

**MODEL 16
INSTRUCTION
MANUAL**



TELERAY 
DIVISION OF  **RESEARCH INC** 

MODEL 16 INSTRUCTION MANUAL

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Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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PREFACE

This Instruction Manual contains information needed by the user for installation, setup, operation, and care of the Model 16 Teleray terminal.

For users who wish to perform their own remedial maintenance, the following Model 16 Reference Manual is available by order from the Teleray Division of Research, Inc.

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SECTION 1

GENERAL INFORMATION & SPECIFICATIONS

1-1 Introduction

The Teleray Model 16 is a microprocessor-controlled, multipage CRT terminal with asynchronous ASCII input/output capabilities. Non-volatile memory storage allows for the retention of operator Selection Menu parameters, 32 programmable functions, and 64 programmable keyboard functions, even when the terminal is powered off. The Model 16 features a serial I/O port and a bi-directional auxiliary peripheral port. Serial communications are full or half duplex, with or without local echo, and the terminal provides line monitoring capabilities.

The Teleray Model 16 offers five character visual attributes, six area qualifications, extensive cursor control, smooth scroll, scrolling window, and horizontal scrolling. Logical line lengths and logical page lengths are user definable on the Model 16. Physical data display capacity is 1920 characters, or 24 lines of 80 characters. The display page also includes a 25th bottom line, for status and operator information purposes. The standard Teleray Model 16 includes four pages of volatile display memory. Optional configurations are eight pages of volatile or four pages of non-volatile, or eight pages of non-volatile display memory.

Other Model 16 features include communications parameters, operator functions, automatic screen saver, full editing, protection, and character/block mode transmission capabilities. The flexibility of the Model 16 is enhanced with a graphic character set, line drawing set, and mosaic character set. Calculator mode, utilizing the terminal's standard numeric keypad, adds to the versatility of the Teleray Model 16.

1-2 Physical Description

The Teleray Model 16 terminal consists of a display cabinet which houses the monitor module, power supply module, and logic module. All enclosure styles include a detached keyboard which can be positioned for optimal user convenience. Model 16 enclosure styles are designed for use on a desk, table top, or in rack-mounted applications (see Section 1-3, Packaging Configurations).

1-3 Packaging Configurations

M



Metal Enclosure, Detached Keyboard

Display: 13-3/4" (349mm) H x 13-1/4" (337mm) W x 17" (432mm) D

Keyboard: 3-1/4" (83mm) H x 18-1/2" (470mm) W x 7" (179mm) D

Weight: 36 lbs. (16 Kg)

POWER REQUIREMENTS

115 V+ 10% or (optionally)

230 V± 15%

40 Watts

137 BTU/Hr

Connections: Detachable 3-wire cord mating with internal line filter.

N



Injection Molded Enclosure, Detached Keyboard, 12" CRT

Display: 15" (381mm) H x 17" (432mm) W x 17" (432mm) D

Keyboard: 3-1/4" (83mm) H x 18-3/4" (476mm) W x 7" (178mm) D

Weight: 30 lbs. (13.6 kg)

ENVIRONMENTAL

Operating Temperature: 40° to 115°F (4° to 46°C)

Storage Temperature: -40° to 149°F (-40° to 65°C)

Relative Humidity: 10% to 90%, non-condensing

NN



Injection Molded Enclosure, Detached Keyboard, 15" CRT

Display: 15" (381mm) H x 17" (432mm) W x 17" (432mm) D

Keyboard: 3-1/4" (83mm) H x 18-3/4" (476mm) W x 7" (178mm) D

Weight: 30 lbs. (13.6 kg)

Modularity: Logic, power, keyboard and display modules, accessible and replaceable without tools

SAFETY

One amp line fuse — UL, CSA listed.

R



Rack Mounted Enclosure, 12" CRT

Display: 12-1/4" (311mm) H x 19" (483mm) W x 17" (432mm) D

Keyboard: 7" (178mm) H x 19" (483mm) W x 3" (76mm) D

Meets FCC regulations.

C



Executive Style Enclosure, Detached Keyboard, 9" CRT

Display: 15-1/2" (394mm) H x 10" (254mm) W x 10" (254mm) D

Control Electronics: 4-1/2" (115mm) H x 11-1/2" (293mm) W x 11-3/4" (299mm) D

Keyboard: 3-1/4" (83mm) H x 18-3/4" (476mm) W x 7" (178mm) D

Weight: 30 lbs (13.6 Kg)

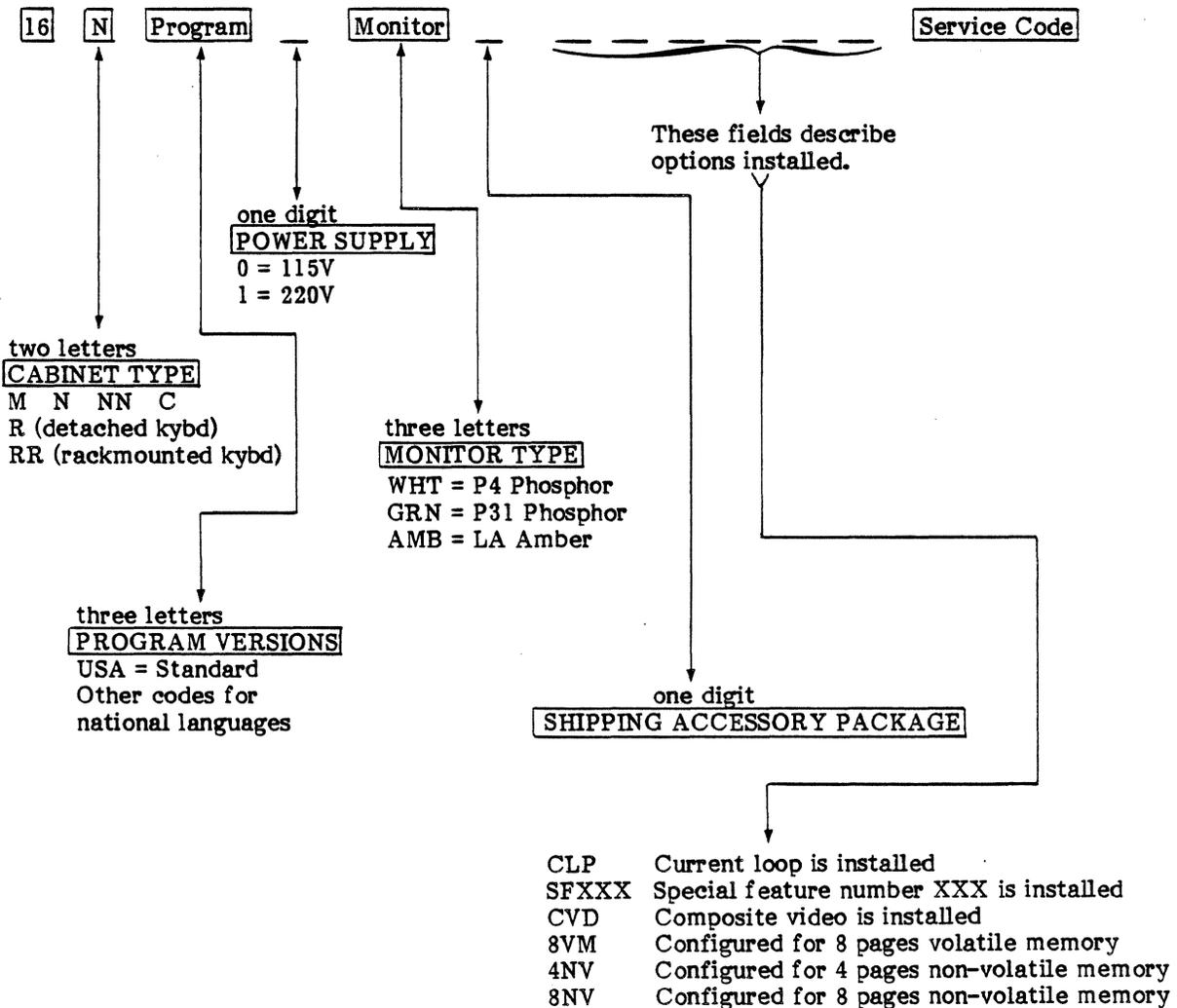
Handwritten notes:
 CURRENT LOOP
 W/ FREQ. NOISE
 W/ RADIATION
 W/ THERMAL

1-5 Label Designations

The option codes and special feature codes that have been installed in the Teleray will be listed on the rear panel label shown below. An insert describing any installed special feature will also be provided.

TELERAY	16 N USA 0 GRN1	MN47
11-1111	CLP SF421	
SERIAL NO	OPTION CODES	

Model Number Interpretation



SECTION 2 INSTALLATION

2-1 Introduction

Several characteristics of the Model 16 Teleray can be set by an installer from the keyboard. These characteristics include communications format, display refresh rate, etc. Setting these characteristics is described in Section 4, Selection Menus. All of the characteristics can also be set by the host computer. The Initial Installation section provides information for preparing the terminal and its site, and information for connecting the Teleray to the host computer and any attached devices.

2-2 Initial Installation and Checkout

A. Unpacking

The Teleray terminal has been carefully packed to ensure safety during shipment. Inspect the carton for external signs of damage before opening. To unpack, simply open the top of the carton, remove the top layer of foam and lift the Teleray out of the carton. Note all problems on the bill of lading to ensure processing of claims. After the terminal has been unpacked, inspect for damage to the terminal. Check immediately for broken or damaged parts. An Installation Report Form is included to assist you in reporting any possible problem.

B. Site Selection

The Teleray terminal is designed for desk or table top mounting. The detached keyboard permits the keyboard to be located independently of the monitor. Rubber mounting feet are provided on the base of the terminal to protect the desk or table top and to provide spacing for air flow beneath the unit. Keep the ventilation slots clear. Blocking these slots by placing objects beside or under the Teleray may cause the terminal to overheat.

C. Power Connections

The Teleray is equipped with a 6-foot (1.8-meter) power cable with an attached 3-prong (grounded) power plug.

CAUTION

Verify the power requirements on the back of the terminal chassis to determine voltage requirements. Do not plug unit in if power rating on label does not match available line power.

D. Initial Connections

1. Connect the keyboard cable to the keyboard jack on the rear of the terminal.
2. Connect power cord to appropriate power source.
3. Operate the power switch to the ON position and allow a 1- to 2-minute warmup period. During this period, the Teleray will automatically perform the power up self-test, sound the bell and then clear the screen.

E. Preliminary Local Mode Checkout

The following procedure utilizes some of the more important features of the Teleray 16 and is designed to familiarize an installer with some of its features.

1. After the warmup period, determine that no error was detected during the power up self-test. (Zero characters will appear on the left of the bottom line if there is an error.)
2. Place the terminal in Page Selection Menu by holding the SHIFT and typing the STATUS key. The display should be similar to that shown in Section 4, Figure 4-1, Page Selection Menu.
3. Adjust the brightness of the display by typing the Cursor Up (\uparrow) key or the Cursor Down (\downarrow) key. With each stroke of the key, the display should increase/decrease in brightness. Select a comfortable level.
4. Check the condition of the ON LINE/LOCAL LED indicators. If the ON LINE indicator is On, select LOCAL. (Move the category indicator using SHIFT and \rightarrow , \leftarrow keys, and the feature indicator using the unshifted \rightarrow , \leftarrow keys. The Teleray will prompt you through the selections.)
5. Exit Selection mode by pressing the STATUS key. The bottom line should now display the lock and other status indicators.
6. Type the following sequence: ESC [16; 7 y. The screen should now display 24 lines by 80 columns of the character ♯ . The ♯ character will be underlined. The bottom status line will remain unchanged.
7. Return to Page Selection Menu and change the sixth feature in the first category. The screen display will change from light on dark to dark on light.
8. Type the sequence ESC [? 2 J (or type the CLEAR PAGE key) to clear the screen.
9. Set the CAPS LOCK key on the left side of the keyboard to the UP (Off) position.
10. Type a grouping of shifted and unshifted characters and observe the display on the CRT.
11. Depress the CAPS LOCK key and it will lock in the On position. Repeat Step 10 above and observe that the characters are displayed in upper case only. (Shifting of the number and symbols group is still controlled by the SHIFT key.)
12. Press CTRL and then the G key. The bell should sound.
13. Type the sequence ESC P 0 l, then type your name. The bell should "click" as you type. Then type the sequence ESC \ . Now type the F1 key. Your name should appear on the Teleray screen.
14. Type the sequence ESC [9 b. Your name should appear nine more times (if you had used ESC [256 b, it would appear 256 times.)
15. Return to Page Selection Menu and change the second feature in the third category. This will allow you to set the correct time. Type the status key, and the correct time will be displayed on the bottom line.
16. Type the sequence ESC [144 space q. The cursor will now be displayed as a heart.

This completes preliminary checkout of the Teleray 16.

2-3 Internal Controls

These controls are preset at the factory and should not normally need adjustment.

SAFETY WARNING

Hazardous voltages of 115, 220 VAC and 15 K VDC are present when the terminal is on, and may remain after power is removed. Use caution when working on internal circuits, and do not work alone.

When handling the cathode ray tube, caution is required as the internal phosphor is toxic. Safety glasses and gloves must be used whenever the CRT tube is handled. Should the tube break and skin or eyes be exposed to the phosphor, rinse the affected area with cold water and consult a physician.

This terminal is supplied with a cord set that includes a safety ground. Do not use this terminal with an ungrounded outlet, missing ground pin, or any adapter that will defeat the safety ground.

Ensure that power is turned off before connecting or disconnecting the keyboard cable.

The outline of the logic module is shown below.

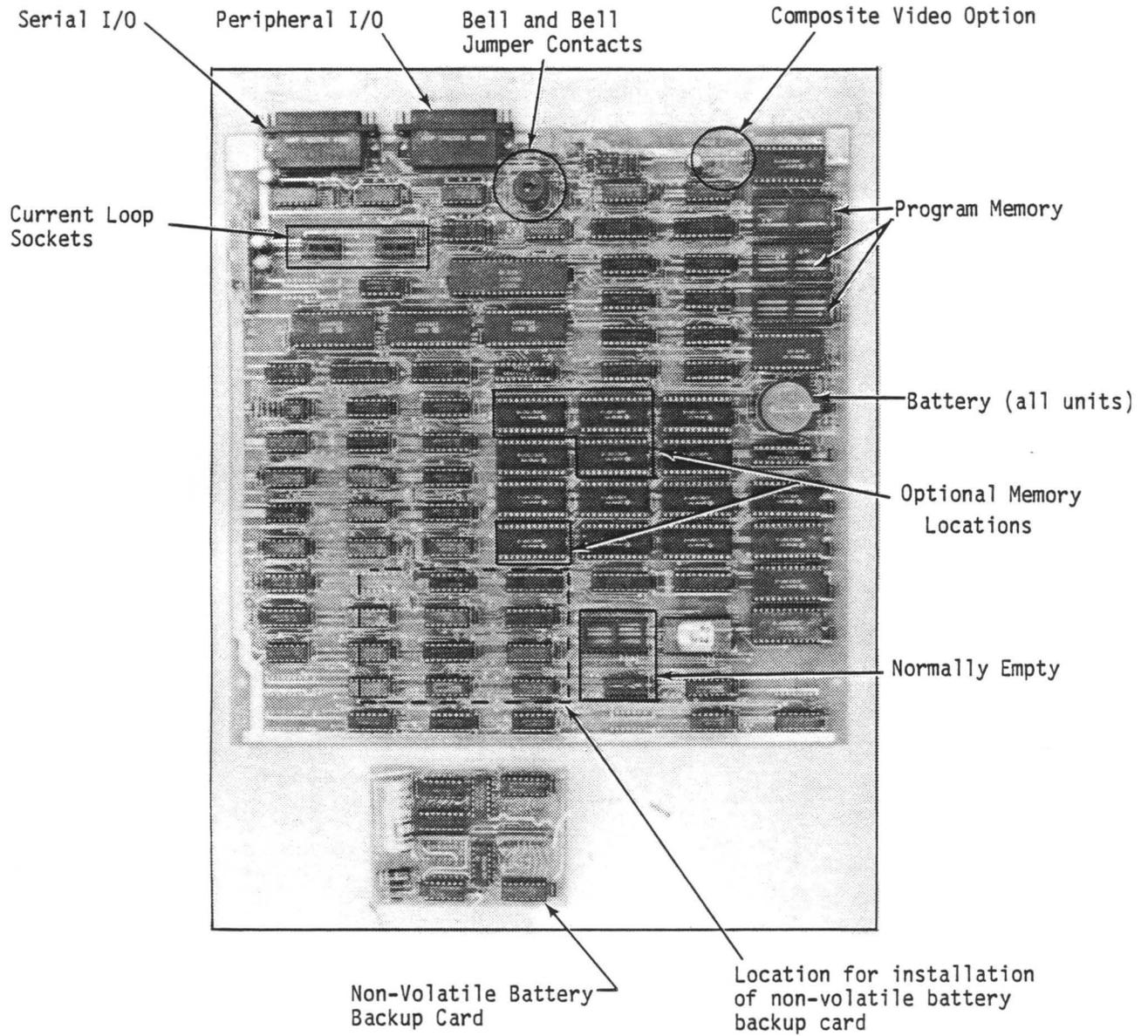


Figure 2-1: Logic Module

Monitor Internal Controls

Normally, these controls should not need adjustment. They are located below the CRT tube on the upper chassis. The names of the controls explain their function.

CAUTION

No work should be attempted on an exposed chassis by anyone not familiar with servicing procedures and precautions.

The Selection Menu contrast controls should be set before attempting these adjustments.

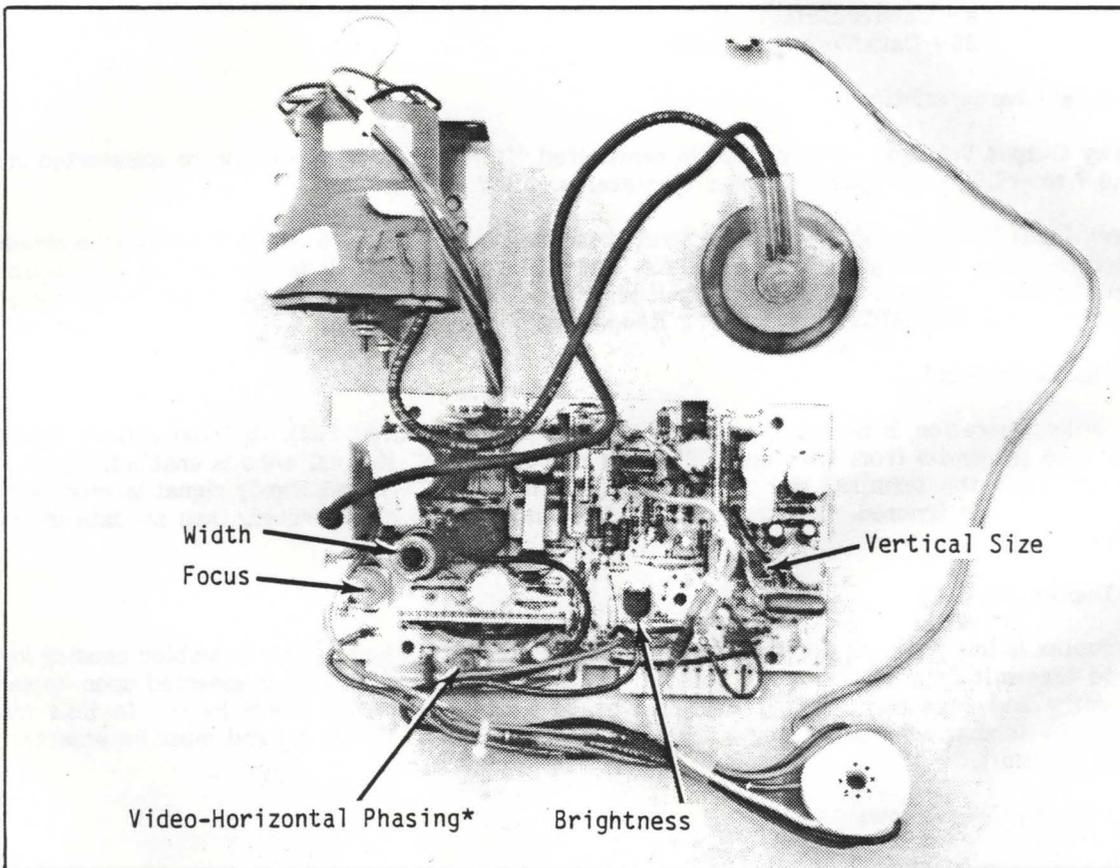


Figure 2-2: Monitor Controls

2-4 Communications Connections

A. Serial I/O

DP25S (female) connector, 25-pin miniature, for on-line communications interfacing in Remote mode. Pin assignments:

RS232C (Standard)

- 1 - Protective Ground
- 2 - Transmitted Data
- 3 - Received Data
- 4 - Request to Send
- 5 - Clear to Send
- 6 - Data Set Ready (Peripheral Port only)
- 7 - Signal Ground
- 8 - Carrier Detect
- 20 - Data Terminal Ready

Electrical Characteristics

Teleray Output Voltages - On all signals designated "from Teleray", the mark, or unasserted state, is -6.0 V to -12.0 V; the space, or asserted state, is +6.0 V to +12.0 V.

Teleray Input Voltages - On signals designated "to Teleray", -25.0 V to -0.75 V or an open circuit is interpreted as a mark or unasserted state, and +25.0 V to +0.75 V is interpreted as a space or asserted state. Voltages greater in magnitude than + 25 V are not allowed. These levels are compatible with EIA STD RS232C and CCITT Recommendation V.28.

Full Duplex Protocol

Full duplex operation is implemented for full duplex modems (Bell 103). If local echo is disabled, keyed data transmits from the terminal and is not displayed. If local echo is enabled, keyed data transmits from the terminal and to the display. The Data Terminal Ready signal is asserted and Carrier Detect is ignored. If Clear to Send is connected but not asserted, then no data is transmitted.

Half Duplex Protocol

Half duplex is implemented for half duplex modems (Bell 202). Local echo is enabled causing keyed data to transmit from the terminal and to the display. Request to Send is asserted upon keyboard data entry and negated following transmission of a Line Feed or a Form Feed. In Edit mode, Request to Send is asserted during a block transmission only. Clear to Send must be asserted for data to transmit.

Signal descriptions follow:

Protective Ground - Pin 1

This conductor is electrically bonded to the Teleray chassis. Use of this conductor for reference potential purposes is not allowed.

Transmitted Data (from Teleray) - Pin 2

The Teleray transmits serially encoded characters and break signals on this circuit, which is held in the mark state when neither characters nor break signals are being transmitted.

Received Data (to Teleray) - Pin 3

The Teleray receives serially encoded characters generated by the user's equipment on this circuit.

Request to Send (from Teleray) - Pin 4

Asserted at all times when terminal is powered up.

Clear to Send (to Teleray) - Pin 5

Must be asserted to allow the Teleray to transmit.

Signal Ground - Pin 7

This conductor establishes the common ground reference potential for all voltages on the interface. It is permanently connected to the Teleray logic ground and to the Teleray chassis.

Carrier Detect (to Teleray) - Pin 8

Must be asserted to allow the Teleray to receive.

**Data Set Ready (to Teleray)
Busy Ready - Pin 6**

This peripheral port signal is used to control the flow of data to the peripheral port. Its active level and its control effect can be programmed in the Selection Menu or by escape sequence.

Data Terminal Ready (from Teleray) - Pin 20

Data Terminal Ready is asserted at all times except under the following conditions:

1. Terminal is not powered up.
2. Terminal is in Local mode.
3. The 3.5-second interval following the pressing of SHIFT-BREAK.

EIA RS232C Signals

CCITT Circuit Number	EIA RS232C	Title	TELERA Y Serial I/O Pin No.	Comments
101	AA	Protective Ground	1	Chassis Ground
103	BA	Transmitted Data from terminal	2	Logical "0" = High +12V Logical "1" = Low -12V Idle = High
104	BB	Received Data to terminal	3	Logical "0" = High +12V Logical "1" = Low -12V Idle = High
105	CA	Request to Send signal from terminal	4	Goes high when terminal is ready to transmit
106	CB	Clear to Send signal to terminal	5	Must be high to allow terminal to transmit
107	CC	Data Set Ready from modem (Busy/Ready)	6	Signals that the modem is available unused by terminal
102	AB	Signal Ground	7	Logic Ground
109	CF	Carrier Detect signal to terminal	8	Must be high to allow terminal to receive
108/2	CD	Data Terminal Ready signal from terminal	20	High when Teleray is On Line

B. Peripheral Interface

The Teleray Model 16 has a bi-directional RS232 peripheral interface.

Pin assignment and electrical characteristics are identical to those of the serial I/O interface, except that the Data Set Ready (Pin 6) signal is also supplied.

C. Optional Current Loop (for Serial I/O only)

The optional current loop module installs in the logic board module at grid locations 1C and 2C (see Section 2-3-A). When installed, the current loop signals become active in the serial I/O connector on the pins shown below.

To activate the current loop, a jumper is required on the serial I/O connector from Pin 18 to Pin 3. When the current loop is installed, the RS232 signals remain active and may be used without removing the option, although different cable connectors are required.

Current Loop (Optional)

12 - Transmitted Data +
24 - Transmitted Data -
13 - Received Data +
25 - Received Data -

18 to 3 enables current loop.

In most current loop applications, the Teleray will be connected in a passive configuration (current is supplied to the Teleray). The transmitter and receiver are both passive, and both are optically isolated from the Teleray power and grounding. The transmitter goes to the mark state when power is turned off.

Conversion from active to passive (or vice versa) requires reconfiguring the current loop module.

In active mode, either the transmitter or the receiver or both may be connected so that the Teleray sources the 20 mA of current. In active mode, the signals are not electrically isolated from Teleray's ground, and the transmitter will go to the space state when power to the Teleray is turned off.

Electrical Characteristics

The electrical characteristics of the 20 mA current loop interface are shown below:

	<u>Transmitter</u>	
	Min	Max
Open circuit voltage	5.0 V	60 V
Voltage drop marking	-	3.0 V
Spacing current	-	2.0 mA
Marking current	10 mA	40 mA

	<u>Receiver</u>	
	Min	Max
Voltage drop marking	-	2.5 V
Spacing current	-	8.0 mA
Marking current	12 mA	40 mA

In addition to the above specifications for passive operation, active mode will place the transmitter or receiver in series with a source of 15 V + 5% and 600 ohms.

D. Optional Composite Video

The Teleray can be optionally supplied with a composite video output. This output is similar to EIA RS170 with the following exceptions:

1. The signal is non-interlaced.
2. Video rate is 13 MHz, exceeding the band width of some RS170 type monitors.

This composite output is fully compatible with the high resolution remote monitors sold by Teleray.

2-5 Maintenance

The keyboard keys are the only moving parts of the Teleray and require no preventive maintenance by the owner. The Teleray surfaces may be cleaned with soap and water or any mild detergent. Cleaners with solvents should not be used.

The Teleray enclosure is not designed to be weatherproof; there are several openings in the case through which liquids, coins, paper clips and other objects can fall. Such objects would disturb the electronic operation of the terminal if they came into contact with the circuitry. For this reason, avoid putting drinks and metal objects on the top of the terminal, or using excessive water to clean the terminal. Rubbing the keys with a dry or barely moist cloth should suffice to clean them.

CAUTION

Do not use cleaner containing organic solvents which are harmful to the faceplate or keytops.

In addition, the following routine maintenance procedures should be performed:

A. Weekly

Check operation of all switches and check all connectors and cables for looseness, abrasion, etc.

B. Annually

1. Inspect monitor screen during operation for burned-in characters (i.e., terminal has been operated for extended periods at high intensity with contrast turned up and constant data pattern displayed). If a pattern has been etched on the screen, reposition the CRT beam using the yoke ring magnets.
2. Ensure that the ventilation slots are clear. Blocking these slots by placing objects on top of or under the Teleray may cause the terminal to overheat.
3. Perform the self-test operations described in the following section taking any required corrective action if a failure is encountered.

C. Bi-Annually

Teleray recommends changing the non-volatile memory batteries bi-annually. While the typical battery will last five years or longer, an atypical battery may last only two years. If the battery is changed with power applied to the Teleray, the non-volatile memory will not have to be rewritten.

CAUTION

There are hazardous voltages inside the Teleray. Changing batteries should be performed only by someone familiar with servicing procedures and safety precautions.

2-6 Local Testing Summary

A. Screen Alignment Test - ESC [16; 7 y

This command causes the screen to be filled with underlined ♪ symbols. This character has a dense dot pattern for focus adjustment and is asymmetrical vertically and horizontally so that yoke nonlinearities are easily observed. This display can be used to adjust the monitor for focus and alignment.

B. Self-Testing

The terminal is automatically tested whenever the Teleray is turned on. The self-test can also be induced in the following ways:

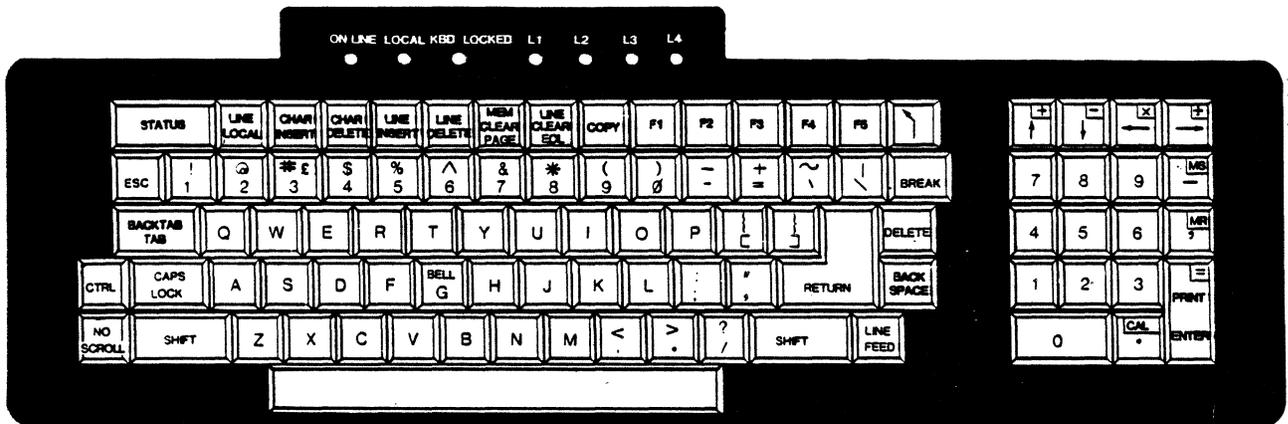
1. Entering a Reset to Initial State function (ESC c).
2. Entering an Invoke Self-Test command (ESC [16; y). The Invoke Self-Test command can perform additional tests not included in the Reset Self-Test (see 5-11).

SECTION 3 KEYBOARD

3-1 General Information

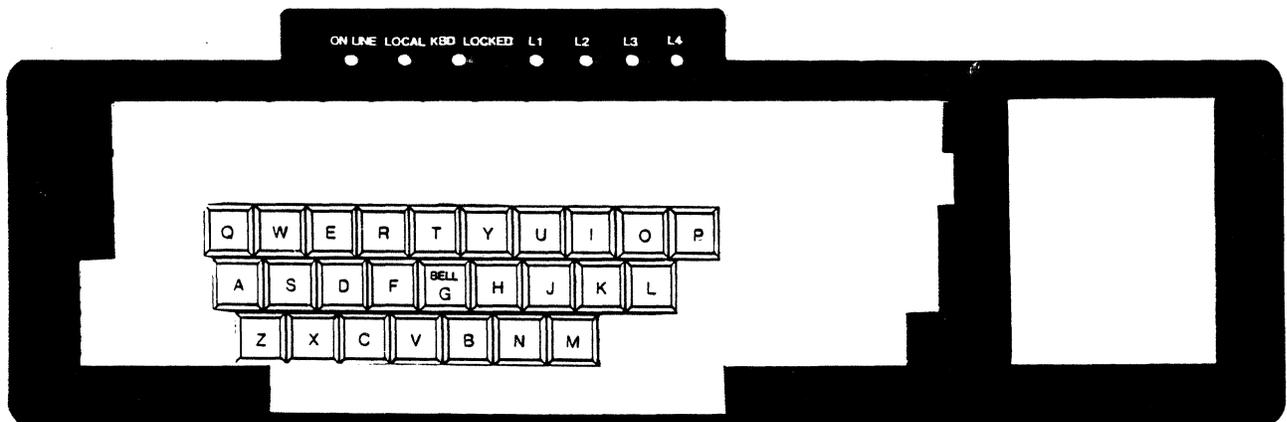
- The keyboard is detachable from the terminal for operator comfort and optimal space utilization. The keytops are sculptured with a dimpled 5 in the numeric pad and "deep dish" F and J keys. The coiled cord leading from the keyboard is terminated in a telephone type 4-pin connector; the cord supplied is compatible with those commonly used on Western Electric type telephones. Do not attempt to plug your keyboard into your telephone. The Teleray 16 keyboard has seven LED indicators: three are used to indicate the (legended) terminal status; the remaining four are used by the host computer to alert the operator of application dependent conditions.

The figure below shows the keyboard.



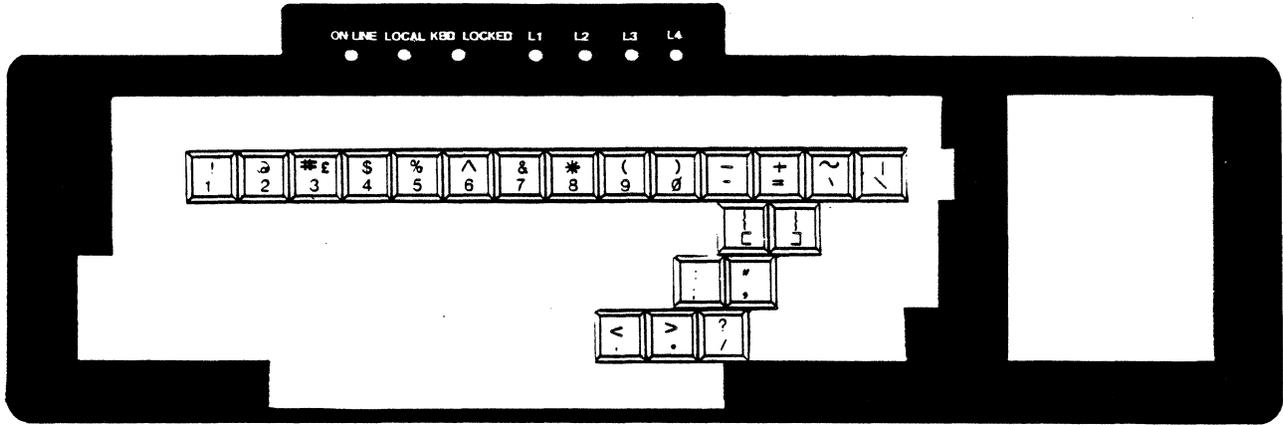
3-2 Alphabetic Keys

The keys shown below generate the appropriate ASCII character. Both upper and lower case can be generated under control of the SHIFT and CAPS LOCK keys.



3-3 Numeric and Special Symbols

The keys shown below generate the appropriate ASCII character. In the unshifted position, the character indicated by the lower legend is generated; in the shifted position, the character indicated by the upper legend is generated. The position of CAPS LOCK does not affect the operation of these keys.



3-4 Keyboard Mode Keys

The keys shown below are used to change the character codes transmitted by the alphabetic, numeric and special symbol keys. All 128 ASCII characters can be generated by the keyboard. Table 3-1 details the keyboard coding.

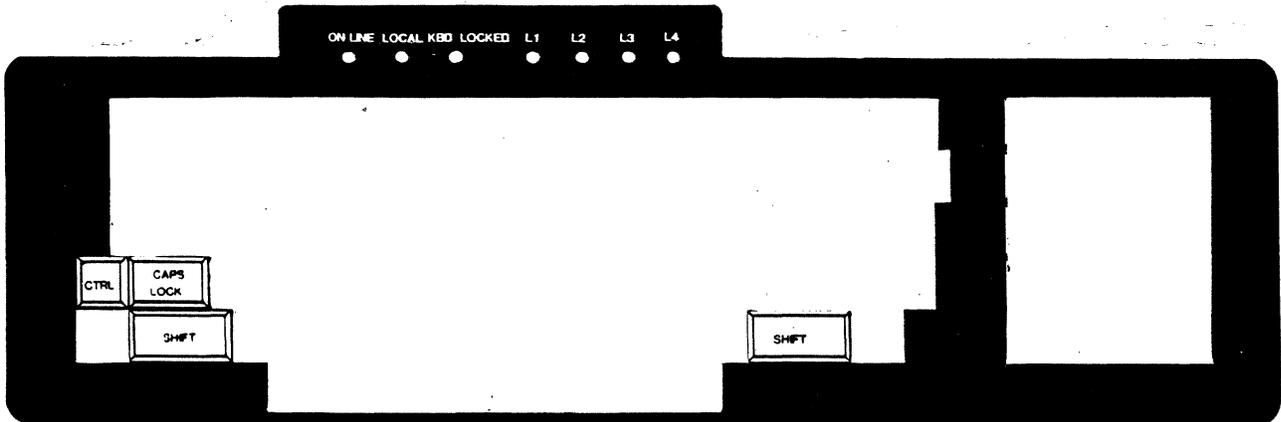
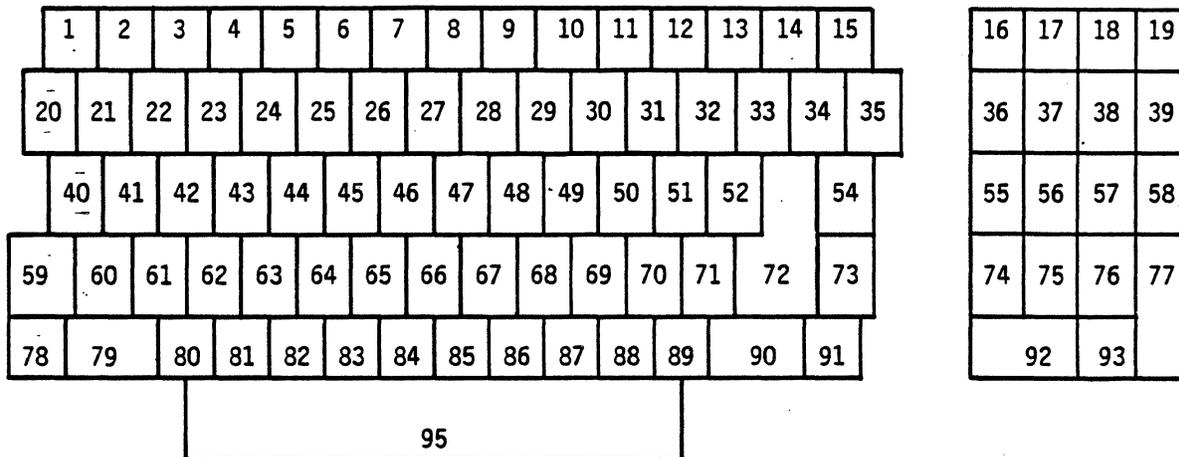


Table 3-1 - Keyboard Coding

Key Numbering Scheme

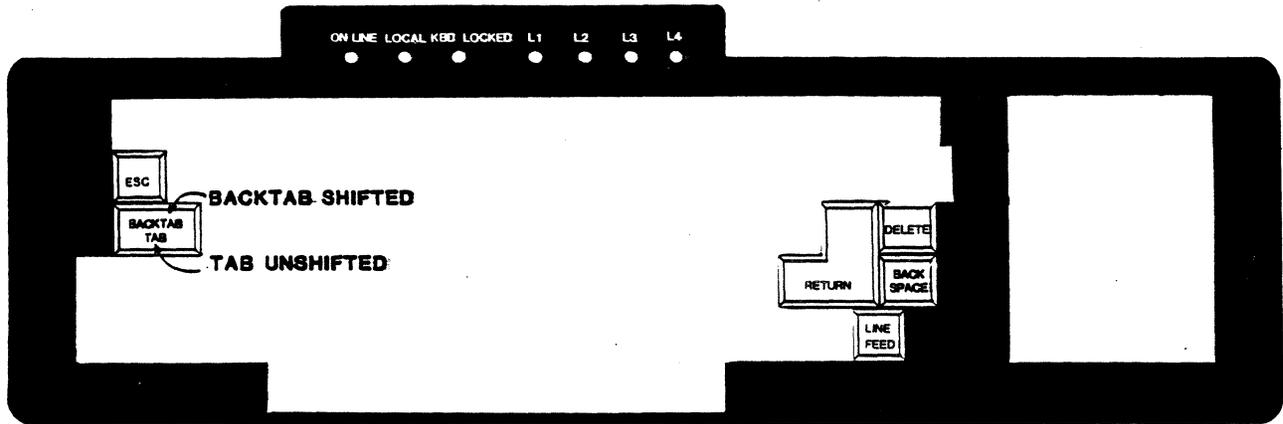


Key No.	Unshifted	Shifted	Control	Key No.	Unshifted	Shifted	Control
1	-----Unencoded-----			54	Delete	DELETE	DELETE
2 thru 15	---Dynamically Programmable---			59	-----Unencoded-----		
20	ESC	ESC	ESC	60	-----Unencoded-----		
21	1	!	1	61	a	A	SOH
22	2	@	NUL	62	s	S	DC3
23	3	#	ESC	63	d	D	EOT
24	4	\$	FS	64	f	F	ACK
25	5	%	GS	65	g	G	BEL
26	6	^	RS	66	h	H	BS
27	7	&	US	67	j	J	LF
28	8	*	DEL	68	k	K	VT
29	9	(	9	69	l	L	FF
30	0	)	0	70	;	;	;
31	-	_	=	71	:	:	:
32	=	+	=	72	CR	CR	CR
33	\	~	RS	73	BS	BS	BS
34	/	|	FS	78	-----Unencoded-----		
35	BREAK	BREAK-	ANSWERBACK	79	-----Unencoded-----		
		DISCONNECT		80	z	Z	SUB
40	HT	ESC [Z	HT	81	x	X	CAN
41	q	Q	DC1	82	c	C	ETX
42	w	W	ETB	83	v	V	SYN
43	e	E	ENQ	84	b	B	STX
44	r	R	DC2	85	n	N	SO
45	t	T	DC4	86	m	M	CR
46	y	Y	EM	87	,	<	,
47	u	U	NAK	88	.	>	.
48	i	I	HT	89	/	?	US
49	o	O	SI	90	-----Unencoded-----		
50	p	P	DLE	91	LF	LF	LF
51	[	{	ESC	95	SP	SP	NUL
52	]	}	GS				

Keys not shown are described in Section 3-7.

3-5 Dedicated Keys

The keys shown below generate fixed ASCII control character codes.



3-6 Special Operation Keys

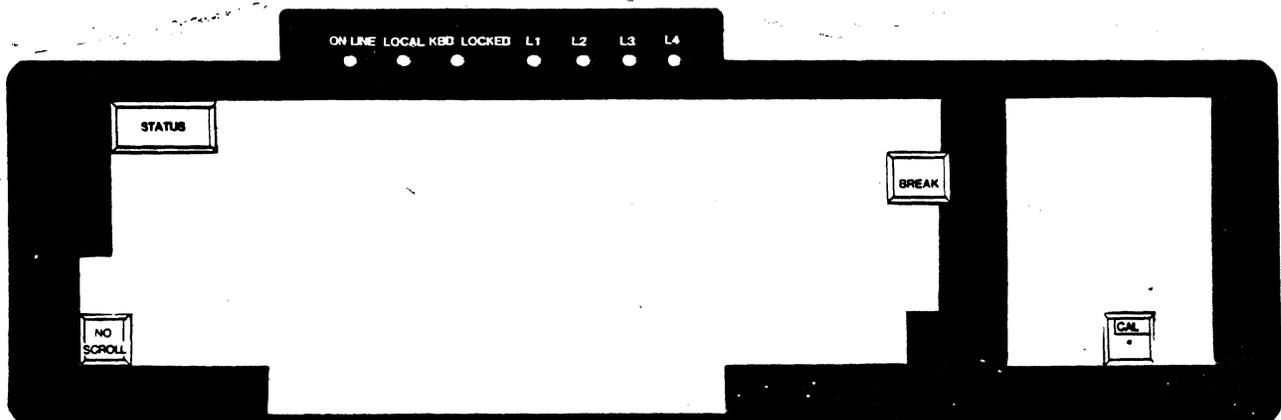
Pressing the BREAK key causes a 250 millisecond spacing condition on the data line. SHIFT and BREAK causes a 3.5 second spacing condition of the data line, and causes the Data Terminal Ready lead to go low for 3.5 seconds. Pressing CTRL and BREAK will initiate transmission of the answerback message if such a message has been previously entered.

The NO SCROLL key alternately transmits the DC3 (Suspend) and DC1 (Resume) control codes if the Suspend/Resume feature has been enabled. These codes are used to stop/start transmissions from the host computer, provided that the host recognizes these codes. If the Suspend/Resume feature is disabled, the NO SCROLL key will transmit no codes. See "Buffering" in Section 5-5, Operations, for further details.

The STATUS key is used to enter and exit Status mode, and to interrupt an undesired long-time function. Pressing this key will also unlock the keyboard and resume transmission.

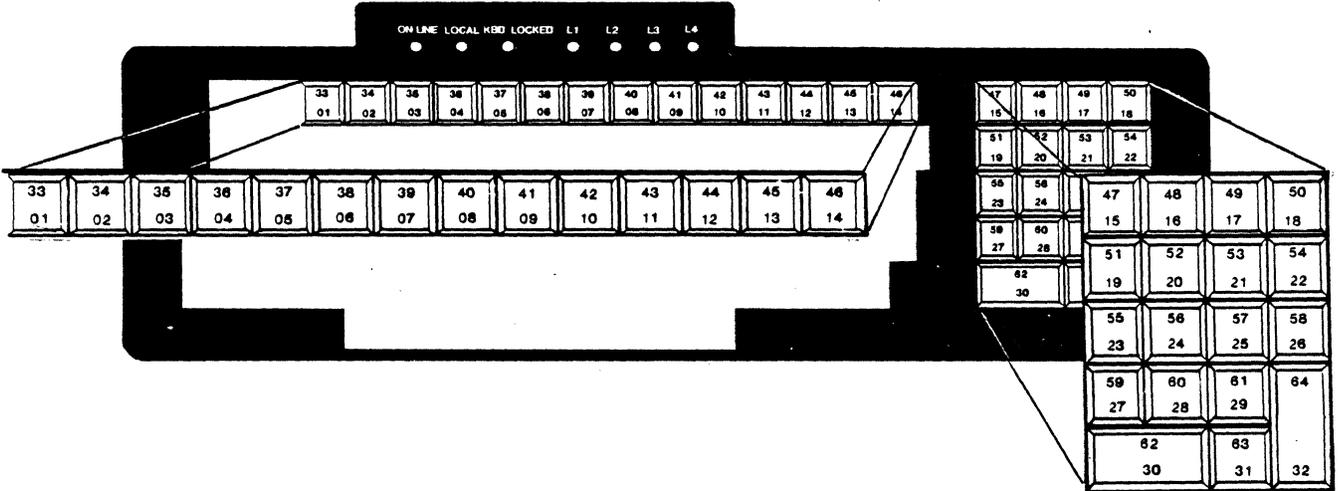
Pressing SHIFT and STATUS will display the Teleray's Selection Menu (see Section 4). Pressing SHIFT and the . in the numeric keypad will invoke Calculator mode. In either Calculator mode or Selection Menu, the numeric keypad is used to perform special functions and is not available for use as a numeric pad.

If the Suspend/Resume feature is enabled, this key will transmit the Suspend code (DC3) when the full page Selection Menu is displayed and transmit the Resume code (DC1) when the menu is exited. If the Suspend/Resume feature is disabled, the STATUS key will transmit no codes when entering or exiting the Page Selection Menu.



3-7 Macro (Reprogrammable) Keys

The keys shown below can be reprogrammed with any 8-character sequence (a macro). The only ASCII characters which may not be entered are NUL and ; (semicolon). Different macro sequences can be assigned to these keys in both shifted and unshifted positions.



The key numbers shown in the above figure are the macro numbers called by the keytop in that position on the keyboard. Table 3-2 shows the codes programmed in these macros by the Teleray factory; these are called the default values. The Reset to Default State command will reprogram these keys to default values; no other command, including Reset to Initial State, will modify the macro value except for the reprogram macro key sequences. These sequences are:

Reprogram Macro Key - Local	ESC P L P _S text; P _S text...
Reprogram Macro Key - Keyboard	ESC P K P _S text; P _S text...
Reprogram Macro Key - Transmitting	ESC P T P _S text; P _S text...
End Macro Key Definition	ESC \

where:

text may be any character or sequence except "ESC P L...", "ESC P K...", "ESC P T...", or "ESC \ " or ";". Program function sequences may be included.

P_S is the 2-digit macro number for the keys as shown in the figure above.

; is used to separate functions; this allows definition of several macros with one escape sequence.

The programming sequences need only redefine those macro keys you wish to change. The macros are stored in non-volatile memory to minimize required reprogramming. If no text (an empty text string) is supplied for a particular P_S, that keyboard macro will not have any effect on the Teleray when that key is pressed. This technique is recommended for those applications requiring certain keys to be disabled.

Therefore, there are three types of keyboard macros: Local, Transmitting, and Keyboard. Local macros operate locally only; no code is transmitted by them, and the ESCape sequence is executed by the Teleray. Transmitting macros are not interpreted by the Teleray, and the macro contents are transmitted to the host computer. If the host echoes the character sequence, it will be interpreted. Keyboard macros are treated as keyboard input. If the Teleray is in Local mode, they will be acted on locally; in Remote and Character modes, they will be transmitted. Figure 3-1 illustrates the operations of these macros.

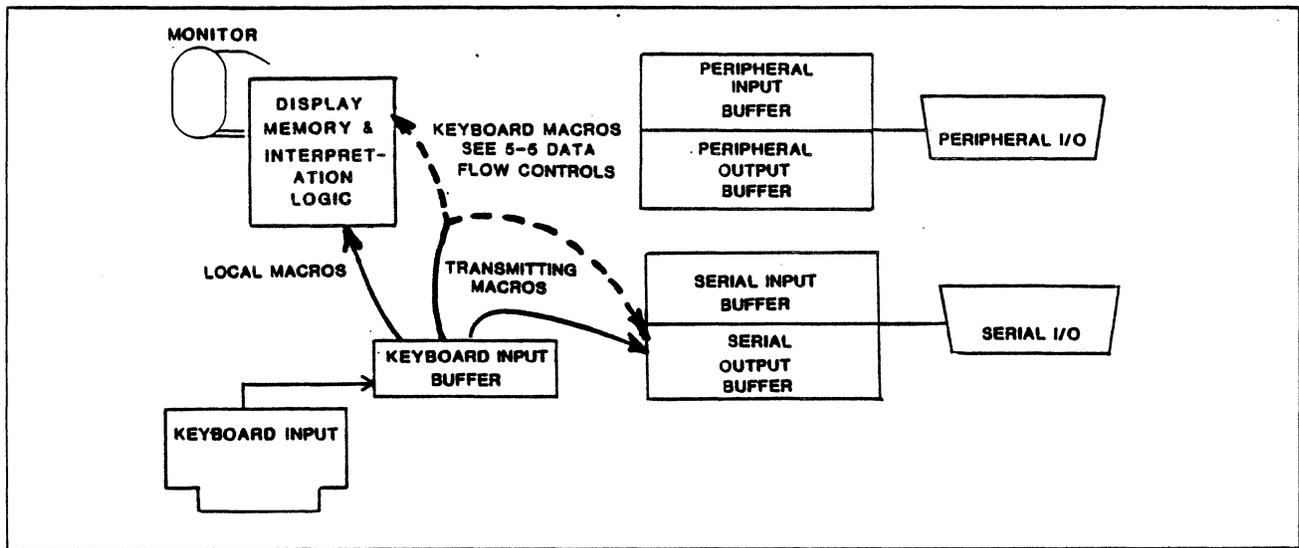


Figure 3-1: Macro Operations

Table 3-2 - Macro Key Default Values

Macro #	Type	Default Value	Macro #	Type	Default Value
01	L	ESC [? 12 h Local	33	L	ESC [? 12 ℓ Remote (on-line)
02	L	ESC [@ Insert Char	34	L	ESC [~ Insert in Para.
03	L	ESC [P Delete Char	35	L	ESC [p Delete Char in Para.
04	L	ESC [L Insert Line	36	L	ESC [L Insert Line
05	L	ESC [M Delete Line	37	L	ESC [M Delete Line
06	L	ESC [2 J Erase Page	38	L	ESC [? 2 J Erase Memory
07	L	ESC [0 K Erase to End of Line	39	L	ESC [2 K Erase Line
08	L	ESC [5 i Copy On	40	L	ESC [4 i Copy Off
09	L	ESC [01 u } See	41	L	ESC [06 t } See
10	L	ESC [02 u } Dynamic	42	L	ESC [07 t } Dynamic
11	L	ESC [03 u } Prog.	43	L	ESC [08 t } Prog.
12	L	ESC [04 u } Funct.	44	L	ESC [09 t } Funct.
13	L	ESC [05 u } 5-7	45	L	ESC ['0 t } 5-7
14	L	ESC [H	46	K	ESC [H
15	K	ESC [A One Up	47	K	ESC M Reverse Index
16	K	ESC [B One Down	48	K	ESC D Index
17	K	ESC [D One Left	49	K	ESC [D One Left
18	K	ESC [C One Right	50	K	ESC [C One Right
19	K	7	51	K	7
20	K	8	52	K	8
21	K	9	53	K	9
22	K	-	54	K	-
23	K	4	55	K	4
24	K	5	56	K	5
25	K	6	57	K	6
26	K	,	58	K	,
27	K	1	59	K	1
28	K	2	60	K	2
29	K	3	61	K	3
30	K	0	62	K	0
31	K	.	63	K	ESC [? 26 h Calc mode
32	K	CR	64	L	ESC [i Print

SECTION 4

SELECTION MENUS

The Teleray Model 16 contains many user-selectable features and modes of operation. The host computer can select features and change modes with ESCape sequences. The operator can change them with the same ESCape sequences or, more simply, with a special display form called a Selection Menu.

This Selection Menu form can be used in one of two ways: as a full-page (66 lines) menu, or sequentially as a single selection line on the terminal's bottom (25th) line. The choice of page selection or line selection menus can be made either by ESCape sequence or within each menu. These choices are described in Section 5-3, Application Controls.

The selection page menu format allows the operator to see all of the choices that are available on a single display page. When this page is accessed, the terminal's internal display memory is used to store the menu messages; consequently, the display memory contents are erased. The selection line menu accesses all of the same parameters as the full-page menu, but accesses them sequentially. The selection line menu does not erase the display memory.

Figure 4-1 represents the Selection Menu. Each individual block in the leftmost group represents a category of selections; each block in the rightmost group represents a feature selection. The current category and feature being selected within these blocks is indicated with a diamond instead of a square block. Of course, the prompt associated with the category and feature appears on the screen so that you do not have to memorize the meaning of each block.

The blocks and diamonds serve to indicate your current position in the table. The Teleray will remember the most recent access to the Selection Menu and will automatically return to that position whenever the Selection Menu is accessed. Each selection feature can be locked via an ESCape sequence so that this feature can no longer be changed from the keyboard. Features that have been locked will appear as dim blocks. If an entire category of features has been locked, the category indicator will appear dim.

Lock/Unlock Selection ESC [P_s; P_s space v / ESC [P_s; P_s space u

These ESCape sequences can be entered from either the computer or from the I/O ports. The second P_s selection parameter is the number of the selection feature within the category; the first P_s is the number of the category. The categories and features are numbered in the order they appear on the Teleray screen (and the order they appear on the following page top to bottom). Example: ESC [3; 7 space v locks the Screen Saver feature (in the Application Controls category). ESC [1; 6 space u unlocks the inverse video features (in the Ergonomic Controls category). If a parameter of 0 (zero) or if no parameter is given, the entire category will be locked or unlocked.

In Selection mode, the keyboard's numeric keypad block is specially interpreted. The remainder of the Teleray remains active, and the display memory will not be disturbed. The CURSOR RIGHT and CURSOR LEFT keys are used to select features within the category. When shifted, the CURSOR RIGHT and CURSOR LEFT keys are used to select categories. CURSOR RIGHT moves forward in the selection sequence; CURSOR LEFT moves backward.

There are three types of selections: On/off selections; parameter selections; and numeric selections.

The CURSOR UP and CURSOR DOWN keys are used to make on/off selections, respectively. The current state of each selection is shown on the display immediately following the feature prompt. These messages are designed to be self-explanatory. The CURSOR UP and CURSOR DOWN keys are used to course through the parameter list for parameter selections. The current state of each selection is displayed. Numeric selections are entered using the numeric keypad (only). Again, the current state of each selection will be displayed.

The selections available in each category are described in the appropriate operations section. The figure on the following page will assist in identifying the categories and locating these sections.

◆■■■■■	1 ERGONOMETRIC CONTROLS		<ul style="list-style-type: none"> 1 Brightness 2 Scroll Type 3 Scroll Rate 4 Keyboard Auto Repeat 5 Auto Repeat Rate 6 Inverse Video 7 Margin Bell Column 8 Cursor Blink 9 Cursor Character 10 Keyclick
■◆■■■■■	2 MEMORY STRUCTURE		<ul style="list-style-type: none"> 1 Tab Column 2 Left Margin Column 3 Right Margin Column 4 Left Margin Wrap 5 Right Margin Wrap 6 Scrolling 7 Page Advance 8 Characters Per Line 9 Lines Per Page 10 Number of Pages
■■◆■■■■	3 APPLICATION CONTROLS		<ul style="list-style-type: none"> 1 Monitor Model 2 Set Hours 3 Set Minutes 4 New Line 5 Function Loading 6 Screen Refresh Rate 7 Screen Saver 8 Answerback 9 Terminal Identity 10 Selection Menu
■■■◆■■■	4 COMMUNICATIONS FORMAT		<ul style="list-style-type: none"> 1 Serial Baud Rate 2 Serial Parity Type 3 Serial Parity Check 4 Serial Duplex 5 Prphl Baud Rate 6 Prphl Parity Type 7 Prphl Parity Check 8 Prphl Duplex
■■■■◆■	5 DATA FLOW CONTROLS		<ul style="list-style-type: none"> 1 Local/Remote 2 Block/Character 3 Serial Copy 4 Serial Suspend-Resume 5 Serial Local Echo 6 Prphl Copy 7 Prphl Suspend-Resume 8 Prphl Busy-Ready 9 Prphl Busy-Ready Level
■■■■■◆	6 BLOCK TRANSMIT FORMAT		<ul style="list-style-type: none"> 1 Transmit 2 Transmit to Cursor 3 Transmit Guarded 4 End of Line Suspend 5 Serial Space Suppression 6 Serial Space Substitution 7 Prphl EOL Suspend 8 Prphl Space Suppression 9 Prphl Space Substitution
■■■■■◆	7 TRANSMIT TERMINATORS		<ul style="list-style-type: none"> 1 Serial Start of Transmit Code 2 Serial Guarded Field Code 3 Serial End of Line Code 4 Serial End of Page Code 5 Serial End of Transmit Code 6 Prphl Start of Transmit Code 7 Prphl Guarded Field Code 8 Prphl End of Line Code 9 Prphl End of Page Code 10 Prphl End of Transmit Code

Figure 4-1: Selection Menu

SECTION 5 OPERATIONS

◆■■■■■ Ergonomic Controls

SECTION 5-1

■◆■■■■■ Memory Structure

SECTION 5-2

■■◆■■■■ Application Controls

SECTION 5-3

■■■◆■■■ Communications Format

SECTION 5-4

■■■■◆■■ Data Flow Controls

SECTION 5-5

■■■■■◆■ Block Transmit Format (& Terminators)

SECTION 5-6

Programmable Functions

SECTION 5-7

Text Presentation Format

SECTION 5-8

Cursor Positioning

SECTION 5-9

Erases, Reports & Messages

SECTION 5-10

Test Reports & Messages

SECTION 5-11

Graphic Sets & Control Characters

SECTION 5-12

5-1 Ergonomic Controls

These controls are provided to increase operator comfort. All of the features can be changed in the Teleray Selection Menu and are immediately stored in non-volatile memory.

A. Display Features

Screen Brightness Level	ESC [P _n space s
Cursor Character Select	ESC [P _s space q
Cursor Character Blink/Steady	ESC [? 33 h / ESC [? 33 l
Screen Background Dark/Light	ESC [? 5 l / ESC [? 5 h
Smooth Scroll/Jump Scroll	ESC [? 3 h / ESC [? 3 l
Scroll Rate 6/12	ESC [? 22 l / ESC [? 22 h

The ↑ and ↓ keys will increase and decrease, respectively, the screen brightness in the Selection Menu; the ESCape sequence shown can be used to set the brightness to any absolute value between 0 and 64; 0 is off, 64 is fully bright.

The cursor character can be selected from any character in the Teleray repertoire. Figure 5-1 lists all possible values for these (decimal) parameters. Other language versions of the Teleray have the same character substitutions in this table as in the ASCII set. The cursor character will blink once per second when the cursor blink feature is selected. If the steady cursor is selected, it will also blink when it is placed over a "non-space" character.

	0	20	40	60	80	100	120	140	160	180	200	220	240
	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU	THRU
	19	39	59	79	99	119	139	159	179	199	219	239	255
0	N _U	D ₄	<	<	P	d	x	Ω					
1	S _H	N _K	)	=	Q	e	y	⊖					
2	S _X	S _Y	*	>	R	f	z	μ					
3	E _X	E _B	+	?	S	g	{	π					
4	E _T	C _N	,	@	T	h	|	♥					
5	E _O	E _M	-	A	U	i	}	♦		°			
6	A _K	S _B	.	B	V	j	~	♣		↑			
7	B _L	E _C	/	C	W	k	■	♠		←			
8	B _S	E _S	0	D	X	l	²	♠		↓			
9	H _T	G _S	1	E	Y	m	³	9		→			
10	L _F	R _S	2	F	Z	n	x	⊙		□			
11	V _T	U _S	3	G	[	o	÷	T _M		▒			
12	F _F		4	H	\	p	°	1/2					
13	C _R	!	5	I	]	q	±	1/4					
14	S _O	"	6	J	^	r	≤	⊙					
15	S _I	#	7	K	_	s	≥	↑					
16	D _L	\$	8	L	'	t	≠	✓					
17	D ₁	%	9	M	a	u	∞	ℓ					
18	D ₂	&	:	N	b	v	Σ	ℓ					
19	D ₃	'	;	O	c	w	∫	♫					

Figure 5-1: Decimal Character Selection Table

The screen background dark/light feature allows the normal screen mode to be either light characters on a dark background or dark characters on a light background. The "inverse" text presentation format selection will reverse the background of the appropriate field.

Scrolling is the upward or downward movement of existing lines on the screen to make room for new lines at the bottom or top of the screen or display memory. It can be performed in two ways: jump scroll or smooth scroll. In jump scroll mode, new lines appear on the screen as fast as the computer sends them to the terminal. At the higher baud rates, the data is very difficult to read due to the rapid movement of the lines. This can be corrected by either writing the pages from the top down or by invoking smooth scroll mode.

In Smooth Scroll mode, a limit is placed on the speed at which new lines of data may be sent to the terminal. The movement of lines occurs at a smooth, steady rate, allowing the data to be read as it appears on the screen. The Teleray supports two vertical smooth scroll rates: 6 or 12 lines of data per second may be selected. The Teleray employs smooth horizontal scrolling to keep the cursor in view when operating with logical line lengths greater than 80 characters per line. The 24 line by 80 character display window can be "panned" smoothly through the display memory.

The Auto Suspend/Resume feature should be enabled and supported by the host computer to ensure that data is not lost when Smooth Scroll mode is enabled. If data is transmitted to the Teleray faster than allowed by the selected smooth scroll rate, the Teleray will automatically revoke smooth scroll when incipient input buffer overrun is sensed. The Teleray will remain in Jump Scroll mode until the input buffer is emptied to a safe level. See Section 5-5-B.

B. Keyboard Features

Auto Repeat On/Off	ESC [? 8 h / ESC [? 8 l
Auto Key Repeat Rate 30/15 cps	ESC [? 21 l / ESC [? 21 h
Keyclick On/Off	ESC [? 28 h / ESC [? 28 l
Right Margin Bell Column	ESC [P _n space r

The auto repeat feature allows a key to be automatically repeated after the key has been held down for more than one-half second. The auto repeat feature affects all keyboard keys.

The repeat rate feature can be selected to 15 characters per second or 30 characters per second. The keyclick is a tone that is generated every time a code transmitting key is pressed. The keyclick may be turned on or off to suit the operator's needs.

The margin bell feature is much the same as the bell in a typewriter. When the cursor enters the column eight characters from the end of the current logical line while typing, the Teleray sounds a tone to alert the operator. The column in which the bell is sounded can be selected in the Menu or by ESCape sequence. The numeric parameter in the ESCape sequence is the number of characters from the end of the current logical line right margin in which the bell will be sounded.

5-2 Memory Structure

The Teleray Model 16 display memory can be user-configured into the organization best suited for the application. Teleray's memory structure is configured by resetting the logical line length, the logical page length, and the number of pages. If the 4-page or 8-page non-volatile memory options are installed, memory not desired as display memory can be allocated as non-volatile dynamic program function memory; the logical line length, logical page length, and the number of pages to be used as display memory are user-specified. The remaining memory will be used as non-volatile dynamic program memory. Excess volatile memory cannot be used as non-volatile dynamic program function memory.

The display and optional non-volatile function memory is cleared when the memory structure is modified.

A. Line Length

Logical Line Length - Default 80 characters per line. Saved in non-volatile memory, changed in the Selection Menu or by ESC [P_n ? q.

Set Left; Right Margins - Defaults left column 1; right column 80. Changed in the Selection Menu or by ESC [P_n; P_n s.

The logical line length can be reset to any integer number from 20 through 255 inclusive. The display line length is fixed at 80 columns; line lengths shorter than 80 columns will appear left justified with unused character positions on the right automatically blanked. If more than 80 characters is selected as the logical line length, smooth horizontal scrolls will automatically keep the cursor in view. This operation can be further controlled or restricted by setting left or right margins. All operations that reference a horizontal line position will reference the logical line length, not the 80-character physical display line length.

B. Margin Wraps

Right Margin Wrap On/Off - Default OFF. Saved in non-volatile memory, changed in the Selection Menu or ESC [? 7 h / ESC [? 7 L

Left Margin Wrap On/Off - Default OFF. Saved in non-volatile memory, changed in the Selection Menu or by ESC [? 29 h / ESC [? 29 L

If left margin wrap is ON and a cursor left function is initiated from Column 1, the cursor will move to the last column in the preceding logical line. Smooth horizontal scrolls will be initiated if necessary to keep the cursor visible. A cursor left initiated in the left margin wrap OFF mode will be ignored. Right margin wraps operate analogously. If a left wrap is initiated from the Home (top left) position of the current display page or if a right wrap is initiated from the bottom line rightmost position of the logical lines, the actions taken will depend on the condition of the Scrolling On/Off and Page Stop/Page Auto Advance modes described below.

C. Page Length

Logical Page Length - Default 24 lines per page. Saved in non-volatile memory, changed in the Selection Menu or by ESC [P_n ? p

Set Top; Bottom Margins - Default Line 1; last line in page. Changed by ESC [P_n; P_n r.

The logical page length can be reset to any integer value from 4 to 255 inclusive; however, it cannot be set to a number that would exceed the memory capacity of the Teleray. The display line length is fixed at 24 lines. Page lengths less than 24 may be used to form "scrolling windows" within the display page, or may be used to format data or text blocks into segments forming complete application records, forms, or files. The top and bottom margins can be used to form display windows which do not affect the organization of the remainder of the display memory and override the page size setting. More than 24 lines are useful for forms that occupy more than a single display page. A single very long page length is important in Character (non-block) mode applications involving searching or editing computer files.

D. Scrolling

Scrolling On/Off - Default ON. Saved in non-volatile memory, changed in Set-Up or by ESC [? 30 l / ESC [? 30 h.

Page Stop/Page Auto Advance - Default page stop. Saved in non-volatile memory, changed in Set-Up or by ESC [? 31 l / ESC [? 31 h.

These two controls affect how the Teleray will act when an attempt is made to position the cursor beyond a page boundary using an Index or Reverse Index command, or if an attempt is caused by the implicit cursor movement associated with character entry.

<u>Scrolling</u>	<u>Page</u>	<u>Action Taken</u>
On	Stop	Scrolls occur within current page
On	Auto Advance	Scrolls occur in all display memory pages
Off	Stop	Overwrite within current pages
Off	Auto Advance	Automatically "flip" into next page in the display memory

The cursor will not move backward (no action will be taken) beyond the first character of the first page of memory, nor will it move forward beyond the last character of the last page of memory. These controls do not affect the operation of Next Page or Previous Page. Scrolling is automatically set OFF (without affecting non-volatile memory) when Protect mode is invoked; the mode will be set to its non-volatile memory condition when Protect mode is revoked. To scroll all of memory from the bottom page, memory must be organized as a single long page.

E. Number of Pages

Select P_n Pages - Default 4 pages. Saved in non-volatile memory, changed in Set-Up or by ESC [P_n space p.

The number of pages can be reset to any integer number from 1 through 255 inclusive; however, it cannot be set to a number that would exceed the memory capacity of the Teleray. Figure 5-2 illustrates the number of lines available with various characters per line sizes. The shaded area in the figure represents the display of the Teleray; the hatched area represents the default memory structure. The number of pages available in the machine is computed from the number of lines available less the amount of memory reserved for additional non-volatile function memory (only if an option is installed) divided by the logical page size. Formulas for memory structure and examples are on the following page.

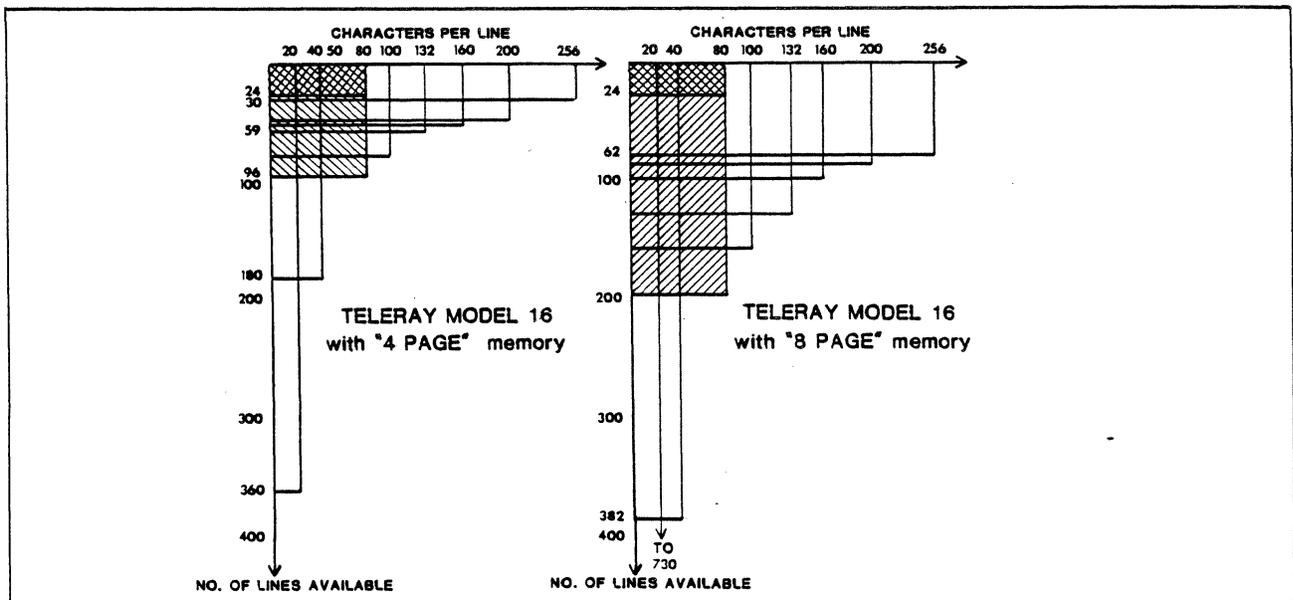


Figure 5-2: Teleray Available Memory

Memory Available:

4-page machine - 15,744 characters
 8-page machine - 32,128 characters

Formulas

M = Memory Available - R

$$N = \frac{M}{2L + 4}$$

$$P = \frac{N}{Q}$$

Note: Discard all fractions; partial lines or pages are not usable except as function memory.

Legend

Memory usable = M
 Memory reserved for function memory = R
 Logical line length = L
 Number of lines available = N
 Number of pages = P
 Logical Page Length = Q

Example 1

4-page Teleray
 Zero characters reserved for function memory.

$$M = 15,744 - 0 = 15,744$$

Logical line length = 160 characters

$$\text{No. of lines available } N = \frac{15,744}{2 \cdot 160 + 4}$$

$$N = 48 \text{ (discard fraction)}$$

24 lines per page.

Number of pages P = 2 (no fraction)

Table 5-1: Number of Lines & 24-Line Pages Available at Selected Logical Line Lengths

Characters Per Line	No. of Lines		No. of 24-Line Pages	
	4-Page Teleray	8-Page Teleray	4-Page Teleray	8-Page Teleray
20	360	730	15	30
40	180	382	7	15
72	106	217	4	9
80	96	195	4	8
100	77	157	3	6
132	59	128	2	5
160	48	99	2	4
200	38	79	1	3
255	30	62	1	2

Example 2

8-page Teleray
 4000 characters reserved for function memory.

$$M = 32,128 - 4000 = 28,128$$

Logical line length = 40 characters

$$\text{No. of lines available } N = \frac{28,128}{2 \cdot 40 + 4}$$

$$N = 334 \text{ (discard fraction)}$$

24 lines per page.

Number of pages P = 13, fraction .952.
 This fraction can be used as additional function memory for $4000 + .952 \times 24 \times 40 = 4,914$ characters total.

Example 3

8-page Teleray
 Zero characters reserved for function memory.

$$M = 32,128 - 0 = 32,128$$

Logical line length = 132 characters

$$\text{No. of lines available } N = \frac{32,128}{2 \cdot 132 + 4}$$

$$N = 119$$

Set machine for 119 lines per page to organize machine as a 119-line scrolling machine.

F. Interactions of Margins and Pages (see also 5-9)

Memory pages are a convenient way to organize the Teleray's memory if the application requires using forms of a specific length (one page per form) or if most records are of a fixed length. Changing memory page length erases the display memory because it involves reformatting the entire display memory.

If the Teleray is to be used in a bottom line entry interactive environment, it is usually advisable to set the machine for one display page. This allows scrolls to occur throughout memory. Alternatively, setting the page length to 24 lines will allow fast searching of the Teleray display using the previous page and next page operations; macro keys can be programmed for that purpose.

Top and bottom margins are used to restrict scrolling or data entry to a specific area within a page. This is particularly useful when a presentation format surrounding an operator entry area exceeds one line; if a single line of format is sufficient, use of the bottom line is recommended. The margin settings must not exceed the display page, and they may not overlap a page boundary.

G. Tab Operations

Cursor to Next Tab Stop	HT
Set Tab Stop in Current Column	ESC H
Clear Tab Stop in Current Column	ESC [g
Clear All Tab Stops	ESC [3 g
Back P _n Tab Stops	ESC [P _n Z

Just like a typewriter, the Teleray Model 16 can jump or tab to preselected points on a line. These tab stops may be individually changed, or totally cleared and then set. Columnar tab stops apply to all lines in the page. They are preset at power-on to Columns 1, 9, 17, 25, 33, 41...(every eight columns to the end of the logical line). If all columnar tab stops are cleared, a columnar tab stop is implied in Column 1. In Protect mode, implicit tab stops are set at the beginning of every unprotected area in addition to the columnar tabs.

The Selection Menu provides a convenient method for operator selection of columnar tab stops. A dim inverse field is presented with a single bright character indicating the current tab stop entry position. The column number of this entry position is indicated; tab stops in the dim field are indicated by a "T". The operator can add tab stops with the unshifted ↑ key and may delete them with the unshifted ↓ key. The shifted ↑ and ↓ keys will move the field through the logical line.

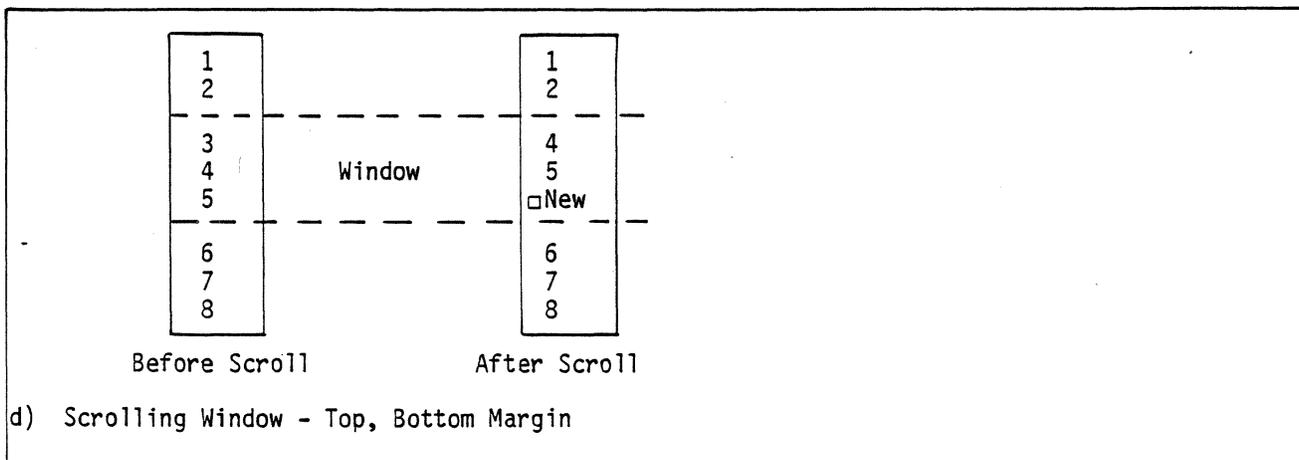
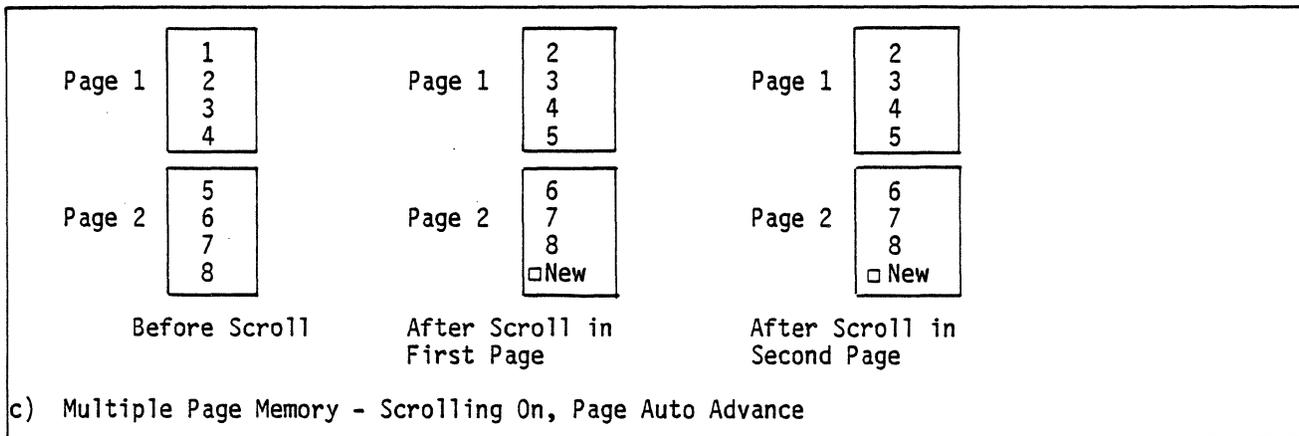
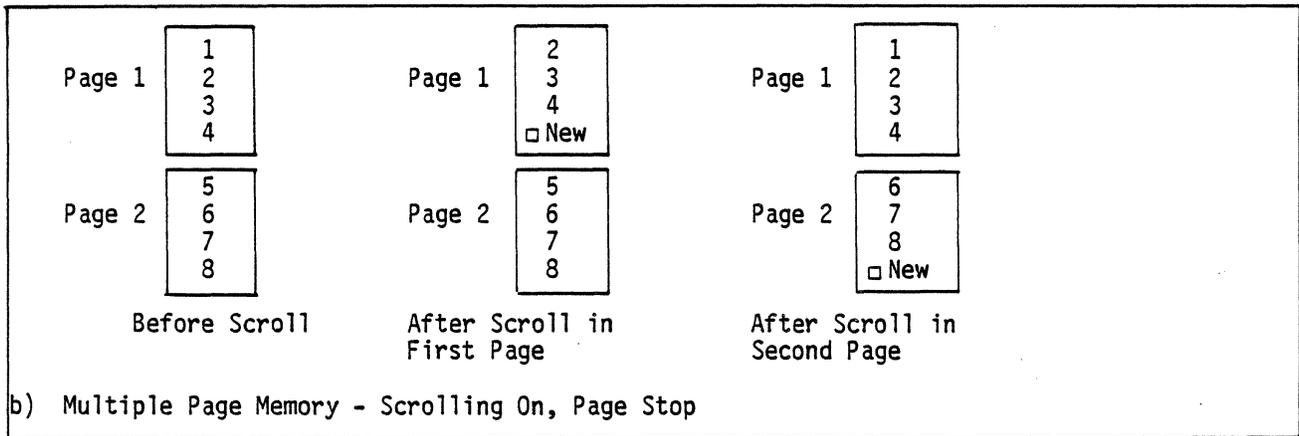
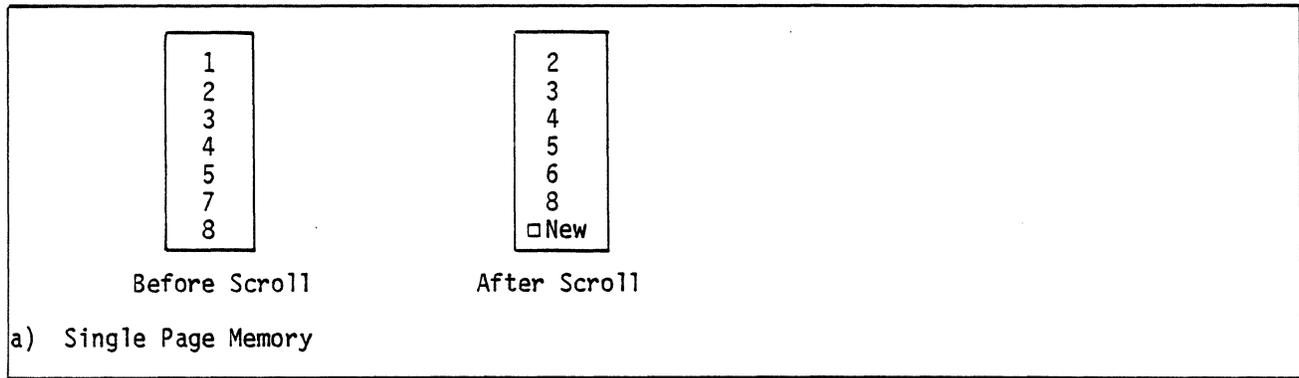


Figure 5-3: Scrolling Page/Margin Interactions

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5-3 Application Controls, Operator Alerts, and Bottom Line Displays

A. Application Controls

Monitor Mode/Normal	ESC [3 h / ESC [3 l
New Line Mode/Line Feed	ESC [20 h / ESC [? 20 l
50/60 Hz Refresh Rate	ESC [? 34 h / ESC [? 34 l
Screen Saver On/Off	ESC [? 32 h / ESC [? 32 l
Selection Menu Line/Page	ESC [? 50 l / ESC [? 50 h

When the Teleray is placed in Monitor mode, all control characters including Escape, NUL, and Delete are treated as data and entered into the display memory. Monitor mode allows the Teleray to be used as a line monitor. This mode allows display entry of control characters, which can also be used to view a programmed function. In Monitor mode, the Teleray automatically wraps on the right margin.

The new line feature enables the RETURN key on the terminal to function like the RETURN key on an electric typewriter. When the new line feature is selected, pressing the RETURN key generates the carriage return (CR) and line feed (LF) codes. When a line feed code is received, the code is interpreted as a carriage return and line feed. When the line feed feature is selected, the RETURN key generates only the CR code; an LF code causes the terminal to perform a line feed only. If double line feeds occur consistently, turn this feature off since the computer is already performing this function automatically.

During the initial installation, the terminal display should be set to the power line frequency. In the U.S., this is set to 60 Hz. This selection also changes the number of lines presented on the optional composite video signal to remain compatible with television systems in countries where the television signals are based on 50 Hz refresh rates.

If Screen Saver is enabled, after 12 minutes of inactivity, the Teleray display will automatically shut down to maximize tube life. Any keyboard or I/O activity will instantly restore the display without a loss of data. The SHIFT keyboard key can be used to restore the screen without affecting the Teleray memory. This feature can be enabled or disabled in the Selection Menu.

The Selection Menu form can be used in one of two ways, as a full-page (66 lines) menu or sequentially as a single selection line on the terminal's bottom (25th) line. The choice of page selection or line selection menus can be made by ESCape sequence or within each menu. When the Selection Menu is changed, the new menu will appear on the Teleray display as soon as any key is struck. Changing the menu from single line to full page will erase the Teleray display memory.

B. Operator Alerts

Sound Bell	Bel
Keyboard Lock/Unlock	ESC [2 h / ESC [2 l
Illuminate/Extinguish LEDs	ESC [P _s ; P _s ;...P _s q

The bell tone is produced upon receipt of the ASCII BEL code. The bell is also used to generate the audible keyclick, which can be selected in the feature menu; a bell tone may also be produced by entering data eight columns from the right margin. A short duration tone is given during programming of the dynamic programmable functions; long tones are issued when the function memory is within 10 characters of capacity. A very long tone (approximately 1.65 seconds) sounds during initial power on; this tone indicates normal operation.

With keyboard action locked, all keyboard characters typed are lost except for STATUS. Entering and exiting STATUS will clear the keyboard locked condition.

The keyboard has seven light emitting diodes (LEDs), of which two are committed to the complementary On-Line/Local function. The power-on condition is implicitly shown by one of the two LEDs being on; that is, if the keyboard is connected and power is on, one of these LEDs will be on. A third LED indicates a "keyboard locked" condition. In this condition, the keyboard has been "turned off" automatically by the terminal due to a full buffer or by the host through the transmission of a Suspend to the terminal.

Whenever the On Line, Local and Keyboard Lock feature selections are changed, the appropriate LED will be placed in the proper condition. It is strongly recommended that the host computer not interfere with this operation by attempting reprogramming of these three LEDs except for diagnostic uses.

P _s	LED Action
0 or none	All off
1	L1 on
2	L2 on
3	L3 on
4	L4 on
5	On Line on
6	Local on
7	Keyboard Locked on

C. Bottom Line (25th Line)

1. General Information

In addition to the 24 display lines used for application information, the Teleray has a 25th line presented below the 24th. Table 5-2 shows the displays that can be presented and shows how to access them.

Table 5-2: Bottom Line Displays

Title	Access By
Teleray Status Line	ESCape sequence or STATUS key
Calculator Line	ESCape sequence or SHIFT and numeric keys
Message Line	STATUS key if "MSG" indicator is on the bottom line
Self Test Result Line	Automatic on completion of self test
Line Selection Menu	SHIFT and STATUS key
Page Selection Menu Prompts	SHIFT and STATUS key
No Display	ESCape sequence or retyping request for current display

Each of these display lines, except for Self Test Result, is also stored in the Teleray's memory. When these lines are requested by the operator or by ESCape sequence, their previous contents will be displayed on the status line. This means that if the computer sends a message to the status line and the operator is using it for another display, the current contents of the display line will not be lost. However, self test values are not saved, nor are previous host computer messages.

An ESC [space w sequence can be used to turn off, or blank, the current bottom display line. If the display line is turned off, the message indicator will still appear. If the bottom line is being used to display the terminal status, calculator mode, single line setup mode, or self test display, and if any other mode is requested, the new operation will have precedence.

2. Status Line - On: ESC [? 27 h Off: ESC [? 27 l

This line displays the current status of the terminal. The clock, cursor column, cursor line number, and cursor page number are displayed, and the state of the copy-on-line and Protect mode features is indicated. A special field will indicate if an incorrect data entry is attempted in a field that has a special attribute, such as alphanumeric only, numeric only, must fill, etc.

3. Calculator Line - On: ESC [? 26 h Off: ESC [? 26 l

The calculator line is enabled by pressing the SHIFT and the numeric keypad PERIOD "." symbol; this key is reverse legended CAL. In Calculator mode, the numeric keypad keys are specially interpreted to perform the operations indicated by the reverse background legends shown on the keytops and in the figure below. MS performs a memory save operation; MR performs memory recall. The shifted = key will clear the current operand. The memory is cleared by storing zero. These keys do not transmit ASCII sequences but are used to control

the calculator built into the Teleray, which uses the bottom line to indicate current operations and totals. The remainder of the terminal remains active, and the display memory contents will not be disturbed by using the calculator line. When entering or leaving calculator line mode, the current contents of the calculation will not be lost. Any intermediate operations that have been partially entered but are not yet complete will be lost, but the total and the memory will be saved.

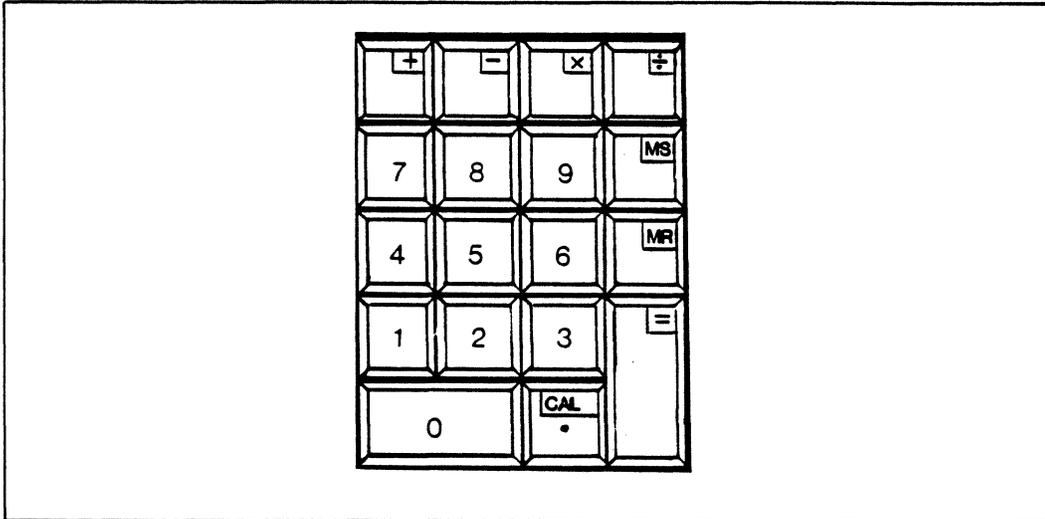


Figure 5-4: Calculator Keypad

4. Message Line - ESC P M text ESC \

When a text message is sent from the host computer, it is not immediately displayed. Instead, a small message indicator appears on the far right-hand side of the Teleray's bottom line. This message will appear regardless of what the bottom line is currently being used for. If the message indicator is being displayed, pressing the upper left keyboard key labeled STATUS will store the current bottom display line and place the computer message on the bottom line. If a message is being displayed and the Teleray receives another message, the second message will be immediately displayed. The maximum text message accepted by Teleray is 80 characters of displayable text. Attributes may be used on the message line.

5. Self Test Result Line

The Teleray bottom line is used to store the self test result. This line will be automatically written following the automatic self testing performed during the power-up sequence, following a reset to initial state sequence, following a reset to default sequence, or following completion of a host computer or operator-directed self test sequence. These directed tests are invoked by ESCape sequences (see Section 5-11, Tests, Reports, and Messages). The self test result is displayed in the following format from left to right.

ROM	Read Only Memory Test
DSP	Display Memory Test
KBD	Keyboard Test
SIO	Serial Input/Output Test
PIO	Peripheral Input/Output Test

Following these 1-character test reports (1 = Pass; 0 = Failed) will be a code that indicates the current Teleray program revision level, a copyright indicator, followed by the name TELERAY. When the self test is transmitted to the computer, only the display up to but not including the copyright indicator will be transmitted.

D. Lock/Unlock Keyboard

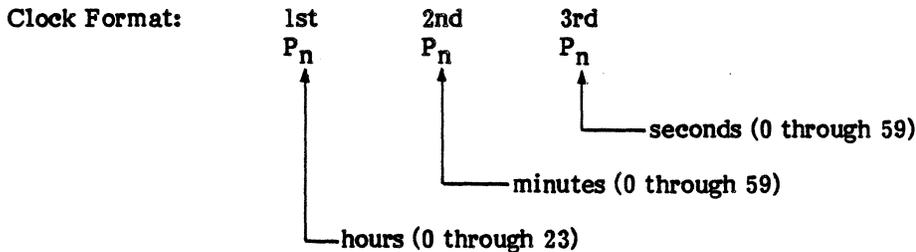
Lock Selection - ESC [P_n; P_n space v
Unlock Selection - ESC [P_n; P_n space u

Each category and feature can be locked against manual intervention by the keyboard. ESCape sequences keyed on the keyboard will unlock the appropriate feature. If a category or feature is locked, it will still be displayed; the diamond or rectangle graphically representing its position in the menu will be displayed dim. The category and feature prompts will still be displayed and the selection description displayed.

E. Clock

Set Clock Time	ESC [P _n ; P _n ; P _n ? s
Request Time	ESC [? 7n
Report Clock Time	ESC [P _n ; P _n ; P _n ? r
Delay Next Operation	ESC [P _n ; P _n ; space t

The Teleray contains a crystal controlled clock. This clock can be written or read by the computer and by the operator. The clock is displayed on the status line.



Status display is a 12-hour clock (no AM, PM)
Computer clock is a 24-hour clock, military time format
(e.g., 14 = 2 PM, 2 = 2 AM, etc.)

The clock can also be used to inhibit Teleray operations for specific periods of time. The delay format is: first P_n in seconds 0 through 59, second P_n in tenths of seconds. During the delay interval, data is accepted into the input buffers, but is not processed. The keyboard is locked during the delay interval. The delay is useful in conjunction with the operator alerts and is useful for performing rudimentary animation with the graphic character set.

Multiple uses of this ESCape sequence in succession can be used to obtain virtually any desired time delay.

Note that while a delay is in effect the cursor disappears from the screen, the keyboard is locked, and the passing of data from the datacomm firmware to display memory is inhibited.

F. Answerback and Identity Messages

Answerback and Identity are question and answer sequences used by the host computer to identify or locate the Teleray. These sequences may be viewed in the Selection Menu, but may only be changed via ESCape sequences. See Section 5-11-C, Reports.

G. Function Loading Interpreted/Transparent

As Dynamic Programmable Functions are being loaded, the data and control sequences being loaded into the DPF may be either ignored (transparent) or interpreted (executed). See Sections 5-7-B and 5-7-C for detailed information on the DPFs.

5-4 Communications Format

A. Asynchronous Character Format

The Teleray can be configured to operate with computers requiring seven or eight bits with odd, even, mark, space or no parity. These modes must be set to match the computer with which the Teleray will be communicating. Figure 5-5, Asynchronous Character Format, describes some typical data formats.

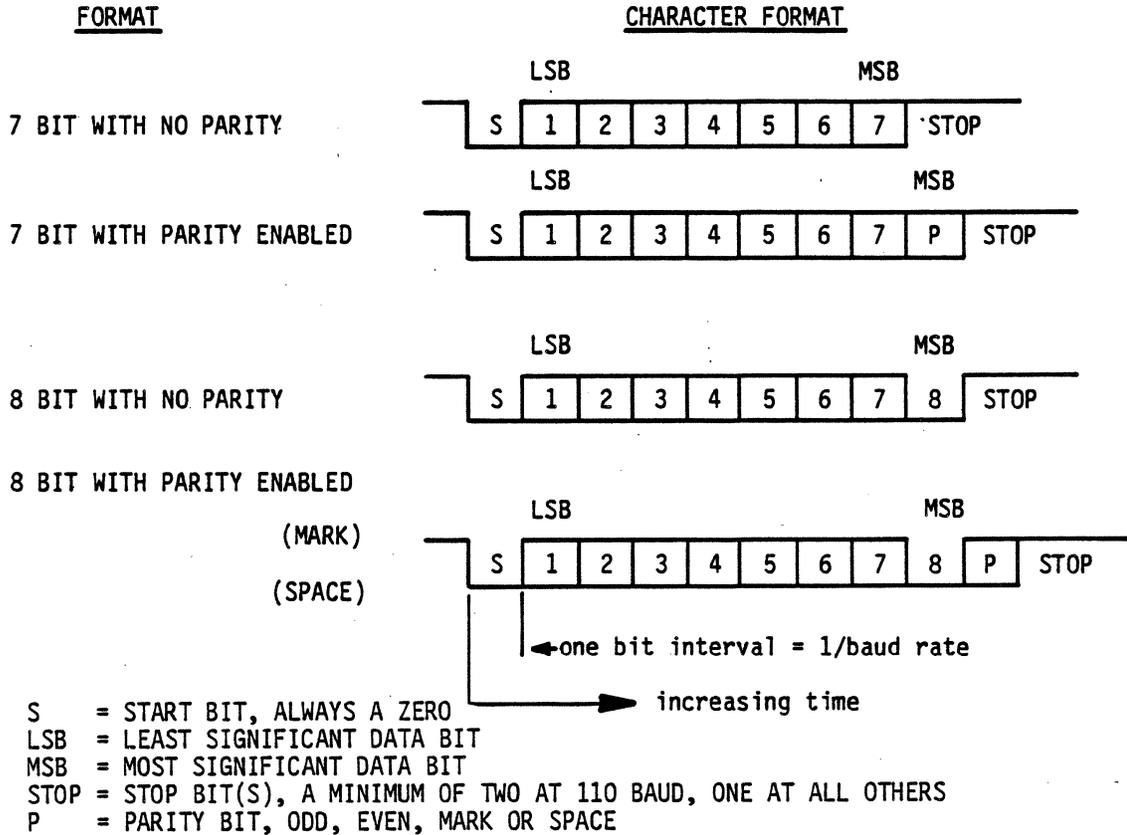


Figure 5-5 - Asynchronous Character Format

Set Baud Rates	ESC [P _S ; P _S ? }
Set Parity	ESC [P _S ; P _S ? ~
Serial I/O Parity Check/None	ESC [? 37 1 / ESC [? 37 h
Peripheral I/O Parity Check/None	ESC [? 45 1 / ESC [? 45 h

The receive speed must be set to match the computer transmit baud rate. The Teleray is capable of receiving at any one of the following preselected baud rates: 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 and 19,200 baud.

The receive baud rate is automatically set to the transmit baud rate; the terminal may not receive data at one baud rate and transmit data at a different baud rate.

The baud rates can be changed in the feature Selection Menu or by ESCape sequence. If the Teleray and computer baud rates are mismatched, the Teleray will not recognize a command to change baud rates, but the ESCape sequences can be used to achieve a host computer coordinated change.

The first P_S selects for serial port; second P_S selects for peripheral port.

P _S	Baud Rate	P _S	Baud Rate
0 (or none)	2400	8	1200
1	50	9	1800
2	75	10	2400
3	110	11	3600
4	134.5	12	4800
5	150	13	7200
6	300	14	9600
7	600	15	19200

The parity settings can be likewise changed. If the parity check is enabled, characters received by the Teleray will be tested for correct parity. An ASCII SUB character (displayed as S_B) will be substituted for any character found to be in error. The serial port and peripheral port can have different parity settings. Data sent into the Teleray's peripheral port which is destined for the host computer, and data sent into the Teleray's serial port which is destined for the peripheral port will have parity regenerated by the Teleray.

The first P_S selects for serial port; second P_S selects for peripheral port.

P _S	Parity Setting
0	None (8 bits no parity)
1	Even
2	Odd
3	Mark
4	Space

B. Half Duplex/Full Duplex

Serial I/O Full Duplex/Half	ESC [? 36 ℓ / ESC [? 36 h
Peripheral I/O Full Duplex/Half	ESC [? 44 ℓ / ESC [? 44 h

These modes can be changed in the Selection Menu or by ESCape sequence. Full and Half Duplex are serial communication protocols. Full Duplex is normally used with Character mode transmission without a terminal supplied local echo. Half Duplex is normally used with Block mode transmission and will frequently require a terminal supplied local echo. See Data Flow Controls for these selections. Table 5-3 illustrates the interactions of Full and Half Duplex with Character-Block modes. Changing duplex modes do not affect Suspend-Resume or Local Echo modes.

Table 5-3: Serial I/O Protocol

(Also see Section 5-5, Data Flow Controls)

	ON-LINE-AND-FULL AND CHARACTER	ON-LINE FULL AND BLOCK	ON-LINE AND HALF AND CHARACTER	ON-LINE AND HALF AND BLOCK
DATA TERMINAL READY	ON (+12V)	ON (+12)	ON (+12)	ON (+12)
REQUEST TO SEND	Will be held on (+12V)	Will be held on (+12V)	On during execution of transmit functions; turned on when operator first types and held on until an LF or NL is typed.	On during execution of transmit functions only.
KEYBOARD DATA TO DISPLAY	NO	YES	Local echo controls	YES
SERIAL DATA INTO DISPLAY	Only if Carrier Detect is on (+12V)	Only if Carrier Detect is on (+12V)	Only if Carrier Detect is on (+12V)	Only if Carrier Detect is on (+12V)
SERIAL DATA OUT STATE	Mark unless Clear to Send is on (+12V) then: All keyed data. Displayed data also during execution of a transmit operation.	Mark unless Clear to Send is on (+12V) then: Mark except: display data during execution of a transmit operation.	Mark unless Clear to Send is on (+12V) then: All keyed data. Display data during a transmit operation.	Mark unless Clear to Send is on (+12V) then: Mark except: display data transmitted under control of the transmit operations.

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5-5 Data Flow Controls

A. Data Routing

Local/Remote Mode	ESC [? 12 h / ESC [? 12 ℓ
Character/Block Mode	ESC [? 25 ℓ / ESC [? 25 h
Copy Serial Input to Peripheral	
Copy Interpreted On/Off	ESC [? 7 i / ESC [? 6 i
Copy Transparent On/Off	ESC [5 i / ESC [4 i
Local Echo Serial Port Off/On	ESC [12 ℓ / ESC [12 h
Copy Peripheral Input to Serial	
Copy Interpreted On/Off	ESC [? 9 i / ESC [? 8 i
Copy Transparent On/Off	ESC [7 i / ESC [6 i

In Character mode, each character code is transmitted individually as the appropriate data key is pressed; blocks may also be transmitted by pressing the transmit keys. In Block mode, keyed data goes to the Teleray display and can only be transmitted by the transmit functions.

The On-Line/Local selection allows the operator to easily place the terminal in either an On-Line or a Local (off-line) condition. When the terminal is on-line (the keyboard ON-LINE indicator is on), all characters typed on the keyboard are sent directly to the computer, and messages from the computer are displayed on the screen (unless the Teleray is also in Block mode). In the Local mode (the keyboard LOCAL indicator is on), the terminal is logically disconnected from the computer; messages are not sent to or received from the computer; and characters typed on the keyboard are always displayed on the screen directly.

Local/Remote and Character/Block selections apply only to keyboard data; the Copy Serial Input to Peripheral and Copy Peripheral Input to Serial selections are still relevant in all combinations of Local/Remote Character/Block.

Data flow control within the Teleray is described in Figure 5-6. This figure graphically illustrates the interactions of Local/Remote and Character/Block modes described above. Feature selections are provided to allow either port to be used to connect to a computer, printer, or magnetic storage device.

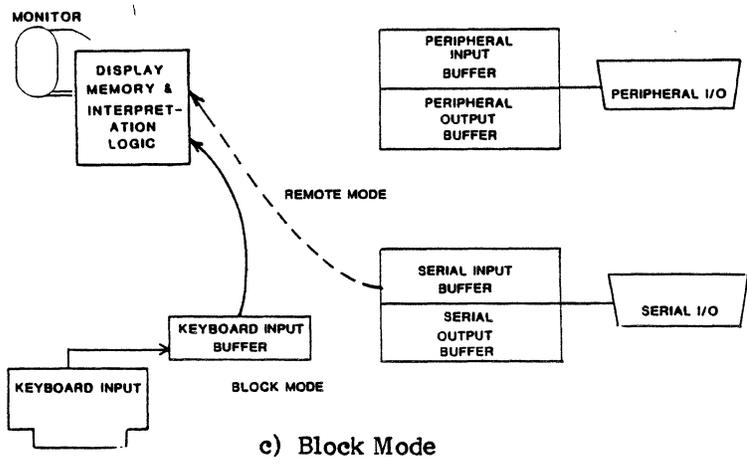
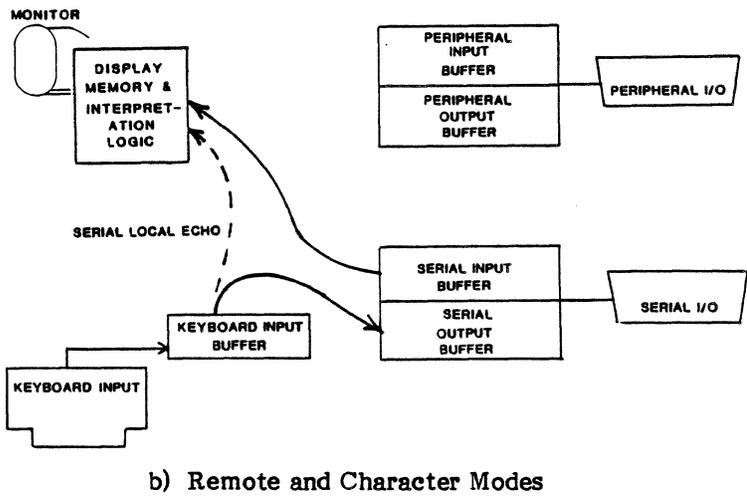
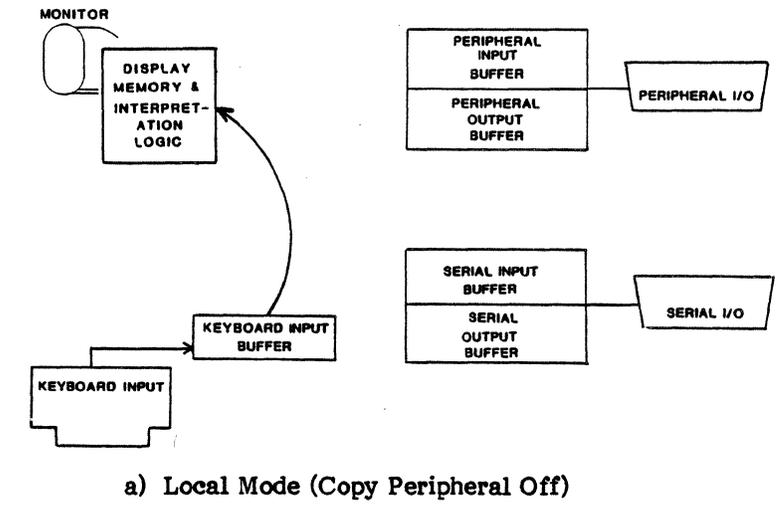
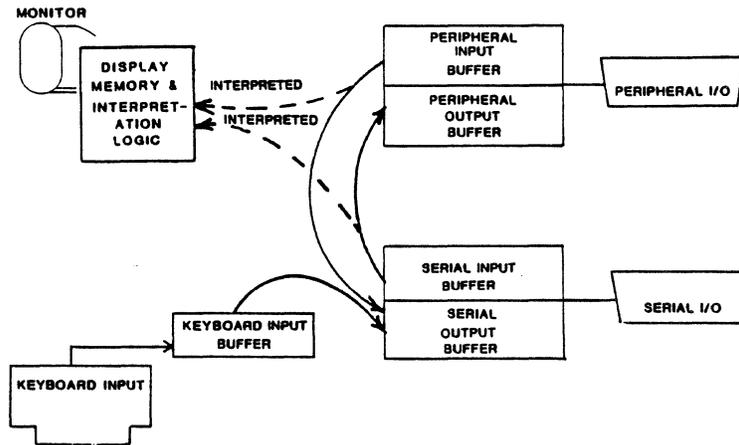
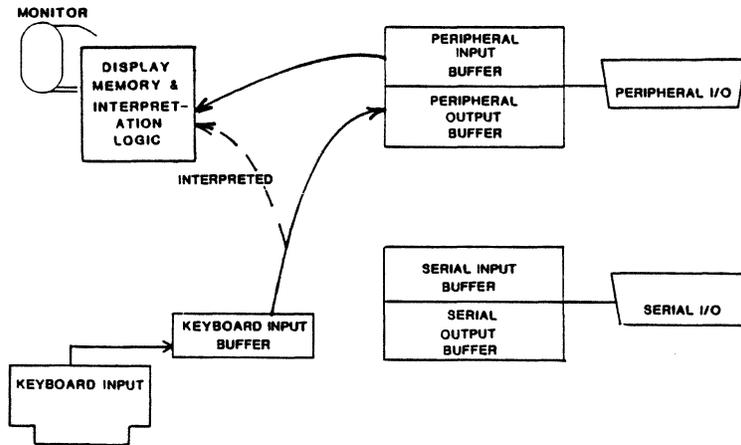


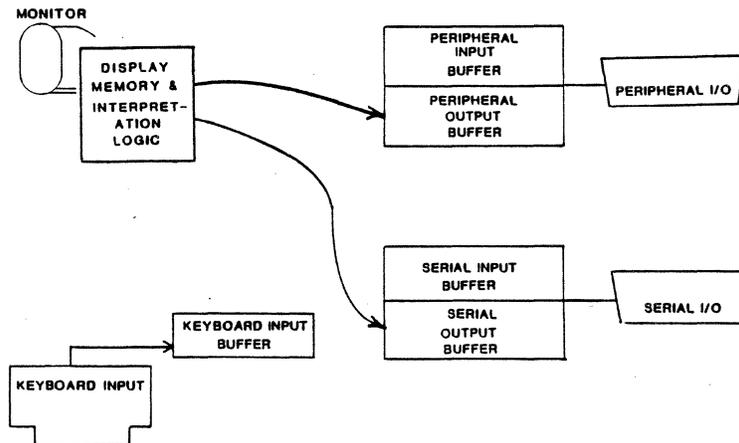
Figure 5-6: Data Flow Controls



d) Remote and Character and Copy Modes



e) Peripheral Copy in Local and Character Modes



f) Transmits

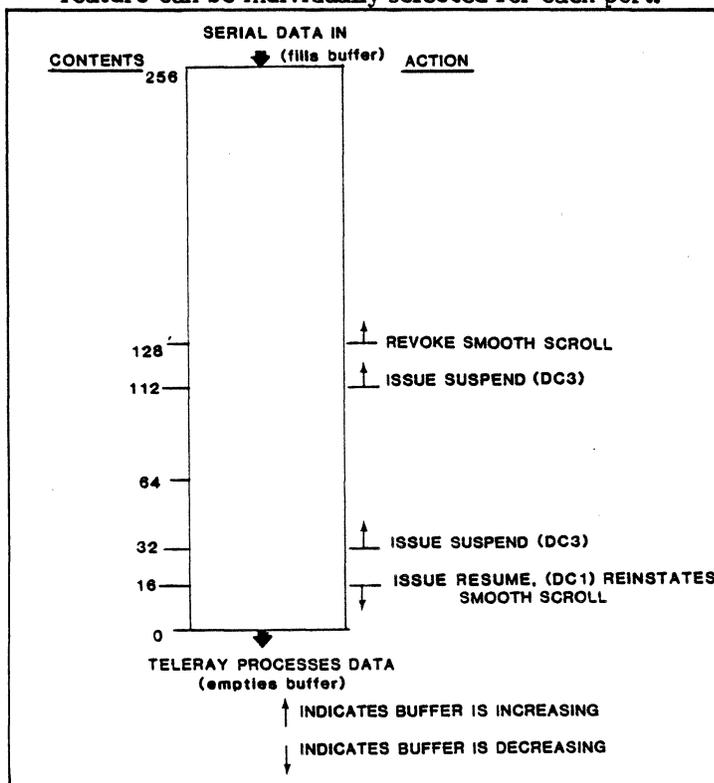
B. Suspend/Resume and Buffering

Enable/Disable Peripheral Busy-Ready Detect
 Peripheral Busy-Ready Level High/Low
 Suspend
 Resume
 Enable/Disable Suspend-Resume - Peripheral
 Enable/Disable Suspend-Resume - Serial I/O

ESC [? 41 h / ESC [? 41 l
 ESC [? 42 h / ESC [? 42 l
 DC3
 DC1
 ESC [? 46 h / ESC [? 46 l
 ESC [? 38 h / ESC [? 38 l

The peripheral port has an additional input signal provided on Pin 6 called Busy/Ready. When asserted, this signal indicates to the Teleray that the connected device is ready to accept data; when negated, the device is busy. This allows a printer with limited buffer capacity to control the flow of data to it. The Teleray will use its internal buffers to smooth the data flow and if connected to a host computer, will use Suspend/Resume (X-ON X-OFF on a teletype) protocol to signal to the host if overrun occurs.

Both the serial I/O and peripheral I/O ports will support Suspend/Resume protocol. This protocol feature can be individually selected for each port.



The Teleray operates at transmission speeds up to 19200 baud. However, the terminal or a connected auxiliary device may not be able to keep up with incoming data with some messages. The terminal stores incoming characters in a 256-character buffer and processes them on a first-in/first-out basis. If the Suspend/Resume feature is selected, if the serial input when the content of the buffer reaches 32 characters, the terminal will transmit a DC3. On this signal, the host should suspend its transmission to the terminal. If the host fails to stop transmitting when the buffer reaches 112 characters, the terminal will transmit a second DC3. This is a last warning to the host that the terminal is about to temporarily revoke any smooth scroll or no scroll conditions. Eventually, if the host stops transmitting, the terminal will deplete the buffer. When 16 characters remain in the buffer, the terminal will transmit DC1 to signal the host that it may resume transmission. Figure 5-7 illustrates the serial input buffer protocol.

Figure 5-7: Input Buffer Controls

If the host fails to respond to a DC3 from the terminal in a timely manner, the buffer will continue to fill. When the 256-character capacity of the buffer is exceeded, a condition occurs called "buffer overflow". To determine if the buffer will overflow, use the following formula:

$$\text{Time to respond to Suspend} = \text{No. of characters to overflow} \times 10 - \text{receiver speed}$$

In addition to the buffer-filling conditions, there are two other means of transmitting Suspend and Resume: the NO SCROLL key and CTRL mode keyboard keys. If the Suspend/Resume feature is enabled, the Teleray will coordinate these three sources so that proper data flow is maintained.

Smooth scroll limits the received data rate to a maximum of 6 or 12 lines per second. If the Teleray is in Smooth Scroll mode and if the incoming data in the buffer exceeds 128 characters (the point at which a 128-character buffer machine will lose data), the Teleray will automatically revoke Smooth Scroll mode and start processing the input buffer in Jump Scroll mode. If the terminal screen had stopped scrolling because the NO SCROLL key was pressed, then the Teleray will also

resume scrolling. The Teleray will remain in Jump Scroll mode until the input buffer content has been reduced to 16 characters. Figure 5-7 illustrates the serial input buffer protocol. If the message contains "normal text" (few extended-time functions), the Teleray can be placed in Smooth Scroll mode and the message transmitted without adherence to Suspend/Resume protocol.

Three of the terminal functions, reset to initial state, reset to default, and self-test, reinitialize the terminal and erase the buffer. This means that if characters are received immediately subsequent to the commands to perform these two functions and the characters are placed in the buffer, these characters would be destroyed without being processed.

1. Immediately after sending the terminal the commands to perform self-test functions, the host may act as if it had received Suspend from the terminal, thus sending no more characters until it receives Resume. The terminal will automatically transmit a Resume code after it completes these operations if the Suspend/Resume feature is selected.
2. When the first method cannot be implemented, a delay of no less than 12 seconds may be used to allow the terminal time to complete the invoked function. This method, however, does not guarantee against the loss of data when an invoked function has detected an error.

C. Suspending Transmissions from Teleray

The Teleray recognizes received Suspend (DC3) and Resume (DC1) codes from either port. Receipt of Suspend will inhibit the Teleray from transmitting any codes except Suspend and Resume. From three to seven keystrokes on the keyboard will be stored in a keyboard buffer (some keys transmit multiple codes so that the exact amount varies). If the keyboard buffer overflows, keyclicks will stop and the KBD LOCKED LED will come on. Transmission resumes upon receipt of Resume.

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5-6 Block Transmits

Ready to Transmit	ESC S
Transmit Text (Serial I/O Port)	ESC 5
Transmit Text (Peripheral I/O Port)	ESC [i or ESC [o i

Block transmits may be initiated by either macro keys or ESCape sequences. The keyboard macro capability allows reprogramming of the ENTER key, which is frequently used to initiate block transmissions. The sequence ESC S is commonly used to indicate that the terminal (operator) is ready to transmit to the computer. The computer would then send the appropriate ESCape sequence to initiate the block transfer of its choice. The macro key also allows programming of the appropriate ESCape sequence directly. If programmed as a local macro, the transfer would immediately take place. If programmed as a transmitting macro, the ESCape sequence would be sent to the computer, and the echo of the ESCape sequence would initiate the transfer. The keyboard macro capability eliminates the need for a "transmit key execution" mode.

Select Text for Transmission	ESC [P _s ; P _s ? t
Transmit from Beginning to Cursor/to End	ESC [16 h / ESC [16 l
Start Select Area (SSA)	ESC F
End Select Area (ESA)	ESC G

Unless otherwise set, all transmissions start at the beginning of the current page and terminate at the end of the page. During transmission, the keyboard is locked. Feature selections allow transmission of the page, line, window (area between margins, if set), memory, or the area demarked by Start of Selected Area (SSA) and the End of Selected Area (ESA). Figure 5-8 lists parameter values for the ESCape sequences.

First P _s selects for serial port; second P _s selects for peripheral port.	
<u>P_s</u>	<u>Area Transmitted</u>
0 or 1	Page
2	Line
3	Window
4	Memory
5	Selected Area (SSA to ESA)

Figure 5-8: ESCape Sequence Parameter Values

A feature selection allows transmission of either the entire selected area, or the transmission can be truncated at the current cursor position. Transmissions always begin with the chosen area. The SSA and ESA commands place invisible markers in the Telera's display memory. When a transmit operation is initiated, the terminal will search its memory from the current cursor position backward until it finds an SSA marker. The transmission will begin at this marker and will end at either the original cursor position or at the first subsequent ESA marker.

Transmit Form and Text	ESC 6
------------------------	-------

This sequence causes the entire screen with all the character attributes to transmit. Character attributes transmit in the same format required to place them on the screen. All characters transmit without regard to protection or space suppression. A control sequence is prefixed to the transmission which indicates which graphic renditions are protected. Two control sequences prefix each transmitted field indicating which graphic renditions are on and indicating the state of the independent protect attribute. These control sequences are identical to the sequences normally used to place graphic renditions on the display. Every line transmitted is terminated by the selected terminator in effect. Figures 5-9 and 5-10 are examples of such a transmission.

Text being displayed before transmission

<u>Name sp</u>	TELERAY	<u>Terminal</u>	<u>sp sp7 sp sp sp</u>
Guarded, underlined		Guarded, inverse & dim	Zero fill & entry required qualified area

Transmitted Data Stream:

```
ESC V ESC [ 2m Name sp ESC W ESC [ m TELERAY ESC V
ESC [ 2; 7m Terminal ESC W ESC [ m ESC [ 6; ? 1 o sp sp 7
ESC [ o sp sp sp EOL
```

ESC V - Start Protect Area
ESC W - End Protect Area
ESC [P_s m - Select Visual Attribute
ESC [P_s o - Select Qualified Areas
EOL - End of Line Terminator
sp - space

Figure 5-9: Example of Transmit Text and Form

Transmit Guarded Fields/Transmit Without Guarded Fields ESC [1 h / ESC [1 ℓ

Certain areas of the display are guarded against transmission. This feature selection permits this designation to be honored or ignored in the block transmission.

Space Suppression On/Off Serial	ESC [? 13 h / ESC [? 13 ℓ
Space Suppression On/Off Peripheral	ESC [? 15 h / ESC [? 15 ℓ
Space Substitution for Fields On/Off Serial	ESC [? 40 h / ESC [? 40 ℓ
Space Substitution for Fields On/Off Peripheral	ESC [? 48 h / ESC [? 48 ℓ

If the feature is selected, unwritten spaces on the right-hand side of each line can be suppressed on each transmission. A space can be substituted for each character of protected or otherwise guarded fields. This feature allows spacing over preprinted forms and provides full line transmission for applications requiring them. These selections can be made independently for each port.

Text being displayed before transmission

<u>Name sp</u>	TELERAY	<u>Terminal</u>	<u>sp sp 7 sp sp sp</u>
Guarded		Guarded	Zero fill qualified area

<u>Modes</u>			<u>Transmitted Data Stream</u>
<u>Space Suppression</u>	<u>Transmit Guarded</u>	<u>Space Substitution</u>	
Off	Data	Off	Name sp TELERAY Terminal 007 sp sp sp EOL
Off	Data	On	sp sp sp sp sp TELERAY sp sp sp sp sp sp sp sp 007 sp sp sp EOL
Off	Separator	Off	GRT TELERAY GRT 007 sp sp sp EOL
Off	Separator	On	GRT TELERAY GRT 007 sp sp sp EOL
On	Data	Off	Name sp TELERAY Terminal 007 EOL
On	Data	On	sp sp sp sp sp TELERAY sp sp sp sp sp sp sp sp 007 EOL
On	Separator	Off	GRT TELERAY GRT 007 EOL
On	Separator	On	GRT TELERAY GRT 007 EOL

GRT - Guarded Field Replacement Identifier
EOL - End of Line Terminator
sp - space

Figure 5-10: Example of Guarded Fields Transmission

Serial Auto Suspend on End of Line/Normal
Peripheral Auto Suspend on End of Line/Normal

ESC [? 39 h / ESC [? 39 ℓ
ESC [? 40 h / ESC [? 40 ℓ

This feature selection will cause each transmission to automatically pause immediately after transmitting the End of Line terminator. Upon receipt of any character from the host computer, the Teleray will resume the transmission at the beginning of the next line.

Transmit Terminator Selections

Select Start of Transmission Identifier (SOT) ESC [P_S; P_S {
Select Guarded Field Replacement Identifier (GRT) ESC [P_S; P_S ? z
Select End of Line Terminator (EOL) ESC [P_S; P_S ? }
Select End of Page Terminator (EOP) ESC [P_S; P_S ? |
Select End of Transmission Terminator (EOT) ESC [P_S; P_S i

These Selection Menu features allow application formatting of the data stream representing text stored in the Teleray (Figure 5-11). These terminators can be selected independently for the serial I/O and peripheral I/O ports. The Start of Transmission identifier is prefixed to each block transmission. The Guarded Field Replacement identifier is used to replace the guarded fields when transmitting a formatted (protected) text. End of Line, End of Page, and End of Transmission terminators are independently selected and are suffixed to the appropriate transmission. Figure 5-11 lists the terminators, Figure 5-11a illustrates the positioning of these terminators in the transmitted text stream.

First P_S selects for serial port; second P_S selects for peripheral port.

P _S Value	Identifier	P _S Value	Identifier	P _S Value	Identifier
0	Default	13	CR	26	SUB
1	SOH	14	SO	27	ESC
2	STX	15	SI	28	FS
3	ETX	16	DLE	29	GS
4	EOT	17	DC1	30	RS
5	ENQ	18	DC2	31	US
6	ACK	19	DC3	32	NUL
7	BEL	20	DC4	33	None
8	BS	21	NAK	34	DEL
9	HT	22	SYN	35	LF CR
10	LF	23	ETB	36	CR LF
11	VT	24	CAN		
12	FF	25	EN		

Figure 5-11: Transmission Terminators

Transmit Type	Transmission Format - Terminators
Line	SOT text EOL EOT
Page	SOT text EOL text...EOL EOP EOT
Window	SOT text EOL text...EOL EOT
Memory	SOT text EOL text...EOL EOP text...EOL EOP EOT
Selected Area	SOT text EOL text...EOL EOT

Figure 5-11a - Transmission Format - Terminators

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5-7 Programmable Functions

A. Macro Keys

Reprogram Macro Key (Local)	ESC P L P _s text; P _s text...
Reprogram Macro Key (Transmitting)	ESC P T P _s text; P _s text...
Reprogram Macro Key (Keyboard)	ESC P K P _s text; P _s text...
End Macro Key Sequence Definition	ESC \

Local macros operate locally only; no code is transmitted by them, and the macro ESCape sequence is interpreted by the Teleray. Transmitting macros are not interpreted by the Teleray, and the macro contents are transmitted to the host computer. If the host echoes the character sequence, it will be interpreted. Keyboard macros are treated as keyboard input. If the Teleray is in Local mode, they will be acted on locally; in Remote and Character modes, they will be transmitted. For a complete description of the programming and operation of these keys, see Section 3-7, Macro Keys.

B. Dynamic Programmable Functions (DPF)

Define Dynamic Function P _s	ESC P P _s text
End Dynamic Function Definition	ESC \
Locally Perform Dynamic Function P _s	ESC [P _s u
Transmit Dynamic Function P _s Contents	ESC [P _s t
Enable Transmits to Dynamic Function P _s	ESC [P _s z
Load Functions Transparent/With Interpretation	ESC [? 23 h / ESC [? 23 ℓ
Clear all Dynamic Function Memory	ESC [2 space x

The Teleray contains 32 dynamic programmable functions (DPF). Any ASCII sequence may be assigned to these DPFs. The first 16 (01 through 16) functions can be allocated in any combination to the 512 bytes of function memory. Optional versions that include non-volatile display memory allow reassignment of excess display memory for use as function memory. See Section 5-2, Memory Structure. DPFs 17 through 32 are reserved for use with this reassignable memory.

C. Programming the DPFs

Programming of the functions is initiated by the sequence ESC P, followed by the 2-digit function number. Both digits must be used (e.g., 01, 02, etc.). If an illegal function number is given, the sequence will be ignored (any succeeding characters will not be ignored). As the function is being programmed, the bell "clicks" as each character or local operation is entered. When the last 10 characters of programmable function memory are entered, the bell will beep (with a long tone) to warn the operator that the memory is nearly full.

A Selection Menu feature allows the function information to be interpreted while it is being loaded or to be ignored (transparent) while being loaded.

Dynamic programmable functions can also be programmed with display memory text using the Enable transmit to Function. When this ESCape sequence is keyed or received, the Teleray enters a special mode in which the subsequent transmit operations do not transmit to a port but instead transmit to the function memory.

If the programming sequence is given for a DPF that has been previously defined, the old program will be discarded and a new definition entered. The DPF contents are automatically saved in non-volatile memory.

Function definition will be ended by:

- End Function Definition (ESC \) - recommended
- Reset to Initial State
- Reset to Default State - also sets DPFs to factory condition
- Execute Programmed Function - will perform function
- Exceeding the Function Memory Available - the Bell will beep (and not click anymore)

D. Executing Dynamic Programmable Functions

Locally Perform DPF
Transmit DPF Contents

ESC [Ps u
ESC [Ps t

The DPF execution will be initiated by the sequence shown. Ps is a decimal number from 1 through 32, inclusive. If an incorrect function number is given, the sequence will be ignored. When a DPF is initiated, the ASCII sequence stored in the function memory is executed locally or transmitted. Figure 5-12 illustrates the two types of DPFs. DPF contents can be examined using the combination of Monitor and Local modes. Embedded control characters and ESCape sequences will be displayed (and not executed) in these modes. If the function programming includes a command to execute another programmed function, this included command will not be executed.

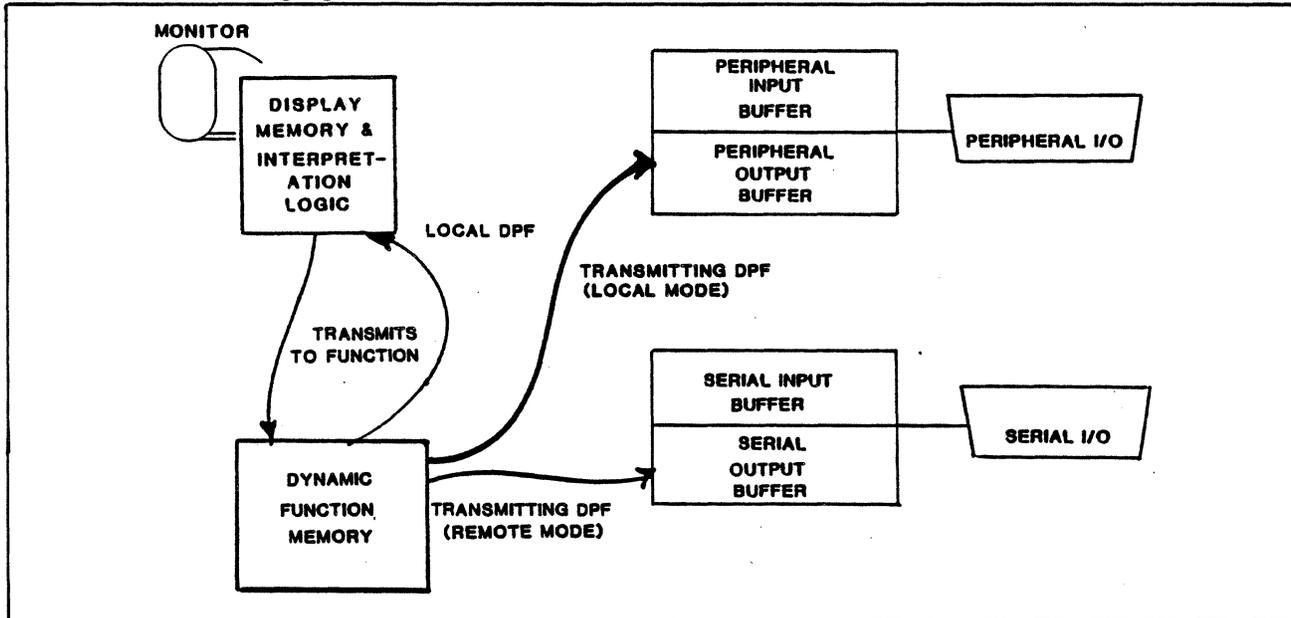


Figure 5-12: Dynamic Programmable Functions

1. Keys for DPFs

There are five DPF keys on the keyboard (Functions 01 through 05); the other functions are initiated by using the SHIFT key (shifted F01 = F06; shifted F02 = F07, etc.). These macro keys have been programmed at the factory with the ESCape sequences to call these DPFs. DPFs 01 through 05 have been programmed as local DPFs; 06 through 10 as transmitting DPFs. The keyboard macros may be user reprogrammed to provide more or fewer DPF keys.

2. Applications

The DPFs can be used to store macro key definitions providing multiple alternate keypad modes. The functions can be used to store forms, control sequences, or answer back messages. Multiple, lengthy forms can easily be accommodated with additional memory available with the non-volatile memory options. DPFs are particularly useful for storing lengthy ANSI ESCape sequences to provide an operator with additional editing or special purpose keys. The dynamic programmable functions are automatically stored in non-volatile memory.

The dynamic programmable functions can also be used to provide a "Wake Up" service following extended time functions, such as Transmit to Peripheral Port. Implementing this Wake Up service would require programming a function with the Transmit command, immediately followed by a command invoking the programmed function. When the Teleray has completed the transmit, it will examine the input buffer and execute the function.

Example of "Wake Up" Service

Computer Transmits:	Telera Does:
<p>ESC P 12 MESSAGE ESC \</p> <p>TEXT</p> <p>ESC [i (Transmit Peripheral) ESC [1 2 t Waits</p> <p>Receives MESSAGE - Knows that Print is complete</p>	<p>Defines programmable function 12 with MESSAGE.</p> <p>Receives text on display screen.</p> <p>Transmits text.</p> <p>Examines input buffer and executes function 12 — this transmits MESSAGE to computer.</p>

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Numeric and Alphabetic Qualifications

The terminal will reject all characters not listed below. A prompt will appear on the bottom line for attempted incorrect entry.

Characters Accepted:

Alphabetic

Upper/lower case
alphabetic, space,
period, comma

Numeric

Digits, space, period,
comma, minus sign,
plus sign

Right Justify Qualification

Whenever the cursor enters a Right Justify field, the cursor will automatically be positioned to the right-hand edge of that field. As data is entered, it will automatically shift to the left within the field. Each entry is then right justified as it is entered.

Zero Fill

Whenever the cursor leaves a zero fill qualified area, all space characters within that field will be replaced with zero characters. Note that "normal" fields are space filled.

Entry Required

If entry required qualified areas are in the current display page, no block transmission or page change operations will be allowed until an entry (non-space) is made in each such area. An operator prompt will be presented on the bottom line.

Must Fill Qualification

For any type of field, you may specify "MUST FILL" qualification. This signifies that if any character position within the field contains a valid character, then every character position within the field must contain a valid character. The "MUST FILL" qualification is checked as the cursor is about to leave the field. If "MUST FILL" is in effect and all character positions of the field do not contain valid characters, then the keyboard is locked, the bell is sounded, the cursor moves to the start of the field, and an error message appears on the bottom line. To correct the situation, re-enter the data item in a manner which ensures that all character positions contain a valid character.

5-9 Cursor Positioning, Tabs, and Text Movement

Cursor Up ESC [P_n A

This sequence causes the active position to move P_n lines up without changing the column position. P_n equal to zero causes the cursor to move one line up. An attempt to move the cursor above the top margin does not move the cursor. If no P_n parameter is given, a value of zero is assumed.

Cursor Down ESC [P_n B

This sequence causes the active position to move P_n lines down without changing the column position. P_n equal to zero causes the cursor to move one line down. An attempt to move the cursor below the bottom margin does not move the cursor. If no P_n parameter is given, a value of zero is assumed.

Cursor Right ESC [P_n C

This sequence causes the active position to move P_n columns to the right. P_n equal to zero causes the cursor to move one column to the right. An attempt to move the cursor beyond the last column does not move the cursor unless right margin wrap is selected. If no P_n parameter is given, a value of zero is assumed.

Cursor Left ESC [P_n D

This sequence causes the active position to move P_n columns to the left. P_n equal to zero causes the cursor to move one column to the left. An attempt to move the cursor to the left of the last column does not move the cursor unless left margin wrap is selected. If no P_n parameter is given, a value of zero is assumed.

Full Left (Cursor Return) CR

Places the active position on the left margin or on the beginning of the line if no margin has been set.

Cursor Home ESC [H or ESC [f

This sequence causes the active position to move to the first line, first column in the display. If in Relative Origin mode, the home position is the first line, first column of the scrolling window.

Line Feed/New Line Mode ESC [20 ℓ / ESC [20 h

In the reset state, a line feed causes the active position to move to the next line without changing column position. In the set state, a line feed causes the active position to move to the first column of the next line, and a typed RETURN key transmits a carriage return and a line feed. In both states, if the cursor was at the bottom margin, a scroll up occurs.

Next Line LF or ESC E

Moves the cursor to the next line, first column. If the cursor starts at the bottom margin, a scroll up occurs.

Index ESC D

This sequence causes the active position to move down one line without changing the column position. If the cursor starts at the bottom margin, then a scroll up occurs.

Reverse Index ESC M

This sequence causes the active position to move up one line without changing the column position. If the cursor starts at the top margin, a scroll down occurs.

Relative/Absolute Origin Mode

ESC [? 6 h / ESC [? 6 l

Relative origin mode causes the display origin to be within the scrolling window; the upper left corner, top margin line, left margin column is Home. Cursor positioning is relative to this origin, and the cursor cannot be positioned outside of the scrolling window. Absolute origin mode causes the display origin to be absolute; the upper left corner of the display first line, first column. If absolute, cursor positioning is not affected by any scrolling window margins.

Direct Cursor Positioning

ESC [P_n; P_n H or ESC [P_n; P_n f

This sequence causes the active position to move to the position specified by the two parameters. The first parameter specifies the line number, and the second parameter specifies the column number. The parameters are decimal numbers indicating either line or column position. If a parameter is omitted or equal to zero, a value of one is assumed. The display origin used for positioning reference is defined by Origin mode.

Request Position Report

ESC [6 n

Causes the Teleray to transmit the current cursor location to the computer.

Cursor Position Response

ESC [P_n; P_n R

Teleray's response to the Request Position Report. The first parameter specifies the line number; the second parameter specifies the column number.

Save Cursor

ESC 7

This sequence causes the cursor position, graphic rendition (character attributes), area qualifications, and character set designation and invocation to be saved.

Restore Cursor

ESC 8

This sequence causes the saved cursor position, graphic rendition (character attributes), area qualifications, and character sets to be restored.

Tab Operations

Cursor to Next Tab Stop

HT

Set Tab Stop in Current Column

ESC H

Clear Tab Stop in Current Column

ESC [g

Clear All Tab Stops

ESC [3 g

Back P_n Tab Stops

ESC [P_n Z

Just like a typewriter, the Teleray Model 16 can jump or tab to preselected points on a line. These tab stops may be individually changed, or totally cleared and then set. Columnar tab stops apply to all lines in the page. They are preset at power-on to Columns 1, 9, 17, 25, 33, 41...(every eight columns to the end of the logical line). If all columnar tab stops are cleared, a columnar tab stop is implied in Column 1. In Protect mode, implicit tab stops are set at the beginning of every unprotected area and the columnar tabs are ignored.

Display Movement (for related information, see 5-2, Memory Structure)

Scroll Display Window Up P_n Lines	ESC [P_n S
Scroll Display Window Down P_n Lines	ESC [P_n T
Scroll Display Right P_n Columns	ESC [P_n sp A
Scroll Display Left P_n Columns	ESC [P_n sp @
Forward P_n Pages	ESC [P_n U
Reverse P_n Pages	ESC [P_n V

Whenever an attempt is made to horizontally move the cursor out of the display window (80 columns) but still within the logical line length, the display will automatically "pan" to accommodate this movement and keep the cursor within view. These movements will be made with a smooth horizontal scroll, if smooth scroll is enabled. If incipient buffer overrun is sensed, the horizontal display will be immediately placed in the new position. Combinations of smooth horizontal and vertical scrolls may occur simultaneously with certain combinations of cursor manipulation.

The Next Page/Previous Page operations are graphically described in Figure 5-13. The next/previous page operation places the cursor in the same position in the next logical page. The display window is automatically moved to keep the cursor in view. If the smooth scroll feature is selected, this window movement will be smooth; otherwise, it will immediately jump to the new page. If margins are invoked in the current page, they will be in effect in the new page in the same line and column positions.

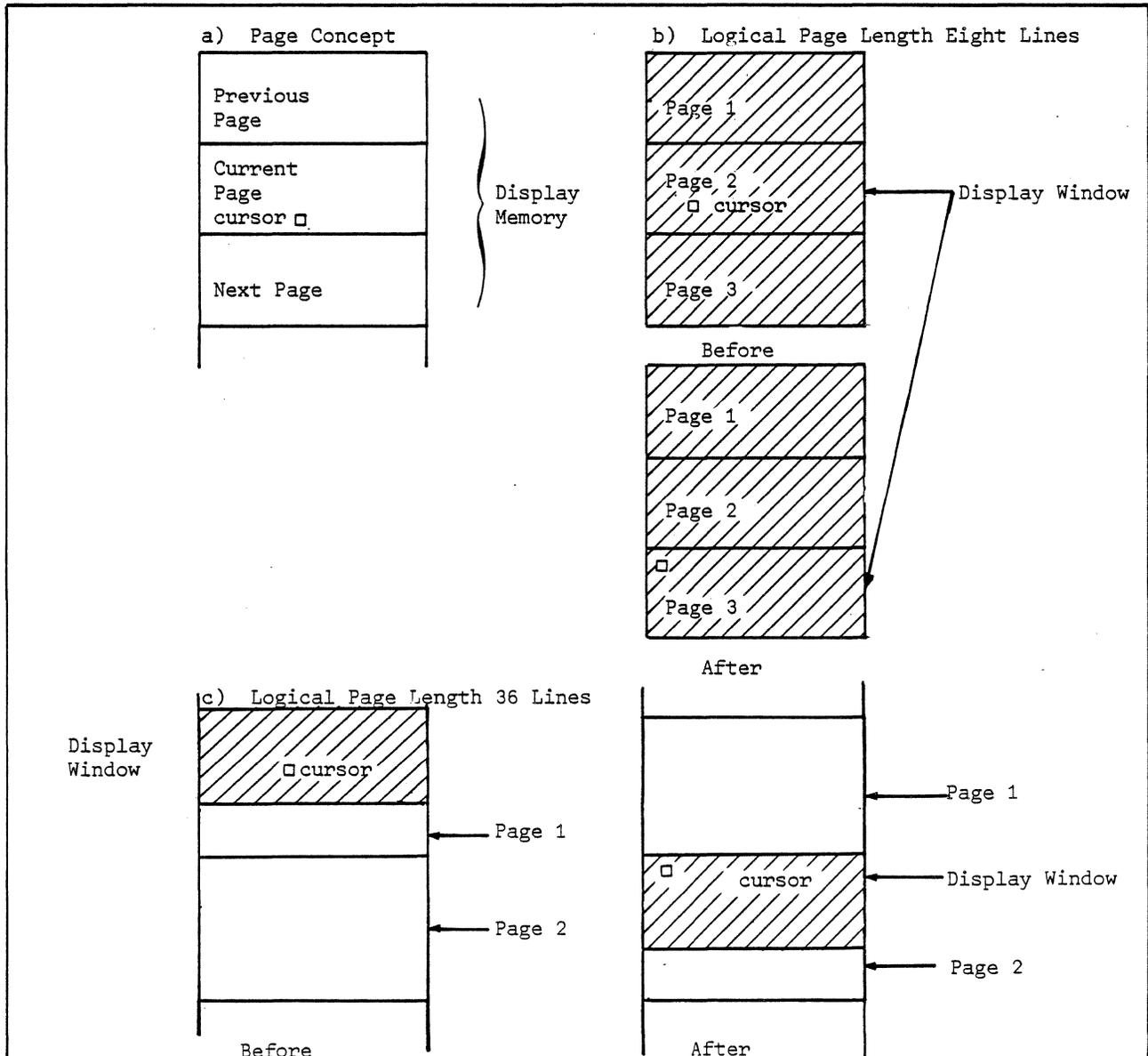


Figure 5-13: Next Page Examples

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5-10 Erases, Resets, and Edits

A. Erases

Erase from Cursor to Right Margin	ESC [0 K
Erase from Cursor to Left Margin	ESC [1 K
Erase from Cursor Entire Line to Both Margins	ESC [2 K
Erase from Cursor to Bottom Margin	ESC [0 J
Erase from Cursor to Top Margin	ESC [1 J
Erase from Cursor Entire Page Within Margins	ESC [2 J
Erase from Cursor to End of Memory	ESC [? 1 J
Erase All Pages	ESC [? 2 J
Erase from Cursor to End of Field	ESC [0 N
Erase from Cursor to Beginning of Field	ESC [1 N
Erase Entire Field	ESC [2 N

The erase functions allow selective clearing of the Teleray's display memory. The character position the cursor is located in is always erased. The field erase operates in the unprotected areas between protected fields in Protect mode.

B. Resets

Reset to Initial State	ESC c
Reset to Default Conditions	ESC [255; 255 space y

After receipt of the Reset to Initial State, the Teleray will return to the same state it would be in if power had just been turned on. This means that the terminal's input buffer will be cleared, so this command should not be followed immediately by additional commands. This command does not affect the contents of the programmable functions, keyboard macros, feature menu selections, or any other parameters stored in non-volatile memory. The reset to default command will perform all the operations as the reset to initial state. Additionally, the non-volatile memory will be rewritten to its "factory" condition. All functions, macros, and menu selections will be reset.

C. Edits

Repeat Previous P_n Times	ESC [P_n b
-----------------------------	---------------

This sequence causes the Teleray to repeat the previous graphic character, control character, or control sequence P_n times. It may be included in a macro key or a programmable function, and it provides a very powerful method for rapid entry of repetitive displays. Parameter values through 256 will be accepted.

Select Editing Extent	ESC [P_s Q
-----------------------	---------------

This controls the extent of Insert/Delete Character controls. For $P_s = 0$, the edit is restricted to operating within the current margins; for $P_s = 1$, the edit is restricted to the current line; for $P_s = 2$, the edit is restricted to the current field (if no fields are in effect, the current page).

Insert P_n Characters	ESC [P_n @
-------------------------	---------------

Inserts one or more erased characters at the cursor position according to the parameter by shifting the character at the cursor position and all following characters forward. The contents of the character positions at the other end of the shifted part are removed. The position of the cursor is not changed. A parameter value of zero or one will insert one erased character. A parameter value of N will insert N erased characters. The number of following characters which are affected is controlled by the Select Editing extent (above). In Protect mode, the editing extent selection will be ignored; in Protect mode, the editing extent will always be the field between protected areas.

Delete P_n Characters

ESC [P_n P

The number of characters specified by the parameter P_n (one character is assumed when no parameter is given) are deleted from the active line starting with the active position. Characters to the right of the active position move P_n characters to the left, leaving P_n spaces on the end of the field. The number of following characters which are affected is controlled by the Select Editing extent. In Protect mode, the editing extent selection will be ignored; in Protect mode, the editing extent will always be the field between protected areas.

Insert P_n Lines

ESC [P_n L

Inserts one or more erased lines at the active line according to the parameter by shifting the contents of the active line and all following lines downward. The contents of the lines at the other end of the shifted part are removed. The position of the cursor is not changed. A parameter value of zero or one inserts one erased line. A parameter value of N inserts N erased lines.

Delete P_n Lines

ESC [P_n M

The number of lines specified by the parameter P_n (one line is assumed when no parameter is given) are deleted from the display starting with the active line. Remaining lines move up P_n lines, leaving P_n lines, which are filled with spaces and have no (normal) display attributes.

Insert P_n Characters in Text Block
Delete P_n Characters in Text Block

ESC [P_n ~
ESC [P_n p

These operations are identical to the Insert and Delete P_n Characters except that these operations extend to the end of the current text block. The end of the current text block is defined as the first display memory location containing three or more contiguous space characters. The search for the end of the text block is performed before the insert/delete operation.

Delete P_n Words

ESC [? w

This operation is identical to the delete character except that the "word" the cursor is currently located on is deleted. The word is defined as the block of characters in which the cursor is positioned bounded on each end by either a space character or a margin. If the cursor is positioned in the middle of a word, only the portion of the word beneath the cursor and to the right of the cursor will be deleted. A parameter value of N will remove the word the cursor is in and the subsequent N-1 words.

Reinstate Last Deleted Word P_n Times

ESC [P_n ? v

Inserts one or more text words at the cursor position according to the parameter by shifting the character at the cursor position and all following characters forward. The extent of this operation is controlled by editing extent mode. Only the last deleted word will be reinstated.

Reinstate Last Deleted Line P_n Times

ESC [P_n ? u

Inserts one or more text lines at the cursor position according to the parameter by shifting the contents of the active line and all following lines downward. The extent of this operation is controlled by editing extent mode.

Insertion/Replacement Mode

ESC [4 h / ESC [4 l

In Insertion mode, entered characters insert at the active position. All characters to the right of and including the active position shift one character to the right when one character is inserted. Characters shifted past the end of the field are lost. In Replacement mode, all entered characters replace the character at the active position. The active position moves one character to the right when one character is replaced.

Identity is a similar question and answer sequence. The message transmitted to the host computer informs the computer of the capabilities of the terminal. This question and answer session takes place automatically. Different types of computers expect differing device identity messages. The identity message can be viewed in the Selection Menu but is permanently locked. It can only be reprogrammed by the ESCape sequence shown.

Request Teleray Status

ESC [P_s n

P _s Value	Status Report Requested
5	Send short form status
6	Send cursor position (see Cursor)
? 7	Send time (see Clock)
? 8	Send detailed Teleray status
? 15	Send peripheral port status

Responses to Status Requests

ESC [P_s n

P _s Value	Meaning
0	Teleray ready
3	Malfunction
? 10	Peripheral port ready
? 11	Peripheral port not ready

} first two comprise
} short form status

Response to Detailed Status Request

ESC P R text ESC \ where text is the self test contents of the bottom line; includes program revision level.

The status requests and possible responses shown allow the computer to interrogate the Teleray and learn its current condition. The self test bottom line display is transmitted; this report should not be requested without first requesting the self test. It is recommended that the keyboard be locked prior to invoking the self test to eliminate potential operator interference on the bottom line.

5-12 Graphic Sets and Control Characters

A. Standards

The control character set employed by Teleray is described in ANSI X3.4 ASCII. Extensions to the ASCII code space are defined by ANSI X3.64, "Additional Controls For Use With American National Standard Code For Information Interchange." The corresponding international standard is ISO DP 6429. These standards define a set of encoded control functions to facilitate data interchange with 2-dimensional imaging devices, such as CRT and printer terminals. Additional controls and features in the Teleray which are not included in this standard were coded as "private use" parameters as described in X3.64.

The control sequences shown in this manual are described in terms of the ASCII character equivalent. Designating or invoking alternate graphic sets does not affect the relationship.

B. Graphic Character Sets

The Teleray has four resident graphic sets: an ASCII set, a UK set, a line drawing set, and a mosaic set. These character sets are designated and invoked as described in Figure 5-17. The graphic set designations are stored in non-volatile memory. The mosaic set is designed so that the cells in the character block have a direct relationship to the six low order ASCII bit values. See Figure 5-14. The UK set is identical to ASCII except that the pound sterling symbol (£) is substituted for the # symbol. The line drawing and mosaic sets are illustrated in Figure 5-16.

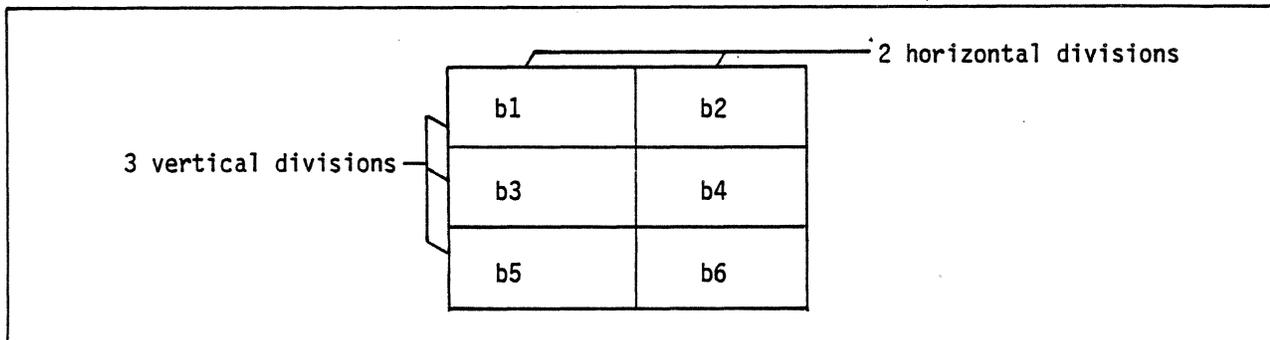


Figure 5-14: Mosaic Character Cell Composition

USA STANDARD CODE FOR INFORMATION INTERCHANGE

BIT NUMBERS							0 ₀₀	0 ₀₁	0 ₁₀	0 ₁₁	1 ₀₀	1 ₀₁	1 ₁₀	1 ₁₁	
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	COLUMN	0	1	2	3	4	5	6	7
↓	↓	↓	↓	↓	↓	↓		ROW							
			0	0	0	0	0	NUL	DLE	SP	0	@	P	\	p
			0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
			0	0	1	0	2	STX	DC2	"	2	B	R	b	r
			0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
			0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t
			0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
			0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
			0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
			1	0	0	0	8	BS	CAN	(	8	H	X	h	x
			1	0	0	1	9	HT	EM	)	9	I	Y	i	y
			1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
			1	0	1	1	11	VT	ESC	+	;	K	[	k	{
			1	1	0	0	12	FF	FS	,	<	L	\	l	!
			1	1	0	1	13	CR	GS	-	=	M	]	m	}
			1	1	1	0	14	SO	RS	.	>	N	^	n	~
			1	1	1	1	15	SI	US	/	?	O	_	o	DEL

CONTROL FUNCTION DEFINITIONS

NUL	Null, or all zeros	DC1	Device control 1
SOH	Start of heading	DC2	Device control 2
STX	Start of text	DC3	Device control 3
ETX	End of text	DC4	Device control 4
EOT	End of transmission	NAK	Negative acknowledge
ENQ	Enquiry	SYN	Synchronous idle
ACK	Acknowledge	ETB	End of transmission block
BEL	Bell, or alarm	CAN	Cancel
BS	Backspace	EM	End of medium
HT	Horizontal tabulation	SUB	Substitute
LF	Line feed	ESC	Escape
VT	Vertical tabulation	FS	File separator
FF	Form feed	GS	Group separator
CR	Carriage return	RS	Record separator
SO	Shift out	US	Unit separator
SI	Shift in	SP	Space
DLE	Data link escape	DEL	Delete

Figure 5-15 ASCII Character Set

BIT NUMBERS					0 ₁₀	0 ₁₁	1 ₀₀	1 ₀₁	1 ₁₀	1 ₁₁
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	COLUMN		ROW	
							2	3	4	5
0	0	0	0	0	0	0			0	2
0	0	0	0	1	1	1			1	3
0	0	1	0	0	2	2			2	x
0	0	1	1	0	3	3			3	÷
0	1	0	0	0	4	4			4	°
0	1	0	1	0	5	5			5	±
0	1	1	0	0	6	6			6	≤
0	1	1	1	0	7	7			7	≥
1	0	0	0	0	8	8			8	≠
1	0	0	1	0	9	9			9	∞
1	0	1	0	0	10	10			10	∑
1	0	1	1	0	11	11			11	∫
1	1	0	0	0	12	12			12	Ω
1	1	0	1	0	13	13			13	⊖
1	1	1	0	0	14	14			14	μ
1	1	1	1	0	15	15			15	π

LINE DRAWING

BIT NUMBERS					0 ₁₀	0 ₁₁	1 ₀₀	1 ₀₁	1 ₁₀	1 ₁₁
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	COLUMN		ROW	
							2	3	4	5
0	0	0	0	0	0	0			0	
0	0	0	1	1	1	1			1	
0	0	1	0	0	2	2			2	
0	0	1	1	0	3	3			3	
0	1	0	0	0	4	4			4	
0	1	0	1	0	5	5			5	
0	1	1	0	0	6	6			6	
0	1	1	1	0	7	7			7	
1	0	0	0	0	8	8			8	
1	0	0	1	0	9	9			9	
1	0	1	0	0	10	10			10	
1	0	1	1	0	11	11			11	
1	1	0	0	0	12	12			12	
1	1	0	1	0	13	13			13	
1	1	1	0	0	14	14			14	
1	1	1	1	0	15	15			15	

MOSIAC

Figure 5-16 Line Drawing and Mosaic Sets

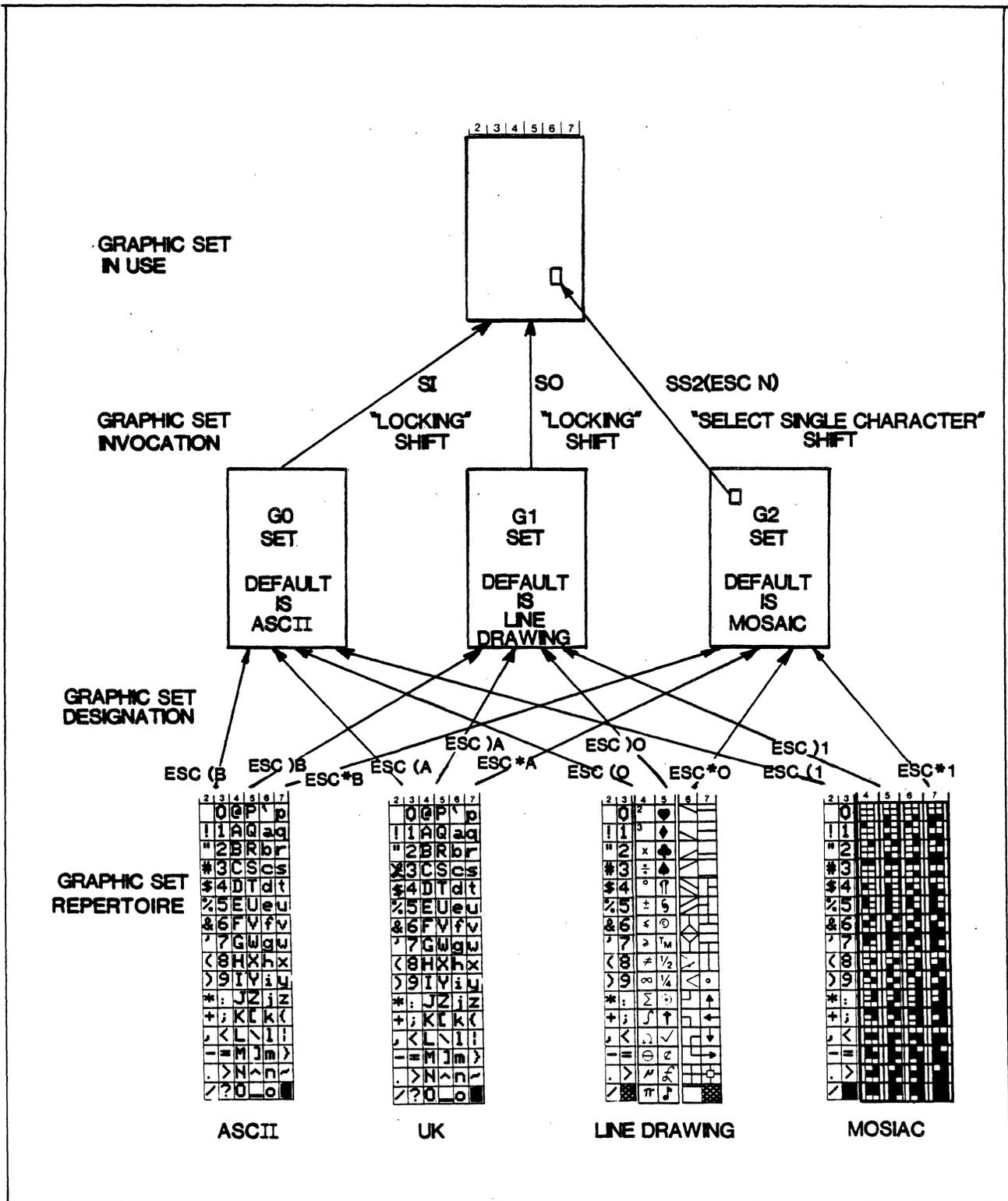


Figure 5-17: Graphic Sets

SECTION 6

CODING SUMMARY ARRANGED BY CODE

The following table lists the control sequences interpreted and transmitted by the Teleray Model 16. They are collated in ASCII order ignoring parameters.

<u>Control Character</u>	<u>Function</u>
NUL	Time Fill
ENQ	Transmit Answerback
BEL	Ring Bell
BS	Cursor One Left
HT	Cursor to Tab Stop
LF	Line Feed or New Line
VT	Same as LF
FF	Same as LF
CR	Cursor Full Left
SO	Invoke G0 Char. Set
SI	Invoke G1 Char. Set
DC1	Resume
DC3	Suspend
CAN	Cancel this Escape Sequence
SUB	Same as CAN
ESC	Introduce Escape Sequence
DEL	Time Fill
ESC (P _s	Select G0 Character Set - Default is ASCII
ESC) P _s	Select G1 Character Set - Default is Special Graphics Set
ESC * P _s	Select G2 Character Set - Default is Mosaic Character Set

<u>P_s Value</u>	<u>Selection</u>
0	Special Graphics Set
1	Mosaic Character Set
A	UK Set
B	ASCII

ESC 5	Transmit a Block to Serial Port
ESC 6	Transmit Text and Form to Serial Port
ESC 7	Save Cursor, Attribute Tag and Character Set
ESC 8	Restore Cursor, Attribute Tag and Character Set
ESC 9	Break
ESC D	Index
ESC E	Next Line
ESC F	Start Selected Area
ESC G	End Selected Area
ESC H	Set a Horizontal Tab Stop - Default Columns 1, 9, 17, 25...
ESC M	Reverse Index
ESC N	Single Shift - Invoke G2 Set for 1 Character (only)
ESC P P _s text ESC \	Enter Text into Program Function P _s (P _s from 01 through 32)
ESC P A text ESC \	Reprogram Answerback Message with Text
ESC P I text ESC \	Reprogram Identity Sequence with Text
ESC P K P _s text; P _s text...ESC \	Reprogram Macro Key P _s with Keyboard Operating Text
ESC P L P _s text; P _s text...ESC \	Reprogram Macro Key P _s with Local Operating Text
ESC P M text ESC \	Display Text as a Status Line Message
ESC P T P _s text; P _s text...ESC \	Reprogram Macro Key P _s with Transmitting Text
ESC P R text ESC \	Teleray Report to Detailed Status Request - Current test result display on bottom (25th) line is transmitted

Control CharacterFunction

ESC S Teleray Ready to Transmit a Block
 ESC V Start of Protected Area SSA
 ESC W End of Protected Area ESA
 ESC [P_n @ Insert P_n Space Characters
 ESC [P_n A Cursor Up P_n Characters
 ESC [P_n B Cursor Down P_n Characters
 ESC [P_n C Cursor Right P_n Characters
 ESC [P_n D Cursor Left P_n Characters
 ESC [P_n; P_n H Cursor to Line no P_n; Column no P_n

ESC [P_s J Erase in Display

P _s Value	Area Erased
0	Cursor to Bottom Margin
1	Top Margin to Cursor
2	Between All Margins
? 1	Cursor to End of Last Page
? 2	All Pages

ESC [P_s K Erase in Line

P _s Value	Area Erased
0	Cursor to Right Margin
1	To Cursor from Left Margin
2	Entire Line Between Margins

ESC [P_n L Insert P_n Lines
 ESC [P_n M Delete P_n Lines
 ESC [P_s N Erase in Field

P _s Value	Area Erased
0	Cursor to End of Field
1	Beginning of Field to Cursor
2	Entire Field

ESC [P_n P Delete P_n Characters
 ESC [P_s Q Select Editing Extent - Default is Between Margins

P _s Value	Area Selected
0	Edit Between Margins
1	Edit Within Line
2	Edit Within Field

ESC [P_n; P_n R Response to Cursor Position Line no P_n; Column no P_n
 ESC [P_n S Scroll Display Window Up P_n Lines
 ESC [P_n T Scroll Display Window Down P_n Lines
 ESC [P_n U Forward P_n Pages
 ESC [P_n V Reverse P_n Pages
 ESC [P_n Z Back Tab P_n Stops
 ESC [P_n b Repeat Previous Character or Control Sequence P_n Times
 ESC [c Request Identity Sequence
 ESC [P_n; P_n f Cursor to Line no P_n; Column no P_n

Control CharacterFunctionESC [P_s g

Clear Tab Stops

P_s Value**Action**

0

Remove Tab Stop at Cursor Location

3

Remove all Tab Stops

ESC [P_s; P_s;...hSet Mode Specified by P_s (also see ESC [P_s; P_s;...L)**Set Mode Meaning****P_s Value****Reset Mode Meaning**

Transmit Guarded Fields

1

Transmit Without Guarded Fields

Keyboard Lock

2

Keyboard Unlock

Monitor Mode

3

Normal Mode

Insertion Mode

4

Character Replacement Mode

Serial Port Local Echo On

12

Serial Port Local Echo Off

Transmit to Cursor

16

Transmit to End

New Line Mode

20

Line Feed Mode

Smooth Scroll

? 3

Jump Scroll

Display Dark on Light

? 5

Display Light on Dark

Addressing Relative to Window

? 6

Addressing Absolute

Right Margin Wrap On

? 7

Right Margin Wrap Off

Keyboard Auto Repeat

? 8

No Auto Repeat

Local Mode

? 12

On-Line Mode

Serial Port Space Suppression

? 13

No Space Suppression

Peripheral Port Suppression

? 15

No Peripheral Port Suppression

Keyboard Repeat Rate 15 cps

? 21

Keyboard Repeat Rate 30 cps

Smooth Scroll Rate 12 lps

? 22

Smooth Scroll Rate 6 lps

No Interpretation During Function

? 23

Interpretation During Function

Loading

Protect Mode On

? 24

No Protection

Block Mode

? 25

Character Mode

Calculator Mode

? 26

Normal Mode

Display Terminal Status

? 27

Status Display Off

Keyclick On

? 28

Keyclick Off

Left Margin Wrap

? 29

No Left Margin Wrap

Scrolling Off

? 30

Scrolling On

Auto Page Advance

? 31

Page Advance Stop

Screen Saver On

? 32

Screen Saver Off

Cursor Character Blink

? 33

Cursor Character Steady

50 Hz Refresh Rate

? 34

60 Hz Refresh Rate

Serial Port Half Duplex

? 36

Serial Port Full Duplex

Serial Port No Parity Check

? 37

Serial Port Parity Check

Serial Port Suspend Resume

? 38

Serial Port No Suspend Resume

Serial Transmit Auto Suspend on EOL

? 39

No Auto Suspend

Space Substitution for Fields, Serial

? 40

No Space Substitution

Peripheral Busy-Ready Detect

? 41

Busy-Ready Not Sensed

Busy-Ready Level High

? 42

Busy-Ready Level Low

Peripheral Port Half Duplex

? 44

Peripheral Port Full Duplex

Peripheral Port No Parity Check

? 45

Peripheral Port Parity Check

Enable Suspend Resume Peripheral Port

? 46

No Suspend Resume Peripheral Port

Peripheral Transmit Auto Suspend on EOL

? 47

No Auto Suspend

Space Substitution Peripheral Port

? 48

No Space Substitution Peripheral Port

Selection Menu Page

? 50

Selection Menu Line

Control CharacterFunctionESC [P_s i

Data Flow Commands (Media Copy)

P _s Value	Meaning
0	Block Transmit to Peripheral Port
4	Copy Serial Transparent to Peripheral Off
5	Copy Serial Transparent to Peripheral On
6	Copy Peripheral Transparent to Serial Off
7	Copy Peripheral Transparent to Serial On
? 6	Copy Serial to Peripheral w/Interpret. Off
? 7	Copy Serial to Peripheral w/Interpret. On
? 8	Copy Peripheral to Serial w/Interpret. Off
? 9	Copy Peripheral to Serial w/Interpret. On

ESC [P_s; P_s;...l
ESC [P_s; P_s;...mReset Mode (see ESC [P_s; P_s;...h)
Select Graphic Rendition

P _s Value	Meaning
0	Normal; No Visual Attributes
2	Dim On
4	Underscore On
5	Blink On
7	Inverse On
8	Blank

ESC [P_s; P_s;...n

Request Teleray to Report

P _s Value	Meaning
5	Send Short Form Status
6	Send Cursor Position
? 7	Send Time
? 8	Send Detailed Status
? 15	Send Peripheral Status

ESC [P_s n

Teleray Status Report

P _s Value	Meaning
0	Teleray Ready
3	Malfunction
? 10	Peripheral Port Ready
? 11	Peripheral Port Not Ready

ESC [P_s; P_s;...o

Define Area Qualification

P _s Value	Meaning
0	Normal (Cancel Previous)
3	Numeric Only
4	Alpha Only
5	Right Justified
6	Zero Fill (else space filled)
8	Protected Transmittable
? 1	Entry Required
? 2	Must Fill

Control Character

Function

ESC [P_n p
ESC [P_s; P_s;...q

Delete P_n Characters Within Text Block
Program Keyboard Indicators

P _s Value	Indicators
0	All Off
1	L1 On
2	L2 On
3	L3 On
4	L4 On
5	On-Line On (Automatically Reset)
6	Local On (Automatically Reset)
7	Keyboard Locked On (Automatically Reset)

ESC [P_n; P_n r
ESC [P_n; P_n s
ESC [P_s t
ESC [P_s u
ESC [16; P_s y

Set Top; Bottom Margins
Set Left; Right Margins
Transmit Dynamic Programmable Function P_s
Locally Perform Dynamic Programmable Function P_s
Self-Test Terminal - Results to Status Line - See ESC ^ 4

P _s Value	Test Performed
0 or 1	All Tests
2	ROM - Program
3	DSP - Display RAM
4	KBD - Keyboard
5	SIO (requires jumper plug)
6	PIO (requires jumper plug)
7	CRT (fills screen)
8	Repeat Previous Test Until Error

ESC [P_s z

Enable Transmits to Dynamic Programmable Function P_s
ESC \ Terminates Function Definitions

ESC [P_s; P_s {

Select Start of Transmission Identifying Character
(First P_s selects for serial port; second for peripheral port.
Default values are "none".)

P _s Value	Identifier	P _s Value	Identifier	P _s Value	Identifier
0	Default	13	CR	26	SUB
1	SOH	14	SO	27	ESC
2	STX	15	SI	28	FS
3	ETX	16	DLE	29	GS
4	EOT	17	DC1	30	RS
5	ENQ	18	DC2	31	US
6	ACK	19	DC3	32	NUL
7	BEL	20	DC4	33	None
8	BS	21	NAK	34	DEL
9	HT	22	SYN	35	LF CR
10	LF	23	ETB	36	CR LF
11	VT	24	CAN		
12	FF	25	EN		

ESC [P_s; P_s |

Select End of Transmission Identifier - Default is EOT
(See ESC [P_s; P_s { for format.)

ESC [P_n ~
ESC [P_n Space @
ESC [P_n Space A
ESC [P_n Space p
ESC [P_s Space q

Insert P_n Characters in Text Block
Scroll Display P_n Columns Left
Scroll Display P_n Columns Right
Select P_n Pages - Default is 4
Select Cursor Character - P_s from 0 through 256 selects from table in Section 5-1 in ascending ASCII order.

Control Character

Function

ESC [P_n Space r Select Right Margin Bell P_n Columns from Right Margin - Default is 8

ESC [P_n Space s Specify Screen Brightness Level from 0 through 64

ESC [P_n; P_n Space t Delay Machine P_n 1st P_n Seconds; 2nd .1 Seconds

ESC [P_s; P_s Space u Unlock Selection in Category P_s; Feature P_s

ESC [P_s; P_s Space v Lock Selection in Category P_s; Feature P_s

ESC [Space w Exit Selection Menu

ESC [2 Space x Clear all Dynamic Function Memory

ESC [255; 255 space y Reset to Default Condition

ESC [space z Duplicate Rendition

ESC [P_n ? p Set Logical Page Length to P_n Lines

ESC [P_n ? q Set Logical Line Length to P_n Characters

ESC [P_n; P_n; P_n ? r Report Time (to Host) P_n hours; P_n minutes; P_n seconds

ESC [P_n; P_n; P_n ? s Set Time (to Teleray) P_n hours; P_n minutes; P_n seconds

ESC [P_s; P_s ? t Select Text for Transmission Serial Port; Peripheral Port

P _s Value	Text Selected
0 or 1	Page (Default)
2	Line
3	Window
4	Memory
5	Selected Area, SSA to ESA (See ESC F, ESC G)

ESC [P_n ? u Reinstate Last Deleted Line P_n Times

ESC [P_n ? v Reinstate Last Deleted Word P_n Times

ESC [? w Delete P_n Words

ESC [P_s; P_s ? z Select Guarded Field Identifier Characters - Default is HT
(See ESC [P_s; P_s {)

ESC [P_s; P_s ? { Select End of Line Terminator Characters - Default is LF CR
(See ESC [P_s; P_s {)

ESC [P_s; P_s ? | Select End of Page Terminator Characters - Default is FF
(See ESC [P_s; P_s {)

ESC [P_s; P_s ? } Select Baud Rate for Serial Port; Peripheral Port

P _s Value	Rate	P _s Value	Rate
0	2400 (default)	8	1200
1	50	9	1800
2	75	10	2400
3	110	11	3600
4	134.5	12	4800
5	150	13	7200
6	300	14	9600
7	600	15	19200

ESC [P_s; P_s ? ~ Set Parity for Serial Port; Peripheral Port

P _s Value	Parity Setting
0	None (8 bits no parity)
1	Even
2	Odd
3	Mark
4	Space

ESC \ String Terminator for Control Sequences

ESC c Reset to Initial State

SECTION 7

CODING SUMMARY ARRANGED BY FUNCTION

S indicates modifiable in Selection Menu
* indicates state saved in non-volatile memory
¶ indicates default condition
ℓ indicates lower case L

- 7-1 Ergonomic Controls
- 7-2 Memory Structure Controls
- 7-3 Application Controls, Operator Alerts, and Bottom Line Displays
- 7-4 Communications Format
- 7-5 Data Flow Controls
- 7-6 Block Transmits
- 7-7 Programmable Functions
- 7-8 Text Presentation Format
- 7-9 Cursor Positioning
- 7-10 Erases, Resets, and Edits
- 7-11 Test Reports and Messages
- 7-12 Character Sets

7-1 Ergonomic Controls

S * Screen Brightness Level	ESC [P _n space s
S * Smooth Scroll/Jump Scroll (1)	ESC [? 3 h / ESC [? 3 l
S * Smooth Scroll Rate 6/12 lps	ESC [? 22 l / ESC [? 22 h
S * Auto Key-Repeat On/Off	ESC [? 8 h / ESC [? 8 l
S * Auto Key-Repeat Rate 30/15 cps	ESC [? 21 l / ESC [? 21 h
S * Screen Background Dark/Light	ESC [? 5 l / ESC [? 5 h
S * Right Margin Bell Column (2)	ESC [P _n space r
S * Cursor Character Blink/Steady (3)	ESC [? 33 h / ESC [? 33 l
S * Cursor Character Select	ESC [P _n space q
S * Keyclick On/Off	ESC [? 28 h / ESC [? 28 l

- (1) Smooth scroll temporarily revoked automatically if input buffer attempts to overflow.
- (2) Set P_n to zero to disable Bell; Bell rings P_n columns from end of logical line. Default = 8.
- (3) If steady, cursor blinks only if placed on a non-space character.

7-2 Memory Structure Controls

Set Top, Bottom Margins (1)	ESC [P _n ; P _n r
S * Set Left, Right Margins (1)	ESC [P _n ; P _n s
S * Left Margin Wrap On/Off	ESC [? 29 h / ESC [? 29 l
S * Right Margin Wrap On/Off	ESC [? 7 h / ESC [? 7 l
S * Scrolling On/Off (2)	ESC ? 30 l / ESC ? 30 h
S * Page Stop/Page Auto Advance	ESC ? 31 l / ESC ? 31 h
S * Set Logical Line Length to P _n Characters (3)	ESC [P _n ? q
S * Set Logical Page Length to P _n Lines	ESC [P _n ? p
S * Select Number of Pages (4)	ESC [P _n space p

- (1) Margins must be smaller than logical page size. Defaults are Line 1; last line of page.

(2) Scrolling	Page	Action on Reaching Page Boundary
On	Stop	Scroll within page
On	Advance	Scroll into next page
Off	Stop	Overwrite in current page
Off	Advance	Auto "flip" into next page

Cursor will not move backward beyond first page or forward beyond last page.

- (3) 255 characters per line maximum.
- (4) Remainder used as dynamic programmable function if non-volatile memory option installed (255 lines per page maximum).

7-3 Application Controls, Operator Alerts, and Bottom Line Displays

A. Application Controls

S * Monitor Mode/Normal	ESC [3 h / ESC [3 ℓ ¶
S * New Line Mode/Line Feed	ESC [20 h / ESC [? 20 ℓ ¶
S * 50/60 Hz Refresh Rate	ESC [? 34 h / ESC [? 34 ℓ ¶
S * Selection Menu Line/Page	ESC [? 50 ℓ / ESC [? 50 h ¶
S * Screen Saver On/Off	ESC [? 32 h / ESC [? 32 ℓ ¶

B. Operator Alerts

Sound Bell	Bel
Keyboard Lock/Unlock	ESC [2 h / ESC [2 ℓ ¶
* Illuminate/Extinguish LEDs (1)	ESC [P _S ; P _S ;...P _S q

(1) P_S Action

0 or none	¶All off
1	L1 on
2	L2 on
3	L3 on
4	L4 on
5	On Line on (Automatically reset)
6	Local on (Automatically reset)
7	Keyboard Locked on (Automatically reset)

C. Bottom Line Displays

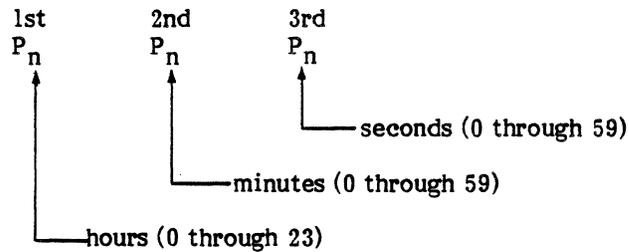
Start/End Message Line Message (1)	ESC P M text ESC
Enter/Exit Calculation Mode	ESC [? 26 h / ESC [? 26 ℓ ¶
Exit Selection Mode (Blank Bottom Line)	ESC [space w
Display Terminal Status On/Off (2)	ESC [? 27 h / ESC [? 27 ℓ ¶
Display Self Test Result (3)	Automatic on self test completion
Lock Selection Feature (4)	ESC [P _S ; P _S space v
Unlock Selection Feature (4)	ESC [P _S ; P _S space u

- (1) Message to be placed on the bottom line is bracketed between the ESC sequences shown. No text will erase the bottom line. MSG indicator will indicate to the operator that a message is waiting if the bottom line is being used to display terminal status, Selection Menu, or self test result.
- (2) Terminal status displays current condition of: clock, cursor column number, line number, page number, entry error, function memory.
- (3) Includes instructions, program revision level, and self test results.
- (4) Each selection feature can be separately locked. First P_S selects group; second P_S selects item. (See Page 4-1.)

D. Clock

Set Clock Time (1)	ESC [P _n ; P _n ; P _n ? s
Request Time	ESC [? 7 n
Report Clock Time (1)(2)	ESC [P _n ; P _n ; P _n ? r
Delay Next Operation (3)	ESC [P _n ; P _n space t

(1) Format



- (2) Status display is a 12-hour clock (no AM, PM)
 Computer clock is a 24-hour clock, military time format
 (e.g., 14 = 2 PM, 2 = 2 AM, etc.)
- (3) First P_n in seconds 0 through 59; second P_n in tenths of seconds. Data accepted into buffers but not processed; keyboard is locked during delay interval.

7-4 Communications Format

S * Set Baud Rates (1)	ESC [P _s ; P _s ? }
S * Set Parity (2)	ESC [P _s ; P _s ? ~
S * Serial I/O Parity Check/None	ESC [? 37 h [¶] / ESC [? 37 ℓ
S * Peripheral I/O Parity Check/None	ESC [? 45 h [¶] / ESC [? 45 ℓ
S * Serial I/O Full Duplex/Half	ESC [? 36 ℓ [¶] / ESC [? 36 h
S * Peripheral I/O Full Duplex/Half	ESC [? 44 ℓ [¶] / ESC [? 44 h

- (1) First P_s selects for Serial port; second P_s selects for Peripheral port.

P _s	Baud Rate	P _s	Baud Rate
0 (or none)	2400	8	1200
1	50	9	1800
2	75	10	2400
3	110	11	3600
4	134.5	12	4800
5	150	13	7200
6	300	14	9600
7	600	15	19200

- (2) First P_s selects for Serial port; second P_s selects for Peripheral port.

P _s	Parity Setting
0	None (8 bits no parity)
1	Even
2	Odd
3	Mark
4	Space

7-5 Data Flow Controls

S * Local/Remote Mode (1)	ESC [? 12 h / ESC [? 12 l [¶]
S * Character/Block Mode (2)	ESC [? 25 l [¶] / ESC [? 25 h
S * Copy Serial Input to Peripheral - Copy Interpreted On/Off	ESC [? 7 i / ESC [? 6 i [¶]
Copy Transparent On/Off	ESC [5 i / ESC [4 i [¶]
S * Enable/Disable Suspend-Resume - Serial I/O	ESC [? 38 h / ESC [? 38 l [¶]
S * Local Echo Serial Port Off/On (3)	ESC [12 l [¶] / ESC [12 h
S * Copy Peripheral Input to Serial - Copy Interpreted On/Off	ESC [? 9 i / ESC [? 8 i [¶]
Copy Transparent On/Off	ESC [7 i / ESC [6 i [¶]
S * Enable/Disable Suspend-Resume - Peripheral	ESC [? 46 h / ESC [? 46 l [¶]
S * Enable/Disable Peripheral Busy-Ready Detect	ESC [? 41 h / ESC [? 41 l [¶]
S * Peripheral Busy-Ready Level High/Low (4)	ESC [? 42 h / ESC [? 42 l [¶]
Suspend	DC3
Resume	DC1
Bell Queue 8 Characters	
Serial Input Buffer 256 Characters	
Peripheral Input Buffer 16 Characters	
Peripheral Output Buffer 16 Characters	

- (1) Operates on Serial I/O port.
- (2) Operates on keyboard data; transmitting functions will continue to transmit.
- (3) Operates on keyboard data and transmitting functions.
- (4) Always active; jumper in plug to disable.

7-6 Block Transmits

Ready to Transmit	ESC S
Transmit Text (1) (Serial I/O Port)	ESC 5
Transmit Text (1) (Peripheral I/O Port)	ESC [i or ESC [o i
Transmit Form and Text	ESC 6
Start Select Area (SSA)	ESC F
End Select Area (ESA)	ESC G
S * Select Text for Transmission (2)	ESC [P _s ; P _s ? t
S * Transmit from Beginning to Cursor/to End	ESC [16 h / ESC [16 l ¶
S * Serial Auto Suspend on End of Line/Normal	ESC [? 39 h / ESC [? 39 l ¶
S * Peripheral Auto Suspend on End of Line/Normal	ESC [? 40 h / ESC [? 40 l ¶
S * Space Suppression On/Off Serial	ESC [? 13 h / ESC [? 13 l ¶
S * Space Suppression On/Off Peripheral	ESC [? 15 h / ESC [? 15 l ¶
S * Space Substitution for Fields On/Off Serial	ESC [? 40 h / ESC [? 40 l ¶
S * Space Substitution for Fields On/Off Peripheral	ESC [? 48 h / ESC [? 48 l ¶
S * Transmit Guarded Fields/Transmit without Guarded Fields	ESC [1 l / ESC [1 h
S * Select Start of Transmission Identifier (3)	ESC [P _s ; P _s } Default is none
S * Select Guarded Field Replacement Identifier (3)	ESC [P _s ; P _s ? z Default is HT
S * Select End of Line Terminator (3)	ESC [P _s ; P _s ? } Default is LF CR
S * Select End of Page Terminator (3)	ESC [P _s ; P _s ? ! Default is FF
S * Select End of Transmission Terminator (3)	ESC [P _s ; P _s !

(1) Text is selected by settings of "Select Text" and "Transmit from Beginning to Cursor/to End".

(2) First P_s selects for Serial port; second P_s selects for Peripheral port.

P _s Value	Area Transmitted
0 or 1	Page
2	Line
3	Window
4	Memory
5	Selected Area (SSA to ESA)

(3) First P_s selects for Serial port; second P_s selects for Peripheral port.

P _s Value	Identifier	P _s Value	Identifier	P _s Value	Identifier
0	Default	13	CR	26	SUB
1	SOH	14	SO	27	ESC
2	STX	15	SI	28	FS
3	ETX	16	DLE	29	GS
4	EOT	17	DC1	30	RS
5	ENQ	18	DC2	31	US
6	ACK	19	DC3	32	NUL
7	BEL	20	DC4	33	None
8	BS	21	NAK	34	DEL
9	HT	22	SYN	35	LF CR
10	LF	23	ETB	36	CR LF
11	VT	24	CAN		
12	FF	25	EN		

7-7 Programmable Functions

A. Macro Keys

* Reprogram Macro Key (Local) (1)(2)	ESC P L P _S text; P _S text...
* Reprogram Macro Key (Transmitting) (1)(2)	ESC P T P _S text; P _S text...
* Reprogram Macro Key (Keyboard) (1)(2)	ESC P K P _S text; P _S text...
End Macro Key Sequence Definition	ESC \

(1) Typical Sequence:

ESC P P_S text; P_S text; P_S text; P_S text;...; ESC \

L for local; T for transmitting; K for keyboard; text limited to eight characters maximum.

P_S = 2-digit key number for key to be reprogrammed; only include P_S text for those functions to be reprogrammed.

(2) Local macros always operate locally; no code is transmitted. Transmitted macro keys always transmit; there is no local effect unless the host computer echoes the macro character string. Keyboard macro keys are treated as keyboard input (e.g., local in Local mode, transmitting in Remote and Character modes, etc.).

B. Dynamic Programmable Functions

* Define Dynamic Function P _S (1)	ESC P P _S text
End Dynamic Function Definition	ESC \
Locally Perform Dynamic Function P _S	ESC [P _S u
Transmit Dynamic Function P _S Contents	ESC [P _S t
Enable Transmits to Dynamic Function P _S	ESC [P _S z
S * Load Functions Transparent/With Interpretation	ESC [? 23 h [¶] / ESC [? 23 ℓ
Clear all Dynamic Function Memory	ESC [2 space x

(1) P_S is 2-digit dynamic programmable function number 01 through 32.

7-8 Text Presentation Format

Start Protected Area	ESC V
End Protected Area	ESC W
Duplicate Rendition	ESC [space z
Protect Mode On/Off	ESC [? 24 h / ESC ? 24 ℓ [¶]
Select Qualified Areas (1)	ESC [P _S ; P _S ;...P _S o
Select Visual Attributes (2)	ESC [P _S ; P _S ;...P _S m

(1) P _S Value	Area Qualification	(2) P _S Value	Attribute
0 or none	Normal; cancel previous	0 or none	Normal; all attributes off
3	Numeric only	2	Dim on
4	Alphabetic only	4	Underscore on
5	Right justify	5	Blink on
6	Zero fill (else will be space filled)	7	Inverse on
8	Protected, transmitting	8	Blank
? 1	Entry required		
? 2	Must fill		

7-9 Cursor Positioning

A. Cursor Manipulation

One Up or P_n Up	ESC [P_n A
One Down or P_n Down	ESC [P_n B
One Right or P_n Right	ESC [P_n C
One Left or P_n Left	ESC [P_n D or BS
Full Left (Cursor Return)	CR
Home	ESC [H or ESC [f
Line Feed (1)	LF
New Line (1)	LF or ESC E
Index	ESC D
Reverse Index	ESC M
Address Origin Window/Absolute	ESC [? 6 h / ESC [? 6 l ¶
Direct Address (2)	ESC [P_n ; P_n H or ESC [P_n ; P_n f
Request Position Report	ESC [6 n
Cursor Position Response (2)	ESC [P_n ; P_n R
* Save Cursor, Attributes and Character Set (in NVM)	ESC 7
Restore Cursor, Attribute Tag and Character Set	ESC 8
(1) ESC [20 h sets LF to New Line function ESC [20 l sets LF to Index function	} Also select what CR and LF keys transmit
(2) First P_n is decimal line number Second P_n is decimal column number	

B. Tab Operations (Default stops every eighth column)

Cursor to Next Tab Stop	HT
S * Set Tab Stop in Current Column	ESC H
S * Clear Tab Stop in Current Column	ESC [g
Clear All Tab Stops	ESC [3 g
Back P_n Tab Stops	ESC [P_n Z

C. Text Movement

Scroll Display Window Up P_n Lines (1)	ESC [P_n S
Scroll Display Window Down P_n Lines (1)	ESC [P_n T
Scroll Display Right P_n Columns (2)	ESC [P_n space A
Scroll Display Left P_n Columns (2)	ESC [P_n space @
Forward P_n Pages	ESC [P_n U
Reverse P_n Pages	ESC [P_n V

- (1) All 24 lines if window not specified or if set to 24. Scrolls also automatically initiated by moving cursor past page or window boundaries.
- (2) Scrolls may also be initiated by moving cursor past page boundaries.

7-10 Erases, Resets, and Edits

A. Erases

Erase from Cursor to Right Margin (1)	ESC [0 K
Erase from Cursor to Left Margin	ESC [1 K
Erase Entire Line to Both Margins	ESC [2 K
Erase from Cursor to Bottom Margin (2)	ESC [0 J
Erase from Cursor to Top Margin	ESC [1 J
Erase Entire Page Within Margins	ESC [2 J
Erase from Cursor to End of Pages	ESC [? 1 J
Erase All Pages	ESC [? 2 J
Erase Field	ESC [P _s N (3)

- (1) To end of logical line if no margin.
- (2) To end of page if no bottom margin.
- (3) P_s

0 or none	From cursor to end of field
1	From cursor to beginning
2	Entire field

B. Resets

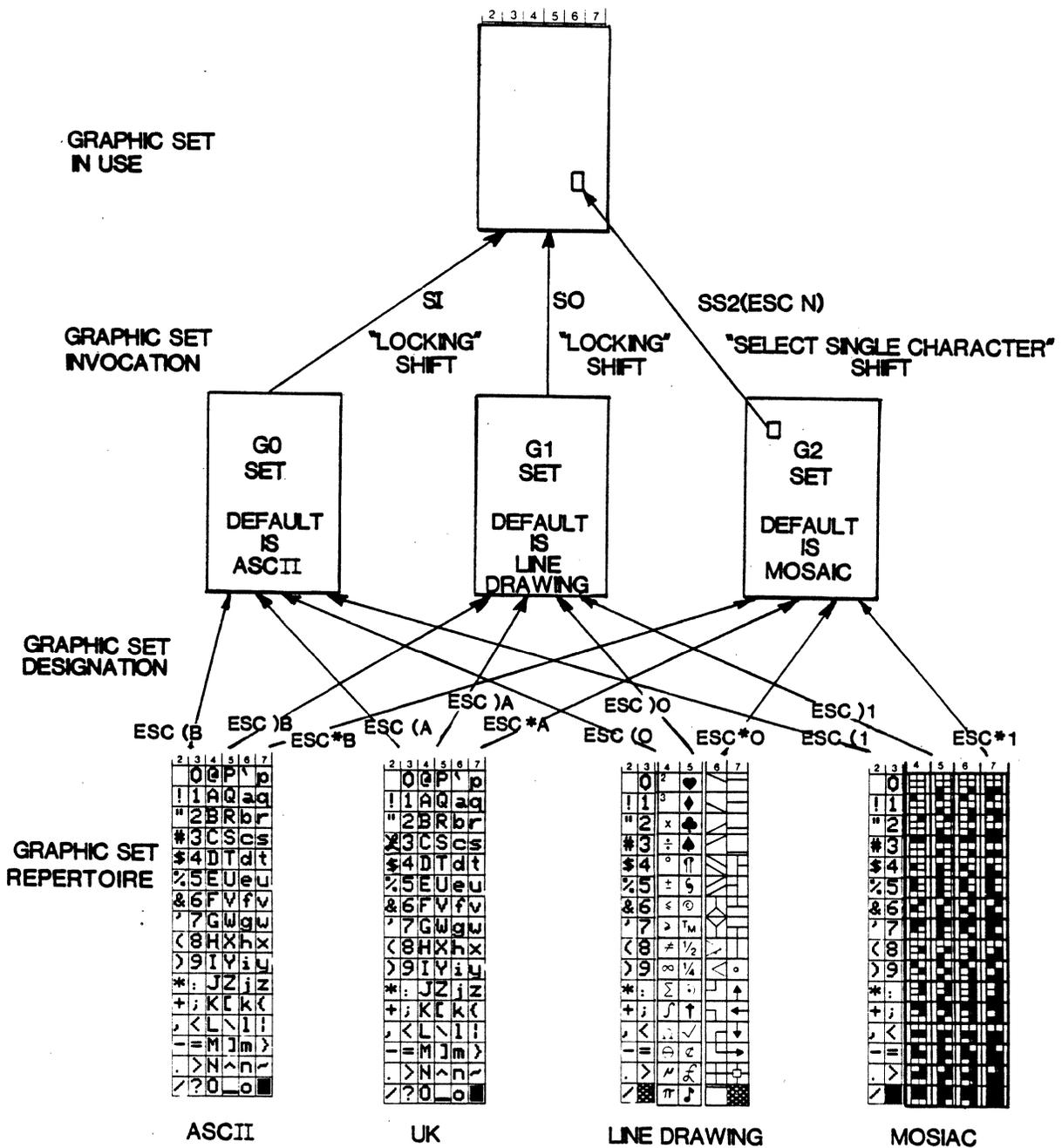
Reset to Initial State	ESC c
Reset to Default Conditions	ESC [255; 255 space y

C. Edit Functions

Repeat Previous P _n Times	ESC [P _n b
Insert P _n Characters (1)	ESC [P _n @
Delete P _n Characters (1)	ESC [P _n P
Select Editing Extent (2)	ESC [P _s Q
Insert P _n Characters in Text Block	ESC [P _n ~
Delete P _n Characters in Text Block	ESC [P _n p
Delete P _n Words	ESC [? w
Reinstate Last Deleted Word P _n Times	ESC [P _n ? v
Insert P _n Lines	ESC [P _n L
Delete P _n Lines	ESC [P _n M
Reinstate Last Deleted Line P _n Times	ESC [P _n ? u
Insert/Replacement Mode	ESC [4 h / ESC [4 l ¶

- (1) Operation extent selected by editing extent mode.
- (2) Edit within the window for P_s = 0 or nothing
Edit within the line for P_s = 1
Edit within the field for P_s = 2

7-12 Graphic Sets



Control Character Display and Generation

Line Monitor Display	Control Character	Keyboard Generation Press ⁽¹⁾ Control &
↓	↓	↓
AK	ACK	F
BL	BEL	G
BS	BS	H
CN	CAN	X
CR	CR	M
D ₁	DC1	Q
D ₂	DC2	R
D ₃	DC3	S
D ₄	DC4	T
DL	DLE	P
EM	EM	Y
EQ	ENQ	E
ET	EOT	D
EC	ESC	3
EB	ETB	W
EX	ETX	C
FF	FF	L
FS	FS	4
GS	GS	5
HT	HT	I
LF	LF	J
NK	NAK	U
NL	NUL	2 or space bar
RS	RS	6
SI	SI	O
SO	SO	N
SH	SOH	A
SX	STX	B
SB	SUB	Z
SY	SYN	V
US	US	7
VT	VT	K
	DEL	8

USA STANDARD CODE FOR INFORMATION INTERCHANGE

BIT NUMBERS								0 ₀₀	0 ₀₁	0 ₁₀	0 ₁₁	1 ₀₀	1 ₀₁	1 ₁₀	1 ₁₁
							COLUMN	0	1	2	3	4	5	6	7
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	ROW								
			0	0	0	0	0	NUL	DLE	SP	0	@	P	\	p
			0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
			0	0	1	0	2	STX	DC2	"	2	B	R	b	r
			0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
			0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t
			0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
			0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
			0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
			1	0	0	0	8	BS	CAN	(	8	H	X	h	x
			1	0	0	1	9	HT	EM	)	9	I	Y	i	y
			1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
			1	0	1	1	11	VT	ESC	+	;	K	[	k	{
			1	1	0	0	12	FF	FS	,	<	L	\	l	;
			1	1	0	1	13	CR	GS	-	=	M	]	m	}
			1	1	1	0	14	SO	RS	.	>	N	^	n	~
			1	1	1	1	15	SI	US	/	?	O	_	o	DEL

CONTROL FUNCTION DEFINITIONS

NUL	Null, or all zeros	DC1	Device control 1
SOH	Start of heading	DC2	Device control 2
STX	Start of text	DC3	Device control 3
ETX	End of text	DC4	Device control 4
EOT	End of transmission	NAK	Negative acknowledge
ENQ	Enquiry	SYN	Synchronous idle
ACK	Acknowledge	ETB	End of transmission block
BEL	Bell, or alarm	CAN	Cancel
BS	Backspace	EM	End of medium
HT	Horizontal tabulation	SUB	Substitute
LF	Line feed	ESC	Escape
VT	Vertical tabulation	FS	File separator
FF	Form feed	GS	Group separator
CR	Carriage return	RS	Record separator
SO	Shift out	US	Unit separator
SI	Shift in	SP	Space
DLE	Data link escape	DEL	Delete

(1) Dedicated keys on keyboard for several of these codes.

TELERAY
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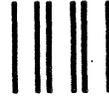
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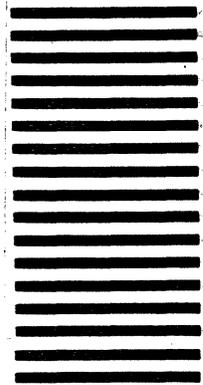
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