Errata

Title & Document Type: 1150A Programmable Waveform Processor Operating

and Service Manual

Manual Part Number: 01150-90901

Revision Date: May 1972

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HEWLETT IP PACKARD

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OPERATING AND SERVICE MANUAL

MODEL 1150A PROGRAMMABLE WAYEFORM PROCESSOR

SERIALS PREFIXED: 1218A

Refer to Section VII for instruments with other Serial Prefixes.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION

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

PRINTED: MAY 1972

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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 each allowed by the Bureau's calibration facility.

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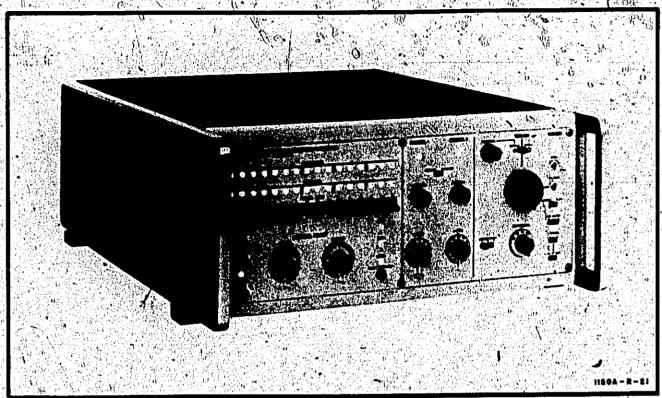


Figure 1-1. Model 1150A Programmable Waveform Processor

Table 1-1. Specifications

	2		•	P1	\sim	B.L
U	PE	м	А.	1 1	u	N

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	ccuracy
	Full scale Full scale
	Full scale
	Full scale
	Full scale Full scale
	Full scale

Note

Specified accuracy, after 1 hr warmup at +25°C, DC voltage measurement accuracy as specified for measurement made immediately after calling calibrate routine; specified accuracy is 30 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

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 1,150A 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.



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 10487A 10488A 10489A	Panel, accessory Kit, Input/Output interface Cable, X-Y-Z Display Cable, Storage Display

1-13. INSTRUMENT AND MANUAL IDENTI-

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.

Internal Noise (appearing on baseline of re-

Filtered - < 2 mV

Channel Isolation: >35 d8 with 350 ps rise-

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.

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 colrection; ±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 flaving 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

>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

confidence without readjustment is

Scan

be expanded.

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 prequires 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, 1 Mps, ½ sine wave.

POWER REQUIREMENT

1-15 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.

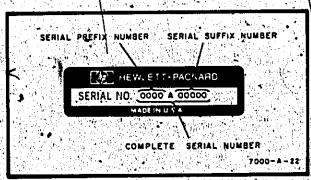


Figure 1-2. Instrument Serial Number

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

			3.00			
= assembly	E	= misc, electrical part	"p "	plug	U	= integrated circult
T = attenuator,	F 1	* fuse	PS	power supply "	V in the	(unrepairable): ; = vacuum tube; ne
resistive termination		= filter = hardware	· Q	🖛 transistor 🌓: 🦠	North Bud	bulb, photocell,
motor, fan battery		= Jack	R	= resistor,	VR:	= voltage regulator
= capacitor	K	= relay	RT .∳ S	thermistor	W	diode)
= coupling	L1	= inductor	3	= transformer	X	= cable.
i • diode i (r i i i i i i i i i	LS	= speaker = meter	TB '	= .terminal board	, Y 🐆	= crystal
= delay line = device signaling (la		= mechanical part	TP	= test point	2	network
		1 L	,	计合理数据 短围 克	W _T	
병원들은 사람들 시간 나타를				gawa da Aleksan 🖟 🖫		
		ABBREVI	ATIONS			
				- (1.2 \ - 1.		
= ampere(s)	FET	= field-affect	n'	= nano (10 ⁻⁹)	rii'	radio frequency interference
npl === amplifier(s)		transistor(s)	no	normally closed \ = normally open \	rms (%)	= root mean squar
yidmessa = vidnosta	100		000	= negative-positive-	rwv .	= reverse working
apito - Shipirtoda	G	⇒ giga (10 ⁹)		negative		voltage
i = board(s) t	gnd	= ground(ed)	ns .	= nanosecond	SCR	= silicon controlle
a bandpass		n henry (ies)		= pico (10 ⁻¹²)	. 301	rectifier - The
= centl (10 ⁻²)	lnr l	= hour(s).	P	= pico (10)	SEC	= second(s)
- carbon	. ≱HP	= Hewlett-Packard	oc .	circuit(s)	\std 0	= standard
w counterclockwise:	Ϋ́ΠΙΖ	er = hertz (1) (b) (iii) ii	pk	= peak	trmr	= trimmer
ax. = coaxial	jr	intermediate freq.	pnp	= positive-negative-	Y ""	
ef = coefficient	intl	= Internal	p/o	positive part of	u' ,	micro (10°°)
RT cathode-ray tube			р-р	= peak-to-peak	usec i	= microsecond
v 🚉 É clockwise	k	= kilo (10")	bram	program *	ν	• volts
= 'deci (10 ⁻¹)	lb.	= pound(s)	v prv €	= peak inverse	var	- variable:
3 deci (10)	ipi	= low-pass filter(s)		voltage(s)		
	99 3 BBC	= milli (10 ⁻³)	D\$	= peak working	w/ w/o	==with
San the control of the first of the first of the control of the co						

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):

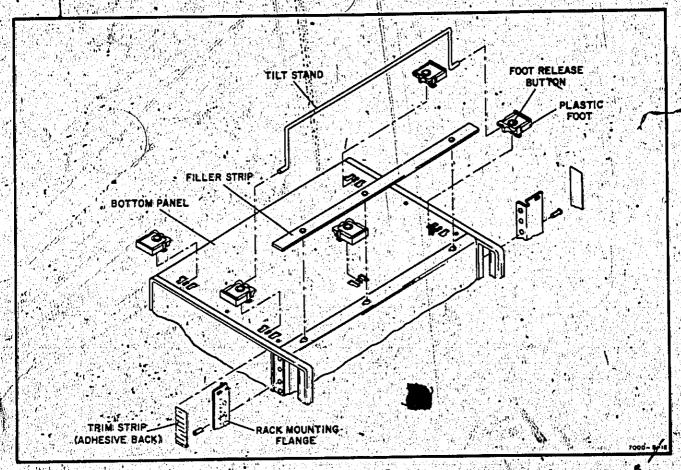


Figure 2-1. Rack Mount Procedure

- a. Detach tilt istand 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, the 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 10 to 30	200 275
 30'to 120 120 to 140 140 to 160'	350 500 600

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 select, ed 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. POTS/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 cap 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

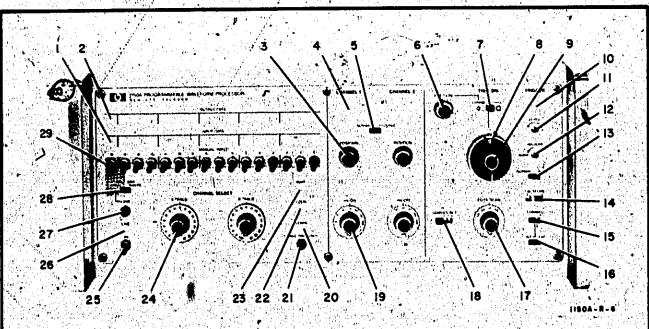
3-20. The vertical attenuation circuit is controlled by the CHANNEL 1 my/DLV switch. Selection of proper attenuation is accomplished by binary code. The binary code, established by the position of the CHANNEL 1 my/DIV switch, can be read directly into the computer.

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.

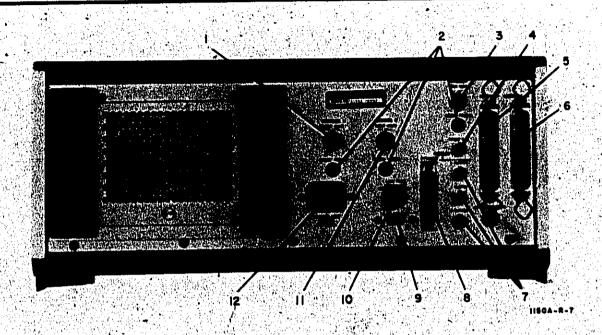
3-23. MANUAL INPUT SWITCHES.

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).
- 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.

- 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).



- 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 frontpanel control settings in computer. After all front-panel setups are stored, test routine can be executed whenever desired.

- The Calibrator Assembly can be programmed to supply a stable time mark signal or accurate do 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 O level ≈ +5V

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

		4 145	BI	T LO	CATI	ON an	d LOC	IC L	EVEL					
14	13	12	11	10	9	8	7	6	5	4,	3	2	1 13 I	0
\ 1	· / O	0			daya Naga Paga				Part of the second seco		3 7 7 S			
			0	0) /					*	**			
			10	1			34.47 11.4 (4			
				1.00%	5									
	14			1 0 0	1 70 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0	0 0 0 1 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0		14 13 12 11 10 9 8 7 1 '0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	14 13 12 11 10 9 8 7 6 1 '0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	14 13 12 11 10 9 8 7 6 5 1 70 0 0 7 7 7 8 7 8 7 8 7 8 7 8 7 8 7 8	14 13 12 11 10 9 8 7 6 5 4. 1 70 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	14 13 12 11 10 9 8 7 6 5 4 3 1 70 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	14 13 12 11 10 9 8 7 6 5 4 3 2 1 70 0 0 7 7 7 7 8 7 8 7 8 8 7 8 8 7 8 8 8 7 8	14 13 12 11 10 9 8 7 6 5 4 3 2 1 1 70 0 0

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 Galibrator Assembly, A04 (Cont'd)

	: 4			14. 1 f 1	В	T LO	CATI	ON ar	id LO	GIC L	EVEL			-	7	
FUNCTION		14	13	12	11	10	9`	8	7	6	5	4	3,	2	1.	o
VERTICAL CAL.	0	1.	0	0	, 1	1		4.000 7.000 1.000				y var				
mV/DIV:							200 m			* t						
200 mV/DIV										0	-o	'o				•
100 mV/DIV 50 mV/DIV				11	,					0	0	1 0			1 (4) 3 (4)	•
20 mV/DIV, .								. 1.		0	1 0	1 0				
10 mV/DIV 5 mV/DIV						*				1	0	` 1		1.	1	
2 mV/DIV] • 1		0	, _f ,		111	3
No. of Div. from QV 🎄		12								7 (A)					1	
	•			Y.		4.00% 7.00%							0	1,	N.	1 و
+ 6												34.1	- 0		o	
4'4 + 3			1				Y						0	0	0 · 1	0 1
+ 2		N											0.	0	1 0	0
O											1		0	0	0	0
- 1 - 2													1	1	1	0
23								3.					1 1 1 1 1 1 1 1 1 1		0	0
												4	. 1	0	1	10
-6	1.7									a s			1	0	0 .	1
								7.00						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.

Horizontal Calibration coding is as follows:

		BIT LOCATION and LOGIC LEVEL											
FUNCTION	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:							0						
20 usec 2 usec							0	1					
0.2 usec								.0					
20 ns			1.7										

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

	1.		ary Co	des f	or Dis	play	Cont	ol As	sembl	y, A()5, are	as .			1	
	4	n land Gelaket		*	ВІ	T LO	CAT	ON a	nd LO	GIC	LEVEL	1 16 1 16 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
FUNCTION	15	14	13	12	-11	10	9	8	7	6	5	4	3	2	1	O
Assembly Address	0		" 0	1		10 1							100			
" X Display					0	0	**		_ Se	Not	e.1 .—	1			다. 기년 (최 관합	
Y Display					0	. 1 9	•		Se	Not	e 2` —				1	
ERASE Mode					1.	ő				1 200 12 1 200 12 1 200 12 2 200 12					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

	detern	nined	tion, in ti by progra owing bin	mmin ary co	g the de:	expan	d posi	tion C)/A co	onvert	9				
FUNCTION	15	14	13 12	11	T LO	CAŢI(ON. and		6	VEL 5	4	3	2.	i y	О
Assembly Address EXPAND POSITION	0		o -							ee No	te —				

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.

- 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:
 - 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 sequentically applies the stored information (front-paral settings) to the Model 1150A to duplicate the previous manual settings and display the waveform under test.
 - c. Take data from waveform being measured.

3. Local/Program digital coding is as follows:

				•	' В	IT LC	CATI	ON an	d LO	GIC L	EVEL					
FUNCTION	15	14	13	12	11	10	. 9	8	7	6	5	4	3	2	12	0
Assembly Address	0	1	1.	1		en en en Maria										
L P FUNCTION					••				0.3	, and the second		9				
IDENTIFIER					1											v
LOCAL MODE					MANAGE AND				. 1		Misi		0	0	0	O :/
PROGRAM					•						Fig. V.		0	n.	n	, . 1
MODE				4.4	1 7	4. 4								1. 11. 14		

Note: LP 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:

	7.4		ै । । । । । । । । । । । । । । । । । । ।		. · · · · · · · · · · · · · · · · · · ·	IT LO	CAT	ON ar	nd LO	GICL	EVEL				ž ga	
FUNCTION	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Ó
Assembly Address	0	1		. 1		etu ir North		in Selection								
"READ" IDENTIFIER					Ö											
LEARN (See Note 1)					.,			. * v			Y J		0	0	0	1
LOCAL/										11. 11. [1]						
PROGRAM (See Note 2)			\$ 10 \$ 20,00						100				0	o	1	O

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

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

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

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

FUNCTION					E	BIT L	OCAT	ION	and LO	OGIC I	LEVE	L	43			
	15 /	14	13	:12	11,	10	9,	. 8	7	6	5	4	3.	2	1	0
Assembly Address "READ" IDENTIFIER EXPAND POSITION (See Note 1) VERTICAL POSITION (See Note 2)								· · · · · · · · · · · · · · · · · · ·					0			

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 OBB® through OBB9. The flag is held busy until the sequence is completed. (Refer to paragraph 6, this table, for A/D converter coding.)

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 OBBØ 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.	Bina outr	ary coo out are	des fo as fo	r readi llows:	ng A/	D con	verte	routpi	it and	l samp	ler				
	3. · · · .	**************************************	, L	1	В	IT LO	CATI	ON ar	nd LO	GIC L	EVEL					
FUNCTION	15	14	13	12	.11	10	9	8	7	6	5	4	3	2	•	0 ;
Assembly Address "READ" IDENTIFIER READ A/D CONVERTER (See Note 1)	0				•								•			
READ SAMPLER (See Note 2)		7		10 (10 y 1 (10 y 1 (10 y 1 (10 y 1 (10 y						1.1			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:

					В	IT LO	CATI	ON a	nd LO	GIC L	EVE	L				
FUNCTION	15	14	13	12	11/	10	9	8	7	6	5	4	3	2		Ö
Assembly Address	0	.1		*.* 											1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	
"READ"					O,	j.										
read SWEEP										10.00				0	1	1
read SCAN CONTROL			1							**************************************			31	1	0	40 1 23
read VERT.													1		1	O
read CHANNEL SELECT								19 X					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 QFF position when reading front-panel control settings.

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

		F. ()			, BI	IT LO	CATI	ON ar	d LO	GIC LI	EVEL				216 127 127 30 137 30	suidy. Massi
FUNCTION	15	14	13 ,	12	11	10	9	8	7.	6	5	4	3.	2	•	0
Assembly Address CHANNEL SELECT: CHANNEL 1: CHANNEL 2	1		0	0								0	0	· •	• • •	

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

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

	44				BI	iτ LO	CATI	ION ar	nd LO	GICL	EVEL	V - 2-2-1 2-3-3-1 - (2-4-2-3)				
FUNCTION	15	14	13	12	11	10	, 9	8	7	6	5	4	3	2	i	0
Assembly Address	<i>"</i> 1;	0	¢													, (
VERTICAL POSITION		7									– See	Note			3	

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

Binary codes for main sweep speed programming are as follows:

FUNCTION		i. Linn			В	וד נכ	CAT	ION) a	and L	OGIC	LEVE	<u> </u>			D	
	15	,14	13	12	11	10	. 9	. 8	7	6	5	4	3	2	1	0
Assembly Address		Ö			1. 旅				1500 • V 1500 • V 1500 • V 1500 • V							
Main Sweep Indicator		•						0					•			
Main/Sweep Speed:		-						•								
50 usec/div													**O	0	Ò	0
20 usec/div													.0	0		0
5 usec/div								γ.					0	1	0	0
2 usec/div 1 usec/div													0	1 1	1	0
0.5 usec/div		Y .											. 1	0	-0	0
0.2 usec/div 0.1 usec/div													1	0	0	1 0
50 ns/div										- 3 27 (1	1	0	0
20 ns/div														1	O	1
10 ns/div											1 60 7 2 7 10 3 8 10			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:

					Ві	T LO	CATI	ON an	d LOC	ilC LI	EVEL	1		r. Magazia	V.	enile Julius Pi
FUNCTION	15	.14	13	12-	11.	10.	9	8	7	6	5	4	3	2 •	100	0
Assembly Address	1	0	11.7	1	حر								1. 15 18. 18.			
Expand Sweep Indicator													é			
Expand Sweep Speed:					1910			10 (21)								
4 20 usec/div									:0	0	0	1				
10 usec/div							7		0,	0	11.7	0	~			
5 usec/div							1 6 1 10		0	1 ;	0	0				● 3.55
2 usec/div					1.000		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		0	[0], i} (1) (1)	0	1				
1 usec/div								, 0	0		1 0*	0				
0.5 usec/div									1	0	0	1				
0.2 usec/div		14. 1							2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	0		o				
0.1 usec/div 50 ns/div										1	0	0				1
20' ns/div				4					1	1	٠٥.	1				4
10 ns/div							***		1	1	1	0	7			
, 5 ns/div , ~									0	0	0.	o .				
2 ns/div		•		1					0	0	0	1	. F.M.			
1 ns/div									0	0	1	0				3.
0.5 ns/div									0'.	1	0	0				
0.2 ns/div									0	1	1	0	n i			

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). Seject desired expand sweep speed (bits 4-7).

 (The ratio of main/expand sweep < 100.)

- 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:

		1 • 1 · 12 3 / 12 5 · 12	riyan, Mijiya		ВІ	T LO	CATI	ON ar	nd LO	GIC L	EVEL					
FUNCTION	15	.14	.13	12	11	10,	9	8,	7	6	5.	4	3	2	; ;	0
Assembly Address	ì		0,	Q						in the second	•					
SCAN Function					O											
Internal Scan	10 mm					0										
SAMPLES/DOT: (See Note)																
													0	.0	N. P. T. S.	
										†			1	0	. 1	
DOTS/SCAN:															0	C
512															0	17.0 18.0 11.7
256															1	0
128						7.5	-								, in	

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

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

	ำ	3.19			В	IT LC	CATI	ON a	nd LO	GIC-I	EVE	L,			1.44.743 • 6.77.7	
FUNCTION	15	,14	13	".12	. 11	10	9	8	7	6	5	4	, r ; 3 ,	2	1	0
Assembly Address	1	3 42 3 1 34	O	•												
SCAN Function					0 -			y Y								
External Scan Identifier			H.			1										
EXTERNAL											See N) ()				
SCAN		\$ 50		Vii		J. WY	1.3		Section X	100	See 11	٠٠ ₎ :-	i Pina	11	90 m	19. july 1

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:

				•	В	IT LO	CATI	ON a	nd LO	GIC L	EVE	L.			M. E	n e
FUNCTION	15	14	134	12	11	"10	9	8	7	6	5	4.	3	2	1	0
Assembly Address SAMPLE	1	1	0	**************************************												
Function Identifier FREERUN					1,											0:
EXTERNAL SAMPLER																
CONTROL		16				an Sila Bilan Mari	35.46 40.46							The same	ar ili. Applici	[] ;; \

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

/ertical Attenuation: 200 mV/DIV 100 mV/DIV 50 mV/DIV 10 mV/DIV 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	regular vegetik est.		BIT LOCATION and LOGIC LEVEL														
/ertical Attenuation: 200 mV/DIV 100 mV/DIV 50 mV/DIV 10 mV/DIV 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1 1 1 1 1	FUNCTION	15	14	13	12		10	9	8	7	9	5	4 1 1 1 1 1 1 1 1	3	2		0
Attenuation: 200 mV/DIV 100 mV/DIV 50 mV/DIV 10 mV/DIV 5 mV/DIV	Assembly Address		. 1	/ 1	0												
200 mV/DIV 100 mV/DIV 50 mV/DIV 10 mV/DIV 10 mV/DIV 5 mV/DIV	/ertical						e.			2	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						
100 mV/DIV 50 mV/DIV 20 mV/DIV 10 mV/DIV 5 mV/DIV										, , ,					0	0	0
50 mV/DIV 20 mV/DIV 10 mV/DIV 5 mV/DIV	100 mV/DIV												1				1
20 mV/DIV 10 mV/DIV 5 mV/DIV	50 mV/DIV															• 1 • 1	
5 mV/DIV							٠,٠								- 1	O	0
[Hander State Programme Market Programme Prog		h i				, e. C.		**************************************					1.8		- 1	0	1
						(a) 100				i i i) }	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.00 P	1.	O
コード たいかんしょうりょう はいれい しょくしょく こうかん 田田 こうがたいはいたい (編集 ためにだい) こうりょうがい こうりょう (編集 はいれい) (音化 しょうにん) かいだい																	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)

SECTION (V PRINCIPLES OF OPERATION

4-1.º 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 horizontially 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 do 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.

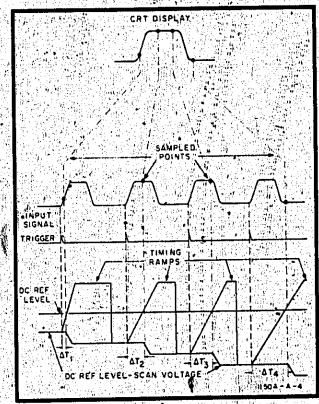


Figure 4-1. Comparator Operation

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 asample 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, Cin begins to charge to Ein 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, Cin charges to only about 5% of Ein. (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 Cin 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 Cin. 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.

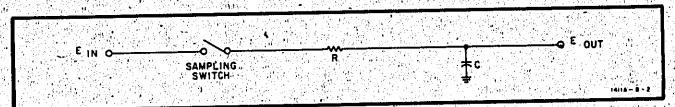


Figure 4-2. Basic Sampling Circuit

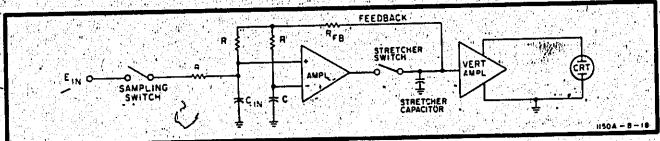


Figure 4-3. Basic Sampler and Vertical Amplifier

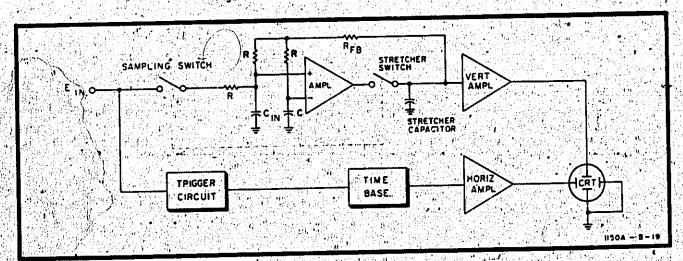


Figure 4-4, Complete Sampling System

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

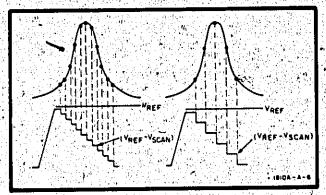


Figure 45. Scan Density

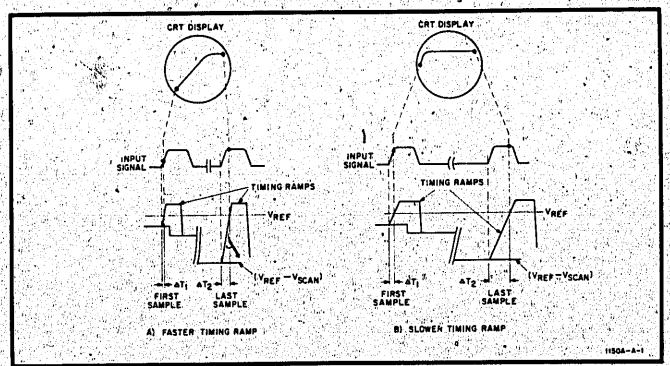


Figure 4-6. Timing Ramp Slope

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 Colhiparator 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

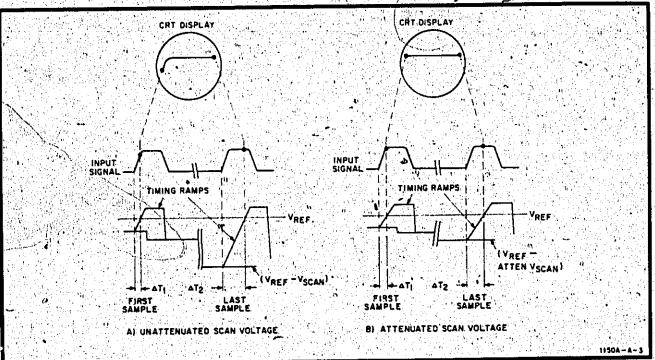


Figure 4-7. Scan (Staircase) Attenuation

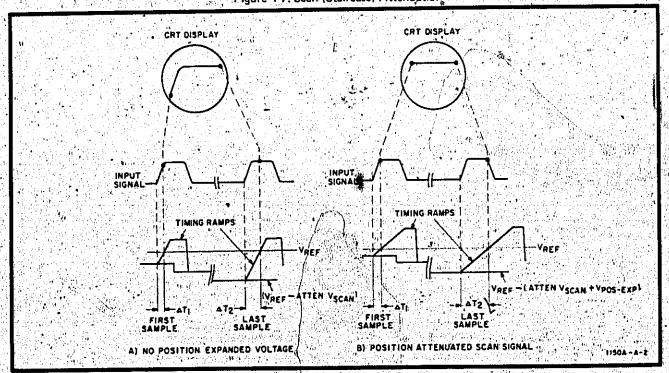


Figure 4-8. POSITION-EXPANDED Operation

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 do 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 frontpanel 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.

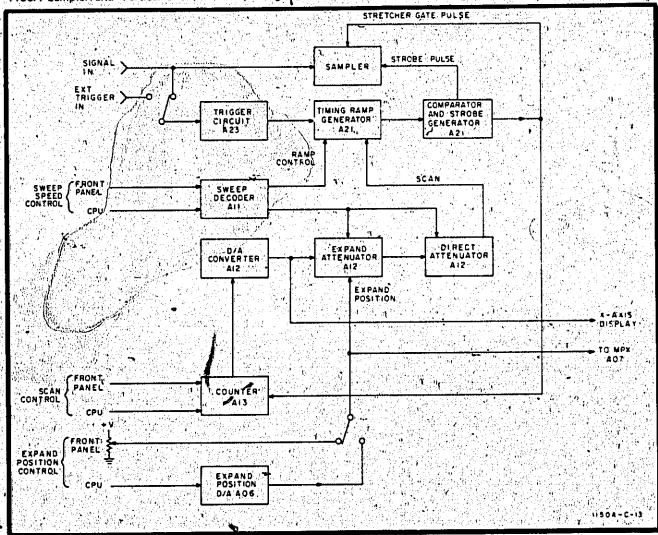


Figure 4-9, Block Diagram, Time Base

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 carribe read directly by the computer (no A/D conversion is necessary).

4-31. To improve the accuracy of measured data, a call-bration 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.

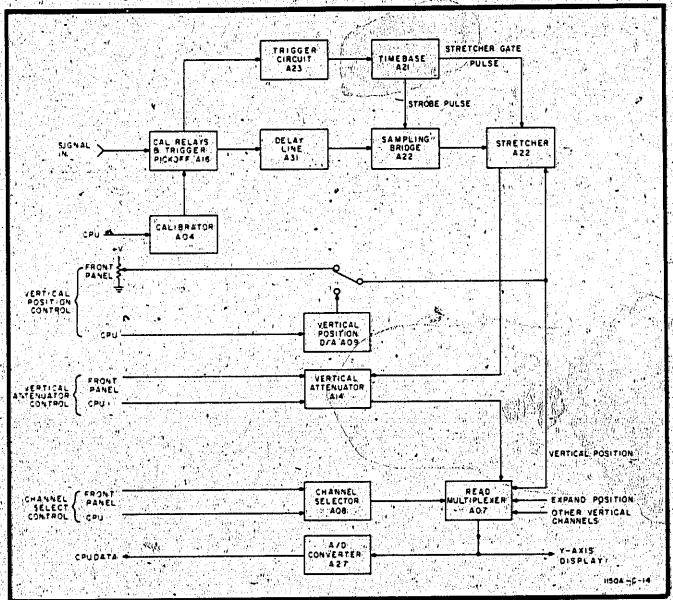


Figure 4-10. Block Diagram, SAMPLING

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 gof 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 AO3 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 scenner, 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

4-44. 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

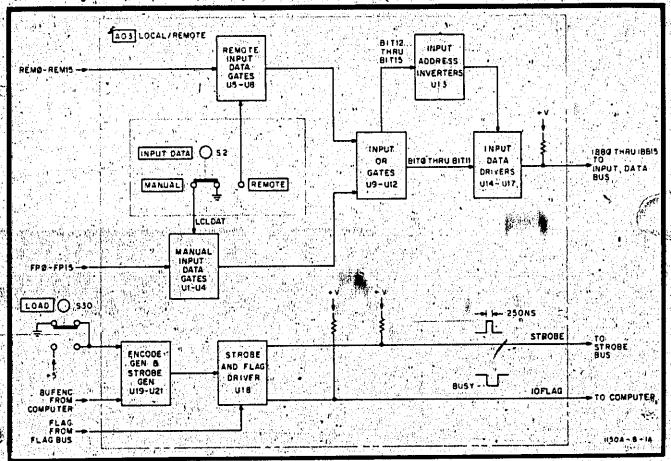


Figure 4-11, Detailed Block Diagram, Assembly A03

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 de voltage levels to calibrate absolute de 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 conneated 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.

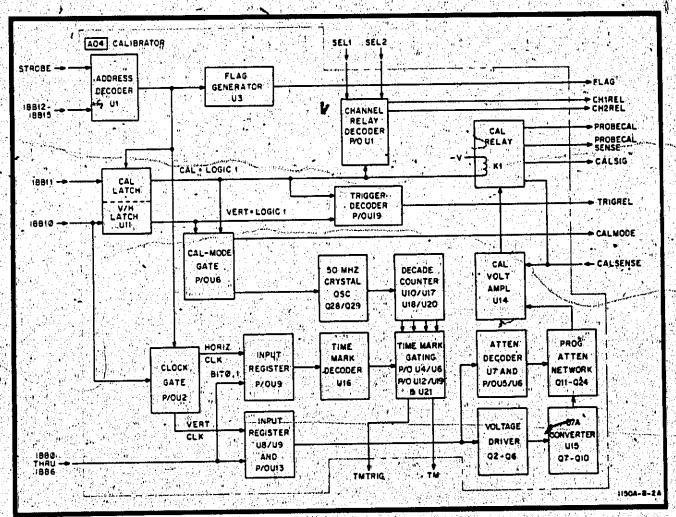


Figure 4-12', Detailed Block Diagram, Assembly A04

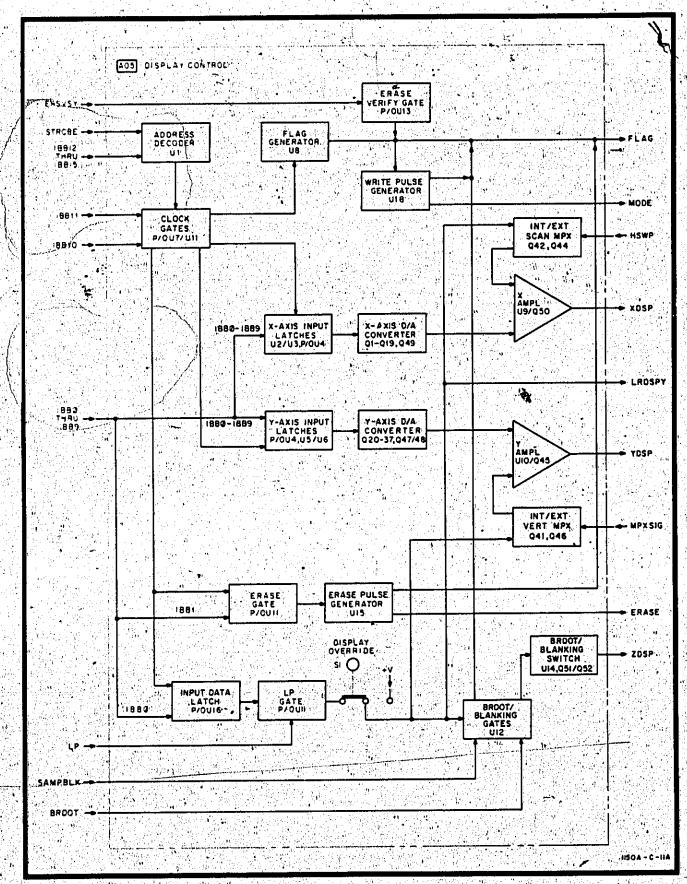


Figure 4-13. Detailed Block Diagram, Assembly A05

Model 1150A Theory

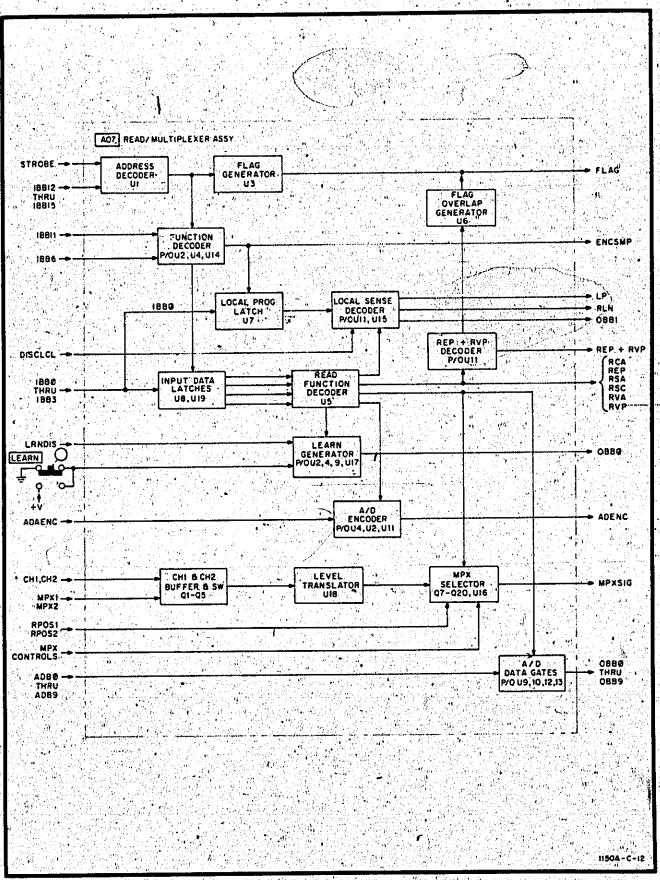


Figure 4-14. Detailed Block Diagram, Assembly A07

Theory Model 1150A

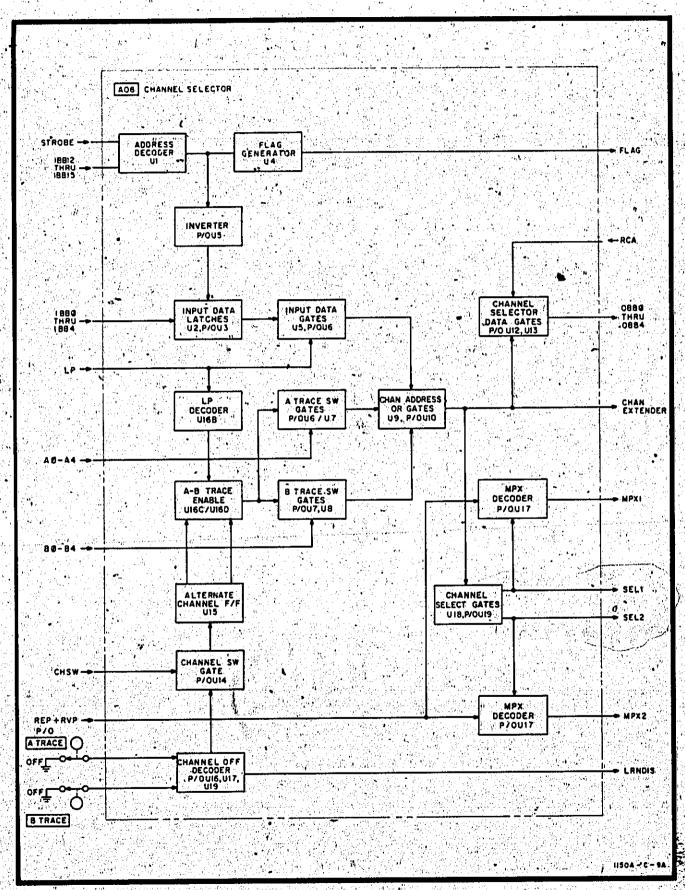


Figure 4-15, Detailed Block Diagram, Assembly A08

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

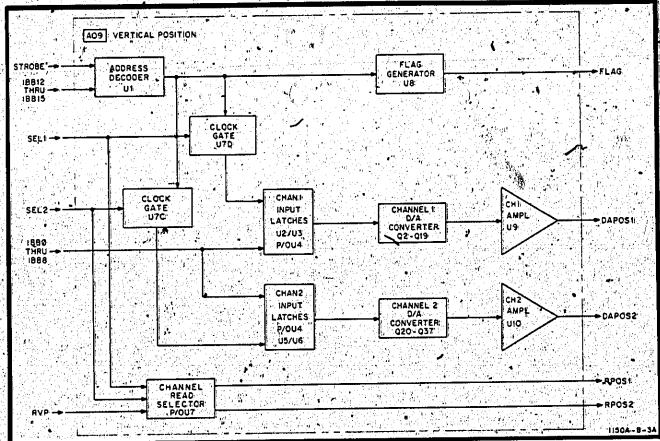


Figure 4-16. Detailed Block Diagram, Assembly A09

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. SCAND/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.

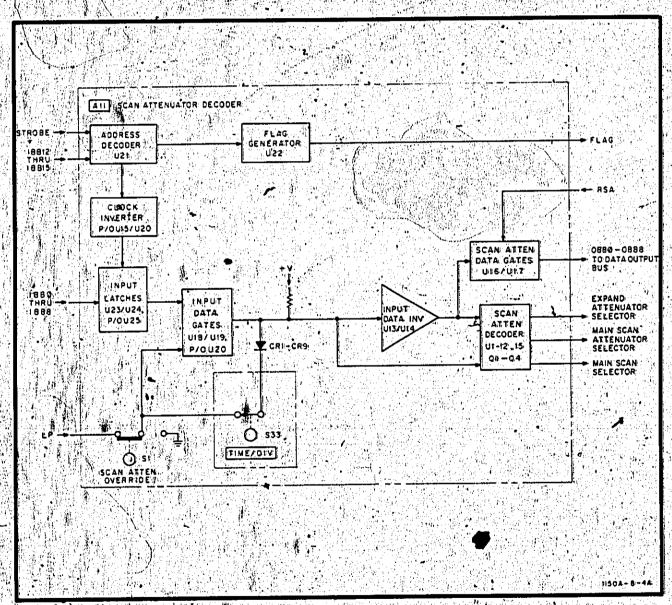


Figure 4-17. Detailed Block Diagram, Assembly A11

Model 1150A

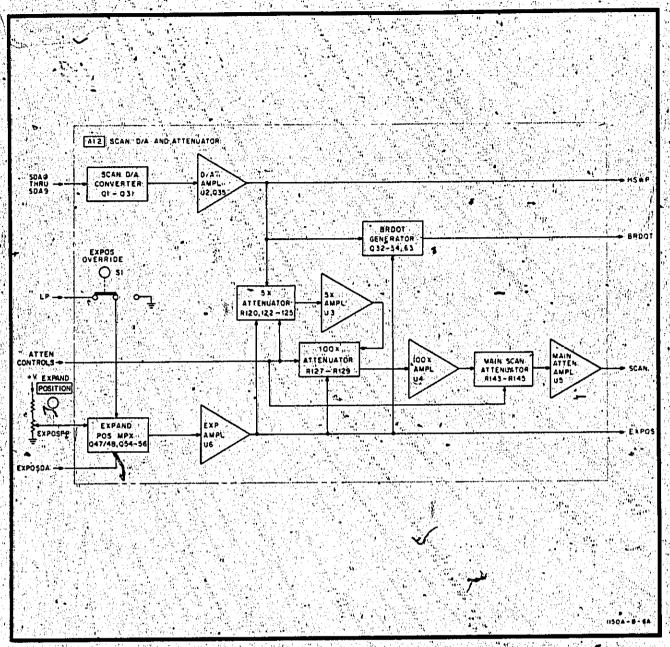


Figure 4-18. Detailed Block Diagram, Assembly A12

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 ion 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 of 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.

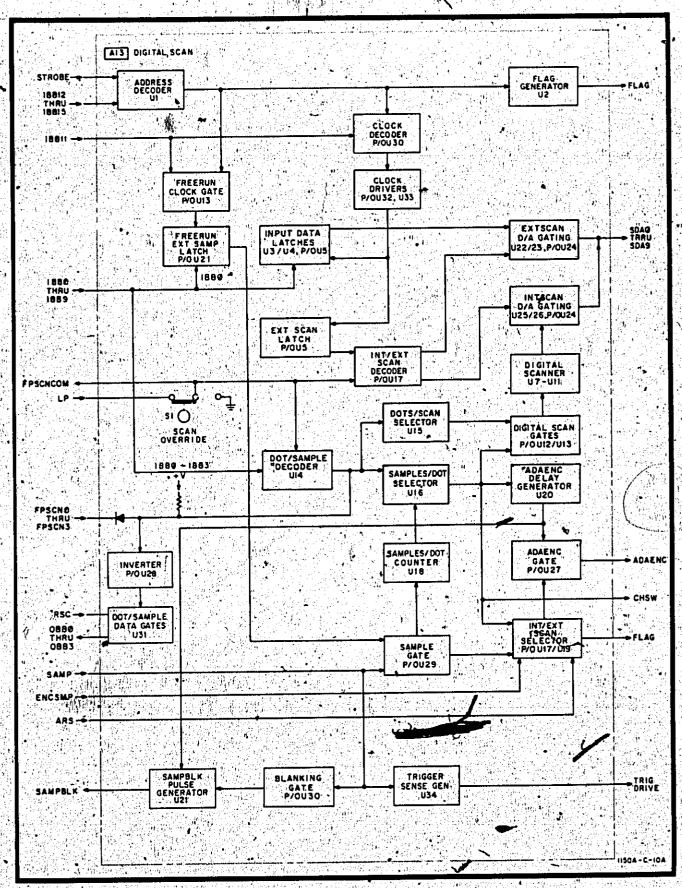


Figure 4-19 Detailed Block Diagram, Assembly A13

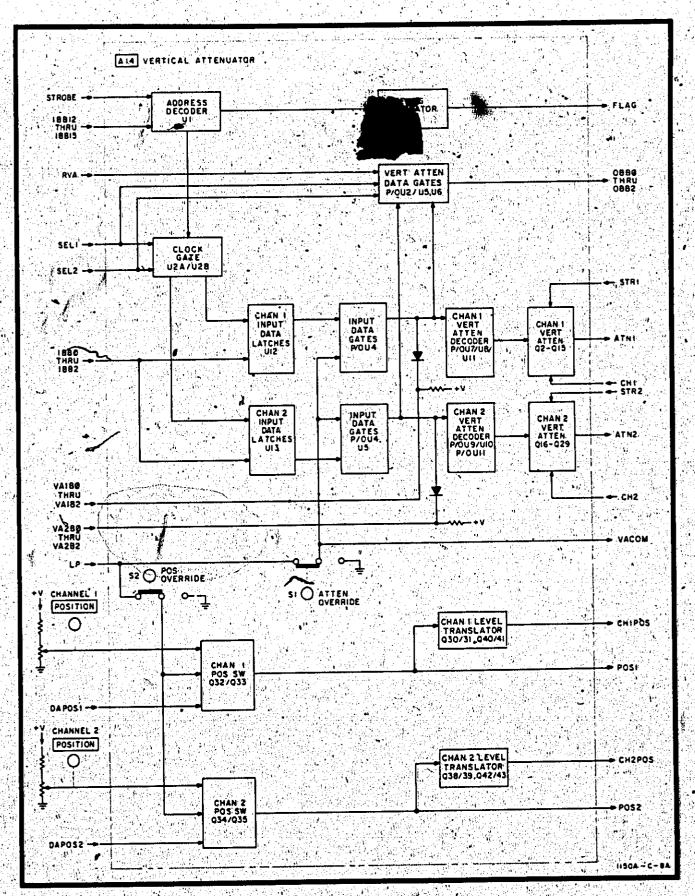


Figure 4-20. Detailed Block Diagram, Assembly A14

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.

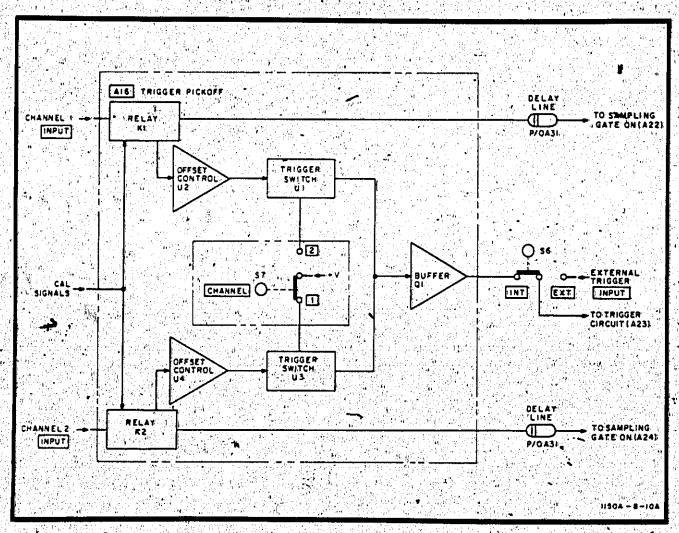


Figure 4-21. Detailed Block Diagram, Assembly A16

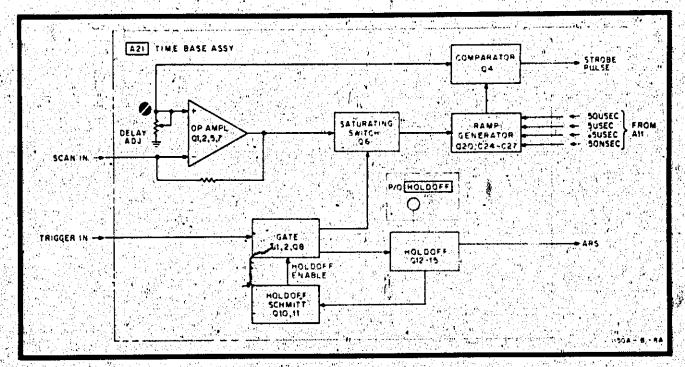


Figure 4-22. Detailed Block Diagram, Assembly A21

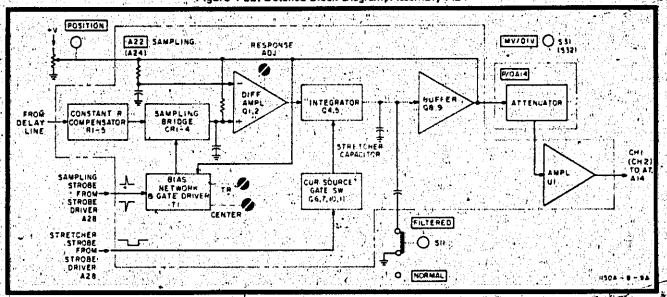


Figure 4-23. Detailed Block Diagram, Assemblies A22 and A24

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.

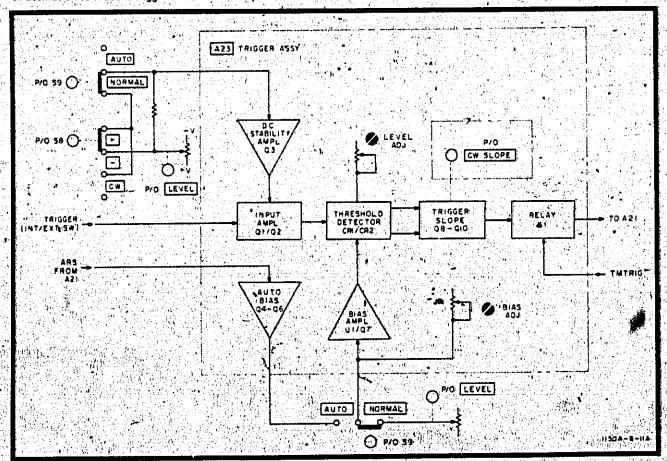


Figure 4-24. Detailed Block Diagram, Assembly A23

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 >+2.4V, and logical 1 <+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 AO3, and routed to the appropriate assembly so that all infours to the address decoder gates are positive for the particular assembly being addressed. To avoid confusion, the terminology high level (>+2.4V) and low level (<+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, HOLD-OFF, 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, I 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 3 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 SZ 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 (\$12 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 250nanosecond 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.

are pull-up 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 IBBT1.
- 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 IBBØ 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 139 (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 Trig-

ger 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 (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) 90ès low. This low accomplishes the following:
- a. It is the CALMODE signal to Trigger Pickoff Assembly A16. The low causes A1602 to conduct. When A1602 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 uncelibrated mode of operation), the output of U6B goes high and accomplishes the following:
- a. The high CALMODE signal to assembly A16 turns off A1602, 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 U118 (pin 12). Upon receipt of the clock pulse from U4C, the Ω 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 (allsections). 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 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 U118 (pin 9) in VERT CAL is low and is applied to NAND gates U68 and U19C. (Refer to paragraph 4-105 for U68 operation. Refer to subparagraph 4-103c for U19C operation.)
- 4-108. When functioning as a vertical calibrator, data on IBBØ 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 (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 IBBØ 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 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 (<+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 amplifler U14 (pin 3). When a control transistor is conducting, -12.6V is applied to the gate of its associated EET. 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 U48 (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 IBBØ and IBB1 determine the selected sweep speed (refer to Section III for coding). Upon receipt of a clock pulse, the data on IBBØ and IBB1 are stored in the output of latches U9C and U9D. Both outputs of the latches (Q and 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 O29 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 (piny12). 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 U198 (pin 5). The other input to U198 (pin 4) comes from 0.2-microsecond decoder U16D. When 0.2-microsecond sweep is selected, the output of U198 will be the pulse train applied to pin 5. Output from U198 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 duramic 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

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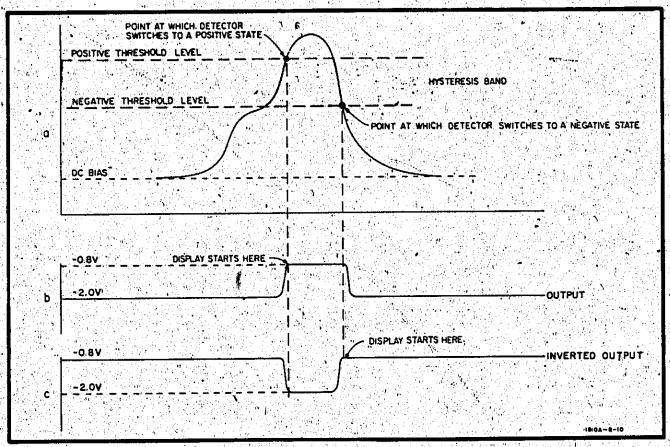


Figure 4-25. Detector Switching

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 focus

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 is established by the LEVEL control.

4-139. Transistor Q38 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, Q38 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 +6V 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 changing 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 bt U18 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 operations the scan can operate in either INTERNAL or TERNAL 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:

al 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. IBBØ 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 IBBØ through IBB1Ø to their output circuits. Then, depending upon the state of IBB1Ø, bits IBBØ through IBB9 will be interpreted either as SAM* LES/DOT and DOTS/SCAN data for IBB1Ø high, or as SCAN position data for IBB1Ø 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 IBBO. When IBBO is high (indicating freerum sampler operation), the clock signal from U13D triggers the flip-flop and transfers the information to its output circuit. The complementary output (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. If 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 EPSCNCOM signal to the switches. Both switches produce a binary code that is applied to diodes CRT 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 (OBBØ 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 IBBIØ 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, U178 (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.
 - balt 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.
- A-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 NANO gate of U22 fall sections), U23 (all sections), U24A, and B. This mables the gates. When a clock pulse is applied to input latches U3 (all sections), U4 (all sections), U5C, and D, the information on IBBØ through 1BB9 will be transferred from the input latches through the NANO 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 IBBØ through IBB3. Information on IBBØ 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 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 IBBØ and IBB1 will be low. The 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 (27).
- 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 result in all 10 stages of the digital counter being used (210).
- 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 Q outputs of U3A and U3B are applied to NAND gates U14A (pin 2) and U,14B (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 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 (pins 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 outwork 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 Q output (pin 8) becomes high. This action produces the blanking signal SAMPBLK. The SAMPBLK

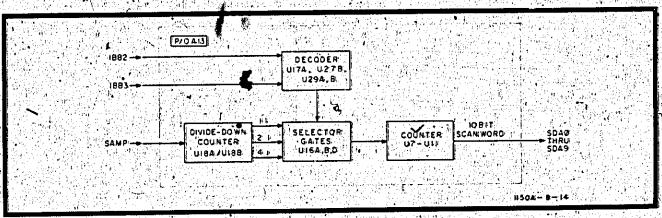


Figure 4-26. Block Diagram, Scan Counter

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 Q output of U18A (pin 6) becoming low. On receipt of the second SAMP signal, the clock signal applied to U18A results in Q output becoming high. With both inputs high, we the output or 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 circulary 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 im 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-QR 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 U198 (pin 11), clocking U198 (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 wheel-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.

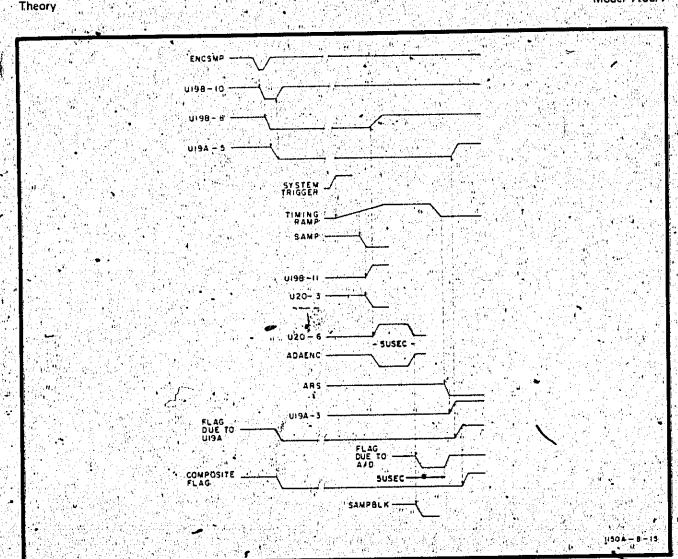


Figure 4-27. Digital Scanner Timing Waveforms

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 6) 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 U198 (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 directly 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 OV 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 0.19, 0.20, and 0.21 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 0.18/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 isgapplied 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 hias of the gate of the FET prevents it from conducting. Where a control transistor is not conducting, the bias applied to the gate of the FET is the output voltage of amplifien U3. The patput 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 ohe, 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 OV 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 drainto-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 (pm 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 of 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 IBB® through IBB® 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 IBBB 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 02/03 and 04/05. 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 020 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 ST to the front panel sweep controls. SWPCOM furnishes the common low logic level (OV) needed to operate these controls. Depending upon the setting of front panel controls, the cathodes of selected diodes in diode string CRT 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) 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 sproduces the clock pulse for input latches U23 (all sections).

c. It is applied to both inputs on NAND gate U20Av which produces the positive clock pulse for input latch U24 (all sections) and flip-flop U25A.

4-208. Digital information on IBBØ through IBB8 is stored by U23, U24, and U25A when a clock pulse is received. Main sweep information is available on IBBØ through IBB3. Expanded sweep information is available on IBBØ through IBB7. Information on IBB8 indicates whether main or expanded sweep is selected. The complementary outputs (QV 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 fligh 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 t 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 Q output of the latches is used, the binary code is complemented and becomes 0.1.1.1.0.1.1.1. The binary code is applied to NAND gates U18 (all sections), U19 (all sections), and U200.

4:205. The outputs of the NAND gates are also applied to a set of inverters comprised of U13 (all sections), U140. 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 OBB® through OBB8.

4-206. The outputs from NAND gates U18 fall 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 1.000.1000, 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 G and H are applied to NOR gate U10D. The obtput of U10D (pin 13) whigh 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 J27 (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 010A, B, and C. Since both designators are high, they hold the outputs of these NOR gates fow. 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
IB84	Low	Ā	Low- High	Expand
1885	E I	B B	High,	Expand
1886	High	C.	High Law	Expand
.i887	High	D D	High Low	Expand
1880	High	E.	High Low	Main
1881	High	F	High Low	Main
1882	High	G	High Low	Main
IBB3	High	H	High*	Main
1888	Low		Low?	indicator

- 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 IBBØ or SWPØ is true (low).
- d. Designator: Fills 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).
- Designators E and F are applied to NOR gate UTA. Since both designators are low, the output of UTA (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. There we 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.
- p. 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 B, F, and 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)

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- will tend to go high unless held low by U6C. Designator 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, holding their outputs high.
- h. NAND gates U4 (alt 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.
 - is 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 1 0 0 0 1 0 0 0 0 to this assembly produces three operating signals for Scan D/A and Attenuator Assembly A12. They are:
 - ma. 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 identically 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 RB 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 justed 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. Besistors 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, QR6 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 feed-back 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, Pislow 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 Programuoperation, 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 yoltage 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 032 or 033 (depending upon the Local-Program mode of operation). The voltage-level translator consists of 030, 031, 040, and 041. 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, R 100 and R 105 (Channel 1), in the voltage level translator, R 105 is the centeradjust control and R 100 is the gain control. With +5 volts applied to the input of the translator, R 105 is adjusted for center display on a CRT screen. R 100 is adjusted so that 0-volt and +10-volt inputs result in the display being 1 division off 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 IBBØ 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 ATNT 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 gateto-source voltage at approximately 0 volt for minimum drain-source resistance. All other FET have high drainsource resistance because of the -12.6 V applied to their gates. Resistor R43 calibrates the attenuator network with reference to stretcher output signal STR1 and feedback amplifier signal CH1...

4.39

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), USC, and USD. 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 smary 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 schematic) 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 IBBØ 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 copyrol 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 10volt 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 conserter 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.

4250. 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 U168 (pin 6). The output of U168 (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 stage 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 S\$ 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).

d. 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 USC (pin 8). The output of USC (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 IBBO 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 O output. The complementary (O) outputs are connected to associated input data gates USA, B, D, U6C, and D.

4-253. Since the input data gates are enabled by the LP signal (Program mode), information from the input fatches are applied through the gates to the Channel Decoder circuit, USA through USC, 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 CØ 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 (USA, 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, 45 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 O 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.

output of U16A 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 cat put 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 was 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 gale 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 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 toltages 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 microsecord pulse that is applied through U9C to the FLAG bus. It additions the busy signal from U3 is applied to an input on NAND gate U108 (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 slock signal to input latches USA, USB, 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 U.S. 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). Warious 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 OBBO 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 NANDI 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 #BB11 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 U78 transferring the information on IBBO to its output.

b. The complementary (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 pulsa that is possible to NAND gate U4D (pin 12). The other input to U4D is the LRNDIS signal from Channel Selector Assembly A08. When LEMDIS is high, the output of U4D

(pin 11) is applied iffrough 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 OBBO. 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/Q3 has been explained previously (refer to subparagraph) 4-267a).

4286. 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 ADS, and REP+RVP is applied to MPX decoder gate AOSU17A, MPX1 (low) is applied to the junction of resistor R 10 and R 11, 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 conducts CH1 from Channel 1 Sampling Assembly A22 to operational amplifier U18, The output of U18 is applied through FET Q6 to operational amplifier UT6 (refer to subparagraph 4-267a for U16 operation). Transistor QB 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 a off Q5. With Q5 cut off, Q6 conducts. This connects the output of amplifier U18 to the (+) input on amplifier 116. 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-vols 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 whereeby 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

- 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 IBBO 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 18810 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 U.11B (pin 4). With both liputs 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 UTA are low, the output of UTA 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 fulse. The O/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 O output of U18 is applied to NAND gare U12A. The output of U12A (pin/1) is applied to the base bias network of Blank Switch transistor O51. [This action ensures that a 10-microsecond 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. Rrogramming the X function automatically results in the aformentioned 10-microsecond unblanking signal.

h, information on IBBØ through IBB9 is applied 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 O 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 U90 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 inflamation applied to the converted circuit, the emitter output of Q50 will vary from 0 to +10 volts. This putput 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.

Note

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

4-278. When IBB10 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 of 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 OUT-PUT (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 IBB10 and IBB11 will be low. The data on IBB0 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 IBB10 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 IBB0 to its Q output. The complementary output of U16B (Q) is connected to NAND gate U11D (pin 12).

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 yow.

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 OVER-RIDE 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 U1D 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 IBB16 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 IBB10 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 IBB0.

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- 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 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 OUT-PUT (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 IBB@ 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.)

\$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. Eusing 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 yolts. Series regulator transistor A2501 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 dutput 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 +100½ supply is protected for turn-on and turn-off voltage transients. Diodes A25A2CR1 and CR2 provide transient protection for transistors A25A2C3 and CA. To prevent the +100V supply from going negative in the event of an accidental short circuit (during trouble-shooting, 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 A25A1CR1. The supply produces approxi-

mately +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.

age 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 turnon or turn-off transients is provided by A25A2QR4. 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 Fil 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 11 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 +5 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 A17VR4 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

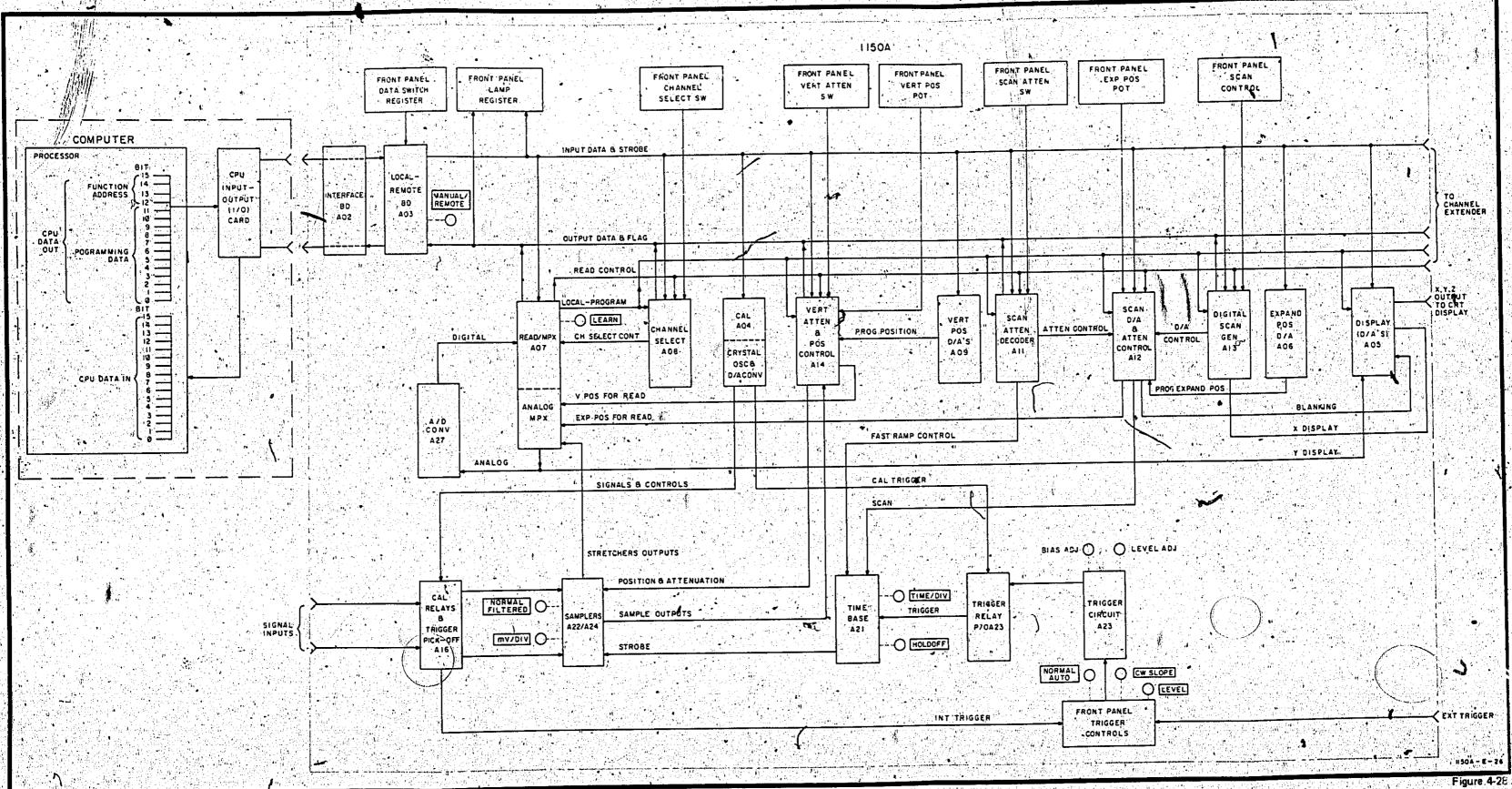
Q3 will either increase of decrease until an output of -15 volts is reestablished.

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 do 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 A1705 and A1706. 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 A1703, resulting in an increase or decrease in conduction. Changes in conduction are reflected in the voltage drop across A17R1,1 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.



Performance Check and Adjustments

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 Pulsa Generator	HP 213A	<100 ps/risetime at >175 mV	(Sampler adjustments
Digital Volt-	HP 3439A W/ HP 3444A Slug-in	100 mV; four significant digits	D/A converter adjustments
Digital Computer (HP 2116B HP 2752	8K or larger memory Computer interface	Performance check Performance check
Teletypewriter Tape Reader	HP 2748A	Computer interface	Performance check
Interface Kit Cable Assembly	HP 10487A HP 10488A	CPU interface X-Y-Z display interconnect	Performance check 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 Prébe	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
			(g) (g) 7000-A-19A

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 the 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

5-7. PRELIMINARY SETUP

Processing Unit) by following the instructions given in the operating note for Model 10487A Interface Kit. Apply power to Model 1150A and allow I hour for warm up. If an error is indicated while running the specification verification tape, refer to the appropriate appendix in the Programmen 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.

59. 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 1-19. 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 competed 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 Channe, position.
 - d. B TRACE switch to OFF position.
- e/CHANNEL 1 mV/DIV switch to 200 mV/DIV po-
- f. CHANNEL 2 mV/DIV switch to 200 mV/DIV po
 - g. NORMAL/FILTER switch to NORMAL position.
 - h. EXPAND/DIRECT switch to DIRECT position.
 - i. Main TIME/DIV switch to 20 ns position.
 - [! Expanded TIME/DIV switch to 10 ns position.
 - k. DOTS/SCAN switch to 1024 position.
 - SAMPLES/DOT switch to 1 position.
 - m. Trigger switch to INT.
 - n. Trigger source to CHANNEL
 - o. CW/SLOPE to (+) position.
 - P. NORMAL/AUTO switch to NORMAL.
 - q. HOLDOFF control fully ccw.

Performance Check

5-14 CALIBRATOR ASSEMBLY A04 PERFORMANCE

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 (cefer to table 5-2 for Octal Code example). Press LOAD pushbutton switch.

Not

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.
 - I. 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 اِ
Leading edge transition time	50 ns
Polarity	(+)
	200 mV
Repetition rate	1 MHz
Triannactionistance - Preservice problems of a state	

- 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		10		8	7	6	5	4	3	2		0
OCTAL CODE WEIGHT		\$ 4 4	2	4	2	•	1000 1000 2. 4 1000 1000 1000 1000 1000 1000 1000 10	2	1	4	2		. 5 \\ 	2	
INPUT DIGITAL CODE	0		0	0.	' 0	1.74°.	o ·		1	.0	0	۰,0	1,		
OCTAL CODE (051307)	(0)		(5)		(1)			(3)			,(O)			(7)	

Model 1150A

Performance Check

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

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
	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. ±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	Ster 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	+0.600V ±5 mV.	Step 13
13	0 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

Performance Check

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

'Step-	MANUAL INPUT Switches	TEST EQUIPMENT	TEST EQUIP	Go to
15	LOAD Oetal 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	Sáme as Step 17	+0.100V ±0.5 mV	Step 22
22	LOAD Octal	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 too 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).

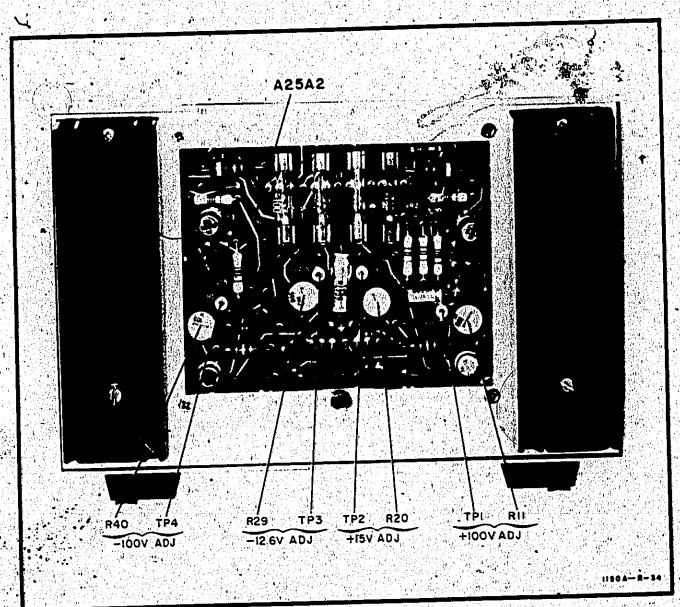


Figure 5-1. Low Voltage Power Supply Adjustments

- 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 ADJUST-MENTS.
- 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 $-12.6V \pm 0.1V$.
 - g. Connect digital voltmeter to-100V test point TP4.
- h. Set -100V adjust R40 to obtain indication on digital voltmeter of -100V ±0.4V.
- 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/DIVswitch 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 BEVEL 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 \$24C20 (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).

Model 1150A

- c. Adjust A04R76 for -1.609V indication 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 ADJUST-MENT. (See figure 5-4.)
- 5-37. Adjustment of Display Control Assembly A05 is as follows:
 - a. Accomplish paragraphs 5-12 and 5-13.
 - by Accomplish table 5-4.

5-38. EXPAND POSITION ASSEMBLY A06 ADJUST-

- 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 OV 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 ADJUST-MENT. (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

		lable 5-4. Assembly	- Moo Mojostijos da jamas		
Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP	Go to
1	LOAD Octal Code 074001,			7	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 OV. Alge- braically 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 +öffset 4	Step 6

Step	MANUAL: INPUT Switches	TEST EQUIPMENT.	ADJUSTMENT	TEST EQUIP	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 OV. Algebrai- cally 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	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 5-133

- 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.
- £ 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	Go to
	LOAD Octal Code 110000	Connect digital voltmeter to test point D/A1 (figure 8-49)		Observe error from OV. Algebrai- cally add to all_ adjustments	Step 2
21	LOAD Octal Code 110100	Same as step 1	A09R31	+1 2 52 V +offset	Step 3

Table 5-5. Assembly A09 Adjustments (cont'd)

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP	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 OV. Algebrai- cally 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 +oifset	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	Go to
	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 AT.1 (figure 8-56)	A12R77	0.000V	Step 6
6		Connect digital voltmeter to test point AT2 (figure 8-56)	A12R103	0.000V	Step 7

Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP	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	A13R67	+2.502V	Step 11.
	LOAD Octal Code 153000	Same as step 8	A12R69	+5.005V	panetuph 5-44

5-46. SAMPLING ASSEMBLIE'S A22 AND A24 ADJUST-

- 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).
 - 1. 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 (tigure 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 EHAN-NEL 1 INPUT and connect CHANNEL A of monitor oscilloscope to CHANNEL 1 INPUT connector on Model
 - q. Set monitor oscilloscope vertical plug-in as follows:

Volts/Di	٧			 		0.005
Display	•			 		, , А
Input Co		q		 		AC
Polarity		:				. +UP
Position	•	• • •			as	required

r. Set monitor oscilloscope time base as follows:

Time/Div 0.1 uses

- 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).

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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.

Not

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	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
3.7	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 POSITION control	i +5,000V	Step 8
8		Connect digital voltmeter to test point Y on Assem- bly A05 (figure 8-35)	Á14R105	+5.000V	Step 9

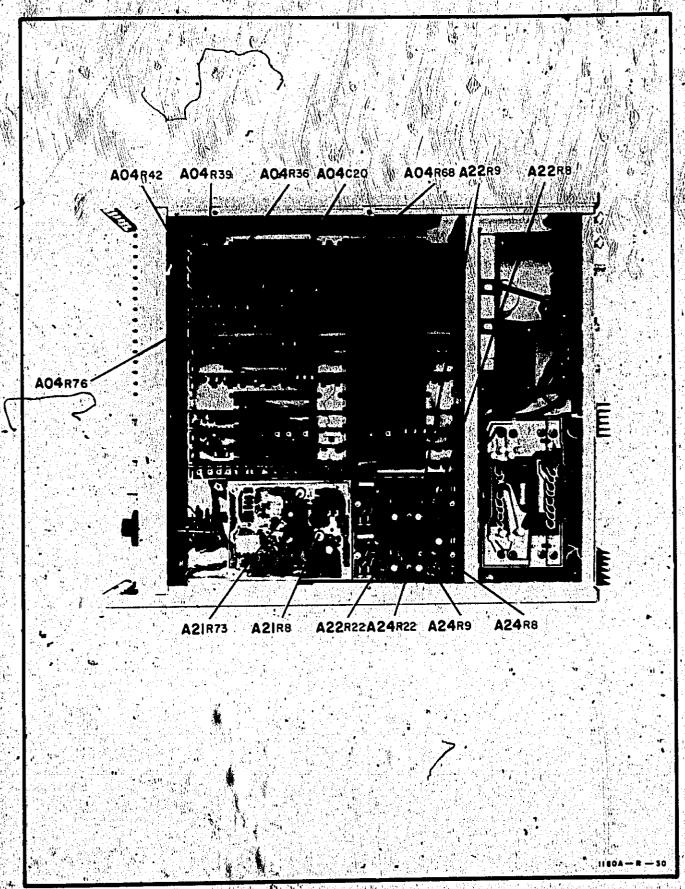


Figure 5-3. Adjustment Location, Assemblies A04, A21, A22, and A24

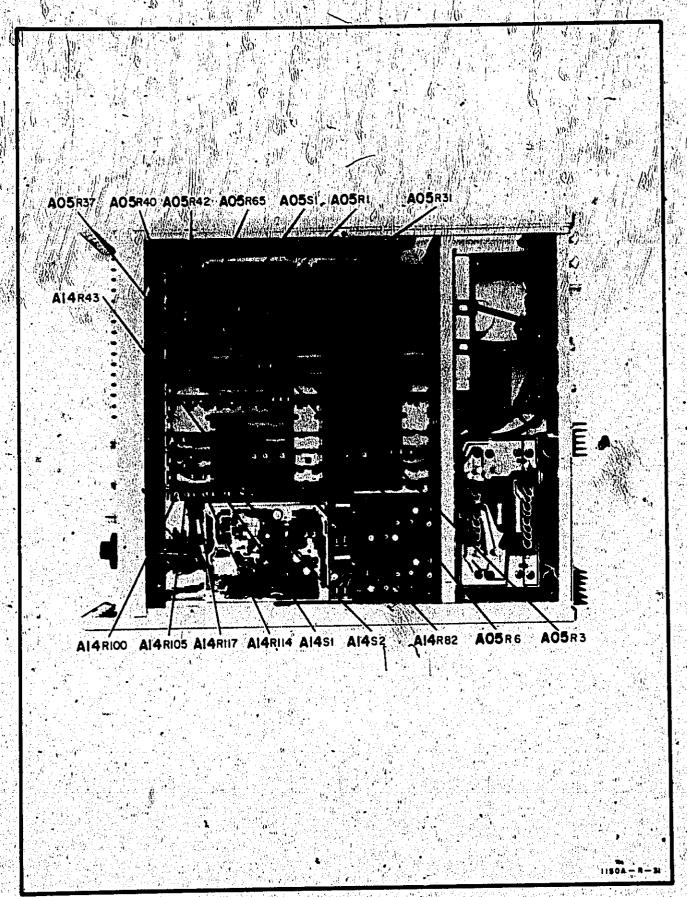


Figure 5-4, Alijustment Location, Assemblies A05 and A14

Table 5-7. Assembly A14 Adjustments (cont'd)

'Step	MANUAL INPUT Switches	TEST EQUIPMENT	ADJUSTMENT	TEST EQUIP	Go to
9		Connect digital voltmeter to test point Y on Assem- bly A05 (figure 8-35)	A14R105	+5,000V	Step 10
10	LOAD Octal Code 046000	Same as stép 8	Front panel Channel 2 POSITION control R6	+5.000V	Step 11
	LOAD Octal Code 046004	Same as step 8	A14R82	V000.e+	Step 12
.12	LOAD Octal Code 046000	Same as step	Turn fully clock- wise 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 Charinel 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)

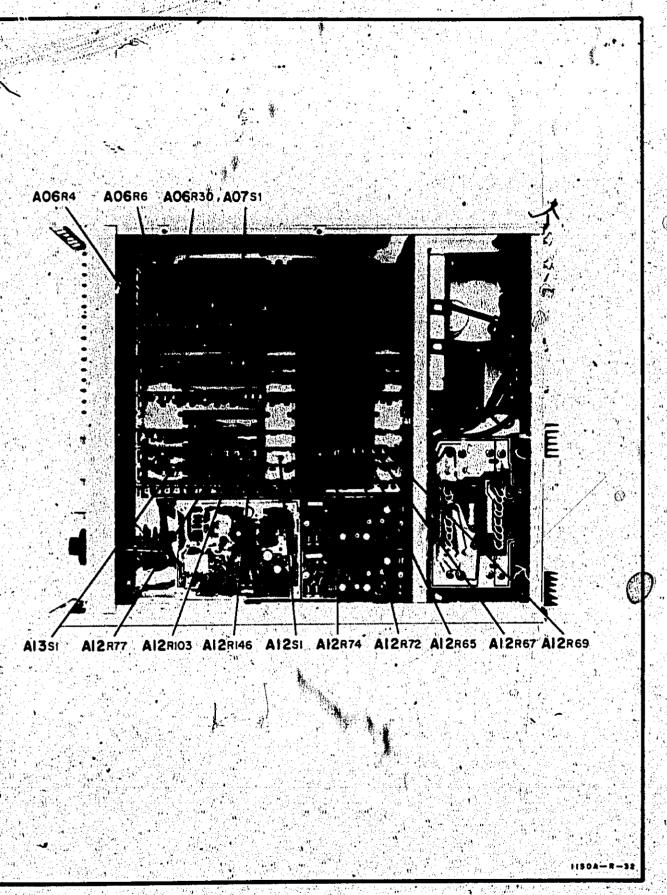


Figure 5-5. Adjustment Location, Assemblies A06, A07, A12, and A13

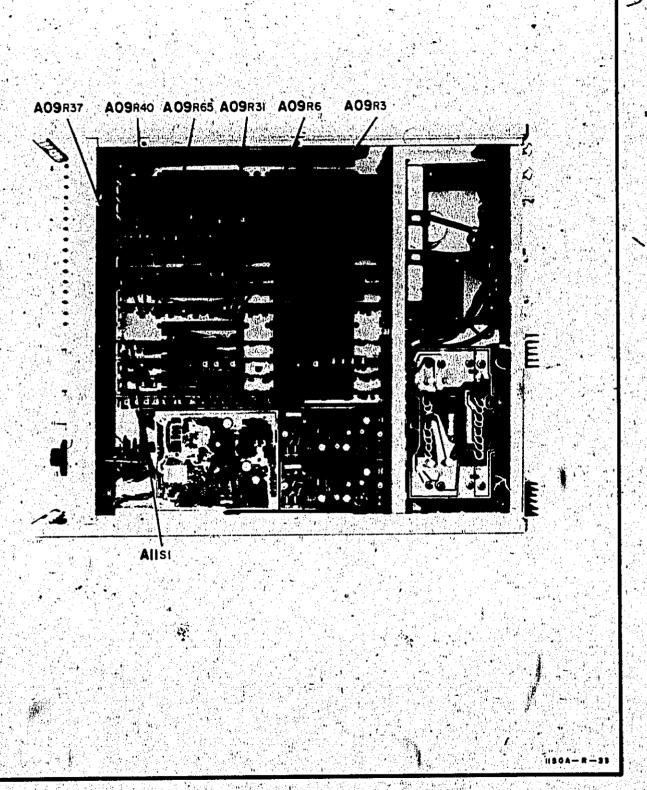


Figure 5-6. Adjustment Location, Assemblies A09 and A11

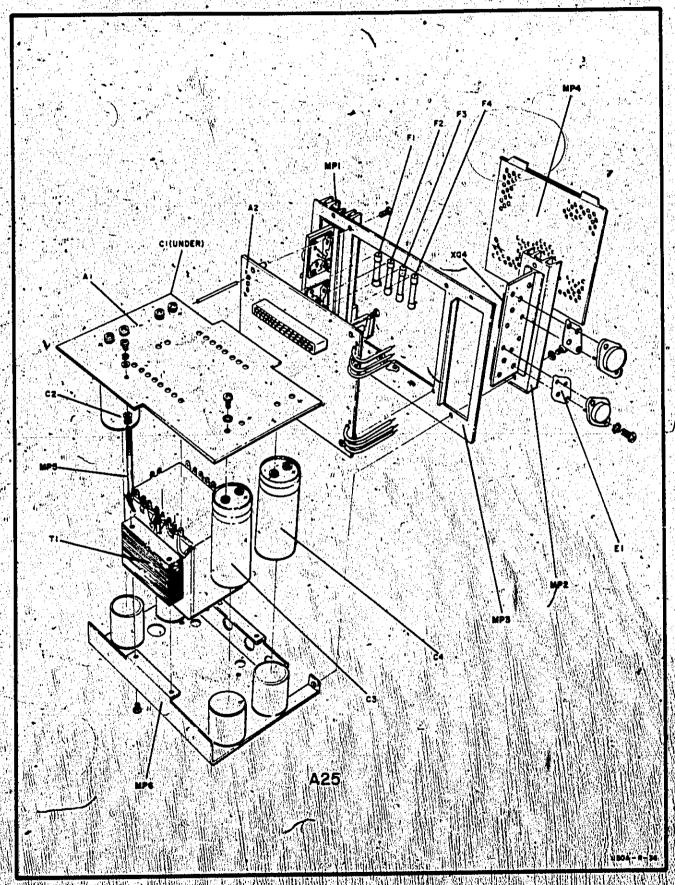


Figure 6-1. Low Voltage Power Supply Module Exploded View

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 manufacturers 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

5 75 97	ampere(s)	"GRD	= ground(ed)	NPO	- negative positive	RWV	= reverse working
	assembly	7 5 4 5 3			zero (zero temper-		voltage
33 I	- assaumorA				sture coefficient)		
		н	= henry(ies)	NPN	= negative-positive-		= slow-plow
D .	board(s)		= mercury		negative	S-B	= silicon controlled
	binder head		- Hewlett-Packard	NSR	= not separately	SCR	
		HZ	= hertz	1	replaceable		rectifier
P. 199	bandpass	- T-				SE	= selenium
					변경 첫 4번 4 4대 시청합의	SEC	= second(s)
	- 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	IF.	= Intermediate freq.	OBD	- order by	SECT	= section(s)
	= centi (10 °)	19.1	= impregnated		description	صرٰ SI	= siticon
	- carbon	INCD	= incandescent	ОН	= oval head	SIL	= silver
	= counterclockwise	INCL	= include(s)	OX	= oxide	SI/3	= slide
	= ceramic		= insulation(ed)		er, in a travel allegate for	SP 🗗	= single pole
	= cabinet mount only .*			Salah Sa		SHE	= special
OAX 📑	= coexial	INT	= internal	P	■ peak	s{[= single throw
OEF 🗀	= coefficient			PC	= printed (etched):	STA	= standard
	= composition	a rajyu dila	3.		circuit(s)		
	= connector(s)	~K	= kilo (10 ³)	PF	= picoferads		
	= cathode-ray tube	KG.	= kilogram	PHL	= Phillips	TA	= tantalum
	= clockwise			PIV	= peak inverse	ΤΩ	= time delay
•	- DIOCKAGISA	-			voltage(s)	TFL	= tellon
aga Mili		LB	= boriuq(s)	PNP	= positive-negative-		
, ,	deci (10 ⁻¹)	LH	- left hand		positive	TGL	- toggle
	= deposited carbon	LIN	= inear taper	P/O	= part of	THYR	= thyristor
		LOG	= logarithmic taper			i The 🦠	= titanium
	= double pole	LPF	= low-pass filter(s)	PORC	= porcelain: "	TNLDIO	= tunnel diode(s)
T . Y	= double throw ()	LVR	= lever	POS }	= position(s)	TOL	- tolerance
				POT	= potentiometer(s).	TRIM	= trimmer
· · · · · · · · · · · · · · · · · · ·				P-P'	= peak-to-peak		
	= electrolytic	M	= milli (10 3)	PRGM	= program		
	= encapsulated	MEG	= mega (10°)	PS	= polystyrene	U .	= micro (10 ⁻⁰)
XT	= external.	MET FILM	= metal film	PWV	- peak working	苦点的 衣饰	
		METOX	= metal oxide		voltage		
1.14	ignetetation promiera i kasa		• metal oxide	150,000,00		v ~ 5	o volts
	= farad(s)	MFR				VAR	· = veriable
ET .	= field-effect	MINAT	= miniature	RECT	= rectifier(s)	VDCW	= dc working volt
	transistor(s)	MOM	- momentary	AF	= radio frequency		
H	= flat head	MTG	= mounting	RFI	= radio frequency	10.00	
	= fillister head	4g MΥ	= mylar : in '	* YOU A	interference	W	= watt(t)
ΧD	= fixed			RH	= round head	W/	- with
	医氯甲基基氏试验检尿病炎		-9 .		Of the Visit of th	WIV	= working inverse
		N.	= nano (10 ⁻⁷)	a brokeri	right hand	is to TVI V 1 to 44 Cu (Suy + Cu Handil	voltage
•	= giga (10 ⁹)	N/C	- normally closed		A. 1.7. The Thirt is the second of the secon	w/o	
E	= germanium	NE	= neon	RMO	,= rack mount only ; ;;		= without
L	= glass	N/O	= normally open	RMS .	= root mean square	WW	= wirewound

Table 6-2. Replaceable Parts

Reference	HP Part Number	Qty	Description	Mfr. Code	Mfr Part Number
Designation					
LO1			CHASSES PARTS		
laz IC	01150-66502 CL110-66503		BOARD ASSY: INTERCONNECT BUARD ASSYSLOCAL/FERCTE	28480 28480 24480	01150-66602 01150-66503 01150-66504
AD4	01150-66506 01150-66506		RDARO ASSYLCALIBRATUR BOARD ASSYLDISPLAY CONTROL BOARD ASSYLEXPAND POSITION	26480 28480	01150-66505 01150-66506
No.	n1150-46507		BUARD ASSYIREAD/ WILTEPLEZER	28480 28480	01150-66507 01150-66509
131 139 110	01150-66508		BOARD ASSYLVERTICAL PUSTION HOT ASSIGNED BOARD ASSYLSCAN ATTENUATOR DECODER	28480	01150-66511
A11 A12 A13	01150-66511 01150-66512 01150-66513		HOARD ASSYLSCAM D/A & ATTEMUATUR	28450 28480 28480	01150-66512 01150-66513 01150-66514
Alb	01150-66514		BOARD ASSYLVERTICAL ATTENUATOR ROARD ASSYLLAND DRIVER BUARD ASSYLTRIGGEN PICK-OFF	284 80 284 80	01150-66515 . 01150-67601
41 Y 01	01150-67601	-	BOARD ASSYLESSY POWER SUPPLY	28480 28480	01150-66517 01150-66518
AL 3 AL 7	01150-66518 01150-66519 31150-66520		NOARD KSSYLEXTENDER BOARD ASSYLEXTENDER	28480 28480 28480	01150-66519 01150-66520 01150-66521
21	01150-44521		BOARD ASSYLTIME BASE	284 40	01150-66522 01150-66523
A22 A21	01150-66522 01150-66523	10 A V 17 15 U 17	BOARD ASSYLTRIGGER BOARD ASSYLOW VOLTAGE POWER MODULE	28480 28480 28480	01150-64522. 00182-60018 L
A25 A25	00182-50018		NOT ASSIGNED	28480	0960-2085
A21 A24	0960-2085 01810-86502 01810-66505	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ASSYLAUD CONVERTER BOARD ASSYLMITERCUNNECT, SAMPLING ROARD ASSYLESTENDER	28480 28480 28480	018L0-66502 018L0-66505
A24 A13 A11	01 810-66505 01 150-60001		BOARO ASSYLEXTENDER DLIDELANLINE	26480 26480	01150-60001 • 0180-1871
C1	01801871 01800196	1	CFXD ELECT 12.000 UF +75-10% 25 VDCW CFXD ELECT 1500 UF 50/80 VDCW	56289	D42962 DFP
	0140-019J 0160-3451		NOT ASSIGNED UF 108 20VDCM CIPAD ELECT 2.2 UF 108 20VDCM CIPAD CER 0.01 UF 180-20% 100 VDCM	56289 56289	1500225X9020A2-0Y5 C023B101F103ZS25-CDH C0678251F102KS25-CD
C5 C7	0160-3448 0160-3448 1901-0525		C.FXD.GEB.1000 PF 10% 1000 VDCW C.FXD.CER 1000 PF 10% 1000 VDCW DIODE ASSY.SI 50V PIV	56289 2 84 80	1901-0625
CRI DSI OS2	1450-0746 1450-0746	39	LIGHT INDICATOR 6VDC 0.25W LIGHT INDICATOR 64VDC 0.25M LIGHT INDICATOR 64VDC 0.25M	28480 28480 28480	1450-0748 1450-0746 1450-0746
053 054 055	1450-0746 1453-0746 1450-0746		LIGHT INDICATORIAVOC 0-25W	28480 28480 28480	1450-0746 1450-0746 1450-0746
DS6	1450-0746		LIGHT INDICATORISTOC 0.25M	28480 28480	1450-0746 1450-0746
05 F 05 8 05 9	1450-0746		LIGHT INDICATORISANDE 0.25M LICHT INDICATORISANDE 0.25M LICHT INDICATORISANDE 0.25M	28480 28480	1450-0746 1450-0746
DSIT	1450-0746 1450-0746		LIGHT, INDICATORISADE 0-25W	28480	1450-0746
0512 0513	1450-0746 1450-0746 1450-0746		LIGHT INDICATOR:6VDC 0-25M* LIGHT INDICATOR:6VDC 0-25M LIGHT INDICATOR:6VDC 0-25M	28480 28480 28480	1450-0746 1450-0746
DS15 DS15	1450-0746 1450-0746		LIGHT INDICATORISANDE O-25M	28480	1450-0746
DS17 DS18	1450-0746 1450-0746		LIGHT INDICATOR: 6VOC 0-25W LIGHT INDICATOR: 6VOC 0-25W	28480 28480 28480	1450-0746 1450-0746
DS20 DS21	1450-0746 " 1410-0746" 1450-0746		LIGHT INDICATORIGADE 0.25W LIGHT INDICATORIGADE 0.25W	28480 28480	1450-0746 1450-0746
D522	1450-0744 1450-0746		LIGHT INDICATORISADE U+23#	29480 29480 28480	1450-0746 1450-0746 1450-0746
D\$25	1450-0746		LIGHT INDICATORISADO 0.25M LIGHT INDICATORISADO 0.25W LIGHT INDICATORISADO 0.25W	26480 28480	III ■ VV E + A = 1 A A A A A A A A A A A A A A A A A
US25 DS27	1450-0746		LIGHT INDICATORIANDE C.25M	28486 28480	1450-0748 1450-0744
0524 0529 0530	1450-0746 1450-0746		LIGHT INDICATOR:640G 0.25W	28480 28480 28480	1450-0746 1450-0744 1450-0746
0532	1450-0746 1450-0746		LIGHT ENGICATORSOVOC 0-25MF LIGHT ENDICATORSOVOC 0-25M LIGHT ENDICATORSOVOC 0-25M	28480 28480	1450-0746
0533 0534 0535	1450-0746		LIGHT INDICATOR SAVOC 0.25M LIGHT INDICATORSA VOC 0.25M LIGHT INDICATOR SAVOC 0.25M	28480 28480 28480	1450-0744 1450-0744 1450-0744
0\$35 0\$17	1453-0746		LIGHT INDICATOR: 6 VDC 0.25W	28480 28480	1450-0746 1450-0746
D\$34 D\$39	1450-0746 1450-0746 1460-0064	, 11,	LIGHT INDICATOR: 6VDC 0.25M LIGHT INDICATOR: 6VDC 0.25M FUSEHOLDER EXTRACTOR TYPE	2 84 8 ¢ 28480	1450-0744

Table 6-2. Replaceable Parts (Cont'd)

Reference !!!!	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			PUSE CANTASTIGE ZAMP \$25V, SEUM ILUM	71400	
	2110-0004	1	FUSEICAMTRINGE NA 1254	75915 28480	312009 319100-3327
i.	. 73100-3327	1	CONNECTURERNO	02660	31-221-1020
12	11,40-0081		CONNECTOREING	026.60	31-221-1050
grown to the	1250=10#3		CHANECTORENNE	02660-	51-221-1070 5080-0467
	1060-0467	3 7	CONNECTORINALE PROBE	24440	3 5060-0467
14	5050-0467		CONNECTORINALE PRIME CONNECTORING & CONTACTSEZ # 221	25480 71785	5060-0467 252-22-30-340
J7	1241+1AN7"		DALTING ALA		
PL PL	1251 -0233		CONNECTORING 44 CONTACTS12 X 221	71785	252-22-30-349
Jio	1251 - 3031	$\beta > P^{k} + \lambda q^{k+1}$	FI CONNECTORING (2X25) CONTACT PLANTED IN THE	71705	252-25-10-340
ns was a second			PART OF A18	1	252-22-30-340
	1251-0233		CONNECTUMINUMA CONTACTST2 X 22)	71765	
J1 6.	1 7251 - 0233		CHMHECTOFERC 44 COMTACTSES # 221 ()	71705	252-22-30-340
Jla			CHANECTOREPE 44 CONTACTS (2 T 22)	1 71705	292-22-30-340
11.4	1251-0233	A A	PART OF ALS	引擎红旗	
J19	1251 3031		CONNECTORISO (2825) CONTACT GIRRON	71785	252-25-30-340
15.7			CONNECTORISS ISESSE CONTACT PLUNON	71785 /	252-24-30-140
J?\$ J ? \$	1251-3031 1		PART OF ALS		
TTT, sede starte	1251-0233	1	CONNECTORISC 44 CONTACTSE2 # 221	71785	1 252-27-30-340
15.4	▼京都在第二司 (1995年) 李	•	PART OF ATA	71745	, 252-22-30-140
156	1251-0233		PART OF A14	71785	212-27-30-340
J21	1251-0233",		CONNECTORING AS CONTACTSEZ # 221		
J24.			CONNECTORISC 44 CUNTACTSEZ # 221	271785	252-22-30-340
J27	1251 0233		- - 	71745	252-72-30-340
131 W.	1251-0233		CHANGETORING 44 CONTACTS (2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		
115			P CONSECTOR PC 44 CONTACTS 12 X.221	71785	252-22-30-340
J.).	1251-0233		PART OF ALB		
J15			PART OF A28	.	251-22-30-261
J16 J17	1251-0233	1 - 4.1	CONNECTORISC ENGE (2 x 11) 22 CONTACT	71785	
434	1251-0087	7	CONNECTOR : FEMALE SO-PIN MINAT	26440 28480	1251-0067 1251-0087
139	1251-0087		CONNECTORIFEMALE SO-PIN MINAT BOOVIES CONNECTOR, MALE BNC SERIES	02660	31-357-1022
J43	1250-0140		CONNECTOR MALE SUMMEN TYPE D SSCONTACT	71468	#-25# 31-221-1020
J+5	1240-0013,				
J ₃ 3			NOT ASSIGNED CONNECTORIPE EDGE & ROW 22 CONTACT	73.745	250-22-30-210
166	1241-0172		PART OF A16		
J46	03702250		PART OF Ate	28480	0170 -2250
MPI			KNOSTJADE GRAY	28490	0370 1091
MP2 MP3	0370-1091 c2 10-0110	28	GAUGE HOLD CONTROL OF THE CONTROL OF	28480	1490-0030
MPA	# 1470-0030 7 5000-8544	1 2	STANDITILT	28480	5000-8549 5060-0224
MPS	5040-0222	2	HANDLE ASSY15H STOE	28480	
MP2	5067-8735	1 2	RETAINER HANDLE ASSYIDLIVE GRAY!	28480 28480	1040-8735 5060-0767
MPa	5060-0767 5060-6511	5	FOOT ASSYSFM	28480	7777 11111 / 8 0
MP9	5060-8519		COVER POTTON KNOB ASSYEBAR	24480 28480	00220-67402
MPIL	00220-67402	l l		28480	01150-00201
MP12	01150-00201	1	PANEL I FRONT	28480	01150-00203
MP14 MP14	01150-00703			28480 28480	01150-01703 0370 2150
MP15	0370-2150 01 150-0400 3		SKIRTIDIAL	29480	01150-04003
Ž	UI 1952 平线数数超过 27	A	KNOB, BAR: A AND B TRACE	28480	0370~2151 "
MP17 MP18	0370-2151 0370-2152		KNOS, BAR MV/DIV	28480 28480	0370-2152 01150-01202
MP19	01150 01202 01150-01204		BAKT POWER SWITCH	28480	01150-01204
MP70	新 x 基 66年7月85年15月		이 집 되면 되는데 무료를 보고 있는데 하는데 모든데 만든	16108	2N3715
02 01	1844-0264		TSTRIST PAP	80131	244918 1854-0300
(03: 1)	1854-0100	ļ.	TSTRIST MPM	28480	2100-3035
R1	2100-3035 2100-3034		REPOTENTIONETER. HOLDOFF	28480	2100-3034
	0757-0832	3.	RIFED MET FLM 4-75K DNM LT 1/24	28480	0757-0832 0757-0832
83 86	0757-0832	3	BIFID WET FLM 4.75K OMF 18 1/2M	28480° 28480	2100-3158
: R3	2100-3158		REVAR COMP TOE OHN 20% LIN 1/28	28480	2100-3150

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	" Qty	Description	Mfr Code	Mfr Part Number
AR M2 M11 M12	0797-0832 0797-0346 ", 0797-0346 ", 0797-0401 0797-0442		RIFRO MET FLM 4.75% CHM 18 1/2W RIFRO MET FLM 1.00 MEGCHM 18 1/4W RIFRO MET FLM 1750 CHM 14 18W RIFRO MET FLM 100 CHM 18 1/8W RIFRO MET FLM 10.0% CHM 18 1/8W	28480 28480 28480 28480 28480 28480	0797-0832 0757-0344 0757-0832 0757-0401 0757-0442
81 1 51 52 53 55 55 55 56 57 58	0684-6721 3101-1508 01150-21401 3100-3037 3100-3037 3101-1266 01150-21401 01150-21401 01150-21401 01150-21401		RIFAD COMP 4700 DMR 108 1/4# SWITCH TOGGLE DPOT SWITCHESLIDE, SLOTTED SWITCHERDEARY 3 SECTION SWITCHERDEARY 3 SECRION SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED SWITCHESLIDE, SLOTTED	01121 09353 28480 28480 28480 28480 28480 28480 28480 28480	C8 +721 73181 01150-21901 3100-3037 3100-3037 3101-1244 01150-21901 01150-21901 01150-21901
513 511 513 513	1101-0199, 1101-0199 1101-0163 1101-0163 3101-0163	14	SWETCHESELDE DPOT 0.54 J25V AC/OC SWETCHESELDE DPOT 0.54 J25V AC/OC SWETCHETUGGLE SPOT SWETCHETUGGLE SPOT SWETCHETUGGLE SPOT	79727 79727 04009 04009 04009	G126-0012 G126-0012 MST-1050 MST-1050 MST-1050
\$15 515 517 514 514	3tot-ole3 3tot-ole3 "101-0le3 31ot-ole3 1101-0le3		SWITCHEFOGGLE SPOT SWITCHEFOGGLE SPOT SWITCHEFOGGLE SPOT SWITCHEFOGGLE SPOT SWITCHEFOGGLE SPOT	04009 04009 04009 04009 04009	MST-1050 MST-1050 MST-1050 MST-1050 MST-1050
\$20 521 \$22 524 524	3101-0163 3101-0163 3101-0163 3101-0163		SWEECHETOGGLE SPOT SWEECHETOGGLE SPOT SWEECHETOGGLE SPOT SWEECHETOGGLE SPOT SWEECHETOGGLE SPOT	04009 04009 04009 04009 04009	451-1050 451-1050 451-1050 451-1050 451-1050
\$25 \$25 \$25 \$21 \$21 \$23	1101-0163 3101-0163 3101-0163 3101-1261 3100-1033		SWITCHITOGGLE SPOT SWITCHITOGGLE SPOT SWITCHITOGGLE SPOT SWITCHIPUSHOUTTON HOW SPST IN 115VAC SWITCHIROTARY 5 POSITION	04009 04009 04009 04009 09353 28460	457-1050 457-1050 457-1050 P8121 1100-1033 -
\$ 13 \$ 11 \$ 12 \$ 13 \$ 5 12	3101-1261 3107-3034 3100-3034 3100-3039 1844-0092		SMETCHEPUSHBUTTON FOR SAST TA TESVAC SMETCHEROTARY I SECTION SMETCHEROTARY I SECTION SMETCHERIFARY & SECTION THYMISTORISCA JEDEC TYPE 2NA641	09153 28480 28480 28480 28480 04713	PRIZE 13100-3034 3100-1014 1100-3039 284441
11 ut u2 u4	9109-3245 8120-1545 9140-31603 01150-81503 01153-61602		TRANSFORMERINGMER CARLE ASSY:AC POWER COAD 7-3 FT CARLE ASSY:INPUT TRIGGER CABLE ASSY:VAIN CARLE ASSY:LITE	28980 70903 28-70 25480 25480	9100-3246 KH 7171 01410-61503 0159-61601 01150-61502
*** per	tean-adam		PUSEMULUERTHHUNZE CLIP POR 86 SCREW		

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
# 1 N 2 N 1					
A11 An/ A+11 A321	uriso 665027 L13 1-refer Option 226 Stade-1846		BOARD ASSY INTERCONNECT MIAMO ASSY INTERCONNECT MIAMO ASSYLE CALPUTORIE CIPPA TICAL COURS OF LOOPUCA CIPPA TICAL COURS OF LOOPUCA	25480 1443 14674	01.949-66562 .51.t-a-r65-33 .03-a-le-323 - winstys-24135
(RU 3s.1) (60% 4 Au3 - B Au3 - B Au3 - B	0144-0112 1134-014 104-124 004-224 004-221 006-1101	74	######################################	246-10 907-11 011-21 011-21	1142-0112 2014-17 2012-17 2012-22 2012-22 21-22-21 21-22-21
A73 V A43 V A43 Ph A03 n Z A44 Ph	1 t pro-1171 1 t pro-1171 1 t pro-1171 2 t pro-1171 2 t pro-1171 t		AFFED COMP 1000 ON 104 1744 FFED COMP 1000 ON 107 1744 HEND COMP 1100 ON 107 1744 AFFED COMP 1100 ON 107 1744 - FFED COMP 1500 ON 107 1744	01121 01121 01121 01121 01121	63 (53) COV1051 COV1051 COV1051 COV1051 COV1051
Aulen Auselu Auselu Aulele Aulele	CA96-1021 Ob96-1321 Ob96-1321 Ob96-1321 Ca96-1321		TERM GIME 1372 HE 138 I/M HERD CHME 1375 HE 108 I/M HERD CHME 1375 HE 108 I/M HERD CHME 1370 HE 108 I/M TERM CHME 1300 HM 108 I/M TERM CHME 1000 HM 108 I/M	61121 61121 61121 61121 61121	CH 1021 CH 1021 CH 1021 CH 1021 CA 1021
A0 35 1 W A0 5 1 D A0 5 4 LD A0 5 4 LT A0 5 4 LT	7,64-1,021 06 46-1,021 (4 46-1,021 9,94-1,021 06,66-1,021		ALERO COME (CON HAM TOR 1746. WEREL COME TON DER TOR 1744 LEFRE COME TON HAM TOR 1744 ALERO COME TON HAM TOR 1744 ALERO COME TON HAM TOR 1744 ALERO COME TON TON TON TON TON	% cii2i nit2i nit2i nit2i nit2i	g 1021 da 1021 CH 1021 CA (1021 G 1021)
#31-1 # #4-24 #4-24 #4-24 #4-24	0646-1021 0646-1021 0646-1021 0646-1021 0646-1021		SIRED CIMP 1000 DHM 102 I/46 WIFED CHMP 1000 DHM 102 I/46 WIFED CHMP 1000 DHM 102 I/46 WIFED CHMP 1000 THM 102 I/46 FIFED/COMP 1000 DHM 102 I/46	91121 01121 91121 01121 01121	Ca 1001 Ca 1101 Ca 1101 Ca 1021 Ca 1021
AJ3424 AJ3425 AJ3425' AJ3-24'	Unna-1971 On 14-1071 OF 94-1071 CY 94-1071 Gosta-1071		TERMS COMP LOSS CHE TOR LYMN - FRESCHE COMP TOSS CHE TOR LYM - FRESCHE COMP TOSS CHE TOR LYMN - FRESCHE C	01121 01121 01121 01121 01121	CA(1)71 CA(1)71 CA(1)721 CA(1)721 CA(1)721
433-24 A03-33 A33-31 A33-32 A31-33	Jp#w=1321 Yoda=1024 Jp 46-4411 Un84-1321 Gp#4-1421		ATPAD GIMP 1003 IMM 107 1/44 GIFAD GIMP 1005 IMM 107 1/44 GIFAD GIMP 545 IMM 108 1/44 ATFAD GIMP 545 IMM 108 1/44	01121 01121 01121 01121 01121	(Ce 1721 Co) (7321 Ci) (7321 Ci) (1721 Ci) (1721
AU to 14 AU to 15 AU in 36 AU in 36 AU in 36 AU in 36 AU in 36	Gr 44-2211 De 44-1021 Cr 44-1321 25 44-1321 Cr 44-1321		ATERU CUMP 230'0HM TOE 1/4M ATERU CUMP 1000 'HM 102 1/4M	r1127 - 01121 - 01121 - 01121 - 01121	2.1 - 2711 CA 1021 C 1021 CH 1021 CH 1021
A03+5+ A03+43 A03441 A03+42 A03J1	Cons-1721 Cons-1021 'Cons-1021 Cons-1021 In 20-0 s2n		#1510 COMP 1002 HM 102 1/4W R1510 COMP 1000 OHM 102 1/4W #1510 COMP 1000 OHM 102 1/4W #1510 COMP 1030 OHM 102 1/4W 1C171 QUAD 2-1MPT MCR GATE	01121 01121 01121 01121 01121 01121 0471	CA LOZI CB NOZI CA 1021 CA 1021 CB 1021 SH7607N
809-15 809-15 809-15 809-15	1 1420-0124		- ICITTE JUAD 2-IMPT NOW GATE ICITTE JUAD 2-IMPT NOW GATE ICITTE JUAD 2-IMPT NOW GATE ICITTE QUAD 2-IMPT NOW GATE ICITTE QUAD 2-IMPT NOW GATE ICITTE JUAD 2-IMPT NOW GATE	04713 04713 04713 04713 04713	\$1,74029 \$4,74029 \$4,74029 \$4,74029 \$4,74029
AJ3J7 A33U4 A03J9 A03J1J	16 20 + 0 328 14 20 - 0 32 4 13 20 - 0 32 5 14 20 - 0 32 8 16 20 - 0 32 8		ICITTE DUAD 2-INPT NUR GATE ICITTE QUAD 2-INPT NUR GATE ICITTE JUAD 2-INPT NUR GATE ICITTE JUAD 2-INPT NUR GATE ICITTE DUAD 2-INPT NUR GATE	04713 04713 04713 04713 04714	5474024 5474024 5474024 5474024 5474024
SILECA LUCCA ALLECA ALLECA ALLECA	1620-0179 1420-0174 1420-0661 1420-0668 1420-0668	12 21	ICTTL QUAIT P-INPT NDR GATE ICTTL HEX DRIVER W/DREN COLLEGOVI.	04713 01245 01245 01245 01245	5174024 5874044 5474024 5174024 5874024
73UE0A 73UE0A 41UE0A 7UE0A 7SUE0A	1920-0068 1920-068 1920-0261 1920-0054 1920-0054	16 17	"ICITTL HEN ORIVER WODEN CULLESOVS ICITTL'HEN ORIVER WODEN COLLESOVS ICITTL'HOND-STÄSLE NUTIVIBRATIA ICITTL QUAD 2-INDT NAMO GATE ICITTL QUAD 2-INDT NAMO GATE	01295 01275 01275 01275 01275	547-074 547-074 547-1214 547-104 547-004
AD4 A04C1 A34C2 V0AC3 L04C4	01150-66504 0180-0224 0180-0195 0160-3453 014C-0125	100 (100 (100 (100 (100 (100 (100 (100	HOARD ASSVECAL BRAZTUR	28460 28460 96289 56289 96289	OL190-06504 O180-0229 15003340001742-DVS OBD 5C192C2S-CML

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	IP Part Number	Qty	Description	Mfr Code	Mfr Part Number
					
AJ413 A3410 A3617	3140-1766 0160-1766 0160-0229		CIFRID ELECT 15 UF 10F 20VDCM CIFRID ELECT 15 UF 10R 20VDCM CIFRID ELECT 31 UF 10R 10VOCM	23480 28490 28490	0160-1746 0180-1744 0160-0229
AD418	0160-0169 0160-3451	18 48	C: FRD CER 0.01 UF .40-208 10040C4	96289 96289	C0213101F1032525-50
A04013 A34011 A34012	0160+0162 0160-0137 0160-0155		CIFED AV 0.022 UF 101 20040CH CIFED FLECT 2.2 UF 101 2040CH CIFED AV 0.0031 UF 101 20040CH	56289 56289 56289 56284	19093525-015 19093524403042-045 2023819161035525-005
AJOLE	0140-1441 0140-0194		CIFRO ELECT 2-32 UF -040-20% LOOVICE CIFRO ELECT 2-32 UF 20% 35VDCH	56289	15003141003542-045
AD-CL5 AU-CL6 AU-CL7	01+0-0197 01+0-0197 01+0-0197 01+0-0197		CIFRO ELECT 2-2 UF 10th 20VOCH CIFRO ELECT 2-2 UF 10th 20VOCH CIFRO ELECT 2-2 UF 10T 20VOCH	56289 56289 56289	1500225X4020A27DYS . 1500225X4020A2-DYS 1500225X4020A2-DYS
A04020	0114-2240		CIFRO CER 2.0 PF NOOVOCA CLVAR CER 7-23 PF N300	72942	39-000-C3#C-239C
A04C21 A04C22	0160-3451 0160-0197 0160-2538		CIEND AICY 400 bb TS 700AOCH CIEND EFFCL 5-5 NE TOS 50AOCH CIEND CEB 0:05 NE : 400-502 F00ADCM	56289 56289 04062 72982	CO238101F1032525-50 15002258902042-0YS 80M15F401F3S 301-000-C0G0-200J
A0+22+	0160-2264	12	CIFED CEP 20 PF 5% SOOVDCW CIFED MICA 100PF 5% CIFED LECT 2.2 UF 10% 2040CM	72134 56289	PDM15F101J3C 1500225R902042-DV5
434125 434127 A04C28	01:0-0197 01:0-0197 01:0-0197 1:01-2040	#4	CIFAD ELECT 2.2 UF 10% 20 VDCW	56289 56289 07263	1500225X9020A2-0Y5 1500225X9020A2 DYS FDG1 0#8
A04C41 A04C1 A04C1 A04C2	0+90-1014 9140-0105 9140-0105	. •	RELAYER FORM C 12 VOC 390 UMM COLLEMPLOED CHIKE 4.20 UM 108 COLLEMPLOED CHORE 4.20 UM 108.	15916 26480 28480	412-6146 9140-0105 9140-0105
834L3 836L4 436L5	9140-0137 9140-0096 9100-1413		COLLIFED RF 1000 UN ST COLLIFED RF 1 UNSV CULLIFED 0.47 JH 201	25480 25480 26480	9140-0137 9143-0096 9100-1613
AJALA AJAL	4140-0105 9140-0105		CUELIMALDED CHORE 8.20 UM 108 CUILIMCLOED CHORE 8.20 UM 108 TSTRISE PHOLSELECTED FROM 2M37021	28480 28480 29480	9140-0105 9140-0105 1851-0020
43631 A3631	1851-0020 1453-0020 1851-0020 ³		TSTRIST PAPESELECTED FROM 2NJF021	2848G 2848G	1853-0020 1951-0020
10434 10435 10436	1#51-0020 1#54-0071 1#53-0020	91.	TSTRIST PAPISELECTED FACH 2M3702) TSTRIST NAMISELECTED FACH 2M3704) TSTRIST PAPESELECTED FACH 2M3702)	28480 28480 28480	1951-0020 1954-0071 1953-0020 243417
A0437 A0438	1854-0087 1854-0087		TSTRESS NON	80131 80131	24341 <i>7</i> 249417
A0434 A04313 A34311	1454-0087 1454-0087 1454-0071		TSTRISE NAM TSTRISE NAM TSTRISE NAMESELECTED FROM 2N3704) TSTRISE NAMESELECTED FROM 2N37041	60131 28480 28480	243417 1854-0071 1854-0071
A04012 A34313	1854-0071 1854-0071		TSTRIST NPMISELECTED FROM 2N37041	28480 28480	1854-0071
A34315 "A34314 A34314	1854-0071 1954-0071 1854-0071		TSTRIST MPNESELECTED FROM 2N37043	28480 28480	1854-0071 1854-0071 1854-0071 201595
A34313	1855-0062	5 ♦	TSTRIST FET 30V TSTRIST FET 30V TSTRIST FET 30V	01295 01295 01295	2M1595 2M1595
A34320 A04321 A34322	1855-0062 1855-0062 1855-0062		TSTRIST FET SOV TSTRIST FET SOV TSTRIST FET SOV	01295 01295 01295	2N1595 2N1595 2N1595
45C404 45C404	1855-0062		TSTRIST FET JOY TSTRIST MPNESELECTED FROM 2N3704)	01295 28480	2N1595 1854-0071 2N1053
4SCADA 4SCADA	1394-0039 1853-0045 1954-0092		TSTRISE NPN	80131 80131 80131	2H4Q36 2H3563
A34329	1894-0012 1994-0215	11	TSTRIST NPN TSTRIST NPN RIFED COMP 2200 OHR 108 1/4W	#0131 #0131 01121	243563 243904 CB 222L
A0441 A0442 A0443	0684-1021 0684-1021		RIFED COMP 2200 OHM 10% 1/4M RIFED COMP 1000 OHM 10% 1/4M RIFED COMP 1000 OHM 10% 1/4M	01121	CR 1021
A0484 A0495 A0486	0684-1021 0684-1021 0684-1021		STREET COMP 1000 DHM 102 1/4M	01121 01121 01121 20400	CB 1021 CB 1021 CB 1021
A344 T	0757-0290 0757-0385		RIFED MET FLM 3-19K DHM 18 1/8w RIFED MET FLM 221 OHM 18 1/8w RIFED COMP 2200 DHM 10K 1/9W	28480 01121	0757-0385 "Ca 2221
A04410 A04411	084-2221 0757-0443 0757-0462 0884-1041	46 48 32	RIFED MET FEM 11.0K DHN 12 1/8W RIFED MET FEM 75.0K DHM-12 1/8W RIFED COMP 100K DHM 102 1/4W	28480 28480 01121	0757-0443 0757-0462 CB-1041
A04813	0644-2271		RIFAD COMP 2200 Dim 108 1/4M	01121	C8 2221



Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
404314	0757-0443		RIFID MET FLM 11.0K DHM 12 1/8H	284 80 284 80	0757-0443 0757-0462
A34815 A34815	0757-0462 0684-1041 0684-2221		RIFAD COMP 100K CHM 10% 1/4W	01121 01121 284 80	CB 1041 CB 2221 0757-0443
A04218	0757-0443		RIFAD MET FLM 11.OR OHM 1% 1/8W TREET MET FLM 15.OK OHM 1% 1/8W	2648C	0757-0462
FIRECA CSRAUA ISBACA	0197-0462 0684-1041 0684-2721		RIFED COMP LOOK OHM LOS LAN	01121	C6 1041 C6 2221 C7 0797-0443
55 P404	0757-0443 0757-0462		RIFED MET FEM 13.0K DHM 12 1/9W RIFED MET FEM 75.0K DHM 12 1/8W	284 00 284 00	0757-0462
4540A	0684-1041 0684-2221		RIFRO COMP 100K DHM 102 1/4M	01121	CN 1041 CD 2221
ESRADA TSRACA	0757-0443; 0757-0462	() ()	RIFED MET FLM 11-OK DHM 1% 1/86 RIFED MET FLM 79-OK DHM 1% 1/86	284 80 284 80 01121	0757-0443 0757-0462 CB 1041
HSF4DA	0684-1041 C684-2221	Angling Sol	RIFED COMP 100K CHM 10% 1/44 RIFED COMP 2200 CHM 10% 1/4M	01121	CA 2221
A04130	0797-0443 0797-0462		HRIFRD MET FLM 11.0K DHM 12 1/84	284 80 284 80 7 011 21	0757-0443 0757-0462 Cm 1041
A04+32 A04+33	0484-1041	17	RIFKO COMP 100K OHM 108 1/4M RIFKO MET FLM 2:00K OHM 18 1/8M	284.80	0757-0283
A74434 A74435	0757-0447 0811-2981	40	REFED HET FLM 10.0K DHM 18 1/4W	28480 28480 28480	0811-2981 2100-3057
A]4436 A04437 A04438	2100-3053 0654-4721 0811-2982	10 52 7	RIVAR CERMET 20 OHM 208 3/4M RIFRO COMP 4700 DHM 108 1/4M RIFRO WW 34988K OHM 0418 1/8M	01121 28480	CB 4721 nB11-2982
A34H39	2100-3053		ATVAN CERNET 20 THM 201 3/44	28480 28460	2100-3053 0611-2763
A04401 A04401 A04462	0811-2983 0811-2980 2100-3052	7	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	28480	0H11-2980 2100-3052
A34443	0757-0283		STREET HET FEM 2.00K OHM ET 1/84	28480	0757-0283
A04444 .	0757-0442 0757-0263		RIFED HET FLM 10.0K DHM 18 1/8M	284 80 284 90	0757-0283 9757-0442
AJ4446 AJ4847 AD4448	0757-0283 0757-0442		RIFAD MET FLM Z.OOK CHM LE 1/84	28480 28480	0757-0243 0757-0442
434449	C684-4721		RIFED COMP 4703 OHM 108 1/4M RIFED COMP 4700 OHM 108 1/4M	01121	CB 4771 CB 4721
434451 434451 434452	C684-4721 C684-4721	23	RIFRO COMP 4700 DHM 10T 1748 RIFRO MET FLM 18 DHM 12 1788	24480	C4 4721
434-53	0757-0280		RIFED COMP 2200 DHM 10% 1/4W	29480	0757-0280 CR 2221
434454 434455 434456	0684-2221 0757-0443 0757-0462		RIFED MET FEM 11.0K CHM 12 1/84	284 90 284 80	0757-0443 0757-0462
434457 404158	C684-1041 0611-3091	1	RIFAD COMP 100K OHM 10% 3/48 RIFAD we 40.0 DHM 0.1% 1/8M	01121 284 90	CM 1041 0811-3091
434457 404460	0811-1090	1	RIFED WW 60.00 CMM 0.12 1/6W	25480 26450	0411-3049
AC+462	0H11-3088		RIFID WW 600.0 CHM 0.1% 1/8W	28480 28480 28480	0411-3088 0411-3087 0811-3086
A04463	0411-3046 0411-3042		#1FXD No 26 DHM 0-15 178W	28480	0-11-30#2
A34465 A34466	0811-3084 0757-0416	9	RIFED WE ZING DHM O.1% 1/8W	28480 28480 28480	0757-0416 0757-0346
10F4CA 80F4CA	2100-251a	1	RIFED MET FLM 10 OHM 1% 1/8W	28480	2100-2514
404444 414444	0757-0391 0757-0283	'	#1FXD FLM 39.2 DNM/12 1/84 R1FXD MET FLM 2.0CK ONN 12 1/84 R1FXD MET FLM 511 CMM 12 1/84	28480 28480 28480	0757-0391 0757-0283 0757-0416
A04-71 A34-72 A34-73	0757-0416 0757-02#3 0757-0408	•	RIFED MET FLM 243 CHM 18 1/86	28480 28440	0757-0283
askii.	0757-0447	Ty and	9:527 WET FLW 10.08 CHM 18 1/48	264 90 284 80	0757-0442
434475 A34476 A3477	7100-3053 0#11-3085		RIFAD NH 557K GHM CLEE 1764 RIVAR CERMET/20 OHM 20% 3/44 FRIFAD NH 65750 CHM CLEE 174M	26480 28480	2100-3053 0911-3065
A34478	Q761-0054		THIFTO MET ON 330 OHM 5% IN	294 90	0761-0056
A34479 A64480 A64481	0757-0416 0757-0458 0761-0052			28480 28480	0757-0458 0761-0052
A34484 A34484	0684-1021 0684-2221		# 1500 COMP 1000 CHM 101 1/4W # 1500 COMP 2000 CHM 108 1/4W	01121 01121	CB 1921
A34484	0684-2221 CA84-4721		RIFKD COMP 2200 OHN 10% 1/4M	01121 01121	CS 7221
434486 434486	0757-0230		NIERD, WET FEM 6-19K THM 18 1/8W	28440 28460	0757-0290 0757-0435
A04484	0757-0431.		NIFRO MET FLM 2 43K OHM IN 18W	294 #0	0757 0431

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A34487 A14493 A34492 A34492 A34493	0757 0401 0757-0409 0757-0401 1-0757-0811		NOT USED REFAU NET FLM 100 CHM 18 1/8M REFAU NET FLM 332 CHM 1.08 1/2W REFAU NET FLM 100 CHM 18 1/8M REFAU NET FLM 392 CHM 18 1/2M	28480 28480 28480 28480	0757-0401 0757-0807 0757-0401 0757-0401
A34.94 A04.95 A34.95 A34.95 A34.12 A34.12	**C684-1021 0757-0416 0757-0452 1920-0070 1#20-0328		PIFADI-CUMP 1000 GHM 10% 1/4M AIFAD MET FLM 511 GHM 1% 1/8M RIFID MET FLM 27-AK CMM 1% 1/8M ICITTU-BENDRI-PIS NAND GATE ICITTU QUAD 2-INPT NCH GATE	01121 28480 29480 01295 04713	CS 1921 0757-0416 0757-0452 5474304 5474304
A34J3 A04J4 A04J5 A04J6 A34J6 A34J6	1820-0271 1820-0174 1820-0127 1820-0068 1820-0068	36 10	ICITTE MONO-STABLE MULTEVIBRATOR ICITTE MEX INVERTER ICITTE QUAD 2-INPT NANO GATE ICITTE TRIPLE 3-INPUT POS NANO GATE ICITTE TRIPLE 3-INPUT POS NANO GATE	01295 01295 04713 12040 12040	SN741214 SN7404N SN7401N SN7401N SN7410N
A3048 A3649 A46413 A46411 A46412	1620-0 101 1420-0 101 1820-0629 1820-0677 1420-0054		ICTTTL JUAD BI-STABLE D-LATCH ICTTTL JUAD BI-STABLE D-LATCH ICTTTL SHS TUAL EDGE TRIG. J-E F/F ICTTTL DHAL D F/F ICTTTL JUAD 2-INPT MAND GATE	01295 01295 01295 01295 01295	SN7475M SN7475M SN745L2M SN7474M SN7474M SN7400M
A04313 AC4314 A04315 A04318 A04318	1820-0077 1828-0009 1820-0201 1820-0328		ICITTL DUAL D F/F ICILINEAR OP. AMPL. INTEGRATED CIRCUITIOPERATIONAL AMPL ICITTL QUAD 2-INPT NOR GATE ICITTL DECADE COUNTER IO MMZ MIN.	01295 28480 04713 04713 01295	SN7474H 1820-0009 NC1439G SN7402N SN7490N
A34318 A34319 A64323 A64321 A64321	1820-0055 1820-0054 1820-0629 1920-0691 1700-0418		CONTIL DECADE COUNTER TO MAZ HIM. CONTIL QUAD 2-IMPT NAND GATE CONTIL SMS. DUAL EDGE TRIG. J-K F/F ICONTIL GUAD 2-IMPT NAND GATE SOCKETTIC TO CONTACT DUAL TYPE, RROWN	01295 	SN7490N SN7400N SN745112N SN74500N 583529-1
A044U2 A04YL A35 A35CL	1200-0441 0410-0089 01150-68505 0180-0197 0180-0197	10 1	SOCKET: IC 14-PIN MINIATURE CAYSTAL: QUARTZ, 48 997 MHz. BOARD: ASSY: DISPLAY CONTROL CIFXO ELECT: 2-2 UF 108 ZOYDCH CIFXO ELECT: 2-2 UF 108 ZOYDCH	28480 28480 28480 54289 56289	1200-0441 0410-0089 01150-66505 150022519020A2-DYS 150022519020A2-DYS
A05C2 A05C3 A05C4 A05C5 A05C6	0160-3453 0160-3453 0160-0107 0180-0229		CIFNO CER 0.05 UF +80-208 100VDCW CIFNO CER 0.05 UF +80-208 100VDCW CIFNO ELECT 2.2 UF 108 20VDCW CIFNO ELECT 33 UF 108 10VDCW CIFNO MY 0.027 UF 108 200VDCW	56289 56289 56289 28480 56289	CO23A101L5032525-CD CO23A101L5032525-CD 150022534020A2-DY5 0180-0229 192P22392-PT5
A0527 A0528 A0529 A05213 A05211	0140-0140 0140-0198 0140-0198 0180-0116 0160-2204	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	CIFXD MY 0.0062 UF 10% 200VDCW CIFXD MICA 200 PF 5% CIFXD MICA 200 PF 5% CIFXD ELECT 6.8 UF 10% 35VDCM CIFXD, MICA 100PF 5%	56289 72136 72136 56289 72136	192P82292-PTS RDM15F201J3C RDM15F201J3C 1500685X903582-DYS RDM15F101J3C
A35C13 A35C13 A35C14 A35C15 A35C15 A35CR1 A35CR2	0160-3451 0160-2204 0160-2204 1901-0040 1901-0040		CIFED CER 0-01 UF +80-20% 100VOCM CIFED MICA 100PF 5% CIFED CER 0-01 UF +80-20% 100VDCM DIODE:SILICOM 30MA 30MV	56 25 7 72136 56289 07263 07263	C0238101F1032525-C0 RDM15F101J3C C0238101F1032525-C0 F0G1088 F0G1088
ADSCR3 ADSCR4 ADSCR5 ADSCR6 ADSCR6 ADSCR7	1901-0040 1901-0040 1901-0040 1901-0040 1901-0040		DIODEISILICON 30MA 30MV OIODEISILICON 30MA 30MV DIODEISILICON 30MA 30MV DIODEISILICON 30MA 30MV	07263 ,07263' 07263 07263 07263	FOGLOSS FOGLOSS FOGLOSS FOGLOSS FOGLOSS
A05L1 A05L2 A05L3 A05L4	9140-0112 9140-0112 9140-0094		COIL:FXD RF 4-7 UH COIL:FXD RF 4-7 UH COIL:FXD RF 0.88 UH	28480 28480 28480 28480 80131	9140-0112 9140-0112 9140-0094 9140-0112 283417
A0532 A0532 A0538 A0538 A0545 A0538	1853-0036 1854-0087 1893-0036 1854-0087 1853-0036	3	TSTREST PNP TSTREST NPN TSTREST PNP: TSTREST PNP:	80131 40131 80131 80131 80131	2M3906 2M3417 2M3906 2M3417 2M3906
A0507 A0938 A0939 A09313	1854-0087		TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST PNP	#0131 #0131 -#0131 #0131	2N3417 2N3406 2N3417 2N3906 2N3417
A05011 A05013 A05013 A05014 A05015	1853-0036 1854-0087 1853-0036 1854-0087.		TSTRESE PAP TSTRESE NAM TSTRESE PAP TSTRESE APP	#0131 #0131 #0131 #0131	2R3900 2R3417 2R3900 2R3417 2R3900
A05016	11953-0034		[1] [3] [4] [4] [4] [4] [4] [4] [4] [4] [4] [4		

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
136261	1454-0087		TSTREST MP.	#01 *1 901 31	2N3417 2N3406
13591# 135317	1451-0016 1854-0087		ISTRIST MAN	60131 - 80131	213617 283906
105320 105321	1853-0036 1854-0097		TSTRIST NOW	10171	243417
135-22	1953-0036 1654-0087		TSTREST PAR TSTREST API	#0131 #0131	24349h 243417
105J21 105J24 105J25	1453-0036 1854-0067		TSTRIST PAP	P0131 80131	243406 243417
105026 17	1453-0036		TSTRISTI PAP	, AG131 AG131	2N3906
105954	1954-9087 1853-0036		TSTREST NPS TSTREST PNP	#0131 50131	243406 241417
102712	1853-0096	• • •	TSTREST NON TSTREST ONE TSTREST NO	60131 60131	2N1906 2N1417
135231 105J32	1854-0087 1851-0036		TSTelst ele	90131	2N3904
105433 105434	1854-00HT		TSTUIST NAME TERMINAL TRANSPORTER	60131 60131	2N3417 2N3906
105035	1854-0087 1853-0036		TSTREST NOW TO THE TOTAL TOTAL TO THE TOTAL THE TOTAL TO THE TOTAL TOT	00131 60131	243417 243476
AD5337	1834-00H7		TSTREST INDIG TSTREST INDIGSELECTED FROM 2N37041	0131 28480	243417 1854-0071
105038 105239	1854-0071 1854-0071		TSTRIST NPW SELECTED FROM 2837041 TSTRIST NPW SELECTED FROM 2837041	29480 28490	1854-0071 1854-0071
(05340 (05241	1854-0071 1855-00%2		TSTRIST FET. 30V	01295	241595
A05447 A05343	1955-0062 1454-0071		TSTRIST FET 30V TSTRIST NPMESELECTED FRCM 2N3TO41	0124* 24480	241595 1854-0071
105u44 135345	1855-0062 1854-0071		TSTREST FET ROY TSTREST NONE SELECTED FROM 2N3 FO4)	01295 28460 01295	2N1599 1854-0071 2N1595
409J46	1455-0062		TSTRIST FET JOV	90131	211340P
105J47 105J48	1853-0036 1954-0087		TSTUIST MPM	#0131 # 00131	2N3417 2N3906
AU549 AU5453	1453-0030 1454-0071 1653-0020		TSTREST MEMISELECTED FROM 2N37041	284F0 284F0	1854-0071 1853-0020
AO1-52	1854-0071		TSTRIST MUNISELECTED FROM 2N3704)	28480	-1654-9071 -2100-3053
A]54] * A]542 *	2100-1053 CR11-2981		RIVAR CERMET 20 OHM 20% 3/48 RIFKD by 1-986A OMM 0-18-1/48	28480 28480 28480	2100-3053 0411-2941 ,2100-3053
A0543 A0544	2100-3053 0811-2982		PIVAP CERMET 20 DHM 207 3/4W	26480	0811-2982
A3585 A3546	0757-0431 2100-3052	48	REFAU MET FLW 2.43K DHM 18 1/9W REVAR CERMET 50 OHM 208 3/4W	28450 28460	0757-0431 2100-3052
A0547" A0598	0757-0442		RIFAD MET FLM 10.0K DHM 1% 1/4M	284 80 264 80	0757-0442 0757-0431
A0549	0747-0442		AIFNO MET FLM 10.0K DHM 17 1/8M	28480	0757-0442
A05411 A05411	0757-0431 0757-0442		RIFKD MET FLM 2.43K OHM 18 1/8W	28480 28480 28480	0757-0431 0757-0442 0811-2983
A05113	0811-2983 0757-0431 0757-0442		RIFKO WW 7.970K 7HM 0.18 1/8M RIFKO NET FLM 2.43K OHM 18 1/8M RIFKO NET FLM 10.0K OHM 18 1/8M	284 80 284 80	0757-0431 0757-0442
AD5414 AD5415	0111-2980		RIFED NO 15.095% DICK G-1% 1/164	20400	0911-2960
ADSRI'S AUSRIT	0757-0431 0757-0442		RIFED NET FLM 2.43K OHM 18 1/8W".	284 80 264 80	0757-0431
ADSALO PIFECA	0698-7891 0757-0431	1.6	RIFAD FLM 32K DHM 0.25% 1/8W	28480 28480	0698-7881 0757-0431
AOSRZO	0757-0442		RIFED MET FLM 10.0K CMM LT 1/8W RIFED FLM 648 CMM 0.5% 1/8W	28480 28480	0757-0442 0898-7882
15121 15120A 15120A	0698-7882 0757-0431 0757-0442	•	RIFXD HET FLM 2.43K DHM 12 1/8M RIFXD HET FLM 10.0K DHM 12 1/8M	28480	0757-0431
105424 105424	0698-7883		RIFED FLM 1284 DHM 1.08 1/86	28480	0698-7683
AOSRZS AOSRZ6	0757-0431 0757-0442		RIFAD MET FLM 2.43K DHM 18 1/8M RIFAD MET FLM 10.0K DHM 18 1/8M	284 80 284 80 284 80	0757-0431 0757-0442 0698-3149
A05427 A05428	0698-3149 0757-0431		RIFRO FLM 255K OHM 1T 1/8M RIFRO MET PLM 2.43K OHM 1T 1/8M RIFRO MET FLM 10.0K OHM 1T 1/8M	28480 28480	0757-0431 0757-0442
A35429	0757-0442		RIFKD MET FLM SILK SMM 12 1/80	28480	0757-0402
A05830 A05831 A05832	2100-3053 0751-0431		RIVAR CERMET 20 DHM 208 3/4W RIFRD NET FLM 7.43K DHM 18.1/8M	28480 28480	2100-3053 0757-0431
A05835	0757-0442		RIFTO MET FLM 10.0K CHM IT 1/4W MAN AND AND AND AND AND AND AND AND AND A	28480 28480	0757-0442
A05435	0757-0732	2	R:FXD MET FLM 909 DHM 18 1/44	29480 01121	0757-0732 CB 2221
A05436	0684-2221 2100-3053		RIFNO COMP 2200 OHM 10% 1/4M RIVAN CERMET 20 OHM 20% 3/4M RIFNO WW 657.0 OHM 0.1% 1/4M	28480 28480	2100-3053 0011-1005
A05838	0811-7085 - 0684-1011	•	RIFED COMP 100 OHM LOE 1/4W	01121	CR LOLL,

Table 6-2. Replaceable Parts (Cont'd

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			• • • • • • • • • • • • • • • • • • • •		
105440	2100-1052		RIVAR CERMET TO OHM 208 3/4H	284 80 284 80	2100-3052 9757-0283
435441 405842 405843	0757-0283 2100-3053 0757-0431		RIVAR CERMET-20 DHM 208 3/5M RIFAD MET FLM 2.43K CHM 18 1/8W	28480 28480	2100-3057 0757-0431
105444	0757-0442		REFEC MET FLM 10.0K CHN 18.178W	284 90	0757-04-2
435445 435846	0411-2981 0757-0431 0757-0442		* RIFKD WW 1.988K CHM 0.18 1/4W RIFKD MET FLM 2.43K CHM 18 1/8W RIFKD MET FLM 10.0K CHM 18 1/8W	284 60 284 60	0757-9431 0757-9442
AD5244 AD5244	0911-2982 0757-0431		RIFED MY 3.986K DHM 0.1% 1/8M RIFED MET FLM 2.43K DHM, 1% 1/8W	28480 28480	0811-2-82 0717-3431
AU3850	6757-0442	3	RIFKD MET FLM 10.0% OHM 18 1/8W RIFKD WH 7.970% OHM 0.18 1/8W	28480 28480	0757-3442 · * 0811-2981
AD5451 AD5452 AD5453	0#11-2983 0757-0431 0757-0442		RIFRO NET FLM 2.43K OHM 18 1/8W	284 80 284 80	0757+0431 , 0757-0442
405454	0811-2980		4:FX0 WW 15.995K DHM 0.1% 1/16%	284 80 264 80	0011-2980 +0757-0431
405455 405456	0757=0431 0757=0442 0649=7881		RIFKD MET FLM 2143K OHM 18 1/8W RIFKD MET FLM 10.0K OHM 18 1/8W, RIFKD FLM 32K OHM 0.25% 1/8W	28480 28480	0757-0442 0698-7881
A35457 A3545d A35459	0757-0431 0757-0442	10. 10.	RIFKO MET FLM 2.43K CHM 18 1/8W RIFKO MET FLM 10.0K CHM 18 1/8W	28480 28480	0757-0431 0757-0442
AD5163	0698-7882 0757-9260		RIFKO FLM 64% OHM 0.5% 1/8W RIFKO MET FLM 1K OHM 1% 1/8W	28480 28480	0698-7882 0757-0280
A35861 A35462 A35463	0757-0280 0684-5621	27	RIFRD NET FLM IN CHM IN 178W 3	264 80 01121	0757-0260 CB 5621
13444	0684-1021		RIFXD COMP 1000 DHM 108 1/46 RIVAR CERMET 20 DHM 208 3/46	" 01121 20480	2100-3053
105465 105465	2100-3053 0811-3085 0757-0732		RIFAD NW 657-0 OHM 0-18 1/4W RIFAD NET FL4 909 DHM 18 1/4W	26480 28480	0611-3085 0757-0732
135667 105168 135867	075740401		RIFKO HET FLM 100 CHM 18 1/8W RIFKO HET FLM 2.00K CHM 18 1/8W	284 80 284 80	0757-0401 0757-0293
A05973	0664-1011	u_{-x}	RIEND COMPILOD CHM 10% 1/4W RIEND COMPILOD CHM 10% 1/4W	01121 01121	C6 1011 ""
105371 135472 135473	C684-1041 C757-0443 O757-0462		RIFKO MET FLM 11.0K OHM 1% 1/8W RIFKO MET FLM 75.0K CHM 1% 1/8W	284 80 284 80	0757-0443 0757-0462
1054 24	0684-1031		RIFKO COMP TOK OHN LOW 1/4W	01121	CB 1031
MOSH 75 MOSH 76 MOSH 77	0684-1041 0757-0472 0684-1041	. 3	RIFED NET FLM 200K OHM 18 1/84 RIFED CUMP 100K CHM 108 1/44	28480 01121	0757-0472 CB 1041
13527d 13527d	0684-1041 0684-1031		RIFKO COMP 100K OHM 10% 174M RIFKO COMP 10K OHM 10% 174M	01121	CB 1041 CB 1031
405180	0757-0431	,,,	RIFAD NET FLM 2.43K DHM 1% 1/8M, QIFAD NET FLM 10.0K DHM 1% 1/8M	284 80 264 80	0757-0431 0757-0442
105861 105882 105883	0048-7483 0048-7483		RIFKO HET FLM 2.43K OHM LT 1/8W	28480 28460	0698-7583 0757-0431
105144	0757-0442		RIFXD MET FLM 10.0K DHM 14 1/8W	284 60 284 80	0757-0442
A35485 A35486 A05487	0698-3147 0757-0431 0757-0442		RIFAD MET FLM 2.43K CHM 18 1/8W RIFAD MET FLM 10.0K CHM 18 1/9W	28480 28480	0757-0431 '0757-0442
05488 05488	0757-0482 0757-0431		RIFAD HET FLM SIIR OHM 1% 1/84 RIFAD HET FLM 2-43K CHM 1% 1/84	28480 28480	0757-0482 0757-0431
A05990	0757-0442 0757-0344	and the	RIFID MET FLM LOUDE DHM 1% 1/4W RIFID MET FLM 1.00 MEGCHM 1% 1/4W	28480 28480	0757-0442
104401 104402 104604	0757-0385 0757-0385		RIFXD MET FLM 22-1 GMM 18 1/9W	28480 28480	0757-0385 0757-0385
M05194	0694-1021		RIFAD COMP 1000 OHN 10% 1/4N	01121	CB 1021
A05995 AJ9445 AD5497	0674-1021 0757-6445 0757-0463		RIFXD FLM 13K UMM 16 1/8W RIFXD MET FLM 82-5K UMM 18 1/8W	28480 28480	0757-0445 0757-0463
105 198 1154 47	0694-2551	1	RIFRD MET FLM 6.81K CHM 14 1/9W	284 80	0757-0439 CB 2221
AGS4100	10644-2221 0757-0443		RIFAD COMP 2200 UHM 108 1/4W PIFAD HET FLM 11.0K DHM 18 1/94	01121 28480	CS 2221 0757-0443
101-101 101-102 101-103	0757-0462 pr57-0456	2	RIFXD MET FLM 7510K CHM 1% 1/8W RIFXD MET FLM 43.2K CHM 1% 1/8W	264 80 284 80	0757-0462 0757-0456 0757-0240
A011134	0757-0280		RIFKO MET FLM 14 DHM 12 1/84	28480 28480	0757-0124
A054105 A054136 A054137	05757-0124 0574-2221 0757-0401		RIFKO CUMP 2200 OHM 101 1/4W RIFKO MET FLM 100 CHM 12 1/8W	01121 26460	CB 2221 0757-0401
AOSSI \	3101-0982 1120-0070		SWITCHISLIDE O.S AMP ICITTL B-INPT POS NAND GATE	19727	GF 124-0007 SN7430M
A05J2	1929-0301 1929-0301		ICITTE QUAD BI-STABLE D-LATCH	101295 01295	3N7475H SN7475H
A05J3 A35J4 A05J5	1820-0301		ICETTE QUAD HI-STABLE D-LATCH	01275 01275	SN7475N SN7475N
AU5Ja	1520-0301		ICITTE QUAD BI-STABLE D-LATCH	01295	SN7475N

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description *	Mfr Code	Mfr Part Number
A05U7 A05U8 •. A05U9 A05U10	1920-0328 1920-0261 1826-0067 1826-0067		ICITTL QUAD 2-INPT NOR GATE IC:TTL MCNG-STABLE MULTIVIRRATOR - IC:LINEAR OPERATIONAL AMPLIFIER IC:LINEAR OPERATIONAL AMPLIFIER IC:TTL QUAD 2-INPT NANO GATE	#04713 01295 18324 18324 01295	SH7602M SH7612IM NES91T NES91T SH7600M
A05J12 A05J13 A05J14 A05J15	1820-0327 1820-0327 1820-0174 1870-0261 1820-0077		ICITEL QUAD 2-INPT NAND GATE ICITE QUAD 2-INPT NAND GATE ICITE HER INVERTER ICITEL HODG-STABLE MULTLYLBRATOR ECITE DUAL DEFF	04713 04713 04293 01295	\$N7401N \$N7401N \$N7404N \$N74121N \$N7474N
A05316 A05017 A05018 A05319 A0531 A05432	1820-0328 1820-0261 1820-0668 1200-0438 1200-0441		ICETIL QUAD 2-INPT NOR GATE SCITTL NONO-STABLE MUDIFICIERATOR ICETIL HEX ORIVER MUDERN COLLESSOYS SOCKETIL LO CONTACT OUAL TYPE, BROWN SOCKETIL LA PIN MINIATURE	04713 01295 01295 00719 28480	\$47402M \$874121M \$47407M \$452941 1200-0441
A06 A0621 A0622 A36G3 A0654	01150-66506 0170-666 0160-0159 0160-3451 0160-1746	2	BOARD ASSYTEXPAND POSITION CIFXO MY 0-027 UF 10% 200VDCW CIFXO MY 0.0068 UF 10% 200VDCW CIFXO CER 0.01 UF -80-20% 100VOCW CIFXO EECK 15 UF 10% 20VDCW	28460 56287 56289 56289 26480	- 01150-66506 -192927392-PTS 192968282-PTS C0218101F1038325-C04 O180-1746
A06C5 A06C6 A36C7 A06L1 A06L2	0180-1746 0180-0729 0180-1746 9140-0112 9140-0112		CIFXU ELECT 15 UF 10% 20VNCW. CIFXU ELECT 33 UF 10% 10VUCM CIFXU ELECT 15 UF 10% 20VOCW. COLLIFXU RF 6.7 UM CUILIFXU RF 6.7 UM	28480 28480 28480 28480 28480	0180-1746 0180-0229 0180-1746 9140-0112
ADAL3 A0531 A0532 A0533 A054	9140-0112 1854-0087 1853-0036 1854-0087 1853-0036		COLLIFXO RF 4.7 UH TSTRISI NPN TSTRISI PNP TSTRISI NPN TSTRISI NPN TSTRISI NPN TSTRISI PNP	257-80 80131 80131 80131 80131	9(40-0112 203417 203406 203417 203906
A0635 A0646 A0644 A0644	1854-0087 1853-0036 1854-0087 1853-0036 1854-0087		TSTRISE UPN ISTRISE PNP ISTRISE NPN ISTRISE NPN ISTRISE PNP ISTRISE PNP	80131 80131 80131 80131	2N3417 2N3906 2N3417 2N3906 2N3417 2N3417
AU6-310 AD6-311- AU6-313 AU6-313 AU6-314	1851-0036 1854-0036 1853-0036 1854-0087 1851-0036		TSTRIST PAP TSTRIST NPN TSTRIST PAP TSTRIST NPN TSTRIST PAP	#G131 #G131 #G131 #G131 #G0131	243406 243417 243406 3,241417 283406
AUGULS AUGULG AUGULG AUGULG AUGULG AUGULG	1854-0087 1853-0036 1854-0087 1853-0036 1854-0087		ESTRISE NOTE TSTRISE PAP TSTRISE PAP TSTRISE PAP TSTRISE PAP	80131 80131 80131 90131	243417 243417 243417 243417 243417
A00J20 A0041 A0067 AJ043 A0084	1854-0071 0757-0280 0757-0431 0811-2982 2100-1053		TSTRIST NOVESELECTED FROM 2N3704) RIFXD MET FLM IK OMM IT 1/8M RIFXD MET FLM 2.4 3K OMM IT 1/8M PIFXD ME 3.99K OMM DET 1/8M RIFXD ME 3.99K OMM DET 1/8M RIFXD ME 2.99K OMM DET 1/8M	28480 - 26480 28480 29480 26480	ta54-0071 0757-0240 0757-0431 0411-2462 2100-1053
ADGAS AJGAG ADG47 ADG48 AGG87	0757-0442 2100-1052 0757-0431 0757-0442 0311-2983		RIFKO MET FLM 10.0K CHM LT 1/8M RIVAR CERMET SO THM ZOT 3/4M HIFKO MET FLM Z.43K CHM: LT 1/4M PWFRO MET FLM 10.0K CHM LT 1/8M RIFKO MW Z.970K CHM 0.1% 1/8M	28480 29490 28480 28490 28490	0157-0442 2100-3052 0757-0431 0357-0442 0831-2983
ADSH10 AUS411 AJSH12 ADS413 ADS414	0757-0431 0757-0442 0511-2480 0757-0431 0757-0442		HIFKD MET FLM 2.43K CHM LT 1/8K" RIFKD MET FLM 10.0K OHM LT 1/8K RIFKD MET FLM 2.43K OHM 0.LT 1/1/4 RIFKD MET FLM 2.43K OHM LT 1/9K RIFKD MET FLM 10.0K OHM LT 1/8K	26480 26480 26480 26480 28480	0757-0431 -0757-0442 0811-2490 -0757-0442
A05715 A36410 A36417 A36414 A36714	0694-748L 0757-0631 0757-0442 069-7482 0757-0631		RIFXD FLM 324 OHN 0.25% 1/8M RIFXO MET FLM 2.45% OHN LW 1/8M RIFXD MET FLM 10.0% OHN LW 1/8M RIFXD FLM 64% OHM 0.5% 1/8M RIFXD FLM 64% OHM 1% 1/8M	28490 28480 28480 28480 28480	049-7881 0197-0431 0757-0431 0757-0432 0797-0431
25 Faca 15 Faca 15 Faca 25 Faca 25 Faca 45 Faca	0757-0442 0492-7493 0757-0431 0757-0442 0658-3149		BIFID YET FLM 10.0K DHM IT 1/8W RIFED FLM 128K OHN 1.0T 1/8W RIFED HET FLM 2.43K DHM IT 1/8W RIFED HET FLM 10.0K DHM IT 1/8W RIFED FLM 255% DHM IT 1/8W	• 28480 28480 28480 28480 29480	0757-0442 0698-7883 0757-0931 0757-0442 0698-3144
AURZS AURZS AURZS AURZS AURZS AURZS	07:57-0431 07:57-0442 07:57-0442 07:57-0432 07:57-0442		RIFAD MET FEM. 2.43M DHM TE 1/8M RIFAD MET FEM. 10.0R DHM TE 1/8M RIFAD MET FEM. 51E. DHM. ET 1/9M RIFAD MET FEM. 2.43M, DHM IE 1/8M RIFAD MET FEM. 10.0R DHM IE.1/8M	29480 28480 28480 28480 28490	0757-0421 0757-0442 0757-0482 0757-0431 0757-0442

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Gty	Description	Mfr Code	Mfr Part Number
A064 30' A0 na 31 A0 na 32 A0 na 32 A0 na 34	2102-3033 0757-0283 0757-0144 0757-0402 08k1-3042		REVAR CERMET 20 DHM. 208.3/4W	29480 29480 28480 28480	2100-3083 6757-0234 0757-0402 0757-0402 0811-3092
ADER35 ADER35 ADER37 ADER36 ADER36 ADER36	0757-0442 .0644-1011 .0757-0790 .0757-0790		RIFXD MET FLM TO OR CHM EE 1/8W RIFXD COMP 100 OMM 101 1/4W RIFXD MET FLM IK DMM 18 1/8W RIFXD MET FLM IK CHM 18 1/8W ICITIL 8-ENPT PNS NAND GATE	25450 01121 20440 28440 01295	0757-0442 CB 101E 0757-0280 0757-0290 5N7430N
SLECA SLECA ALEGO CLECA GLECA GLECA	1920-0261 1920-0301 1620-0301 1620-0377 1820-0201		ICTTE MOND-STABLE MULTITIORATOR ICTTE QUAD BE-STABLE O-LATCH ICTTE QUAD BE-STABLE O-LATCH ICTTE QUAD BE-STABLE O-LATCH ICTTE QUAL DE FAF INTEGRATED CIRCULTIOPERATIONAL AMPL	01275 01245 01299 01295 04711	SN76121N SN7675N SN7675N SN7676N HC2639G
ACOUR ACOUR ACOUR ACOUR ACOUR ACOUR	1820-0174 1200-0438 1200-0448 01150-66507 0180-0229	1	ICITTL HEX INVERTER SOCKETTIC TO CONTACT DUAL TYPE, BROWN SOCKETTIC TO PIN MINIATURE BOARD ASSYMERAD/MULTIPLEXER CIFXD ELECT 33 UF 10% 10VOCW	01295 00779 28480 28480 26480	547404M 583529-1 1200-0441 01150-66507 0180-0229
A07CZ A07C3 A07C4 A07C5 A07C5	- 0160-0157 0160-0161 0160-0228 0180-1743 0150-0072	5 10	CIFXD MY 0,0068 UF 10% 200VDCW CIFXD HY 0:01 UF 10% 200VDCW CIFXD ELECT ,22 UF 10% 15VOCH CIFXD ELECT D.1 UF 10% 35VDCW CIFXD CER 200 PF 5% 1000VOCN	542 89 56289 56289 56289 56289	192P68282-PT5 192P10392-PT5 1500226X901582-0Y5 1500104X903542-DY5 C0288102E20LJ527-CDH
A07CT A07CB A07C9 A07C13 A07C13	0150-0072 0160-2265 0160-3451 0350-0072 0160-3453		CIFAD CER 200 PF ST 1000VOCM CIFAD CER 22 PF ST 500VDCM CIFAD CER 0.01 UF +80-201 100VDCM CIFAD CER 200 PF ST 500VDCM CIFAD CER 0.05 UF +80-201 100VDCM	56289 72982 56289 56289 56289	C0288102E201J327-CDH 301-MPD-22PF C0238101F103£325-CDH C0285102E20J3527-COH C023A101L5032525-CDH
A07C13 A07C13 A07C14 A07C15 A07C15	0180-0197 Ut80-0197 0180-0197 0180-0229 0160-3451		CIFXO ELECT 2:2 UF 10% 20VOCW CIFXO ELECT 2:2 UF 10% 20VOCW EIFXO ELECT 2:2 UF 10% 20VOCW CIFXO ELECT 3:3 UF 10% 10VOCW CIFXO CER 0:01 UF +80-20% 100VOCW	56289 56289 56289 28480 • 56289	1500 225 X 90 20A 2 - DYS 1500 225 X 90 20A 2 - DYS 1500 225 X 90 20A 2 - DYS 0180 - 0229 C0238 101F 1032 525 - CDH
A07CL7 A07CL9 A07CL9 A07C20 A07C21	0160-2204 0150-0072 0150-0072 0150-0072 0150-0072		CIFAD MICA 100PF SE CIFAD CER 200 PF SE 1000VOCH CIFAD CER 200 PF SE 1000VOCH CIFAD CER 200 PF SE 1000VOCH CIFAD CER 200 PF SE 1000VOCH	72136 56289 56289 56289 56269	ROM15F101J3C CO28B102E201J527-COH CO28B102E201J527-COH CO28B102E201J527-COH CO28B102E201J527-COH
107C22 A07C23 A07C24 407CR1 A07CR2	0110-0672 0150-0072 0150-0072 1901-0040 1901-0040		CIFAD CER 200 PF SE EGGOVOCH CIFAD CER 200 PF SE EGGOVOCH CIFAD CER 200 PF SE EGGOVOCH DIGGESTILICON 30MA 30MV	56289 56289 56289 07263 07263	CO288102620135272CDH CO28810262013627-CDH CO28810262013527-CDH FDG1088
AO7L1 AO7L2 AO1L3 AO7L4 AO7OL	9140-0112 9140-0112 9140-0112 9140-0112 1855-0062		COLLERD RF 4.T UH COLLERD RF 4.T UH COLLERD RF 4.T UH COLLERD RF 4.T UH TSTRIST FET JOY	28480° 28480 28480 28480 01295	9140-0112 9140-0112 9140-0112 9140-0112 2N1595
A0702 A0703 A0703 A0705 A0706	1855-0062 1854-0071 1854-0071 1854-0071 1855-0062		TSTRISE FET 30V TSTRISE NPMESELECTED FROM 2N37041 TSTRISE NPMESELECTED FROM 2N37041 TSTRISE NPMESELECTED FROM 2N37041 TSTRISE FET 30V	28480 28480 28480 28480 03295	241595 1854-0071 1854-0071 1854-0071 241595
A0107 8.0708 A0709 A07010 A07011	1855-0062 1855-0062 1855-0062 1855-0062 1855-0062		TSTREST FET 30V JSTREST FET 30V TSTREST FET 30V TSTREST FET 30V TSTREST FET 30V	01295 01295 01295 01295 01295	2N1595 2N1595 2N1595 2N1595 2N1595 2N1595
A07312 A07013 A07015 A07015	1855-0062 1855-0062 1854-0071 1854-0071 1854-0071		TSTRIST FET. 30V ISTRIST FET. 30V ISTRIST HET 30V ISTRIST HENESTECTED FROM 2N3704) ISTRIST HENESTECTED FROM 2N3704) ISTRIST HENESTECTED FROM 2N3704)	01295 01295 28480 28480 28480	2N1595 2N1595 1894-0011 1894-0071 1854-0071
A07017 A07018 A07019 A07020 A07021	1854-0071 1854-0071 1854-0071 1854-0071 1854-0087		TSTRISE NONESELECTED FROM 2N3704) TSTRISE MONESELECTED FROM 2N3704) TSTRISE NONESELECTED FROM 2N3704) TSTRISE NONESELECTED FROM 2N3704) TSTRISE NONESELECTED FROM 2N3704) TSTRISE NONE	28480/ 28480 28480 28480 80131	1854-0071 1854-0071 1854-0071 1854-0071 2854-1
A01022 A07023 A0702 A0782 A0782	1854-0087 1854-0087 		TSTRISE MPM TSTRISE MPM RIFED MET FEM IK OHM IR EFRM RIFED COMP 2200 OHM IOT BFAM RIFED MET FEM IK OHM ISTE/8M	80131 80131 28480 01121 4 28480	2M3417 2M3417 0757-0280 CB 2221 0757-0280

Table 6-2. Replaceable Parts (Cont'd)

Reference, Designation	HP Part Number	Oty	Description	Mir (*) Code	Mn Part Number
	0757-0408		Alexan/met six 243-then 14 1/Am	294 80 01121	0751-0408 Cp. 222L
TOTAL MOTAT ADTAIN	0684-2271 - 0684-2221 - 0684-2221 - 7 0684-4721//		RIFERD COMP 2200 OHM 10 MILANE RIFERD COMP 2200 OHM 10% I/AN CRIFFED COMP 2200 OHM 10% I/AN RIFERD COMP 4700 OHM 10% I/AN	01121 01121 01121	CB 2221 GB 2221 (CB 4721
A0789- A07810 A0781L A0781Z	0684-2221 0684-3221 0757-0641/ 0757-0662		RIPMU COMP 2200 (HMM 10% 1/4M RIPMO COMP, 2200 (OHP 10% 1/4M RIPMO MET FLM /11.0% (HM 1% 1/4M RIPMO MET FLM /75.0% (HM 1% 1/4M	7 28480 01131 01131	CB 222' CB 2221 D797-0441 C797-0442
A07413	+ 0684-2221 0757-0443 0757-0462		# 6 F O COMP 2700 OHM 10% 1/44 () # 16 F O MET FUN 11 10 OHM 18 1/84 () # 16 F O MET/FUN 73 OHM 18 1/84 ()	04121 24480 28480 01171	CB 2221 0757-0443 0757-0462
A07815 A07817 A07818	068-1331 068-1331 0787-0448	X (2) (3):1 2	RIFED COM 334 OHN 108 FAM RYFED COMP 334 OHN 108 FAM RIFED MET FEM 1510K OHN 18 L/8M RIFED MET FEM 5,118 OHN 18 L/8M	01121 28480 28480	CB 3331 0767-0446 075740478
# # # # # # # # # # # # # # # # # # #	0757-0438 // / / / / / / / / / / / / / / / / /		REFED MET FUM 681 DHM 12 1/8W //REFED MET FUM 619 DHM 12 1/8W /REFED MET FUM 681 DHM 12 1/8W /REFED MET FUM 15:00M 12 1/8W	214 90 24 460 24 480 214 60	0757-0419 0757-70418 d155750419 d757-0444
A01424 A01425 A01426	0757-0418 . 0664-2321 . 0131-0441		ATE AD MET FLM SCILK OMMILE LIPE RIFFO CAMP 2000 OMM 105 1/44 "LIFFO MET FLM IL.OK CMM-12 1/44	28480 01121 28460 28460	0757-0438 Cft 2221 0757-0441\ 0757-04621
A07128 85710A	0757-0462 0757-0385 08-94-10425		RIFKD MET FEM 75 OK OHM LT 1/5M RIFKD MET FEM 22-1 OHM LT 1/5M RIFKD (COMP. LOOK) DHM' LOE 1/5M RIFKD COMP. LOOK OHM LOE 1/5M	20480 01121 01121	
A07430 A37431 A07832 A07433-4	0684-1041 0684-1041 70684-1041 0684-1041		RIFKO COMP. TOOK OMM. TOT. 1744 RIFKO COMP. TOOK OMM. TOT. 1744 RIFKO COMP. TOOK OMM. TOT. 1744	01121 G 01121 01121	E0 1041 CB 1041 CB 1041
AD723A 1 7439 1 407436 AD7437	9694-104 9084-1941 9084-1941 9757-0416	Y W	RIERO COMPILOS OMM 10% 1/4W RIERO COMPIDOS OMM 10% 1/4W VIERO COMPIDOS OMM 10% 1/4W RIERO METIFIM/SIL DMM 1% 1/4W	01471 01621 01121 28480	CB 1041 CB 1041 CB 1041 D737-0-10 0757-0-10
ADTRIA ADTRIA ADTRIA	0757-0346 0757-0462 0757-0463		FIFTO ACTIPES 10'OHM 18 1/85 [REFED ACT FLM 75 OK CHOM LE LASS RIFED COMP 2000 DHM 10'S LASS RIFED COMP 2000 DHM 10'S LASS	28461 29460 Jos 21	677 J - 302
ADTR-1 ADTR-2 ADTR-3 ADTR-43	0644-7221 -0791-0462 -0787-0463 -0787-0463		RIFID YEST FLM 13-00 DHM LETTEM RIFID WEST FLM 11:00 CHM LETTEM WIFID CUMP 22DO DHM 10273/4W	204 46 204 40 101 121 8	671 - 041 1 Ca 227
A07845 A07846 A07847 A07847	0757-0467 0757-0463 0684-2221 0757-0462		ETEND MEE ETH 12-OK GHM-IS INSM BIRNO COMPASSOO CHM, 105 INSM BIRNO SEL FIN II-OK DHM IS INSM STEND SEL ETH 12-OK CHM IS INSM	284 80 284 80 0112	0757-0462 0757-0443 CB 2271 0757-0462
A01349 A01450 A01451	9 0757-0441		RIFED MET FLM 11.0K OMM IT L'AM REFED COMP 2200 DMM 10T 174W REPED MET FLM 75.0K OMM IT 178W REFED MET FLM 11.0K OMM IT 178W	28-80 01121 264-80 (284-80	0757-0443 CB 2221 0757-0462
A07433 A07433 A07434 A07434	0757-0443 0684-2221-1 0757-0462		REFUNET FLA TROM ON 10% 1746 REFUNET FLA TROM ON 10% 1784 1786	26480 28490	0757-0462 0757-0443
407456 407857 407453	0757-0441 0857-221 0357-0462 0757-0443		REFECT COMP 2200 CHM LOT 174M REFECT MET FLM 15-00 CHM LET 178M REFECT MET FLM 11-00 CHM LET 178M	28480 28480	C8 2221 0757-0462 0757-0443 C8 2221
A07859 A0751 A0718	06 84-2221 3101-0982 18 20-0970 118 28-0 174		PRINCE COMP 2200 OHR LOW 174M SWITCHISLIDE O.S AMP ICITY, M-INPT POS NAMO GATE ICITY, HEN INVERTER	01121 79727 01295 01295	GF:24-0007 SN74-30N SN74-04N SN74-04N
AUTUA AUT AUT	1820-0261 1820-0054 1820-0495 1820-0261		TOTTE JUD 2-INFT NAMO GATE LCCTTE JUF LA DECOCE LCCTTE MODISTANTE MILITATUR	01295 01295 01295	SN7400H -SN74154N SNT412LN
Carried The State of	1820-0077 1820-0077		ICOTTE DUAT D F/F ICOTTE DUAL D F/F ICOTTE DUAL D F/F	01295 01295 04713	SN7474N
AGTUET AGTUET AGTUET AGTUET	1820-0068 1820-0054 1820-0327 1820-0327		LETTE TRIPLE 3-INPUT POS NAMO GATE LETTE QUAD 2-INPT NAMO GATE LETTE QUAD 2-INPT NAMO GATE LETTE QUAD 2-INPT NAMO GATE	12040 01295 04713 04713	SN7410N SN7400N SN7401N SN7401N
407JE4 407JE4 407JE5 407JE5 407JE7	1820-0054 1920-0127 1924-0047 1820-0261		ICITE QUAD 2-INPT MAND GATE ICITE QUAD 2-INPT MAND GATE ICITE QUAD 2-INPT MAND GATE ICITENFAM JPERATIONAL AMPLIFIER ICITEN NOWD-STABLE MULTIVIBRATUR	01295 04713 18324 01295	SN7400N SN7401N NE931T SN74121N

Table 6-2. Replaceable Parts (Cont.d)

Reference Designation	HR Part Number	(Ory	Description:	Mfr Code	Mfr Part Number
ACCOMPANY OF THE PROPERTY OF T	(144)9400 tT (1044/0431) (1044/0431)	沙滨	TOSTTE/MAL OF AMESTINES SUCHETER PIN MINISTRE SOCIETE LE PIN MINISTRE SOCIETE LE PIN MINISTRE SOCIETE LE PIN MINISTRE	01346 28480 23440	7 (04) (40) (2 (04) (40) (3 (150-654) (6) (150-6558)
AGP 1 AGP 1 AGP 2 AGP 2	01190-54504 0100-0229 01105-0159 9140-0112		(if any a Leon of the total country)	78447 24440 30744 24480	01+0-0174 140-0117 140-0117
ADS=1	0644-1321 0644-1324 10644-1324		# 1 FE COMP (100 COMP) DIE 1/AM # 1 FE COMP (100 COMP) DIE (1/AM # 1 FE COMP (100 COMP) DIE (1/AM # 1 FE COMP (100 COMP) DIE (1/AM)	(01121 (01121 (01121 (01121	CB 1921 CH 3131 CBF3321 CBF3321
Addas Addas Addas Addas Adas	0034-F333 0048-1371 0034-3321 0644-3121		ATRO COM- 3300 CHP 101 16M REFED COM- 3300 CHP 101 16M REFED COM- 3300 CHP 101 174M REFED COM- 3300 CHP 105 16M	01121	CB 1721 CB 1711 CB 1721 CB 1721
AD ALL ALL ALL ALL ALL ALL ALL ALL ALL A	ORBA-1121 ORGA-128 ORBA-			01121 01121 01121 01121 01121	() CB (1321) CB (4721 (CB) 2221 CB (2221)
ADMAIL ADMAIL ADMAIL ADMAIL ADMAIL	ChW4-7-12\ [1-20-0070 1-8-20-0070 1-9-20-0077 1-9-20-0077		IFAIFA COMP STOC DHM 102 1/4W IC:TTE W-18PT PGS NAMO GATE! IC:TTE WAMO'RI-STABLE D-LATCH () IC:TTE DUAD'RI-STABLE D-LATCH () IC:TTE DUAD'RI-STABLE D-LATCH () IC:TTE DUAD'RI-STABLE WANTIVIBRATIA	01121 01295 01295 01295 01295	CR 4721 SN7430N" SN7475N SN7474N SN7474N
AGNAN AMAD JE ROST/7 NOA JE	(M20-0644 1430-0054 (M37-0054 (M37-0054 (M40-0056)		ICLITE QUAD 2-INPT MAND GATE ICETTE TRIPLE 3-INPUT PUS MAND GATE	01295 01295 01295 01295 12040	SN7400N SN7400N SN7400N SN7400N SN7400N SN7410N
Columba Alaman Alaman Alaman	1 1428-00+8: '.* 1 1426-0 174, (1 1426-0 172, (1 1420-0 172,		ILLITY TRIPLE 3-INPUT POS MAND GATE TO THE TRIPLE STEEL TO THE TAND GATE TO THE TOTAL OLDO 2-INPT MAND GATE TO THE QUAD 2-INPT MAND GATE	12040 01295 04713 04713 01295	SN7410N SN7404N SN7401N SN7401N SN7401N
AGU 15	190-0304 1820-0328 1820-0354 1920-0364 1820-068 1820-074		CICITIL J-R M/S F/F M/CLUCKED & IMPTS "ICITIL QUAD 2-IMPT NOR GATE ICITIL QUAD 2-IMPT NAND GATE ICITIL QUAD 2-IMPT NAND GATE ICITIL QUAD 2-IMPT NAND GATE ICITIL QUAL 4 IMPT POS NAND GATE ICITIL HEX INVERTER SOCKET IC 15 CONFACT DUAL TYPE, BROWN	04295 04714 01295 01295 28480 01295 00779	\$N7472N \$N7402N \$N7400N \$N7400N 1820-0089 \$N7440N 563929-1
A04402 A09 A09 A09C1 A09C2	1200-0441 01150-6650 9 0170-0666 0160-0519 0160-3451		SCENETIC LA PIN MINIATURE BOARD ASSYLVERTICAL POSITION C.FXD.MY 0.027 UF.10% 200VDCW. C.FXD.MY 0.0068 UF. 10% 200VDCM C.FXD.CERD.CER.0.01.UF.+80-20% 100VDCM	28480 28480 56289 56289 56289	1200-0441 01150-46509 1922/392-PTS 19268282-PTS C0238181F1032525-CDH
#19C4 #0 165 #096# #19C7 #19C8	01:90-0197 01:90-0229 01:90-0197 01:80-0197		CIFRO ELECT 2.2 UF LOR 2040CM CIFRO MY D.0068 UF LOR 2040CM	56289 26480 56289 56289 56289	1500225
A09C9 A09L1 A09L2 A09L3	0160-3451 9160-0112 9140-0112 9140-0112 1854-0087		CIFED CER 0.01 UF. *80-202 100VDCM COILIFED RF 4.7 UM COILIFED RF 4.7 UM COILIFED RF 4.7 UM TSTRIST NPN	56289 28480 28480 28480 1 80131	C0238101F1032525-CRH 9100-0112 9100-0112 9140-0112 203417
\$0902 \$1004 \$0904 \$0904 \$0904	1853-0036 1854-0067 1853-0036 1854-0087 1851-0036		TSTREST PNP TSTREST NPM TSTREST NPM TSTREST NPM TSTREST NPM TSTREST PNP	80131 80131 80131 80131	2N3906 2N3917 2N3906 2N3917 2N3906
A0937 A0908 A0939 A09310 A09311	1854-0087 1853-0034 1854-0087 1853-0034 1854-0087		TSTREST NPM TSTREST PNP TSTREST NPM TSTREST PNP TSTREST PNP TSTREST NPM	* 00131	283-17 283-90 283-17 283-90 283-17
A09012 A09013 A09016 A09016	L853-0036 1854-0087 1853-0036 L854-0087 [853-0038	At The but case :	TSTRIST PAP TSTRIST NPM TSTRIST PAP TSTRIST PAP TSTRIST NPM TSTRIST NPM TSTRIST PAP	80131 80131 80131	2 233-06 2 233-07 2 33-06 2 33-07 2 33-06
A09317 A09018 A09019 A09020 A09021	1854-0087 1853-0034 1854-0087 1853-0034 1854-0087		TSTRIST NPM TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST NPM TSTRIST NPM	40131	(a) 203417 p. Palesta ja (1965)

Table 6-2. Replaceable Parts (Cont'd)

Reference , Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
		1 21 5			
55LP04 15UP04 45LF04	1453-0034 1454-0087 1453-0036		TSTAISE PAP TSTAISE APP TSTAISE APP	#0131 80131 #0131 90131	2H3906 2H3417 2H3906 2H3417
45060Y	1853-0034		TSTRESS MPN	60131 60131	2N3406
109027 209028 209029 209030	1854-0087 1453-0036 1854-0087 1853-0036		TSTRIST NPN TSTRIST NPN TSTRIST NPN TSTRIST NPN TSTRIST NPN	80131 80131 80131 80131	2N3906 2N3917 2N3906 2N3917
109332 109333 109334 109435 109435	1853-0036 1854-0087 1853-0036 1854-0087 1853-0036		TSTRISE ONP TSTRISE NPN TSTRISE NPN TSTRISE NPN TSTRISE NPN TSTRISE PNP	#0131 #0131 #0131 #0131 #0131	243906 283417 283906 283417 283906
A09037 A09034 A09039 A09040 A0961	1854-0087 1854-0071 1854-0071 1854-0071 0884-1021		TSTRIST MPN' TSTRIST MPN(SELECTED FACM 2N37041 TSTRIST MPN(SELECTED FACM 2N37041 TSTRIST MPN(SELECTED FACM 2N3704) RIFAD COMP 1000 DMN 108 1/4M	80131 28480 28480 28480 01121	2N3+17 1854-0071 1854-0071 1854-0071 CB 1021
A3932 A3933 A3934 A3936	0797-0431 2100-309 1 0811-2482 0648-3109 2100-3092	20	RIFKU MET FLM 2.63R DHM 13.1/8W RIVÁR CERNET 20. DHM 203.3/4W RIFRD MM 3.986K DHM 0.18.1/8W RIFRD MET FLM 10.1K THM 13.1/8W RIFRD MET FLM 10.1K THM 13.1/8W RIVAR CERMET 50 DHM 203.3/5W	264 80 28480 294 80 284 80 284 80	0797-0431 2100-3053 0811-2482 0698-3109 2100-3052
AU947 AJ948 AJ989 AU941J	0797-0431 0811-2483 0898-3109 0797-0431		RIFRO MET FLY 2.43% ONN 18 1/68 HIFRO ME T.970K DHM Q.1% 1/88 RIFRO MET FLM 10.1K OHM 18 1/88 RIFRO MET FLM 2.43% CHM 18 1/68 RIFRO MET FLM 10.1% OHM 18 1/68	26480 26480 26480 26480 28480	0757-0431 0811-2983 0648-3109 0757-0431 0648-3109
21 k609 11 k609 11 k609 11 k609	0811-2980 0757-0431 0698-3109 0699-7881 0757-0431		RIFKO WM 151995K OHM D.18"1/16M RIFKO MET FLW 2.63K OHM 18 1/8M RIFKO MET FLW 10.1K OHM 18 1/8M PIFKO FLW 32K OHM 0.25% 1/8M RIFKO MET FLW 21.63K OHM 18 1/8M	28480 28480 28480 28480 28480	0811-2980 0757-0431 - 0698-3109 0699-7881 0757-0431
11460 11460 11460 11460	0698-3109 0698-7882 0757-0431 0698-3109 0698-783		RIFED MET FLM. LO-IR CHM 18 1/AM RIFED FLM 6-K DHM 0-38 1/8M RIFED MET FLM 2-45K DHM 18 1/8M RIFED FLM 10-IR DHM 18 1/8M RIFED FLM 128K CHM 1608 1/6M	28480 26480 28480 28480 28480	De98-3109 De98-7882 O757-0431- De98-3109 De98-7893
AD4672 AD4672 AD4673 AD4674 AJ4676	0757-0431 0598-3109 0598-3149 0757-0431 0698-3109		- 11 17 MET FLM 7.43K DHM 18.1/84 - 11 17 MET FLM 10.1K DHM 18.1/84 RIFKD FLM 255K DHM 18.1/84 RIFKD MET FLM 2.43K DHM 18.1/84 - 11 17 MET FLM 10.1K DHM 18.1/84	254 50 264 50 264 50 284 50 284 60	0797-0631 0698-3109 0698-3169 0757-0631 0698-3109
7598CA 2598CA 2598CA 2698CA 2698CA 2698CA	C757-04# 2 0751-6411 0698-3109 0757-0344 \$2109-3053		RIFRD WET FEM SILK OWN 18 1/84 RIFRD MET FEM 2,43% OHM 18 1/86 WIFRD MET FLM 10-1K OHM 18 1/96 RIFRD MET FLK 1-00 MEGOHM 18 1/44 RIVAK LEMMET 20 OHM 208 3/4M	28480 28480 28480 28480 28480	0757-0482 0757-0481 0498-3109 0757-0344 2100-3053
AJ9432 AO9R33 AJ9434 AJ9434 AO9R35	0411-1092 0757-0402 0757-0263 0698-3109 0698-1011		PIFED WM 1.323K OHM 0.1% 1/8W RIFKD MET FLM 110 OHM 18 1/8W RIFKD MET FLM 2.00K OHM 18 1/8W RIFKD MET FLM 10.1K OHM 18 1/8W AIFKD COMP 100 OHM 10% 1/4W	284 90 284 90 284 90 284 80 01121	0811-3092 0757-0402 0757-0261 0648-3109 CB 1011
A34417 A098 38 A34373 A34443 A34443	2100-1053 0757-0431 0411-2482 2100-3052 06-96-3109		REVAR CENTET 20 JAM 20% 3/AM REFXD MET FLM 2.43K DJM 1% 1/8M REFXD MET 50 00 JAM 0.1% 1/8M PIVAR CENTET 50 00 JAM 0.1% 1/8M REFXD MET FLM 10.1% 0MM 1% 1/FM	28480 28480 28480 28480 28480	2109-3053 0757-0431 0811-2482 2100-3052 0449-3109
A09442 A09443 A09446 A09446	0757-0431 0P11-2983 0A98-1109 0757-0431		AIFID MET FLM 2.43K UNM IR 1/6W RIFAD MM 7.470K UMM 0.18 1/8W Tap RIFAD MET FLM 1C.1K UMM IR 1/FMR RIFAD MET FLM 2.43K UMM IR 1/FMR RIFAD MET FLM 10.1K CMM 1R 1/8M	284 90 284 80 284 80 284 80 284 80	0757-0431 0811-2983 0648-3109 0757-0431 0698-3109
A07-47 A04448 A04444 A04453	- 0911-2960 0757-0431 0699-3109 0699-7861 0757-0431		RIFRD. WW 15-995K. CHM 0.1% 1/16# #1FRD MET FLM 24-3K. CHM 18-1/8M #1FRD MET FLM 10-1K. CHM 18-1/8M #1FRD FLM 32K UMM 0.25% 1/8M #4FRD MET FLM 24-3K. CHM 18-1/8#	284 FD 284 FD 284 FD 284 FD 284 FD	0811-2-90 0797-0931 0998-3107 0994-7881 0797-0431
A09452 A09453 AJ9454 AJ9455	CA94-3109 Oh3A-7482 O747-7431 OA98-3109 OA98-7883		RIFID HET FLM 10.18 UHM 18 1/84 arkab flm net, chm 0.57 1/84 arkab HET FLM 2.23% CH4 18 1/94 RIFID HET FLM 10.18 CMH 18 1/94 Brad flm 1288 UHM 1.08 1/84	28480 28480 28480 29480 28480	0648-3104 0649-7882 0757-0431 0644-3109 0644-7883

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Oty	Description	Mfr. Gode	Mfr Part Number
AUTANE	0757-0431 G648-3109		HIFRD HET FLM 2.43K DHM IT 1/88 RIFAD HET FLM 10.1X DHM IT 1/88	29480 284FD	0757-0431
A09453	0698-3149 0757-0431		A'SFRO FLM,755K OIM 18:1/84 ASFRO MET FLM 2.43K OHM 18:1/94	26480 26460	0698-3149
Aŭ IRAZ	0696-3109 0758-0682		HIFAD MET FEM 10-18 DMM 18 1/4W MIFAD MET FEM 511K DMM 18 1/8W	"28480 28480	0696-3109 0757-0482
Alisas	0777-0431 0698-1109		RIFRO MET FLM 2-3K OHM 18 1/8M RIFRO MET FLM 10-1K OHM 18 1/8W	284 80 284 80	0757-0431 0498-3109
AJ94n5	21 30 -10°3 3757-01-4		RIVAR CERMET 20 DHM 20% 3/44 RIFAD MET.FLM 1:00 MEGUHM 1% 1744	284 80 284 60	2100-3053 0757-0344
A09467 A09268	0811-3092 0757-0402		RIFND WE 1.323K DWRTO.LE 1/8W RIFND MET FEM. 10 DHM 12 1/8W	28480 28480	0811-3092 0757-0402
+a=V[A 11+VIA	0747-0263.* 0599-3104		RIFID MET FLM 2.00K CHM 12 1/8W	284 60 284 60	0757-0283 ,0698-3109
A09472	0644-1011 		HIFRO COMP 100 CHM 10% 1/4M	01121	CM 1011
A394 71 .A344 74	0494-1021 C644-2221		RIFAD COMP 1000 HMM 10% 1/4W RIFAD COMP 2200 OMM 10% 1/4W	01121	CB 1021
Auvelo	0684-2221 0757-0290		RIFAD COMP 2200 UMM TOR TANK RIFAD MET FLM IN CHM 12 1/8W	01121 28480	CB 2221 0757-0280
A04477	0757-0280 1820-0070		AIFXD MET FLM IX OHM IT LIAW ICITEL N-INT POS NAND GATE	28480 01295	0757-02F0 SM7430N
LEPGA 11 PGA	1820-0301 1420-0301		ICITIL DUAD 61-STABLE D-LATCH	01295 01295	\$47475H \$47475H
40414	1170-0101		IC:FTL QUAD 81-STABLE D-LATCH	01295	SN7475N
AU 1.5 A0 4.17	1620-0301 1429-0324		ICETTL QUAD BE-STABLE O-LATCH	01295	SN7475N SN7402N
ACATA	1420-0261 1620-0201		ICITIL MONO-STABLE MULTIVIAMATOR	01295 04713	5N74121N MC1439G
A09013 "	1420-0201 1220-0668		INTEGRATED CIRCUITIDPERATIONAL AMPL	04713 01295	MC1439G SN7407N
SUKFOW 103 CUK	1700-0438 1200-0441		SOCKETHIC TO CONTACT DUAL TYPE BROWN	00779 28480	583529-1 1200-0441
All	01150-66511		HOAPO ASSTESCAN ATTENUATOR DECODER	28480	01150-66511
ALIC2	1910-0101 010-010		CIFKD BY 0.01 UF 108 200VDCW	56289 28480	192910392-812
ALICA	0140-2205 0140-2205	riania 🆫 🗝 🖠	CIFAD MICA 120 PF 5% CIFAD MICA 120 PF 5%	28410 28480	0160-2205
ALICHZ	1901-0040 1901-0040		DIDDE'S ILICON 30MA 30MA	07263 07263	FDG1098
ALLCHA ALLCHA ALLCHA	1901-0040 1901-0040		DIOGESTATION SOME SOME DIOGESTATION SOME SOME DIOGESTATION SOME SOME	07263 07263 07263	FDG1088 FDG1088
ATICAN	-1701-0040		DIOREISTLICUN JONA JONY	07263	FDG1088
ALICAT ALICAS ALICAS	1931-0040 1901-0040		OTODEISILICON SOMA SOMY DIODEISILICON SOMA SOMY DIODEISILICON SOMA SOMY	07263 07263 07263	FDG1088 FDG1088 FDG1088
Aiici	7140-0112	, w	COILERRO AF 4.7 UM	28480	\$140-011Z
A1131 A1132 A1133	1854-0071 1854-0071 1854-0071		TSTRIST NPMESELECTED FROM EN37041 TSTRIST NPMESELECTED FROM EN37041 TSTRIST NPMESELECTED FROM EN37041	28480 28480 28480	1854-0071 1854-0071 1854-0071
A1134 A1141	1854-0071 0684-2221		TSTRIST NPMISELECTED FROM 2N17041	28480 01121	L854-0071 CB 2221
AL LAZ	0684-4721		R:FXD COMP 4700 DHM 108 1/4W R:FXD COMP 4700 DHM 108 1/44	01121	CB 4721 CB 4721
ALIN3 ALIRA ALIRA	0584-4721 :0684-4721 :70684-4721		RIFED COMP 4700 DHM 10% 1/46 RIFED COMP 4700 DHM 10% 1/46	01121 01121 01121	CB 4721 CB 4721
11115	0684-4771		REFXD CORP 4700 DHM 10% 1/4W	01121	CB 4721
	0684-4721 0684-4721 0684-4721		RIFED COMP 4700 DHN 102 1/4M RIFED COMP 4700 DHN 102 1/4M RIFED COMP 4700 DHN 102 1/4M	01121 01121 01121	CB 4721 CB 4721
411410 411411	.0684-4721 0684-2221		RIFED COMP 4700 DWN 10% 1/4W RIFED COMP 2200 DWN 10% 1/4W	01121" · 01121	CB 4721
Atiriz Atiriz	0684-2221 0684-2221		RIFED COMP 2200 OMM LOS 1/4M RIFED COMP 2200 UMM 10% 1/4M	01121 01121	CB 2221
ALLE16	0684-1021 0684-9621		RIPAD COMP 1000 DHM 10E 1/4W RIPAD COMP 5.6K DHM 10E 1/4W RIPAD COMP 5.6K DHM 10E-1/4W	01121	CB 1021 CB 9421
	0684-5621		RIFED COMP 5.6K DMP 108-1/4M	01121	CB 5621
ALIAIB	0484-5621 0484-5621 0684-3621		A:FXD COMP 5.6K DHM 108 1/4M A:FXD COMP 5'6K DHM 108 1/4M	01121	CB 5021
111420 111421	0684-5621		RIFED COMP S.AK DWM 108 1/4W RIFED COMP S.AK DWM 108 1/4W	01121	CB 5421 CB 5421

Table 6-2, Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	MfrCode	Mfr Part Number
Allk22 Allb1 Allu2 Allu2	06 84-56 21 3101-0982 1820-0 128 1820-0 327 1820-0 327		RIPED COMP 5.5K DHM 108 1748 SMITCHISLIDE 0.5 APP ICITIC QUAD 2-INPT NOR GATE ICITIC QUAD 2-INPT NAND GATE ICITIC QUAD 2-INPT NAND GATE	01121 79727 04713 04713 04713	CB 9821. GF124-0007 SN7402N SN7401N SN7401N
Alije Alijs Alije Alijr, Alijr	1820-0327 1820-0327 1820-0327 1820-0325 1820-0328		ICETTL QUAD 2-INPT NAND GATE ICETTL QUAD 2-INPT NOR GATE ICETTL QUAD 2-INPT NOR GATE	04713 04713 04713 04713 04713	SN7401N SN7401N SN7401N SN7402N SN7402N
Allija Aliulo Aliuli Aliili Aliili	1820-0327 1920-0328 1820-0327 1820-0068 1820-0174		ICETTL MAD 2-IMPT MAND GATE ICETTL QUAD 2-IMPT NOR GATE ICETTL QUAD 2-IMPT NAND GATE ICETTL GUAD 2-IMPT NAND GATE ICETTL FREGE 3-IMPUT POS MAND GATE ICETTL MEX INVERTER	04713 04713 04713 12040 01295	SN7401N SN7402N SN7401N SN741ON SN740AN
Allule Allule Allule Allule	1820-0174 1820-0174 1820-0327 1820-0327 1870-0327		ICITEL HEX INVERTER ICITEL HEX INVERTER ICITEL QUAD 2-INPT NAND GATE ICITEL QUAD 2-INPT NAND GATE ICITEL QUAD 2-INPT NAND GATE	01295 01296 04713 04713 04713	SN76GAN SN76GAN SN74GAN SN74GIN SN74GIN
Fluiia Islia Islia Stlia Estia	1420-0327 1420-0327 1420-0070 1620-0261 1420-0301		ICITTL QUAD 2-IMPT MAND GATE ICITTL GUAD 2-IMPT MAND GATE ICITTL B-IMPT POS MAND GATE ICITTL MONO-STABLE MURTIVIBRATUR ICITTL QUAD BI-STABLE, D-LATCH	04713' 04713 01295 01295 01295	7 SN7401% SN7401N SN7430N SN74221N SN7479N
Alluza Alluza Alluul Allauz	1#20-0301 1#20-0077 1700-043# 1700-0441	''.	ICITTE QUAD BI-STABLE D-LATCH . ICITTE DUALD F.F. SOCKETIEC 16 CONTACT DUAL TYPE. BACHY. SOCKETIEC 16 PIN HINTATURE. BUARD ASSYISCAN DZA & ATTENUATOR.	01295 01295 00779 28460 26480	5874758 5874748, 583524-1 1200-0441 01150-66512
A1251 A1267 A1264 A1264 A1264	0140-0198 0160-2204 0160-2265 0140-0196 0160-2704		CIFAD MICA 200 PF 5% CIFAD MICA 100PF 5% CIFAD CR 22 PF 5% 500V0CM CIFAD MICA 200 PF 5% CIFAD-MICA 100PF 5%	72136 72134 72982 72136 72136	#DM19F201J3C ROM19F101J3C 301-#PO-22PF #DM19F201J3C #DM19F101J3C
A12C6 A12C7 A12C8 A12C9 A12C13	0140-2265 0140-0196 0140-2204 0140-2765 0140-0198		CIFRO CER 22 PF 5% 500VDCW CIFRO MICA 200 PF/5% CIFRO MICA 100PF 5% CIFRO CER 22 PF 5% 500VDCW () CIFRO MICA 200 PF 5%	72482 72136 72134 72982 72136	301-MPQ-22PF ROM15F201J3C POM15F101J3C 301-MPD-22PF RDM15F201J3C
AT2C12 AT2C12 AT2C12 AT2C14 AT2C14	0160-2204 0160-2205 0160-0198 0160-2204 0160-2265		C:FXD NICA 100PF 38 C:FXD CFR 22 PF 58 500VDCW C:FXD NICA 200 PF 58 C:FXD NICA 200PF 58 C:FXD CHR 22 PF 58, 500VDCW	72136 72982 72136 72136 72982	RDH15F101J3C 301-NPO-22PF RDM15F20YJ3C ADM15F101J3C 301-NPC-22PF
AT2C14 AT2C17 AT2C18 AT2C13 AT2C73	0140-2204 n 0140-1451 0140-0195 0140-2704 0150-2765		CIFAD AICA 100PF 58 CIFAD CER 0-01 UF +80-208 100VDCW CIFAD MICA 200 PF 58 CIFAD HICA 100PF 58 CIFAD CER 22 PF 58 500VDCW	72136 56289 72136 72136 721967	ROMINFIDLUSC CO238101F1032529-CDM RDM15F201J3C RDM15F101J3C 301-NPD-32PF
A12C21 A12C22 A12C22 A12C24 A12C25	0140-0148 0140-0148 0160-2265 0142-0148 0140-0148		CZERD MECA 200 PF 5T CZERD MICA 200 PF 5T CZERD CER 22 PF 5T NOOVOCH CZERD MICA 200 PF 5T CZERD MICA, 200 PF 5T	72136 7204 7204 7202 72136 72134	ROMESF2GEJSC ROMESF2GLJSC 3G1-APD-22PF ROMESF2GEJSC ROMESF2GEJSC
A12C26 A12U27 A12C27 A12C27 A12U33	3140-2765 9140-0199 9140-0199 9140-0199 9160-7265 9143-9198		CIFRU CEP 22 PF SE 500VUCH CIFRO MICA 200 PF 58 CIFRU MICA 200 PF 58 CIFRU CEP 22 PF 58 500VUCH CIFRU MICA 200 PF 58	72982 72136 72136 72136 72982 72136	301-NPU-22FF BDM13F2013C BDM13F2013C 301-NPO-22PF BDM13F20133C
A12:31 A12:32 A12:33 A12:34	- 0140-0198 0160-2265 0160-2704 0160-1451 0160-1451		CIPKD MICA 200 PF 98 CIPKO CEP 22 PF 98 500VOCM CIPKO CEP 22 PF 98 500VOCM CIPKO CEP 0.03 15F 980-208 100VDCM CIPKO CEP 0.03 UF 980-208 100VDCM CIPKO CER 0.03 UF 980-208 100VUCM	72136. 72982 72136 56289 56289	#DM15F201J3C 301-MPG-22PF PDM15F101J3C C023B101F103E529-CDM C023B101F103E529-CDM
412C16 A12C37 A12C34 A12C34 A12C43	0160-3451 0160-3451 0160-2704 0160-3451 0160-2704		CIFAD CEN C.OI UF *80-20% 1004DCM CIFAD CEN D.OI UF *80-20% 1004DCM CIFAD MICA 100PF 5% CIFAD MICA 100PF 5% CIFAD MICA 100PF 5%	56249 56249 72136 56289 72136	C0238101F1032525-C0H R0M15F101J3C C023R101F1032525-C0H
A12C41 A12C42 A12C42 A12C44 A12C44	0140-3451 0140-220- 0140-3451 0140-3454		CIPAD CER G.OT UP -RO-ZOE LOOVDCH CIPAD PICA LOOPF 5E CIPAD CER G.OT UP - 80-ZOE 100VDCH CIPAD CER GOOT PF FOR 1000VDCH CIPAD MICA 4P PF 5E,NPG 500VDCH	56289 72136 56289 56289 16655	

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	w				
And the second of the	utan-3-1		Capen cem 0:05 UF +80-208 10040Cm	40249	CO21410115032525-67H
11/14N 11/141	0140-0197		CIFNO ELECT 2.2 OF LOW 20VOCH	56284	15005524405045-042
112264 - 125 Asia 112644 - 125 Asia	0140-0147		CIFED ELECT 2.2 UF LOR ZOVOCH CIFED ELECT 2.2 UF LOR ZOVOCH	56249 56249	1400335x403043-045
11.2.50	0110-0155		Curap wy 0.003 ut tox 20040C	562 89	192813242-875
417.41 417.41	1931-0040		DEDUCES IL ICHM 30MA 30MA DEDUCES LEICHN 30MA 30MA	97263 87263	FOGIORS
412C42 1	1931-004C	9.0	DIODEISTATION 3044 3044 DIODEISTATION 1044 3044	07263 07263	FUGLOSE,
Alztak	14-11-0040		DEQUESTS ICIN TOMA JOHN	07263	.F0G1048
Alecho Alecho	1901-0047	- 5 - 5	DIDDESSILICUM, 30MA 30MV	07263	FNG1084
ALZCHA .	1301-0040		DIODESSICON JOHN JOHN	28480	4140-0115
41211 41312	9140 0117		COLLEXO REATUR	28480 29480	9140 0112 4140-0112
412L3 412L4 & 1	9170 0016		BEAD MAGNETIC SHIELDING FSTRISE NEWSELECTED FROM 2837043	02114 28430	56 590 65 38 1854-0071
AL2-1'45	1854-0071 1851-0020		TSTRIST PRPESELECTED FROM 2N31021	28450 28480	1953-0020 1953-0020
115.1	1851-0020		TSTRISE PROFISELECTED FROM 2NATOSE	28440	t 153-0020
41744 A1735	1443-0020 1853-0020		TSTRIST PARTSELECTED FROM 2N37021: TSTRIST PARTSELECTED FROM 2N37021:	28480 28480	1853-0020
41246 41247	1441-0020 1491-0020		TSTAIST PAPERFLECTED FROM 2437021	28490 28490	1857-0020 1853-0020
Allow	1451-0070		TESTREST PROFESELECTED FROM 2NATOZI	28480	1951-0720
Alguir (Communication) Alguir (Communication)	1851-0020		TSTRIST PROTSPECTED FROM 2837021	2848Q 2848Q	1651-0020 1853-0020
Alžili Alžili	1841-0020		TETHESE PAPESFLECTED FROM 2N3TO23	28470 28480	1854-GD71 1854-0071
417314	1#54-0071	1, 46	TESTRESE MANCESELECTED FROM 2NATONE CONTROL	28480	1854-0071
A12-14 A12-15	1454-0071		TSTRISE MANESPLECTED FROM 2N37043	28480 28480	1854-007E
Alzulo Alzulo	1994-0071 1894-0087		TSTREST NEWL SELECTED FROM 2N3TO45	80111	203417
alzyla	1954-00N7		TO TSTRIBLENDA DE PROPERTO DE LA COMPANSIONE DEL COMPANSIONE DEL COMPANSIONE DE LA COMPANSIONE DEL C	. e0111 80111	243417
41 * 21 * 41 2 2 2 0	1854-0087		TSTREST NPN	80131	243417 243417
A17.21	1454-00F7 1843-00Z0		TSTRIST NPN TSTRIST PHPISELECTED FRUM 2037021	401 11 28480	1851-0020
ALTER	1841-0020		TSTREES PROFISELECTED-FACH 2017021	28480	1851-0020
ABZUZA ALZUZA	L453-0020 L653-0020		TSTRISE PAPESELECTED FROM 2N37021	28480 28480	.1653-0020 1853-0020
ALZOZA ALZOZA	1853-0020 1853-0020		TSTRIST PHPESELECTED FROM 2N37021	2848G	1853-0020
ALLUZ	1451-0020 n		treesp puptetecten From 2017021	28490	1853-0020
12021A	1453-2020 1853-0020		TSTRISE PHRESELECTED FROM 2N37021	78440 28460	1953-0020
A12031 A12032	1893-0020 1493-0036		TSTRIST PARTSELECTED FROM 2N37027	28490 80131	\$M3900 1853-0020
VISANI VISANI	1853-0036		TSTAISE PAP	40111	243906
412u34 412J35	1493-0049 1954-0215	```` ``` (TSTRISE PAP	80131	1853-0049 2N1904
A12016 A12017	1954-0071		TSTRIST NPMESELECTED FROM 2N37041	28480 28480	1854-0071 1854-0071
W15514	1854-0071		ISTRIST NEWL SELECTED FROM 2437041		1854-0071
A12340	1894-3071 1854-0071		TSTREST MANESELECTED FROM ZN3TONE	24480 24480	1854-0071
412341 412341 41234	1854-007L	331	terrest upnesseested from 2037046	28480	1854-0071 1854-0071 1854-0071
VESTA .	1854-0071		TSTRESS NPNESELECTED FROM 2037043	28480	1.
A12044 A12345	1854-0071		TSTREST NAMESELECTED FROM 2037041 TSTREST NAMESELECTED FROM 2037041 TSTREST NAMESELECTED FROM 2037041	28480 V	1954-0071 1854-0071
ALZ344 ALZ344	1854-0071 1877-0062		TSTRIST MANESELECTED FROM 2017041	28480 01299	1894-0071 241595
A12048	2 1454-0062		TSTRIST PET 30V	01295	42N1595
A12J47 A12090	1855-0062 1855-0062		FSTRISE FET 30V	01295	2N1595
ALZJŠE	1859-0062 1859-0062		TSTRISE FEE 30V		2N1595
A12052 A12053	1855-0062			01345	241505
A	1854-0071 1854-0071	1.73 R	TETRICE MENESELECTED FROM 283704)	28480	1854-0071 1854-0071
WISCOOL .	1854-0071		TSTRISE NAMESELECTED FROM 2N3704) TSTRISE NAMESELECTED FROM 2N37046 TSTRISE FET 30Y	29480 01295	1854-0071 2N1595
AV237	1855-0062		TSTRISE PET JOY	01295	2N1595

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr .Code	Mfr Part Number
		, _h			
A12-59 A12-63 A12-63 A12-64 A12-64	1 46 5 4 166 4 1 2 5 5 6 6 6 2 1 6 5 6 6 6 6 7 1 6 7 6 7 16 7 1 6 7 6 7 16 7		TCINES: FAT NOW EXPRESS PER TON EXTRESS PER TON EXTRESS PER SON EXTRESS PROSSEPPILIER 2000001	01295 01294 01294 01294 01294 78480	241595 241595 241595 201544 1854-0221
A1241 A1742 A1243 A1244 A1244	10151-52-0 0151-6,560 0166-5521 01.44-6.77 1014-5671		PARTY WATTER IN CHAIT TAND PARTY ART FLM 10 (MAY 12 1740 TERRI COMP 0-60 (MAY 102 1740 WERD COMP 0-70) (MAY 102 1740 ATROCCOP 0-604 (MAY 102 1740 TERRI COMP 0-604 (MAY 102 1740	2764-0 274-0 01171 01171 01121	0797-0240 07:7-0240 CM 6071 CM 4721 CM,9621
#12-0 #12-2 #12-2 #12-2 #12-2 #12-10	1) Pm 7-1145# Pn Pm-LAu L Co 44-5 n P L 1944-47 P L 2557-6344		PERRO MOT FLM STATE CAM IN 1744 A1640 COMP, THOM COMP, 109 L744 PERRO COMP, SAME OHM LOT 1744 REPRO COMP STORO OHM IN 1744 MERRO MOT FLM IADO MEGIMM IN 1744	264kg 01121 01121 01121 2844q	0797-0454 CH 1541 CH 5671 CH 4721 0797-0344
Al Pall Al Pall Al Pall Al Pall Al Pall Al Pall Al Pall Al Pall	U++5521 UF\$7-045P, OnF4-1F61 OnF4-0F21		SIFILE COMP NOR THAN 10%, 124m of the SIFILE COMP NOR THAN 12%, 124m of the SIFILE COMP NOR THAN 10% 124m of the SIFILE COMP NOR THAN 10% 124m of the SIFILE COMP. TOO THE	0112) 2H440 (0112) - 0112) - 01121	[# 5521; 5757-0458 CR 1841 CR 5621 CR 4721
Al7-16 Al7-17 Al2-19 Al2-19 Al2-20	7997-04#3 - 09#4-5621 - 0757-04% - 044-9621		STERU MET FLW STER HAM IT 1/MM V STERU COMP SONR WHW 107 1/MM BIFRU MET BLW STER CHW LE 1/MM WIFRU COMP 1808 DHW 102 1/MM MEER COMP SON HAW 102 1/MM	78450 01171 28460 01121 01121	0757-0482 EM 5021 0757-0456 CM-1841 CM-5671 - 17
A[?-2] A[2-2] A[2-2] A[2-2] A[2-2-7	C6M4-4701 '0974-1144 C6M4-5771 0757-0458 Och4-1441		A SPAID COMP 4700 ON LOS 1/44 OFFAD, FLW 2550 CHW LT 1/84 WHEND COMP 4-68 ONW 102 1/44 ASPAID COMP 100 COMP 12 1/64 WERND COMP 100 CHW 102 1/44	01121 1 20010 01121 204#0 01121	CR 4721. CR 9571 CR 9571 0757-0458 CR 1841
A17+76 A12-77 A12-24 A12-24 A12-24	Ch84-3621 Ch84-4721 Ch04-7643 Ch64-3621 C757-0454		REFER COMP SON THE 10F 1/44 WENT TO HE HOLD OFF ME CHERK WENT TO HE CHERK HOLD SON THE CHERK WENT TO HOLD HOLD TO HE HOLD THE HE	01121 28490 01121 28490	CB 5621" CR 6721 CB 96721 CB 5621 C777-D657
A12+1L A12+12 A12+12 A12+14 A12+14 A17+15	On#4-1841 Ob7A-7822 On#4-9621 On#4-4721 On#4-4921		HIFRE COMP-IROR CHM 10X:2/4M hifre FLM 64X CHM 0.5% 1/4M 4IFXD COMP-5.6W CHM 10X 1/4M HIFRE COMP-470G-CHM 10X 1/4M DIFXE COMP-5.6W CHM 10X 1/4W	01121 28480 01121 01121 01121	CB 1941 GA97-7892 CB 9621 CB 4721 CB-5621
A12k36 A12k37 A12k38 A12k38 A12k48	UTS7-C458 (DR4-1841 (DR4-5671 (D84-5671 (D84-72)		RIFRD MET BLM 51-18 CMM 12 E/OM	28490 01121 01121 01121 28490	0757-0458 C6 1941 C6 5021 C6 4721 U009-7681
A12-41 A12-42 A12-43 A12-44 A12-45	0584-2221 0757-0447 0584-6531 0684-5521 0684-4721		RIFERD COMP 2200 CHM 10% 1/46 RIFERD HET FEM 10.0K CHM 18 1/86 RIFERD COMP 64% CHM 10% 1/46 RIFERD COMP 5.46K CHM 10% 1/46 RIFERD COMP 4700 CHM 10% 1/46 MI	01121 28460 01121 01121	CR 2221 0757-0442 CB 6831 CR 5621 CB 4721
A12446 A12467 A12448 A12449 A12490	0#11-2980 - 0684-2221 - 0797-0442 - 0684-46811 - 0484-5621		RIFED ME 19.495K DMM D.12 I/16W RIFED COMP 2200 DHM LOE I/4W RIFED MET FLW 10.0K DMM LE 1/8W RIFED COMP BAK DMM LOE 1/4W RIFED COMP 5.46K DMM 10E 1/4W	28480 01121 28480 01171 01121	0911-2940 CA 2221 0757-0442' CB 6411 CB,5621
A12451 A12852 A12853 A12554	0664-6721 0911-2963 0684-2221 0797-0442 £1		RIFND COMP.4700 OHP 103 1/48 RIFND WM 7-970K OHM 0-12 1/88 RIFND COMP 2200 OHM 103 1/48 RIFND MET FLM 10-0K OHM 12 1/88 RIFND COMP 66K OHM 103 1/48	01121 29400 01121 29400 01121	C8 4721 G811-2763 C8 2221 G757-042 C5 6891
A12556 A12556 A22557 A2458 A12459 A12460	On84-5021 Os84-4721 Os81-7982 Os84-2221 O757-0442		RIFAD COMP 3.6% OHM 102 1/44	01121 01121 28480 01121 28480	(6 502) C8 4721 0011-2402 C0 2221 0757-0442
A12461 A12662 A12663 A12864	044-4431 0811-2481 0811-2481 0498-0082		RIFXD COMP 488 OHR 108 1/4W RIFAD MW 1,988K OHP 0,18 1/4W RIFAD MW 457.0 OHR 0,18 1/4M RIFAD MET FLM 444 CMP 18 1/8W RIVAR CERMET 30 DMM 208 3/4W	C1121 28440 28460 28460 28460	CS 6831 0811-2981 0811-3085 0898-0082 2100-3052
A12465 A12866 A12867 A12866 A12866	2100-1052 0757-0438 100-1053 0757-0401 2100-3053		RIFAD MET FLM 5-11R DMM 14 1/8W RIFAD MET FLM 5-11R DMM 14 1/8W RIFAD MET FLM 100 DMM 14 1/8W RIFAD MET FLM 100 DMM 18 1/8W RIFAD GERMET 20 DMM 208 3/4W	28480 28480 28480 28480 28480 01121	0757-0638 2100-3053 0757-0601 2100-3053 C9 2221

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	City	Description	Mfr Code	Mfr Part Number
117-71	of farlant	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RIFED MET FLM LL-ON CHW IT 3/44	284 80 284 80	0757-0643
AL7-72	01:00-1049 C797-0467	:	CREERO MET FLW. TALIES, THE BE BEEN TO BE	29440	7757-9462 2100-2572
AL2-14 AL2-75	2110-2522 0586-1341	7	PRESENT COMP COMP COMP 108 LIMITATION CONTRACTOR COMP COMP COMP COMP COMP COMP COMP COMP	01151 54440	C# 1341
ALZETA .	G747+0401		M 18 AD MET FEM 100 OHM 18 1/20	284 FC 284 FG	0157-0501
A12-71	05100-2522		BINE CLEARL TOE DIM TOE THE TASE	01121 28480	CH 2271 0757-0441
A12474	0757-0443		HIFED WET FEW 11-00: UHW112 17HH	284.60	0157-0462"
Alž-1E	gene-1341		RIFED COMP 1004 DHM 108 1/4%	01121	CH 1041 CH 2221
Alzanz Alzani	0n+4-2221 0757-0443		REFER COMP 2700 UMM TOE 1746 REFER MET FEM 11 UF CHM 18 17 WE	28440	0757-04-1
ALC-14	0757-0452		GIF4D COMP LOCK CHM LOT 1/46	citsi	GR 1041 4 C
ALZANO	CA84-2221		8:FRD (29P 220) DHP 108 1/68	01121	CH 2221
A12-17 A12444	0141-0443.		RIFAD MET FLM 11.CR DHM 18 1748 RIFAD MET FLM 75.CR DMM TE 1/48	28480 01121	0717-0462 Ca 1041
A12-47) A12171	1144-1041	10000	RIFED COMP. 2006 OHM 102 1748	01121	CH 2221
Alze di	0747-0443		ASERD WED FEW ELON UMM IN LINE BEERD WED FEW FOOD DHM IN LINE	284 HO 4	0757-0443
A17497	COR6-1041		HIFRE COMP SOON CHM TOE 1/4M	01171	CH 1041
A129-94 A129-95	CHR4-222E	=	urpso wet few files one it 1/44	28480	0757-0441
A12435	C757-0662		RIFRD MET FLW 75'-ON DHM 12 1/84" L RIFRD COMP DOD ONE THE 12 1/44	264#0 01121	0757-0462 CB 1941
ALZ-SZ ALZ-SZ	0644-2721		1 81610 COMP 2200 OHM 108 174M	01121	CR 2221 0757-0943
A124447	0797-0441 0797-0443		RIFRO MET FLM 11.0H OHM 12 1/84 RIFRO MET FLM 75.0K DHM 12 1/84	28410	- 0757-0-62
ATZRIDI	0584-1041		RIFED COMP LOOK CHM 102 1/4M	01121	CH 1041 0757-0401
A124102 A124103	2100-2522	1	STREET HET FLM 100 CHM 1X 1/8W	28460 01121	2100-2522 CB 2221
412-1134 AL2-143	0884-2221 0757-0443		RIFED COMP. 2200 CHM, 106 1/40 RIFED MET FLM 11-0H DMM 18 1/46	25480	0757-0443
A1 23.13h	0757-0462		A : F 40 ' NET FLM 75-ON THM TE 1/8H	29480 01171	U757-0462 CR 1041
A12+107	0684-1941 0684-2221		RIFED-COMP 100K OHP 10% 1/4W	01121	CB 2221
A124109.	0757-0441		RIFED MET FLM 11-OK CHM 12 1/4W RIFED MET FLM 75-OK (HHM 12 1/8W	2 64 90	0757-0462
Algett	0684-10 %	13.00	RIFED COMP 1004 THM 10% 1/4H	01121	CB 1041
ALZPEIZ	06#4-2221 0757-0441		RIFAU HET FLM 11-QK UMS LE 1/84 RIFAU HET FLM 75-QR GHM LT 1/84	26460 26480	0757-0443 0757-0462
A124116	0757-0462 . 0644-1041		SIESO GOME TOOK UNH 108 1/46	ailei	CB 1041
ALZELIS	0484-2221		RIFED CUMP 2200 DHM LOT 1/48 RIFED MET FLM II.OK DMM 18 1/84	01171 28480	CB 2221 0757-0441
A124118	0757-0443 0757-0462	1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RIFAD HET FEM TS-ON DHM IT 1/8W NIFAD COMP 100K DHM 10T 1/4W	284 90	0757-0462 CB 1041
#15+110 #	G084-1041 G094-5579	1	A 1540 FLH SOOD OHN 0.5% 1/8W	28450	0695-5579
A12+121	G757-028 3		RIPAD MET FLM 2-DOK CHM 12 1/34 RIFAD MET FLM 1K DHM 12 1/64	28480 28480	0757-0283 0757-0280
A124127	0757-0260 0757-0427	. 3	BIRND MET FEM 1.5% OHM IS IVAN	28480 28480	0757-0427 0699-5852
A124124	0757-0293		HIPAD MET FEM 7.00H CHM 18 1/5M	284RG	0757-0293
A126124	0757-0416	1	RIPRO MET FLM SUL DHM LE 1/86 RIPRO MET FLM 98 DMN 0.25% 1/86	284 80 264 80	0757-0416 0698-5414
A124127	0157-1097	2 % (t)	RIFED FLW 900 DMM 18 1/8W RIFED MET FLW 100 DMM 18 1/8W	284 80 284 80	0757-1099 0757-040t
415414 4 C416414	0757-0401 0757-0408		RIFRO HET FEN 243 DHM 18.1/68	244 00	0757-0408
MISELSE	0751-0442		RIFED MET FLM 10.0K CHM LT 1/6W RIFED COMP TOOK DHM 10% 1/4W	28480 01121	7 0757-0442 CB 1041
W154133	0684-1041 0684-1041		RIFKO COMP 100K CHM 10% 1/4M RIFKO MET REM 75-0K CHM 1% 1/4M	01121 284 80	CB 1041
A124135	0757-0462 0757-0443		RIFAD HET PLH 11-QK OHM LT 1/80	28486	0.757-0443
A124136	0644-2221		AIFED COMP 2200 CHR 10% 174W	01171 28480	0757-0442
A120137	0757-0462 0757-0443		RIFAD COMP 2200 OHM 10% 1/4M	28480 01121	0757-0443 CR 2221
A126139 A120140	0684-4721	(Decide	RIFAD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A129141	0757-0442		TO ALEXO MET PLM 10.0K OHM IN 1888	28480 28480	0757-0442
A124143	0797-0283 0698-4017 0757-0283		ALPED FLM 6000 OHM 0.58 1/89 BIRED MET FLM 2.00K CHM 18 1/84	28480 28480	0698-4017 0757-0283
, A124144 A124145	0757-0283		RIFED HET FLM Z-DOK DHM 18 1/84)	28480	0157-0283

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A128146 A128147 A1281487 A1281487 A128150	2100-2522 0757-0401 0757-0417 0757-0427 0757-0442		RIVAR CERMET TOK OHM TOT LIN 1/2W RIFXD MET FLM 1QO DHM 1X 1/8W RIFXD MET FLM 1-542 DHM 1X 1/8W'' RIFXD MET FLM 1-5A DHM 1X 1/8W RIFXD MET FLM 10-0N DHM 1X 1/8W	28460 26480 26480 28480 28480	2100-2522 0757-0401 0757-0417 0757-0427 0757-0442
A124151 A128152 A128153 A128154 A124155	0757-0463 0757-0282 0757-0282 0757-0481 0757-0442		REFER MET FLM 82-5K OMM 1% 1/8W REFER MET FLM 221 OMM 1% 1/8W REFER MET FLM 221 OMM 1% 1/8W REFER MET FLM 475K OMM 1% 1/8W REFER MET FLM 10-0K OMM 1% 1/8W	284.80 284.80 284.80 284.80 284.80	0757-0463 0757-0282 0757-0282 0757-0481 0757-0442
A128156 A128157 A128158 A128159 A128160	0757-0344 0757-0455 0757-0455 0757-0439		REFXD MET FLM 1.00 MEGOMM 1% 1/4m REFXD FLM 30.5% DMM 1% 1/8M REFXD MET FLM 3.32% DMM 1% 1/8W REFXD FLM 30.5% DMM 1% 1/8W REFXD MET FLM 0.81% DMM 1% 1/8M	28480 28480 28480 28480 28480	0757-0344 0757-0455 0757-0433 0757-0455 0757-0439
A124161 A12R162 A124163 A124164 A1251**	0757-0442 0757-0439 0757-0437 0698-3430 3101-0982		RIFXD MET FLM 10.0K OHM 12 1/8W RIFXD MET FLM 6.8IR OHM 12 1/8W RIFXD MET FLM 9750 OHM 12 1/8W RIFAD MET FLM 9750 OHM 12 1/8W SMITCHISLIDE, 0.5 AMP	284 80 284 80 284 80 284 80 79727	0757-0442 0757-0439 0757-0437 0898-3430 GF124-0007;
11211 11213 11214 11216 11217	1820-0067 1926-0067 1826-0067 1826-0067		MOT ASSIGNED ICALINEAR OPERATIONAL AMPLIFIER ICALINEAR OPERATIONAL AMPLIFIER ICALINEAR OPERATIONAL AMPLIFIER ICALINEAR OPERATIONAL AMPLIFIER	18324 18324 18324 18324	NESSLT NESSLT NESSLT NESSLT
A13L3 A13C1 A13C1 A13C3	1820-0201 01150-86513 0160-0156 0180-0106 0180-0156		INTEGRATED CIRCUITIOPERATIONAL AMPL BOARD ASSYIDIGITAD SCAM CIFXD MY 0.0019 UP 103 200VOCW CIFXD BLECT 60 UP 203 64VOCW CIFXD MY 0.0019 UF 103 200VOCW	04713 28480 56289 28480 56289	MC1439G 01150-66513 192P39292-PT5 0180-0106 192P39292-PT5
11364 11365 113663 113682	0180-0197 0180-0229 1901-0040 1901-0940 - 1901-0040		CIFED ELECT 2.2 UP 10% 20VDCW CIFED ELECT 33 UF 10% 10VDCW DIODESSILICON 30MA 30WV DIODESSILICON 30MA 30WV	56289 28480 07263 07263	1500225x902042-DYS 0180-0229 FDG1088 FDG1088 FDG1088
113584 11351 11352 11351	1911-0040 9140-0112 9140-0112 1454-0071 0684-1971		DIODEISILICON 30NA 30WY COILIFRO RF 4.7 UH COILIFRO RF 4.7 UH TSTRISI NPMISELECTED FROM 2N37041 RIFRO COMP 1000 CHM LOT 1/4W	07263 28480 28480 28480 01171	FDG1088 9140-0112 9140-0112 1854-0071: C6 1021
11312 11343 11345 11345	0684-2221 0684-4721 0684-4721 0684-4721 0684-4721		RIFAD COMP 2200 OHN 108 1/4M RIFAD COMP 4700 CHM 108 1/4M RIFAD COMP 4700 DHM 108 1/4M RIFAD COMP 4700 DHM 108 1/4M RIFAD COMP 4700 DHM 108 1/4M	01121 01121 01121 01121	CB 2221 CB 4721 CB 4721 CB 4721 CB 4721 CB 4721
113#7 11348 11349 113410	0684-4721 0757-0464 0757-0476 684-2221 0684-4721		REFXD COMP 4700 CMM 108 1/4M REFXD NET FLM 90-9K CMM 18 1/8M REFXD NET FLM 301K CMM 18 1/8W PEFXD CUMP 2200 CMM 108 1/4W REFXD CUMP 2700 CMM 108 1/4W	01171 28480 28490 01121 01121	CB 4721 '0757-0444
1134 12 1134 13 1134 13 1134 1 1134 1	0684-3931 0694-2221 0101-0002 1820-0070 1820-0261		RIFAD COMP 395 UNH 10% LYAM RIFAD COMP 2200 DHN 10% LYAM SWITCHISLIDE 0.5 AMP 102112 A-1hpt pcs namd gate 102176 MOMO-STABLE MULTIVIBRATOR	01121 01121 79727 01295 01295	CB 3931 CB 2221 GF124-0007 SNT430N SNT4321N
11333 11344 11345 11346	1820-030T 1820-0301 1820-0301 1820-0327 1820-0077		ICETTL QUAD RI-STABLE D-LATCH ICETTL QUAD RI-STABLE D-LATCH ICETTL QUAD BI-STABLE D-LATCH ICETTL QUAD 2-INPT NANU GATE ICETTL QUAD 7-INPT NANU GATE	01295 01295 01295 01295 04713 01295	SR7475N SR7475N SR7475N SR7475N SR7401N SR7474N
11308 11304 113011 113011 113011	1820-0077 1820-0077 1820-0077 1820-0077 1820-0128		SHIRCH SLIDE 0.5 AND ICITIL B-INPT PCS NAMD GATE ICITIL B-INPT PCS NAMD GATE ICITIL GUAD BI-STABLE D-LATCH ICITIL QUAD BI-STABLE D-LATCH ICITIL QUAD BI-STABLE D-LATCH ICITIL QUAD BI-STABLE D-LATCH ICITIL QUAD P-INPT NAMD GATE ICITIL DUAL D-F/F ICITIL QUAD 2-INPT NOR GATE ICITIL QUAD 2-INPT NAMD GATE	01295 01295 01295 01295 01295 04717	\$47474M \$47474M \$47474M \$47474M \$47474M \$47402M
113013 113014 113015 123016 113017	1620-0328 1620-0327 1820-0054 1820-0054		ICITIL QUAD 2-INPT NOR GATE ICITIL QUAD 2-INPT NAMO GATE	04713 04713 01295 04713 01295	\$N7402N \$N7401N \$N7400N III \$N7400N \$N7400N
113310 113310 113323 113323	1820-0077 1820-0077 1820-0261 1820-0077 1820-0027		ICITTE QUAD 2-INPT NAMD GATE ICITTE QUAL D F/F ICITTE QUAL D F/F ICITTE MOMO-STABLE MULTIVEBRATOR : ICITTE QUAD 2-INPT NAMD GATE		ENTATAM A SALE AT A

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Numbe
		<u>.</u>			
A13023 A13024 A13024 A13026 A13027	1420-0327 1420-0327 1420-0327 1420-0327 1420-004d		(CITTL JUAN 2-INPT NAND GATE ICITTL GUAD 2-INPT NAND GATE ICITTL FEIPLE 3-INPUT POS NAND GATE	04713 04713 04713 04713 12040	\$47401M \$87401M \$87401M \$87401M \$87401M
Altran Alvia Alvia Altria Altria	P20-0174		LCSITL MEN INVERTER ICSTTL JUAD 2-INPT MOR GATE ICSTTL JUAD 2-INPT NAND GATE ICSTTL JUAD 2-INPT NAND GATE ICSTTL MEX INVERTER	71295 04713 04713 04713 04713 01295	SN7404N SN7402N SN7401N SN7401N SN7404N
aliji aliji aliji aliji al	1620-0668 1470-0261 1200-0416 1200-0446 1200-0441		ICTITE MEY DRIVER W/UPEN COLLESOY) ICTITE MONI-STABLE MULTIVISEATOR SOCKETIIC LA CONTACT DUAL TYPE, BROWN SOCKETIIC LA PIN MINIATURE BUANO ASSYLVERTICAL ATTENUATOR	01295 01295 00779 28480 28480	\$N7407N \$N74121N \$83527-1 1200-0441 01150-56514
A1+51 A1+62 A1+63 A1+64	0160-0161 0160-7250 -0160-7250 0160-73453		CIFKD MY 0.01 UF 10% 200YDCM CIFKO CER 5.1 PF 5% 500VDCW CIFKO CER 5.1 PF 5% 500VDCW CIFKO CER 0.05 UF +40-20% 100VOCM	56289 72982 72982 56289	192P10392-PTS 301-000-COHO-531E 301-000-COHO-531E CO238101L5032525-COH
A1 625 A1 626 A1 627 A1 628 A1 624 [0160-3453 0190-0197 0180-0197 0180-0229 1921-0040		CIFAD CEN 0.05 UF +80-204 100YOCM CIFAD ELECT 2.2 UF 108 20YOCM CIFAD ELECT 2.2 UF 108 20YOCM W CIFAD ELECT 33 UF 108 10YOCW OTDOE:5111C3M, 30MA 30WV	56289 56289 56289 28480 07263	C023A101L503f525-CD 1500225X9020A2-DY5 1500225X9020A2-DY5 0180-0229 FDG1088
Alech2 Alech4 Alech4 Alech4 Alech4	1731-0040 1701-0040 1701-0040 1701-0040 1201-0040		OTODE:STLECON SONA SCHV OTODE:STLECON SONA SONV OTODE:STLECON SONA SONV OTODE:STLECON SONA SONV OTODE:STLECON SONA SONV	07263 07263 07263 07263 07263	FDG1088 FDG1088 FDG1088 FDG1088 FDG1088
A16C47 A16C64 A16C49 A16C410 A16C411	1701-0040 1731-0040 1901-0040 1701-0040 1701-0040		DIDDETSILICON 30MA 30MV	07263 07263 07263 07263 07263	FDG1088 FDG1088 FDG1088 FDG1088 FDG1088
A1+CR12 A1+L1 A1+L2 A1+L3 A1+L3	[93]-0040 9140-0112 9140-0112 9140-0112		DIODE:SILICIN 30MA JONY COTL:FXD RF 4.7 UH COTL:FXD RF 4.7 UH COTL:FXD RF 4.7 UH NOT ASSIGNED	07263 28480 28480 28480	F0G1088 9140-0112 9140-0112 9140-0112
A1402 A1403 A1403 A1405 A1406 A1407	1854-0071 1854-0071 1854-0071 1854-0071 1854-0071		TSTR.SINPNISELECTED FROM 2N3704) TSTR:SI NPNISELECTED FROM 2N3704)	28480 28480 28480, 28480 28480 28480	1854-0071 1854-0071 1854-0071 1854-0071 1854-0071 1854-0071
A1438 A1439 A14313 A14311 A14012	1854-0071 1835-0062 1835-2062 1835-0062 1835-0062		TSTRIST NPNESELECTED FROM 2N3704) TSTRIST FET 30V TSTRIST FET 30V TSTRIST FET 30V TSTRIST FET 30V	28480 01295 01295 01295 01295	1854-0071' 2M1595 2M1595 2M1595 2M1595 2M1595
A14011 A14014 A14014 A14016 A14017	1855-0062 1855-0062 1855-0067 1856-0071 1856-0071		TSTRIST FET 30V TSTRIST FET 30V TSTRIST FET 30V TSTRIST PRISELECTED FROM 2N37041 TSTRIST NPMISELECTED FROM 2N37041	01295 01295 01295 28480 28480	2N1395 2N1395 2N1595 2N1595 1654-0071 1854-0071
A14318 F1641A OS41A A1432 A14322	1854-0071 1854-0071 1854-0071 1854-0071 1854-0071		TSTRISE MPMESELECTED FROM 2M3704) TSTRISE MPMESELECTED FROM 2M3704) TSTRISE MPMESELECTED FROM 2M37041 TSTRISE MPMESELECTED FROM 2M37041 TSTRISE MPMESELECTED FROM 2M37041	28480 28480 28480 28480 28480	1854-0071 1854-0071 1854-0071 1854-0071 1854-0071
AL4323 AL4324 AL4325 AL4326 AL4327	1855-0062 1855-0062 1855-0062 1855-0062		TSTRIST FET 30V	01295 01295 01295 01295 01295	2N1595 2N1595 2N1595 2N1595 2N1595 2N1595
A16028 PEC41A 0000 A A16032 A16032	1855-0062 1855-0062 1851-0080 1854-0234 1855-0062		TSTRIST FET JOV TSTRIST FET JOV TSTRIST PRP TSTRIST NPN TSTRIST NPN TSTRIST FET JOV	01295 01295 (80131 80131 01295	2N1995 2N1999 2N4898 2N3440 2N1593
A14033 A14034 A14335 A14336 A14337	1855-0062 1855-0082 1853-0062 1856-3071 1854-0071		TSEASS: FET 30V TSTAISS FET 30V TSTAISS FET 30V TSTAISS PET 30V TSTAISS PPM(SELECTEO FROM 2N3704) TSTAISS NPM(SELECTED FROM 2N3704)	01295 01295 01295 28480 28480	2H1595 2H1595 2H1595 1854-0071 1854-0071

Table 6.2 Replaceable Parts (Cont'd

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
		T.			
AL-AJA	6; 1043-03300		1. TSTF # \$ 1 - MAP ()	90131	2N4688 2N1460
A14.43	1424-0244		TATHES 1402: TOTALES 1940 TATHES 1940	28480	1853-0047
6]4.4] 6]4.4?	1653-0740	10 m	tsterst Published August 1997	28490	1853-0049
A14444	1456-0164 0684-6721		TSTREE PICE THE LOT 1/44	28480 01121 01121	1653-0049 CA 6721 CA 4721
11447 11441	0684-4728 0684-4721		RIFED COMP 4700 UMP 101"1/4W - RIFED COMP 4700 OMP 107 1/4W - RIFED COMP 4700 UMP 107 1/4W	01121	CR 4721 CH 4721
	Фера-4771 Фала-2771		HI KU CIMP 2200 DH4 198 1/4H	01171	C6 2221
llers	0797+0443 0757-0462		STEND MET FLM 11-UN LAM 15 17-00 14-00 15 17-00	784 80 284 80"	0757-0443 0757-0443 CR 2221
416-6 A16-9	0674-2731 0757-0441		PIFED CIMP 2209 CHM 10% 1/4W PFED MET FLM 11.CK CHM 14 1/9W	01121 28480	0151-0441
A14010	0757-0467 0684-2221		F1FXD GDWD 7200 00W 10X 1/9W 1	284AU - 01121	0757-0462 Ce 2721
A14417::	0757-9443 0757-6462		F1FHD 4CT FLM 11.0K DAM 18 1/8m 41FHD 4ET FLM 7540K DAM 18 1/4W	78480 78480	0757-0443 -0757-0462 -08-2221
A14: 14	G684-2271		RIFRD WHT FLW 11.08 DHM 1 C.1/4W	204'80	.p757-2443
Al4-15 Al4-16 Al4-17	0757-0442 0757-0442 0684-2221		41FXU MET FLM 75.0K (MM 18 1/9W	284P0 01121	0757-0462 CH 27C1
A15: 1h A16419	9757-9443 0757-9467		RIFED WET FEM 13-ON OHM IS 1744	284 RO 284 RO	0757-0463
114420 July 15	0684-7721		RIFKO COMP 2200 OHM 108 1/44 BIFKO MIT FLM 11.0K. CHN 11 1/44	28480	CB 2221 0757-0443
A14422 A14422	0757-0443 0757-0462 0444-2721		HIFHD MET FLA 75-08 CHM 12 1/4W	294 90 01121	0757-0462 C9 2221
A14424	0757-0443		RIFED MET FLM 11:04 OHM 18 1/84	284.90 284.90	0797-0443
A14475	0757-0467 Ub NA-2241 -EA98-1324	10		284 0	CR 2741
A14221 A14224 A14224	0757-1100 C757-110#	2	REFRO FER 603 3HM 12:1/34 REFRO WET FER 30C CHM 12 1/84	28480 26480	0757-1100 0757-1100
A14+33	0757-1102	2	RIFED MET FLM 182 CHM 12 1/84 RIFED FLM 60 UMM 12 1/84	28480 28480 10	0757-1102 0757-1104
A14431	0757-1104 0757-1107 0757-1107		RIFED FLM 30 DHM 17 1/84 RIFED FLM 30 UMM 17 1/84	284 FO	0757-1107 0757-1107
A14+33 A14+34	G684-2241		REFERENCE OF THE TOTAL OF THE TENER OF THE T	01121	CB 2241
A14835 A14636	0684-2241 0684-2241		RIFED COMP 220K CHM 108 1/4W RIFED COMP 220K CHM 108 1/4W RIFED COMP 220K CHM 108 1/4W	01121	Cn 2241 CB 2241
A14-37 A14-3H A14-39	0684-2741 0644-2741 0664-2241	10.11	RIFRO COMP 220% CHM 10% 1/4# RIFRO COMP 220% CHM 10% 1/4#	01121 01121	CB 2241 CA 2241
A14-19	0757-0449	•	RIFED FLM 20K OHN 12 1/84	28460 28480	0757-0449 0757-0280
A14442	0757-0260 0664-4721		RIFNO WET FEM IN CHM 12 1/46 RIFNO COMP 4700 OHM 101 1/44 RIVAR CEMET IN CHM 102 LIN 1/26	01121 28460	CB 4721 2100-2633
A14444	2100-2633 0684-4721	2 ,	91FAR COMP 4700 OHM 108 1/4M	01131	CB 4721
A14945	0684-4721 0684-2221		RIFED COMP 4700 OHM 10% 1/4M RIFED COMP 2200 OHM 10% 1/4M	01121 01121 28490	CR 4721 CB 2221 0757-0443
A14447 A1444B	0757-0443 0757-0462		RIFXD MET FLM 11.0K OHM 1% 1/8M RIFXD MET FLM 75.0K OHM 1% 1/4M RIFXD COMP 2200 OHM 10% 1/4M	28480 01121	0757-0462 -CB 2221
A14650	0684-2221	1.	REFED MET FLM 11.0K CHM 18 1/84	28480	0757-04-3
A14951	0797-0462 0684-2221		RIFED MET FLM 75-OK CHM 18 1/86 RIFED COMP 2200 CHM 103"1/46 RIFED MET FLM 11-OK CHM 18 1/86	28480 01121 28480	0757-0462 CB 2221 0757-0443
A14353 A14854	0757-0443 0757-0462		ATFED MET FLM 75.OK OHN 18 1/8M	28480	0797-0462
A14855 A14856	0684-2221 0757-0443		RIFAD COMP 2200 DHM 108 1748 RIFAD MET HEN 11.0K DHM 18 1788	20480	CB 2221 0757-0443 0757-0462
A14457 A14458	0757-0462 6684-2221		AIFXD MET FLM 75.0K CHM 18 1/AW AIFXD COMP 2200 CHM 108 1/AW AIFXD MET FLM 11.0K CHM 18 1/AW	26480 01121 28480	CB 2221 0757-0443
A14960	0757-0443		RIFXO MET FLM 75.08 CHM 12 1/88	20480	0757-0462
A14461 A14862	0684-2721 0757-0447		RIFED COMP 2200 DHM 108 1/4M	01121 '28480 26460	CR 2271 0757-0443 0757-0442
A14263 A14P64	0757-0462 0684-2221		RIFXD MET FLM TS-OK OHM 18 1/88 RIFXD COMP 2200 OHP 108 1/48	01121	CB 2221
A14965	0757-0443 0757-0462		RIFKO MET FLM 11.0K CHM 18 1/8W RIFKO MET FLM 75.0K CHM 18 1/8W	28480 28480	0757-0443 0757-0442
AL4867	0684-2241 0698-3324		HIFKD COMP 250K DHM 0-5% 1/4M	01121 26480	C8 2241 0498-3324 0757-1100
ALARGY	0757-1100		REFER FLM 600 DHM 18 1/8M	26480	

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Numbe
in a suite de la company. Transportation de la company de la compa					
A14370	0757-1108		RIFKD MET FLM 300 DHM 18 1/8M RIFKD MET FLM 180 DHM 18 1/8M	28480 28480	0797-1108 0757-1102
A16471 A16473	0757-1102 0757-1104 3757-1107		RIFKO FLM BO CHM 18 1/8M	28480 26480	0757-1104 0757-1107 0757-1107
MISSIS.	0757-1107		PIFED FLM 30 OHM 12 1/4W	26480	CB 2241
AL 6275 AL 6276 AL 6277	0684-2241 0684-2741 0684-2241		RIFED COMP 220K OHM 10% 1/4W	01121 01121	CB 2241
A11479	0684-2241 0684-2241		RIFAD COMP 220K DHM 10% 1/4M RIFAD COMP 220K DHM 10% 1/4M	01121	CB 2241 CB 2241
Ale48D	0164-2241 0797-0449		PIFRO COMP 220K OHM 10% 174M RIFRO FLM 20K DHM 1% 178M	01121 26480	CB 2241 0757-0449
A14482	2100-2633		RIVAR CERNET IN OHN 10% LEN 1/28	28480 28480 26480	2100-2633 0757-0280 0698-3430
Alecae	0694-3430		RIPAD MET PLM 21.5 DHM 18 1/8W	28480	0698-3430
Alekas Alekas	0757-0442 0757-0442		RIFKO MET FLM 10.0K DHM 1% 1/8W	28480 28480 01121	0757-0442 0757-0442 C8 2221
ALGEN	C684-2221 0757-0443		RIFKO CHMP 2200 CHM 10% L/4M RIFKO MET FLM 11.0K CHM 1% 1/8M	26480	0757-0443
A14490 A14491	0757-0462 0654-222t		RIFXD HET FLM 75.0K OHN 18 1/84 RIFXD CUMP 2200-THM 108 1/4M	28480 01121 28480	0157-0462 CB 2221 0757-0443
A14843	0757-0443		RIFKD HET FLM 11.0K CHM 18 1/8W RIFKD HET FLM 75.0K CHM 18 1/8W RIFKD COMP 220K CHM 108 1/4W	28480 01121	0757-0462 CB 2241
A148.45	0694-2241	1.34	R:FXD COMP 220K UMM 10% 1/4M	01121	CB 2241 0757-0453
AL 4- 70	0757-0453 0757-0453	2 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RIFKD MET FLM 30-LK CHM-1% 1/8M RIFKD MET FLM 30-LK CHM-1% 1/8M RIFKD COMP 220K CHM 10% 1/4M	28480 28480 01121	0757-0453 CB 2241
\$144.00 \$144.04	0584-2241 0m84-2741		REFEC COMP 220K THM 10% 1/4M	01151	CB 2241
Alexido	2100-2517	2	RIVAR ELM SOK OHM 108 LIN 1/2W RIVAD HET FLM 12-1K OHM 18 1/4W	28480 26480 26480	2100-2517 0757-0444 0757-0768
A14-103 101-21A	0757-0768 0757-0481 0757-0449	7.0	RIFKO FLM 47.5K OHM IR 1/4W RIFKO NET FLM 475K OHM IR 1/4W RIFKO FLM 20K OHM IR 1/4W	28480 28480	0757-0481 0757-0449
A14-105	2100-2517		REVAR FLM SOK CHM LOT LIN 1/2M REFXO HET FLM 811K OHM 1% 1/8W	284A0 28490	2100-2517 0757-0482
A143136 A148107	0757-0482 0757-0444 0757-0422	2	RIFXD MET_FLM 16-2K CMM 18 1/2W RIFXD MET_FLM 1909 CMM 18 1/8W	264 60 2 64 60	0757-0844 0757-0422
VI 64128	0761-2019	. 87 (a) 2 (∆	RIFRO MET OX 39K OHN 58 1W	28480	0761-0019
Alekill	0757-0463 0757-0438 0757-0444		RIFAD HET FLM 82.5K OHM LE 1/8M RIFAD HET FLM 5.11K OHM LE 1/8M RIFAD HET FLM [2.1K OHM LE 1/8M	284 90 284 80	0757-0438 0757-0444
A144113 A144114	0757-7768 2100-2517		RIFAD FLM 47.5K DMP LE L/4M RIVAR FLM 50K DMM 10X LIN 1/2W	28480 28480	0757-0768 2100-2517
A146113	0757-0481		RIFKO MET FLM 475K DMM 18 1/8M RIFKO FLM ZUK DMM 18 1/8M	284 80 ·	0757-0481 0757-0449
A144117 A164117	1757-0449 2100-2517 0757-0482		RIVAR FLM SOK DHM TOT LTN 1/24 RIFXD MET FL4 STIK DHM 1% 1/8W	28480 28480	2100-2517 0757-0482 0757-0844
A14×11.9	U.S.Z-0444		RIFAD MET FLM 16-2K OHM 1% 1/2M	284 90	0757-0422
A144123 A144121 A144122	0757-0422 0761-0019 0757-0461		REFED MET ON 39K CMM 5% 1M	28480 28480	0761-0017 0757-0463 0757-0433
A145123	0757-9438 3101-0982		RIFAD WET FLM 5-11K OHM 18 1/88 SWITCHISLIDE 0-5 AMP	26480 79727	GF124-0007
A1 -52 A1 -01	3101 - 0982 1920 - 0970		SWETCHESLEDE O.S AMP	79727 01295	GF124-0007 SM74 10N
ALSUS	1970-0128		COTTL QUAD 2-INPT NOR GATE COTTL HEX INVERTER COTTL QUAD 2-INPT NAND GATE	04717 01295 04713	\$N7402N \$N7404N \$N7401N
A14J4	1920-0327		ICITTE QUAD 2-INPT MAND GATE	04713	"SN74 GEM
A1 406	1870-0327 1420-0327		IC:TTL QUAD 2-INPT NAND GATE IC:TTL QUAD 2-INPT NAND GATE IC:TTL TRIPLE 3-INPUT POS NAND GATE	04713 04713 12040	SM7401M SM7401M SM7410M
AL-JB AL-GUY	1820-0664" 1820-0666		IC:17L TRIPLE 3-INPUT POS NANO GATE	12040	SN7410H
ALCILO ILUCIA	1420-0127 1420-0088		SIGNITE TRIPLE 3-INPUT PUS NAND GATE	04713 12040 01295	SN740IN SN74IQN SN747544
Aleula	1420-0101 1420-0301 1420-0261	1	IC:TTL QUAD BI-STABLE D-LATCH IC:TTL QUAD BI-STABLE D-LATCH IC:TTL MONO-STABLE MULTIVI RRATOR	01295 01295	SN7475N SN74121N
Altul	1200-0434		SOCKETTEL TO EINTACT DUAL TYPE, BROWN	0G779 28480	583529-1. 1200-0441
Alexu2	1270-2441	1	SOCRETIC LE PIN MINIATURE	284 80 254 80	01150-66515
AISCL	01 80-0 229 01 80-0159	1		28480	0180-0159

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	. Mfr Code	Mfr Part Numbe
The second secon					
15L1 15#1	9140-0112 0757-0722 -		CD1LIFED RF 4.7 UH RIFED FLM 332 OHM 12 1/44	28480 29480 79727	9140-0112 0757-0722 GF124-0007
1551 1501 1502	3101-0982 1820-0668 1820-0668		SWITCHISLIDE 0.5 AND ICITE HEX DELVER WADDEN COLLIBOY! ICITE HEX DRIVER WADDEN COLLIBOY!	01295	\$H7407N \$H1607N
1503 1504	1820-0668 1820-0668		ICITIL HEX DRIVER WARPEN COLLIJON)	01295	SN7407N SN7407N SN7407N
15J5 15U6 15U7	1420-0668 1420-0668 1820-0668		ICITTL HEX DRIVER WIDDEN COLLEGOR	01295 01295 01295	SN7407N SN7407N
1150A 115J9	1#20-046# 1#20-046#		ICITTL HEX DRIVER WYOPEN COLLEGOVE	01295 	SA74QTH SH74Q7H
15013 15011 15012	1820-0668 1829-0668 1820-0668		ICITTE HEX DRIVER WODEN COLLEGOYS ICITTE HEX DRIVER WODEN COLLEGOYS ICITTE HEX DRIVER WODEN COLLEGOYS	01295 01295 01295	\$N7407N \$N7407N \$N7407N
15U13 15xU1	1820-0668 1200-0441		CETTE HEX DRIVER WIGHEN COLLEGOVE SOCKETEIG 14 PIN MINIATURE	01295° 28480	\$N7407N \$200-0441
1661 1662	01150-67601 0160-3451 0160-3654	22	BOARD ASSYSTREGGER PICK-OFF. CSFXD CER 0.01 UF +80-20% BOOVOCH CSFXD CER +700 PF 20% SOVUCH	725480 > 56289 72982	01150-67601 C0239101F1032525-C0 8111-A050-651-672#
1863 1864	0160-3654 0160-3654		C:FXD CER 4700 PF 20% SOVECH C:FXD CER 4700 PF, 20% SOVECH	72962 72982	9131-4050-651-4724 8111-4050-651-4724
44C5	0160-3654 0160-2238		CIFXO CER 1700 PF 20% SOVOCH	729 #2 28480' .	8111-A050-651-472* 0160-2236
.16 C 7	0140-2236		CIFXD CER (- 1 PF 500YDCM	28480	0160-2236
.16C8	0140-3451		CIFXD CER 0.01 UF 480-208 100VDCH	56289	C0238101F1032525-C0
116C9 116C10	0160-3451 0140-3451	1	CIFED CER O.OL UF +80-20% TOOVDCH	56289 56289 72982	C0238101F1032525-CD C0238101F1032525-CD 8121-050-651-104M
A16C11 A16C12 A16C13	0160-3558 0160-3558 0160-3654		C:FXD CER 0.1 UF 20% 50VDCW C:FXD CER 0.1 UF 20% 50VDCW C:FXD CER 4700 PF 20% 50VDCW	72982* 72982	8121-050-651-104M 8111-4050-651-4724
A16C14 A16C15	0160-3451 0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCH C:FXD CER 0.01 UF +80-20% 100VDCH	56289 56289 56289	C0236101F1032525-C0 C0236101F1032525-C0 1500225X9020A2 DYS
A16C16 A16C17 A16C18	0180-0197 0180-0197 0160-3848		C.FXD ELECT 2.2 UF 10% 20 VDCW C.FXD ELECT 2.2 UF 10% 20 VDCW C.FXD CER 3.3 PF +5 PF 100VDCW C.FXD CER 3.3 PF +5 PF 100VDCW		150D225X9020A2 DYS 0160-3848 0160-3848
A16C19 A16CH1 A15CB2	1901-0040 1901-0040		DIODE:SILICON 30MA. 30MV DIODE:SILICON 30MA 30MV DIODE:SILICON 30MA 30MV	07263 07263 07263	FOGLOSS FOGLOSS FOGLOSS
A15CR3 A15Cl A16C2	1901-0040 0490-1034 0490-1034		RELAY:2 FORM C E2 VOC 390 OHM RELAY:2 FORM C 12 VOC 390 OHM RELAY:2 FORM C 12 VOC 390 OHM	15818 15818 15816	412-6346 412-6346 412-6346
414X3 415L1'	0490-1034 9100-2276 9100-2276	3	COIL/CHOKE 100 UM 10%	28480 28480 28480	9100-2276 9100-2276 9100-2247
416L3 415J1 416Q2	9100-2247 1854-0483 1853-0020	1	COLLEXO RF 0-10 UM 10% TSTRISE NPN TSTRISE PNPESELECTED FROM 2N3702)	2848Q 28480	1854-0483 1853-0020
A1503 A1504	1853-0020 1853-0020	•	TSTRIST PHPESELECTED FROM 2N37021	28480 28480 28480	1853-0020 1653-0020 0757-0438
A1522 A152 A1623	0757-0435 0757-0280 0757-0290		RIFXD MET FLM 5.11K OHM 18 1/8W RIFXD MET FLM 1K OHM 18 1/8W RIFXD MET FLM 6.19K OHM 18 1/8W	28480 28480	0757-0280 0757-0290
A1684 A1685	0757-0280 0757-0290	i i	RIFKO MET PLM 1K CHM 18 1/8W RIFKO MET FLM 6.19K CHM 18 1/8W RIFKO MET-FLM 1K CHM 18 1/8W	28480 28480 28480	0757-0280 0797-0290 0757-0280
Albro Albro Albro	0757-0280 0757-0290 0684-6211	2	RIPED MET FLM 6-19K OHK 1E 1/8W RIPED COMP. 820 OHK 10E 1/4W	28480 01121	0757-0290 C6 0211
A1629	0757-0715 0684-1021	?	RIFKD HET FLM 150 OHM 12 1/4W RIFKD COMP 1000 OHM 102 1/4W RIFKD COMP 1000 OHM 102 1/4W	2848G 01121 01121	0757-0715 C8 1021 C8 1021
A15811 A16812 A16813	0684-1021 0757-0394 0757-0394		RIFID MET FLM SELL DHR 18 1/8W RIFID MET FLM SELL DHR 18 1/8W	28480 28480	0757-0394 0757-0394
Alenie Alenie	0684-4711 0684-2221	\$	R:FXD COMP 670 CHM 10% 1/4W R:FXD COMP 2200 CHM 10% 1/4W R:FXD COMP 680 CHM:10% 1/4W	01121 01121 01121	C8 4711 C8 2221 C8 4811
A16816 A16817 A16818	0684-6811 0757-0809 0757-0412	1	RIFKD MET FLM 332 OHR 1.03 1/2W	28480 28460	0757-0809 0757-0412 -
A15419 A16820	0684-6811 1 1 0684-2221	i i grada Grada (Mari	RIFXD COMP 680 OHM 10% 1/4M RIFXD COMP 2200 OHM 10% 1/4M RIFXD COMP 470 OHM 10% 1/4W	01121 01121	CB 6811 CB 2221 CB 4711
A15221 (SSREIA A16423 (0684-4711 0757-0913 0757-0926	1	RIFKO MET FLM 360 DHM 28 E/8W RIFKO FLM 1-2K DHM 28 L/8W	28480	0757-0913 0757-0926

Table 6-2. Replaceable Parts (Cont'd)

Reference : Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16724 A16825 A15826 A16827 A15821	0684-1021 0757-0715 0684-1021 0684-9211 5060-0509		RIFED COMP 1000 DHM 10% L/AM RIFED MET FEM 150 DHM 1% 1/AM RIFED COMP 1000 DHM 10% 1/AM RIFED COMP 820 DHM 10% 1/AM ICISEALED PACKAGE	OLI21 28480 01121 01121 28480	CB 1021 0757-0715 CB 1021 CB 8211 5060-0509
ALSUZ ALSUZ ALSUZ ALSUZ ALSUZ ALSUZ ALSUZ ALSUZ ALSUZ	1826-0003 6 5060-0510 1826-0003 1902-3048		ICELINEAR OP AMP ICESEALED PACKAGE ICELINEAR OP AMP OLOGE BREAKDOWNISTEICON 32484/5% OLOGE BREAKDOWNISTEICON 32484/5%	28480 28480 28480 28480 28480	1826-0003 5060-0510 1826-0003 1902-3048 1902-3048
Alfai Alfai Alfai Alfai Alfai	OLLSO-66517 D180-0098 OL60-0344 OL60-0155 O180-0100		BUARD ASSYTESS POWER SUPPLY// CIFED ELECT 100 UF 20% 2000CM CIFED CER 1000 PF.10% 1000VDCM CIFED HT 0.0033 UF 10% 200UDCM CIFED HT 0.0033 UF 10% 200UDCM	28460 56289 56289 56289 26480	01150-66517 1500107X002032-675 C0678251F102R525-C0H 192P33292-PTS 0180-0100
ALTCS A17C6 A17C7 A17C8 ALTCR1 ALTCR2 ALTCR3 ALTCR3 ALTCR3 PALT31 ALTCR3	0140-0159 0180-0210 0180-0116 0180-0100 1401-0049 1401-0049 1401-0044 1401-0044 1401-0044 153-0006 1853-0006	3	C:FRO ELECT 220 UF 201 10VDCM C:FRIR ELECT 8.0 UF 201 50VDCM C:FRIR ELECT 8.0 UF 201 50VDCM C:FRIR ELECT 8.0 UF 10X 35VDCM C:FRIR ELECT 8.0 UF 10X 30VD C:FRIR ELECT 8.0 UF 20X 30WD T:FRIR I PNP T:FRIR I PNP ISELECTED FRIM 20X	28480 56289 56289 28480 28480 28480 07263 80131 28480 80131	0180-0159 15001051005002-045 15004553903582 DYS 15004753903582 DYS 1701-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049 1401-0049
ALTON ALTON ALTON ALTON	1854-0053 1854-0071 1854-0071 1853-0020 0757-0280		TSERISE NPM ISTRISE NPMESTEECTED FROM 2N37043 TSTRISE NPMESEECTED FROM 2N37043 TSTRISE NPMESEECTED FROM 2N37043 TSTRISE NPMESEECTED FROM 2N37043 TSTRISE NPMESEECTED FROM 2N37023 RIFAD MET FRM 1K OMM 1K 1/8M	28480 28480 28480 28480 28480	1854-0071 1854-0071 1854-0071 1853-0020 0757-0280
ATTAL ATTAL ATTAL ATTAL ATTAL ATTAL	0157-0848 0157-0416 0011-1666 0757-0408		PIERD MET ELM 30.1K CHM LE 1/3M RIFRD MET NEW 511 CHM LE 1/3M RIFRD MM 110 CHM 52.2W RIFRD MET ELM 243 CHM LE 1/8M RIFRD MET FLM 10-GK CHM 12 1/8M	284 80 284 80 284 80 284 80 284 80	0757-0848 0757-0416 0811-1666 0757-0408 0757-0442
A1747 A1748 A1749 A17410 A17411	0757-0274 0811-3094 2100-1794 0811-3093 0757-0280		RIFXD HET FLR 1-21K OHR 12 1584 RIFXD WW 4.32K OHM 0.1% 1/8W RIFXAR HW 500 OHN 107 IN RIFXD HW 6.22K OHM 0.1% 1/5W RIFXD HET FEM IN OHM 12 1/8W	26480 28480 28480 28480 25480	0757-0274. 0811-3094 21.00-1799 0811-3091 0757-0280
AL7912 AL7913 AL7915A AL7915 AL7915	0737-0718 -0737-0388 -0812-0045 -0737-0416 -0757-0437	1 % 1 '2'	RIFID MET FLY 200 CHM IT 1/4M RIFID FLM 30-1 CHM IT 1/4M RIFID WM 0-15 DHY 5T 3M RIFID MET FLM 5TI CHM IT 1/4M RIFID MET FLM 4750 CHM IT 1/4M	28480 28480 28480 29480	0757-0714 " 0757-0388 0812-0045 0757-0416 0757-0437
A17417 A17413 A17413 A17420 ? A17421	0757-0290 0757-0273 0757-0289 0760-0012 0757-0389		RIFKD MET FEM 6.10K OMM IE 1786 RIFKD MET FEM 3.01K DMM IE 1786 RIFKD MET FEM 3.04K OMM IE 1786 RIFKD MET DX SE OMM 2C.16 RIFKD MET FEM 33.2 OMM IE 1786	28480 28480 28480 28480 28480	0757-0290 0757-0273 0757-0258 0760-0012 0757-0189
ALTHEZ ALTAZA ALTRZA ALTRZA ALTRZA	0757-0391 0757-0284 0257-0416 0757-0273 0757-0280		REFAD FLW 39-2 OHM 13 15/84 REFAD HET FLW 312 OHM 13/15/84 REFAD MET FLW 312 OHM 13/16/86 REFAD MET FLW 3016 OHM 13/16/86 REFAD MET FLW 3016 OHM 13/16/86 INTEGRATED CERCUIT: UPERATIONAL PUPE	28480 28480 28480 28480 04713	0757-0391 0757-0284 0757-0416 0757-0273 0757-0280 4C1439G
ALTJI ALTVAL ALTVAL ALTVAL ALTVAL ALTVAL ALTVAL ALTVAL ALTVAL ALTVAL	190-0201 1902-0025 1902-0680 1902-1070 01150-55514 1251-1887	122	DIODE-BREAKUCHILID-OW ST 400 MV. DIODESTC REF. JEDEC TYPE DIODESTREAKUCHM 4-22V ST ADARD ASSYLINTERCONNECT CONNECTURIPC 44 CONTACTSS 2 Z Z Z Z CONNECTURIPC 44 CONTACTSS 2 Z Z Z Z	25480 06713 06713 28480 1271765	1902-0025 18827 28 5210919-74
Aldula Aldula Aldula Algula Algula	1251-2414 1251-1887 1251-1887 1251-1887		CONNECTORISO FZXZSS CONTACT REBOON () CONNECTORIPC '44 CONTACTS(2 X 22) CONNECTORIPC 44 CONTACTS(2 X 22) CONNECTORIPC 44 CONTACTS(2 X 22) CONNECTORIPC 44 CONTACTS(2 X 22) CONNECTORISO FZXZSS CONTACT RESOON	71705 71705 71705 71705 71706	
Alejze Atejze Atejze	1251-2414 1251-1867 1251-1867 1251-1867 1251-1867		CONNECTORISO EZEZS CONTACT, EBBON. CONNECTORISC 44 CONTACTSEZ X 221 (/) CONNECTORISC 44 CONTACTSEZ X 221 (/) CONNECTORISC 44 CONTACTSEZ X 221 (/) CONNECTORISC 44 CONTACTSEZ X 221	71785 71780 71780 71780 71785 77785	257-25-30-340 252-22-30-340 252-22-30-340 252-22-30-340 252-22-30-340
A1 e132 A1 e13	L251-1887 1251-1887 01150-66519 011-0-44520 01150-66521		CONNECTORIPC 64 CONTACTSE2, E, 221, 1) CONNECTORIPC 84 CONTACTSE2, E, 221, 1) BOARD ASSYLEXTENDER ROARD ASSYLETIME BASE	71785 71785 20480 28480 78480	252-22-30-340 252-22-30-340 01150-66519 01150-66520 01150-66521

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	1 - 4 27 1	Description	Mfr Code	Mfr Part Number
A7121 A2127 A2123 A2124 A2124	01e0-2197 01e0-3e51 01e0-3e51 01e0-3e51 01e0-1e51		CIFXD MICA 10 PF 3E CYFXD CEA.D.OI UF -80-20E 100VDCW CIFXD CEA.D.OI UF -80-20E 100VDCW CIFXD CEA.D.OI UF -80-20E 100VDCW CIFXD CEA.D.OI UF -80-20E 100VDCW	72136 56289 6209 56209 56289	#0 #1 5C 1 00 J 3C C023 # 10 I F 10 7 L 5 2 5 4 C D H. C023 # 10 I F 10 7 L 5 2 5 4 C D H. C023 # 10 I F 10 7 L 5 2 5 5 C D H. C023 # 10 I F 10 9 L 5 2 5 5 C D H.
"AZICS AZICZ AZICZ AZICS AZICS AZICS	Q160-3677 0160-3450 0160-3451 0180-0197 0160-3558		CIFAD CER 1000 PF 20% 250VDCM C:FAD CER 5000 PF 10% 250 VDCW 10VDCW C:FAD CER 0.01 UF +80-20% 100VDCW C:FAD CER 0.01 UF +80-20% 100VDCW C:FAD CER 0.1 UF 20% 60VDCW	80031 56289 56289 56289	CV1598X78102# 50 C087#951H502x532 CD C087#951H502x532 CD C02795101F1017#25-CDH "150275589020A2-0Y5 8121-050-651-1044
A21C11 6 A21C12 A21C13 A21C15 A21C15	0160-1558 0160-1558 0160-1558 0160-1651 0160-2651		CIFXD CER 0-E UF 208 SOVDCM CIFXD CER 0-E UF 208 SOVDCM CIFXD CER 0-D UF 208 SOVDCM CIFXD CER 0-D UF 208 SOVDCM	72992 72982 72982 72982 56289	8121-050-811-108M 8121-050-851-104M 8121-050-851-104M C0238101F1032525-CDH C0238101F1032525-CDH
AZILIĞ AZILI? (AZILI? (AZILI? (AZILI?)	0160-0153 0160-2291 0160-0102 0160-0153 0160-3451	3 1 ,2	CIFXD MY 00001 UF 102 20040CH CIFXD MY 0016 UF 102 30040CH CIFXD MY 0001 UF 102 20040CH CIFXD CER 0.01 UF +80-208 10040CH	36289 56289 56289 56289 56289	192910292-PTS 1929184988-PTS 1929184992-PTS 192910292-PTS C023910181032925-CDH
A)1C21 A21C22 A21C23 A21C24 A21C24	0180-0197 0180-0197 0180-0197 -0160-3666		CIPAD ELECT 2.2 UF 10E ZOVOCH CIPAD ELECT 2.2 UF 103 ZOVOCH CIPAD ELECT 2.2 UF 103 ZOVOCH CIPAD PG (MATCHED SET) (PART OF CZ4, MATCHED, SET OF 4)	56289 56289 56289 28480	- 1500225X9020A2-DY5 1500225X9020A2-DY5 1500225X9020A2-DY5 0160-3666
A21226 A21227 A21228 A21229 A21230	0160-3451 0160-345B 0180-2490		I PART OF C24, MATCHED SET OF 41 (PART OF C24, MATCHED SET OF 41 CIFAN CER, N.O. UF :- #0-20% 100VDCM CIFAN CFR N.O. UF :- #0-20% 100VDCM CIFAN TA'15 UF 20 WVDC	362 69 562 89 28480	C0238101F1032525-CDH C0238101F1032525-CDH 0180-2490 - (-)
A71C31 A21C32 A21C33 A21C34 A21C35	0160-3470 0160-3451 0140-0205 0180-0291 0140-0153		C:FXOCER 0.01 UF +80-20% 50V0CM C:FXD CER 0.01 UF +80-20% 109V0CM C:FXD M:CA 62 PF 5% 300V0CM C:FXD ELECT 1.0 UF 10% 35V0CM C:FXD NY 0.001 UF 10% 200V0CM	77982 54289 00853 56289 56289	" DBD. CO23N101F1032525-CDM RDM15E62033C 1500105x9035A2-DY5 142P10242-PT5
AZICIO AZICIZ AZICIS AZICIS AZICISI AZICINI APILIPZ	0140-0197 0160-3451 0160-3451 0140-0201 1991-0040 1901-0179	160	CIFXD'ELECT 2.2 UF 10% 20VDCW CFXD CER 0.01 UF :80-70% 100VDCW CFXD CER 0.01 UF :80-70% 100VDCW CFXD MICA 12PF 5% 0 100E 15 LLI CON 3 GRA 3 GRAV D 100E 15 LL CON 15 WW	56289 56289 28480, 07263 28480	15 002 25 x 902 042 - 045 C0238 101 F 1032 25 CDH C0238 101 F 1032 25 CDH 0140 - 020 1 F 001 088 1 901 - 01 79
AZICAS AZICAS AZICAS AZICAS AZICAS AZICAS AZICAS AZICAS	1901-0040 1901-0040 1901-0533 1901-0040 1901-0533 (1901-0533		DIDDETSILICON JOHN JONY OTODETSILICON JOHN JONY DIDDETSILICON JOHN JOHN DIDDETSILICON JOHN JOHN DIDDETSILICON JOHN JOHN DIDDETSILICON JOHN JONY DIDDETSILICON JOHN JONY DIDDETSILICON JOHN JONY DIDDETSILICON HOT CARRIER	07263 07263 284 RO 07263 284 BO 07263 284 BO	FDG1088 1901-0533 FDG1088 1901-0533 FDG1088 1901-0533
AZICRIO AZICRIZ AZICRIZ VAZICRIZ AZICRIZ	1901-0040 1901-0040 1901-0040 1901-0040	N.	DIODEISTLICON 30MA 30MW YOU DIODEISTLICON 30MA 30MW	07263 07263 07263 07263 07263	FOGIOSS FOGIOSS FOGIOSS FOGIOSS FOGIOSS
AZICRIS AZICRIO AZICRITA AZICRIS AZICRIS	1901-0040 1931-0040 1901-0040 1901-0040 1901-0040	, (g	DICOESSILICON SONA SONY OLOGESSILICON SONA SONY DICOESSILICON SONA SONY DICOESSILICON SONA SONY DICOESSILICON SONA SONY	07263 07263 07263 07263 07263	FDG1088 FDG1088 FDG1088 FDG1088 FDG1088
A21C#20 A21C#21 A21C#21 A21C#24	1901-0040 1901-0040 1901-0040 1901-0040 1901-0040		OLODE: 21 I I COM 30MY 30MA DIODE: 21 I I COM 30MY 30MA	07263 07263 07263 07263 07283	FDG1048- FDG1048- FDG1048- FDG1048- FDG1048-
AZICAZS. AZICAZ6 AZIEI AZIEZ AZIHRI AZILI	1901-0040 1901-0179 01150-01701 01150-0201 0410-0454		DIGDE:SILICON JONA JONY DIGDE:SILICON JONY HEAT SINK FLPK SHIELD HEAT GVEN COMPONENT FOR ANIO2? COIL/CHOKE LOO UM 108	07263 28480 26480 28480 28480 *1	FDG1088 1901-0179 01150-01101 001150-20007 00110-0454 9100-2276
A2102 A2102 A2102 A2102 A2103	9140-0114 9170-0016 1854-0221 (1853-0089 1854-0071		COLL FFED. RF. 10 UM BEAD MAGNETIC SHIELDING () TSTRUST (NPM) TSTR:STPNP TSTR:STPNP TSTR:ST NPM (SELECTED FROM 2N3704)	28480 02314 28480 80131	9140-0116 56-580-66/18 1854-0221 2N4917 1854-0071
A2104 A2115 A2106 A2107	1854-0457 1853-0058 1854-0019	2/	TSTRIST NON TSTRIST NON TSTRIST NON TSTRIST NON TSTRIST NON	28480 80131 28480 28480 80131	1854-0457 283844 1854-0014 1856-0019 283343()
A2108 (7) A21010 A21011	1854-0092 1854-0215 1854-0215	(100 mm)	TSTRIST HON TSTRIST HONG TSTRIST NON	#0131 #0131 9 #00131	283563 283904 1283904

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr: Code /	Mfr Part Number
AZISIZ AZISIZ AZISIS AZISIS AZISIS	1854-0071 1854-0071 1653-0030 1854-0071 1853-0030		TSTRIST NPNISELECTED FROM 2N37041 TSPRIST NPNISELECTED FROM 2N37041 TSTRIST NPNISELECTED FROM 2N37041 TSTRIST NPNISELECTED FROM 2N37041	28480 28480 80131 26460 80131	1854-0071 1854-0071 2854-0071 1854-0071 283806
A21017 A21019 A21019 A21020 A21021	1653-0036 - 1653-0036 1653-0036 1453-0050 1856-0344		TSTREST PRP TSTREST PRP TSTREST PRP TSTREST PRP TSTREST PRP	80131 80131 80131 28450 78480	2N3 906 2N3 906 2N3 906 1853 - 0050 1854 - 0344
A21324 A21323 A2161 A2162	1853-0201 1856-0215 0757-0972 0751-0972 0751-0970	•	TSTRIST PNP TSTRIST HPN RIFRO FLM ICOX ONN 25/18W RIFRO FLM LOOK ONN 25/18W PRIFRO FLM LOOK ONN 25/18W	28480 80131 28460 28480 28480	4 1853-0201 2N3904 0757-0972 0757-0972 0757-0970
A2154 A2154 A2155 A2155 A2156 A2157	0757-0468 0757-0468 0757-0924 0808-5675 0757-0948	1 10 10	RIFED MET FLM -009K UMM 1E 1/8W RIFED MET FLM 1K OMM 2E 1/8W RIFED MET FLM 10K OMM 5% 1/8W RIFED FLM 10K OMM 5% 1/8W RIFED FLM 10K OMM 5% 1/8W	28480 28480 28480 28480 28480	0757-0488 0757-0924 0098-5575 0757-0948 2100-1778
A21+0 A21+10 A21+11 A41+12	2100-1776 0698-5575 - 0757-0924 0757-0917 0757-0931		RIFAD MET FLM 100K OHM 5% 1/8W RIFAD MET FLM 1K/CMM 2% 1/8W RIFAD MET STO CHM 2% 1/8M RIFAD MET OW 10K CHM 5% 1/8M	289 50 284 80 284 80 284 80 264 80	0698-5575 0757-0924 0757-0917 0757-0931 0761-0006
AZIRIA AZIRIA AZIRIA AZIRIA AJIRIA	0761-0006 (4) 0757-0765 (4) 0754-0146 (7) 0684-1827 0684-4721		MEFRO ELMSSER OMN 23 1/88 REFRO MET-FLM 10 DMM 13 1/4W REFRO CIMP 1000 OMN 103 1/4W REFRO CIMP 4700 DMN 103 1/4W REFRO COMP 100 DMN 103 1/4W	28440 26480 01121 01121 01121	0757-0965 0757-0346 CR 1021 CR 4721 CB 1011
A21414 A21419 A21420 A21421 A21422 A21422	0646-1011 0754-0073 - C664-4721 0646-1011 0698-8150		RIFXD MET DX 2-K DHN 5% 1/2M RIFXD COMP - 770 - OHN 10% 1/4M RIFXD COMP 100 DHN 10% 1/4M R.FXD COMP 560 DHN 10% 183/ RIFXD FLM 110 DHN 2% JAM	28480 01121 01121 25480 26480	0759-0073 C8 4721 C6 1011 0698-8150 0757-0901
AZINZ4 AZINZ4 AZINZ0 AZINZ0	0757-0901 0757-0921 0757-0718 0694-1011 0757-0926 0696-4110		######################################	284 80 284 80 01121 284 80 284 80	0757-0921 0757-0918 CB 1011 0757-0926 0698-4130
A21448 (A21437 (A21430 (A21431) (A21431)	06.96-4130 C757-0921 O684 1021 0 1-57-0170		RIFKO COPP 39 OHM 5% 1/8W RIFKO HET FLM,750 OHM 2% 1/8W RIFRO COMP, 1000 OHM 10% 1/4W RIFRO FLM 82% OHM 2% 1/8W RIFRO COMP, 2000 OHM 10% 1/4W	28480 25480 Q\121 28480 OLL21	0698-4130 0757-0921 CB 1021 C 0757-0970 CB 2221
A21-34 A21-35 A21-35 A21-36 A21-37(0157-0160 0157-014 0157-0411 0157-0411		GIFRD FLM 31K DHM 22 1/8M RIFRD FLM 120K DHM 22 1/8M AIFRD MET FLM 182K DHM 12 1/8M MIFRD MET FLM 68K CHM 22 1/8M PIFRD MET DW 11K CHM 22 1/8M	28480 28480 28480 28480 28480	0157-0960 0157-0974 0757-0971 0757-0964 9.0761-0073
A21 + 14 A21 + 3 + 1 A21 + 40 A21 + 40 A21 + 42	0761-0073 0684-2724 0684-4771 0757-0683 0747-0630		RIFKO COMP 2700 HM 10% 1/44 RIFKO COMP 470 CHM 10% 1/44 RIFKO FEM 36K OHM 2% 1/8W RIFKO FEM 1-8K OHM 2% 1/8W	01121 01121 1 28480 28480 (01121	C6 2721 (100 4711 (2057-0461 (2737-10430) (1337-10430)
A2 144 2 1 2 1 2 2 2 2 2 2	0h =4-1901 07:97-0972 07:97-0975 06:94-1021 06:96-1021		RIFAD FLM A20 OMA 21 1/88 RIFAD FLM 130K CMM 21 1/88 PIFAD GUMP 1000 OMM 101 1/48 BEND GUMP 1000 OMM 101 1/48	25,80 26,60 01,21 01,21 01,21	0757-0922: 0751-0625 C6 1021 C6 1021 C8 4721
A211A3 A211A3 A211A3 A21A31 A21A31	0004-0721 -0094-1021 0011-2854 0044-1321 0044-1321		RIFAD COMP.4700 UMM. LOS Z/AM RIFAD COMP.1000 OMM. LOS Z/AM RIFAD MW 55 DMM. 18.34 RIFAD COMP.3300 OMM. LOS Z/AM RIFAD COMP.3300 OMM. LOS Z/AM RIFAD COMP.3300 OMM. LOS Z/AM RIFAD COMP.3300 OMM. LOS Z/AM	01121 24400 01121 01121 01121	CR. 1021 08:11-2854 CB:3321 CR:3321
21 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0A94-1051 C9A6±1051 P684-1051 P684-1051		AFFED CORP 1 MESONE 15 1/4W RIFKO COMP 10W 10W 10W 1/4W	01121 01121 01121 01121 01121	CB 1051 3
A11-9- A11-9- A11-9- A11-9- A11-8-	064-1031 064-1031 064-1031 064-1031 064-123 064-123		ARIERO CURP ION (HM) IOT 1/44 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/	01121 01121 01121 01121	(ce los) ta los) ta los) (ce -72)

See intriductionity this section for extering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Oty	Description	Mfr Code	Mfr Part Number
451-64	CB 84 -4 771		Preso Cime 4700 the 107 1746	91121 01121	C1 4721 C4 4721
A21 (05) A21 (46)	044444721 0758-0310 0758-0300		- HERRO SET CA-510 (MH) 57 1/24 1/4/1/10 1	24+40 24+40	0758-0030 0758-0033 0758-0030
API-bel.	C754-0530	1.5	TATE AND DET SHE SEC CHAST 1/200 A TANKE OF	24440 24440	0758-0030 At
A2116) A21170	C75H-0010		TAREND COMP. BRECOMM 12 1/44	01131	CH 1051
A21472 A21472 A21473	C643-0325 0764-0020 - 2100-1773		REFEID WET FEM SEID IHM ST ZW	264-40 294-60	0764-0020 2100-1771
AZLATA	U757-0400	2	REFER MET FLM 100 LINE ZE LIGH	28440	0757-0900 CB 3901
421275 A21876	06 94-3701 06 94-4721 06 46-1021		nifino Comp 19 CH4 108 174H hifino Comp 4760 OHP 108 174H Hifino Comp 1980 OHP 108 174H	01121	CH 4721 CH 1021
A21-77 A21-78	Co-4-1071		HIFKU GÖMP LONG OHM 108 1/44	01131	Ca 1021
A21474	0014-5521 0484-2721		#2FXD COMP 5-6K DEM 10T 174W #2FXD COMP 2700 DMM 10T 174W	01121 01121 26460	C8 2721 0157-0984
A21481 A21+62	8 0757-0964 6 0761-0006 9757-0924		RIPAD HET DE TON CHM ST 1788 RIPAD HET DE TON CHM SE 18 RIPAD HET FLM IN CHM 22 1768	28480	0761-0006 0757-0924
A21483	0741-0714		Biern-Met. UR 140 UMM 58 14	284 9Q 264 9Q	07q1-0016 1820-0157
YSI 71	1020-0157		ICIECL 4-14PT UP/NICA OPTVE - ICIECL 4-14PT UP/NICA DRIVE DIUDEIRREAKDOWN 5.02V 5%	28+80 0471?	1720-0157 5210919-110
AZIVAI AZIVAI	1902-3104 1902-3192	N. 1	DIQUE BREAKOURNISTCICIN 12-14 ST	58480	1907-1182
AZIVA3	1672-0579		DIODE BREAKDOWN 17-PV SR 400MM	26480 28480	1902-0579 1902-3224 1902-3245
AZEVAS	1402-3245		DIODE AREANDANISTERCON 21.5V.5%	2.64 BC	
A22	01150-66522	2.	HOARD ASSYL SAMPLING, CHANNEL 1	28480	01150-65527 5101-8100-858-1518
AZZCZ	0160-1402 0160-3647	2	CIFYD CER 150 PF 101 100VDCW	7294? 72982 72982	#111-#112-CDG-220J
W55C2	0160-2205		CIFRO CER 22 PF 58 100VOCM	20480	0169-2305
AZZC5	0160-3466		C1FXD CER 100 PF 10% 250VDCH	362 19 729 02	1
AZZCT AZZCB	0160-3451 0160-3567	2	CIFKU CER U.U. UF +80-20% 100VUCH	76219 72962 * 72982	C0239101F1032525-C01 3101-100-C0G-100J
ASSE4	0160-3654		CIFNO CER 4.700 PF 20% SOVOCH	36299	15002251902047-045
A22C11 A22C11	0180-0197		CIFED FLECT 2.2 UF 10% 2040CW	56289 :: 3 84411	1500275×902342-045
A22C13 A22S14	01 70-0040 01 80-0197	3	CIEND AL GOOS IN TOR SOLOCH	56289 56289	192847392-PTS 1500225x902042-DYS
422015	0160-3466 0180-0197	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CIFXD CER 100 PF 10T 250VDCW	56289 56289	C157F251F101K5Z2-CD
A22C16 A22C17	0160-2197 0160-0197		CIFED MICA TO PF 5%	72136 56289	#DM15C100J3C 150D225#9020A2-0YS
A22C17	0160-3688	2	CIEND CEN 5500 ME FOR SPOADCA	56289	1500225X9020AZ-DYS
AZZCZO AZZCRI	0180-0197 1901-0340-	•	CIFKO ELECT 2.2 UF 108 20VDC# DIODE:SILICON HOT CARRIER DIODE:SILICON HOT CARRIER	28450 28460	1901-0340 1901-0340
AZZCRZ AZZCR3 AZZCR4	1991-0340 1991-0340		DIODE:SILICON HOT CARRIER	28480 28480	1901-0340 1901-0340
A22CR5	1901-0040		DIDDERSTLICON 304A 30WV	07263 03508	F0G1088
AZZCR6 AZZCRT	1901-0579 1901-0579 1901-0040		DIODE:SIISPECIALI DIODE:SIESPECIALI DIODE:SILICON 30MA 30WV	07763	SE 445 FOG1088
A22CRB A22CR9	1401-0533	#1	DIODE INTERIO HOT CARRIER	2848G	1901-0533
AZZCR10 AZZCR11	1901-0533		OF CODE: NY SRID HOT CARRIER DIODE: STLICON JONA JONY DIODE: STLICON JONA JONY	07263	
A22CR12 A22E1	1401-0040 0340-0060	2.1	PEEDTHAULINSULATED MOUNTING ;	28480	0340-0040
AZZLI AZZLZ	9140-0142	3	COIL: PAD RF 2.20 UH 108	92142 28440	09-4436-4R 1854-0221
A2202	1854-0221 1854-0360		TSTRIST NPHEREPLOY ZNAGAAD TSTRIST NPH DUAL TSTRIST NPHISELECTED FROM 2N37041	28480 28480	1854-0360 1854-0071
A2234	1854-0071 1853-0058		TSTRIST PNP STATE OF THE STATE	90131	283644
A2295 A2296	1854-0246 1854-0215	2	TO PERSON NEWSCOOL CONTRACTOR OF THE STATE O	90131 80131	2N3643 2N3904 2N3906
TOSSA , DESSA	1853-0036 1855-0062		TSTRIST PMP	0131 01299 00131	2N1595 2N3904
A 200	1854-0215		TSTREST NPN	The fact of the second of	

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2731J A27011 A2701 A2701 A2101 A2101	1859-0016 1854-0215 0698-6042 0698-6042 0757 0421		TSTRIST PMP TSTRIST PMP TSTRIST NPM #IFXO MET FLM L30 OHM 1/4M #IFXO MET FLM L30 OHM 1/4M #IFXO MET FLM 825 OHM 1/4 I	#0131 #0131 #0431 #8480 26480 28460	243906 243904 0646-4042 0646-8042 0757-0421
A2245 A2245 A2216 A2227 A2248	01810-61901 0698 3428 ,0757-0744 0757-0924 2100-1718		RESISTOR ASSY READ MELET LM 14.7 OHM 1% 1.8W RIFAD FER TOR OHM 2% 1/AW APER NET FLM IK CHM 2% 1/AW RIMAR FLM 104, DHM 10% LTM 1/2W	29480 29480 29480 29480	01810-61501 0698-3428 0757-0948 0757-0924 2100-1738
A2244 A22411 A22411 A22412 A22412 A22A11	2100-1738 0757-0462 0757-0475 0757-0476 0757-0476		RIVAR FLM LOR DAM 10% LIN 1/26° RIFAD FLM 39K DAM 2% 1/86 RIFAD MET FLM 2/8K DAM 18 1/86 RIFAD MET FLM 2/8K DAM 18 1/86 RIFAD FLM 30K DAM 2% 1/86	28480 78480 28480 78440 28480	2100-1738 0757-0962 0757-0675 0757-0676 0757-0678
a22415 a22415 a22417 a22417	0757-0962 0757-0968 0698-7026 0698-7266 0757-0956		RIFAD FLM 39K DHM 2% 1/8M RIFAD FLM 10X DHM 2% 1/8M RIFAD FLM 10X DHM 10% 1/8M RIFAD FLM 103/K OHM 2% 1/4M RIFAD FLM 22% DHM 2% 1/4M	26480 24480 01121 28480 28490	0157-0962 0157-0968 88 9101 0696-7266 0757-0936
A22414 A17423 A22421 A22422 A22422	0757-0973 0649-7264 0757-0672 2100-2447 0757-0407		#IFID FLW 2.4M CHW 2E 1/8W #IFID FLW 14.7K CHW 2E 1/8W #IFID MET 54M 200K CHW 1E 1/4W #IFINA FLW 200G CHW 12E 1/41/2W #IFINA FLW 200 CHW 2E 1/8W	28480 28480 28480 25480 28480	0757-0933 0696-7264 0757-0672 2100-2697 0757-0907
22210- "22225 42225 42225 42228 42228	0757-0472 0757-0948 0544-1021 0757-0973 0747-0969		AIFAD MET FLW ZOOK CHM 18 1/86 MIFAD FLM 10A CHM 28 1/96 BIFAD CAMP 100 CHM 107 1/96 MIFAD FLW 91A CHM 28 1/96 BIFAD FLW 91A CHM 28 1/96 BIFAD FLW 91A CHM 28 1/96	28440 01121 28480 28480 28440	0757-0472 0757-0948 CR 1021 0757-0971 0757-0945
A27-2+ A12-33 A12-31 A22-32 A22-32 A22-33	0157-0148 0698-1429 0698-4157 0638-4157 0638-4157		PIFID FLM TOK OHM 2R 1/50 RIFAD MET FLM 19-6 OHM LE 1/50 RIFAD FLM LON OHM O-1E 1/64 RIFAD FLM LON OHM O-1E 1/64 RIFAD MET FLM 19-6 CMM LE 1/64	28480 24480 28480 28480 28480	0757-0744 0698-3429 0698-4557 0699-4157 0699-3429
A224 50 A224 15 A224 15 A224 16 A224 17	0757-0761 0596-4157 0757-0317 0757-0910 0696-4157		REFUD MET FLM 22-IM OHM 18:1/4W BEFOD FLM 106 UMM 0-18 1/4W REFUD FLM 910 OHM 28 1/6W REFUD MET FLM 270 CHM 28:1/9W N REFUD FLM 10R UMM 0-18:1/9W	294 MQ 244 BQ 244 BQ 294 BQ 294 BQ	0757-0761 0598-457 0757-0917 0797-0910 0698-4157
A22457 A22467 A22467 A22462 A22463	On 14-1911 Cn94-9911 On 44-1911 Un44-3911 C694-0271		SIFED COMP 100 DHM 10% 1/44 RIFED COMP 100 DHM 10% 1/44 RIFED COMP 100 DHM 10% 1/44 RIFED COMP 100 DHM 10% 1/44	01121	Co. 3911 Cb. 3911 Cb. 3911 Cb. 3911
A22406 A22405 A22406 A22406	Ch44-1941 0644-1901 0747-0410 0144-1021 Ch44-201		RIFAD CUMP 1904 UNH 10% 1/4W AIFED CUMP 19 OHM 10% 1/4W RIFED CUMP 1900 UHM 10% 1/4W RIFED CUMP 1000 UHM 10% 1/4W RIFED CUMP 22 UHM 10% 1/4W	01121 01121 28450 31121 01171	CB 1541 CB 3401 0797-0930/ CB 1021 CD 1291
A22463 A22453 A22451 A2255	0757-0924 C644-102t C757-0755 0757-0931 		AIFED GOMP 104 CHM 28 E/AM AIFED SEN PH 28 CHM 28 E/AM AIFED FLM 204 CHM 28 E/AM AIFED FLM 204 CHM 28 E/AM AIFED AEF FLM 30 CHM 28 E/AM	26480 01121 24480 26489 01121	0757-0924 C6 1/21 0757-0955 0757-0931 C6 1031
AP2154 AZZTV AZDIL BZZ444 AZZ444	0797-0917 01910-91101 11420-0201 1902-0706 1902-1902		GIFED SUMSIO DHE 28 L/ME TRANSFORME ASSVIBATON INTEGRATED SIRCUSTIONERSATIONAL AMPL OLIDE BREAKUMINISTON SE DIDE BREAKUMINISTON SE	26490 25490 04717 28480 26480	0757-0717 01810-01101 -40140 1402-0706 1402-3002
ASSANT ASSANT ASSANT ASSANT	1902-1907 -1700-0745 -01-150-6692 5 -01-40-0127 -0140-0123		DEDUC BREAKDINGLE-379 98 SUCRETICE B-PLG- FOR TO-5 CASE MIGAN ASSISTREGER CIFED CEQ. 2-2 UF 108 2040CH CIFED CEQ. 2-2 UF 208 2540CH	26490 71745 28490 56289 56289	4102-3002 131-48-97-001 01191-48523 13002244072043-0745 50147025-044
A21C) A23C6 A21C5 A2AC6 A2AC6	11 M1-0197 01:50-1444 11:40-3654 01:40-1654		CIFED FLECT 2:2 UF 10% 20VOCM CIFED CER 4700 PF 20% 50VOCM CIFED CER 4700 PF 20% 50VOCM	562 89 52982 72982 72983 72983	9111-8090-651-472* 8111-8090-651-472* 9131-350 651:105*
A2314 A2100 A21110 A21114	0140-0197 0140-1494 0140-4329 0140-3641 0140-0197		CIFED CER - 702 UF TOR 20VOCH CIFED CER - 702 IF TOR 20VOCH CIFED CER - 702 IF TOR 20VOCH CIFED CER 0-11 UF - 801-20 E 100VOCH CIFED CER 0-11 UF - 801-20 E 100VOCH CIFED CER 0-11 UF - 801-20 E 100VOCH	56249 72982 28440 36249 56249	C0234101F1032525-C0

Table 6-2, Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
423213 423614 423614 423615 423615	nlen-uluz' 0180-3451 0180-3451 0180-3451 0180-3451		C:FRD MY 0.018 OF 10R 200VICH C:FRD CER 0.01 UF +80-20R 10NVOCH C:FRD CER 0.01 UF +80-20R 10NVOCH C:FRD CER 0.01 UF +80-20R 10NVOCH C:FRD CER 4700 PF 20R 50NUCH	56289 56289 56289 56289 72982	19291#192-PT5 C0238101#1032529-CDH C0238101#1032529-CDH C0238101#1032529-CDH 3111-A050-651-6724
A23C18 A23C19 A23C20 A23C21 A23C24	01.00-3.653 01.00-3.654 01.00-3.654 01.00-3.657 01.60-3.653		CIFRO CER 13 PF 5E 200VOCW CIFRO CER 6100 PF 20T 50VOCW CIFRO CER 6100 PF 20T 50VOCW CIFRO CER 53 PF 5E 200VOCW CIFRO CER 700 PF 20T 50VOCW	#0031 72962 72982 #0031 72982	CV154C1303 8111-8090-651-4724 8111-8090-651-4724 CV154C130C1 8111-8050-651-4724
A23223 A21624 A21629 A21628 A23628	01 AD=3548 01 AD=3558 01 AD=0147 , 01 AD=3654 01 AD=0128		CIFAD CER 0.1 UF 20% SOVOCH CIFAD CER 0.1 UF 20% SOVOCH CIFAD CER 0.2 UF 10% 20VOCH CIFAD CER 4.700 NF 20% SOVOCH CIFAD CER 3.2 UF 20% 25VOCH	72962 72982 55289 72982 56289	8121-050-651-1044 8121-050-651-1044 15002253902042-075 8111-4050-651-6724 50152025-044
A21C#L	50 80-7443		DIODEIMATCHED PAIRI	74480	5080-7643
AZICRZ AZICRI AZICRA AZICRI	1901-0535 1901-0535 1901-0040	2 ,	DIODE:HYMAID HOT CAMPIER DIODE:HYMRID HOT CAMPIER DIODE:SILICON JONA JONY	28480 28480 (07263	1901-0919 1901-0535 FDG1088
AZICAN AZICAT AZICI AZILI AZILI	1901-0040 1901-0040 0490-1034 9170-0016		DIODEISTETCON 30MA 30NV DIODEISTETCON 30MA 30NV HELAYIZ FORM C LZ VOC 390 OHM BEADIMAGNETIC SMIFLDING BEADIMAGNETIC SMIFLDING	07263 07263 13614 02114	FDG1088 FDG1098 612-6166 56-390-65/38 56-390-65/38
A23L3 A23L4 A23L5 A23L6 A23L6	9170-0014 01425-66002 9100-2254 9170-0025 9170-0029		BEADINACHETIC SHIELDING COILIFACTORY SELECTED PART COILIFACTORY SELECTED PART COREFERRITE READ COREFERRITE READ	02114 28460 78460 02114 02114	56-590-69/38 01425-64002 9100-2254 56-590-6582/48 56-590-6582/68
A2318 A2303 A2303 A2318	9170-0029 1453-0284 1453-0284 1854-0360 1853-0049	2	GURE:FERRITE BEAD TSTRISE PMP TSTRISE PMP TSTRISE PMP USTRISE PMP TSTRISE PMP	02114 28480 28480 28480 78480	90-590-6582/48 1853-0286 1853-0284 1854-0380 1453-0049
AZ 135 AZ 136 AZ 137 AZ 138 AZ 138	1851-0049 1853-0049 1853-0004 1854-0344 1854-0344		PSTRIST, PNP PSTRIST PNP TSTRIST PNP TSTRIST PNP TSTRIST NPN TSTRIST NPN	28480 28480 80131 28480 28480	1833-0049 1833-0049 283134 1854-0344 1854-0344
A2341 A21011 A21011 A21011 A21011 A21011	1853-0036 1853-0020 0757-0941 0644-4701 0761-0074		TSTRIST PRP TSTRIST PRPSSELECTED FROM 2017021 RIPED FLM B.7K DHM 27 1/46 RIPED COMP 47 DHM 107 1/46 RIPED MET OX 154 DHM 58 18	80131 28480 28480 01121 28480	283906 1833-0020 0797-0943 CR 4701 0761-0074
A2184 A2385 A2386 A2387 A2348	0757-0928 0757-0925 0757-0901 0644-1011 0757-0924		REFED FLM 1-5% CHM 2% 1/8% REFED FLM 1-1% CHM 2% 1/8% REFED FLM 10 CHM 2% 1/8% REFED COMP 100 CHM 10% 1/4% REFED MEE FLM 1% CHM 2% 1/8%	28480 28480 28480 01121., 28480	0757-0928 0757-0925 0757-0901 CB 1011 0757-0924
A2349 A23410 A23411 A23412 A23413	0757-0933 0684-6701 0757-0917 0684-1831 0684-6721		RIFED FLM 2R DHM 2% 1/86 RIFED COMM 47 DHM 10% 1/46 RIFED COMM 18, DHM 10% 1/46 RIFED COMM 18, DHM 10% 1/46 RIFED COMM 4700 DHM 10% 1/46	28490 01121 28490 01121 01121	0757-0431 C8 4101 0757-0917 C8 1831 C8 4721
A23414 A23415 A23416 A23417 A23418 A23418 A23413 A23420 A23420 A23422 A23422	0644-4711 9684-1031 0757-0435 0757-0462 0698-3156 0698-3156 0757-070 0757-070 0757-0738		RIFED COMP 470 OHR 10% 1/4M RIFED COMP 10K OHR 10% 1/4M RIFED FLM 3020 OHM 1% 1/8W /4M RIFED MET FLM 27 4K OHM 1% 1/8W RIFED MET FLM 464K OHM 1% 1/8W RIFED MET FLM 464K OHM 1% 1/8W RIFED MET FLM 587K OHM 1% 1/8W RIFED FLM 587K OHM 2% 1/8M RIFED FLM 387K OHM 2% 1/8M RIFED FLM 387K OHM 2% 1/8M RIFED FLM 387K OHM 2% 1/8M	0112t 0112t 78480 28480 28480 28480 28480 28480 28480 28480 28480	C9 4711 C8 1031 O757-0435 O757-0435 O757-0452 O688-3155 O757-0200 O757-0200 O757-0200 O757-0200 O757-0236 O757-0336 O757-0938
AZ3RZ4 AZ3RZ4 AZ3RZ5 AZ3RZ6 AZ3RZ6 AZ3RZ7 AZ3RZ7	0797-0931 0741-0074 2100-1946 0797-0290 0757-0924 0757-0952		RIPRO FEM 24 CMM 28 1/86 RIPRO MET OR 154 CMM 58 16 RIPRO MET FEM DISTOR CMM 18 1/86 RIPRO MET FEM 14 CMM 28 1/86 RIPRO FEM 154 CMM 28 1/86	28480 28480 28480 28480 28480	0761-0074 2100-1948 0757-0290 0757-0924 0757-0952
#23429 0 (#25424 2 (#25424 2 (#25424	2100-1948 Oas-1521 0757-0895 0498-7838 0757-0294	2	RIVAR MU SOL OMP 58 TYPE H 1M / RIFYD CHMP 1500 OMM 10% 1/4M RIFYD PLW 62 OMP 2% 1/5W RIFYD FLW 6.6 OMP 2% 1/5W RIFYD MRT FLW 57.6 OMP 1% 1/5W	28480 01121 28480 28460 28480	2100-1948 CB: 1521 0757-0895 0698-7838 0797-0294

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference	HP Part Number	Qty	Description	Mfr	Mfr Part Number
Designation		15 se 1 14,4 s		\ ₹	A STATE OF STATE OF THE STATE O
AJ 14 14 A214 15	0516-7456 0757-0435		atend fla 6.0 UM 22 1/40 nebed fla 62 UM 22 1/40 geful fla 39.2 UM 22 1/40	28490 28490	0757-0395
A21435 A21417 A21474	0151-0511 0151-0411 0554-1001	•	STEAD COMP TO CHM TOE TAGE.	2944G 01121	0751-0411 CA 1001
A21+11 A21+61 A21461	0616-1001 0717-0700 0757-7660		RIFAD COMP TO DHW FOR SETAN RIFAD HET FLM TOO CHW SE TAN PRIFAD FLM SAR CHW SE TAN	01121 28480 . 28460 	0217-0100 0757-0100 En 4731
APIGE	07514094A		RIFAD COMP ATE DIM 10% 17% A RIFAD FEW 10% CHM 28 1/8% RIFAD FEW A198 DHM 1:0% 1/8%	28460 28450	0151-0484
421445 421445	0741-0484 3141-0347 0747-0314		HIRRO FLM 3.0K CHM 28 1/AM BIRTO FLM 22TK CHM 28 1/AM BIRTO WET FLM BIG CHM 18 1/AM	24440 25460 24480 28480	0757-0937 u757-0934 9757-0418 0757-0419
A23H48 A23H48	0797-0414 0767-0439 1926-0303		READ FLM 6819 OHM 20 1 894	28480	1824-0001
451441 421442 421441	1932-9149 1702-0000 1737-3169	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	DIDUTE STEADDWRITE GY ST DIONE STEADDWRITE ST DIDE STEADDWRITE ST BOAD ASSYSAMPLING, CHANNEL 2	28480 28480 28480	1902-0640 1902-3169 01150-66522
3.	01140-66427 0160-1402		CIEND CEN 150 PF TOX ICONOCH	72952	BIL-ALIZ-CDG-220J BIL-ALIZ-CDG-220J
454C4 454C4	0160-3647 0160-2235 0160-3666		COPAD CER 22 PF 5% TOOSUCK	72982 24480 54289 72992	0160-2205 C137F251F101R522-CD+ + 811-A050-651-477*
424C1	0160-3654		CIPAD CER 4100 PF 202 5090CM	36289 72982	-11 CO2 18 TO1F 1032525-COH 8101-100-COG-100J
A24C8 A24C8 A24C13	U160-3367 0160-3636 0190-0197		CIPAD CER STOR PF. 20% SOVDCH CIPAD FLECT 12.2 UF 10% 20VOCH CIPAD FLECT 2.2 UF 10% 20VOCH	72912 56289 36289	#111-A050-651-672# 1500225x9020A2-075 1500225x9020A2-075
APACIE APACIE APACIE	01 50-3 541		CIFAD POLY GLOT UP 5% EGOVOCE	94411 96289 96289	HEM-192 192847392-815 19002254902042-045
AZUCTU AZUCTU AZUCTU	0140-0197 0160-1466 0130-0197		CIFRO ELECT 2.2 UF 108 20VOCM CIFRO CER 100 PF 108 250VOCM CIFRO ELECT 2.2 UF 108 20VOCM	56299 56299	150027519020A2-0YS
A24C14	1415-0410 1410-0410 1401-0410	4 9 70 V	CIPAD GER 2200 PF 108 20VOCH CIPAD CER 2200 PF 108 250VOCH	72136 56289 56789	#001351903042-045 15002351902042-045 1500235192321525-CDH
A24014 A24023 , A24081	0140-0147		OTODETSTITCON HOE CARRIER	28480	1901-0340
A24642 A24643 A74644	1931-0340 1931-0340 1931-0340		DIODE:SILICON HOT CARRIER DIODE:SILICON HOT CARRIER DIODE:SILICON HOT CARRIER DIODE:SILICON JORA JONY	28480 28480 07263	1901-0340 1901-0340 FDG1088
WACER	1901-0979 1901-0979		DIGGES LESPECTALS	03508	SE 445 FDG1088
AZAÇAR AZAÇAR AZAÇAR AZAÇAR	1931-0840 1931-0843 1901-0513		DIDDE STEECON JONA JONY GEODE: MYSRED HOT CARREE DIDDE: MYSRED HOT CARREE	28480 28480 07263	1901-0933 1901-0533 PDG1006
AZACALZ	1901-0040		DECOCESSICION JOHA JONY DECOCESSICION JOHA JONY FRECTMULTISSICATED MOUNTING	07243 28480	FDG1G88 Q340-006G
43461 A2401	0140-0060 9140-0142 1954-0271		ENSA PART OF AZARAN	82142 28480	09-4434-4R - 1854-0228
82632 82632	1854-0360 1854-0071		ISTRISE NOW DUAL ISTRISE NOWSELECTED: FROM 2M3704h	20480 20480 80133	1854-0360° 1854-0071 201644
#2405 #2405 #2405	1899-0048 1894-0246 1894-0219		ISTATOR APPO	00131	2N1404
AZ+JZ AZ+JB			TSTRIST PAP FSTRIST PET 30V FSTRIST NPM FSTRIST NPM FSTRIST NPM FSTRIST NPM	01295 01295 0131 80131	2H3906 2H1595 2N1906 2N3906
A2439 A24313 A24310	1855-0016		이 나는 사람이 가지 않는데 가게 되었다고 소프로 되었다.	28480	283904
A2441 A2442 A2443	G648-6042 O648-6042 0757-0421		PARTICION ASSY	28480 28480 28480	
2444 2.42445	01810-81501 0698-3428 0797-0948		REXO MET FLM 14 FOHM IN 18W	284 80 284 80	
#2446 #2447 #2449	0157-0476 2100-1778 2100-1778		RIFID HET FUR IN DAW 25 15 MIL RIFID HET FUR DAW 108 LIN 1/2# RIFID HET SUR DHM: 108 LIN 1/2#	28480 28480 28480 28480	2100-1736 2100-1738
A24413	\$197-0962		# 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Oty.	Description	Mfr Code	Mfr Part Numbe
A24411	0757-0475 0757-0474		RIFZO MET FLM 274R UMB 12 1/4M RIFZO MET FLM:243R OMB 12 1/4M	284 80 284 80	0757-0475 0757-0474
174412 124413 124414	0757-0959		RIFAD FLM BOK DHM 28 1/8W	26480	0797-0959 0797-0962
1248 (S	0757-094#		REFERD FLM BOK DHM 28 1/8m	28480 01121	0757-0944 88 9101
24x16 24x16	0698-7026 0698-7264 0797-0956		ATEXD FLM 14-78 SHM 28 1/8# RIFRD FLM 22K DHM 28 1/8W	284 80 284 80	0655-7264 0757-0956
24113 24820	0757-0933 0698-7264	a ()	RIPAD FLM 2-4K DHM 28 1/8K RIFKD, FLM 14-7K DHM 28 1/8K	28480 3 26480	0757-0933 0696-7244
24428	0757-0472 2100-2447		RIFIC MET FLM 2000 UMM 18 1/94 RIVAR FLM 2000 UMM 108 114 1/24	26480	0757-0472 2100-2497
24822 24823 24824	0757-0907 0757-0472		BIRND MET FEM 5000 DHM 12 1/84	26480 28480	0757-0907 0757-0472
24425	0757-0948		RIFRO COMP LONG OHM 28 1/88	01121	0757-0948 CR 1021 4
24426 24427 24428	0584-1021 0757-0971 0757-0945		RIFED FLM STE DHM 28 1/86	28480 28480	0757-0971 0757-0965
24830 24830	0757-0948 0498-3429		RIFED FLW 10K DHR 28 1/84 RIFED WET FLW 19-6 DHM 18 1/84	20480	0757-0948 0695-3429
26431 26431	0498-4157 0498-4157		AIFAD FLM TOK CHM 0-18 3/8# RIFID FLM TOK CHM 0-18 3/8#	78480 28480	0498-4157 0498-4157
24-23 24-233	0494-1429 0757-0761		RIFAD MET FLM 19.6 OHM 18 1/68 RIFAD MET FLM 27.1K CHM 18 1/46	284 80 284 80	0698-3429 0757-0761 0698-4(37
14472	0648-4157		RIFED FEM 510 CHM 28 1/86	284 10	0797-0917
124436 124437 124438	0757-0917 0757-0910 0898-4157		RIFED MET FLM 270 OHM 28 1/86 RIFED FLM ING OHM 0.18 1/96 RIFED COMP 190 OHM 108 1/46	254 50 25480	0757-0910 0698-4187
24439 24440	0644-3911 0644-3911		STEXD COMP 300 CHM 108 1/4M	01121	CB 3911
24441 24842	0484-3918 0684-3918	alle Salar Lasterije is	RIFRD COMP 390 DHM 108 1/46 RIFRD COMP 390 DHM 108 1/46	15110	CB 3911
26463 26464	0684-0271 0684-1541		RIFED COMP 2.7 DHM 10% 1/44 RIFED COMP 1508 DHM 10% 1/44	01121	CB 2761 CB 1541 CB 3901
26745	10024-1901		REPAIR FLM E-BK DHM 23 1/8W	28480	0757-0910
24846 }444] 24848	0757-0910 0684-1021 0684-2701		9:FXO COMP 1000 OHM 108 1/4W	01171	C8 2201
124444	0757-0724		RIFRD COMP 1000 UNN 108 1/46	01131	0757-0924' CB 1721
124451	0753-0455 0757-0431		RIFID FEM 208 CHM 28 1/84	28480 28480	0757-0955 0757-0931
124453	0644-L011 0757-0917	\$ 1.00 miles	RIFXD COMP 10H DHM 10T 1/46	26440	0757-0917
12478	01810-61101		THANSFORMER RESTRALUM INTEGRATED CINCULTIOPERATIONAL AND	284 60	01010-61101 WC1439G
42441 42443 42443	1920-0201 1902-0766 1902-1002		DIODE BREAKDOWNIES-27 5E	26460 26460	1902-3002
424483 4244UB	1902-1002 1200-0763		DIDDE SMEAROGNNIZ-37V 5T SOCRETIC B-PIN- FCM TO-5 CASE	28480 71785	1902-3002
A25	00182-60018	1	ASSY LOW VOLTAGE POWER MODULE C1940 RECT 290 UF +50-103 200VDC#	284.80 56289	00182-60018 , 320291F20CAB2A-DQR
A2963 A2962 A2963	0180-1865 0180-1809	i	CIPRO ELECT 3400 UF +75-10T 40VOCK	56289 56289 56289	320341F200AR3A-038 320342G035AB7A-038 320341F200AR3A-03R
42564	0160-1807 #	•	CIFNO ELECT 290 UF +50-10% ZOOVOCH	,71705	243011
4256 B. 42561 43563	2110-0007	2	FUSE CO. 375A 250V	75915	312.375
125F3 125F4	2110-0003 2110-0065		FUSERCANTRIDGE 2 AMP 7 AG FUSERCASTSA 250V	75915	312.002
1254P1	00140-41103	2.	FRANSESTOREHEAT SENK RH ENCLUDES NOT, NO29	29480	00186-61103
LISTON	00180-61104		TRANSESTOR PHEAT SINK LH	284 90	00182-00205
25427	00182-00205		PANFLIREAS, LVPS PANELIACCESS	28460	30195-00509
1254P4 1254P5 1254P5	01142-00204 00142-24701 00162-61201		BRACHET ASSETRANSPORMER	28480	00182-24701 00192-61231
12512 12512	1754-0417 1854-0067	2 2	TSTEESE NAME OF THE STREET APPLY	78440 HOL7L	1854-0417 2×1055
4752}	1894-0063 1854-0412		TSTRESE APM TSTRESE APM	40131 28480	243055 1854-0417
12504 12571	1200-00-1	:	TRANSFORMERSPONER	25480 71785	9100-1129 133-32-10-013
A25032	1200-0041	1000	SOCHETETAANSESTOR	78763 W	£13-12-10-01)

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Oty	Description	Mfr Code	Mfr Part Number
Service Contracts					
A29441 A2944 A2941 A2941 A294144	1201-0041 1201-0041 1201-0041 1201-0041		SUCHETITEMISSISTUM SPCAETITAMISSISTUM ASSYZIOM VILTAGE RECTEELE ROAND CEPEU ELECTION UP OFS-LOT ZOVUCA BEIDESSICION SOPIE	71745 71785 26460 56249 28460	133-12-10-013 133-32-10-013 00142-26503 21001276026004 1901-0049
APARCHI APARCHI APARCHA M APARCHA	1721-0949 1701-0044 1401-0944 1401-0028 1401-0028		COTAGETS IS ICON SOPTY ALGORES IS ICON SOPTY OROGETS IS ICON SOPTY OROGETS IS ICON 9.754 SOUPTY OROGETS IS ICON 9.754 SOUPTY	28480 28480 128490 04713 04713	1901-0049 1901-0049 1901-0049 581358-9 581358-9
arsaltar arsaltar arsaltar arsaltar	1971-002* 2 1991-002* 3 1991-0045 1991-0415		DIODETS LECTIF QUITSA SOCPIN BIODETS LLICIN QUITSA SOCPIN DIODETS LLICIN SOCPIN 14 OLIODETS LLICON 30 PIN 14 DIODETS LLICON 30 PIN 14	04713 04713 28490 28460 28460	Sal358-9 Sal358-9 1901-0415 1901-0415 1901-0415
APPALIAEL APPALIAEL APPALIAEL APPALIAEL APPALIAEL	1901-0414 1901-0614 1901-0414		O 1 306 LS LL LCON 50 PTV 3A O 1 706 LS LL LCON 50 PTV 3A O 1 706 LS LL LCON 50 PTV 3A O LUDGES LL LCON 50 PTV 3A U LUDGES LL LCON 50 PTV 3A	28480 28480 26480 28480 28480	1401-0415 1401-0415 1401-0415 1401-0415
125411415 125411415 125411415 125411415	1901-0-15 1901-0-024 1901-0-028 1901-0-024 1901-0-028		OTODESSILICIA OLTSA 400PIV OTODESSILICON OLTSA 400PIV OTODESSILICON OLTSA 400PIV OTODESSILICON OLTSA 400PIV OTODESSILICON OLTSA 400PIV OTODESSILICON OLTSA 400PIV	04713 04713 04713 04713	\$A1358-9 \$A1358-9 \$P1358-9 \$B1358-9 \$R1358-9
13541CR22 12541CR22 1254142 1254142	1901-00+9 1901-0045 0147-0342 0757-0342 D0102-68514		Digners (Licow 0.75a 100Pty 2:F iD MET FLW 100K 0HM 12 1/4W 8:FRD MET FLW 100K 0HM LE 1/4W ASSY LOW VOLTAGE REGULATOR BOARD	04713 29480 28480 28480 72136	\$81358-7 0757-0342 0757-0342 00182-66514 RDM15F101JDC
125A2C) 125A2C3 125A2C3 125A2C4	0160-2204 0160-0269 0160-0064 0160-0064		C.FXD.MICA 100 PF 5% CIPAD: ELECT 1-0 UF +50-10% 150 VDCW CIPAD: AL ELECT 10 UF +50-10% 150 VDCM CIPAD: AL ELECT 30 UF +75-10% 25 VDCW CIPAD: AL ELECT 30 UF +75-10% 25 VDCW CIPAD: AL ELECT 30 UF +75-10% 25 VDCW	56289 56289 56289 56289 56289	300105F150RA2-054 300106F150D02-054 192P10392-F15 300506G025CCZ-054 192P47392-F15
7445CNF 7445CG 7445CG	01:00-0048 01:00-0048 01:10-0089 1:01-0040		CIFED AL ELECT TO UP +75-LOR 25VDCH NOT ASSIGNED! CIFED AL ELECT TO UF +50-LOR E50VDCH I DIODESSILICUM-30M-30MV- DIODESSILICUM-30M-30MV-	36289 56289 07263 07263	300504G025CC2-05M 300106F150D02-D5M FDG1088 FDG1088
12542C#3 12542C#3 12542C#3	1901-0040 1901-0040 1901-0040 1901-0040		DIODE:SILICAM OLTSA ZOOPEV DIODE:SILICAM JONA JONY	04713 07263 07263 07263 04713	\$21358-8 FOGIOM8 FDGIOM8 FDGIOM8 FDGIOM8 \$21336-8
152457) 1524571 1524561 1544561	\$170-0269 \$170-0269		CLIP:FUSF 0.250" DIA NOT ASSIGNED NOT ASSIGNED CONNECTORIPC 15 CONTACT TSTRIST 494	91506 95354 80131	91-6915-0702-00 2N1053
125 1202 125 1202 125 1203 121 1204 121 1235	1444-0071 1444-0071 1454-0071 1454-0071 1454-0071		TSTRISE NPHISELECTED FROM 2N37045 TSTRISE NPHISELECTED FROM 2N37041 TSTRISE NPHISELECTED FROM 2N37041 TSTRISE NPHI TSTRISE NPHI	28480 28480 28480 80131 28480	1854-0071 1854-0071 1854-0071 283053 1854-0071
1294230 1294237 1294248 1254234 12542313	1454-0071 [#54-0071 1554-0019 1554-0071		TSTRIST NPNGSELECTED FROM 2N37049 TSTRIST NPNGSELECTED FROM 2N37049 TSTRIST NPNG TSTRIST NPNG TSTRIST NPNGSELECTED FROM 2N37049 TSTRIST NPNGSELECTED FROM 2N37049	29480 28460 80131 29460	1854-0071 1854-0071 203053 1854-0071 1854-0071
A23A2313 A23A2313 A23A2314 A23A2314	1854-0071 1854-0071 1854-0071 1854-0071 1854-0071		TSTRIST NOMESCLECTED FROM ZN37041 TSTRIST NOMESCLECTED FROM ZN37041 TSTRIST NOMESCLECTED FROM ZN37042 TSTRIST NOMESCLECTED FROM ZN37042 TSTRIST NOMESCLECTED FROM ZN37043	28480 80131 28480 28480 28480	1854-0071 243053 1854-0071 1854-0071 1854-0071
AZSAZAI6 AZSAZAZ AZSAZAZ AZSAZAZ AZSAZAZ AZSAZAA AZSAZABA AZSAZABI AZSAZABI AZSAZABI AZSAZABI AZSAZABI AZSAZABI	0747-0713 0797-0281 0757-0285 0812-0050 0797-0060 0757-0060 0757-0435 0757-0446 0757-0446		RIGID FLM 110 OMN 1E 2/4W RIFRO MET FLM 2.74K OMN 1E 1/8W RIFRO MET FLM 100K OMN 1E 1/8W RIFRO ME FREM 20 OMN 5E 2W RIFRO METICA 25K OMN 1E 1/2W RIFRO METICA 25K OMN 1E 1/2W RIFRO METICA 25K OMN 1E 1/4W RIFRO METICA 25K OMN 1E 1/4W RIFRO METICA 33.2K OMN 1E 1/4W RIFRO METICA 30.0KM 1E 1/4W RIFRO METICA 30.0KM 1E 1/4W RIFRO METICA 30.0KM 1E 1/4W	284 80 284 80 284 80 284 80 284 80 284 80 284 80 284 80 284 80	0757-0713 0757-0281 0757-0281 0757-028 0757-028 0757-028 0757-0418 0757-0418 0757-0418 2100-1773

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation			Mfr Code	Mfr Part Number	
A25A2912 A25A2413 A25A2414 A25A2414 A25A2415	0757-0767, 0811-1746 0757-0767 0757-0638 0757-0638		RIFRD FLM 43.2K OHM 1E L/4M RIFRD WM 0.36 OHM 5E ZM RIFRD FLM 43.2K OHM 1E 1/4M RIFRD MEE FLM 5.11R OHM 1E 1/8M RIFRD FLM 43.2K OHM 1E 1/4M	24480 28480 28480 28480 29480	0757-0767 0811-1746 0757-0767 0757-0438 0757-0707
A25A2R17 A25A2R18 A25A2R19 A25A2R19 A25A2R2 A25A2R2	0757-0431 0757-0273 0757-0283 2100-1772 0757-0438		AIFAD MET FLM Z.ASK OHN LT 1/8# AIFAD MET FLM S.OTK OHN 18:1/4# RIFKD MET FLM Z.OOK OHN 18:1/8W RIFKD ME 500 OHM 55:TYPE:H IW RIFKD MET FLM S.LIK OHM IX 1/8W	28480 28480 28480 28480 28480	0757-043L 7 0757-0273 0757-0283 2100-1772 0757-0438
A29A2W2D A29A2W2 A29A2W2D	0811-1746 0757-0769 0757-0436 0757-0430 0757-0749		AFFED HE 0-16 OHM 5% 2M RIFED FLA 51.1% UHM 1% 1/4W RIFED HET FLM 6-32% CHM 1% 1/5W ### 1/4W 1 1/	28480 28480 28480 28480 28480	0811-1748 0757-0759 0757-0436 0757-0430 0757-0769
A25A2427 A25A2424 A25A2424 A25A2430 A25A2431	0757-0281 0757-0428: 2100-1772 0757-0435 0757-0367		RIPED MET FLM 2.79K OHM 18 1/80 RIPED MET FL4-1.62K OHM 18 1/80 NIVAR WU 500 OHM 58 TYPE H 10 RIPED FLM 3920 OHM 18 1/80 RIPED MET FLM 100K OHM 18 1/2M	284 90 284 80 284 90 284 90 284 90	0757-0281 0757-0428 2100-1772 0757-0435 0757-0467
12442032 12442033 12442434 12442434 12442435	0757-0283 0812-0058 0757-0769 0757-0768		RIFED HET FLM 2.744 DNM 12 1/64 RIFED HE 52 DNM 52 26 RIFED FLM 51.14 DNM 12 1/44 RIFED FLM 47.52 DNM 12 1/44 RIFED HET FLM 33.22 DNM 12 1/76	284 NG 284 NG 284 NG 284 NG 284 NG	07%7-028% 0812-0038 0757-0769 0757-0768 0757-0044
A25A243T A25A243U A25A243U A25A2443 A25A2443	0757-0367 0757-0450 0757-0780 2100-1774 0757-0788		RIFAD HET FLM 100K DHM 18 1/2W RIFAD HET FLM 2231K DHM 18 1/4W RIFAD HET FLM 1K DHM 18 1/4W RIFAD HET FLM 1K DHM 18 1/4W RIFAD FLM 67-5K DHM 18 1/4W	28440 24480 28480 28480 28480 28480	0757-0367 0757-0550 0757-0260 2100-1774 0757-076h
A25A2R42 A25A2TP1 B25A2TP2 B25A2TP3 B25A2TP6	0687-5611 1291-020a 1291-020a 1291-020a 1291-020a		R FXD COMP 560 OHM TO \$ 1.7W CONNECTOR 15 CORET OLLS BOY OIL TEFLUN CONNECTOR 15 CORET OLLS BOY OIL TEFLUN CONNECTOR 53 CORET OLLS BOY OIL TEFLUN CONNECTOR 53 CORET OLLS BOY OIL TEFLUN	01121 98291 18291 98291 98291	E8 5611 SRT-400 SRT-400 SRT-400 SRT-400
12542411 12542482 146	1902-3096 1902-0787 0960-2085 01310-66502		UTIDE BREARDOWNS-23V 38:400 NW DIDDEST.G. HEFFRENCE INGSR NUT ASSIGNED ASSY.AD CONVENTER DOADS ASSYSINTERCONNECT, SAMPLING	26480 04713 28480 28480	1902-1096 18918 0960-2086 01610-66502
124C1 124C1 124C2 124C3 124C3 124C4	01:0-3652 01:0-3651 01:0-3652 01:0-3651 01:0-1652		CIPAD CER 64.7 PF 0.5% 200VDC# CIPAD CER 64. PF 1C% 200VDC# CIPAD CER 64.7 PF 0.5% 200VDC# CIPAD CER 64.7 PF 0.5% 200VDC# CIPAD CER 64.7 PF 0.5% 200VDC# CIPAD CER 66.7 PF 10% 200VDC#	72982 72982 72982 72982 72982 72982	8101-A200-C0G-6734 8101-A200-C0G-6737 9101-A200-C0G-6737 8101-A200-056-680 9101-A200-056-680 8101-A200-058-680
12406 Azacp Azach Azeki Azabi	016G-3651 016G-3652 016G-3651 1901-1039 0163-0066 1231-0213	1	CIPRO CER 88" PP 10" 7000000 CIPRO CER 88" PP 10" 7000000 DIOREISE 19" CONTACTITÉE MIMAE CONTACTITÉE MIMAE CONTACTITÉE MIMAE	779 92 729 92 284 90 00000 95354	#ICI-#200-COG-4792 #IOI-#200-#55-4694 ! 140I-1024 UND 9I-6415-1700-00
36, 1284't 12832	1291-0213 0757-0391 0757-0491		(PART OF A28) CONNECTURING EINSE 15 CONTACT (PART OF A28) RIFID FLY 19-2 DHM 18 1788 RIFID FLY 19-2 UM 18 1788	95354 24480 28440	91-6915-),700-00 0727-0391 0757-0391
124+1 17446 1211 14111 144-2	7797-0391 4757-0391 01640-46007 31810-61616		RIFAD FLM 30.2 CHM IR Y/FBM RIFAD FLM-39.2 CHM IR Y/FBM TRANSFIRMER ASSYLALUM CABLE ASSYLSTATRE CHANNEL 1 CABLE ASSYLSTATRE CHANNEL 2	26460 29460 25480 26480	0757-0591 0757-0391 01510-66007 01610-61614 01810-61614
A17	Ct 410-AA505 ULH tC-AA505 Ot 150-AJ001	**************************************	HUAND ASSYLEATENDER (135) 304D ASSYLEATENDER (136) DE DELAY LINE ASSY	2 64 80 2 84 90 2 84 80	21810-66503, 01812-66503 01350-6000)

Table 6-3. List of Manufacturers' Codes

	anourss Cine
The Control of Management Management of the Control	되어도 한 계계를 들어가 되었다면 하게 하는 것이 되었다.
支制 그들은 그들은 사람이 가는 그 사람들은 학생님들은 전에 하는 것은 것은 점점을 가지 않아 점점을 받아	ANY SUPPLIES OF U.S.A.
nagous was a Cheen	HARRICALINA DAL MARRICALINA DAL MARRICALINA DE 12101
COTTO SAME INC. CALACUARY, ME INC. PEND.	THE REPORT OF THE PROPERTY OF
OTTEL ALLEN HEADLEY LTS THE TOTAL THE COMMINENTS OF	
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SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

7-2. This section contains information required to back date; on update this manual for a specific instrument. Descriptions of special options and standard options are also in this section.

7-3. MANUAL CHANGES.

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	

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. 0684-3331; 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. 192P19392 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.

A23R 19: 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.

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, croubleshooting 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.

- 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 MILstandard 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 righthand 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 Ma/ch 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 critic code of the connecting wire. Connector pins of plugicand 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.

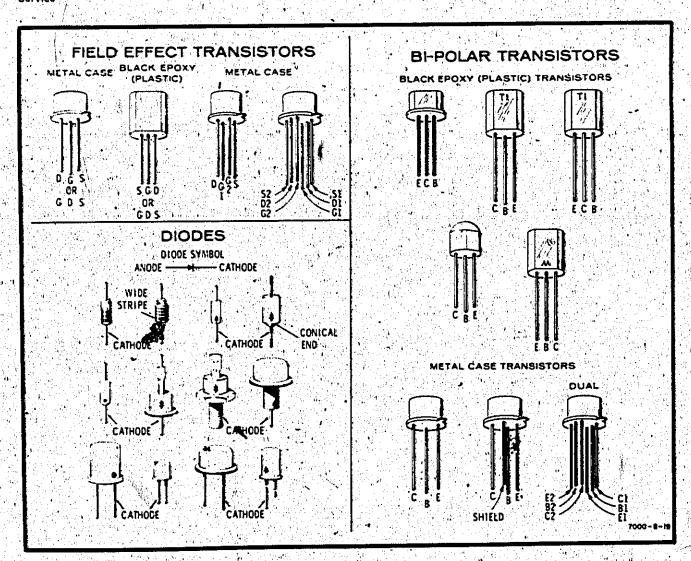


Figure 8-1. Semiconductor Terminal Identification

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 unsaldering 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_O inputs are high, the counter will be reset to 0. When Rg 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 $\overline{\Omega}$ output is always opposite in level to the Ω 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 Q output is the complement of the Q output.

8-32. J.K MASTER-SLAVE FLIP-FLOP. The J-Kmasterslave 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.

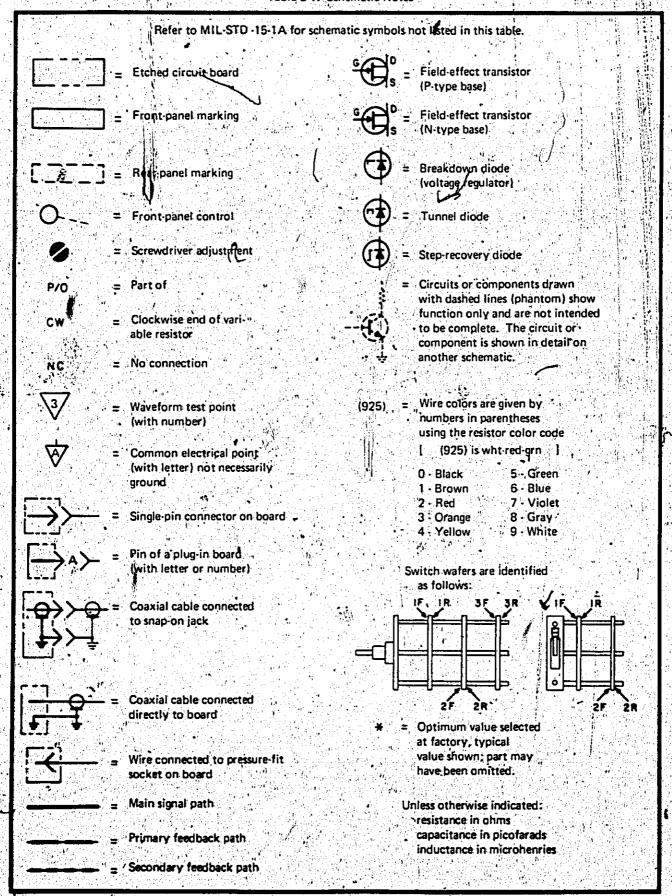
8-42. TRIGGER PICKOFF CIRCUITS

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)



- 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 remeasure 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 groubleshooting this assembly is by the front-panel input data switches. Using the pro-

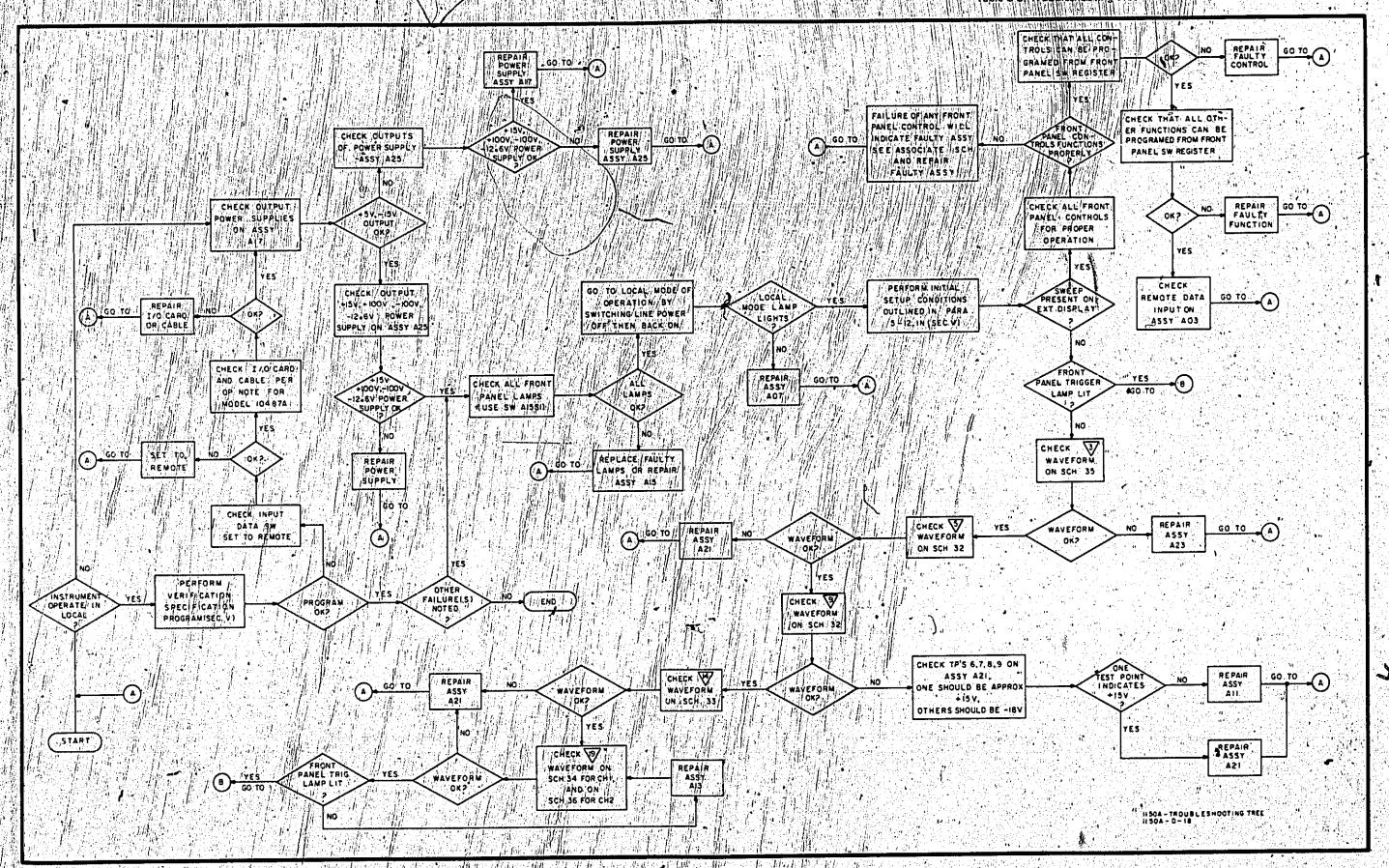
gram codes given in Section III, each command should be programmed and checked. The command signals generated by this assembly can be verified at connectors J19 and 120

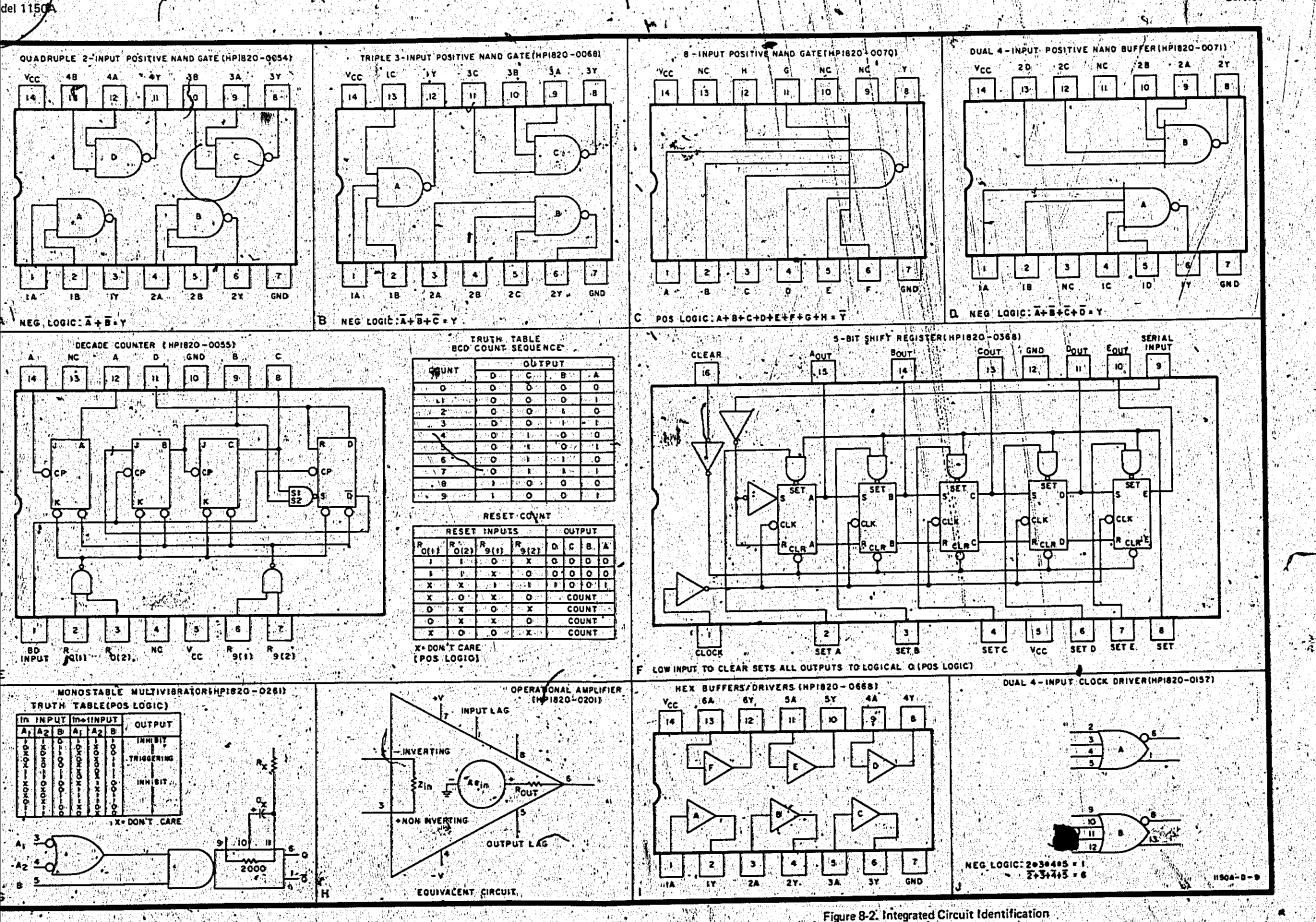
8-48. BOARD EXCHANGE PROGRAM

- 8-49. A field sequice 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		Oty (Part No.		Blue Stripe No.	
A03	Bd assy Local Rem		01150-66503	None	
A04	Bd assy - Calibrator.	\$ 100 PM	01150-66504	01150-69502	
A05	Bd assy Disp. Cont.		01150-66505	01150 69503	
A06	Bd assy Xpnd Pos	1	01150-66506	None	
A07	Bd/assy - Read MPX	1 1	01150-66507	01150-69504	
A08	Bd assy - CH Select)	01150-66508	None	
A09	Bd assy • Vert Pos	31.47 (8)	01150-66509	01150-69505	
A11	Bd assy - Scan Attn	1/1/	01150-66511	None	
A12	Bd assy - Scan D/A	1/	01150-66512	01150-69506	
A13	Bd assy - Dig Scan	119	01150-66513	None	
A14	Bd assy - Vert Attn		01150-66514	01150-69507	
A16	Bd assy - Trigger P. O. assy	1 1	01150-67601	01150-69508	
A17	Bd assy Power Supply	1	01150-66517	None	
A21	Bd assy - Time Base	1.0	01150-66521	01150-69509	
A22, A24	Bd assy - Sampling	V1**	01150-66522	01150-69510	
A23	Bd assy - Triggering	111	01150-66523	01150-69511	
.A27	A/D Converter		0960-2085	.01150-69512	
Part of A25	Power Module		00182-69501	None	
A19	Extender bd	1 1	01150-66519	None	
A20	Extender bd	17.	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 4 2 6	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	1.1	(NSN)	None	
	1150 Manual		01150-90901	None	





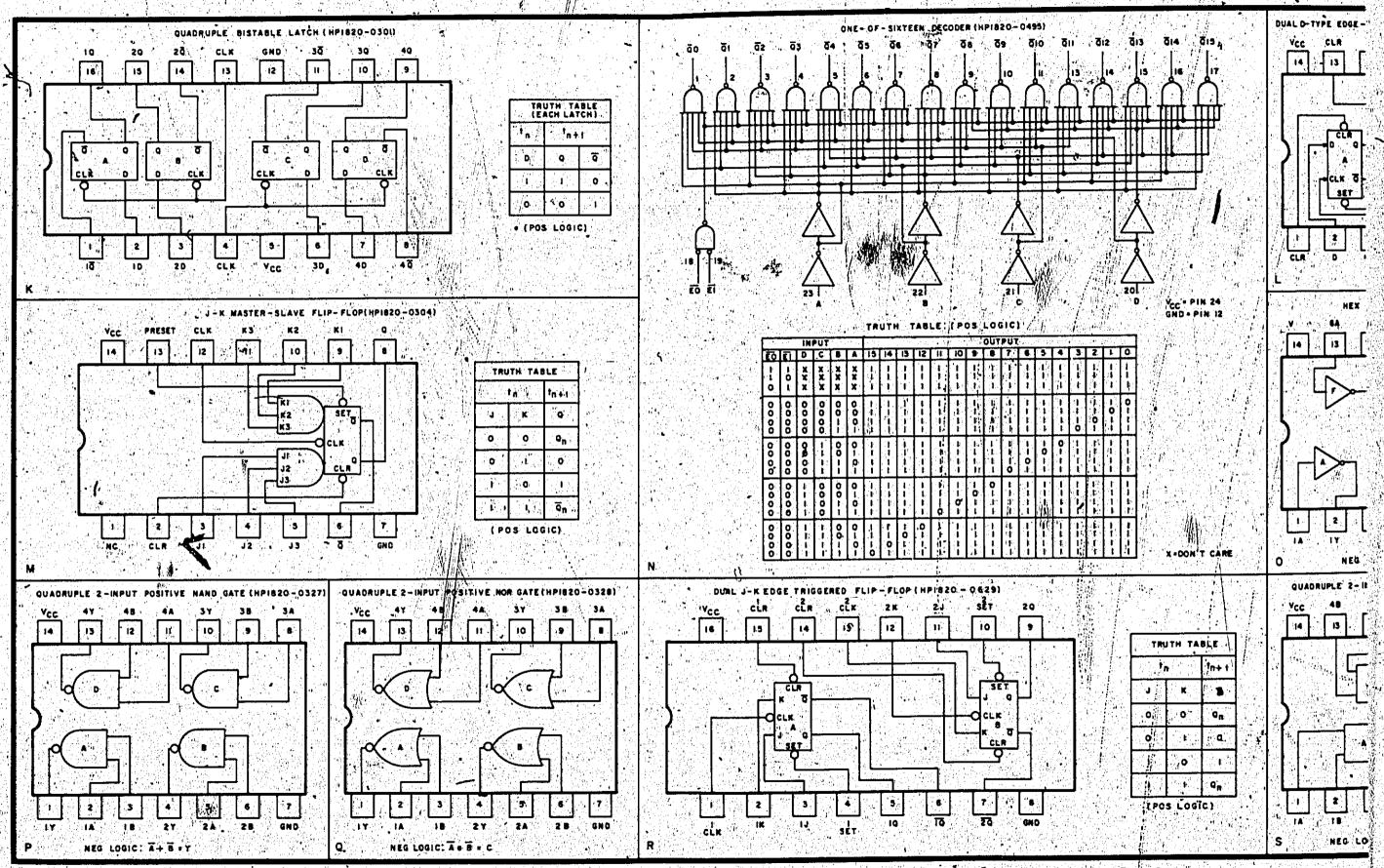


Figure 8-2. Integrated Circuit Identification (Con-

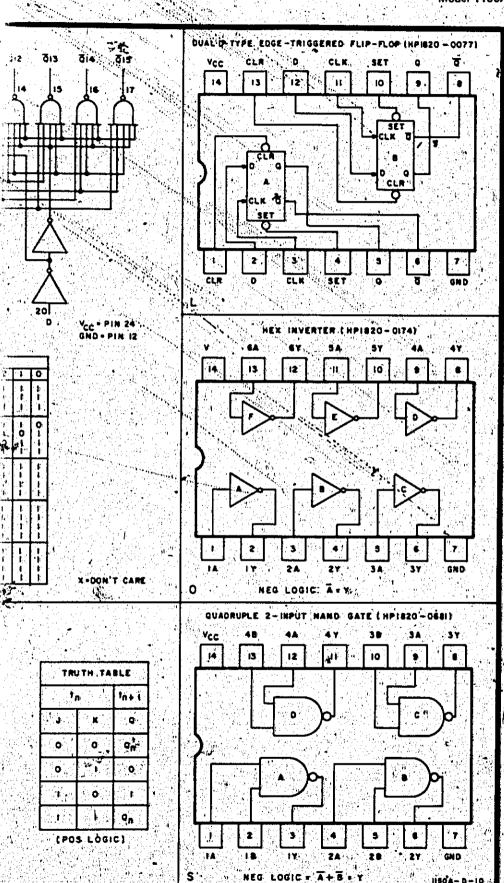


Figure 8-2. Integrated Circuit Identification (Cont'd)

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		INTERFACE		LOCAL/REMOTE	,,	CALIBRATOR	:	DISPLAY	CONTROL	EXPAND		READ/	MOLTIPLEXER	CHANNEL	• b	VERTICAL		SCAN ATTN DECODER		SCAN D/A ATTN			VERTICAL ATTN		LAMPADRIVER		TRIGGER PICKOFF		TIME BASE		SAMPLING	TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		AO	2	ΑO	3	A O	4 3	AC)5	AO	6	ΑO	7	AO		A09		All	. A	12	A	3	i,, A l	4	A15		AI6	A		A	24	A23	A27	y 34 (4)			
SCHEMAT	IC NO.	N A	Tijs.		2	3,4	,5	6,7	, 8	9		0,11	,12	. 15	. 6,	16,1	7	18,19	2	1,22	23,2				28,29)':	30	-	32	34		- 35	NA	Light, William	No ENGL	Sugar Salar	1,55.4.5
SIGNAL	SOURCE	J9 J	_	Jiij		J13	_		J16 .	J17 J	118	J19.	J2 \$	J21 .	122 J	23 J	24 J	27 J2	8 J29	130	J31	J32	133	J34			Maryland	J35	J36	J35	J36		J37	/ J38 ···	J39	J41	
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DB4	• J37 Pin X	• <i>i</i> · · •	or, S			i paga s	Ç. j	200				S.			10.4	tio j		- v 1	. 11.		Q.E.		T_{ij}		A		sa tarata	5.15	. t .	3.37	1 100		X	Safety et	2 100 24	4.54/05	. 15,538
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	i egginena jekkaj 1966.	19 m	3 (A)	-1894	975	7.45				tişt,			375,0	37.5		505	it y		31	100	40.4	27	100	30.74			ar in the		. [447]	•			3124 3			in was in	S 4 17

Table 8-4. Signal Matrix (Cont'd)

		NTEDEACE		COAL VREMOTE		CALIBRATOR		DISPLAY	CONTROL	EXPAND	POSITION	READ/	MOLIFIEXER	CHANNEL SELECTOR		VERTICAL		SCAN ATTN	The contract of the contract o	SCAN D/A ATTN	7 L	-DIGITAL BCAN	The state of the s	VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF		TIME BASE	ZWEDI + NG	V 1	TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
West of	The North	ΑO	2	ΑC	3	ΑO	4	AC		ΑO		AO	7	ÁO	8	AO	9 /	ΑJ)	AI	2	ÄÌ	3,	Al	4	AL	5 ∥′	. A I 6	A 2	<i>'</i> -	A 2 A 2		A23	A27		1		
SCHEMAT	FIC NO-	N		1 - 11	, 2	3,4	,5	6,7		9	100	10,11	, 12	15		16,	r7	18	19			23,24		26,		8,2	9	30	;31		34		35	NA	120	J39	J41	200
SIGNAL	SOURCE	J9					J14			J17	J18.	J19	J2 9	J21 .	122	23 J	24	J27 _/	J28	J29	J39 .	J31	J32	J33 .	J34	6.5	71	र्व्यापुर्वे पूर्व क्रिके	J35	J36	J35	J36	in the sale	J37	J38		det i viv	and the
in jagangan galam	* 1. 1. J. A. (a. 14 Ch.)	a .	1.		ds.	124	1. A	1.00	133	len	44 ti	7 P	1.	1		Figure 1	j.	7 G	₹ 3	4	-1,	独立	Specific	6,5	1/4-7	417	7 7/9			3, 23	W.G.		#263112161 1 15 1 4 1 1 1	i de la companya de La companya de la co	angstill at Sissa. Tagistilla	1965年編集1 1967年初第三		S3-C2
Α4	9 \$3 . ∀.∂d/ ;	# (X)	1000 1860		1	¥.	$\psi_{i,j}^{*} \in \mathcal{P}$	V. 74	5 (1.15)	$\ell \in \gamma(\Sigma)$	$\{q_{i}, \dots$	56.75	dr :	J.	,		(%)	1914	: · · g .	i iji	5,4	M.	10	,33	土土	4/2	-ifi	A second	1								1	20.0
	i ungalijakan d	150 m		7.0	结进	, X	1.14	14,54			E^{2}	<u> </u>	j. e. j.						~ 1/		304	35 19	16"	2 3 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	v (1975	16/1	M. Jr.	10 g	100	8	*	The second				egy a rough	S4-F9
BOFF	S4	100	Visit .	36.7	2		4	0 B		4.0	P. Carlo	13 A	14 7	<u> </u>	-	4		**	- //	9 117 Sec. 80	\dashv		# 3. 1: 1:	7.5.	- ' '	1115 P	1935 Útro		9.5%	21	2.5	3.3	an en en entre	ķ.		Francisco (Co.	. 2001 (5.67	9.19.2
	. The Mark of the second		9 (3.1	<u>}</u>			5.0	25 for	3/1.7	* V		·- 3 ,	•	1		1 - 3 - 1	10.6°	9, 3	. 493 1877	12		23 m () 24 .	•	1877 S.	10		liga.			14:	1.00			Zaria in		11.54	• 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	dian't
BRDOT 1/2	'J29 Pin 12	1 34.5	1.5	#(F)		7/17	7.2°	5/	75		erk, sa gazas	- 41 - 41 - 1	1.0	general Distriction	7		A 2	iografia Albania	Mai		5 46 1 34		5.	1	1	, 14 h	jyr .	J. Ameriy.		1	(100)		grafia	21 930 22 0	est National	and some	1501.125	10 Te
nge sand. Kie	a loger of the sec	19	46,1	Z		3040	,	en e	No.	1.05		⇔ β ∀∽ βå	,,	1.1.	1000 S		•	7	$ijj_{k,j}$	7. 17	- ,			l;	. 6	./1	17: × 1	Serve.	1994	1	200	1.5	Healing 1	可以内侧型	\$ 10 at \$ 1.50			9-11-150
BUFENC	J9 Pin 19	19		. 6. 1	2,1 0	190 S 141 S	()	to the	11.7.9	n ete Lister	1.5	$\frac{1000}{100}$	15.8	3	- 7. - 7.	f_{i}	٠, ا	1	900 B	. , ;	100	6.2%		1 🐷	₩,.	j. j. i	Harris .	NEVEN	, 0.5,	40.0	1374	150	. 55 .475c	f 0	100000		4 1 1 1	3 545
BØ 4 1 1 1 4 1 4 1	S4	200				7			14	3. 3		E_L	r i	кİ	11	T_i	4dl;	,	120	WH	Fig.	1.55	4	•	$I_{1,1,\pm 1}$	W4.			1.00	11.0	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	5,5		944. 24 944.	4 10 to 10 t		1814 STV	S4-A
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B1 "	S4	71	1	Sh			r thy h		$S \to S_{\rm tot}^{\rm tot}$	i di	1011	t in	. 33. j	L	1113 9		10	1	45.7	115	ħ	175	- //	sinfy	100	<u> </u>	gag d	r gán Asir jir			N.		Jul			(4.7)		S4-D
r a negyv s (Als), á	in Spark and the	19.50	.] ;	St.	12.5		40.0	1.4			ं 4	A	i^{-1}		165. A		H_{i}	11/	5 3	11.5	*	1994	25.4	.45 35 ¹⁷ 2	,	44) ·		33.55655.0					91.			1 1 1 1 1 1	The second	S4-B
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ing to be given			$\int_{\Omega} dx$	111	100		4.4		·i		100	r.ej	1/0 /			11	4.5 pt	at/s	///	P y	* 1		/	48.2	ا الانتها. الانتها	\$11.00 a	4.4	10 30 10		+-	,,,		11 m		, adigasi			\$4-E9
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			12.57		100		1.7.	21.2	4	Ç.		7	40.5			Υ.	1		2545	3 12	755	3.4%	$g_{c_{i}}$	16 1			1	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	2, 10		•			•			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	+
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t agent for the sec	/ / / / / / / / / / / / / / / / / / / /						•		, . /	english Santa		4.4	116 E	177	\dashv	h	10 fo	200		3 2 1 1 1 3 4 5 1	• •	t	7 1 11	8				190		15		14	ing state of the		1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	· ·	And Park	
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014004	126 8:- 5	1		\vdash	773		$\frac{dS_{ij}}{dt}$		12. PS.	14	191.0.2				3)		943 1943			11111	i sajer		1.3.45	7	4,.6	11 72	5000	ale parties	a 1		- Cen	5	and the second		1.19			* ##F##
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CHIFIL			1		14,10	4 4	11/	18.35	11.14	14, 4				160		M_{\parallel}		j. 1%	aggraf (31.5	77.5	17.67		Sec.				25 OF 5	H	1				and the state of t		 Egyptis de agriculture Egyptis de agriculture 		
CHIPOS	J33 Pin B		136	3 1 22	$b_i(R)$	$K_{i,j}^{*} = \{$	4/2	77,5	10/28	1	- 37	5.5 N	EA.	(X_{n+1})		Alli,	_	Ħ.		17.	y E		1 2	В			40.00 A	t despession d			1	<u> 13</u>		to be the fi	rition (iii)	i den al <u>aine.</u> Si profit est		er (n. 1919) 2. finijuar
489 n Satan		(1 /2)	140	13.5	$g_{\mu_{1},\sigma_{2}}$	4. 9			1.498	South	6.1800	Physical Property of the Party		i ig	415	112:37	# #	o A	3.37	7.5	1.5	3. 6	33/0° 3			34.	7	gurtheter Colons						i i granding Mi Kanggi Alim	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	e e e	3 32	
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		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY		EXPAND POSITION		READ/ MULTIPLEXER	SANAL	SELECTOR	VERTICAL	POSITION	SCAN ATTN	DECODER	SCAN D/A ATTN		DIGITAL SCAN		VERTICAL ATTN	′	LAMP DRIVER		TRIGGER PICKOFF		I'ME GASE	SAMPLING		TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
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n a tali nganja		11/4/1	1-1-1-1 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		$\overline{\cdot}$	9.48 to	·			"			- Jan 14						10.0			14.14 14.11				-	7 1 1 421 * 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	144			*4.3	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E Section	30 31 18 3	45		14. 15. 1 A
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0000			10		- AS	13.		- -	+				2 -		•			12	-				4		(907)	_				ДЪ,	0.13			Line	32	. Art. Co.	DS16
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negaritas sei	, lager period to	 \						7. C	1.50 P	+				+	12			100	1,1					4:1	(915)		in the		'N)	75.7		1, 54. T	: Walley			1 15 T 18	DS11
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n delpar spile	Control of the contro	1	1.0		-'8			, , ,	,		1	95 3			12/12		725		1.314.		1204	10.07	for a	7	-2,3,	•	0.00			19 mj	1		1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1			T whether	

		INTERFACE			LOCAL/ WE MO! E.		CALIBRATOR	NISPI AY	CONTROL	EXPAND	POSITION	READ/	MULTIPLEXER	CHANNEL	SELECTOR	VERTICAL	POSITION	SCAN ATTN	DECODER	SCAN D/A: ATTN		DIGITAL SCAN		- VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF		LIMETAR	1 1	9811	TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	DISPLAY	FRONT PANEL
		AO	2	A	03	A	04	A	0,5	AC)6	AC	-	,	80	Ą		, A	. ''	AI		Al	—	ΔI		Al		A16	A 2		A 2 A 2		A23	A27		1865./k		
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SIGNAL	SOURCE	J9 .	J10	Jij	J12	J13	3 J14	J15	J16	J17.	J18	J19	J20	J21	J22	J23	J24	J27	j28	J29	J30	J31	32	133	J34				135	J36	J35.	J36	**************************************	737	300			ne e
	1965 B. B. B. B.	27/2	10 mg	100	12.74				i der	ર્શ		A COM					90.37		11.00	1		14/12				(9.1	31		1.34	11.74	3 11 3		Logaria (* 17)	State of the Control	1 3,00		See a see	DS9
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van en kan vagaren e			1						X 12	15 ¹ .				-	7	1.4.4.3						The second		- Ai		(91	81			3.5				The State of		. p. 15 e. 45.	Notes (a)	D\$8
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Great Later 1995		4		Ti.	290	1			47.2	50.00	1				A ST	7.57	11.	34 B		$\mathcal{F}_{i_1} = 1$	2 Kg			116		11.5	βp^{-1}				16.0%		1.080.5	<u> </u>	1 48. 69.14Y		1 20 to 12 t	
OB1	J38 Pin 2	1 2	Н				1		11.0		104	. W			11,11	-M	•	in part	1. 10	100			5 B	V 25	3	15.5		17 / 5.	11.		47 1		graduation of	ng king si giliku. Waliota	2	Table Yale 1000	Tarana and	
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ODC	J38 Pin 7		N			+-	+						 	•					1977	•	100			1.00	J 8 45.	3-3	127	M 18 43		150	•	b poli	J. W. 18		··· 7 ·		14 E 14 D	
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OB7	J38 Pin 8	100	P		3 3 5	+	+	_	1.0	or to			3	4,77				11.5	•	1000		917		1, 1		74.7						1,24		6.	5/1 8		1 11	I start
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andar goderna.	13 km; 13, 2 km;	77.3	11.1			41.5	У,					1		1 1 X 1 X			,		·	in.	4.1		•	•					.11		7,13	1			10			* P
OB9	J38 Pin 10	10.0	S . •		1 200		ole :				1 1 mg/s				1.7			شنا			\$ 25		. /		3.25	3.00	-14		-	-	а			A 44	10	1 4 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		
• The second			1		1						1.00		3.55	1		100	<u> </u>		* .												4.5	7			. 11			1 (1 1 1 2 1
OB10	J38 Pin 11	. 4	<u> </u>	**				1_		1.1		4,500	- 3	ų `	. "	(S) +		<u> </u>			2.65	200									V)		7. 7.		100		Selva velk	1 (67)
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6 OB12	J38 Pin 13	1	V	-4,	-					16.44	100	- AS				-		1		255	5,000	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		\$.14.	1,37	100	72)	P. Calley		ωr.	点曲	9.0	grading to A	e Program	f(X) = g(X)	State of the	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
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epolitical state of the ex-	336 F III 14				1				4.5		3.37	. 7,			1.10		135		1.1	45 T		: (! "	11.77	4 1	4.3	$t_{+}s(\rho)$	3.5			1965				april ma	ti (A. A. A	y same side	+	er Teinnesi Lineau
OB14	J38 Pin 15 💸		X	1.5	4.5		1.		1 1 1		1.75%	186	al d		(132)	1.71		1000	: i i i :	1- j		3,44	∰w.	100	50.5	1 7		# 35.50		. 332	• <u></u>	, ESTA	· 中国。		15	4		
ra ig i Ajakera de	Anthorna Services	51,56	-500 14	$\gamma_i \setminus h$	10.07		$\Sigma = i \cdot i$. <u>S</u> K.	41/2	12.76	3.40	3.11	$\partial_{x}^{\frac{1}{2}}(h)_{x}^{-1}$	i ali	**	(* ; ^V		7.	Pala.	< (h)		2.64	24	, 6 r j	3.77	1.3	11/15/24/3	9,7%	100		17	10 1 1 1 1 1 1 1 1			S 33 (200.3)		a la sestión de la compansión de la comp
OB15	J38 Pin 16	120	Y	(4)	- 1					ti	7.55	48° 5	15 1		3,577		1	$a_i^* A_i^*$	· ·	77.Mg	· -	andjo _a r			3.15	3 133	4.53	A SAMAR S	1_	41.5	13.5tr	<u> </u>	1.54 G.Y.	4.4	16	The Control of the Co	3 MAN (4)	
artis programme to the gran	April of the said	\mathcal{H}_{i}	34.	1	3/27	15.1	1 1 1	1.7	i e wije	15 10 3	: 45%	1	ز چاوند	g. ()		1,750	4.46	2.5	1.4	22.50	9 Sy	, it.	14%		10			fan 2 iv				1 179			a laga sang Kabupatèn	e Sparket		
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ร์ คั้งสู่ที่ มีของที่ได้จริง ย	grandet 1945		1 34	100	,	-	S. S. S.			1353			1,50	1.75	11.1	1				2 - 12 N	<u> </u>	10 g 1 d 1 d 1 d 1 d 1 d 1 d 1 d 1 d 1 d 1	10 (A) 15	!		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	46°4, 5° 27.14.7	1971			i i i i i jaran. Tarah mer	7.0	17 2 2 2	o Company		• • • • • • • • • • • • • • • • • • • •	. 71 . 31	
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		INTERFACE		LOCAL/REMOTE		CALIBRATOR		DISPLAY	CONTROL	EXPAND	201100	READ/	MULTIPLEXER	CHANNEL SELECTOR		VERTICAL		SCAN ATTN	ресорен	SCAN DA ATTN		DIGITAL SCAN		VERTICAL ATTN		LAMP DRIVER		TRIGGER PICKOFF		IIME BASE	SAMPI ING	0.7	TRIGGER	A/D CONVERTER	CONTROLLER	CHANNEL EXTENDER	OISPLAY	FRONT PANEL
		AO	2	AO	3	A O	4	ΑÒ	5	AO	6	ΑO	7	A'0	8	A0	9 .	Αl	1	A 1		ΑĴ		Al	<u> </u>	Al		A16	A2		A 2		A23	A27	lv ,			1
SCHEMAT	TIC NO.	N A	A .	- t,	2	3,4,	5	6,7	, 8			10,11		ંગ[16		18			22 2			26,	_	28,2	29	30		,32	34,		6 35 %	NA	J38	J39	J41	
SIGNAL	SOURCE			J11 J	112	J13 J	14 J	115 J	116, J	17 .	J18 .	J19	J20 .	J21 .	J22	J23	24	J27	J28	J29 .	130 1	31 .	132	133	134			::X/., -	J35	136	J35	J36		J3/	138	133	May the great	
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to and John o	COMPANIES CONTRACTOR	11.7	20	90.5	15/34		12.1	\$154	40.0	174	, vi			<u>```</u>		4		$\{e_{\lambda}\}$			٠		•	 _						, (a)	22.52	2 , i.i.		100	33.0		1,000	R6-2
POS2FP	R6-2	ai.			200			130		:57	<i>)</i>		14.4		्ा	17.5	11/4/11					"		3	\dashv		, (1) (1)	na filosofi Attendidas		11					100 100 100	10. B. F.	1. 10	
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		ΑĊ	2	AC		ÀC	4	Á(05	A	06	4.4	0.7	Α	08	Α	09	A	11	À	12	AI	3.	AI	4	A 1 5	5	A 1 6	A.2	ì	AZ	2 4	A23	A27	100 m			
SCHEMAT	IC NO.	N	<u> </u>	1	2	3,4	.5	6,	7, 8	45.4	3 (4)	10,	1,12	3.51	15	16	5,17	1.8	, 19	2	,22	23,2	4,25	.26	27.	28,29	9	30		,32	34	36	35 👌	/ NA		A SHEET	र्वेद्यार्थीय संस्थ	
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MTRIG 🚋	J13 Pin 13	1,274			11.	13				V	2.55	-	1, 1, 10			97.11		15.50	3.73	27	1			g y Gr	(335)	·	1 e	1. M. 1536				-	ี ป3	Φ_{i}	1 200 B	1440,454	VP 700 100	.: [37.]

			INTERFACE		LOCAL/REMOTE	1	CALIBRATOR	DISPLAY	CONTROL	EXPAND	POSITION	READ/	300111108	CHANNEL. SELECTOR		VERTICAL		SCAN ATTN	DECODER	SCAN D.A ATTN:	\$		DIGITAL SCAN	WEBTICAL ATTN	֭֚֭֡֞֝֞֟֝֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֡֡֓֓֓֓֓֓֡֓֓֡֡֡֡֓֓֡֓֡֡֡֡	L AMP ORIVER		TRIGGER PICKOFF		TIME BASE			TRIGGER	A/O . CONVERTER	CONTROLLER	CHANNEL Extender	DISPLAY	FRONT PANEL
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SCHEMAT	IC NO	<u> </u>	A		,2		4,5	↓—	7, 8		9.	10,11,	12	15		16,	17	18	.19	21	,22	23,2	4,25	26	27	28,	_	30	31	,32			35	N'A		elikari eli		Agailte gr
SIGNAL	SOURCE		J10		J12					J17				J21	-			J27		J29	_		_			erigh.	100	Market Park	J35	J36	J35	J36	A Park State	J37	J38	J39	J41	W W
TRIG	FP-S6	14.0	. 50	13,545		, s. j.	., .	17.5			(/ (BW	375.7	3,15				15	14.7	1.50	7,1371	Section.	95.5				1.00	2,6	100		*			J1 💢	18.44				S6
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M. Mari Amazira	egyttergjergyer			121	1 2		3.0	₫ id.	, ; -	t of	4		2 / 7 2	(A)		-7	1797	'' y	$\mathcal{A}_{\mathcal{A}}^{(1)}$	7.3	A 50	1	7.5%	v_{12K}	2.313	24.4	5.5	State of the state	12	150	8 98	. .	$f(x, \mathcal{F}_{k}(x, \mathcal{F}_{k}))$		33. 18. Sec	100	200	
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out the steading this	पुर्व स्थलित । ३ व्य			$(s_i)^{1/2}$	1			4.5		1,3	101	18	A. 1			•		97			1 31	er er reg	4						$\{\gamma_i\} \in \mathbb{C}$		15 m		al Severa	Coppe.	100 pp 100			70000
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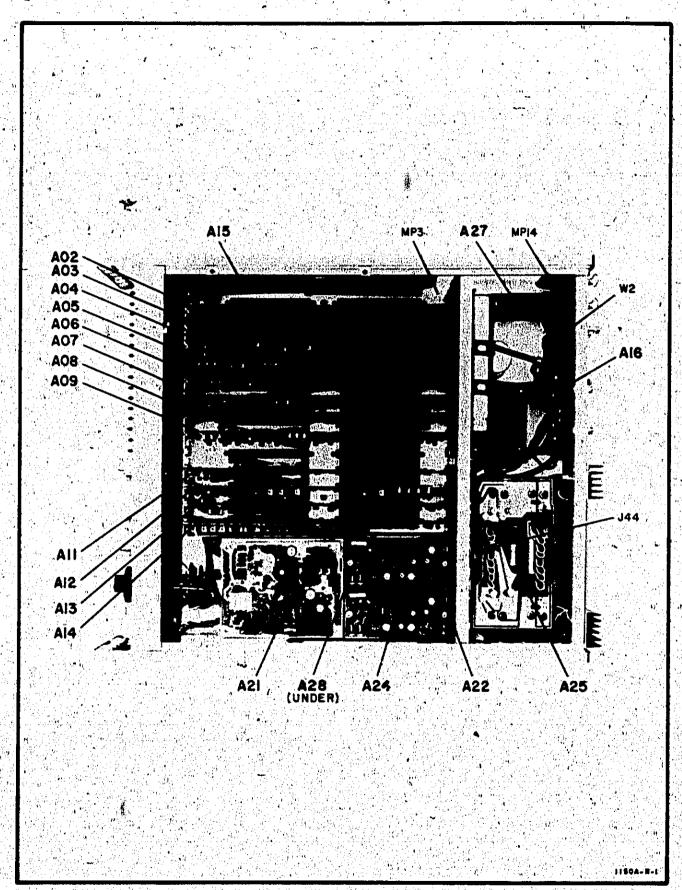


Figure 8-3. Parts Identification, Top View

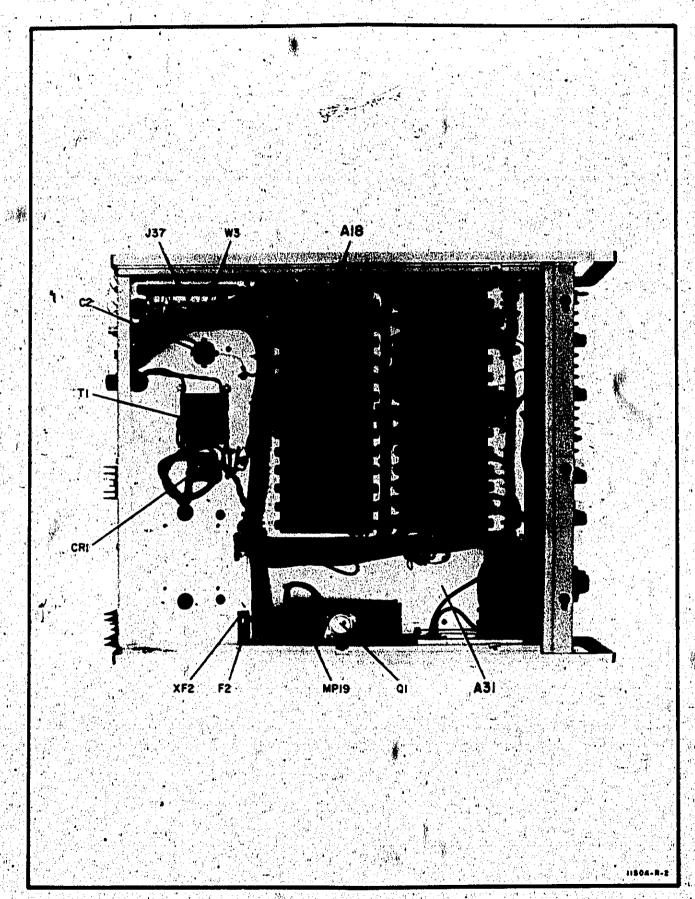


Figure 8-4. Parts Identification, Bottom View

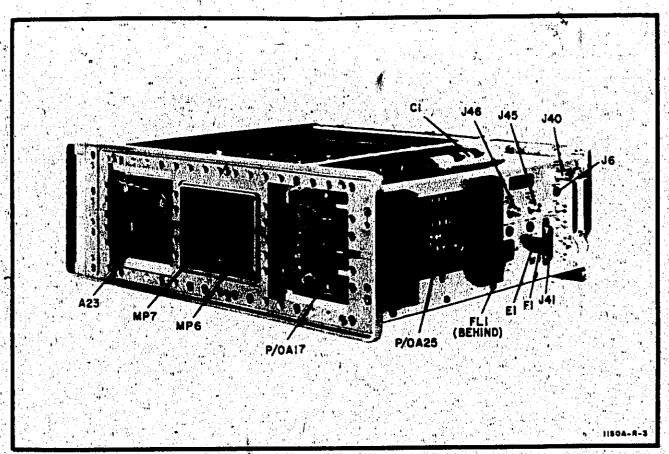


Figure 8-5. Parts Identification, Right Side

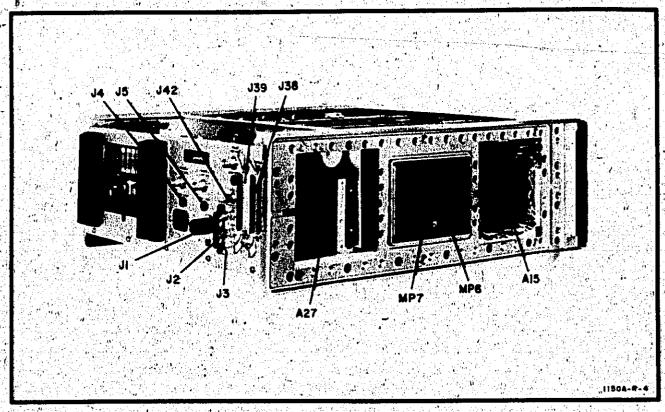


Figure 8-6, Parts Identification, Left Side

Service Model 1150A

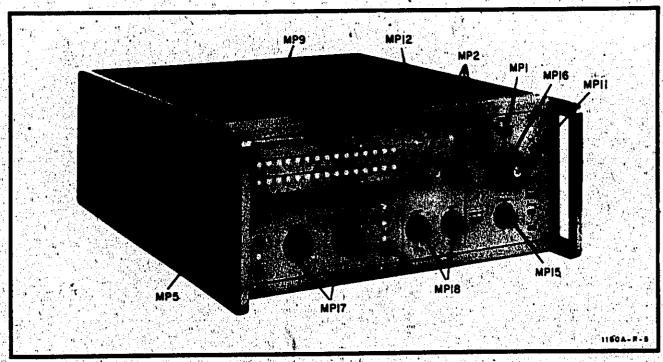


Figure 8-7. Parts Identification, Front Panel (Front)

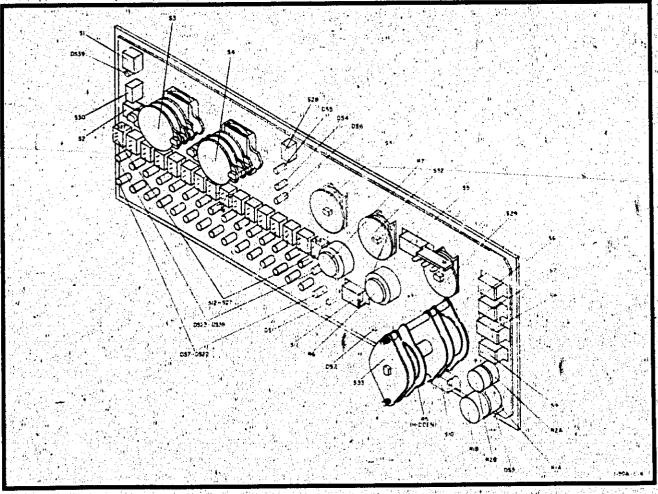
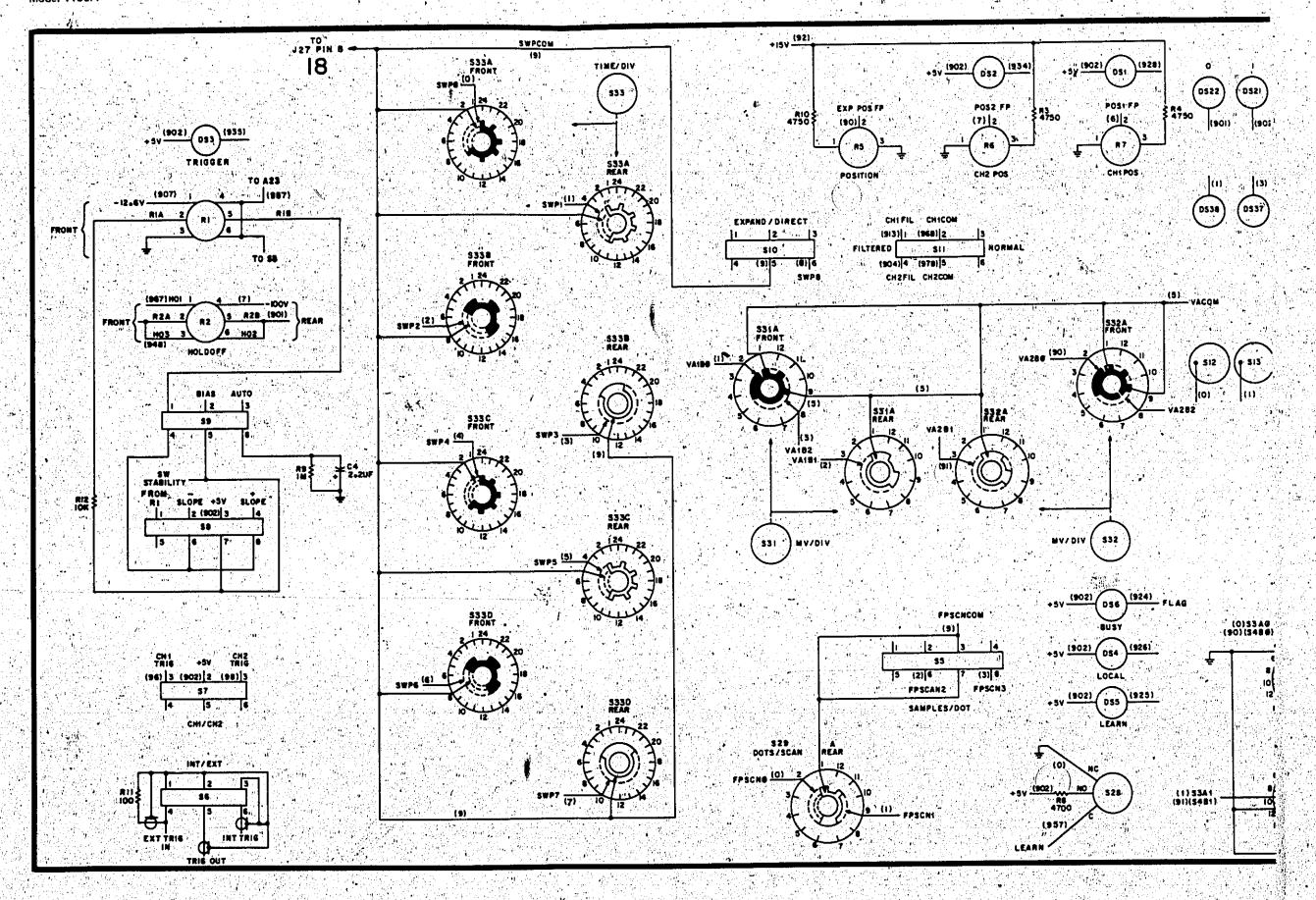
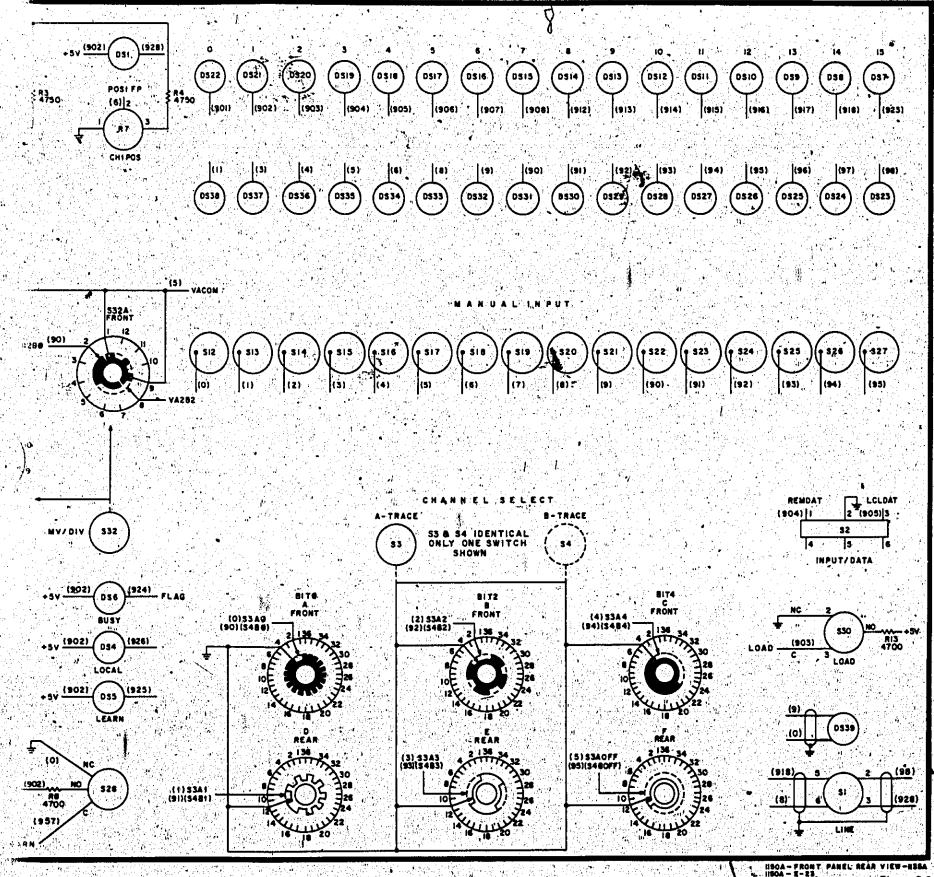


Figure 8-8. Parts Identification, Front Panel (Rear)





HISOA - FRONT PANEL REAR VIEW-NISA
Figure 8-9.
Front Panel Wiring Diagram

8.25

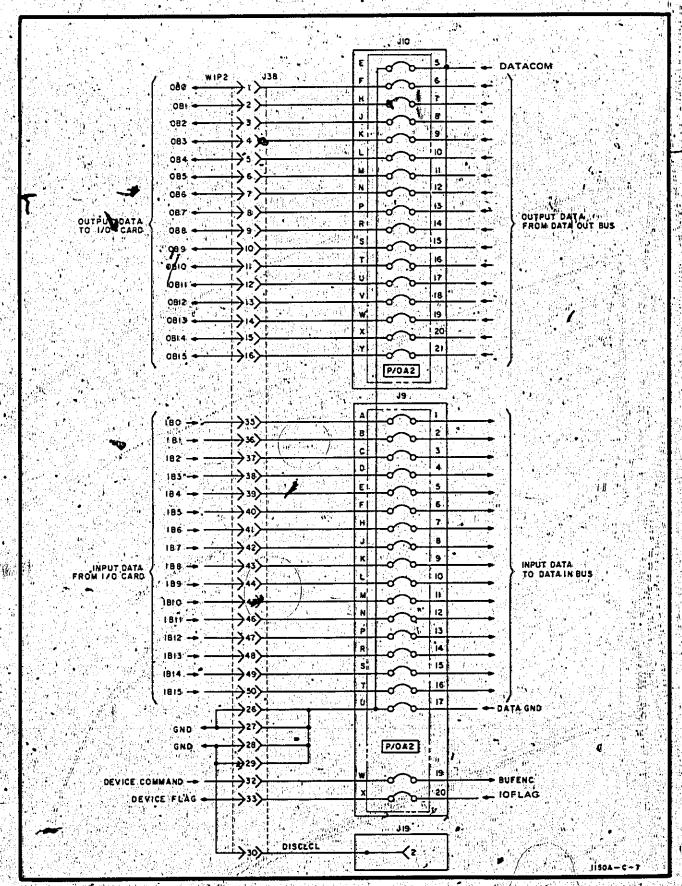


Figure 8-10. Interface Assembly A02, Connector Wiring

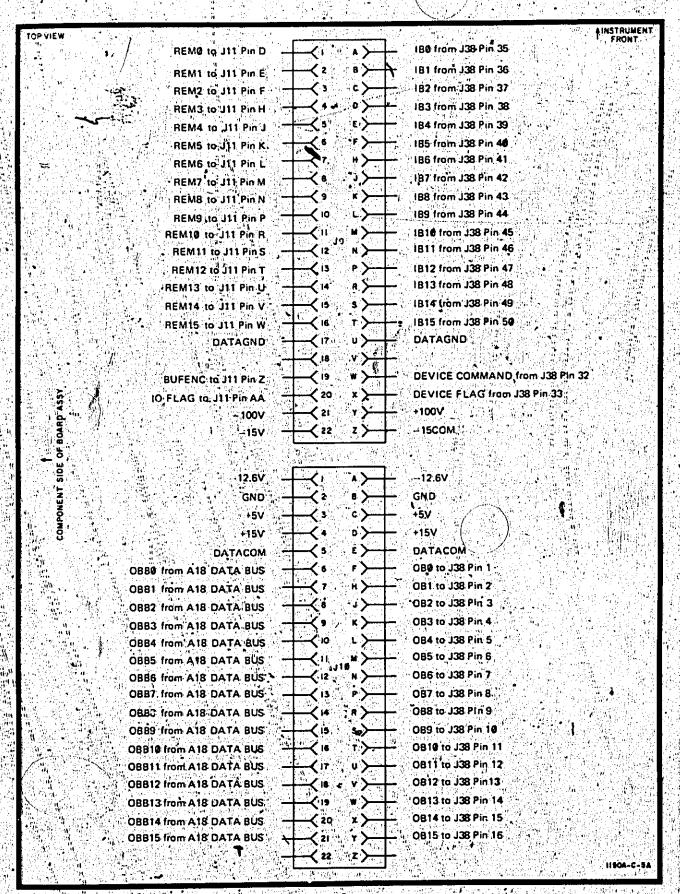


Figure 8-11, Connectors J9 and J10, Signal Identification

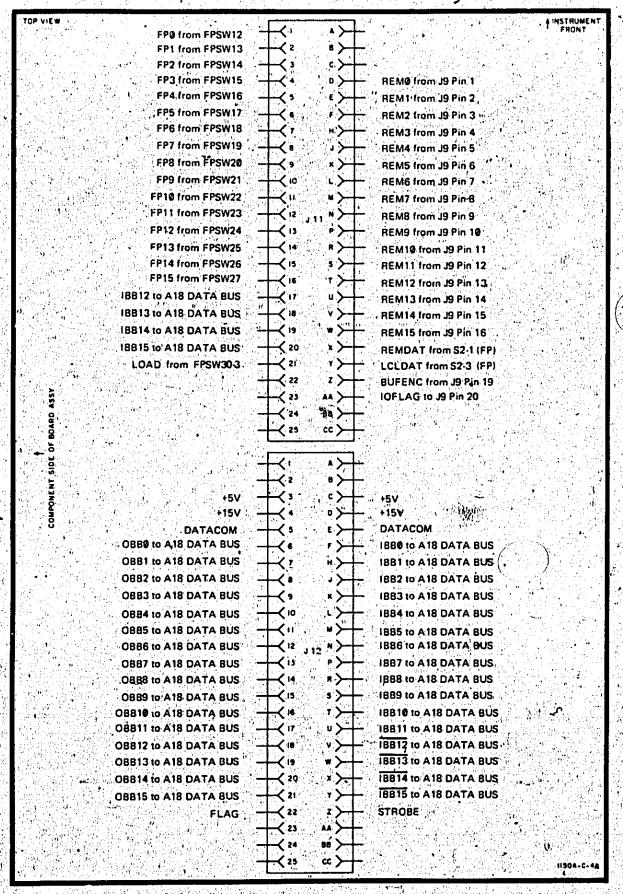


Figure 8-12. Connectors J11 and J12, Signal Identification

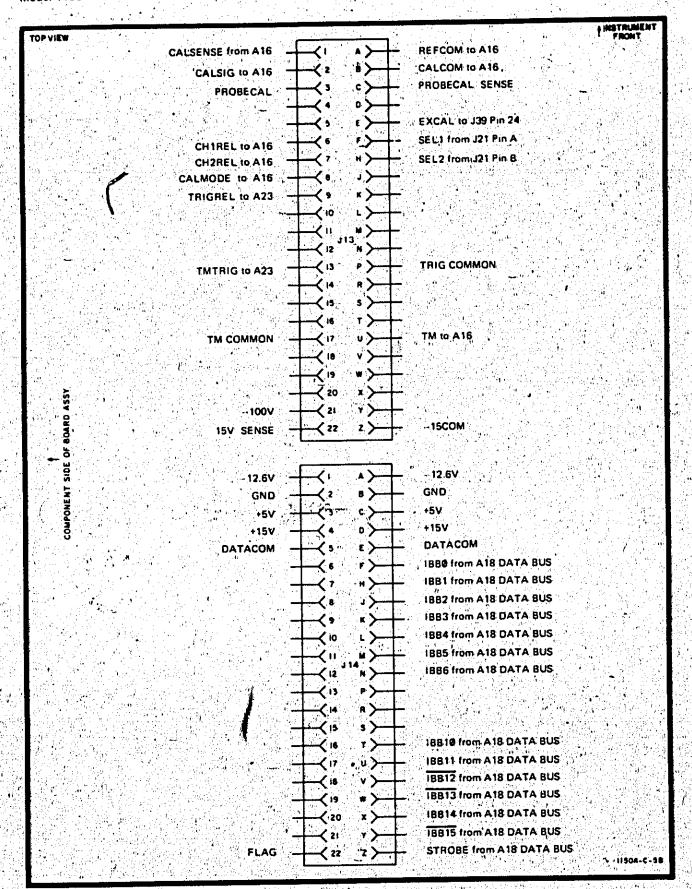


Figure 8-13. Connectors J13 and J14, Signal Identification

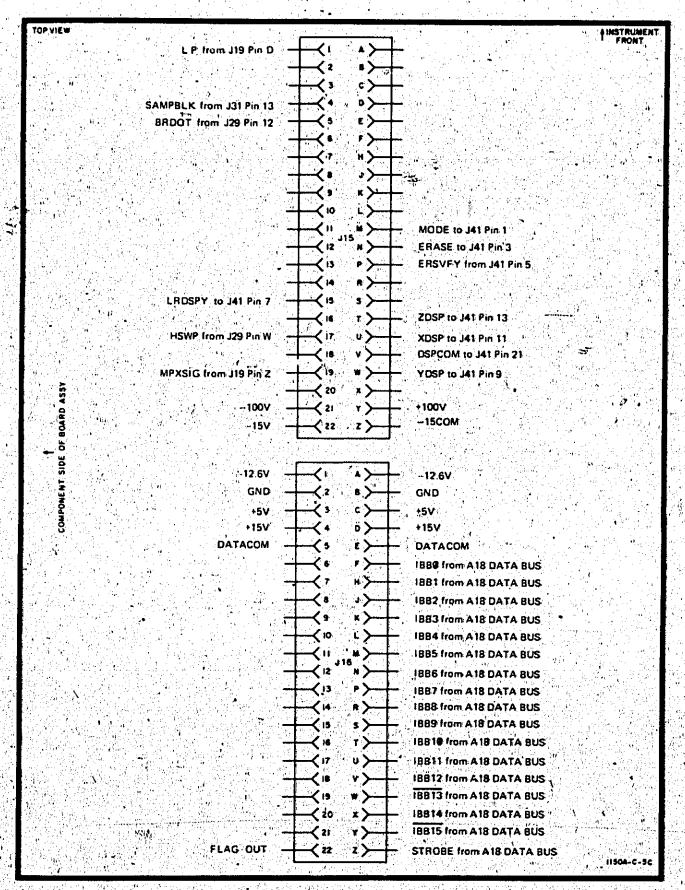


Figure 8-14. Connectors J15 and J16, Signal Identification

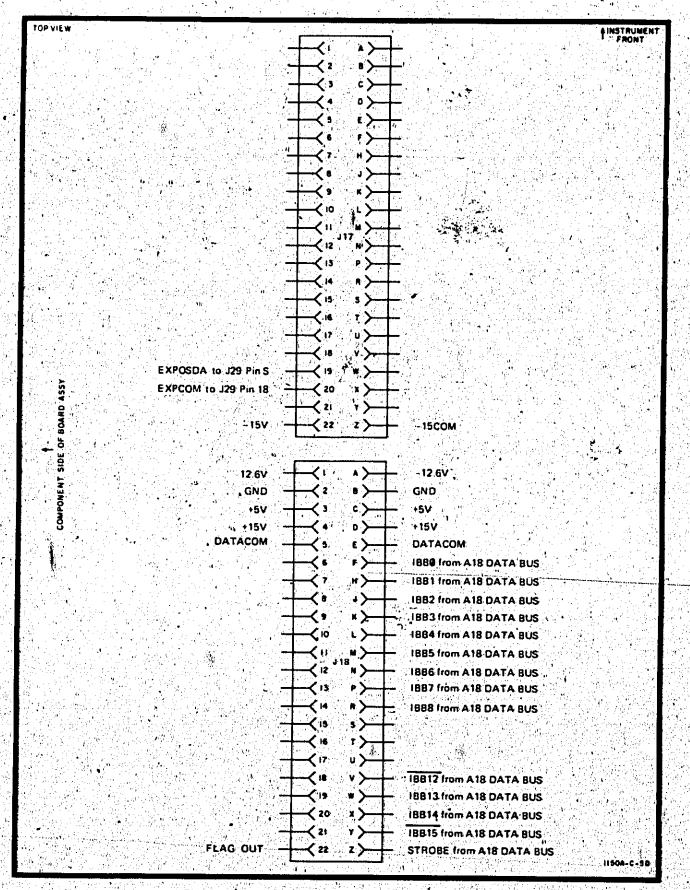


Figure 8-15, Connectors J17 and J18, Signat Identification

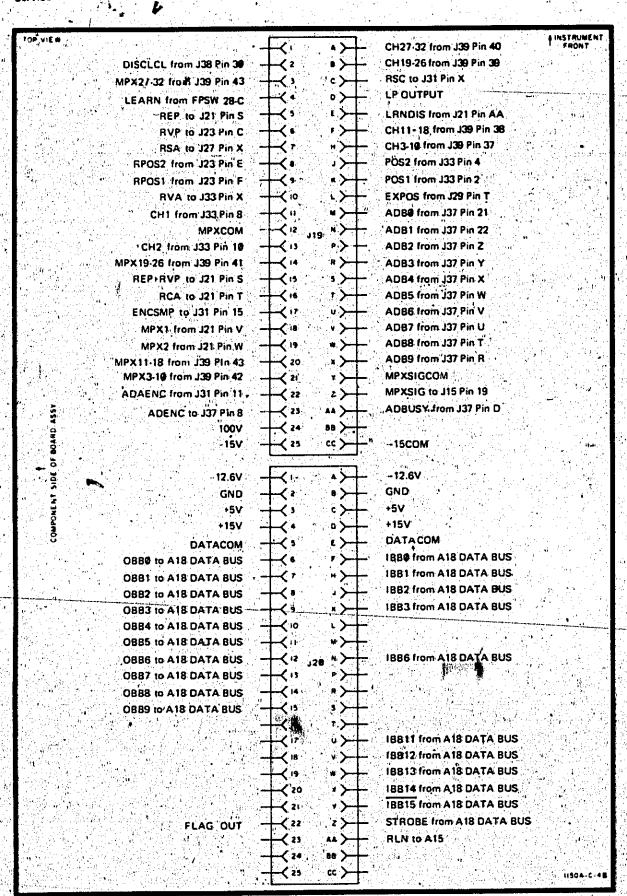


Figure 8-16. Connectors J19 and J20, Signal Identification

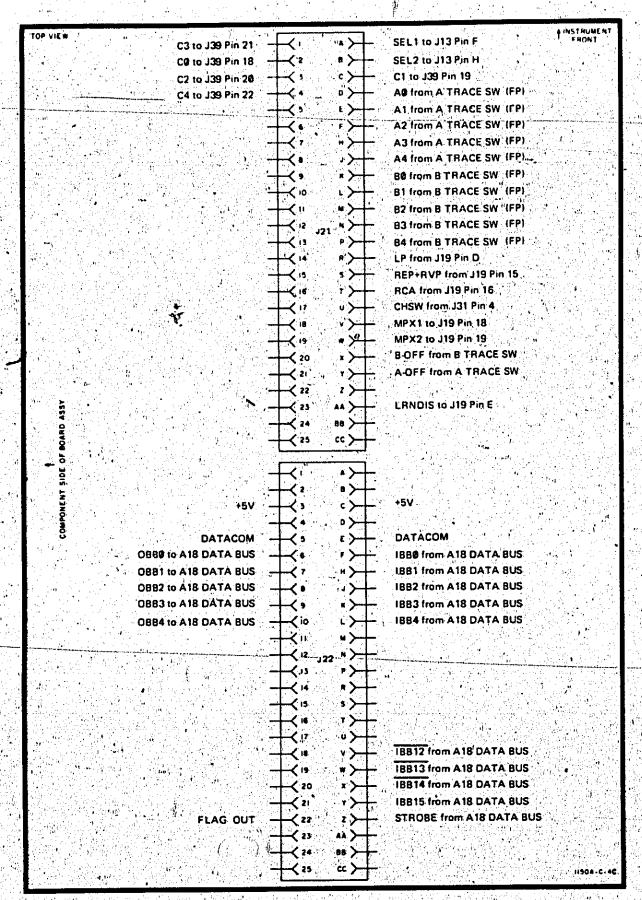


Figure 8-17. Connectors J21 and J22, Signal Identification

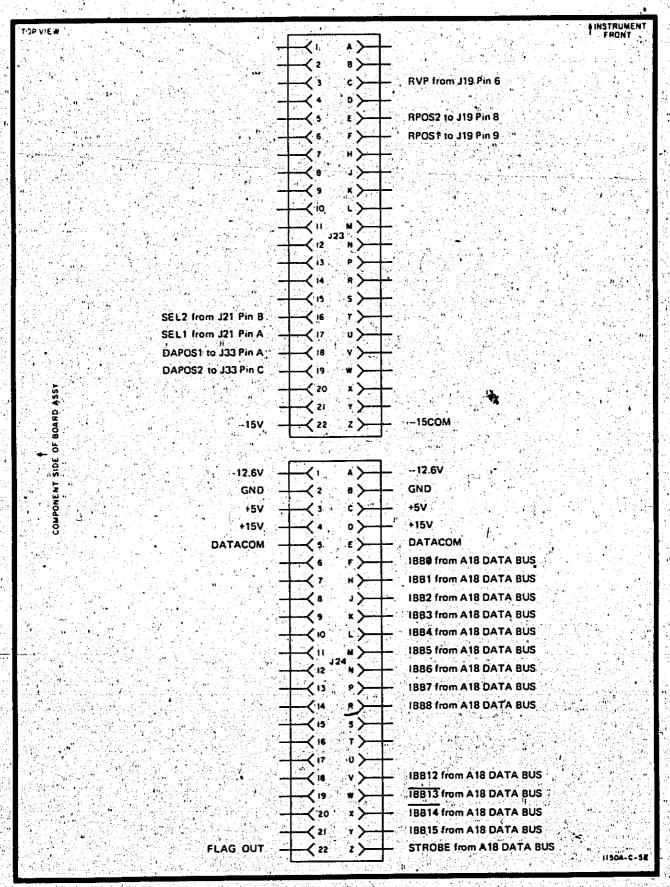


Figure 8-18, Connectors J23 and J24, Signal Identification

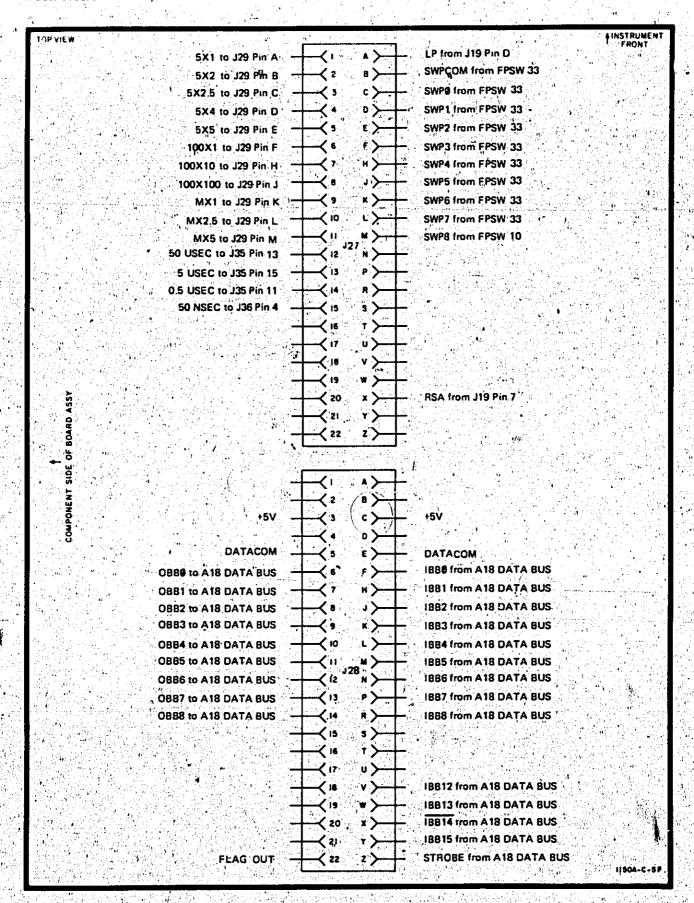


Figure 8-19. Connectors J27 and J28, Signal Identification

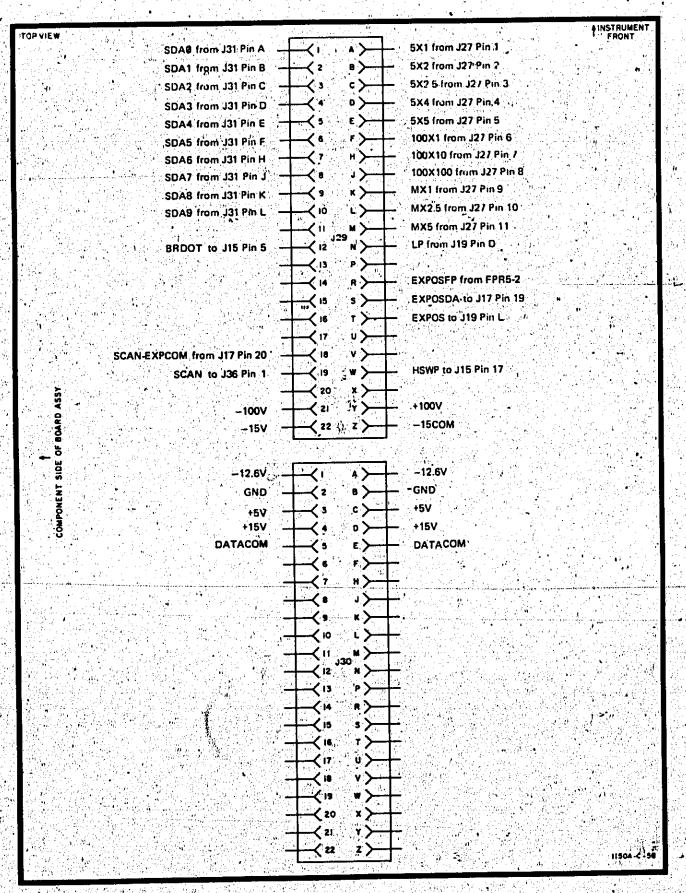


Figure 8-20. Connectors J29 and J30, Signal Identification

4

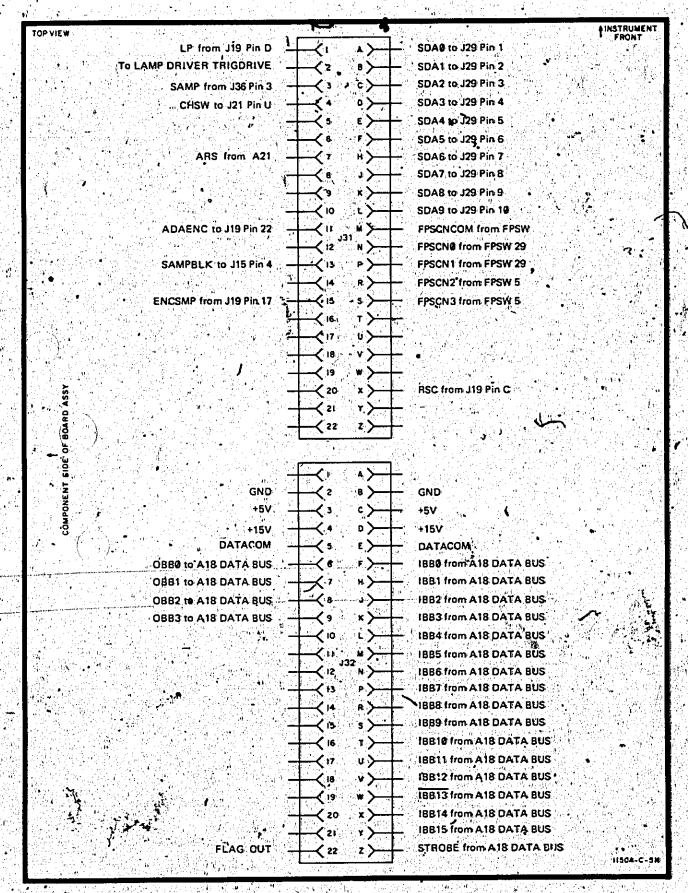


Figure 8-21. Connectors J31 and J32, Signal Identification

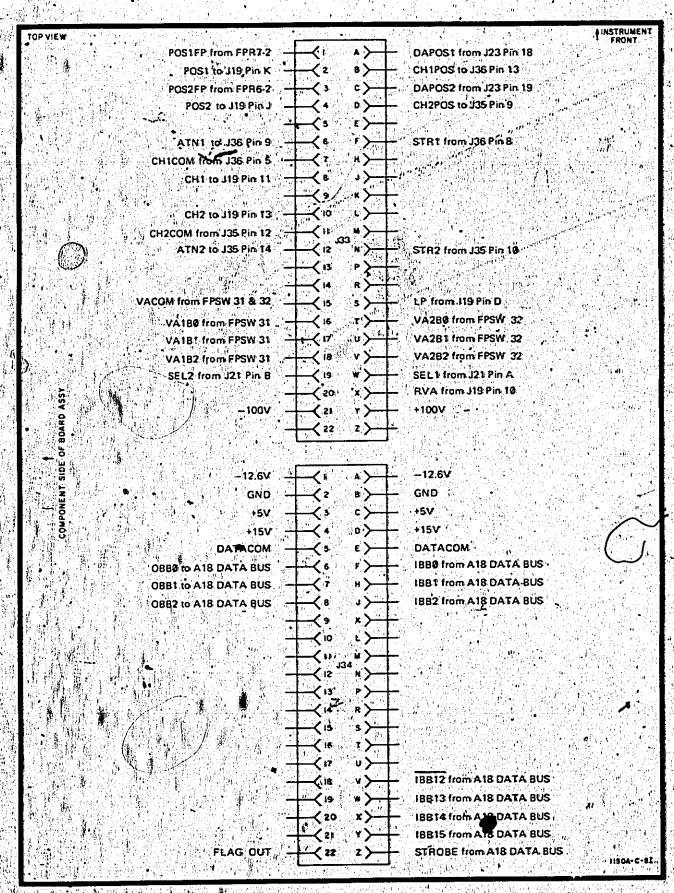


Figure 8-22. Connectors J33 and J34, Signal Identification

Model 1150A

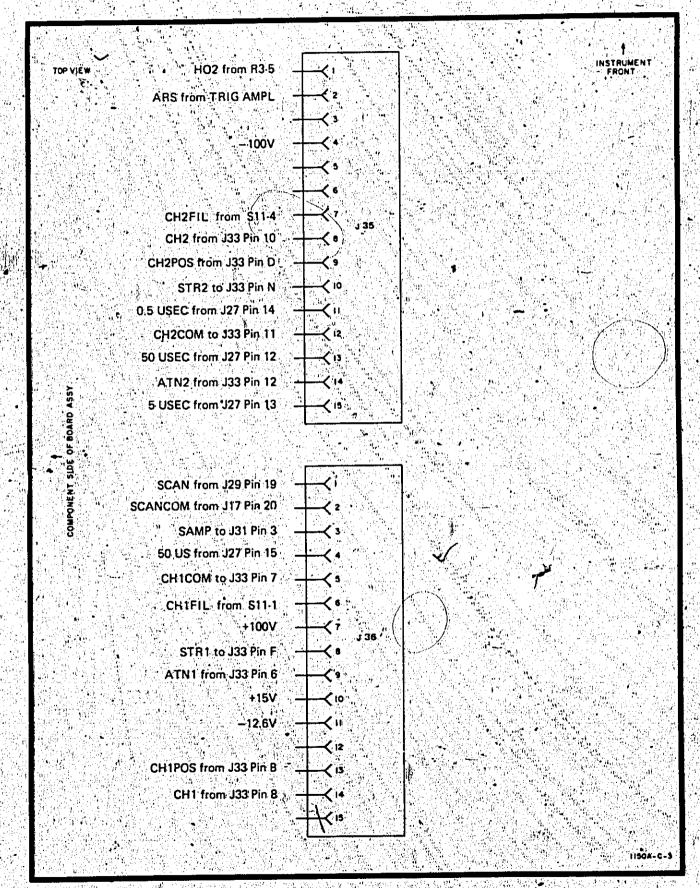


Figure 8-23. Connectors J35 and J36, Signal Identification

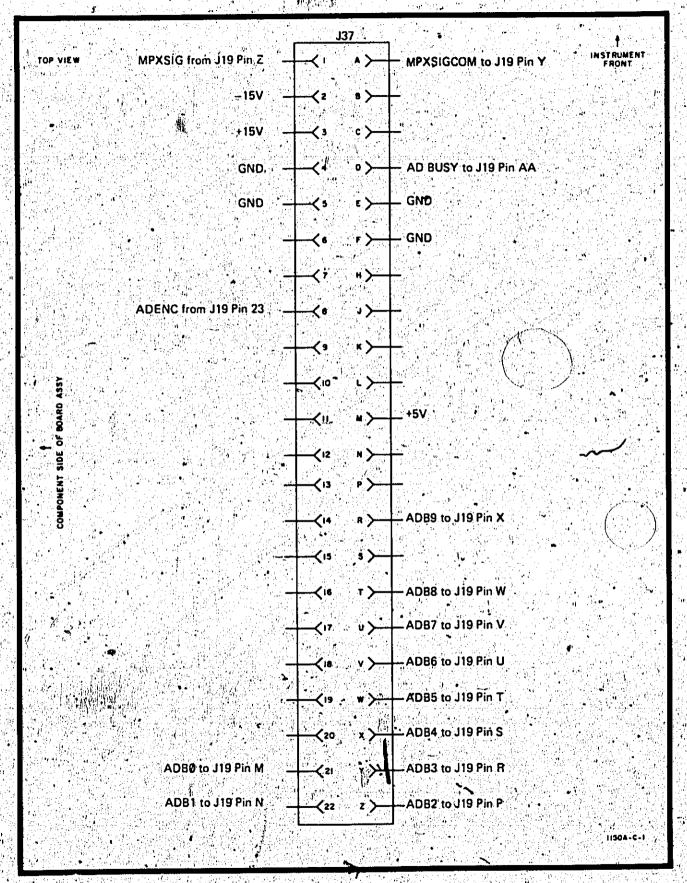


Figure 8-24. Connector J37, Signal Identification

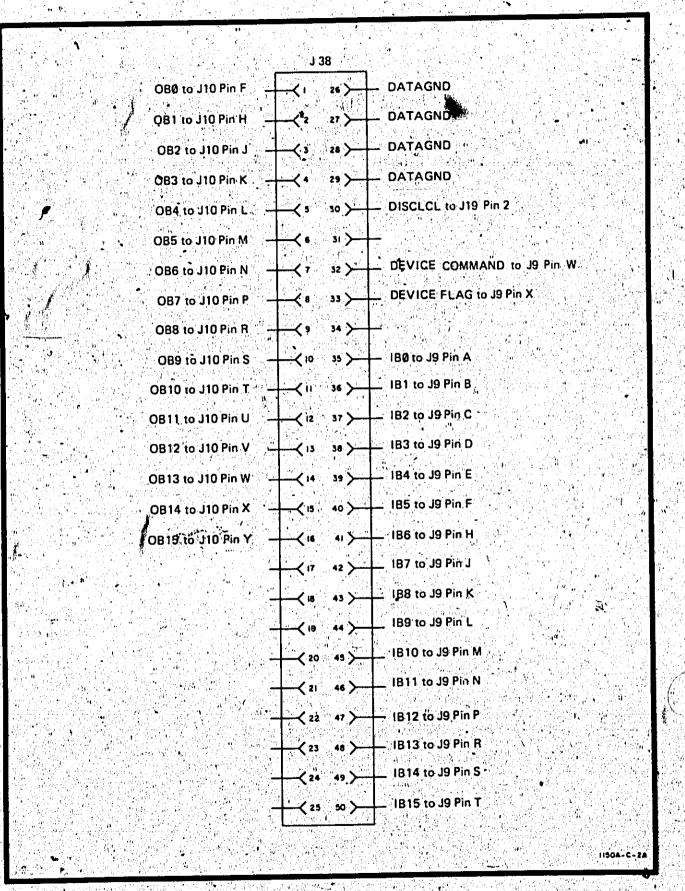


Figure 8-25 Connector J38, Signat Identification

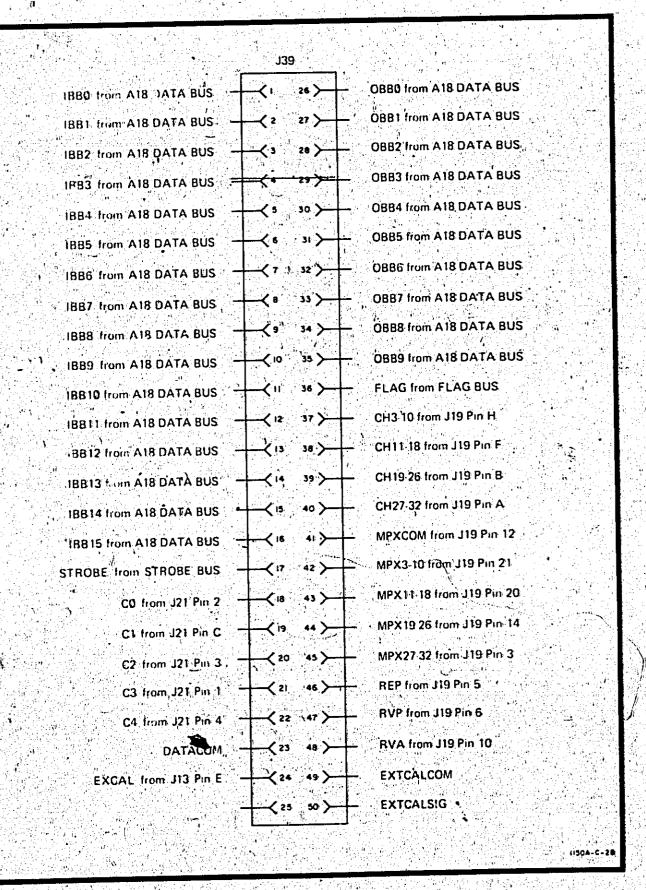
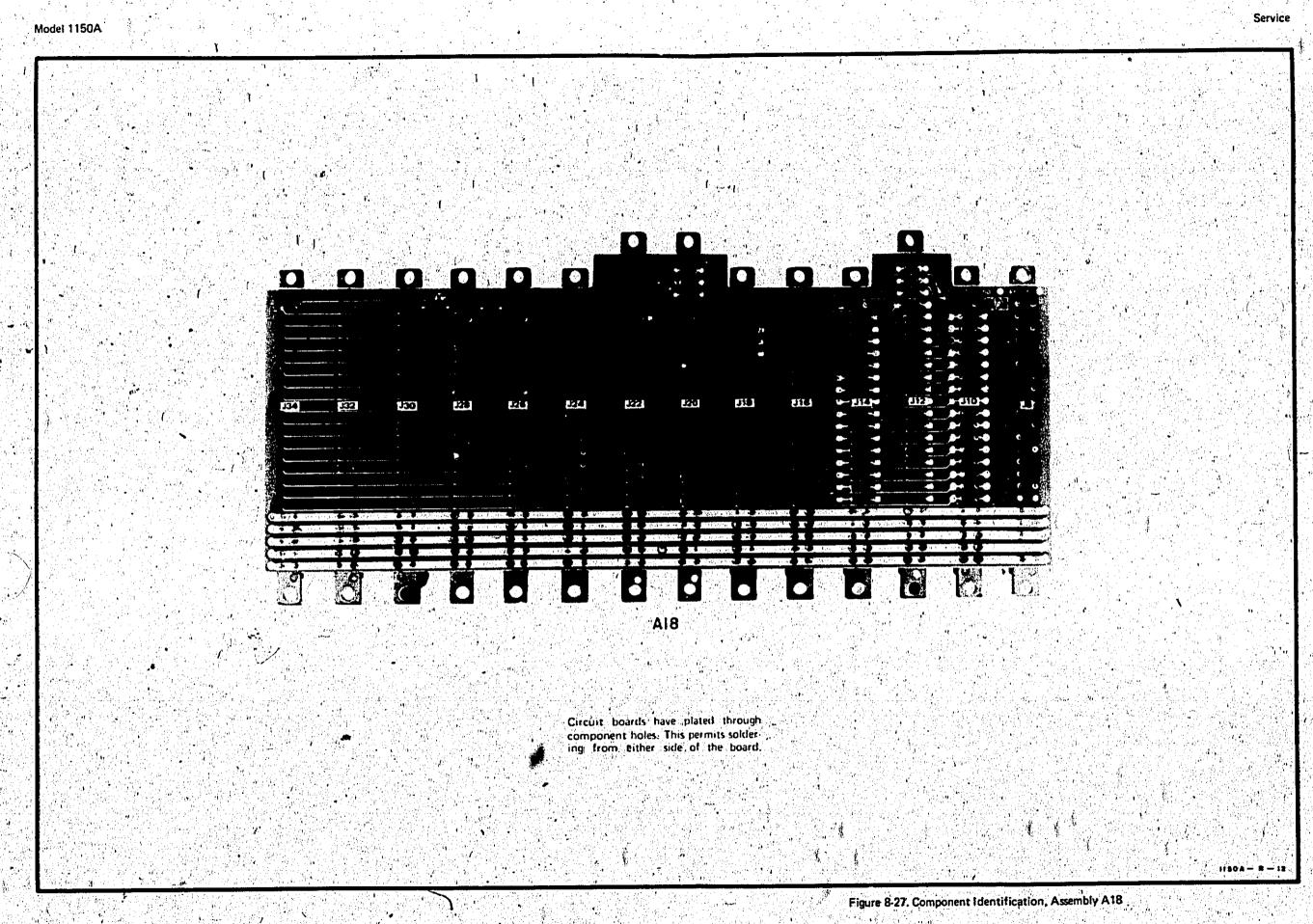


Figure 8-26. Connector J39, Signal Identification



	A	В	·c	D.	E		Ġ	R)	K	1	M	
2		V.		earns (ODD THE	5		070	E Ray	CID.	1			2
3							सुद्ध <u>पा</u> ड			EIII				3
4					(ED)									
5				JII ABCDE	FHUKLMNPRS	TUVWXYZAAC		ABCDEFHJ	RLMNPRSTUV	WXY ZAA CC BB				5
6						component	ards have plated tholes. This permeither side of t	nits solder "						6
					and some and the	REF GRID REF	M. The Man	100 F 10 To 10	RID REF GAID OC DESIG LOC F-3 U1D E-2					
					C1 H4 C2 I2 L1 H4 Q1 I2 R1 F4 R2 F3 R3 I3 R4 I3 R6 I4 R7 I3	R8	14 R30 14 R31 14 R32 14 R33 14 R35 14 R35 14 R36 14 R36 14 R38 14 R39 14 R39	G-3 U4 G-3 U5 G-4 U6 G-4 U7	F3 U10 E-2 E4 U12 D-2 E4 U13 J-3 D-4 U14 I-3 D-4 U15 H-3 F3 U16 G-3 E3 U17 F-3 D-3 U18 J-2 D-3 U19 H-2 F-2 U20 H-2 U21 H-3					
					A7 1-3	R18 H-4 R29	1.4 R40	F-3 U9	0-3 U18 J-2 0-3 U19 H-2 -2 U20 H-2 U21 H-3				HEOA	

Figure 8-28. Component Identification, Assembly A03

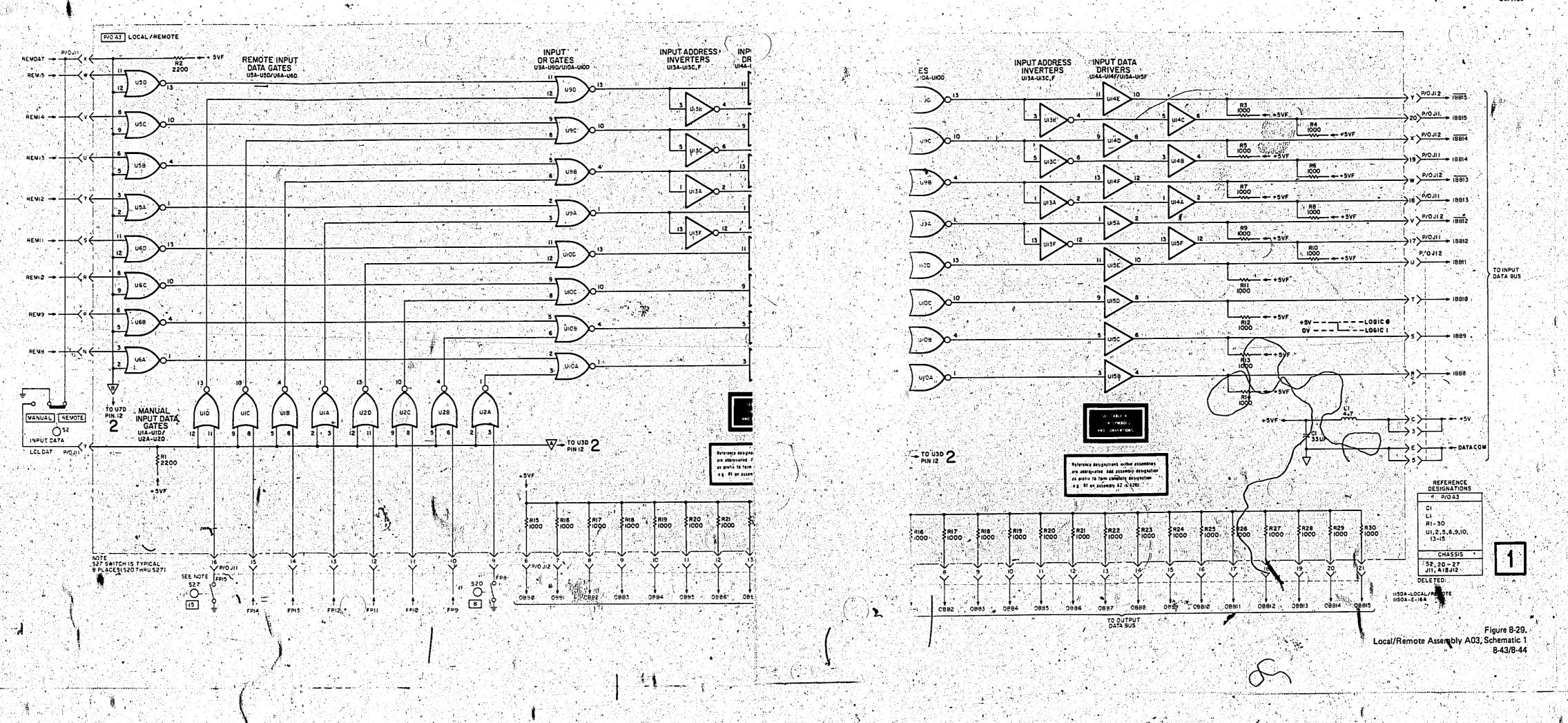
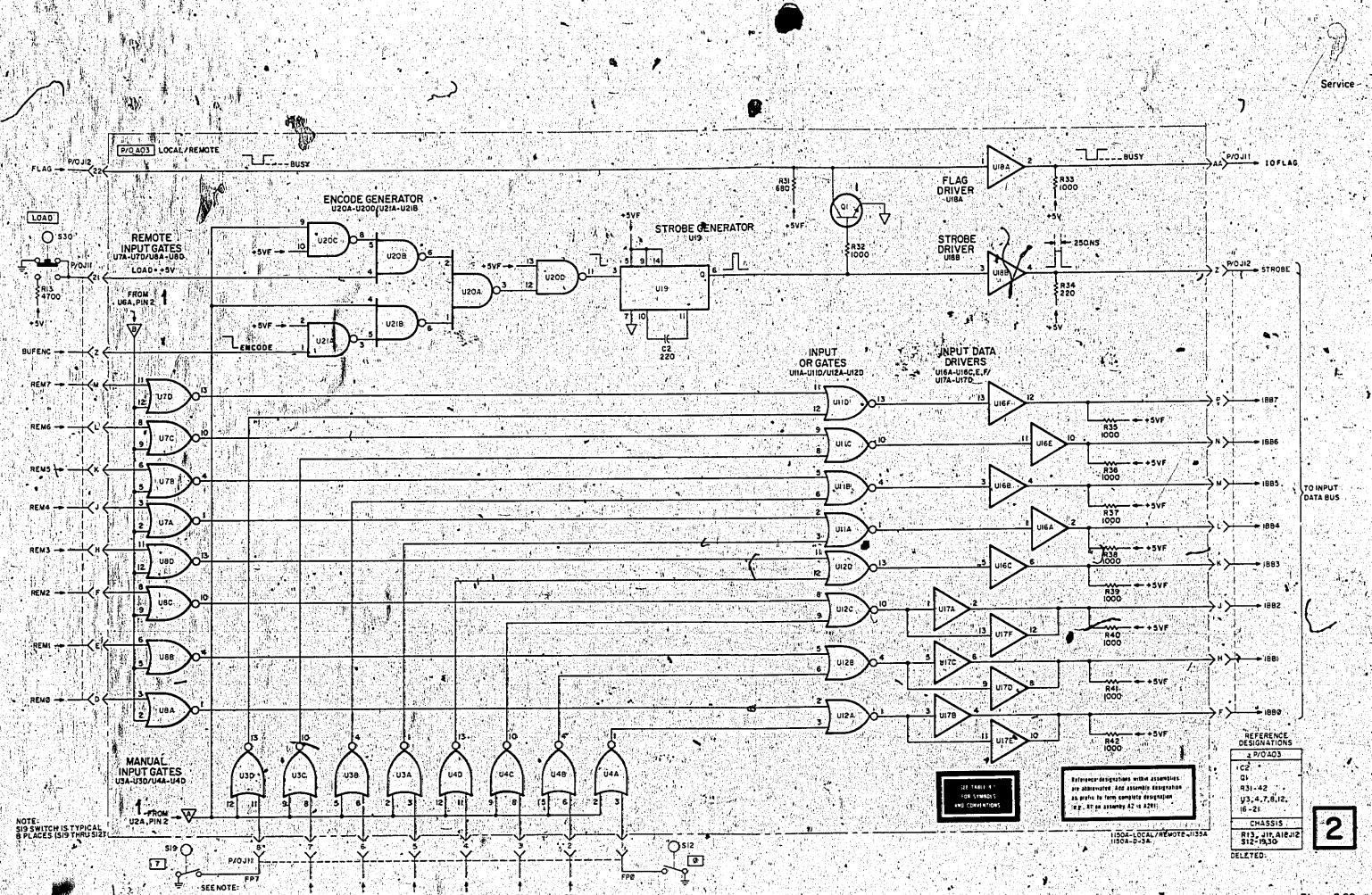


Figure 8-22. Connectors J33 and J34, Signal Identification.



Local/Remote Assembly A03, Schematic 2

J-45

	A	В	C	D	E	F	G		A Company of the Comp		K	M	
				R35 07 88 82	R41 E E C	y = COM AT R79 R80 R86 R66 R66	- 11 - D/A 3 RBI	R12 R59 R58 R16 R20	022 015 021 021 017	R10 2 C-R11 211 R14 2 T-R9 R19 2 C-R15 2 R18 2 C-R13 7 R23	y -		
2			R42.	08 U.S. R44 N R43 R45	(G) R73 (U) (G) (R52 (G) R53 (G)	GE PROPERTY OF THE PROPERTY OF		R60 R61 R28 R62 R62 R62 R62 R63					2
3			# CR1 R7 R6 R5	22 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	S GUAS			9830			LEI LEI LEI LEI LEI LEI LEI LEI LEI LEI		3
4				1888 16182 18182 18183 1818 18183 18183 18183 18183 18183 18183 18183 18183 18183 18183 18	100 100 00 00 00 00 00 00 00 00 00 00 00	See See	E GBE	TIG	US S	UH I	. E3 .		4
45				J13 1 234 ABC D	gelile and inite	RSTUVWXY	AO4	A B C D E F	ASCHELL HIKLM NPR	d Alescozzz STUVWXYZ	114		5
6.						Circuit b componer ing from	oards have plate nt holes. This per either side of	ed through mits solder- the board					6
			C1 C2 C3 C4 C5 C6 C7 C8 C9 A C10 C11 C12 C13 C14	RID REF GRI OC DESIG LOX J4 C20 E-4 K-3 C21 E-5 G-5 C23 D-4 H-3 C25 D-6 G-1 C27 D-6 G-1 CR1 C-7 E-2 L1 H-7 E-3 L3 G-7 E-4 L5 F-4 E-4 L5 F-4 E-5 L7 D-7 E-4 C1 C-7 E-4 C1 C1 C-7 E-4 C1	Q2 E-2 Q3 E-2 Q4 E-2 Q5 E-2 Q6 E-2 Q7 D-2 Q8 D-2 Q9 D-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q11 I-2 Q13 I-2 Q14 I-1 Q15 I-1	REF GRID R 0ESIG LOC DE 021 I-J R10 022 I-J R1 023 I-J R1 024 I-J R1 025 E-J R1 026 F-J R1 027 F-2 R1 029 E-4 R1 029 E-4 R1 R1 J-4 R2 R2 D-3 R2 R3 D-2 R2 R4 D-3 R2 R5 C-3 R2 R6 C-3 R2 R7 C-3 R2 R8 G-3 R2 R8 G-3 R2 R8 G-3 R2	EF GRID REF SIG LOC DESIG J-1 R29 J-1 R30 R-1 R31 3 J-1 R32 J-1 R35 J-1 R35 J-1 R35 J-1 R35 J-1 R37 J-1 R38 J-1 R42 R44 J-2 R44 J-2 R44 J-2 R45 J-2 R46 J-2 R46 J-2 R46 J-2 R46 J-2 R46 J-2 R46 J-2 R46 J-2 R46	J-2 R48 J-2 R49 J-2 R50 H-2 R51 D-2 R52 D-2 R53 D-1 R54 C-2 R55 G-2 R55 G-1 R57 C-2 R58 D-1 R59	GRID REF GRI LOC DESIG LO D.2 R67 G- G-2 R68 G- G-2 R69 F- E-2 R70 F- E-2 R71 G- J-2 R73 E- I-2 R74 F- I-2 R75 E- H-1 R75 E- H-1 R77 E- H-1 R78 F- H-2 R80 F- H-2 R80 F- H-2 R81 F- H-2 R82 D- E-1 R85 D- E-1 R85 D-	D REF GRID C DESIG LOC 2 R86 E-4 1 R87 E-4 1 R88 F-4 1 R90 E-4 2 R91 D-3 1 R92 D-4 1 R93 D-3 1 R94 G-4 1 R96 K-3 2 TP-15V E-1 1 TPAT F-1 1 TPC/A G-1 4 U1 K-4 4 U2 I-3 4 U3 K-4 4 U4 J-3	REF GRID DESIG LOC U5 K-3 U6 I-4 U7 I-3 U8 J-3 U9 I-4 U10 G-3 U11 J-4 U12 E-3 U13 K-3 U14 G-2 U15 E-2 U16 G-4 U17 E-4 U19 I-4 U19 I-4 U19 I-4 U19 I-4 U19 I-4 U19 I-4 V1 E-4		

Figure 8-31. Component Identification, Assembly A04

- The Calibrator Assembly can be programmed to supply a stable time mark signal or accurate do 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. Calibrater binary coding is as follows:

Note

Logic O level ≈ +5V-

Logic 1 level ≈ OV (at J38 and data buses)

					В	T LO	CATI	ON ar	nd LOC	SIC L	EVEL					
FUNCTION	15	14	13.	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address Normal Operation	0	1	0	ro	0	0					Acres					
Probe Calibration Horizontal Calibration					0	1										
Vertical Calibration		110			1	1			i is is Xiri							

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):

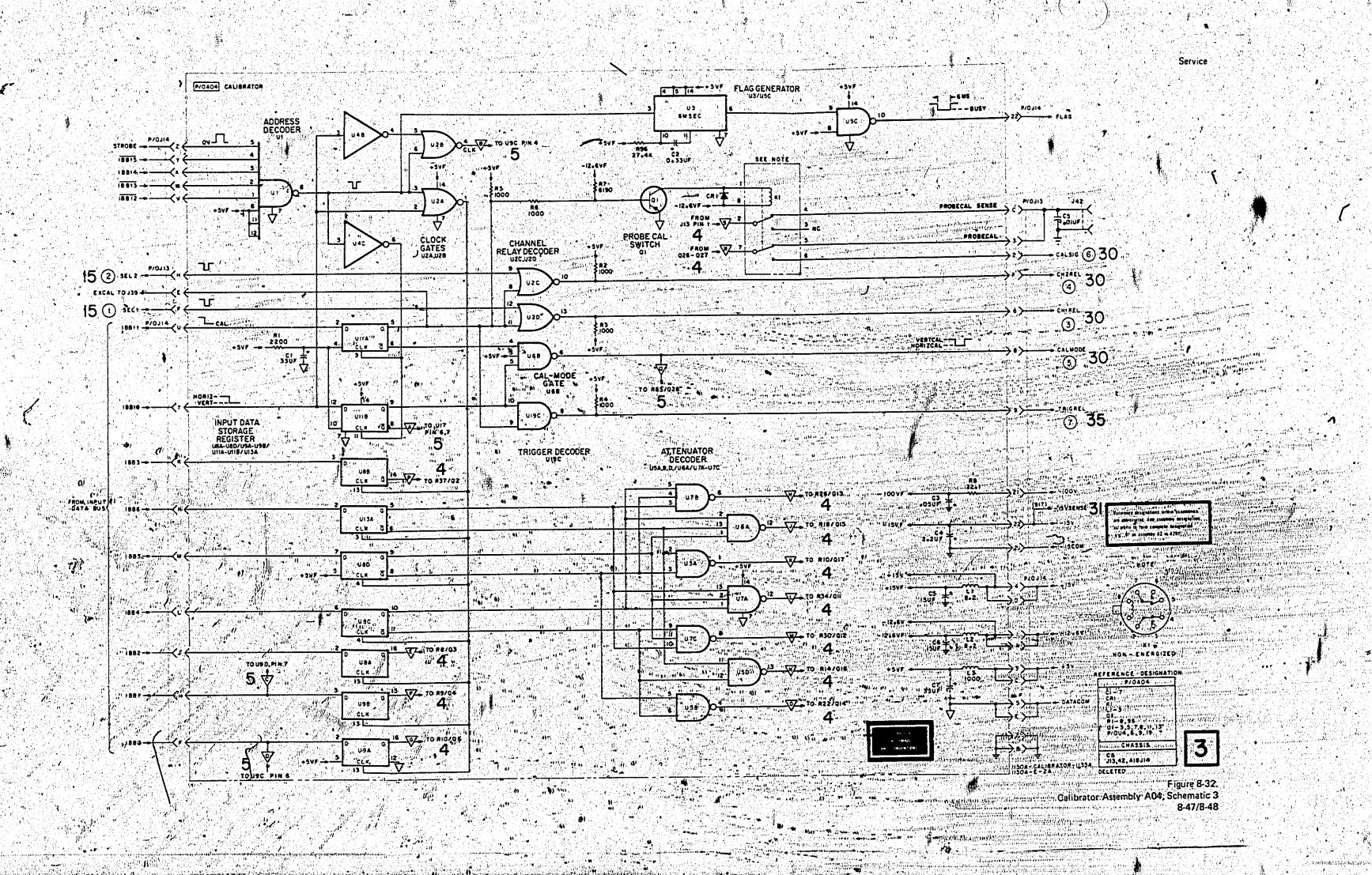
					ВІ	T LO	CATI	ON an	d LO	GIC L	EVEL					
FUNCTION	15	14	13	•12	11	10	·9	8	7,,	6	5	4	3	2 ;	1	0
VERTICAL CAL.	o'	1	0	a!	1.	1.					rado" Vilado	X 1 1 1 1				
mV/DIV:						1									,	
200 mV/DtV		-X	٩	9						, ο	0	0			3	
100 mV/DIV 50 mV/DIV						,		1		0	0/	1 0		31.		
, 20 mV/DIV									Ver ver	0	1 0	1 0		\		
10 mV/DIV 5 gy//DIV					-				λ	1.4	0	1 0				
2 ·mV/DIV						1		か計 生む計			1.	7		\ 11 .15	ya.	Š.
No. of Div. from OV							, 1	n,						, i		
1			•					3	13 4 0.37 137.47				0	1	1	1 0
+.5					-).		j		•				Ó		0	, 1 0
+ 4							\$						0	0	1	1
+ 2 + 1							*						0	0	î 0	0
0		n											0	0	0	1
$\frac{7}{2}$,					*			(d)	or officers	1	1	1 0	0
- 3/		i÷, +idi		→ γ							•		1	#1 O	0	ζ.
<u> </u>									4.			1 (b) 1 (1)	1	0	1	1 0
- 7 - 8				4									, 1 1	0	0	ו נ

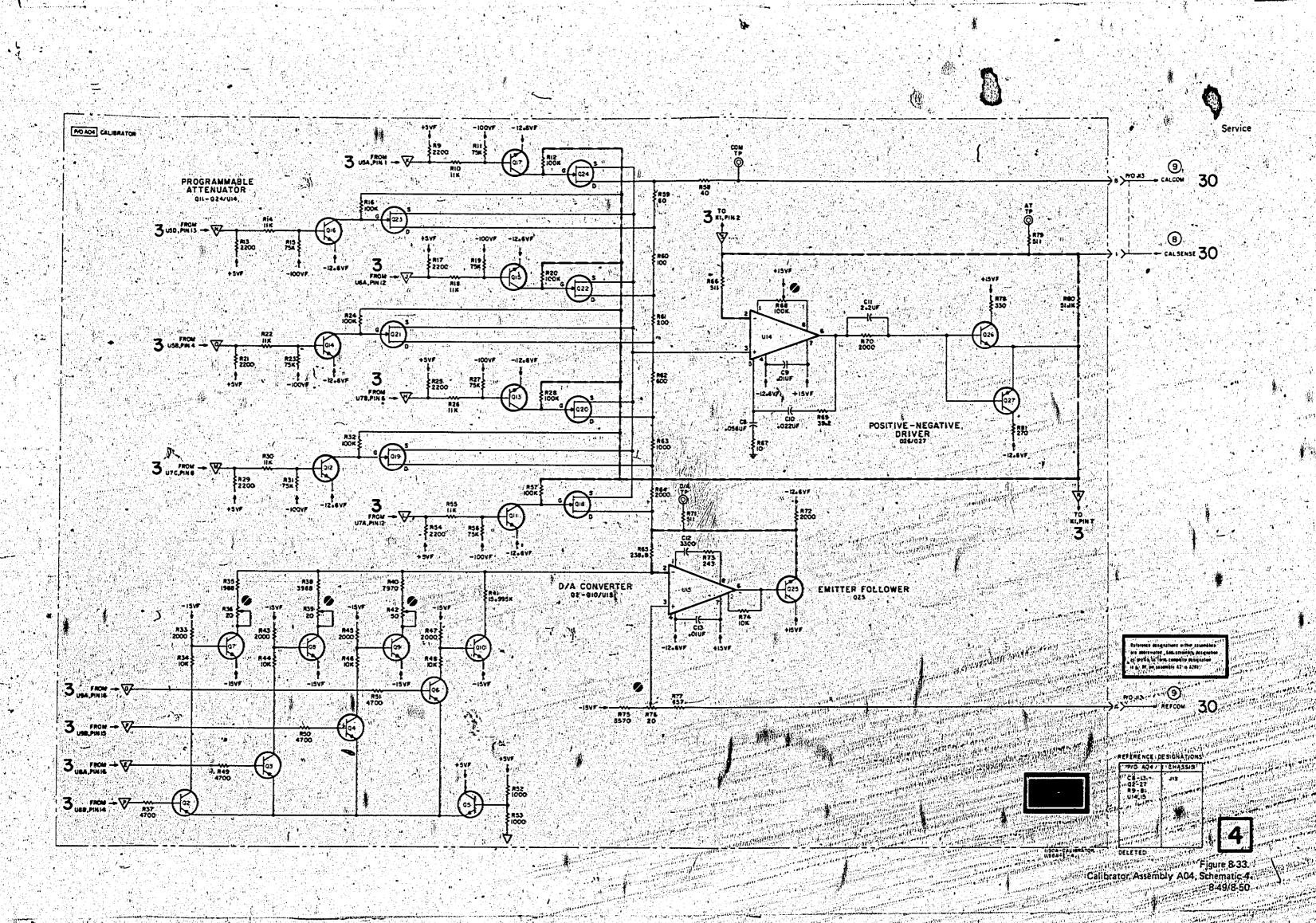
Note: 1. Bits 0, 1, and 2 control a D/A converter at 200 mV/bit...

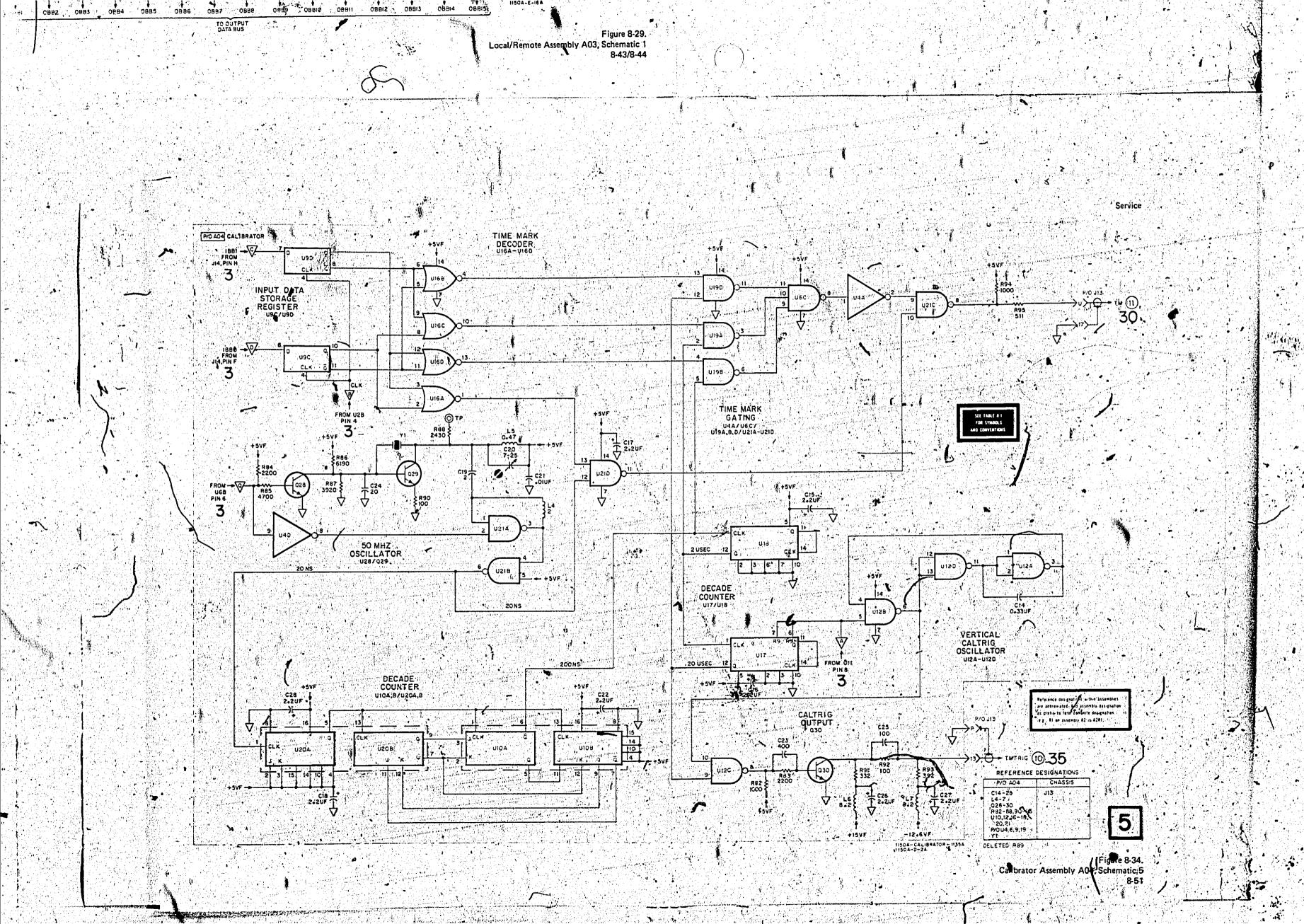
2. Bits 4, 5, and 6 control an attenuator in series with D/A converter

Horizontal Calibration coding is as follows:

					BI	T LO	CATI	ON ar	nd LO	GIC L	EVEL	1,2			yen t Valyd	1
FUNCTION	15	14	13	12	11	10	9	8	7.	•6	5.	4	3	2	1 1	ó
HORIZONTAL CAL. MARKER INTERVAL: 20 usec 2 usec 0.2 usec	0	は、100mmの 100mmの 100mm 100mm 100mm 100mm 100mm 100mm 100m	0 1	0											0	0



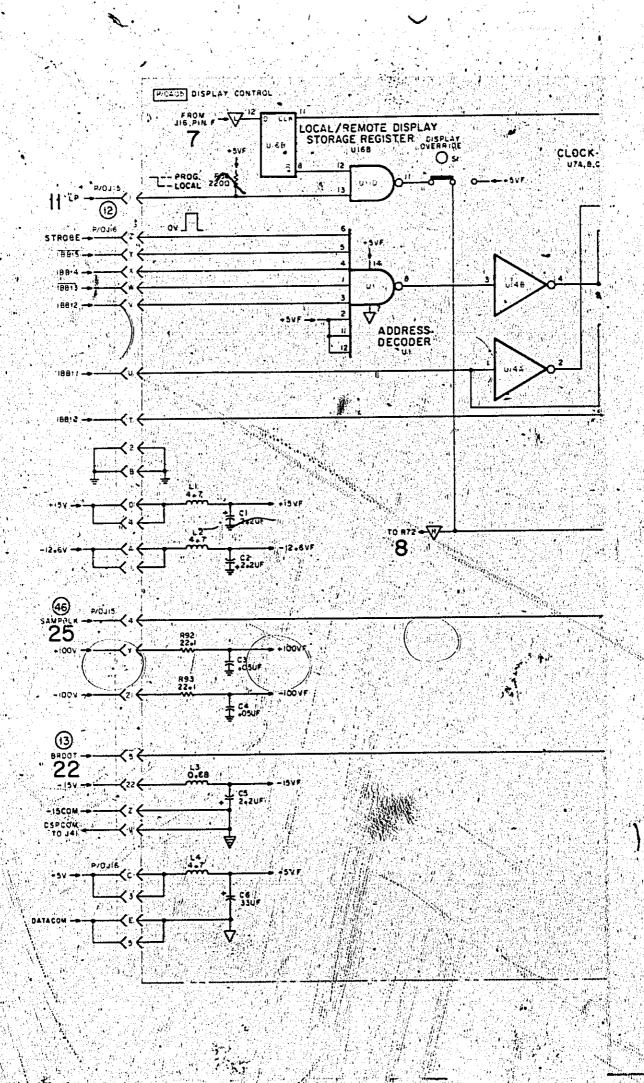


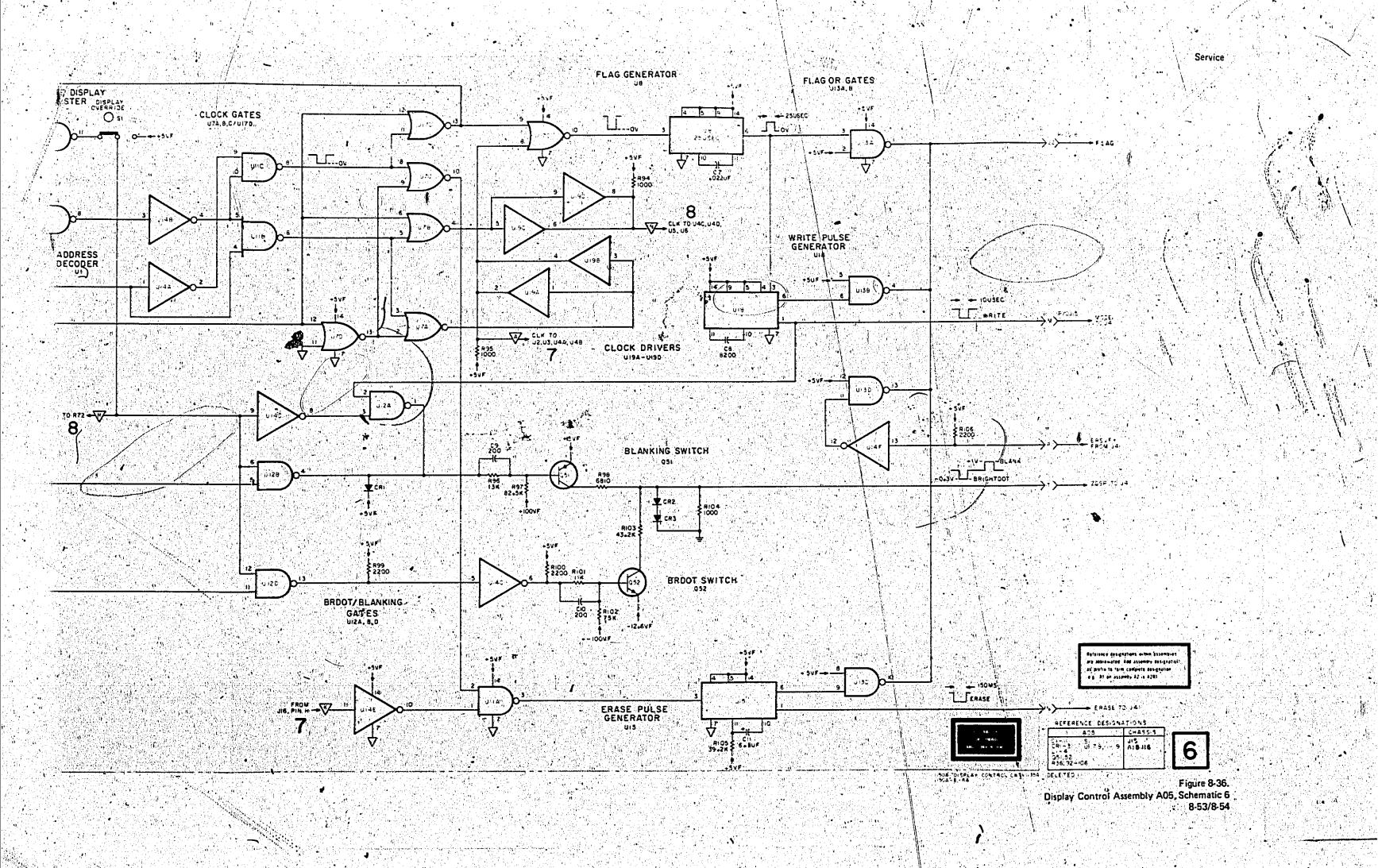


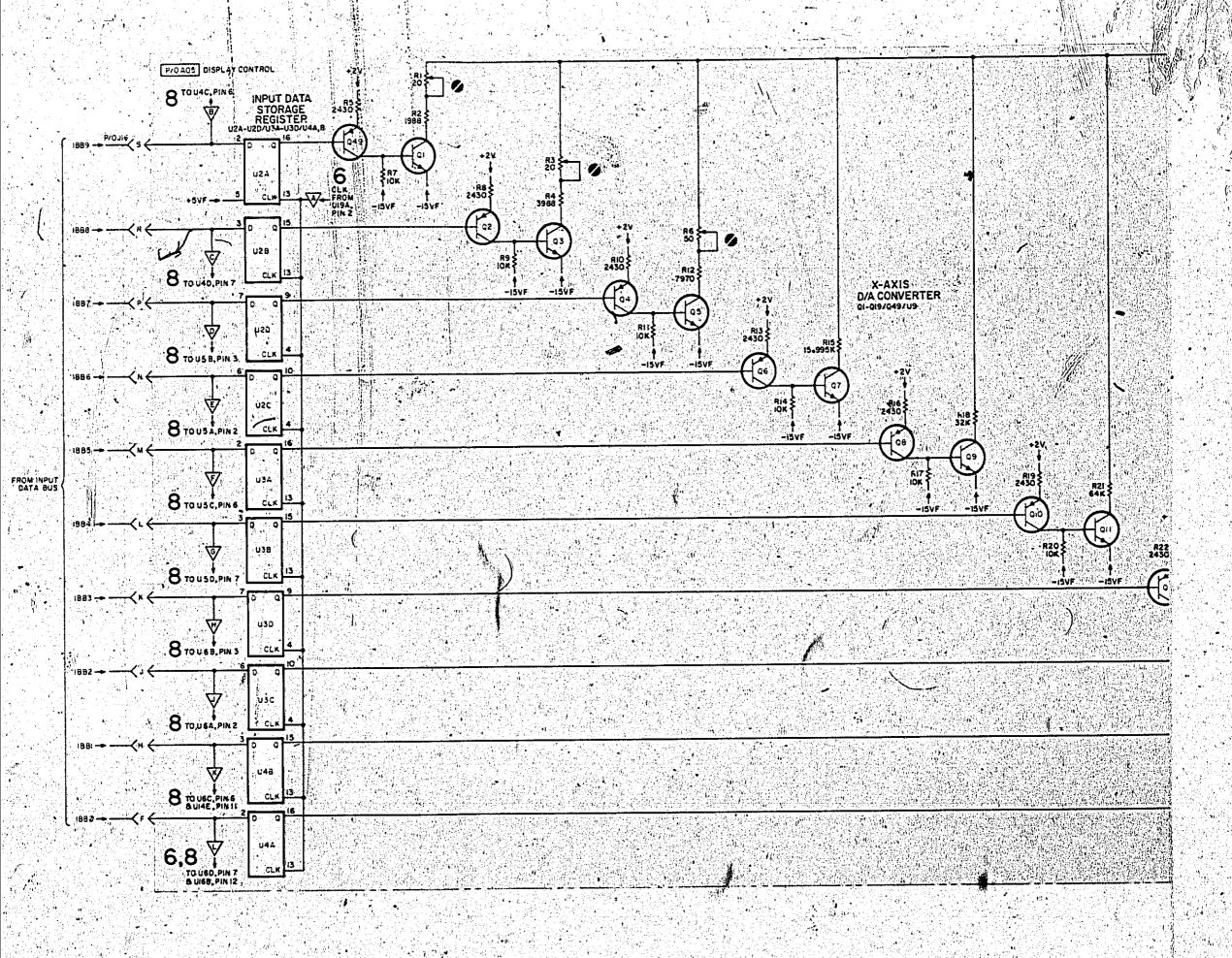
	i de la compansión de l		ows:	••	,,	ر. دارند				cic i	EVEL	9				
FUNCTION	15	14	13	12-	11	T LO	9	ON a	na LO	6	EVEL 5	4	3	2	1	0
Assembly Address	0.	j. 1	0	1					Co	e Note						
X Display					هر ا	1				e Note	1					
ERASE Mode)	0									1	a

Note: | 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 19 microsecond signal which unblanks the display.







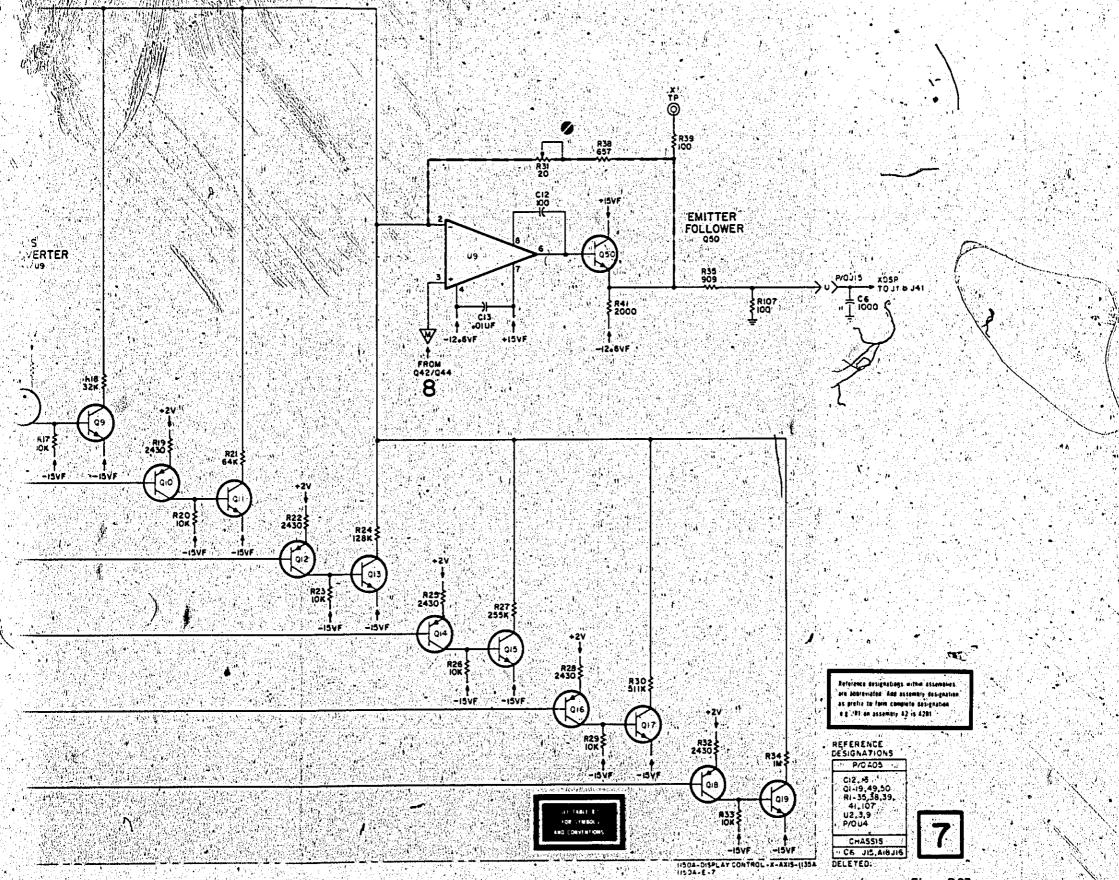


Figure 8-37.
Display Control Assembly A05, Schematic 7
8-55/8-56

r Bergere

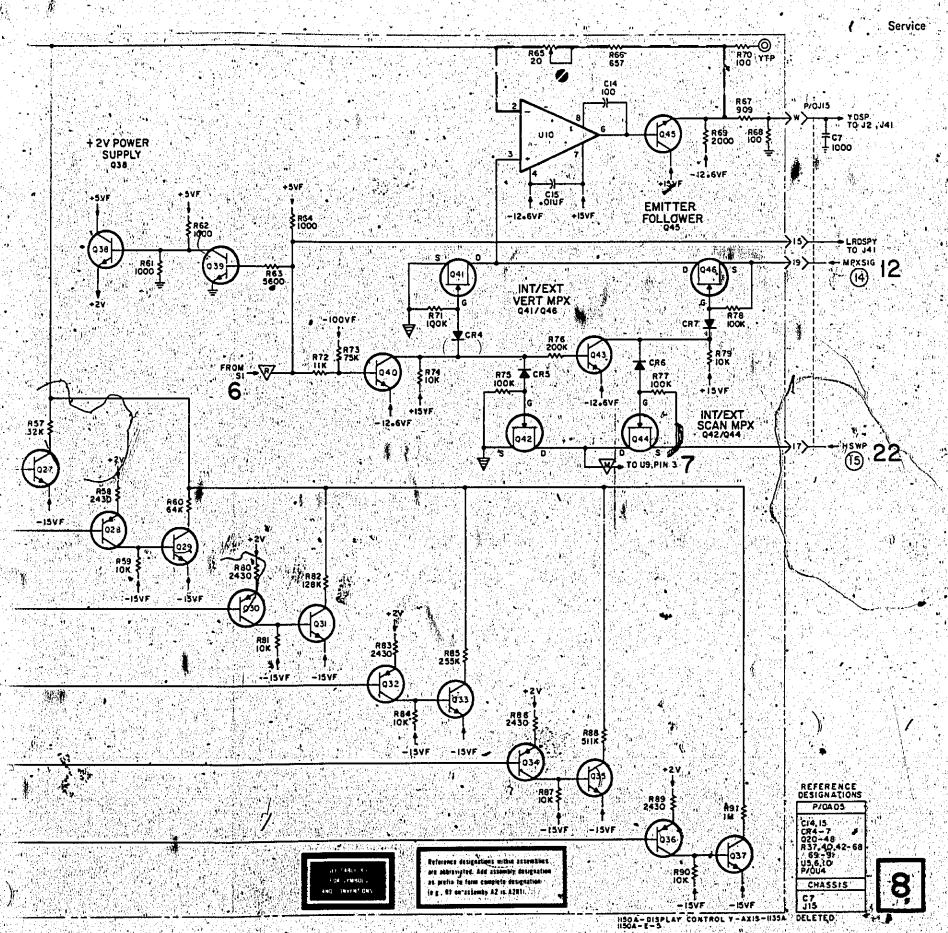
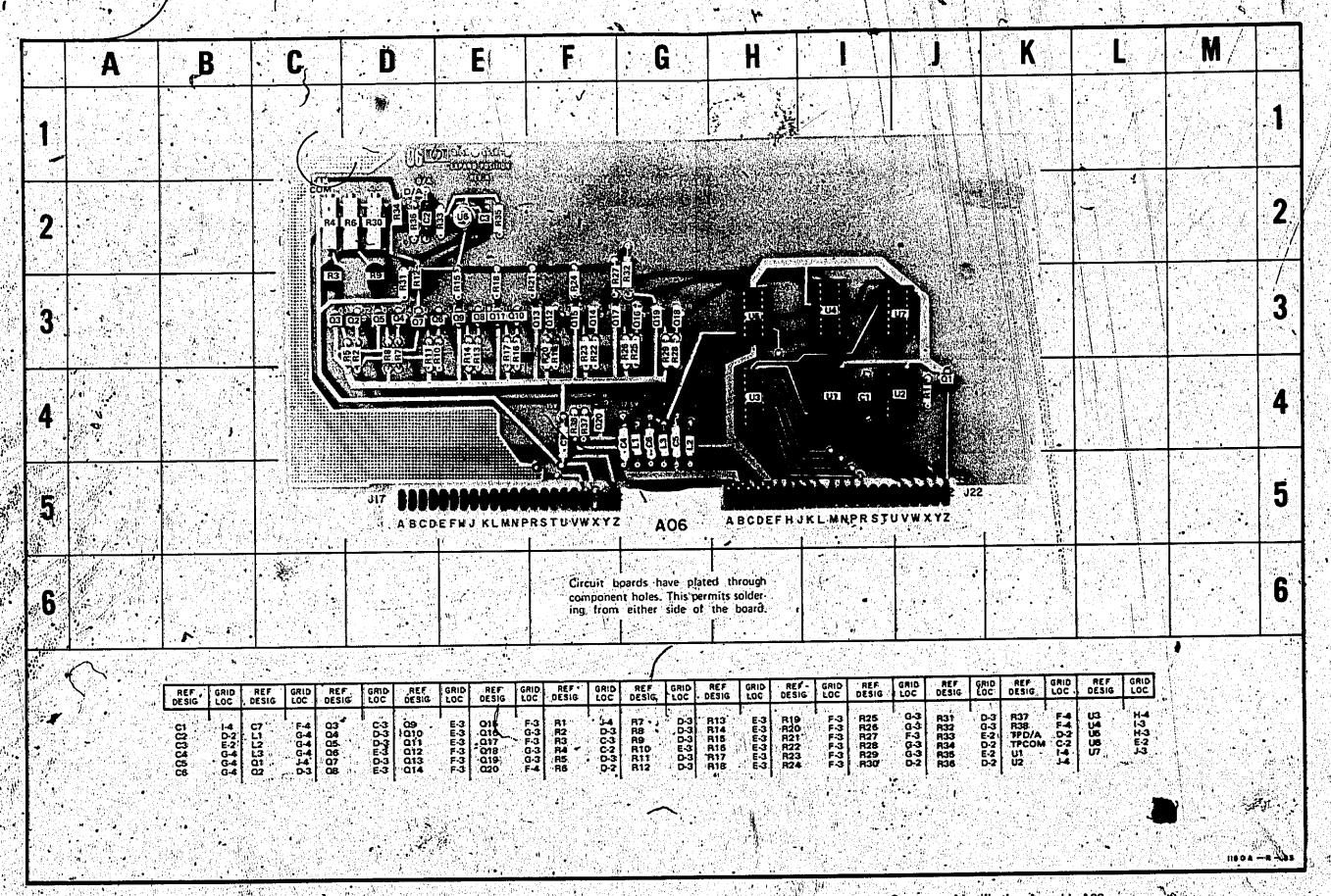


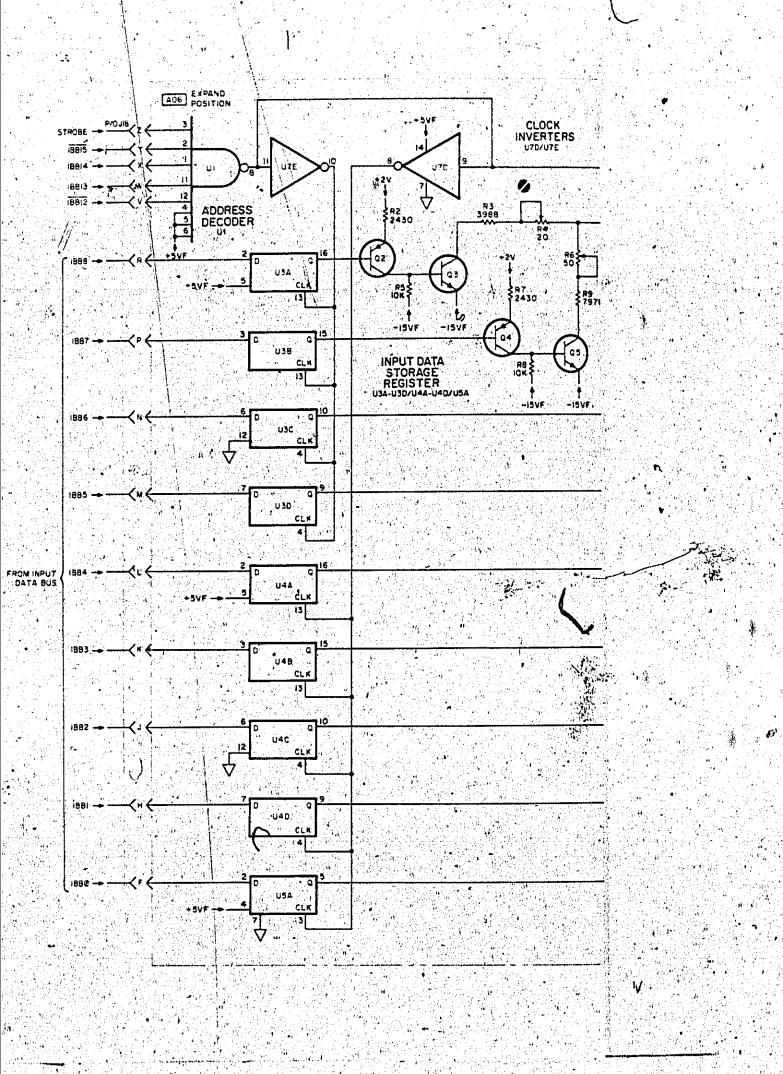
Figure 8-38.
Display Control Assembly A05, Schematic.8



	dete	rmine	d by	, in ti progra	mmin	g the	which expa	the synd posi	veep i ition [ş expa	orided onver	is ter				
	<u>(</u>				, B۱	IŢ LO	CATI	ON and	ı, LOC	IC L	VEL		Mil. X			
FUNCTION	15	14	13	12	11	10	. 9	8	7	6	5	4	3	2	1	0
Assembly Address	0	i	1	0												
POSITION										— s	ee No	ote -				2 2 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

Note: Bit 0 through 8it 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



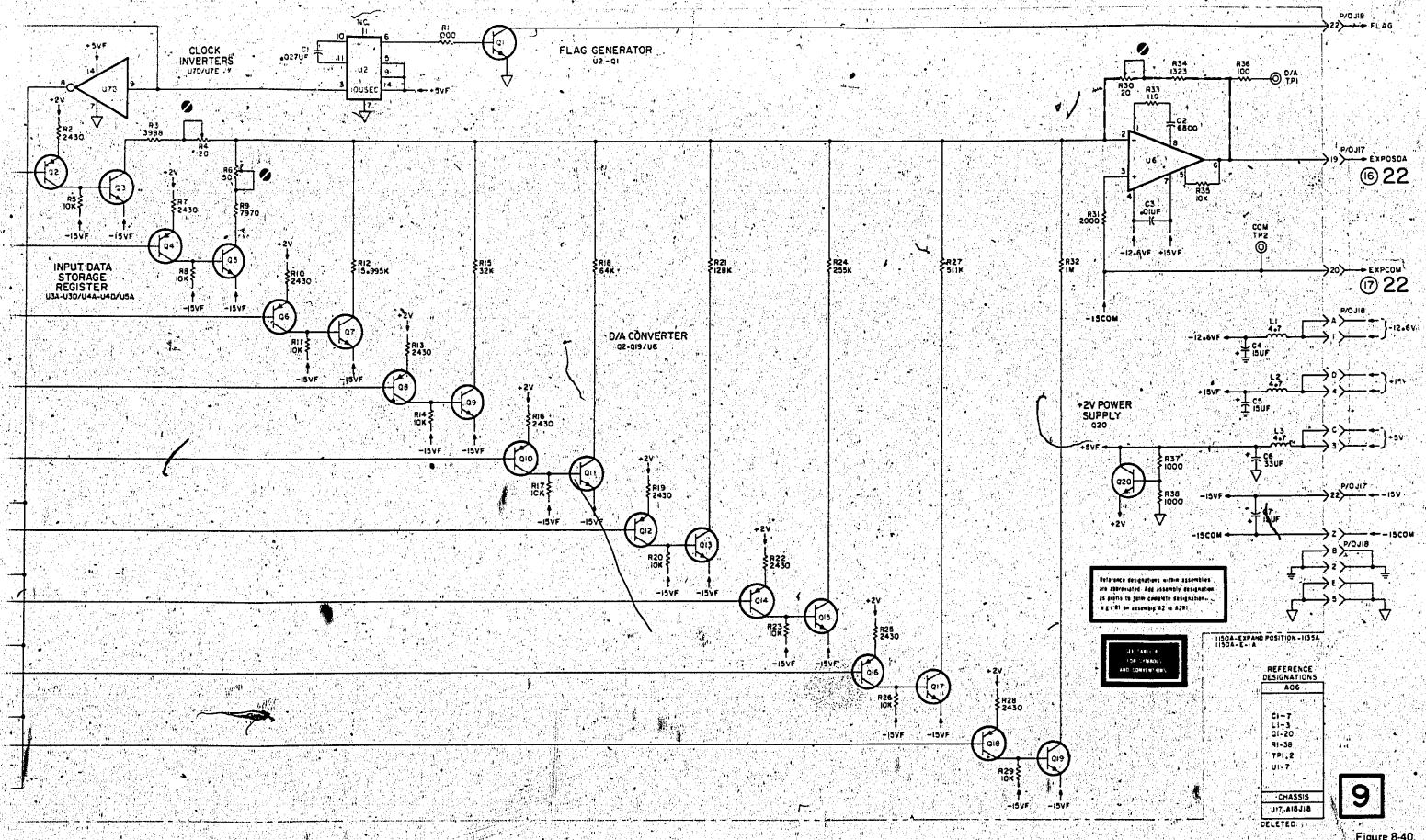


Figure 8-40.
Expand Position Assembly A06, Schematic 9
8-59

· A	В		C		D		Ē		F		G			H		1					K		l		N	1	
		R2 R2 R2 CR		2 R2	OM ICIE UIE	AVO NI G RIS G RIS (03)	(<u>ni</u>			R5	073 073	UIS.		G -		41		Œ Š	はない (本本語) できる (本語) できる (本語) できる (本本語) できる (本語) になり								
		R1 R1 R2 R2 R2 R2 R3		(H)		(CS R11 R10 R17		UIT				=:		LVJ ENU	100 mg/s												2
			5 67 4 67 8 67		R51 5 R51 5 R51 5 R51 5 R51 5 R38 R44 5			US			· //-//			1010 1				JIBI		VI -							3
		RS	010					UE I				C GEB 3	000 S	1.60	414			6.5		25 ,20							4
			JI9	ABC	DEFH J	KLMN	PRST	U V W X		3B 1					JKLN	NPR	ŲSTU	VW X	Y Z AA Y Z AA E		6						5
									compo	onent h	oles: Th	is pern	rits sold	ler													6
		nik estadari Granik	a video e		المستراع التيارية الم		• 146 - 1			REFOESIG R4 R5 R8 R9 R10 R11 R12 R13 R14 R15		n a sign				, u r	74:	N. 15		U7 U8	GRID LOC .G-2 .G-2 .J-4 .A-3 .G-3 .F-4 .F-2 .G-1 .F-2 .G-1						
			R2 CR R1 R2 R2 R2 R2 R3 R3 R3 R3 R3 R3 R3 R3 R3 R3 R3 R3 R3	REF. OESIG	R22 CB	R21 COM ACIS R22 COM ACIS R22 COM ACIS R23 COM ACIS R24 COM ACIS R25 COM ACIS R26 COM ACIS R27 COM ACIS R27 COM ACIS R28 C	REF. GRID REF GRID REF BRID REF DESIG LOC DESIG	REF. GRID REF. GRID REF. GRID REF. GRID REF. GRID REF. GRID RES. GRID REF. G	REF. GRID REF. G	RZZ UB RZZ UB RZZ UB RZZ ZZ RZZ RZZ RZZ RZZ RZZ RZZ RZZ RZZ	REST OF THE PROPERTY OF THE PR	RECOMMENDATION OF THE PROPERTY	ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC Circuit boards have plate component holes: This pern ing from either side of the component holes: This pern ing from either side of the component holes: This pern ing from either side of the compo	ABCDEFNIKLMNPRSTUVWXYZAA CC ABCDEFNIKLMNPRSTUVWXYZAA CC ACTION TO THE COMPONENT OF THE CO	ABC DEFH JKL M NPR STUV W X Y ZAA CC ABC DEFH JKL M NPR STUV W X Y ZAA CC ACT DESTRUCTION OF THE PROPERTY OF	ABCDEFHJKLMNPRSTUVWXYZAACC Circuit boards have plated through component holes: This permits soldering from either side of the board. The state of the board of the board of the board.	ABCDEFHIKLM NPRSTUVWXYZBBC AO7 ABCDEFH JKLM NPR Circuit boards have plated throubh component hole: This permit solder ing from either side of the board. The state of the boards have plated throubh component hole: This permit solder ing from either side of the board.	ABCDEFHUKLMNPRSTUVWXYZAACC AB	ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACC ABCDEFHJKLMNPRSTUVWXYZAACCC ABCDEFHJKLMNPRSTUVWXXZAACCC ABCDEFHJKLMNPRSTUVWXXAACCCC ABCDEFHJKLMNPRSTUVWXXAACCCC ABCDEFHJKLMNPRSTUVWXXAACCCC ABCDEFHJKLMNPRSTUVWXXAACCCC ABCDEFHJKLMNPRSTUVWXXAACCCCC ABCDEFHJKLMNPRSTUVWXXAAC	ABCDEFH JKLMNPRSTUVWXYZAA CC ABCO REF GRID REF G	ABCDEFNJKLMNPRSTUVWXYZAA CC ACT STID STITE STID STID STID STID STID STID STID STID	ABODE FH JIKL MN PR STUVWXYZA CO AOT ABODE FH JIKL MN PR STUVWXYZA BOO CONSTRUCTION OF THE PRINCIPLE OF THE BOOK OF THE PRINCIPLE OF THE BOOK OF THE B	ABCDEFHIKLMNPRSTUVWXYZAACC Circuit beads have plated through component holes: This permits solvering from either side of the board. This permits solvering from either side of the board. This p	ABCDEFHJKLMNPRSTUVWXYZAACC Circuit boards have plated through component holes. This permits solder ing. from 'either side of the board. Circuit boards have plated through component holes. This permits solder ing. from 'either side of the board.	ABCDEFHIKLM NPRSTUVWXYZABC Circuit basids have plated through component holes: The permits soldering from either site of the board. Testing Loc locks for the locks for the board. Testing Loc locks for the locks for the board. Testing Loc locks for the locks for the board. Testing Loc locks for the locks	ABCOEFHURLMAPRITUVXXYZABC Circuit boards have plated through component holes: This permits sollen-ing from other safe of the board. The component holes that prints sollen-ing from other safe of the board.	ASCOETH JKIN NPRSYLVVXXYZA GO ASSO OSCI OSCI OSCI OSCI OSCI OSCI OSCI O

Figure 8-41, Component Identification, Assembly A07

SAMPLER (See Note 2)

	6	Bina outp	ry coo	des fo	lows:	<u> </u>					EVEL	196			x) (
FUNCTION	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)	1												0	1	3°	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:

					В	IT LO	CĄTI	ON a	nd LO	GIC L	EVEL	- 1.00			7/4 / / F / / /	•
FUNCTION	15	14	13	/12	11	10	9	8	, 7	6	5	4	3	2	1	0
Assembly Address	0	1	1.	1		7 1										
"READ" IDENTIFIER					0											
read SWEEP TIME	5													6	1	1
read SCAN CONTROL													1.	/1	0	1
read VERT. SENSITIVITY				V									1	10	1	0
read CHANNEL SELECT													1	0	.0	0

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

3. Local/Program digital coding is as follows:

			je za je	SIT LO	CATI	ON ar	d LO	GIC L	EVEL		10 AG 20 10 10 10 10 10 10 10 10 10 10 10 10 10			
FUNCTION	15 14	13	12 11	10	9	8	7	. 6	5	4	3	2	1	0
Assembly Address	0 1	1			17 17 17 Specifical			A.S. Pedic					i V	
EPFUNCTION														
IDENTIFIER											1 1 1 1 1 1	¥. ;	L	• .
LOCAL MODE								•			0	0	M	U
PROGRAM MODE											0	Ŏ	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:

					. 8	IT LO	CAT	ON ar	nd LC	GIC,L	EVEL	1				
FUNCTION	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assembly Address "READ" IDENTIFIER LEARN	0				0											
(See Note 1) LOCAL/ PROGRAM (See Note 2))			• 0	0	0 1	0

iote: 1. This coding connects the 100-microsecond LEARN pulse to output data bus line OBBØ when Data bus line

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

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

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

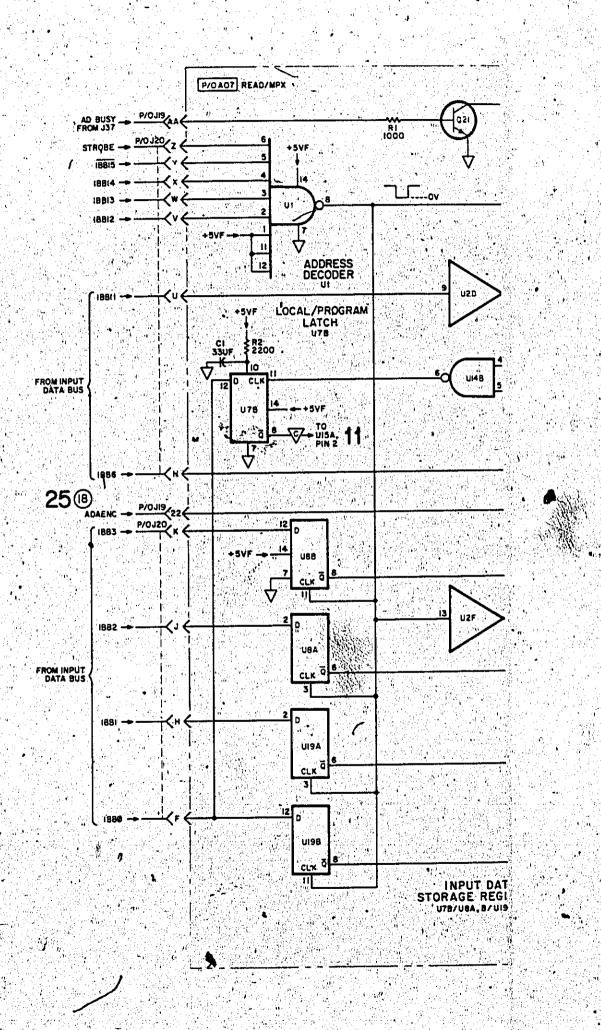
	BIT LOCATION and LOGIC LEVEL															
FUNCTION	15	14	13	12	11	10	9	∴8	黨7	6	5	4	3	2	111	0
Assembly Address "READ" IDENTIFIER	٥.	w 1 ::			0											
EXPAND POSITION (See Note 1)													O'	1	31	0
VERTICAL POSITION (See Note 2)								1						0	0	

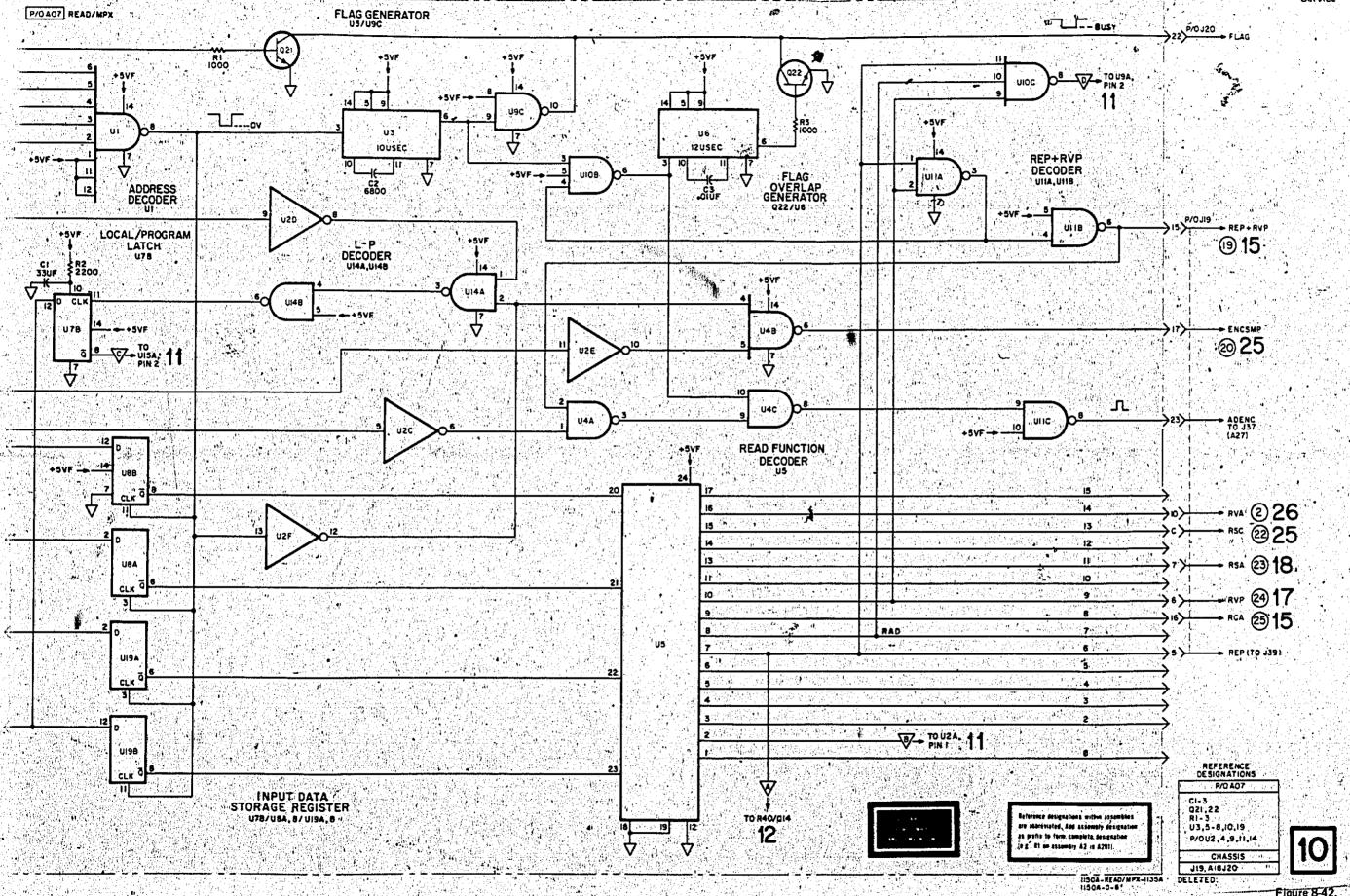
Note: 1. This code connects the voltage from front panel expand POSITION control to the A/D converter.

Digital information from the A/D converter is connected to output data bus lines. OBBØ through OBBØ. The flag is beld busy until the sequence is completed. (Refer to paragraph 6, this table, for A/D converter coding.)

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 OBBØ 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.)

- 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 sequentically 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.





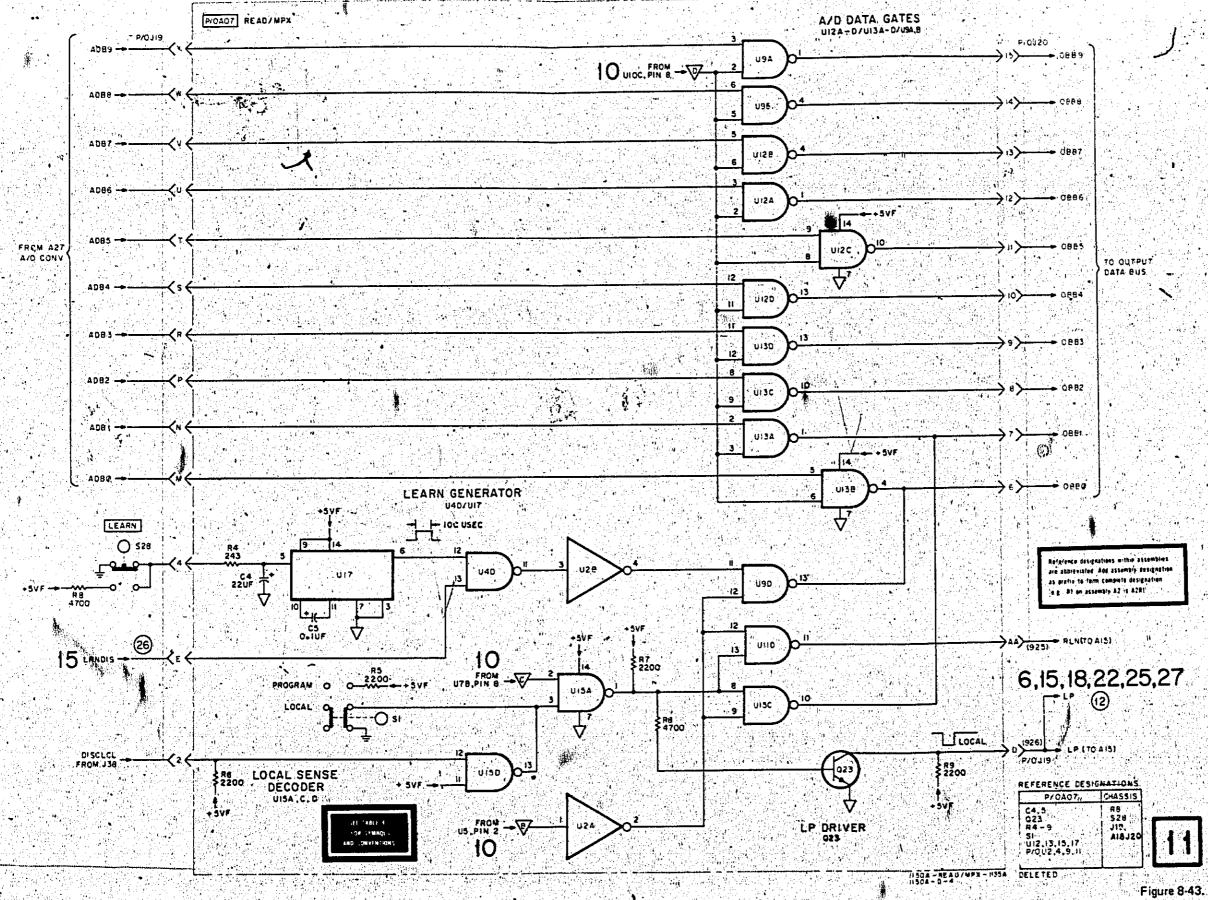
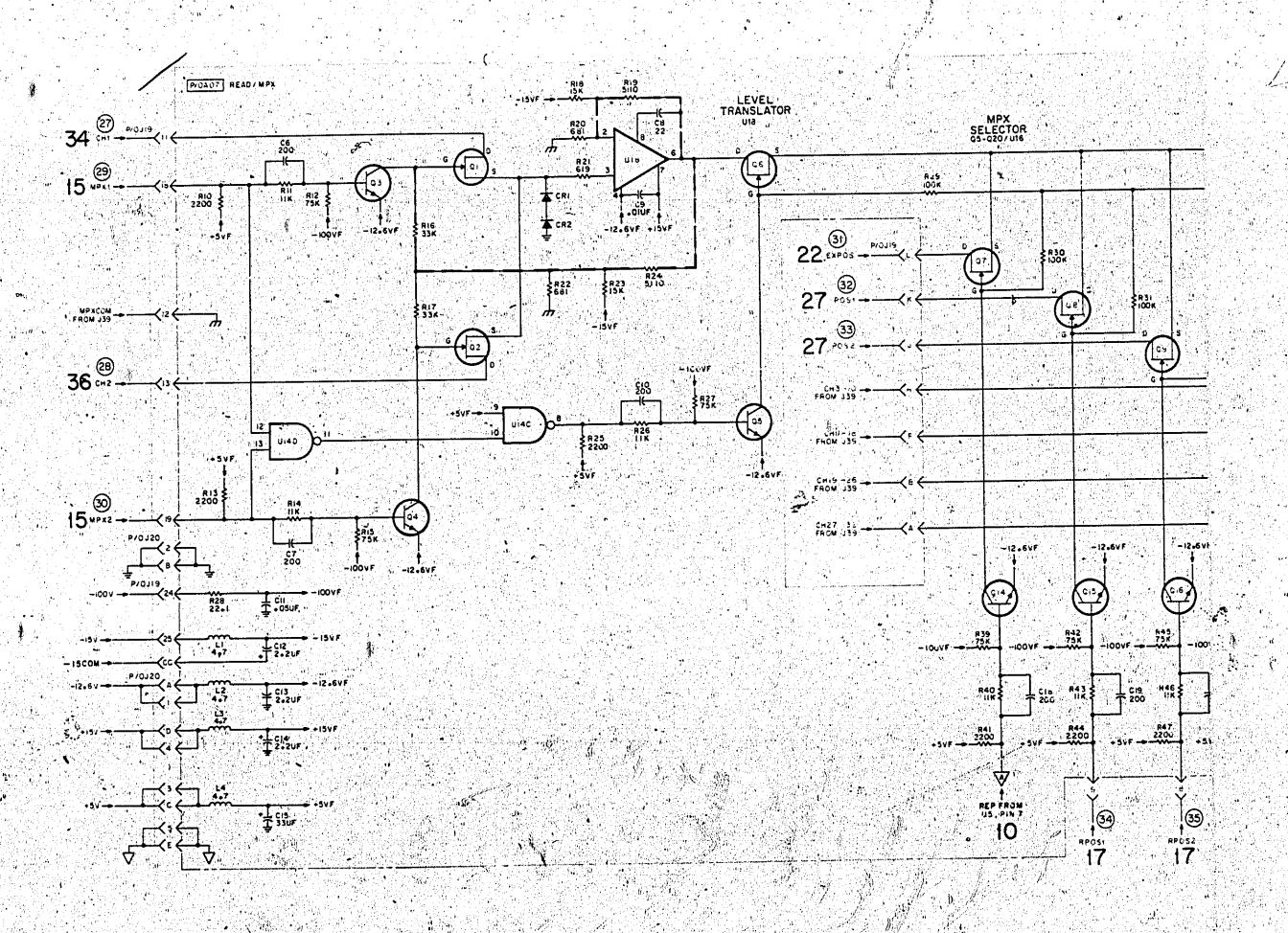


Figure 8-43.

Read/Multiplexer Assembly A07, Schematic 11

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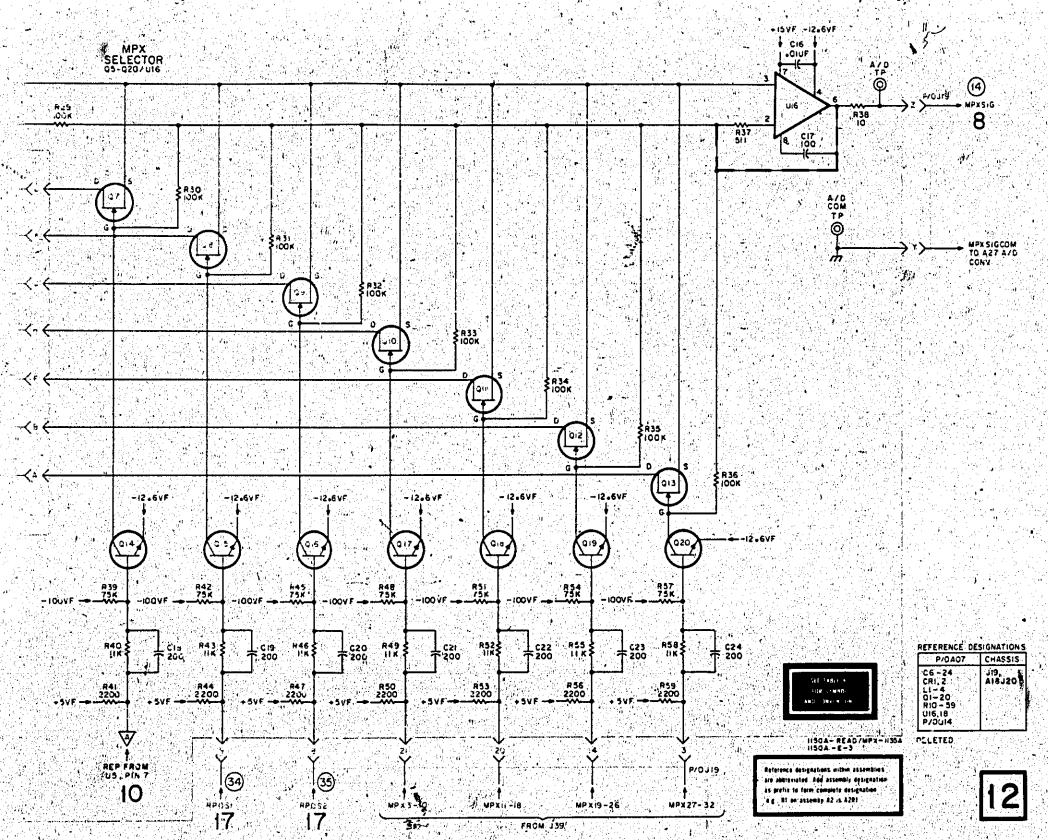
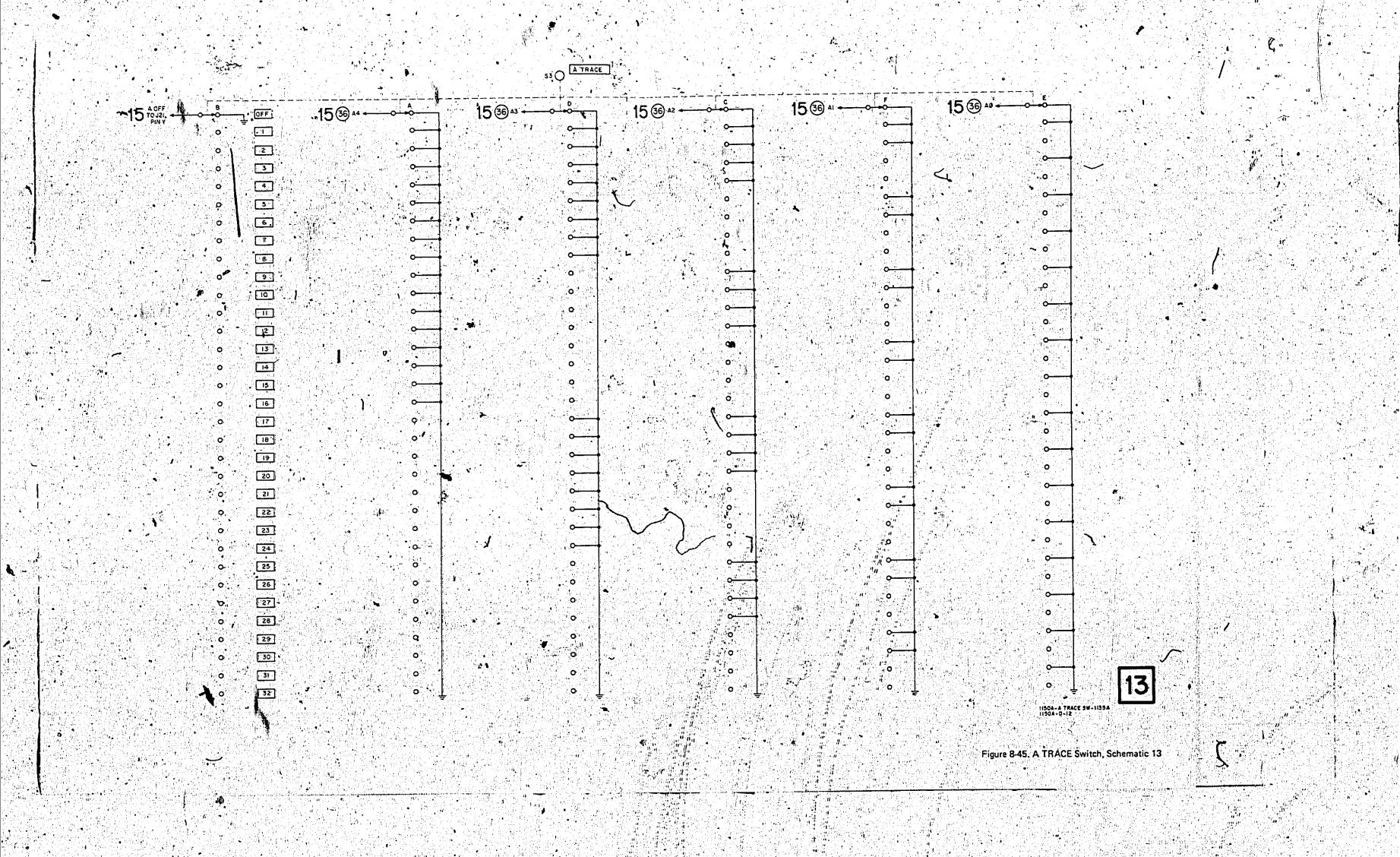
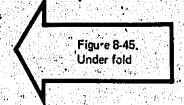


Figure 8-44.
Read/Multiplexer Assembly A07, Schematic 12
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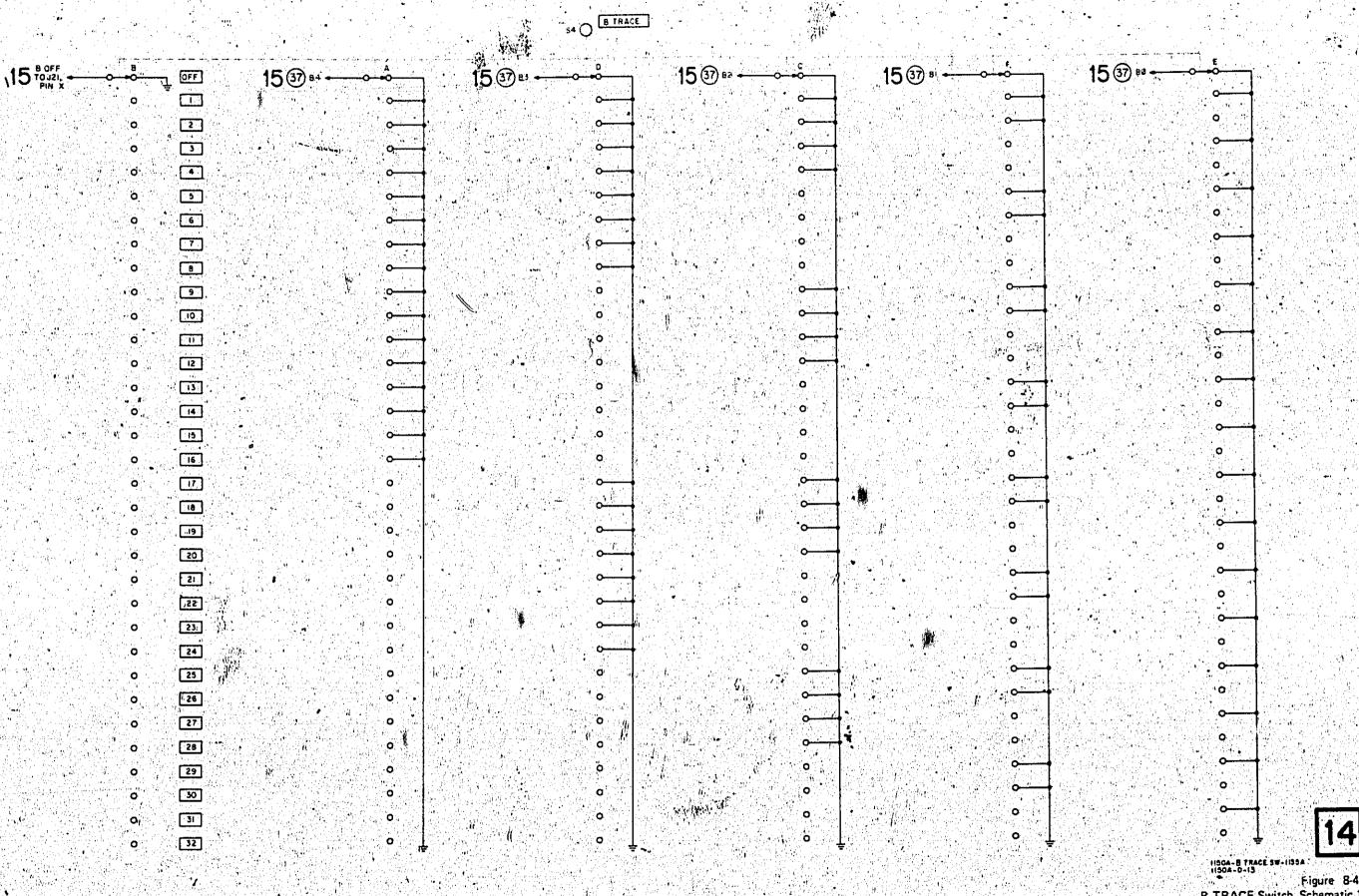
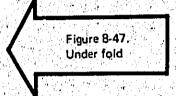


Figure 8-46.
B TRACE Switch, Schematic 14

)	A	В	 C		D	E	F	G	H		J	K	M	
					See			and the state of t						
2				Tung.	Turo (S .	SID SID	WIND IN		C Canada	an /			2
3					100		(Ta)			N E G	-10.			3
4								60 100 100 100 100 100 100 100 100 100 1			22 25 22			4
5					21 1 2344 ABCD	56789 Q 23 E FHJKLMNP	RSTUVWXYZ ^{AA} BI	ČČ AO8	ABCDEFHUI	dula अधिक्रां cumners tuv	W X Y Z ^{AA} CC BB			5
6							compor	boards have planent holes. This porm either side o	ermits solder					6
							REF GRID RE DESIG LOC DES C1 G-4 R7 C2 1-3 R8 L1 G-4 R9 R1 D-4 R10	24 (24) 24 (24) 24 (24)	GRID REF GR LOC DESIG LO H-3 U11 H H-3 U12 J- 1-3 U13 I					
							C1 G4 R7 C2 I-3 R8 L1 G4 R9 R1 D-4 R10 R2 D-4 R11 R3 D-4 R12 R4 E-4 R13 R5 E-4 R14 R6 E-4 U1	E-4 U-3 E-4 U-3 E-4 U-5 G-2 U-5 G-2 U-7 G-2 U-7 G-2 U-9 J-3 U-10	H-3 U11 H H-3 U12 J I-3 U13 J G-3 U14 F D-3 U15 E E-3 U15 G E-3 U17 F E-2 U18 H D-2 U19 C	2 2 3 2 2 3 3			11804	

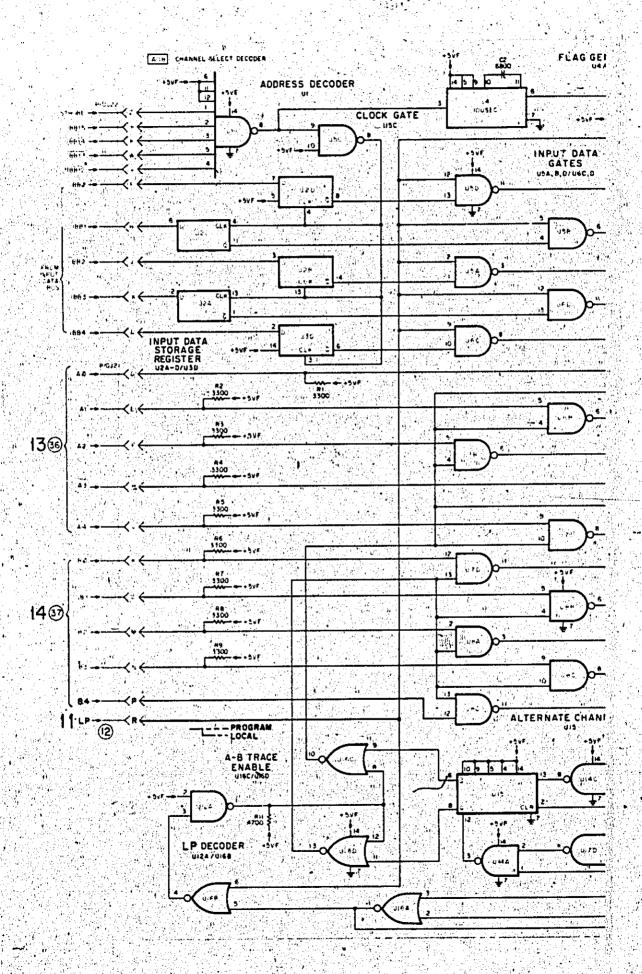
Figure 8-47. Component Identification, Assembly A08

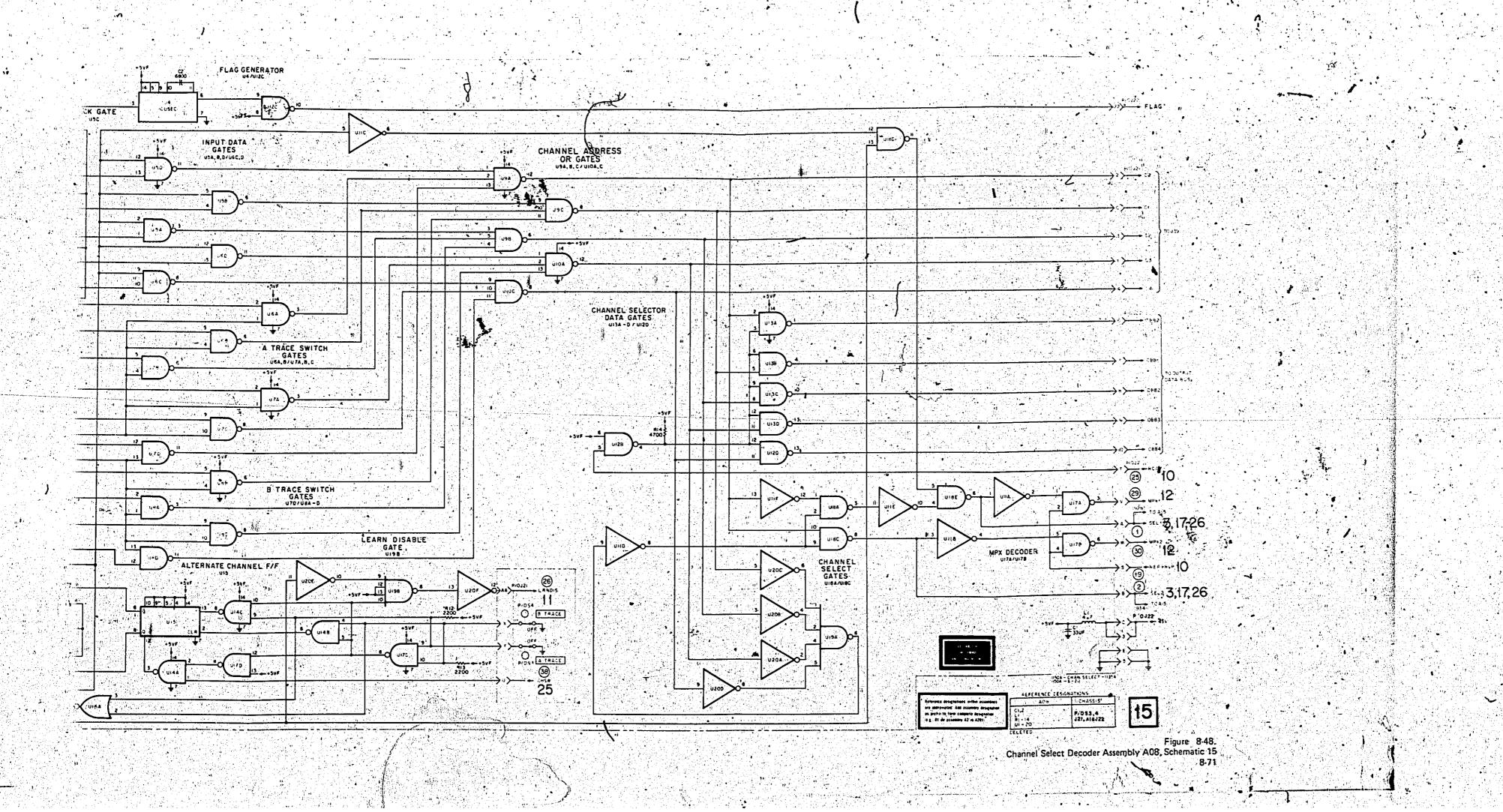


Binary codes	for Channel	Select Assembly	, A08, are as I	allows:
--------------	-------------	-----------------	-----------------	---------

					В	IT LC	CATI	ON ar	id LO	GIC LI	EVEL					λ_{i}
FUNCTION	15	14	13	12	11.	10	9	8	7	6	5	4	3	2	4	0
Assembly Address CHANNEL SELECT: CHANNEL 1 CHANNEL 2		0	0	0								0	0	0	0.0	•

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





	Å	В	C	D			F	Ğ					K	M	
			Tajūryatassu.		3 19 1000	FIGURE 1									
2				R40 Fi.	2 8 WO	(E)	10 G	CRESS PORTING THE PROPERTY OF	03 03 03 04 J		TID CITE	in the constant of the constan			2
3				RA 7 021 EE CO 021 EE CO 022 EE CO 0	1 000 1 000	100 1189 1850 1891 1850 1850 1850 1850 1850 1850 1850 185		CELLY CO.	TITES	w (0 00 r7 5	20 12 12 12 12 12 12 12 12 12 12 12 12 12	(a)		3
4.									ing .	113	W.	•••	5 1		4
5				/ j23 (1 A	BCD EFHJ K	CLMNPRST	uvwxyż	A09	ABCDE	FH JK LMNP	RSTUVWX	JUZ4 WZ			5
6							component	acds have plat holes. This der either side of	mits solder					4	6
			REF DESIG C1 C2 C3 C4 C5 A C6 C7 C8 C9 L1 L2 L3 Q1	GRID REF LOC DESIG J.3 C3 F-2 Q4 F-2 Q5 F-4 Q6 G-4 Q8 F-4 Q9 D-2 Q10 E-2 Q11 G-4 Q12 G-5 Q13 G-5 Q13 G-6 Q14 K-3 Q15 H-2 Q16	GRID REF EOC DESIG G-2 Q17 G-2 Q18 G-2 Q19 H-2 Q20 H-2 Q21 F-2 Q22 H-2 Q23 J-2 Q24 J-2 Q25 I-2 Q26 I-2 Q28 J-2 Q28 J-2 Q28 J-2 Q28 J-2 Q28 J-2 Q29 K-2 Q30		GRID REF LOC DESI F-3 R5 G-3 R6 G-3 R8 G-3 R9 F-3 R10 F-3 R11 F-4 R12 J-3 R13 J-3 R14 K-2 R15 H-2 R15 G-2 R17 G-1 R18	G GRID REF LOC DESIG H-2 R19 F-2 R20 G-2 R21 G-1 R22 G-2 R23 H-2 R24 H-2 R25 H-1 R26 L-2 R27 H-2 R28 H-1 R29 J-2 R31 L-1 R32	GRID REF LOC DESIG 1-2 R33 1-2 R34 1-1 R35 1-2 R36 1-2 R37 1-1 R38 K-2 R39 K-2 R40 1-1 R41 1-2 R42 1-2 R43 1-1 R44 1-2 R43 1-1 R45 1-2 R46 1-2 R46 1-2 R46	GRID REF	GRID REF LOC DESIG E-3 R62 D-3 R64 D-3 R65 E-3 R66 E-3 R67 E-3 R69 F-3 R70 E-3 R71 G-3 R71 G-3 R72 G-3 R73 G-3 R74 G-3 R75	GRIO RE LOC DES	F4 /A1 F1 /A2 E1 OM E2 K-4 J-4 I-3	11804	*-20

Figure 8-49. Component Identification, Assembly A09

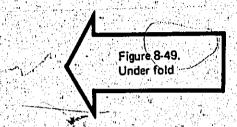
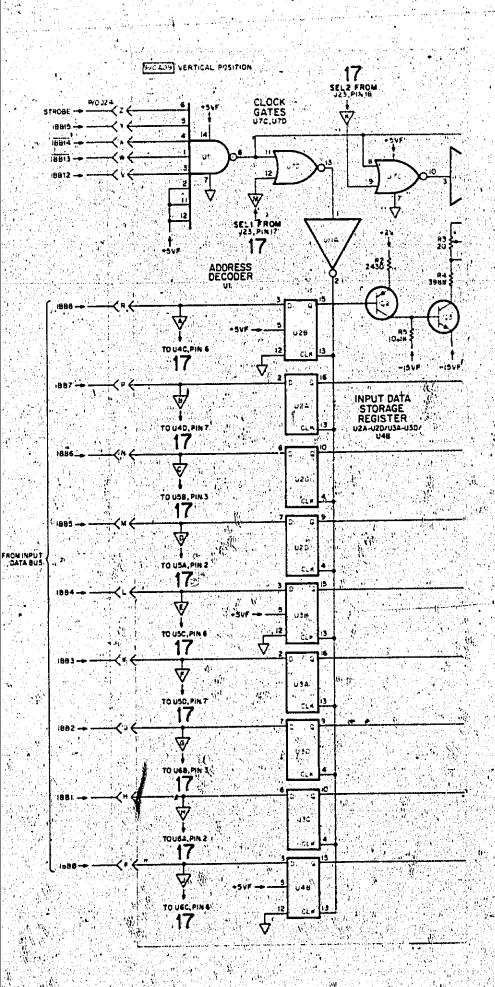




Table 8-10. Binary Coding for Assembly A09

				BIT LC	CATION	and LOGIC L	ĖVĖL		
	FUNCTION	15 14	13 12	11 10	9 8	7 6	5 4	3 2	1 0
l	Assembly Address	1 0	0 1						
	VERTICAL						- See Note		
	POSITION						- See Note		

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



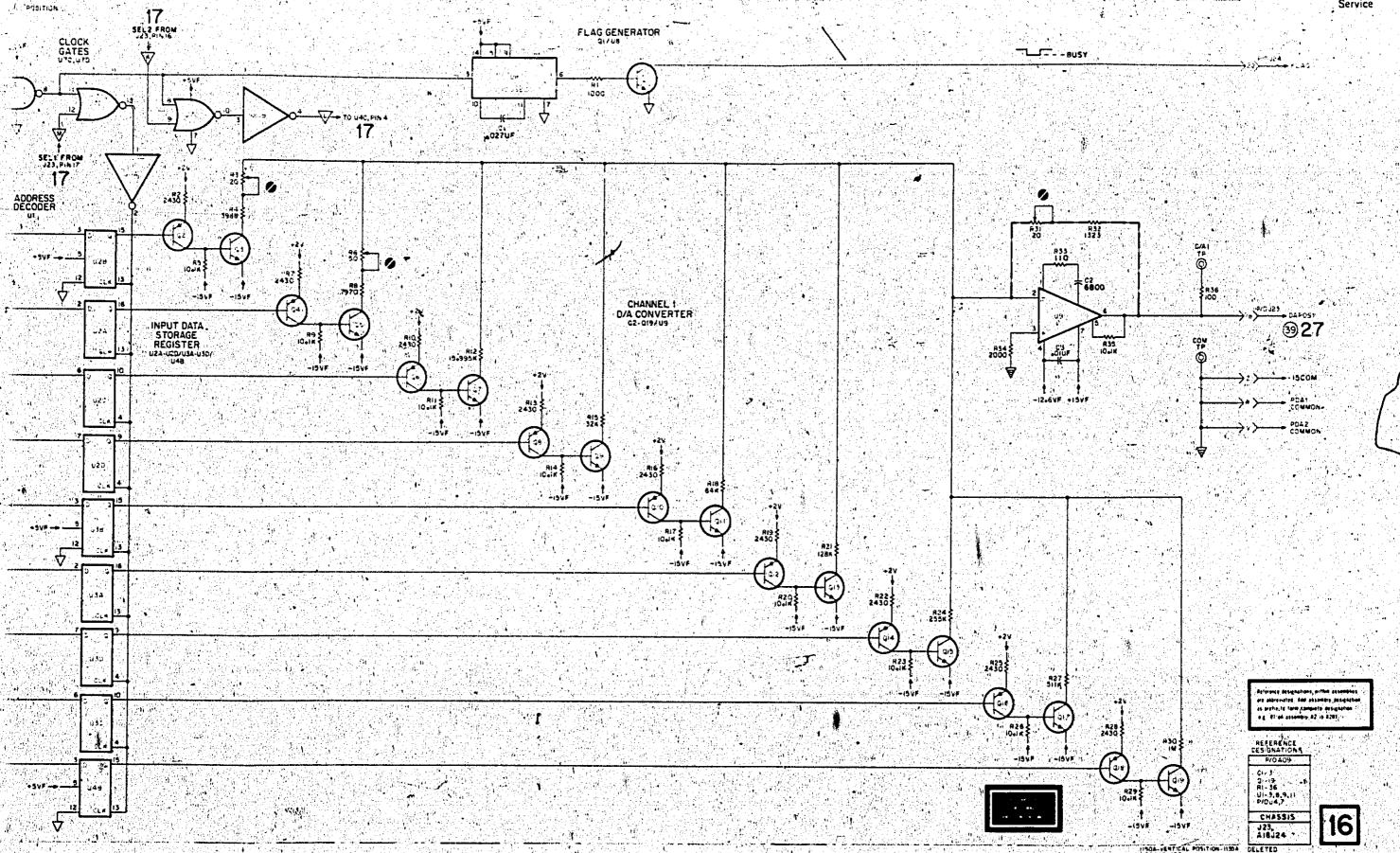
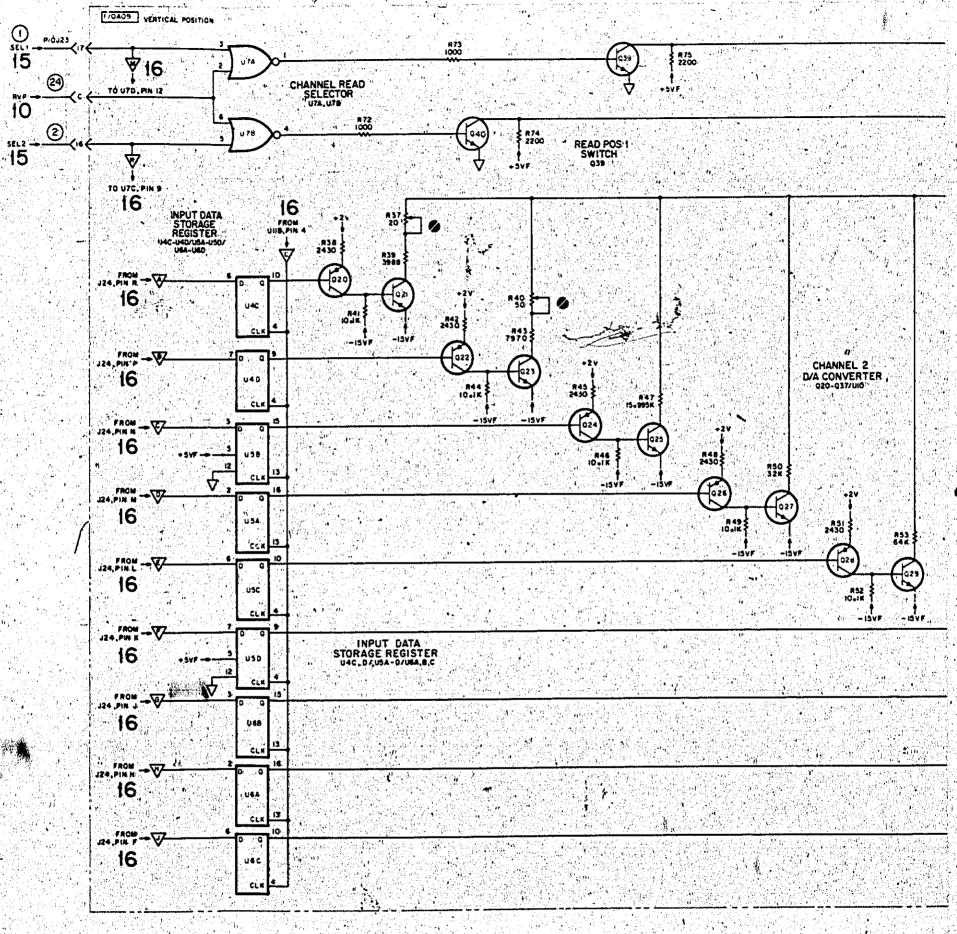
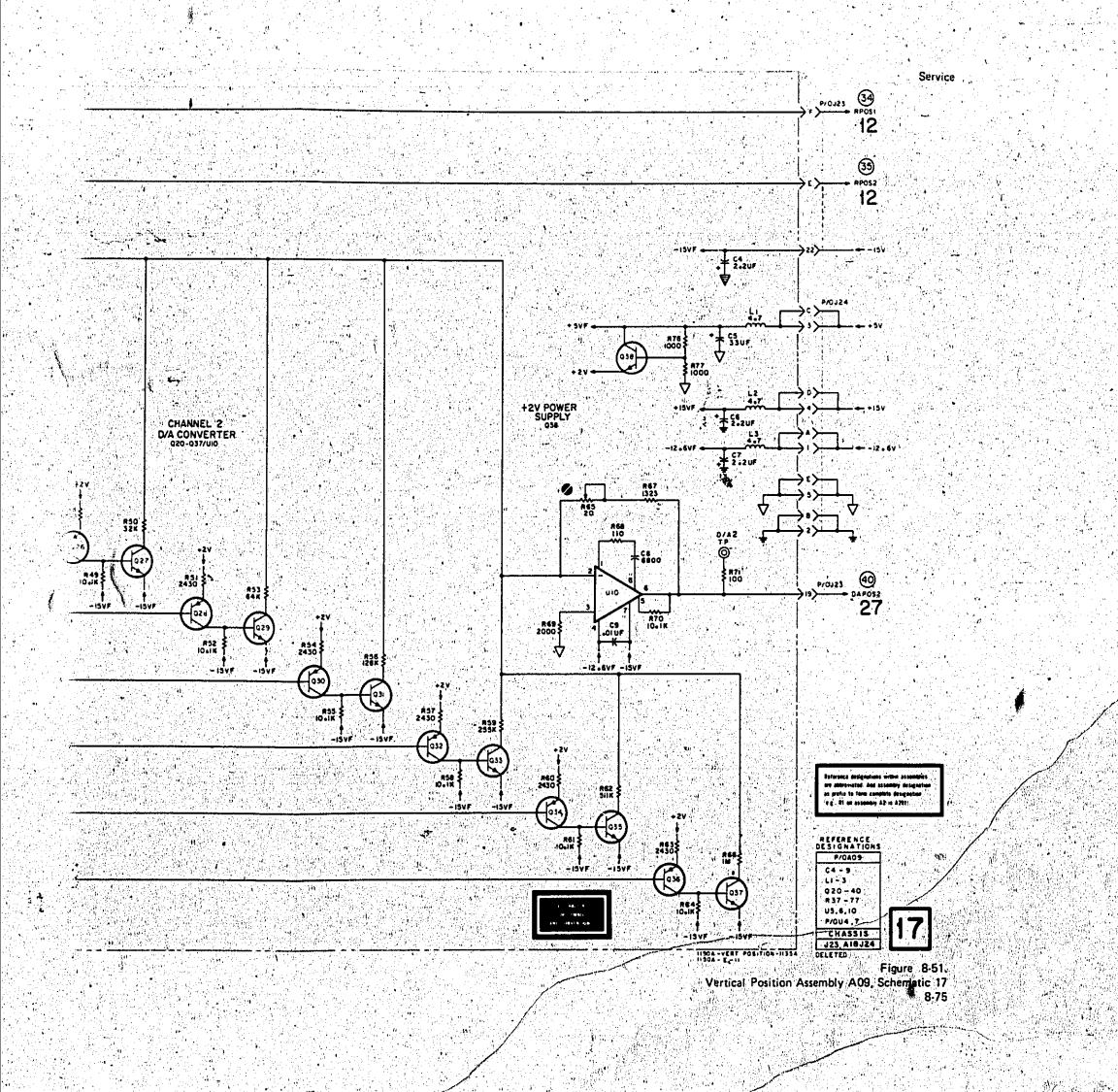


Figure 8-50. Vertical Position Assembly A09, Schematic 16





	A	B			G	H Ji		K		M	
		· S		CONTRACT TO THE COLUMN TO THE		21// ₂ // _{23//}					
2			TIEST TO THE STATE OF THE STATE		alu alu	TID I	oza V				2
3		SOLO MISS MISS MISS MISS MISS MISS MISS MIS	E3	8 5		AZO AZO	id /4/3)				3
4		<u> </u>		EB 600			B				4
.5			J27) 2345 A BCDE	FHJKLMNPRSTUVWXYZ	All	AAS et i e e e e e e e e e e e e e e e e e	7 181920212 2 J28				5
6									Y		6
			눈이 넘 내는 눈이 보지 못했다. 일 병 너무	REF GRID REF GRID REF DESIG LOC DESIG LOC DESIG C1 J-3 CR9 G-4 R5 C2 I-4 CR9 G-4 R6 C3 D-4 L1 I-3 R7 C4 C-4 Q1 C-4 R8 CR1 H-4 Q2 C-3 R9 CR2 H-4 Q3 C-4 R10 CR3 G-4 Q4 C-3 R11 CR4 G-4 R1 H-4 R12 CR5 F-4 R2 H-4 R13 CR6 F-4 R3 H-4 R14 CR7 I G-4 R4 H-4 R15	G-4 R16 C-3 F-4 R17 C-2 F-4 R18 C-3 G-4 R19 C-2 G-4 R20 C-3 G-4 R21 C-2 k-3 R22 C-3 F-2 S1 C-1 F-2 U1 F-3 C-2 U2 F-2 C-2 U3 E-2						
				Circuit bo componen ing from	pards have plated through thoses. This permits sold either side of the boa	igh ier ird	2			1150	A = R = 11.

Figure 8-52. Component Identification, Assembly A11

		galag. Se ye	ws:		В	IT LC	CAT	ON a	nd L0	OGIC	LEVE	1				
FUNCTION	15	14	13	12	.11	10	9	8	7	6	5	4	3	2	10	0
Assembly Address	1	0	1	1	76.7 25.7				- 3 A			in the second	# 6.4 # 1.4			
Main Sweep	V, 40							0					ay •			
Indicator Main Sweep							*									
Speed:		9														
50 usec/div							• **)			-	0 ,	0	0	0
usec/div*		gradi gradi						¢					. O	0	: 1.	0
0 usec/div													0		.0	0
5 usec/div													0	1	0	3 // 1
2 usec/div 1 usec/div								•				2000 III 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	0		1	0
1 usec/div				,				• 14					1	0	o	0
0.2 usec/div								•					, 1,	0	.0	, 1
0.1 usec/div							1.						1	0	1	Ō
50 ns/div													1	į	0	0
20 ns/div		k.							อพูร อ				1	1	0	1
10 ns/div												Sept.	مهبي	1	1.1	0

Binary codes for expanded sweep speed programming are as follows:

					श्र	T LO	CATI	ON an	d FOC	iic Li	VEL				in and Staget	
FUNCTION	15	14	13	12	11,	10	9	8 ,	7	6	5	4	3	2	1	0
Assembly Address	1	0,	, 1	1	W.			1							10 10 to	
Expand Sweep Indicator		γ			Y			1								3
Expand Sweep.		Villa Sign												À.		
, 20 usec/div	1	Mr.							0	0	0	1				
10 usec/div \			#65 1875 \ 1875 \						0	0	1 .	0	J.			
5 usec/div							* ·		0 😽	\ 1 \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0	0	1. T. T.			
2 usec/div					11), † N. e	0	1	. O	1	Y	go ind North		
1 Vusec/div				1	A.				0	1	i.	0	F.	185 (4) (4) (4)		35
0.5 usec/div			***		υ. " ν		S.		1	0	0	0.				
0.2 usec/div					31, 4 31, 4	1			1	0	0	1 / 2 2 1				
0.1 usec/div		\		1				₹ P	1	0	1	0	3.41		\.\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
50 ns/div			W						1	1 4	0	0)	, Y	
20 ns/div						1 W.C. 1 Sept. 1			1	1	0	1 1			Y	
10 ns/div				1				. '	1 %	1	7. 1 5.7 7-2	0				20
5 ns/div		•			W				0	0	0	0				
2 ns/dix									0	0	0	1				
1 .ns/div				1.					0	0	1	0				
0.5 ns/div									0		0	0		5.14		
0.2 ns/div	3.		T : ")				$\int_{\mathbb{R}^{N}} X_{n,j}$		0	1	1.00	0		1		1.33

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

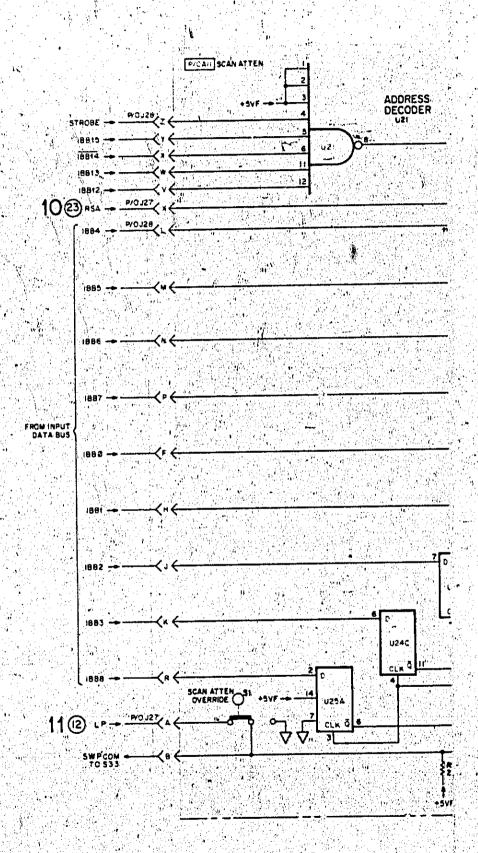
2. Expanded sweep selection procedure:

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

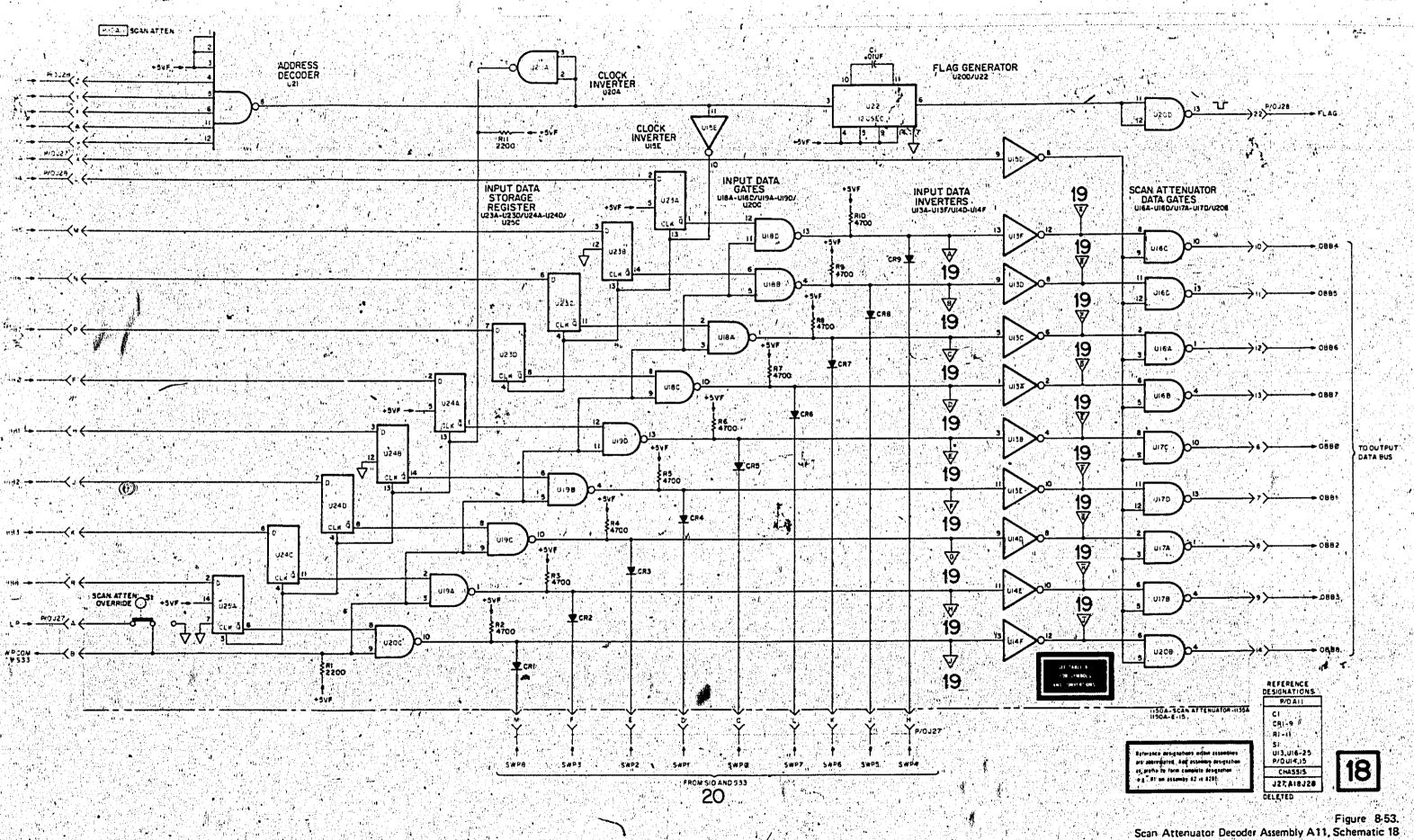
(b). Select expand position on Expand Position Assembly, A06.

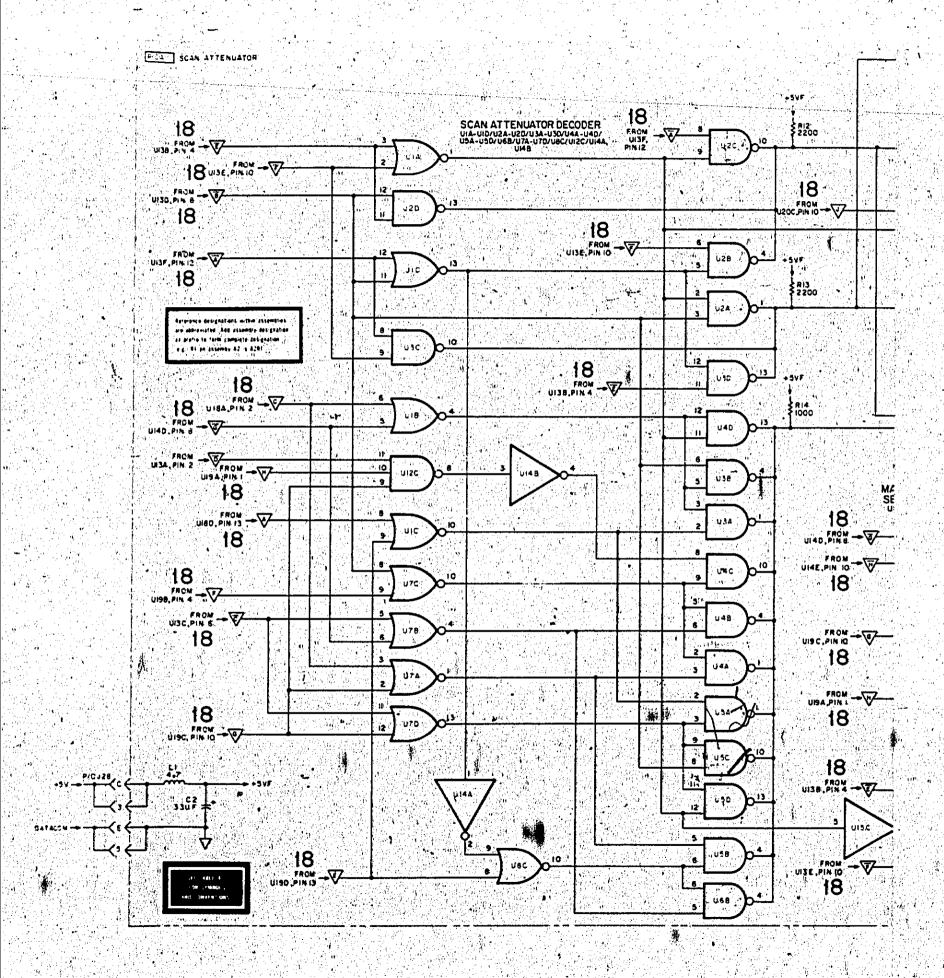
(c). Select desired expand sweep speed (bits 4-7).

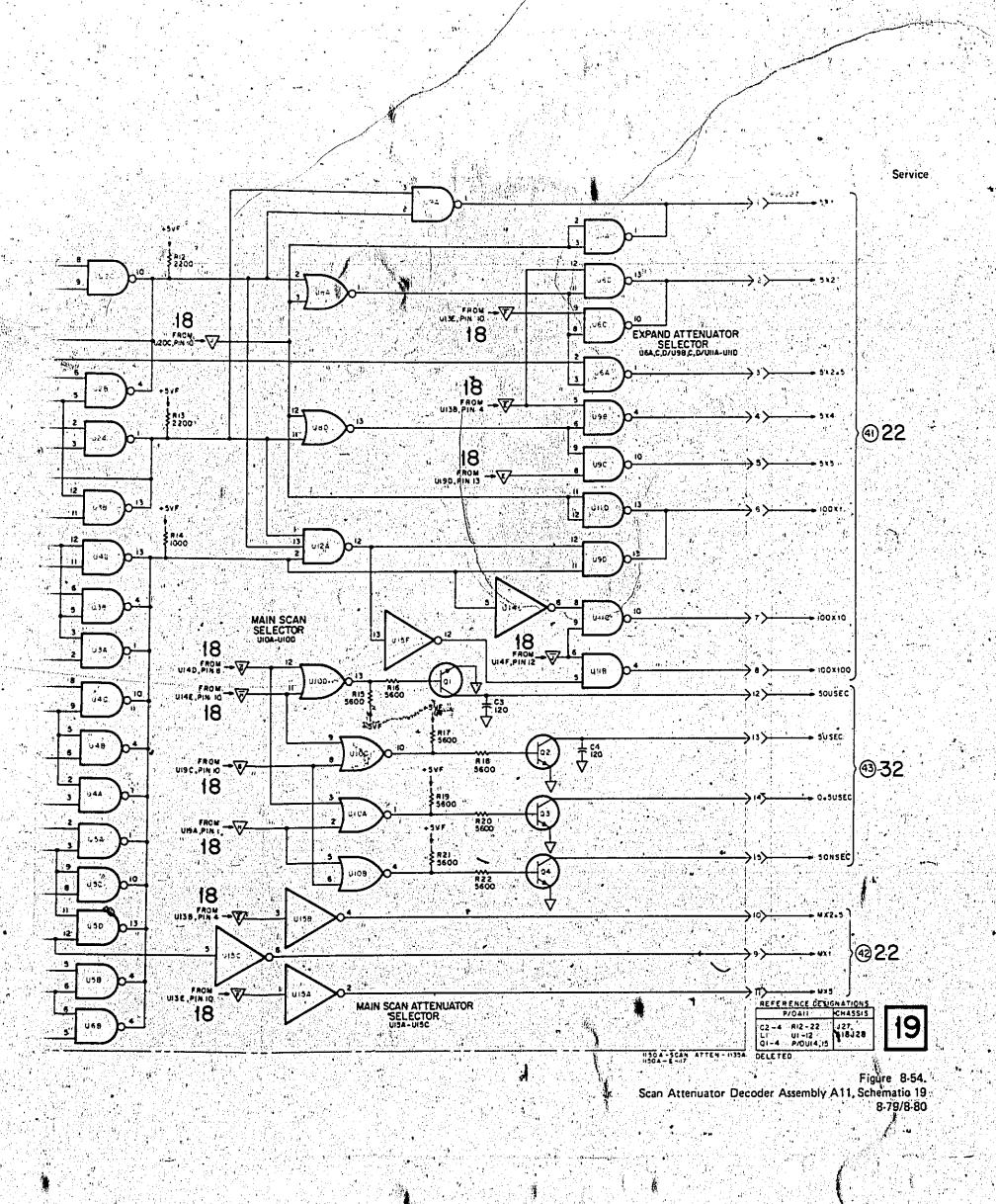
(The ratio of main/expand sweep ≤ 100.)



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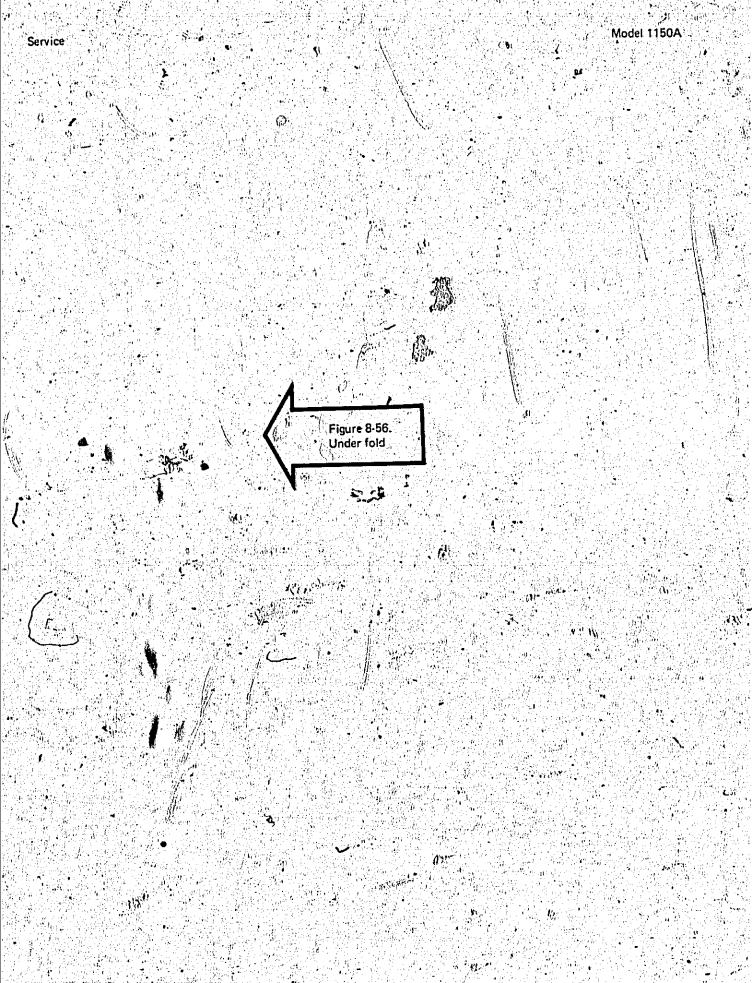


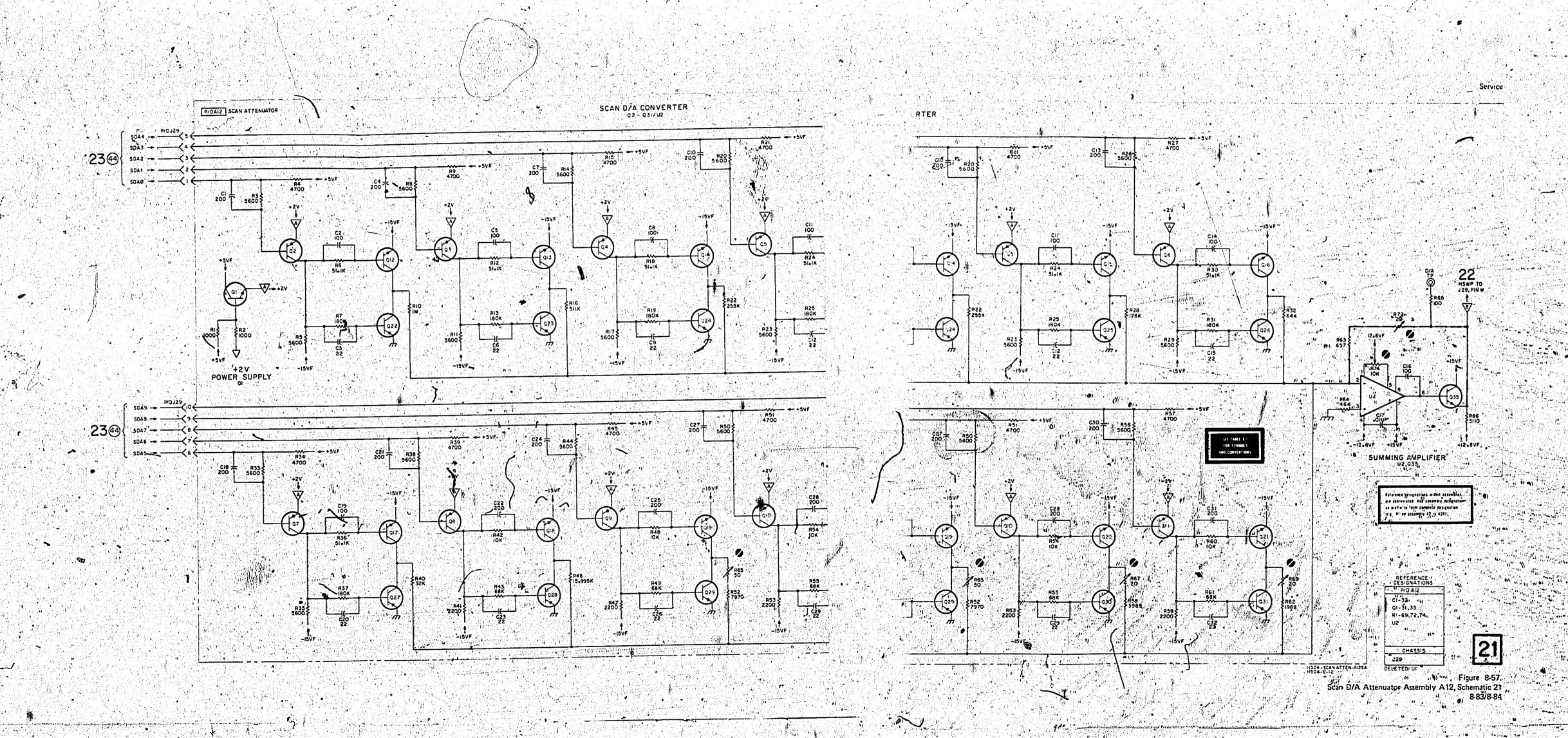


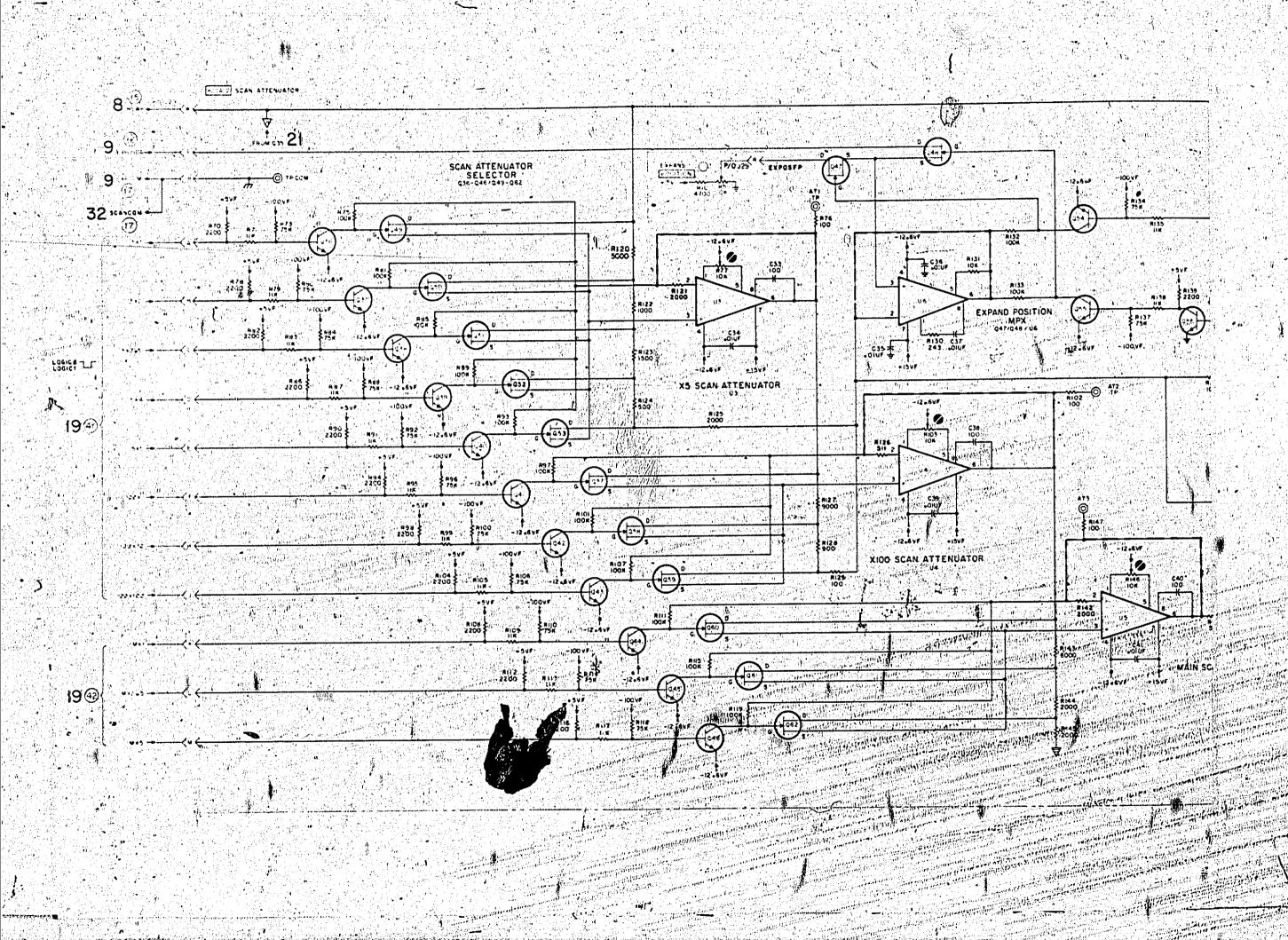


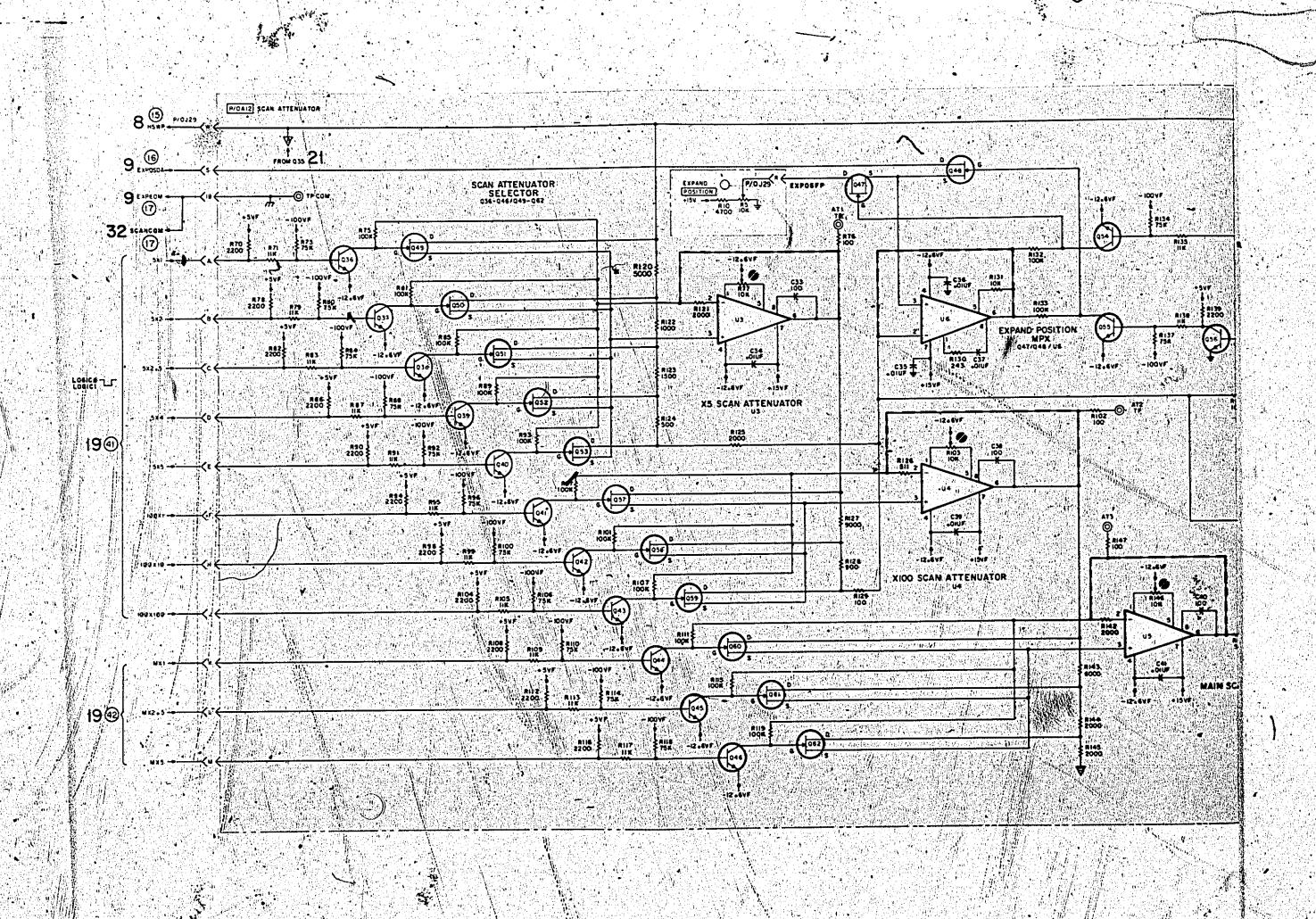
									1 100													***********								
		A			B		C			D		E		F		G								K :				M		
1						が 100mm (大きな) 10								AT2	AT3		D/A	COM	Ř7											
2		を できる		を対する			A 100 CO	CR5 R152 CR5 R152 CR6 R150 CR7	CR8 R162 C42 R160 R151	1 033 C43 034 1159	(SH) (SH) (SH) (SH) (SH) (SH) (SH) (SH)	EST FEET OF THE PERSON NAMED IN COLUMN TO A COLUMN TO	ii Kiris	TE SE	16	i si	0222 · RES	RTIG REA .	025 R28 R66 C16	027 R40		R58 R6								2
3							(B)(0) 9(0)	037* 050 878 037* 050 8122 038 Q51 813	O39 O52 R128	R93 C41 R12 R127 C42 C45/ R97	O43 O58 R101 R179 O44 O59 R179 R107	COLS COCO RICE COCS COCO RICE	- ,	RIST (S)	R136 R136 R138	R136 R140	RF .	R13 R19 R19	C12) R25 O15 C11 R24 R23 C11 R31 R33	R30 ,	R42 R49 R48	R55 R64 R61	R60 .							3
4								R73 R73 R79 R80 R80 R82	R86 R87	R94 R95 R94 R95 R96 R96	R104 R105 R106 R106 R109 R110	(R112) R113 R114 (R118) R117 R118	_	(25) (25)	R164 C46 056 C27	1.2 C.5 C.5 C.5 C.5		명 등 명 등 명 등 명 등 명 등 명 명 명	R14 C7 R20				3							4
5									J 29	1234 ABCE	5678 EFHJ	PIOILIZI3	14151617 R S T U	181920212	22 7	Al2	1 2 3 _ A B C	4 5 6 7 D E F H	891011 12 J K L M N		7 8 9 202 U. V.W. X. \	122 J30 (Z				J				5
6														compone ing from	ent holes.	ave plate This perr side, of	nits solde the boar	r- d.					5 45 5 C + 5	a condi		6910	REF	GRID		6,
	C1 C2 C3 C4 C5 C6 C7 C8 C9 C10		00 [REF DESIG C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C35 C37	GRID LOC 14 13 13 14 13 14 13 14 13 14 13 14 13 14 13 14 13 13 14 13 14 13 14 14 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	REF DESIG C41 C42 C43 C44 C45 C46 C47 C48 C51 C51 C72 C72 C72 C72 C72 C72	GREC GDDWDGGGGTFW	REF DESIG L2 L3 Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10	GRID EOC G4 G4 H4 H4 H4 H4 H4 H4 H3 H3 H3 H3	Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27	GRID REELOC DES	D3 D	Q59 Q60 Q61 Q62 Q63 R1 R2			H-2 H-36 H-3 H-3 H-3 H-3 H-3 H-3 H-3 H-3 H-3 H-4 H-4 H-5 H-4 H-5 H-4 H-3 H-4 H-4 H-4 H-4 H-4 H-5 H-4 H-5 H-4 H-5 H-4 H-5 H-4 H-6 H-6 H-6 H-6 H	IG FOC	REF DESIG R551 R557 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68	14. 15. 12. 13. 13. 13. 14. 14. 14. 14. 14. 14. 14.	0ESIG L 1776 1777 178 179 180 181 182 183 184 185	RID REI OC DESI RE2 R96 E-2 R97 C-4 R98 C-4 R10 C-4 R10 C-4 R10 C-4 R10 D-4 R10 D-4 R10 D-4 R10 D-4 R10 D-4 R10	-0.4 0.3 0.4 0.4	R116 R117 R118 R119 R120 R121 R122 R123 R124 R125 R125		REF 'OESIG R136 R137 R138 R139 R140 R141 R142 R144 R145 R144 R145 R145 R147 R148 R150 R151 R152 R153	G-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3	R156 R157 R158 R159 R160 R161 R162 R163 R164 S1 TPAT1	D-2 E-2 E-2 D-2 D-2 E-2 D-2 F-4 G-2 E-2		
	C12 C14 C14 C16 C17 C16 C18 C18 C20	3.4 5.6 7.8 9.0	14 13 13 14 14 14	C33 C34 C35 C35 C36 C37 C39 C39	F-3 G-3 F-2	CR5 CR6 CR7 CR8	E-2 E-2 C-2 C-2 C-2	Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18	13	Q35 Q37	J-2 Q4 J-2 Q5 J-2 Q5 D-2 Q5 D-2 Q5 C-3 Q5 C-3 Q5 C-3 Q5	5 F-4 6 G-4 7 D-3	R12	H-3	R28 R29 R30 R31 R32 R33 R34	1-2 R48 1-3 R56 1-3 R5 1-2 R55 1-4 R55 1-5 R54 1-3 R55	1 J.5 2 J.2 3 J.3	R68 R69 R70 R71 R72 R73 R74 R75	C4 F C4 F	190 191 192 193 194	D-4 R10 D-3 R10 D-4 R11 D-4 R11 D-3 R11 D-4 R11 D-4 R11	1 E-3 2 E-4 3 E-4 4 E-4	R129 R130 R131 R132 R133 R134	13333333 F F F F F G	R149 R150 R151 R152 R153 R154 R155	C-2 C-2 C-2 C-2	TPAT3 TPD/A TPCOM U2 U3 U4 U5 U6	# H-2 H-2 E-2 F-2	BOA	

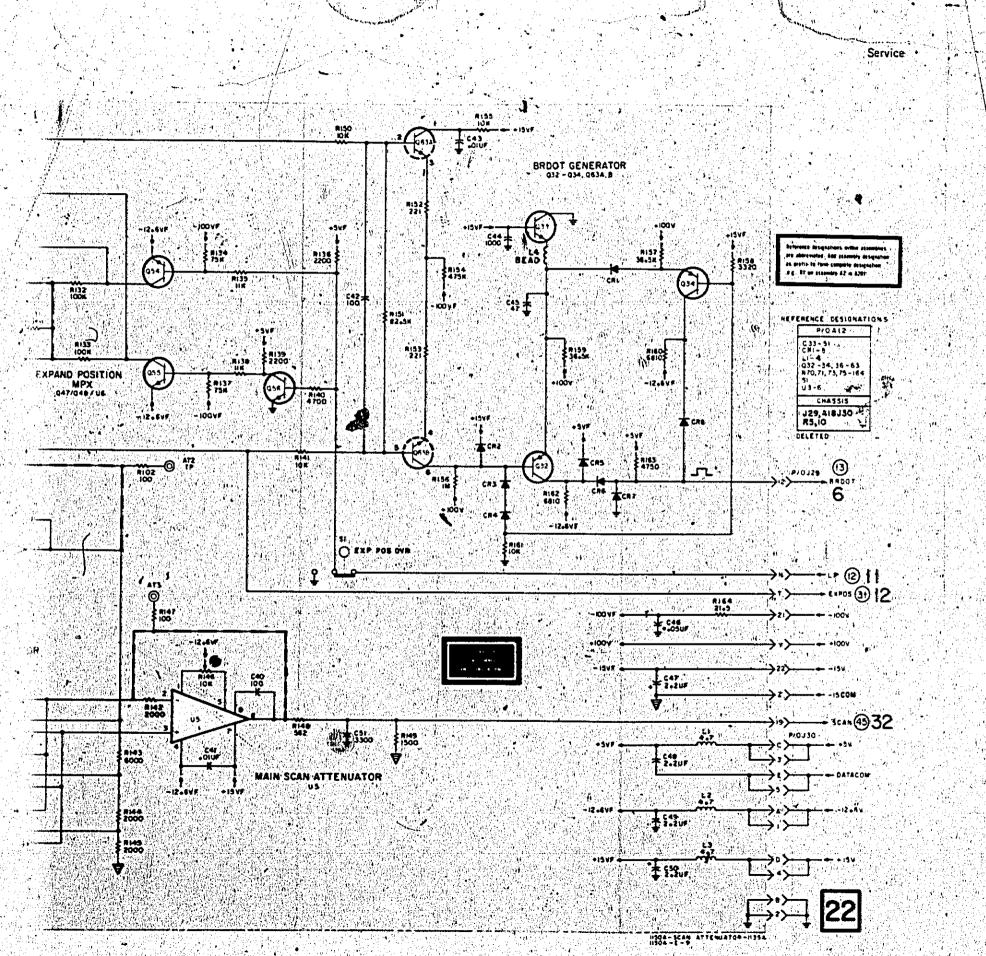
Figure 8-56. Component Identification, Assembly A12











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A	B .	C	· D	E		G		./(1		Winds and the second	
		لمنا	13 ST			-enn (III)	COLD .	TETO.					'2 '
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			Tra V	777	(C. 10. (.)	END CONTRACTOR	609 609 609 609	3 9 9	3	,		<i>, 4</i> ,	
			7-1-1-1-131	ABCOE FHJKL	MNPRSTUVWXY	Al3	ABCDEFHJKL	MNPRSTUVWXY	3 J32 2		\bigcap		5
													6
				11 Karls 41 1	2 H4 R9 11 H4 R10 11 H4 R10 12 G4 R12 13 H3 R13 14 E2 S1 15 E2 U1 16 F2 U2 17 F2 U3 18 H4 U4	H-4 U5 H-2 U6 H-4 U7 F-3 U8 F-4 U9 D-2 U10 J-4 U11 J-2 U12 H-4 U13 1-4 U14	i4 U16 I H3 U16 I H3 U17 I I3 U18 I D2 U19 I I2 U20 I I2 U21 I I2 U22 I G3 U23 E2 U24 I						
					TID TO TO TO THE PROPERTY OF T		The color The	AIS ABCOEFHJIKLINNPRSTUVWXYZ ABCOE FHUKL MNPRSTUVWXYZ ABCOE FHUKL MNPRSTUVWXYZ ABCOE FHUKL MNPRSTUVWXYZ AA13 DESCRIPTION OF THE PROPERTY OF THE PROPERT	A SCOEFNIKLMAPRSTUVWXYZ A SCOEFNIKLMAPRSTUVWXYZ A SCOEFNIKLMAPRSTUVWXYZ A SCOEFNIKLMAPRSTUVWXYZ A SCOEFNIKLMAPRSTUVWXYZ A 13 A 13 A 14 A 15 A	ABODE FIJAL MINDASTUVWXYZ ABCDEF FIJAL MINDASTUVWXYZ ABC	A BODEFNIKLMARSTUVWYZ	ABGGE FIJALUAPASTUVENTZ ABGGE FIJALUAPASTUVEN	

Figure 8-59. Component I dentification, 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:

					В	IT LO	CATI	ON a	nd LC	GIC L	EVEL					
FUNCTION	15	14	13	12	ίi	10	9 .	8	. 7	6	5	4	3	2	i	0
Assembly Address	; j,	1	O	1												i de la
SCAN Function Identifier				1	0 (
Internal Scan Identifier																
SAMPLES/DOT: (See Note)																
													0	0		
3									4.0				0 1	0		
DOTS/SCAN:										ym,						
1024 512															0	0 1"
256																0
128								e e Nasa	•						1	1

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

3. Binary codes for the external scanning function are as

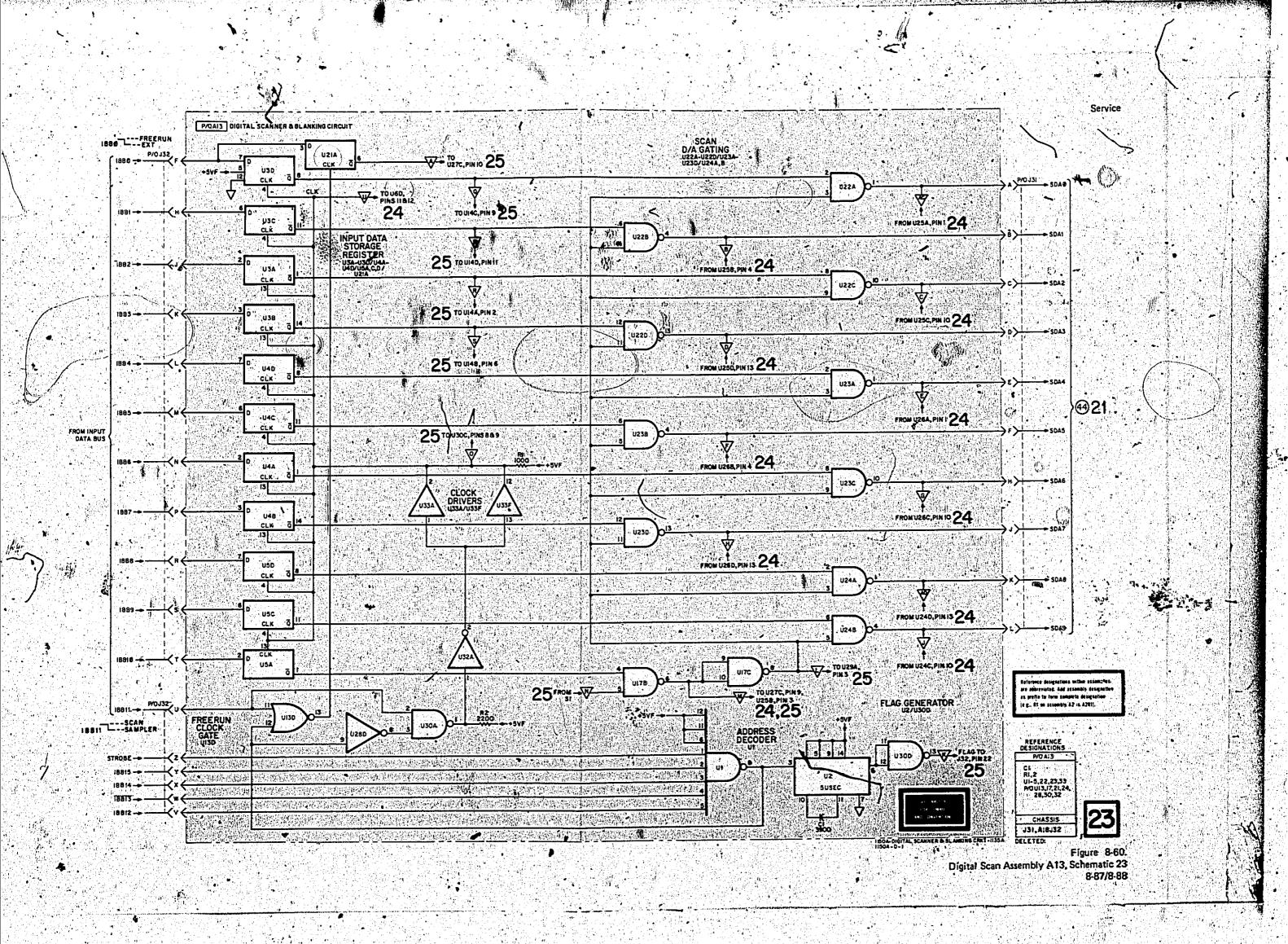
					В	Ţ.LC	CATI	ON a	nd LO	GIC I	EVE	ا الله				
FUNCTION	15	.14	13	12	11	10	9,	8	√ 7 ∴	6	5	*	3	12	(t)	0
Assembly Address SCAN Function Identifier: External Scan Identifier EXTERNAL "SCAN		· 多种种 · · · · · · · · · · · · · · · · ·	0		0						See N					

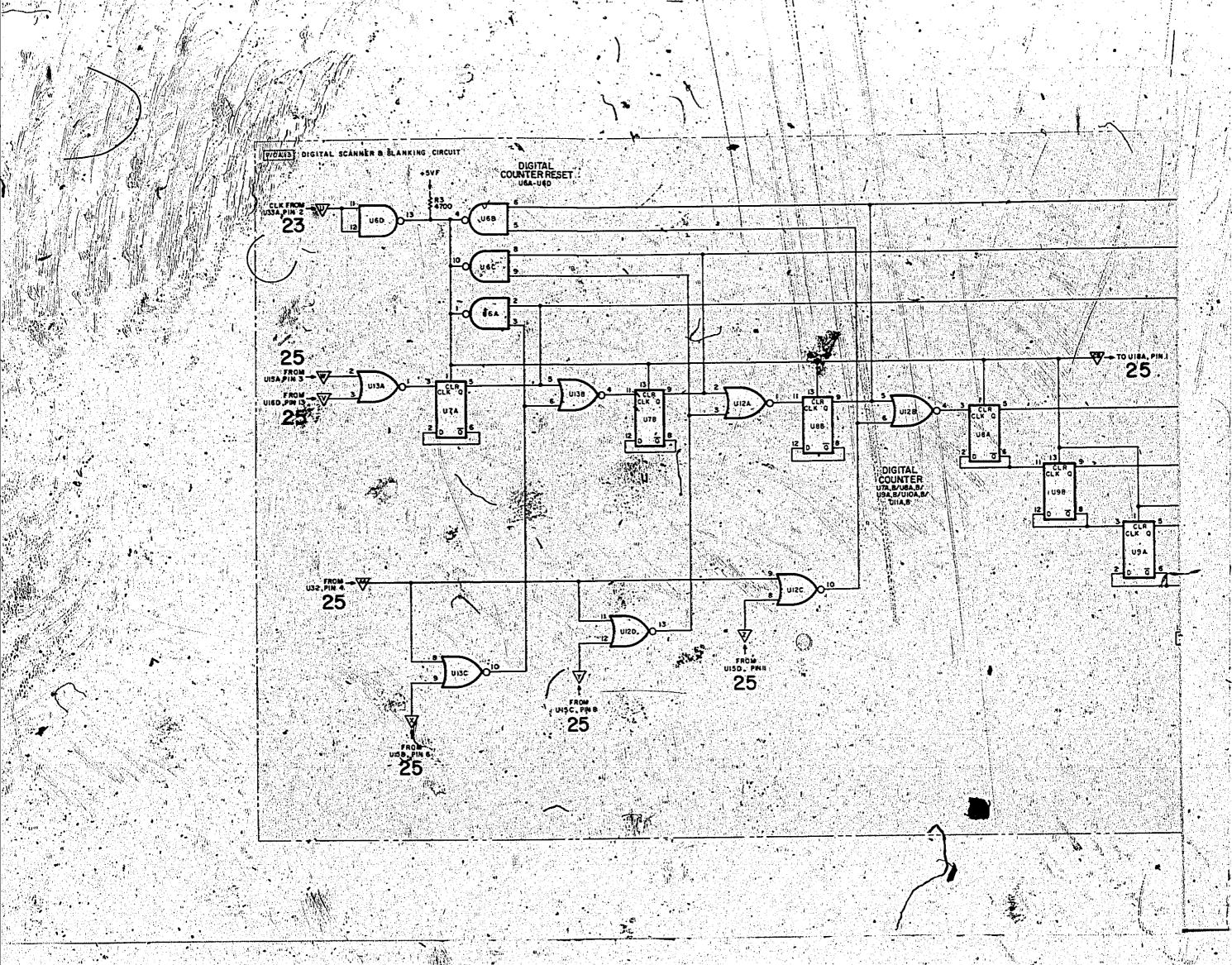
Note: 10-bit word that is applied to a D/A converter, Analog output of 0 to +10V represents 0 to 10 horizontal divisions on the CRT.

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

				(jør	В	T LC	CATI	ON a	nd LO	GIC L	EVE	L'				
FUNCTION	15	14	13	12	11	10	9	8	版物語 人 7 語	6	5	4	3.3 3.3	2.	1.	0
Assembly Address SAMPLE Function Identifier FREERUN EXTERNAL SAMPLER CONTROL	· 化二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十		0	1.32			/	1988年の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の								· •

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.





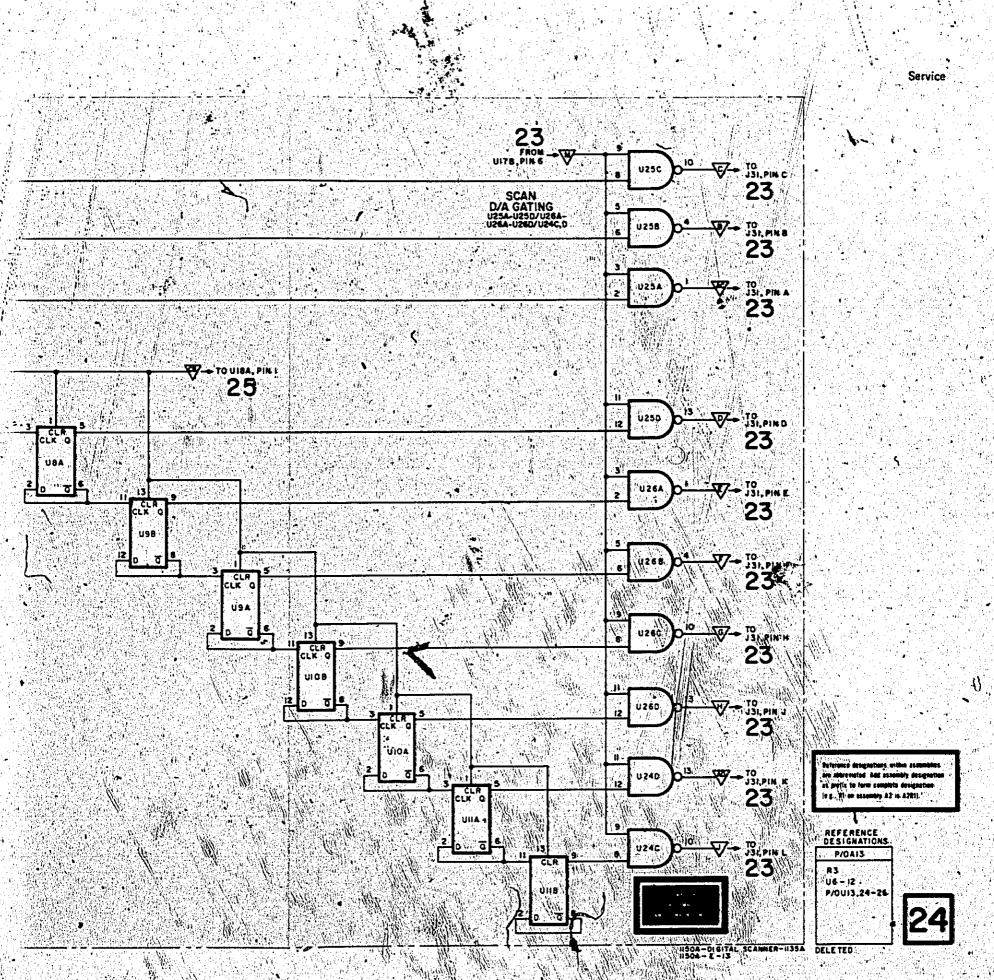
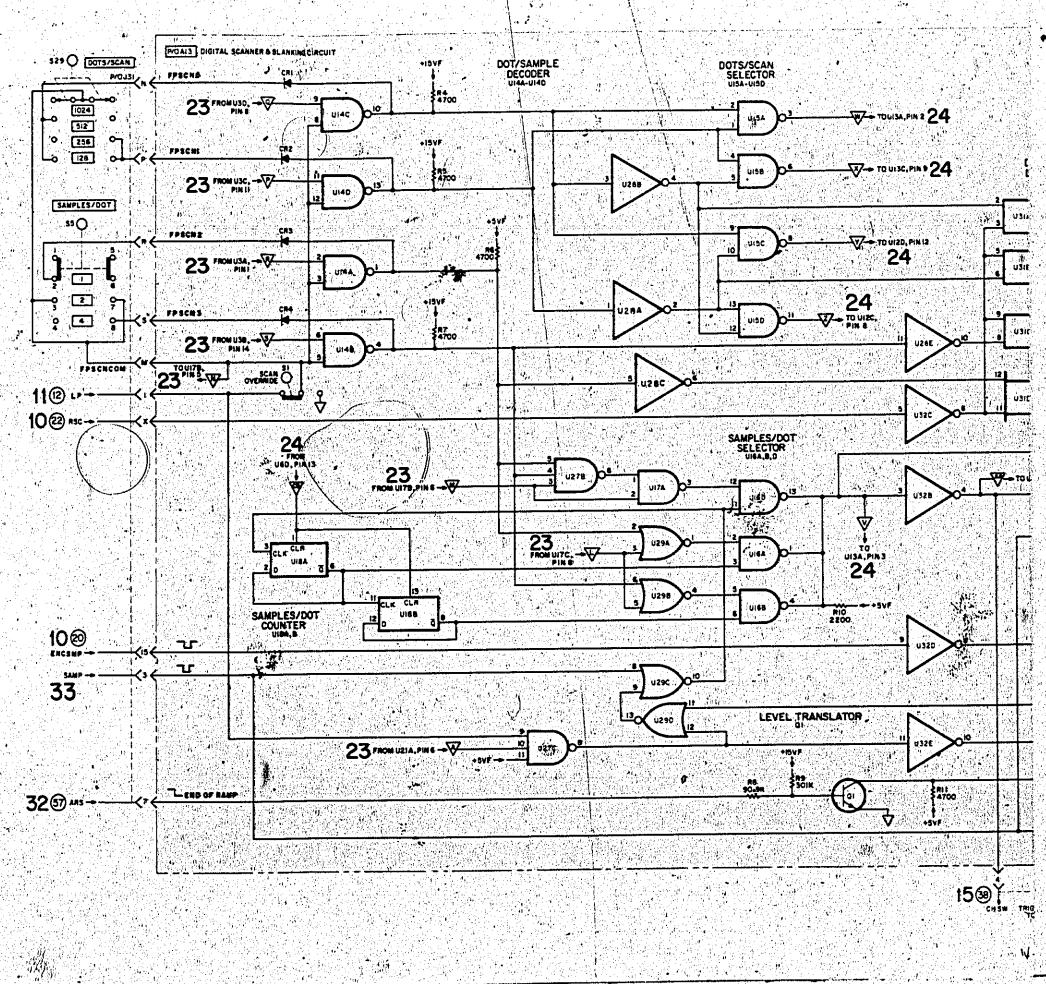
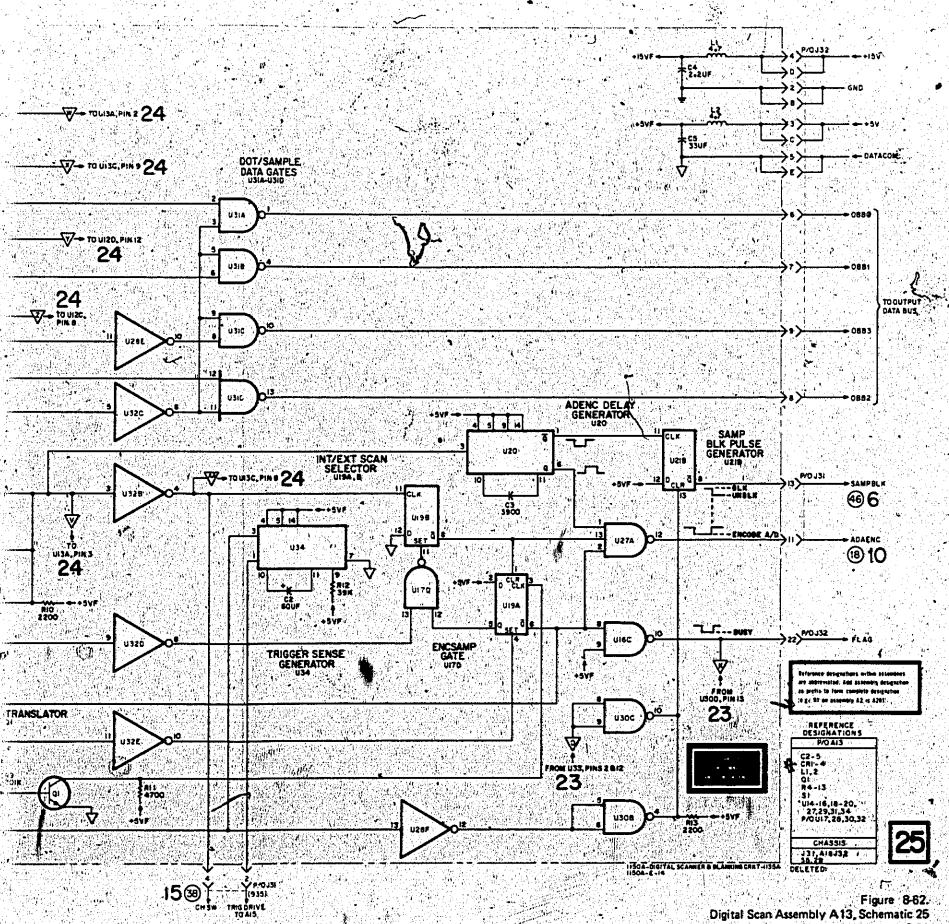


Figure 8-61.
Digital Scan Assembly A13, Schematic 24

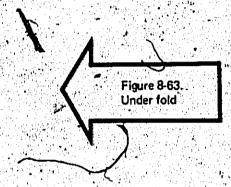


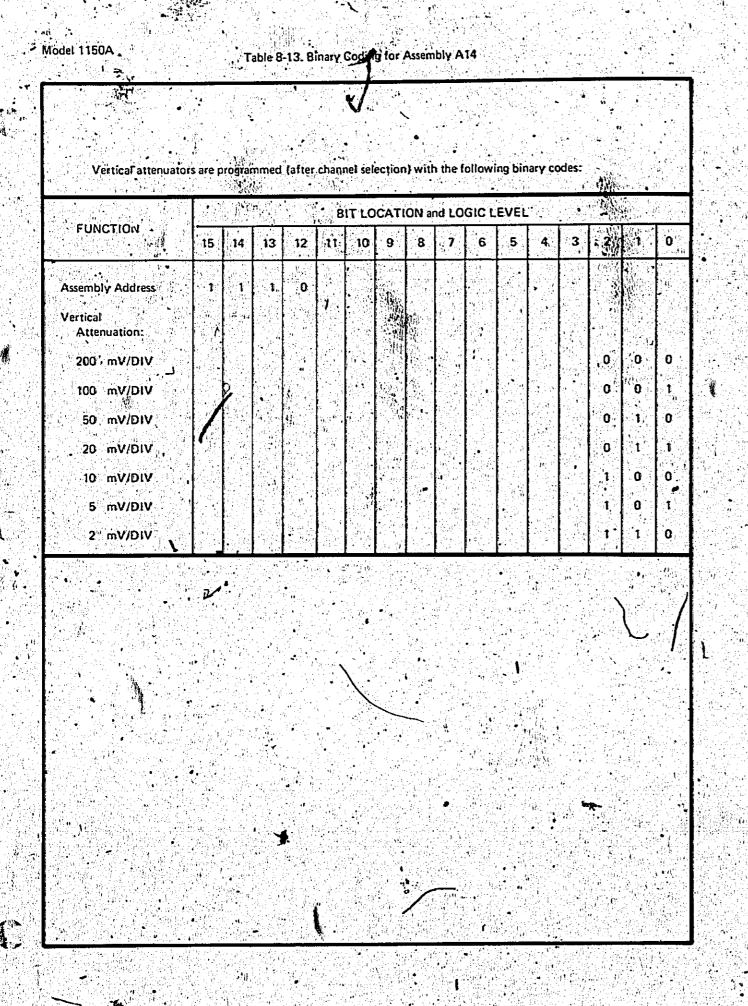


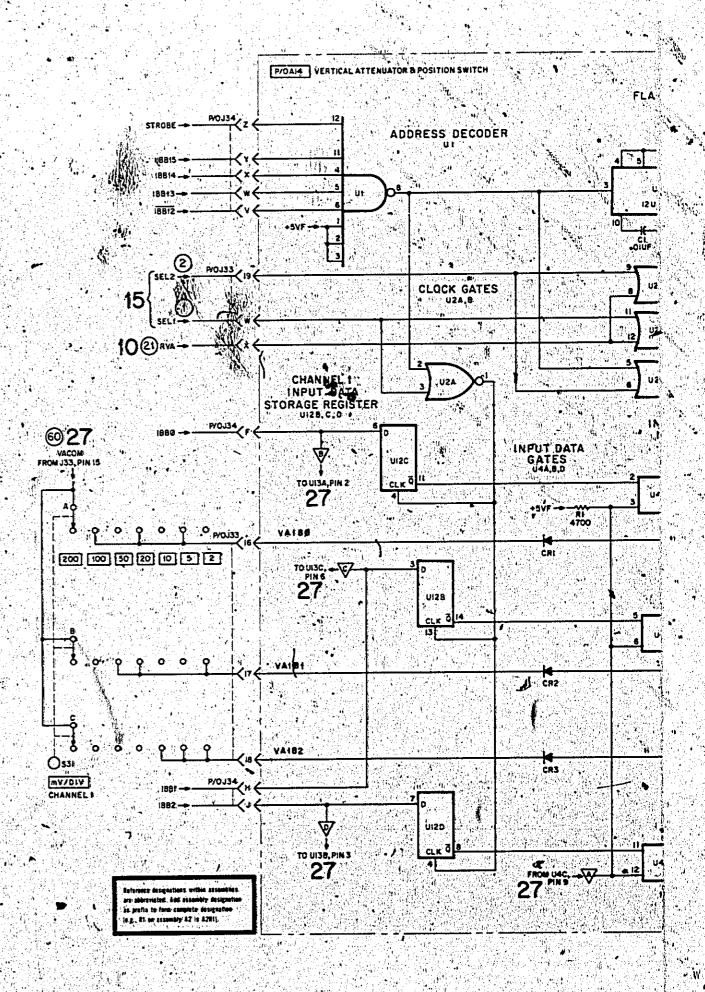
Digital Scan Assembly A13, Schematic 25

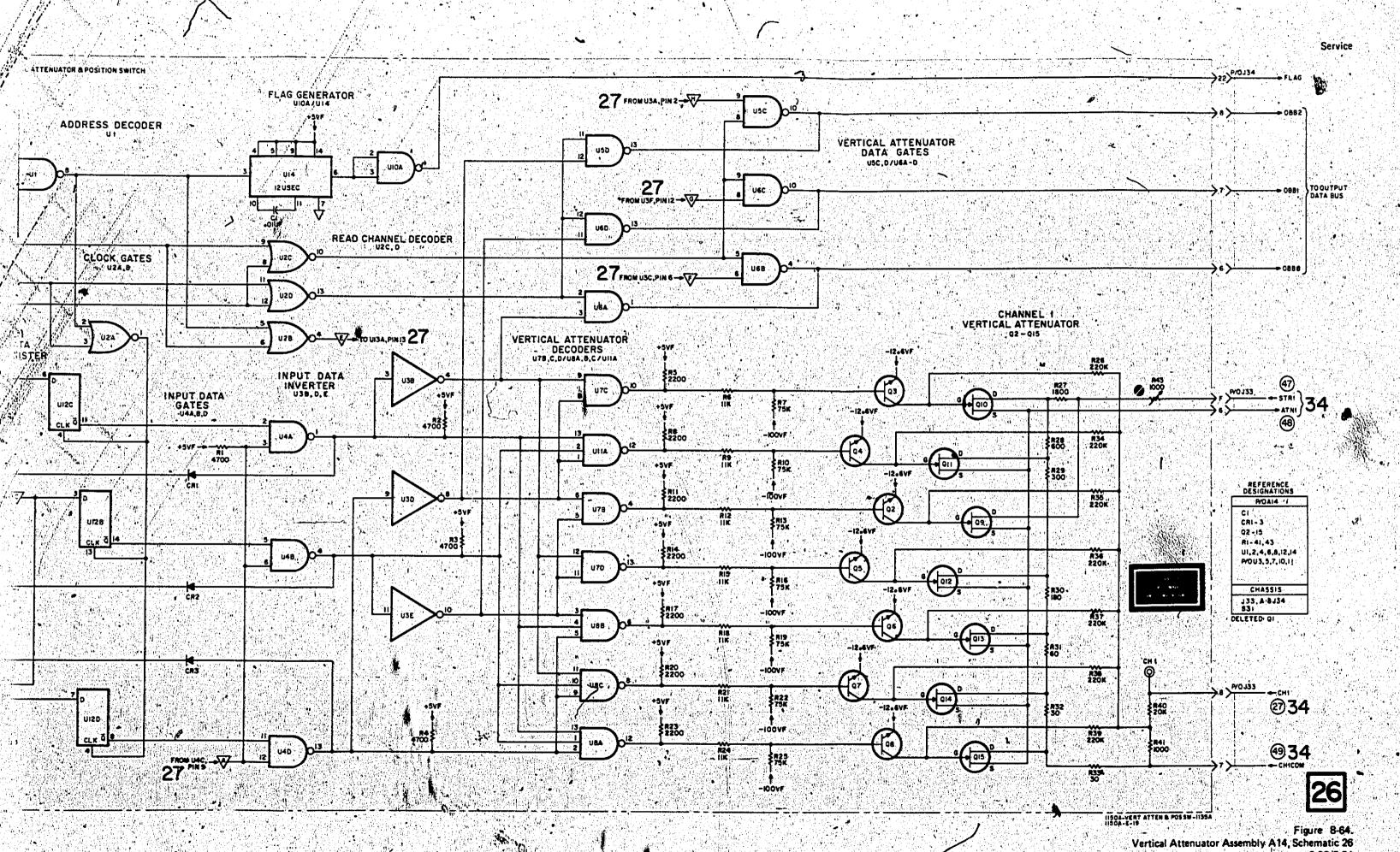
							•			F 13.5%		•	<u> </u>	<u> </u>				,			Artest La	El .	<u> </u>
4	A	В	C	[*] D		E		F		G			H					J * ·	K			.≽M	
								4		and the second													
2	V				CALL E	8]				67×1824 CH1	C REST			UB _		E E	20		면 기/6 기구 대 기/6 기구				2
3						(Z)			_ ^	~	00 00 00 00 00 00		" · ' <u> </u>	第2 图 · 图 · 图		(E)			U 1				3
4					Comp.					8 É 8	19 ·	(E)	(C. (L.)		- Marie 1								4
5				J33 (A 8	COEFH	JKLM	PRST	u v\v	Y Z	A	4	AB	CDEF	нукі	WNP	AAA R STI	TA DE	92 J3 YZ	4				5
)				REF	GRID I	EF GRI	REF	GRID	REF DESIG	GRID	REF	GRID LOC	REF DESIG	GRID	REF DESIG	GRID LOC	REF DESIG	GRID		6			
				C1 C2 C3 C4 C5 C6 C7 C8 CR1 CR2 CR3 CR4 CR5 CR7 CR8 CR7 CR8 CR10 CR11 CR12 L1 L2 L3 Q2 Q3	K11 D22 G G G G G G G G G G G G G G G G G G	1884 O.F	Q31 Q32 Q33 Q34 Q35 Q36 Q37 Q38 Q39 Q40 Q41 Q41 Q42 Q41 Q43 R1 R2 R3 R4 R6 R7 R8 R8 R9 R10 R11 R11 R11 R11 R11 R11 R11 R11	00000000000000000000000000000000000000		Garanto a de	R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R58 R69 R60 R61 R62 R63 R63 R65	E44 149 149 149 149 149 149 149 149 149 1	R66 R67 R68 R69 R70 R71 R72 R73 R75 R76 R77 R78 R80 R81 R82 R83 R84 R85 R86 R86 R87 R88 R89 R89		R92 R93 R94 R95 R96 R97 R98 R99 R100 R101 R102 R103 R104	D44 D33 D34 D33 C52 D52 D52 D52 D52 D52 D52 D52 D52 D52 D	R119 R120 R121 R122 R123 S1 S2 AT1 AT3 AT4 CH1 CH2 U1 U2 U3 U4- U5 U6 U7 U8 U9 U10 U110 U111 U12 U13 U13 U14	C2 C4 C2 D3 C4 C2 D3 C4 C2 C2 C3 C4 C2 C3 C4 C4 C2 C2 C3 C4 C4 C2 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4	Ci	cuit boards mponent hole from eithe	have pl	ated through	

Figure 8-63. Component Identification, Assembly A14

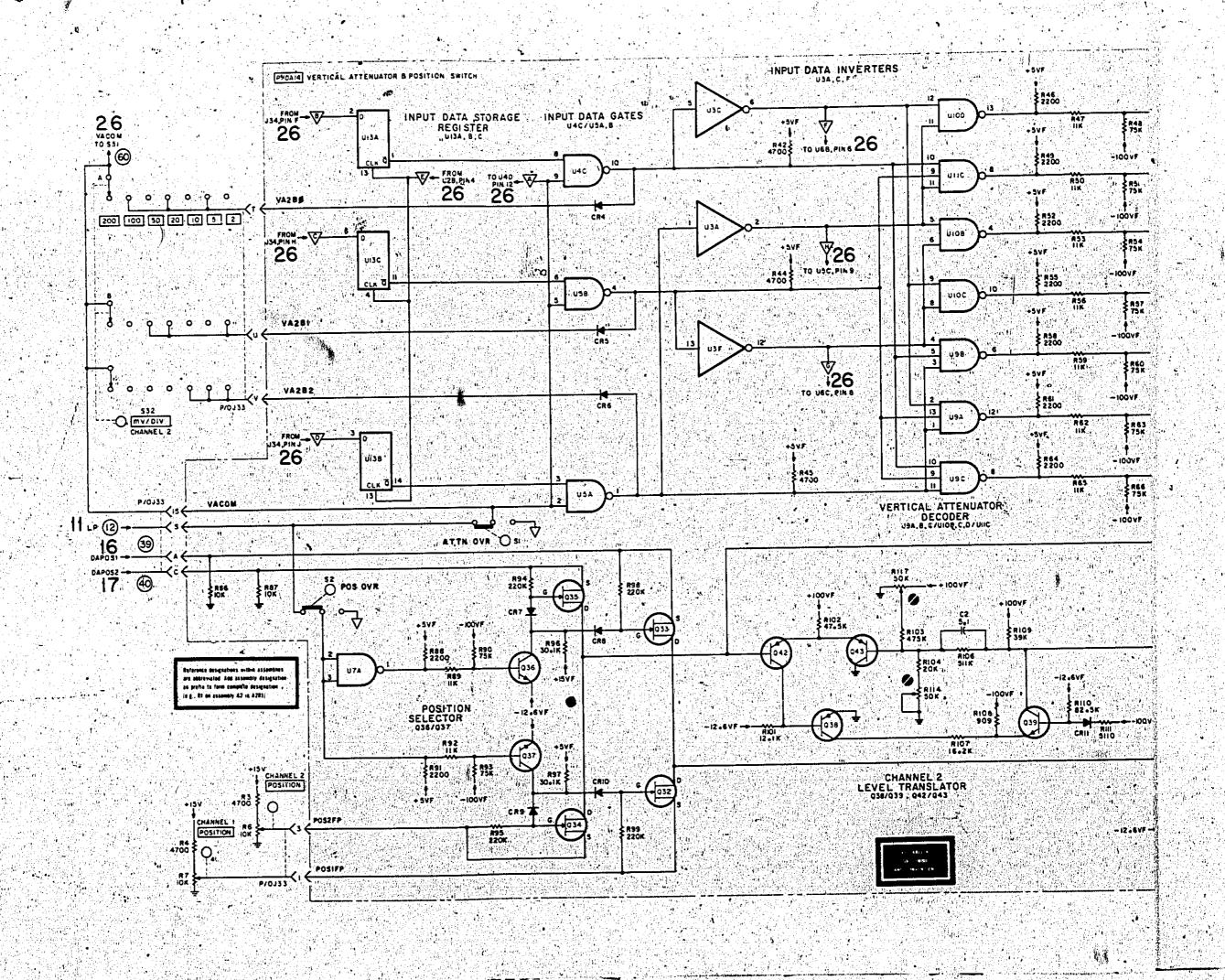


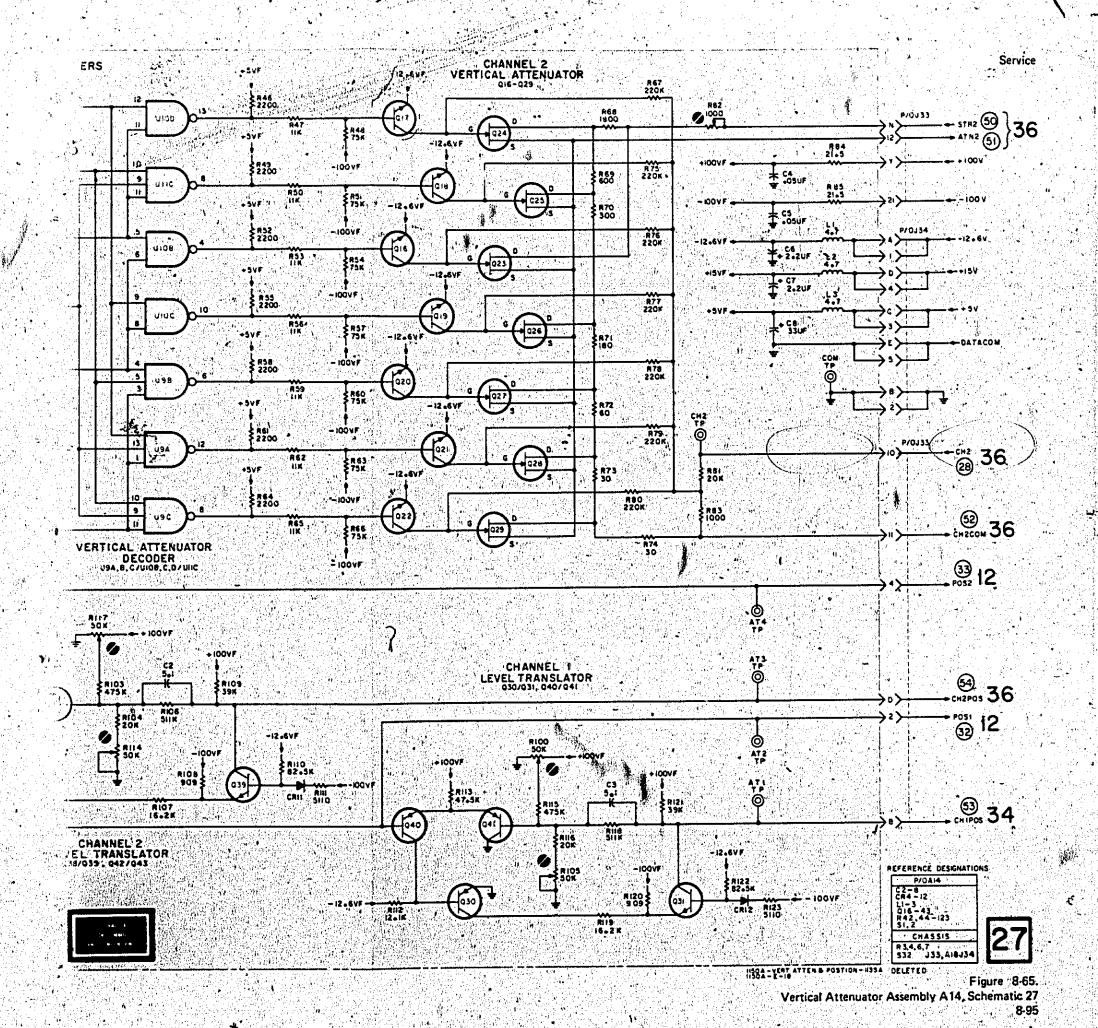






8-93/8-94





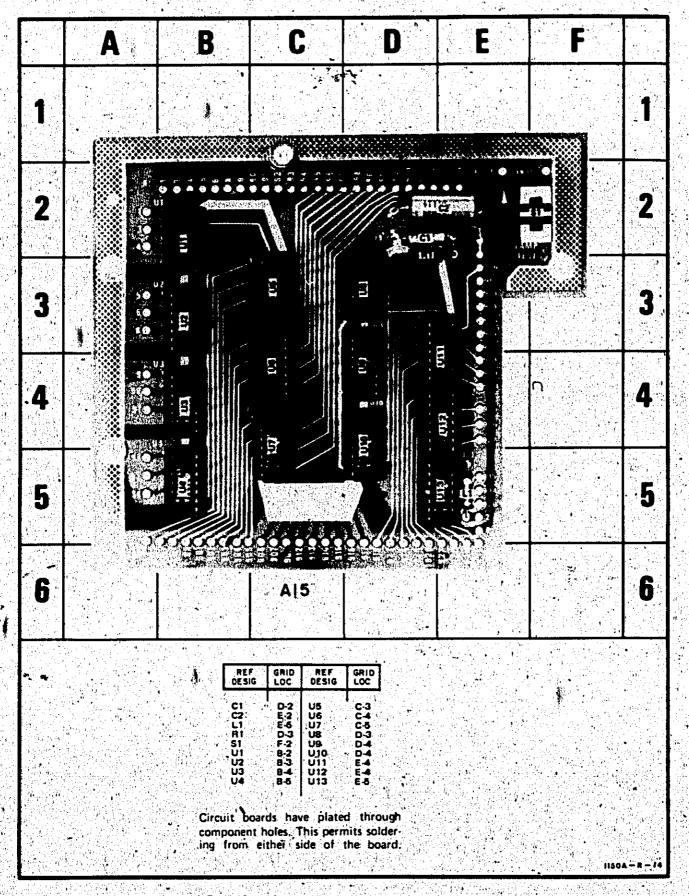
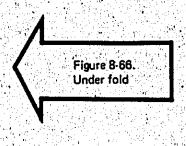


Figure 8-66. Component Identification, Assembly A15



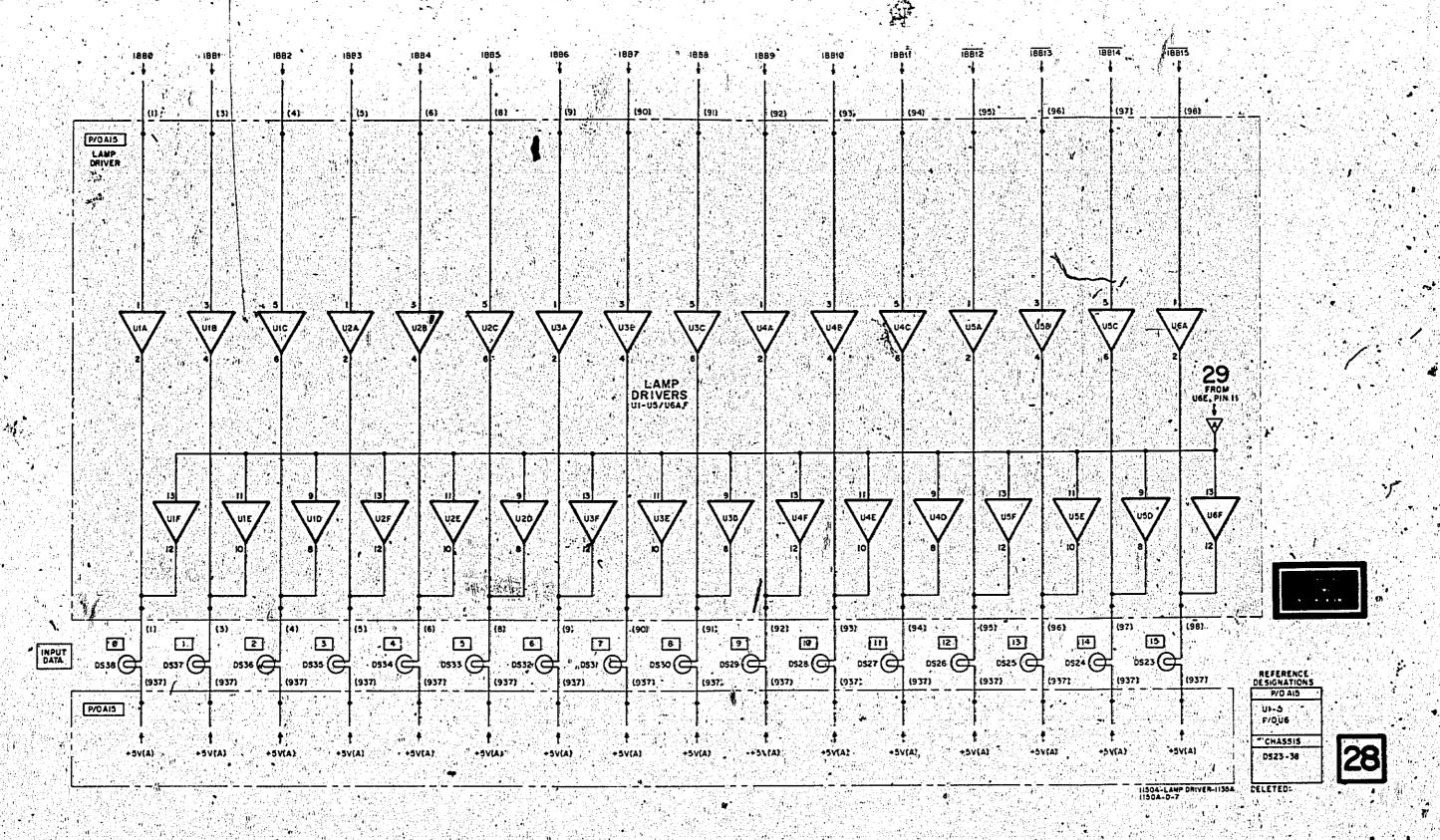
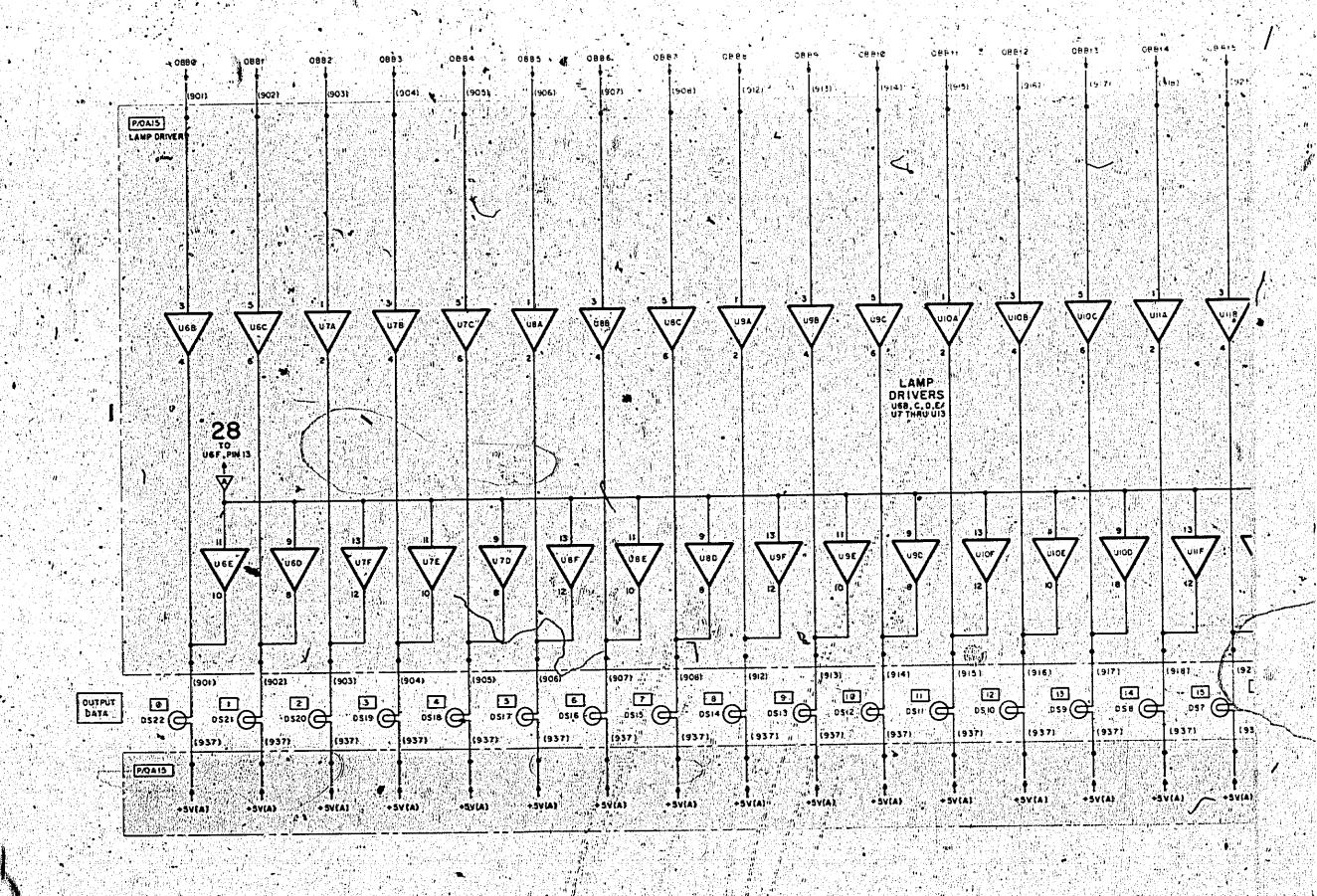


Figure 8-67. Lamp Driver Assembly A15, Schematic 28 8-97/8-98



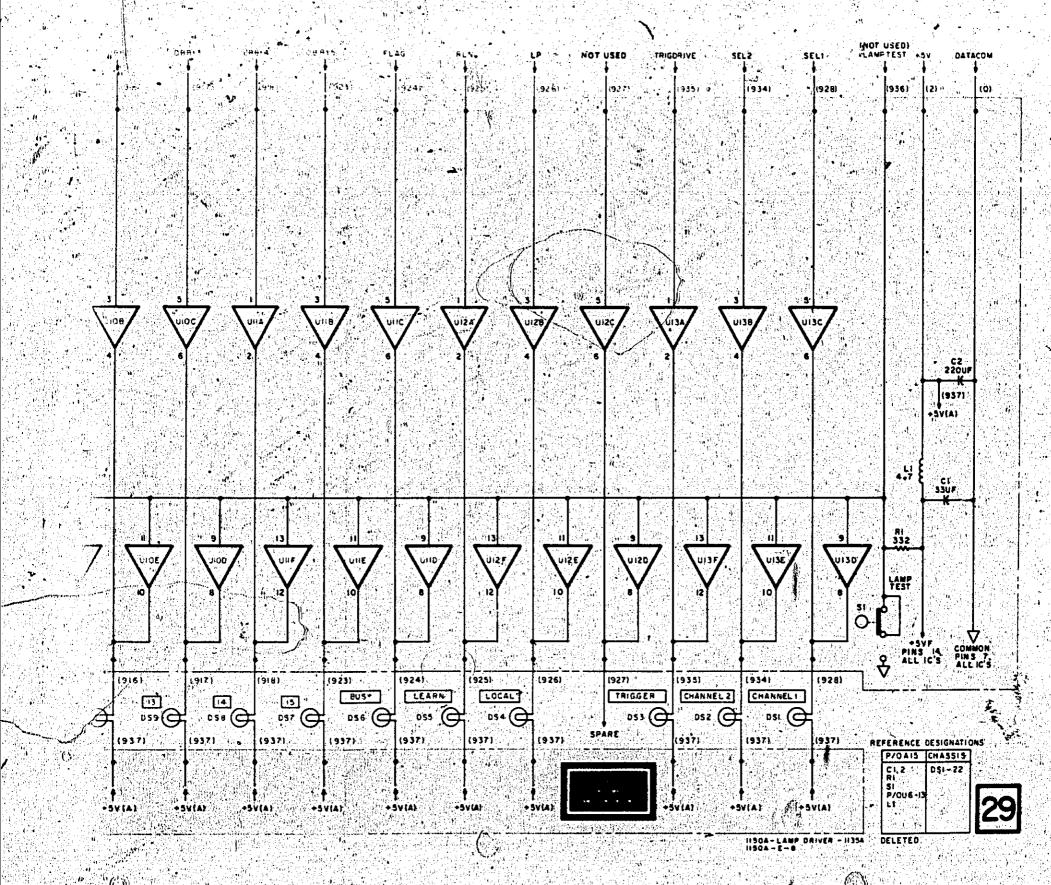
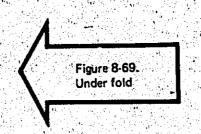


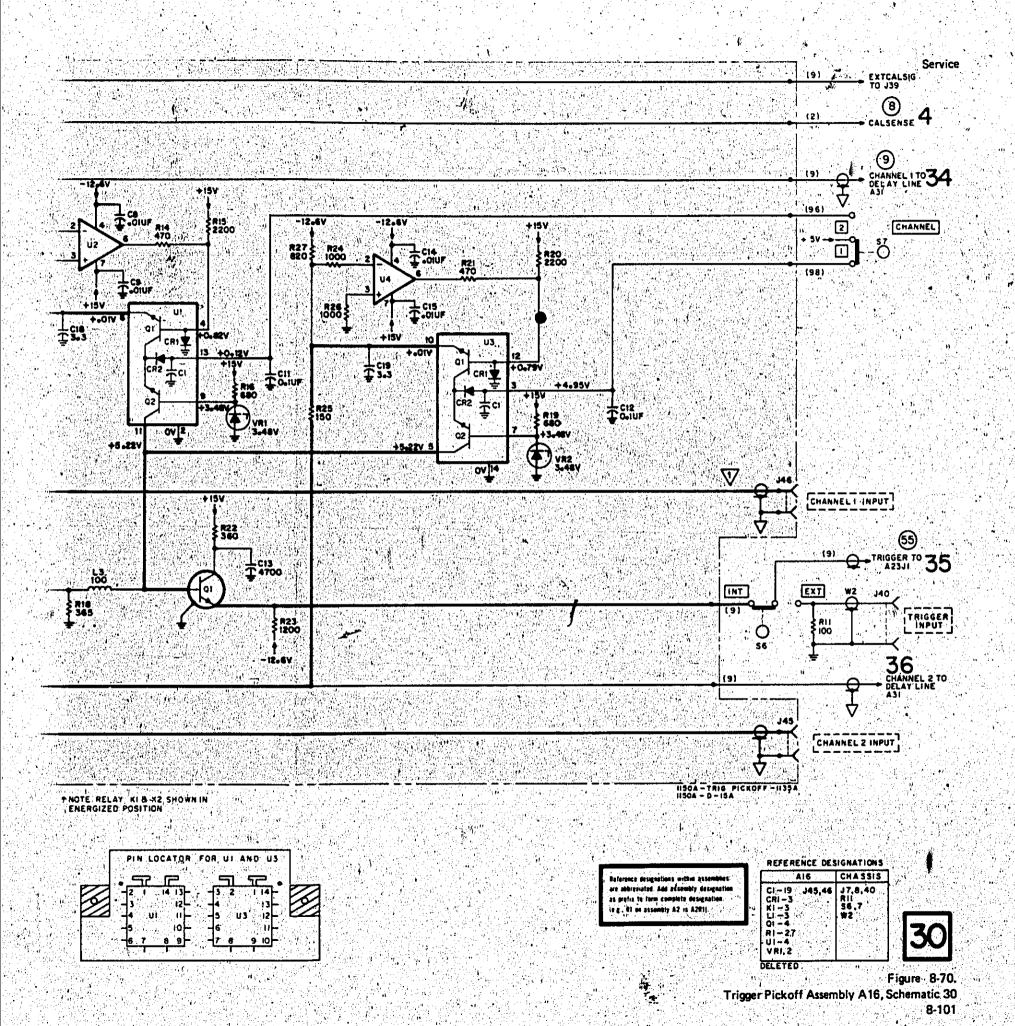
Figure 8-68. Lamp Driver Assembly A15, Schematic 29 8-99

REF	GRID LOC D-4 F-2 F-3 82 8-3 E-3 C-3 E-2	REF DESIG C9 C10 C11 C12 C13 C14	E-2 D-2 D-3 D-3	C17 C18 C19 CR1 CR2	GRID LOC	REF DESIG K3 L1 L2 L3 Q1	9-3 C-3 D-4 D-2 D-3 A-3 E-3	REF DESIG R1 R2 R3 R4 R6	A-2 A-3 A-3 F-3 F-3 A-2 A-2	REF DESIG R9 R10 R11 R12 R13	GRID LOC E-2 E-3 E-3 C-3 D-2	REF DESIG R17 R18 R19 R20 R21 R22	GRID LOC D-1 D-2 D-2 C-2 D-3 D-3 C-2	REF 0ESIG R25 R26 R27 U1 U2 U3 U4 VR1 VR1	0000
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					con	cuit bo nponent from	holes.	This pe	rmits s	older					
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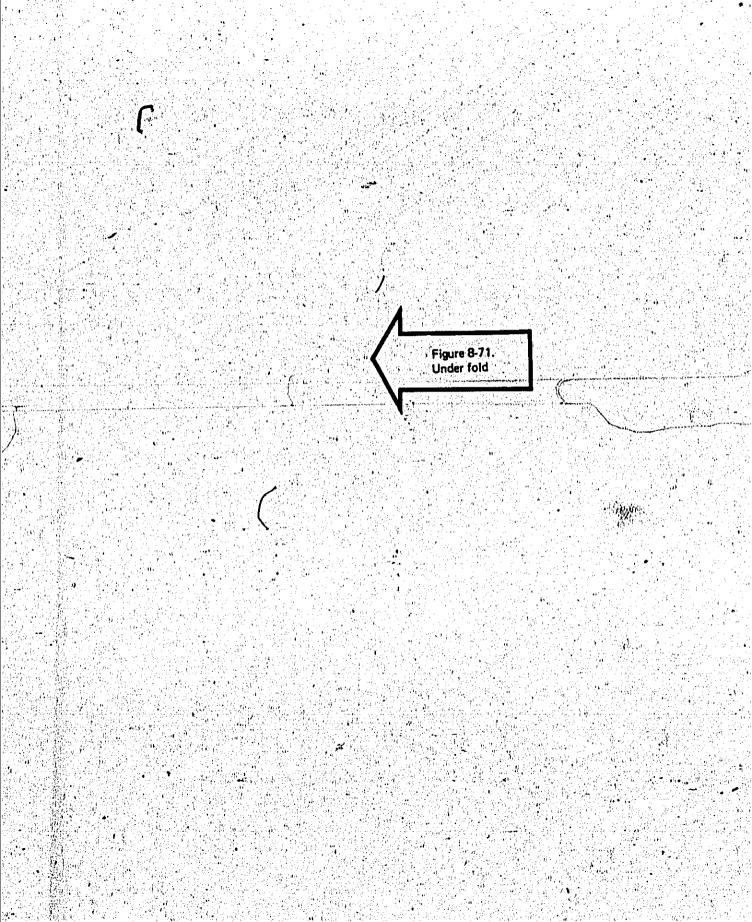
Figure 8-69. Component Identification, Assembly A16

Model 1150A





	A	3	C	D.					
2									
		ंट्याः ०-छ	5 (03) C R13	ລີໃ≅ <u></u>	REF DESIG	GRID'	REF	GRIO LOC	
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5		C-E			Circuit boo component ing from	irds ! a holes either	ve plate This peri side of	d thro	ugh der ard.
8									
	A	B	C			a Marie Ca			



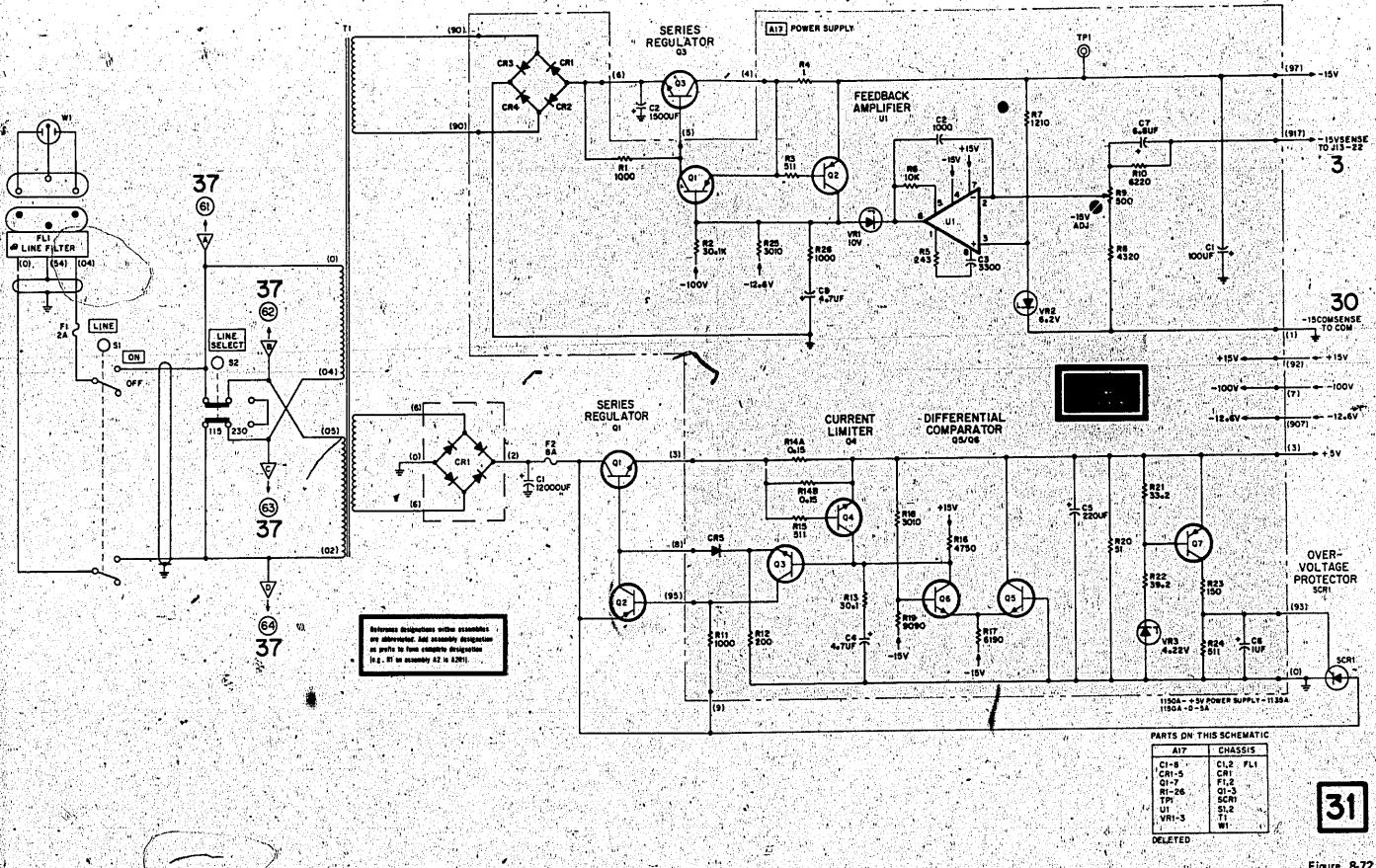


Figure 8-72. +5-volt Power Supply Assembly A17, Schematic 31

Service Model 1150A

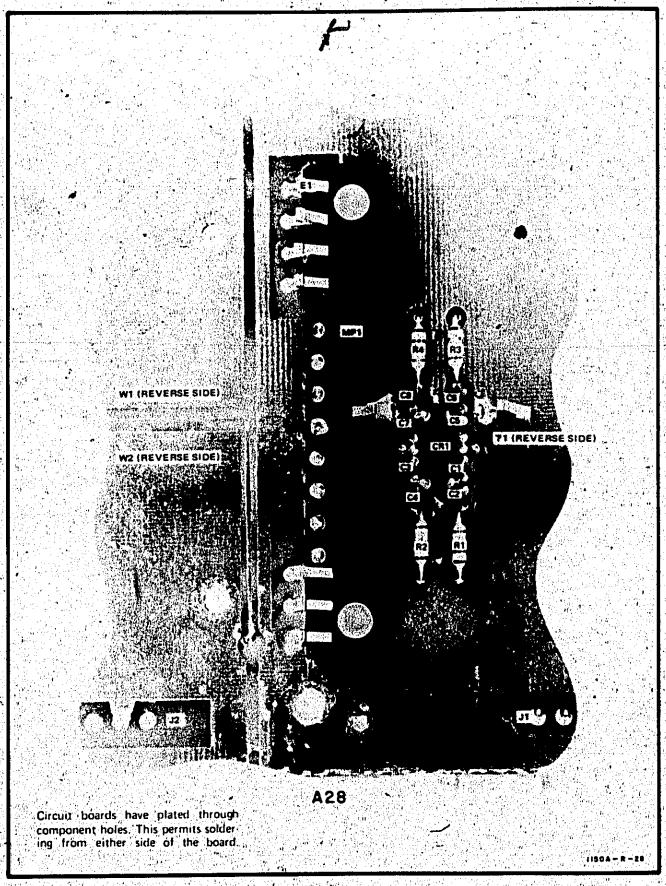
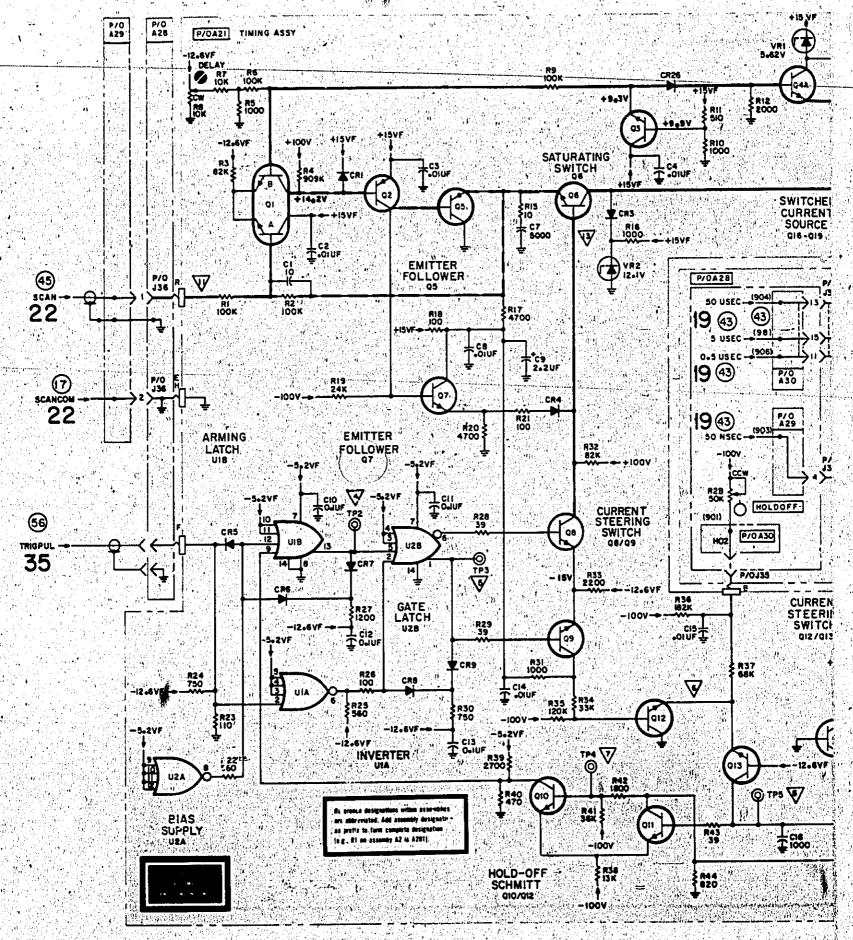
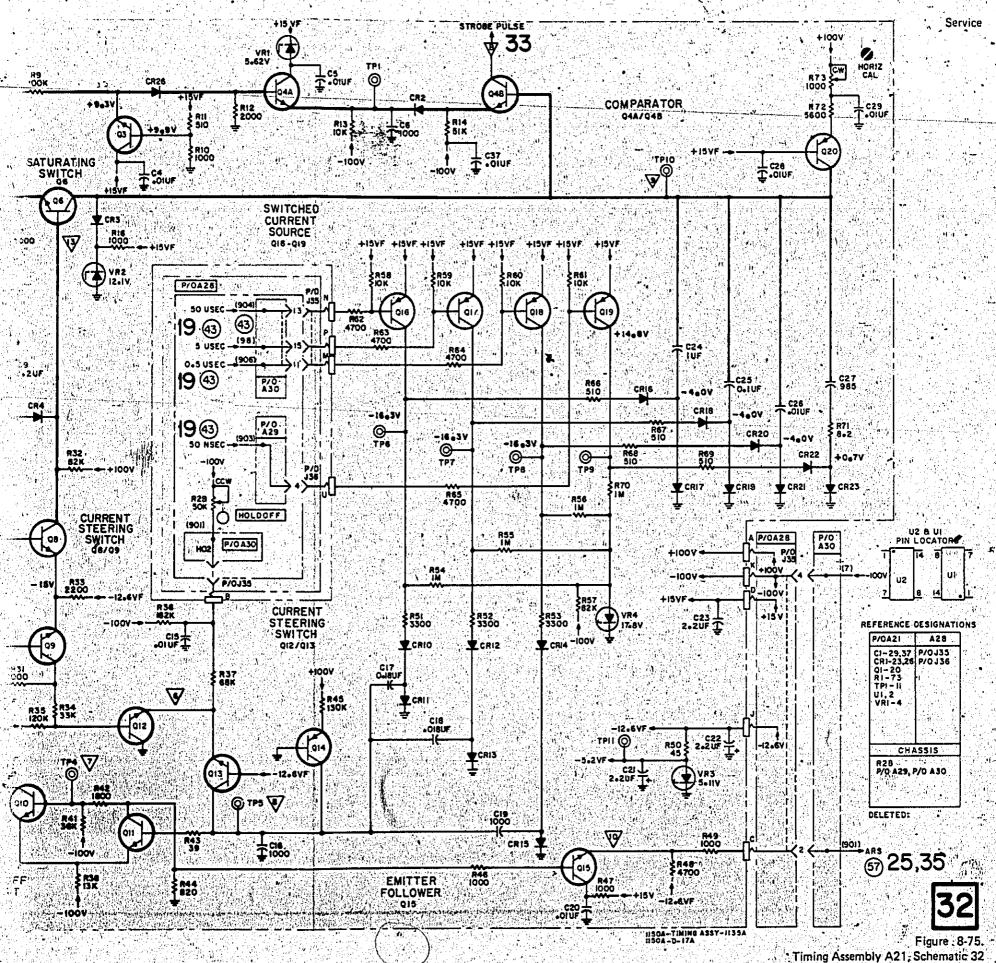


Figure 8-74. Component Identification, Assembly A28

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3										RS III	01				-w	0					U2 (MIDDEN)	(HIDDEN)	6	(1								3
4										Corn	1712			20 CF LAZI	· 全国语图 和图	ha ((C) (E)	<u> </u>	GIII	ੌ ਖ਼ ਮ ਵਾ	m [E								4
										(C)			Liti	ائنت ان 10		-	(UNDER)	PER CONTRACTOR	9-137	(2010-2) (2011) - (2011) - (2011) (2011) - (2011) (2011) - (2011) - (2011) (2011) -	T. J. zon	1776 1885 1443 1443	म् जिन्ही									5
5							<u>) </u>		(022)							T)	Lúi	10	CM B VDC			GGG GGGG MGG VR4										6
6																A2I																
	REF DESIG	E-2	REF DESIG		REF DESIG	GRID LOC	REF DESIG	GRID LOC	CRII	J. 4.4.	REF DESIG CR23 CR24	H-4	REF DESIG Q6 Q7	GRID LOC	REF DESIG	1 a. No. 1	REF DESIG R7 R8	D-3	REF DESIG R19 R20 R21	GRID LOC F-2	REF DESIG P31 P32	11	REF DESIG R43 R44	1-1 J-1	REF DESIG R55 R56	GRID LOC.	REF DESIG R67 R68	100	REF DESIG R79 R80	GRID LOC	artoj (j. l.)	J.5 J.5 J.5
	C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12	0.2 F.3 G.5 G.5 G.6 H.4 G.2 G.3 J.2 I.3	C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24	G-3 H-3 H-1 F-1 G-2 G-1 J-2 J-4 H-8	C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36	H4 H4 GB FF FF FF FF FF FF FF FF FF FF FF FF FF	C37 C38 CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10	07.44.77.77.77.77.77.77.77.77.77.77.77.77	CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22	F-2 F-2	CR24 CR25 CR26 HR1 L1 L2 Q1 Q2 Q3 Q4 Q5	D-4 D-4 E-4 F-3 D-3 E-2 F-3	Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	G3 H3 H2 12 11 H2 H-1 G-1, H-1 E-1 E-2	Q19 Q20 Q21 Q22 Q23 R1 R2 R3 R4 R5 R6	H-6 D-4 E-4	R9 R10 R11 R12 R13 R13 R14 R15 R16 R47	33555544432 EFGFHFFGG	R21 R22 R23 R24 R25 R26 R27 R28 R29 R30	H3 H3 H3 H3 H3 H3 H3 H3 H3 H3 H3 H3 H3 H	R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41	G-2 G-3 H-3 G-2 G-2 I-1 I-2 H-2 H-2	R43 R44 R45 R46 R47 R49 R50 R51 R52 R53 R54	G-2 G-1 G-1 G-2 I-1 G-2 G-2 G-2 G-2 G-2 I-6	R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66	14 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R75 R78	######################################	R79 R80 R81 R82 R83 R84 TP1 TP2 TP3 TP4 TP5 TP6	D4 D4	TP11 TP12 TP13	J-5 G-4 J-1 E-4 D-4 J-3 I-3 F-5 F-4 J-1 I-6 E-5
	C10 C11 C12	13 13 12	C22 C23 C24	J2 J4 H8	C34 C35 C38	E-5 D-4 D-4	CR8 CR9 CR10	1-2 H-2 F-2			O3 O4 O5 boards		17 318 S. 17 74			D-3 D-3									R65 R66	0.2 1-5	A77 A78		TPS	3.5	U2 VR1 VR2 VR3 VR4 VR5	J-1 I-6 E-5





hematic 3: 8-10!

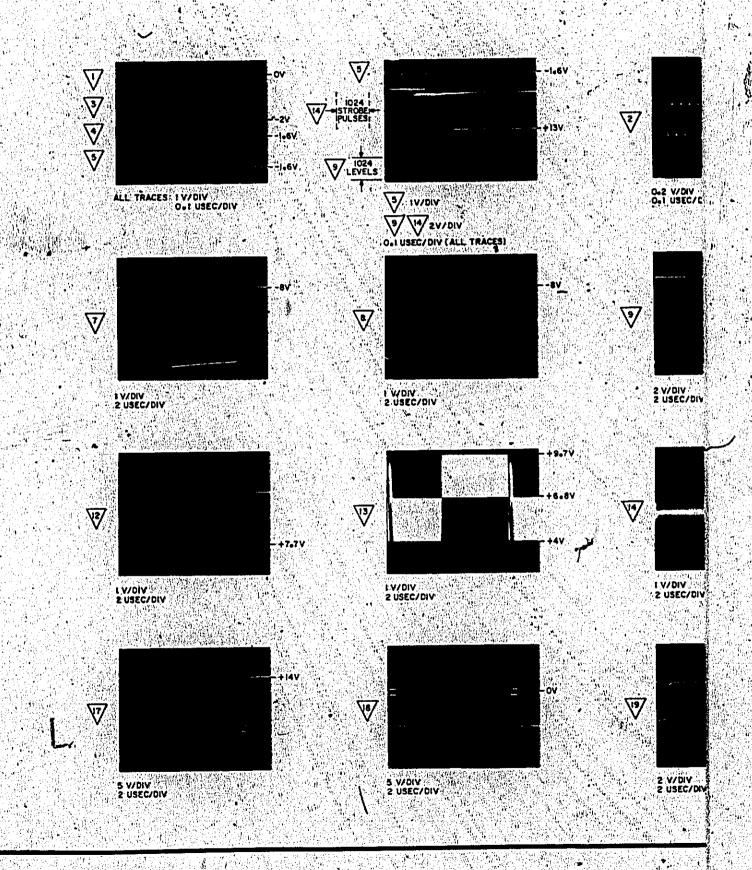
DC VOLTAGE MEASUREMENT CONDITIONS

- 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

- 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	Waveform	Test Point Schematic
$\sqrt{1}$	J46 30	\ 1 3/	Base of A2106 32
$\sqrt{2}$	Junction of A23CR1 35	14/	A21TP12 , 33
	A23CR2	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	A21TP33 33
\3/ \47	A 23TP6 35 A21TP2 32	167	Base of A22Q1B 34 Base of A24Q1B 36
\$\sqrt{\sqrt{5}}\$	A21TP3 32	$\nabla \nabla$	A22TP2 34 A24TP2 36
\$\sqrt{6}\\7\\\\\7\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Emitter of A21012 32 A21TP4 32	. \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	A22TP1 34 A24TP1 36
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	\$21TP5 32 A21TP10 32	197.	A22TP3 A 34 A24TP3 36
, W	Emitter of A21015	20/	A22TP5 34 A22TP5 36
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	J36 Pin R 32 A21TP1 32	21/	A22TP6 34 A22TP6 36



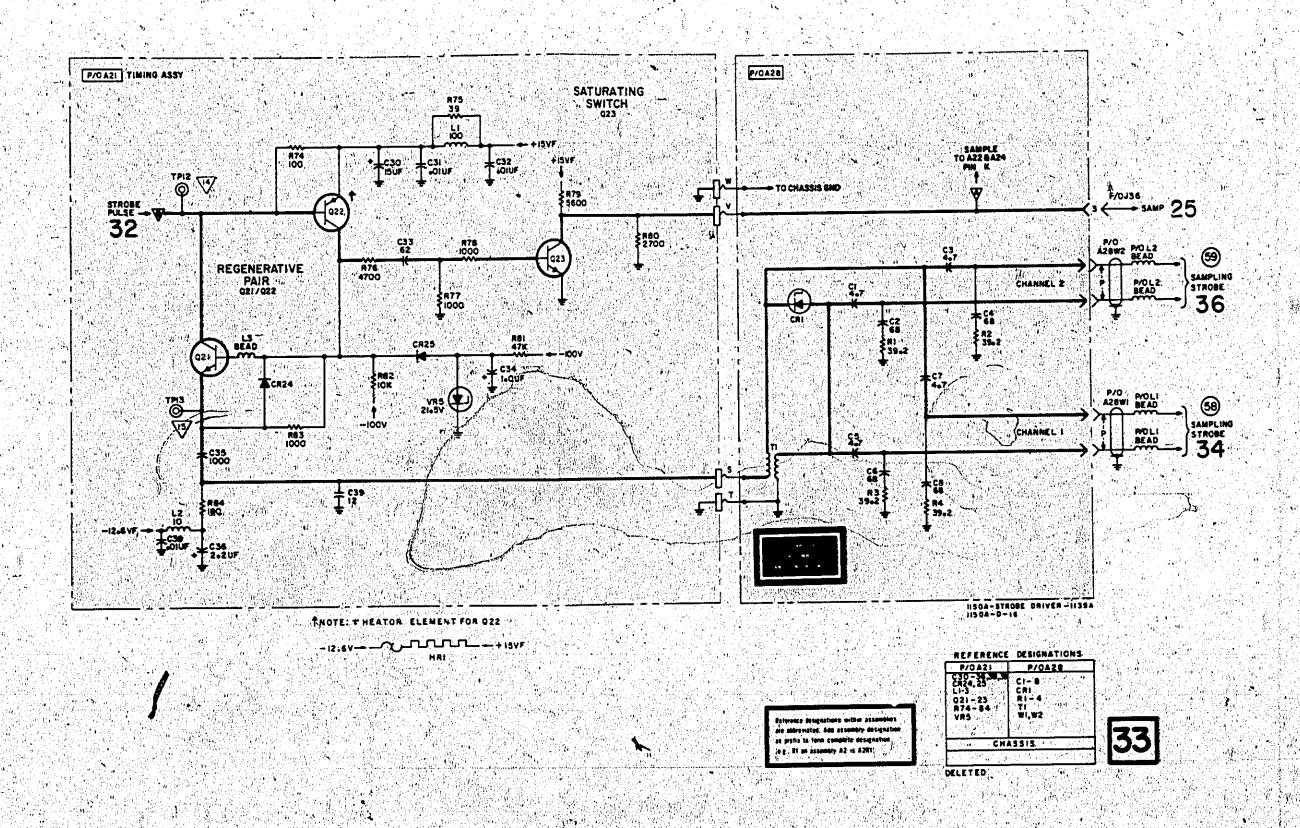
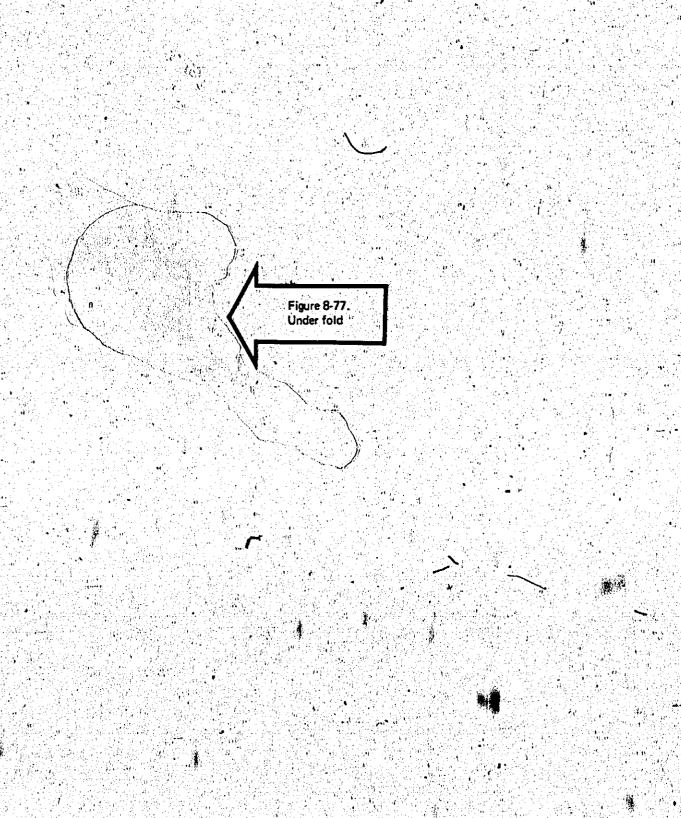
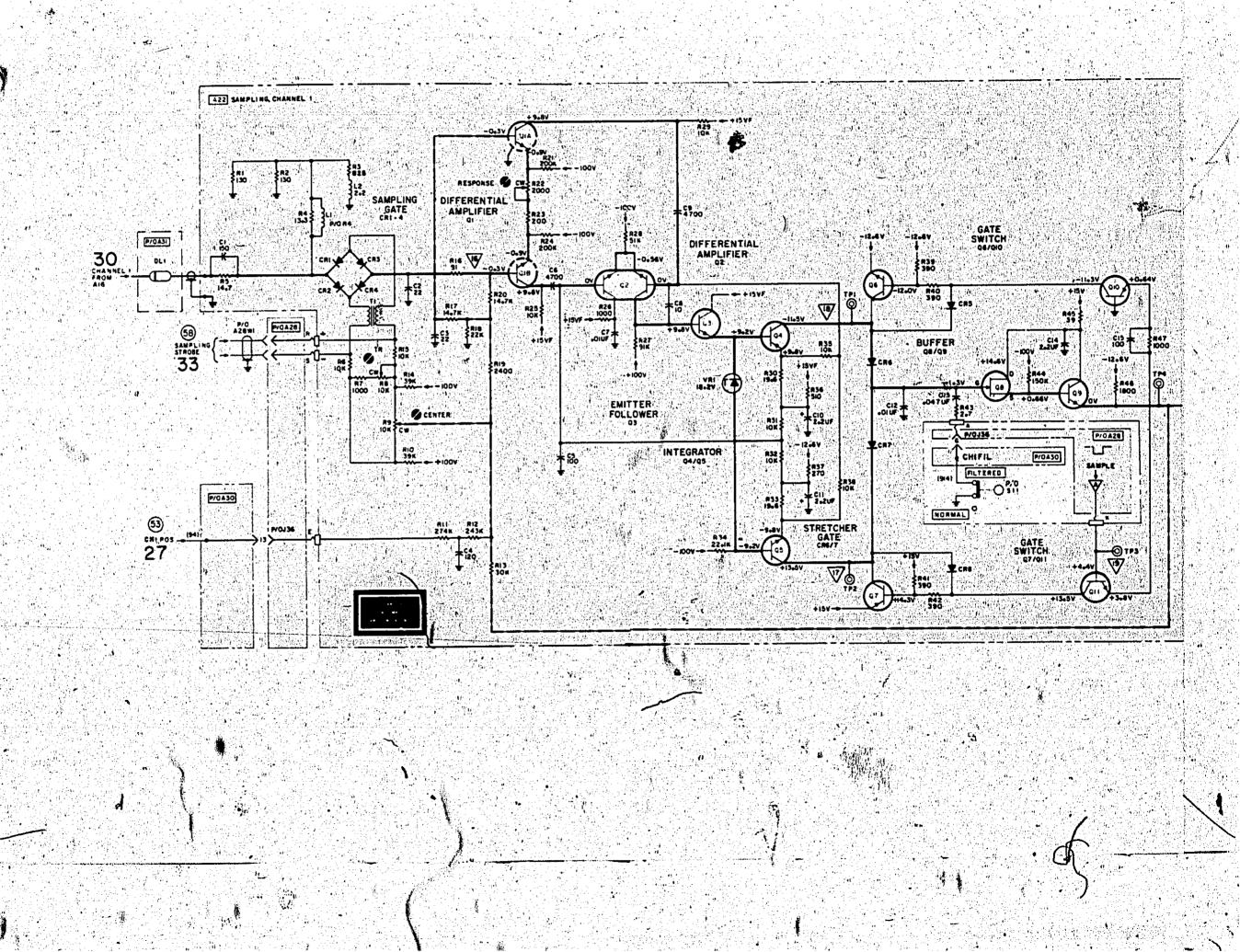


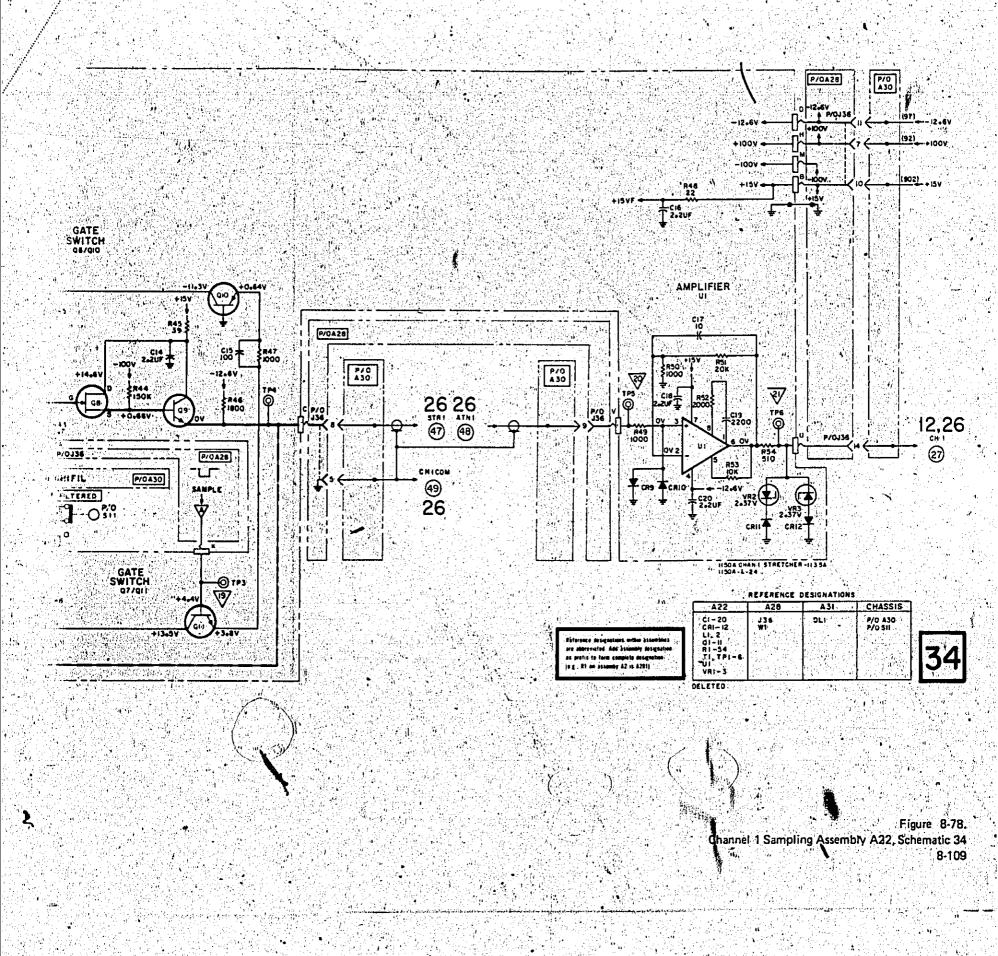
Figure 8-76.
Timing Assembly A21, Schematic 33
8-107

B. C D	
	REF GRID REF GRID DESIG LOC
	C1 B-7 R12 C-5 C2 A-5 R13 C-5 C3 B-5 R16 C-5 C4 C-4 R15 C-5 C5 A-4 R16 A-6 C5 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 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 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 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 R41 C-4 CR10 C-5 R41 C-4 CR10 C-5 R41 C-4 CR11 C-7 R42 C-4 CR11 C-7 R42 C-4 CR10 C-5 R41 C-4 CR11 C-7 R42 C-4 CR11 C-6 CR10 C-6 R50 C-7 CR1 C-7 R50 C-7 C7
8	Circuit, boards have plated through component holes. This permits soldering from either side of the board.
A B C D	7.000-0-00

Figure 8-77: Component Identification, Assembly A22

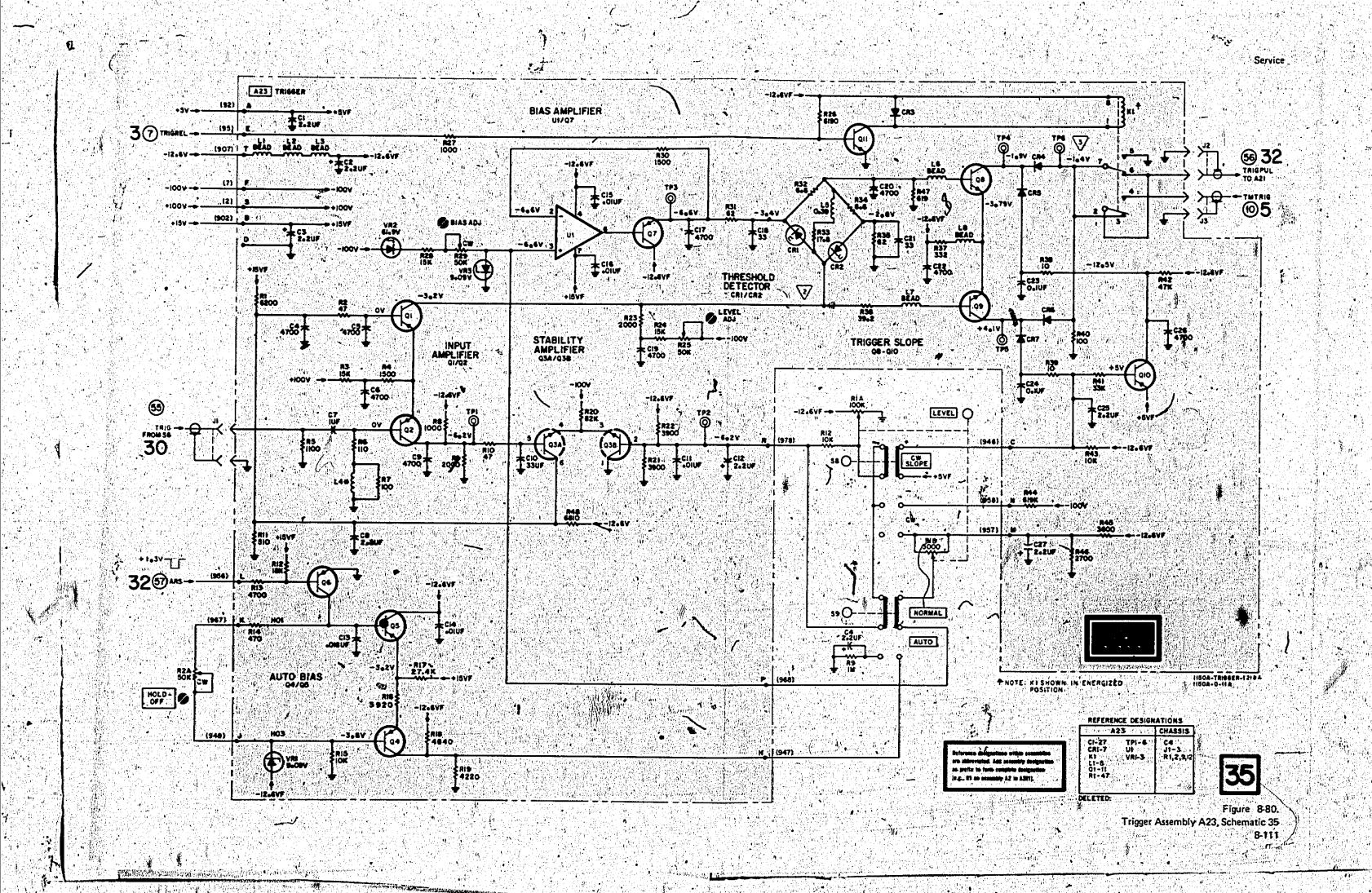






	(10 명본 명본 (25)	E SE E E E E E E E E E E E E E E E E E	A) (UNDER) (B)	R12 R10 R16 R17 R19 R19 R20 R21 R21 R22 R32 R32 R32 R32 R32 R32	GE .	-				1 2 3
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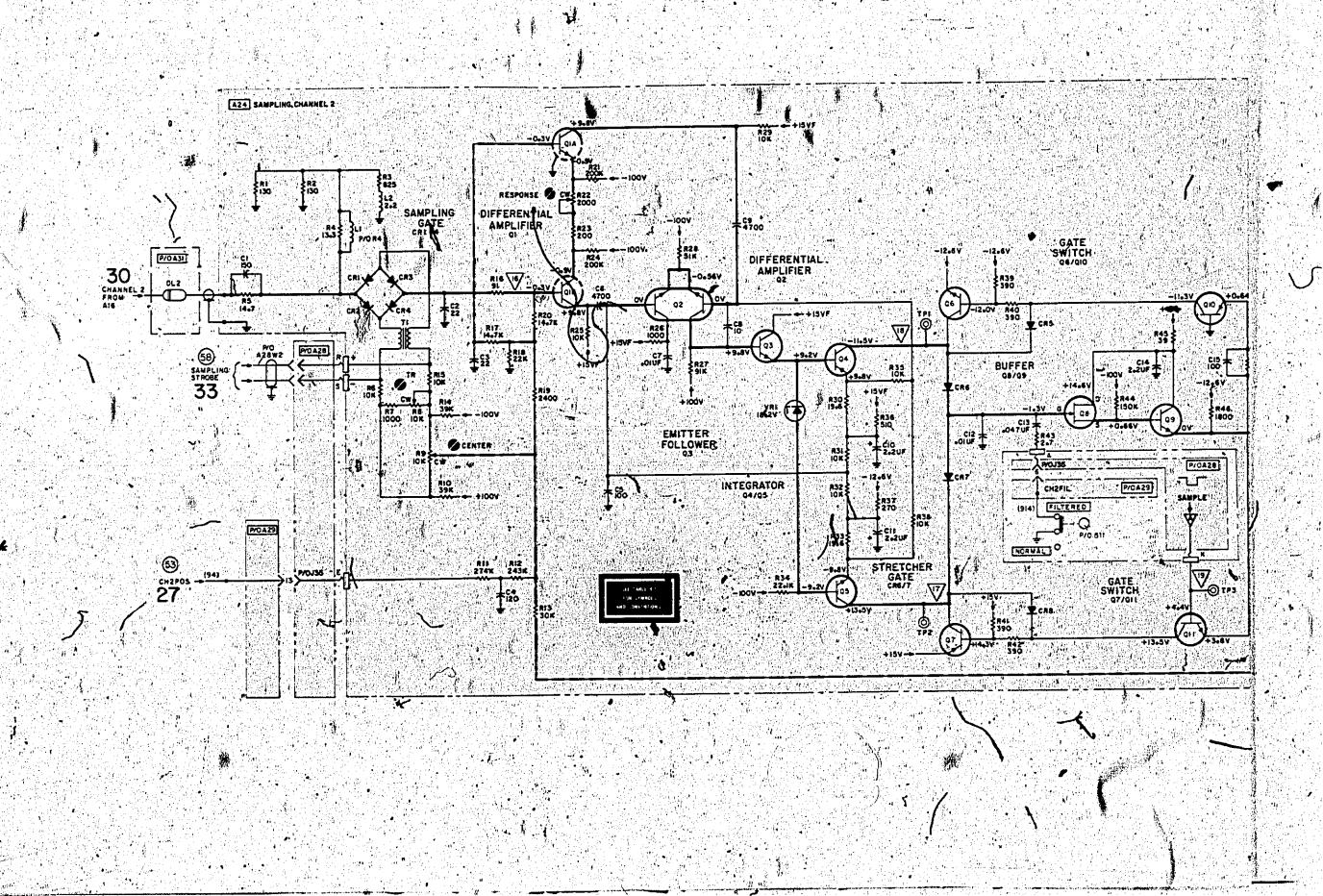
Figure 8-79. Component Identification, Assembly A23



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Figure 8-82. Component Identification, Assembly A24



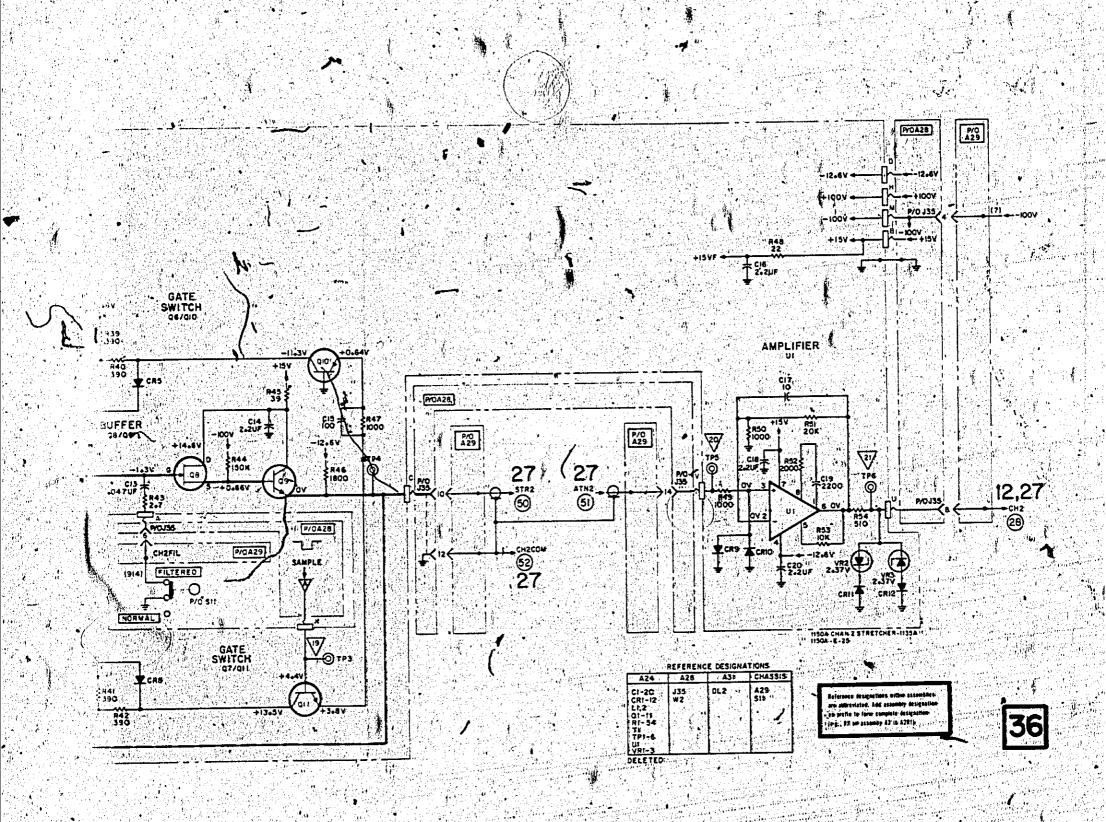
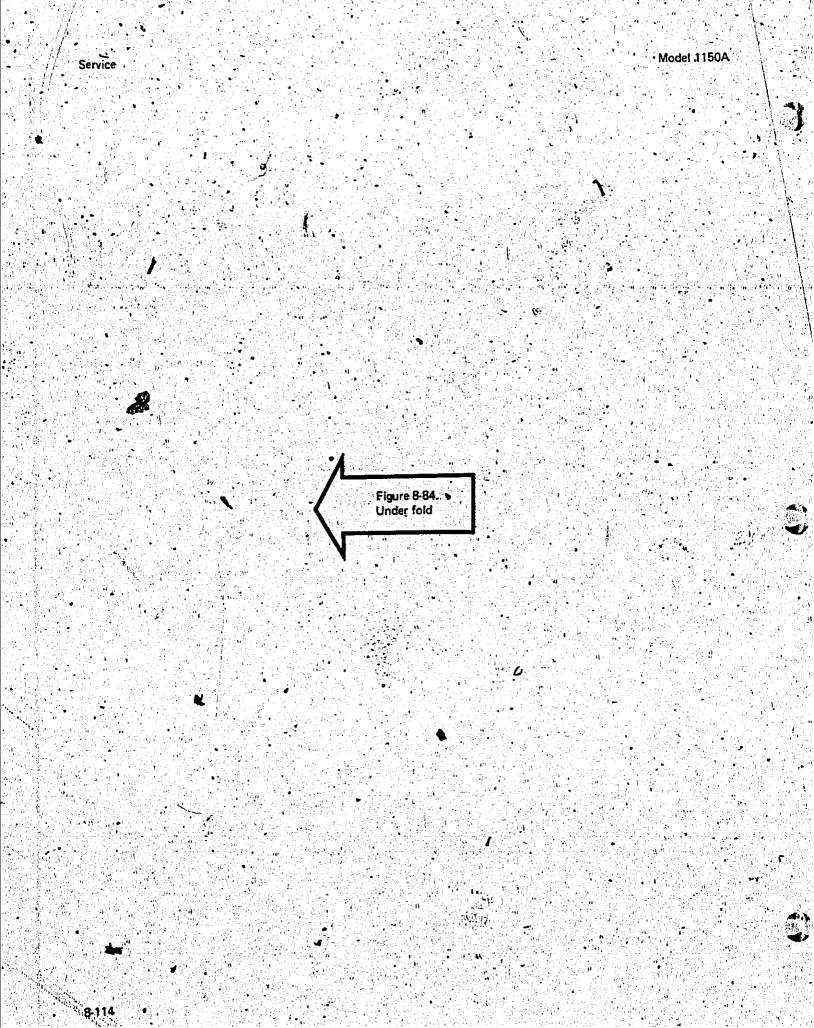


Figure 8-83, Channel 2 Sampling Assembly A24, Schematic 36 8-113

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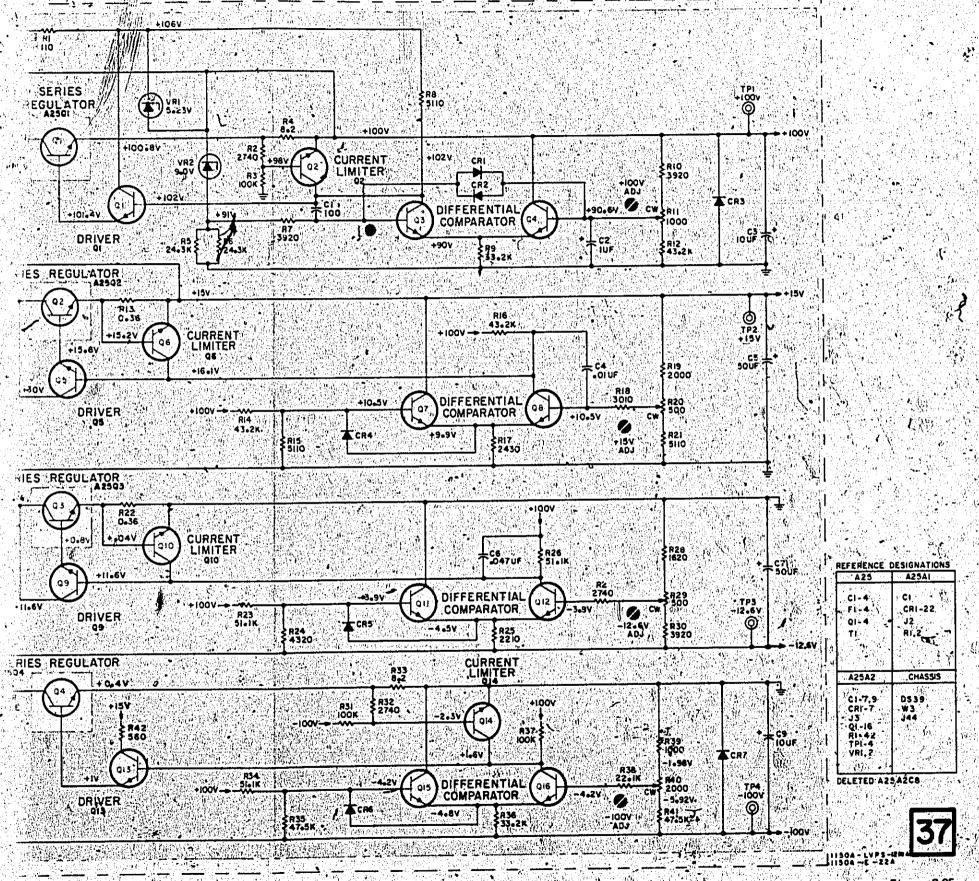


Figure 8-85. Low Voltage Power Supply Assembly A25, Schematic 37 8-115/8-116

