



# SERIES 500 DATA - SCREEN TERMINAL SYSTEMS

LOCAL OR REMOTE, SINGLE OR MULTI-STATION INFORMATION DISPLAY



TRANSISTOR ELECTRONICS CORPORATION

MAN/MACHINE INTERFACE

# TEC Series 500 DATA-SCREEN<sup>TM</sup> Terminal Systems ...



# a family of low cost, single and multi-station information display terminals

- **SYSTEM COMPATIBILITY** -- Custom-tailored communication pre-processing provides unmatched "turn-key" compatibility.
- **TEXT EDITING** -- User can select split screen, roll-and-scroll plus text format features.
- **SERIAL COMMUNICATIONS ADAPTERS** -- Synchronous or asynchronous operation . . . 8, 10, 11-bit character formats. Compatible with 103, 202 and 201-type data sets.
- **HUMAN ENGINEERED** -- Large (0.375" H), bright, flicker free characters are displayed on specially designed dark screen. Operators need no special training. Status indicators and controls provide positive feedback for precise interactive operation.
- **ECONOMICAL** -- Up to 32 DATA-SCREEN Display Terminals may time-share a single 510 Controller. Flexibility in choice of terminals allows exact matching of total system display requirements by single-source manufacturer dedicated to information display systems' design for the past 10 years.

TEC's new Series 500 DATA-SCREEN Terminal System for single, stand-alone or multi-station CRT operation provides efficient, fast, low cost computer information display and inquiry.

Large, bright, stroke-written characters appear boldly and flicker free on the 8 $\frac{3}{4}$ " wide by 6 $\frac{3}{4}$ " high CRT screen. Character contrast is further improved by a dark glass front panel which also incorporates fixed message displays in custom colors and shapes.

Up to 32 Model 545 (256 characters), 16 Model 555 (512 characters) or eight Model 565 (1000 characters) DATA-SCREEN Display Terminal stations can function simultaneously when coupled to TEC's Model 510 DATA-SCREEN Controller. Significant data communications economies result when several displays time-share the common interface, memory and control logic contained within the Controller.

Whatever your application -- source data entry, terminal inquiry/response, process control, management information -- Series 500 DATA-SCREEN Terminal Systems provide high speed, economical access to on-line, real time data processing systems. Whether your computer is in the next room or across the continent, Series 500 Terminal Systems can be used with equal ease. Message composition, text editing and keyboard entries are all local, off-line tasks. Your display stations are only on-line to computer or communications facilities during actual transmission, easing the processing load of

the computer and sharply reducing time sharing costs.

Single station DATA-SCREEN Displays are completely self-contained within an attractive, functional enclosure. Each contains a 12-inch rectangular CRT, a display buffer and refresh memory, control and editing logic, input/output interface adapter, optional electronic keyboard and power supplies.

Multi-station DATA-SCREEN Displays are housed in the same enclosure as single station units but contain only CRT, character generator, control logic and power supplies. Memory, station selector, multiplexor, editing and interface logic are contained in the central Controller. A compact maintenance panel, concealed behind the door of the Controller, verifies operational status of the Controller and associated display terminals and significantly reduces mean time to repair in the event of component or module failure.

Designed by computer peripheral equipment specialists, TEC's Series 500 DATA-SCREEN Terminal Systems provide low cost, reliable computer inquiry. All operations and editing features are designed for easy, accurate operator understanding and simplified data entry. Human factors design considerations result in a keyboard with touch, key travel and arrangement very similar to standard electric typewriters. Keyboard indicators report status of the display station to the operator.

## KEYBOARD

Keyboard and controls are designed for maximum operator efficiency. Electronic interlock eliminates erroneous entry when two or more keys are pressed simultaneously. An optional, audible end-of-line and last-line signal is available. This option also provides an audible key-strike signal activated with any keyboard entry to simulate normal typewriter key sound. Tests show that this signal greatly increases data entry typing speed, reduces operator fatigue and improves operator acceptance. Separate keyboard permits operator to move and orient as desired.

Keyboard mounted controls provide fingertip commands for Transmit, Print and Clear Memory. Matching indicators verify power and terminal system status, transmission mode and error indication. Wait, End-of-Line and End-of-Page indicators inform the operator of keyboard and display status.

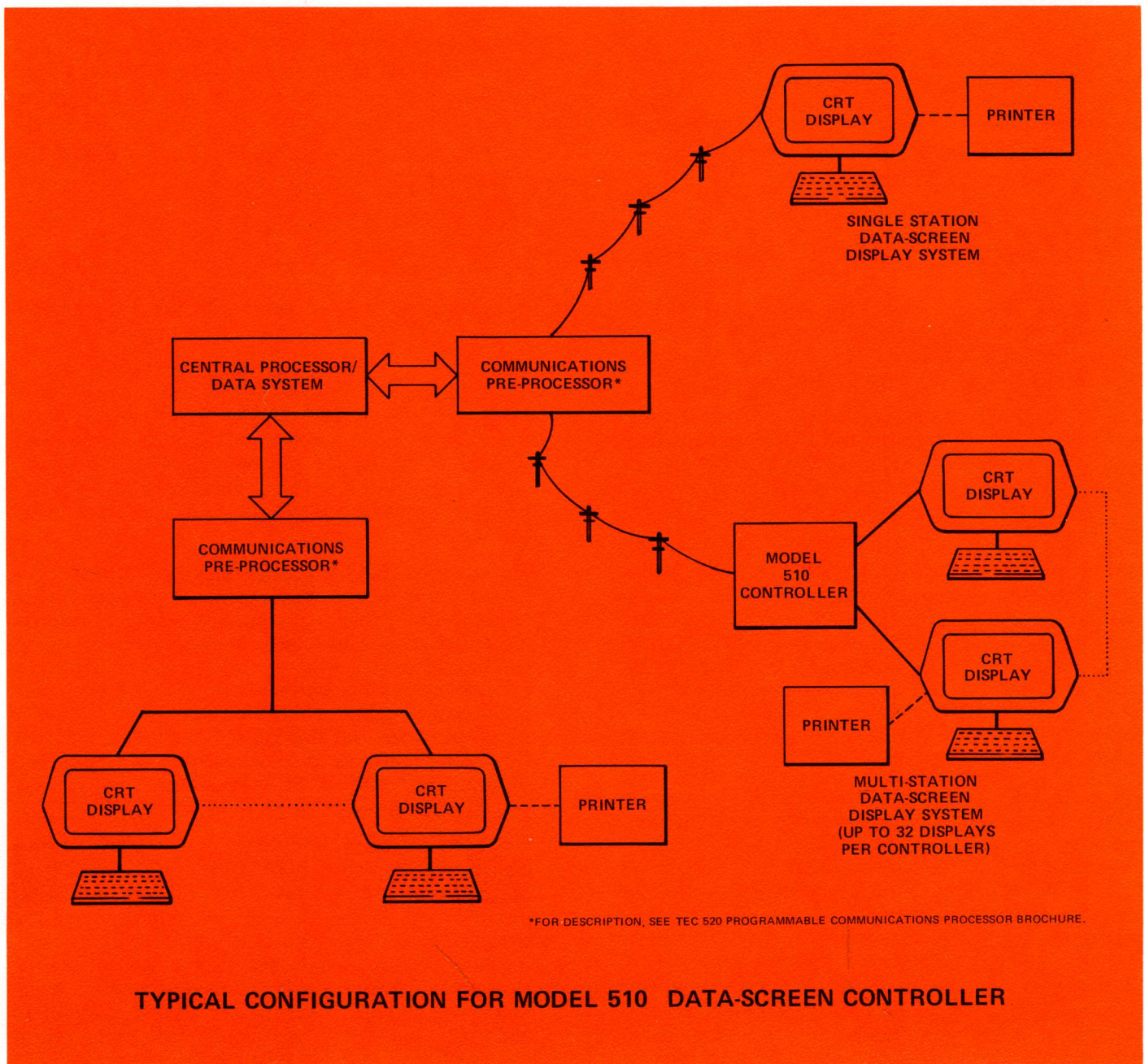
Logically arranged cursor controls and REPEAT key simplify cursor positioning during text preparation.

## PRINTOUT ADAPTER

Teletypewriter printout of information displayed on the CRT screen may be called for by the operator. An additional feature of this adapter allows direct computer commanded printout. This option provides an additional logic assembly within the terminal. Simply connect to a Teletype Model 33 or 35 receive-only printer and hard copy is produced on command of operator or computer.

## FIXED MESSAGE INDICATORS

Fixed messages or indications can be provided adjacent to the CRT screen by using TEC's DATA-PANEL<sup>®</sup> Display System. These backlighted indicators are customized to present messages in a variety of shapes, sizes and colors.



## DESIGN FEATURES

TEC's DATA-SCREEN Terminals and multi-station Controllers provide a full range of information display and control features to give you maximum flexibility and reliable performance at low cost.

Two editing module options provide a wide range of computer controllable functions and permit fast, accurate message composition by even the most inexperienced operators. The keyboard operates and feels the same as a standard electric typewriter.

These outstanding features are available on every Series 500 DATA-SCREEN Terminal System:

- Large Characters -- viewing screen provides greater message capacity; as many as 1000 characters may be displayed. Characters as high as 0.375 inch may be selected for easy, error-free viewing.

- Split Screen -- unique addressability features of the Terminal allow efficient, multiple message display.
- Conversational Mode -- provides convenient, efficient dialogue between operator and computer. Multiple inquiry/response displays are unaffected by succeeding dialogue. You send only the message you want, reducing transmission and computer processing costs.
- Polling -- permits communication to remote sites or display stations via a single half-duplex facility. Display Stations and Controllers contain necessary addressing logic.
- Message Checking -- in addition to a horizontal parity-by-character check, TEC provides a high level of message integrity through use of a longitudinal message check. This provides a redundancy check on a complete message basis, greatly reducing the chance of undetected transmission errors.

## FORMAT FEATURES

- Tab -- variable tab set for tabular formatting.
- Blink -- characters, words or lines, in a completely random pattern -- or the entire screen display -- will blink when activated on computer command.
- Format -- fixed and variable field screen display can be combined to present fixed headings with variable data filled in by operator or computer. Fixed field text is displayed at reduced intensity for error-free interpretation.
- Line Addressing -- line addressability offers direct selection of a displayed line by computer initiated command and reduces the number of commands usually required to position text on the screen. Line address,

when combined with the Tab function, gives the computer rapid access to any character position on the screen.

- Expandability -- multi-station displays can be added in the field . . . modular expansion allows plug-in memory and display station interface.
- Hard Copy -- adapter designed to provide a hard copy record generated from any individual or multi-station display on command of operator or computer.
- Data Transmission -- serial communication adapters accommodate synchronous or asynchronous 8, 10 or 11-bit character formats at data rates up to 4800 bits per second. Compatible with series 103, 201 and 202 data sets.

## EDITING FEATURES

- Cursor -- indicates point of data entry. May be moved anywhere on the screen by five cursor controls. A Home key/function returns the cursor to upper left. Repeat function speeds cursor movement.
- Erase Feature -- three erase functions provide Screen Erase, Erase Rest of Line and Erase Rest of Page.
- Insert/Delete Features -- insert functions are Insert Character and Insert Line. Both functions move displayed characters or lines to permit text manipulation. Delete functions are Delete Character and Delete Line. Realigned characters move to fill spaces left by deleted characters or lines.

- Roll and Scroll -- computer controlled roll and scroll (in which the message on the screen appears to be rolling up or down past the viewer) is achieved by using the line insert/delete controls.
- Special Symbols -- display any carriage return, erroneous character, start-of-text and end-of-text.
- Repeat -- offers rapid, repetitive entry of any character or movement of the cursor. Extremely useful in message or form composition.
- Backspace -- moves the cursor one position back. Identical to that of a standard typewriter.
- Carriage Return -- erases unused portion of line to right hand margin.

## DATA-SCREEN

### Display Terminal Station and Keyboard

Display stations with character capacities of 128 characters (8 lines of 16 characters each), 256 characters (8 lines of 32 characters), 512 characters (16 lines of 32 characters), and 1000 characters (20 lines of 50 characters) are available as stand alone terminal stations. Display stations used with the Controller have capacities of 256, 500 (10 lines of 50 characters), 512 or 1000 characters.

Efficient man-machine interface is provided by TEC's DATA-SCREEN Display Terminal and Electronic Keyboard which allows an operator to communicate with the data source either directly or indirectly, via a DATA-SCREEN Controller. The DATA-SCREEN Display Terminal station gives the operator a data source or Controller-generated visual presentation consisting of 67 alphanumeric characters and special symbols.

To increase total display versatility and application flexibility, TEC's DATA-SCREEN Display Stations offer DATA-PANEL® Display System indicator modules combined with the CRT screen. This optional feature provides distinctive, dramatic display of customized, fixed alphanumeric messages and special symbols which are visible only when illuminated. Up to 32 full color, backlighted indicator positions are available behind the dark screen front panel.



TEC's Electronic Keyboard allows the operator to send to or request information from the data source. The keyboard is used to compose, edit and control transmission of all messages and provides internal terminal status indications.

The keyboard can be divided into six functional control types:

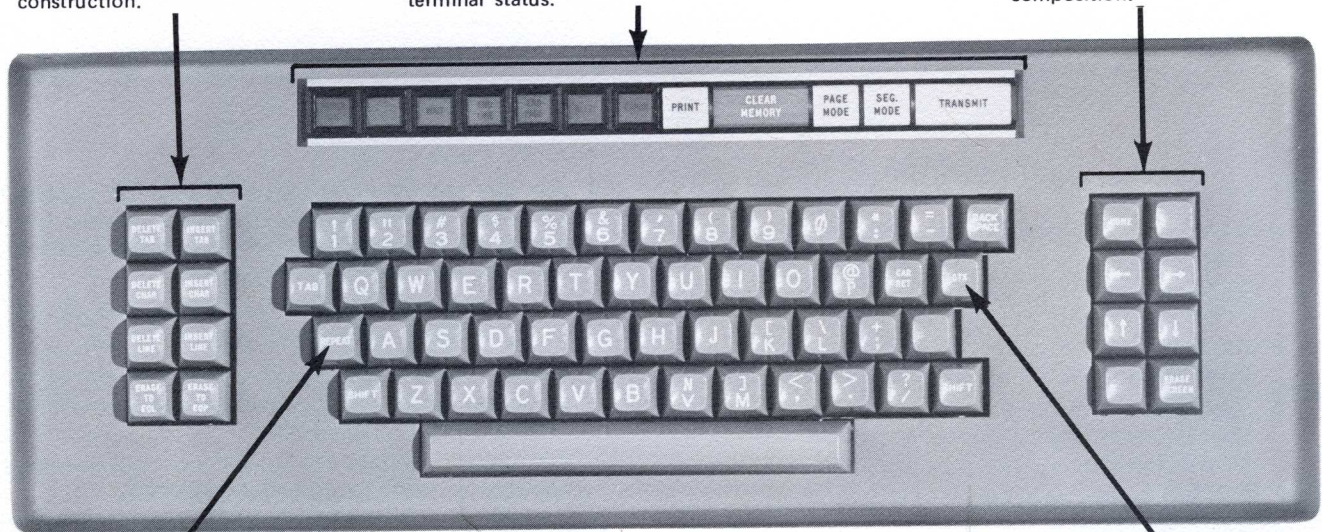
1. Alphanumeric character and symbol keys
2. Cursor control keys
3. Editing keys
4. Data control keys
5. Special purpose keys
6. Status indicators.

Alphanumeric character and symbol keys -- used by the operator to compose messages stored in memory, displayed on the CRT screen and, if required, sent to the data source. There are forty-two keys which, when used with the SHIFT key, will generate a total of 67 characters.

Optional editing function keys permit fast, accurate message construction.

Keyboard indicators and switches provide operator control of the terminal and report terminal status.

Logically arranged cursor and screen erase controls aid text composition.



REPEAT key provides repetitive entry of any character or cursor movement.





TEC's compact electronic keyboard is arranged in standard typewriter configuration for alphanumeric characters.

Editing and control functions are separated from the alphanumeric keys to facilitate error-free operation.

STX -- Start of Text identifier for text segment to be transmitted.

## CURSOR CONTROL KEYS

The cursor, displayed on the CRT as a blinking underscore or as an underscore alternating with an existing symbol, indicates where the next symbol from either the keyboard or the data source will be displayed. The cursor control keys used in conjunction with the Repeat Key, allow the operator to rapidly position the cursor any place in the display area without affecting existing data. The cursor control keys and functions are listed below.

KEY NAME	FUNCTION
 (Cursor Up) . . . . .	Pressing this key moves the cursor up one line and, if at the top line, the cursor moves to the same character position in the last displayable line.
 (Cursor Down) . . . . .	Pressing this key moves the cursor down one line and, if at the last displayable line, the cursor moves to the same character position of the top line.
 (Cursor Left) . . . . .	Pressing this key moves the cursor left one position and, if at the left margin, the cursor moves to the right margin on the line above. If the cursor is at the home (extreme upper left) position, it moves to the far right position of the last displayable line.
 (Cursor Right) . . . . .	Pressing this key moves the cursor right one position and, if at the right margin, moves to the left margin on the line below. If the cursor is at the far right position of the last displayable line, it moves to the home position.
HOME . . . . .	Pressing this key moves the cursor directly to the first character position (extreme upper left) of the CRT screen.
BACK SPACE . . . . .	This key functions exactly the same as the Cursor Left key.
CAR. RET. (Carriage Return) . .	Pressing this key moves the cursor to the first character position of the next line down. A carriage return symbol ( $\Delta$ ) is displayed on the screen (and stored in memory) in the cursor character position where the carriage return occurred. All characters remaining on that line are erased.
(Spacebar) . . . . .	Pressing the spacebar inserts a space in that character position (deleting the character previously stored) and moves the cursor one position to the right.
INSERT TAB . . . . .	Pressing this key inserts a tab "flag" at the character position indicated by the cursor and simultaneously advances the cursor one position. The tab position remains available for symbol display.
TAB . . . . .	Pressing this key deletes the tab "flag" at the character location indicated by the cursor. The cursor advances one position.
DELETE TAB . . . . .	Pressing this key moves the cursor from its present position to the next tab "flag" position. If a tab "flag" is not encountered prior to the last position of the display, the cursor will return to the home position. There are two methods of clearing the tab "flags": <ol style="list-style-type: none"><li>1. The CLEAR MEMORY key located above the keyboard will clear memory and all tab "flags" simultaneously.</li><li>2. The DELETE TAB key clears each key "flag" individually when the cursor is located at the tab "flag" position.</li></ol>

## EDITING KEYS

Editing Keys are used by the operator and/or data source to edit and format messages. The editing keys, listed below, are inoperative if the optional editing module is not part of the terminal system.

KEY NAME	FUNCTION
ERASE TO EOL . . . . .	Pressing this key erases all characters from the cursor position to the end of the line, including the character at the cursor position.
ERASE TO EOP . . . . .	Pressing this key erases all characters from the cursor to the bottom right of the display, including the character at the cursor position.
DELETE CHAR . . . . .	Pressing this key causes the characters in the line to the right of the cursor to shift left one position. The original character at the cursor is deleted and a space is entered into the last character position in the line.
DELETE LINE . . . . .	Pressing this key causes all lines of characters below the cursor to move up one line. This action replaces the characters in the cursor line with those in the line directly below. At the completion of this operation, the cursor will be in the extreme left character position of the new line.
INSERT CHAR . . . . .	Pressing this key causes all the characters from and including the cursor position to shift right one position in that line only. If a character is shifted out of the last position of that line, it is lost.
INSERT LINE . . . . .	Pressing this key causes the cursor line and all lines below to move down one line. This action replaces the cursor line with spaces. Any characters in the last displayable line are lost.

**EXTENDED EDITING:** the format function, when activated by the computer, prohibits modification of formatted text by the operator. Characters thus formatted and protected from operator modification or movement are displayed at reduced intensity to assist the operator in identification of protected text fields. When the Format Protect Function is activated by the computer, certain other functions are not permitted, namely: Delete Character, Delete Line, Insert Character, Insert Line. The Erase Rest Line, Erase Rest Page and Clear Screen functions leave all protected characters unaffected when performed by either the computer or operator. Attempts

by the operator to position the cursor in a protected area by the use of keyboard cursor controls will result in automatic movement of the cursor forward and out of the protected area. The Clear Memory function, when performed, will clear all characters and functions whether or not protected. If transmission occurs from a page containing protected data, all characters in the message will be transmitted except the protect sequences which will be omitted from the transmission, reducing transmission time and computer processing requirements.

## STATUS INDICATORS

Nine indicators located on the upper portion of the keyboard show the status of the Display Station.

KEY NAME	FUNCTION
POWER ON . . . . .	This indicator lights whenever AC power is applied to the unit.
SEG. MODE . . . . .	This indicator lights when the unit is in segmented mode.
PAGE MODE . . . . .	This indicator lights when the unit is in page mode.
WAIT . . . . .	This indicator lights when the display unit is performing an operation that makes the keyboard inoperative. The WAIT indicator is automatically extinguished when the operation is completed and the keyboard activated or when the CLEAR MEMORY key is depressed.
END LINE . . . . .	This indicator lights when the cursor is at one of the last eight character positions of any line.
END PAGE . . . . .	This indicator lights when the cursor is at any character position of the last displayable line.
ALERT . . . . .	This indicator lights when the computer has unsuccessfully attempted a read, poll or write function on the display unit. The indication will be as follows: <ol style="list-style-type: none"> <li>1. If a poll or read function were attempted unsuccessfully, the ALERT indicator will light momentarily (approximately 1 second).</li> <li>2. If a write function was attempted unsuccessfully, the ALERT indicator will remain illuminated until the display unit is available to the computer.</li> </ol>
ERROR . . . . .	This indicator lights when one of several error conditions occur; for example, incorrect parity or incorrect LRC.
LOCAL . . . . .	This indicator lights while the unit is in the local or off-line mode.



### SPECIAL PURPOSE KEYS

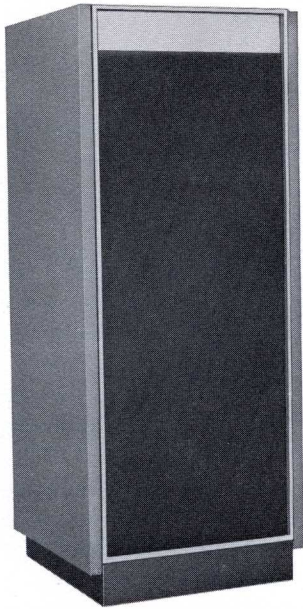
Six special purpose keys are described in the following table.

KEY NAME	FUNCTION
ERASE SCREEN . . . . .	Pressing this key erases all characters on the display except those that are formatted and therefore "protected" by the computer. The cursor then moves to the home position.
CLEAR MEMORY . . . . .	This key is operative only when used in conjunction with the SHIFT key. When both keys are pressed simultaneously, <u>all of memory is cleared without exception and all displayed characters are cleared from the CRT.</u> Any print, transmit, edit, wait or other function in process is terminated. All keyboard indicators and all logic including the interface adapter are cleared.
STX (Start of Text) . . . . .	Pressing this key inserts an STX code in memory and displays an STX character ( ▶ ) at the current cursor position. The STX denotes the beginning of the message to be transmitted or printed when in segmented mode. This key is operational only when the SEG. MODE indicator is illuminated.
SHIFT . . . . .	Pressing this key in conjunction with one of the dual symbol alphanumeric or character keys will result in displaying the symbol shown on the top half of that key. Certain control keys also require the use of the shift key.
LOCAL . . . . .	Pressing this key illuminates or extinguishes the LOCAL indicator and places the terminal in one of the following modes: <ol style="list-style-type: none"> <li>1. Local (Indicator illuminated) -- Data transfer inhibited to or from the computer. If the computer attempts a write function, the ALERT indicator will light. Local does not inhibit the print option.</li> <li>2. Remote (Indicator extinguished) -- Data can be transmitted to or received from the computer.</li> </ol>
REPEAT . . . . .	Pressing this key in conjunction with any other key causes the character or function to be repeated sequentially at approximately a 15 Hz rate. The result is the same as if the operator repeated the character or function manually.

### DATA CONTROL KEYS

Data Control Keys perform one of two functions: The TRANSMIT key signals the data source or Controller that data is ready for transmission in response to the next poll message. The PRINT key is used by the operator to control operation of the optional print feature.

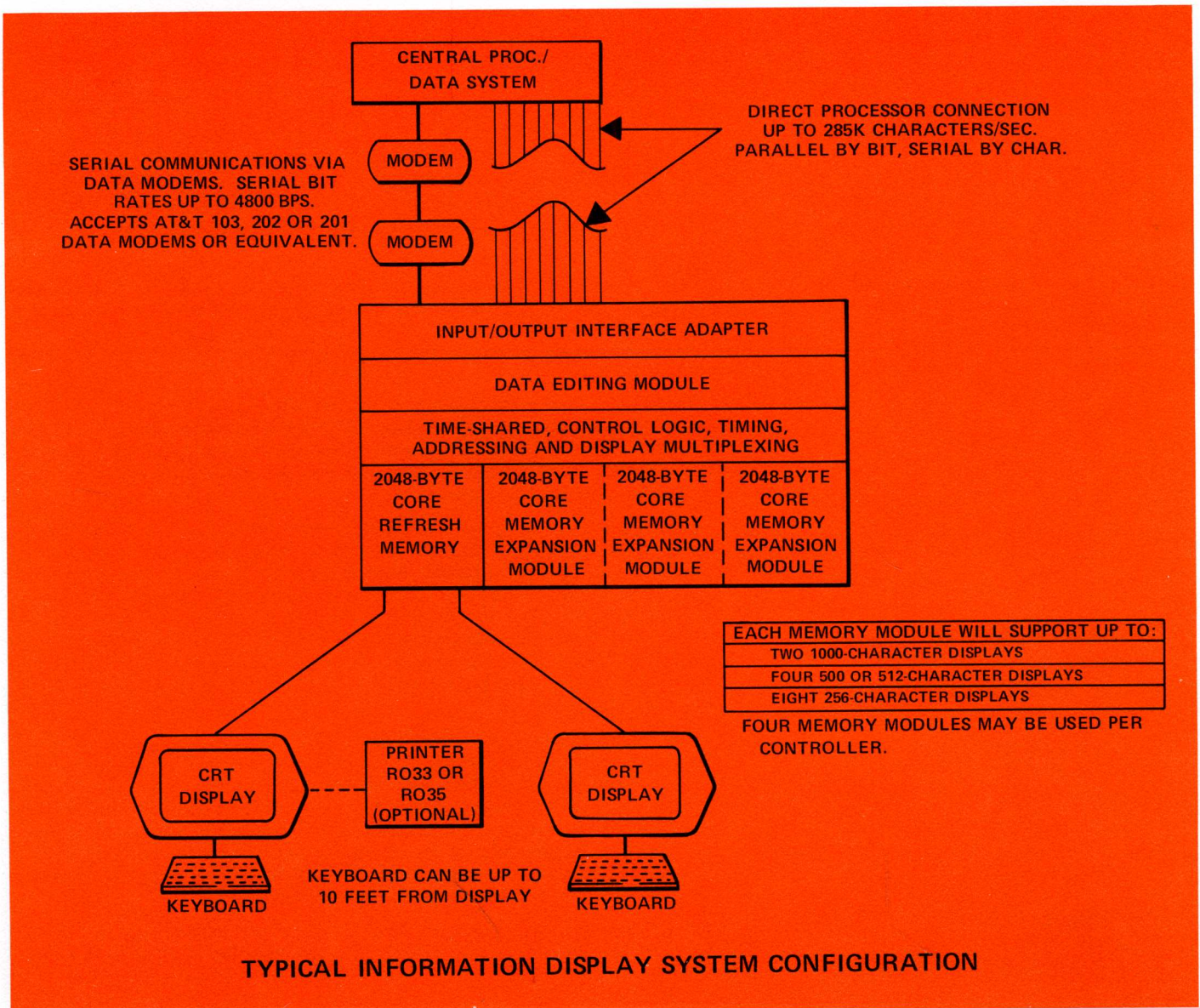
KEY NAME	FUNCTION
TRANSMIT . . . . .	The TRANSMIT key, when depressed, causes data to be transmitted in response to the next received poll message. The transmission mode is controlled by the data source. The data transmit mode will be indicated by the SEG. MODE or PAGE MODE indicator being illuminated above the keyboard. The two modes function in this manner: <ol style="list-style-type: none"> <li>1. Page Mode -- Pressing the TRANSMIT key while in page mode places an end-of-text code (ETX) in memory and an ETX symbol ( ◀ ) on the display at the position currently occupied by the cursor. The cursor then moves to the home position. Data transmission begins when the terminal is successfully polled by the data source. Data transmission continues as the cursor advances sequentially towards the ETX symbol. The cursor will stop and data transmission terminate one character past the ETX symbol. During data transmission, the keyboard is disabled, preventing a keyboard entry.</li> <li>2. Segmented Mode -- Pressing the TRANSMIT key while in segmented mode places an end-of-text code (ETX) in memory and an ETX symbol ( ◀ ) on the screen at the position currently occupied by the cursor. The cursor then moves to the preceding STX character position identified by an STX symbol ( ▶ ) and data transmission begins when the station is successfully polled by the data source. Data transmission continues as the cursor advances sequentially toward the ETX symbol. During data transmission, the keyboard is disabled, preventing keyboard entry.</li> </ol>
PRINT . . . . .	The PRINT key transfers displayed text to a separate printer for hard copy. The data source (computer) may initiate this data transfer. Partial or full page printout may be obtained.



## TEC Model 510 DATA-SCREEN CONTROLLER

Highly reliable, the Model 510 Controller is a low cost controller capable of driving up to 32 TEC Series 500 DATA-SCREEN Display Stations. Modular design ensures low down time and easy field expansion. Use of integrated circuits increases reliability, simplifies maintenance and reduces space requirements.

The Controller performs all functions of the stand-alone Series 500 DATA-SCREEN Display Stations. It contains the interface, control and message formatting logic, read/write memory and editing and print option logic. In addition, the Controller contains all time-shared station select and multiplexing logic, station drivers and memory modules necessary to control up to 32 Series 500 DATA-SCREEN Display Stations. With only minor changes in message formats, the interface, control and data transmission processes are identical in both single station and multi-station systems.



## MEMORY

A random access core memory module with a 1 micro-second cycle time is used in the Controller. Each memory module will store 2048 character and control codes and will drive two 1000-character displays, four 500 or 512-character displays or eight 256-character displays. Four memory modules may be included, giving the Controller the capability of storing 8192 characters equally divided between eight 1000-character, sixteen 500 or 512-character or thirty-two 256-character displays. Data is entered into memory from the interface or from the display station keyboard with the memory module and starting address determined by the station address. Display station models cannot be mixed when connected to a specific Controller.

## MULTI-STATION DISPLAY DRIVERS

Associated with each memory module are up to eight station drivers, each capable of driving a display station over

a distance of 1000 cable feet. All communication between the Controller and the individual display stations takes place through these drivers. Digital character information is sent from the Controller to the display station where it is converted to signals necessary to generate the display. The character, whose code is stored in the memory address being read, is displayed on the CRT at the current cursor address. Both the cursor address and the memory address are updated for each character. Coded character information is transmitted from the display station keyboard to the Controller where consecutive codes are stored in sequential memory addresses. The cursor address and the memory address are both updated for each character code entered by the keyboard.

All bidirectional data transmission between the Controller and an individual display station takes place on a single twisted wire pair. Data is transmitted in bit-serial form and includes character codes, cursor positioning information, unblank pulses, indicator enables, etc.

### OPERATOR'S CONTROL PANEL

Operator controls are provided to control primary AC power and to inform the user of internal power conditions. The switch, POWER ON, controls primary AC input to the Controller power supplies and, if installed, the data set.

### CONTROL PANEL INDICATORS

INDICATOR	COLOR	FUNCTION
POWER ON . . . . .	green . . . . .	This indicator lights whenever the POWER ON switch is in the on position.
OVER TEMP. WARNING . . . . .	orange . . . . .	This indicator lights when internal cabinet temperature reaches +110°F.
HIGH TEMP. POWER OFF . . . . .	red . . . . .	This indicator lights when internal cabinet temperature reaches +125°F. Simultaneously, primary AC input power is shut off.

### MAINTENANCE PANEL

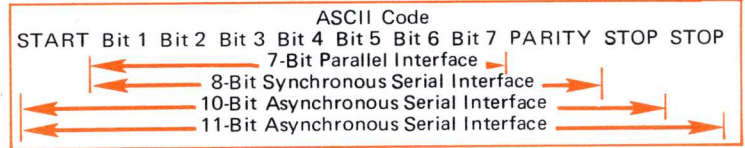
A maintenance panel is provided to facilitate system checkout. The seven switches on this panel inhibit certain operational functions of the system and allow system operations to be tested and performance evaluated during installation, software debugging trouble shooting and repair.

FUNCTION	DESCRIPTION
CRT . . . . .	This switch disables all symbol generation on all display stations.
KEYBOARD . . . . .	This switch disables all display station keyboard operations and prevents operator action.
EDIT . . . . .	This switch disables only the editing capabilities of the display stations.
I/O . . . . .	This switch disables the data source/Controller interface and effectively places the Controller off line.
PRINT . . . . .	This switch prevents operation of the printer or printers that are part of the subsystem.
CURSOR ADVANCE . . . . .	This switch prevents automatic cursor incrementing. This means sequential symbols will be generated at a single position on the CRT.
FUNCTION CLEAR . . . . .	This switch prevents clearing of any interface or keyboard-entered function and if a single key on any keyboard is depressed, the entire memory will be loaded with that symbol code.

## INTERFACE

All communication between the data source and the single or multi-station display is controlled by an input/output interface adapter. Interface options allow communication in either of two serial character modes of operation, bit-serial or bit-parallel. Bit-parallel interface adapters allow the display station to be located near and connected directly to a computer or peripheral controller. A parallel interface adapter allows the Terminal Station to receive and transmit 7-bit character codes at rates up to 285,000 characters per second.

Bit-serial interface adapters are used if the display station is to be remotely installed. Serial interface adapters communicate with the data source over voice grade telephone lines and operate in conjunction with synchronous and asynchronous data sets such as A.T.&T. 103F, 201 A/B and 202 C/D in half duplex two or four-wire modes. Depending on which data set is used, data transfer rates will range up to 4800 bits per second in 8, 10 or 11-bit character formats.



The character format is determined by the interface adapter used in the Terminal System.

The Controller or display station receives and transmits 7-bit ASCII compatible character and control codes. The ASCII code set is modified to include those codes necessary for Controller and display station operations. The code set is shown in Table 1. The control codes govern the majority of Controller and display operations; i.e., interface timing, text editing, cursor control, bidirectional transmission of data, etc. Columns, marked character subset, depend on control and code sequences to specify their functions. Normally, the codes in these columns specify a character or function and the address and type of device performing the function. Following an escape code, the codes in columns 2 and 3 specify a line address and the codes in columns 4 and 5 specify any one of up to 32 fixed message indicators displayable on the viewing screen.

TABLE 1 – ASCII CODE SET

				Bit 7	0	0	0	0	1	1	1	1			
				Bit 6	0	0	1	1	0	0	1	1			
Bit 4	Bit 3	Bit 2	Bit 5 Bit 1	0	1	0	1	0	1	0	1	0	1		
0	0	0	0	NUL		SP	L1	0	L17	@	I1	P	I17	Print	
0	0	0	1	SOH	SPS	!	L2	1	L18	A	I2	Q	I18	Seq.	Page
0	0	1	0	STX	EPS		L3	2	L19	B	I3	R	I19	IT	DT
0	0	1	1	ETX	SB	#	L4	3	L20	C	I4	S	I20	EEOL	EEOP
0	1	0	0	EOT	EB	\$	L5	4	L21	D	I5	T	I21	IC	DC
0	1	0	1		NAK	%	L6	5	L22	E	I6	U	I22	IL	DL
0	1	1	0	ACK	SYN	&	L7	6	L23	F	I7	V	I23	CI	CM
0	1	1	1	H		'	L8	7	L24	G	I8	W	I24		
1	0	0	0	←		(	L9	8	L25	H	I9	X	I25		
1	0	0	1	HT	CS	)	L10	9	L26	I	I10	Y	I26		
1	0	1	0	↓		*	L11	:	L27	J	I11	Z	I27		
1	0	1	1	↑	ESC	+	L12	;	L28	K	I12	[	I28		
1	1	0	0	→		/	L13	<	L29	L	I13	\	I29		
1	1	0	1	CR		-	L14	=	L30	M	I14	]	I30		
1	1	1	0			.	L15	>	L31	N	I15	^	I31		
1	1	1	1			/	L16	?	L32	O	I16	-	I32		

- NUL = NULL
- SOH = Start of Header
- STX = Start of Text
- ETX = End of Text
- EOT = End of Transmission
- ACK = Acknowledge
- H = Home Cursor
- ← = Move Cursor Left 1 space
- ↓ = Move Cursor Down 1 line
- ↑ = Move Cursor Up 1 line
- = Move Cursor Right 1 space
- ↵ = Carriage Return
- SPS = Start Protected Sequence
- EPS = End Protected Sequence
- SB = Start Blink
- EB = End Blink
- NAK = Negative Acknowledge
- SYN = Synchronous Idle
- CS = Clear Screen
- ESC = Escape
- SP = Space
- I1-I32 = Enable Indicator 1-32
- L1-L32 = Line Address
- PRINT = Print Text
- SEG = Segmented Mode
- PAGE = Page Mode
- IT = Insert Tab
- DT = Delete Tab
- EEOL = Erase to End of Line
- EEOP = Erase to End of Page
- IC = Insert Character
- DC = Delete Character
- IL = Insert Line
- DL = Delete Line
- CI = Clear Indicators
- CM = Clear Memory

Each of the following codes has an assigned use in the various message structures.

**SOH** (Start of Header) is the first character used by the data source in all write or control command sequences.

**STX** (Start of Text) signals the start of a text message transmitted to or from the data source. It sets the station in text mode and initiates the Longitudinal Redundancy Check (LRC) accumulation.

**ETX** (End of Text) signals the end of a text message to or from the data source and indicates that the next character is the LRC character. The ETX character is included in the LRC accumulation.

**EOT** (End of Transmission) is the first character used by the data source in all poll or read command sequences. It is also used by the data source in conjunction with an STX, as a positive response to a message when no reply from the Terminal is needed. The EOT is used by the station as a response during operations to indicate that text data is not available. During write or control commands, it is used to indicate that the addressed device is busy. During text transfer to the display station, it is used to indicate lost data or buffer overrun.

**ACK** (Positive Acknowledge) indicates to the station or data source that the message transmitted was received without errors and that the operation may proceed.

**NAK** (Negative Acknowledge) indicates an error in transmission when received in reply to a text message. The NAK is also sent by the station during a command sequence to indicate a "not-ready" condition.

**SYN** (Synchronous Idle) is used as a time fill to ensure completion of certain control functions during a Write/Control function.

**ESC** (Escape) is the first of a two code sequence to be interpreted as a control. Each second sequence code is chosen from columns 2 through 7 of the ASCII code set.

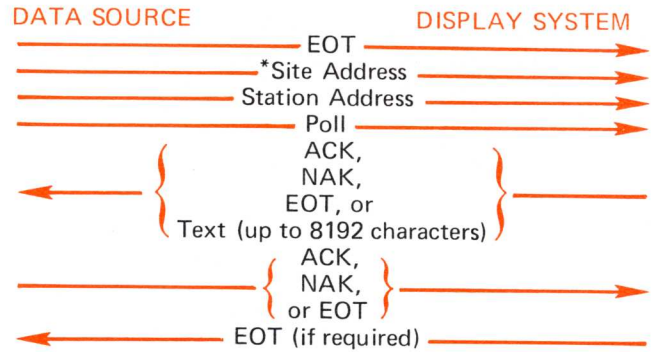
**NUL** (Null) is used in the same way as the SYN.

### OPERATING PROCEDURES

Specific operations to be performed are determined by a particular message format -- specific sequences of control and character codes. Message formats depend, to a large extent, on the type of interface adapter employed by the data source. For example: certain operating functions or code sequences may be required to insure matching data transmission and reception rates. The following descriptions represent typical operating procedures for a single or multi-station display system using a serial data set and matching interface adapter. There are three basic messages to which the station will receive and respond: poll, read and write.

**POLL MESSAGE** -- The poll message, when received, indicates that the data source is interrogating the station to determine if the Controller or single station display has data to send. Once synchronization is established, the poll mes-

sage consists of the following code sequence:

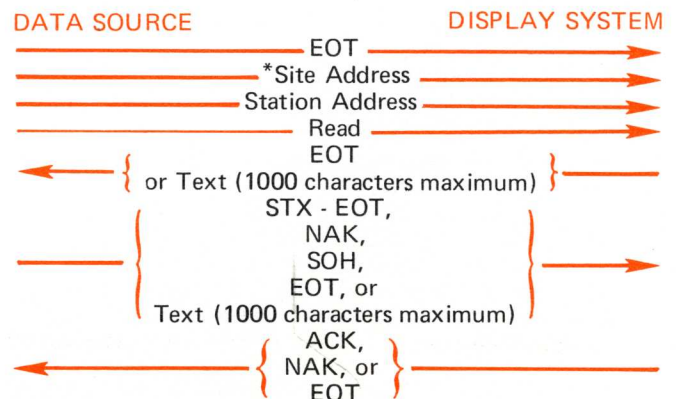


\*Not used in single station display.

The poll message is initiated by an end-of-transmission code. Then one or two address codes specify the particular site (multi-station) and/or station (single station) to be polled and the poll code selects the poll function. If there is data available for transmission, the data is sent to the data source. Upon receipt by the data source, an ACK code is returned and the station terminates communication with an EOT code. If incorrect, the data source returns a NAK code and the station sends the text again. If data is not available when the poll sequence is received, the station responds with an EOT code, terminating the operation. If the poll command sequence is incorrectly received, the station does not connect or respond. If the poll sequence is correct but the display station is in a not-ready condition, it responds with a NAK code, causing the data source to terminate the operation with an EOT code.

There are two different poll commands. A "general" poll command instructs the Controller to sequentially scan each connected display station for a depressed TRANSMIT key. The Controller then transmits, in order, the station address and text from each station having its TRANSMIT key depressed. A "specific" poll command specifies, by address, a particular station. If the TRANSMIT key on the designated station has been depressed, the address and text from that station is sent to the data source.

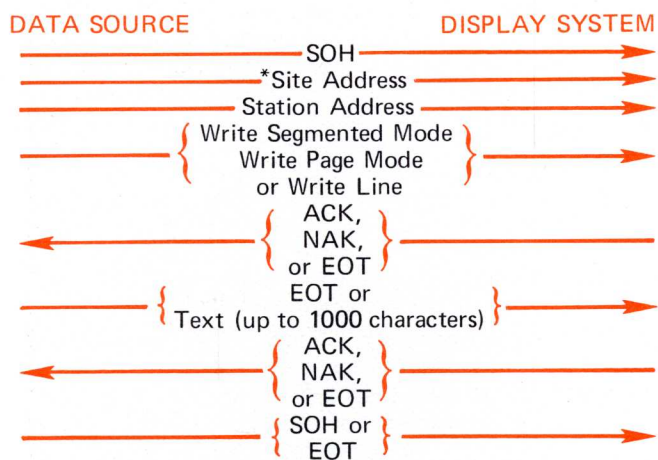
**READ MESSAGE** -- The read message instructs the selected display station to transmit the text from the station memory to the computer. Once synchronization is established, the following code sequence is exchanged:



\*Not used in single station display.

The read message is initiated by an end of transmission code (EOT). The site and/or station addresses select the memory to be read and the read code selects the read function. The data from the selected memory (up to 1000 characters) is returned to the data source. If the data is correctly received by the data sources, an STX-EOT code sequence is returned, terminating the operation. If incorrect, a NAK code is returned and the station is expected to retransmit the data. If the read command is not received correctly, the station will not connect or respond. If the station is busy performing a temporary operation, such as print control, an EOT code is returned in response to a read command.

**WRITE MESSAGE** -- The write message instructs the selected display station to receive and store in memory the data (up to 1000 characters) which follows for subsequent display. Once synchronization is established, the following code sequence is exchanged:



\*Not used in single station display.

The write message is initiated by a start-of-heading code (SOH). One or two addresses then specify the site and/or display station into whose memory data is to be written. A write code selects the write function and particular mode. If the write command is not correctly received, the station will not connect or respond. If the station is active and on-line but is not in a "ready" status, a negative acknowledge (NAK) code is returned to the data source. If the station is in a "ready but busy" status; i.e., off-line or performing a temporary operation such as printout, an EOT code is returned to the data source. An ACK code is returned if the station can receive data or perform the function and the data source then sends the data. The data source terminates the write operation with an SOH or EOT code if, for any reason, the station does not respond to the write message with an ACK code. If data transmitted by the data source is received incorrectly by the station, a NAK code is returned. The data source can terminate the operation with an EOT or SOH code or it can retransmit the text.

There are three types of write messages, each selected by a different write code. Write "segmented" mode causes data to be entered into the selected display station memory

starting at the present cursor position. The first entry is an STX code. The last entry is an ETX code. Upon completion of a write segment operation, the cursor is positioned at the ETX position and the remainder of the selected memory is cleared. Write page mode causes data to be entered into the selected display station memory starting at the cursor's home position. The first entry is the code for the first text character. The last entry is the code for the last text character. Upon completion of a write page operation, the cursor is positioned at the last text character position plus one and the remainder of the selected memory is cleared. The write "line function" causes data to be entered into the selected display memory starting at the first position of a specified line. The line is specified either by the first text code or by an escape/first text code sequence. Neither the escape code nor the line address are stored. Upon completion of a write line function, the cursor is positioned at the last text character plus one and the memory is cleared from the cursor to the end of the line.

**TEXT** -- The display station responds to a correctly received and accepted poll or read message with a text sequence consisting of: an STX code, the display station address, up to 1000 characters of text, an ETX code and the longitudinal redundancy check character (LRC). When transmitting text to the station on any operation, the data source sends the following sequence: an STX code, up to 1000 characters of text, an ETX code and the longitudinal redundancy check character (LRC). The data source can send text to the station in response to an ACK or ETX code from the station. Normally, a specific text message is retransmitted if it is not received correctly.

## SPECIAL OPERATIONS

**KEYBOARD LOCKOUT** -- The keyboard associated with the specified display station is automatically disabled upon receipt and acknowledgement of any read or write function or by depression of the TRANSMIT key prior to a poll function. The keyboard is enabled by the receipt of an ACK, SOH, EOT or STX - EOT from the data source or by station transmission of an EOT or NAK code to the data source. The station WAIT indicator is lit whenever the keyboard is disabled.

**LONGITUDINAL REDUNDANCY CHECK** -- The longitudinal redundancy check (LRC) is an even parity check on the total data bits (7-bits, not including parity bits) of the transmitted text from the first character following STX through and including ETX. The cumulative value of all the data becomes the longitudinal redundancy check (LRC) character and is transmitted immediately after the ETX. SYN characters are not included. Upon receipt of the ETX, a comparison is made of the generated LRC and the received LRC. If they are not in agreement, an error (NAK) response will be generated. The LRC is transmitted by both the data source and the station for each of their respective text transmissions if the particular interface adapter used contains the required logic.

**ERROR CONTROL** Certain error conditions are recognized and acknowledged by the display station for received messages and text only. The station responds with a NAK code if character parity is incorrect at any time or the received LRC does not match the computed LRC. An EOT code is sent if data is lost during transmission by the data source or too much data is sent to the addressed memory by the data source. Detection of these conditions causes the ERROR light on the addressed station to be lit. These

error conditions are cleared and the indicator turned off by receipt of a new function sequence from the data source or operator activation of the TRANSMIT or CLEAR MEMORY key on the addressed station.

The station does not respond to incorrect or undefined functions, address or operation codes or to premature termination of an operation. Under these conditions, the station is made ready to receive a new function sequence. The data source must have the capability to detect no response conditions via a "timeout". The time allowed for "timeout" is a function of the communication facilities and the message lengths.

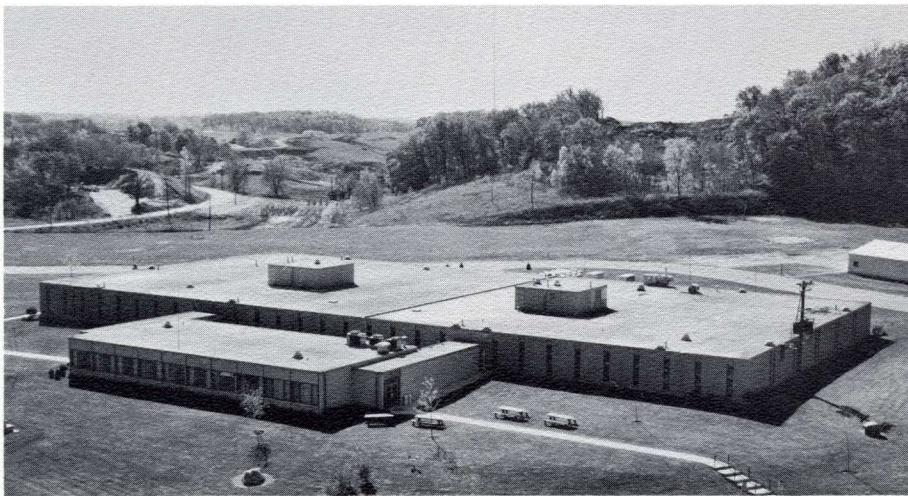
### TEC... DISPLAY/CONTROL SPECIALISTS

TEC, an independent corporation, is the originator, patentee and world's largest manufacturer of transistor-controller indicators. Since its formation in 1958, the company has been totally involved in the man-machine communications aspect of computers, control systems and peripheral equipment and serves the leading companies in these areas. TEC's product growth has kept pace with the industries it serves, and the single and multi-station display terminal systems explained in this brochure are good examples of that growth.

**ADDRESSING** -- Since any number of peripheral equipments may be connected to a data source, each must respond to only one address. The Model 510 Controller will respond to a specific 7-bit site or Controller address. All other site addresses are ignored. The Controller's site address is determined by internal hard wiring and does not depend on the type or number of display stations connected. The specific station address for both single and multi-station systems is likewise determined by a 7-bit address. Single station systems require receipt of only the station address. The multi-station systems require receipt of both site and station addresses.

The total system compatibility and adaptability of these terminals is unusual when you consider that they can be ordered, essentially "off the shelf." TEC is a single-source supplier of the terminal in total, including the controller.

Full design and production responsibility...engineering, fabrication, assembly and quality assurance...is assumed by TEC and delivery assured through close production control methods. A technical staff of experienced professionals is available for those applications requiring specialized research and design capabilities.



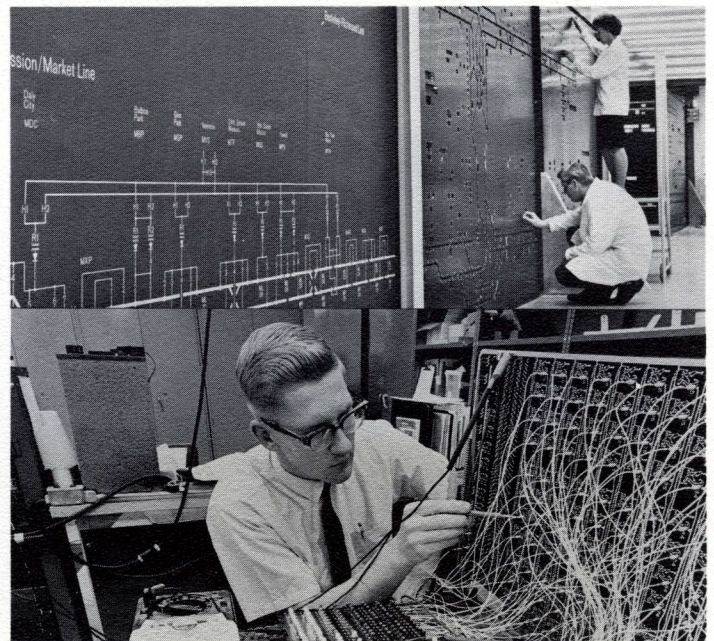
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MINNEAPOLIS, MINN. 55424

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LOCATED ON COUNTY ROAD 18 • 1½ MILES NO. OF INTERSTATE HWY. 494



# SINGLE STATION DISPLAY TERMINAL SPECIFICATIONS

CHARACTERISTIC	MODEL 530	MODEL 540	MODEL 550	MODEL 560
CHARACTERS	128	256	512	1000
CHARACTERS PER LINE	16	32	32	50
LINES	8	8	16	20
CHARACTER HEIGHT	0.375 nominal	0.26 nominal	0.26 nominal	0.18 nominal
CHARACTER WIDTH	0.25 nominal	0.175 nominal	0.175 nominal	0.120 nominal
CHARACTER SPACING	0.125 nominal	0.098 nominal	0.098 nominal	0.055 nominal
LINE SPACING	0.125 nominal	0.162 nominal	0.162 nominal	0.157 nominal
CRT TYPE	8-inch rectangular	12-inch rectangular		
CRT PHOSPHOR	P4(white), P31(green) Optional	P4(white), P31(green) Optional		
CRT VIEWING AREA	6 inches by 4 inches	8 $\frac{3}{4}$ inches by 6 $\frac{3}{4}$ inches		
DEFLECTION	Magnetic	Magnetic		
FOCUS	Electrostatic	Electrostatic		
BRIGHTNESS	37 foot-lamberts, nominal	37 foot-lamberts, nominal		
REFRESH RATE	63 Hertz	60 Hertz synchronized with power source		
CHARACTER GENERATION METHOD	Continuous line strokes	Continuous line strokes		
CHARACTER REPERTOIRE	Up to 63 alphanumeric and special symbols	Up to 67 ASCII alphanumeric and special symbols		
STORAGE METHOD	Ferrite Core	Ferrite Core		
SYSTEM CODE	ASCII	ASCII		
INTERFACE	DTL compatible, bit parallel, character serial	Serial: EIA Standard RS-232B Compatible Parallel: TTL compatible, bit parallel, character serial		
TRANSMISSION RATE	Parallel I/O transfer rate up to 38.5K characters per second	Serial: up to 4800 bits per second synchronous or asynchronous with 8-, 10-, or 11-bit character format Parallel: I/O transfer rate up to 38.5K characters per second. Higher rates on request.		
KEYBOARD	ASCII coded, alphanumeric	ASCII coded, alphanumeric, plus editing and control keys and status indicators. Can be operated up to 10 feet from terminal.		
INPUT POWER	115 VAC $\pm$ 10%; 60 Hertz; 150 watts	115 VAC $\pm$ 10%; 60 Hertz; less than 200 watts		
OPERATING TEMPERATURE	+10°C. to +40°C.	+10°C. to +40°C.		
SIZE	20" wide x 12 $\frac{1}{4}$ " high x 24" deep (including keyboard)	Terminal only: 18" wide x 14 $\frac{1}{2}$ " high x 20" deep Keyboard: 18" wide x 4" high x 7" deep		
WEIGHT	95 pounds	95 pounds		

# CONFIGURATIONS (Models 540, 550 and 560)

AVAILABLE MODULES	Description	Minimum Prerequisite Module
Module Number -01	<b>Basic Display Unit:</b> Includes refresh memory, character generator, control logic, power supply, enclosure and basic editing module with logic for cursor, repeat, backspace, screen erase, segment mode, page mode, carriage return, and line addressing.	None
-02	<b>Serial Synchronous Interface Adapter:</b> Replaces Module-03 to accommodate a serial 2000, 2400 or up to 4800 bits per second, 8-bit character format.	-01
-03 -03	<b>Parallel Interface Adapter:</b> Parallel by bit, serial by character interface with line drivers, receivers.	-01
-04	<b>Inquiry Editing Module:</b> Includes editing for line erase, partial screen erase, insert character and/or line, delete character and/or line, tab, character or message blink, and text format feature.	-01
-05	<b>Basic Keyboard:</b> 49 alphanumeric key array with electronic interlock, five cursor keys, screen erase, status indicators, and transmit controls.	-01
-06	<b>Editing Keyboard:</b> Includes -05 module plus additional editing and control keys.	-04
-07	<b>Key-Strike Feedback:</b> Generates an audible key-strike feedback signal with any keyboard entry.	-05
-08	<b>Serial Asynchronous Interface Adapter:</b> 10 or 11-bit character code, up to 4800 bits per second; 7-bit ASCII code plus even parity plus one start bit and one or two stop bits. Compatible with type 103, 202, and 201 or equivalent data sets. Replaces Module-03.	-01
-09	<b>DATA-PANEL® Display System Features:</b> Backlighted message displays, custom designed.	
-10	<b>Enclosure Color Option:</b> (specify)	-01
-11	<b>Delete Enclosure:</b> For custom installation or rack mounting.	-01
-12	<b>Interface Adapter Customized for Application:</b> (on request)	-01
-13	<b>Teletypewriter Adapter for Teletype Model No. 33 or 35:</b> (receive only)	-05

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TELETYPE  
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LOCATED ON COUNTY ROAD 18 • 1½ MILES NO. OF HWY. 494

Printed in U.S.A.

# MULTI-STATION DISPLAY TERMINAL SYSTEM SPECIFICATIONS

CHARACTERISTIC	MODEL 545	MODEL 555	MODEL 575	MODEL 565
CHARACTERS	256	512	500	1000
CHARACTERS PER LINE	32	32	50	50
LINES	8	16	10	20
CHARACTER HEIGHT nominal	0.26	0.26	0.18	0.18
CHARACTER WIDTH nominal	0.175	0.175	0.120	0.120
CHARACTER SPACING nominal	0.098	0.098	0.055	0.055
LINE SPACING nominal	0.162	0.162	0.157	0.157
CRT TYPE	12-inch rectangular tube			
CRT PHOSPHOR	P4 (white), P31 (green) Optional			
CRT VIEWING AREA	8¾ inches by 6¾ inches			
DEFLECTION	Magnetic			
FOCUS	Electrostatic			
BRIGHTNESS	37 foot-lamberts, nominal			
REFRESH RATE	60 Hertz synchronized with power source			
CHARACTER GENERATION METHOD	Continuous line strokes			
CHARACTER REPERTOIRE	Up to 67 ASCII alphanumeric and special symbols			
KEYBOARD	ASCII coded. Alphanumeric, plus editing and control keys and status indicators. Can be operated up to 10 feet from terminal.			
INPUT POWER	115 VAC $\pm$ 10%; 60 Hertz, less than 200 watts			
ENVIRONMENT	+10°C. to +40°C.			
SIZE	Terminal only: 18" wide x 14½" high x 20" deep Keyboard: 18" wide x 4" high x 7" deep			
WEIGHT	90 pounds			

## MODEL 510 CONTROLLER

STORAGE METHOD	Ferrite Core, Read/Write, random access memory
SYSTEM CODE	ASCII
INTERFACE	Serial: EIA RS-232B compatible Parallel: TTL compatible, bit parallel, character serial
TRANSMISSION RATE	Serial: up to 4800 bits per second synchronous or asynchronous with 8-, 10-, or 11-bit character formats Parallel: I/O transfer rate up to 285K characters per second. Higher rates on request
MAXIMUM DRIVE CAPABILITIES	Up to 8 Model 565, 16 Model 555 or 575, or 32 Model 545 Display Stations located up to 1000 cable feet away
SIZE	22" wide x 22" deep x 56" high
WEIGHT	250 pounds
POWER INPUT	115 VAC $\pm$ 10%; 60 Hertz; 1 $\emptyset$ ; 500 watts nominal, 1000 watts maximum.
ENVIRONMENT	55°F. - 95°F.; 0 - 90% relative humidity

# CONFIGURATIONS

## (Model 510 DATA-SCREEN Controller)

AVAILABLE MODULES	Description	Minimum Prerequisite Module
-01	<b>Basic DATA-SCREEN Controller:</b> Includes text editing module, control logic, power supplies, hard copy driver.	Either -02, -03, or -08
-02	<b>Serial Synchronous Interface Adapter:</b> Replaces Module-03 to accommodate a serial 2000, 2400 or up to 4800 bits per second, 8-bit character format.	-01
-03	<b>Parallel Interface Adapter:</b> Parallel by bit, serial by character interface with line drivers, receivers.	-01
-04	<b>Basic Memory Module:</b> 2048 characters of display refresh core memory.	-01
-05	<b>Extended Memory Module:</b> 8192 characters of display refresh core memory.	-01
-06	<b>Display Driver Module:</b> One module required for every 2 DATA-SCREEN Displays.	-04 or -05
-07	<b>Maintenance Panel</b>	-01
-08	<b>Serial Asynchronous Interface Adapter:</b> 10 or 11-bit character format, up to 4800 bits per second, 7-bit ASCII code plus even parity plus one start bit and one or two stop bits. Compatible with type 103, 202 and 201 or equivalent Data Sets. Replaces Module-03.	-01

## (DATA-SCREEN Displays)

545-01	<b>256-Character Display</b> Eight lines of 32 characters per line.	<b>Controller and Display Station</b>
555-01	<b>512-Character Display</b> Sixteen lines of 32 characters per line.	
565-01	<b>1000-Character Display</b> Twenty lines of 50 characters per line.	
575-01	<b>500-Character Display</b> Ten lines of 50 characters per lines.	
-02	<b>Keyboard</b> Specify by Display Station model (545, 555, 565, 575).	



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