intel®

intellec® mds-crt keyboard display

SERVICE
MANUAL

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TABLE OF CONTENTS

SECTION I
GENERAL INFORMATION

SECTION II
OPERATION

SECTION III
INSTALLATION

SECTION IV — THEORY OF OPERATION

SECTION V
MAINTENANCE

SECTION VI
DIAGRAMS

SECTION VII
GLOSSARY OF TERMS

FIGURES

TABLES

Table 1-1. MDS-CRT Specifications

PHYSICAL SPECIFICATIONS

Dimensions:
Width	16.6 inches (421.6 mm)
Height	13.9 inches (353.0 mm)
Depth w/keyboard	21.4 inches (543.6 mm)
Depth less keyboard	1⁵.0 inches (381 mm)
Depth of keyboard only	9.8 inches (248.9 mm)

Weight:
Monitor	45 lbs (20.4 kg) approx.
Keyboard	8 lbs (3.6 kg) approx.

POWER REQUIREMENTS

Input Voltage Options:
117 V/230 V ± 10% 60 Hz
117 V/230 V ± 10% 50 Hz (optional)

Power Consumption:
130 watts (max.)

ENVIRONMENTAL SPECIFICATIONS

Altitude:
Sea Level to 10,000 ft. (operational)

Temperature:
Non-operating temperature -20°C to $+60^{\circ}$C (-4°F to $+140^{\circ}$F)
Operating temperature $+5^{\circ}$C to $+40^{\circ}$C ($+50^{\circ}$F to $+104^{\circ}$F)

BTU:
30 BTU/hr.

Humidity:
50% to 90% non-condensing

Vibration:
Shock in shipping container   Drop tested from 18 inches
Vibration   10 Hz to 55 Hz; .01 inch peak-to-peak

GENERAL SPECIFICATIONS

Display Size:
Standard   12" (304.8 mm) rectangular

Active Display Size:
Standard   6.5" x 8.4"
(165.1 mm x 213.4 mm) Approx.

Display Format:
Standard   25 lines of 80 characters

Table 1-1. MDS-CRT Specifications (continued)

Character Type: Standard	5 x 7 dot matrix (7 x 10 scan) Approximately .08 x .18 inch
Character Set:	64 upper case ASCII set
Cursor Type:	Non-destructive blinking double underscore
Cursor Controls:	Right, Left, Up, Down and Home
Erase Functions:	Clear memory Erase line· Erase to end of screen
Operation Modes:	LOCAL OFF-LINE
Transmission Modes:	HDX/FDX 10/11 bit asynchronous
Strapping Option:	External I/O clock (Times eight clock) Parity odd/even Parity check on/off 10/11 bit word
Communications Interface:	Per EIA Standard RS232C

Signal Characteristics:
    Transmit
        Mark
        Space
	
	−10 volts nominal
	+ 12 volts nominal

Receive
        Mark
        Space
	
	−3 to −25 volts
	+ 3 to + 25 volts

Transmission Rates: X 110 switch setting	 110, 220, 440, 880, 1760, 3520, and 7040 baud
X 150 switch setting	150, 300, 600, 1200, 2400, 4800 and 9600 baud

Transmission Code:
    Start bit
    Data bits
    Parity bit
    Stop bit
	
	1 bit
	7 bits USASCII
	1 bit
	1/2 bits

Baud Selection:	Switch selectable

Table 1-1. MDS-CRT Specifications (continued)

Refresh Rate:	50/60 Hz (Strap Selectable)
Display Memory:	MOS shift registers
Character Generation:	MOS ROM
Fuse Rating:	115 Volts 1.25 amp Slow Blow 230 Volts .7 amp Slow Blow

SECTION II
OPERATION

2-1. INTRODUCTION

2-2. This section provides basic operating instructions for the MDS-CRT Computer Terminal. To operate this terminal efficiently, the operator should be familiar with the instructions contained in this section and the computer program with which he will converse. The MDS-CRT terminal should be properly installed in accordance with the procedures outlined in Section III of this manual.

2-3. OPERATOR CONTROLS AND INDICATORS

2-4. The keyboard is illustrated in Figure 2-1. Rear panel controls are shown in Figure 2-2. Table 2-1 describes the functions of the keyboard controls and indicators and Table 2-2 describes the functions of the rear panel controls. Operation of any key on the keyboard causes either character codes, control codes, or function codes to be generated. The keycaps are engraved as alphanumeric keys, control keys, and escape keys. All escape sequence keys are indicated by the red legend on the key. The sequence of operation is to depress the escape key followed by the desired legend key to perform the desired escape sequence (Refer to Table 2-1.). The sequence of operation for performing a control function is to depress the CTRL and second (code) key simultaneously (e.g., CTRL and G to sound bell).

The cursor control keys perform their respective function only after the code generated by the key is transmitted to the remote computer, converted to an escape sequence (e.g., ESC, A is up, ESC, C is right, etc.) and sent back to the terminal for action. If the terminal is Local mode, these keys do not function.

The bell is used to direct the attention of the operator to a particular condition of the terminal. The bell sounds: (a) each time the cursor reaches the 70th character location on each line, (b) at the 80th character location on a line when the cursor is wrapped backward to the previous line, (c) when a CTRL-G is performed at the keyboard, (d) on receipt of a CTRL-G, and (e) when terminal is turned on.
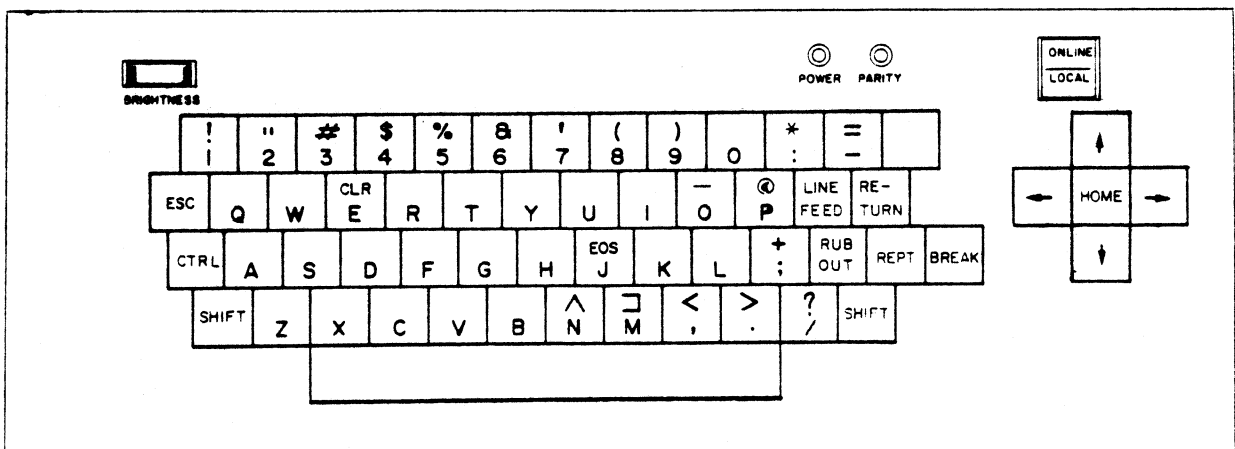
Figure 2-1. Keyboard

2-1
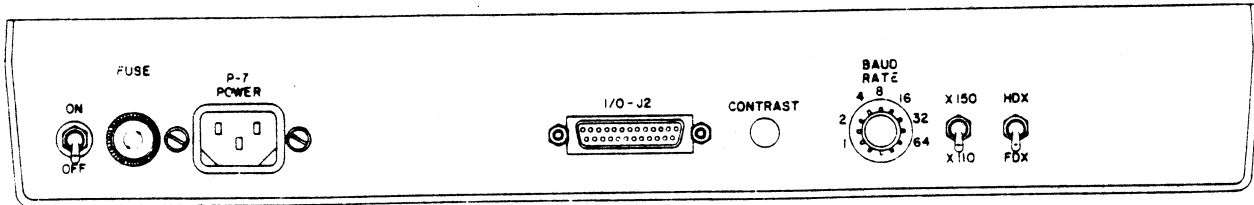
Figure 2-2. Rear Control Panel

Table 2-1. MDS-CRT **Computer Terminal Keyboard, Controls and Indicators**

FUNCTION	DESCRIPTION
Alphabetical and numerical keys, SHIFT, and space bar.	Generate character codes corresponding to letter, number, or symbol engraved on key. The keyboard layout is similar to a standard Model 33 TTY.
ESC (Escape) key	Generates the initial code in an escape code sequence.
↑ (Cursor Up) or Escape, A	Repositions the cursor up one line in same column as previously located. If the cursor is on the first line, it will wrap around to the bottom line (unless strapped to scroll on a cursor down, in which case the display scrolls one line at a time, and the first line of memory is lost).
↓ (Cursor Down) or Escape, B	Repositions the cursor down one line in same column as previously located. If the cursor is on the last line, it will wrap around to the top line.
→ (Cursor Right) or Escape, C	Repositions the cursor one character location to the right. If the cursor is located in the last character position of a line, it will reposition to the first character position of the next line. If the cursor is located in the last character location of the display, it will reposition to its home position (unless strapped to scroll when at end of memory, in which case the display scrolls one line, erasing the first line, and the cursor is located in the first character location of the newly opened up last line).

Table 2-1 (continued)

FUNCTION	DESCRIPTION
← (Cursor Left) or Escape, D	Repositions the cursor one character location to the left. If the cursor is located in the first character position of a line, it will reposition to the last character position of the preceding line. If the cursor is located in the home position, it will reposition to the last display character location.
CLR (Clear) or Escape, E	Fills all memory locations with space codes and cursor moves to the home position.
HOME Escape, H	Repositions the cursor to first character location of the memory. Contents of the memory are not altered.
EOS (Erase to End of Screen) Escape, J	Fills all memory locations on the line where the cursor is located to the end of the screen, with space codes.
EL (Erase Line) Escape, K	Fills all memory locations of the line where the cursor is located with space codes.
CTRL (Control) key	When used in conjunction with any alpha key, the code structure of the alpha key is changed by forcing the seventh bit to zero. This allows operation of the control codes assigned to Column One and Two of the ASCII Code Chart shown in Figure 2-3.
Bell Control - G	Causes the audio alarm to sound.
Back Space Control - H	Repositions the cursor one character position to the left. If the cursor is located in the first character position of a line, it will reposition to the last character position of the preceding line. If the cursor is located in the home position, it will reposition to the last display character location.
LINE FEED Control - J	Repositions the cursor one line down in the same column. If the cursor is located on the bottom line, the cursor will remain stationary and the entire display will scroll up one line leaving the bottom line blank. The top line is lost.
RETURN Control - M	Repositions the cursor to first character location of the current line.
BRIGHTNESS control	Adjusts the brightness level of the video display. Reference para 2-6b
ON LINE/LOCAL	Selects either ON LINE or LOCAL operating mode. Refer to para 2-10.

Table 2-1 (continued)

FUNCTION	DESCRIPTION
POWER indicator	Lit when power is applied to unit.
Parity Error indicator	Lit by a parity error and reset to off by depressing any key on the keyboard, with the exception of the break key.
BREAK	When depressed, a 500 millisecond (approx) one-shot signal is transmitted, advising the computer of a break in transmission. The terminal does not react to this key.
REPT repeat	Depression of the REPT key causes the alpha numeric and control codes to be repeated, entered into memory, and performed and/or displayed.

Table 2-2. MDS-CRT Computer-Terminal Rear Panel, Controls

CONTROL OR CONNECTOR	DEFINITION
HDX/FDX switch	Selects half-duplex (HDX) or full-duplex (FDX) operation. During FDX operation, data characters generated by the keyboard are routed to the I/O but not stored in memory or displayed. During HDX operation, the data characters are stored in memory, displayed, and routed to the I/O.
X150/X110 switch	Multiplies baud rate selected by BAUD RATE switch by either 150 or 110.
BAUD RATE switch	Selects basic baud rate to be multiplied by 110 or 150.
CONTRAST control	Adjusts the contrast level of the video display
I/O J2 connector	Provides data source interface with the terminal.
P7 POWER connector	Provides AC power input to the terminal.
FUSE	Protects terminal from power overloads.
ON/OFF switch	Applies AC power to the terminal.

Figure 2-3. ASCII Code Chart

	CONTROL CHARACTERS		DISPLAYABLE CHARACTER						ESCAPE SEQUENCE					
BIT 765 → 4321	000	001	010	011	100	101	110	111	010	011	100	101	110	111
0000	NUL (@)	DLE (P)	SP	0	@	P								
0001	SOH (A)	DC1 (Q)	!	1	A	Q					** ↑ (A)			
0010	STX (B)	DC2 (R)	"	2	B	R					** ↓ (B)			
0011	ETX (C)	DC3 (S)	#	3	C	S					** → (C)			
0100	EOT (D)	* DC4 (T)	$	4	D	T					← (D)			
0101	ENQ (E)	NAK (U)	%	5	E	U					** CLR (E)			
0110	ACK (F)	SYN (V)	&	6	F	V								
0111	BEL (G)	ETB (W)	'	7	G	W								
1000	BS (H)	CAN (X)	(	8	H	X					** HOME (H)			
1001	HT (I)	EM (Y)	)	9	I	Y								
1010	LF (J)	SUB (Z)	*	:	J	Z					EOS (J)			
1011	VT (K)	ESC	+	;	K	[					EL (K)			
1100	FF (L)	* FS ↓	,	<	L	\								
1101	CR (M)	* GS HOME	–	=	M	]								
1110	SO (N)	* RS ↑	.	>	N	∧								
1111	SI (O)	* US ←	/	?	O	–								

Note:
1. Lower case code will display upper case characters on MDS-CRT
2. MDS-CRT will initiate all control codes, But act on only those specified in Table 2-1
3. ▒ Shaded blocks = control functions MDS-CRT will react to. Others can be generated but are ignored upon receipt.

* Code as sent by terminal to computer.

** Code as received from computer for action by terminal

2-5

2-5. INITIAL TURN ON PROCEDURE

2-6. The proper turn-on procedure for the terminal is as follows:

a. Set the rear panel ON/OFF power switch to ON. Ensure that the power on light illuminates and allow a warm-up period of approximately five minutes.

b. Turn BRIGHTNESS control (located on keyboard) clockwise until a raster is faintly visible on the screen. Turn contrast adjustment (located through access hole, rear panel) until a blinking cursor appears in the home position. Write several different characters on the screen and turn the brightness control counter-clockwise until the raster scan lines disappear from the screen. Then adjust the contrast adjustment until the displayed characters are sharp and provide the operator with maximum eye comfort and then clear the screen. The contrast adjustment should be performed by technical personnel.

2-7. OPERATOR CHECKOUT PROCEDURE

2-8. To test the functional capabilities of the terminal, actuate the keys and ensure that the observed display agrees with the functions listed in Table 2-1 in the local mode. •

2-9. OPERATING MODES

2-10. The MDS-CRT terminal operates in one of two modes, Local and On-Line. During LOCAL operation, characters entered from the keyboard are stored in the terminal memory and displayed, but are not communicated to the I/O port. Characters received at the I/O port are ignored. During ON-LINE operation, characters entered from the keyboard are transmitted from the I/O port as they are entered. If operated in half duplex (HDX), the characters are stored in the memory and displayed as they are transmitted. When operated in full duplex (FDX), the characters are transmitted to the I/O port only, and are stored in the memory and displayed if a remotely connected data source echoes each transmitted code. This technique provides the operator with a character-by-character check to ensure that the terminal transmission was correctly received by the data source. Proper utilization of the terminal can only be achieved if operated in the INTEL system in FDX (e.g., Cursor Control keys).

2-11. MEMORY AND DISPLAY ORGANIZATION

2-12. The memory has 2000 displayable character locations and is in line oriented organization where characters are stored in the memory on a line basis. The line always has 80 characters. The lines in the memory are organized on a page basis where 25 lines make up one page.

2-13. The memory location where characters are stored is marked by the cursor. Character codes already entered can be replaced by a space or any other code. Scroll condition occurs when any attempt is made to write beyond the end of the display. The display scrolls up one line at a time as a line is filled. The data in the first line is lost. Scroll is strap selectable to occur when a Cursor Down or Line Feed function occurs on the last line or when the 80th character of the last line is overwritten.

2-14. RECEIVING AND TRANSMITTING DATA

2-15. Two conditions are required for the MDS-CRT to receive and react to incoming data. The terminal must be ON LINE and, if a modem or other device is interfaced which utilizes the RS232 circuit, CF (Received Line Signal Detector) must be in an "ON" condition. If not utilized by the modem, the CF line will float high, providing an "ON" condition. A parity error light is provided to indicate an error for the received data if the terminal is strapped for parity check. A check will be made according to the even/odd parity strap. The parity error light is reset when a key on the keyboard is depressed with the exception of the break key.

2-16. When the terminal is On Line and a key is depressed on the keyboard, the I/O will place circuit CA (Request-to-Send) in an "ON" condition. If a modem or other device interfaced to MDS-CRT utilizes circuit CB (Clear-to-Send), transmission of the keyed character will be ineffective until this line is in an "ON" condition. If not utilized by this modem, the CB line will float high, providing an "ON" condition. If Clear-to-Send is not used the data will be transmitted immediately. The parity bit position will be transmitted according to the even/odd parity strap. The MDS-CRT terminal affords serial asynchronous transmission and reception of data. Asynchronous word structure consists of a start bit, seven data bits, a parity bit and one or two stop bits depending on the configuration of the stop bit option strap (See Figure 2-4.).

DATA BITS

START BIT ... 2 LSB 3 4 5 6 7 8 MSB ... PARITY BIT STOP BIT STOP BIT START BIT

11 Bit word w/parity Bit

DATA BITS

START BIT ... 2 LSB 3 4 5 6 7 8 MSB ... PARITY BIT STOP BIT START BIT
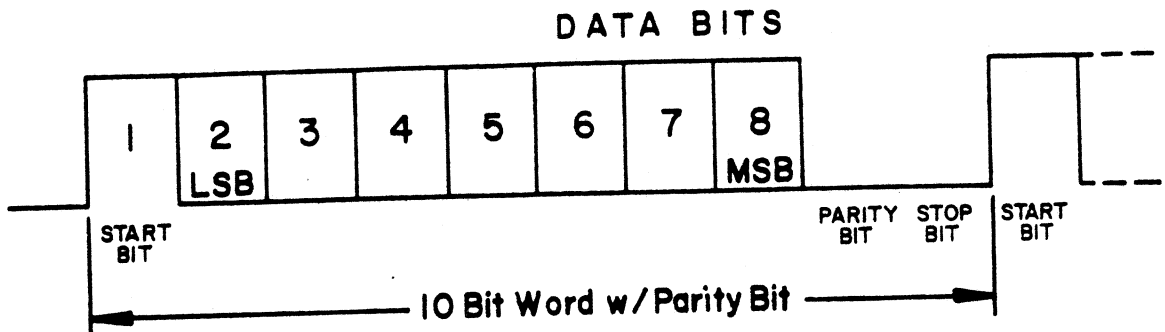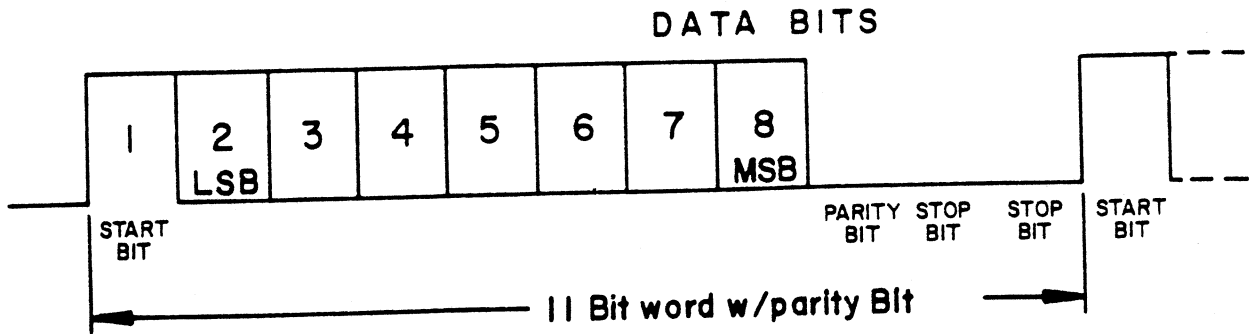
10 Bit Word w/Parity Bit

Figure 2-4. Input/Output Word Structure

SECTION III
INSTALLATION

3-1. INTRODUCTION

3-2.   This section contains information for un-
packing, initial inspection, connection of the com-
munications interface, physical placement of the
terminal, and preliminary selection of functional
control settings for the specific requirements of a
given user.

3-3. UNPACKING

3-4.   The MDS-CRT is ready for operation after
removal from its shipping container. There are no
tiedowns or packing materials inside the unit which
need to be removed. Store the carton for future
use during relocation or reshipment.

3-5. INSPECTION FOR IN-SHIPMENT DAMAGE

3-6.   The MDS-CRT is carefully inspected and
tested prior to shipment from the factory. Upon
receipt, carefully remove all components from the
shipping container and check each item against the
packing slip to ensure completeness of your order.
Visually inspect all items for any possible shipping
damage. All shipping containers have been custom
engineered to protect their contents and special
care has been taken to prevent damage under nor-
mal shipping conditions. Damage to the contents
should not occur unless the package has been mis-
handled. Mishandling should be evident upon in-
spection of the shipping container and, if damage
is found after visual inspection, care should be
taken not to destroy the evidence. Take pictures
of the damaged container and contact the trans-
port carrier as soon as possible.

3-7. PLACEMENT FOR OPERATION

CAUTION: The terminal relies on air flow
for cooling through its perforated bottom panel
and slots in the rear of the terminal case. There-
fore it is important that the terminal never be plac-
ed in a position where free air circulation is restrict-
ed. To maintain efficient air circulation, maintain
at least two inches of clearance at the rear and on
the sides of the terminal. Avoid placing the ter-
minal on plush carpet or on soft or spongy material
where the bottom plate might come in contact with
the mounting surface and shut off or restrict air
circulation.

3-8.   The MDS-CRT is fully self-contained and
can be moved and relocated to alternate operating
positions without removing or altering any hard
wiring. Select a convenient level surface and place
the terminal where the power cable and data I/O
cables will not be in the way of the operator.
Route the cables in such a manner that they will
not be inadvertently pulled, or disturbed by nearby
personnel. Rotate the terminal until it is conven-
iently oriented for operator viewing. The cable
which attaches the keyboard to the terminal is flex-
ible which allows the keyboard to be placed in al-
most any position within a 30-inch distance of the
viewed terminal.

3-9. DATA INTERFACE CONNECTION

3-10.   All data source interconnections are made
through the rear panel RS232C type I/O connector
J2. The I/O connector mates with ITT Cannon
solder pin connector, Part No. DM-25P or Amphe-
nol Part No. 17-20250-1. Table 3-1 contains a list
of pin assignments for I/O connector J2.

Table 3-1. Connector J2 Pin Assignments

Pin No.	Signal Description	RS232 Circuit	Signal in	Signal out
1	Frame Ground	AA		
2	Transmitted Data	BA		→
3	Received Data	BB	←	
4	Request to Send	CA		→
5	Clear to Send	CB	←	
7	Signal Ground	AB		
8	Received Line Signal Det.	CF	←	
11	+ 5 Volt Output	–		→
16	X8 Terminal Data Clock (TTL Level) (Strap Selectable)	*		→
18	+15 Volt Output	–		→
20	Data Terminal Ready	CD		→
25	–12 Volt Output	–		→

* Not RS232 (Optional)

The terminal interface complies with the electrical requirements of RS232. All voltages are measured at the connecter with respect to AB. The output line delivers between -12v and +15v into a resistance of 3000 ohm. The input circuit will respond to voltages between 3v and 25v. Pins 11, 18, and 25 deliver DC voltages to drive an optional external Current Loop Module.

Frame Ground (AA)

This conductor, where used, is electrically bonded to the machine frame.

Transmitted Data (BA)

This circuit transfers data from the terminal to the data set for transmission to the external device. The terminal holds circuit BA in the mark condition during any-time interval between characters or words, or when no signals are to be transmitted.

Received Data (BB)

This circuit transfers data from the data set to the terminal. Signals on this circuit are generated by the data set in response to data signals received from the external device. The data set holds this line in the mark condition when the line is idle or the carrier is not detected.

Request To Send (CA)

Signals on this circuit are generated by the terminal to condition the local data set to transmit. The "on" condition is maintained whenever the terminal has information ready for transmission or being transmitted. The terminal transmits data on circuit BA (Transmitted Data) only when the "on" condition is maintained on circuits CA, CB and CD. In half-duplex service, the "off" conditions holds data set in the Receive Data condition, and the "on" condition holds the data set in the Transmit Data condition.

Clear To send (CB)

Signals on this circuit are generated by the data set to indicate that it is prepared to transmit data. The "on" condition on circuit CA (Request to Send) is delayed as long as may be required to establish a connection to a external device. If CB is not used but allowed to float, CB will go high and create an "ON" condition.

Signal Ground (AB)

This conductor established the common ground reference for all interface lines.

Data Terminal Ready (CD)

Data Terminal Ready is high whenever the terminal power is on.

Received Line Signal Detector (CF)

The signal on this line indicates that the data set has established the carrier and the data set is about to input data to the terminal. If CF is not used, but allowed to float, CF will float high and create an "ON" condition.

X 8 Clock

An internal clock signal is available (at TTL levels) on pin 16 of the I/O connector. This clock is 8 times the baud rate of the MDS-CRT terminal and allows a computer or modem to use these signals for its external clock.

3-11. SPECIAL PRECAUTIONS

CAUTION: If the terminal is to be operated in conjunction with a data phone or data modem, special care should be taken to ensure that the interfaces are per EIA Specification RS232C. The logic levels required by this specification may cause serious damage to communication interfaces designed strictly for standard DTL or TTL integrated circuit logic levels. The same precaution should be made when connecting hard wire to any communications I/O. Pins 11-18, and 25 are DC power outputs. Refer to Table 3-1 when connecting to the I/O Port.

WARNING: To protect operating personnel, this unit is equipped with a detachable, three-conductor, shielded power cable that grounds the unit. The unit should be operated only with this or a similar type grounded power cable.

CAUTION: Some MDS-CRT Terminals are now equipped with power supplies manufactured by AC DC and Lambda. Each power supply configuration has a specific VAC power source requirement which is determined at the factory at the time of assembly. Therefore, terminals equipped with either of these power supplies should not have the strapping changed on the power block as provided from the factory (see Figure 3-2).

3-12. REAR PANEL SWITCH SELECTIONS (Refer to Figure 2-2.)

Set rear panel switches as follows:

a. Set the HDX/FDX toggle switch to the desired mode of operation.

b. Set the BAUD RATE toggle switch and rotary switch in accordance with Table 2-2. The MDS-CRT will operate under any condition at 2400 baud or less with no timing considerations.

Certain functions require longer than one character time at high transmission rates. For example, when the memory scrolls as a result of a LF (line feed) code and the cursor is positioned on the bottom line, code fillers are required as follows: (Refer to Table 3-2.)

Table 3-2. Filler Codes

Function	Baud Rate	Number of Fillers 112-0620 Board	112-0686 Board
LF	9600	3	2
EL	9600	2	1
EOS	9600	2	1
CLEAR	9600	2	1
AUTO SCROLL:			
Cursor Down	9600	–	2
Last Char. of Mem.	9600	–	1

(Null codes are applicable from 4800 bps and over and include a 1 mill code pad.)

3-13. MDS-CRT LOGIC CARD STRAP SELECTION LOCATION

3-14. Refer to Figure 3-1 for location and strap selections. When no PARITY test is selected, the terminal output will be either even or odd as per the Even/Odd strap. The X8 clock strap applies a TTL signal to pin 16 of the RS 232C interface connector. This signal is eight time the baud rate frequency.

MDS-CRT Terminals equipped with the new Line Board (112-0686) also include various scrolling strapping options. These and all other strapping configurations are listed in Table 3-3. The terminal may be strapped to scroll on a LF only, or on LF and cursor down (↓), or on LF and upon reaching the last character of memory, or upon all of the above. The new board also includes a strap for selecting either a 50 or 60 Hz refresh rate and straps to make a 10 bit word with parity to the marking state.

Figure 3-1. MDS-CRT Logic Card Strap Selections

3-4

112-0686

Table 3-3. Strapping Options (112-0686 Line Board)

Part No. & Option	Delete	Add
112-0686-0000 25 Line Option	Jumpers: F, H, K, L, M, N, P Chips: A91 & A86 Meter: M1	Jumpers: J, I, G, O
112-0686-0001 25 Line Option with Elapsed Time Meter	Jumpers: H, K, F, P Chips: A91 & A86	Jumpers: I, J, L, M, N, G, O Meter: M1
112-0686-0002 12 Line Option	Jumpers: G, I, J, L, M, N, P Chips: A105 through A110, A103, A92 Resistors: R46-R51, R36, R37 Meter: M1	Jumpers: F, H, O and Pin 1 to Pin 5 on each of A105 through A110 Chips: A86 & A91
112-0686-0003 25 Line Option with 10 bit word parity to marking state.	Jumpers: F, H, K, O, L, M, N Chips: A91 & A86 Meter: M1	Jumpers: I, J, P, G
112-0686-0004 25 Line w/German Char.	Jumpers: F, H, K, L, M, N Chips: A91 & A86 Meter: M1	Jumpers: J, I, G, O Change Chip A95 to German Character Generator

Special Options	Delete	Add
1. 60 Hz Refresh rate		Jumper E
2. 50 Hz Refresh rate	Jumper E	
3. Scroll on LF only	Jumper B, A	Jumper D
4. Scroll on LF and ↓		Jumper A, B, and C to A88 side of D
5. Scroll on LF & last char.	Jumper B	Jumper A, D, C
6. Scroll on LF, last char. & ↓	Jumper C	Jumper A, B, D

Other Options	Delete	Add
X8 clock on J2-16 (TTL LEVEL)		Jumper: X8 clock
J2 completely RS232 Compatable	Jumper: X8 clock	
Check Parity	Jumper: N	Jumper: O
No Parity Check		Jumper: N, O
Odd Parity	Jumper: N	Jumper: K, O
Even Parity	Jumpers : N, K	Jumper: O
Transmit/Receiver Parity enable	Jumper: P	Jumper: O
10 Bit Word Parity to Marking State	Jumpers: O	Jumper: P

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION

4-2 This section contains the theory of operation for the MDS-CRT computer terminal.

4-3. GENERAL DISCUSSION

4-4. The MDS-CRT is a stand-alone CRT terminal shown in the detailed block diagram of Figure 4-1. The interaction of these blocks provide the capabilities of the terminal. Individual operation of these blocks is discussed in paragraphs 4-5 through 4-10. Figure 4-2 is a basic functional flow diagram of the MDS-CRT and shows the relationship of the major operations performed by the terminal.

4-5. POWER SUPPLY

4-6. The power supply block contains the necessary transforming, rectifying and solid state controlling circuitry to provide the other major assemblies, through the MDS-CRT LOGIC CARD, with the proper D.C. potentials for their operation.

4-7. MONITOR

4-8. The monitor block contains a 12" T.V. type CRT screen and its supporting solid state circuitry. The monitor is controlled by the vertical and horizontal synchronization signals developed on the MDS-CRT LOGIC CARD and the video output signal to produce a full screen of information consisting of 25 lines of 80 characters each.

4-9. KEYBOARD

4-10. The keyboard block contains the key switches and supporting solid state logic circuitry to generate the appropriate control signals and ASCII characters utilized in the MDS-CRT. It also contains indicators and receives signals for the indicators and logic circuitry from the MDS-CRT LOGIC CARD.

4-11. MDS-CRT LOGIC CARD

4-12. The main logic block consists of the major functioning and controlling circuits in the MDS-CRT. It receives the various output voltage from the POWER SUPPLY and distributes the proper voltages to their respective destinations in the other main assemblies and within itself. As a product of the timing and synchronization considerations, control signals are impressed upon the MONITOR to present an organized pictorial of the data under consideration. The MDS-CRT LOGIC CARD also receives 7 bit encoded data words and several control signals from the KEYBOARD, which it scrutinizes and then reacts accordingly. It also supplies the KEYBOARD with signals to control the operator monitored indicators. In addition, it controls the reception and transmission of data between the MDS-CRT and any external equipment.

4-13. UART (RECEIVER)

4-14. Data can be received by the MDS-CRT from one of two modes; from the EIA RS232C interface into the UART or from the Keyboard through the transmit side of the UART to the receive side of the UART. The interface has a clock which has the capability of transfer rates between 110 baud and 9600 baud. This is composed of an oscillator running at 1.6896 MHz into a counter which has a 110/150 switch. This goes into a counter which act as dividers to provide 16 times the I/0 rate. This clock is applied to the receive side of the UART and the UART has the circuitry to take the 16 times and baud rate and break it down to the baud rate. The EIA line receiver can receive data at EIA levels and gate them into the UART when the MDS-CRT is On-Line. Through the same gating, data is brought in from the transmit side
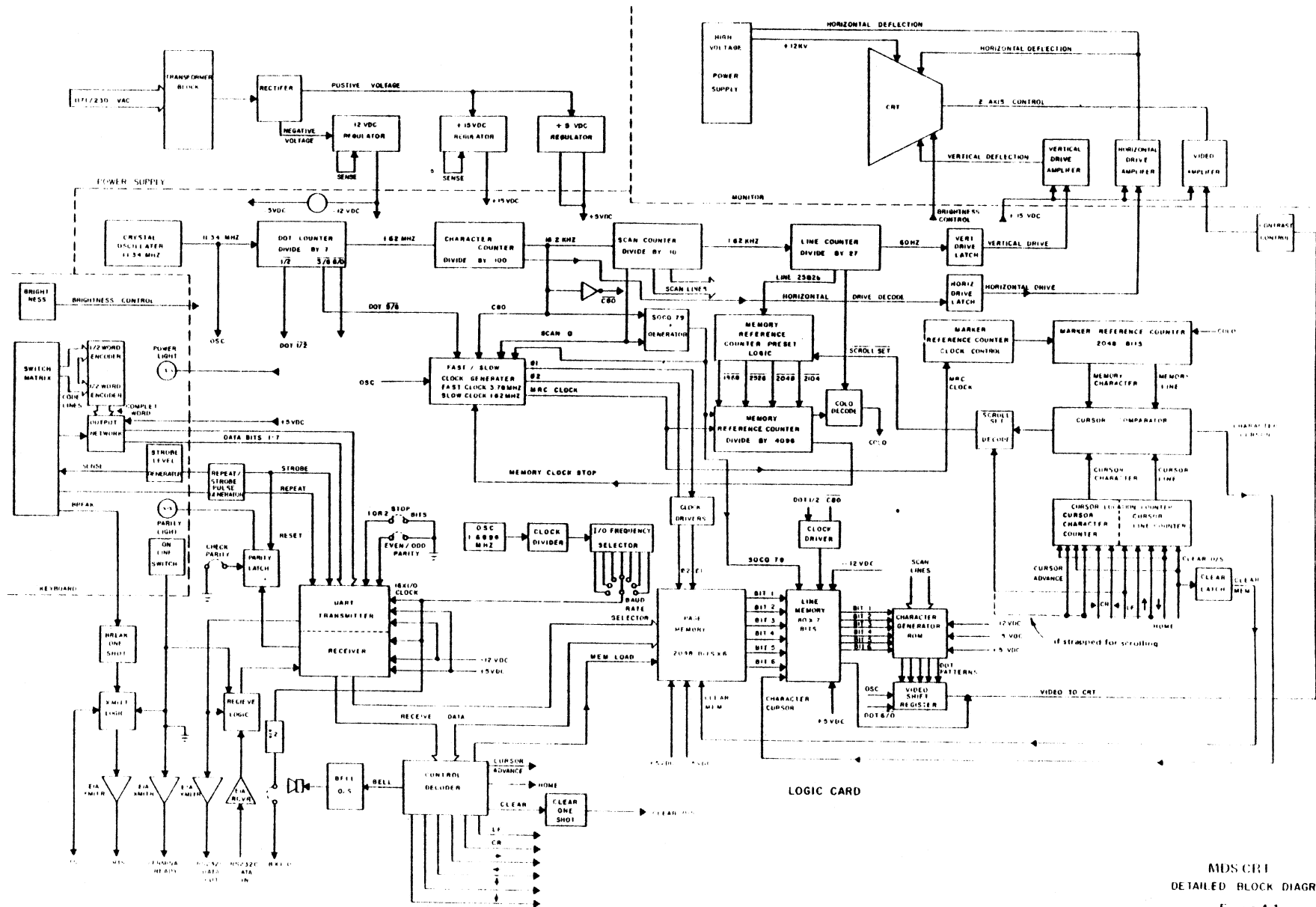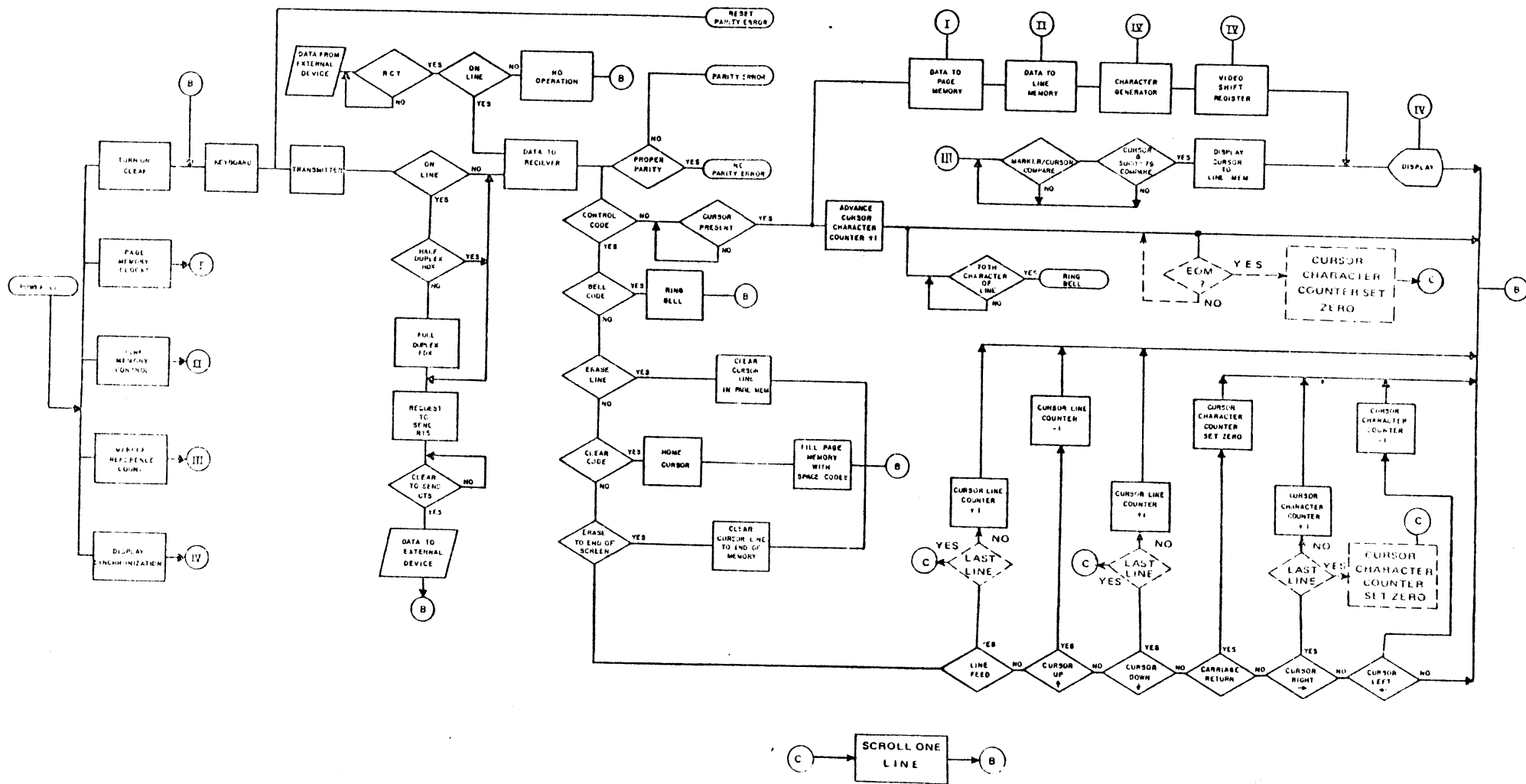
MDS CRT
DETAILED BLOCK DIAGRAM
Figure 4.1
4.2/4.3

Figure 4-2. Basic Functional Flow Diagram

- - - - - - Performed only if strapped for scrolling

of the UART. Also monitored through an EIA line receiver is the carrier detect from the modem. The data is brought into the UART and the UART converts it to parallel data on a data buss (seven bits). The UART also does VRC parity checks. The data from the data buss is applied to two points. It is applied to a series of decoders which decode the data to check if it is a control code or a printable character. It is applied first to the input of the Page Memory. If the data is a printable character, the associated circuitry generates the signal Mem Load. As the character is decoded, a Mem Load is generated as well as a Cursor Advance which makes the cursor move one character to the right.

4-15. UART (TRANSMIT)

The Keyboard data lines bit 1-7 are applied to the transmit side of UART. Also coming from the Keyboard is Keyboard Strobe and Keyboard Repeat which, together, enable the repeat oscillator which retriggers the UART and retransmits the character being generated. As the UART receives the character from the Key-

board, it performs the appropriate parity generation, considers one or two stop bits for a 10- or 11-bit word, and, by having a 16 times the baud rate clock applied to it, breaks down the clock and transmits the character. The character is applied through an EIA RS232C interface to the computer. Also coming from the UART is output data at a TTL level which is applied to the receive side of the UART through the previously mentioned logic. Also generated to the EIA output interface is a Terminal Ready signal which indicates the status of the MDS-CRT to the computer and a Request to Send signal which indicates a desire to transmit data to the computer. The Clear to Send line coming from the computer is monitored at the EIA RS232 interface levels. It is received by a line receiver which converts it to TTL levels and applies it to the UART as a consideration for enabling transmission. The 16x baud rate clock is also applied to the computer interface and, if required, a clock which is at 8 times the baud rate (TLL levels). The BREAK key on the keyboard fires a one shot which holds the RS232 interface to a mark position for approximately 500 milliseconds.

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains information to aid in the maintenance of the MDS-CRT Terminal. Preventive and corrective maintenance procedures are specified as well as troubleshooting aids and techniques.

5-3. PREVENTIVE MAINTENANCE

5-4. There is no scheduled periodic maintenance; however, there are several things that could be done should the need arise.

5-5. Care should be exercised to see that there is proper air circulation for the fan. The unit should not be set on a shag carpet or other soft surface that could impede the air entrance to the fan. Also, the degree of dust density in the air should be considered because there is a possibility of foreign matter clogging up the fan filter. In the event that this should occur, the filter must be vacuumed out. The dust can be sucked out of the filter while still in the unit. In more severe instances, the fan filter can be replaced. This is done by first taking off the main cover of the unit, removing four screws, taking out the fan and filter guard, then the filter itself.

5-6. The non-glare CRT is highly scratch resistant and may be wiped clean with a soft cloth.

5-7. The interior of the unit may be wiped free of dust. Accumulation of dirt causes overheating and component breakdown. Dirt acts as an insulating blanket and prevents efficient heat dis-sipation. A small brush is very useful for dislodging dirt; a cotton-tipped applicator is good for narrow or hard to get places.

5-8. TROUBLESHOOTING AIDS

- Circuit Schematics
- Basic Block Diagram
- Interconnect Diagram
- Glossary of Terms
- Disassembly/Assembly Procedures
- Adjustment Procedures
- ASCII Code Sheet
- Configuration/Strapping Information
- Character Dot Matrix

5-10. TROUBLESHOOTING EQUIPMENT

5-11. The following is a list of tools and standard equipment required to repair a MDS-CRT terminal:

- V/O Multimeter
- Oscilloscope
- Assorted Electronic Hand Tools

5-12   FULL DUPLEX ECHOPLEX TEST

5-13.   A specially wired connector may be assembled which mates with J2 (See Figure 5-1). This connector tester allows the terminal to be operated and tested independent of an external data device. The basic set-up for the test is as follows:·

- FDX (Full Duplex Mode)

- On-line

- Baud Rate - Any Setting

Enter data from the keyboard as you would if you were on-line to a computer. If data is displayed on the screen properly, then the MDS-CRT is transmitting and receiving data properly.
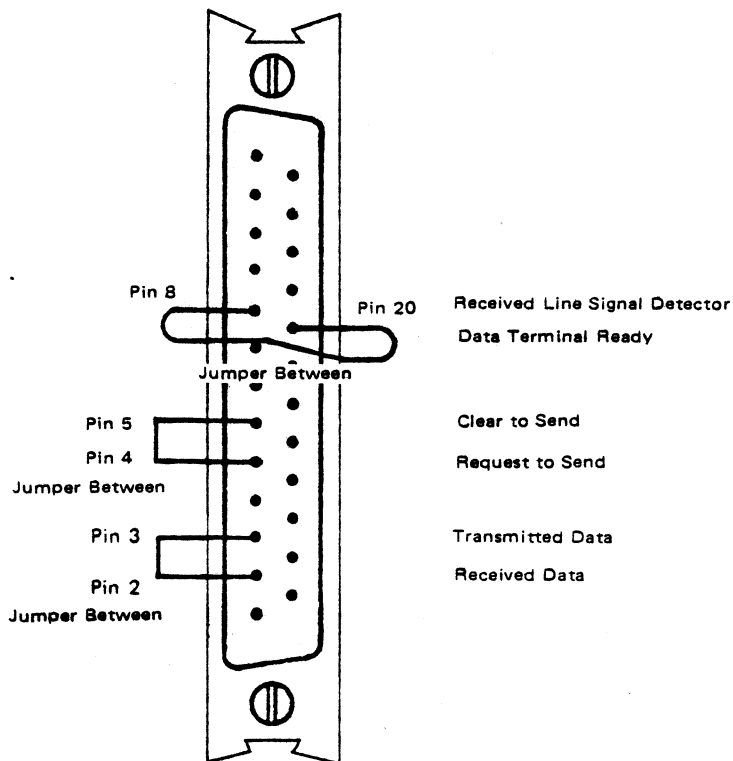
Amphenol Male Type
Connector

Amphenol Part No. 17-20250-1

Figure 5-1
ECHOPLEX TEST CONNECTOR

The test connector is wired as follows: (Refer to Figure 5-1.)

- Connects Transmitted Data Line out of the terminal to received data line into the terminal. Pin 2 to Pin 3 of J2

- Connects Request to Send control line out of the terminal to Clear-to-send line into the terminal Pin 4 to Pin 5 of J2

- Connects Receive Line Signal Detector line into Data Terminal Ready. Pin 8 to Pin 20 of J2

5-14.   CORRECTIVE MAINTENANCE

5-15.   This section provides corrective maintenance information to aid in servicing the MDS-CRT terminal. It is suggested that the configuration sheet and the turn-on procedure be consulted before performing the corrective maintenance described here.

5-16.   TROUBLESHOOTING PRELIMINARY CONSIDERATIONS

5-17.   The most common problems occuring in MDS-CRT are switch, control, and operation-related. A simple procedure may be followed to help determine if the problem is control and/or operation-related or internal circuitry related by checking the following:

- Illegal Operation (Refer Section II)

- Improper Baud Rate Setting

- Wrong Transmit or Receive Mode (HDX/FDX)

- Loose Interconnect Cable

NOTE: Because the POWER SUPPLY output voltages may affect the terminal in various ways, manifesting itself differently each time, it is suggested that the output voltages be verified good in accordance with the POWER SUPPLY adjustment procedures.

5-18. POWER SUPPLY ADJUSTMENTS

The MDS-CRT is produced using power supplies manufactured by various companies. Some power supply units do not require adjustment. All are the same in form, fit and function. Adjustment of applicable power supply units are monitored by connecting a volt meter at the test points (A through D) indicated on Figure 5-2. Adjustments should be made to assure the output levels are as follows:

Nominal	Minimum	Maximum
-12	-11.8	-12.1
+15	+14.8	+15.2
+5	+ 4.8	+ 5.2

CAUTION: Remove the AC power cord from the terminal before proceding with any internal adjustments.

Supplied in this section is a written description with drawings of the AC DC and Lambda power supplies. Instructions for changing the voltage and refresh rates are included for service personnel only.

5 -19 CHANGE AC VOLTAGE TO 115 VAC OR 230 VAC

Voltages supplied with the terminal are either 115 VAC or 230 VAC. This voltage can be changed to either of the above voltages by rearranging the straps in the Power Supply Terminal Block. The Terminal Block is located on the bottom of the chassis (refer to figure 5-3). The terminal's metal case must first be removed, then locate the Terminal Block warning cover (see figure 5-3), and remove the cover. Figure 5-3 shows the placement of the straps for the appropriate voltages.

5-20. CHANGE THE 50/60 Hz REFRESH RATE

The 50 or 60 Hz refresh rate can be changed by inserting a jumper at the appropriate point on the Logic Card.

Remove the metal case and pull the Logic Card (see figure 5-3). The jumper is connected at point E for 60 Hz refresh rate and is deleted for the 50 Hz refresh rate (see figure 5-2). The refresh rate adjustment is independent of any voltage adjustment and the technician should check to see that this rate conforms to the local power requirements.

5-21. CHANGE AC VOLTAGE to 100 VAC or 200 VAC

NOTE: To change the terminal Power Supply to 100 or 200 VAC, requires technical experience and should not be attempted by operating personnel.

The terminal Power Block should first be adjusted to the corresponding voltage, i.e., 115 VAC for the 100 VAC input, and 230 VAC for the 200 VAC input. To change the Power Supply to 100 or 200 VAC, two wires in the transformer's primary winding must be cut and resoldered as shown from the following diagram (see figure 5-4). This completes the procedure.

5-22. THEORY OF OPERATION

These two Power Supply assemblies are similar in basic operation as shown in Figure 5. Each power supply unit supplies three DC voltages required for terminal operation. The unit outputs three voltages with a total DC power out of 75.5 watts; +5VDC at 7 amps, +15 VDC at 1.5 amps and − 12 VDC at 1.5 amps. A 115 VAC output is supplied on pin 2 of the input connector and another 115 VAC output is supplied on the AC output connector.

The AC voltage enters the transformer, is changed in voltage and isolated by the transformer which supplies AC voltage to the regulators. The AC voltage is DC rectified and filtered. The regulator section regulates the applicable voltage to meet output levels as described above. The three output voltages require no adjustment or maintenance.

The DC Voltage regulation should remain within $\pm$1% for a $\pm$10% input voltage change and within $\pm$1% for a load increase from 50% to 100%. The +5 VDC requires remote sensing for regulation. With the remote sensing disconnected, the +5 VDC will not be accurate. The ripple voltage should not exceed 2 mv rms and 20 mv peak-to-peak. These Power Supply units do not have temperature or over voltage protection. Overload protection, however, is provided on each DC voltage output as follows
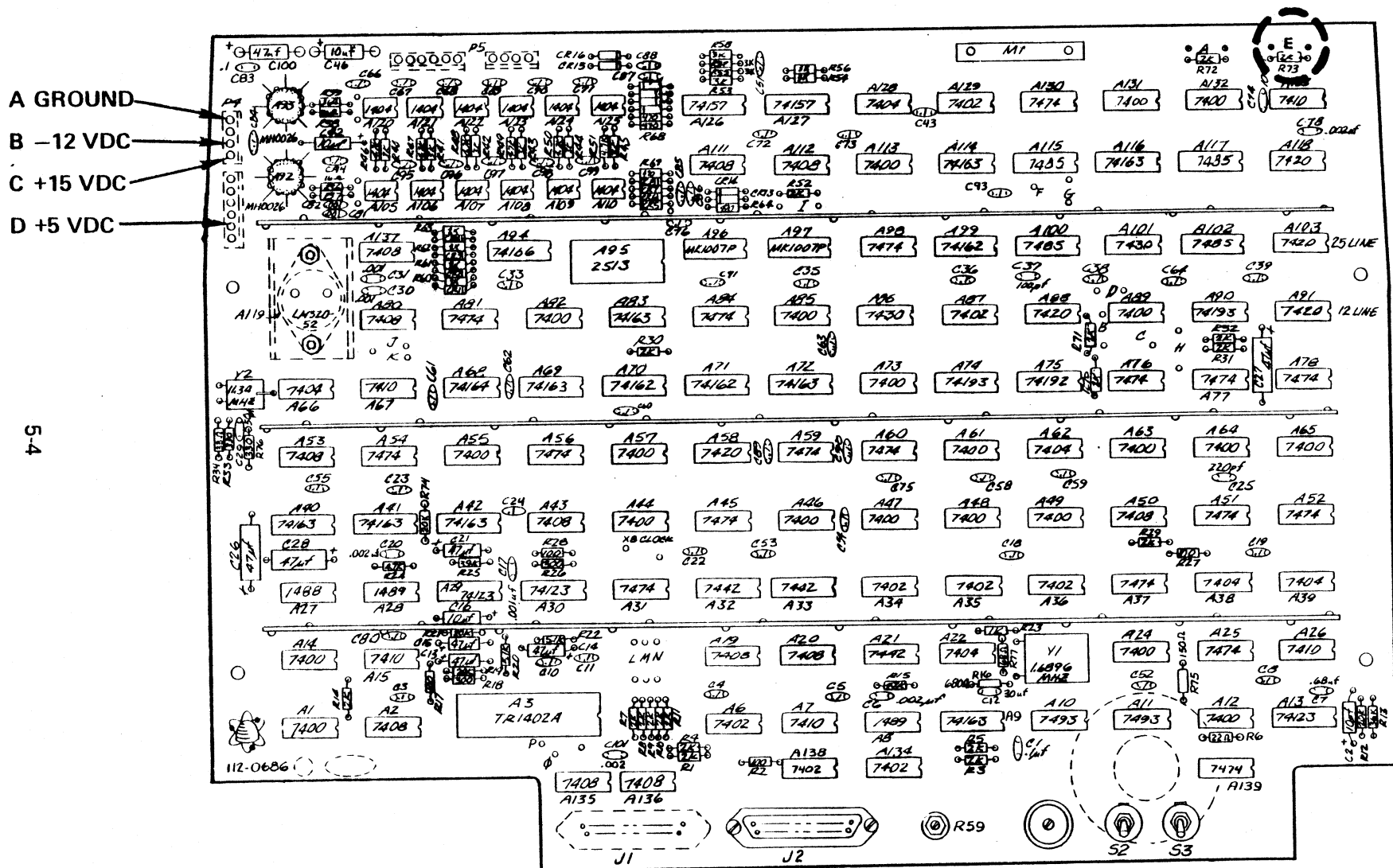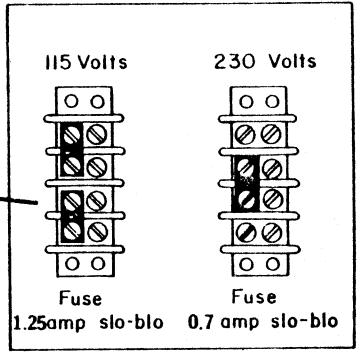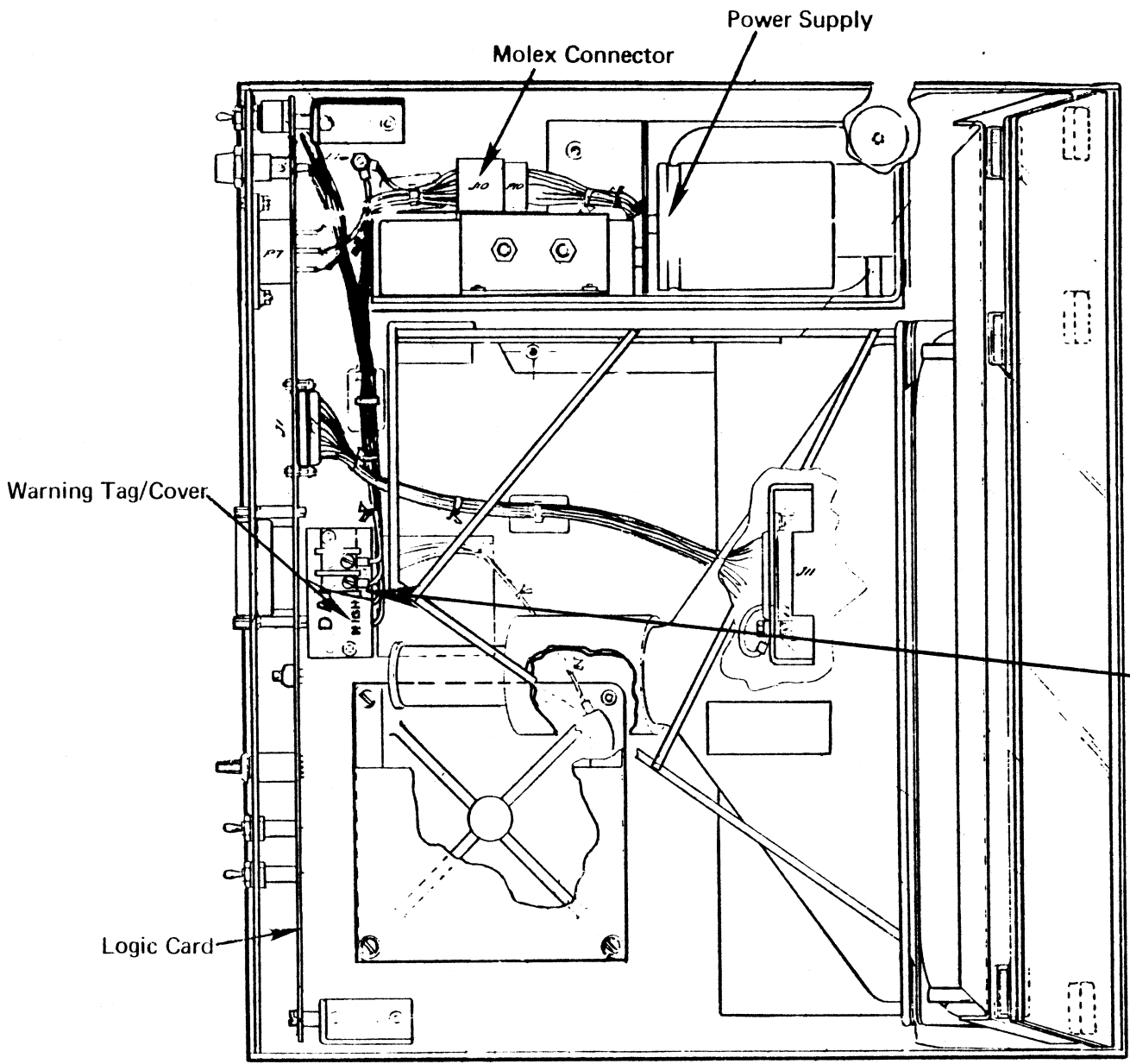
Figure 5-2. MDS-CRT Logic Card 112-0686

Power Supply

Molex Connector

Warning Tag/Cover

Logic Card

Chassis Top View

115 Volts	230 Volts
Fuse 1.25amp slo-blo	Fuse 0.7 amp slo-blo

TERMINAL BLOCK
DO NOT ALTER STRAPPING
DANGER
HIGH VOLTAGE

WARNING STICKER

Figure 5-3. Terminal Block Location & Strapping Configuration

Output Voltage	Current Limit Minimum	Maximum
+5.0V	8.0 amp	10.5 amp
+15.0V	1.7 amp	2.1 amp
−12.0V	1.7 amp	2.1 amp

Two configurations of the AC DC unit are supplied: 610-0333-0000 is a 115 VAC, 60 Hz. intended for domestic use only; 610-0333-0001 is strappable for 100, 115, 200 or 230 VAC, 47 to 66 Hz and is intended for export or domestic use as required.

The Lambda Power Supply unit 112-0858-0001 is strappable for 100 or 115 or 200 or 230 VAC, 47 to 63 Hz.

The AC/DC and Lambda Power Supply units do not require adjustment. These units are factory adjusted and tailored to output the proper voltages. Should the units fail, they should be returned to Beehive for servicing.

NOTE: Schematics for Lambda and AC DC are contained in section VI of this manual.
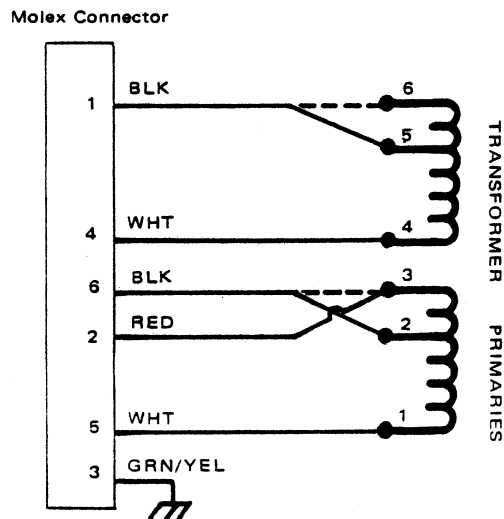
Molex Connector

Soldering the black wire from pin 1 (Molex Connector) to tap 5 of the transformer primary, and the black wire from pin 6 (Molex Connector) to tap 2 of the transformer primary, changes the voltage to 100/200 VAC.
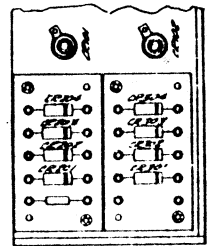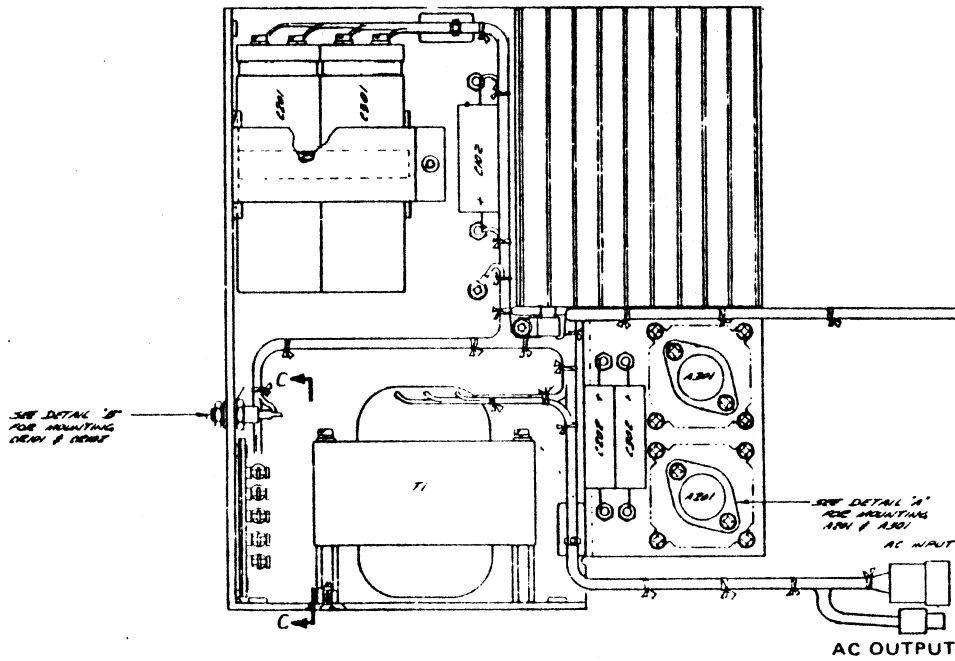
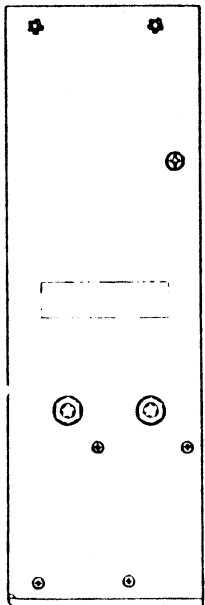Figure 5-4. Tap Changes on Transformer Primary Winding
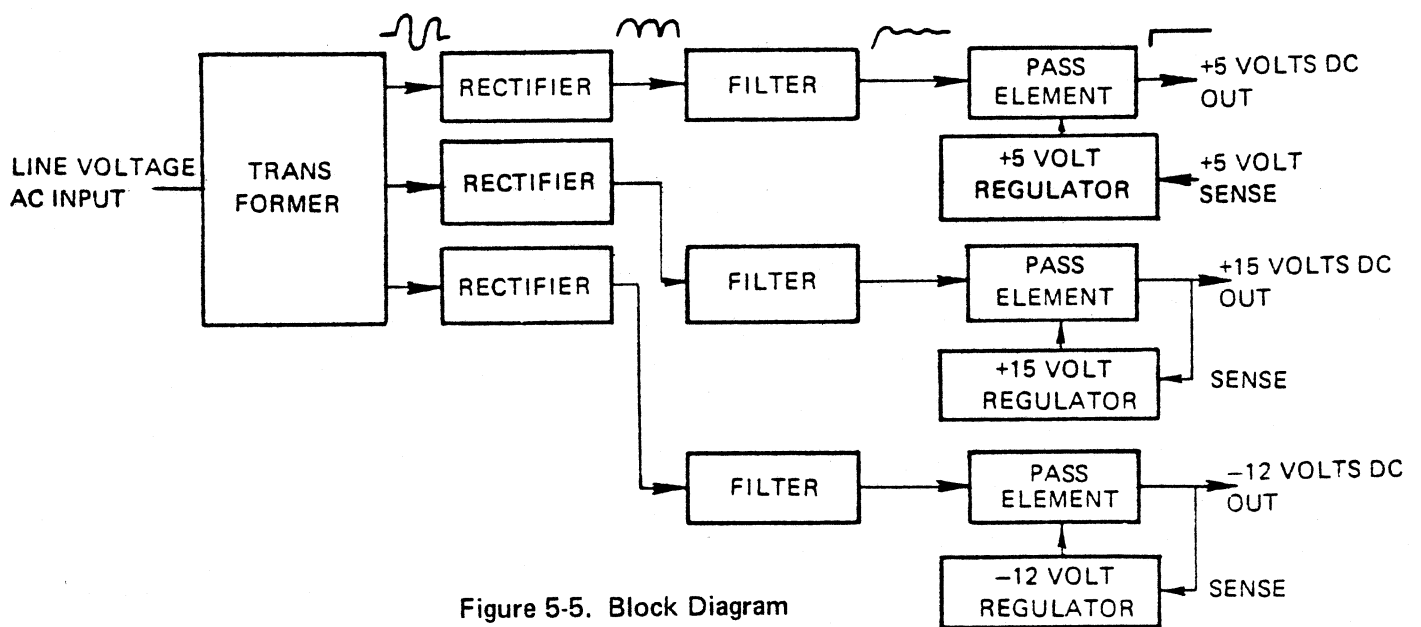
Figure 5-5. Block Diagram
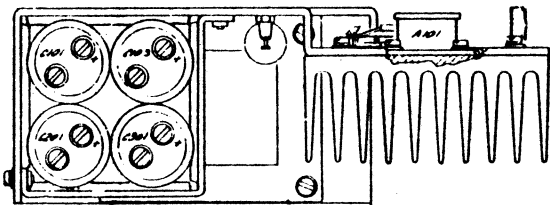
5-6

Figure 5-5A. Lambda Power Supply Assembly Drawing

Lambda Power Supply (112-0858)

Figure 5-5B. AC DC Power Supply Assembly Drawing

C2

C6

C11 C6

CR3 CR4

T1

1 3 2 4

DC OUTPUT

AC INPUT

AC OUTPUT
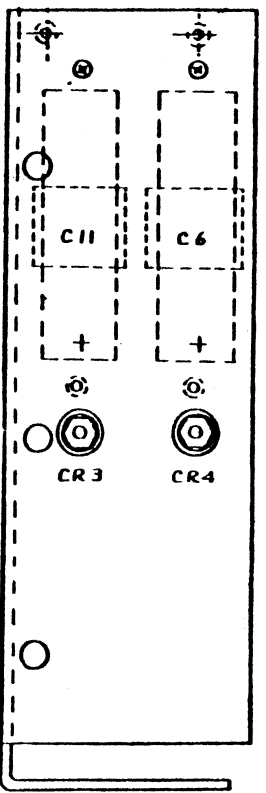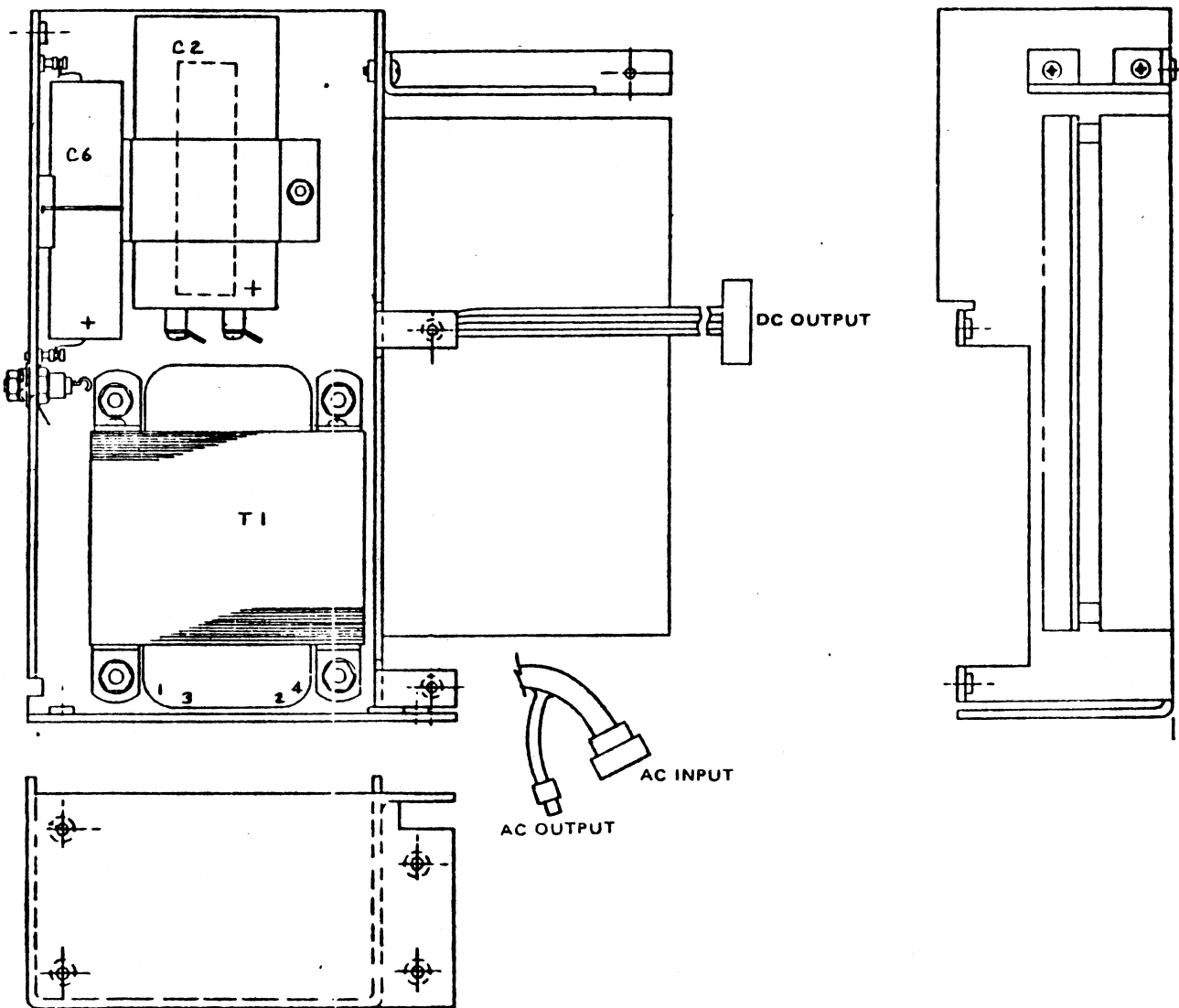
ACDC Power Supply Assembly (610-0333)

5-23. MONITOR ADJUSTMENTS

The following adjustments should be made while the monitor is in the MDS-CRT terminal. The adjustments described here are in reference to Figures 5-6 and 5-7 consist of the following sections:

- BRIGHTNESS

- CONTRAST

- VERTICAL ADJUSTMENTS

- HORIZONTAL ADJUSTMENTS

- FOCUS

- CENTERING

Figure 5-6 shows the location of the MONITOR PC board, CRT and shield cone. Figure 5-7 shows the physical location of the specific adjustments on the MONITOR PC board. Figure 5-8 shows the CRT mounted adjustments.

WARNING: The MONITOR employs high voltages. Care should be used in making any adjustments as power will be applied to the MONITOR and could be dangerous to the operator. Care should be taken to determine that all leads are secure before attempting to adjust the MONITOR.

The BRIGHTNESS control (located on the MDS-CRT KEYBOARD assy) should be positioned to a point where the white raster on the CRT is extinguished.

The vertical frequency control R 116 Figure 5 7 is set to approximately its mechanical mid-point initially. This adjustment will correct for a rolling display and should be adjusted to correct that symptom alone. No discrete measurement is necessary, except for a visual observation as to the steadiness of the display.

Fill the screen of the CRT with characters from the KEYBOARD (i.e., all E's). The CONTRAST control is located on the Logic Board. Adjustment access is gained through the opening in the back panel marked CONTRAST. Using a screwdriver, adjust the CONTRAST control for the sharpest display in the upper left hand side of the screen

Fill the screen once again with characters, if none exist. The vertical height control R 124, Figure 5-7 , should be adjusted for 6.5 inches from the top of the characters on the first row to the bottom of the characters on the last row.

The vertical linearity control Figure 5-7 should be adjusted so the characters on the first row are equally as tall as the characters on the last row. Their height should be approximately 0.18 inches.

If the screen is blank, fill it with a character and adjust the horizontal width coil L 101 Fig. 5-7 for 8.4 inches from the left margin to the right margin of the displayed characters.

If BRIGHTNESS or CONTRAST controls are turned up too high, focus can be distorted. Adjust the FOCUS control R 107 Figure 5-7 for the best over-all display focus. It may be necessary to readjust the CONTRAST control and repeat this step.

Adjustment relative to focus, centering and linearity require separating the two halves of the tube shield or removal of the tube shield from the CRT. The tube shield causes the display size to be compressed. The size of the display may be adjusted to size after removal and replacement of the shield. The horizontal linearity is adjusted to correct for the compression of the display on the left-hand side of the screen. To correct this, loosen the clamp securing the yoke and slide the cardboard or mylar sleeve (horizontal linearity sleeve), refer Figure 5-8 (point D) in or out to give uniform width to the characters on the right and left-hand borders of the display.

Centering of the display is accomplished by rotating the tabbed ring magnets on the CRT behind the deflection yoke, refer to Figure 5-8 points A and B. If the display as a whole is tilted, correction may be accomplished by rotating the entire yoke, point C.

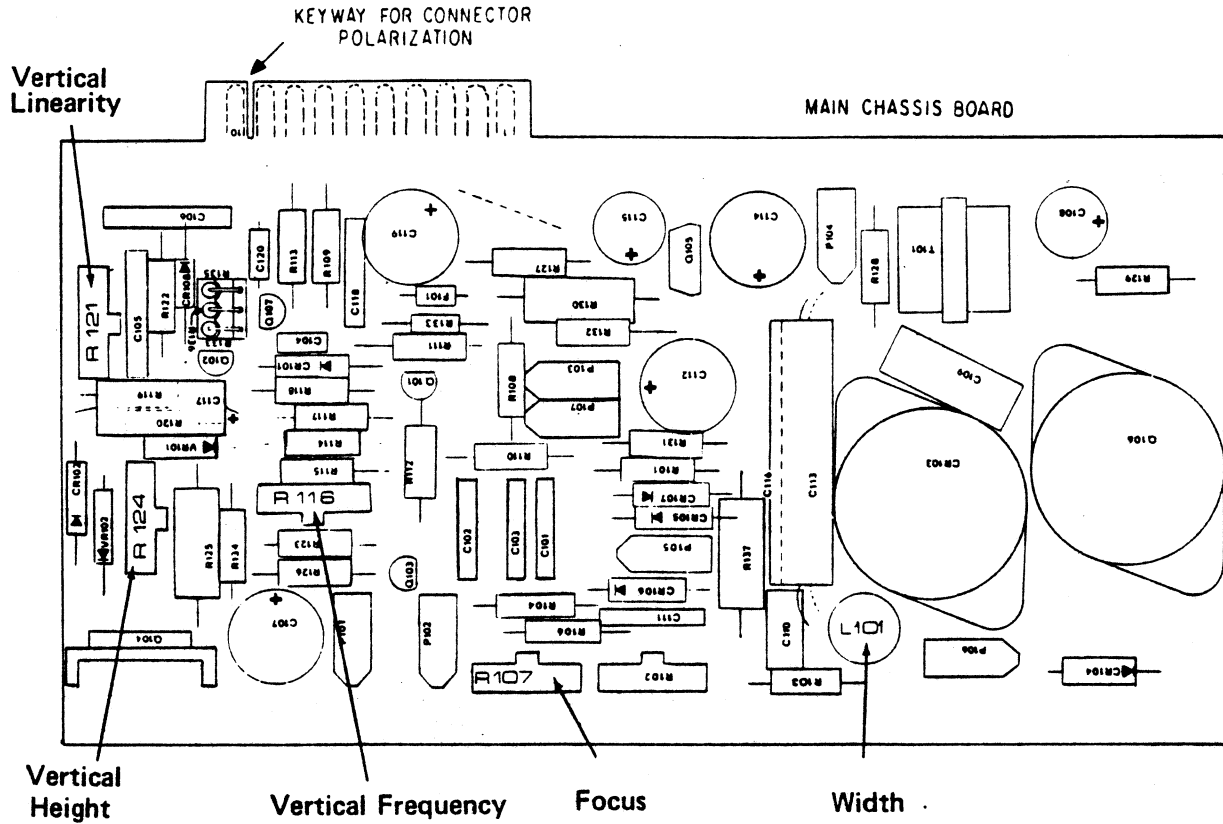FIOI AND RIO8 ARE USED ONLY WHEN LOW VOLTAGE POWER SUPPLY IS NOT SUPPLIED

KEYWAY FOR CONNECTOR
POLARIZATION

Vertical
Linearity

MAIN CHASSIS BOARD

Vertical
Height

Vertical Frequency   Focus   Width

Figure 5-7   Monitor P.C. Card Adjustments

P.C. Board

Vertical Linearity

Width

Vertical Height

CRT
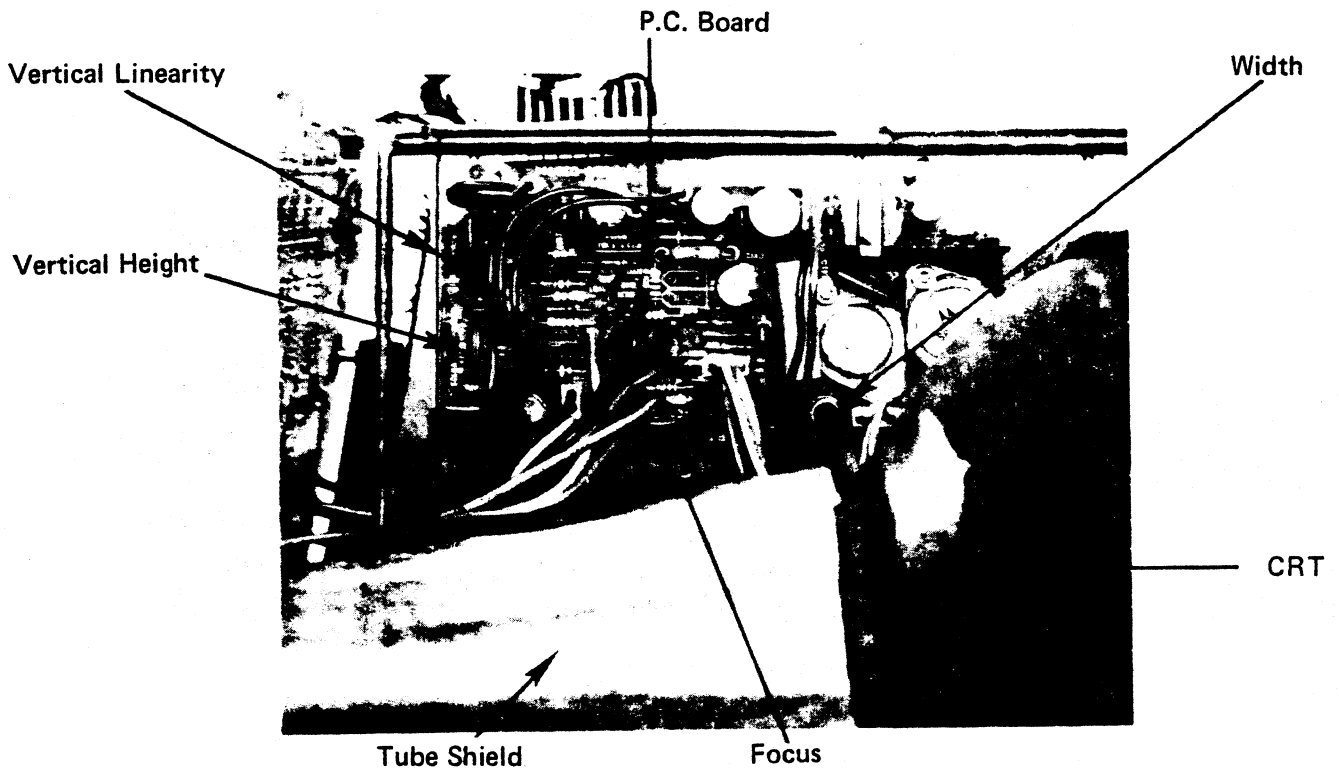
Tube Shield   Focus

Figure 5-6   Monitor PC Board, CRT and Tube Shield

C YOKE

A

B

CENTERING
RING MAGNETS

E FOCUSING
MAGNETS

HORIZONTAL LINEARITY
D SLEEVE (MYLAR OR CARDBOARD)
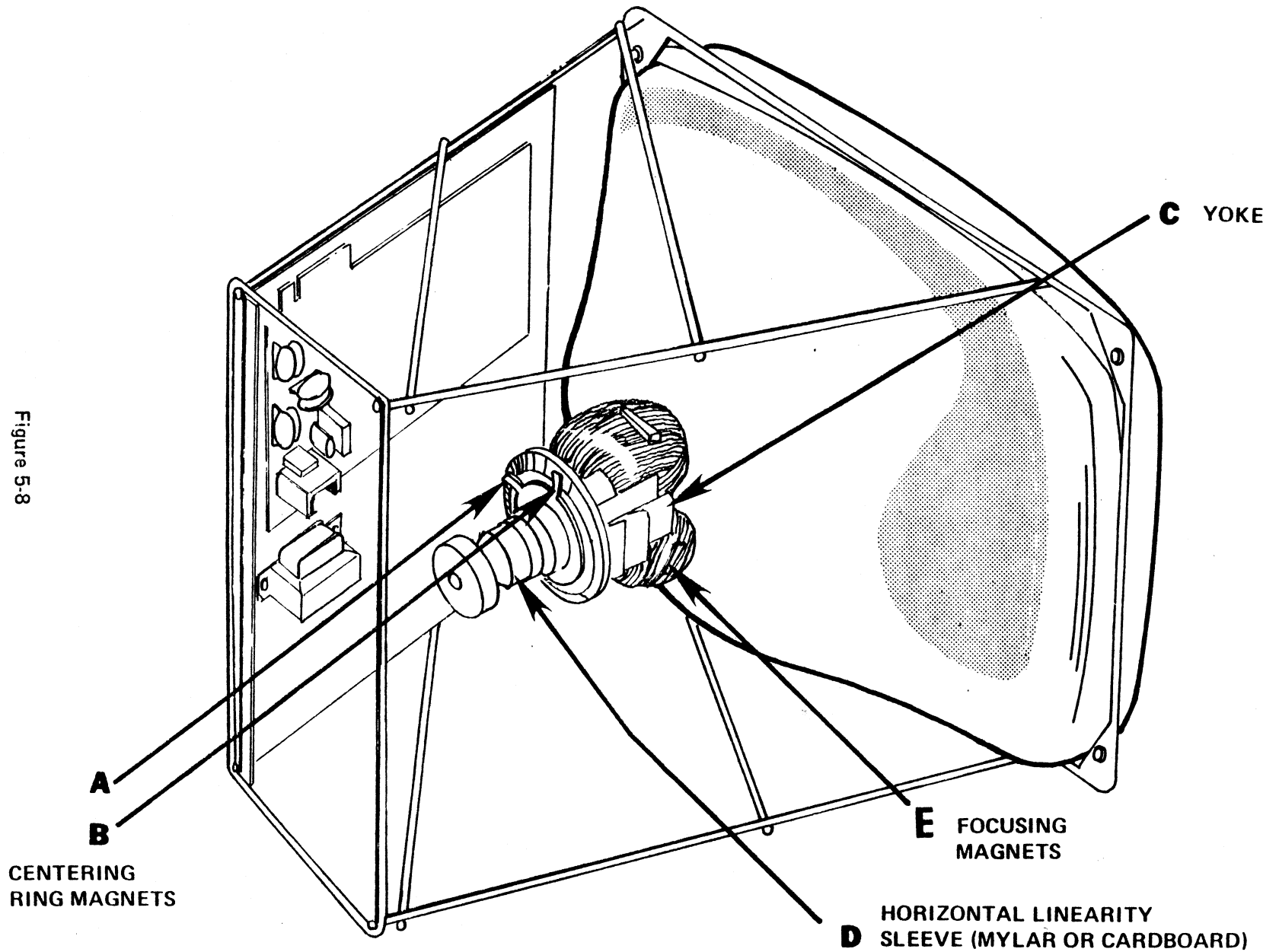
Monitor Yoke Adjustments

Figure 5-8

Replacement of the yoke or CRT may cause problems with adjustment of the display which require the installation of small ceramic bar magnets, The vertical and horizontal linearity, vertical, height, horizontal width, and focus adjustment should be checked first. Then if the actual display is not square, with straight lines and sharp corners, additional adjustment using the magnets will be required. If the MONITOR has a number of magnets already in place and the display is still not square, these magnets may need to be removed and adjustment rechecked before proceeding.

Place a small magnet on the flared end of the yoke coil near the CRT (see Figure 5-8 , point E). Note the effect the magnet exerts on the display. Alignment of the magnet with or against the magnetic field will cause the line or corner to move up or down. Move the magnet around the CRT until the best possible alignment is achieved. Additional magnets or various sized magnets may be required to correct a single distortion problem or other problems on the display. When the number, size and location of the magnets has been determined, RTV adesive is used to secure the magnet(s) in position.

5-24. KEYBOARD ADJUSTMENT

The keyboard contains the MONITOR BRIGHTNESS control.

The keyboard requires no other adjustment.

5-25. MDS-CRT LOGIC CARD

The LOGIC CARD includes the MONITOR CONTRAST adjustment control. The only other adjustable components on the MDS-CRT LOGIC CARD are associated with the specific operation to be performed by the MDS-CRT terminal, i.e., baud rate.

5-26. REMOVAL AND REPLACEMENT PROCEDURES FOR THE MDS-CRT TERMINAL

The procedures presented here are disassembly steps. To assemble the MDS-CRT these procedures should be executed in the reverse order.

WARNING: These procedures should not be attempted with any electrical power connected, or terminal circuits energized.

5-27. REMOVAL OF THE OUTER COVER

The outer cover, or skin has six flat head no. 6 screws holding it to the lower base assembly; three on the right and three on the left.

a.   Remove the six screws to free the outer covering.

b.   Lift the upper shell up and off the terminal.

5-28. REMOVAL OF THE POWER SUPPLY

The removal procedure for the all power supply designs is the same. With the cover removed:

a.   Remove the J4 connector on the upper left hand corner of the MDS-CRT LOGIC CARD. This is accomplished by placing the tip of a standard screw driver in the gap between the logi card and the connector and prying the connector off. (Use caution not to break the connector.)

b.   Disconnect the connector (P10) that connects to the AC power outlet and is located in the rear, bottom left-hand corner of the terminal near the power supply.

c.   Tip the terminal on its side so the power supply is at the bottom.

d   Remove the front bottom foot.

e.   Remove the three large (No. 10) bolts located on the bottom that secure the POWER SUPPLY to the terminal base (see Figure 5-10).

f.   Lift the terminal away from the power supply.

WARNING: The power supply is very heavy and care must be taken not to allow it to fall away from the terminal.

5-29. REMOVAL OF THE KEYBOARD P.C. CARD

Care must be used in removing the P.C. card to prevent damage to the components.

a.   Unplug the keyboard from the terminal.

b.   Tip the keyboard upside down on a protected surface (i.e.mat, carpet, etc.). You will find three large holes on the bottom front edge of the keyboard.

c.   Remove the nuts located in the holes and lift the front of the keyboard housing up. The keyboard insert assembly should fall away from the housing. If not, push it through by pushing it with a small screw driver from the center hole on
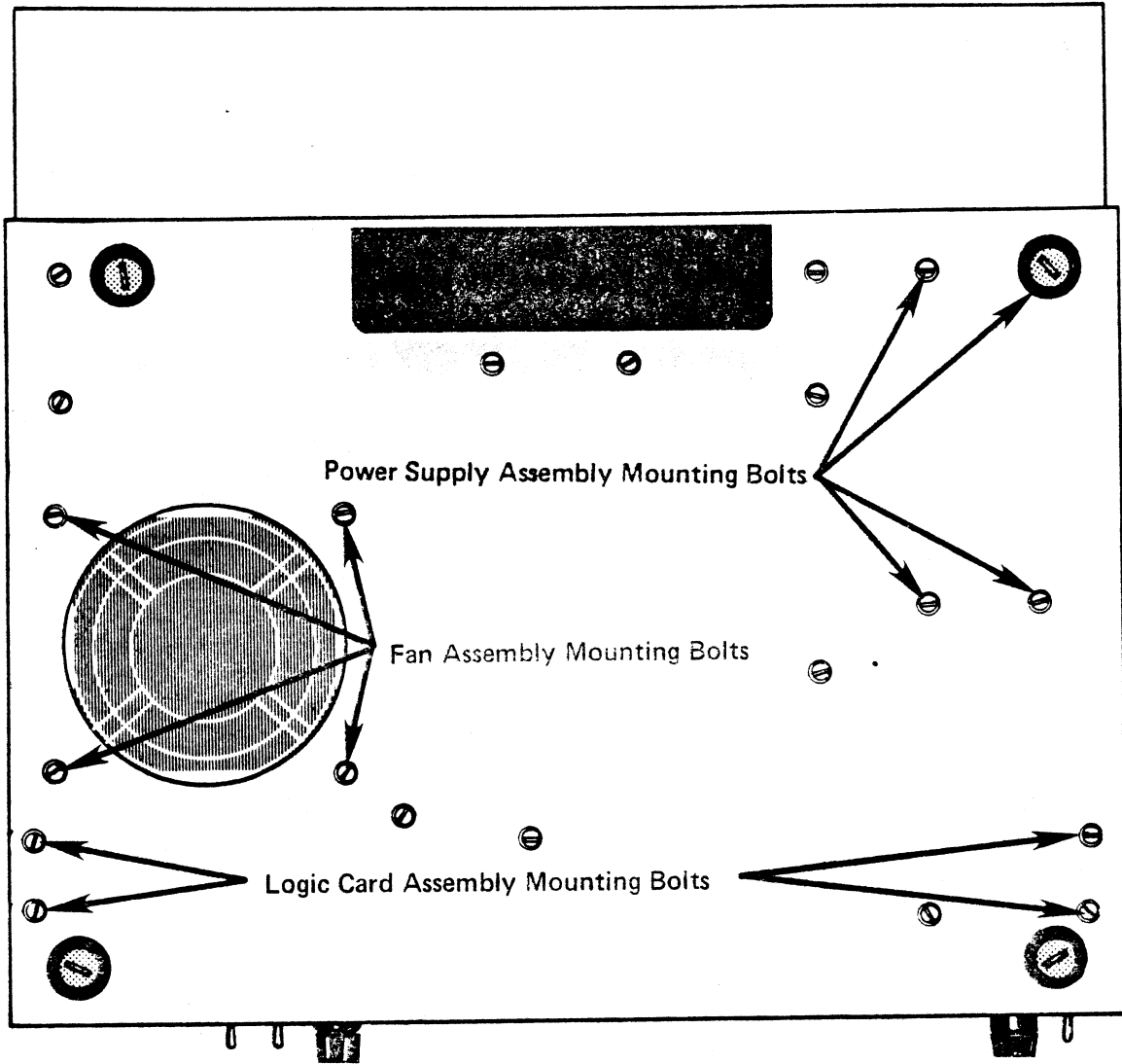
Power Supply Assembly Mounting Bolts

Fan Assembly Mounting Bolts

Logic Card Assembly Mounting Bolts

Figure 5-10

the bottom side.

d. Turn the keyboard right side up and com-pletely remove the keyboard insert assembly.

e. Remove the connector in the left hand cor-ner of the keyboard P.C. assembly.

f. Remove the four nuts and washers securing the P.C. card to the keyboard insert assembly located on either side of the P.C. assembly.

g. Remove the P.C. assembly using care not to snag any of the wires or components.

Note: Care must be used not to lose spacers between P.C. assembly and insert.

h. Remove the two nuts and four washers attaching the BRIGHTNESS control to the key-board panel and remove the control.

i. With keyboard panel upside down, locate the bottoms of the LEDs. Using sharp instrument (e.g., small screwdriver, knife, etc.) gently pry the black collar up and off the LED mount. Squeeze LED mount edges together and press through holes.

j. Gently pull LED straight up and out of LED mount.

Note: For reassembly, the LED with 3 red leads is the POWER indicator (connect the black band on red, lead to cathode) and LED with one red and one green is the PARITY indicator (connect the green lead to cathode). Cathode of LED is indicated by notch in red case and double width leg.

k. With the keyboard panel upside down, cut the three leads to the ON-LINE/LOCAL switch.

Note: For reassembly, place the switch such that when looking at the bottom of the switch the "A" mark is on the left and the "2" is on the right. Run the three leads from the bottom through and out the top of the panel. After stripping the leads and adding 1/2 inch of shrink tube, solder leads to right side ("2" side) of the switch. Blue to the bottom (nearest you), black to center and black stripe on white on top.

l. Separate keyboard panel from keyboard assembly.

m. To remove the cable, turn the keyboard housing upside down, locate and remove six (No. 6) screws attaching cable housing to keyboard housing.

n. Pull cable out of cable housing.

o. Cut the cable tie attaching cable to cable housing.

p. Separate and remove cable from cable housing.

5-30 REMOVAL OF THE MONITOR

Use extreme caution in handling the MONITOR to prevent damage to the CRT tube neck and connector pins. Striking the face of the CRT or dropping the CRT may cause the tube to implode.

a. Remove the edge (J12) connector from the MONITOR P.C. card located on the top of the MONITOR assembly by removing the holding clamp at the end of the connector and pull the connector away. Look inside the edge (J12) connector and ensure the polarity key is intact and in position.

b. Remove the window assembly from the MDS-CRT by pulling it directly out from the terminal separating the hedlocks.

c. Remove the four bolts which connect the bezel frame to the MONITOR, remove the frame and spacers. Bolts should be retightened to secure the CRT to frame unless the tube is to be removed from the monitor assembly.

d. With the front of the terminal to your right, locate and remove two bolts in bottom edge of the MONITOR frame . These bolts attach the MONITOR to the MONITOR mount.

e. Lift the MONITOR directly away from the terminal.

5-31. REMOVAL OF TUBE SHIELD

Adjustment and centering of the display may require the removal of the tube shield.

Early models of MDS-CRT are equipped with a one-piece tube shield. Removal of the shield is as follows:

Note: If the shield is to be removed while the MONITOR is in the chassis, the LOGIC PC CARD must be removed first.

a. Remove the CRT pin connector.

b. Loosen the shield screws and slide shield off tube neck.

Later models of MDS-CRT use a tube shield consisting of two halves. Removal of the shield is described by the following steps:

a.   Loosen three screws along the top half edge of tube shield. (When reassembling, replace screws with heads out and away from MONITOR PC board.)

b.   Move half of tube shield out and down to expose CRT yoke and adjustments.

c.   To remove shield, remove screw attaching strap, and remove strap from monitor frame. Rotate shield around the CRT neck until free and remove.

5-32. REMOVAL OF MONITOR PC CARD

To remove the MONITOR PC CARD from the chassis:

a.   Disconnect the CRT pin connector.

b.   Disconnect the following connections from the board:
   (1) J-12 edge connector,
   (2) P104 - red and black, P105 - yellow, orange and green, P106 - red and blue, P101 - yellow and black, P102 - yellow and green.

Note: P107 and P103 are not used in this application.

c.   Disconnect 3 single pin connectors - all black.

d.   Place forefinger under edge of the PC card and lift until card is free of mounting pins.

e.   Remove PC board from chassis.

5-33. REMOVAL OF THE FAN

To remove the Fan Assembly:

a.   Position the terminal so the terminal is facing your right. (Terminal front to your right).

b.   Remove the four bolts holding the fan deflection cover to the fan housing.

c.   Disconnect fan cable from terminal block on early models or disconnect fan connector on later models.

d.   Turn Terminal on its side, and locate and remove four bolts attaching fan to base (see Figure 5-10).

e.   Turn Terminal right side up and remove fan housing, finger guard and screen.
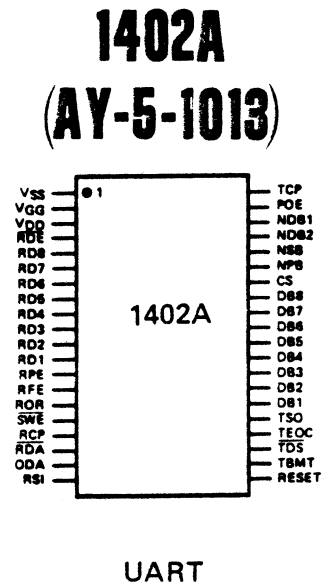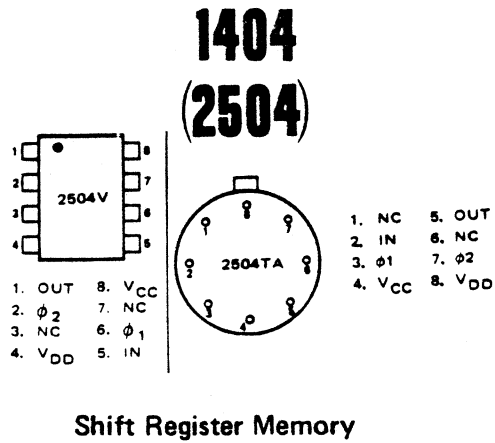
5-34. REMOVAL OF THE MDS-CRT LOGIC BOARD

When removing the LOGIC CARD, care must be used to protect the components on the board.

a.   Turn the terminal so the back is facing you.

b.   If fan has not been removed entirely and is necessary, remove the two outer bolts and the rear inner bolt that secures the fan to the terminal base leaving the remaining bolt to hold the fan to the terminal.

c.   Rotate the fan counter-clockwise.

d.   Disconnect the P5 connector from the upper left-hand corner by placing the tip of a standard screwdriver in the gap between the logic card and the connector and prying the connector off. (This should require only moderate force, and should not damage the logic card.)

e.   Remove the P4 connector located adjacent to the P5 connector in the same manner.

f.   Remove the black rotary baud switch knob with a 1/16th inch Allen wrench.

g.   Remove the three nuts holding the HDX/ FDX switch, the 110/150 selector switch, and the rotary selector baud rate switch with a 5/16th inch wrench.

h.   Remove the two bolts on both sides of the I/O connector (J2) with a 3/16th inch wrench or nut driver.

i.   Tip the MDS-CRT so it rests on the side of the terminal on a protected surface.

j.   Remove the four bolts at the right rear and left rear of the terminal base that hold the upright supports for the MDS-CRT LOGIC CARD to the chassis (see Figure 5-10). Care should be taken to support the LOGIC CARD so no damage will occur when it is freed in the terminal.

k.   Return the terminal to its upright position with the back of the terminal facing you.

l.   Tilt the top of the LOGIC CARD toward you.

m.   Remove the two bolts connecting the keyboard (PI) extension cable connector to the logic card and disconnect their coupling.
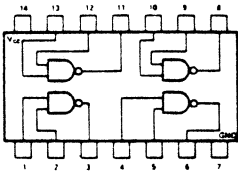
SECTION VI
DIAGRAMS

IC DESCRIPTION

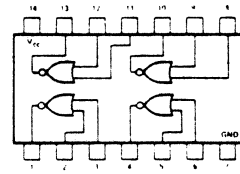The pin assignments, name and type of all integrated circuit used in MDS-CRT are shown in the following pages.

1404 (2504)

```
     ┌─────┐
  1 ─┤ •   ├─ 8
  2 ─┤     ├─ 7
     │2504V│
  3 ─┤     ├─ 6
  4 ─┤     ├─ 5
     └─────┘
```

```
        2504TA
```

1. OUT	8. V_CC
2. φ2	7. NC
3. NC	6. φ1
4. V_DD	5. IN

1. NC	5. OUT
2. IN	6. NC
3. φ1	7. φ2
4. V_CC	8. V_DD

Shift Register Memory

1402A (AY-5-1013)

Left	Right
VSS	TCP
VGG	POE
VDD	NDB1
RDE	NDB2
RD8	NSB
RD7	NPB
RD6	CS
RD5	DB8
RD4	DB7
RD3	DB6
RD2	DB5
RD1	DB4
RPE	DB3
RFE	DB2
ROR	DB1
SWE	TSO
RCP	TEOC
RDA	TDS
ODA	TBMT
RSI	RESET

1402A

UART

N7400

A,F PACKAGE

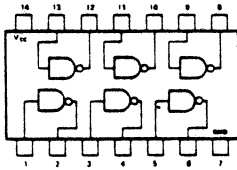Quadruple 2-Input Positive
Nand Gate

N7402

A,F PACKAGE

Quadruple 2-Input
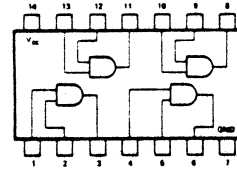Positive Nor Gate

N7404

A,F PACKAGE

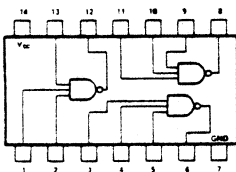HEX Inverter

N7408

A PACKAGE

Quadruple 2-Input
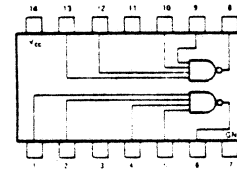Positive And Gates

N7410

A,F PACKAGE

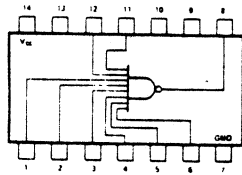Triple 3-Input
Positive Nand Gate

N7420

A,F PACKAGE
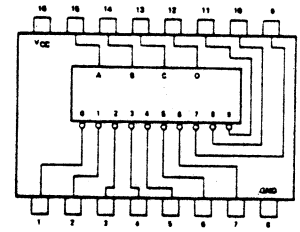
Dual 4-Input
Positive Nand Gate
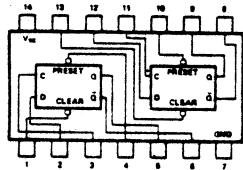
N7430

A,F PACKAGE

8-Input Positive Nand Gate

N7442

B,F,W PACKAGE

8CD-To-Decimal Decoder

N7474

A,F PACKAGE

Dual D-Type Edge-Triggered
Flip-Flop

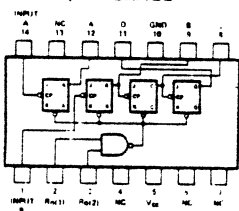## N7485

DATA INPUT
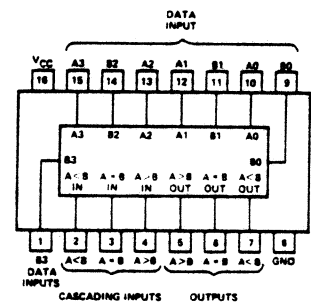
4-Bit Magnitude Comparators

N7493

A,F PACKAGE

4-Bit Binary Counter

N74123

74122 A,F PACKAGE
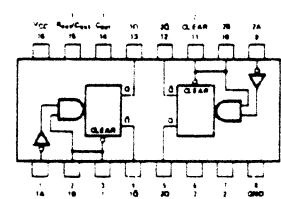
Retriggerable Monostable
Multivibrator with Clear

N74157

B,F,W PACKAGE
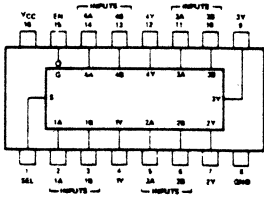
Quadruple 2-Input Data Selector/Multiplexer

N74163

B,F,W PACKAGE
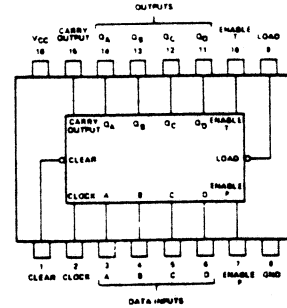
Synchronous 4-Bit Counter

N74164

A,F PACKAGE
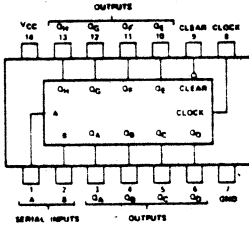
8-Bit Parallel-Out Serial Shift Registers

N74166

B,F,W PACKAGE
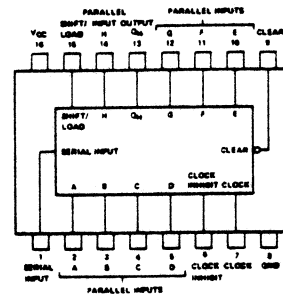
8-Bit Shift Register

N74192

B,F PACKAGE
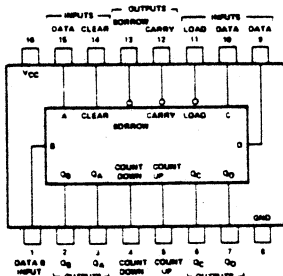
Synchronous Decade Up/Down Counter with Preset Inputs

N74193

B,F PACKAGE
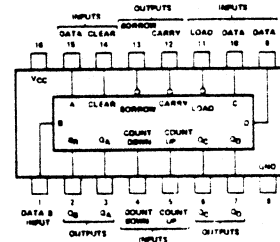
Synchromous 4-Bit Binary Up/Down Counter with Preset Inputs

MONITOR

BRIGHTNESS 3
BRIGHTNESS 2
BRIGHTNESS 1
+15 VDC
PWR GND
VERT DRIVE
HORIZ DRIVE
RET
VIDEO

J12 P12
2 2
3 3
7 7
9 9
1 1
6 6
10 10
8 8

J5 12 11 10 8 7 4 3 2 1
P5 12 11 10 8 7 4 3 2 1

POWER
SUPPLY

P7
L
N

S4   F1   TB1

115 VAC
AC RET
115 VAC
AC RET
CHASSIS GND

FAN

J10 P10
1 1
2 2
4 4
6 5
3 3

GND
GND
-12 VDC
+15 VDC
-SENSE
+SENSE
+5 VDC
+5 VDC

J4 P4
2 2
3 3
5 5
8 8
7 7
10 10
11 11
12 12

MINI BEE LOGIC BOARD

J1 1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20
P1 1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20

J2 20 16 8 7 5 4 3 2 1
P2 20 16 8 7 5 4 3 2 1

CUSTOMER FURNISHED

BRIGHTNESS 1
BRIGHTNESS 2
BRIGHTNESS 3
BREAK
PARITY
REPEAT
STROBE
+5 VDC
GND
ON LINE
LOCAL
PWR IND
BIT 7
BIT 6
BIT 5
BIT 4
BIT 3
BIT 2
BIT 1

P11 J11
1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8
9 9
10 10
11 11
13 13
14 14
15 15
16 16
17 17
18 18
19 19
20 20

CHASSIS GND
XMIT DATA
REC DATA
RTS
CTS
GND
CARRIER DET
X8 CLOCK
TERM RDY

DATA
SET

1 1
2 2
3 3
4 4
5 5
7 7
8 8
16 16
20 20

CW   CCW
BRIGHTNESS
100 K

J9 J H 12 2 1 9 10 11 4 5 6 7
P9 J H 12 2 1 9 10 11 4 5 6 7

KEYBOARD

POWER   PARITY
CR1   CR2

ON LINE

LOCAL

KEYBOARD HOUSING

MDS-CRT
INTERCONNECTION DIAGRAM

MDS-CRT Logic Card — 112-0686
Sheet 1 of 5

NOTES:

1.
A	SCROLL OPTION SELECT	SEE TABLE ON ASSY
B	CURSOR DOWN	SEE TABLE ON ASSY
C	CURSOR DOWN WITHOUT 80 CHAR ADVANCE	SEE TABLE ON ASSY
D	80 CHAR ADVANCE	SEE TABLE ON ASSY
E	50/60 Hz REFRESH	IN FOR 60Hz, OUT FOR 50Hz
F	12 LINE END OF PAGE	IN FOR 12 LINE, OUT FOR 25
G	25 LINE END OF PAGE	IN FOR 25 LINE, OUT FOR 12
H	12 LINE CURSOR LOCATION	IN FOR 12 LINE, OUT FOR 25
I	25 LINE VERTICAL DRIVE	IN FOR 25 LINE, OUT FOR 12
J	25 LINE VERTICAL BLANKING	IN FOR 25 LINE, OUT FOR 12
K	12 LINE VERTICAL BLANKING	IN FOR 12 LINE, OUT FOR 25
L	ODD/EVEN PARITY	IN FOR ODD PARITY, OUT FOR 12
M	1/2 STOP BITS	IN FOR 1 STOP BIT, OUT FOR 2 STOP BITS
N	PARITY CHECK	IN FOR NO PARITY CHECK, OUT FOR CHECK PARITY
O	NORMAL STRAPPING INHIBIT	IN FOR NORMAL STRAPPING, OUT FOR 10 BIT WORD PARITY TO MARKING
P	10 BIT WORD PARITY TO MARKING STATE	IN FOR 10 BIT WORD AND PARITY TO MARKING, OUT FOR NORMAL STRAPPING

2. ADD JUMPER WIRE BETWEEN P N 1 AND 3 ON A105, A106, A107 A108 A109 AND A110 FOR 12 LINE OPERATION, AND 12 LINE REMOVE A103 - 25 LINE REMOVE A86 AND A91

3. FOR GERMAN CHARACTER SET (DASH NO -0004) USE GERMAN CHARACTER GENERATOR (SME I NO 604-V104-06) IN A95 POSITION

4. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE IN 914B

112-0686

Sheet 3 of 5

112-0686
Sheet 4 of 5

112-0686
Sheet 5 of 5

6-10

MDS-CRT KEYBOARD

MODE SELECTION KEYS

FUNCTION KEYS

ALL KEYS HAVE SOURCE LEVEL OUTPUTS.

NO KEYS OPERATED=
ALL CODED LINES .25 VDC MAX

ONE KEY OPERATED*
TWO CODED LINES 3.5 VDC NOMINAL
REMAINING CODED LINES 1.0 VDC NOMINAL

BITS
87654321

R10-R36
1080±1%
(27)

R37-R38
R54-R55
~330Ω

INHIBIT CONTROL

EMD (LOCATED IN SWITCH MATRIX)

EMD IN OUT

STROBE

A8 RCA CA-3046

CONTROL

INHIBIT SHIFT

SHIFT

BIT BLOCKING

INHIBIT SHIFT

(SAME AS A9)

(SAME AS A6)

8 BIT QUAD MODE POSITIVE LOGIC
POSITIVE STROBE ODD PARITY (ESC CODE-KEY 24)

NOTES

A. "CPS" REFERS TO COMPONENT MOUNTING SIDE OF PC BOARD
"SDR" REFERS TO SOLDERED SIDE OF P.C BOARD
B. ALL RESISTORS 1/4 W CARBON 5% TOL UNLESS OTHERWISE SPECIFIED
C. 1% RESISTORS ARE 1/8 W METAL FILM TYPE
D. SUPPLY (+) 5.0 0.25 VOLTS DC, MEASURED AT CONNECTOR TERMINALS
E. ALL CODE DESIGNATIONS SHOWN WITH LEAST SIGNIFICANT BIT TO RIGHT
F. ABBREVIATIONS: R= RESISTOR, C= CAPACITOR, A= INTEGRATED CIRCUIT, B= BIT, F = FUNCTION
STB = STROBE, GND= GROUND, EMD= ELECTRICAL MONITOR DETECTOR, P.C = PRINTED CIRCUIT BOARD
G. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED
H. DO NOT MAKE CONNECTIONS TO UNIDENTIFIED TERMINATION PADS

KEYBOARD
EL607-2023

Datapower Power Supply Schematic

AC INPUT STRAPPING TABLE

AC Input Voltage 47 Hz to 63 Hz	AC Input Connected to Transformer Tap Number	Transformer Tap Jumpers #1 GAWG Buss Wire Size 16 Sleeving
100 Volts	6	1 to 4 2 to 5 3 to 6
115 Volts	6	1 to 4 3 to 6
200 Volts	5	2 to 4
230 Volts	6	3 to 4
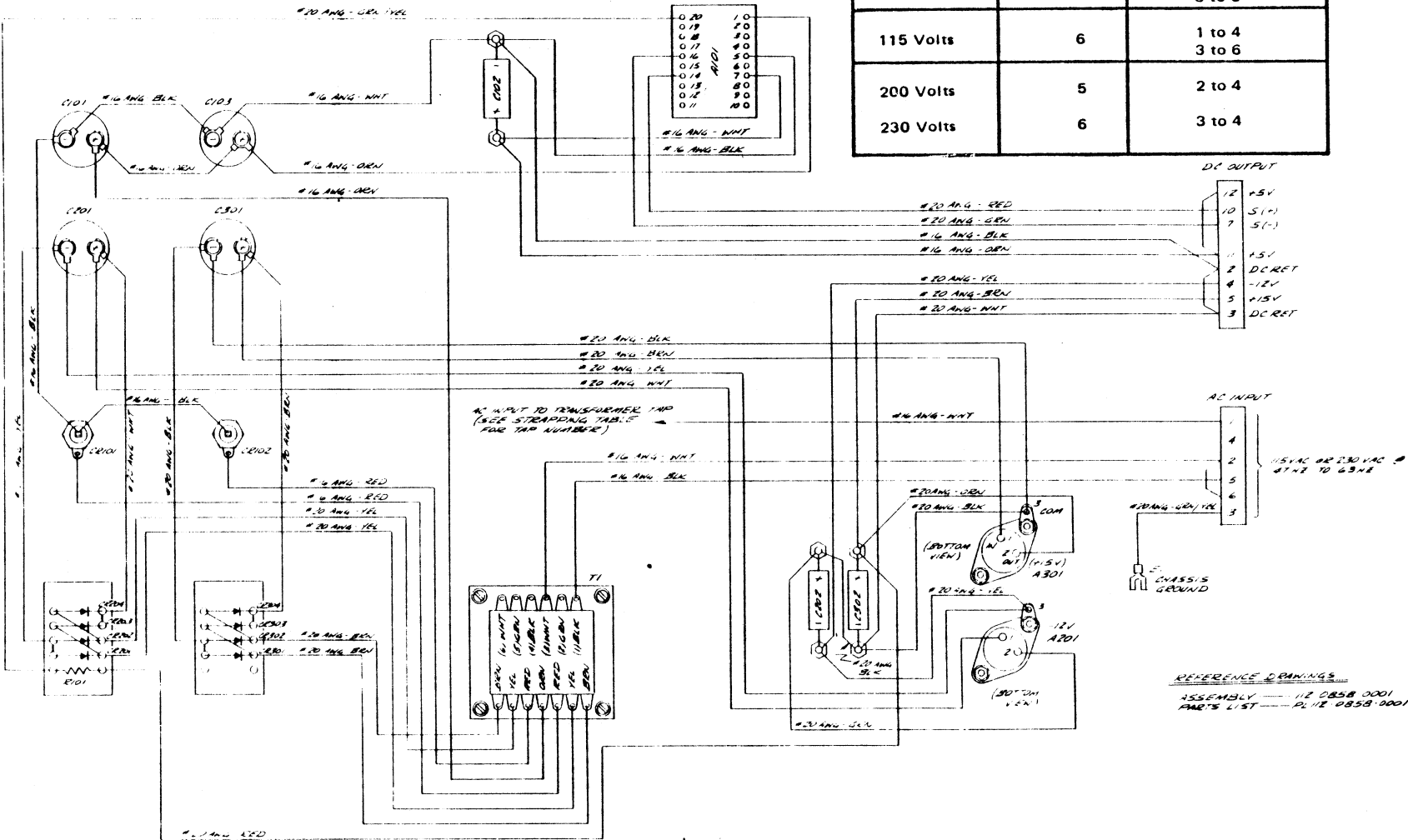
Lambda Power Supply Wiring Diagram
230 VAC @ 47 Hz to 63 Hz (WD112-0858-0001)

Lambda Power Supply Wiring Diagram
115 VAC @ 60 Hz (WD112-0858- 0000 / 0003)

AC/DC Power Supply Schematic (EL610-0333)

UNLESS OTHERWISE SPECIFIED:

A. CAPACITORS AND RESISTORS MARKED ✴ VARY IN VALUE OR ARE OMITTED.

B. CAPACITANCE VALUES ARE IN μF'S.

C. RESISTOR TOLERANCE AND SIZE:
   ○ ±5%, 2 W
   △ ±5%, 1/2 W
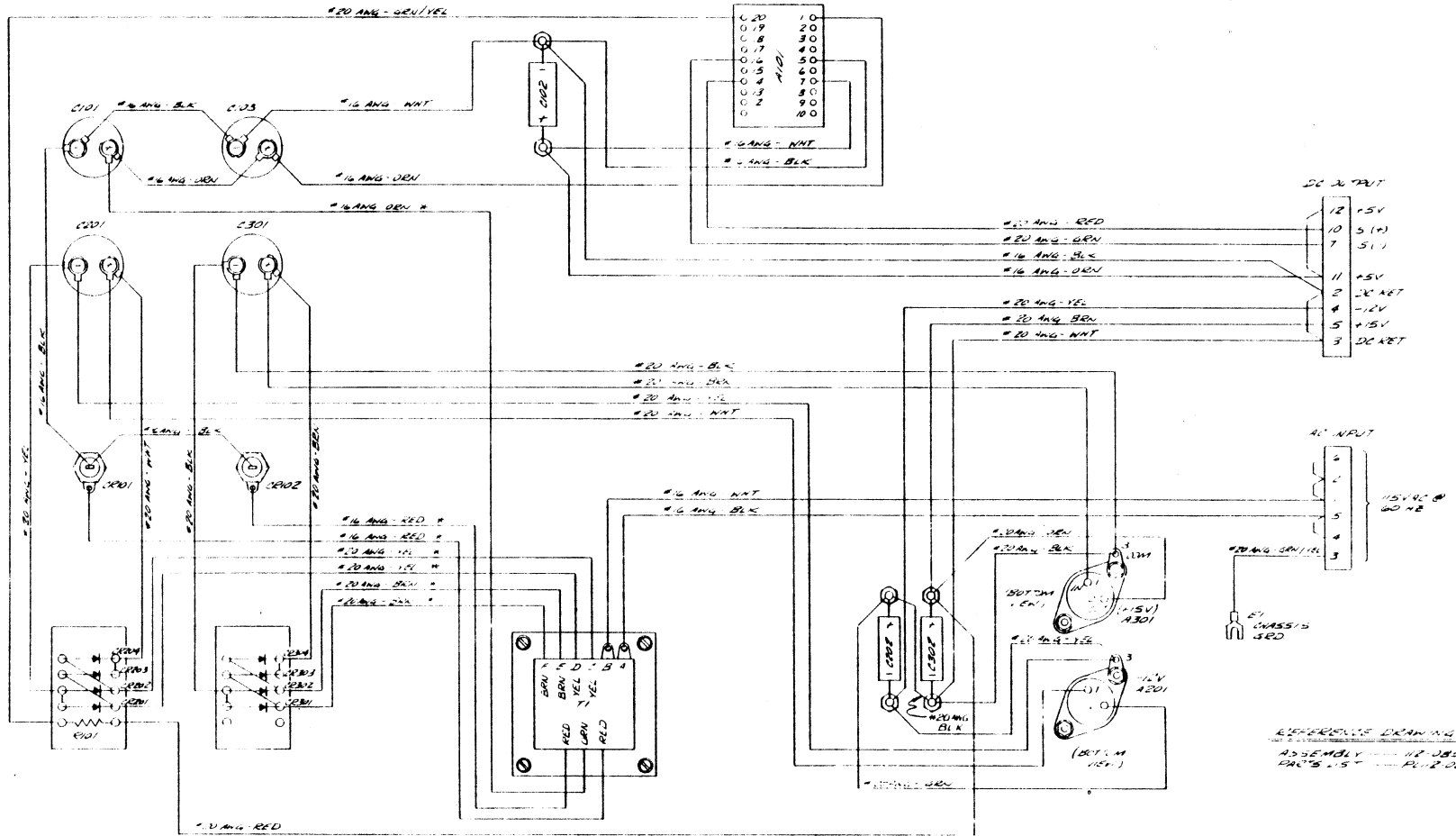   □ ±1%, 1/8 W
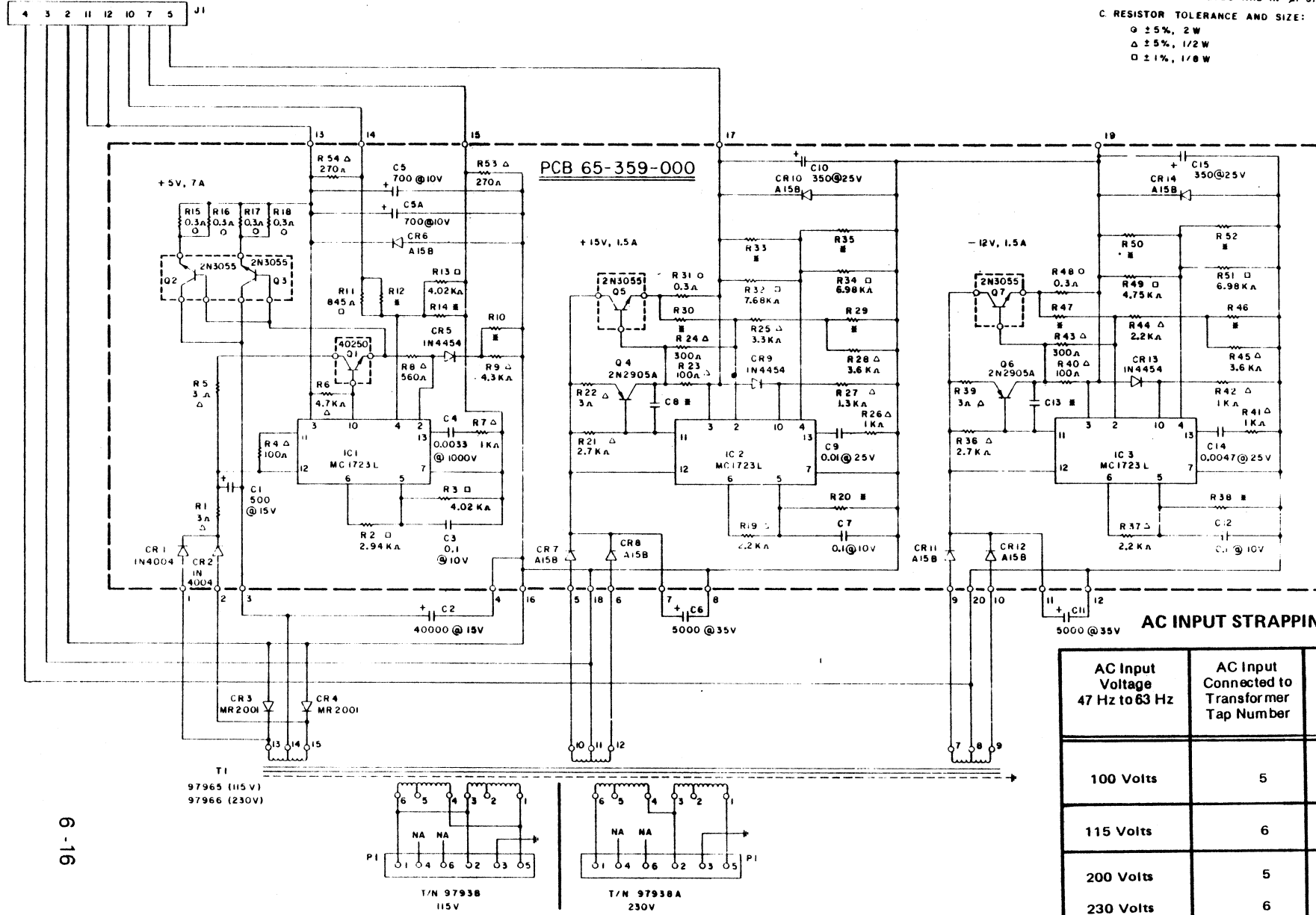
PCB 65-359-000

AC INPUT STRAPPING TABLE

AC Input Voltage 47 Hz to 63 Hz	AC Input Connected to Transformer Tap Number	Transformer Tap Jumpers #1 GAWG Buss Wire Size 16 Sleeving
100 Volts	5	1 to 4 2 to 5 3 to 6
115 Volts	6	1 to 4 3 to 6
200 Volts	5	2 to 4
230 Volts	6	3 to 4

SECTION VII

GLOSSARY OF TERMS

$\overline{\text{ADVANCE}}$

Advance (Not) is a low going pulse moving the cursor one position to the right on the CRT screen. It is derived from the MEM LOAD SIGNAL.

$\overline{\text{BELL}}$

Bell (Not) is a low going signal, decoded from a control G, and triggers the bell one shot.

$\overline{\text{BELL 70}}$

Bell 70 (Not) is a low going pulse, decoded from character 70. It is a low to high transition that triggers the bell one shot.

BREAK ONE SHOT

Break One Shot is triggered by a positive level from the keyboard break key and develops a 400 M sec. signal which is transmitted on the data and RTS EIA lines.

C80

C80 is a high going pulse from the Character Counter that defines character 80 to character 100 time.

$\overline{\text{C80}}$

C80 (Not) is the inverse of C80 used to inhibit the clock of the line memory.

CCW

Counter-clockwise

CHARACTER COUNTER

The Character Counter is made up of two decade counters with a modulus of 100, and it defines the characters on the line. Each character is 7 dots wide.

CHARACTER CURSOR

Character Cursor is a high going signal when a compare is made between the cursor location counter and the marker reference counter.

CHECK PAR

Check Parity enables a parity check on incoming data when low no parity check is made.

$\overline{\text{CLEAR}}$

Clear (Not) is a low going signal used to clear the screen and move the cursor home, made up of TURN ON CLEAR or the decode of escape E.

CLEAR MEM

Clear Memory is a positive going signal used to clear all or part of the screen derived from clear or EOS (decode of escape J) or EL (escape K) or during a scroll. To clear the screen, space codes are loaded into the memory in the required locations.

$\overline{COLO}$

Character Zero Line Zero (Not) is a low going signal derived from coincidence between the rollover of the memory reference counter and the overflowing of the main timing chain. Character 0 line 0 signifies that the memory and the display are coincidence at the Home position.

$\overline{CONTROL\ DECODER}$

Control Decoder (Not) decodes a control character when the sixth and seventh bits are zeros.

CURSOR COMPARITOR

Cursor Comparitor compares the marker reference counter outputs to the cursor location counter outputs. The compare signal is called the Character Cursor.

CURSOR LOCATION COUNTER

Cursor Location Counter has the cursor location stored in it. Both line and character are stopped and are modified by home, advance, $\longrightarrow$ $\longleftarrow$ $\downarrow$ $\uparrow$ etc.

CW

Clockwise

DISPLAY CURSOR

Display Cursor signal is generated by inverting Character Cursor twice for buffering. It is applied to the line memory, loaded into the line memory when it is coincident with SOCO-79, and then displayed as a blinking double underscore on scans 8 and 9.

DOT COUNTER

Dot Counter is a divide-by-7 ring oscillator having outputs which are two dots wide labeled $\overline{6}$ and $\overline{0}$, $\overline{0}$ and $\overline{1}$, $\overline{1}$ and $\overline{2}$, etc.

DOT $\overline{6/0}$

Dot 6/0 (Not) is an output from the dot counter that is 2 dots wide and used to clock the dot shifter.

DOT $\overline{1/2}$

Dot 1/2 (Not) is an output from the dot counter two dots wide, and used in conjunction with C80 to clock the line memories.

EIA RCVR

Used to receive data at EIA levels transform them to TTL levels

EIA XMTR

Used to raise the outgoing data from TTL to EIA levels.

EL

Erase Line signal is generated by decoding an escape K and is used to erase the entire line the cursor is on.

EOS

Erase to end of screen is a signal generated from escape J and used to erase the screen beginning with the line the cursor is on.

HDX

Half-Duplex is a mode of communication in which the data entered from the keyboard is displayed on the screen and transmitted. The terminal will receive through the I/O connector, but not at the same time it is transmitting.

$\overline{HOME}$

Home (Not) is a signal used to reset the cursor location counters which sets the cursor to the first location on the first line.

HZ DRIVE

Horizontal Drive to monitor is used for sync and to develop high voltage for the CRT. It is generated by decoding count 84 of the Character Counter and reset by count 20.

IN DATA 1

Buffered bit 1 parallel data from UART. Applied to decoders and memory.

IN DATA 2

Buffered bit 2 parallel data from UART. Applied to decoders and memory.

IN DATA 3

Buffered bit 3 parallel data from UART. Applied to decoders and memory.

IN DATA 4

Buffered bit 4 parallel data from UART. Applied to decoders and memory.

IN DATA 5

Buffered bit 5 parallel data from UART. Applied to decoders and memory.

IN DATA 6

Buffered bit 6 parallel data from UART. Applied to decoders and memory.

IN DATA 7

Buffered bit 7 parallel data from UART. Applied to decoders and memory.

KBD BRK

Keyboard Break is a function from the keyboard and stays in a high or binary
'1' state while the key is depressed. (Terminal outputs break signal for 500ms max.)

KBD STRB

Keyboard Strobe is a high level from the keyboard occuring when any keys,
except function, are depressed.

KBD RPT

Keyboard Repeat is a function key and stays high while 'REPT'. key is depressed
on keyboard in conjunction with another key.

KBD 1

Bit 1 from keyboard is set to a logic 1 or 0 when a key is depressed on the key-
board and remains until the key is released.

KBD 2

Bit 2 from keyboard is set to a logic 1 or 0 when a key is depressed on the key-
board and remains until the key is released.

KBD 3

Bit 3 from keyboard is set to a logic 1 or 0 when a key is depressed on the key-
board and remains until the key is released.

KBD 4

Bit 4 from keyboard is set to a logic 1 or 0 when a key is depressed on the key-
board and remains until the key is released.

KBD 5

Bit 5 from keyboard is set to a logic 1 or 0 when a key is depressed on the key-
board and remains until the key is released.

KBD 6

Bit 6 from keyboard is set to a logic 1 or 0 when a key is depressed on the keyboard and remains until the key is released.

KBD 7

Bit 7 from keyboard is set to a logic 1 or 0 when a key is depressed on the keyboard and remains until the key is released.

LF DECODER

Line Feed decodes a control J which is used to move the cursor to the next line down. If the cursor is on the bottom line, the terminal will scroll everything up one line and the top line will be lost.

LINE MEMORY

The line memory is used to synchronize the page memory with the monitor display. 80 characters are shifted into the line memory and then applied to the character generator at a different rate.

MEM LOAD

Memory Load (Not) signal is generated when any printable character is received from the keyboard or I/O port. It switches the multiplexer on the page memory from its usual recirculate path so that new data can be loaded.

LOCAL

The terminal uses this mode of operation for operator familiarization only. Characters are entered into memory and displayed, but not transmitted, from the keyboard. Also, anything received at the I/O port is ignored.

LOCAL SWITCH

Local Switch (Not) toggle switch located on the keyboard housing switches the terminal between online and local mode.

MARKER REFERENCE COUNTER

Marker Reference Counter will count to 2,048 in increments of 80 to define 25 line with 48 undefined locations. It identifies each of the 2,000 locations of the screen.

MRC CLK

Memory Reference Counter Clock is made up of slow and fast pulses used to clock the page memory shift registers.

ON LINE

In On Line mode of operation, the terminal transmits and receives data via and EIA RS232 I/0 connector.

OSC

The Oscillator Signal is generated by a 11.34 MHTZ crystal oscillator and buffered by a 7404.

PAGE MEMORY

Page Memory is a 2,048 x 6 bit recirculating shift register. It defines the 2,000 character locations on the screen with 48 left over.

PARITY LIGHT

The Parity Light located on the keyboard housing is illuminated by receiving a parity error and is resetable by depressing any alphnumeric key on the keyboard.

RCT

Carrier Signal Detect is an EIA RS232 signal. It must be high to receive data and is usually used with a modem. It indicates suitability of the signal presented to the data communications equipment.

RECEIVER

Circuitry dedicated to converting a serial word into parallel data, also included in this section, would be the parity checking circuit, CTS & RTS circuits.

REC DATA

Received Data is an EIA RS232 line that transfers data to the terminal. It is held in a marking condition when the line is idle.

RTS

Request to Send is an EIA RS232 line that informs the external device that information is ready to be transmitted from the terminal. It is held in an on condition when in FDX.

SCAN COUNTER

Scan Counter has a modulus of ten, thus defining 10 scans per line.

SCROLL

Scroll signal is generated by the scroll latch and is used to modify MRC clock and scroll the display up one line when it is true.

SCROLL SET

Scroll Set (Not) signal is generated and used to set the scroll latch when line 24 and a line feed are decoded at the same time.

$\overline{\text{SOCO-79}}$

Scan O, Character O to 79 (Not) represents the first 80 characters of scan 0. It is used to generate slow clocks in MRC clock to transfer the page memory information into the line memory and is also used as timing signal for received control and escape codes after they leave the UART.

SOCO-79

Inverse of SOCO-79 and used as load signal on the line memories.

S1, S2, S4 and S8

Outputs of the scan counter are applied to the character generator to define the scans in the character matrix.

TERM READY

Terminal Ready is an EIA RS232 line that goes high when the terminal is turned on.

THRE

Transmitter Holding Register Empty is a high level indicating that the transmitter holding register is empty and may be loaded with a new character.

TOC

Turn on Clear is a signal generated by power up initiated by the UART.

$\overline{\text{TOC}}$

Turn on Clear (Not) is a signal used on power up to clear the screen and home the cursor.

$\overline{\text{THRL}}$

Transmitter Holding Register Load (Not). When this signal is low, a character is entered into the transmitter holding register of the UART, and on a low to high transition the character is moved to the transmitter register.

TRC

Transmitter Register Clock is 16 x Baud rate.

TRE

Transmitter Register Empty stays low while transmitting a character and goes high when completed.

TRO

Transmitter Register Output. The start bit, data bits, parity bit, and stop bit(s) are serially shifted out this line. It remains at a high level when no data is

being transmitted.

TRANSMITTER

The Transmitter circuitry is dedicated to converting parallel data into a serial word complete with start bit, data bits, parity bit and stop bit(s); also, RTS, terminal ready, are included in this section.

UART

Universal Asynchronous Receiver/Transmitter, MOS/LSI Device. The transmitter section converts parallel data into a serial word which contains a start, parity, and stop bits. The receiver section converts a serial word into parallel data and checks parity.

VERT DRIVE

Vertical Drive (Not) signal is derived by decoding count 30 from the line counter and the reset signal at count 32. It is used for synchronization in the monitor and blanking of the video signal.

VIDEO

Data from the dot shifter with blanking added, that is, applied to the monitor. A low level yields a dark screen and a high level yields a bright screen.

VIDEO RET

Video Return is the signal ground line for the monitor.

XMIT DATA

Transmit Data is an EIA RS232 line used for transferring data from the terminal to the EXTERNAL DEVICE and held to a mark condition during idle time.

X8 CLK

Times 8 Clock is a TTL signal required by some external equipment and is eight times the baud rate frequency. It is available at the I/O connector if strapped.

X16 CLK

Times 16 Clock is required by the UART and is sixteen times the baud rate frequency.

1/2 STOP BIT

One or Two Stop Bit is a strap that enables the UART to attach one or two stop bits to a data word.

$\emptyset 1$, $\emptyset 2$

Phase 1, Phase 2 are clocks used to clock the page memory, derived from MRC Clock and level shifted with drivers to swing from -5V to +10V levels.

5V SENSE—
5V SENSE+

5 Volt Sense Negative and 5-Volt Sense Postive are lines used by the power supply to regulate the voltage at a remote point. These lines must be tied to the power supply voltage in order for the power supply to regulate properly.

$$\overline{\downarrow}$$

Cursor Down (Not) is a signal generated by the decode of an escape B or an LF decode and is applied to the cursor location counter to move the cursor to the next line down.

$$\overline{\uparrow}$$

Cursor Up (Not) is a signal generated by an escape decode and is applied to the cursor location counter to move the cursor to the left one character position.

$$\overline{\leftarrow}$$

Cursor Left (Not) is a signal generated by the decode of an escape D or a control H decode and applied to the cursor location counter to move the cursor to the left one character position.

$$\overline{\rightarrow}$$

Cursor Right (Not) is a signal generated by the decode of an escape C and is applied to the cursor location counter to move the cursor one character position to the right.