character displayed in this message: this is the command character, which you must type whenever you type commands to the 4024.

2. Check to be sure that the light on the COMMAND LOCKOUT key is off. If the light is on, press the key once to turn it off.

3. Now type the command character. Immediately after it, type the command WORKSPACE 15 K and press the RETURN key.

   For instance, if the command character is the exclamation point (!), you type:[1]

   !WORKSPACE 15 K <CR>

[1] **In these examples, and throughout this manual, the RETURN key is denoted by <CR>. Also, in most examples, we shall assume that the command character is the exclamation point (!).**

4. After the screen erases, a cursor (underline) appears in the upper left corner of the screen. You may now type on the 4024's keyboard without sending information to the computer.

Exercise 3

Perform the procedure just described. That is, examine the short-form status message to learn the command character. Then check that the COMMAND LOCKOUT light is off and, after typing the command character, give the WORKSPACE 15 K command.

(This command defines a *workspace,* allots 15 lines of the screen to displaying the workspace, and causes characters typed on the keyboard to be stored in the workspace rather than sent directly to the computer. The workspace, and the WORKSPACE 15 K command, are described in Section 3, under "The Workspace and the Monitor.")

THE KEYBOARD

The 4024's keyboard is shown in Fig. 2-2. Its keys fall into three main categories:

- *ASCII keys.* The ASCII keys are used to send data to the computer. These comprise the largest block of keys and are similar to the standard keys of a typewriter. (We call them "ASCII keys" because they send characters of the ASCII code- the American Standard Code for Information Interchange. This code is described in Appendix B.)

- *Cursor/numeric pad keys.* The keys of the cursor/numeric pad serve two functions:

  - When the pad acts as a cursor pad, some of its keys move the cursor on the screen, and others scroll text in view up and down.

  - When the pad acts as a numeric pad, its keys are used to enter numeric data.

- *Function Keys.* The function keys control the 4024, causing it to erase text from its memory, insert or delete characters or lines of text, and so on. Many of these keys have no predefined meanings; they are reserved for programming by the user (or the computer).

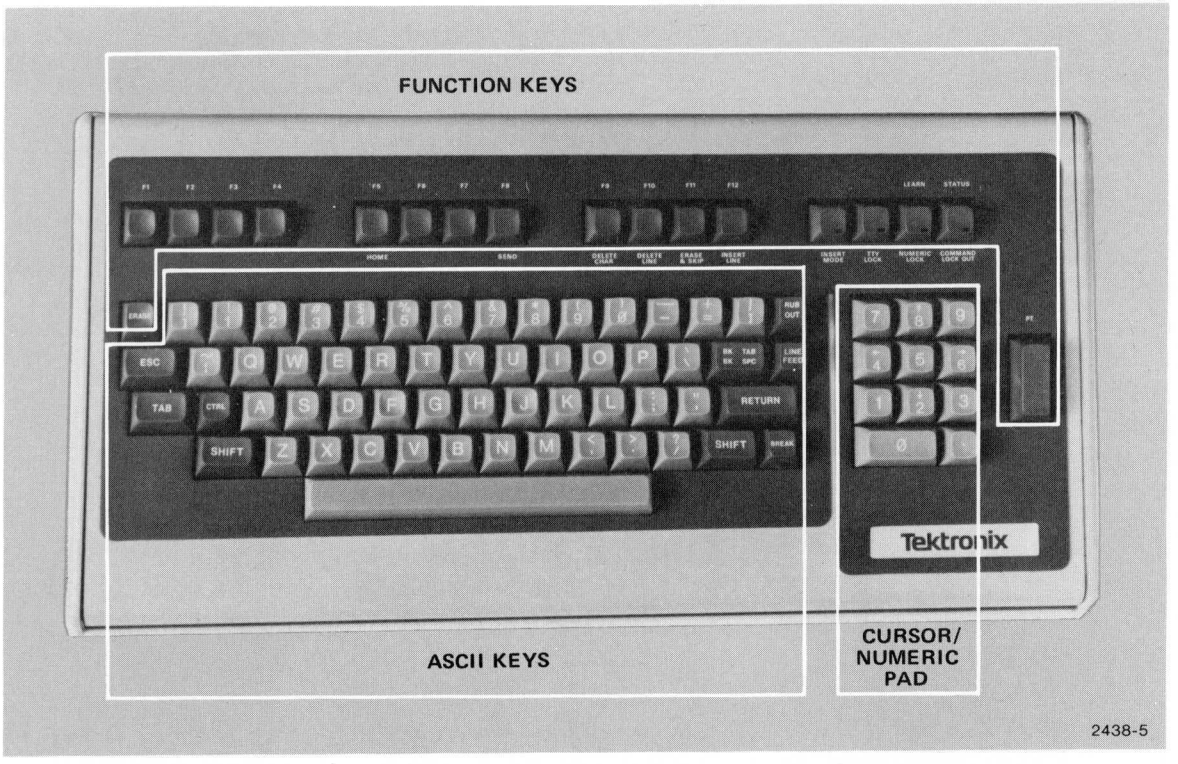
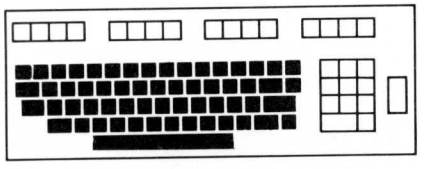


Fig. 2-2. Keyboard.

ASCII Keys



The main part of the 4024's keyboard, which holds the ASCII keys, resembles an ordinary typewriter keyboard. However, there are some important differences. The easiest way to learn about these is to experiment with the keyboard. To guide you in this experimentation, this manual includes exercises to try.

Exercise 4

(Be sure that you have done Exercise 3 first.)

Type a few words of some test sentence. Then press the RETURN key.

As you type, the cursor moves to the right. (The cursor is an underline which serves as a position marker.) The cursor always indicates where the next character you type will be displayed.

The distinction between the ASCII keys and the 4024's other keys is important when you are communicating directly with the computer by typing on the keyboard:

- As you press an ASCII key, the 4024 sends a character to the computer. Thus, if you move the cursor by pressing RETURN, LF, or BK SPAC (which are ASCII keys), the computer is informed that you have moved the cursor.

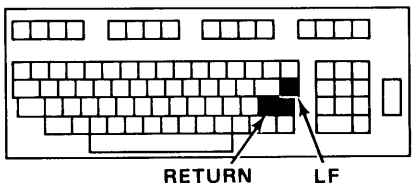
- If you move the cursor with the cursor control keys (which are not ASCII keys), no characters are sent to the computer. Therefore, the computer is not informed that the cursor has moved.

The ASCII keys fall into three categories: alphanumeric keys, keys for non-alphanumeric characters, and the BREAK key. (While the BREAK key does not actually send an ASCII character, it does communicate with the computer by sending a *break* signal. Therefore, it is convenient to discuss it together with the ASCII keys.)

The alphanumeric keys, colored light gray, send the "printing" ASCII characters to the computer. These represent letters, numerals, and special symbols. ("Space" is considered a printing character.)

The non-alphanumeric keys, colored dark gray, send certain of the special "non-printing" ASCII characters. These include the rub out (or delete) character, and the escape, horizontal tab, back-space, carriage return, and line feed characters. Also included among the non-alphanumeric keys are the SHIFT and CTRL keys, which help select the characters sent when alphanumeric keys are pressed.

RETURN and LF



The RETURN and LF keys send the *carriage return* and *line feed* ASCII characters. *Carriage return* returns the cursor to the left edge of the screen, and *line feed* advances the cursor to the following line.

Exercise 5

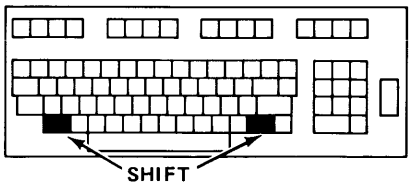
Type a few words of text; do not press RETURN. Then press LF a few times and watch the cursor move down the screen.

Type a few more lines, pressing RETURN at the end of each line.

NOTE

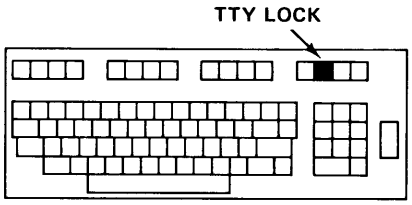
When communicating with a computer, the characters sent when you press RETURN may differ as required by the system. However, the net visual response will be the same: pressing RETURN moves the cursor to the start of the next line.

SHIFT



Most of the 4024's keys have two meanings: the *normal* and *shifted* meanings. For instance, pressing the Q key while holding down SHIFT sends the uppercase letter (Q); pressing the same key without SHIFT sends the lowercase letter (q). Function keys, as well as other keys, have shifted meanings: SHIFT-HOME is not the same as HOME.

TTY LOCK

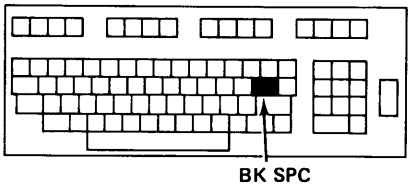


The 4024 does not have a shift lock key like that on a typewriter. Instead, it has the TTY LOCK function key. Pressing TTY LOCK lights the light on that key and locks the keyboard so that it cannot send lowercase letters of the alphabet. (TTY LOCK does not affect the action of the other keys.) Pressing TTY LOCK again unlocks the keyboard and turns off the TTY LOCK light. An advantage of TTY LOCK is that you can type numerals on the alpha keys with TTY LOCK active, whereas a shift lock key would not permit this. (You should use the TTY LOCK key when using computers or computer programs that do not accept lowercase letters.)

Exercise 6

Press TTY LOCK; the light in that key will turn on. Type a few words, and notice that they are displayed in all uppercase letters. Then press TTY LOCK again, and type a few more words, using lowercase letters.

BK SPC



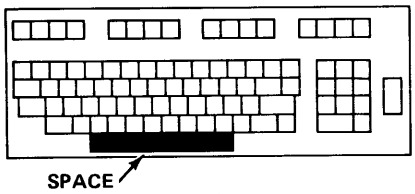
The BK SPC (backspace) key sends the *backspace* ASCII character. This moves the cursor backwards (to the left) one character position.

Exercise 7

Type a few words and then use BK SPC to move the cursor back to the beginning of the line. Repeat this several times, typing over the words which you have previously typed.

Notice that as you type over characters already displayed on a line, the characters typed replace characters formerly on the line. This provides an easy way to change text in the workspace.

The Space Bar



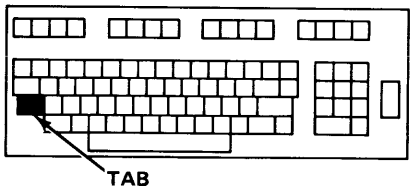
The space bar sends the ASCII *space* character. The 4024 and the computer treat *space* just like any other letter of the alphabet. For instance, when you type over previously entered characters with the space bar, those characters are replaced with spaces.

This means that you cannot use the space bar just to move across the page, as you would the space bar of a typewriter. To move the cursor without entering or changing text, you must use the cursor control keys, discussed later in this section.

Exercise 8

Type a few words of text. Use BK SPC to move the cursor back to the beginning of the line. Then hold the space bar down; notice that as the cursor moves to the right, characters previously on the line are erased (replaced with spaces).

TAB

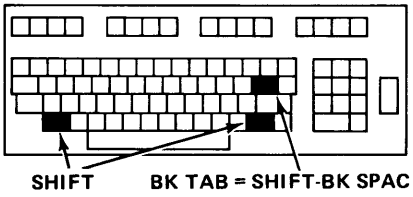


The TAB key sends the *tab* character of the ASCII code.

When you are typing into the 4024's workspace rather than directly to the computer, TAB moves the cursor to the next tab stop, or to the beginning of the next line if there are no tab stops defined to the right of the cursor. If you are filling in the blanks of a form (4024 in "form fillout mode"), TAB moves the cursor to the next blank in the form.

When you are typing from the keyboard directly to the computer, you should avoid using TAB unless you know how the computer will respond to that character.

BK TAB

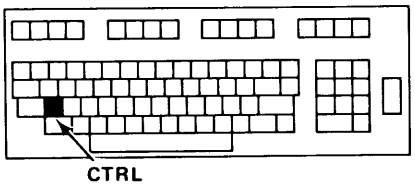


When SHIFT is held down, the BK SPC key becomes the BK TAB (backtab) key.

When you are typing into the 4024's workspace rather than directly to the computer, BK TAB moves the cursor to the previous tab stop in a line, or to the beginning of the line if there are no tab stops to the left of the cursor. If you are filling in the blanks of a form (4024 in "form fillout mode"), BK TAB moves the cursor to the preceding blank of the form.

When you are typing from the keyboard directly to the computer, BK TAB moves the cursor to the preceding tab stop in a line, but does not send any character to the computer. (There is no *backtab* character in the ASCII code.) Thus, BK TAB serves only to move the cursor; it sends no information to the computer.

Control Characters and the CTRL Key



The ASCII alphabet includes a number of *control* characters which have special meanings. For instance, *carriage return* and *line feed* are control characters; so are *bell* and *form feed.* Only a few of the control characters have their own keys on the keyboard: the RETURN, LF, BK SPC, TAB, ESC, and RUB OUT keys.

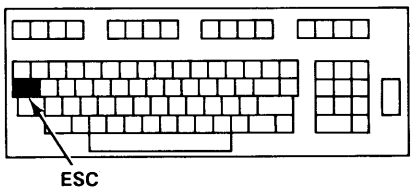
By means of the CTRL key, however, you can send any of the control characters. To do this, hold down CTRL while typing another key. For each control character there is a key which, when pressed while holding CTRL down, sends that control character.

For instance, CTRL together with G sends the *bell* character, CTRL-M sends *carriage return,* and CTRL-J sends *line feed.*

Exercise 9

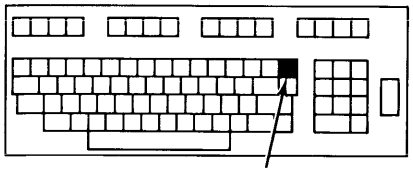
Hold down the CTRL key and type the letter G. Then, while holding down CTRL, type J.

CTRL-G sends the *bell* character, ringing the 4024's bell. CTRL-J sends *line feed,* moving the cursor down one line. Table B-2 in Appendix B lists the ASCII control characters with the keys to press to send those characters.

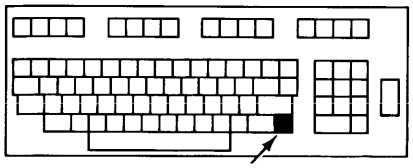


ESC. When you are typing from the 4024's keyboard directly to the computer, the ESC key sends the ASCII *escape* character. *Escape* is one of the non-printing control characters of the ASCII code.

When typing into the 4024's workspace rather than directly to the computer, ESC has no effect.



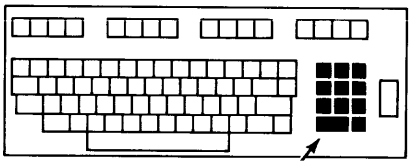
RUB OUT. The RUB OUT key sends another special ASCII character, the *rub out* or *delete* character. Like ESC, RUB OUT has no effect when typing into the workspace.



BREAK. The BREAK key is occasionally used to interrupt the host computer, but should be used with caution. (Consult your computer systems analyst to learn when to use BREAK.) To use this key to interrupt the computer, press it twice in quick succession.

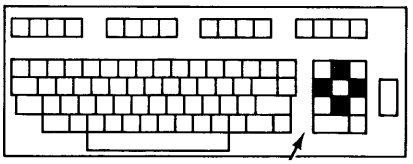
You can also use the BREAK key to remove the 4024 from its buffered mode of operation. This is described in Section 3, under "Buffered Operation".

Cursor/Numeric Pad Keys



The *cursor/numeric pad* consists of the eleven light gray keys located to the right of the ASCII keys. They can be used in two ways: as a *cursor pad* and as a *numeric pad.*

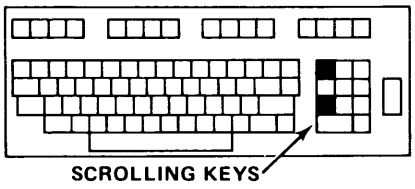
Functioning as a Cursor Pad



When the light on the NUMERIC LOCK key is off, the pad acts as a cursor pad. The four keys marked with arrows move the cursor in the direction of the arrows.

Exercise 10

Check that the light on the NUMERIC LOCK key is off. (If the light is on, press NUMERIC LOCK once to turn it off.) Then experiment with the cursor control keys, moving the cursor about on the screen.



The two keys with triangular markings scroll the text in the workspace up and down. (If the keyboard is typing into the monitor, rather than the workspace, these keys move the monitor scroll rather than the workspace scroll.)

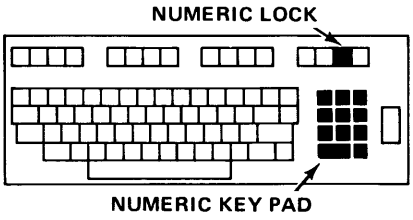
Exercise 11

Type several lines of text, until the display scrolls upward to accommodate the text you have entered. You now have enough text in the workspace to use the scrolling keys. Type several more lines of text, and then use the scrolling keys to move the text up and down.

NOTE

The scrolling keys will not move the workspace or monitor scrolls past the end of the text already in memory. Thus, if the entire text is in view, the scrolling keys will have no effect. (For this purpose, "text in memory" includes any empty lines that may have been inserted by moving the cursor below the end of the scroll.)

Functioning as a Numeric Pad

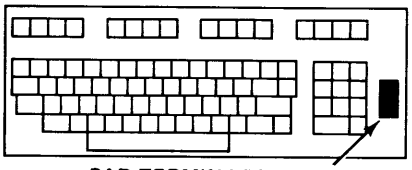


To use the keypad to enter numeric data, press the NUMERIC LOCK key; the light on that key will turn on. To return the pad to its cursor control functions, press NUMERIC LOCK again; the light will turn off. With NUMERIC LOCK on, you can use the pad as a numeric keypad; its keys send ASCII characters for the numeric digits. With NUMERIC LOCK off, the keys do not send anything to the computer, they only move the cursor.

Exercise 12

Press NUMERIC LOCK, and use the numeric pad to type several numbers. Then press NUMERIC LOCK again, and use it to move the cursor.

You can move the cursor even when the pad is a functioning as a numeric pad (NUMERIC LOCK on). To do this, hold SHIFT down; the shifted versions of the pad keys still function to move the cursor and to scroll text up and down.

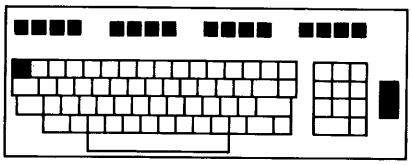

PAD TERMINATOR KEY

The pad terminator function key (labeled "PT") is just to the right of the cursor/numeric pad. Pressing this key has no effect unless you or the computer has assigned a meaning to it. (This is done with the LEARN key, discussed in Section 3.)

For instance, you might use a *space* to separate numbers to be entered. In that case, you would program the PT key to mean *space*. After entering each number, you would press the pad terminator key to type a *space* before entering the next number.

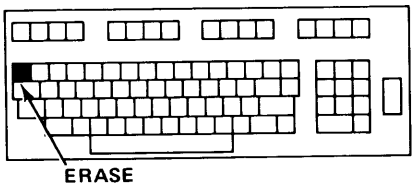
(Alternatively, after entering each number, you might want to give a SEND MOD command, as described in Section 3. In that case, PT would be programmed to give the SEND MOD command.)

Function Keys


FUNCTION KEYS

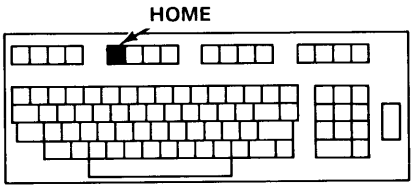
The function keys control the 4024, causing it to erase the screen, display the status message, insert characters, etc. These keys do not necessarily send ASCII characters to the computer, although most of them can be programmed to do so.

Some of the function keys have no labels describing their functions. These are reserved for you or the computer to program with the LEARN key or the LEARN command. (The LEARN key is described in Section 3. For the LEARN command, see the Programmer's Reference Manual.)



ERASE

The ERASE key erases the scroll (workspace or monitor) into which the keyboard is typing. (The workspace and monitor are described in Section 3.) If you are typing into the workspace, the entire workspace is erased. (This includes any text that may be scrolled up out of view.) Similarly, if you are typing into the monitor, ERASE clears the entire monitor.

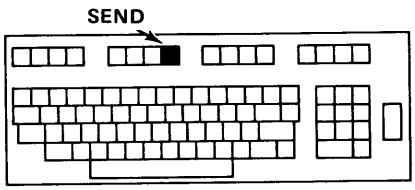


HOME

The HOME key moves the cursor back to the beginning of the workspace or the monitor, rewinding the workspace or monitor scroll if necessary. If you are typing into the workspace, the cursor moves to the beginning of the workspace. Likewise, if you are typing into the monitor, HOME moves the cursor to the beginning of the monitor.

Exercise 13

Press HOME, and see the cursor move back to the start of the workspace. Then press ERASE to clear the workspace.



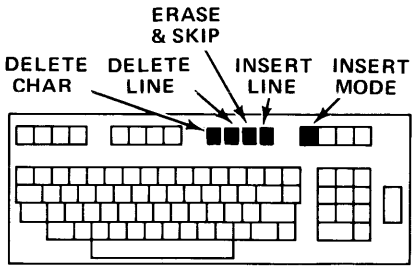
SEND

When it has been suitably programmed, you can use the SEND key to give the SEND ALL or SEND MOD commands. The SEND ALL command sends the entire contents of the workspace to the host computer, while the SEND MOD command sends only certain parts of the workspace to the computer. (For more information on these commands, see "Sending Workspace Contents to the Computer", in Section 3 of this manual.)

NOTE

Unlike the other labeled function keys, the SEND key performs no function until the 4024 has LEARNed a meaning for it.

Editing Keys



EDITING KEYS

Five of the function keys are used for editing text in the 4024's memory.[2] These are the DELETE CHAR, DELETE LINE, ERASE & SKIP, INSERT LINE, and INSERT MODE keys.

The DELETE CHAR key deletes the character at the cursor position from the text on the screen. Characters to the right of the cursor move left to fill the gap.

The DELETE LINE key deletes the entire line in which the cursor is located. Lines below it move up to fill the gap left by the deleted line.

The ERASE & SKIP key deletes the characters from the cursor position to the end of the line. The cursor moves to the start of the next line.

The INSERT LINE key inserts a blank line below the present cursor position and moves the cursor to the beginning of that line.

The INSERT MODE key lets you insert characters into a line. When you press INSERT MODE, a light on that key turns on. While the light is on, any characters typed are inserted in the line at the present position of the cursor. Characters at or to the right of the cursor move right to make room for the inserted characters. (If any of these characters move right off the end of the line, they are lost.) Pressing the key again removes the 4024 from "insert mode" and turns off the INSERT MODE light.

---

[2]You can edit text typed into the workspace, and then later send that text to the computer with the SEND ALL or SEND MOD command, as described in Section 3.

Exercise 14

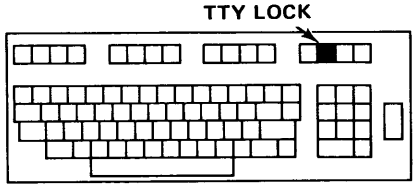
Type some text, and then experiment with the DELETE CHAR, DELETE LINE, ERASE & SKIP, INSERT LINE, and INSERT MODE keys.

Ordinarily, you would use the editing keys only when typing into the workspace, as you have been doing in this section's exercises.

You should not use the editing keys when typing text from the keyboard directly to the computer. This is because the editing keys only affect the display in the 4024, and do not send information to the computer. Consequently, if you try to use the editing keys to change text already typed in the monitor and sent to the computer, you won't accomplish the desired result. Although the 4024's display of the text will be edited, the text already sent to the computer won't be.

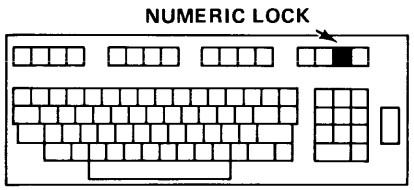
An exception to this occurs when the 4024 is operating in buffered mode, described in Section 3. In buffered mode, you can use the editing keys to edit each line of text typed in the monitor, but only before you press RETURN. Once you press RETURN, that line of text is beyond recall.

TTY LOCK



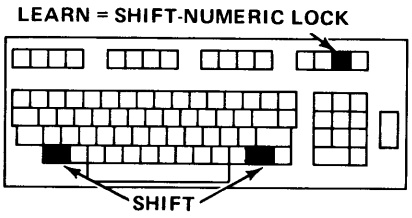
The TTY LOCK key has already been mentioned in connection with the ASCII keys. It is used with those keys much like a typewriter's shift lock key. Pressing this key lights a light on the key and locks the keyboard so that it cannot send lowercase letters of the alphabet. (The corresponding uppercase letters are sent instead.) Pressing the key again unlocks the keyboard and turns off the light.

NUMERIC LOCK



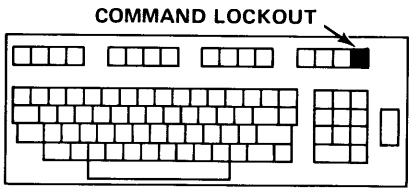
The NUMERIC LOCK key has already been mentioned in connection with the cursor/numeric pad. Pressing this key lights the light on the key and lets the cursor/numeric pad function as a numeric pad for entering numbers. Pressing the key again turns off the light and returns the pad to its usual cursor movement function.

LEARN



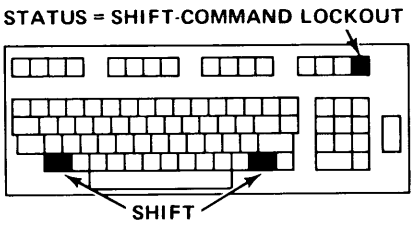
The LEARN KEY is the shifted version of the NUMERIC LOCK key. It is discussed in Section 3, under "Using the LEARN Key".

COMMAND LOCKOUT



The COMMAND LOCKOUT key is the rightmost of the four lighted function keys. Pressing this key turns on the light on the key and causes the 4024 to ignore the command character which signals the start of a command. (The command character is described in Section 3, under "Typing Commands on the Keyboard".) With COMMAND LOCKOUT active, the 4024 will not respond to commands typed on the keyboard or received from the computer. Pressing the key again turns off the light and enables the 4024 to respond to commands.

STATUS



The STATUS key is the shifted version of the COMMAND LOCKOUT key. Use this key to examine the *status message.* (Fig. 2-3.)

Exercise 15

While holding down SHIFT, press STATUS. A *status message* **will appear.**

The status message has three parts:

- The first part is a single letter, either U (for "unbuffered") or B (for "buffered"). This indicates whether the 4024 is operating in *buffered mode.*[3]

- The second part of the short-form status message is a single character. This is the command character, which you must use to give the 4024 most of its commands.

NOTE

If the command character is one of the non-printing ASCII characters (such as escape, *for instance), a two-letter mnemonic for the character appears in the status message. Table B-2 in Appendix B shows the two-letter mnemonic for each ASCII control character.*

- The third part of the status message shows the number of blocks of memory left in the 4024 (Each block contains 16 words of memory, and may hold from 7 to 14 characters of text.)

[3] **Buffered mode is described in Section 3 of this manual.**

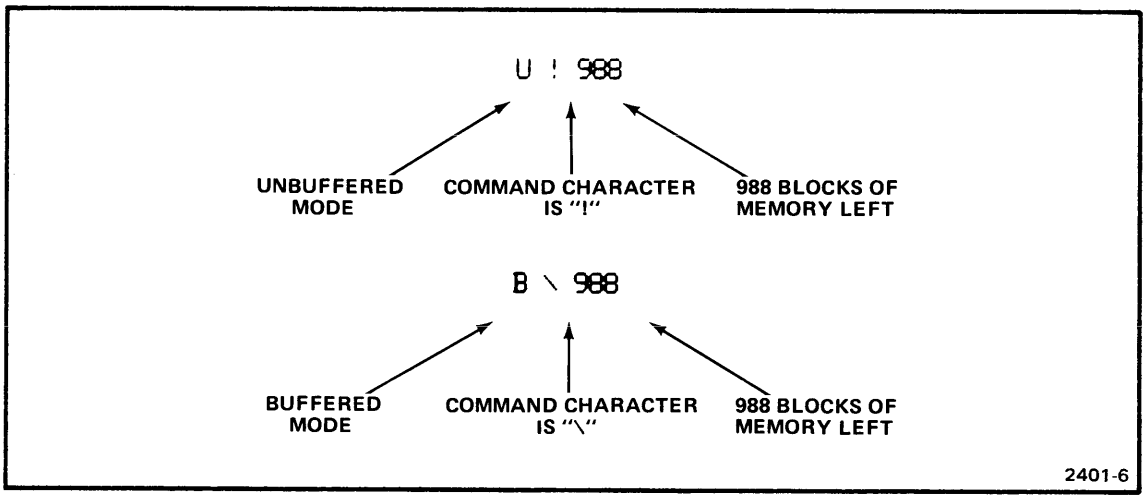


Fig. 2-3. Status message.

Section 3

COMMANDS

This section describes some of the commands which you can give the 4024. Not all the commands are discussed; for more information, see the 4024/4025 Programmer's Reference Manual. Appendix A gives examples of all commands, including those not described in this manual. These are the topics discussed in this section:

- Typing commands on the keyboard.
- Interpreting the SYSTAT message.
- Using the two scrolls (workspace and monitor) which the 4024 displays on its screen.
- Setting margins and tab stops.
- Buffered operation.
- Making the 4024 "learn" new meanings for its keyboard keys; and making it "forget" what it has "learned."
- Selecting a different command character.
- Setting the communications parameters: baud rate, parity, etc.
- Copying on a printer.

TYPING COMMANDS ON THE KEYBOARD

You can give a few commands to the 4024 by just pressing keys such as ERASE or HOME. Most commands, however, must be typed on the keyboard or sent from the computer.

Before entering a command, be sure the COMMAND LOCKOUT light is off. (If the light is on, the 4024 will not respond to the commands you type, although it will respond to keys like ERASE and HOME.) If the light is on, press the key once to turn it off.

To enter a command, begin by typing the command character. (See the discussion of the STATUS key in Section 2.) This notifies the 4024 that a command is to follow. The 4024 responds by moving the cursor to the monitor (if it is not already there) and displaying the command character.

Type the command **immediately** after the command character, with no intervening spaces. Each command starts with a *keyword* - the name of the command. For instance, to set the tab stops, you type the keyword STOPS. (If you wish, you may abbreviate any keyword by typing only its first three letters.)

NOTE

If you misspell the keyword, or otherwise mistype the command, the 4024 will display an error message. (It will display "WHAT?" and the mistyped command.) If this happens, type the command again correctly.

Some commands require options to be installed. For instance, if the COPY command is typed without Option 3 installed, the 4024 will give the "WHAT?" error message.

Follow the keyword with a space, and then type any *parameters* which the command may require. (Parameters are additional numbers or letters which give the 4024 more details about what you want it to do.) Separate the parameters from the keyword with a space, and from each other with commas or spaces. After typing the parameters, if any, end the command by pressing RETURN.

Suppose that you want to set the left and right margins to columns 10 and 70, respectively. If the command character is the exclamation point (!), you would type:

!MARGINS 10 70 <CR> or !MAR 10 70 <CR>

(In this example, the "10" and "70" are parameters for the MARGINS command. This command is described later in this section.)

If the command character were the ampersand (&) and you wanted to erase the monitor, you would type:

&ERASE MONITOR <CR> or &ERA M <CR>

THE "SYSTAT" MESSAGE

The 4024's system status message, or *SYSTAT* message, tells you almost everything you may need to know about the 4024's status. You should examine this message after changing any of the 4024's settings. If you are in doubt about the 4024's operation, examining the SYSTAT message may help you understand what is happening.

On the last page of this manual, there is a table in which you should record the SYSTAT settings for you particular computer installation. (Your computer systems analyst can tell you what these settings should be.)

To see the SYSTAT message, type:

!SYSTAT <CR> or !SYS <CR>

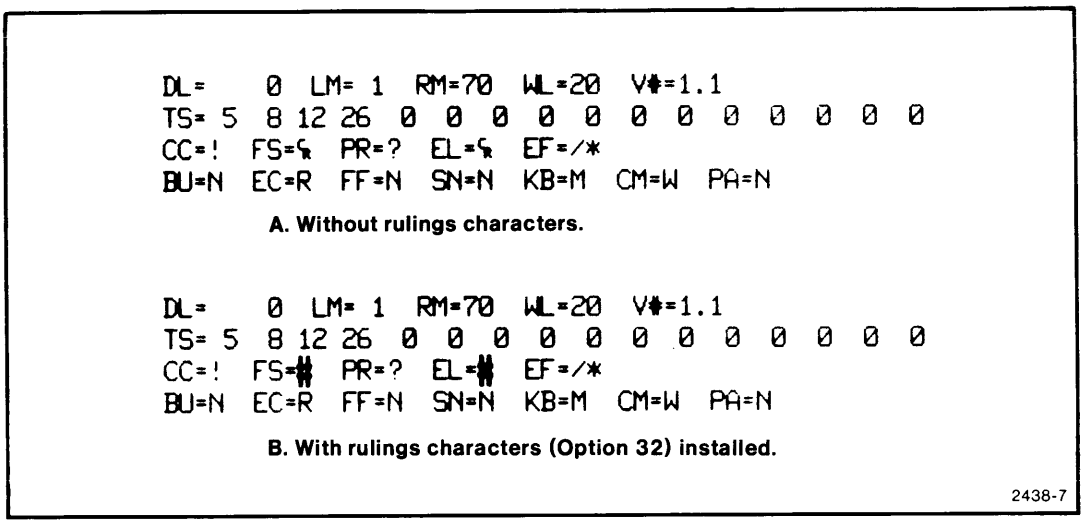


Fig. 3-1. The SYSTAT message.

If your 4024 has the rulings character set (Option 32) installed, rulings characters may appear in the SYSTAT message instead of the two-letter mnemonics which represent the control characters. (This is shown in Fig. 3-1B.) Table B-2 in Appendix B lists the ASCII control characters, with their two-letter mnemonics and corresponding control characters.

The following "translation" interprets the message shown in Fig. 3-1. Some of the settings will be explained later in this manual, and many are of interest only to the person who programs the computer to talk to the 4024. (See the Programmer's Reference Manual for more information about these settings.)

`DL= 0` The delay before the 4024 responds to a prompt from the host computer is set to 0 milliseconds.

`LM= 1 RM=70` The workspace's left margin is set at column 1, and the right margin at column 70.

`WL=20` The visible workspace length is set to 20 lines. That is, 20 lines of the screen are used to display the workspace, and the remainder (14 lines) to display the monitor.

`V#=1.1` This 4024 has firmware version 1.1 installed. (This information is for use by service personnel.)

TS= 5 8 12 26 0 0 0 0 0 0 0 0 0 0 0 0	The tab stops are set at columns 5, 8, 12, and 26.
CC=!	The command character is the exclamation point (!).
FS=↵	The field separator is *carriage return.*
PR=?	The prompt string consists of a single character, the question mark (?).
EL=↵	The end-of-line string consists of a single character, *carriage return.*
EF=/*	The end-of-file string is set to "/*."
BU=N	The 4024 is not in buffered mode.
EC=R	The 4024 is set for remote echo rather than local echo.
FF=N	The 4024 is not in form fillout mode.
SN=N	The 4024 is not in snoopy mode.
KB=M	Text coming from the keyboard is directed to the monitor.
CM=W	Text from the computer is directed to the workspace.
PA=N	No parity checking is being done.

THE WORKSPACE AND THE MONITOR

Two Scrolls of Memory

Think of the 4024's display memory as consisting of two *scrolls* (Fig. 3-2). The screen displays part of each scroll, but not the entire scroll. You may use one scroll to hold the text or form on which you are working, and the other to display your communications with the computer. That way, messages from the computer are not written over your text or form.

The bottom scroll is the *monitor.* (When the 4024 is first turned on, the monitor occupies the entire screen; there is no top scroll.) The monitor has two uses:

- The monitor displays conversations that you have with the 4024. For instance, whenever you type a command to the 4024, that command is displayed in the monitor. Similarly, if the 4024 does not understand the command, it displays an error message in the monitor. When you press SHIFT-STATUS or give a SYSTAT command, the status or SYSTAT message appears in the monitor.

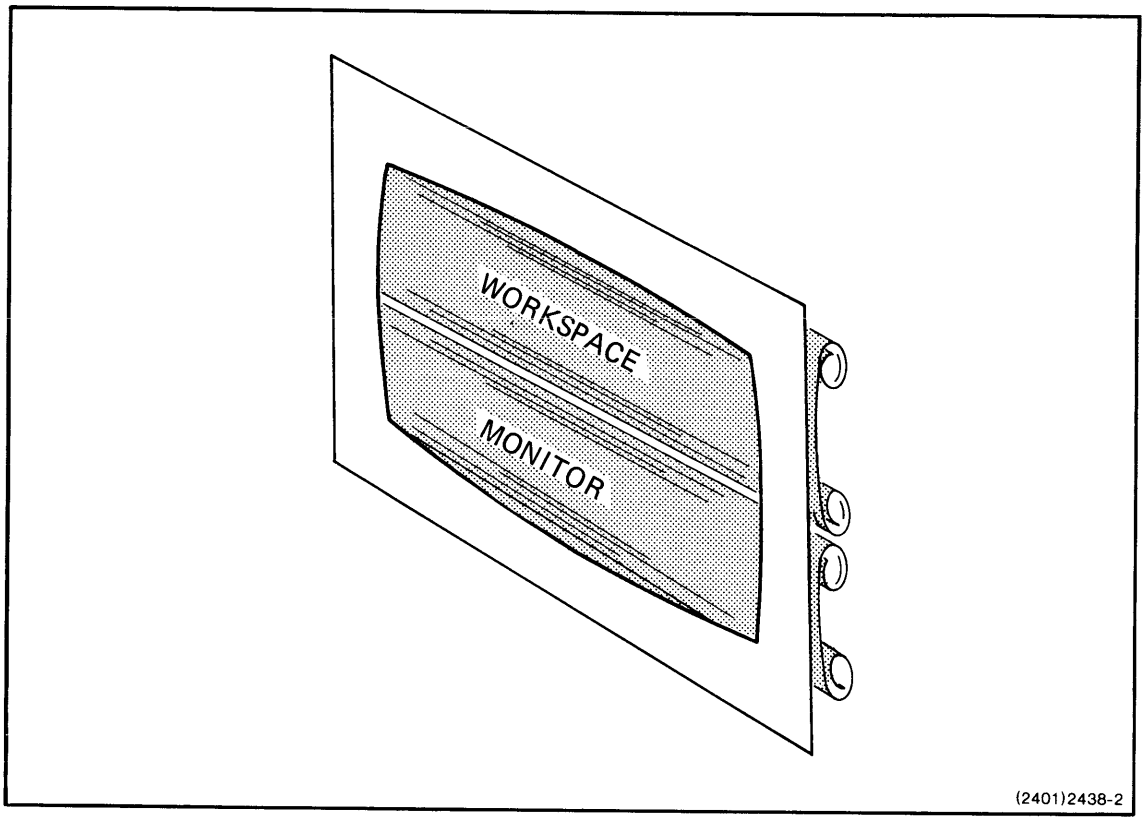


Fig. 3-2. The workspace and the monitor.

- You can use the monitor to display conversations between you and the host computer. When you use the 4024 this way, it behaves like an ordinary teletypewriter; the monitor scroll imitates the roll of paper on which a teletypewriter prints.

The top scroll is the *workspace.* The workspace has many features which the monitor lacks:

- Text typed into the workspace is not immediately sent to the computer, but instead is held until you command the 4024 to send that text. This allows you to edit the text (delete or add characters or lines to get it just right) before sending it on to the computer.

- In the workspace (but not the monitor), you can set right and left margins.

- The workspace can hold a form with blanks which either you or the computer can fill. With the 4024 operating in form fillout mode, you can send to the computer the contents of all the blanks in the form, or of only those blanks whose contents have been modified.

- In creating a form, you can make the 4024 emphasize certain parts of the text by *enhanced* backgrounds.

- If your 4024 has the optional rulings characters (Option 32), you can draw vertical and horizontal lines in the workspace to create forms.

Defining a Workspace

When the 4024 is first turned on, the monitor occupies the entire screen. Before you can use a workspace, you (or the computer) must create that workspace. This is called *defining a workspace,* and it is done with the WORKSPACE command or the MONITOR command.

When you define a workspace, you do two things:

- You cause the 4024 to separate its display memory into two parts: the workspace and monitor scrolls.

- You tell the 4024 the number of lines of the screen to use for displaying the workspace scroll, and the number of lines to use for the monitor scroll.

The 4024's screen can display 34 lines of text. In defining a workspace, you can either tell the 4024 how many lines to use for the workspace, or you can tell it how many to use for the monitor.

- You can use a WORKSPACE command to tell the 4024 how many lines of the screen to use for displaying the workspace. The 4024 will then use the remaining lines to display the monitor.

- You can use the MONITOR command to designate how many lines to use for displaying the monitor. The 4024 will then use the remaining lines to display the workspace.

CAUTION

Whenever a workspace is defined (or redefined), the contents of the monitor and the workspace (if already defined) are lost. Therefore, you should define a workspace only at the start of your work.

To create a workspace and reserve the top 30 lines of the screen for displaying it (leaving the bottom 4 lines for the monitor), type:

!WORKSPACE 30 <CR> or !WOR 30 <CR>

To reserve the bottom 5 lines of the display for the monitor and leave the remaining 29 lines above it for the workspace, type:

!MONITOR 5 <CR> or !MON 5 <CR>

The parameter in a WORKSPACE command may be any number from 0 to 33; in a MONITOR command, it may be any number from 1 to 34. (There are 34 lines in the display, at least one of which must be reserved for the monitor.)

Directing Text to the Workspace or the Monitor

Text entered from the keyboard can go to either the workspace or the monitor, as can text coming over the communications line from the host computer. Use the WORKSPACE and MONITOR commands to tell the 4024 where to put text coming from the keyboard or the computer.

Characters typed on the keyboard fall into two categories:

- **Conversational communications** between you and the 4024 are always displayed in the monitor. That is, when you type a command, the command appears in the monitor. Also, when you use the LEARN key, described later in this section, a *key definition* is displayed in the monitor.

- **Text** (everything but commands and key definitions) typed on the keyboard can go to either the workspace or the monitor. To send text from the keyboard to the workspace, type:

  !WOR <CR> or !WOR K <CR>

  (The "K" stands for "keyboard.")

  To send text from the keyboard to the monitor, type:

  !MON <CR> or !MON K <CR>

Characters coming over the communications line from the host computer also fall into two categories:

- **Commands** from the computer are executed, but not displayed.
- **Text** (everything but commands) from the computer can go to either the workspace or the monitor.

  To direct text from the computer to the workspace, type:

  !WORKSPACE H <CR> or !WOR H <CR>

  (The "H" stands for "host computer.")

To direct text from the computer to the monitor, type:

!MONITOR H <CR> or !MON H <CR>

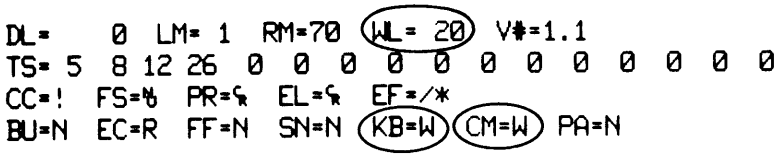
It is possible in one WORKSPACE or MONITOR command to define a workspace and direct text to it or to the monitor. For instance:

!WOR 15 H K <CR>

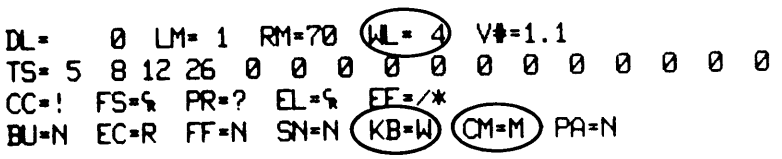
creates a workspace, allots the top 15 lines of the screen to it, and directs text from the computer and from the keyboard to that workspace.

Exercise

Type a WORKSPACE 20 H K command, and then examine the SYSTAT message. You should see "WL=20," "KB=W," and "CM=W."



Then type a MONITOR 30 H command, and examine the SYSTAT message again. You should have "WL=4". (With 30 lines taken for the monitor, only the top four lines of the screen will display the workspace.) The keyboard will still type into the workspace ("KB=W"), but the computer will now type into the monitor ("CM=M").



When the 4024 is first turned on, or when MASTER RESET is pressed, there is no workspace defined ("WL=0" in the SYSTAT message), and both computer and keyboard send text to the monitor ("KB=M", "CM=M").

Erasing the Workspace or the Monitor

One way to erase the contents of the workspace or the monitor is to press the ERASE key. Pressing this key erases the scroll (workspace or monitor) into which the keyboard is typing.

You can accomplish the same thing by typing:

!ERASE <CR> or !ERA <CR>

Suppose, however, that you are typing text into the workspace, but you want to erase the monitor rather than the workspace. To do this, designate the monitor in an ERASE command:

!ERASE MONITOR <CR> or !ERA M <CR>

Similarly, while typing into the monitor, you can erase the workspace by typing:

!ERASE WORKSPACE <CR> or !ERA W <CR>

Erasing the workspace or the monitor frees some of the 4024's memory for other uses.

NOTE

The ERASE key and the ERASE command erase the entire workspace or monitor, not just the part displayed on the screen.

Form Fillout Mode

The 4024 has a *form fillout* mode of operation. In this mode, the workspace holds a prepared form, and either you or the computer can fill in the *blanks* of the form. Ways of using form fillout mode are summarized here; look in Section 5 to learn how to create a form in the workspace.

To see whether the 4024 is in form fillout mode, examine the SYSTAT message (Fig. 3-3). Look for the "FF= " part of the message: "FF=Y" means the 4024 is in form fillout mode, and "FF=N" means it is not.

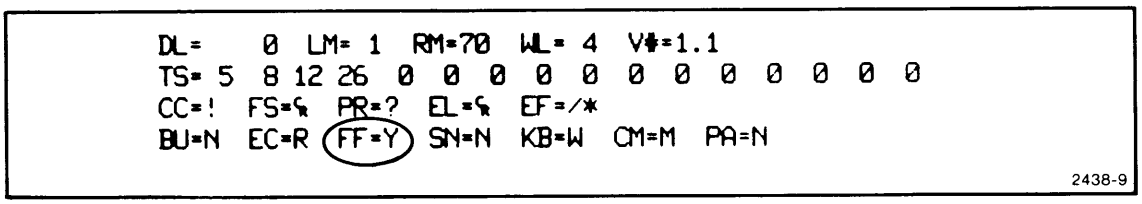


Fig. 3-3. SYSTAT indication of form-fillout mode.

These are the special features of form fillout mode:

- You can type only in the *blanks* of the form (the *unprotected fields*). If you try to type elsewhere, the bell sounds and the character typed is inserted in the next blank.
- The TAB key no longer moves the cursor to the next tab stop. Instead, it moves the cursor to the next blank of the form. Similarly, BK TAB moves the cursor back to the preceding blank.
- HOME moves the cursor to the start of the first blank, rather than to the start of the first line.
- ERASE doesn't erase the whole workspace, but just the data in the blanks of the form.
- Some of the blanks (the *numeric fields*) will accept numerals and special characters, but not letters of the alphabet.

Sending Workspace Contents to the Computer

The SEND command sends the workspace contents to the computer. This command takes two forms: SEND ALL and SEND MOD. (If you leave out the word ALL or MOD, the 4024 interprets the command as a SEND ALL command.) These commands perform differently when the 4024 is in form fillout mode than when it is not.

CAUTION

Use the SEND command (or the SEND key) only as required by the particular host computer program you are using.

When the 4024 is **not** in form fillout mode, the SEND ALL and SEND MOD commands are treated alike. Each of these commands sends the entire contents of the workspace to the computer.

In form fillout mode, the SEND ALL and SEND MOD commands behave as follows:

SEND ALL. The SEND ALL command sends the contents of all the blanks in the form.

SEND MOD. The SEND MOD command sends the contents of only those blanks whose contents have been modified.[1]

SYSTAT Fields Pertaining to the Split Screen

Fig. 3-4 illustrates the parts of the SYSTAT message which pertain to the workspace and the monitor. The SYSTAT message shows:

- The number of lines of the screen used to display the workspace.
- Whether the keyboard types into the workspace or the monitor.
- Whether text from the communications line is directed to the workspace or the monitor.

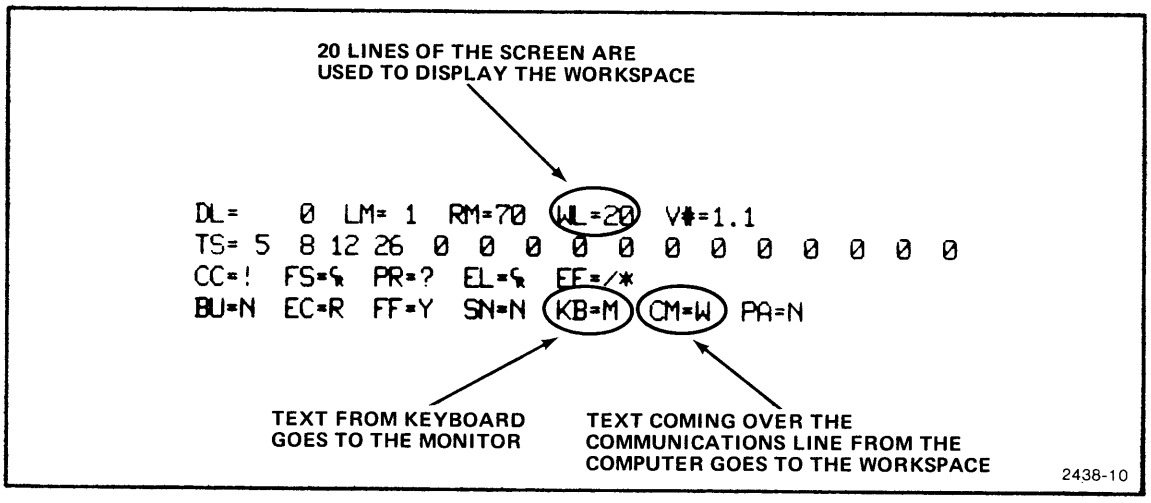


Fig. 3-4. Parts of the SYSTAT message pertaining to the workspace and the monitor.

[1] It is, however, possible to designate other parts of the form (*protected fields*) as "modified," so that they, too, will be sent each time a SEND MOD command is executed. This is described in Section 5.

MARGINS AND TAB STOPS

Either you or the computer can set margins and tab stops in the workspace, similar to the margins and tab stops in a typewriter. (Margins affect only the workspace; the monitor has no margins.) There are eighty character positions (columns) in each line, and you can set the margins at any of these. You can define up to 16 tab stops, putting them in any of the columns except column 1.

Margins

To set the margins at the extreme left and right edges of the screen, type this command:

!MARGINS <CR> or !MAR <CR>

To set the left margin at column 10 and the right margin at column 70, type this:

!MARGINS 10, 70 <CR> or !MAR 10, 70 <CR>

To change the setting of the left margin without disturbing the right margin, enter only one number in the command. For instance, to set the left margin at column 15 (leaving the right margin where it is) type:

!MARGINS 15 <CR>

You cannot type to the left of the left margin, but you can type beyond the right margin (right out to column 80). If you type in the column in which the right margin is set, the bell sounds. (However, if the margin is at column 80, the bell does not sound if you type there.)

The "LM" and "RM" parts of the SYSTAT message (Fig. 3-5) tell you the current settings of the left and right margins. It is wise to examine the SYSTAT message to check that you have set the margins correctly.

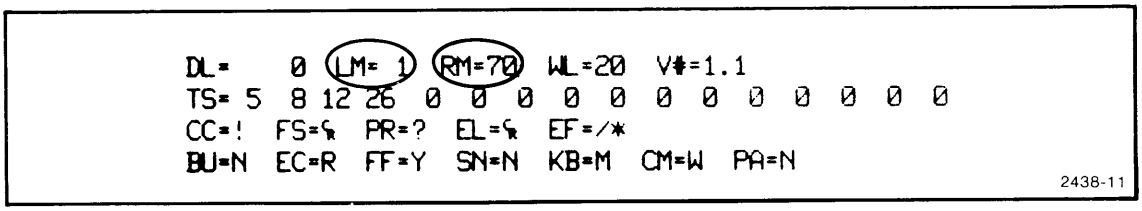


Fig. 3-5. SYSTAT indications of margin settings.

Tab Stops

The STOPS command sets the tab stops. For instance, to set tab stops in columns 10, 15, and 20, type:

!STOPS 10, 15, 20 <CR>

You may set up to 16 tab stops, in columns 2 to 80. When using the STOPS command, you should remember two things:

- You must list the column numbers in increasing order. For instance, you may type:

  !STOPS 10,15,20 <CR>,

  however, you should not type:

  !STOPS 15,10,20 <CR>

- Each time you use the STOPS command, you must list all columns where you want tab stops. If you leave any column numbers out, tab stops previously at those columns are deleted.

Fig. 3-6 shows how the SYSTAT message indicates where the tab stops are located. After setting the tab stops, it is wise to check the SYSTAT message to be sure that you have set them correctly.

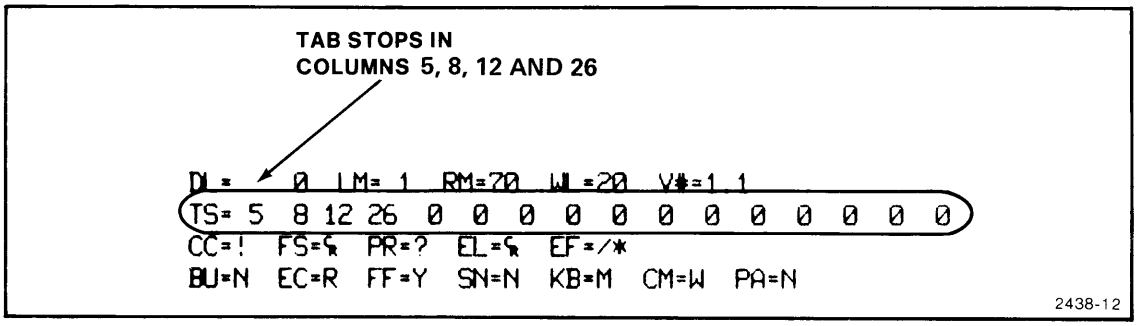


Fig. 3-6. SYSTAT indication of tab stops.

BUFFERED OPERATION

The 4024 has a *buffered* mode of operaton, in which it sends data to the computer only when the computer has requested that data.

To learn whether the 4024 is in buffered mode, press SHIFT-STATUS. The 4024 will display the status message (Fig. 3-7). The first character in this message is a B if the 4024 is in buffered mode, and a U if it is not.

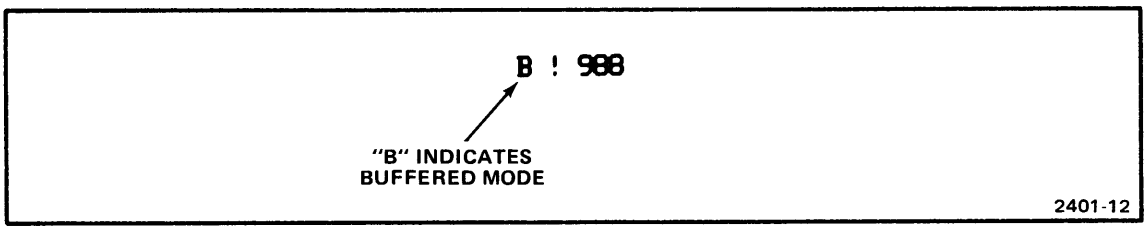


Fig. 3-7. Status message.

Sending Text from the Keyboard to the Computer

Buffered operation differs from unbuffered operation in the way that text typed into the monitor is sent to the computer. In unbuffered mode, as you type into the monitor, the 4024 sends each character on to the computer as soon as you type it. In buffered mode, on the other hand, the 4024 does not send the characters right away. Instead, it holds each line of text and sends that line to the computer only after (a) you press RETURN to mark the end of the line, and, moreover, (b) the computer has asked for that line to be sent.

Fig. 3-8 illustrates buffered operation. As you type into the monitor, you can change a line of text any time before pressing RETURN. When you press RETURN, the 4024 copies that line into a part of its memory called the *transmit buffer.* You can continue to type in lines of text. As you press RETURN at the end of each line, that line is copied into the transmit buffer, where it waits its turn to be sent to the computer.

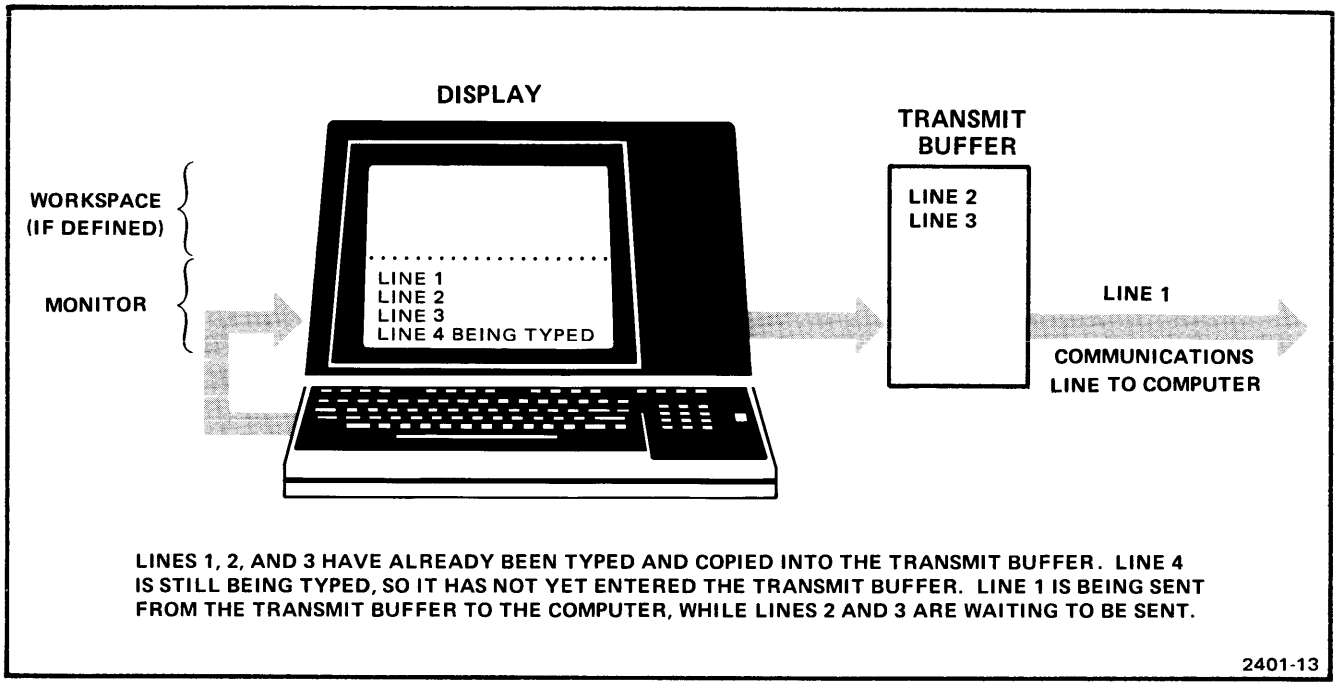


Fig. 3-8. Buffered operation

The 4024 sends lines of text from the transmit buffer one at a time, in order. If you type several lines of text, the computer must make several requests for data from the 4024. At each request, the 4024 sends one line of text.

CAUTION

The 4024 will not go on to its next task (such as executing a command typed on the keyboard) until it has finished sending the contents of its transmit buffer. If the computer does not send the necessary prompts, the 4024 cannot go on to the next task.

If this happens, press BREAK twice in quick succession. This removes the 4024 from buffered mode and sends a break signal to interrupt the host computer.

If you encounter this problem, consult your computer systems analyst; there may be a fault in the computer's program.

Sending the Workspace Contents

Suppose the 4024 is in buffered mode, and you want to send the workspace contents to the computer. To do this, give a SEND ALL or SEND MOD command, either by typing the command, or by pressing the SEND key. (The SEND key must first be programmed to give the SEND ALL or SEND MOD command. This may be done by the computer or by means of the LEARN key, described later in this section.)

When the 4024 executes the SEND command, it copies the contents of the workspace into its transmit buffer and waits for the computer to request that each line be sent. When the computer has requested and received each line from the transmit buffer, the 4024 is ready for the next task.

Entering Buffered Mode

When you first turn on the 4024, it powers up in unbuffered mode. To put it in buffered mode, type the BUFFERED or BUFFERED YES command. For instance, if the command character is the exclamation point (!), you would type:

!BUFFERED <CR> or !BUF <CR> or !BUF Y <CR>

Leaving Buffered Mode

There are three ways to remove the 4024 from buffered mode:

- The normal way to remove the 4024 from buffered mode is with the BUFFERED NO command. That is, to remove the 4024 from buffered mode, type:

  !BUFFERED NO <CR> or !BUF N <CR>

  When the 4024 has emptied its transmit buffer, it will execute the BUFFERED NO command and revert to unbuffered mode.

- Another way to exit buffered mode is to press the BREAK key twice in quick succesion. (In addition to removing the 4024 from buffered mode, this sends a *break* signal to interrupt the computer.) You would use this method if the 4024 were not responding to commands because the host was not sending prompts. (Without the prompts, the 4024 could not empty its transmit buffer and go on to the next command.)

- Since the 4024 powers up in unbuffered mode, you can remove it from buffered mode by turning the power off and then on again, or by pressing MASTER RESET. This method is not recommended, as it destroys any text in the 4024's memory and may reset some of its settings.

USING THE LEARN KEY

You can assign a new meaning to almost any key on the keyboard. Defining a new meaning for a key is called *programming* that key, and it is done with the LEARN key. (The LEARN key is the shifted version of the NUMERIC LOCK function key.)

NOTE

Anything the LEARN key can do can also be done by the computer with the LEARN command (described in the Programmer's Reference Manual). Since the computer ordinarily programs the function keys, you normally need not use the LEARN key.

Unless you need to program a key, you do not have to read the following explanation of the LEARN key.

Programming a Key

To program a key:

1. Press SHIFT-LEARN.
2. Press the key you want to program.
3. Press, in order, the keys whose meanings you want to assign to the key being programmed.
4. Press SHIFT-LEARN again.

As you program a key, the 4024 displays in the monitor the meaning (*key definition*) you are assigning to that key. Fig. 3-9 illustrates what would appear in the monitor if you assigned the meaning "This is a test" to the "{" key.

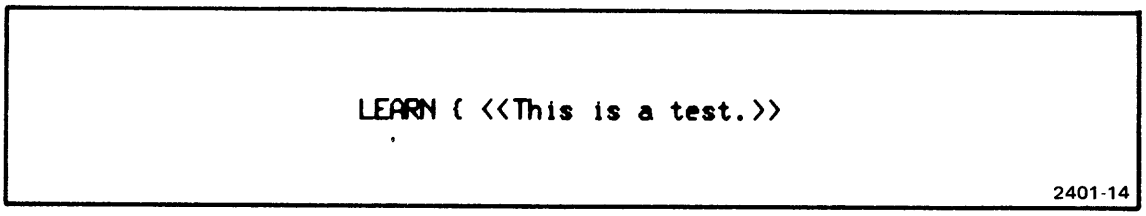


Fig. 3-9. Key definition displayed in the monitor.

Exercise

Program the "{" key to mean, "This is a test." That is, press SHIFT-LEARN and type "{"; then type "T","h","i", etc., to spell "This is a test." Finally, press SHIFT-LEARN again.

As you do this, notice the message that appears in the monitor. First, as you press SHIFT-LEARN, the word LEARN appears. Then, as you press the key being programmed, the character for that key appears. (If the key has no ASCII character, a "blotch" - the "rubout" symbol - appears instead.) After displaying the character (or "blotch") for the key being programmed, the display shows two left angle brackets (<<). Next, as you press the keys whose meanings you are giving the key being programmed, the characters for those keys appear. Finally, as you press SHIFT-LEARN again, two right angle brackets (>>) appear.

Check to be sure that text from the keyboard is directed to the workspace. (The cursor should be in the top part of the screen - the workspace - and the SYSTAT message should show "KB-W.") Now press the "{" key; you should see the message, "This is a test."

The shifted and unshifted versions of each key are programmed independently. For instance, when you programmed "{", you did not change the meaning of "[".

Every key that you press while programming a key will be interpreted as part of the key definition. Thus, you cannot use the cursor movement keys or editing keys in the usual way. If you make a mistake while programming a key, terminate the programming by pressing SHIFT-LEARN. Then start over again.

During a key definition you can press keys such as RETURN or LF if you wish; the corresponding ASCII characters will become part of the key definition. In fact, you can include any ASCII character in a key definition. (The control characters are represented in the monitor by two-letter mnemonics, such as CR for *carriage return.*) You can also incorporate function keys or cursor control keys in a key definition. These have no corresponding ASCII characters, so they are represented by "blotches" in the display.

NOTE

If your 4024 has the rulings character set (Option 32) installed, either rulings characters or "snoopy" characters (two-letter mnemonics for the ASCII control characters) may be displayed, depending on the setting of an internal strap. If the strap is set for "rulings" characters, each of the control characters will be represented by a corresponding ruling character, rather than by a two-letter mnemonic.

Thus, when programming a key, you might see this:

LEARN % <<!HCO W>>

Instead of this:

LEARN % <<!HCO W>>

Table B-2 in Appendix B lists the ASCII control characters, with their two-letter mnemonics and corresponding "rulings" characters.

The only keys you can't program, and can't incorporate into the programming of other keys, are:

- The three lighted function keys, TTY LOCK, NUMERIC LOCK/LEARN, and COMMAND LOCKOUT/STATUS.
- CTRL, SHIFT, and BREAK.

Making the 4024 "Forget" a Key Definition

To restore a key to its original meaning:

1. Press SHIFT-LEARN.
2. Press the key you wish to restore to its original meaning.
3. Press SHIFT-LEARN again.

Exercise

Restore the "{" key to its original meaning. When you have done so, press "{" to check that it no longer means "This is a test."

The CLEAR Command

You can restore all the keys of the keyboard to their ordinary meanings by typing the CLEAR command. For instance, if the command character were the exclamation point, you would type:

!CLEAR <CR> or !CLE <CR>

NOTE

The CLEAR command clears all the function keys; after a CLEAR command you must re-program any keys (such as the SEND key) whose programmed meanings you want to keep.

SELECTING THE COMMAND CHARACTER

When you apply power, or press MASTER RESET, the 4024 automatically sets its command character to be the exclamation point (!). However, you (or the computer) can choose another command character by means of the COMMAND command. For instance:

!COMMAND <CR> or !COM <CR>

changes the command character from "!" to " ".

To set the command character to one of the non-printing ASCII control characters, use the ASCII decimal equivalent for that character in the command. (Table B-1 in Appendix B gives ASCII decimal equivalents for all the ASCII characters.) For instance, the ASCII decimal equivalent for the *shift out* control character is 14, so

!COM 14 <CR>

changes the command character from "!" to *shift out.*

CAUTION

When using the ASCII decimal equivalent to specify a control character in the COMMAND command, you must type the ASCII decimal equivalent as a two- or three-digit numeral. (A one-digit numeral is not interpreted as an ASCII decimal equivalent, but as a character itself.)

For instance, !COM 02 sets the command character to the start of heading *character, whose ASCII decimal equivalent is 2; but !COM 2 sets the command character to the digit "2".*

SETTING THE COMMUNICATIONS PARAMETERS

To communicate successfully with the host computer, certain 4024 settings must agree with what the computer expects. For instance, if the 4024 sends *carriage return* at the end of each line of text, and the computer expects to receive the ASCII *record separator* control character instead, the computer may not understand what the 4024 is saying.

The communications parameters which must be set correctly are:

- Transmit and receive baud rates.
- Parity.
- Remote or local echo.
- End-of-line string.
- Prompt string.

With these five parameters set correctly, it should be possible to log in on a computer system. Once you have logged in, each application program that you run on the computer will set the 4024's other settings as needed.

Baud Rates

The transmit and receive baud rates are the speeds at which the 4024 sends and receives characters from the computer. These speeds are set internally when the 4024 is installed; it should not normally be necessary to change them.

Parity

The *parity* setting determines how the 4024 treats the eighth bit (*parity bit*) in each ASCII character. There are four possible parity settings: "even," "odd," "none," and "data." If the host computer uses the parity bit, then the 4024's parity setting must correspond with that of the computer. (If the computer uses even parity, so must the 4024.) You can learn the 4024's parity setting from the "PA=" part of the SYSTAT message.

Exercise

Type the SYSTAT command, and examine the SYSTAT message. On power-up, or after pressing MASTER RESET, the parity setting will be "PA-N," which means that no parity checking is being done. Consult your computer systems analyst to learn what the proper parity setting should be ("even," "odd," "none," or "data"). Record this setting for future reference in the table on the last page of this manual.

If the proper parity setting is other than N (for "none"), you will have to set the parity each time you turn on the 4024 or press MASTER RESET. To set the 4024 for **even** parity, type:

!PARITY E <CR>

To set it for **odd** parity, type:

!PARITY O <CR>

To set parity to **none,** type:

!PARITY N <CR>

To set parity to **data,** type:

!PARITY D <CR>

Echo

When you are typing directly to the computer (typing into the monitor in unbuffered mode), there are two ways that the characters you type may be displayed on the screen: *remote echo* and *local echo.* (In buffered mode, characters typed are always displayed locally, as if you had selected local echo.)

In *remote echo* data communications, characters typed into the monitor are sent to the computer without first being displayed. As the computer receives each character, it "echos" it back to the 4024. It is the received echo, rather than the original transmitted character, that the 4024 displays on its screen. This has the following advantages:

- As you type each character into the monitor, you can tell immediately whether the computer has received the character correctly.
- *Selective echo* is possible, because the computer can be programmed to decide which characters to echo. For instance, in time sharing systems, the computer usually does not echo the password typed when logging in.

In **local echo** data communications, as you type each character into the monitor, the 4024 supplies the echo within itself. That is, it displays each character sent to the computer without waiting for the computer to echo the character back to the 4024.

The ECHO command is used to choose between remote echo and local echo data communications. To choose remote echo, type:

!ECHO REMOTE <CR> or !ECH R <CR>

To choose local echo, type:

!ECHO LOCAL <CR> or !ECH L <CR>

After typing an ECHO command, check the SYSTAT message to be sure that you have set the echo parameter correctly. Look for the "EC=" part of the SYSTAT message "EC=R" means "remote echo," and "EC=L" means "local echo."

End-of-Line String

The 4024 sends the computer an *end-of-line* string at the end of each line of text. For instance, when you are typing directly to the computer (that is, with the keyboard typing into the monitor), the 4024 sends the end-of-line string whenever you press RETURN. Similarly, when sending the workspace contents to the computer, the 4024 inserts an end-of-line string at the end of each line of text.

Some computers may expect to receive *carriage return* (<CR>) at the end of each line, while others may require *carriage return, line feed,* (<CR>,<LF>) or some other string of characters. For this reason, the 4024 has an EOL command for setting the end-of-line string as required.

You can learn the current end-of-line string by examining the "EL=" part of the SYSTAT message (Fig. 3-10). Usually the end-of-line string does not include ordinary letters of the alphabet, but instead consists of one or more non-printing ASCII control characters. These control characters are represented by two-letter mnemonics in the SYSTAT message. You can learn the meanings of these mnemonics by consulting Table B-2 in Appendix B.

NOTE

If your 4024 has the rulings character set (Option 32) installed, "rulings" characters may appear in the SYSTAT message instead of the two-letter mnemonics which represent the control characters. That is, you may see:

```
DL=    0  LM= 1  RM=70  WL=20  V#=1.1
TS= 5  8 12 26  0  0  0  0  0  0  0  0  0  0  0  0
CC=!  FS=#  PR=?  EL=#  EF=/*
BU=N  EC=R  FF=N  SN=N  KB=M  CM=W  PA=N
```

Instead of:

```
DL=    0  LM= 1  RM=70  WL=20  V#=1.1
TS= 5  8 12 26  0  0  0  0  0  0  0  0  0  0  0  0
CC=!  FS=↖  PR=?  EL=↖  EF=/*
BU=N  EC=R  FF=Y  SN=N  KB=M  CM=W  PA=N
```

Table B-2 in Appendix B lists the ASCII control characters, with their representations both as two-letter mnemonics and as "rulings" characters.

```
DL=    0  LM= 1  RM=70  WL=20  V#=1.1
TS= 5  8 12 26  0  0  0  0  0  0  0  0  0  0  0  0
CC=!  FS=↖  PR=?  EL=↖  EF=/*
BU=N  EC=R  FF=Y  SN=N  KB=M  CM=W  PA=N
```

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Fig. 3-10. SYSTAT indication of end-of-line string.

Exercise

Type the SYSTAT command, and examine the SYSTAT message. On power-up, or after pressing MASTER RESET, the end-of-line string will be set to "carriage return," indicated by either the two-letter mnemonic "CR" (if Option 32 is not installed) or the rulings charcter "intersection of two double lines" (if Option 32 is installed).

Your computer systems analyst can tell you if your computer requires a different end-of-line string than "carriage return." If it does, you should record that end-of-line string for future reference in the table on the last page of this manual; each time you turn on the 4024, or press the MASTER RESET, you should refer to that table and set the end-of-line string to its proper value.

To set the end-of-line string, use the EOL command. The Programmer's Reference Manual describes several forms this command may take. One way to give the EOL command is to list (as parameters in the command) the ASCII decimal equivalents of the characters which are to make up the end-of-line string.

Appendix B lists the ASCII decimal equivalents for all the characters of the ASCII code. For instance, the ASCII decimal equivalents for *carriage return* and *line feed* are 13 and 10, respectively. Thus, to set the end-of-line string to *carriage return, line feed,* you would type:

!EOL 13,10 <CR>

Similarly, to set the end-of-line string to be just *carriage return,* you could type:

!EOL 13 <CR>

If you omit the ASCII decimal equivalent in the EOL command, the 4024 sets the end-of-line string to *carriage return.* Thus,

!EOL <CR> and !EOL 13 <CR>

have the same effect.

After setting the end-of-line string, you should examine the SYSTAT message to be sure that you have set it correctly.

End-of-File String

If Option 32 (RS-232 Peripheral Interface) is installed, the 4024 uses an *end-of-file string* when copying text from the host computer onto a 4642 Printer. (The host appends the end-of-file string at the end of the text, to signal the 4024 to stop copying.)

The EOF command sets the end-of-file string. This command is like the EOL command; you can specify any string of up to ten characters by listing the ASCII decimal equivalents for those characters. For instance, to set the 4024 to recognize "backspace, backspace, bell" as the end-of-file string, you could type:

!EOF 8, 8, 7 <CR>

(Here, "8" is the ASCII decimal equivalent of "backspace," and "7" is the ASCII decimal equivalent of "bell." See Table B-1, Appendix B, to find the decimal equivalent of any ASCII character.)

For end-of-file strings that do not include non-printing control characters, there are other ways to type the EOF command. These are described in the Programmer's Reference Manual.

On power-up, or when MASTER RESET is pressed, the end-of-file string is "fraction bar, asterisk" (/*). An EOF command with no parameters resets the end-of-file string to "/*".

Prompt String

If you use the 4024 in buffered mode, you should be sure that the 4024 and the computer agree on what characters comprise the *prompt string.* (The prompt string is the character or characters which the computer sends the 4024 when it is ready for the 4024 to send it another line of text.)

You can specify any prompt string (up to 10 characters) by naming the ASCII decimal equivalents of those characters in the PROMPT command. (See Appendix B.) For instance, the ASCII decimal equivalents for *ampersand* and *line feed* are 38 and 10. To set the prompt string to *ampersand, line feed,* type:

!PROMPT 38,10 <CR> or !PRO 38,10 <CR>

After setting the prompt string, you should check it by examining the "PR=" part of the SYSTAT message. The non-printing ASCII characters are represented in the SYSTAT message by two-letter mnemonics; the meanings of these mnemonics are given in Table B-2 of Appenidix B.

Information on other forms of the PROMPT command can be found in the Programmer's Reference Manual.

COPYING ON A PRINTER

If your 4024 is equipped with Option 3 (RS-232 Peripheral Interface), you can print the contents of the workspace on a TEKTRONIX 4642 Printer. Also, you can have the 4642 print text coming from the host computer.

To print the workspace contents on the 4642, check that the printer's SELECT light is on, and type this command:

!COPY W P <CR> or !COP W P <CR>

(If the 4642's SELECT light is off, press the SELECT key just below it to turn the light on.)

In the COPY command, W stands for workspace, and P for printer. The command tells the 4024 to copy the contents of the workspace onto the printer.

To direct text coming from the host computer to the 4642 Printer, type this command:

!COPY H P <CR> or !COP H P <CR>

(The H stands for "host computer", this command tells the 4024 to copy text from the host computer onto the printer.)

The 4024 will continue to copy data from the host computer onto the printer until one of three things happens:

- The computer sends an *end-of-file string* to tell the 4024 to stop copying. (See the Programmer's Reference Manual for information on end-of-file strings.)
- The 4024, in buffered mode, receives a prompt string from the computer.
- You type on the keyboard with the 4024 in unbuffered mode.

Section 4

OPERATING CONSIDERATIONS

This section describes operating considerations. Topics included are:

- Things to do when you turn the 4024 on.
- Using the workspace and the monitor.
- What to do . . .
  - If you get a RAM ERROR message.
  - If the characters you type are not displayed properly.
  - If the 4024 does not respond to commands typed on its keyboard.
  - In case of difficulty.

But first, a word of caution:

CAUTION

Do not place papers, books, etc. on the 4024's cabinet. Be especially careful not to cover the slits in the cabinet cover. These slits are needed to ventilate the 4024's internal components.

WHEN YOU TURN THE POWER ON

When you turn on the 4024, or when you begin working with it, you should familiarize yourself with its current settings.

1. Press SHIFT-STATUS to examine the status message. Check to see what the command character is.

2. Type a SYSTAT command to examine the SYSTAT message. Look especially for these things:

   - Whether a workspace is defined. ("WL=0" if there is no workspace.)

   - Whether text from the keyboard is directed to the workspace ("KB=W") or to the monitor ("KB=M").

   - Whether text from the computer is directed to the workspace ("CM=W") or to the monitor ("CM=M")

   You should also check that the 4024 is correctly set for talking to the computer. Check these parts of the SYSTAT message:

   - The parity ("PA=") setting.

   - Whether the echo is remote ("EC=R") or local ("EC=L").

   - Whether the prompt string and end-of-line string are their usual values. (The "PR" and "EL" settings.)

At the rear of this manual is a table for recording the most important SYSTAT settings for future reference.

If a RAM ERROR message is displayed when you turn on the power (or press MASTER RESET), refer to "If You get a RAM ERROR Message," later in this section.

USING THE WORKSPACE AND THE MONITOR

The workspace and the monitor each have specific uses. Don't use the workspace to do things for which the monitor is designed, or vice versa.

Use the **monitor** to display general conversations with a computer time-sharing system. For instance, when you first dial up a computer and "log in," you should direct text from both the keyboard and the computer to the monitor.

Use the **workspace** only to hold the particular text or form on which you are working. Don't use it to display general conversation with the computer; this will quickly exhaust the 4024's memory.

If you are filling out a form, the form will be in the workspace, so text from the keyboard should be directed to the workspace. If the computer is filling in some of the blanks in the form, text from the computer should be directed to the workspace. Should the computer send an error message, it will first send the MONITOR H command so that the error message is displayed in the monitor and does not overprint text in the workspace.

You can use the workspace to hold text which you are editing before sending it to the computer. However, if the text is lengthy, the 4024 may run out of memory. If this happens, the text you type will overprint the last line of the workspace.

WHAT TO DO . . .

If You Get a RAM ERROR Message

When you turn on the 4024, or press MASTER RESET, the 4024 checks its memory before displaying the cursor. If all is well, only the cursor will appear. However, if the check discloses a memory error, the RAM ERROR message will appear. This indicates a malfunction; call your Tektronix Service Center to have the 4024 repaired.

If the Characters You Type Are Not Displayed Properly

If the characters you type are not displayed properly, you should examine the SYSTAT message. Check the echo setting and look to see where text from the keyboard and the computer is sent.

Displayed Not At All

If you are typing into the monitor rather than the workspace, it is possible that the characters you type may not be displayed. This is probably because neither the 4024 nor the computer is providing the necessary echo of each character typed. The following are possiblilities:

- You may not be connected to the computer. (You may have forgotten to dial its telephone number, or the telephone connection may be faulty.)
- The computer may not be set to echo the characters you type. In that case, you should type a command to the computer, telling it to provide this echo.
- Your computer installation may expect the 4024, rather than the computer, to provide the echo - and the 4024 is set for remote echo rather than local echo. If this is the case, type an ECHO L command on the 4024's keyboard:

!ECHO L <CR>

Displayed Twice

If both the 4024 and the computer are providing echoes, the letters you type will appear twice on the screen. To remedy this, set the 4024 for remote echo, as follows:

!ECHO R <CR>

Displayed in the Workspace when Typing into the Monitor

If the computer is providing a "remote echo" for the characters you type, it is possible for these characters to appear in the workspace, even if you are typing into the monitor. Examine the SYSTAT message, and see if the following is the case:

- Text from the keyboard is directed to the monitor ("KB=M").
- Text coming over the communications line from the computer is directed to the workspace ("CM=W").
- The 4024 is set for "remote echo" ("EC=R").

If this is the case, then each character that you type into the monitor is sent to the computer, which echoes it - sends it back for display on the screen. The echoed

character, coming from the computer rather than the keyboard is displayed in the workspace. To display the echoed characters in the monitor, type:

!MON H <CR>

This causes text from the computer to be directed to the monitor.

If the 4024 Does Not Respond to Commands

If the 4024 does not respond to commands, check the following things:

1. Look to see if the COMMAND LOCKOUT light is on. If it is, press the COMMAND LOCKOUT key to turn it off.

2. Press SHIFT-STATUS, and examine the status message:

   - Is the command character what it should be? If you type commands using the exclamation point (!) when the command character is the ampersand (&), the 4024 will not understand the commands. If the 4024 is set to the wrong command character, use the COMMAND command to set it back. For instance, if the command character is the exclamtion point, you can change it to the ampersand by typing this:

     !COMMAND & <CR>

   - Is the 4024 in buffered mode? (If it is, the first letter of the status message will be B instead of U.) In buffered mode, the 4024 cannot execute commands until it has emptied its transmit buffer - and it cannot empty the transmit buffer until it receives the necessary prompts from the computer.

     You can break the 4024 out of buffered mode, so that it will respond to commands, by pressing the BREAK key twice in quick succession. (This also sends a "break" signal to interrupt the computer.)

In Case Of Difficulty

If the 4024 has its settings set differently than you think, you can easily become confused. In case of difficulty, then, the first thing you should do is press SHIFT-STATUS and examine the status message. Then, knowing the command character, type the SYSTAT command and examine the SYSTAT message. Often this message will give you a clue as to what is happening, since it displays almost all the 4024's settings.

If the difficulty persists, consult your computer systems analyst. Make a note for the analyst of what you were doing when the problem occurred, what the SYSTAT settings were, and which keyboard lights were on.

Section 5

CREATING FORMS

This section describes how to create a *form* in the workspace, with *blanks* that either you or the computer can fill in. Topics included are:

- General overview: form fillout mode, creating a form.
- Basic concepts: lines and fields, the display list, attribute codes.
- The ATTRIBUTE command: how it affects the display list.
- Visual attributes: standard and enhanced backgrounds, blinking between standard and enhanced.
- Logical attributes: *protected* and *unprotected* fields, and the *alphanumeric* and *numeric* types of unprotected fields.
- Rulings: drawing vertical and horizontal lines on a form.

GENERAL OVERVIEW

Creating a form consists of attaching properties, or *attributes* to parts of the workspace. The process is as follows:

1. With the 4024 not in form fillout mode, use the ATTRIBUTE command to create the form. (The ATTRIBUTE command is described later in this section.)
2. By means of a FORM or FORM YES command, put the 4024 into form fillout mode.

Once you have created the form, you can use it: fill in the blanks, send the contents of the blanks to the computer, etc. The special properties of forms, and of form fillout mode, are described in Section 3, under "Form Fillout Mode."

When done using the form, you would usually:

1. Remove the 4024 from form fillout mode with a FORM NO command.
2. Erase the workspace and use it for something else.

NOTE

The ATTRIBUTE command, used to create forms, has no effect when the 4024 is in form fillout mode. Therefore, one must always create a form with the 4024 not in form fillout mode, and then put it into form fillout mode with a FORM or FORM YES command.

Also, in form fillout mode, certain parts of the form are protected from being erased or written over. Therefore, in order to erase a form, one must always remove the 4024 from form fillout mode.

BASIC CONCEPTS

Lines and Fields

Figure 5-1 shows the parts of a typical form. A form consists of several *lines* of text in the workspace. Each line consists of one or more *fields,* which are subdivided into the individual characters of text.

The Display List and Attribute Codes

To display text in the workspace, the 4024 must store that text in a part of its memory reserved for the workspace scroll. This part of memory is called the workspace's *display list.* In addition to characters actually displayed on the screen, the display list includes markers which are not displayed. These markers are of two types:

- Markers indicating where one line of text ends and the next begins.

  Markers, called *attribute codes,* that divide a line into fields and determine the properties (*attributes*) of those fields.

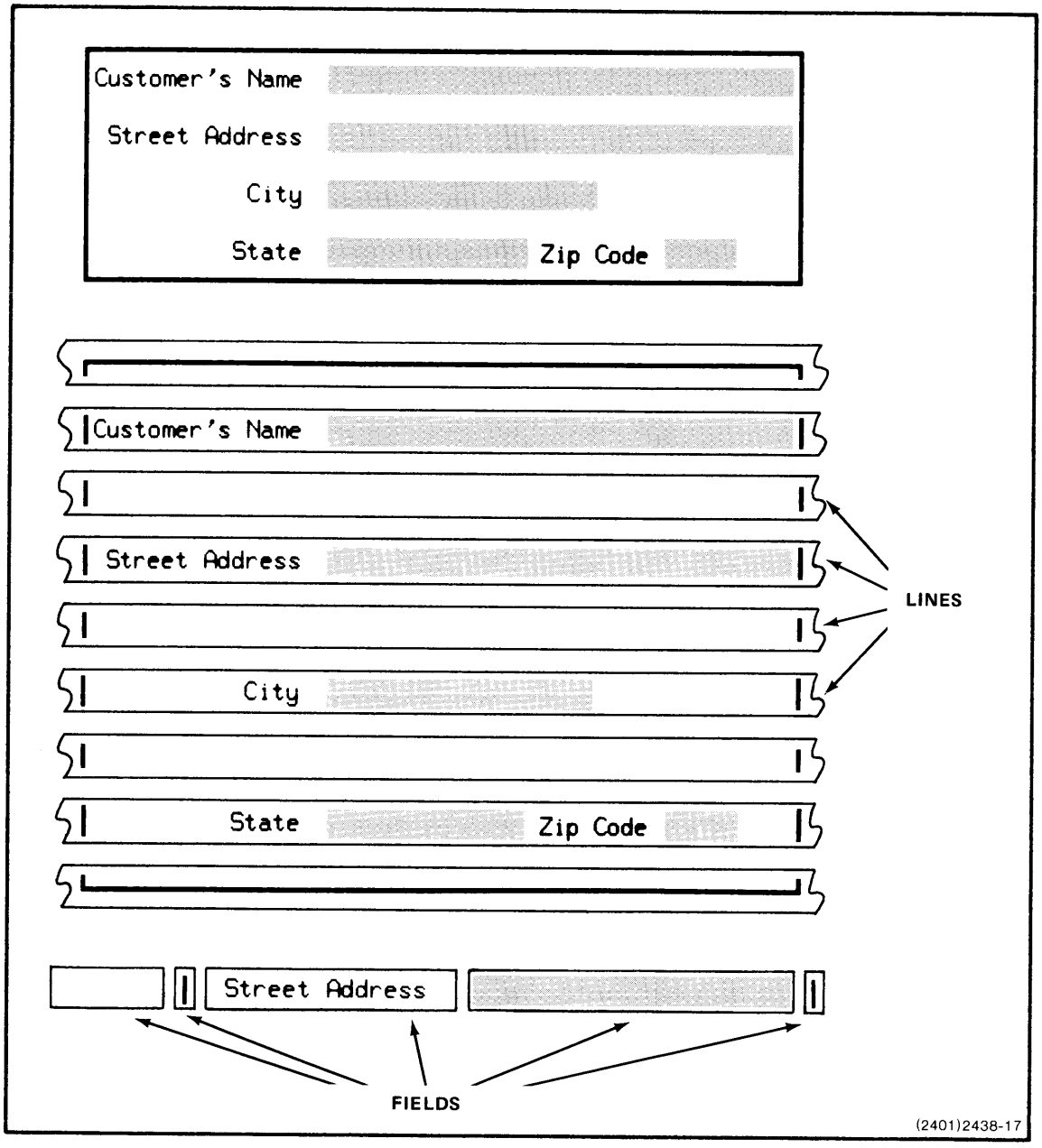


Fig. 5-1. The parts of a typical form.

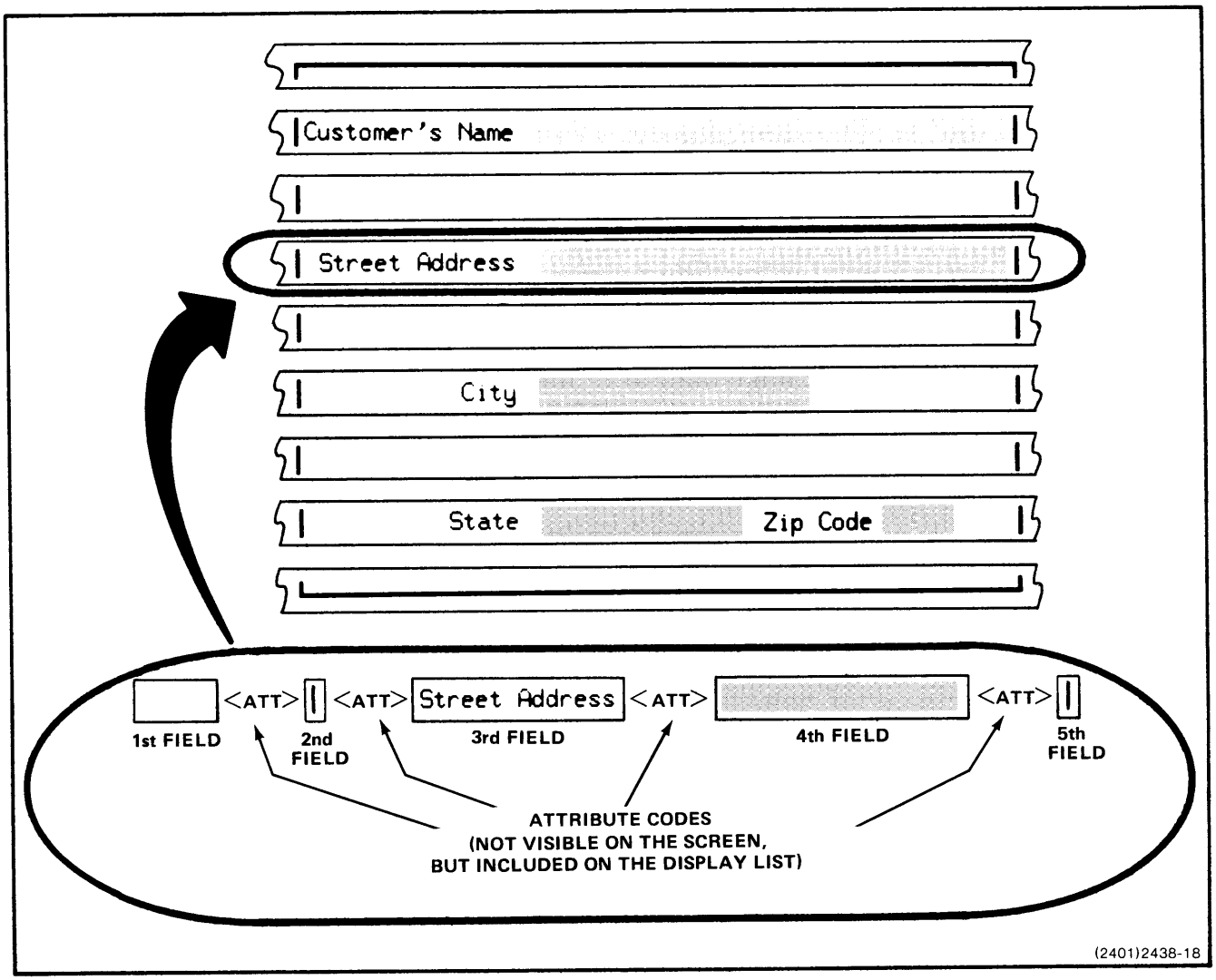


Fig. 5-2. Position of attribute codes in a display list.

Field attributes are of three types:

- Visual attributes: *standard,* and *enhanced.*
- Logical attributes: *alphanumeric, numeric,* and *protected.*
- Character font attributes: *font zero* or *font one.* (Font zero is the standard character set, and font one the rulings characters, described later in this section.)

The 4024 scans the display list from left to right across each line. When it encounters an attribute code, it starts a new field. It may also change one or more of the attributes in effect, as called for by that attribute code. Each line starts with the *default* attributes: *standard* visual attribute, *alphanumeric* logical attribute, and *font zero* character font attribute.

If an attribute code specifies a visual attribute, the fields to its right will have that visual attribute until another attribute code changes the visual attribute in effect. However, the logical and character font attributes do not change unless the attribute code also specifies new logical or character font attributes.

Similarly, the logical attribute may change without affecting the visual or character font attributes, and a character font attribute may change without affecting visual or logical attributes.

Figure 5-3 illustrates the process. As the 4024 scans the display list, it begins the line with the default attributes. The first attribute code changes the visual attribute to *enhanced,* but does not affect the logical or character font attributes. The second attribute code changes the visual attribute back to *standard,* and the logical attribute to *protected.*

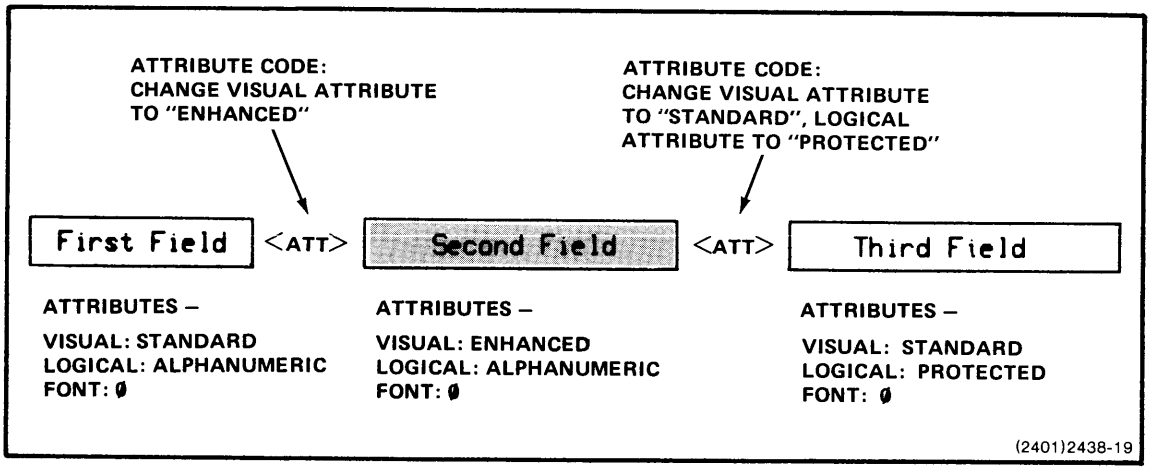


Fig. 5-3. Effect of field attribute codes

The ATTRIBUTE Command

Earlier in this section, we stated that creating a form consists of attaching attributes to parts of the workspace. This may now be restated with more precision: We create forms by using the ATTRIBUTE command to insert field attribute codes into the display list.

To see how the ATTRIBUTE command works, do the following exercise:

Exercise

1. **First, define a workspace, if one is not already defined. (See "Defining a Workspace" in Section 3.) Direct the keyboard to type into that workspace. (See "Directing Text to the Workspace or the Monitor," in Section 3.)**
2. **Erase the workspace, and type a few words of text.**
3. **Type the ATTRIBUTE E command.**

   !ATTRIBUTE E <CR> or !ATT E <CR>

4. **Type a few more words of text. These will be displayed with the "enhanced" background.**
5. **Type the !ATTRIBUTE S command.**

   !ATTRIBUTE S <CR> or !ATT S <CR>

6. **Type a few more words on the same line. These will be displayed with the "standard" background.**

NOTE

For the 4024 to insert attribute codes correctly, you must type the ATTRIBUTE commands as you come to the appropriate points in the text while typing that text. You may not, for instance, first type text into the workspace and then later insert attribute codes in the midst of the text.

Syntax

Figure 5-4 illustrates the format, or *syntax*, of the ATTRIBUTE command.

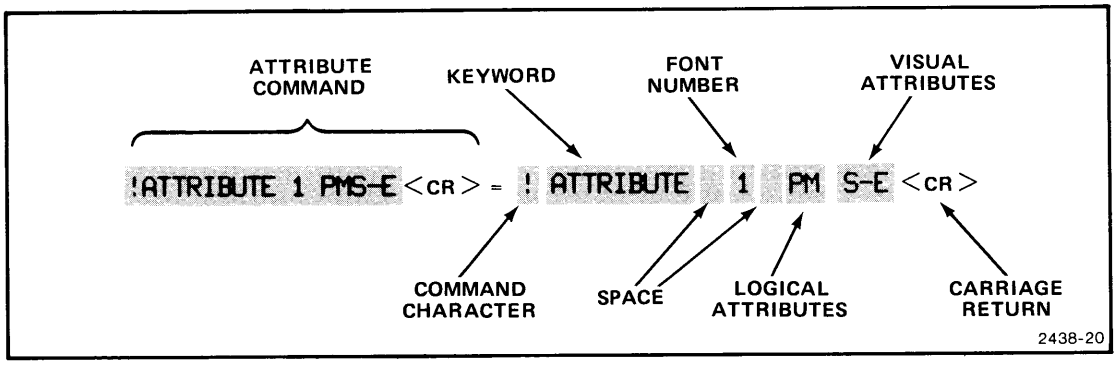


Fig. 5-4. Parts of the ATTRIBUTE command.

There are eight possible parts to an ATTRIBUTE command, some of which are optional:

- The command character (required).
- Immediately after the command character, the word ATTRIBUTE (required). It may be abbreviated to its first three letters. No spaces are allowed between the command character and the keyword.
- A space (required) to separate the keyword from the parameters to follow.
- A number (optional) to designate which character font is to be used in the field to follow. (This will be discussed later, under "Rulings.")
- A space (optional) to separate the number designating the character font from the parameters to follow.
- One or more letters (optional) to designate logical attributes.
- One or more letters (optional) to designate visual attributes. No spaces are allowed between the characters designating logical and visual attributes.
- A carriage return to mark the end of the command. (A *terminator* to end the command is required; carriage return is one such terminator. The Programmer's Reference Manual describes other possible terminators.)

Now that the general syntax of the ATTRIBUTE command has been discussed, we'll examine the visual, logical, and character font attributes in more detail.

VISUAL ATTRIBUTES

A field's visual attributes determine how it is displayed on the screen. There are two possible visual attributes: *standard* and *enhanced*.

Standard

The *standard* attribute is the ordinary (default) way of displaying text. It is denoted by the letter S in the ATTRIBUTE command. Since standard is the default visual attribute, you don't need an ATTRIBUTE command to designate the first field of a line as standard.

Enhanced

The *enhanced* visual attribute makes the background of a field brighter than standard. The letter E denotes enhanced in ATTRIBUTE commands.

Blinking Between Visual Attributes

You can set up a field which *blinks*, or alternates, between the standard and enhanced visual attributes. To do this, specify both visual attributes in the ATTRIBUTE command, separating them with a hyphen, as follows:

!ATT S-E <CR>

or

!ATT E-S <CR>

LOGICAL ATTRIBUTES

Visual attributes may give interesting visual effects, but it is the *logical* attributes of fields in a form which make the form behave as a form, rather than just as a collection of words in the workspace.

Logical attributes have effect only when the 4024 is in form fillout mode. (You create the form with the 4024 not in form fillout mode, and then put it into form fillout mode with a FORM YES command.) With the 4024 in form fillout mode, fields have the following logical properties:

- Those fields with *protected* logical attributes act as the permanent parts of the form. That is, they are the parts which remain the same each time the form is filled out.

- Those fields with *unprotected* logical attributes comprise the form's blanks, into which you type when filling out the form.

You can specify four different logical attributes in ATTRIBUTE commands: the *alphanumeric, numeric, protected,* and *modified* attributes. The first two of these specify different kinds of unprotected fields. The *protected* attribute sets up protected fields. *Modified* is an additional attribute which you may give to fields which you have already designated protected.

Alphanumeric

The first logical attribute is called *alphanumeric unprotected,* or *alphanumeric* for short. You can type any text into alphanumeric fields. Such fields are used as the blanks of a form.

Alphanumeric is the default logical attribute. That is, each line starts with an alphanumeric field, unless you specify otherwise with an ATTRIBUTE command. The alphanumeric attribute remains in effect until the first field whose attribute code specifies a different logical attribute.

In the ATTRIBUTE command, the letter A designates an alphanumeric field. For example, these two commands set up alphanumeric fields:

```
!ATTRIBUTE A <CR>

!ATT AE <CR>
```

The first command sets only the logical attribute of the field it defines; that field will share the visual attributes of the preceding field in its line. The second command sets up an alphanumeric field and defines that field's visual attribute to be enhancedN

Numeric

The second logical attribute is *numeric unprotected,* or *numeric* for short. Like alphanumeric fields, numeric fields are used for the blanks of a form. The difference is that numeric fields will not accept letters of the alphabet. You can type numbers and certain special symbols into a numeric field, but not letters.

In an ATTRIBUTE command, the letter N designates a numeric field. For instance, these commands set up numeric fields:

```
!ATTRIBUTE N <CR>

!ATT NE <CR>

!ATT NS-E <CR>
```

The first example sets up a numeric field, but does not specify the visual attributes of that field. The field will share the visual attributes of the preceding field in its line.

The second example defines a numeric field with the enhanced visual attribute.

The third example defines a numeric field that alternates between the standard and enhanced visual attributes.

Protected

The *protected* logical attribute designates the permanent fields of a form. These are the fields into which you cannot type with the 4024 in form fillout mode.

In an ATTRIBUTE command, the letter P designates a protected field. For instance, these commands set up protected fields:

```
!ATTRIBUTE P <CR>

!ATT PE <CR>

!ATT PS-E <CR>
```

The first example sets only the logical attribute of the field it defines. That field shares the visual attributes of the preceding field in its line.

The second example defines a protected field with the enhanced visual attribute, while the third example sets up a protected field which blinks between the standard and enhanced visual attributes.

Modified

Modified is an additional attribute which you can attach to a protected field. (There is no benefit to specifying an unprotected field as modified, although there is nothing to prevent you from doing so.)

The modified attribute affects how a field is treated when the 4024 executes a SEND MOD command. In form fillout mode, SEND MOD sends to the computer the contents of only those blanks whose contents have been modified. Ordinarily, this is text from unprotected fields whose contents have not already been sent to the computer. However, you can also designate protected fields as modified, so that their contents will also be sent during a SEND MOD operation.

To designate a protected field as modified, use the letter M in the ATTRIBUTE command that sets up the field. For instance, these commands define fields with the modified logical attribute:

```
!ATTRIBUTE PM <CR>

!ATT PMS-E <CR>

!ATT M <CR>
```

In the first example, the ATTRIBUTE command sets up a protected field which is tagged as modified for future SEND MOD operations. Since the command does not specify the visual attributes, this field shares the visual attributes of the preceding field in its line.

The second example sets up a protected field, labels it modified for SEND MOD operations, and causes it to blink between standard and enhanced.

The third example sets up a new field and attaches the modified label for SEND MOD operations. The field shares the other logical and visual attributes of the preceding field in its line. If the preceding field is protected, then this field will be protected also; if the preceding field is displayed with an enhanced background, this field will have an enhanced background also.

(See the Programmer's Reference Manual for more information on the modified logical attribute and the SEND MOD command.)

RULINGS

If your 4024 has Option 32 (Rulings Characters) installed, you can draw horizontal and vertical single and double lines in the workspace. This is done with special *rulings characters*. To the 4024, the rulings characters are just alternate ways of displaying the characters it has stored in its memory. The standard way of displaying the letters of the alphabet is known as *character font zero*, the *standard character font*, and the alternate way of displaying the characters is *character font one*, the *rulings character font*. For instance, character number 89 of the ASCII telegraph alphabet is the letter Y; it appears as a Y when displayed in the standard font, and as a horizontal line when displayed in the rulings font.

Exercise

If you have not already done so, define a workspace and set the keyboard to type into that workspace. Move the cursor to the start of a new line, and type an ATTRIBUTE 1 command. For instance, if the command character is the exclamation point, type:

!ATTRIBUTE 1 <CR> or !ATT 1 <CR>

Then type the letters of the alphabet. As you type each letter, the corresponding rulings character for that letter will appear.

NOTE

If there should appear "blotches" (character cells with all dots turned on) or "snoopy mode characters" (two-letter mnemonics for the control characters), then the 4024 is not configured for drawing rulings. It will be necessary to install Option 32 (if not already installed), or to have service personnel set an internal strap to enable the rulings characters.

Drawing Rulings

The easiest way to draw rulings is by means of the rulings commands, VRULE and HRULE. In each command, you define the line to be drawn (in the workspace) by specifying four numbers:

- The first number in the command tells the 4024 at which line of the workspace to begin the ruling.
- The second number specifies at which character position in that line to put the first rulings character.
- The third number specifies how many character positions the ruling is to occupy.
- The fourth number specifies whether the ruling is to be a single line or a double line.

The VRULE command draws vertical rulings, and the HRULE command draws horizontal rulings.

Exercise

Erase the workspace; then type an HRULE 1,1,10,1 command. That is, if the command character is the exclamation point, type:

!HRULE 1,1,10,1 <CR>

The 4024 will draw a horizontal ruling, starting at the first line of the workspace, first character in that line, and continuing for 10 character positions. The ruling drawn will be a single line, rather than a double line.

Now try these commands:

!HRULE 2,1,10,2 <CR>

!HRULE 5,10,10,1 <CR>

!VRULE 1,1,10,1 <CR>

!VRULE 1,10,10,2 <CR>

As the 4024 executes a VRULE or HRULE command, it does the following things:

- First, the 4024 inserts attribute codes to set up *rulings fields.* A rulings field is a field in which characters are displayed using the rulings characters, Font 1. An HRULE command draws its ruling in only one line of the workspace, so only one rulings field is needed. A VRULE command, however, inserts a one-character rulings field in each horizontal line through which the vertical ruling passes.

- Secondly, the 4024 inserts characters in the rulings field or fields it has created.

  For single vertical lines, it inserts the left bracket character ([), which appears as a vertical line when displayed with the rulings font.

  Similarly, for a double vertical line, it inserts the underscore character (—); for a single horizontal line, the capital letter Y; and for a double horizontal line, the right bracket (]).

- Thirdly, the 4024 terminates each rulings field by inserting another attribute code after the rulings field. This attribute code defines a new field and returns the character font to the standard font (0).

Getting the Junctions Right

While the HRULE and VRULE commands are convenient, they do not automatically provide the correct characters to draw the junctions where one ruling joins another. To display these junctions correctly, we need other rulings characters.

Figure 5-5 shows all the rulings characters, both as they are displayed in rulings fields (fields in which Font 1 is used) and and as displayed with the standard character font (Font 0). You can quickly pick out from this figure exactly which character you need to make a neat junction between two rulings.

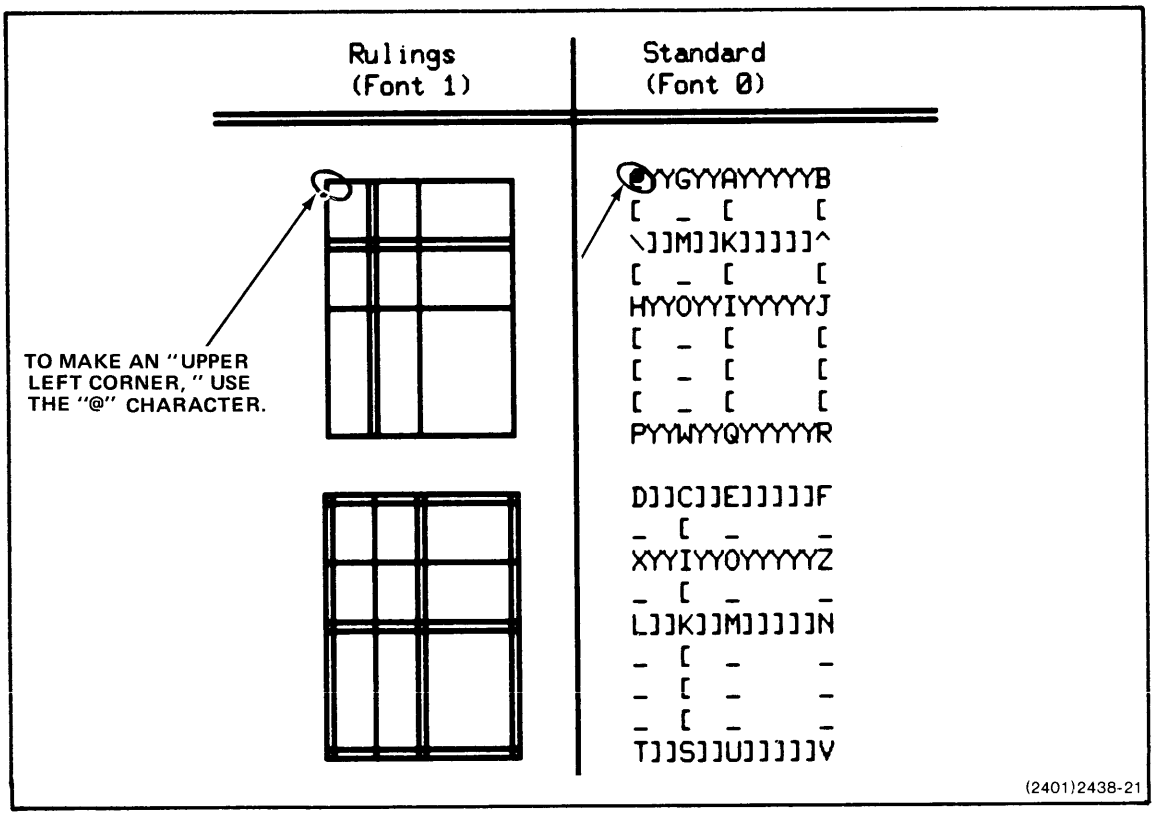


Fig. 5-5. Rulings characters.

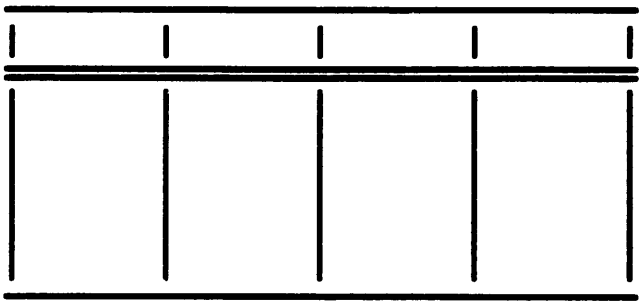
To illustrate how to use the figure, let's draw the following form:

n	2n	3n	4n
1	2	3	4
2	4	6	8
3	6	9	12
4	8	12	16
5	10	15	20
6	12	18	24

We begin by erasing the workspace and drawing the rulings with several rulngs commands. Assuming the command character is the exclamation point, we type:

```
!VRU 3,20,10,1 <CR>
!VRU 3,30,10,1 <CR>
!VRU 3,40,10,1 <CR>
!VRU 3,50,10,1 <CR>
!VRU 3,60,10,1 <CR>
!HRU 3,20,41,1 <CR>
!HRU 5,20,41,2 <CR>
!HRU 12,20,41,1 <CR>
```

At this point, the workspace looks like this:

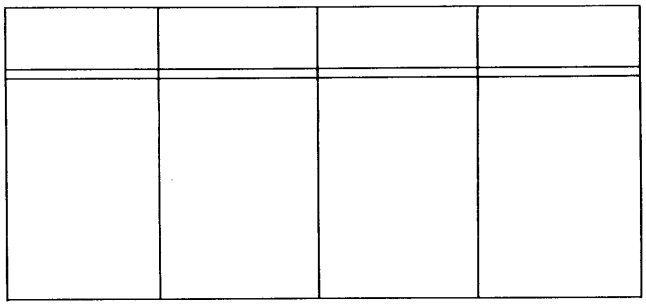


The rulings are in place, but their junctions aren't right. To remedy this, we consult Fig. 5-5 to see which characters, when displayed in the rulings font, give the correct junctions. For instance, we see that the upper left corner can be made with an @ character, that the "T" junctions in the top row can be made with the letter A, and that the upper right corner can be made with the letter B.

Accordingly, we move the cursor (with the cursor movement keys, **not** the space bar) to the upper left corner of the box formed by the rulings, and type an @ . The rulings character for the upper left corner appears. Similarly, we move the cursor to the "T" junctions along the top of the form, and type the letter A at each junction; the rulings characters for the "T" junctions appear.

Likewise, we type the letter B at the upper right corner of the rulings, and the characters , K, K, K, ^ at the five juctions of the horizontal double line with the vertical lines. We finish making the junctions by typing the characters P, Q, Q, Q, R at the junctions of the bottom horizontal line with the vertical lines.

At this point, the workspace looks like this:



To finish the form, we need only type the text inside the boxes formed by the rulings characters.

Appendix A

EXAMPLES OF COMMANDS

The following examples of the 4024's commands all assume that the command character is the exclamation point; <CR> denotes the RETURN key. Commands are included which are not discussed in this manual; for information on those commands, see the 4024/4025 Programmer's Reference Manual.

ATTRIBUTE	!ATT 1 <CR>	Sets up a new field at the current cursor location in the workspace, and causes characters in that field to be displayed with character font number 1 (the rulings characters).
	!ATT 0 <CR>	Selects character font 0 for the field which begins at the current cursor position in the workspace.
	!ATT P <CR>	Defines a "protected" field, starting at the current cursor position.
	!ATT A <CR>	Defines an "alphanumeric" unprotected field at the current cursor location.
	!ATT N <CR>	Defines a "numeric" unprotected field at the current cursor location.
	!ATT M <CR>	Marks the field at the current cursor location as a "modified" field.
	!ATT S <CR>	Displays the field at the current cursor location using the "standard" visual attribute.
	!ATT E <CR>	Attaches the "enhanced" visual attribute to the field at the current cursor position.
	!ATT PE-S <CR>	Establishes a protected field, with visual attributes that "blink" between "enhanced" and "standard."

	!ATT 2 NS-E <CR>	Establishes a field which is displayed using character font 2, which is "numeric," and which is displayed "blinking between standard and enhanced."
BACKTAB	!BAC 5 <CR>	Equivalent to pressing the BACKTAB key 5 times.
BELL	!BEL <CR>	Sounds the 4024's bell.
BUFFERED	!BUF <CR> !BUF Y <CR>	Puts the 4024 in buffered mode.
	!BUF N <CR>	Removes the 4024 from buffered mode.
CLEAR	!CLE <CR>	Clears all current key definitions; all keyboard keys revert to their original meanings.
COMMAND	!COM # <CR>	Changes the command character to the "number sign" (#).
	!COM 19 <CR>	Changes the command character to the ASCII character whose decimal equivalent is 19: the "DC3," or "device control #3" character.
COPY	!COPY W P <CR>	Sends the contents of the workspace to a peripheral device, such as the 4642 Printer. (Requires Option 3.)
	!COPY H P <CR>	Sends text from the host computer to the 4642 Printer. (Requires Option 3.)

DCHAR	!DCH 5 <CR>	Equivalent to pressing the DELETE CHAR key 5 times.
DELAY	!DEL 20 <CR>	Sets (to at least 20 milliseconds) the length of time that the 4024 delays before responding to a prompt from the host computer.
DLINE	!DLI 6 <CR>	Equivalent to pressing the DELETE LINE key 6 times; deletes 6 lines of text.
DOWN	!DOW 15 <CR>	Moves the cursor down 15 lines; like pressing the "down" cursor movement key 15 times.
ECHO	!ECH L <CR>	Sets the 4024 for "local echo."
	!ECH R <CR>	Sets the 4024 for "remote echo."
EOF	!EOF /abc/<CR>	Sets the end-of-file string to the ASCII characters <a>,<b>,<c>. This string is used in COPY commands to mark the end of a file being sent from the host computer for the 4024 to copy on a 4642 printer.
EOL	!EOL <CR>	Sets the end-of-line string to "carriage return."
	!EOL 13 10 <CR>	Sets the end-of-line string to the ASCII characters whose decimal equivalents are 13 and 10: <CR>, <LF> ("carriage return, line feed").
	!EOL /abcDEF/ 13 10 <CR>	Sets the end-of-line string to the ASCII characters <a>,<b>,<c>,<D>, <E>,<F>,<CR>,<LF>.

ERASE	!ERA W <CR>	Erases the workspace.
	!ERA M <CR>	Erases the monitor.
	!ERA <CR>	When this command is typed on the keyboard, the 4024 erases that scroll (workspace or monitor) into which text from the keyboard is directed. When this command comes from the computer, the 4024 erases that scroll into which text from the computer is directed.
FIELD	!FIE @ <CR>	Sets (to "@") the character which is used to precede fields when they are transmitted to the host computer.
	!FIE 02 <CR>	Selects the ASCII character whose decimal equivalent is "2" as the character which precedes fields when they are transmitted to the host computer.
	!FIE 2 <CR>	Selects the numeral 2 as the character to precede fields when they are transmitted to the host computer.
FORM	!FORM <CR> or !FORM Y <CR>	Puts the 4024 in form fillout mode.
	!FORM N <CR>	Removes the 4024 from form fillout mode.
HRULE	!HRU 3,5,15,2<CR>	Starts at row 3, column 5 in the workspace, and draws a horizontal ruling through 15 character positions. The ruling is a double line. (Requires Option 32.)
	!HRU 3,5,15,1<CR> !HRU 3,5,15<CR>	Starts at row 3, column 5 in the workspace, and draws a horizontal ruling through 15 character positions. The ruling is a single line. (Requires Option 32.)

ICHAR	!ICH <CR>	Puts the 4024 into insert mode. (The 4024 leaves insert mode on receiving a cursor movement character or a command which moves the cursor.)
ILINE	!ILI 3 <CR>	Inserts 3 lines in the text, starting at the current cursor location; equivalent to pressing INSERT LINE 3 times.
JUMP	!JUM <CR>	Moves the cursor to the start of the first line of the workspace.
	!JUM 15 <CR>	Moves the cursor to the start of the 15th line of the workspace.
	!JUM 15,26 <CR>	Moves the cursor to row 15, column 26 in the workspace.
LEARN	!LEA Q /abc/ <CR>	Programs the shifted version of the Q key (uppercase Q) to mean the string of characters, <a>,<b>,<c>.
	!LEA Q /abc/ 13 <CR>	Programs the uppercase Q key to mean the string of characters, <a>,<b>,<c>,<CR>. The <CR> ("carriage return") character is represented in the LEARN command by its ASCII decimal equivalent, the number 13.
	!LEA F1 /abc/<CR>	Programs Function Key 1 to mean the string, <a>,<b>,<c>.
	!LEA S1 /abc/<CR>	Programs the shifted version of Function Key 1 to mean the string <a>, <b>, <c>.
LEFT	!LEF 5 <CR>	Moves the cursor 5 character positions to the left.

MARGINS	!MAR <CR>	Sets the left margin workspace to column 1, and the right margin to column 80.
	!MAR 5 <CR>	Sets the left margin to column 5, leaving the right margin unchanged.
	!MAR 10,70 <CR>	Sets the left margin to column 10, and the right margin to column 70.
MONITOR	!MON 5 H K <CR>	Creates a workspace. Reserves the bottom 5 lines of the screen for displaying the monitor, leaving the 29 lines above for displaying the workspace. Directs text from the host computer and the keyboard to the monitor.
	!MON H <CR>	Directs text from the host computer to the monitor.
	!MON K <CR>	Directs text from the keyboard to the monitor.
	!MON <CR>	If this command is typed on the keyboard, it directs text from the keyboard to the monitor. If this command comes from the host computer, it directs text from the host computer to the monitor.
PARITY	!PAR E <CR>	Sets the 4024 to even parity.
	!PAR O <CR>	Sets the 4024 to odd parity.
	!PAR N <CR>	Sets parity to "none;" the 4024 ignores the parity bit on input, and sets it to "0" on output.
	!PAR D <CR>	Sets parity to "data;" the parity bit is available for use as a data bit.

PROMPT	!PRO /abc/ <CR>	Sets the prompt string to <a>,<b>,<c>. In buffered mode, the 4024 must receive this string from the host before it sends each line of text from its transmit buffer.
	!PRO 13 10 <CR>	Sets the prompt string to the ASCII characters whose decimal equivalents are 13 and 10: <CR>,<LF>.
	!PRO <CR>	Sets the prompt string to the single character, <LF> ("line feed").
REPORT	!REP 5 <CR>	Causes the 4024 to send a report to the host computer, describing the status of device number 5.
RDOWN	!RDO 5 <CR>	Rolls the workspace or monitor scroll down 5 lines. (Equivalent to pressing the "down" scrolling key 5 times.) The action stops when the top of the scroll is in view on the screen.
RIGHT	!RIG 5 <CR>	Moves the cursor 5 character positions to the right.
RUP	!RUP 5 <CR>	Rolls the workspace or monitor scroll up 5 lines. (Equivalent to pressing the "up" scrolling key 5 times.) The action stops when the last line of text already entered in the scroll comes into view on the screen.
SEND ALL	!SEN A <CR> !SEN <CR>	If not in form fillout mode, sends to the computer all the data in the workspace, including attribute codes, which are encoded as ATTRIBUTE commands. If in form fillout mode, sends to the computer the contents of all the "blanks" of the form (the unprotected fields).

SEND MOD	!SEN M <CR>	If not in form fillout mode, functions like SEND ALL; sends the entire contents of the workspace to the computer. If in form fillout mode, sends to the computer the contents of those blanks ("unprotected fields") which have been modified since the last SEND MOD command. Also sends the contents of those protected fields which have been marked with the "modified" logical attribute.
SEND	!SEN <CR>	Same as SEND ALL.
SNOOPY	!SNO <CR> !SNO Y <CR>	Puts the 4024 in "snoopy mode." (In snoopy mode, the "non- printing" ASCII characters are represented on the display by two-letter abbreviations.) *NOTE* *If Option 32 (Rulings) is installed, the 4024 may be internally set to display rulings characters in lieu of the two-letter "snoopy mode" mnemonics.*
	!SNO N <CR>	Removes the 4024 from snoopy mode.
STOPS	!STO 5,10,15 <CR>	Puts tab stops in columns 5, 10, and 15.
SYSTAT	!SYS <CR>	Displays the system status message in the monitor.
TAB	!TAB 2 <CR>	Performs the same action as pressing the TAB key twice. If not in form fillout mode, each tab advances the cursor one tab stop or to the beginning of the next line.

		If in form fillout mode, each tab advances the cursor to the next blank (unprotected field) of the form.
TEST	!TES <CR>	Checks the 4024's memory, testing each character location and displaying the four checksums for the system ROM (Read Only Memory). In addition to the checksums, displays a sample of each character that may be displayed from fonts 0 and 1, and rings the bell. In checking the memory, any text in the workspace or monitor is destroyed.
UP	!UP 5 <CR>	Moves the cursor up 5 lines; similar to pressing the "up" cursor movement key 5 times.
VRULE	!VRU 3,5,15,2<CR>	Starts at workspace row 3, column 5, and draws a vertical ruling downward through 15 character positions. The ruling is a double line. (Requires Option 32.)
	!VRU 3,5,15,1<CR>	Starts at workspace row 3, column 5, and draws a vertical ruling down through 15 character positions. The ruling is a single line. (Requires Option 32.)
WORKSPACE	!WOR 20 H K <CR>	Creates a workspace, and allots the top 20 lines of the screen for displaying it. Directs text from the host computer and the keyboard to that workspace.
	!WOR H <CR>	Directs text from the host computer to the workspace.
	!WOR K <CR>	Directs text from the keyboard to the workspace.

Table B-1

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

NOTE: The rulings character for each "uppercase" character appears next to it. The corresponding "control," "figures," and "lowercase" characters share the same rulings character. For instance, "SOH," "!," "A," and "a" are all displayed as " T " in the rulings font.

Appendix B

THE ASCII CODE

When the 4024 stores text in its memory, or sends and receives text from the computer, it represents that text as a collection of telegraph characters, using the ASCII telegraph code. ("ASCII" stands for "American Standard Code for Information Interchange." This code is known internationally as the "ISO-7" code.)

Bits. Each character of the ASCII code is a collection of seven "bits" ("binary digits"). (Often an eighth bit, the "parity bit" is added for error-detection purposes.) Each bit is either 1 or 0. With 7 bits, there are 128 possible combinations; these are the 128 ASCII characters.

ASCII Decimal Equivalents. Each character may be regarded as a binary numeral, representing a number in the range from 0 to 127. For instance, the ASCII character for Z is 1011010, which is the binary numeral for the number 90. We say that 90 is the "ASCII decimal equivalent" for the letter Z.

Printing and Non-Printing Characters. The 128 characters in the ASCII alphabet include many characters which can be printed on paper: upper and lower case letters of the alphabet, numerals, the "space" character, punctuation marks and special symbols. In addition, there are some "non-printing" characters, or "control characters." These have special meanings such as "carriage return" or "device control #1," and are used to control machines.

Using the ASCII Code Chart. Table B-1 is an "ASCII Code Chart;" it lists the 128 ASCII characters, and shows the binary bits and ASCII decimal equivalent for each character. The chart is a rectangular array of 8 columns, each containing 16 characters; this makes it more compact than a table with a single column of 128 characters.

The "high order bits" (B7,B6,B5) for the characters in each column are the same; they appear at the top of the column. Similarly, the "low order bits" (B4,B3,B2,B1) for the characters in each row are the same, and are shown at the left of the row.

For instance, the letter Z is in the sixth column and twelfth row. At the top of the column, we see its high order bits, 101; its low order bits, 1010, appear at the left of the row. Hence, its seven binary bits are:

B7	B6	B5	B4	B3	B2	B1
1	0	1	1	0	1	0

The binary numeral 1011010 represents the number 90. This is the ASCII decimal equivalent for Z, and appears next to it in the chart.

The "control characters" occupy the first two columns in Table B-1. There are keys on the keyboard for only a few of these characters: "escape" ("ESC"), "tab" ("HT"), "backspace" ("BS"), "carriage return" ("CR"), and "line feed" ("LF"). However, you can send any control character to the computer by using the CTRL key.

To send one of the control characters, hold down the CTRL key and type one of the other ASCII characters. For instance, to type an "ENQ" character, press CTRL-E; to type a "DC3," press CTRL-S. Table B-2 lists the control characters, the keys you press to type these characters, and the two-letter mnemonics by which they are displayed when using the LEARN key. The table also shows the "rulings character" which may be displayed instead of the two-letter mnemonic if Option 32 is installed.

Table B-2

ASCII CONTROL CHARACTERS

Mnemonic	Corres Rulings Character	Usual ASCII Abbrev.	Name of Character	Keys to Press
NU	┌	NUL	Null	CRTL- @
SH	┬	SOH	Start of Heading	CTRL-A
SX	┐	STX	Start of Text	CTRL-B
EX	├	ETX	End of Text	CRTL-C
ET	┼	EOT	End of Transmission	CTRL-D
EQ	┤	ENQ	Enquiry	CTRL-E
AK	└	ACK	Acknowledgement	CTRL-F
BL	┴	BEL	Bell	CTRL-G
BS	┘	BS	Backspace	CTRL-H
HT	─	HT	Horizontal Tab	CTRL-I
LF	│	LF	Line Feed	CTRL-J
VT	╞	VT	Vertical Tab	CTRL-K
FF	╟	FF	Form Feed	CTRL-L
CR	╚	CR	Carriage Return	CTRL-M
SO	╔	SO	Shift Out	CTRL-N
SI	╩	SI	Shift In	CTRL-O
DL	╦	DLE	Data Link Escape	CTRL-P
D1	╠	DC1	Device Control 1	CTRL-Q
D2	═	DC2	Device Control 2	CTRL-R
D3	╬	DC3	Device Control 3	CTRL-S
D4	╧	DC4	Device Control 4	CTRL-T
NK	╨	NAK	Negative Acknowledgement	CTRL-U
SY	╤	SYN	Synchronization Character	CTRL-V
EB	╥	ETB	End of Transmission Block	CTRL-W
CN	╫	CAN	Cancel	CTRL-X
EM	┘	EM	End of Medium	CTRL-Y
SB	┼	SUB	Substitute	CTRL-Z
EC	│	ESC	Escape	CTRL-[
FS	┼	FS	Field Separator	CTRL-\
GS	=	GS	Group Separator	CTRL-]
RS	┼	RS	Record Separator	CTRL- ^ (CTRL-circumflex accent)
US	═	US	Unit Separator	CTRL-_ (underscore)

Appendix C

OPTIONS

The following options are available for the 4024.

Option 2: Current Loop

Permits the 4024 to communicate with its host computer or another device by means of a 20 mA current loop rather than the standard RS-232 interface.

Option 3: RS-232 Peripheral Interface

Permits the 4024 to transmit to RS-232 compatible peripheral devices such as the TEKTRONIX 4642 Printer. With this option, data from the host computer or the 4024's workspace can be printed on the 4642 Line Printer.

Option 10: Polling Interface

Permits the 4024 to function in a polling environment, as one of several display stations communicating with the host computer through a polling controller. (See Option 11.)

(Includes Option 2.)

Options 20, 21, and 22: Added Display Memory

The standard 4024 includes 4096 bytes of display memory. (Each byte is 8 binary bits, and can hold one ASCII character.) Options 20, 21, and 22 expand this, permitting larger quantities of text to be stored in the 4024's workspace and monitor.

Option 20: A total of 8192 (8K) bytes of display memory.

Option 21: 16,384 (16K) bytes.

Option 22: 32,768 (32K) bytes.

Option 32: Ruling Characters

Adds the "ruling" character font, permitting single and double lines to be drawn on forms in the workspace.

Option 48: 220 Volt Power

Enables the 4024 to operate from 220 volt 50 or 60 Hz power lines.

Appendix D

SPECIFICATIONS

Table D-1

DISPLAY MECHANISM	
Display type	Video monitor.
Screen size	30.0 cm (12.0 in) diagonal.
Usable display area	17.0 cm x 23.0 cm (6.7 in x 9.0 in)
Phosphor type	P-39 green phosphor
Video bandwidth	20 MHz
Raster lines	Standard 525 line scan, with 480 lines displayed.
Scan	30 Hz interlaced scan.
Refresh rate	
Dot	30 times/second
Frame	30 times/second
Field	60 times/second

Table D-2

DISPLAY CHARACTERISTICS	
Cursor type	Wide underscore
Character size	7 x 9, in an 8 x 14 dot matrix. (Graphics cells are 8 x 14 matrix.)
Character sets Standard	64/96 upper and lower case ASCII. (A special "snoopy mode" is provided which displays all characters and commands. Snoopy mode enables the display of 128 characters.)
Optional	64 rulings characters.
Characters/line	80
Lines/display	34
Total characters/display	2720
Visual attributes	Characters may be displayed with an "enhanced" background or standard background, or may "blink" between "standard" and "enhanced."
Logical attributes	Fields can be protected, modified, alphanumeric, or numeric.

Table D-3

INTERFACE CHARACTERISTICS	
Transmission speed	The transmitting and receiving baud rates may be independently selected up to 9600 baud.
Interface with host computer	
Standard	RS-232 full duplex.
Option 2	20 mA current loop.
Optional interface with peripheral devices	
Option 3	RS-232, transmit only, for printer.
Video Signals	Generates 525 line interlaced 60 Hz composite video. Does not accept external synchronizing pulses.

Table D-4

BUFFERING AND EDITING CAPABILITIES	
Size of display memory	4K bytes standard; may be expanded to 8K, 16K, or 32K (Options 20, 21, and 22.)
Parts of memory	
Monitor	Holds and displays conversational text, such as conversations between the user and the host computer, or commands to the 4024.
Workspace	Holds and displays text or forms. One or several pages of text can be saved in the workspace, edited, and later sent to the host.

Table D-5

KEYBOARD SPECIFICATIONS	
Number of keys	86
Lighted keys	4 (Insert Mode, TTY Lock, Numeric Lock, Command Lockout)
Programmable keys	80
Major keyboard functions	Typewriter keys, terminal function control, programmable function keys, numeric pad, cursor control, scrolling.
Tactile features	Curved profile, tactile feedback at typing "home" position.
Relationship to display	Detachable (flexible 8 foot cable)
Editing keys	Delete Character Delete Line Erase and Skip Insert Line Insert Mode

Table D-6

PHYSICAL CHARACTERISTICS	
Weight	27.2 kg (60 lb)
Dimensions	
Cabinet	
Height	31.7 cm (12.5 in)
Width	44.5 cm (17.5 in)
Depth	54.0 cm (21.25 in)
Keyboard	
Height	7.6 cm (3.0 in)
Width	45.7 cm (18.0 in)
Depth	23.5 cm (9.25 in)

Table D-7

POWER REQUIREMENTS			
Line plug and power cord	15 ampere capability, detached.		
Input Line voltages	VOLTAGE	RANGE	FUSE
Standard	115 Vac	90-100 V (low) 105-125 V (med) 112-125 V (high)	3 A
Option 48	220 Vac	180-220 V (low) 208-250 V (med) 224-250 V (high)	1.5 A
Line frequency	49 to 61 Hz		
Power consumption	295 W maximum at 125 Vac		

OPERATOR'S REFERENCE TABLE

Please record the following settings for future reference:

Command Character	CC =
Prompt String	PR =
End-of-Line String	EL =
Echo (Remote or Local)	EC =
Parity (None, Even, Odd, or Date)	PA =

This 4024 is internally set for the following baud rates:

Transmitting Baud Rate	baud
Receiving Baud Rate	baud

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MANUAL CHANGE INFORMATION

PRODUCT SEE LIST BELOW

CHANGE REFERENCE C1/179 (Revised)

DATE 1-18-79

CHANGE:	DESCRIPTION

EFF ALL SN

4024 Operators	070-2438-00
4051R05	070-2171-00
4501 Scan Converter Unit	070-1158-00
4632 Option 6	070-2063-01
4661 Operators	070-1804-00
4924 Operators	070-2128-00
4953/4954 Operators	070-2212-00

This Warranty is to be added to the Copyright page of your manual. It supercedes any other Warranty this instrument may carry.

WARRANTY

Tektronix warrants to the original purchaser that this product and options, excluding customer supplied equipment, is free from defects in materials and workmanship, under normal use, for a period of one (1) year from the date of shipment. Tektronix will, at its option, repair or replace the product if Tektronix determines it is defective within the warranty period, and it is returned, freight prepaid, to a Tektronix Service Center.

In the forty-eight (48) contiguous United States and the District of Columbia, and in other areas where Tektronix normally has service available for this product, Tektronix will provide on-site warranty service at no charge during the first ninety (90) days from the date of shipment.

Tektronix shall be under no obligation to furnish warranty service if:

a. Attempts to repair or service the product are made by personnel other than Tektronix service representatives.
b. Modifications are made to the hardware or software by personnel other than Tektronix representatives.
c. Damage results from connecting the product to incompatible equipment.

There is no implied warranty of fitness for a particular purpose. Tektronix is not liable for consequential damages.