

EXTENDED DISPLAY SUPPLEMENT
BASIC DISPLAY UNIT
USER'S GUIDE

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CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual is a supplement to the Basic Display Unit User's Guide and provides general information, installation, and operating instructions for the Extended Display Feature.

1.2 FEATURES

The following list briefly describes the major functions incorporated into the Extended Display Feature.

1.2.1 Virtual/Absolute Display Areas

The Absolute Display area is defined as the maximum area available in the CRT display contained in the 80 column by 24 row matrix.

One of the unique features available is the ability to define a screen size smaller than the 80 column by 24 row matrix. The display area can be changed in dimension via a set of commands that establishes the upper and lower line positions and left and right column positions. The resulting area is referred to as the Virtual Display area. With two exceptions, all subsequent cursor movement, display updating, and display reading will be done within the Virtual Display area. The exceptions are when the read and write absolute commands are used. These two commands allow data to be written to or read from any area within the Absolute Display area.

1.2.2 Page Mode

In Page mode, the Virtual Display area represents the page of information. The cursor moves about within this page, is controlled by commands, and provides a "prompt" position to indicate where the next data byte will be displayed. All Field Attribute Codes (FACs) stored within the Absolute Display area will be in effect with the exception of the Set Protected Field FAC. This FAC will be in effect only if the system is in Protect mode.

The target lighted Page mode key will be on in this mode. Depressing the key will cause the key light to turn off, and will cause the terminal to revert to the Scroll mode.

1.2.3 Protect Mode

The Protect mode is a more constrained Page mode, and causes the cursor to move about only within those fields defined as unprotected by use of Field Attribute Codes (FACs). The Virtual Display area represents the page of information containing both protected and unprotected fields. The cursor moves about within the unprotected fields of this page, is controlled by commands, and provides a "prompt" position to indicate where the next data byte will be displayed. All FACs will be in effect.

The target lighted Page mode key will be on in this mode. Depressing the key will cause the system to revert to Page mode.

1.2.4 Cursor Positioning

The cursor always serves as a prompt, and indicates where the next data byte will be displayed. As the data bytes are displayed, the cursor advances under control of certain mode settings, and at all times is restricted to the Virtual Display area.

In Page mode, the cursor's position changes according to mode settings and its relative position in the Virtual Display area. When Protect mode is set, the cursor always prompts at a non-protected position. As a data byte is displayed, the cursor advances to the right to the next non-protected position.

The cursor may be moved or positioned within the Virtual Display area through the following methods:

- . Cursor Home - the cursor will be positioned at the home position. In Page mode, the home position is located in the upper left corner of the Virtual Display area. In Protect mode, the home position is located in the first byte of the first unprotected field. If no unprotected fields are found, the cursor will remain in the upper left corner of the Virtual Display area.
- . The cursor may be moved one position at a time by means of cursor left or cursor right commands. If the Protect mode is set, the cursor will move to the next field if the cursor is moved out of an unprotected field.
- . The cursor may be moved up or down one line at a time by means of the cursor up and cursor down commands. In Protect mode, a cursor down command will cause the cursor to search down and to the right for an unprotected field. A cursor up command will cause the cursor to search up and to the left for an unprotected field.
- . Tabbing may be used to move the cursor a field at a time. In Page mode, the cursor moves left or right to the next tab position. In Protect mode, the cursor moves left or right to the next unprotected field.
- . The cursor may be positioned through the use of a cursor load command. The load command includes the X-Y coordinates of the row and column where the cursor is to be located. If located outside the Virtual Display area, the cursor will be moved to the right until it is within the Virtual Display area.

Refer to Table 1 for the cursor positioning X-Y coordinates.

TABLE 1. Cursor Position Code

LINE/COLUMN	ASCII CODE	LINE/COLUMN	ASCII CODE	LINE/COLUMN	ASCII CODE
1	SPACE	28	;	55	V
2	!	29	<	56	W
3	"	30	=	57	X
4	#	31	>	58	Y
5	\$	32	?	59	Z
6	%	33	@	60	[
7	&	34	A	61	\
8	'	35	B	62]
9	(	36	C	63	^
10	)	37	D	64	_
11	*	38	E	65	`
12	+	39	F	66	a
13	,	40	G	67	b
14	-	41	H	68	c
15	.	42	I	69	d
16	/	43	J	70	e
17	0	44	K	71	f
18	1	45	L	72	g
19	2	46	M	73	h
20	3	47	N	74	i
21	4	48	O	75	j
22	5	49	P	76	k
23	6	50	Q	77	l
24	7	51	R	78	m
25	8	52	S	79	n
26	9	53	T	80	o
27	:	54	U		

NOTE: CURSOR POSITION = COMMAND BYTE(S), LINE CODE, COLUMN CODE

1.2.5 Editing

Editing of data on the display may be accomplished by positioning the cursor on the data to be changed, and replacing the existing characters with new information. In addition to this simplistic method of changing data, there are several functions available to assist in the editing process.

- . Insert Character
- . Delete Character
- . Insert Line
- . Delete Line
- . Erase Page
- . Erase Line

For a detailed explanation of the functions of these commands, refer to Table 2 in this document.

1.2.6 Tabulation

Cursor positioning may be accomplished through the use of the tab feature. Tabbing may be done to the left or to the right.

In Page mode, the cursor will move left or right to the next tab position. In Protect mode, the cursor moves left or right to the left-most position of the next field.

The tab setting used in Page mode may be set and/or cleared through the use of the Set Tab command.

Upon initialization, the tab settings are preset to columns 1, 11, 21, 31, 41, 51, 61, and 71.

1.2.7 Field Attribute Codes

Field Attribute Code (FAC) commands can set or reset the following display attributes:

- . Blink
- . Half-Bright
- . Video Invert
- . Underline
- . Non-Display
- . Field Protect

All of the attributes are under hardware control, and are always in effect when set, with one exception -- the protect attribute is under control of the resident firmware and is active only in Protect mode.

Once set, the FACs remain in effect until reset by another FAC or until the physical end of the line is reached, at which time all FACs are reset.

The FACs occupy one position in the display, but a single position may contain any or all of the attributes listed above.

The ASCII representation for the FACs may be displayed and the FACs may be inhibited (except for field protect) through the use of the system configuration switches located in the back of the terminal.

Refer to the Basic Display Unit User's Guide for detailed descriptions of the system configuration switches.

1.2.8 Message Transmission to Host System

In Page and Protect modes, all keystrokes are directed to the display, with the following exceptions. If the terminal is in the on-line mode, all function key values are sent on the communication line. If the break key is depressed, the communication's process sets a break condition on the line but does not send the break command value.

If the terminal operator or remote computer initiates a request for data to be sent from the terminal, the data sent will be bracketed by the start-of-data and end-of-data commands. Data will be sent by the terminal upon receipt of one of the following commands:

- . Send Page
- . Send Line
- . Read Absolute
- . Read Cursor

The data sent on the communications line can be in either 7-bit or 8-bit mode, depending on the configuration switch settings. (Refer to the Basic Display Unit User's Guide for more detailed information on the configuration switch settings). In 8-bit mode, all commands are sent as 8-bit values. In 7-bit mode, all commands are sent as an escape sequence. The escape sequence is generated by stripping the high order bit (bit 7) from the command byte. The 7-bit value is then transmitted immediately, preceded by an ASCII escape character.

1.2.9 Remote Commands

All commands and data entered through the keyboard may also be sent to the terminal by the host computer, which may elect to transmit to the terminal commands in 8-bit or 7-bit mode. However, if the 8-bit option is selected, the proper configuration switch must be manually set before the terminal can receive 8-bit commands. If the 7-bit mode of transmission is desired, the host computer must send the commands as an escape sequence. Refer to Table 2 in this document for detailed explanations and descriptions of all 8-bit commands and their associated 7-bit escape sequences.

1.3 SPECIFICATIONS

1.3.1 Software (ROM)

The Extended Display Feature is self-contained in one 2K ROM (part number M68SVS20200) and is designed to interface directly with the firmware resident in the Basic Display Unit.

1.3.2 Keyboard

Refer to the Keyboard Assembly Supplement.

1.4 GENERAL INFORMATION

1.4.1 Interface to Basic Software

The Extended Display Feature is designed to interface directly with the resident firmware contained in the Basic Display Unit. During Power On Restart and System Reset, the basic firmware detects the presence of the Extended Display firmware and initializes the system to accept and recognize the Extended Display commands.

1.4.2 Command Processing

All command and/or data bytes may originate from the keyboard or remotely via the communications interface. A byte whose value is within the hexadecimal range of 80 to FF potentially represents a command. Restricting these commands to this range provides a means of representing command bytes as escape sequences without making use of the ASCII control characters, thereby avoiding conflicts with existing communications protocols which place special significance on certain ASCII control characters.

An escape sequence consists of an ASCII Escape character, followed by a byte whose value is within the hexadecimal range of 20 to 7F. The Escape character is used to represent the left-most bit of the following byte. Hence, the escape sequence allows command bytes to be communicated on the interface in a strict 7-bit format. Two Escape characters in sequence are used to represent a character to be displayed.

Command bytes are processed by the display process firmware as they are received. If an invalid command is received, it will be ignored.

Several commands require multiple bytes to complete the command sequence. If an invalid byte sequence is detected in a multiple byte command, the command will be aborted and all bytes up to, but not including, the next command byte will be ignored (i.e., not displayed). Data bytes received as part of a command are not displayed. All other data bytes are displayed at the current cursor position, and the cursor is advanced "one position to the right".

Data received on the communications line will have priority over data received from the keyboard. If a command sequence being entered from the keyboard is pre-empted by data being received from the communications line, the keyboard command will be aborted.

Refer to Table 2 in this document for detailed explanations of all display commands.

TABLE 2. Extended Display Feature Communication Interface Commands

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
HOME	C0	ESC,@	VIRTUAL	SCROLL	CURSOR MOVES TO LEFT-MOST COLUMN IN TOP LINE.	1	2	COMMAND BYTE(S)
				PAGE	CURSOR MOVES TO LEFT-MOST COLUMN IN TOP LINE.			
				PROTECT	CURSOR MOVES TO LEFT-MOST COLUMN IN TOP LINE, SEEKS NON-PROTECTED COLUMN TO RIGHT; IF NONE EXISTS, CURSOR REMAINS IN LEFT-MOST COLUMN OF TOP LINE.			
CURSOR UP ONE LINE (↑)	C1	ESC,A	VIRTUAL	SCROLL	IGNORED	1	2	COMMAND BYTE(S)
				PAGE	CURSOR MOVES UP ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER.			
				PROTECT	CURSOR MOVES UP ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER, SEEKS NON-PROTECTED COLUMN TO THE LEFT.			
CURSOR DOWN ONE LINE (↓)	C2	ESC,B	VIRTUAL	SCROLL	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN. IF ALREADY IN LAST LINE, SCROLL IS EXECUTED AND LAST LINE IS BLANKED.	1	2	COMMAND BYTE(S)
				PAGE	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER.			
				PROTECT	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER, SEEKS NON-PROTECTED COLUMN TO THE RIGHT.			
CURSOR LEFT ONE COLUMN (←)	C3	ESC,C	VIRTUAL	SCROLL	CURSOR MOVES LEFT ONE COLUMN WITHOUT LINE ROLLOVER.	1	2	COMMAND BYTE(S)
				PAGE	CURSOR MOVES LEFT ONE COLUMN WITH LINE AND PAGE ROLLOVER.			
				PROTECT	CURSOR MOVES LEFT ONE COLUMN WITH LINE AND PAGE ROLLOVER. SEEKS NON-PROTECTED COLUMN TO THE LEFT.			

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
CURSOR RIGHT ONE COLUMN (→)	C4	ESC,D	VIRTUAL	SCROLL	CURSOR MOVES RIGHT ONE COLUMN WITHOUT LINE ROLLOVER.	1	2	COMMAND BYTE(S)
				PAGE	CURSOR MOVES RIGHT ONE COLUMN WITH LINE AND PAGE ROLLOVER.			
				PROTECT	CURSOR MOVES RIGHT ONE COLUMN WITH LINE AND PAGE ROLLOVER. SEEKS NON-PROTECTED COLUMN TO THE RIGHT.			
LOAD CURSOR	C5	ESC,E	VIRTUAL	SCROLL, PAGE	IF POSITION IS OUTSIDE VIRTUAL DISPLAY, COMMAND IS IGNORED; OTHERWISE, CURSOR MOVES TO DESIGNATED POSITION.	3	4	COMMAND BYTE(S) PLUS TWO BYTES DESIGNATING CURSOR POSITION (See TABLE 3-2)
				PROTECT	IF POSITION IS OUTSIDE VIRTUAL DISPLAY, COMMAND IS IGNORED; OTHERWISE, CURSOR MOVES TO DESIGNATED POSITION. IF POSITION CONTAINS A PROTECT FAC OR IS PART OF A PROTECTED FIELD, CURSOR IS MOVED RIGHT TO NON-PROTECTED COLUMN. IF POSITION CONTAINS A NON-PROTECT FAC, CURSOR REMAINS AT DESIGNATED POSITION; HOWEVER, ONLY FACS MAY BE INSERTED AT THIS POSITION AND A CURSOR RIGHT COMMAND SHOULD FOLLOW TO ENSURE CURSOR POSITIONING AT A NON-PROTECTED COLUMN.			
SET SCROLL MODE	C8	ESC,H	VIRTUAL	SCROLL PAGE, PROTECT	IGNORED PAGE AND PROTECT MODES ARE RESET, SCROLL MODE IS SET, CURSOR RETURNS TO HOME POSITION.	1	2	COMMAND BYTE(S)
ENABLE KEYBOARD	D2	ESC,R	N.A.	SCROLL, PAGE, PROTECT	CAUSES KEYBOARD TO BE ENABLED (DATA CAN BE ENTERED FROM KEYBOARD).	1	2	COMMAND BYTE(S)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
DISABLE KEYBOARD	D3	ESC,S	N.A.	SCROLL, PAGE, PROTECT	CAUSES KEYBOARD TO BE DISABLED (DATA CANNOT BE ENTERED FROM THE KEYBOARD).	1	2	COMMAND BYTE(S)
BOTTOM DISPLAY LINE	CA	ESC,J	ABSOLUTE	SCROLL, PAGE, PROTECT	THE VIRTUAL DISPLAY AREA'S LAST LINE IS MADE TO CORRESPOND WITH THE LINE DESIGNATED (SEE NOTE 3).	2	3	COMMAND BYTE(S), ONE BYTE DESIGNATING THE LINE (SEE TABLE 3-3).
TAB	DA	ESC,Z	VIRTUAL	SCROLL PAGE PROTECT	CURSOR MOVES RIGHT TO NEXT TAB POSITION (WITHOUT LINE ROLLOVER). CURSOR MOVES RIGHT TO NEXT TAB POSITION (WITH LINE AND PAGE ROLLOVER) AS DEFINED BY THE SET TABS COMMAND. CURSOR MOVES RIGHT TO LEFT-MOST COLUMN OF NEXT NON-PROTECTED FIELD (WITH LINE AND PAGE ROLLOVER).	1	2	COMMAND BYTE(S)
BACK TAB	DB	ESC,[	VIRTUAL	SCROLL PAGE PROTECT	CURSOR MOVES LEFT TO PREVIOUS TAB POSITION (WITHOUT LINE ROLLOVER). CURSOR MOVES LEFT TO PREVIOUS TAB POSITION (WITH LINE AND PAGE ROLLOVER). CURSOR MOVES LEFT TO LEFT-MOST COLUMN OF PREVIOUS NON-PROTECTED FIELD (WITH LINE AND PAGE ROLLOVER).	1	2	COMMAND BYTE(S)
SET TABS	DC	ESC,	VIRTUAL	PAGE, SCROLL, PROTECT	THE BLOCK OF DATA FOLLOWING THE COMMAND BYTE DEFINES THE TAB POSITIONS. THE TAB POSITIONS ARE INDICATED BY HTS (09) TO SET A TAB OR CANCEL (18) TO CLEAR A TAB, AND ARE SEPARATED BY SPACE (20) CHARACTERS TO INDICATE TAB SPACE (SETTING). THE BLOCK IS TERMINATED BY A LINE FEED CHARACTER. THE COMMAND BYTE FOLLOWED BY LF WITH NO SPACES, CANCELS OR HTS WILL CAUSE ALL TABS TO BE RESET.	VARIABLE	VARIABLE	COMMAND BYTE(S) SPACES, HTS (09), OR CANCEL (18), LF

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC.SEQ.	
SET TRANSPARENT MODE	EC	ESC,l	ABSOLUTE	SCROLL, PAGE, PROTECT	SETS TRANSPARENT MODE OPERATION; CURSOR DOES NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
RESET TRANSPARENT MODE	ED	ESC,m	ABSOLUTE	SCROLL, PAGE, PROTECT	RESETS TRANSPARENT MODE OPERATION; CURSOR DOES NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
SET VIDEO INVERT	EE	ESC,n	ABSOLUTE	SCROLL, PAGE, PROTECT	SETS VIDEO INVERT OPERATION; CURSOR DOES NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
RESET VIDEO INVERT	EF	ESC,o	ABSOLUTE	SCROLL, PAGE, PROTECT	RESETS VIDEO INVERT OPERATION; CURSOR DOES NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
SET DISPLAY SPECIAL CHARACTERS	FC	ESC,:	N.A.	SCROLL, PAGE, PROTECT	PERMITS SPECIAL CHARACTER TO BE DISPLAYED.	1	2	COMMAND BYTE(S)
RESET DISPLAY SPECIAL CHARACTERS	FD	ESC,}	N.A.	SCROLL, PAGE, PROTECT	SPECIAL CHARACTERS CANNOT BE DISPLAYED.			
END-OF-LINE FAC	FE	ESC,~	N.A.	SCROLL, PAGE, PROTECT	AN OUTPUT COMMAND USED TO MARK UNUSED SPACE IN LINE. LINE LENGTH DETERMINED BY RIGHT-MOST DATA BYTE POSITION. REMAINING UNUSED, UNFILLED POSITIONS TO 80TH COLUMN ARE NOT CONSIDERED PART OF LINE.	1	2	COMMAND BYTE(S)
TERMINAL RESET	F1	ESC,q	ABSOLUTE	SCROLL, PAGE, PROTECT	CAUSES THE BASIC DISPLAY UNIT TO BE RESET AS IF THE "RESET" SWITCH HAD BEEN ACTIVATED.	1	2	COMMAND BYTE(S)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION												
	NON-ESC.	ESC SEQ.				NO. OF BYTES														
						NON-ESC.	ESC. SEQ.													
DISPLAY STATUS ON	F2	ESC,r	ABSOLUTE	SCROLL, PAGE, PROTECT	CERTAIN STATUS COMMANDS CAN BE RECEIVED ON THE COMMUNICATIONS INTERFACE AND DISPLAYED. THE LAST THREE POSITIONS IN THE ABSOLUTE DISPLAY AREA ARE USED TO SHOW A BLINKING STATUS INDICATOR. THE INDICATORS AND THEIR ASSOCIATE CODES ARE: <table border="1"> <thead> <tr> <th>INDICATOR</th> <th>CODE</th> <th>FUNCTION</th> </tr> </thead> <tbody> <tr> <td>PE</td> <td>98</td> <td>PARITY ERROR</td> </tr> <tr> <td>RO</td> <td>9A</td> <td>RECEIVE OVERRUN</td> </tr> <tr> <td>FE</td> <td>9B</td> <td>FRAMING ERROR</td> </tr> </tbody> </table> FRAMING AND PARITY ERROR COMMANDS ARE FOLLOWED BY THE BYTE SUFFERING THE ERROR CONDITION.	INDICATOR	CODE	FUNCTION	PE	98	PARITY ERROR	RO	9A	RECEIVE OVERRUN	FE	9B	FRAMING ERROR	1	2	COMMAND BYTE(S)
INDICATOR	CODE	FUNCTION																		
PE	98	PARITY ERROR																		
RO	9A	RECEIVE OVERRUN																		
FE	9B	FRAMING ERROR																		
DISPLAY STATUS OFF	F3	ESC,s	ABSOLUTE	SCROLL, PAGE, PROTECT	RECEIVED STATUS INDICATORS PE, RO, and FE CANNOT BE DISPLAYED.	1	2	COMMAND BYTE(S)												
ASCII BEL (BELL)	07	NONE	N.A.	SCROLL, PAGE, PROTECT	CAUSES THE BELL TO ISSUE TONE FOR A PERIOD OF ONE-HALF SECOND.	1		COMMAND BYTE												
ASCII BS (BACKSPACE)	08	NONE	VIRTUAL	SCROLL PAGE PROTECT	CURSOR MOVES LEFT ONE COLUMN WITHOUT LINE ROLLOVER. CURSOR MOVES LEFT ONE COLUMN WITH LINE AND PAGE ROLLOVER. CURSOR MOVES LEFT ONE COLUMN WITH LINE AND PAGE ROLLOVER. SEEKS NON-PROTECTED COLUMN TO THE LEFT.	1		COMMAND BYTE												

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
ASCII HT (HORIZONTAL TAB)	09	NONE	VIRTUAL	SCROLL	CURSOR MOVES RIGHT TO NEXT TAB POSITION (WITHOUT LINE ROLLOVER) AS DEFINED BY THE SET TABS COMMAND.	1		COMMAND BYTE
				PAGE	CURSOR MOVES RIGHT TO NEXT TAB POSITION (WITH LINE AND PAGE ROLLOVER) AS DEFINED BY THE SET TABS COMMAND.			
				PROTECT	CURSOR MOVES RIGHT TO THE LEFT-MOST COLUMN OF THE NEXT NON-PROTECTED FIELD (WITH LINE AND PAGE ROLLOVER).			
SET PAGE MODE	C7	ESC,G	VIRTUAL	SCROLL	SCROLL MODE IS RESET, PAGE MODE IS SET, CURSOR RETURNS TO HOME POSITION.	1	2	COMMAND BYTE(S)
				PAGE	IGNORED			
				PROTECT	PROTECT MODE IS RESET, PAGE MODE IS SET, CURSOR RETURNS TO HOME POSITION.			
TOP DISPLAY LINE	C9	ESC,I	ABSOLUTE	SCROLL, PAGE, PROTECT	THE VIRTUAL DISPLAY AREA'S TOP LINE IS MADE TO CORRESPOND WITH THE LINE DESIGNATED (SEE NOTE 3)	2	3	COMMAND BYTE(S), ONE BYTE DESIGNATING THE LINE (SEE TABLE 3-3)
READ CURSOR	C6	ESC,F	VIRTUAL	SCROLL, PAGE, PROTECT	4 BYTES ARE SENT ON THE INTERFACE - START DATA COMMAND, TWO BYTE CURSOR POSITION, END DATA COMMAND.	1	2	COMMAND BYTE(S)
ASCII LF (LINE FEED)	0A	NONE	VIRTUAL	SCROLL	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN. IF ALREADY IN LAST LINE, SCROLL IS EXECUTED AND LAST LINE IS BLANKED.	1		COMMAND BYTE
				PAGE	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN, WITH PAGE ROLLOVER.			
				PROTECT	CURSOR MOVES DOWN ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER. SEEKS PROTECTED COLUMN TO THE RI			

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
ASCII VT (VERTICAL TAB)	0B	NONE	VIRTUAL	SCROLL PAGE PROTECT	IGNORED CURSOR MOVES UP ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER. CURSOR MOVES UP ONE LINE IN SAME COLUMN WITH PAGE ROLLOVER. SEEKS NON-PROTECTED COLUMN TO THE LEFT.	1		COMMAND BYTE
ASCII FF (FORM FEED)	0C	NONE	VIRTUAL	SCROLL PAGE PROTECT	CURSOR MOVES RIGHT ONE COLUMN WITHOUT LINE ROLLOVER. CURSOR MOVES RIGHT ONE COLUMN WITH LINE AND PAGE ROLLOVER. CURSOR MOVES RIGHT ONE COLUMN WITH LINE AND PAGE ROLLOVER. SEEKS NON-PROTECTED COLUMN TO THE RIGHT.	1		COMMAND BYTE
ASCII CR (CARRIAGE RETURN)	0D	NONE	VIRTUAL	SCROLL, PAGE PROTECT	CURSOR MOVES TO LEFT MARGIN. CURSOR MOVES TO LEFT MARGIN. SEEKS NON-PROTECTED COLUMN TO THE RIGHT.	1		COMMAND BYTE
LEFT DISPLAY COLUMN	CB	ESC,K	ABSOLUTE	SCROLL, PAGE, PROTECT.	THE VIRTUAL DISPLAY AREA'S LEFT COLUMN IS MADE TO CORRESPOND WITH THE COLUMN DESIGNATED (SEE NOTE 3).	2	3	COMMAND BYTE(S), ONE BYTE COLUMN (SEE TABLE 3-3)
RIGHT DISPLAY COLUMN	CC	ESC,L	ABSOLUTE	SCROLL, PAGE, PROTECT	THE VIRTUAL DISPLAY AREA'S RIGHT COLUMN IS MADE TO CORRESPOND WITH THE COLUMN DESIGNATED (SEE NOTE 3).	2	3	COMMAND BYTE(S), ONE BYTE COLUMN (SEE TABLE 3-3)
SET PROTECT MODE	CD	ESC,M	VIRTUAL	SCROLL PAGE PROTECT	SCROLL MODE IS RESET, PROTECT MODE IS SET. PAGE MODE IS RESET, PROTECT MODE IS SET. IGNORED - CURSOR SEEKS FIRST NON-PROTECTED COLUMN ON SCREEN. SIMULATES "HOME" COMMAND.	1	2	COMMAND BYTE(S)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC SEQ.	
WRITE ABSOLUTE	CE	ESC,N	ABSOLUTE	SCROLL, PAGE, PROTECT	THE BLOCK OF DATA OR COMMAND BYTES ARE WRITTEN INTO THE ABSOLUTE DISPLAY AREA STARTING AT THE ABSOLUTE CURSOR POSITION DESIGNATED. THE COMMAND BYTES ARE RESTRICTED TO THE SET OF FIELD ATTRIBUTE COMMANDS. THE CURSOR DOES NOT CHANGE POSITION.	VARIABLE	VARIABLE	COMMAND BYTE(S), START DATA COMMAND, 2 BYTE CURSOR POSITION, VARIABLE DATA OR COMMAND BYTES, END DATA COMMAND
READ ABSOLUTE	CF	ESC,0	ABSOLUTE	SCROLL, PAGE, PROTECT	THE ABSOLUTE DISPLAY POSITIONS, STARTING WITH THE 1ST CURSOR POSITION IN THE COMMAND SEQUENCE AND ENDING WITH THE 2ND CURSOR POSITION ARE SENT OUT ON THE INTERFACE. THIS BLOCK OF DATA IS FRAMED WITH THE START DATA AND END DATA COMMANDS. EACH END OF LINE FROM THE DISPLAY AREA IS FLAGGED BY AN END-OF-DATA (F9;ESC,y) CHARACTER.	5	6	COMMAND BYTE(S), 2 BYTE CURSOR POSITION - "START", 2 BYTE CURSOR POSITION - "END"
CHARACTER INSERT	DO	ESC,P	VIRTUAL	SCROLL PAGE PROTECT	IGNORED ALL COLUMNS IN LINE, STARTING WITH CURSOR COLUMN, ARE MOVED RIGHT ONE COLUMN. THE BYTE IN THE RIGHT-MOST COLUMN IS DISCARDED. THE DATA BYTE IS PLACED AT THE CURSOR AND THE CURSOR IS ADVANCED ONE COLUMN TO THE RIGHT WITH LINE ROLLOVER. SAME AS PAGE, EXCEPT MOVEMENT RESTRICTED TO SEQUENCE OF NON-PROTECTED COLUMNS TO THE RIGHT OF CURSOR POSITION. (CONTIGUOUS NON-PROTECTED FIELD).	3	5	COMMAND BYTE(S), DATA BYTE(S), COMMAND BYTE(S) (SEE NOTE 4)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC.SEQ.	
CHARACTER DELETE	D1	ESC,Q	VIRTUAL	SCROLL PAGE PROTECT	IGNORED ALL COLUMNS IN LINE, STARTING WITH CURSOR COLUMN +1 ARE MOVED TO THE LEFT ONE COLUMN. THE RIGHT-MOST COLUMN IS FILLED WITH A SPACE (20) CHARACTER. CURSOR DOES NOT CHANGE POSITION. SAME AS PAGE, EXCEPT THE NON-PROTECTED COLUMNS UNDER AND CONTIGUOUS TO THE RIGHT WITHIN THE NON-PROTECTED FIELD ARE MOVED.	1	2	COMMAND BYTE(S)
PAGE ERASE	D4	ESC,T	VIRTUAL	SCROLL, PAGE PROTECT	ERASES ALL CHARACRERS FROM CURSOR TO END OF DISPLAY AND REPLACES WITH SPACE (20) CHARACTER. CURSOR DOES NOT CHANGE POSITION. ERASES ALL UNPROTECTED CHARACTER POSITIONS FROM THE CURSOR TO THE END OF DISPLAY AND REPLACES WITH SPACE (20) CHARACTER. CURSOR DOES NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
LINE ERASE	D5	ESC,U	VIRTUAL	SCROLL, PAGE, PROTECT	STARTING WITH CURSOR POSITION, LINE IS BLANKED TO THE RIGHT WITH SPACE (20) CHARACTER. CURSOR DOES NOT CHANGE POSITION. ALL COLUMNS IN NON-PROTECTED FIELD UNDER AND CONTIGUOUS RIGHT OF CURSOR ARE BLANKED. CURSOR NOT CHANGE POSITION.	1	2	COMMAND BYTE(S)
LINE INSERT	D6	ESC,V	VIRTUAL	SCROLL, PROTECT PAGE	IGNORED ALL LINES, STARTING WITH CURRENT LINE, ARE MOVED DOWN ONE LINE. LAST LINE IS DISCARDED. CURRENT LINE IS BLANKED WITH SPACE (20) CHARACTER. CURSOR RESTS IN FIRST POSITION OF NEW BLANK LINE.	1	2	COMMAND BYTE(S)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC.SEQ.	
SEND PAGE	D9	ESC,Y	VIRTUAL	SCROLL	IGNORED	1	2	COMMAND BYTE(S)
				PAGE	ALL POSITIONS FROM HOME THROUGH CURSOR POSITION, OR END OF LINE FAC ON THE LINE ON WHICH CURSOR RESTS (WHICHEVER IS FOUND FIRST), ARE SENT ON THE INTERFACE AS A BLOCK OF DATA. THIS BLOCK IS FRAMED BY THE START DATA COMMAND AND THE END DATA COMMAND. EACH END OF LINE IS FLAGGED BY AN END-OF DATA (F9;ESC,y) CHARACTER. CURSOR DOES NOT CHANGE POSITION. NOTE: ANY PROTECTED FIELDS THAT MAY BE SENT IN THIS MODE WILL BE BRACKETED BY FIELD ATTRIBUTE CODES TO INDICATE START AND END OF PROTECTED FIELDS.			
				PROTECT	ALL NON-PROTECTED POSITIONS FROM HOME THROUGH END OF PAGE ARE SENT ON THE INTERFACE AS A BLOCK OF DATA. THIS BLOCK IS FRAMED AS IN PAGE MODE. EACH END OF FIELD IS FLAGGED BY AN END-OF-DATA (F9;ESC,y) CHARACTER. CURSOR DOES NOT CHANGE POSITION.			
LINE DELETE	D7	ESC,W	VIRTUAL	SCROLL, PROTECT PAGE	IGNORED ALL LINES, STARTING WITH LINE DIRECTLY BELOW CURRENT LINE, ARE MOVED UP ONE LINE. LAST LINE IS BLANKED. CURSOR MOVES TO FIRST CHARACTER POSITION OF LINE IN WHICH IT INITIALLY RESTED.	1	2	COMMAND BYTE(S)

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		
	NON-ESC.	ESC SEQ.				NO. OF BYTES		DESCRIPTION
						NON-ESC.	ESC.SEQ.	
CLEAR	D8	ESC,X	VIRTUAL	SCROLL, PAGE	ALL POSITIONS IN DISPLAY AREA ARE FILLED WITH SPACES (20). CURSOR MOVES TO HOME POSITION.	1	2	COMMAND BYTE(S)
				PROTECT	ALL NON-PROTECTED POSITIONS IN DISPLAY AREA ARE FILLED WITH SPACES (20). CURSOR MOVES TO LEFT-MOST POSITION OF FIRST NON-PROTECTED FIELD OR, IF NO NON-PROTECTED FIELD, MOVES TO HOME POSITION.			
ENABLE LOAD	FA	ESC,z	N.A.	SCROLL, PAGE, PROTECT	THIS COMMAND CAUSES THE NEXT OCCURRENCE OF AN ASCII CONTROL CHARACTER "DC2" (12) TO SIGNAL THE START OF LOAD RECORDS AS DESCRIBED FOR THE EXBUG MEMORY LOAD FUNCTION. (See: M6800 EXORciser User's Guide Figure 4-1.) ALSO CAUSES OCCURRENCE OF AN ASCII CONTROL CHARACTER "DC4" (14) TO SIGNAL THE END OF LOAD RECORDS. (SEE NOTE 5).	1	2	COMMAND BYTE(S)
DISABLE LOAD	FB	ESC,{	N.A.	SCROLL, PAGE, PROTECT	THIS COMMAND CAUSES THE ASCII CONTROL CHARACTERS "DC2" AND "DC4" TO BE TREATED IN THE NORMAL MANNER.	1	2	COMMAND BYTE(S)
START DATA	DD	ESC,]	VIRTUAL, ABSOLUTE	SCROLL, PROTECT, PAGE	THIS COMMAND BYTE IS USED TO FRAME BLOCKS OF DATA AT THE BEGINNING AND PRECEDES THE BYTE.	1	2	COMMAND BYTE(S)
END DATA	DE	ESC,^	VIRTUAL, ABSOLUTE	SCROLL, PAGE, PROTECT	THIS COMMAND BYTE IS USED TO FRAME BLOCKS OF DATA AT THE END AND FOLLOWS THE LAST DATA BYTE.	1	2	COMMAND BYTE(S)
END-OF-DATA INDICATOR	F9	ESC,y	N.A.	PAGE, PROTECT	OUTPUT CHARACTER(S) IDENTIFYING END OF LINE (PAGE MODE) OR END OF UNPROTECTED FIELD (PROTECT MODE). USED ONLY IN SEND PAGE, SEND LINE, AND READ ABSOLUTE COMMANDS.			

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC.SEQ.	
SEND LINE	DF	ESC, _	VIRTUAL	SCROLL PAGE	IGNORED ALL POSITIONS FROM BEGINNING OF THE LINE ON WHICH CURSOR RESTS THROUGH END OF LINE ARE SENT ON THE INTERFACE AS A BLOCK OF DATA. THIS BLOCK IS FRAMED BY THE START DATA COMMAND AND THE END DATA COMMAND. CURSOR DOES NOT CHANGE POSITION. ANY PROTECTED FIELDS THAT MAY BE SENT IN THIS MODE WILL BE BRACKETED BY FIELD ATTRIBUTE CODES TO INDICATE START AND END OF PROTECTED FIELDS.	1	2	COMMAND BYTE(S)
				PROTECT	ALL NON-PROTECTED POSITIONS FROM BEGINNING OF LINE ON WHICH CURSOR RESTS THROUGH END OF THE LINE ARE SENT ON THE INTERFACE AS A BLOCK OF DATA. THIS BLOCK IS FRAMED AS IN PAGE MODE. EACH END OF FIELD IS FLAGGED BY AN END-OF-DATA (F9;ESC,y) CHARACTER. CURSOR DOES NOT CHANGE POSITION.			

TABLE 2. Extended Display Feature Communication Interface Commands (cont'd)

COMMAND	INTERFACE VALUE		DISPLAY AREA	MODE	ACTION/EFFECT	BYTE SEQUENCE		DESCRIPTION
	NON-ESC.	ESC SEQ.				NO. OF BYTES		
						NON-ESC.	ESC.SEQ.	
FIELD ATTRIBUTES -			VIRTUAL ABSOLUTE	SCROLL, PROTECT, PAGE	THESE COMMANDS ARE USED TO DEFINE ATTRIBUTES IN THE DISPLAY AREA. AS SUCH, THEY SET OR RESET THE ATTRIBUTES FOR THE CURSOR PROMPT POSITION. CONTIGUOUS ATTRIBUTE COMMANDS WILL SET (OR RESET) THOSE ATTRIBUTES FOR A SINGLE PROMPT POSITION. CURSOR POSITION IS NOT CHANGED BY A FIELD ATTRIBUTE COMMAND.	1	2	COMMAND BYTE(S)
SET BLINK	E0	ESC,^						
RESET BLINK	E1	ESC,a						
SET VIDEO INVERT	E2	ESC,b						
RESET VIDEO INVERT	E3	ESC,c						
SET HALF BRIGHT	E4	ESC,d						
RESET HALF BRIGHT	E5	ESC,e						
SET UNDERLINE	E6	ESC,f						
RESET UNDERLINE	E7	ESC,g						
SET NON-DISPLAY	E8	ESC,h						
SET DISPLAY	E9	ESC,i						
SET FIELD PROTECT	EA	ESC,j						
RESET FIELD PROTECT	EB	ESC,k						

NOTES:

1. All non-escape interface values are in hexadecimal.
2. All escape interface values are ASCII characters.
3. After executing each of the virtual display boundary commands (C9, CA, CB, CC), the cursor is checked for being within the virtual display. If it is not, it is moved to the right until it is and if Protect mode is set, it seeks a non-protected column to the right.
4. The second character insert command byte terminates the Character Insert mode. Any other command will also terminate this mode, but will not be executed.
5. Following a "DC2" control character, an improperly formatted load record or the presence of a command byte will cause this command to be aborted. The occurrence of any character other than a NULL, Line Feed, or Carriage Return embedded between load records will cause this command to be aborted.

1.4.3 Host Message Formats

The host computer has the option of transmitting messages in either 8-bit or 7-bit format. However, if the 8-bit format is desired, the proper configuration switches on the back of the terminal must be manually set to 8-bit mode in order for the terminal to respond properly to 8-bit commands.

Regardless of whether 7-bit or 8-bit mode is selected, the commands must conform to the format described in Table 2 of this document.

1.4.4 Terminal Message Formats

Data transmitted or processed by the display terminal falls into three categories: 1) function keys, 2) break conditions, and 3) data associated with the characters displayed on the CRT.

- . Function key values are transmitted to the host system whenever a function key is depressed. The values received by the host computer will be either an 8-bit value or a 7-bit escape sequence, depending on the terminal's configuration switch settings.
- . When the Break key is depressed, a break level is transmitted instead of the break command itself.
- . Data associated with the characters displayed on the CRT are transmitted on the communications line after being bracketed by the Start-of-Data (DD) and the End-of-Data (DE) commands.

Reference should be made to Table 2 of this document for a description of the actual data contents and field delimiters for the various commands.

1.4.5 Target Lighted Keys

Two target lighted keys are affected by the installation of the Extended Display Feature: 1) Page Mode Key and 2) Character Insert Key.

- . The target light on the Page mode key will be turned on if the terminal is in Page or Protect modes. When the system reverts to Scroll mode, the light is turned off. If the system is in Page mode and the Page mode key is depressed, the system will revert to the Scroll mode. If the system is in Protect mode and the Page mode key is depressed, the system will revert to Page mode and the light will remain on. A second key depression will cause the light to go out, and the system will revert to Scroll mode.
- . When the Character Insert key is depressed, the target light on the key will be turned on and the system will be in the Character Insert mode. The system will remain in this mode until the Character Insert key is depressed or until another command key is depressed. Upon exiting the Insert mode, the target light will be turned off.

If a command other than a Character Insert command terminates the Insert mode, that command will be ignored.

CHAPTER 2

UNPACKING, INSPECTION, AND INSTALLATION

2.1 INTRODUCTION

This chapter provides instructions for unpacking, inspection, and installation of the Extended Display Feature. If a keyboard is included in this shipment, refer to the Keyboard Supplement for keyboard installation instructions.

2.2 UNPACKING INSTRUCTIONS

Unpack the Extended Display Feature ROM from its shipping carton and, referring to the packing list, verify that part number M68SVS20200 is present. Save the packing material for storing and reshipping of the part. If the shipping carton is damaged upon receipt, request that the carrier's agent be present while the unit is being unpacked and inspected.

2.3 INSPECTION

The Extended Display Feature ROM should be inspected upon receipt for any physical damage to the ROM.

2.4 ROM INSTALLATION

The ROM may be easily installed following the procedure described below:

- a. Remove system power.
- b. Carefully lay the Basic Display Unit on its side.
- c. Remove the eight retaining screws in the bottom panel of the Basic Display Unit. Make certain that the panel is not allowed to slide down while removing the retaining screws. Damage to the internal components could result.
- d. Carefully remove the bottom panel by pulling it straight out. Again, do not allow the panel to slide down.
- e. Locate socket U49 on the CRT controller board and carefully plug the ROM into the socket. Make sure that pin 1 is properly matched to pin 1 of the socket. Refer to the EPIC 68 User's Guide for a schematic of the CRT controller board.
- f. Replace the bottom panel and retaining screws by reversing steps b, c, and d above.
- g. Replace system power, power system on, and perform the Operator Test Procedure detailed in the EPIC 68 User's Guide.
- h. If the system performs properly, go on to step 'i'. If the system does not perform according to the Operator Test Procedure, verify that the ROM has been installed correctly and that no damage has been done to the CRT controller board.

- i. Depress the Page mode key (if it is available) or 'ESC,G' on the keyboard. The target lighted key should come on.
- j. Depress and hold down the LINE FEED key. The cursor should move to the bottom of the display and as it reaches the bottom, it should go back to the top line of the display. If this test doesn't work, go back to step 'h'.

CHAPTER 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

Information in this chapter is intended to familiarize the user with certain programming considerations that may be unique to the Basic Display Unit terminal.

3.2 COMMAND DESCRIPTIONS

Refer to Table 2 of this document for detailed explanations of the terminal commands and their functions.

3.3 KEYBOARD FUNCTIONS

Refer to the Keyboard Supplement for information concerning the various functions associated with the keyboard.

3.4 PROGRAMMING INFORMATION

3.4.1 Setting Page/Protect Modes

Setting of either of these modes implies that the user has a particular implementation in mind.

Page mode is generally used when the user wishes to treat the Virtual Display Area as a page of data that may be modified at will without the danger of scrolling data out of the display.

Protect mode is used when the user wishes to activate field protect Field Attribute Codes (FACs). This mode will permit the cursor to move only within unprotected fields.

When creating a display that is to contain protected and unprotected fields, the user should first set Page mode, followed by those FAC commands and data bytes that are to define the display.

After all FACs and data bytes have been sent to the display, the last command should be a Set Protect mode command. This will cause the firmware to recognize the Field Protect FACs, and will send the cursor to the left-most position of the first unprotected field. If an unprotected field does not exist, the cursor will remain in the upper left-hand corner of the virtual display.

When setting Protect mode that is to be followed by a string of data, care should be taken to ensure that an unprotected field exists near the top of the screen. If no unprotected field exists when Protect mode is set, there is a danger of a receive over-run condition if more than 256 bytes are sent to the terminal immediately following the Set Protect command.

3.4.2 Establishing a Virtual Display Area

One of the unique features available with the Extended Display module is the ability to section off an area of the absolute display that will be used as the Virtual Display area. The display area may be sectioned off to create any size virtual area from the full 80-column by 24-line display to a 1-column by 1-line area located anywhere within the display. The commands to effect this screen partitioning are described in Table 2 of this document. These commands may be used to set the left and right columns and top and bottom lines that would define the desired virtual display area.

In creating a virtual display area, the following facts should be noted:

- a. FACs are in effect across all real and pseudo virtual display boundaries. Therefore, each line of each virtual display area should be initialized to reflect the attributes desired for that portion of the virtual display.
- b. The display may be partitioned off for any number of virtual display areas, but only the area currently defined will be considered as having the "real" boundaries. All other partitioned areas are considered pseudo areas because of their exclusion from any cursor positioning.
- c. An area that will be used in the Page or Scroll mode will have the FACs at the beginning of each line overwritten unless the following procedure is followed:
 - (1) Set the top, bottom, right, and left limits for the desired area.
 - (2) Place the desired attributes in the left-most position of each line through FAC commands.
 - (3) Move the left-hand margin of the virtual display one column to the right. This will enable the user to write data in his virtual display area without disturbing the FACs.
- d. An area that will be used in the Page or Scroll mode will have the section heading(s), if any, overwritten unless the following procedure is used:
 - (1) Set the top, bottom, left, and right limits for the desired area.
 - (2) Place the desired heading(s) in the display.
 - (3) Move the top limit of the display to the line directly beneath the heading(s).
- e. In creating a virtual display area, the left and right or top and bottom values may not cross each other's boundaries; i.e., if the left margin is set at column 40, the right margin cannot be set to a column value less than that of column 40.

Although the Virtual Display concept may be used for many different applications, the following two examples may serve as guides to future user system developments:

- . Buffered Display

In transaction oriented applications, the host system may require lengthy validation and updating procedures in its processing that can tie up the terminal until all of the transactions have been processed. With the display partitioning capabilities, the user may elect to split the display in half with each half having identical protected and unprotected fields. After the terminal operator has filled in the transaction information for the first set and depresses the Send Page key, the host may change the virtual display area to the second area, thus allowing the terminal operator to begin inputting while the host is processing the first batch.

If any errors were detected in the first batch, the host may cause the field(s) in error to blink or be identified by reverse video. The host may revert to the first area to allow the operator to correct any errors. Upon receipt of the corrected data, the host computer can allow the operator to go to the second buffer with the cursor positioned at the point the operator was interrupted.

By flip-flopping between the two display buffers, the host can allow the operator to enter new transaction information without losing the transaction data currently being processed. Upon successful completion of processing one of the buffers, the host may clear the unprotected areas in preparation for releasing the area to the operator for further input.

- . Host to Terminal Message Area

In some applications, it may be particularly useful and desirable to reserve an area for host system messages to the terminal operator. The host system may define a Virtual Display area that will permit normal terminal operations. The area outside the Virtual Display area will be inaccessible to the operator but accessible to the host system. This allows the host system to communicate messages without fear of the terminal operator over-writing them. The host may write into the area external to the Virtual Display by means of a Write Absolute command that does not require any cursor positioning. Refer to section 3.4.3 of this document for more information on the Write Absolute command.

3.4.3 Addressing Absolute Display Area

By definition, the Absolute Display area refers to the full 80-column by 24-line display. The absolute addressing commands allow the user to address any area within the Absolute Display, regardless of the Virtual Display boundaries. No cursor movement transpires during the execution of the absolute addressing commands. Instead, the user may specify through the use of X-Y coordinates the area to read from or to write to.

The Read and Write Absolute commands will be most helpful when the user wishes to write data into an area outside the virtual display, or when it is desired to read from and write to protected areas when the Protect mode is in effect.

When in Protect mode, the cursor is prohibited from moving into a protected area (with one exception). Thus, the Read and Write Absolute commands allow the reading and writing of data located in protected areas without having to revert to the Page mode. The one exception permitting the cursor to be positioned in a protected area is if positioning is on a FAC that is an "unprotect" FAC. This feature is explained in more detail in section 3.4.4 of this document.

Care should be taken with the Write Absolute command to ensure that the only commands embedded as part of the message are:

- a. Start Data Command
- b. Field Attribute commands
- c. End Data command

Any other commands will cause the Write Absolute to be aborted.

3.4.4 Setting Field Attribute Codes

Field Attribute Codes are referenced as FACs and refer to the attributes that may be assigned to a field. These attributes include the following:

- . Blink
- . Video Invert
- . Half Bright
- . Underline
- . Non-Display
- . Protect

A FAC occupies a position in display memory, but may contain any one or all of the above attributes.

When writing FACs to the display, the following items should be noted:

- a. A FAC position that is being created requires a Field Attribute command for each attribute that is to be set. If a field is being created to reset FACs, only one FAC reset will be required to reset all FACs. If FACs are being reset at an existing FAC position, a reset FAC command is required for each attribute that is to be reset.
- b. Cursor movement does not take place while FAC commands are being processed. This allows multiple FAC command bytes to be processed sequentially at the same cursor position.
- c. Upon completion of FAC settings for a given cursor position, a cursor movement command should be used to move the cursor off the current FAC. Otherwise, any following data will overwrite the FAC. An exception to this rule is when FACs are part of a message being sent through the Write Absolute command. Automatic pseudo cursor positioning takes place so that the FAC will not be overwritten.

- d. FACs are in effect until reset by another FAC or until the physical end of line (column 80) is reached. At this time, all FACs for the line are reset.
- e. Because of 'd' above, FACs must be set for each line of the display where display attributes are desired.
- f. All of the attributes will be in effect for Page and Protect modes, with the exception of the Protect FAC. This attribute is active in the Protect mode only.
- g. The cursor may be positioned over a non-protect FAC in Protect mode. This allows the user to alter the attributes for an unprotected field without having to revert to Page mode. The user should position the cursor on the first byte of an unprotected field after the FAC command has been processed.

3.4.5 Using Transparent Mode

The Transparent mode of operation provides a very useful debugging aid when debugging command strings and messages sent to the terminal by the host computer.

This mode will cause the ASCII escape sequences for all commands to be displayed. The user can then view the command/data string displayed on the CRT to determine where command formats may be in error.

Again, all commands will be displayed as 7-bit escape sequences.

The only command honored in this mode is the Reset Transparent Mode command. Transparent Mode may be set and reset from the keyboard, from the configuration switches located in the back panel of the Basic Display Unit, or by means of remote commands sent from the host computer.

3.4.6 Using Display Special Character Mode

This mode of operation provides a means for the user to display any of the ASCII control characters falling in the hexadecimal range of 00 to 1F. Any ASCII commands normally processed (i.e., LINE FEED, CARRIAGE RETURN, etc.) will have their ASCII equivalents displayed on the CRT. No ASCII command will be executed in this mode.

The mode may be set and reset from the keyboard, from the configuration switches located in the back panel of the Basic Display Unit, or by means of remote commands sent from the host computer.

3.4.7 Remote Control of Display Terminal

Any of the commands detailed in Table 2 of this document may be sent to the terminal by the host computer. The host may exercise some control over when the operator is allowed to enter data by remotely locking and unlocking the keyboard.

For example, if the host has received a batch of transactions from the terminal and doesn't wish to allow the terminal operator to input data until the last batch is verified, the host may send a Disable Keyboard command. The terminal operator will be unable to enter any data until the host has released the system. Upon completion of validation and updating processes, the host may then cause the screen to be prepared for new transaction entry by clearing the screen and sending an Enable Keyboard command. If erroneous data was detected by the host system, the field or fields in error may be blinked, the cursor positioned at the first erroneous field, and the keyboard enabled. The terminal operator may then make whatever corrections are necessary and the process is then repeated.

With some applications, it may be desirable for the host to build a table of X-Y coordinates for each field in the display. The following procedure is offered as a method to accomplish this task:

- a. Upon initialization or creation of a new CRT display, the host may position the cursor at the home position or at the first field.
- b. By issuing a Read Cursor command, the host may receive the X-Y coordinates of the current cursor position.
- c. By sequentially tabbing to and issuing a Read Cursor command for each field, the host may build a complete table of X-Y coordinates.
- d. By remembering the X-Y coordinates of the first field, the user can terminate the Tab/Read cursor cycle when a screen wraparound has occurred.
- e. The X-Y coordinates received from the Read Cursor command reflect the address of the first byte of each field. The Y coordinate should be decremented by one to locate the normal position of the FAC associated with the field.
- f. The user may then use the values contained in the X-Y table to locate the fields when FAC changes are desired.

The use of the above procedure should permit the user to relocate, add, and delete fields without having to be concerned with coding the X-Y coordinates in the host computer.

3.4.8 Application of Function Keys

When a function key is depressed, the Basic Display Unit's firmware causes the corresponding hexadecimal value for the key to be sent on the communications interface. Depending on the terminal's configuration switch settings, the format for the function key value will be in either 8-bit or 7-bit Escape mode. The host system may be initialized to accept either of the two modes. Regardless of the mode selected, the function key value will be transmitted on the communications interface without being bracketed by the Start Data and End Data commands.

Upon receipt of a function key value, the host computer may elect to interpret the value in any way desired. For example, depressing function key 'one' may indicate to the host that a menu of available host programs is wanted by the terminal operator. The host system could then respond by transmitting the commands and data that would paint the desired menu on the CRT.

The use of function keys can eliminate needless dialogue between the host and the terminal operator. The interpretation of the function keys is entirely up to the host system. There needs to be only the implicit agreement and understanding between the host and terminal operator as to the interpretation of the function key values.

A useful application of the function keys and the virtual display commands would be to initialize the CRT with the first 22 lines set aside for the Virtual Display area. Lines 23 and 24 could be used to identify the function keys and what function each would perform. This helps the user when there is some question as to the feature associated with the key.