Errata

Title & Document Type: **1150A Programmable Waveform Processor Operating and Service Manual**

Manual Part Number: **01150-90901**

Revision Date: **May 1972**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

HP 115

OPERATING AND SERVICE MANUAL

PROGRAMMABLE WAVEFORM PROCESSOR 1150A

HEWLETT hp PACKARD

HP 1150A

OPERATING AND SERVICE MANUAL

MODEL 1150A PROGRAMMABLE WAVEFORM PROCESSOR

SERIALS PREFIXED: 1218A

Refer to Section VII for instruments with other Serial Prefixes.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 01150-90901.
Microfiche Part Number 01150-90801.

PRINTED: MAY 1972

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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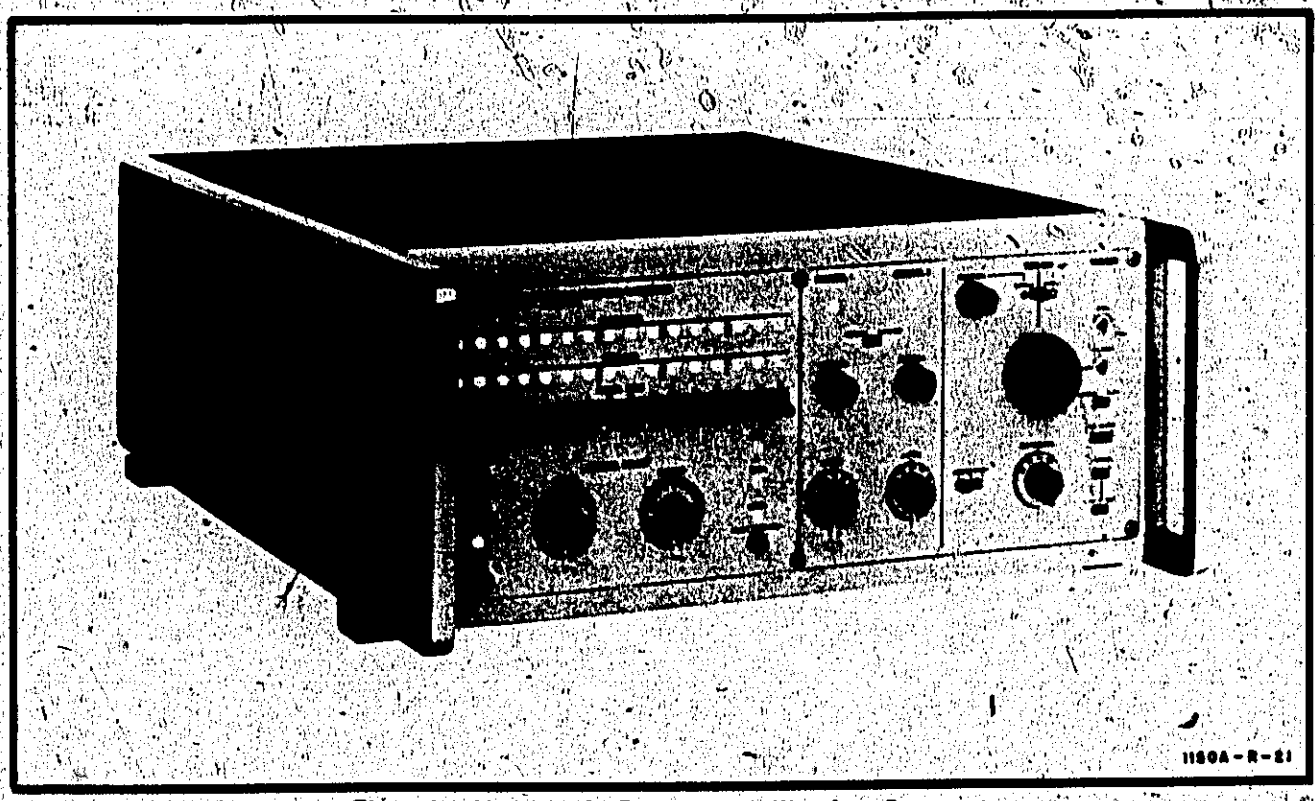

Figure 1-1. Model 1150A Programmable Waveform Processor

Table 1-1. Specifications

OPERATION

MODE

Channel 1 only; channel 2 only; channel 1 and 2 display on alternate samples.

VERTICAL

Bandwidth: dc to 1 GHz.

Ranges: 2 mV/div to 200 mV/div (7 calibrated positions) in 1, 2, 5 sequence.

Accuracy under computer control (at dc):

Range	Accuracy
200 mV/div	±1% Full scale
100 mV/div	±1% Full scale
50 mV/div	±1% Full scale
20 mV/div	±1% Full scale
10 mV/div	±3% Full scale
5 mV/div	±5% Full scale
2 mV/div	±10% Full scale

Note

Specified accuracy after 1 hr warm-up at +25°C. DC voltage measurement accuracy as specified for measurement made immediately after calling calibrate routine; specified accuracy is 3σ limits of measurements.

DC Drift: 5 mV/hr; 10 mV/8 hr after 1-hr warm-up at +25°C.

Pulse Response: perturbations <10% p-p.

Polarity: +UP.

Dynamic Range: ≈2V.

Positioning Range: ≈±1V on all deflection ranges.

INPUT Resistance: 50 ohms ±2%.

Maximum Input: ±5V (dc + pk ac).

Reflection Coefficient: <10%, measured with HP Model 1415A TDR and Model 1150A in measure mode.

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and servicing information for the Hewlett-Packard Model 1150A Programmable Waveform Processor (figure 1-1). The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual and can be unfolded and used for reference while reading any part of manual.

Note

Throughout the text of this manual, the Hewlett-Packard Model 1150A Programmable Waveform Processor shall be called the Model 1150A.

1-3. This section contains a description of the Model 1150A. Instrument specifications are listed in table 1-1. Table 1-3 lists and describes abbreviations used in this manual (except section VI). The parts list uses computer-supplied abbreviations (refer to table 6-1). Accessories available, but not supplied, are listed in this section. Accessories furnished with the instrument are listed in table 1-1.

1-4. INSTRUMENT DESCRIPTION.

1-5. Basically, Model 1150A is a fully programmable, dual channel, 1-GHz sampling oscilloscope that digitizes the incoming analog waveform and counts the frequency down to 50 kHz or less. Sampler features include 2-mV/div deflection factor, internal triggering to 1 GHz, 50-ohm inputs, and signal averaging. The number of data points is programmable and can be set to 128, 256, 512, or 1024 dots.

1-6. Any two channels can be selected for presentation on a remote CRT (cathode-ray tube) display. By manual or program selection, the two channel traces can be displayed on alternate samples. Internal 10-bit (1024 dots) digital-to-analog (D/A) converters are used to drive the X and Y axes of a remote display. These general purpose D/A converters also allow any computer-generated graphics or alphanumerics to output through the Model 1150A to the system display.

1-7. An internal calibrator, operating under software control, improves the measurement accuracy of the Model 1150A to 1% in both time and amplitude. Calibration is accomplished by calling a driver subroutine (software) that generates precision reference signals through the calibrator hardware. The computer transfers digital calibration words to the Model 1150A which converts these words to analog references. The analog references are then applied to the Model 1150A inputs, sampled, digitized, and returned to the computer in binary format. The ratio of the initial value to that sent through the system is called a correction factor and is used to correct all raw data from the Model 1150A.

1-8. External probing devices can be included in the calibration loop through a BNC connector located on the rear panel of the Model 1150A. Connecting the probe to the calibration connector calibrates the probe along with the Model 1150A and allows the software to sense the probe's sensitivity to properly scale the results. Power connections are provided for three active probes.

1-9. WARRANTY.

1-10. The warranty statement applicable to this instrument is located in the front of this manual.

CAUTION

The warranty may be void for instruments having a mutilated serial number tag.

1-11. ACCESSORIES AVAILABLE.

1-12. Table 1-2 lists accessories used with the Model 1150A. These accessories are available at additional cost. For additional information concerning the listed accessories, contact the nearest Hewlett-Packard Sales/Service Office.

Table 1-2. Accessories for Model 1150A

HP Part Number	Description
10486A	Panel, accessory
10487A	Kit, Input/Output Interface
10488A	Cable, X-Y-Z Display
10489A	Cable, Storage Display

1-13. INSTRUMENT AND MANUAL IDENTIFICATION.

1-14. This manual applies directly to Model 1150A instruments with a serial prefix number as listed on the manual title page. The serial prefix number is the first group of digits in the instrument serial number (figure 1-2). The instrument serial number is on a tag located on the rear panel of the instrument.

Table 1-1. Specifications (Cont'd)

Internal Noise (appearing on baseline of remote display).
Filtered - < 2 mV.

Channel Isolation: >35 dB with 350-ps rise-time input.

Time Difference Between Channels: < 100 ps.

HORIZONTAL

Ranges

Normal: 10 ns/div to 50 usec/div (12 calibrated positions) in 1, 2, 5 sequence. ±3% accuracy without software correction, ±1% with software correction.

Expanded: direct reading expansion up to X100 in seven calibrated steps on all normal time scales; extends range to 100 ps/div. Accuracy is ±4% without software correction; ±1% with software correction on all time scales except X100 expansion which is ±2%.

Triggering: preset to obtain stable triggering for internal or external trigger signals having amplitude of 200 mV to 1V, any risetime less than 50 ns, and repetition rate of 100 kHz. Pulse width must be greater than 30 ns and duty cycle must be less than 20%. For repetition rates between 10 kHz and 1 MHz, trigger confidence without readjustment is >95%. For trigger conditions other than foregoing, recessed front-panel controls may be manually adjusted to obtain triggering over wider range of conditions.

Marker Position: intensified marker segment indicates point about which sweep is to be expanded.

Scan

Internal: dots/scan selected manually or by program at 128, 256, 512, or 1024. Samples/dot selected manually or by program at 1, 2, or 4.

External: controlled by computer with maximum of 1024 dots/scan.

GENERAL

DISPLAY OUTPUTS

X, Y, Z outputs are provided at rear panel to drive external display. X and Y scale factor are 0 to +1V. Z blanking equals +1V; Z unblanking equals 0V, intensify equals −300 mV.

PROGRAMMED OPERATION

Programming: accomplished by means of 16-bit control word. Four most significant bits (15, 14, 13 and 12) are address bits to select appropriate program board assembly. Each program board contains local storage and will retain its programmed value indefinitely or until reprogrammed.

Interface: TTL, ground true. Requires one Input-output Kit, HP Model 10487A.

ENVIRONMENT

Temperature Range: 0° to +55°C.

Humidity: to 95% relative humidity to +40°C.

Altitude: to 15000 ft.

Vibration: vibrated in three planes for 15 min each with 0.010 in. excursion, 10 to 55 Hz; shock, 30g, 11 ms, ½ sine wave.

POWER REQUIREMENT

115 or 230 Vac ±10%, 50 to 400 Hz, 175 VA.

PROBE POWER

Furnishes power to operate three Hewlett-Packard active probes.

WEIGHT

Net, 42 lb (19,1 kg); shipping, 50 lb (22,7 kg).

ACCESSORIES SUPPLIED

Rack Mounting Adapter Kit, HP Part No. 5060-0776.

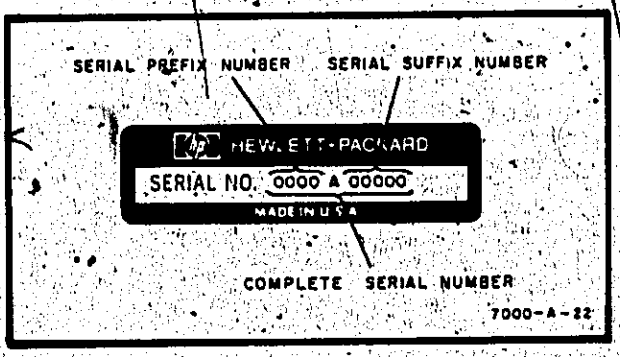

Figure 1-2. Instrument Serial Number

1-15. Check the serial prefix number of the instrument. If the serial prefix number is different from that listed on the title page of this manual, refer to section VII for the way to adapt this manual for proper instrument coverage.

1-16. Errors in the manual are listed under errata on an enclosed MANUAL CHANGES sheet (if any).

1-17. INQUIRIES.

1-18. Refer any questions regarding the manual, the change sheet, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the rear of this manual for a world-wide listing of HP Sales/Service Offices.

Table 1-3. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A	= assembly	E	= misc. electrical part	P	= plug	U	= integrated circuit (unrepairable)
AT	= attenuator, resistive termination	F	= fuse	PS	= power supply	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor, fan	FL	= filter	Q	= transistor	VR	= voltage regulator (diode)
BT	= battery	H	= hardware	R	= resistor	W	= cable
C	= capacitor	J	= Jack	RT	= thermistor	X	= socket
CP	= coupling	K	= relay	S	= switch	Y	= crystal
CR	= diode	L	= inductor	T	= transformer	Z	= network
DL	= delay line	LS	= speaker	TB	= terminal board		
DS	= device signaling (lamp)	M	= meter	TP	= test point		
		MP	= mechanical part				

ABBREVIATIONS

A	= ampere(s)	FET	= field-effect transistor(s)	n	= nano (10^{-9})	rfi	= radio frequency interference
ampl	= amplifier(s)			nc	= normally closed	rms	= root mean square
assy	= assembly			no	= normally open	rwv	= reverse working voltage
amptd	= amplitude			npn	= negative-positive-negative		
		G	= giga (10^{9})			SCR	= silicon controlled rectifier
bd	= board(s)	gnd	= ground(ed)	ns	= nanosecond	sec	= second(s)
bp	= bandpass					std	= standard
		H	= henry(ies)	P	= pico (10^{-12})		
c	= centi (10^{-2})	hr	= hour(s)	pc	= printed (etched) circuit(s)	trmr	= trimmer
C	= carbon	HP	= Hewlett-Packard				
ccw	= counterclockwise	Hz	= hertz	pk	= peak	u	= micro (10^{-6})
coax	= coaxial			pnp	= positive-negative-positive	usec	= microsecond
coef	= coefficient	if	= intermediate freq.				
com	= common	intl	= internal	p/o	= part of	V	= volts
CRT	= cathode-ray tube			p-p	= peak-to-peak	var	= variable
cw	= clockwise	k	= kilo (10^{3})	prgm	= program		
				prv	= peak inverse voltage(s)	w/	= with
d	= deci (10^{-1})	lb	= pound(s)			w/o	= without
dB	= decibel	lpf	= low-pass filter(s)	ps	= picosecond	wiv	= working inverse voltage
				pwv	= peak working voltage		
ext	= external	m	= milli (10^{-3})				
		M	= mega (10^{6})	rf	= radio frequency		
F	= farad(s)	ms	= millisecond				

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SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of Model 1150A. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for repairs and for repacking the instrument for shipment are also described in this section.

2-3. INITIAL INSPECTION.

2-4. The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors, and dents or scratches. If damage is found, refer to the claims paragraph in this section. Retain the packing material for possible future use.

2-5. Check the electrical performance of the instrument immediately after receipt. Refer to Section V for the performance check procedure. The performance check will determine whether or not the instrument is operating within the specifications listed in table 1-1. If the instrument does not operate as specified, refer to the claims paragraph in this section.

2-6. PREPARATION FOR USE.

2-7. RACK-MOUNTING PROCEDURE.

2-8. The instrument is designed for either bench or rack mounting. A rack-mounting kit is shipped with the instrument for proper installation. Install the mounting hardware by following the instructions given below (see figure 2-1 for parts identification):

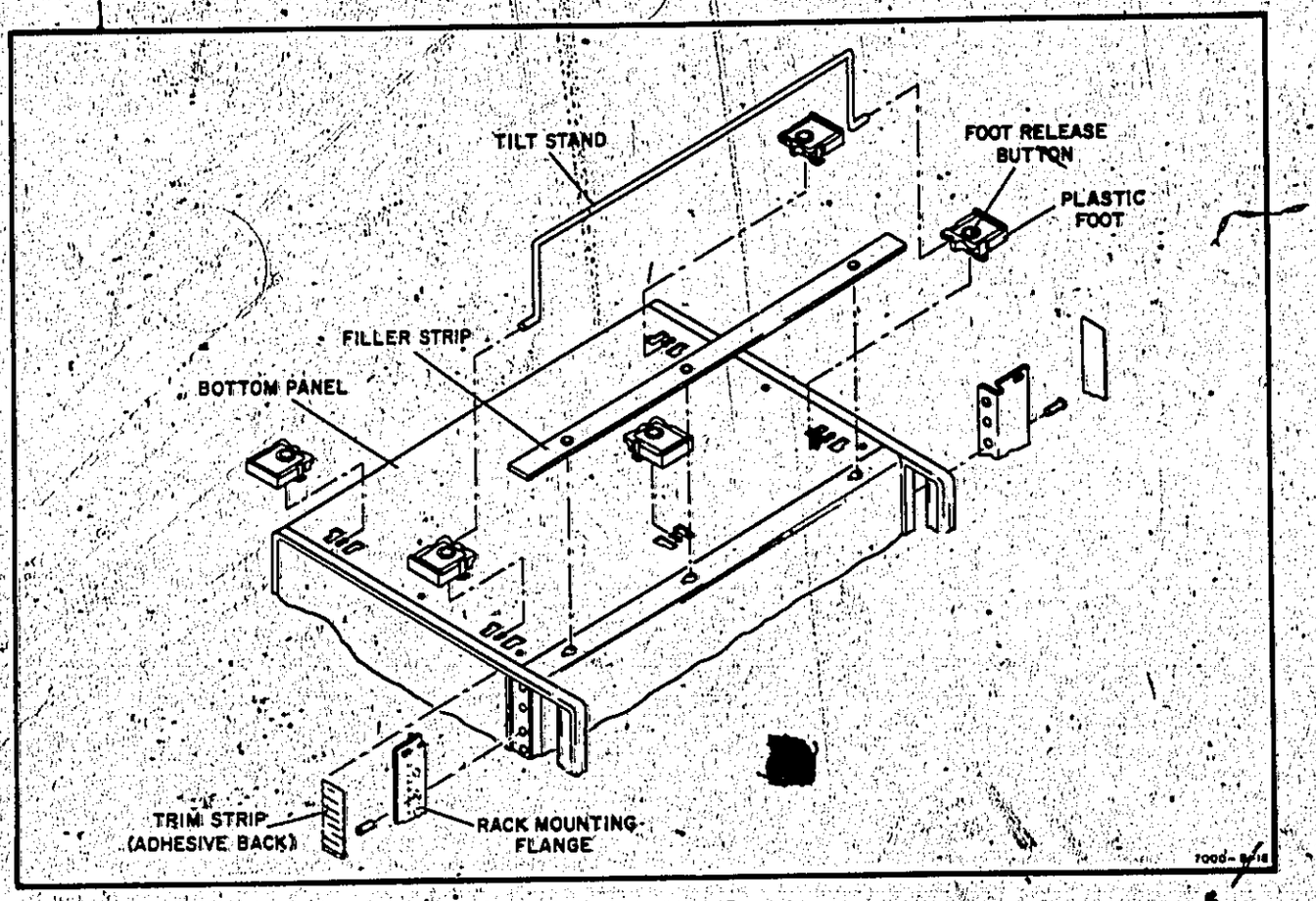


Figure 2-1. Rack Mount Procedure

a. Detach tilt stand by pressing it away from front feet. Remove all plastic feet by depressing foot release button and sliding feet free.

b. Remove aluminum trim strip from each side of instrument with thin blade tool.

c. Attach rack mounting flange in space where trim strip was removed (use screws provided with kit). Large notch of flange should be positioned at bottom of instrument.

2-9. POWER REQUIREMENTS.

2-10. The instrument requires a power source of either 115 or 230 volts ac ±10%, single-phase, 50 to 400 Hz that can deliver 175 volt-amperes (maximum). The instrument is normally shipped from the factory set to operate from a 115-volt ac power source. To operate the instrument from a 230-volt ac power source, proceed as follows:

a. Remove input power cord (if connected).

b. Replace factory installed LINE FUSE (2A) located on rear of instrument with 1-ampere fuse, HP Part No. 2110-0007.

c. Move LINE SELECT switch to 230V position.

d. Reconnect input power cord.

2-11. THREE-CONDUCTOR POWER CABLE.

2-12. For the protection of operating personnel, Hewlett-Packard Company recommends that the instrument panel be grounded. This instrument is equipped with a three-conductor power cable, that when connected to an appropriate receptable, grounds the instrument through the offset pin. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards. To preserve this protection feature when operating from a two-contact outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to ground at the power outlet.

2-13. INSTRUMENT COOLING.

2-14. The instrument is adequately cooled by normal air circulation. No special cooling is required.

2-15. CLAIMS.

2-16. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and nearest Hewlett-Packard Sales/Service Office immediately. The Hewlett-Packard Sales/Service Office will arrange for repair and replacement without waiting for settlement of the claim with the carrier.

2-17. REPACKING FOR SHIPMENT.

2-18. If the Model 1150A is to be shipped to an HP Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-19. Use the original shipping carton and packing material. If the original packing material is not available, the HP Sales/Service Office will provide information and recommendations on materials to be used. Materials used for shipping an instrument normally include the following:

a. A double-walled carton; refer to table 2-1 for test strength required.

b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a nonabrasive material such as polyurethane or a sealed air packaging material such as AIRCAP around all projecting parts.

c. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material such as extra-firm polyurethane foam.

d. Heavy-duty shipping tape for securing outside of carton.

Table 2-1. Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)
up to 10	200
10 to 30	275
30 to 120	350
120 to 140	500
140 to 160	600

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains an explanation of instrument operating controls, operator's checks, operator coding tables, and a typical test routine.

3-3. CONTROLS AND CONNECTORS.

3-4. Figure 3-1 and figure 3-2 show the instrument front and rear panels, and provide functional descriptions of the operating controls, indicators, and connectors. Where the controls for Channel 1 and 2 are identical, only those for Channel 1 are described. The following paragraphs provide detailed descriptions of controls with multiple or complex functions.

3-5. NORMAL/FILTERED.

3-6. The NORMAL/FILTERED slide switch selects between normal sampler efficiency and noise (NORMAL) and a reduced sampler efficiency (FILTERED) for use when the input signal has excessive noise. The FILTERED mode introduces some distortion for low density.

3-7. MAIN TIME/DIV.

3-8. The main TIME/DIV switch determines the time to sweep horizontally one graticule division. Main sweep speeds are selected in 12 ranges from 10 ns/div to 50 usec/div. The switch produces a binary code that is used to select the proper sweep developed in the time base assembly. By using a binary code for sweep-speed selection, the position of the main TIME/DIV switch can be read directly into the computer.

3-9. EXPANDED TIME/DIV.

3-10. The expanded TIME/DIV switch selects the desired attenuation for EXPAND position. The expand sweep speed must always be faster than the main sweep speed. The expanded TIME/DIV switch produces a binary code which is used to select the proper expand sweep speed. The binary code, established by the position of the switch, can be read directly into the computer.

3-11. LEVEL.

3-12. The trigger LEVEL control adjusts the point where triggering will occur on the input signal. In CW operation, it controls the frequency of trigger generation.

3-13. HOLDOFF.

3-14. The trigger HOLDOFF control varies the holdoff time before the next sample can be taken. When a selected trigger-level and slope combination occurs more than once per cycle on a complex waveform, HOLDOFF allows selection of the exact point where triggering is desired.

3-15. DOTS/SCAN.

3-16. The DOTS/SCAN switch controls the dot density of the sweep. Depending upon the switch setting, a fixed number of samples are taken per time window. This switch also produces a binary code that can be read directly into the computer.

3-17. SAMPLES/DOT.

3-18. The SAMPLES/DOT switch selects the number of samples taken per dot by controlling the operation of the counter in the digital scanner. The switch produces a binary code that can be read directly into the computer.

3-19. CHANNEL 1 MV/DIV.

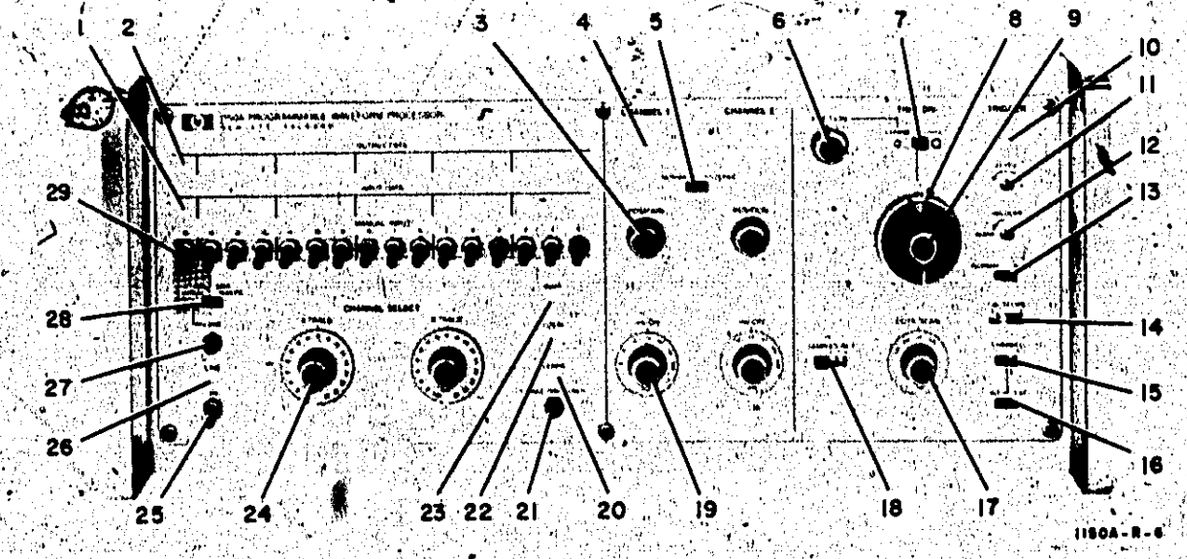
3-20. The vertical attenuation circuit is controlled by the CHANNEL 1 mV/DIV switch. Selection of proper attenuation is accomplished by binary code. The binary code, established by the position of the CHANNEL 1 mV/DIV switch, can be read directly into the computer.

3-21. A TRACE.

3-22. The A TRACE switch selects the channel displayed by the A trace. Two channels can be displayed simultaneously by selecting another channel with the B TRACE switch; however, only one channel at a time can be processed by the computer. The A TRACE switch produces a binary code which selects one of 32 channels (only 2 channels are currently available). The binary code can be read directly into the computer.

3-23. MANUAL INPUT SWITCHES.

3-24. The MANUAL INPUT switches are used to manually insert program information into the instrument for troubleshooting. A 16-bit data word can be inserted into the instrument by pressing the LOAD pushbutton switch. The MANUAL/REMOTE switch must be in MANUAL position for this mode of operation. It normally is in REMOTE position for computer operation.



1. INPUT DATA bus lamp. Lights when information is present on input data bus lines (typical 16 places).

2. OUTPUT DATA bus lamp. Lights when bit information is present on output data bus line (typical 16 places).

3. CHANNEL 1 POSITION. Input voltage that adjusts vertical position of display.

4. CHANNEL 1 lamp. Lights when Channel 1 is selected for operation.

5. NORMAL/FILTERED. Selects normal sampler efficiency or filtered response to reduce effect of noise. It is not programmable.

6. Expand POSITION. In EXPAND mode, selects point on unexpanded display to be expanded. Point about which display is expanded is shown on CRT display as bright dot.

7. EXPAND/DIRECT. Selects either expanded or direct mode of display.

8. TIME/DIV. Selects horizontal sweep time per division in DIRECT mode of operation.

9. expanded TIME/DIV. Controls sweep speed when EXPAND mode of operation is used.

10. TRIGGER lamp. Lights when trigger signal is present.

11. LEVEL. Selects level on trigger waveform where main sweep starts. It is not programmable.

12. HOLDOFF. Varies holdoff time between sweeps. It is not programmable.

Figure 3-1. Front-panel Controls

13. NORMAL/AUTO. Selects mode where sweep is triggered only by incoming trigger signal (NORMAL); selects mode where free-running sweep results to provide baseline in absence of incoming trigger signal (AUTO). It is not programmable.

14. CW/SLOPE. Selects (+) or (–) slope on which sweep triggers. CW setting used for triggering on sine waves above 750 MHz. It is not programmable.

15. CHANNEL 1–2. Selects channel used for internal triggering. It is not programmable.

16. INT/EXT. Selects internal or external trigger source. It is not programmable.

17. DOTS/SCAN. Selects number of dots per sweep.

18. SAMPLES/DOT. Selects number of samples per dot.

19. CHANNEL 1 mV/DIV. Selects attenuation factors for Channel 1 vertical sensitivity.

20. LEARN lamp. Lights when computer is ready to receive information from front-panel controls.

21. LEARN. Tells computer to read front-panel control settings.

22. LOCAL lamp. Lights in Local mode of operation.

23. BUSY lamp. Lights when instrument is processing computer command.

24. A TRACE. Channel selector for A trace.

25. Power Switch. Applies ac power to instrument.

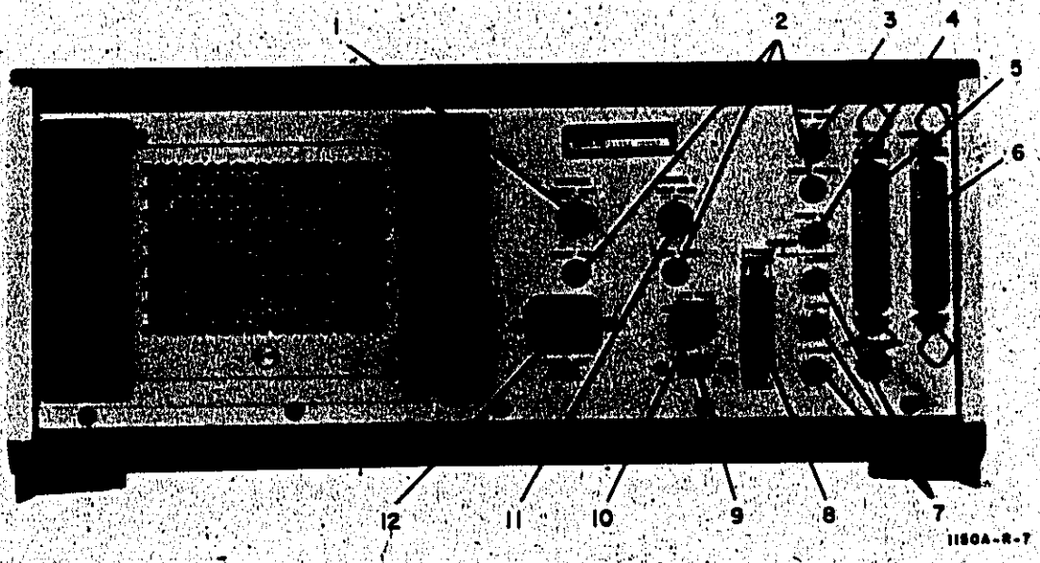
26. LINE lamp. Lights when power is applied to instrument.

27. LOAD. Loads data into instrument from MANUAL INPUT switches.

28. MANUAL/REMOTE. Selects front-panel MANUAL INPUT switches or computer as source of input data.

29. MANUAL INPUT. Switch used to manually insert bit information into instrument (typical 16 places).

Figure 3-1. Front-panel Controls (Cont'd)



1. CHANNEL 1 INPUT. Connector for Channel 1 signal input.
2. PROBE POWER. Supplies +15 volts, −12.6 volts, and ground to active probes (if used).
3. TRIGGER INPUT. Connector for external trigger input.
4. PROBE CAL. Used to calibrate probe with internal calibration signal (under computer control only.)
5. EXTENDER. Output to additional, external vertical channels.
6. CONTROLLER. Connects instrument to I/O device in computer.
7. X-, Y-, Z-OUTPUT. Output signals to external display.
8. STORAGE CONTROL. Output to external storage-type CRT display.
9. LINE SELECT. Selects 115-volt or 230-volt ac power operation.
10. LINE FUSE. Fuse for input ac power.
11. CHANNEL 2 INPUT. Connector for Channel 2 signal input.
12. Input ac power connector. Connects ac power source to instrument.

Figure 3-2. Rear-panel Controls and Connectors

3-25. OPERATORS CHECKS.

3-26. Channel controls are selected by the A TRACE and B TRACE switches. The channel controls, in turn, control the signal applied to CHANNEL 1 INPUT or CHANNEL 2 INPUT connectors. When two channels are being viewed (for example, A TRACE is set to Channel 1 and B TRACE is set to Channel 2), an alternate dot mode of display will result. This mode is used for display only since the computer can process data from only one channel at a time.

3-27. The instrument operates in either Local or Program mode of operation. The mode of operation is controlled by the computer. With the CONTROLLER connector (J38 on the rear of the instrument) disconnected, the instrument will operate in Local mode only.

3-28. To insert information from the MANUAL INPUT switches on the front panel of the instrument, the MANUAL/REMOTE switch must be in MANUAL position. A 16-bit word can be set up on the MANUAL INPUT switches and processed by pressing the LOAD pushbutton switch. Information is manually inserted into the instrument only as a troubleshooting aid.

3-29. A diagnostic tape is furnished with Interface Kit Model 10487A for initial checkout of the Model 1150A with the computer. Refer to Section V for initial setup procedures and use of the diagnostic tape.

3-30. To use the MANUAL INPUT switches for troubleshooting the instrument, refer to tables 3-1 through 3-9. The tables give proper binary coding for those assemblies (slots) which can be individually addressed.

3-31. TYPICAL TEST ROUTINE.

3-32. The ability to read front-panel controls directly into the computer simplifies the generation of test routines. The operator does not have to calculate each control setting and then program each control separately. A typical sequence used to generate a test routine is as follows:

a. Computer will light LEARN lamp on Model 1150A when it is ready to accept information.

b. Manually set Model 1150A front-panel controls for desired waveform on CRT display.

c. Press LEARN pushbutton switch. This results in computer storage of Model 1150A front-panel control settings. These settings can now be duplicated by computer for future testing of this waveform.

d. Select another waveform to be tested. Repeat steps b and c above.

e. Continue selecting waveforms and storing front-panel control settings in computer. After all front-panel setups are stored, test routine can be executed whenever desired.

Table 3-1. Coding for Calibrator Assembly, A04

1. The Calibrator Assembly can be programmed to supply a stable time mark signal or accurate dc voltage to enable the generation of correction factors by software routines. In calibrate mode of operation, the calibrator waveform is connected to the sampler input. In addition, an appropriate trigger is applied to the time base assembly to generate the sampling strobe.

2. Calibrator binary coding is as follows:

Note

Logic 0 level ≈ +5V

Logic 1 level ≈ 0V (at J38 and data buses)

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	0	0												
Normal Operation					0	0										
Probe Calibration					0	1										
Horizontal Calibration					1	0										
Vertical Calibration					1	1										

Note: At power turn-on, the calibrator is forced into normal mode of operation (bit 11 storage on calibrator assembly is set to logic 0).

Table 3-1. Coding for Calibrator Assembly, A04 (Cont'd)

3. Vertical Calibration coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VERTICAL CAL.	0	1	0	0	1	1										
mV/DIV:																
200 mV/DIV										0	0	0				
100 mV/DIV										0	0	1				
50 mV/DIV										0	1	0				
20 mV/DIV										0	1	1				
10 mV/DIV										1	0	0				
5 mV/DIV										1	0	1				
2 mV/DIV										1	1	0				
No. of Div. from 0V																
+ 7													0	1	1	1
+ 6													0	1	1	0
+ 5													0	1	0	1
+ 4													0	1	0	0
+ 3													0	0	1	1
+ 2													0	0	1	0
+ 1													0	0	0	1
0													0	0	0	0
− 1													1	1	1	1
− 2													1	1	1	0
− 3													1	1	0	1
− 4													1	1	0	0
− 5													1	0	1	1
− 6													1	0	1	0
− 7													1	0	0	1
− 8													1	0	0	0

Note: 1. Bits 0, 1, and 2 control a D/A converter at 200 mV/bit.

2. Bits 4, 5, and 6 control an attenuator in series with D/A converter.

4. Horizontal Calibration coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HORIZONTAL CAL.	0	1	0	0	1	0										
MARKER INTERVAL:																
20 usec															0	0
2 usec															0	1
0.2 usec															1	0
20 ns															1	1

Table 3-2. Coding for Display Control Assembly, A05

1. Binary Codes for Display Control Assembly, A05, are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	0	1												
X Display					0	0	← See Note 1 →									
Y Display					0	1	← See Note 2 →									
ERASE Mode					1	0									1	
LOCAL DISPLAY					1	1										0
REMOTE DISPLAY					1	1										1

Note: 1. Bit 0 through Bit 9 encode a 10-bit D/A converter. D/A converter output is 0 to +1V which corresponds to 10 horizontal divisions on the display (+0.5V = horizontal center of display).

2. Bit 0 through Bit 9 encode a 10-bit D/A converter. D/A converter output is 0 to +1V which corresponds to 10 vertical divisions on the display (+0.5V = vertical center of display).

3. When programming, the Y-data word should be programmed first. X-data word triggers a 5- to 10-microsecond signal which unblanks the display.

Table 3-3. Coding for Expand Position Assembly, A06

The position, in time, about which the sweep is expanded is determined by programming the expand position D/A converter with the following binary code:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	0												
EXPAND POSITION								← See Note →								

Note: Bit 0 through Bit 8 encode a nine-stage D/A converter. D/A converter output is 0 to +10V which represents 0 to 10 horizontal divisions on display.

Table 3-4. Coding for Read/Multiplexer Assembly, A07

1. The Read/Multiplexer Assembly, A07, is used when programming the following functions:

   a. Program Commands:

      (1). Local/Program Mode.

      (2). Sampler Command.

   b. Read Commands:

      (1). Read - Expand Position (REP).

      (2). Read - Vertical Position (RVP).

      (3). Read - Sweep Time Scale (RSA).

      (4). Read - Scan Control (RSC).

      (5). Read - Vertical Sensitivity (RVA).

      (6). Read - A/D Data Output (RAD).

      (7). Read - Channel Select (RCA).

      (8). Read - Learn (RLN).

      (9). Read - Local/Program Mode.

2. A typical sequence of operation for the Model 1150A is as follows:

   a. In Local mode of operation, the operator makes a front-panel setup to obtain the desired display and then presses LEARN pushbutton switch. This generates a 100-microsecond pulse to the computer. The computer then stores the front-panel settings as six digital words.

   b. In Program mode of operation, the computer sequentially applies the stored information (front-panel settings) to the Model 1150A to duplicate the previous manual settings and display the waveform under test.

   c. Take data from waveform being measured.

Table 3-4. Coding for Read/Multiplexer Assembly, A07 (Cont'd)

3. Local/Program digital coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
L P FUNCTION IDENTIFIER					1											
LOCAL MODE													0	0	0	0
PROGRAM MODE													0	0	0	1

Note: L P Function Identifier, Bit 11, tells assembly to read Bit 0 to determine whether Local or Program mode is to be used.

4. Binary codes to sense LEARN and Local/Program signals are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
LEARN (See Note 1)													0	0	0	1
LOCAL/ PROGRAM (See Note 2)													0	0	1	0

Note: 1. This coding connects the 100-microsecond LEARN pulse to output data bus line OBBØ when LEARN pushbutton switch is pressed.

2. This coding connects LOCAL sense line to output data bus line OBB1.

Local operation = 0V; Program operation = +5V.

Table 3-4. Coding for Read/Multiplexer Assembly, A07 (Cont'd)

5. Binary codes for reading Expand and Vertical Positions are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
EXPAND POSITION (See Note 1)													0	1	1	0
VERTICAL POSITION (See Note 2)													1	0	0	1

Note: 1. This code connects the voltage from front-panel expand POSITION control to the A/D converter. Digital information from the A/D converter is connected to output data bus lines OBB0 through OBB9. The flag is held busy until the sequence is completed. (Refer to paragraph 6, this table, for A/D converter coding.)

2. This code connects the voltage from front-panel vertical CHANNEL 1 or CHANNEL 2 POSITION control to the A/D converter. Digital information from the A/D converter is connected to output data bus lines OBB0 through OBB9. The flag is held busy until the sequence is completed. Desired vertical channel must be selected prior to this command. (Refer to table 3-5 for Channel Select coding.)

Table 3-4. Coding for Read/Multiplexer Assembly, A07 (Cont'd)

6. Binary codes for reading A/D converter output and sampler output are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
READ A/D CONVERTER (See Note 1)													0	1	1	1
READ SAMPLER (See Note 2)										1			0	1	1	1

Note: 1. This code connects the digital output of the A/D converter to the output data bus lines. It should be sent prior to taking a series of samples.

2. This digital sequence encodes the sampler, and after proper delay encodes the A/D converter. The flag is held busy until the sequence is completed.

7. Binary codes for other "read" commands are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
read SWEEP TIME													1	0	1	1
read SCAN CONTROL													1	1	0	1
read VERT. SENSITIVITY													1	1	1	0
read CHANNEL SELECT													1	0	0	0

Note: Since the computer can read only one channel at a time, either the A TRACE switch or B TRACE switch must be in the OFF position when reading front-panel control settings.

Table 3-5. Coding for Channel Select Assembly, A08

Binary codes for Channel Select Assembly, A08, are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	0	0												
CHANNEL SELECT:																
CHANNEL 1												0	0	0	0	0
CHANNEL 2												0	0	0	0	1

Note: Channel selection must be programmed before programming any vertical control.

Table 3-6. Coding for Vertical Position Assembly, A09

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	0	1												
VERTICAL POSITION								← See Note →								

Note: Code for 9-bit D/A converter that produces an analog voltage of 0 to +10V (+5V = center of CRT).

Table 3-7. Coding for Scan Attenuator Decoder, A11

1. Binary codes for main sweep speed programming are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	1	1												
Main Sweep Indicator								0								
Main Sweep Speed:																
50 usec/div													0	0	0	0
20 usec/div													0	0	0	1
10 usec/div													0	0	1	0
5 usec/div													0	1	0	0
2 usec/div													0	1	0	1
1 usec/div													0	1	1	0
0.5 usec/div													1	0	0	0
0.2 usec/div													1	0	0	1
0.1 usec/div													1	0	1	0
50 ns/div													1	1	0	0
20 ns/div													1	1	0	1
10 ns/div													1	1	1	0

Table 3-7. Coding for Scan Attenuator Decoder, A11 (Cont'd)

2. Binary codes for expanded sweep speed programming are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	1	1												
Expand Sweep Indicator								1								
Expand Sweep Speed:																
20 usec/div									0	0	0	1				
10 usec/div									0	0	1	0				
5 usec/div									0	1	0	0				
2 usec/div									0	1	0	1				
1 usec/div									0	1	1	0				
0.5 usec/div									1	0	0	0				
0.2 usec/div									1	0	0	1				
0.1 usec/div									1	0	1	0				
50 ns/div									1	1	0	0				
20 ns/div									1	1	0	1				
10 ns/div									1	1	1	0				
5 ns/div									0	0	0	0				
2 ns/div									0	0	0	1				
1 ns/div									0	0	1	0				
0.5 ns/div									0	1	0	0				
0.2 ns/div									0	1	1	0				

Note: 1. Expanded sweep speed must be faster than main sweep speed.

2. Expanded sweep selection procedure:

(a). Select desired main sweep speed (bits 0-3).

(b). Select expand position on Expand Position Assembly, A06.

(c). Select desired expand sweep speed (bits 4-7).

(The ratio of main/expand sweep $\leq$ 100.)

Table 3-8. Coding for Digital Scan Assembly, A13

1. Horizontal scanning is furnished by an internal digital scan generator or from an external source such as a computer.
2. Binary codes for internal scanning function are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SCAN Function Identifier					0											
Internal Scan Identifier						0										
SAMPLES/DOT: (See Note)																
1													0	0		
2													0	1		
4													1	0		
DOTS/SCAN:																
1024															0	0
512															0	1
256															1	0
128															1	1

Note: In the case of multiple samples per dot, only the last sample is converted by the A/D converter.

Table 3-8. Coding for Digital Scan Assembly, A13 (Cont'd)

3. Binary codes for the external scanning function are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SCAN Function Identifier					0											
External Scan Identifier						1										
EXTERNAL SCAN							See Note									

Note: 10-bit word that is applied to a D/A converter. Analog output of 0 to +10V represents 0 to 10 horizontal divisions on the CRT.

4. Binary codes for freerun on external sampler control are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SAMPLE Function Identifier					1											
FREERUN																0
EXTERNAL SAMPLER CONTROL																1

Note: In FREERUN, scanner freeruns; in EXTERNAL SAMPLER CONTROL, scanner waits for READ SAMPLE command (table 3-4) to increment scanner one dot position. Both commands apply to the PROGRAM mode only. In LOCAL mode, the scanner always freeruns.

Table 3-9. Coding for Vertical Attenuator Assembly, A14

Vertical attenuators are programmed (after channel selection) with the following binary codes:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	1	0												
Vertical Attenuation:																
200 mV/DIV														0	0	0
100 mV/DIV														0	0	1
50 mV/DIV														0	1	0
20 mV/DIV														0	1	1
10 mV/DIV														1	0	0
5 mV/DIV														1	0	1
2 mV/DIV														1	1	0

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides circuit description of Model 1150A Programmable Waveform Processor. Due to the unique nature of the instrument, sampling circuit theory will be covered first on a general basis, followed by a block-diagram explanation for Model 1150A. Detailed block diagrams are located in this section. Refer to the applicable diagrams while reading the text. Schematics for the instrument are located in Section VIII (rear of manual).

4-3. GENERAL SAMPLING THEORY.

4-4. Sampling oscilloscopes differ from conventional oscilloscopes. Instead of presenting a complete display for each input waveform occurrence, only one voltage sample is taken at a discrete point in time for each occurrence of the input signal. Subsequent occurrences of the input waveform are sampled at other discrete points in time. These voltage samples are displayed on the vertical axis of the CRT (cathode-ray tube) display.

4-5. A conventional oscilloscope uses a linear ramp to sweep the beam horizontally across the CRT. The horizontal signal used in sampling oscilloscopes is provided by a scan generator and is normally a staircase waveform. Each time an input trigger is accepted, the input signal is sampled and held, and a dot is displayed on the CRT at a horizontal position corresponding to the amplitude of the scan voltage. After each sample, the scan voltage level is increased by one step. This moves the CRT beam one position and increments the time at which the next sample is taken on the input waveform by one position. Each step of the staircase represents one sampled point and the entire staircase represents one sweep across the CRT. At the end of a sweep, the scan voltage is reset and the process repeats.

4-6. The sampling process is initiated by a trigger obtained from a fixed point on a repetitive input waveform (figure 4-1). The trigger starts a linearly rising ramp whose initial value is determined by the level of the scan voltage. The timing ramp appears on one side of a voltage comparator. The other input to the voltage comparator is a dc reference level. The ramp voltage rises until it is equal to the reference voltage, and then the comparator fires. The comparator output becomes the take-a-sample command to the sampler and the scan step command to the generator. This generates a time delay between the trigger signal and the time at which the sample is taken. The delay is proportional to the scan voltage.

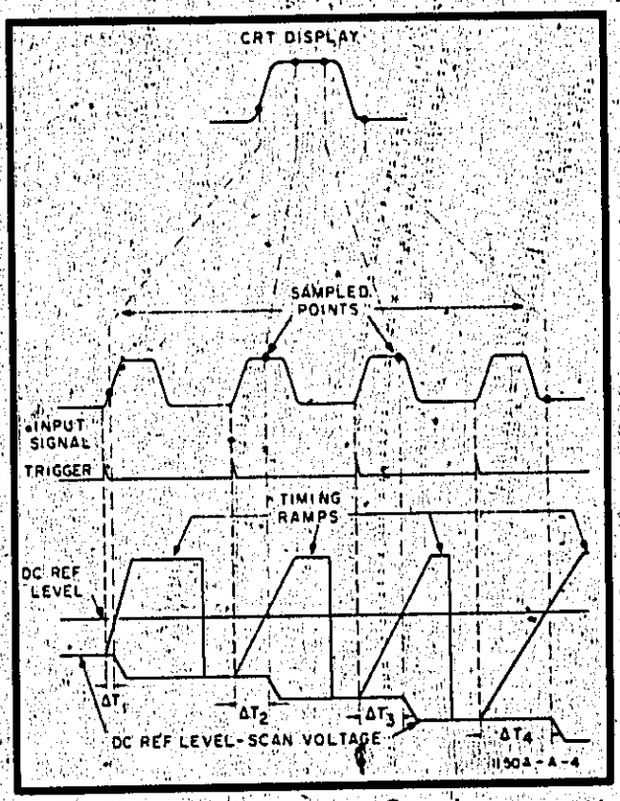


Figure 4-1. Comparator Operation

4-7. On the first sample of a scan, the scan voltage is zero. Each time the scan generator is triggered by the comparator, it increases the scan voltage by one increment. The scan voltage is subtracted from the dc reference at the comparator to determine the starting voltage of the next timing ramp. The time required for the ramp to reach the dc comparator level is proportional to the difference between the ramp-start voltage and the dc comparator level. As the scan voltage is increased, each sample is taken at a successively later point on the input waveform.

4-8. BASIC SAMPLING CIRCUITRY.

4-9. VERTICAL.

4-10. In order to display amplitude information on the CRT, a sample and hold circuit is used. A simple sample and hold circuit is shown in figure 4-2. When the take-a-sample command occurs at the comparator, the sampling switch is closed for a short period of time. For Model 1150A, the sample time is approximately 350 picoseconds. This time determines the minimum risetime signal that can be displayed (350 picoseconds). In practice, the sampling

switch is a diode bridge that is normally biased off. The bridge is momentarily switched on by a narrow strobe pulse.

4-11. When the sampling switch is closed, C_{in} begins to charge to E_{in} with a time constant determined by R, the circuit impedance (figure 4-3). Since the time constant is long compared to the time that the switch is closed, C_{in} charges to only about 5% of E_{in}. (The sampling efficiency is said to be 5%.) It is desirable for the sampling efficiency to be 100% so that the voltage displayed on the CRT is exactly the same as the input waveform voltage at the time of the sample. To do this, a stretcher circuit is used. The stretcher consists of an amplifier, a stretcher capacitor and switch, and a feedback circuit.

4-12. The voltage produced on C_{in} when the sampling switch is closed is amplified approximately 20 times to compensate for the 5% sampling efficiency. The stretcher switch is closed for about 5 microseconds and the stretcher capacitor charges to 20 times the voltage on C_{in}. This is equivalent to the voltage of the input waveform when the sample was taken, resulting in an overall sampling efficiency of 100%. The feedback time constant is fairly slow so that at some time after the stretcher switch is opened C_{in} and C become charged to the voltage on the stretcher capacitor. The change in voltage on the stretcher capacitor is proportional to the difference between E_{in} and the voltage on C_{in}; therefore, if the overall sampling efficiency is not 100%, each additional sample at voltage E_{in} reduces the output error because of the feedback. Sampling efficiency of less than 100% is sometimes used to reduce noise. A large number of samples per scan must be used to maintain fidelity of the displayed waveform.

4-13. TIME BASE.

4-14. Figure 4-4 shows a complete sampling circuit including time base. The time base of a sampling oscilloscope differs from that of a conventional oscilloscope. As discussed in paragraphs 4-6 and 4-7, the time base generates a series of successively longer delay intervals between the acceptance of a trigger and the point of signal sampling. The length of a given interval is proportional to the scan voltage amplitude.

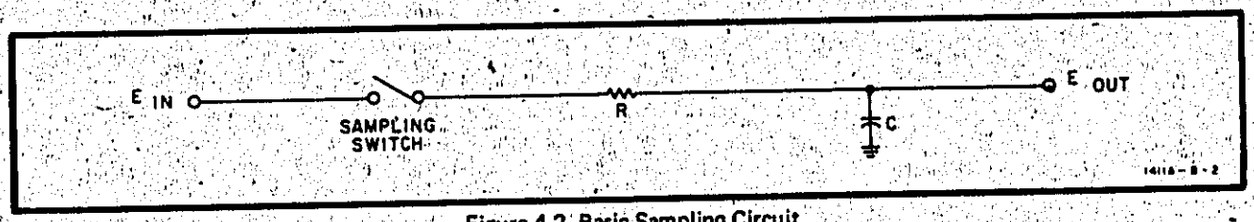


Figure 4-2. Basic Sampling Circuit

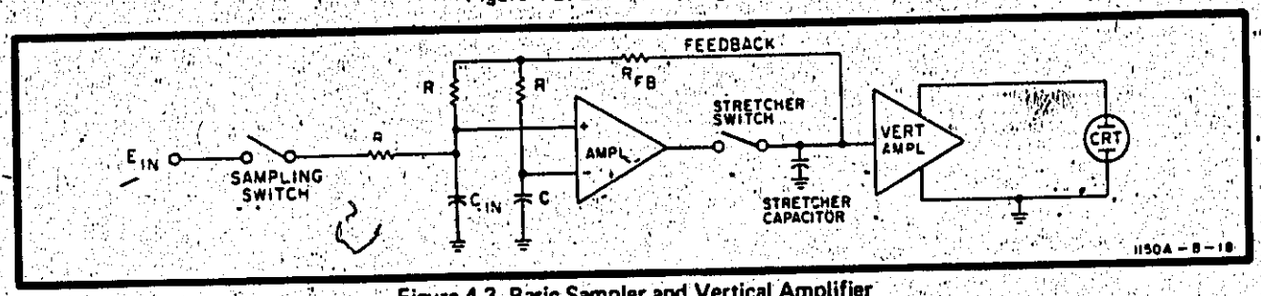


Figure 4-3. Basic Sampler and Vertical Amplifier

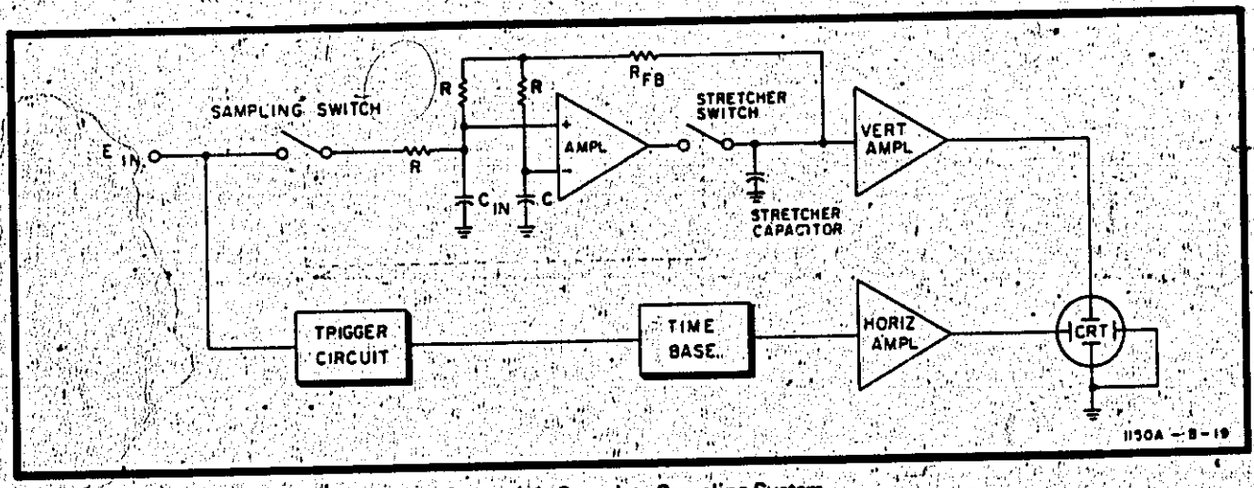


Figure 4-4. Complete Sampling System

4-15. The other function of the time base is to reconstruct the input waveform by positioning the samples (dots) in the proper order on the CRT with the earliest one at the left and each subsequent sample farther to the right. This is done by applying the scan voltage to the horizontal deflection circuitry. Each increase in scan voltage moves the dot farther to the right on the CRT while increasing the delay between the trigger and the point of signal sampling.

4-16. VARIATIONS IN PRESENTATION.

4-17. The number of samples plotted during one scan is determined by the number of steps in the scan. Changing the scan density varies the number of samples taken in each scan without affecting the horizontal time scale (figure 4-5). Increasing the scan density improves display resolution. Decreasing the scan density reduces trace flicker. By varying scan density, the display can be optimized between resolution and flicker.

4-18. The horizontal time scale of the presentation can be varied in two ways. The slope of the timing ramp may be changed (figure 4-6), or the scan voltage to the delay generator may be attenuated (figure 4-7). The staircase voltage to the horizontal amplifier is not attenuated. Decreasing the amplitude of the scan by attenuation has the same effect as increasing the slope of the timing ramp, expanding the display on the face of the CRT.

4-19. The slope of the timing ramp is changed to make decade changes in the horizontal time scale. For each decade change, a different timing capacitor is switched into the fast ramp generator by the TIME/DIV switch. Scan attenuation is used for establishing the intermediate (DIRECT) ranges within the decades selected. Scan attenuation is also used on the expanded portion of the TIME/DIV switch to obtain expansion of the horizontal scale up to 100 times.

4-20. As shown in figure 4-8, when the time scale is expanded, only a fraction of the timing ramp is scanned. In the EXPANDED sweep mode, the scan rides on a dc voltage adjusted by the POSITION-EXPANDED control. This control allows any portion of the unexpanded (direct) sweep to be viewed, expanded (or magnified) up to 100 times.

4-21. MODEL 1150A TIME BASE.

4-22. Figure 4-9 shows a block diagram of the Model 1150A Time Base. The signal in or external trigger is applied to the Trigger Circuit (A23) where a signal is generated that starts the timing ramp. The correct timing

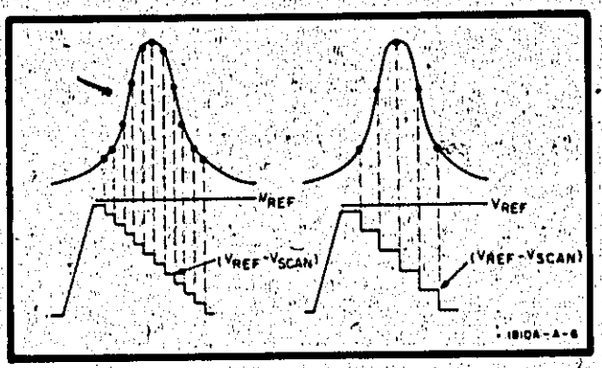


Figure 4-5. Scan Density

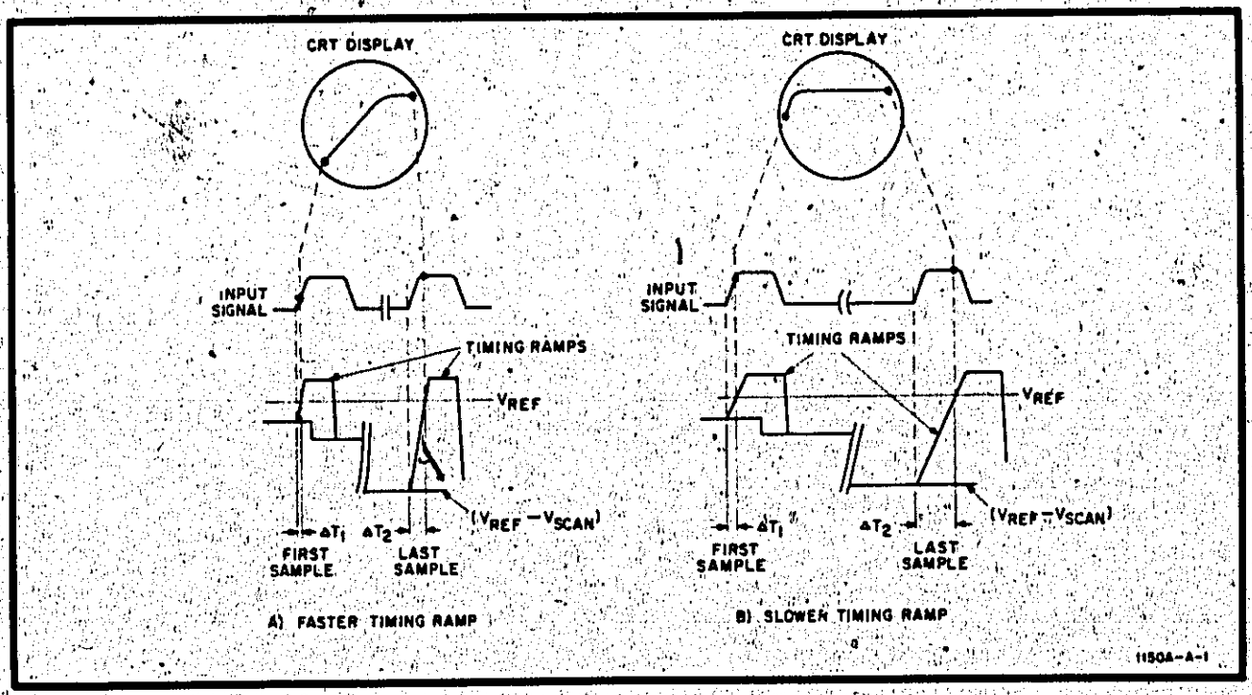


Figure 4-6. Timing Ramp Slope

ramp is selected by Sweep Decoder A11. The scan signal from A12 sets the voltage level at which the timing ramp starts. The timing ramp is applied to Comparator and Strobe Generator A21 which generates the strobe pulse and stretcher gate pulse when the timing ramp reaches the compare level. The strobe pulse and stretcher gate pulse cause the input signal to be sampled and the voltage level stored until the next sample is taken.

4-23. The scan voltage, generated by a D/A converter on A12, is the signal applied to the X-axis of the CRT. The correct attenuation of the scan voltage for the desired sweep speed is selected by Sweep Decoder A11. The sweep speed is selected by front-panel controls or is programmed by the computer. The scan D/A converter is controlled by a counter on assembly A13 so that each time a sample is taken, the counter is incremented one count. This switches

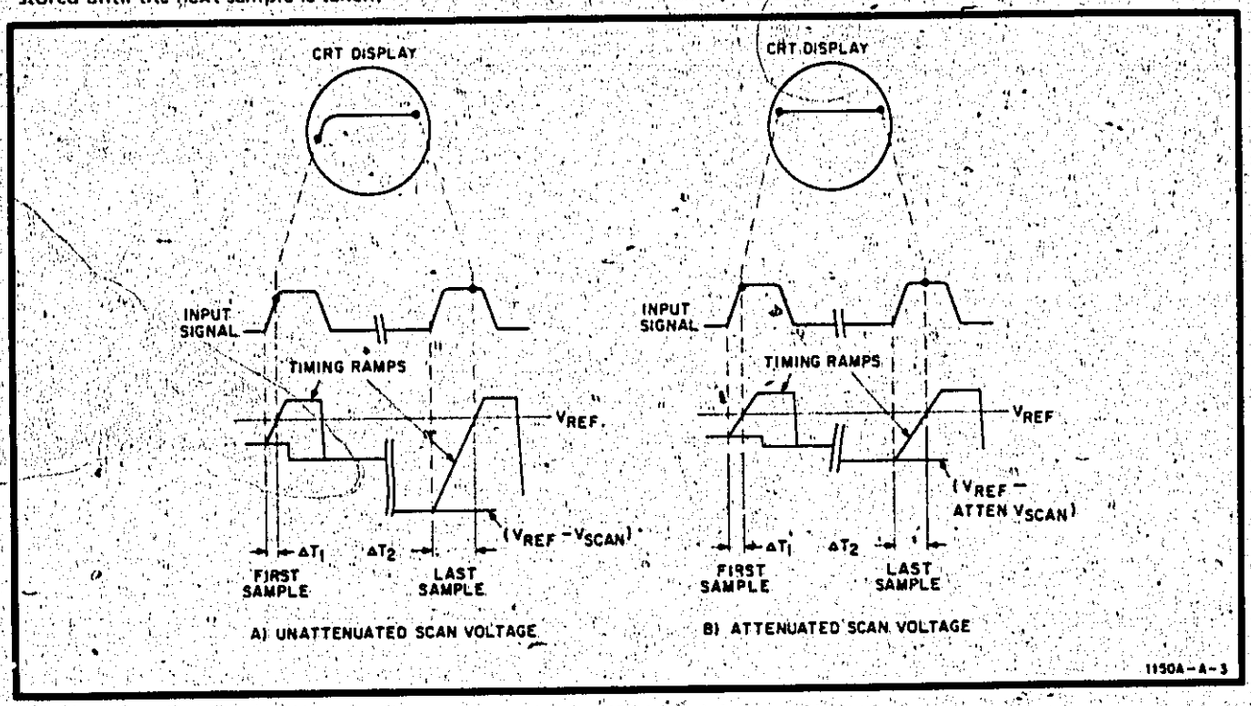


Figure 4-7. Scan (Staircase) Attenuation

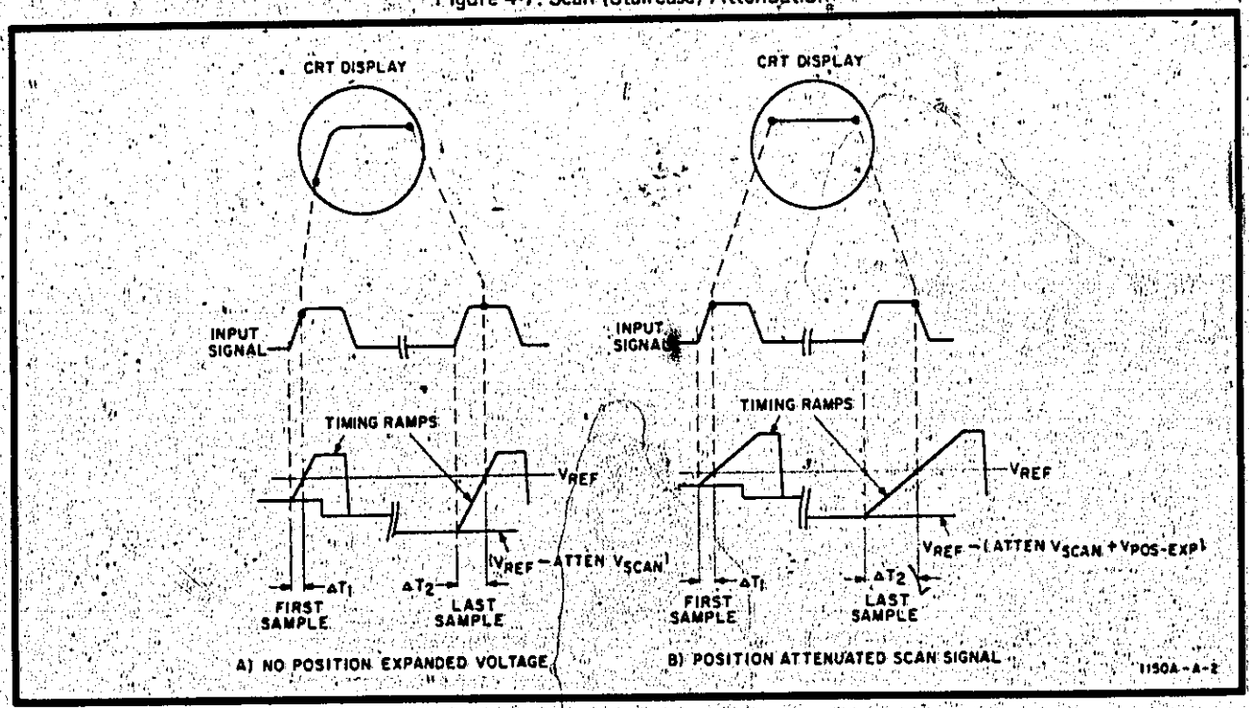


Figure 4-8. POSITION EXPANDED Operation

the D/A converter to the next voltage level and the next sample taken is moved over one position on the input waveform. The counter can be controlled by front-panel controls or by the computer. In addition, the computer can control the D/A converter directly. This allows the computer to determine what point on the input waveform is sampled.

4-24. When the expanded sweep mode is used, the portion of the waveform to be expanded may be selected by the expand POSITION control. A voltage is generated by a front-panel control or by the computer using Expand Position D/A A06. This voltage is summed with the scan voltage in Expand Attenuator A12 to generate an appropriate dc offset for the attenuated scan signal. The expand voltage is also routed to Read/Multiplexer A07 so that the front-panel settings can be read by the computer.

4-25. MODEL 1150A SAMPLING.

4-26. Figure 4-10 shows a block diagram of the Model 1150A Sampler and Vertical circuit. The input signal is applied to Trigger Pickoff circuit A16, where it is routed to the trigger circuit (A23) to start the timing ramp. The input signal also goes through a delay line (A31) to generate enough delay so that the edge of the input signal that generates the trigger can be observed on the display. The signal from the delay line is applied to a sampling bridge on assembly A22 where it is sampled when the time base generates the strobe signal. After the sample is taken, Stretcher A22 is activated by the Stretcher Gate Pulse. The stretcher regenerates the voltage of the input waveform at the time the sample was taken and holds that voltage until another sample is taken.

4-27. A vertical position voltage is generated by a front-panel control or by a D/A converter circuit (A09) when under computer control. This voltage is applied to the Stretcher where it is used to position the waveform on the display.

4-28. The output voltage from the Stretcher is routed to Vertical Attenuator A14 where the desired scale factor of the displayed waveform is obtained. The attenuator is controlled by front-panel controls or by the computer.

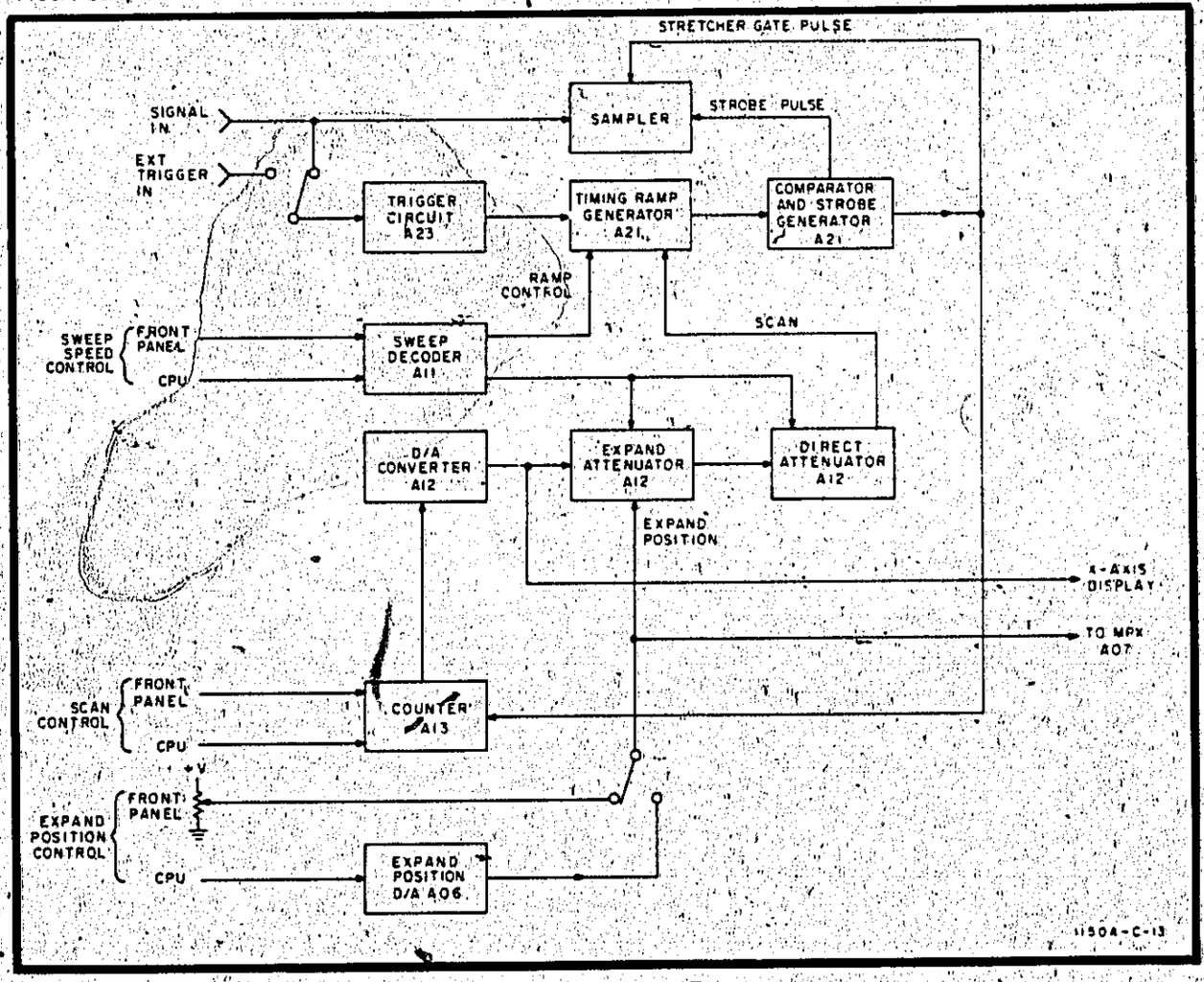


Figure 4-9. Block Diagram, Time Base

4-29. The output of the attenuator is routed to Read/Multiplexer A07 that selects one of several analog signals and applies it to A/D Converter A27 and to the Y-axis of the display. Normally Channel Selector A08 selects the output of the desired channel vertical attenuator. An A/D conversion is then made on the signal for each sample taken. The digital data is routed to the computer for processing. By controlling the scan counter and scan D/A converter, the computer also knows at what point in time each voltage occurred. This allows the computer to reconstruct the waveform and calculate the risetime, pulsewidth, overshoot, amplitude, etc., of the waveform.

4-30. The Read/Multiplexer can also select the expand position or the vertical position signals for A/D conversion. In this manner, front-panel control settings can be stored in the computer for use at a later time. Recall of front-panel control settings is accomplished by programming the appropriate D/A converter. In addition, the Read/Multiplexer routes the Channel Select, Vertical Attenuation, Scan Control, and Sweep Control signals to the computer for storage. The signals from these controls are digitized and can be read directly by the computer (no A/D conversion is necessary).

4-31. To improve the accuracy of measured data, a calibration signal can be switched into the signal input of Model 1150A by Calibration Relays on assembly A16. The calibration signals are generated by Calibrator A04 and consist of a time calibration signal from a crystal-controlled oscillator and an amplitude calibration signal from a D/A converter. These signals are used only when under computer control. They are switched in and are measured by the computer to obtain correction factors to apply to data taken on external waveforms being measured.

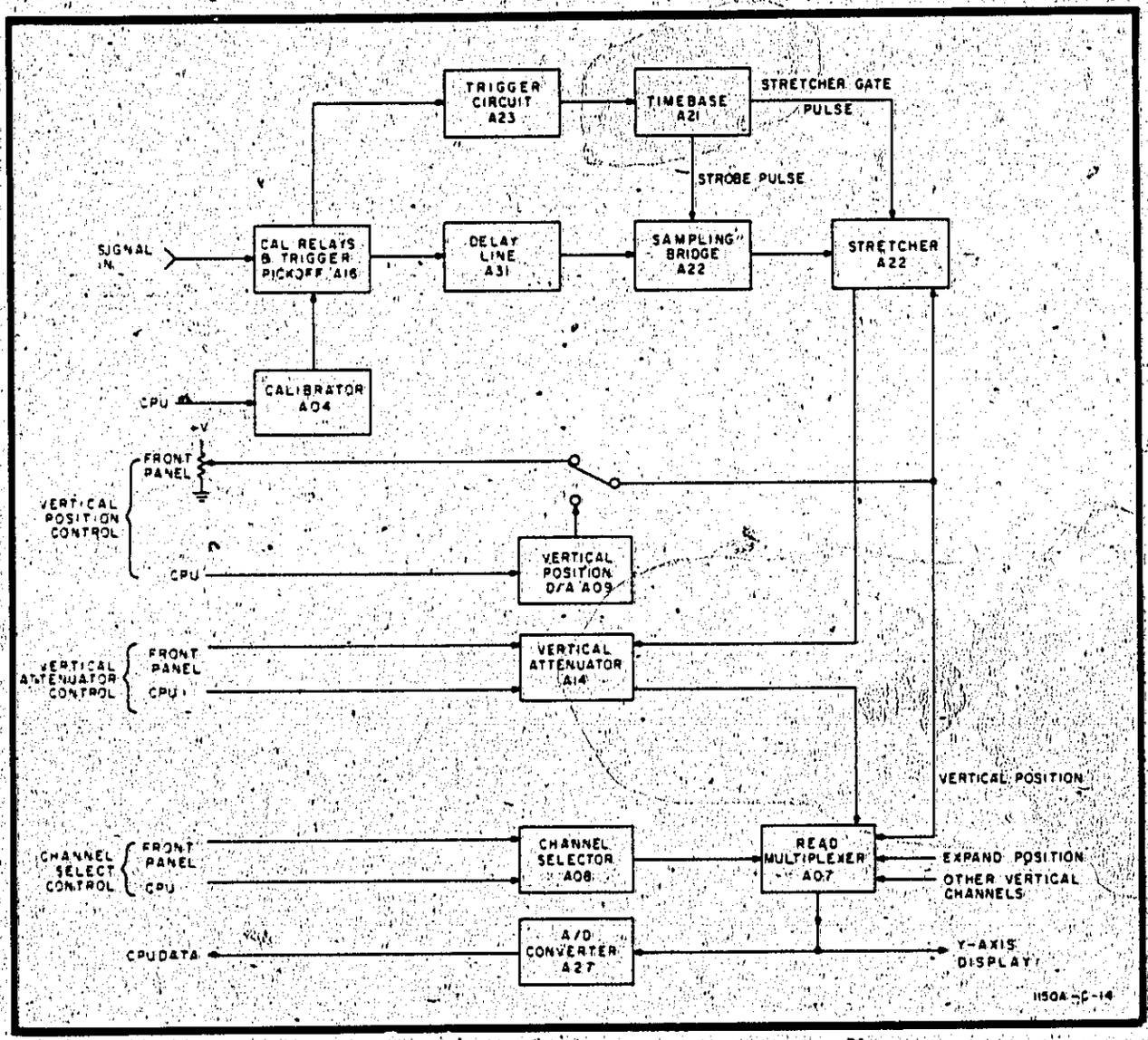


Figure 4-10. Block Diagram, SAMPLING

4-32. BLOCK DIAGRAM DISCUSSION.

4-33. Figure 4-28 located at the end of this section is the overall block diagram for Model 1150A. Controls and functional blocks are shown along with types of signals exchanged. Refer to the overall block diagram and certain selected detail block diagrams when examining the functional descriptions that follow.

4-34. Two operating modes of Model 1150A are Local and Program. In Local mode, all functions of Model 1150A are controlled by front-panel controls. This mode is used for setup and troubleshooting. The Program mode of operation is used to process data on the waveform under test. This mode is selected by the computer. Certain front-panel controls can be programmed so that the waveform under test will fall within the time window of Model 1150A. Data is then taken on the waveform and processed by the computer. The computer communicates with Model 1150A using a 16-bit word for output data (from Model 1150A) and a 16-bit word for input data (to Model 1150A). Refer to Section III for coding information. The bit data, to and from the computer, are in parallel. In addition, there is a device command generated by the computer which initiates an operation by the instrument. Model 1150A, in turn, generates a flag signal that indicates (to the computer) that the instrument is busy with an operation. When the busy signal ends, the computer senses its absence and reads the information on the output data bus lines. The flag signal is generated by control assemblies A03, A04, A05, A06, A07, A08, A09, A11, A13, and A14. Each assembly develops a busy signal for the length of time required to complete its specific operation. Since this time varies for the different assemblies, the duration of the flag signal will also vary.

4-35. A brief description of the computer interface operation of Model 1150A is as follows (figure 4-28):

a. The computer generates a 16-bit program word and a device command signal. These signals appear at the output of the CPU I/O card. The signals go through Interface Assembly A02 to Local/Remote Assembly A03 where the most significant four bits of data (bit 12 through bit 15) are decoded into an address for the function to be programmed. In addition, the device command signal from the computer is converted to a data strobe pulse by assembly A03.

b. Assembly A03 can be controlled by a front-panel switch to select data from the front-panel switch register instead of the computer. The front-panel switch register is used when troubleshooting the instrument.

c. The signals generated through assembly A03 are applied to the input data bus lines which are connected to all programmable assemblies and to the Channel Extender connector on the rear panel of the instrument. From the address signals, only one assembly is selected to receive the program data. The data strobe pulse clocks the data into storage registers on the assembly addressed.

d. When an assembly is properly addressed and receives a data strobe, it initiates a Flag signal. The Flag and output data generated by the programmed operation are wired-OR to the output data bus lines. This information is routed through assemblies A03 and A02 to the computer.

e. The front-panel lamp registers are connected to the input and output data bus lines and to the Flag bus to indicate status of these signals for troubleshooting purposes.

4-36. In Program mode of operation, a local-program (LP) signal is generated by the computer through Read/Multiplexer Assembly A07 which switches all assemblies to the program mode. Some assemblies have override switches to force a particular assembly to local (front-panel) operation when troubleshooting.

4-37. A Learn mode of operation allows the computer to read front-panel control settings of the instrument. This feature is used when programming a test sequence. The Learn sequence is as follows:

a. The computer sends a command (Read-Learn) to Read/Multiplexer Assembly A07 which connects the LEARN pushbutton switch to an output data bus line and lights the LEARN lamp on the front-panel of the instrument.

b. After front-panel controls are set to display the waveform to be measured, the LEARN pushbutton switch is pressed, causing the computer to initiate a series of Read commands.

c. When a Read command for a particular control is received by assembly A07, a signal is generated which causes the data for that control setting to be applied to the output data bus lines. The computer stores the data and then generates a command to read another control. This process is repeated until all controls are read and stored. The computer will then send another read-learn command and wait for another operator input or it goes on to execute some other programmed sequence.

4-38. To sample data on a waveform under test, the computer switches the instrument to Program mode of operation. Next, the scan must be set to a nonfreerun condition. A scan data word is applied to Digital Scan Assembly A13 to select a point, in time, on the waveform where the sample will be taken. The computer then sends a sample command signal. An A/D conversion is made on the output voltage of the stretcher after a trigger is received and a sample is taken. The data is sent to the computer on the output data bus lines for processing.

4-39. An alternate method of generating the scan is to use the internal scanner counter. The counter can be programmed by the computer for a particular number of dots per scan. The computer generates the sample command and the first sample is taken upon receipt of the next trigger pulse. The counter is incremented to the

second position. The sample data is stored by the computer which then generates another sample command. When the next trigger occurs, a sample is taken at the second position, and the counter is incremented to the third position. The computer stores the latest sample taken, and again, generates a sample command. This process is repeated until the number of samples for a complete scan are taken. Since the samples are taken in sequence, the computer knows at what point in time a sample was taken on the input waveform. With this information, the computer can calculate the parameters of the waveform under test.

4-40. Model 1150A has the capability of processing remote displays. Display Control Assembly A05 contains two D/A converters (X-axis and Y-axis) that can be controlled by the computer. In remote display mode of operation, digital waveform information that is stored in the computer is applied to assembly A05. The data is converted to an X-Y analog voltage which is applied to the CRT display. In local display mode of operation, Model 1150A furnishes the display information.

4-41. INTERFACE BOARD ASSEMBLY.

4-42. Information to and from the computer will normally be connected through Interface Assembly A02. Under current configuration, this assembly slot is jumpered (see figure 8-10 for wiring). When required, this assembly can be designed to allow for voltage level shifting and isolation when computers other than Hewlett-Packard's are used.

4-43. LOCAL/REMOTE ASSEMBLY A03. (See figure 4-11.)

4-44. Input data lines from the computer and front-panel data switches are connected to Local/Remote Assembly A03. Each set of input lines is connected to separate input gates. Depending upon the setting of front-panel MANUAL-REMOTE switch, one set of input gates is enabled. In REMOTE position, the remote input gates are enabled and input data lines from the computer are gated to the input data bus lines. In MANUAL position, the local input gates are enabled and front-panel data switches control the information applied to the input data bus lines. The input data bus distributes the information to all control assemblies and the front-panel data lights.

4-45. CALIBRATOR ASSEMBLY A04. (See figure 4-12.)

4-46. The calibrator assembly develops the horizontal and vertical calibration signals used to determine correction factors needed for absolute measurements of waveforms. The calibrator must be programmed to produce either a horizontal or vertical calibration signal. It cannot

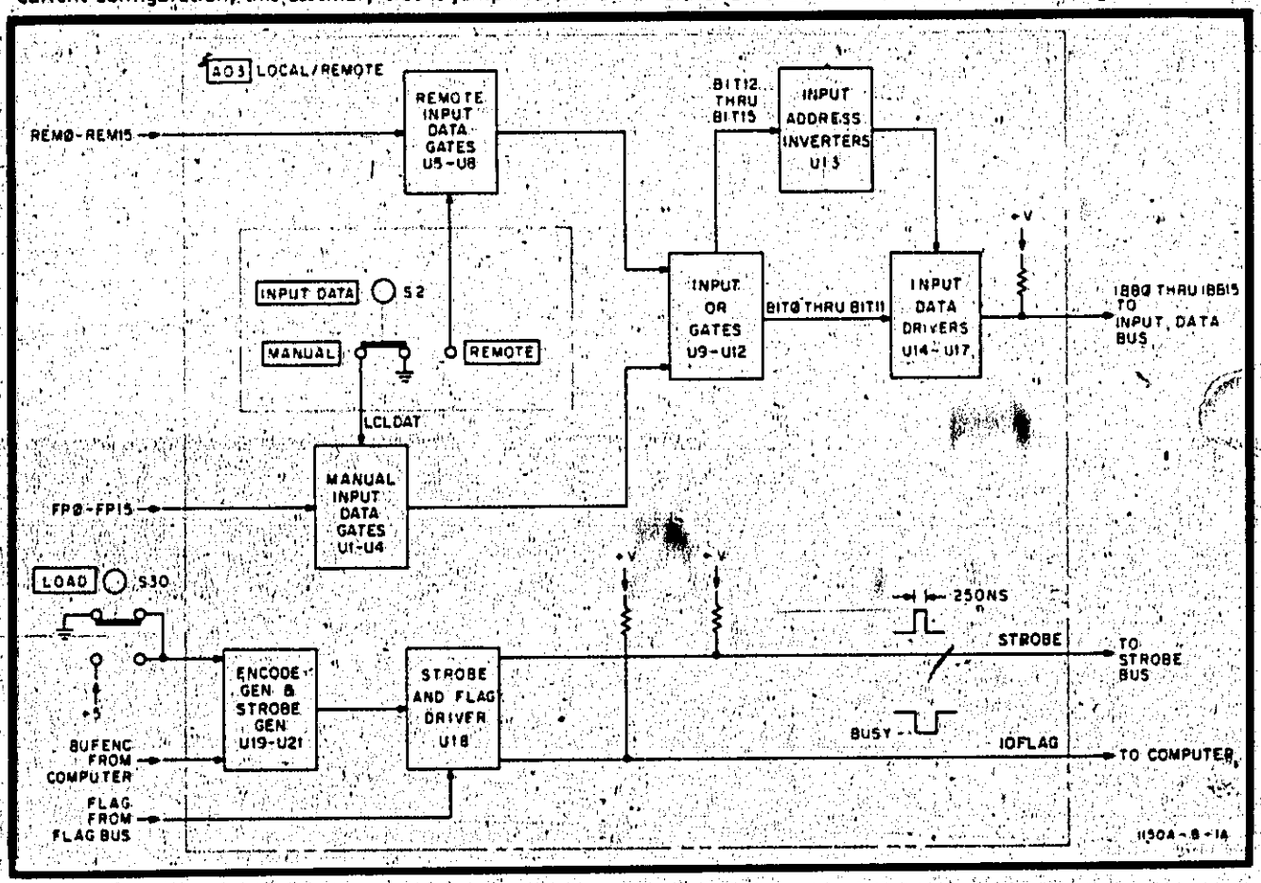


Figure 4-11. Detailed Block Diagram, Assembly A03

perform both functions simultaneously. When the horizontal calibration function is selected, a 50-MHz crystal-controlled oscillator generates four timing signals and a trigger signal which is used to calibrate the time base. When the vertical calibration function is programmed, a D/A converter generates several dc voltage levels to calibrate absolute dc voltage and gain correction factors. An attenuator network is used to develop the appropriate level for each mV/DIV scale. In addition, a 50-kHz square wave is generated to supply the trigger signal since the 50-MHz oscillator (used for horizontal calibration) is inhibited during vertical calibration.

4-47. When the calibration function is programmed, a relay on assembly A16 selects either the vertical or horizontal calibration signal and applies it to the sampler input ahead of the trigger pickoff circuit and signal delay line. To accomplish this, the channel relay of the channel being calibrated is switched. This disconnects the channel INPUT signal and connects the calibration signal to the trigger pickoff circuit and delay line.

4-48. DISPLAY ASSEMBLY A05. (See figure 4-13.)

4-49. The display assembly is used to generate X-Y-Z-axes information needed for displaying the output from the sampler on an external display device. It can also be programmed to display computer data on the same external display device. Two 10-stage, digital-to-analog (D/A) converters are used to convert a 10-bit computer data word to an analog function that furnishes the X-axis or Y-axis voltage for an external display. Since the assembly uses the same 10-bit input data bus lines for both the X-axis and Y-axis information, both functions cannot be programmed simultaneously. When programming, the Y function should be programmed first. Programming the X function automatically results in a 10-microsecond (approximately) unblanking signal being applied to the Z-axis of the external display. The erase function needed to control a storage type display is also developed in this assembly. To display the sampler output, the D/A converters are disconnected and the sampler outputs are connected to the X-output and Y-output circuits. Signals from the sampler are used to generate the bright-dot or blanking signal for the Z axis.

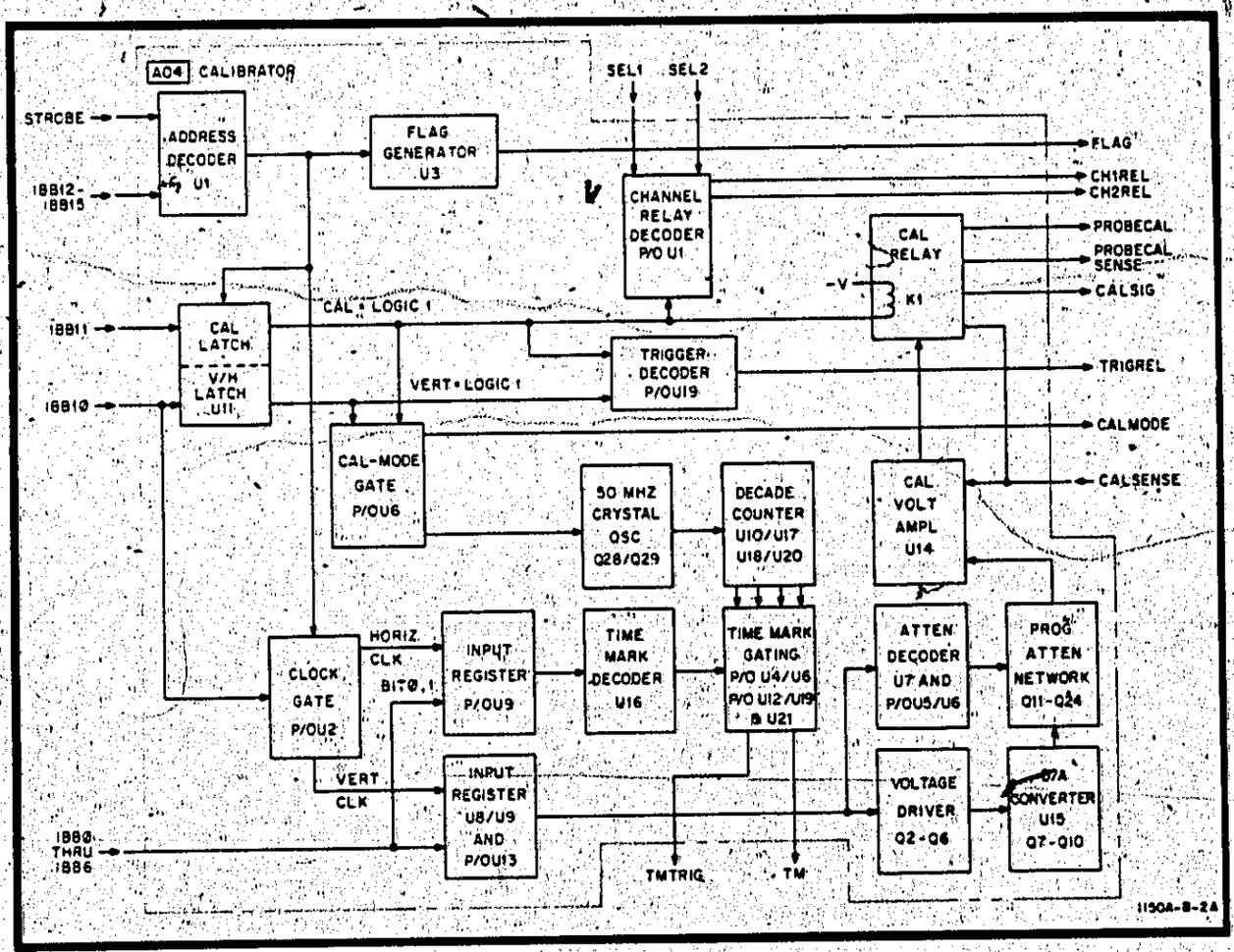


Figure 4-12. Detailed Block Diagram, Assembly A04

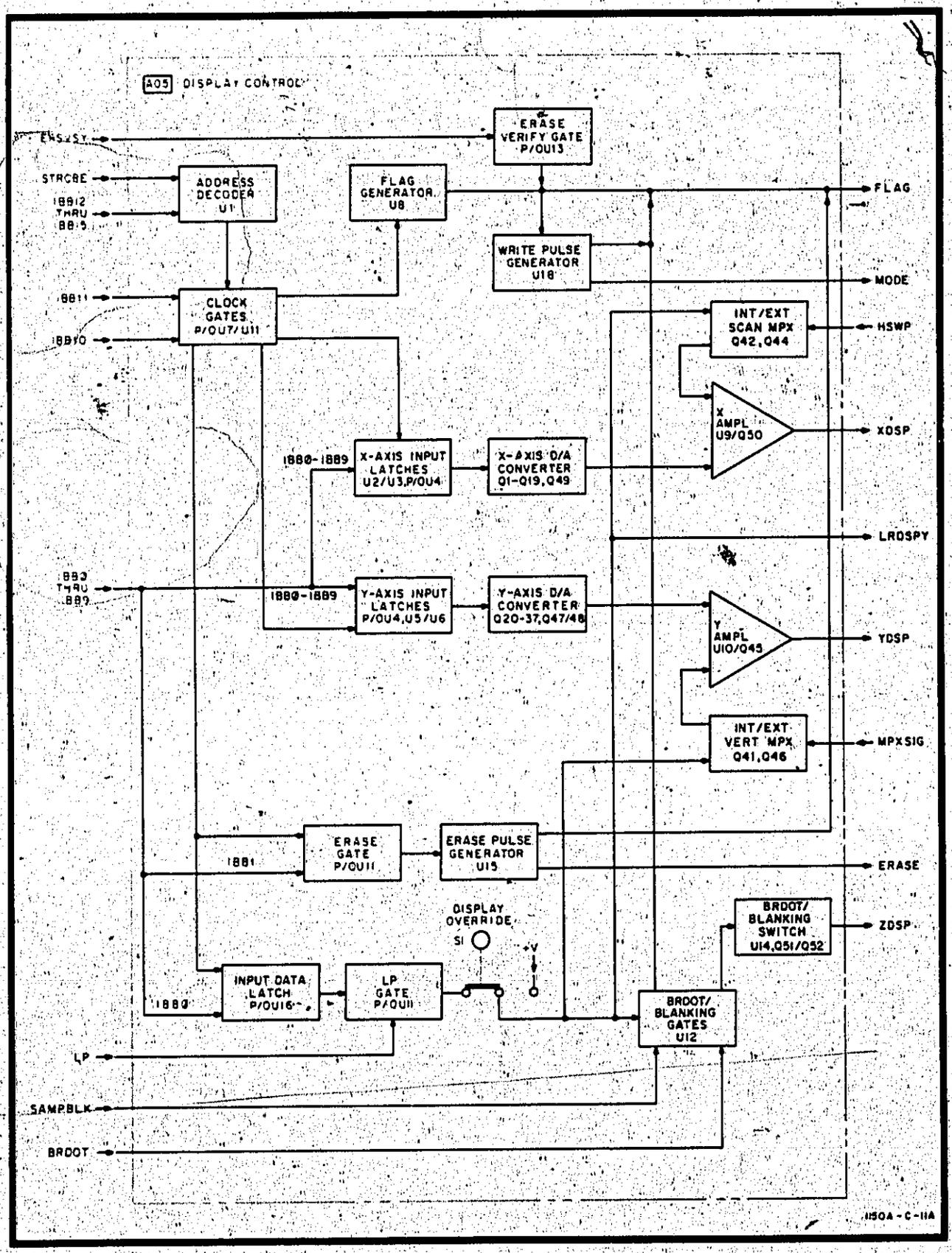


Figure 4-13. Detailed Block Diagram, Assembly A05

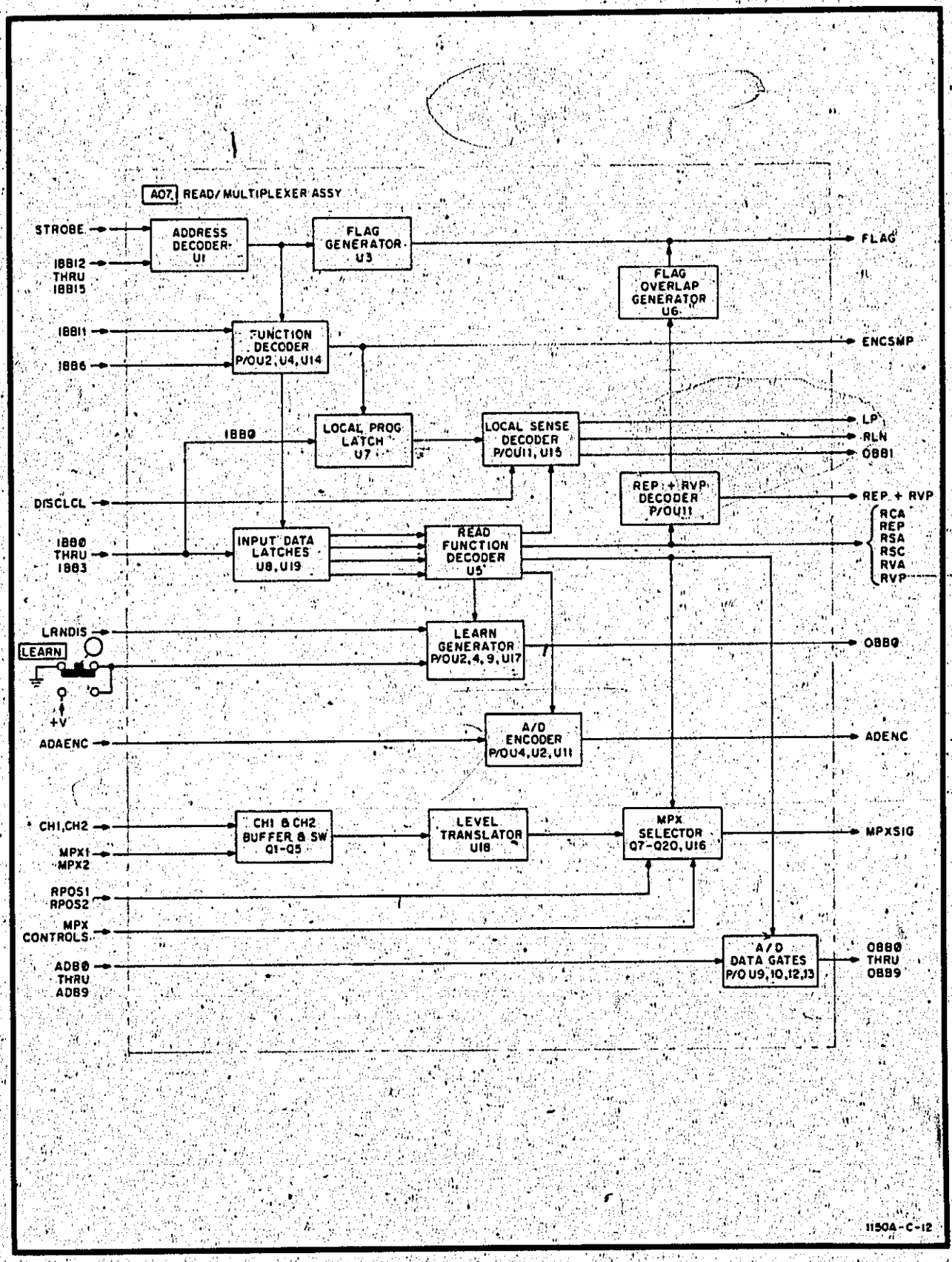


Figure 4-14. Detailed Block Diagram, Assembly A07

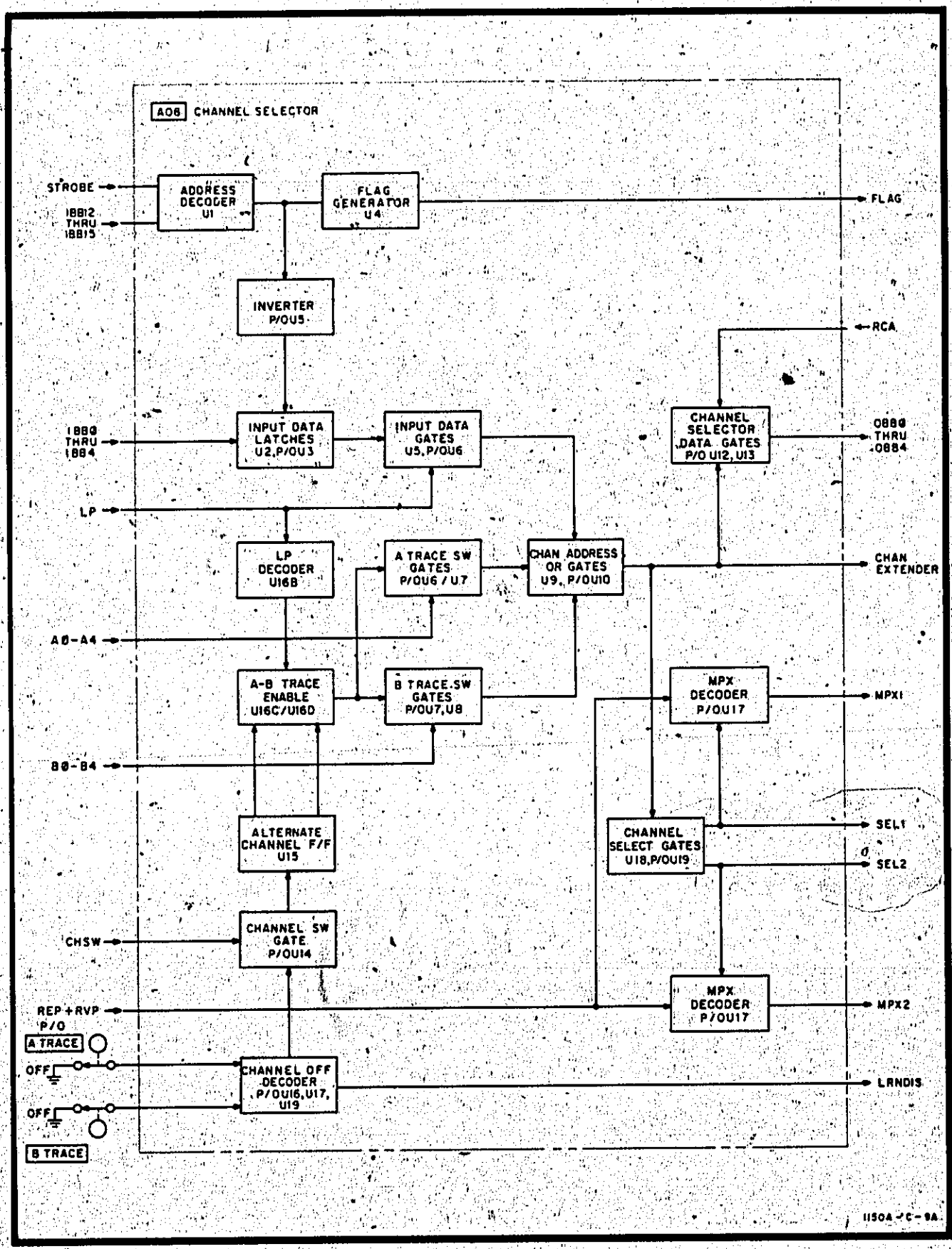


Figure 4-15. Detailed Block Diagram, Assembly A08

4-50. EXPAND POSITION BOARD ASSEMBLY A06.

4-51. The expand position assembly is used for the remote mode of operation. It consists of a nine-stage D/A converter that converts the digital data stored by the computer to an analog voltage. The voltage is used to position the expanded sweep time window. The analog voltage is applied to Scan D/A and Attenuator Assembly A12. When the instrument is in the Local mode of operation, front-panel EXPAND POSITION potentiometer controls the analog voltage applied to assembly A12.

4-52. READ/MULTIPLEXER BOARD ASSEMBLY A07. (See figure 4-14.)

4-53. The read/multiplexer assembly controls the overall operation of the instrument. It controls the Local-Program mode and the Learn mode. It determines whether data on a waveform or front-panel controls are read by the computer. It selects which front-panel control is to be read and generates a signal that connects data from that control to the appropriate output data bus lines.

4-54. The read/multiplexer also contains an analog multiplexer that routes the correct analog signal to Analog-to-digital (A/D) Converter Assembly A27. Then an A/D conversion command is generated. After conversion, the digital information is routed back through the read/multiplexer assembly to the output data bus lines. The digital information applied to the output data bus lines is then processed by the computer.

4-55. CHANNEL SELECTOR BOARD ASSEMBLY A08. (See figure 4-15.)

4-56. The channel selector assembly selects one of two channels currently available. The instrument can be extended for 32-channel operation by adding future external equipment. When operating in Program mode, channel selection is accomplished by the computer. The computer cannot select both channels simultaneously. When operating in Local mode, channel selection is made by the CHANNEL SELECT switches on the front panel of the instrument. If the A TRACE switch is set for Channel 1 and the B TRACE switch is set for Channel 2, a chopped mode of display will result. One channel switch must be in the OFF position when using the Learn mode of operation.

4-57. VERTICAL POSITION ASSEMBLY A09. (See figure 4-16.)

4-58. The vertical position assembly is used by the computer to generate a positional voltage for the sampler when operating in Program mode. The assembly receives its information from the input data bus lines. It contains two digital-to-analog (D/A) converter circuits (one for each channel). Each converter circuit has ten stages. When properly addressed and strobed by the computer, the digital

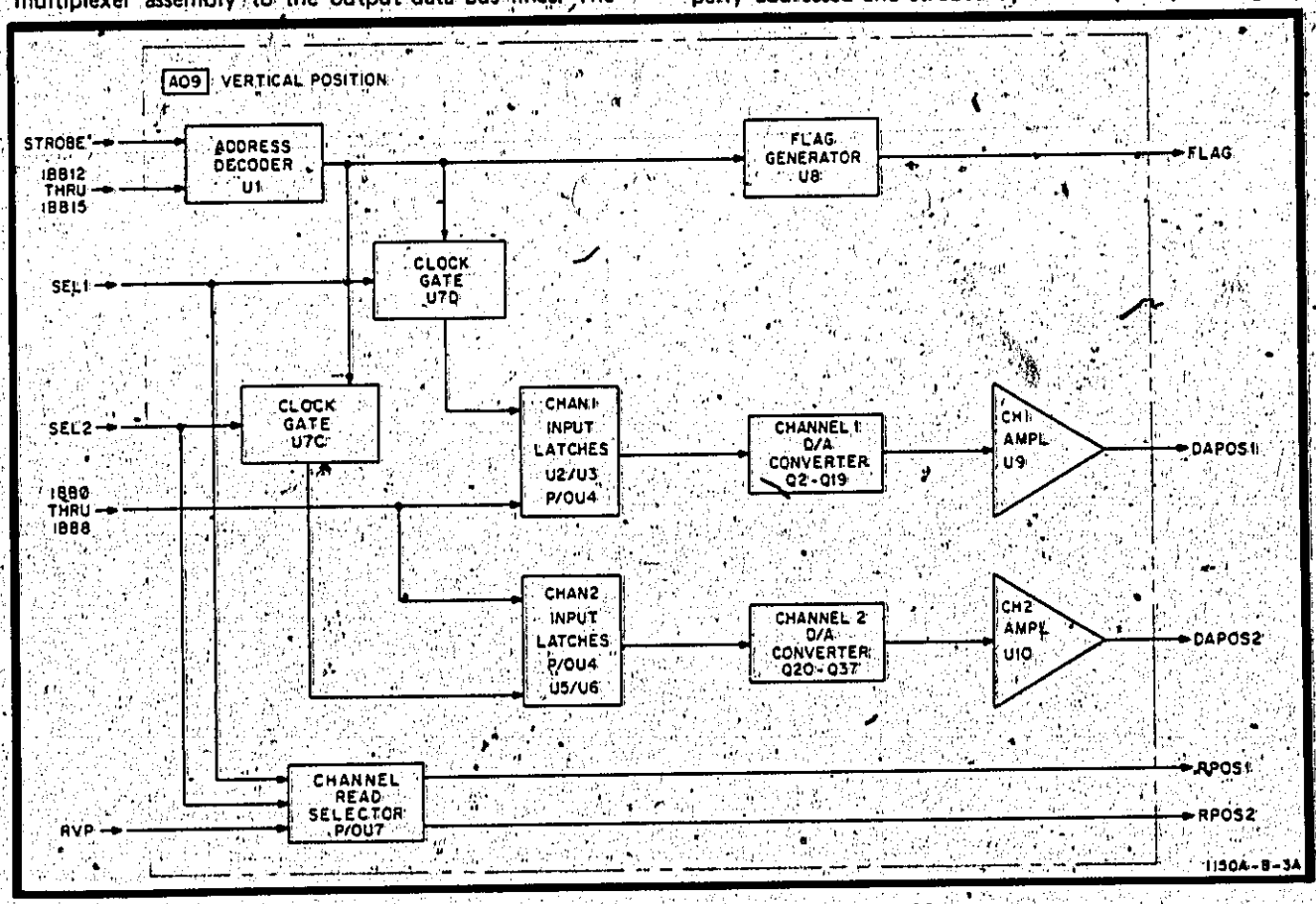


Figure 4-16. Detailed Block Diagram, Assembly A09

information on the input data bus lines is applied to one of the D/A circuits where it is converted to an analog voltage. The output of A09 is applied to Vertical Attenuator Board Assembly A14.

4-59. SCAN ATTENUATOR DECODER ASSEMBLY A11. (See figure 4-17.)

4-60. The scan attenuator decoder accepts digital information from either the computer or front-panel TIME/DIV switch. The information is in digital form for both main and expanded sweeps. The information is decoded and applied to Scan D/A and Attenuator Board Assembly A12 and to Time Base Assembly A21 where the selected fast ramp signal is produced (refer to paragraph 4-19 for fast ramp explanation).

4-61. SCAN D/A AND ATTENUATOR ASSEMBLY A12. (See figure 4-18.)

4-62. The scan D/A and attenuator assembly generates the stairstep voltage required for sampling and sweeping. (Refer to paragraph 4-3 for sampling theory.) The assembly receives scan data (in digital form) from Digital Scan Assembly A13. The digital information is converted to an analog voltage that is applied to an attenuation network. Scan attenuation information decoded by assembly A11 selects the proper attenuation for the sweep speed desired. The output of A12 is applied to Time Base Assembly A21 and Display Control Assembly A05.

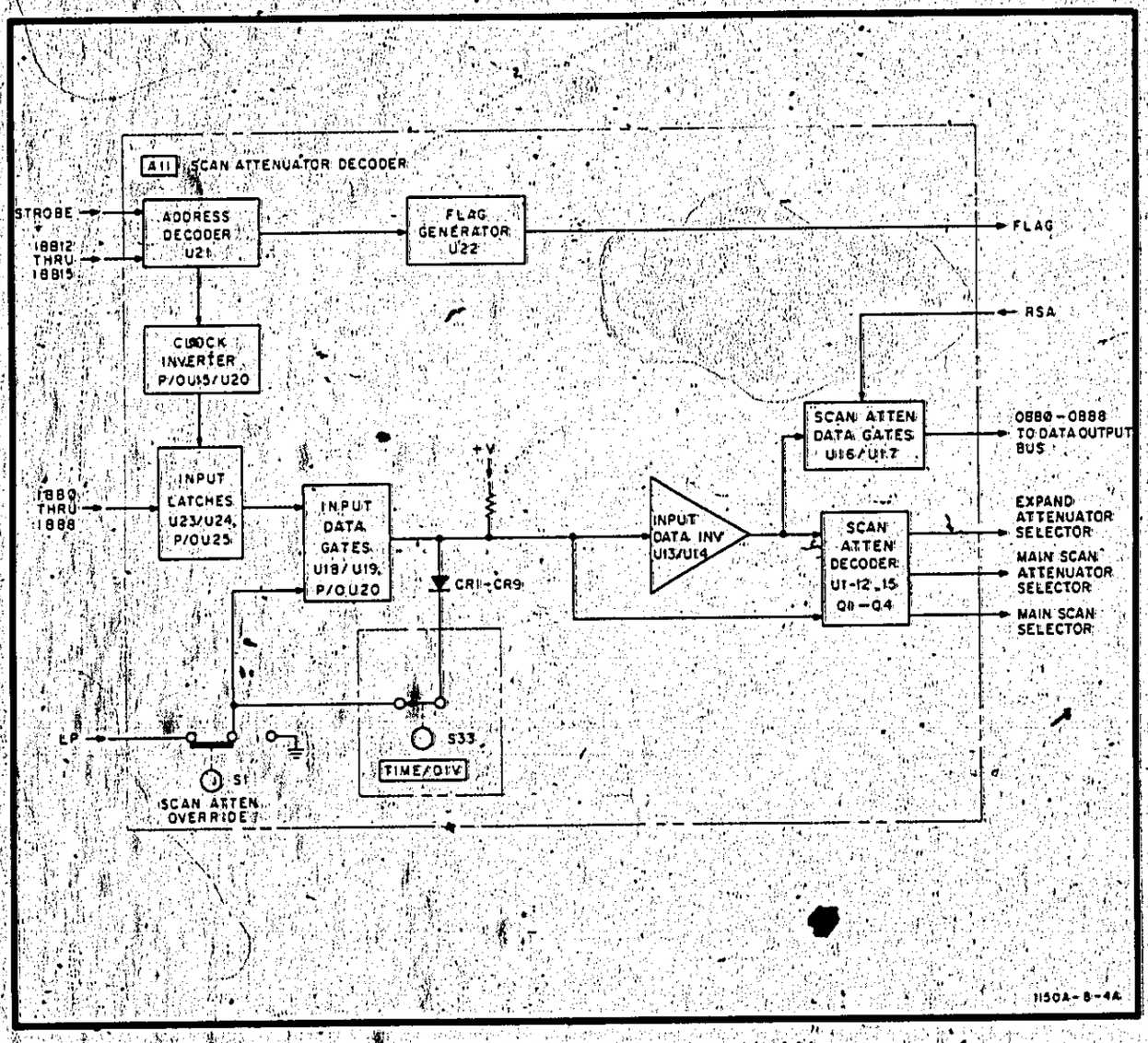


Figure 4-17. Detailed Block Diagram, Assembly A11

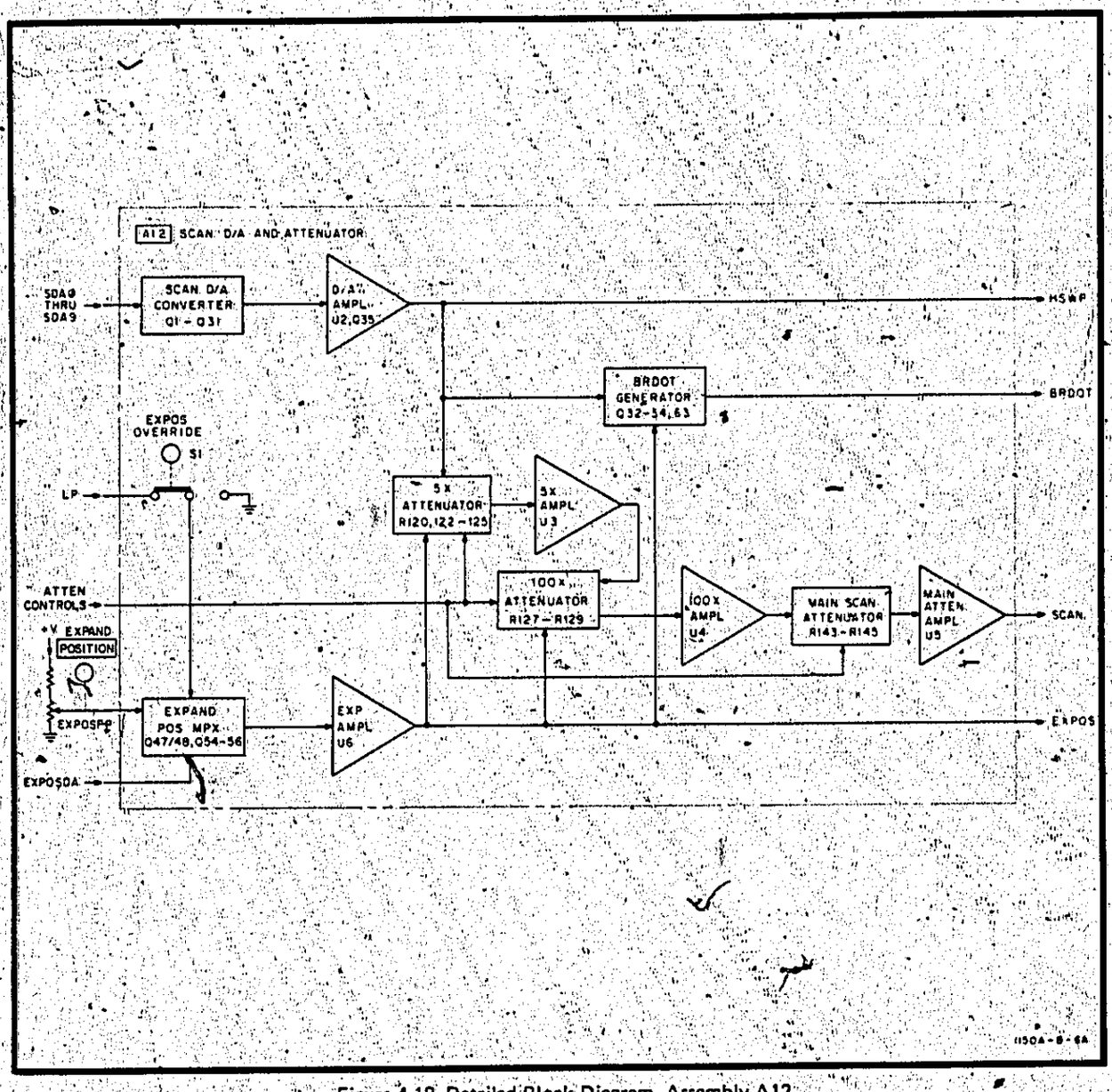


Figure 4-18. Detailed Block Diagram, Assembly A12

4-63. DIGITAL SCAN ASSEMBLY A13. (See figure 4-19.)

4-64. The digital scan assembly contains a digital counter and other circuitry that produces scan D/A information for assembly A12. The scanner is operated in one of three modes: free-running, stepped by the computer, or positioned to a certain point by the computer. The scanner is free-running when the instrument is operated locally. In remote operation, the computer steps the counter by initiating each sample. This is the normal operating method for remote operation. In addition to the normal method of operation, the computer can position the scanner to any point on a given display in order to take a specific sample.

4-65. VERTICAL ATTENUATOR ASSEMBLY A14. (See figure 4-20.)

4-66. Depending upon the mode of operation (Local-Program), the vertical attenuator accepts information from front-panel controls or the computer. POSITION information is applied to a voltage-adjust circuit where the level is changed (proportionally) to that required by Sampling Assemblies A22 and A24. Input attenuation data from both front-panel controls and computer are in digital form. The digital word is decoded and applied to one of two attenuation networks (one for each channel). The proper attenuation level is selected and the analog output from the sampler is thereby attenuated.

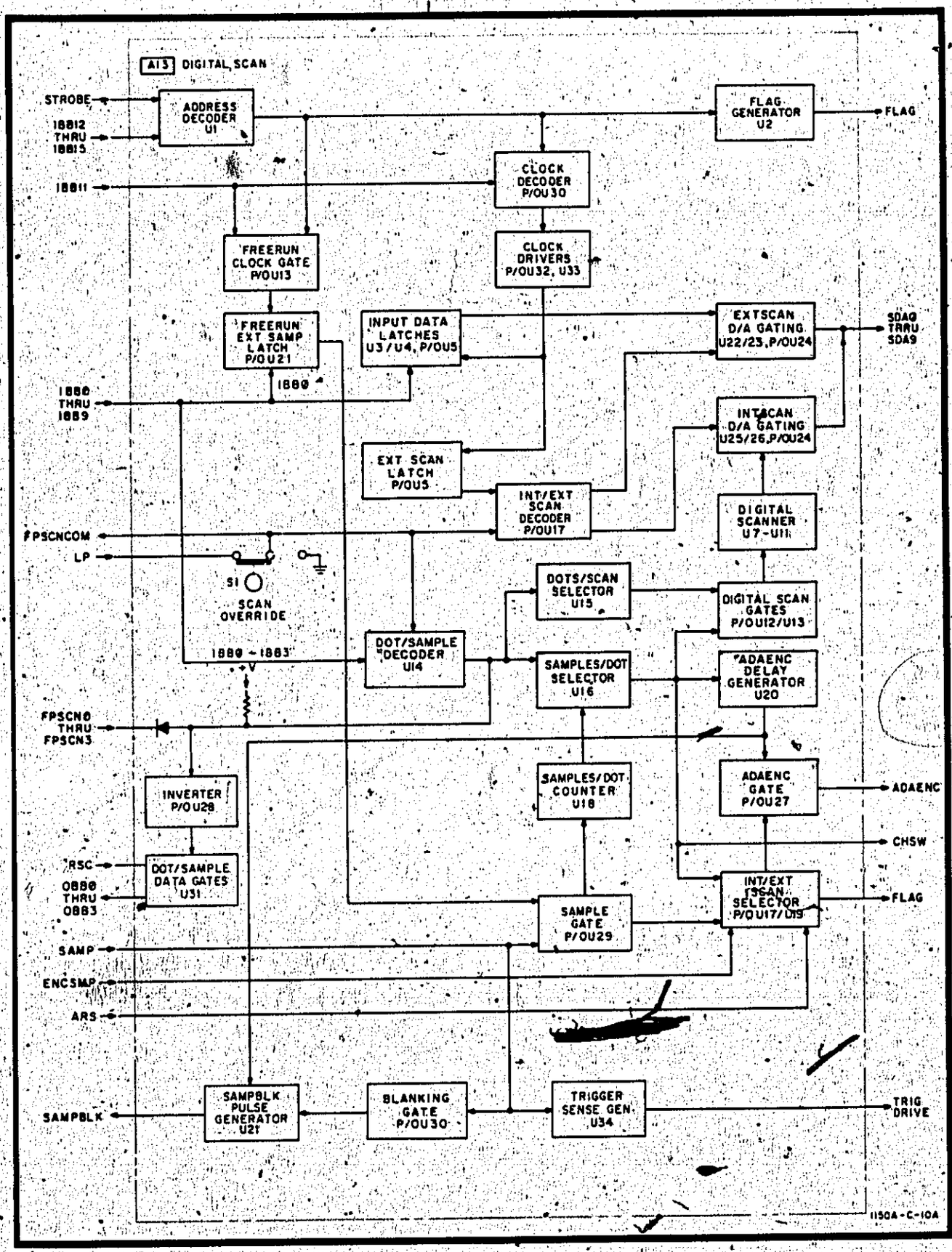


Figure 4-19. Detailed Block Diagram, Assembly A13

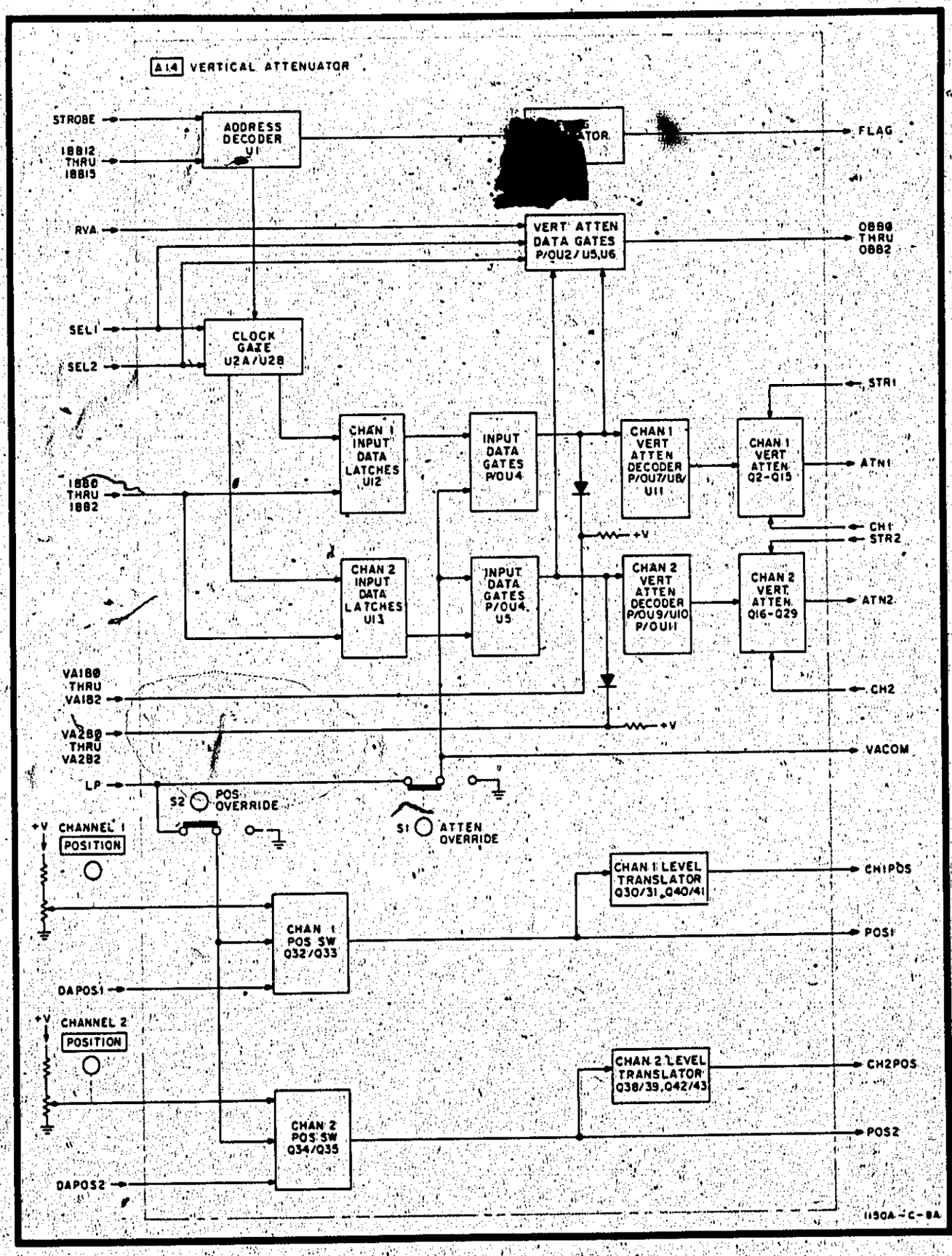


Figure 4-20. Detailed Block Diagram, Assembly A14

4-67. TRIGGER PICKOFF ASSEMBLY A16. (See figure 4-21.)

4-68. Input signals may be connected to CHANNEL 1, CHANNEL 2, or both INPUT connectors on the rear panel of the instrument. The selection of input signal is accomplished by relays. The parallel impedance of the delay line (A31) and trigger pickoff circuit provide a 50-ohm input impedance at either INPUT connector. The trigger pickoff circuit selects an input signal from Channel 1 or Channel 2 (controlled by the front-panel CHANNEL switch), and applies it to Trigger Assembly A23 for internal triggering. The trigger pickoff assembly also contains relays used to switch a calibration signal into the input of Channel 1 or Channel 2 in place of the external signal. These calibration signals are used for automatic calibration of Model 1150A by the computer.

4-69. TIME BASE ASSEMBLY A21. (See figure 4-22.)

4-70. The main element of the timing circuit is the comparator. The pulse output of Trigger Assembly A23 starts a linearly rising ramp (a composite of the scan and fast ramp signal) which drives one input of the timing comparator. The other input to the comparator is a reference level. When the ramp voltage equals the dc reference level, the timing circuit generates a strobe pulse.

4-71. When the trigger pulse from A23 is received, the timing circuit also energizes a holdoff circuit. The holdoff circuit prevents recognition of a new trigger pulse for a period long enough to permit one sampling cycle. The front-panel HOLDOFF control may be adjusted to synchronize the holdoff period with the period of a complex pulse train.

4-72. When triggered, the strobe driver generates a step that is differentiated into a pair of narrow pulses, one positive and the other negative. The narrow pulses (sampling strobe) initiate the taking of one sample in the samplers by gating the diode bridge. Another wider pulse is also generated. This pulse (stretcher gate) turns on the stretcher circuit in the sampling channel and triggers the scan and blanking generators on Digital Scan Assembly A13.

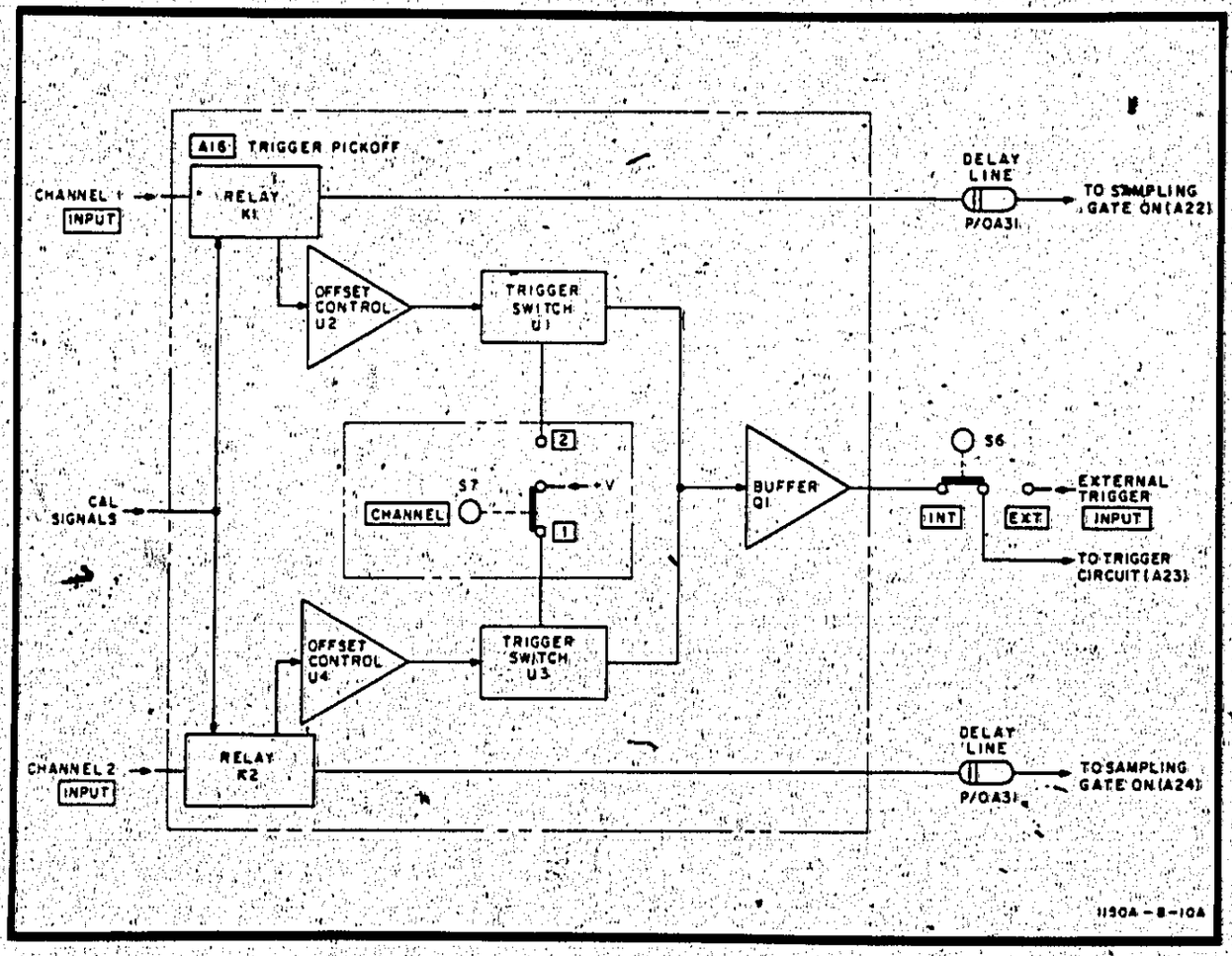


Figure 4-21. Detailed Block Diagram, Assembly A16

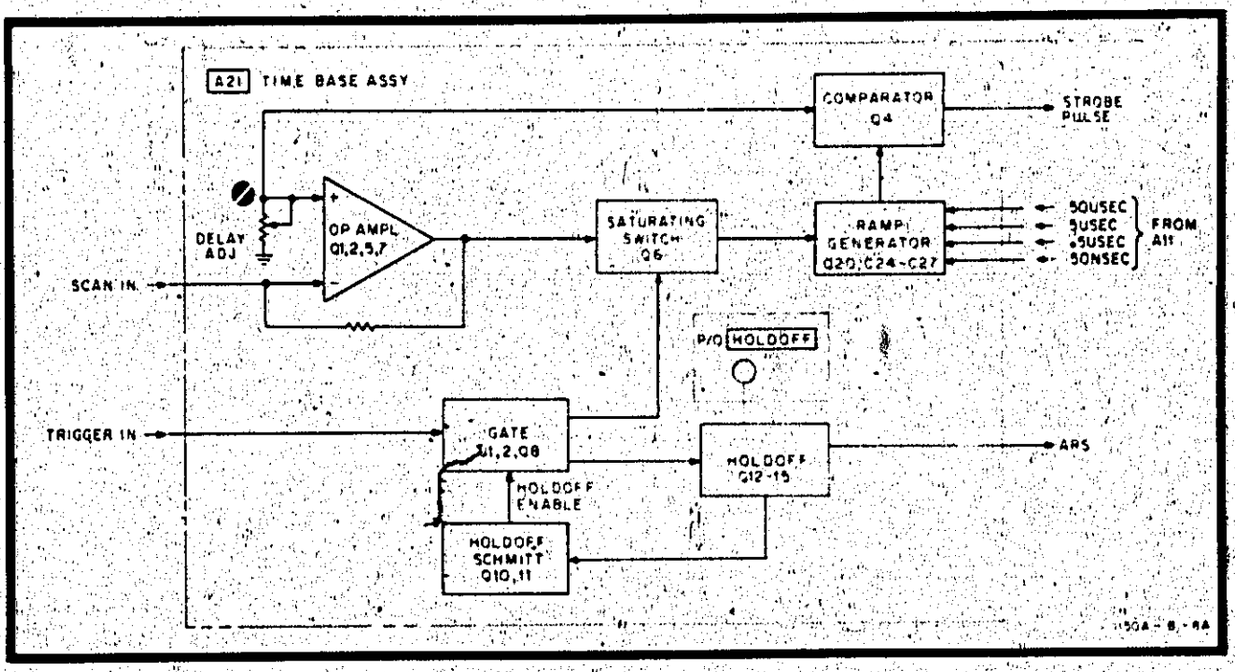


Figure 4-22. Detailed Block Diagram, Assembly A21

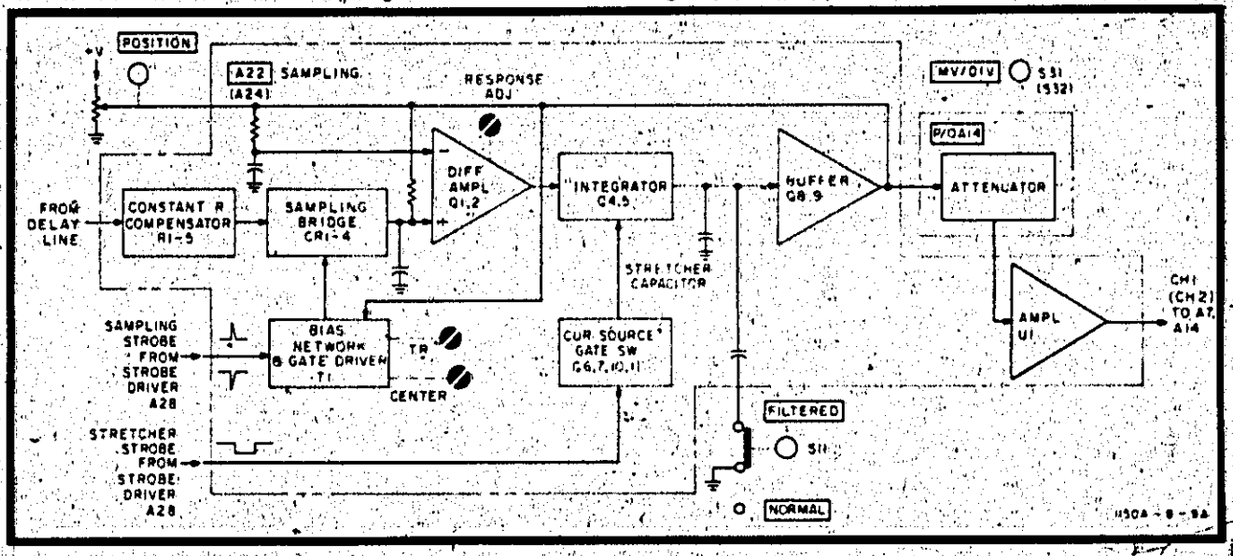


Figure 4-23. Detailed Block Diagram, Assemblies A22 and A24

4-73. SAMPLING ASSEMBLIES A22 AND A24. (See figure 4-23.)

4-74. There are separate sampling assemblies for each channel. The two samplers are identical. A sampling bridge in the sampling circuit is turned on for approximately 350 picoseconds by the sampling strobe from A21. When the sampling gate is turned on, the sampling capacitor charges toward the applied signal from the delay line. The change in charge on the sampling capacitor causes the stretcher output to change by an amount equal to the full signal change between the last sample and the current sample. The new output voltage, equal to the new input voltage, is held constant by the stretcher until the next sample is taken.

4-75. The voltage stored by the stretcher is fed back to charge the input sampling circuit capacitor to the actual input voltage at the time the sample was taken. With this correction, the sampler will respond only to the difference between the signal value stored and the input voltage at the next sampling.

4-76. When the instrument is operated in the FILTERED mode, the amount of change in stretcher output voltage for a given change of input voltage is reduced. This reduces

unwanted noise on the display. The FILTERED mode introduces some distortion of a waveform if the dot density on a transition of the waveform is low.

4-77. TRIGGER ASSEMBLY A23. (See figure 4-24.)

4-78. The INT/EXT trigger switch selects either the trigger pickoff signal or an external trigger signal to drive the trigger circuit. The trigger circuit accepts the waveform from the INT/EXT switch and generates a trigger for the time base assembly. The trigger circuit functions as a bistable or astable threshold detector, depending on the trigger LEVEL control setting. In the bistable mode, the LEVEL control adjusts the point where triggering will occur on the input signal. In the astable mode, the LEVEL control adjusts the frequency of trigger generation for cw countdown triggering.

4-79. In either (+) or (−) slope, the trigger circuit is biased to operate in the bistable mode over most of the range of the LEVEL control. The slope of the input signal on which triggering occurs is selected by choosing either (+) or (−) slope.

4-80. In the CW setting, the trigger circuit is biased for astable operation over most of the range of the LEVEL control. The LEVEL control adjusts the astable frequency of oscillation so that the trigger circuit will be synchronized to an exact subharmonic of the input signal. In CW, there is no control over the trigger slope.

4-81. In AUTO, the bias on the trigger circuit is a ramp. The ramp varies the sensitivity of threshold detection from an initial insensitive state to a final free-running state. If an input signal is present, the sensitivity will be adequate to trigger at some point on the signal. If no input signal is present, triggering will occur when the free-run, astable state is reached. In AUTO, the LEVEL control provides limited selection of the trigger point. The HOLDOFF control adjusts the slope of the bias ramp for automatic triggering on signals with low repetition rates.

4-82. When the instrument is operated in the calibration mode, a trigger relay is energized and a 50-MHz trigger signal is applied to the time base (A21). When the instrument is operated normally, the trigger relay applies the output of the trigger circuit to the time base.

4-83. ANALOG-TO-DIGITAL ASSEMBLY A27.

4-84. The A/D assembly is a high-speed, analog-to-digital converter capable of encoding ±10-volt input signals into 10 binary bits of data. The converter performs two basic functions: it measures the input voltage by comparing it against an internal precision reference voltage, and it converts the measurement into a digital word.

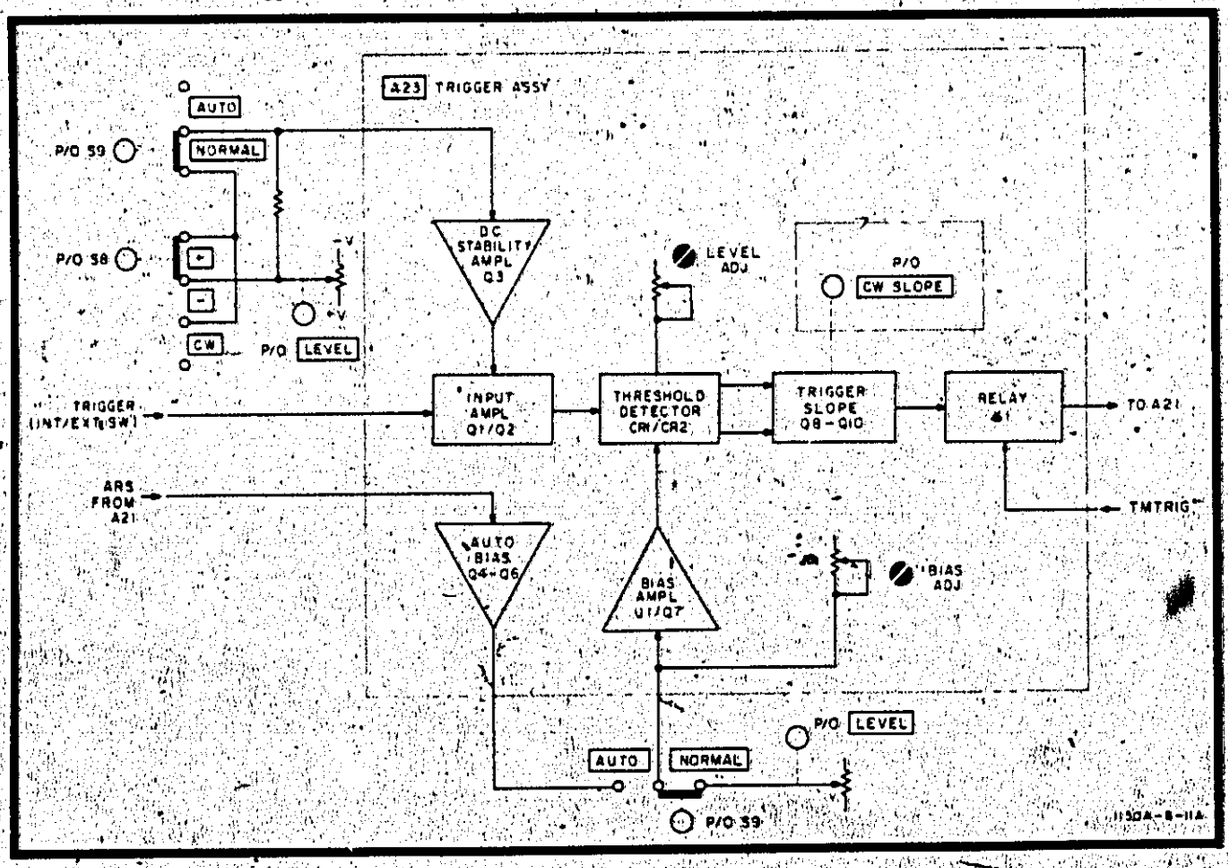


Figure 4-24. Detailed Block Diagram, Assembly A23

4-85. CIRCUIT DETAILS.

4-86. In logic circuitry, it is necessary to establish two voltage levels that represent a logical 1 and a logical 0. These voltage levels are referred to as either the high or low state of the logic circuit. The high state is always more positive than the low state. When using positive logic, the logical 1 is the more positive state (high) and the logical 0 state is the more negative state (low). Negative logic is just the opposite. The logical 1 state is more negative than the logical 0 state. In defining positive or negative logic, the only consideration necessary is whether logical 1 is more positive or more negative than logical 0. This relationship holds regardless of whether or not the two levels are above or below ground (0V).

4-87. Most logic used throughout the instrument is negative logic; that is, logical 0 $\geq$+2.4V, and logical 1 $\leq$+0.4V. However, all gates on the schematics are drawn using standard positive true TTL symbols. The computer interface and both data buses are ground true. One exception is to be noted. The four address bits and the data strobe are positive true. The address bits are inverted on assembly A03 and routed to the appropriate assembly so that all inputs to the address decoder gates are positive for the particular assembly being addressed. To avoid confusion, the terminology high level ($\geq$+2.4V) and low level ($\leq$+0.4V) will be used throughout the following discussion.

4-88. The instrument is primarily a digital system where an understanding of the circuitry organization is far more important than an understanding of circuit details. The circuit theory that follows will refer to functions performed by different integrated circuits (IC) as opposed to tracing each signal through the circuit. Detailed, internal construction and a brief description of IC used in this instrument are given in Section VIII. While reading the following circuit theory, use the schematics in Section VIII as a reference.

4-89. OVERVIEW.

4-90. Certain front-panel controls cannot be programmed. The controls are physically constructed to prevent the operator from inadvertently changing them while in the Program mode of operation. These controls are INT/EXT, CHANNEL, CW/SLOPE, NORMAL/AUTO, HOLDOFF, LEVEL, and NORMAL/FILTERED.

4-91. The computer programs the instrument for Local or Program mode of operation. Disconnecting the interconnect cable from the computer returns the instrument to Local mode of operation. In local mode of operation, the instrument is controlled by front-panel controls.

4-92. When operated locally, the instrument can process waveforms applied to CHANNEL 1 INPUT, CHANNEL 2 INPUT, or both channels simultaneously. When operated remotely by a computer, only one channel can be processed at a time.

4-93. LOCAL/REMOTE CIRCUITS. (See schematics 1 and 2.)

4-94. Local/Remote Assembly A03 serves as a buffer/selector for input data from the computer or front-panel data switches. Integrated circuits, U1 through U4, are the input gates for the 16 front-panel data switches. Integrated circuits U5 through U8 are the input gates for the 16-bit word from the computer. Front-panel MANUAL/REMOTE switch S2 enables one set of input gates while disabling the other set.

4-95. All input gates function identically; therefore, only the remote bit 8 gate will be explained (schematic 1). With front-panel switch S2 in REMOTE, a ground (low) is applied to one input on all remote input NOR gates (U5 through U8). In addition, +5V (high) is applied through load resistor R1 to one input on each local input NOR gate (U1 through U4). A high state applied to one input holds the output of each local input gate low. The presence of REM8 signal on the input line will make U6A (pin 3) low. With both inputs low, the output of U6A will be high. This high is applied to NOR gate U10A. A high applied to either input on a NOR gate holds its output low. A low is applied to buffer/driver U15B (pin 3). The output of U15B (low) is connected to input data bus line IBB8.

4-96. The absence of REM8 on the input line from the computer will apply a high to U6A (pin 3). Since a high applied to either input on the NOR gate will produce a low in its output, a low is applied to U10A (pin 2). A low is also applied to the other input on U10A (pin 3) from local input NOR gate U2A. With both inputs low, the output of U10A is high. The high is applied through buffer/driver U15B to the input data bus line IBB8.

4-97. The outputs of NOR gates U9A, B, C, D (bit 12 through bit 15) are also applied to inverters U13A, B, C, and F where the complements of the bit information on the computer input lines are developed. The complementary bit information is used for the positive logic NAND-gate address decoders on the control assemblies. The outputs of U13 are applied through buffer/drivers to the input data bus lines.

4-98. For the instrument to process data on the input data bus lines, a strobe pulse is required. The strobe pulse and address code (bits 12 through 15) determine which assembly accepts the data. In manual operation, the strobe pulse is initiated by LOAD switch S30. To insert data into the instrument, front-panel data switches (S12 through S27) are set for the desired 16-bit word. No information will enter the instrument until S30 is pressed. Integrated circuits U20 and U21 are gated so that the two signals (MANUAL operation and LOAD) trigger monostable multivibrator U19. The multivibrator produces a 250-nanosecond strobe pulse. The strobe pulse is applied through buffer/driver U18B to the input data strobe bus. In remote operation, the computer supplies a BUFENC signal which initiates the strobe pulse. The two signals (REMOTE operation and BUFENC) are gated through

U20 and U21 to U19. This again results in a 250-nanosecond strobe pulse being developed.

4-99. The strobe pulse is also applied to the base of Q1, causing it to saturate. The output of Q1 is applied through buffer/driver U18A to the IOFLAG line. This signal indicates to the computer that the instrument is busy. In addition, the instrument's FLAG bus is wired-OR to the input of U18A. Whenever an assembly within the instrument is busy, a FLAG signal is generated and routed through U18A to the computer as IOFLAG.

4-100. Resistors R3 through R14 and R35 through R42 are pull-up resistors for the input data bus lines. Resistors R15 through R30 are pull-up resistors for the output data lines.

4-101. CALIBRATION CIRCUIT. (See schematics 3, 4, and 5.)

4-102. Calibrator Assembly A04 is selected by applying the proper assembly address to IBB12 through IBB15 (refer to Section III for address coding). When the proper address is applied to NAND gate decoder U1, the strobe produces a negative pulse at its output (pin 8). This negative pulse accomplishes the following:

a. It triggers Flag Generator U3 which produces a a 6-millisecond FLAG (busy) signal. The busy signal is routed to the computer through assembly A03.

b. It is inverted by U4C and applied as a clock pulse to flip-flops U11A and U11B. The flip-flops store the data that is on IBB10 and IBB11.

c. It is applied to NOR gates U2A and U2B. These gates furnish the clock pulses for latches U8 (all sections), U9 (all sections), and U13A. The latches store the data on IBB0 through IBB6.

4-103. The data on IBB11 causes the instrument to operate in either the calibrate or uncalibrate mode. When calibrate mode is selected, the Q output of U11A (pin 5) is low. This low accomplishes the following:

a. It is applied to NOR gates U2C and U2D. The other input to these NOR gates (SEL1 or SEL2) selects the channel to be calibrated. The output of the selected channel gate (U2C or U2D) switches the appropriate channel relay on Trigger Pickoff Assembly A16 to calibrate position.

b. It is the EXCAL signal to EXTENDER connector J39 (pin 24) on the rear panel of the instrument. The signal is made available for future instruments having more than two channels.

c. It is applied to NAND gate U19C (pin 9). The other input to U19C (pin 10) comes from flip-flop U11B. A low on either input of U19C holds its output (pin 8) high. The high is applied to trigger relay A23K1 on Trigger Assembly A23, deenergizing it. This action connects the TMTRIG signal from the calibrator to Time Base Assembly A21.

d. It is applied to the base of Q1 causing it to saturate. When Q1 conducts, relay K1 energizes. This action switches the output of the vertical calibration section from the rear panel PROBE CAL connector, J42, to Trigger Pickoff Assembly A16.

4-104. The complementary output ($\overline{Q}$) of U11A (pin 6) is applied to NAND gate U6B (pin 4). The other input to U6B (pin 5) is from U11B, indicating vertical or horizontal calibration. A high (+5V) is applied to the third input on U6B. When both pin 4 and pin 5 on U6B are high (indicating horizontal calibration), the output of U6B (pin 6) goes low. This low accomplishes the following:

a. It is the CALMODE signal to Trigger Pickoff Assembly A16. The low causes A16Q2 to conduct. When A16Q2 conducts, calibration relay A16K3 energizes and connects the TM signal (from the horizontal calibration circuit) through either A16K1 or A16K2 to both the trigger pickoff circuit and delay line of the channel being calibrated.

b. It is applied to the base of Q28, turning it off. With Q28 cut off, the 50-MHz, crystal-controlled oscillator is free-running.

4-105. When either pin 4 or pin 5 on U6B is low (indicating vertical calibration or the uncalibrated mode of operation), the output of U6B goes high and accomplishes the following:

a. The high CALMODE signal to assembly A16 turns off A16Q2, causing A16K3 to deenergize. In the deenergized position, A16K3 applies the CALSIG signal from the vertical calibrator to both the trigger pickoff circuit and delay line of the channel being calibrated.

b. It is applied to the base of Q28, turning it on. With Q28 conducting, the 50-MHz, crystal-controlled oscillator is inhibited.

c. It is applied to inverter U4D. The inverted output (low) of U4D is applied to U21A (pin 2), holding its output high. This prevents spurious operation of digital counter U20A.

4-106. The data on IBB10 causes the assembly to function as a vertical or horizontal calibrator. To function as a vertical calibrator, IBB10 must be low. A low on IBB10 accomplishes the following:

a. It is applied to flip-flop U11B (pin 12). Upon receipt of the clock pulse from U4C, the Q output of the flip-flop (pin 9) goes low.

b. It is applied to clock NOR gate U2A (pin 2). The strobe pulse from U1 is applied to the other input on U2A (pin 3). When the strobe pulse is received, U2A

furnishes the clock pulse for bistable latches U8 (all sections), U9A, and U9B. Upon receipt of the clock pulse, data present on IBB0 through IBB6 are transferred to the Q outputs of these latches.

c. It is applied through inverter U4B to clock NOR gate U2B (pin 5), disabling it. This prevents U2B from generating a clock pulse to latches U9C and U9D.

d. The complementary output (high for vertical calibration) of U11B (pin 8) is connected to U17 (pins 6 and 7). This forces the output of U17 (pin 12) to a high state. This high enables NAND gate U12C (pin 9), allowing vertical CALTRIG signal to pass from U12B to Q30.

e. The $\overline{Q}$ output of U11B is also applied to NAND gate U12B (pin 5). U12A, U12B, and U12D form a free-running multivibrator whose period is fixed by C14. The output of the multivibrator U12B (pin 6) is applied to U12C (pin 10). Since U12C has been enabled by U17, its output is the square wave output of the multivibrator. The square wave signal is applied to the base of Q30. The output of Q30 is the TMTRIG signal (refer to subparagraph 4-102c for TMTRIG signal routing). The TMTRIG signal ensures that the sampler runs when the calibrator is in vertical calibration mode of operation.

4-107. The output of U11B (pin 9) in VERT CAL is low and is applied to NAND gates U6B and U19C. (Refer to paragraph 4-105 for U6B operation. Refer to subparagraph 4-103c for U19C operation.)

4-108. When functioning as a vertical calibrator, data on IBB0 through IBB3 program the polarity and number of CRT screen divisions selected. The clock pulse from U2A (pin 1) stores the information in bistable latches U9A, U9B, U8A, and U8B. The complementary output ($\overline{Q}$) of U8B is applied to the base of Q2. A positive polarity (+) indication on IBB3 will result in a low being applied to the base of Q2, turning it on. When Q2 conducts, it forward biases Q7. The operation of Q3, Q4, and Q6 is the same as for Q2 except that the inputs to their respective bases are the Q output from latches U9A, U8B, and U8A. A low on IBB0 through IBB2 will bias Q3, Q4, and Q6 into conduction.

4-109. Transistors Q2 through Q10, amplifier U15, and transistor Q25 form a bipolar digital-to-analog converter circuit. When Q2 conducts, it turns on Q7; when Q3 conducts, it turns on Q8. Q4 and Q6 function identically for Q9 and Q10, respectively. The collector circuits of Q7 through Q10 have weighted-value load resistors. The outputs of Q7 through Q10 are applied to amplifier U15 (pin 2) which sums the separate outputs from the transistors. The output of U15 (pin 6) is applied to the base of emitter-follower Q25. Conduction through Q25 will increase or decrease until the current, fed back through R65 to the (−) input of the amplifier (pin 2), balances the weighted currents from transistors Q7 through Q10. The voltage developed in the emitter circuit of Q25 serves as a voltage source for attenuator network R58 through R64. Operation of the attenuator network is discussed in paragraph 4-112. In reference to the overall digital-to-analog circuit, Q5 serves as a constant voltage source for control transistors Q2, Q3, Q4, and Q6.

4-110. A three-bit digital code is used to program the required attenuation level (refer to Section III for attenuation coding). The code is applied to the Calibrator on input data bus lines IBB4 through IBB6. There are seven levels of attenuation covering a voltage range of 2 millivolts/division to 200 millivolts/division. When the clock pulse from U2A is applied to input latches U8C and U8D, and flip-flop U13A; the data on IBB4, IBB5, and IBB6 are transferred to the Q outputs of the above latches and flip-flop. Both outputs (Q and $\overline{Q}$) from these integrated circuits are applied to a decoding circuit. The decoding circuit consists of NAND gates U5A, B, D, U6A, U7A, B, and C. The signal from this decoder selects the proper attenuation level.

4-111. The signal developed for the desired attenuation is a low state at the output of one of the above NAND gates. All other NAND-gate outputs are high. The output of each NAND gate is applied to the biasing network of an associated control transistor, Q11 through Q17. When a low state is applied to a particular biasing network, the transistor associated with that network will turn off. Under normal operating conditions, Q11 through Q17 are conducting. For example, if the output of NAND gate U7C (pin 8) is low, the junction between R29 and R30 is grounded for all practical purposes ($\leq$+0.4 volt). This results in reverse bias being applied to the base of Q12, turning it off.

4-112. The output (collector) of each control transistor is applied to the base of an associated field-effect transistor (FET), Q18 through Q24. Each FET is connected between a tap on attenuator network R58 through R64 and the input to operational amplifier U14 (pin 3). When a control transistor is conducting, −12.6V is applied to the gate of its associated FET. This bias on the gate of the FET prevents it from conducting. When a control transistor is not conducting, the bias applied to the gate of the FET is the calibrated output signal from an emitter-follower (Q26 or Q27). The FET conducts and, depending upon its connection to the attenuation network, transfers the voltage from divider R58 through R64 to the input of U14 (pin 3). FET transistors are used because of their high input impedance. When conducting, they do not load the attenuation network which could result in an erroneous output.

4-113. Operational amplifier U14 is a unity-gain amplifier. Its output is applied to the bases of emitter followers Q26 and Q27. Depending upon the polarity of the output from U14, either Q26 or Q27 conducts. The emitter output of the conducting transistor is applied through contacts on relay K1 to either the PROBE CAL connector, J42, on the rear panel of the instrument or to Trigger Pickoff Assembly A16. The calibration signal is monitored on assembly A16 and fed back to the calibrator as the CALSENSE signal. CALSENSE is applied to

amplifier UT4 (pin 2). This feedback signal compensates for any IR drop in the CALSIG circuitry.

4-114. When the data on IBB10 is high, the assembly functions as a horizontal calibrator. A high on IBB10 accomplishes the following:

a. It is applied to clock NOR gate U2A (pin 2). The output of U2A is held low, preventing a clock pulse from being generated to input latches U8 (all sections), U9A, U9B, and flip-flop U13A.

b. It is applied to inverter U4B (pin 3). The output of the inverter is connected to clock NOR gate U2B (pin 5). On receipt of the strobe pulse from U1, a clock pulse is generated by U2B which is applied to latches U9C and U9D. Data on IBB0 and IBB1 are stored in these latches.

c. It is stored in the Q output of flip-flop U11B (upon receipt of the clock pulse). The high from U11B (pin 9) is applied to NAND gate U6B. Since all inputs to U6B are high (HORIZ CAL), its output (pin 6) is low. The CAL-MODE signal is applied to the control circuit of relay A16K3 on assembly A16. The relay energizes and removes the vertical calibration signal (CALSIG) from the trigger pickoff circuitry and connects the TM signal.

4-115. Data on IBB0 and IBB1 determine the selected sweep speed (refer to Section III for coding). Upon receipt of a clock pulse, the data on IBB0 and IBB1 are stored in the output of latches U9C and U9D. Both outputs of the latches (Q and $\overline{Q}$) are applied to a decoding section consisting of NOR gates U16A, B, C, and D. The outputs of the NOR gates are applied to separate NAND gates in a sweep selector circuit consisting of U19A, B, D, and U21D.

4-116. In calibrate mode of operation, the 50-MHz, crystal-controlled oscillator is free-running (subparagraph 4-104b). Output from oscillator Q29 is applied to a shaping circuit consisting of NAND gates U21A and U21B. The pulse train at the output of U21B (pin 6) has a pulse repetition period of 20 nanoseconds. This pulse train accomplishes the following:

a. It is applied to NAND gate U21D (pin 12). The other input to U21D (pin 13) comes from 20-nanosecond decoder U16A. When 20-nanosecond sweep is selected, the output of U21D will be the pulse train applied to pin 12. The output of U21D is applied through NAND gate U21C to furnish the TM calibration signal. The TM signal is routed through relay A16K3 to the trigger pickoff circuit (schematic 30).

b. It is applied as clock pulses to J-K type flip-flop U20A. Flip-Flops U20A, B, U10A, and B are interconnected to form a decade counter.

4-117. The output of the decade counter is a pulse train with a pulse repetition period 0.2 microsecond. The output of the counter (U10A, pin 6) accomplishes the following:

a. It is applied to NAND gate U19B (pin 5). The other input to U19B (pin 4) comes from 0.2-microsecond decoder U16D. When 0.2-microsecond sweep is selected, the output of U19B will be the pulse train applied to pin 5. Output from U19B is gated through NAND gate U6C, inverter U4A, and NAND gate U21C to furnish the TM calibration signal.

b. It is applied to decade counter U18 (pin 1). (Refer to paragraph 4-118.)

4-118. The output of decade counter U18 (pin 12) is a pulse train with a pulse repetition period of 2 microseconds. The pulse train accomplishes the following:

a. It is applied to NAND gate U19A (pin 2). The other input to U19A (pin 1) comes from 2-microsecond decoder U16C. When 2-microsecond sweep is selected, the output of U19A will be the pulse train applied to pin 2. Output from U19A is applied through NAND gate U6C, inverter U4A, and NAND gate U21C to furnish the TM calibration signal.

b. It is applied to decade counter U17 (pin 1). (Refer to paragraph 4-119.)

4-119. The output of decade counter U17 (pin 12) is a pulse train with a pulse repetition period of 20 microseconds. The pulse train accomplishes the following:

a. It is applied to NAND gate U19D (pin 12). The other input to U19D (pin 13) comes from 20-microsecond decoder U16B. When 20-microsecond sweep is selected, the output of U19D will be the pulse train applied to pin 12. Output from U19D is applied through NAND gate U6C, inverter U4A, and NAND gate U21C to furnish the TM calibration signal.

b. It is applied through NAND gate U12C to the base of transistor Q30. U12C is enabled in the horizontal calibration mode of operation. The output (collector) of Q30 is a pulse train with a pulse repetition period of 20-microseconds. The pulse train is applied through network R92/C25 to Trigger Assembly A23 as the TMTRIG calibration signal.

4-120. TRIGGER PICKOFF. (See schematic 30.)

4-121. Trigger Pickoff Assembly A16 selects the trigger source that is used for internal triggering (Channel 1 or Channel 2 input signal). The trigger pickoff amplifier obtains a portion of the input signal current at the input to the delay line, amplifies it, and sends it to front-panel INT/EXT switch S6 as the internal trigger signal. External triggering occurs when switch S6 is in EXT position and a signal is applied to TRIGGER INPUT connector J40 on the rear panel of the instrument.

4-122. Since the two trigger pickoff circuits are the same, only Channel 1 will be discussed. Rear-panel Channel 1 INPUT connector J46 provides a 50-ohm termination which is derived from the parallel impedances of delay line A31DL1 and pickoff resistor R9.

4-123. Channel 1 calibration relay (K1) is energized to connect the Channel 1 signal to the input circuitry. For the computer to switch to the calibration signal, a high appears as the CH1REL signal, turning off Q3 and deenergizing K1.

4-124. Trigger switch U1 is composed of common-base amplifiers U1Q1 and U1Q2 and electronic switch U1CR2. To trigger on the Channel 1 signal, U1 (pin 13) is open circuited by front-panel trigger channel switch S7. (In Channel 1 position, S7 connects +5 volts to the Channel 2 electronic switch U3, pin 3. This prevents the Channel 2 signal from being applied to the trigger circuit.) Signal current from R9 and bias current from R8 flow through U1Q1 and U1Q2 to load resistors R17 and R18 (through peaking inductor L3), and to the base of buffer Q1. When triggering on Channel 2, Channel 1 signal is shut off because U1CR2 is forward biased by +5 volts (from S7) being applied to its anode. This shunts the input signal and bias currents in Channel 1 through U1CR2 to the +5-volt power supply.

4-125. Operational amplifier U2 is connected as a feedback amplifier with the base-emitter junction of U1Q1 and R10 as the feedback path. Amplifier U2 is used to maintain the bias on U1Q1 so that the voltage on its emitter (pin 6) is always 0V. The gain of U2 is very large. Due to the feedback loop, its output voltage (pin 6) forces the voltage at U1 (pin 6) to nearly equal that at U2 (pin 3). Bias current from R15 keeps U1CR1 conducting at the proper level to allow U2 to operate within its dynamic range.

4-126. Transistor Q1 provides buffering between the trigger switch (U1 or U3) and the trigger circuit input to assembly A23. The signal in the emitter of Q1 follows the signal applied to the selected channel INPUT connector. This trigger signal is selected by front-panel INT/EXT switch S6.

4-127. TRIGGER CIRCUITRY. (See schematic 35.)

4-128. The main feature of the trigger circuit is a threshold detector consisting of tunnel diodes CR1 and CR2. The bias circuit for these diodes consists of U1/Q7, R31, R32, R34, and R35. Current through R31 and R35 is approximately equal and this establishes the bias applied to the bridge circuit. The resistances of R32 and R34 are such that most of the bias current flows through them. The value of current flow between the two resistors will vary, depending upon the unbalanced condition of the bridge circuit. For example: when tunnel diode CR1 is operating in its high voltage state, most of the bias current flows through R32 with only a small portion of the current flowing through CR1. This produces an unbalance situation across the bridge circuit and current will flow through L5 and R33.

4-129. The voltage applied across the bridge circuit diodes (CR1 and CR2) is approximately 550 millivolts. Normally one diode is operating in its high voltage state while the other diode is operating in its low voltage state. The voltage drop across the high voltage state diode is approximately 450 millivolts and the drop across the low voltage state diode is approximately 100 millivolts. Current is either applied to or drained from the junction of CR1 and CR2 to switch operating states of the diodes. For example: if CR1 is operating in its high voltage state, then CR2 is operating in its low voltage state. Additional current applied to the junction of CR1 and CR2 will result in CR2 switching to its high voltage state. Due to minute stray inductance in the bridge circuit, CR1 momentarily remains in its high voltage state and the voltage drop across both CR1 and CR2 now becomes approximately 900 millivolts. Since the voltage applied to the bridge circuit is from a constant voltage source (U1/Q7), the increased voltage drop results in a decrease in current flow through the tunnel diodes. When the valley current point on the E-I operating curve of CR1 is reached, CR1 switches to its low voltage operating state. The direction of current flow into the bridge at the junction of CR1 and CR2 always ensures that the diode originally in the high voltage state is the diode that reaches the valley current point on its E-I operating curve first; therefore, it will switch to its low voltage state before the other diode can reach its valley current point.

4-130. In the absence of a trigger signal from INT/EXT switch S6, current through Q1 and Q2 is stabilized at some value as determined by stability amplifier Q3. With Q1 conducting, current is applied to the junction of CR1 and CR2. Under this condition, CR1 is in its high voltage state and CR2 is in its low voltage state. When a trigger signal is received, it is ac coupled to the base of Q2, changing its conduction. An increase in conduction through Q2 decreases the conduction through Q1. When conduction through Q1 decreases, current is no longer applied to the junction of CR1 and CR2. Instead, current is drained from the junction of the diodes by LEVEL ADJ network R23, R24, and R25. The additional current drained from the junction of CR1 and CR2 will switch CR2 to its high voltage state. The offset current from LEVEL ADJ (R25) shifts the hysteresis band up or down on the input signal without changing the trigger sensitivity (figure 4-25). To vary the trigger point on the input signal, the offset current from Q1 is varied through Q3 by changing front-panel LEVEL control R1A.

4-131. The trigger sensitivity, smallest signal that the threshold detector will recognize, is equal to the width of the hysteresis band. Trigger sensitivity is controlled by the bias current from U1/Q7. The greater the bias current, the smaller the hysteresis band and the greater the trigger sensitivity. If the bias current is increased beyond that required for zero hysteresis, the threshold detector begins to oscillate at a frequency determined by the time constant of L5 and R33 and the bias current supplied. This mode provides a trigger countdown.

4-132. When the bridge is oscillating, it will count down to trigger on an incoming signal. To trigger on frequencies above 15 to 30 MHz, the bridge is forced to oscillate at some harmonic of the incoming signal. This is accomplished by using the incoming signal to pulse current into and out of the bridge circuit.

4-133. The bridge bias current is determined by the voltage applied to U1 (pin 3). When NORMAL/AUTO switch

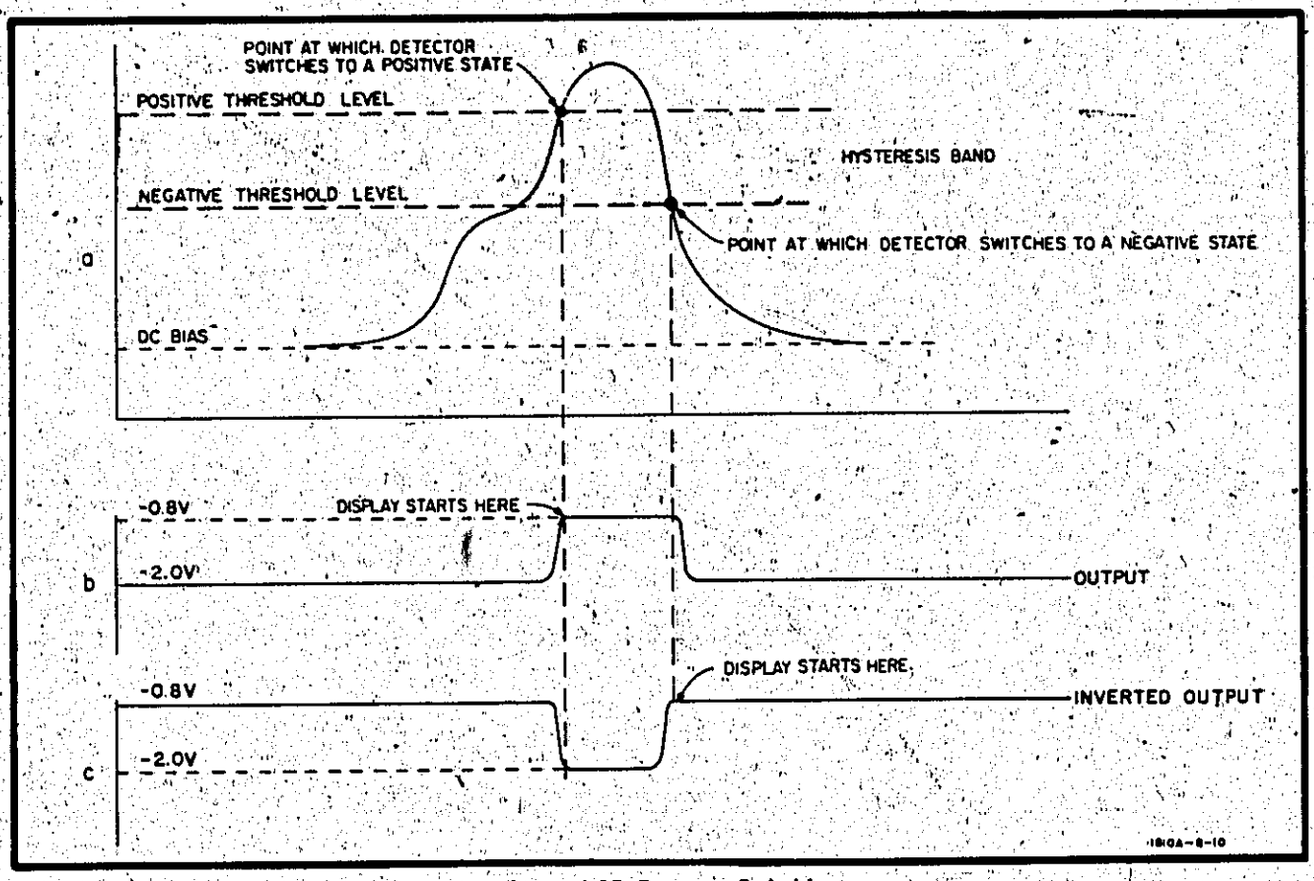


Figure 4-25. Detector Switching

S9 is in NORMAL position, this voltage is supplied by voltage divider network R45, R46, and R18 in conjunction with VR2, R28, and R29.

4-134. When CW SLOPE switch S8 is in CW position, current from R44 is connected to divider R45/R46 to shift the voltage applied to U1 (pin 3). The additional current supplied to the bridge by U1 increases the region of trigger oscillation so that it covers almost the entire range of the trigger level control, increasing trigger sensitivity.

4-135. When NORMAL/AUTO switch is in AUTO, the threshold detector will trigger on a wide variety of input signals without readjustment. Bias current is controlled by auto bias generator Q4 through Q6. The auto bias generator develops a voltage ramp and supplies it to U1 (pin 3). The bias ramp starts with low bridge current at the end of each sampling cycle and rises toward a final current large enough to cause the threshold detector to oscillate. If an input signal is present, the threshold detector will become sensitive enough to trigger on the input signal at some intermediate value of bias current. If no input signal is present, a baseline will appear when oscillation occurs.

4-136. The auto bias generator consists of asymetrical differential amplifier Q4 and Q5 and reset switch Q6. Initially Q6 is saturated and holds the base of Q5 at 0 volt. The base of Q4 is held at −3.5V by VR1, and all current through R17 flows through R16 and Q4. This current flows into the junction of R18 and R19, reducing the negative voltage to U1. At the end of each sampling cycle, Q6 is unsaturated, and the base voltage of Q5 and C13 charges toward the base voltage of Q4. The rate of charge is adjusted by HOLDOFF control R2A in order to stabilize triggering on signals with low repetition rates.

4-137. If a trigger does not occur, the base voltage of Q4 becomes equal to the base voltage of Q5. When the bias voltage of Q4 and Q5 are equal, all of the emitter current flows through Q5. All of the current from R29 flows into R18 and R19. This increases the negative voltage on U1 sufficiently to make the threshold detector oscillate, starting the next sampling cycle.

4-138. The signal into the threshold detector bridge comes from input amplifier Q1/Q2. The total current flowing in Q1 and Q2 is established by R3 and R4. Amplifier Q3 compares the voltage at the collector of Q2, proportional to Q1/Q2 current, with the reference voltage on the wiper of LEVEL potentiometer R1A. Amplifier Q3A controls the voltage on the base of Q1. Transistor Q1 controls the current through Q2 to obtain stable quiescent current values as established by the LEVEL control.

4-139. Transistor Q3B operates as described when it has a base voltage of from −4.3V to −8.3V, midrange of R1A. When the base voltage is outside this range, Q3B is either saturated or cut off and the voltage on the base of Q1 is controlled by the state of Q3A. Either Q1 or Q2 is cut off and all of the emitter current flows through the

conducting transistor. In this state, the input voltage applied to the base of Q2 must nearly equal the voltage on the base of Q1 to change the threshold detector current.

4-140. When NORMAL/AUTO switch is in AUTO, or CW SLOPE switch is in CW, R12 is switched in series with R1A to restrict its range of control. In CW, trigger LEVEL sensitivity is decreased for better sine-wave triggering. In AUTO, this restriction ensures that a baseline will always be displayed in the absence of an input signal.

4-141. Slope switching is accomplished by selecting either the noninverting output of Q8 or the inverting output of Q9. When +SLOPE is selected, the junction of R39 and R41 is connected to +5V. This forward biases CR7 and reverse biases CR6 so that the current output from Q9 is absorbed in the +5V power supply. At the same time, Q10 is cut off by +5V through R41. Current from R42 reverse biases CR5 which forward biases CR4, connecting Q8 to supply the trigger pulse. The trigger pulse is routed through relay K1 to the time base circuitry on A21.

4-142. When the SLOPE switch is set to (−), voltage across R43 saturates Q10. This forward biases CR5 and reverse biases CR4. Current through R43 reverse biases CR7, forward biasing CR6 to supply the signal from Q9 as the trigger pulse. Relay K1 is used to switch in a trigger signal from Calibrator Assembly A04 when the instrument is operating in calibrate mode. The calibrator generates a high level TRIGREL signal at pin E. A high shuts off Q11 which deenergizes K1 and switches in the calibration signal.

4-143. TIMING CIRCUITRY. (See schematics 32 and 33.)

4-144. Time Base Assembly A21 consists of the strobe generator, timing ramp, comparator, and holdoff circuits. The circuits that make up the comparator and timing circuit are described first.

4-145. Comparator Q4A and Q4B compares the reference level established at the emitter of Q3 with the ramp generated by timing capacitors C24 through C27 and current source Q20. Only one timing capacitor is used at a time. To select C24, J35 (pin 13) is grounded (low) by the time/division decoding that takes place on Scan Attenuator Decoder Assembly A11. Grounding the base of Q16 causes it to saturate. Transistor Q16 supplies current to forward bias diodes CR16 and CR17, effectively grounding one end of C24. Since Q17, Q18, and Q19 are shut off, diodes CR18 through CR23 are reverse biased by VR4, removing C25 through C27 from the timing circuit. Clamp VR2, R16, and CR3 limit the timing ramp to about +13V.

4-146. The timing ramp is reset by saturating switch Q6. During the reset cycle, Q8 is cut off and Q6 is saturated by current through R32. Through Q6, the timing ramp is reset to the SCAN voltage level established by operational amplifier Q1, Q2, Q5, and Q7.

4-147. The operational amplifier consists of differential amplifier Q1, common-emitter amplifier Q2, and emitter followers Q5 and Q7. The base of Q1A is the negative input and the base of Q1B is the positive input. Emitter follower Q5 absorbs the timing-ramp charging current from Q20 when Q6 is saturated. Emitter follower Q7 absorbs the excess turn-off current from Q8 when Q6 is turned off.

4-148. The resistances in the bases of Q1A and Q1B are chosen to make the gain equal into either input of the operational amplifier. This makes the output voltage at the emitter of Q5 equal to the difference between the SCAN signal and the reference voltage at the emitter of Q3. DELAY R8 adjusts the dc offset voltage of the amplifier so as to begin sampling with minimum scan voltage.

4-149. The trigger recognition circuitry consists of arming latch U1B and gate latch U2B. The holdoff circuit supplies either −3V (low) or −0.8V (high) to U1B (pin 9). When the holdoff circuit applies a low to pin 9, U1B is armed. When the next trigger pulse (low) appears through diode CR5, the output of U1B (pin 13) becomes low. Feedback through CR6 and CR7 keeps U1B latched in this state as long as a low remains on pin 9. While latched, CR5 is reverse biased and prevents U1B from receiving additional triggers. Gate U2A supplies bias to U1B when it is not latched.

4-150. Gate latch U2B operates the same as U1B except that U1A and U1B provide the logic inputs. This arrangement allows U1B to arm U2B after the holdoff period and as soon as the trigger pulse becomes low. Gate U1A inverts the trigger pulse to supply a high to U2B when the trigger pulse becomes low. A high prevents U2B from switching low at this time. When the trigger pulse switches back to a high state, U2B switches low since all inputs are now low. This causes the timing ramp to start on the positive-going transition of the trigger pulse.

4-151. The outputs of U2B control the operation of current switch Q8/Q9. When Q8 turns on, Q6 cuts off, starting the fast ramp from C24 through C27. In addition, U2B controls the holdoff circuits. When Q9 turns off, Q12 turns on and starts the holdoff cycle. When Q12 turns on, it cuts off Q13, allowing C16 through C19 to begin charging positive from current supplied by Q14. While C16 is charging, the timing ramp rises to the compare level in Q4B and a sample is taken.

4-152. When the charge on C16 reaches the positive threshold of Q10 and Q11, the Schmitt trigger changes states, applying a high to U1B (pin 9). This resets both U1B and U2B. When U2B resets, Q8 turns off and Q9 turns on. This action turns off Q12 and turns on Q13. Current through Q13 is greater than that through Q14 so C16 charges in the negative direction. The slope of this negative ramp can be controlled by HOLDOFF control R2B to allow selection of the length of the holdoff period. When the voltage on C16 reaches the negative threshold of Q10 and Q11, the Schmitt trigger changes

state, applying a low to pin 9 of U1B arming it to accept the next trigger, and the ramp/holdoff cycle is complete.

4-153. When slower timing ramps are selected, C17 through C19 are switched in parallel with C16 to lengthen the holdoff period proportionately. They are selected in the same way that the timing capacitors are selected (paragraph 4-145). When Q10 and Q11 reset, Q15 sends a signal (ARS) to the circuitry shown on schematic 35 to reset the auto-bias ramp in the trigger circuit. This signal also goes to the digital scanner circuit to clock the flag flip-flop U19A on its negative transition.

4-154. The strobe driver circuit consists of Q21 through Q23 (schematic 33). In the quiescent state, regenerative pair Q21 and Q22 are cut off by the positive voltage through R74 and the negative voltage through R82. Transistor Q23 is cut off by grounding its base through R77. The emitter of Q21 is clamped at −20V by CR25 and VR5. The emitter of Q22 is at +15 volts. Step-recovery diode A28CR1 is conducting through R84 and holding a stored charge.

4-155. The strobe pulse drives Q21 and Q22 into saturation by regenerative feedback. The regenerative pair remains saturated until the timing ramp is reset. They are returned to the nonconducting state by the bias across R74.

4-156. When Q21 turns on, the emitter develops a strong, fast-rising, positive-going step. Capacitor C35 and resistor R84 differentiate the step. The differentiated pulse is coupled through balun transformer A28T1. The secondary develops the complement of the pulses. The pulse pair reverse biases A28CR1. Diode A28CR1 continues to conduct for about 6 nanoseconds due to the charge stored during its conduction period. When the charge has been depleted, A28CR1 cuts off suddenly, generating a pair of complementary square waves on its cathode and anode. These square waves are differentiated by A28C1 through A28C8 to obtain 350-picosecond wide complementary pulses. The pair of complementary pulses (sampling strobe) are applied to the sampling gate diodes in both channels by way of A28W1 and A28W2.

4-157. When Q21 and Q22 turn on, the transistion on the collector of Q22 is coupled through C33 to the base of Q23. Transistor Q23 generates a negative pulse of approximately 1.5-microsecond duration (SAMP) to gate the stretcher circuits and trigger the scan generator.

4-158. DIGITAL SCANNER. (See schematics 23, 24, and 25.)

4-159. Digital Scan Assembly A13 contains circuitry to control the scan and also circuitry to determine the mode of sampler control. Each of these functions has two modes of operation: the scan can operate in either INTERNAL or EXTERNAL mode and the sampler can operate in either FREERUN or EXTERNAL CONTROL mode. Both functions are programmable according to the coding shown in table 8-11. All combinations of the two parameters are permissible; however, EXTERNAL sampler mode must be used any time that data is being transferred to the computer. A further explanation of the INTERNAL and EXTERNAL scan is as follows:

a. INTERNAL scan and FREERUN sampler is the normal mode of operation. This provides standard sampling oscilloscope performance. If INTERNAL scan and EXTERNAL sampler mode is chosen, the scan is stepped across the screen by an internal counter but the steps occur only upon receipt of sample commands (which arm the trigger circuit) from the computer by way of assembly A07.

b. EXTERNAL scan is used for complete computer control of the scan operation. IBB0 through IBB9 of the EXTERNAL scan control word determine where in equivalent time (0 to 10 divisions) a sample will be taken. In EXTERNAL scan and EXTERNAL sampler, the computer must furnish sample commands to arm the trigger circuit.

4-160. When the assembly is addressed by the computer (or front-panel switches) and a strobe pulse is received, the negative pulse output of address decoder U1 (pin 8) is applied to Flag Generator U2 (pin 3). The output of U2 (pin 6) is connected to both inputs on NAND gate U30D. The output of U30D (a 5-microsecond pulse) is the busy signal applied to the FLAG bus. NAND gates U30D and U16C have their outputs wired-OR. (Refer to subparagraph 4-178b for operation of U16C.)

4-161. The logic level on IBB11 and IBB10 select either internal or external scan, and, along with IBB0, determine either freerun or externally controlled sampler operation. IBB11 is connected through J32 (pin U) to NOR gate U13D (pin 11). It is also connected to NAND gate U30A (pin 2). A high state on IBB11 accomplishes the following:

a. NAND gate U30A (pin 2) is high. Upon receipt of the strobe pulse from U1, the output of inverter U28D (pin 9) goes high. With both inputs on U30A high, the clock circuits for input latches U3 (all sections), U4 (all sections), U5A, C, and D are strobed with a positive pulse which causes the latches to transfer the information on input data bus lines IBB0 through IBB10 to their output circuits. Then, depending upon the state of IBB10, bits IBB0 through IBB9 will be interpreted either as SAMPLES/DOT and DOTS/SCAN data for IBB10 high, or as SCAN position data for IBB10 low.

b. A low state on NOR gate U13D (pin 11), indicating a SAMPLER control word, and the negative pulse from U1 (pin 8) produces a positive-going pulse at the output of U13D (pin 13). The output pulse is applied as a clock signal to flip-flop U21A. Input data to the flip-flop is from IBB0. When IBB0 is high (indicating freerun sampler operation), the clock signal from U13D triggers the flip-flop and transfers the information to its output circuit. The complementary output ($\overline{Q}$) is low. The Q output is

connected to NAND gate U27C (pin 10). With any of its inputs low, the output of U27C (pin 8) is held high.

4-162. A high state at the output of U27C (pin 8) accomplishes the following:

a. It is connected to NOR gate U29C (pin 9). (Refer to subparagraph 4-175c for operation of U29C.)

b. It is connected to inverter U32E (pin 11). The output (low) of U32E (pin 10) is applied to the Preset input of flip-flop U19A (pin 4). This low applied to the Preset input sets the flip-flop (Q output high). (Refer to subparagraph 4-178b for operation of U19A.)

4-163. When IBB11 is high, the following occurs:

a. The output of buffer/drivers U33A/U33F is high and is connected to both inputs on NAND gate U6D. The low output of U6D (pin 13) is applied to the Clear input on each stage of the digital counter (U7 through U11) and sampling counter (U18A and U18B) resetting them to count zero.

b. The output of buffer/drivers U33A/U33F is also connected to both inputs on NAND gate U30C. U30C (pin 10) is low and is applied to the Clear input on flip-flop U21B. When U21B resets, it generates a blanking signal (SAMPBLK) to Display Control Assembly A05.

c. A high is applied to NOR gate U13D (pin 11). This holds the output of U13D (pin 13) low and prevents a clock signal from being applied to input flip-flop U21A. (Refer to subparagraph 4-161b for operation of U21A.)

4-164. In Local mode of operation, front-panel SAMPLE/DOT and DOT/SCAN switches S5 and S29 are enabled by the local/program signal (LP) from Read/Multiplexer Assembly A07. LP furnishes the FPSCNCOM signal to the switches. Both switches produce a binary code that is applied to diodes CR1 through CR4. The diodes are wired-OR with the outputs of NAND gates U14 (all sections). The signals from the diodes are applied to a decoding network consisting of inverters U28A, B, C, E, and NAND gates U31 (all sections).

4-165. An RCS signal (Read Scan Control) is also developed by the read/multiplexer (A07). The signal is connected to this assembly (A13) at J31 (pin X). It passes through inverter U32C and is applied to an input on each section of NAND gate U31. Each output of the four NAND gates is connected to an output data bus line (OBB0 through OBB3). The binary-coded information applied to the output data bus lines indicates the settings of the front-panel switches (S5 and S29). The information, in binary form, can be read directly into the computer.

4-166. Information on IBB10 sets up the assembly for external or internal digital scanning. The LP signal is connected to NAND gate U17B (pin 5) through SCAN OVERRIDE switch S1. The other input to U17B (pin 4) is the inverted data on IBB10. The IBB10 data is applied to U17B through input latch U5A (pin 1).

4-167. In Program mode of operation, U17B (pin 5) will be high. If external scan is selected, U5A (pin 2) is low. Upon receipt of the clock pulse, information on IBB10 is transferred to the output of U5A. The complementary output ($\overline{Q}$) of U5A (high) is connected to the other input on NAND gate U17B (pin 4). With both inputs high, the output of U17B is low. This signal accomplishes the following:

a. It is connected to one input on NAND gates U25 (all sections), U26 (all sections), U24C, and D, disabling them. With these gates disabled, the digital counter (U7 through U11) is disconnected from Scan D/A and Attenuator Assembly A12.

b. It is applied to U27B (pin 3), holding its output high.

c. It is applied to U17A (pin 2), holding its output high.

d. It is applied to both inputs on U17C, holding its output high.

4-168. The high output of U17C (pin 8) accomplishes the following:

a. It is applied to NOR gate U29A (pin 3), holding its output low. This low is connected to NAND gate U16A (pin 2). This holds the output of U16A high which inhibits the digital counter.

b. It is applied to NOR gate U29B (pin 5), holding its output low. This low is connected to NAND gate U16B (pin 5). This holds the output of U16B high which inhibits the digital counter.

c. It is applied to one input on each NAND gate of U22 (all sections), U23 (all sections), U24A, and B. This enables the gates. When a clock pulse is applied to input latches U3 (all sections), U4 (all sections), U5C, and D, the information on IBB0 through IBB9 will be transferred from the input latches through the NAND gates to assembly A12.

4-169. In Program mode of operation, one input on each NAND gate of U14 is high. This enables the NAND gates. The other inputs to these NAND gates are input latches U3 (all sections). The four sections of U3 store the information on IBB0 through IBB3. Information on IBB0 and IBB1 carry data concerning the number of data points per scan. Information on IBB2 and IBB3 carry data concerning the number of samples per dot.

4-170. The $\overline{Q}$ outputs of U3D and U3C are applied to NAND gates U14C (pin 9) and U14D (pin 11). The outputs of the NAND gates are applied to a decoding circuit consisting of inverters U28A, B, and NAND gates U15 (all sections). The output of the decoder will start the digital counter at a position that will produce the required number of dots per scan. For example, when 128 dots/

scan is selected, the signals on IBB0 and IBB1 will be low. The $\overline{Q}$ outputs of U3C and U3D will be high. With both inputs on NAND gates U14C and U14D high, their outputs are low. The two outputs are applied to the decoding circuit through inverters U28A and U28B. The only NAND gate with both inputs high is U15D. The output of U15D is low while the outputs of the other decoding NAND gates (U15A, B, and D) are high. The output of U15D is applied to NOR gate U12C (pin 8). The other input to U12C is low (from inverter U32B). With both inputs low, the output of U12C is high and accomplishes the following:

a. It is connected to NAND gate U6B (pin 5). The other input to U6B is the Q output of digital counter stage U8B (pin 9). If the counter is reset, the output of U8B (pin 9) will be low; however, if the counter is out of sequence and the output of U8B is high, the counter will be reset by the output of NAND gate U6B (both inputs high).

b. It is connected to NOR gate U12B (pin 6), resulting in a low output. The output of U12B (pin 4) is applied as a clock pulse to counter stage U8A (pin 3). The counter now functions as a seven-stage counter, producing 128 dots/scan (2^7).

4-171. By selecting 256, 512, or 1024 dots/scan, the decoding circuit, U15 (all sections) and inverters U28A and B, will start the counter at the proper stage. Selecting 1024 dots/scan results in all 10 stages of the digital counter being used (2^{10}).

4-172. Information on IBB2 and IBB3 carries the data that selects the number of samples per dot. Normally the scan counter is advanced one count by the SAMP signal which is produced when a sample is taken (figure 4-26). The scan counter output is a 10-bit word that determines the scan position. In order to take 2 samples (or 4) at one point in equivalent time, SAMP is connected through a divide-down counter so that the scan counter is triggered once for each 2 (or 4) samples. Divide-down counter U18A/U18B has three simultaneous outputs: 1:1, 2:1, and 4:1. The desired ratio is determined by IBB2 and IBB3 by way of decoder U17A, U27B, U29A, B, and selector gates U16A, B, and D. The $\overline{Q}$ outputs of U3A and U3B are applied to NAND gates U14A (pin 2) and U14B (pin 6). In Program mode of operation, these NAND gates are enabled by LP (high). The outputs of the gates are applied to a decoding circuit consisting of NAND gates U27B, U17A, and inverters U29A and B. The output of the decoder will select the number of samples/dot. For example: when 4 samples per dot is desired, the signal on IBB2 will be high and the signal on IBB3 will be low. The $\overline{Q}$ outputs of latches U3A and U3B are applied to U14A and U14B, respectively. Since these NAND gates are enabled by LP, the output of U14A (pin 1) will be high and the output of U14B (pin 4) will be low.

4-173. The low from U14B and the low from U17C (resulting from INTERNAL scan selection) are applied to U29B (pins 6 and 5). This causes U29B (pin 4) to go high, thus gating the divide by 4 signal from the divide-down counter to the wired-OR configuration at the common outputs of U16A, B, and D.

4-174. The output of U14B is applied to inverter U28E (refer to paragraph 4-165 for output data bus information).

4-175. The SAMP signal (generated by Time Base Assembly A21) is connected to this assembly at connector J31 (pin 3). The negative pulse accomplishes the following:

a. It is connected to Trigger Sense Generator U34. The output of U34 is the TRIGDRIVE signal that is routed through Lamp Driver Assembly A15 to front-panel TRIGGER lamp DS3. The pulse generated by U34 has a duration of approximately 1 second. Since SAMP is generated with a frequency much greater than one per second, front-panel TRIGGER lamp lights continuously during the scanning function.

b. It is connected to inverter U28F (pin 13). The output of U28F (pin 12) is applied to both inputs on NAND gate U30B. With both inputs high, the output of U30B (pin 4) will be low. When the Clear input on flip-flop U21B is low, the $\overline{Q}$ output (pin 8) becomes high. This action produces the blanking signal SAMPBLK. The SAMPBLK

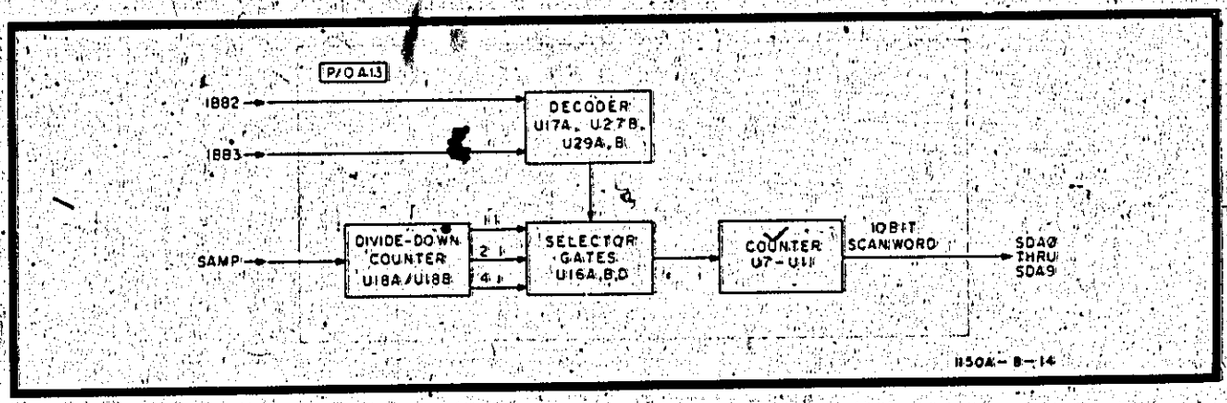


Figure 4-26. Block Diagram, Scan Counter

signal is routed to Display Control Assembly A05 by way of connector J31 (pin 13).

c. It is connected to NOR gate U29C (pin 8). The other input to U29C (pin 9) is from U29D (pin 13). When the output of U29D (pin 13) is low, the SAMP signal from assembly A21 produces a high at the output of U29C (pin 10). The output of U29C is applied as a clock signal to the divide-down counter (U18A and U18B), and to an input on the 1 samples/dot selector, U16D.

4-176. Divide-down counter U18A and U18B produces the sample count applied to NAND gates U16A and U16B. The 2-count output of U18A (pin 6) is applied to U16A (pin 3). The 4-count output of U18B (pin 8) is applied to U16B (pin 6). The combination of U18A/U18B and sample selectors U16A, B, and D determines whether the digital counter (U7 through U11) receives a clock pulse on every SAMP signal (1 samples/dot), on every other SAMP signal (2 samples/dot), or on every fourth SAMP signal (4 samples/dot).

4-177. The sample selector gate (U16A, B or D) that is enabled by either computer input or front-panel switches will generate a logic low signal when the selected number of SAMP signals is decoded. For example: when 2 samples/dot function is selected, the output of U29A (pin 1) is high. The first SAMP signal received is applied as a clock signal to sample counter U18A (pin 3). This results in the $\overline{Q}$ output of U18A (pin 6) becoming low. On receipt of the second SAMP signal, the clock signal applied to U18A results in $\overline{Q}$ output becoming high. With both inputs high, the output of U16A becomes a low which accomplishes the following:

a. If 1024 dots/scan is selected, the output of U15A is low. The output is connected to NOR gate U13A (pin 2). When a low state is generated by U16A, a clock pulse will be applied to flip-flop U7A (first stage of the digital counter). (Refer to paragraph 4-170 for operation of dot/scan decoder U15.)

b. The negative edge of SAMP is coincident with the sample strobe. Since the sampling circuitry requires approximately 5 microseconds to settle after a sample is taken, there must be a delay between SAMP and the encode time (ADAENC) for the A/D converter. In addition, the unblanking signal (SAMPBLK) to the CRT must be delayed. SAMPBLK and ADAENC are generated as a result of the output from U16A, B, D which occurs once for every sample for the 1 samples/dot, once for every two samples in the case of 2 samples/dot, and once for every four samples in the case of 4 samples/dot. To summarize, the A/D converter is encoded and the CRT is unblanked only after the last sample in a group is taken.

c. It is applied to inverter U32B which furnishes the CHSW signal. In addition U32B clocks flip-flop U19B and the digital counter selectors U12C, U12D, and U13C.

4-178. Generation of A/D encode signal (ADAENC), sample unblanking (SAMPBLK), sample Flag, and A/D Flag is accomplished by U19A, B, U20, U21B, U17D, U27A, and U16C (schematic 25). The sequence of operation is as follows:

a. In Program mode of operation, the sequence is started by ENCSMP which results from a computer command to assembly A07 (figure 4-27).

Note

The waveforms in figure 4-27 are not drawn to an accurate X-axis time scale. They are drawn to show relationship only.

b. ENCSMP is a short pulse of approximately 250 nanoseconds in width. Flip-flop U19A (pin 5) is high, having been clocked high by ARS (Auto Reset) being applied through Q1 to pin 3. The ENCSMP pulse from inverter U32D and the high from U19A (pin 5) are applied to NAND gate U17D. With both inputs high, the output of U17D (pin 11) goes low, setting flip-flop U19B. The complementary output of U19B (pin 8) goes low and clears U19A. The output of U19A (pin 5) now goes low. The complementary output of U19A (pin 6) is inverted by U16C which is wired-OR to the FLAG bus. This low from U16C is the busy signal to the computer.

c. At this point, all conditions are set up for the receipt of a sampling signal. At some variable time (depending upon the repetition rate of the signal producing the sampling trigger), a system trigger initiates a timing ramp in assembly A21. When the ramp reaches a compare voltage previously set by Scan Attenuator Assembly A12, a sampling strobe is generated which results in a SAMP signal at connector J31 (pin 3).

d. In the case of one sample per dot, the negative edge of SAMP causes a positive transition at U19B (pin 11), clocking U19B (pin 8) to a high state. Coincident with that, a negative transition occurs at U20 (pin 3), triggering the delay generator. A 5-microsecond, positive-going pulse is developed in the output of U20 (pin 6). All three inputs to U27A are now high and this produces a low state for ADAENC. On the trailing edge of the 5-microsecond pulse from U20 (pin 6), ADAENC goes high. The positive transition of ADAENC encodes the A/D Converter Assembly A27. During this transition, the A/D Converter generates a 5-microsecond busy signal which is wired-OR to the FLAG bus.

e. The trailing edge of the 5-microsecond pulse from U20 (pin 1) also clocks U21B, producing a low at U21B (pin 8). This low (SAMPBLK) unblanks the CRT. To summarize at this point, a sample command has been received, a busy signal generated, a trigger has been received, a sample has been taken, A/D Converter encoded, and the CRT unblanked.

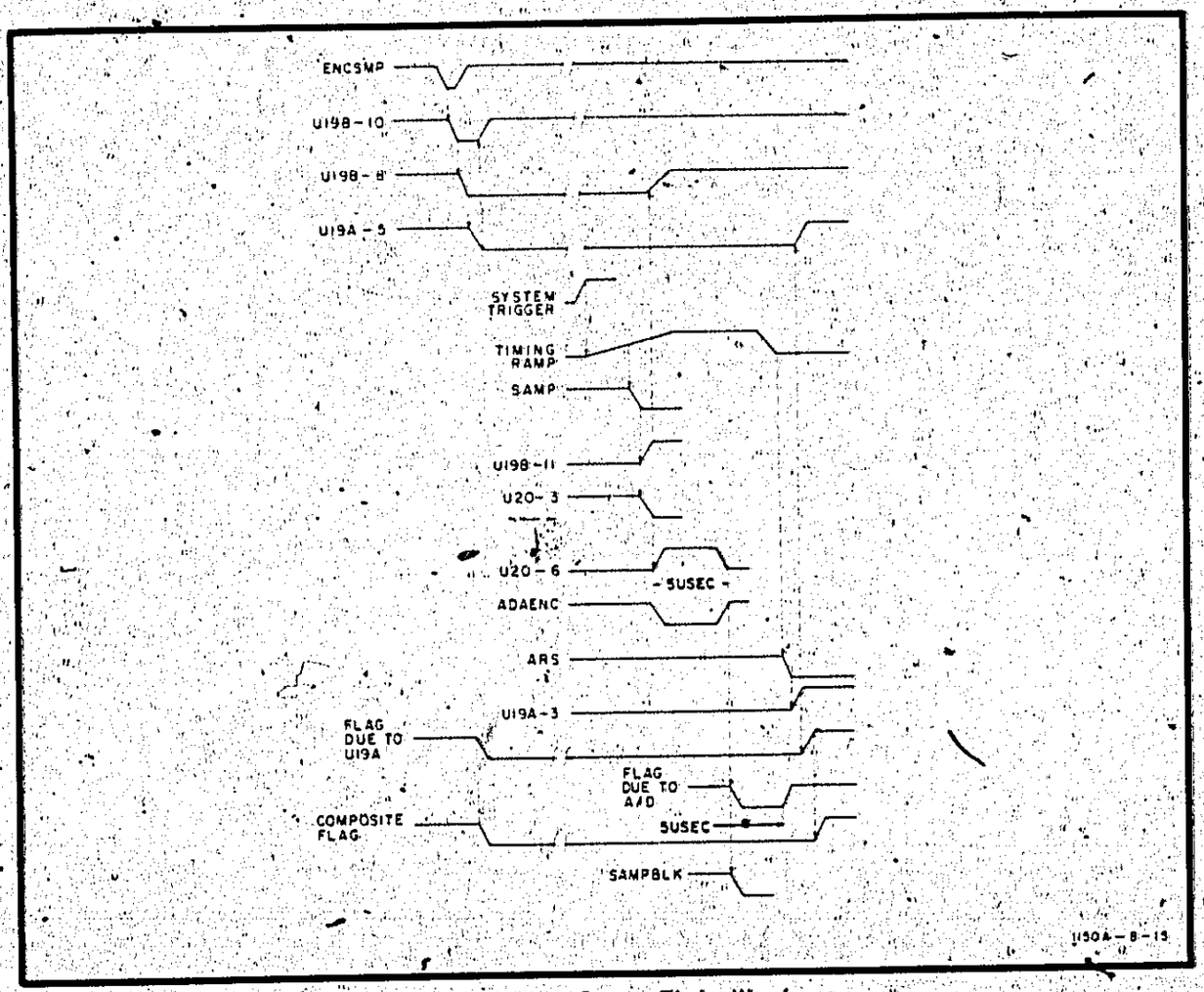


Figure 4-27. Digital Scanner Timing Waveforms

f. The circuitry is reset to initial conditions by the negative edge of ARS. ARS is level shifted and inverted by Q1. The positive transition of ARS clocks U19A, forcing U19A (pin 5) high and U19A (pin 6) low. The low from U19A (pin 6) is applied to U16C, forcing the Flag high (not busy). Observing the waveforms in figure 4-27, it can be seen that the composite Flag is made up of the wired-OR Flag generated by ENCSMP and the A/D Converter.

g. In the case of 2 or 4 samples/dot, timing is the same as above except that a positive transition occurs at U19B (pin 11) only for the second or fourth SAMP. This results in A/D encoding and unblanking for the last sample in a group.

h. For Local mode of operation, Flag is forced high (not busy) by a low state being applied to U27C (pin 9 or pin 10). The output of U27C is applied through U32E to U19A (pin 4). A low applied to U19A (pin 4) sets U19A, forcing U19A (pin 6) low. This low, applied to U16C, sets Flag high.

i. SAMPBLK is reset to blanking level by a low to U21B (pin 13). This low occurs coincidental with every SAMP by way of U28F and U30B, or everytime a scan control word is programmed to this assembly (A13).

4-179. SCAN D/A AND ATTENUATOR. (See schematics 21 and 22.)

4-180. The digital scanning information from assembly A13 is applied to a digital-to-analog converter circuit consisting of Q1 through Q31. Since each stage in the converter functions identically, only one stage will be discussed. Signal SDA9 is applied to the assembly through connector J29 (pin 10). When SDA9 goes low, Q11 conducts. Transistor Q31 is normally conducting and applies 0V to R62 and R69. When Q11 conducts, it forward biases Q21 and reverse biases Q31. Transistor Q31 turns off and Q21 conducts. This applies −15V (approximately) to load resistors R62 and R69 which are connected to the (−) input of amplifier U2.

4-181. The output circuit of each D/A stage is weighted with different value load resistors. The currents from all D/A stages are summed by summing amplifier U2/Q35 and then converted to a voltage at the emitter of Q35. Depending upon the combination of stages selected, the output of emitter-follower Q35 ranges from 0 to +10 volts. The output of Q35 is the HSWP (Horizontal Sweep) signal applied to assembly A05.

4-182. The three most significant stages of the converter circuit Q19, Q20, and Q21 have, in addition to their weighted load resistors (R52, R58, and R62), variable resistors R65, R67, and R69. The variable resistors are used for precision adjustment of the output from these stages. Resistor R72 is used to adjust the output of the fourth stage, Q18/R46.

4-183. The HSWP signal from Q35 is also applied to the bright-dot generator (Q63A) and to the X5 scan attenuator, R120 and R122 through R125. When operating in the direct mode of operation (unexpanded), only the main scan attenuation is used. The X5 and X100 scan attenuators are set to X1 attenuation and the main scan attenuation is used to obtain the desired sweep speed by attenuating HSWP by X1, X2.5, or X5. (Refer to paragraph 4-201 through 4-210 for X5 or X100 attenuation selection.) The control transistors for the X5 attenuation selection are Q36 through Q40.

4-184. The output (collector) of each control transistor is applied to the base of an associated field-effect transistor, Q49 through Q53. Each FET is connected between a tap on an attenuation network (R120 and R122 through R125) and the input to operational amplifier U3 (pin 3). Only one FET is biased on; all others are biased off by their control transistors. When a control transistor is conducting, −12.6V is applied to the gate of its associated FET. This bias off the gate of the FET prevents it from conducting. When a control transistor is not conducting, the bias applied to the gate of the FET is the output voltage of amplifier U3. The output of U3 is fed back to its (−) input (pin 2) through resistor R121, and to the gates of all FET. Amplifier U3 has a voltage gain of one, so the voltage applied to the gate of the FET whose control transistor is not conducting is the same as the FET source voltage. This biases the conducting FET at 0V gate to source, which is the lowest drain-to-source resistance condition. All other FET are biased at greater than −12.6V gate-to-source which gives a very high drain-to-source resistance.

4-185. Since all stages of the attenuator circuit function identically, only the 5X1 stage will be discussed. When 5X1 attenuation is selected, a low state is applied to the junction of R70 and R71. A low at this junction reverse biases Q36, turning it off. Since no attenuation is required for 5X1 operation, the drain of Q49 is connected to the top of the attenuator network. With Q36 not conducting, Q49 is biased on. Q49 conducts and applies the HSWP signal to U3 (pin 3).

4-186. The output of U3 is applied to attenuator network R127 through R129. This attenuator network is used for X100 attenuation. Control transistors Q41 through Q43 function identically as control transistors Q36 through Q40. When 100X1 magnification is selected, the output of amplifier U3 is applied through FET Q57 to operational amplifier U4 (pin 3). Amplifier U4 functions the same as U3. The output of U4 is applied to the main sweep magnifier attenuator network R143 through R145.

4-187. The main magnifier circuit is controlled by transistors Q44 through Q46. When the MX1 selection is made, a low is applied to the junction of R108 and R109. Transistor Q44 is reverse biased and Q60 conducts. The output of amplifier U4 is applied through Q60 to operational amplifier U5 (pin 3). The output of U5 is the SCAN signal that is applied to Time Base Assembly A21.

4-188. When using the Expanded Sweep mode of operation, the portion of the direct sweep waveform to be expanded may be selected with the EXPAND POSITION control R5. The expand position voltage is generated by R5 when in Local mode of operation. In Program mode of operation, the expand position voltage is generated by Expand Position Assembly A06. In Local mode of operation, the LP input at connector J29 (pin N) is low. This low turns on Q47 and turns off Q48 through control transistors Q54, Q55, and Q56. Amplifier U6 acts as a buffer amplifier. The output of U6 is applied to the base of the X5 and X100 attenuation networks. This results in the expanded position voltage being summed with the attenuated scan signal to give the proper expanded position on the waveform.

4-189. The expand position signal from U6 is also applied to Read/Multiplexer Assembly A07 as the EXPOS signal. Upon receipt of REP (Read Expand Position) from the computer, the read/multiplexer routes EXPOS through an operational amplifier (A07U16) to A/D Converter Assembly A27.

4-190. The bright dot generator (Q63, Q32, Q33, and Q34) brightens a segment of the trace on the CRT at a point that will remain on the screen when the signal is expanded horizontally. The bright dot generator is a comparator circuit used to detect the point where the HSWP voltage from Q35 equals the expanded position voltage from U6.

4-191. The output of Q35 is connected to the base of Q63A through R150. The output of U6 is connected to the base of Q63B through R141. The high gain of Q63A will clamp Q63B at one extreme of its range except when the HSWP signal voltage and the expand position voltage (EXPOS) are very nearly equal. At the start of the HSWP scan, EXPOS is more positive than HSWP so Q63B and Q32 are turned on while Q34 is turned off. Diodes CR7 and CR8 are forward biased and CR6 is reverse biased. As HSWP increases, it becomes almost equal to EXPOS. Q63B starts to shut off, causing its collector to go positive.

When the collector of Q63B reaches approximately +10 volts, diodes CR3 and CR4 become reverse biased, allowing Q34 to turn on. Diode CR8 becomes reverse biased when the voltage on the collector of Q34 reaches approximately +10.5 volts. When Q34 turns on, the output (BRDOT) goes high since Q32 is still on. When the collector of Q63B reaches +15 volts, Q32 turns off and CR6 becomes forward biased, causing BRDOT to go low.

4-192. EXPAND POSITION CONTROL. (See schematic 9.)

4-193. In Program mode of operation, Expand Position Control Assembly A06 accepts digital information from the computer and converts it to an analog voltage. The output of this assembly is the EXPOSDA signal that is applied to Scan D/A Attenuator Assembly A12.

4-194. When the proper address is applied to NAND gate decoder U1 and the strobe pulse is received, a clock pulse is generated by clock inverters U7D and U7E. The clock signals are applied to input data latches U3 (all sections), U4 (all sections), and flip-flop U5A. Information on IBB0 through IBB8 is transferred to the Q outputs of the above latches. In addition, the strobe pulse from U1 is applied to Flag Generator U2. The output of U2 is a 10-microsecond pulse (approximately) which is applied to the base of Q1. Q1 conducts and generates the Flag signal that is applied to the FLAG bus.

4-195. Since each stage of the Digital-to-Analog Converter (Q2 through Q19 and U6) function identically, only one stage will be described. For example, if a low state is present on IBB8 and a clock pulse is generated by U7E, the information will be transferred to the Q output of U3A. The low output of U3A is applied to the base of control transistor Q2, turning it on. When Q2 conducts, it forward biases Q3. The output of Q3 is applied through R3 and R4 to the (−) input of amplifier U6 (pin 2). The output of U6 is the EXPOSDA signal that is applied to assembly A12.

4-196. The output circuits of each D/A stage are weighted by different value load resistors. Depending upon the expand position information received, a certain number of D/A stages will turn on. Outputs of the conducting D/A stages will be summed by U6. The output of U6 will vary from 0 to +10 volts, depending upon the input information.

4-197. The two most significant stages of the converter are Q2/Q3 and Q4/Q5. They have, in addition to their weighted load resistors (R3 and R9), variable resistors R4 and R6. The variable resistors are used for precision adjustment of the output from these significant stages. Variable resistor R30 is the balance adjustment for amplifier U6.

4-198. Transistor Q20 develops the +2 volts used by all the control transistors.

4-199. SCAN ATTENUATOR CONTROL. (See schematics 18, 19, and 20.)

4-200. Scan Attenuator Decoder A11 decodes the digital information from the computer or from front-panel TIME/DIV switches S10 and S33. Schematic 20 shows the digital code combinations selected by TIME/DIV switch S33 and EXPAND switch S10.

4-201. Local-program operation is controlled by the LP signal from Read/Multiplexer Assembly A07. LP accomplishes the following:

a. In Local mode of operation, LP is low and is applied through switch S1 to input data gates U18 (all sections), U19 (all sections), and U20C. A low state at one input to these gates inhibit the data from input latches U23 (all sections), U24 (all sections), and U25A. In Program mode of operation, an input on each gate is forced high, allowing them to process the data from the input latches.

b. In Local mode of operation, a low is also applied through S1 to the front-panel sweep controls. SWPCOM furnishes the common low logic level (0V) needed to operate these controls. Depending upon the setting of front-panel controls, the cathodes of selected diodes in diode string CR1 through CR9 will be forced low. This forward biases the diode, resulting in a low being applied to a decoding network. In Program mode of operation, the diode cathodes will be forced high by way of switch S33. This reverse biases the diodes and prevents front-panel data entry.

4-202. The assembly address (IBB12 through IBB15) is applied to NAND gate decoder U21. When properly addressed, the strobe pulse produces a negative pulse at U21 (pin 8). This signal accomplishes the following:

a. It triggers Flag Generator U22 which produces a 12-microsecond Flag signal. The busy signal is routed through NAND gate U20D to the computer by way of assembly A03.

b. It is applied to inverter U15E which produces the clock pulse for input latches U23 (all sections).

c. It is applied to both inputs on NAND gate U20A which produces the positive clock pulse for input latch U24 (all sections) and flip-flop U25A.

4-203. Digital information on IBB0 through IBB8 is stored by U23, U24, and U25A when a clock pulse is received. Main sweep information is available on IBB0 through IBB3. Expanded sweep information is available on IBB4 through IBB7. Information on IBB8 indicates whether main or expanded sweep is selected. The complementary outputs (Q) of the input latches and flip-flop are connected to associated NAND gates. In Program mode of operation, NAND gates U18 (all sections), U19 (all sections), and U20C are enabled by the high applied

to one of their inputs. Data from the input latches and flip-flop are applied to the other input on these gates. The outputs of the NAND gates are wired-OR with the binary input information from the front-panel controls. The binary coded input information from the input data bus or from the front-panel controls is applied to a decoding circuit consisting of U1 through U14.

4-204. Since many combinations of main and expanded sweeps are possible, only one typical sweep combination will be described. For example: the computer programs the instrument for a main sweep of 50 microseconds/division and an expanded sweep of 20 microseconds/division. The binary code for the above combination will be 1 0 0 0 1 0 0 0 0. This code will appear on IBB8 through IBB0. The clock pulse will store the code in the input latches and flip-flop. Since the $\overline{Q}$ output of the latches is used, the binary code is complemented and becomes 0 1 1 1 0 1 1 1 1. The binary code is applied to NAND gates U18 (all sections), U19 (all sections), and U20C.

4-205. The outputs of the NAND gates are also applied to a set of inverters comprised of U13 (all sections), U14D, E, and F. The outputs of the inverters accomplish the following:

a. They form the complement of the code designators.

b. They are applied to a set of NAND gates, U16 (all sections), U17 (all sections), and U20B. When RSA (Read Scan Attenuator) is received from Read/Multiplexer Assembly A07, the NAND gates are enabled. The outputs of the NAND gates are applied to output data bus lines OBB0 through OBB8.

4-206. The outputs from NAND gates U18 (all sections), U19 (all sections), and U20C, along with the complementary outputs from U13 (all sections), U14D, E, and F, are applied to a decoding section which selects the main and expanded sweep. With binary coded input 1 0 0 0 1 0 0 0 0, the logic levels of the designators applied to the decoding section (schematic 19) are shown in table 4-1.

4-207. The main sweep is decoded as follows:

a. Designators $\overline{G}$ and $\overline{H}$ are applied to NOR gate U10D. The output of U10D (pin 13) is high and is applied to the base-bias network (R15 and R16) of transistor Q1. A high applied to the junction of the bias network allows Q1 to conduct. With Q1 conducting, the 50USEC signal line J23 (pin 12) is forced low. The 50USEC signal is routed to an associated transistor on Time Base Assembly A21, turning it on.

b. There are four different ramp speeds which, in conjunction with scan attenuators, determine sweep speed. One of the four ramps is selected by turning on Q1, Q2, Q3 or Q4. Designators G and H are applied to NOR gates U10A, B, and C. Since both designators are high, they hold the outputs of these NOR gates low. A low applied to the base-bias network of associated transistors Q2, Q3, and Q4 turns them off. For example: the output of U10C (pin 10) is low. A low applied to the junction of R17 and R18 will reverse bias Q2, turning it off. With Q2 cut off, its associated transistor on Time Base Assembly A21 will be turned off. U10A and B control Q3 and Q4 in the same manner.

Table 4-1. Logic Level of Code Designators

Input Data Bit	Bit State	Gate Designator	Logic Level	Sweep Decoder
IBB4	Low	A	Low	Expand
		$\overline{A}$	High	
IBB5	High	B	High	Expand
		$\overline{B}$	Low	
IBB6	High	C	High	Expand
		$\overline{C}$	Low	
IBB7	High	D	High	Expand
		$\overline{D}$	Low	
IBB0	High	E	High	Main
		$\overline{E}$	Low	
IBB1	High	F	High	Main
		$\overline{F}$	Low	
IBB2	High	G	High	Main
		$\overline{G}$	Low	
IBB3	High	H	High	Main
		$\overline{H}$	Low	
IBB8	Low	J	Low	Indicator
		$\overline{J}$	High	

c. Designator E is applied to inverter U15B. The output of U15B (pin 4) develops the MX2.5 signal (low-true) used by Scan D/A and Attenuator Assembly A12 for cases where either IBB0 or SWP0 is true (low).

d. Designator F is applied to inverter U15A. The output of U15A (pin 2) develops the MX5 signal used by assembly A12 for cases where IBB1 or SWP1 is true (low).

e. Designators $\overline{E}$ and $\overline{F}$ are applied to NOR gate U1A. Since both designators are low, the output of U1A (pin 1)

is high. The output of U1A is used in a number of decoding circuits. One application is to the input on inverter U15C. The output of U15C, when low, develops the MX1 signal used by assembly A12.

f. A low on any signal line (MX1, MX2.5, or MX5) selects the main sweep multiplication attenuator on assembly A12.

4-208. The decoding section for expand operation is more intricate than decoding the main sweep. Important points to remember when decoding or troubleshooting the assembly are as follows:

a. A high applied to either input on a NOR gate produces a low at its output.

b. Both inputs on a NAND gate must be high to cause its output to go low. Conversely, if either input to a NAND gate is low, the output will be high, regardless of the other input(s).

c. The outputs of most NAND gates are paralleled with the outputs of other NAND gates to furnish a wired-OR configuration. Therefore, a low at the output of any NAND gate holds the output of all associated wired-OR NAND gates low. This point is extremely important when troubleshooting the assembly.

4-209. The expand operation is decoded as follows (refer to paragraph 4-206 for logic levels of the designators):

a. NAND gates U2B, C, and D have their outputs wired-OR. Both inputs of U2C are high, resulting in a low output. The low output is applied to NAND gates U12A and U9A. The output of U12A and U9A will be high.

b. Designator J is applied to both inputs on NAND gate U11A, producing a high at its output. The outputs of U9A and U11A are wired-OR. Since both outputs are high, the 5X1 signal to assembly A12 is high.

c. The output of U12A (high) is applied to NAND gate U9D and inverter U15F. The output of U15F (pin 12) is low. This holds the output of U11B high. The output of U11B is the 100X100 signal to assembly A12.

d. The outputs of NAND gates U2A, U3C, and D are wired-OR. The output of each NAND gate is high because one input on each gate is low (designators $\overline{B}$, $\overline{F}$, and $\overline{E}$ respectively). Output of the NAND gates (high) is applied to NOR gate U8D. Output of U8D (pin 13) is low and it is applied to NAND gates U9B and C. The output of U9B (pin 4) is high. This output, when low, is the 5X4 signal to assembly A12. The output of U9C (pin 10) is high. This output, when low, is the 5X5 signal to assembly A12.

e. The output of NAND gates U6C and D are wired-OR. Designator E (high) is applied to U6D (pin 12). U6D (pin 11) is high from U8A; therefore, U6D (pin 13) will tend to go high unless held low by U6C. Designator $\overline{F}$ is applied to an input on U6C, forcing its output high. The output of both NAND gates (wired-OR) are high. The output of these NAND gates, when low, is the 5X2 signal to assembly A12.

f. High states from U1A (pin 1) and U8A (pin 1) are applied to the two inputs on NAND gate U6A, producing a low at its output (pin 1). The output of U6A is the 5X2.5 signal that is applied to assembly A12. A low applied to this signal line selects the 2.5 attenuation level in the X5 magnification attenuator circuit on assembly A12.

g. Designator C (high) is applied to NOR gates U1B and U7A. The outputs of these gates are low. The output of U1B is applied to NAND gates U4D, U3A, and B. A low applied to these gates holds their outputs high. The output of U7A (low) is applied to NAND gates U4A and U5B, holding their outputs high. Code designator F (high) is applied to NOR gate U7C, holding its output (pin 10) low. This low is applied to NAND gates U4A, B, and C, holding their outputs high. Designator G (high) is applied to NOR gate U7D, holding its output (pin 13) low. This low is applied to NAND gates U5A, C, and D, holding their outputs high. Designator E (high) is applied to NOR gate U8C, holding its output low. This low is applied to NAND gates U5B and U6B, holding their outputs high.

h. NAND gates U4 (all sections), U5 (all sections), U3A, B, and U6B have their outputs wired-OR. Since all outputs of these NAND gates are high, U9D (pin 11) and U14C (pin 5) are high. The output of U14C (low) is applied to NAND gate U11C (pin 8), holding its output high. The output of U11C (pin 10), when low, is the 100X10 signal applied to assembly A12.

i. Since both inputs to U9D are high, its output is low. The outputs of U9D and U11D are wired-OR and provide the 100X1 signal applied to assembly A12. A low applied to this signal line selects the 1 attenuation level in the X100 magnification attenuator circuit on assembly A12.

4-210. In summary, application of binary code 1000010000 to this assembly produces three operating signals for Scan D/A and Attenuator Assembly A12. They are:

a. 50USEC signal that selects the main sweep.

b. 100X1 signal that indicates no expansion for X100 magnification.

c. 5X2.5 signal that indicates 2.5 expansion for X5 magnification.

4-211. CHANNEL 1 AND CHANNEL 2 SAMPLING. (See schematics 34 and 36.)

4-212. Sampling Assemblies A22 and A24 are identical; therefore, only assembly A22 will be discussed in detail.

Assembly A22 services Channel 1 and assembly A24 services Channel 2.

4-213. Network R1 through R5, C1, L1, and L2 make up a 75-ohm delay-line termination. This network compensates for high frequency loss in the delay line while maintaining the 75-ohm termination at all frequencies up to 1 GHz.

4-214. Normally diode bridge CR1 through CR4 is reverse biased. The signal under observation is applied to the junction of CR1 and CR2. The sampling strobe pulse described for schematic 33 is applied through balun transformer T1, and forward biases CR1 through CR4. This allows current from the input signal to charge C2. Since the strobe pulse is only 350 picoseconds long, the voltage on C2 only changes by about 15% to 20% of the difference between the initial charge on C2 and the momentary voltage of the input signal.

4-215. Sampling gate bias network R6 through R10, R14, and R15 supplies about 5 volts reverse bias to the diode bridge. Potentiometer R9 applies a sample of the stretcher output to the network to keep the diode bias centered around the stretcher output voltage. Potentiometer R9 is adjusted to offset the sampling gate bias and thereby compensate for small mismatches in sampling diode parameters or strobe pulse unbalance. TR adjustment R8 controls the reverse bias amplitude. Since the sampling strobe is essentially a triangular waveform, increasing reverse bias causes the sampling gate to remain open for a shorter period, increasing the observed rise-time.

4-216. Resistors R11 and R12 carry the offset current (CH1POS) from Vertical Attenuator and Position Assembly A14. The CH1POS signal is used to offset the stretcher output with respect to the voltage at the sampling gate. This controls the vertical position of the display on the CRT.

4-217. When the sampling gate is reverse biased, the charge on C2 bleeds off into C3 through R16, R20, and R17. The voltage on C2 and C3 equalizes in approximately 1.5 microseconds. During this period of unequal voltage, Q1A and Q1B amplify the difference and supply it to the bases of dual transistor Q2. RESPONSE R22 is used to adjust the gain of Q1 for 100% sampling efficiency.

4-218. Transistors Q2 and Q3 amplify the signal and supply it to the bases of integrator current source Q4 and Q5. Resistors R30 through R33, R35, and R38 comprise a feedback path that causes the differential output current from Q4 and Q5 to be proportional to the differential input voltage at the bases of Q2.

4-219. During the quiescent period, +5 volts is applied to the base of Q11. This keeps Q6, Q7, Q10, and Q11 on to reverse bias CR6 and CR7, isolating the charge on C12. Diodes CR5 and CR8 keep Q6 and Q7 respectively from saturating.

4-220. During the 1.5-microsecond period following the taking of a sample, the stretcher gate at pin K is 0V. This turns off Q6, Q7, Q10, and Q11, removing reverse bias from CR6 and CR7, and allowing the current from Q4 and Q5 to charge stretcher capacitor C12. When the 1.5-microsecond period has ended, the stretcher gate returns to +5V, turning on Q6, Q7, Q10, and Q11.

4-221. Transistors Q8 and Q9 comprise a unity-gain buffer amplifier that provides a low impedance stretcher output and keeps C12 from being discharged. Resistor R13 is the feedback resistor that enables C2 and C3 to charge to the stretcher output. Resistors R13, R19, and R18 make up an attenuator which establishes an overall gain of 5 in the stretcher.

4-222. Operational amplifier U1 is connected as a feedback amplifier with a voltage gain of 20. Diodes CR9 and CR10 are input overload protectors. Diodes CR11 and CR12 and voltage regulators VR2 and VR3 are output limiters which prevent damage to the circuitry that follows. Capacitor C19 and resistors R52 and R53 are frequency compensating components which stabilize U1.

4-223. When the NORMAL/FILTERED switch is in FILTERED, C13 is in parallel with C12. This increased capacity reduces the change in stretcher voltage for a given error signal at the bases of Q1. No loss of accuracy occurs on the display because the error signal is repeated at each sample until the stretcher output has built up to the new input signal value (amplified by 5). The FILTERED mode eliminates unwanted noise and time jitter at the expense of a small distortion and loss of detail on the observed signal.

4-224. VERTICAL ATTENUATION AND POSITION. (See schematics 26 and 27.)

4-225. Vertical Attenuation Assembly A14 accepts digital information from the computer or front-panel sensitivity switches S31 and S32. It decodes the data and selects the desired level of vertical attenuation. In addition, positional voltage from assembly A09 or front-panel POSITION controls R6 and R7 is converted to the appropriate voltage level required by Sampling Assemblies A22 and A24.

4-226. Local-Program operation is controlled by the LP signal from Read/Multiplexer Assembly A07. LP accomplishes the following:

a. In Local operation, LP is low and is applied through ATTN OVR switch S1 to input gates U4 (all sections), U5A, and U5B. A low state at one input on each of these gates inhibits the data stored by input latches U12 and U13. In Program operation, one input on each gate is high. This enables the gates to process the data from the input latches.

b. In Local operation, VACOM signal is low. The signal is applied to front-panel switches S31 and S32. Depending on their setting, S31 and S32 apply VACOM to certain

input diode gates (CR1 through CR6). A low will forward bias the diode to which it is applied. In Program operation, a high will reverse bias the diode.

c. In Local operation, LP (low) is applied through POS OVR switch S2 to the bias network of transistor Q37 and to both inputs on NAND gate U7A.

4-227. Output from U7A (pin 1) is connected to the bias network of Q36. Since the output of U7A is high, it has no effect on the bias applied to the base of Q36 which is conducting. When conducting, Q36 turns off FET transistors Q33 and Q35. Since Q33 and Q35 are not conducting, the DAPOS1 and DAPOS2 signals are disconnected from the level translator circuits.

4-228. The low applied to the bias network of Q37 turns it off. Turning off Q37 results in FET transistors Q32 and Q34 being forward biased. Q32 gates the analog signal (POS1FP) from Channel 1 POSITION control R7 to Channel 1 voltage-level translator Q30, Q31, Q40, and Q41. POS1FP is also routed to Read/Multiplexer Assembly A07 as POS1. Transistor Q34 gates the analog signal (POS2FP) from Channel 2 POSITION control R6 to Channel 2 voltage-level translators Q38, Q39, Q42, and Q43. POS2FP is also routed to Read/Multiplexer Assembly A07 as POS2.

4-229. In Program operation, LP is high and is applied through S2 to the bias network of Q37 and to both inputs on NAND gate U7A. Therefore, FET transistors Q32 and Q34 are reverse biased and the front-panel POSITION controls are disconnected from the level translator circuits. FET transistors Q33 and Q35 are forward biased because Q36 is turned off. This connects signals DAPOS1 and DAPOS2 to their respective voltage-level translator circuits and also to Read/Multiplexer Assembly A07 as POS1 and POS2.

4-230. The vertical position analog voltage from assembly A09 (program) or from front-panel POSITION controls (local) have a voltage range of 0 to +10 volts. Since the operation of Channel 1 and Channel 2 is identical, only Channel 1 will be discussed. The vertical position voltage is applied to the input of a voltage-level translator circuit by either Q32 or Q33 (depending upon the Local-Program mode of operation). The voltage-level translator consists of Q30, Q31, Q40, and Q41. The circuit accepts the applied vertical position voltage (0V to +10V, corresponding to UP and DOWN positioning) and converts it to an equivalent value for a voltage range of −80V to +80V. The −80V to +80V range is required for proper operation of Sampling Assembly A22 (assembly A24 for Channel 2).

4-231. There are two adjustments, R100 and R105 (Channel 1), in the voltage-level translator. R105 is the center-adjust control and R100 is the gain control. With +5 volts applied to the input of the translator, R105 is adjusted for center display on a CRT screen. R100 is adjusted so that 0-volt and +10-volt inputs result in the display being 1 division off the top or bottom of the CRT screen. R114 and R117 are the adjustments associated with Channel 2.

4-232. The attenuation level (mV/DIV) is also produced by this assembly. There are two identical attenuator circuits (one for each channel). Since each circuit functions identically, only Channel 1 will be discussed.

4-233. The assembly address (IBB12 through IBB15) is applied to NAND gate decoder U1. When properly addressed, the strobe pulse produces a negative pulse at the output of U1 (pin 8). This signal accomplishes the following:

a. It triggers Flag Generator U14 which produces a 12-microsecond (approximately) Flag signal. The busy signal is routed through NAND gate U10A to the computer by way of assembly A03.

b. It is applied to two sections of NOR gate U2. The other signals applied to these sections are the SEL1 and SEL2 signals.

4-234. Since Channel 1 is being discussed, SEL1 will be low. This produces a clock pulse in the output of U2A (pin 1). The clock pulse is applied to input latches U12B, C, and D. Upon receipt of the clock pulse, the latches will store the information on IBB0 through IBB2. Outputs from the latches are applied to input data gates U4A, B, and D. In Program mode of operation, an enable signal (high) is applied to the other input on these gates through switch S1. The data from the input gates is applied to a decoding circuit consisting of U7B, C, D, U8 (all sections), and U11A. The output from the decoder selects one of seven levels of attenuation.

4-235. The attenuation circuit consists of Q2 through Q15. It functions identically to the attenuation network on Calibrator Assembly A04 (refer to paragraphs 4-112 through 4-114 for explanation of operation).

4-236. The signal applied to the attenuation network R27 through R33 is stretcher output signal STR1 from Sampling Assembly A22. STR1 is attenuated by the network and returned through one of the FET, Q9 through Q15, to A22 as the ATN1 signal. Only one FET is conducting for a particular attenuation setting. All other FET are biased off with −12.6V applied to their gates by transistors Q2 through Q8. ATN1 is applied to operational amplifier A22U1 on the sampling assembly. A22U1 is used as a feedback amplifier with a gain of 20. The output of A22U1 is returned to a 20:1 voltage divider network R40 and R41. (This network compensates for the gain of A22U1.) The voltage at the junction of R40 and R41 will equal the input voltage of A22U1. This voltage is applied to the gate of one of the FET to maintain its gate-to-source voltage at approximately 0 volt for minimum drain-source resistance. All other FET have high drain-source resistance because of the −12.6V applied to their gates. Resistor R43 calibrates the attenuator network with reference to stretcher output signal STR1 and feedback amplifier signal CH1.

4-237. Channel 1 and Channel 2 function identically. The attenuator circuit consists of Q16 through Q29 and attenuator network R68 through R74. Resistor R82 is the calibration resistor. The sampling assembly for Channel 2 is assembly A24.

4-238. When the computer wants to read the vertical attenuation level selected by front-panel controls, it programs Read/Multiplexer Assembly A07 which develops the RVA (Read Vertical Attenuation) signal. RVA (low) is applied to one input on NOR gates U2C and U2D (assembly A14). Depending upon the channel selection, SEL1 or SEL2 will be low. With both inputs to either U2C or U2D low, the output of the selected channel NOR gate will be high. A high from either NOR gate enables an associated set of NAND gates consisting of U6 (all sections), U5C, and U5D. One set of NAND gates (U6A, U6D, and U5D) is associated with Channel 1. The other set (U6B, U6C, and U5C) is associated with Channel 2. The outputs of U6A-U6B, U6C-U6D, and U5C-U5D are wired-OR. The binary coded attenuation levels of the front-panel controls are applied to the other input to the NAND gates through inverter U3 (all sections). The outputs of the enabled NAND gates are connected to output data bus lines OBB0 through OBB2. When the busy signal terminates, the computer reads the coded attenuation level applied to the output data lines.

4-239. Switches S1 and S2 are override switches to facilitate troubleshooting the attenuator and position circuits. In the override position, the assembly functions as in the Local mode of operation.

4-240. VERTICAL POSITION DECODER. (See schematics 16 and 17.)

4-241. Vertical Position Assembly A09 is used to convert digital information to a Y-axis analog voltage. The assembly address (IBB12 through IBB15) is applied to NAND gate decoder U1. When properly addressed, the strobe pulse produces a negative pulse at the output of U1 (pin 8). This strobe pulse accomplishes the following:

a. It triggers Flag Generator U8 which produces a 10-microsecond Flag signal. The busy signal is routed through Q1 to the computer by way of assembly A03.

b. It is applied to NOR gates U7C and U7D. The other input to the NOR gates is the channel select signals SEL1 and SEL2. The strobe pulse plus a low on either SEL1 or SEL2 input line causes the output of either U7C or U7D to go high. When Channel 1 is selected, the output of U7D (pin 13) will be high. When Channel 2 is selected, the output of U7C (pin 10) will be high. The outputs of the two NOR gates are applied to separate inverters that produce the clock pulses for the input latches.

4-242. If Channel 1 is selected, the clock pulse will be applied to input latches U2 (all sections), U3 (all sections), and U4B. If Channel 2 is selected, the clock pulse will be applied to input latches U4C, U4D, U5 (all sections), U6A, B, and C. When a clock pulse is applied to one of the above set of latches, data present on IBB0 through IBB8 will be stored in that particular set of latches.

4-243. Assembly A09 contains two digital-to-analog (D/A) converter circuits, one D/A circuit for each channel. Each D/A circuit contains nine weighted stages.

4-244. Data stored in the input latches are applied to associated stages in the D/A converter. For example, if IBB8 is low, the data will be transferred to the Q output of latch U2B (pin 15) when the clock signal is generated. The low from U2B is applied to the base of control transistor Q2, turning it on. When Q2 conducts, it turns on Q3. The collector current of Q3 is weighted by load resistor R4. R3 is used for precision adjustment of this stage. Each load resistor in the following stages is twice the value of the previous stage; therefore, each succeeding stage produces half the current of the previous stage. Any combination of stages can be selected to produce the desired current level.

4-245. The output of each D/A stage (Q2 through Q19) is applied to operational amplifier U9 whose feedback resistors are the balancing resistors for the binary weighted current. The output of U9 (pin 6) is the vertical analog voltage DAPOS1. It is connected to Vertical Attenuator Assembly A14. Channel 2 D/A converter circuit, Q20 through Q37, and Channel 1 D/A converter operate identically.

4-246. Each D/A converter has three adjustments. Adjustments in Channel 1 D/A converter are R3, R6, and R31. Feedback resistor R31 adjusts the output of amplifier U9 for proper gain. Turning on a D/A converter stage with a fixed load resistor results in a fixed current being applied to the amplifier. R31 is adjusted until the output voltage of the amplifier is the same as the fixed input. R3 and R6 are then used to adjust the two most significant stages in the analog string. Adjustment of R3 and R6 are critical. Incorrect adjustment could result in loss of the least significant digit in the circuit. For example, in a 10-volt full-scale converter, Q18 and Q19 will generate approximately 20 millivolts whereas Q2 and Q3 will generate 5 volts. As can be seen, adjustment of R3 is extremely critical since turning on stage Q2 and Q3 and stage Q18 and Q19 should generate 5.02 volts in the output of the operational amplifier. Adjustments for Channel 2 D/A converter are R37, R40, and R65. Adjustments are the same as for Channel 1.

4-247. Two additional signals are developed by this assembly. The RVP (Read Vertical Position) signal from Read/Multiplexer Assembly A07, in conjunction with the SEL1 or SEL2 signal, are gated through NOR gate U7A or U7B to produce the RPOS1 or RPOS2 signal. RPOS1 or RPOS2 selects the channel POSITION control that is to be read by the computer.

4-248. CHANNEL SELECTOR CONTROL. (See schematic 15.)

4-249. Channel Selector Assembly A08 is designed to accept digital information from either the computer or front-panel CHANNEL select switches A TRACE (S3) and B TRACE (S4). The information is decoded and routed to various assemblies in the instrument as a channel-enable signal.

4-250. The Local-Program (LP) signal from Read/Multiplexer Assembly A07 controls the selection of the source of information that is processed by this assembly. When operating in the Program mode, LP will be high. This signal accomplishes the following:

a. It is applied to NOR gate U16B (pin 6). The output of U16B (low) is applied to NAND gate U12A (pin 3). The high output of U12A (pin 1) is applied to A TRACE Enable NOR gate U16C (pin 8) and to B TRACE Enable NOR gate U16D (pin 12). With a high state applied to one of their inputs, the outputs of U16C and are held low. These signals disable the A and B TRACE Switch gates, U7 (all sections), U8 (all sections), U6A, and B. This prevents any information from front-panel CHANNEL switches S3 and S4 from being processed.

b. It is applied through inverter U11C to NAND gate U18D (pin 12). The output of U18D (high) is applied to NAND gate U18E (pin 5).

c. It is applied as an enable signal to one input on input data gates U5A, B, D, U6C, and D.

4-251. When the assembly is properly addressed and strobed, the output of NAND gate decoder U1 is a negative pulse. This signal accomplishes the following:

a. It is applied to Flag Generator U4. The output of U4 is a 10-microsecond positive pulse that is applied to NAND gate U12C (pin 9). The output of U12C (pin 10) is the busy signal (low) that is applied to the FLAG bus.

b. It is applied to NAND gate U5C (pin 9). The output of U5C (pin 8) is the positive clock pulse that is applied to the Input Data Storage Register, U2 (all sections) and U3D.

4-252. Information on IBB0 through IBB4 is the digital word used for channel selection. The data bus lines are connected to the D input of the storage register latches. When the clock pulse is applied to the latches, information on the D input terminal is transferred to the Q output. The complementary ($\overline{Q}$) outputs are connected to associated input data gates U5A, B, D, U6C, and D.

4-253. Since the input data gates are enabled by the LP signal (Program mode), information from the input latches are applied through the gates to the Channel Decoder circuit, U9A through U9C, U10A, and U10C. Each channel decoder gate has three inputs: one input from its associated input data gate, one input from its associated A TRACE gate, and one input from its associated B TRACE gate. Each input to the channel decoder gate will be a logic high when its associated gates are inhibited; therefore, the input from those gates which are enabled will determine the output logic level of its associated channel decoder gate.

4-254. The outputs of the channel decoder gates are applied to three separate circuits. These circuits are:

a. The direct outputs of the channel decoder gates are the C0 through C4 signals that are applied to EXTENDER connector J39 on the rear panel of the instrument. This digital output can be used by future external equipment for extending the available channels to 32.

b. The output of each channel decoder gate is applied to an associated channel selector data gate. The channel selector data gates, U13 (all sections) and U12D, are enabled by the RCA (Read Channel Address) signal from Read/Multiplexer Assembly A07. Outputs from the channel selector data gates are applied to output data bus lines OBB0 through OBB4.

c. The outputs of the channel decoder gates are applied to a selector circuit consisting of NAND gates U18A, U18C, and U19A. The outputs of the channel select gates produce the SEL1 or SEL2 signal used to enable certain circuits throughout the instrument. The outputs of the channel select gates are also applied to the MPX decoder circuit consisting of U17A and U17B. Upon receipt of read command REP+RVP, the MPX decoder will generate either the MPX1 or MPX2 signal used for channel selection by Read/Multiplexer Assembly A07.

4-255. When operating in the Local mode, LP will be low. This signal accomplishes the following:

a. It is applied to an input on each input data gate (U5A, B, D, U6C, and D). This action prevents any information from being transferred to the channel decoder gates from the input data bus lines.

b. It is applied through inverter U11C to NAND gate U18D (pin 12). The other input to U18D (pin 13) is from NOR gate U16A. A high from U16A indicates that both of the front-panel switches, A TRACE and B TRACE, are in the OFF position. When this occurs, the output of U18D becomes low and the SEL1 signal is not generated.

4-256. If either the A TRACE or B TRACE switch is in any position other than OFF, a number of events will occur. Since both the A TRACE and B TRACE switches function identically, only the A TRACE switch will be discussed in detail. When the A TRACE switch is in any position other than OFF, +5 volts will be applied through R12 to the following:

a. It is applied to U17C (pin 9.)

b. It is applied to U14C (pin 9). If B TRACE switch is in the OFF position, a high from NAND gate U17C (pin 8) is applied to the other input on U14C (pin 10). With both inputs high the output of U14C (pin 8) is low. The output of U14C is connected to the preset input of flip-flop U15 (pin 13). A low applied to the preset input will set the flip-flop. The Q output of U15 (high) is connected to NOR gate U16D (pin 11). The output of U16D is the enable signal for the B Trace Switch gates, U8 (all sections) and U7D. With a high state applied to one input, the output of U16D is low. This signal disables the B Trace Switch gates.

c. It is applied to NOR gate U16A (pin 3). The low output of U16A is applied to NOR gate U16B (pin 5). The other input to U16B is also low (LP). The high output of U16B is inverted by U12A and applied to NOR gates U16C (pin 8) and U16D (pin 12). The other signal applied to U16C (pin 9) is the complementary output (low) of flip-flop U15 (pin 6). With a low applied to both inputs, the output of U16C (pin 10) is high. This high is applied to one input on A TRACE switch gates U6A, U6B, and U7A through U7C. This action enables these gates so that digital information (from front-panel A TRACE switch) applied to their other input is transferred to the channel decoder gates.

4-257. When both of the switches (A TRACE and B TRACE) are in any position other than the OFF position, a chopped type of display occurs. This is accomplished as follows:

a. The A TRACE switch functions as described above.

b. The B TRACE switch, in any position other than OFF, applies +5V through R13 to an input on NAND gates U14B and U17C. This high is also applied to NOR gate U16A (pin 3).

c. The output of U17C will be low (both inputs high). This signal is applied to U14B (pin 5), U17D (pin 12), U14C (pin 10), and U19B (pin 10). With one input low, the output of these gates will be high.

d. The output of U14C (pin 8) is high. This prevents flip-flop U15 from presetting.

e. The output of U14B (pin 6) is high. It is applied to the Clear input of flip-flop U15.

f. The output of U19B (pin 8) is applied through inverter U20F to Read/Multiplexer Assembly A07 as the LRNDIS (Learn Disable) signal.

g. The output of U17D is applied to NAND gate U14A (pin 2) as an enable signal. The other input to U14A (pin 1) is the CHSW signal from Digital Scan Assembly A13. The CHSW signal, developed with each sweep of the scanner, is applied through U14A to flip-flop U15 as a clock signal. This results in the Q and $\overline{Q}$ outputs of U15 alternating between low and high states. These outputs enable either the A or B Trace switch gates through NOR gates U16C or U16D. This action produces an alternate type display.

4-258. READ/MULTIPLEXER CONTROL. (See schematics 10, 11, and 12.)

4-259. Read/Multiplexer Assembly A07 contains the control circuitry used throughout the instrument. It decodes the read commands from the computer and applies them to the appropriate assemblies as control signals. In addition, it gates the various analog voltages developed by the different front-panel controls and associated assemblies to the A/D Converter Assembly, A27.

4-260. When the assembly is properly addressed and a strobe pulse is received, the output of NAND gate decoder U1 accomplishes the following:

a. It is applied to Flag Generator U3. The output of U3 is a 10-microsecond pulse that is applied through U9C to the FLAG bus. In addition, the busy signal from U3 is applied to an input on NAND gate U10B (pin 3).

b. It is applied through inverter U2F to NAND gate U14A (pin 2) and U4B (pin 4).

c. It is applied as a clock signal to input latches U8A, U8B, U19A, and U19B. Information on IBB0 through IBB3 is clocked into these latches on the trailing (positive) edge of the pulse.

4-261. Information stored in the input storage latches is applied to Read Function Decoder U5. The decoder produces a low signal for the selected read command. The output from the decoder is routed to various assemblies in the instrument (refer to schematic 10 for signal identification). Various outputs of the decoder are also used in this assembly for the following:

a. The REP (Read Expand Position) signal is applied to the base-bias network of control transistor Q14. A low applied to this bias network turns off Q14. With Q14 cut off, the reverse bias applied to the gate of FET Q7 is removed and it conducts. The signal applied to the drain of Q7 is the analog voltage from front-panel EXPAND position control, R5. When Q7 conducts, this analog voltage is applied to the (+) input on operational amplifier U16 (pin 3). The output of U16 is the analog MPXSIG applied to A/D Converter Assembly A27 and Display Control Assembly A05.

b. The output signals of the decoder for RAD (Read A/D), REP (Read Expand Position), and RVP (Read Vertical Position) are connected to separate inputs on NAND gate U10C. If none of these read commands are selected, the output of U10C is low. This low is applied to an input on each of the A/D Data gates, U12A through U12D, U13A through U13D, U9A and U9B. A low state applied to an input of these gates will disable them. This prevents digital information from A/D Converter Assembly

A27, from being applied to the output data bus lines OBB0 through OBB9. If either the RAD, REP, or RVP signal is selected, an input on each A/D data gate will be high. This will enable the gates and the digital information from assembly A27 will be applied to the output data bus lines.

c. The REP and RVP signals are applied to separate inputs on NAND gate U11A. When either command is selected, the REP+RVP signal (low) is generated by U11B (pin 6). This signal is applied to Channel Select Assembly A08 as an enable signal for the MPX decoder. It is also applied to NAND gate U4A (pin 2) on this assembly. NAND gates U4A, U4C, and U11C form a decoding network that produces the ADENC (A/D Encode) command to A/D Converter Assembly A27.

4-262. The output of U11A (REP+RVP decoder) is also applied to NAND gate U10B. When either the REP or RVP signal is generated, the output of U10B will pulse Flag Overlap Generator U6. The output of U6 is applied through Q22 to the FLAG bus. This 12-microsecond busy signal is to ensure that sufficient time is allowed for performing the analog-to-digital conversion by assembly A27.

4-263. The LP function identifier code is carried on IBB11. When IBB11 is low, the assembly looks at the information on IBB0. (Data on IBB0 selects either Local or Program mode of operation.) With IBB11 low, the following occurs:

a. NAND gate U14A (pin 1) is high. The strobe pulse is applied through inverter U2F to the other input on U14A (pin 2). This produces a negative pulse at its output. The pulse is inverted and applied to flip-flop U7B, transferring the information on IBB0 to its output.

b. The complementary ($\overline{Q}$) output of U7B is connected to NAND gate U15A (pin 2). A high input indicates selection of Program mode of operation. A low input indicates Local mode of operation. With Local-Program switch S1 in PROGRAM position, U15A (pin 3) is high. This produces a low in its output which turns off transistor Q23. The output of Q23 (high) is the LP signal used throughout the instrument. In addition, a low output from U15A (pin 1) is applied to NAND gates U11D (pin 13) and U15C (pin 8). The output of U15C (pin 10) is wired-OR to output data bus line OBB1. A high state on this output line indicates Program mode of operation to the computer. The output of U11D (pin 11) is the RLN (Read Learn) signal that is applied to the LEARN lamp on the front panel of the instrument. In Program mode of operation, the lamp will be out.

4-264. When the operator wants the computer to store certain front-panel control settings, he presses LEARN pushbutton switch S28 which forces U17 (pin 5) high. The output of U17 is a 100-microsecond pulse that is applied to NAND gate U4D (pin 12). The other input to U4D is the LRNDIS signal from Channel Selector Assembly A08. When LRNDIS is high, the output of U4D (pin 11) is applied through inverter U2B to NAND gate U9D (pin 11). The read command developed at the output of U5 (pin 2) is routed through inverter U2A to the other input on U9D. With both inputs high, the output of U9D (pin 13) is low. The output of U9D is wired-OR to the output data bus line OBB0. A low state on this output line tells the computer to read the settings of the front-panel controls.

4-265. The multiplexer portion of assembly A07 is used to apply an analog voltage to A/D Converter Assembly A27. The analog voltages can be those generated by front-panel controls or from remote sampling channels (future instruments). All control transistors (Q14 through Q20) and their associated FET (Q7 through Q13) function identically. Operation of Q14/Q7 has been explained previously (refer to subparagraph 4-261a).

4-266. The circuits for multiplexing the CH1 and CH2 signals are identical. Only the CH1 multiplexer circuit will be discussed. When SEL1 is generated by Channel Selector Assembly A08, and REP+RVP is applied to MPX decoder gate A08U11A, MPX1 (low) is applied to the junction of resistor R10 and R11, turning off transistor Q3. With Q3 cut off, the reverse bias on the gate of FET Q1 is removed and it conducts. When Q1 conducts, it connects CH1 from Channel 1 Sampling Assembly A22 to operational amplifier U18. The output of U18 is applied through FET Q6 to operational amplifier U16 (refer to subparagraph 4-261a for U16 operation). Transistor Q6 is normally biased off by Q5. However, MPX1 is also applied to NAND gate U14D (pin 12) holding its output high. With both inputs high, the output of U14C is low. This low is applied to the junction of resistors R25 and R26. These resistors are part of the base-bias network for Q5. The low state applied to the junction of R25 and R26 turns off Q5. With Q5 cut off, Q6 conducts. This connects the output of amplifier U18 to the (+) input on amplifier U16. The output of U16 is applied to A/D Converter Assembly A27, and to Display Control Assembly A05.

4-267. ANALOG-TO-DIGITAL CONVERTER.

4-268. A/D Converter Assembly A27 is a high speed, high accuracy analog-to-digital converter capable of encoding ±10-volt input signals into 10 binary bits of data. It has a resolution of 1 part in 1024 at the maximum rate of 6.5 microseconds per conversion. It measures the input voltage against the internal precision reference voltage source with an accuracy of ±0.025% of full range.

4-269. The unit is repairable on the component level with only the precision resistor network being encapsulated to maintain temperature stability. To facilitate repair in the field, an operation and maintenance manual furnished by Phoenix Data, Inc., Phoenix, Arizona has been enclosed with the Model 1150A.

4-270. An exchange program has been established whereby customers can ship a repairable A/D Converter Assembly (A27) to Hewlett-Packard in exchange for a like

item that has been repaired. The procedures to be followed for this program are given in Section VIII of this manual.

4-271. DISPLAY CONTROL. (See schematics 6, 7, and 8.)

4-272. Display Control Assembly A05 contains all the circuitry required to operate an external display. It has two D/A converter circuits, a bright-dot/blanking circuit, an erase pulse generator, a write pulse generator, and a +2-volt Power Supply.

4-273. The two 10-stage D/A converter circuits are used to generate the X-axis and Y-axis analog voltage used to position an external display on a CRT. Since both converter circuits are identical, only the X-axis circuitry will be discussed.

4-274. There are two sets of input latches. One set, U2 (all sections), U3 (all sections), U4A, and U4B, is used to control the X-axis D/A converter circuit. The other set, U5 (all sections), U6 (all sections), U4C, and U4D, is used to control the Y-axis D/A converter circuit. The two sets of latches operate in parallel from input data bus lines IBB0 through IBB9; however, the computer cannot select both sets of latches simultaneously. Selection is accomplished by the coding on IBB10 and IBB11. A high on IBB11 will enable clock NOR gates U7A and U7B. A low state on IBB11 will disable the input latches by preventing a clock pulse from being generated. Information on IBB10 determines which NOR gate (U7A or U7B) will generate the clock pulse. A high on IBB10 results in a clock pulse being applied to the X-axis input latches. A low on IBB10 results in a clock pulse being applied to the Y-axis input latches.

4-275. With IBB10 and IBB11 both high, the following occurs:

a. When the assembly is properly addressed and a strobe pulse is generated, the output of NAND gate decoder U1 (pin 8) will be a negative pulse. The output of U1 is applied through inverter U14B to NAND gate U11B (pin 5).

b. The high on IBB11 is applied directly to NAND gate U11B (pin 4). With both inputs high, the output of U11B (pin 6) is low. This low is applied to NOR gates U7A and U7B.

c. The high on IBB10 is applied directly to NOR gate U7B (pin 6). In addition, the signal is applied to NOR gate U7D (pin 12). A high input to U7D causes its output to go low. This low is connected to U7A (pin 2).

d. The high on IBB10 holds the output of U7B low. This prevents a clock pulse from being generated to the Y-axis input latches.

e. Since both input signals to U7A are low, the output of U7A remains high. This high is applied through parallel buffer/drivers U19A and U19B to the X-axis input latches.

f. The outputs of U19A and U19B are also applied to NOR gate U17C (pin 8). The output of U17C (pin 10) is connected to Flag Generator U8 which generates a 25-microsecond Flag signal. The busy signal is routed through NAND gate U13A to the FLAG bus. The output of U8 is also applied to Write Pulse Generator U18.

g. The trailing edge of the 25-microsecond pulse from U8 triggers U18. When U18 is triggered, it produces a 10-microsecond write pulse. The Q output of U18 (pin 1) is the MODE signal that is applied to the external display through the STORAGE CONTROL connector, J41 (pin 1), on the rear panel of the instrument. In addition, the Q output of U18 is applied to NAND gate U12A. The output of U12A (pin 1) is applied to the base-bias network of Blank Switch transistor Q51. This action ensures that a 10-microseocnd unblanking signal is applied to the external display through J15, pin T (ZDSP signal).

Note

When programming this assembly, the Y function should be programmed first. Programming the X function automatically results in the aformentioned 10-microsecond unblanking signal.

h. Information on IBB0 through IBB9 is applied to to the D input of the associated input storage latches. When the clock signal becomes high, the information applied to the D input of these latches will be transferred to the Q output. The Q output of the latches will follow the data on the D input as long as the clock is high. When the clock pulse terminates (goes low), information that was present at the D input will be retained at the Q output until the clock again goes high.

4-276. The information that is retained at the Q outputs of the X-axis input storage latches is applied to the X-axis D/A converter circuit. This circuit consists of Q1 through Q19, Q49, and U9. It functions the same as the D/A converter circuit described in paragraphs 4-243 through 4-245.

4-277. The output of operational amplifier U9 is applied to the base of emitter follower Q50. Depending upon the digital information applied to the converter circuit, the emitter output of Q50 will vary from 0 to +10 volts. This output is applied to a 10:1 voltage divider network consisting of R35 and R107. The output of this network is the XDSP signal that is available at STORAGE CONTROL connector J41 (pin 11) on the rear panel of the instrument. The voltage range of the XDSP signal is 0 to +1 volt.

Note

For quick interconnection to a standard CRT external display, XDSP is jumpered directly to a BNC connector, X OUTPUT (J1), on the rear panel of the instrument.

4-278. When IBB1Ø is low, a clock pulse is developed by NOR gate U7B. NOR gate U7A is inhibited. This results in a clock pulse being applied to the Y-axis input storage latches. The outputs of the Y-axis storage latches are applied to the Y-axis D/A converter circuit. This circuit and the X-axis D/A converter circuit function identically.

4-279. The output of the Y-axis operational amplifier (U10) is applied to the base of emitter follower Q45. Depending upon the digital information applied to the converter circuit, the emitter output of Q45 will vary from 0 to +10 volts. This output is applied to a 10:1 voltage divider network consisting of R67 and R68. The output of this network is the YDSP signal that is available at STORAGE CONTROL connector J41 (pin 9) on the rear panel of the instrument. The voltage range of the YDSP signal is 0 to +1 volt.

Note

For quick interconnection to a standard CRT external display, YDSP is jumpered directly to a BNC connector, Y OUTPUT (J2), on the rear panel of the instrument.

4-280. Operational amplifiers U9 and U10 are used for generating X and Y signals from an external source. When Remote Display mode of operation is selected, data on IBB1Ø and IBB11 will be low. The data on IB8Ø will also be low. These logic states accomplish the following:

a. The data on IBB11 is applied through inverter U14A to NAND gate U11C (pin 9). The other input to U11C (pin 10) is the strobe pulse from inverter U14B. Upon receipt of the strobe pulse, both inputs to U11C will be high, causing the output of U11C to go low. This low state is applied to NOR gates U7C and U17D.

b. The data on IBB1Ø is applied directly to U17D and through inverter U7D to U7C. The inverted output of U7D holds the output of U7C low. This low is applied to NAND gate U11A. The low that is applied directly to an input on U17D will enable it. Upon receipt of the strobe pulse from NAND gate U11C, a clock pulse is generated in the output of U17D (pin 13). The clock pulse is applied to flip-flop U16B, transferring the data on IB8Ø to its Q output. The complementary output of U16B ($\overline{Q}$) is connected to NAND gate U11D (pin 12).

c. The other input to NAND gate U11D is the LP signal from Read/Multiplexer Assembly A07. In Program mode of operation, U11D (pin 13) is high. With both inputs to NAND gate U11D high, its output will be low.

4-281. The output of NAND gate U11D (pin 11) will be low when Remote Display/Program mode of operation is selected. The low, applied through DISPLAY OVERRIDE switch S1, accomplishes the following:

a. It is applied through inverter U14D to unblanking NAND gate U12A (pin 3).

b. It is applied to blanking NAND gate U12B (pin 6).

c. It is applied to bright dot NAND gate U12D (pin 12).

d. It is connected to STORAGE CONTROL connector J41 (pin 7) on the rear panel of the instrument. This is the LRDSPY applied to the external display.

e. It is applied to the base of transistor Q39. A low applied to the base of Q39 turns it off. When Q39 turns off, Q38 conducts. This action applies the +2-volt power supply to the D/A circuit control transistors.

f. It is applied to the base of control transistor Q40.

4-282. A low applied to the base of control transistor Q40 turns it off. With Q40 off, the following occurs:

a. Transistor Q41 is conducting, grounding U10 (pin 3) and allowing its output to be determined by the Y-axis D/A converter.

b. With Q43 conducting, FET Q44 and Q46 are biased off, disconnecting MPXSIG and HSWP from operational amplifiers U10 and U9.

c. When Q43 is turned off in LOCAL DISPLAY mode by the action of Q40, Q44 conducts. When Q44 conducts, it applies the HSWP signal from Scan D/A and Attenuator Assembly A12 to the (+) input on operational amplifier U9. The output of U9 was explained previously (paragraph 4-277).

4-283. The external display may employ a standard or storage type CRT. When a storage-type tube is used, an erase signal must be generated to precondition the CRT. When the Erase mode is programmed by the computer, the logic level on IBB1Ø will be high and the logic level on IBB11 will be low. In addition, the logic level on IBB1 will be low (ERASE command from the computer). These signals accomplish the following:

a. A low on IBB11 prevents a clock pulse from being applied to the Input Data Storage Register latches (paragraph 4-274).

b. The high from IBB1Ø is applied directly to NOR gates U7D (pin 12) and U17D (pin 12). The signal applied to U17D prevents a clock pulse from being generated to flip-flop U16B. This inhibits the Local-Remote selector signal that may be present on IB8Ø.

c. The high (IBB10) applied to NOR gate U7D results in a low being applied to NOR gate U7C (pin 9). Upon receipt of the strobe pulse from U11B (pin 8), the output of U7C goes high. This high is applied to NAND gate U11A (pin 2).

d. The low on IBB1 is inverted by U14E and applied to the other input on NAND gate U11A (pin 1). With both inputs high, the output of U11A (pin 3) becomes low.

4-284. The output of NAND gate U11A is applied to Erase Pulse Generator U15. The output of U15 is a 150-millisecond pulse (approximately) which accomplishes the following:

a. The $\overline{Q}$ output from U15 (pin 1) is a negative pulse of 150-millisecond duration. This pulse is the ERASE signal applied to an external display through STORAGE CONTROL connector J41 (pin 3) located on the rear panel of the instrument.

b. The Q output from U15 (pin 6) is a positive pulse that is applied to NAND gate U13C (pin 9). With both inputs high, U13C produces a 150-millisecond busy signal that is applied to the FLAG bus by way of connector J16 (pin 22). The output of U13C is wired-OR with the outputs of Flag gates U13A, B, and D.

c. The ERSVFY (Erase Verify) signal from the external display is applied through inverter U14F to NAND gate U13D. As long as the ERSVFY signal is low, U13D develops a busy signal which is applied to the FLAG bus by way of connector J16 (pin 22).

4-285. The bright-dot and blanking circuits on this assembly are controlled by the BRDOT and SAMPBLK signals. The BRDOT signal is developed by Scan D/A and Attenuator Assembly A12, and applied to this assembly through connector J15 pin 5. The SAMPBLK signal is developed by Digital Scan Assembly A13 and applied to this assembly through connector J15 (pin 4).

4-286. When operating in Local Display or Local mode of operation, U12B (pin 6) and U12D (pin 12) are high (via DISPLAY OVERRIDE switch S1). This high will enable these gates for application of the SAMPBLK and BRDOT signals.

4-287. When the SAMPBLK signal is generated by assembly A13, U12B (pin 5) goes high. With both inputs high, the output of U12B (pin 4) is low. This low is applied to the base-bias network of transistor Q51, turning it on. With Q51 conducting, the voltage drop across diodes CR2 and CR3 produces a +1-volt blanking signal that is applied through connector J15 (pin T) to STORAGE CONTROL connector J41 (pin 13) on the rear panel of the instrument. This is the ZDSP that is applied to the external display.

Note

For quick interconnection to a standard CRT external display, ZDSP is jumpered directly to a BNC connector, Z OUTPUT (J3), on the rear panel of the instrument.

4-288. When the BRDOT signal is generated by assembly A12, U12D (pin 11) goes high. With both inputs high, the output of U12D (pin 13) is low. This low is applied through inverter U14C to the base-bias network of transistor Q52, turning it on. With Q52 conducting, the voltage drop across resistor R104 produces a −0.3-volt bright-dot voltage that is applied through connector J14 (pin T) to STORAGE CONTROL connector J41 (pin 13). This is also the ZDSP that is applied to the external display.

4-289. LAMP DRIVER CIRCUITRY. (See schematics 28 and 29.)

4-290. Lamp Driver Assembly A15 controls the operation of the front-panel lamps. Since all lamp circuits function identically, only one circuit will be discussed.

4-291. A low state on IBB0 will be applied to buffer/driver U1A (pin 1). The output of U1A (pin 2) is applied to one terminal of lamp DS38. Since the other terminal of lamp DS38 is connected to a +5V bus, the lamp will light.

4-292. To test all lamps simultaneously, LAMP TEST switch S1 is provided. Moving the slide switch to the LAMP TEST position applies a ground to a set of buffer/drivers. (Each driver is associated with a particular lamp.) The output of the buffer/drivers will ground one terminal of each lamp, lighting all of them.

4-293. LOW VOLTAGE POWER SUPPLY. (See schematic 37.)

4-294. Low Voltage Power Supply Assembly A25 is a self-contained, detachable power supply used within the instrument. For disassembly, an exploded view is presented in Section VI of this manual.

4-295. The line power transformer A25T1 is connected in parallel with power transformer T1 associated with +5-volt Power Supply Assembly A17. Refer to paragraphs 4-307 and 4-308 for input power connections.

4-296. The low voltage supply produces four regulated voltages for use throughout the instrument: +100V, −100V, +15V, and −12.6V. Each supply is referenced to the +100V supply for regulation purpose, with the +100V supply referenced to a 9-volt temperature compensated zener diode (A25A2VR2). The +100V and −100V supplies are also foldback current limited, providing short-circuit protection.

4-297. +100-VOLT SUPPLY. The +100V supply is used throughout the LVPS as a reference for the other supplies.

It is both voltage and current regulated. Refer to the LVPS schematic 37 while reading the following explanation.

4-298. One of the secondary outputs of A25T1 is coupled to a bridge rectifier consisting of A25A1CR5 through CR8. This ac input is full-wave rectified, filtered by A25C1, and applied through fuse A25F1 to the regulator assembly. Fusing protects the rectifiers and transformer if a regulator malfunction results in excessive current flow. The regulator supplies sufficient current to the load to keep the output voltage at a constant +100 volts. Series regulator transistor A25Q1 is used to control the amount of current which will be supplied to the load to maintain the output voltage at +100V. Variations in output voltage to changes in load or input line voltage are sensed by a differential comparator A25A2Q3 and Q4. If the output of the +100V supply changes, the full amount of the voltage change is applied to A25A2Q3 by A25A2VR2. A25A2Q4 senses only a small part of the change in output voltage. The +100V adjustment potentiometer A25A2R11 sets the operating point of A25A2Q4. The output of the differential comparator is coupled to driver A25A2Q1, amplified and used to control series regulator A25Q1.

4-299. A current limiting function is also part of the +100V supply operation. All current furnished by the supply flows through A25A2R4. The voltage drop across this resistor depends on the amount of current required. As the current requirements increase to the limit of the supply capability, the voltage drop across A25A2R4 is used to set A25A2Q2 into conduction. Since the collector of this transistor and the output of differential comparator A25A2Q3 and Q4 are coupled to drive A25A2Q1, the amount of current flowing as well as voltage variations control the operation of series regulator A25Q1.

4-300. Resistors A25A2R2 and A25A2R3 are used in conjunction with A25A2R4 to set up a condition for current foldback operation. In this type of operating condition, fully regulated voltage will be provided to the limit of the supply capability. When current exceeds capability, the output voltage will begin to drop and the load will receive less current. If the output of the supply is short circuited, the output current will be limited to considerably less than the current available at full loading.

4-301. The +100V supply is protected for turn-on and turn-off voltage transients. Diodes A25A2CR1 and CR2 provide transient protection for transistors A25A2Q3 and Q4. To prevent the +100V supply from going negative in the event of an accidental short circuit (during troubleshooting, for example), diode A25A2CR3 provides reverse voltage protection.

4-302. A separate supply is used to obtain voltage for the +100V regulator. This supply is used only within the LVPS regulator. The ac voltage from pins 11 and 12 of A25R1 is bridge rectified by A25A1CR1 through CR4 and filtered by A25A1C1. The supply produces approximately +10V which is added to the +100V supply to provide a reference source for the +100V regulator. Zener diode A25A2VR1 stabilizes the collector voltage for A25A2Q3.

4-303. +15-VOLT POWER SUPPLY. The secondary voltage developed by the power transformer at pins 13 and 14 is full-wave bridge rectified by A25A1CR9 through CR12 and filtered by A25C2. Series regulator A25Q2 controls the amount of current supplied to the load to maintain the output voltage at +15V. Variations in output voltage are sensed by differential comparator A25A2Q7 and Q8. A reference voltage derived from the +100V regulated supply is applied to A25A2Q8, while A25A2Q7 samples any change in output voltage due to load changes. The +15V adjustment potentiometer A25A2R20 sets the operating point of A25A2Q8. The output of the differential amplifier is coupled to driver A25A2Q5 and used to control series regulator A25Q2.

4-304. Current drawn from the supply flows through A25A2R13. The voltage drop across this resistor is used to control the conduction of A25A2Q6 which has its collector coupled to driver A25A2Q5. Thus, large currents sensed by A25A2Q6 and voltage changes sensed by the differential amplifier are both fed to driver A25A2Q5 to control series regulator A25Q2. Protection from turn-on or turn-off transients is provided by A25A2CR4. Fuse A25F2 protects the LV rectifier and transformer in the event of a regulator short circuit.

4-305. −12.6-VOLT SUPPLY. This supply operates in a manner similar to the +15V supply. Changes in output voltage are sensed by differential comparator A25A2Q11 and Q12. Amplified and coupled to driver A25A2Q9, voltage variations are used to control the conduction of series regulator A25Q3. Current limiting action is provided by A25A2R22 and A25A2Q10. Fuse A25F3 protects against damage due to regulator failure and A25A2CR5 is used for voltage transient protection.

4-306. −100-VOLT SUPPLY. Operation of the −100V supply is similar to the +100V supply. A25A2Q15 and Q16 operate as a differential comparator with A25A2Q16 sensing any change in output voltage. Transistor A25A2Q14 with A25A2R33 provides current limiting. Current foldback operation reduces the current output in the event of a short circuited load. Voltage and current variations are coupled to driver A25A2Q13 which is used to control the conduction of series regulator A25Q4. Adjustment of the supply output voltage is accomplished with potentiometer A25A2R40. Diode A25A2CR7 provides reverse voltage protection. The differential comparator is voltage transient protected by A25A2CR6.

4-307. +5-VOLT POWER SUPPLY. (See schematic 31.)

4-308. Input line power is supplied by a detachable, three-conductor power cord. This cord has a standard plug for wall-outlet connection, providing an electrical ground. Instrument power input is by way of a rear-panel IEC

connector. Both sides of the line power are filtered immediately at the power input connector by filter FL1.

4-309. The input power lines from FL1 are applied through fuse F1 (rear panel), LINE switch S1 (front panel), and LINE SELECT switch S2 (rear panel) to the primary of two power transformers. Chassis-mounted transformer T1 is associated with the +5-volt Power Supply Assembly A17. The other power transformer, A25T1, is associated with the Low Voltage Power Supply Assembly A25.

4-310. Power transformer T1 has two primary windings. LINE SELECT switch S2 connects these windings in parallel for 115V operation or in series for 230V operation. Fuse F1 protects the instrument against excessive input current. With the front panel LINE switch in the ON position, power is applied to the input power transformers and to power lamp DS39 (see schematic 37 for lamp connection).

4-311. The +5V Power Supply produces two regulated voltages for use throughout the instrument. These voltages are −15 volts and +5 volts. The −15V section consists of Q3, A17Q1, A17Q2, and A17U1. The +5V section consists of Q1, Q2, A17Q3 through A17Q7. Thyristor SCR1 is an over-voltage protection device that limits the supply output to +5 volts. This protects the Integrated Circuits (IC) used throughout the instrument from over-voltage application.

4-312. The −15V Power Supply will be discussed first. Line voltage from power transformer T1 is rectified by diode bridge A17CR1 through A17CR4. The rectified ac voltage is filtered by C2. The unregulated dc voltage is applied to the emitter of series regulator Q3. A voltage divider network, consisting of A17R8, A17R9, and A17R10, is connected from the −15V output to ground. The −15V adjustment, A17R9, is used to establish the input level to feedback amplifier A17U1. Any variation in output voltage is sensed by A17U1 and applied to the cathode of breakdown diode A17VR1. The anode of A17VR1 is connected to the center tap of voltage divider A17R2 and A17R25 which furnishes the base bias for driver transistor A17Q1. Therefore, variations in the −15V output are applied to the base of A17Q1 through A17U1 and A17VR1. Conduction through A17Q1 will either increase or decrease according to the changes in base bias. The changes in conduction are reflected by changes in the voltage drop across A17R1. Conduction variations through A17R1 result in corresponding voltage variations being applied to the base of series regulator Q3 thereby controlling its conduction. Conduction through Q3 will either increase of decrease until an output of −15 volts is reestablished.

4-313. Current drawn from the −15V supply flows through A17R4. The voltage drop across this resistor is used to control the conduction of A17Q2 which has its collector connected to the base of driver A17Q1. Thus, large currents sensed by A17Q2 and voltage variations sensed by A17U1 are both fed to driver A17Q1 to control series regulator Q3.

4-314. The +5V Power Supply functions similarly to the −15V Power Supply. Line voltage from power transformer T1 is rectified by rectifier element CR1 which is mounted on the chassis. The rectified ac voltage is filtered by C1. The unregulated dc voltage is applied to the collector of series regulator Q1 through fuse F2. Series regulator Q1 determines the amount of current supplied to the load to maintain the output voltage at +5 volts. Variations in output voltage are sensed by differential comparator A17Q5 and A17Q6. A reference voltage derived from the −15V regulated supply is applied to A17Q5 while A17Q6 samples any variation in output voltage due to load changes. Voltage variations occurring at the collector of A17Q6 are applied to the base of driver A17Q3. Therefore, variations in the +5V output are applied to the base of A17Q3, resulting in an increase or decrease in conduction. Changes in conduction are reflected in the voltage drop across A17R11 which is applied to the base of control transistor Q2. The output of Q2 controls the base bias for series regulator Q1.

4-315. Current drawn from the +5V supply flows through parallel resistors A17R14A and A17R14B. The voltage drop across these resistors is used to control the conduction of A17Q4 which has its collector connected to the base of driver A17Q3. Thus large currents sensed by A17Q4 and voltage variations sensed by differential comparator A17Q5/A17Q6 are both fed to driver A17Q3 to control series regulator Q1.

4-316. Transistor A17Q7 is the control element for Thyristor SCR1. The base bias applied to A17Q7 is controlled by a voltage divider network consisting of A17R21, A17R22, and A17VR3. An increase in the +5 volts applied to its emitter will result in an increase in current flow through A17R23, A17R24, and the transistor. With an increase in current flow, the voltage at the junction of A17R23 and A17R24 increases (becomes more positive). The voltage developed at the junction of A17R23 and A17R24 is applied to the gate of SCR1. A positive voltage increase applied to the gate of SCR1 will cause it to conduct heavily. This action will open fuse F2.

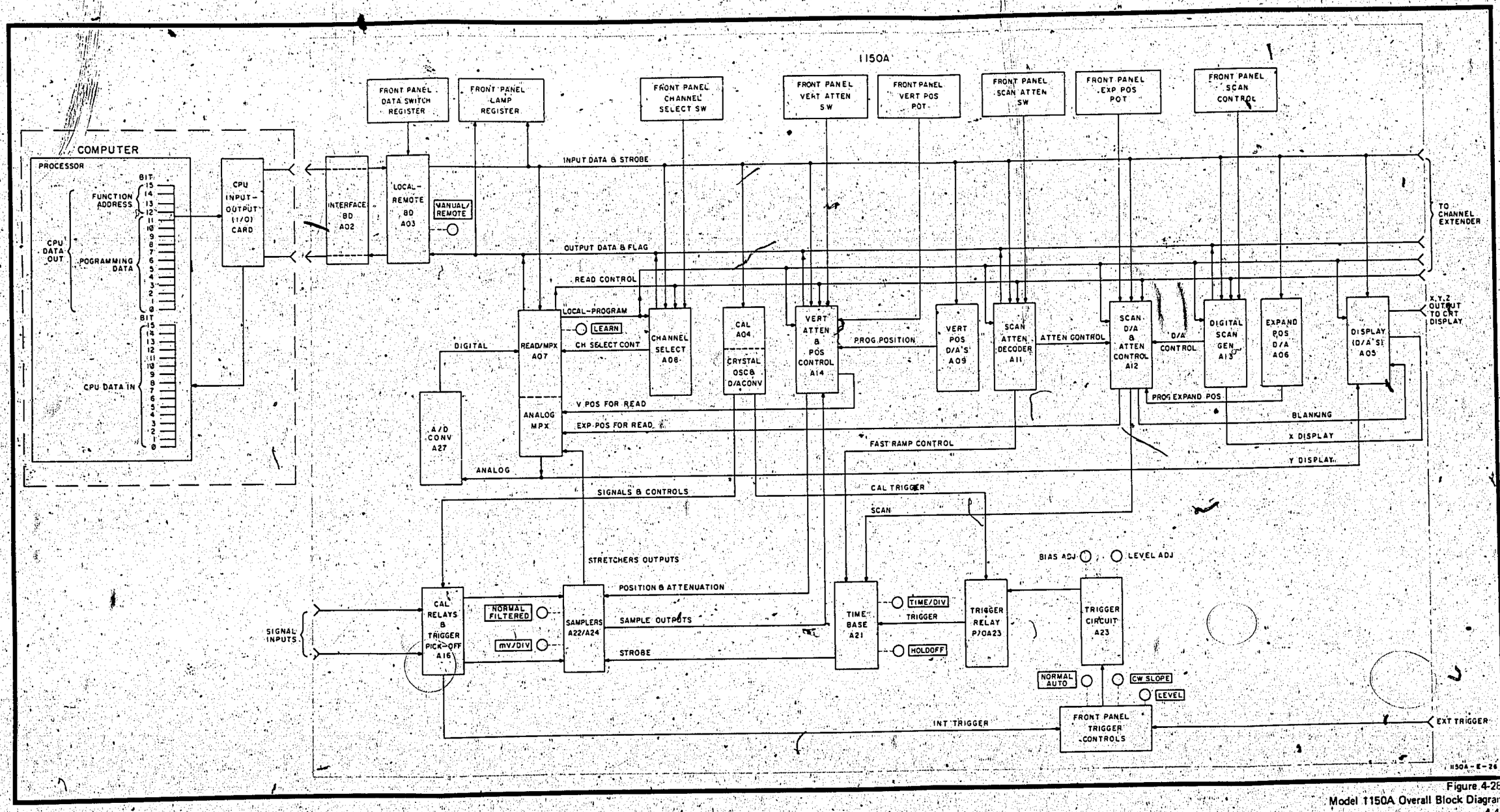


Figure 4-26
Model 1150A Overall Block Diagram

Table 5-1. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Monitor Oscilloscope	HP 180A W/ HP 1801A and HP 1820A plug-ins	50-MHz oscilloscope system	Performance check and trigger adjustment
X-Y Display	HP 1331A	Storage; bandwidth 1 MHz; 0.1 V/div	Performance check and adjustments
Fast Risetime Pulse Generator	HP 213A	≤100 ps risetime at ≥175 mV	Sampler adjustments
Digital Voltmeter	HP 3439A W/ HP 3444A plug-in	100 mV; four significant digits	D/A converter adjustments
Digital Computer	HP 2116B	8K or larger memory	Performance check
Teletypewriter	HP 2752	Computer interface	Performance check
Tape Reader	HP 2748A	Computer interface	Performance check
Interface Kit	HP 10487A	CPU interface	Performance check
Cable Assembly	HP 10488A	X-Y-Z display interconnect	Performance check
Cable Assembly	HP 10489A	Storage display interconnect	Performance check and adjustments
Electronic Counter	HP 5245L W/ HP 5252A plug-in	50 MHz ±0.02%	Performance check
10:1 Divider Probe	HP 10004B	3% accuracy	Performance check and adjustments
Pulse Generator	HP 8007A	Risetime: <50 ns Pulse width: >30 ns Rep. rate: 10 kHz to 1 MHz Duty cycle: <20%	Performance check

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SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures for checking the instrument specifications as given in table 1-1. These specifications are checked by a verification tape furnished with Model 10487A Interface Kit. The procedures for making all internal adjustments are covered in paragraph 5-19 through 5-49. Photographs showing the location of all internal adjustment controls are also furnished in this section.

5-3. TEST EQUIPMENT.

5-4. Test equipment required for procedures in this section is listed in table 5-1. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics listed in the table. For best results, use recently calibrated test equipment.

5-5. PERFORMANCE CHECK.

5-6. The performance check can be used as part of an incoming inspection, as a periodic operational test, or to check calibration after repairs or adjustments have been made.

5-7. PRELIMINARY SETUP.

5-8. Interconnect Model 1150A with the CPU (Central Processing Unit) by following the instructions given in the operating note for Model 10487A Interface Kit. Apply power to Model 1150A and allow 1 hour for warm up. If an error is indicated while running the specification verification tape, refer to the appropriate appendix in the Programmer Software Manual (HP Part No. 01150-9000) and determine the cause of the malfunction. Isolate the trouble to a particular assembly and then perform the adjustment procedures (given in this section) for that assembly.

5-9. SPECIFICATION VERIFICATION TAPE.

5-10. A Specification Verification Program Tape, HP Part No. 10487-91402 is furnished with Model 10487A Interface Kit. The tape will check the performance of Model 1150A against those specifications listed in table 1-1. To accomplish the performance check, use the tape in accordance with the procedures given in the Programmer Software Manual. Prior to running the tape it is recommended that the manual performance check which follows be accomplished.

5-11. MANUAL PERFORMANCE CHECK.

5-12. INITIAL SETUP CONDITIONS.

Note

If the cable connecting J38 to the CPU has been removed, a jumper wire must be connected from J19 pin 2 to ground. This will allow Program mode simulation from the front-panel MANUAL INPUT switches.

5-13. To establish initial operating conditions for performance checks and adjustment procedures, set Model 1150A front-panel controls as follows:

a. MANUAL INPUT switches to off (down) position.

b. MANUAL/REMOTE switch to MANUAL position.

c. A TRACE switch to Channel 1 position.

d. B TRACE switch to OFF position.

e. CHANNEL 1 mV/DIV switch to 200 mV/DIV position.

f. CHANNEL 2 mV/DIV switch to 200 mV/DIV position.

g. NORMAL/FILTER switch to NORMAL position.

h. EXPAND/DIRECT switch to DIRECT position.

i. Main TIME/DIV switch to 20 ns position.

j. Expanded TIME/DIV switch to 10 ns position.

k. DOTS/SCAN switch to 1024 position.

l. SAMPLES/DOT switch to 1 position.

m. Trigger switch to INT.

n. Trigger source to CHANNEL 1.

o. CW/SLOPE to (+) position.

p. NORMAL/AUTO switch to NORMAL.

q. HOLDOFF control fully ccw.

5-14. CALIBRATOR ASSEMBLY A04 PERFORMANCE CHECK.

Note

Throughout the performance checks and adjustment procedures, the various MANUAL INPUT switch settings will be given in Octal Code. Refer to table 5-2 for example.

5-15. Calibrator Assembly A04 is used in conjunction with the specification verification tape provided in Interface Kit, Model 10487A. The performance of the 50-MHz Oscillator and associated countdown circuits on assembly A04 is accomplished as follows:

a. Set LINE power switch on Model 1150A to off.

b. Remove assembly A04 from Model 1150A.

c. Use Extender Assembly A19 and reinstall assembly A04 into Model 1150A.

d. Set LINE power switch on Model 1150A to ON.

e. Set front-panel controls of Model 1150A in accordance with paragraphs 5-12 and 5-13.

f. Use front-panel MANUAL INPUT switches and select Octal Code 044003 (refer to table 5-2 for Octal Code example). Press LOAD pushbutton switch.

Note

Hereafter, reference to LOAD a particular Octal code indicates that the operator should manually set up the selected Octal code on front-panel MANUAL INPUT switches and then press LOAD pushbutton switch.

g. Connect electronic counter to junction of resistors A04R94 and A04R95 using 10:1 divider probe (see figure 8-31 for component location). Electronic counter should indicate 50 MHz ±0.2%.

h. LOAD Octal code 044002. Electronic counter should indicate 50 MHz ±0.2%.

i. LOAD Octal code 044000. Electronic counter should indicate 50 kHz ±0.2%.

j. Set LINE power switch on Model 1150A to off.

k. Remove assembly A04 and Extender Assembly A19 from Model 1150A.

l. Reinstall assembly A04 into Model 1150A.

m. Set LINE power switch on Model 1150A to ON.

5-16. The performance check for the Calibrator Assembly A04 D/A Converter circuit is listed in table 5-3. The table should be accomplished in numerical step sequence.

5-17. TRIGGER CIRCUIT PERFORMANCE CHECK.

5-18. The performance check for the trigger circuit in Model 1150A is accomplished as follows:

a. Set pulse generator for following pulse output characteristics:

Pulse width	200 ns
Leading edge transition time	50 ns
Polarity	(+)
Amplitude	200 mV
Repetition rate	1 MHz

b. Connect pulse generator to CHANNEL 1 INPUT connector on Model 1150A.

c. Connect Model 1150A X-Y-Z connectors to monitor display.

d. Set initial setup conditions in accordance with paragraphs 5-12 and 5-13 except set TIME/DIV control to 0.1 usec/div. Model 1150A should trigger.

Table 5-2. Octal Coding Example

MANUAL INPUT SWITCHES	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OCTAL CODE WEIGHT	1	4	2	1	4	2	1	4	2	1	4	2	1	4	2	1
INPUT DIGITAL CODE	0	1	0	1	0	0	1	0	1	1	0	0	0	1	1	1
OCTAL CODE (051307)	(0)	(5)			(1)			(3)			(0)			(7)		

e. Model 1150A should remain triggered as input pulse parameters are varied as follows:

Duty cycle	<20%
Repetition rate	10 kHz to 1 MHz
Leading edge transition time	50 ns or less
Amplitude	+200 mV to +1V
Trigger confidence	>95% without readjustment

Table 5-3. Assembly A04 Performance Check

Step	MANUAL INPUT Switches	TEST EQUIPMENT	TEST EQUIP Indication	Go to
1	LOAD Octal Code 046010	Connect digital voltmeter to point A04D/A (figure 8-31)	−1.600V ±5 mV	Step 2
2	LOAD Octal Code 046011	Same as Step 1	−1.400V ±5 mV	Step 3
3	LOAD Octal Code 046012	Same as Step 1	−1.200V ±5 mV	Step 4
4	LOAD Octal Code 046013	Same as Step 1	−1.000V ±5 mV	Step 5
5	LOAD Octal Code 046014	Same as Step 1	−0.800 ±5 mV	Step 6
6	LOAD Octal Code 046015	Same as Step 1	−0.600V ±mV	Step 7
7	LOAD Octal Code 046016	Same as Step 1	−0.400V ±5 mV	Step 8
8	LOAD Octal Code 046017	Same as Step 1	−0.200V ±5 mV	Step 9
9	LOAD Octal Code 046000	Same as Step 1	0.000V ±5 mV	Step 10
10	LOAD Octal Code 046001	Same as Step 1	+0.200V ±5 mV	Step 11
11	LOAD Octal Code 046002	Same as Step 1	+0.400V ±5 mV	Step 12
12	LOAD Octal Code 046003	Same as Step 1	+0.600V ±5 mV	Step 13
13	LOAD Octal Code 046004	Same as Step 1	+0.800V ±5 mV	Step 14
14	LOAD Octal Code 046005	Same as Step 1	+1.000V ±5 mV	Step 15

Table 5-3. Assembly A04 Performance Check (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	TEST EQUIP Indication	Go to
15	LOAD Octal Code 046006	Same as Step 1	+1.200V ±5 mV	Step 16
16	LOAD Octal Code 046007	Same as Step 1	+1.400V ±5 mV	Step 17
17	LOAD Octal Code 046000	Connect digital voltmeter to test point A04AT (figure 8-31)	0.000V ±5 mV	Step 18
18	LOAD Octal Code 046005	Same as Step 17	+1.000V ±5 mV	Step 19
19	LOAD Octal Code 046025	Same as Step 17	+0.500V ±2.5 mV	Step 20
20	LOAD Octal Code 046045	Same as Step 17	+0.250V ±1.25 mV	Step 21
21	LOAD Octal Code 046065	Same as Step 17	+0.100V ±0.5 mV	Step 22
22	LOAD Octal Code 046105	Same as Step 17	+0.050V ±0.75 mV	Step 23
23	LOAD Octal Code 046125	Same as Step 17	+0.010V ±0.5 mV	paragraph 5-17

5-19. ADJUSTMENT PROCEDURE.

5-20. The following paragraphs outline the procedure for accomplishing the adjustments required for the Model 1150A. Use the equipment recommended in table 5-1 or similar equipment having at least equivalent capability. Use a nonmetallic adjustment tool when making adjustments.

5-21. The adjustment procedures should be performed in the sequence listed, since some adjustments are dependent on control settings and results of previous steps. The adjustments may be accomplished individually, if desired, by referring to the preliminary control settings and the steps before the desired procedure.

5-22. COVER REMOVAL.

5-23. The top and side covers, and the rear Low Voltage Supply access panel must be removed to gain access to adjustment locations. Removal of the covers can be accomplished as follows:

a. Ensure that LINE power switch is off.

b. Disconnect power plug from ac power source.

c. Remove four screws holding top cover in place.

d. Remove cover by sliding toward rear of instrument.

e. Remove six screws from right side panel that covers assembly A23 (see figure 8-5 for assembly location).

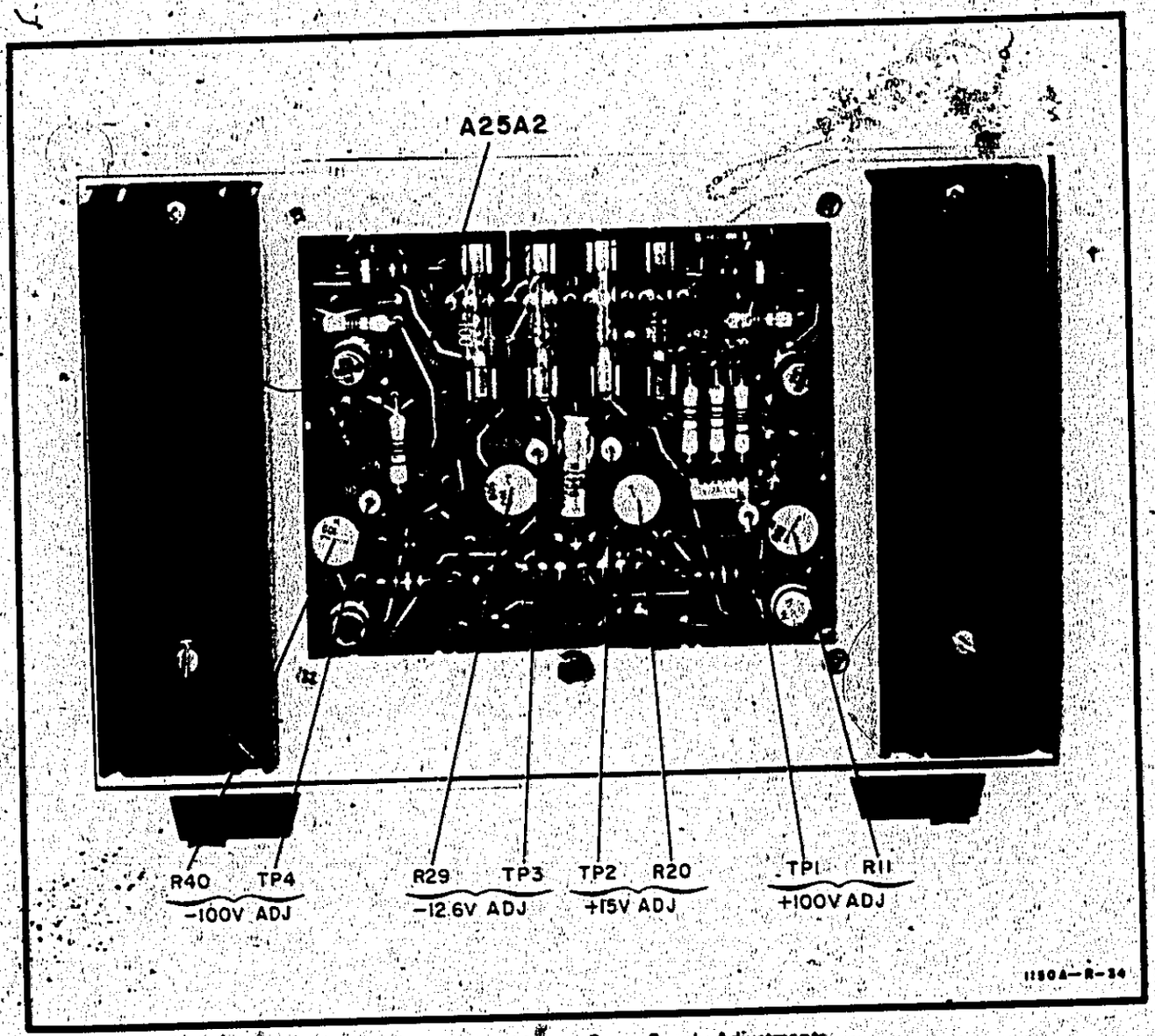


Figure 5-1. Low Voltage Power Supply Adjustments

f. Remove side panel.

g. Loosen captive screw holding rear access panel on LVPS.

h. Remove access panel.

5-24. Connect instrument to 115 Vac power source and turn LINE power switch to ON. Allow 1 hour warm up period for proper operation of instrument.

5-25. Adjustment locations, except for assemblies A17 and A23, are identified in the photographs at the end of this section. The pages may be folded out for easy reference while performing the adjustments.

5-26. LOW VOLTAGE POWER SUPPLY ADJUSTMENTS.

5-27. Adjustment of Low Voltage Power Supply Assembly A25 is as follows:

a. Connect digital voltmeter to +100V test point TP1 (figure 5-1).

b. Set +100V adjust R11 to obtain indication on digital voltmeter of +100V ±0.1V.

c. Connect digital voltmeter to +15V test point TP2.

d. Set +15V adjust R20 to obtain indication on digital voltmeter of +15V ±0.1V.

e. Connect digital voltmeter to −12.6V test point TP3.

f. Set −12.6V adjust R29 to obtain indication on digital voltmeter of −12.6V ±0.1V.

g. Connect digital voltmeter to −100V test point TP4.

h. Set −100V adjust R40 to obtain indication on digital voltmeter of −100V ±0.1V.

5-28. POWER SUPPLY ASSEMBLY A17 ADJUSTMENT.

5-29. Adjustment of Power Supply Assembly A17 is as follows:

a. Connect digital voltmeter to −15V test point A17TP1 (see figure 8-71 for test point and adjustment location).

b. Set −15V ADJ potentiometer A17R9 to obtain indication on digital voltmeter of −15V ±15 mV.

5-30. TRIGGER ASSEMBLY A23 ADJUSTMENT.

5-31. Adjustment of Trigger Assembly A23 is as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. Disconnect all external inputs from CHANNEL 1 INPUT and CHANNEL 2 INPUT connectors on rear panel of instrument.

c. LOAD Octal Code 040000. (This will ensure that Calibrator Assembly is disconnected from trigger circuit.)

d. Connect monitor oscilloscope to A23TP6 using 10:1 divider probe (see figure 8-79 for test point and adjustment locations).

e. Set monitor oscilloscope time base TIME/DIV. switch for 0.1 usec.

f. Set monitor oscilloscope vertical amplifier V/DIV switch for 0.02 Volts/Div.

g. Adjust monitor oscilloscope for stable display.

h. Adjust Model 1150A front-panel trigger LEVEL control for maximum frequency display on monitor oscilloscope.

i. Adjust A23R29 BIAS ADJ for 11 cycles per 10 divisions of display (11 cycles per microsecond).

j. Adjust A23R25 LEVEL ADJ for most symmetrical display on monitor oscilloscope.

k. Since Adjustments A23R25 and A23R29 interact, repeat steps i and j until best symmetry is obtained.

5-32. CALIBRATOR ASSEMBLY A04 ADJUSTMENT.

5-33. Adjustment of the 50-MHz oscillator is as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. LOAD Octal Code 074000. (LOCAL mode of operation.)

c. Connect X-Y display (HP Model 1331A) to instrument using X-, Y-, Z- connectors on rear panel of Model 1150A.

d. LOAD Octal Code 044003. (This selects Calibrator Assembly.)

e. Observe 50-MHz oscillator display on X-Y display unit.

f. Adjust A04C20 (figure 5-3) until oscillator free-runs. Adjust C20 for center of free-run range.

5-34. Adjustment of D/A Converter section on Calibrator Assembly A04 is as follows:

a. LOAD Octal Code 046010.

b. Monitor D/A test point on assembly A04 with digital voltmeter (see figure 8-31 for test point location).

c. Adjust A04R76 for −1.600V indication on digital voltmeter.

d. LOAD Octal Code 046000.

e. Adjust A04R36 for 0.000V indication on digital voltmeter.

f. LOAD Octal Code 046004.

g. Adjust A04R39 for +0.800V indication on digital voltmeter.

h. LOAD Octal Code 046002.

i. Adjust A04R42 for +0.400V indication on digital voltmeter.

5-35. Nulling the attenuator offset on Calibrator Assembly A04 is accomplished as follows:

a. LOAD Octal Code 046000.

b. Monitor A/T test point on assembly A04 with digital voltmeter.

c. Adjust A04R68 for indication of 0.000V on digital voltmeter.

5-36. DISPLAY CONTROL ASSEMBLY A05 ADJUSTMENT. (See figure 5-4.)

5-37. Adjustment of Display Control Assembly A05 is as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. Accomplish table 5-4.

5-38. EXPAND POSITION ASSEMBLY A06 ADJUSTMENT.

5-39. Adjustment of Expand Position Assembly A06 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. LOAD Octal Code 060000.

c. Connect digital voltmeter to test point D/A on assembly A06 (see figure 8-39 for test point location).

d. Observe error from 0V and algebraically add to following adjustments.

e. LOAD Octal Code 060100.

f. Adjust A06R30 (figure 5-5) for digital voltmeter indication of +1.253V +offset.

g. LOAD Octal Code 060200.

h. Adjust A06R6 for digital voltmeter indication of +2.505V +offset.

i. LOAD Octal Code 060400.

j. Adjust A06R4 for digital voltmeter indication of +5.010V +offset.

5-40. VERTICAL POSITION ASSEMBLY A09 ADJUSTMENT. (See figure 5-6.)

5-41. Adjustment of Vertical Position Assembly A09 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

Table 5-4. Assembly A05 Adjustments

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
1	LOAD Octal Code 074001				Step 2
2	LOAD Octal Code 056001				Step 3
3	LOAD Octal Code 050000	Connect digital voltmeter to test point X (figure 8-35)		Observe error from 0V. Algebraically add to all adjustments	Step 4
4	LOAD Octal Code 050100	Same as step 3	A05R31	+0.6256V +offset	Step 5
5	LOAD Octal Code 050200	Same as step 3	A05R6	+1.251V +offset	Step 6

Table 5-4. Assembly A05 Adjustments (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
6	LOAD Octal Code 050400	Same as step 3	A05R3	+2.502V +offset	Step 7
7	LOAD Octal Code 051000	Same as step 3	A05R1	+5.005V +offset	Step 8
8	LOAD Octal Code 052000	Connect digital voltmeter to test point Y (figure 8-35)		Observe error from 0V. Algebraically add to all adjustments	Step 9
9	LOAD Octal Code 052100	Same as step 8	A05R65	+0.6256V +offset	Step 10
10	LOAD Octal Code 05220	Same as step 8	A05R40	+1.251V +offset	Step 11
11	LOAD Octal Code 052400	Same as step 8	A05R37	+2.503V +offset	Step 12
12	LOAD Octal Code 053000	Same as step 8	A05R42	+5.005V +offset	paragraph 5-38

b. Turn off ac power to Model 1150A; then turn on.

c. Accomplish table 5-5.

5-42. SCAN D/A AND ATTENUATOR ASSEMBLY A12 ADJUSTMENTS. (See figure 5-5.)

5-43. Adjustment of Scan D/A and Attenuator Assembly A12 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. Accomplish table 5-6.

5-44. TIMING ASSEMBLY A21 ADJUSTMENT.

5-45. Adjustment of Timing Assembly A21 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. Connect X-Y display (calibrated for 1 V/div) to instrument, using X-, Y-, Z- connectors on rear panel of Model 1150A.

c. LOAD Octal Code 074000 (LOCAL mode).

d. Adjust front-panel Channel 1 POSITION control to set sweep to center of CRT display.

e. LOAD Octal Code 044003.

f. Adjust A21R73 (figure 5-3) for exactly 1 cycle per division.

g. Adjust A21R8 clockwise until sweep stops; then, adjust A21R8 counterclockwise until sweep just starts.

h. Continue to adjust A21R8 counterclockwise for 6-nanosecond delay as observed on X-Y display.

Table 5-5. Assembly A09 Adjustments

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
1	LOAD Octal Code 110000	Connect digital voltmeter to test point D/A1 (figure 8-49)		Observe error from 0V. Algebraically add to all adjustments	Step 2
2	LOAD Octal Code 110100	Same as step 1	A09R31	+1.252V +offset	Step 3

Table 5-5. Assembly A09 Adjustments (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
3	LOAD Octal Code 110200	Same as step 1	A09R6	+2.505V +offset	Step 4
4	LOAD Octal Code 110400	Same as step 1	A09R3	+5.010V +offset	Step 5
5			Set Channel Select A TRACE switch to Channel 2		Step 6
6	LOAD Octal Code 110000	Connect digital voltmeter to test point D/A2 (figure 8-49)		Observe error from 0V. Algebraically add to all adjustments	Step 7
7	LOAD Octal Code 110100	Same as step 6	A09R65	+1.253V +offset	Step 8
8	LOAD Octal Code 110200	Same as step 6	A09R40	+2.505V +offset	Step 9
9	LOAD Octal Code 110400	Same as step 6	A09R37	+5.010V +offset	Step 10
10			Set Channel Select A TRACE switch to Channel 1		paragraph 5-42

Table 5-6. Assembly A12 Adjustments

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
1	LOAD Octal Code 074001				Step 2
2			Set EXP POS OVR switch A21S1 to its OFF position		Step 3
3	LOAD Octal Code 060000				Step 4
4	LOAD Octal Code 152000	Connect digital voltmeter to test point D/A (figure 8-56)	A12R74	0.000V	Step 5
5		Connect digital voltmeter to test point AT1 (figure 8-56)	A12R77	0.000V	Step 6
6		Connect digital voltmeter to test point AT2 (figure 8-56)	A12R103	0.000V	Step 7

Table 5-6. Assembly A12 Adjustments (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
7		Connect digital voltmeter to test point AT3 (figure 8-56)	A12R146	0.000V	Step 8
8	LOAD Octal Code 152100	Connect digital voltmeter to test point D/A (figure 8-56)	A12R72	+0.6256V	Step 9
9	LOAD Octal Code 152200	Same as step 8	A12R65	+1.251V	Step 10
10	LOAD Octal Code 152400	Same as step 8	A12R67	+2.502V	Step 11
11	LOAD Octal Code 153000	Same as step 8	A12R69	+5.005V	paragraph 5-44

5-46. SAMPLING ASSEMBLIES A22 AND A24 ADJUSTMENTS.

5-47. Adjustment of Sampling Assembly A22 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. LOAD Octal Code 040000.

c. LOAD Octal Code 074000.

d. Connect fast risetime pulse generator to CHANNEL 1 INPUT connector on rear panel of instrument.

e. Connect X-Y display to instrument using X-, Y-, Z- connectors on rear panel of Model 1150A.

f. Adjust fast risetime pulse generator for a stable display on CRT.

g. Set EXPAND/DIRECT switch (Model 1150A) to EXPAND position.

h. Set main TIME/DIV control to 10 nanoseconds.

i. Set expanded TIME/DIV control to 0.1 nanosecond.

j. Adjust expand POSITION control to center positive slope of pulse (adjust Channel Sensitivity and Channel Position controls as required).

k. Adjust Channel 1 TR (A22R8) for 340-picosecond risetime (figure 5-3).

l. Set expanded TIME/DIV control to 0.5 nanosecond.

m. Set DOTS/SCAN control to 128.

n. Adjust Channel 1 response A22R22 for 100% sampling efficiency (figure 5-2).

o. Step n adjustment interacts with step j above. Repeat steps j through n until correct risetime and sampling efficiency are obtained.

p. Disconnect fast risetime pulse generator from CHANNEL 1 INPUT and connect CHANNEL A of monitor oscilloscope to CHANNEL 1 INPUT connector on Model 1150A.

q. Set monitor oscilloscope vertical plug-in as follows:

Volts/Div	0.005
Display	A
Input Coupling	AC
Polarity	+UP
Position	as required

r. Set monitor oscilloscope time base as follows:

Time/Div	0.1 usec

s. Adjust monitor oscilloscope trigger level for stable display of strobe kickout.

t. Adjust A22R9 for minimum strobe kickout amplitude on monitor oscilloscope.

u. Repeat steps n through t to correct for interaction.

v. Repeat steps d through t for Channel 2 (Assembly A24).

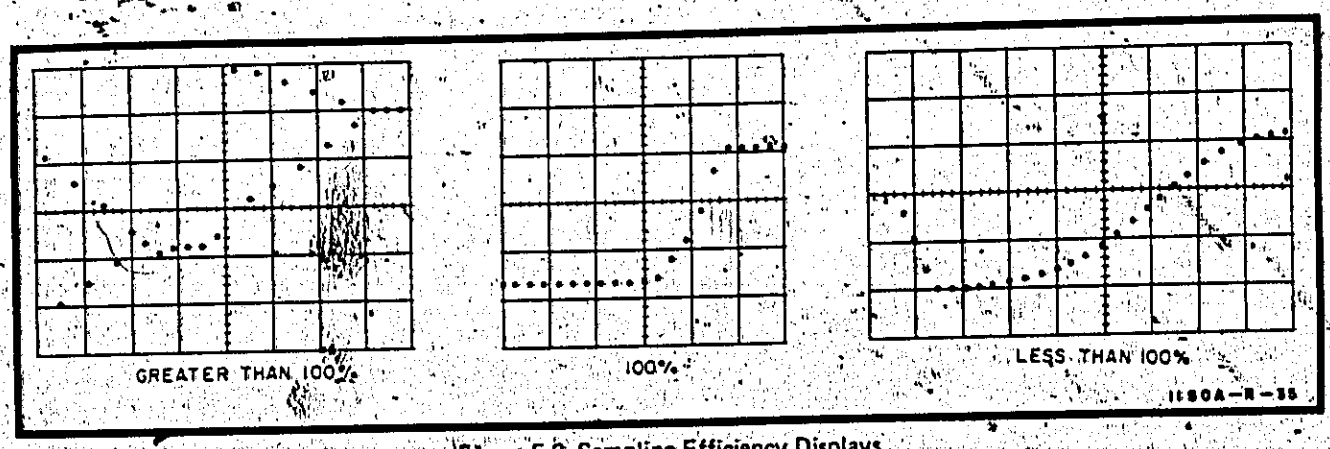


Figure 5-2. Sampling Efficiency Displays

5-48. VERTICAL ATTENUATOR ASSEMBLY A14 ADJUSTMENTS.

5-49. Adjustment of Vertical Attenuator Assembly A14 is accomplished as follows:

a. Accomplish paragraphs 5-12 and 5-13.

b. Accomplish table 5-7.

Note

In step 2 of table 5-7, ensure that Model 1150A is in Local mode of operation (front-panel LOCAL lamp will be lit). If Model 1150A is not in Local mode, LOAD Octal Code 074000. Accomplish step 2 of table 5-7 again and then go to step 3.

Table 5-7. Assembly A14 Adjustments

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
1			Set main TIME/DIV switch S33 to 0.1 microsecond		Step 2
2	LOAD Octal Code 070016	Connect digital voltmeter to test point Y on Assembly A05 (figure 8-35)			NOTE after paragraph 5-49
3	LOAD Octal Code 046000	Same as step 2	Front-panel Channel 1 POSITION control R7	+5.000V	Step 4
4	LOAD Octal Code 046004	Same as step 2	A14R43 (figure 5-4)	+9.000V	Step 5
5	LOAD Octal Code 046000	Same as step 2	Turn fully clockwise front-panel Channel 1 POSITION Control R7		Step 6
6		Same as step 2	A14R100	+10.000V	Step 7
7		Connect digital voltmeter to test point A14AT2 (figure 8-63)	Front-panel Channel 1 POSITION control R7	+5.000V	Step 8
8		Connect digital voltmeter to test point Y on Assembly A05 (figure 8-35)	A14R105	+5.000V	Step 9

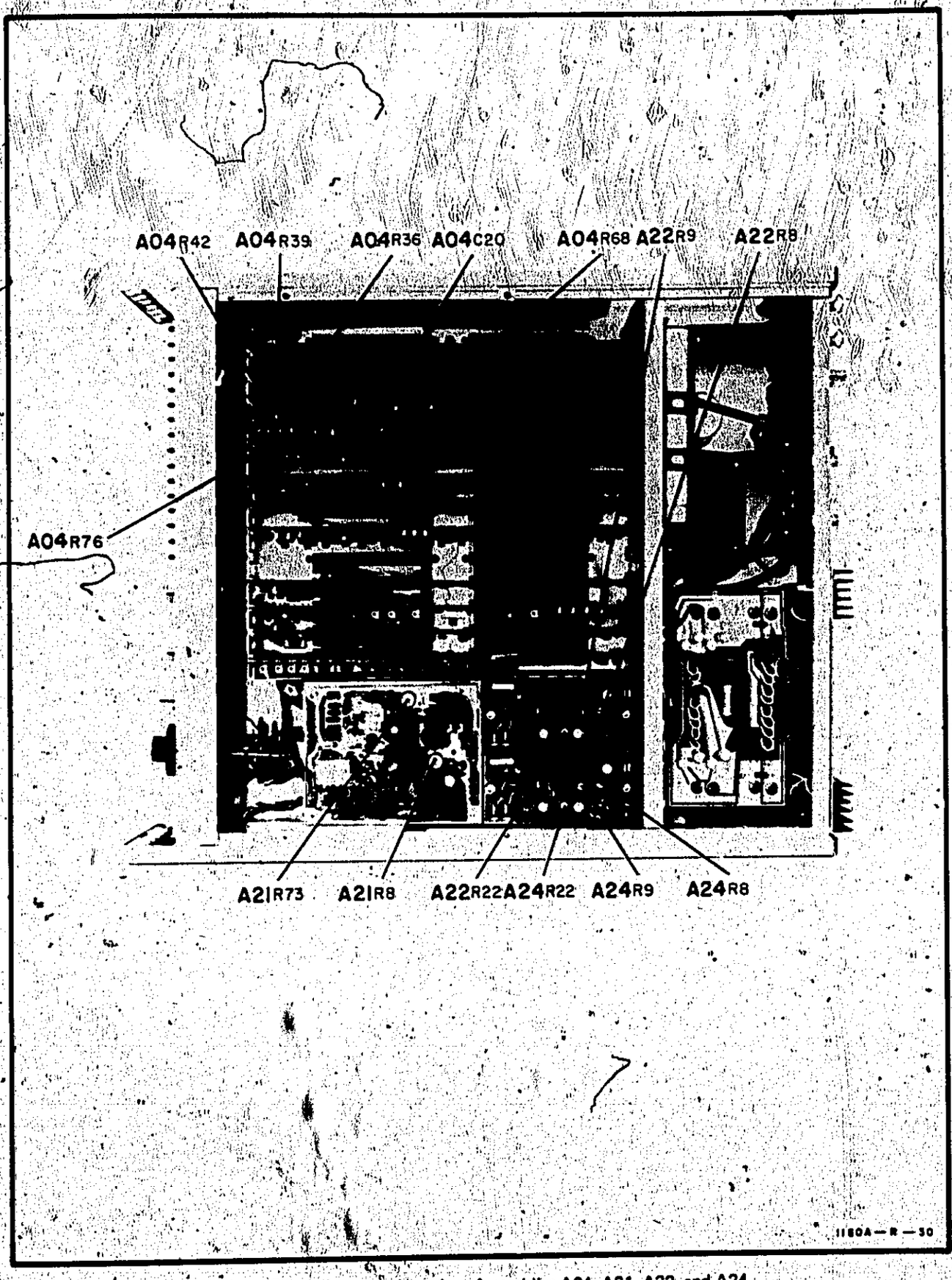


Figure 5-3. Adjustment Location, Assemblies A04, A21, A22, and A24

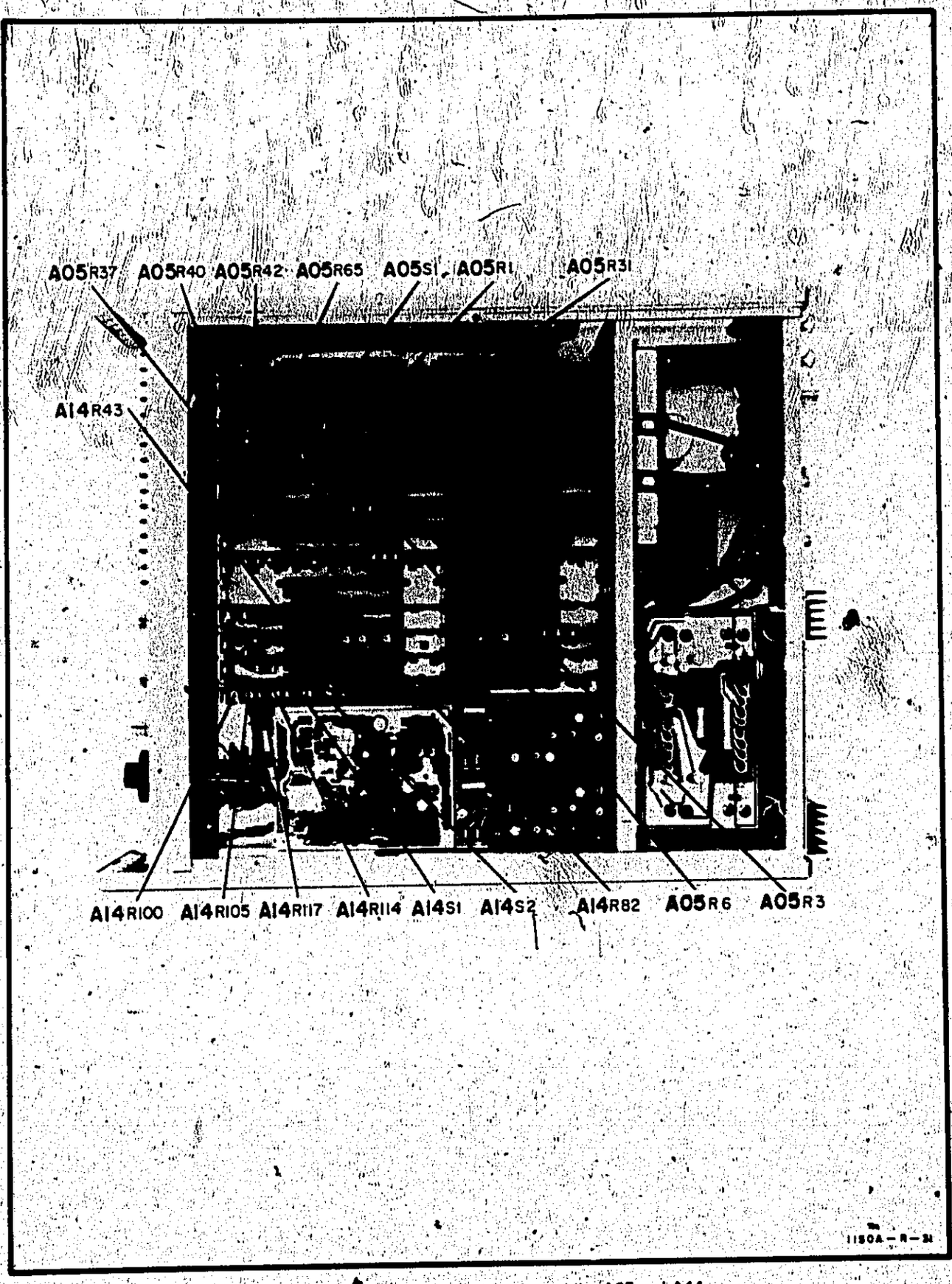


Figure 5-4. Adjustment Location, Assemblies A05 and A14

Table 5-7. Assembly A14 Adjustments (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP Indication	Go to
9		Connect digital voltmeter to test point Y on Assembly A05 (figure 8-35)	A14R105	+5.000V	Step 10
10	LOAD Octal Code 046000	Same as step 8	Front-panel Channel 2 POSITION control R6	+5.000V	Step 11
11	LOAD Octal Code 046004	Same as step 8	A14R82	+9.000V	Step 12
12	LOAD Octal Code 046000	Same as step	Turn fully clockwise front-panel Channel 2 POSITION control R6		Step 13
13		Same as step 8	A14R117	+10.00V	Step 14
14		Connect digital voltmeter to test point A14AT4 (figure 8-63)	Front-panel Channel 2 POSITION control R6	+5.000V	Step 15
15		Connect digital voltmeter to test point Y on Assembly A05 (figure 8-35)	A14R114	+5.000V	(End of Adjustments)

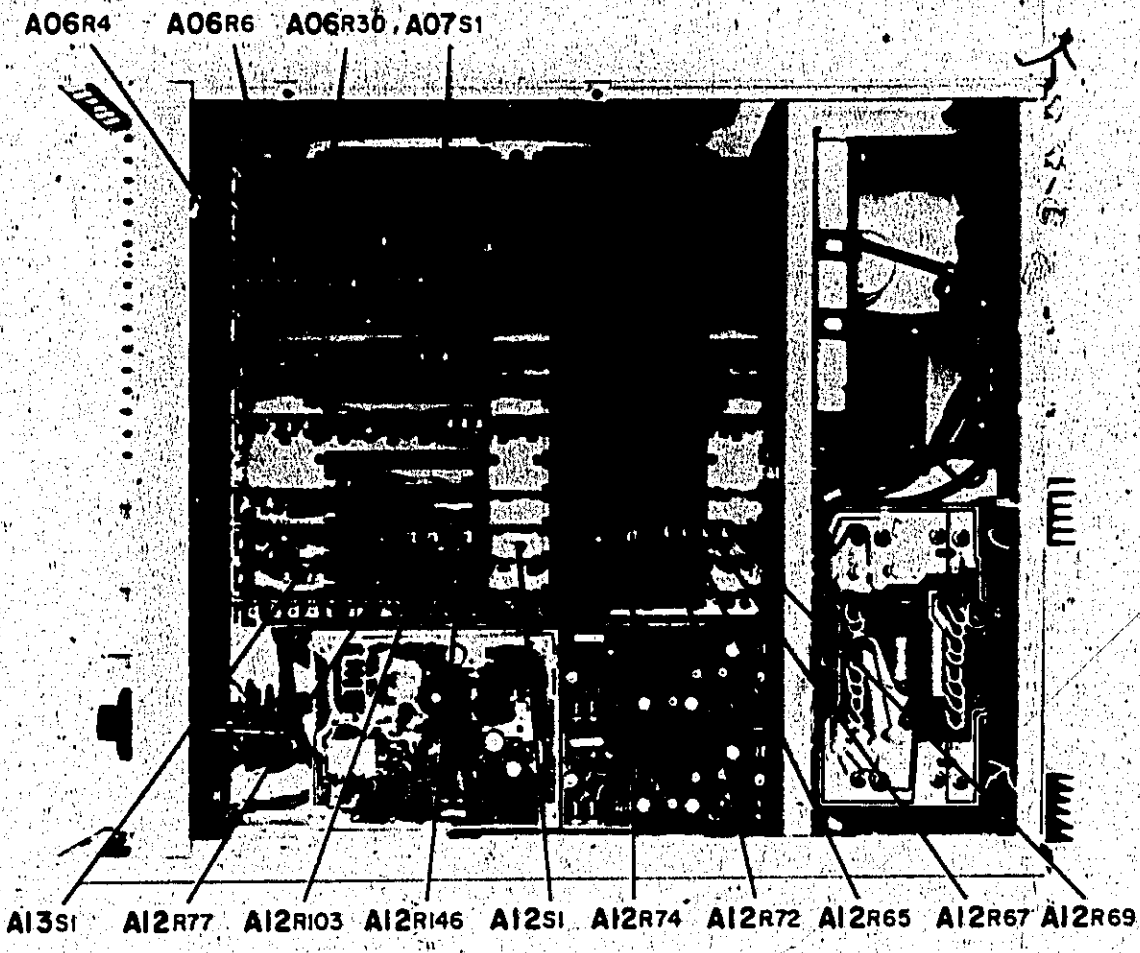


Figure 5-5. Adjustment Location, Assemblies A06, A07, A12, and A13

Figure 5-6. Adjustment Location, Assemblies A09 and A11

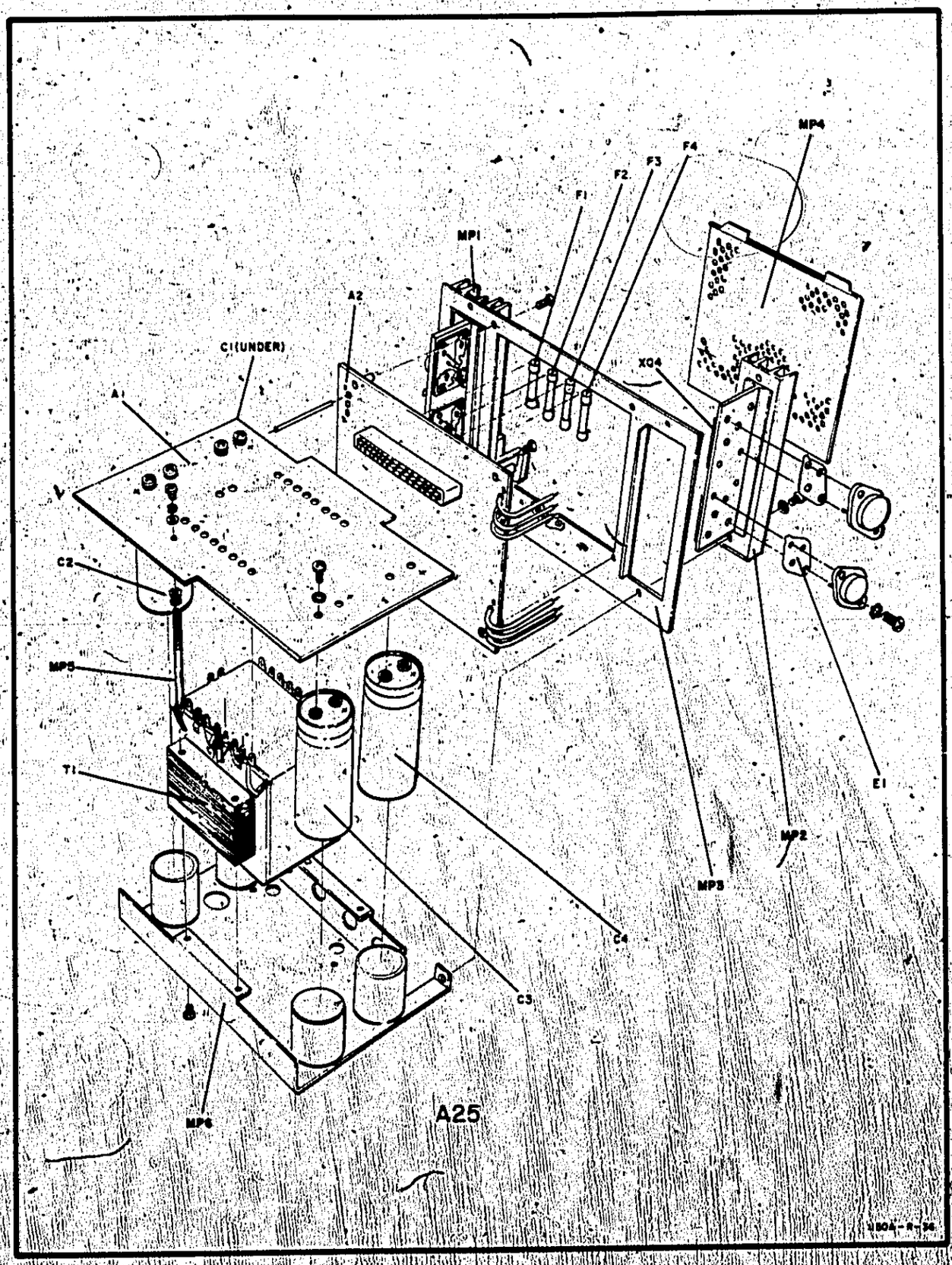


Figure 6-1. Low Voltage Power Supply Module Exploded View

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designator and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes. Figure 6-1 is an exploded view of the Low Voltage Power Supply, A25.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP Part Number of item(s).

c. Quantity of part(s) desired.

d. Reference designator of part(s).

6-5. To order a part not listed in the table, provide the following information:

a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

A	= ampere(s)	GRD	= ground(ed)	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
ASSY	= assembly	H	= henry(ies)	NPN	= negative-positive-negative	S-B	= slow-blow
BD	= board(s)	HG	= mercury	NSR	= not separately replaceable	SCR	= silicon controlled rectifier
BH	= binder head	HP	= Hewlett-Packard	OBD	= order by description	SE	= selenium
BP	= bandpass	HZ	= hertz	OH	= oval head	SEC	= second(s)
C	= centi (10^{-2})	IF	= intermediate freq.	OX	= oxide	SECT	= section(s)
CAR	= carbon	IMPG	= impregnated	P	= peak	SI	= silicon
CCW	= counterclockwise	INCD	= incandescent	PC	= printed (etched) circuit(s)	SIL	= silver
CER	= ceramic	INCL	= include(s)	PF	= picofarads	SL	= slide
CMO	= cabinet mount only	INS	= insulation(ed)	PHL	= Phillips	SP	= single pole
COAX	= coaxial	INT	= internal	PIV	= peak inverse voltage(s)	SPL	= special
COEF	= coefficient	K	= kilo (10^{3})	PNP	= positive-negative-positive	ST	= single throw
COMP	= composition	KG	= kilogram	P/O	= part of	STD	= standard
CONN	= connector(s)	LB	= pound(s)	PORC	= porcelain	TA	= tantalum
CRT	= cathode-ray tube	LH	= left hand	POS	= position(s)	TD	= time delay
CW	= clockwise	LIN	= linear taper	POT	= potentiometer(s)	TFL	= teflon
D	= deci (10^{-1})	LOG	= logarithmic taper	P-P	= peak-to-peak	TGL	= toggle
DEPC	= deposited carbon	LPF	= low-pass filter(s)	PRGM	= program	THYR	= thyristor
DP	= double pole	LVR	= lever	PS	= polystyrene	TI	= titanium
DT	= double throw	M	= milli (10^{-3})	PWV	= peak working voltage	TNLDIO	= tunnel diode(s)
ELECT	= electrolytic	MEG	= mega (10^{6})	RECT	= rectifier(s)	TOL	= tolerance
ENCAP	= encapsulated	MET FILM	= metal film	RF	= radio frequency	TRIM	= trimmer
EXT	= external	MET OX	= metal oxide	RFI	= radio frequency interference	U	= micro (10^{-6})
F	= farad(s)	MFR	= manufacturer	RH	= round head or right hand	V	= volts
FET	= field-effect transistor(s)	MINAT	= miniature	RMO	= rack mount only	VAR	= variable
FH	= flat head	MOM	= momentary	RMS	= root mean square	VDCW	= dc working volt(s)
FIL H	= fillister head	MTG	= mounting			W	= watt(s)
FXD	= fixed	MY	= mylar			W/	= with
G	= giga (10^{9})	N	= nano (10^{-9})			WIV	= working inverse voltage
GE	= germanium	N/C	= normally closed			W/O	= without
GL	= glass	NE	= neon			WW	= wirewound
		N/O	= normally open				

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
A01			NOT ASSIGNED		
A02	01150-66502		BOARD ASSY: INTERCONNECT	28480	01150-66502
A03	01150-66503		BOARD ASSY:LOCAL/REMOTE	28480	01150-66503
A04	01150-66504		BOARD ASSY:CALIBRATOR	28480	01150-66504
A05	01150-66505		BOARD ASSY:DISPLAY CONTROL	28480	01150-66505
A06	01150-66506		BOARD ASSY:EXPAND POSITION	28480	01150-66506
A07	01150-66507		BOARD ASSY:READ/MULTIPLEXER	28480	01150-66507
A08	01150-66508		BOARD ASSY:CHANNEL SELECTOR	28480	01150-66508
A09	01150-66509		BOARD ASSY:VERTICAL POSITION	28480	01150-66509
A10			NOT ASSIGNED		
A11	01150-66511		BOARD ASSY:SCAN ATTENUATOR DECODER	28480	01150-66511
A12	01150-66512		BOARD ASSY:SCAN D/A & ATTENUATOR	28480	01150-66512
A13	01150-66513		BOARD ASSY:DIGITAL SCAN	28480	01150-66513
A14	01150-66514		BOARD ASSY:VERTICAL ATTENUATOR	28480	01150-66514
A15	01150-66515		BOARD ASSY:LAMP DRIVER	28480	01150-66515
A16	01150-67601		BOARD ASSY:TRIGGER PICK-OFF	28480	01150-67601
A17	01150-66517		BOARD ASSY:+5V POWER SUPPLY	28480	01150-66517
A18	01150-66518		BOARD ASSY:INTERCONNECT	28480	01150-66518
A19	01150-66519		BOARD ASSY:EXTENDER	28480	01150-66519
A20	01150-66520		BOARD ASSY:EXTENDER	28480	01150-66520
A21	01150-66521		BOARD ASSY:TIME BASE	28480	01150-66521
A22	01150-66522		BOARD ASSY:SAMPLING, CHANNEL 1	28480	01150-66522
A23	01150-66523		BOARD ASSY:TRIGGER	28480	01150-66523
A24	01150-66522		BOARD ASSY:SAMPLING, CHANNEL 2	28480	01150-66522
A25	00182-60018		ASSY:LOW VOLTAGE POWER MODULE	28480	00182-60018 1
A26			NOT ASSIGNED		
A27	0960-2085	1	ASSY:A/D CONVERTER	28480	0960-2085
A28	01810-66502		BOARD ASSY:INTERCONNECT, SAMPLING	28480	01810-66502
A29	01810-66505		BOARD ASSY:EXTENDER	28480	01810-66505
A30	01810-66505		BOARD ASSY:EXTENDER	28480	01810-66505
A31	01150-60001		DL:DELAY LINE	28480	01150-60001
C1	0180-1871	1	C:FXD ELECT 12,000 UF +75-10% 25 VDCW	28480	0180-1871
C2	0180-0198	1	C:FXD ELECT 1500 UF 50/60 VDCW	56289	D42962 DFP
C3			NOT ASSIGNED		
C4	0180-0197		C:FXD, ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
C5	0160-3451		C:FXD CER 0.01 UF +80-20% 100 VDCW	56289	C0238101F103ZS25-CDH
C6	0160-3448		C:FXD CER 1000 PF 10% 1000 VDCW	56289	C0678251F102KS25-CD
C7	0160-3448		C:FXD CER 1000 PF 10% 1000 VDCW	56289	C0678251F102KS25-CD
CR1	1901-0525	1	DIODE ASSY:SI 50V PIV	28480	1901-0525
DS1	1450-0746	39	LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS2	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS3	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS4	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS5	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS6	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS7	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS8	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS9	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS10	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS11	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS12	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS13	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS14	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS15	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS16	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS17	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS18	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS19	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS20	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS21	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS22	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS23	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS24	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS25	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS26	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS27	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS28	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS29	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS30	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS31	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS32	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS33	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS34	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS35	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS36	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS37	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS38	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
DS39	1450-0746		LIGHT INDICATOR:6VDC 0.25W	28480	1450-0746
F1	1400-0084	1	FUSEHOLDER:EXTRACTOR TYPE	71785	293011
F2	1200-0043		INSULATOR:FSTR MOUNTING(TO-3)		

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
F1	2110-0004	1	FUSE:CARTRIDGE 2AMP 125V SLOW BLOW	71400	MDL2
F2	2110-0036	1	FUSE:CARTRIDGE 8A 125V	75915	312008
FL1	9100-3127	1	FILTER:LINE	28480	9100-3127
J1	1250-0083	4	CONNECTOR:BNC	02660	31-221-1020
J2	1250-0083		CONNECTOR:BNC	02660	31-221-1020
J3	1250-1083		CONNECTOR:BNC	02660	31-221-1020
J4	5060-0467	3	CONNECTOR:MALE PRIME	28480	5060-0467
J5	5060-0467		CONNECTOR:FEMALE PRIME	28480	5060-0467
J6	5060-0467		CONNECTOR:MALE PRIME	28480	5060-0467
J7	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J8			PART OF A18		
J9	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J10			PART OF A18		
J11	1251-3031		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
J12			PART OF A18		
J13	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J14			PART OF A19		
J15	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J16			PART OF A18		
J17	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J18			PART OF A19		
J19	1251-3031		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
J20			PART OF A18		
J21	1251-3031		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
J22			PART OF A19		
J23	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J24			PART OF A19		
J25	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J26			PART OF A18		
J27	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J28			PART OF A19		
J29	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J30			PART OF A18		
J31	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J32			PART OF A18		
J33	1251-0233		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
J34			PART OF A18		
J35			PART OF A20		
J36			PART OF A20		
J37	1251-0233	1	CONNECTOR:PC EDGE (2 X 11) 22 CONTACT	71785	251-22-30-261
J38	1251-0087	7	CONNECTOR:FEMALE 50-PIN MINAT	28480	1251-0087
J39	1251-0087		CONNECTOR:FEMALE 50-PIN MINAT	28480	1251-0087
J43	1250-0140	2	BODY:RF CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J41	1251-0083	1	CONNECTOR MALE SUBMIN TYPE D 25CONTACT	71468	M-25P
J42	1250-0083		CONNECTOR:BNC	02660	31-221-1020
J43			NOT ASSIGNED		
J44	1251-0172	1	CONNECTOR:PC EDGE 1 ROW 22 CONTACT	71785	250-22-30-210
J45			PART OF A16		
J46			PART OF A16		
MP1	0370-2250	1	KNOB:BNO	28480	0370-2250
MP2	0370-1091	3	KNOB:JADE GRAY	28480	0370-1091
MP3	0340-0140	28	GAUGE	00000	000
MP4	1490-0030	1	STAND:TILT	28480	1490-0030
MP5	5000-8549	2	COVER:SIDE	28480	5000-8549
MP6	5060-0222	2	HANDLE ASSY:ISH SIDE	28480	5060-0222
MP7	5060-8735	2	RETAINER HANDLE ASSY(OLIVE GRAY)	28480	5060-8735
MP8	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
MP9	5060-8511	1	COVER:TOP	28480	5060-8511
MP10	5060-8519	1	COVER:BOTTOM	28480	5060-8519
MP11	00220-67402	1	KNOB ASSY:BAR	28480	00220-67402
MP12	01150-00201	1	PANEL:FRONT	28480	01150-00201
MP13	01150-00203	1	PANEL:REAR	28480	01150-00203
MP14	01150-01203	1	BRACKET:AID CONVERTER	28480	01150-01203
MP15	0370-2150	1	KNOB, BAR DOTS/SCAN	28480	0370-2150
MP16	01150-04003	1	SKIRT:DIAL	28480	01150-04003
MP17	0370-2151	2	KNOB, BAR A AND B TRACE	28480	0370-2151
MP18	0370-2152	2	KNOB, BAR MV/DIV	28480	0370-2152
MP19	01150-01202	1	BRKT:TRANSISTOR	28480	01150-01202
MP20	01150-01204	1	BRKT:POWER SWITCH	28480	01150-01204
Q1	1854-0284	1	TSTR:SI NPN	80131	2N3715
Q2	1853-0084	1	TSTR:SI PNP	80131	2N4918
Q3	1854-0100	1	TSTR:SI NPN	28480	1854-0300
R1	2100-3035	1	R:VAR CERMET 100K/3K OHM 10% LIN	28480	2100-3035
R2	2100-3034	1	R:POTENTIOMETER, HOLDOFF	28480	2100-3034
R3	0757-0832	3	R:FXD MET FLM 4.75K OHM 1% 1/2W	28480	0757-0832
R4	0757-0832		R:FXD MET FLM 4.75K OHM 1% 1/2W	28480	0757-0832
R5	2100-3158	3	R:VAR COMP 10K OHM 20% LIN 1/2W	28480	2100-3158
R6	2100-3158		R:VAR COMP 10K OHM 20% LIN 1/2W	28480	2100-3158
R7	2100-3158		R:VAR COMP 10K OHM 20% LIN 1/2W	28480	2100-3158

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R8	0757-0832		R:FXD MET FLM 6.75K OHM 1% 1/2W	28480	0757-0832
R9	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
R10	0757 0832	1	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757 0832
R11	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R13	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
S1	3101-1508	1	SWITCH TOGGLE DPDT	09353	7318I
S2	01150-21901	4	SWITCH:SLIDE, SLOTTED	28480	01150-21901
S3	3100-3037	2	SWITCH:ROTARY 3 SECTION	28480	3100-3037
S4	3100-3037		SWITCH:ROTARY 3 SECTION	28480	3100-3037
S5	3101-1266	1	SWITCH:SLIDE DP3P	28480	3101-1266
S6	01150-21901		SWITCH:SLIDE, SLOTTED	28480	01150-21901
S7	01150-21901		SWITCH:SLIDE, SLOTTED	28480	01150-21901
S8	3101-1266	1	SWITCH:SLIDE, SLOTTED	28480	3101-1266
S9	01150-21901		SWITCH:SLIDE, SLOTTED	28480	01150-21901
S10	3101-0199	2	SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0012
S11	3101-0199		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0012
S12	3101-0163	14	SWITCH:TOGGLE SPDT	04009	MST-1050
S13	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S14	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S15	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S16	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S17	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S18	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S19	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S20	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S21	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S22	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S23	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S24	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S25	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S26	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S27	3101-0163		SWITCH:TOGGLE SPDT	04009	MST-1050
S28	3101-1261	2	SWITCH:PUSHBUTTON MOM SPST 1A 115VAC	09353	P8121
S29	3100-1033	1	SWITCH:ROTARY 5 POSITION	28480	3100-3033
S30	3101-1261		SWITCH:PUSHBUTTON MOM SPST 1A 115VAC	09353	P8121
S31	3100-3034	2	SWITCH:ROTARY 1 SECTION	28480	3100-3034
S32	3100-3034		SWITCH:ROTARY 1 SECTION	28480	3100-3034
S33	3100-3039	1	SWITCH:ROTARY 4 SECTION	28480	3100-3039
SCR1	1884-0092	1	THYRISTOR:SCR JEDEC TYPE 2N4441	04713	2N4441
T1	9100-3246	1	TRANSFORMER:POWER	28480	9100-3246
W1	8120-1545	1	CABLE ASSY:AC POWER CORD 7.5 FT	70903	KH 7171
W2	01410-61601	1	CABLE ASSY:INPUT TRIGGER	28480	01410-61601
W3	01150-61601	1	CABLE ASSY:MAIN	28480	01150-61601
W4	01150-61602	1	CABLE ASSY:LITE	28480	01150-61602
XF1	1400-0084	1	FUSEHOLDER:BRONZE CLIP FOR 86 SCREW	75915	3510-11

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A01			[illegible] ASSY [illegible]	28480	01150-66502
A02	01150-66502		BOARD ASSY INTERCONNECT	28480	01150-66503
A03	01150-66503	1	BOARD ASSY:[illegible]	28480	0180-0229
A03C1	0180-0229	14	C:FXD ELECT 33 UF 10% 10VDCW	28480	[illegible]
A03C2	0160-[illegible]	1	C:FXD MICA [illegible] 5% 300VDCW	14655	[illegible]
A03L1	9140-0112	2	COIL:FXD RF 4.7 UH	28480	9140-0112
A03Q1	1854-0087	6	TSTR:SI NPN	80131	2N3417
A03R1	0684-2221	74	R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A03R2	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A03R3	0684-1021	63	R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R4	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R5	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R6	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R7	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R8	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R9	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R10	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R11	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R12	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R13	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R14	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R15	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R16	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R17	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R18	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R19	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R20	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R21	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R22	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R23	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R24	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R25	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R26	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R27	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R28	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R29	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R30	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R31	0684-5611		R:FXD COMP 560 OHM 10% 1/4W	01121	CB 5611
A03R32	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R33	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R34	0684-2211	1	R:FXD COMP 220 OHM 10% 1/4W	01121	CB 2211
A03R35	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R36	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R37	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R38	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R39	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R40	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R41	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03R42	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A03J1	1820-0328	26	IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J2	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J3	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J4	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J5	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J6	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J7	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J8	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J9	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J10	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J11	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J12	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A03J13	1820-0174	12	IC:TTL HEX INVERTER	01295	SN7404N
A03J14	1820-0668	21	IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A03J15	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A03J16	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A03J17	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A03J18	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A03J19	1820-0261	16	IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A03J20	1820-0054	17	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A03J21	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A04	01150-66504	1	BOARD ASSY:CALIBRATOR	28480	01150-66504
A04C1	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A04C2	0180-0195	2	C:FXD ELECT 0.33 UF 20% 35VDCW	56289	150D334X0035A2-DYS
A04C3	0160-3453	1	C:FXD CER 0.05 UF +80-20% 100VDCW	56289	OBD
A04C4	0160-0127	3	C:FXD CER 2.2 UF 20% 25VDCW	56289	5C152C2S-CML

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A04C5	0140-1746	9	C:FXD ELECT 15 UF 10% 20VDCW	28480	0140-1746
A04C6	0180-1746	1	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A04C7	0140-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A04C8	0160-0169	1	C:FXD MY 0.056 UF 10% 200VDCW	56289	192P56392-P15
A04C9	0160-3451	48	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0213101F103Z525-CDH
A04C10	0160-0162	2	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-P15
A04C11	0180-0197	47	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C12	0160-0155	5	C:FXD MY 0.0033 UF 10% 200VDCW	56289	192P33292-P15
A04C13	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A04C14	0140-0195		C:FXD ELECT 0.33 UF 20% 35VDCW	56289	150D334X9035A2-DYS
A04C15	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C17	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C18	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C19	0160-2260	1	C:FXD CER 2.0 PF 500VDCW	72982	301-000-COGO-209C
A04C20	0121-0169	1	C:VAR CER 7-25 PF N300	72982	538-006 B7-25
A04C21	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A04C22	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C23	0160-2538	1	C:FXD MICA 300 PF 1% 300VDCW	04062	RDM15FA301F3S
A04C24	0160-2264	1	C:FXD CER 20 PF 5% 500VDCW	72982	301-000-COGO-200J
A04C25	0160-2204	15	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A04C26	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C27	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A04C28	0180-0197		C:FXD ELECT 2.2 UF 10% 20 VDCW	56289	150D225X9020A2 DYS
A04C41	1901-0040	85	DIODE:SILICON 30MA 30MV	07263	FDG1088
A04K1	0490-1036	5	RELAY:2 FORM C 12 VDC 390 OHM	15818	412-6346
A04L1	9140-0105	4	COIL:MOLDED CHOKE 8.20 UH 10%	28480	9140-0105
A04L2	9140-0106		COIL:MOLDED CHOKE 4.20 UH 10%	28480	9140-0105
A04L3	9140-0137	1	COIL:FXD RF 1000 UH 5%	28480	9140-0137
A04L4	9140-0098	1	COIL:FXD RF 1 UH 5%	28480	9140-0098
A04L5	9100-1613		COIL:FXD 0.47 UH 20%	28480	9100-1613
A04L6	9140-0105		COIL:MOLDED CHOKE 8.20 UH 10%	28480	9140-0105
A04L7	9140-0105		COIL:MOLDED CHOKE 8.20 UH 10%	28480	9140-0105
A04Q1	1853-0020	32	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A04Q2	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A04Q3	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A04Q4	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A04Q5	1854-0071	91	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q6	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A04Q7	1854-0087		TSTR:SI NPN	80131	2N3417
A04Q8	1854-0087		TSTR:SI NPN	80131	2N3417
A04Q9	1854-0087		TSTR:SI NPN	80131	2N3417
A04Q10	1854-0087		TSTR:SI NPN	80131	2N3417
A04Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q17	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q18	1855-0062	94	TSTR:SI FET 30V	01295	2N1595
A04Q19	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q20	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q21	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q22	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q23	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q24	1855-0062		TSTR:SI FET 30V	01295	2N1595
A04Q25	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A04Q26	1854-0039	5	TSTR:SI NPN	80131	2N1053
A04Q27	1853-0065	1	TSTR:SI PNP	80131	2N4036
A04Q28	1854-0092	4	TSTR:SI NPN	80131	2N3563
A04Q29	1854-0092		TSTR:SI NPN	80131	2N3563
A04Q30	1854-0215	11	TSTR:SI NPN	80131	2N3904
A04R1	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04R2	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04R3	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04R4	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04R5	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04R6	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04R7	0757-0290	7	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A04R8	0757-0385	6	R:FXD MET FLM 221 OHM 1% 1/8W	28480	0757-0385
A04R9	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04R10	0757-0443	48	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04R11	0757-0462	48	R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04R12	0684-1041	32	R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04R13	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A04A16	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A15	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A13	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A17	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A18	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A19	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A20	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A21	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A22	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A23	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A24	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A25	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A26	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A27	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A28	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A29	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A30	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A31	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A32	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A33	0757-0283	17	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A34	0757-0442	48	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A04A35	0811-2981	4	R:FXD WW 1.988K OHM 0.1% 1/4W	28480	0811-2981
A04A36	2100-3053	18	R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A04A37	0684-4721	52	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A04A38	0811-2982	7	R:FXD WW 3.988K OHM 0.1% 1/8W	28480	0811-2982
A04A39	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A04A40	0811-2983	7	R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A04A41	0811-2980	7	R:FXD WW 15.995K OHM 0.1% 1/16W	28480	0811-2980
A04A42	2100-3052	7	R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A04A43	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A44	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A04A45	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A46	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A04A47	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A48	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A04A49	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A04A50	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A04A51	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A04A52	0757-0280	23	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A04A53	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A04A54	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A55	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A04A56	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A04A57	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A04A58	0811-3091	1	R:FXD WW 40.0 OHM 0.1% 1/8W	28480	0811-3091
A04A59	0811-3090	1	R:FXD WW 60.00 OHM 0.1% 1/8W	28480	0811-3090
A04A60	0811-3089	1	R:FXD WW 100.0 OHM 0.1% 1/8W	28480	0811-3089
A04A61	0811-3088	1	R:FXD WW 200.0 OHM 0.1% 1/8W	28480	0811-3088
A04A62	0811-3087	1	R:FXD WW 600.0 OHM 0.1% 1/8W	28480	0811-3087
A04A63	0811-3086	1	R:FXD WW 1.000K OHM 0.1% 1/8W	28480	0811-3086
A04A64	0811-3082	1	R:FXD WW 2K OHM 0.1% 1/8W	28480	0811-3082
A04A65	0811-3084	1	R:FXD WW 23K.2 OHM 0.1% 1/8W	28480	0811-3084
A04A66	0757-0416	9	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A04A67	0757-0346	3	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A04A68	2100-2516	1	R:VAR CERMET 100K OHM 10% LIN 1/2W	28480	2100-2516
A04A69	0757-0391	7	R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A04A70	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A71	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A04A72	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A04A73	0757-0408	5	R:FXD MET FLM 243 OHM 1% 1/8W	28480	0757-0408
A04A74	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A04A75	0811-3083	1	R:FXD WW 557K OHM 0.1% 1/8W	28480	0811-3083
A04A76	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A04A77	0811-3085	4	R:FXD WW 857.0 OHM 0.1% 1/4W	28480	0811-3085
A04A78	0761-0054	1	R:FXD MET OX 330 OHM 5% 1W	28480	0761-0054
A04A79	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A04A80	0757-0458	7	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A04A81	0761-0052	1	R:FXD MET OX 270 OHM 5% 1W	28480	0761-0052
A04A82	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A04A83	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A84	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A04A85	CA84-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A04A86	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A04A87	0757-0435	4	R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0435
A04A88	0757-0431	1	R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0431

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A4A9			NOT USED		
A3A4B3	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A3A4B1	0757-0809	2	R:FXD MET FLM 332 OHM 1.0% 1/2W	28480	0757-0809
A3A4B2	0757-0401	9	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A3A4B3	0757-0811	1	R:FXD MET FLM 392 OHM 1% 1/2W	28480	0757-0811
A3A4B4	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A3A4B5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A3A4B6	0757-0452	1	R:FXD MET FLM 27.4K OHM 1% 1/8W	28480	0757-0452
A3A4J1	1820-0070	9	IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A3A4J2	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A3A4J3	1820-0281		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A3A4J4	1820-0176		IC:TTL HEX INVERTER	01295	SN7404N
A3A4J5	1820-0127	36	IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A3A4J6	1820-0068	10	IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A3A4J7	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A3A4J8	1820-0101	23	IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A3A4J9	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A3A4J10	1820-0629	25	IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A3A4J11	1820-0077	16	IC:TTL DUAL D F/F	01295	SN7474N
A3A4J12	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A3A4J13	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A3A4J14	1826-0009	1	IC:LINEAR OP. AMPL.	28480	1826-0009
A3A4J15	1820-0201	8	INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A3A4J16	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A3A4J17	1820-0055	2	IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A3A4J18	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A3A4J19	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A3A4J20	1820-0629		IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A3A4J21	1820-0681	1	IC:TTL QUAD 2-INPT NAND GATE	01295	SN74S00N
A3A4J1	1200-0438	9	SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A3A4U2	1200-0441	10	SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A3A4Y1	0410-0089	1	CRYSTAL:QUARTZ, 49.997 MHz	28480	0410-0089
A3S	01150-66505	1	BOARD ASSY:DISPLAY CONTROL	28480	01150-66505
A3SC1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A3SC2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A3SC3	0160-3453	6	C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023A101L503Z525-CDH
A3SC4	0160-3453		C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023A101L503Z525-CDH
A3SC5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A3SC6	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A3SC7	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3SC8	0160-0160	1	C:FXD MY 0.0082 UF 10% 200VDCW	56289	192P8292-PTS
A3SC9	0140-0198	17	C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A3SC10	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A3SC11	0180-0116	2	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	1500685X9035B2-DYS
A3SC12	0160-2204		C:FXD, MICA 100PF 5%	72136	RDM15F101J3C
A3SC13	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A3SC14	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A3SC15	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A3SCR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SCR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3SL1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A3SL2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A3SL3	9140-0084		COIL:FXD RF 0.68 UH	28480	9140-0084
A3SL4	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A3S31	1854-0087		TSTR:SI NPN	80131	2N3417
A3S32	1853-0036	59	TSTR:SI PNP	80131	2N3906
A3S33	1854-0087		TSTR:SI NPN	80131	2N3417
A3S34	1853-0036		TSTR:SI PNP	80131	2N3906
A3S35	1854-0087		TSTR:SI NPN	80131	2N3417
A3S36	1853-0036		TSTR:SI PNP	80131	2N3906
A3S37	1854-0087		TSTR:SI NPN	80131	2N3417
A3S38	1853-0036		TSTR:SI PNP	80131	2N3906
A3S39	1854-0087		TSTR:SI NPN	80131	2N3417
A3S310	1853-0036		TSTR:SI PNP	80131	2N3906
A3S311	1854-0087		TSTR:SI NPN	80131	2N3417
A3S312	1853-0036		TSTR:SI PNP	80131	2N3906
A3S313	1854-0087		TSTR:SI NPN	80131	2N3417
A3S314	1853-0036		TSTR:SI PNP	80131	2N3906
A3S315	1854-0087		TSTR:SI NPN	80131	2N3417
A3S316	1853-0036		TSTR:SI PNP	80131	2N3906

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A05J17	1854-0087		TSTR:SI NPN	80131	2N3417
A05J18	1853-0036		TSTR:SI PNP	80131	2N3906
A05J19	1854-0087		TSTR:SI NPN	80131	2N3417
A05J20	1853-0036		TSTR:SI PNP	80131	2N3906
A05J21	1854-0087		TSTR:SI NPN	80131	2N3417
A05J22	1853-0036		TSTR:SI PNP	80131	2N3906
A05J23	1854-0087		TSTR:SI NPN	80131	2N3417
A05J24	1853-0036		TSTR:SI PNP	80131	2N3906
A05J25	1854-0087		TSTR:SI NPN	80131	2N3417
A05J26	1853-0036		TSTR:SI PNP	80131	2N3906
A05J27	1854-0087		TSTR:SI NPN	80131	2N3417
A05J28	1853-0036		TSTR:SI PNP	80131	2N3906
A05J29	1854-0087		TSTR:SI NPN	80131	2N3417
A05J30	1853-0036		TSTR:SI PNP	80131	2N3906
A05J31	1854-0087		TSTR:SI NPN	80131	2N3417
A05J32	1853-0036		TSTR:SI PNP	80131	2N3906
A05J33	1854-0087		TSTR:SI NPN	80131	2N3417
A05J34	1853-0036		TSTR:SI PNP	80131	2N3906
A05J35	1854-0087		TSTR:SI NPN	80131	2N3417
A05J36	1853-0036		TSTR:SI PNP	80131	2N3906
A05J37	1854-0087		TSTR:SI NPN	80131	2N3417
A05J38	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J39	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J40	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J41	1855-0062		TSTR:SI FET 30V	01295	2N1595
A05J42	1855-0062		TSTR:SI FET 30V	01295	2N1595
A05J43	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J44	1855-0062		TSTR:SI FET 30V	01295	2N1595
A05J45	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J46	1855-0062		TSTR:SI FET 30V	01295	2N1595
A05J47	1853-0036		TSTR:SI PNP	80131	2N3906
A05J48	1854-0087		TSTR:SI NPN	80131	2N3417
A05J49	1853-0036		TSTR:SI PNP	80131	2N3906
A05J50	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05J51	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A05J52	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A05R1	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R2	0811-2981		R:FXD WW 1.980K OHM 0.1% 1/4W	28480	0811-2981
A05R3	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R4	0811-2982		R:FXD WW 3.984K OHM 0.1% 1/8W	28480	0811-2982
A05R5	0757-0431	48	R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R6	2100-3052		R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A05R7	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R8	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R10	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R12	0811-2983		R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A05R13	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R15	0811-2980		R:FXD WW 15.995K OHM 0.1% 1/16W	28480	0811-2980
A05R16	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R17	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R18	0698-7881	6	R:FXD FLM 37K OHM 0.25% 1/8W	28480	0698-7881
A05R19	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R20	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R21	0698-7882	6	R:FXD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A05R22	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R23	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R24	0698-7883	6	R:FXD FLM 128K OHM 1.0% 1/8W	28480	0698-7883
A05R25	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R26	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R27	0698-3149	6	R:FXD FLM 255K OHM 1% 1/8W	28480	0698-3149
A05R28	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R30	0757-0482	6	R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A05R31	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R32	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R33	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R34	0757-0344	8	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A05R35	0757-0732	2	R:FXD MET FLM 909 OHM 1% 1/4W	28480	0757-0732
A05R36	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A05R37	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R38	0811-3085		R:FXD WW 657.0 OHM 0.1% 1/4W	28480	0811-3085
A05R39	0684-1011	9	R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A05R43	2100-3052		R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A05R44	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A05R45	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R46	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R47	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R48	0811-2981		R:FXD WW 1.988K OHM 0.1% 1/4W	28480	0811-2981
A05R49	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R50	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R51	0811-2982		R:FXD WW 3.988K OHM 0.1% 1/8W	28480	0811-2982
A05R52	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R53	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R54	0811-2983		R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A05R55	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R56	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R57	0811-2980		R:FXD WW 15.995K OHM 0.1% 1/16W	28480	0811-2980
A05R58	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R59	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R60	0698-7881		R:FXD FLM 32K OHM 0.25% 1/8W	28480	0698-7881
A05R61	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R62	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R63	0698-7882		R:FXD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A05R64	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A05R65	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A05R66	0684-5621	27	R:FXD,COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A05R67	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A05R68	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A05R69	0811-3085		R:FXD WW 657.0 OHM 0.1% 1/4W	28480	0811-3085
A05R70	0757-0732		R:FXD MET FLM 909 OHM 1% 1/4W	28480	0757-0732
A05R71	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A05R72	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A05R73	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A05R74	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A05R75	C757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A05R76	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A05R77	0684-1031	9	R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A05R78	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A05R79	0757-0472	5	R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A05R80	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A05R81	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A05R82	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A05R83	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R84	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R85	0698-7883		R:FXD FLM 128K OHM 1.0% 1/8W	28480	0698-7883
A05R86	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R87	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R88	0698-3149		R:FXD FLM 255K OHM 1% 1/8W	28480	0698-3149
A05R89	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R90	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R91	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A05R92	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A05R93	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A05R94	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A05R95	0757-0385		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A05R96	0757-0385		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0385
A05R97	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A05R98	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A05R99	0757-0445	1	R:FXD FLM 13K OHM 1% 1/8W	28480	0757-0445
A05R100	0757-0463	4	R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A05R101	0757-0439	3	R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A05R102	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A05R103	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A05R104	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A05R105	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A05R106	0757-0456	2	R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0757-0456
A05R107	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A05R108	0757-0124	1	R:FXD MET FLM 39.2K OHM 1% 1/8W	28480	0757-0124
A05R109	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A05R110	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A05S1	3101-0982	8	SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A05U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A05U2	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A05U3	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A05U4	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A05U5	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A05U6	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A05U7	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A05U8	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A05U9	1826-0067	8	IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A05U10	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A05U11	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A05U12	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A05U13	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A05U14	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A05U15	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A05U16	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A05U17	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A05U18	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A05U19	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A05XU1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A05XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A06	01150-66506	1	BOARD ASSY:EXPAND POSITION	28480	01150-66506
A06C1	0170-0068	2	C:FXD MY 0.027 UF 10% 200VDCW	56289	192P27392-PTS
A06C2	0160-0159	5	C:FXD MY 0.0068 UF 10% 200VDCW	56289	192P68282-PTS
A06C3	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1012525-COM
A06C4	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A06C5	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A06C6	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A06C7	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A06L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A06L2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A06L3	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A06Q1	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q2	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q3	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q4	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q5	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q6	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q7	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q8	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q9	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q10	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q11	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q12	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q13	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q14	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q15	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q16	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q17	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q18	1853-0036		TSTR:SI PNP	80131	2N3906
A06Q19	1854-0087		TSTR:SI NPN	80131	2N3417
A06Q20	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A06R1	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A06R2	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R3	0811-2982		R:FXD WW 3.999K OHM 0.1% 1/8W	28480	0811-2982
A06R4	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A06R5	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R6	2100-3052		R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A06R7	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R8	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R9	0811-2983		R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A06R10	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R12	0811-2980		R:FXD WW 15.995K OHM 0.1% 1/8W	28480	0811-2980
A06R13	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R15	0698-7881		R:FXD FLM 32K OHM 0.25% 1/8W	28480	0698-7881
A06R16	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R17	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R18	0698-7882		R:FXD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A06R19	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R20	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R21	0698-7883		R:FXD FLM 128K OHM 1.0% 1/8W	28480	0698-7883
A06R22	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R23	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R24	0698-3149		R:FXD FLM 255K OHM 1% 1/8W	28480	0698-3149
A06R25	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R26	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R27	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A06R28	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A06R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A06R30	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A06R31	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A06R32	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A06R33	0757-0402	3	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0402
A06R34	0811-3092	3	R:FXD WW 1.33K OHM 0.1% 1/8W	28480	0811-3092
A06R35	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A06R36	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A06R37	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A06R38	0757-0290		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0290
A06U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A06U2	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A06U3	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A06U4	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A06U5	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A06U6	1820-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A06U7	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A06XU1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BRONZE	00779	583529-1
A06XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A07	01150-66507		BOARD ASSY:READ/MULTIPLEXER	28480	01150-66507
A07C1	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A07C2	0160-0159		C:FXD MY 0.0068 UF 10% 200VDCW	56289	192P68282-PTS
A07C3	0160-0161	5	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A07C4	0180-0228	1	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A07C5	0180-1743	1	C:FXD ELECT 0.1 UF 10% 35VDCW	56289	150D104X9035A2-DYS
A07C6	0150-0072	10	C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C7	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C8	0160-2265	11	C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A07C9	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A07C10	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C11	0160-3453		C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C0234101L503Z525-CDH
A07C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A07C13	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A07C14	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A07C15	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A07C16	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z525-CDH
A07C17	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A07C18	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C19	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C20	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C21	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C22	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C23	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07C24	0150-0072		C:FXD CER 200 PF 5% 1000VDCW	56289	C0288102E201J527-CDH
A07CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A07CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A07L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A07L2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A07L3	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A07L4	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A07Q1	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q2	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q6	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q7	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q8	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q9	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q10	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q11	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q12	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q13	1855-0062		TSTR:SI FET 30V	01295	2N1595
A07Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q17	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q18	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q19	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q20	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A07Q21	1854-0087		TSTR:SI NPN	80131	2N3417
A07Q22	1854-0087		TSTR:SI NPN	80131	2N3417
A07Q23	1854-0087		TSTR:SI NPN	80131	2N3417
A07R1	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A07R2	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R3	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A07R4	0757-0408		R:FXD MET FLM 243 OHM 1% 1/8W	28480	0757-0408
A07R5	0684-2271		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2271
A07R6	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R7	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R8	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A07R9	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R10	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R11	0757-0441		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0441
A07R12	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R13	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R14	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R15	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R16	0684-3331		R:FXD COMP 330 OHM 10% 1/4W	01121	CB 3331
A07R17	0684-3331		R:FXD COMP 330 OHM 10% 1/4W	01121	CB 3331
A07R18	0757-0446	2	R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A07R19	0757-0438	9	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A07R20	0757-0419	2	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A07R21	0757-0418	2	R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A07R22	0757-0419		R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A07R23	0757-0446		R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A07R24	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A07R25	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R26	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R27	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R28	0757-0389		R:FXD MET FLM 22.1 OHM 1% 1/8W	28480	0757-0389
A07R29	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R30	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R31	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R32	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R33	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R34	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R35	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R36	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A07R37	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A07R38	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A07R39	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R40	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R41	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R42	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R43	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R44	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R45	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R46	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R47	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R48	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R49	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R50	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R51	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R52	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R53	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R54	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R55	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R56	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07R57	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A07R58	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A07R59	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A07S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A07U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A07U2	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A07U3	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A07U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A07U5	1820-0495		IC:TTL 1 OF 16 DECODER	01295	SN74154N
A07U6	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A07U7	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A07U8	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A07U9	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A07U10	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A07U11	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A07U12	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A07U13	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A07U14	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A07U15	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A07U16	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A07U17	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A07U18	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A07J13	1251-0027		IC:TTL,DUAL D F/F	01295	SN7474N
A07U1	1820-0431		SOCKET:IC 24 PIN MINIATURE	28480	1200-0441
A07U2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A08	01150-66509	1	BOARD ASSY:CHANNEL SELECTOR	28480	01150-66509
A08C1	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A08C2	0160-0159		C:FXD MY 0.0068 UF 10% 200VDCW	56289	192P6822-PTS
A08K1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A08R1	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R2	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R3	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R4	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R5	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R6	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R7	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R8	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R9	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R10	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A08R11	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A08R12	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A08R13	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A08R14	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A08U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A08U2	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A08U3	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A08U4	1820-0260		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A08U5	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U6	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U7	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U9	1820-0183		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A08U10	1820-0083		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A08U11	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A08U12	1820-0328		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A08U13	1820-0727		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A08U14	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U15	1820-0304	1	IC:TTL J-K M/S F/F W/CLOCKED & INPTS	04295	SN7472N
A08U16	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A08U17	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U18	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A08U19	1820-0088		IC:TTL DUAL 4 INPT POS NAND GATE	28480	1820-0069
A08U20	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A08XU1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583929-1
A08XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A09	01150-66509	1	BOARD ASSY:VERTICAL POSITION	28480	01150-66509
A09C1	0170-0066		C:FXD MY 0.027 UF 10% 200VDCW	56289	192P27392 PTS
A09C2	0160-0519		C:FXD MY 0.0068 UF 10% 200VDCW	56289	192P68282-PTS
A09C3	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A09C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A09C5	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A09C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A09C7	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A09C8	0160-0519		C:FXD MY 0.0068 UF 10% 200VDCW	56289	192P68282-PTS
A09C9	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A09L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A09L2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A09L3	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A09Q1	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q2	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q3	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q4	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q5	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q6	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q7	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q8	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q9	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q10	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q11	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q12	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q13	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q14	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q15	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q16	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q17	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q18	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q19	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q20	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q21	1854-0087		TSTR:SI NPN	80131	2N3417

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A09Q22	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q23	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q24	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q25	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q26	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q27	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q28	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q29	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q30	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q31	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q32	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q33	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q34	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q35	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q36	1853-0036		TSTR:SI PNP	80131	2N3906
A09Q37	1854-0087		TSTR:SI NPN	80131	2N3417
A09Q38	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A09Q39	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A09Q40	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A09R1	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A09R2	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R3	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A09R4	0811-2982		R:FXD WW 3.988K OHM 0.1% 1/8W	28480	0811-2982
A09R5	0698-3109	20	R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R6	2100-3052		R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A09R7	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R8	0811-2983		R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A09R9	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R10	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R11	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R12	0811-2980		R:FXD WW 15.995K OHM 0.1% 1/16W	28480	0811-2980
A09R13	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R14	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R15	0698-7881		R:FXD FLM 12K OHM 0.25% 1/8W	28480	0698-7881
A09R16	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R17	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R18	0698-7882		R:FXD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A09R19	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R20	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R21	0698-7893		R:FXD FLM 128K OHM 1.0% 1/8W	28480	0698-7893
A09R22	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R23	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R24	0698-3149		R:FXD FLM 255K OHM 1% 1/8W	28480	0698-3149
A09R25	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R26	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R27	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A09R28	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R29	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R30	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A09R31	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A09R32	0811-3092		R:FXD WW 1.323K OHM 0.1% 1/8W	28480	0811-3092
A09R33	0757-0402		R:FXD MET FLM 110 OHM 1% 1/8W	28480	0757-0402
A09R34	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A09R35	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R36	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A09R37	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A09R38	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R39	0811-2982		R:FXD WW 3.988K OHM 0.1% 1/8W	28480	0811-2982
A09R40	2100-3052		R:VAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A09R41	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R42	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R43	0811-2983		R:FXD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A09R44	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R45	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R46	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R47	0811-2980		R:FXD WW 15.995K OHM 0.1% 1/16W	28480	0811-2980
A09R48	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R49	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R50	0698-7881		R:FXD FLM 12K OHM 0.25% 1/8W	28480	0698-7881
A09R51	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R52	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R53	0698-7882		R:FXD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A09R54	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R55	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R56	0698-7883		R:FXD FLM 128K OHM 1.0% 1/8W	28480	0698-7883

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A09R57	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R58	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R59	0698-3149		R:FXD FLM 255K OHM 1% 1/8W	28480	0698-3149
A09R60	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R61	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R62	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A09R63	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A09R64	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R65	2100-3053		R:VAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A09R66	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A09R67	0811-3092		R:FXD WW 1.323K OHM 0.1% 1/8W	28480	0811-3092
A09R68	0757-0402		R:FXD MET FLM 110 OHM 1% 1/8W	28480	0757-0402
A09R69	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A09R70	0698-3109		R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109
A09R71	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A09R72	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A09R73	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A09R74	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A09R75	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A09R76	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A09R77	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A09U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A09U2	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A09U3	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A09U4	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A09U5	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A09U6	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A09U7	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A09U8	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A09U9	1820-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A09U10	1820-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A09U11	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A09XU1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A09XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A10			NOT ASSIGNED		
A11	01150-66511	1	BOARD ASSY:SCAN ATTENUATOR DECODER	28480	01150-66511
A11C1	0160-0161		C:FXD MY 0.01 UF 10% 200VDCM	56289	192P10392-PTS
A11C2	0180-0229		C:FXD ELECT 33 UF 10% 10VDCM	28480	0180-0229
A11C3	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A11C4	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A11CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A11J1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11J2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11J3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11J4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11R1	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A11R2	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R3	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R4	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R5	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R6	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R7	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R8	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R9	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R10	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A11R11	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A11R12	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A11R13	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A11R14	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A11R15	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R16	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R17	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R18	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R19	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R20	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11R21	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11R22	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A11S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A11U1	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A11U2	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U3	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U4	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U5	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U6	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U7	1820-0329		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A11U8	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A11U9	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U10	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A11U11	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U12	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A11U13	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A11U14	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A11U15	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A11U16	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U17	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U18	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U19	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U20	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A11U21	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A11U22	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A11U23	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7479N
A11U24	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A11U25	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A11A1U1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A11A1U2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A12	01150-66512		BOARD ASSY:SCAN D/A & ATTENUATOR	28480	01150-66512
A12C1	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C2	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C3	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C4	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C5	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C6	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C7	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C8	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C9	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C10	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C11	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C12	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C13	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C14	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C15	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C16	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C17	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C18	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C19	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C20	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C21	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C22	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C23	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C24	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C25	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C26	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C27	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C28	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C29	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C30	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C31	0140-0198		C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A12C32	0160-2265		C:FXD CER 22 PF 5% 500VDCW	72982	301-NPO-22PF
A12C33	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C34	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C35	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C36	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C37	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C38	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C39	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C40	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C41	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C42	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A12C43	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A12C44	0160-3448	2	C:FXD CER 1000 PF 10% 1000VDCW	56289	C067B225F102K525-CDH
A12C45	0140-0204	1	C:FXD MICA 47 PF 5%,NPO 500VDCW	14655	RDM15E470J5C

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12A46	0160-3453		CAPACITOR-FXD 0.05 UF +80-20% 100VDC	56289	C023A101L503Z525-C3H
A12A47	0160-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDC	56289	150D225X9020A2-DYS
A12A48	0160-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDC	56289	150D225X9020A2-DYS
A12A49	0160-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDC	56289	150D225X9020A2-DYS
A12A50	0160-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDC	56289	150D225X9020A2-DYS
A12A51	0160-0155		CAPACITOR-FXD MY 0.003 UF 10% 200VDC	56289	192P33292-MTS
A12A52	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A53	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A54	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A55	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A56	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A57	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12A58	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A12L1	9140-0112		COIL-FXD RF 4.7 UH	28480	9140-0112
A12L2	9140-0112		COIL-FXD RF 4.7 UH	28480	9140-0112
A12L3	9140-0112		COIL-FXD RF 4.7 UH	28480	9140-0112
A12L4	9170-0614		BEAD-MAGNETIC SHIELDING	02114	56-590-65-3B
A12Q1	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q2	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q3	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q4	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q5	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q6	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q7	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q8	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q9	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q10	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q11	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q12	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q13	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q14	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q15	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q16	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q17	1854-0087		TSTR-SI NPN	80131	2N3417
A12Q18	1854-0087		TSTR-SI NPN	80131	2N3417
A12Q19	1854-0087		TSTR-SI NPN	80131	2N3417
A12Q20	1854-0087		TSTR-SI NPN	80131	2N3417
A12Q21	1854-0087		TSTR-SI NPN	80131	2N3417
A12Q22	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q23	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q24	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q25	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q26	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q27	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q28	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q29	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q30	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q31	1853-0020		TSTR-SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A12Q32	1853-0036		TSTR-SI PNP	80131	2N3906
A12Q33	1853-0036		TSTR-SI PNP	80131	2N3906
A12Q34	1853-0049		TSTR-SI PNP	28480	1853-0049
A12Q35	1854-0215		TSTR-SI NPN	80131	2N3904
A12Q36	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q37	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q38	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q39	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q40	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q41	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q42	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q43	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q44	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q45	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q46	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q47	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q48	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q49	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q50	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q51	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q52	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q53	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q54	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q55	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q56	1854-0071		TSTR-SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A12Q57	1855-0062		TSTR-SI FET 30V	01295	2N1595
A12Q58	1855-0062		TSTR-SI FET 30V	01295	2N1595

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12A69	1854-0071		TSTR=SI FET NPN	01295	2N5595
A12A70	1854-0071		TSTR=SI FET NPN	01295	2N5595
A12A71	1854-0071		TSTR=SI FET NPN	01295	2N5595
A12A72	1854-0071		TSTR=SI FET NPN	01295	2N5595
A12A73	1854-0221		TSTR=SI NPN(MATCHED PAIR 2N4041	28480	1854-0221
A12A74	0757-0290		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0290
A12A75	0757-0290		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0290
A12A76	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A77	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A78	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A79	0757-0459		RESD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0459
A12A80	0698-1841		RESD COMP 180K OHM 10% 1/4W	01121	CB 1841
A12A81	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A82	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A83	0757-0344		RESD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A12A84	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A85	0757-0459		RESD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0459
A12A86	0698-1841		RESD COMP 180K OHM 10% 1/4W	01121	CB 1841
A12A87	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A88	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A89	0757-0482		RESD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A12A90	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A91	0757-0459		RESD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0459
A12A92	0698-1841		RESD COMP 180K OHM 10% 1/4W	01121	CB 1841
A12A93	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A94	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A95	0698-3149		RESD FLM 255K OHM 1% 1/8W	28480	0698-3149
A12A96	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A97	0757-0459		RESD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0459
A12A98	0698-1841		RESD COMP 180K OHM 10% 1/4W	01121	CB 1841
A12A99	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A100	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A101	0698-7882		RESD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A12A102	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A103	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A104	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A105	0757-0459		RESD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0459
A12A106	0698-1841		RESD COMP 180K OHM 10% 1/4W	01121	CB 1841
A12A107	0698-7882		RESD FLM 64K OHM 0.5% 1/8W	28480	0698-7882
A12A108	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A109	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A110	0698-7881		RESD FLM 32K OHM 0.25% 1/8W	28480	0698-7881
A12A111	0684-2221		RESD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12A112	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12A113	0684-6831		RESD COMP 68K OHM 10% 1/4W	01121	CB 6831
A12A114	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A115	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A116	0811-2980		RESD WW 19.995K OHM 0.1% 1/10W	28480	0811-2980
A12A117	0684-2221		RESD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12A118	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12A119	0684-6831		RESD COMP 68K OHM 10% 1/4W	01121	CB 6831
A12A120	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A121	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A122	0811-2983		RESD WW 7.970K OHM 0.1% 1/8W	28480	0811-2983
A12A123	0684-2221		RESD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12A124	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12A125	0684-6831		RESD COMP 68K OHM 10% 1/4W	01121	CB 6831
A12A126	0684-5621		RESD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A12A127	0684-4721		RESD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12A128	0811-2982		RESD WW 3.988K OHM 0.1% 1/8W	28480	0811-2982
A12A129	0684-2221		RESD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12A130	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12A131	0684-6831		RESD COMP 68K OHM 10% 1/4W	01121	CB 6831
A12A132	0811-2981		RESD WW 1.998K OHM 0.1% 1/4W	28480	0811-2981
A12A133	0811-3085		RESD WW 657.0 OHM 0.1% 1/4W	28480	0811-3085
A12A134	0698-0082	1	RESD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A12A135	2100-3052		RVAR CERMET 50 OHM 20% 3/4W	28480	2100-3052
A12A136	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A12A137	2100-3053		RVAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A12A138	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A12A139	2100-3053		RVAR CERMET 20 OHM 20% 3/4W	28480	2100-3053
A12A140	0684-2221		RESD COMP 2200 OHM 10% 1/4W	01121	CB 2221

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12R71	0757-0443		RESISTOR 11.0K OHM 1% 1/4W	28480	0757-0443
A12R72	2100-3053		RESISTOR CERMET 20 OHM 20% 1/4W	28480	2100-3053
A12R73	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R74	2100-2522		RESISTOR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A12R75	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R76	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A12R77	2100-2522		RESISTOR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A12R78	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R79	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R80	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R81	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R82	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R83	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R84	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R85	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R86	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R87	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R88	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R89	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R90	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R91	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R92	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R93	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R94	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R95	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R96	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R97	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R98	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R99	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R100	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R101	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R102	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A12R103	2100-2522		RESISTOR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A12R104	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R105	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R106	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R107	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R108	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R109	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R110	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R111	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R112	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R113	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R114	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R115	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R116	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R117	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R118	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R119	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R120	0698-5579	1	RESISTOR FLM 5000 OHM 0.5% 1/8W	28480	0698-5579
A12R121	0757-0283		RESISTOR 2.00K OHM 1% 1/8W	28480	0757-0283
A12R122	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A12R123	0757-0427	2	RESISTOR 1.5K OHM 1% 1/8W	28480	0757-0427
A12R124	0698-5852	1	RESISTOR 500 OHM 1% 1/8W	28480	0698-5852
A12R125	0757-0283		RESISTOR 2.00K OHM 1% 1/8W	28480	0757-0283
A12R126	0757-0416		RESISTOR 511 OHM 1% 1/8W	28480	0757-0416
A12R127	0698-5414	1	RESISTOR 98 OHM 0.25% 1/8W	28480	0698-5414
A12R128	0757-1099	1	RESISTOR FLM 900 OHM 1% 1/8W	28480	0757-1099
A12R129	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A12R130	0757-0408		RESISTOR 243 OHM 1% 1/8W	28480	0757-0408
A12R131	0757-0442		RESISTOR 10.0K OHM 1% 1/8W	28480	0757-0442
A12R132	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R133	0684-1041		RESISTOR COMP 100K OHM 10% 1/4W	01121	CB 1041
A12R134	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R135	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R136	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R137	0757-0462		RESISTOR 75.0K OHM 1% 1/8W	28480	0757-0462
A12R138	0757-0443		RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A12R139	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A12R140	0684-4721		RESISTOR COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12R141	0757-0442		RESISTOR 10.0K OHM 1% 1/8W	28480	0757-0442
A12R142	0757-0283		RESISTOR 2.00K OHM 1% 1/8W	28480	0757-0283
A12R143	0698-4017	1	RESISTOR FLM 6000 OHM 0.5% 1/8W	28480	0698-4017
A12R144	0757-0283		RESISTOR 2.00K OHM 1% 1/8W	28480	0757-0283
A12R145	0757-0283		RESISTOR 2.00K OHM 1% 1/8W	28480	0757-0283

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12R146	2100-2522		R:VAR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A12R147	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A12R148	0757-0417	1	R:FXD MET FLM 562 OHM 1% 1/8W	28480	0757-0417
A12R149	0757-0427		R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A12R150	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R151	0757-0463		R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A12R152	0757-0282	2	R:FXD MET FLM 221 OHM 1% 1/8W	28480	0757-0282
A12R153	0757-0282		R:FXD MET FLM 221 OHM 1% 1/8W	28480	0757-0282
A12R154	0757-0481	3	R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A12R155	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R156	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A12R157	0757-0455	2	R:FXD FLM 36.5K OHM 1% 1/8W	28480	0757-0455
A12R158	0757-0433	1	R:FXD MET FLM 3.32K OHM 1% 1/8W	28480	0757-0433
A12R159	0757-0455		R:FXD FLM 36.5K OHM 1% 1/8W	28480	0757-0455
A12R160	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A12R161	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R162	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A12R163	0757-0437		R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A12R164	0698-3430	3	R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A12S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A12J1			NOT ASSIGNED		
A12J2	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A12J3	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A12J4	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A12J5	1826-0067		IC:LINEAR OPERATIONAL AMPLIFIER	18324	NE531T
A12J6	1820-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A13	01150-66513	1	BOARD ASSY:DIGITAL SCAN	28480	01150-66513
A13C1	0160-0156	2	C:FXD MY 0.0039 UF 10% 200VDCW	56289	192P39292-PTS
A13C2	0180-0106	1	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A13C3	0160-0156		C:FXD MY 0.0039 UF 10% 200VDCW	56289	192P39292-PTS
A13C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020B2-DYS
A13C5	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A13CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A13L2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A13Q1	1854-0071		TST:SI NPN:SELECTED FROM 2N3704	28480	1854-0071
A13R1	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A13R2	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A13R3	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R4	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R5	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R6	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R7	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R8	0757-0464	1	R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464
A13R9	0757-0476	1	R:FXD MET FLM 301K OHM 1% 1/8W	28480	0757-0476
A13R10	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A13R11	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A13R12	0684-3931	1	R:FXD COMP 39K OHM 10% 1/4W	01121	CB 3931
A13R13	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A13S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A13U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A13U2	1820-0281		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A13U3	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A13U4	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A13U5	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A13U6	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U7	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U8	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U9	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U10	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U11	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U12	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A13U13	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A13U14	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U15	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A13U16	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U17	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A13U18	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U19	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U20	1820-0281		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A13U21	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A13U22	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A13U23	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U24	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U25	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U26	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U27	1820-0048		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A13U28	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A13U29	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A13U30	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U31	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A13U32	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A13U33	1820-0668		IC:TTL-HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A13U34	1820-0261		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A13XU1	1200-0418		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A13XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A14	01150-66414	1	BOARD ASSY:VERTICAL ATTENUATOR	28480	01150-66514
A14C1	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A14C2	0160-2250	2	C:FXD CER 5.1 PF 5% 500VDCW	72982	301-000-COH0-531E
A14C3	0160-2250		C:FXD CER 5.1 PF 5% 500VDCW	72982	301-000-COH0-531E
A14C4	0160-3453		C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023A101L503ZS25-COH
A14C5	0160-3453		C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023A101L503ZS25-COH
A14C6	0190-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A14C7	0190-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A14C8	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A14CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A14L2	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A14L3	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A14Q1			NOT ASSIGNED		
A14Q2	1854-0071		TSTR:SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
A14Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q9	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q10	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q11	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q12	1855-0062		TSTR:SI FET 10V	01295	2N1595
A14Q13	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q14	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q15	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q17	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q18	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q19	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q20	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q21	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q22	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q23	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q24	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q25	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q26	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q27	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q28	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q29	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q30	1853-0080	2	TSTR:SI PNP	80131	2N4888
A14Q31	1854-0234	2	TSTR:SI NPN	80131	2N3440
A14Q32	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q33	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q34	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q35	1855-0062		TSTR:SI FET 30V	01295	2N1595
A14Q36	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A14Q37	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14A38	1853-0380		TSTR:SI PNP	80131	2N6BBB
A14A39	1854-0214		TSTR:SI NPN	80131	2N3440
A14A40	1853-0049		TSTR:SI PNP	28480	1853-0049
A14A41	1853-0049		TSTR:SI PNP	28480	1853-0049
A14A42	1853-0049		TSTR:SI PNP	28480	1853-0049
A14A43	1853-0049		TSTR:SI PNP	28480	1853-0049
A14R1	0684-4721		RESISTOR 4700 OHM 10% 1/4W	01121	CB 4721
A14R2	0684-4721		RESISTOR 4700 OHM 10% 1/4W	01121	CB 4721
A14R3	0684-4721		RESISTOR 4700 OHM 10% 1/4W	01121	CB 4721
A14R4	0684-4721		RESISTOR 4700 OHM 10% 1/4W	01121	CB 4721
A14R5	0684-2221		RESISTOR 2200 OHM 10% 1/4W	01121	CB 2221
A14R6	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R7	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R8	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R9	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R10	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R11	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R12	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R13	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R14	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R15	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R16	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R17	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R18	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R19	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R20	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R21	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R22	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R23	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R24	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R25	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R26	0684-2241	18	RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R27	0698-3324	2	RESISTOR FLM 1.8K OHM 0.5% 1/8W	28480	0698-3324
A14R28	0757-1100	2	RESISTOR FLM 600 OHM 1% 1/8W	28480	0757-1100
A14R29	0757-1108	2	RESISTOR MET FLM 300 OHM 1% 1/8W	28480	0757-1108
A14R30	0757-1102	2	RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-1102
A14R31	0757-1104	2	RESISTOR FLM 60 OHM 1% 1/8W	28480	0757-1104
A14R32	0757-1107	4	RESISTOR FLM 30 OHM 1% 1/8W	28480	0757-1107
A14R33	0757-1107		RESISTOR FLM 30 OHM 1% 1/8W	28480	0757-1107
A14R34	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R35	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R36	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R37	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R38	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R39	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R40	0757-0449	4	RESISTOR FLM 20K OHM 1% 1/8W	28480	0757-0449
A14R41	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A14R42	0684-4721		RESISTOR COMP 4700 OHM 10% 1/4W	01121	CB 4721
A14R43	2100-2633	2	RESVAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A14R44	0684-4721		RESISTOR COMP 4700 OHM 10% 1/4W	01121	CB 4721
A14R45	0684-4721		RESISTOR COMP 4700 OHM 10% 1/4W	01121	CB 4721
A14R46	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R47	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R48	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R49	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R50	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R51	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R52	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R53	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R54	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R55	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R56	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R57	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R58	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R59	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R60	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R61	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R62	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R63	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R64	0684-2221		RESISTOR COMP 2200 OHM 10% 1/4W	01121	CB 2221
A14R65	0757-0443		RESISTOR MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A14R66	0757-0462		RESISTOR MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A14R67	0684-2241		RESISTOR COMP 220K OHM 10% 1/4W	01121	CB 2241
A14R68	0698-3324		RESISTOR FLM 1.8K OHM 0.5% 1/8W	28480	0698-3324
A14R69	0757-1100		RESISTOR FLM 600 OHM 1% 1/8W	28480	0757-1100

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R170	0757-1108		R:FXD MET FLM 300 OHM 1% 1/8W	28480	0757-1108
A1R171	0757-1102		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-1102
A1R172	0757-1104		R:FXD FLM 60 OHM 1% 1/8W	28480	0757-1104
A1R173	0757-1107		R:FXD FLM 30 OHM 1% 1/8W	28480	0757-1107
A1R174	0757-1107		R:FXD FLM 30 OHM 1% 1/8W	28480	0757-1107
A1R175	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R176	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R177	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R178	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R179	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R180	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R181	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A1R182	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A1R183	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R184	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1R185	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1R186	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R187	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R188	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A1R189	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R190	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A1R191	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A1R192	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R193	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
A1R194	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R195	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R196	0757-0453	2	R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A1R197	0757-0453		R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A1R198	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R199	0684-2241		R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A1R200	2100-2517	4	R:VAR FLM 50K OHM 10% LIN 1/2W	28480	2100-2517
A1R201	0757-0444	2	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A1R202	0757-0768	4	R:FXD FLM 47.5K OHM 1% 1/4W	28480	0757-0768
A1R203	0757-0481		R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A1R204	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A1R205	2100-2517		R:VAR FLM 50K OHM 10% LIN 1/2W	28480	2100-2517
A1R206	0757-0482	2	R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A1R207	0757-0844	2	R:FXD MET FLM 16.2K OHM 1% 1/2W	28480	0757-0844
A1R208	0757-0422	2	R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A1R209	0761-0019	2	R:FXD MET OX 39K OHM 5% 1W	28480	0761-0019
A1R210	0757-0463		R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A1R211	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R212	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A1R213	0757-0768		R:FXD FLM 47.5K OHM 1% 1/4W	28480	0757-0768
A1R214	2100-2517		R:VAR FLM 50K OHM 10% LIN 1/2W	28480	2100-2517
A1R215	0757-0481		R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A1R216	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A1R217	2100-2517		R:VAR FLM 50K OHM 10% LIN 1/2W	28480	2100-2517
A1R218	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A1R219	0757-0844		R:FXD MET FLM 16.2K OHM 1% 1/2W	28480	0757-0844
A1R220	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A1R221	0761-0019		R:FXD MET OX 39K OHM 5% 1W	28480	0761-0019
A1R222	0757-0463		R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A1R223	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A1S2	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A1U1	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1U2	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1U3	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1U4	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A1U5	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A1U6	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A1U7	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A1U8	1820-0066		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1U9	1820-0066		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1U10	1820-0327		IC:TTL QUAD 2-INPT NAND GATE	04713	SN7401N
A1U11	1820-0066		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1U12	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A1U13	1820-0101		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A1U14	1820-0761		IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A1XU1	1200-0434	1	SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A1S	01150-66515	1	BOARD ASSY:LAMP DRIVER	28480	01150-66515
A1C1	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A1C2	0180-0159	1	C:FXD ELECT 220 UF 20% 10VDCW	28480	0180-0159

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15L1	9140-0112		COIL:FXD RF 4.7 UH	28480	9140-0112
A15R1	0757-0722	1	R:FXD FLM 332 OHM 1% 1/4W	28480	0757-0722
A15S1	3101-0982		SWITCH:SLIDE 0.5 AMP	79727	GF124-0007
A15U1	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U2	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U3	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U4	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U5	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U6	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U7	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U8	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U9	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U10	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U11	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U12	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15U13	1820-0668		IC:TTL HEX DRIVER W/OPEN COLL(30V)	01295	SN7407N
A15XU1	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A16	01150-67601	1	BOARD ASSY:TRIGGER PICK-OFF	28480	01150-67601
A16C1	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C2	0160-3654	22	C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A16C3	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A16C4	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A16C5	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A16C6	0160-2236	2	C:FXD CER 1 PF 500VDCW	28480	0160-2236
A16C7	0160-2236		C:FXD CER 1 PF 500VDCW	28480	0160-2236
A16C8	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C9	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C10	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C11	0160-3558		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A16C12	0160-3558		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A16C13	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A16C14	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C15	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103Z5S5-CDH
A16C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20 VDCW	56289	150D225X9020A2-DYS
A16C17	0180-0197		C:FXD ELECT 2.2 UF 10% 20 VDCW	56289	150D225X9020A2-DYS
A16C18	0160-3848		C:FXD CER 3.3 PF +.5 PF 100VDCW	28480	0160-3848
A16C19	0160-3848		C:FXD CER 3.3 PF +.5 PF 100VDCW	28480	0160-3848
A16CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15K1	0490-1034		RELAY:2 FORM C 12 VDC 390 OHM	15818	412-6346
A16K2	0490-1034		RELAY:2 FORM C 12 VDC 390 OHM	15818	412-6346
A16K3	0490-1034		RELAY:2 FORM C 12 VDC 390 OHM	15818	412-6346
A15L1	9100-2276	3	COIL/CHOKE 100 UH 10%	28480	9100-2276
A16L2	9100-2276		COIL/CHOKE 100 UH 10%	28480	9100-2276
A16L3	9100-2247	1	COIL:FXD RF 0.10 UH 10%	28480	9100-2247
A15Q1	1854-0483	1	TSTR:SI NPN	28480	1854-0483
A16Q2	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15Q3	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15Q4	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15R1	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A16R2	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A16R3	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A16R4	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A16R5	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A16R6	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A16R7	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A16R8	0684-8211	2	R:FXD COMP 820 OHM 10% 1/4W	01121	CB 8211
A16R9	0757-0715	2	R:FXD MET FLM 150 OHM 1% 1/4W	28480	0757-0715
A16R10	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A15R11	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A16R12	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A16R13	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A16R14	0684-4711	5	R:FXD COMP 470 OHM 10% 1/4W	01121	CB 4711
A15R15	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A16R16	0684-6811		R:FXD COMP 680 OHM 10% 1/4W	01121	CB 6811
A16R17	0757-0809		R:FXD MET FLM 332 OHM 1.0% 1/2W	28480	0757-0809
A16R18	0757-0412	1	R:FXD MET FLM 365 OHM 1% 1/8W	28480	0757-0412
A15R19	0684-6811		R:FXD COMP 680 OHM 10% 1/4W	01121	CB 6811
A16R20	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A15R21	0684-4711		R:FXD COMP 470 OHM 10% 1/4W	01121	CB 4711
A15R22	0757-0913	1	R:FXD MET FLM 360 OHM 2% 1/8W	28480	0757-0913
A16R23	0757-0926	2	R:FXD FLM 1.2K OHM 2% 1/8W	28480	0757-0926

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16R24	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A16R25	0757-0715		R:FXD MET FLM 150 OHM 1% 1/4W	28480	0757-0715
A16R26	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A16R27	0684-8211		R:FXD COMP 820 OHM 10% 1/4W	01121	CB 8211
A16U1	5060-0509	1	IC:SEALED PACKAGE	28480	5060-0509
A16U2	1826-0003	3	IC:LINEAR OP AMP	28480	1826-0003
A16U3	5060-0510	1	IC:SEALED PACKAGE	28480	5060-0510
A16U4	1826-0003		IC:LINEAR OP AMP	28480	1826-0003
A16VR1	1902-3048	2	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A16VR2	1902-3048		DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A17	01150-66517	1	BOARD ASSY:+5V POWER SUPPLY	28480	01150-66517
A17C1	0180-0098	1	C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A17C2	0160-3448		C:FXD CER 1000 PF 10% 1000VDCW	56289	C067B251F102KS25-CDH
A17C3	0160-0155		C:FXD MY 0.0033 UF 10% 200VDCW	56289	192P33292-PTS
A17C4	0180-0100	1	C:FXD ELECT 4.7 UF 10% 35VDCW	28480	0180-0100
A17C5	0180-0159	1	C:FXD ELECT 220 UF 20% 10VDCW	28480	0180-0159
A17C6	0180-0230	1	C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X0050A2-DYS
A17C7	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2 DYS
A17C8	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2 DYS
A17CR1	1901-0049	8	DIODE:SILICON 50PIV	28480	1901-0049
A17CR2	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A17CR3	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A17CR4	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A17CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17Q1	1853-0006	2	TSTR:SI PNP	80131	2N3134
A17Q2	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A17Q3	1854-0053	1	TSTR:SI NPN	80131	2N2218
A17Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A17Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A17Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A17Q7	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A17R1	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A17R2	0757-0848		R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0848
A17R3	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A17R4	0811-1666	1	R:FXD WW 1.0 OHM 5% 2W	28480	0811-1666
A17R5	0757-0408		R:FXD MET FLM 243 OHM 1% 1/8W	28480	0757-0408
A17R6	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R7	0757-0274	1	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A17R8	0811-3094	1	R:FXD WW 4.32K OHM 0.1% 1/8W	28480	0811-3094
A17R9	2100-1799	1	R:VAR WW 500 OHM 10% 1W	28480	2100-1799
A17R10	0811-3093	1	R:FXD WW 6.22K OHM 0.1% 1/8W	28480	0811-3093
A17R11	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A17R12	0757-0718	1	R:FXD MET FLM 200 OHM 1% 1/4W	28480	0757-0718
A17R13	0757-0388	1	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A17R14A, B	0812-0045	2	R:FXD WW 0.15 OHM 5% 3W	28480	0812-0045
A17R15	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A17R16	0757-0437		R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A17R17	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A17R18	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A17R19	0757-0289	1	R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0289
A17R20	0760-0012	1	R:FXD MET OX 51 OHM 2% 1W	28480	0760-0012
A17R21	0757-0389	1	R:FXD MET FLM 33.2 OHM 1% 1/8W	28480	0757-0389
A17R22	0757-0391		R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A17R23	0757-0284	1	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A17R24	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A17R25	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A17R26	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A17U1	1820-0201		INTEGRATED CIRCUIT:UPERATIONAL AMPL	04713	MC1439G
A17VR1	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A17VR2	1902-0680	1	DIODE:TC REF. JEDEC TYPE	04713	1N827
A17VR3	1902-1070	1	DIODE:BREAKDOWN 4.22V 5%	04713	SZ10939-74
A18	01150-66518	1	BOARD ASSY:INTERCONNECT	28480	01150-66518
A18J8	1251-1887	22	CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J10	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J12	1251-2414		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
A18J14	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J16	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J18	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J20	1251-2414		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
A18J22	1251-2414		CONNECTOR:50 (2X25) CONTACT RIBBON	71785	252-25-30-340
A18J24	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J26	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J28	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J30	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J32	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A18J34	1251-1887		CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
A19	01150-66519	1	BOARD ASSY:EXTENDER	28480	01150-66519
A20	01150-66520	1	BOARD ASSY:EXTENDER	28480	01150-66520
A21	01150-66521	1	BOARD ASSY:TIME BASE	28480	01150-66521

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A21C1	0160-2197	1	C:FXD MICA 10 PF 5%	72136	RDM15C100J3C
A21C2	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C3	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C4	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C5	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C6	0160-3677	1	C:FXD CER 1000 PF 20% 2KVDCW	80031	CV159AX7B102M
A21C7	0160-3450	1	C:FXD CER 5000 PF 10% 250 VDCW 10VDCW	56289	CD67B251H502KS2 CD
A21C8	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C9	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A21C10	0160-3558	6	C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A21C11	0160-3558		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A21C12	0160-3558		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A21C13	0160-3558		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-104M
A21C14	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C15	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C16	0160-0153	3	C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A21C17	0160-2291	1	C:FXD MY 0.18 UF 10% 80VDCW	56289	192P1849RB-PTS
A21C18	0160-0107	2	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P18392-PTS
A21C19	0160-0153		C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A21C20	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C21	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A21C22	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A21C23	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A21C24	0160-3666	1	C:FXD PC (MATCHED SET)	28480	0160-3666
A21C25			(PART OF C24, MATCHED SET OF 4)	—	
A21C26			(PART OF C24, MATCHED SET OF 4)		
A21C27			(PART OF C24, MATCHED SET OF 4)		
A21C28	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C29	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C30	0180-2490		C:FXD TA 15 UF 20 WVDC	28480	0180-2490
A21C31	0160-3470		C:FXD CER 0.01 UF +80-20% 50VDCW	72982	D80
A21C32	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525-CDH
A21C33	0140-0205		C:FXD MICA 62 PF 5% 300VDCW	00853	RDM15E620J3C
A21C34	0180-0291	1	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	1500105X9035A2-DYS
A21C35	0160-0153		C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A21C36	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A21C37	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525 CDH
A21C38	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F1032525 CDH
A21C39	0140-0201		C:FXD MICA 12PF 5%	28480	0140-0201
A21CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR2	1901-0179	2	DIODE:SILICON 15WV	28480	1901-0179
A21CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR5	1901-0533	7	DIODE:HYBRID HOT CARRIER	28480	1901-0533
A21CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR7	1901-0533		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A21CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR9	1901-0533		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A21CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR18	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR19	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR20	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR21	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR22	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR23	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR24	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR25	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A21CR26	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A21E1	01150-01101		HEAT SINK FL PK	28480	01150-01101
A21E2	01150-20601		SHIELD HEAT	28480	01150-20601
A21HR1	0410-0454	1	OVEN COMPONENT FOR A21Q22	28480	0410-0454
A21L1	9100-2276		COIL/CHOKE 100 UH 10%	28480	9100-2276
A21L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A21L3	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/16
A21Q1	1854-0221		TSTR:SI NPN	28480	1854-0221
A21Q2	1853-0089		TSTR:SI PNP	80131	2N4917
A21Q3	1854-0071		TSTR:SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
A21Q4	1854-0457	1	TSTR:SI NPN	28480	1854-0457
A21Q5	1853-0058	3	TSTR:SI PNP	80131	2N3644
A21Q6	1854-0019	2	TSTR:SI NPN	28480	1854-0019
A21Q7	1854-0019		TSTR:SI NPN	28480	1854-0019
A21Q8	1854-0092		TSTR:SI NPN	80131	2N3563
A21Q9	1854-0092		TSTR:SI NPN	80131	2N3563
A21Q10	1854-0215		TSTR:SI NPN	80131	2N3904
A21Q11	1854-0215		TSTR:SI NPN	80131	2N3904

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A21J12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A21J13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A21J14	1853-0036		TSTR:SI PNP	80131	2N3906
A21J15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A21J16	1853-0036		TSTR:SI PNP	80131	2N3906
A21J17	1853-0036		TSTR:SI PNP	80131	2N3906
A21J18	1853-0036		TSTR:SI PNP	80131	2N3906
A21J19	1853-0036		TSTR:SI PNP	80131	2N3906
A21J20	1853-0050	1	TSTR:SI PNP	28480	1853-0050
A21J21	1854-0344	1	TSTR:SI NPN	28480	1854-0344
A21J22	1853-0201	3	TSTR:SI PNP	28480	1853-0201
A21J23	1854-0215		TSTR:SI NPN	80131	2N3904
A21R1	0757-0972	2	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A21R2	0757-0972		R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0972
A21R3	0757-0970	3	R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0970
A21R4	0757-0468	1	R:FXD MET FLM 909K OHM 1% 1/8W	28480	0757-0468
A21R5	0757-0924	10	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A21R6	0698-5575	2	R:FXD MET FLM 100K OHM 5% 1/8W	28480	0698-5575
A21R7	0757-0948	10	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A21R8	2100-1776	4	R:VAR WW 10K OHM 5% 1W	28480	2100-1776
A21R9	0698-5575		R:FXD MET FLM 100K OHM 5% 1/8W	28480	0698-5575
A21R10	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A21R11	0757-0917	6	R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A21R12	0757-0931	1	R:FXD MET FLM 2K OHM 2% 1/8W	28480	0757-0931
A21R13	0761-0006	2	R:FXD MET OX 10K OHM 5% 1W	28480	0761-0006
A21R14	0757-0965	3	R:FXD FLM 31K OHM 2% 1/8W	28480	0757-0965
A21R15	0757-0346	1	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A21R16	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R17	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R18	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A21R19	0759-0073	1	R:FXD MET OX 24K OHM 5% 1/2W	28480	0759-0073
A21R20	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R21	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A21R22	0698-8150	1	R:FXD COMP 560 OHM 10% 1/8W	28480	0698-8150
A21R23	0757-0901	2	R:FXD FLM 110 OHM 2% 1/8W	28480	0757-0901
A21R24	0757-0921	2	R:FXD MET FLM 750 OHM 2% 1/8W	28480	0757-0921
A21R25	0757-0918	1	R:FXD FLM 560 OHM 2% 1/8W	28480	0757-0918
A21R26	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A21R27	0757-0926		R:FXD FLM 1.2K OHM 2% 1/8W	28480	0757-0926
A21R28	0698-4130	2	R:FXD COMP 39 OHM 5% 1/8W	28480	0698-4130
A21R29	0698-4130		R:FXD COMP 39 OHM 5% 1/8W	28480	0698-4130
A21R30	0757-0921		R:FXD MET FLM 750 OHM 2% 1/8W	28480	0757-0921
A21R31	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R32	0757-0970		R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0970
A21R33	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A21R34	0757-0960	2	R:FXD FLM 31K OHM 2% 1/8W	28480	0757-0960
A21R35	0757-0974	1	R:FXD FLM 120K OHM 2% 1/8W	28480	0757-0974
A21R36	0757-0471		R:FXD MET FLM 162K OHM 1% 1/8W	28480	0757-0471
A21R37	0757-0968	1	R:FXD MET FLM 69K OHM 2% 1/8W	28480	0757-0968
A21R38	0761-0073	1	R:FXD MET OX 13K OHM 5% 1W	28480	0761-0073
A21R39	0684-2721	2	R:FXD COMP 2700 OHM 10% 1/4W	01121	CB 2721
A21R40	0684-4711		R:FXD COMP 470 OHM 10% 1/4W	01121	CB 4711
A21R41	0757-0961	1	R:FXD FLM 36K OHM 2% 1/8W	28480	0757-0961
A21R42	0757-0930	3	R:FXD FLM 1.8K OHM 2% 1/8W	28480	0757-0930
A21R43	0684-1901	4	R:FXD COMP 19 OHM 10% 1/4W	01121	CB 1901
A21R44	0757-0922	1	R:FXD FLM 820 OHM 2% 1/8W	28480	0757-0922
A21R45	0757-0975	1	R:FXD FLM 130K OHM 2% 1/8W	28480	0757-0975
A21R46	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R47	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R48	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R49	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R50	0811-2854	1	R:FXD WW 55 OHM 1% 3W	28480	0811-2854
A21R51	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A21R52	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A21R53	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A21R54	0684-1051		R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A21R55	0684-1051		R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A21R56	0684-1051		R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A21R57	0684-8231	1	R:FXD COMP 82K OHM 10% 1/4W	01121	CB 8231
A21R58	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A21R59	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A21R60	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A21R61	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A21R62	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R63	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A21R64	C0B4-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R65	0686-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R66	0758-0030	4	R:FXD MET OX 510 OHM 5% 1/2W	28480	0758-0030
A21R67	0758-0030		R:FXD MET OX 510 OHM 5% 1/2W	28480	0758-0030
A21R68	0758-0030		R:FXD MET OX 510 OHM 5% 1/2W	28480	0758-0030
A21R69	0758-0030		R:FXD MET OX 510 OHM 5% 1/2W	28480	0758-0030
A21R70	0684-1051		R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A21R71	C683-0925	1	R:FXD COMP 9.2 OHM 5% 1/4W	01121	CB 9255
A21R72	0764-0020	1	R:FXD MET FLM 5620 OHM 1% 2W	28480	0764-0020
A21R73	2100-1773	2	R:VAR 4W 1K OHM 5% TYPE H 1W	28480	2100-1773
A21R74	0757-0900	2	R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0900
A21R75	0684-3901		R:FXD COMP 39 OHM 10% 1/4W	01121	CB 3901
A21R76	0686-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A21R77	0686-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R78	C0B4-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A21R79	0684-5621		R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A21R80	0684-2721		R:FXD COMP 2700 OHM 10% 1/4W	01121	CB 2721
A21R81	0757-0964	1	R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A21R82	0761-0006		R:FXD MET OX 10K OHM 5% 1W	28480	0761-0006
A21R83	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A21R84	0761-0014	1	R:FXD MET OX 140 OHM 5% 1W	28480	0761-0014
A21U1	1820-0157	2	IC:ECL 4-INPT OR/NOR DRIVE	28480	1820-0157
A21U2	1820-0157		IC:ECL 4-INPT OR/NOR DRIVE	28480	1820-0157
A21VR1	1902-3104	1	DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A21VR2	1902-1182	1	DIODE BREAKDOWN:SILICON 12.1V 5%	28480	1902-1182
A21VR3	1902-0579	1	DIODE BREAKDOWN:5.11V	28480	1902-0579
A21VR4	1902-3224	1	DIODE:BREAKDOWN 17.8V 5% 400MW	28480	1902-3224
A21VR5	1902-3245	1	DIODE BREAKDOWN:SILICON 21.5V 5%	28480	1902-3245
A22	01150-66522	2	BOARD ASSY:SAMPLING, CHANNEL 1	28480	01150-66522
A22C1	0160-1902	2	C:FXD CER 150 PF 10% 100VDCW	72982	8101-A100-W5R-151K
A22C2	0160-3647	4	C:FXD CER 22 PF 5% 100VDCW	72982	8111-A112-C0G-220J
A22C3	0160-3647		C:FXD CER 22 PF 5% 100VDCW	72982	8111-A112-C0G-220J
A22C4	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A22C5	0160-3466	4	C:FXD CER 100 PF 10% 250VDCW	56289	C157F251F101K522-COM
A22C6	0160-3654		C:FXD CER 4700 PF +80-20% 50VDCW	72982	8111-A050-651-472M
A22C7	0160-3441		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-COM
A22C8	0160-3667	2	C:FXD CER 10.0 PF 5% 100VDCW	72982	8101-100-C0G-100J
A22C9	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A22C10	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22C12	0160-3541	2	C:FXD POLY 0.01 UF 5% 100VDCW	84411	HEW-192
A22C13	0170-0040	3	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A22C14	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22C15	0160-3466		C:FXD CER 100 PF 10% 250VDCW	56289	C157F251F101K522-COM
A22C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22C17	0160-2197		C:FXD MICA 10 PF 5%	72136	RDM15C100J3C
A22C18	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22C19	0160-3668	2	C:FXD CER 2200 PF 10% 250VDCW	56289	C067B251F222K525-COM
A22C20	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A22CR1	1901-0340	8	DIODE:SILICON HOT CARRIER	28480	1901-0340
A22CR2	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A22CR3	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A22CR4	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A22CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22CR6	1901-0579	4	DIODE:SI(SPECIAL)	03508	SE 445
A22CR7	1901-0579		DIODE:SI(SPECIAL)	03508	SE 445
A22CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22CR9	1901-0533		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A22CR10	1901-0533		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A22CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22E1	0340-0060	2	FEEDTHRU:INSULATED MOUNTING	28480	0340-0060
A22L1			(NSR PART OF A22B4)		
A22L2	9140-0142	2	COIL:FXD RF 2.20 UH 10%	82142	09-4436-4R
A2201	1854-0221		TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
A2202	1854-0360		TSTR:SI NPN DUAL	28480	1854-0360
A2203	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2204	1853-0058		TSTR:SI PNP	80131	2N3644
A2205	1854-0246	2	TSTR:SI NPN	80131	2N3643
A2206	1854-0215		TSTR:SI NPN	80131	2N3904
A2207	1853-0036		TSTR:SI PNP	80131	2N3906
A2208	1855-0062		TSTR:SI FET 30V	01295	2N1595
A2209	1854-0215		TSTR:SI NPN	80131	2N3904

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A22Q13	1853-0036		TSTR:SI PNP	80131	2N3906
A22Q11	1854-0215		TSTR:SI NPN	80131	2N3904
A2241	0698-8042	4	R:FXD MET FLM 130 OHM 1/4W	28480	0698-8042
A2242	0698-8042		R:FXD MET FLM 130 OHM 1/4W	28480	0698-8042
A2243	0757-0421	2	R:FXD MET FLM 825 OHM 1% 1 8W	28480	0757-0421
A2244	01810-61501	2	RESISTOR ASSY	28480	01810-61501
A2245	0698-3428		R:FXD MET FLM 14.7 OHM 1% 1 8W	28480	0698-3428
A2246	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A2247	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A2248	2100-1738	4	R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738
A2249	2100-1738		R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738
A22413	0757-0962	4	R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A22411	0757-0475	2	R:FXD MET FLM 274K OHM 1% 1/8W	28480	0757-0475
A22412	0757-0476	2	R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0476
A22413	0757-0959	2	R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A22414	0757-0962		R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A22415	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A22416	0698-7226	2	R:FXD COMP 91 OHM 10% 1/8W	01121	BB 9101
A22417	0698-7264	4	R:FXD FLM 14.7K OHM 2% 1/4W	28480	0698-7264
A22418	0757-0956	2	R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A22419	0757-0933	2	R:FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A22420	0698-7264		R:FXD FLM 14.7K OHM 2% 1/8W	28480	0698-7264
A22421	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A22422	2100-2497	2	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2497
A22423	0757-0907	2	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A22424	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A22425	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A22426	0686-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A22427	0757-0971	2	R:FXD FLM 91K OHM 2% 1/8W	28480	0757-0971
A22428	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A22429	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A22430	0698-3429	4	R:FXD MET FLM 19.6 OHM 1% 1/8W	28480	0698-3429
A22431	0698-4157	6	R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A22432	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A22433	0698-3429		R:FXD MET FLM 19.6 OHM 1% 1/8W	28480	0698-3429
A22434	0757-0761	2	R:FXD MET FLM 22.1K OHM 1% 1/8W	28480	0757-0761
A22435	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A22436	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A22437	0757-0910	2	R:FXD MET FLM 270 OHM 2% 1/8W	28480	0757-0910
A22438	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A22439	0686-3911	8	R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A22440	0686-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A22441	0686-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A22442	0686-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A22443	0686-0271	2	R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 2705
A22444	0686-1941	2	R:FXD COMP 190K OHM 10% 1/4W	01121	CB 1941
A22445	0686-1901		R:FXD COMP 90 OHM 10% 1/4W	01121	CB 3901
A22446	0757-0930		R:FXD FLM 1.24K OHM 2% 1/8W	28480	0757-0930
A22447	0686-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A22448	0686-2201	2	R:FXD COMP 22 OHM 10% 1/4W	01121	CB 2201
A22449	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A22450	0686-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A22451	0757-0955	2	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A22452	0757-0931	4	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A22453	0686-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A22454	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A2271	01810-61101	2	TRANSFORMER ASSY:BALUN	28480	01810-61101
A2272	1420-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A22D1	1902-0766	2	DIODE:BREAKDOWN=18.2V 5%	28480	1902-0766
A22D2	1902-3002	4	DIODE:BREAKDOWN=2.37V 5%	28480	1902-3002
A22D3	1902-3002		DIODE:BREAKDOWN=2.37V 5%	28480	1902-3002
A22D4	1200-0743	2	SOCKET:IC 4-PIN FOR TO-5 CASE	71785	131-98-97-061
A22E1	01810-61101	1	MISC ASSY:TRIGGER	28480	01810-61101
A23	01150-66521	1	CHASSIS	56289	150022X9020A3-DYS
A23C1	0140-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	5C1X7C25-CML
A23C2	0140-0123		C:FXD CER 2.2 UF 20% 25VDCW		
A23C3	0140-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150022X9020A2-DYS
A23C4	0160-3456		C:FXD CER 4700 PF 20% 50VDCW	72982	411I-A050-A5L-472M
A23C5	0160-3456		C:FXD CER 4700 PF 20% 50VDCW	72982	411I-A050-A5L-472M
A23C6	0160-3456		C:FXD CER 4700 PF 20% 50VDCW	72982	411I-A050-A5L-472M
A23C7	0160-3904	1	C:FXD CER 1.0 UF +80-20% 50VDCW	72982	411I-040-A5L-105M
A23C8	0140-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150022X9020A2-DYS
A23C9	0160-3456		C:FXD CER 4700 PF 20% 50VDCW	72982	411I-A050-A5L-472M
A23C10	0140-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0140-0229
A23C11	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101E103Z5S-CDH
A23C12	0140-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A23C13	0160-0102		C:FXD MY 0.018 UF 10% 200VDCW	56289	192P183?2-PTS
A23C14	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023A101F103Z525-CDH
A23C15	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023A101F103Z525-CDH
A23C16	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023A101F103Z525-CDH
A23C17	0160-3694		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-4729
A23C18	0160-3653	2	C:FXD CER 33 PF 5% 200VDCW	80031	CV15NC330J
A23C19	0160-3694		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-4729
A23C20	0160-3694		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-4729
A23C21	0160-3653		C:FXD CER 33 PF 5% 200VDCW	80031	CV15NC330J
A23C22	0160-3694		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-4729
A23C23	0160-3598		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-1049
A23C24	0160-3598		C:FXD CER 0.1 UF 20% 50VDCW	72982	8121-050-651-1049
A23C25	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A23C26	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-4729
A23C27	0160-0128		C:FXD CER 2.2 UF 20% 25VDCW	56289	5C192C25-CML
A23CR1	5080-9643	1	DIODE:(MATCHED PAIR)	28480	5080-9643
A23CR2			PART OF A23CR1		
A23CR3	1901-0535	2	DIODE:HYBRID HOT CARRIER	28480	1901-0535
A23CR4	1901-0535		DIODE:HYBRID HOT CARRIER	07263	FDG108A
A23CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG108A
A23CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG108A
A23CR7	1901-0040		DIODE:SILICON 30MA 30WV	15818	412-6144
A23K1	0490-1034		RELAY:2 FORM C 12 VDC 390 OHM	02114	56-590-65/3B
A23L1	9170-0016	3	BEAD:MAGNETIC SHIELDING	02114	56-590-65/3B
A23L2	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/3B
A23L3	9170-0016		BEAD:MAGNETIC SHIELDING	28480	01425-66002
A23L4	01425-66002	1	COIL:FACTORY SELECTED PART	28480	9100-2254
A23L5	9100-2254	1	COIL/CHOKE .39 UH 10%	02114	56-590-65A2/4A
A23L6	9170-0029	3	CORE:FERRITE BEAD	02114	56-590-65A2/4A
A23L7	9170-0029		CORE:FERRITE BEAD	02114	56-590-65A2/4A
A23L8	9170-0029		CORE:FERRITE BEAD	28480	1853-0284
A23Q1	1853-0284	2	TSTR:SI PNP	28480	1853-0284
A23Q2	1853-0284		TSTR:SI PNP	28480	1854-0360
A23Q3	1854-0360		TSTR:SI NPN DUAL	28480	1853-0049
A23Q4	1853-0049		TSTR:SI PNP	28480	1853-0049
A23Q5	1853-0049		TSTR:SI PNP	28480	1853-0049
A23Q6	1853-0049		TSTR:SI PNP	80131	2N3136
A23Q7	1853-0006		TSTR:SI PNP	28480	1854-0344
A23Q8	1854-0344	2	TSTR:SI NPN	28480	1854-0344
A23Q9	1854-0344		TSTR:SI NPN	80131	2N3906
A23Q10	1853-0036		TSTR:SI PNP	28480	1853-0020
A23Q11	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	0757-0963
A23R1	0757-0963	1	R:FXD FLM 6.2K OHM 2% 1/8W	01121	CB 4701
A23R2	0684-4701	2	R:FXD COMP 47 OHM 10% 1/4W	28480	0761-0074
A23R3	0761-0074	2	R:FXD MET OX 15K OHM 5% 1W	28480	0757-0928
A23R4	0757-0928	1	R:FXD FLM 1.5K OHM 2% 1/8W	28480	0757-0925
A23R5	0757-0925	1	R:FXD FLM 1.1K OHM 2% 1/8W	28480	0757-0901
A23R6	0757-0901		R:FXD FLM 110 OHM 2% 1/8W	01121	CB 1011
A23R7	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	28480	0757-0924
A23R8	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0931
A23R9	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	01121	CB 4701
A23R10	0684-4701		R:FXD COMP 47 OHM 10% 1/4W	28480	0757-0917
A23R11	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	01121	CB 1831
A23R12	0684-1831	1	R:FXD COMP 18K OHM 10% 1/4W	01121	CB 4721
A23R13	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4711
A23R14	0684-4711		R:FXD COMP 470 OHM 10% 1/4W	01121	CB 1031
A23R15	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	28480	0757-0435
A23R16	0757-0435		R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0462
A23R17	0757-0462		R:FXD MET FLM 27.4K OHM 1% 1/8W	28480	0698-3156
A23R18	0698-3156	1	R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3154
A23R19	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0757-0200
A23R20	0757-0200	1	R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0970
A23R21	0757-0970		R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0938
A23R22	0757-0938	2	R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0938
A23R23	0757-0931		R:FXD FLM 3.9K OHM 2% 1/8W	28480	0757-0931
A23R24	0761-0074		R:FXD FLM 2K OHM 2% 1/8W	28480	0761-0074
A23R25	2100-1948	2	R:FXD MET OX 15K OHM 5% 1W	28480	2100-1948
A23R26	0757-0290		R:VAR WW 50K OHM 5% TYPE H 1W	28480	0757-0290
A23R27	0757-0924		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0924
A23R28	0757-0952	1	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0952
A23R29	2100-1948		R:FXD FLM 15K OHM 2% 1/8W	28480	2100-1948
A23R30	0684-1521	1	R:VAR WW 50K OHM 5% TYPE H 1W	01121	CB 1521
A23R31	0757-0895	2	R:FXD COMP 1500 OHM 10% 1/4W	28480	0757-0895
A23R32	0698-7838	2	R:FXD FLM 82 OHM 2% 1/8W	28480	0698-7838
A23R33	0757-0294	1	R:FXD FLM 6.6 OHM 2% 1/4W	28480	0757-0294
			R:FXD MET FLM 17.8 OHM 1% 1/8W		

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A21R34	0698-7818		R:FXD FLM 5.6 OHM 2% 1/4W	28480	0698-7818
A21R35	0757-0395		R:FXD FLM 62 OHM 2% 1/8W	28480	0757-0395
A21R36	0757-0392		R:FXD FLM 19.2 OHM 1% 1/8W	28480	0757-0392
A21R37	0757-0411	1	R:FXD MET FLM 332 OHM 1% 1/8W	28480	0757-0411
A21R38	0698-1001	2	R:FXD COMP 10 OHM 10% 1/4W	01121	CB 1001
A21R39	0698-1001		R:FXD COMP 10 OHM 10% 1/4W	01121	CB 1001
A21R40	0757-0700		R:FXD MET FLM 100 OHM 2% 1/8W	28480	0757-0700
A21R41	0757-0460		R:FXD FLM 31K OHM 2% 1/8W	28480	0757-0460
A21R42	C698-4731	1	R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A21R43	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A21R44	0757-0484	1	R:FXD FLM 619K OHM 1.0% 1/8W	28480	0757-0484
A21R45	0757-0937	1	R:FXD FLM 3.0K OHM 2% 1/8W	28480	0757-0937
A21R46	0757-0934	1	R:FXD FLM 2.67K OHM 2% 1/8W	28480	0757-0934
A21R47	0757-0419		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0419
A23R38	0757-0439	1	R:FXD FLM 6810 OHM 2% 1/8W	28480	0757-0439
A23U1	1826-0001		IC:LINEAR OP AMP	28480	1826-0001
A21VR1	1902-3149	2	DIODE:BREAKDOWN:9.09V 5%	28480	1902-3149
A21VR2	1902-0660	1	DIODE:BREAKDOWN:1.9V 5%	28480	1902-0660
A21VR3	1902-3149		DIODE:BREAKDOWN:9.09V 5%	28480	1902-3149
A2	01150-66522		BOARD ASSY:SAMPLING, CHANNEL 2	28480	01150-66522
A24C1	0160-3402		C:FXD CER 150 PF 10% 100VDCW	72982	8101-A100-W5R-151K
A24C2	0160-3667		C:FXD CER 22 PF 5% 100VDCW	72982	8111-A812-COG-220J
A24C3	0160-3667		C:FXD CER 22 PF 5% 100VDCW	72982	8111-A812-COG-220J
A24C4	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A24C5	0160-3668		C:FXD CER 100 PF 10% 250VDCW	56289	C157F251F101K522-CDH
A24C6	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A24C7	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F1032S25-CDH
A24C8	0160-3567		C:FXD CER 10.0 PF 5% 100VDCW	72982	8101-100-COG-100J
A24C9	0160-3654		C:FXD CER 4700 PF 20% 50VDCW	72982	8111-A050-651-472M
A24C10	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24C12	0160-3541		C:FXD POLY 0.01 UF 5% 100VDCW	94411	HEW-192
A24C13	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A24C14	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24C15	0160-3668		C:FXD CER 100 PF 10% 250VDCW	56289	C157F251F101K522-CDH
A24C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24C17	0140-2197		C:FXD MICA 10 PF 5%	72136	DM15C100J3C
A24C18	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24C19	0160-3669		C:FXD CER 2200 PF 10% 250VDCW	56289	C067B251F222K525-CDH
A24C20	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A24CR1	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A24CR2	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A24CR3	1901-0340		DIODE:SILICON HOT CARRIER	28480	1901-0340
A24CR4	1901-0040		DIODE:SILICON 10MA 10NV	07263	FDG1088
A24CR5	1901-0579		DIODE:SI:SPECIAL>	03508	SE 445
A24CR7	1901-0579		DIODE:SI:SPECIAL>	03508	SE 445
A24CR8	1901-0040		DIODE:SILICON 30MA 30NV	07263	FDG1088
A24CR9	1901-0579		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A24CR10	1901-0533		DIODE:HYBRID HOT CARRIER	28480	1901-0533
A24CR11	1901-0040		DIODE:SILICON 30MA 30NV	07263	FDG1088
A24CR12	1901-0040		DIODE:SILICON 30MA 30NV	07263	FDG1088
A24H1	0140-0060		FEEDTHRU:INSULATED MOUNTING	28480	0140-0060
A24L1			INSD PART OF A24R43		
A24L2	9140-0142		COIL:FXD RF 2.20 UH 10%	82142	09-4436-4R
A24Q1	1854-0221		TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
A24Q2	1854-0360		TSTR:SI NPN DUAL	28480	1854-0360
A24Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A24Q4	1853-0048		TSTR:SI PNP	80131	2N3644
A24Q5	1854-0246		TSTR:SI NPN	80131P	2N3643
A24Q6	1854-0215		TSTR:SI NPN	80131	2N3904
A24Q7	1853-0016		TSTR:SI PNP	80131	2N3906
A24Q8	1855-0042		TSTR:SI FET 30V	01295	2N1595
A24Q9	1854-0215		TSTR:SI NPN	80131	2N3904
A24Q10	1853-0016		TSTR:SI PNP	80131	2N3906
A24Q11	1854-0215		TSTR:SI NPN	80131	2N3904
A24R1	0698-8042		R:FXD MET FLM 130 OHM 1/4W	28480	0698-8042
A24R2	0698-8042		R:FXD MET FLM 130 OHM 1/4W	28480	0698-8042
A24R3	0757-0421		R FXD MET FLM 825 OHM 1% 1.8W	28480	0757-0421
A24R4	01810-61501		RESISTOR ASSY	28480	01810-61501
A24R5	0698-3428		R:FXD MET FLM 14.7 OHM 1% 1.8W	28480	0757-3428
A24R6	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A24R7	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A24R8	2100-1738		R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738
A24R9	2100-1738		R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738
A24R13	0757-0962		R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A24A11	0757-0475		R:FXD MET FLM 274K OHM 1% 1/8W	28480	0757-0475
A24A12	0757-0474		R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0474
A24A13	0757-0959		R:FXD FLM 30K OHM 2% 1/8W	28480	0757-0959
A24A14	0757-0962		R:FXD FLM 39K OHM 2% 1/8W	28480	0757-0962
A24A15	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A24A16	0698-7026		R:FXD COMP 91 OHM 10% 1/8W	01121	BB 9101
A24A17	0698-7264		R:FXD FLM 14.7K OHM 2% 1/8W	28480	0698-7264
A24A18	0757-0956		R:FXD FLM 22K OHM 2% 1/8W	28480	0757-0956
A24A19	0757-0933		R:FXD FLM 2.4K OHM 2% 1/8W	28480	0757-0933
A24A20	0698-7264		R:FXD FLM 14.7K OHM 2% 1/8W	28480	0698-7264
A24A21	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A24A22	2100-2497		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2497
A24A23	0757-0907		R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907
A24A24	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A24A25	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A24A26	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A24A27	0757-0971		R:FXD FLM 91K OHM 2% 1/8W	28480	0757-0971
A24A28	0757-0965		R:FXD FLM 51K OHM 2% 1/8W	28480	0757-0965
A24A29	0757-0948		R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A24A30	0698-3429		R:FXD MET FLM 19.6 OHM 1% 1/8W	28480	0698-3429
A24A31	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A24A32	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A24A33	0698-3429		R:FXD MET FLM 19.6 OHM 1% 1/8W	28480	0698-3429
A24A34	0757-0761		R:FXD MET FLM 22.1K OHM 1% 1/4W	28480	0757-0761
A24A35	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A24A36	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A24A37	0757-0910		R:FXD MET FLM 270 OHM 2% 1/8W	28480	0757-0910
A24A38	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A24A39	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A24A40	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A24A41	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A24A42	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A24A43	0684-2711		R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 2711
A24A44	0684-1541		R:FXD COMP 150K OHM 10% 1/4W	01121	CB 1541
A24A45	0684-3901		R:FXD COMP 39 OHM 10% 1/4W	01121	CB 3901
A24A46	0757-0910		R:FXD FLM 1.8K OHM 2% 1/8W	28480	0757-0910
A24A47	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A24A48	0684-2201		R:FXD COMP 22 OHM 10% 1/4W	01121	CB 2201
A24A49	0757-0924		R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A24A50	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A24A51	0757-0955		R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A24A52	0757-0931		R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0931
A24A53	0684-1031		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1031
A24A54	0757-0917		R:FXD FLM 510 OHM 2% 1/8W	28480	0757-0917
A24T1	01810-61101		TRANSFORMER ASSY:BALUN	28480	01810-61101
A24U1	1820-0201		INTEGRATED CIRCUIT:OPERATIONAL AMPL	04713	MC1439G
A24VR1	1902-0786		DIODE BREAKDOWN:18.2V 5%	28480	1902-0786
A24VR2	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A24VR3	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A24XU1	1200-0763		SOCKET:IC 8-PIN, FOR TO-5 CASE	71785	133-98-92-063
A25	00182-60018	1	ASSY:LOW VOLTAGE POWER MODULE	28480	00182-60018
A25C1	0180-1807	2	C:FXD ELECT 290 UF +50-10% 200VDC	56289	32D291F200AB2A-DQR
A25C2	0180-1865	1	C:FXD ELECT 2100 UF +75-10% 40VDC	56289	32D212G040AH2A-DJR
A25C3	0180-1809	1	C:FXD ELECT 3400 UF +75-10% 25VDC	56289	32D342G025AB2A-DQR
A25C4	0180-1807		C:FXD ELECT 290 UF +50-10% 200VDC	56289	32D291F200AB2A-DJR
A25E1	1200-0043	2	INSULATOR:FSTR MOUNTING:TO-3	71785	29301
A25F1	2110-0065	2	FUSE:0.375A 250V	75915	312.375
A25F2	2110-0002	2	FUSE:CARTRIDGE 2 AMP 3 AG	75915	312.002
A25F3	2110-0002		FUSE:CARTRIDGE 2 AMP 3 AG	75915	312.002
A25F4	2110-0065		FUSE:0.375A 250V	75915	312.375
A25HP1	00180-61103	2	TRANSISTOR:HEAT SINK RH (INCLUDES XQ1, XQ2)	28480	00180-61103
A25HP2	00180-61104	1	TRANSISTOR:HEAT SINK LH (INCLUDES XQ3, XQ4)	28480	00180-61104
A25HP3	00182-00205	1	PANEL:REAR, LVPS	28480	00182-00205
A25HP4	00182-00206	1	PANEL:ACCESS	28480	00182-00206
A25HP5	00182-24701	1	SPACER:LVPS	28480	00182-24701
A25HP6	00182-61201	1	BRACKET ASSY:TRANSFORMER	28480	00182-61201
A25Q1	1854-0417	2	TSTR:SI NPN	28480	1854-0417
A25Q2	1854-0063	2	TSTR:SI NPN	80131	2N3055
A25Q3	1854-0063		TSTR:SI NPN	80131	2N3055
A25Q4	1854-0417		TSTR:SI NPN	28480	1854-0417
A25T1	9100-1129	1	TRANSFORMER:POWER	28480	9100-1129
A25XQ1	1200-0543	4	SOCKET:TRANSISTOR	71785	133-32-10-013
A25XQ2	1200-0543		SOCKET:TRANSISTOR	71785	133-32-10-013

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A25A21	1200-0041		SOCKET:TRANSISTOR	71785	133-12-10-013
A25A22	1200-0041		SOCKET:TRANSISTOR	71785	133-12-10-013
A25A1	00182-66505	1	ASSY:LOW VOLTAGE RECTIFIER BOARD	28480	00182-66505
A25A1C1	0180-1811	1	C:FXD ELECT 100 UF +75-10% 20VDCW	56289	6100107G020004
A25A1C41	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A25A1C42	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A25A1C43	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A25A1C44	1901-0049		DIODE:SILICON 50PIV	28480	1901-0049
A25A1C45	1901-0028	4	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C46	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C47	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C48	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C49	1901-0415	4	DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C410	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C411	[illegible]-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C412	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C413	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C414	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C415	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C416	1901-0415		DIODE:SILICON 50 PIV 1A	28480	1901-0415
A25A1C417	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C418	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C419	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1C420	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A25A1CR21	1901-0049	2	DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A25A1CR22	1901-0049		DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A25A1R1	0757-0342	2	R:FXD MET FLM 100K OHM 1% 1/4W	28480	0757-0342
A25A1R2	0757-0342		R:FXD MET FLM 100K OHM 1% 1/4W	28480	0757-0342
A25A2	00182-66514		ASSY:LOW VOLTAGE REGULATOR BOARD	28480	00182-66514
A25A2C1	0160-2204	1	C:FXD,MICA 100 PF 5%	72136	RDM15F101J3C
A25A2C2	0180-0269	1	C:FXD ELECT 1.0 UF +50-10% 150VDCW	56289	300105F150R42-DSM
A25A2C3	0180-0374	2	C:FXD AL ELECT 10 UF +50-10% 150VDCW	56289	300106F150002-DSM
A25A2C4	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A25A2C5	0180-0098	2	C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	300506G025CC2-DSM
A25A2C6	0170-0340		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A25A2C7	0180-0098		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	300506G025CC2-DSM
A25A2C8			NOT ASSIGNED		
A25A2C9	0180-0374		C:FXD AL ELECT 10 UF +50-10% 150VDCW	56289	300106F150002-DSM
A25A2CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A25A2CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A25A2CR3	1901-0026	2	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A25A2CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A25A2CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A25A2CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A25A2CR7	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A25A2F1	2110-0269	1	CLIP:FUSE 0.250" DIA	91506	6008-32CN
A25A2J1			NOT ASSIGNED		
A25A2J2			NOT ASSIGNED		
A25A2J3	1251-2571	1	CONNECTOR:PC 15 CONTACT	95354	91-6915-0702-00
A25A2Q1	1854-0039		TSTR:SI NPN	80131	2N1053
A25A2Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q5	1854-0039		TSTR:SI NPN	80131	2N1053
A25A2Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q9	1854-0039		TSTR:SI NPN	80131	2N1053
A25A2Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q13	1854-0039		TSTR:SI NPN	80131	2N1053
A25A2Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A25A2R1	0757-0713	1	R:FXD FLM 110 OHM 1% 1/4W	28480	0757-0713
A25A2R2	0757-0281	3	R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A25A2R3	0757-0465	1	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A25A2R4	0812-0058	2	R:FXD WW 8.2 OHM 5% 2W	28480	0812-0058
A25A2R5	0757-0060	2	R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	0757-0060
A25A2R6	0757-0060		R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	9757-00[illegible]
A25A2R7	0757-0439		R:FXD FLM 1920 OHM 1% 1/8W	28480	0757-0439
A25A2R8	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A25A2R9	0757-0044	2	R:FXD MET FLM 33.2K OHM 1% 1/2W	28480	0757-0044
A25A2R10	0757-0435		R:FXD FLM 1920 OHM 1% 1/8W	28480	0757-0435
A25A2R11	2100-1773		R:VAR 4W 1K OHM 5% TYPE H-1M	28480	2100-1773

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A25A2R12	0757-0767	1	R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A25A2R13	0811-1746	2	R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A25A2R14	0757-0767		R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A25A2R15	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A25A2R16	0757-0767		R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A25A2R17	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A25A2R18	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A25A2R19	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A25A2R20	2100-1772	2	R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772
A25A2R21	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A25A2R22	0811-1746		R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A25A2R23	0757-0769	1	R:FXD FLM 51.1K OHM 1% 1/4W	28480	0757-0769
A25A2R24	0757-0436	1	R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A25A2R25	0757-0430	1	R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430
A25A2R26	0757-0769		R:FXD FLM 51.1K OHM 1% 1/4W	28480	0757-0769
A25A2R27	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A25A2R28	0757-0428	1	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A25A2R29	2100-1772		R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772
A25A2R30	0757-0435		R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0435
A25A2R31	0757-0367	2	R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
A25A2R32	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A25A2R33	0812-0058		R:FXD WW 0.2 OHM 5% 2W	28480	0812-0058
A25A2R34	0757-0769		R:FXD FLM 51.1K OHM 1% 1/4W	28480	0757-0769
A25A2R35	0757-0748		R:FXD FLM 47.5K OHM 1% 1/4W	28480	0757-0748
A25A2R36	0757-0444		R:FXD MET FLM 33.2K OHM 1% 1/2W	28480	0757-0444
A25A2R37	0757-0367		R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
A25A2R38	0757-0450	1	R:FXD MET FLM 22.1K OHM 1% 1/4W	28480	0757-0450
A25A2R39	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A25A2R40	2100-1774	1	R:VAR WW 2K OHM 5% TYPE H 1W	28480	2100-1774
A25A2R41	0757-0748		R:FXD FLM 47.5K OHM 1% 1/4W	28480	0757-0748
A25A2R42	0687-5611	1	R:FXD COMP 560 OHM 10% 1/2W	01121	EB 5611
A25A2TP1	1251-0206	4	CONNECTOR:SOCKET 0.15 BOY DIA TEFLON	98291	SKT-400
A25A2TP2	1251-0206		CONNECTOR:SOCKET 0.15 BOY DIA TEFLON	98291	SKT-400
A25A2TP3	1251-0206		CONNECTOR:SOCKET 0.15 BOY DIA TEFLON	98291	SKT-400
A25A2TP4	1251-0206		CONNECTOR:SOCKET 0.15 BOY DIA TEFLON	98291	SKT-400
A25A2VR1	1902-3096	1	DIODE BREAKDOWN:5.23V 5% 400 MW	28480	1902-3096
A25A2VR2	1902-0767	1	DIODE:T.C. REFERENCE 1N938	04713	1N938
A26			NOT ASSIGNED		
A27	0960-2086	1	ASSY:A/D CONVERTER	28480	0960-2086
A28	01910-66502	1	BOARD ASSY:INTERCONNECT, SAMPLING	28480	01810-66502
A28C1	0160-3652	4	C:FXD CER 4.7 PF 0.5% 200VDCW	72982	8101-A200-COG-4738
A28C2	0160-3651	4	C:FXD CER 68 PF 10% 200VDCW	72982	8101-A200-W5R-6809
A28C3	0160-3652		C:FXD CER 4.7 PF 0.5% 200VDCW	72982	8101-A200-COG-4738
A28C4	0160-3651		C:FXD CER 68 PF 10% 200VDCW	72982	8101-A200-W5R-6809
A28C5	0160-3652		C:FXD CER 4.7 PF 0.5% 200VDCW	72982	8101-A200-COG-4738
A28C6	0160-3651		C:FXD CER 68 PF 10% 200VDCW	72982	8101-A200-W5R-6809
A28C7	0160-3652		C:FXD CER 4.7 PF 0.5% 200VDCW	72982	8101-A200-COG-4738
A28C8	0160-3651		C:FXD CER 68 PF 10% 200VDCW	72982	8101-A200-W5R-6809
A28CR1	1901-1039	1	DIODE:SI 15V	28480	1901-1039
A28P1	0143-0044	1	CONTACT:TERMINAL	00000	ORD
J35	1251-0213	2	CONNECTOR:PC EDGE 15 CONTACT (PART OF A28)	95354	91-6915-1700-00
J36	1251-0213		CONNECTOR:PC EDGE 15 CONTACT (PART OF A28)	95354	91-6915-1700-00
A28R1	0757-0391		R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A28R2	0757-0391		R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A28R3	0757-0391		R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A28R4	0757-0391		R:FXD FLM 39.2 OHM 1% 1/8W	28480	0757-0391
A28T1	01810-66002	1	TRANSFORMER ASSY:BALUN	28480	01810-66002
A28W1	01910-61614	2	CABLE ASSY:STRIPE CHANNEL 1	28480	01910-61614
A28W2	01910-61614		CABLE ASSY:STRIPE CHANNEL 2	28480	01910-61614
A29	01810-66505	2	BOARD ASSY:EXTENDER (J35)	28480	01810-66505
A30	01810-66505		BOARD ASSY:EXTENDER (J36)	28480	01810-66505
A31	01950-60001	1	DL DELAY LINE ASSY	28480	01950-60001

Table 6-3. List of Manufacturers' Codes

MFR. NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00779	AMP INC.(AIRCRAFT MARINE PROD.)	HARRISBURG, PA.	17101
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
04734	ARROW, HART & HEGEMAN ELECT. CO.	HARTFORD, CONN.	06106
04062	NO MFR DESCRIPTION FOR THIS MFG NUMBER		
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
09353	C & K COMPONENTS INC.	NEWTON, MASS.	02158
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
13103	THERMALLOY CO.	DALLAS, TEX.	75247
14655	CORNELL DUBILIER ELECT. DIV. FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07105
15818	TELEDYNE INC. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94042
18324	SIGNETICS CORP.	SUNNYVALE, CALIF.	94086
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.	94304
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71468	ITT CANNON ELECT. INC.	LOS ANGELES, CALIF.	90031
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PRODS. INC.	ERIE, PA.	16512
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
79727	CONTINENTAL-WIRT ELECTRONICS CORP.	PHILADELPHIA, PA.	19144
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
91418	RADIO MATERIALS CO.	CHICAGO, ILL.	60646

See introduction to this section for ordering information

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

7-2. This section contains information required to backdate or update this manual for a specific instrument. Descriptions of special options and standard options are also in this section.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: If backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either in the title page or in table 7-1, refer to an enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
1135A	1

CHANGE 1

Page 6-2 and Page 6-33, table 6-2,
A25: Change to HP Part No. 00182-60001; ASSY: LOW VOLTAGE POWER MODULE; Mfr. Code 28480; Mfr. Part No. 00182-60001.

Page 6-31, table 6-2,
A23R16: Change to HP Part No. 0684-5621; R:FXD COMP 5.6K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB 5621.
A23R17: Change to HP Part No. 0684-3321; R:FXD COMP 33K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB 3331.
A23R18: Change to HP Part No. 0757-0290; R:FXD MET FLM 6.19K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0290.
A23R19: Change to HP Part No. 0757-0200; R:FXD MET FLM 5.62K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0200.

Page 6-34, table 6-2,
A25A2: Change to HP Part No. 00182-66506; ASSY LOW VOLTAGE REGULATOR BOARD; Mfr. Code 28480; Mfr. Part No. 00182-66506.
A25A2C1: Change to HP Part No. 0160-0161; C:FXD MY 0.01 UF 10% 200 VDCW; Mfr. Code 56289; Mfr. Part No. 192P10392-PTS.

Page 6-35, table 6-2,
Delete: A25A2R42.

Page 8-111, schematic 35,
A23R16: Change value to 5600.
A23R17: Change value to 33K.
A23R18: Change value to 6190.
A23R19: Change value to 5620.

Page 8-115/8-116, schematic 37,
A25A2C1: Change value to 0.01 UF.
Delete: A25A2R42; connect +15V directly to collector of A25A2Q13.

7-5. SPECIAL OPTIONS.

7-6. Most customer special application requirements and/or specifications can be met by factory modification of a standard instrument. A standard instrument modified in this way will carry a special option number, such as Model 0000A/Option C01.

7-7. An operating and service manual and a manual insert are provided with each special option instrument. The operating and service manual contains information about the standard instrument. The manual insert for the special option describes the factory modifications required to produce the special option instrument. Amend the operating and service manual by changing it to include all manual insert information (and MANUAL CHANGES sheet information, if applicable). When these changes are made, the operating and service manual will apply to the special option instrument.

7-8. If you have ordered a special option instrument and the manual insert is missing, notify the nearest Hewlett-Packard Sales/Service Office. Be sure to give a full description of the instrument, including the complete serial number and special option number.

7-9. STANDARD OPTIONS.

7-10. Standard options are modifications installed on HP instruments at the factory and are available on request. Contact the nearest Hewlett-Packard Sales/Service Office for information concerning standard options.

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains component identification photographs, troubleshooting hints, signal matrix, J-connector signals (to be used with the schematics), and schematics. Table 8-1 defines symbols and conventions used with the schematics.

8-3. GENERAL INFORMATION.

8-4. SIGNAL MATRIX.

8-5. A signal matrix (table 8-4) is furnished so that the user can readily locate signal sources and interconnections. Code names are assigned to the different signals and these names are used on the schematics. The signal matrix lists the code names in alphabetical order.

8-6. SCHEMATICS.

8-7. Schematics are printed on foldout pages for ready reference. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or only part of a particular board assembly. Some MIL-standard symbols and conventions used in the schematic are defined in table 8-1. The schematics are numbered in sequence with a bold number in a box at the lower right-hand corner of each page. These numbers are used to cross-reference signal connections between schematics. At each circuit breaking point, a notation is made by a circled reference number and a number (bold type). This bold type number indicates the associated schematic that contains the source or destination of the signal. To find the source or destination of any point on a given schematic (indicated by arrows), turn to the schematic referred to by number and find the circled reference number in question.

8-8. A reference designation table on each schematic lists all components shown on the schematic. Component reference designators which have been deleted on the schematics are listed below the table.

8-9. Each plug-in assembly has designated J connectors which are numbered consecutively. For quick signal references, each J-connector configuration has been inserted in front of assembly schematics. The illustrations show which signal or voltage is applied to each pin of the J connector. They also indicate signal source or signal destination. For detailed signal distribution, refer to the signal matrix (table 8-4).

8-10. REFERENCE DESIGNATIONS.

8-11. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32.16-1968, Reference Designations for Electrical and Electronics Parts and Equipments, dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-12. Each electrical component is assigned a class letter and number. This letter- number combination is the basic reference designation. Components which are not part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly of which the component is a part (resistor R23 on assembly A03 is called A03R23).

8-13. Assemblies are numbered consecutively. If an Assembly reference designation is assigned and later deleted, that number is not reused.

8-14. SEMICONDUCTOR REPLACEMENT.

8-15. Figure 8-1 is included to help identify the leads of the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nose pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead that was used for the original part.

8-16. CIRCUIT BOARDS.

8-17. The following paragraphs provide information regarding servicing procedures for etched circuit boards, use of heat sinks, and special soldering considerations.

8-18. BOARD CONNECTIONS.

8-19. Square pin connectors are identified on circuit boards by the color code of the connecting wire. Connector pins on plugs and jacks are identified by a letter or number. The letters G, I, O, and Q have been omitted.

8-20. BOARD EXTENDERS.

8-21. Two plug-in board extenders are provided (A19 and A20). The extenders may be used with associated plug-in boards (22- or 25-pin connectors), permitting a circuit board to remain connected to the instrument, yet physically raised to a convenient level for circuit checks and adjustments.

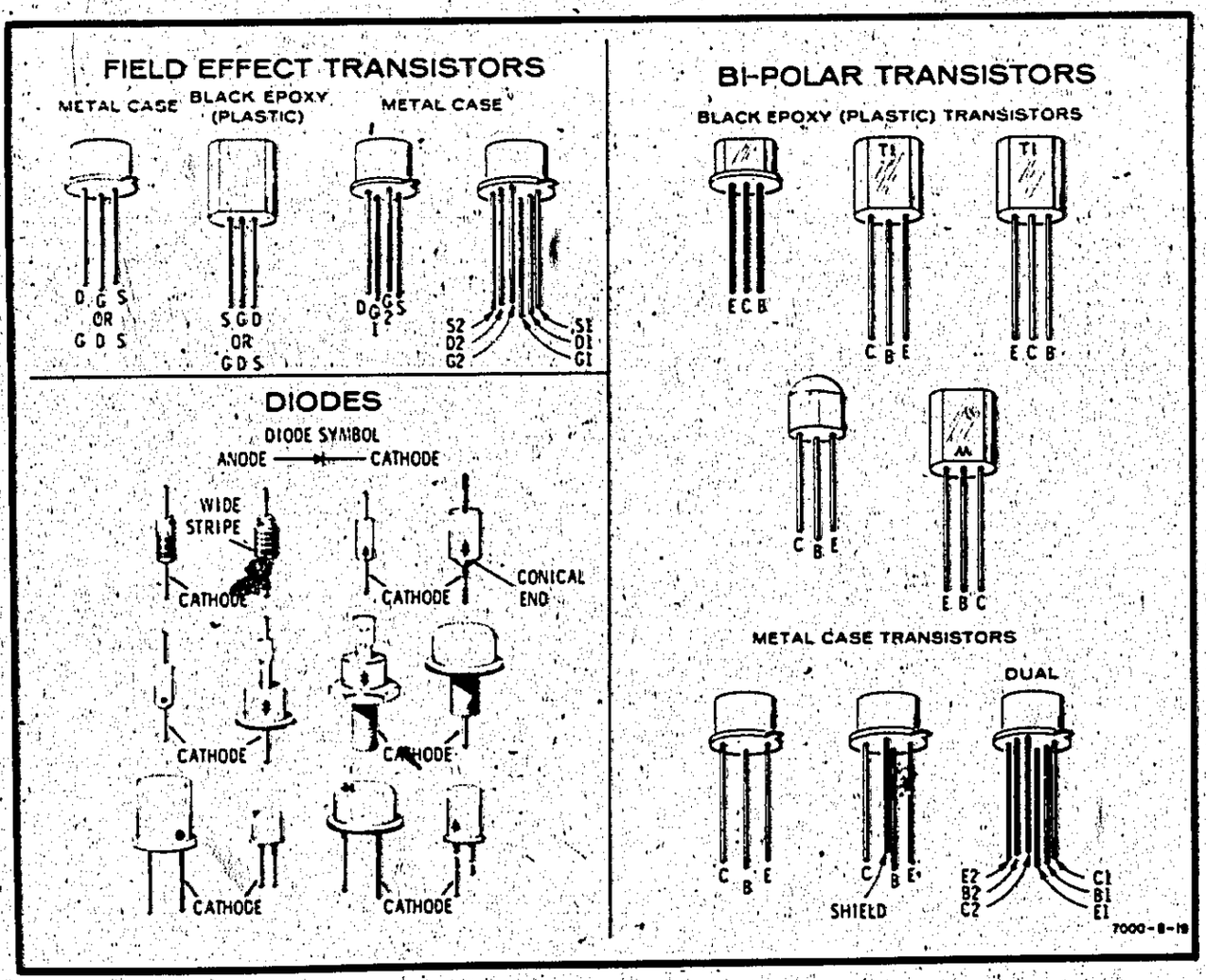


Figure 8-1. Semiconductor Terminal Identification

8-22. SERVICING ETCHED CIRCUIT BOARDS.

8-23. This instrument uses etched circuit boards with plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information on the repair of etched circuit boards.

8-24. INTEGRATED CIRCUIT REPLACEMENT.

8-25. The IC (integrated circuits) in this instrument are plug-in types. Remove a plug-in IC with a straight pull away from the board. When replacing an IC, note the mark or notch used for orientation. The component identification photos and IC diagrams of this manual show IC orientation.

8-26. INTEGRATED CIRCUIT (IC) OPERATION.

8-27. Ordinary NAND, NOR, and inverter packages will not be described in this section. Figures 8-2A through 8-2S show IC packages used in this instrument. All IC packages shown are viewed from the top.

8-28. DECADE COUNTER. The decade counter is shown in figure 8-2E. The A input is divided by 2 and appears as the A output (pin 12). The BD input is divided by 5 and appears as the D output (pin 11). If A output (pin 12) is connected to BD input, the A input will be divided by 10 and appear at the D output. The A, B, C, and D outputs represent the position-logic BCD version of the stored count. The counter will advance on the negative transition of the input pulse. When both R_0 inputs are high, the counter will be reset to 0. When R_9 inputs are high, the counter will reset to 9.

8-29. DUAL D-TYPE EDGE-TRIGGERED FLIP-FLOP. The dual D-type flip-flop is shown in figure 8-2L. The Q

output will assume the same state as the D input on the positive transition of the clock input. The $\overline{Q}$ output is always opposite in level to the Q output. The flip-flop can be set or reset directly by applying a logic low to the Preset or Clear input.

8-30. MONOSTABLE MULTIVIBRATOR. The monostable multivibrator is shown in figure 8-2G. Input A1 and A2 trigger on the negative-going edge of the input pulse, and input B triggers on the positive-going edge. The output pulse widths may be varied by using appropriate external timing components.

8-31. QUADRUPLE BISTABLE LATCH. The quadruple bistable latch is shown in figure 8-2K. Information at the D input (logic 1 or logic 0) is transferred to the Q output when the clock is high. The Q output follows the D input as long as the clock remains high. When the clock goes low, the information present at transition remains on the Q output until the clock again goes high. The $\overline{Q}$ output is the complement of the Q output.

8-32. J-K MASTER-SLAVE FLIP-FLOP. The J-K master-slave flip-flop is shown in figure 8-2M. An AND-input configuration is used, consisting of three J inputs and three K inputs ANDed together. The flip-flop triggers on the negative edge of the clock. The flip-flop can be set or reset by applying a low state to the Preset and Clear inputs.

8-33. 5-BIT SHIFT REGISTER. The 5-bit shift register is shown in figure 8-2F. The shift register consists of five R-S master-slave flip-flops connected to perform parallel-to-serial or serial-to-parallel conversion of binary data. Transfer of information to the output occurs when the Clock input goes high. All flip-flops are simultaneously set to the logical 0 state by applying a logical low voltage to the clear input. The flip-flops may be independently set to the logical 1 state by applying a logical high to both the preset input of the specific flip-flop and the common preset input.

8-34. ONE-OF-SIXTEEN DECODER. The one-of-sixteen decoder is shown in figure 8-2N. It converts four BCD inputs to select one of sixteen outputs. The selected output is in the logic low state while all other outputs are in the logic high state.

8-35. TROUBLESHOOTING.

8-36. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front-panel controls. Suspected malfunctions may be caused by improper control settings or circuit connections. Before doing the test and/or troubleshooting procedures, refer to Section III (Operation) for an explanation of controls and general operating considerations, and Section IV (Principles of Operation) for an explanation of circuit theory.

8-37. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Check to see that all circuit board connections are making good contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check the power supply voltages in the unit. Prior to any extensive troubleshooting, check the external power sources also.

8-38. SPECIFICATION VERIFICATION TAPE.

8-39. When a malfunction is suspected or known to have occured, the quickest means of isolating the trouble to a particular assembly is to use Specification Verfication Tape, HP Part No. 10487-91402 as described in Section V. Each test on the tape should be checked for proper results. When an error occurs, determine which assembly or assemblies are involved in that particular test. Refer to table 8-3 for troubleshooting hints.

8-40. Check the operation of the suspected assembly (or assemblies) by using the front-panel data switches. Refer to Section III for proper coding of the different assemblies.

Note

Ensure that all functions of the suspected assembly are checked. For example, an assembly containing a D/A circuit should have all stages in the converter checked.

8-41. Except for the power supplies, the two areas where malfunctions might occur that will affect the entire operation of the instrument are:

a. The trigger circuitry.

b. Read/Multiplexer Assembly A07.

8-42. TRIGGER PICKOFF CIRCUITS.

8-43. The most significant troubleshooting measurement in the trigger pickoff circuit is made at U1 pin 6 (or U3 pin 10.) With no signal applied to the INPUT connector, a measurement of 0 volt (±15 mV) at pin 6 will usually indicate that the input circuitry and U1 (or U3) are all functioning properly.

8-44. TRIGGER ASSEMBLY A23.

8-45. The basic operation of the trigger circuit is best checked with the NORMAL/AUTO switch set to NORMAL. Before troubleshooting the trigger circuit, accomplish the LEVEL and BIAS adjustments described in Section V. If proper adjustment does not correct a trouble, set CW SLOPE switch to CW and make the following tests.

a. Ensure that voltage at TP1 is equal to that at TP2 for center-range setting of LEVEL control (center-range ≈−6V).

Table 8-1. Schematic Notes

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front-panel marking

= Rear-panel marking

= Front-panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

NC = No connection

3 = Waveform test point (with number)

A = Common electrical point (with letter) not necessarily ground

= Single-pin connector on board

A = Pin of a plug-in board (with letter or number)

= Coaxial cable connected to snap-on jack

= Coaxial cable connected directly to board

= Wire connected to pressure-fit socket on board

= Main signal path

= Primary feedback path

= Secondary feedback path

G D S = Field-effect transistor (P-type base)

G D S = Field-effect transistor (N-type base)

= Breakdown diode (voltage regulator)

= Tunnel diode

= Step-recovery diode

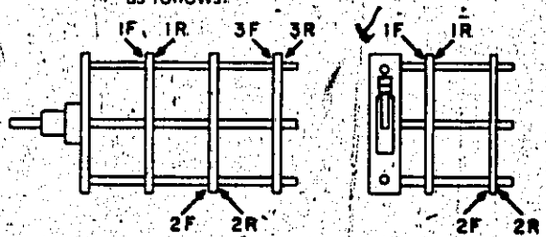
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

(925) = Wire colors are given by numbers in parentheses using the resistor color code

[(925) is wht-red-grn]

0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

Switch wafers are identified as follows:



* = Optimum value selected at factory, typical value shown; part may have been omitted.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

b. Check bias circuitry by measuring voltage at TP3. Voltage should be between −6 volts and −7 volts and most negative at center of range of LEVEL control R1B.

c. Check Q8 through Q10 with CW SLOPE switch in (+) or (−) position and LEVEL control fully clockwise. Measure biases on CR4 through CR7 to ensure that they are correct (refer to Section IV for operation).

d. Set CW SLOPE switch to other polarity and re-measure these biases.

e. Check relay K1 for proper operation.

8-46. TROUBLESHOOTING ASSEMBLY A07.

8-47. Read/Multiplexer Assembly A07 can be considered, functionally, as the most important assembly in the instrument. The surest method of troubleshooting this assembly is by the front-panel input data switches. Using the program codes given in Section III, each command should be programmed and checked. The command signals generated by this assembly can be verified at connectors J19 and J20.

8-48. BOARD EXCHANGE PROGRAM.

8-49. A field service kit, HP Part Number 01150-69501, has been established to facilitate field repair of Model 1150A. This kit constitutes recommended spares for field maintenance (table 8-2).

8-50. Certain components of the kit are on the Blue Stripe Exchange Program as a means of replenishing parts used out of the kit. All parts set up in the Blue Stripe program will have their HP Part Numbers modified with an appropriate tag to indicate that the assembly is rebuilt. Blue Stripe HP Part Numbers are listed in table 8-2. For additional information concerning this program, contact the nearest Hewlett-Packard Sales/Service Office.

Table 8-2. Field Service Kit, HP Part Number 01150-69501

Desig	Description	Qty	Part No.	Blue Stripe No.
A03	Bd assy - Local Rem	1	01150-66503	None
A04	Bd assy - Calibrator	1	01150-66504	01150-69502
A05	Bd assy - Disp. Cont.	1	01150-66505	01150-69503
A06	Bd assy - Xpnd Pos	1	01150-66506	None
A07	Bd assy - Read MPX	1	01150-66507	01150-69504
A08	Bd assy - CH Select	1	01150-66508	None
A09	Bd assy - Vert Pos	1	01150-66509	01150-69505
A11	Bd assy - Scan Attn	1	01150-66511	None
A12	Bd assy - Scan D/A	1	01150-66512	01150-69506
A13	Bd assy - Dig Scan	1	01150-66513	None
A14	Bd assy - Vert Attn	1	01150-66514	01150-69507
A16	Bd assy - Trigger P. O. assy	1	01150-67601	01150-69508
A17	Bd assy - Power Supply	1	01150-66517	None
A21	Bd assy - Time Base	1	01150-66521	01150-69509
A22, A24	Bd assy - Sampling	1	01150-66522	01150-69510
A23	Bd assy - Triggering	1	01150-66523	01150-69511
A27	A/D Converter	1	0960-2085	01150-69512
Part of A25	Power Module	1	00182-69501	None
A19	Extender bd	1	01150-66519	None
A20	Extender bd	1	01150-66520	None
DS1-39	6 VDC 0.25W Light Indicator	5	1450-0746	None
A15U1-13	IC (TTL Hex driver)	2	1820-0668	None
Q2	Trans Pwr 2N4918	2	1853-0084	None
Q3	Trans	2	1854-0300	None
SCR1	THYR SCR2N4441	2	1884-0082	None
Q1	Trans 2N3715	2	1854-0264	None
CR1	Diode assy: Si 50V PIV	2	1901-0525	
F1	Fuse: 2 ASB	5	2110-0006	None
F2	Fuse: Cartridge 8A, 125V	5	2110-0036	None
A25F1 & 4	Fuse: 0.375A 250V	5	2110-0065	None
A25F2 & 3	Fuse: 2 AMP 3 AG	5	2110-0002	None
	Material List	1	(NSN)	None
	1150 Manual		01150-90901	None

Table 8-3. Troubleshooting Tree

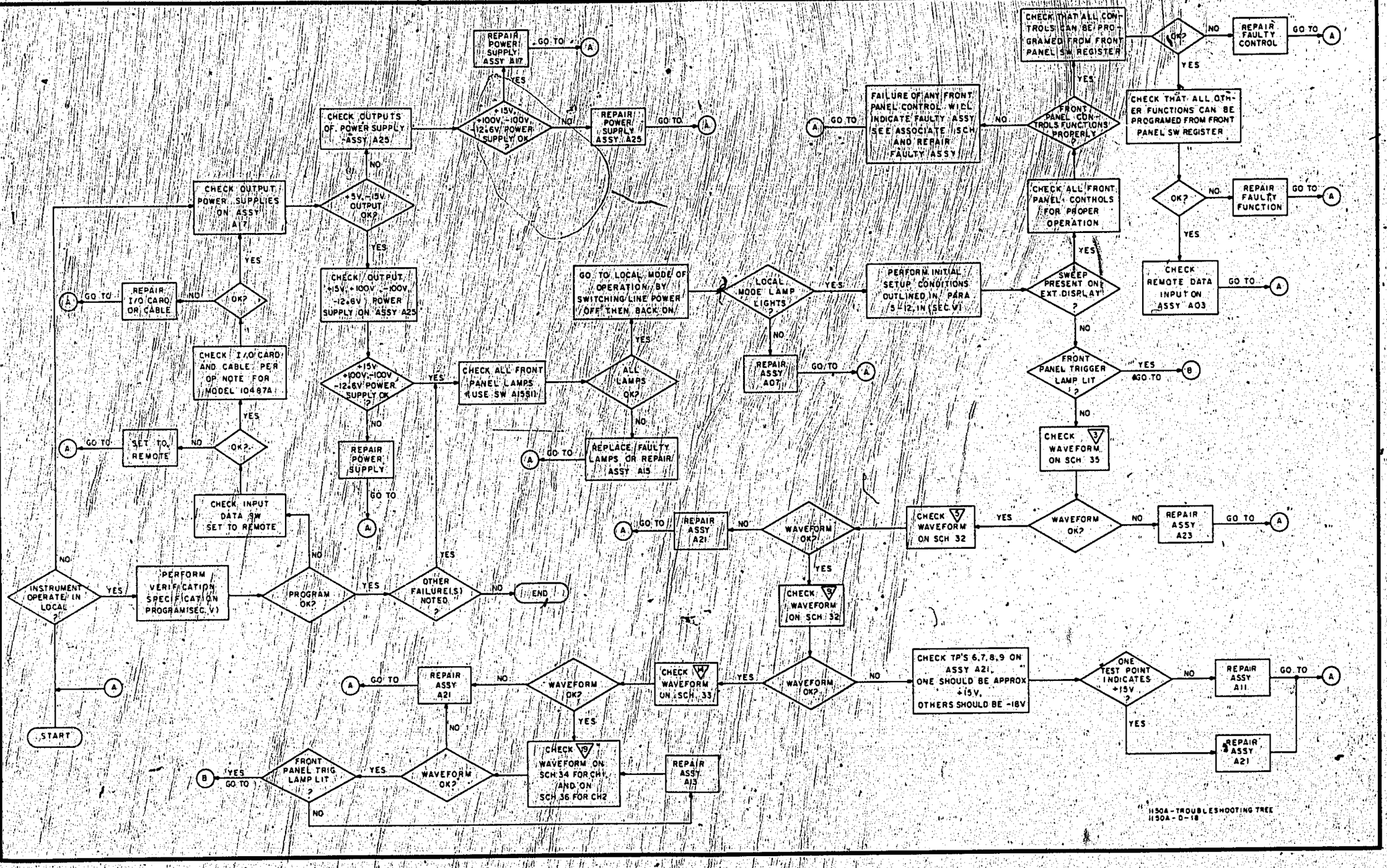
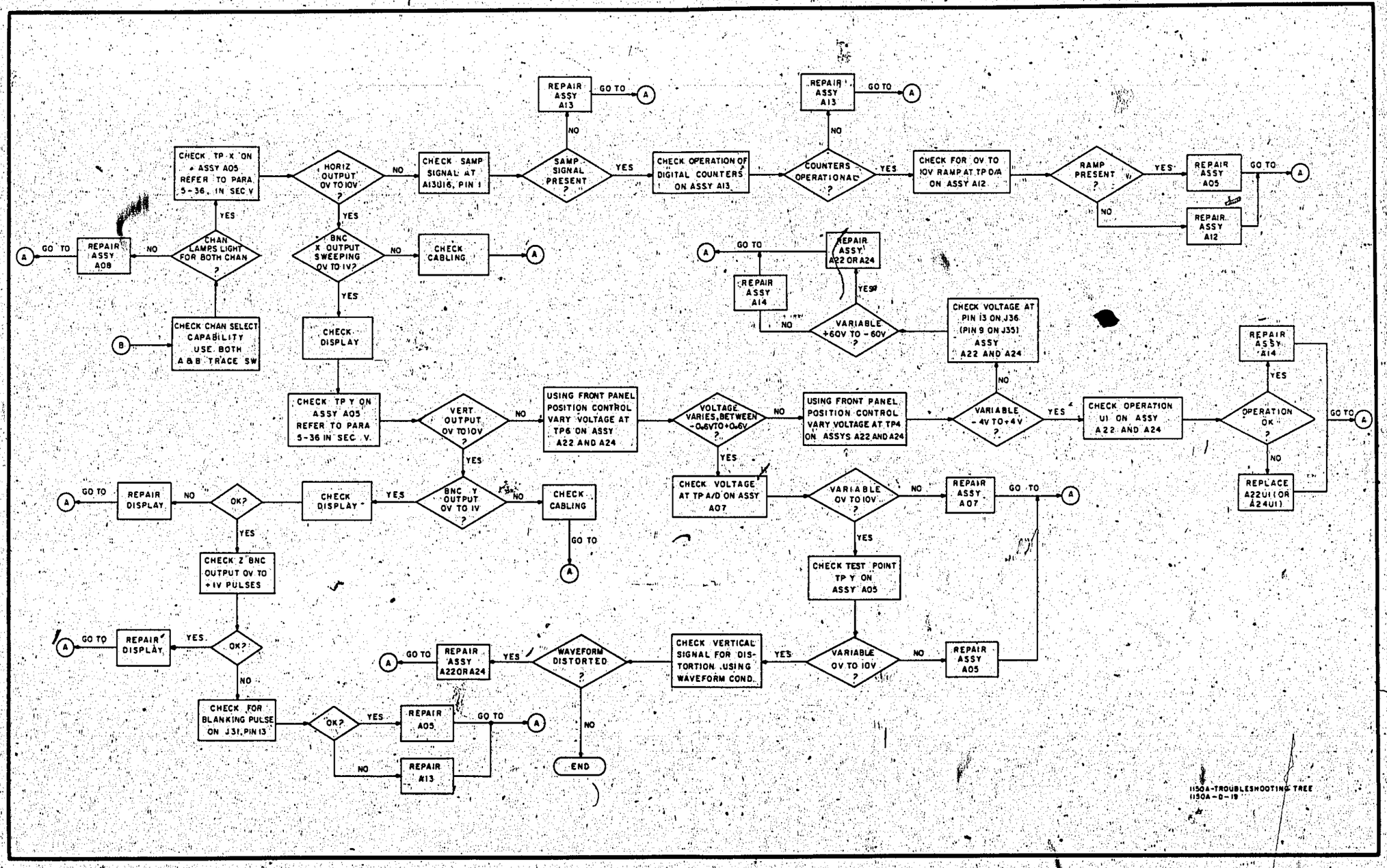
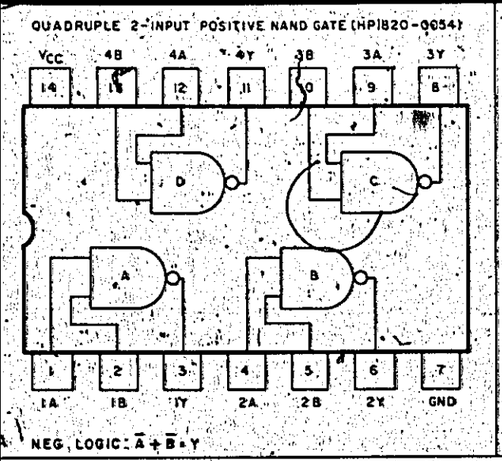
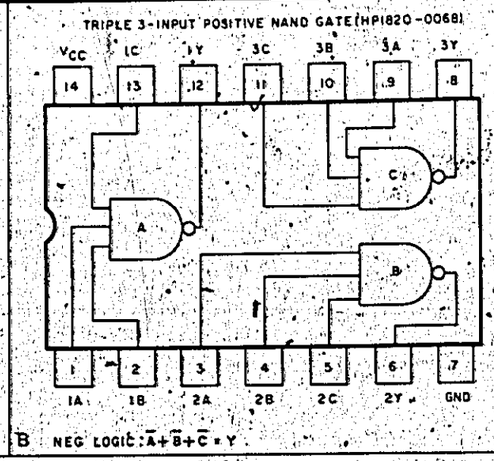
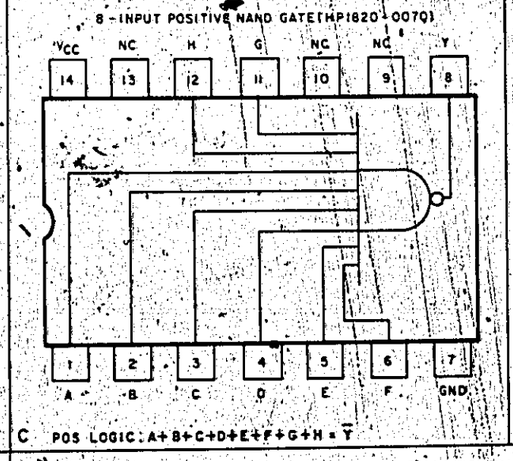


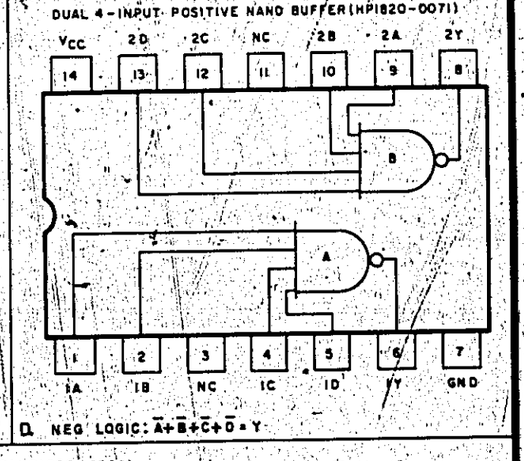
Table 8-3. Troubleshooting Tree (Cont'd)

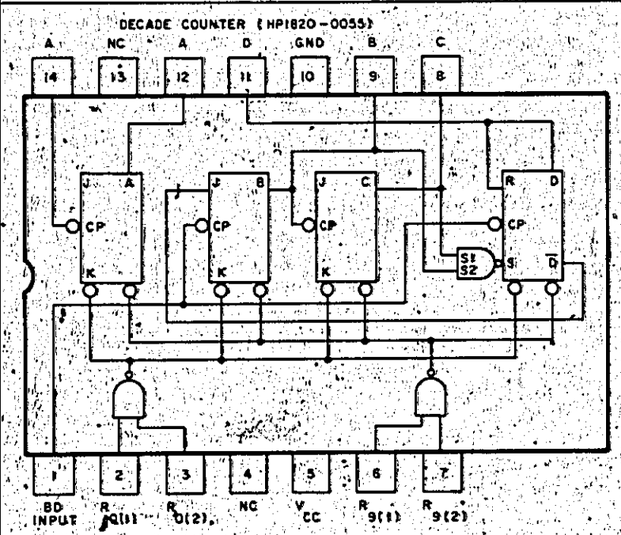












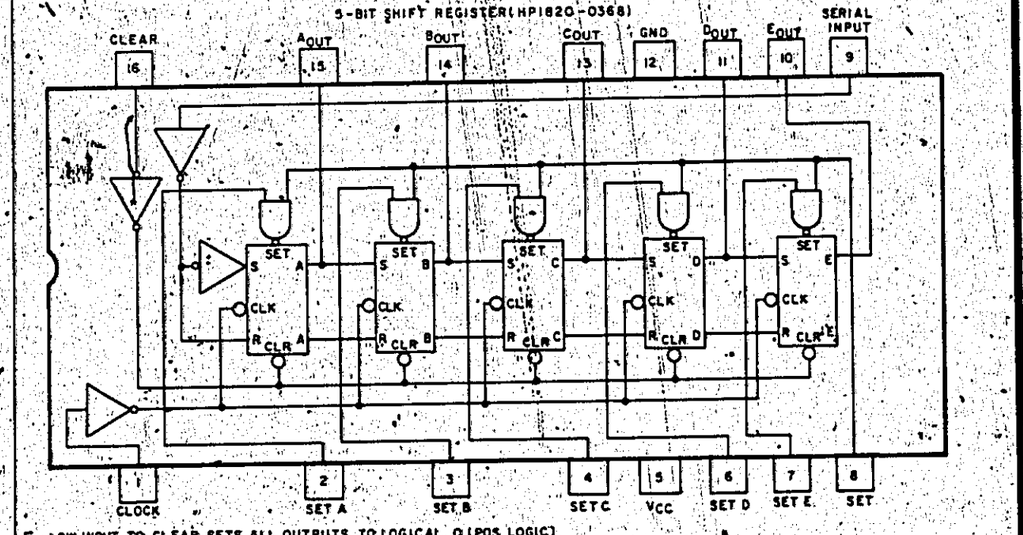
TRUTH TABLE
BCD COUNT SEQUENCE

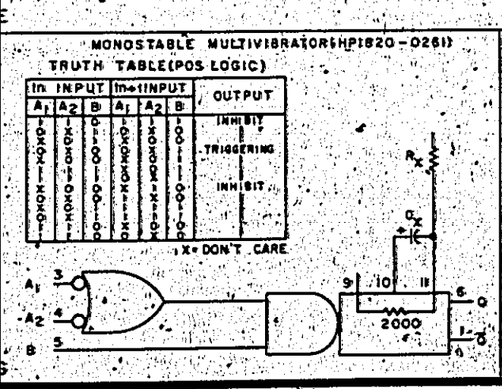
COUNT	OUTPUT D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

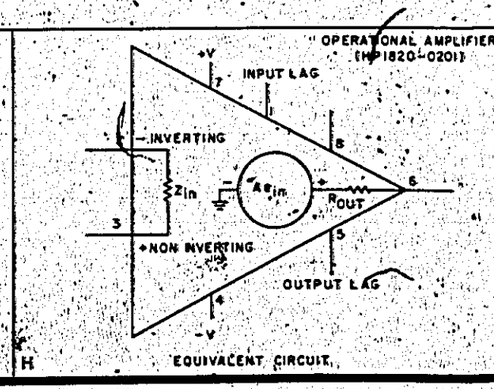
RESET COUNT

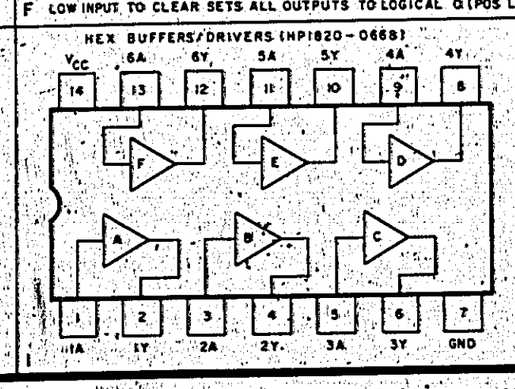
RESET INPUTS $R_{0(1)}$	$R_{0(2)}$	$R_{9(1)}$	$R_{9(2)}$	OUTPUT D	C	B	A
1	1	0	X	0	0	0	0
1	1	X	0	0	0	0	0
X	X	1	1	1	0	0	1
X	0	X	0	COUNT			
0	X	0	X	COUNT			
0	X	X	0	COUNT			
X	0	0	X	COUNT			

X = DON'T CARE
(POS LOGIC)









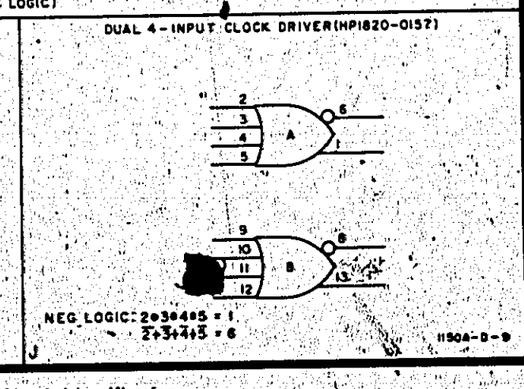


Figure 8-2. Integrated Circuit Identification

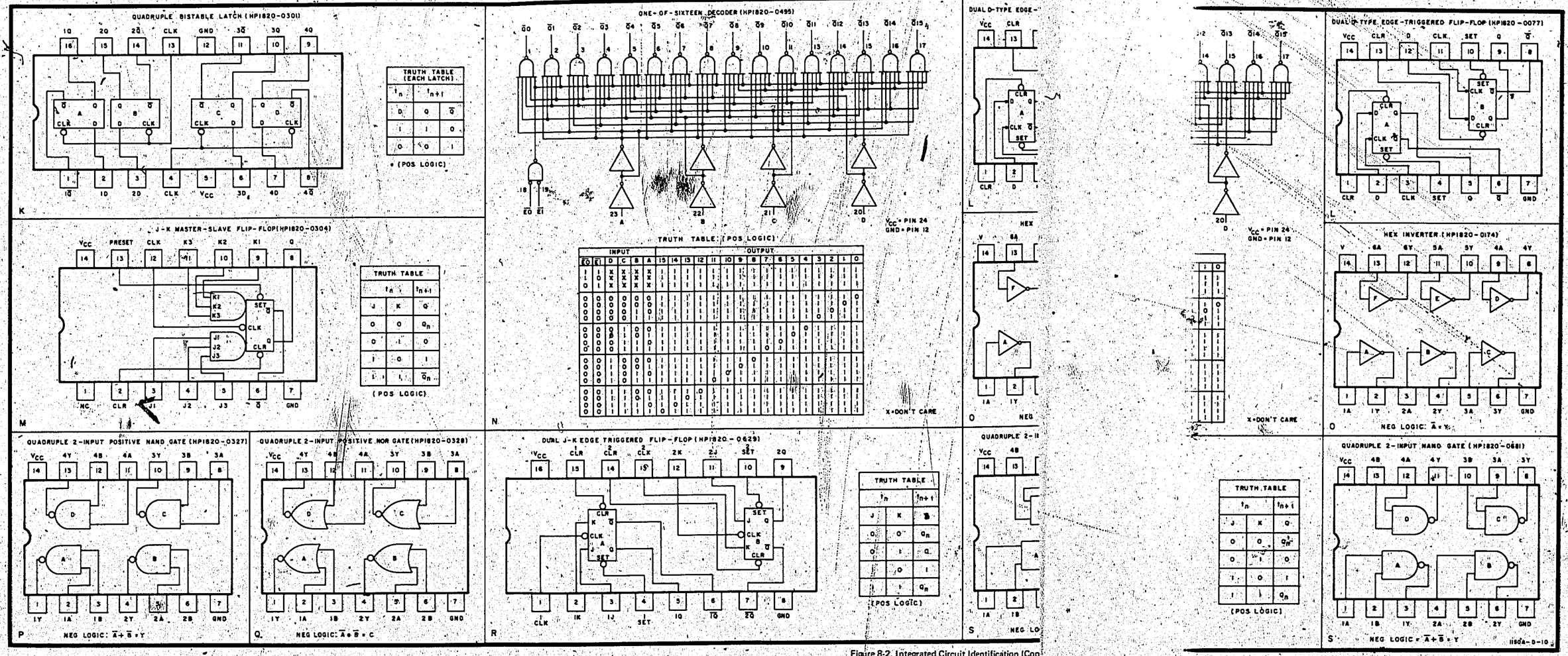


Figure 8-2. Integrated Circuit Identification (Con

Figure 8-2. Integrated Circuit Identification (Cont'd)

Table 8-4. Signal Matrix

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1,2		3,4,5		6,7,8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36		J37	J38	J39	J41	
ADAENC	J31 Pin 11											22										11																
ADBUSY	J37 Pin D											AA																						D				
ADB0	J37 Pin 21											M																						21				
ADB1	J37 Pin 22											N																						22				
ADB2	J37 Pin Z											P																						Z				
ADB3	J37 Pin Y											R																						Y				
ADB4	J37 Pin X											S																						X				
ADB5	J37 Pin W											T																						W				
ADB6	J37 Pin V											U																						V				
ADB7	J37 Pin U											V																						U				
ADB8	J37 Pin T											W																						T				
ADB9	J37 Pin R											X																						R				
ADENC	J19 Pin 23											23																						8				
AOFF	S3													Y																								S3-F9
ARS	J35 Pin 2																					7							2				L					
ATN1	J33 Pin 6																							6							9							
ATN2	J33 Pin 12																							12							14							
A0	S3													D																								S3-A2
A1	S3													E																								S3-D9
A2	S3													F																								S3-B2
A3	S3													H																								S3-E9

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3, 4, 5		6, 7, 8		9		10, 11, 12		15		16, 17		18, 19		21, 22		23, 24, 25		26, 27		28, 29		30	31, 32		34, 36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36		J37	J38	J39	J41	
																																						S3-C2
A4	S3													J																								
																																						S4-F9
BOFF	S4													X																								
BRDOT	J29 Pin 12							5												12																		
BUFENC	J9 Pin 19	19		Z																																		
																																						S4-A2
B0	S4													K																								S4-D9
B1	S4													L																								S4-B2
B2	S4													M																								S4-E9
B3	S4													N																								S4-C2
B4	S4													P																								
CALCOM	J13 Pin 8							B																				COM										
CALMODE	J13 Pin 8							8																				MODE										
CALSENSE	A16							1																				SENSE										
CALSIG	J13 Pin 2							2																				CAL										
CHSW	J31 Pin 4													U								4																
CH1	J36 Pin 14											11												8							14							
CH1COM	J36 Pin 5																							7							5							
CH1FIL	S11																														6						S11-1
CH1POS	J33 Pin 8																							8							13							
CH1REL	J13 Pin 6							6																				CH1REL										
CH2	J35 Pin 8											13												10							8							
CH2COM	J35 Pin 12																							11							12							

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A1		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3,4,5		6, 7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36		J37	J38	J39	J41	
CH2FIL	S11																												7								S11-4
CH2POS	J3 Pin D																							D					9								
CH2REL	J13 Pin 7					7																				CH2REL										
CH3-10	J39 Pin 37											H																							37		
CH11-18	J39 Pin 38											F																							38		
CH19-26	J39 Pin 39											B																							39		
CH27-32	J39 Pin 40											A																							40		
C0	J21 Pin 2													2																					18		
C1	J21 Pin C													C																					19		
C2	J21 Pin 3													3																					20		
C3	J21 Pin 1													1																					21		
C4	J21 Pin 4													4																					22		
DAPOS1	J23 Pin 18															18								A													
DAPOS2	J23 Pin 19															19								C													
DATACOM				5,E		5,E		5,E		5,E		5,E		5,E		5,E		5,E		5,E		5,E		5,E		5,E									23		
DATAGND		17,U																																26-29			
DEVICE FLAG	J9 Pin X	X																																33			
DISCLCL	J38 Pin 30											2																						30			
DSPCOM	J15 Pin V							V																												23, 25	
DEVICE COMMAND	J38 Pin 32	W																																32			
ENCSMP	J19 Pin 17											17										15															

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER	TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15	A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3,4,5		6,7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26, 27		28,29	30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34			J35	J36	J35	J36		J37	J38	J39	J41	
ERASE	J15 Pin N							N																											3	
ERSVFY	J41 Pin 5							P																											5	
EXCAL	J13 Pin E					E																												24		
EXPCOM & SCANCOM	J17 Pin 20									20										18								2		2							
EXPOS	J29 Pin T											L								T																
EXPOSDA	J17 Pin 19									19										S																
EXPOSFP	R5																			R																R5-2
EXTCALCOM	A16																									COM									49		
EXTCALSIG	A16																									EXTCAL									50		
FLAG	All Assys to A3					22		22		22		22		22		22		22				22		22		(924)									36		DS6
FPSCNCOM	J31 Pin M																				M																S5,S29
FPSCN0	S29																				N																S29-A2
FPSCN1	S29																				P																S29-A9
FPSCN2	S5																				R																S5-6
FPSCN3	S5																				S																S5-8
FP0	S12			1																																	S12
FP1	S13			2																																	S13
FP2	S14			3																																	S14
FP3	S15			4																																	S15
FP4	S16			5																																	S16
FP5	S17			6																																	S17

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1,2		3,4,5		6,7,8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36		J37	J38	J39	J41	
FP6	S18			7																																		S18
FP7	S19			8																																		S19
FP8	S20			9																																		S20
FP9	S21			10																																		S21
FP10	S22			11																																		S22
FP11	S23			12																																		S23
FP12	S24			13																																		S24
FP13	S25			14																																		S25
FP14	S26			15																																		S26
																																						S27
FP15	S27			16																																		
GND		2,B				2, B		2, B		2, B		2, B				2,B				2, B		2, B		2, B							°C	E,F,4,5					
HO1	R2																														K						R2A-1
																																						R2B-6
HO2	R2																																					
																															J						R2A-3
HO3	R2																																					
HSWP	J29 Pin W							17												W																		
IBB0	J12 Pin F			F		F		F		F		F		F		F		F				F		F												1		DS38
IBB1	J12 Pin H			H		H		H		H		H		H		H		H				H		H												2		DS37
IBB2	J12 Pin J			J		J		J		J		J		J		J		J				J		J												3		DS36
IBB3	J12 Pin K			K		K		K		K		K		K		K		K				K														4		DS35
IBB4	J12 Pin L			L		L		L		L		L		L		L		L				L														5		DS34
IBB5	J12 Pin M			M		M		M		M		M				M		M				M														6		DS33

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER	TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15	A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1,2		3,4,5		6,7,8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29	30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34			J35	J36	J35	J36		J37	J38	J39	J41	
IBB6	J12 Pin N				N		N		N		N		N				N		N				N			(9)								7		DS32
IBB7	J12 Pin P				P				P		P						P		P				P			(90)								8		DS31
IBB8	J12 Pin R				R				R		R						R		R				R			(91)								9		DS30
IBB9	J12 Pin S				S				S														S			(92)								10		DS29
IBB10	J12 Pin T				T		T		T														T			(93)								11		DS28
IBB11	J12 Pin U				U		U		U				U										U			(94)								12		DS27
IBB12	J12 Pin V				V		V				V				V										V	(95)										DS26
IBB12	J11 Pin 17			17					V				V				V		V				V											13		
IBB13	J12 Pin W				W		W		W						W		W						W			(96)										DS25
IBB13	J11 Pin 18			18							W		W						W						W									14		
IBB14	J12 Pin X				X										X		X		X							(97)										DS24
IBB14	J11 Pin 19			19			X		X		X		X										X		X									15		
IBB15	J12 Pin Y				Y		Y		Y		Y		Y													(98)										DS23
IBB15	J11 Pin 20			20											Y		Y		Y				Y		Y									16		
IB0	J38 Pin 35	A																															35			
IB1	J38 Pin 36	B																															36			
IB2	J38 Pin 37	C																															37			
IB3	J38 Pin 38	D																															38			
IB4	J38 Pin 39	E																															39			
IB5	J38 Pin 40	F																															40			
IB6	J38 Pin 41	H																															41			

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER	TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15	A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3,4,5		6, 7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29	30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34			J35	J36	J35	J36		J37	J38	J39	J41	
IB7	J38 Pin 42	J																																42			
IB8	J38 Pin 43	K																																43			
IB9	J38 Pin 44	L																																44			
IB10	J38 Pin 45	M																																45			
IB11	J38 Pin 46	N																																46			
IB12	J38 Pin 47	P																																47			
IB13	J38 Pin 48	R																																48			
IB14	J38 Pin 49	S																																49			
IB15	J38 Pin 50	T																																50			
IOFLAG	J11 Pin AA	20		AA																																	
LCLDAT	S2			Y																																S2-3	
LEARN	S28											4																								S28-C	
LOAD	S30			21																																S30-3	
LP	J19 Pin D							1				D		R				A		N		1		S		(926)										
LRDSPY	J15 Pin 15							15																											7		
LRNDIS	J21 Pin AA											E		AA																							
MODE	J15 Pin M							M																											1		
MPXCOM	J19 Pin 12											12																						41			
MPXSIG	J19 Pin Z							19				Z																					1				
MPXSIGCOM	J19 Pin Y											Y																					A				
MPX1	J21 Pin V											18		V																							

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER	TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15	A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3,4,5		6,7,8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29	30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34			J35	J36	J35	J36		J37	J38	J39	J41	
MPX2	J21 Pin W											19		W																							
MPX3-10	J39 Pin 42											21																							42		
MPX11-18	J39 Pin 43											20																							43		
MPX19-26	J39 Pin 44											14																							44		
MPX27-32	J39 Pin 45											3																							45		
MX1	J27 Pin 9																	9		K																	
MX2.5	J27 Pin 10																	10		L																	
MX5	J27 Pin 11																	11		M																	
OBB0	All Assys		6		6								6		6				6				6		6	(901)								26		DS22
OBB1	All Assys		7		7								7		7				7				7		7	(902)								27		DS21
OBB2	All Assys		8		8								8		8				8				8		8	(903)								28		DS20
OBB3	All Assys		9		9								9		9				9				9			(904)								29		DS19
OBB4	All Assys		10		10								10		10				10							(905)								30		DS18
OBB5	All Assys		11		11								11						11							(906)								31		DS17
OBB6	All Assys		12		12								12						12							(907)								32		DS16
OBB7	All Assys		13		13								13						13							(908)								33		DS15
OBB8	All Assys		14		14								14						14							(912)								34		DS14
OBB9	All Assys		15		15								15													(913)								35		DS13
OBB10	All Assys		16		16																					(914)										DS12
OBB11	All Assys		17		17																					(915)										DS11
OBB12	All Assys		18		18																					(916)										DS10

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF		TIME BASE		SAMPLING		TRIGGER		A/D CONVERTER		CONTROLLER		CHANNEL EXTENDER		DISPLAY		FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16		A21		A22 A24		A23		A27								
SCHEMATIC NO.		NA		1, 2		3,4,5		6, 7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26, 27		28,29		30		31,32		34,36		35		NA								
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34					J35	J36	J35	J36			J37		J38		J39		J41		
OBB13	All Assys		19		19																					(917)																DS9
OBB14	All Assys		20		20																					(918)																DS8
OBB15	All Assys		21		21																					(923)																DS7
OB0	J38 Pin 1		F																																	1						
OB1	J38 Pin 2		H																																	2						
OB2	J38 Pin 3		J																																	3						
OB3	J38 Pin 4		K																																	4						
OB4	J38 Pin 5		L																																	5						
OB5	J38 Pin 6		M																																	6						
OB6	J38 Pin 7		N																																	7						
OB7	J38 Pin 8		P																																	8						
OB8	J38 Pin 9		R																																	9						
OB9	J38 Pin 10		S																																	10						
OB10	J38 Pin 11		T																																	11						
OB11	J38 Pin 12		U																																	12						
OB12	J38 Pin 13		V																																	13						
OB13	J38 Pin 14		W																																	14						
OB14	J38 Pin 15		X																																	15						
OB15	J38 Pin 16		Y																																	16						
POS1	J33 Pin 2											K												2																		
POS1FP	R7-2																							1																		R7-2

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF		TIME BASE		SAMPLING		TRIGGER		A/D CONVERTER		CONTROLLER		CHANNEL EXTENDER		DISPLAY		FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16		A21		A22 A24		A23		A27							
SCHEMATIC NO.		NA		1, 2		3, 4, 5		6, 7, 8		9		10, 11, 12		15		16, 17		18, 19		21, 22		23, 24, 25		26, 27		28, 29		30		31, 32		34, 36		35		NA							
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34					J35	J36	J35	J36			J37		J38		J39		J41		
POS2	J33 Pin 4											J												4																			
POS2FP	R6-2																							3																		R6-2	
PROBECAL	J13 Pin 3					3																																				
PROBECAL SENSE	J13 Pin C					C																																				
RCA	J19 Pin 16											16		T																												
REFCOM	J13 Pin A					A																						COM														
REMDAT	S2			X																																					S2-1	
REM0	J9 Pin 1	1		D																																						
REM1	J9 Pin 2	2		E																																						
REM2	J9 Pin 3	3		F																																						
REM3	J9 Pin 4	4		H																																						
REM4	J9 Pin 5	5		J																																						
REM5	J9 Pin 6	6		K																																						
REM6	J9 Pin 7	7		L																																						
REM7	J9 Pin 8	8		M																																						
REM8	J9 Pin 9	9		N																																						
REM9	J9 Pin 10	10		P																																						
REM10	J9 Pin 11	11		R																																						
REM11	J9 Pin 12	12		S																																						
REM12	J9 Pin 13	13		T																																						
REM13	J9 Pin 14	14		U																																						

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA		1, 2		3,4,5		6, 7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36		J37	J38	J39	J41	
REM14	J9 Pin 15	15		V																																	
REM15	J9 Pin 16	16		W																																	
REP	J19 Pin 5											5																							46		
REP+RVP	J19 Pin 15											15		S																							
RLN	J20 Pin AA												AA													(925)											
RPOS1	J23 Pin F											9				F																					
RPOS2	J23 Pin E											8				E																					
RSA	J19 Pin 7											7						X																			
RSC	J19 Pin C											C										X															
RVA	J19 Pin 10											10												X											48		
RVP	J19 Pin 6											6				C																			47		
SAMP	J36 Pin 3																					3							3								
SAMPBLK	J31 Pin 13							4														3															
SCAN	J29 Pin 19																			19									1								
SCANCOM	J29 Pin 18																			18									2								
SDA0	J31 Pin A																			1		A															
SDA1	J31 Pin B																			2		B															
SDA2	J31 Pin C																			3		C															
SDA3	J31 Pin D																			4		D															
SDA4	J31 Pin E																			5		E															
SDA5	J31 Pin F																			6		F															

		INTERFACE	LOCAL/REMOTE	CALIBRATOR	DISPLAY CONTROL	EXPAND POSITION	READ/ MULTIPLEXER	CHANNEL SELECTOR	VERTICAL POSITION	SCAN ATTN DECODER	SCAN D/A ATTN	DIGITAL SCAN	VERTICAL ATTN	LAMP DRIVER	TRIGGER PICKOFF	TIME BASE	SAMPLING	TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02	A03	A04	A05	A06	A07	A08	A09	A11	A12	A13	A14	A15	A16	A21	A22 A24	A23	A27				
SCHEMATIC NO.		NA	1,2	3,4,5	6,7,8	9	10,11,12	15	16,17	18,19	21,22	23,24,25	26,27	28,29	30	31,32	34,36	35	NA				
SIGNAL	SOURCE	J9 J10	J11 J12	J13 J14	J15 J16	J17 J18	J19 J20	J21 J22	J23 J24	J27 J28	J29 J30	J31 J32	J33 J34			J35 J36	J35 J36		J37	J38	J39	J41	
SDA6	J31 Pin H										7	H											
SDA7	J31 Pin J										8	J											
SDA8	J31 Pin K										9	K											
SDA9	J31 Pin L										10	L											
SEL1	J21 Pin A			F				A	17				W	(928)									
SEL2	J21 Pin B			H				B	16				19	(934)									
STROBE	J12 Pin Z		Z	Z	Z	Z	Z	Z	Z	Z		Z	Z								17		
STR1	J36 Pin 8										1		F				8						
STR2	J35 Pin 10												N			10							
SWPCOM	J27 Pin B									B													S33
SWP0	S33									C													S33-A1
SWP1	S33									D													S33-B4
SWP2	S33									E													S33-C7
SWP3	S33									F													S33-D10
SWP4	S33									H													S33-E1
SWP5	S33									J													S33-F4
SWP6	S33									K													S33-H7
SWP7	S33									L													S33-J10
SWP8	S10									M													S10-6
TM	J13 Pin U			U											TM								
TMTRIG	J13 Pin 13			13														J3					

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER		A/D CONVERTER	CONTROLLER		CHANNEL EXTENDER		DISPLAY		FRONT PANEL
		A02		A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23		A27							
SCHEMATIC NO.		NA		1, 2		3,4,5		6,7, 8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35		NA							
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34				J35	J36	J35	J36			J37	J38		J39		J41		
TRIG	FP-S6																																J1									S6
TRIGREL	J13 Pin 9					9																											E									
TRIGDRIVE	J31 Pin 2																					2				(935)															
TRIGPUL	A23-J2																												F				J2									
VACOM	S31, S32							6																15																		S31,S32
VA1B0	S31																							16																		S31A2
VA1B1	S31																							17																		S31B3
VA1B2	S31																							18																		S31A8
VA2B0	S32																							T																		S32A2
VA2B1	S32																							U																		S32B3
VA2B2	S32																							V																		S32A8
XDSP	J15 Pin U							U																																		11	
YDSP	J15 Pin W							W																																		9	
ZDSP	J15 Pin T							T																																		13	
50USEC	J27 Pin 12																	12											13													
5USEC	J27 Pin 13																	13											15													
0.5USEC	J27 Pin 14																	14											11													
50 NSEC	J27 Pin 15																	15												4												
5X1	J27 Pin 1																	1		A																						
5X2	J27 Pin 2																	2		B																						
5X2.5	J27 Pin 3																	3		C																						
5X4	J27 Pin 4																	4		D																						
5X5	J27 Pin 5																	5		E																						

Table 8-4. Signal Matrix (Cont'd)

		INTERFACE	LOCAL/REMOTE		CALIBRATOR		DISPLAY CONTROL		EXPAND POSITION		READ/ MULTIPLEXER		CHANNEL SELECTOR		VERTICAL POSITION		SCAN ATTN DECODER		SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF	TIME BASE		SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		A02	A03		A04		A05		A06		A07		A08		A09		A11		A12		A13		A14		A15		A16	A21		A22 A24		A23	A27				
SCHEMATIC NO.		NA	1, 2		3,4,5		6,7,8		9		10,11,12		15		16,17		18,19		21,22		23,24,25		26,27		28,29		30	31,32		34,36		35	NA				
SIGNAL	SOURCE	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24	J27	J28	J29	J30	J31	J32	J33	J34			J35	J36	J35	J36		J37	J38	J39	J41	
100X1	J27 Pin 6																	6		F																	
100X10	J27 Pin 7																	7		H																	
100X100	J27 Pin 8																	8		J																	
+5V	A17		3,C		3,C		3,C		3,C		3,C		3,C		3,C		3,C		3,C		3,C		3,C									D	M				
+15V	A25		4,D		4,D		4,D		4,D		4,D		4,D				4,D				4,D		4,D		4,D				10		10	F	3				
+100V	A25	Y																		Y				Y					7		7	T					
−12.6V	A25		1,A				1,A		1,A		1,A		1,A				1,A				1,A				1,A				11		11	R					
−15COM	A17	Z				Z		Z		Z		CC				Z				Z																	
−15COMSENSE	A17																										COM									
−15V	A17	22				22		22		22		25				22				22													2				
−15VSENSE	A17					22																														
−100V	A25	21				21		21				24								21				21				4		4		H				R3-B4	

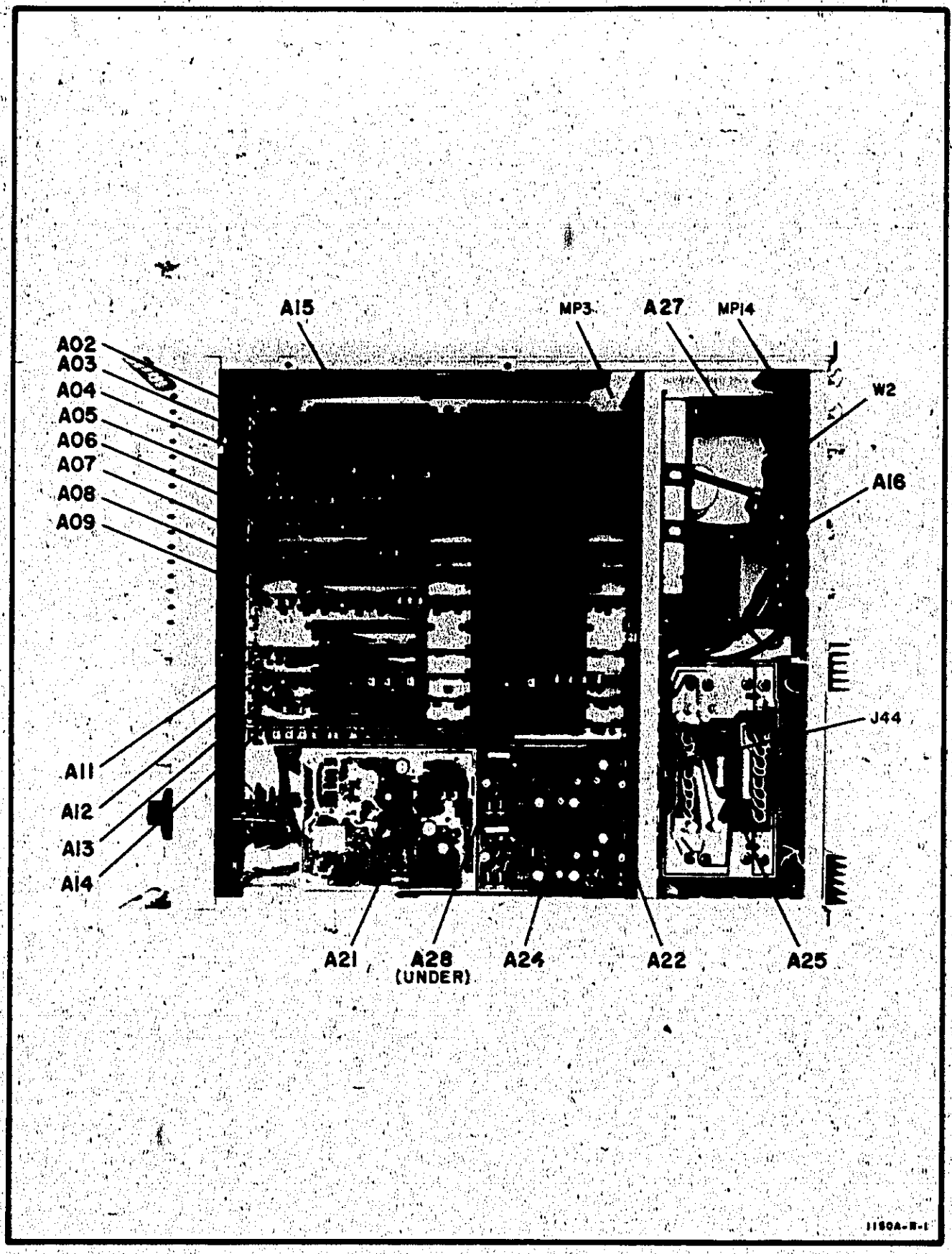


Figure 8-3. Parts Identification, Top View

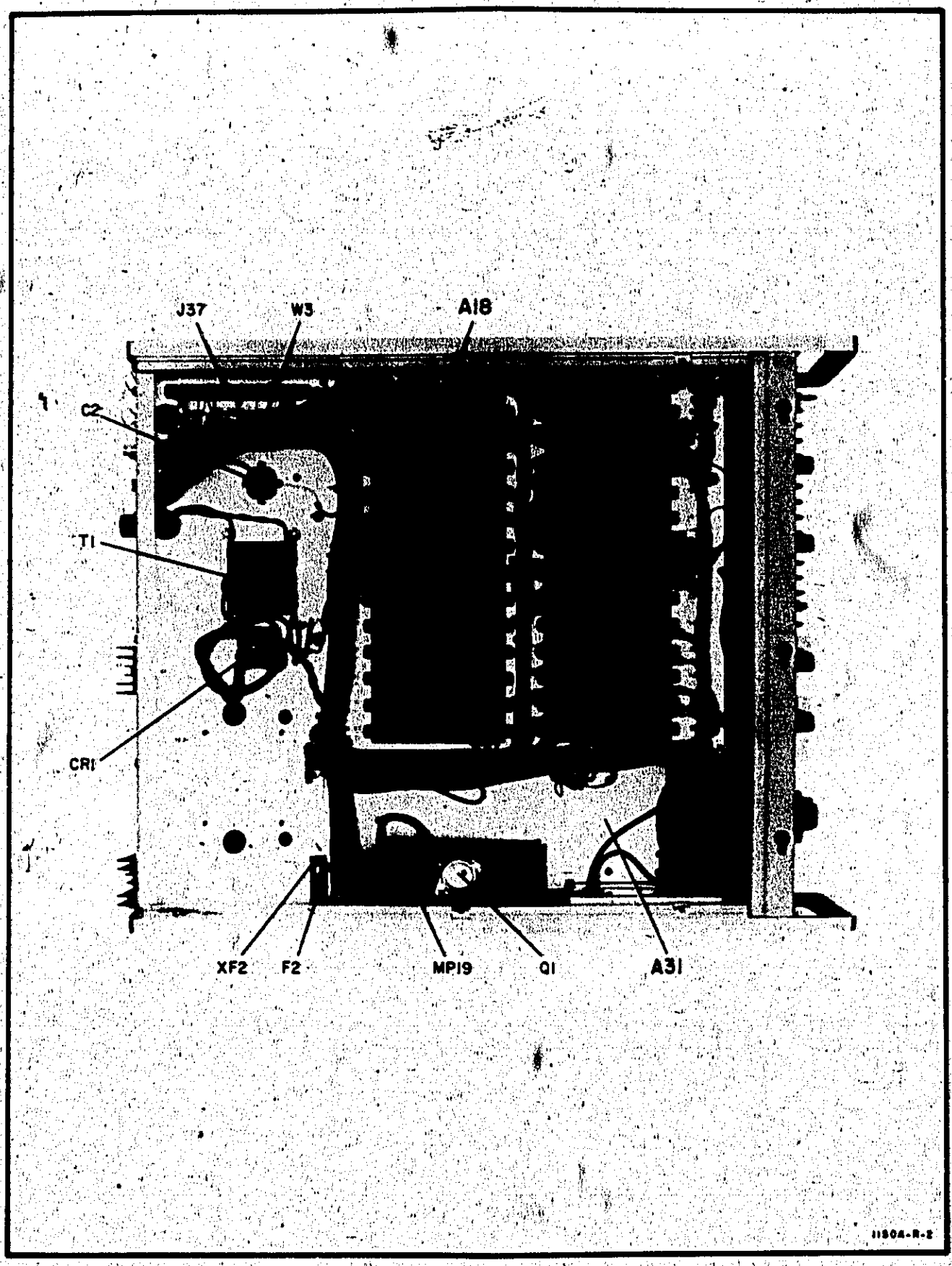


Figure 8-4. Parts Identification, Bottom View

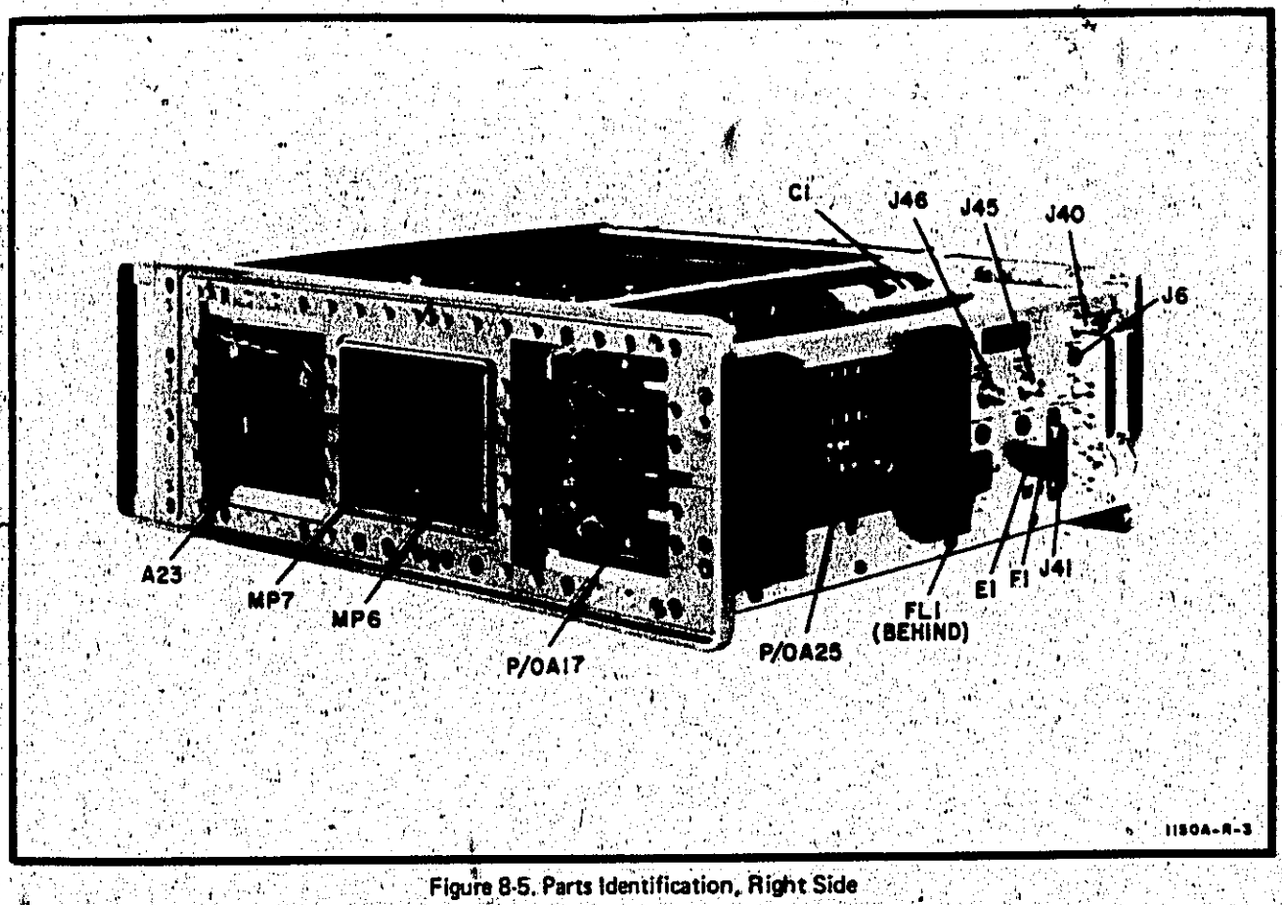


Figure 8-5. Parts Identification, Right Side

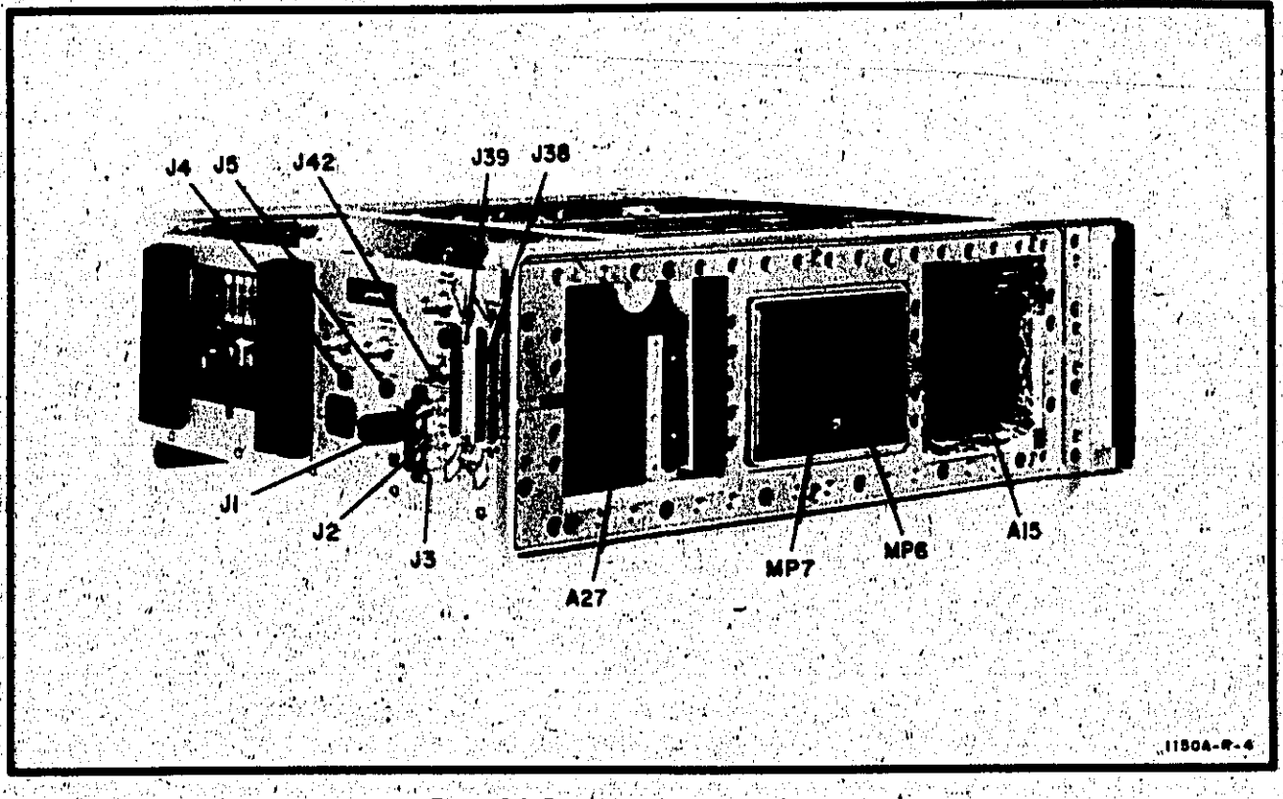


Figure 8-6. Parts Identification, Left Side

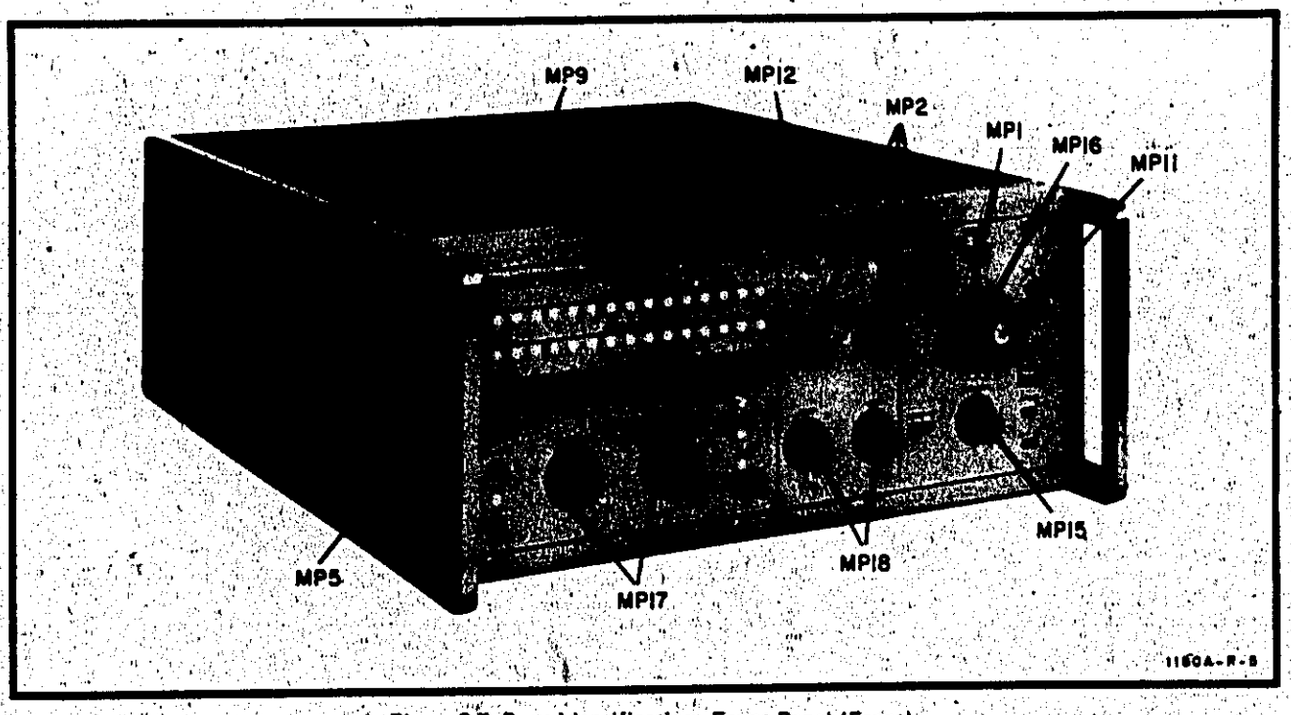


Figure 8-7. Parts Identification, Front Panel (Front)

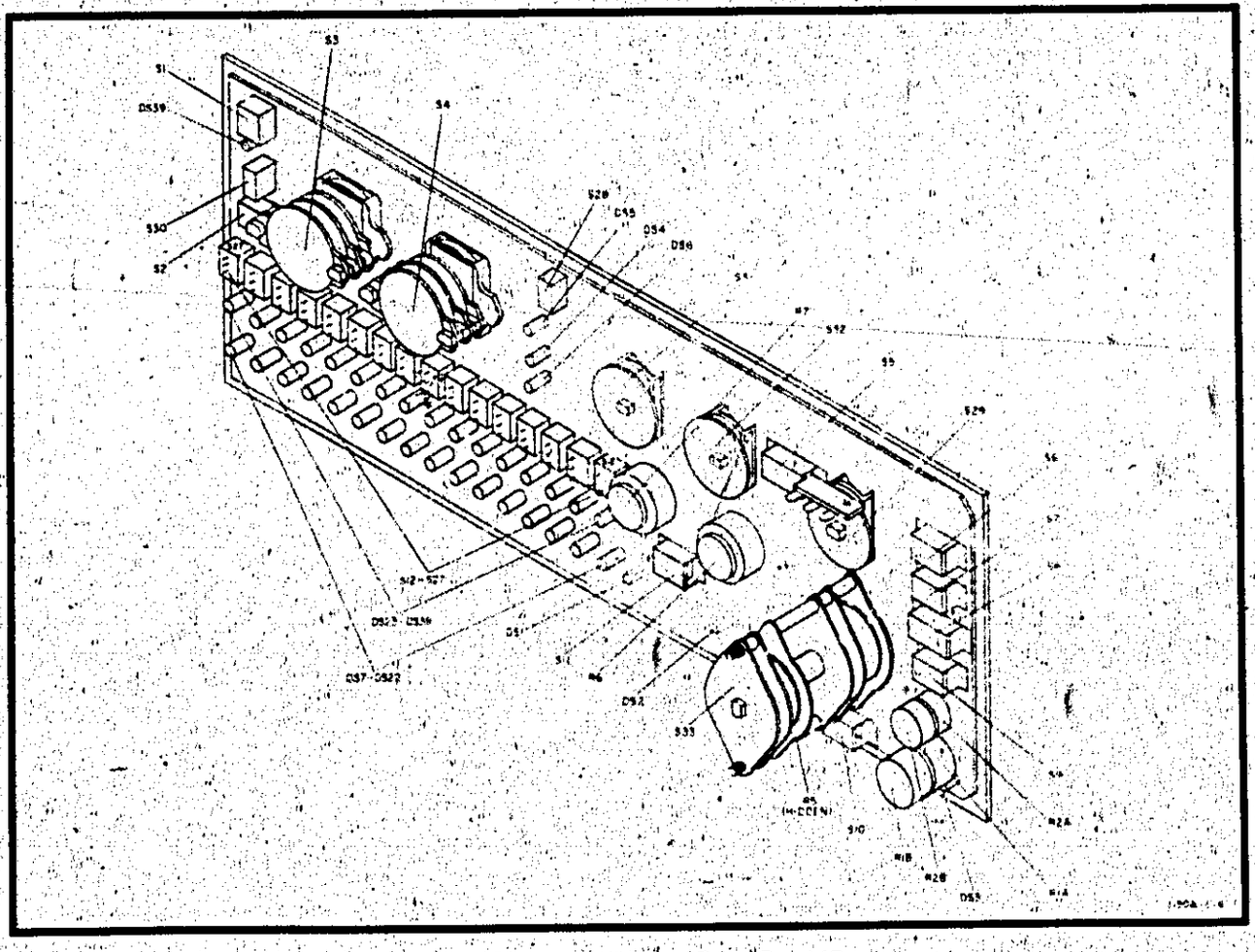
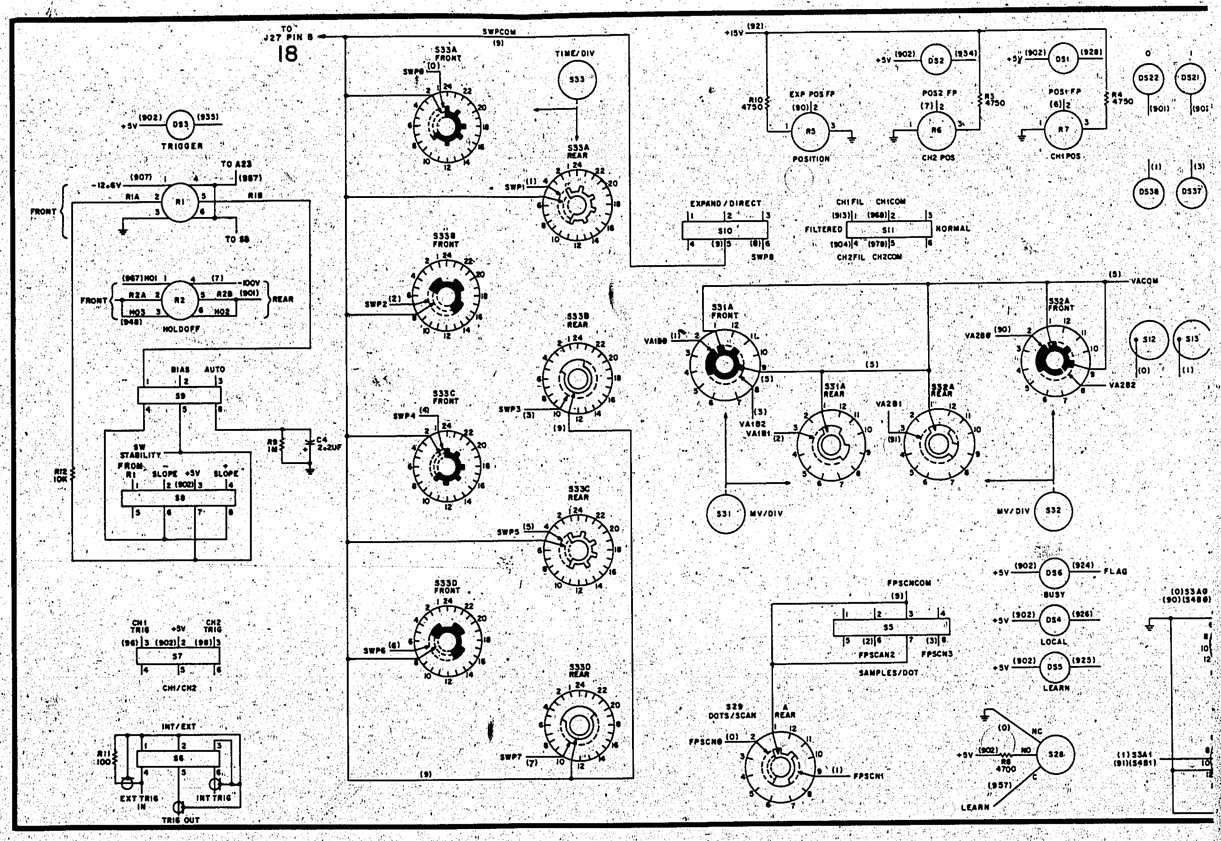


Figure 8-8. Parts Identification, Front Panel (Rear)



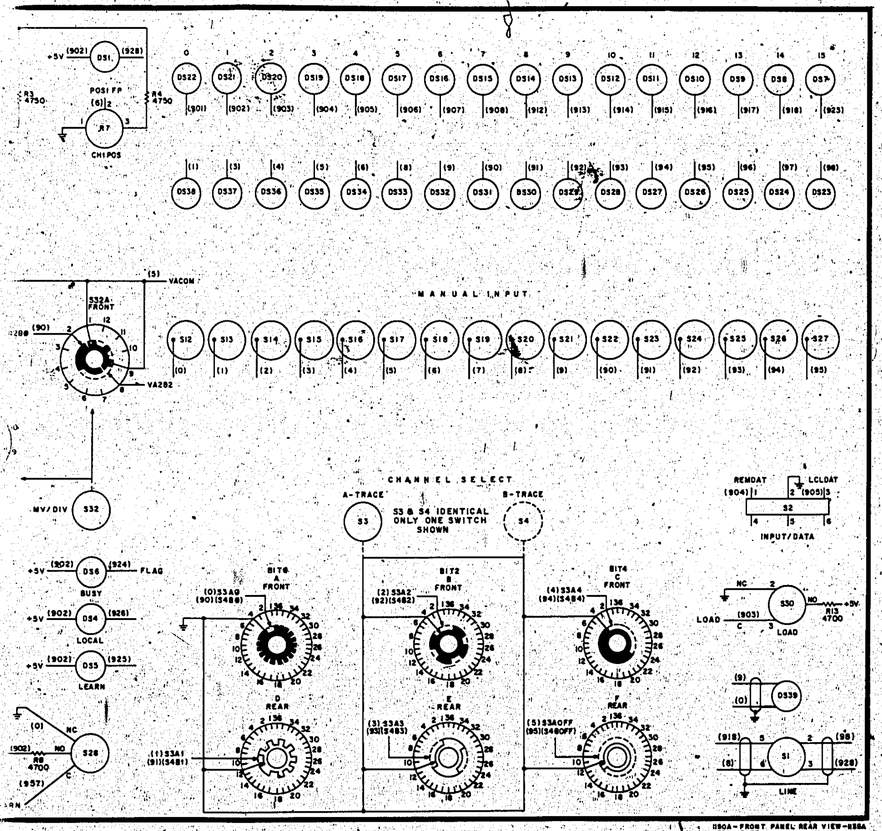


Figure 8-9.
Front Panel Wiring Diagram

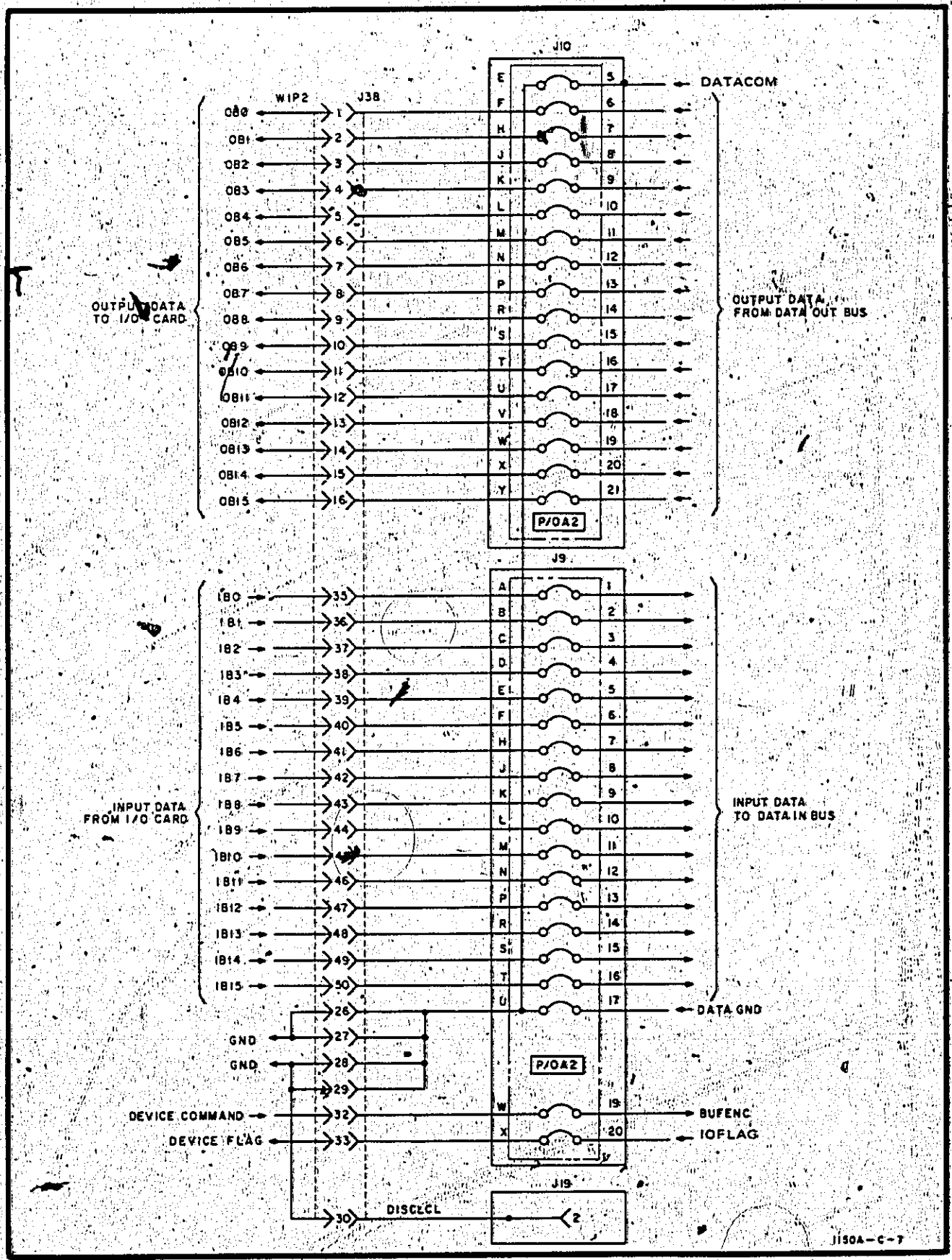


Figure 8-10. Interface Assembly A02, Connector Wiring

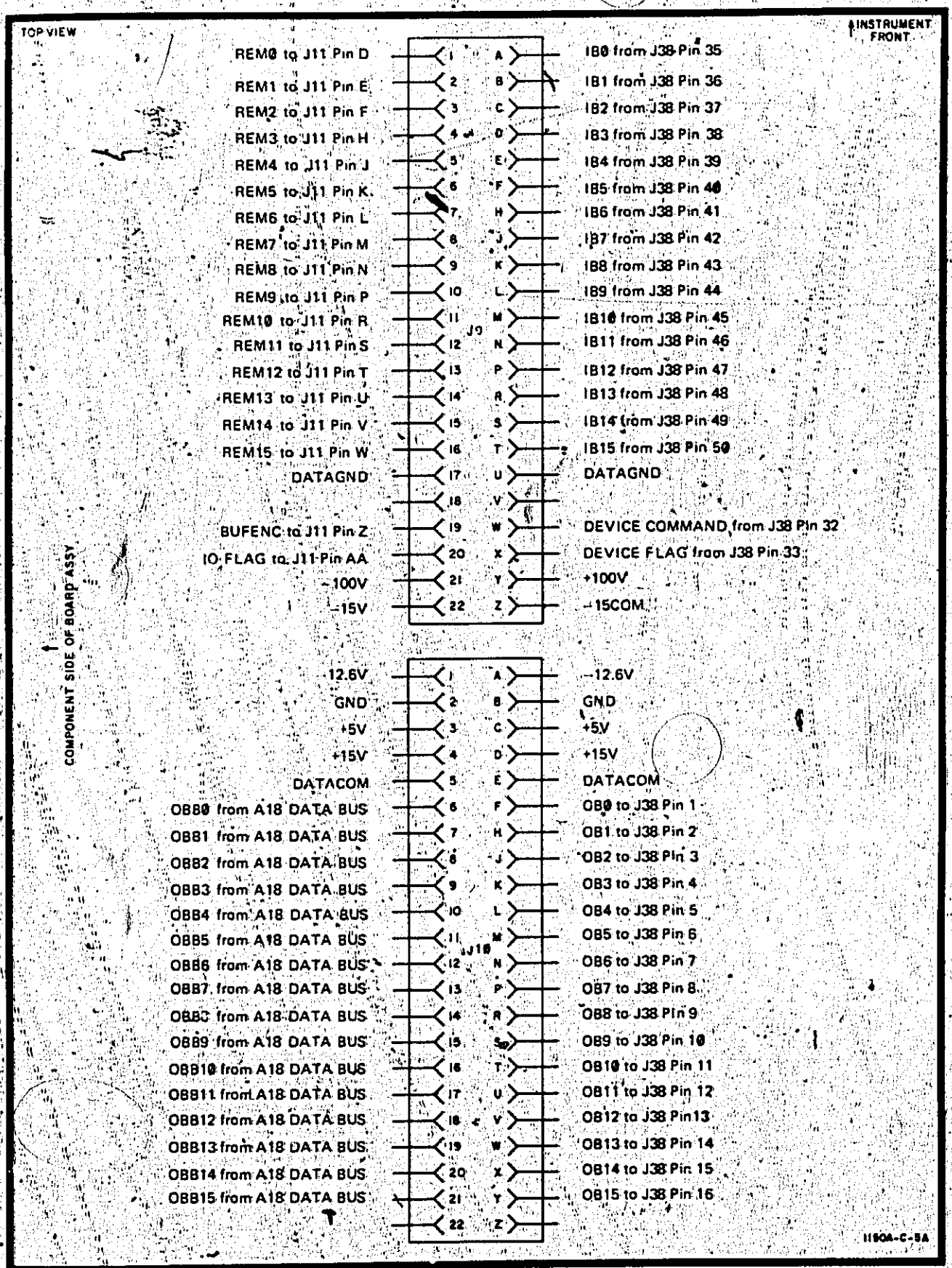


Figure 8-11. Connectors J9 and J10, Signal Identification

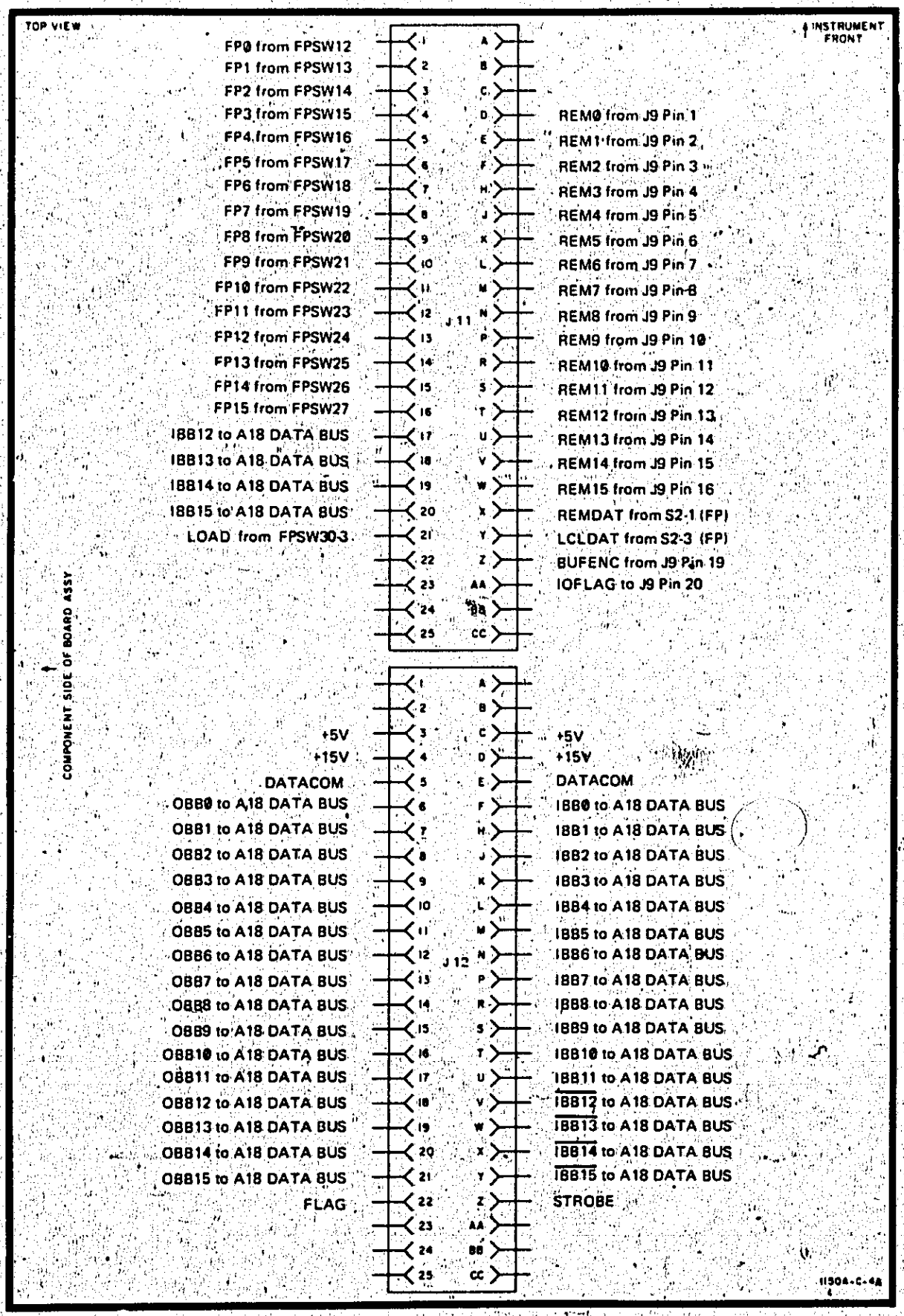


Figure 8-12. Connectors J11 and J12, Signal Identification

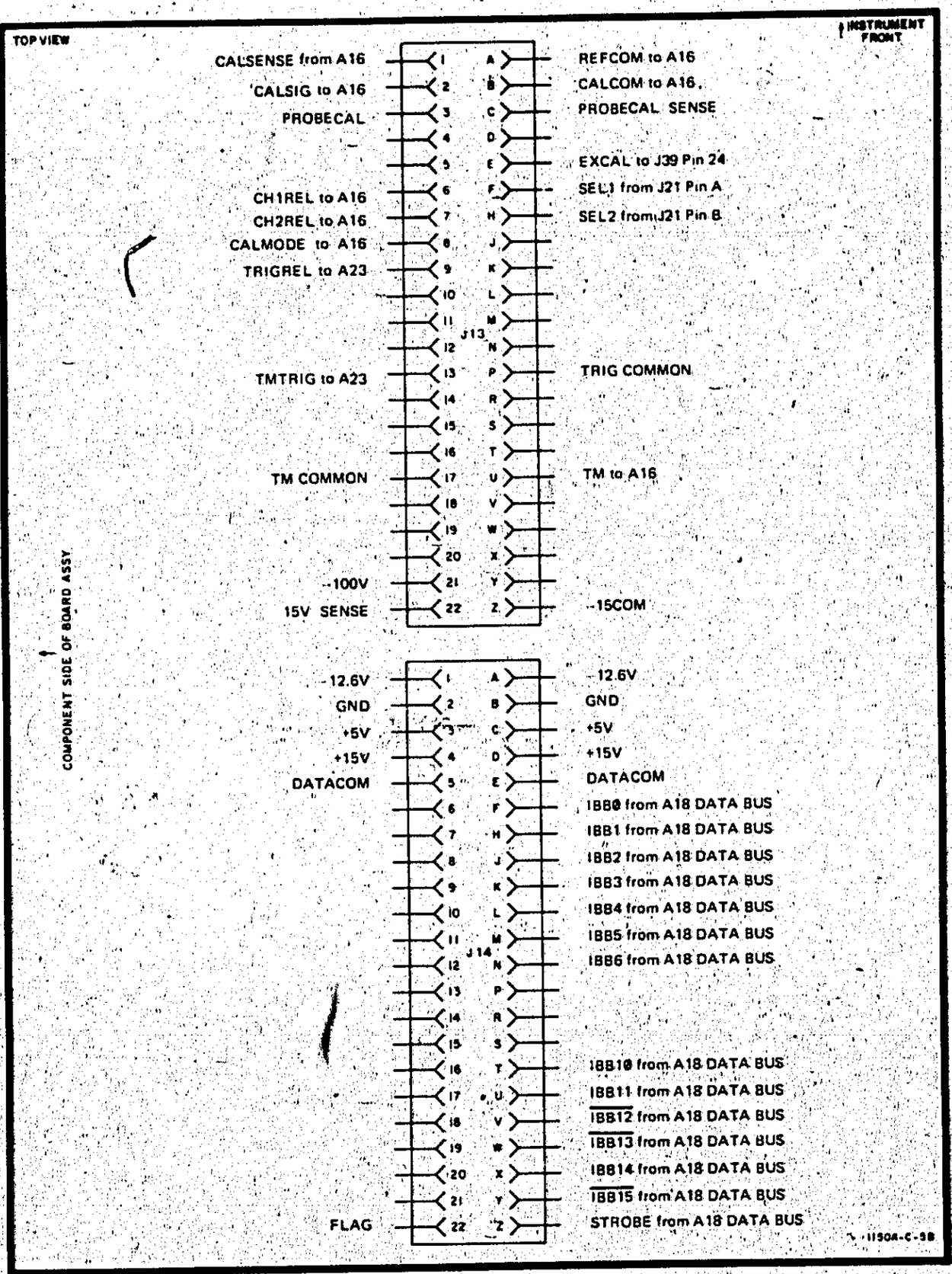


Figure 8-13. Connectors J13 and J14, Signal Identification

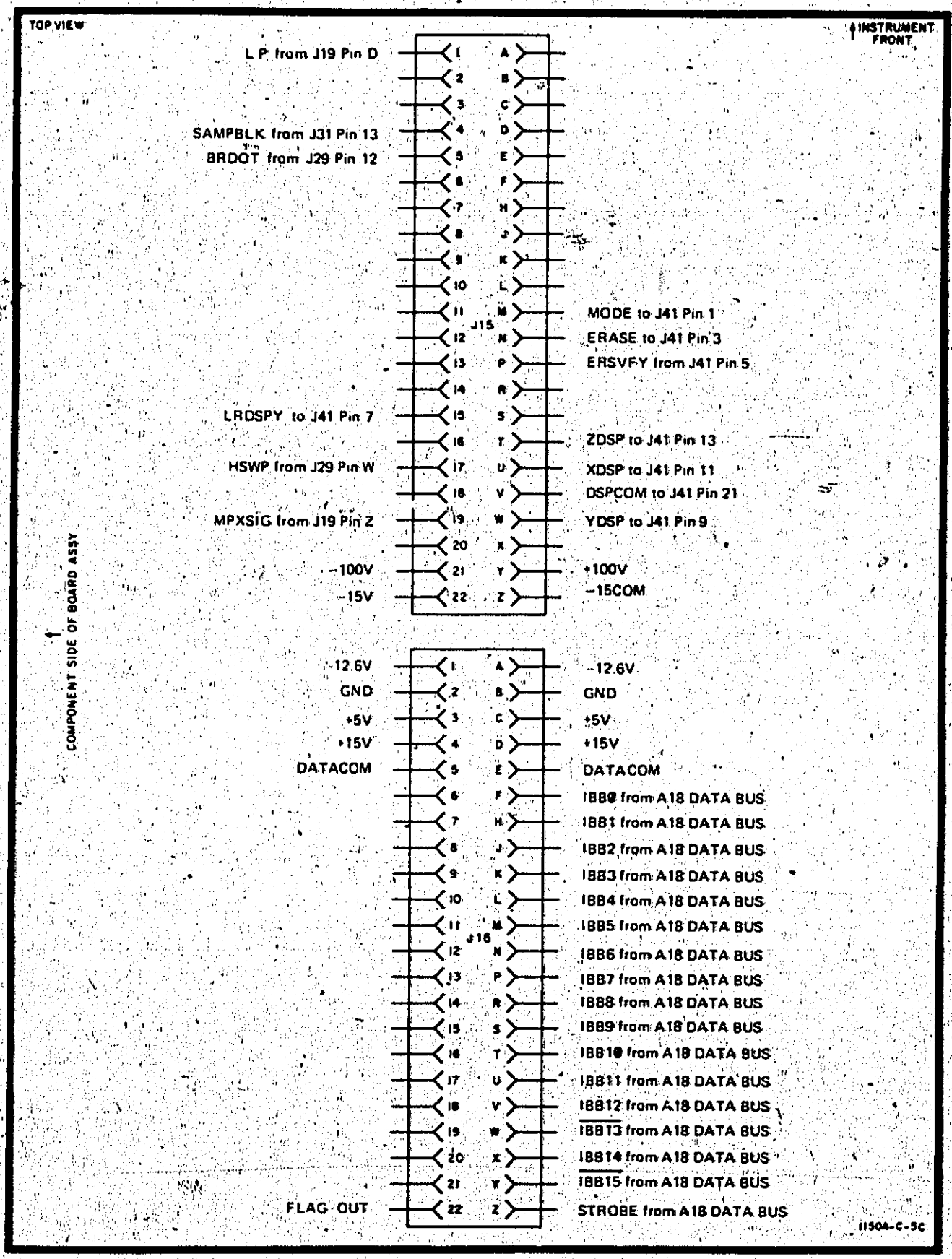


Figure 8-14. Connectors J15 and J16, Signal Identification

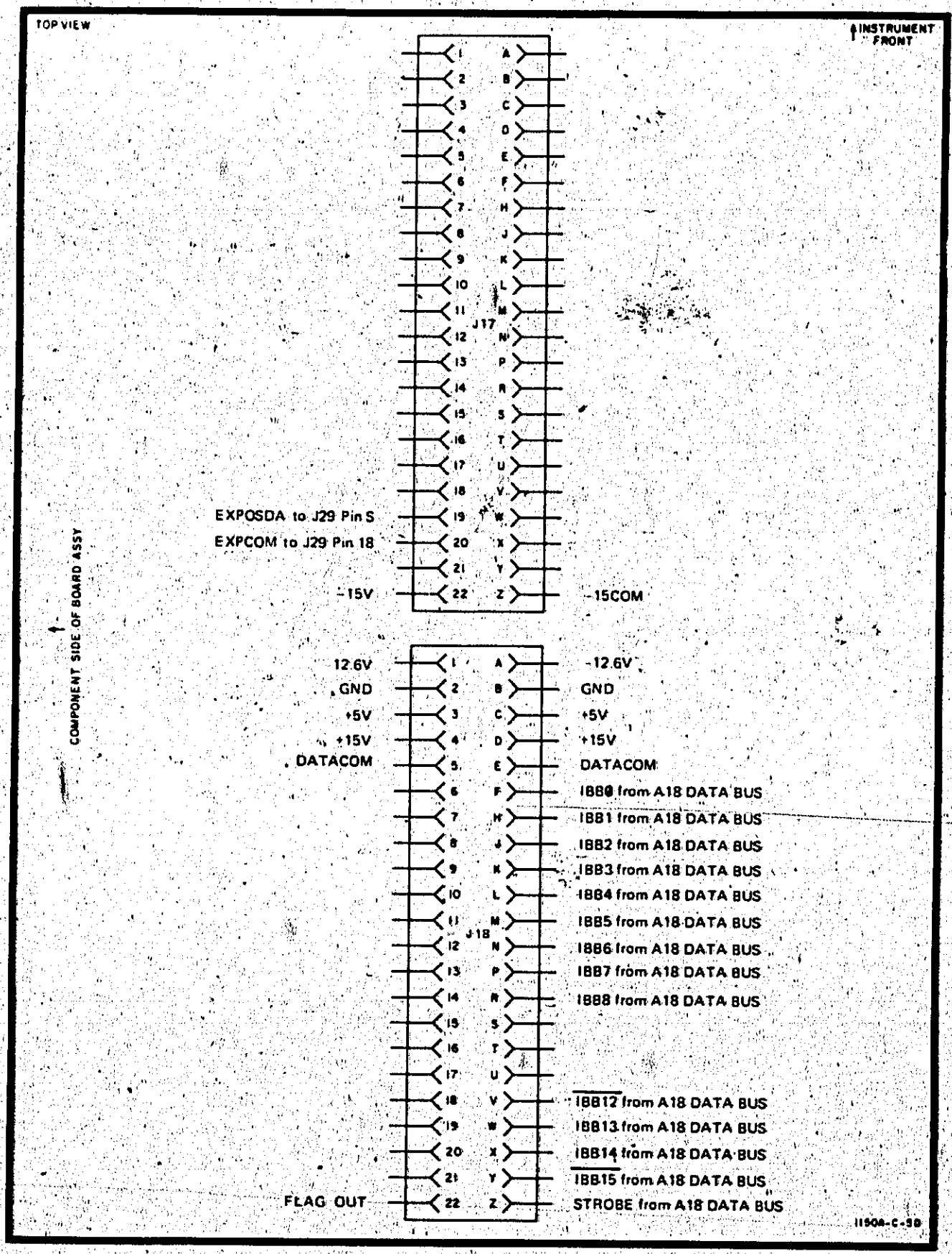


Figure 8-15. Connectors J17 and J18, Signal Identification

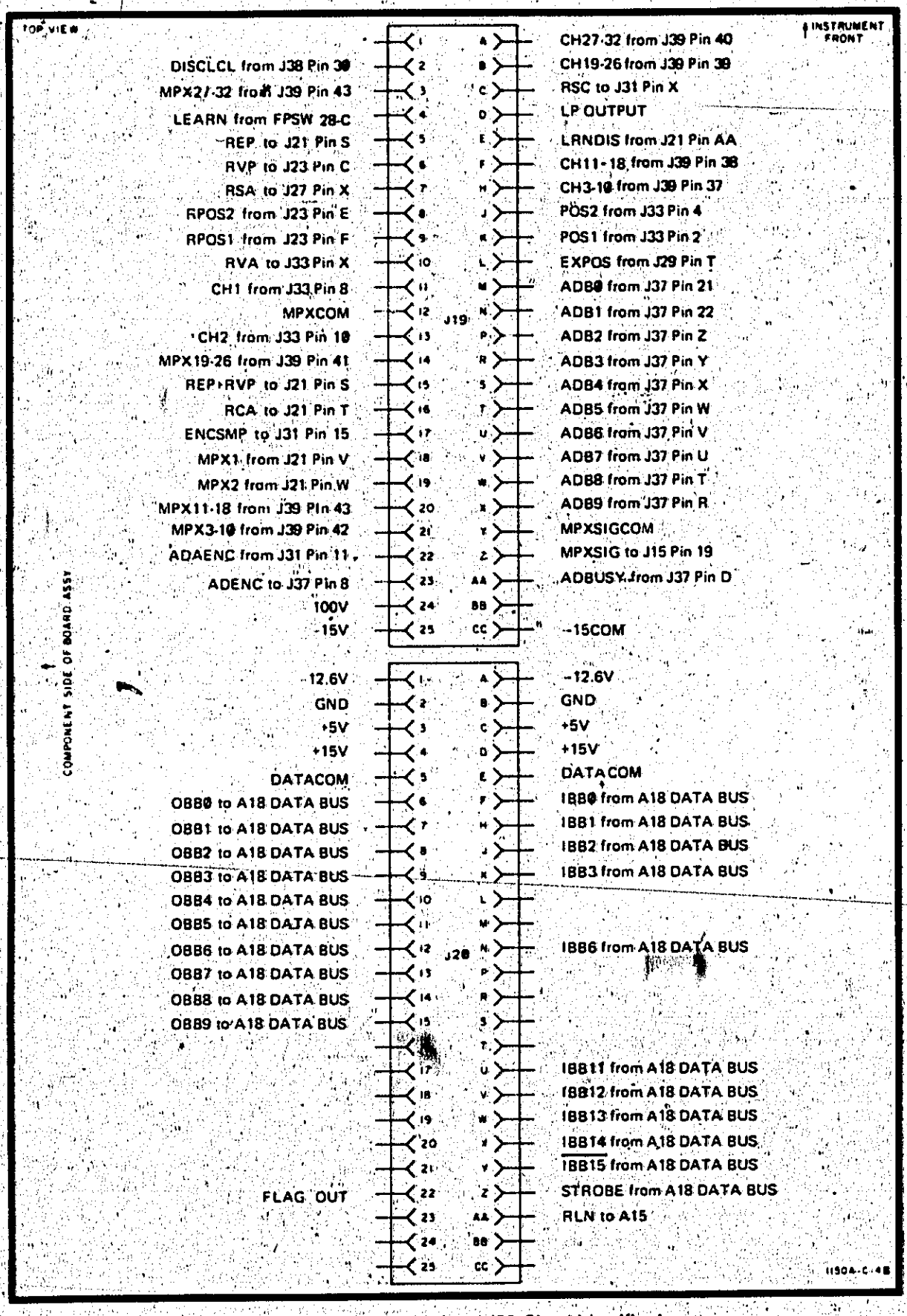


Figure 8-16. Connectors J19 and J20, Signal Identification

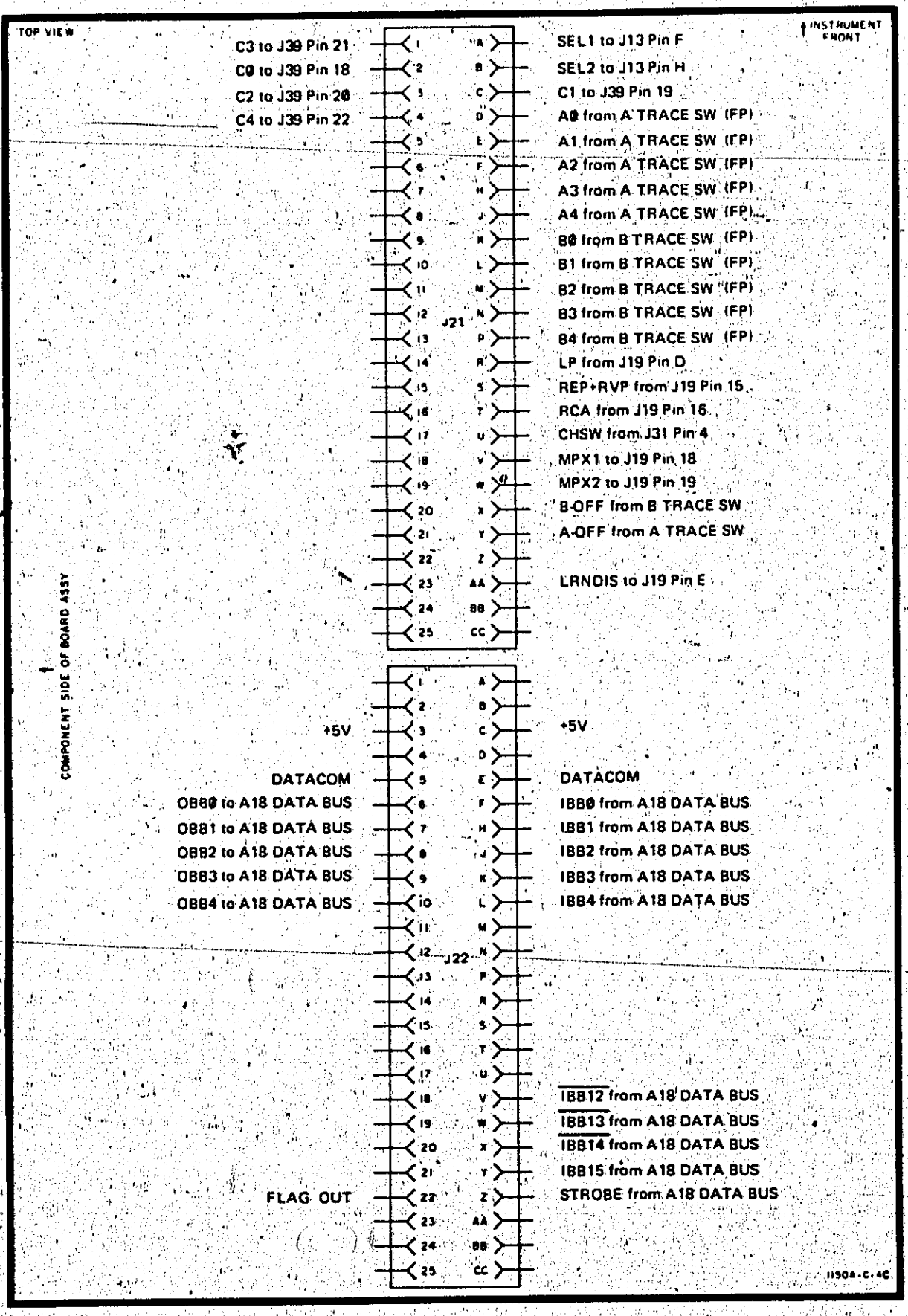


Figure 8-17. Connectors J21 and J22, Signal Identification

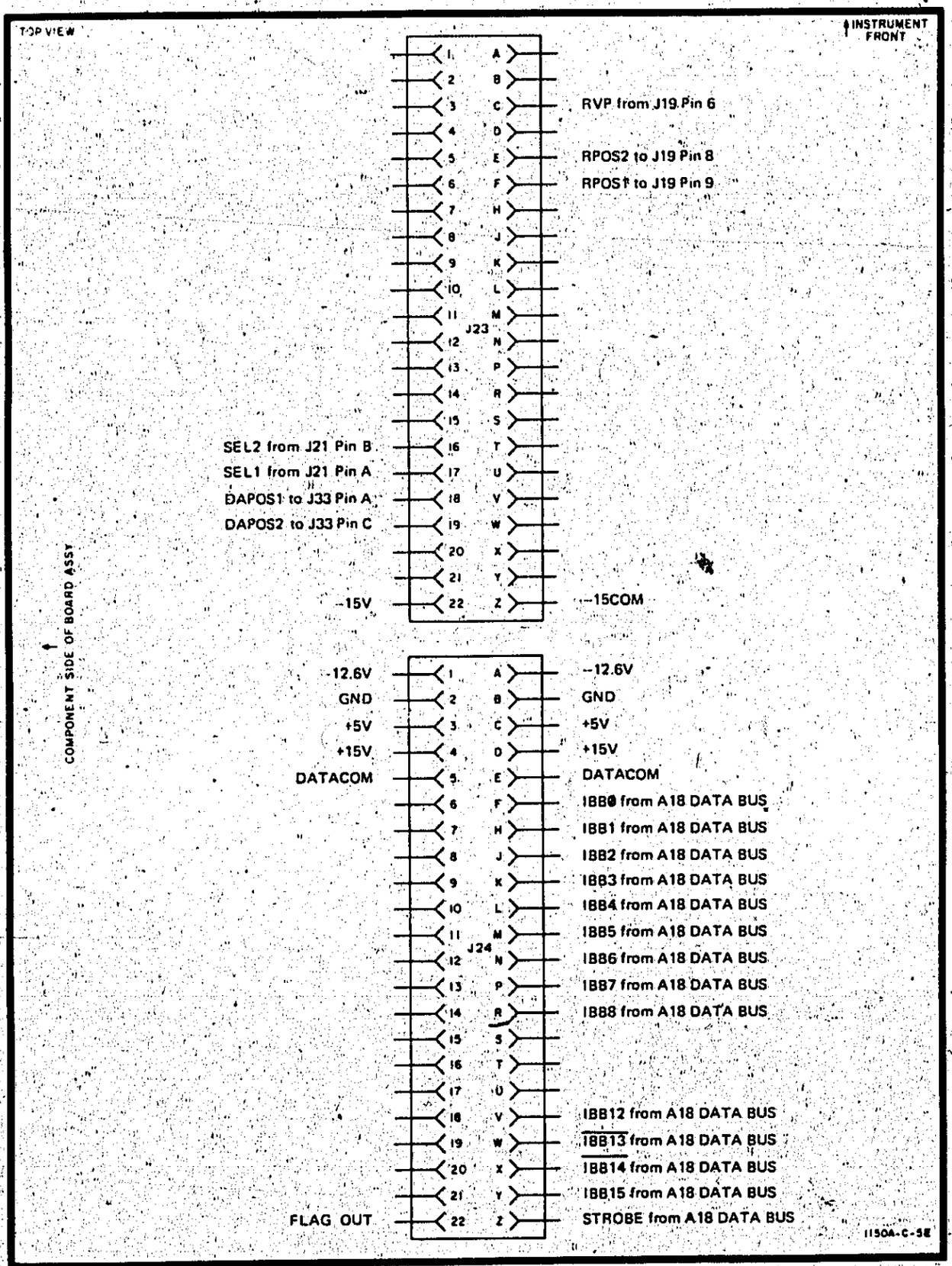


Figure 8-18. Connectors J23 and J24, Signal Identification

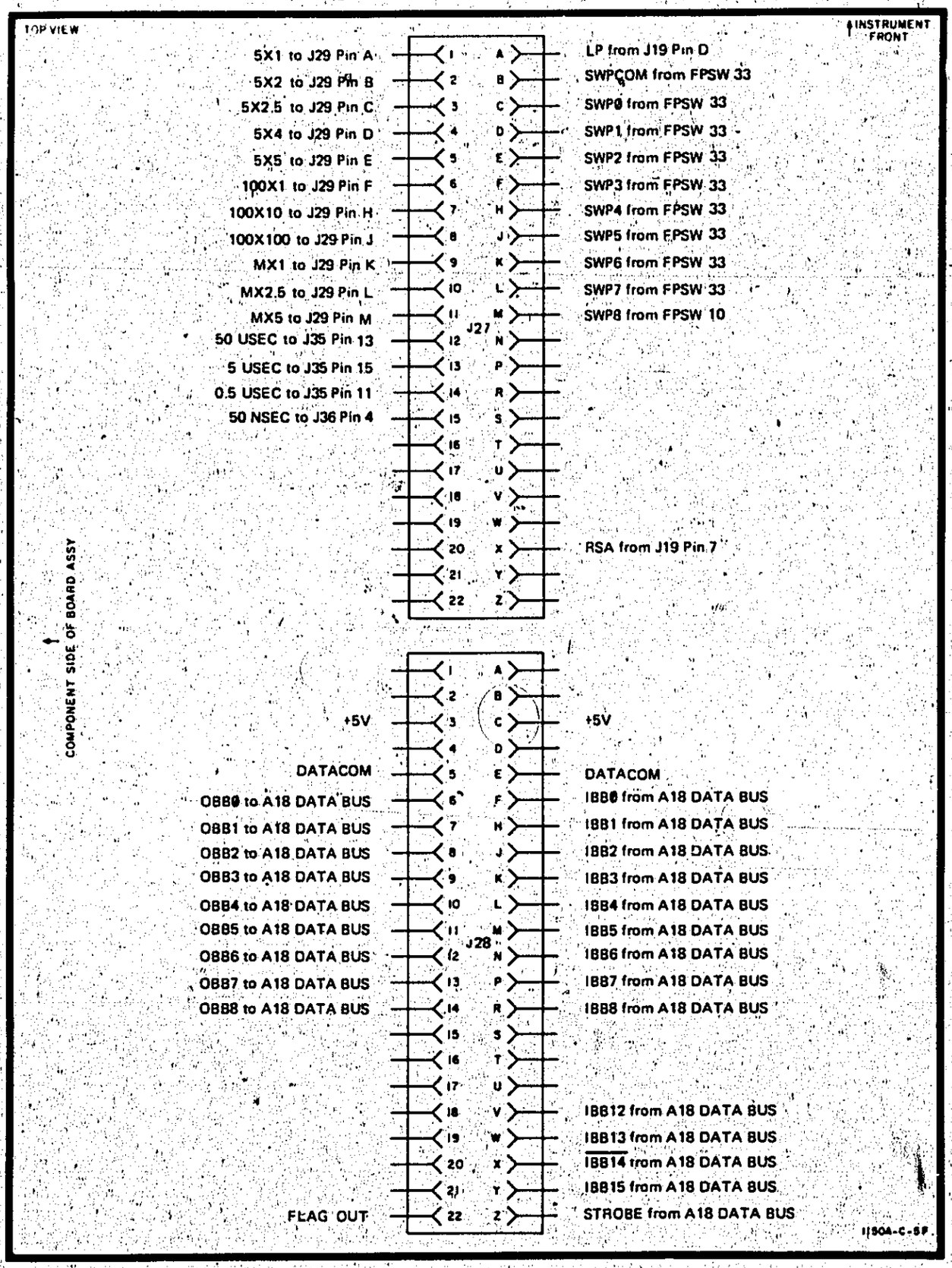


Figure 8-19. Connectors J27 and J28, Signal Identification

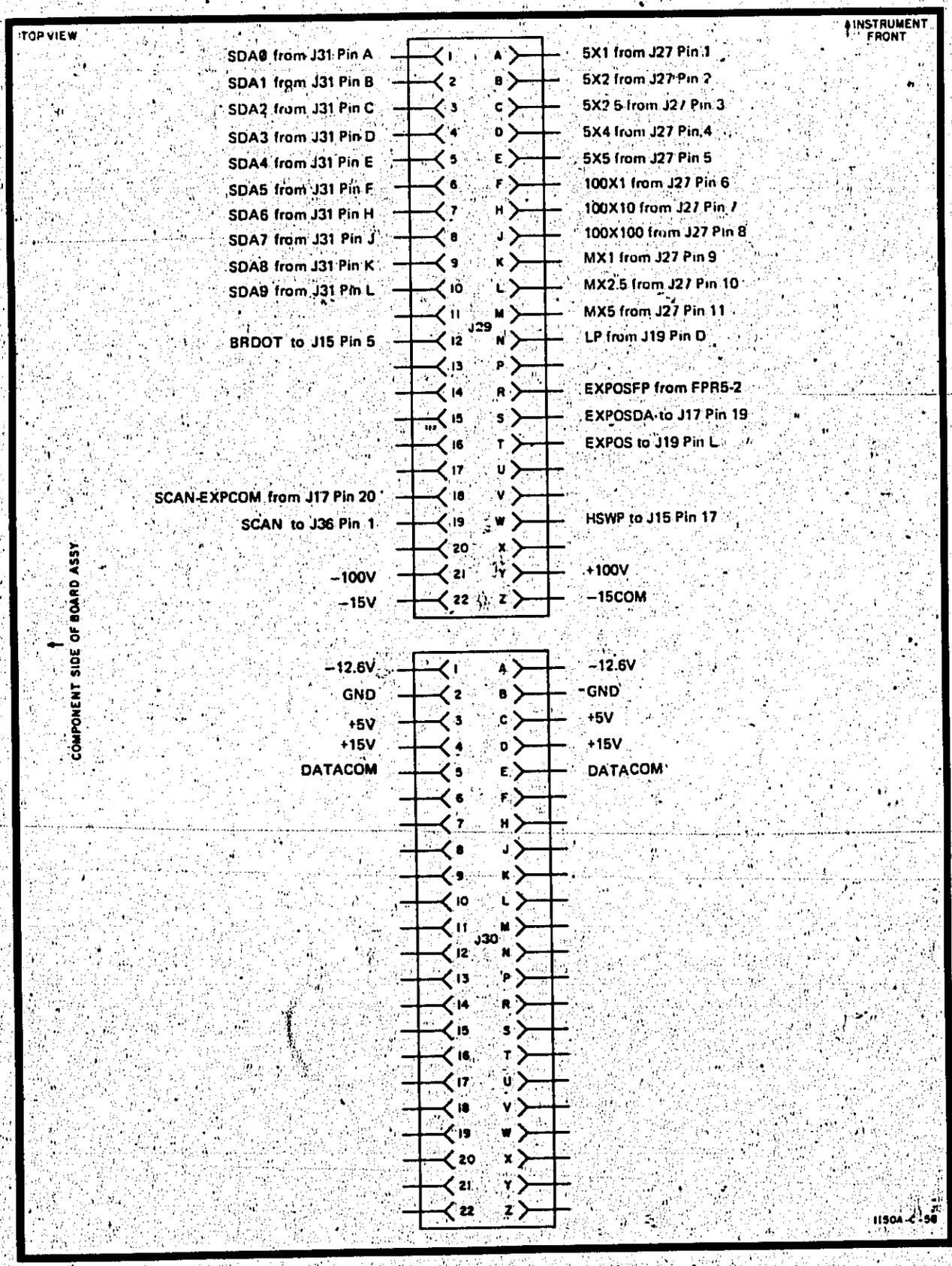


Figure 8-20. Connectors J29 and J30, Signal Identification

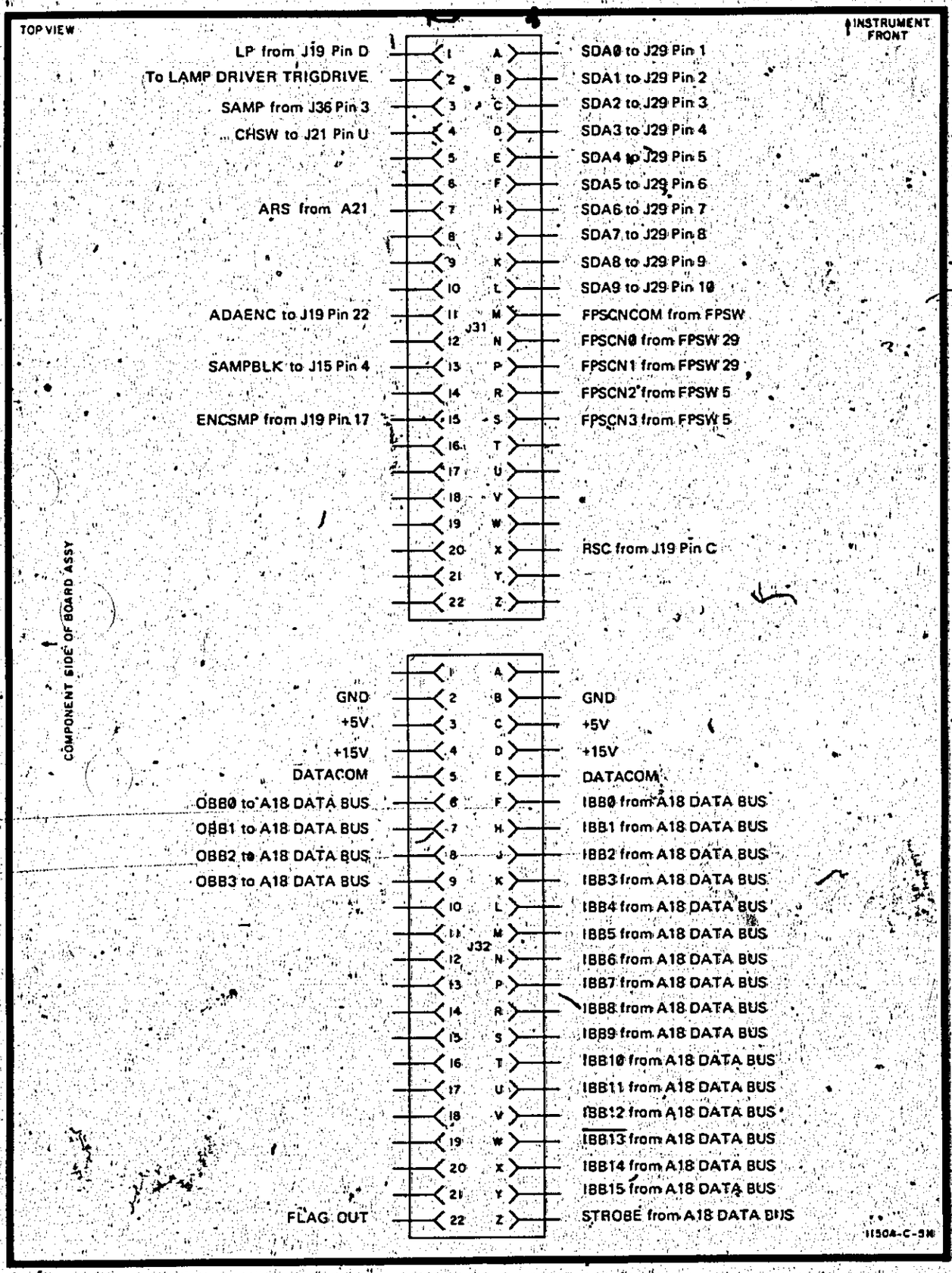


Figure 8-21. Connectors J31 and J32, Signal Identification

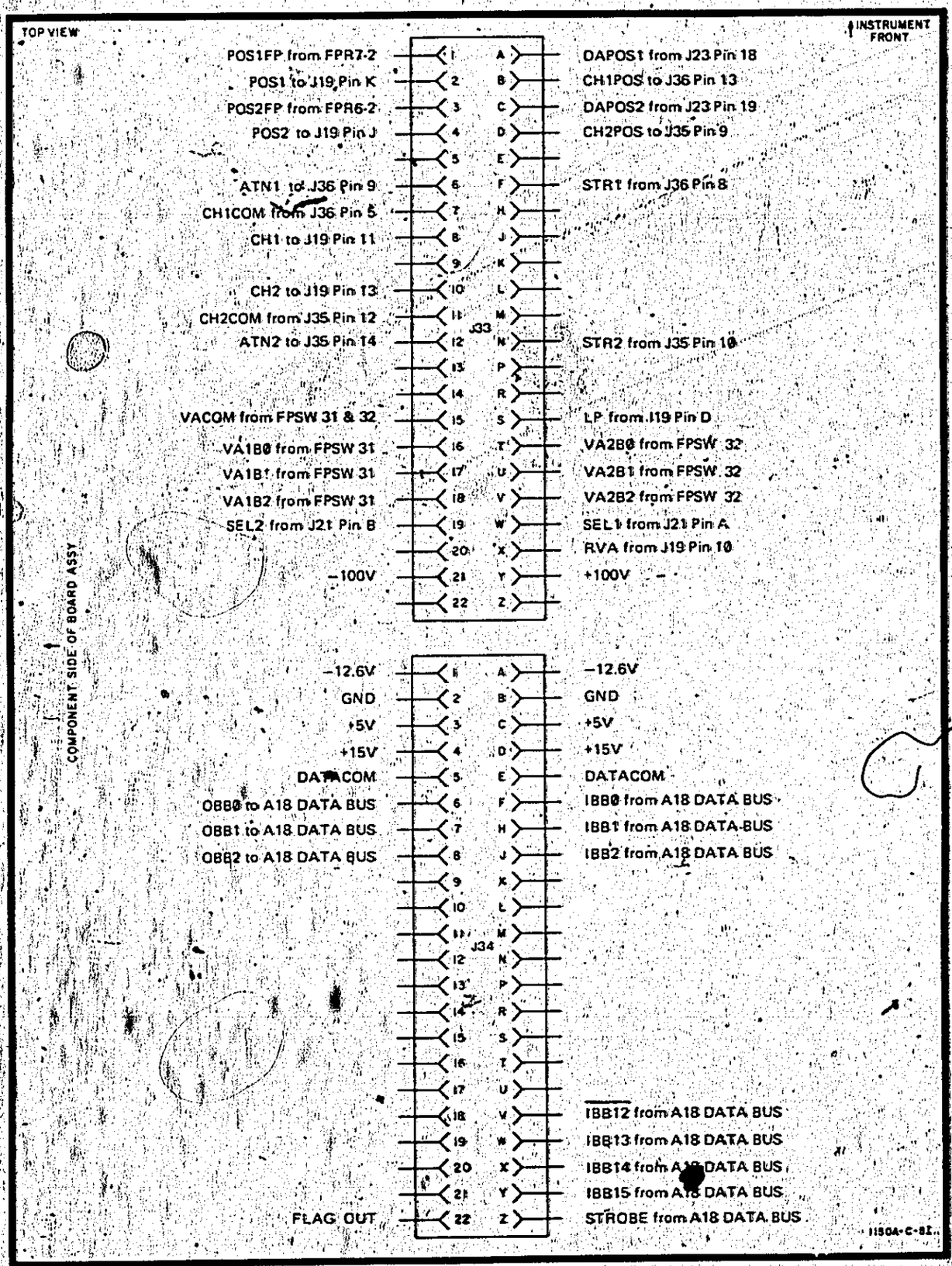


Figure 8-22. Connectors J33 and J34, Signal Identification

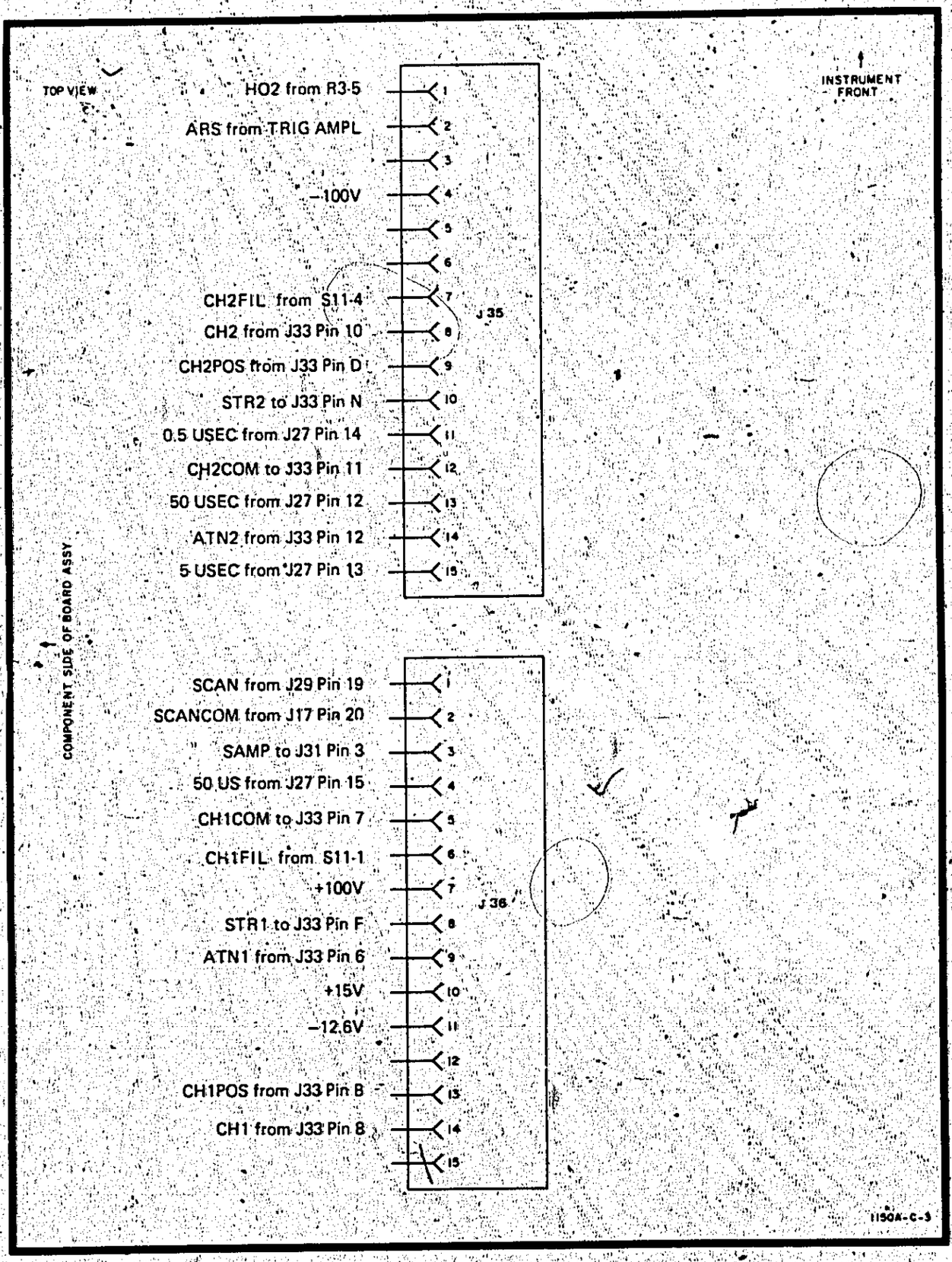


Figure 8-23. Connectors J35 and J36, Signal Identification

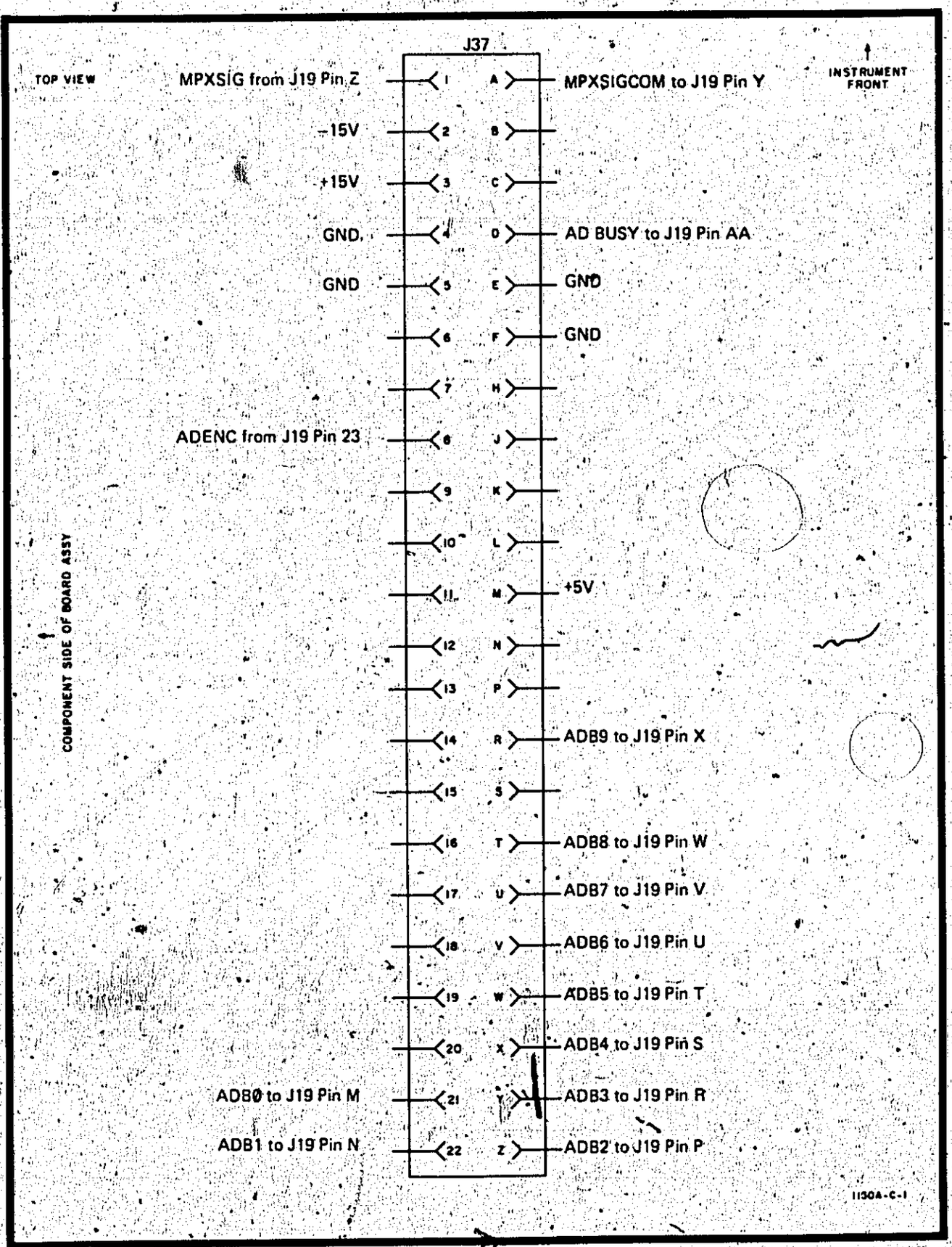


Figure 8-24. Connector J37, Signal Identification

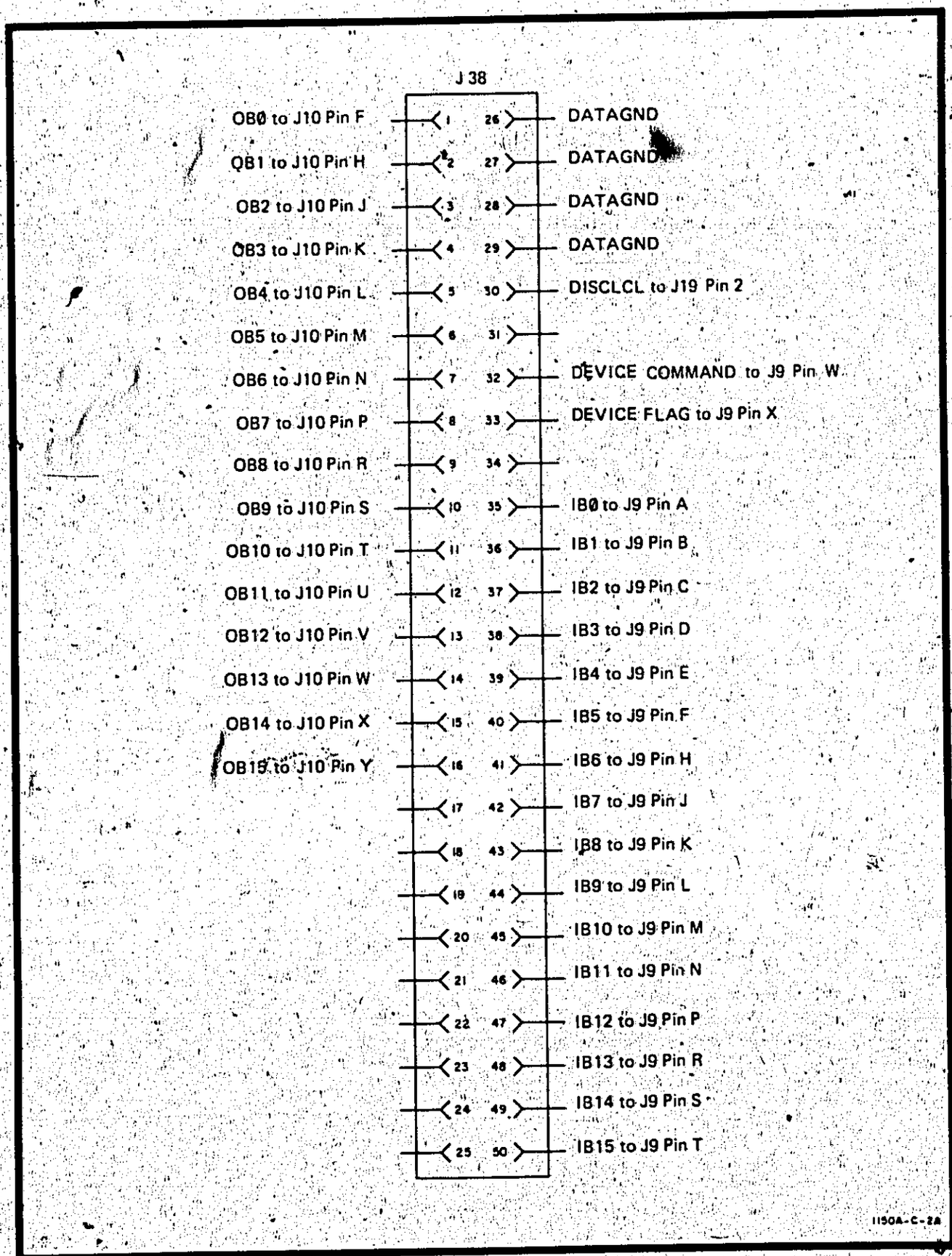


Figure 8-25 Connector J38, Signal Identification

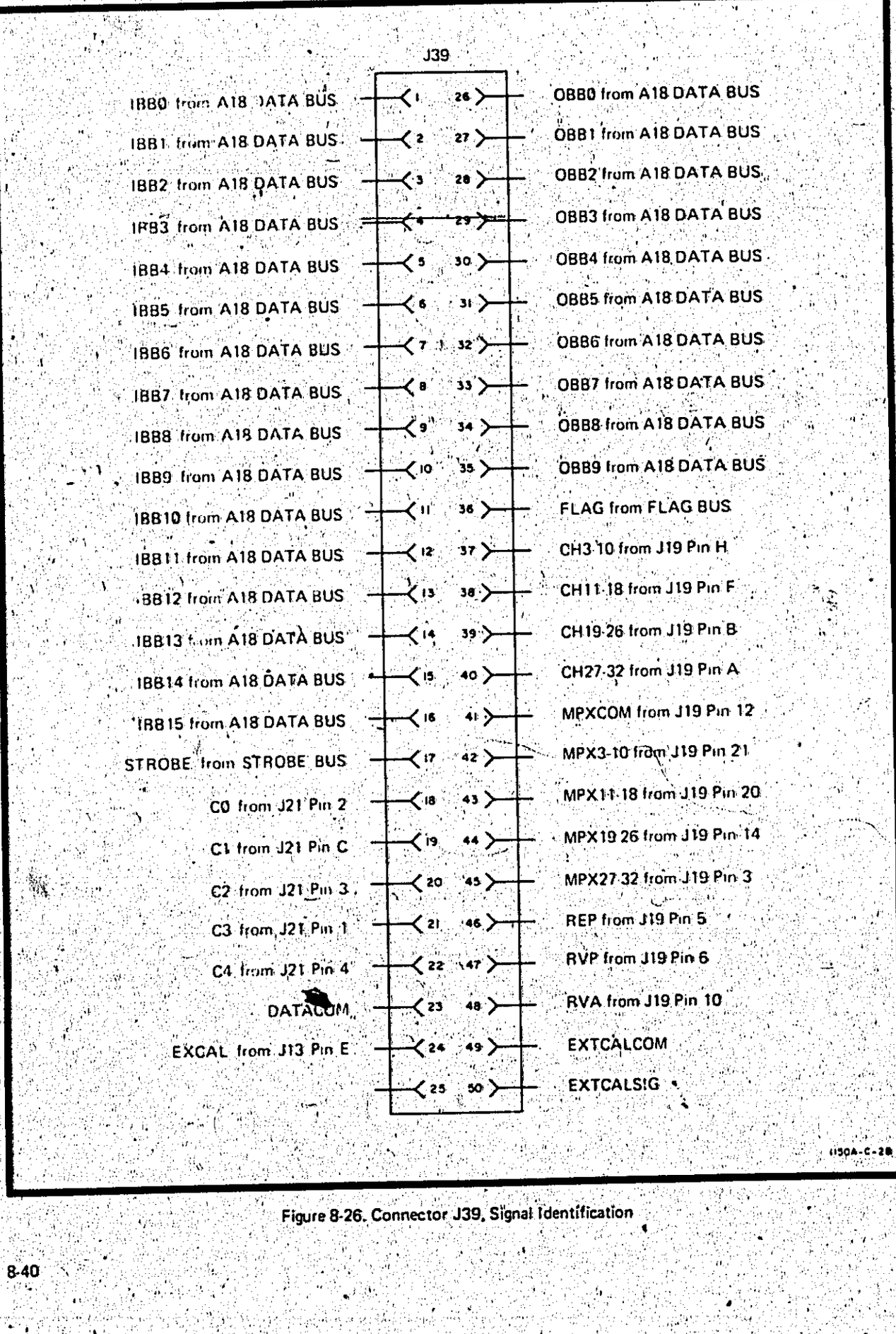
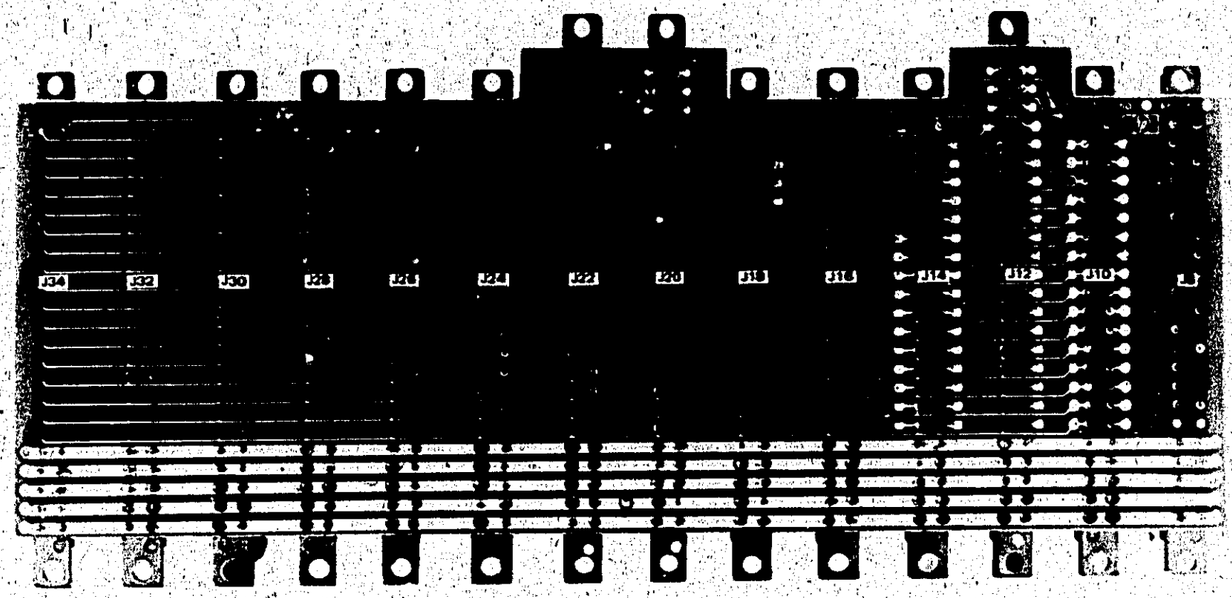


Figure 8-26. Connector J39, Signal Identification



A18

Circuit boards have plated through component holes. This permits soldering from either side of the board.

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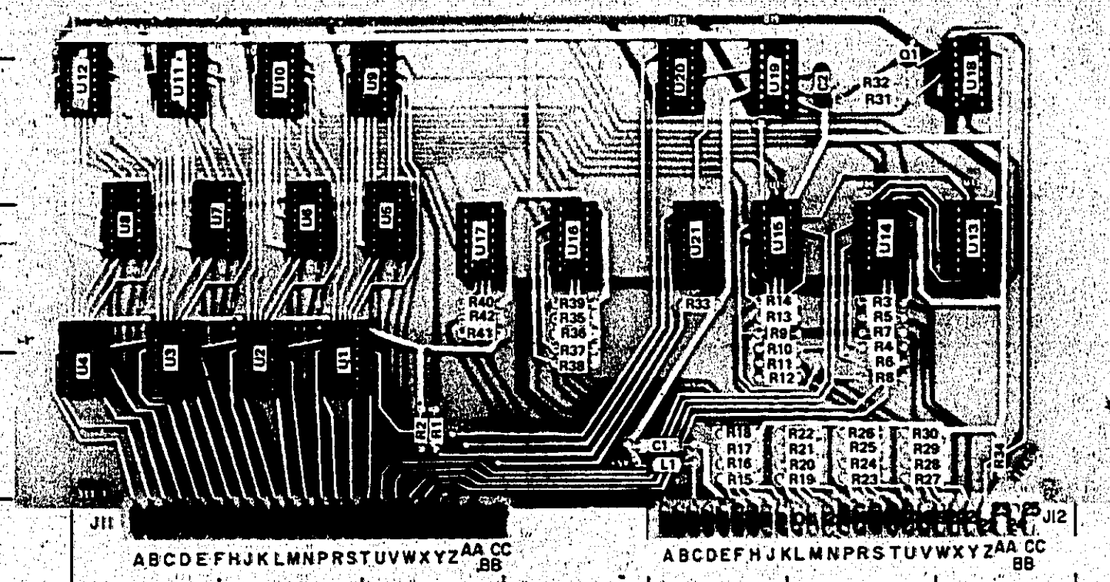
Figure 8-27. Component Identification, Assembly A18



Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	H-4	R8	I-4	R19	I-4	R30	I-4	R41	F-3	U10	E-2
C2	I-2	R9	H-3	R20	I-4	R31	I-2	R42	F-3	U11	D-2
L1	H-4	R10	H-4	R21	I-4	R32	I-2	U1	E-4	U12	D-2
Q1	I-2	R11	H-4	R22	I-4	R33	H-3	U2	E-4	U13	J-3
R1	F-4	R12	H-4	R23	I-4	R34	J-4	U3	D-4	U14	I-3
R2	F-4	R13	H-3	R24	I-4	R35	G-3	U4	D-4	U15	H-3
R3	I-3	R14	H-3	R25	I-4	R36	G-3	U5	F-3	U16	G-3
R4	I-3	R15	H-4	R26	I-4	R37	G-4	U6	E-3	U17	F-3
R5	I-3	R16	H-4	R27	I-4	R38	G-4	U7	D-3	U18	J-2
R6	I-4	R17	H-4	R28	I-4	R39	G-3	U8	D-3	U19	H-2
R7	I-3	R18	H-4	R29	I-4	R40	F-3	U9	F-2	U20	H-2
										U21	H-3

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Figure 8-28. Component Identification, Assembly A03

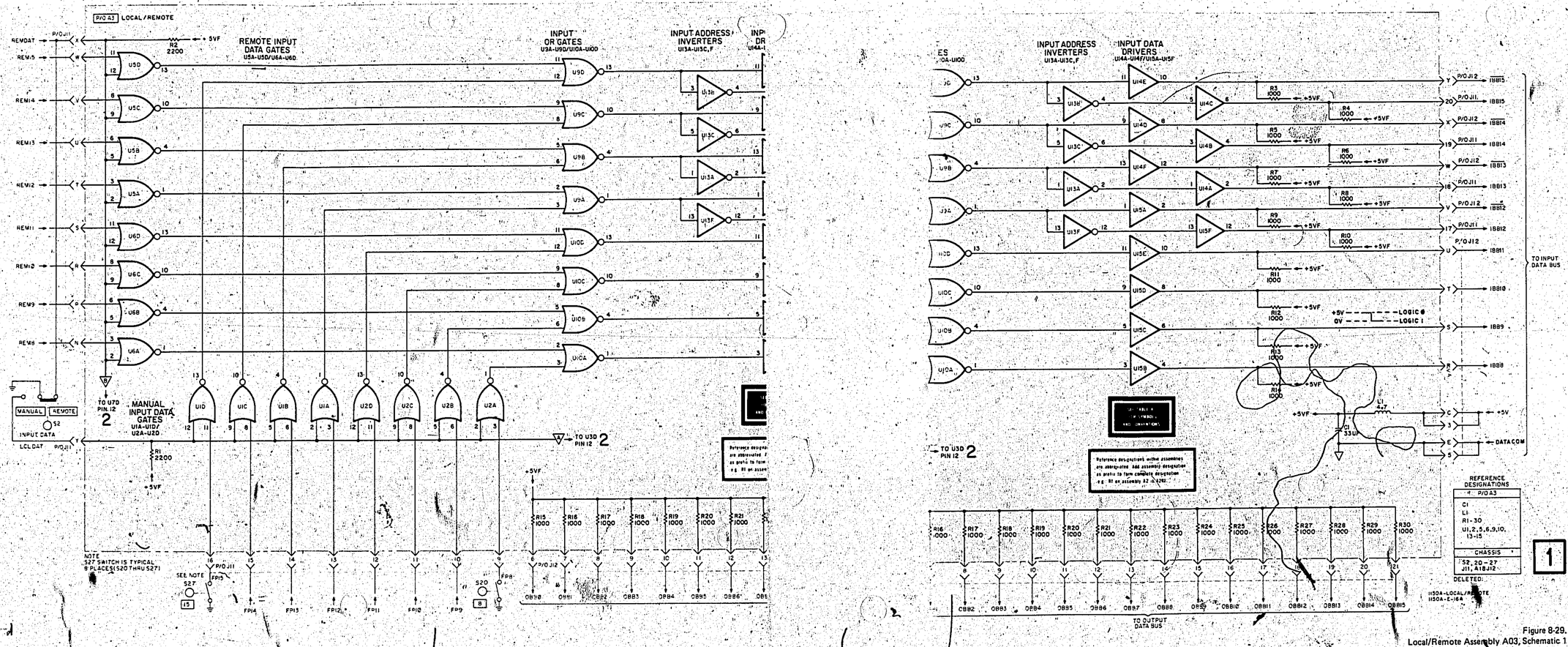

Figure 8-29.
Local/Remote Assembly A03, Schematic 1
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Figure 8-22. Connectors J33 and J34, Signal Identification.

Figure 8-23. Connectors J35 and J36, Signal Identification

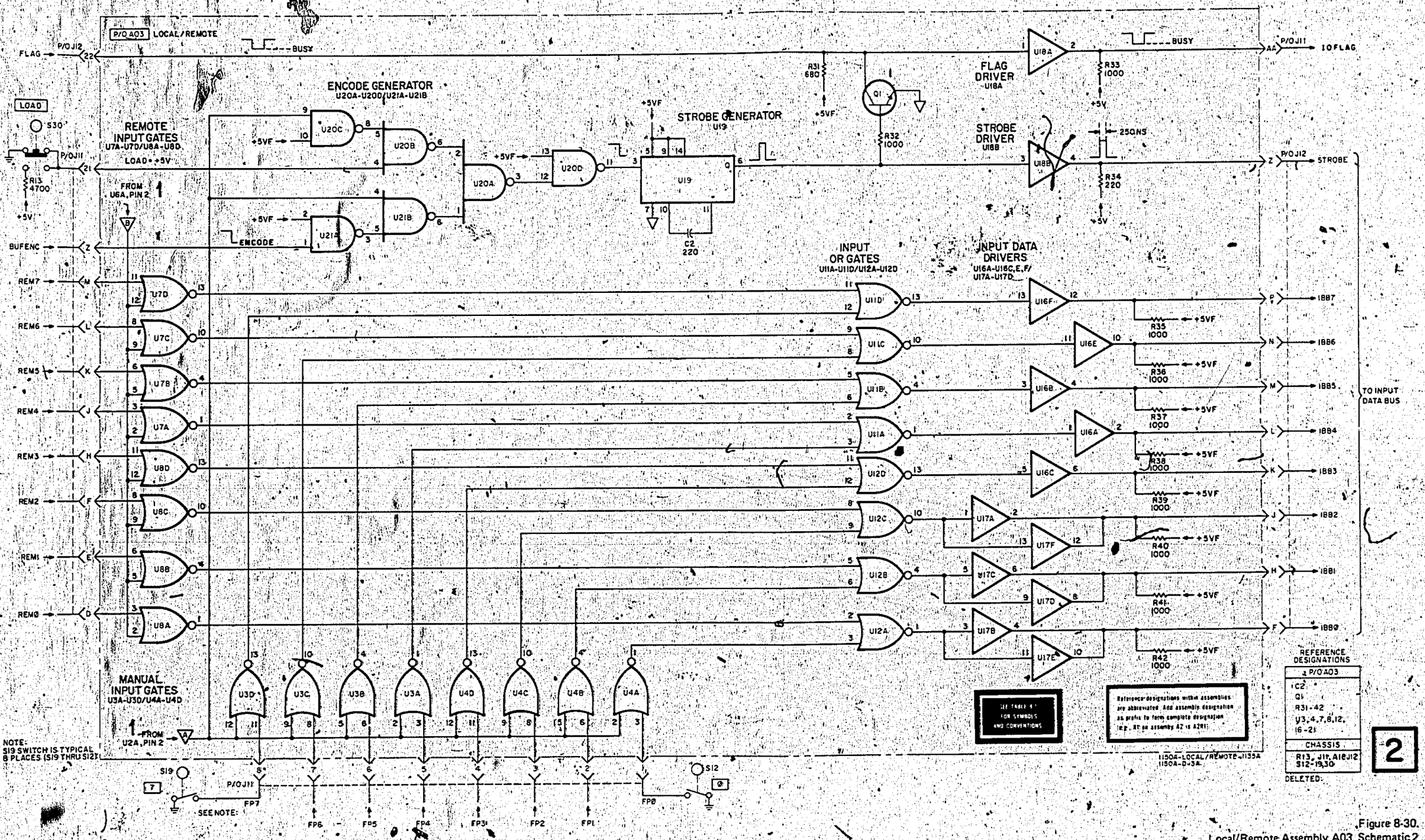
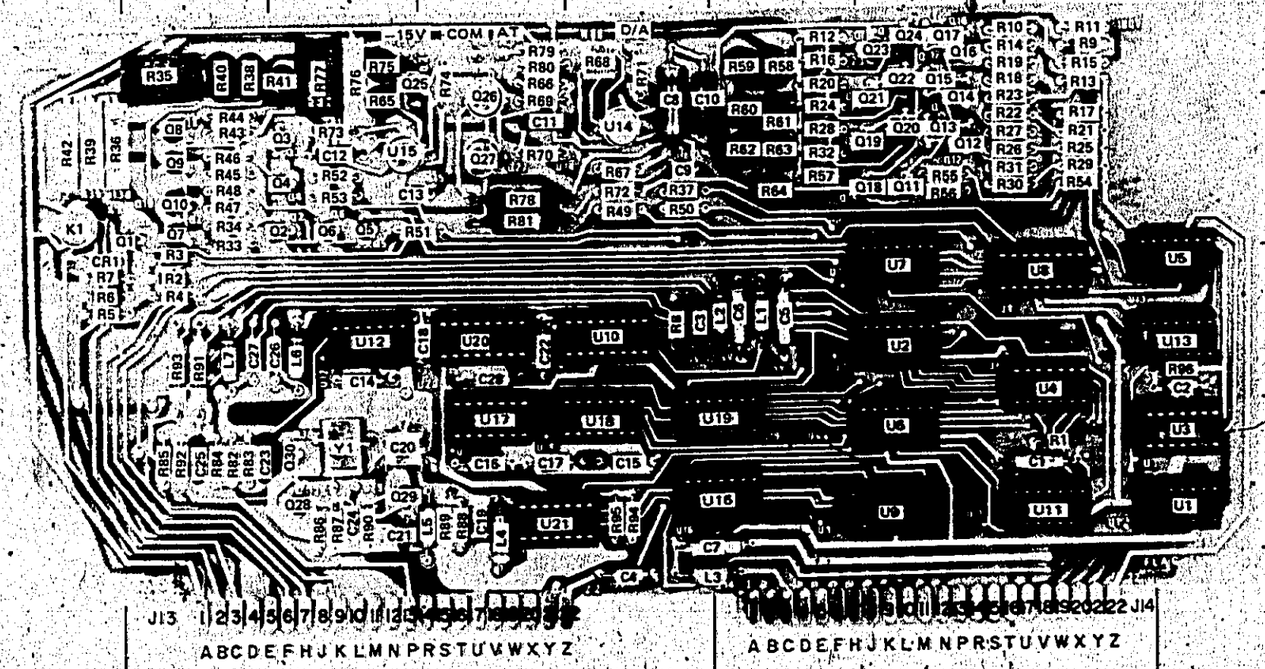


Figure 8-30.
Local/Remote Assembly A03, Schematic 2
8-45



Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-4	C20	E-4	Q2	E-2	Q21	I-1	R10	J-1	R29	J-2	R48	D-2	R67	G-2	R86	E-4	U5	K-3
C2	K-3	C21	E-4	Q3	E-2	Q22	I-1	R11	J-1	R30	J-2	R49	G-2	R68	G-1	R87	E-4	U6	I-4
C3	G-3	C22	F-3	Q4	E-2	Q23	I-1	R12	H-1	R31	J-2	R50	G-2	R69	F-1	R88	F-4	U7	I-3
C4	G-5	C23	D-4	Q5	E-2	Q24	I-1	R13	J-1	R32	H-2	R51	E-2	R70	F-2	R89	F-4	U8	J-3
C5	H-3	C24	E-4	Q6	E-2	Q25	E-1	R14	J-1	R33	D-2	R52	E-2	R71	G-1	R90	E-4	U9	I-4
C6	H-3	C25	D-4	Q7	D-2	Q26	F-1	R15	J-1	R34	D-2	R53	E-2	R72	G-2	R91	D-3	U10	G-3
C7	G-4	C26	E-3	Q8	D-2	Q27	F-2	R16	H-1	R35	D-1	R54	J-2	R73	E-2	R92	D-4	U11	J-4
C8	G-1	C27	D-3	Q9	D-2	Q28	E-4	R17	J-2	R36	C-2	R55	I-2	R74	F-1	R93	D-3	U12	E-3
C9	G-2	C28	F-3	Q10	D-2	Q29	E-4	R18	J-1	R37	G-2	R56	I-2	R75	E-1	R94	G-4	U13	K-3
C10	G-1	CR1	C-3	Q11	I-2	Q30	E-4	R19	J-1	R38	D-1	R57	H-2	R76	E-1	R95	G-4	U14	G-2
C11	F-2	K1	C-2	Q12	I-2	R1	J-4	R20	H-1	R39	C-2	R58	H-1	R77	E-1	R96	K-3	U15	E-2
C12	E-2	L1	H-3	Q13	I-2	R2	D-3	R21	J-2	R40	D-1	R59	H-1	R78	F-2	TP-15V	E-1	U16	G-4
C13	E-2	L2	H-3	Q14	I-1	R3	D-2	R22	J-2	R41	E-1	R60	H-2	R79	F-1	TPAT	F-1	U17	F-4
C14	E-3	L3	G-5	Q15	I-1	R4	D-3	R23	J-1	R42	C-2	R61	H-2	R80	F-1	TPCOM	F-1	U18	G-4
C15	G-4	L4	F-4	Q16	I-1	R5	C-3	R24	H-2	R43	D-2	R62	H-2	R81	F-2	TPD/A	G-1	U19	H-4
C16	F-4	L5	F-4	Q17	I-1	R6	C-3	R25	J-2	R44	D-2	R63	H-2	R82	D-4	U1	K-4	U20	F-3
C17	F-4	L6	E-3	Q18	I-2	R7	C-3	R26	J-2	R45	D-2	R64	H-2	R83	D-4	U2	I-3	U21	F-4
C18	F-3	L7	D-3	Q19	I-2	R8	G-3	R27	J-2	R46	D-2	R65	E-1	R84	D-4	U3	K-4	Y1	E-4
C19	F-4	Q1	C-2	Q20	I-2	R9	J-1	R28	H-2	R47	D-2	R66	F-1	R85	D-4	U4	J-3		

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Figure 8-31. Component Identification, Assembly A04

Table 8-5. Binary Coding for Assembly A04

1. The Calibrator Assembly can be programmed to supply a stable time mark signal or accurate dc voltage to enable the generation of correction factors by software routines. In calibrate mode of operation, the calibrator waveform is connected to the sampler input. In addition, an appropriate trigger is applied to the time base assembly to generate the sampling strobe.

2. Calibrator binary coding is as follows:

Note

Logic 0 level ≈ +5V

Logic 1 level ≈ 0V (at J38 and data buses)

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	0	0												
Normal Operation					0	0										
Probe Calibration					0	1										
Horizontal Calibration					1	0										
Vertical Calibration					1	1										

Note: At power turn-on, the calibrator is forced into normal mode of operation (bit 11 storage on calibrator assembly is set to logic 0).

Table 8-5. Binary Coding for Assembly AO4 (Cont'd)

3. Vertical Calibration coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VERTICAL CAL.	0	1	0	0	1	1										
mV/DIV:																
200 mV/DIV										0	0	0				
100 mV/DIV										0	0	1				
50 mV/DIV										0	1	0				
20 mV/DIV										0	1	1				
10 mV/DIV										1	0	0				
5 mV/DIV										1	0	1				
2 mV/DIV										1	1	0				
No. of Div. from 0V																
+ 7													0	1	1	1
+ 6													0	1	1	0
+ 5													0	1	0	1
+ 4													0	1	0	0
+ 3													0	0	1	1
+ 2													0	0	1	0
+ 1													0	0	0	1
0													0	0	0	0
− 1													1	1	1	1
− 2													1	1	1	0
− 3													1	1	0	1
− 4													1	1	0	0
− 5													1	0	1	1
− 6													1	0	1	0
− 7													1	0	0	1
− 8													1	0	0	0

Note: 1. Bits 0, 1, and 2 control a D/A converter at 200 mV/bit.
2. Bits 4, 5, and 6 control an attenuator in series with D/A converter.

4. Horizontal Calibration coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HORIZONTAL CAL.	0	1	0	0	1	0										
MARKER INTERVAL:																
20 usec															0	0
2 usec															0	1
0.2 usec															1	0
20 ns															1	1

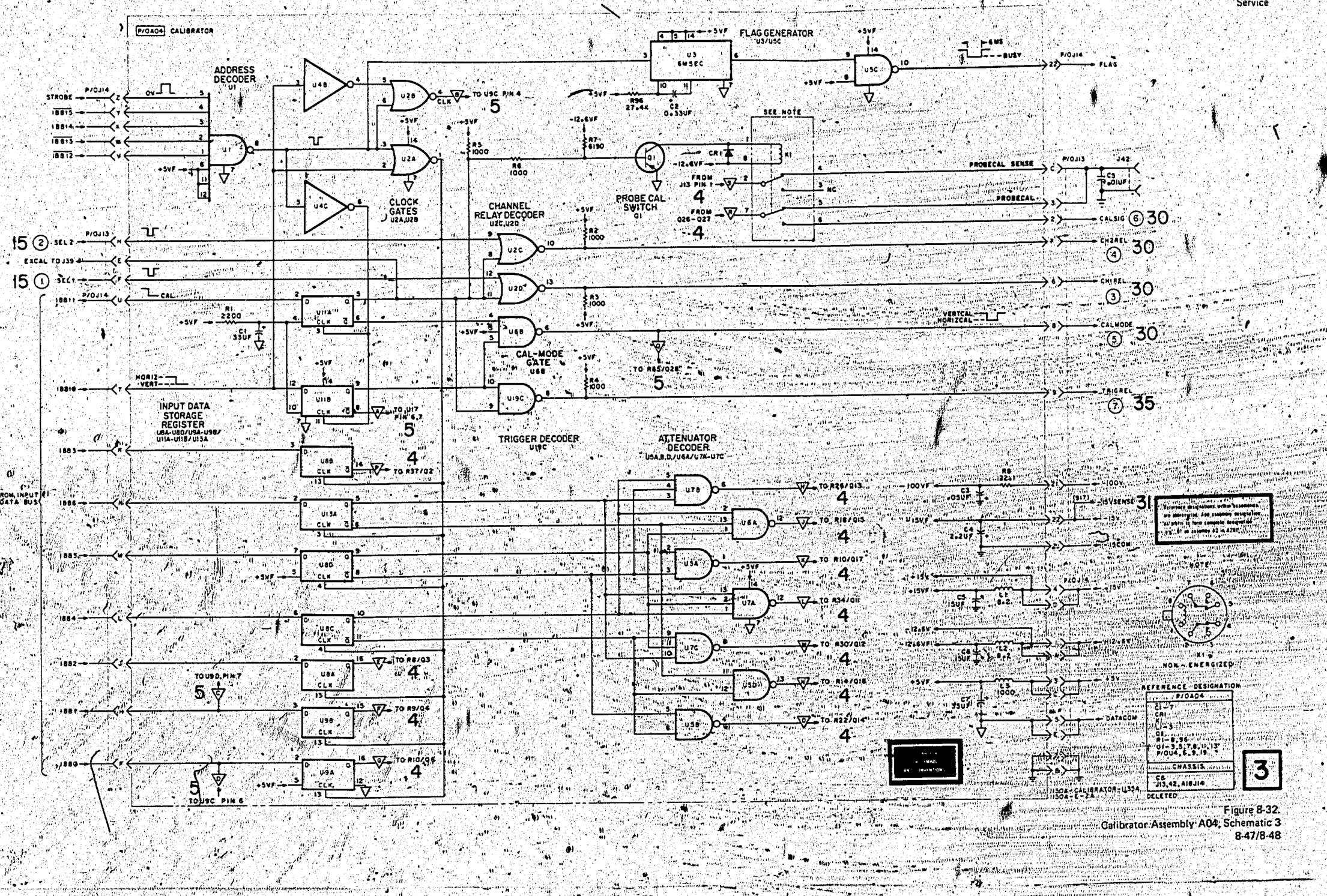


Figure 8-32.
Calibrator Assembly A04, Schematic 3
8-47/8-48

Figure 8-28. Component Identification, Assembly A03

Service

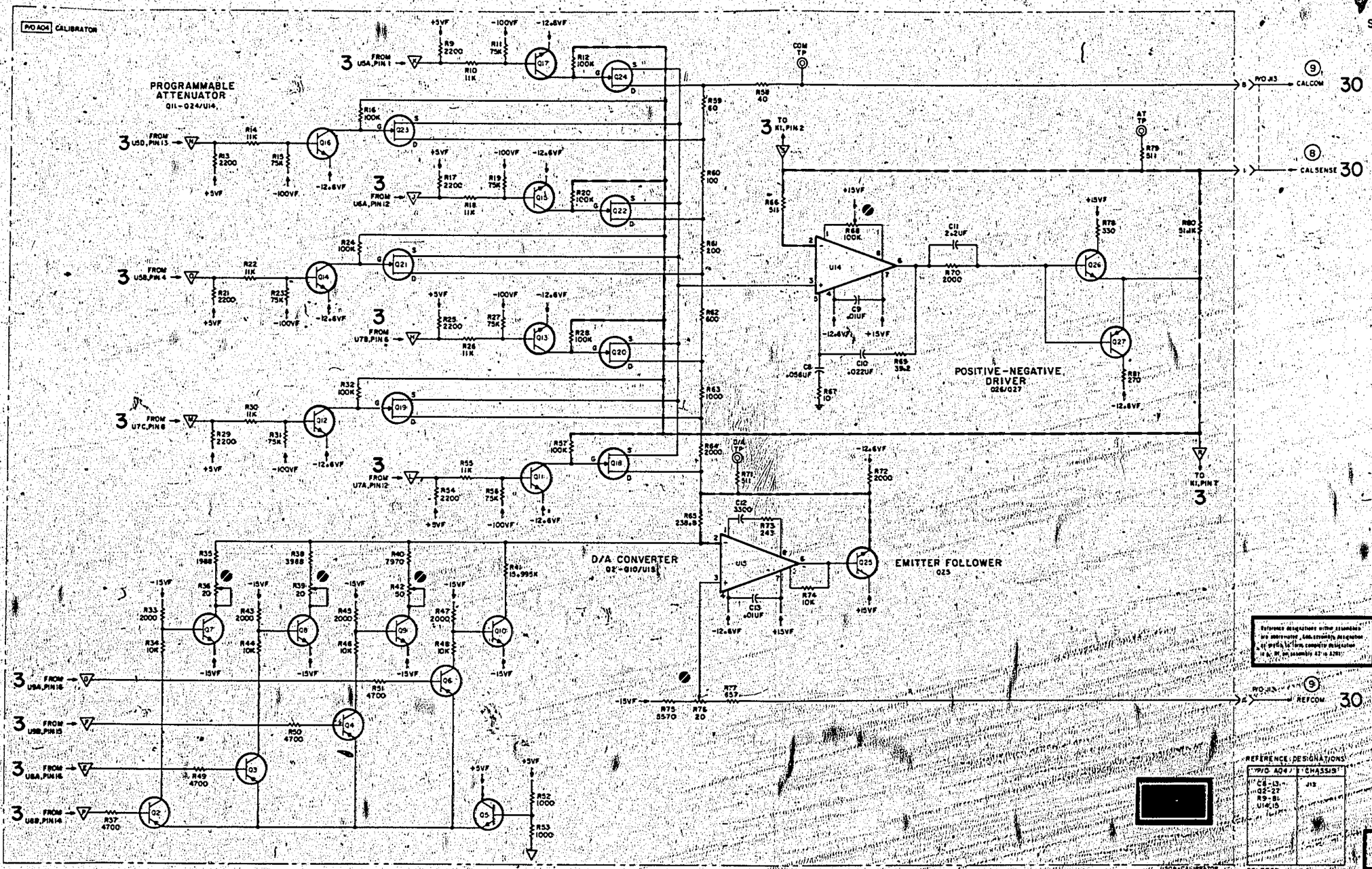


Figure 8-33.
Calibrator Assembly A04, Schematic 4.
8-49/8-50.

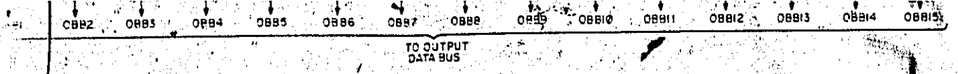


Figure 8-29.
Local/Remote Assembly A03, Schematic 1
8-43/8-44

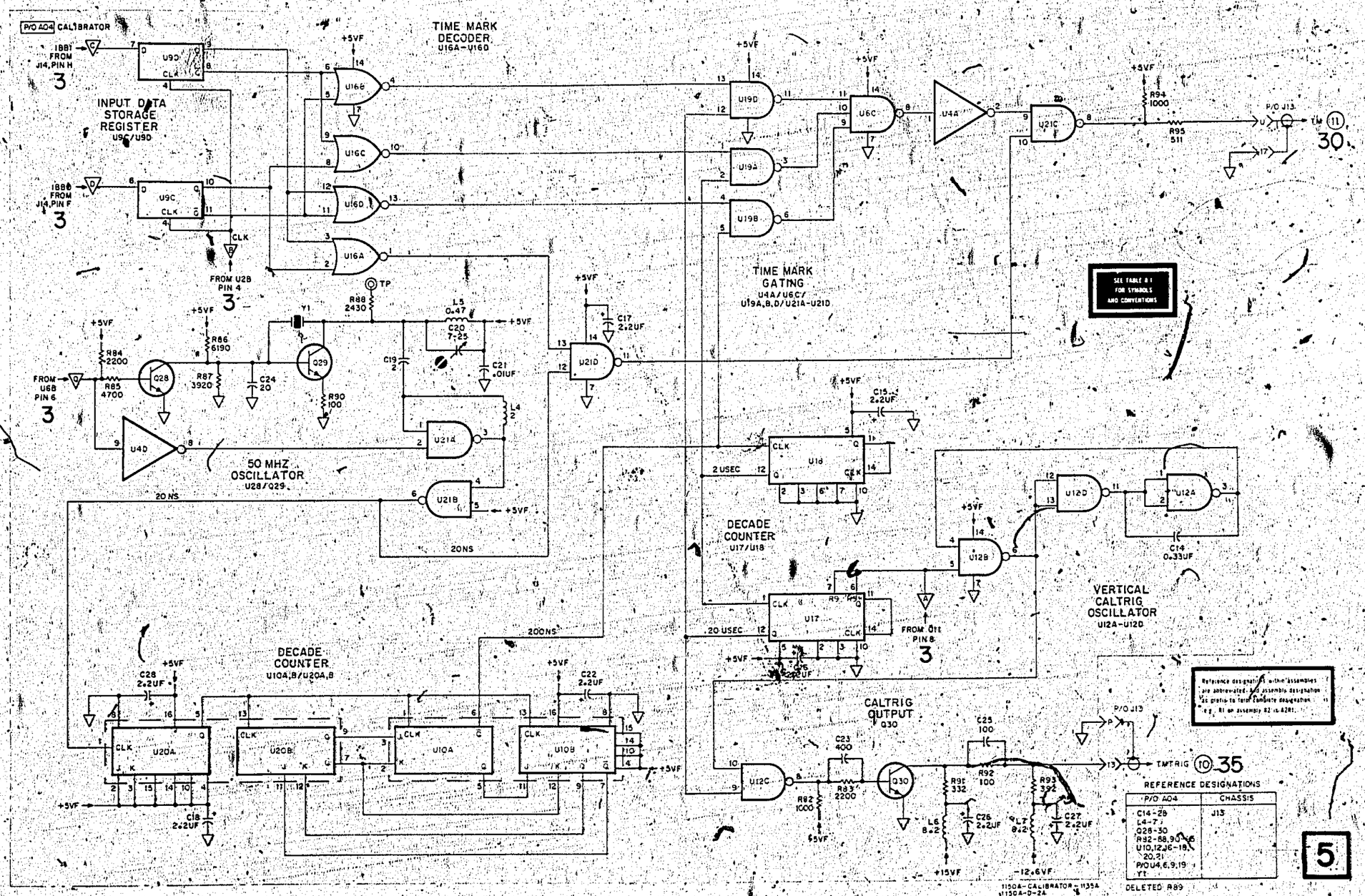


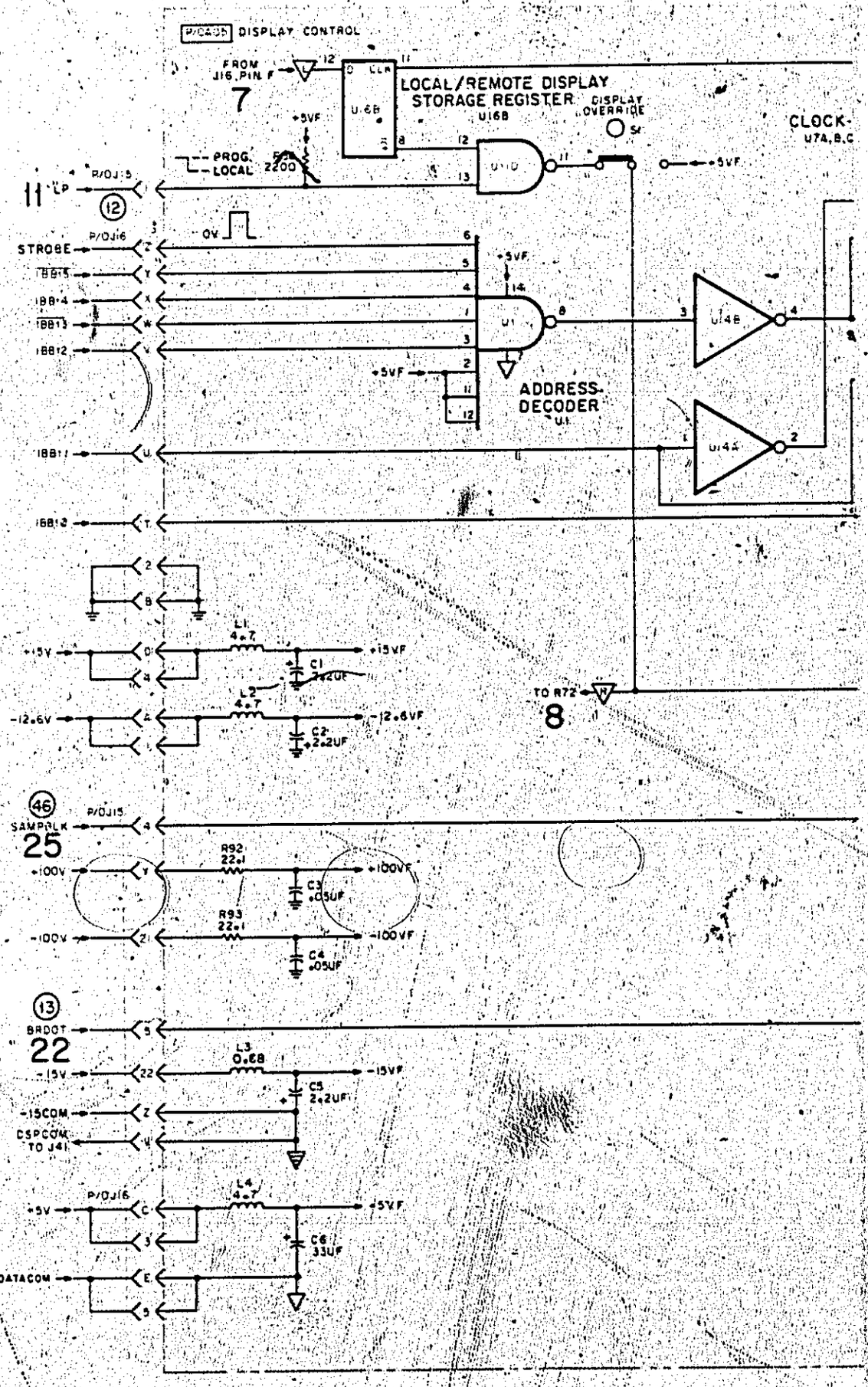
Figure 8-34.
Calibrator Assembly A04, Schematic 5
8-51

Table 8-6. Binary Coding for Assembly A05

1. Binary Codes for Display Control Assembly, A05, are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	0	1												
X Display					0	0	← See Note 1 →									
Y Display					0	1	← See Note 2 →									
ERASE Mode					1	0									1	
LOCAL DISPLAY					1	1										0
REMOTE DISPLAY					1	1										1

Note:
1. Bit 0 through Bit 9 encode a 10-bit D/A converter. D/A converter output is 0 to +1V which corresponds to 10 horizontal divisions on the display (+0.5V = horizontal center of display).
2. Bit 0 through Bit 9 encode a 10-bit D/A converter. D/A converter output is 0 to +1V which corresponds to 10 vertical divisions on the display (+0.5V = vertical center of display).
3. When programming, the Y-data word should be programmed first. X-data word triggers a 5- to 10-microsecond signal which unblanks the display.


P/O A5 DISPLAY CONTROL
FROM J16, PIN F
7
LOCAL/REMOTE DISPLAY STORAGE REGISTER
U16B
DISPLAY OVERRIDE
CLOCK
U7A,B,C
+5VF
PROG.
LOCAL
2200
P/O J15
LP
(12)
11
0V
P/O J16
STROBE
IBB15
IBB14
IBB13
IBB12
IBB11
IBB12
ADDRESS-DECODER
U1
U14B
U14A
TO R72
8
L1
4.7
C1
2.2UF
+15V
+15VF
L2
4.7
C2
2.2UF
-12.6V
-12.6VF
(46)
SAMPCLK
25
+100V
R92
22.1
C3
.05UF
+100VF
-100V
R93
22.1
C4
.05UF
-100VF
(13)
BRDOT
22
-15V
L3
0.68
C5
2.2UF
-15VF
-15COM
DSPCOM
TO J41
L4
4.7
C6
33UF
DATACOM

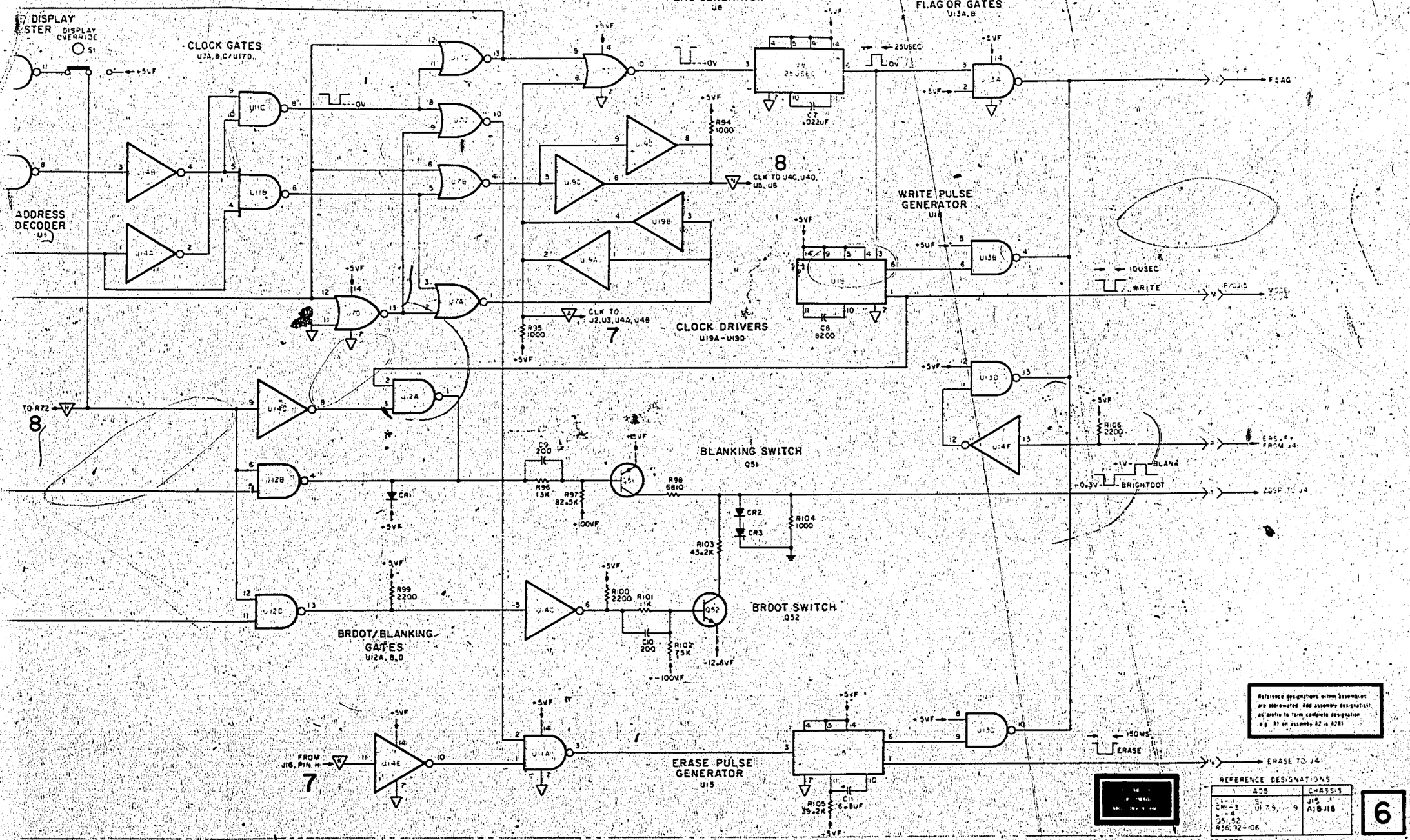


Figure 8-36.
Display Control Assembly A05, Schematic 6
8-53/8-54

P/O A05 DISPLAY CONTROL

FROM INPUT DATA BUS

INPUT DATA STORAGE REGISTER U2A-U2D/U3A-U3D/U4A,B

1889 P/O J16 S — U2A
1888 R — U2B
1887 P — U2D
1886 N — U2C
1885 M — U3A
1884 L — U3B
1883 K — U3D
1882 J — U3C
1881 H — U4B
1882 F — U4A

8 TO U4C, PIN 6
8 TO U4D, PIN 7
8 TO U5B, PIN 3
8 TO U5A, PIN 2
8 TO U5C, PIN 6
8 TO U5D, PIN 7
8 TO U6B, PIN 3
8 TO U6A, PIN 2
8 TO U6C, PIN 6 & U14E, PIN 11
6,8 TO U6D, PIN 7 & U16B, PIN 12

6 CLK FROM U19A, PIN 2

+5VF

+2V
-15VF

R1 20
R2 1988
R3 20
R4 3988
R5 2430
R6 50
R7 10K
R8 2430
R9 10K
R10 2430
R11 10K
R12 7970
R13 2430
R14 10K
R15 15.995K
R16 2430
R17 10K
R18 32K
R19 2430
R20 10K
R21 64K
R22 2430

Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q49

X-AXIS D/A CONVERTER Q1-Q19/Q49/U9

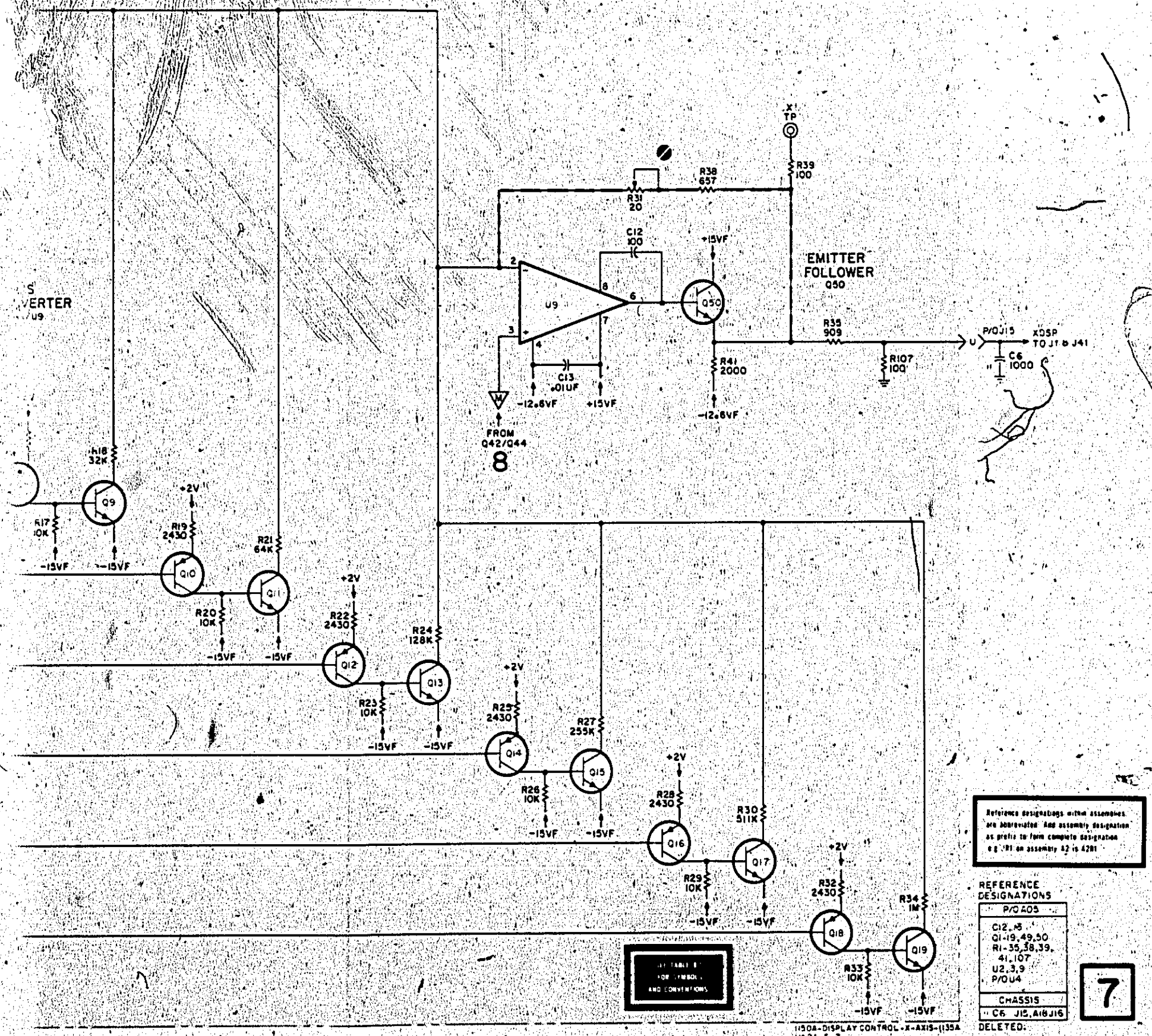


Figure 8-37.
Display Control Assembly A05, Schematic 7
8-55/8-56

P/O A05 DISPLAY CONTROL

INPUT DATA STORAGE REGISTER
U4C,D/U5A-U5D/U6A-U6D

FROM J16, PIN S 7 → B → U4C
FROM J16, PIN R 7 → C → U4D
FROM J16, PIN P 7 → D → U5B
FROM J16, PIN N 7 → E → U5A
FROM J16, PIN M 7 → F → U5C
FROM J16, PIN L 7 → G → U5D
FROM J16, PIN K 7 → H → U6B
FROM J16, PIN J 7 → J → U6A
FROM J16, PIN H 7 → K → U6C
FROM J16, PIN F 7 → L → U6D

FROM U19C, PIN 6 6 → N

+2V
R43 2430
R42 20
R45 1988
Q47
Q48
R44 10K
-15VF
R46 2430
Q20
R37 20
R48 3988
Q21
R47 10K
R49 2430
Q22
R40 50
R51 7970
Q23
R50 10K
R52 2430
Q24
R54 15.995K
Q25
R53 10K

Y-AXIS D/A CONVERTER
Q20-Q37,Q47,Q48/U40

+2V POWER SUPPLY
Q38

+5VF
R62 1000
Q38
R61 1000
Q39
+2V

R55 2430
Q26
R57 32K
Q27
R56 10K
R58 2430
Q28
R60 64K
Q29
R59 10K

FR

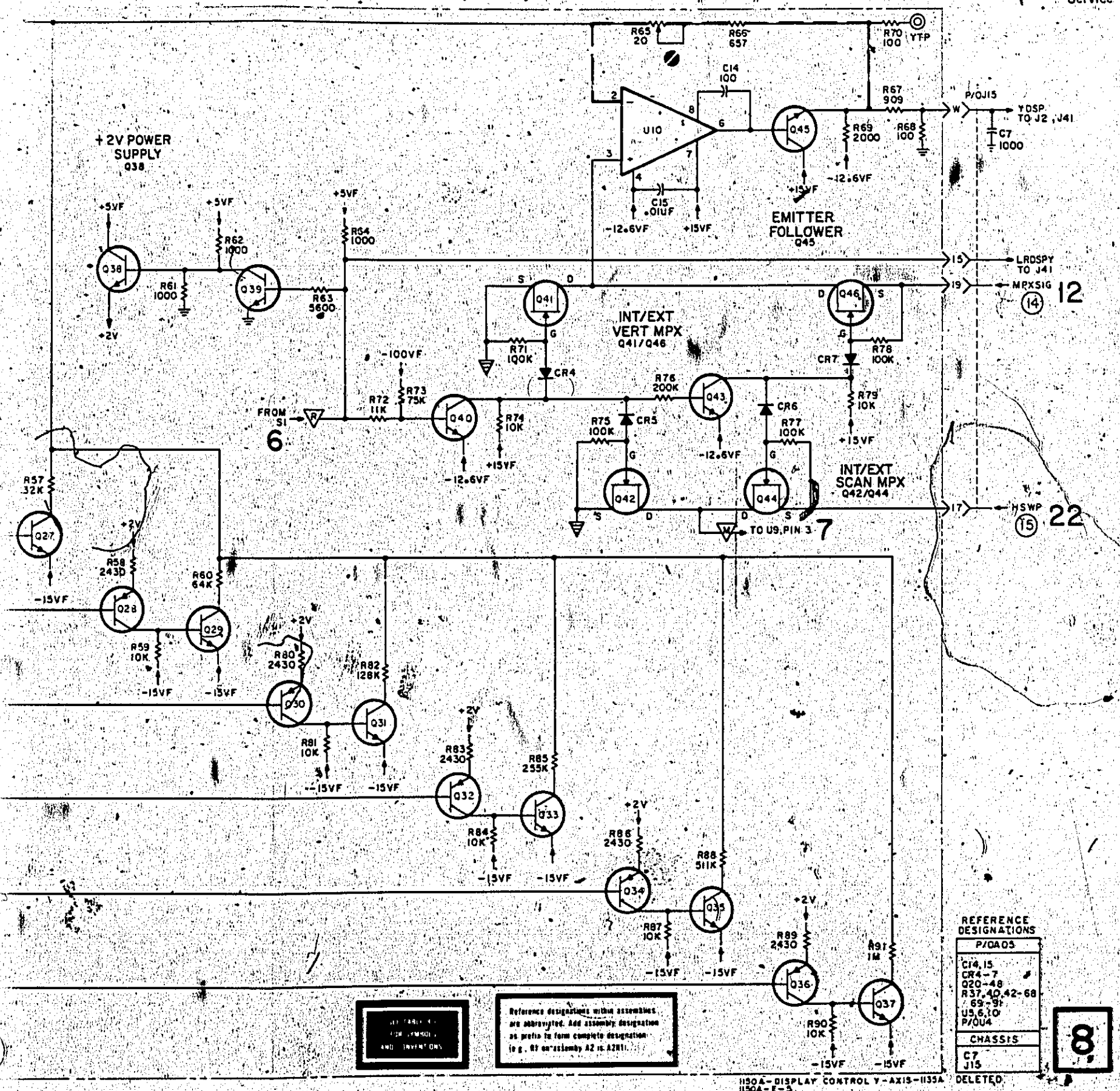
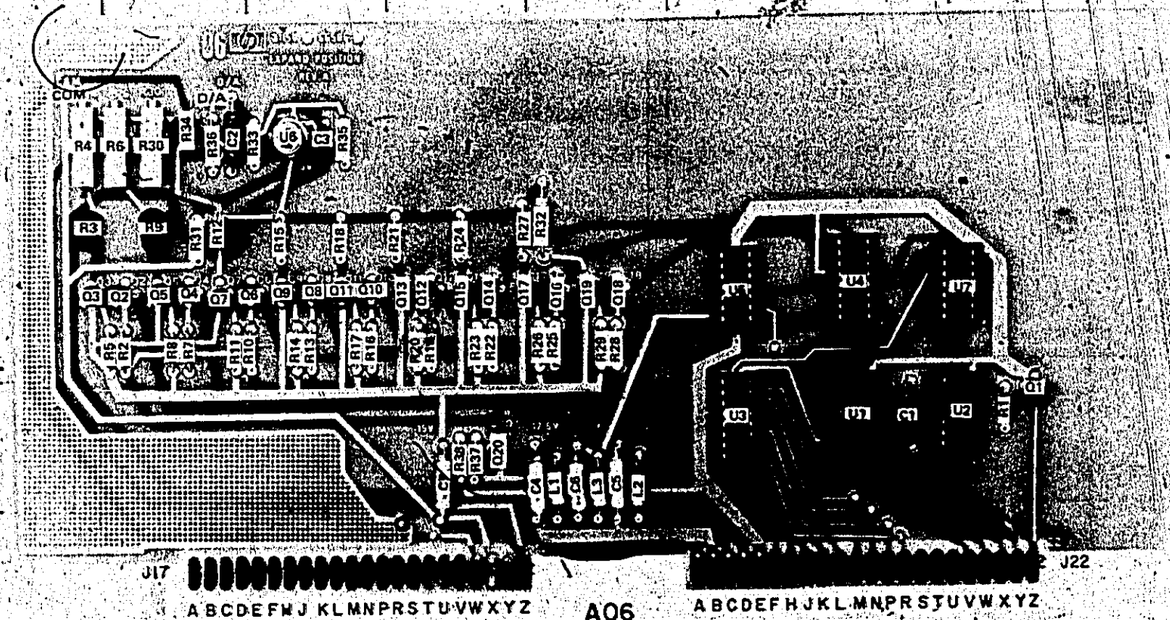


Figure 8-38.
Display Control Assembly A05, Schematic 8



Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	I-4	C7	F-4	Q3	C-3	Q9	E-3	Q15	F-3	R1	I-4	R7	D-3	R13	E-3	R19	F-3	R25	G-3	R31	D-3	R37	F-4	U3	H-4
C2	D-2	L1	G-4	Q4	D-3	Q10	E-3	Q16	G-3	R2	D-3	R8	D-3	R14	E-3	R20	F-3	R26	G-3	R32	G-3	R38	F-4	U4	I-3
C3	E-2	L2	G-4	Q5	D-3	Q11	E-3	Q17	F-3	R3	C-3	R9	D-3	R15	E-3	R21	F-3	R27	F-3	R33	E-2	TPD/A	D-2	U5	H-3
C4	G-4	L3	G-4	Q6	E-3	Q12	F-3	Q18	G-3	R4	C-2	R10	E-3	R16	E-3	R22	F-3	R28	G-3	R34	D-2	TPCOM	C-2	U6	E-2
C5	G-4	Q1	J-4	Q7	D-3	Q13	F-3	Q19	G-3	R5	D-3	R11	D-3	R17	E-3	R23	F-3	R29	G-3	R35	E-2	U1	I-4	U7	J-3
C6	G-4	Q2	D-3	Q8	E-3	Q14	F-3	Q20	F-4	R6	D-2	R12	D-3	R18	E-3	R24	F-3	R30	D-2	R36	D-2	U2	J-4		

1180A—R—33

Figure 8-39. Component Identification, Assembly A06

Figure 8-39.
Under fold

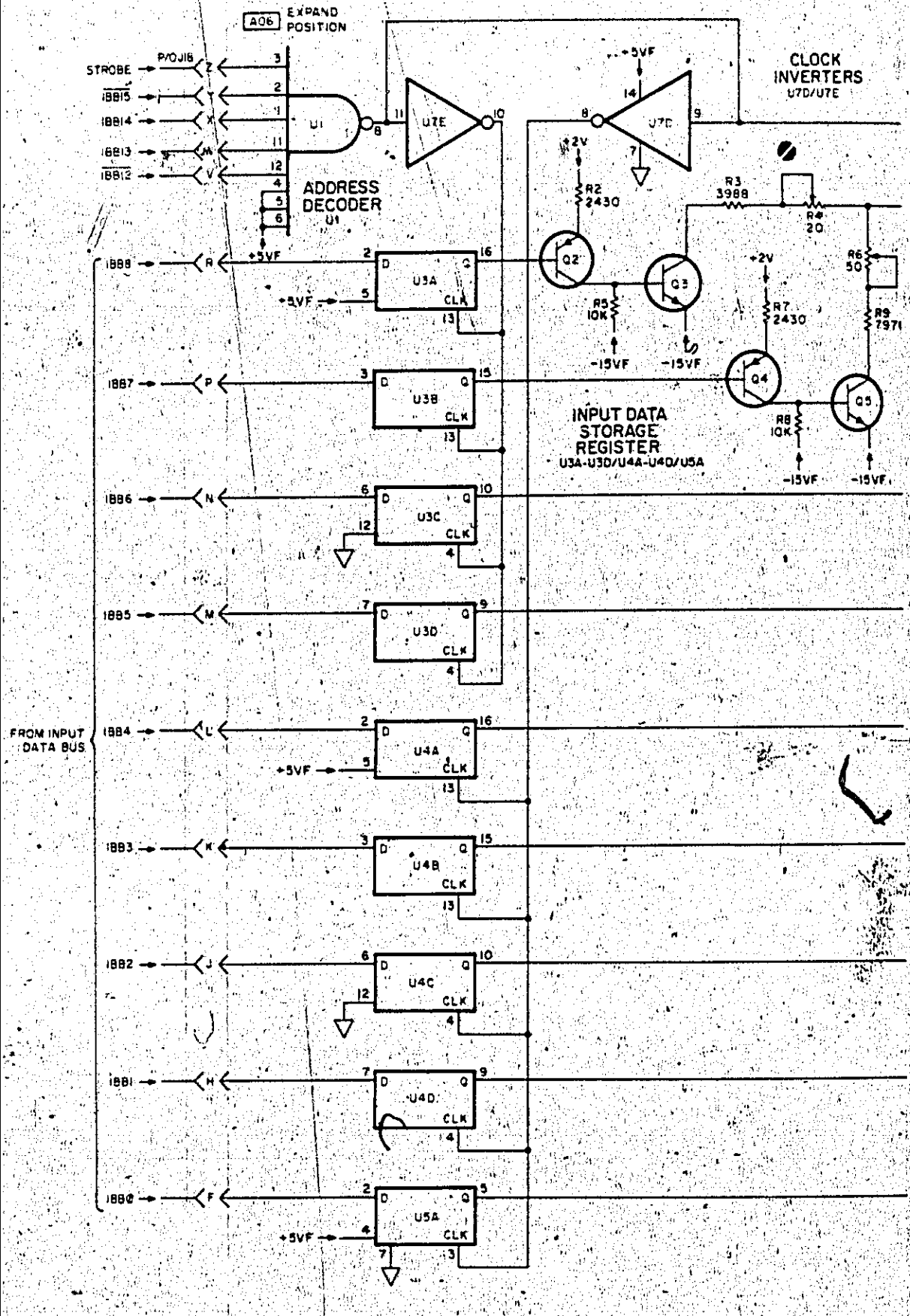
Table 8-7. Binary Coding for Assembly A06

The position, in time, about which the sweep is expanded is determined by programming the expand position D/A converter with the following binary code:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	0												
EXPAND POSITION								← See Note →								

Note: Bit 0 through Bit 8 encode a nine-stage D/A converter. D/A converter output is 0 to +10V which represents 0 to 10 horizontal divisions on display.

FROM INPUT DATA BUS


A06 EXPAND POSITION
STROBE
P/O J18
Z
Y
X
W
V
18B15
18B14
18B13
18B12
U1
ADDRESS DECODER
U1
U7E
U7D
+5VF
CLOCK INVERTERS
U7D/U7E
+2V
R2 2430
R3 3988
R4 20
R5 10K
R6 50
R7 2430
R8 10K
R9 797I
Q2
Q3
Q4
Q5
-15VF
18B8
18B7
18B6
18B5
18B4
18B3
18B2
18B1
18B0
R
P
N
M
L
K
J
H
F
U3A
U3B
U3C
U3D
U4A
U4B
U4C
U4D
U5A
D
Q
CLK
INPUT DATA STORAGE REGISTER
U3A-U3D/U4A-U4D/U5A
FROM INPUT DATA BUS

CLOCK INVERTERS U7D/U7E

FLAG GENERATOR U2-Q1

INPUT DATA STORAGE REGISTER U3A-U3D/U4A-U4D/U5A

D/A CONVERTER Q2-Q19/U6

+2V POWER SUPPLY Q20

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation — e.g. R1 on assembly A2 is A2R1

SEE TABLE 8 FOR SYMBOLS AND CONVENTIONS

1150A-EXPAND POSITION-1135A 1150A-E-1A

REFERENCE DESIGNATIONS

A06

C1-7
L1-3
Q1-20
R1-38
TP1,2
U1-7

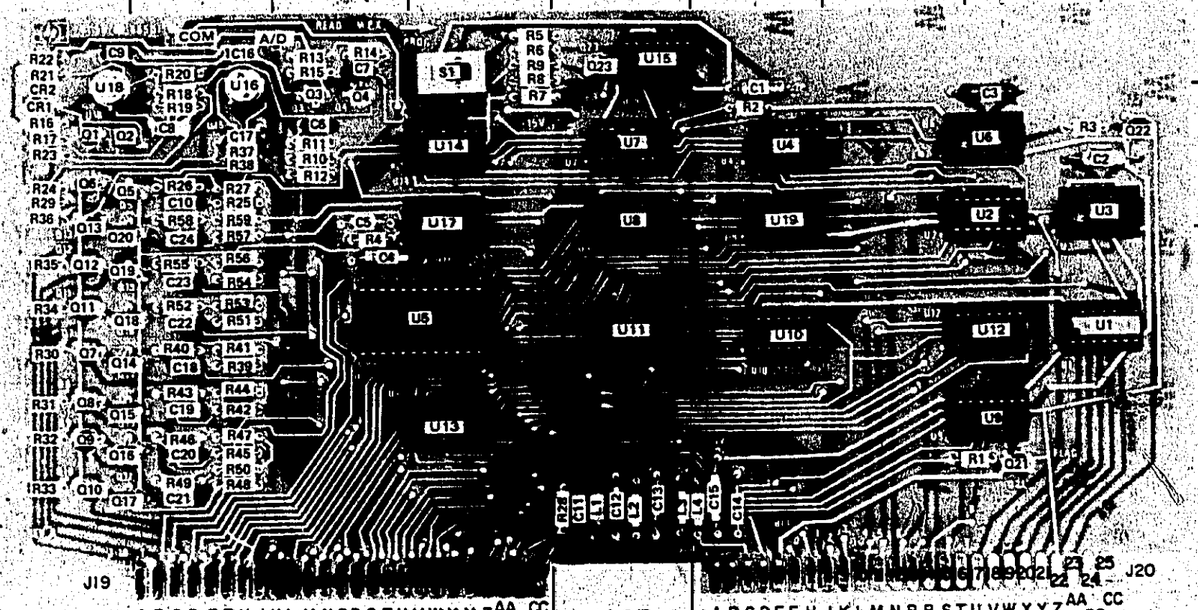
CHASSIS

J17, A18J18

DELETED

9

Figure 8-40.
Expand Position Assembly A06, Schematic 9



Circuit boards have plated through component holes: This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	H-1	C15	H-4	L3	G-4	Q13	C-2	R4	E-3	R17	C-2	R30	C-3	R43	D-4	R56	D-3	U7	G-2
C2	J-2	C16	D-1	L4	H-4	Q14	C-3	R5	F-1	R18	D-1	R31	C-4	R44	D-4	R57	D-2	U8	G-2
C3	J-2	C17	D-2	Q1	C-2	Q15	C-4	R6	F-1	R19	D-2	R32	C-4	R45	D-4	R58	D-2	U9	J-4
C4	E-3	C18	D-3	Q2	C-2	Q16	C-4	R7	F-2	R20	D-1	R33	C-4	R46	D-4	R59	D-2	U10	A-3
C5	E-2	C19	D-4	Q3	E-1	Q17	C-4	R8	F-1	R21	C-1	R34	C-3	R47	D-4	S1	F-1	U11	G-3
C6	E-2	C20	D-4	Q4	E-2	Q18	C-3	R9	F-1	R22	C-1	R35	C-3	R48	D-4	TPA/D	E-1	U12	J-3
C7	E-1	C21	D-4	Q5	C-2	Q19	C-3	R10	E-2	R23	C-2	R36	C-2	R49	D-4	TPCOM	D-1	U13	F-4
C8	D-2	C22	D-3	Q6	C-2	Q20	C-2	R11	E-2	R24	C-2	R37	D-2	R50	D-4	U1	J-3	U14	F-2
C9	C-1	C23	D-3	Q7	C-3	Q21	J-4	R12	E-2	R25	D-2	R38	D-2	R51	D-3	U2	J-2	U15	G-1
C10	D-2	C24	D-2	Q8	C-4	Q22	K-2	R13	E-1	R26	D-2	R39	D-3	R52	D-3	U3	J-2	U16	D-1
C11	G-4	CR1	C-2	Q9	C-4	Q23	G-1	R14	E-1	R27	D-2	R40	D-3	R53	D-3	U4	H-2	U17	F-2
C12	G-4	CR2	C-1	Q10	C-4	R1	J-4	R15	E-1	R28	G-4	R41	D-3	R54	D-3	U5	F-3	U18	C-1
C13	G-4	L1	G-4	Q11	C-3	R2	H-2	R16	C-1	R29	C-2	R42	D-4	R55	D-3	U6	J-2	U19	H-2
C14	H-4	L2	G-4	Q12	C-3	R3	J-2												

1180A-R-19

Figure 8-41. Component Identification, Assembly A07

Table 8-8. Binary Coding for Assembly A07 (Cont'd)

6. Binary codes for reading A/D converter output and sampler output are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
READ A/D CONVERTER (See Note 1)													0	1	1	1
READ SAMPLER (See Note 2)										1			0	1	1	1

Note: 1. This code connects the digital output of the A/D converter to the output data bus lines. It should be sent prior to taking a series of samples.

2. This digital sequence encodes the sampler and after proper delay encodes the A/D converter. The flag is held busy until the sequence is completed.

7. Binary codes for other "read" commands are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
read SWEEP TIME													1	0	1	1
read SCAN CONTROL													1	1	0	1
read VERT. SENSITIVITY													1	1	1	0
read CHANNEL SELECT													1	0	0	0

Note: Since the computer can read only one channel at a time, either the A TRACE switch or B TRACE switch must be in the OFF position when reading front-panel control settings.

Table 8-8. Binary Coding for Assembly A07 (Cont'd)

3. Local/Program digital coding is as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
L P FUNCTION IDENTIFIER					1											
LOCAL MODE													0	0		0
PROGRAM MODE													0	0	0	1

Note: L P Function Identifier, Bit 11, tells assembly to read Bit 0 to determine whether Local or Program mode is to be used.

4. Binary codes to sense LEARN and Local/Program signals are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
LEARN (See Note 1)													0	0	0	1
LOCAL/ PROGRAM (See Note 2)													0	0	1	0

Note: 1. This coding connects the 100-microsecond LEARN pulse to output data bus line OBB0 when LEARN pushbutton switch is pressed.

2. This coding connects LOCAL sense line to output data bus line OBB1.

Local operation = 0V; Program operation = +5V.

Table 8-8. Binary Coding for Assembly A07 (Cont'd)

5. Binary codes for reading Expand and Vertical Positions are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	0	1	1	1												
"READ" IDENTIFIER					0											
EXPAND POSITION (See Note 1)													0	1	1	0
VERTICAL POSITION (See Note 2)													1	0	0	1

Note: 1. This code connects the voltage from front-panel expand POSITION control to the A/D converter. Digital information from the A/D converter is connected to output data bus lines OBB0 through OBB9. The flag is held busy until the sequence is completed. (Refer to paragraph 6, this table, for A/D converter coding.)

2. This code connects the voltage from front-panel vertical CHANNEL 1 or CHANNEL 2 POSITION control to the A/D converter. Digital information from the A/D converter is connected to output data bus lines OBB0 through OBB9. The flag is held busy until the sequence is completed. Desired vertical channel must be selected prior to this command. (Refer to table 3-5 for Channel Select coding.)

1. The Read/Multiplexer Assembly, A07, is used when programming the following functions:

   a. Program Commands:

      (1). Local/Program Mode.

      (2). Sampler Command.

   b. Read Commands:

      (1). Read - Expand Position (REP).

      (2). Read - Vertical Position (RVP).

      (3). Read - Sweep Time Scale (RSA).

      (4). Read - Scan Control (RSC).

      (5). Read - Vertical Sensitivity (RVA).

      (6). Read - A/D Data Output (RAD).

      (7). Read - Channel Select (RCA).

      (8). Read - Learn (RLN).

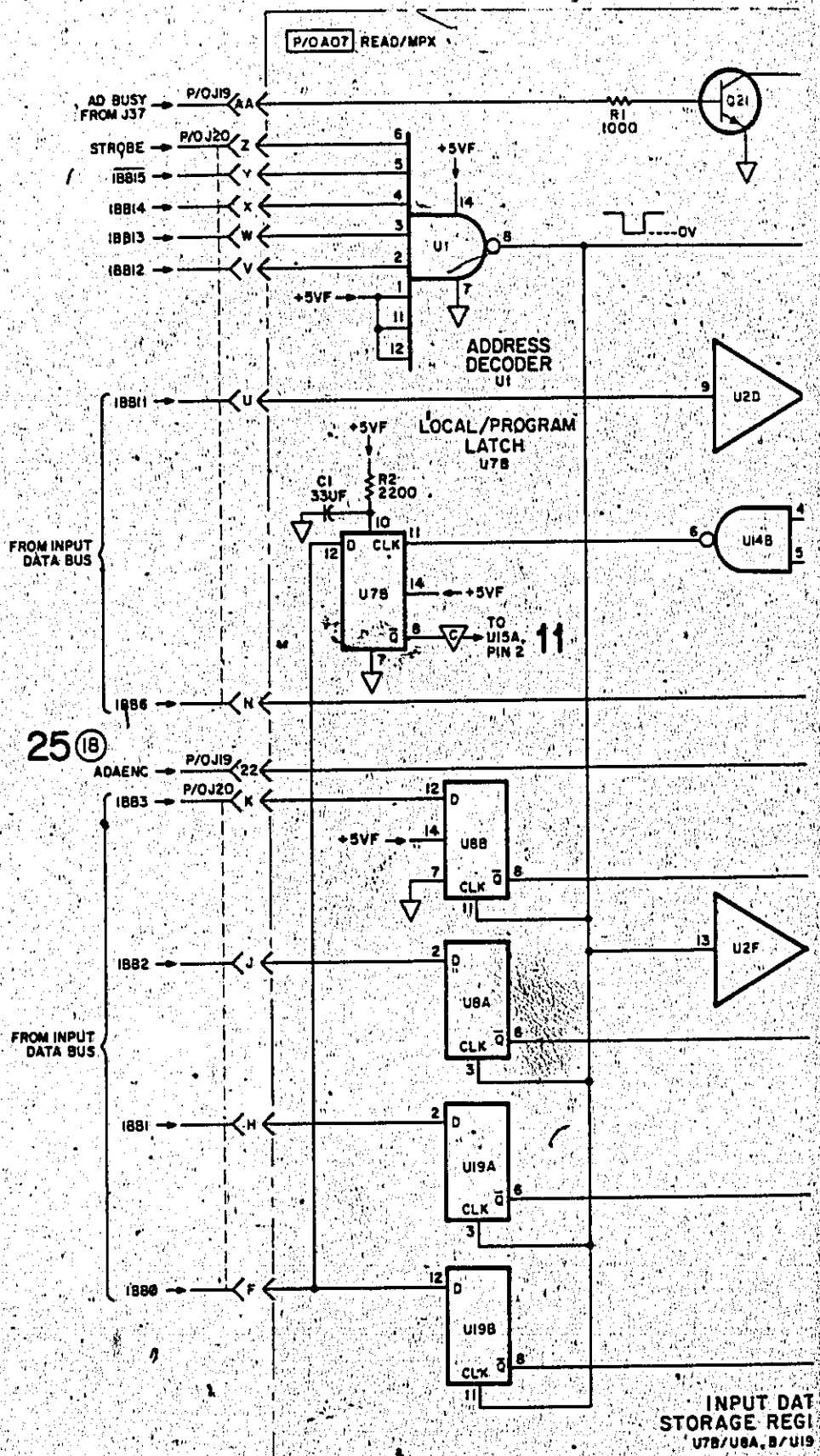
      (9). Read - Local/Program Mode.

2. A typical sequence of operation for the Model 1150A is as follows:

   a. In Local mode of operation, the operator makes a front-panel setup to obtain the desired display and then presses LEARN pushbutton switch. This generates a 100-microsecond pulse to the computer. The computer then stores the front-panel settings as six digital words.

   b. In Program mode of operation, the computer sequentially applies the stored information (front-panel settings) to the Model 1150A to duplicate the previous manual settings and display the waveform under test.

   c. Take data from waveform being measured.


P/O A07 READ/MPX
AD BUSY FROM J37
P/O J19
AA
Q21
R1 1000
STROBE
P/O J20
Z
+5VF
IB815
Y
IB814
X
IB813
W
IB812
V
U1
0V
+5VF
ADDRESS DECODER U1
IB811
U
U2D
LOCAL/PROGRAM LATCH U7B
+5VF
C1 33UF
R2 2200
FROM INPUT DATA BUS
U7B
U14B
+5VF
TO U15A, PIN 2
11
IB86
N
25 (18)
ADAENC
P/O J19
22
IB83
P/O J20
K
U8B
+5VF
IB82
J
U8A
U2F
FROM INPUT DATA BUS
IB81
H
U19A
IB80
F
U19B
INPUT DAT
STORAGE REGI
U7B/U8A,B/U19

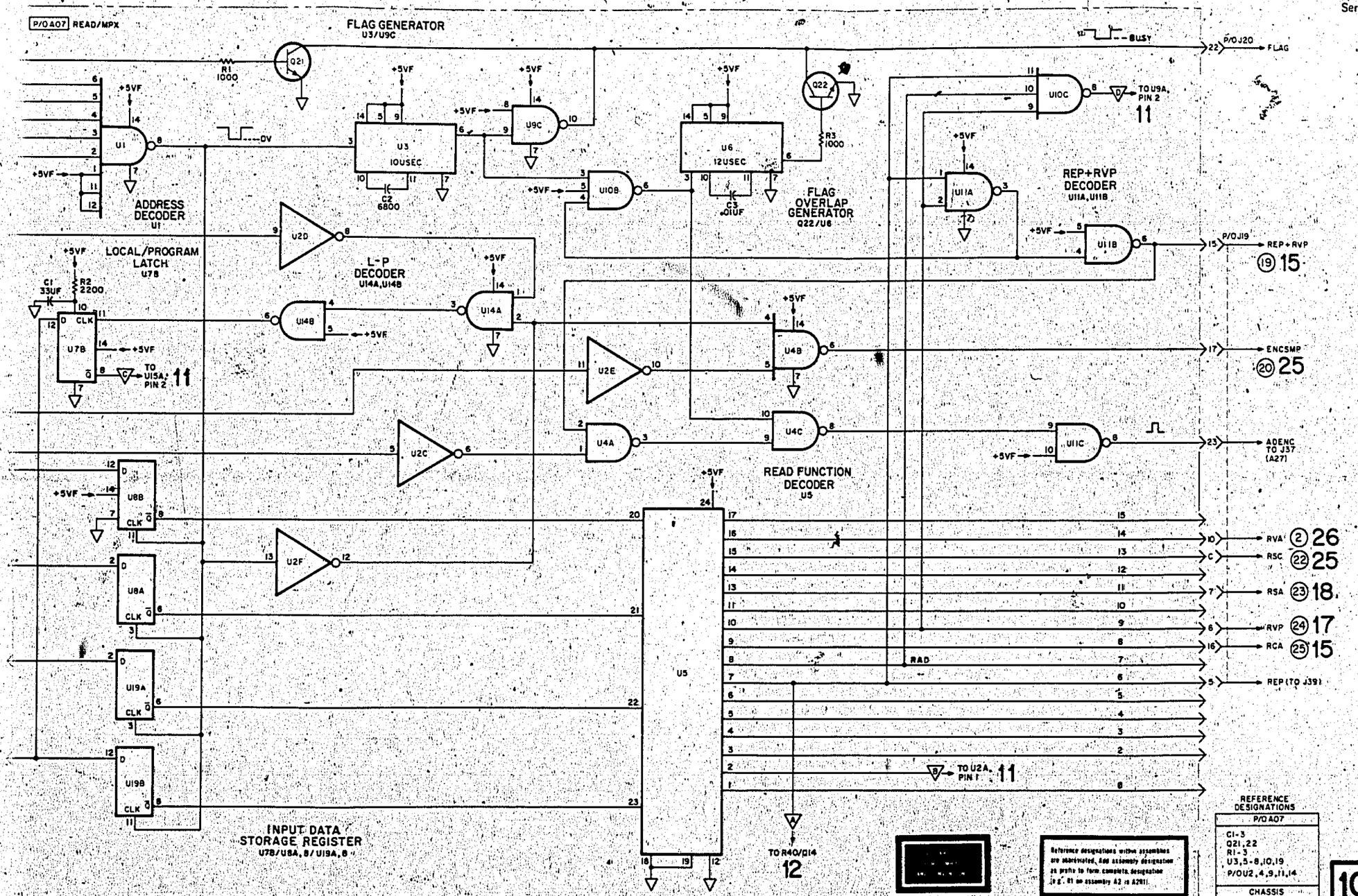


Figure 8-42.
Read/Multiplexer Assembly A07, Schematic 10
8-63/8-64

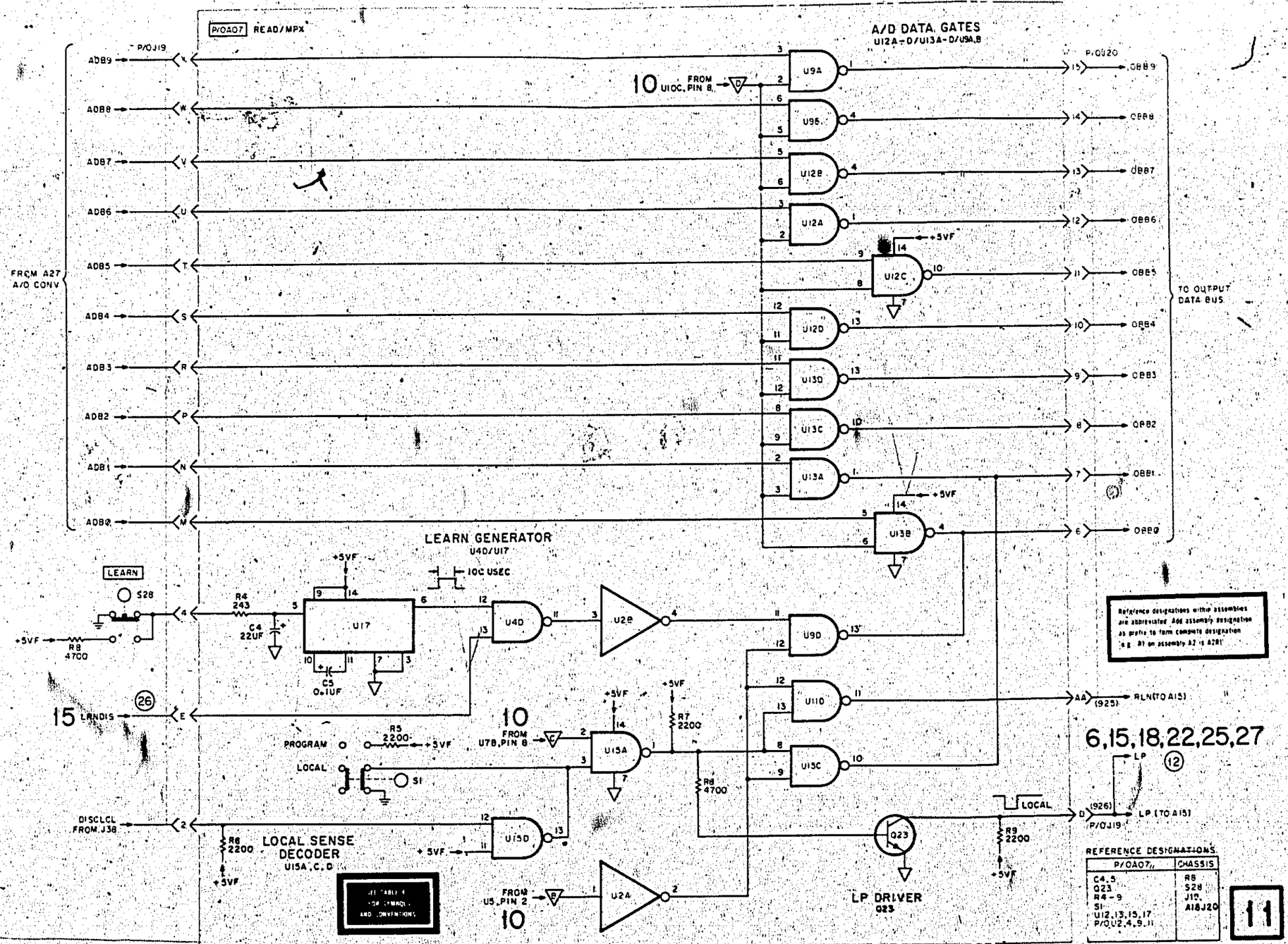


Figure 8-43.
Read/Multiplexer Assembly A07, Schematic 11
8-65/8-66

P/OA07 READ / MPX

LEVEL TRANSLATOR U18

MPX SELECTOR Q5-Q20 / U16

34 (27) CH1 — P/OJ19 pin 11

15 (29) MPX1 — P/OJ19 pin 15

R10 2200 — +5VF

C6 200

R11 11K

R12 75K — -100VF

Q3 — -12.6VF

R16 33K

Q1

R18 15K — -15VF

R19 5110

R20 681

R21 619

U18

C8 22

CR1

CR2

C9 .01UF — -12.6VF, +15VF

R24 5110

R22 681

R23 15K — -15VF

R17 33K

Q2

MPXCOM FROM J39 — pin 12

36 (28) CH2 — P/OJ19 pin 13

U14D — pins 12, 13, 11

U14C — pins 9, 10, 8

+5VF

C10 200

R26 11K

R25 2200 — +5VF

R27 75K — +10VF

Q5 — -12.6VF

R13 2200

R14 11K

C7 200

R15 75K — -100VF

Q4 — -12.6VF

15 (30) MPX2 — P/OJ19 pin 19

P/OJ20 pins 2, B

-100V — P/OJ19 pin 24

R28 22.1

C11 .05UF — -100VF

-15V — P/OJ20 pin 25

-15COM — P/OJ20 pin CC

L1 4.7

C12 2.2UF — -15VF

-12.6V — P/OJ20 pin A

L2 4.7

C13 2.2UF — -12.6VF

+15V — P/OJ20 pin D

L3 4.7

C14 2.2UF — +15VF

+5V — P/OJ20 pin C

L4 4.7

C15 33UF — +5VF

P/OJ20 pins 3, E

R29 100K

22 (31) EXPOS — P/OJ19 pin L

Q7

R30 100K

27 (32) POS1 — pin K

U12

R31 100K

27 (33) POS2 — pin J

Q9

CH3 -10 FROM J39 — pin H

CH11 -18 FROM J39 — pin F

CH19 -26 FROM J39 — pin B

CH27 -34 FROM J39 — pin A

-12.6VF

Q14

Q15

Q16

R39 75K — -100VF

R42 75K — -100VF

R45 75K — -100VF

R40 11K

C18 200

R43 11K

C19 200

R46 11K

R41 3200 — +5VF

R44 2200 — +5VF

R47 2200 — +5VF

REF FROM U5, PIN 7

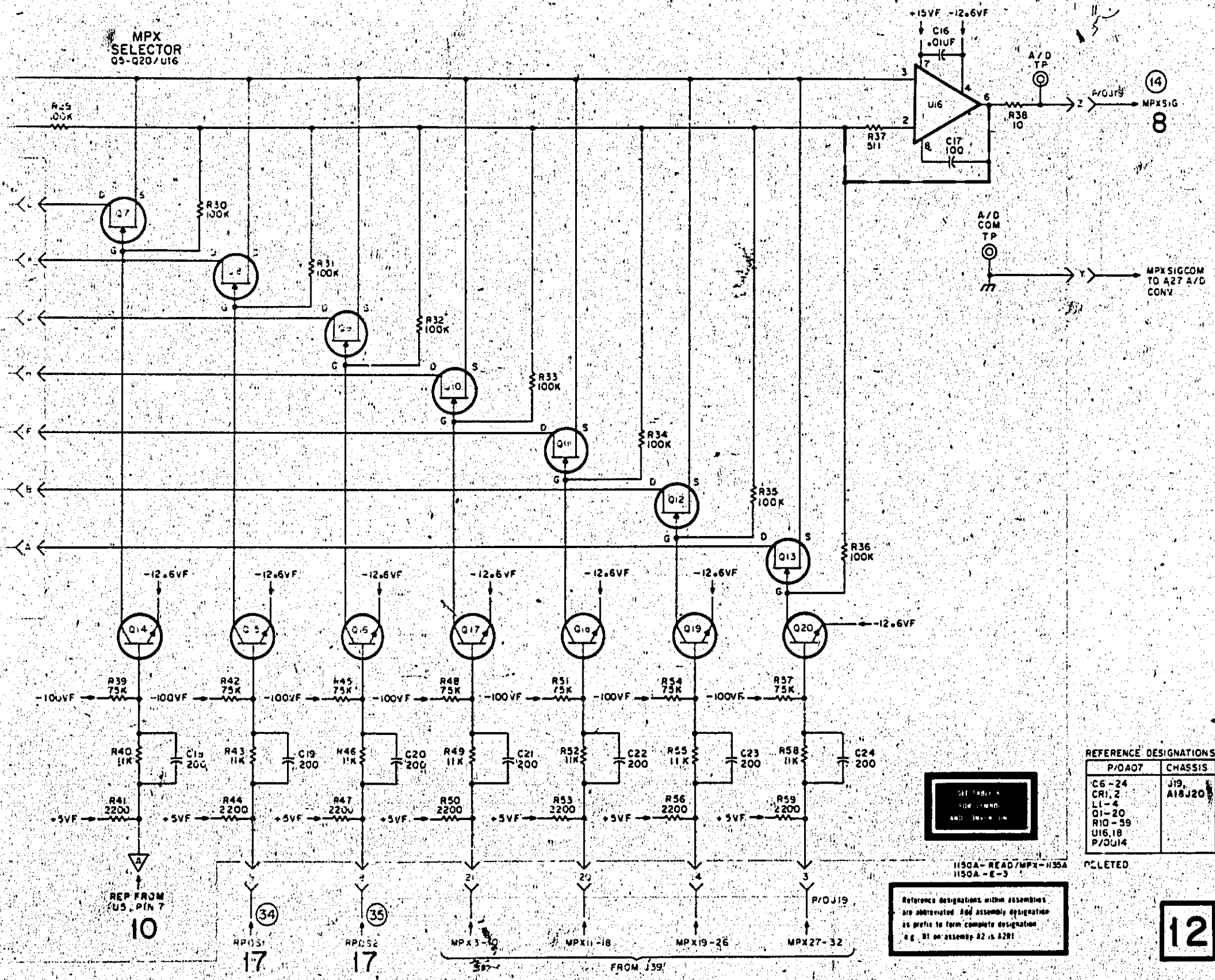
10

(34) RPOS1

17

(35) RPOS2

17



REFERENCE DESIGNATIONS

P/OA07	CHASSIS
C6-24 CR1, 2 L1-4 Q1-20 R10-39 U16, 18 P/OJ14	J19, A18J20

DELETED

Figure 8-44.
Read/Multiplexer Assembly A07, Schematic 12

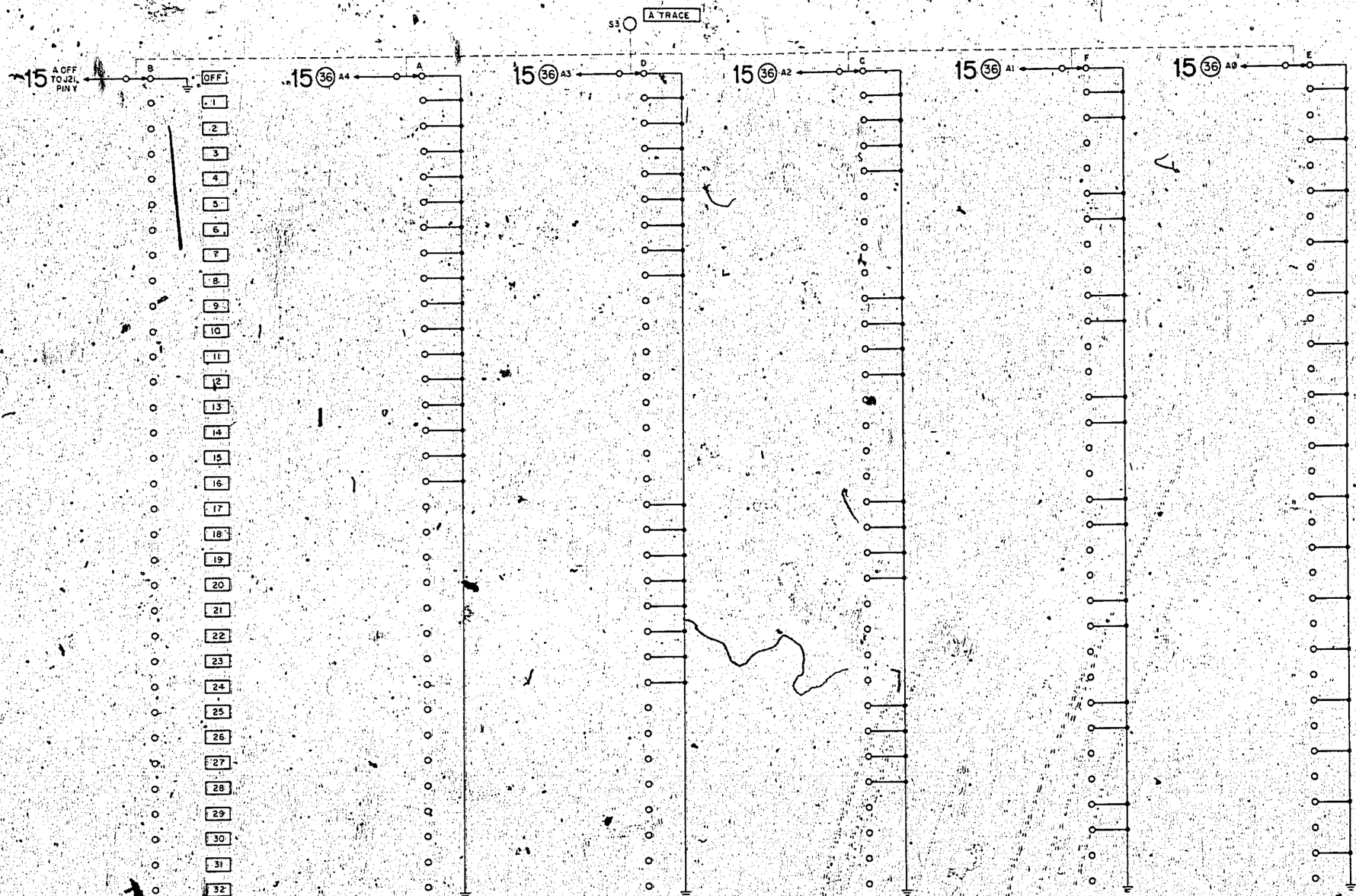


Figure 8-45. A TRACE Switch, Schematic 13

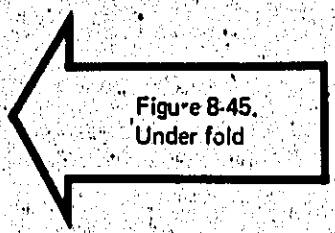


Figure 8-45.
Under fold

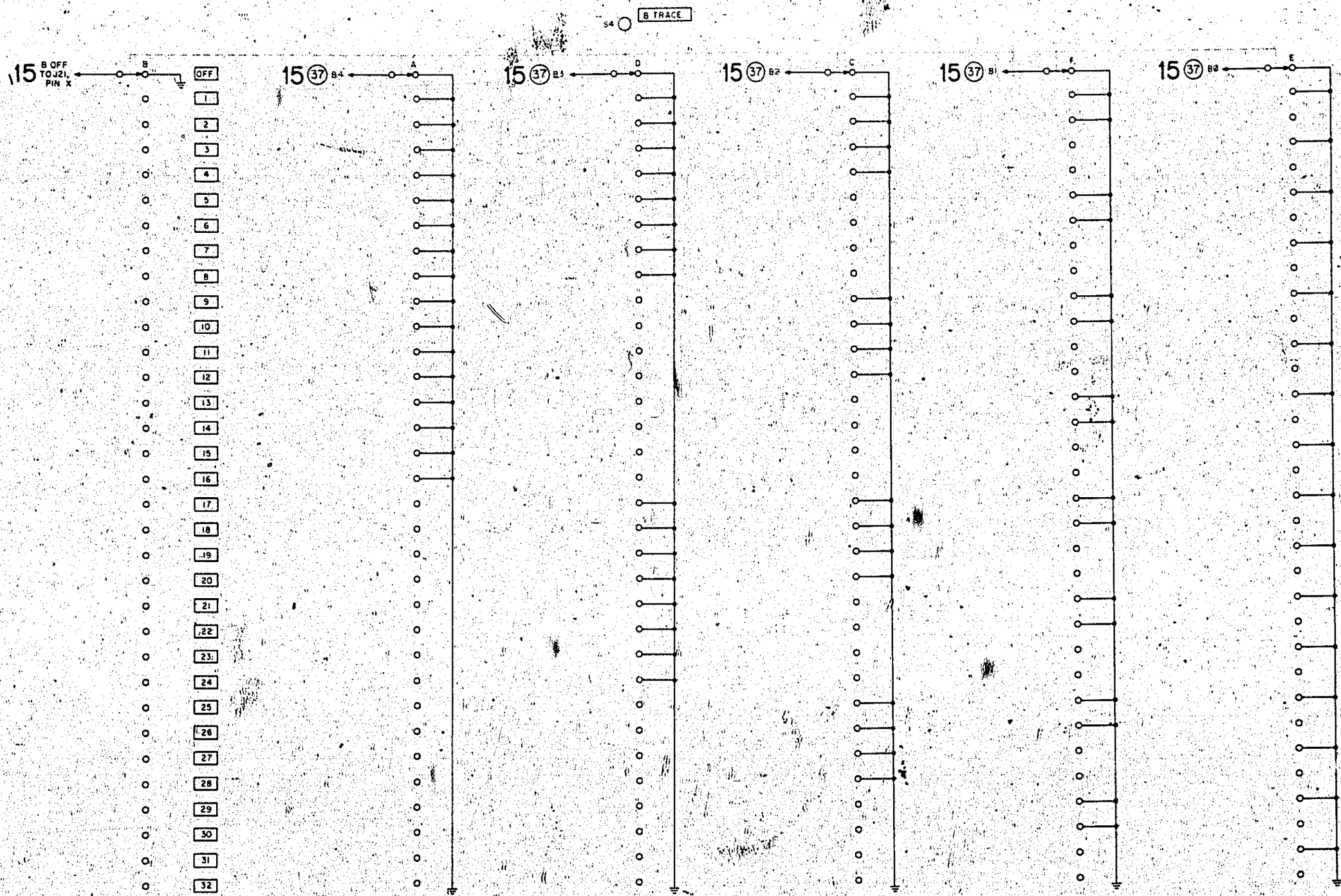
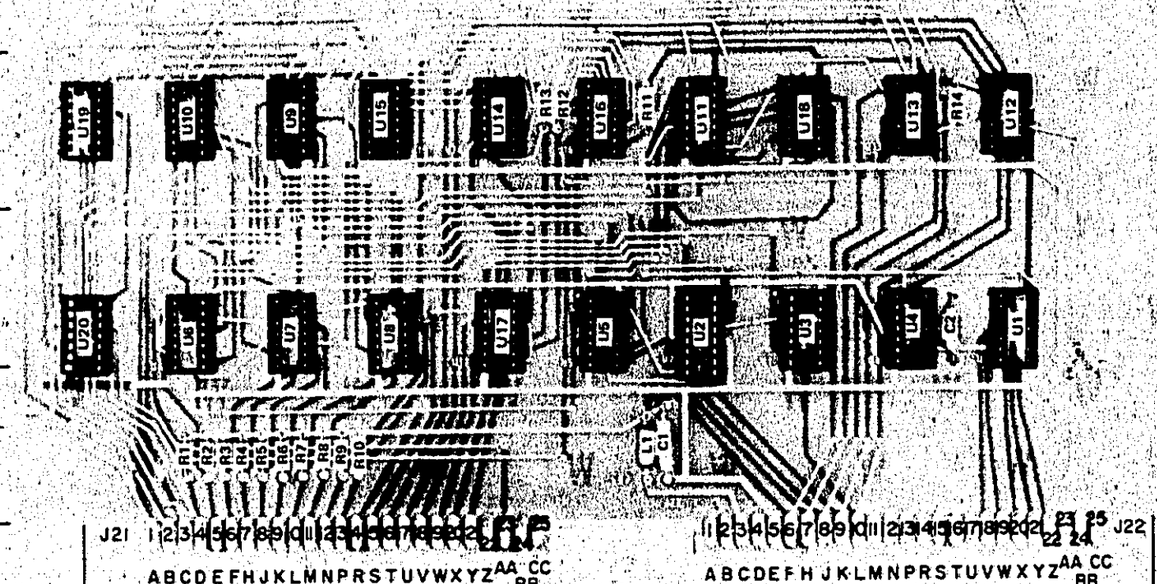


Figure 8-46.
B TRACE Switch, Schematic 14



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	G-4	R7	E-4	U2	H-3	U11	H-2
C2	I-3	R8	E-4	U-3	H-3	U12	J-2
L1	G-4	R9	E-4	U4	I-3	U13	I-2
R1	D-4	R10	E-4	U5	G-3	U14	F-2
R2	D-4	R11	G-2	U6	D-3	U15	E-2
R3	D-4	R12	G-2	U7	E-3	U16	G-2
R4	E-4	R13	G-2	U8	E-3	U17	F-3
R5	E-4	R14	I-2	U9	E-2	U18	H-2
R6	E-4	U1	J-3	U10	D-2	U19	C-2
						U20	C-3

11804—R—18

Figure 8-47. Component Identification, Assembly A08

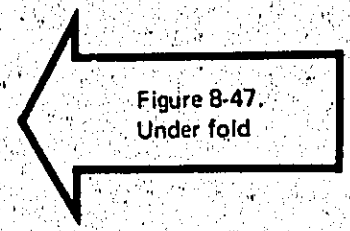


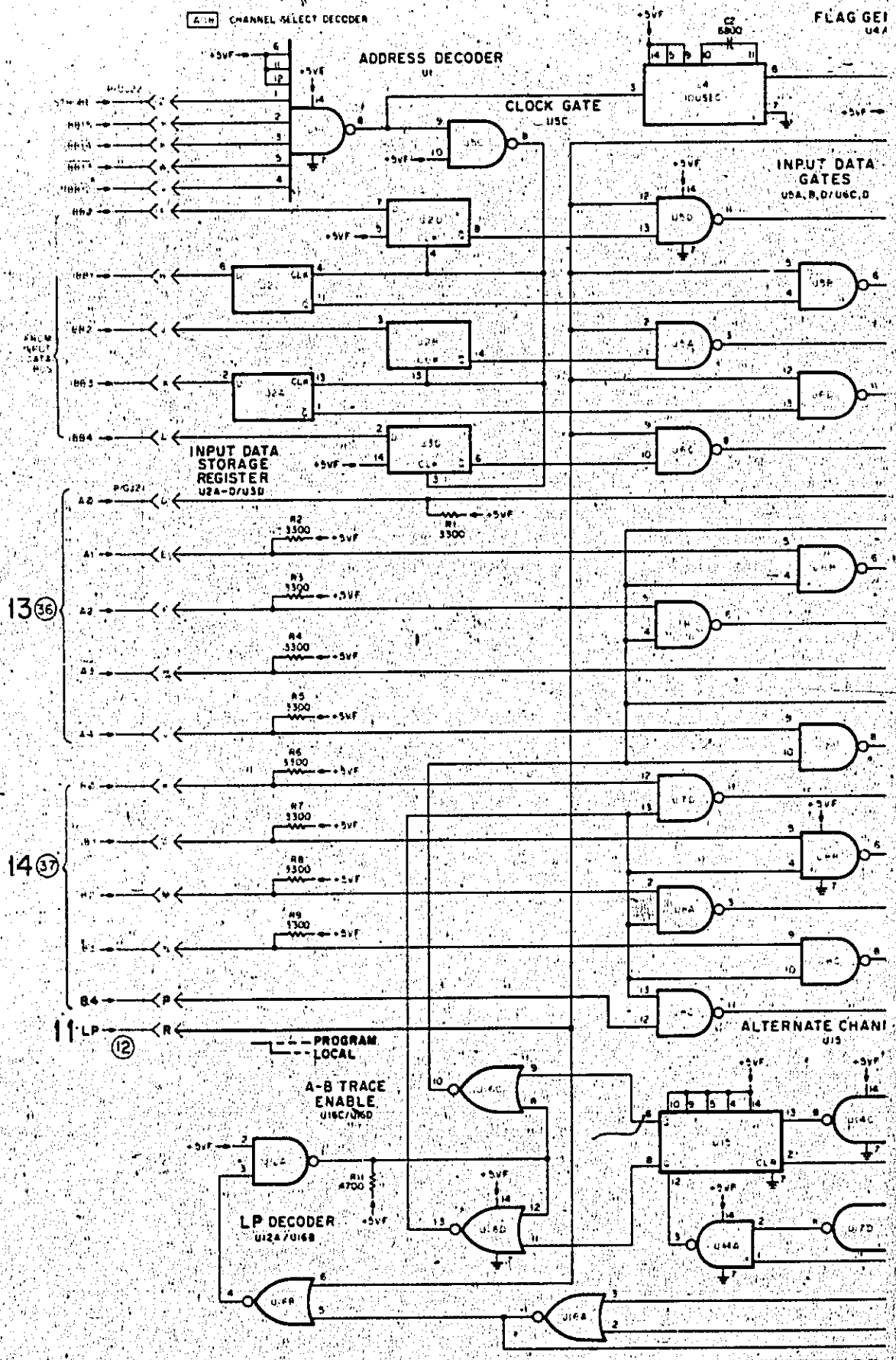
Figure 8-47.
Under fold

Table 8-9. Binary Coding for Assembly A08

Binary codes for Channel Select Assembly, A08, are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	0	0												
CHANNEL SELECT:																
CHANNEL 1												0	0	0	0	0
CHANNEL 2												0	0	0	0	1

Note: Channel selection must be programmed before programming any vertical control.


CHANNEL SELECT DECODER
ADDRESS DECODER
U1
CLOCK GATE
U5C
FLAG GEI
U4A
INPUT DATA
GATES
U5A,B,D/U6C,D
INPUT DATA
STORAGE
REGISTER
U2A-D/U3D
R1
3300
R2
3300
R3
3300
R4
3300
R5
3300
R6
3300
R7
3300
R8
3300
R9
3300
13 36
14 37
11 LP 12
PROGRAM
LOCAL
ALTERNATE CHANI
U15
A-B TRACE
ENABLE
U16C/U16D
R11
4700
LP DECODER
U12A/U16B

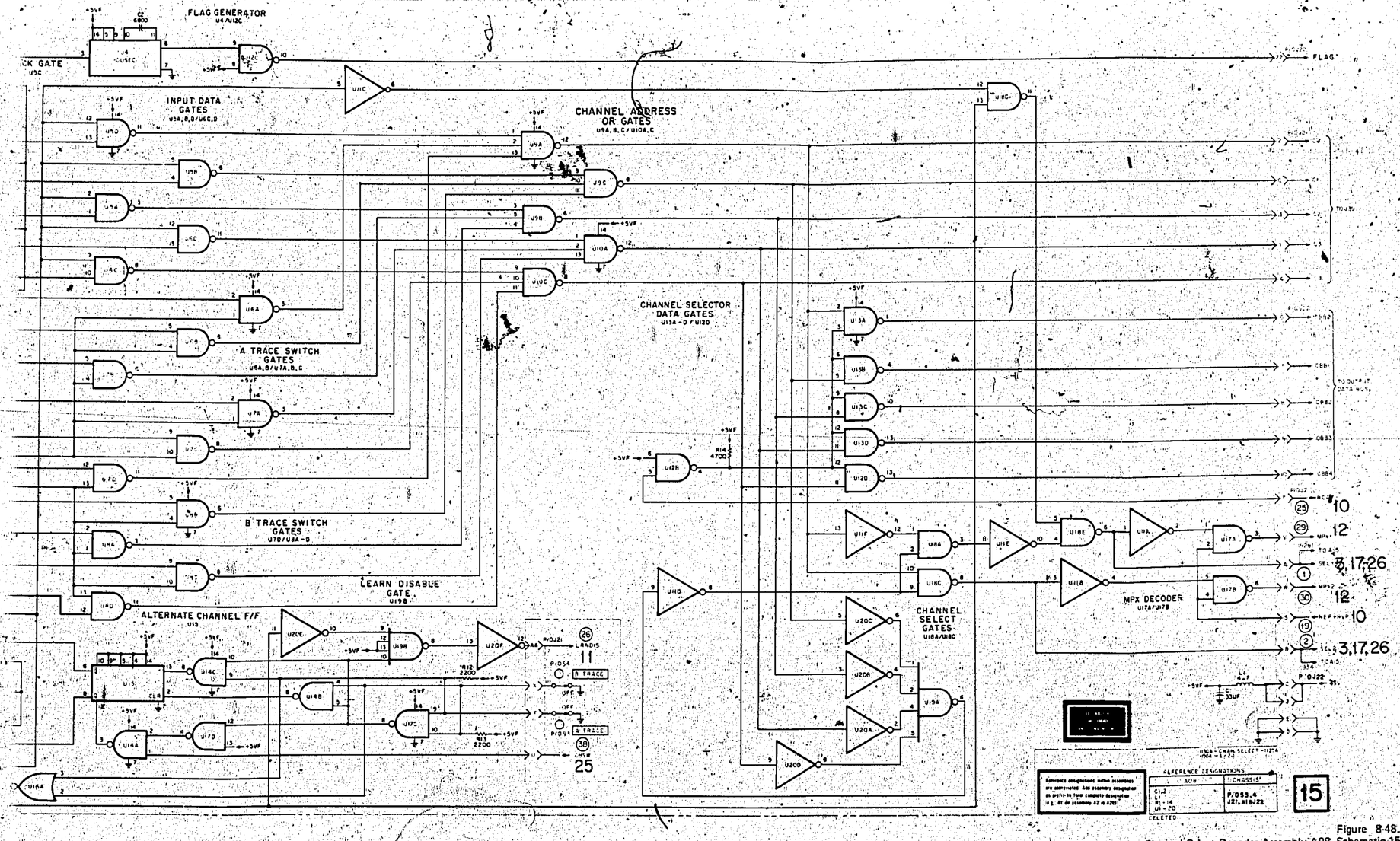
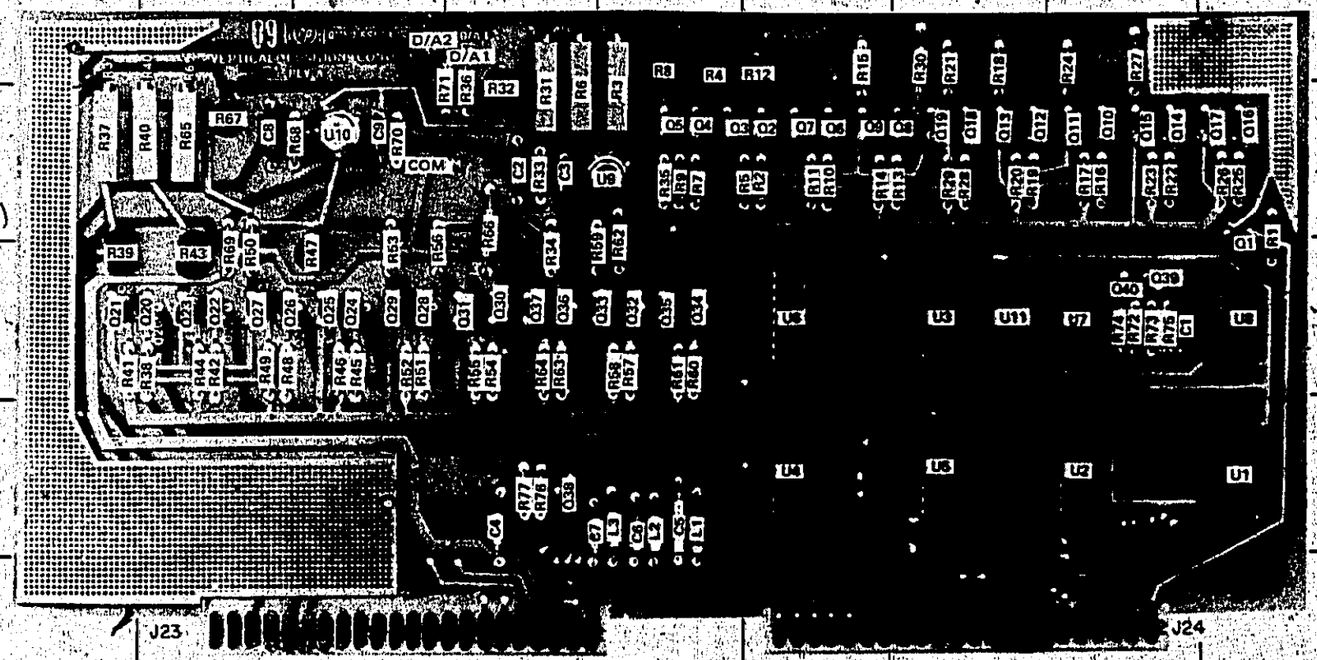


Figure 8-48.
Channel Select Decoder Assembly A08, Schematic 15



Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-3	Q3	G-2	Q17	K-2	Q31	F-3	R5	H-2	R19	I-2	R33	F-2	R47	E-3	R62	G-3	R77	F-4
C2	F-2	Q4	G-2	Q18	I-2	Q32	G-3	R6	F-2	R20	I-2	R34	F-3	R48	D-3	R63	F-3	TPD/A1	F-1
C3	F-2	Q5	G-2	Q19	I-2	Q33	G-3	R7	G-2	R21	I-1	R35	G-2	R49	D-3	R64	F-3	TPD/A2	E-1
C4	F-4	Q6	H-2	Q20	D-3	Q34	G-3	R8	G-1	R22	J-2	R36	F-1	R50	D-3	R65	D-2	TPCOM	E-2
C5	G-4	Q7	H-2	Q21	E-3	Q35	G-3	R9	G-2	R23	J-2	R37	C-2	R51	E-3	R66	F-2	U1	K-4
C6	G-4	Q8	I-2	Q22	D-3	Q36	F-3	R10	H-2	R24	J-1	R38	D-3	R52	E-3	R67	D-2	U2	J-4
C7	F-4	Q9	H-2	Q23	D-3	Q37	F-3	R11	H-2	R25	K-2	R39	C-3	R53	E-3	R68	E-2	U3	I-3
C8	D-2	Q10	J-2	Q24	E-3	Q38	F-4	R12	H-1	R26	K-2	R40	D-2	R54	F-3	R69	D-3	U4	H-4
C9	E-2	Q11	J-2	Q25	E-3	Q39	J-3	R13	I-2	R27	J-1	R41	C-3	R55	F-3	R70	E-2	U5	I-4
L1	G-4	Q12	I-2	Q26	D-3	Q40	J-3	R14	H-2	R28	I-2	R42	D-3	R56	E-3	R71	F-1	U6	H-3
L2	G-5	Q13	I-2	Q27	D-3	R1	K-2	R15	H-1	R29	I-2	R43	D-3	R57	G-3	R72	J-3	U7	J-3
L3	G-4	Q14	J-2	Q28	E-3	R2	H-2	R16	J-2	R30	I-1	R44	D-3	R58	G-3	R73	J-3	U8	K-3
Q1	K-3	Q15	J-2	Q29	E-3	R3	G-2	R17	J-2	R31	F-2	R45	E-3	R59	G-3	R74	J-3	U9	G-2
Q2	H-2	Q16	K-2	Q30	F-3	R4	G-1	R18	I-1	R32	F-2	R46	E-3	R60	G-3	R75	J-3	U10	E-2
														R61	G-3	R76	F-4	U11	I-3

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Figure 8-49. Component Identification, Assembly A09

Figure 8-49.
Under fold

Table 8-10. Binary Coding for Assembly A09

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	0	1												
VERTICAL POSITION								← See Note →								

Note: Code for 9-bit D/A converter that produces an analog voltage of 0 to +10V (+5V = center of CRT).

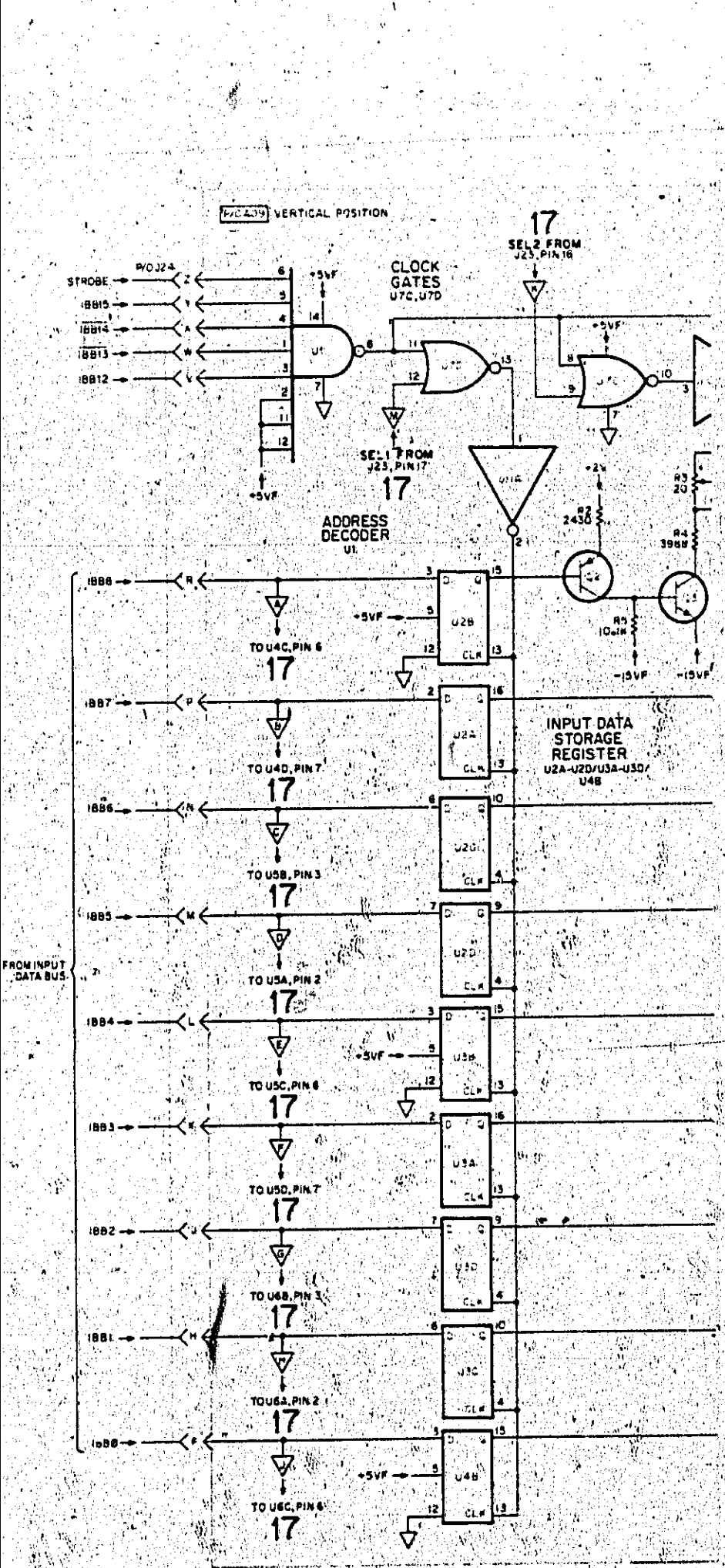
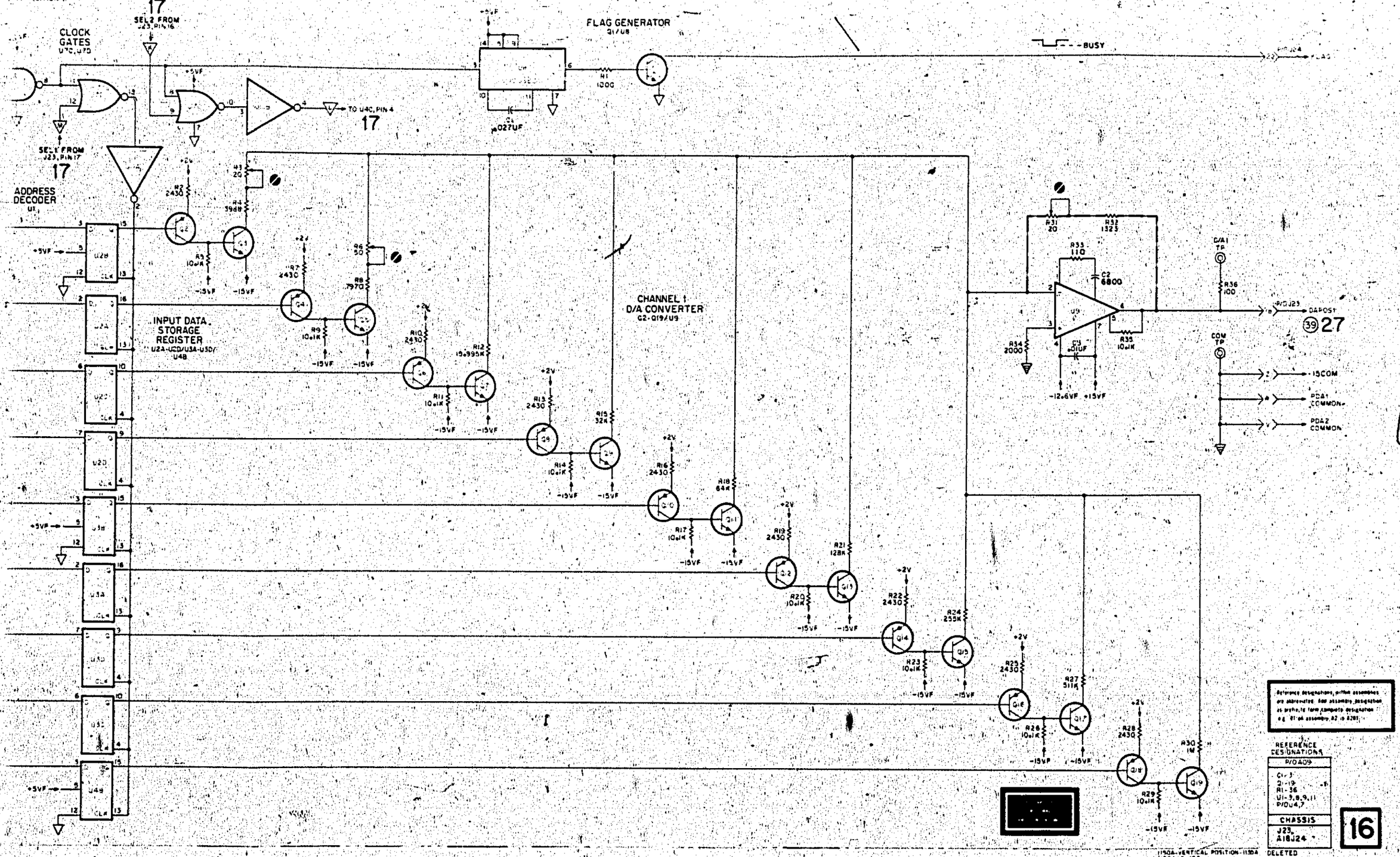
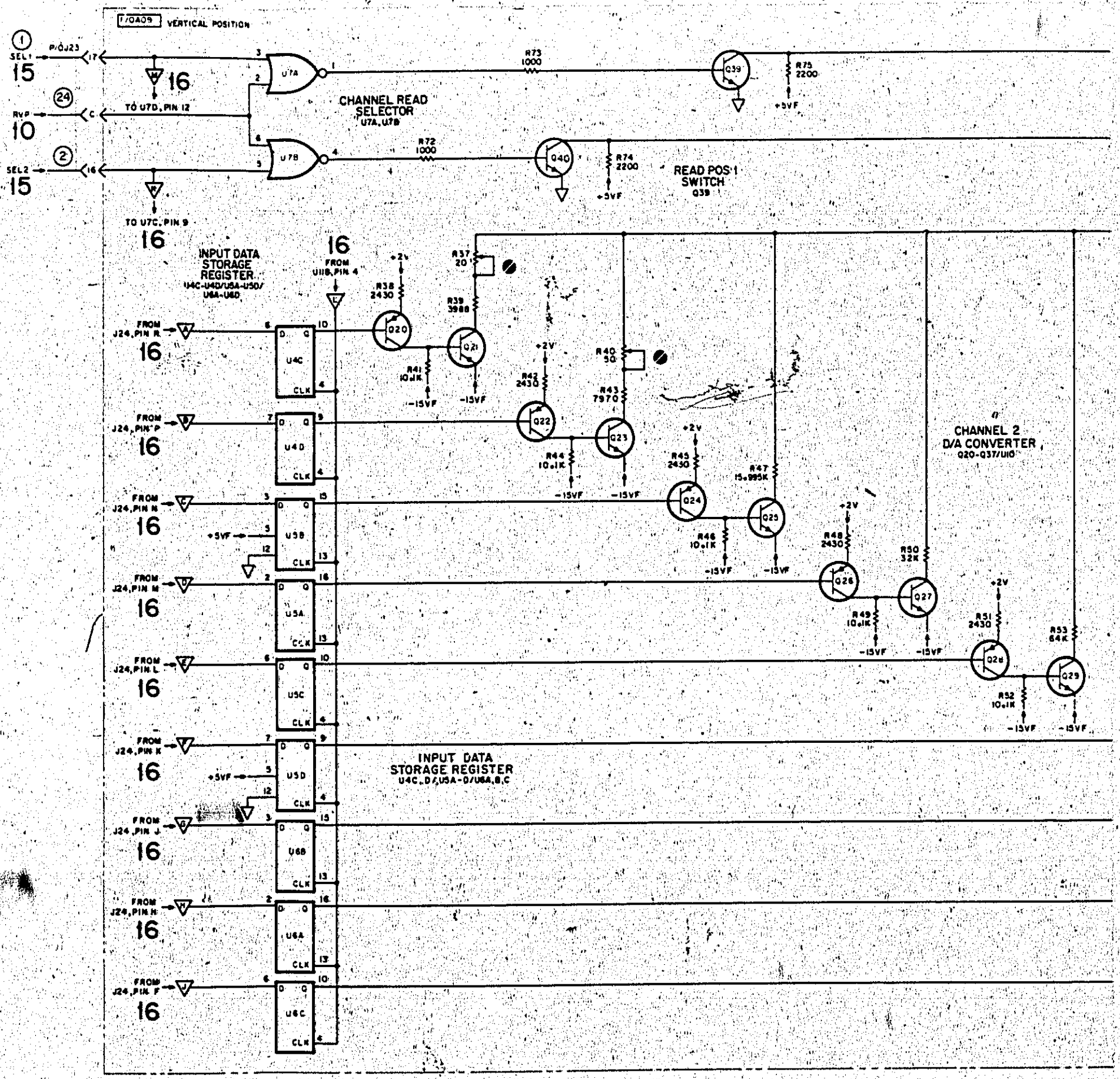


FIG. 4-39 VERTICAL POSITION
17
SEL 2 FROM J23, PIN 16
P/O J24
STROBE
IBB15
IBB14
IBB13
IBB12
+5VF
CLOCK GATES U7C, U7D
SEL 1 FROM J23, PIN 17
17
ADDRESS DECODER U1
+2V
R3 20
R2 2430
R4 398Ω
R5 10.2K
-15VF
IBB8
IBB7
IBB6
IBB5
IBB4
IBB3
IBB2
IBB1
IBB0
INPUT DATA STORAGE REGISTER U2A-U2D/U3A-U3D/U4B
TO U4C, PIN 6
TO U4D, PIN 7
TO U5B, PIN 3
TO U5A, PIN 2
TO U5C, PIN 6
TO U5D, PIN 7
TO U6B, PIN 3
TO U6A, PIN 2
TO U6C, PIN 6
FROM INPUT DATA BUS


CLOCK GATES
SEL2 FROM J23, PIN 16
17
SEL1 FROM J23, PIN 17
17
ADDRESS DECODER
FLAG GENERATOR
TO U4C, PIN 4
17
INPUT DATA STORAGE REGISTER
U2A-U2D/U3A-U3D/U4B
CHANNEL 1 D/A CONVERTER
G2-Q19/U9
BUSY
FLAG
D/A1 TP
COM TP
DAPOST
-15COM
PDA1 COMMON
PDA2 COMMON
27
REFERENCE DESIGNATIONS
P/O A09
CHASSIS
J23, A18J24
DELETED
16
Figure 8-50.
Vertical Position Assembly A09, Schematic 16
8-73/8-74


I/OA09 VERTICAL POSITION
SEL1 15
P/OJ23
RVP 10
SEL2 15
TO U7D, PIN 12
TO U7C, PIN 9
U7A
U7B
CHANNEL READ SELECTOR U7A, U7B
R73 1000
R72 1000
Q39
Q40
R75 2200
R74 2200
+5VF
READ POS 1 SWITCH Q39
INPUT DATA STORAGE REGISTER U4C-U4D/U5A-U5D/U6A-U6D
FROM U11B, PIN 4
FROM J24, PIN R
FROM J24, PIN P
FROM J24, PIN N
FROM J24, PIN M
FROM J24, PIN L
FROM J24, PIN K
FROM J24, PIN J
FROM J24, PIN H
FROM J24, PIN F
U4C
U4D
U5B
U5A
U5C
U5D
U6B
U6A
U6C
CLK
+2V
-15VF
R37 20
R38 2430
R39 3988
R40 50
R41 10.1K
R42 2430
R43 7970
R44 10.1K
R45 2430
R46 10.1K
R47 15.995K
R48 2430
R49 10.1K
R50 32K
R51 2430
R52 10.1K
R53 64K
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
CHANNEL 2 D/A CONVERTER Q20-Q37/U10
INPUT DATA STORAGE REGISTER U4C, D/U5A-D/U6A, B, C

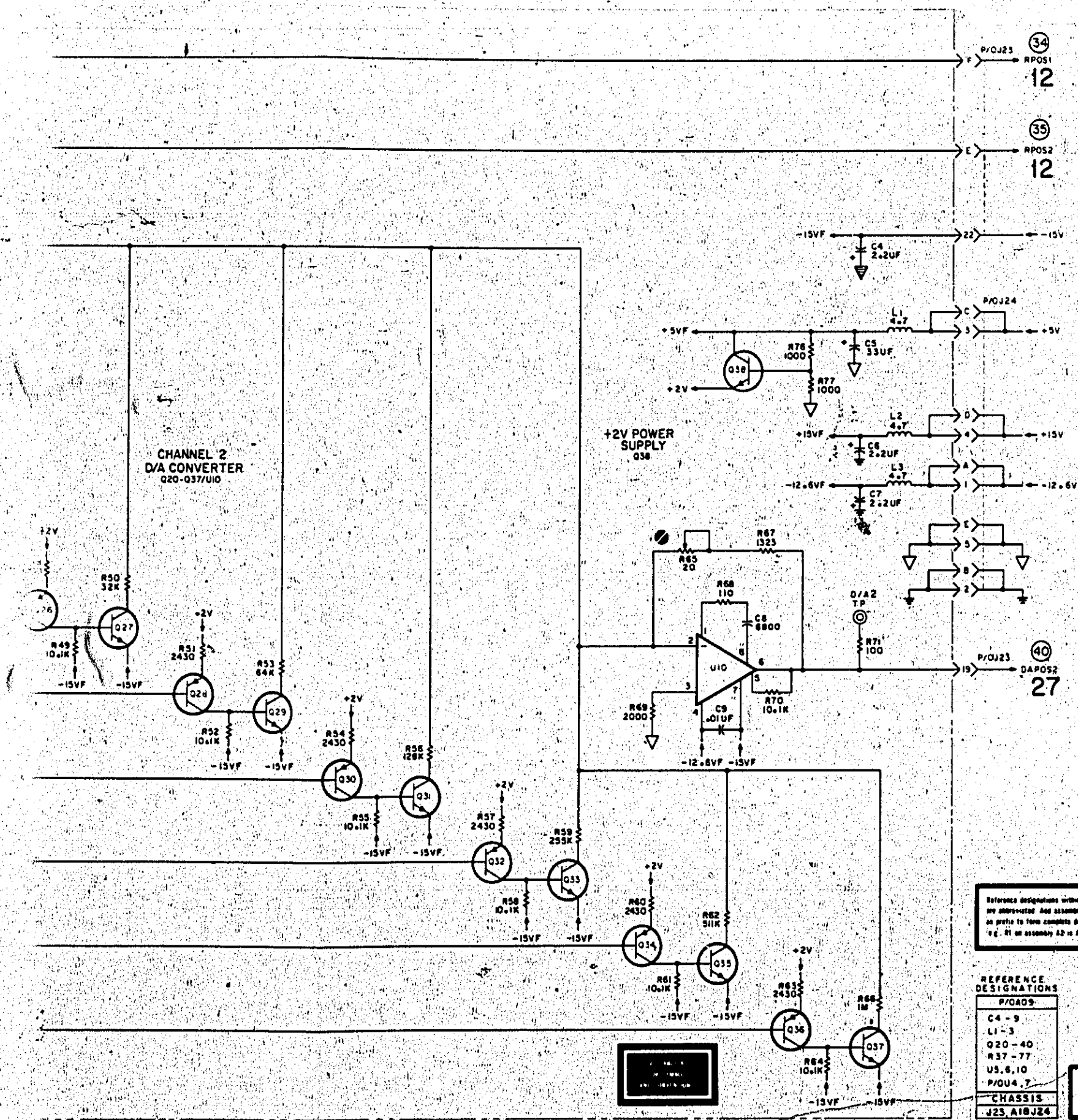
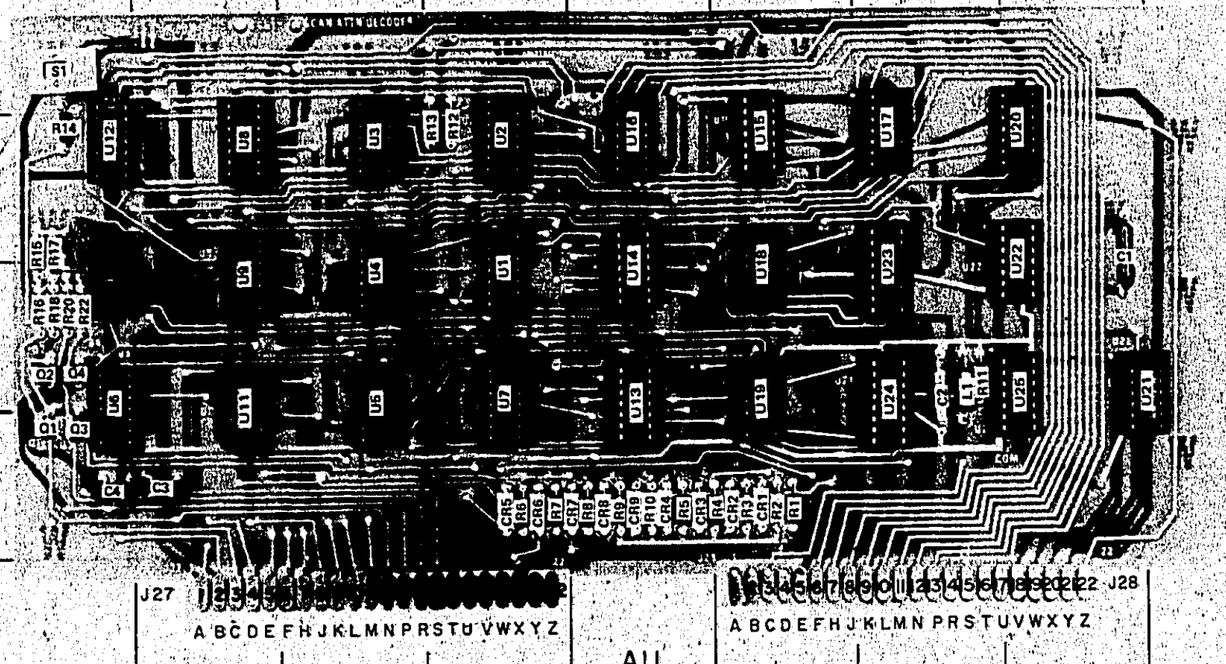


Figure 8-51.
Vertical Position Assembly A09, Schematic 17



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-3	CR8	G-4	R5	G-4	R16	C-3	U4	E-3	U15	H-2
C2	I-4	CR9	G-4	R6	F-4	R17	C-2	U5	E-4	U16	G-2
C3	D-4	L1	I-3	R7	F-4	R18	C-3	U6	C-4	U17	I-2
C4	C-4	Q1	C-4	R8	G-4	R19	C-2	U7	F-4	U18	H-3
CR1	H-4	Q2	C-3	R9	G-4	R20	C-3	U8	D-2	U19	H-4
CR2	H-4	Q3	C-4	R10	G-4	R21	C-2	U9	D-3	U20	J-2
CR3	G-4	Q4	C-3	R11	I-3	R22	C-3	U10	C-3	U21	J-4
CR4	G-4	R1	H-4	R12	F-2	S1	C-1	U11	D-4	U22	J-2
CR5	F-4	R2	H-4	R13	F-2	U1	F-3	U12	C-2	U23	I-3
CR6	F-4	R3	H-4	R14	C-2	U2	F-2	U13	G-4	U24	I-4
CR7	G-4	R4	H-4	R15	C-2	U3	E-2	U14	G-3	U25	J-4

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1150A—R—11

Figure 8-52. Component Identification, Assembly A11

Table 8-11. Binary Coding for Assembly A11

1. Binary codes for main sweep speed programming are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	1	1												
Main Sweep Indicator								0								
Main Sweep Speed:																
50 usec/div													0	0	0	0
[redacted] usec/div													0	0	0	1
0 usec/div													0	0	1	0
5 usec/div													0	1	0	0
2 usec/div													0	1	0	1
1 usec/div													0	1	1	0
0.5 usec/div													1	0	0	0
0.2 usec/div													1	0	0	1
0.1 usec/div													1	0	1	0
50 ns/div													1	1	0	0
20 ns/div													1	1	0	1
10 ns/div													1	1	1	0

Table 8-11. Binary Coding for Assembly A11 (Cont'd)

2. Binary codes for expanded sweep speed programming are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	0	1	1												
Expand Sweep Indicator								1								
Expand Sweep Speed:																
20 usec/div									0	0	0	1				
10 usec/div									0	0	1	0				
5 usec/div									0	1	0	0				
2 usec/div									0	1	0	1				
1 usec/div									0	1	1	0				
0.5 usec/div									1	0	0	0				
0.2 usec/div									1	0	0	1				
0.1 usec/div									1	0	1	0				
50 ns/div									1	1	0	0				
20 ns/div									1	1	0	1				
10 ns/div									1	1	1	0				
5 ns/div									0	0	0	0				
2 ns/div									0	0	0	1				
1 ns/div									0	0	1	0				
0.5 ns/div									0	1	0	0				
0.2 ns/div									0	1	1	0				

Note: 1. Expanded sweep speed must be faster than main sweep speed.

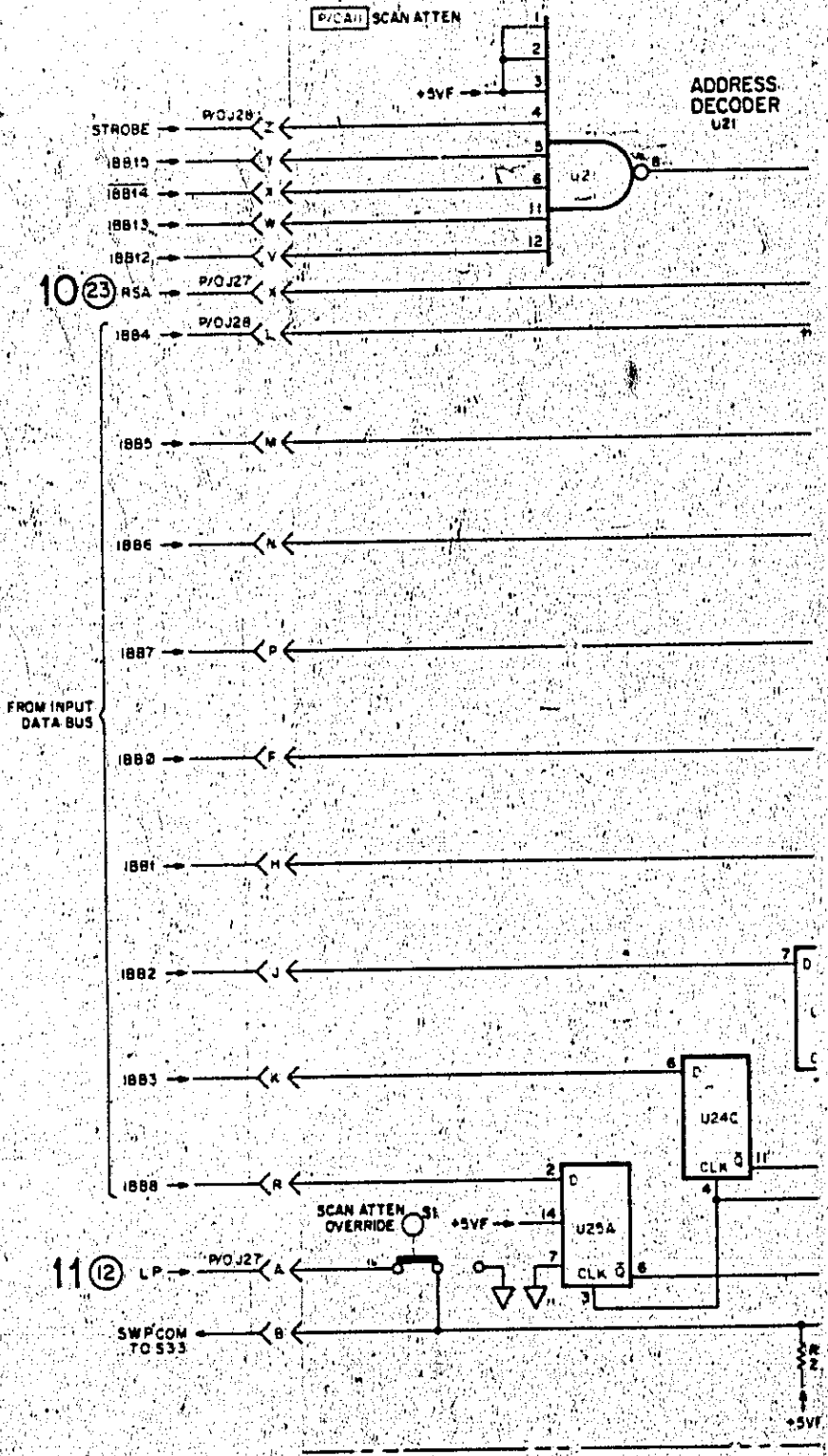
2. Expanded sweep selection procedure:

(a). Select desired main sweep speed (bits 0-3).

(b). Select expand position on Expand Position Assembly, A06.

(c). Select desired expand sweep speed (bits 4-7).

(The ratio of main/expand sweep ≤ 100.)


P/CA11 SCAN ATTEN
+5VF
ADDRESS DECODER U21
STROBE
P/OJ28
18815
18814
18813
18812
U2
10 (23) RSA
P/OJ27
1884
P/OJ28
1885
1886
1887
FROM INPUT DATA BUS
1880
1881
1882
1883
1888
U24C
U25A
SCAN ATTEN OVERRIDE
S1
11 (12) LP
P/OJ27
SWP COM TO S33
+5VF

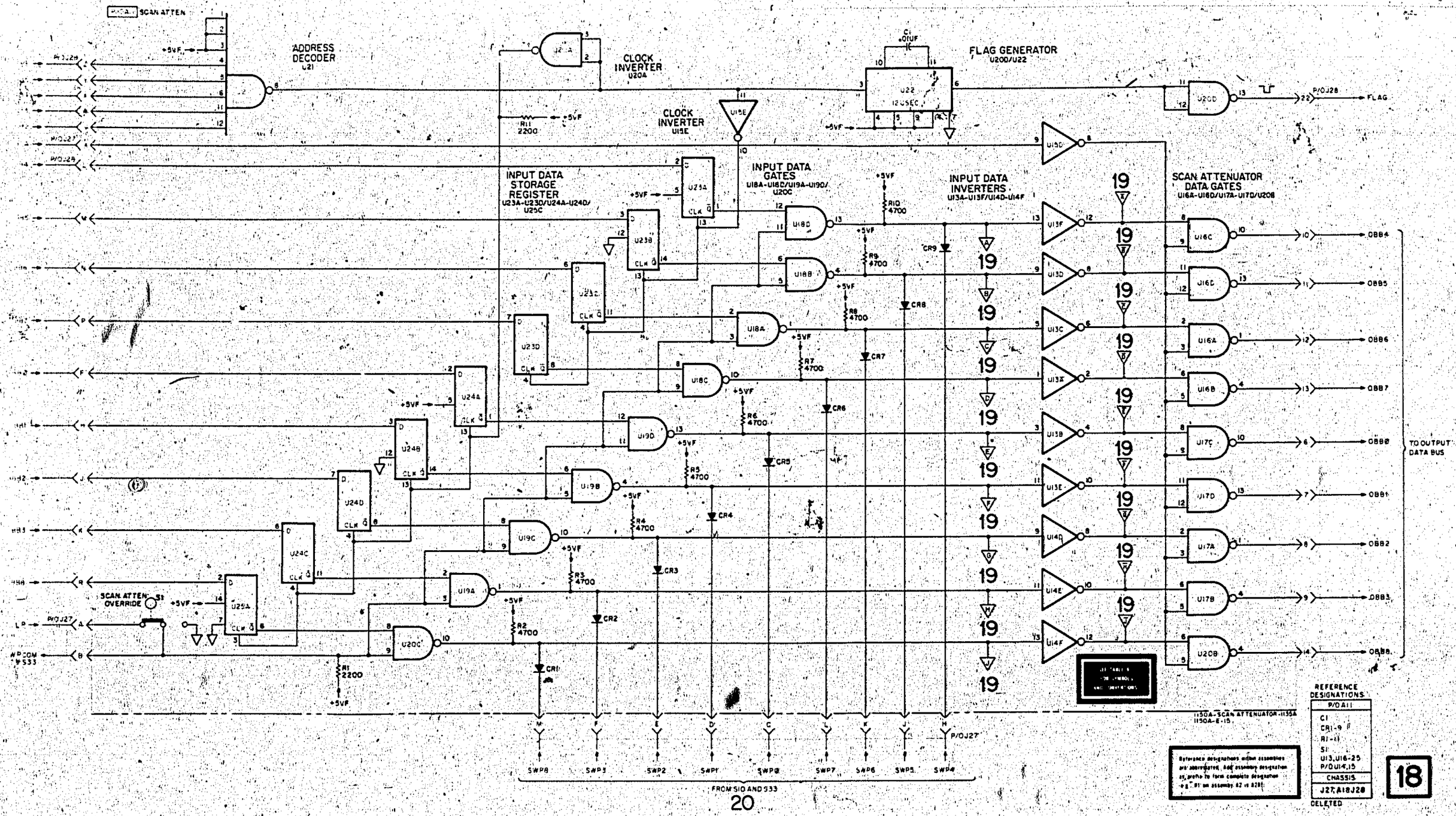
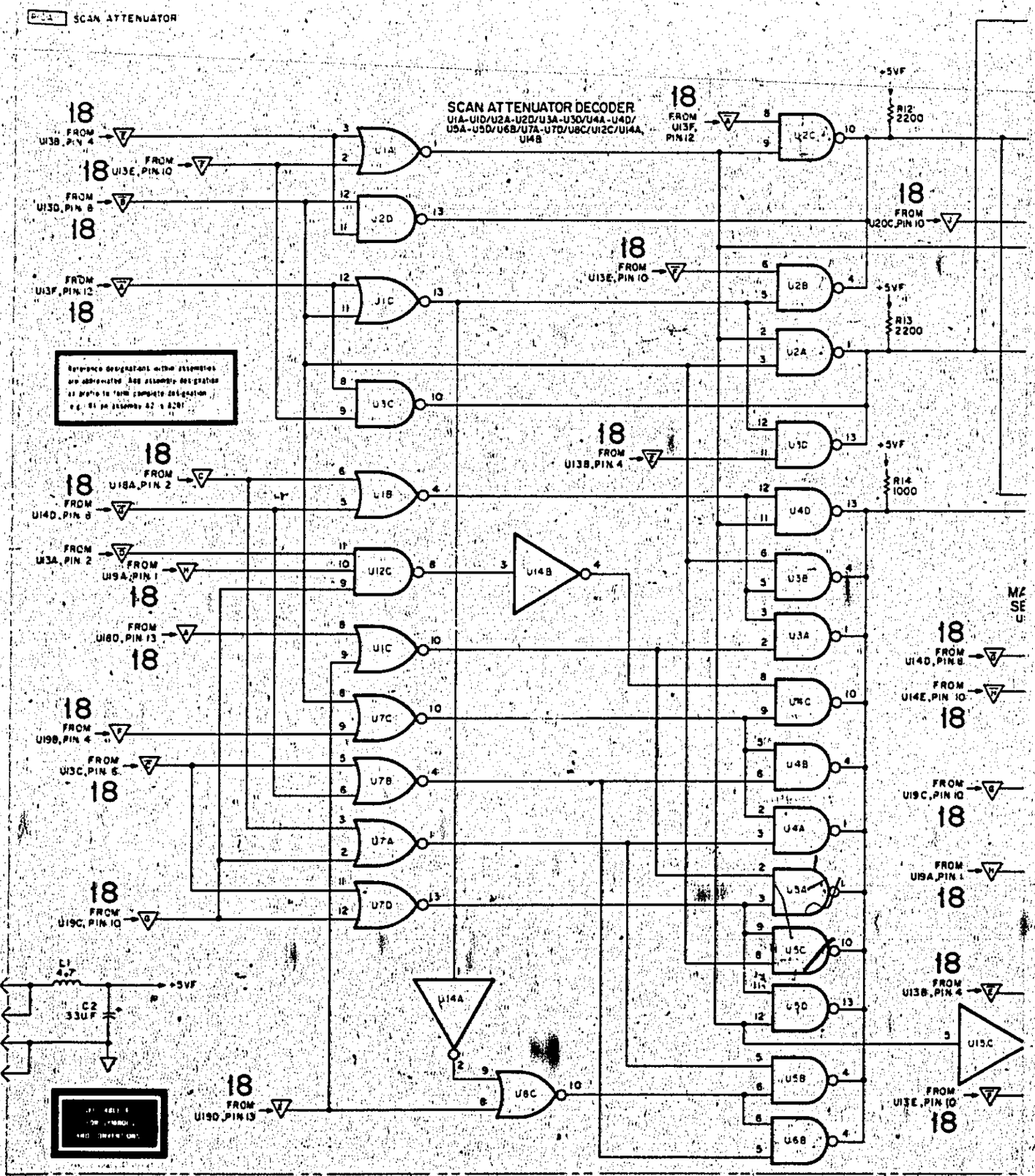
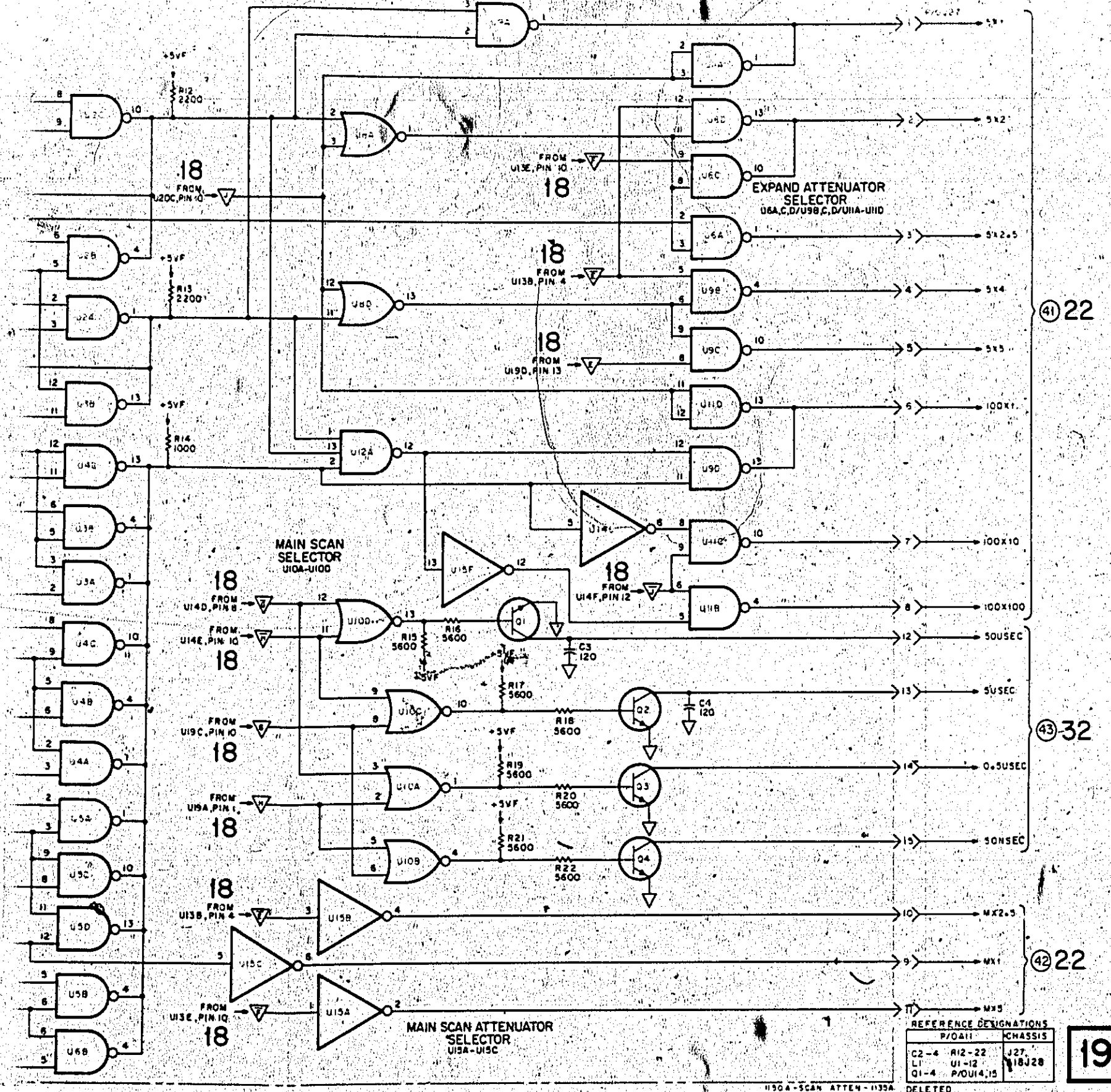


Figure 8-53.
Scan Attenuator Decoder Assembly A11, Schematic 18
8-77/8-78


SCAN ATTENUATOR
SCAN ATTENUATOR DECODER
U1A-U1D/U2A-U2D/U3A-U3D/U4A-U4D/
U5A-U5D/U6B/U7A-U7D/U8C/U12C/U14A,
U14B
+5VF
R12
2200
R13
2200
R14
1000
C1
.47
C2
33UF
P/O J28
+5V
DATACOM
Reference designations within assemblies
are abbreviated. See assembly designation
at prefix to form complete designation
(e.g. A1 on assembly A2 = A2A1).



REFERENCE DESIGNATIONS

P/O A11		CHASSIS
C2-4	R12-22	J27, J8, J28
L1	U1-12	
Q1-4	P/O U14, 15	

DELETED

19

Figure 8-54.
Scan Attenuator Decoder Assembly A11, Schematic 19
8-79/8-80

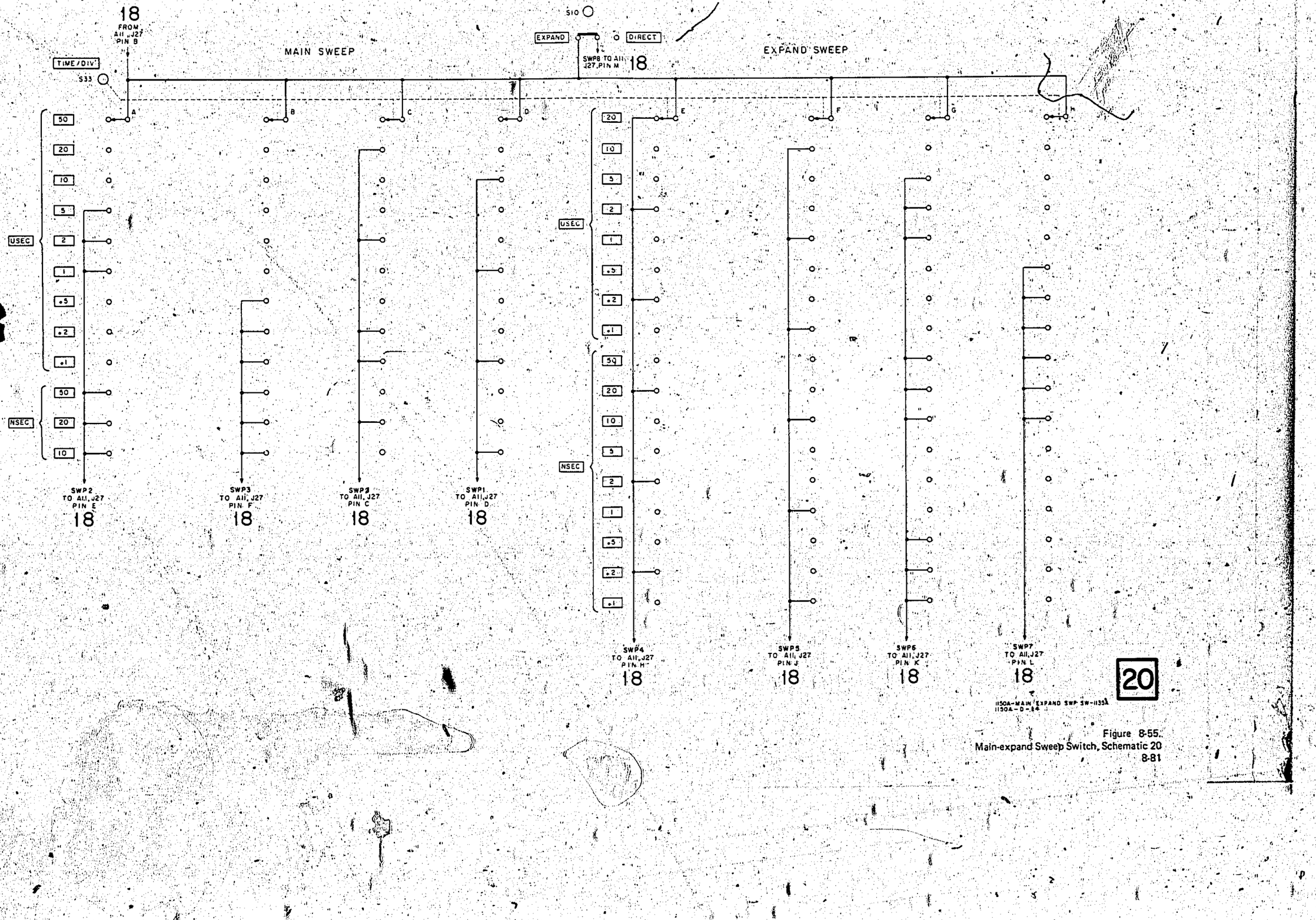
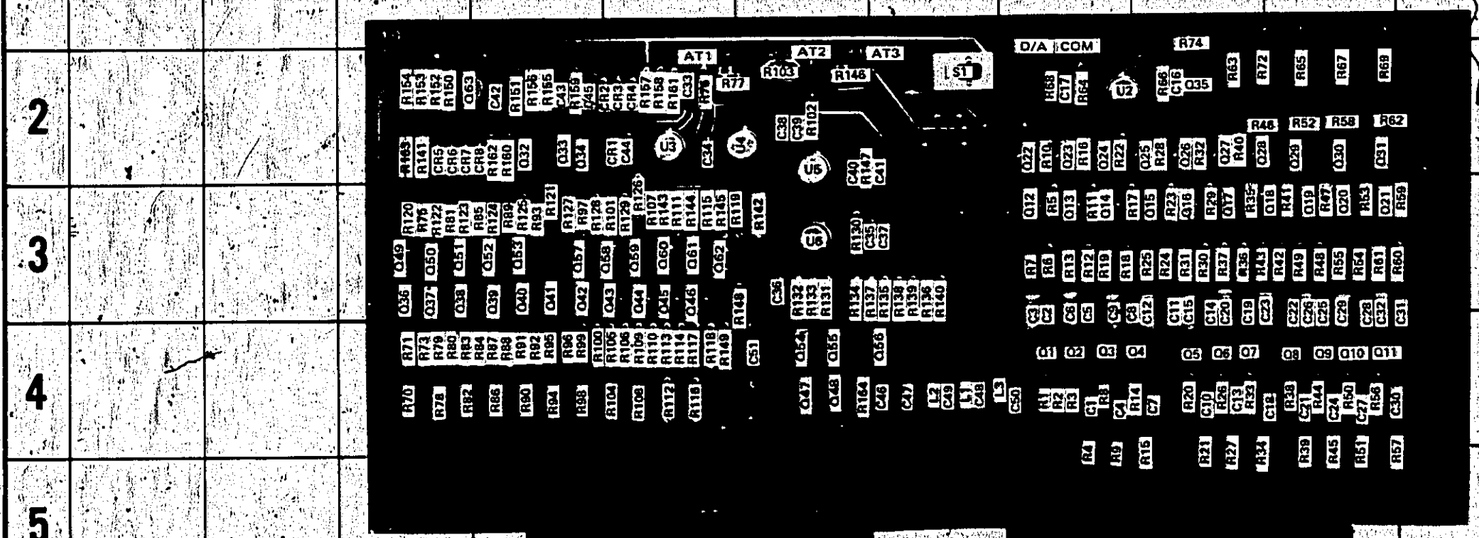


Figure 8-55.
Main-expand Sweep Switch, Schematic 20

Figure 8-52. Component Identification, Assembly A11



Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	H-4	C21	J-4	C41	G-2	L2	G-4	Q19	J-3	Q39	D-3	Q59	E-3	R16	H-2	R36	I-3	R56	J-4	R76	E-2	R96	D-4	R116	E-4	R136	G-3	R156	D-2
C2	H-3	C22	J-3	C42	D-2	L3	G-4	Q20	J-3	Q40	D-3	Q60	E-3	R17	H-3	R37	I-3	R57	J-5	R77	E-2	R97	D-3	R117	E-4	R137	F-3	R157	E-2
C3	H-3	C23	I-3	C43	D-2	Q1	H-4	Q21	J-3	Q41	D-3	Q61	E-3	R18	H-3	R38	J-4	R58	J-2	R78	C-4	R98	D-4	R118	E-4	R138	G-3	R158	E-2
C4	H-4	C24	J-4	C44	E-2	Q2	H-4	Q22	H-2	Q42	D-3	Q62	E-3	R19	H-3	R39	J-5	R59	J-3	R79	C-4	R99	D-4	R119	E-3	R139	G-3	R159	D-2
C5	H-3	C25	J-3	C45	D-2	Q3	H-4	Q23	H-2	Q43	E-3	Q63	C-2	R20	I-4	R40	I-2	R60	J-3	R80	C-4	R100	D-4	R120	C-3	R140	G-3	R160	D-2
C6	H-3	C26	J-3	C46	G-4	Q4	H-4	Q24	H-2	Q44	E-3	R1	H-4	R21	I-5	R41	J-3	R61	J-3	R81	C-3	R101	E-3	R121	D-3	R141	C-2	R161	E-2
C7	I-4	C27	J-4	C47	G-4	Q5	I-4	Q25	I-2	Q45	E-3	R2	H-4	R22	H-2	R42	J-3	R62	J-2	R82	C-4	R102	F-2	R122	C-3	R142	F-3	R162	D-2
C8	H-3	C28	J-3	C48	G-4	Q6	I-4	Q26	I-2	Q46	E-3	R3	H-4	R23	I-3	R43	I-3	R63	I-2	R83	C-4	R103	F-2	R123	C-3	R143	E-3	R163	C-2
C9	H-3	C29	J-3	C49	G-4	Q7	I-4	Q27	I-2	Q47	F-4	R4	H-5	R24	I-3	R44	J-4	R64	H-2	R84	D-4	R104	E-4	R124	D-3	R144	E-3	R164	F-4
C10	I-4	C30	J-4	C50	H-4	Q8	J-4	Q28	I-2	Q48	F-4	R5	H-3	R25	I-3	R45	J-5	R65	J-2	R85	D-3	R105	E-4	R125	D-3	R145	E-3	S1	G-2
C11	I-3	C31	K-4	C51	F-4	Q9	J-4	Q29	J-2	Q49	C-3	R6	H-3	R26	I-4	R46	I-2	R66	J-2	R86	D-4	R106	E-4	R126	E-3	R146	F-2	TPAT1	E-2
C12	I-3	C32	J-3	CR1	E-2	Q10	J-4	Q30	J-3	Q50	C-3	R7	H-3	R27	I-5	R47	J-3	R67	J-2	R87	D-4	R107	E-3	R127	D-3	R147	F-2	TPAT2	F-2
C13	I-4	C33	E-2	CR2	E-2	Q11	J-4	Q31	J-2	Q51	C-3	R8	H-4	R28	I-2	R48	J-3	R68	H-2	R88	D-4	R108	E-4	R128	D-3	R148	F-3	TPAT3	G-2
C14	I-3	C34	E-2	CR3	E-2	Q12	H-3	Q32	D-2	Q52	D-3	R9	H-5	R29	I-3	R49	J-3	R69	J-2	R89	D-3	R109	E-4	R129	E-3	R149	E-4	TPD/A	H-2
C15	I-3	C35	F-3	CR4	E-2	Q13	H-3	Q33	D-2	Q53	D-3	R10	H-3	R30	I-3	R50	J-4	R70	C-4	R90	D-4	R110	E-4	R130	F-3	R150	C-2	TPCOM	H-2
C16	I-2	C36	F-3	CR5	C-2	Q14	H-3	Q34	D-2	Q54	F-4	R11	H-3	R31	I-3	R51	J-5	R71	C-4	R91	D-4	R111	E-3	R131	F-3	R151	C-2	U2	H-2
C17	H-2	C37	G-3	CR6	C-2	Q15	I-3	Q35	I-2	Q55	F-4	R12	H-3	R32	I-2	R52	J-2	R72	I-2	R92	D-4	R112	E-4	R132	F-3	R152	C-2	U3	E-2
C18	J-4	C38	F-2	CR7	C-2	Q16	I-3	Q36	C-3	Q56	G-4	R13	H-3	R33	I-4	R53	J-3	R73	C-4	R93	D-3	R113	E-4	R133	F-3	R153	C-2	U4	F-2
C19	I-3	C39	F-2	CR8	D-2	Q17	I-3	Q37	C-3	Q57	D-3	R14	H-4	R34	I-5	R54	J-3	R74	I-2	R94	D-4	R114	E-4	R134	F-3	R154	C-2	U5	F-2
C20	I-3	C40	F-2	L1	G-4	Q18	J-3	Q38	C-3	Q58	E-3	R15	I-5	R35	I-3	R55	J-3	R75	C-3	R95	D-4	R115	E-3	R135	G-3	R155	D-2	U6	F-3

1180A—K—26

Figure 8-56. Component Identification, Assembly A12

Figure 8-56.
Under fold

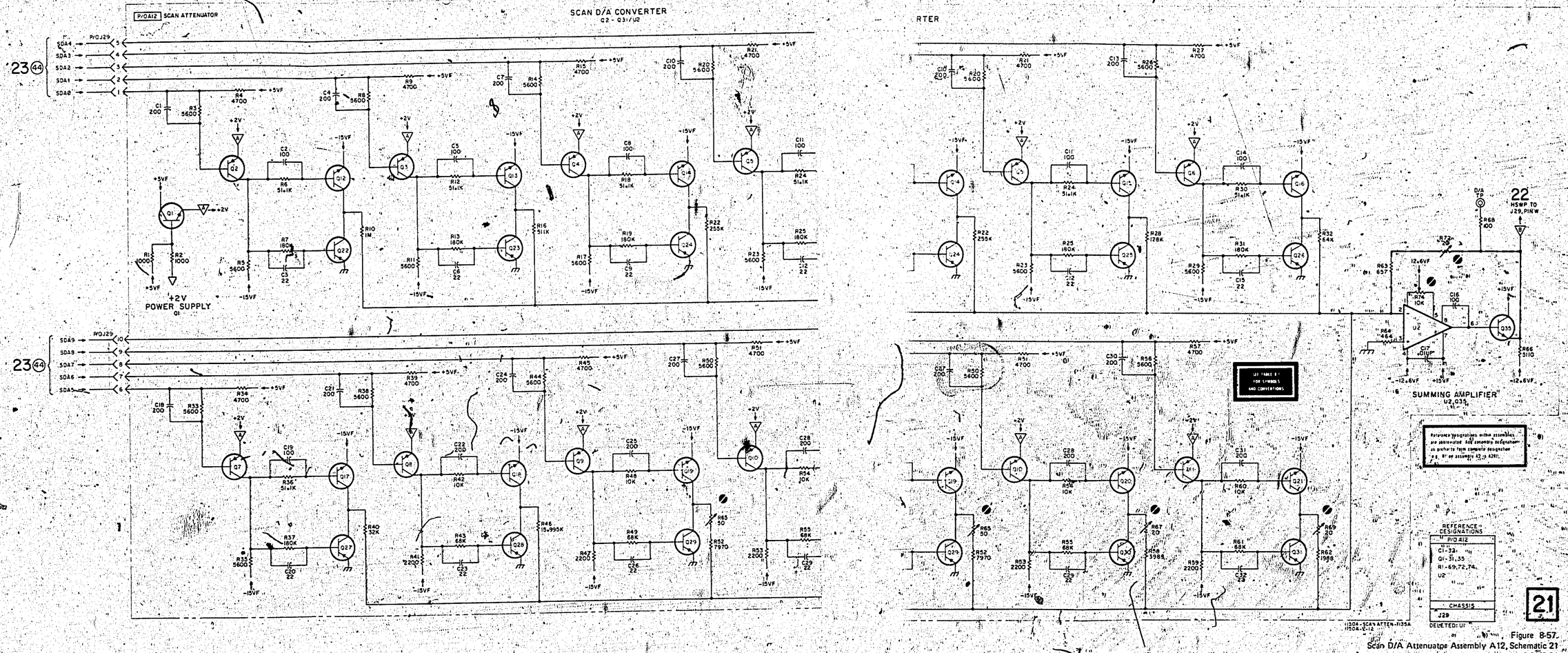


Figure 8-57.
Scan D/A Attenuator Assembly A12, Schematic 21
8-83/8-84

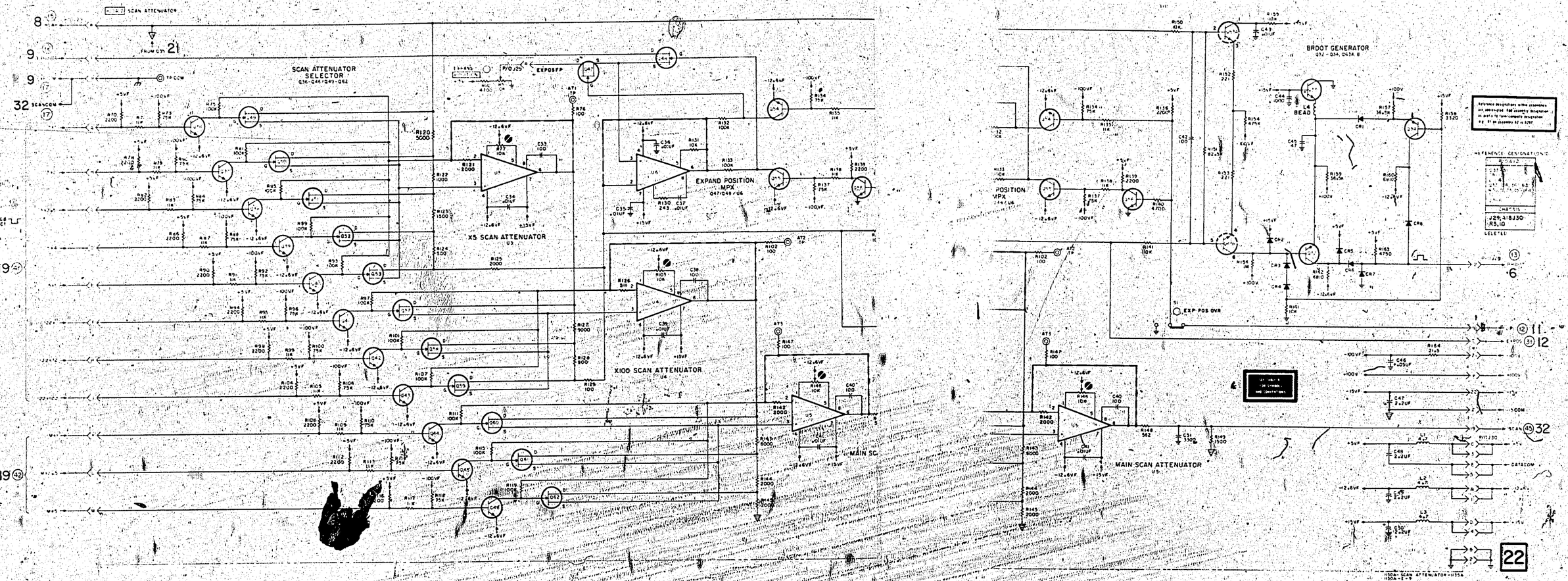


Figure 8-58.
Scan D/A Attenuator Assembly A12, Schematic 22

P/OA12 SCAN ATTENUATOR

8 (15) P/OJ29 HSWP — W

FROM Q35 21

9 (16) EXPOSDA — S

9 (17) EXPROM — 10

32 SCANCOM (17) — 5X1 — A

TP COM

SCAN ATTENUATOR SELECTOR
Q36-Q46/Q49-Q62

5X2 — B

5X2.5 — C

LOGIC0
LOGIC1

5X4 — D

19 (41)

5X5 — E

10X1 — F

10X2.5 — G

10X4 — H

10X10 — J

10X10 — K

MX1 — L

MX2.5 — M

19 (42)

MX5 — N

EXPAND POSITION +15V — R10 4700 — R5 10K — P/OJ29 EXPOSFF

AT1 TP — R76 100

X5 SCAN ATTENUATOR
U3

X100 SCAN ATTENUATOR
U4

EXPAND POSITION MPX
Q47/Q48/U6

AT2 TP — R102 100

AT3 TP — R147 100

MAIN SC

R120 5000 — R121 2000 — R122 1000 — R123 1500 — R124 500 — R125 2000 — R126 811 — R127 9000 — R128 900 — R129 100

R132 100K — R133 100K — R134 75K — R135 11K — R136 11K — R137 75K — R138 11K — R139 2200 — R130 243

R140 2000 — R141 2000 — R142 2000 — R143 8000 — R144 2000 — R145 2000

C33 100 — C34 .01UF — C35 .01UF — C36 .01UF — C37 .01UF — C38 100 — C39 .01UF — C40 100 — C41 .01UF

R103 10K — R146 10K — R147 100

-12.6VF — +15VF — -100VF — +5VF

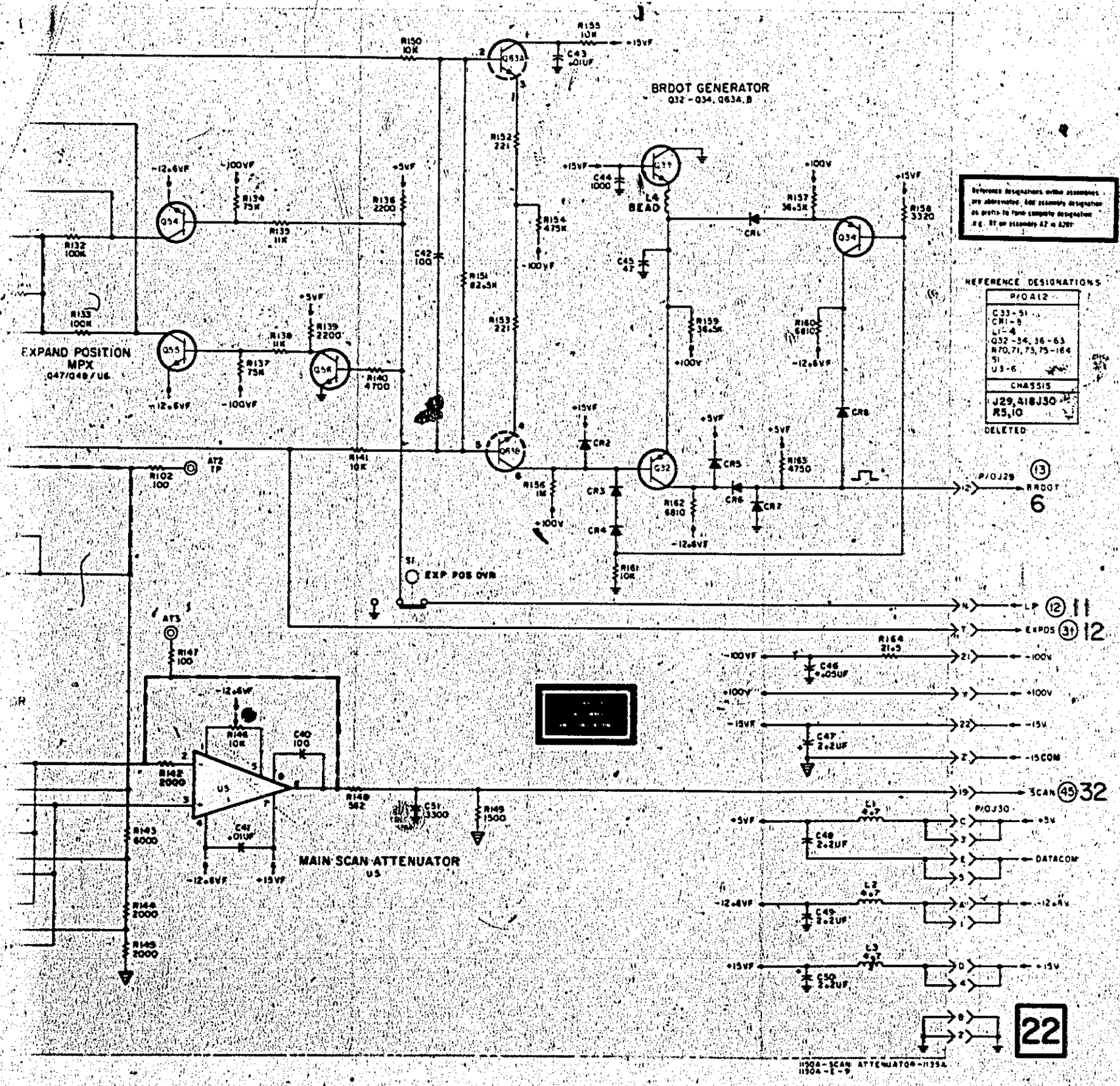
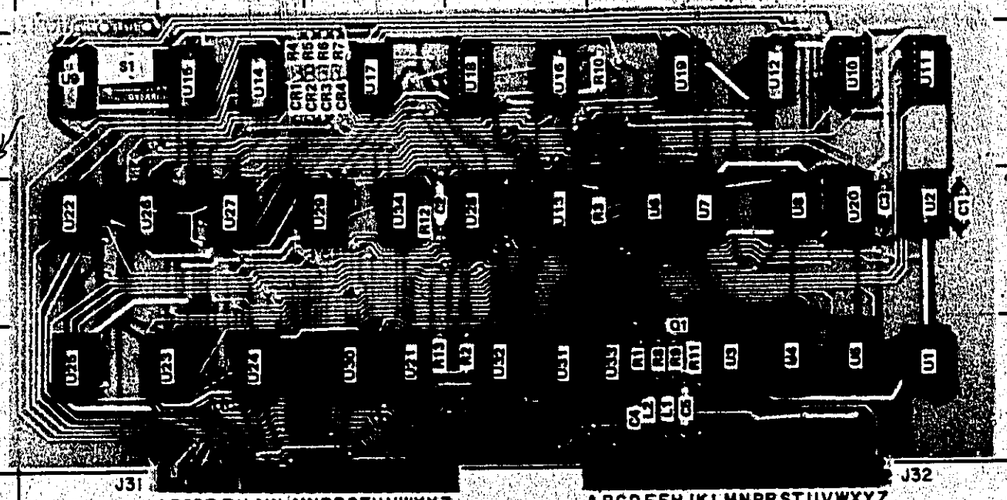

BRDOT GENERATOR
Q32 - Q34, Q63A, B
EXPAND POSITION MPX
Q47/Q48/U6
MAIN SCAN ATTENUATOR
U5
EXP POS OVR
L4 BEAD
P/O A12
C33-51
CR1-8
L1-4
Q32-34, 36-63
R70, 71, 73, 75-164
S1
U3-6
CHASSIS
J29, A18J30
R5, 10
DELETED
BRDOT
EXPOS
LP
SCAN
DATACOM
+5V
-12.6V
-100V
+15V
-15V
-15COM
+100V
-100V
6
11
12
32
22

Figure 8-58.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-3	L2	H-4	R9	H-4	U5	I-4	U15	E-2	U25	D-4
C2	F-3	Q1	H-4	R10	H-2	U6	H-3	U16	G-2	U26	D-3
C3	J-3	R1	H-4	R11	H-4	U7	H-3	U17	F-2	U27	E-3
C4	H-4	R2	G-4	R12	F-3	U8	I-3	U18	G-2	U28	G-3
C5	H-4	R3	H-3	R13	F-4	U9	D-3	U19	H-2	U29	F-3
CB1	E-2	R4	E-2	S1	D-2	U10	I-2	U20	I-3	U30	F-4
CR2	F-2	R5	E-2	U1	J-4	U11	J-2	U21	F-4	U31	G-4
CR3	F-2	R6	F-2	U2	J-2	U12	I-2	U22	D-3	U32	G-4
CR4	F-2	R7	F-2	U3	H-4	U13	G-3	U23	E-4	U33	H-4
L1	H-4	R8	H-4	U4	I-4	U14	E-2	U24	E-4	U34	F-3

Circuit boards have plated through component holes. This permits soldering from either side of the board.

11804-R-13

Figure 8-59. Component Identification, Assembly A13

Table 8-12. Binary Coding for Assembly A13

1. Horizontal scanning is furnished by an internal digital scan generator or from an external source such as a computer.
2. Binary codes for internal scanning function are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SCAN Function Identifier					0											
Internal Scan Identifier						0										
SAMPLES/DOT: (See Note)																
1													0	0		
2													0	1		
4													1	0		
DOTS/SCAN:																
1024															0	0
512															0	1
256															1	0
128															1	1

Note: In the case of multiple samples per dot, only the last sample is converted by the A/D converter.

Table 8-12. Binary Coding for Assembly A13 (Cont'd)

3. Binary codes for the external scanning function are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SCAN Function Identifier					0											
External Scan Identifier						1										
EXTERNAL SCAN							← See Note →									

Note: 10-bit word that is applied to a D/A converter. Analog output of 0 to +10V represents 0 to 10 horizontal divisions on the CRT.

4. Binary codes for freerun on external sampler control are as follows:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	0	1												
SAMPLE Function Identifier					1											
FREERUN																0
EXTERNAL SAMPLER CONTROL																1

Note: In FREERUN, scanner freeruns; in EXTERNAL SAMPLER CONTROL, scanner waits for READ SAMPLE command (table 3-4) to increment scanner one dot position. Both commands apply to the PROGRAM mode only. In LOCAL mode, the scanner always freeruns.

P/O A13 DIGITAL SCANNER & BLANKING CIRCUIT

Service

1B86 ---FREERUN
---EXT

P/O J32

FROM INPUT DATA BUS

1B80 F
1B81 H
1B82 J
1B83 K
1B84 L
1B85 M
1B86 N
1B87 P
1B88 R
1B89 S
1B810 T
1B811 U

U3D U21A U3C U3A U3B U4D U4C U4A U4B U5D U5C U5A

+5VF

TO U27C, PIN 10 25

TO U6D, PINS 11 & 12 24

TO U14C, PIN 9 25

INPUT DATA STORAGE REGISTER
U3A-U3D/U4A-U4D/U5A,C,D/U21A

25 TO U14D, PIN 11

25 TO U14A, PIN 2

25 TO U14B, PIN 6

25 TO U30C, PINS 8 & 9

R5 1000 +5VF

CLOCK DRIVERS U33A/U33F

U33A U33F

SCAN D/A GATING
U22A-U22D/U23A-U23D/U24A,B

U22A U22B U22C U22D U23A U23B U23C U23D U24A U24B

FROM U25A, PIN 1 24
FROM U25B, PIN 4 24
FROM U25C, PIN 10 24
FROM U25D, PIN 13 24
FROM U26A, PIN 1 24
FROM U26B, PIN 4 24
FROM U26C, PIN 10 24
FROM U26D, PIN 13 24
FROM U24D, PIN 13 24
FROM U24B, PIN 5 24
FROM U24C, PIN 10 24

P/O J31

A SDA0
B SDA1
C SDA2
D SDA3
E SDA4
F SDA5
H SDA6
J SDA7
K SDA8
L SDA9

(44) 21

U32A

U17B U17C

25 FROM S1

TO U29A, PIN 3 25

TO U27C, PIN 9, U25B, PIN 3 24,25

U13D U28D U30A

R2 2200 +5VF

FREERUN CLOCK GATE U13D

1B811 ---SCAN
---SAMPLER

P/O J32

STROBE Z
1B815 Y
1B814 X
1B813 W
1B812 V

ADDRESS DECODER U1

U1

FLAG GENERATOR U2/U30D

U2 5USEC

U30D

FLAG TO J32, PIN 22 25

C1 3900

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

REFERENCE DESIGNATIONS

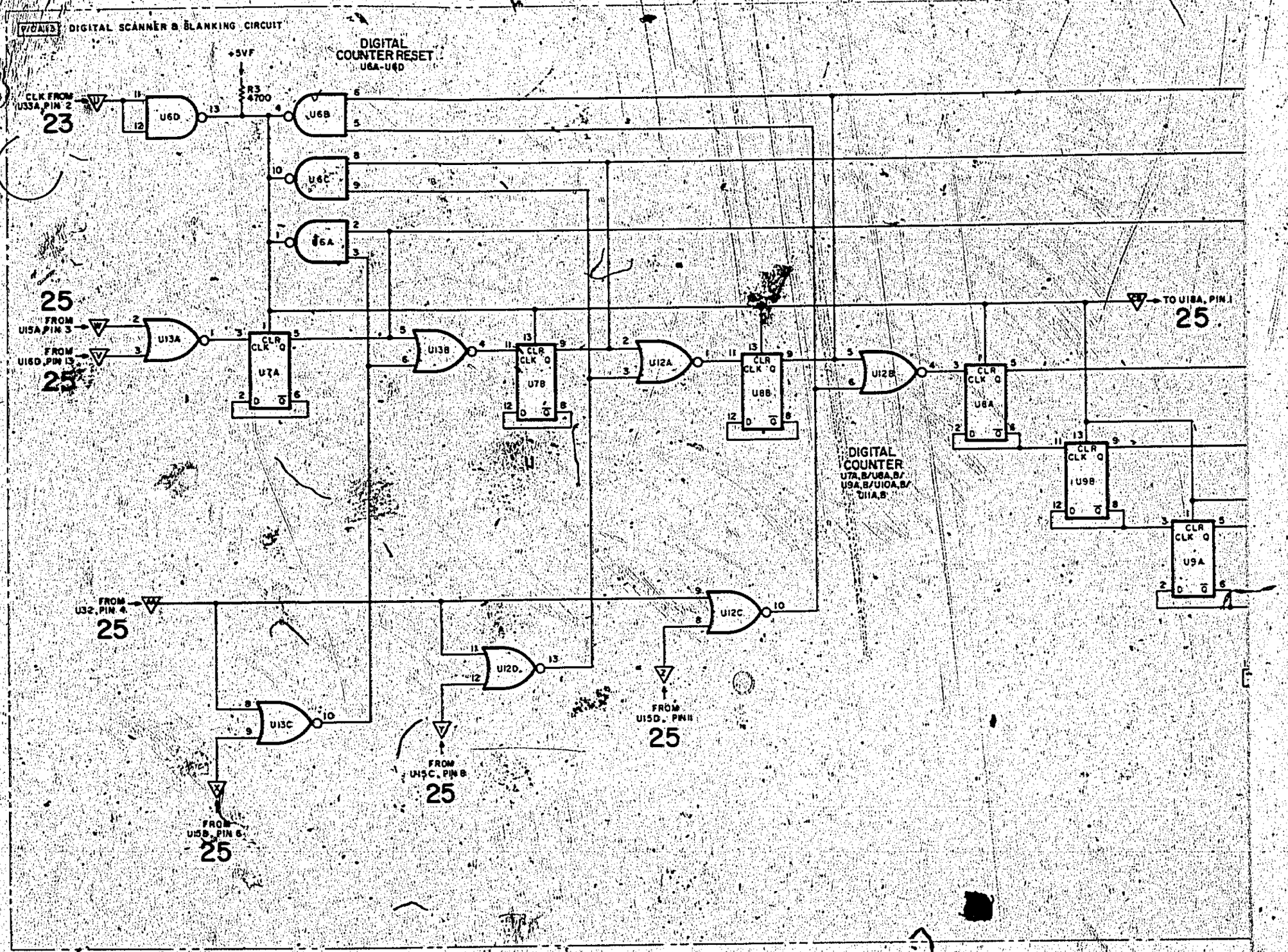
P/O A13
C1
R1,2
U1-5,22,23,33
P/O U13,17,21,24, 28,30,32
CHASSIS
J31, A1B J32

DELETED:

23

1B0A-DIGITAL SCANNER & BLANKING CRT-1135A
11504-D-1

Figure 8-60.
Digital Scan Assembly A13, Schematic 23
8-87/8-88


DIGITAL SCANNER & BLANKING CIRCUIT
+5VF
DIGITAL COUNTER RESET U6A-U6D
R3 4700
CLK FROM U33A, PIN 2
23
U6D
U6B
U6C
U6A
FROM U15A, PIN 3
25
FROM U16D, PIN 13
25
U13A
U7A
U13B
U7B
U12A
U8B
U12B
U8A
U9B
U9A
TO U18A, PIN 1
25
DIGITAL COUNTER U7A,B/U8A,B/ U9A,B/U10A,B/ U11A,B
FROM U32, PIN 4
25
U13C
U12D
U12C
FROM U15C, PIN 8
25
FROM U15D, PIN 11
25
FROM U15B, PIN 6
25

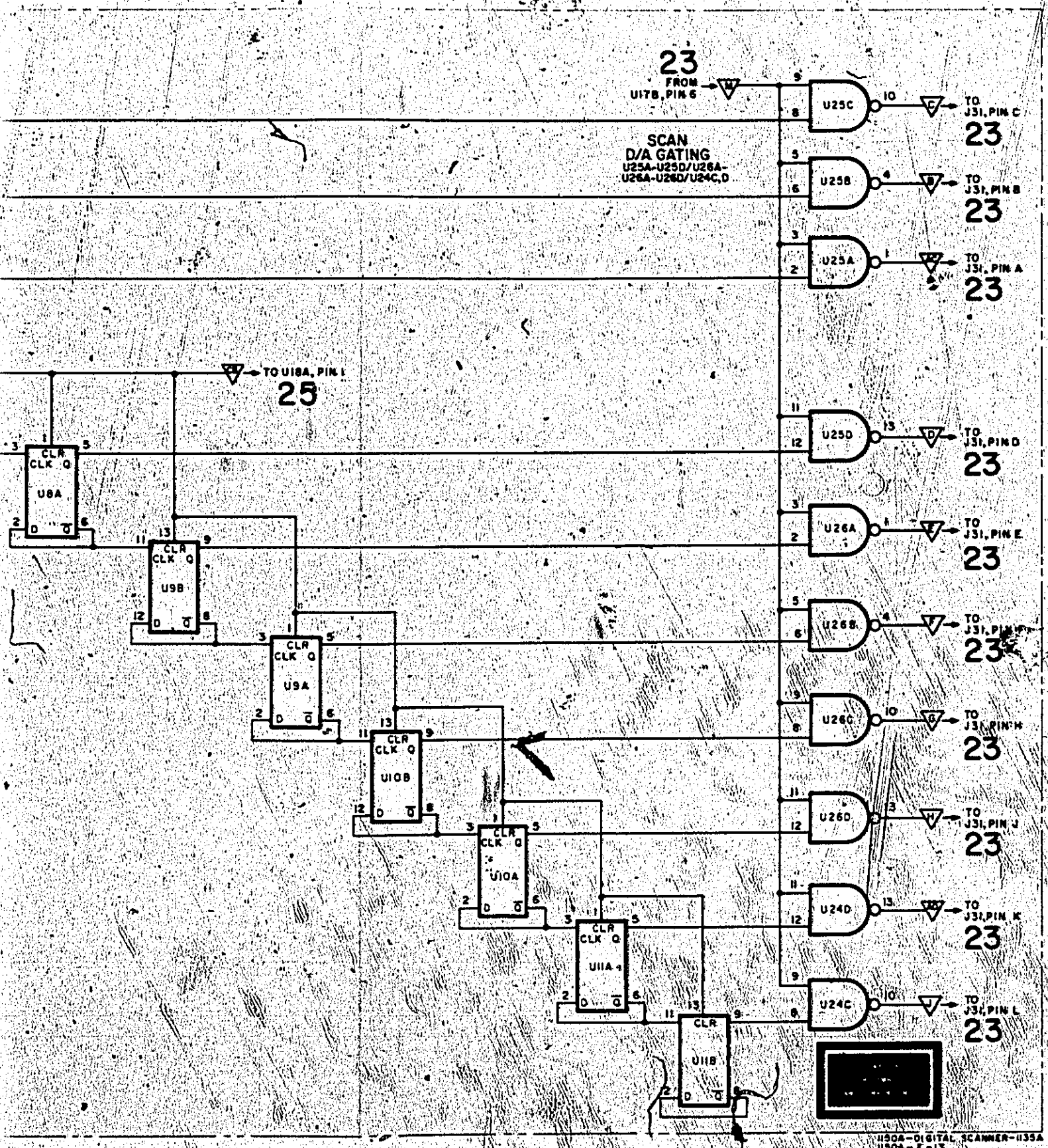
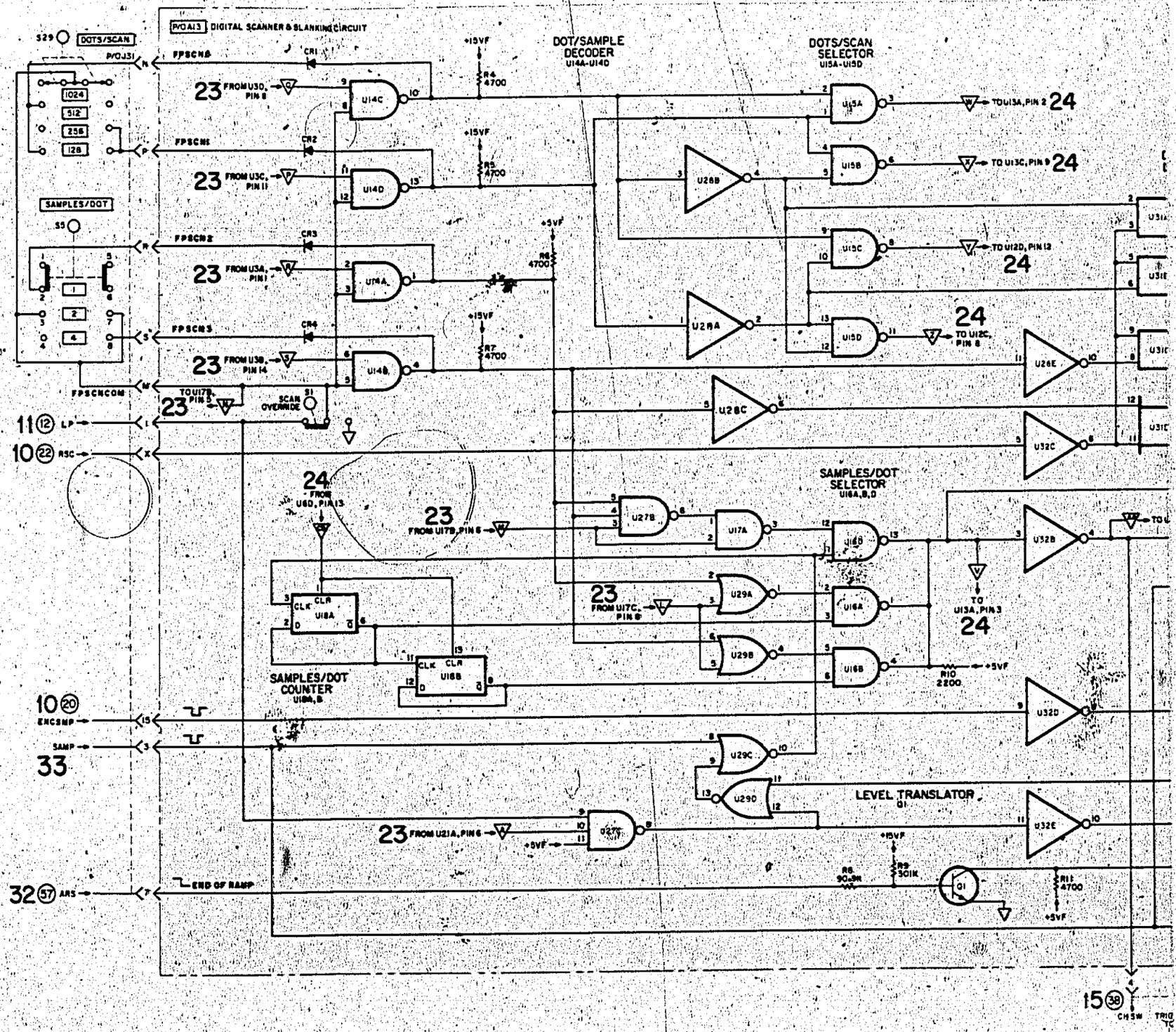


Figure 8-61.
Digital Scan Assembly A13, Schematic 24
8-89/8-90


P/O A13 DIGITAL SCANNER & BLANKING CIRCUIT
S29 DOTS/SCAN
P/O J31
1024
512
256
128
SAMPLES/DOT
S5
1
2
4
FPSCNCOM
FPSCN0
FPSCN1
FPSCN2
FPSCN3
CR1
CR2
CR3
CR4
+15VF
+5VF
R4 4700
R5 4700
R6 4700
R7 4700
23 FROM U3D, PIN 8
23 FROM U3C, PIN 11
23 FROM U3A, PIN 1
23 FROM U3B, PIN 14
U14C
U14D
U14A
U14B
TO U17B, PIN 5
SCAN OVERRIDE S1
11 (12) LP
10 (22) RSC
24 FROM U6D, PIN 13
U16A
CLR
CLK
D
Q
SAMPLES/DOT COUNTER U16A, B
U16B
10 (20) ENCSMP
SAMP
33
32 (57) ARS
END OF RAMP
DOT/SAMPLE DECODER U14A-U14D
DOTS/SCAN SELECTOR U15A-U15D
U15A
U15B
U15C
U15D
U28B
U28A
U28C
U26E
U32C
U31A
U31E
U31C
TO U13A, PIN 2 24
TO U13C, PIN 9 24
TO U12D, PIN 12 24
TO U12C, PIN 8 24
SAMPLES/DOT SELECTOR U16A, B, D
U27B
U17A
U16D
U29A
U16A
U29B
U16B
U32B
U32D
TO U13A, PIN 3 24
R10 2200
23 FROM U17B, PIN 6
23 FROM U17C, PIN 6
23 FROM U21A, PIN 6
U27D
U29C
U29D
LEVEL TRANSLATOR Q1
U32E
R8 90.9K
R9 3.01K
R11 4700
15 (38) CHSW TRIG

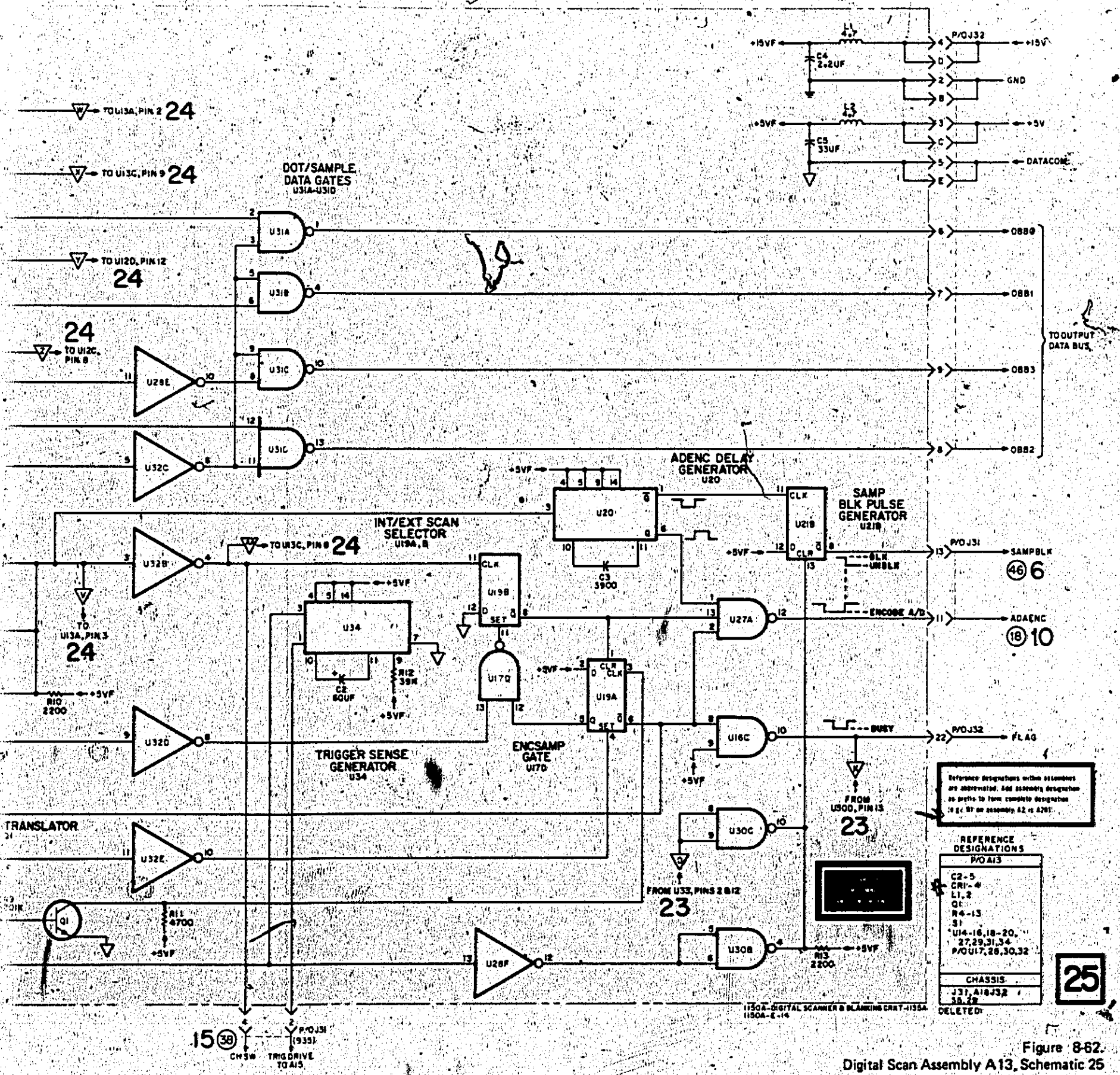
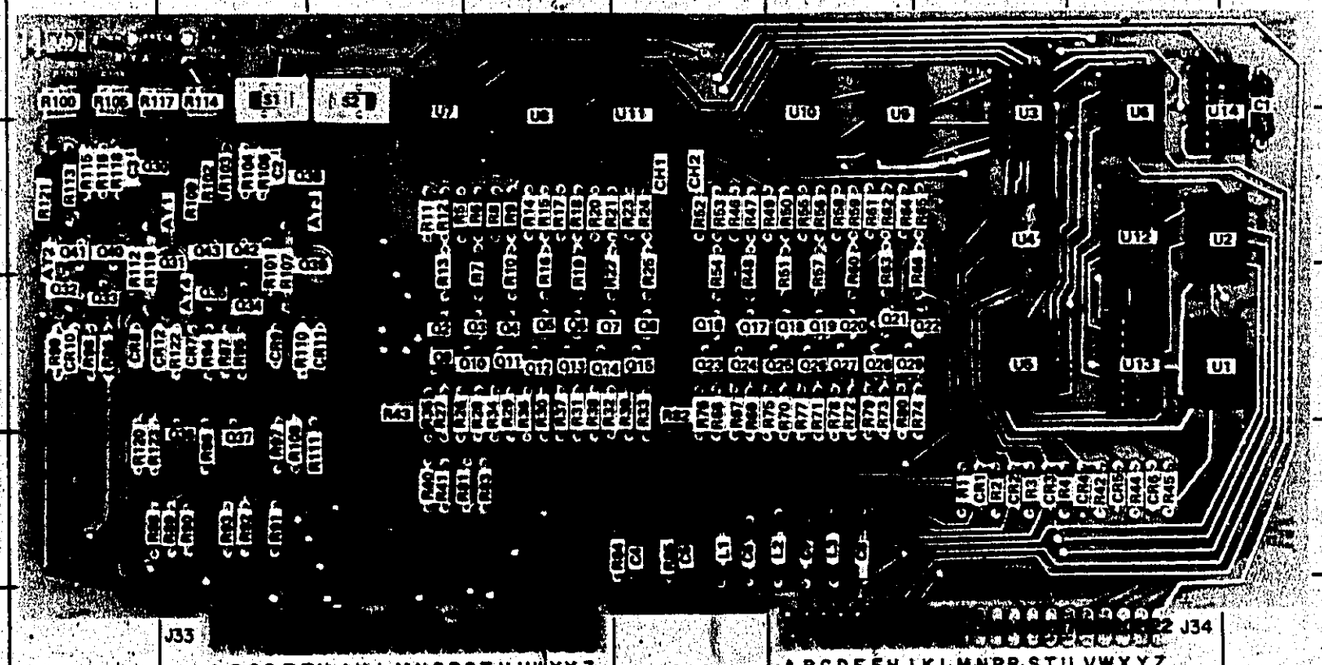


Figure 8-62.
Digital Scan Assembly A13, Schematic 25



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	K-1	Q5	F-3	Q31	D-2	R14	F-2	R40	E-4	R66	I-2	R92	D-4	R119	C-2
C2	D-2	Q6	F-3	Q32	C-3	R15	F-2	R41	E-4	R67	G-3	R93	D-4	R120	C-4
C3	C-2	Q7	F-3	Q33	C-3	R16	F-3	R42	J-4	R68	G-3	R94	D-3	R121	C-2
C4	G-4	Q8	G-3	Q34	D-3	R17	F-2	R43	E-3	R69	G-3	R95	D-3	R122	D-3
C5	G-4	Q9	E-3	Q35	D-3	R18	F-2	R44	J-4	R70	H-3	R96	D-4	R123	C-4
C6	G-4	Q10	F-3	Q36	D-4	R19	F-3	R45	J-4	R71	H-3	R97	D-4	S1	D-1
C7	H-4	Q11	F-3	Q37	D-4	R20	F-2	R46	G-2	R72	H-3	R98	C-3	S2	E-1
C8	H-4	Q12	F-3	Q38	D-2	R21	F-2	R47	G-2	R73	H-3	R99	C-3	AT1	D-2
CR1	I-4	Q13	F-3	Q39	E-2	R22	F-3	R48	G-3	R74	I-3	R100	C-1	AT2	C-2
CR2	I-4	Q14	F-3	Q40	C-2	R23	G-2	R49	H-2	R75	H-3	R101	D-2	AT3	E-2
CR3	I-4	Q15	G-3	Q41	C-2	R24	G-2	R50	H-2	R76	G-3	R102	D-2	AT4	D-3
CR4	J-4	Q16	G-3	Q42	D-2	R25	G-3	R51	H-3	R77	H-3	R103	D-2	CH1	G-2
CR5	J-4	Q17	G-3	Q43	D-2	R26	E-3	R52	G-2	R78	H-3	R104	D-2	CH2	G-2
CR6	J-4	Q18	H-3	R1	I-4	R27	E-3	R53	G-2	R79	H-3	R105	C-1	U1	K-3
CR7	D-3	Q19	H-3	R2	I-4	R28	F-3	R54	G-3	R80	H-3	R106	D-2	U2	K-2
CR8	C-3	Q20	H-3	R3	I-4	R29	F-3	R55	H-2	R81	E-4	R107	D-2	U3	I-2
CR9	D-3	Q21	H-3	R4	I-4	R30	F-3	R56	H-2	R82	G-3	R108	D-4	U4	I-2
CR10	C-3	Q22	I-3	R5	E-2	R31	F-3	R57	H-3	R83	F-4	R109	D-2	U5	I-3
CR11	E-3	Q23	G-3	R6	F-2	R32	F-3	R58	H-2	R84	G-4	R110	D-3	U6	J-2
CR12	D-3	Q24	G-3	R7	F-3	R33	G-3	R59	H-2	R85	G-4	R111	E-4	U7	E-1
L1	G-4	Q25	H-3	R8	F-2	R34	F-3	R60	H-3	R86	C-3	R112	C-2	U8	F-2
L2	H-4	Q26	H-3	R9	F-2	R35	E-3	R61	H-2	R87	D-3	R113	C-2	U9	H-2
L3	H-4	Q27	H-3	R10	F-3	R36	F-3	R62	H-2	R88	C-4	R114	D-1	U10	H-1
Q2	E-2	Q28	H-3	R11	E-2	R37	F-3	R63	H-3	R89	D-4	R115	C-2	U11	G-1
Q3	F-3	Q29	H-3	R12	E-2	R38	F-3	R64	H-2	R90	D-4	R116	C-2	U12	J-2
Q4	F-3	Q30	C-2	R13	E-3	R39	G-3	R65	I-3	R91	D-4	R117	C-1	U13	J-3
												R118	C-2	U14	K-2

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1180A—8—9

Figure 8-63. Component Identification, Assembly A14

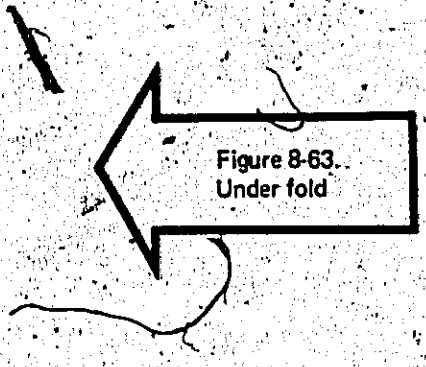
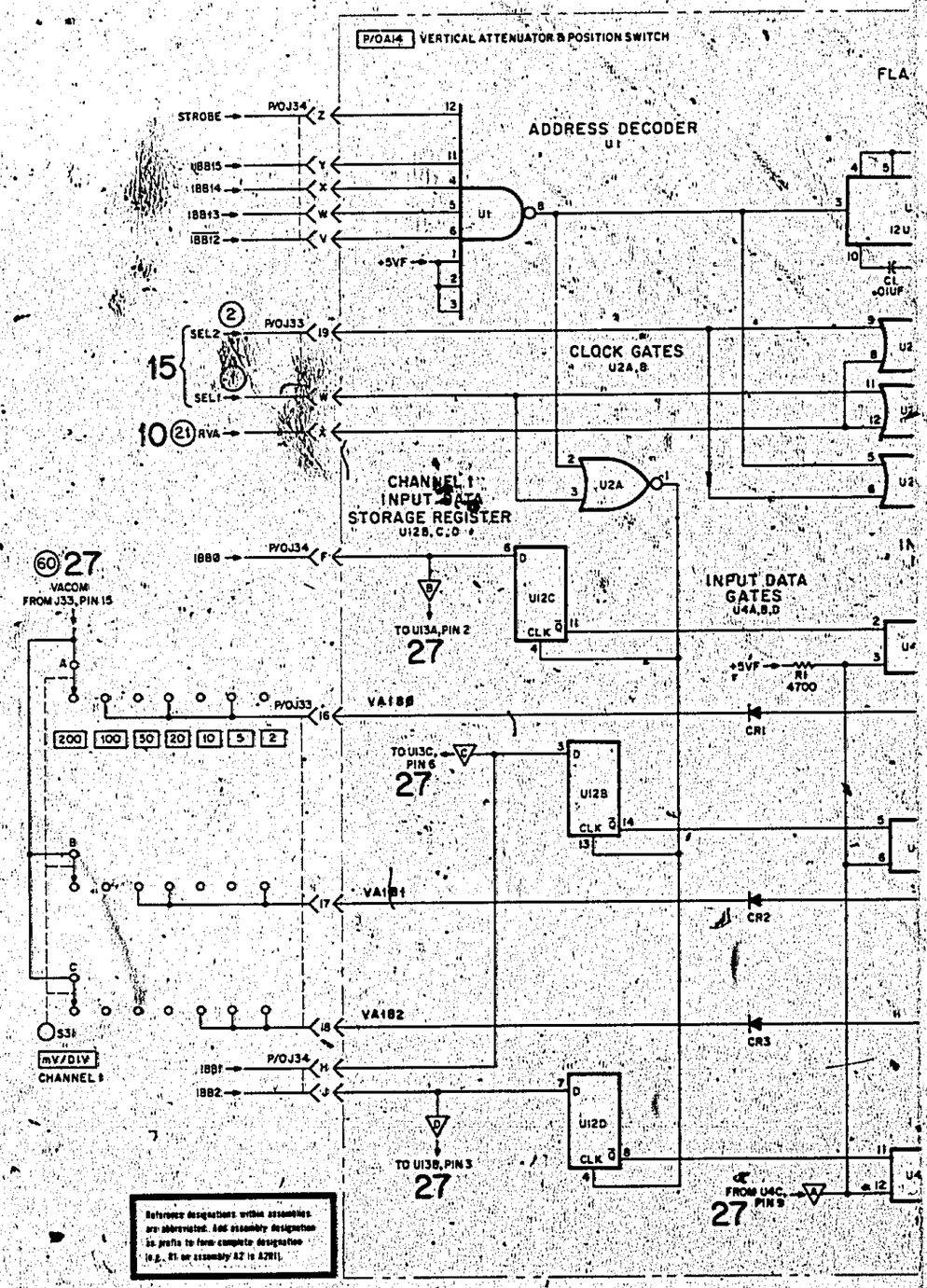


Figure 8-63.
Under fold

Table 8-13. Binary Coding for Assembly A14

Vertical attenuators are programmed (after channel selection) with the following binary codes:

FUNCTION	BIT LOCATION and LOGIC LEVEL															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address	1	1	1	0												
Vertical Attenuation:																
200 mV/DIV														0	0	0
100 mV/DIV														0	0	1
50 mV/DIV														0	1	0
20 mV/DIV														0	1	1
10 mV/DIV														1	0	0
5 mV/DIV														1	0	1
2 mV/DIV														1	1	0



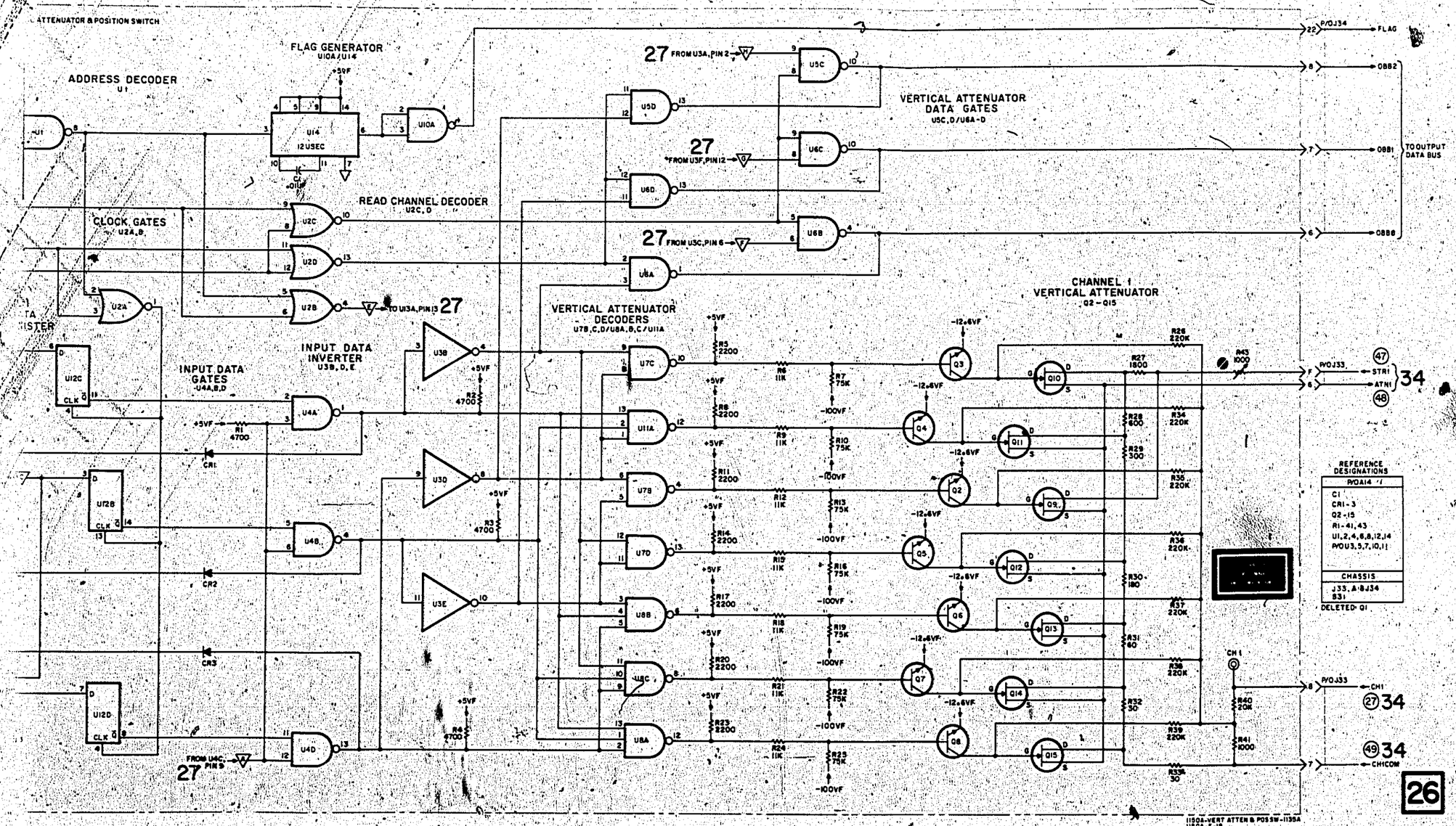


Figure 8-64.
Vertical Attenuator Assembly A14, Schematic 26
8-93/8-94

P/O A14 VERTICAL ATTENUATOR & POSITION SWITCH

INPUT DATA STORAGE REGISTER U13A, B, C

INPUT DATA GATES U4C/U5A, B

INPUT DATA INVERTERS U3A, C, F

VERTICAL ATTENUATOR DECODER U9A, B, C/U10B, C, D/U11C

CHANNEL 2 LEVEL TRANSLATOR Q38/Q39, Q42/Q43

POSITION SELECTOR Q36/Q37

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A7 is A7R1).

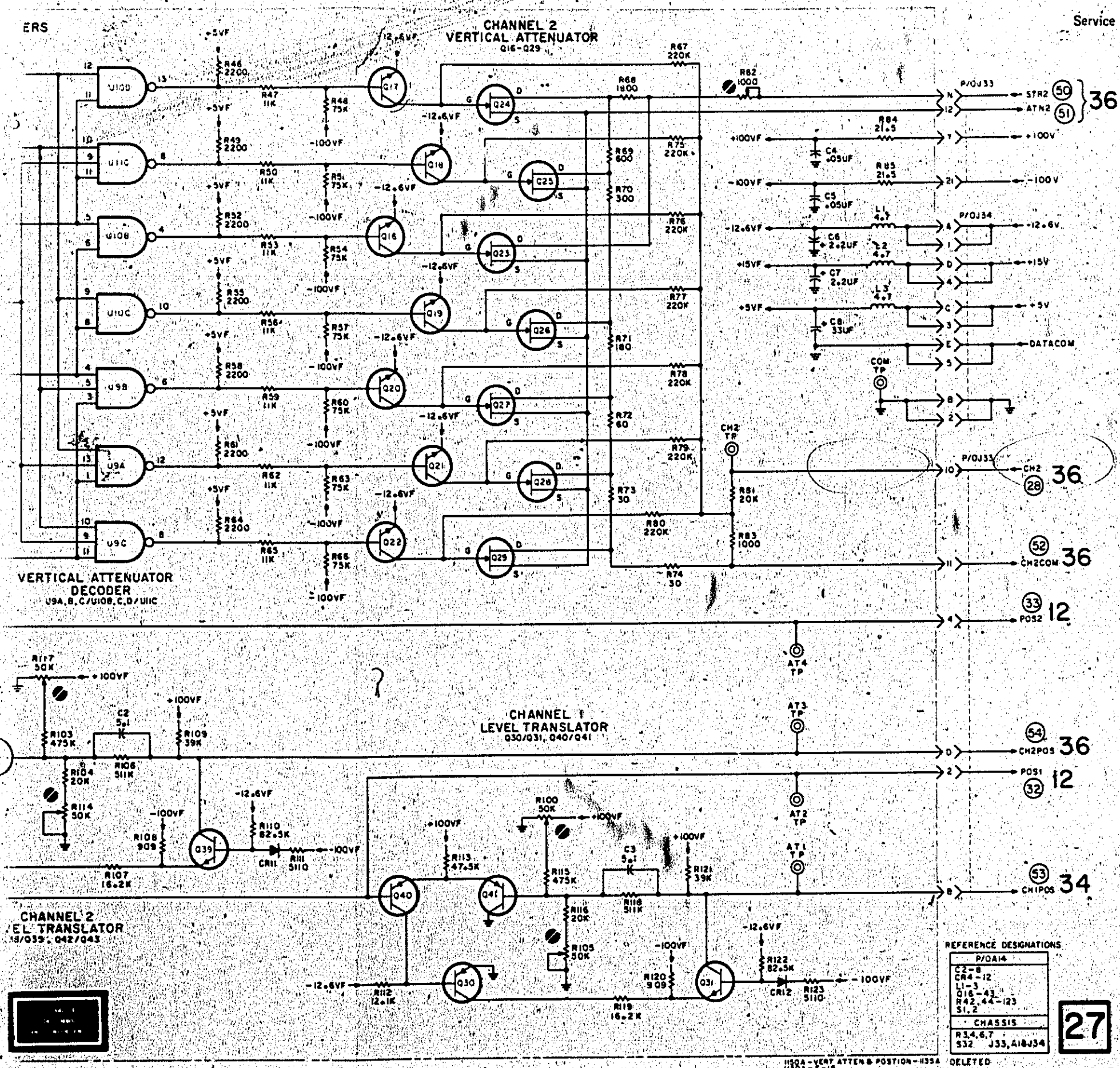
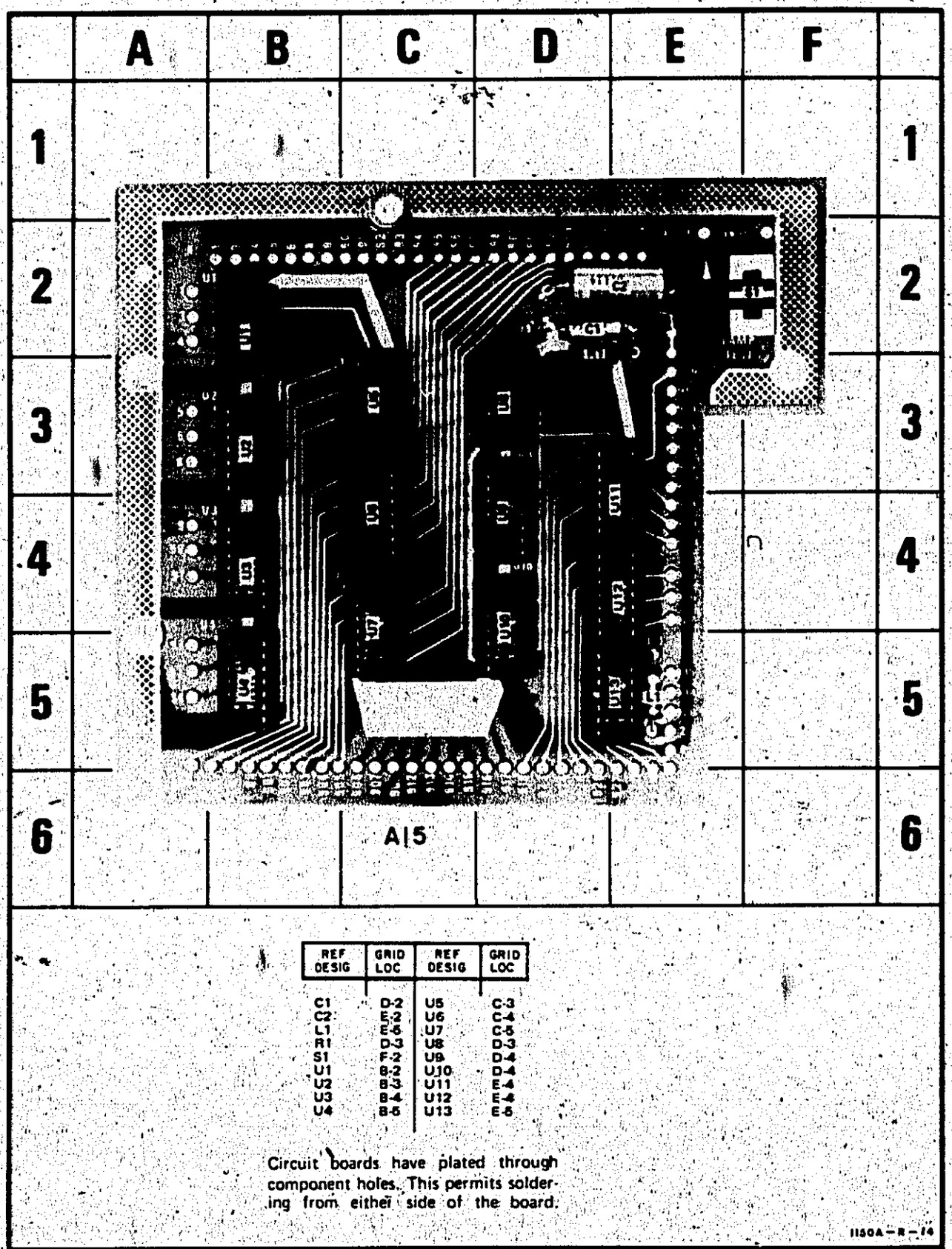


Figure 8-65.
Vertical Attenuator Assembly A14, Schematic 27



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-2	U5	C-3
C2	E-2	U6	C-4
L1	E-5	U7	C-5
R1	D-3	U8	D-3
S1	F-2	U9	D-4
U1	B-2	U10	D-4
U2	B-3	U11	E-4
U3	B-4	U12	E-4
U4	B-5	U13	E-5

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1150A-R-14

Figure 8-66. Component Identification, Assembly A15

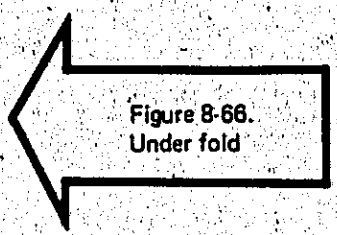


Figure 8-66.
Under fold

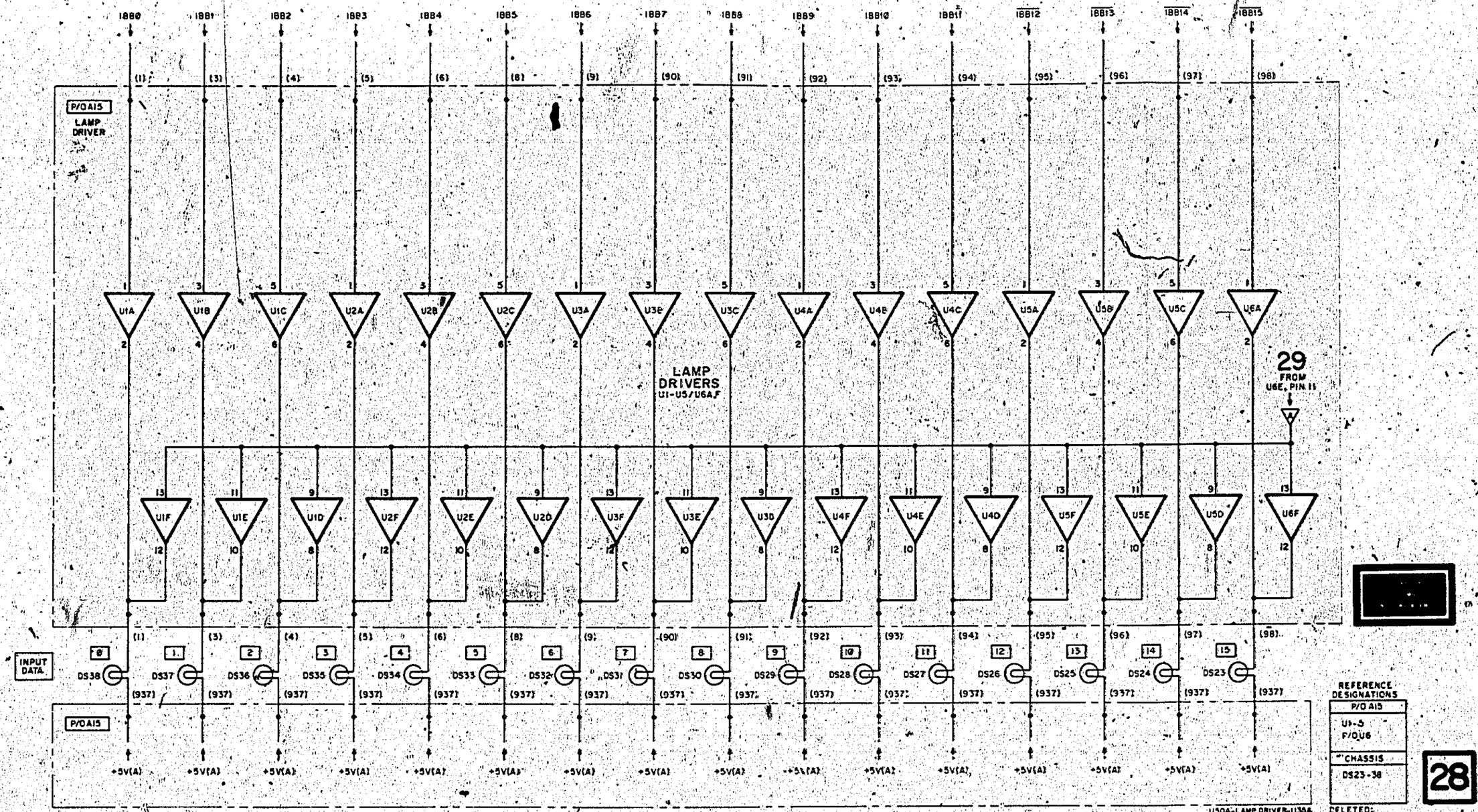
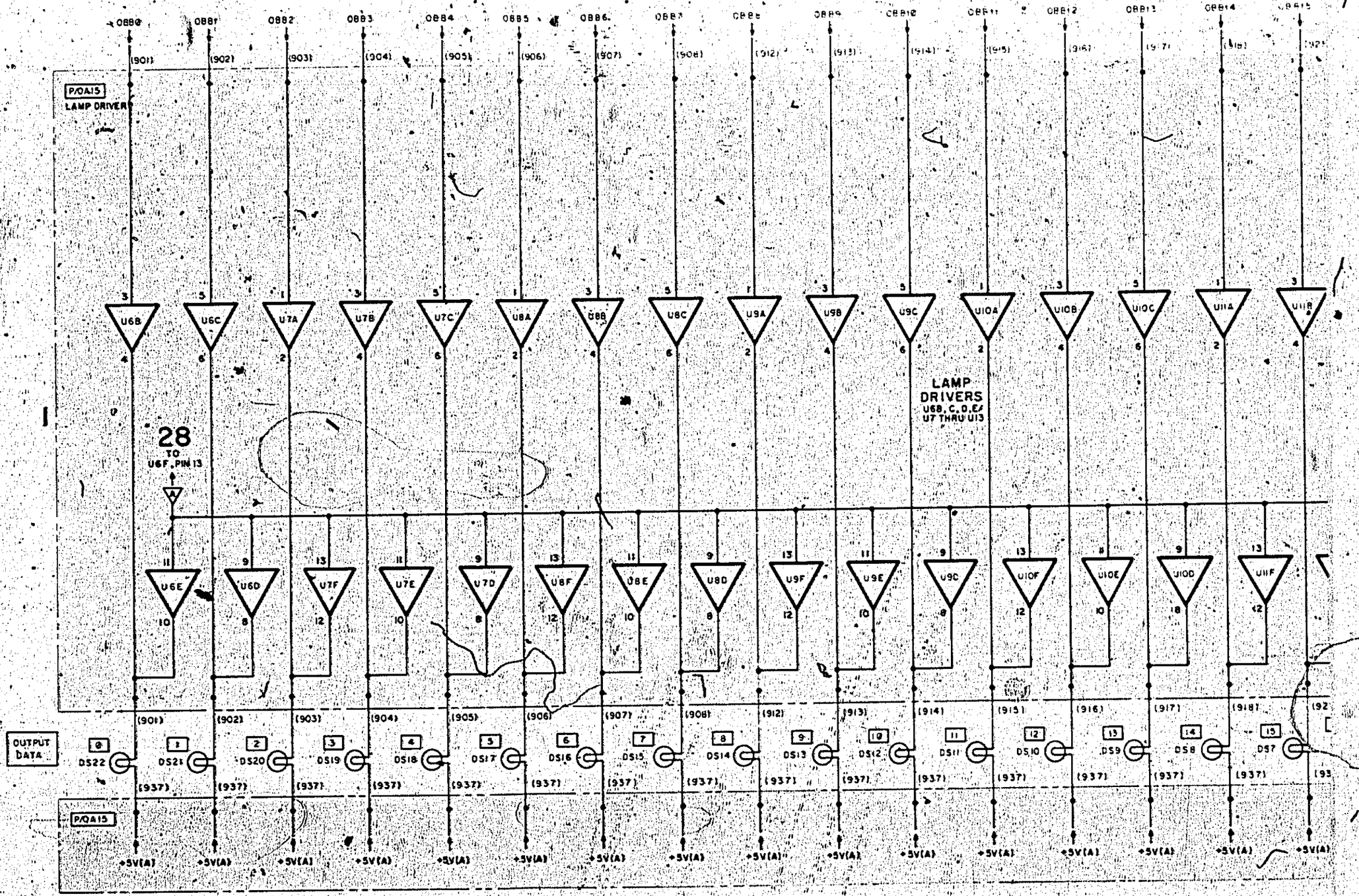


Figure 8-67.
Lamp Driver Assembly A15, Schematic 28
8-97/8-98


P/OA15
LAMP DRIVER
OBB0
OBB1
OBB2
OBB3
OBB4
OBB5
OBB6
OBB7
OBB8
OBB9
OBB10
OBB11
OBB12
OBB13
OBB14
OBB15
(901)
(902)
(903)
(904)
(905)
(906)
(907)
(908)
(912)
(913)
(914)
(915)
(916)
(917)
(918)
U6B
U6C
U7A
U7B
U7C
U8A
U8B
U8C
U9A
U9B
U9C
U10A
U10B
U10C
U11A
U11B
U6E
U6D
U7F
U7E
U7D
U8F
U8E
U8D
U9F
U9E
U9D
U10F
U10E
U10D
U11F
LAMP DRIVERS U6B, C, D, E/ U7 THRU U13
28
TO U6F, PIN 13
OUTPUT DATA
DS22
DS21
DS20
DS19
DS18
DS17
DS16
DS15
DS14
DS13
DS12
DS11
DS10
DS9
DS8
DS7
(937)
P/OA15
+5V(A)

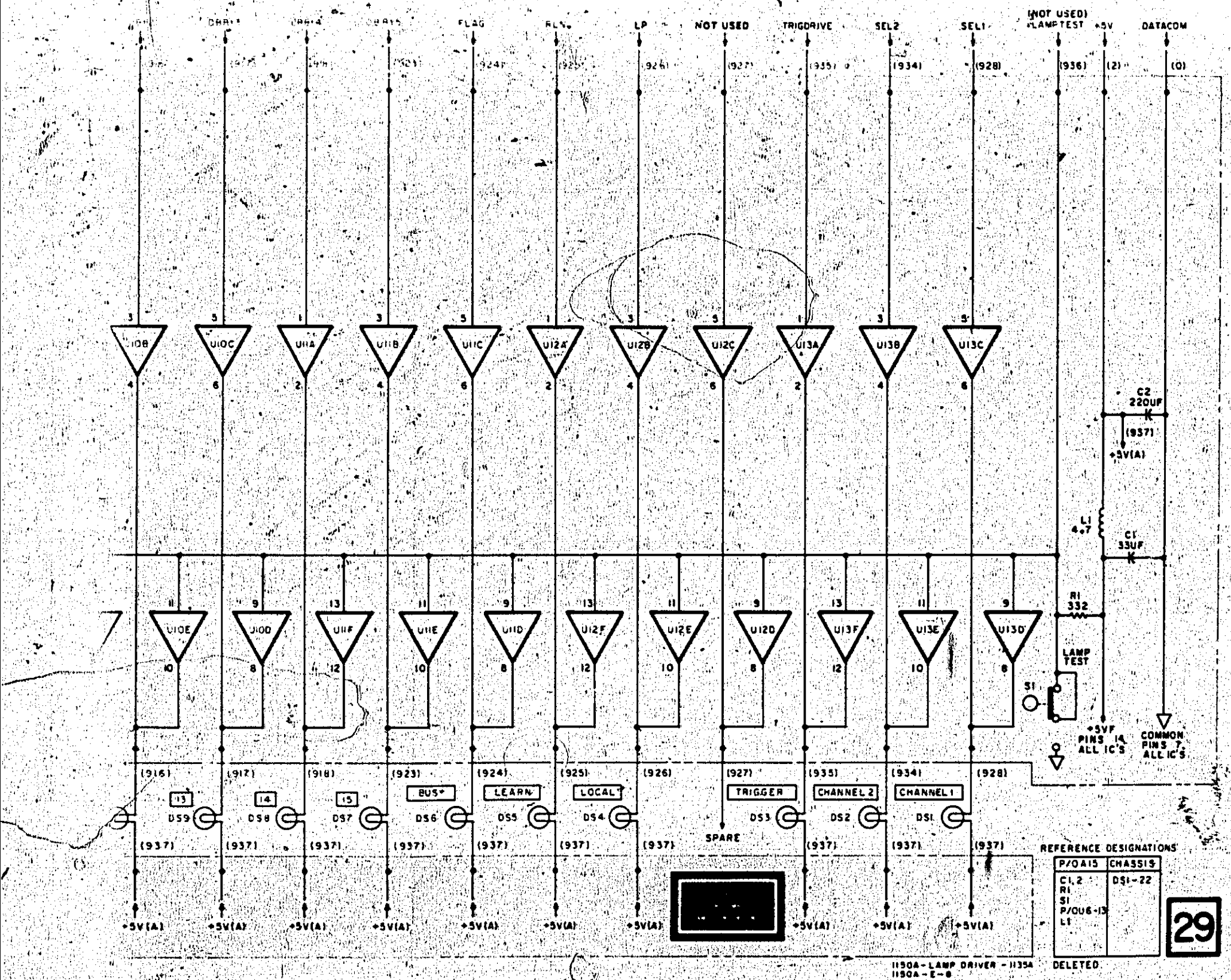
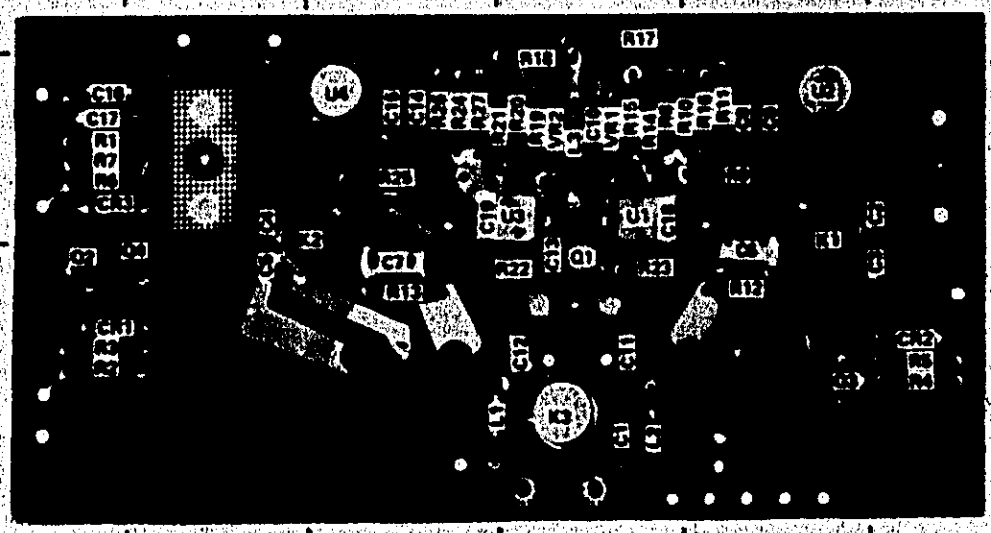


Figure 8-68.
Lamp Driver Assembly A15, Schematic 29



A16

Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-4	C9	E-2	C17	A-2	K3	B-3	R1	A-2	R9	E-2	R17	D-1	R25	C-2
C2	F-2	C10	D-2	C18	D-2	L1	C-3	R2	A-3	R10	E-2	R18	D-2	R26	C-2
C3	F-3	C11	D-3	C19	C-2	L2	D-4	R3	A-3	R11	E-2	R19	D-2	R27	C-2
C4	B2	C12	D-3	CR1	A-3	L3	D-2	R4	F-3	R12	E-3	R20	D-2	U1	D-2
C5	B-3	C13	D-3	CR2	F-3	Q1	D-3	R5	F-3	R13	C-3	R21	C-2	U2	E-2
C6	E-3	C14	C-2	CR3	A-2	Q2	A-3	R6	A-2	R14	D-2	R22	D-3	U3	D-2
C7	C-3	C15	C-2	K1	E-3	Q3	E-3	R7	A-2	R15	D-2	R23	D-3	U4	C-2
C8	E-2	C16	A-2	K2	B-2	Q4	B-3	R8	D-2	R16	E-2	R24	C-2	VR1	D-2
														VR2	D-2

1150A-R-16

Figure 8-69. Component Identification, Assembly A16

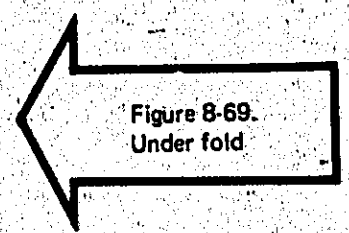
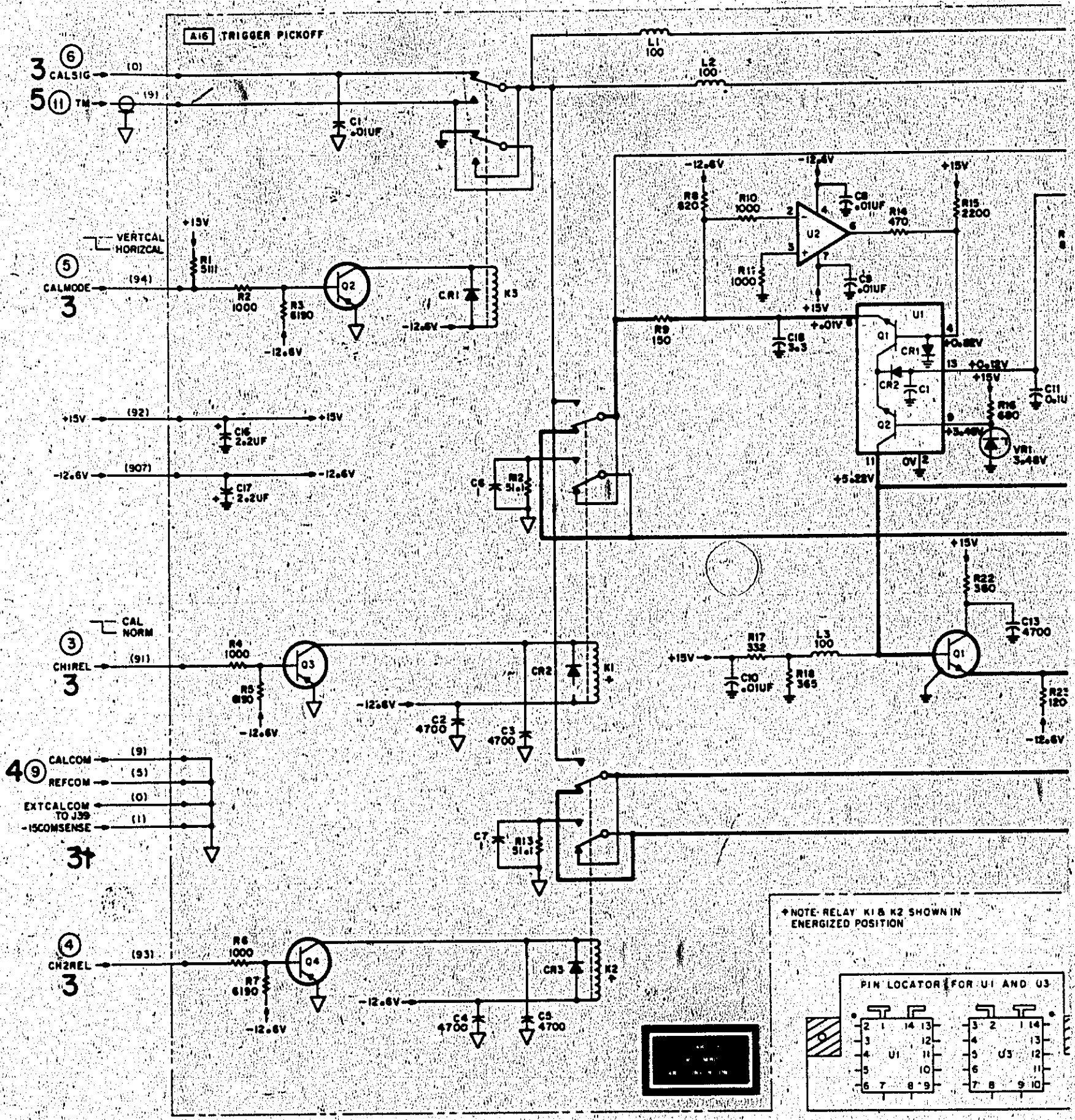
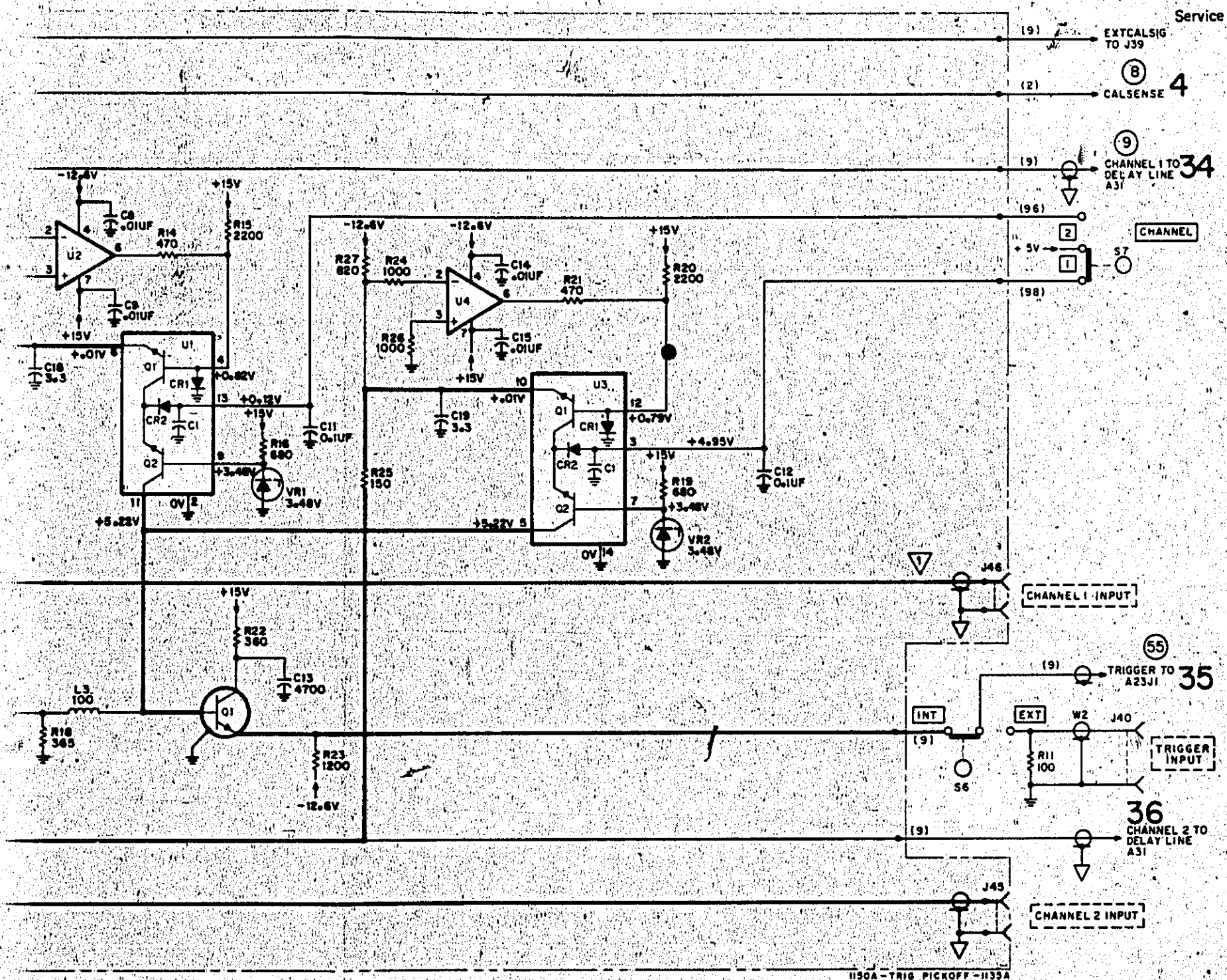
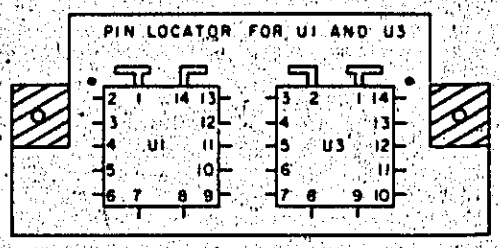


Figure 8-69.
Under fold


A16 TRIGGER PICKOFF
3 6 CALSIG (0)
5 11 TM (9)
C1 .01UF
L1 100
L2 100
VERTCAL
HORIZCAL
5 CALMODE (94)
3
+15V
R1 511
R2 1000
R3 6190
Q2
CR1
K3
-12.6V
+15V (92)
C16 2.2UF
-12.6V (907)
C17 2.2UF
C6
R12 51.1
R8 820
R10 1000
U2
C8 .01UF
R14 470
R15 2200
R17 1000
C9 .01UF
R9 150
C18 3.3
U1
Q1
CR1
CR2
C1
Q2
+0.82V
+0.12V
+5.22V
R16 680
+3.48V
VR1 3.48V
C11 0.1U
0V
R22 360
C13 4700
R17 332
L3 100
C10 .01UF
R18 365
Q1
R23 120
CAL NORM
3 CH1REL (91)
R4 1000
Q3
R5 680
CR2
K1
C2 4700
C3 4700
4 9 CALCOM (9)
REFCOM (5)
EXTCALCOM TO J39 (0)
-15COMSENSE (1)
3†
C7
R13 51.1
4 CH2REL (93)
R6 1000
Q4
R7 6190
CR3
K2
C4 4700
C5 4700
†NOTE: RELAY K1 & K2 SHOWN IN ENERGIZED POSITION
PIN LOCATOR FOR U1 AND U3
U1
U3



↑NOTE: RELAY K1 & K2 SHOWN IN ENERGIZED POSITION



Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

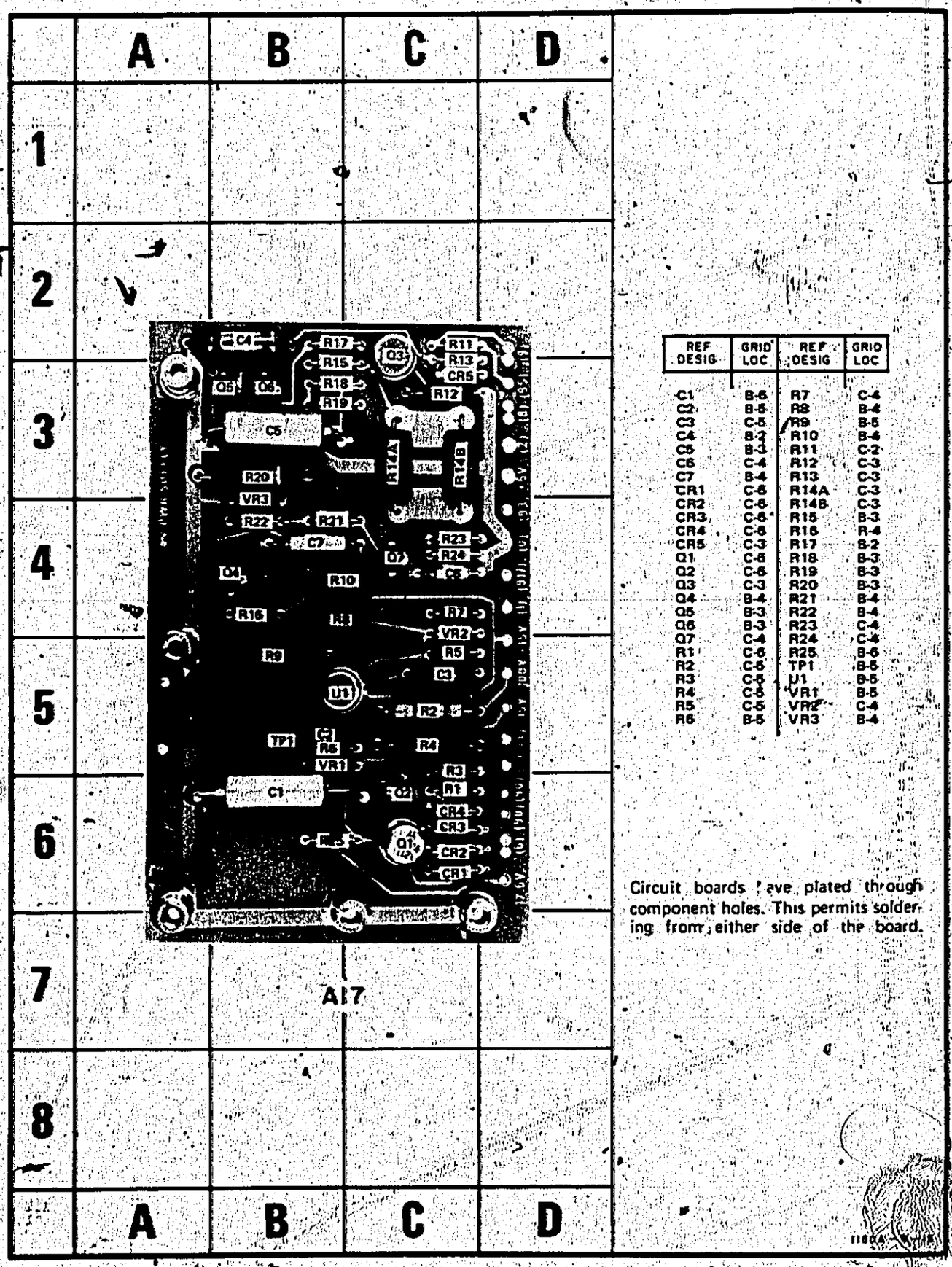
REFERENCE DESIGNATIONS

A16		CHASSIS
C1-19	J45,46	J7,8,40
CR1-3		R11
K1-3		S6,7
L1-3		W2
Q1-4		
R1-27		
U1-4		
VR1,2		

DELETED

30

Figure 8-70.
Trigger Pickoff Assembly A16, Schematic 30



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-6	R7	C-4
C2	B-5	R8	B-4
C3	C-5	R9	B-5
C4	B-2	R10	B-4
C5	B-3	R11	C-2
C6	C-4	R12	C-3
C7	B-4	R13	C-3
CR1	C-6	R14A	C-3
CR2	C-6	R14B	C-3
CR3	C-6	R15	B-3
CR4	C-6	R16	B-4
CR5	C-3	R17	B-2
Q1	C-6	R18	B-3
Q2	C-6	R19	B-3
Q3	C-3	R20	B-3
Q4	B-4	R21	B-4
Q5	B-3	R22	B-4
Q6	B-3	R23	C-4
Q7	C-4	R24	C-4
R1	C-6	R25	B-6
R2	C-5	TP1	B-5
R3	C-5	U1	B-5
R4	C-5	VR1	B-5
R5	C-5	VR2	C-4
R6	B-5	VR3	B-4

Circuit boards have plated through component holes. This permits soldering from either side of the board.

Figure 8-71. Component Identification, Assembly A17

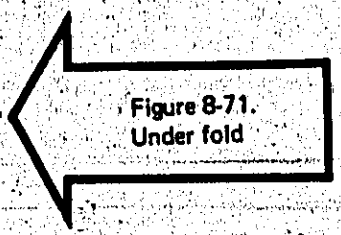
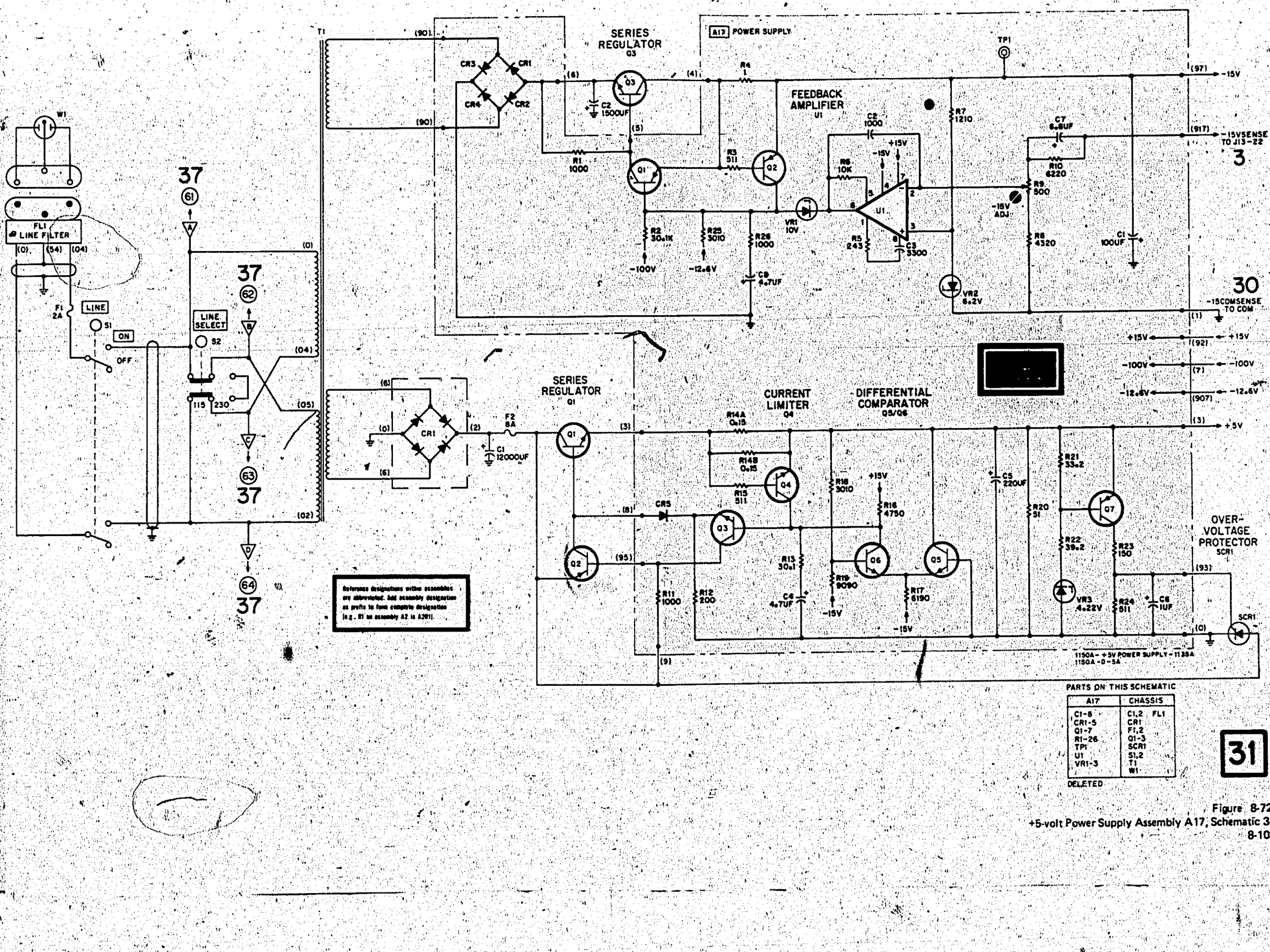


Figure 8-71.
Under fold



Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

PARTS ON THIS SCHEMATIC

A17	CHASSIS
C1-8	C1,2 FL1
CR1-5	CR1
Q1-7	F1,2
R1-26	Q1-3
TP1	SCR1
U1	S1,2
VR1-3	T1
	W1

DELETED

Figure 8-72.
+5-volt Power Supply Assembly A17, Schematic 31

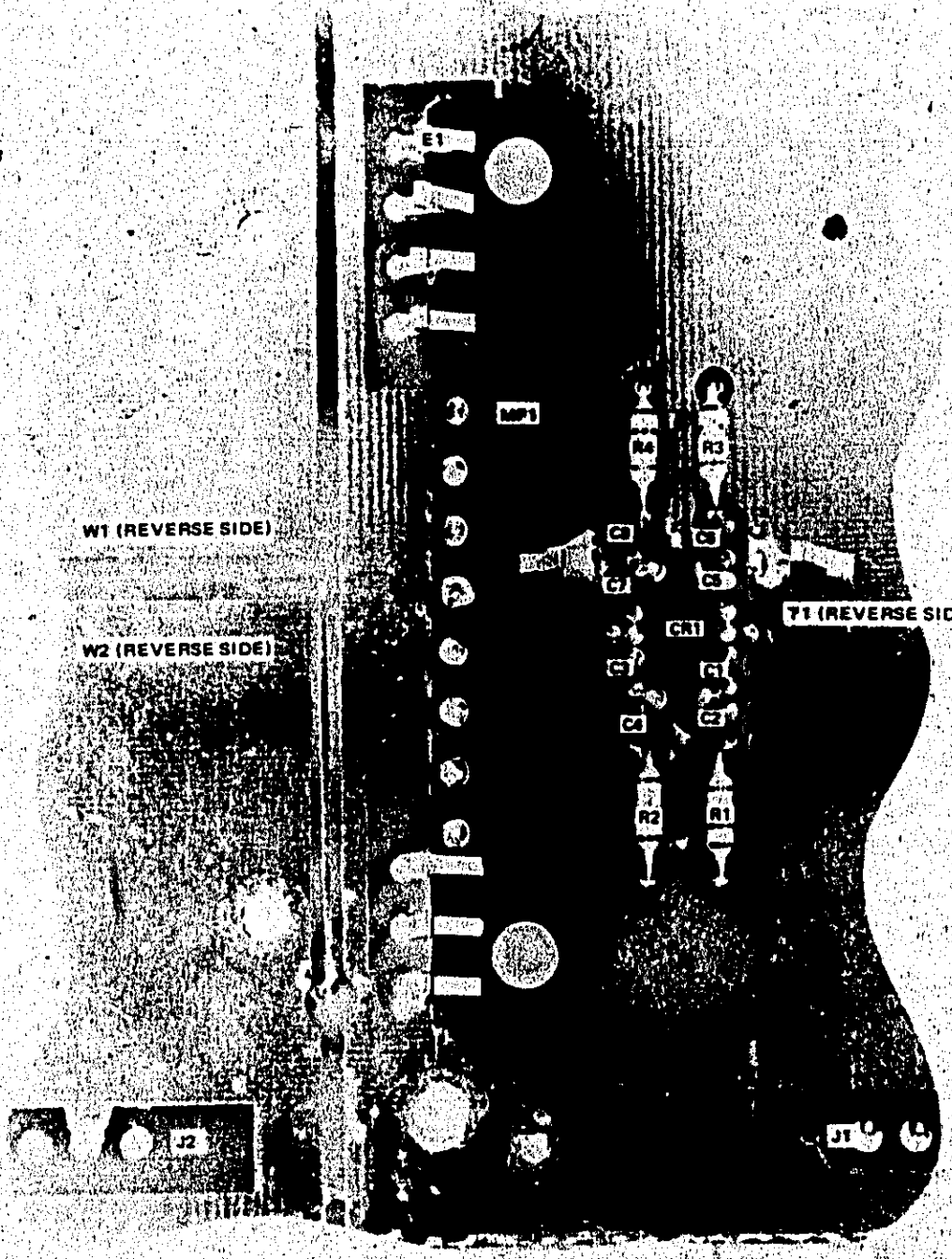
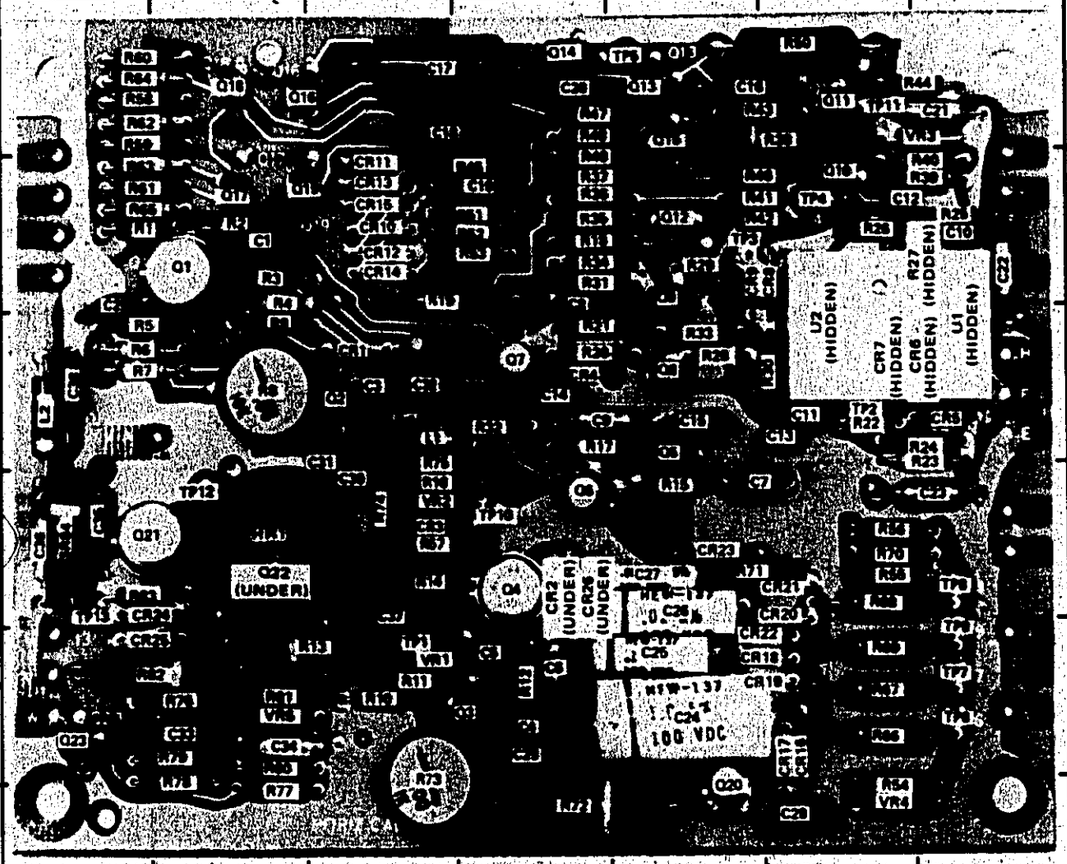


Figure 8-74. Component Identification, Assembly A28

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1														1
2														2
3														3
4														4
5														5
6														6

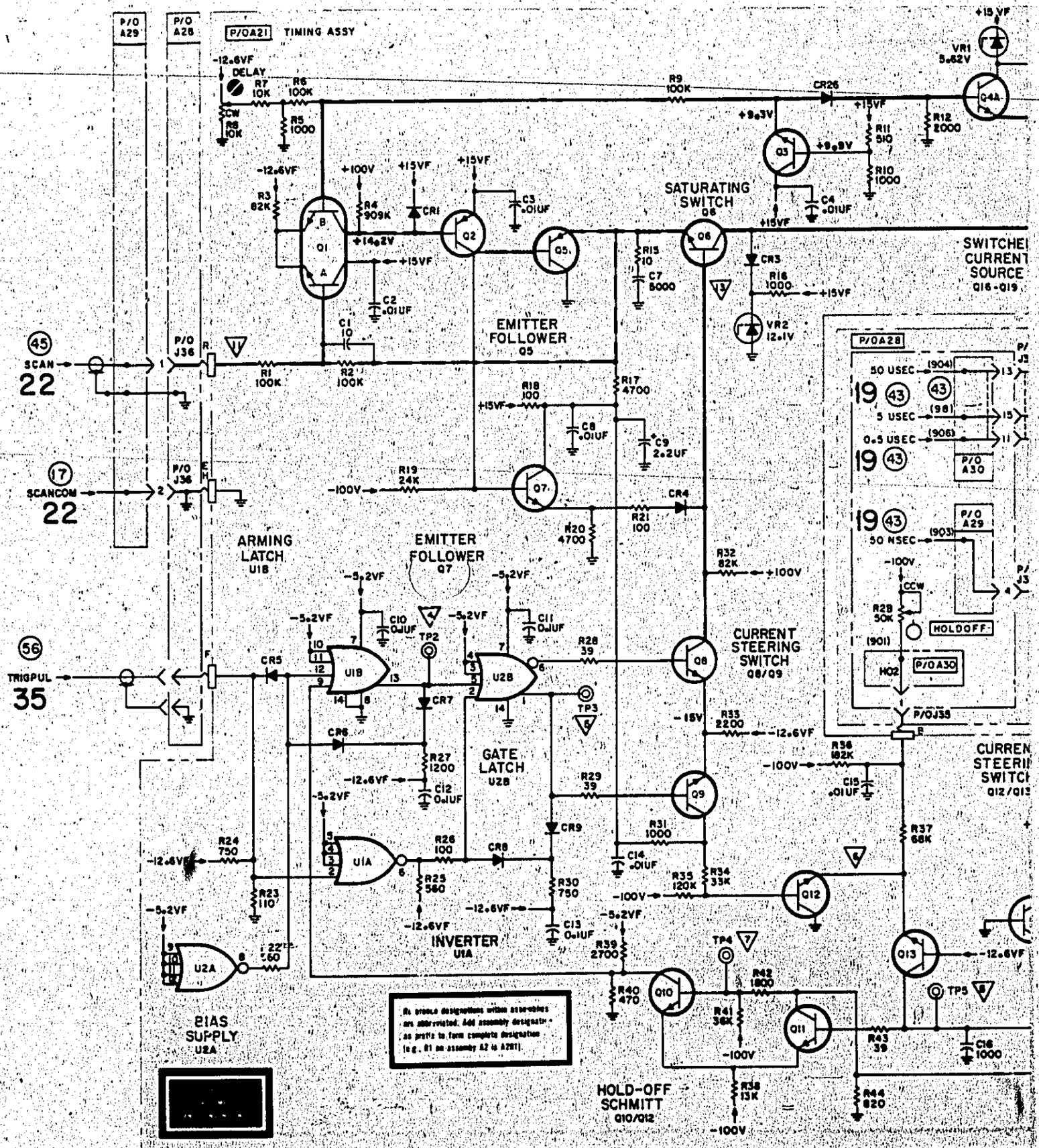


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-2	C13	I-3	C25	H-5	C37	F-4	CR11	F-2	CR23	H-4	Q6	G-4	Q18	E-1	R7	D-3	R19	F-2	R31	G-2	R43	I-1	R55	I-4	R67	I-5	R79	E-5	TP7	J-5
C2	D-2	C14	G-3	C26	H-4	C38	D-3	CR12	F-2	CR24	D-4	Q7	G-3	Q19	E-2	R8	E-3	R20	G-3	R32	G-3	R44	J-1	R56	I-4	R68	I-4	R80	E-5	TP8	J-4
C3	F-3	C15	H-3	C27	H-4	CR1	F-3	CR13	F-2	CR25	D-4	Q8	H-3	Q20	H-5	R9	E-3	R21	G-3	R33	H-3	R45	G-2	R57	F-4	R69	I-5	R81	E-5	TP9	J-5
C4	G-5	C16	H-1	C28	I-5	CR2	G-4	CR14	F-2	CR26	G-4	Q9	H-2	Q21	D-4	R10	E-5	R22	I-3	R34	G-2	R46	H-2	R58	D-1	R70	I-4	R82	D-5	TP10	G-4
C5	G-5	C17	F-1	C29	G-5	CR3	F-4	CR15	F-2	HR1	E-4	Q10	I-2	Q22	E-4	R11	F-5	R23	J-3	R35	G-2	R47	G-1	R59	D-1	R71	H-4	R83	D-4	TP11	I-1
C6	G-5	C18	F-1	C30	F-4	CR4	G-3	CR16	I-5	L1	F-3	Q11	I-1	Q23	D-5	R12	G-5	R24	J-3	R36	G-2	R48	G-1	R60	D-1	R72	G-5	R84	D-4	TP12	E-4
C7	H-4	C19	G-2	C31	F-3	CR5	J-3	CR17	I-5	L2	D-3	Q12	H-2	R1	D-2	R13	F-5	R25	J-2	R37	G-2	R49	G-2	R61	D-2	R73	F-5	TP1	F-5	TP13	D-4
C8	G-2	C20	G-1	C32	F-3	CR6	J-3	CR18	H-5	Q1	E-2	Q13	H-1	R2	E-2	R14	H-4	R26	J-2	R38	I-1	R50	I-1	R62	D-1	R74	F-4	TP2	I-3	U1	J-3
C9	G-3	C21	J-1	C33	E-5	CR7	I-3	CR19	H-5	Q2	F-3	Q14	G-1	R3	E-2	R15	F-4	R27	J-2	R39	J-2	R51	G-2	R63	D-2	R75	E-3	TP3	H-2	U2	I-3
C10	J-2	C22	J-2	C34	E-5	CR8	I-2	CR20	I-4	Q3	G-5	Q15	H-1	R4	E-2	R16	F-4	R28	H-3	R41	H-2	R53	G-2	R65	D-2	R77	E-5	TP5	H-1	VR1	F-5
C11	I-3	C23	J-4	C35	D-4	CR9	H-2	CR21	I-4	Q4	G-4	Q16	E-1	R5	D-3	R17	G-3	R29	H-2	R42	H-2	R54	I-5	R66	I-5	R78	E-5	TP6	J-5	VR2	F-4
C12	I-2	C24	H-5	C36	D-4	CR10	F-2	CR22	H-5	Q5	H-3	Q17	E-2	R6	D-3	R18	G-2	R30	I-3											VR3	J-1
																														VR4	I-5
																														VR5	E-5

Circuit boards have plated through component holes. This permits soldering from either side of the board.

11504—R—29

Figure 8-73. Component Identification, Assembly A21


P/O A29
P/O A28
P/OA21 TIMING ASSY
-12.6VF
DELAY
R7 10K
R6 100K
CW
R8 10K
R5 1000
R9 100K
CR26
+15VF
VR1 5.62V
Q4A
+9.3V
Q3
R11 510
R12 2000
R10 1000
C4 .01UF
SATURATING SWITCH Q6
+100V
R3 82K
R4 909K
CR1
Q1
B
A
+14.2V
Q2
C3 .01UF
Q5
C2 .01UF
C1 10
R15 10
C7 5000
CR3
R16 1000
VR2 12.1V
SWITCHED CURRENT SOURCE Q16-Q19
EMITTER FOLLOWER Q5
45
SCAN
22
P/O J36
R1 100K
R2 100K
R17 4700
R18 100
C8 .01UF
C9 2.2UF
17
SCANCOM
22
R19 24K
Q7
CR4
R21 100
R20 4700
ARMING LATCH U1B
EMITTER FOLLOWER Q7
-5.2VF
C10 0.1UF
C11 0.1UF
TP2
R32 82K
+100V
56
TRIGPUL
35
CR5
U1B
U2B
R28 39
Q8
CURRENT STEERING SWITCH Q8/Q9
CR7
TP3
-15V
R33 2200
-12.6VF
CR6
R27 1200
C12 0.1UF
GATE LATCH U2B
R29 39
Q9
R36 182K
-100V
C15 .01UF
CURRENT STEERING SWITCH Q12/Q13
R24 750
U1A
R26 100
CR8
CR9
R31 1000
C14 .01UF
R37 68K
R25 560
R30 750
R35 120K
R34 33K
Q12
R23 110
C13 0.1UF
INVERTER U1A
R39 2700
TP4
Q13
U2A
R40 470
Q10
R42 1800
TP5
R41 36K
Q11
R43 39
C16 1000
BIAS SUPPLY U2A
HOLD-OFF SCHMITT Q10/Q12
R38 13K
R44 820
All circuit designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).
P/OA28
50 USEC (904)
19 43
5 USEC (905)
0.5 USEC (906)
P/O A30
50 NSEC (903)
P/O A29
CCW
R28 50K
HOLDOFF
(901)
HO2
P/O A30
P/O J35

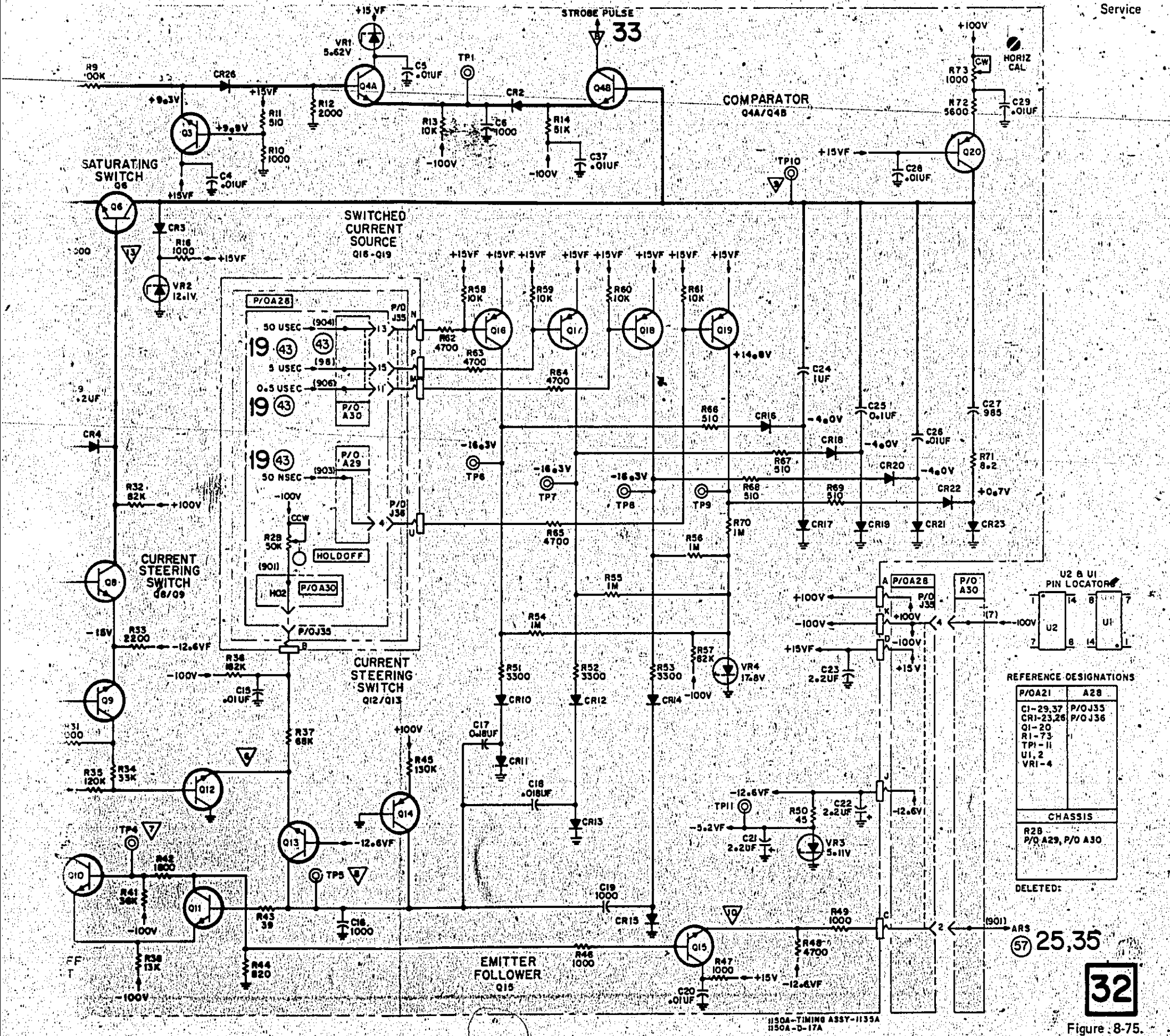


Figure 8-75.
Timing Assembly A21, Schematic 32

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1150A front-panel controls in accordance with paragraph 5-13 (Section V).
2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

WAVEFORM MEASUREMENT CONDITIONS

1. Set Model 1150A front-panel controls in accordance with paragraph 5-13 (Section V).
2. Apply 50-MHz signal (≈800-mV amplitude) to CHANNEL 1 INPUT connector on rear panel of Model 1150A.
3. Use test point A21TP3 to externally trigger monitor oscilloscope (−slope) unless otherwise indicated beneath particular waveform. Set monitor oscilloscope controls for sweep speed and sensitivity as indicated under each waveform. Use 10:1 voltage divider probe.
4. Use following for waveform test point location:

Waveform	Test Point	Schematic
1	J46	30
2	Junction of A23CR1 A23CR2	35
3	A23TP6	35
4	A21TP2	32
5	A21TP3	32
6	Emitter of A21Q12	32
7	A21TP4	32
8	A21TP5	32
9	A21TP10	32
10	Emitter of A21Q15	32
11	J36 Pin R	32
12	A21TP1	32
13	Base of A21Q6	32
14	A21TP12	33
15	A21TP33	33
16	Base of A22Q1B Base of A24Q1B	34 36
17	A22TP2 A24TP2	34 36
18	A22TP1 A24TP1	34 36
19	A22TP3 A24TP3	34 36
20	A22TP5 A22TP5	34 36
21	A22TP6 A22TP6	34 36

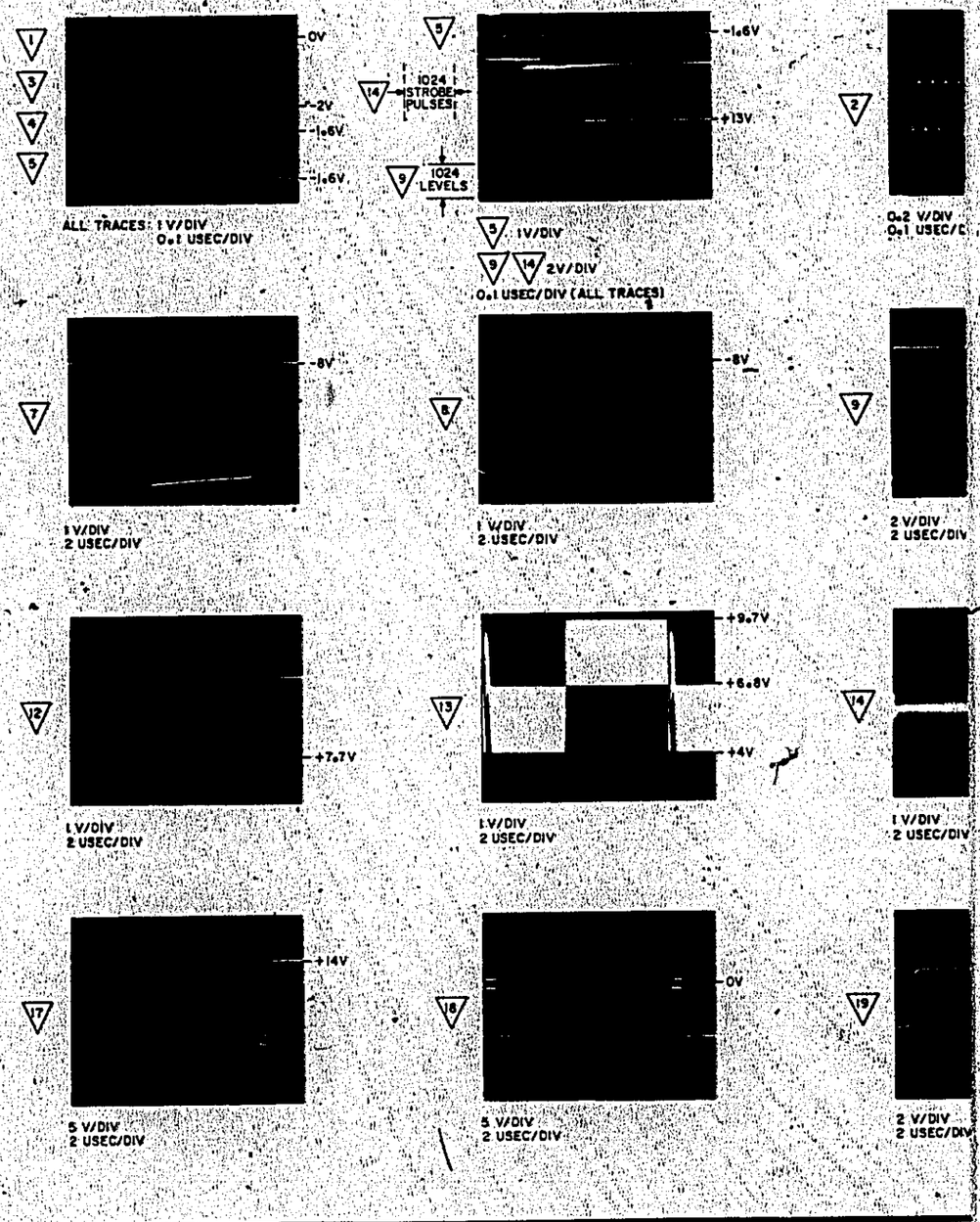
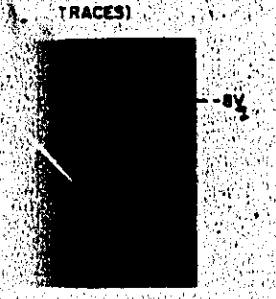
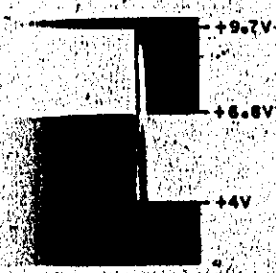
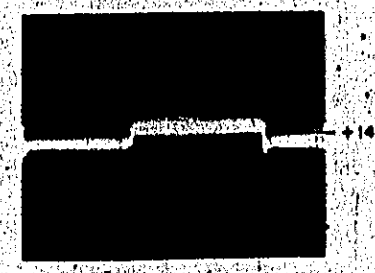
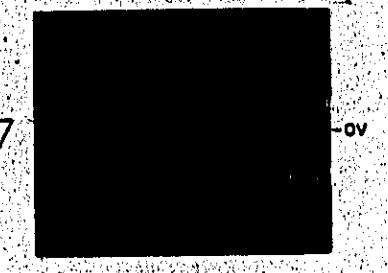


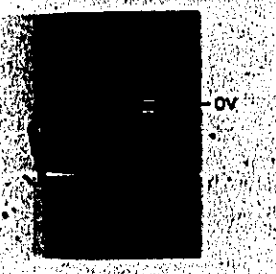
Table 8-14. Timing Measurement Conditions

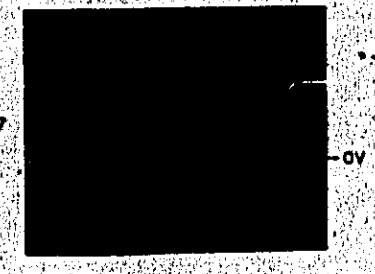


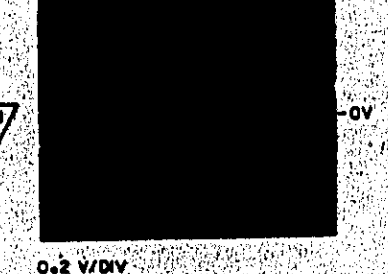




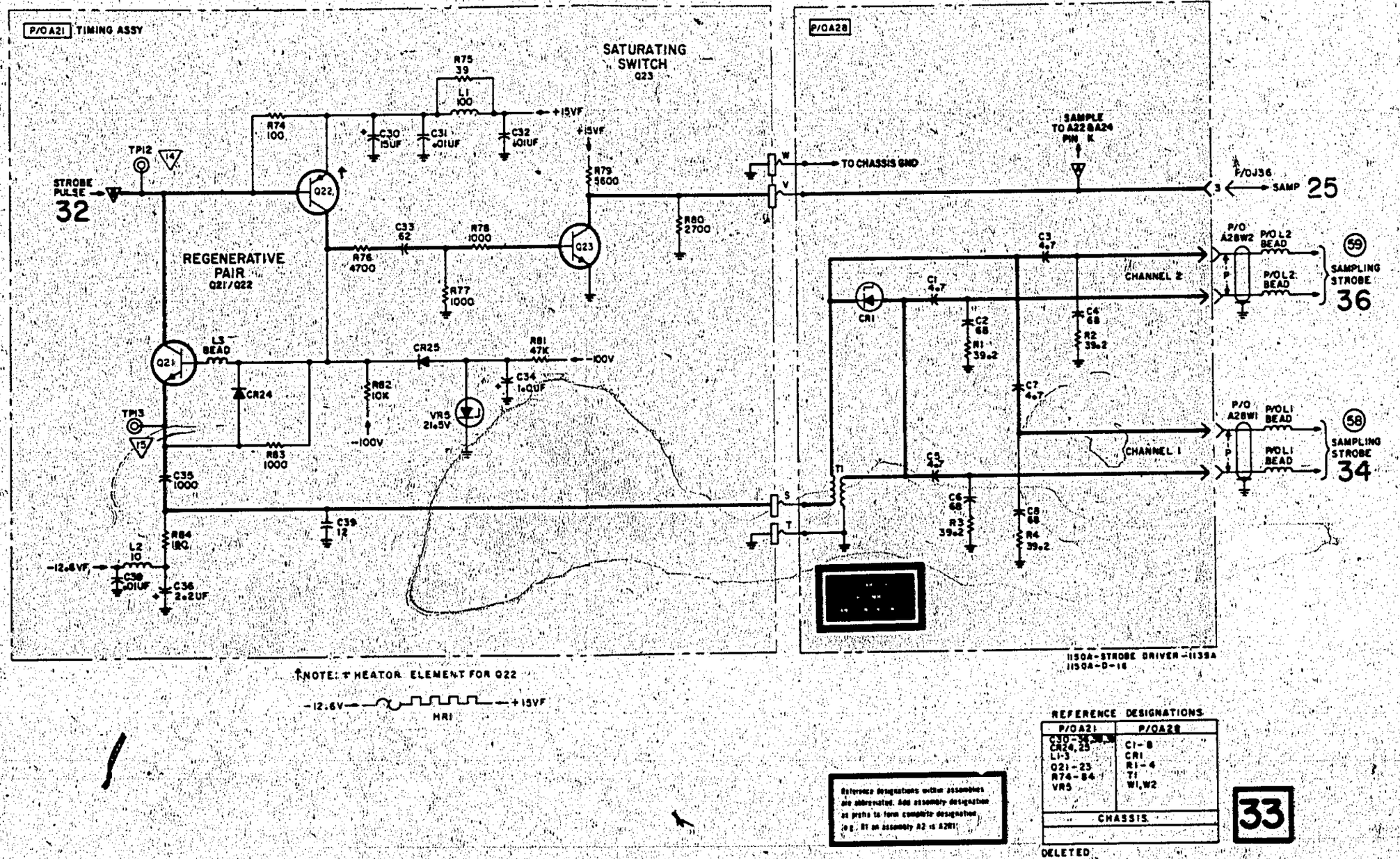








1150A-B-30



Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

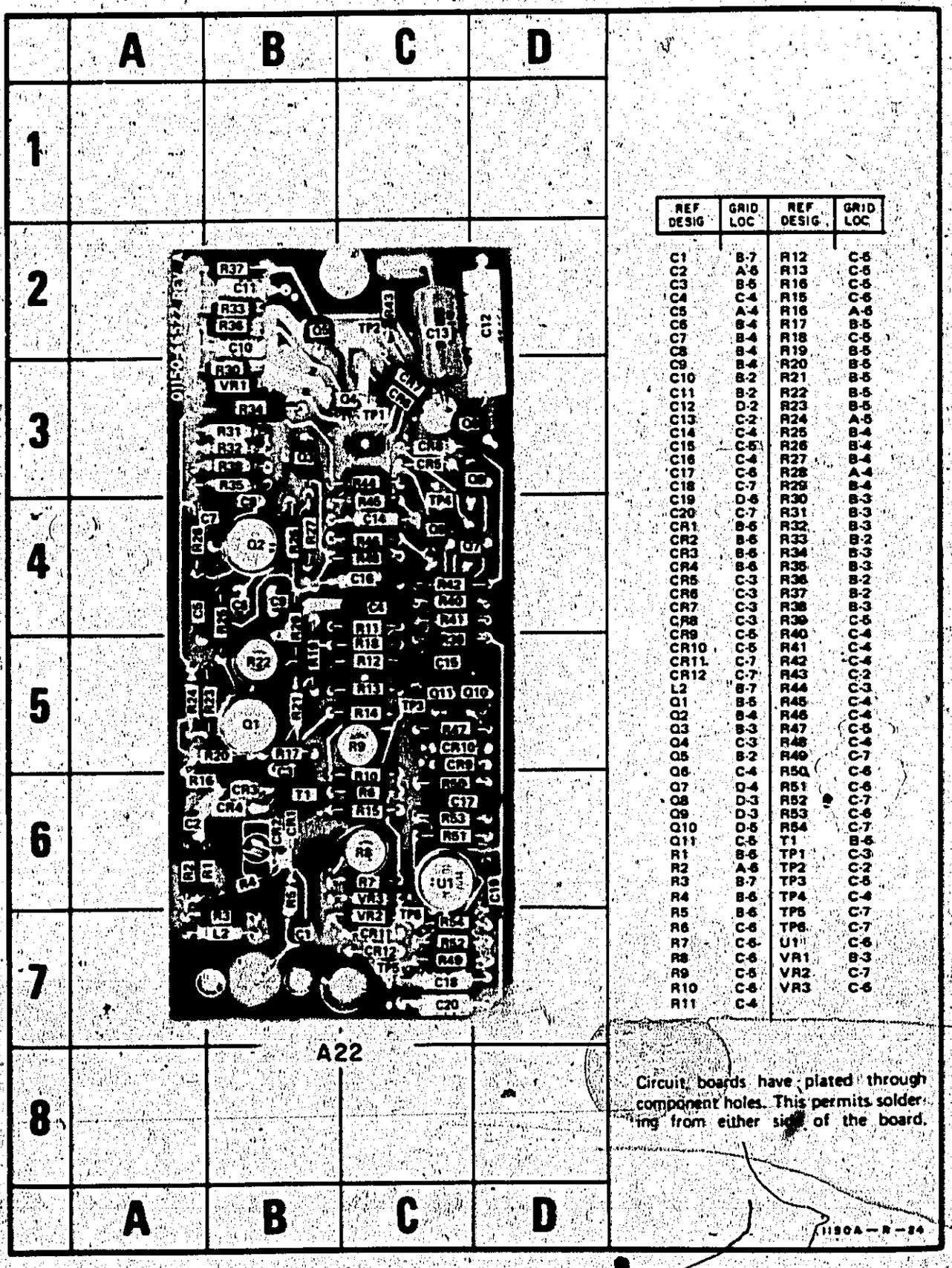
REFERENCE DESIGNATIONS

P/O A21	P/O A28
C30-36, 38, 39	C1-8
CR24, 25	CR1
L1-3	R1-4
Q21-23	T1
R74-84	W1, W2
VR5	
CHASSIS	

DELETED

33

Figure 8-76.
Timing Assembly A21, Schematic 33



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-7	R12	C-5
C2	A-6	R13	C-5
C3	B-5	R14	C-5
C4	C-4	R15	C-6
C5	A-4	R16	A-6
C6	B-4	R17	B-5
C7	B-4	R18	C-5
C8	B-4	R19	B-5
C9	B-4	R20	B-5
C10	B-2	R21	B-5
C11	B-2	R22	B-5
C12	D-2	R23	B-5
C13	C-2	R24	A-5
C14	C-4	R25	B-4
C15	C-5	R26	B-4
C16	C-4	R27	B-4
C17	C-6	R28	A-4
C18	C-7	R29	B-4
C19	D-6	R30	B-3
C20	C-7	R31	B-3
CR1	B-6	R32	B-3
CR2	B-6	R33	B-2
CR3	B-6	R34	B-3
CR4	B-6	R35	B-3
CR5	C-3	R36	B-2
CR6	C-3	R37	B-2
CR7	C-3	R38	B-3
CR8	C-3	R39	C-5
CR9	C-5	R40	C-4
CR10	C-5	R41	C-4
CR11	C-7	R42	C-4
CR12	C-7	R43	C-2
L2	B-7	R44	C-3
Q1	B-5	R45	C-4
Q2	B-4	R46	C-4
Q3	B-3	R47	C-5
Q4	C-3	R48	C-4
Q5	B-2	R49	C-7
Q6	C-4	R50	C-6
Q7	D-4	R51	C-6
Q8	D-3	R52	C-7
Q9	D-3	R53	C-6
Q10	D-5	R54	C-7
Q11	C-5	T1	B-6
R1	B-6	TP1	C-3
R2	A-6	TP2	C-2
R3	B-7	TP3	C-6
R4	B-6	TP4	C-4
R5	B-6	TP5	C-7
R6	C-6	TP6	C-7
R7	C-6	U1	C-6
R8	C-6	VR1	B-3
R9	C-5	VR2	C-7
R10	C-6	VR3	C-6
R11	C-4		

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1150A—R—84

Figure 8-77. Component Identification, Assembly A22

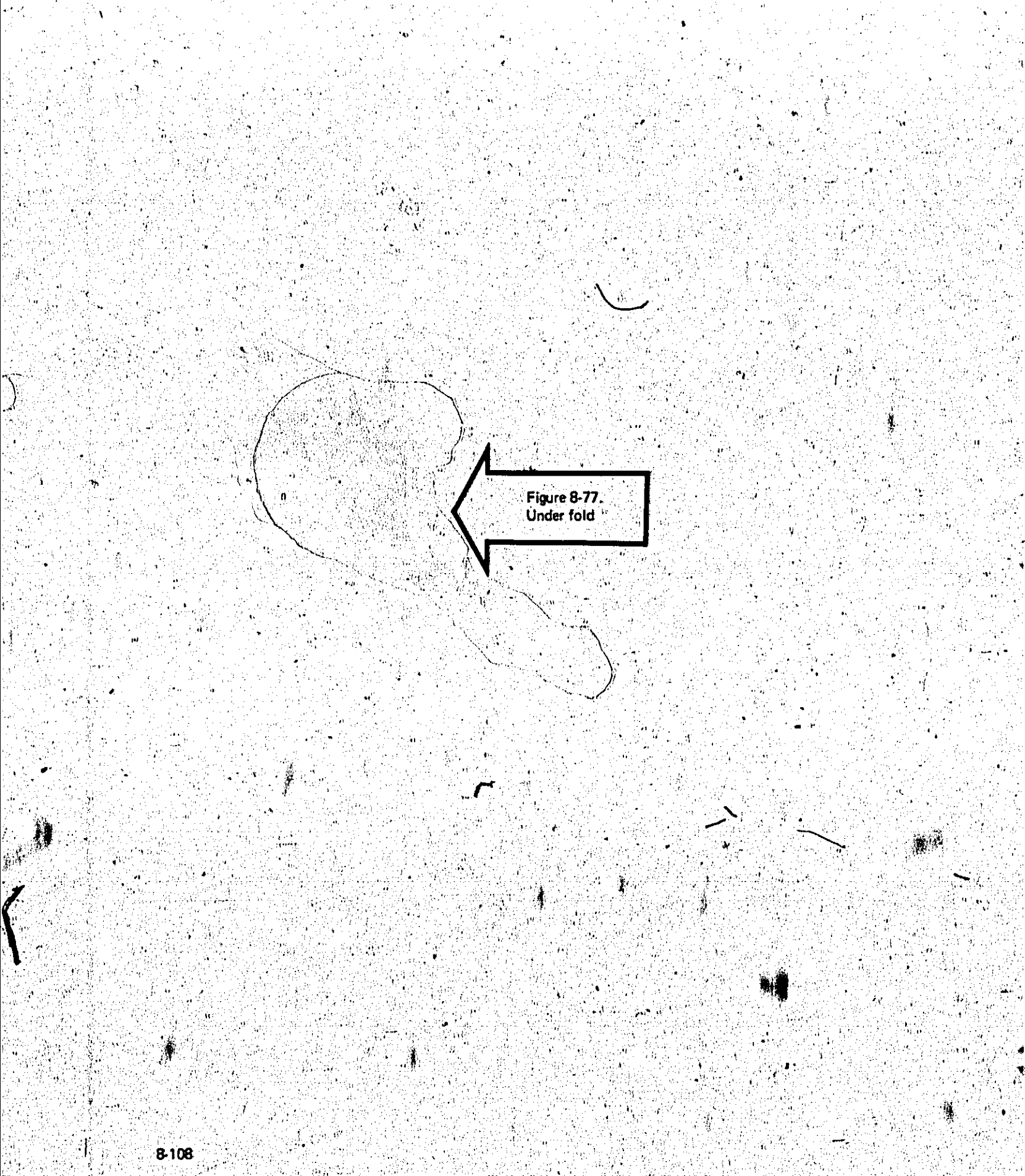
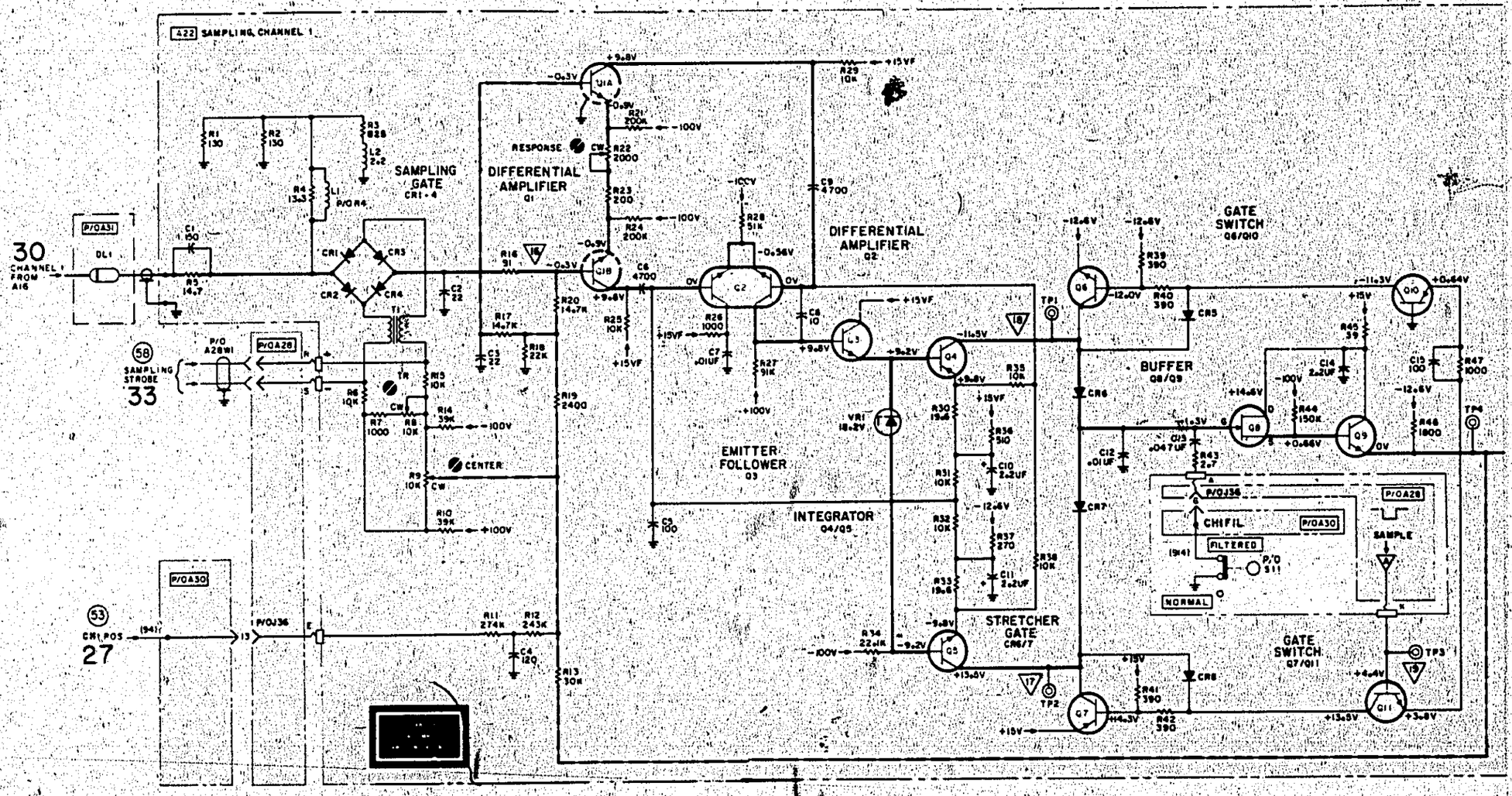
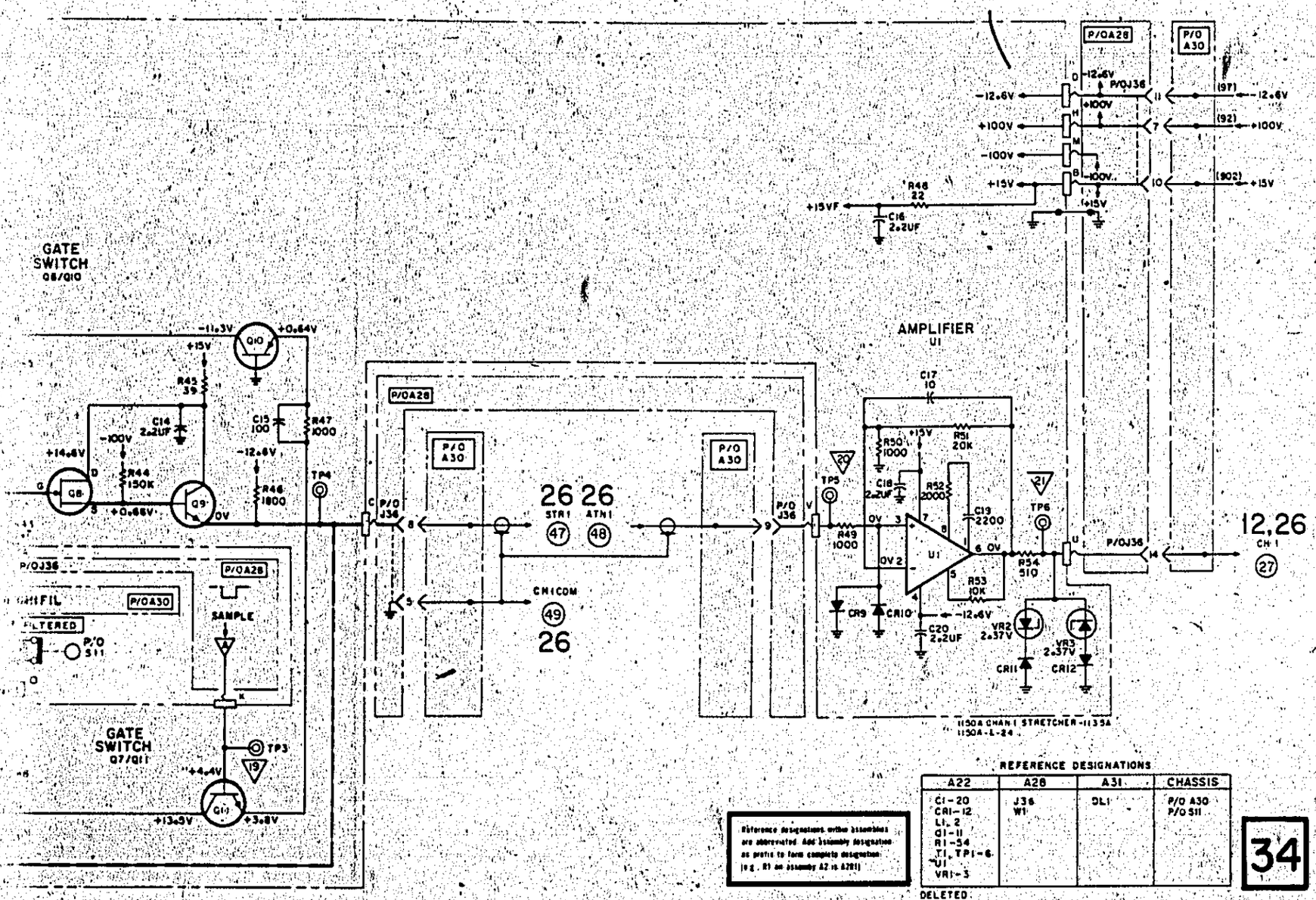


Figure 8-77.
Under fold


A22 SAMPLING, CHANNEL 1
30
CHANNEL 1 FROM A16
P/O A31
DL1
C1 150
R3 14.7
CR1
CR2
CR3
CR4
C2 22
T1
58
SAMPLING STROBE
33
P/O A28W1
P/O A26
TR
R5 10K
R6 10K
R7 1000
R8 10K
R14 39K
-100V
CENTER
R9 10K CW
R10 39K
+100V
SAMPLING GATE CR1-4
R1 130
R2 130
R3 825
L2 2.2
R4 13.3
L1 P/O R4
RESPONSE
DIFFERENTIAL AMPLIFIER Q1
+9.8V
-0.3V
Q1A
Q1B
R21 200K
-100V
R22 2000 CW
R23 200
R24 200K
-100V
-0.3V
R16 91
-0.3V
+9.8V
C6 4700
R20 14.7K
R25 10K
+15VF
R17 14.7K
R18 22K
C3 22
R19 2400
-100V
C9 4700
DIFFERENTIAL AMPLIFIER Q2
R29 10K
+15VF
R28 51K
-0.56V
0V
Q2
0V
R26 1000
+15VF
C7 .01UF
-100V
C8 10
+9.8V
R27 91K
TP1
+15VF
Q3
+9.2V
-11.5V
Q4
+9.8V
R35 10K
VR1 18.2V
R30 19.6
+15VF
R36 510
R31 10K
C10 2.2UF
-12.6V
R37 270
R32 10K
C11 2.2UF
R38 10K
R33 19.6
EMITTER FOLLOWER Q3
C5 100
INTEGRATOR Q4/Q5
-9.8V
R34 22.1K
-100V
-9.2V
Q5
+13.8V
STRETCHER GATE CR6/7
CR7
CR8
+15V
R41 390
Q7
-14.3V
R42 390
TP2
+15V
+13.8V
GATE SWITCH Q7/Q11
+4.4V
Q11
+3.8V
TP3
+9
GATE SWITCH Q6/Q10
-12.6V
-12.6V
Q6
-12.0V
R39 390
R40 390
CR5
-11.3V
Q10
+0.66V
BUFFER Q8/Q9
CR6
+15V
R45 39
C14 2.2UF
-100V
R44 150K
+14.6V
Q8
+0.66V
Q9
0V
C15 100
R47 1000
-12.6V
R46 1800
TP4
C12 .01UF
C13 .047UF
T1.3V
R43 2.7
P/O J36
P/O A28
CH1FIL
P/O A30
FILTERED
(94)
P/O J11
SAMPLE
NORMAL
53
CH1 POS
27
(94)
P/O A30
P/O J36
13
E
R11 274K
R12 243K
C4 120
R13 30K



REFERENCE DESIGNATIONS

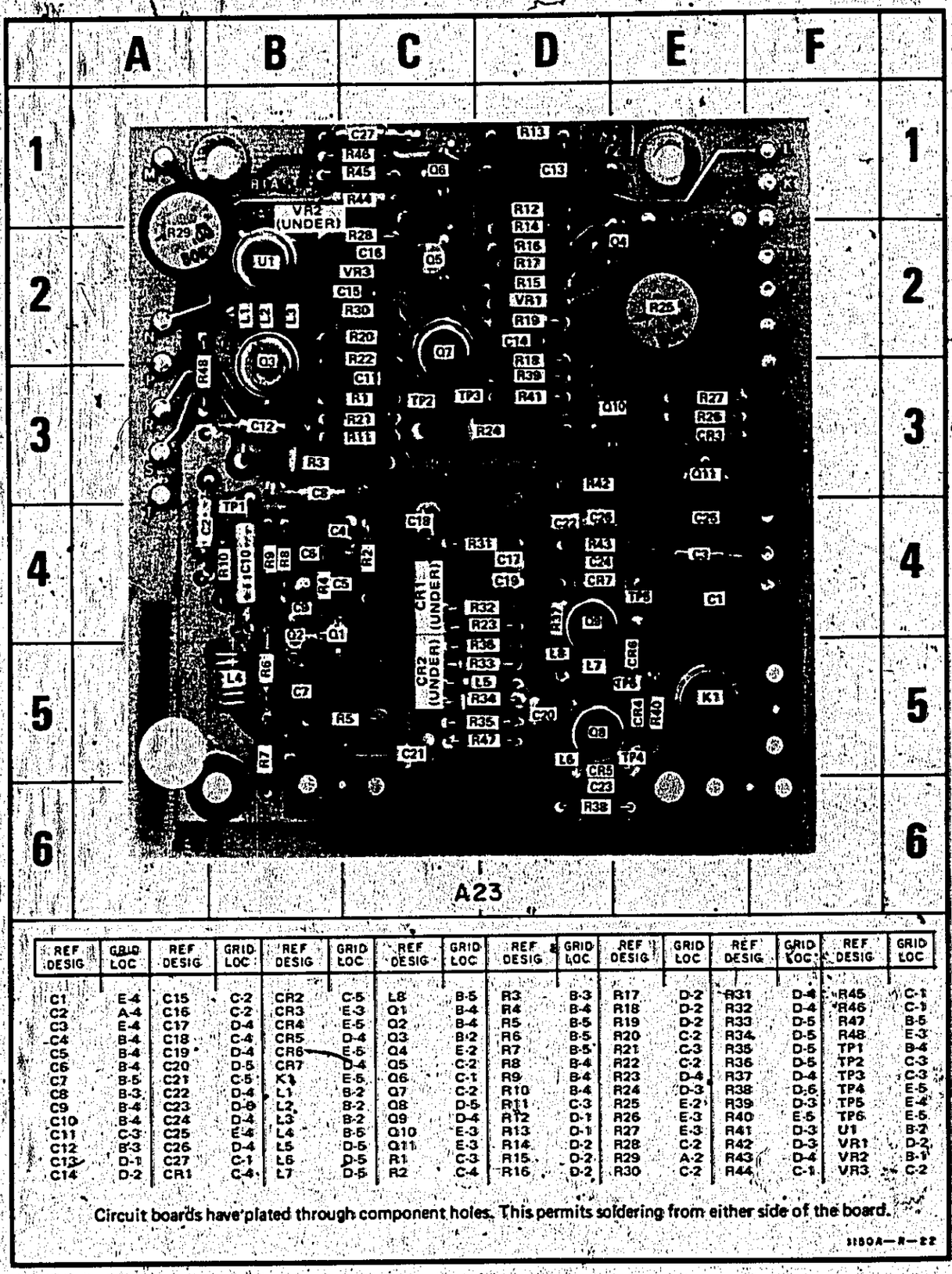
A22	A28	A31	CHASSIS
C1-20 CR1-12 L1, 2 Q1-11 R1-54 T1, TP1-6 U1 VR1-3	J36 W1	DL1	P/O A30 P/O S11

DELETED

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1)

34

Figure 8-78.
Channel 1 Sampling Assembly A22, Schematic 34



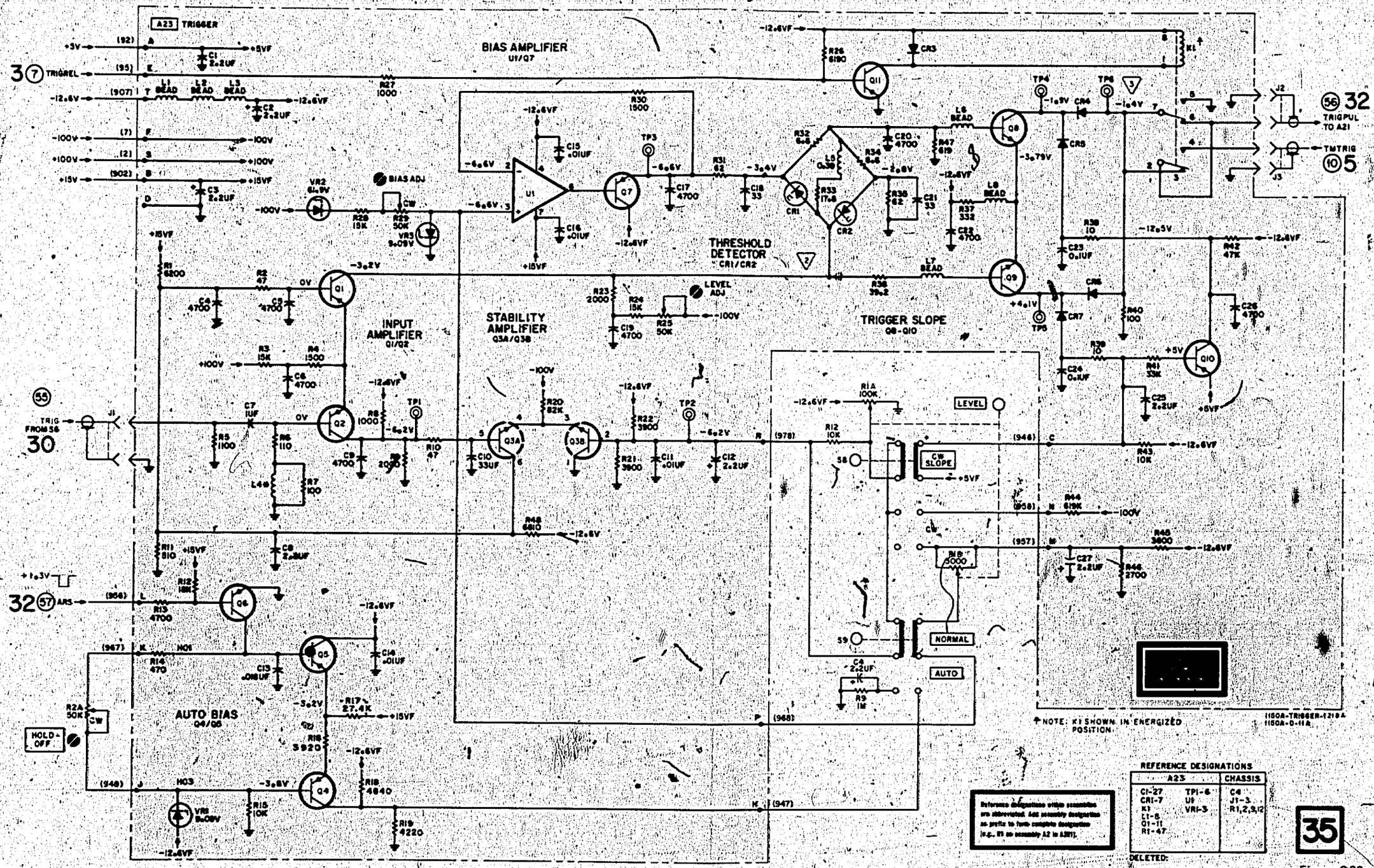
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-4	C15	C-2	CR2	C-5	L8	B-5	R3	B-3	R17	D-2	R31	D-4	R45	C-1
C2	A-4	C16	C-2	CR3	E-3	Q1	B-4	R4	B-4	R18	D-2	R32	D-4	R46	C-1
C3	E-4	C17	D-4	CR4	E-5	Q2	B-4	R5	B-5	R19	D-2	R33	D-5	R47	B-5
C4	B-4	C18	C-4	CR5	D-4	Q3	B-2	R6	B-5	R20	C-2	R34	D-5	R48	E-3
C5	B-4	C19	D-4	CR6	E-5	Q4	E-2	R7	B-5	R21	C-3	R35	D-5	TP1	B-4
C6	B-4	C20	D-5	CR7	D-4	Q5	C-2	R8	B-4	R22	C-2	R36	D-5	TP2	C-3
C7	B-5	C21	C-5	K1	E-5	Q6	C-1	R9	B-4	R23	D-4	R37	D-4	TP3	C-3
C8	B-3	C22	D-4	L1	B-2	Q7	C-2	R10	B-4	R24	D-3	R38	D-6	TP4	E-5
C9	B-4	C23	D-6	L2	B-2	Q8	D-5	R11	C-3	R25	E-2	R39	D-3	TP5	E-4
C10	B-4	C24	D-4	L3	B-2	Q9	D-4	R12	D-1	R26	E-3	R40	E-5	TP6	E-5
C11	C-3	C25	E-4	L4	B-5	Q10	E-3	R13	D-1	R27	E-3	R41	D-3	U1	B-2
C12	B-3	C26	D-4	L5	D-5	Q11	E-3	R14	D-2	R28	C-2	R42	D-3	VR1	D-2
C13	D-1	C27	C-1	L6	D-5	R1	C-3	R15	D-2	R29	A-2	R43	D-4	VR2	B-1
C14	D-2	CR1	C-4	L7	D-5	R2	C-4	R16	D-2	R30	C-2	R44	C-1	VR3	C-2

Circuit boards have plated through component holes. This permits soldering from either side of the board.

5150A—R—22

Figure 8-79. Component Identification, Assembly A23

Figure 8-79.
Under fold



REFERENCE DESIGNATIONS

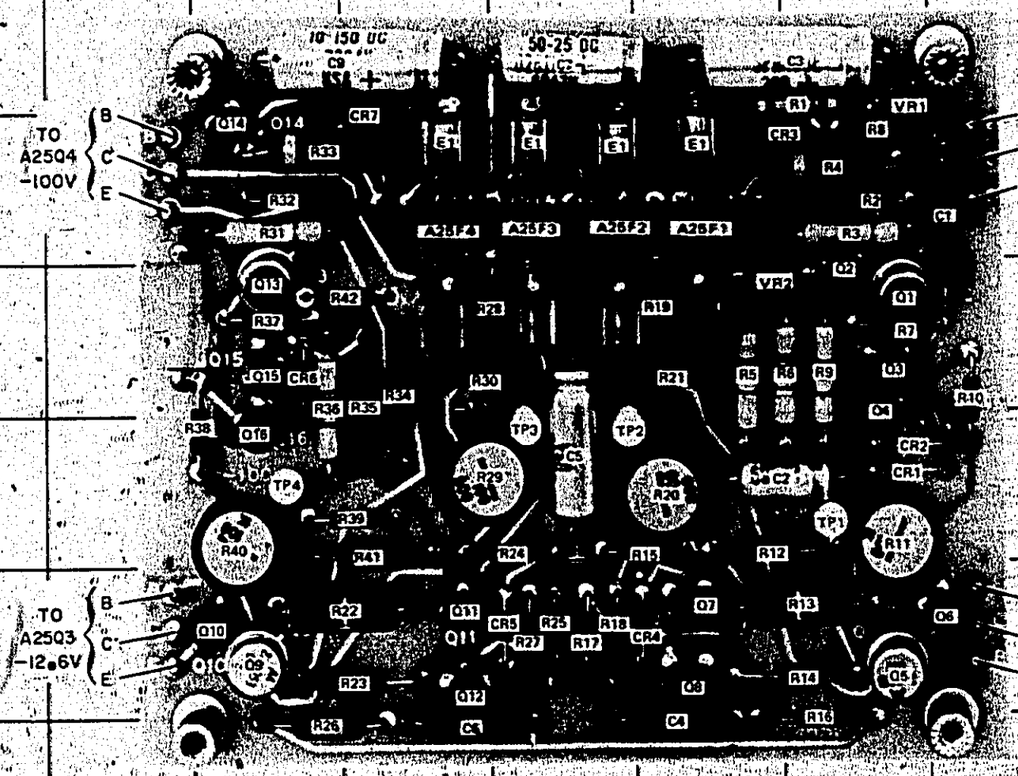
A23		CHASSIS
C1-27	TP1-6	C4
CR1-7	U1	J1-3
K1	VR1-3	R1,2,9,12
L1-5		
Q1-11		
R1-47		

DELETED:

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R5 on assembly A2 is A2R5).

35

Figure 8-80.
Trigger Assembly A23, Schematic 35

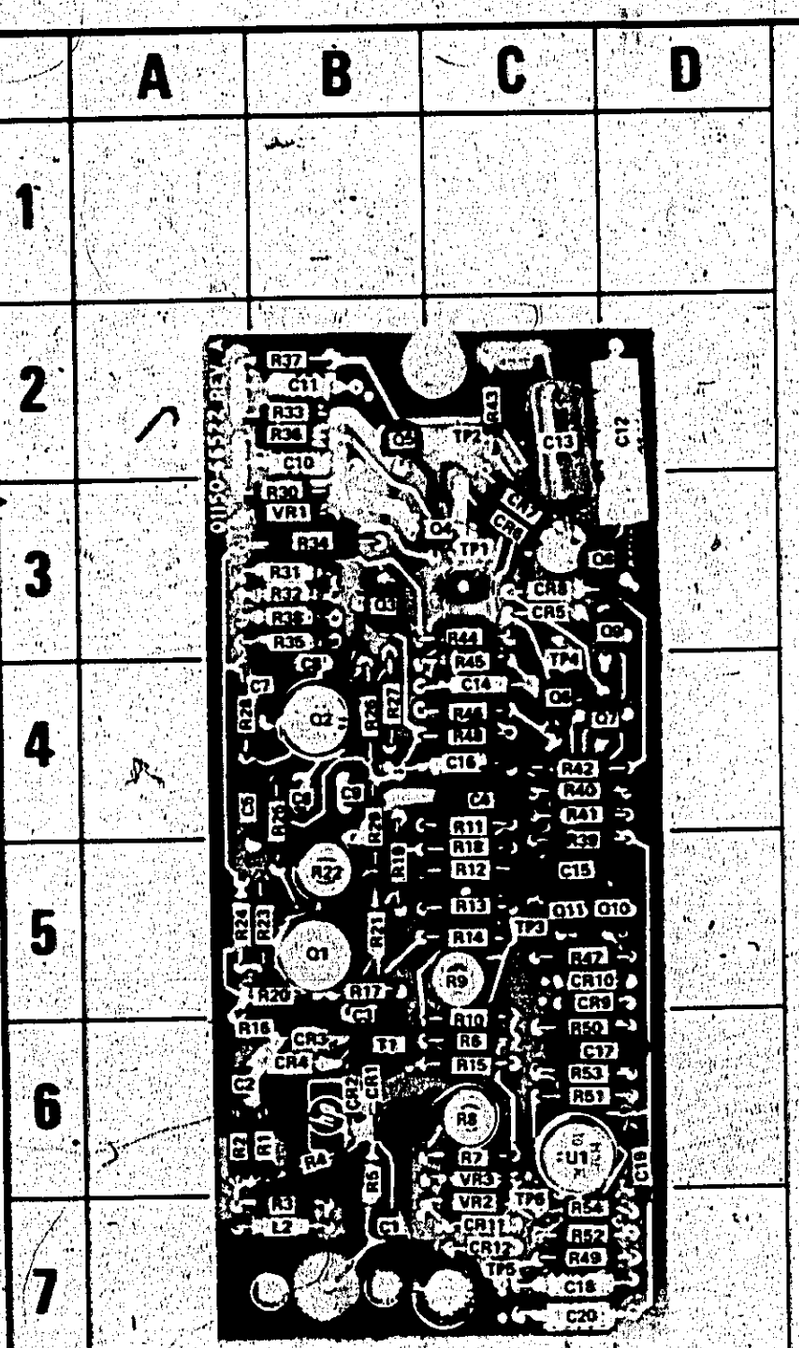


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A25F1	H-2	C7	G-1	Q1	I-3	Q11	F-5	R5	H-3	R15	H-4	R26	E-6	R37	E-3
A25F2	G-2	C9	E-1	Q2	I-3	Q12	F-5	R6	I-3	R16	I-6	R27	G-5	R38	E-4
A25F3	G-2	CR1	I-4	Q3	I-3	Q13	E-3	R7	I-3	R17	G-5	R28	F-3	R39	F-4
A25F4	F-2	CR2	I-4	Q4	I-4	Q14	E-2	R8	I-2	R18	G-5	R29	F-4	R40	E-4
C1	J-2	CR3	I-2	Q5	I-5	Q15	E-3	R9	I-3	R19	H-3	R30	F-3	R41	F-4
C2	H-4	CR4	H-5	Q6	J-5	Q16	E-4	R10	J-3	R20	H-4	R31	E-2	R42	F-3
C3	I-1	CR5	G-5	Q7	H-5	R1	I-1	R11	I-4	R21	H-3	R32	E-2	TP1	I-4
C4	H-6	CR6	E-3	Q8	H-5	R2	I-2	R12	H-4	R22	F-5	R33	E-2	TP2	G-4
C5	G-4	CR7	F-2	Q9	E-5	R3	I-2	R13	I-5	R23	F-5	R34	F-3	TP3	G-4
C6	F-6	E-1	F-2	Q10	E-5	R4	I-2	R14	I-5	R24	G-4	R35	F-3	TP4	E-6
										R25	G-4	R36	E-3	VR1	I-1
														VR2	H-3

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1160A—8—28A

Figure 8-81. Component Identification, Assembly A25A2

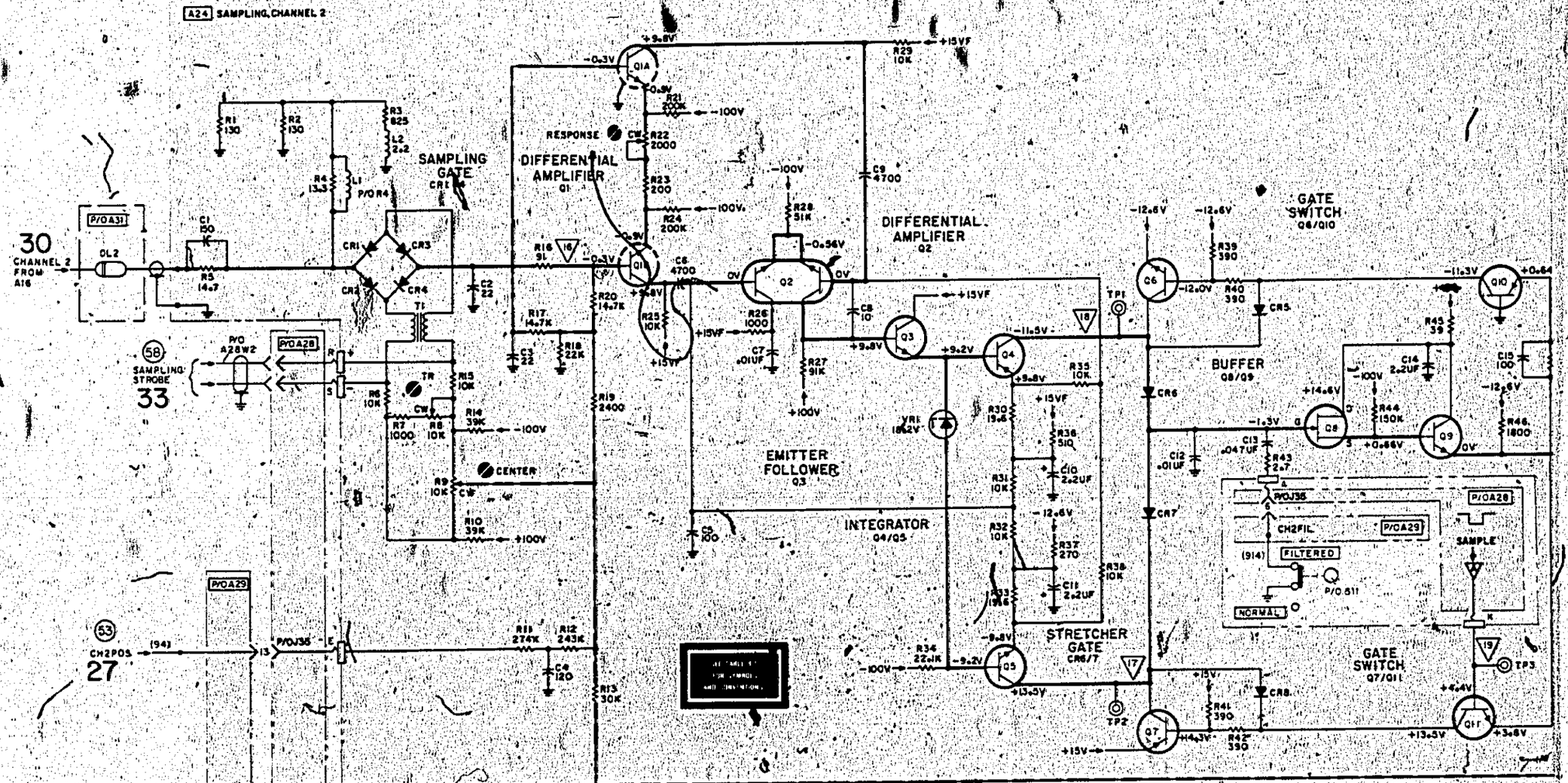


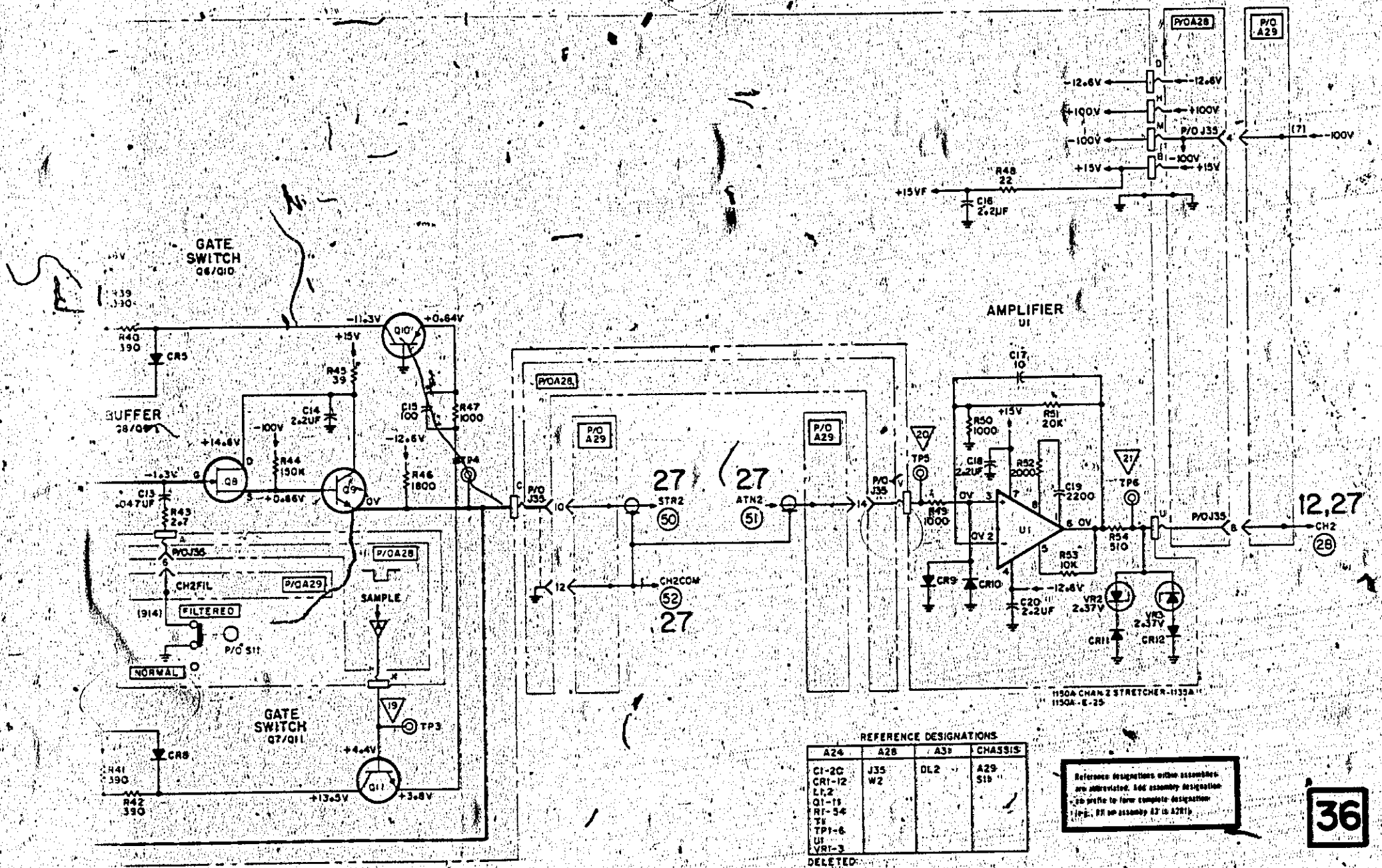
REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-7	R12	C-5
C2	A-6	R13	C-5
C3	B-5	R16	C-5
C4	C-4	R15	C-6
C5	A-4	R16	A-6
C6	B-4	R17	B-5
C7	B-4	R18	C-5
C8	B-4	R19	B-5
C9	B-4	R20	B-5
C10	B-2	R21	B-5
C11	B-2	R22	B-5
C12	D-2	R23	B-5
C13	C-2	R24	A-5
C14	C-4	R25	B-4
C15	C-5	R26	B-4
C16	C-4	R27	B-4
C17	C-6	R28	A-4
C18	C-7	R29	B-4
C19	D-6	R30	B-3
C20	C-7	R31	B-3
CR1	B-6	R32	B-3
CR2	B-6	R33	B-2
CR3	B-5	R34	B-3
CR4	B-6	R35	B-3
CR5	C-3	R36	B-2
CR6	C-3	R37	B-2
CR7	C-3	R38	B-3
CR8	C-3	R39	C-5
CR9	C-5	R40	C-4
CR10	C-5	R41	C-4
CR11	C-7	R42	C-4
CR12	C-7	R43	C-2
L2	B-7	R44	C-3
Q1	B-5	R45	C-4
Q2	B-4	R46	C-4
Q3	B-3	R47	C-5
Q4	C-3	R48	C-4
Q5	B-2	R49	C-7
Q6	C-4	R50	C-6
Q7	D-4	R51	C-6
Q8	D-3	R52	C-7
Q9	D-3	R53	C-6
Q10	D-5	R54	C-7
Q11	C-5	T1	B-6
R1	B-6	TP1	C-3
R2	A-6	TP2	C-2
R3	B-7	TP3	C-5
R4	B-6	TP4	C-4
R5	B-6	TP5	C-7
R6	C-6	TP6	C-7
R7	C-6	U1	C-6
R8	C-6	VR1	B-3
R9	C-5	VR2	C-7
R10	C-6	VR3	C-6
R11	C-4		

Circuit boards have plated through component holes. This permits soldering from either side of the board.

A50A—R—24

Figure 8-82. Component Identification, Assembly A24


A24 SAMPLING, CHANNEL 2
30
CHANNEL 2 FROM A16
P/O A31
DL2
C1 150
R1 130
R2 130
R3 825
L2 2.2
R4 13.3
L1
P/O R4
R5 14.7
CR1
CR2
CR3
CR4
C2 22
T1
58
SAMPLING STROBE
33
P/O A28W2
P/O A28
R6 10K
TR
R7 1000
R8 10K
R14 39K
-100V
CENTER
R9 10K
R10 39K
+100V
R15 10K
R19 2400
R13 30K
P/O A29
53
CH2 POS.
27
(94)
P/O J35
E
13
R11 274K
R12 243K
C4 120
SAMPLING GATE
DIFFERENTIAL AMPLIFIER
Q1
RESPONSE
CW
Q1A
+9.8V
-0.3V
-0.9V
R21 200K
-100V
R22 2000
R23 200
R24 200K
-100V
R16 91
16
-0.3V
Q1
C6 4700
+9.8V
R25 10K
+15VF
R17 14.7K
R18 22K
C3 22
R20 14.7K
R26 1000
+15VF
C7 .01UF
+100V
R28 51K
-0.56V
Q2
0V
0V
C9 4700
R29 10K
+15VF
DIFFERENTIAL AMPLIFIER
Q2
C8 10
+9.8V
Q3
+15VF
+9.2V
-11.5V
Q4
+9.8V
R35 10K
+15VF
R27 91K
+100V
EMITTER FOLLOWER
Q3
YR1 1862V
R30 19.6
R36 510
C10 2.2UF
R31 10K
-12.6V
R37 270
C11 2.2UF
R38 10K
R32 10K
R33 19.6
INTEGRATOR
Q4/Q5
C5 100
-9.8V
Q5
-9.2V
R34 22.1K
-100V
+13.5V
STRETCHER GATE
CR6/7
17
TP2
+15V
Q7
+4.3V
R42 390
R41 390
CR8
+15V
+13.5V
TP1
18
-12.6V
-12.6V
GATE SWITCH
Q6/Q10
Q6
-12.0V
R39 390
R40 390
CR5
-11.3V
Q10
+0.64
BUFFER
Q8/Q9
CR6
R45 39
C14 2.2UF
-100V
+14.6V
Q8
-1.3V
G
S
R44 150K
Q9
+0.66V
0V
C15 100
-12.6V
R46 1800
C13 .047UF
C12 .01UF
R43 2.7
P/O J35
CH2 FIL
P/O A29
(914)
FILTERED
NORMAL
P/O 511
CR7
P/O A28
SAMPLE
K
19
TP3
GATE SWITCH
Q7/Q11
+4.4V
+3.6V
CR8
+13.5V



REFERENCE DESIGNATIONS

A24	A28	A38	CHASSIS
C1-2C	J35	DL2	A29
CR1-12	W2		S11
L1,2			
Q1-11			
R1-54			
T1			
TP1-6			
U1			
VR1-3			

DELETED:

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (i.e., R1 on assembly A3 is A3R1).

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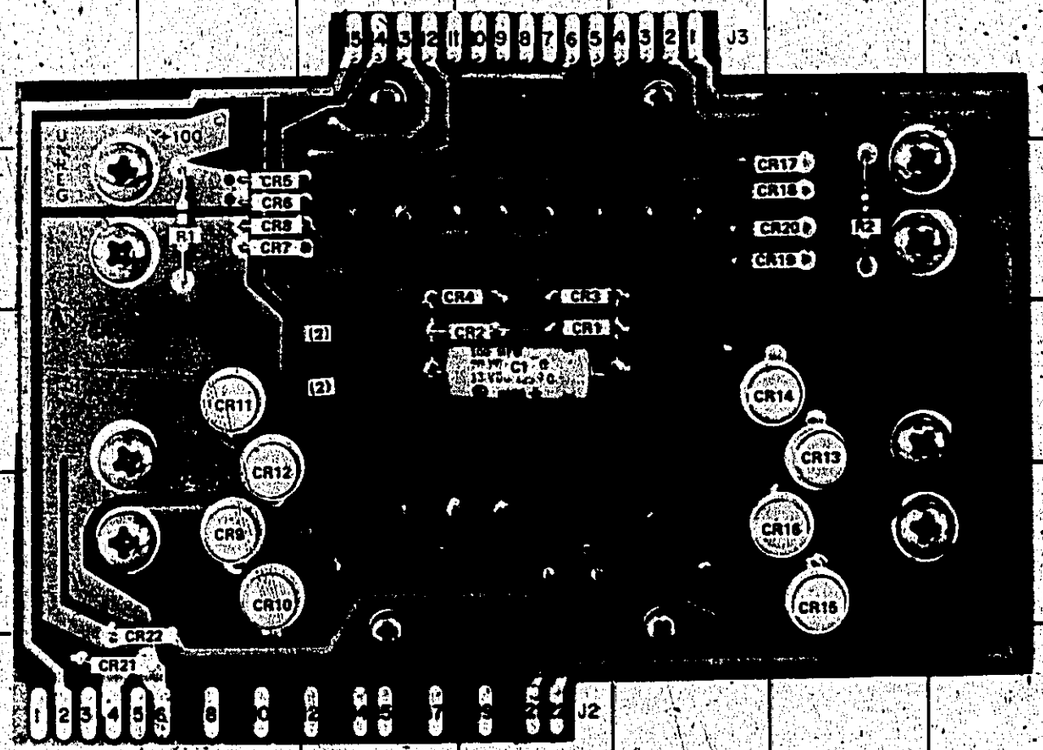
Figure 8-83.
Channel 2 Sampling Assembly A24, Schematic 36



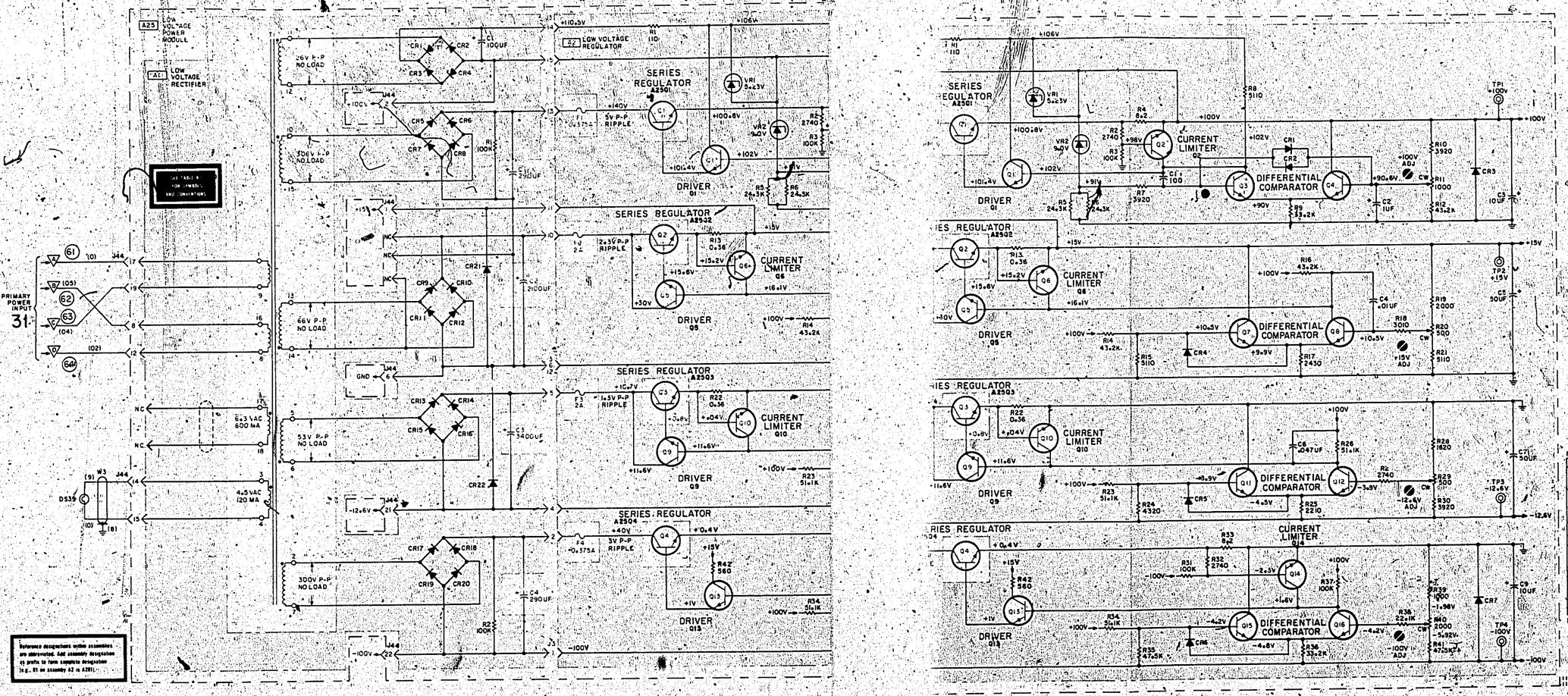
Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	G-3	CR5	E-2	CR10	E-4	CR15	I-4	CR20	I-2
CR1	G-3	CR6	E-2	CR11	E-3	CR16	I-4	CR21	D-5
CR2	G-3	CR7	E-2	CR12	E-4	CR17	I-2	CR22	D-5
CR3	G-2	CR8	E-2	CR13	I-3	CR18	I-2	R1	E-2
CR4	G-2	CR9	E-3	CR14	I-3	CR19	I-2	R2	I-2

1180A-R-E7

Figure 8-84. Component Identification, Assembly A25A1

Figure 8-84.
Under fold



REFERENCE DESIGNATIONS

A25	A25A1
C1-4, F1-4, Q1-4, T1	C1, CR1-22, J2, R1, 2
A25A2	**CHASSIS**
C1-7,9, CR1-7, F3, Q1-16, R1-42, TP1-4, VR1, 2	D539, W3, J44

DELETED: A25A2C8

Figure 8-85.
Low Voltage Power Supply Assembly A25, Schematic 37