

WANG

# Model 2236DE Interactive Terminal User Manual





# **Model 2236DE Interactive Terminal User Manual**

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LABORATORIES, INC.

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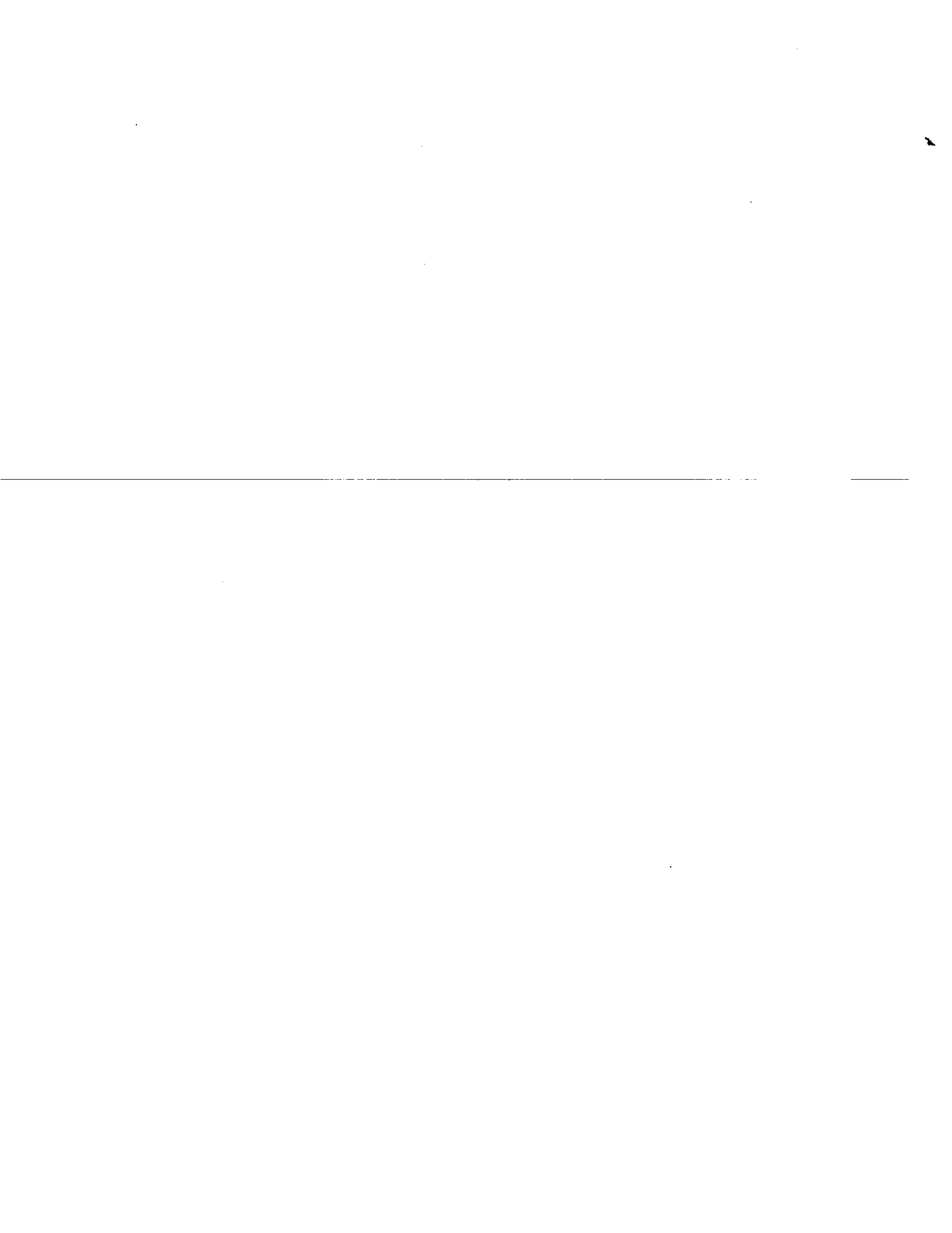
## PREFACE

This manual introduces the Wang 2236DE Interactive Terminal to the user. Chapter 1 provides a brief overview of the terminal's features, environmental care, and system maintenance. Chapter 2, designed for the operator, 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 useful to a programmer such as control codes, character display attributes, alternate character sets, the PRINT BOX function, repeating keys, and the self-identification message. Examples and short programs are used to explain each feature. 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, 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 following documentation supplied with every system.

- The *BASIC-2 Language Reference Manual* — Provides complete descriptions of the system's operational features, documents the extensive set of commands, and describes in detail each statement in the BASIC-2 instruction set.
- The *BASIC-2 Disk Reference Manual* — Describes loading and operating procedures for all 2200 series disk drives, and documents the complete set of disk I/O instructions.
- *Programming in BASIC* — Introduces a beginner to BASIC programming and the utilization of peripherals which are frequently used with the System 2200.

In addition to these manuals, a separate reference manual is provided for each optional peripheral device attached to the system.



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# CHAPTER 1 INTRODUCTION

## 1.1 THE MODEL 2236DE INTERACTIVE TERMINAL

The Model 2236DE Interactive Terminal, shown in Figure 1-1, enables each user to communicate with a Wang 2200VP, MVP, LVP, or SVP system and to control it easily. Each terminal consists of a 24 x 80 Cathode Ray Tube (CRT); a multipurpose, typewriter-style keyboard with a 10-key numeric keypad; user-definable Special Function keys; and Program Control keys.

The Model 2236DE gives the programmer the ability 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 Model 2236DE is capable of both box and character graphics.

The Model 2236DE 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 all standard characters present on the screen.

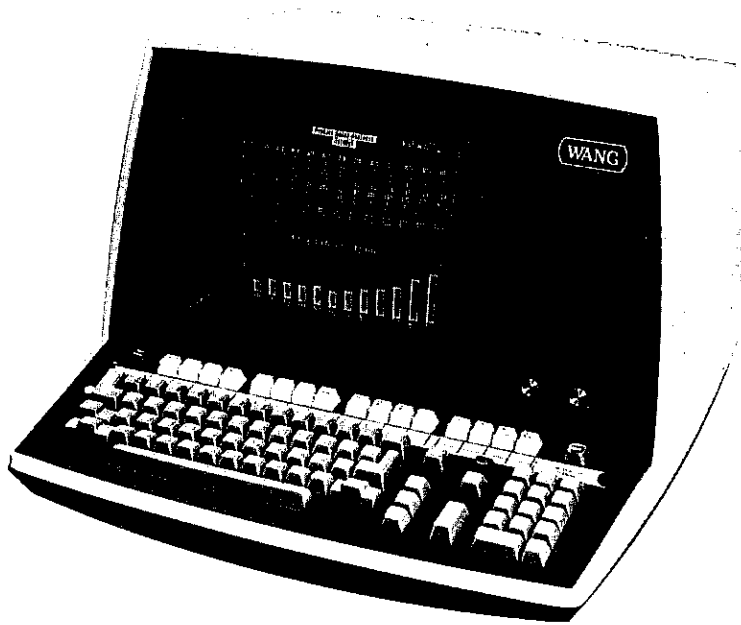


Figure 1-1. The Model 2236DE Interactive Terminal

## **1.2 ENVIRONMENTAL CONSIDERATIONS**

Although the System 2200 is designed to operate in most office environments, the environment should be designed to encourage optimal system performance. An ideal environment is one in which the temperature and humidity are controlled and airborne contaminants are minimal. The AC power source should be grounded, adequate for present and proposed system needs, regulated, and noise free. The room should have space for future expansion and be easily accessible to operating personnel, yet sufficiently removed from the main traffic flow to permit the system to operate smoothly. Generally, an environment comfortable for the operator will be acceptable for the system. (Refer to Appendix B for more information on preventive maintenance and recommended office environments.)

## **1.3 UNPACKING, INSPECTION, AND INSTALLATION**

Special factory packing techniques require that the Model 2236DE 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.)

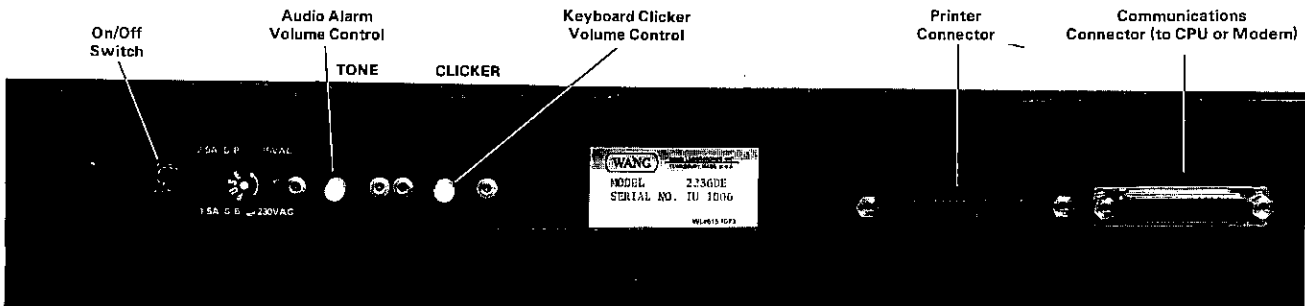
## CHAPTER 2 OPERATING THE TERMINAL

### 2.1 THE TERMINAL CONTROLS

The Model 2236DE Interactive Terminal is the user's principal means of controlling the system. The terminal's power switch is located on the back of the terminal, on the right side as one faces the CRT screen. Figure 2-1 shows the location of this 2-position power switch. When the switch is in the up position, the terminal's power is on; when in the down position (as shown), the terminal's power is off.

When the terminal is turned on, the terminal microprocessor performs a self-diagnostic to ensure that the terminal is functioning properly. A continuous alarm will sound if the diagnostic has found a terminal fault. When this alarm is sounded, power the terminal off for several seconds and then back on. If the alarm persists, notify a Wang Service Representative.

After successful execution of the diagnostic, a message is displayed at the top of the screen indicating the current version of the terminal microprogram, the communication rate, and the communication character format. The power-on message is displayed until a key is pressed or the CPU outputs to the terminal (refer to Section 3.7).



**Figure 2-1. Controls on the Back Panel of the Model 2236DE Interactive Terminal**

Also located on the rear panel are volume controls for the keyboard clicker and audio alarm. The keyboard clicker provides audio feedback to the operator when a key is sufficiently pressed. The audio alarm indicates the occurrence of a variety of 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.

## 2.2 THE CRT

The terminal's 12-in. (30.5 cm) diagonal-measure CRT and typewriter-like keyboard are the principal means of communicating information between the operator and the CPU. Up to 1,920 uppercase and lowercase characters can be displayed on the CRT, which contains 24 lines of 80 characters. Lines are displayed sequentially on the screen. If more than 24 lines need to be displayed at any time, the new line is displayed at the bottom of the screen, all previously displayed lines move up one line, and the top line leaves the screen. The CRT displays the complete keyboard character set, in addition to offering some foreign-language characters, special symbols, and underlining.

A special display character resembling an underscore is used to indicate the location on the display where the next character entered will appear. This special character is called the cursor. As characters are entered into the display, the cursor automatically advances to the next character entry position. In the Edit mode, the cursor can be positioned to any location on the display where character insertion or deletion will occur. The Edit mode keys and their functions are detailed in Section 2.4.

In addition to controlling cursor movement and positioning, a programmer can also 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.

Screen brightness and contrast can be adjusted to provide sharp, clear output for maximum viewer comfort. The brightness and contrast controls function in the same manner as brightness and contrast on a television set: brightness controls the overall brightness of the display; contrast controls the difference in intensity between high and low intensity characters. The brightness and contrast controls should be adjusted while the CRT is displaying both high and low intensity characters. This can be done during the terminal's power-on message, because "2236DE" is displayed in high intensity. Use the following procedure whenever adjusting the CRT display.

1. Slowly rotate both the contrast and brightness control knobs entirely counterclockwise.
2. Turn the brightness control clockwise until a raster (frame with lines) appears dimly on the screen. Characters will not yet appear.
3. Now turn the contrast control clockwise until characters appear. Adjust the contrast control until the difference between the intensity of normal and high intensity may be easily distinguished. (If the contrast control is turned too far clockwise, the characters will first begin to appear out of focus and finally become uniformly intense and washed out. This is especially noticeable with reverse video characters.)
4. Turn the brightness control counterclockwise to remove any remaining raster lines from the screen.

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 is designed for users who are already familiar with a standard typewriter keyboard and numeric keypad. The keyboard, illustrated in Figure 2-2, is the operator's means of interactively communicating with and controlling the system. By using the keyboard, an operator can enter data, write programs, perform calculations, and enter commands to the processor.

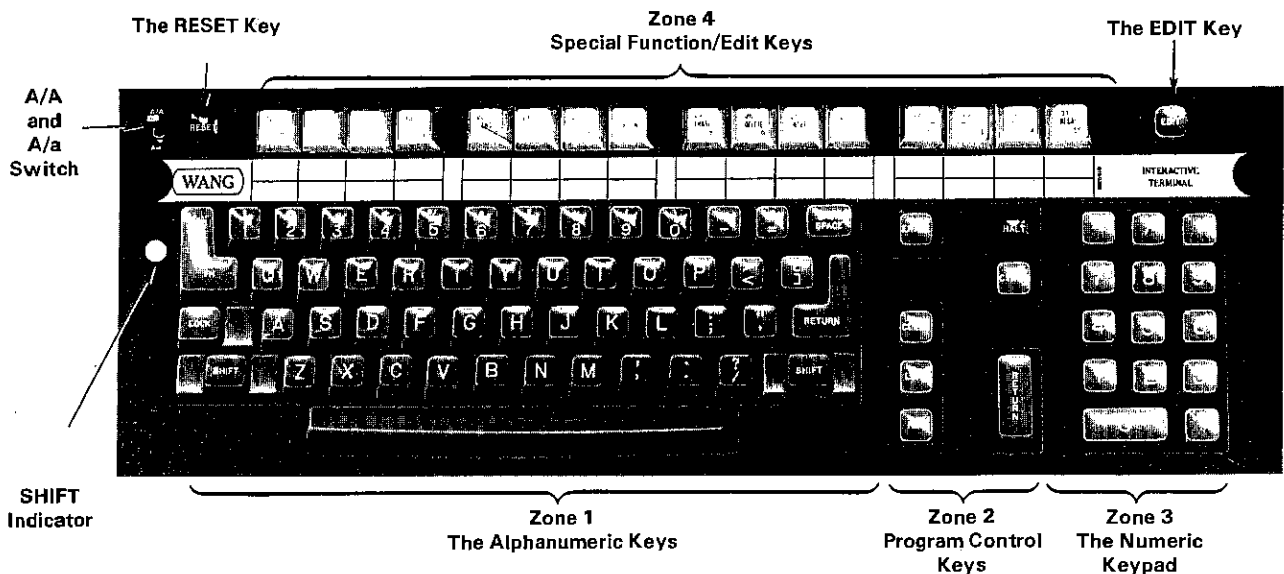


Figure 2-2. The Model 2236DE Keyboard

The keyboard has two modes of operation, selected by means of a toggle switch labeled "A/A" and "A/a." This switch is located in the upper-left corner of the keyboard. In the A/a mode, the keyboard functions as a standard typewriter, producing both uppercase and lowercase characters. In the A/A mode, all alphabetic characters are produced as uppercase whether or not SHIFT is pressed; the other keys function in the A/a mode. Whenever the SHIFT key is pressed, the SHIFT indicator illuminates. (Locking the SHIFT key in place will cause the SHIFT indicator to remain illuminated.)

In addition to the standard typewriter-like keyboard, the Model 2236DE contains a 10-key numeric pad, a Program Control key area, and 17 user-definable Special Function keys which can be used to either start program or subroutine execution, or customize the entry of characters not found on the keyboard. The Special Function keys also access the system-defined Edit mode functions, which enable an operator to change lines of program text recalled from memory or modify data currently input and displayed on the CRT screen.

All keys on the Model 2236DE keyboard (except RESET, EDIT, and underline) 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. The keyboard clicker sounds each time the repeated character is transmitted. Thus, both aural and visual evidence of the repeated character are given to the user. (The repeating key is particularly useful for moving the cursor when editing.)

Special features of the Model 2236DE keyboard include the following.

- *Keyboard Clicker* — The clicker provides audio feedback when a key is sufficiently pressed. The volume of the keyboard clicker may be adjusted. (Refer to Section 2.1.)
- *Underline* — On those versions of the keyboard that have an Underline key, characters can be underlined by pressing the Underline key before keying the character to be underlined.
- *Accents* — On international versions of the keyboard, characters may also be accented in the manner similar to underlining.
- *N-key Rollover* — This feature permits a new key to be pressed and output to the terminal while a previous key is still being held down. This process can continue for any number of keys; each new key 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, typing beyond a specified field, displaying an error message. The volume of this audio alarm may also be adjusted. (Refer to Section 2.1.)

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; signals ready; and returns to the console user (Console Input mode). RESET is also used during Master Initialization and hardware diagnostic operations. The RESET key is an undesirable means of terminating execution and generally should not be used to end program execution; HALT/STEP should be used for this purpose.

**NOTE**

On a 2200MVP or LVP, RESET affects *only* the partition to which the terminal is currently attached (the terminal's foreground partition). *No other* partitions are affected by RESET.

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

*Zone 1 — The Alphanumeric Keys* — Similar to a standard typewriter, this zone contains the alphanumeric characters; special characters (e.g., #, \$, %); the numeric operators (+, \*, /, -, †); and the FN, RETURN, and SHIFT keys. The RETURN key, which is used to signal that the entry of a field is complete, is equivalent to the EXEC key on some other Wang 2200 keyboard models. The FN key provides Special Function '126 when unshifted and '127 when shifted (refer to the description of Zone 4).

*Zone 2 — Program Control Keys* — Program Control keys directly control system command operations from the keyboard. These command keys provide single keystroke entry of the following command verbs: CLEAR (clears program text and variable areas), LOAD (loads specified programs from storage media into memory), RUN (initiates execution of the program), HALT/STEP (causes program execution to halt upon completion of the current statement or to execute one line at a time), and CONTINUE (continues program execution after a STOP verb has been executed or the HALT/STEP key has been touched). Note that system operations such as CLEAR and RESET, affect only that partition currently attached to the terminal from which they are executed. Each of these commands may also be entered character by character using the alphanumeric keys.



*Zone 3 — The 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 keys in either the numeric or the alphanumeric zone.

*Zone 4 — Special Function/EDIT Keys* — Across the top of the keyboard are 16 user-programmable Special Function keys. Since each of these keys may be pressed in conjunction with the SHIFT key, an effective 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. Special Function keys may be used to perform a variety of tasks, e.g., start program execution, access subroutines, or enter a predefined text string. The operator is informed of the meanings of the Special Function keys either by screen prompts or by means of the label strip located immediately below this row of keys. In order to perform a given task, a Special Function key must be defined by the user with a DEFFN' statement in the currently loaded program. The Special Function keys are also used during Master Initialization to load the BASIC-2 interpreter and operating system.

Special Function keys used as Edit mode keys are described in the following section.

## **2.4 ENTERING AND EDITING DATA**

The editor is field-oriented (although, under some conditions, it is possible for a BASIC-2 program to input and validate data character by character). Data entry is confined to a specific field on the CRT screen. The location of the beginning of the field to be entered may be readily identified by the position of the cursor. As a character is entered, the cursor automatically advances to the next character entry position. A BASIC-2 program may optionally make the operator aware of the size of the field by displaying a series of underscores within the field. Attempting to type beyond the end of the specified field sounds the audio alarm.

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 BASIC-2 program. Touching an undefined Special Function key sounds the audio alarm, but does not otherwise affect system operation.

There are two keys which can perform editing operations without placing the system in Edit mode. The BACKSPACE key, located in the top right of Zone 1 on the keyboard, moves the cursor one position to the left and erases the character in that position. The ERASE key located in Zone 2 erases the entire field and positions the cursor at the beginning of the field. (The ERASE key located in Zone 4 has a different meaning, as discussed in Table 2-1.)

Pressing the EDIT key, located in the upper-right corner of the keyboard, places the system in the Edit mode. In the Edit mode, Special Function keys '4 — '15 become system-defined EDIT keys. The remaining Special Function keys, with the exception of the FN key, are disabled. The Edit mode provides the operator with powerful capabilities for editing Immediate mode statements and alphanumeric characters either in a line of program text resident in memory or a line of text currently being entered. Insertion and deletion of characters, nondestructive spaces and backspaces, and line-to-line movement of the cursor may be performed in the Edit mode. The editing functions are described in Table 2-1. Text entry and editing are still confined to the field being edited to preserve display integrity. Terminating the entry of the field with RETURN or again pressing the EDIT key 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 2200MVP or LVP configuration, actual line-editing functions are performed by the 2236MXD Terminal Processor, and a blinking cursor is displayed on the CRT screen to indicate that the system is in Edit mode. However, in a 2200VP or SVP configuration, the system CPU performs the editing functions and Edit mode is indicated by an asterisk displayed immediately to the left of the field being edited.

**Table 2-1. Edit Mode Keys and Their Functions**

Key	Function
EDIT	Used to both enter and exit Edit mode.
RECALL	Used to recall a specified program line (desired program line must be entered first), field value, or Immediate mode statement from memory for editing.
<-----	Moves the cursor five spaces to the left.
<-----	Moves the cursor a single space to the left, but does <i>not</i> delete any characters.
----->	Moves the cursor five spaces to the right.
----->	Moves the cursor a single space to the right.
INSERT	Expands a field for additional text and data entry by inserting a space character at the current CRT cursor position.
DELETE	Deletes the character at the current CRT cursor position and condenses the remaining field.
ERASE	Erases that portion of the line from the current CRT cursor position to the end of the field.
BEGIN	Moves the cursor to the beginning of the field.
END	Moves the cursor to the end of the field.
↑	Moves the cursor up to the previous CRT line (current text must occupy more than one line on the CRT).
↓	Moves the cursor down to the next line on the CRT (current text must occupy more than one line on the CRT).

## 2.5 THE TERMINAL PRINTER

Printers can be physically attached either to a printer controller in the CPU or directly to a Model 2236DE terminal. Printers attached to the CPU are referred to as system printers because they are generally available to any partition; printers attached directly to a terminal are called terminal printers because they are 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 2236DE terminal.

The MVP (multiuser) 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 "hog" the printer and 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 processors and terminal and releases the printer from its hogged state.

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

## 2.6 THE SCREEN DUMP

The screen dump feature allows the user to obtain a hard copy record of the CRT on a printer attached to the terminal. Screen dump is a temporary off-line terminal operation which may be initiated only by the terminal operator. In fact, a BASIC-2 program can neither initiate nor detect the activation of a screen dump. Therefore, 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, this also means it is the terminal operator's responsibility not to activate screen dump while the terminal printer is in use. If screen dump is activated while a program is using the printer, the screen dump output will be inserted on its own separate page, and printing will then resume without missing any characters. To activate a screen dump, use the following procedure.

1. Press the EDIT key and hold it down for approximately two seconds. An immediate click will be heard. The CRT image will be frozen 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 key is treated as the EDIT key and 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. Pressing any key will terminate the screen dump and restore normal processing. If the screen dump fails, make sure the printer is selected and try again. If the screen dump still fails, use the CLEAR button found on many printers. *Do not use* the terminal's RESET, because it will clear the screen.

It is not possible for a screen dump to produce an exact image of the screen because the terminal microprocessor cannot tell what sort of printer is attached to the terminal. A conservative subset of the CRT character set is therefore employed during a screen dump. The USA version of the Model 2236DE can screen dump 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 actual character set used for screen dump varies among the international versions of the Model 2236DE. However, the following general rules do apply.

1. Any character not in the screen dump character set is translated to #.
2. Display attributes are ignored. All characters are printed in the same font and pitch. (Refer to Section 3.3.)
3. Character set graphics are also translated to #. (Refer to Section 3.4.)
4. Box graphics are ignored. (Refer to Section 3.5.)

**CAUTION**

Since normal 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.

## **CHAPTER 3**

### **TERMINAL PROGRAMMING**

#### **3.1 INTRODUCTION**

Programmable features of the Model 2236DE include control of cursor movement, character display attributes, box graphics, and alternate character sets (including character graphics). A special BASIC-2 print function, the PRINT BOX statement, allows easy implementation of the box graphics feature.

All other features are programmed by outputting a series of one or more control codes to the terminal. Although the 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) — 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.

## Cursor Control Codes

The cursor can be positioned at any specified row and column on the screen with the PRINT AT function. In addition, cursor control codes can be sent to the terminal by using the PRINT HEX function. 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(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) — 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) will clear the screen and home the cursor (03), insert a line feed (0A), and indent 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 Statement 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 Statement 20 issues two line feeds before displaying any output. Notice the difference between the displays produced by Statements 30 and 40 (Refer to Figure 3-1). Statement 30 issues both a carriage return and a line feed, HEX(0D0A). The display produced is a neatly formatted address. However, Statement 40 only issues a line feed, HEX(0A). Since a HEX(0A) moves the cursor down one line from its current position, a staggered address is now produced.

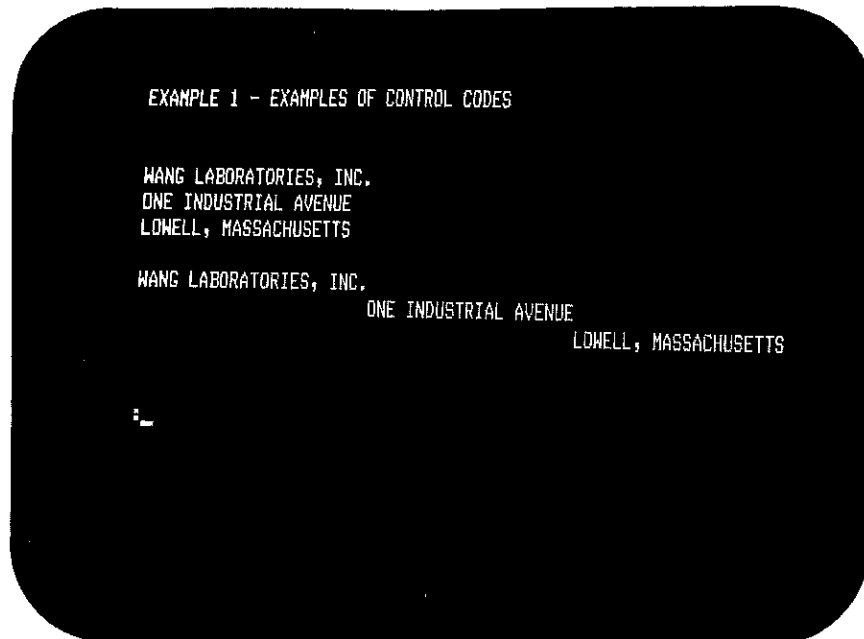


Figure 3-1. Examples of Control Codes

### Cursor Appearance

The blinking cursor sequence is output 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 MVP (multiuser) operating system uses the blinking cursor to indicate the Edit mode. For programs utilizing 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.

### The Audio Alarm

The terminal's audio alarm can be programmed to beep by issuing a PRINT HEX(07) to the CRT. Several discrete 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 2236DE provides several display attributes that can be selected for any character displayed on the screen. The available display attributes are the following.

- 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.

#### HEX Codes Used to Invoke Display Attributes

Immediately after power is turned on, the Model 2236DE displays characters in normal intensity, non-blinking, normal video (light on dark), and non-underlined (this attribute shall henceforth be referred to as simply "normal intensity"). The power-on-default meaning of HEX(OE) is bright, non-blinking, normal video, and non-underlined. To further understand the default meaning of HEX(OE), refer to the subsection titled "The Use of Isolated HEX(OE)."

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

HEX(02 04 xx yy OE)  
or  
HEX(02 04 xx yy OF)

where:

02 04 = The control code sequence which 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

OE or OF = A terminator character which causes the display attributes selected by xx yy to be turned on or off; HEX(OE) turns the selected attributes on, HEX(OF) turns them off.

Note that there are two ways to code the attribute "blinking." However, on the Model 2236DE, blinking normal intensity and blinking high intensity characters both appear as blinking, high intensity.



## 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 activate (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
```

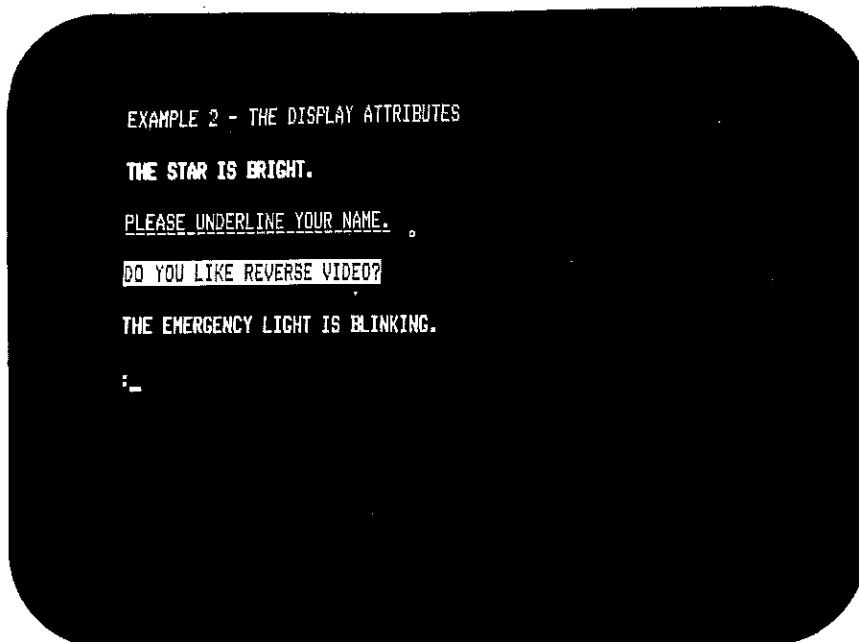


Figure 3-2. The Display Attributes

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
```

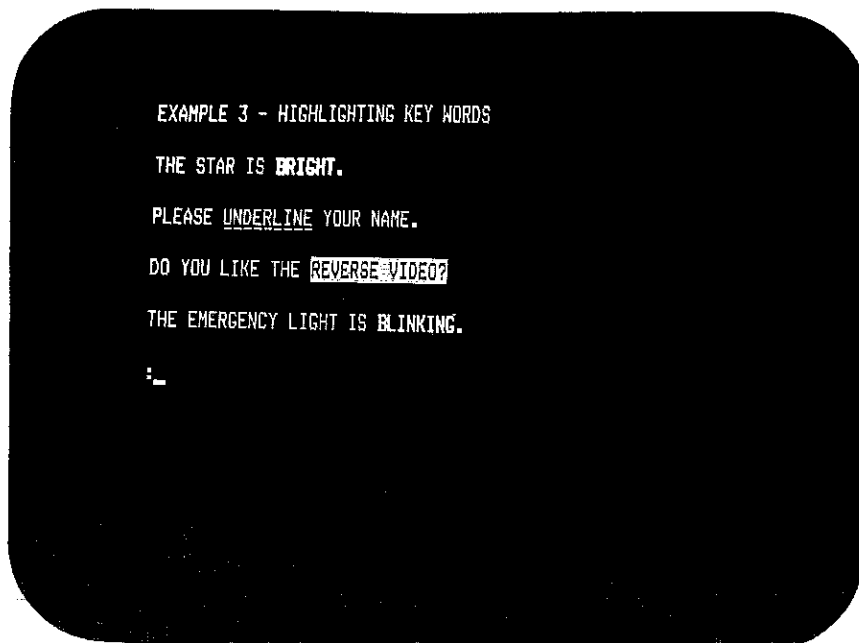


Figure 3-3. Highlighting Key Words

## Turning Off Character Display Attributes

Once turned on, the selected attribute will remain 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 Statement 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 sentences (Statements 20-50) appear on the CRT screen in bright intensity. In this example, the HEX(0F) in Statement 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.

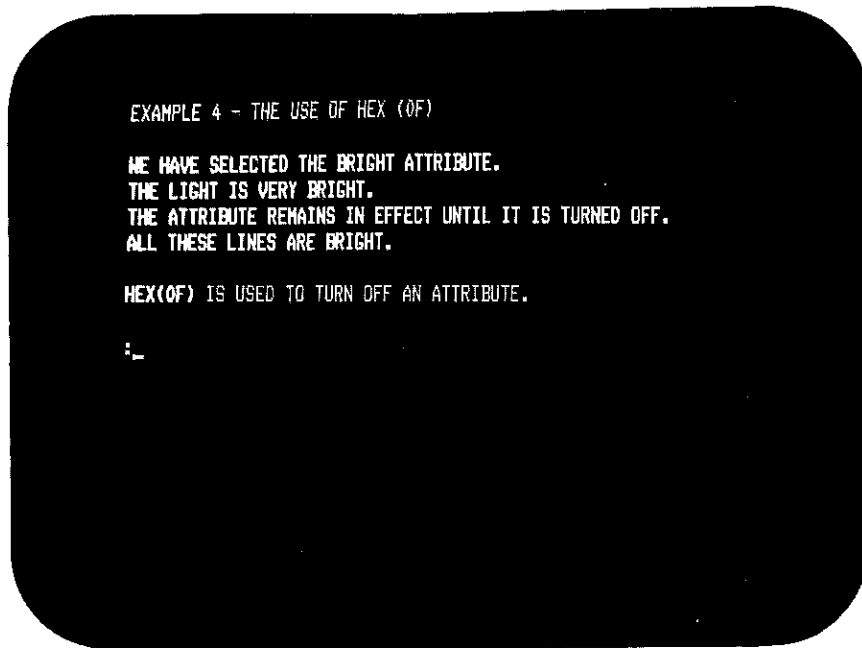


Figure 3-4. The Use of HEX(0F)

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 will turn 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 Statement 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 Statement 30 selects and activates the attribute "underline," thus turning off the bright intensity attribute. Both Statements 30 and 40 will be underlined when displayed on the screen. Similarly, the HEX sequence in Statement 50 selects and activates the attribute "reverse video," thus turning off the underline attribute. Lastly, the HEX(0F) in Statement 60 turns off the attribute and restores normal intensity. (Refer to Figure 3-5.)

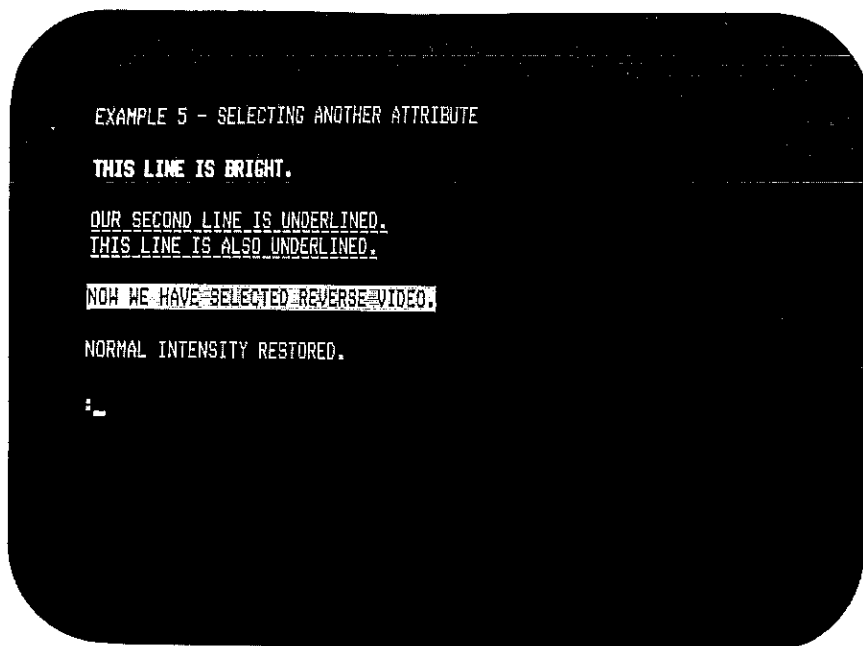


Figure 3-5. Selecting Another Attribute

## The Use of Isolated HEX(OE)

An isolated HEX(OE) may be used to activate the *last* attribute selected by a HEX(O204. . . sequence. However, when an attribute is turned on in this manner, the attribute will remain in effect for a maximum of *one* text line. Therefore, either an automatic carriage return, a programmed carriage return issued with a HEX(OD), or a HEX(OF) will turn the attribute off. Execute the following program.

```
CLEAR
5 PRINT HEX(O3)
10 PRINT "EXAMPLE 6 - TESTING ISOLATED HEX(OE)"
20 PRINT
30 PRINT HEX(O20400020E); "SELECTING REVERSE VIDEO"; HEX(OF)
40 PRINT
50 PRINT "HOW MUCH OF THIS LINE "; HEX(OE); "APPEARS IN REVERSE
VIDEO?"
60 PRINT "NOTICE THAT NORMAL INTENSITY HAS BEEN RESTORED. WHY?"
70 PRINT
80 PRINT HEX(OE); "REVERSE VIDEO HAS BEEN REACTIVATED."; HEX(OD0A);
"WHAT HAPPENED WHEN WE PROGRAMMED A CARRIAGE RETURN?"
RUN
```

Statement 30 selects and activates reverse video, and then immediately turns the attribute off after one line. The HEX(OF) statement turns the attribute off and restores normal intensity. The beginning of Statement 50 appears on the CRT screen in normal intensity, until the isolated HEX(OE) reactivates the reverse video attribute for the remainder of the line. Since the attribute was activated by a HEX(OE), the attribute is turned off by the implied carriage return produced by not ending the statement with a comma or semicolon. Therefore, Statement 60 appears in normal intensity. The attribute is reactivated with the HEX(OE) in Statement 80. In this case, the programmed carriage return, HEX(OD), turns off the reverse video attribute and again restores normal intensity. HEX(OA) in Statement 80 issues a line feed so that the second statement of line 80 does not strike over the first statement of line 80. HEX(OA) itself does not deactivate the current attribute. In any of these cases, the attribute also could have been turned off by a HEX(OF). (Refer to Figure 3-6.)

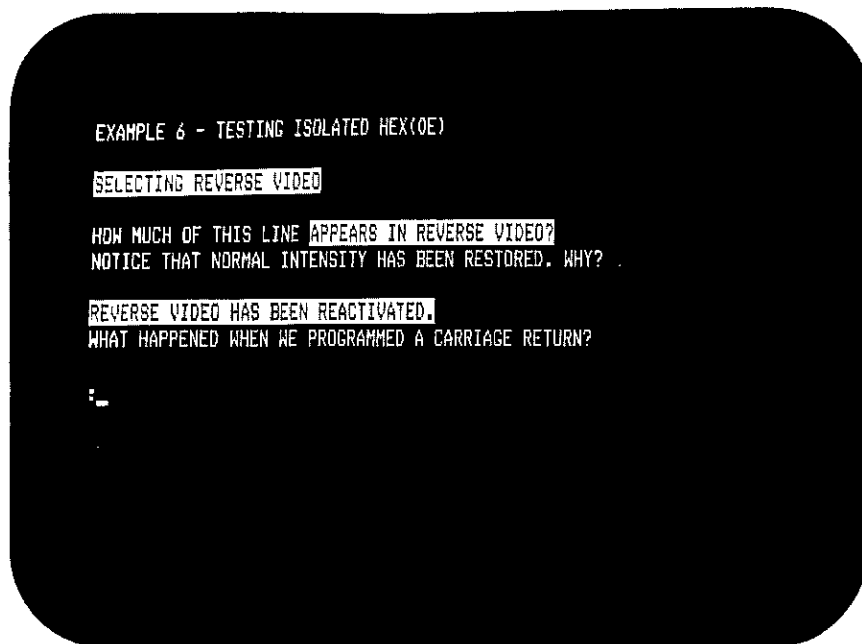


Figure 3-6. Testing Isolated HEX(OE)

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(0FOA)
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.)

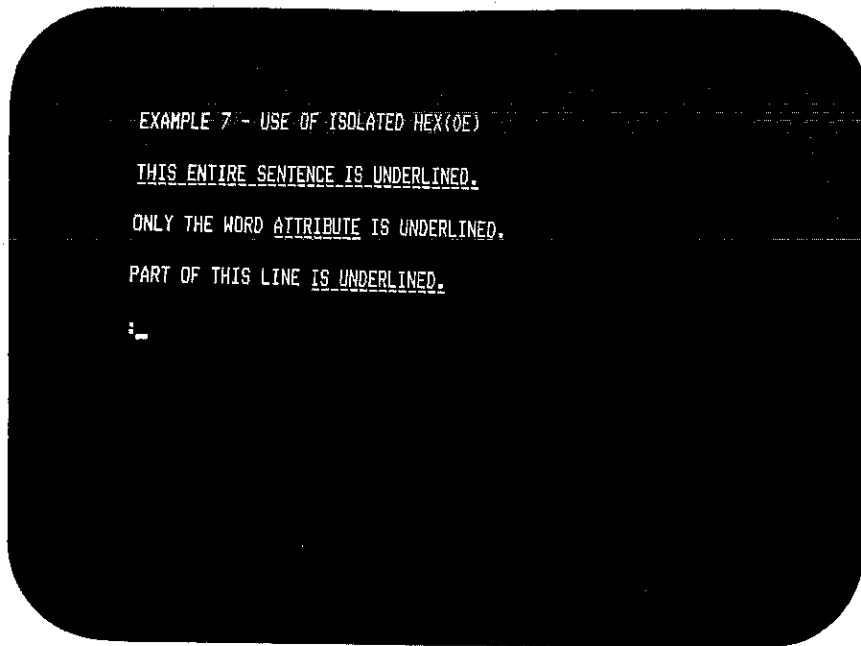


Figure 3-7. Use of Isolated HEX(0E)

## Sequences Ending in OF

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

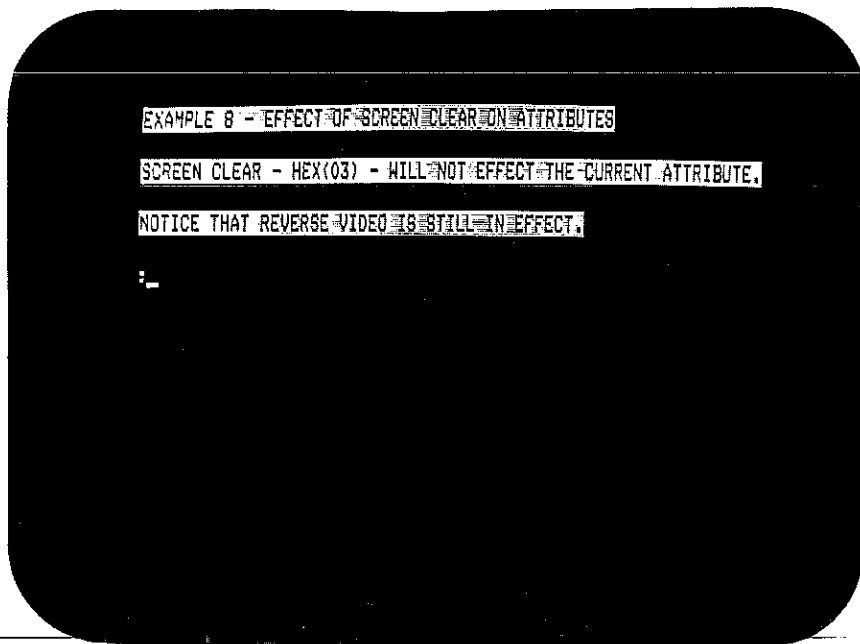
```
CLEAR
5 PRINT HEX(03)
10 PRINT "SEQUENCES ENDING IN OF"; HEX(0A)
20 PRINT HEX(020400020F); "WE HAVE SELECTED THE REVERSE VIDEO
ATTRIBUTE, BUT WE HAVE NOT ACTIVATED IT."
30 PRINT "NORMAL INTENSITY IS ACTIVATED INSTEAD."
RUN
```

## Using Screen Clear and Character Display Attributes

The control code HEX(03) will clear the screen and home the cursor, but otherwise have 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
```

Statement 10 selects and activates the reverse video attribute for the first two lines. Statement 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. Statement 40 selects "pause off" for the remainder of the program. A screen clear, which will clear the screen to black, is issued by Statement 50. However, the reverse video stays in effect even though a screen clear was issued. Notice that the three lines of text (Statements 60, 70, and 80) all appear on the screen in reverse video. (Refer to Figure 3-8.) The HEX(0F) in Statement 90 turns off the reverse video attribute and restores normal intensity.



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

### **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, simply 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(0FOA)
30 PRINT TAB(25); HEX(020400020E); "REVERSE VIDEO"; HEX(0F)
RUN
```



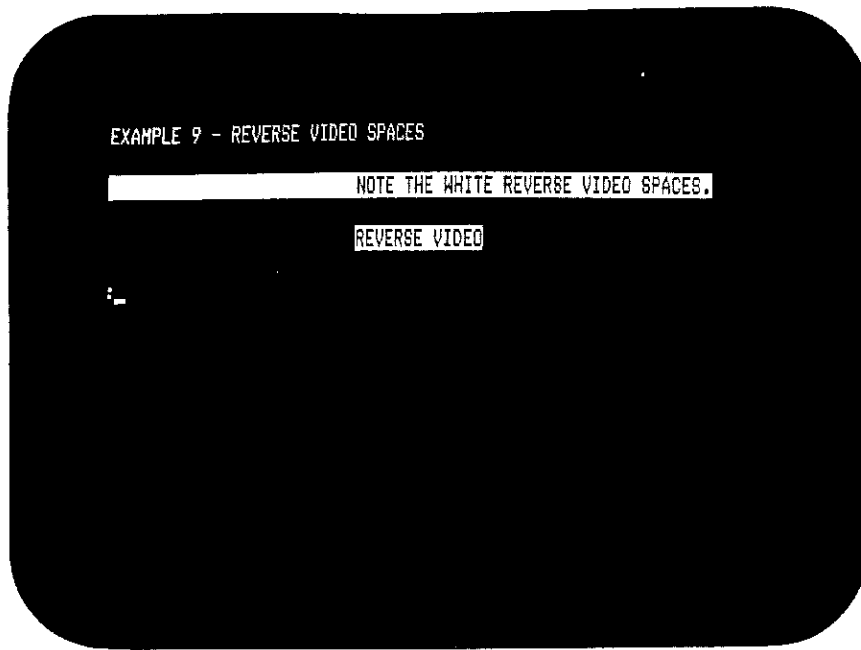


Figure 3-9. Reverse Video Spaces

### 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\$

This time, only the prompt appears in the most recently selected alternate attribute.

## 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 either 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. Programmers are reminded that 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. Terminal power on and 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) — 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) — 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 Model 2236DE 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 underline 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

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

Low-order  
HEX Digit

**Figure 3-10. The Normal Character Set**

### High-order HEX Digit

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

**Low-order  
HEX Digit**

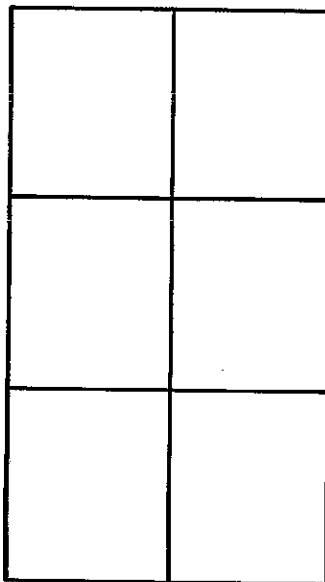
**Figure 3-11. The Alternate Character Set**

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 Model 2236DE 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 set.
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) to 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**

## 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.

## 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 meaning of codes HEX(90) to HEX(FF) are defined to be the normal characters HEX(10) to 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. Power on and RESET select the default character set (the normal character set for the standard USA Model 2236DE).
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 explicitly 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

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. If the signs are nonnegative, lines are drawn; negative signs cause lines to be erased. If the box height is zero, a horizontal line is drawn or erased. A width of zero causes a vertical line to be drawn or erased. The BOX function positions the box so that the upper-left 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); "ØTITLE"		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$)+1); "Ø"; A$
```

where A\$ is the given field, LEN(A\$) is the length of the field A\$, and the symbol Ø represents one space.



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
```

### Box Graphics

The Model 2236DE can display continuous horizontal or vertical lines, enabling forms to be drawn or information to be separated by lines or boxes. 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.

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, a programmer 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 blobs.

The terminal allows the programmer to consider the CRT 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.



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

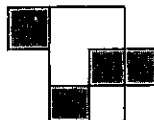


Figure 3-14. Box Graphic Line Placement Relative to Graphic Character Set

### 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. 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 CRT screen as the following.

```
*2236DE R01 19200BPS 8+0 (USA)
```

where:

2236DE is the model number, preceded by an asterisk

R01 is the revision number of terminal firmware, preceded by R

19200BPS is the data rate, followed by BPS

8+0 is the number of data bits (7 or 8); E is even parity, O 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.

```
10 PRINT "WHAT KIND OF TERMINAL DO YOU HAVE  
   (Default = 2236D)?"  
20 M$ = "2236D" : INPUT HEX(0208090F), M$
```

### 3.8 REINITIALIZE TERMINAL

Because the meaning of codes HEX(80) — 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, 2236D compatible state; specifically,

1. Clears the screen, homes the cursor, and turns the cursor on
2. Selects normal intensity characters
3. Selects bright as attribute to be activated by HEX(OE)
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 Model 2236DE keyboards 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 the programmer uses KEYIN or \$GIO to talk to the keyboard on a character by character basis, it becomes the responsibility of the programmer to properly handle dead keys.

KEYIN sees a dead key as two characters — a HEX(FF) followed by the ASCII code for the underline mark. 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 mark 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 mark 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 mark 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 will 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) — HEX(F9)
- Line Erase, HEX(E5)
- Statement number, HEX(E6)
- 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) — HEX(FF)
-

## CHAPTER 4

# LOCAL AND REMOTE TERMINAL/CPU INTERFACE

### 4.1 LOCAL CONNECTION

Each Model 2236DE Interactive Terminal is connected to either a Model 2236MXD Terminal Processor or a Model 22C32 Triple Controller when configured with a 2200MVP, LVP, or VP Central Processing Unit (CPU). These devices control I/O operations between the CPU and the terminals, and buffer data entered from or transferred to the interactive terminal. The Model 2236MXD can be used on the 2200MVP or LVP CPU. The Model 22C32 Triple Controller supports a single terminal and can be used on the 2200VP, MVP, or LVP CPU. The Model 2236DE plugs directly into the terminal connector on the back of the SVP CPU; no additional controllers are necessary.

Model 2236DE terminals can be attached locally to the 2200MVP or LVP CPU at distances up to 2,000 feet (606.1 meters), or remotely via modems and telephone lines. However, terminals connected to a 2200SVP or VP CPU can only be attached locally at a maximum distance of 50 feet (15.2 meters) and 2,000 feet (606.1 meters) respectively. The following are possible local connections.

- Local Connection — For distances up to 25 feet (7.6 meters), transmission rates of 19.2K bits per second (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 Terminal Processor, transmission rates 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 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 2236DE Interactive Terminals is also possible using the built-in telecommunications capabilities of the 2236MXD Terminal Processor and the terminal itself. With the addition of the proper modems, the MXD can communicate with Model 2236DE terminals over virtually unlimited distances. Speeds ranging from 300 to 9600 bps can be attained by using readily available modems and communications lines supplied by various common carriers and modem vendors. This equipment is *not* available from Wang Laboratories, Inc.

When the 2236MXD 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.

Two modems are needed for each remotely used terminal. One modem must be located at the site of the 2236MXD Terminal Processor, and the other modem must be located at the site of the 2236DE Interactive 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 expected to be received must be identical for both modems.

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 1200 to 9600 bps.

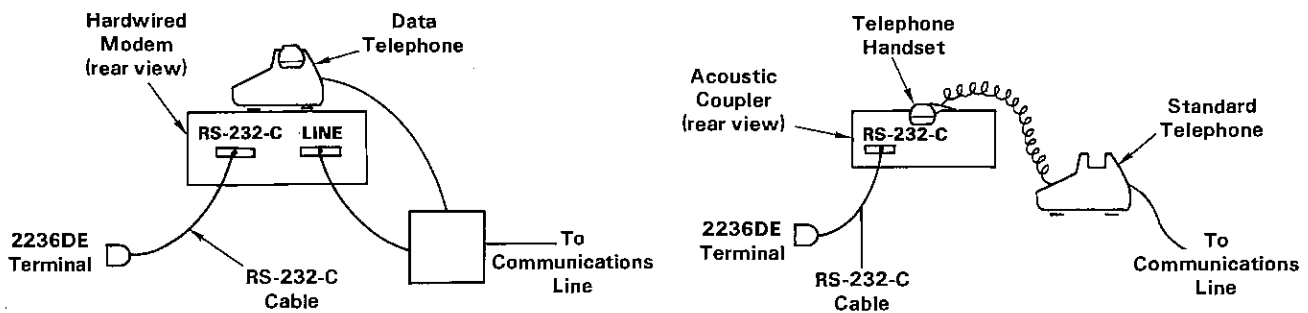
Switched lines are accessed through the common carrier's switching system by telephone dialing. The speed on switched lines is usually limited to 1200 bps because the switching apparatus may introduce noise on the line. A leased line presents a faster, but more costly, alternative to a switched line.

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. Speed on a leased line may be as high as 9600 bps; however, the customer must determine whether the increase in transmission speed justifies the additional expense of a leased line. Information about leased lines and their cost should be obtained from the common carrier in the customer's area.

Communication between the Model 2236MXD and the 2236DE Interactive Terminal is asynchronous serial. Data is sent one bit at a time, with each character framed by a number of control bits. The 2236MXD and the 2236DE terminal send eleven bits for each character transmitted: one start bit, followed by eight data bits, followed by a parity bit, and ending with one 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 MVP utilizes 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 2236MXD or the 2236DE 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 2236MXD 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 and the remote terminal is full-duplex, enabling data to travel simultaneously from the 2236MXD to the terminal and from the terminal to the 2236MXD. Therefore, modems utilized in this system must be full-duplex, capable of asynchronous transmission, and support 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 lines.



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

Since transmission is occurring in two directions simultaneously, the two modems must transmit at slightly different tones to prevent confusion of signals. Therefore, one modem is considered to be the "originating" modem, and the other is the "answering" modem; each transmits at a different pitch. 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.)

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.

1. Switched line, with hardwired modems at both sites; 1200 bps maximum. 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; 1200 bps maximum. (Refer to Figure 4-3.)
3. Leased line, with hardwired modems at both sites; 9600 bps maximum. (Refer to Figure 4-4.)
4. Short-haul line (leased line), using short-haul modems at both the remote and central sites; 9600 bps maximum. (Refer to Figure 4-5.)

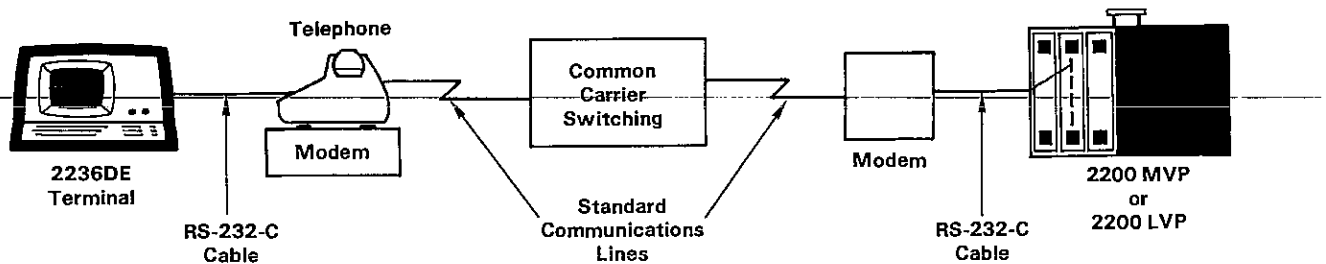


Figure 4-2. Switched Line and Hardwired Modems

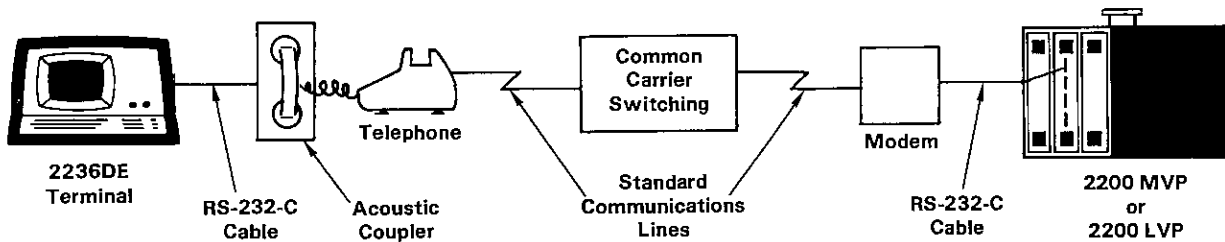


Figure 4-3. Switched Line, Acoustic Coupler, and Hardwired Modem

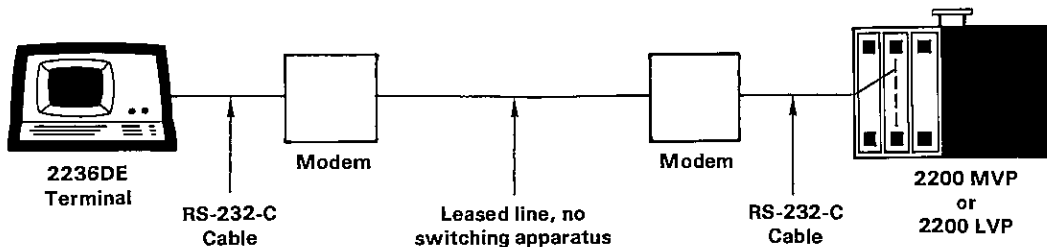
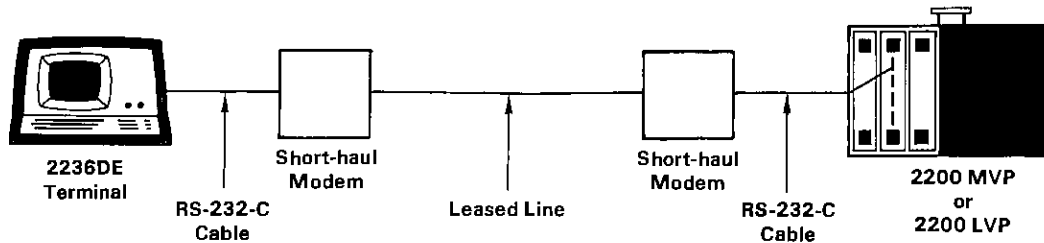


Figure 4-4. Leased Line and Hardwired Modems





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

The Model 2236DE 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 2236DE 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 2236DE 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 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 command after it has transmitted characters to the terminal. This delay, between the cause of an event (the need to send a Stop command) and the effect of an event (terminal processor awaits command) may be defined as hysteresis. The non-Wang supplied 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 2236DE 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. (A list of vendors is provided at the end of this chapter for customer convenience.) Connecting the 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 Terminal Processor and the Model 2236DE 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 # 220-0113)
- 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 2236MXD Terminal Processor and the modem at the central site, and the second cable is connected between the 2236DE 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 2236MXD is designated as Terminal 1. *Do not use* Port 1 on the 2236MXD 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.

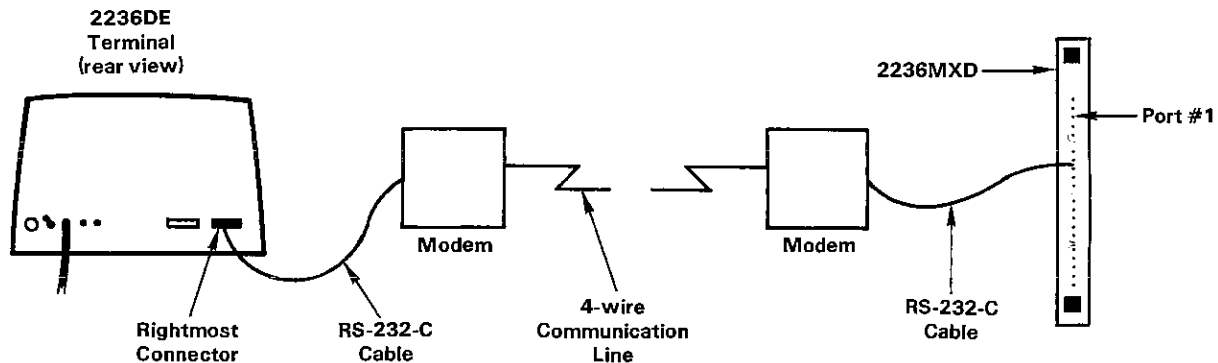


Figure 4-6. Cable Connections for Remote Terminal Operation

#### 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 2236DE 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 2236MXD Terminal Processor's modem is attached. If the modem attached to the Model 2236MXD 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 illuminates 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 2236DE Interactive Terminal and 2236MXD 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 2236MXD 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 2236MXD.
2. Check that the transmission speeds selected for both modems, the 2236MXD port to which the central modem is attached, and the 2236DE terminal are in agreement.
3. Examine the indicator lamp on each modem to ensure that a connection was made. If the indicator is not illuminated, follow the normal procedure for establishing the telecommunications link. If this approach fails, continue with Procedure 4.
4. The Model 2236DE terminal depends on the 2236MXD Terminal Processor for character echo. Each keyed character is transmitted to the 2236MXD, 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 2236MXD. It is therefore useful to isolate the terminal from the 2236MXD 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. (Procedure 5 outlines tests to be performed at the central site.)

If no echo can be observed at either the remote or the central site after performing this procedure, the modem supplier should be contacted and the modems tested. The common carrier can test modem operation from a central site and a field visit is not required. If the

modems are operational, contact the common carrier and determine whether the communications line is functioning properly.

5. If the remote site is free from problems, both the modem and the 2236MXD at the central site should be checked. The modem may be checked as in Procedure 4, using a local terminal and the RS-232-C compatible cable. The 2236MXD may be tested by configuring the system for 4-terminal, 4-partition operation 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 2236MXD 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.

#### 4.6 MODEM SUPPLIERS

Modems may be purchased, rented, or leased from several sources. The following list of suppliers is intended for the convenience of the customer; Wang Laboratories, Inc., is neither affiliated with any modem supplier nor recommends any particular modem. Wang *does not* supply modems for remote terminal operation. (The modem supplier will be especially interested in Appendix A and Section 4.3 of this manual in order to recommend appropriate modems.)

The Bell Telephone Company is the largest supplier of modems in the country. Although not a supplier of short-haul modems, Bell Telephone does supply a number of modems for long-haul applications. Their local business office may be contacted for information.

In addition, the following manufacturers and suppliers can provide modems for 2200MVP or LVP remote terminal operations.

Anderson Jacobson, Inc.  
1065 Morse Avenue  
Sunnyvale, CA 94086  
(408) 263-8520

Omnitec Data Corporation  
2405 South 20th Street  
Phoenix, AZ 85034  
(602) 258-8244

GTE Lenkurt, Inc.  
1105 County Road  
San Carlos, CA 94070  
(415) 591-8461

Penril Data Communications Corp.  
5520 Randolph Road  
Rockville, MD 20852  
(301) 881-8151

Intertel, Inc.  
6 Vine Brook Park  
Burlington, MA 01803  
(617) 273-0950

Racal-Vadic  
222 Caspian Drive  
Sunnyvale, CA 94086  
(408) 744-0810

Livermore Data Systems, Inc.  
2050 Research Drive  
Livermore, CA 94550  
(415) 447-2252

Rixon, Inc.  
2120 Industrial Parkway  
Silver Spring, MD 20904  
(301) 622-2121

Syntech Corporation  
11810 Parklawn Drive  
Rockville, MD 20852  
(301) 770-0550

The following vendors specialize in short-haul modems.

Computer Transmission Corp.  
2352 Utah Avenue  
El Segundo, CA 90245  
(213) 973-2222

Penril Data Communications Corp.  
5520 Randolph Road  
Rockville, MD 20852  
(301) 881-8151

Gandalf Data Communications, Ltd.  
1019 South Noel  
Wheeling, IL 60090  
(312) 541-6060

Spectron Corporation  
Church Road & Roland Avenue  
Mt. Laurel, NJ 08057  
(609) 234-5700



## APPENDIX A MODEL 2236DE TERMINAL SPECIFICATIONS

### Size

Height .....	13.5 in. (34.3 cm)
Depth .....	20.5 in. (52.1 cm)
Width .....	19.8 in. (50.3 cm)

### Weight

51 lb (23.1 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)

### 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

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)

### Power Requirements

115 or 230 VAC  $\pm$  10%  
50 or 60 Hz  $\pm$  1.0 Hz  
50 Watts

### Fuses

2 amp (SB) @ 115 V/60 Hz  
1 amp (SB) @ 230 V/50 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 2200MVP, LVP, SVP, or VP 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 Model 2236DE, unless an optional direct connection cable is ordered for a terminal. Nonextendable cables (refer to Table A-1) are available optionally 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**

<b>Length in Feet</b>	<b>Length in Meters</b>	<b>Part Number</b>
12	3.7	220-0113
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**

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 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.

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.

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.

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 defined by the following parameters.

~~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 230 VAC  $\pm$  10%, 50 or 60 Hz  $\pm$  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 24 x 80 CRT of the Model 2236DE console. 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 (nondestructive backspace)
09	Cursor right 1 space (nondestructive)
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

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
<b>Low-order HEX Digit</b>	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

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

Low-order  
HEX Digit

**Figure C-2. The Alternate Character Set**





# APPENDIX D CHANGING THE TRANSMISSION RATE OF THE MODEL 2236DE INTERACTIVE TERMINAL AND THE 2236MXD TERMINAL PROCESSOR

## D.1 INTRODUCTION

### CAUTION

Wang Laboratories, Inc., does not guarantee any equipment modified by the user. Damage to equipment incurred as a result of such modification is the financial responsibility of the user. We recommend that only Wang Customer Engineers modify Wang equipment.

With all switch types, one end of the switch will be marked ON (-). The "push-in" type of 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" type of switch requires a sliding motion toward either the ON or OFF position. The "rocker" type switch operates similarly to the "push-in" type. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-1 for an illustration of the three types of switches.)

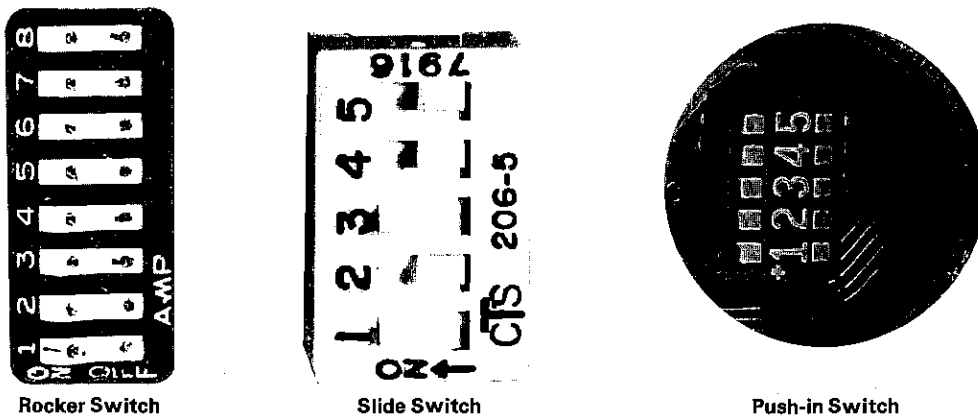


Figure D-1. The Three Types of Switches

### NOTE

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 MODEL 2236DE TERMINAL

To change the data transmission rate of the 2236DE Interactive Terminal, observe the following procedure.

1. Switch the terminal's power off.
2. Locate the cap in the rear of the terminal. If necessary, the terminal may be moved slightly to provide better access to the cap.
3. Using a screwdriver (as shown in Figure D-2), gently remove the cap by placing the tip of the screwdriver underneath it.
4. The transmission rate switch is now exposed. Note that any of the three switch types may be located on the terminal. When setting the switches, follow the instructions for whatever type of switch is installed in the terminal.

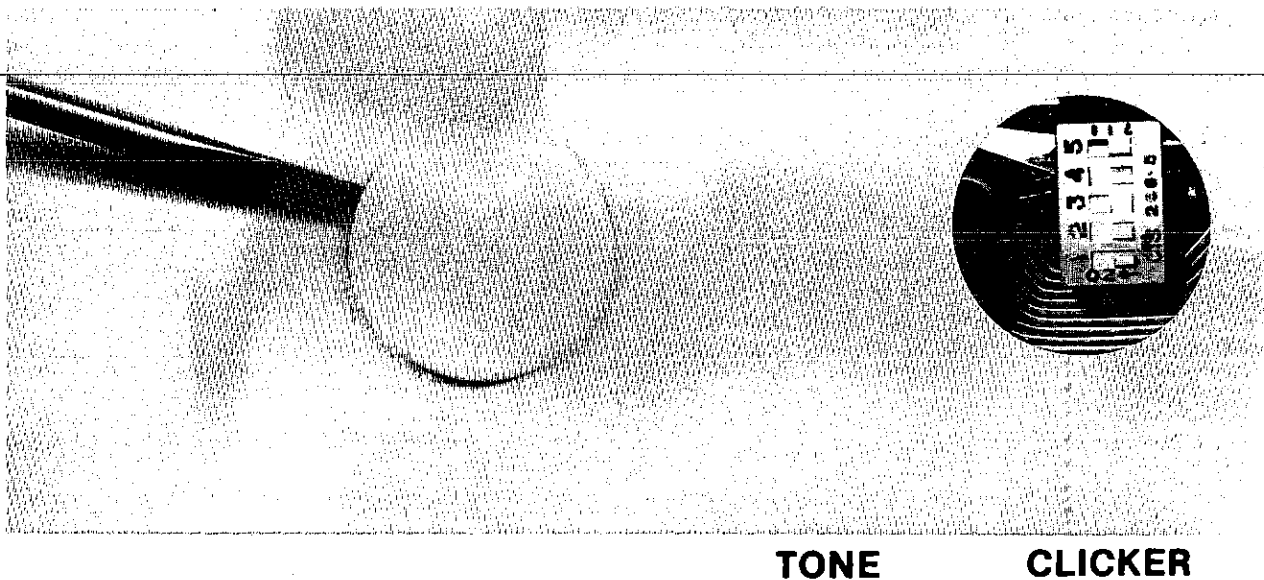
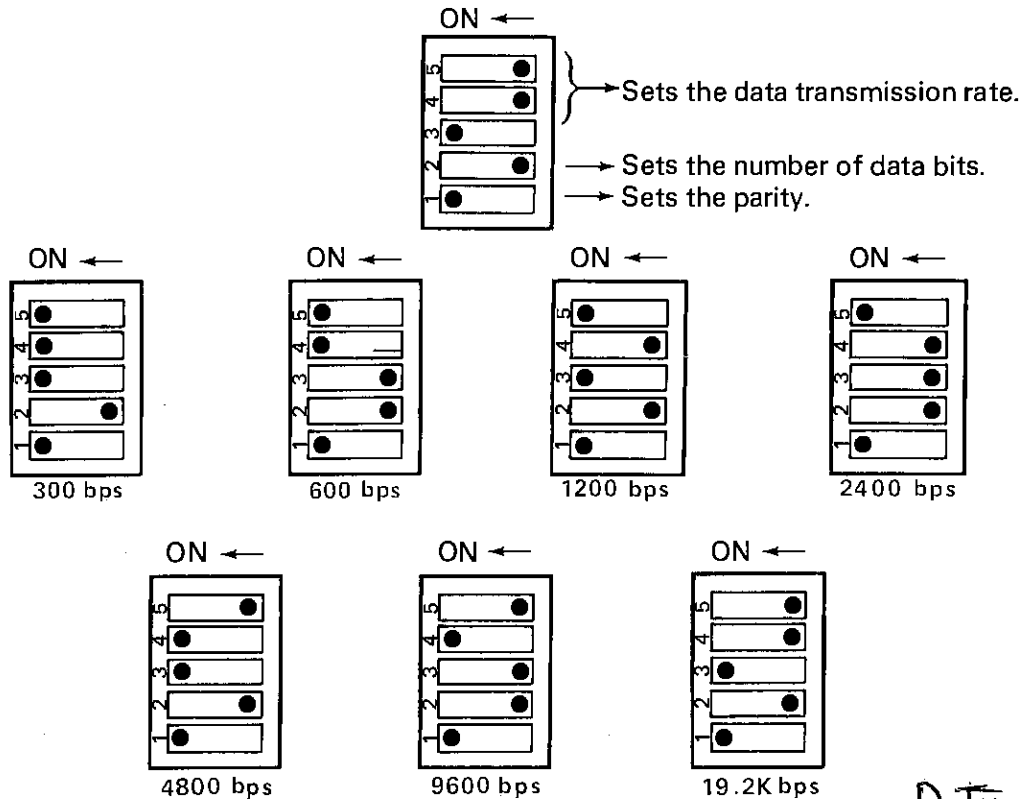


Figure D-2. Removing the Cap

- The switch settings that correspond to each possible data transmission rate appear in Figure D-3. Set the three uppermost switches to the appropriate positions for the transmission rate desired.



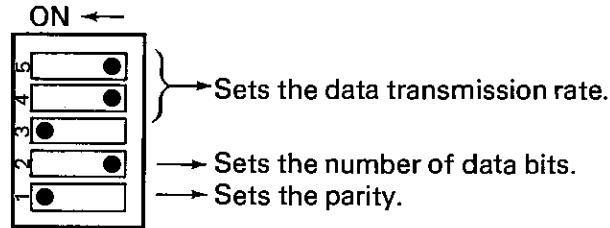
All settings with 8 data bits and odd parity.

*Demos setting  
For 19.2K  
1 2 3 5*

**Figure D-3. The Data Transmission Rate Switch Settings on the 2236DE Interactive Terminal**

- Set the number of data bits to 8 and parity to ODD. All settings in Figure D-3 appear with 8 data bits and odd parity. When using a 2200 system configuration, the number of data bits must be 8 and the parity must be odd.
- After setting the switches, place the cap back into position on the back of the terminal.
- The terminal's power may now be switched on.
- The terminal will display its "power-on" message [2236DE R01 19200BPS 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:

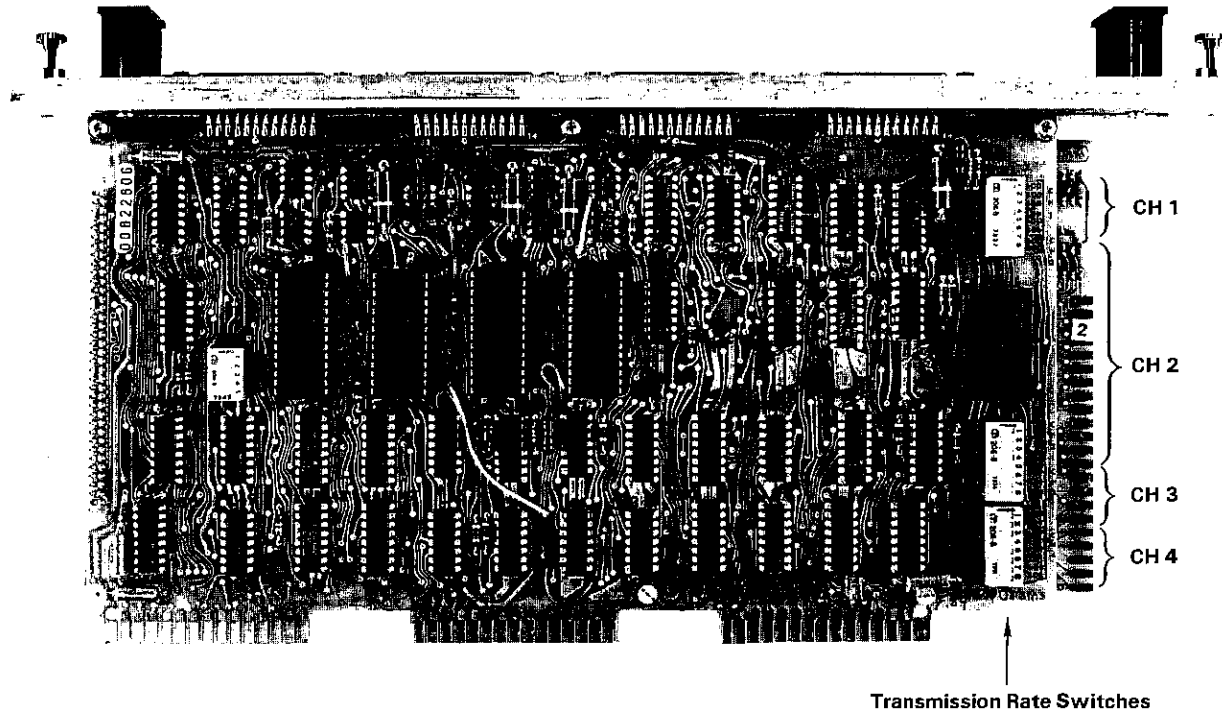
- Left for odd parity with 8 data bits
- Left for odd parity with 7 data bits
- Right for no parity with 8 data bits
- Right for even parity with 7 data bits

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

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, followed by all disk drives, the Disk Processing Unit (DPU), and finally the Central Processing Unit (CPU).
2. Loosen the retaining screws which 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-4). Note that any of the three switch types may be located on the processor. Follow the instructions for setting whatever type of switch is installed on the 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 Wang Customer Service 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 possible terminal). Each set is divided into six switches (one switch for each possible data rate of each terminal). (Refer to Figure D-4.)
6. After setting the switches, replace the terminal processor in the CPU I/O port and tighten the retaining screws.
7. The system may now be powered on. Begin by turning on the CPU, followed by the DPU, all disk drives, and lastly, all printers and terminals.



**Figure D-4. The Transmission Rate Switch Settings on the 2236MXD Terminal Processor**



## APPENDIX E

### SETTING THE DEVICE ADDRESS OF THE 2236MXD TERMINAL PROCESSOR

#### CAUTION

Wang Laboratories, Inc., does not guarantee any equipment modified by the user. Damage to equipment incurred as a result of such modification is the financial responsibility of the user. We recommend that only Wang Customer Engineers modify Wang equipment.

When one to four terminals are configured, one 2236MXD Terminal Processor is used. The address of the primary processor is always set at address /00 (the processor also reserves addresses 01—07). When five to eight terminals are configured, two 2236MXD Terminal Processors are required. The address of the second processor is always set at address /40 (the processor also reserves addresses 41—47). When nine to twelve terminals are configured, three 2236MXD Terminal Processors are required. The address of the third processor is always set at address /80 (the processor also reserves addresses 81—87).

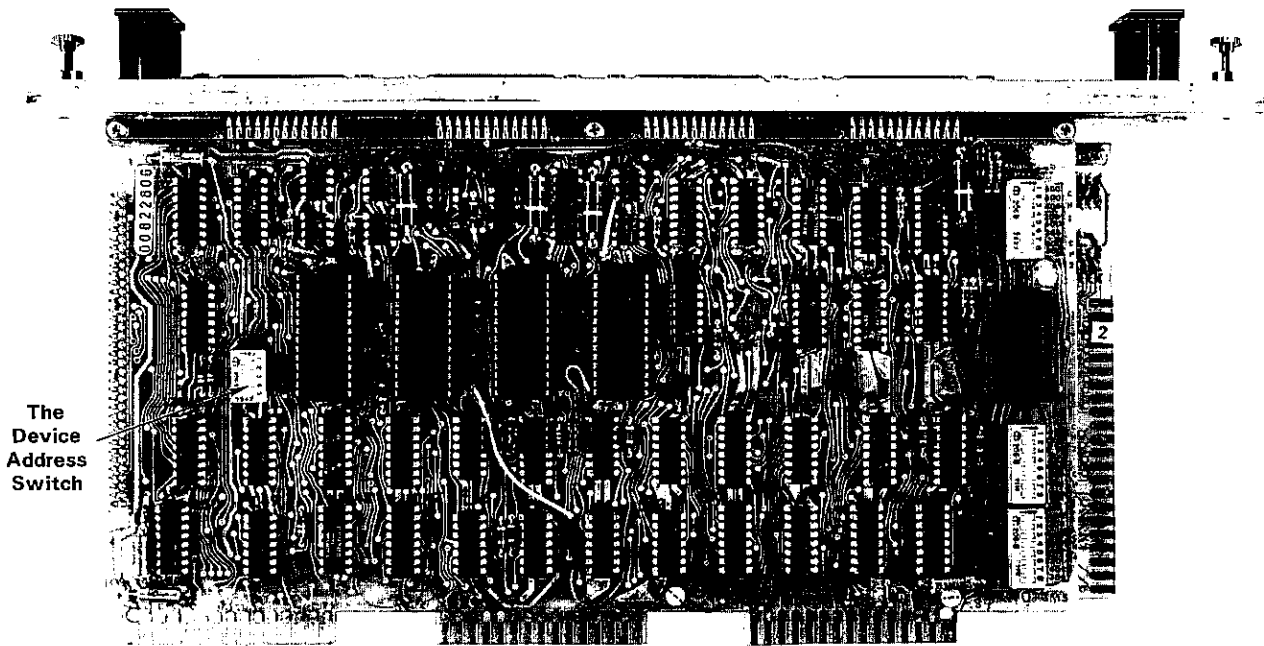
Note that unlike other peripheral processors, the physical device address set on the 2236MXD Terminal Processor is not the address specified in a program for access to the terminal CRT, keyboard, and local printers. The programmable device addresses for *all* terminals are: CRT /005, keyboard /001, and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

With all switch types, one end of the switch will be marked ON(-). The push-in type of 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 type of switch requires a sliding motion toward either the ON or OFF position. The rocker type of switch operates similarly to the push-in type. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-1 for an illustration of the three types of switches.)

To set the 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, the Disk Processing Unit (DPU), and finally the Central Processing Unit (CPU).
2. Loosen the retaining screws which 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 processor board used to set the device address (refer to Figure E-1). Note that any of the three switch types may be located on the processor. 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 MXD 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 MXD 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 MXD Terminal Processors. The third processor, which must be set at /80, controls Terminals 9-12.)
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. 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.

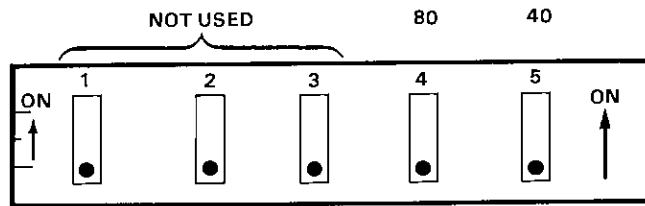


Figure E-2. Device Address /00

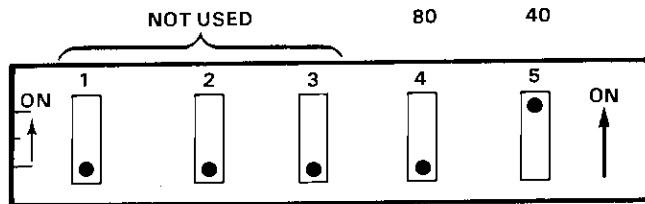


Figure E-3. Device Address /40

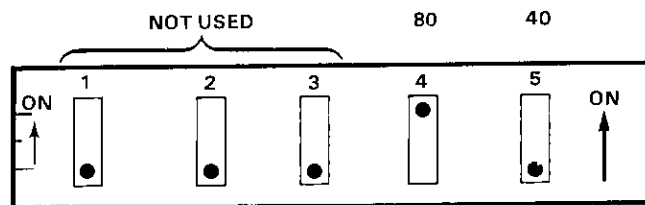


Figure E-4. Device Address /80

**NOTE**

Addresses 01–07, 41–47, 81–87, and C1–C7 are reserved for the 2236MXD Terminal Processor and *cannot* be used for any other devices.

If the processor connectors are not numbered, they can be easily distinguished and identified. The two connectors nearest the handles on top of the processor are always offset such that the plug on one end will be closer to the handle than the plug on the other end of the processor. The jack which is closest to the handle has the highest number. The jack numbers descend sequentially from this end toward the opposite end of the processor board. (Refer to Figure E-5.)

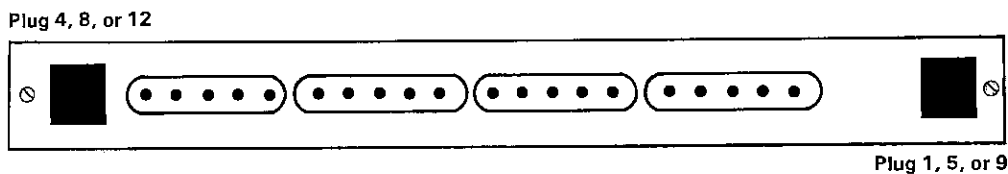


Figure E-5. Determining the Number Assigned to the Jacks



## APPENDIX F

### SETTING THE DEVICE ADDRESSES ON THE 22C32 TRIPLE CONTROLLER

#### CAUTION

Wang Laboratories, Inc., does not guarantee any equipment modified by the user. Damage to equipment incurred as a result of such modification is the financial responsibility of the user. We recommend that only Wang Customer Engineers modify Wang equipment.

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 type of 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 type of switch requires a sliding motion toward either the ON or OFF position. The rocker type of switch operates similarly to the push-in type. When one end of the switch is pushed in, the opposite end projects out. (Refer to Figure D-1 for an illustration of the three types of switches.)

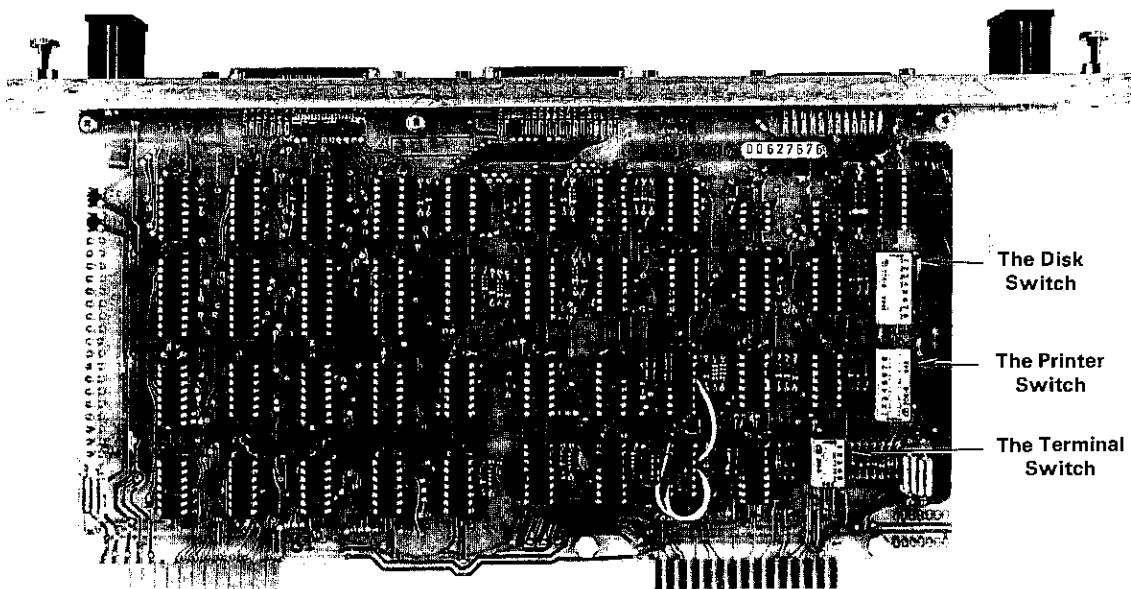


Figure F-1. The Device Address Switches on the 22C32 Triple Controller

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.

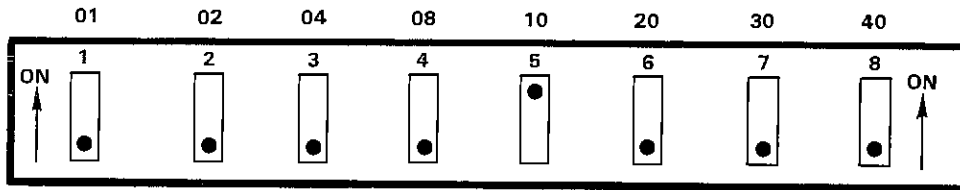


Figure F-2. Disk Address 10

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.

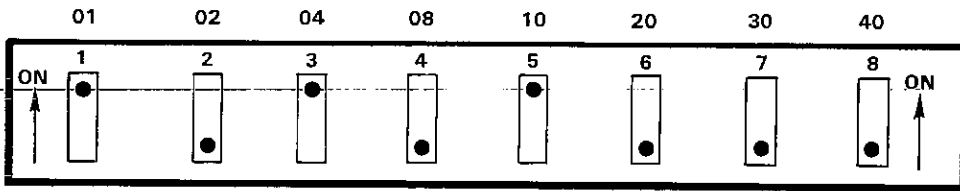


Figure F-3. Printer Address 15

Whenever 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.

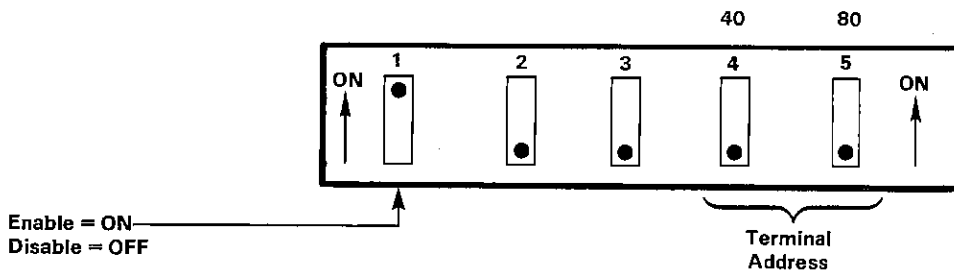
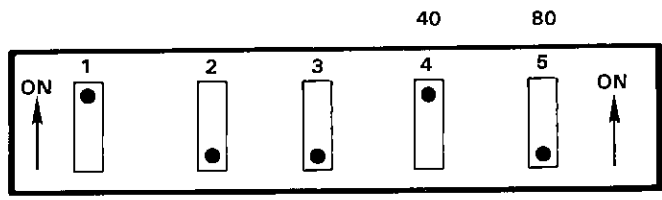


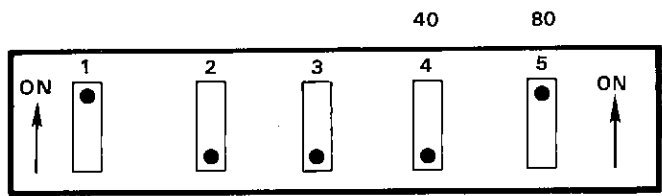
Figure F-4. Switches Set for Terminal 1

On 5-terminal MVP systems, the 22C32 should be used for the fifth terminal. The switches should be set such 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.



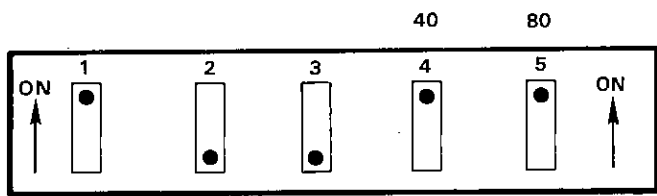
**Figure F-5. Switches Set for Terminal 5**

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



**Figure F-6. Switches Set for Terminal 9**

On 13-terminal MVP systems, the 22C32 should be used for the thirteenth terminal. The switches should be set such that both the 40 and 80 bits are on (the controller then responds to addresses C1—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 local 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, the Disk Processing Unit (DPU), and finally the Central Processing Unit (CPU).
2. Loosen the retaining screws which 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 2236MXD 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.

**WANG**

LABORATORIES, INC.

TO: MODEL 2236DW TERMINAL USERS  
FROM: CORPORATE PUBLICATIONS DEPARTMENT  
SUBJECT: ADDENDUM TO MODEL 2236DE USER MANUAL (700-5711A)  
DATE: MARCH 15, 1981

Please insert the attached addendum, "Appendix G: Model 2236DW Integrated Terminal", into the Model 2236DE User Manual. This appendix describes the features and operation of the 2236DW Integrated Terminal.

Thank you

Corporate Publications Department

**WANG**

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# **Model 2236DE Interactive Terminal User Manual**

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700-5711A



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## **APPENDIX G**

### **MODEL 2236DW INTEGRATED TERMINAL**

#### **G.1 INTRODUCTION**

The Model 2236DW Integrated Terminal allows the user 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.

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

#### **G.2 TERMINAL KEYBOARD**

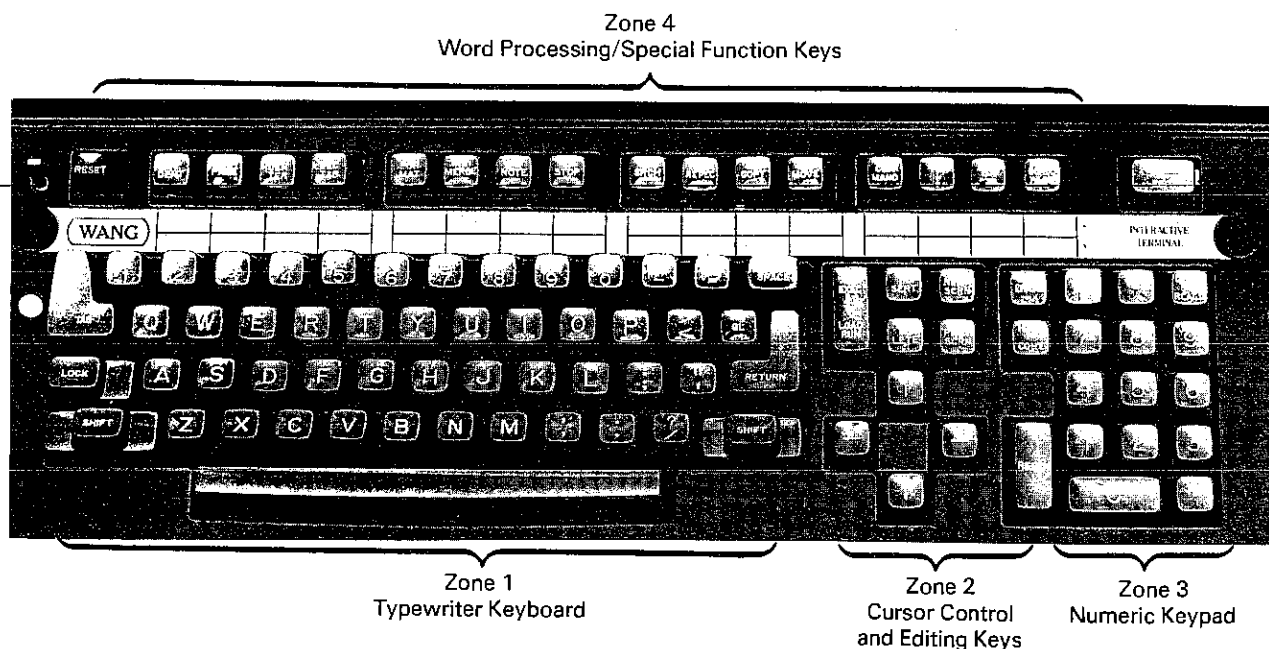
The terminal is designed for users who are already familiar with a standard typewriter keyboard and numeric keypad. The keyboard, illustrated in Figure G-1, is the operator's means of interactively communicating with and controlling the system. By using the keyboard, an operator can enter data, write programs, perform calculations, and enter commands to the processor.

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 in unshifted operation.

The 2236DW also includes a Caps Lock feature. In either A/A or A/a mode, Caps Lock, activated by pressing the Lock key, produces uppercase alphabetic characters; all other characters, such as the numeric keys, are lowercase. (Refer to Table G-1 for a detailed listing of the performance of the keys in each different operating mode.)

The keys are well designed and are ideally suited for high-speed typing or data entry. Positive response keys provide adjustable audio feedback when they are touched with sufficient pressure to ensure entry of a character. An experienced typist need not "bottom out" a key to ensure entry, thereby increasing input speed and lessening the need to verify entry by checking the CRT. A program-controlled audio alarm with adjustable volume can also be used to minimize operator monitoring by signaling when special conditions occur.



**Figure G-1. The Model 2236DW Keyboard**

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 microprocessor in the terminal automatically adjusts the repeat key rate according to the rate at which characters are being echoed to the CRT. The keyboard clicker sounds each time the repeated character is transmitted. Thus, both aural and visual evidence of the repeated character are given to the user. (The repeat key is particularly useful for moving the cursor when editing.)

Special features of the Model 2236DW keyboard include the following.

- **Keyboard Clicker** — The clicker provides audio feedback when a key is sufficiently pressed. The volume of the keyboard clicker may be adjusted.
- **N-key Rollover** — This feature permits a new key to be pressed and output to the terminal while a previous key is still being held down. This process can continue for any number of keys; each new key 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, typing beyond a specified field, displaying an error message. 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; signals ready; and returns to the console user (Console Input mode). RESET is also used during Master Initialization and hardware diagnostic operations. The RESET key is an undesirable means of terminating execution and generally should not be used to end program execution; 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 2200MVP or LVP, RESET affects *only* the partition to which the terminal is currently attached (the terminal's foreground partition). *No other* partitions are affected by RESET.

**Table G-1. Operation of Keyboard Modes**

	<b>A/A mode</b>	<b>A/a mode</b>
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

For convenience of discussion, the keyboard has been divided into the following four physical zones. Refer to Figure G-1.

**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 provides Special Function '126 when unshifted and '127 when shifted (refer to the description of Zone 4).

**Zone 2 - Cursor Control and Editing Keys** — This zone contains Editing keys (INSERT and DELETE), Location keys (NEXT SCRNL and PREV SCRNL), and Cursor Control keys (controls movement of cursor in indicated direction — up, down, right, and left).

**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 keys in either the numeric or the alphanumeric zone. This zone also includes such keys as ERASE, HALT/CONT, and RETRN.

**Zone 4 - Word Processing/Special Function Keys** — Across the top of the keyboard are 16 Word Processing/Special Function keys. 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 by the programmer 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, access subroutines, or enter a predefined text string. The operator is informed of the meanings of the Special Function keys either by screen prompts or by means of the label strip located immediately below this row of keys. In order to perform a given task, a Special Function key must be defined by the user with a DEFFN' statement in the currently loaded program. The Special Function keys are also used during Master Initialization to load the BASIC-2 interpreter and operating system.

### G.3 CRT DISPLAY

The 2236DW Integrated Terminal contains a 12-inch (30.5 centimeter) diagonal measure Cathode Ray Tube (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. Both the 2236DW and the 2236DE have the same control codes and character sets (refer to Appendix C).

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. Brightness and contrast controls provide a sharp, clear image on the screen. Display speed is approximately 2,000 characters per second at 19,200 baud. A cursor, resembling an underscore, 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.

#### **G.4 TERMINAL/CPU INTERFACE**

Each 2236DW Integrated Terminal is connected to either a 2236MXD Terminal Processor or a 22C32 Triple Controller when configured with a 2200MVP, LVP, or VP Central Processing Unit. (Existing controllers must be revised to current standards to support the 2236DW terminal.) These devices handle I/O operations between the CPU and the terminals, and buffer data entered from or transferred to the terminals.

The 2236MXD Terminal Processor is used on the 2200MVP CPU, which can support 12 terminals (4 per terminal processor). The Model 2236MXD is also used on the 2200LVP, which can support 4 terminals. Since 2200/WP Word Processing Software requires 28K of user memory per terminal, the maximum number of terminals that can simultaneously operate WP varies with available user memory. The 22C32 Triple Controller supports a single terminal and can be used on the 2200VP, MVP, and LVP CPU. The 2236DW plugs directly into the terminal connector on back of the SVP CPU; no additional controllers are necessary.

Model 2236DW terminals can be attached locally to the 2200MVP or LVP CPU at distances up to 2000 feet (606.1 meters), or remotely via modems and telephone lines. Terminals connected to a 2200SVP or VP CPU can be attached locally at a maximum distance of 50 feet (15.2 meters) and 2000 feet (606.1 meters) respectively. 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.

Each 2236DW can support its own terminal printer which can be used for program output. Additionally, hard copy of CRT displays can be created at each terminal site. A dump of the display screen to the terminal printer may be initiated from the keyboard, resulting in the printing of all standard characters present on the screen. The screen dump feature requires no special software and can be performed at any time.

The 2236DW and its controller employ microprocessors to optimize data throughput. For example, strings of four or more identical characters are compressed for transmission into 3-byte blocks. A ready/busy protocol controls information flow between the terminals and the terminal processor. Thus, it is unnecessary for the attached printer to keep up with the serial communication line data rate. These features are automatic and are completely transparent to the software executing in the 2200 CPU.

As an added feature, the 2236DW performs self-testing diagnostics every time it is turned on. These diagnostics ensure optimal terminal condition before use. If the unit fails one of the tests, a continuous alarm sounds, alerting the user to the failure. The tests allow a Wang Customer Service Representative to quickly identify the problem and minimize downtime.



The 2236DW terminal also incorporates a power supply that relies on air convection cooling, rather than a fan. This feature provides quiet terminal operation.

Any standard Wang printer or plotter with a 36-pin cable connection may be plugged into the printer connector on the 2236DW Integrated Terminal. A Wang-supplied direct-connection cable or an optional modem cable plugs into a RS-232-C-compatible connector on the terminal.



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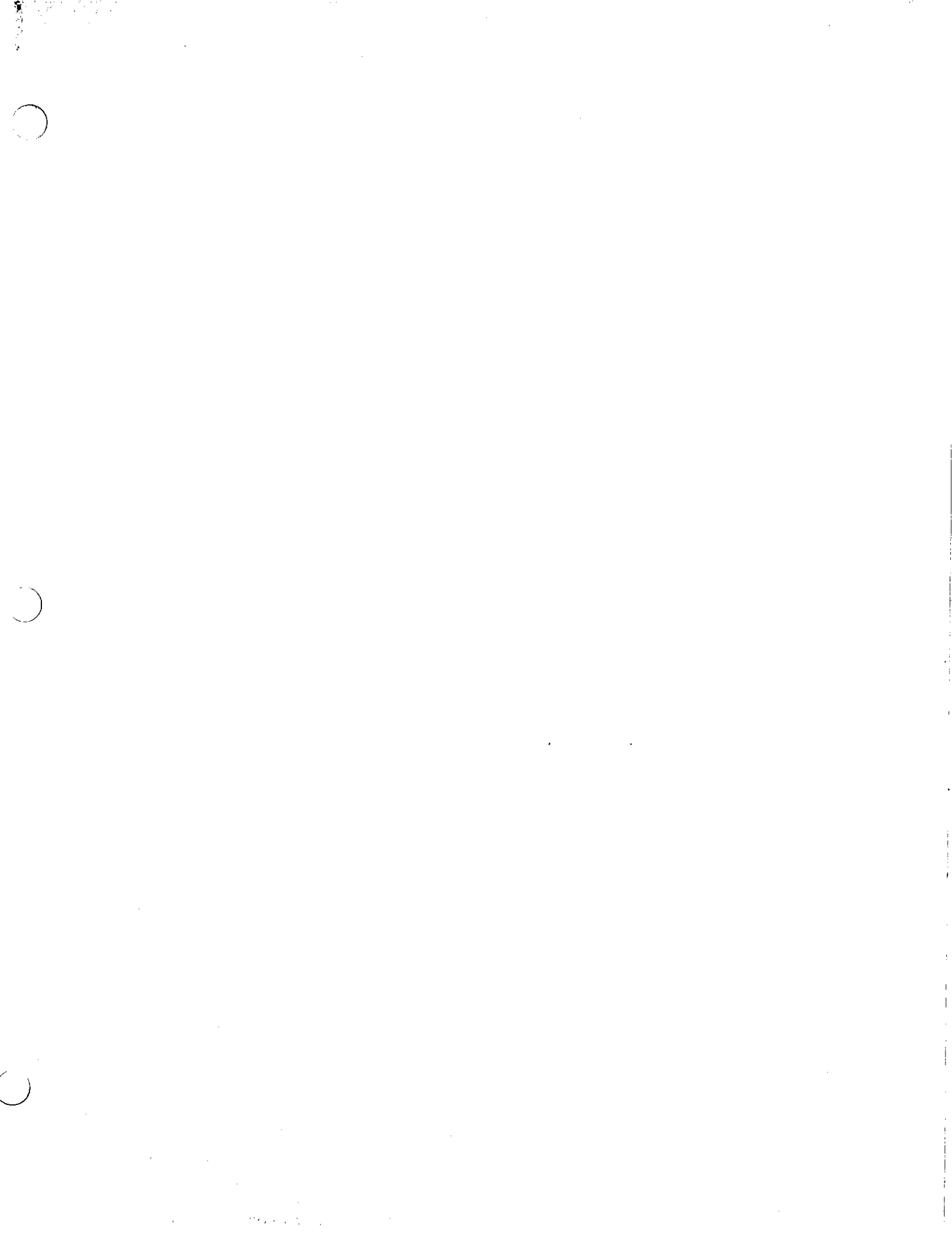
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