

ComputerAutomation

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**CRT TERMINAL
USER'S MANUAL**

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SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The CRT Terminal is a self-contained desktop terminal designed for use as a control console or as a data entry and display terminal for a computer. The CRT Terminal uses an industry standard interface and can be directly or remotely (via telephone lines) connected to a CPU. Hard copy can be produced by coupling a printer to the terminal at the connector provided.

1.1.1 Terminal Applications

The basic application for the CRT Terminal is in place of the teletypewriter as a computer console. In this type of operation, the CRT monitor screen replaces the paper tape roll and the cursor replaces the moving typehead. Though essentially compatible, the CRT Terminal has minor operational differences from a teletypewriter.

A second type of application is the use of one or more CRT Terminals as direct, on-line data input devices. In this application, a degree of direct CPU supervision is required to format the entered data, duplicate repetitive information, etc.

A third type of application is to have several terminals at locations remote from the CPU. In such a system each terminal could be used to retrieve data from the CPU on demand, edit and/or update data, or enter and execute programs.

1.1.2 Features

The main features of the CRT Terminal are:

- Filtered monitor screen for easier viewing and reduced lighted room image wash-out.
- Separate typewriter and numeric keyboard areas for easy data entry.
- Keyboard generates the full 128 ASCII character set (96 characters displayed).
- Terminal control section responds to 23 of the designated control characters.
- Screen display is 1920 characters, arranged as 24 lines of 80 characters.
- Flashing cursor indicates relative data entry point.
- Full cursor position control capability.



- Automatic display scroll.
- Automatic 50/60 Hz refresh rate selection.
- Standard EIA RS232C/CCITT interface.
- Built-in bit serial EIA RS232C/CCITT extension printer interface.
- Strap-selectable independent baud rate for transmit and receive.
- Full duplex operation.

1.1.3 Specifications

Table 1-1 summarizes the physical, electrical and environmental specifications of the CRT Terminal.

Table 1-1. CRT Terminal Specifications

<u>Item</u>	<u>Specification</u>
Height	14.0 in (35.6 cm)
Width	20.5 in (52.1 cm)
Depth (w. keyboard)	22.5 in (57.2 cm)
Depth (monitor only)	14.7 in (37.3 cm)
Weight	40 lbs (18.2 kg)
Voltages	100 $\pm$ 10 vac, 49-63 Hz
	117 $\pm$ 12 vac, 49-63 Hz
	220 $\pm$ 22 vac, 49-63 Hz
	240 $\pm$ 24 vac, 49-63 Hz
Power Dissipation	60 watts (nominal)
Temperatures	0 °C to 45 °C (operating)
	-40 °C to 70 °C (non-operating)
Humidity	0 to 95%, without condensation

1.2 CRT TERMINAL DESCRIPTION

The CRT Terminal consists of three distinct parts: the terminal control section, the CRT monitor, and the keyboard. The terminal control section and the CRT monitor are housed in a single cabinet, hereafter referred to as the monitor cabinet. The keyboard is housed in a separate cabinet and is connected to the monitor cabinet by a cable. The two cabinets are designed to fit together with the appearance of being a single unit. The cable connecting the two cabinets allows a maximum separation of about 1 1/2 feet (45 cm) between the cabinets when such separation is desired. Figure 1-1 is a functional block diagram of the CRT Terminal.

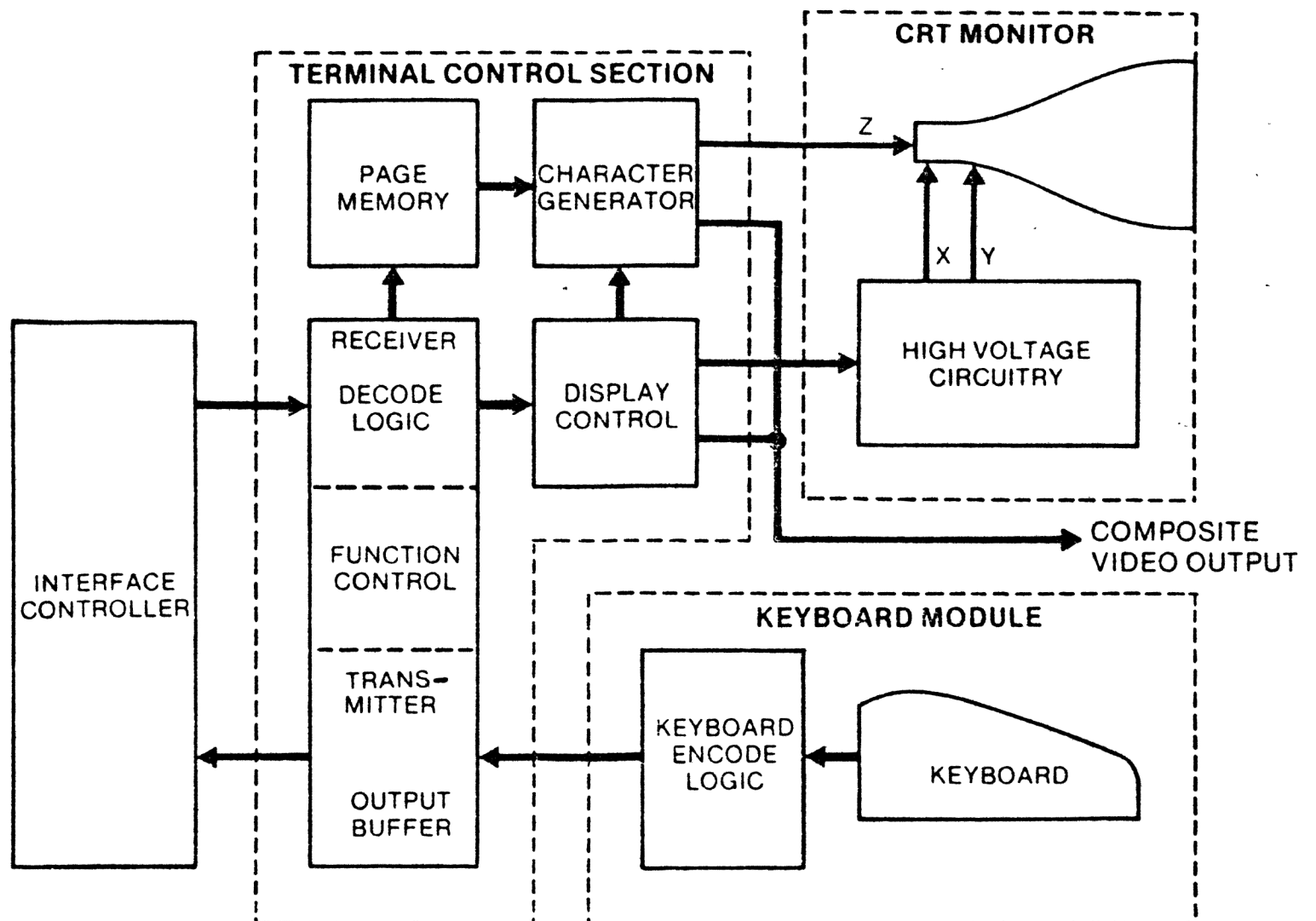


Figure 1-1. CRT Terminal Block Diagram



1.2.1 CRT Monitor

The CRT monitor consists of a 12-inch (30.5 cm) overall diagonal cathode ray tube and associated high voltage circuitry mounted in a separate chassis. The image area used for display is approximately 5 1/4 inches (13.5 cm) high by 7 1/4 inches (18.5 cm) wide.

The CRT monitor circuitry provides the basic vertical and horizontal deflection control and high-voltage generation. Synchronization pulses from the terminal control section are used to produce the deflection rates.

The display image is developed by varying the screen biasing with the output of the character generator as each horizontal sweep is made. The display biasing is normally adjusted for a dark screen in the non-character areas. The characters are displayed as light (or white) on dark.

1.2.2 Keyboard

The keyboard module consists of the data and control keys and their encoding logic. The keys are physically separated into three keyboard areas: The typewriter keyboard area, the numeric keyboard area, and the control keyboard area. With the exception of the LOCK and ALL CAPS keys, all keys are individual momentary switches. LOCK and ALL CAPS are alternate action switches; that is, once pressed, the switch remains on until pressed a second time and released.

Each time a key is pressed, the keyboard encode logic generates the 7-bit ASCII character code corresponding to the key pressed. The terminal control section is then signaled to initiate transmission of the character.

1.2.3 Terminal Control Section

The terminal control section supervises the internal operation of the terminal. The supervision required consists of two main operations: one continuous, the other on a demand basis.

The continuous operation is the display of information on the monitor screen. This operation includes control of the page memory and character generator to develop the display and deflection rate control that positions the characters on the screen.

The demand operation is the control of the transfer of characters to/from a CPU. Data characters received are stored at the cursor location in the page memory; control characters received are decoded and the proper function initiated.

The information displayed on the monitor at any given time represents the current contents of the page memory. The page memory may contain data entered from the keyboard, data output from the CPU or a mixture of both.

This display information is no longer available for transmission to the CPU, but is available as a composite video signal consisting of the display information along with the horizontal and vertical synchronization information. This signal is available at the composite video output connector.



SECTION 2

OPERATOR'S INFORMATION

2.1 INTRODUCTION

This section describes the controls and procedures for normal operation of the CRT Terminal.

The on-line operation of the terminal is restricted to conversational mode operation. During this mode, an encoded character is transferred to an external interface controller each time a data or control key is pressed. For data display or terminal control to occur, the interface controller must return both the data and control characters to the terminal control section.

The relative location for the entry of the next data character is indicated by a flashing cursor on the CRT monitor screen. The cursor control alternates the cursor character area between a white character on a dark background and a dark character on a white background. The alternations occur approximately eight times a second.

2.2 OPERATOR'S CONTROLS

There are four operator's controls on the CRT Terminal; Figure 2-1 shows the location of the controls.

CAUTION

Do not alter the settings of the voltage select switches located on the rear panel. These switches are set during installation for the available power; changing the setting of these switches can result in damage to the terminal circuitry.

2.2.1 POWER ON/OFF Switch

The POWER ON/OFF switch is located on the right side of the CRT Terminal. When turned ON, power will be applied to the high voltage and logic circuits of the terminal.

2.2.2 LINE/LOC Switch

The LINE/LOC switch is located on the rear panel of the terminal. The LINE position selects normal on-line operation of the terminal. The LOC (local) position selects off-line operation. When local operation is selected, the CPU is denied access to the terminal. Off-line operation is described further in Section 3.2.3.

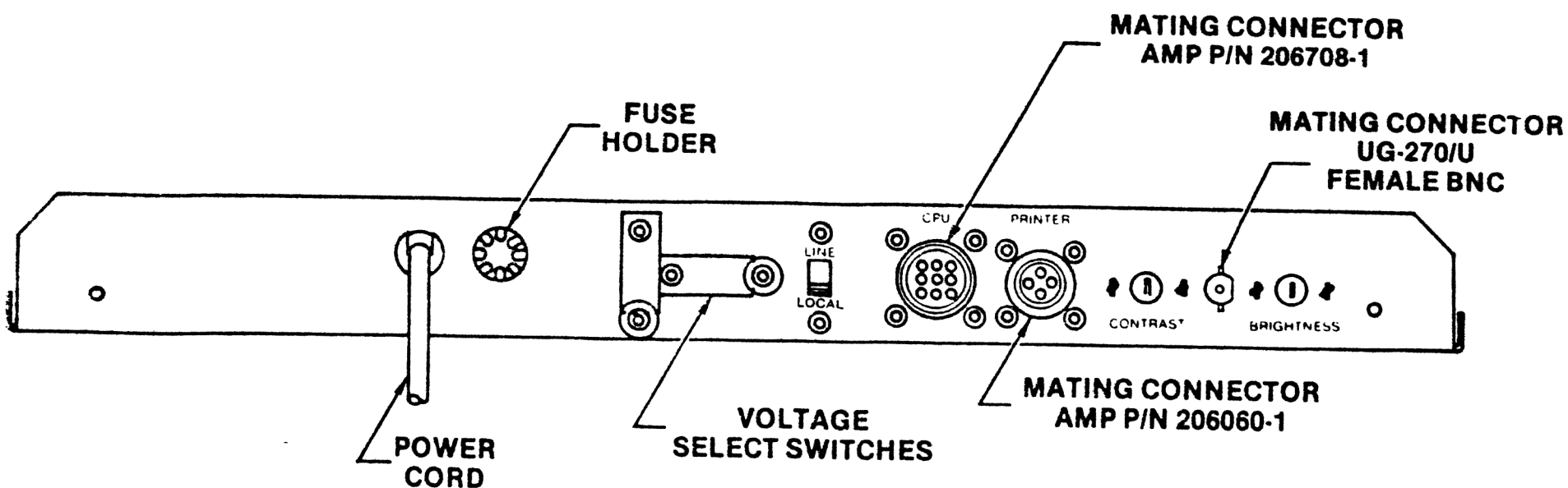
2.2.3 BRIGHTNESS Control

The BRIGHTNESS control is located on the rear panel of the terminal and controls the overall brightness of the CRT display. A common slot-blade screwdriver is required to change the setting of the BRIGHTNESS control. Once a satisfactory setting is obtained, the BRIGHTNESS control should not require further adjustment. The screen brightness should be adjusted to a point where the white raster (screen illumination with no characters displayed) is just extinguished. This permits the maximum contrast ratio between the background and the displayed characters.

2.2.4 CONTRAST Control

The CONTRAST control is located on the rear panel of the terminal and controls the brightness of the displayed characters in relation to the background. A common slot-blade screwdriver is required to change the setting of the CONTRAST control. Once a satisfactory setting is obtained, the CONTRAST control should not require further adjustment. The contrast should not be adjusted until the screen brightness is set. Adjust the contrast for sharp, well-defined characters. Fuzzy edges and characters that tend to fill in indicate the contrast is set too high.

MONITOR — REAR PANEL



MONITOR — RIGHT SIDE

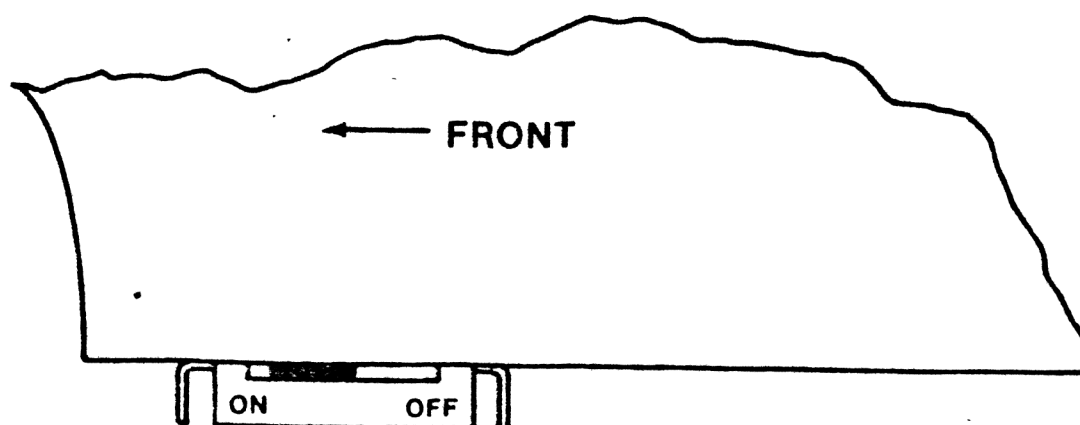


Figure 2-1. Operators Controls

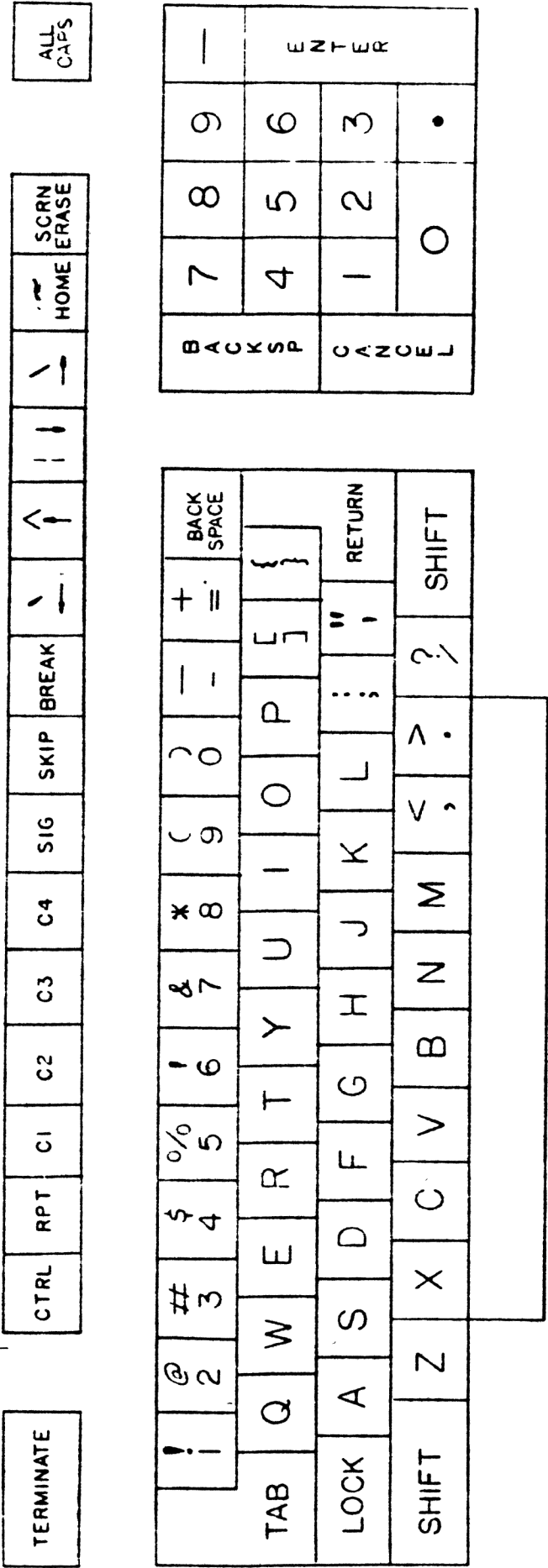


Figure 2-2. Keyboard Layout



2.3 KEYBOARD DESCRIPTION

The terminal keyboard is separated into three functional areas: an IBM Selectric style keyboard area, a 15-key numeric keyboard area and the special function keys. Refer to Figure 2-2.

2.3.1 Typewriter Keyboard Area

The typewriter keyboard area uses the sculptured keys, key style, and shape of the popular IBM Selectric office typewriter. The layout of the alphabetic and numeric keys is the same as the standard typewriter keyboard. Symbol placement also follows conventional typewriter layout as much as possible.

The typewriter control keys perform the following functions:

- RETURN - Returns the cursor to position 1 of the current line; does not advance to the next line. An automatic return and line advance occurs following the entering of a data character at position 80 of any line.
- TAB - Advances the cursor to the corresponding character position of the next line. If the cursor is on line 24, the display will scroll; that is, line 1 is deleted, all other lines move up one, and the cursor stays on the now-blank line 24.
- SHIFT and LOCK - Normal operation is the same as on a typewriter; however, the ALL CAPS key can override the lower case position of the SHIFT key. The all caps override applies only to the alphabetic keys; the shift function remains the same for number and symbol keys.
- SPACE - Advances the cursor one position and displays a blank on the monitor screen at the old cursor position. Space from position 80 of a line moves the cursor to position 1 of the next line. From position 80 of line 24, the display scrolls one line and the cursor returns to position 1 of line 24.
- BACKSPACE - Moves the cursor one position backward and erases the character at the old cursor position. Backspace from position 1 of a line moves the cursor to position 80 of the previous line. The cursor will not backspace from line 1, position 1.

2.3.2 Numeric Keyboard Area

The numeric keyboard area uses a layout similar to the keyboard of a 10-key adding machine. As such, the numeric keyboard area is generally best suited to entering all or mostly numeric data, though either keyboard area can be used interchangeably.

The numeric keyboard is not affected by the SHIFT or ALL CAPS keys. The BACKSP and ENTER keys duplicate the typewriter BACKSPACE and RETURN keys, respectively. The CANCEL key encodes as a :18 code which is transmitted to the CPU. The terminal control section does not decode the :18 and no terminal operation is initiated.

A keyboard encode option allows flagging the numbers entered on the numeric keyboard by encoding the 27 bit = 1. The numeric keyboard number keys would then be transmitted as :B0 through :B9 and the typewriter number keys would be transmitted as the normal :30 through :39.



2.3.3 Special Function Keys

The special function keys are arranged in a single row across the top of the keyboard module. These keys provide additional terminal functions or symbols not directly related to normal typewriter or adding machine functions.

The special function keys perform the following functions:

- TERMINATE - Generates the :04 control character for software use. No terminal function is initiated from this key.
- CTRL - Modifies the encoding of the keyboard to complete the encoding of the full ASCII character set. CTRL must be pressed and held while the appropriate second key is pressed.
- RPT - While the RPT key is held down, the last character encoded will be re-transmitted to the CPU approximately 15 times per second.
- C1 - Moves the cursor to position 1 of the next line. If the cursor is on line 24, the display will scroll upward and the cursor will move to position 1 of the now-blank line 24.
- C2 - Generates the :1B control character for software use. No terminal function is initiated by this key.
- C3 - Turns on the extension printer interface (refer to Section 4.1.3).
- C4 - Turns off the extension printer interface and releases the CRT monitor display for normal updating.
- SIG - Sounds a short, audible, beep tone.
- SKIP - Disables the updating of the CRT monitor display. The keyboard is not locked, however.
- BREAK - When pressed, forces the continuous transmission of a logical 0 on the transmit data line for use by the interface controller. Transmit data remains a logical 0 until the key is released. No terminal function is initiated by this key.

NOTE

The ←, ↑, ↓, →, and HOME special function keys are also symbol keys. The CTRL (control) key selects the symbol function of these keys.

- ← - Non-destructive backspace that moves the cursor backward one position. From position 1 of a line, the cursor will move to position 80 of the previous line. From line 1, position 1, the cursor will move to line 24, position 80 (i.e., to the final position on the screen).
- ↑ - Moves the cursor to the corresponding position on the previous line. From line 1, the cursor will move to the same position on line 24.



- **|** - Moves the cursor to the same position on the next line. From line 24, the cursor will move to the corresponding position on line 1.
- **→** - Moves the cursor one position forward. From position 80 of a line, the cursor will move to position 1 of the next line. From line 24, position 80, the cursor will move to line 1, position 1; the display does not scroll.
- **HOME** - Moves the cursor to line 1, position 1.
- **SCRN ERASE** - Moves the cursor to line 1, position 1 and clears the monitor screen of all displayed data.
- **ALL CAPS** - Causes the alphabetic keys to be encoded as all upper case. The typewriter SHIFT and LOCK keys continue to select the upper and lower case character on the number and symbol keys.



SECTION 3

PROGRAMMING CONSIDERATIONS

3.1 INTRODUCTION

The possible uses of the CRT Terminal are so varied that any real attempt to present programming samples is beyond the scope of this manual. The material in this section consists of a brief description of the CRT Terminal transmit and receive operation, code charts and a detailed description of the control characters.

3.2 DATA TRANSFER

The CRT Terminal uses the standard EIA RS232C/CCITT full duplex interface. The CRT Terminal does not require any operation initiation commands.

3.2.1 Transmit Data Operation

The transmission of an encoded character occurs as a result of pressing the appropriate key on the keyboard. The encoded character may be either data or control; a determination is not made at the time of transmission. Data transmission can be inhibited by the CPU (or interface controller) issuing a Keyboard Lock control character (:19) to the terminal. The keyboard remains disabled until the CPU issues the Keyboard Unlock control character (:06).

The transmission of data can also be inhibited through the use of the Clear-To-Send (CTS) line. If the interface controller operates full duplex without automatic echo, the CTS line is not required. If the interface controller (half duplex or full duplex) uses automatic echo to display the keyboard data, the CTS line should be used to inhibit transmission from the terminal until the interface controller has completed transmission of the character.

3.2.2 Receive Data Operation

The CRT Terminal is able to receive data at any time it is on-line. Each character codes received is first checked to determine if the character is a data or control character. Data characters are stored in the page memory at the cursor location and the automatic terminal update functions, such as cursor advance, are made. Control characters are not stored and do not initiate automatic terminal update functions. An attempt is made to decode each control character received. If the control character cannot be decoded, it is ignored. If the control character is decoded, the corresponding function is initiated.

The combination of the time required for the terminal to complete a function and the character transmission rate impose restrictions on the chaining of control characters. These restrictions are detailed in Section 4.1.2, Operation Restrictions. Any control character may be followed immediately by a data character.

The reception of data characters cannot be inhibited; however, the updating of the CRT monitor can be inhibited if the CPU or controller interface issues a CRT Off control character (:OF) to the terminal. This causes the terminal control section to ignore all data characters, and all control characters except Printer On (:11) and Printer Off, CRT On (:12). The latter control character releases the CRT monitor for updating.

3.2.3 Off-line Operation (Test)

Setting the LINE/LOC switch to the LOC (local) position places the CRT Terminal off-line. Specifically, LOC will connect the transmitted data line to the received data line, forming the loop-back arrangement shown in Figure 3-1. Off-line operation permits independent testing of both the terminal and the communications link with the CPU.

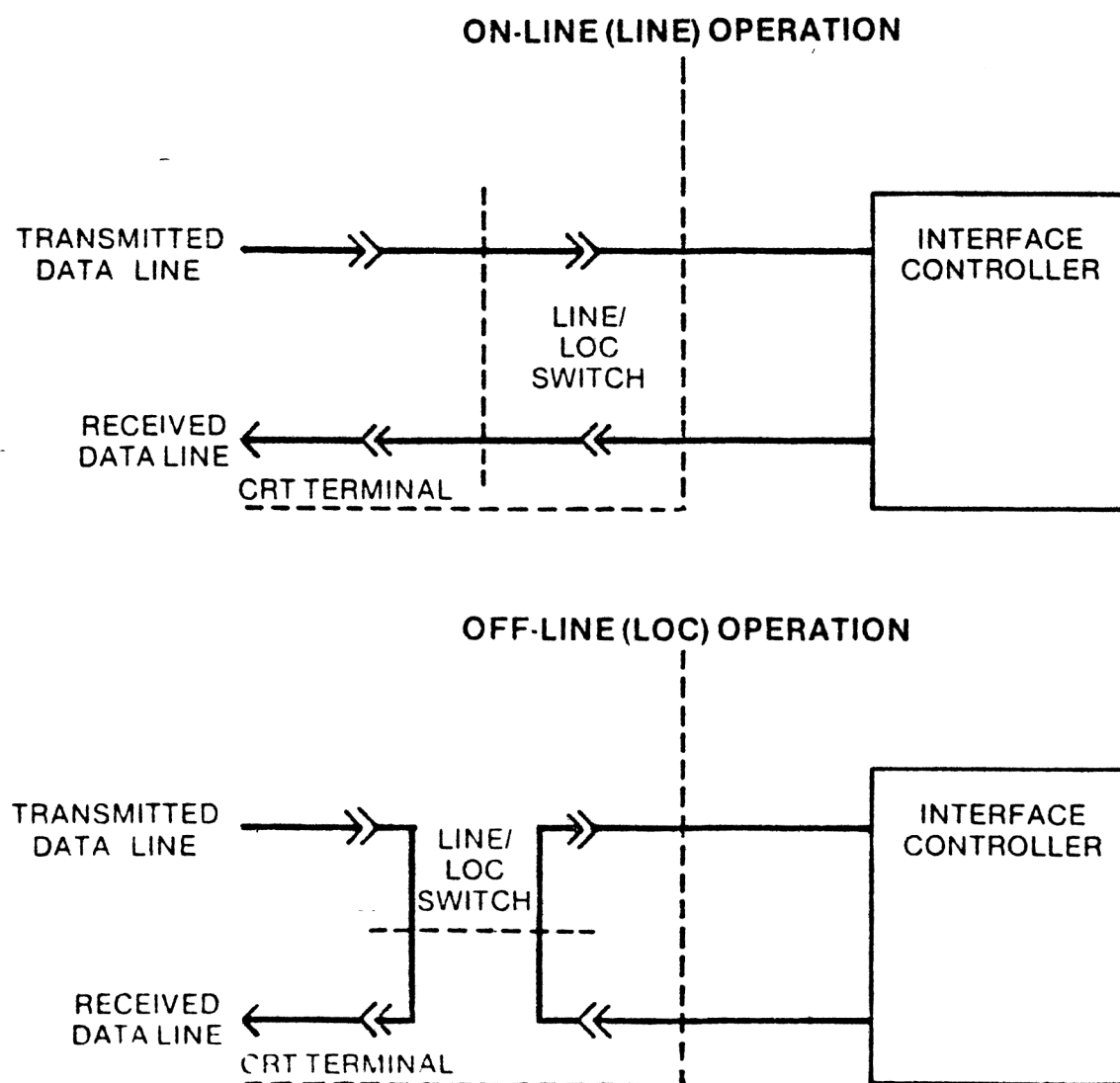


Figure 3-1. Line/Loc Switch Connections



3.3 CODE GENERATION

The keyboard encoding logic is capable of generating the full 7-bit ASCII character set, from :00 through :7F. The various character codes are encoded by pressing one or more keys.

Figure 3-2 is a summary of the hexadecimal codes and the key(s) that generate each code. In some cases, a different key or keys may generate a given code. The chart here does not list these alternate means of generating a given code since these usually represent a more complex, less direct method of generating the code.

All 96 of the data codes from :20 to :7F are displayed by the CRT Terminal. The control codes from :00 to :1F are not displayed.

3.4 CONTROL CHARACTER FUNCTIONS

Control characters can perform three different types of functions:

- Some characters control the overall operation of the CRT Terminal.
- Other characters control the cursor position.
- Other characters control the display.

Table 3-1 summarizes the characters in each of these functional groups.

3.4.1 Terminal Control

The terminal control functions directly affect the use of the CRT Terminal and includes the disabling and enabling of terminal operation.

CRT OFF (:0F) - Directs the terminal control section to ignore all control characters except :11 (Printer On) and :12 (Printer Off, CRT On). Further updating of the page memory is disabled until the :12 control character is received. The keyboard remains active unless previously locked.

KEYBOARD LOCK (:19) - Electrically locks the keyboard by inhibiting the transmission of any encoded characters. A "beep" tone will sound each time a key is pressed while the keyboard is locked.

KEYBOARD UNLOCK (:06) - Unlocks the keyboard and removes the transmission inhibit. The keyboard will also automatically unlock upon power-up. Keyboard unlock can be generated by the keyboard logic, but is recognized by the terminal control section only if the keyboard is already unlocked.

PRINTER ON (:11) - Enables the interface to the extension printer.

PRINTER OFF AND CRT ON (:12) - Disables the interface to the extension printer and removes the inhibit on the updating of the page memory. Allows the terminal control section to resume recognition of the control characters.

SIGNAL (:07) - Sounds a short, audible "beep." Corresponds to the bell on a teletype-writer used to attract an operator's attention. Also sounds when a key is pressed while the keyboard is locked and when the data entry rate exceeds the transmission rate to such an extent that data is lost.

MOST
SIGNIFICANT
HALF-BYTE →

↓

LEAST
SIGNIFICANT
HALF-BYTE

NOT
DISPLAYED

OPTIONAL
NUMERIC KEYBOARD
ENCODE

HEX	0	1	2	3	4	5	6	7	89A	B	CDEF
0	(])	(p)	SPACE	0	α	P	(\)	p		0	
1	(a)	C3	!	1	A	Q	a	q		1	
2	(b)	C4	"	2	B	R	b	r		2	
3	(c)	(s)	#	3	C	S	c	s		3	
4	TERM	(t)	\$	4	D	T	d	t		4	
5	(e)	←	%	5	E	U	e	u		5	
6	(f)	↑	&	6	F	V	f	v		6	
7	SIG	↓	'	7	G	W	g	w		7	
8	BACK SPACE	CANCEL	(	8	H	X	h	x		8	
9	→	(y)	)	9	I	Y	i	y		9	
A	TAB	(z)	*	:	J	Z	j	z			
B	(k)	C2	+	;	K	[	k	{			
C	SCRN ERASE	(:)	,	<	L	(\)	l	(;))	NOT GENERATED		
D	ENTER RETURN	(=)	—	=	M	J	m	}			
E	(n)	HOME	.	>	N	(^)	n	(~)			
F	SKIP	C1	/	?	O	—	o	({)			

DISPLAY IS ■

CHARACTERS BRACKETED WITH PARENTHESES () REQUIRE THE CTRL KEY BE PRESSED ALONG WITH THE KEY INDICATED

Figure 3-2. Keyboard Code Chart



Table 3-1. Summary of Control Characters

Function	Hex Code	Description
Terminal Control (Section 3.4.1)		
CRT Off	:0F	Disables CRT
Keyboard Lock	:19	Lock Keyboard
Keyboard Unlock	:06	Unlocks Keyboard
Printer On	:11	Enables Printer Interface
Printer Off, CRT On	:12	Disables Printer Interface, Enables CRT
Signal	:07	Sounds beep tone
Cursor Control (Section 3.4.2)		
Back Space	:08	Back Spaces Cursor W/Erase
Cursor Disable	:14	Turns Off Cursor
Cursor Enable	:13	Turns On Cursor
Home	:1E	Moves Cursor to Home position
Line Feed	:0A	Moves Cursor to Next Line W/Scroll
New Line	:1F	Moves Cursor to Pos. 1 of Next Line W/Scroll
Position Cursor	:02	Moves Cursor to Specified Line and Position
Return	:0D	Moves Cursor to Pos. 1 of Line.
	:09	Moves Cursor forward One Position
	:15	Backspaces Cursor W/O Erase
	:16	Moves Cursor to Previous Line W/O Scroll
	:17	Moves Cursor to Next Line W/O Scroll
Display Control (Section 3.4.3)		
Frame Erase	:1C	Erases from Cursor to Line 24, Position 8
Line Erase	:1D	Erases from Cursor to End of Line
Roll Up	:0B	Rolls Display Upward One Line
Screen Erase	:0C	Clears the Display

Note: Control character codes :00, :01, :03, :04, :05, :10, :18, :1A and :1B are not decoded by the terminal control section.



3.4.2 Cursor Control

The cursor control functions are used for repositioning the cursor on the CRT monitor display.

BACKSPACE (:08) - Moves the cursor backward one character position and erases the page memory location at the new cursor position. Backspacing from position 1 of a line moves the cursor to position 80 of the previous line. The cursor will not backspace from position 1 of line 1.

CURSOR DISABLE (:14) - Turns off the display of the cursor. Cursor position is retained as the data entry point to the page memory.

CURSOR ENABLE (:13) - Turns on the display of the cursor at the point corresponding to the page memory data entry. This condition occurs automatically upon power-up.

HOME (:1E) - Moves the cursor to position 1 of line 1 without altering the page memory.

LINE FEED (:0A) - Advances the cursor to the corresponding character position on the next line. If the cursor is on line 24, the page memory will scroll upward; that is, line 1 disappears, all other lines move up one position on the monitor, and line 24 is cleared while the cursor remains on the now-blank line 24.

NEW LINE (:1F) - Moves the cursor to position 1 of the next line. If the cursor is on line 24, the page memory will scroll upward and the cursor will move to position 1 of the new line 24.

POSITION CURSOR (:02) - Moves the cursor to a specified line and position location. The first and second characters received following the position cursor control character are interpreted as the line and position numbers, respectively. For positioning purposes, the numerical value of the characters, rather than the ASCII code, is used. Line numbers = 0 or >24 and position = 0 or >80 are ignored and the present line and/or position location is unchanged by the positioning operation.

READ CURSOR (:0E) - Directs the terminal control section to transmit a three-character group that gives the present location of the cursor in relation to the page memory. The sequence of characters transmitted in response to the read cursor control character is as follows:

1. Cursor Position control character (:02)
2. Line number (1 through 24)
3. Position number (1 through 80)

The terminal control section initiates response to the Read Cursor control character prior to the completion of the interface controller's transmission sequence. An interface controller using automatic echo is not ready to receive a character at this time. Clear-to-Send must be used to inhibit terminal response until the interface is ready to receive a character.

NOTE

If Read Cursor is entered at the keyboard on a system that is interfaced half duplex or full duplex with automatic echo, the terminal control section will decode the control character and transmit the cursor position 3-character group automatically.



RETURN (:0D) - Moves the cursor to position 1 of the line on which the cursor is located. Contents of the line is not altered.

→ (:09) - Moves the cursor one position forward without altering the page memory. Cursor will progress from line to line and will reset from position 80 of line 24 to position 1 of line 1 without initiating scroll.

← (:15) - Moves the cursor one position backward without altering the page memory. The cursor will reset from position 1 of a line to position 80 of the previous line and will reset from position 1 of line 1 to position 80 of line 24. Scroll is not initiated.

↑ (:16) - Moves the cursor to the corresponding character position on the previous line. If the cursor is on line 1, the cursor moves to line 24. Scroll is not initiated.

↓ (:17) - Advances the cursor to the corresponding character position on the next line. If the cursor is on line 24, the cursor moves to line 1. Scroll is not initiated.

3.4.3 Display Control

The display control functions are used to modify the positioning of the displayed data or to erase all or part of the displayed data.

FRAME ERASE (:1C) - Clears the page memory from the cursor position (inclusive) through position 80 of line 24. The corresponding display is erased from the monitor screen. The Cursor position is not changed by Frame Erase. Refer to the description of the Screen Erase control character :0C for specific timing restrictions.

LINE ERASE (:1D) - Clears the page memory from the cursor position (inclusive) through position 80 of the same line. The Cursor position is not changed by Line Erase. There are no timing restrictions on line erase.

ROLL UP (:0B) - Scrolls the page memory. Line 1 is deleted, all other lines move up one position on the display and line 24 is cleared. The cursor remains on the same line and does not move with the displayed data.

SCREEN ERASE (:0C) - Returns the cursor to position 1 of line 1 and clears the page memory. All information is erased from the Monitor Screen.

The terminal control section performs this function (and also frame erase) by starting at the page memory position corresponding to position 80 of line 24 and sequentially, in reverse, clearing the page memory until encountering the cursor. This automatically buffers the display of data characters, regardless of the transmission rate from the CPU. However, time must be allowed to complete the screen (or frame) erase operation before issuing a Position Cursor (:02), ↑ (:16), ↓ (:17), Line Feed (:1F), or Roll Up (:0B) control character from the CPU. The following are the timing requirements:

Screen Erase Period - 7.6 ms.

Frame erase is proportionally shorter based on cursor position.

BAUD RATE

9600
4800
2400
1200

CHARACTER PERIOD (8 data bits, 2 stop bits)

1.14 ms
2.29 ms
4.58 ms
9.17 ms

Control characters ↑ (:16), ↓ (:17), Line Feed (:1F), or Roll Up (:0B) can be issued immediately at baud rates 1200 and below; the Position Cursor (:02) 3-character sequence at baud rates 2400 and below.

SECTION 4

INTERFACE REQUIREMENTS

4.1 INTERFACE DESCRIPTION

The CRT Terminal communicates with the interface controller (or CPU) via an asynchronous, bit-serial, full duplex interface; that is, EIA RS232C/CCITT compatible. Figure 4-1 illustrates the various communication configurations for the CRT Terminal.

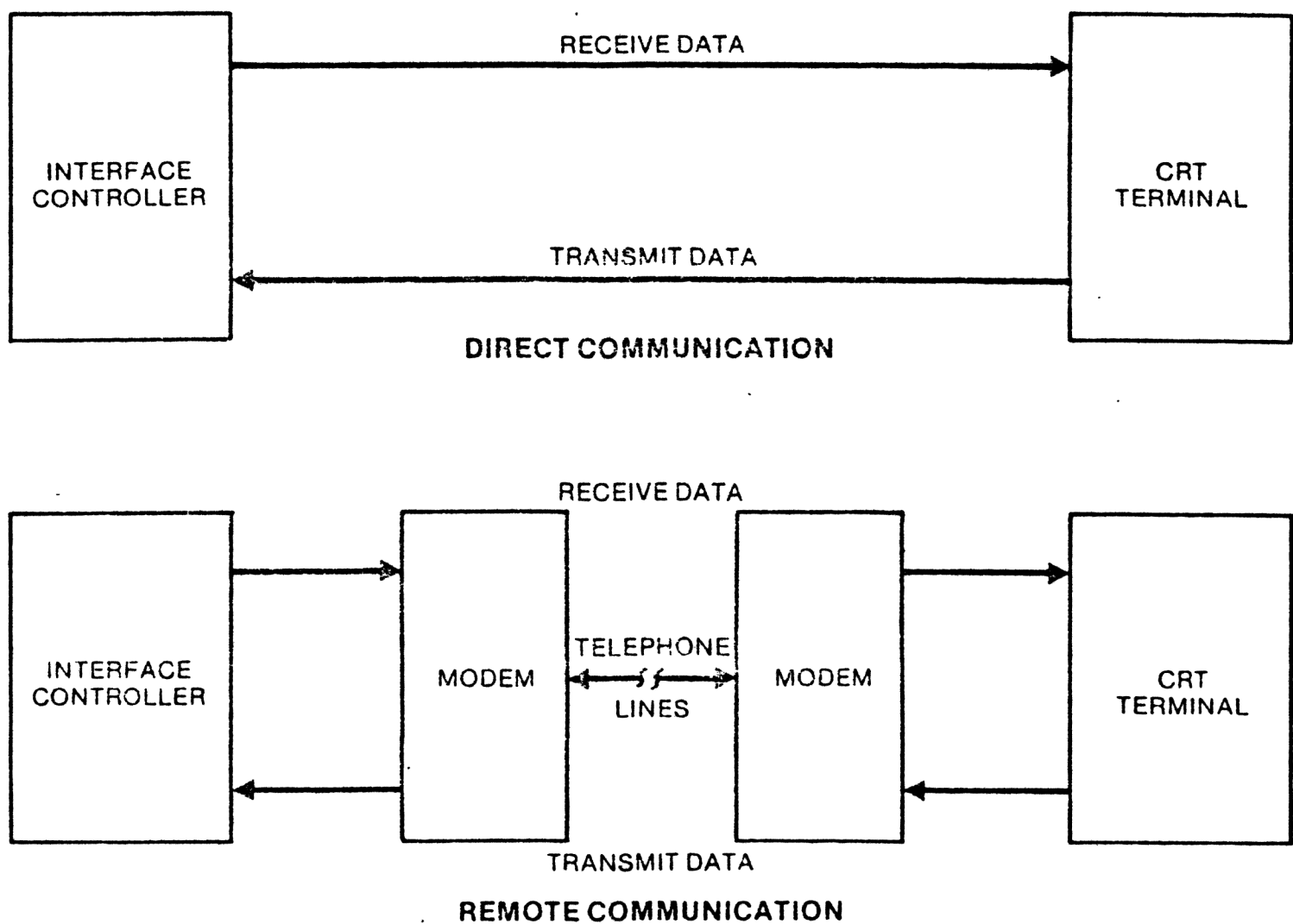


Figure 4-1. Communication Configurations



4.1.1 Data Timing Options

The data transfer rate for the CRT Terminal is factory-set at 2400 baud for both transmitting and receiving data. The terminal control section can be strapped to operate at any of the baud rates shown in Figure 4-2. Figure 4-3 shows the strapping location of the terminal control section. Different transmit and receive baud rates can be specified. Different transmit and receive baud rates must not be used if the interface controller uses automatic echo to display the transmitted character. To set or change a baud rate, the required jumpers are installed on the headers provided at J7 and J8 using number 24 to 28 AWG wire and soldered connections.

The data word length is factory-set to select an 8-bit word plus one start bit and two stop bits, but a 5-, 6- or 7-bit data word length can be selected per Figure 4-2. The number of stop bits can be strapped for either one or two stop bits.

To change the word length, determine the strap configuration for the desired word length. Then cut the etched strap(s) where necessary and install the strap(s) specified for the required word length. For example, to change from an 8-bit to a 7-bit word, cut the etch between 15C and PUP and install a strap (jumper) from 15C to GND.

The number of stop bits is strapped in the same manner as the word length.

The Clear-to-Send (CTS) is factory-strapped to accept a negative true signal. For positive true, cut the etched strap at W1.

NOTE

Make all strapping changes carefully. Missing straps or double straps will cause the CRT Terminal to be inoperative or operate erratically.

4.1.2 Operation Restrictions

The screen and frame erase functions are performed by the terminal control section by starting at the page memory position corresponding to position 80 of line 24 and sequentially, in reverse, clearing each page memory location until encountering the cursor. Time must be allowed to complete the screen or frame erase before issuing a Position Cursor (:02), ↑ (:16), ↓ (:17), Line Feed (:1F), or Roll Up (:0B) control character from the CPU. The following are the timing requirements:

Screen Erase Period - 7.6 ms.

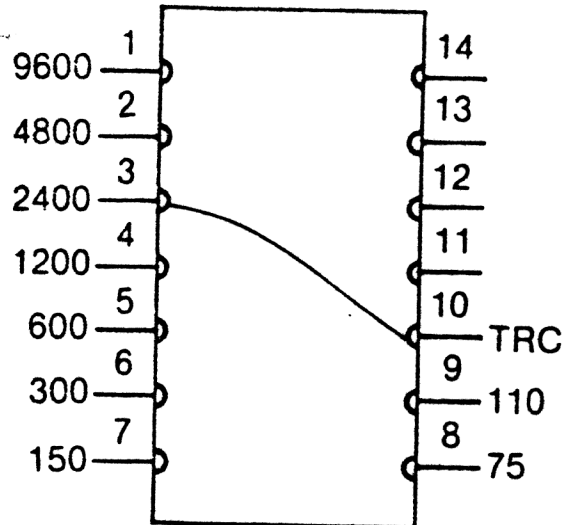
Frame erase is proportionally shorter based on cursor position.

BAUD RATE	CHARACTER PERIOD (8 data bits, 2 stop bits)
9600	1.14 ms
4800	2.29 ms
2400	4.58 ms
1200	9.17 ms

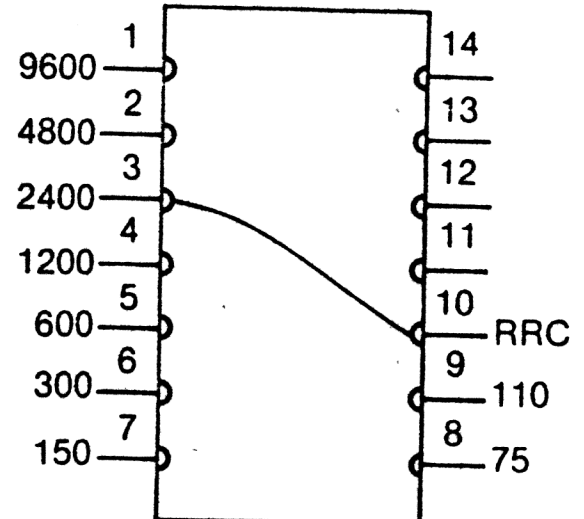
The ↑ (:16), ↓ (:17), Line Feed (:1F), or Roll Up (:0B) codes can be issued immediately at baud rates of 1200 and below. The Position Cursor (:02) 3-character sequence can be issued immediately at baud rates of 2400 and below.



TRANSMIT CLOCK (TRC) J7 CONFIGURATION



RECEIVE CLOCK (RRC) J8 CONFIGURATION



WORD LENGTH	STRAPPING	
8-BITS*	15C TO PUP	17C TO PUP
7-BITS	15C TO GND	17C TO PUP
6-BITS	15C TO PUP	17C TO GND
5-BITS	15C TO GND	17C TO GND
STOP BITS	STRAPPING	
1-BIT	16C TO GND	
2-BITS*	16C TO PUP	
CLEAR TO SEND (CTS) POLARITY	STRAPPING	
POSITIVE TRUE	OPEN	
NEGATIVE TRUE*	W1 STRAPPED	

*FACTORY ETCHED STRAP

PUP COMMON GND (C)

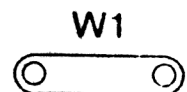
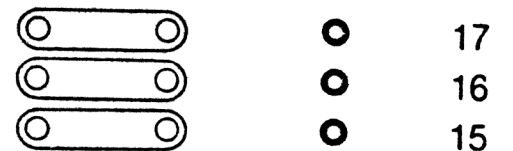
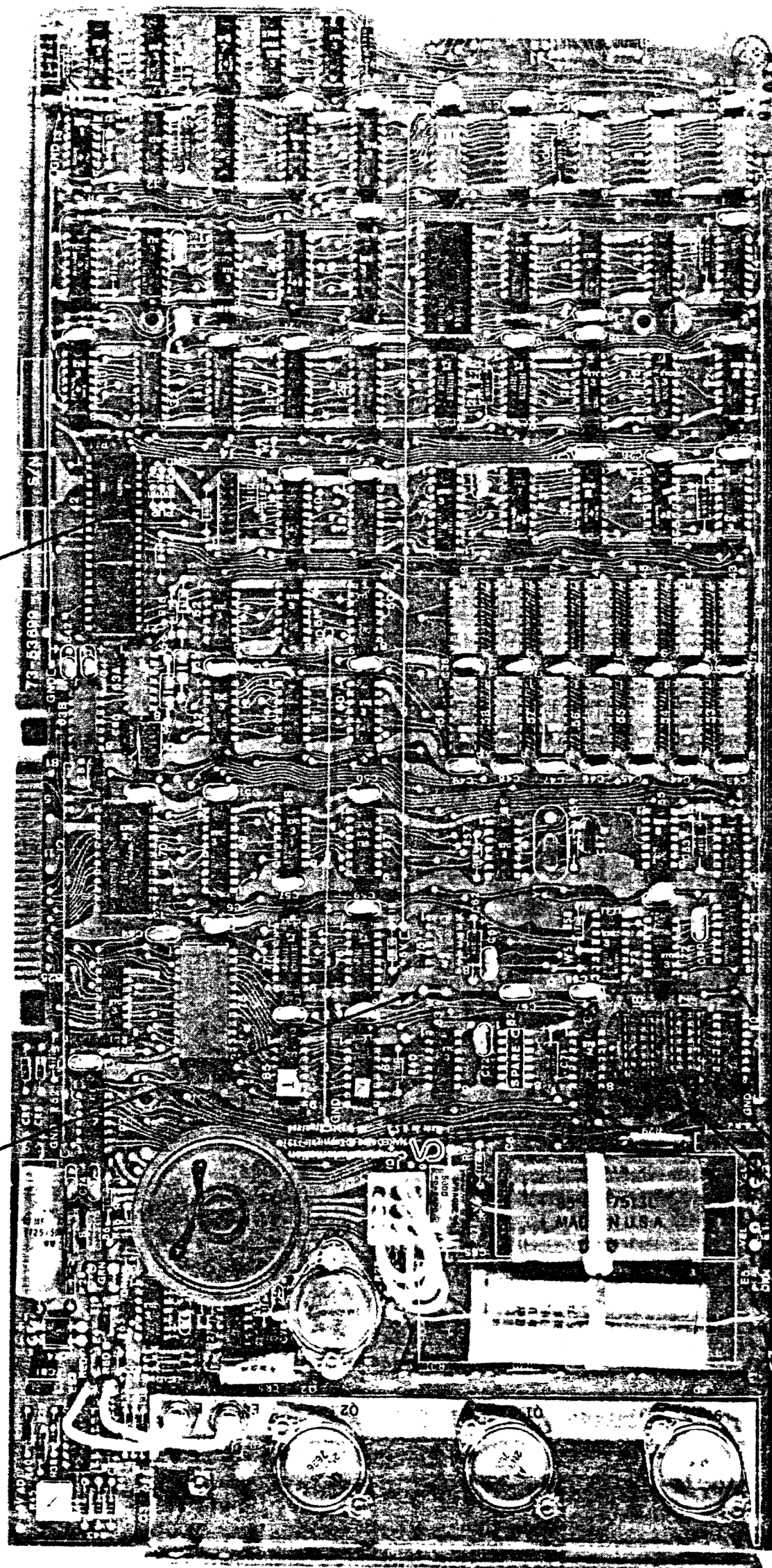


Figure 4-2. Strapping Options
4-3



Word Length And
Stop Bit Strapping

Clear To Send Strapping



Transmit Clock Strapping

Receive Clock Strapping

Figure 4-3. Terminal Control Section



4.1.3 Interface to Printer

The CRT Terminal interface to the printer is a two-wire, EIA RS232C, data interface. The terminal control section does not control printer operation. The data sent to the printer is the same data received by the terminal. The Printer Off and CRT On (:12) control character causes the terminal control section to inhibit data transfer to the printer. The Printer On (:11) control character enables data transfer to the printer.

4.1.4 Composite Video Output

The CRT Terminal composite video output is co-axial cable, EIA RS-170 compatible interface. The output is the display information along with the horizontal and vertical synchronization information. This signal is available anytime the monitor screen is illuminated.

4.2 INTERFACE CABLING DESIGN

The rear panel of the CRT Terminal provides connectors for a logic cable to the CPU (interface controller), a logic cable to the printer, and composite video.

The rear panel CPU jack accepts an AMP Part Number 206708-1 plug. The rear panel printer jack accepts an AMP Part Number 206060-1 plug. Both plugs use the AMP Part Number 66538-1 contact pin. The rear panel composite video jack accepts a BNC, UG-2701V connector.

The following is a list of the pin assignments for the CPU logic cable.

PINS 1, 5, 8, and 9 - GND. The ground pin assignments are located for easy wiring if twisted pair signal lines are used.

PIN 2 - Transmitted Data (TD OUT).

PIN 3 - Data Terminal Ready (DTR OUT). Output is the same as pin 7.

PIN 4 - Received Data (RD).

PIN 6 - Clear-to-Send (CTS IN). This pin accepts a negative true (true < 3V) transmit data inhibit signal from the interface controller. Must be used if the interface controller operation is half duplex or full duplex using automatic echo. No connection is required for full duplex operation without automatic echo. The terminal control section can be strapped to accept a positive true (true > 3V) Clear-to-Send signal.

PIN 7 - Request-to-Send (RTS OUT). The request to send and data terminal ready pins output a voltage level pulled up to +15V through a resistor, any time the terminal power switch is On.

The following is a list of the pin assignments for the printer logic cable.

PIN 1 - Data. This is the same signal as the received data line on the CPU connector unless the printer is logically turned off in the terminal control section.

PIN 2 - Ground.

PINS 3 and 4 - No connection.



SECTION 5

INSTALLATION

The CRT Terminal is shipped from the factory fully assembled and packed in a protective container.

The sections to follow present unpacking instructions, the initial power-up procedure and the procedure to adjust the CRT monitor controls for a satisfactory display.

5.1 UNPACKING INSTRUCTIONS

Before unpacking the CRT Terminal--at the time of delivery, if possible--check the packing container for signs of visible damage. Report any such damage to the carrier immediately. Also check container tilt indicator, and report to carrier if it is activated.

To remove the CRT Terminal from the packing carton, proceed as follows:

1. Open the top of the carton.
2. Locate the monitor face screen (packed loose) and remove it from the carton.
3. Lift the CRT Terminal, along with foam end caps, out of the carton.
4. Place the CRT Terminal and end caps on a suitable work surface.
5. Carefully remove end caps. AVOID DROPPING TERMINAL.
6. Remove the protective paper from the front and back of the monitor screen.
7. Remove the protective backing from the Velcro fasteners on the monitor.
8. Clean the monitor screen if required and install the monitor screen on the front of the monitor.



5.2 INITIAL POWER-UP PROCEDURE

Terminals intended for use with 110 Vac are shipped with a line cord having a standard 3-prong ac male connector. Terminals intended for use with 220/240 Vac are shipped with a line cord lacking a connector due to the number of 220/240 Vac connectors available. The appropriate 2 pole, 3 wire, 15 amp, 240 Vac male connector must be installed prior to initial powering. NEMA type 6-15P is the suggested pin configuration for 220/240 Vac. Color coding for the wires contained in the ac line cord is as follows:

Voltage Supply (Hot) Line - fused	Black or Brown
Neutral - unfused	White or Blue
Ground (Earth)	Green or Green/Yellow

Before applying power to the CRT Terminal, set the voltage select switches as follows:

1. Determine the ac line voltage available.
2. Disconnect the line cord from the ac power source.
3. Carefully lift the plastic strips covering the voltage select switches on the terminal rear panel. The strips are fastened at one end only.
4. Determine switch settings from Figure 5-1 and set the switches accordingly.
5. Install the proper fuse according to Figure 5-1.
6. Replace plastic switch covers under the nylon washers.

Complete the initial power-up sequence as follows:

1. Make sure the power switch is turned off.
2. Set the LINE/LOCAL switch to LOCAL.
3. Connect the attached power cord to the power source.
4. Turn the power switch on.
5. If operation is abnormal in any way (e.g., arcing, smoke, etc.) turn the power switch off and disconnect the power cord. Do not attempt to repower the terminal until corrective action has been taken.

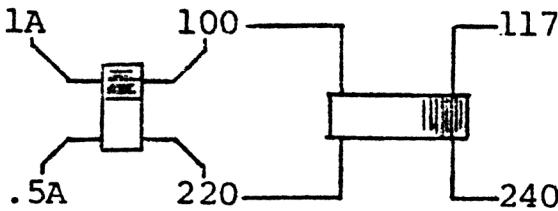
5.3 DISPLAY ADJUSTMENTS

Turn the power on and allow a brief warm-up period (about 5 minutes). Adjust the CRT monitor brightness and contrast as follows:

- 1. Using a common slot-blade screwdriver, advance the brightness control until the white outline of the monitor screen is visible through the filter screen.
- 2. Reduce the brightness until the white outline of the monitor screen just disappears.
- 3. Enter a variety of data characters until the monitor screen is filled.
- 4. Using a common slot-blade screwdriver, adjust the contrast control for sharp, well-defined characters. Ragged edges on characters and a tendency to fill-in indicate the contrast control is set too high.

Voltage Select Switches

Switch A Switch B



Ac Voltage			Switch Position		Fuse Value
Nominal	Low	High	Switch A	Switch B	
100	90	110	1A - 100	100 - 220	1.0A
117	105.3	128.7	1A - 100	117 - 240	1.0A
220	198	242	.5A - 220	100 - 220	0.5A
240	216	264	.5A - 220	117 - 240	0.5A

Shown

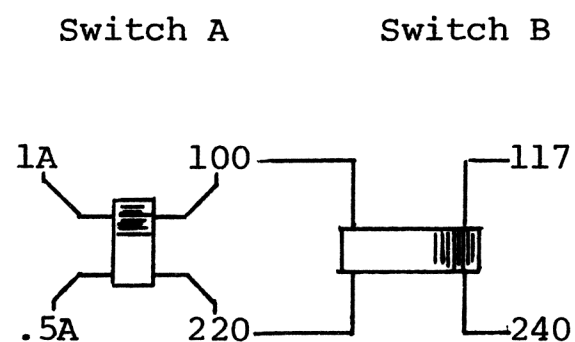
Figure 5-1. Voltage Selection

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Voltage Select Switches



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220	198	242	.5A - 220	100 - 220	0.5A
240	216	264	.5A - 220	117 - 240	0.5A

Shown :

Figure 5-1. Voltage Selection

