

SERIES 2510 COMMUNICATIONS DISPLAY TERMINAL (CDT)
WITH CDDC801 OR CDDC803 MODULE
GENERAL DESCRIPTION AND OPERATION

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	2	F. Receive	19
2. TECHNICAL DATA	6	G. Horizontal Tabulation Option	19
PHYSICAL CHARACTERISTICS	6	SERIES 2510 CDT WITH CDDC803 DISPLAY CONTROLLER MODULE	20
TEMPERATURE AND POWER REQUIREMENTS	6	A. Operational Controls	20
HUMIDITY AND ALTITUDE REQUIREMENTS	6	B. Operation	22
CHARACTER SIZE REQUIREMENTS	6	C. On-Line Edit Features	22
3. MODULES	6	D. Power Turn On	22
4. ELECTRONICS	7	E. Local	22
5. DESCRIPTION OF TERMINAL FEATURES WITH EITHER CDDC801 OR CDDC803 MODULE	12	F. Transmit	22
CURSOR	12	G. Receive	23
KEYBOARD	13	H. Horizontal Tabulation Option	23
KEYBOARD CONTROLS	13	6. TERMINAL OPTIONS	23
EDITING CONTROLS	15	SIGNAL LINE FILTERS	23
DISPLAY ADJUSTMENT CONTROLS	16	FORMAT	23
SERIES 2510 CDT WITH CDDC801 DISPLAY CONTROLLER MODULE	16	BOTH CDDC801 AND CDDC803 DISPLAY CONTROLLER MODULE STRAPPING OPTIONS	23
A. Operational Controls	16	INTERFACE MODULES	25
B. Operation	18	BUFFER MODULES	25
C. Power Turn On	18	7. ACCESSORIES	29
D. Local	18	AUXILIARY BUFFER SET	29
E. Transmit	19	INDEPENDENT BUFFER SET	29
		HIGH SPEED DX READER	29
		HIGH SPEED DRPE PUNCH	29

SECTION 578-100-100

1. GENERAL

1.01 This section provides a general description and operation of the Series 2510 Communications Display Terminal (CDT) equipped with either a CDDC801 or CDDC803 Display Controller Module. Issues 1 through 3 of this section were limited printing editions and did not receive general system-wide availability nor distribution. This reissue incorporates the latest engineering design information and is the first standard printing available for general Bell System distribution. For similar information concerning the Series 2511 Communications Display Terminal, refer to Section 578-101-100.

1.02 The CDT (Figures 1 and 2) during operation uses a visual display tube (cathode ray) as the medium to display message data to an attendant. Displayed data that was either prepared locally or received from a distant send/receive device, can be edited or verified with utmost accuracy before transmission. Using the local keyboard and the editing key cluster, an attendant may easily insert words, lines, or sentences into the display and thereby make necessary alterations, additions, corrections, or include file numbering codes prior to a data transmission.

1.03 The Communications Display Terminal (Figures 4 and 5) hereafter referred to as CDT, is provided with adjustable levelers (feet), transporting handles, and rear panel bumpers that insure proper air flow for the cabinet ventilating fans. Safety interlock switches are also provided in the enclosure so that if the CDT top cover, front panel, etc, is opened while the set power is on, the interlock switch is mechanically released causing shut-down of incoming ac power to the CDT. Also provided internally in the enclosure are maintenance controls, on/off power supply controls, and a deflection disable switch. For additional information, refer to the appropriate section concerning the specific information needed within the other sections of this nine-digit number series.

1.04 The CDT is capable of receiving and storing for display or for transmission, up to 2000 alpha-numeric data characters that are compatible to the ASCII (American National Standard Code for Information Interchange). Four types of visual display formats exist for the 2000 character display on the screen of the cathode ray tube. CRT display formats are explained in Part 6. The CDT having a horizontally mounted CRT (Figure 1) provides for a basic 25 line by 80 character display format. The other display formats are available on the CDT having a vertically mounted CRT (Figure 2).

1.05 All data reception and transmission for a CDT is accomplished at speeds of up to 3000 or at speeds up to 12,000 words per minute. The receive/transmit character speed is determined by the type of plug-in character buffer circuit card used in the terminal's display controller A module. A two-character buffer circuit card allows operation at speeds up to 3000 wpm and a six-character buffer circuit card will permit operation at speeds up to 12,000 wpm. Character speed is the maximum speed at the send or receive interface logic of the terminal. External send devices having higher speed character rates than the maximum character rate of the CDT, will be hobbled (slowed to the CDT maximum word per minute character rate). A hobbled data input is regulated by character control signals between the receive interface of the CDT and the higher speed device.

1.06 To send or receive messages, the CDT send/receive interface code structure is compatible with the binary 7-bit level 1968 ASCII with exception that the eighth bit level is used for parity. Transmission or reception of information bits within a character is accomplished using an 8-bit level character (even parity) in a parallel terminal interface (PTI) signaling arrangement. Other parallel or serial signal arrangements are available as options using communications display interface (CDIF) module arrangements.



Figure 1 - CDT (Horizontally Mounted CRT)

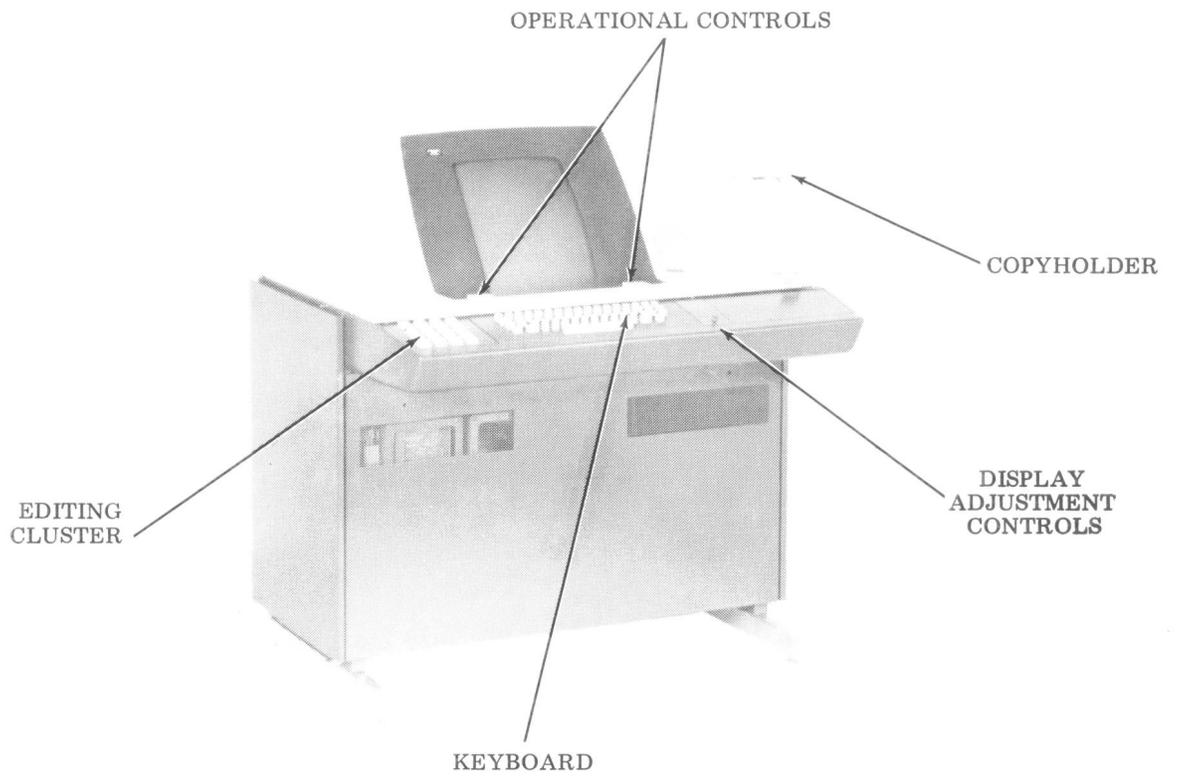


Figure 2 - CDT (Vertically Mounted CRT)

SECTION 578-100-100

1.07 The CDT (Figure 3) is housed in a self-contained console cabinet, that provides room for two additional accessory modules and an optional low voltage power supply unit, in addition to the display controller module (A module) and low voltage power supply necessary for operation of the basic set.

1.08 There are several options and accessories that can be used with the CDT. Interface and buffer modules (CDIF and CDBU) are described in Part 6 and auxiliary and independent buffer sets are described in Part 7.

1.09 The basic CDT consists of a display (cathode ray) tube, keyboard, character memory storage circuits, electromagnetic deflection circuits, video drive circuits, power supply circuits, a character generator (read only memory), editing control logic, and several editing, operational, and display adjustment controls.

1.10 The CDT is capable of accepting and storing up to a maximum of 2000 data characters (full screen display) by use of the refresh shift register circuit (4.34) which is controlled in the set logic to perform both a read stored character or a write character into storage function. The refresh shift register comprises all of the 2000 character bit level storage circuitry for the set. It consists of several circuit card assemblies located in the respective connector receptacles in the display controller, CDDC801 or CDDC803 module.

1.11 The internal read only memory (ROM), Figure 3, is an assembly attached to the left side of the display controller module. The ROM is actually an electronic character generator that when electronically addressed is caused to generate the proper electrical signal output to effectively display any ASCII character in any of the 2000 character positions on the CDT display screen.

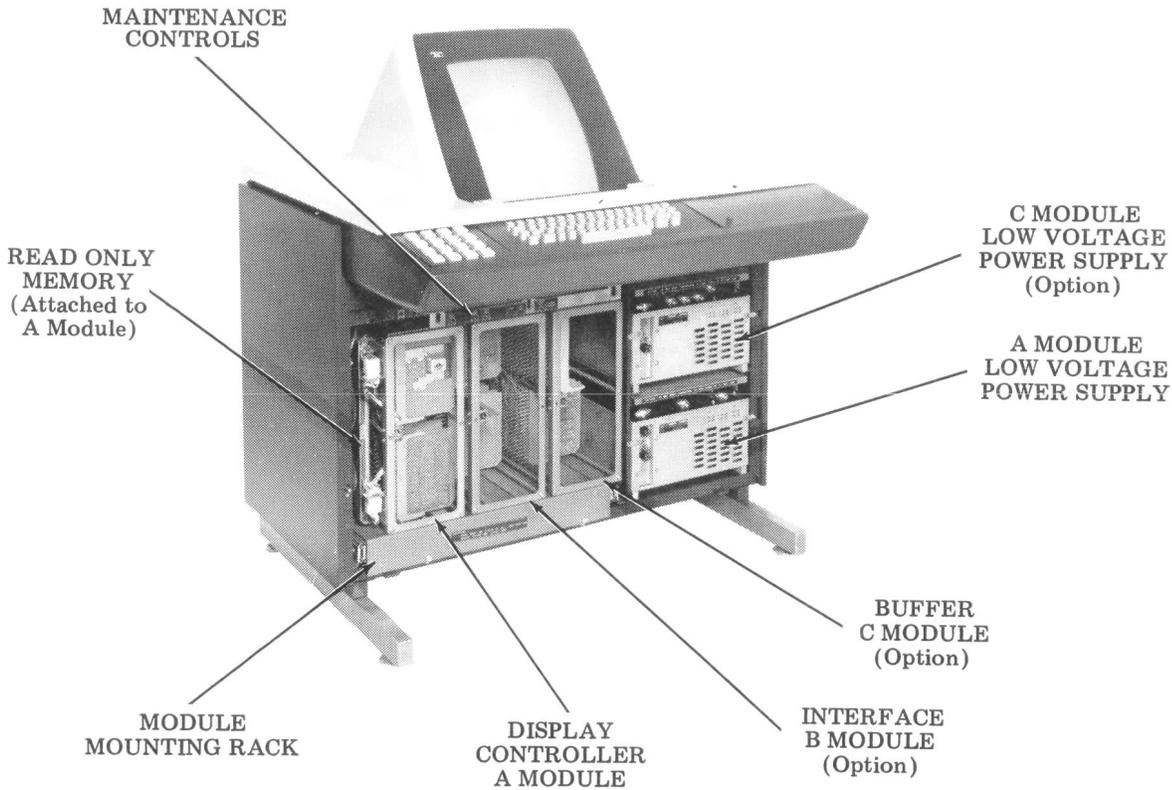


Figure 3 - Communications Display Terminal (Front Panel Removed)

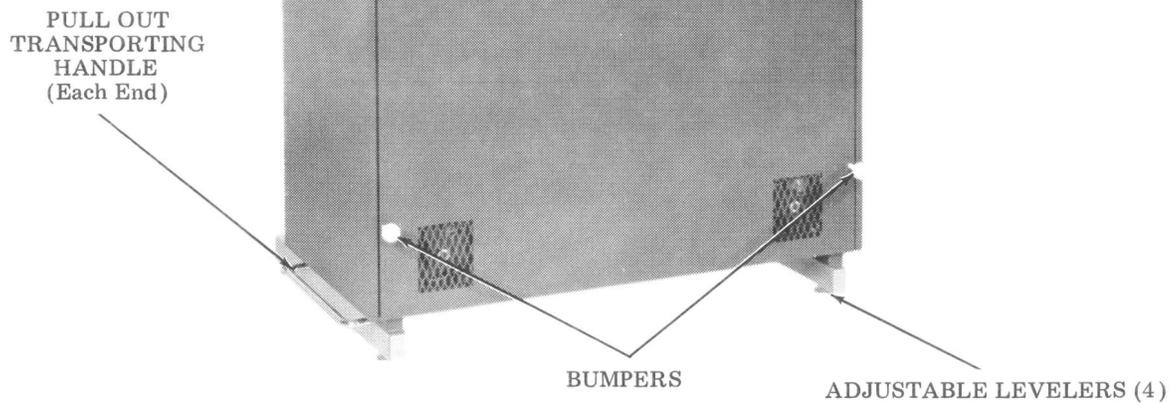


Figure 4 - CDT (Rear View)

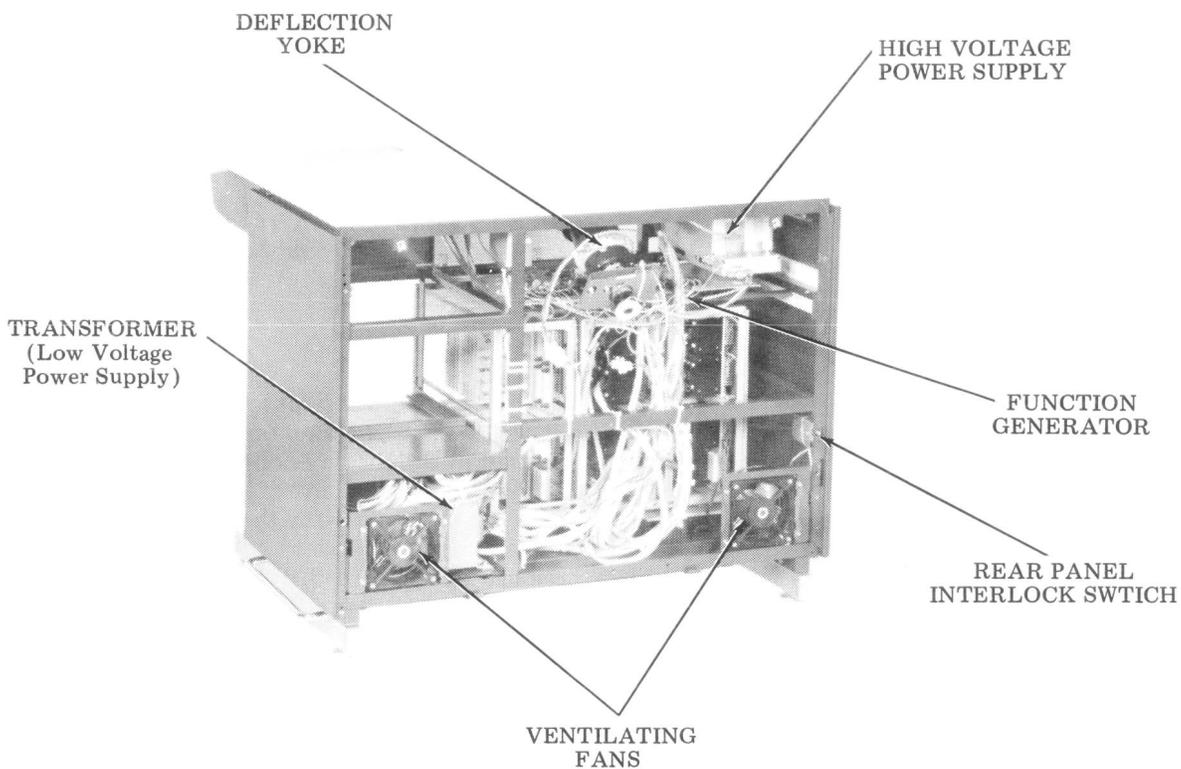


Figure 5 - CDT (Rear Panel Removed)

SECTION 578-100-100

1.12 A 17-inch, diagonally measured, rectangular cathode ray tube (CRT) is used as the display medium in the CDT and presents a display area of 8 inches by 11 inches. The CDT can be ordered with the longer side of the CRT mounted either vertically or horizontally. Vertical mounting will allow a format of up to 50 lines and horizontal mounting will allow a format of up to 25 lines. A matte surfaced safety shield covers the CRT face, improving contrast and minimizing reflection glare from overhead room lighting.

2. TECHNICAL DATA

PHYSICAL CHARACTERISTICS

Table Size:

- Height — 29 inches
- Width — 36 inches
- Depth — 24 inches

Overall Size (includes CRT dome and the keyboard):

- Height — 38 inches
- Width — 36 inches
- Depth — 30 inches

Weight (maximum) — 225 pounds

Accessibility — Front, Top, Rear, and Sides

TEMPERATURE AND POWER REQUIREMENTS

Temperature Requirements:

- Storage -40° to +110°F
- Operating +40° to +110°F

Note: This equipment is intended to be operated in a room environment within the temperature range of 40°F to 110°F. Serious damage to it could result if this range is exceeded.

Power Requirements:

- Input Voltage 115 v ac ±10%,
60 Hz ±0.5 Hz

Consumption:

- (a) CRT Filament ON, Set in Standby Condition 2 watts

- (b) Basic Set,
Full ON 275 watts with a
5 ampere, 0.1
second, surge
- (c) Set With Maximum
Interface and Buffer,
Full ON 500 watts with a
6 ampere, 0.1
second, surge

HUMIDITY AND ALTITUDE REQUIREMENTS

Humidity: The unit should be stored and operated at more than 2% but less than 95% humidity.

Altitude: Operation should be between sea level and 10,000 feet. Shipping altitude can be up to 50,000 feet.

CHARACTER SIZE REQUIREMENTS

- Height: Nominal 0.140 inch (tube mounted vertically)
Nominal 0.150 inch (tube mounted horizontally)
- Width: Nominal 0.108 inch (tube mounted vertically)
Nominal 0.133 inch (tube mounted horizontally)
- Spacing: 2/7 of character width (tube mounted vertically or horizontally)

3. MODULES

3.01 The electronic circuits used for the control and operation of the CDT are housed in the display controller A module (Figure 3). The optional interface and buffer modules that can be used with the CDT are placed in the adjacent space next to the A module (Figure 3). Each module is 14-3/8 inches high, 6-inches wide, and 19-inches deep. Each module, located in the bottom of the cabinet, contains plug-in circuit cards on which electronic components are mounted. The modules can be pulled forward out of the cabinet, for testing and maintenance by use of the module mounting rack. Connecting cables at the back of each module are long enough to permit the removal of a module without disrupting operation.

3.02 Either the CDDC801 or the CDDC803 module can be provided for electronic display control in the basic CDT. The CDDC801 module provides a limited number of display control options, which are enabled during local operation, in addition to the basic features necessary for terminal operation. The CDDC803 module provides a more variable option programming arrangement, which may be arranged according to the requirements of the communications system. In addition, the CDDC803 module provides many additional display control features which may be activated by the attendant in local operation or by a central computer processing unit engaged in data exchange with the CDT.

4. ELECTRONICS

Low Voltage Power Supply

4.01 A single low voltage power supply provides the necessary multivoltage power to operate all analog and digital logic circuits in the CDT terminal. The ac voltage to the full-wave bridge type rectifiers in the supply is provided by a ferro-resonant transformer assembly. The transformer is mounted to the cabinet frame just behind the power supply (Figure 5). Rubber strips are used between the transformer and frame to prevent unnecessary generation of low frequency noise. Cabling between the transformer and power supply is of adequate length to allow the power supply to be removed and placed onto the floor in front of the cabinet for repair or maintenance.

4.02 Voltages supplied by the power supply are: +30 v dc, -20 v dc, -16 v dc, -11 v dc, +12 v dc, +6 v dc, +5 v dc, and 6.3 v ac from a separate filament transformer. The filament transformer is used for operating the heater filament in the cathode ray tube.

4.03 Two fuses are provided on the front plate of the power supply. The input power to the supply is protected by F1 fuse and the power to the cathode ray tube filament transformer is protected by F2 fuse. Three other fuses are provided on the heat sink assembly of the power supply. These are accessible when the supply is removed from the cabinet and a screen type cover is unfastened and pivoted to the open position.

4.04 If an optional interface module (CDIF) is added to the terminal cabinet for accommodating connection of peripheral send/receive devices, hard copy equipment, or data

systems, it may use power furnished from the CDT low voltage power supply. However, in some instances, certain interface modules require greater power demands and a second low voltage power supply is required for interface module operation, or to operate an additional buffer module as described in 4.05.

4.05 A second low voltage power supply is required in the terminal when an optional buffer module (CDBU) is added into the terminal to increase the data input or data output capability. The second power supply mounts into the cabinet directly above the low voltage power supply provided with the terminal, Figure 3.

High Voltage Power Supply

4.06 The high voltage power supply (Figures 5 and 6) provides the necessary multivoltage that is required for operation of the cathode ray tube. The 15 kilovolt dc output from the supply is used to drive the second anode (electron beam accelerating anode) in the cathode ray tube.

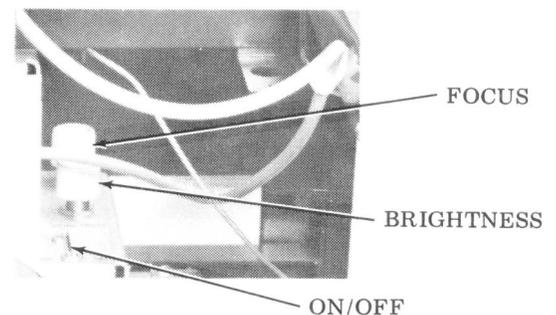


Figure 6 - High Voltage Power Supply Controls

4.07 The FOCUS control on the supply is adjustable to regulate the positive voltage output anywhere from 0 to 320 volts dc. This voltage is connected to the focus grid of the CRT and is adjustable to effectively focus the electron beam.

4.08 The main BRIGHTNESS control (master control) on the power supply chassis is to be adjusted at the time of CDT installation. This control is located so that it is not accessible to the CDT attendant. When properly adjusted, it limits the attendant's brightness control operation so that too high of a video

SECTION 578-100-100

display intensity is prevented and proper intensity is attainable. CRT tube life may be greatly increased if the main BRIGHTNESS control is adjusted conservatively. The main control is adjustable to set the negative voltage output of the supply anywhere from 0 to 150 volts dc. This voltage output is used to bias the signal output from the video amplifier that is located on the function generator circuit assembly.

4.09 The high voltage power supply is powered during operation from a positive 12 volt dc output from the CDT low voltage power supply. The high voltage power supply is equipped with a power on/off switch for control and a main fuse for input voltage protection. A filter choke in series with the dc input voltage is used in the supply to filter out and prevent any noise within the high voltage driver circuit from reflecting back on the dc power input voltage.

Cathode Ray Tube

4.10 A TP335780 cathode ray tube is supplied in the CDT. The tube has a very thin coating of aluminized P4 type (white) phosphorous material on the inside area of that part of the tube called the screen. During operation, the display viewed on the screen will consist of light characters on a dark background.

4.11 The "instant on" feature of the terminal is accomplished by keeping the cathode ray tube heater filament warm. In off position of the CDT power button, only one-half of the 6.3 v ac sine wave is supplied to the tube heater filament. The tube filament keeps the cathode element in the CRT electron gun preheated and acts to prolong tube filament life. When the set power button is subsequently operated to on position, full ac filament voltage is supplied to the heater which causes the cathode element to reach operating temperature in several seconds-instant on.

4.12 To display video data on the CRT screen, positive going potentials must be placed on the tube video control grid element. When the tube grid receives a positive going video signal, a narrow stream of electrons (electron beam) pass the grid element and are accelerated toward the phosphor coating on the tube display screen. Wherever the electron beam strikes the phosphor, the phosphor undergoes an excitation and is caused to fluoresce. The fluorescence of the phosphor in that area produces a white spot (glow of light) on the tube display screen. If the spot were left undeflected the electron beam

would be concentrated in one area and cause a small illuminated white dot to appear in the center of the display screen.

4.13 In the CDT, a negative voltage is placed on the grid of the tube to cut off the electron beam (blank video) until a video signal is placed on the tube grid. Video signals consist of a series of very short positive going electrical pulses (dot information) supplied by the read only memory. When a video signal is placed on the grid of the tube, the electron beam writes a dot on the tube screen. Groups of dots are electromagnetically positioned by the set deflection circuitry to form characters on the screen. This is a basic description of tube operation.

Deflection

4.14 In order to form characters, numbers, or symbols on the screen of the CRT, the displayed dot information written by the electron beam in the cathode ray tube must be positioned from up to down, and from left to right across the screen in successive sweeps. Waveform generators, deflection amplifiers (Figure 8), and two electromagnetic deflection yokes in the set comprise the video drive circuits that direct movement of the electron beam in the tube.

4.15 For an effective presentation of the dot information on the screen, it is necessary to have a reference or base. This is accomplished using a constant vertical (up and down) sweep and horizontal sweep or trace across the screen of the CRT. The constant sweep is controlled by the horizontal and vertical coil windings in the major deflection yoke.

4.16 Starting horizontal sweep from the left side of the display screen, the horizontal deflection coils in the major yoke electromagnetically sweep the electron beam across to the right side of the display screen, and then return the beam again to the left side of the display in order to begin the next horizontal scan. The movement of the electron beam returning from the right to the left side of the display screen is termed retrace time. During retrace the electron beam is turned off (blanked) to prevent the beam from writing a retrace line across the video data displayed on the screen.

4.17 With the horizontal scan reference established (4.16), it is also necessary to have a vertical (up-down) reference. The vertical deflection coils in the major yoke electromagnetically deflect the electron beam to start at

the top line of the display, and move downward one line spacing each time a horizontal sweep scan from left to right across the display screen is completed.

4.18 With the electron beam horizontal and vertical scan references established (4.16 and 4.17), the minor yoke or character yoke as it is sometimes called, superimposes an electromagnetic vertical deflection onto the horizontal and vertical electromagnetic sweeps, which are traced only once for each line of characters. The minor yoke deflects the electron beam along a vertical axis the total height of a displayed character. Character raster or deflection begins at a point just above the top part of a displayed character and moves the electron beam downward to a point just below the character. After a downward vertical stroke, the beam is then swept upward in retrace action into position to begin the next downward vertical raster stroke. A total of 9 vertical raster strokes occur for each character position on the page display. Vertical raster is controlled by the vertical coils in the minor yoke. Video signals to the CRT grid element turn the electron beam on or off at the proper times during vertical raster deflection to accomplish writing of a character on the display screen.

4.19 The italics feature (slanted characters) is also controlled by a set of coils in the minor yoke. The horizontal coils when energized from MC912 Function Generator horizontally deflect the 9 vertical raster strokes of each italicized character. Slanting of the vertical raster strokes causes the video information to appear slanted on the CRT screen. Italics feature is not provided if TP322612 Function Generator is used.

4.20 The early design character yoke consisted of a printed circuit conductor lamination with vertical and horizontal circuit foils. This yoke was tightly wrapped around the neck of the CRT tube and positioned in a way such that the end of the yoke wrapper was just touching the rear housing of the major yoke. A plastic band retained the yoke to the tube neck. Late design deflection yokes (Figure 7) include a major and minor yoke in one assembly and are interchangeable with the early design deflection yokes.

Function Generator

4.21 Except where noted otherwise, the function generator (Figure 5) described in 4.22 through 4.27 applies to both the early TP322912 and the present TP322612 function generator circuit cards. The function generator circuitry converts digital logic signals received

from the display controller A module into analog signals for driving the vertical and horizontal amplifiers (Figure 8), and the CRT deflection yoke. It also provides the necessary circuitry to amplify video signals to the cathode ray tube. Paragraphs 4.22 through 4.27 provide a general description of the circuits in the function generator.

4.22 The vertical step generator circuit receives digital line count signals from the display controller logic and converts these to an analog staircase type voltage waveform for driving the vertical deflection preamplifier. The output from vertical deflection preamplifier drives the power deflection amplifier which then converts the voltage waveform to a current waveform through the vertical coils of the major deflection yoke. The electromagnetic field generated by the yoke positions rastered video information to the proper up or down vertical line position on the screen of the cathode ray tube.

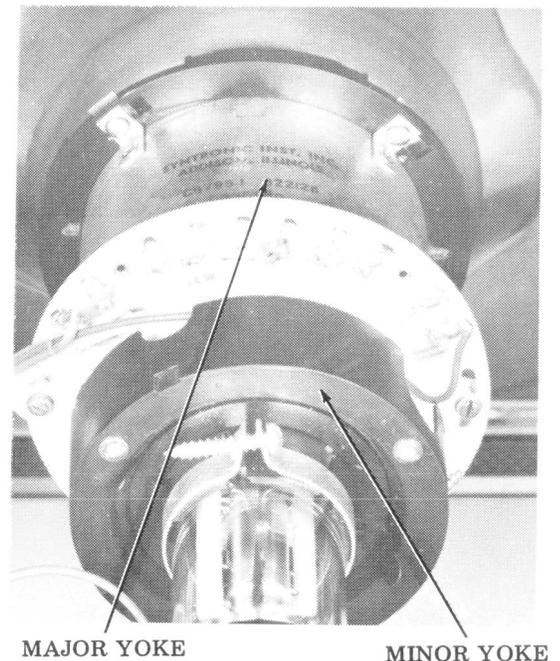
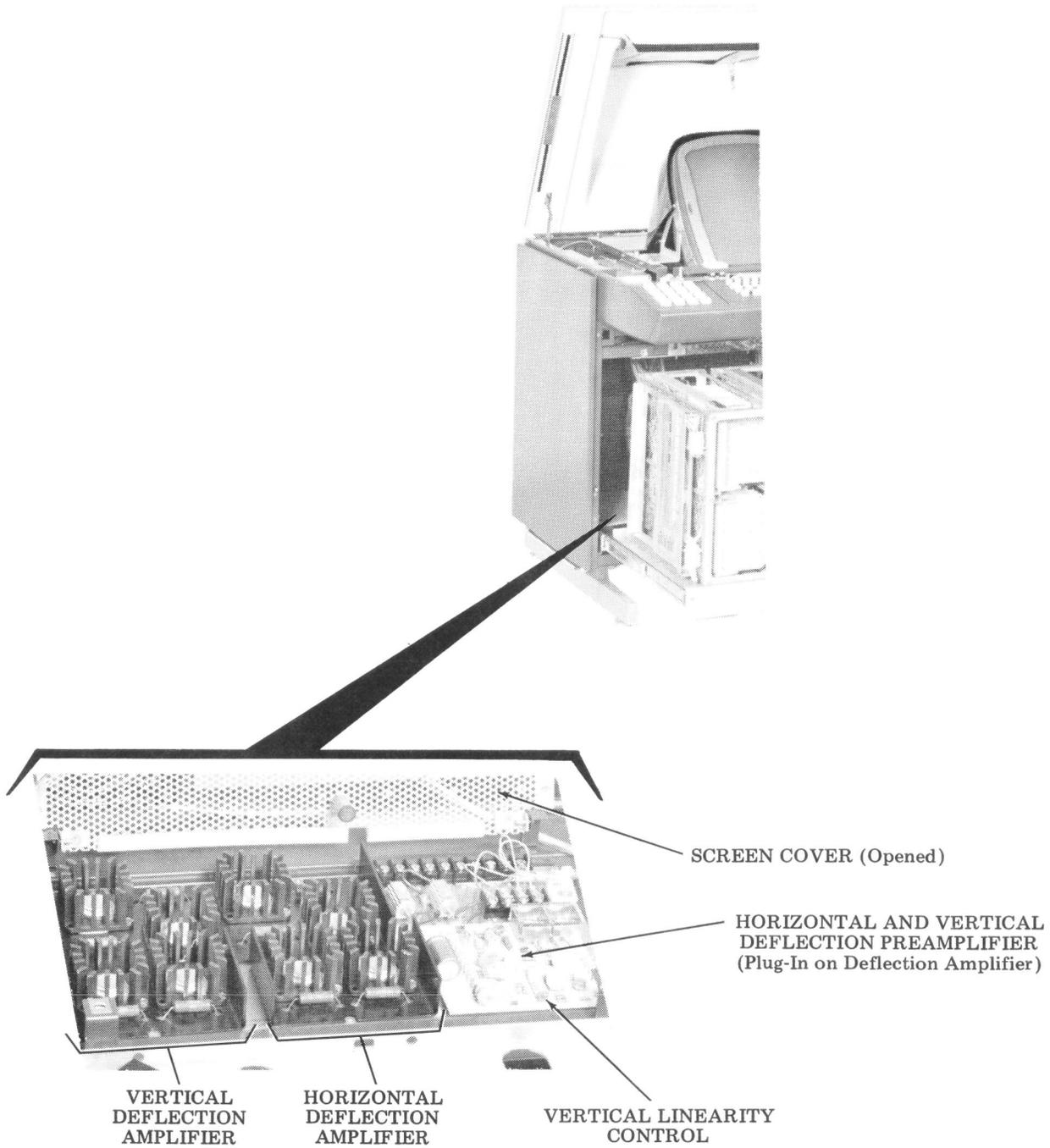


Figure 7 - Deflection Yoke
(Late Design)

4.23 The video amplifier is actually an inverting type, Class A, two-stage amplifier circuit. The video output signal from the amplifier is designed to drive the control grid of the cathode ray tube. Low level video signals from the display controller module are presented to the amplifier where they are amplified to a more positive voltage level. A positive going



Note: The horizontal and vertical deflection preamplifier and deflection drive amplifier is accessible when the CDT module shelf is opened and a screen type cover over the deflection amplifier is loosened and pivoted to the opened position.

Figure 8 - Deflection Amplifiers

voltage on the control grid of the CRT causes the electron beam to accelerate past the grid and write a dot on the tube screen. Normally, the control grid is biased with a negative voltage to cut off or blank until a video signal is received.

4.24 The horizontal sawtooth generator circuit is commonly referred to as the horizontal ramp generator or sawtooth generator. This circuit generates a sawtooth (ramp) voltage output to the horizontal deflection preamplifier circuit. From the preamplifier, the sawtooth waveform is presented to the horizontal drive portion of the deflection amplifier which converts the sawtooth voltage waveform to a current waveform through the horizontal coils in the major deflection yoke. The sawtooth generator provides the horizontal sweep that moves the electron beam horizontally from left to right across the display screen.

4.25 The character raster generator (vertical raster generator) circuit receives low level digital signals from the display controller module and converts them to a current waveform through the vertical raster coils in the minor yoke. The vertical raster coil generates an electromagnetic sweep onto the horizontal and vertical electromagnetic sweeps of the electron beam (vertical raster strokes 4.18).

4.26 The italics raster generator circuit provided only on the TP322912 function generator on early factory production CDT sets, drives current through the horizontal coil windings in the character yoke (minor yoke) when "italics" operation is selected (ESCAPE and 3). In italics operation, a horizontal yoke coil develops a magnetic field that deflects the vertical raster electromagnetic deflection by approximately 12 degrees. Deflected raster causes all characters to the right of the cursor position to slant (italics) on the cathode ray tube screen. The italics raster generator circuit is not provided on the TP322612 function generator.

4.27 The function generator also contains its own positive 15 volt dc regulator circuit and a negative 15 volt regulator circuit. The voltage output from these two voltage regulators is derived from the respective positive 30 volt and negative 20 volt unregulated voltages supplied to the generator from the CDT low voltage power supply.

Read Only Memory

4.28 The CRT electron beam writes all characters, symbols, and number information on the screen from receiving video dot signals supplied from the read only memory logic, that is attached to the left side of the display controller module (Figure 3).

4.29 The read only memory produces all upper and lower case letters, as well as numbers and punctuations using a 7-dot by 9-dot display matrix for each character position on the CRT. All 95 printing characters as well as the control code symbols for the 1968 ASCII can be generated as shown in Figure 9.

4.30 Some early factory production models of the CDT were equipped with a core type read only memory assembly. The read only memory, hereafter referred to as character generator or ROM, consisted of an electrically unalterable transformer matrix. The matrix assembly consisted of very small transformer type cores and word wires physically located in fixed positions. The output data generated from the ROM is considered electrically unalterable since the only way the output could be changed would be to physically add or change word wire placement with respect to a transformer core.

4.31 Signal pulses (dot information) were read out from the core type memory at the appropriate time by driving pulses along selected word wires, and simultaneously monitoring the pulse output (dot signals) at each transformer core that the wires passed through. If a word wire did not pass through a transformer core, that core would not have an output pulse. Thus, no video would be generated for that dot position on the display matrix.

4.32 Present factory production models of the CDT are equipped with an LSI (large scale integration) ROM assembly. Unlike the transformer core memory used in some CDT sets, the LSI memory operates using transistor-transistor logic (TTL) circuitry. Additional information concerning operation of the LSI ROM may be found in the circuit description included with the wiring diagram package furnished with the CDT.

4.33 These are the basic operating principles for generation of video on signals from message character information, which is constantly circulating in the refresh shift register logic circuitry.

Refresh Shift Register

4.34 The refresh shift register logic is not completely contained on one circuit card assembly, but is made up from a group of circuit card assemblies that are plugged into circuit card receptacles in the display controller module. Each circuit card assembly contains two or three data bit storage levels, depending on the type of circuit card used.

BITS				b ₇ b ₆ b ₅	0 0	0 0	0 1	0 1	1 0	1 0	1 1	1 1
b ₄	b ₃	b ₂	b ₁	COLUMN ROW	0	1	2	3	4	5	6	7
0	0	0	0		0	NUL (•)	DLE (D _L)	SP ()	0	ⓐ	P	~	p
0	0	0	1	1	SOH (S _H)	DC1 (D ₁)	|	1	A	Q	a	q
0	0	1	0	2	STX (S _X)	DC2 (D ₂)	"	2	B	R	b	r
0	0	1	1	3	ETX (E _X)	DC3 (D ₃)	#	3	C	S	c	s
0	1	0	0	4	EOT (E _T)	DC4 (D ₄)	\$	4	D	T	d	t
0	1	0	1	5	ENQ (E _N)	NAK (N _K)	%	5	E	U	e	u
0	1	1	0	6	ACK (A _K)	SYN (S _N)	&	6	F	V	f	v
0	1	1	1	7	BEL (B _L)	ETB (E _B)	/	7	G	W	g	w
1	0	0	0	8	BS	CAN (C _N)	(	8	H	X	h	x
1	0	0	1	9	HT (H _T)	EM (E _M)	)	9	I	Y	i	y
1	0	1	0	10	LF (≡)	SUB (S _B)	*	:	J	Z	j	z
1	0	1	1	11	VT (V _T)	ESC (E _C)	+	;	K	[	k	{
1	1	0	0	12	FF (F _F)	FS (F _S)	,	<	L	\	l	|
1	1	0	1	13	CR (←)	GS (G _S)	-	=	M	]	m	}
1	1	1	0	14	SO (S _O)	RS (R _S)	.	>	N	^	n	~
1	1	1	1	15	SI (S _I)	US (U _S)	/	?	O	_	o	DEL (//)

0 = SPACE

1 = MARK

DISPLAYED SYMBOLS SHOWN IN ()

Figure 9 - ASCII X3.4-1968 Set With Symbols Displayed on CDT

4.35 A bit level of storage is accomplished in the CDT circuitry by using ten integrated circuit (IC) packages. Each integrated circuit package is a monolithic serial-in serial-out 200 bit shift register that is interconnected with nine other IC packages on the circuit card assembly to form a 2000 bit dynamic shift register (200 bit register times 10 registers). These small IC logic packages are called medium scale integration — metal oxide semiconductor (MSI-MOS) circuit packages.

4.36 The refresh shift register is the “read-write” data storage area (memory) for all data received or generated locally by the CDT.

4.37 Parallel data character signals generated locally or received are stored in the shift register by loading each character bit level, mark or space, into its respective register level. Nine bit storage levels are provided in the shift register. Character data is stored in bit levels one through eight and the ninth bit level is used to store the underline character.

4.38 Up to 2000 characters (one display frame) may be stored and circulated within the set refresh shift register. In order that a flickerless video display be provided, the data stored in the refresh register is circulated at a rate of 60 frames per second. The display frame frequency rate is not synchronized with the ac power line frequency. The normal cleared condition of the memory is a Null character in all 2000 shift register character positions.

5. DESCRIPTION OF TERMINAL FEATURES WITH EITHER CDDC801 OR CDDC803 MODULE

CURSOR

5.01 The cursor is a white rectangle, slightly larger than character size, that is used to show where the next character will be displayed or the next function will take place. When positioned over a character already on the screen, the character will appear black within the cursor rectangle. The cursor can be positioned by using certain keyboard functions or the editing controls.

KEYBOARD

5.02 The Model 37 free-running keyboard using parallel output is used in the CDT (Figure 11). It can generate all 128 characters of the 1968 ASCII. Several characters generated by the keyboard provide special operations. Many of these characters will automatically repeat if the key is held depressed. These special operations are described in 5.05 through 5.11.

5.03 The keyboard electronic interface logic is arranged so that it can be programmed to generate either only monospace characters (all capitals) or both upper and lower case (capitals and lower case) ASCII characters for each respective keytop depression. This feature may be programmed for either option on the keyboard interface logic assembly (Figure 10).

5.04 An audible "click" feature is also provided that simulates a typewriter sound when a keytop is depressed as an operation feedback to the attendant. The audible "click" sounds each time that a keytop is depressed for normal or repeat keytop operation. This sound is generated by a clacker magnet located on the keyboard interface logic assembly. The "click" sound may be disabled by the attendant placing the clacker magnet control switch to off position (Figure 10).

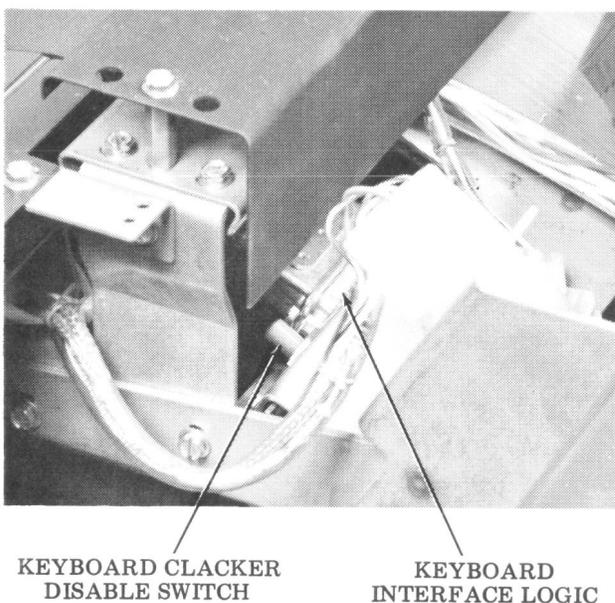


Figure 10 - Keyboard Interface Logic
(Cabinet Cover Raised)

KEYBOARD CONTROLS

5.05 BACKSPACE (repeatable) — Moves the cursor one character position to the left without destroying the displayed character. This function is not stored in the memory.

5.06 RETURN — Stores a carriage return in the memory for transmission to receiving devices. The cursor moves one character position to the right but no function is performed in the CDT. New Line should always follow Return. A format of Return, Return, New Line is recommended when the receiving device requires a fill character to complete the Carriage Return operation.

5.07 NEW LINE (repeatable) — Stores a line feed (line space) in the memory for transmission to receiving devices. The cursor will move to the first character position of the next line. Any characters that appear to the right of the cursor at the time the New Line function is placed into the memory will be replaced by nulls. A New Line function must be inserted at the end of each line or the cursor will remain at the end of the line and any characters generated by the keyboard will overwrite on that position.

5.08 SPACE (repeatable) — Cursor moves one character position to the right and a space is stored in the memory. Characters in the display and in memory will be overwritten with space as the cursor moves to the right.

5.09 Several other characters generated on the keyboard are repeatable. These are:

- (a) NULL
- (b) DELETE
- (c) X, x
- (d) Asterisk, Colon
- (e) Equal Sign, Hyphen
- (f) Underscore
- (g) Period

5.10 ESCAPE and 3 sequence — Marks all subsequent data on the screen from and to the right of the cursor position for italics (slanted characters only if set has TP322912 function generator) until an ESCAPE and 4 sequence is reached. If set is equipped with TP322612 function generator, neither italics nor highlight is provided on CRT screen.

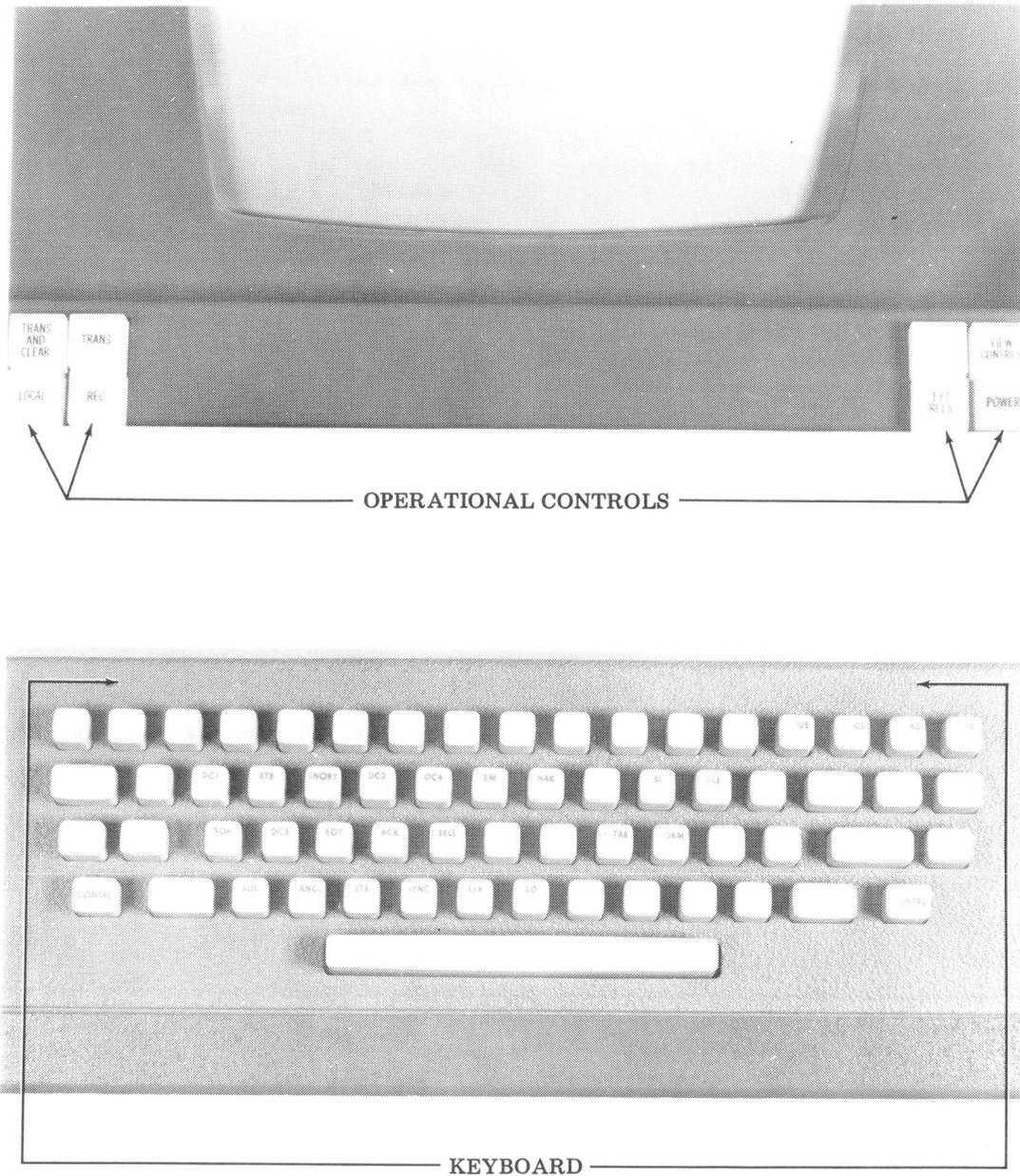


Figure 11 - Keyboard and Operational Controls

5.11 ESCAPE and 4 sequence — All subsequent characters are changed from italics to their normal configuration.

Note: The functions described in 5.10 and 5.11 are available only when the CDT is equipped with TP322912 Function Generator. The code sequences are used to identify or give significance to certain data in the message as it would on a two-color printing receive device.

5.12 HORIZONTAL TABULATION — The keyboard TAB keytop when operated, stores the horizontal tabulate code into the internal memory of the set at the original position of the cursor. If horizontal tabulate feature is provided (optional on CDDC801 only), it also causes the cursor to quickly move to the right of the display screen until it reaches the first preset tab marker (5.52 through 5.55); or it goes to the end of the line if there are no tab markers present.

EDITING CONTROLS (Figures 2 and 12)

5.13 CLEAR — A momentarily operated button when depressed, causes all data from the cursor to the last character position of the last line, to be replaced with nulls (cleared condition of memory).

5.14 HOME — A momentarily operated button when depressed, places the cursor in the first character position of the first line (ie, home position). Displayed information will not be affected.

5.15 ◀ CURSOR LEFT (repeatable) — A momentarily operated button when depressed, moves the cursor one character position to the left without affecting any displayed data. If repeated, the cursor will stop at the left end of the line.

5.16 ▶ CURSOR RIGHT (repeatable) — A momentarily operated button when depressed, moves the cursor one character position to the right without affecting any displayed data. If repeated, the cursor will stop at the right end of the line.

5.17 ▲ CURSOR UP (repeatable) — A momentarily operated button when depressed, moves the cursor up one line in the same column without affecting any displayed data. If repeated, the cursor will stop at the uppermost available line of the display in that column.

5.18 ▼ CURSOR DOWN (repeatable) — A momentarily operated button when depressed, moves the cursor down one line in the same column without affecting any displayed data. If repeated, the cursor will stop at the lowest available line of the display in that column.

5.19 CURSOR RETURN — A momentarily operated button when depressed, repositions the cursor to the first character position of the line it is in without affecting any displayed data.

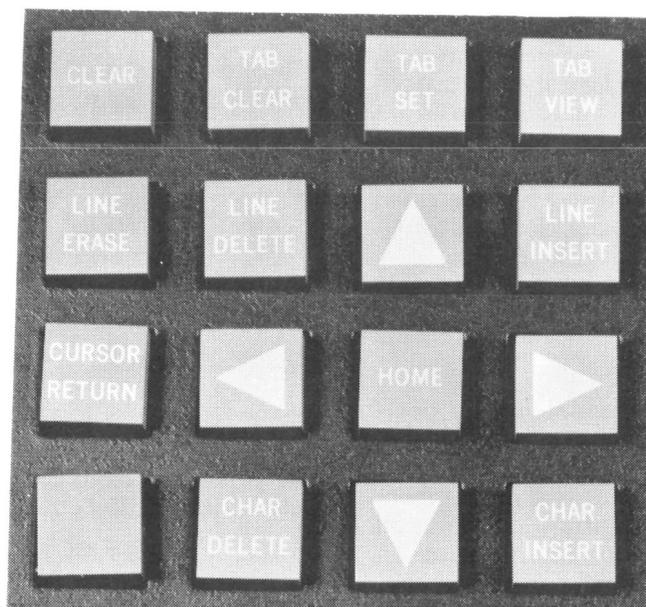


Figure 12 - Editing Controls

5.20 LINE ERASE — A momentarily operated button when depressed, replaces all data from the cursor position to the end of the same line with Nulls. The cursor will not move.

5.21 CHAR DELETE (repeatable) — A momentarily operated button when depressed, causes the character overlaid by the cursor to be deleted from the display, and the memory and all characters to the right of the cursor to move one position to the left. A Null will be added to the right end of the line. If repeated, the operation will stop when all characters from the cursor to the end of the line have been replaced by Nulls.

5.22 CHAR INSERT (repeatable) — A momentarily operated button when depressed, causes the character overlaid by the cursor and all characters to the right of the cursor to move one position to the right. A Null will appear in the cursor position. The function will not operate if the right end of the line does not contain a Null or a Space. If repeated, the function will stop when all Nulls or Spaces at the end of the line have been replaced with characters.

Note: If horizontal tabulate markers have been set and the horizontal tab option is being used, when either the character delete or character insert is initiated, the function will take place only within the horizontal tabulation markers where the cursor is located. The operation will be the same as stated in 5.21 and 5.22.

5.23 LINE DELETE — A momentarily operated button that when depressed, repositions the cursor to the last character position on the line. The cursor then moves from right to left causing that entire line to be removed from the display. All subsequent lower lines move up one line position on the display. A line filled with Null characters replaces any data that may have been displayed in the last line of the message. At the completion of a line delete function, the cursor is repositioned to the first character position of the line.

5.24 LINE INSERT — A momentarily operated button that when depressed, repositions the cursor to the first character position on the line. The cursor then moves from left to right causing that entire line and all sublines to be moved down one line position on the display. The inserted line will contain all Null characters. At the completion of the line insert function, the cursor will be repositioned to the first character position in the line. The line insert

function will be prevented from operating if the last line of the display format on the screen contains any character other than null or space.

Note 1: The LINE DELETE and LINE INSERT functions will not operate in the top six lines of the 50-line format, the top four lines of the 46-line format, or the top line of the 39-line format.

Note 2: The TAB CLEAR, TAB SET, TAB VIEW, and INTERLOCK (blank top) editing functions for a CDT equipped with either CDDC801 or CDDC803 modules are the same and explained in 5.52 through 5.55.

DISPLAY ADJUSTMENT CONTROLS (Figures 2 and 13)

5.25 VERT CTR — A variable control that is used to move the entire display either up or down.

5.26 HORZ CTR — A variable control that is used to move the entire display either left or right.

5.27 BRIGHTNESS — A variable control that adjusts the brightness level of the displayed information.

SERIES 2510 CDT WITH CDDC801 DISPLAY CONTROLLER MODULE

5.28 The CDDC801 display controller A module provides the electronics circuits necessary for operation of the basic CDT terminal. Use of this module is generally limited to Business Information System (BIS) applications which do not require sophisticated on-line control of the CDT terminal.

A. Operational Controls (Figure 11)

5.29 POWER — A red push-on push-off button that controls power to the CDT electronic circuits. The button is illuminated when the power is ON.

5.30 LOCAL — A momentary action switch having a white button top that when depressed to on position (illuminated), places the CDT into the local operation. Messages can then be generated from the keyboard and corrected by use of the editing controls.

5.31 VIEW CONTROLS — A white push-on push-off button when in ON position, causes all control characters that have been generated to be displayed. The button is illuminated during View Controls operation.

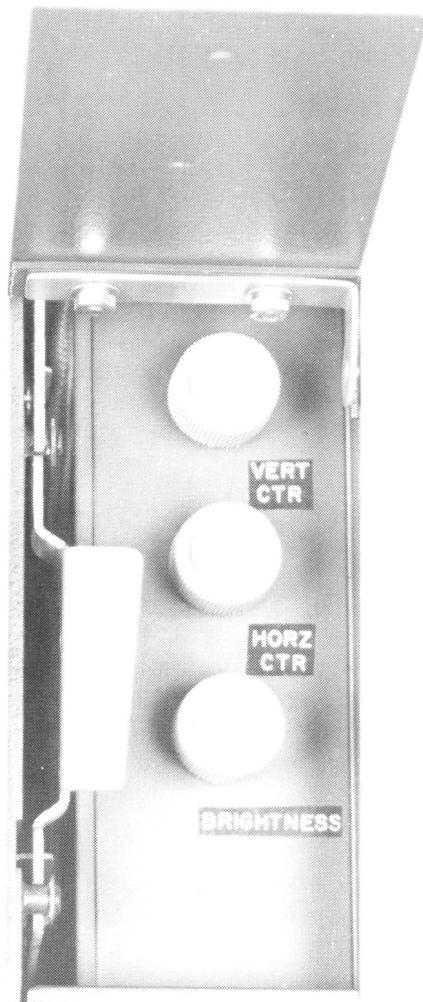


Figure 13 - Display Adjustment Controls

5.32 TRANS — A momentary action switch having a white button top that when depressed to ON position (illuminated), electronically connects the refresh memory to the output of the display controller module. The keyboard and editing controls are blinded. The button is illuminated when the CDT is in transmit. The message will remain in the memory at the end of transmission until a proper message ending character is sent. The CDT will then automatically go into local. If no message ending character is present, the LOCAL button must be manually depressed to terminate the transmit condition.

5.33 TRANS AND CLEAR — A momentary action type switch having a white button top that illuminates in ON position. When depressed in conjunction with the TRANS

button, it causes the message to be cleared from the memory at the end of transmission. The button is illuminated when the CDT is in transmit and clear operation. The memory will be cleared and the CDT transferred into local, only if a proper message ending character is present.

5.34 REC — A momentary action switch having a white button top that when in ON position (illuminated), electronically connects the refresh memory to the input of the display controller module. The keyboard and editing controls are blinded. The button is illuminated when the CDT is in receive. The CDT will automatically go into the local operation after the proper message ending sequence is received.

5.35 EXT RELS (optional) — A momentary action pushbutton switch that under certain conditions, is provided to allow the CDT attendant to initiate message transmission from a CDBU character buffer module or independent roll-up buffer storage set. If the EXT RELS switch button top lights during operation, it is signaling a Buffer Full Alarm indication to the attendant. Depending upon the hookup arrangement, the EXT RELS switch may be located on the device control panel of the CDT or it may be located on the control panel of the 2541 independent roll-up buffer set. The following descriptions may be applicable depending upon the terminal operating arrangement.

(a) The EXT RELS pushbutton may be used when the CDBU is optionally arranged so that it cannot begin transmission of a stored message until a message ending character has been inserted into the character storage buffer. In this arrangement, the ending character (usually EOT) automatically conditions the buffer for transmission. However, if a message not containing an EOT character is inserted into the buffer, or if an exceptionally long message is inserted (ie, one exceeding the character storage capacity of the buffer causing a buffer full condition before the ending character is entered), it would not be possible for the character buffer to begin transmission. In this instance, depression of the EXT RELS button simulates detection of an ending character to the character buffer electronic logic and causes transmission to begin. The character buffer electronic logic resets after the ending character has passed through the buffer. The proper message ending character must always be entered at the end of the message on the CDT display.

SECTION 578-100-100

(b) EXT RELS button may be arranged for control of a receive character buffer storage unit. If an incoming multipage message fills the buffer to its maximum storage capacity, EXT RELS button will illuminate indicating a Buffer Full Alarm to the CDT attendant. The CDT attendant by depressing EXT RELS, and then the RECEIVE button will cause the buffer to transfer the first page of the multipage message to the CDT. Usually, each page of a long message stored in the buffer is separated by an end of text (ETX) or form feed (FF) message delimiter character. The CDT will receive the first page of the message until either the ETX or FF character is detected. Upon detection of the page ending character, the CDT stops its reception and reverts to local for editing or verification of the received data. Reoperating the CDT RECEIVE button releases the next page of the message, etc. Meanwhile, space is made available in the buffer unit for storing additional pages of the incoming message until the last page is transferred and the EOT character is detected. When the EOT is detected in the CDT, all circuits revert to normal operation.

(c) Other operating arrangements may exist. Consult the field engineering operating arrangement program. For information concerning the use of EXT RELS switch when the CDT is equipped with a CDDC803 display controller module for operating as a supervisory CDT with a Series 2550 Cluster Controller, refer to 5.64.

B. Operation

5.36 All messages that are received by or sent from a CDT must comply with a definite message ending procedure. The message ending sequence depends upon the requirements of the application in which the CDT is used, and/or any internal wiring options that may be connected with the CDT itself.

5.37 The CDDC801 module in the CDT is internally wired to recognize the EOT character (end-on character) as a message terminator. Optionally, the module can be programmed to recognize two additional, either one or both, message terminating characters in addition to EOT character. The following characters can terminate a message:

- (a) End of Transmission (EOT)

- (b) End of Text (ETX)

- (c) Form Feed (FORM)

C. Power Turn On

5.38 Depress the POWER button to activate the CDT. The POWER lamp illuminates when on. The display appears immediately.

5.39 When the CDT power is first turned on, a "power-on-reset" feature automatically clears the CDT display and places the cursor to the first character position of the first line. If the horizontal tab option is used, any tab marks will also be cleared from the display.

5.40 Power-on-reset circuit automatically places the CDT set in local and enables the keyboard and editing controls for operation.

5.41 With the VIEW CONTRLS button on (VIEW CONTRLS lamp illuminated), control characters will be displayed on the CRT. The null character is represented by a single dot in the center of the character position. This dot on the display indicates the existence of a clear condition and these dots are employed as indicators for line limits.

5.42 With the VIEW CONTRLS button off (VIEW CONTRLS lamp extinguished) control characters will be blanked from display on the CRT.

D. Local

5.43 The CDT can be conditioned for local operation in one of the following four ways:

- (a) When the POWER button is depressed and the CDT is on, local operation is automatically established.

- (b) When the CDT is in transmit and the logic circuitry detects a message ending sequence in the message being transmitted, message transmission will stop, the TRANS lamp will no longer be illuminated, and the CDT will change to local.

- (c) When the CDT is in receive operation and the logic circuitry detects a message ending sequence in the message, the REC lamp will no longer be illuminated, and the CDT will change to local.

(d) Depressing the LOCAL button (illuminated) will force the CDT into local. The keyboard and editing controls can then be used to generate a message or edit a received message.

E. Transmit

5.44 After a message is prepared or is edited for accuracy, it is transmitted by depressing the TRANS button, the button lamp will illuminate. The display screen will blank during message transmission and the information will transfer from the memory to the output line without clearing from the memory.

5.45 The New Line character serves as the end of line indicator and is the last character transmitted on each line.

5.46 When a message ending character is detected in the transmitted message indicating an end of transmission condition, the cursor stops at the first character position following the message ending character, the TRANS lamp extinguishes indicating the end of message transmission and the CDT is returned to the local. To clear the display it is necessary to operate the HOME and CLEAR buttons or the CLEAR button alone, if the home on clear option is used.

5.47 The TRANS AND CLEAR button lamp will illuminate when depressed simultaneously with the TRANS button, and allows the message contained in the memory to be transmitted on-line followed by a simultaneous clearing of the memory, and display upon detecting a message ending character in the message format. When detected, the cursor stops at the first character position following the message ending character, the TRANS AND CLEAR lamp extinguishes indicating completion of message transmission, and the CDT transfers from Transmit And Clear operation to local. The cursor then returns to the Home position with the display cleared.

5.48 If the TRANS or the TRANS AND CLEAR lamp is lighted but the transmission does not start or is not completed, it may indicate that the distant receiving terminal is not operating. In this instance, the CDT can be manually taken out of transmit by operating the LOCAL button.

F. Receive

5.49 Before placing the CDT into receive, be sure that the display is cleared and the cursor is in the home position, otherwise the CDT will begin to receive data from the cursor position.

5.50 Depress the REC button, lamp will illuminate to prepare the CDT to receive a message.

5.51 When a message is received, it is written into the refresh memory for storage. Display of the message on the tube screen does not occur until after the message ending sequence is received. When a message ending sequence is detected by the logic circuitry, the REC lamp will no longer be illuminated and the CDT will automatically go into the local.

G. Horizontal Tabulation Option

5.52 If the CDT is equipped with the horizontal tabulation (HT) option, the operation is described in 5.53 through 5.55.

Note: The word "column," that is used in 5.53 is defined as: a vertical row of character positions with the top located at the cursor position and the bottom located in the bottom line of that column.

5.53 The tab setting procedure is as follows:

- (a) Position the cursor in the column where tabs are to be set.
- (b) Operate TAB SET button. This causes all character positions in that column from the cursor position to the bottom line of the display to have the tab marker set.
- (c) To determine the positions at which tabs are set, depress the TAB VIEW button. A marker (2 dots wide) is displayed at the bottom left corner of each character position at which a tab has been set. By depressing the TAB VIEW button a second time, the tab markers are removed from the display.

5.54 The tab setting is used as follows:

- (a) Depress the TAB key on the keyboard.
- (b) The HT character is inserted into memory and the cursor is positioned to the first position following the next marker in the line containing a tab set (memory input is blinded during tabbing operation).
- (c) If a HT function is initiated on the keyboard and a tab has not been set in the balance of the line, the cursor will move to the last character position on the line and remain there.

SECTION 578-100-100

(d) All characters stored in memory, including HT and Null, are transmitted. The Null characters that separate an HT and the next tab marker provide three times the necessary timing characters to allow a hard copy machine to position itself in response to the HT character.

(e) The procedure outlined in 5.54 (a) through (d) make the CDT compatible with model 35 and 37 printers equipped with horizontal tabulation features. The procedures also permit each line to have tab markers independent of other lines. Horizontal tabulation will then only be compatible with a central processing unit or another CDT that has been programmed for the variable HT formats. Compatibility with ASCII signaling equipment not equipped for horizontal tabulation can be maintained by utilizing the Space on HT wiring option described in 6.12.

5.55 A tab set can be cleared as follows:

(a) The tab sets are cleared by positioning the cursor to the tab set marker to be removed.

(b) Simultaneous operation of TAB CLEAR button and INTERLOCK button (an unmarked button at lower left of editing button group) causes all tab sets to be removed from all positions to the right of and below the cursor position. All tab sets are cleared if the TAB CLEAR button and INTERLOCK button are operated with the cursor in the home position.

SERIES 2510 CDT WITH CDDC803 DISPLAY CONTROLLER MODULE

5.56 A CDT equipped with a CDDC803 A module is primarily designed to operate in more advanced BIS applications, such as company service order processing where a computer terminal is used as the central processor unit. In this application, a group or cluster of CDTs (as few as one or as many as thirty-two) are connected to a Series 2550 Cluster Controller terminal. This provides each CDT with a controlled line access arrangement into the computer unit. Service order information originates at the CDT and is sent through the cluster controller to the computer. The computer may quickly respond to the CDT service order or inquiry by utilizing the on-line display control edit features provided in the CDT terminal CDDC803 module.

A. Operational Controls

5.57 POWER — A red push-on push-off switch button that controls power to the CDT electronic circuits. The button is illuminated when the terminal power is on.

5.58 LOCAL — A momentary action switch having a white button top that when depressed to on position (illuminated), places the CDT into local. Messages can then be generated from the keyboard and corrected by use of the editing controls. The button is illuminated when the CDT is in local (5.62).

5.59 VIEW CONTRLS — A white push-on push-off button when in its on position, causes all control characters that have been generated to be displayed. The button is illuminated when in View Controls operation.

5.60 TRANS — A momentary action switch that when depressed to on position, is illuminated. In on position, the refresh memory (message storage area) is electronically connected to the send output of the display controller module. During transmission of a message the CRT screen will be blanked (video off) and the keyboard and editing controls are disabled. When the proper message ending character has been sent (EOT, ETX, or FF), the CDT will revert to local. The CRT screen will unblank, and the keyboard and editing controls will be operational. The message that was transmitted will be displayed on the CRT and the cursor will be positioned after the message ending character.

5.61 If the CDT is operating with a Series 2550 Cluster Controller, transmission operation is the same as that described in 5.60, except for the following. The message on the screen must contain a message ending character, normally ETX. Before the TRANS button will initiate a transmission, the message ending character must be located somewhere between the cursor position and the last character position on the bottom line. After the message and ending character have been transmitted from the CDT, the cluster controller will await a response from the central processor unit (CPU) to find out if the message was correctly received. If the message is acknowledged, the cluster controller will send a transmit data acknowledge (TDA) signal to the CDT. Upon receipt of the TDA signal, the CDT will automatically place the cursor to home position and change to receive. However, if the message was received in error at the central processor, operation of the CDT is as described in 5.62.

5.62 If the cluster controller is signaled by the processor unit that the message received was in error, the cluster controller will, depending upon the negative acknowledgement received from the processor, send either a TDE (transmit data error) or TA (transmit abort) signal to the CDT. Receipt of a TDE signal at the CDT is an indication that an error was detected. The TDE signal conditions the CDT for retransmission and places the cursor in home position (first character position on first line). If after a predetermined number of transmission attempts, (normally two) if an error is still detected, the cluster controller will send a TA (transmit abort) signal to the CDT interface. In response to the TA signal, the CDT local lamp will flash at a one hertz rate and the CRT screen will unblank. The cursor will remain positioned after the ETX character and the CDT will remain in the transmit abort condition (flashing LOCAL button). At this time the keyboard, editing, and device controls will be electronically prevented from operating (blinded). In order to remove the CDT from the transmit abort condition, the terminal attendant must depress LOCAL button. This causes the LOCAL lamp to stop flashing and remain lit. The keyboard, editing, and device controls will then be operational. The message must then be directed through the system recovery procedures.

Note: A screw type programming option, 6.15(b), is provided on the external mode control circuit card that can be programmed to return the cursor to home position after the message is sent and a transmit data acknowledge (TDA) signal is received from the external CDT control device.

5.63 RECEIVE — When selected (a momentary action switch), the switch button lamp lights and the input of the display controller module is electronically connected to the refresh memory logic (message storage area) of the CDT. During receive operation, the keyboard and editing controls are disabled. After a message is received containing the proper message ending character (ETX when operating with the cluster controller), a clear from cursor function takes place and the CDT then reverts to local. If any errors were detected during CDT receipt of a message, the cluster controller will respond to the computer control unit with a NAK character at the appropriate time. The cluster controller will also condition the CDT terminal to receive a retransmission by pulsing the receive data error lead to the terminal interface; this returns the

cursor to Home position and in most operating arrangements clears the CDT display. The centralized computer unit will send a terminate sequence to the cluster controller immediately after receipt of the NAK character, or it may make several attempts to retransmit the message before terminating. The cluster controller, upon receiving the terminate sequence, signals the CDT to return the cursor to Home position, unblanks the CDT display screen, and the terminal receive lamp remains lit as an indication to the attendant that the message was not received properly.

5.64 EXT RELS (External Release-Option) — A momentary action pushbutton switch that under certain conditions, is provided to allow the CDT attendant to initiate message transmission from a CDBU character buffer storage unit, or to externally control a magnetic tape transceiver when the CDT is operating in a Series 2550 Cluster Controller arrangement. The following descriptions may be applicable, depending upon the operating arrangement.

(a) If the CDT is not used in a Series 2550 Cluster Controller arrangement, operation may occur as described in 5.35.

(b) The supervisory CDT in a Series 2550 Cluster Controller station arrangement is provided with an EXT RLS button for controlling operation of the magnetic tape standby receiver set. During standby operation of the 2550 Cluster Controller, the peripheral CDTs (as few as one or as many as thirty-two) operate in a controlled non-contention arrangement and input service order messages into the magnetic tape cartridge in the magnetic tape set. After the responsible attendant or supervisor at the supervisory CDT removes the cluster controller from standby operation, the service order data in the magnetic tape set can be sent to the computer unit from the supervisory CDT using the following procedure: The tape in the magnetic tape transceiver should be rewound to Begin-of-Tape position. With the tape set conditioned to SEND, operating EXT RLS on the CDT permits the stored service order data to be displayed on the supervisory CDT. There it may be re-edited or checked if necessary, then after verification, transmitted to the centralized computer station using the standard transmission format required by the BIS (Business Information System) application.

SECTION 578-100-100

B. Operation

5.65 When the CDT is equipped with a CDDC803 A module, the terminal is capable of performing local and on-line edit functions. The on-line edit features include the following: (1) On-Line Cursor HOME, (2) Clear Display, and (3) Horizontal Tabulate, Set and Clear Tabulate Markers. In addition, the terminal module may be programmed to recognize the proper message ending character or characters required by the application in which the CDT is used. All messages that are received by or sent from the CDT must comply with a definite message ending character. Three End-On character options are available for programming as message terminators.

5.66 When the CDT terminal is operating with a Series 2550 Cluster Controller, only ETX character should be programmed as the message terminating (End-On) character. The following characters, either one or all, may be programmed for terminating a message depending upon terminal application requirements.

- (a) End of Transmission (EOT)
- (b) End of Text (ETX)
- (c) Form Feed (FORM)

C. On-Line Edit Features

5.67 Upon receiving the ASCII characters H, J, 1, and 2 preceded by the ESCAPE character, the following on-line edit functions will be initiated:

- (a) ESCAPE H — When received will position the cursor in the Home position.
- (b) ESCAPE J — When received it will clear (change to nulls) all ASCII information from the cursor position to the last character position of the last line.
- (c) ESCAPE 1 — When received will set horizontal tabulate markers.
- (d) ESCAPE 2 — When received will clear horizontal tabulate markers.

Note 1: On-line control characters transmitted to a CDT must be followed by a minimum of three delete or null characters. The delete or null characters act as a time or media fill, which allows the CDT to initiate and complete the

required function of the received control character sequence. The appropriate reject null or delete option should be installed in the CDT to prevent fill characters from being stored in the memory logic.

Note 2: When the CDT is operating with a Series 2550 Cluster Controller, only the null character should be used for time or media fill following an on-line control character transmission. If the delete character is used, the cluster controller terminal will abort character synchronization upon receipt of two or more delete characters (16 continuous marking bits). This will cause a message data delay until the controller and processor character synchronization is re-established.

D. Power Turn On

5.68 Power turn on operation for the CDT with the CDDC803 module is the same as that described in 5.38 through 5.42.

E. Local

5.69 Local operation for the CDT equipped with a CDDC803 module is the same as that described in 5.43 with exception to (b). When the CDT is in transmit operation and the logic detects a message ending sequence in the message being transmitted, transmission will stop, TRANS button will no longer be illuminated, and the CDT will change to receive.

F. Transmit

5.70 This description of terminal operation is applicable to the CDT when connected to a Series 2550 Cluster Controller. The attendant, after preparing and editing a service order message or inquiry in local, may send the data by depressing TRANS button. Transmit button lights and the cluster controller is signaled that the CDT has send traffic. At the proper time, transmission will begin. The CDT display screen is blanked (video off) and message transmission and data is transferred from the memory to the output line without clearing the data from the memory. The cursor must be in home position before transmit operation is selected. Otherwise, transmission will begin from the cursor position. The set is provided with a wiring option which automatically homes the cursor when TRANS button is selected before transmission is begun.

5.71 During all transmission or receive operation, the CDT display screen will blank and then unblank after the message transmission or reception is completed.

5.72 Each line of data in the message intended for transmission must end with a New Line character. If the New Line character is omitted from a line in the message which has no ending character, the cursor during transmission will advance through the message to the end of that line and stop. Transmission from the CDT will be stopped even though TRANS button is lit. If this condition should occur, the CRT display screen during transmission will unblank to signal the attendant of the New Line character omission.

5.73 When the message ending character (ETX) is detected in the transmitted message indicating an end-of-transmission condition, the CDT will stop transmission, receive a transmit data acknowledge (TDA) signal from the cluster controller, and then revert from transmit to receive operation.

G. Receive

5.74 Receive operation for the CDT terminal equipped with a CDDC803 module is the same as that described in 5.49 through 5.51 and 5.63.

H. Horizontal Tabulation Option

5.75 The horizontal tabulation feature for use in local operation is the same as that described in 5.52 through 5.55.

6. TERMINAL OPTIONS

SIGNAL LINE FILTERS

6.01 When the CDT is operating in areas that are carpeted and have relatively low humidity conditions, static voltages can be generated and discharged by the attendant into the CDT. These static charges may create a sufficient enough radiated electrical radio frequency interference noise upon discharge to enter the CDT and disturb stored or displayed message data.

6.02 Two types of signal line filters are available to add to the CDT for elimination of static interference when the CDT is operated in areas subject to static electricity. One filter, TP335548 modification kit, is recommended for use between a CDT and cluster controller; and a TP335433 is also recommended

if the CDT has a magnetic tape transceiver. A TP335434 modification kit is recommended for CDT sets in non-cluster controller arrangements.

FORMAT

6.03 There are four different formats in which the 2000 characters can be displayed on the terminal display tube.

(a) A 50-line format with the first six lines containing 62 characters and the remaining lines containing 37 characters on a vertically mounted display tube.

(b) A 39-line format with the first line containing 24 characters and the remaining lines containing 52 characters on a vertically mounted display tube.

(c) A 46-line format with the first four lines containing 59 characters and the remaining lines containing 42 characters on a vertically mounted display tube.

(d) A basic 25-line format with all lines containing 80 characters on a horizontally mounted display tube.

Note: Certain limitations concerning Line Delete and Line Insert functions on the CRT line display formats are given in Note 1 that follows 5.24.

BOTH CDDC801 AND CDDC803 DISPLAY CONTROLLER MODULE STRAPPING OPTIONS

6.04 There are several variations of certain conventional functions that can be obtained by inserting wire straps on the display controller module. They are as follows:

6.05 REJECT "DELETE" — Causes the CDT to reject Delete characters when received from the receive line and not store them in the refresh memory. The ability to insert Delete characters from the keyboard and transmit them from the memory is not affected.

6.06 REJECT "NULL" — Causes the CDT to reject Null characters when received from the receive line and not store them in memory. The ability to insert Null characters from the keyboard, and to transmit them from memory, is not affected.

SECTION 578-100-100

6.07 END ON "END OF TEXT" — Causes the CDT to stop message transmission or reception when an ETX character is sensed, causing the unit to return to local from the transmit or receive operation.

6.08 END ON "FORM FEED" — Causes the CDT to stop message transmission or reception when a form feed (FF) character is sensed, causing the unit to return to local from the transmit or receive operation.

6.09 HOME ON "TRANSMIT" — Causes the cursor to return to the home position prior to message transmission. Without the Home On "Transmit" option, message transmission starts from the cursor position, which may not be the home position.

6.10 HOME ON "CLEAR" — Provides for clearing the screen when the CLEAR button is operated. If the Home On "Clear" option is not provided operation of the CLEAR button causes the screen to be cleared from the cursor position to the end of the display (clear from cursor).

6.11 DISPLAY CONTROL CHARACTERS — Causes the control characters to be displayed at all times (unblanked). Normally, control characters are displayed only when the VIEW CONTRLS is operated.

6.12 WRITE SPACE ON HORIZONTAL TABULATE — (This option exists only if the horizontal tabulate circuit card is present in the A module.) With the option strap TP193220 connected to the A module field matrix, a horizontal tabulate character generated from the keyboard in local or received from the CDT receive interface in receive causes the following operation. Instead of the horizontal tabulate (HT) character, a space (SP) character is written into the refresh shift register (set memory) in the character position the cursor is positioned over, and each subsequent character position as the cursor moves to the right until a HT stop or end-of-line condition is detected. When the option strap is connected, the HT character cannot be inserted into the refresh shift register (memory). This option permits rapid preparation of a tabulated message for transmission to receive devices that are not equipped with horizontal tabulation facilities.

6.13 Removing the option strap from the display controller field matrix allows the horizontal tabulate (HT) character to be written into the refresh shift register (memory) at

the character position the cursor is positioned over. The cursor is caused to horizontally tabulate (HT) across the display until a HT marker or an end-of-line is detected. All character positions in the set memory between the stored HT character and the HT stop remain in their original state (unchanged — normally NULL character in each character position). This option is applicable only if horizontal tabulate option is present in A module.

6.14 END ON "END OF TRANSMISSION" — Is only applicable to CDDC803 module. The CDDC801 module is internally wired to detect EOT — not optional. When the CDT receives an EOT character, message transmission or reception will be stopped causing the terminal to change from receive to local or if in transmit it changes from transmit to receive.

6.15 STOP TRANSMISSION OR RECEPTION ON ETX, FF, OR EOT (External Mode Control Applicable to CDDC803 Module Only) — Detecting any one of the message ending characters will cause the CDT to stop without changing the operating mode. This feature is provided on the TP322966 (MC966) circuit card assembly when the CDT is used with the Series 2550 Cluster Controller or other station controller equipment. The cluster controller maintains control of the CDT transmit and receive operation in connection with the system error control procedures. With this option enabled, the CDT depends upon signals from the external device to change operating modes after a message has been transmitted or received.

(a) INCOMING MESSAGE OVERWRITE — If pre-empt to receive operation of the CDT is required for the system or station operating arrangement, this option is enabled. Whenever the external station control device sends a receive message (RM) control signal to the CDT, it will automatically change the CDT from local or transmit operation into receive. At the same time, a cursor home function occurs positioning the cursor to the first line, first character position in the display. Any data previously contained on the display will be overwritten by the incoming message.

(b) HOME CURSOR UPON TDA SIGNAL — This option is usually enabled along with the Go Receive or Go Local options. With the option enabled, the CDT after completing a successful message transmission will automatically return the cursor to home position (first line, first character position)

upon receiving the transmit data acknowledge (TDA) signal from the external station control device.

(c) GO LOCAL ON TDA SIGNAL — With this option enabled, the CDT will automatically change from transmit (after completing a successful transmission) to local upon receiving the transmit data acknowledge (TDA) signal from the external station device.

(d) GO RECEIVE ON TDA SIGNAL — With this option enabled, the CDT will automatically change from transmit (after completing a successful transmission) to receive when the transmit data acknowledge (TDA) signal is received from the external station device.

(e) FORM FILL (Write Null Inhibit) — Not used on CDDC803 module.

Note: Additional operation program options are provided on some of the circuit card assemblies used in the display controller module; refer to the CDT wiring diagram package (WDP) for additional information.

INTERFACE MODULES

6.16 The interface modules that can be added to the CDT and used to provide various input/output signaling arrangements, are listed within Table A. Detailed interface module description and operation information is provided in Sections 578-110-100 and 578-110-101. Other types of interface modules requiring signaling arrangements other than those listed in Table A may be available through factory ordering.

BUFFER MODULES

6.17 Listed within Table B are the various buffer modules that may be used with CDT sets. All buffer modules, except for CDBU803, are designed to be housed within the CDT cabinet. The buffer module provides the necessary additional message character storage circuitry. The CDBU803 buffer module has a module frame that is too large to be housed in the CDT cabinet. This module is designed for use in the auxiliary or independent roll-up buffer set (7.01 and 7.02 respectively). Detailed buffer module description and operation information is described in Sections 578-120-100 and 578-120-101.

TABLE A
CDT INTERFACE MODULES

CDIF INTERFACE MODULES (OPTIONAL)					COMPATIBLE WITH CDT DISPLAY CONTROLLER		
UNIT CODE	INPUTS RECEIVE PORT		OUTPUTS SEND PORT		NOTES	CDDC801	CDDC803
CDIF801/AA	8-LEVEL PARALLEL	2 to 4	NONE	0	1,2	YES	NO
CDIF803/BG	8-LEVEL PARALLEL	2 to 4	8-LEVEL SERIAL 100 WPM 110 BAUD	1	1,2,3	YES	NO
CDIF805/BM	8-LEVEL SERIAL 1200 W/M 1200 BAUD	1	8-LEVEL SERIAL 1200 W/M 1200 BAUD	1	1,4,5	YES	NO
CDIF806/BN	5-LEVEL PARALLEL	1	8-LEVEL SERIAL 150 WPM 150 BAUD	2	1,3,6,7,8	YES	NO
CDIF806/BP	5-LEVEL PARALLEL	1	8-LEVEL SERIAL 100 WPM 110 BAUD	2	1,3,6,7,8	YES	NO
CDIF806/BQ	5-LEVEL PARALLEL	1	5-LEVEL SERIAL 100 WPM 75 BAUD	1	1,3,6,8,9	YES	NO
CDIF806/BS	5-LEVEL PARALLEL	1	NONE	0	1,6	YES	NO
CDIF806/BT	NONE	0	8-LEVEL SERIAL 150 WPM 150 BAUD	2	1,3,7,8	YES	NO
CDIF806/BU	NONE	0	8-LEVEL SERIAL 100 WPM 110 BAUD	2	1,3,7,8	YES	NO
CDIF806/BV	NONE	0	5-LEVEL SERIAL 100 WPM 75 BAUD	1	1,3,8,9	YES	NO

CDT INTERFACE MODULES (Continued)

CDIF INTERFACE MODULES (OPTIONAL)					COMPATIBLE WITH CDT DISPLAY CONTROLLER		
UNIT CODE	INPUTS RECEIVE PORT		OUTPUTS SEND PORT		NOTES	CDDC801	CDDC803
CDIF808/BW	8-LEVEL PARALLEL	2 to 4	5-LEVEL SERIAL 100 WPM 75 BAUD	1	1,3,9	YES	NO
CDIF810/BZ	8-LEVEL PARALLEL	2	8-LEVEL PARALLEL	1	1,10,11	NO	YES
CDIF814/CD	8-LEVEL SERIAL 3000 WPM 2400 BAUD SYNCHRONOUS	1	8-LEVEL SERIAL 3000 WPM 2400 BAUD SYNCHRONOUS	1	1,12,13,14 15,16	NO	YES

Notes:

General — Table A represents a general listing of available CDT terminal options using CDIF modules. For a more complete description of the features and options available, refer to the appropriate section for that module. All 5-level codes and 8-level codes in this table are compatible with Baudot and ASCII, respectively. Also, all 5-level and 8-level serial input or output signals are compatible to EIA (Electronic Industries Association) RS-232-C.

1. If provided: Receive port output is 8-level parallel (PTI to CDT). Transmit port input is 8-level parallel (PTI from CDT).
2. Receive port is operated in a noncontention arrangement.
3. Letters feed-out/null delete on transmit port.
4. Mode control (change to receive after transmit).
5. Vertical parity checked on received data (overwrite character option for errored characters).
6. Up to six characters substitution to alter 5-level to 8-level conversion.
7. Dual serial output (1-data set, 1-local receiver).
8. Contacts available to indicate if serial output channel is inoperative.
9. Up to six characters substitution to alter 8- to 5-level code conversion.
10. Provides a "back-up" system for central processor unit (CPU) (magnetic tape transceiver is used to simulate CPU operation in Series 2550 Cluster Controller arrangements).
11. Provides error and mode control of CDT equipped with magnetic tape transceiver (supervisory CDT).

TABLE A
CDT INTERFACE MODULES (Continued)

CDIF INTERFACE MODULES (OPTIONAL)	COMPATIBLE WITH CDT DISPLAY CONTROLLER
<p>12. Provides 8-level parallel output to external buffer module CDBU804 with provision for local hard copy.</p> <p>13. Provides CDT with station control for operation in multipoint systems.</p> <p>14. Designed for use with 201 type data sets.</p> <p>15. Provides station identification and generation, format checking, error checking and control, with parity option on send/receive.</p> <p>16. Provides separate station identification and on-line data transfer (through CDBU804) to local Model 37 teletypewriter or from CDT terminal.</p>	

TABLE B — OPTIONAL BUFFER MODULES

CODE	BUFFER CHARACTERISTICS
CDBU801	Provides a single character buffer storage channel for use with CDT set (2000 to 12,000 character capacity).
CDBU802	Provides dual character buffer storage channels for use on send and receive side of CDT set (2000 to 6000 character storage per channel).
CDBU803	Provides large capacity character buffer storage channels for CDT set (2000 to 20,000 character capacity). Module is housed in roll-up buffer set.
CDBU804	Provides a single character buffer storage channel (2000 to 4000 character capacity) for the auxiliary receive port of the CDIF814 interface module with error control operation to hard copy auxiliary receiver. Used in CDT station controller arrangements.

7. ACCESSORIES

AUXILIARY BUFFER SET

7.01 The auxiliary buffer set provides storage of up to 20,000 characters input and/or 20,000 characters output. The set comes in its own cabinet and is styled to complement the CDT.

INDEPENDENT BUFFER SET

7.02 The independent buffer set provides for reception, storage, and retransmission of up to 20,000 characters of information. It can house an optional interface module if desired. The independent buffer set is described in Section 578-140-100. The set comes in its own cabinet that is styled to complement the CDT.

HIGH SPEED DX READER

7.03 A high speed DX reader can be used as a read-in device to insert data contained on punched paper tape into a CDT for editing or checking prior to transmission. The tape reader can be either table mounted, or by use of an adapter kit it may be mounted on a customer provided 19-inch relay rack.

7.04 Electronic logic for the DX reader unit is contained on the reader base and it provides the necessary PTI signal interface for driving the CDT input. Cabling between the CDT and reader is not provided. However, cable recommendations and termination information is provided with the equipment.

HIGH SPEED DRPE PUNCH

7.05 A high speed DRPE punch can be used to transform the output of a CDT into a punched tape. The DRPE punch set can be either rack mounted or table mounted.