WANG

2200

2436 Series Interactive Terminal User's Manual

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PREFACE

NOTE

This manual applies to the following Wang Interactive Terminals:

- Wang Model 2436DE (U.S.A. version, Data Processing only)
- Wang Model 2436DW (U.S.A. version, Data Processing and Word Processing)
- Wang Model 2426DW (Foreign, expanded keyboard version, Data Processing and Word Processing)

For simplicity, all three models are referred to in this manual as the 'Interactive Terminal.' The Model 2426DW is not shown in this manual.

This manual is your introduction to the Interactive Terminal. Chapter 1 provides a brief overview of the terminal's features and system maintenance. Chapter 2 includes a discussion of the terminal controls, the CRT, the keyboard, how to enter and edit data, and how to activate a screen dump. Chapter 3 discusses information on control codes, character display attributes, alternate character sets, the PRINT BOX function, repeating keys, and the self-identification message. Each feature is explained by examples and short programs. Chapter 4 deals with terminal/CPU interfacing including both local and remote terminal connection. The appendices include terminal specifications, preventive maintenance information, charts of character sets and control codes, information on terminal processors, and procedures for changing transmission rates and device addresses.

This manual is intended to be used in conjunction with the introductory manual for your system, as well as the user's manual for each optional peripheral device attached to the system.

CHAPTER 1
INTRODUCTION

1.1 THE MODEL 2436DE/DW INTERACTIVE TERMINAL

The Model 2436DE/DW Interactive Terminal, shown in Figure 1-1, enables you to communicate with your 2200 system and to control it easily. The terminal consists of an adjustable cathode ray tube (CRT) display, an electronics unit, and a lightweight, low-profile, movable keyboard. The ergonomic design includes a tilting video display that can be easily adjusted to conform to your natural line of vision and preferred working posture.

Figure 1-1. The Model 2436DE/DW Interactive Terminal

The Interactive Terminal allows you to create highlighted displays with special character display attributes such as bright, blinking, underlined, and reverse video (dark characters on a light background). All characters may be displayed using one or more character display attributes. Additionally, the terminal is capable of both box and character graphics.

The Interactive Terminal can support its own local printer; hard copy output can be created on a printer attached to the terminal. A dump of the screen to the local printer may be initiated from the keyboard, resulting in the printing of the standard characters present on the screen. When a Wang matrix printer is used as the local printer, the box and character graphics of the terminal are included in the screen dump.

When used in conjunction with the Model 2236MXE Terminal Processor, the terminal can save its screen contents in a variable of a BASIC program; the CRT screen can then be reproduced on the system printer, saved in a disk file for later processing, or transmitted to another system.

The Model 2436DW or the Model 2426DW allows you to perform word processing and data processing applications at the same terminal. Word processing functions are executed by the 2200/WP Word Processing Software. The software is document-oriented, thereby allowing complete documents rather than individual pages to be created, edited, or printed.

Among the features of the 2200/WP Word Processing Software are operator prompts and automatic word wraparound; automatic indexing for superscripts and subscripts; automatic centering, indenting, and decimal alignment; global search and replace; text movement; text copy; and right-margin justification.

Text-editing capabilities include the insertion and deletion of characters, words, lines, paragraphs, or entire sections of text. Another special feature is Glossary, which allows you to record commonly used words, phrases, or standard paragraphs, that may be recalled and displayed on the screen with only two keystrokes.

1.2 UNPACKING, INSPECTION, AND INSTALLATION

Special factory packing techniques require that the Model 2436DE/DW Interactive Terminal be unpacked, inspected, and installed by a Wang service representative. When the system arrives, call the Wang Customer Engineering Office and request that this service be performed. Failure to follow this procedure voids the warranty.

The Wang service representative will check that all equipment has been delivered, inspect each unit for possible shipping damage, connect each device in the system, and perform tests to verify the proper operation of all system components.

If modems and telephone lines are to be used, it is recommended that this equipment be installed before the Wang equipment is delivered. The Wang service representative will connect the Wang equipment to the modems. The modem vendor or phone company, however, must connect all modems to the proper transmission lines. (For further details, refer to Chapter 4.)

Refer to Appendix B for information on preventive maintenance and recommended office environments.

CHAPTER 2
OPERATING THE TERMINAL

2.1 THE TERMINAL CONTROLS

The Interactive Terminal is your principal means of controlling the system. The terminal's power switch is located on the front of the terminal base. When the switch is in the (1) position (pressed to the right), the terminal's power is on; when in the (0) position (pressed to the left), the terminal's power is off.

Located on the rear panel of the electronics unit (refer to Figure 2-1) are volume controls for the keyboard clicker and audio alarm; these controls require a screwdriver for adjustment. The keyboard clicker provides audio feedback to the operator when a key is pressed. The audio alarm indicates errors and special conditions. Clockwise motion of the controls increases the volume of the audio alarm and keyboard clicker. Turning these controls counterclockwise decreases the volume.

Also located on the rear panel to the left of the power cord jack is the voltage setting switch. Your Wang service representative will ensure that this switch is set to the voltage appropriate to your location.

WARNING

Do not change the setting on the voltage switch. Depending on the line voltage appropriate to your country, the setting is either 115 volts or 220 volts.

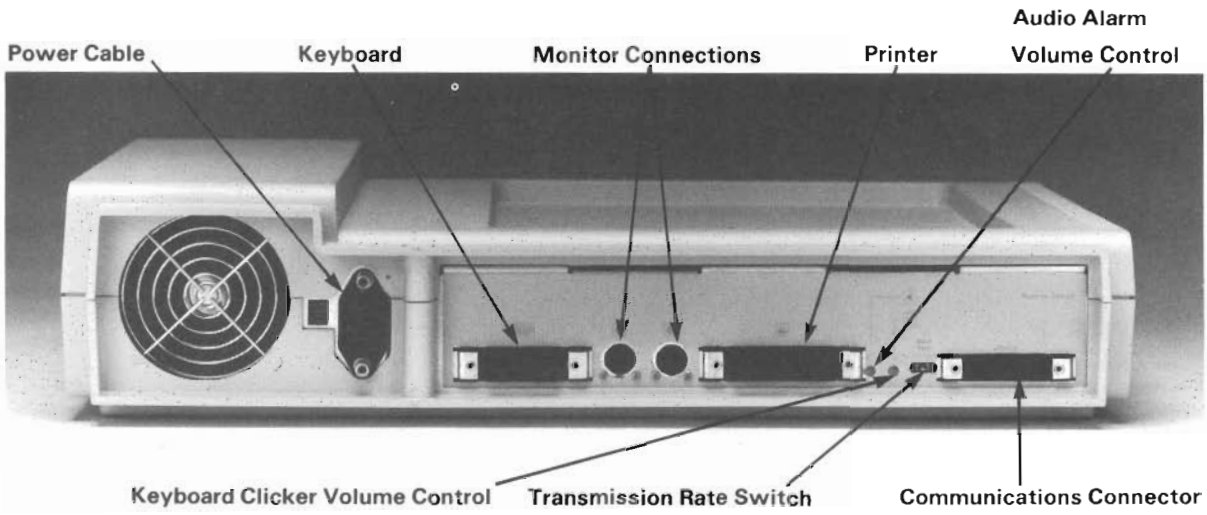


Figure 2-1. Controls on the Back Panel of the Electronics Unit

Terminal Power On

When the terminal is turned on, the terminal microprocessor performs a self-diagnostic to ensure that the terminal is functioning properly. If the diagnostic finds a terminal fault, the terminal alarm sounds once and an error message and error code are displayed on the screen. If this happens, turn the terminal off for several seconds and then back on. If the error recurs, notify a Wang service representative.

After successful execution of the terminal diagnostic on an initial start-up of the terminal, the terminal displays a copyright notice and its self-identification message at the top of the screen, which indicates the current version of the terminal microprogram, the communication rate, and the communication character format. (If the terminal is attached to a 2236MXE terminal processor, the self-identification message is displayed and erased fairly quickly.) To attach a terminal to a partition, press SHIFT RESET. If the terminal is already warm, a video screen diagnostic appears and disappears before the self-identification message is displayed.

2.2 THE CRT

The Interactive Terminal contains a 12-inch (30.5 centimeter) diagonal measure CRT screen display. The CRT displays a full 128-character set, including uppercase and lowercase keyboard characters, some foreign language characters, special symbols, and underlining. The CRT also displays an alternate character set of graphic characters and box graphics. All characters may be displayed using one or more of several character display attributes.

The CRT has a 24-line, 80 characters-per-line capacity (1,920 character positions) for full-screen operator prompting and verification of keyed characters. A slide switch to the left of the CRT controls the brightness of the image on the screen. Display speed is approximately 2,000 characters per second at 19,200 baud. A cursor indicates the location on the display where the next character will appear. In addition to controlling cursor movement and positioning from the keyboard, a number of codes can be used to manipulate the cursor under program control for specially formatted displays.

The terminal also allows you to program underscores, character attributes, and box graphics. These special features, which simplify full-screen operator prompting and highlight portions of a CRT display, are discussed in Chapter 3.

The screen should be cleaned periodically with mild soap and water, using a soft cloth. Do not use an alcohol pad or abrasive compound, as these could cause damage to the screen and adjacent areas.

WARNING

Due to the danger of high voltage, do not attempt to remove the cover of the console for any reason. Call a Wang service representative if any maintenance is required.

2.3 THE KEYBOARD

The terminal keyboard is similar to the standard typewriter keyboard and numeric keypad. The keyboard (refer to Figure 2-2) allows you to communicate with and control the system. By using the keyboard, you can enter data, write programs, perform calculations, enter commands to the processor. On the Model 2436DW or the Model 2426DW you can also operate word processing software.

For convenience of discussion, the keyboard has been divided into the following four physical zones. Refer to Figures 2-2 and 2-3.

Zone 1, Typewriter Keyboard -- Similar to a standard typewriter, this zone contains the alphanumeric characters; special characters (e.g., #, $, %); the numeric operators (+, *, /, -,); and the TAB, GL, RETURN, and SHIFT keys. The GL key provides Special Function '124 when unshifted and '125 when shifted; the TAB key (FN key on the Model 2436DE) provides Special Function '126 when unshifted and '127 when shifted (refer to the description of Zone 4).

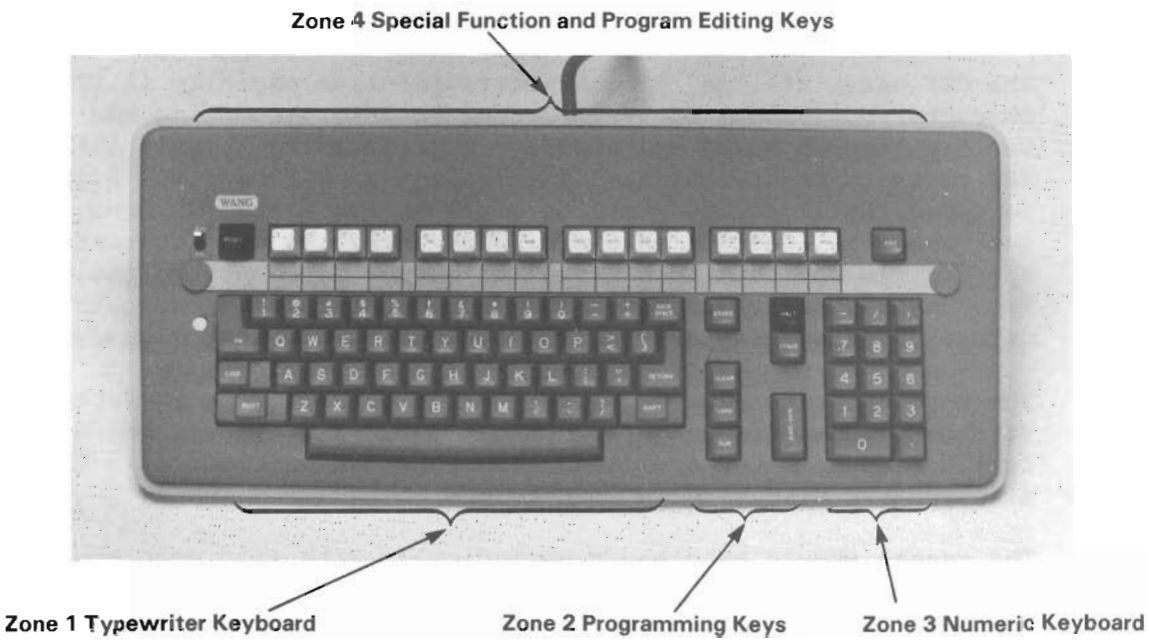


Figure 2-2. The Model 2436DE Keyboard

Zone 2, Cursor Control and Editing Keys -- On the Model 2436DE, this zone contains the Programming keys ERASE, CLEAR, LOAD, RUN, HALT, CTNUE (Continue), and RETURN. Refer to Figure 2-2.

On the Model 2436DW, this zone contains Editing keys (INSERT and DELETE), Location keys (NEXT SCRN and PREV SCRN), Cursor Control keys (control movement of cursor in indicated direction - up, down, right, and left), and the EXEC, LOAD RUN key. Refer to Figure 2-3.

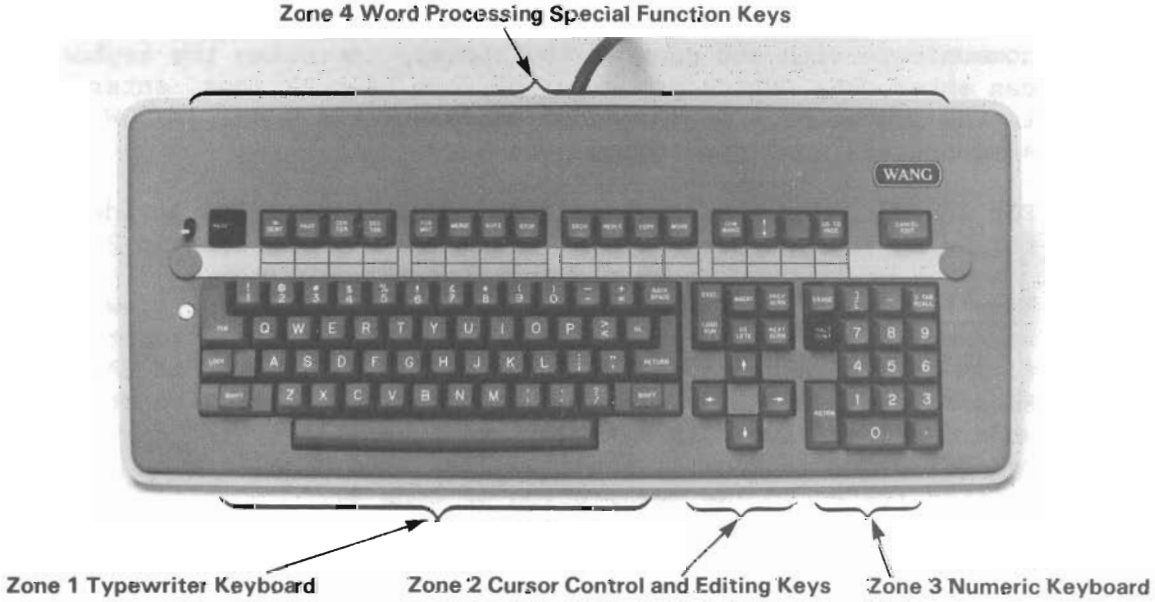


Figure 2-3. The Model 2436DW Keyboard

Zone 3, Numeric Keypad -- The numeric zone is designed like a standard 10-key numeric pad for rapid entry of numeric characters. The numeric keys are grouped here for convenience. Digits may be entered by using the numeric or the alphanumeric zone. This zone also includes such keys as ERASE, HALT/CONT, D TAB/RCALL, and RETURN for the Model 2436DW.

Zone 4, Word Processing/Special Function Keys -- On the Model 2436DE there are 16 Special Function keys across the top of the keyboard. On the Models 2436DW and 2426DW there are 16 Word Processing/Special Function keys across the top of the keyboard. When using the word processing software, the Word Processing Function keys simplify document creation and revision. For example, the CENTER key automatically centers a line of text, the MOVE key allows any amount of text to be moved within a document, and the REPLC key allows a character-defined sequence to be replaced with another within a document.

The Word Processing keys also serve as Special Function keys that can be set up to perform program-defined functions. Since each of these keys may be pressed in conjunction with the SHIFT key, a total of 32 Special Function keys is available. The keys are numbered '0 - '15 (lowercase) and '16 - '31 (uppercase). Simultaneously pressing a key numbered '0 - '15 with SHIFT accesses a key from '16 - '31. The function key number is labeled on the front surface of each key. Additionally, the TAB key and the GL key in Zone 1 can be used as Special Function keys.

Special Function keys may be used to perform a variety of tasks (e.g., start program execution, subroutines) or enter a predefined text string. The meanings of the Special Function keys are shown either by screen prompts or by the label strip located immediately below the row of keys. In order to perform a given task, a Special Function key must be defined with a DEFFN' statement in the currently loaded program. The Special Function keys are also used during Master Initialization to load the operating system.

The keyboard supports both uppercase and lowercase characters. Control functions are handled by several types of function keys. The keyboard has two modes of operation, selected by a toggle switch labeled A/A and A/a. The dual mode keyboard is designed for both data processing and word processing applications.

In Programmer's mode (A/A), uppercase alphabetic characters are produced, whether the keyboard is shifted or unshifted. Shifted numeric keys produce symbols and special characters. In Operator's mode (A/a), the keyboard functions as a standard typewriter, producing uppercase and special characters when shifted, and producing lowercase and numeric characters when unshifted.

The Interactive Terminal also includes a Caps Lock feature that is activated by pressing the Lock key. In either A/A or A/a mode, Caps Lock produces uppercase alphabetic characters; all other characters, such as the numeric keys, are lowercase. (Refer to Table 2-1 for a detailed listing of the performance of the keys in each operating mode.)

The keys are well designed and are ideally suited for high-speed typing or data entry. The keys provide adjustable audio feedback when they are touched with sufficient pressure to ensure entry of a character. A program-controlled audio alarm with adjustable volume can also be used to minimize operator monitoring by signaling when special conditions occur.

The keyboard allows characters to be underlined. On non-English versions of the keyboard, characters can also be accented. All keys on the keyboard will repeat if held down. The keyboard clicker sounds each time the repeated character is transmitted. Thus, both audio and visual evidence of the repeated character are given to the user.

Special features of the keyboard include the following:

Keyboard clicker -- The clicker provides audio feedback when a key is pressed. The volume of the keyboard clicker may be adjusted.

N-key roller -- This feature permits a new key to be pressed and the character displayed on the screen while a previous key is still being held down. This process can continue for any number of keys; each new key that is pressed takes precedence over any keys already held down. The N-key rollover feature helps eliminate errors during high-speed typing.

Terminal Alarm -- The alarm provides audio feedback to indicate the occurrence of errors or special conditions, e.g., pressing an undefined special function key or typing beyond a specified field. The volume of this audio alarm may also be adjusted.

The RESET key, located in the upper-left corner of the keyboard, immediately stops program execution, listing, and I/O operations; clears the CRT; homes the cursor; displays the partition-ready message; and returns to the console user (Console Input mode). RESET is also used during Master Initialization and hardware diagnostic operations. The RESET key should be not be used to end program execution, since it could clear necessary variables; HALT should be used for this purpose. As a protective feature, RESET and HALT are active only in Programmer's mode (A/A), and only if pressed in conjunction with the SHIFT key.

NOTE

On a 2200 MVP-type system (multi-user), RESET affects only the partition to which the terminal is currently attached.

Table 2-1. Operation of Keyboard Modes

	A/A mode	A/a mode
Unshifted Operation	Alpha Keys - Uppercase Punctuation - Lowercase Numerics - Lowercase (numbers) Special Function - '0 to '15 CONTINUE - Active HALT - Inactive RESET - Inactive ERASE - From cursor position LOAD RUN key - RUN	Alpha Keys - Lowercase Punctuation - Lowercase Numerics - Lowercase (numbers) Special Function - '0 to '15 CONTINUE - Active HALT - Inactive RESET - Inactive ERASE - From cursor position LOAD RUN key - RUN
Caps Lock Operation	Alpha Keys - Uppercase Punctuation - Lowercase Numerics - Lowercase (numbers) Special Function - '0 to '15 CONTINUE - Active HALT - Inactive RESET - Inactive ERASE - From cursor position LOAD RUN Key - RUN	Alpha Keys - Uppercase Punctuation - Lowercase Numerics - Lowercase (numbers) Special Function - '0 to '15 CONTINUE - Active HALT - Inactive RESET- Inactive ERASE - From cursor position LOAD RUN Key - RUN
Shifted Operation	Alpha Keys - Uppercase Punctuation - Uppercase Numerics - Uppercase (symbols) Special Function - '16 to '31 CONTINUE - Inactive HALT - Active RESET - Active ERASE - Line Erase LOAD RUN key - LOAD	Alpha Keys - Uppercase Punctuation - Uppercase Numerics - Uppercase (symbols) Special Function - '16 to '31 CONTINUE - Inactive HALT - Inactive RESET - Inactive ERASE - Line Erase LOAD RUN key - LOAD

2.4 ENTERING AND EDITING DATA

The system editor enables program lines, immediate mode lines, and data entered in response to input statements to be modified using the editing keys. The editing keys are used to recall a text line or data value for editing, to move the cursor to the character to be changed, to insert space for new characters, and to delete characters.

The RETURN key is usually used to terminate the entry of a data item and signal the CPU to process the entered data. The Special Function keys may also be used to terminate an entry, if so defined by the user program. Touching an undefined Special Function key sounds the audio alarm, but does not otherwise affect system operation.

There are several keys on the terminal that are used for editing. The editing functions performed by these keys are described in Table 2-2. Text entry and editing are usually confined to the field being edited, although it is possible for an application program to redefine the use of the editing keys.

Table 2-2. Editing Keys and Their Functions

Key	Zone	Function
Cursor Control Keys	2	Move the cursor a single space to the left or right, or up or down one CRT line (if the current text occupies more than one line on the CRT).
RECALL	3	Recalls a specified program line, data value, or Immediate mode statement from memory for editing.
INSERT	2	Expands a field for additional text and data entry by inserting a space character at the current CRT cursor position.
DELETE	2	Deletes the character at the current CRT cursor position.
ERASE	3	If unshifted, erases that portion of the line from current CRT cursor position to the end. If shifted, erases entire line.
BACKSPACE	1	Moves the cursor one position to the left and erases the character in that position.

Edit Mode

The terminal performs program-editing functions by means of a special Edit mode. The system is put in Edit mode by pressing the EDIT key, located in the upper right-hand corner of the keyboard.

In the Edit mode, Special Function keys '4 through '15 become system-defined EDIT keys. The remaining Special Function keys, with the exception of the FN key, are disabled. The editing functions are described in Table 2-3. Terminating the entry of the field with **RETURN** or by pressing the EDIT key again causes the system to leave the Edit mode and reactivates user-defined Special Function keys. The Edit mode may also be entered under program control.

In a 2200 MVP-type configuration, actual line-editing functions are performed by the terminal processor, and a blinking cursor is displayed on the CRT screen to indicate that the system is in Edit mode.

Table 2-3. Edit Mode Keys and Their Functions

SF Key	Function
EDIT	Used to both enter and exit Edit mode.
'15	Used to recall a specified program line, data value, or Immediate mode statement from memory for editing.
'14	Moves the cursor five spaces to the left.
'13	Moves the cursor one space to the left.
'12	Moves the cursor one space to the right.
'11	Moves the cursor five spaces to the right.
'10	Expands a field for additional text and data entry by inserting a space character at the current CRT cursor position.
'9	Deletes the character at the current CRT cursor position.

(continued)

Table 2-3. Edit Mode Keys and Their Functions (continued)

SF Key	Function
'8	Erases that portion of the line from the current CRT cursor position to the end of the field.
'7	Moves the cursor to the beginning of the field.
'6	Moves the cursor to the previous CRT line (current text must occupy more than one line on the CRT).
'5	Moves the cursor to the next line on the CRT (current text must occupy more than one line on the CRT).
'4	Moves the cursor to the end of the field.

2.5 THE TERMINAL PRINTER

Printers can be physically attached either to a printer controller in the CPU or directly to the Interactive Terminal. Printers attached to the CPU are referred to as system printers because they are generally available to any partition; a printer attached directly to a terminal is called a terminal printer because it is only available to partitions assigned to that terminal.

The terminal printer is used in the same manner as the system printer, except that the terminal printer may only be accessed by programs initiated at the terminal to which it is attached. The device address is fixed at /204. The terminal printer can also be used for screen dumps (refer to Section 2.6). Any standard Wang printer or plotter with a 36-pin cable connection may be plugged into the printer connector on the terminal.

The MVP-type operating system permits only the current foreground partition to access the terminal's CRT and keyboard. The terminal printer, however, may be used by any partition assigned to the terminal, whether foreground or background. The $RELEASE TERMINAL statement releases the terminal CRT and keyboard from the current foreground partition, but does not affect the terminal printer or the partition outputting to it.

Programmers should use the $OPEN statement to maintain exclusive control of the printer to prevent the intermixed output that could result if two partitions try to print at the same time. If the $OPEN statement has been used in the foreground partition, the resulting print job can readily be halted by keying RESET. This flushes the printer buffers of the terminal processor and terminal and releases the printer from its exclusive state.

Background printing is not recommended for terminals using communication rates less than 1200 baud since keystroke echoing may be delayed noticeably.

2.6 THE SCREEN DUMP

The screen dump feature of the Interactive Terminal allows you to obtain a hard copy record of the CRT screen. There are two methods of producing a screen dump. In the first method, the current screen is recorded on the terminal printer. In the second method, the contents of the current screen are put into a BASIC program, at which point the screen can be processed in any way a programmer desires. Using the second method, a CRT screen can, for example, be reproduced on the system printer or saved in a disk file for later processing.

The contents of the screen can be saved to a variable only when the terminal is used with a 2236MXE terminal processor.

2.6.1 Local Screen Dump

The Local Screen Dump feature allows you to obtain a hard copy record of the CRT screen on a printer attached to the terminal. Local screen dump is a temporary off-line terminal operation that may be initiated only by the terminal operator. In fact, a program can neither initiate nor detect the activation of a local screen dump.

The screen dump may be used to preserve hard copy records of the screen even after the program has stopped with an error or after a CPU failure. However, it is the terminal operator's responsibility not to activate local screen dump while the terminal printer is in use. If local screen dump output is activated while a program is using the printer, the screen dump output is inserted on its own separate page, and printing is resumed without missing any characters.

To activate a local screen dump, use the following procedure:

1. Press the EDIT key (without SHIFT) and hold it down for approximately two seconds. A click is heard immediately. The CRT image freezes with the image to be dumped.

2. When a second click is sounded, the screen dump has been activated. (If the EDIT key is released before the second click is heard, the screen image is unfrozen.)

3. The screen image is transmitted to the printer, preceded by a carriage return and form feed, which neatly formats the output. (If a screen dump is activated while a program is using the printer, the screen dump output will be inserted on its own separate page.)

4. The screen dump ends with another form feed.

5. Normal processing of output from the CPU is resumed. (No data is lost, even if the CPU has attempted output to the CRT or printer while screen dump was in progress.)

During a screen dump, the keyboard remains active, except for RESET and SHIFT RESET. Pressing RESET terminates the screen dump and leaves the CRT screen intact. Pressing SHIFT RESET terminates the screen dump and clears the screen. If the screen dump fails, make sure the printer is selected and properly connected and try again. If the screen dump still fails, use the CLEAR button found on many printers.

When the local screen dump facility is used with, for example, a Wang Model 2245/160 matrix printer, the screen is reproduced with box and character graphics intact, as they appear on the screen. Refer to Chapter 3 for descriptions of the Interactive Terminal's graphics capabilities.

When a Wang printer other than a matrix printer is used for a screen dump, a subset of the CRT character set is used. The U.S. version of the Model 2436DE/DW screen dumps all characters between HEX(20) and HEX(7E), including all uppercase and lowercase characters on the keyboard. Underlined characters are translated to their nonunderlined equivalents. The character set used for screen dump varies among the international versions of the Model 2436DE/DW. However, the following general rules do apply:

- Any character not in the screen dump character set is translated to #.

- Display attributes are ignored. All characters are printed in the same font and pitch. (Refer to Section 3.3.)

- Character set graphics are also translated to #. (Refer to Section 3.4.)

- Box graphics are ignored. (Refer to Section 3.5.)

CAUTION

Since printing is interrupted when a screen dump is requested, the screen dump will be inserted into a report already printing. Although screen dumps eject a page before and after a dump, the user's report may be temporarily halted in the middle of the page. For some reports, this may be acceptable, but for preprinted forms such as invoices or customer statements, a screen dump which interrupts current printing could present problems.

2.6.2 Storing a Screen in a Variable

When used with a Model 2236MXE Terminal Processor, the Interactive Terminal lets you store an image of the currently displayed screen in a BASIC variable. The screen can then, for example, be printed on the system printer or saved in a disk file for later processing.

A screen dump of this type can be initiated either by a BASIC program or by the terminal operator. In the first case, a BASIC program reads the screen of the terminal attached to the current partition by executing the INPUT SCREEN command. In the second case, the operator presses SHIFT EDIT, thereby attaching the terminal to a partition that has previously been made available for screen input.

The INPUT SCREEN Command

In order to read the screen of the terminal attached to the current partition, you must use a BASIC command of the following form:

General Form:

```
INPUT SCREEN alpha-variable
```

Example of valid syntax:

```
INPUT SCREEN A$()
```

The INPUT SCREEN statement reads the screen of the terminal attached to the current partition and stores an image of the screen in the alpha-variable. Each character on the screen and its associated display attributes are represented in the screen image. Display attributes of the terminal are described in Chapter 3.

An error results if you attempt to execute the INPUT SCREEN on the terminal with controllers other than the 2236MXE.

During screen input, the terminal sends a total of 4080 bytes (characters) to the alpha-variable. Therefore, the alpha-variable should be at least 4080 characters in length in order to receive a full screen. The screen image stored in the alpha-variable consists of the following items:

- Terminal self-identification message
- Current cursor position
- Characters currently displayed
- Display attributes for each character

The first 78 bytes contain the self-identification message. The message identifies the type of terminal and its character set. The next 2 bytes identify the cursor location: the first byte identifies the row position; the second byte identifies the column position. Rows are numbered 0 to 24; columns are numbered 0 to 79.

The next 2000 bytes in the alpha-variable represent the characters currently displayed (25 rows by 80 columns). The terminal uses the character codes of the Alternate Character Set (refer to Figure 3-11). Codes are sent row by row, starting at the first character in the first row. The 25th row of characters is all zeros.

Each character has an associated attribute byte describing how the character is displayed. The 2000 bytes representing the characters are followed by 2000 bytes representing the display attributes. The 25th row of display attributes is used only for the box graphics under the characters of the 24th row. A display attribute has the following format:

```
Bit 80 = 1 if character graphic
Bit 40 = 1 if reverse video
Bit 20 = 1 if blinking
Bit 10 = 1 if high intensity
Bit 08 = 1 if underline
Bit 04 = 1 if left horizontal box graphic segment
Bit 02 = 1 if vertical box graphic segment
Bit 01 = 1 if right horizontal box graphic segment
```

INPUT SCREEN can only be executed by a foreground partition (i.e., a partition with a terminal attached). If a background partition with a terminal assigned to it executes INPUT SCREEN, execution is suspended until the terminal is attached and the partition becomes a foreground partition.

Operator-Initiated Screen Input

Executing INPUT SCREEN in a partition that has previously executed a $RELEASE PART command notifies the operating system that this partition is available to receive screen input initiated by a terminal operator. Execution is suspended until a request for screen input is received.

To initiate screen input, you must press SHIFT EDIT for at least two seconds. The operating system then temporarily attaches the terminal to a partition waiting to receive screen input. If no such partition becomes available, the INPUT SCREEN request remains pending until a partition becomes available, or until you abort the request by pressing RESET or SHIFT RESET. Pressing RESET terminates the screen dump and resets the user's foreground partition.

In order to handle more than one screen input concurrently, more than one partition can be set up to receive screen input. The operating system selects one of the available partitions for each screen input. Once the terminal has been attached to a partition, the INPUT SCREEN statement resumes execution.

When INPUT SCREEN is finished, the partition remains assigned to the terminal but becomes a background partition. The #TERM function can be used to identify the terminal from which the screen input was done. The partition from which INPUT SCREEN was evoked becomes the foreground partition once more, and normal processing of output from the CPU is resumed. No data is lost, even if the CPU attempted output to the CRT or printer while screen dump was in process.

As soon as the screen data has been processed, the partition that executed the INPUT SCREEN command can be made available for another screen input by re-executing the $RELEASE PART and INPUT SCREEN statements.

The following program outlines how a program to receive screen input might be structured.

```
000010 DIM A$(68)60
000020 REM release partition from any terminal
 : $RELEASE PART
000030 REM wait for screen input
 : INPUT SCREEN A$()
000040 REM process screen input ...
000050 GOTO 10
```

CHAPTER 3
TERMINAL PROGRAMMING

3.1 INTRODUCTION

Programmable features of your Interactive Terminal include control of cursor movement, character display attributes, box graphics, and alternate character sets (including character graphics). The BASIC-2 BOX function allows easy implementation of the box graphics feature.

All other features are programmed by sending a series of one or more control codes to the terminal. Although the BASIC-2 HEX function is used for most examples in this chapter, programmers should realize that cursor control codes may be stored and transmitted to the terminal in alpha-variables.

The HEX function is a special kind of literal string used to describe one or more characters in terms of their hexadecimal representation. The HEX codes are composed of a pair of hexadecimal digits (the integers 0 through 9 and the letters A through F). There is no limit to the number of characters which may be described in a single HEX function. Since a HEX literal must describe complete characters, a HEX literal must consist of an even number of hexadecimal digits.

Any character may be represented by a HEX literal (refer to Appendix C). Usually, however, HEX literals are used to describe characters not found on the keyboard or codes that perform control functions.

3.2 THE CRT CONTROL CODES

The codes HEX(00) through HEX(0F) are reserved by the terminal for controlling such features as cursor movement, display attributes, and the terminal alarm. The codes HEX(0E) and HEX(0F) are used for controlling the character attributes, while the code HEX(02) introduces the start of a multibyte sequence. The various uses of these three codes are detailed in the following sections. The code HEX(00) represents a null action. The codes HEX(0B) and HEX(04) are reserved for future use.

Programs using these codes in other than the manner documented in this manual may not be compatible with future Wang 2200 CRT devices. All remaining codes are used to control cursor appearance and movement. A complete chart listing the CRT control codes and their respective actions can be found in Appendix C.

3.2.1 Cursor Control Codes

The PRINT AT function positions the cursor at any specified row and column on the screen. In addition, the PRINT HEX function sends cursor control codes to the terminal. For example, either PRINT AT (0,0) or PRINT HEX(01) will move the cursor to the top left corner of the CRT. The following cursor controls are available:

HEX Value	Action
HEX(01)	Moves cursor to the home position (top left of the CRT)
HEX(03)	Clears the screen and homes the cursor
HEX(05)	Cursor on
HEX(02050F)	Cursor blink
HEX(06)	Cursor off
HEX(08)	Cursor left 1 space (nondestructive backspace)
HEX(09)	Cursor right 1 space (nondestructive space)
HEX(0A)	Cursor down 1 line (line feed)
HEX(0C)	Cursor up 1 line
HEX(0D)	Moves the cursor to the beginning of current line (carriage return).

HEX codes can be combined in a single statement to perform several functions. Each function is executed as it occurs in the sequence. For example, the statement HEX(030A0909) clears the screen and homes the cursor (03), inserts a line feed (0A), and indents two spaces to the right (0909). Programmers are reminded that PRINT and PRINTUSING statements automatically issue a carriage return and a line feed if they are not terminated with a comma or a semicolon. To observe the effect of several control codes, execute the following program:

```
CLEAR
10 PRINT HEX(03)
20 PRINT "EXAMPLE 1 - EXAMPLES OF CONTROL CODES"; HEX(0A0A)
30 PRINT "WANG LABORATORIES, INC."; HEX(0D0A); "ONE INDUSTRIAL
AVENUE"; HEX(0D0A); "LOWELL, MASSACHUSETTS"; HEX(0A)
40 PRINT "WANG LABORATORIES, INC."; HEX(0A); "ONE INDUSTRIAL
AVENUE"; HEX(0A); "LOWELL, MASSACHUSETTS"; HEX(0A)
RUN
```

The HEX(03) in Line 10 clears the screen and homes the cursor. The title "Example 1 - Examples of Control Codes" is then printed starting at screen position (0,0). The HEX(0A0A) in Line 20 issues two line feeds before displaying any output. Notice the difference between the displays produced by Lines 30 and 40 (Refer to Figure 3-1). Line 30 issues both a carriage return and a line feed, HEX(0D0A). The display produced is a neatly formatted address. However, Line 40 only issues a line feed, HEX(0A). Since HEX(0A) moves the cursor down one line from its current position, a staggered address is now produced.

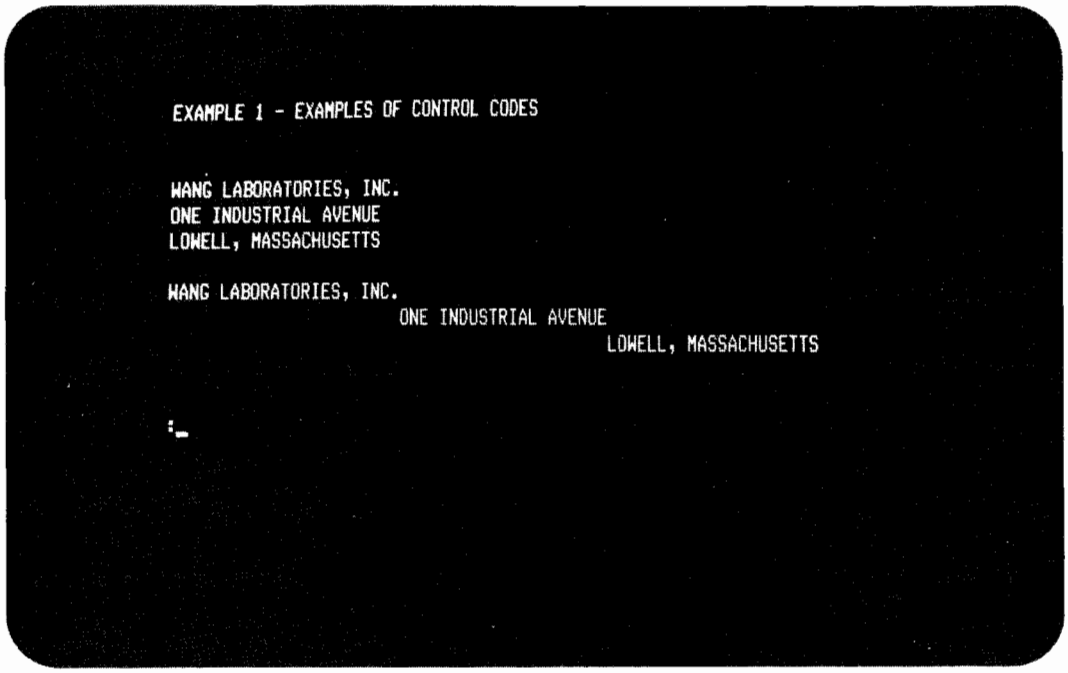


Figure 3-1. Examples of Control Codes

3.2.2 Cursor Appearance

The blinking cursor sequence is sent to the terminal with a PRINT HEX(02050F) statement. The cursor blink sequence is intended for use in applications that take in data on a character-by-character basis with KEYIN. The MicroVP operating system uses the blinking cursor to indicate the Edit mode. For programs using a display monitor, a more aesthetic display may result if the cursor is turned off with a HEX(06). The operating system use of the blinking cursor cannot be overridden. Each time an INPUT or LINPUT statement is executed, or Console Input is entered by executing STOP or END or pressing the HALT or RESET keys, the operating system turns on the cursor and sets it blinking or steady as appropriate.

3.2.3 The Audio Alarm

The terminal's audio alarm can be programmed to beep by issuing a PRINT HEX(07) to the CRT. Several beeps can be produced by selecting a pause between beeps with the SELECT P command. The digit following P specifies the length of the pause in increments of 1/6th of a second. The following example causes the terminal audio alarm to sound three times with 1/3rd of a second pause between beeps.

```
CLEAR
10 SELECT P 2
20 FOR I=1 to 3
30 PRINT HEX (070D)
40 NEXT I
RUN
```

3.3 CHARACTER DISPLAY ATTRIBUTES

In order to highlight information on the screen, the Model 2436DE/DW provides several display attributes that can be selected for any character displayed on the screen. The following display attributes are available:

- Bright -- Characters are displayed in high intensity.
- Blink -- Characters blink.
- Reverse Video -- The character itself is dark while the character background display is light (dark on light).
- Underline -- Characters are displayed with an underscore.

3.3.1 HEX Codes Used to Invoke Display Attributes

Immediately after power is turned on, the terminal displays characters in normal intensity (non-bright), non-blinking, normal video (light on dark), and non-underlined; the combination of these four attributes is called "normal intensity."

On the other hand, the power-on default meaning of HEX(0E) is bright, non-blinking, normal video, and non-underlined. To further understand the default meaning of HEX(0E), refer to the subsection titled "The Use of Isolated HEX(0E)" in Section 3.3.

The display attribute to be used is selected by sending a command of the following form to the CRT:

```
HEX(02 04 xx yy 0E)
or
HEX(02 04 xx yy 0F)
```

where:

02 04 = The control code sequence that indicates to the terminal that special character display attributes are to be selected.

xx yy = The HEX codes specifying the display attributes to be selected, where:

xx = 00 for normal intensity, no blink
02 for bright, no blink
04 for normal intensity, blinking
0B for bright, blinking

yy = 00 for normal video, no underline
02 for reverse video
04 for underline
0B for reverse video, underline

0E or 0F = A terminator character that causes the display attributes selected by xx yy to be turned on or off; HEX(0E) turns the selected attributes on, HEX(0F) turns them off.

Note that there are two ways to code the attribute "blinking." However, on the screen, blinking normal intensity and blinking high intensity characters both appear as blinking, high intensity.

3.3.2 Turning On Character Display Attributes

To highlight portions of the display area, a programmer must execute the appropriate HEX(0204...) sequence before the character or string of characters that require an attribute is output. A sequence ending in 0E, e.g., HEX(020400020E), will select and immediately turn on an attribute. However, a sequence ending in 0F, e.g., HEX(020402040F), will select an attribute, but will not turn it on. Execute the following program to see the possible display attributes, i.e., bright, blinking, underline, and reverse video. Notice that each HEX statement is located before output to be highlighted and that each HEX sequence ends with an 0E. (Refer to Figure 3-2.)

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 2 - THE DISPLAY ATTRIBUTES"
 20 PRINT
 30 PRINT HEX(020402000E); "THE STAR IS BRIGHT."
 40 PRINT
 50 PRINT HEX(020400040E); "PLEASE UNDERLINE YOUR NAME."
 60 PRINT
 70 PRINT HEX(020400020E); "DO YOU LIKE REVERSE VIDEO?"
 80 PRINT
 90 PRINT HEX(020404000E); "THE EMERGENCY LIGHT IS BLINKING."
100 PRINT HEX(0F)
RUN
```

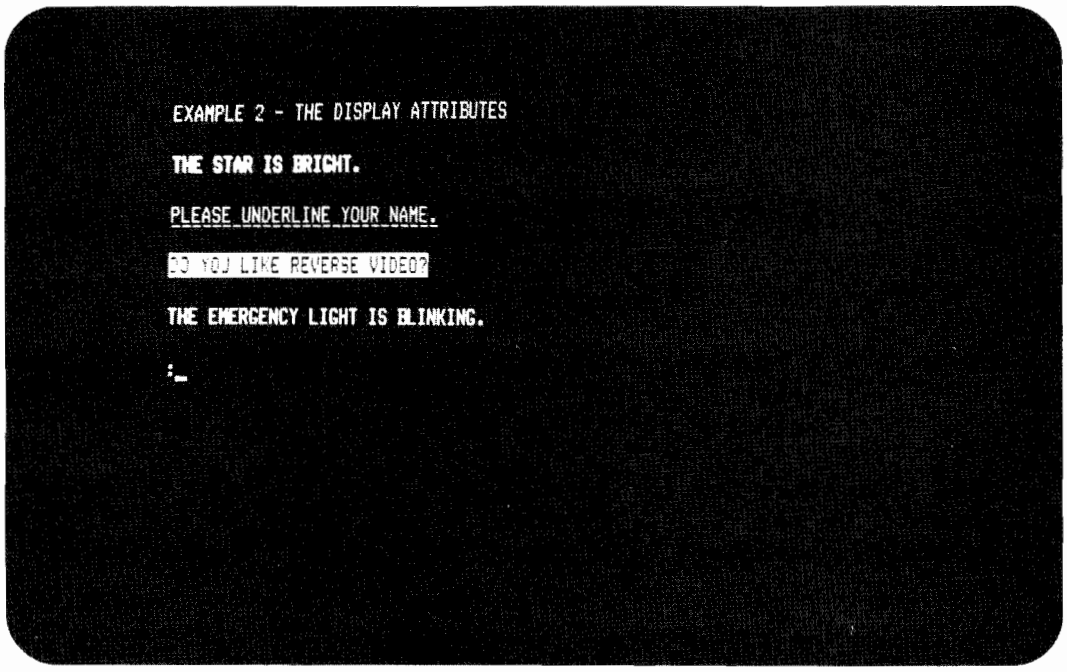


Figure 3-2. The Display Attributes

If the appropriate code is used, any combination of one or more attributes is possible. The following HEX sequences and their respective screen displays are just a few of the possible combinations of attributes.

- PRINT HEX(020402020E) -- Sequence for a bright, reverse video display
- PRINT HEX(020402040E) -- Sequence for a bright display with underline
- PRINT HEX(02040B0B0E) -- Sequence for a bright, blinking, underlined, reverse video display

By placing the HEX(0204...) sequence in the appropriate position, the previous example could be modified to highlight only the key words that describe an attribute. Also, instead of using the PRINT statement to insert blank lines between each displayed sentence, use the control code for line feed, HEX(0A). In the following example, notice the changed location of the HEX sequence and the difference between the two screen displays. (Refer to Figure 3-3.)

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 3 - HIGHLIGHTING KEY WORDS"
 20 PRINT HEX(0A)
 30 PRINT "THE STAR IS "; HEX(020402000E); "BRIGHT."
 40 PRINT HEX(0F0A)
 50 PRINT "PLEASE "; HEX(020400040E); "UNDERLINE"; HEX(0F); " YOUR
NAME."
 60 PRINT HEX(0A)
 70 PRINT "DO YOU LIKE THE "; HEX(020400020E); "REVERSE VIDEO?"
 80 PRINT HEX(0F0A)
 90 PRINT "THE EMERGENCY LIGHT IS "; HEX(020404000E); "BLINKING."
100 PRINT HEX(0F)
RUN
```

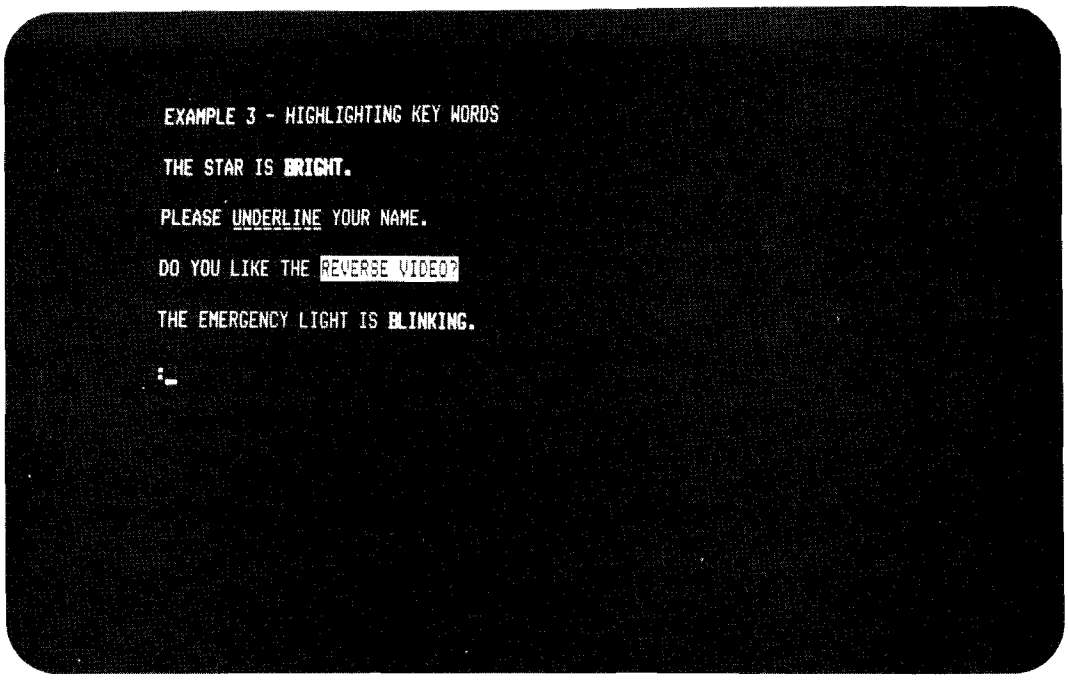


Figure 3-3. Highlighting Key Words

3.3.3 Turning Off Character Display Attributes

Once turned on, the selected attribute remains in effect until it is turned off. Since there are several ways to turn an attribute off, first consider the following example:

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 4 - THE USE OF HEX(0F)"; HEX(0A)
 20 PRINT HEX(020402000E); "WE HAVE SELECTED THE BRIGHT ATTRIBUTE."
 30 PRINT "THE LIGHT IS VERY BRIGHT."
 40 PRINT "THE ATTRIBUTE REMAINS IN EFFECT UNTIL IT IS TURNED OFF."
 50 PRINT "ALL THESE LINES ARE BRIGHT."; HEX(0A)
 60 PRINT "HEX(0F)"; HEX(0F); " IS USED TO TURN OFF AN ATTRIBUTE."
 RUN
```

The HEX sequence in Line 20 selects and activates the attribute "bright intensity" (normal video, no blink, no underline). Notice how the attribute remains in effect for as many lines as desired. (Refer to Figure 3-4.) Each of the four literals in Lines 20 through 50 appear on the CRT screen in bright intensity. In this example, the HEX(0F) in Line 60 is used to turn off the selected attribute and restore normal intensity. An isolated HEX(0F) will always turn off a selected attribute and restore normal intensity.

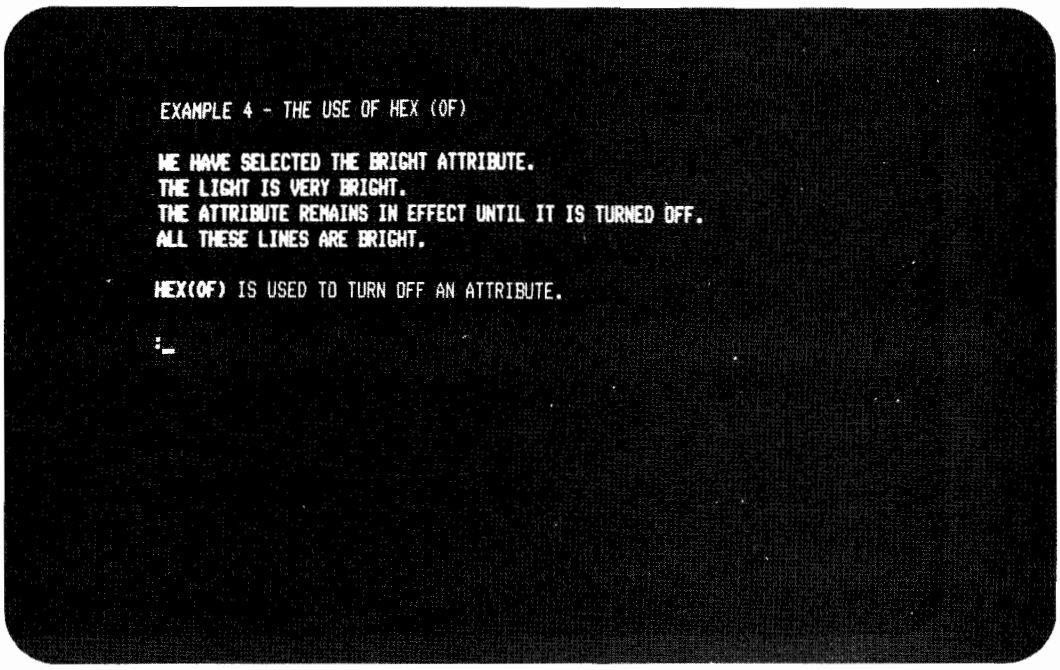


Figure 3-4. The Use of HEX(0F)

The second way to turn off a selected attribute is to select another attribute. As demonstrated in the next example, each new HEX(0204...) sequence turns off the previous attribute.

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 5 - SELECTING ANOTHER ATTRIBUTE"; HEX(0A)
 20 PRINT HEX(020402000E); "THIS LINE IS BRIGHT."; HEX(0A)
 30 PRINT HEX(020400040E); "OUR SECOND LINE IS UNDERLINED."
 40 PRINT "THIS LINE IS ALSO UNDERLINED."; HEX(0A)
 50 PRINT HEX(020400020E); "NOW WE HAVE SELECTED REVERSE VIDEO.";
HEX(0A)
 60 PRINT HEX(0F); "NORMAL INTENSITY RESTORED."
RUN
```

The HEX sequence in Line 20 selects and activates the attribute "bright intensity." Therefore, the sentence "This line is bright." appears on the CRT screen in bright intensity. However, the new HEX sequence in Line 30 selects and activates the attribute "underline," thus turning off the bright intensity attribute. The literals in Lines 30 and 40 will be underlined when displayed on the screen. Similarly, the HEX sequence in Line 50 selects and activates the attribute "reverse video," thus turning off the underline attribute. Finally, the HEX(0F) in Line 60 turns off the attribute and restores normal intensity. (Refer to Figure 3-5.)

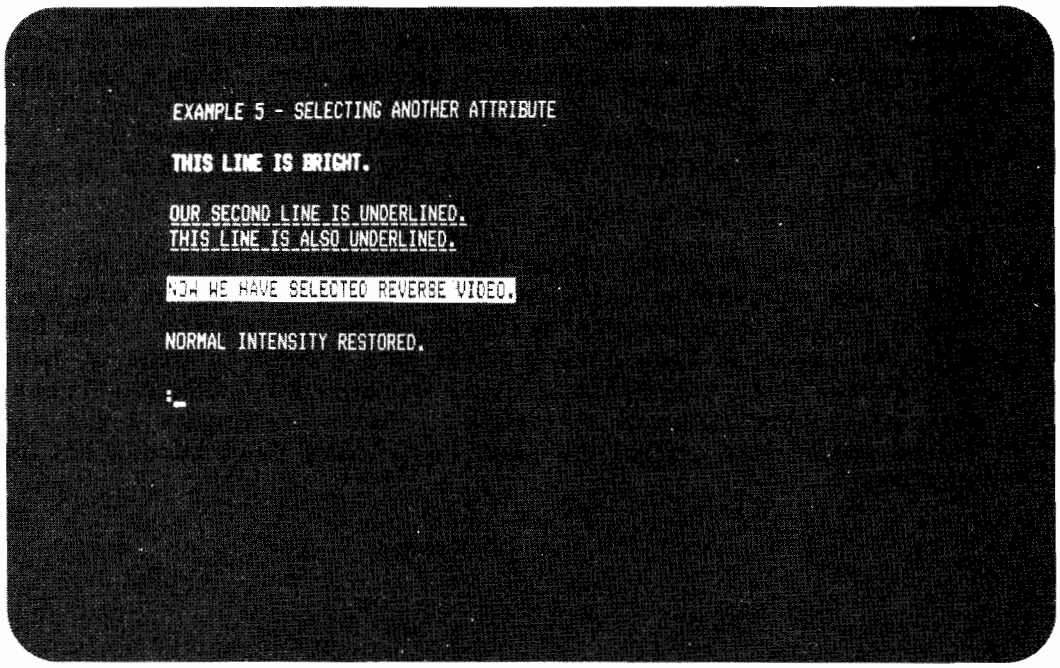


Figure 3-5. Selecting Another Attribute

3.3.4 The Use of Isolated HEX(0E)

An isolated HEX(0E) may be used to activate the last attribute selected by a HEX(0204...) sequence. However, when an attribute is turned on in this manner, the attribute remains in effect for a maximum of one text line. Therefore, either an automatic carriage return, a programmed carriage return issued with a HEX(0D), or a HEX(0F) will turn the attribute off. Execute the following program:

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 6 - TESTING ISOLATED HEX(0E)"
 20 PRINT
 30 PRINT HEX(020400020E); "SELECTING REVERSE VIDEO"; HEX(0F)
 40 PRINT
 50 PRINT "HOW MUCH OF THIS LINE "; HEX(0E); "APPEARS IN REVERSE
VIDEO?"
 60 PRINT "NOTICE THAT NORMAL INTENSITY HAS BEEN RESTORED. WHY?"
 70 PRINT
 80 PRINT HEX(0E); "REVERSE VIDEO HAS BEEN REACTIVATED."; HEX(0D0A);
"WHAT HAPPENED WHEN WE PROGRAMMED A CARRIAGE RETURN?"
RUN
```

Line 30 selects and activates reverse video, and then immediately turns the attribute off after one line. The HEX(0F) statement turns the attribute off and restores normal intensity.

The first literal of Line 50 appears on the CRT screen in normal intensity, until the isolated HEX(0E) reactivates the reverse video attribute for the second literal of the line. Since the attribute was activated by a HEX(0E), the attribute is turned off by the implied carriage return produced by not ending the statement with a comma or semicolon. Therefore, the literal in Line 60 appears in normal intensity.

The attribute is reactivated with the HEX(0E) in Line 80. In this case, the programmed carriage return, HEX(0D), turns off the reverse video attribute and again restores normal intensity. The HEX(0A) in Line 80 issues a line feed so that the second literal of Line 80 does not strike over the first literal of Line 80. HEX(0A) itself does not deactivate the current attribute. (Refer to Figure 3-6.) In any of these cases, the attribute also could have been turned off by a HEX(0F).

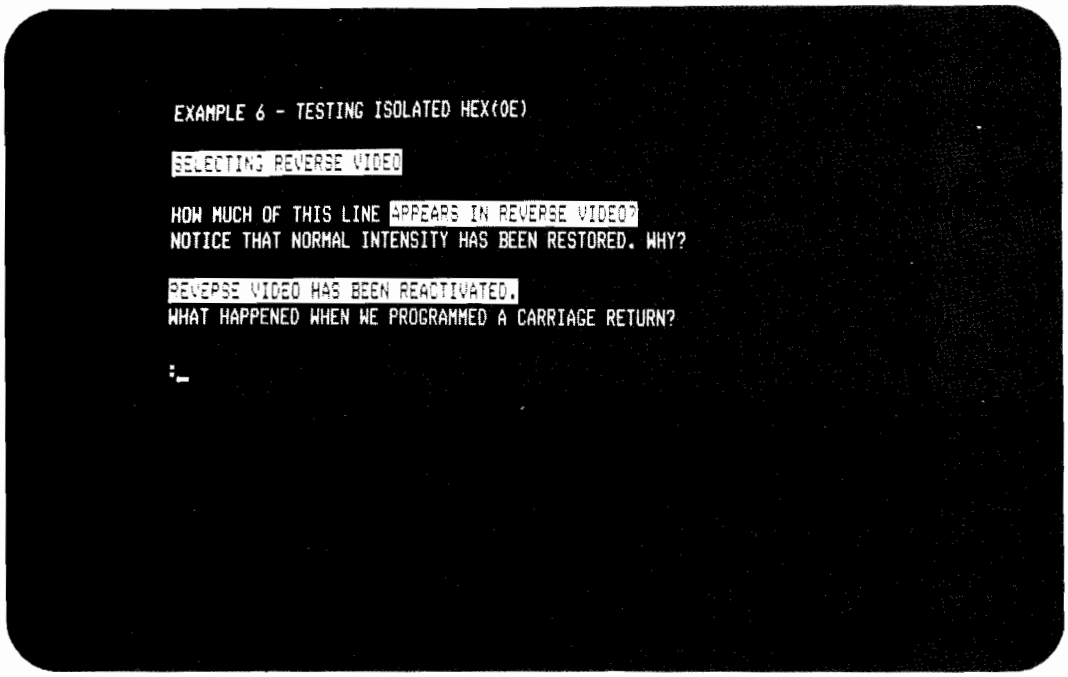


Figure 3-6. Testing Isolated HEX(0E)

The isolated HEX(0E) can be extremely helpful when highlighting portions of one or more lines that require the same attribute. Consider the following example.

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT "EXAMPLE 7 - USE OF ISOLATED HEX(0E)"; HEX(0A)
 20 PRINT HEX(020400040E); "THIS ENTIRE SENTENCE IS UNDERLINED.";
HEX(0F0A)
 30 PRINT "ONLY THE WORD "; HEX(0E); "ATTRIBUTE"; HEX(0F); " IS
UNDERLINED."; HEX(0A)
 40 PRINT "PART OF THIS LINE "; HEX(0E); "IS UNDERLINED."
 RUN
```

Statement 20 selects and activates the underline attribute for the first line of output. The beginning of Statement 30 appears in normal intensity without underline, but the HEX(0E) reactivates the last attribute selected (in this case, underline). After just one word, the attribute is again turned off and the remainder of the sentence appears in normal intensity. The HEX(0E) in Statement 40 then reactivates the underline attribute for the last part of the sentence. Since a HEX(0E) was used to reactivate the attribute, the underline attribute will be turned off by the automatic carriage return. (Refer to Figure 3-7.)

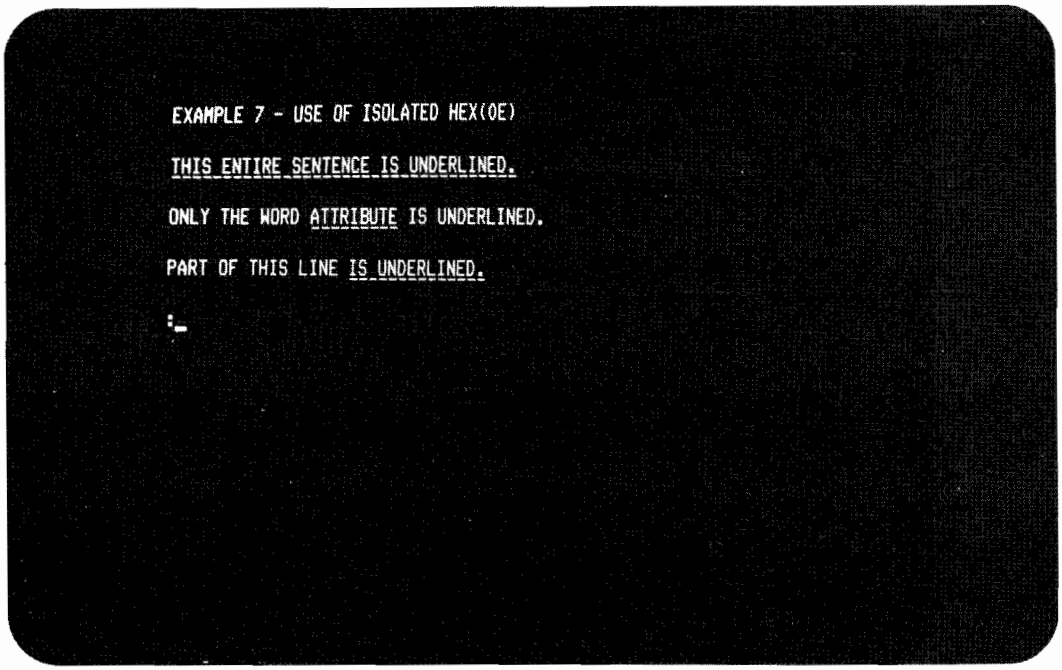


Figure 3-7. Use of Isolated HEX(0E)

3.3.5 Sequences Ending in 0F

As mentioned earlier, a HEX sequence that ends with an 0F instead of an 0E, e.g., HEX(020400040F), selects an attribute but does not activate it. Normal intensity will be activated. Consider this example:

```
 CLEAR
 5 PRINT HEX(03)
10 PRINT "SEQUENCES ENDING IN 0F"; HEX(0A)
20 PRINT HEX(020400020F); "WE HAVE SELECTED THE REVERSE VIDEO
ATTRIBUTE, BUT WE HAVE NOT ACTIVATED IT."
30 PRINT "NORMAL INTENSITY IS ACTIVATED INSTEAD."
RUN
```

3.3.6 Using Screen Clear and Character Display Attributes

The control code HEX(03) clears the screen and homes the cursor, but otherwise has no effect on the attribute currently in use. Execute the following program:

```
 CLEAR
  5 PRINT HEX(03)
 10 PRINT HEX(020400020E); "SELECTING REVERSE VIDEO"
 20 SELECT P 9
 30 PRINT "THESE TWO LINES WILL APPEAR ONLY BRIEFLY."; HEX(0A)
 40 SELECT P
 50 PRINT HEX(03)
 60 PRINT "EXAMPLE 8 - EFFECT OF SCREEN CLEAR ON ATTRIBUTES"; HEX(0A)
 70 PRINT "SCREEN CLEAR - HEX(03) - WILL NOT EFFECT THE CURRENT
ATTRIBUTE."; HEX(0A)
 80 PRINT "NOTICE THAT REVERSE VIDEO IS STILL IN EFFECT."
 90 PRINT HEX(0F)
RUN
```

Line 10 selects and activates the reverse video attribute for the first two lines. Line 20 causes a 1.5 second pause after the text of Line 30 is output so that the text of Lines 10 and 30 remains on the screen long enough to be read. Line 40 selects "pause off" for the remainder of the program. A screen clear, which clears the screen to black, is issued by Line 50. However, the reverse video stays in effect even though a screen clear was issued. Notice that the three lines of text (Lines 60, 70, and 80) all appear on the screen in reverse video. (Refer to Figure 3-8.) The HEX(0F) in Line 90 turns off the reverse video attribute and restores normal intensity.

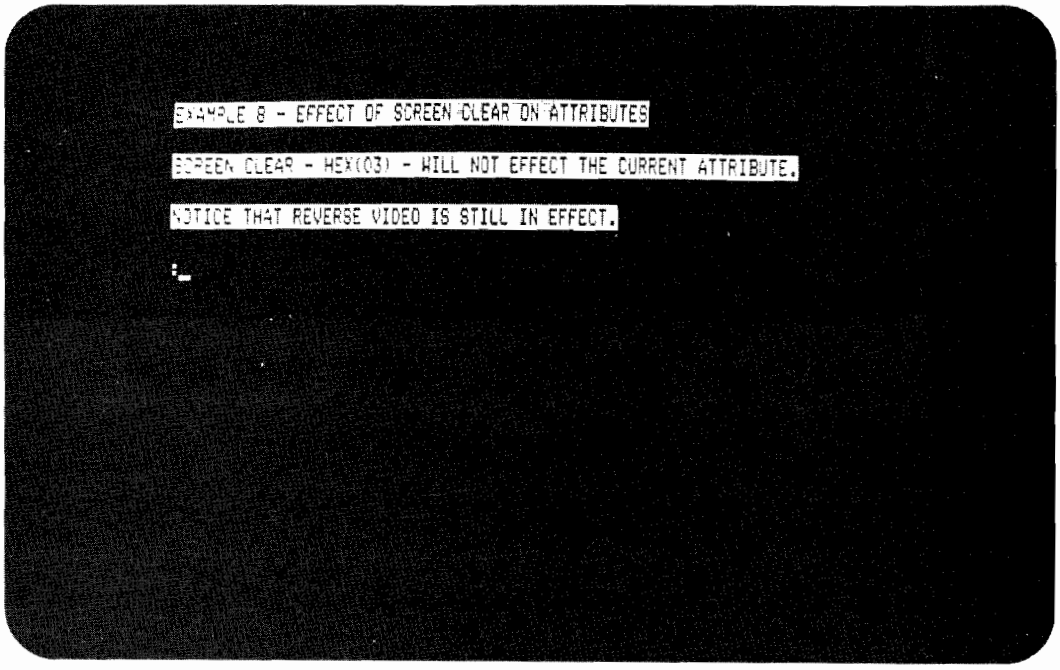


Figure 3-8. Effect of Screen Clear on Display Attributes

3.3.7 Reverse Video Spaces

Programmers should realize that reverse video spaces are white, not black. The next example shows how white spaces appear on the screen when using PRINT TAB statements. If the reverse video attribute is turned on, tabbing any number of spaces will produce white spaces on the screen. To prevent the appearance of white spaces, tab the required number of spaces before turning on the reverse video attribute. Note the different location of the HEX(0204...) sequence with respect to the TAB statement in Lines 20 and 30. Observe the screen display produced by each statement. (Refer to Figure 3-9.)

```
 CLEAR
 5 PRINT HEX(03)
10 PRINT "EXAMPLE 9 - REVERSE VIDEO SPACES"; HEX(0A)
20 PRINT HEX(020400020E); TAB(25); "NOTE THE WHITE REVERSE VIDEO
SPACES."; HEX(0F0A)
30 PRINT TAB(25); HEX(020400020E); "REVERSE VIDEO"; HEX(0F)
RUN
```

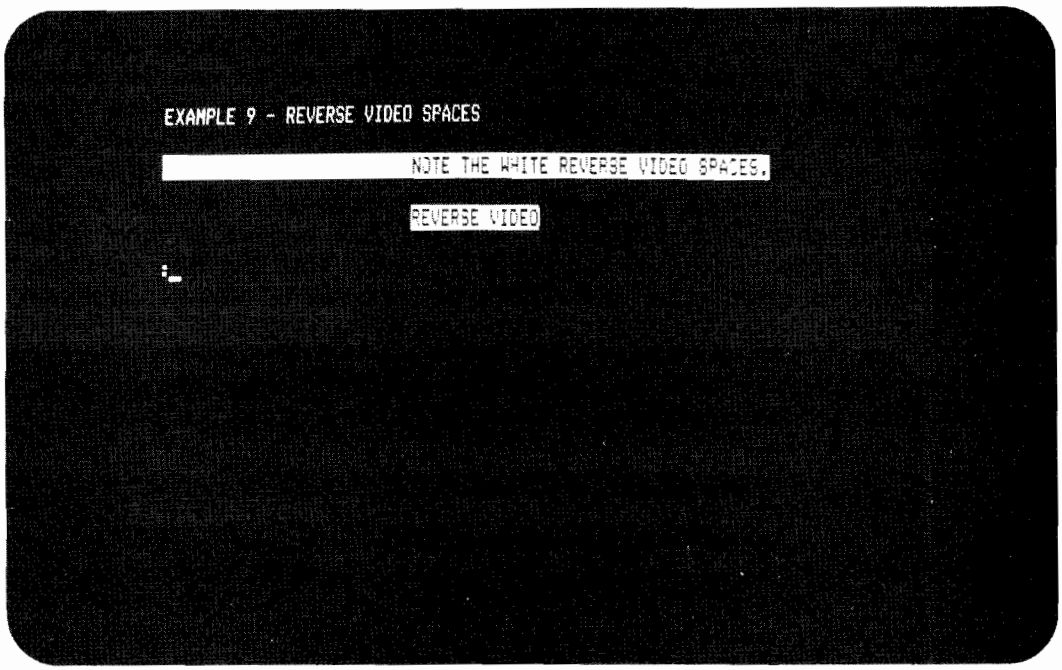


Figure 3-9. Reverse Video Spaces

3.3.8 Special Uses of Alternate Display Attributes

1. LIST D

   The CPU sends out a HEX(0E) at the beginning of each REM% statement in the program. Thus, comment statements appear in the most recently selected alternate display attribute.

2. 100 PRINT "PROMPT";: LINPUT HEX(0E), A$: PRINT A$

   The field to be entered appears in the most recently selected alternate display attribute. When entry is terminated with a carriage return, the alternate attribute is cancelled, so the PRINT statement prints A$ in normal intensity.

3. 150 PRINT HEX(0E); "PROMPT"; HEX(0F);

   160 LINPUT A$

   Only the prompt appears in the most recently selected alternate attribute.

3.3.9 Summary of Display Attribute Rules

The following list contains the general rules discussed in the previous sections for governing the use of display attributes.

1. HEX(02 04 xx yy 0E) selects and activates a display attribute. Attributes activated in this manner are turned off only by HEX(0F) or by another HEX(0204...) sequence. The attribute is not turned off by carriage return, HEX(0D). Thus, it is possible to highlight a portion of one or several lines.

2. HEX(02 04 xx yy 0F) selects, but does not activate, a display attribute. Normal intensity is activated instead.

3. An isolated HEX(0E) activates the attribute selected by the last HEX(0204...) sequence for a maximum of one text line. The attribute remains in effect until the occurrence of either an automatic carriage return, a programmed HEX(0D), or a HEX(0F).

4. Rule 1 takes precedence over Rule 3. If an attribute is selected and activated by Rule 1, a subsequent HEX(0E) will not cause the attribute to be turned off by the next carriage return.

5. An isolated HEX(0F) always turns off the alternate attribute and restores normal intensity.

6. Screen clear, HEX(03), clears the screen to black, but otherwise has no effect on the meaning of HEX(0E) or the attribute currently in effect. Likewise, scrolling the screen scrolls in a black line, but otherwise has no effect on attributes.

7. Reverse video spaces are white, not black. Zoned format PRINT statements, i.e., PRINT, PRINT TAB, and the third parameter of PRINT AT, use spaces to clear the screen. These statements will leave white areas on the screen when reverse video is activated.

8. Turning the terminal on and using the RESET key cause normal intensity characters to be selected and the meaning of HEX(0E) to be defined as high intensity.

9. The system considers all codes HEX(00) through HEX(0F) to occupy no space on the output medium. Thus, attribute selection sequences do not cause the system to issue automatic carriage returns or throw off the column count used by TAB and zoned format PRINT statements.

10. Control codes HEX(00) through HEX(0F) do not have attributes. It is not possible to change the attribute of a character by passing the cursor through it with a PRINT AT statement.

11. The meaning of isolated HEX(0E) is maintained by the terminal, not the partition. If a program gives up control of the CRT with $RELEASE TERMINAL, there is a good chance that a program in another partition will change the meaning of HEX(0E) in the course of using attributes.

3.4 SELECTION OF CHARACTER SETS

The Interactive Terminal actually offers two character sets: the normal character set (refer to Figure 3-10) and the alternate character set (refer to Figure 3-11). The following sequence is used for selecting either character set.

```
HEX (02 02 xx 0F)
```

where:

02 02 = The control code sequence which indicates to the terminal that a character set will be selected.

xx = A HEX code specifying the character set to be selected.

If xx = 00 The normal character set is selected. The codes HEX(90) to HEX(FF) are underlined versions of characters from HEX(10) to HEX(7F).

If xx = 02 The alternate character set is selected. The codes HEX(80) to HEX(FF) represent the graphic characters and symbols.

0F = A terminator character that signals the end of the character selection sequence.

High-order HEX Digit

Low-order HEX Digit

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	Space	â	_	0	@	P	°	p
1	ê	!	1	A	Q	a	q	♦	ê	!	1	A	Q	a	q
2	î	"	2	B	R	b	r	▶	î	"	2	B	R	b	r
3	ô	#	3	C	S	c	s	◀	ô	#	3	C	S	c	s
4	û	$	4	D	T	d	t	→	û	$	4	D	T	d	t
5	ä	%	5	E	U	e	u	⌙	ä	%	5	E	U	e	u
6	ë	&	6	F	V	f	v	|	ë	&	6	F	V	f	v
7	ï	'	7	G	W	g	w	··	ï	'	7	G	W	g	w
8	ö	(	8	H	X	h	x	'	ö	(	8	H	X	h	x
9	ü	)	9	I	Y	i	y	`	ü	)	9	I	Y	i	y
A	à	*	:	J	Z	j	z	^	à	*	:	J	Z	j	z
B	è	+	;	K	[	k	§	■	è	+	;	K	[	k	§
C	ù	,	<	L	\	l	£	!!	ù	,	<	L	\	l	£
D	Ä	-	=	M	]	m	é	↕	Ä	-	=	M	]	m	é
E	Ö	.	>	N	↑	n	ç	ß	Ö	.	>	N	↑	n	ç
F	Ü	/	?	O	←	o	¢	¶	Ü	/	?	O	←	o	¢

Figure 3-10. The Normal Character Set

High-order HEX Digit

Low-order HEX Digit	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	.	•						
1	ê	!	1	A	Q	a	q	♦	◇						
2	î	"	2	B	R	b	r	▶	▲						
3	ô	#	3	C	S	c	s	◀	▼						
4	û	$	4	D	T	d	t	→	↓						
5	ä	%	5	E	U	e	u	⌙	¬						
6	ë	&	6	F	V	f	v	|	√						
7	ï	'	7	G	W	g	w	··	◦						
8	ö	(	8	H	X	h	x	'	{						
9	ü	)	9	I	Y	i	y	`	}						
A	à	*	:	J	Z	j	z	^	⅄						
B	ë	+	;	K	[	k	§	■	□						
C	ù	,	<	L	\	l	£	!!							
D	Ä	-	=	M	]	m	é	↕							
E	Ö	.	>	N	↑	n	ç	ß							
F	Ü		?	O	←	o	¢	¶							

Figure 3-11. The Alternate Character Set

Programmers are reminded that any character of either character set can be underlined by using the underline character attribute (refer to Section 3.3). Either character set may differ on foreign language versions of the Interactive Terminal. All versions of the terminal are capable of producing uppercase alphabet, numbers, and most of the special characters used in BASIC programming.

In the character set selection, the following items should be noted:

1. With the exception of the HEX(80) code, the characters represented by the codes HEX(10) to HEX(8F) are identical in both the normal and the alternate character sets.

2. In the alternate character set, the codes HEX(9C) to HEX(BF) are presently undefined and reserved for future expansion. Any use of these codes involves the risk of being incompatible with future use of the terminal.

The 64 graphic characters HEX(C0) through HEX(FF) are represented by all the combinations of sixths of a character space, where the character space is divided as shown in Figure 3-12. When displayed, graphic characters are extrapolated to fill the entire character position. For this reason, adjacent areas of two graphic characters will touch; thus, continuous lines (bars) of light or dark areas can be displayed on the screen. When combined with display attributes, character graphics are useful for the construction of bar graphs, histograms, and other special displays.

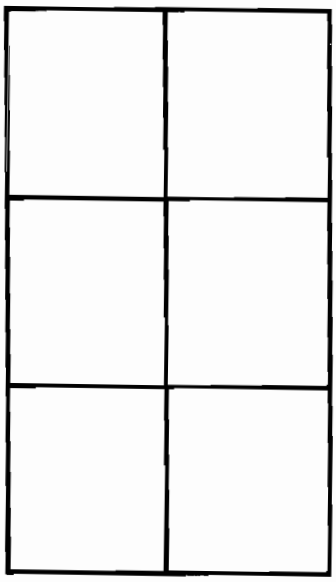


Figure 3-12. Division of a Character Space

3.4.1 Examples of the Character Sets

```
PRINT HEX(02 02 00 0F); HEX(D5 CE C4 C5 D2 CC C9 CE C5 C4)
```

This statement selects codes 90-FF to represent normal characters 10-7F with underline. Thus, an underlined "UNDERLINED" is displayed on the screen.

```
PRINT HEX(02 02 02 0F); HEX(FF FC F0);
```

This statement selects the alternate character set and displays three character boxes of decreasing heights (). These are the characters most useful for constructing vertical bar graphs.

3.4.2 Summary of Character Set Selection

The rules concerning the use of character set selection can be summarized as follows:

1. HEX(02 02 00 0F) selects the normal character set. The codes HEX(90) through HEX(FF) are defined to be the normal characters HEX(10) through HEX(7F) with underline.

2. HEX(02 02 02 0F) selects the alternate character set. The codes HEX(80) to HEX(FF) represent the graphic characters and other special symbols.

3. Turning on the terminal and pressing RESET select the default character set (the normal character set for the standard USA Model 2436DW).

4. Carriage return does not affect character set selection. The sequences given in Rules 1 to 3 are the only methods for changing character sets.

5. As with attributes, the character set selection sequences affect the interpretation of characters at the time they are received by the terminal. Therefore, underlined and graphic characters may be used in different areas of the same display. Once on the screen, a character is modified only by striking over it with another character or by screen clear.

6. All display attributes (described in Section 3.3) can be used with both the normal and the alternate character set.

3.5 PRINT BOX FUNCTION

The Interactive Terminal provides box graphics for the Wang BASIC-2 language.

General Form:

```
BOX (height, width)
```

where:

height = Expression specifying the height of the box; each unit is the height of a character space.

width = Expression specifying the width of the box; each unit is the width of a character space.

Purpose

The BOX function is used within a PRINT statement to draw or erase a box or line on a CRT which has box graphics capability. The first expression specifies the height of the box; the second is the width of the box. The sign of the arguments determines whether lines are drawn or erased. Positive signs instruct the system to draw lines; negative signs instruct the system to erase lines.

If the box height is zero, the system draws or erases a horizontal line, depending on whether the width is positive or negative. A width of zero causes a vertical line to be drawn or erased. The BOX function positions the box so that its upper left-hand corner is at the current cursor position. Drawing a box does not move the CRT cursor.

Examples

```
PRINT BOX (3, 4);                          -- Draws a 3 x 4 box

PRINT BOX (-3, -4);                        -- Erases a 3 x 4 box

PRINT BOX (0, X);                          -- Draws a horizontal line
                                              X units long

PRINT BOX (-7, 0);                         -- Erases a vertical line 7
                                              units long

PRINT AT (5, 10); BOX (1, 6); " TITLE"     -- Displays TITLE enclosed
                                              in a box
```

Note that in order to include the field TITLE in the last example, the box had to be one character wider than the length of the field, and the left edge of the box had to be one character position to the left of the field to be enclosed. Therefore, to box a field in general, use the statement:

```
PRINT BOX (1, LEN(A$)+1); " "; A$
```

where A$ is the given field, and LEN(A$) is the length of the field A$.

Box graphics can also be used for highlighting entry fields as shown in the following example.

```
CLEAR
10 PRINT "PROMPT"; BOX(1, 17);:LINPUT A$
RUN
```

3.5.1 Box Graphics

The Interactive Terminal can display continuous horizontal or vertical lines, enabling forms to be drawn or information to be separated by lines or boxes. Horizontal lines are drawn at the top of a character space. The horizontal line unit is a line segment the width of a character space, but positioned from the middle of one character space to the middle of the next character space. Horizontal lines are displayed between rows of characters.

```
PRINT AT(10,15); BOX (0,5); "HELP"
RUN
```

```
____
HELP
```

The vertical line unit has the height of a character space. Vertical lines are drawn through the middle of a character space; the line coexists with the character at that location. (Note that since the height and width of a character space are not the same unit measurement, boxes are not drawn proportionally. However, because of these measurements, you can easily box fields of characters.)

Figures 3-13 and 3-14 illustrate the placement of box graphic lines. Figure 3-13, which shows the smallest possible box, was produced by the statement PRINT BOX(1,1); "AB". It illustrates the placement of horizontal and vertical box graphic lines relative to the character position. Figure 3-14, which was produced by the statement PRINT BOX(1,1); HEX(0202020F); HEX(E1CC), demonstrates where box graphic lines appear relative to character set graphic characters.

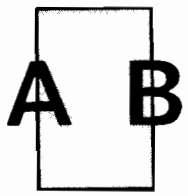


Figure 3-13. Box Graphic Line Placement Relative to Character Position

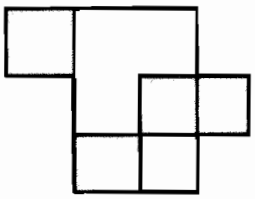


Figure 3-14. Box Graphic Line Placement Relative to Graphic Character Set

The terminal can be considered as both a box graphics display and a character display that just happen to be displayed on the same screen. While in Character mode, only the characters and their attributes are modified while box graphics remain intact. For example, within a boxed area used to highlight a prompt, the prompt may be rewritten a number of times without altering or erasing the box itself. The one exception to this rule is screen clear, HEX(03), which clears both characters and box graphics. During a box graphics sequence, characters and their attributes are undisturbed.

Because the Character and Box Graphic modes are independent, it is easy to update portions of either display. The third argument of PRINT AT is useful for clearing portions of the display. Though slower than screen clear, the statement PRINT AT (0,0,) is useful for clearing the characters from the screen without disturbing the box graphics.

3.6 THE TIMING OF REPEATING KEYS

As discussed in Section 2.3, a key will repeat if held down for more than one-third of a second. The microprocessor in the terminal automatically adjusts the repeat key rate according to the rate at which characters are being echoed to the CRT.

After the initial key has repeated, the next repeat of the key will be delayed until

1. At least one character is output to the CRT in response to the last key sent.

2. Output to the CRT has ceased for either 1/15 of a second or two character times the terminal data rate; whichever is the greater.

In most situations, this repeat key strategy prevents operators from typing ahead between fields by holding down a repeat key. In some situations, it may be desirable to use KEYIN to intentionally flush the keyboard buffer of unwanted keystrokes that may have come in between fields.

3.7 THE SELF-IDENTIFICATION MESSAGE

The sequence HEX(0208090F) causes the terminal to transmit to the user program the exact information displayed on the screen at power on time (with the exception of the copyright notice). After the use of a HEX(0208090F) sequence, the terminal "types" the self-identification message. The application program cannot distinguish the message from operator keystrokes. The terminal keyboard is disabled during the transmission of the message. The self-identification message, which consists of several fields separated by spaces, appears on the Model 2436DW CRT screen this way.

```
*2436DW R0101 19200B 8+0 (USA)
```

where:

2436DW	is the model number, preceded by an asterisk
R0101	is the revision number of terminal firmware and keyboard table, preceded by R
19200B	is the data rate, followed by B (baud)
8+0	is the number of data bits (7 or 8); E is even parity, 0 is odd parity, N is no parity
(USA)	is the version of the keyboard and CRT character set, enclosed in parenthesis

The recommended procedure for obtaining the self-identification message from a terminal is with an INPUT statement.

```
05 DIM M$64
10 PRINT "WHAT KIND OF TERMINAL DO YOU HAVE (Default = 2436DW)?"
20 M$ = "2436DW" : INPUT HEX(0208090F), M$
```

3.8 REINITIALIZE TERMINAL

Because the meaning of codes HEX(80) through HEX(FF) differ among international versions of the terminal, the reinitialize sequence is not only necessary, but extremely helpful. The reinitialize sequence, HEX(020D0C030F), restores the terminal to its power-on state. Specifically, the sequence

1. Clears the screen, homes the cursor, and turns the cursor on
2. Selects normal intensity characters
3. Selects bright as the attribute to be activated by HEX(0E)
4. Selects the default character set for that version of terminal

The PRINT HEX(020D0C030F) sequence is comprised of control characters that have traditionally been used to initialize devices. For instance, this sequence causes a screen clear on older CRT devices, such as the 2236D, and causes a form feed on most printers.

3.9 USING KEYIN AND DEAD KEYS

The terminal keyboard support "dead key" operations for underlining and accenting characters (foreign keyboards only). Dead keys are those which do not advance the cursor when pressed. These keyboards have visible accent and underline operations. On these keyboards, the underline or accent code is sent to the CPU preceded by a HEX(FF) code flagging the next code as a special character.

The operating system is designed to handle dead keys in field-oriented statements like LINPUT and INPUT. When you use KEYIN or $GIO to talk to the keyboard on a character by character basis, it becomes your responsibility to properly handle dead keys.

KEYIN sees a dead key as two characters: a HEX(FF) followed by the ASCII code for the underline. The keystroke following a dead key generates the ASCII code for the underlined character. Programs using KEYIN will probably choose to use the HEX(FF) as a signal to display the bare underline without advancing the cursor and store the bare underline mark without advancing the buffer pointer. The keystroke following the dead key will then overstrike the bare underline with the underlined character that the operator intended to enter. The sequence HEX(FF08) is generated when a dead key is followed by a backspace. The program will probably want to take this sequence as a signal to remove the bare underline generated by the dead key, but not to move the cursor.

Foreign language and underline characters whose codes are above HEX(80) are sent to the CPU with the Special Function (ENDI) bit on, in order to distinguish them from text atoms. Foreign language characters thus cause KEYIN to branch to the second line number specified on the KEYIN statement. In summary, the statement KEYIN C$, 10, 20 will branch to Line 10 for the following types of keystrokes.

- Text characters, including backspace, whose ASCII codes are in the range HEX(00) through HEX(7F)
- Text atom keys, such as CLEAR, LOAD, RUN, CONTINUE, whose codes are HEX(80) through HEX(F9)
- Line Erase, HEX(E5)
- Dead key to follow signal, HEX(FF)

The sample KEYIN statement will branch to Statement 20 for the following types of keystrokes:

- Special Function keys -- HEX(00) through HEX(7F)
- Edit key -- HEX(F0)
- Foreign language and underlined characters whose codes are in the range HEX(80) through HEX(FF)

CHAPTER 4
LOCAL AND REMOTE TERMINAL/CPU INTERFACE

4.1 LOCAL CONNECTION

When configured with a 2200 system, each Interactive Terminal is connected to either a Model 2236MXD Terminal Processor, a Model 2236MXE Terminal Processor, or a Model 22C32 Triple Controller. These devices handle I/O operations between the CPU and the terminals; they also buffer data entered from or transferred to the terminals.

One 2236MXD or 2236MXE Terminal Processor can support four terminals. Each CPU can support four processors. The 22C32 Triple Controller supports a single terminal, in addition to a disk drive and a printer. The 2200 system thus can support a maximum of 16 terminals if four processors are used, or 13 terminals if three processors and one triple controller are used.

NOTE

Since 2200/WP Word Processing software requires 28K of user memory per terminal, the maximum number of 2436DW or 2426DW terminals that can simultaneously operate word processing varies with available user memory.

Terminals can be attached locally to the 2200 CPU at distances up to 2,000 feet (606.1 meters), or remotely via modems and telephone lines. Communication between the terminal and the CPU is asynchronous and full-duplex, with selectable line speeds ranging from 300 to 19,200 bits per second (bps). To accelerate communications between the terminals and the CPU, the system performs automatic data compression on information transmitted to each terminal. The following are possible local connections:

- Local Connection -- For distances up to 25 feet (7.6 meters), transmission rates of 19.2K bps are available with direct connection using a Wang-supplied cable. A local connection is the standard configuration.

- Extended-Local Connection -- For distances from 25 feet (7.6 meters) to 2,000 feet (606.1 meters), optional Wang-supplied cables provide direct extended-local connection with transmission rates of 19.2K bps. (Refer to Appendix A for a list of available cable lengths.)

The 22C32 Triple Controller has a fixed communication rate of 19,200 bps. A terminal attached to that controller must be local (i.e., direct connections up to 2,000 feet from the CPU). However, with the 2236MXD or 2236MXE Terminal Processor, transmission rates on a terminal ranging from a minimum of 300 to a maximum of 19,200 bps may be selected. (Possible transmission rates include 300, 600, 1200, 2400, 4800, 9600, and 19.2K bps; where 19.2K equals about 1,750 characters per second.) Both the Model 2236MXD or MXE and the terminal connected to it must be set at the same data transmission rate. The procedure for setting the transmission rate is discussed in Appendix D.

4.2 REMOTE CONNECTION USING MODEMS

Remote use of Interactive Terminals is also possible using the built-in telecommunications capabilities of the 2236MXD or 2236MXE Terminal Processor and the terminal itself. With the addition of the proper modems, the Terminal Processor can communicate with Interactive Terminals over virtually unlimited distances. Speeds ranging from 300 to 9600 bps can be attained by using modems and communications lines supplied by various common carriers and modem vendors.

When the 2236MXD or MXE Terminal Processor is used to transfer information from the CPU to the terminals over common carrier lines, the digital signals of the processor must be translated into corresponding analog signals at the sending end and returned to digital form at the receiving end. The same transformation must be performed on information transferred from the terminal to the CPU. Data is converted from one form to another by using modems, devices which first MOdulate the digital signals and then DEModulate the resultant analog signals.

The Wang WA3451 modem, which can operate at 300 and 1200 bits per second, is the recommended modem for data processing using the 2436DE terminal with switched-line remote terminal connection. The 1200-bps line speed, however, is generally too slow for remote word processing; for this reason, the remote terminal connection of a 2436DW or 2426DW terminal using a WA3451 modem is not recommended for use with 2200 Word Processing software.

For remote terminal operation, one modem is needed at each end. One modem must be located at the site of the 2236MXD or 2236MXE Terminal Processor, and the other modem must be located at the site of the terminal. Both modems must be either the same model or, if they are different models, compatible in order to permit the remote terminal setup to function. In particular, the speed, type of communication, and number of bits must be identical for both modems and appropriate for a 2200 system remote terminal connection.

The type of modem used and the speed of transmission depend largely on the distance which the signals will travel between the modems. The following are possible remote connections:

- Short-Haul Connection -- For distances from 2,000 feet (606.1 meters) to 5 miles (8 kilometers), short-haul modems are used with either private or leased lines. A maximum speed of 9600 bps can be maintained. Equipment designed for long-haul applications may also be used to establish a short-haul connection.

- Long-Haul Connection -- For distances greater than 5 miles (8 kilometers), either switched or leased lines can be used for signal transmission. Depending on the type of line used, obtainable speeds range from 300 to 1200 bps.

Switched lines are accessed through the common carrier's switching system by telephone dialing. The speed on switched lines is usually limited to 1200 bps because the switching apparatus may introduce noise on the line. A leased line presents a faster, but more costly, alternative to a switched line.

Unlike switched lines, a leased line is a communications line leased from a common carrier in the area for the exclusive use of the customer. When a leased line is used to transmit signals, the line is run directly from the CPU to the terminal location and no switching occurs. Information about leased lines and their cost should be obtained from the common carrier in your area.

Communication between the Model 2236MXD or MXE and the terminal uses an asynchronous serial protocol. Data is sent one bit at a time, with each character framed by a number of control bits. The 2236MXD or MXE and the terminal send 11 bits for each character transmitted: 1 start bit, followed by 8 data bits, followed by a parity bit, and ending with 1 stop bit. The start bit indicates the beginning of the character to be transmitted. The following eight bits represent the character which has been sent and the parity bit serves as an error-checking technique.

The 2200 system uses odd parity, i.e., the parity bit is set to logical one or zero so that the total number of logical one bits in the character plus the parity bit is always odd. When either the terminal processor or the terminal receives a character, a count is made to ensure that the number of logical one bits is odd. If the number of logical one bits is even, the error is recognized and the terminal signals this error by displaying a # on the CRT screen or terminal printer and then sounding the audio alarm. (A parity error discovered by the terminal processor results in conversion of the offending character to a #, which is then sent to the terminal.) The stop bit indicates the end of the transmitted character.

In addition to being asynchronous, communication between the 2236MXD or MXE and the remote terminal is full-duplex, enabling data to travel simultaneously from the terminal processor to the terminal and from the terminal to the terminal processor. Therefore, modems used in this system must be full-duplex, capable of asynchronous transmission, and support an 11 bits character.

Asynchronous modems may be either hardwired or acoustically coupled to communications lines. (Refer to Figure 4-1.) Hardwired modems are attached directly to the communications line. A hardwired modem may be attached to a telephone used for dialing a switched line, or it may be the sole device attached to a leased line. When a switched line is used, the modem at the CPU site should be equipped with automatic answer and automatic disconnect capabilities. These features allow communication with remote terminals to be automatically established when the remote station dials the central site, and automatically terminated when the remote station hangs up.

The acoustic coupler is a freestanding modem that is attached to the communications line by an ordinary telephone. The telephone handset is inserted into cups on the acoustic coupler. The telephone picks up the analog signals generated by the modem as audible tones and transmits these tones to the other modem. When audible signals return to the telephone, the acoustic coupler picks them up and converts the audible signals to digital signals. Acoustic couplers are used only with switched lines; hardwired modems can be used with either switched or unswitched (leased) lines.

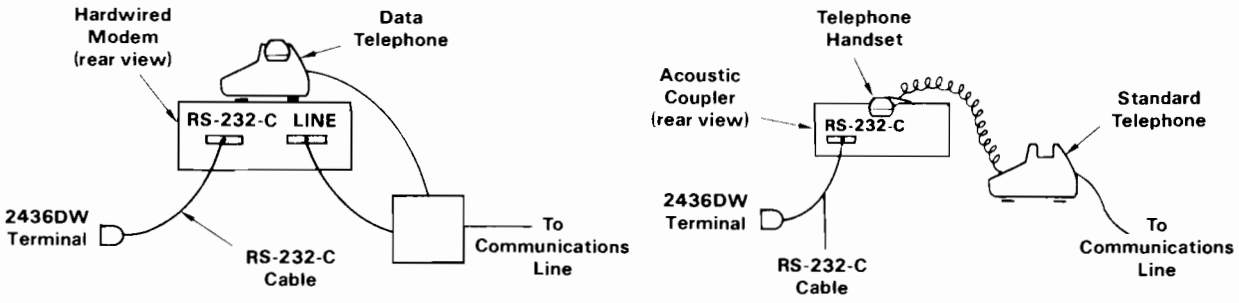


Figure 4-1. Hookup of Hardwired Modem and Acoustic Coupler

Since transmission can occur in two directions simultaneously, the two modems must transmit at slightly different frequencies (tones) to prevent confusion of signals. Therefore, the "originating" or "calling" modem, transmits at a different frequency than the "answering" modem.

Although each modem should be able to transmit as either an originating or an answering modem, only one modem of each type is required for the remote terminal setup to function. Typically, the originating modem is located at the remote site and the answering modem at the central site. This setup allows the remote terminal to initiate the communication. It is possible, however, to set modems up in the opposite manner.

To summarize, the modems used must be

- Asynchronous.
- Full-duplex.
- Same or compatible model.
- Capable of transmitting at least 11 bits per character: one start bit, eight data bits, one parity bit, and at least one stop bit.
- Capable of the desired transmission speed.
- Suitable for the type of line being used.
- Set to the same transmission speed. (The processor and terminal must be able to operate at this speed.)

When choosing modems for a 2200 system remote terminal connection, it is critical to bear the above requirements in mind. Failure to ensure speed compatibility among all components in a communications link is one of the most common sources of error encountered in telecommunications.

4.3 LINE AND MODEM COMBINATIONS

There are four recommended combinations of lines and modems. In all cases, the line speed depends upon the available telecommunications equipment (modems, phones, and lines).

1. Switched line, with hardwired modems at both sites. Available line speeds usually do not exceed 1200 bps. This combination is the most common option. (Refer to Figure 4-2.)

2. Switched line, with an acoustic coupler at the remote site and a hardwired modem at the central site. Available line speeds usually do not exceed 1200 bps. (Refer to Figure 4-3.)

3. Leased line, with hardwired modems at both sites. Available line speeds usually do not exceed 9600 bps. (Refer to Figure 4-4.)

4. Short-haul line (leased line), using short-haul modems at both the remote and central sites. Available line speeds usually do not exceed 9600 bps. (Refer to Figure 4-5.)

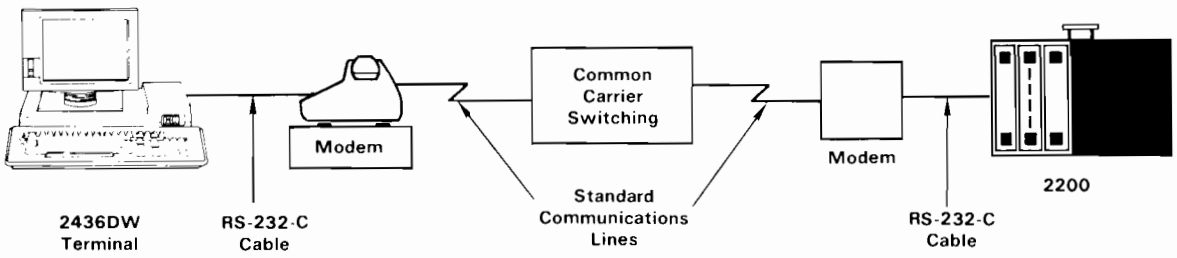


Figure 4-2. Switched Line and Hardwired Modems

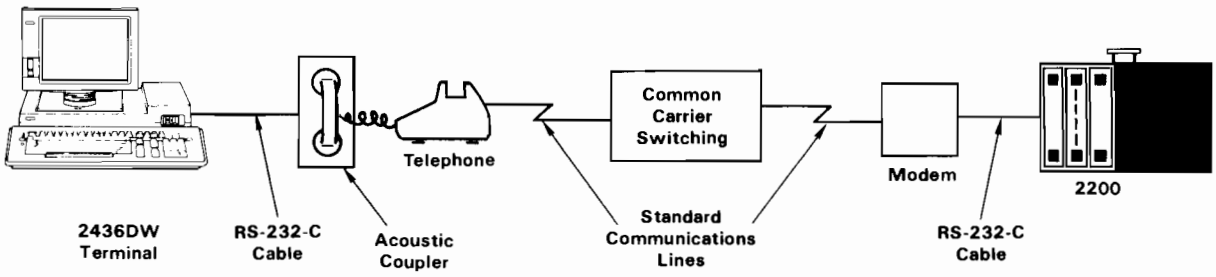


Figure 4-3. Switched Line, Acoustic Coupler, and Hardwired Modem

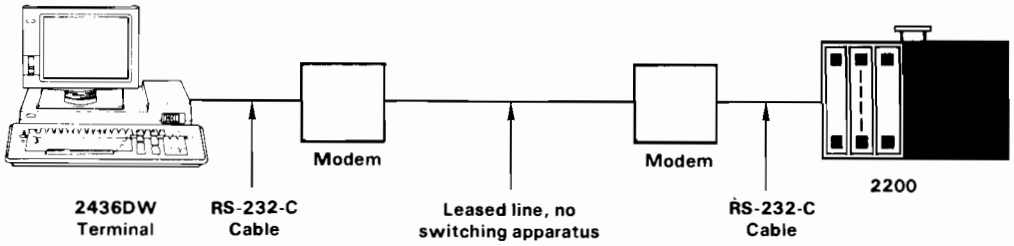


Figure 4-4. Leased Line and Hardwired Modems

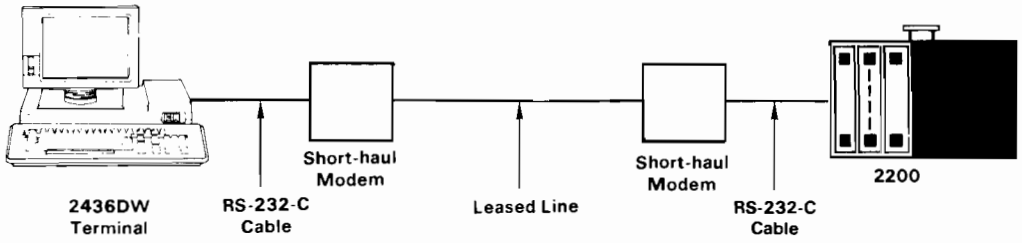


Figure 4-5. Short-Haul Line and Short-Haul Modems

The Interactive Terminal has been designed to allow communication at 1200 bps over switched lines between most points in the continental United States. Over extremely long distances, the protocol used between the terminal and the controller fails because of communication channel propagation delays. Therefore, there are some restrictions imposed on the maximum distance a terminal may be located from the controller.

In general, the common carrier should be consulted for detailed propagation delay specifications before attempting communication via international phone lines, especially satellite channels. Similar restrictions apply to the use of digital data services, such as packet switching networks and line multiplexing devices (e.g., statistical multiplexers).

It is not necessary for the terminal, or the printer attached to it, to keep up with the data stream coming in over the communication line. If the CRT or printer falls behind such that it is beyond the capability of the terminal to buffer the data, the terminal sends a Stop Sending command character to the processor.

Over extremely long communications lines, the time it takes for the Stop Sending command to reach the processor becomes significant. Therefore, although the terminal has sent a Stop Sending command, there is some delay before the processor actually receives the command character. Because of the delay, the processor receives the Stop Sending command after it has transmitted characters to the terminal. This delay between the cause of an event (the need to send a Stop Sending command) and the effect of an event (terminal processor awaits command) may be defined as hysteresis.

Non-Wang communication equipment (modems, communication channel, etc.) may not impose more than 64 characters of hysteresis round trip between the terminal and the processor if terminal buffer overruns are to be prevented. The 64 characters may be the result of time delays and/or digital buffering. (If data is lost over a long communication line, try lowering the data rate.) The most common situation is the case in which a time delay is caused by a long communication line. In such a case, it is useful to express the allowable network hysteresis in terms of time.

$$\text{Time in seconds} = \frac{(64 \text{ char}) * (11 \text{ bits/char})}{(\text{DATA RATE in bits/second})}$$

At 1200 bps, 64 character times works out to about 1/2 second keystroke echoing delay. However, it is not wise to push the terminal to its 64-character limit, as the keystroke echoing time begins to become objectionable.

4.4 SETTING UP THE DATA LINK

Once the transmission speed, type of line, and location of the remote terminal have been selected, setup of the remote terminal system may begin. A modem must be selected and either purchased, rented, or leased from a vendor. Connecting non-Wang modems to the communications line is the responsibility of the modem vendor or the common carrier providing the line; it is not the responsibility of Wang Laboratories, Inc.

When the modems are installed, the customer must contact a Wang service representative, who will then connect the 2236MXD or MXE Terminal Processor and the Interactive Terminal to the modems. The connection must be made using RS-232-C compatible cable and not the standard processor/terminal connecting cable. The RS-232-C cable is available in the following lengths:

- 12 feet (3.7 meters) Part # 120-2227-12
- 25 feet (7.6 meters) Part # 220-0219
- 50 feet (15.2 meters) Part # 220-0220

Two cables are required for each remote terminal; one cable is connected directly between a port on the terminal processor and the modem at the central site, and the second cable is connected between the terminal and the modem at the remote site. (Refer to Figure 4-6.) No special communications controller or emulation software is necessary to operate the remote terminal since all appropriate electronics are built into the processor and terminal. The terminal connected to Port 1 of the primary terminal processor is designated as Terminal 1. Do not use Port 1 on the primary terminal processor to support a remote terminal. Terminal 1 should reside in the same area as the CPU because this terminal acts as the system console for Master Initialization when the system is turned on and is responsible for reporting and correcting system errors.

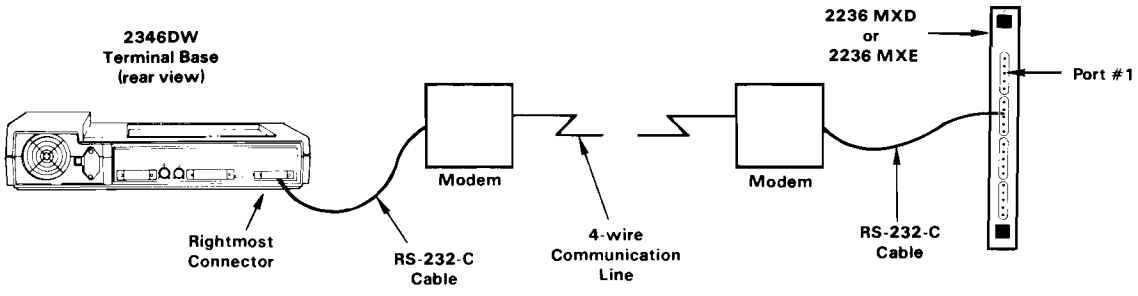


Figure 4-6. Cable Connections for Remote Terminal Operation

4.5 ESTABLISHING COMMUNICATION

Once the installation process is complete and the modems are set for asynchronous, full-duplex operation, and once all components are set to the same transmission rate, the remote terminal setup is complete. The next step is to establish communication between the remote terminals and the CPU. Once communication is established, the remote terminal behaves exactly as if it were a locally connected terminal.

One common setup involves an acoustic coupler at the remote site, a switched line, and a hardwired modem at the CPU site. To establish communication, the operator at the terminal site turns on the power to all equipment and dials the number of the line to which the terminal processor's modem is attached. If the modem attached to the terminal processor is not an automatic answering model, an operator at the central site must answer the telephone and ready the central site by pressing the telephone button which sets that end of the link to the Data mode. Pressing this button allows the modem to begin transmission.

If the modem has an automatic answer feature, the line is "picked up" without operator intervention. In either case, the terminal operator then hears a high-pitched tone on the telephone. The telephone handset should then be placed in the cups of the acoustic coupler. The orientation of the telephone handset must conform to the explanation noted on the modem itself or contained in the accompanying instructions. An indicator on the acoustic coupler illuminates when a proper connection has been made. The CRT screen should display the READY (BASIC-2) message at this point. If no message appears, RESET should be keyed; the message will then be displayed.

If hardwired modems are used at both ends of a switched communications link, the procedure for establishing communication between the remote terminals and the CPU resembles the procedure used when an acoustic coupler is located at the remote site. When hardwired modems are located at both sites, however, the operator at the terminal site presses the talk button before dialing the number, listens for the high-pitched tone, and then presses the button on the telephone for the Data mode to establish communication. An indicator on the modem lights up when the proper connection has been made. Again, if the modem at the CPU site does not have an automatic answer feature, operator intervention at that site is necessary to establish the link.

In the case of a leased line, the modems are always active and the line is always open. No special procedures are necessary to establish a communications link.

The vendor or common carrier supplying the modem should establish all modem switch settings at the time of installation. Transmission rate switches on the terminal and 2236MXD or MXE Terminal Processor should be set by a Wang service representative at the time of installation. It should not be necessary to set any switches when the communications link is established.

If a link cannot be established, the following procedures should be observed:

1. Ensure that all power switches at both the remote and central sites are set to ON (including power to modems). Check that the 2200 system is operational and ensure that its configuration includes at least one partition assigned to the terminal processor port corresponding to the remote terminal. Check that all connections are intact and that the modem at the central site is plugged into the correct port on the terminal processor.

2. Check that the transmission speeds selected for both modems, the terminal processor port to which the central modem is attached, and the terminal are in agreement. Refer to Appendix D for information on changing the transmission speed.

3. Examine the Data Set Ready (modem ready) indicator on each modem to ensure that a connection was made. If the indicator is not lit up, follow the normal procedure for establishing the telecommunications link. If this approach fails, continue with Procedure 4.

4. The terminal depends on the terminal processor for character echo. Each keyed character is transmitted to the terminal processor, which then sends the same character back to the CRT for display. No screen output will appear on a remote CRT if data is not being sent back to the terminal from the terminal processor.

   It is useful to isolate the terminal from the terminal processor to determine if the terminal is functioning properly. Most modems have test settings called "local test" or "loop back". These settings allow the terminal to send characters from the keyboard to the modem, which then transmits these characters directly to the CRT. (These tests may be performed by the customer or the modem supplier.) If these tests generate screen output, the line itself or the equipment at the central site may be the source of the problem. If tests at the central site indicate no local trouble, call the common carrier who supplied the communications line. (Step 5 outlines tests to be performed at the central site.)

If no echo is observed at either the remote or the central site after performing this procedure, the modem supplier should be contacted and the modems tested. If the modems are operational, contact the common carrier and determine whether the communications line is functioning properly. The common carrier can test modem operation from a central site, in which case a field visit is not required.

5. If the remote site is free from problems, both the modem and the terminal processor at the central site should be checked. The modem may be checked as in Step 4, using a local terminal and the RS-232-C compatible cable. The terminal processor may be tested by configuring the system with one partition for each terminal port on the system and then, using standard terminal cable, attaching a local terminal to each port in succession.

   If the modem test fails, contact the modem vendor. If the terminal processor does not function properly, contact a Wang service representative.

6. If all other components are functioning properly, yet no link can be established, contact a Wang service representative.

APPENDIX A
MODEL 2436DE/DW TERMINAL SPECIFICATIONS

Terminal Size

Height	11.8 in. (30.0 cm)
Depth	10.8 in. (27.4 cm)
Width	13.0 in. (33.0 cm)

Terminal Weight

14 lb (6.4 kg)

CRT

Display Size	12 in. diagonal (30.5 cm)
Capacity	24 lines, 80 characters/line
Character Height	0.16 in. (0.41 cm)
Character Width	0.09 in. (0.23 cm)

Electronics Unit Size

Height	4.38 in. (11.13 cm)
Depth	14.25 in. (36.20 cm)
Width	18.88 in. (47.96 cm)

Terminal Base Weight

13.0 lb (5.85 kg)

Character Set

128 characters, including uppercase and lowercase letters; each character is assigned one or more attributes for high- or low-intensity display, blinking, reverse video, or underlining. Additional alternate character set consisting of 64 graphic characters and other special symbols is supplied. Also capable of displaying line-segment (box) graphics, separate from either character set.

Keyboard Size

Height	2.75 in. (6.99 cm)
Depth	9.00 in. (22.9 cm)
Width	21.5 in. (54.6 cm)

Keyboard Weight

10 lb (4.5 kg)

Keyboard Features

Typewriter keyboard which can generate 88 different ASCII characters, including uppercase and lowercase letters, numbers, and symbols. Also included are a numeric keypad, several Program Control keys, and 17 user-definable Special Function keys: 16 numbered keys along the top of the keyboard and one key labeled FN located in the upper left corner of the alphanumeric keyboard zone. Each Special Function key can be used with the SHIFT key for a total of 34 Special Function keys.

Operating Environment

Temperature
  50°F to 90°F (10°C to 32°C)
Relative Humidity
  35% to 65% noncondensing (recommended)
  20% to 80% noncondensing (allowable)

Electrical Requirements

115 or 220 VAC ± 10%
50 or 60 Hz ± 1.0 Hz

Communication Mode

Asynchronous, full-duplex

Transmission Rates

Manually selectable for each terminal at 300, 600, 1200, 2400, 4800, 9600, or 19.2K baud

Character Format

When communicating with a 2200 system:
  1 start bit, 1 stop bit
  8 data bits, plus odd parity (11 bits/character)
Other selectable character formats:
  8 data bits, no parity
  7 data bits, odd parity
  7 data bits, even parity (10 bits/character)

Terminal/CPU Cable

One 8-ft (2.4 m) cable to power source. One 25-ft (7.6 m) direct connection cable is provided with each terminal, unless an optional direct connection cable is ordered for a terminal. Nonextendable cables (refer to Table A-1) are available for direct connection up to 2,000 ft (606.1 m).

Table A-1. Direct Connection Cables

Length in Feet	Length in Meters	Part Number
25	7.6	120-2236-25
50	15.2	120-2236-50
100	30.3	120-2236-1
200	60.6	120-2236-2
300	90.9	120-2236-3
400	121.5	120-2236-4
500	151.5	120-2236-5
600	181.8	120-2236-6
700	212.1	120-2236-7
800	242.4	120-2236-8
900	272.7	120-2236-9
1,000	303.0	120-2236-10
1,250	378.8	120-2236-11
1,500	454.5	120-2236-12
1,750	530.3	120-2236-13
2,000	606.1	120-2236-14

Modem cables are available optionally in lengths of 12 ft (3.7 m), with extensions of 25 ft (7.6 m) and 50 ft (15.2\m). Combined cable distance however, from Wang equipment to a modem is 50 ft (15.2 m) maximum according to EIA standards.

Table A-2. Modem Cables

Length in Feet	Length in Meters	Part Number
12	3.7	120-2227-12
25	7.6	220-0219
50	15.2	220-0220

APPENDIX B
PREVENTIVE MAINTENANCE AND ENVIRONMENTAL CONSIDERATIONS

B.1 PREVENTIVE MAINTENANCE

It is recommended that the equipment be serviced semi-annually, and a Maintenance Agreement is available to assure this servicing automatically. If no Maintenance Agreement is acquired, any servicing must be arranged for by the customer. A Maintenance Agreement protects the customer's investment and offers the following benefits:

- Preventive Maintenance -- The equipment is inspected semi-annually for worn parts, and adjusted, lubricated, cleaned, and updated with any engineering changes. Preventive maintenance minimizes "downtime" by anticipating repairs before they are necessary.

- Fixed Annual Cost -- When a Maintenance Agreement is bought, only one purchase order for service is issued for an entire year and one annual billing is received. More frequent billing can be arranged, if desired.

Further information regarding Maintenance Agreements can be acquired from your local Sales/Service Office.

NOTE

Wang Laboratories, Inc., neither honors maintenance agreements for, nor guarantees, any equipment modified by the user. Damage to equipment incurred as a result of such modification is the financial responsibility of the user.

B.2 ENVIRONMENTAL CONSIDERATIONS

Temperature -- When the recommended temperature range is exceeded, both component failure rates and the loss of data through distortion of data storage materials are likely to increase.

Airborne Contaminants -- Airborne contaminants can accumulate rapidly on the circuit boards and their components, forming a film which not only prevents adequate heat dissipation from the electronic elements, but also creates leakage paths, causing errors in the system signals. Additionally, dust will cause excessive wear in the disk read/write heads and the oxide coatings of storage media. The filters of all HVAC (heating, ventilating, air conditioning) equipment should be cleaned or replaced regularly. In areas where these filters do not sufficiently remove airborne contaminants, an electrostatic air filter should be installed.

Humidity -- Low humidity increases the probability of static buildup, causes oxide shed in data storage materials, and increases the static charge imparted to carpets and clothing. When the operator comes in contact with the system, the resultant static discharge, which could be several thousand volts, will also cause system errors or destruction of data. High humidity rapidly deteriorates paper stock and magnetic disks and tape. Humidifiers or dehumidifiers should be installed in the environment's heating, ventilating, and air conditioning systems as required.

Static -- Carpeting that is to be installed should be a nonstatic variety. Static carpeting that is already installed must be treated with nonstatic spray, or an electrically conductive mat should be installed under the system operating area and be properly connected to an earth ground to prevent static buildup.

EMI -- Computers and peripherals are susceptible to malfunction due to electromagnetic interference (EMI) from devices such as radio transmitters and industrial motors. EMI can enter the system by conduction through wiring and cabling or by direct radiation. An illustration of EMI is a television which becomes full of "snow" when a car with a poorly tuned engine idles outside (radiated EMI) or someone turns on a hair dryer or vacuum cleaner in the next room (conducted EMI).

To minimize such interference, the 3-prong AC power line should be dedicated to the system, grounded, properly installed in a steel conduit, and isolated from interference-generating devices like office machines, fluorescent lighting, motors, and HVAC units. If these devices are located near the system area, they must be relocated, repaired, or filtered to ensure that they do not disturb the system. (EMI filters, isolation transformers, and line conditioners should be installed on the system's AC power line.) In cases of high residual EMI, it may also be necessary to shield all peripheral cables.

The recommended operating environment is:

Temperature: 50°F to 90°F (10°C to 32°C).

Relative Humidity: 35% to 65%, noncondensing.

Dust: No accumulation should be obvious in a 24-hour period.

Power: Grounded, noise-free, dedicated 115 or 220 VAC ± 10%, 50 or 60 Hz ± 1.0 Hz

Interference: All sources of static electricity, extreme magnetism, and EMI shall be controlled.

APPENDIX C
CONTROL CODES AND CHARACTER SETS

The following charts show the control codes, the character set, and the alternate character set for the CRT of your Interactive Terminal. In the normal character set, the codes HEX(90) to HEX(FF) are underlined versions of characters from HEX(10) to HEX(7F); thus adding HEX 80 to a non-underlined character's HEX value yields the HEX code of its underlined counterpart.

Table C-1. The CRT Control Codes

HEX	Action
00	Null
01	Moves cursor to the home position (top left corner of the CRT)
02	Start of multibyte control sequence
03	Clears the screen and homes the cursor
04	Reserved
05	Cursor on
06	Cursor off
07	Audio alarm
08	Cursor left 1 space (does not erase)
09	Cursor right 1 space (does not erase)
0A	Cursor down 1 line (line feed)
0B	Reserved
0C	Cursor up 1 line
0D	Carriage return
0E	Activates attribute
0F	Attribute off; restores normal intensity

Table C-2. The Multibyte Control Codes

HEX Sequence	Action	Section Reference
0202...0F	Character set control	3.4
0204...0E/0F	Attribute control	3.3
02050F	Blinking cursor	3.2
0208090F	Request self-identification message	3.7
020D0C030F	Reinitializes terminal to power-on state	3.8

High-order HEX Digit

Low-order HEX Digit

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	Space	â	_	0	@	P	°	p
1	ê	!	1	A	Q	a	q	♦	ê	!	1	A	Q	a	q
2	î	"	2	B	R	b	r	▶	î	"	2	B	R	b	r
3	ô	#	3	C	S	c	s	◀	ô	#	3	C	S	c	s
4	û	$	4	D	T	d	t	→	û	$	4	D	T	d	t
5	ä	%	5	E	U	e	u	⌙	ä	%	5	E	U	e	u
6	ë	&	6	F	V	f	v	|	ë	&	6	F	V	f	v
7	ï	'	7	G	W	g	w	··	ï	'	7	G	W	g	w
8	ö	(	8	H	X	h	x	'	ö	(	8	H	X	h	x
9	ü	)	9	I	Y	i	y	'	ü	)	9	I	Y	i	y
A	à	*	:	J	Z	j	z	^	à	*	:	J	Z	j	z
B	è	+	;	K	[	k	§	■	è	+	;	K	[	k	§
C	ù	,	<	L	\	l	£	!!	ù	,	<	L	\	l	£
D	Ä	-	=	M	]	m	é	↕	Ä	-	=	M	]	m	é
E	Ö	.	>	N	↑	n	ç	ß	Ö	.	>	N	↑	n	ç
F	Ü	/	?	O	←	o	¢	¶	Ü	/	?	O	←	o	¢

Figure C-1. The Normal Character Set

High-order HEX Digit

Low-order HEX Digit	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	.	•						
1	ê	!	1	A	Q	a	q	♦	◊						
2	î	"	2	B	R	b	r	▶	▲						
3	ô	#	3	C	S	c	s	◀	▼						
4	û	$	4	D	T	d	t	→	¦						
5	ä	%	5	E	U	e	u	⌙	¬						
6	ë	&	6	F	V	f	v	|	√						
7	ï	'	7	G	W	g	w	··	◦						
8	ö	(	8	H	X	h	x	'	¦						
9	ü	)	9	I	Y	i	y	`	}						
A	à	*	:	J	Z	j	z	^	⅄						
B	è	+	;	K	[	k	ŝ	■	□						
C	ù	,	<	L	\	l	£	!!							
D	Ä	-	=	M	]	m	è	↕							
E	Ö	.	>	N	↑	n	ç	ß							
F	Ü	/	?	O	←	o	¢	¶							

Figure C-2. The Alternate Character Set

APPENDIX D
CHANGING THE TRANSMISSION RATE OF THE TERMINAL AND TERMINAL PROCESSOR

D.1 INTRODUCTION

CAUTION

Equipment modifications made by the user may void the warranty and maintenance agreement. Any damage to equipment caused by unauthorized modifications or attachments is the user's responsibility.

Important

The data transmission rate set at a terminal must equal the baud rate set at the terminal processor's plug for that terminal. If a terminal is attached to a modem, the transmission speed of the terminal must be within the range supported by the modem.

D.2 CHANGING THE TRANSMISSION RATE OF THE 2436DE/DW TERMINAL

To change the data transmission rate of the Interactive Terminal, use the following procedure:

1. Switch the terminal's power off.
2. Locate the transmission rate switch on the back of the terminal base, as pictured in Figure 2-1.
3. The switch settings that correspond to each possible data transmission rate appear in Figure D-1. Set the three uppermost switches to the appropriate positions for the transmission rate desired.

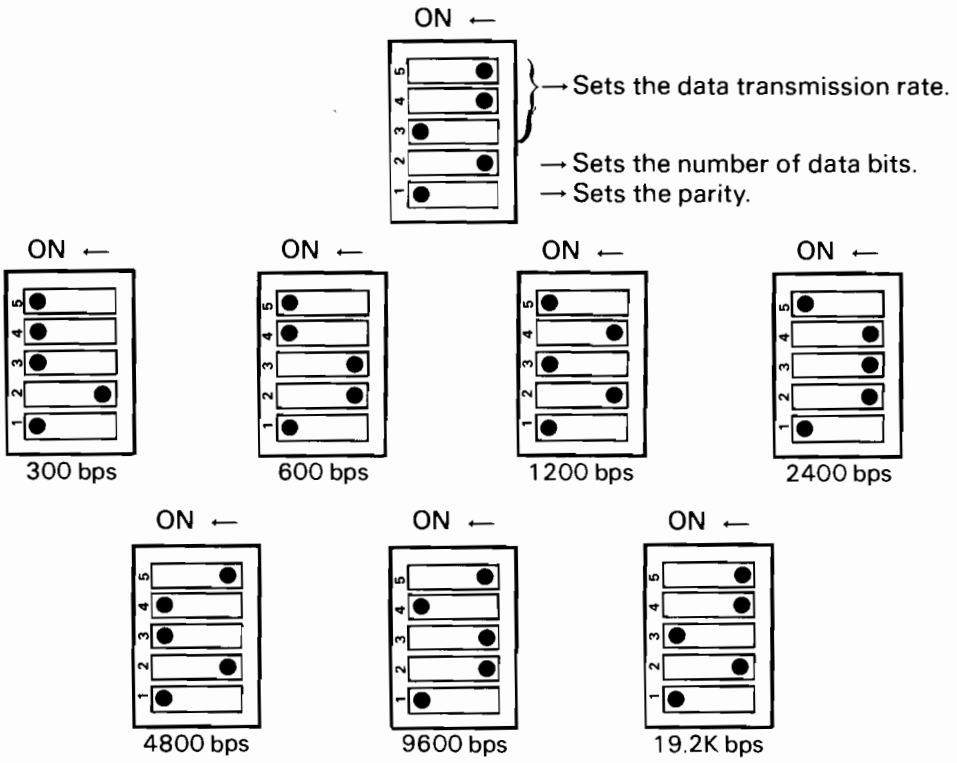


Figure D-1. The Data Transmission Rate Switch Settings on the 2436DE/DW Interactive Terminal

4. Set the number of data bits to 8 and parity to ODD. When using a 2200 system configuration, the number of data bits must be 8 and the parity must be odd.

5. You may now switch on the terminal's power.

6. The terminal will display its "power-on" message [2436DW R0101 19200B 8+0 (USA)] so that the switch settings can be verified. (Refer to Section 3.7 for a discussion of this message.)

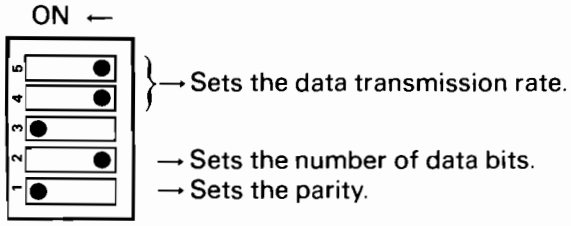
Users are reminded that whenever using a 2200 system, the number of data bits must be 8 and the parity must be odd. However, a user may wish to change the number of data bits or the parity in order to be compatible with other systems. To change either the number of data bits or the parity, perform the following procedure.

To set the number of data bits, move the data bit switch:

- Left for 7 data bits
- Right for 8 data bits

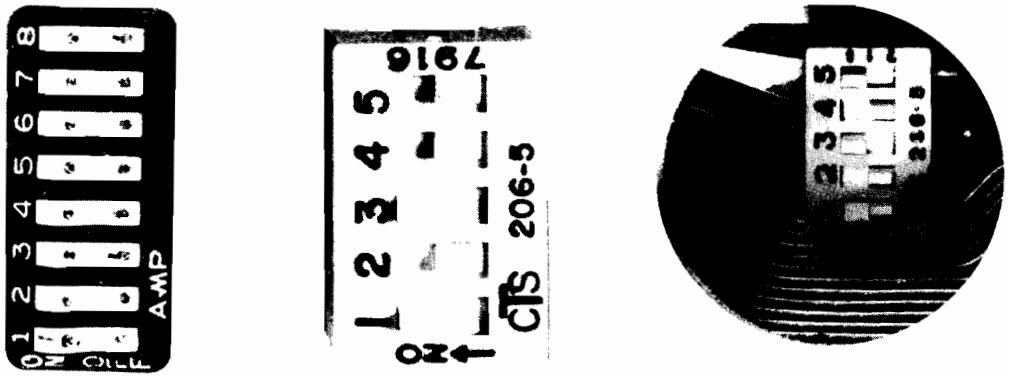
To set the parity, move the parity switch:

- Left for odd parity with 8 data bits
- Left for odd parity with 7 data bits
- Right for no parity with 8 data bits
- Right for even parity with 7 data bits



D.3 CHANGING THE TRANSMISSION RATE OF THE 2236MXD TERMINAL PROCESSOR

With all switch types, one end of the switch is marked On (-). The push-in switch has two white squares, one above and one below each switch's number. When a square at the On end is pressed in, the switch is on and the opposite square projects out. The slide switch requires a sliding motion toward either the On or Off position. The rocker switch operates similarly to the push-in switch. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-2 for an illustration of the three types of switches.)



Rocker Switch **Slide Switch** **Push-in Switch**

Figure D-2. The Three Types of Switches

To change the transmission speed of the Model 2236MXD, perform the following procedure:

1. Power the system down by turning off all terminals and printers, then all disk drives, and finally, the Central Processing Unit (CPU).

2. Loosen the retaining screws that attach the terminal processor to the CPU. Using the two handles on top of the processor, pull the processor board straight up and out of the CPU I/O port.

3. Locate the three 8-bank switches on the processor board used to set the transmission rate (refer to Figure D-3). Note that the processor may have any of the three switch types. Follow the instructions for setting whatever type of switch is installed on the processor.

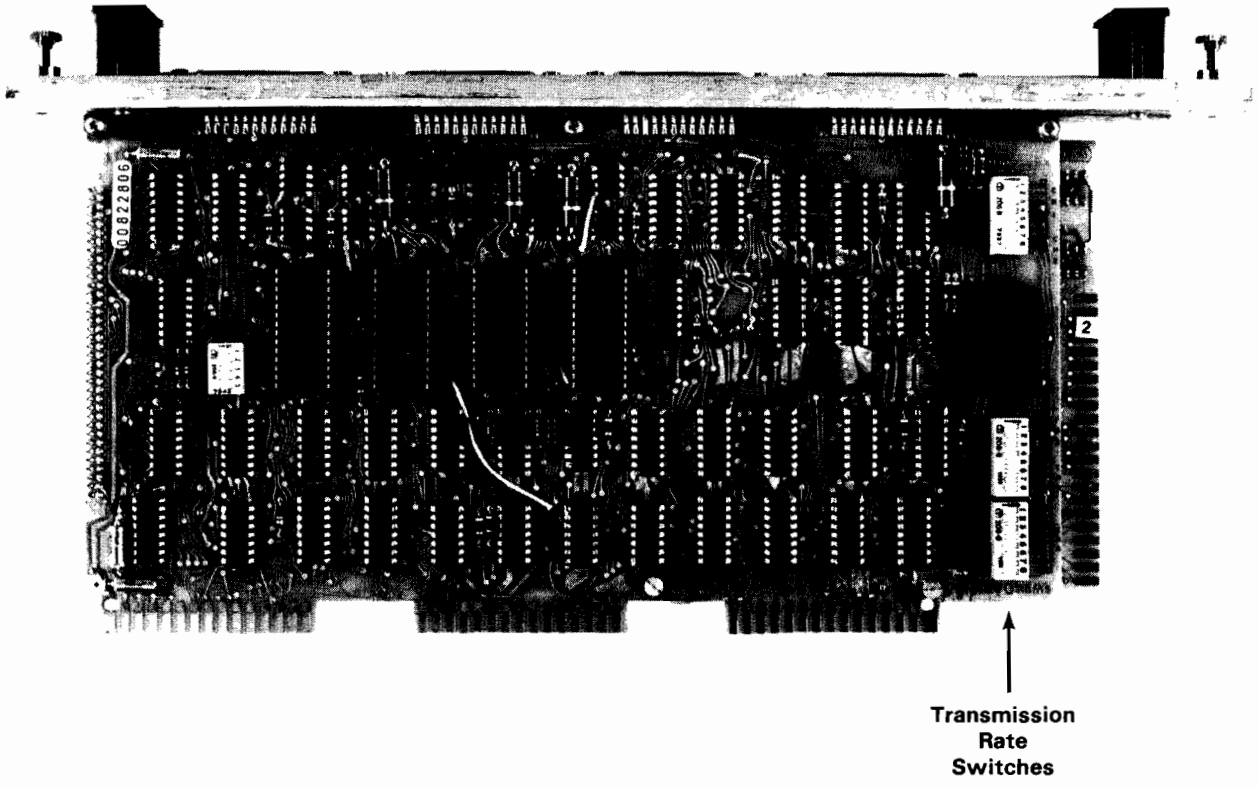


Figure D-3. Transmission Rate Switch Settings on the 2236MXD Terminal Processor

4. The switch position labeled "4800 baud" actually specifies 19.2K bps in normal operation. If 4800-bps operation is required, then the board must be physically modified because the 19.2K bps and 4800 bps rates are mutually exclusive. Contact a Wang service representative for further details.

5. For each terminal, set the corresponding processor switch to the same data transmission rate set on the terminal. The 24 switches are divided into four sets (one set for each terminal). Each set is divided into six switches (one switch for each data rate of each terminal). (Refer to Figure D-3.)

6. After setting the switches, replace the terminal processor in the CPU I/O port and tighten the retaining screws.

7. You may now power on the system. Begin by turning on the CPU, then all disk drives, and finally, all printers and terminals.

D.4 CHANGING THE TRANSMISSION RATE OF THE 2236MXE TERMINAL PROCESSOR

To change the transmission speed of the Model 2236MXE, perform the following procedure:

1. Power the system down by turning off all terminals and printers, then all disk drives, and finally, the CPU.

2. Loosen the retaining screws that attach the terminal processor to the CPU. Using the two handles on top of the processor, pull the processor board straight up and out of the CPU I/O port.

3. Locate the two 8-bank switches on the processor board used to set the transmission rate. (Refer to Figure D-4.) Note that the processor may have any of the three switch types. Follow the instructions for setting whatever type of switch is installed on the processor.

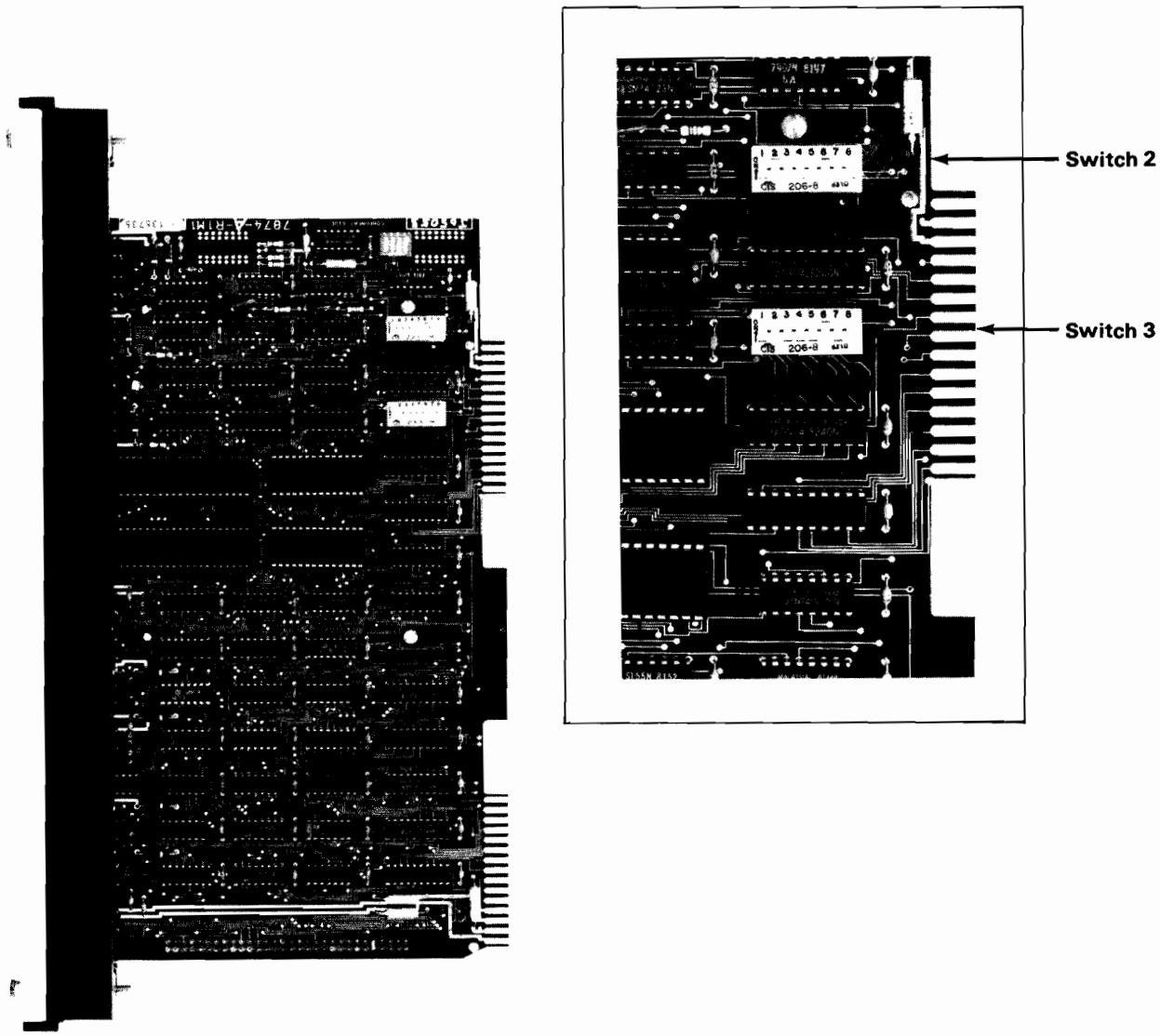


Figure D-4. Transmission Rate Switch Settings on the 2236MXE Terminal Processor

4. Using Figure D-4, note that Settings 1 through 4 on Switch 3 set the transmission rate of Port 1; Settings 5 through 8 on Switch 3 set the transmission rate of Port 2; Settings 1 through 4 on Switch 2 set the transmission rate of Port 3; and Settings 5 through 8 on Switch 2 set the transmission rate of Port 4. If you use more than one processor board, note that the corresponding settings on the second and third boards set the transmission rates for Ports 5 through 8 and 8 through 12, respectively.

Table D-1. Transmission Rate Switch Settings for the Model 2236MXE

Transmission Rate bps	Hex	Switch Settings 1 5	2 6	3 7	4 8
110	0	off	off	off	off
134.5	1	on	off	off	off
150	2	off	on	off	off
200	3	on	on	off	off
300	4	off	off	on	off
600	5	on	off	on	off
1200	6	off	on	on	off
2400	8	off	off	off	on
4800	A	off	on	off	on
9600	C	off	off	on	on
19,200	D	on	off	on	on

5. For each terminal, set the corresponding processor switch to the same data transmission rate set on the terminal. Table D-1 shows the switch settings for each transmission rate.

6. After setting the switches, replace the terminal processor in the CPU I/O port and tighten the retaining screws.

7. You may now power on the system. Begin by turning on the CPU, then the DPU, all disk drives, and finally, all printers and terminals.

APPENDIX E
SETTING THE DEVICE ADDRESS OF THE TERMINAL PROCESSOR

E.1 INTRODUCTION

CAUTION

Equipment modifications made by the user may void the warranty and maintenance agreement. Any damage to equipment caused by unauthorized modifications or attachments is the user's responsibility.

Device address settings for the 2236MXD or 2236MXE Terminal Processors are shown in Table E-1.

Table E-1 Physical Device Address of the Terminal Processor

Number of Terminals	Number of Processors Required	Address Setting of 2236MXD or 2236MXE Terminal Processor
1 to 4	1	The address of the primary processor is always set at address /00. The processor also reserves addresses 01 - 07.
5 to 8	2	The address of the second processor (for terminals 5 - 8) is always set at address /40. The processor also reserves addresses 41 - 47.

(continued)

Table E-1 Physical Device Address of the Terminal Processor

Number of Terminals	Number of Processors Required	Address Setting of 2236MXD or 2236MXE Terminal Processor
9 to 12	3	The address of the third processor (for terminals 9 - 12) is always set at address /80. The processor also reserves addresses 81 - 87.
13 to 16	4	The address of the fourth processor (for terminals 13 - 16) is always set at address /C0.

Note that, unlike other peripheral processors, the physical device address set on the 2236MXD or MXE Terminal Processor is not the address specified in a program for access to the terminal CRT, keyboard, and terminal printers. The programmable device addresses for all terminals are: CRT /005, keyboard /001, and local printers /004. The operating system translates these programmable addresses into the appropriate physical processor addresses.

With all switch types, one end of the switch will be marked On (-). The push-in switch has two white squares, one above and one below each switch's number. When a square at the On end is pressed in, the switch is on and the opposite square projects out. The slide switch requires a sliding motion toward either the On or Off position. The rocker switch operates similarly to the push-in switch. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-2 for an illustration of the three types of switches.)

E.2 THE 2236MXD TERMINAL PROCESSOR

To set the 2236MXD Terminal Processor's physical device address, perform the following procedure.

1. Power the system down by turning off all terminals and printers, followed by all disk drives and accessories, and finally, the CPU.

2. Loosen the retaining screws that attach the processor to the CPU. Using the two handles on top of the processor, pull the processor board straight up and out of the CPU I/O port.

3. Locate the 5-bank switch on the 2236MXD Terminal Processor used to set the device address. (Refer to Figure E-1.) Note that the processor may have any of the three switch types. Follow the instructions for setting whatever type of switch is installed on the processor.

4. For each processor, set the device address as required.

   a. To set the address at /00 -- Place all switches in the Off position. Refer to Figure E-2. (An address of /00 indicates the primary terminal processor, which controls Terminals 1-4.)

   b. To set the address at /40 -- Place the 40 switch in the On position; place all other switches in the Off position. Refer to Figure E-3. (An address of /40 indicates that there are two terminal processors. The second processor, which must be set at /40, controls Terminals 5-8.)

   c. To set the address at /80 -- Place the 80 switch in the On position; place all other switches in the Off position. Refer to Figure E-4. (An address of /80 indicates that there are three terminal processors. The third processor, which must be set at /80, controls Terminals 9-12.)

   d. To set the address at /C0 -- Place the 40 switch and the 80 switch in the On position; place all other switches in the Off position. Refer to Figure E-5. (An address of /C0 indicates that there are four terminal processors. The fourth processor, which must be set at /C0, controls Terminals 13-16.)

5. After setting the address, reinsert the processor in the CPU I/O port and tighten the retaining screws.

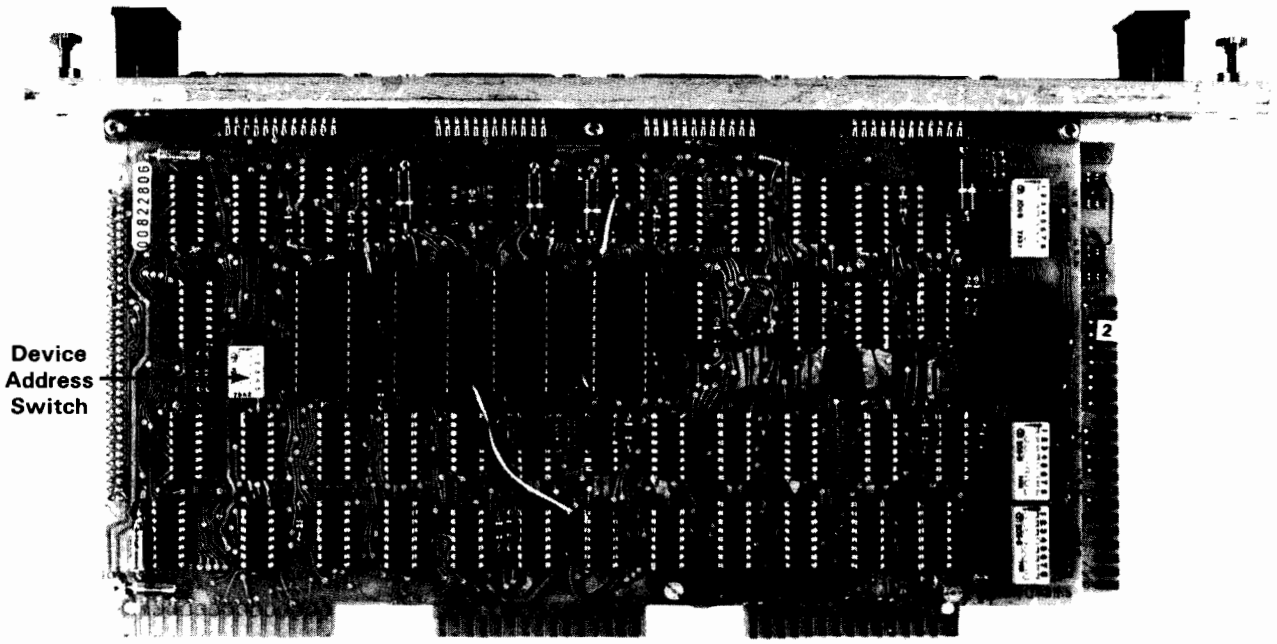


Figure E-1. The Device Address Switch on the 2236MXD Terminal Processor

6. You may now power on the system. Begin by turning on the CPU, all disk drives and accessories, and finally, all printers and terminals.

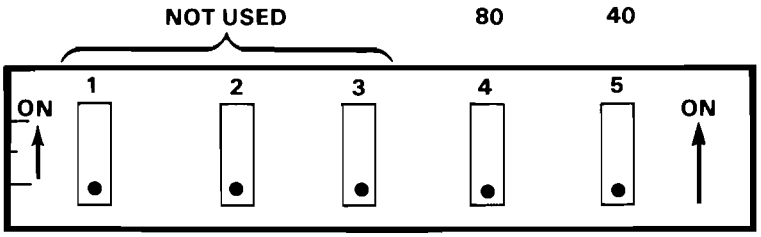


Figure E-2. Device Address /00

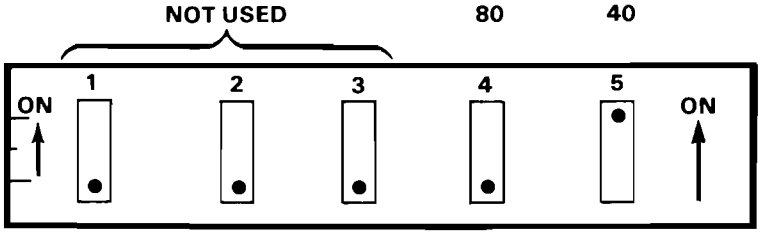


Figure E-3. Device Address /40

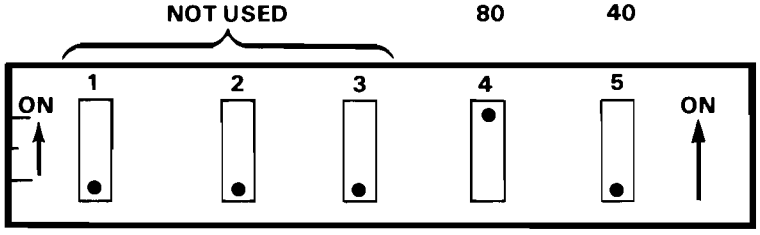


Figure E-4. Device Address /80

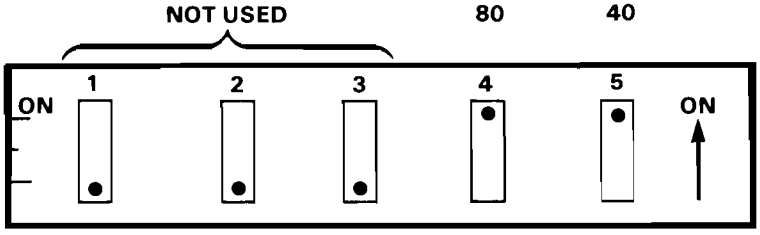


Figure E-5. Device Address /C0

NOTE

Addresses 01--07, 41--47, 81--87, and C1--C7 are reserved for the terminal processor and cannot be used for any other device.

E.3 THE 2236MXE TERMINAL PROCESSOR

To set the 2236MXE Terminal Processor's physical device address, perform the following procedure:

1. Power the system down by turning off all terminals and printers, then all disk drives and accessories, and finally, the CPU.

2. Loosen the retaining screws that attach the processor to the CPU. Using the two handles on top of the processor, pull the processor board straight up and out of the CPU I/O port.

3. Locate the four-bank switch on the 2236MXE Terminal Processor used to set the device address. (Refer to Figure E-6.) Note that the processor may have any of the three switch types. Follow the instructions for setting the type of switch installed on the processor.

4. For each processor, set the device address as required.

   a. To set the address at /00 -- Place all switches in the Off position. Refer to Figure E-7. (An address of /00 indicates the primary terminal processor, which controls Terminals 1-4.)

   b. To set the address at /40 -- Place Switch 1 in the On position; place all other switches in the Off position. Refer to Figure E-8. (An address of /40 indicates that there are two terminal processors. The second processor, which must be set at /40, controls Terminals 5-8.)

   c. To set the address at /80 -- Place Switch 2 in the On position; place all other switches in the Off position. Refer to Figure E-9. (An address of /80 indicates that there are three terminal processors. The third processor, which must be set at /80, controls Terminals 9-12.)

   d. To set the address at /C0 -- Place Switchs 1 and 2 in the On position; place all other switches in the Off position. Refer to Figure E-10. (An address of /C0 indicates that there are four terminal processors. The fourth processor, which must be set at /C0, controls Terminals 13-16.)

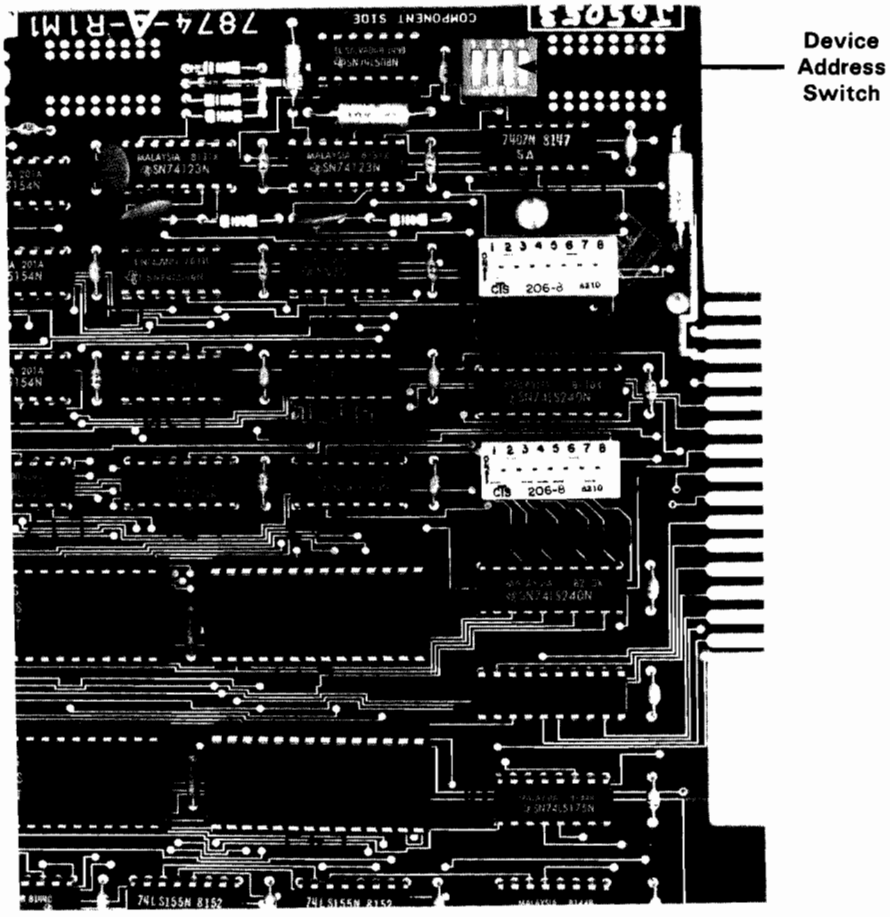


Figure E-6. The Device Address Switch on the 2236MXE Terminal Processor

5. After setting the address, reinsert the processor in the CPU I/O port and tighten the retaining screws.

6. The system may now be powered on. Begin by turning on the CPU, followed by all disk drives and accessories, and finally, all printers and terminals.

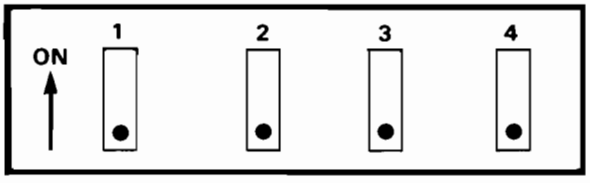


Figure E-7. Device Address /00

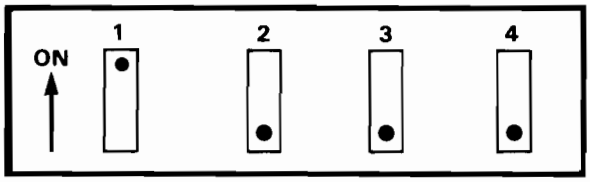


Figure E-8. Device Address /40

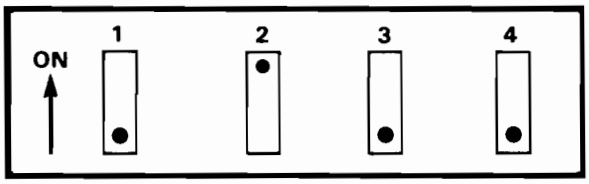


Figure E-9. Device Address /80

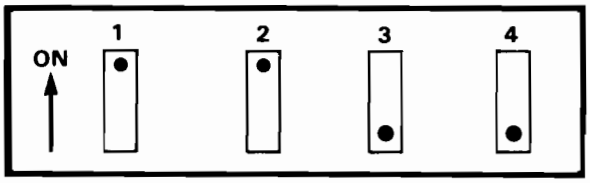


Figure E-10. Device Address /C0

E.4 DETERMINING THE NUMBER ASSIGNED TO THE JACKS

If the processor connectors are not numbered, they can be easily distinguished and identified. On the Model 2236MXE, there is a Light-Emitting Diode (LED) next to Port 1 on the board.

On the Model 2236MXD, the two connectors nearest the handles on top of the processor are always offset so that the plug on one end will be closer to the handle than the plug on the other end of the processor. The jack that is closest to the handle has the highest number. The jack numbers descend sequentially from the end closest to the handle to the opposite end of the processor board. (Refer to Figure E-11.)

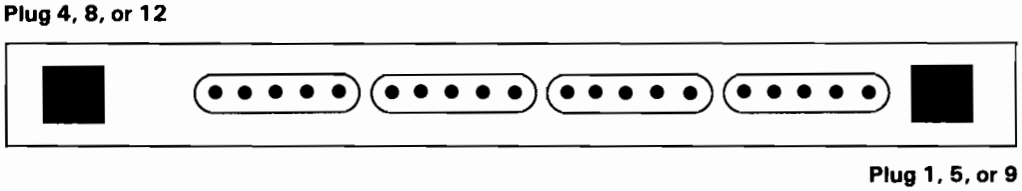


Figure E-11. Determining the Number Assigned to the Jacks on the 2236MXD Terminal Processor

APPENDIX F
SETTING THE DEVICE ADDRESSES ON THE 22C32 TRIPLE CONTROLLER

CAUTION

Equipment modifications made by the user may void the warranty and maintenance agreement. Any damage to equipment caused by unauthorized modifications or attachments is the user's responsibility.

The 22C32 Triple Controller has three switch banks for setting the device addresses of the printer, disks, and terminal. The disk switch bank is closest to the cable connectors, the printer is next, and the terminal switch bank is the lowest, with only five switches in the bank. (Refer to Figure F-1.)

With all switch types, one end of the switch will be marked On(-). The push-in switch has two white squares, one above and one below each switch's number. When a square at the On end is pressed in, the switch is on and the opposite square projects out. The slide switch requires a sliding motion toward either the On or Off position. The rocker switch operates similarly to the push-in switch. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-2 for an illustration of the three types of switches.)

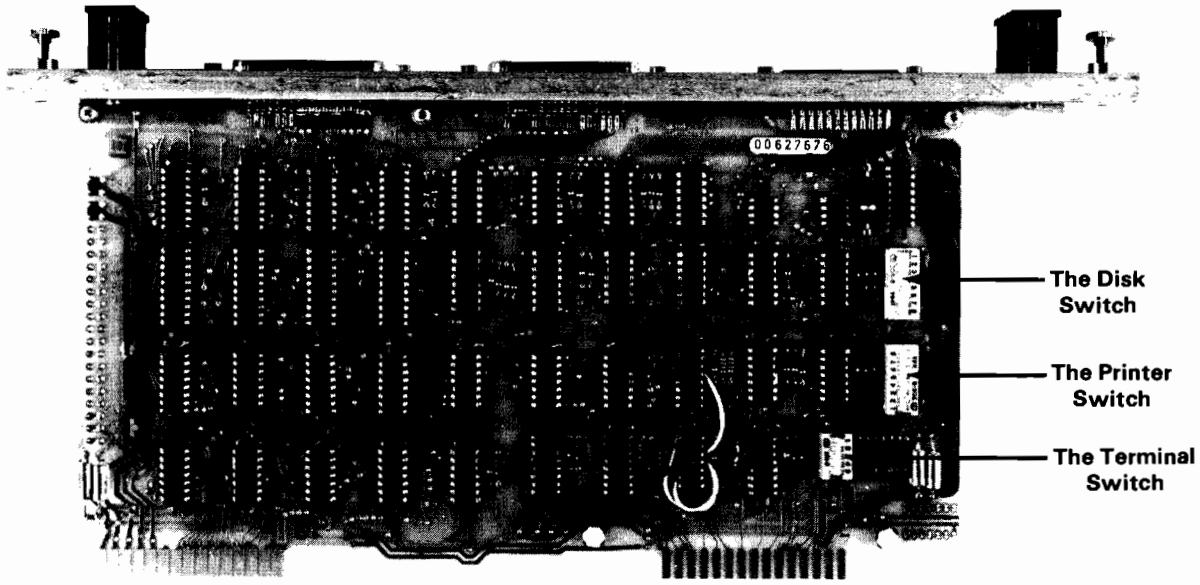


Figure F-1. Device Address Switches on the 22C32 Triple Controller

The standard disk address is 10. However, the address can be set to 20 or 30 if more than one disk is attached to the system. (Refer to Figure F-2.)

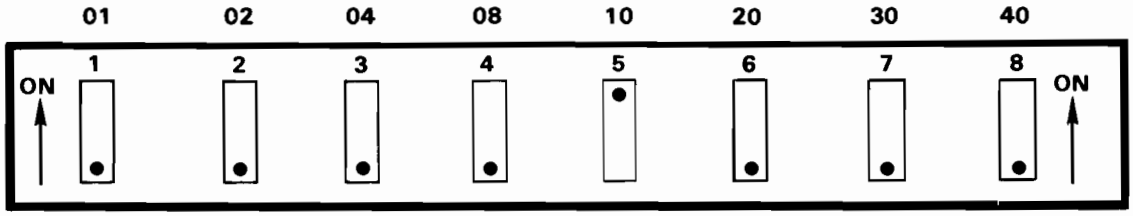


Figure F-2. Disk Address 10

The standard printer address is 15. However, if more than one printer is attached to the CPU, Addresses 16 or 17 can be used. (Refer to Figure F-3.)

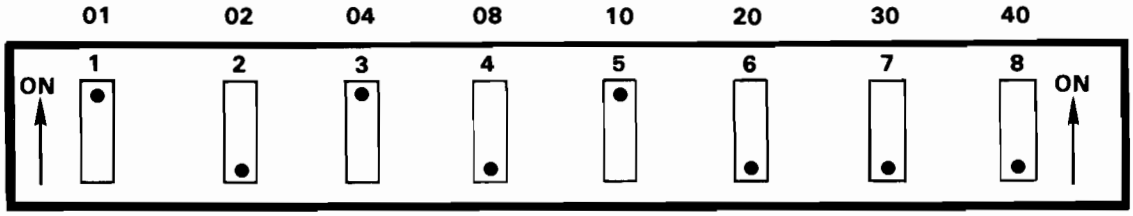


Figure F-3. Printer Address 15

When setting the address of the terminal, Switch 1 must always be placed in the On position. If Switch 1 is off, the terminal controller is disabled and only the printer and disk can be used.

On single-terminal systems, the 40 and 80 bits of the switch are always placed in the Off position (the controller then responds to Addresses 01--07). Refer to Figure F-4.

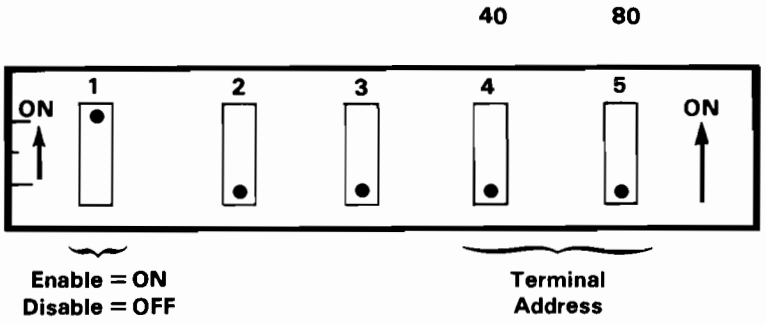


Figure F-4. Switches Set for Terminal 1

On 5-terminal systems, the 22C32 should be used for the fifth terminal. The switches should be set so that the 40 bit is on and the 80 bit is off (the controller then responds to Addresses 41--47). Refer to Figure F-5.

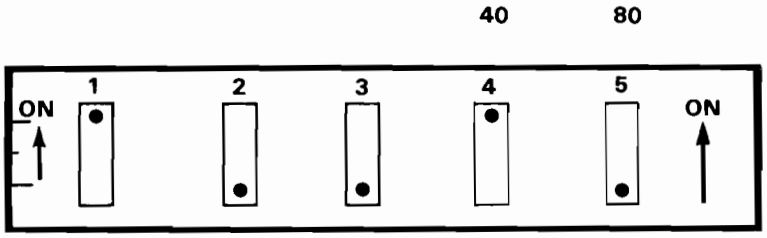


Figure F-5. Switches Set for Terminal 5

On 9-terminal systems, the 22C32 should be used for the ninth terminal. The switches should be set so that the 80 bit is on and the 40 bit is off (the controller then responds to Addresses 81 through 87). Refer to Figure F-6.

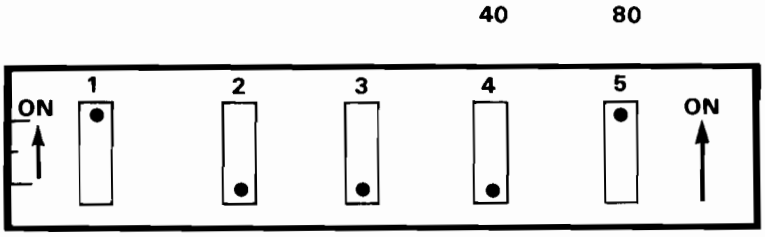


Figure F-6. Switches Set for Terminal 9

On 13-terminal systems, the 22C32 should be used for the 13th terminal. The switches should be set so that both the 40 and 80 bits are on (the controller then responds to Addresses C1 through C7). Refer to Figure F-7.

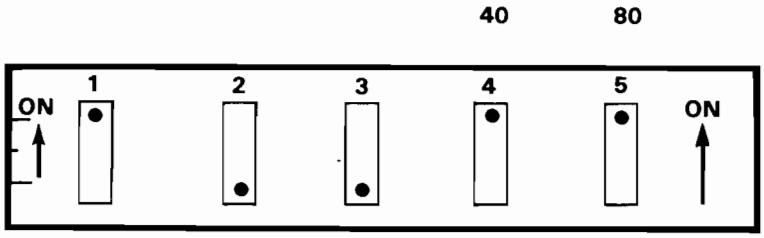


Figure F-7. Switches Set for Terminal 13

Note that unlike other peripheral controllers, the physical device address set on the terminal controller is not the address specified in a program for access to the terminal CRT, keyboard, and terminal printers. The programmable device addresses for all terminals are: CRT /005, keyboard /001, and local printers /004. The operating system translates these programmable addresses into the appropriate physical controller address.

To set the physical device address of the 22C32 Triple Controller, perform the following procedure:

1. Power the system down by turning off all terminals and printers, followed by all disk drives and their accessories, and finally, the Central Processing Unit (CPU).

2. Loosen the retaining screws that attach the controller to the CPU. Using the two handles on top of the controller, pull the controller board straight up and out of the CPU I/O port.

3. Locate the appropriate switch on the controller board used to set each device address. Note that any of the three switch types may be located on the controller. Follow the instructions for setting whatever type of switch is installed on the controller.

4. Set the device addresses as desired. (Refer to Figures F-2 to F-7.)

5. After setting the addresses, reinsert the controller in the CPU I/O port and tighten the retaining screws.

6. The system may now be powered on. Begin by turning on the CPU, followed by the DPU, all disk drives, and finally, all printers and terminals.

NOTES

Addresses 01--07, 41--47, 81--87, and C1--C7 are reserved for the 2236MXE Terminal Processor and 22C32 Triple Controller and cannot be used for any other devices.

The transmission rate of the 22C32 Triple Controller is preset at 19.2K bps and cannot be modified.

APPENDIX G
INSTALLING THE OPTIONAL MONITOR ARM

WARNING

To protect yourself from electric shock, always make sure you turn the 2200 system off and unplug all power cables from the electrical outlet before you install the monitor arm.

The monitor arm (optional equipment) can be used with the Model 2436 series terminals when you want the monitor away from your desktop. Make sure that there are about 26 inches of open space surrounding the desk to allow free movement of the monitor arm. You will need someone to assist you when you begin to attach the monitor arm to your desk.

Before you install the monitor arm, use the following guidelines to determine if you can safely install the monitor arm to your desk (refer to Figure G-1).

- The monitor arm cannot be used with a pedestal based desk.
- If the desktop has rounded edges, the curve on each edge must be less than 1/4 inch thick.
- The desktop must be secured to supports.
- There must be at least a 3/4-inch clearance between the edge of the desktop and the outer edge of any supports underneath the desk.
- The desktop must be between 3/4 inch and 2 inches thick.

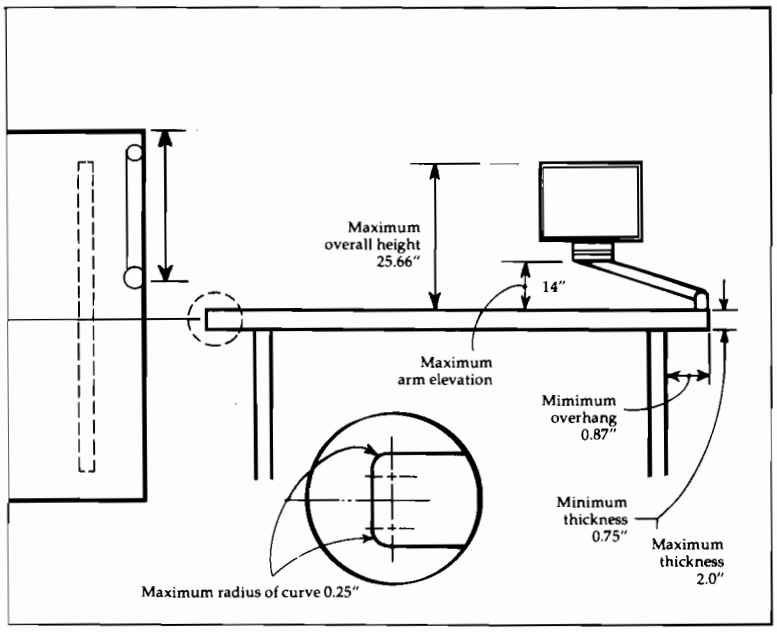


Figure G-1. Appropriate Desk Dimensions

Opening the Monitor Arm Box

Remove the contents of the monitor arm box and make sure you have the item shown in Figure G-2 and the 8-foot cable which you will use to connect the monitor to the back panel of the electronics unit.

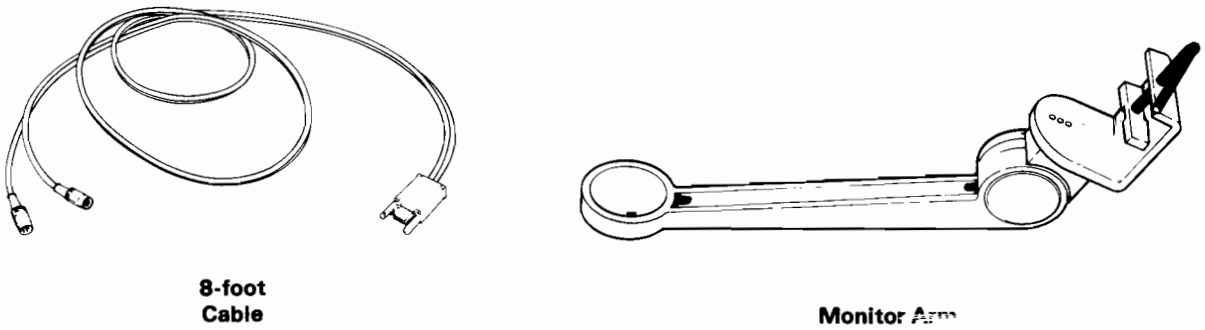


Figure G-2. Monitor Arm

Preparing the Monitor

Follow these steps to prepare the monitor for the monitor arm.

1. Disconnect the monitor cable from the monitor and the back panel of the terminal base. This cable will be replaced with the 8-foot cable when you attach the monitor arm to the monitor.

2. Turn the monitor upside down (refer to Figure G-2).

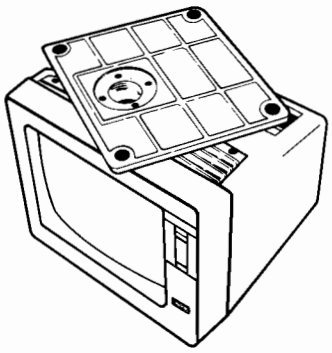


Figure G-3. Monitor with Pedestal Base

3. Remove the four screws (refer to Figure G-4).

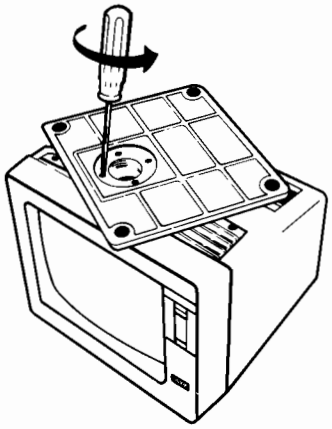


Figure G-4. Removing the Four Screws from the Pedestal Base

4. Remove the pedestal base (refer to Figure G-5).

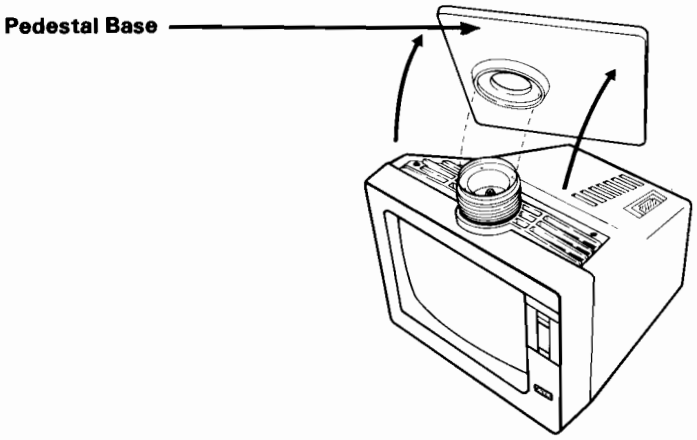


Figure G-5. Pedestal Base

5. Remove the rubber bellows (refer to Figure G-6).

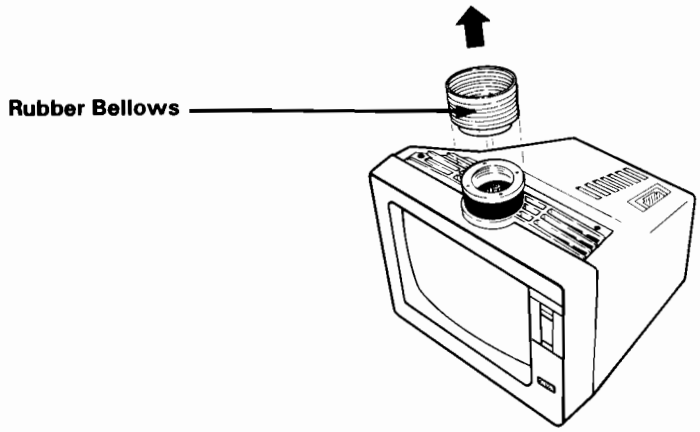


Figure G-6. Rubber Bellows

6. Remove the movement restrictor band (refer to Figure G-7). Store the restrictor band for future use.

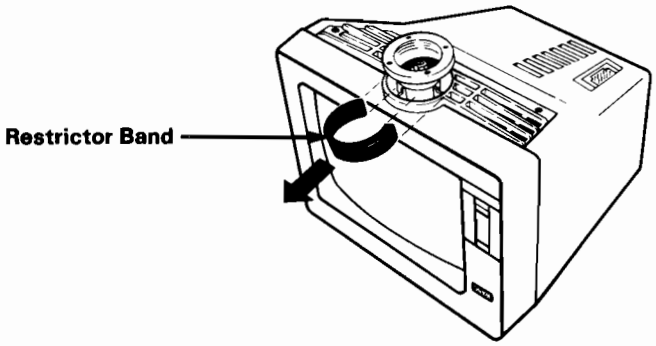


Figure G-7. Restrictor Band

7. Replace the rubber bellows (refer to Figure G-8).

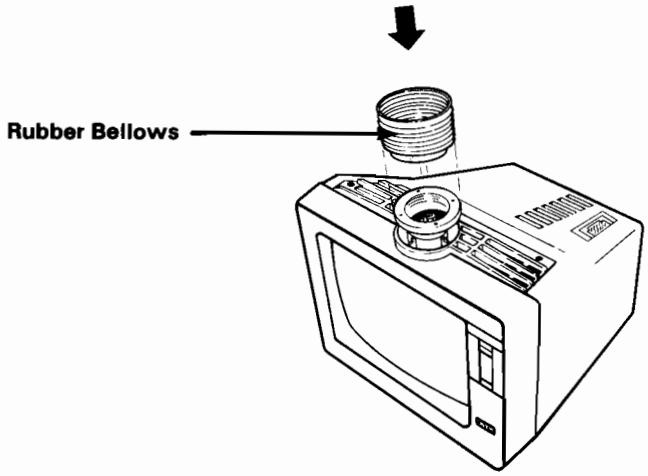


Figure G-8. Replacing the Rubber Bellows

Adjusting the Movement Setting

Follow these steps to adjust the movement setting on the monitor arm.

1. The monitor arm is preset to swing 180 degrees to the left and to the right. This setting may be adjusted. The movement setting is located as shown in Figure G-9.

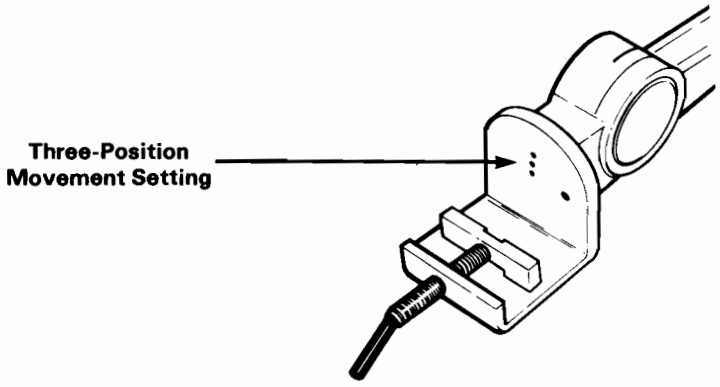


Figure G-9. Position Movement Setting

2. You can adjust the movement settings (refer to Figure G-10) as follows:

WARNING

To ensure the monitor's stability, do not allow the monitor to swing beyond the width of tke desk.

a. If you want the monitor to swing 180 degrees, leave the screw in the first setting.

b. If you want the monitor to swing only 90 degrees to the right, move the screw to the center setting.

c. If you want the monitor to swing only 90 degrees to the left, move the screw to the last setting.

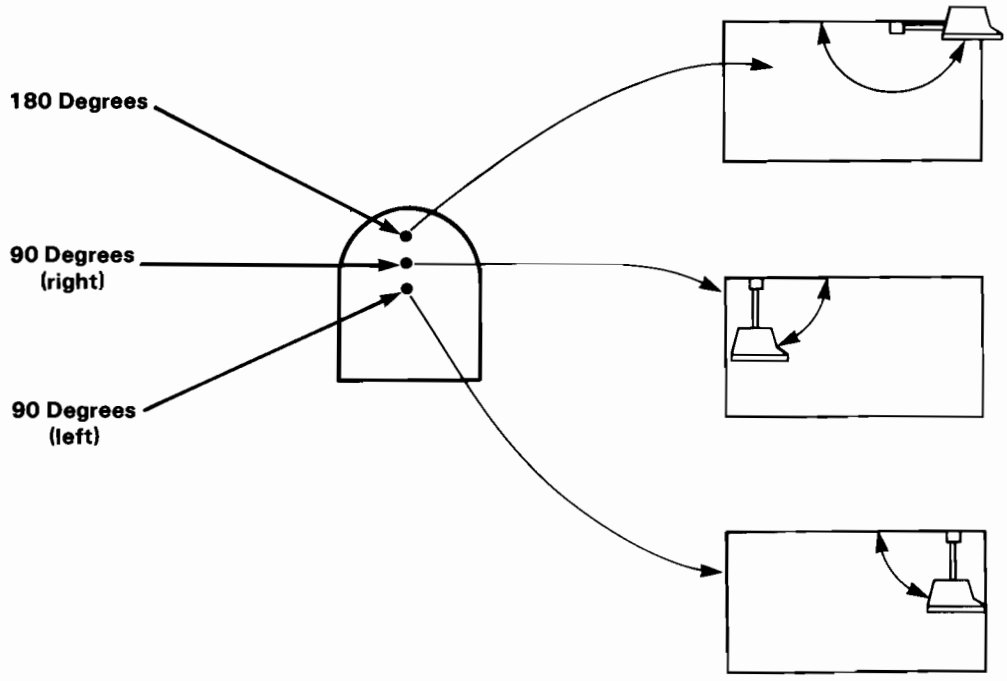


Figure G-10. Screw Settings

Attaching the Monitor Arm to the Monitor

Use the following steps to attach the monitor arm to the monitor.

1. Place the monitor arm on the monitor. The gray plastic cable cover should be facing you (refer to Figure G-11).

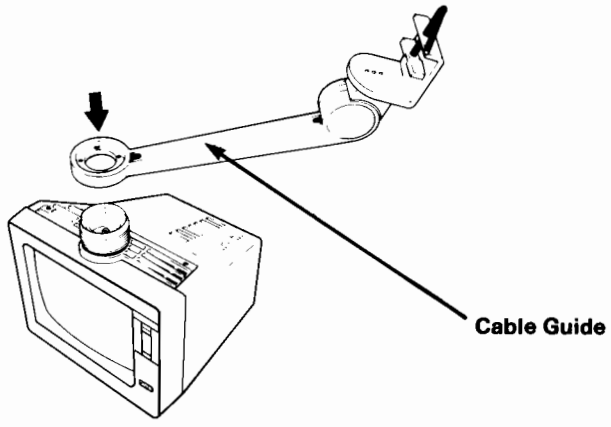


Figure G-11. Cable Cover

2. Line up the screw holes in the arm with those on the monitor. Using the four screws you removed from the pedestal base, attach the arm to the monitor. Do not let go of the monitor until you have secured the arm (refer to Figure G-12).

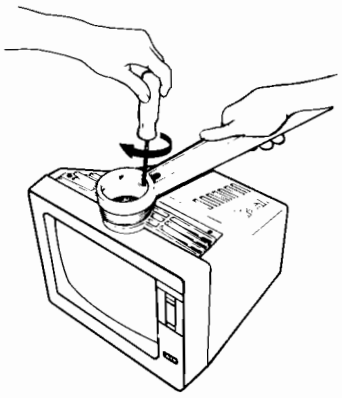


Figure G-12. Securing the Monitor Arm to the Monitor

3. Remove the cable cover from the arm (refer to Figure G-13).

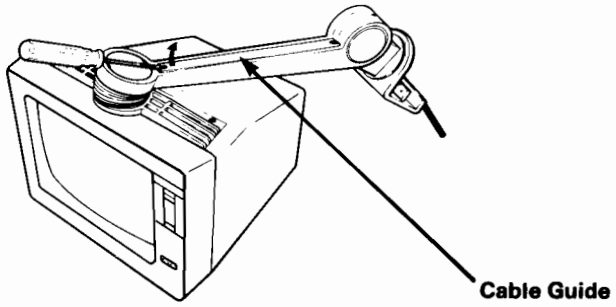


Figure G-13. Removing the Cable Cover

4. Thread the 8-foot monitor cable into the cover. Then, press the assembly into the arm (refer to Figure G-14).

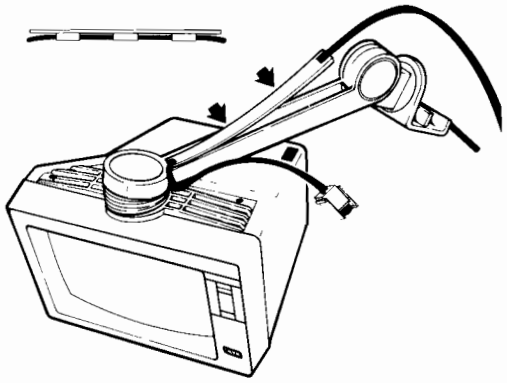


Figure G-14. Monitor Cables

Attaching the Monitor Arm to the Desk

Follow these steps to attach the monitor arm to the desk.

1. Open the clamp (refer to Figure G-15).

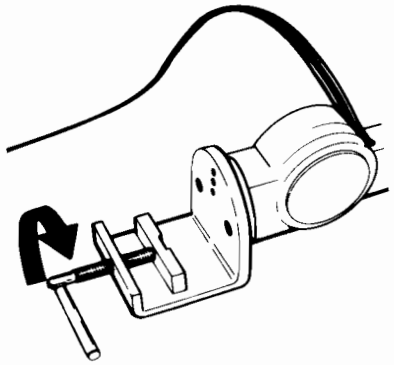


Figure G-15. Monitor Arm Clamp

2. Have someone pick up the monitor arm assembly, supporting it from underneath. Position the clamp in the desired location on the desk. Make sure that the back edge of the clamp is flush against the edge of your desk (refer to Figure G-16).

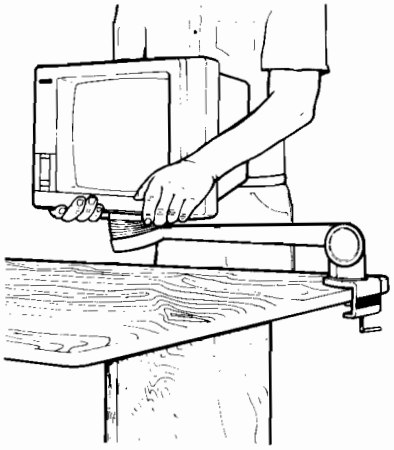


Figure G-16. Placing the Monitor Arm on the Desk

3. Tighten the clamp until it is completely secured (refer to Figure G-17).

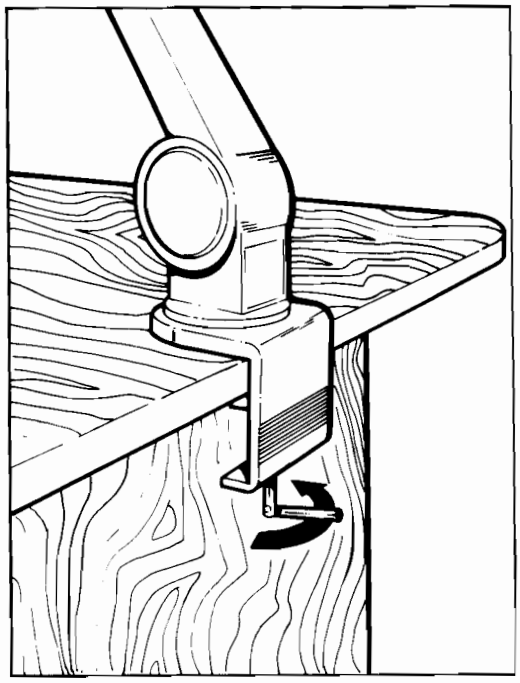


Figure G-17. Tightening the Clamp

4. Connect the monitor cable to the monitor and the electronics unit.

INDEX

WANG

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