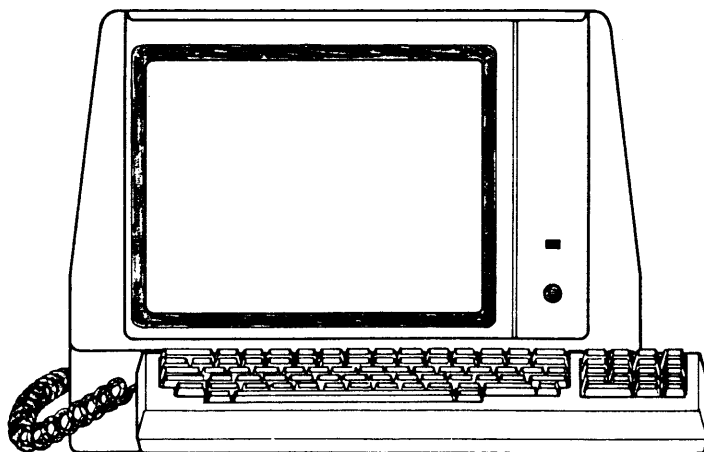


**MDT20**

**Terminal Reference Manual**



**MORROW DESIGNS** 

Morrow Designs 20 (MDT20)  
Terminal Reference Manual  
Revision 1 January 1983

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# SECTION I GENERAL DESCRIPTION

## 1.1 INTRODUCTION

This section describes the specifications of the Morrow Terminal, along with its functional capabilities. These specifications are also listed in Table 1-1.

## 1.2 PURPOSE AND USE

There are numerous applications of the Morrow Terminal, all involving the transfer of data to and from your Morrow Designs Computer. Data transfer in some applications may be almost exclusively unidirectional, such as from the unit to the computer. A more frequent application is one in which you communicate with your computer, and the computer responds in accordance with its stored program for word processing or other application programs.

The Morrow Terminal has the following general capabilities (all included to enhance the level of performance of your system):

- . Twelve inch (30.5 cm) diagonal non-glare display
- . Full 128 ASCII character set, in an 80 column by 24-row format
- . Four visual attributes - blink, reduce, reverse and underline
- . Detachable 92-key keyboard with a typewriter style layout
- . Fourteen key numeric keypad
- . Separate cursor control keys
- . Seven function keys
- . Remote or local display editing
- . Conversational or block mode communications at fifteen selectable transmission rates
- . RS-232C serial asynchronous interfacing
- . RS-232C auxiliary buffered communications port
- . Non-volatile set-up mode for terminal configuration directly from the keyboard

### 1.3 PHYSICAL DESCRIPTION

The Morrow Terminal is a two-piece modular design that includes a monitor assembly and a keyboard assembly. The monitor assembly contains the main logic board, the display driver board with associated cathode ray tube (CRT), and the regulated power supply. For user convenience, the power ON/OFF switch and video contrast control are located on the front of the monitor assembly. At the back of the housing are the interface connectors, keyboard connector, and power cord. The keyboard assembly contains the 92-key keyboard and associated logic. A six-foot coiled cord connects the keyboard to the monitor assembly. Both assemblies are packaged in lightweight, compact housings that provide flexibility and convenience in operation.

### 1.4 OPERATIONAL DESCRIPTION

The Morrow Terminal is an interactive device which is used to communicate with your Morrow Designs computer. Using a keyboard similar to that of a typewriter, you may enter information which is either immediately transmitted to the computer (conversation mode), or, stored in display memory for block transmission to the computer (block mode). (For most applications, your Morrow Terminal will be used in the conversation mode.) Data from the computer is received and displayed at baud rates as high as 19200.

#### 1.4.1 Control Logic

The Control Logic contains the microprocessor and various integrated circuits which control the operation of your Morrow Terminal. These operations include: timing and control, data handling and storage, interpreting and responding to commands from the keyboard and the computer, video control, I/O interfacing and status control.

Data sent to the terminal is received by the Control Logic from the Interface Port. The microprocessor decodes the input data and reformats it into data and control instructions for the Video Logic and Control Logic.

#### 1.4.2 Video Logic and Drive

The Video Logic and Drive section provides the circuitry needed to drive the CRT on the display drive board. The 2K bytes of display random access memory (RAM), and character generation circuits, as well as the video logic, are on the main logic board. The CRT screen can display 24 lines of data containing as many as 80 characters per line. Data from the control logic is written into the display RAM; control instructions from the CRT controller cause the contents of the RAM to be displayed on the monitor screen. Figure 1-1 depicts the character format and associated hex codes used for display in the Morrow Terminal.



00 NUL	01 SOH	02 STX	03 ETX	04 EOT	05 ENQ	06 ACK	07 BEL	08 BS	09 HT	0A LF	0B VT	0C FF	0D CR	0E SO	0F SI
10 DLE	11 DC1	12 DC2	13 DC3	14 DC4	15 NAK	16 SYN	17 ETB	18 CAN	19 EM	1A SUB	1B ESC	1C FS	1D GS	1E RS	1F US
20	21 !	22 "	23 #	24 \$	25 %	26 &	27 '	28 (	29 )	2A *	2B +	2C ,	2D -	2E .	2F /
30	31 0	32 1	33 2	34 3	35 4	36 5	37 6	38 7	39 8	3A 9	3B :	3C ;	3D <	3E =	3F >
40	41 @	42 A	43 B	44 C	45 D	46 E	47 F	48 G	49 H	4A I	4B J	4C K	4D L	4E M	4F N
50	51 O	52 P	53 Q	54 R	55 S	56 T	57 U	58 V	59 W	5A X	5B Y	5C Z	5D [	5E \ ]	5F ^ _
60	61 `	62 a	63 b	64 c	65 d	66 e	67 f	68 g	69 h	6A i	6B j	6C k	6D l	6E m	6F n
70	71 o	72 p	73 q	74 r	75 s	76 t	77 u	78 v	79 w	7A x	7B y	7C z	7D {	7E 	7F } ~ %

Figure 1-1. 128 Character ASCII Format, with Hex Codes

		CONTROL CHARACTERS		DISPLAYABLE CHARACTERS						
HEX BYTE	1ST		0	1	2	3	4	5	6	7
	2ND	BITS 4321	BITS 765	000	001	010	011	100	101	110
0	0000		NUL	DLE		0	@	P	'	p
1	0001		SOH	DC1	!	1	A	Q	a	q
2	0010		STX	DC2	"	2	B	R	b	r
3	0011		ETX	DC3	#	3	C	S	c	s
4	0100		EOT	DC4	\$	4	D	T	d	t
5	0101		ENQ	NAK	%	5	E	U	e	u
6	0110		ACK	SYN	&	6	F	V	f	v
7	0111		BEEP	ETB	'	7	G	W	g	w
8	1000		BS (←)	CAN	(	8	H	X	h	x
9	1001		(SKIP) HT	EM	)	9	I	Y	i	y
A	1010		LF (↓)	SUB	*	:	J	Z	j	z
B	1011		VT (↑)	ESC	+	;	K	[	k	{
C	1100		FF (→)	FS	'	<	L	\	l	!
D	1101		CR	GS	-	=	M	]	m	}
E	1110		SO	(HOME) RS	·	>	N	^	n	~
F	1111		SI	(NEW LINE) US	/	?	O	--	o	DEL

USE CTRL KEY  
WITH DISPLAYABLE  
CHARACTER KEYS  
TO PRODUCE  
CONTROL CODES

Figure 1-2. Displayable USASCII Character Set and Control Codes

### 1.4.3 Keyboard

The keyboard contains 92 keys from which data entry and control functions are locally initiated. In the conversational transmission mode, each keystroke is encoded into a corresponding ASCII character by the control logic, which is immediately transmitted to the computer. In half-duplex operation the character is also routed back to the video logic, or in full-duplex operation, echoed from the computer via the Main Port. In the block transmission mode, characters are displayed on the CRT and held within the terminal, but are not transmitted to the computer until the appropriate SEND LINE or SEND PAGE command has been given.

### 1.4.4 Main and Auxiliary Ports

The Morrow Terminal comes standard with two ports - the Main Port and the Auxiliary Port, both of which are located on the back of the terminal. Your Morrow Designs computer and the Morrow Terminal interface via the Main Port. The Auxiliary Port is an RS-232C serial output port, with a control signal interface. Usually, an asynchronous serial receive only (RO) printer is connected to the Auxiliary Port. The printer used may be a character-by-character or buffered type, and may operate at a different transmission rate than that used on the Main Port.

With the X-ON/X-OFF (Busy/Ready Handshake) feature enabled, the Morrow Terminal is able to pass a busy status of the Auxiliary Port device to the computer and also state the terminal's local condition during operations which need long execution times. This avoids any loss of data.

Data and control information from the computer is routed through the Main Port to the Control Logic. The control logic causes data to be displayed on the monitor in the same manner as the keyboard data. The interface logic contains the circuitry appropriate for interfacing via RS-232C signals. The interface logic also contains the baud rate clock which permits the Morrow Terminal to receive and transmit data at selected baud rates from 75 to 19200 baud.

The Morrow Terminal transmits blocks of data by retrieving data from the display memory for routing by the control logic. The control logic reformats the data and routes data and control information to the appropriate interface. Interface logic is used to prepare data and control information for transmission to the appropriate device connected.

### 1.4.5 Set-Up Logic

The Morrow Terminal features a non-volatile Set-Up Mode to establish terminal operating characteristics. Through commands from the keyboard or computer, the control logic causes the Set-Up parameters to be loaded or read into system RAM. This information can then be

"saved" to non-volatile RAM pressing the "SAVE" key on the keyboard, thereby retaining the set-up with the power off. Features selectable in Set-Up Mode include: baud rates, word structure, protected-field, visual attributes, cursor type, communications control, operating modes, emulations and scrolling.

#### 1.4.6 Regulated Power Supply

The Morrow Terminal power supply is located in the rear of the base. The power supply can accept line voltage inputs of 115 VAC or 230 VAC (with 230-volt power supply option installed).

Table 1-1  
Morrow Terminal Specifications

SPECIFICATION	DESCRIPTION
<b>DISPLAY</b>	
CRT Screen	12-inch (30.5 cm) diagonal, P31 Green Phosphor with etched faceplate.
Vertical Refresh Rate	50 or 60 Hz, depending on line frequency non-interlaced.
Horizontal Refresh Rate	19.2 kHz.
Display Page	1920 characters/page.
Display Format	80 characters x 24 lines, plus a status line which indicates terminal configuration.
Character Set	128 ASCII characters, plus line drawing and four-segment cell graphics.
Character Matrix	7 x 11 dot matrix.
Character Field	9 x 12 dot matrix.
Cursor	9 x 12 dot matrix, selectable block or underline; steady or blinking.
Cursor Controls	Left, Right, Up, Down, Home, Return, Read Cursor, and Cursor Addressing.
Visual Attributes/ Protected Fields	Blink, reverse, underline, reduced intensity, and combinations thereof, used to designate protected fields for editing and transmission formatting when protect mode is set.
Alpha-Numeric	26-letter alphabet with upper and lower case, numerics 0 through 9, Return, Shift, Punctuation, Backspace, Tab, and Caps Lock. Most keys are auto repeating (approximately 15 characters per second). Selectable audible key-click.

SPECIFICATION	DESCRIPTION
<b>KEYBOARD</b>	
Numeric Key Pad	14 keys: 0 through 9, Enter, Comma, Period, and Minus.
Cursor Control Keys	Right, Left, Up, Down, plus Home.
Edit Keys	Character insert, character delete, line insert, and line delete.
Function Keys	F1 - F7 which transmit a single-character control code.
Functional Command Keys	Set-Up, Break, ESCape, Control Print Screen, Line Feed, Delete and Save.
<b>EDITING</b>	
Edit Operation	Clear Entire Screen, insert characters, delete characters, insert lines, delete lines, erase line, erase to the end of line, erase to the end of page; all or unprotected only.
<b>COMMUNICATIONS</b>	
Block Mode	Send line, and send page; all or unprotected only.
Conversation Mode	Interactive (character-by-character transmission, Full or Half Duplex).
Program Mode	Control characters may be transmitted to computer and/or entered on screen.
Monitor Mode	Hex codes are displayed for all received data.
Interfaces	Main Port: RS-232C Auxiliary Port: RS-232C
Data Rates	75, 110, 150, 300, 450, 600, 900, 1200, 1800, 2400, 3600, 4800, 7200, 9600, and 19200 baud.

SPECIFICATION	DESCRIPTION
Word Length	7 or 8 data bits.
Parity	Even, odd, or no parity.
Stop Bits	1 or 2 stop bits.
Format	ASCII serial asynchronous communications.
Busy Indication	Main Port: Sends X-OFF (DC3) or X-ON (DC1) to computer on busy/ready condition of main or auxiliary port.  Auxiliary Port: Senses busy level on Pin 20 (DTR) of the auxiliary interface.
 <b>GENERAL</b>	
Operating Environment:	
Temperature	Operating: 10° C to 40° C (41° F to 104° F) Storage: -15° C to 65° C (5° F to 150° F)
Humidity	10% to 85% without condensation.
Power Requirements:	
Standard	115V + 10%, 60 Hz, 50 watts.
Optional	230V + 10%, 50 Hz, 50 watts.
Heat Dissipation	222 BTU/Hr.
Dimensions:	
Width (Monitor)	16.5 inches (42.0 cm).
Depth (Monitor)	14.6 inches (37.0 cm).
Height (Monitor)	12.2 inches (31.0 cm).
Depth (Keyboard)	7.5 inches (19.0 cm).
Height (Keyboard)	2.8 inches (7.0 cm).
Weight	24.2 pounds (11.0 kg).

## 1.5 DISPLAY CHARACTER FORMAT

The standard Morrow Terminal character set contains 128 ASCII characters, 32 of which are control characters (see Figures 1-1 and 1-2). The entire character set may be displayed on the CRT screen by setting the terminal in Program Mode.

## 1.6 MORROW TERMINAL WORD STRUCTURE

The Morrow Terminal transmits serial asynchronous data in a 10 or 11 bit format in the following sequence: one start bit, seven or eight data bits, one or no parity bit and one or two stop bits. The parity bit can be either odd, even, or none and is defined by a Set-Up Mode selection.

The received data shall be formatted the same as the transmitted data. The word structure, baud rates, and other communications characteristics are established via Set-Up Mode selections. Refer to Section II for details.

## 1.7 230 VAC OPERATION

The Morrow Terminal may be optionally ordered to operate on 230-volts AC. This option must be requested at the time of the order.



## SECTION II INSTALLATION

### 2.1 INTRODUCTION

This section contains installation instructions for the Morrow Terminal. Also included are descriptions of on-site safety requirements, initial terminal configuration, communications interfaces, plus procedures for power turn-on, power turn-off, and routine maintenance.

### 2.2 SAFETY REQUIREMENTS

No special safety precautions are required when installing your Morrow Terminal. Simply observe normal safety procedures.

### 2.3 UNPACKING AND INITIAL INSPECTION

Each Morrow Terminal is thoroughly inspected and carefully packaged prior to shipment. Every precaution is taken to ensure that each unit is complete and ready for installation at the customer's site. However, it is recommended that each unit be inspected upon receipt for transit damage. Start by examining the exterior of the package for evidence of rough or careless handling; then perform a thorough visual inspection of the internal components and subassemblies. As a rule, most transportation companies will not honor claims for damage unless they are filed promptly; therefore, the following steps should be taken:

1. Verify that each item shown on the Sales Order Packing Slip has been included in the shipment. Contact Morrow Designs or your dealer immediately in the event of a packing shortage.
2. Verify that the serial number of the unit corresponds to that shown on the invoice.
3. Check the hardware to determine if any assemblies or screws were loosened during shipment. Tighten as required.
4. Inspect for dust or foreign material which may impair electrical contact when cable connections are made.
5. Install and test the Morrow Terminal as soon as possible after delivery. (This is very important since internal damage to the equipment cannot be determined by visual inspection alone.)

6. If, in your opinion, the equipment has been damaged - either internally or externally - notify your dealer immediately, and ask him to make an inspection. If assistance is needed to describe the extent of damage or the repairs that will be necessary, contact our Customer Service Department.

## 2.4 SITE REQUIREMENTS

The Morrow Terminal may be conveniently used in a normal office environment, as no special mounting provisions are required. It is recommended that the environment be weather protected, with an ambient temperature range of 41° F to 104° F (10° C to 40° C), and a relative humidity of not greater than 85%.

### CAUTION

Whenever the Morrow Terminal is physically moved from a cold location to a warmer environment, be sure to allow sufficient time for the equipment temperature to equalize with the warmer location before activating the unit. Condensation developed by the temperature differential could possibly impair the Morrow Terminal.

The physical dimensions of the Morrow Terminal are shown in Figure 2-1. The basic requirements for installation are as follows:

- . Table or desk mounting.
- . Standard three-pronged 115-volt (230-volt) A.C. power outlet.
- . Cable connection to the computer; serial printer, or other auxiliary device.

## 2.5 INITIAL PREPARATION

### 2.5.1 Line Voltage Selection

The Morrow Terminal is shipped connected for either 115-volt or 230-volt AC operation, as specified on the purchase order. Any change in line voltage requires circuit changes which can only be performed by factory authorized maintenance personnel.

### 2.5.2 Set-Up Mode Features

The operating characteristics of the Morrow Terminal are controlled by firmware "switches" that are displayed on the status line when Set-Up Mode is commanded. Figure 2-3 illustrates the display of the status line and the standard default settings. The status line is broken into nine four-bit "nibbles," one through nine, and baud = xxxx, nibble 10. Each nibble has four bits, or switches, that can be set to "0" or "1". Table 2-1 summarizes the functions that are selectable in nibbles 1 through 10 when in Set-Up Mode.

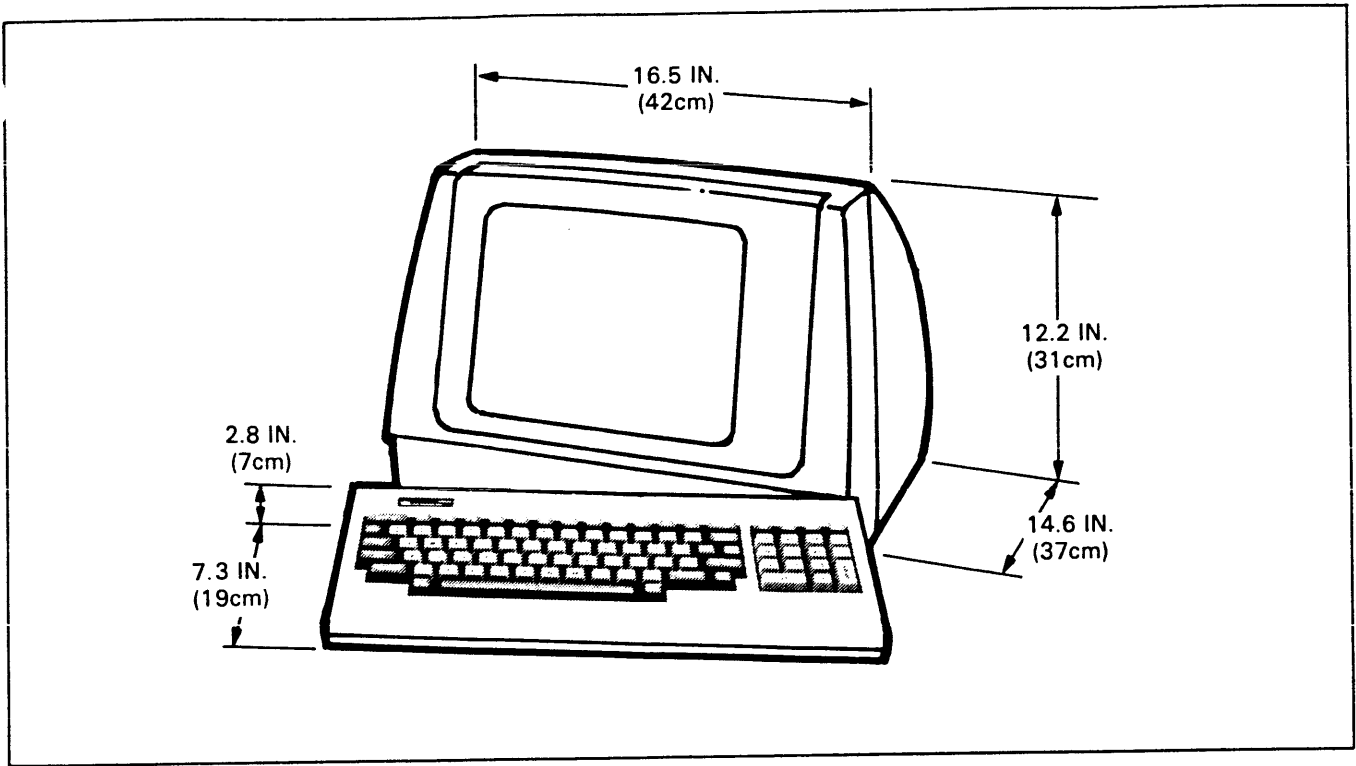


Figure 2-1. Morrow Terminal Mounting Requirements

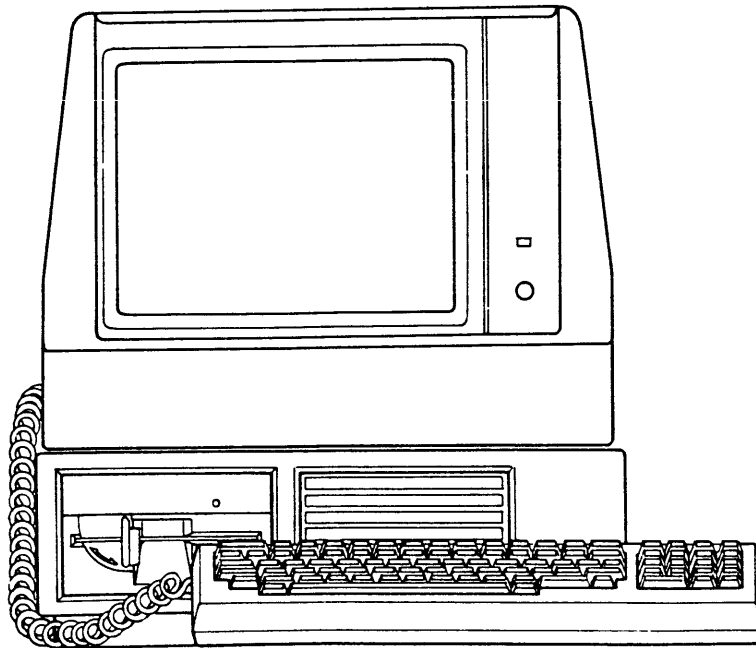


Figure 2-2. Typical Morrow Terminal Applications

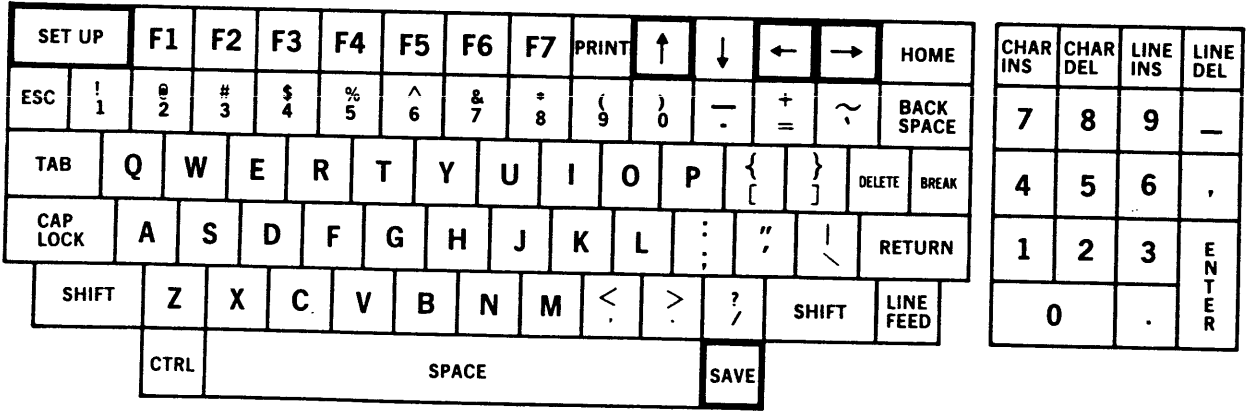
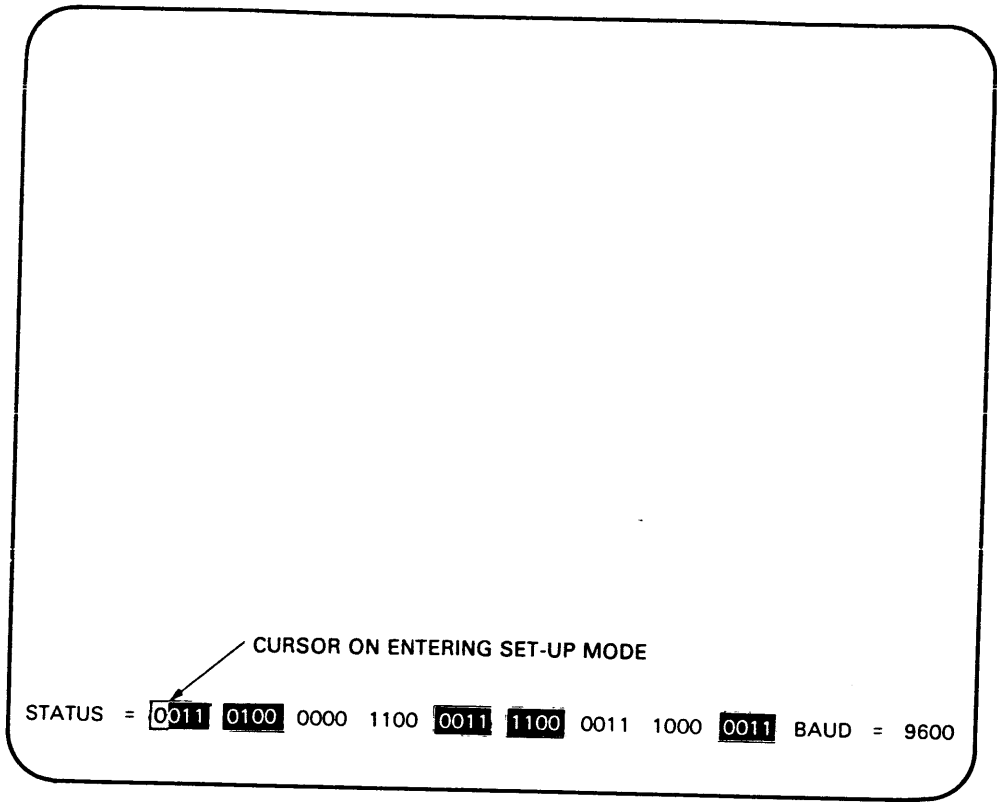


Figure 2-3. Morrow Terminal Set-Up Mode Display and Associated Keys

Entering Set-Up Mode - Pressing the Set Up key on the upper-left corner of the keyboard causes the Morrow Terminal to enter Set-Up Mode. Pressing the key again will cause the terminal to exit set-up and return the previously established mode. When Set-Up Mode is entered the Morrow Terminal will:

1. Scroll the display up one line and present the 25th status line, and
2. Transmit an X-OFF (DC3) code to the computer - if the terminal was on-line and the X-ON/X-OFF protocol was enabled.

When Set-Up Mode is exited the display will scroll down one line (no data is lost) and the terminal will transmit an X-ON (DC1) code under the conditions noted in number 2 above.

#### Note

Changing communications characteristics when in Set-Up Mode may affect or prevent further data transfer with the computer or auxiliary device.

Selecting Functions - When Set-Up Mode is entered, the cursor will move to bit 3 of nibble 1 (refer to Figure 2-3). The cursor is moved to the bit to be changed by the ← and → cursor control keys. Pressing the ↑ key when the cursor is positioned over the desired bit (the "=" for nibble 10) will alternately select "0" or "1" for that function, or sequentially select the various baud rates for nibble 10. Any invalid keystroke will sound the audible alarm and the character will be ignored.

Saving Set-Up Functions - When the various functions are selected they take effect upon exiting Set-Up Mode. If Set-up Mode is exited by pressing the SET-UP key, then the set-up is stored in temporary "working" memory and will be lost if the terminal is powered-down. To cause the set-up functions to be saved in non-volatile memory, press the SAVE key when in Set-Up Mode. A save operation will not be performed if the SAVE key is pressed while the terminal is in any mode other than Set-Up. The Morrow Terminal will always power-up with the last saved set-up condition.

## 2.6 INTERFACE INFORMATION

The Morrow Terminal may be cabled directly to a local computer; serial printer, or other auxiliary device; or it may be connected via telephone data lines to a remote computer located anywhere in the world. Figure 2-2 shows a typical Morrow Terminal application. Figure 2-4 shows the rear panel locations of the interface connectors.

### 2.6.1 RS-232C Interface (J1)

The Main Port interface provides RS-232C signals and levels as specified in the RS232 standard. The maximum permissible cable length is 50 feet for RS-232C applications.

## 2.6.2 Auxiliary Port Interface (J2)

The Auxiliary Port is used for connecting a receive only (RO) serial printer or other RO device to the terminal using RS-232C signal levels. The Auxiliary Port may be set for a different baud rate and word structure than the Main Port. The Morrow Terminal can sense a busy condition to prevent data loss by the auxiliary device.

## 2.7 POWER TURN-ON

1. Set the ON-OFF switch to ON (refer to Figure 2-4).
2. Wait approximately 20 seconds for the unit to warm up. The cursor should appear in the HOME position and the terminal will sound the audible alarm.
  - 2a. If the cursor does not appear, turn off the Morrow Terminal, wait 15 seconds and apply power again. If the cursor still does not appear, check the CONTRAST control, then contact your dealer or our Customer Service Department.

### CAUTION

To avoid damage to the CRT screen when the terminal is to remain ON but unchanged for extended periods of time, reduce the screen brightness using the CONTRAST control.

3. Adjust CONTRAST control (Figure 2-4) for desired display brightness.

## 2.8 POWER TURN-OFF

Turn off the Morrow Terminal by setting the ON/OFF switch to OFF.

## 2.9 INSTALLING THE MORROW TERMINAL

1. Check the ON/OFF switch (refer to Figure 2-4) to ensure that it is set to OFF.
2. Connect the data interface cable(s) to the terminal using the appropriate interface information (paragraph 2.6).
3. Plug the power cord into a grounded AC outlet of the proper voltage.
4. Turn on the terminal.

### Note

The BAUD RATE is factory set to 9600 baud.

5. Select the Set-Up Mode functions as desired to establish the operating parameters of the Morrow Terminal (refer to Table 2-1). If the terminal is to power-up with the selected functions, execute a Set-Up "SAVE" operation (refer to paragraph 2.5.2).

## 2.10 CARE OF THE MORROW TERMINAL

Proper care of the Morrow Terminal consists of performing the routine cleaning and inspection procedures listed in the following paragraphs.

### 2.10.1 Cleaning

At periodic intervals, clean the exterior housing and lightly dust the unit using a soft brush or damp lint-free cloth. Paper towels may be substituted if desired. Do not use petroleum base cleaners, such as lighter fluid, as this could be harmful to the painted surface. Remove smudges from the CRT exterior screen and the housing with conventional glass cleaners or alcohol. Be careful not to scratch the CRT screen.

### 2.10.2 Inspection

Periodically inspect the keyboard assembly and switches for freedom of movement. Determine that the intensity of characters displayed on the CRT screen have not diminished. Any required mechanical and electrical adjustment shall only be performed by our factory authorized maintenance personnel.

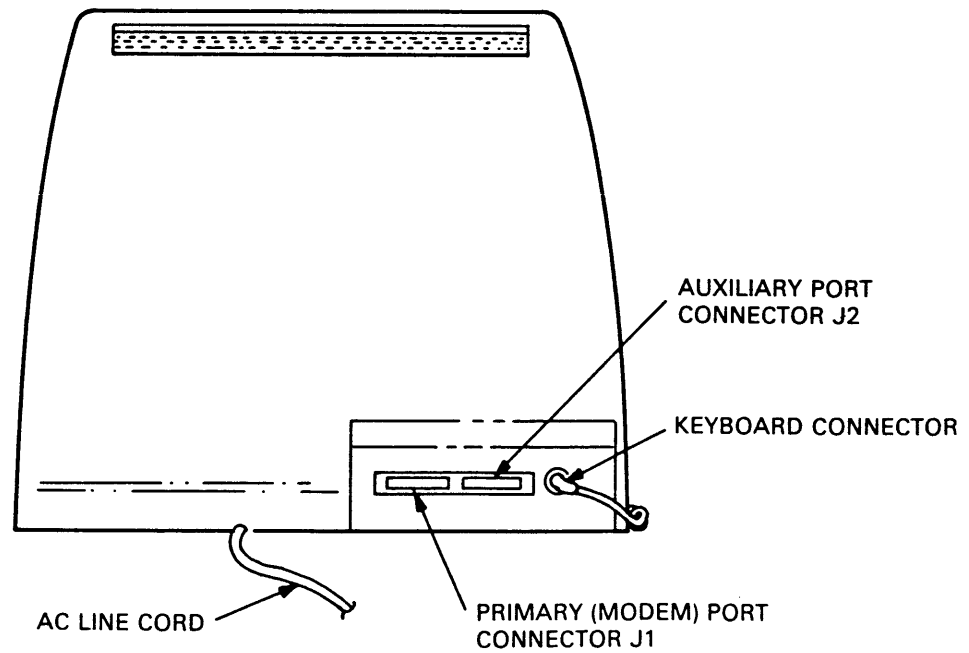
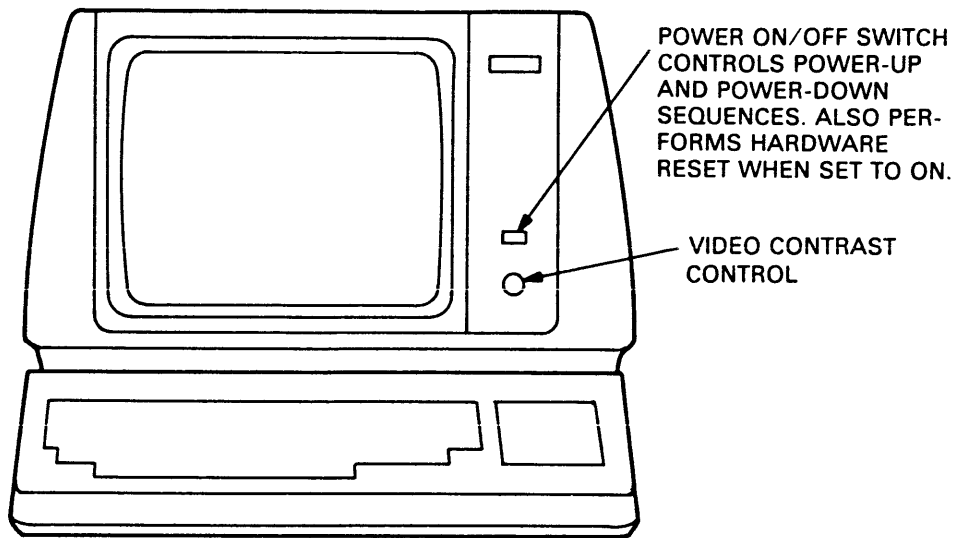
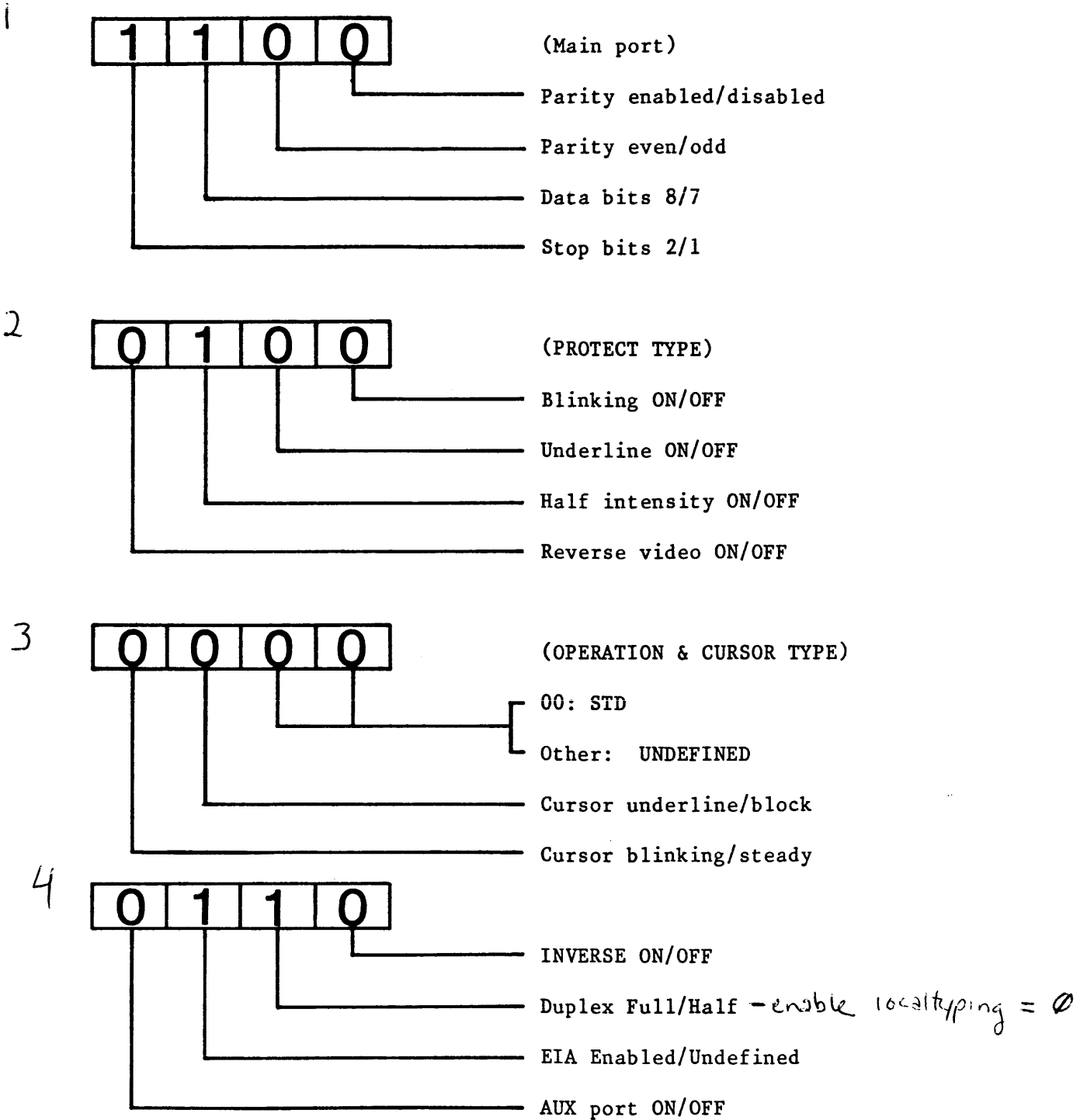
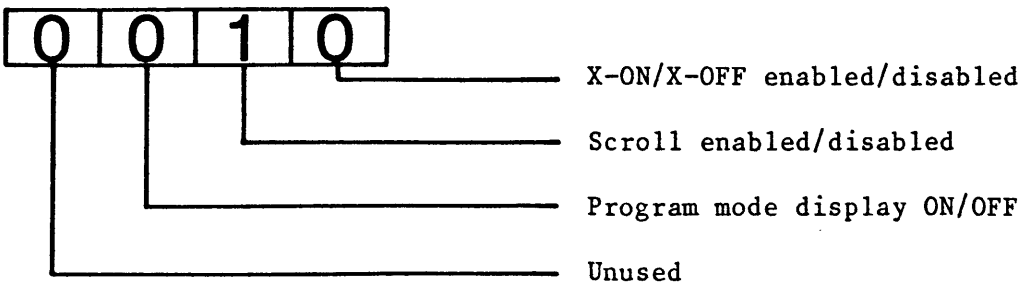
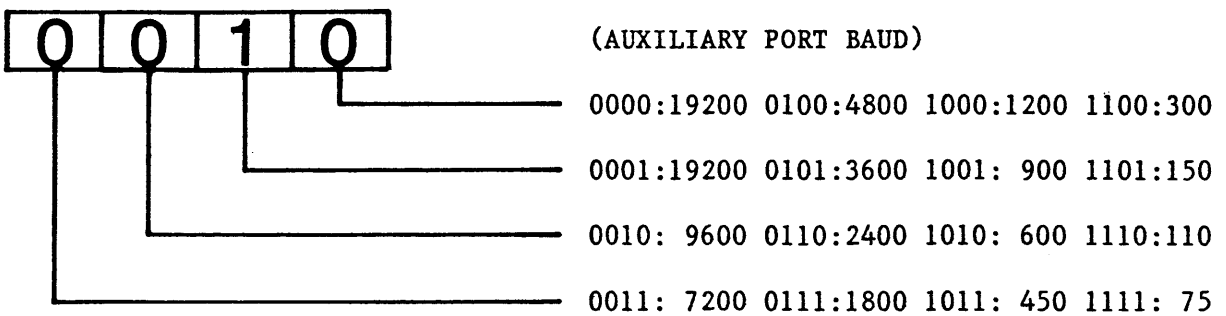
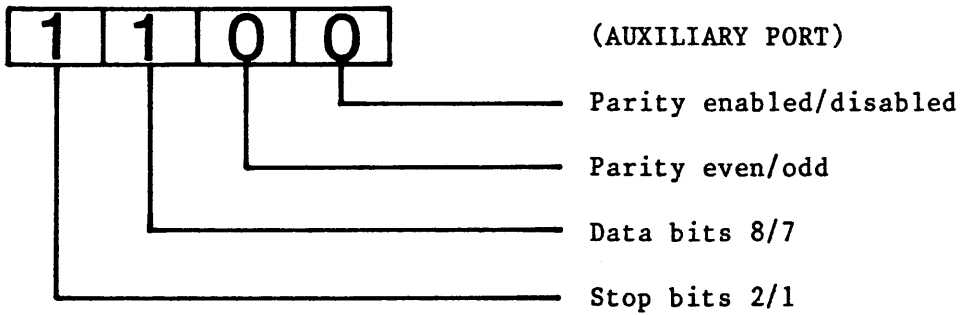
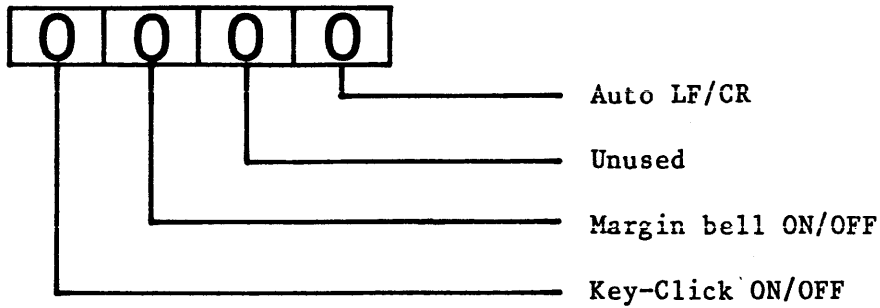
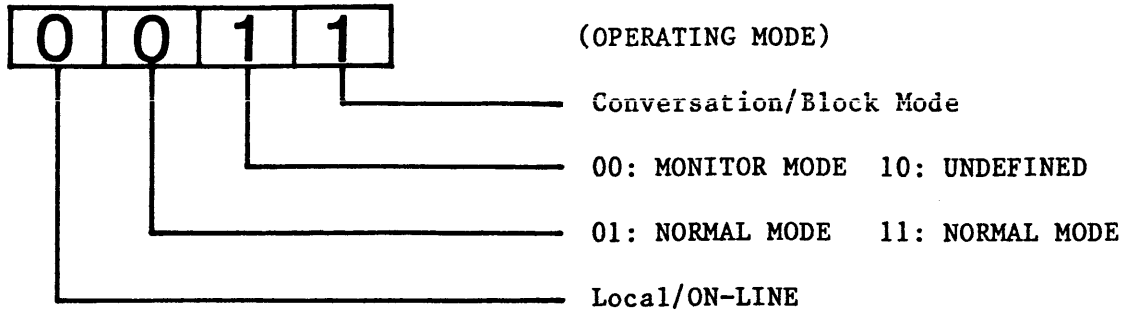


Figure 2-4. Morrow Terminal Controls and Connectors



Table 2-1  
Status Line and Recommended Set Up





## SECTION III OPERATION

### 3.1 INTRODUCTION

This section provides the information necessary for the operator to utilize the Morrow Terminal to its fullest capabilities. This section emphasizes the commands required to initiate and control various terminal operations, whether originating from the Morrow Designs computer or the keyboard.

### 3.2 OPERATIONAL MODES

The Morrow Terminal provides several different modes of operation which are selectable by the computer or from the keyboard. The following paragraphs summarize the operating modes and the associated interactions. The power-on mode conditions are established by the last saved functions selected in the associated Set-Up features. The various command sequences used to change the operating characteristics of the Morrow Terminal are detailed in paragraph 3.4.

#### 3.2.1 On-Line Or Local Mode

**On-Line Mode** - When the terminal is placed On-Line, data being received will be displayed or acted upon, and keyboard entries will be transmitted and/or displayed, depending on the communications mode selected.

**Local Mode** - In Local Mode the terminal ignores the communications interface and keyboard entries are displayed or acted on locally, no transmission takes place.

#### 3.2.2 Conversation or Block Mode

**Conversation Mode** - This is the normal mode for operation with the Morrow Designs Computer. In Conversation Mode, data entered on the keyboard is immediately transmitted to the computer, character-by-character. When Conversation Mode is selected the display action is determined by the setting of Full or Half Duplex Mode as follows:

**Full Duplex** - Characters typed are transmitted only, no local operation takes place. In order for data to be displayed, it must be echoed from the computer.

**Half Duplex** - Characters typed are transmitted to the computer and routed to the display locally.

Block Mode - When Block Mode is selected data entered on the keyboard is sent to the display only. This allows the operator the ability to format and correct a screen of data prior to transmission to the computer. The extent of transmission (line or page, unprotected only or all) depends on the command issued to initiate the send operation.

### 3.2.3 Protect Mode

Protect Mode operation allows specified characters on the display to be "protected" or reserved when performing block transmission, tabbing, or erase operations. Characters to be protected are entered after a "Set Write Protect" command is issued. This will cause the data subsequently entered to be displayed with the "Protected-Field Visual Attribute" selected in Set-Up Mode. If "Protect Mode" is not set, no special actions take place. If Protect Mode is set, then the highlighted (Write-Protected) data is not transmitted or erased when the appropriate commands are initiated and tabbing to unprotected fields is enabled. Setting Protect Mode also prevents the display from scrolling.

### 3.2.4 Normal Or Monitor Mode

Normal Mode - Normal Mode causes the 96-displayable ASCII characters (20-7F Hex) to be displayed when received. The 32 codes (00-1F Hex) are acted upon only if they are control codes for the Morrow Terminal, otherwise they are ignored.

Monitor Mode - Enabling Monitor Mode causes all received data to be displayed as ASCII hexadecimal pairs (00-7F). No control codes are acted upon and all data is displayed. Monitor Mode may only be exited by resetting the terminal or through Set-Up Mode.

### 3.2.5 Program Mode

Setting Program Mode causes the terminal to display all 32-control codes (00-1F) instead of acting upon them. This allows the embedding of formatting information particularly useful in block transmission or print output, and as a diagnostic aid.

### 3.2.6 Set-Up Mode

Set-Up Mode is entered by pressing the SET-UP key on the keyboard. The terminal will sound the audible alarm, transmit an X-OFF code (DC3-13 Hex), if X-ON/X-OFF is enabled, and present the 25th status line on the display by scrolling the data up one line. Changes may then be made to the Set-Up Mode features as described in paragraph 2.5.2. Pressing the SET-UP key again exits Set-Up Mode and causes any changes that were made to take effect. The terminal will transmit an X-ON Code (DC1-11 Hex), if X-ON/X-OFF is enabled, and scroll the data down one line returning the original display. The Morrow Terminal ignores all received data while in Set-Up Mode and any invalid keystroke sounds the audible alarm.

### 3.3 KEYBOARD OPERATION

The operator uses a keyboard very similar to that of a standard office typewriter to enter data and perform control operations. Functionally the keyboard consists of the displayable 96-ASCII character set keys and various control or modifier keys. All keys will repeat automatically if held down for approximately one-half second or more. Paragraphs 3.3.2 thru 3.3.9 detail the keyboard by the following classes of keys:

- . Alphanumeric and Punctuation Keys
- . Numeric Keypad
- . Modifier Keys
- . Cursor Control Keys
- . Edit Keys
- . Transmission Keys
- . Function Keys
- . Special Operation Keys

#### 3.3.1 Keystroke Conventions

Ordinarily each keystroke typed by the operator is independent of the one preceding or following it. The 2-key lockout feature of the unit prevents the production of a second code before the key already typed is released.

#### 3.3.2 Alphanumeric and Punctuation Keys

The upper/lower case, numerics, and punctuation characters from the 96-displayable ASCII character set, (21-7E Hex) including SPACE (20 Hex) and DEL (7F Hex), are output to the display and/or transmitted when a key is pressed. Keys that have a double legend produce the lower-case or lower legend unshifted, and the upper-case or upper legend when pressed with the SHIFT key. The SPACE key generates an ASCII 20 Hex code for transmission and occupies a space on the display.

#### 3.3.3 Numeric Keypad

The ASCII numerals 0 through 9 along with minus, comma, and period, are output to the display and/or transmitted (depending upon the communications mode selected) when a key is pressed. The ASCII hex codes generated are identical to the lower legend numerals and punctuation on the main keyboard area.

### 3.3.4 Modifier Keys

The following keys do not generate an output by themselves, but modify the code generated by the alphanumeric keys on the keyboard.

SHIFT causes the upper legend character of a double legend key to be produced when pressed in conjunction with either SHIFT key. The 26-alpha characters are shifted for upper-case, and unshifted for lower-case.

CAP LOCK this push-on/push-off key causes the 26-alpha characters to stay shifted (upper-case) when on. The numeric and punctuation keys, as well as the various control keys, are not affected.

CTRL causes one of the 32-ASCII control codes to be generated when pressed in conjunction with an otherwise displayable character key. The character generated will not occupy a space on the display unless program mode or monitor mode are set. Some control codes are utilized by the Morrow Terminal, refer to Table 3-1 for details.

### 3.3.5 Cursor Control Keys

The Cursor is used to indicate the next character position to be entered on the display. The cursor may be positioned by remote commands from the computer or by cursor control keys on the keyboard. The following keys are used to position the cursor on the display:

← → ↑ ↓ and HOME move the cursor as indicated and transmit the ASCII control codes listed in Table 3-1 when the standard Morrow Terminal command code set has been selected.

If the position moved to is protected, the cursor will move to the first unprotected position in the direction commanded.

TAB will cause the cursor to advance to the next tab stop and an HT (09 Hex) code to be generated. There are two types of tab operations possible, Modulo and Protected Field. When Protect Mode is not set, the tab stops are automatically set at every eight character position, 0, 8, 16, ...72. When Protect Mode is set, TAB will cause the cursor to advance to the first unprotected character position following the next protected field. Tabbing will move the cursor to the first tab stop on the next line when at the last tab position on a line.

BACKSPACE causes the cursor to move one character position to the left, or end of the previous line if the cursor has been at the beginning of a line. A BS code (08 Hex) is generated when the key is pressed.

RETURN moves the cursor to the beginning of the line it was in, or the beginning of the next line (carriage return + line feed) depending upon the auto-line feed selection made in Set-Up Mode. The key will generate a CR (0D Hex) or US (1F Hex) code per the auto-line feed selection.

LINE FEED moves the cursor to the same column position of the next line down. This will cause a scroll operation to occur if the cursor was on the bottom line of the display, scrolling was enabled in Set-Up Mode, and Protect Mode is not set. If scrolling is disabled or Protect Mode is set, the cursor will move to the same column in the top line. If the position is protected, the cursor will move to the first unprotected position on the line. The Line Feed key produces an LF (0A Hex) code when pressed.

### 3.3.6 Edit Keys

The Edit keys on the Morrow Terminal operate differently depending on the serial number of the unit. On units with serial numbers lower than 25110000, the Edit keys will only work when the terminal is being used in Block Mode, and therefore will not normally be used. The operations of the Edit keys in Block Mode are detailed below.

On units with serial numbers from 25220000 and up, the Edit keys operate as described below in Block Mode, and when in Conversation Mode, transmit the appropriate WordStar codes.

Terminals with serial numbers between 25110000 and 25220000 may be upgraded at a small cost to give the added convenience of WordStar code transmission.

In Conversation Mode on terminals which have the WordStar capability, the Edit keys perform as follows in WordStar:

CHAR INS toggles WordStar's INSERT mode on and off. It does this by sending a ^V (control-V) when pressed.

CHAR DEL deletes the character at the current cursor position. All characters on the line to the right of the cursor get moved left one position. It sends a ^G (control-G) when pressed.

LINE INS will insert a new line at the current cursor position, moving all text on the line from the cursor to the end of the line, along with all subsequent lines, down one position. It does this by sending a ^N (control-N) when pressed.

LINE DEL will delete the entire line the cursor is on, after which all subsequent lines will be moved up one row. It generates a ^Y (control-Y) when pressed.

When not in WordStar, the function performed by the keys is dependent upon the applications program being run.

Operation of the Edit keys in Block Mode is as follows:

CHAR INS causes the character under the cursor and all following characters to move one position to the right. The character insert operation terminates at the end of the line, or first protected field if Protect Mode is set, and the last character on the line is lost. A space character is written under the cursor.

CHAR DEL deletes the characters under the cursor and moves all characters that follow on the line, or first protected field if Protect Mode is set, to the left. A space is written in the last character position of the line or field.

LINE INS causes the entire line the cursor is in to move down one line as well as all lower lines. The bottom line of the display scrolls off and is lost. The cursor moves to the beginning of the line created which is filled with spaces. If Protect Mode is set, no operation is performed.

LINE DEL erases the line containing the cursor and moves all lower lines upward one line. The cursor moves to the beginning of the first line that moves upward. The bottom line of the display is filled with spaces. If Protect Mode is set no operation takes place.

### 3.3.7 Transmission Keys

Two types of data transmission may be initiated from the keyboard - a Send Page Unprotected and a Page Print, as follows:

ENTER will cause the unprotected data from home to the cursor position to be transmitted out the Main Port if Block Mode and Protect Mode are set. If Protect Mode is not set, all data from home to the cursor position will be sent. If Conversation Mode is set, then the ENTER key generates a CR (0D Hex) code only and no block transmission takes place.

COPY causes the data from home to the cursor position to be output to the Auxiliary Port device, usually a printer. At the end of each line transmitted, the Morrow Terminal automatically inserts a CR (0D Hex) and LF (0A Hex) code in the output data. The Auxiliary Port must be enabled in Set-Up Mode for the operation to take place.

### 3.3.8 Function Keys

The seven function keys, F1 thru F7, transmit a single control character. The keys perform no local operation and are used as special commands to be interpreted by the computer for particular system operations. The keys and each associated transmit sequence are as follows:

	ASCII	HEX
	<u>NAME</u>	<u>CODE</u>
F1 =	SOH	01H
F2 =	STX	02H
F3 =	ETB	17H
F4 =	EOT	04H
F5 =	ENQ	05H
F6 =	CAN	18H
F7 =	SUB	1AH



### 3.3.9 Special Operation Keys

The keys listed below perform special operations or have a unique effect on the Morrow Terminal.

SET-UP key causes the Morrow Terminal to enter Set-Up Mode when pressed, as described in paragraph 2.5.2. Pressing the key again exits Set-Up Mode.

SAVE is active only when the terminal is in Set-Up Mode. Pressing the key causes the current set-up functions to be saved in non-volatile memory. The saved selections are used to establish the power-on or reset configuration of the Morrow Terminal. The SAVE key has no effect when not in Set-Up Mode.

BREAK causes a break (mark) condition to be presented on the transmit data line of the Main Port for approximately 300 milliseconds. This operation has no effect on the terminal and is usually used for control signaling to the computer device.

ESC generates a special control code (1B Hex), usually followed by one or more characters, used for command operations. Thus, ESCape is usually considered as a "Lead-In" character for terminal control operations. Paragraph 3.4 and Table 3-2 detail the ESCape sequence utilized by the Morrow Terminal.

## 3.4 CONTROL CODES AND ESCAPE SEQUENCES

### 3.4.1 Control Codes

The operational characteristics of the Morrow Terminal are controlled, in part, by a group of control codes which may originate at the computer or at the keyboard. Control codes are not displayed unless Program Mode is set. In that case the Morrow Terminal will display, but not act upon, the recognized control code. Of the 32-ASCII standard control codes available for use, the Morrow Terminal utilizes the control codes listed in Table 3-1.

### 3.4.2 Escape Sequences

An ESCape sequence is formed by executing the ESC ASCII control code, followed by one or more otherwise displayable ASCII characters. Each ESCape sequence controls a specific terminal operation. Some operations are one-time only, others remain operative for as long as power to the unit is not interrupted or until terminated by a control code or ESCape sequence.

Table 3-2 shows the ESCape sequences used by the Morrow Terminal, whether initiated from the computer or the keyboard. ESCape sequences may be initiated from the keyboard using the ESC key during Conversation Mode or Block Mode operations, as follows:

Conversation Mode, Full Duplex - ESC is transmitted directly to the computer and is utilized by the Morrow Terminal only when echoed back by the computer.

Conversation Mode, Half Duplex - ESC is transmitted and acted upon locally by the Morrow Terminal.

Block Mode - each ESC sequence is immediately acted upon by the Morrow Terminal, unless program mode is set. If embedded in memory, the ESC sequence will be displayed but not acted upon, and will be transmitted, along with the block of data.

Table 3-1  
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE		HEX CODE	DESCRIPTION
	FROM CPU	FROM KEYBOARD		
Bell	BEL	CONTROL G	07	Sounds the audible alarm. (If margin bell enabled in set-up.)
Backspace	BS	← BACKSPACE or CTRL H	08	Moves the cursor to the left one character position. The cursor moves to the last posi- tion of the previous line when at the first character posi- tion of the line.
Tab	HT	TAB or CTRL I	09	Moves the cursor to the next tab stop - Beginning of the next unprotected field if pro- tect mode is set, to every eighth character position (modulo 8 column tabs) if protect mode is reset. (Same as ESC I)
Line Feed	LF	↓ or CTRL J	0A	Moves the cursor to the next line down in the same column. If the cursor is located on the last line, a scroll opera- tion will be performed, if enabled.
Upline	VT	↑ or CTRL K	0B	Moves the cursor to the pre- vious line up in the same col- umn. If the cursor is located on the first line, no opera- tion takes place.
Forespace	FF	→ or CTRL L	0C	Moves the cursor to the right one character position. The cursor moves to the first position of the next line, when at the last character position of a line.
Carriage Return	CR	RETURN* or CTRL M	0D	Moves the cursor to the first character position of the current line.

Table 3-1 (Continued)  
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE		HEX CODE	DESCRIPTION
	FROM CPU	FROM KEYBOARD		
Keyboard Enable	S0	CTRL N *	0E	Allows data to be entered on the keyboard - keyboard unlock (*from computer only if keyboard is already locked). (Same as ESC ")
Keyboard Disable	S1	CTRL O	0F	Prevents data from being entered on the keyboard - keyboard lock. (Same as ESC #) Auto line feed is disabled.
Reset Auxiliary Port with/without Display	DC4	CTRL T	14	When printing through auxiliary port, with/without display will continue until the buffer is empty.
Clear all to Spaces	SUB	CTRL Z	1A	Erases the display to spaces, and moves the cursor to the Home position.
Escape	ESC	ESC or CTRL [	1B	Recognized by the Morrow Terminal as a code extension character which must be followed by otherwise displayable character or characters to invoke a specific terminal operation.
Home Cursor	RS	HOME or CTRL ^	1E	Moves the cursor to the first character position of the first line of the display.
New Line	US	RETURN * or CTRL _	1F	Moves the cursor to the first character position of the next line (*when auto line feed is enabled)

Table 3-2  
Morrow Terminal Escape Sequences

(Operations which have an \* beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Keyboard Unlock	ESC "	1B 22	Enables data entry from the keyboard. (Same as S0) (Hitting SET-UP twice will unlock the keyboard.)
Keyboard Lock	ESC #	1B 23	Disables data entry from the keyboard.
Set Protect Mode	ESC &	1B 26	Causes protect mode to be entered, highlighted (write-protected) data is reserved (protected) during certain editing and transmit operations.
Reset Protect Mode	ESC ^	1B 27	Causes protect mode to be exited.
Reset Write Protect	ESC (	1B 28	Causes write protect to be terminated.
Set Write Protect	ESC )	1B 29	Causes all subsequent data to be entered as write protected. Data will be highlighted by the protected field visual attribute selected in the set-up field. Data will not be "protected", however, unless protect mode is set.
Clear all to Null	ESC *	1B 2A	Causes all display data to be cleared to nulls protected or not, and the cursor moves home.
Clear Unprotected to Spaces	ESC +	1B 2B	Causes only unprotected data on display to be cleared to spaces, cursor moves home. If protect mode is not set, all data is cleared. (Same as ESC ;)

Table 3-2 (Continued)  
Morrow Terminal Escape Sequences

(Operations which have an \* beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Load Default Status Line	ESC 0	1B 30	Causes the diagnostic test mode to be entered.
Send Line	ESC 4	1B 34	Transmits the unprotected data in the line containing the cursor, starting at the beginning of the line and up to the cursor position.
Send Page-Unprotected	ESC 5	1B 35	Transmits the unprotected data on the display starting at home and through to the cursor position. A CR (code 0D Hex) is transmitted at the end of the block.
Send Line-All	ESC 6	1B 36	Transmits all data in the line containing the cursor starting at the beginning of the line and up to the cursor position.
Send Page-All	ESC 7	1B 37	Transmits all data on the display beginning at home and continuing through to the cursor position.
Clear Unprotected to Spaces	ESC ;	1B 3B	Causes the unprotected data on the display to be cleared to spaces and the cursor to be moved to the home position. (Same as ESC +)
Address Cursor	ESC=(X <sup>1</sup> X <sup>2</sup> )	1B 3D (20-6F) (20-37)	Used to position the cursor to a specified row and column on the display. The location is expressed as two ASCII characters. The first (X <sup>1</sup> ) specifies the column coordinate (20-6F Hex). The second (X <sup>2</sup> ) specifies the row (20-37 Hex). Refer to Fig. 3-2.

Table 3-2 (Continued)  
Morrow Terminal Escape Sequences

(Operations which have an \* beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Read Cursor	ESC ?	1B 3F	Causes the terminal to transmit the cursor row and column position in the same format as described in "Address Cursor" Command. Column position is transmitted first, followed by the row position.
Enable Auxiliary Port with Display	ESC ,	1B 2C	This command causes all data received by the primary port to be displayed and/or acted upon, and transmitted to the auxiliary port device. In conversation/half duplex mode, keyboard entries are also transmitted.
Set Block Mode*	ESC B	1B 42	Cancel conversation mode and causes block mode to be entered. Refer to para. 3.2.2 for details of block mode operation.
Set Conversation*	ESC C	1B 43	Cancel block mode and causes conversation mode to be entered. Refer to Paragraph 3.2.2 for details of conversation mode operation.
Insert Line	ESC E	1B 45	Causes a line of spaces to be inserted at the line containing the cursor. All lower lines scroll down one line, the bottom line being lost. No action takes place if protect mode is set.
Back Tab	ESC I	1B 49	Moves the cursor to the beginning of the previous unprotected field if protect mode is set; to the left eight character positions (modulo 8 tab) if protect mode is reset.

Table 3-2 (Continued)  
Morrow Terminal Escape Sequences

(Operations which have an \* beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Set Monitor Mode*	ESC A	1B 41	When set, all received data will be displayed as hexadecimal ASCII pairs, 00-7F.
Print Page-All	ESC P	1B 50	Causes all data from home up to the cursor position to be transmitted to the auxiliary port device, a CR and LF code (0D and 0A Hex) are added at the end of each line as it is sent. (Pressing [PRINT] on keyboard performs the same function.)
Insert Char- acter	ESC Q	1B 51	Moves all data from the cursor position to the end of the line or protected field one position to the right. A space is written at the cursor position.
Delete Line	ESC R	1B 52	Erases the line containing the cursor and moves all lower lines upward one line. No action takes place if protect mode is set.
Erase to End- of-Line Unpro- tected	ESC U	1B 55	Erases the unprotected data from the cursor position up to the end of the line or protected field.
Delete Character	ESC W	1B 57	Deletes the character under the cursor and moves all characters from the cursor to the end of the line or protected field to the left one position.
Erase to End- of-Page Unprotected	ESC Z	1B 5A	Erases the unprotected data from the cursor position up to the end of the display or protected field.



Table 3-2 (Continued)  
Morrow Terminal Escape Sequences

(Operations which have an \* beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Enable Auxil- iary Port without Display	ESC -	1B 2D	This command causes all data received by the primary port to be transmitted to the auxiliary port device. No data are sent to the display.
Erase to End- of-Line All	ESC T	1B 54	Erases all data from the cursor position up to the end of the line.
Erase to End- of Page All	ESC Y	1B 59	Erases all data from the cursor position up to the end of the display.

### 3.5 DATA TRANSMISSION

Data entered from the keyboard may be transmitted to your computer either character-by-character as during Conversation Mode operation, or in message blocks, as during Block Mode operation. Transmission is serial asynchronous, with an ASCII character format of 1 start bit, 7 or 8 data bits, odd/even, or no parity bit and 1 or 2 stop bits. The word structure and baud rate used are selectable in Set-Up Mode. Main Port communications are via a bi-directional RS-232C interface as detailed in Section II. Auxiliary Port communication is uni-directional via an RS-232C interface, also detailed in Section II.

Data communications can take place whenever the Morrow Terminal is placed in On-Line Mode. When receiving data the Morrow Terminal has an X-ON/X-OFF busy indication feature used to command the computer to suspend transmission to prevent data loss.

#### 3.5.1 Conversation Mode Characteristics

When the terminal is operating in Conversation Mode, characters entered on the keyboard are immediately transmitted to the computer. This includes any control codes or ESCape sequences which are normally not displayed. If Full Duplex Mode is set, then only those codes echoed by the computer will be displayed or cause any action to take place.

#### 3.5.2 Block Mode Characteristics

During Block Mode operation, data entered on the keyboard is routed only to the display or acted upon for command sequences utilized by the Morrow Terminal. This allows complete display editing and formatting prior to transmission to the computer. By setting Program Mode, control codes may also be embedded in the display for transmission. A block of data can be transmitted in whole or in part by the use of the Protect Mode feature. This allows the computer the ability to send a form to the terminal which is Write-Protected. When Protect Mode is set, data the operator enters is transmitted only when commanded. Block Mode commands may be used to cause the terminal to transmit a line or page, unprotected only, or all of the data. Received data is accepted conversationally or in blocks, regardless of the mode selected.

#### 3.5.3 X-ON/X-OFF (Busy/Ready Status)

The Morrow Terminal has the ability to signal the computer of a potential data loss if the printer buffer is nearly full or the terminal is otherwise unable to accept data. The X-ON/X-OFF feature may be enabled or disabled through Set-Up Mode. When enabled the terminal will transmit an X-OFF code (DC3-13 Hex, Control S) to the computer if the input buffer has fewer than 256 character locations remaining. An

X-ON code (DC1-11 Hex, Control Q) will be transmitted when there are 1024 locations available in the input buffer. Using the Page Print function or the Pass-through Print with low speed printers will also cause the X-ON/X-OFF commands to be issued when appropriate. Busy/Ready condition is sensed on the Auxiliary Port via one of the RS-232C signal levels. The CP/M operating system will recognize these X-ON/X-OFF codes and stop the transmission when requested by the terminal.

### 3.6 CURSOR CONTROL

#### 3.6.1 Relative Cursor Positioning

The Cursor may be moved to any position on the screen using the separate cursor control keys. Its position signifies the next character position in the display. When data is being entered, the cursor moves one position to the right on the line or to the first position in the next line each time a character is written. The control codes required to control the cursor position are outlined in Table 3-1.

#### 3.6.2 Absolute Cursor Positioning

Absolute Cursor Addressing requires commanding the cursor to a specific display location. Commanding the cursor to a specific location (loading the cursor) is normally executed by the computer. The Load command is executed by means of an ESCape sequence in which the row and column location of the cursor is expressed in a pair of ASCII characters.

##### 3.6.2.1 Load Cursor Operation

When the Load Cursor operation is initiated the cursor moves to the commanded position. The Load Cursor operation codes required are as follows:

ESC = COL            ROW  
ASCII            ASCII  
└──────────┬──────────┘  
          └──ASCII Character associated with  
                  row (1-24) position.  
└──────────┬──────────┘  
          └──ASCII Character associated with cursor  
                  column (1-80) position.

EXAMPLE: "ESC=1/" commands the cursor to Column 18, Row 16.

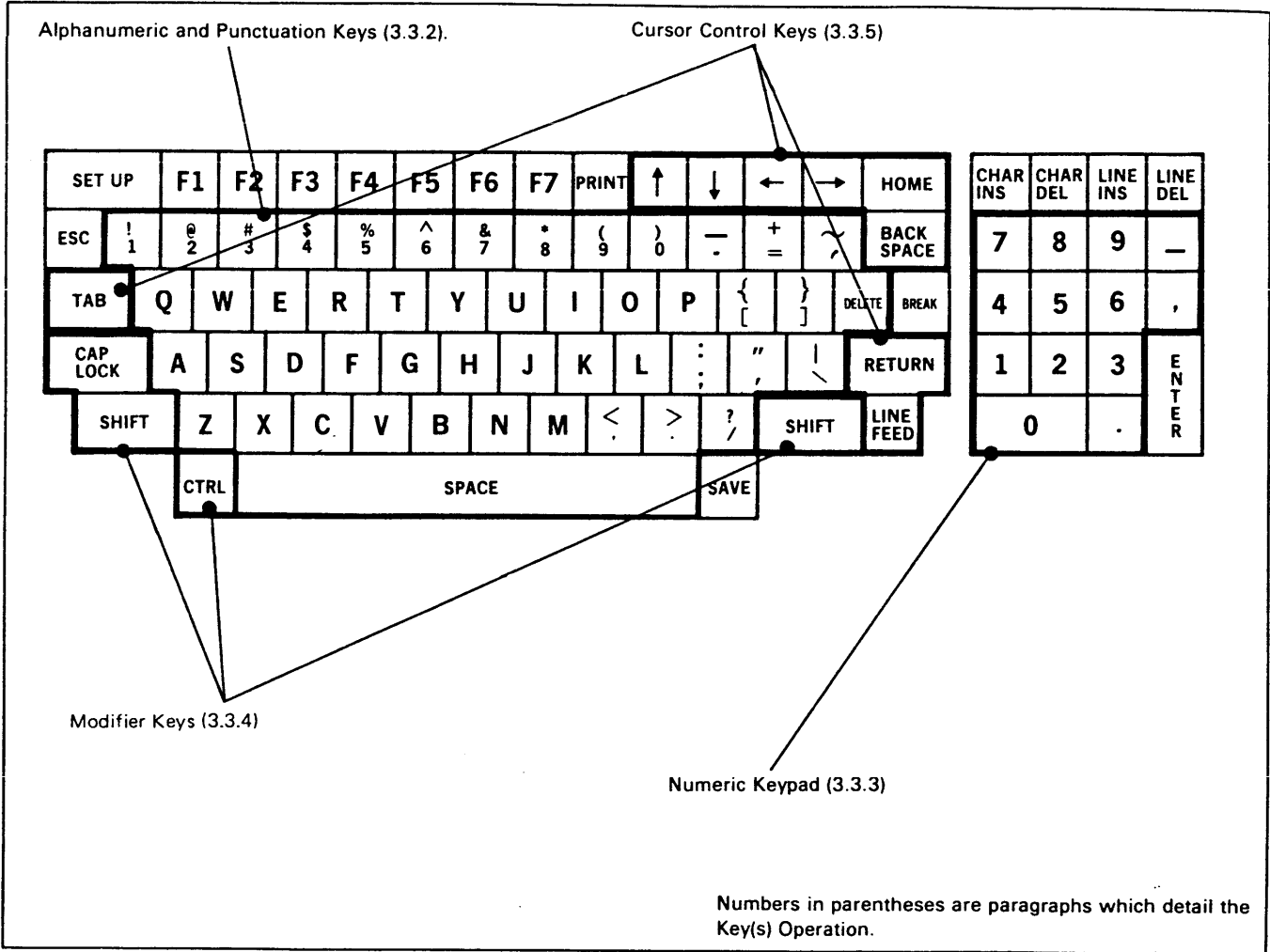


Figure 3-1. Morrow Terminal Keyboard Functions

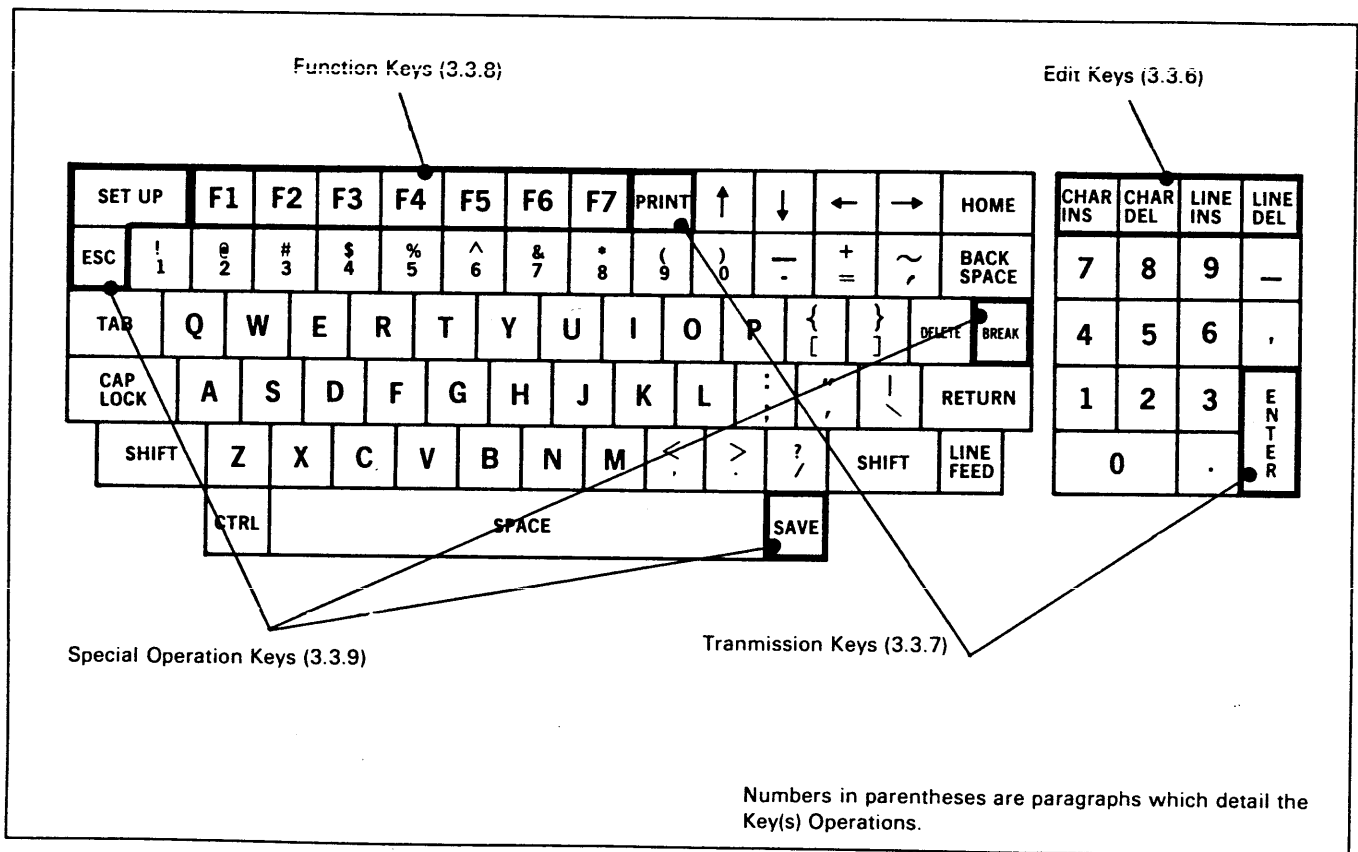


Figure 3-1. Morrow Terminal Keyboard Functions

### 3.6.3 Tab Control

The Morrow Terminal supports two types of tab operations: Modulo tabs and Protected Field tabs. The tab and back-tab commands are detailed in Tables 3-1 and 3-2. The type of tab performed depends upon whether Protect Mode is set or reset. When Protect Mode is set, the Tab command will cause the cursor to advance to the beginning of the next unprotected field. If no protected fields are encountered by the end of the display, the cursor moves home, or to the first unprotected position if home is protected. When Protect Mode is reset the cursor will advance or backspace by eight character positions (Modulo 8 tab) for each command received.

### 3.6.4 Scrolling

In the Morrow Terminal, data is entered into display memory starting at the HOME position, and continues through Position 80 or Line 24, (last data position). When Position 80 is filled, or when a New Line or Line Feed occurs in Line 24, the display is shifted upwards one line and data entry continues in Position 1 of the new Line 24. The original top line of the display is lost. Scrolling continues indefinitely. Scrolling may be enabled or disabled through a selection in Set-Up Mode. Scroll is automatically disabled when Protect Mode is set.

## 3.7 DISPLAY FORMATTING OPERATIONS

The Morrow Terminal may have various attributes and fields used to highlight data on the display. The visual and field attributes used for display formatting are discussed in the paragraphs that follow.

### 3.7.1 Visual Attributes

There are four Visual Attributes that can be assigned to any character on display. They include: Blink, Underline, Reversed, and Reduced Intensity. The attribute that will be used is assigned singularly or in combination through a set-up function selection. When the "Set Write Protect" command is received all subsequent data entered will appear with the selected attribute. If Protect Mode is not set, the data is not treated uniquely; it may be overwritten and erased or cleared by all associated commands. If Protect Mode is set, the data is treated as protected.

### 3.7.2 Field Attributes

When the "Set Write Protect" command is received all subsequent data takes on the visual attribute as noted in paragraph 3.6.1, until a Reset Write Protect is issued. By setting Protect Mode, the write protected data is treated as reserved, or protected. This will allow the commands that specify "Unprotected Only" to be used to improve throughput characteristics. In block sends, the protected data will not be sent during "Send Unprotected Only" commands for line or page. During Edit operations the Erase or Clear Unprotected Only commands will leave the protected data on the display. Insert and Delete operations will terminate upon encountering a protected field. Scrolling is also disabled when Protect Mode is set.

## 3.8 SET-UP MODE OPERATIONS

The general operating characteristics of the Morrow Terminal are controlled by ten 4-bit "nibbles" of information that is displayed on the 25th line of the display, when Set-Up Mode is entered. Both the operator and computer have the ability to change the functions selectable in Set-Up Mode. Selections may be saved in non-volatile memory to re-establish the same functions on the next power-on cycle or terminal reset operation. The operation of Set-Up Mode is fully described in paragraph 2.5.2.

## 3.9 PRINT OPERATIONS

The Auxiliary Port of the Morrow Terminal is most typically connected to a serial RO printer. The communications of data to the auxiliary device is uni-directional via an RS-232C interface. A Busy/Ready signal level is monitored for status during print operations. The Auxiliary Port may be enabled or disabled through a function setting in Set-Up Mode. The three types of print output are: Page Print, Auxiliary Port with Display, and Auxiliary Port without Display, details as follows:

### 3.9.1 Page Print

Upon receipt of a Print Page command the Morrow Terminal will transmit data from home up to the cursor position to the auxiliary device. The command may either specify to send all data, or, send the unprotected data normally but the protected data as spaces. This is useful when using a formatted screen being output to a pre-printed form. The Print Page commands can be generated from the computer or keyboard. Each print line output is followed by a CR and LF (OD and OA Hex) in the data stream.

### 3.9.2 Auxiliary Port With Display

Auxiliary Port with display is enabled or disabled by entering a command from the keyboard or by receiving the ESCape sequence from the computer. When using this method of transmission the terminal will display and act upon all received data as well as transmitting the data out the Auxiliary Port to the printer. When operating in Conversation Mode Half-Duplex keyboard entries are also output to the printer.

### 3.9.3 Auxiliary Port Without Display

Auxiliary Port without display is enabled or disabled by entering command from the keyboard or by receiving command from the computer. When operating in this mode, the terminal will not display received data, however, the terminal will transmit the received data out the Auxiliary Port to the printer. No commands except the reset Auxiliary Port with/without display are acted upon.

### 3.10 POWER-ON RESET

A Power-On Reset consists of a complete recycling of the Morrow Terminal functions, including power. This is accomplished by setting the ON/OFF switch to OFF, waiting 10 seconds, then setting the switch to ON. All display and other volatile memory is erased when powering down. Upon power up, the unit is subject to the complete Power Turn-On procedure specified in Section II.

### 3.11 SELF-TEST

When the Morrow Terminal is reset the terminal Self-Test will be executed. Self-Test will verify the integrity of the display memory, the program memory, non-volatile memory and the associated internal control logic. Upon completion of Self-Test the terminal will sound the audible alarm and the cursor will appear in the upper left corner of the screen.