SPERRY UNIVAC
DEFENSE SYSTEMS

Type 2049 Alpha-Numeric Display

SUMMARY OF CHARACTERISTICS

FUNCTIONAL CHARACTERISTICS

CATHODE RAY TUBE DISPLAY (P31 PHOSPHOR)

- 15 inch diagonal screen
- 12 inch (diagonal) viewing area
- 2000 character screen capacity (1 page)
- 25 lines of 80 characters
- Variable intensity-characters legible in ambient lighting to 70-foot candles
- Flicker-free self-refresh rate — 60 Hz nominal

CHARACTER GENERATOR

- 7 x 9 dot matrix
- 7-bit ASCII control and character set
- 32 control codes
- 64-character subset
- Reverse polarization for character emphasis
- Protected characters

REFRESH (DISPLAY) MEMORY

- MOS Integrated circuits
- One-minute data protection during power loss
- 2000 words per memory page
- Optional three-page capacity
- Interrupt or audible alarm on overflow

KEYBOARD

- Basic keyboard per MIL-STD-188C Type I, Class 1
- 8 special function keys
- 12 editing and cursor control keys

CONTROL AND INTERFACE LOGIC

MICROPROGRAMMED CONTROLLER

- Translates and executes commands
- Refreshes display CRT from memory
- Controls input and output transmissions
- Interrupts computer on abnormal conditions
- Controls scroll process (on 3-page option)

INPUT/OUTPUT

- Burst mode to or from computer
- Character mode to computer
- Interrupt on error detection

OPTIONAL DISPLAY-COMPUTER INTERFACES

- 8-bit parallel channel per MIL-STD-1397
- -15 volt, -3 volt or +3.5 volt interface
- 9600 baud serial synchronous channel per MIL-STD-188C
- 2400 baud serial asynchronous channel per MIL-STD-188C or EIA-STD-RS232C
- Daisy chaining to maximum of 8 displays on one asynchronous serial computer channel

CONTROL PANEL

- Controls, switches and indicators for normal display operation

MAINTENANCE PANEL

- Switches for data and function simulation during maintenance procedures

PHYSICAL CHARACTERISTICS

- Militarized construction
- 0° to 50°C operating temperature
- One-half minute warmup time at 20°C
- 20 inches high by 19 inches wide by 27 inches deep including 7-inch keyboard assembly
- Weight — 155 pounds maximum
- Optional 28-inch high pedestal

POWER

- Approximately 250 watts
- 60 Hz or 400 Hz ±5%
  - 1 Phase, 115V
  - 3 Phase, 115V, DELTA
  - 3 Phase, 208V, WYE

INTRODUCTION

The SPERRY UNIVAC® Type 2049 Display is a militarized (MIL-E-16400), modular, versatile display system designed to provide reliable and trouble-free operation on surface and subsurface vessels as well as in mobile land-based vans (see Figure 1). The Type 2049 has standard computer and communication interfaces that allow it to be used in numerous digital systems and applications.

The 2049 Display provides 25 lines of 80 characters for data display and a versatile keyboard for operator entry and control. The display is controlled internally by a microprogram controller which translates and executes commands, refreshes the display CRT from the 2049 memory, controls input and output transmission to a computer, provides status information to the computer and controls the scroll process (on the multi-page option).

FIGURE 1. SPERRY UNIVAC 2049

Recognizing that modularity in the design of military products enhances maintainability and, in most instances, contributes to reliability, the 2049 utilizes plug-in printed wiring cards which are heavily populated with MSI devices. All assemblies may be repaired by component replacement under emergency (non-economic) maintenance conditions.

The design of the 2049 Display accommodates the removal or addition of the options specified below:

- Computer Interface Type
- Additional Refresh (Display) Memory for Paging
- Power Supply
- Mounting Pedestal
- Keyboard Including Special Interrupt Keys

The 2049 display set is constructed to provide ease of maintenance, accessibility and replacement of line replaceable items (LRI) and parts. In addition to test programs utilizing a U-1600, provisions have been made for localizing malfunctions by means of off-line testing utilizing the maintenance panel. The display has a mean corrective maintenance time (MCT) of less than or equal to 15 minutes and a maximum corrective maintenance time (Mmax) of 120 minutes when repair is accomplished by replacement of the LRIs. The Mean-Time Between-Failures (MTBF) for the maximum 2049 configuration is 3000 hours.

The modular sections of the 2049 Display excluding the keyboard, are packaged in a ruggedized cabinet that is designed for rack mounting or directly to a deck or pedestal (see Figure 2) without using shock mounts. With the removal of the keyboard any configuration will pass through a submarine hatch (MIL-E-16400). The dimensions are shown in Figure 3. The overall weight does not exceed 155 pounds.

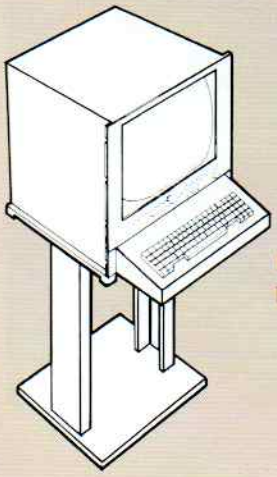

FIGURE 2.
PEDESTAL MOUNTING

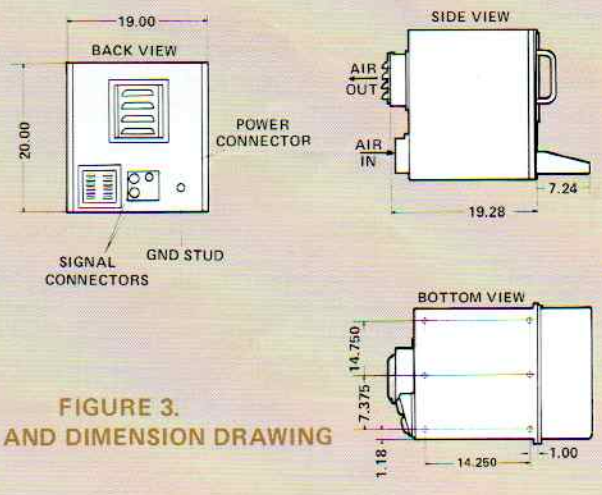

FIGURE 3.
OUTLINE AND DIMENSION DRAWING

FUNCTIONAL ARCHITECTURE

The 2049 Display is a remote operated keyboard input, cathode ray tube output display device, used for operator/computer interface. The unit provides the means for the operator to assemble a message from a keyboard for local display or entry into a computer. It also provides the computer with a remote display unit for data output. The keyboard and display when used together permit the operator to examine a data message stored in the computer, make additional entries or changes, and return the message to the computer.The display is composed of eight functional units.

- Element and Display Electronics
- Character Generation
- Refresh (Display) Memory
- Control and Interface Logic
- Keyboard
- Power Supply
- Control Panel
- Maintenance Panel

Element and Display Electronics

The 15-inch cathode ray tube, is a non-glare type with medium persistence green phosphor (P31). One display page contains 2000 characters, 25 lines of 80 characters. When operating under ambient lighting conditions of 1 to 70 foot candles, the operator may adjust the intensity of the page displayed to improve readability.

Character Generator

The 2049 character generator generates the 7-bit ASCII character set shown in Table 1. The control (non-printing) characters are displayed only when the CONT CHAR switch is enabled on the front panel.

Refresh (Display) Memory

The refresh memory is available in two sizes (one full display page — 2000 characters standard, or three full display pages — 6000 characters optional). The optional display pages are a plug-in section. When memory overflows as a result of computer output, the computer is interrupted and the appropriate status code sent. When memory overflows as a result of operator input from keyboard, an audible alarm is enabled.

Any ASCII character stored in display memory under program control may be protected from being changed or destroyed from the keyboard. All characters may be protected individually. Protected fields are skipped over when the cursor is positioned at them as a result of keyboard entries. Character editing of fields between two protected areas or between a protected area and the end of the line is treated identically as editing of an unprotected area.

Any ASCII character stored in display memory, via program or operator control, may be emphasized by polarization. The polarized character is displayed using inverted video (black characters on a lighted background). When the display is under program control, the emphasis control codes are included in the data stream.

Control and Interface Logic

The display controller performs all routing, control, and timing for the display device along with accepting commands from either the computer or operator. All control characters stored in memory are displayable when in "display memory" mode. The input/output data interface provides either a parallel or serial input/output channel to

TABLE 1. ASCII 64-SYMBOL PAGE PRINTING SUBSET

COLUMN→	0	1	2	3	4	5	
b7	0	0	0	0	1	1	ROW ↓
b6	0	0	1	1	0	0	
b5	0	1	0	1	0	1	
b4 b3 b2 b1	←NON-PRINTING→		←PRINTING→				
0 0 0 0	NUL	DLE	SP	0	@	P	0
0 0 0 1	SOH	DC1	!	1	A	Q	1
0 0 1 0	STX	DC2	"	2	B	R	2
0 0 1 1	ETX	DC3	#	3	C	S	3
0 1 0 0	EOT	DC4	$	4	D	T	4
0 1 0 1	ENQ	NAK	%	5	E	U	5
0 1 1 0	ACK	SYN	8	6	F	V	6
0 1 1 1	BEL	ETB	(apos)	7	G	W	7
1 0 0 0	BS	CAN	(	8	H	X	8
1 0 0 1	HT	EM	)	9	I	Y	9
1 0 1 0	LF	SUB	*	:	J	Z	10
1 0 1 1	VT	ESC	+	;	K	[	11
1 1 0 0	FF	FS	,	<	L	\	12
1 1 0 1	CR	GS	-	=	M	]	13
1 1 1 0	SO	RS	.	>	N	^	14
1 1 1 1	SI	US	/	?	O	–	15

The diamond (◇) is displayed to indicate the detection of an output transmission error.

the computer. Programming the parallel and serial interfaces is handled the same with control management and data codes being imbedded in the data stream. Refer to the section on software protocol (page 12) for a discussion of input/output transfer modes. The input/output data channel interface is optional and pluggable.

Transfer Modes and Parity

The 2049 provides two data transfer modes, burst mode (or block) and character mode. In the output burst mode, data is transferred from the computer starting at the cursor position and continuing until data transfer is complete. In input burst mode, an operator or computer specified contiguous block of data is transferred to the computer. Delineating of the start and stop point of the block of data is controllable by ASCII control symbols. The length of data block transferred in either direction varies from one character to the entire display memory. During burst mode, operator intervention is inhibited, and an indicator is illuminated indicating keyboard inhibit. In input character mode, data is displayed and one character is transferred to the computer as it is typed in by the operator. Refer to the section on software protocol (page 12) for a discussion of input/output transfer modes. Refer to Tables 2 through 4 for command and data codes.

The 2049 Display is capable of performing all input and output operations with either even character parity or no character parity (switch selectable). When parity is selected and a parity error occurs, a diamond symbol is displayed for the character in error and the display will generate a computer interrupt and send a status word indicating bad parity.

Functions

The *cursor* is generated by the controller and displayed at the location selected by either the operator control switches or computer as appropriate. The cursor character blinks at a 3 Hz rate, alternating with the character in memory at that location.

The display sounds an audible *alarm* to signify memory overflow by the operator. The sounding is continuous – unlike the alarm sounded for the end-of-a-line condition or in response to the bell code to distinguish between the two alarms. The alarm will continue to sound until disabled by the operator.

Clear Display (Operator Control) – The CLEAR SCREEN key positions the cursor to the upper left-hand corner of the screen and erases the screen (except protected characters).

Clear Display (Computer Control) – This command clears the display screen (including protected characters), and positions the cursor at the first memory position on the screen.

Character Deletion (Operator Control) – The DEL IN LINE key deletes the character at the cursor location and then compacts the rest of the characters in the row. A space code is entered at the last character position in the row. Activation of this function between protected fields affects only the unprotected characters up to the first protected field. If the polarized mode was selected, the space code entered is polarized.

TABLE 2. COMMAND CODES

OCTAL CODE	COMMAND	PURPOSE
140	Initiate Output with status response	Causes selected 2049 to set up for an output data cycle, inhibit the keyboard, and respond with interrupt.
141	Initiate Output without status response	Used by computer to send data to a 2049 when no status response is desired (e.g., to unlock the keyboard).
142	Initiate Input, Burst Mode	Causes the selected 2049 to transfer data to the computer in the burst mode, inhibit the keyboard, and respond with interrupt.
143	Initiate Input, Char Mode	Causes the selected 2049 to transfer data to the computer one character at a time as each key is depressed, and respond with interrupt.
144	Read Cursor	Causes the selected 2049 to transfer to cursor location to the computer.
145	Return Status	Causes the selected 2049 to send the present status information to the computer. This code automatically resets the status register and re-enables the keyboard.

TABLE 3. DATA CODES (SENT TO THE 2049 CONTROLLER)

OCTAL CODE	FUNCTION	EFFECT
000	NUL Character	Entered into display memory at the cursor location.
001	SOH Code	Used for designating the start of the header code (control management only).
002	STX Character	Entered into display memory at the cursor location. This character will be used denote the starting point for data transmissions.
003	ETX Character	Entered into display memory at the cursor location. This code will be used to denote the stopping point for data transmission.
004	EOT Code	This code is used for control management purposes and signals the end of a transmission cycle.
005	ENQ Character	Entered into display memory at the cursor location.
006	ACK Code	Entered into display memory at the cursor location.
007	BEL (Audible Alarm)	Entered into display memory at the cursor position and will cause the audible alarm to sound when received from the computer (250 millisecond tone).
010	BS Character	Entered into display memory at the cursor location.
011	HT Character	Entered into display memory at the cursor location.
012	New Line	Entered into display memory at the cursor location and then the cursor will be dropped to the beginning of the next line.
013	VT Character	Entered into display memory at the cursor location.
014	FF Character	Entered into display memory at the cursor location.
015	CR Character	Entered into display memory at the cursor location.
016	SO Character	Entered into display memory at the cursor location.
017	SI Character	Entered into display memory at the cursor location.
020	DLE (Data Link Escape)	This communication control character will change the meaning of the next character to that of a function. The code entered into display memory if received from the keyboard.
021	DC1	Entered into display memory at the cursor location.
022	DC2	Entered into display memory at the cursor location.
023	DC3	Entered into display memory at the cursor location.
024	DC4	Entered into display memory at the cursor location.
025	NAK	Entered into display memory at the cursor location.
026	SYN Code	This code is used by the serial synchronous interface and is provided to synchronize data communication sequences. The code is entered into display memory if received from the keyboard.
027	ETB Character	Entered into display memory at the cursor location.
030	CAN Character	Entered into display memory at the cursor location.
031	EM Character	Entered into display memory at the cursor location.
032	SUB Character	Entered into display memory at the cursor position.
033	ESC Character	Entered into display memory at the cursor position.
034	FS Character	Entered into display memory at the cursor position.

TABLE 3. DATA CODES (SENT TO THE 2049 CONTROLLER) (CONTINUED)

OCTAL CODE	FUNCTION	EFFECT
035	GS Character	Entered into display memory at the cursor position.
036	RS Character	Entered into display memory at the cursor position.
037	US Character	Entered into display memory at the cursor location.
040-137	ASCII Data Characters	ASCII data characters entered into memory at the cursor location.
140-177		The 2049 does not recognize lower case ASCII data codes from 140-177.

NOTE: All data codes entered into display memory advance the cursor.

TABLE 4. SPECIAL FUNCTION CODES

OCTAL CODE	FUNCTION	EFFECT
110	Master ClearDisplay	This code shall cause a reset operation to occur that will clear all necessary controller logic, stop any I/O transfers that might be in progress, and clear the keyboard lockout.
111	Clear Display	Causes the screen and associated memory locations to be filled with space codes. Code should be followed by 3 SYN codes when 2400 baud serial channel is used and 11 SYN codes if 9600 baud serial channel is used.
112	Set Margin	Causes the margin to be set at the present cursor location. If the cursor is to the left of column 20, the margin will be set at column 79.
113	Lock Keyboard	This code locks the keyboard so that operator entries are prohibited.
114	Unlock Keyboard	This code unlocks the keyboard.
115	Home Memory	Causes the cursor and screen to return to the beginning of memory.
116	Home Cursor	Causes the cursor to be set at the upper left corner of the screen.
117	Page	Causes the screen to advance ahead 25 lines in memory.
120	Backspace Cursor	Causes the cursor to be moved to the left one space.
121	Transfer Cursor	Causes the cursor to be moved to the position specified by the next two words from the computer.
122	Set Memory Protect	Sets the appropriate logic so that all data that follows from the computer will be memory protected until a clear memory protect or EOT code is received.
123	Clear Memory Protect	Will clear the appropriate logic so that all data that follows from the computer will not be memory protected.
124	Set Polarization	Will set up the display so that all data that follows from the computer will be polarized (black characters on a green background).
125	Clear Polarization	Will clear the display logic such that all data that follows from the computer will be unpolarized (normal video).
126	Store Cursor	Stores the cursor position, scroll value and video polarization in a portion of the non-displayable refresh memory.
127	Restore Cursor	Reinstates the previously stored cursor position, scroll value and polarization level. During a power-up or master-clear operation, the memory locations used for this function will be cleared. If the function is performed after a master clear, the cursor will be located at the HOME MEMORY position, the scroll register will be cleared, and the keyboard will be set up for unpolarized data entries.

Character Insertion (Operator Control) – The INS IN LINE key shifts all characters to the right of, and including, the cursor one space to the right leaving a space at the cursor location. The last character in the line is lost. Only the cursor line is affected by the shift. Activation of this function between protected fields affects only the unprotected characters up to the first protected field. If the polarized mode was selected, the space code entered is polarized.

Repeat (Operator Control) – The REPEAT key allows the operator to repeat data entry as long as the key is held down. To repeat a character, the REPEAT key is depressed first and then the desired character key. The character key may then be released because the repeating function shall continue until the REPEAT key is released. The repeat cycle occurs at a 15 Hz nominal rate.

Page (Computer or Operator Control) – The page command advances the screen contents to the next 25 lines of memory. If the screen is at page 3 to start with, it will advance to page 1.

Set Polarization (Computer or Operator Control) – This command causes subsequent characters, to the display, to be polarized. A polarized character is displayed using inverted video (black character on light background). The command may be initiated from the computer or by operating the VIDEO RVS key.

Clear Polarization (Computer or Operator Control) – This command causes subsequent characters, to the display, to be returned to normal video (unpolarized). The command may be initiated from the computer or by operating the VIDEO RVS key. Subsequent depressions of the VIDEO RVS key will toggle the polarization mode back and forth.

Lock Keyboard (Computer Control) – This command locks the keyboard, inhibiting operator control.

Unlock Keyboard (Computer or Operator Control) – This command unlocks the keyboard, enabling operator control. This command may be initiated from the computer or by depressing the KYBD LOCKOUT indicator-switch on the control panel.

Backspace Cursor (Computer Control) – This command moves the cursor one space left. This command is initiated from the computer.

Home Memory (Computer or Operator Control) – The operator can position the cursor to the beginning of display memory by operating the HOME MEM key. The cursor is transferred to the upper-left-hand corner of the screen. This function is also available to the computer with the use of a special function code. If the two optional pages are not used, HOME MEM key operates identical to HOME key.

Transfer Cursor (Computer Control) – This command positions the cursor to any desired memory location. The location is sent in two data words as specified in Figure 4 except that an octal value 040 must be added to each word prior to transmission so as to avoid confusion between ASCII control codes and cursor coordinates. When a cursor location outside the present screen display is transferred, the scroll counter is loaded with the transferred count. Thus, the screen is updated to track with the cursor if necessary.

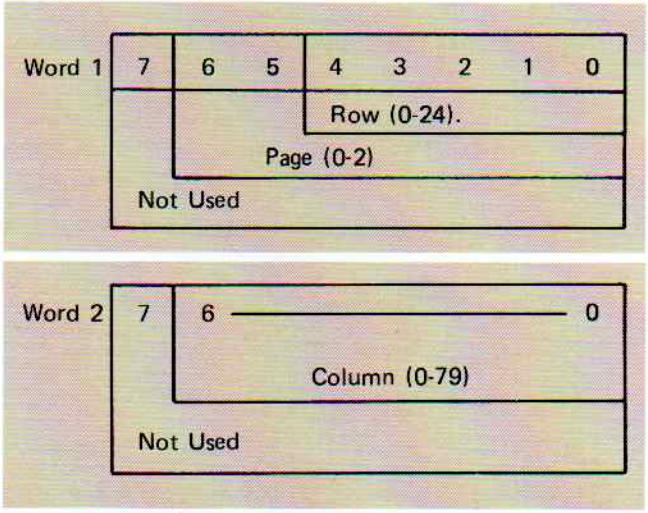

FIGURE 4. CURSOR COORDINATE FORMAT

Cursor Positioning Keys (→, ←, ↑, ↓) (Operator Control) – The cursor positioning keys are used to move the cursor to any desired position on the screen or to scroll the screen contents to a desired location. All four of the cursor positioning keys may be used to slew the cursor at a 15 Hz nominal rate. If the key is depressed longer than 250 milliseconds, the cursor (or scroll) will cycle at 15 Hz.

Read Cursor (Computer Control) – This command requests the display to give the present cursor location. The location is sent to the computer as two data words (offset by an octal 040).

Control Character Display (Operator Control) – The CONT CHAR switch up position allows all displayable control characters and the 64 symbol printing subset to be displayed. The down position allows only the 64 symbol printing subset to be displayed.

Set Memory Protect (Computer Control) – This command enables the memory protect bit in all data transfers to the display following receipt of the command. All data that follows this command will be protected and cannot be altered by the keyboard.

Clear Memory Protect (Computer Control) – This command disables the memory protect bit in all data transfers to the display following the receipt of the command. All data that follows this command is unprotected and may, therefore, be altered by the keyboard.

Master Clear (Computer or Operator Control) – This command clears all pertinent display logic, such that all data transfer operations with the computer cease and the display is cleared to accept new computer commands. The memory contents are not changed by this function. The keyboard is unlocked if keyboard lockout was in effect before the command was sent.

Margin Set (Computer or Operator Control) – Setting a margin prevents the operator from entering a character past a preset right-hand margin. The right-hand margin value is entered at the cursor column using the MARG SET key or MARGIN SET function code from the computer. Once a margin value has been set, an audible alarm is enabled whenever the cursor moves to a point ten characters from the margin point. When the cursor reaches the margin point, the cursor drops to the beginning of the next line. Data entries from the computer are not affected by the margin set point. If a margin is attempted between columns 0 and 20, the margin will automatically be placed at column 79 instead.

Home (Operator Control) – The HOME key positions the cursor to the upper left-hand corner of the screen.

Home Cursor (Computer Control) – This command positions the cursor to column 0, line 0 of the screen. The screen contents do not change and the page and scroll counters are not changed.

Interrupt Responses

When an abnormal condition is detected, the computer is interrupted and a status word may be transmitted. The status word contains a unique code identifying each abnormal condition and is accepted by the computer when the computer is ready. See Table 5 for interrupt codes and meanings.

Parallel Interfaces

The parallel computer interface is either Type A, B or C as defined by Category I of MIL-STD-1397. The 2049 functions with 8 input and 8 output data lines (see Figure 5). The 2049 accepts the following control line signals.

- Output Data Acknowledge
- Input Data Acknowledge
- External Function Acknowledge(*)

The 2049 generates the following control line signals.

- Output Data Request
- Input Data Request
- External Function Request(*)
- External Interrupt Request

*EFR/EFA signals are not used by the display under normal programming conditions.

TABLE 5. INTERRUPT RESPONSES

Normal Interrupts & Assigned Keys

Control Key	Control Code	Function
N/A	060	IDLE (no request)
F_1-F_7	061–067	Special function key interrupts
XMIT	070	Sends external interrupt to computer
N/A	071	Transmission complete

Abnormal Condition Interrupts

Code	Condition
072	Memory Overflow
073	Parity Error
074	Transmission Error Detected (Serial Channels only)

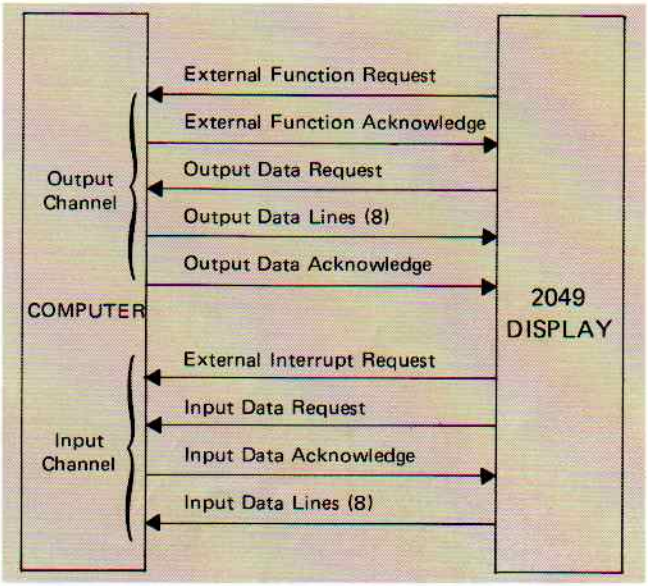

FIGURE 5. PARALLEL INTERFACE LINES

Serial Interface MIL-STD-188C

The serial interface is a low level, serial synchronous input/output interface, as defined by MIL-STD-188C for data and clock. The transmission speed is defined as 9600 baud. This interface consists of five control lines with +6V, −6V levels (see Figure 6). The 2049 has provisions for an optional 2400 baud MIL-STD-188 asynchronous interface.

Serial Interface EIA-STD-RS232C

Also available is an optional 2400 baud EIA-STD-RS232C asynchronous interface. This interface provides 6 discrete control lines (see Figure 7).

Daisy Chaining

The asynchronous serial interfaces include the capability to daisy chain a maximum of eight units on a single serial channel. The daisy chain provides the computer with the capability to send data in either broadcast (all 2049 Displays on chain receive) or specified unit mode. The convention for providing unique unit addresses is restricted to the use of device identification embedded in the data stream (see Table 6). The daisy chain interface is of the passive nature and failure of one 2049 on the chain will not inhibit operation of others on the chain unless the cabling between units is interrupted.

Keyboard

The alphanumeric keyboard is a plug-in unit (see Figure 8). It is capable of generating necessary ASCII control codes and all upper case characters. The keyboard layout is a Type I, Class I as specified in MIL-STD-188, Appendix C. Eight special keys are provided as part of the keyboard. These keys cause unique 7-bit characters to be generated to the computer along with an interrupt to the computer interface. The keyboard has features that prohibit character entry error when two keys are pressed simultaneously. (N-KEY Rollover).

Power Supply

The 2049 Display is capable of operating with any of of the power sources shown in Table 7. If input power is lost for up to 1 minute, there is no loss of data in the display memory assuming the front panel POWER and BLOWER switches are left in the ON positions. Power supplies utilize current limiting and overvoltage protection circuits to minimize component failures.

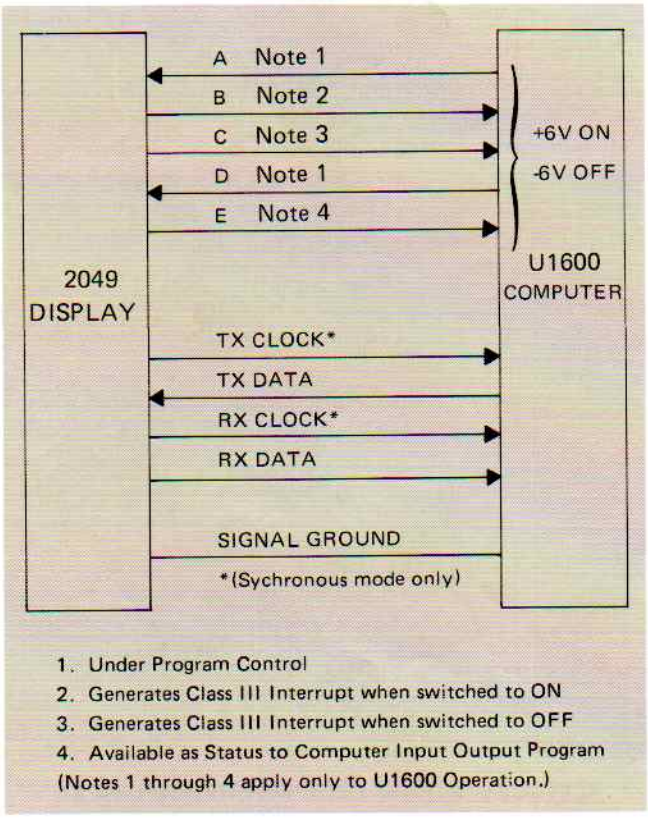

FIGURE 6. MIL-STD-188C SERIAL INTERFACE LINES

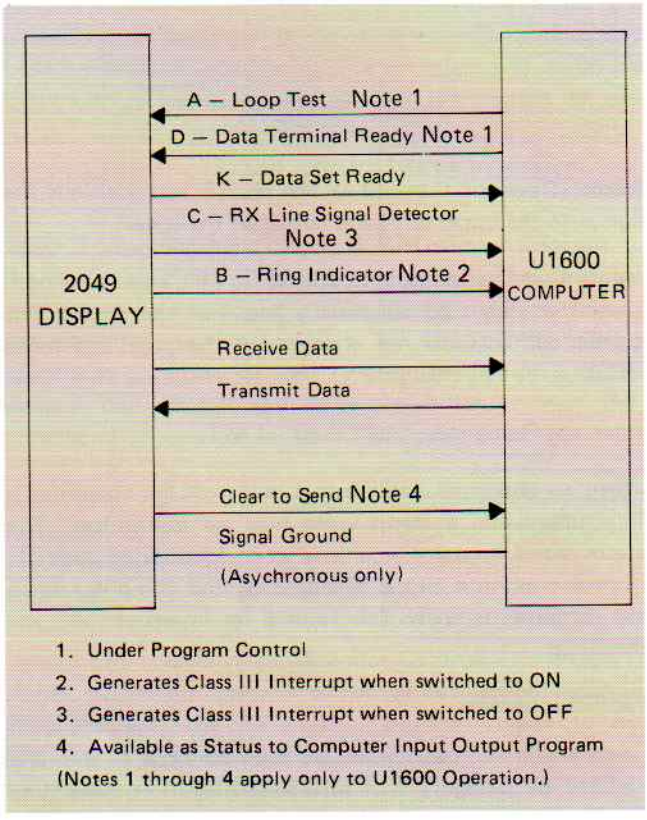

FIGURE 7. EIA-STD-RS232C SERIAL INTERFACE LINES

Control Panel

A control panel is located on the front of the 2049 and includes the indicators and switches described in Table 8. The indicators are visible and the switches operable without opening any doors or covers. (See Figure 8.)

Maintenance Panel

A maintenance panel is located behind the 2049 control panel. The panel permits manual insertion of commands and data and contains sufficient controls and displays to achieve the MTTR specified under Maintainability. The maintenance panel switches and indicators are described in Table 9. (See Figure 8.)

TABLE 6. DTS UNIT ADDRESSING

DISPLAY ADDRESS SWITCHES			SELECTED DTS	OCTAL ADDRESS CODE
2	1	0		
OFF	OFF	OFF	UNIT 0	150
OFF	OFF	ON	UNIT 1	151
OFF	ON	OFF	UNIT 2	152
OFF	ON	ON	UNIT 3	153
ON	OFF	OFF	UNIT 4	154
ON	OFF	ON	UNIT 5	155
ON	ON	OFF	UNIT 6	156
ON	ON	ON	UNIT 7	157
BROADCAST MODE (ALL UNITS)				160

TABLE 7. PRIMARY POWER CHARACTERISTICS

PARAMETER	REQUIREMENT
VOLTAGE	115 OR 208 VOLTS (V)
PHASES	SINGLE OR 3 PHASE DELTA (115V) OR 3 PHASE WYE (208V)
FREQUENCY	EITHER 400 HZ ±5 PERCENT OR 60 HZ ±5 PERCENT
MAXIMUM TRANSIENT VOLTAGE	AS SPECIFIED IN MIL-E-16400
MAXIMUM TRANSIENT FREQUENCY	AS SPECIFIED IN MIL-E-16400
MAXIMUM SPIKE VOLTAGE	AS SPECIFIED IN MIL-STD-1399

FIGURE 8. KEYBOARD CONTROL/MAINTENANCE PANELS

TABLE 8. CONTROL PANEL

NAME	TYPE	FUNCTION AND USE
INTENSITY	control	The INTENSITY control permits adjustment of the brightness of the characters on 2049 CRT.
MASTER CLEAR	switch	The MASTER CLEAR switch clears all necessary logic in the 2049 and upon release, initializes the display controller.
CHAR MODE	indicator	The CHAR MODE indicator lights when data is being displayed and transferred from the 2049 to the computer in the character mode.
KYBD LOCKOUT	indicator switch	The KYBD LOCKOUT indicator lights when the keyboard is inhibited or locked out. The KYBD LOCKOUT switch clears the disabled condition.
CONT CHAR	switch	The CONT CHAR switch allows displayable control characters to be displayed, when enabled, and only the 64 symbol printing subset, when disabled.
BATTERY	switch	When momentarily activated enables the BATTERY low indicator.
BATTERY	indicator	The BATTERY indicator lights when the battery charge is low and the BATTERY switch is enabled.
PARITY EVEN/NONE	switch	When in EVEN position, selects the even parity mode of operation. When in NONE position selects no parity mode of operation.
ALARM ENABLE/ DSBL/TEST	switch	When in DISABLE position, the ALARM switch disables the audible alarm. When in ENBL position, enables the audible horn. When in TEST position, sounds the audible horn and lights the OVER TEMP indicator.
OVER TEMP	indicator	The OVERTEMP indicator lights if a high temperature condition exists. If an extremely high temperature is reached, power will be cut off.
BATTLE SHORT	switch	When enabled, the BATTLE SHORT switch overrides the overtemp cutoff and when disabled, power will drop if an extreme overtemperature condition exists.
BATTLE SHORT	indicator	The BATTLE SHORT indicator lights whenever the BATTLE SHORT switch is enabled.
BLOWER	switch	When enabled, the BLOWER switch applies power to the 2049 blower, and enables primary power to the power switch.
DC OPR	indicator	The DC OPR indicator lights when +5 VDC power is present.
POWER	switch	When enabled, the POWER switch applies primary power to the DC power supplies (if the BLOWER switch is enabled).
CIRCUIT BREAKER	switch	When enabled and an overcurrent condition exists, the CIRCUIT BREAKER will remove primary power from the 2049. The CIRCUIT BREAKER should not be used to turn power on or off because this could cause the battery back-up system to be drained. The POWER and BLOWER switches should be used for applying power to the 2049.

TABLE 9. MAINTENANCE PANEL

NAME	TYPE	FUNCTION AND USE
HOURS	meter	The HOURS meter cumulatively records the time in hours the DC power is applied to 2049
INST RPT	switch	When enabled, the INST RPT switch repeats the instruction displayed in the instruction register.
START	switch	When enabled, the START switch starts the operation to execute one instruction or a continuous program, depending upon setting of STEP/RUN switch.
STOP/JMP	switch	When in STOP position, enables program stops on the STOP/JUMP command, otherwise only the program jump occurs.
STEP/RUN	switch	When in STEP position, enables a step of one instruction for each operation of START switch. RUN position enables continuous program operation.
STOP	indicator	When STOP/JMP switch is enabled, the STOP indicators light when a program stop occurs.
RUN	indicator	The RUN indicator lights when 2049 is in run mode for continuous operation.
ECHO	switch	When operated, the ECHO switch enables end-around of all data from computer. (Maintenance test only.)
MON EXER	switch	When operated, the MON EXER switch enables a test pattern of all E's to be displayed on the 2049 screen. (Maintenance only.)
MAINT	switch	When operated, the MAINT switch enables a micro-instruction program, allows computer to simulate the keyboard, and enables a register write and dump to the computer.
CLR INST	switch	When operated, the CLR INST switch clears the instruction register (if the ALU OUTPUT/INST REG switch is in the INST REG position).
CLR SOURCE	switch	When operated, clears the source portion of the instruction register.
OP	indicator switches	With ALU OUTPUT selected, OP indicators 5, 6, and 7 display the upper three bits of the 2049 register selected by SOURCE field. With INST REG selected, present contents of OP field of micro-instruction register is displayed.
DESTINATION	indicator switches	With ALU OUTPUT selected, DESTINATION indicators 0, 1, 2, 3, and 4 display 2049 register (lower 5 bits) selected by SOURCE field. With INST REG selected, present contents of DESTINATION field of micro-instruction register is displayed.
M	indicator switches	The M indicator switches select and display the modifier code bits that determine the function that will be accomplished between source and destination registers.
SOURCE	indicator switches	The SOURCE indicator-switches select and display the source register address for each instruction. A total of 27 2049 registers may be displayed in the OP and DESTINATION fields of the instructions registers when selected by source switches.
INST REG/ ALU OUTPUT	switch	With INST REG selected, enables display of the instruction register operation and destination codes in the OP/DESTINATION registers. With ALU OUTPUT selected, enables display of any of 27 2049 registers in the OP/DESTINATION registers.
DISPLAY ADDRESS 0-2	switches	The DISPLAY ADDRESS 0-2 BINARY switches select a 2049 display address (one of eight, see Table 6).

SOFTWARE PROTOCOL

The 2049 Display in the idle state will be searching for a start of header (SOH) code and upon the receipt of the SOH (ASCII Code 001), will then look for and test the address code (see Table 6) for validity. If the address received does not correspond to the device address switch settings or is not broadcast mode the display will go back into the search for SOH mode. If a valid address is received, the display will go into "command mode," looking for a valid code (see Table 2). The command code will tell the display what kind of response is called for when the computer message is complete. After receipt of the command code, a communication link between the 2049 and the computer is established. The 2049 is now ready to accept functions and/or data from the computer. Keyboard inputs will temporarily be inhibited until the computer message is terminated.

The 2049 Display will automatically assume a function mode of operation following the command code. In function mode, all codes received from the computer will be interpreted as functions and will perform the operations listed in Table 4. If a data transfer to the display memory (screen) is desired, data mode may be achieved by inserting an ASCII start of text (STX) code in the data stream. An STX code causes the conversion from function mode to data mode which enables the 2049 to accept display data. Once in data mode, the 2049 will accept ASCII data codes per Table 3. The computer can return to function mode at any time by inserting an ASCII end of text (ETX) code which will cause the 2049 to return to function mode indefinitely. If the 2049 is in data mode and a single function code is desired, this can be accomplished using an ASCIL data link escape (DLE) code. The DLE code takes the 2049 out of data mode momentarily for one function. This function will follow the DLE code in the data stream after which the 2049 will automatically go back to data mode.

When the computer message is over and all data and function words have been transferred, the computer can terminate its control of the display by inserting an end of transmission code (EOT), ASCII Code 004). This code, whether received in the data mode or function mode, will stop the I/O cycle and it will cause the microcode to go back and analyze the original command word in the header. If the command word is one that calls for a response from the display (data input, status transfer, cursor coordinates, etc.) then the response will be made at this time. If, at any point in the data stream, an illegal code is received, then the 2049 will return to searching for SOH and ignore the rest of the message.

Figures 9–14 show flowcharts for computer control of the 2049 Display and the response of the 2049 Display. (Figures 9, 10 and 11 show steps in the computer program to control the 2049 Display. Figure 9 shows the computer output to the 2049 Display and Figures 10 and 11 show two methods of generating a status response from the 2049 Display. Figures 12, 13 and 14 show the 2049 micro code response to the computer generated status requests.

TABLE 10. 2049 STATUS RESPONSE

2049 TO COMPUTER SEQUENCE	NOTES
SYN (026) } ONLY ON SYNCHRONOUS I/O SYN (026) }	1. FOR STATUS CODE SEE TABLE OF INTERRUPT RESPONSES (PAGE 7).
SOH (001)	2. ACK WILL BE SENT WITH NON-ERROR STATUS CODES (060 THRU 071)
ADDRESS (TABLE 6)	3. NAK WILL BE SENT WITH ERROR STATUS CODES (072, 073, AND 074)
STATUS CODE	4. KEYBOARD INHIBIT, IF IN EFFECT, WILL BE REMOVED FOLLOWING THE EOT TRANSFER.
ACK (006) OR NAK 025)	
ACK (006) OR NAK (025)	
EOT (004)	
SEE FIGURES 10 AND 11 FOR COMPUTER STATUS REQUEST PROCEDURE THAT IS USED TO INITIATE THE TRANSFER.	

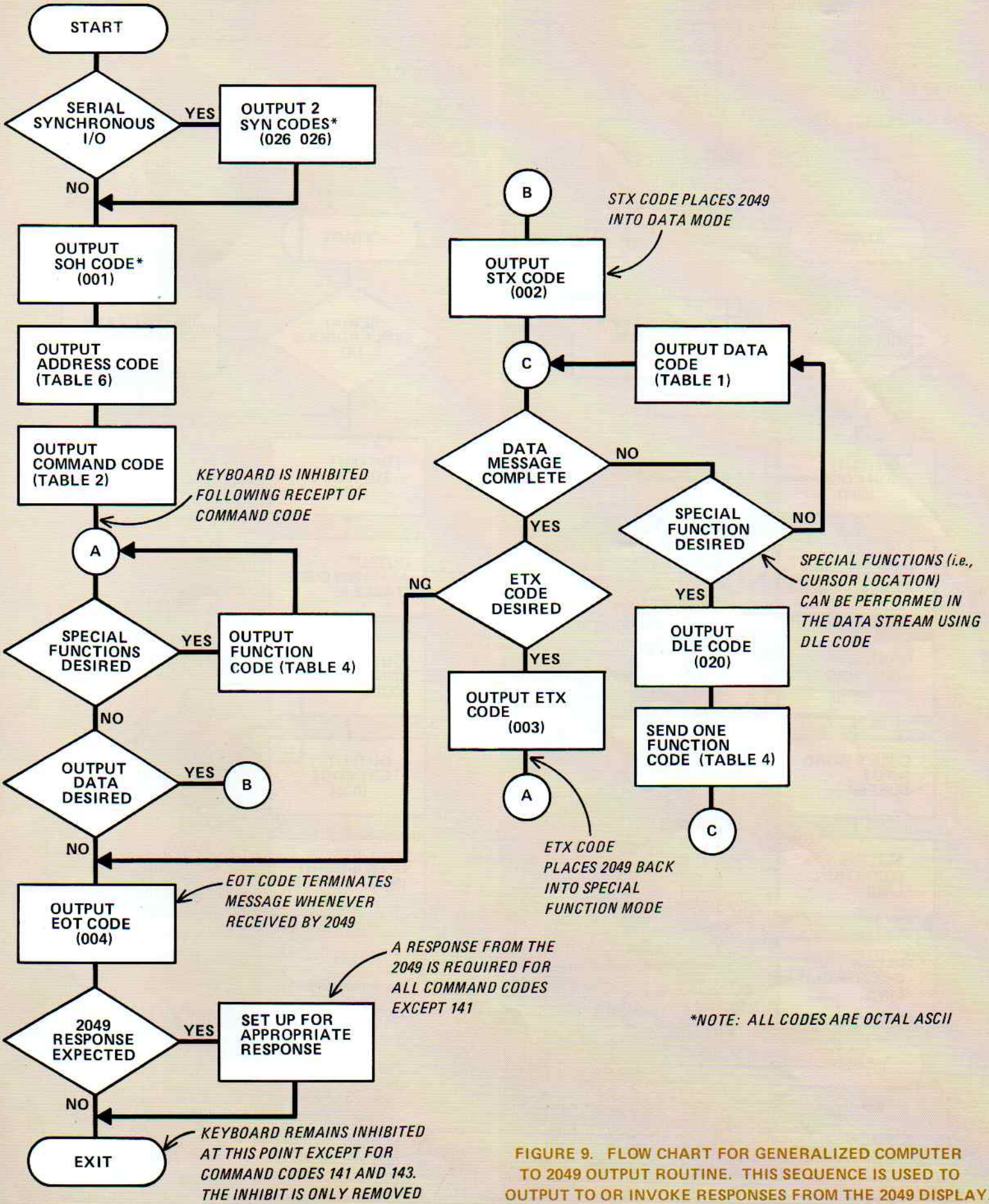

FIGURE 9. FLOW CHART FOR GENERALIZED COMPUTER TO 2049 OUTPUT ROUTINE. THIS SEQUENCE IS USED TO OUTPUT TO OR INVOKE RESPONSES FROM THE 2049 DISPLAY.

METHOD 1

USING D CONTROL LINE
(SERIAL ONLY)

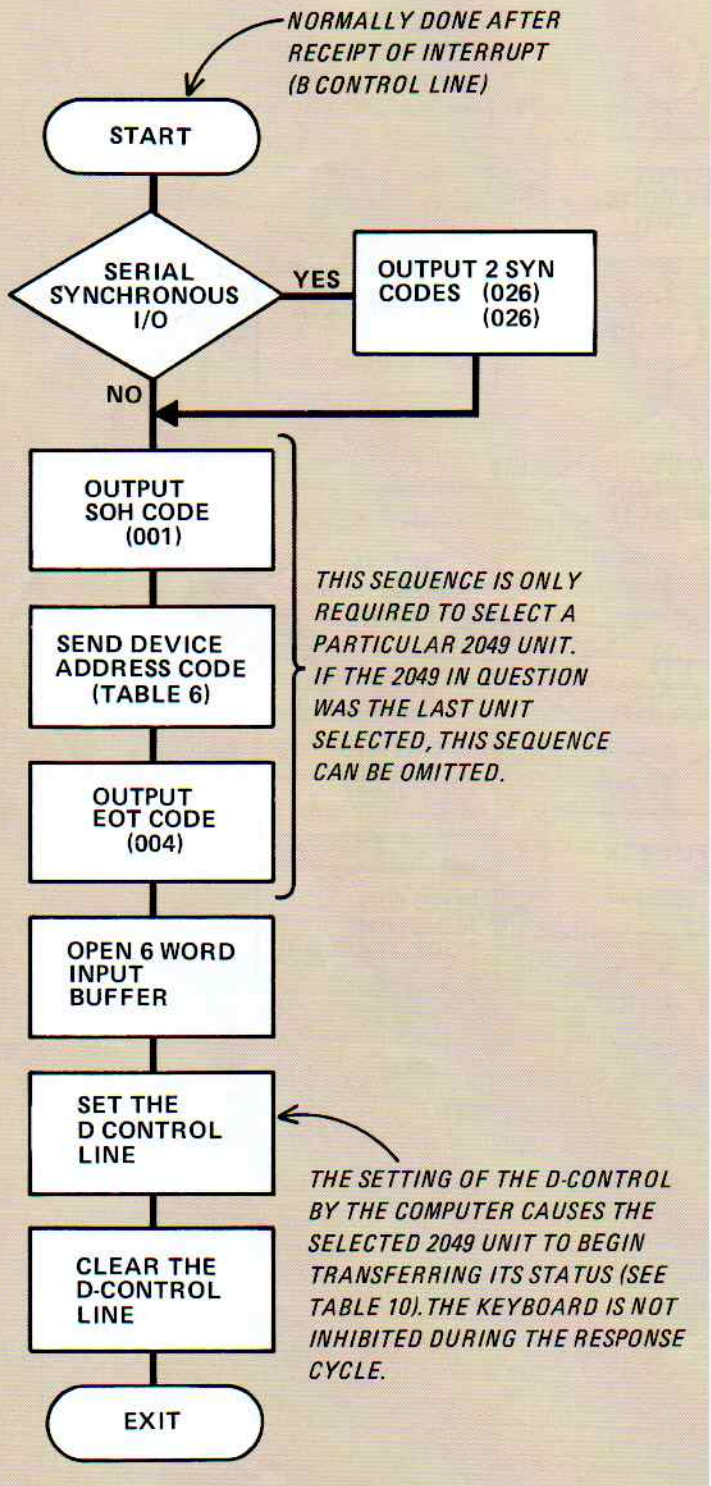

FIGURE 10. COMPUTER OUTPUT ROUTINE FOR INITIATING STATUS RESPONSE FROM THE 2049 DISPLAY

METHOD 2

USING "145"
COMMAND CODE
(SERIAL OR PARALLEL I/O)

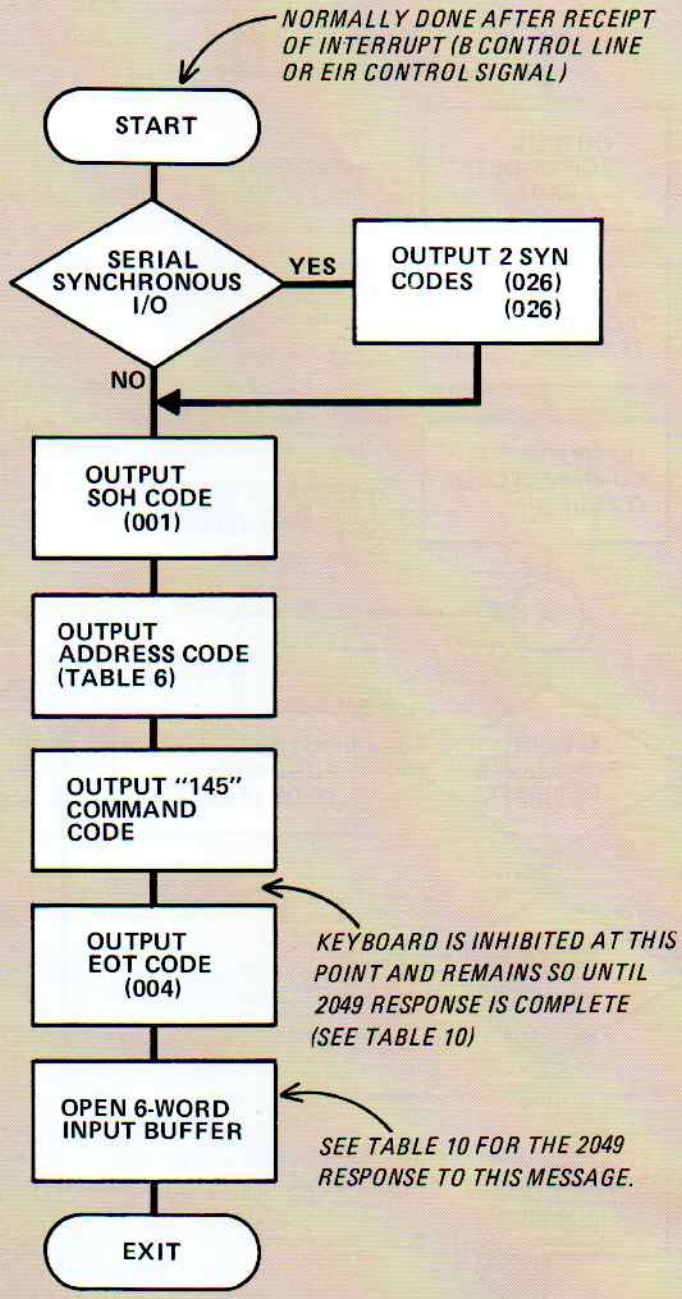

FIGURE 11. COMPUTER OUTPUT ROUTINE FOR INITIATING STATUS RESPONSE FROM THE 2049 DISPLAY

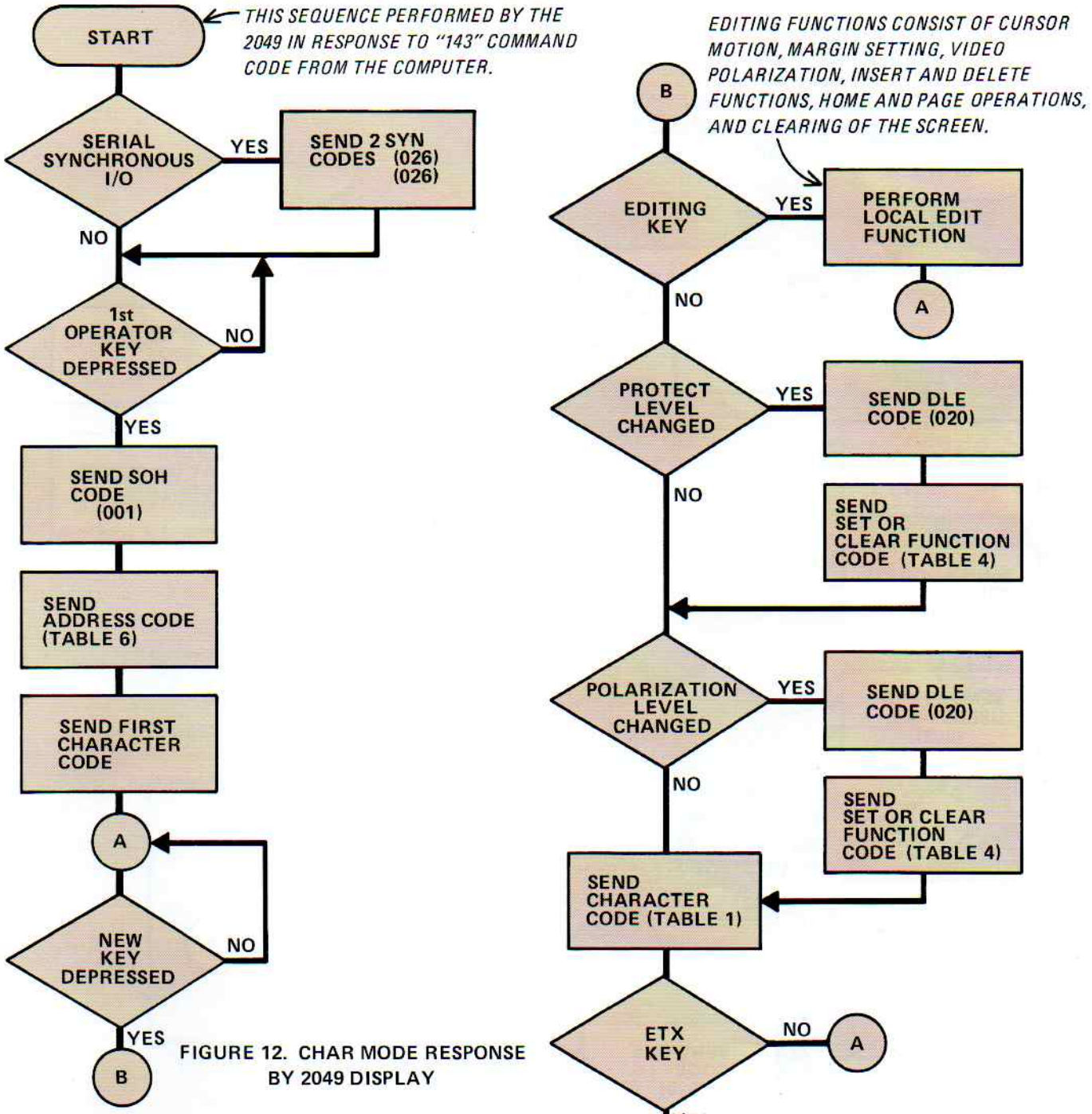

FIGURE 12. CHAR MODE RESPONSE BY 2049 DISPLAY

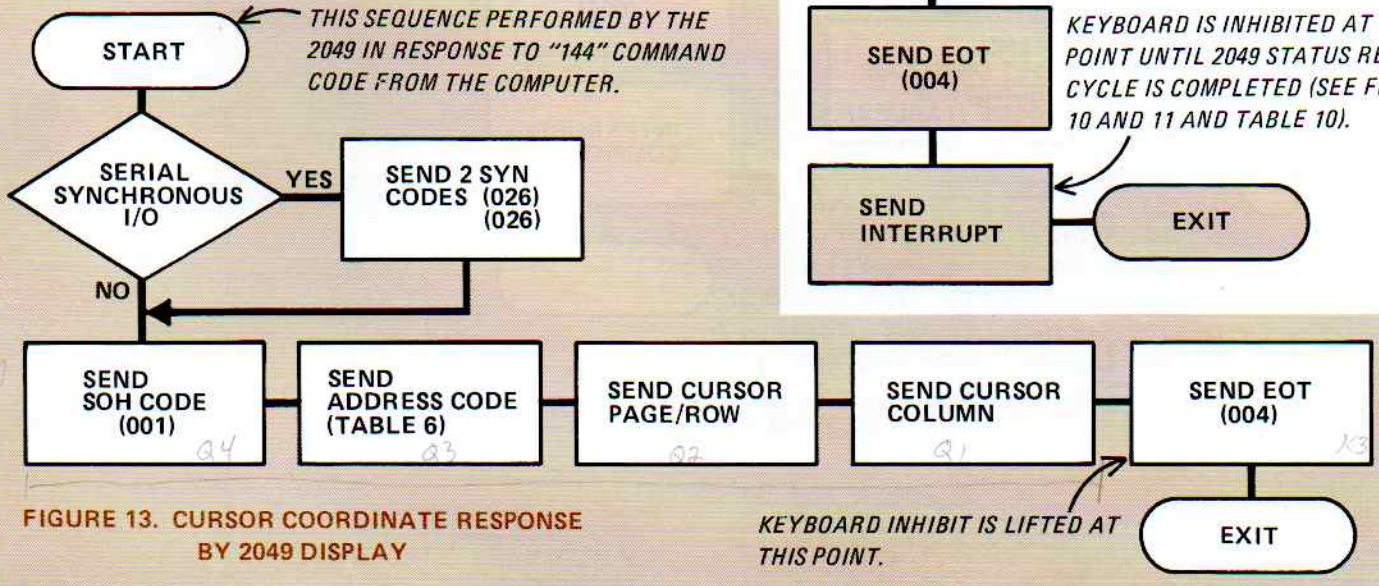

FIGURE 13. CURSOR COORDINATE RESPONSE BY 2049 DISPLAY

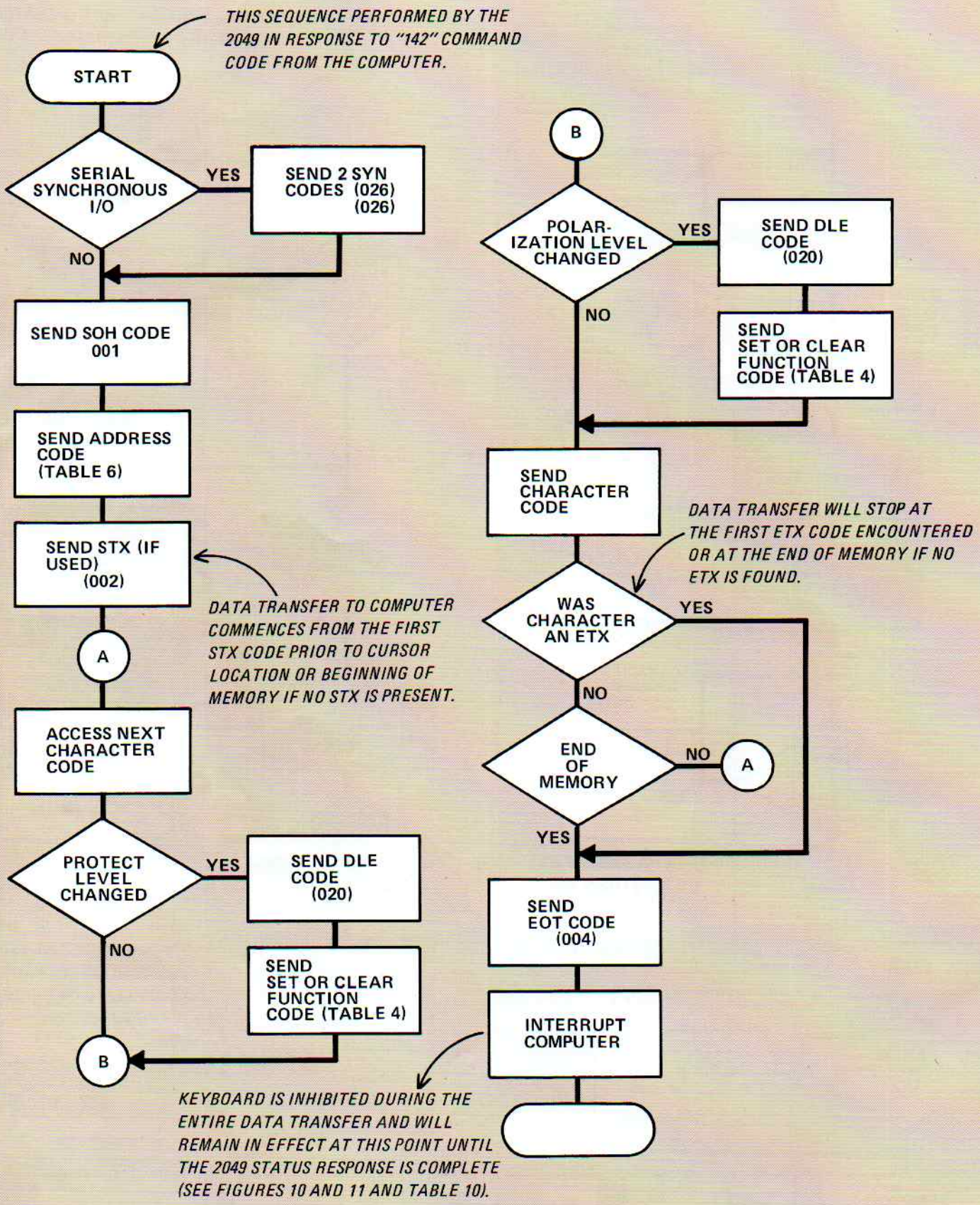

FIGURE 14. BURST MODE RESPONSE BY 2049 DISPLAY