DIDS-400™

DIGITAL INFORMATION DISPLAY SYSTEM

RAYTHEON

RAYTHEON COMPANY
Communications and Data Processing Operation

IMD712210-0

INSTALLATION AND MAINTENANCE MANUAL

for

DIDS*-400

Digital Information Display System

MODEL 402-2M10 DISPLAY TERMINAL

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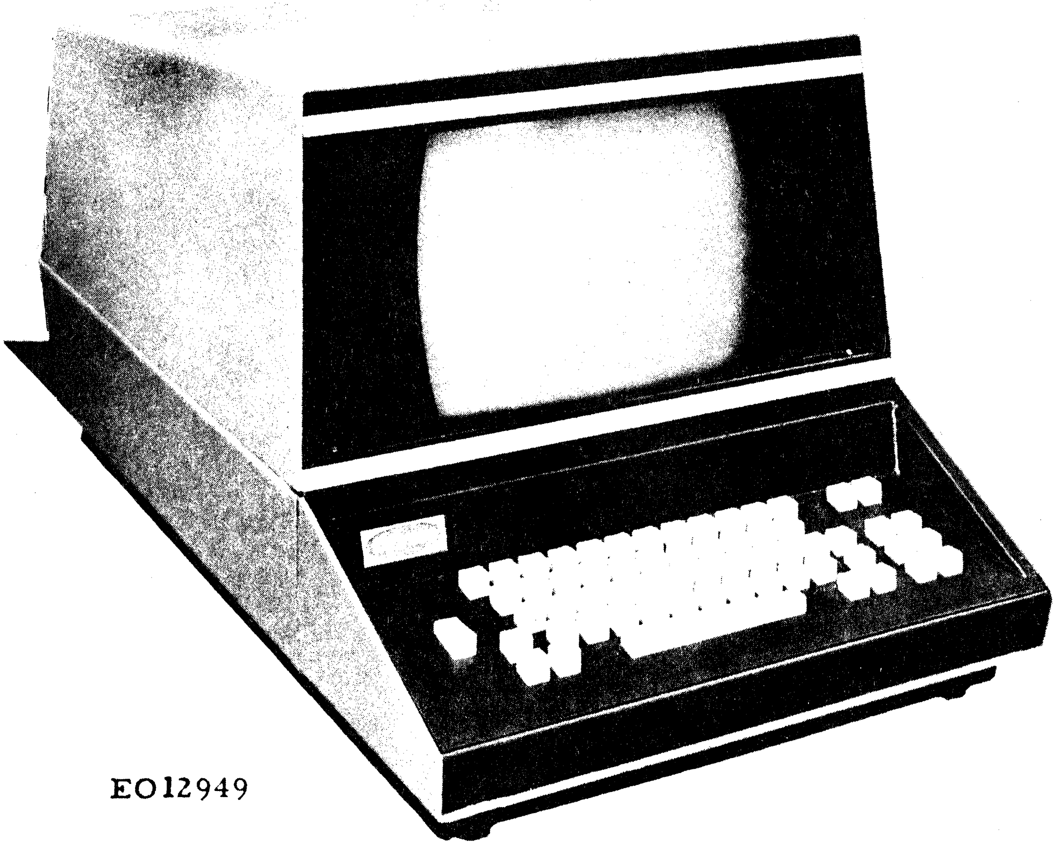

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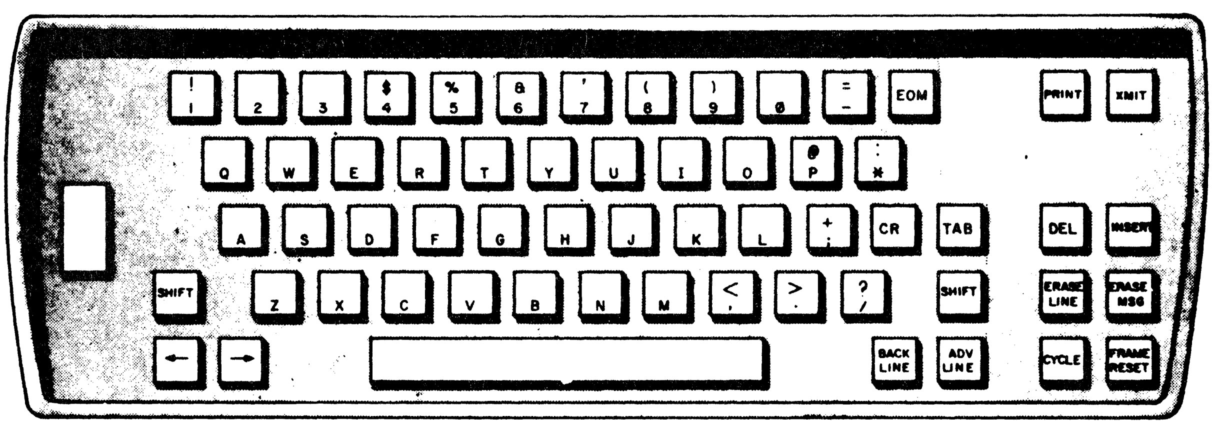

Figure 1-1. Model 402-2M10 Display Terminal

SECTION 1

INTRODUCTION

1-1 SCOPE

This manual contains information needed to install and align the DIDS*-400 Display Terminal, Model 402-2M10 (figure 1-1). See table 1-1 for a listing of other standard displays.

Table 1-1. DIDS-400 Standard Display Terminals

Model	Control Unit Reqd	Coding	Characters Displayed
401-2	Yes	ASCII	520
401-2A	Yes	ASCII	1040
402-1	No	BCD	520
402-2	No	ASCII	520
402-2A	No	ASCII	1040

1-2. PURPOSE AND USE OF EQUIPMENT

The purpose of the 402-2M10 Display Terminal is to provide quick-response, on-line communication with a digital computer. The unit consists of a display and keyboard with a self-contained interface to permit direct connection to either the Bell System 202 C/D modem, the Western Union 2121 modem, or its equivalent.

1-2.1 Technical Characteristics

a. The Model 402-2M10 Display Terminal can display 520 characters on its cathode ray tube (CRT) screen which has a viewing surface of 6-1/2 inches by 8-1/2 inches. The format consists of 13 lines with 40 characters on each line. The character size is approximately 0.17 inch high by 0.14 inch wide. The high-quality continuous-type characters greatly reduce operator fatigue, and the bright flicker-free presentation can be viewed easily in normal room lighting. Each Display Terminal contains its own buffer memory, character generation, interface logic, and timing circuits.

b. Data transfer to and from the Display Terminal takes place at a nominal rate of 120 characters/second.

c. Solid-state integrated circuitry provides high reliability, reduced power consumption, and compactness. All composing and editing is accomplished off-line - that is, the system is connected to the computer only during transmission of information.

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1-2.2 Description of Units. The physical characteristics and power requirements of the Model 402-2 Display Terminal are as follows:

Height	14-1/2 in.		
Width	16-1/2 in.		
Depth	26-1/2 in.		
Weight	96-1/2 lb		
Power	115 vac ±10% 60 Hz, single-phase, 200 W	or	220 vac ±10% 50-60 Hz, single-phase, 200 W

1-2.3 Operating Information. For operating information, refer to "User Manual DIDS-400 Model 402-2, Model 402-2A."

1-2.4 Abbreviations and Symbols

Abbreviations and Symbols	Definitions
BA	Transmitted Data
BB	Receive Data
CA	Request to Send
CB	Clear to Send
CF	Data Carrier Detector
CFR	Cursor Frame Reset
CR	Carriage Return
CRQ	Cursor Right Request
CSP	Character Select Pulse
CTS	Cursor Time Slot
CTS+1	Cursor Time Slot + One Bit (LSB of a Character)
DL	Delay Line
D/A	Digital-to-Analog
EOLG	End of Line Gate
EOLP	End of Line Pulse
EOM	End of Message
EOT	End of Transmission

Abbreviation and Symbols	Definitions
ETX	End of Text
FWL	First Word of Line Pulse (same as Δ)
KYD	Keyed
LCE	Last Character Entered
LWL	Last Word of a Line Pulse
LSB	Least Significant Bit
MSB	Most Significant Bit
R	Receive Mode
RE	Receive Enable
SOM	Start of Message
SOS	Shift Off Screen
SR	Shift Register
STX	Start of Text
T	Transmit Mode
XMIT	Transmit
1CTS	Phase One of Cursor Time Slot
3CTS	Phase Three of Cursor Time Slot
4CTS	Phase Four of Cursor Time Slot
FΔ	First Word of First Line Pulse (Frame Pulse)
Δ	First Word of a Line Pulse

SECTION 2

INSTALLATION

2-1 SERVICE UPON RECEIPT OF EQUIPMENT AND INSTALLATION PROCEDURES

Unpack Display Terminal 402-2M10 and place it in the desired location. Remove the cover from the Display Terminal and make the following visual checks:

a. Inspect for any obvious damage such as a broken CRT, loose components, etc.

b. Check all terminal screws on power supplies A4 and A5 to ensure that they are tight.

c. Check to see that all leads connecting the six printed circuit boards are tightly fastened to their respective terminals.

d. Check low-voltage power supply A4 to make certain that it is wired for 120-volt operation. Operational wiring for 220-volt operation is given in paragraph 3-5.

The following figures are provided to assist in identifying and locating the printed circuit board and chassis-mounted components:

Figure 2-1. 402-2M10 Display Terminal, Right Side
Figure 2-2. 402-2M10 Display Terminal, Left Side
Figure 2-3. 402-2M10 Display Terminal, Top View
Figure 2-4. 402-2M10 Display Terminal, Rear View
Figure 2-5. Horizontal and Vertical Deflection Amplifier A2
Figure 2-6. Video Amplifier A8
Figure 2-7. Monoscope Deflection Amplifier A3
Figure 2-8. Monoscope Preamplifier A7

Connect the power and data cables and perform a complete alignment of the Display Terminal. Note that when the cover has been removed, interlock switch S1 must be cheated before power is applied to the Display Terminal.

2-2 TURN-ON PROCEDURE

The turn-on procedure consists simply of turning brightness control R8 and on-off switch S2 on the Display Terminal (figure 2-1) to the on position. After a 3-minute warm-up period, adjust brightness control R8 until sweeps approximately 0.17 inch high are visible.

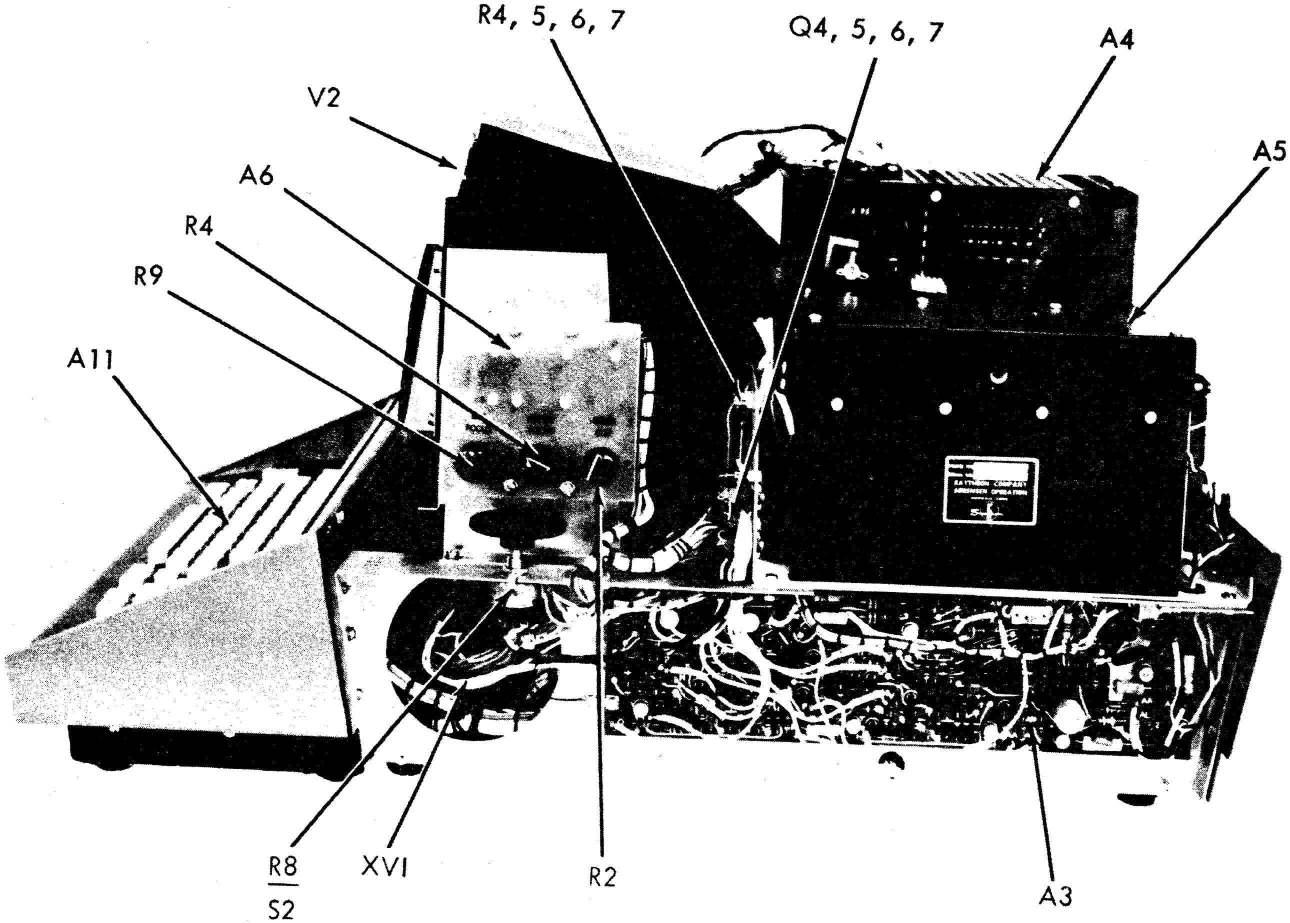

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Figure 2-1. DIDS-402-2M10 Display Terminal, Right Side

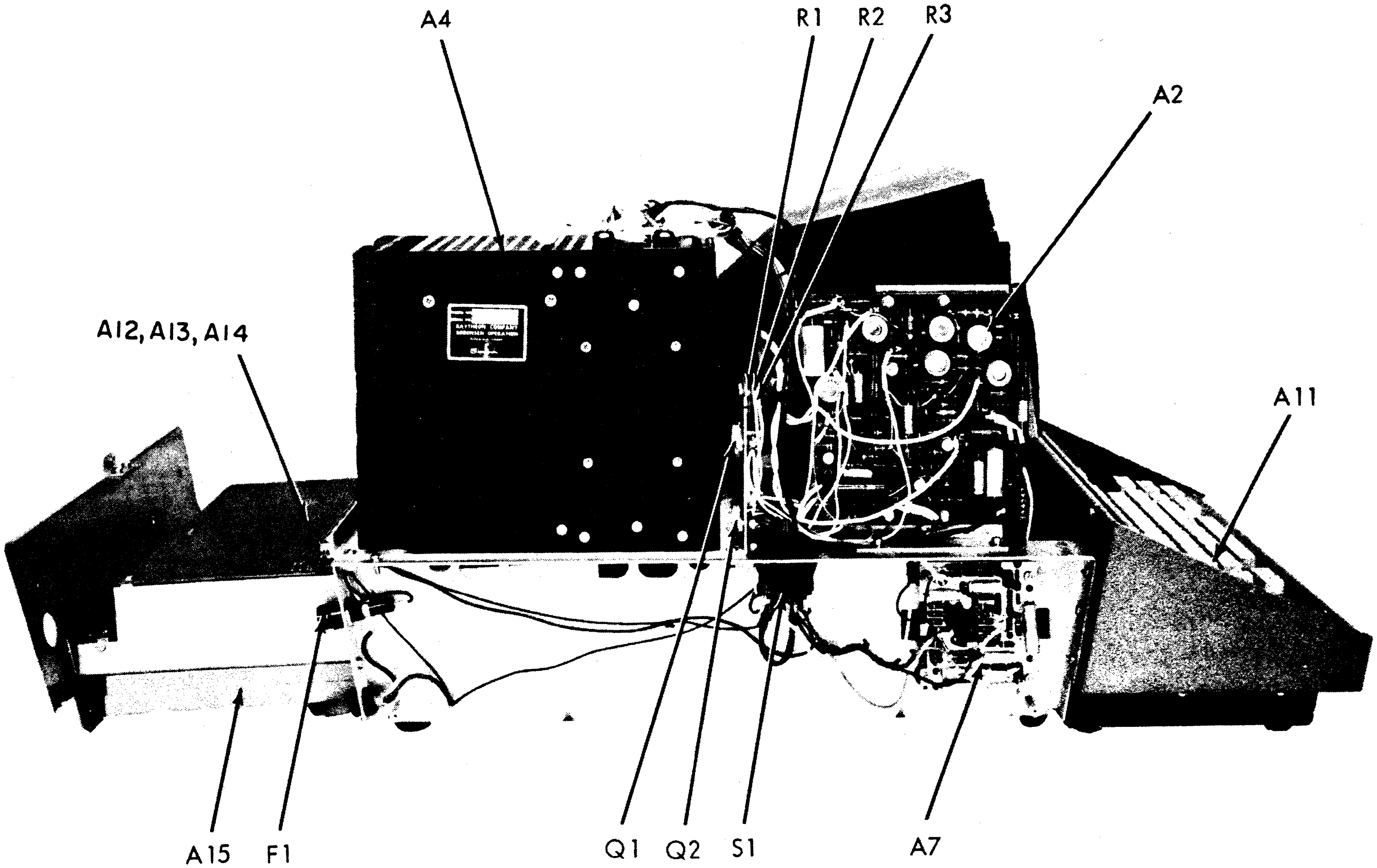

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Figure 2-2. DIDS-402-2M10 Display Terminal, Left Side

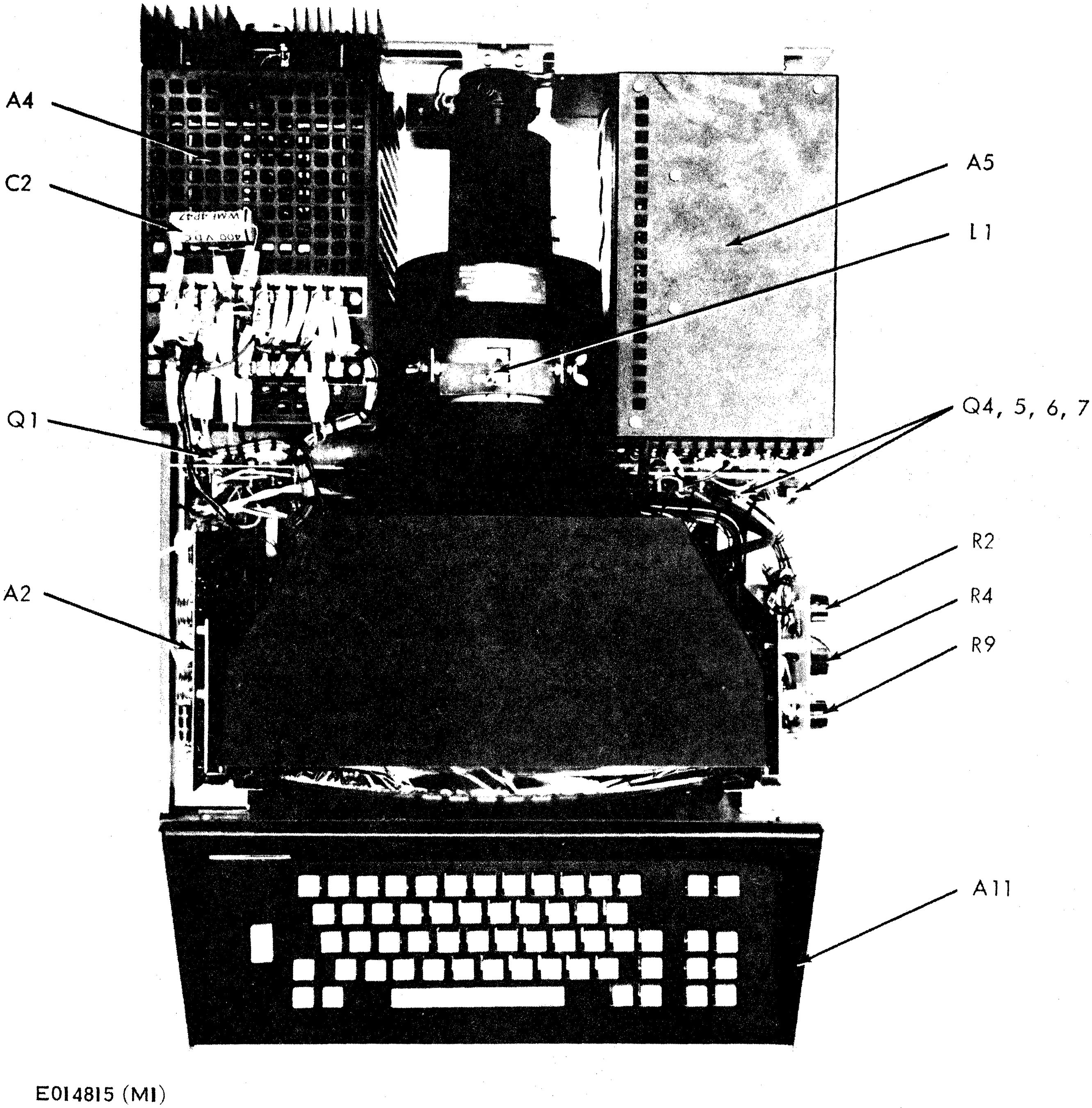

Figure 2-3. DIDS-402-2M10 Display Terminal, Top View

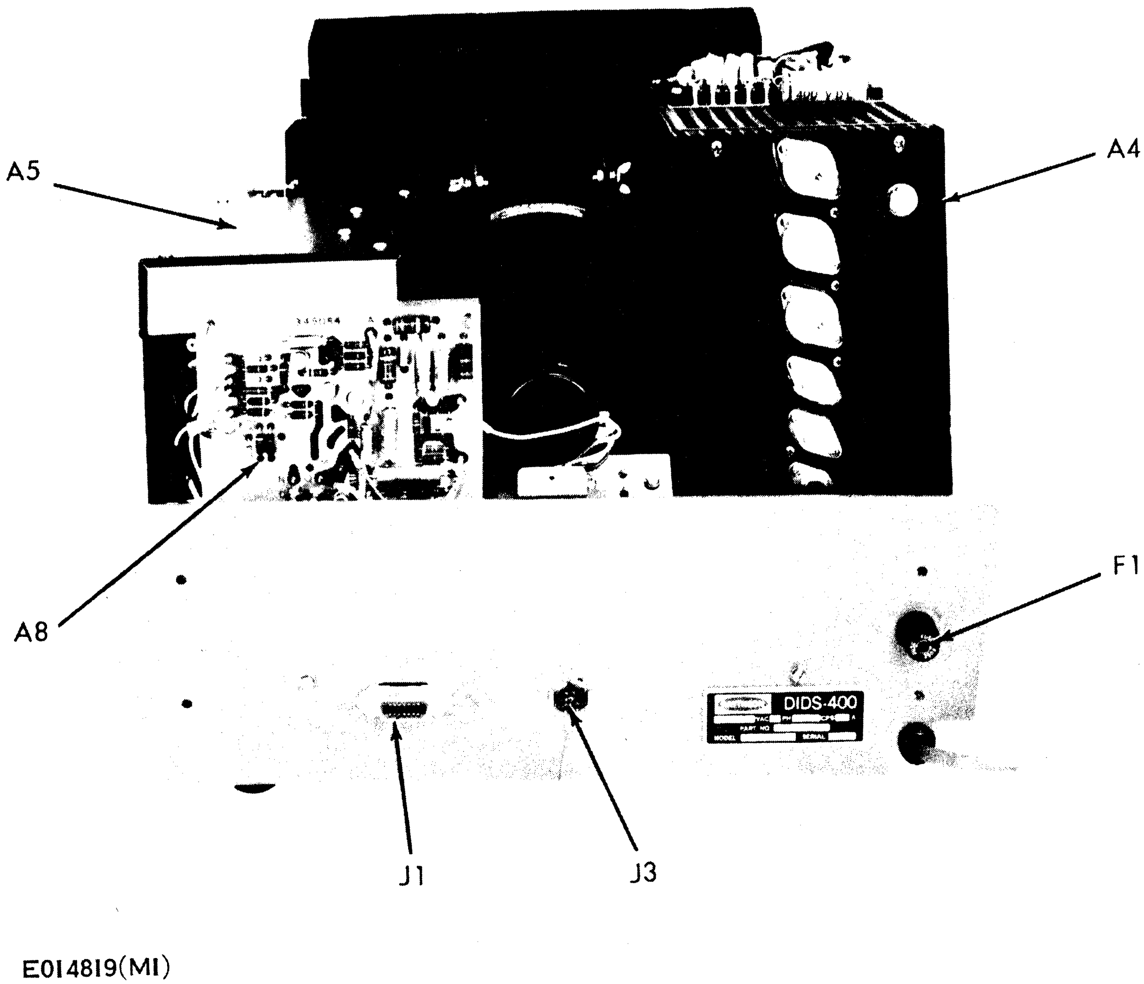

Figure 2-4. DIDS-402-2M10 Display Terminal, Rear View

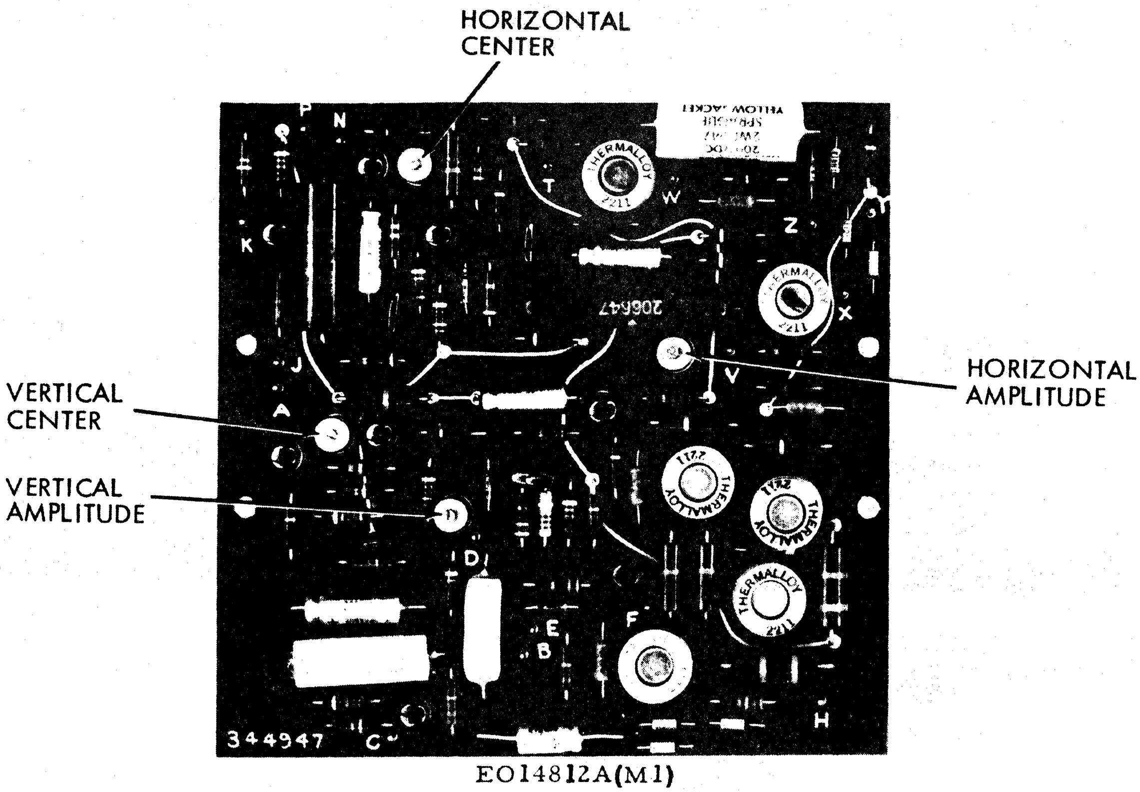

Figure 2-5. Horizontal and Vertical Amplifier A2

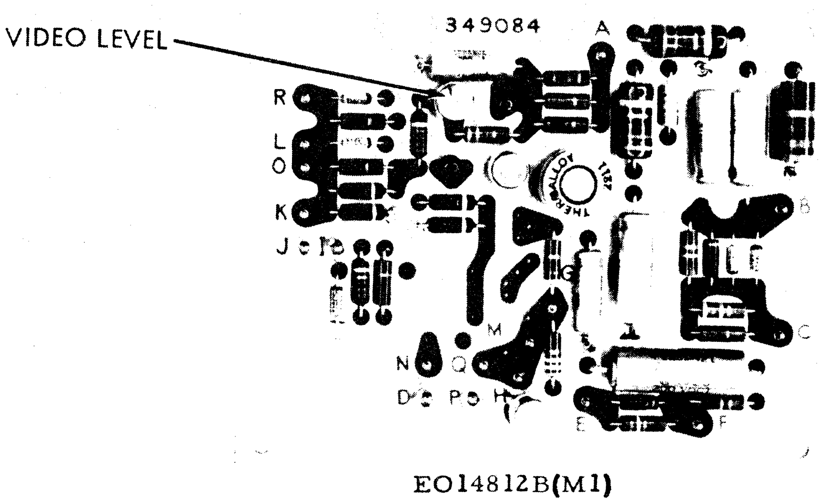

Figure 2-6. Video Amplifier A8

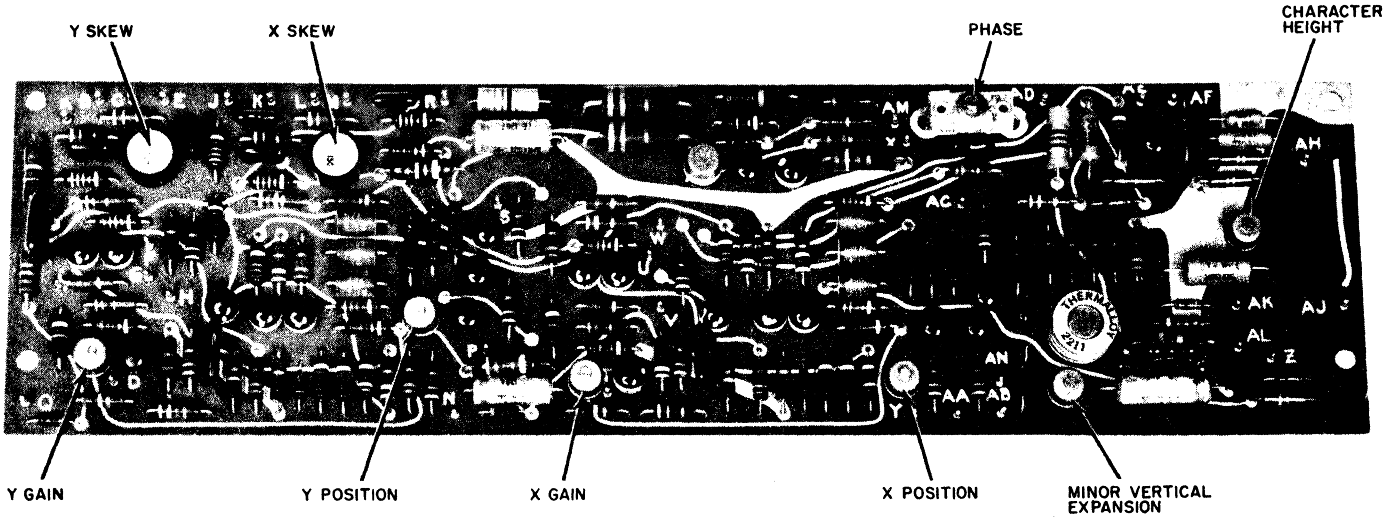

Figure 2-7. Monoscope Deflection Amplifier A3

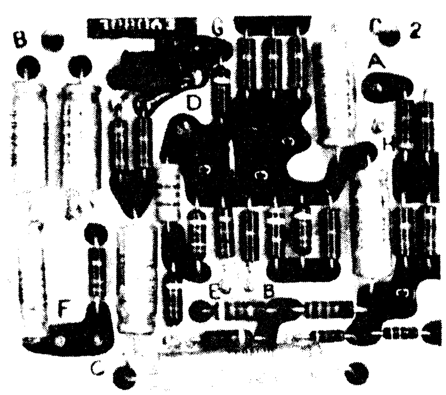

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Figure 2-8. Monoscope Preamplifier A7

2-3 ALIGNMENT AND ADJUSTMENT PROCEDURES

The following alignment and adjustment procedures are provided to enable the repairman to set up the Display Terminal for optimum performance.

2-3.1 Alignment of Horizontal and Vertical Deflection Amplifier A2

a. Adjust vertical centering control R4 (figure 2-5) to center the raster vertically on the display tube.

b. Adjust vertical amplifier control R27 (figure 2-5) to produce the frame height.

c. Adjust horizontal centering control R35 (figure 2-5) to center the raster horizontally on the display tube.

d. Adjust horizontal amplitude control R50 (figure 2-5) to produce the frame width.

2-3.2 Adjustment of Video Level on Video Amplifier A8

a. Depress FRAME RESET key.

b. Adjust BEAM CUR. control R2 until cursor shows in first character, first line position. Set for required character brightness.

c. Adjust video level control R7 (figure 2-6) until character boxes just appear on sweeps.

2-3.3 Adjustment of MONO FOCUS Control A6-R4. Observe cursor and adjust MONO FOCUS control R4 on circuit board A6 (figure 2-1) for the sharpest cursor image ( ).

2-3.4 Adjustment of CRT FOCUS Control A6-R9. Adjust CRT FOCUS Control R9 on circuit board A6 (figure 2-1) for the sharpest cursor image (≣) possible.

2-3.5 Delay Line Adjustment

Note

It should not be necessary to adjust the delay line more than six turns ccw or cw from the factory adjustment.

a. Single delay-line adjustment

(1) Depress and release the FRAME RESET key and at the same time turn the delay-line adjustment screw two turns.

(2) Repeat step (1) above until the screen displays stable characters.

(3) Check that the displayed chzracters remain stable for a minimum of three complete turns of the delay-line adjustment screw.

(4) Turn the adjustment screw to the center of its stable range.

b. Double delay-line adjustment

(1) Remove the wire from A13, pin 6.

(2) Connect the oscilloscope external trigger to A10, pin F and switch to minus (-) extension trigger. Connect one oscilloscope probe to A10, pin F and the other to A10, junction of C7 and R26.

(3) Turn the top delay-line adjustment screw so that the falling edges of the clock pulses are lined up with the centers of the peaks of the sine waves (see figure 2-9). The waveforms shown are not representative of any particular character.)

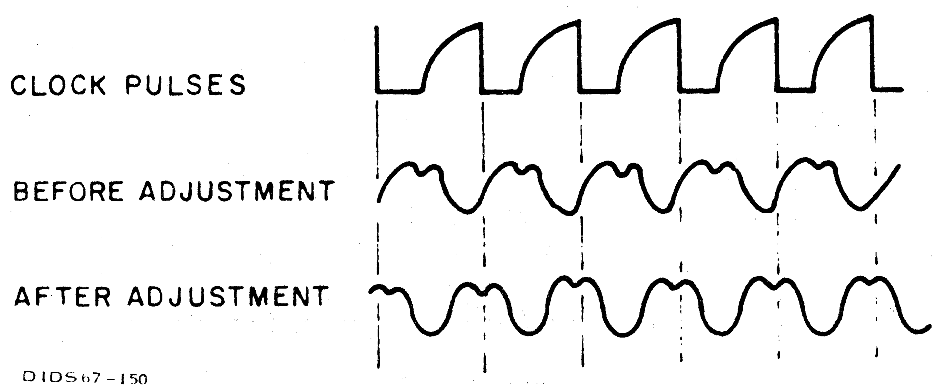


Figure 2-9. Delay-Line Adjustment

(4) Reconnect the wire to A13, pin 6.

(5) Depress and release the FRAME RESET key and, at the same time, turn the delay-line adjustment screw on the delay line two turns.

(6) Repeat step (5) until the screen displays stable character.

(7) Check that the displayed characters remain stable for a minimum of three complete turns of the delay-line adjustment screw.

(8) Turn the delay-line adjustment screw to the center of its stable range.

2-3.6 Alignment of Monoscope Deflection Circuit A3

a. Adjust brightness control R8 (figure 2-1), on the side of the Display Terminal, until the character boxes are just visible behind the characters. Character brightness can also be adjusted by means of BEAM CUR. control A6-R2 on the high-voltage network. Refer to Adjustment of BEAM CUR. control A6-R2 (paragraph 2-3.2) for proper adjustment.

b. Adjust character height control R108 (figure 2-7) until the characters are approximately 3/16 inch high.

c. Adjust minor vertical sweep expansion control R103 (figure 2-7) so that the character height is 80 percent of the visible character box height.

d. Adjust phase control C11 (figure 2-7) until single characters are produced (double characters are seen when the phase control is improperly adjusted).

e. Press the keys to display the characters G @ ! Y 1 V 6 Q H O at the upper left corner of the display.

f. If the letters do not appear, adjust X and Y position control R5 and R47 (figure 2-7) until the characters ! and G are visible.

g. Adjust Y position control R47 (figure 2-7) so that the character ! is properly positioned within its frame.

h. Adjust Y gain control R50 (figure 2-7) until the character Y is properly positioned within its frame.

i. Repeat steps g and h above until the characters ! and Y are both properly positioned within their respective frames.

j. Adjust X position control R5 so that the character G is properly positioned within its frame.

k. Adjust X gain control R32 (figure 2-7) until the character @ is properly positioned within its frame.

l. Repeat steps j and k above until the characters G and @ are both properly positioned within their respective frames.

2-4 INITIAL OPERATION

After the Display Terminal is completely aligned, remove the interlock cheat and replace the display terminal covers. To determine that the equipment is operating properly, turn on the Display Terminal as described in paragraph 2-2, type in all characters, and exercise all functions. Then send the CPU a message which will elicit a reply that can be used to check out the receive mode of operation.

SECTION 3

THEORY OF OPERATION

This chapter contains theory of operation. The major components and signal flow are shown in figure 3-1, a simplified block diagram.

Keyboard assembly A11 provides a specific six-bit digital code for each character. The character is inserted into delay-line refresh-storage A15 where it circulates continually around the refresh memory loop. It is amplified after the delay-line attenuation and fed out once/frame to digital-to-analog (D/A converter circuits in monoscope deflection amplifier A3.

The purpose of the monoscope deflection amplifier is to convert the digital information (which represents the letter 'A', for example) figure 3-2 to analog information and to develop monoscope X- and Y-deflection voltages which will cause the monoscope beam to paint across the letter 'A'. The 'A' output from the monoscope is then amplified by monoscope preamplifier A7 and video amplifier A8 before it is applied to the cathode of display CRT V2.

The system is synchronized by the master oscillator circuit on circuit board A14. The oscillator on the circuit board drives the timing circuits to provide the following signals.

a. Timing pulses that control when the keyboard character is to be inserted into the register

b. Horizontal amplifier signals for the horizontal sweep on the display CRT

c. Vertical amplifier signals for the vertical sweep on the display CRT

d. Blanking pulses

The presentation on the display consists of 13 horizontal sweeps approximately 0.3 inch apart. The 583-kHz sine wave is applied to the minor vertical deflection coil, increasing the apparent line width to a letter height of 0.17 inch. This sinusoidal signal, (known as the minor vertical expansion voltage) corresponds to the sine wave that is sweeping over the letter 'A'. The resulting video signal is amplified and applied to the display CRT, thus duplicating this letter on the CRT.

When the XMIT (on keyboard assembly A11) is pressed, the information is extracted from delay-line memory circuit A15 and processed by the display logic circuit on circuit board A13, the control logic circuit on board A12, and discrete circuits on board A14. The information, in the form of a series of digital signals, is dispatched from the Display Terminal. The operation is as follows.

An output from the display logic circuit (part of board A13) is fed to the dataphone interface storage registers on board A12. Three storage registers are used to smooth the data so that it can be transmitted at a slower rate over the telephone line. Since the line transmits up to 1200 bits/second (this corresponds to 833 μs/bit), the information from the input to the character readout register (part of board A13), which is at a rate of 3.43 μs/bit, is stored in three consecutive storage registers. The message is then picked off at the reduced rate of 1200 bits/second. When the message is being received, this process is reversed. The dataphone interface mode control and timing section of board A12 provides or uses the following functions:

a. A 1200-Hz counter which controls the bit transmission rate into the phone line

b. The start-of-message control circuit

c. The end-of-message control circuit

d. The carriage return decode circuit in the transmit and receive modes

e. The parity generator and parity check circuits

Low voltage power supply A4 furnishes a +22 vdc, +100 vdc, +5 vdc, -22 vdc, and two 6.3 vac outputs. High voltage power supply A5 furnishes +12 kvdc, +500 vdc, and -1.2 kvdc outputs.

3-1 DISPLAY TERMINAL CHARACTER GENERATION (Figure 3-1)

When the 'A' key on keyboard assembly A11 is pressed, the binary signal for 'A' is put on the six data lines as follows:

Lead	Signal Level
FX0	1
FX1	0
FX2	0
FY0	0
FY1	0
FY2	1

The six-bit digital information is applied to the character entry and readout register (part of circuit board A13), which causes the bits to be placed in sequence. The data is then fed through a portion of the display logic (also part of circuit board A13) to delay-line refresh-storage A15.

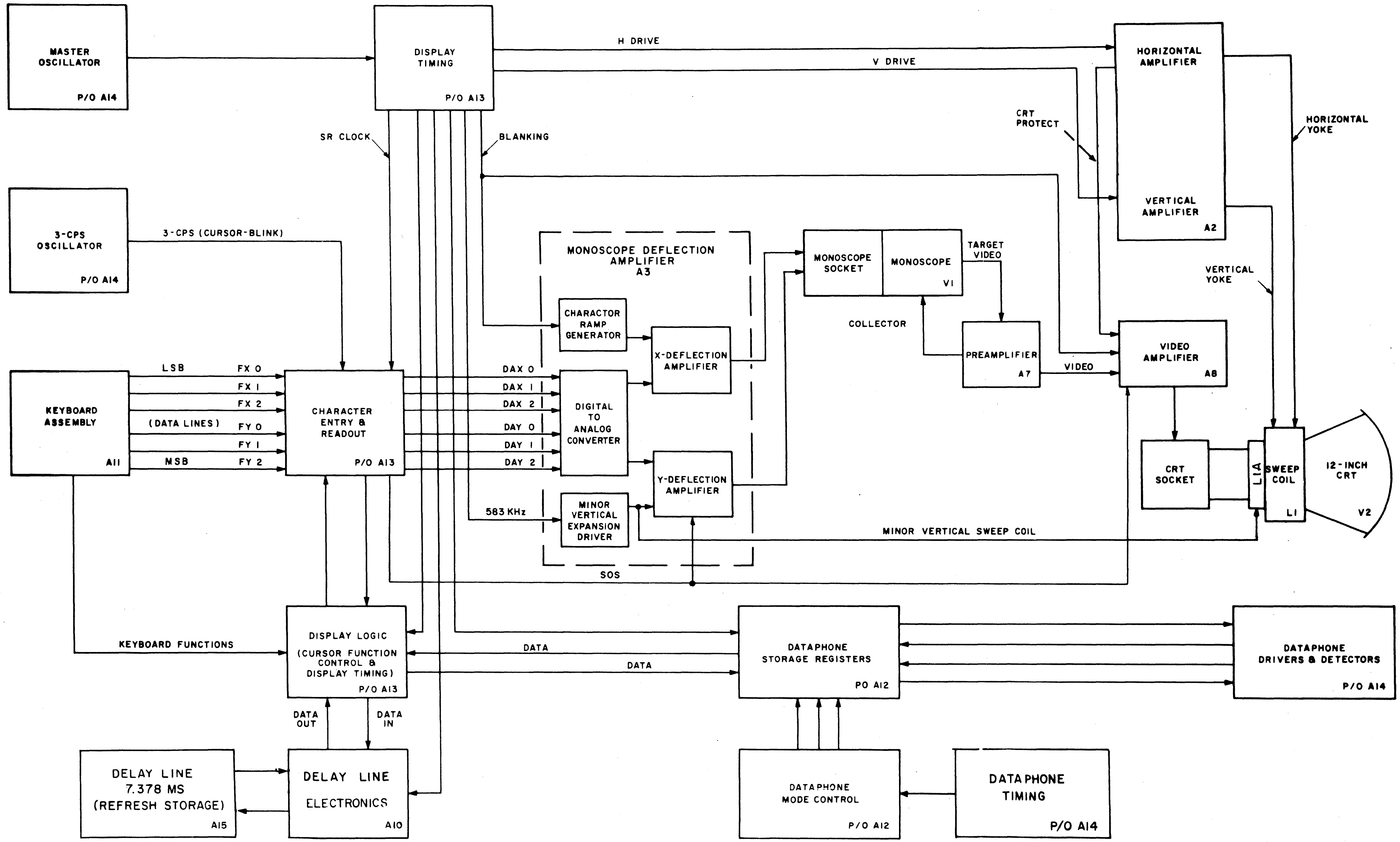


Figure 3-1. DIDS-402-2M10 Display Terminal Block Diagram

The delay-line refresh-storage circuit consists of amplifier A10 and a 7.378-ms magnetostrictive delay line, A15. The six-bit digital information that was inserted in the refresh-storage is fed back through a part of the display logic to the character entry and readout register to complete a cycle. It continually circulates around the loop. The character readout register (a group of flip-flops) stores the six bits and applies them to the digital-to-analog (D/A) converter circuits of monoscope deflection amplifier A3.

The six bits of data at the output of the character readout register are designated as:

DAX0 DAX1 DAX2	X-Deflection	DAY0 DAY1 DAY2	Y-Deflection

3-1.1 X-Deflection. The three least significant bits (LSB's), DAX0, DAX1, and DAX2, are converted from digital information to analog information in the D/A converter of monoscope deflection amplifier A3. This analog voltage is combined with the ramp and skew voltages, amplified by the X-deflection amplifier, and applied to the X-axis deflection plates in the monoscope.

The X-axis analog voltage positions the beam on the appropriate vertical column of characters. The ramp voltage (a simple sawtooth) derived from each unblanking pulse moves the beam from the left to the right side of each character. (The ramp generator is located on the A3 board.) The 'skew in-1' (derived by sampling the Y-deflection voltage) is a correction voltage used to compensate for any slight angular difference between the X-axis line of characters and the X-axis sweeps. Figure 3-2 shows the monoscope character generator technique. Figure 3-3 is the modified ASCII (American Standard Code for Information Interchange) character matrix used in the monoscope.

3-1.2 Y-Deflection. The three most significant bits (MSB's), DAY0, DAY1, and DAY2, are converted from digital information to analog information. The resulting analog voltage is combined with the minor vertical sweep expansion and the skew voltage, amplified by the Y-deflection amplifier, and applied to the Y-axis deflection plates in the monoscope.

The Y-axis analog voltage positions the beam on the appropriate horizontal line of characters. The 583-kHz sine wave modulates the Y-axis analog voltage so that the beam paints up and down over the character height. The 'skew in-2' (derived by sampling the X-deflection voltage) is a correction voltage used to compensate for any slight angular difference between the Y-axis line of characters and the Y-axis sweep. As the beam sweeps up and down at 583 kHz, it moves rapidly from left to right across the character. When it strikes the character, it varies the output current in the input circuit of the monoscope preamplifier A7, causing the voltage to change and appear as video. This video is further amplified by video amplifier A8 and applied to the cathode of the display CRT. The 583-kHz voltage applied to the minor vertical sweep coil (about the neck of the CRT) is produced from the same circuit that generated the 583-kHz voltage sweeping across the letter in the monoscope tube. Thus, the letter is reproduced on the display CRT. The Shift Off Screen (SOS) signal

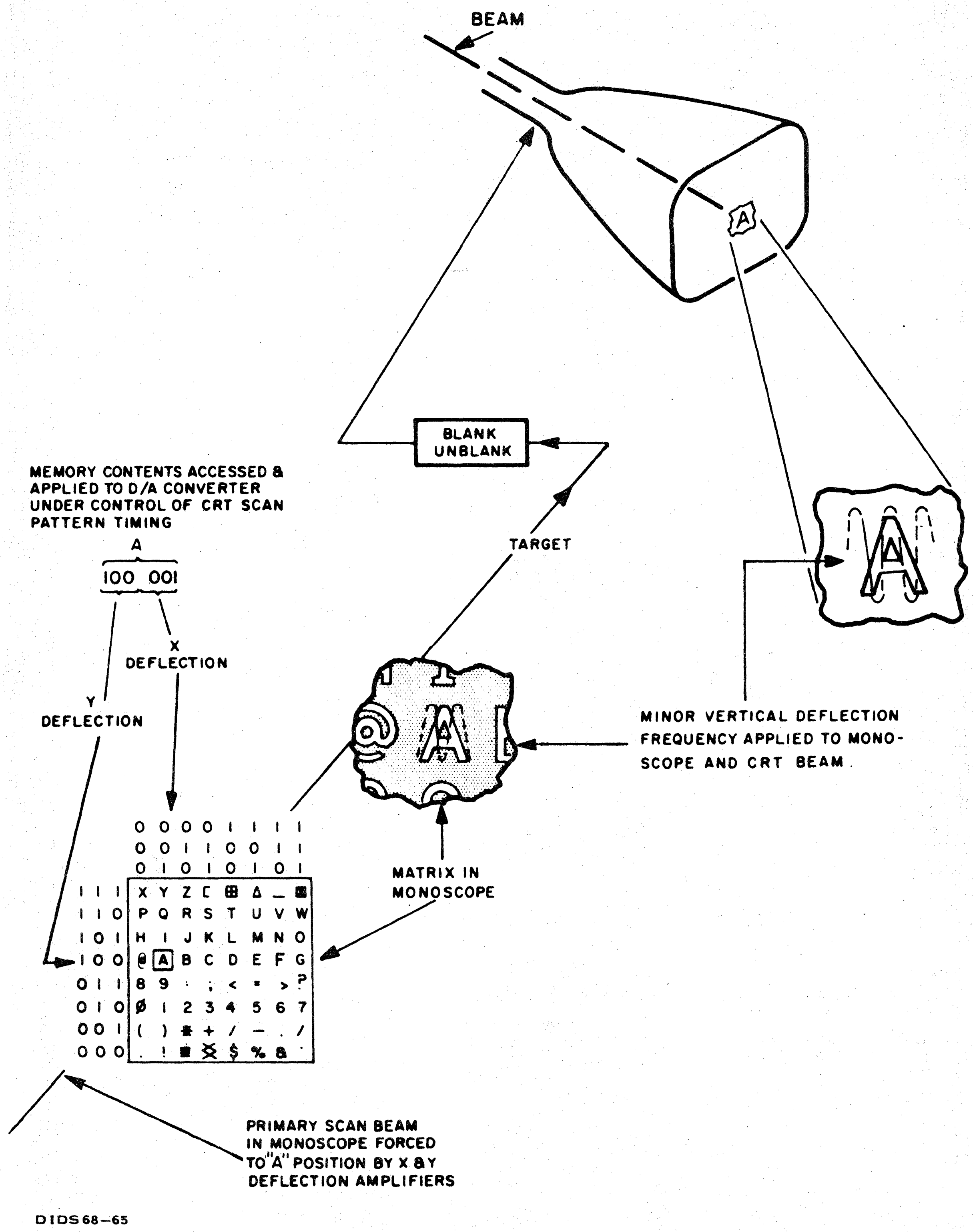
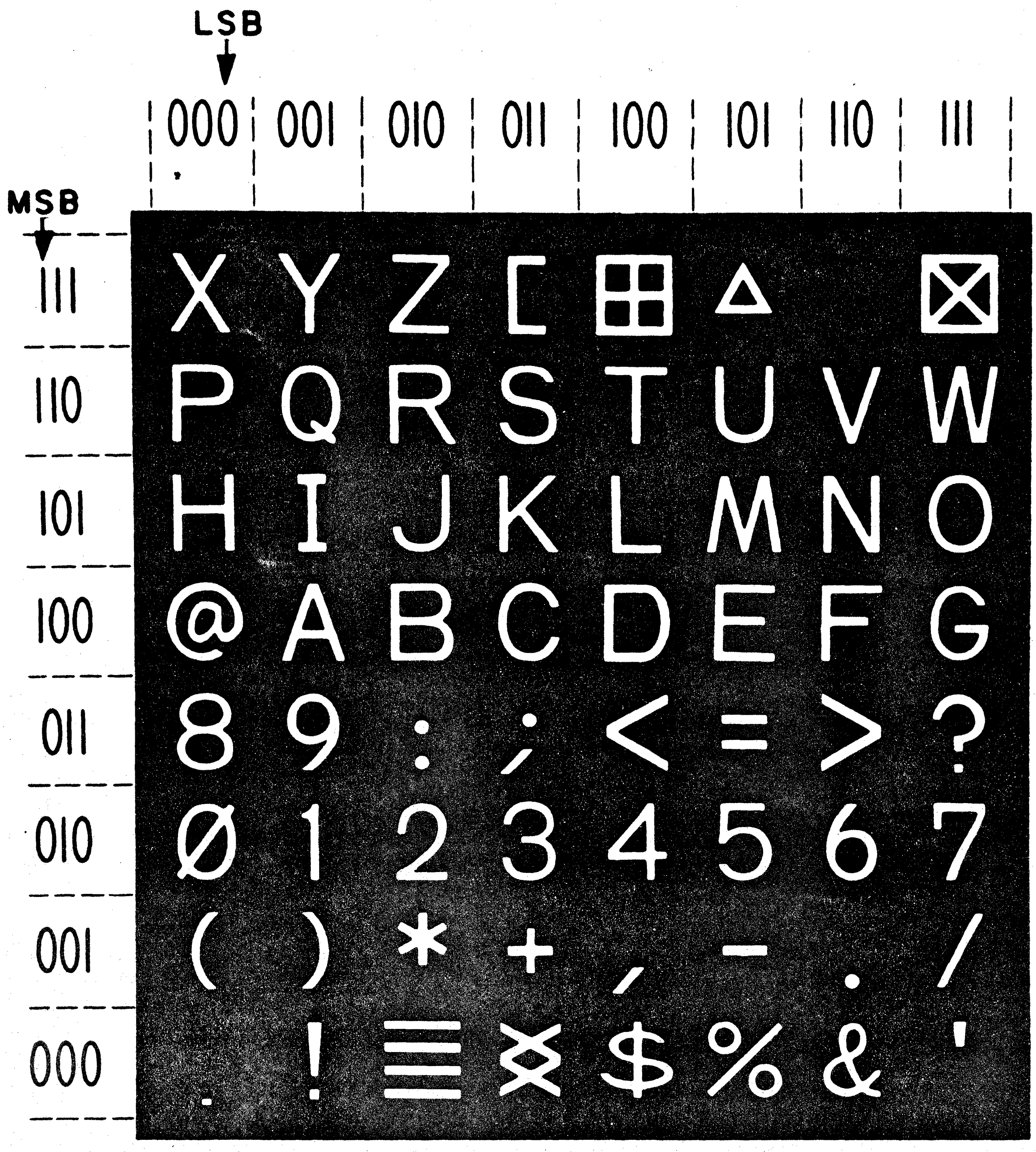


Figure 3-2. Monoscope Character Generator Technique



DIDS67-2

Figure 3-3. Modified ASCII Character Matrix Showing Digital Code is applied to the D/A converter and used to position the monoscope beam off-screen when the code of 000 000 is located in the entry register. The generation of the CRT raster is discussed in paragraph 3-4.

3-2 DISPLAY TERMINAL KEYBOARD

The detachable keyboard uses keys which incorporate a magnetically actuated reed switch. A diode matrix is used to produce the proper binary code from the single switch closures. Figure 3-4 shows a simplified keyboard system, including a part of the diode matrix. When the 'A' key (for example) is pressed, voltages appear on the X_0 and Y_2 lines, and the coding diodes conduct to produce output levels on the appropriate lines. Thus, the binary code for 'A' is produced by pressing the 'A' key:

X_0	X_1	X_2	Y_0	Y_1	Y_2
1	0	0	0	0	1

Gating and delaying logic circuits are provided to jam the code into the readout register and then into the memory circuit.

3-3 DISPLAY TERMINAL VIDEO AMPLIFICATION

Monoscope preamplifier A7 and video amplifier A8 amplify the video associated with the character being scanned by the monoscope beam and intensity-modulate the beam of the CRT for viewing. Each receives its power from low-voltage power supply A4.

a. The monoscope preamplifier has the following signal input/output:

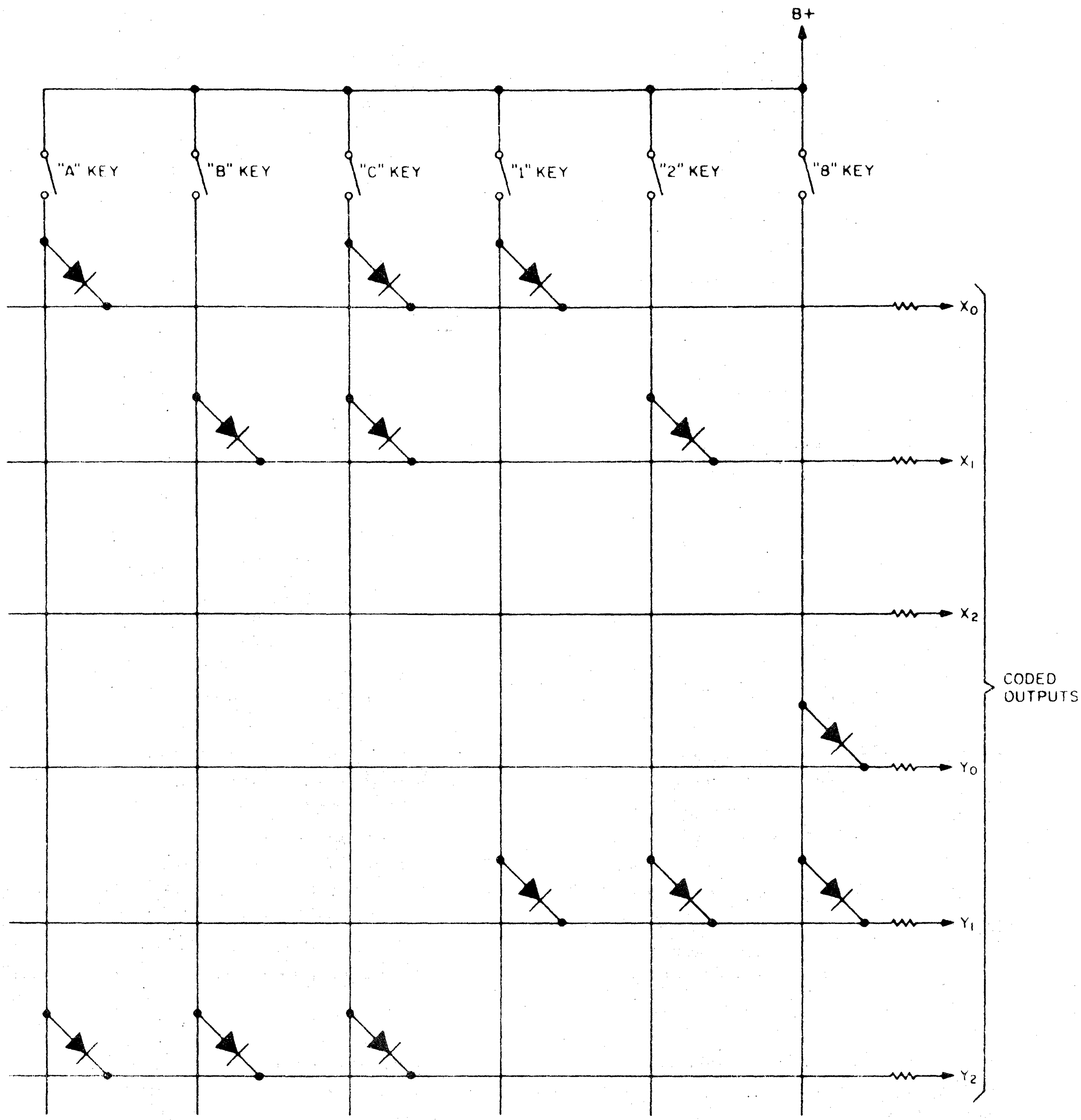
(1) The input signal video from the monoscope tube is present whenever the sweep crosses a part of a character. The current path is from the monoscope target through the input circuit of the preamplifier and back to the collector of the monoscope.

(2) The amplified video output is fed through 75-ohm coax to the video amplifier.

b. The video amplifier receives four input signals and a control voltage and produces two outputs as explained below:

(1) A video signal is received from the monoscope preamplifier. This video corresponds to the character that the monoscope beam is scanning. The signal video is amplified and then applied to the cathode of CRT V2.

(2) A blanking signal is received from timing board A14. This signal cuts off the video amplifier between characters, effectively blanking the CRT during the positioning time required for the monoscope beam to switch from one character to another and during horizontal and vertical retraces.



CHARACTER DISPLAYED	MODIFIED ASCII CODE
A	100001
B	010001
C	110001
1	100010
2	010010
8	000110

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Figure 3-4. Simplified Keyboard System (Showing a Part of Diode Matrix)

(3) The SOS signal is received from the control logic board. The signal cuts off the video amplifier when the code of 000 000 is located in the video entry register.

(4) The CRT protection signal and the brightness level are connected to the CRT grid.

(5) The brightness control, located on the side of the chassis, adjusts the brightness of the display.

(6) The amplified video is sent to the CRT cathode.

3-4 DISPLAY TERMINAL RASTER GENERATION

The raster is generated by horizontal and vertical deflection amplifier A2 and minor vertical sweep driver A3.

The horizontal deflection amplifier receives a horizontal drive trigger which starts a sawtooth generator. The resulting sawtooth is amplified and applied to the horizontal deflection coil as a linearly increasing current. Thus, the beam moves horizontally across the face of the CRT (figure 3-5).

If there were no vertical deflection, the sweep would be perfectly horizontal. As soon as the vertical deflection begins to push the sweep downward, however, the sweeps are no longer horizontal but decline as they move across the face of the CRT (figure 3-5B). To correct this unwanted movement, a sawtooth is taken from the horizontal deflection amplifier and applied to the vertical deflection amplifier as a corrective 'skew-out' voltage. As the beam sweeps across the tube, the effect of this voltage is to maintain a constant vertical deflection current until the end of the sweep. Thus, the sweeps remain perfectly horizontal (figure 3-5C). The CRT protect circuit detects the negative peak of the horizontal sweep. When the horizontal sweep is not present, the CRT grid is grounded. This cuts off the CRT, which would normally be painting one extremely intense vertical line, and thereby prevents damage to the CRT phosphor.

The vertical deflection amplifier receives a vertical drive trigger which starts a sawtooth generator. The resulting sawtooth is combined with the 'skew' voltage, amplified, and applied to the vertical deflection coil. Thus, the sawtooth which drives the sweeps downward has a horizontal step for each horizontal line during the time that the horizontal sweeps occur (figure 3-5C). The CRT protection circuit in the horizontal deflection amplifier operates in the same way, except that it has a longer time constant. If the vertical sweep is not present, the CRT grid is grounded. This cuts off the CRT, which would otherwise be painting one extremely intense horizontal line, and thereby prevents damage to the CRT phosphor.

The minor vertical sweep voltage consists of a sine wave from monoscope deflection amplifier A3 (figures 3-1 and 3-5E). When the controls are properly adjusted, only the characters are visible. If the minor vertical sweep signal is absent and the brightness potentiometer on the control panel is turned up, nar-

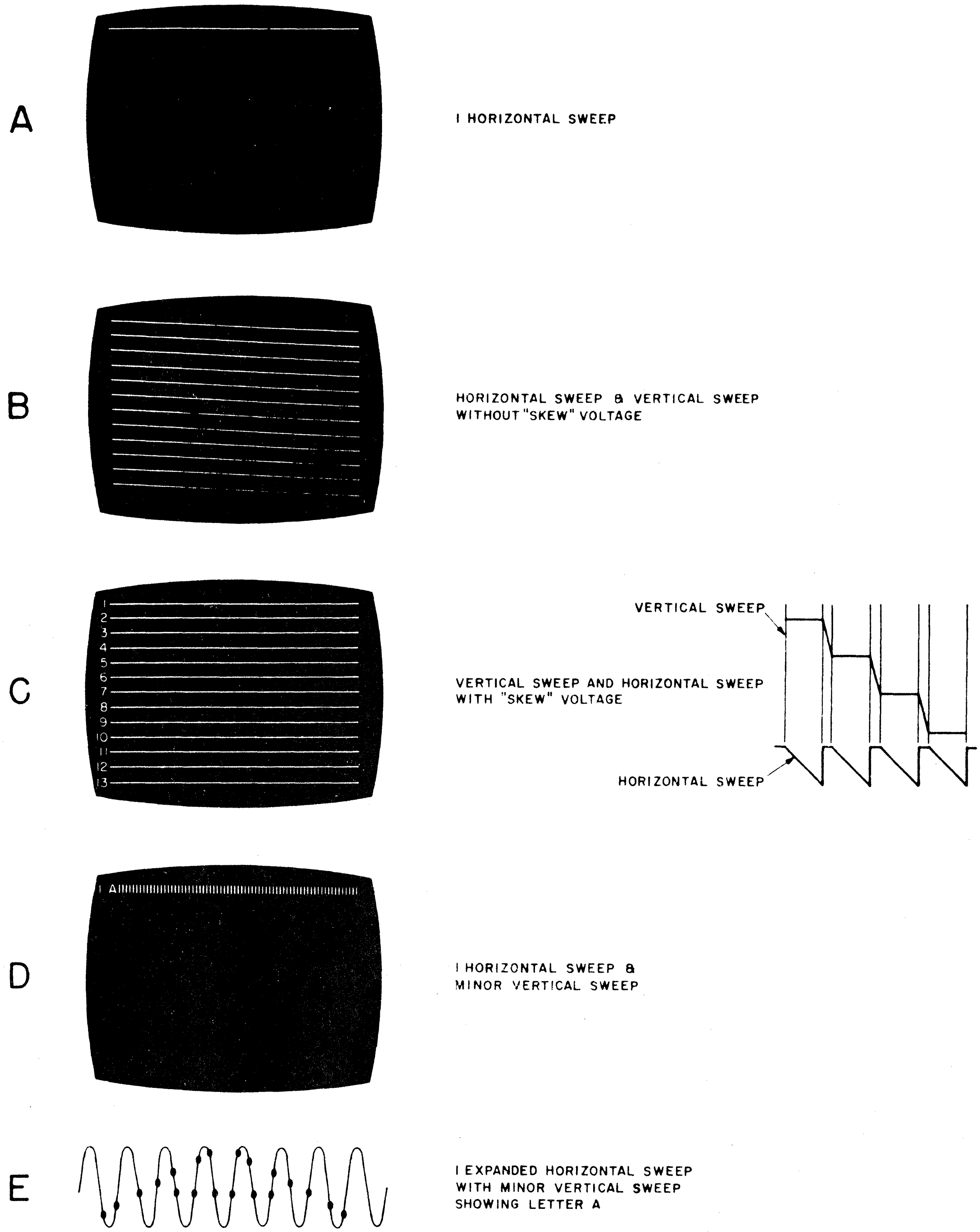


Figure 3-5. Raster Generation

row horizontal lines will appear on the CRT. When the minor vertical sweep voltage is present, lines, each approximately one character height in thickness, will appear on the CRT (figure 3-5E).

3-5 DISPLAY TERMINAL POWER SUPPLIES

High-voltage power supply A5 is a compact, solid-state unit which furnishes regulated voltages of +12 kvdc, +500 vdc, and -1.2 kvdc.

Low-voltage power supply A4 is similar in construction to unit A5. It furnishes regulated voltages of +22 vdc, -22 vdc, +100 vdc, and +5 vdc. It also furnishes two 6.3-vac outputs. Optional wiring for 220-volt operation is:

	Power Supply Terminal
Input	11 and 14
Jumper	12 to 13

3-6 DISPLAY TERMINAL LOGIC

To understand more clearly the nature of the display terminal logic, certain factors of the characters and the cursor should be explained. Each character consists of a special six-bit code in the DIDS-400 System. All data transfer in serial form contains the LSB first. In the memory circuit, a cursor slot precedes the six data-bit slots. The cursor and six bits are circulated through the refresh memory (the cursor is attached to only one character in the whole message) as shown in figure 3-6. The cursor is merely a place marker in the refresh memory and has no meaning external to the memory; therefore, only the six data bits are extracted from each memory word for transmission. Since the computer uses ASCII, which is a seven-bit code, a conversion from six to seven bits must occur in the storage registers. A parity bit is added for the purpose of detecting errors generated in transmission. Since the computer and the DIDS-400 System are asynchronous (not synchronized by a common timing source), each character must have a start bit and a stop bit to ensure synchronism. Two bits are therefore added, one at the beginning and one at the end of the character, thus yielding 10 bits/character. The 1200 bits/second are equivalent to 1200 ÷ 10, or 120 characters/second. The logic circuits perform timing, display refresh, display editing functions, and data transmission to and receipt from the dataphone. These functions will be discussed in the following subparagraphs.

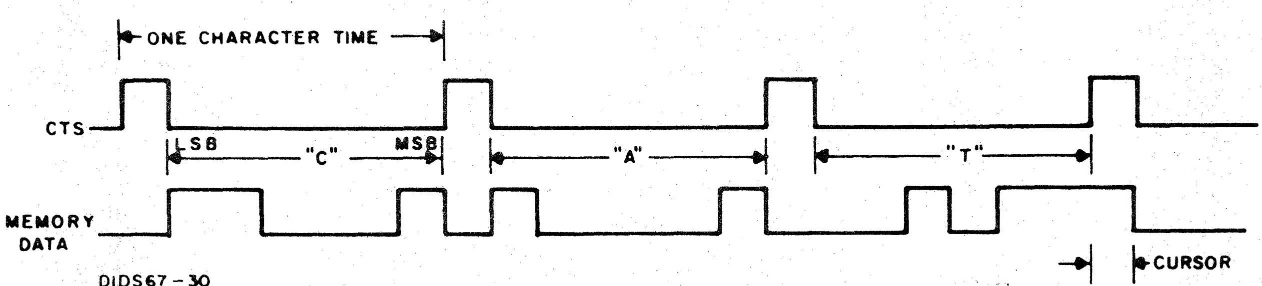


Figure 3-6. Memory Data

3-6.1 Timing Circuit. The timing circuit receives pulses from the master oscillator at a frequency of 1.1667 MHz. This clock pulse is counted down by a 2:1 countdown circuit to give a gate of approximately 583-kHz which is processed for use as the minor vertical deflection frequency (figures 3-7 and 3-8). In turn, the resulting frequency is counted down by another 2:1 countdown circuit to provide an approximate 291-kHz gate. By proper combination of the previous gates, four phases of clock pulses are produced. The phase 2, 291-kHz frequency is applied to a 7:1 countdown circuit. The resulting 41.667-kHz pulses are 24.0 μs apart; this time represents the character time. The 41.667-kHz pulses are applied to a 4:1 countdown circuit. The resulting 10.42-kHz pulses are 96.0 μs apart; this time represents the horizontal line retrace time and is equivalent to four characters. The 10.42-kHz pulses are applied to an 11:1 countdown circuit. The resulting 0.947-kHz pulses are 1056 μs apart; this time represents the horizontal line time, or the time taken to paint 40 characters plus horizontal retrace. The 0.947-kHz pulses are finally applied to a 14:1 countdown circuit. The resulting 67.7-Hz pulses are 14.784 ms apart; this time represents the frame time, or the time taken to paint 13 horizontal lines plus the vertical retrace. The vertical retrace time is equivalent to one horizontal line time.

The A14 board contains the following individually distinct timing circuits, in addition to the master oscillator.

a. A 3-Hz oscillator which supplies timing pulses for cursor blinking and generates a 6-Hz pulse, the speed at which a character or function can be repeated when in the cycle mode

b. A 1200-Hz oscillator that controls the rate at which information is clocked out to the telephone lines. This is described in paragraph 3-6.4.

3-6.2 Display Refresh. The display refresh loop consists of delay-line assembly A15, delay-line electronics A10, and a character entry register. The register is connected in series with the delay line and provides parallel access to the code of one character at a time. The intelligence frame is stored in the delay-line loop and is read out at the frame frequency to maintain the brightness of the characters on the Display Terminal screen.

The memory device used consists of an amplifier and a magnetostrictive torsional delay line which produces a 7.378-ms delay, and an amplifier following the delay line (figure 3-9). The information, in pulse form, is applied to the input transducers, which push one of the magnetostrictive tapes while pulling on the other. These tapes, which are welded to the transmission wire, convert longitudinal motion to torsional motion as the wire twists. This torsional motion travels down the cylindrical medium in a helical path at a longitudinal rate of approximately 4.5 μs/inch. When the torsional motion reaches the end of the wire, it is converted back to longitudinal motion by a push-pull force on the magnetostrictive tapes. The output transducer converts this motion into an electrical pulse. The pulse is then recirculated in the delay line to obtain the frame time.

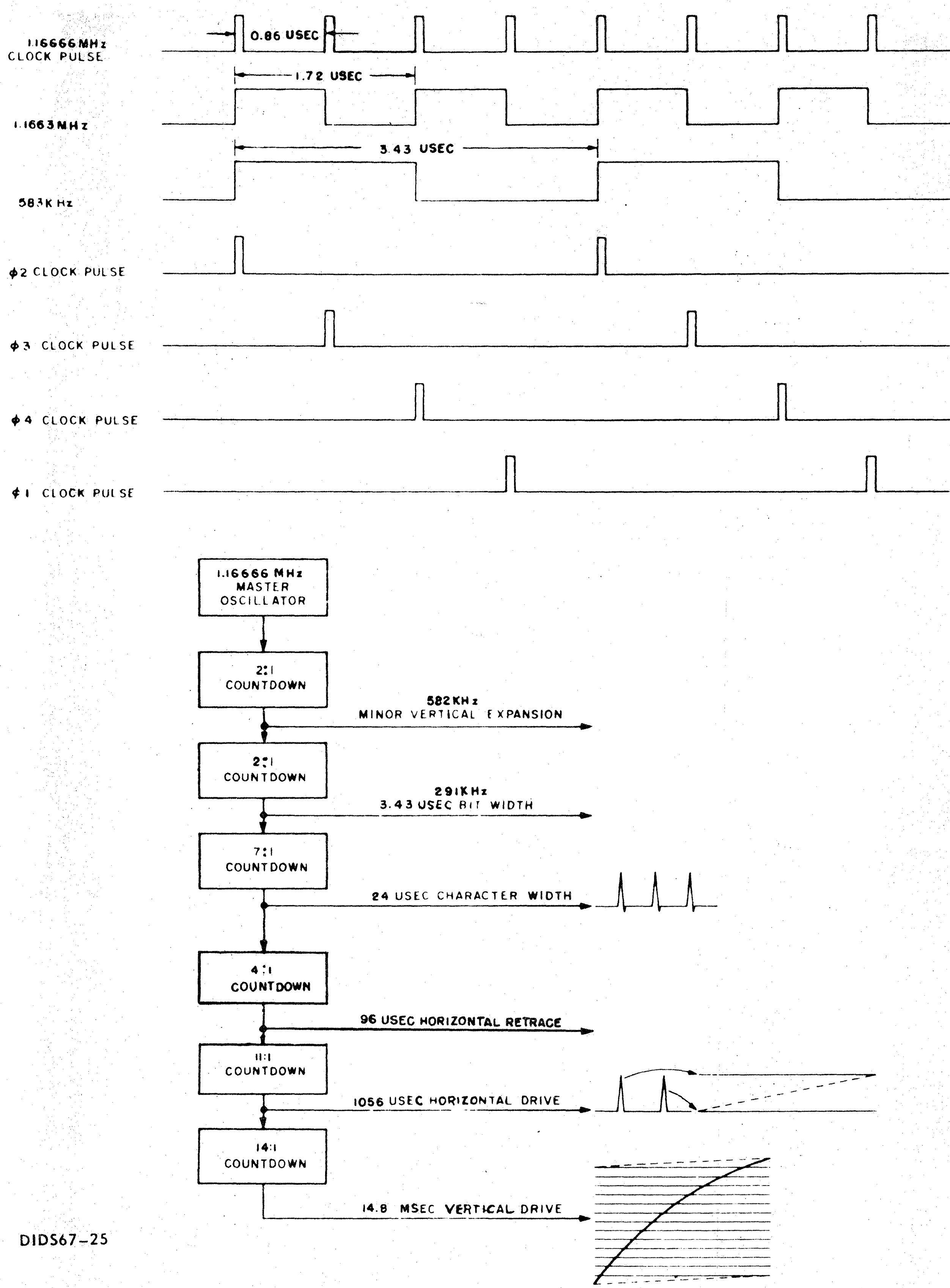


Figure 3-7. Timing Circuit Block Diagram

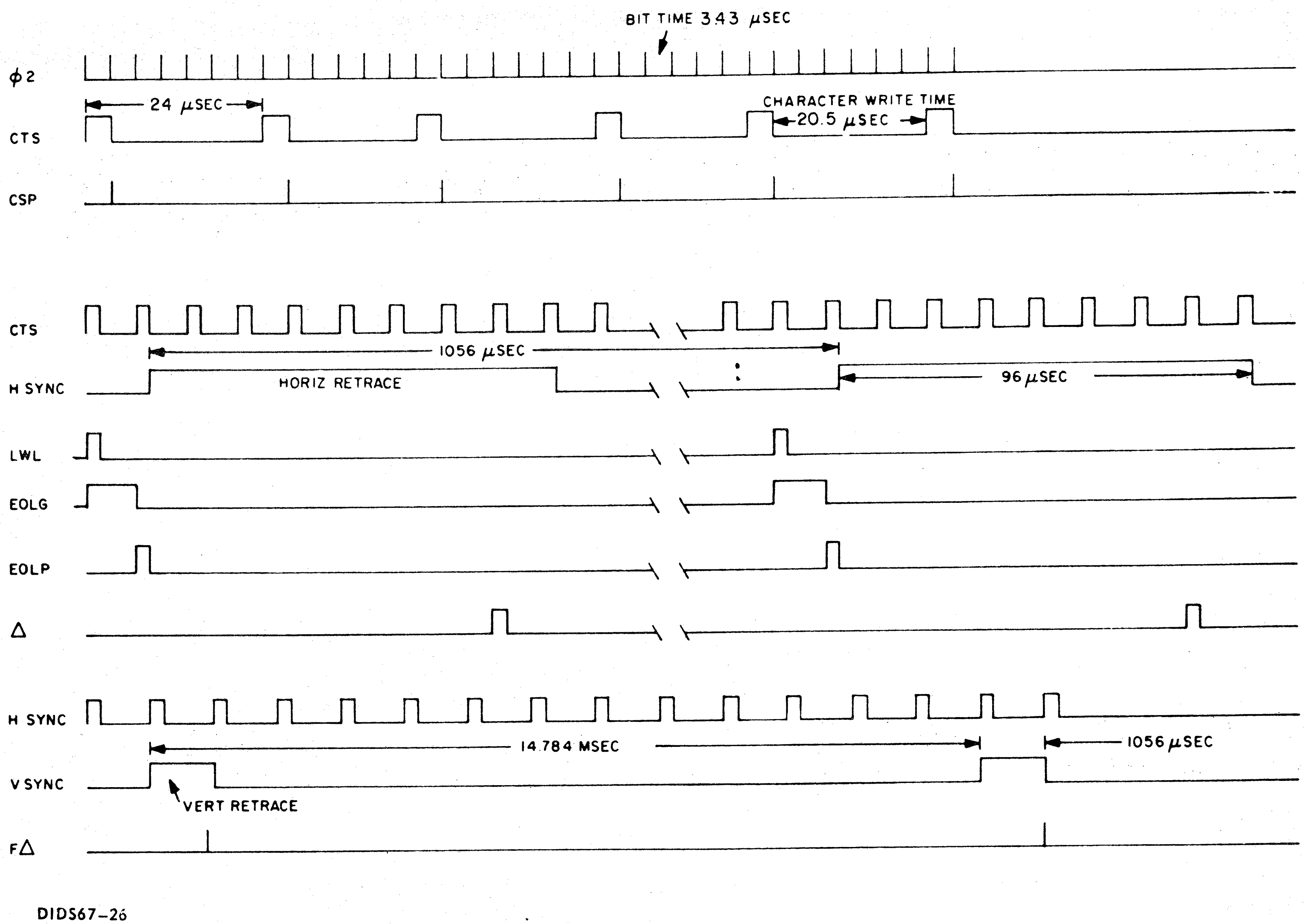


Figure 3-8. Timing Diagram

DIDS1402-2M10
Fig. 3-8

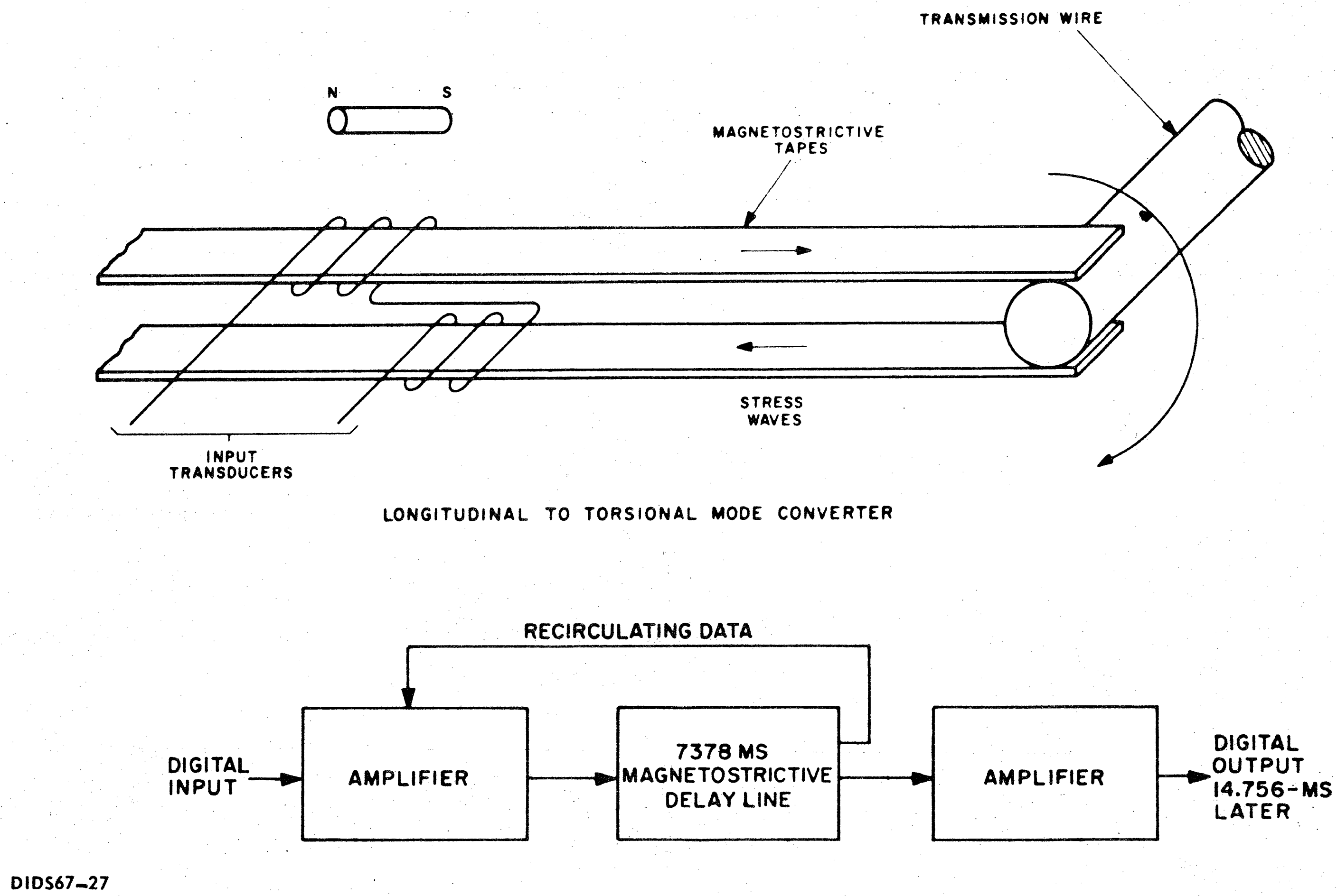


Figure 3-9. Delay Line Memory

When a complete character code is in the character entry register prior to being shifted into the delay line, it is strobed simultaneously into the six-character readout flip-flops and held for the duration of character time (figure 3-10). The output of the character readout circuit is fed to the monoscope deflection amplifier where it is converted from digital information to analog information to position the monoscope beam so that it sweeps across the target character.

3-6.3 Display Editing. The display editing circuits consist of the specific editing functions that take place before and after the character entry register functions.

The message from the delay line is fed into the display logic circuits (located on board A13), through the shift register, and then back to the display logic circuits prior to re-entering the delay line (figure 3-11). Access to the message is possible both before and after it goes through the shift register. The message is processed in the display logic circuits which can perform the following functions:

- Shift cursor to the left
- Shift cursor to the right
- Erase a line
- Erase a message
- Advance line
- Back line
- Return cursor to beginning of frame
- Insert
- Delete
- Cycle

The delay line stores the message minus one character. There is always one character in the shift register preparing to enter the display logic and then the delay line. In order to shift the cursor to the right, the cursor must be delayed in time by one character.

To accomplish this shift, the cursor is removed from its slot when it appears at the end of the shift register and is inserted at the beginning of the shift register in the cursor slot of the next character (figures 3-11 and 3-12). A similar process is used to shift the cursor to the left. The cursor must be made to occur one character time earlier. To do this, the cursor is removed from its slot after leaving the delay line, and inserted into the cursor slot of the character in the shift register. In effect, the cursor bypasses the trip through the shift register. It is then added to the preceding character, with the result that the cursor shifts to the left.

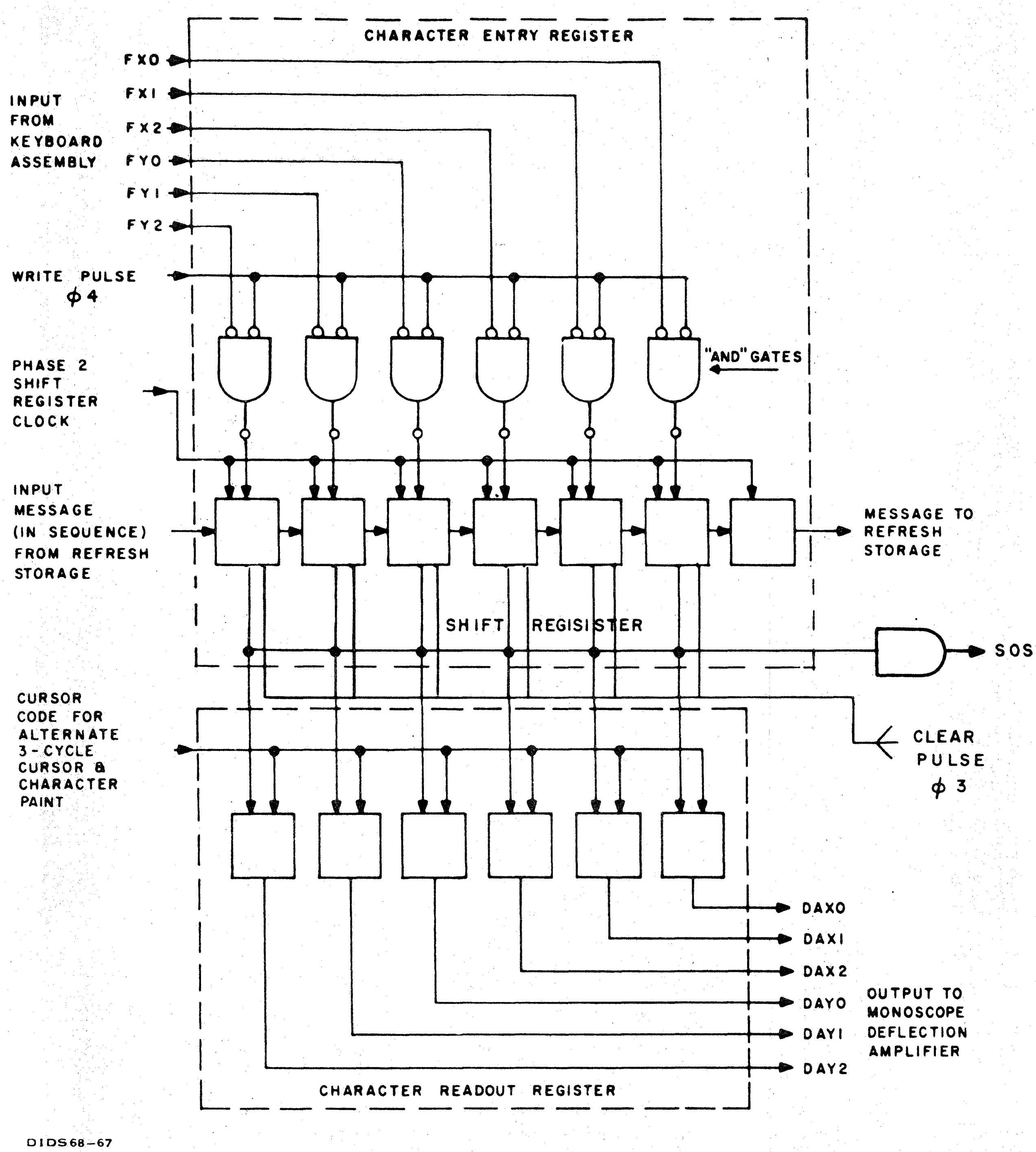


Figure 3-10. Character Entry and Readout

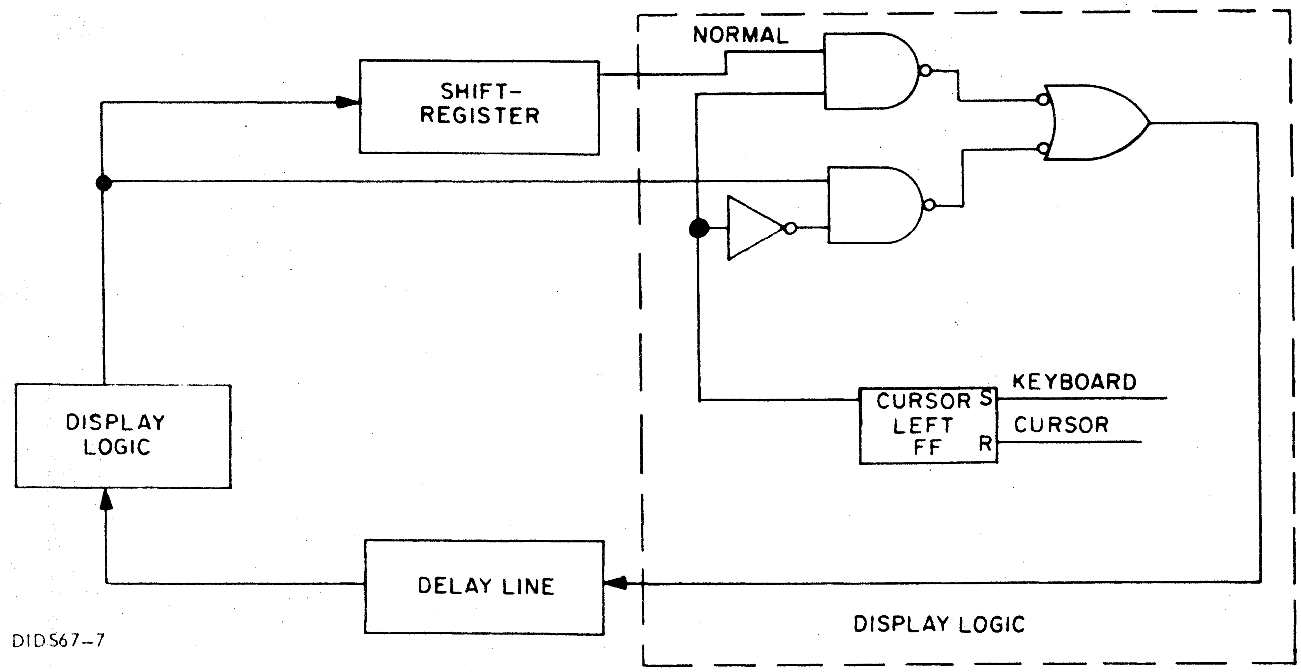


Figure 3-11. Display Editing Cursor Left Mode

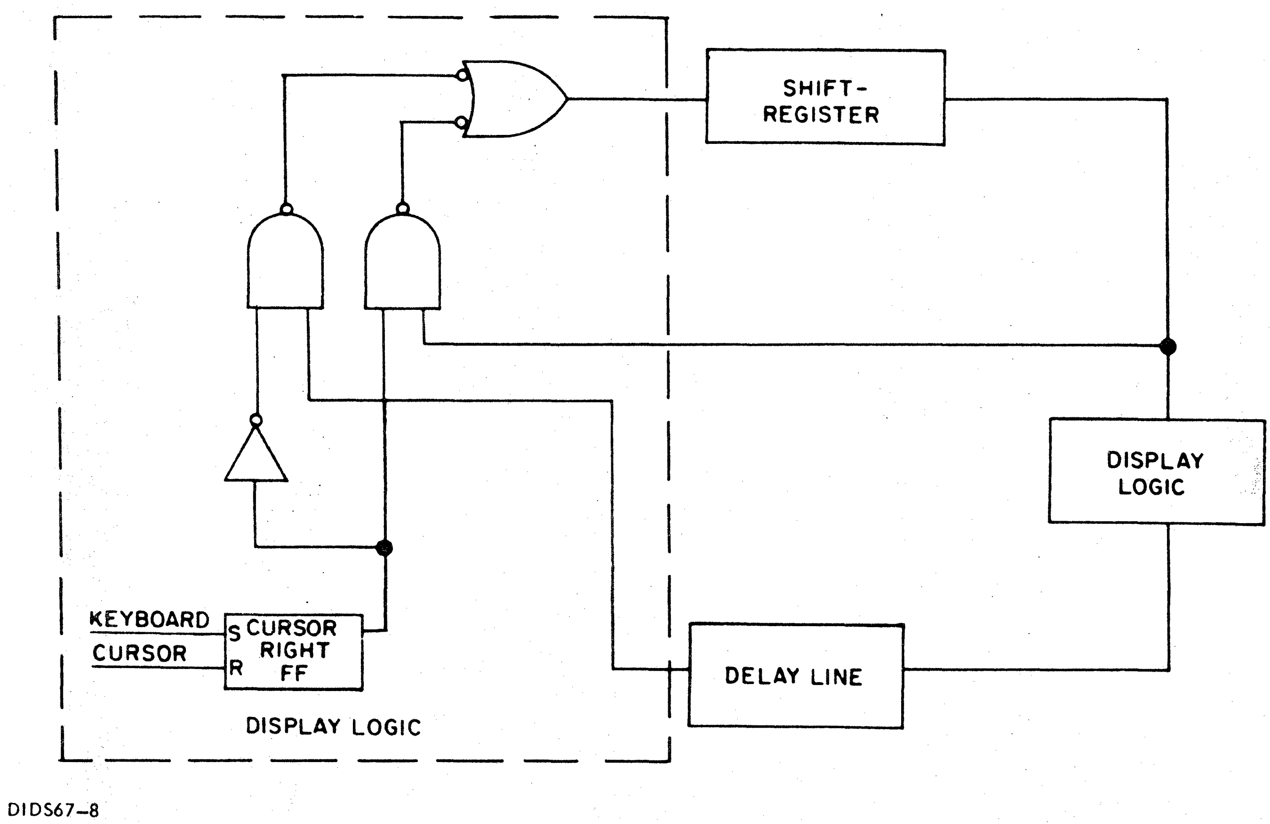


Figure 3-12. Display Editing Cursor Right Mode

To erase the message, a logical 0 is inserted into each bit slot to the right of the cursor bit. The frame pulse terminates this function and the line is erased in a similar manner. However, the last word of the line pulse terminates the function (figure 3-13). In order to advance the cursor to the next line, the cursor must be delayed in time until the first character slot of the next line occurs. To accomplish this, the cursor is removed from its slot and inserted in the cursor slot of the first word of the next line when it reaches the input to the shift register (figure 3-14). This function is terminated with the Δ pulse. To move the cursor to the first character slot of the previous line, the cursor must be advanced in time by the frame period minus one horizontal line time and the time remaining on the cursor line. This function is controlled by a counter which counts the number of active horizontal lines minus two (figure 3-15).

The insert function is accomplished with the aid of a second seven-bit shift register. To insert a character, all characters to the right of the cursor and on the same line as the cursor are delayed in time by one character period. The second shift register, which has the code of 0000000 stored, is allowed to become a part of the memory loop when the cursor is located in the first shift register.

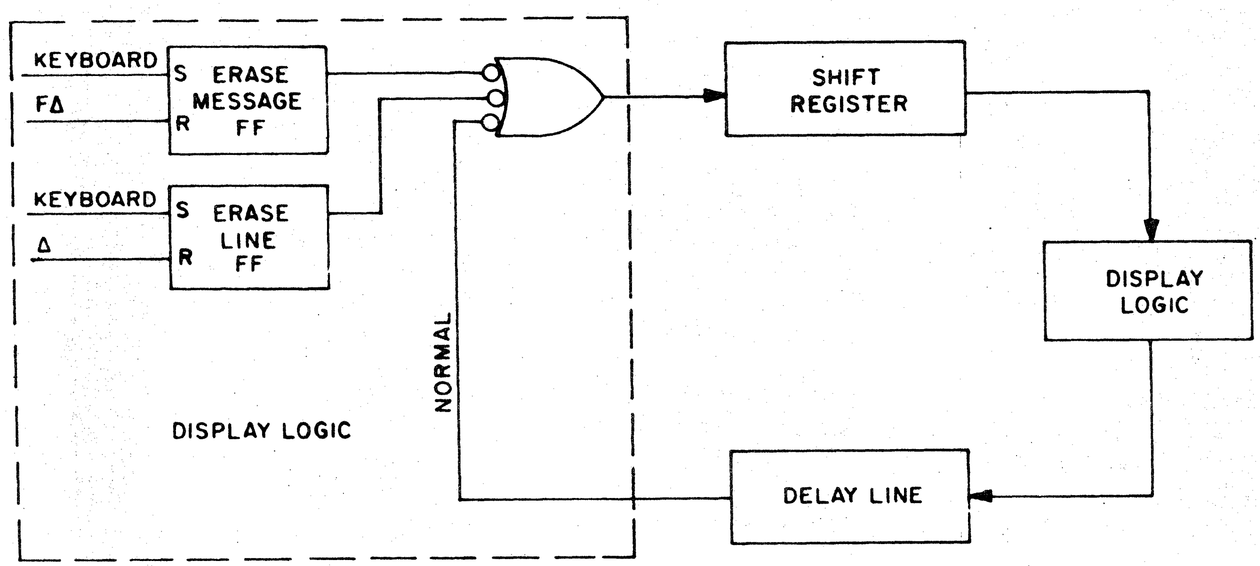
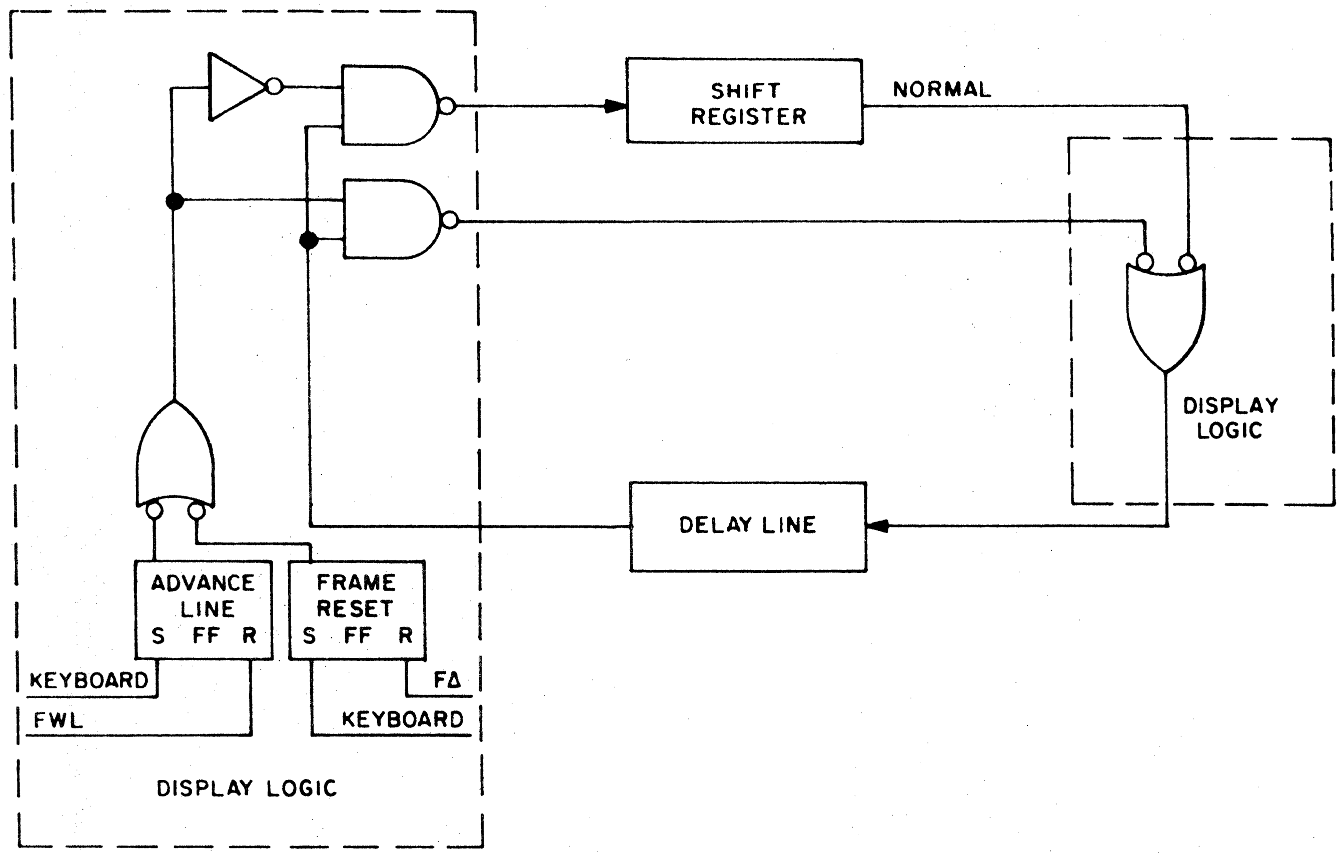
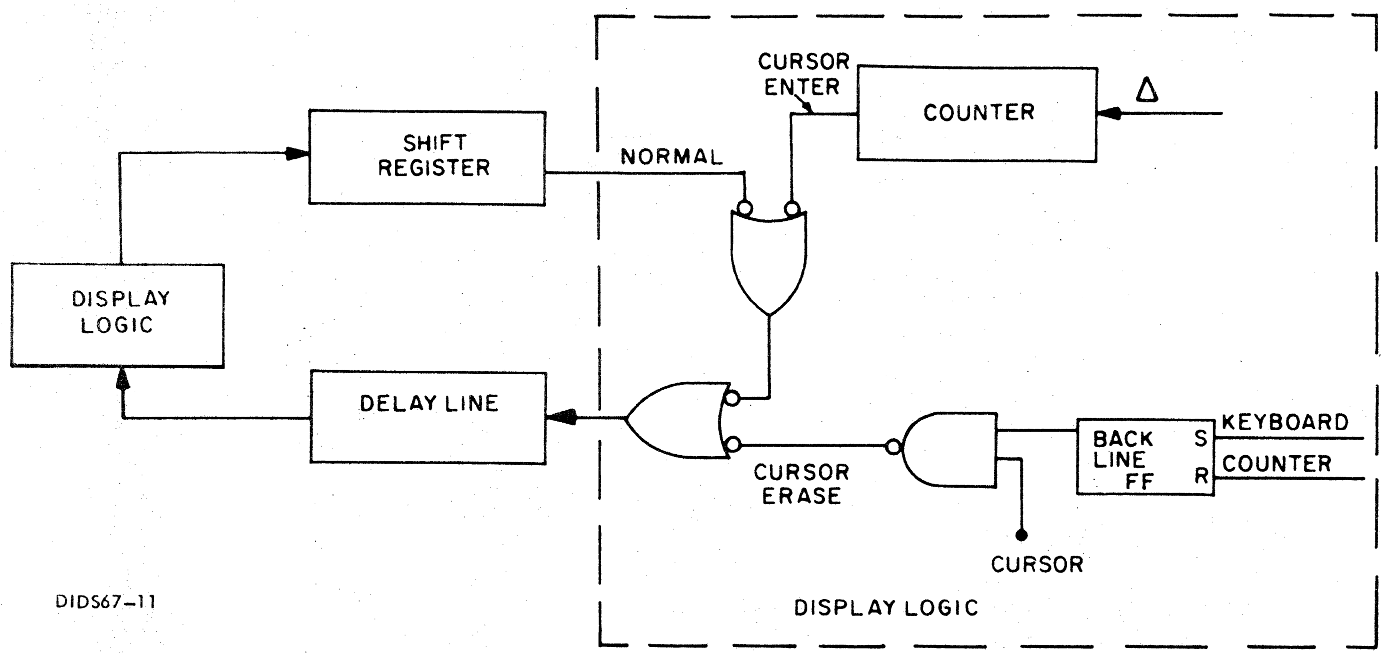


Figure 3-13. Display Editing Erase Mode

This inserts a new character of all 0's in the memory loop. The second shift register is removed from the memory loop when it contains the last word of the line. Therefore, the character that was in the last active slot of the line is removed from the memory loop (figure 3-16).



DIDS67-10 Figure 3-14. Display Editing Advance Line and Frame Reset Mode



DIDS67-11

Figure 3-15. Display Editing Back Line Mode

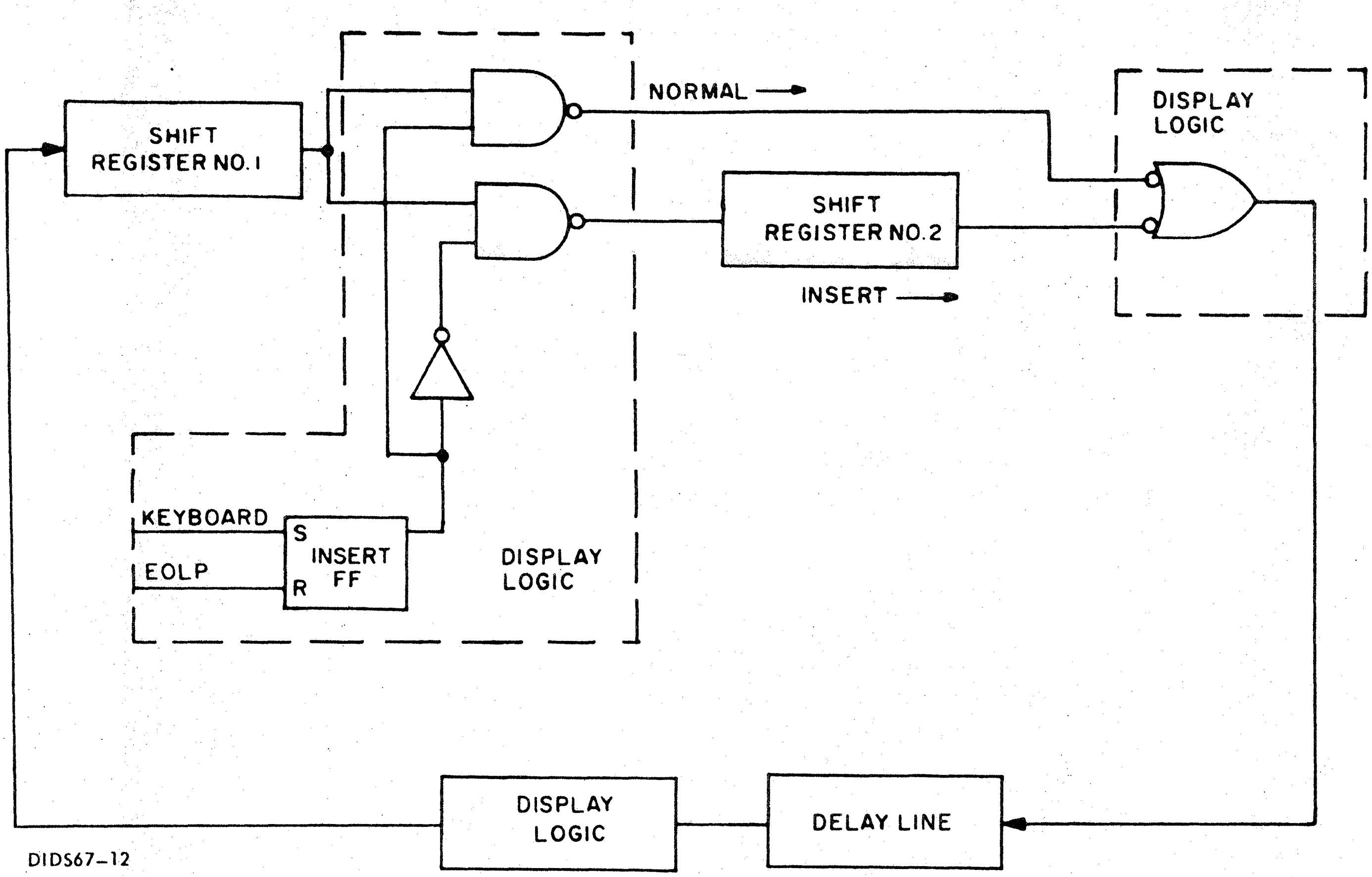


Figure 3-16. Display Editing Insert Mode

To delete a character, all characters to the right of the cursor on the same line as the cursor are advanced in time by one character period. When the character to be deleted is in the shift register, the remaining characters on the line are allowed to bypass the register. A character code of 000 000 is inserted as the last character of the line. This function is terminated by the end-of-line pulse (figure 3-17).

The cycle function allows the following to be performed at a rate of 6 Hz:

- Character entry
- Cursor right
- Cursor left
- Back line
- Advance line
- Insert
- Delete

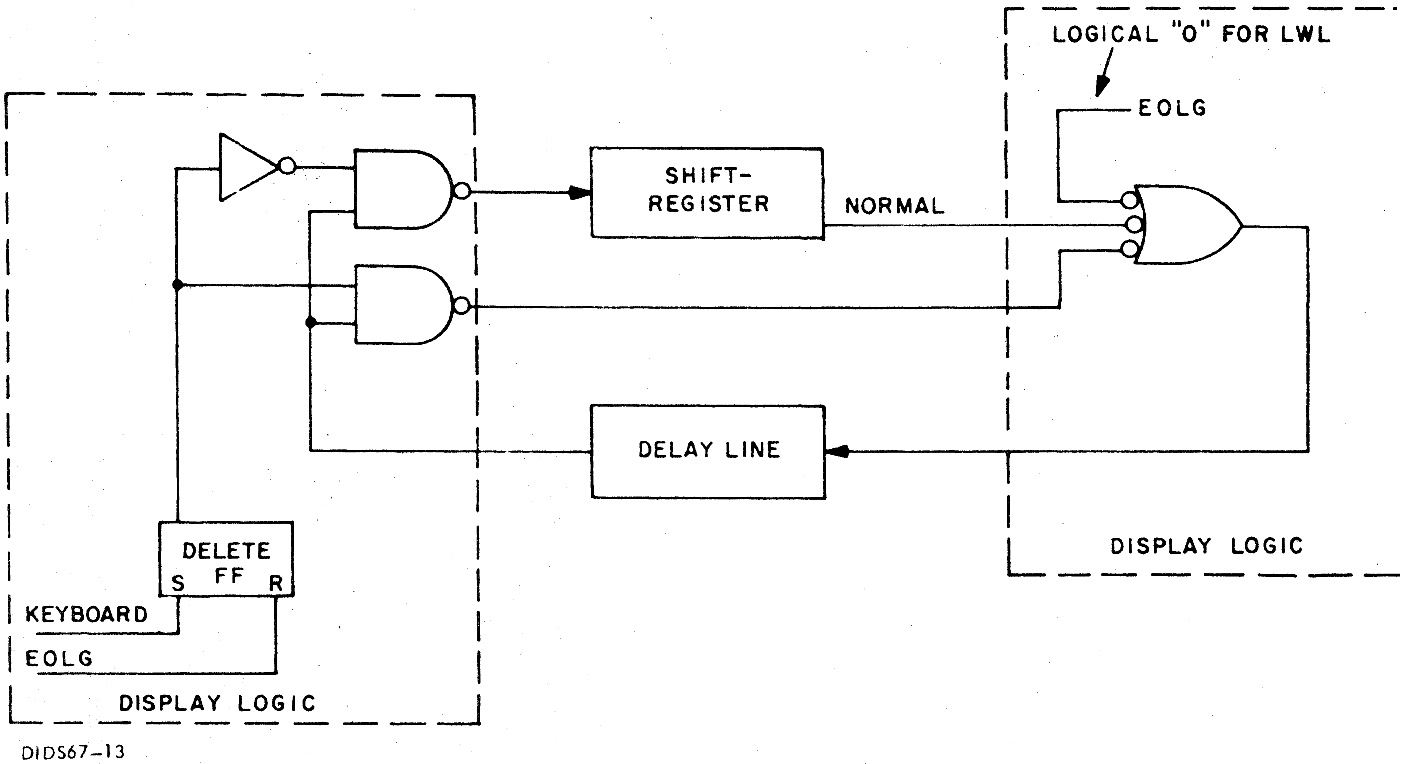


Figure 3-17. Display Editing Delete Mode

The operation of the character entry register can be explained easily. (The character entry and readout registers are both located on circuit board A13.) Assume that the desired message is the word 'CAT' and that the 'C' (in the form of six-bit digital information) is already circulating in the refresh memory and is on display. When the 'C' was entered, the cursor automatically stepped right one character slot. When the 'A' key on keyboard assembly A11 is pressed, the six digital bits, 100001, are applied simultaneously to the character entry register, which consists of one AND gate for each of these six bits followed by one flip-flop (or register) for each of these six bits (figure 3-10). When the six AND gates receive the 'write' pulse (this will happen immediately after the 'C' passes through the character entry register because the cursor appears in the next character slot), the six bits will be inserted into the flip-flops and will be shifted at the phase 2 clock-pulse rate through the editing logic into refresh storage (figure 3-18).

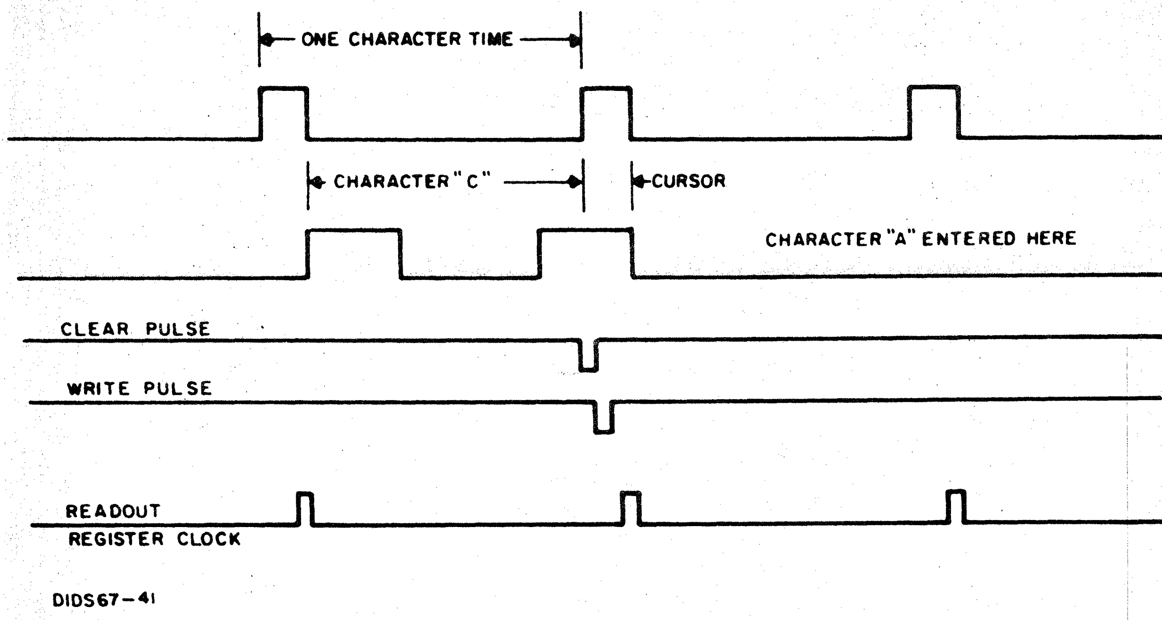


Figure 3-18. Character Entry Timing

3-6.4 Data Transmission and Receipt Logic. The following paragraphs describe the storage registers, the 120-character-second timing control, the transmit-receive mode control, and the dataphone drivers and detectors. The action of these circuits will be discussed in the following order: when equipment is in the transmit mode, when equipment is in the receive mode, word format and parity (or error detection), and modem control signals.

a. Transmission of message. The purpose of the registers is to provide what is called smoothing of the data. Since access to the data in the refresh memory loop occurs only once per frame, enough data must be extracted at the time the cursor is found to supply the 1200 bits/second (this corresponds to 833 μs/bit) until the cursor comes around again, one frame period later. In other words, when access to the data occurs, enough data must be extracted and stored to feed out at the 1200-Hz transmission rate until access to the delay line data is again possible. Between access times, 18 bits will be sent out at the lower transmission frequency. Therefore, at least 18 bits must be stored for smooth operation (hence the term smoothing). Three registers are provided, each of which will store six bits (figure 3-19). The steering logic is simply an electronic switch which selects either the message going from the delay line to the telephone line (XMT-transmit) or the message coming from the telephone line to the delay line (RCV-receive). Three steering logic circuits are controlled by the transmit-receive mode control logic circuit. Storage registers No. 2 and No. 3 consist of six flip-flops, and storage register No. 1 consists of seven flip-flops which receive and store the six binary bits representing a character until the shift-out pulses are applied. (The additional flip-flop in storage register No. 1 adds a seventh bit for compatibility with ASCII.)

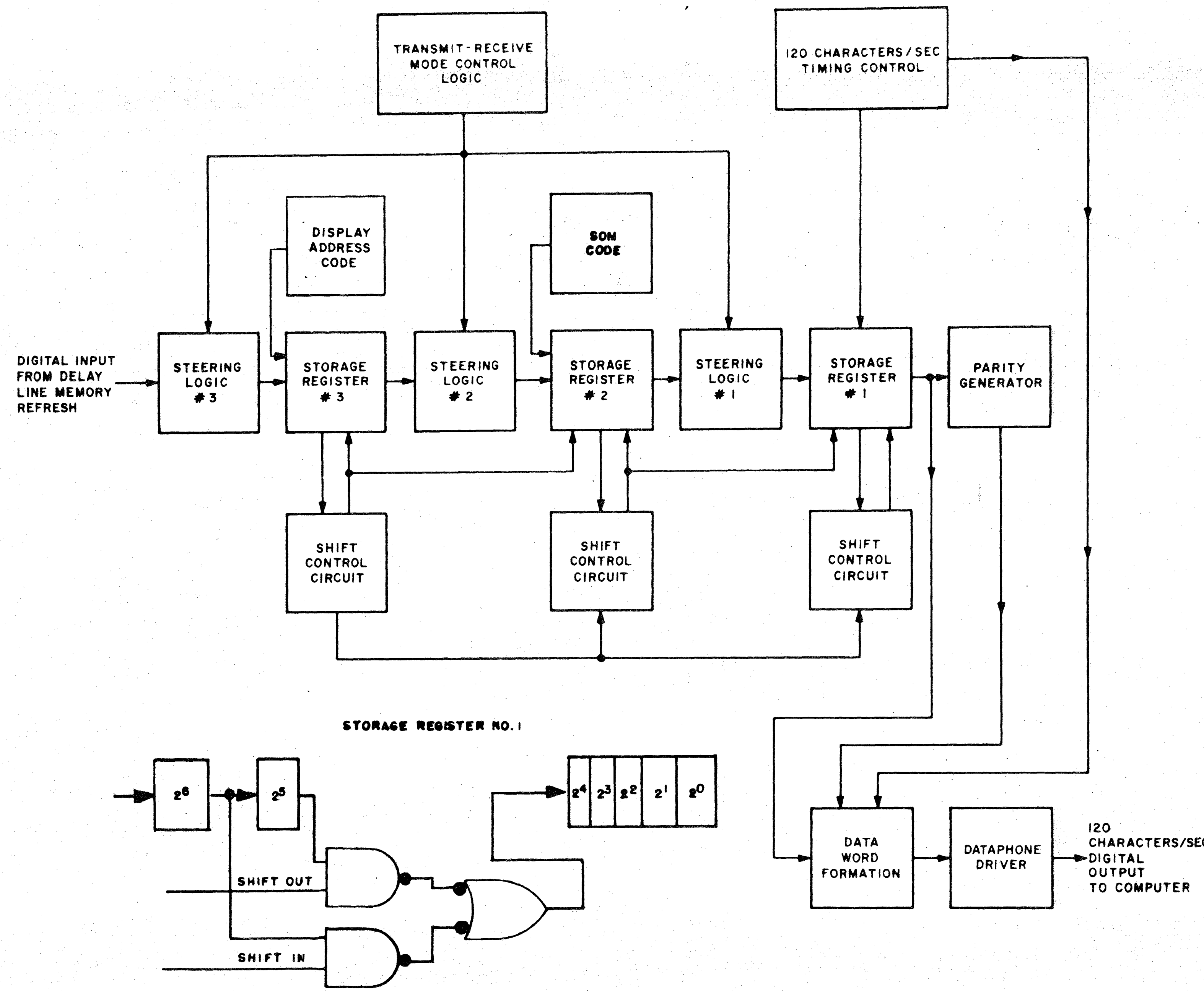
(1) After the operator types in the desired message, and the EOM (end-of-message) key is depressed, the cursor is reset to the first character to be transmitted.

(2) The operator presses the XMIT key. The STX (start of text) code is inserted into register No. 1; and the display address is inserted into register No. 2. When the first character leaves the delay line and the display logic, it is routed through steering logic circuit No. 3 into register No. 3. At this time, register No. 1 contains the STX, register No. 2 contains the display address, and register No. 3, the first character of the message. The cursor is automatically stepped right one character slot when a character from the refresh memory loop enters register No. 3.

(3) Data is shifted into register No. 1, bypassing the 2^5-bit slot in the register as shown in figure 3-19. The MSB, or 2^6-bit slot, is examined. If it contains a logical 1, then a logical 0 is inserted into the 2^5-bit flip-flop. If the MSB contains a logical 0, then a logical 1 is inserted into the 2^5-bit flip-flop. In the case of the ETX and carriage return codes, the six bits are decoded when they are in register No. 1; then the correct seven-bit code is inserted into register No. 1. The STX code need not be code converted since the seven-bit code is inserted, not shifted, into register No. 1.

	Six-Bit Code MSB LSB	Seven-Bit Code MSB LSB
STX	000010	0000010
ETX	000011	0000011
(CR)	111101	0001101

(4) The dataphone timing control circuit produces shift pulses for storage register No. 1 at a rate which is compatible with the 1200-bit/second limitation of the telephone circuits. The first message character is shifted through the data word formatting circuit where the parity generator addition, which will be described in paragraph 3-6.4c, takes place. The start and stop bits are also added here. The first message character is amplified in the dataphone driver and then sent from the logic circuits into the telephone line. The message is circulating through the memory loop at a rate much higher than the message pick-off rate. Note that as soon as storage register No. 1 is emptied, the data in storage registers No. 2 and 3 are moved ahead one register. Data are always moved ahead as soon as possible to make room for the removal of data from the delay line when the cursor comes around again. This process continues until the ETX code is found.



DIDS67-14

Figure 3-19. Logic Circuits in Transmit Mode

b. <u>Reception of message.</u> When a message is sent from the computer, the first character is the STX code, the second is the display address code, and the third is the first character of the text. Each character contains 10 bits: a start bit, seven data bits, a parity bit, and a stop bit. The start bit of each character is used to sync the incoming data to the DIDS-400. If the start-of-message and the proper display address codes are not present, storage register No. 1 does not shift, and therefore all succeeding characters are ignored. The incoming data is code converted at register No. 1 by shifting seven bits/character into the register and six bits/character out. The 2^5 bit is ignored when register No. 1 is shifting data into register No. 2 (figure 3-20). Data enters the memory loop at a maximum rate of two characters/frame. If registers No. 3 and 2 contain a character, when the cursor begins to enter the readout register, both characters will enter the memory loop. The cursor is stepped right automatically each time a character enters the memory loop. When the message is concluded, the ETX code is decoded and enters the ETX control circuit. This causes storage register No. 1 to stop shifting and no further information is sent into the refresh memory loop. The circuits are freed from the control of the computer and returned to the operator who may transmit another message if desired.

c. <u>Word format and parity.</u> As previously mentioned, a character code is carried internally as six bits. Since the standard ASCII coding uses seven bits, a code conversion from six to seven bits must be performed in storage register No. 1. The total transmitted character code, which contains 10 bits, begins with a start bit (a logical 0). This is followed by the seven-bit character code, a parity bit, and the stop bit (a logical 1). Since this is an even parity system, the parity bit is generated so that the total count of logical 1's in the transmitted word (excluding start and stop bits) is an even number. In the receive mode, parity is checked in the same way. If the count of 1's is not an even number, the error code is substituted for the character code received. Thus, the operator knows that a malfunction has occurred. He can then obtain clarification by repeating the transmit-receive procedure.

d. <u>Modem control signals.</u> When the XMIT key is depressed, a Request-to-Send signal level is sent to the modem. When the signals Clear-to-Send and Data-Carrier-Detect are received from the modem (and only when the two are present), the Display Terminal will transmit data. The ETX code, when decoded in register No. 1, removes the Request-to-Send signal; this terminates the transmit mode. When the Data-Carrier-Detect signal is received from the modem and the Request-to-Send signal is not present, the Display Terminal is in the receive mode. The Data-Terminal-Ready signal

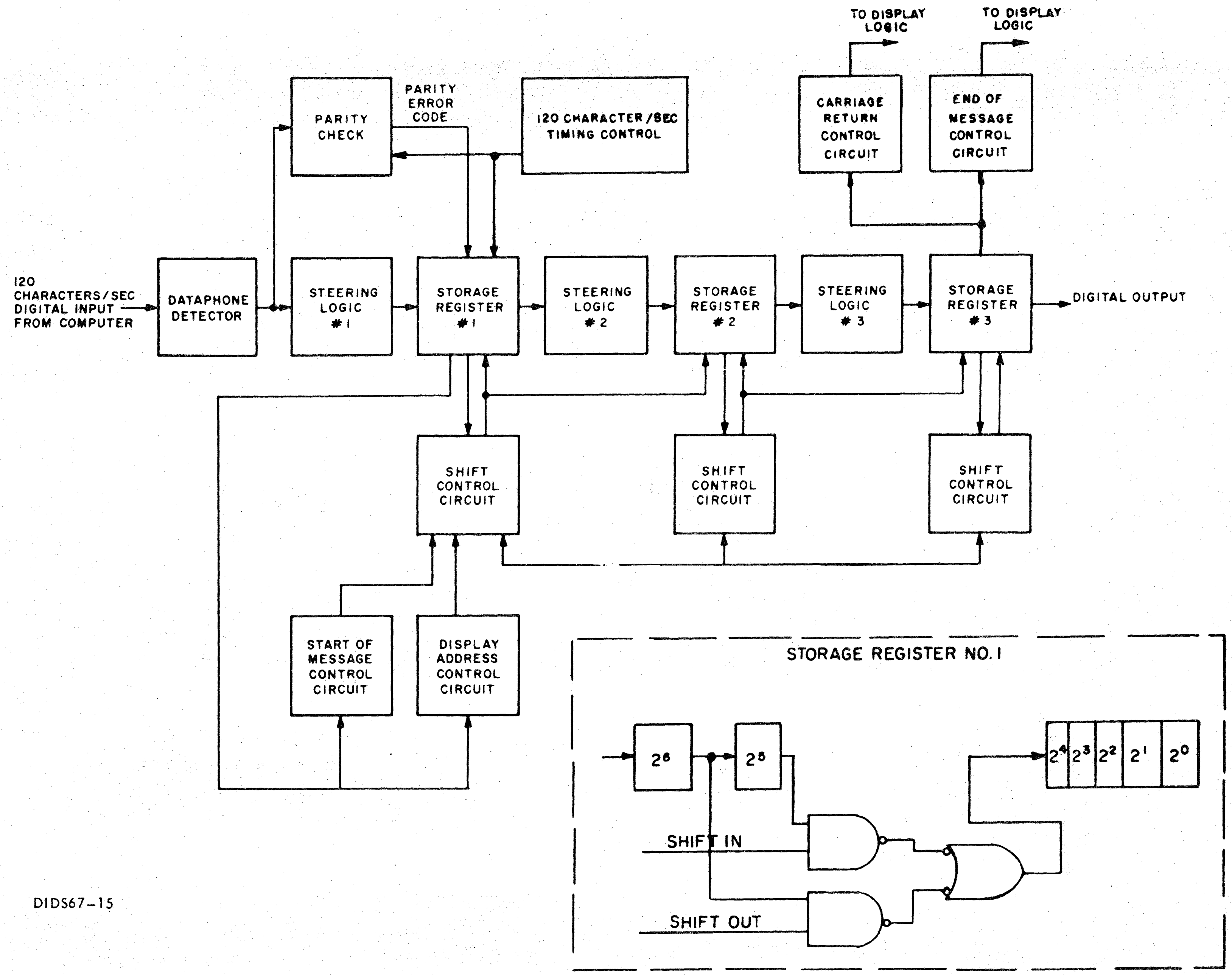


Figure 3-20. Logic Circuits in Receive Mode

is sent to the modem to indicate that the Display Terminal has been turned on. The DIDS-402 interface signals are bipolar as follows:

Data Signals

MARK -8 ±2 V (logical 1)

SPACE +8 ±2 V (logical 0)

Control Signals

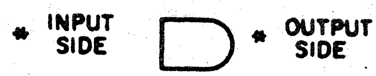
OFF -8 ±2 V

ON +8 ±2 V

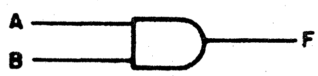
3-7 LOGIC SYMBOLS AND DEFINITIONS

In the following list of logic symbols, explanations accompany the graphic representations.

3-7.1 <u>AND Function.</u> The symbol shown below represents the AND function.

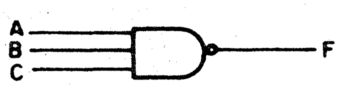


The AND output is high if, and only if, all the inputs are high.



INPUT A	INPUT B	OUTPUT F
L	L	L
L	H	L
H	L	L
H	H	H

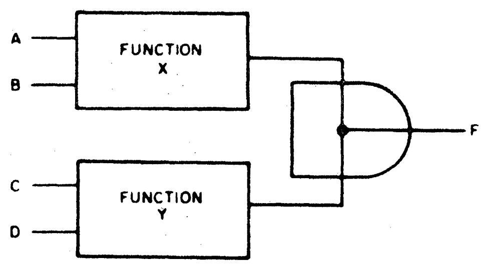
The symbol shown below represents one version of the AND function. The output is low if, and only if, all the inputs are high.

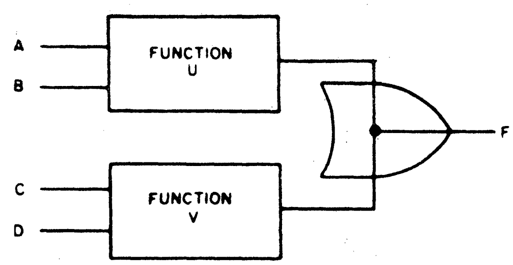


INPUT A	INPUT B	INPUT C	OUTPUT F
L	L	L	H
L	L	H	H
L	H	L	H
L	H	H	H
H	L	L	H
H	L	H	H
H	H	L	H
H	H	H	L

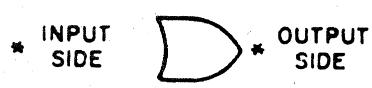
* Not a part of symbol

Where functions can be combined according to the AND (or OR) function simply by having the outputs connected, that capability is shown by enveloping the branched connection with a smaller sized AND or OR symbol.

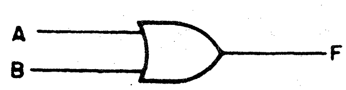




3-7.2 INCLUSIVE OR Function. The symbol shown below represents the INCLUSIVE OR function.



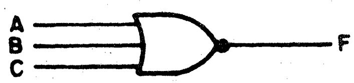
The OR output is high (H) if, and only if, any one (or more) of the inputs is high (H).



INPUT		OUTPUT
A	B	F
L	L	L
L	H	H
H	L	H
H	H	H

* Not a part of symbol

The symbol shown below represents one version of the INCLUSIVE OR function. The output is low if any one (or more) of the inputs is high.



INPUT			OUTPUT
A	B	C	F
L	L	L	H
L	L	H	L
L	H	L	L
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	L
H	H	H	L

3-7.3 State Indicator (Active). The presence of the small circle symbol at the input(s) or output(s) of a function indicates:

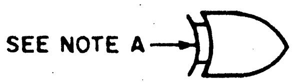
a. Input condition: the electrical condition at the input terminal(s) which controls the active state of the respective function.

b. Output condition: the electrical condition existing at the output terminal(s) of an activated function.

c. A small circle(s) at the input(s) to any element (logical or nonlogical) indicates that the relatively low (L) input signal activates the function. Conversely, the absence of a small circle indicates that the relatively high (H) input signal activates the function.

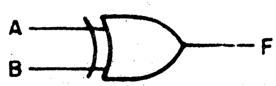
d. A small circle at the symbol output indicates that the output terminal of the activated function is relatively low (L). This small circle will never be drawn by itself on a diagram.

3-7.4 <u>EXCLUSIVE OR Function.</u> The symbol shown below represents the EXCLUSIVE OR function.



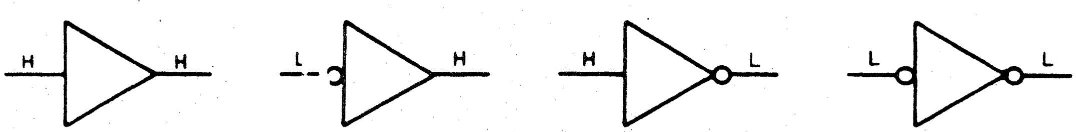
Note A: Arc displacement determined by location of paragraph 3-7.6 template center input line guide hole.

The EXCLUSIVE OR output is high if, and only if, any one input is high and all other inputs are low.

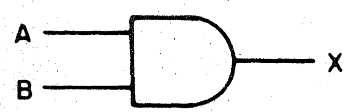
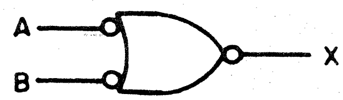
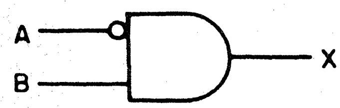
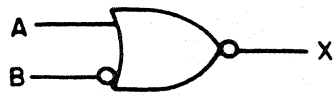
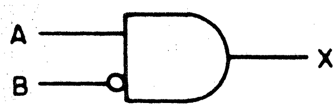
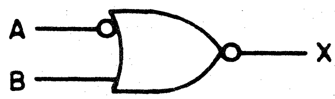
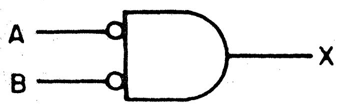
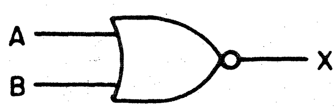
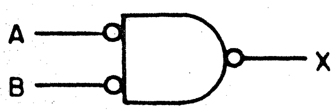
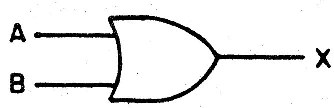
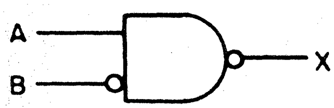
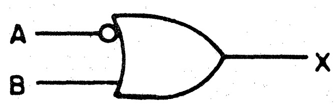
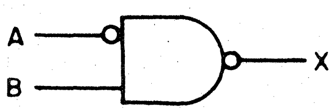
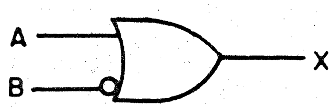
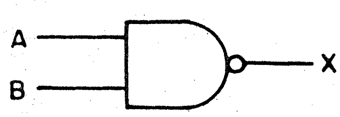
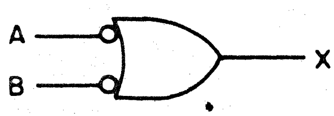


INPUT		
A	B	F = A(H) AND B(L) OR B(H) AND A(L)
L	L	L
L	H	H
H	L	H
H	H	L

3-7.5 <u>Amplifier Symbol.</u> This symbol represents a linear or nonlinear current or voltage amplifier. This amplifier may have one or more stages and may or may not produce gain or inversion. Level changes and inverters, pulse amplifiers, emitter followers, cathode followers, relay pullers, lamp drivers, and shift register drivers are examples of devices for which this symbol is applicable.

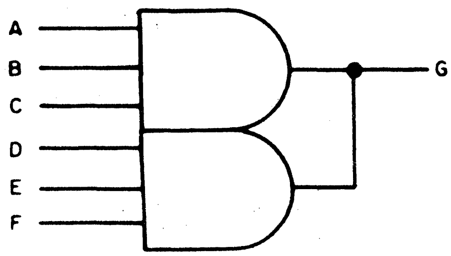


3-7.6 Table of Combinations. This table illustrates the application and functions of two variables and equivalents.

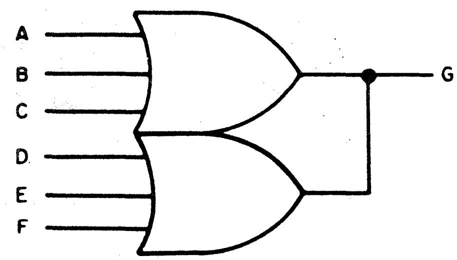
SYMBOLS		COMBINATIONS		
AND	OR	A	B	X
		H H L L	H L H L	H L L L
		H H L L	H L H L	L L H L
		H H L L	H L H L	L H L L
		H H L L	H L H L	L L L H
		H H L L	H L H L	H H H L
		H H L L	H L H L	H L H H
		H H L L	H L H L	H H L H
		H H L L	H L H L	L H H H

3-7.7 Multiple Inputs to Physically Separated Functions with Common Outputs

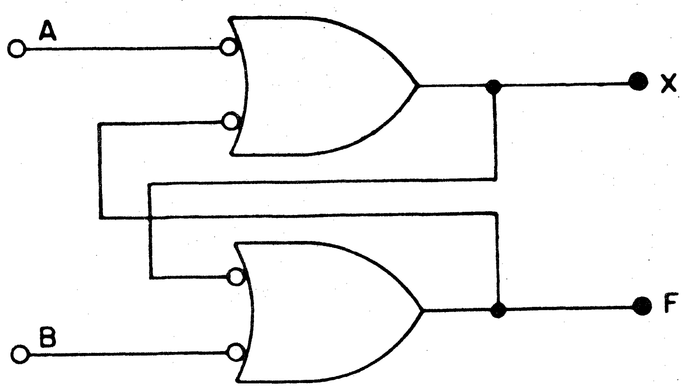
AND Function



OR Function



3-7.8 Latch-Type Flip-Flop. The symbol shown below represents a latch-type flip-flop.



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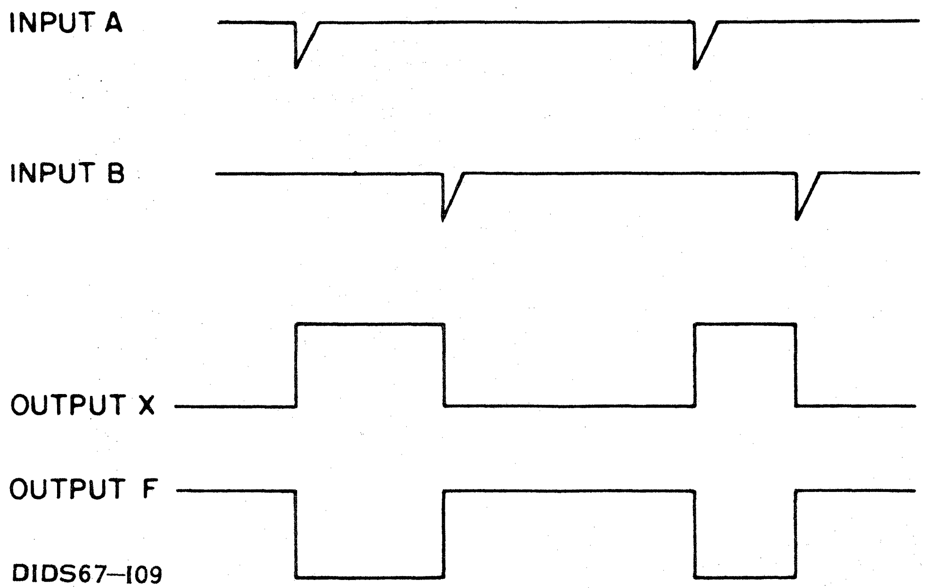
The input-output waveforms for a latch-type flip-flop are shown below.



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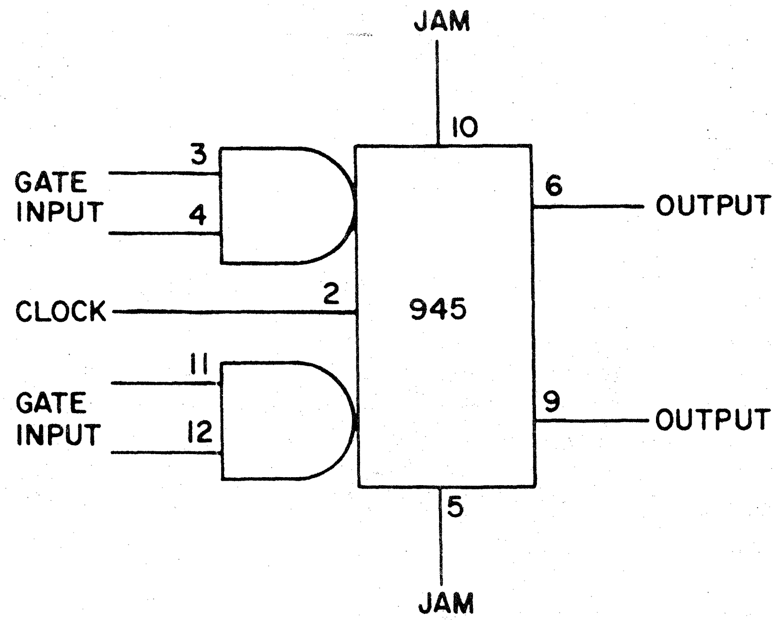
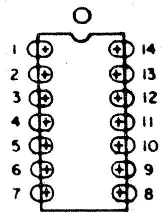
3-7.9 Clocked-Type Flip-Flop. The symbol shown below represents a clocked-type flip-flop. The circuit features an AND gate input and two flip-flops connected as a master-slave combination. The master flip-flop stores the input information when the clock voltage is high and transfers it to the slave when the clock voltage is low. Direct (unclocked) set and clear pulses are also provided. The unclocked pulses are used on the jam terminals of the flip-flop and will override the clocked input. A low signal on jam input pin 10 will force output pin 9 low, and a low signal on jam input pin 5 will force output pin 6 low.

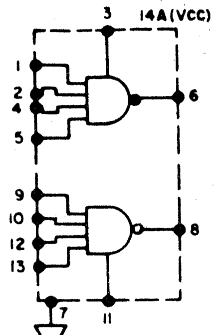


DIDS67-110

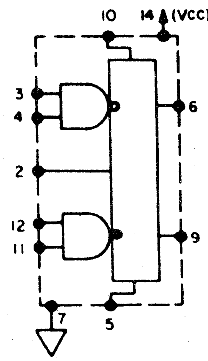
3-7. 10 Circuit Configuration and Pin Number Assignment of (DTL) Logic Elements



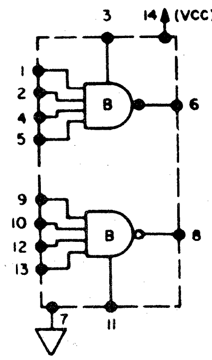
TOP VIEW
COMPONENT SIDE



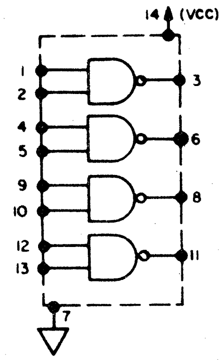
930
DUAL A-INPUT GATE



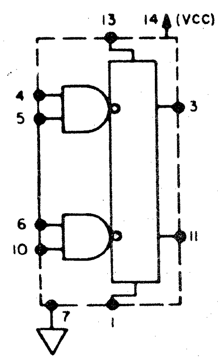
SPARE PIN 1-8-13
CLOCK GATED FLIP FLOP
931-945-948



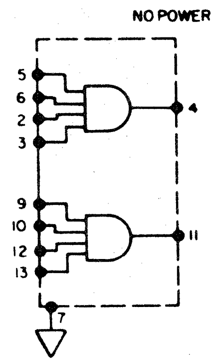
DUAL BUFFER OR
POWER GATE
932-944



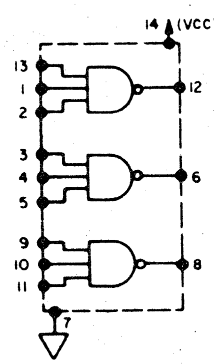
QUAD GATE
946



SPARE PIN 2-8-9-12
CAP. COUPLED FLIP-FLOP
950



SPARE PIN 1-8-14
DUAL INPUT
EXTENDER
933



TRIPLE "B"
INPUT GATE
962

Types of Circuit	Part No. Equivalent			
Circuit No.	Raytheon	Fairchild		Motorola
0930	C-329796	U6A9 930	59X	SC4105
0932	C-331378	U6A9 932	59X	SC4106
0933	C-329804	U6A9 933	59X	SC4107
0936	A-385796-2	U6A9 936	59X	SC4125
0944	C-333404	U6A9 944	59X	SC4108
0946	C-331377	U6A9 946	59X	SC4110
0948	385566-2	U6A9 948	59X	SC4124
0962	C-331407	U6A9 962	59X	SC4111
945	329814	U6A9 945	59X	SC4109

SECTION 4

MAINTENANCE

This section contains procedures for troubleshooting to the extent of replacing components mounted on or under the main chassis assembly, and procedures for removing and replacing parts.

Use the following test equipment (or equivalent) when taking measurements:

a. Simpson Model 260 Multimeter (20, 000 ohms/volt)

b. Tektronix 545A Oscilloscope

c. Tektronix Type 53/54C Dual Trace Preamplifier

d. Tektronix Type P6022 (10X Attenuation) Probe

e. Test Set TS-402

If an oscilloscope with a narrower bandwidth capability is used, a reduction in the fidelity of the waveshape reproduction will occur. This factor should be considered when determining whether or not a board is performing properly.

4-1 TROUBLESHOOTING

The following paragraphs cover the troubleshooting methods for the high- and low-voltage power supplies, the analog circuits by individual circuit board, and the digital circuits.

A thorough understanding of the theory covered in Section 3 will provide the repairman with sufficient system concept to enable him to logically determine which boards or components could cause a particular fault.

4-1.1 Routine Visual Checks. Depending upon the nature of the trouble, the following items should be checked:

a. Interlock switch S1 (figure 2-2)

b. Fuse F1 (figure 2-2)

c. All leads to printed circuit boards to make certain that they are properly fastened to their respective terminals

4-1.2 Voltage Checks. Use the symptom and probable cause chart (table 4-1) to check the high- and low-voltage power supplies.

WARNING

Extreme caution should be exercised when making measurements on the high-voltage power supply (12 kV).

a. Check the output voltages at the terminals of low-voltage power supply A4 and high-voltage power supply A5. The proper voltages and their respective terminals are given in figure 4-1. Since regulation is more important than the exact value of voltage, slight variations from the prescribed voltage value should be ignored. If either power supply is faulty, it should be replaced.

b. Connect an ac-coupled oscilloscope probe to each of the dc voltages in turn. With the oscilloscope gain control set for 0.5V/cm, check that the trace on the oscilloscope does not move (jump). Allow the probe to remain on each voltage for 2 minutes to be sure that it is stable.

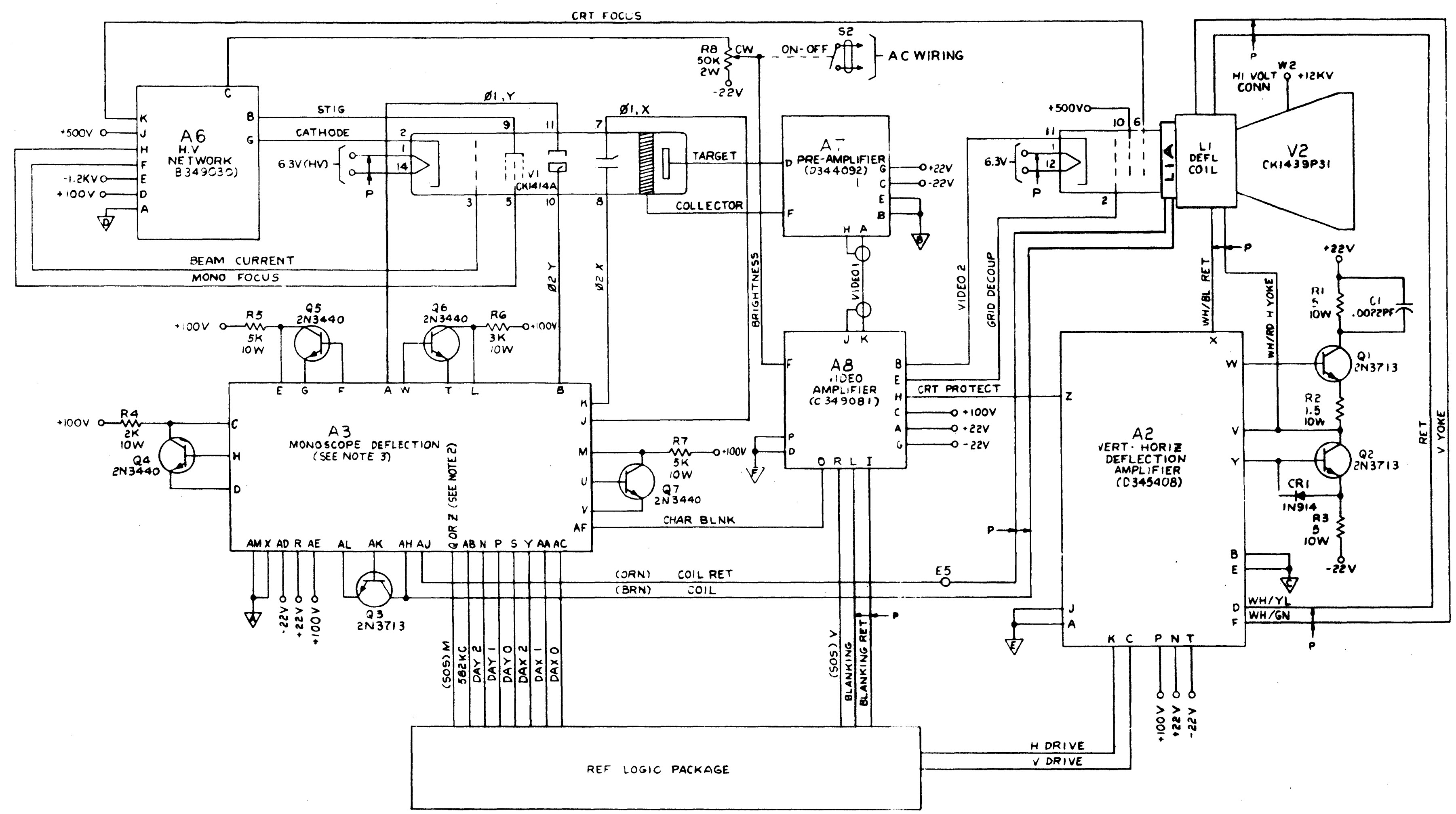
Table 4-1. Power Supply Failure Chart

Symptom	Probable Cause
1. Characters moving within their respective character boxes.	-1.2 kV unstable or excessive ripple
2. No characters displayed	-1.2 kV absent
3. Intensity of display varying and/or flashing of presentation	+22 V unstable or excessive ripple
4. No presentation on the CRT	+22, -22, +5, +100 or -1.2 kV absent
5. CRT sweeps jumping	+100, +22, or -22 V unstable
6. CRT sweeps unstable on right side only	+100 V excessive ripple
7. No presentation on the CRT, and the 10-ohm resistors on horizontal and vertical deflection amplifiers A2 overheating	-22 V unstable
8. Intensity of CRT varying and/or characters unstable in their respecitve character boxes	-1.2 kV unstable
9. -1.2 kV unstable	+22 or -22 unstable

4-1.3 Vertical Deflection Amplifier A2 (figure 4-2)

a. Check the dc voltages on the board (figure 4-1).

b. Check the vertical drive (pin C). If it is not present, the trouble is not in the vertical amplifier. Check the vertical drive output from display timing board A14, pin 16 (figure 4-3).



NOTES

1. FOR 210/250 V AC OPERATION CHANGE WIRING TO A4 AS FOLLOWS:
   A REMOVE JUMPERS FROM 11 TO 13 & 12 TO 14.
   B ADD JUMPERS FROM 12 TO 13.
   C CONNECT A C INPUT TO TERMINALS 11 & 14.

2. SEE LOGIC SCHEMATIC FOR PIN THAT IS USED.

3. E349031 FOR 520 CHARACTERS.
   E349078 FOR 1040 CHARACTERS.

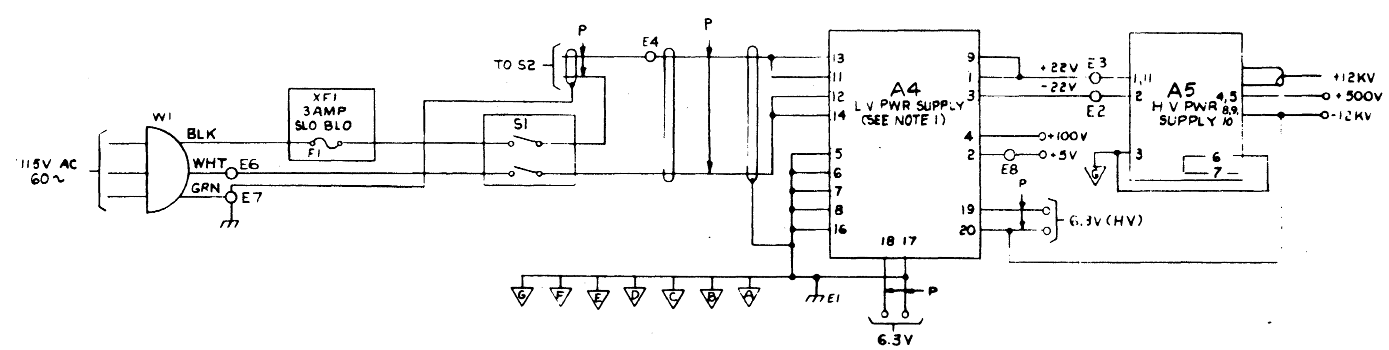


Figure 4-1. DIDS-402-2M10 Display Terminal Schematic

c. Check the output sweep waveform at terminal D. If improper, check deflection yoke L1 (figure 2-3) resistance and compare it with that of the spare yoke. If the deflection yoke is normal, replace amplifier A2.

d. Check the CRT protect at terminal Z. If the voltage is more than 1 V and the sweep output is present in the previous step, check the horizontal deflection amplifier.

e. If the deflection amplifier is replaced, the replacement board must be aligned (paragraph 2-3.1).

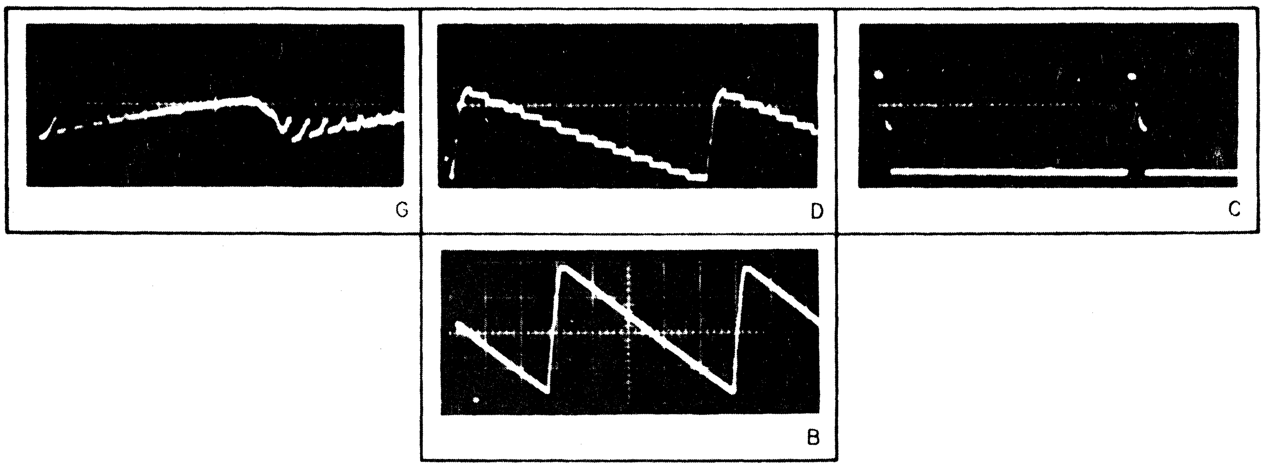


Figure 4-2. Vertical Deflection Amplifier A2 Waveforms

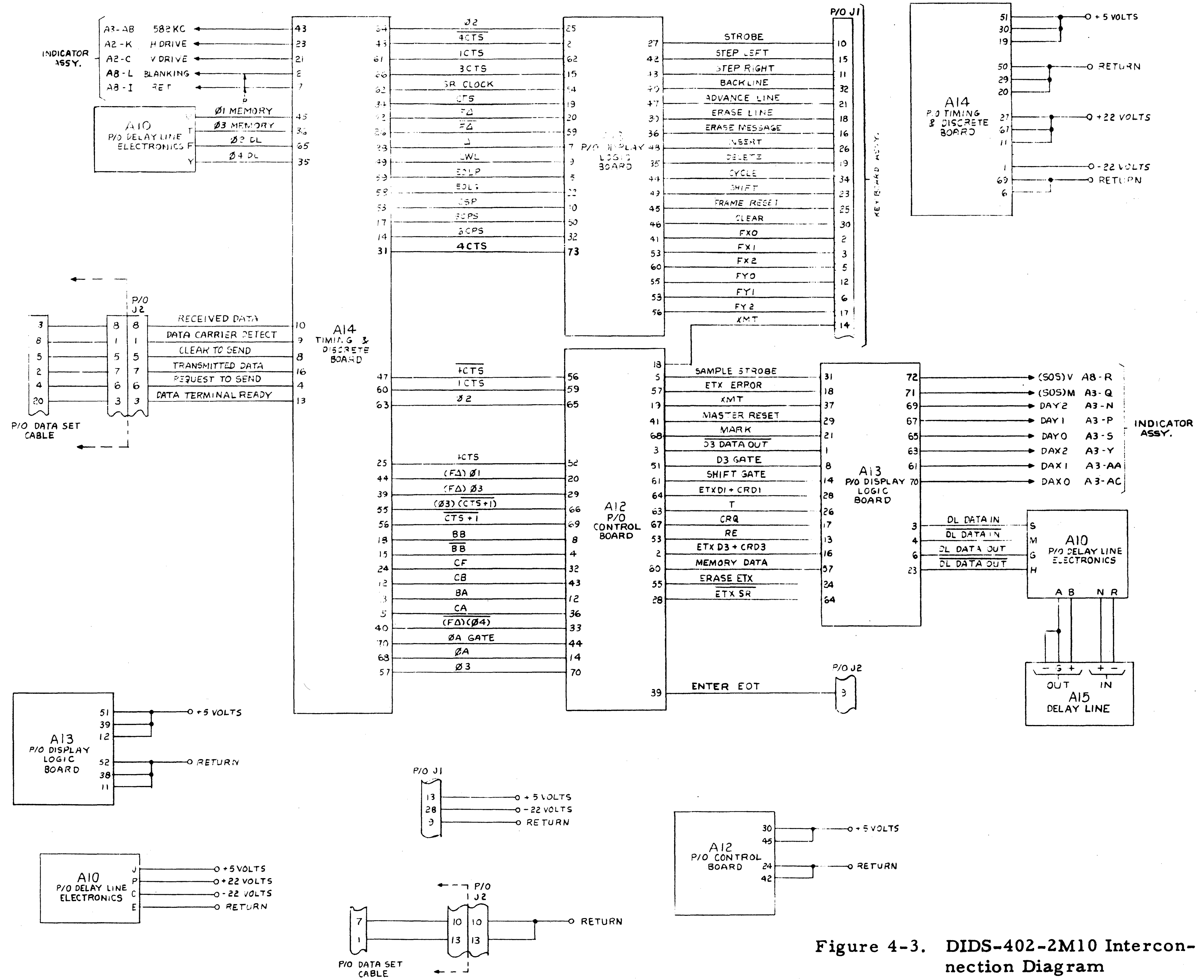
4-1.4 Horizontal Deflection Amplifier A2 (figure 4-4)

a. Check the dc voltages on the board (figure 4-1).

b. Check the horizontal drive (pin K). If it is not present, the trouble is not in the horizontal deflection amplifier. Check the horizontal drive output from display timing board A14, pin 19 (figure 4-3).

c. Check the waveform at terminal W. If there is no waveshape, replace amplifier A2. If the waveshape is present at terminal W but the waveshape at terminal V is distorted, check Q1, C1, R1, and R2 and associated wiring (figure 4-1). Check deflection yoke L1 (figure 2-3) resistance and compare with that of the spare.

d. Check the waveform at terminal Y. If there is no waveshape, replace amplifier A2. If the waveshape is present at terminal Y but the waveshape at terminal V is distorted, check Q2, CR1 and R3, and associated wiring (figure 4-1).



349332

Figure 4-3. DIDS-402-2M10 Interconnection Diagram

e. Check the CRT protect at terminal Z. If the voltage is more than 1 V and the sweep output is present at terminal V, check the vertical deflection amplifier.

f. If deflection amplifier A2 is replaced, the replacement board must be aligned (paragraph 2-3.1).

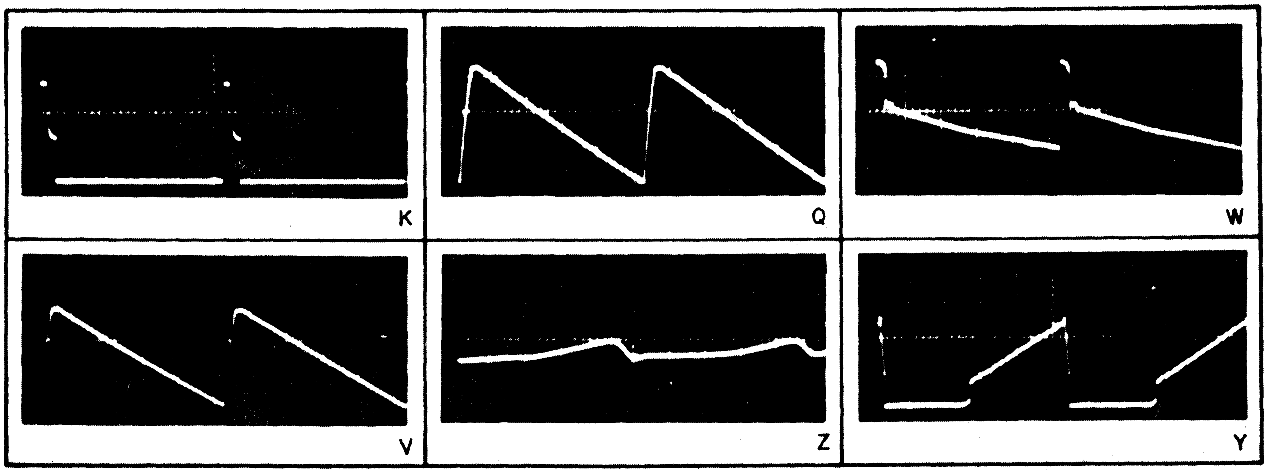


Figure 4-4. Horizontal Deflection Amplifier A2 Waveforms

4-1.5 Monoscope XY Deflection Amplifier A3 (figure 4-5)

a. Check the dc voltages on the board (figure 4-1).

b. Press only the following character keys at the beginning of the frame: @ ∅ (& % $.

c. Check the four analog outputs of the monoscope: Y outputs are at terminals A and B; X outputs, at terminals J and K. Note whether any one of these four output waveforms is different from that shown in figure 4-2. Check the minor vertical deflection signal on terminal AB. If it is absent, check the output from display timing board A14, pin 43 (figure 4-1); it if is present but there is no minor vertical deflection (only horizontal lines on the CRT), proceed to step e.

Check for presence of the blanking signal on terminal AF. If it is not present, check the blanking output from display timing board A14 pin 2 (figure 4-1). Make sure the leads to this circuit board are properly fastened to their respective terminals. If proper signals are present, check the monoscope filament, monoscope preamplifier A7, and video amplifier A8. If proper signals are absent, proceed to the following step.

d. Check the six input digital bits as follows:

DAX0	terminal	AC
DAX1	terminal	AA
DAX2	terminal	Y
DAY0	terminal	S
DAY1	terminal	P
DAY2	terminal	N

If proper signals are present, replace monoscope XY deflection amplifier A2 and align (paragraph 2-3.6). If proper signals are not present, check all leads to keyboard assembly A11 and check the keyboard by substitution.

e. If replacement of circuit board A3 does not resolve the difficulty, those parts of the monoscope XY deflection circuit located on the indicator chassis must be checked.

(1) If the waveform at pin B is improper, check transistor Q5, resistor R5, and associated wiring (figure 2-1).

(2) If the waveform at pin A is improper, check transistor Q4, resistor R4, and associated wiring (figure 2-1).

(3) If the waveform at pin J is improper, check transistor Q6, resistor R6, and associated wiring (figure 2-1).

(4) If the waveform at pin K is improper, check transistor Q7, resistor R7, and associated wiring (figure 2-1).

f. Check the waveforms at terminals AH and AK. If waveforms are present but not proper, check transistor Q3 and wiring (figure 2-1), then check the wiring to the deflection coil and the minor vertical deflection winding on the coil. If no waveform is present at terminal AH, replace monoscope XY deflection amplifier A3. If A3 is replaced, the replacement board may require alignment (paragraph 2-3.6).

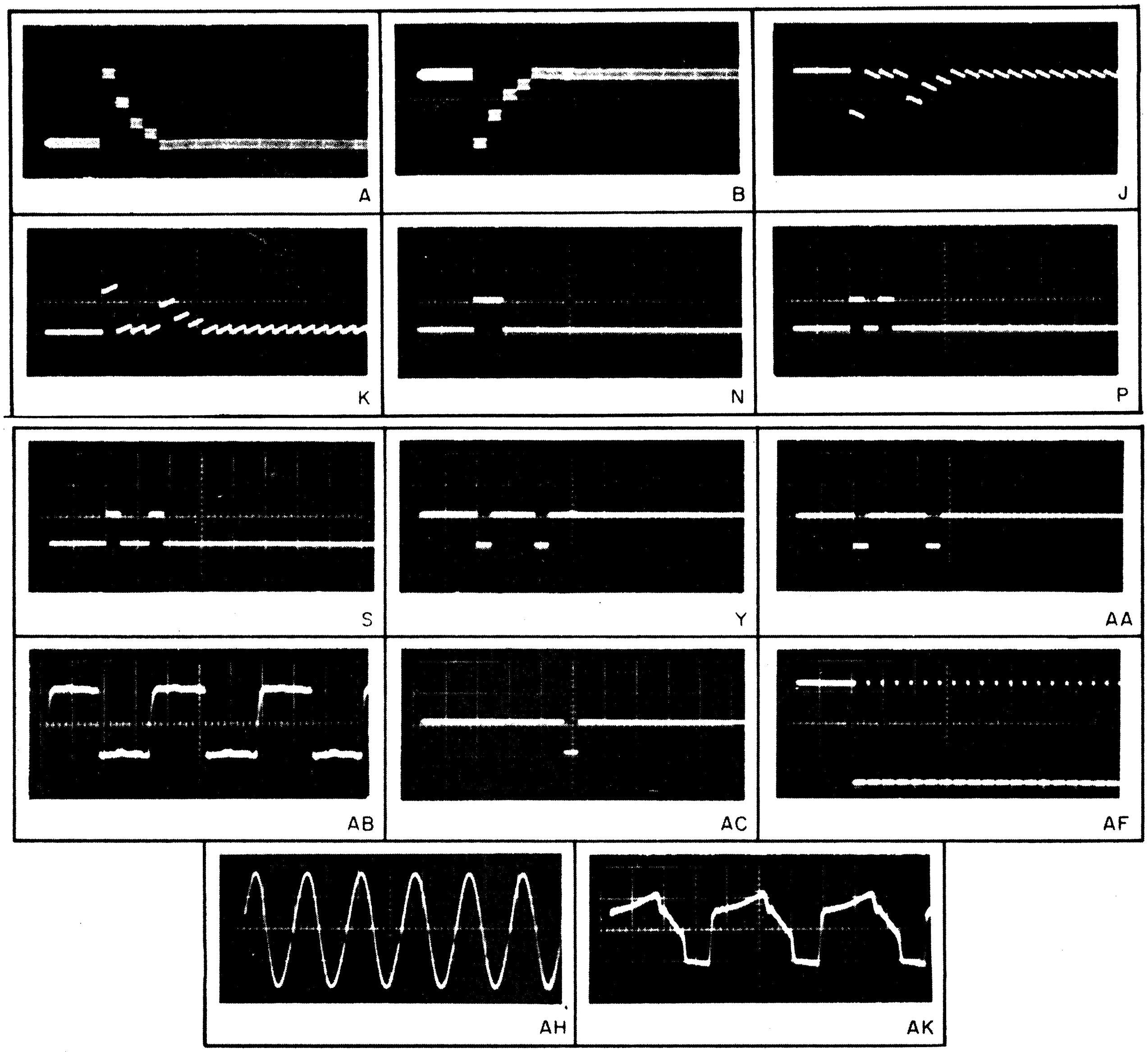


Figure 4-5. Monoscope XY Deflection Amplifier A3 Waveforms

4-1.6 Monoscope Preamplifier A7 (figure 4-6)

a. Check the dc voltages on the board (figure 4-1).

b. Check the waveform at pin A, the output of the preamplifier (figure 4-6). If the waveform is not present, check that the proper waveform is present at pin F (figure 4-6), the input to the preamplifier. Check that all leads are properly fastened to terminals. Replace monoscope preamplifier A7. Check monoscope V1. If signal is present (at the output of the preamplifier), troubleshoot video amplifier A8.

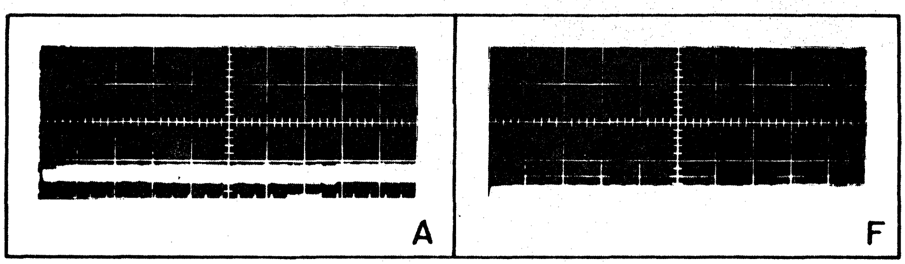


Figure 4-6. Monoscope Preamplifier A7 Waveforms

4-1.7 Video Amplifier A8 (figure 4-7)

a. Check the dc voltages on the board (figure 4-1).

b. Check the input waveform at pin K. If it is not present, refer to paragraph 2-3.2.

c. Check the blanking signal at pin L. If it is not present, check the output from circuit board A14, pin 2 (figure 4-1) and wiring.

d. Check the CRT protect signal at terminal H. This waveform will be improper or the voltage more than 1 V when either the vertical or horizontal sweep is not being generated. Troubleshoot appropriate deflection amplifier A2 (paragraph 4-1.3 or 4-1.4).

e. Check the video output waveform at pin B. If improper, replace video amplifier A8. Adjust the video level control (paragraph 2-3.2) only if necessary.

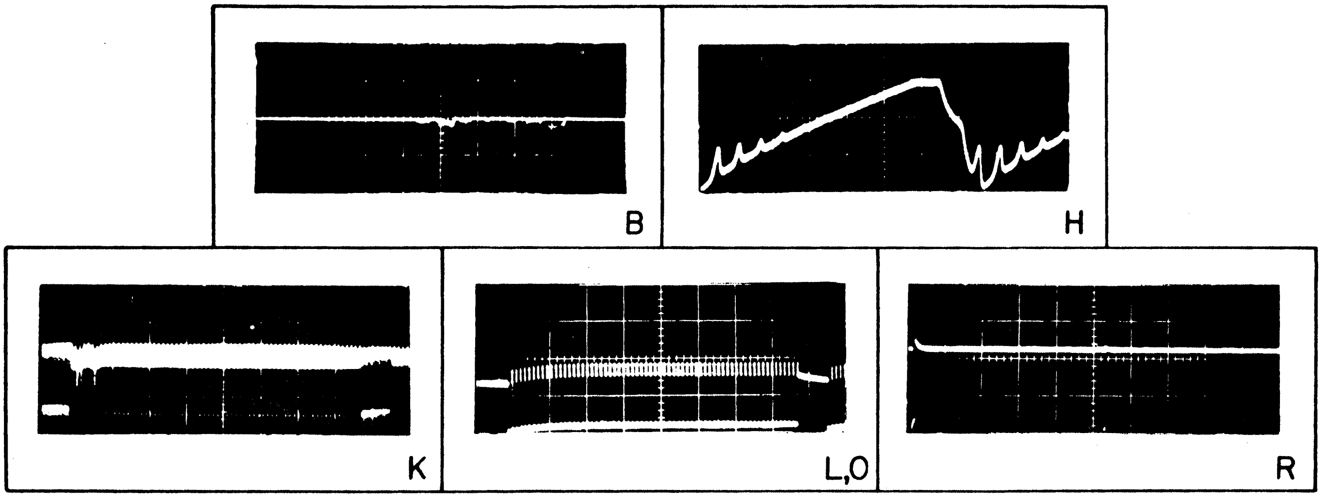


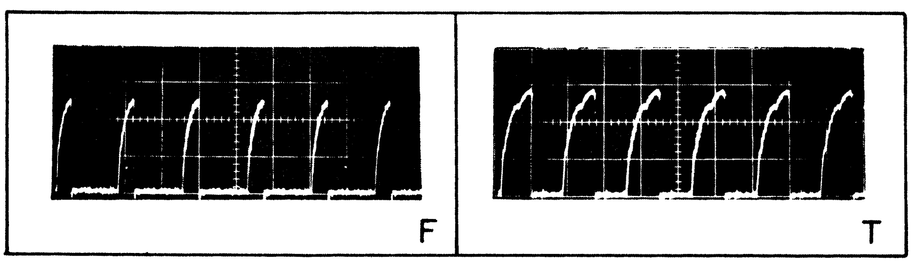
Figure 4-7. Video Amplifier A8 Waveforms

4-1.8 Delay-Line Electronics (figure 4-8)

a. Check the dc voltage on the board (figure 4-3).

b. Check the clock on pins $V_1 Y_1$ T and F (figure 4-3).

c. Check the input and output signal on the board (figure 4-3).



DIDS68 62

Figure 4-8. Delay-Line Electronics A10 Waveforms

4-1.9 Digital Circuits

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart

<table>
<tr><th>Symptom</th><th>Check Procedure</th><th>Corrective Action</th></tr>
<tr><td></td><td>Note: Check the voltages at the terminals of the digital circuits (use fig. 4-3 for identification of terminals that handle the dc voltages on the circuit boards).</td><td></td></tr>
<tr><td>1. Unable to write a character or characters or perform functions such as carriage return, cursor left, etc., when proper keys are pressed.</td><td>a. Press and hold the keys to paint the characters listed and check that the signal level changes occur at the terminals on board A13 as listed:
<table>
<tr><th>Key</th><th>FX0 on 41</th><th>FX1 on 53</th><th>FX2 on 60</th><th>FY0 on 55</th><th>FY1 on 58</th><th>FY2 on 56</th></tr>
<tr><td>V</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>M</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>D</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>9</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
</table>
b. Check that strobe level at A13-27 changes when any character key is pressed.</td><td>If functions or characters do not check out in a, b, or c, replace keyboard assembly A11. If present, replace A13.</td></tr>
</table>

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
	c. Check that signal level at corresponding terminals of A13 changes when FRAME RESET, CR, cursor left, cursor right, ERASE LINE, ERASE MSG, INSERT, DEL, ADV LINE, BACK LINE or XMIT keys are pressed.	
	d. If the cycle function is inoperative, check for a 6-Hz pulse at A13-terminal 32 when the CYCLE and right key are depressed.	If the signal is absent, replace A14. If present, replace A13.
2. Character disappears as soon as key is released.	a. Connect the oscilloscope probe to terminal 3 of A13. Press and hold the FRAME RESET key. Observe on the oscilloscope that the frame reset pulse is present once every 14. 8 ms (once/frame).	If the pulses are not present, replace A13. If present, perform check b.
	b. Press and hold the FRAME RESET key and observe the frame pulse once/frame at terminal 6 of A13.	If the pulses are absent, adjust the delay line. If they are still absent, replace the A10 board if the unit has a single delay line. If the unit has a double delay line, perform check c. If the pulses are present, replace the A13 board.

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
	c. Connect an oscilloscope probe to pin G of A10 and repeat check b.	If the pulses are absent, replace A10. If present, replace A9.
3. Screen blank.	a. Check horiz and vert. drive pulses at A14-22 and A14-24. These may be checked at A2-K or A2-C.	If absent, replace A14.
	b. Check minor sweep expansion at A14-43. This may be checked at A3-AB.	If absent, replace A14.
	c. Check CRT protect circuits (para 4-2. 7d).	Follow the procedure given in para 4-2. 7d.
4. No blanking between character slots.	a. Check blanking at video amplifier A8 (para 4-2. 7c).	If the blanking gates are present, replace video amplifier A8. If not present, replace A14.
5. Characters change on face of display after being keyed in.		Adjust the control on the delay line for stability. If necessary, replace the delay line read-write amplifier A9 or A10 repeating step 2.

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
6. When a character key is pressed, a different character appears on the display.	a. Check monoscope XY deflection amplifier A3 by performing the alignment given in para 4-1.2.	If the six digital inputs in step 4-2.5c are correct but incorrect characters are painted even after alignment, replace monoscope XY deflection board A3.
	b. Check the keyboard assembly as in step 1a in this Symptom Troubleshooting Chart.	If the keyboard assembly operates properly, replace board A13. If not, replace keyboard assembly A11.
	Notes 1. The ETX character must be typed and displayed on the CRT before each transmission. 2. All codes written in this procedure are for a display which utilizes even parity. 3. In this procedure, the codes for STX and ETX are stated below. If the display under test does not use the codes stated for ETX or STX insert the codes which are used for that display into the procedure. LSB P SOM 01000001. EOM 11000000	

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

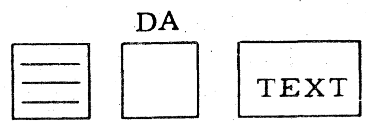
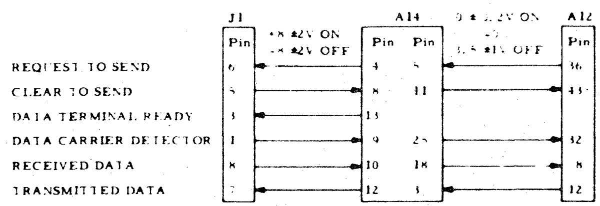
Symptom	Check Procedure	Corrective Action
	4. When pin 40 of A12 is grounded the STX and DA characters are displayed on the CRT. Example  Character Slot 1 2 3 5. Check the control lines in accordance with the diagram below. 	

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
7. The terminal unit is unable to transmit or receive data after a message is typed into the unit, the cursor is reset to the beginning, and the EOM code is displayed.	a. Check the voltage at A14 pin 13 for +6 ±2V.	If absent, check R48 on A14. If present, connect the 402-2 test set to J1 of the unit and proceed to check b.
	b. Place the character select switch on the 402-2 Test Set to 1. Enter the ETX code in the last character slot of the last line. On the test set, place the character select switch to LAST and connect an oscilloscope probe to pin 14 of A12. Observe that the ϕA clock is 833 ±10 μs. apart.	If incorrect, adjust R26 on the A14 board. If correct and the light readout on the test set indicates LSB 00000110, the trouble is not in the Terminal Unit.
8. Unable to transmit data, receive mode is operational.	a. Connect the 402-2 Test Set to J1 of the terminal unit and enter the ETX code in the last character slot of the last line. Place the character select switch on the test set to 1 and connect an oscilloscope probe to pin 12 of A12. Observe that the level changes after the XMIT key is depressed.	If the level does change and the light readout on the test set does not indicate LSB 00000101, replace the A14 board. If the level does not change, replace the A12 board.

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
9. Transmitted data contains the wrong parity.	a. Connect the 402-2 Test Set to J1 of the Terminal Unit and place the character select switch to 3. On the display, enter the characters Y and X̄ in the first and second character slots of the first line and depress the XMIT key. Observe that the test set lamp readout indicates LSB 10011010.	If the readout indication is incorrect, replace A12. If the readout indication is correct, perform check b.
	b. Enter X and X̄ in the first and second character slots of the first line, and depress the XMIT key. Observe that the test set lamp readout indicates LSB 00011011.	If the readout indication is incorrect, replace A12. If the readout indication is correct, the trouble is not in the Terminal Unit.
10. Transmitted data contains no STX.	a. Connect the 402-2 Test Set to J1 of the Terminal Unit and place the character select switch to 1. Enter the ETX code and depress the XMIT key. Observe that the test set lamp readout indicates LSB 01000001.	If the indication on the lamp readout is incorrect, replace A12 board. If the indication on the lamp readout is correct, the trouble is not in the Terminal Unit.

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
11. Transmitted data incorrect.	a. Connect the 402-2 Test Set to J1 of the Terminal Unit and set the character select switch to 3. Enter the characters "(" and $\overset{x}{x}$ in the first and second character slots of the first line and depress the XMIT key. Observe that the indication on the lamp readout is LSB 00010100.	
	b. Enter the characters "W" and X in the first and second character slots of the first line and depress the XMIT key. Observe that the indication on the lamp readout is LSB 11101011.	If a or b is incorrect, replace the A12 board. If a and b are correct, the trouble is not in the Terminal Unit.
12. Unable to receive data. Transmit mode is operational.	a. Connect the 402-2 Test Set to J1 of the Terminal Unit. Depress the SHIFT and CLEAR keys on the keyboard. Enter the following code from the test set. SOM LSB 01000001 P DA To be determined K 11010010 F 01100011 5 10101100 EOM 11000000	If the CRT presentation is incorrect, perform check b. If the CRT presentation is correct, the trouble is not in the Terminal Unit.

Table 4-2. Digital Circuits, Symptom Troubleshooting Chart (Continued)

Symptom	Check Procedure	Corrective Action
	On the display, the characters K, F, and 5 are painted in character slots one, two, and three of the first line.	
	b. Connect an oscilloscope probe to pin 8 of A12 and repeat step a. Observe a level change on the scope.	If the level does not change, replace the A14 board. If the level does change, perform check c.
	c. Connect an oscilloscope probe to pin 61 and a second probe to pin 3 of A12. Sync the scope from pin 61 of A12 and repeat step a. Send the character K about 10 times.	If the presentation on the scope is correct, replace A13. If neither level changes, replace the A12 board.
13. The parity error symbol is the only character displayed in the receive mode.	Repeat step 12.	If the display presentation is correct, the trouble is not in the Display Terminal. If the presentation is incorrect, repeat step 7b. If the ØA clock pulses are 833 ±10 μs apart, replace the A12 board. If not, adjust R26 on A14.

4-2 REMOVAL AND REPLACEMENT OF PARTS

Removal and replacement of most components in the DIDS-400 System is simple enough to obviate detailed instructions. A few procedures are given, however, to facilitate the repairman's task. Unless otherwise instructed, replacement procedures are the reverse of removal.

4-2.1 Removal of Cover. Remove the two screws at the front and one at the rear that fasten the cover to the chassis. Remove the cover.

4-2.2 Removal of Keyboard Assembly A11. Remove the four screws located on the underside of the keyboard chassis. Lift the keyboard assembly away from chassis, and disconnect the plug located inside chassis.

4-2.3 Removal and Replacement of Monoscope Preamplifier A7

a. Disconnect the leads from all terminals on the monoscope preamplifier. Remove the screws that fasten the circuit board to the chassis. Be sure to retain the spacers.

CAUTION

Pull the board out slowly to prevent breaking the lead connected to the tip of the monoscope tube.

b. Remove the lead.

4-2.4 Removal and Replacement of Circuit Boards

a. Disconnect leads from all terminals.

b. Remove all screws and washers that fasten the circuit board to the chassis.

c. To replace, fasten the circuit board to the chassis.

d. Refer to the illustration of the specific board being removed to determine the lead that fastens to each terminal as follows:

Horizontal and Vertical Deflection Amplifier A2	Figure 2-5
Monoscope XY Deflection Amplifier A3	Figure 2-7
Monoscope Preamplifier A7	Figure 2-8
Video Amplifier A8	Figure 2-6

DIDS-402-2M10
Para 4-2.5/4-2.8b

4-2.5 Removal and Replacement of CRT

a. Remove the high-voltage connector on the side of the CRT.

b. Remove the connector from the rear of the tube.

c. Remove the four screws holding the rubber clamps to the face of the CRT and withdraw the CRT.

4-2.6 Removal and Replacement of Deflection Yoke

a. Remove the three wing nuts from the U-bracket attached to the CRT shield cover.

b. Remove the CRT (paragraph 4-2.5)

c. Draw a diagram showing the yoke lead destinations.

d. Remove the yoke wire connections.

e. Alignment consists simply of rotating the yoke for a level horizontal display after replacement.

4-2.7 Removal and Replacement of Monoscope Tube

a. Remove the screws holding the side covers to the chassis, four on each side.

b. Remove the preamplifier according to paragraph 4-2.3.

c. Pull the tube socket from the end of the monoscope.

d. Withdraw the monoscope and shield from the left side of the display.

e. Loosen the clamp on the neck of the tube and remove the collector lead.

f. When replacing the monoscope tube, make sure the collector connection is on the tube and aligned with the hole provided for the collector lead in the shield.

4-2.8 Removal and Replacement of High-Voltage Power Supply

a. Remove the four screws holding the power supply to the bottom of the chassis

b. Remove the high voltage lead from the CRT.

c. Observe color coding and lead destinations; then remove the leads from the power supply. Remove the four screws holding the power supply to the bottom of the chassis. Lift the power supply from the unit.

4-2.9 Removal and Replacement of Low-Voltage Power Supply

a. Remove the four screws holding the power supply to the bottom of the chassis.

b. Observe color coding and lead destinations; then remove leads from the power supply.

c. Lift the power supply from the unit.

SECTION 5

PARTS LIST - DISPLAY CONSOLE

Assy	Description	Part No.	Qty
	Display Console	349086-1	
	Indicator Assy	349090-1	1
All	Keyboard Assy	349427-1	1
	Delay Line Micro-logic Assy	349022-1	1

INDICATOR ASSY 349090-1

Schematic 349326

Ref Desig	Description	Vendor	Vendor Part No.	Qty
A2	Vert and Horizontal Deflection Amplifier	Raytheon	344947-1	1
A3	Monoscope Defl Amplifier		349062-1	1
A4	LVPS		345723-1	1
A5	HVPS		345724-1	1
A6	HV Network		349020-1	1
A7	Preamplifier		388063-1	1
A8	Video Amplifier		349084-1	1
R1, 3	Resistor 5 ohm ±5%, 10W	Raytheon TRU-OHM	333645-6	2
R2	Resistor 1.5 ohm ±5%, 10W	Raytheon TRU-OHM	333645-2	1
R4	Resistor 2K ohm ±5%, 10W	Raytheon TRU-OHM	333645-3	1
R5, 7	Resistor 5K ohm ±5%, 10W	Raytheon TRU-OHM	333645-5	2
R6	Resistor 3K ohm ±5%, 10W	Raytheon TRU-OHM	333645-4	1
C1	Capacitor .0022μf ±2%, 200V	Raytheon Sprague	235-1684P17 192P	1
CR1	Diode 1N914	Cont Dev Corp		1
L1	Yoke	Raytheon	347265-1	1
Q1,2,3	Transistor 2N3713	Motorola		3
R8S2	Resistor & Switch		RV4NBYSD503A	1
V1	Monoscope CK1414	Raytheon	333662-3	1

INDICATOR ASSY 349090-1

Ref Desig	Description	Vendor	Vendor Part No.	Qty
V2	CRT CK1439P31	Raytheon	333663-3	1
F1	Fuse 3A S. B.	Raytheon	226-1039P12	1
XF1	Fuseholder	Raytheon Bussman	343-1010P1 HKP-JQ-BB	1
Q4, 5, 6, 7	Transistor 2N3440	RCA		4
S1	Micro Switch	Raytheon Honeywell	333617-1 2DM4	1
W1	Line Cord	Raytheon	341029-1	1

VERT & HORIZ DEFL AMPL A2, ASSY 344947-1

Schematic 345408

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	344947-2	1
R47	Resistor		RC20GF221K	1
R2, R32	Resistor		RL20S334J	2
R3, R34	Resistor		RC20GF153K	2
R4, R35	Var Resistor 10K ±5%, 0.5W	Bourne Raytheon	3307P-1-103 333262-5	2
R5, 30, 31, 38	Resistor		RC20GF224K	4
R6, R36	Resistor		RL20S472J	2
R7	Resistor		RC20GF623J	1
R8, R37	Resistor		RL20S392J	2
R9, 21, 43, 45	Resistor		RC20GF222K	4
R10, 39	Resistor		RC32GF153K	2
R11, 40, 53	Resistor		RC20GF470K	3
R12, 41	Resistor		RC20GF682K	2
R13, 42	Resistor		RL20S821J	2
R14, 44	Resistor		RL20S103J	2
R15	Resistor		RC20GF101K	1
R16, R18	Resistor		RC32GF220K	2
R17, 19	Resistor		RC32GF100K	2
R20, 48, 54, 55	Resistor		RC20GF102K	4
R22, 56	Resistor		RC20GF270K	2
R25	Resistor		RC20GF332K	1

VERT & HORIZ DEFL AMPL A2, ASSY 344947-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R26	Resistor 10 ohm ±5%, 5W	Tru-ohm Raytheon	 333645-1	1
R27, 50	Var Resistor 100 ohm ±5%, 0.5W	Bourne Raytheon	3307P-1-101 345262-1	2
R28, 51	Resistor		RL20S510J	2
R29, 52	Resistor		RC20GF683K	2
R1, 33	Resistor		RC20GF181K	1
R23, 24	Resistor		RC42GF560K	2
R46	Resistor		RC20GF680K	1
R49	Resistor 1.5 ohm ±5%, 10W	Tru-ohm Raytheon	 333645-2	1
C1	Capacitor 1μF ±20%, 50VDC	Sprague Raytheon	218P1059R5S4 333646-1	1
C2	Capacitor 50μF ±10%, 25V	Sprague Raytheon	TE1209-C-616 333649-6	1
C3, 12	Capacitor 470μμF ±5%, 300V	Cornell-Dubilier Raytheon	CD15 235-1535P44	2
C4, 10, 13	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204-C-616 333649-4	3
C5, 6, 14, 16	Capacitor, 0.0022μF ±10%, 200V	Sprague Raytheon	192P 235-1684P17	4
C7	Capacitor 150μμF ±5%, 500V	Cornell-Dubilier Raytheon	CD15 235-1535P57	1
C8	Capacitor 5μF ±10%, 50VDC	Sprague Raytheon	TE1084-C-616 333649-2	1
C9	Capacitor, 0.068μF ±20%, 50V	Sprague Raytheon	194P6839R5 333648-1	1

VERT & HORIZ DEFL AMPL A2, ASSY 344947-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C15	Capacitor 0.47 µF ±10%, 100VDC	Sprague Raytheon	2WF-P47 333647-1	1
C11	Capacitor 330µµF ±5%, 500V	Cornell-Dubilier Raytheon	CD15 235-1534P40	1
CR1 thru CR11	Diode 1N914	Cont Dev Corp		11
Q1, 2, 3, 4 Q10, 11, 12	Transistor 2N3643	Fairchild		7
Q5, 6, 8, 9, 13	Transistor TN53	Sprague Raytheon	 333659-1	5
Q7	Transistor 2N3638	Fairchild		1
Q14	Transistor 2N3133	Motorola		1

MONOSCOPE DEFL AMPL A3, ASSY 349062-1

Schematic 349031

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	349062-2	1
R1, R42	Resistor 57K ±0.1%, 0.25W	Daven Raytheon	1649 333640-3	2
R2, R43	Resistor 27K 0.1%, 0.25W	Daven Raytheon	1649 333640-2	2
R3, R44	Resistor 12K ±0.1%, 0.25W	Daven Raytheon	1649 333640-1	2
R4	Resistor		RL20S333J	1
R5, R47	Var Resistor 1K ±0.5%, 0.5W	Bourne Raytheon	3307P-1-102 345262-2	2
R6, R46	Resistor		RC20GF474K	2
R7	Resistor		RL20S682J	1
R8	Resistor		RL20S332J	1
R9	Resistor		RL20S122J	1
R10, R11, R54, R55	Resistor		RL20S221J	4
R12, R56	Resistor		RL20S392J	2
R13, R57	Resistor		RL20S683J	2
R14, R38, R58, R78, R114	Resistor		RC20GF222K	5
R15, R16, R18, R21, R41, R61, R65, R68, R81, R88, R89, R90, R91, R92, R93	Resistor		RC20GF471K	15

MONOSCOPE DEFL AMPL A3, ASSY 349062-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R17	Resistor		RC20GF272K	1
R19	Resistor		RC20GF390K	1
R20, R28	Resistor		RC20GF183K	2
R22, R69	Resistor 200K ±20%, 2W	IRC Raytheon	Series 150 333641-1	2
R23, R27, R70, R74	Resistor		RL20S473J	4
R24, R71	Resistor		RL32S153J	2
R25, R73, R51	Resistor		RL20S562J	3
R26, R33, R52, R75, R98	Resistor		RC20GF332K	5
R29	Resistor		RL32S471J	1
R30, R36, R60, R63	Resistor		RC20GF103J	4
R31, R77	Resistor		RL20S103J	2
R32, R50	Var Resistor 2K ±5%, 0.5W	Bourne Raytheon	3307P-1-202 345262-3	2
R34, R37, R53, R72	Resistor		RC20GF681K	4
R35, R59, R107	Resistor		RC20GF682K	3
R39, R110, R79	Resistor		RC20GF680K	3
R40, R76	Resistor		RL20S183J	2
R45	Resistor		RL20S222J	1
R48	Resistor		RL20S472J	1

MONOSCOPE DEFL AMPL A3, ASSY 349062-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R49	Resistor		RL20S752J	1
R62	Resistor		RC20GF331K	1
R66, R80	Resistor		RC20GF270K	2
R82 thru R87	Resistor 3K ±0.5%, 1W	Daven Raytheon	DAX-2 333639-1	6
R94, R96, R97, R99	Resistor		RC20GF102K	4
R95	Resistor		RL20S223J	1
R100	Resistor		RC20GF822K	1
R101, R64	Resistor		RC20GF152K	2
R102, R115	Resistor		RC20GF101K	2
R103, R108	Var Resistor 100 ohm ±5%, 0.5W	Bourne Raytheon	3307P-1-101 345262-1	2
R104	Resistor		RC20GF330K	1
R105	Resistor		RC20GF472K	1
R106	Resistor		RC32GF2R7K	1
R109, R111	Resistor 2 ohm ±5%, 1/2W	Tru-ohm Raytheon	FR-10 333638-2	2
R112	Wire Resistor		RL20S132J	1
R113	Resistor		RC32GF102K	1
R116	Resistor		RC32GF131J	1
R117, R118	Resistor		RC42GF331K	2
C1	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204 333649-4	1
C2	Capacitor 560μμF ±10%, 500V	Aerovox Raytheon	ADM-19-561 333651-2	1

MONOSCOPE DEFL AMPL A3, ASSY 349062-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C3, C4, C6, C7	Capacitor 5.0µµF ±5%, 500V	Cornell-Dublier	CD15	4
		Raytheon	235-1535P4	
C5	Capacitor	Aerovox	19-471	1
		Raytheon	333651-1	
C8	Capacitor .015µF ±10%, 200V	Sprague	192P	1
		Raytheon	235-1684P27	
C9	Capacitor 0.100µF ±2%, 200V	Sprague	192P	1
		Raytheon	235-1684P37	
C10	Capacitor 0.1µF	Raytheon	235-1671P1	1
		Glenco Corp	GBM-1-9	
C11	Trimmer Capacitor 37-250µµF	Elmenco	426	1
		Raytheon	333652-1	
C12	Capacitor .001µµF ±10%, 200V	Sprague	TE-1209	1
		Raytheon	235-1684P13	
C13	Capacitor .0082 µF ±2%, 200V	Sprague	192P	1
		Raytheon	235-1684P24	
C14	Capacitor 25µF ±10%, 25V	Sprague	TE-1207	1
		Raytheon	333649-5	
C16	Capacitor	Cornell-Dublier	19-681	1
		Raytheon	333651-3	
C17	Capacitor 220µF ±5%, 500V	Cornell-Dublier	CD15	1
		Raytheon	235-1535P35	
C18	Capacitor 50µF ±10%, 25V	Sprague	TE1209	1
		Raytheon	333649-6	
C20	Capacitor 39µµF ±5%, 500V	Cornell-Dublier	CD15	1
		Raytheon	235-1535P16	
CR1 thru CR7	Diode 1N914	Cont Dev Corp		7

MONOSCOPE DEFL AMPL A3, ASSY 349062-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
L1, L2	Coil 22μH	Delevan Raytheon	MS16226-17 375-2011P17	2
Q1, Q2, Q3, Q4, Q6, Q7, Q9, Q10, Q11, Q13, Q14, Q15, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q26	Transistor 2N3643	Fairchild		20
Q24	Transistor 2N3563			1
Q25, Q28	Transistor 2N2219A	Sprague Raytheon	 333659-1	2
Q27	Transistor 2N3638	Fairchild		1
VR1, VR2	Diode 1N942	Motorola		2

LVPS A4, ASSY 345723-1

Schematic 200-4030

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C1	Capacitor, .0022μF, 200V	Sorensen	24-2409-3	1
C2 a, b	Capacitor, 1.5μF, 40V		24-2453-1	2
C4	Capacitor, 500μF, 25V		24-2452-1	1
C5	Capacitor, .0022μF 200V		24-2409-3	1
C6 a, b	Capacitor, 1.8μF, 15V		24-2441-1	2
C7	Capacitor, 500μF, 6V		24-2283-5	1
C8 a, b	Capacitor, 1.5μF, 40V		24-2453-1	2
C9	Capacitor, 500μF, 25V		24-2452-1	1
C10	Capacitor, 50μF, 25V		24-2286-5	1
C11	Capacitor, 250μF, 25V		24-2286-7	1
C12	Capacitor, 40μF, 250V		24-2289-5	1
C13, C21	Capacitor, .0022μF, 200V		24-2409-3	2
C14	Capacitor, 0.33μF, 200V		24-2409-16	1
C15	Capacitor, 20μF, 250V		24-2289-4	1

Sor

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C16	Capacitor, .0022μF, 200V	Sorensen	24-2409-3	1
C17	Capacitor, .0022μF, 200V		24-2409-3	1
C18	Capacitor, .0022μF, 200V		24-2409-3	1
C19	Capacitor, 0.22μF, 200V		24-2409-15	1
C20	Capacitor, 22μF, 6V		24-2018	1
C22	Capacitor, 0.47μF, 600V		24-2410-17	1
CR3-6	Rectifier, 3A, 100V, PIV		26-1006-2	4
CR7,8	Rectifier, 3A, 50V, PIV		26-1006-1	2
CR9-12	Rectifier, 3A, 100V, PIV		26-1006-2	4
CR13,14	Rectifier, 0.75A, 100V, PIV		26-158-1	2
CR15-18	Rectifier, 1.5A, 600V, PIV		26-1151	4
CR19	Rectifier, 0.75A, 100V, PIV		26-158-1	1
CR20	Rectifier, 0.1A 50V, PIV		26-1017	1
CR21	Rectifier		26-1060	1
Q1	Transistor, 2N697		18-161-2	1
Q2	Transistor, 40312		18-142	1
Q3	Transistor, 2N3641		18-144	1
Q4,5	Transistor, 2N3641		18-144	2

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
Q6	Transistor, 2N3055	Sorensen	18-151	1
Q7	Transistor, 2N3641		18-144	1
Q8	Transistor, 40312		18-142	1
Q9	Transistor, 2N3055		18-151	1
Q10	Transistor, 2N3641		18-144	1
Q11, 12	Transistor, 2N3641		18-144	2
Q13	Transistor, 2N697		18-161-2	1
Q14	Transistor, 40312		18-142	1
Q15	Transistor, 2N3055		18-151	1
Q16	Transistor, 2N3641		18-144	1
Q17, 18	Transistor, 2N3641		18-144	2
Q19	Transistor, 2N3641		18-144	1
Q20	Transistor, 2N3583		18-168	1
Q21	Transistor, 2N3641		18-144	1
Q22, 23	Transistor, 2N3641		18-144	2
Q24	Transistor, RT9338		18-146	1
Q25	Transistor, 2N3638		18-143	1
R1	Resistor, 100K, 1/2W		27-117	1
R2	Resistor, 6.8K, 1/2W		27-185	1
R3	Resistor, 1.8K, 1/2W		27-192	1
R4	Resistor, 220 ohm, 1/2W		27-101	1
R6	Resistor, 0.47 ohm, 3W		27-397-17	1

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R7	Resistor, 10K, 1/2W	Sorensen	27-133	1
R8	Resistor, 22K, 1/2W		27-142	1
R9	Resistor, 10K, 1W		27-212	1
R10	Resistor, 10K, 3W		27-398-22	1
R11	Potentiometer, 5K, 2W		29-505-4	1
R12	Resistor, 1.5K, 3W		27-398-2	1
R13	Resistor, 27K, 1W		27-218	1
R14	Resistor, 680 ohm, 1/2W		27-156	1
R15	Resistor, 330 ohm, 1/2W		27-102	1
R16	Resistor, 68 ohm, 1/2W		27-160	1
R18	Resistor, 18 ohm, 7W		27-470-7	1
R19	Resistor, 1.5K, 1/2W		27-171	1
R20	Resistor, 22K, 1/2W		27-142	1
R21	Resistor, 6.8K, 3W		27-398-18	1
R22	Potentiometer, 400 ohm, 2W		29-505-5	1
R23	Resistor, 120K, 1/2W		27-1179	1
R24	Resistor, 6.8K, 1/2W		27-185	1

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R25	Resistor, 1.8K, 1/2W	Sorensen	27-176	1
R26	Resistor, 220 ohm, 1/2W		27-101	1
R27	Resistor, 0.47 ohm, 3W		27-397-17	1
R28	Resistor, 12K, 1W		28-734	1
R29	Resistor, 6.8K, 1/2W		27-185	1
R30	Resistor, 2.2K, 1/2W		27-152	1
R31	Resistor, 820 ohm, 1/2W		27-182	1
R32	Resistor, 1K, 3W		27-397-97	1
R33	Potentiometer, 400 ohm, 2W		29-518-1	1
R34	Resistor, 300 ohm, 3W		27-397-84	1
R35	Resistor, 47K, 1/2W		27-112	1
R36	Resistor, 100K, 1/2W		27-117	1
R37	Resistor, 1.5K, 1/2W		27-171	1
R39	Resistor, 3.9 ohm, 3W		27-397-39	1
R40	Resistor, 22K, 1/2W		27-142	1
R41	Resistor, 22K, 1/2W		27-142	1

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R42	Resistor, 180 ohm, 1/2W	Sorensen	27-190	1
R43	Resistor, 820 ohms, 1/2W		27-182	1
R44	Resistor, 1K, 1/2W		27-103	1
R45	Resistor, 510 ohm, 3W		27-397-90	1
R46	Potentiometer, 400 ohm, 2W		29-518-1	1
R47	Resistor, 10K, 3W		27-398-22	1
R48	Resistor, 3.3K, 3W		27-398-10	1
R49	Resistor, 10K, 1/2W		27-133	1
R50	Resistor, 15K, 1/2W		27-179	1
R51	Resistor, 3.9K, 1/2W		27-186	1
R52	Resistor, 470 ohm, 3W		27-397-89	1
R53	Resistor, 10K, 1/2W		27-133	1
R54	Resistor, 12K, 1/2W		27-1108	1
R55	Resistor, 1.5K, 1/2W		27-171	1
R56	Resistor, 6.8K, 3W		27-398-18	1
R57	Resistor, 274 ohm, ±1%, 1/4W		28-1227	1

LVPS A4, ASSY 345723-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R58	Resistor, 28 ohm, ±1%, 1/4W	Sorensen	28-1247	1
R59	Resistor, 182 ohm, 1/4W		28-1222	1
R60	Resistor, 680 ohm, 1/2W		27-156	1
R61	Resistor, 180 ohm, 1/2W		27-190	1
R62	Resistor, 6.8 ohm, 1/2W		27-1126	1
R63	Resistor, 470 ohm, 3W		27-397-89	1
R64	Resistor, 22 ohm, 1/2W		27-153	1
Z2	Zener Diode, 1N751A		26-204	1
Z3	Zener Diode, 1N751A		26-204	1
Z4	Zener Diode, 1N751A		26-204	1
Z5	Zener Diode, 1N746A		26-251	1
T1	Transformer		126-2980	1
F1	Fuse, 4A, 250V		42-847	1

HVPS A5, ASSY 345724-1

Schematic 200-4041

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C1, C2	Capacitor, 25μF, 25VDC	Sorensen	24-2279-10	2
C3	Capacitor, 50μF, 50VDC		24-2280-12	1
C4	Capacitor, 0.47μF, 100VDC		24-2473	1
C5	Capacitor, 4.7μF, 20V		24-2551	1
C6	Capacitor, .047μF, 200V		24-2409-11	1
C7	Capacitor, 100μF, 50V		24-2442	1
C8, 9	Capacitor, 47μF, 10V		24-2012	2
C10, 11	Capacitor, .047μF, 1600V		24-2474	2
C12	Capacitor, .02μF, 10KV		24-2146	1
C13	Capacitor, .02μF, 5KV		24-2147	1
C14	Capacitor, .01μF, 15KV		24-2148	1
C15	Capacitor, .015μF, 1000V		24-2475	1
C16	Capacitor, 1000PF		24-2016	1
CR1, 2	Rectifier RD 9119		26-1017	2
CR3	Reference Diode 1N936		26-238	1

HVPS A5, ASSY 345724-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
CR4	Reference Diode 1N750A	Sorensen	26-211	1
CR5	Rectifier CER 68		26-158-1	1
CR6, 7	Rectifier CER 68		26-158-1	2
CR8 - 11	Rectifier SLA-02		26-1044	4
CR12 - 14	Rectifier 5SN10		26-1058	3
CR15	Rectifier DD9119		26-1017	1
Q1	Transistor, 40312		18-142	1
Q2	Transistor, RT9343		18-145	1
Q3	Transistor, 2N3638		18-143	1
Q4	Transistor, 2N3641		18-144	1
Q5, 6	Transistor, 2N3904		18-166	2
Q7	Transistor, 2N3641		18-144	1
Q8, 9	Transistor, 40346		18-167	2
Q10, 11	Transistor, 2N3441		18-157	2
R1	Resistor, 270 ohm, 1/2W		27-191	1
R2	Resistor, 1.5K ohm, 1/2W		27-171	1
R3	Resistor, 2.7 ohm, 2W		28-1242	1
R4	Potentiometer, 2.5K ohm, 2W		29-505-3	1
R5	Resistor, 1.74K ohm, 1/2W		28-1243	1
R6	Resistor, 3.3K ohm, 1W		27-292	1
R7	Resistor, 33K ohm, 1/2W		27-163	1

HVPS A5, ASSY 345724-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R8	Resistor, 1K ohm, 1W	Sorensen	27-297	1
R9	Resistor, 4.7K ohm, 1/2W		27-107	1
R10	Resistor, 560 ohm, 1/2W		27-1103	1
R11	Resistor, 825 ohm, 1/2W		28-1217	1
R12	Resistor, 22.6K ohm, 1/2W		28-1244	1
R13	Potentiometer, 5K ohm, 1W		29-514	1
R14	Resistor, 180 ohm, 1/2W		27-190	1
R15	Resistor, 6.8K ohm, 1/2W		27-185	1
R16, 17	Resistor, 56 ohm, 1/2W		27-1158	2
R18	Resistor, 3.3K ohm, 1W		27-292	1
R19	Resistor, 2.2K ohm, 1W		27-290	1
R20, A, B	Resistor, 1.5M ohm, 2W		28-1219	2
R21	Resistor, 0.15M ohm, 1/2W		28-525	1
R22	Resistor, 10K ohm, 1W		27-212	1
R23	Resistor, 82K ohm, 2W		27-372	1

HVPS A5, ASSY 345724-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R24, A, B,	Resistor, 30M ohm 2W	Sorensen	28-1245	2
R25	Resistor, 4.75M ohm, 1W		28-1246	1
L1	Filter choke		127-1791	1
T1	Transformer		126-2981	1
T2	Transformer		126-2960	1

HV NETWORK A6, ASSY 349020-1

Schematic 349030

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	Panel	Raytheon	349021-1	1
R8	Resistor		RL20S473J	1
R1	Resistor		RL32S153J	1
R2	Var Resistor	Raytheon	240-1316P20	1
R5, R6, R7	Resistor		RL32S434J	3
R4	Var Resistor	Raytheon	240-1316P24	1
R9	Var Resistor	Raytheon	240-1316P31	1
R10	Resistor		RC20GF123K	1
R11	Resistor		RL20S513J	1
R12	Resistor		RC20GF105J	1
R3	Resistor		RL32S334J	1
C1	Capacitor 0.100μF ±2%, 200V	Sprague Raytheon	192P 235-1684P37	1

PREAMPLIFIER A7, ASSY 388063-1

Schematic 388065

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	388063-2	1
R2	Resistor		RC20GF821K	1
R3	Resistor		RC20GF681K	1
R4	Resistor		RL20S681J	1
R5	Resistor		RC20GF102K	1
R6	Resistor		RL20S222J	1
R7	Resistor		RC20GF222K	1
R8	Resistor		RL20S392J	1
R9	Resistor		RC20GF101K	1
R10	Resistor		RL20S220J	1
R11	Resistor		RC20GF392K	1
R12, R17	Resistor		RC20GF122K	2
R13	Resistor		RC20GF100K	1
R14	Resistor		RL20S472J	1
R15	Resistor		RC20GF822K	1
R16	Resistor		RC20GF682K	1
R18	Resistor		RC20GF472K	1
R19	Resistor		RC20GF683K	1
R20	Resistor		RC20GF272K	1
R21	Resistor		RC20GF220K	1
R22	Resistor		RC20GF470K	1

PREAMPLIFIER A7, ASSY 388063-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R23	Resistor		RC20GF820K	1
C1	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204-C-616 333649-4	1
C2, C3, C4, C7, C8	Capacitor 50μF ±10%, 25V	Sprague Raytheon	TE1209-C-616 334649-6	5
C5	Capacitor 15.0μμF ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P7	1
C6	Capacitor 300μF ±10%, 3V	Sprague Raytheon	TE1066 333649-9	1
C9	Capacitor 0.1μF ±30%, 500V	Glenco Corp Raytheon	CBM1-9 235-1671P1	1
CR1, CR2	Diode 1N914	Cont Dev Corp		2
L1	Choke 4.70μH ±10%	 Raytheon	MS16225-15 375-2016P15	1
Q1 thru Q5	Transistor 2N3563	Fairchild		5

VIDEO AMPL A8, ASSY 349084-1

Schematic 349081

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	349084-2	1
R1, R3	Resistor		RL20S151J	2
R2, R15	Resistor		RC20GF122K	2
R4	Resistor		RL30S152J	1
R5	Resistor		RL20S222J	1
R7	Var Resistor, 2K ±5%, 0.5W	Bourne Raytheon	3307P-1-202 345262-3	1
R8	Resistor		RC20GF102K	1
R9, R6	Resistor		RC20GF222K	2
R10	Resistor		RC20GF472K	1
R11	Resistor		RL20S270J	1
R12, R19	Resistor		RL42S331J	2
R13	Resistor		RC20GF220K	1
R14	Resistor		RL20S562J	1
R17	Resistor		RC20GF473K	1
R18	Resistor		RC20GF331K	1
R20	Resistor		RC42GF682K	1
R21	Resistor		RC20GF101K	1
R23	Resistor		RC20GF564K	1
R24	Resistor		RC20GF394K	1
R30	Resistor		RC20GF154K	1
R25	Resistor		RC20GF104K	1
C1	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204-C-616 333649-4	1

VIDEO AMPL A8, ASSY 349084-1 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C3, 4, 10	Capacitor 5μF, ±10%, 150V	Sprague Raytheon	TE1504-C-616 333649-7	3
C5	Capacitor 0.5μF, ±20%, 200V	Aerovox Raytheon	P123ZN 333650-1	1
C6	Capacitor 5μF, 50V	Raytheon	333649-11	1
Q1, Q2	Transistor 2N3563	Fairchild		2
Q3	Transistor 2N2219A	Sprague Raytheon		1
Q4	Transistor 2N1893	Raytheon		1
Q6	Transistor 2N3440	RCA		1
CR1, 2, 4, 5, 7	Diode 1N914	Cont Dev Corp		5
CR3, CR10	Diode 1N4384	Texas Inst		2
L1	Choke 3.3μH	Delevan Elec Raytheon	MS16225-13 375-2016P13	1

KEYBOARD A11, ASSY 349427-1

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	Keyboard & Matrix	NAVCOR	1051D-14B	1

DELAY LINE MICROLOGIC ASSY 349022-1

Ref Desig	Description	Vendor	Vendor Part No.	Qty
A10	Delay Line Read-Write Amplifier	Raytheon	343056-1	1
A12	Control Board		348917-1	1
A13	Display Logic		348919-1	1
A14	Timing and Discrete Board		343061-1	1
A15	Delay Line		334741-1	1

DELAY LINE READ-WRITE AMPL A10, ASSY 343056

Schematic 343808

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	343056-2	1
R1	Resistor		RC20GF681K	1
R2	Resistor		RC20GF153K	1
R3	Resistor		RC20GF101K	1
R4	Resistor		RC20GF271K	1
R5, R21	Resistor		RC20GF100K	2
R6, 18, 22	Resistor		RC20GF102K	3
R7	Resistor		RC20GF150K	1
R8	Resistor		RC20GF562J	1
R9	Resistor		RC20GF4R7J	1
R10, 26, 28	Resistor		RC20GF332K	3
R11	Resistor		RC20GF821K	1
R12	Resistor		RC20GF392J	1
R13, 14	Resistor		RC20GF561K	2
R15	Resistor		RC20GF152K	1
R19, 23	Resistor		RC42GF391K	2
R20, 24	Resistor		RC20GF220K	2
R25	Resistor		RC20GF680K	1
R16, 17	Resistor		RC20GF222K	2
R27, 29	Resistor		RC20GF472K	2
L1	Choke 22μH	Delevan Elec	MS16222-17	1
		Raytheon	375-2011P17	

DELAY LINE READ-WIRTE AMPL A10, ASSY 343056 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C1, 5, 6, 10	Capacitor 5μF, 50V	Sprague Raytheon	 333649-11	4
C2	Capacitor 100μμF, ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P27	1
C3	Capacitor 220μμF, ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P35	1
C7, C8	Capacitor 0.01μF, ±2%, 200V	Sprague Raytheon	192P 235-1684P25	2
C9, C11	Capacitor 10μF, ±10%, 25V	Sprague Raytheon	TE-1204 333649-4	2
CR1, CR2	Diode 1N914	Cont Dev Corp		2
Q1, 5, 6, 9, 10	Transistor 2N3563	Fairchild		5
Q2, 3, 4, 7, 8	Transistor 2N3643	Fairchild		5
A1, A2	DTL 945	Fairchild Raytheon	SL2659 329814-1	2
A3	DTL 946	Fairchild Raytheon	SL2660 331377-1	1
C4	Capacitor	Raytheon	CS13BE106K	1

CONTROL BOARD A12, ASSY 348917

Schematic No. 349316

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	348917-2	1
A1,2,3,7,8, 14,15,19, 21,22,27, 29,30,33, 37,38,39, 45,46,47, 56,57,63, 66,71,72, 73,75,76, 79,87	DTL 945	Fairchild Raytheon	SL2659 329814-1	31
A4,9,17,18, 20,23,26, 28,31,32, 34,36,41, 42,43,48, 51,52,54, 55,58,59, 60,62,64, 68,74,77, 80,83,85	DTL 946	Fairchild Raytheon	SL2660 331377-1	31
A5,6,12,24, 44,50,61, 70,81,82, 84,90	DTL 962	Fairchild Raytheon	SL2662 331407-1	12
A10,11,35, 49,67,69, 78,86,88	DTL 930	Fairchild Raytheon	SL2656 329796-1	9
A13,25,40 53,56	DTL 932	Fairchild Raytheon	SL2657 331378-1	5
A16,89	DTL 933	Fairchild Raytheon	SL2658 329804-1	2
C1 thru C8	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204-C616 333649-4	8
C9,10,11, 12	Capacitor		CM06DF471K3	4

CONTROL BOARD A12, ASSY 348917 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
L1 thru L8	Choke 22μH	Delevan Elec	MS16222-17	8
		Raytheon	375-2011P17	
R1, 6, 7, 10	Resistor		RC07GF202J	4
R2, 4, 9, 12, 14, 15	Resistor		RC07GF332J	6
R3, 5, 8, 11, 16	Resistor		RC07GF102J	5
Q1, 2, 3, 4	Transistor		388822-1	4
R13	Resistor		RC07GF182J	1
CR1, 2, 3, 4, 5, 6	Diode 1N914	Cont Dev Corp	1N914	6

DISPLAY LOGIC A13, ASSY 348919

Schematic 349396

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	348919-2	1
A1,3,4,7, 8,10,11, 14,16,17, 19,20,22, 27,28,29, 35,36,39, 44,46,52, 56,59,67, 69	DTL 946	Fairchild Raytheon	SL2660 331377-1	26
A2,5,18,32, 33,40,41, 42,45,47, 48,50,51, 53,54,55, 57,58,62, 63,64,65, 66,70,71	DTL 945	Fairchild Raytheon	SL2659 329814-1	25
A6,23,37, 68	DTL 930	Fairchild Raytheon	SL2656 329796-1	4
A12,38,60	DTL 933	Fairchild Raytheon	SL2658 329804-1	3
A9,13,15, 21,24,25, 26,31,61	DTL 962	Fairchild Raytheon	SL2662 331407-1	9
A30,34,43, 49,72	DTL 932	Fairchild Raytheon	SL2657 331378-1	5
L1 thru L6	Choke 22μH	Delevan Elec Raytheon	MS16222-17 375-2011P17	6
C1 thru C6	Capacitor 10μF ±10%, 25V	Sprague Raytheon	TE1204-C-616 339649-4	6

DISPLAY LOGIC A13, ASSY 348919 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C7, 8	Capacitor		CM06DF471J3	2
Q1, 2	Transistor		388822-1	2
R1, 4	Resistor		RC07GF332J	2
R2, 5, 7	Resistor		RC07GF202J	3
R3, 6, 8, 9, 10, 11, 12, 13	Resistor		RC07GF102J	8
CR1, 2, 3, 4	Diode 1N914	Cont Dev Corp	1N914	4

TIMING AND DISCRETE BOARD A14, ASSY 343061

Schematic 344066

Ref Desig	Description	Vendor	Vendor Part No.	Qty
	PC Board	Raytheon	343061-2	1
R1	Resistor		RC20GF473K	1
R2, 5, 6, 14, 15, 16, 55, 56, 57	Resistor		RC20GF222K	9
R3	Resistor		RC20GF3330K	1
R4	Resistor		RC20GF151K	1
R7, 46, 47, 49, 51, 53	Resistor		RC20GF102K	6
R8 thru 13, 44, 45, 58	Resistor		RC20GF472K	9
R18, 48	Resistor		RC20GF822K	2
R19, 23	Resistor		RC20GF392K	2
R20, 24	Resistor		RL20S363J	2
R21, 22, 50, 52, 54	Resistor		RC20GF332K	5
R25	Resistor		RL20S153J	1
R26	Var Resistor 10K ±10%, 0.5W	Bourne Raytheon	3307P-1-103 333643-3	1
R27	Resistor		RC20GF333K	1
R28, 29, 38, 39	Resistor		RC20GF682K	4
R30 thru 35	Resistor		RC20GF683K	6
R36, 37	Resistor		RC20GF272K	2
R40, 41	Resistor		RC20GF183K	2
R42, 43	Resistor		RC20GF122K	2

TIMING AND DISCRETE BOARD A14, ASSY 343061 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
R59, 60, 61, 62	Resistor		RC20GF202K	4
L1	Choke 8.2μH	Delevan Raytheon	MS16222-12 375-2184P12	1
L2 thru 11	Choke 22μH	Delevan Raytheon	MS16222-17 375-2011P17	10
Q1	Transistor TN53	Raytheon	333659-1	1
Q2	Transistor 2N3563	Fairchild		1
Q3, 4, 5	Transistor 2N3638	Fairchild		3
Q6 thru 19	Transistor 2N3643	Fairchild		14
CR1 thru 29	Diode 1N914	Cont Dev Corp		29
X1	Crystal 1.6666MC	Clark Crystal	341293-1CR85/μ	1
C1	Capacitor 430μμF ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P43	1
C2	Capacitor 820μμF ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P51	1
C3, 4	Capacitor ±2%, 200V	Raytheon	235-1684P29	2
C5, 6, 7, 11, 12, 13, 18, 19, 20, 21	Capacitor 10μH ±10%, 25V	Sprague Raytheon	TE1204-C-616 333649-4	10
C8, 9	Capacitor 0.015μFD ±10%, 50V	Sprague Raytheon	194P1539R5 333648-2	2
C10	Capacitor ±5%, 500V	Cornell-Dublier Raytheon	 235-1535P27	1

TIMING AND DISCRETE BOARD A14, ASSY 343061 (Continued)

Ref Desig	Description	Vendor	Vendor Part No.	Qty
C14, 15	Capacitor 220$\mu\mu$H ±5%, 500V	Cornell-Dublier Raytheon	CD15 235-1535P35	2
C16, 17	Capacitor		CS13AF3R3K	2
A1, 7 thru 11, 16, 17, 18, 19, 28, 29, 30, 31, 38, 37, 39	Quad Gate	Fairchild Raytheon	DTL946(SL2660) 331377-1	17
A2, 3, 4, 13, 14, 15, 21 thru 26, 32, 33, 34, 35	Clock Gated FF	Fairchild Raytheon	DTL945(SL2659) 329814-1	16
A5, 6, 36	Triple Gate	Fairchild Raytheon	DTL962(SL2662) 331407-1	3
A12, 27	Dual Buffer	Fairchild Raytheon	DTL932(SL2657) 331378-1	2
A20	Dual Gate	Fairchild Raytheon	DTL930(SL2656) 329796-1	1

DELAY LINE A15, ASSY 334741-1

Ref Desig	Description	Vendor	Vendor Part No.	Qty
A15	Delay-Line	Raytheon	334741-1	1

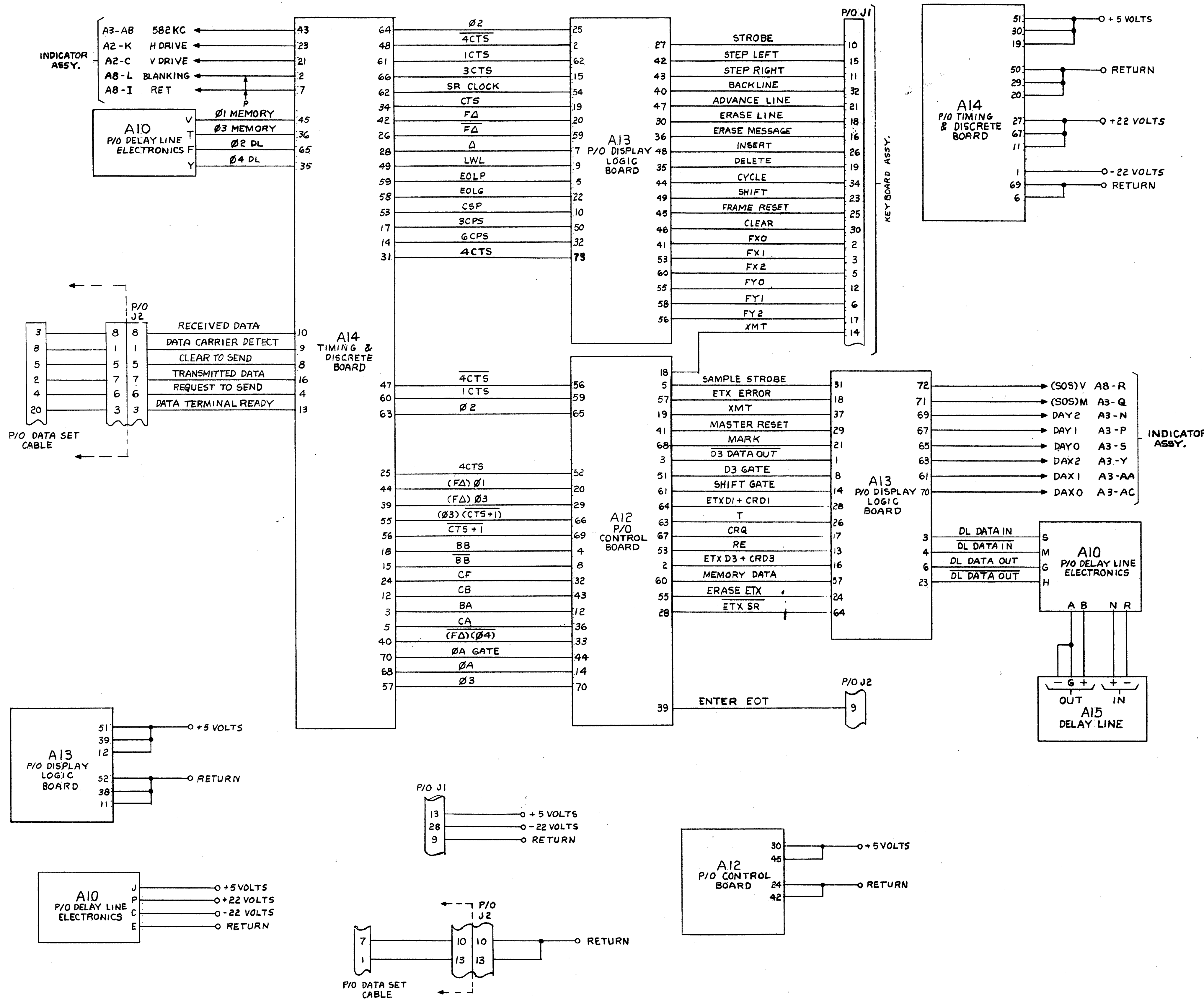
SECTION 6

SCHEMATIC AND PARTS LAYOUT DRAWINGS

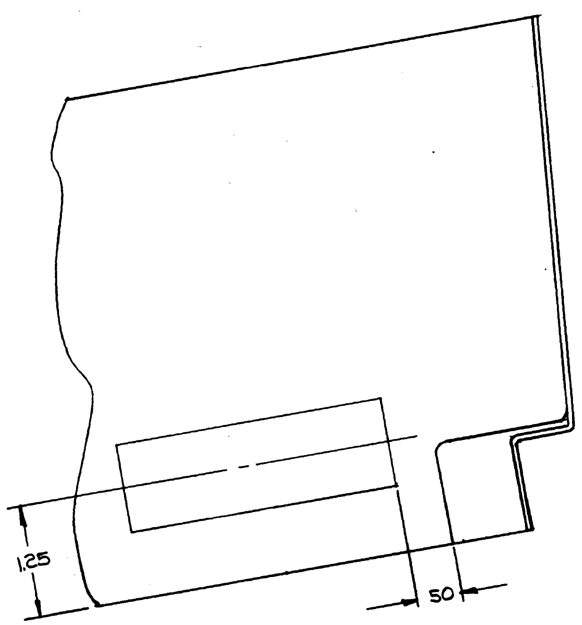
Assy	Description	402-2M10
	Display Console	
	Schematic	349332
	Parts Layout	349086
	Indicator	
	Schematic	349326
	Parts Layout	349090
A2	Vertical and Horizontal Deflection Amplifier	
	Schematic	345408
	Parts Layout	344947
A3	Monoscope Deflection Amplifier	
	Schematic	349031
	Parts Layout	349062
A4	Low-Voltage Power Supply	
	Schematic	2004030
A5	High-Voltage Power Supply	
	Schematic	2004041
A6	High-Voltage Network	
	Schematic	349030
	Parts Layout	349020
A7	Preamplifier	
	Schematic	388065
	Parts Layout	388063
A8	Video Amplifier	
	Schematic	349081
	Parts Layout	349084
A10	Delay-Line Read-Write Amplifier	
	Schematic	343808
	Parts Layout	343056

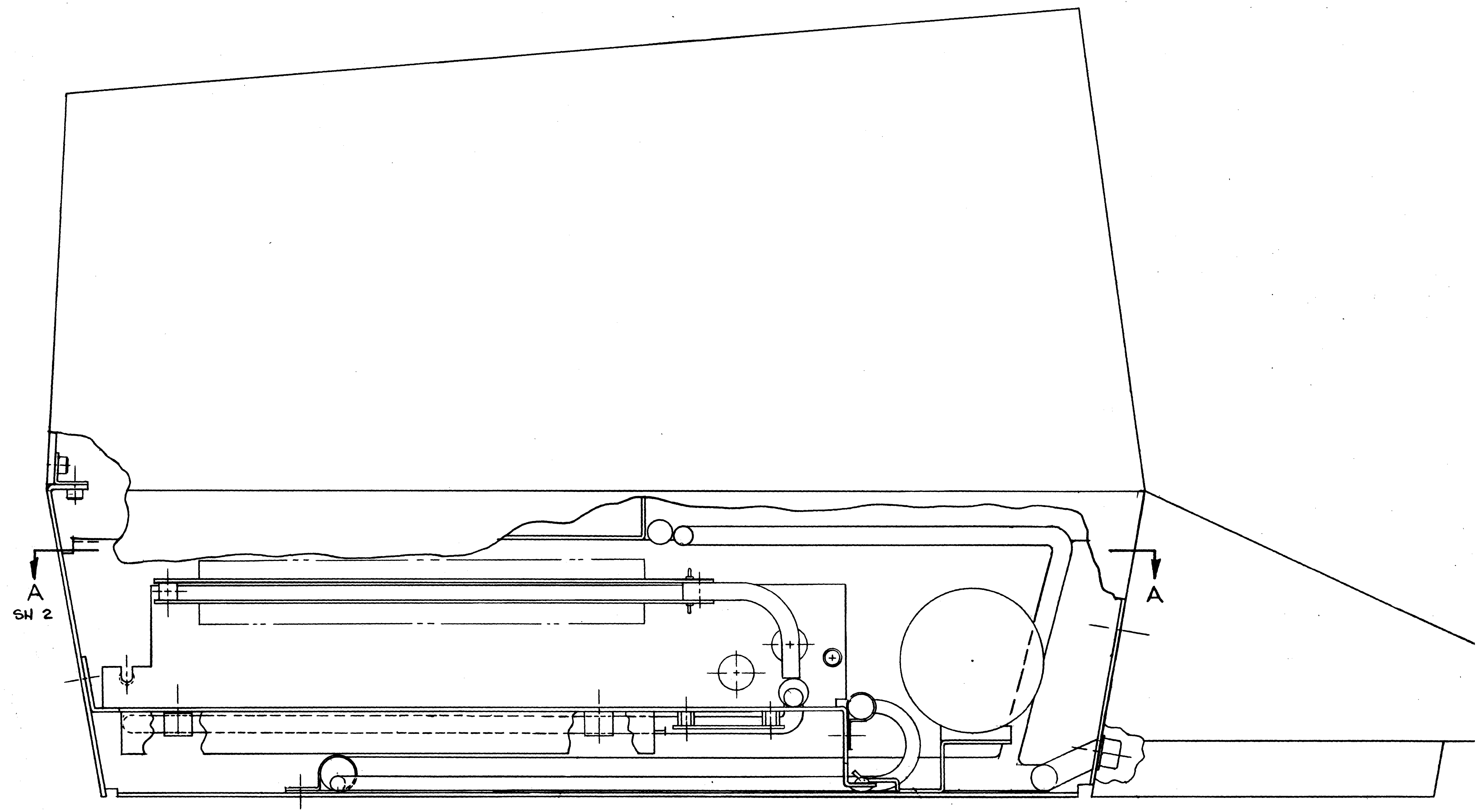
SCHEMATIC AND PARTS LAYOUT DRAWINGS (Continued)

Assy	Description	402-2M10
A12	Control Logic Board	
	Schematic	349316
	Parts Layout	348917
A13	Display Logic Board	
	Schematic	349396
	Parts Layout	348919
A14	Timing and Discrete Board	
	Schematic	344066
	Parts Layout	343061

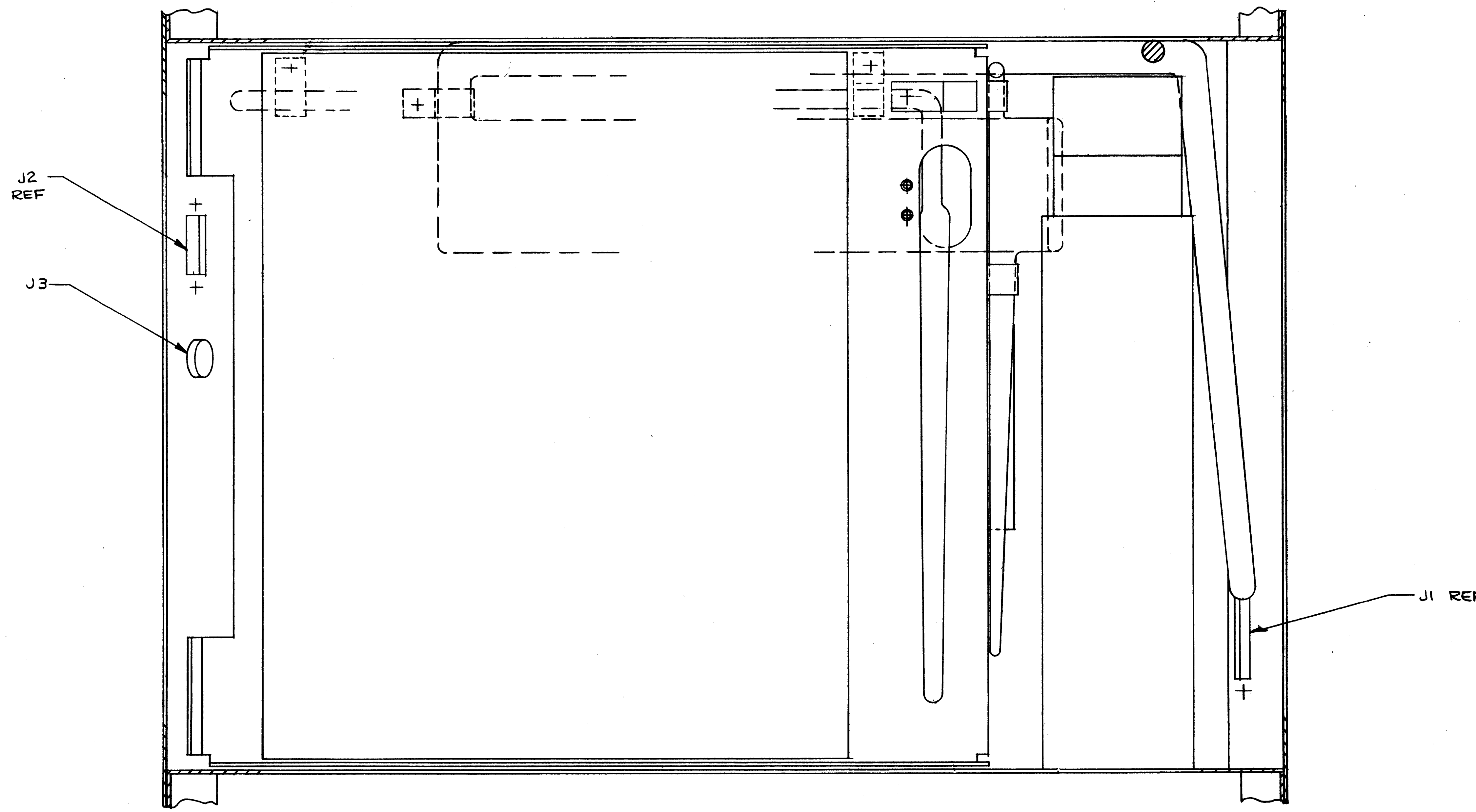


Console Assembly Schematic 349332



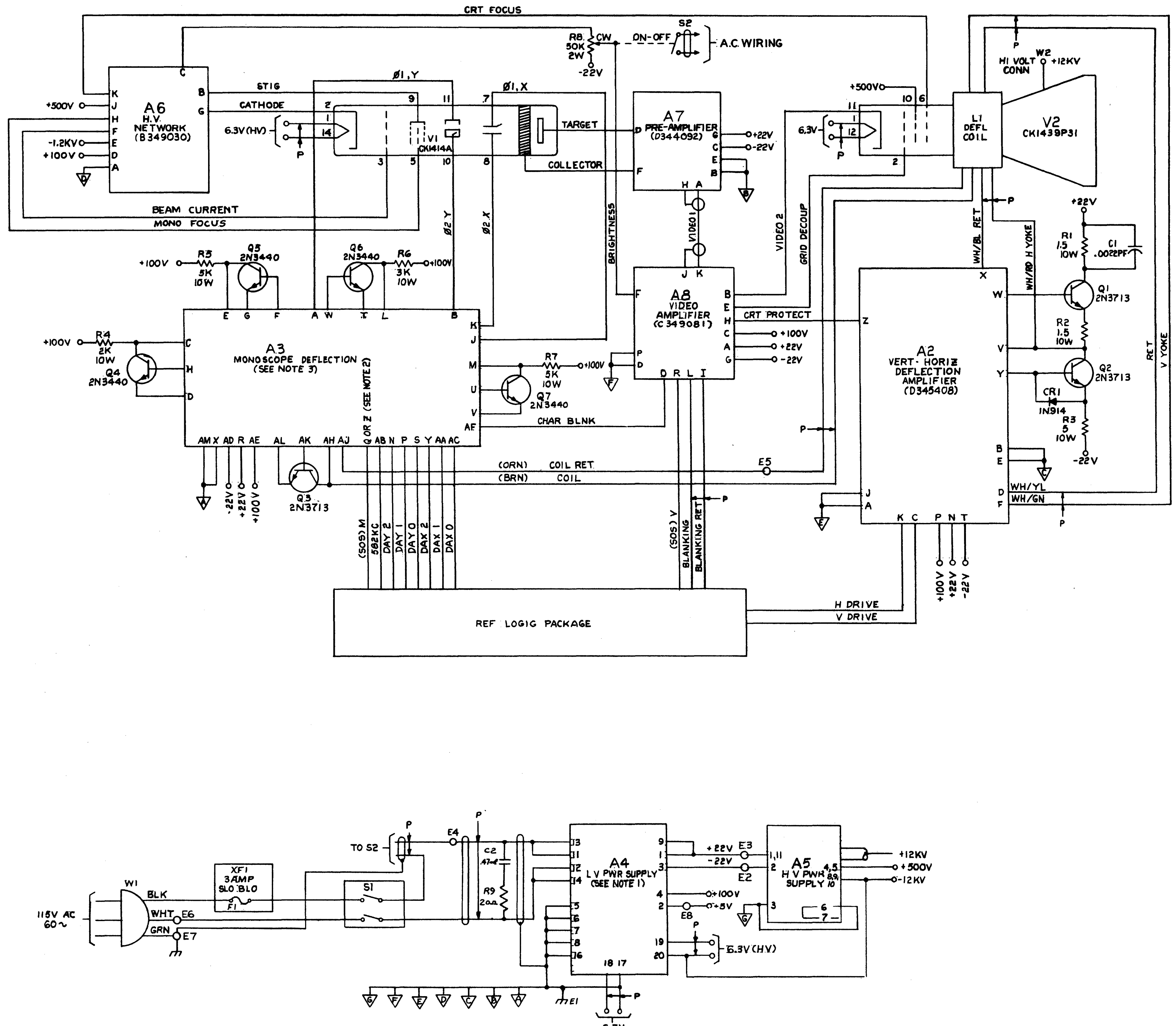


Display Console Parts Layout 3490
Sheet 1 of 2



SECTION A-A
TAKEN FROM SH 1

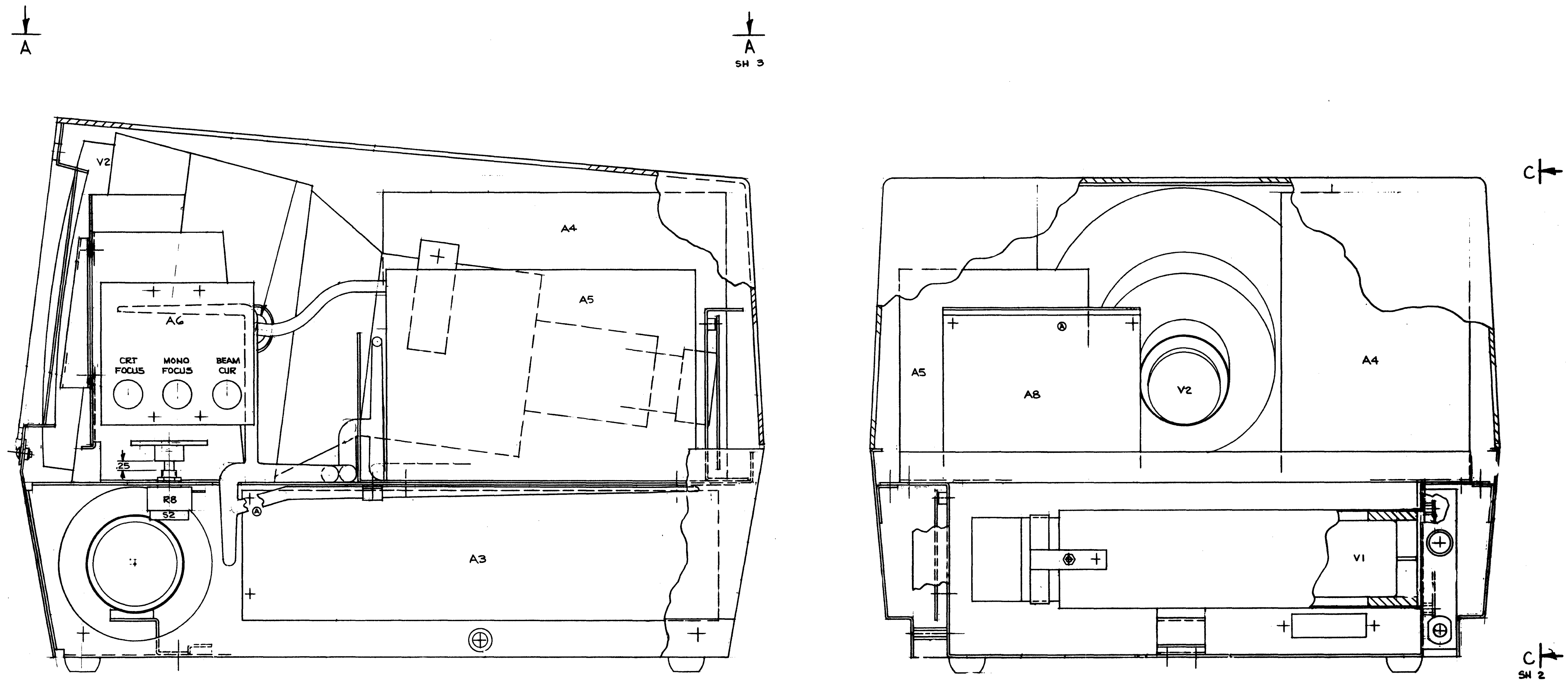
Display Console Parts Layout 349086
Sheet 2 of 2



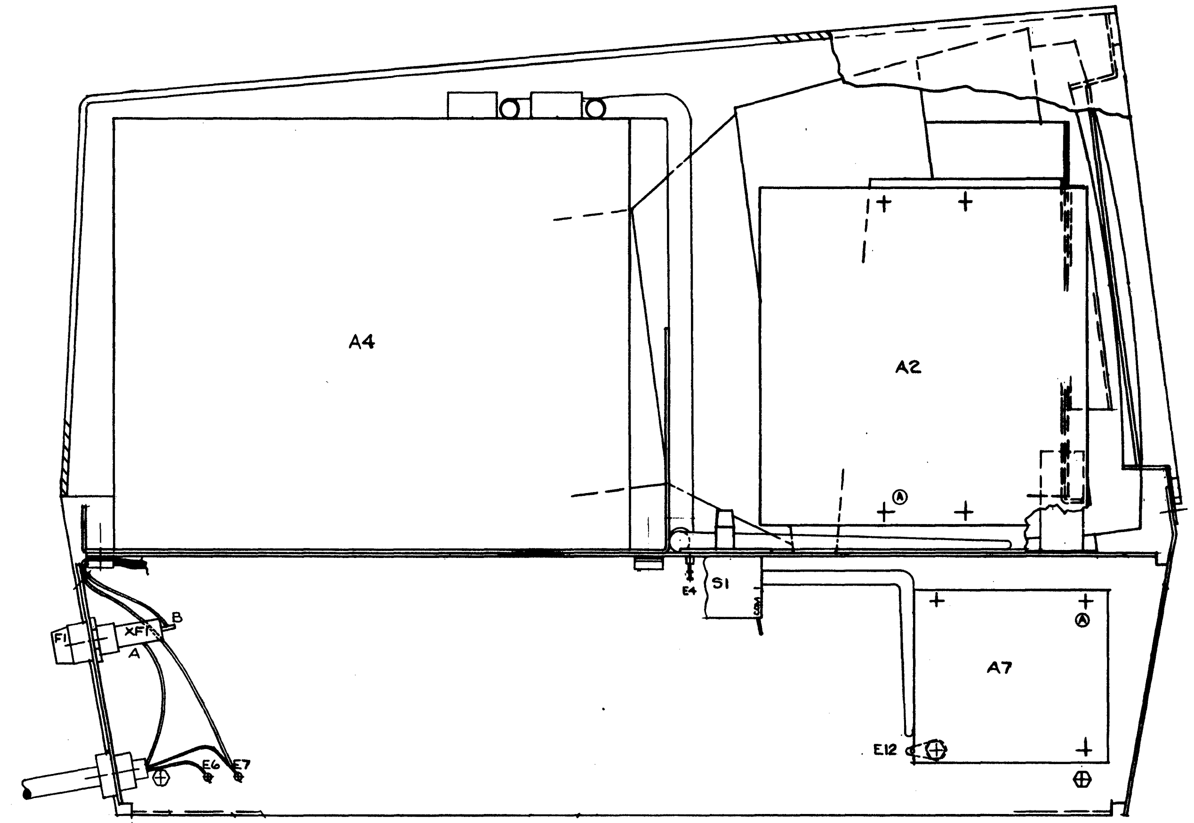
NOTES

1. FOR 210/250V AC OPERATION CHANGE WIRING TO A4 AS FOLLOWS:
   A REMOVE JUMPERS FROM 11 TO 13 & 12 TO 14.
   B ADD JUMPERS FROM 12 TO 13.
   C CONNECT A.C INPUT TO TERMINALS 11 & 14.
2. SEE LOGIC SCHEMATIC FOR PIN THAT IS USED.
3. E349031 FOR 520 CHARACTERS.
   E349078 FOR 1040 CHARACTERS.

Indicator Schematic 349326

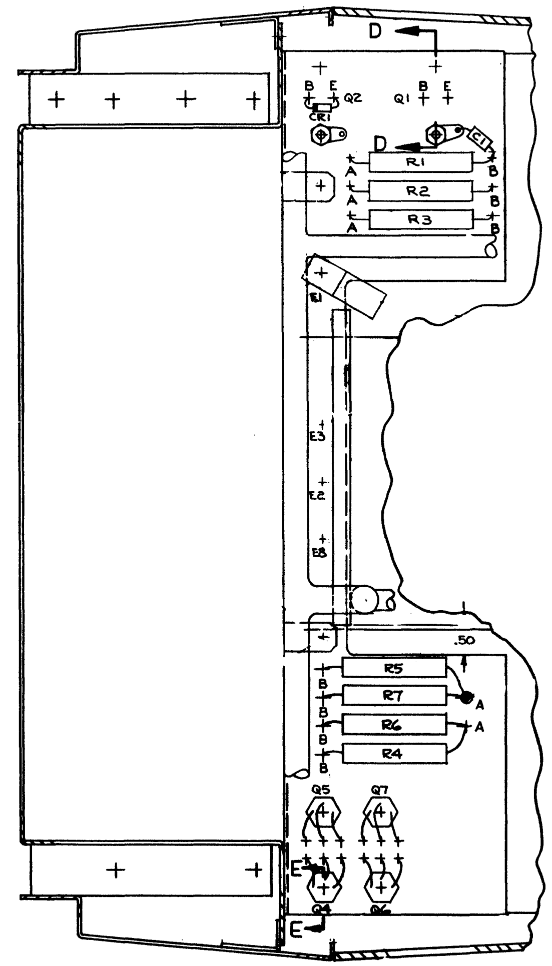


Indicator Parts Layout 349090
Sheet 1 of 3

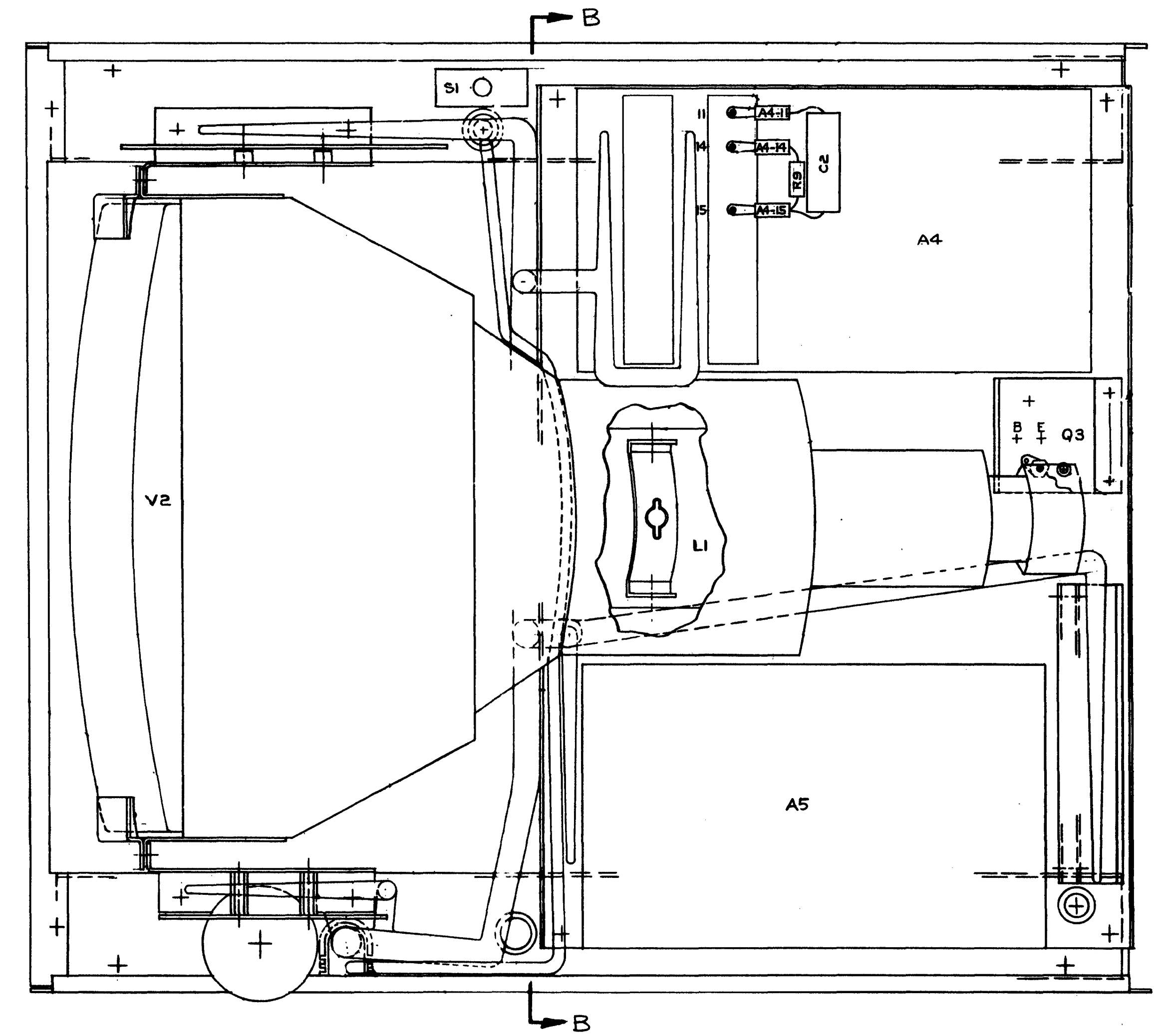


VIEW C-C
TAKEN FROM SH 1

Indicator Parts Layout 349090
Sheet 2 of 3

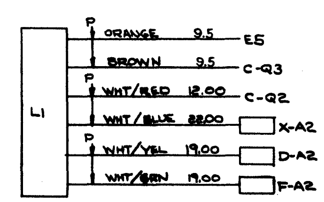


SECTION B-B



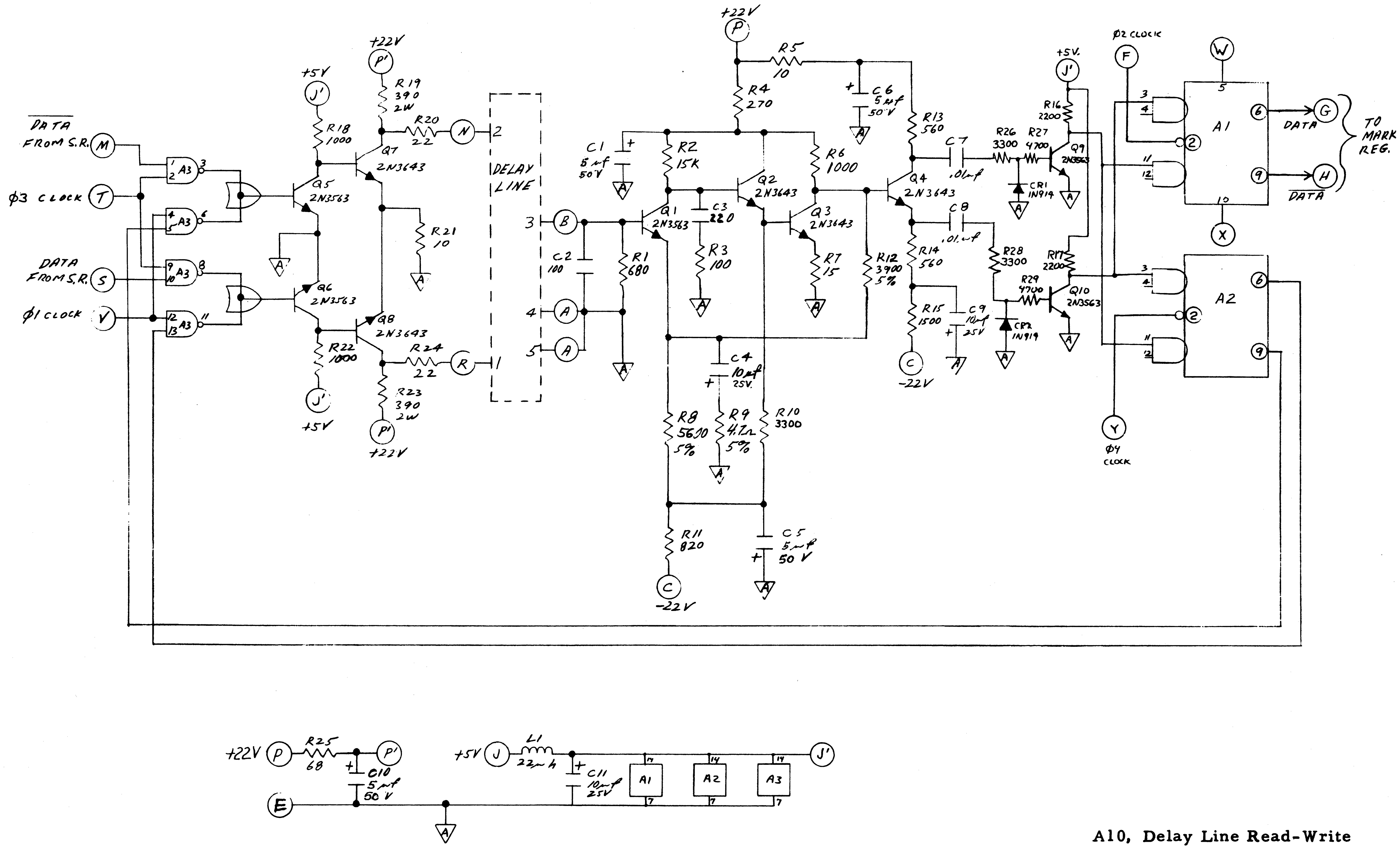
VIEW A-A

TAKEN FROM SH 1

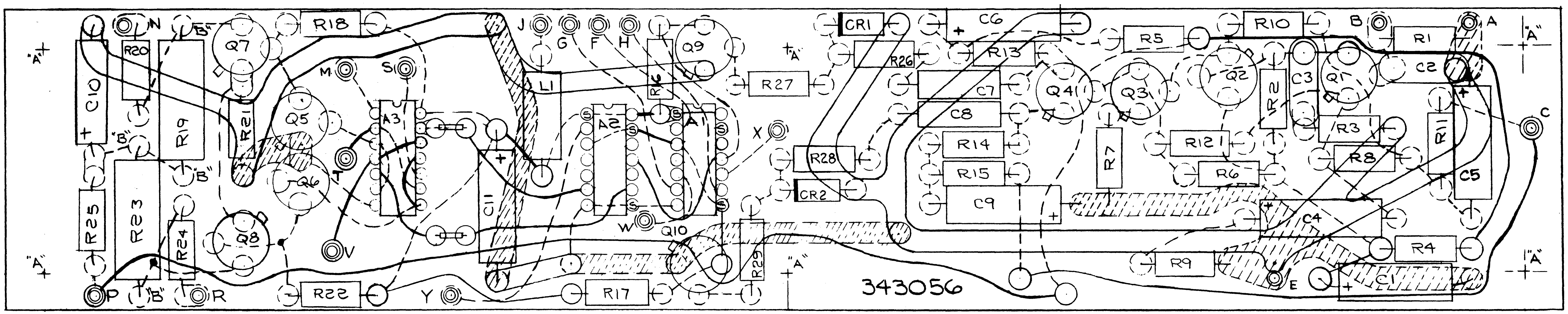


FABRICATE PER 296-1414

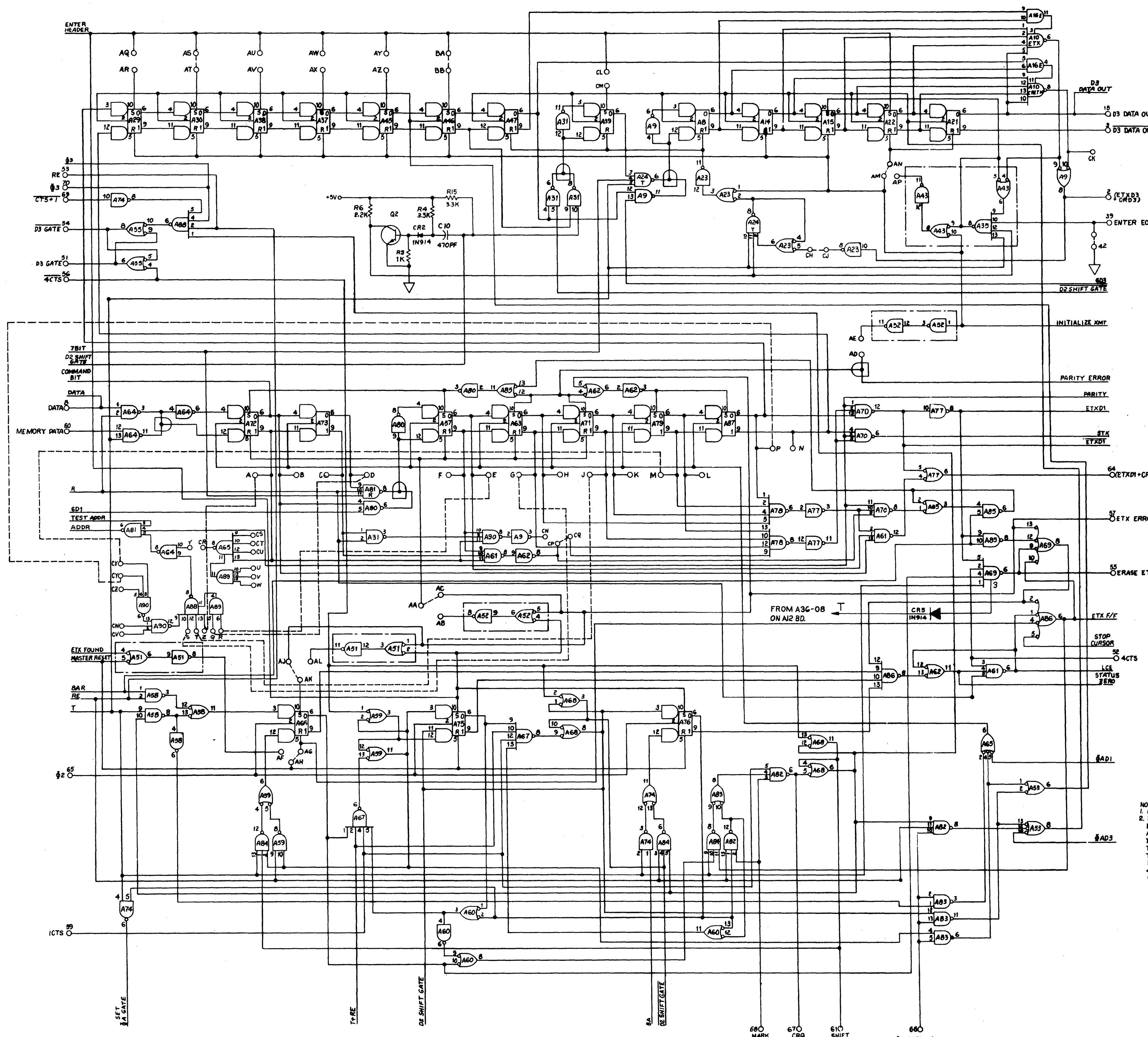
Indicator Parts Layout 349090
Sheet 3 of 3



A10, Delay Line Read-Write Amplifier Assembly Schematic 343808

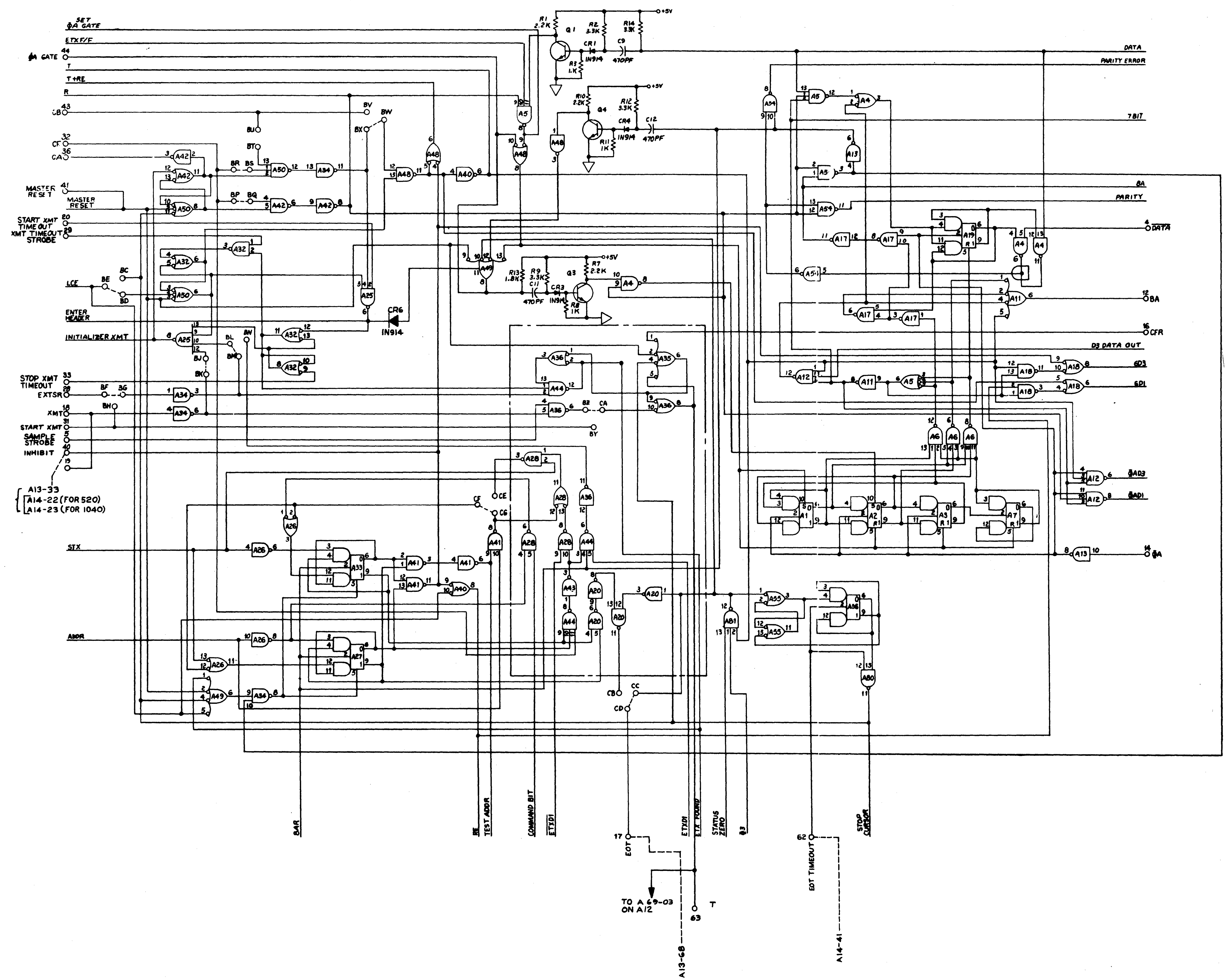


A10, Delay Line Read-Write
Amplifier Assembly
Parts Layout 343056

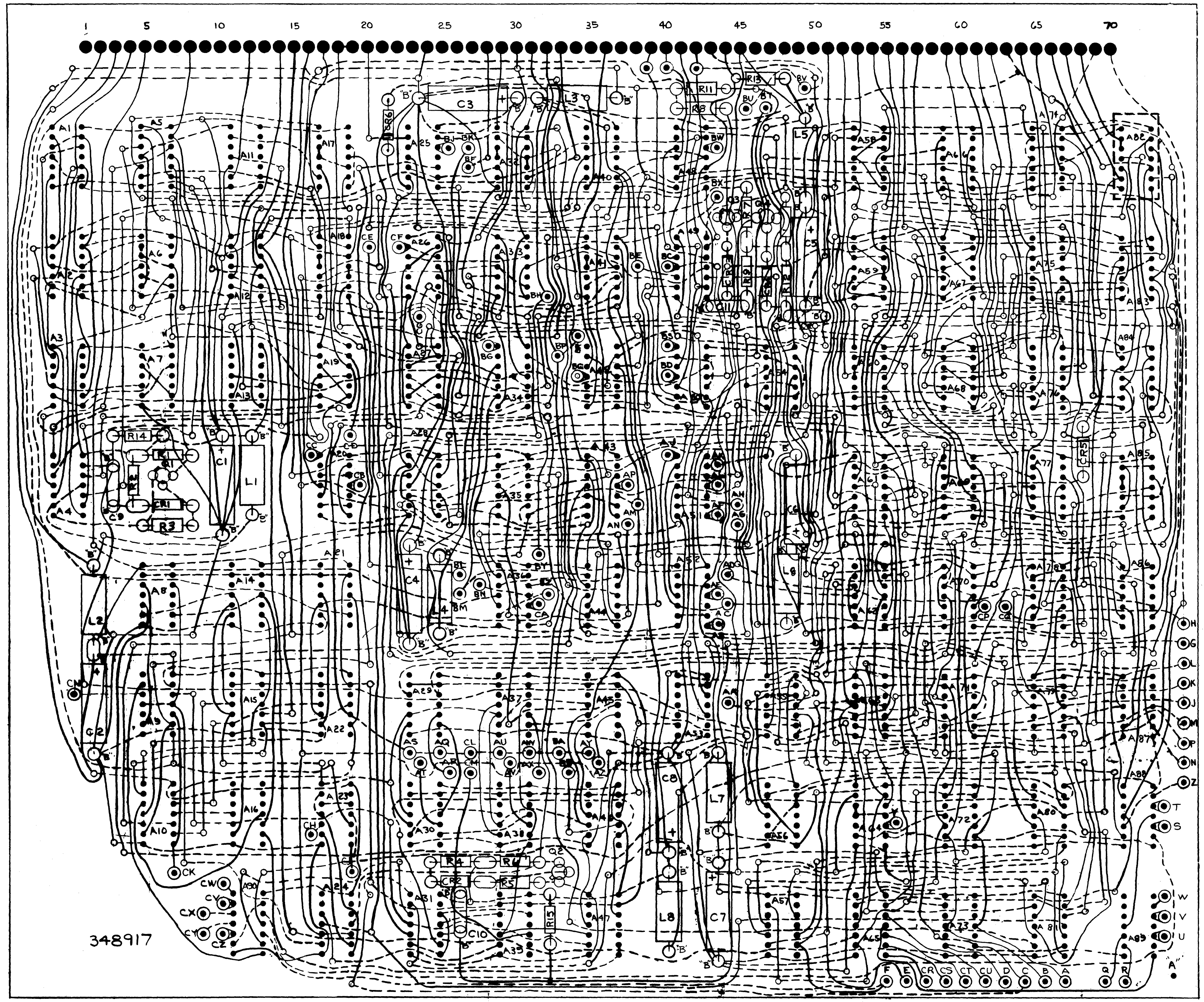


NOTE
1. FOR OPTIONS SEE 347217
2. DASHED CONNECTIONS BETWEEN TERMINALS, BP TO BQ, BR TO BS, BU TO BT, BX TO BW, A12-62 TO A14-41, CG TO CP, BE TO BD, BF TO BG, BK TO BJ, BL TO BM, AH TO AG, AJ TO AK, AA TO AC, AN TO AM, CH TO CJ, CP TO CQ, BZ TO CA, A12-39 TO A12-42, Z TO A, Q TO D, R TO E, S TO G, T TO J, CX TO M, CY TO P, AS TO AT, BA TO BB, CC TO CD, A12-17 TO A13-68, A12-40 TO A13-33, TO A14-22 TO A14-23 ARE TO SHOW OPTION 11220 ADDED TO STANDARD BOARD.

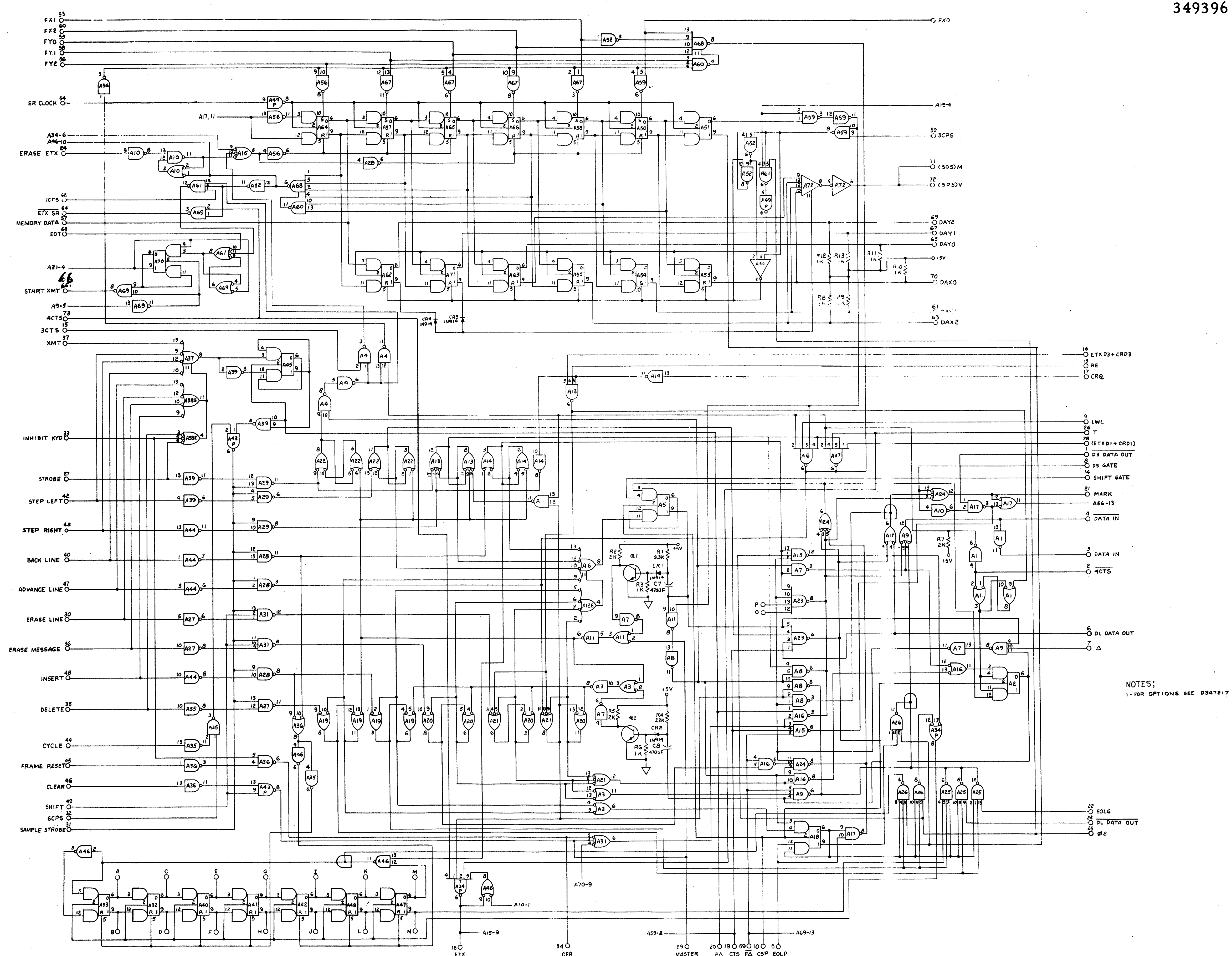
A12, Control Logic Board Assembly
Schematic 349316 (Sheet 1 of 2)



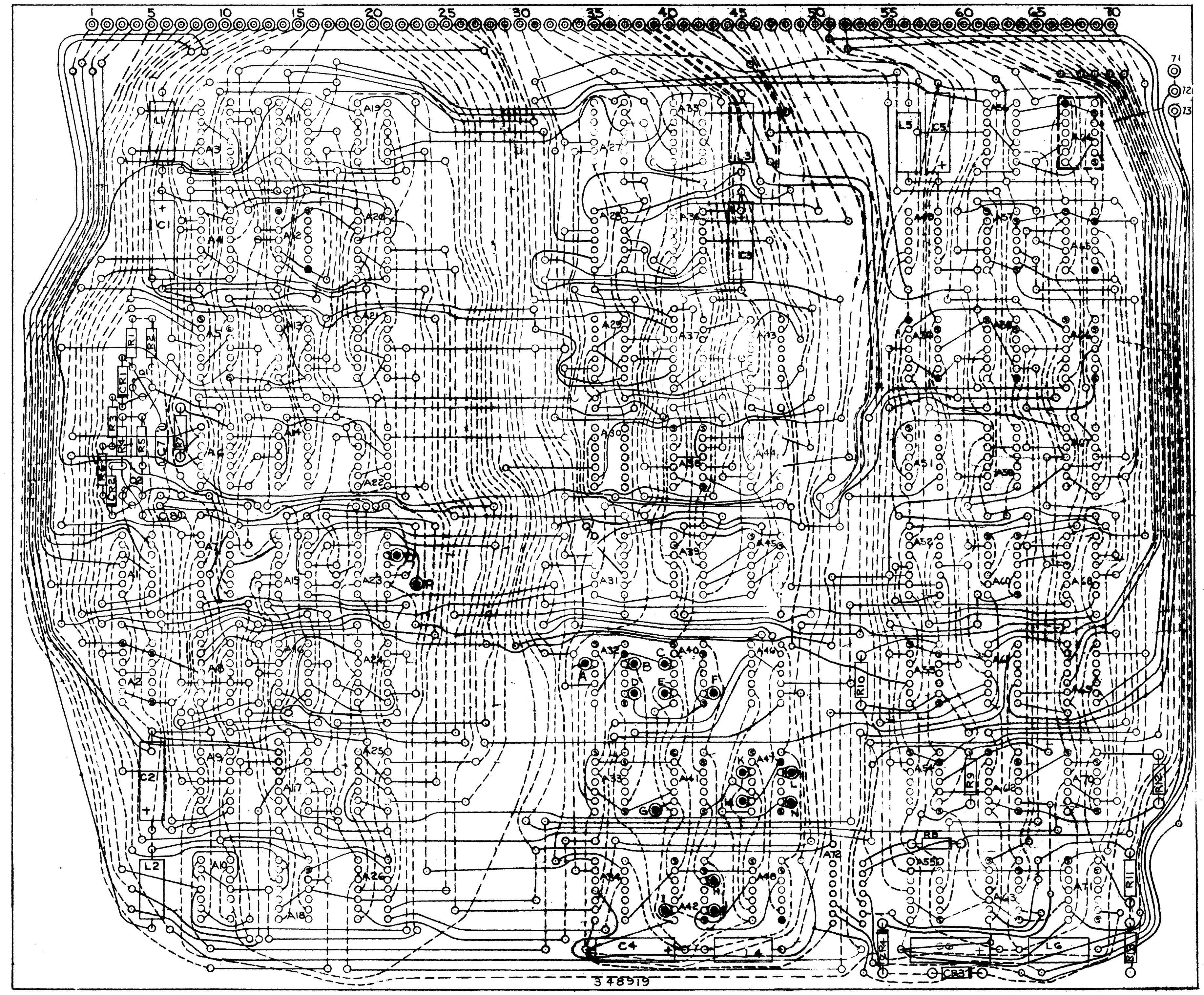
A12, Control Logic Board Assembly
Schematic 349316 (Sheet 2 of 2)



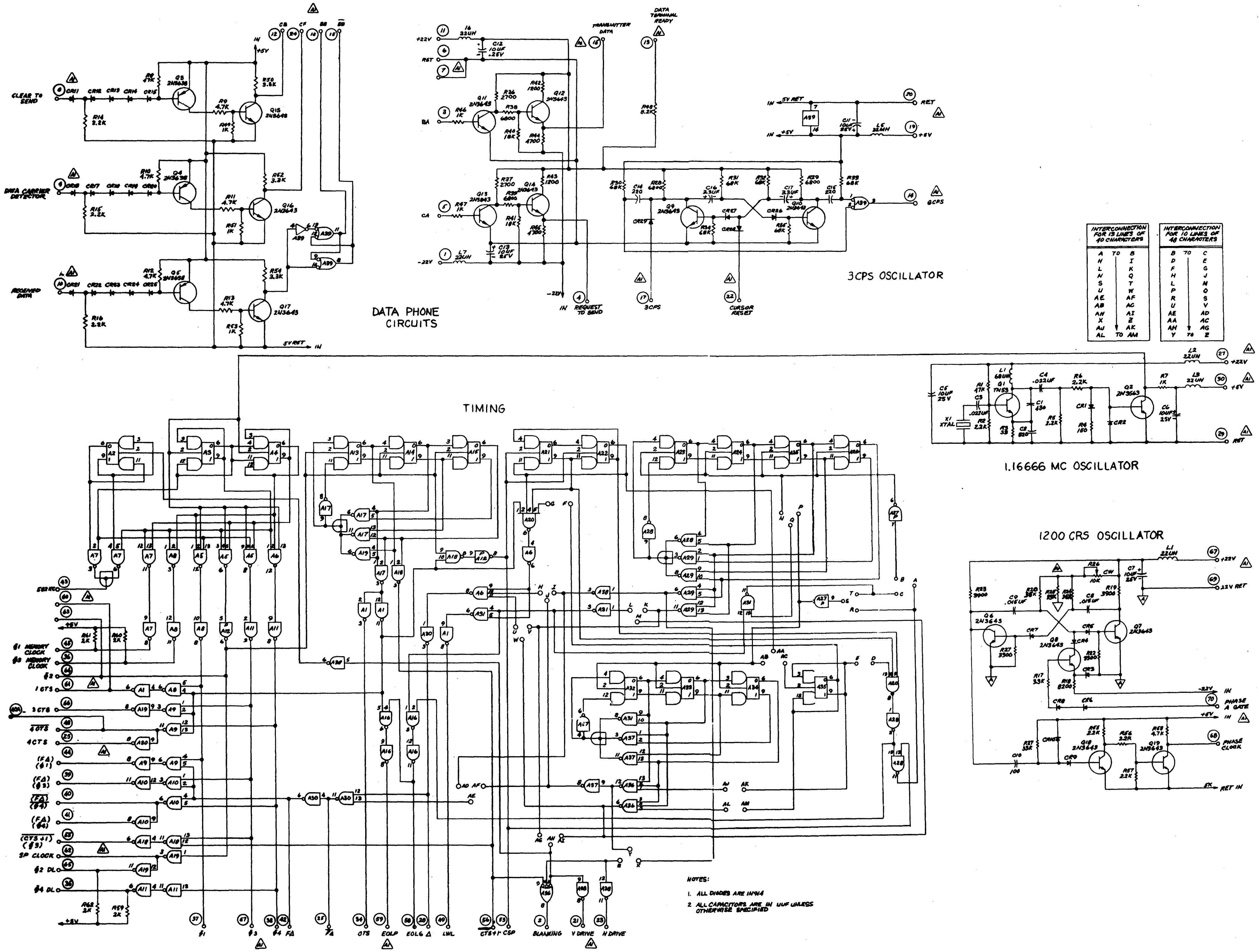
A12, Control Logic Board Assembly
Parts Layout 348917



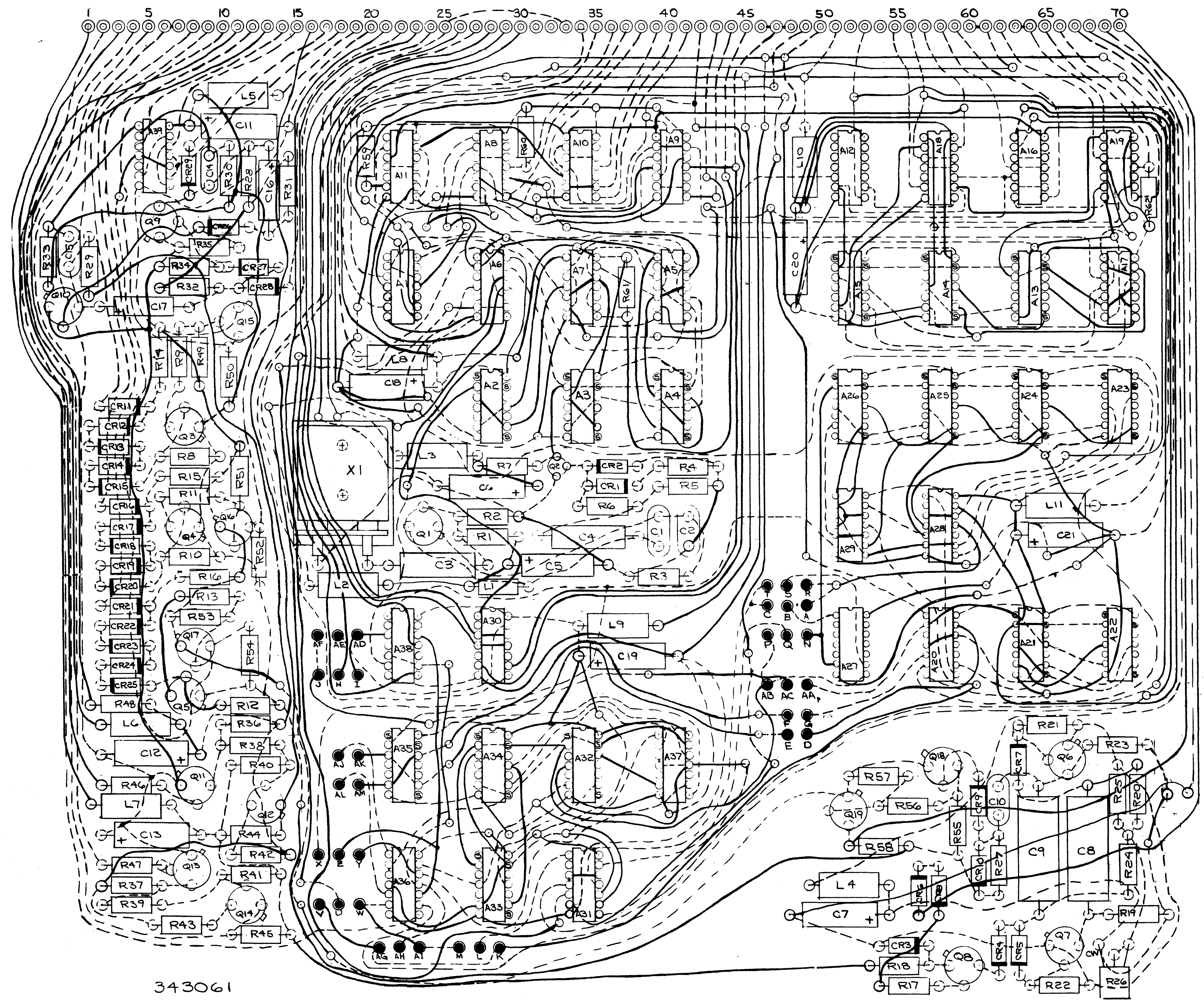
A13, Display Logic Board Assembly
Schematic 349396



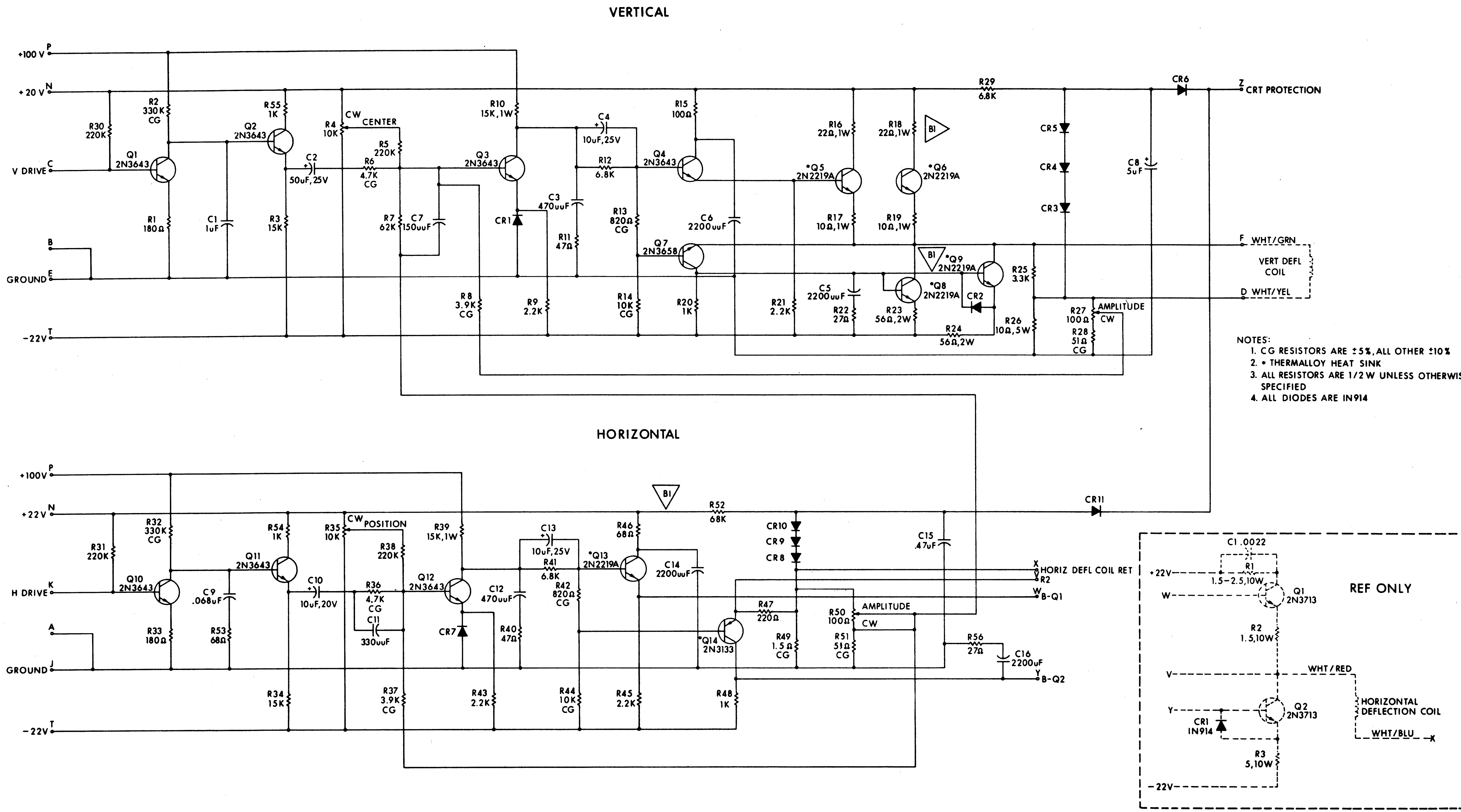
A13, Display Logic Board Assembly
Parts Layout 348919



A14, Timing and Discrete Board
Schematic 344066

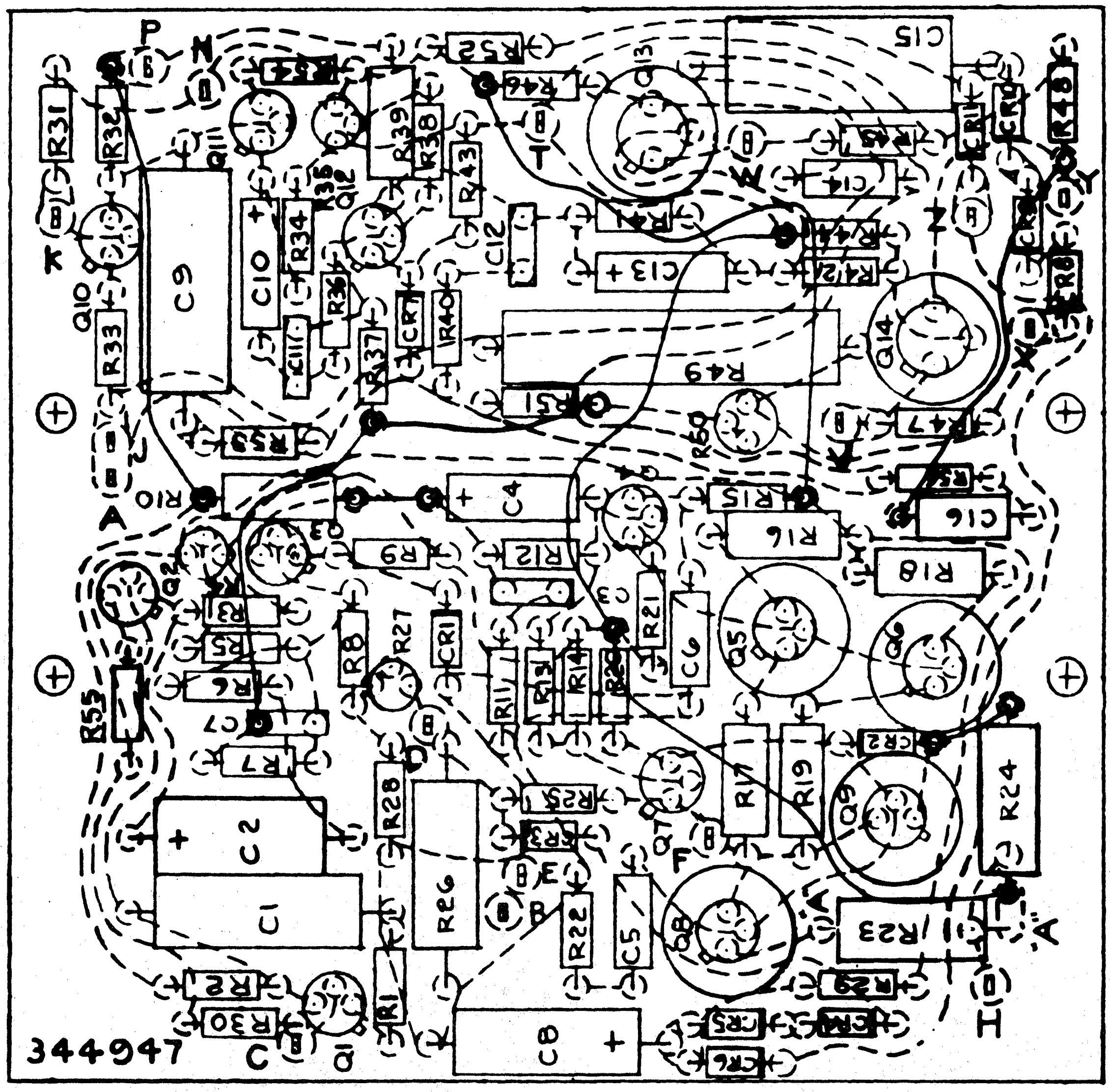


A14, Timing and Discrete Board
Parts Layout 343061

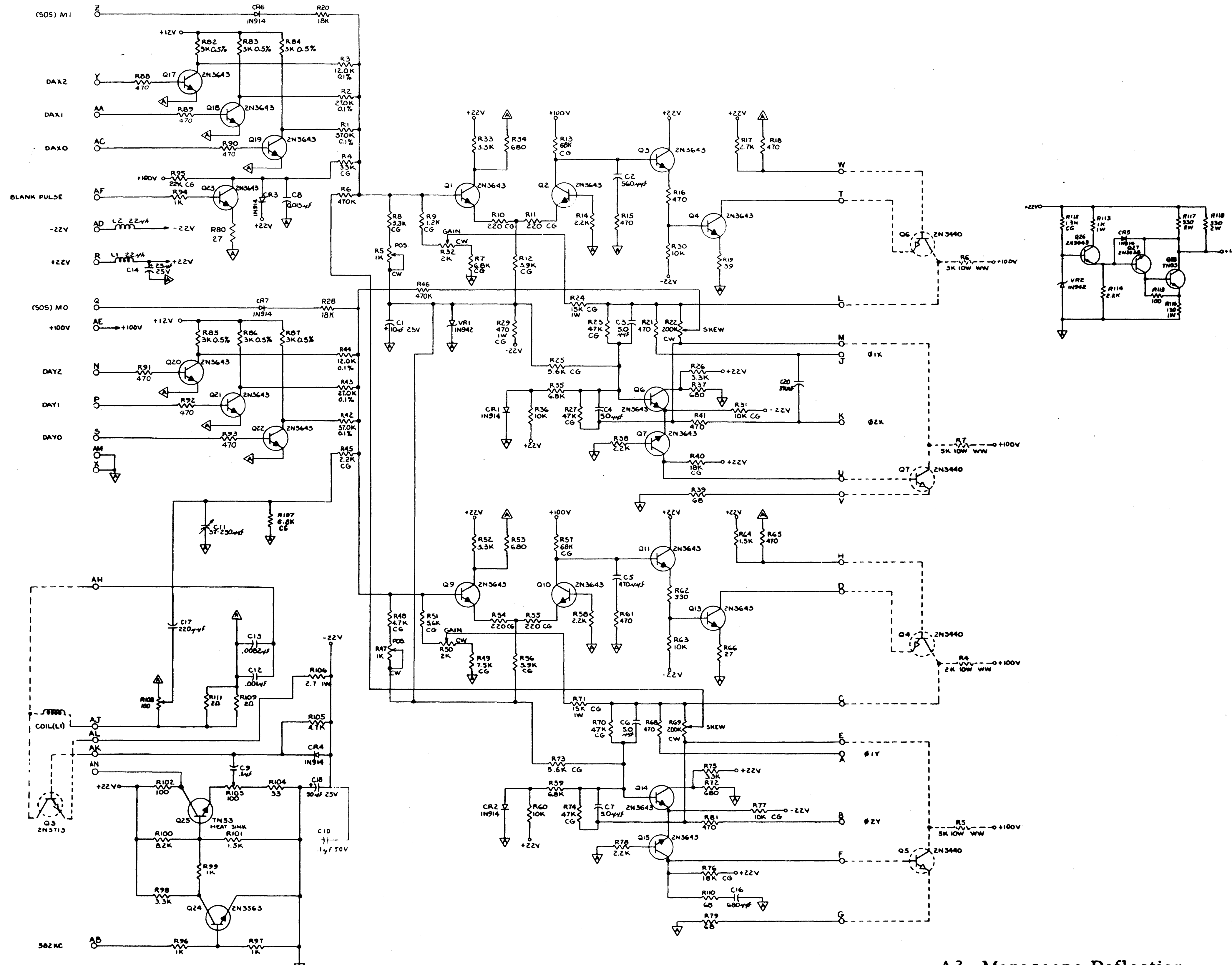


NOTES:
1. CG RESISTORS ARE ±5%, ALL OTHER ±10%
2. * THERMALLOY HEAT SINK
3. ALL RESISTORS ARE 1/2 W UNLESS OTHERWISE SPECIFIED
4. ALL DIODES ARE IN914

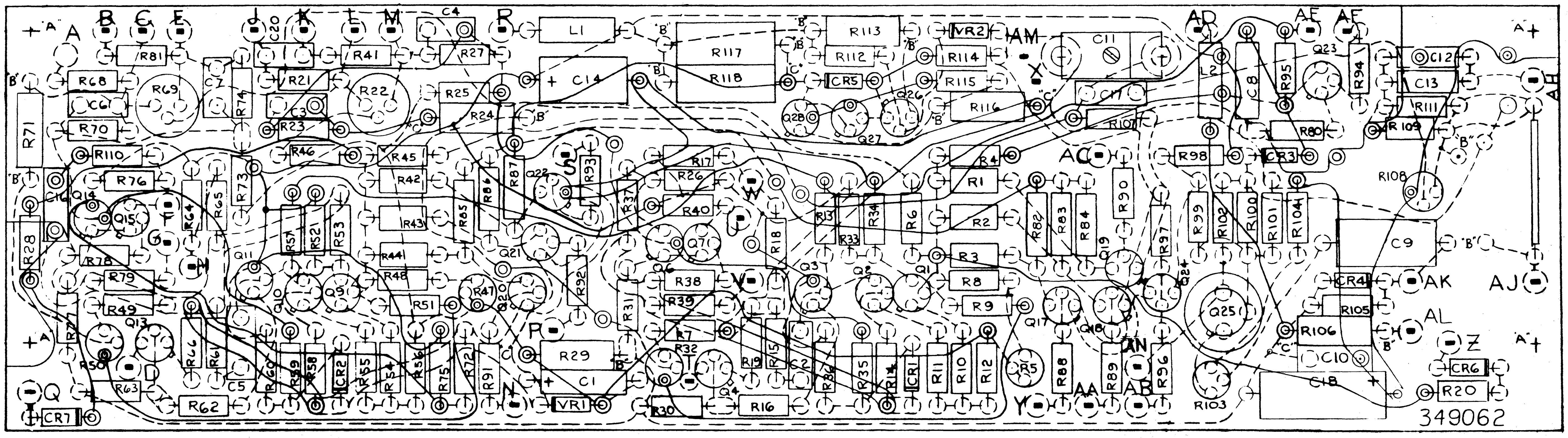
A2, Vertical and Horizontal Deflection Amplifier Assembly Schematic 345408



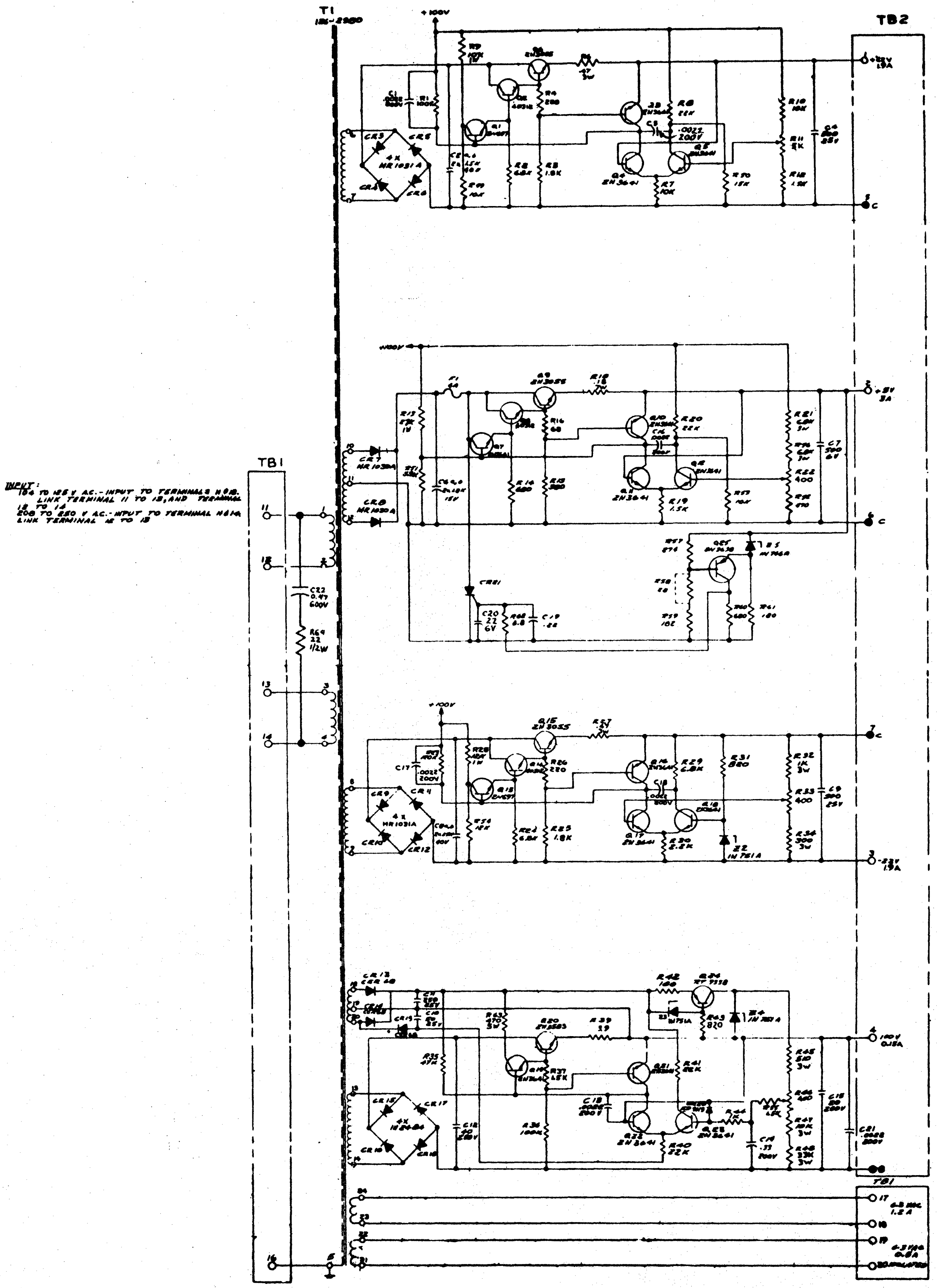
A2, Vertical and Horizontal Deflection Amplifier Assembly
Parts Layout 344947



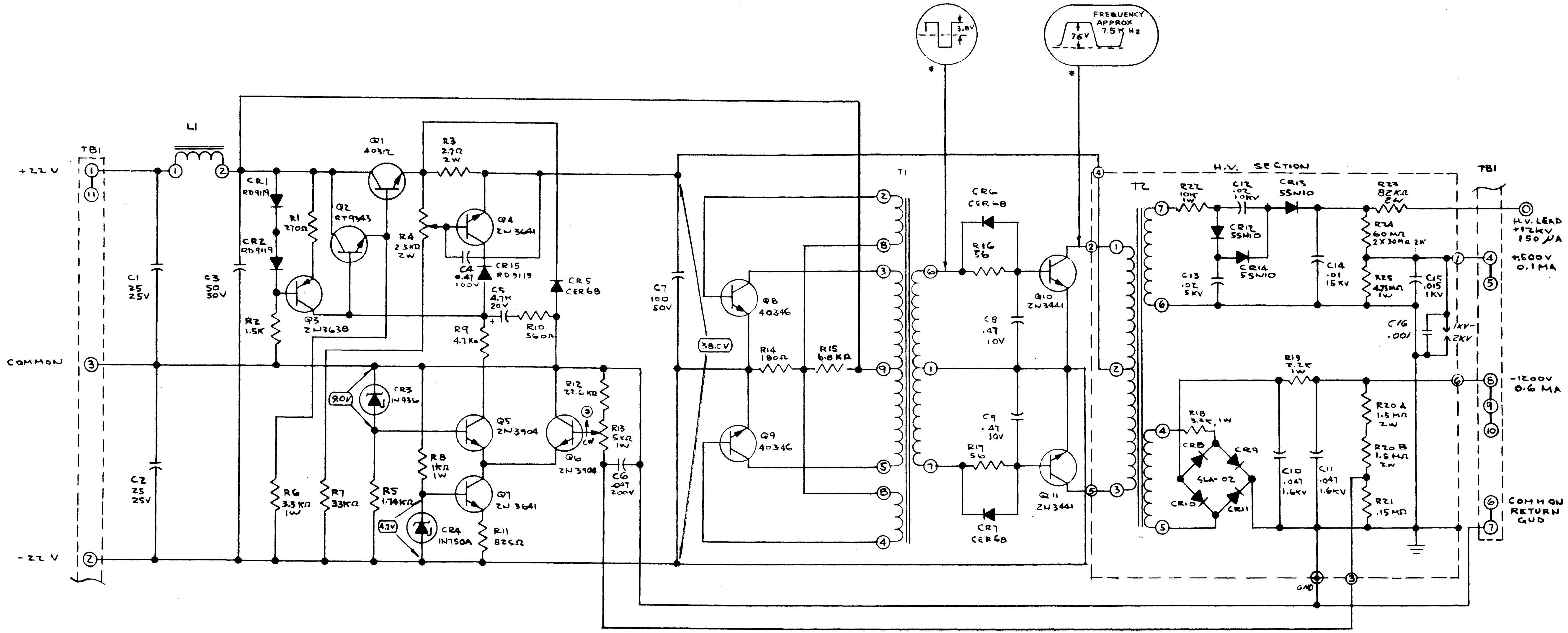
A3, Monoscope Deflection
Amplifier Assembly
Schematic 349031



A3, Monoscope Deflection
Amplifier Assembly
Parts Layout 349062



A4, Low-Voltage Power Supply Assembly
Schematic 2004030



NOTES:

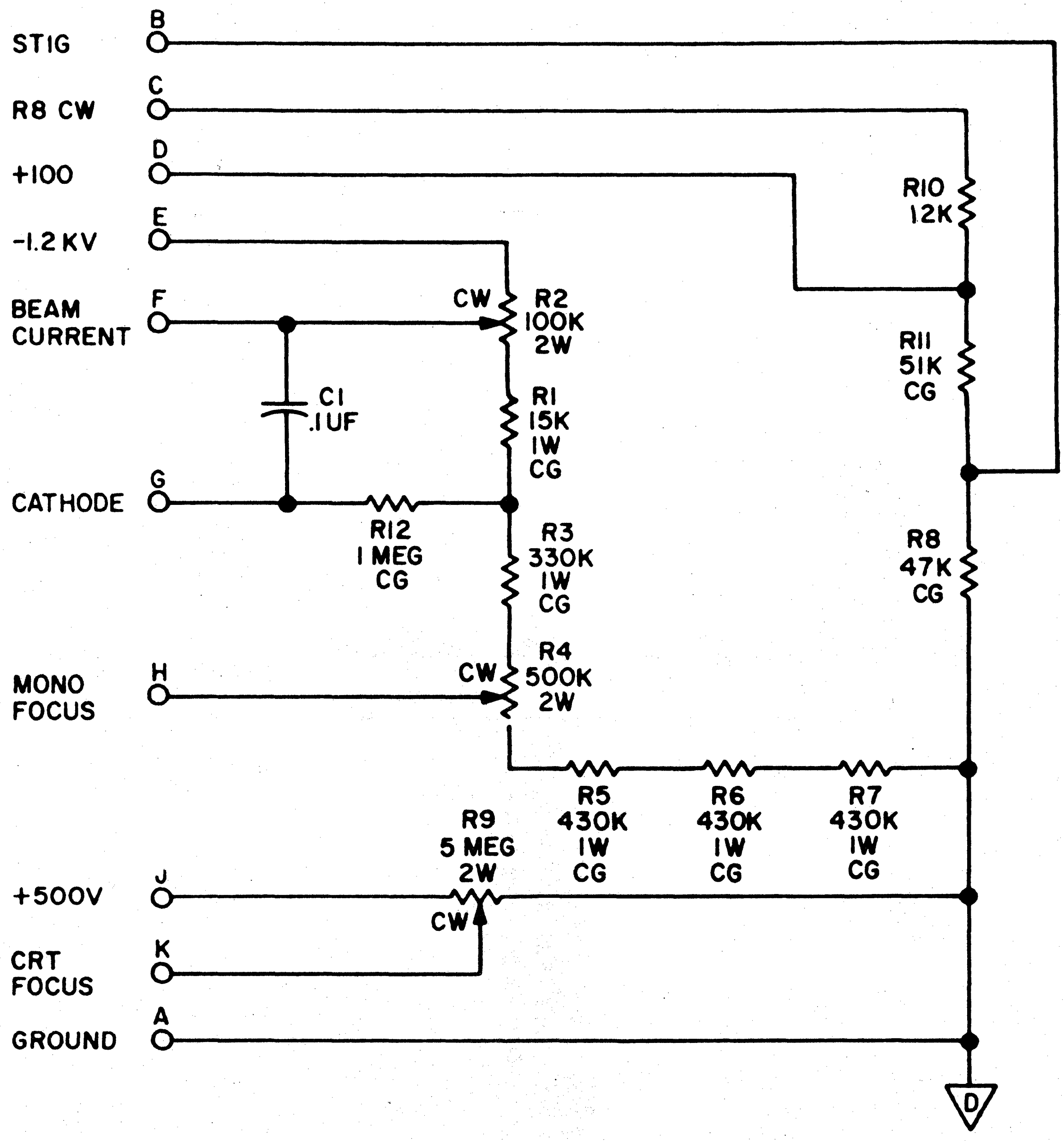
1- ALL VALUES EXPRESSED IN OHMS OR MICROFARADS UNLESS OTHERWISE SPECIFIED.

2- ALL VOLTAGES MEASURED AT NOMINAL INPUT, NOMINAL OUTPUT, AND NO LOAD

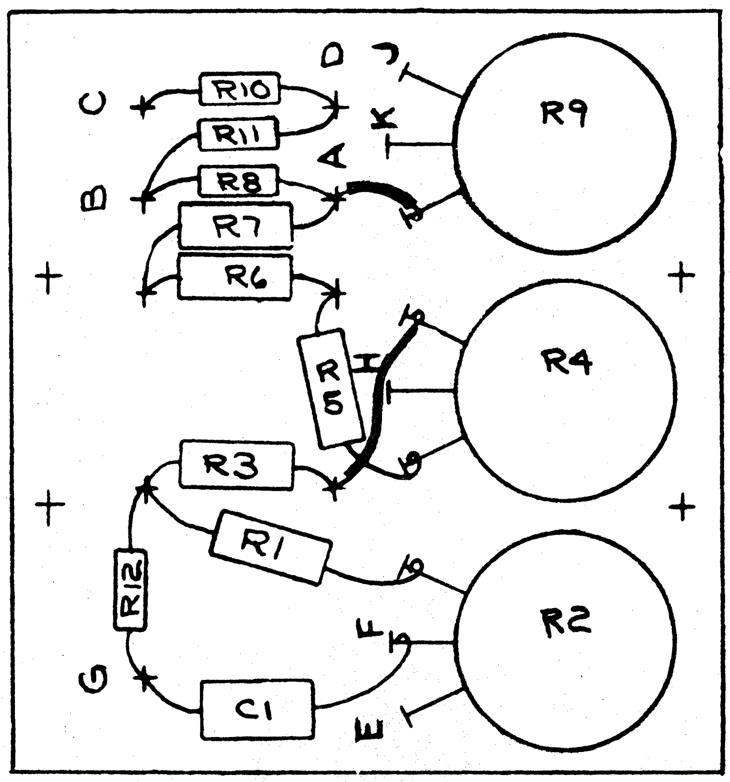
3- ◎ DENOTES OUTPUT ADJUST.

* 4- MEASURE BETWEEN -22V LINE AND POINT INDICATED.

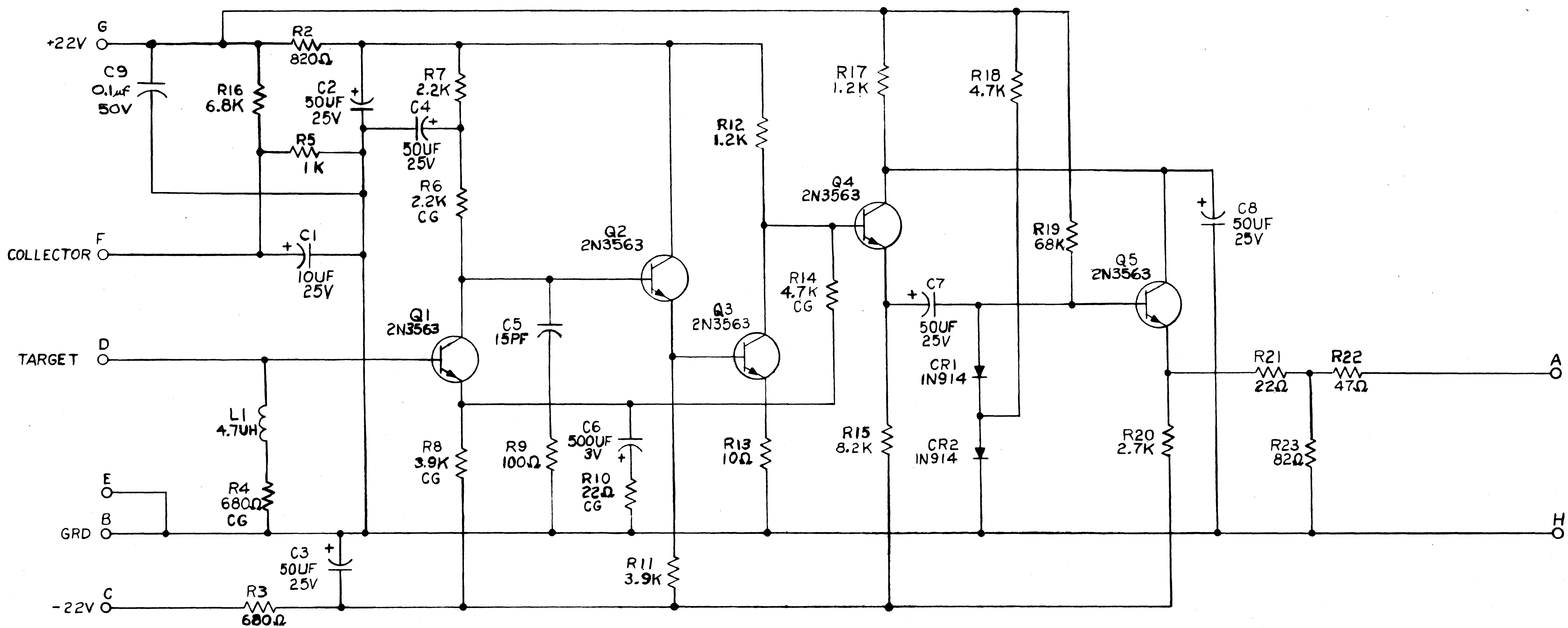
A5, High Voltage Power Supply Assembly
Schematic 2004041



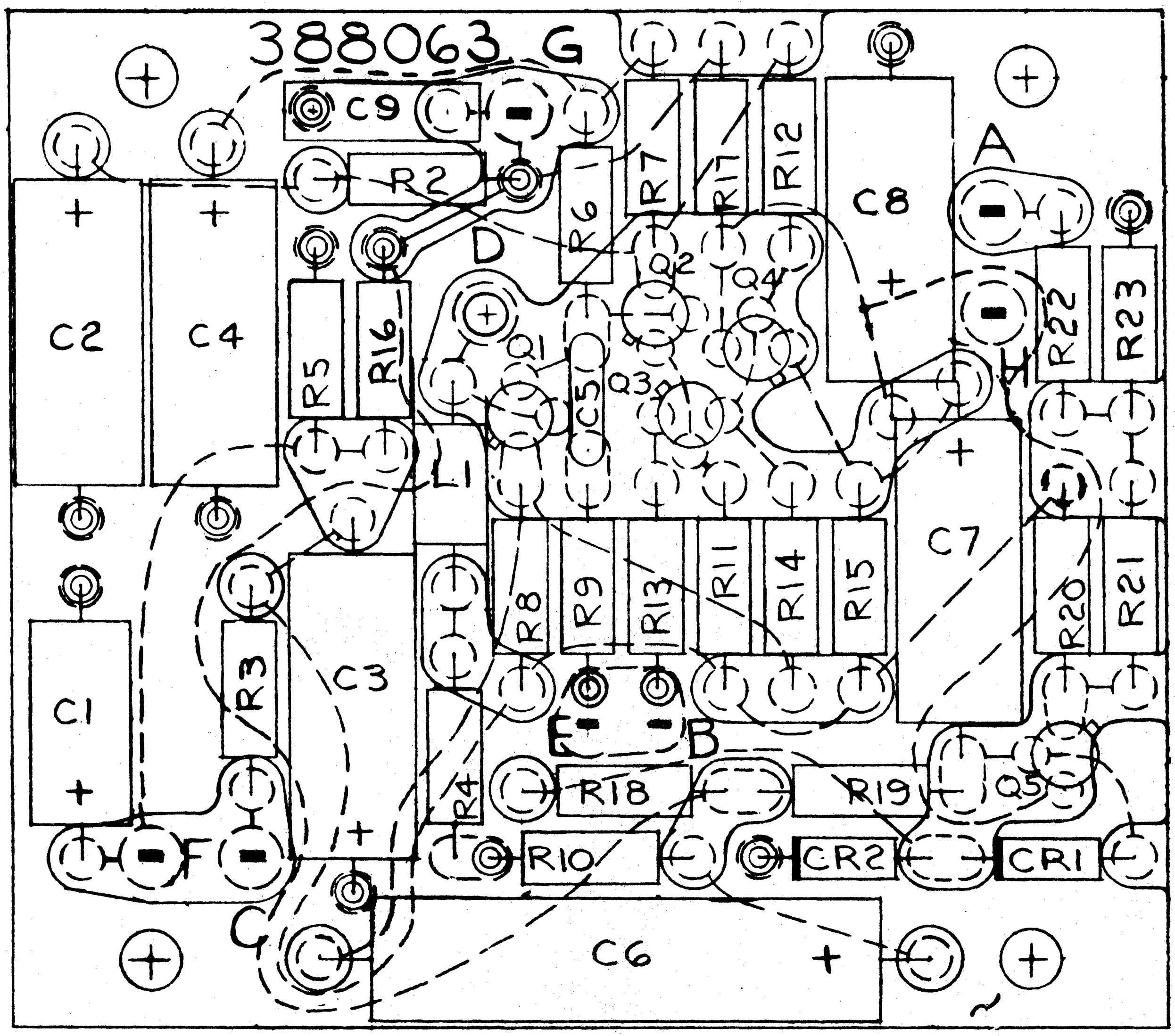
A6, High Voltage Network Assembly
Schematic 349030



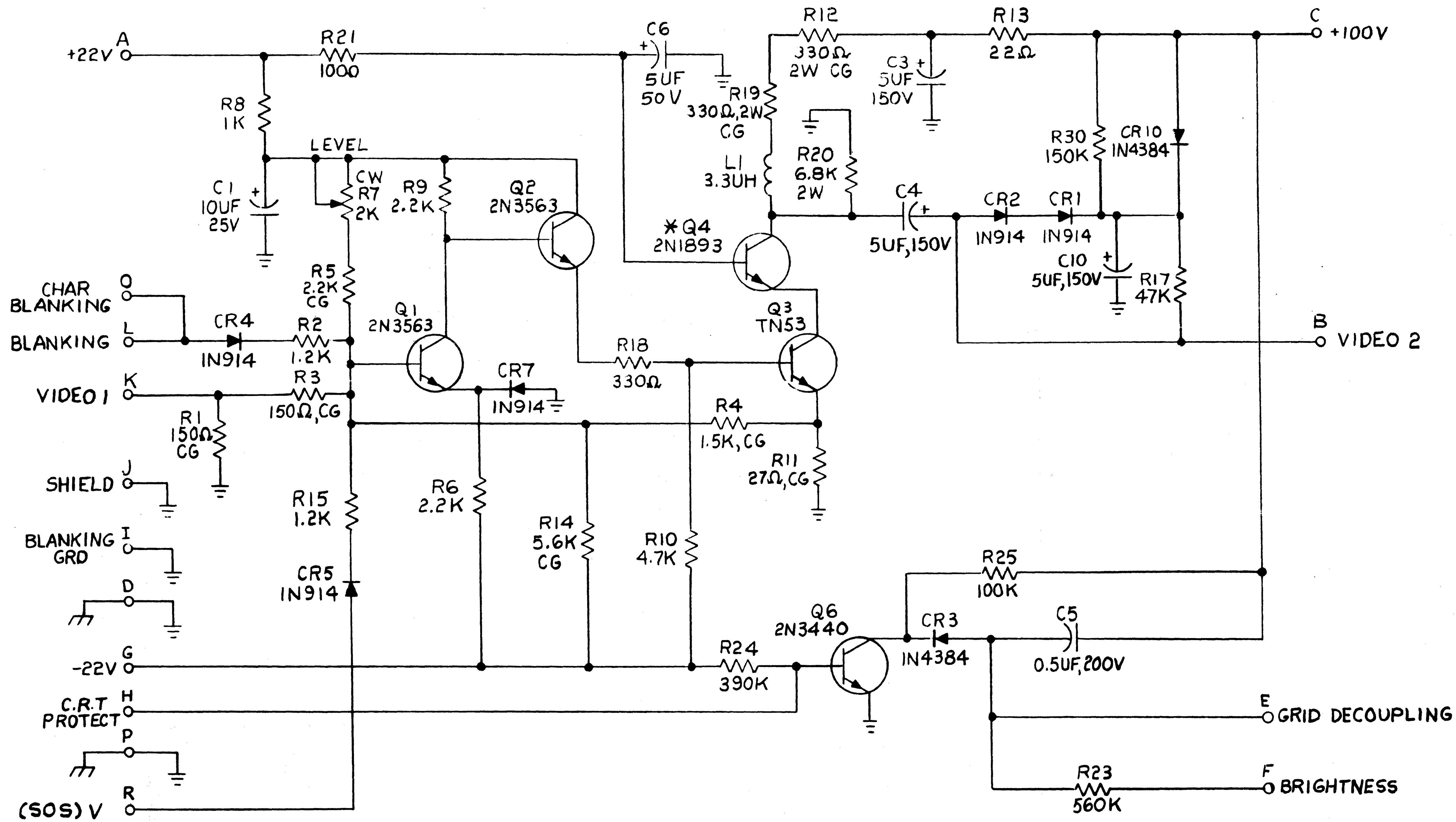
A6, High-Voltage Network Assembly
Parts Layout 349020



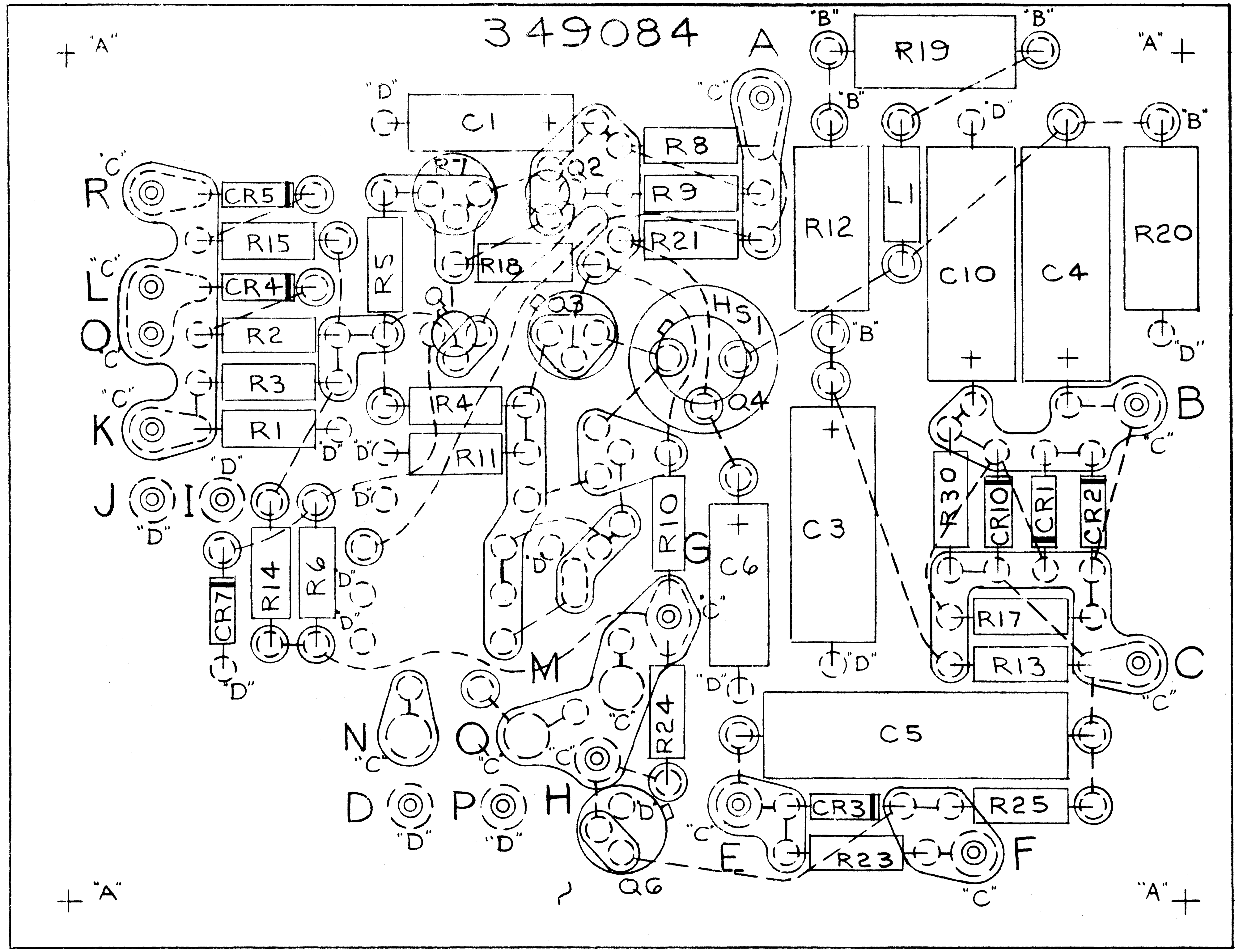
A7, Preamplifier Assembly
Schematic 388065



A7, Preamplifier Assembly
Parts Layout 388063



A8, Video Amplifier Assembly
Schematic 349081



A8, Video Amplifier Assembly
Parts Layout 349084