Errata

Title & Document Type: 8754A Operating & Service Manual

Manual Part Number: 08754-90015

Revision Date: May 1979

HP References in this Manual

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

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Agilent Technologies

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

8754A NETWORK ANALYZER

4—1300 MHz

SERIAL NUMBERS

This manual applies directly to instruments whose serial number prefix is 1914A.

With changes described in Section VII, this manual also applies to instruments whose serial number prefixes are 1812A, 1825A, 1908A.

For additional information about serial numbers, see INSTRUMENTS COVERED BY THE MANUAL in Section I.

1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA 95404, U.S.A.

MANUAL PART NUMBER 08754-90015
Microfiche Part No. 08754-90017
Operating Information Supplement Part No. 08754-90016

Printed: May 1979

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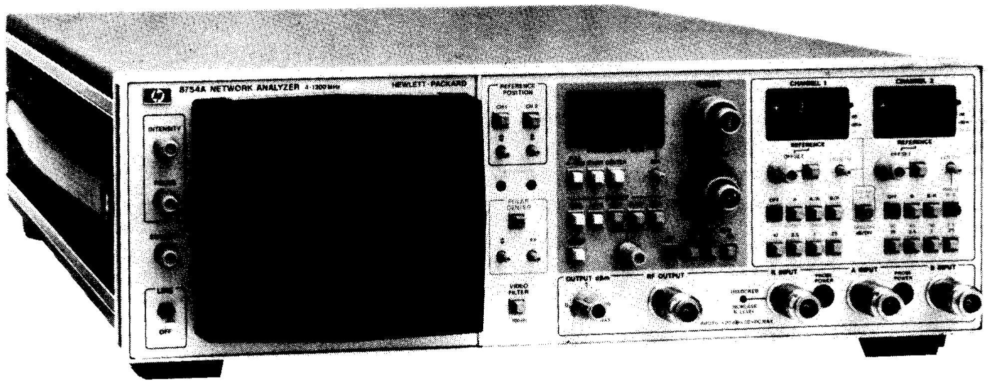
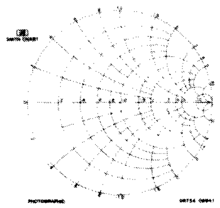
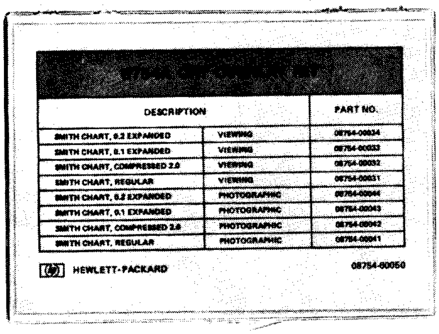


CRT OVERLAY KIT
08754-60050

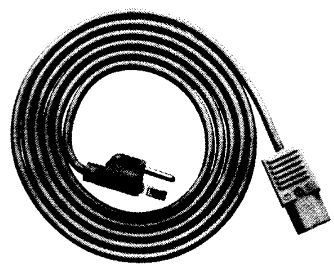




PROGRAMMING MATING CONNECTOR
1251-0063

ADAPTER, TEKTRONIX C5B CAMERA
08754-00030

LINE POWER CABLE



Power cable and plug supplied according to country of destination. Refer to Section II for Part Number information.

Figure 1-1. Model 8754A Network Analyzer with Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8754A Network Analyzer. Figure 1-1 shows the instrument and accessories supplied. This section covers instrument identification, description, options, accessories, specifications, and other basic information.

1-3. This manual is divided into eight sections, which provide the following information:

a. SECTION I, GENERAL INFORMATION, presents a brief description of the instrument, specifications, and lists of accessories and recommended test equipment.

b. SECTION II, INSTALLATION AND OPERATION VERIFICATION, presents information relative to initial inspection, preparation for use, mounting, packing, shipping, and operation verification.

c. SECTION III, OPERATION, presents instructions for operation of the instrument.

d. SECTION IV, PERFORMANCE TESTS, presents procedures required to verify that performance of the instrument is in accordance with published specifications.

e. SECTION V, ADJUSTMENTS, presents procedures required to properly adjust and align the instrument after repair.

f. SECTION VI, REPLACEABLE PARTS, presents information required to order all parts and assemblies.

g. SECTION VII, MANUAL BACKDATING CHANGES, presents backdating information to make this manual compatible with earlier shipment configurations.

h. SECTION VIII, SERVICE, presents circuit descriptions, schematic diagrams, component location diagrams, and troubleshooting procedures to aid the user in maintaining the equipment.

1-4. SPECIFICATIONS

1-5. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Table 1-2 lists performance characteristics, which are not specifications but typical characteristics included as additional information for the user. To ensure that the instrument meets the specifications listed in Table 1-1, performance tests (Section IV) should be performed every six months.

1-6. SAFETY CONSIDERATIONS

1-7. General

1-8. The Model 8754A is a Safety Class I instrument and has been manufactured and tested according to international safety standards.

1-9. Operation

1-10. BEFORE APPLYING POWER, make sure the ac input to the instrument is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken. (Refer to Safety Considerations at the beginning of this section.)

1-11. Service

1-12. Although the instrument has been manufactured in accordance with international safety standards, this manual contains information, cautions, and warnings which must be observed to insure safe operation and to avoid damage to the instrument. Warnings and cautions appear as appropriate throughout the manual. Service should be performed only by qualified personnel.

1-13. INSTRUMENTS COVERED BY THE MANUAL

1-14. Attached to the rear panel of the instrument is a serial number plate that is similar to that shown in Figure 1-2. The serial number is in two parts, a prefix and a suffix. The first four digits and the letter (e.g., 1339A) are the serial number prefix. The prefix is the same for all identical instruments; it is changed only when the instrument is modified. However, the numbers in the suffix are consecutive, regardless of changes in the prefix. The suffix is different for each instrument. The manual applies to instruments that have the serial number prefixes listed under SERIAL NUMBERS on the title page.

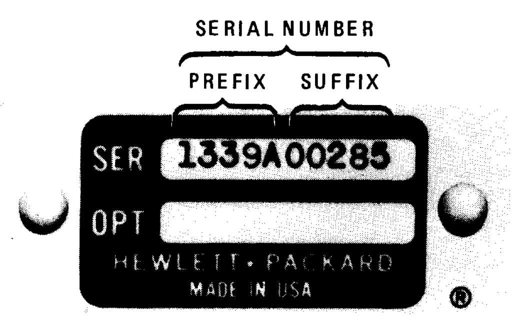


Figure 1-2. Typical Serial Number Plate

1-15. An instrument manufactured after the printing of this manual might have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from that described in the manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement, which contains "change information" that explains how to adapt the manual to the newer instrument.

1-16. In addition to change information, the supplement might contain information for correcting errors in the manual. Such "errata' information applies to all serial numbers.

1-17. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the print date and part number of the manual, both of which appear on the title page of the manual. Complimentary copies of the supplement are available from Hewlett-Packard. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-18. DESCRIPTION

1-19. The HP Model 8754A Network Analyzer consists of an internally leveled, 4- to 1300-MHz, swept source. Polar or rectangular measurements are displayed on a cathode-ray tube (CRT) through two independent channels. With appropriate signal-routing accessories, the 8754A is a fully integrated stimulus/response test system that measures magnitude and phase characteristics of linear networks by comparing the incident signal with the signal transmitted by the device under test or reflected from its input.

1-20. The basic transmission measurements are insertion loss or gain, insertion phase, and transmission coefficient (S_{21} or S_{12}). The basic reflection measurements are return loss, from which SWR can be calculated, and reflection coefficient (S_{11} or S_{22}), from which impedance can be calculated or read from a Smith chart overlay.

1-21. OPTIONS

1-22. Option 907, Front Handles

1-23. Option 907 instruments are supplied with a front handle kit. Refer to Section II for a detailed description of this kit and instructions for installation.

1-24. Option 908, Rack Flanges

1-25. Option 908 instruments are supplied with a rack flange kit. Refer to Section II for a detailed description of this kit and instructions for installation.

1-26. Option 909, Front Handles and Rack Flanges

1-27. Option 909 instruments are supplied with a front handle and rack flange kit. Refer to Section II for a detailed description of this kit and instructions for installation.

1-28. Option 910, Extra Manual

1-29. The standard instrument is supplied with one Operating and Service Manual. Option 910 instruments are supplied with two manuals.

1-30. ACCESSORIES SUPPLIED

1-31. Figure 1-1 shows the instrument and the accessories supplied. These accessories are:

- Power cable (refer to Section II for part number)
- Smith chart overlays. Set of four for viewing and four for photography. HP Part No. 08754-60050.
- Adapter for Tektronix Model C5B camera, HP Part No. 08754-00030.
- Mating connector for PROGRAMMING connector, A23J7. HP Part No. 1251-0063.

1-32. ACCESSORIES AVAILABLE

1-33. Service Accessories

1-34. A service accessories package is available for convenience in troubleshooting and adjustment of the instrument. The service accessories package, with a complete list of its contents, is illustrated in Figure 1-3. The complete package may be obtained from Hewlett-Packard by ordering HP Part No. 08754-60051.

1-35. Measurement Accessories

1-36. The measurement accessories listed below are available for use with the 8754A. Refer to Section III for detailed descriptions of accessories.

- HP Model 8501A Storage-Normalizer
- HP Model 8750A Storage-Normalizer
- HP Model 8748A S-Parameter Test Set
- HP Model 11850A Power Splitter, 50 ohm
- HP Model 11850B Power Splitter, 75 ohm
- HP Model 8502A Transmission/Reflection Test Set, 50 ohm
- HP Model 8502B Transmission/Reflection Test Set, 75 ohm
- HP Model 10855A Broadband Preamp, 2 MHz to 1.3 GHz
- HP Model 1121A AC Probe
- HP Model 11853A Type N Accessory Kit, 50 ohm
- HP Model 11854A Type BNC Accessory Kit, 50 ohm
- HP Model 11855A Type N Accessory Kit, 75 ohm
- HP Model 11856A Type BNC Accessory Kit, 75 ohm

1-37. RECOMMENDED TEST EQUIPMENT

1-38. Equipment required for testing and adjustment of the instrument is listed in Table 1-3. Other equipment may be substituted if it meets the critical specifications indicated in the table.

Table 1-1. HP 8754A Network Analyzer Specifications (1 of 2)

SOURCE

FREQUENCY

Range: 4 MHz to 1300 MHz

Sweep Modes: Linear full sweep (4 MHz to 1300 MHz) and calibrated sweep widths with variable start or center frequency.

Markers: Internal, crystal-generated harmonic markers; amplitude markers for rectangular displays, intensity markers for polar displays.

- **Spacing:** 1, 10, and 50 MHz
- **Accuracy:** ±0.01%

Digital Frequency Readout: Indicates frequency of variable marker in linear full sweep mode and start or center frequency in calibrated sweep width mode.

- **Resolution:** 1 MHz
- **Accuracy:** ±10 MHz (20°C to 30°C). Readout is adjustable for calibration to internal crystal markers.

OUTPUT

Power:

- **Range:** Calibrated 0 to +10 dBm
- **Accuracy:** ±0.8 dB at 50 MHz
- **Flatness:** ±0.5 dB

Spectral Purity (at +10 dBm RF output level):

- **Residual FM**[1]: ⩽7 kHz RMS (10 kHz bandwidth) bandwidth)
- **Harmonics:** −28 dBc
- **Spurious Signals:** 4 MHz to 500 MHz, −65 dBc; 500 MHz to 1300 MHz, −50 dBc

GENERAL

Trigger Modes: AUTO (repetitive) and TRIG (single sweep triggered by front-panel pushbutton or rear-panel PROGRAMMING connector)

RF Output Connector: Type N Female

RECEIVER

INPUT

Frequency Range: 4 MHz to 1300 MHz

Input Channels: Three Inputs, R, A, and B. Two test inputs (A and B) with 80 dB dynamic range and a reference input (R) with 40 dB dynamic range.

Impedance: 50Ω. Input port match ⩾20 dB return loss (⩽1.22 SWR).

Maximum Input Level: 0 dBm

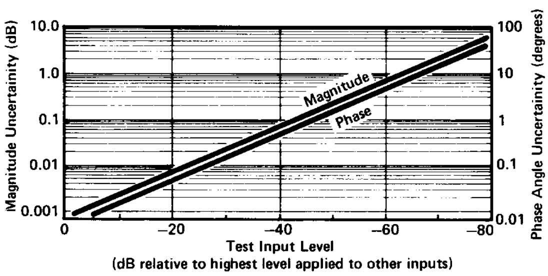
Damage Level: +20 dBm (50 Vdc)

Noise Level: <−80 dBm, A and B inputs

Minimum R Input Level: −40 dBm (⩾−40 dBm required to operate R input phase lock)

Crosstalk Between Channels: >83 dB

Error Limits:



MAGNITUDE

Frequency Response (flatness):

- **Absolute (A, B, R):** ±1 dB
- **Ratio (A/R, B/R):** ±0.3 dB

Dynamic Accuracy (+20°C to +30°C):

±0.3 dB from 0 to −50 dBm
±0.5 dB from −50 to −60 dBm
±1 dB from −60 to −70 dBm
±2.5 dB from −70 to −80 dBm

[1] Applies in swept and CW modes.

Table 1-1. HP 8754A Network Analyzer Specifications (2 of 2)

RECEIVER (Cont'd)

Reference Offset:
- **Range:** ±199 dB in 1 dB steps
- **Accuracy:** Included in Dynamic Accuracy above.

Display Resolution: 10, 2.5, 1, 0.25 dB/div
Display Accuracy: ±2% ±0.05 division

PHASE

Frequency Response: ⩽±2.5°

Range: ±180°
Dynamic Accuracy:
- ±2° from 0 to −50 dBm
- ±4° from 0 to −70 dBm

Reference Offset:
- **Range:** ±199° in 1° steps
- **Accuracy:** ±1%

Display Resolution: 90°, 45°, 10°, 2.5°/major division
Display Accuracy: ±2% ±0.05 division

POLAR

See Magnitude and Phase specifications for Frequency Response, Dynamic Accuracy, and Reference Offset.
Display Accuracy: Actual value is within 2.5 mm of displayed value.

DISPLAY

Measurement Functions: CRT displays either polar trace or two independent rectangular traces.

Channel 1:	A Magnitude Absolute (dBm)
	R Magnitude Absolute (dBm)
	A/R Magnitude Ratio (dB)
	B/R Magnitude Ratio (dB)
Channel 2:	B Magnitude Absolute (dBm)
	B/R Magnitude Ratio (dB)
	B/R Phase (degrees)
Polar:	A/R Magnitude Ratio (dB) and Phase (degrees)

DISPLAY (Cont'd)

Reference Position: Reference lines for Channel 1, Channel 2, and Polar Center can be independently set to any position on the CRT for calibration. Display resolution expands about the Reference Position line.

Graticule size:
- **Rectangular (cartesian):** 100 mm (3.94 in.) horizontal by 80 mm (3.15 in.) vertical.
- **Polar:** 80 mm (3.15 in.) in diameter
- Both graticules internal to CRT

Smith Chart Overlays:
- **Viewing:** 0.2 expanded, 0.1 expanded, compressed 2.0, regular
- **Photographic:** 0.2 expanded, 0.1 expanded, compressed, 2.0, regular

Phosphor: P39

GENERAL

Magnitude/Phase Output: −10 mV/degree and −100 mV/dB at BNC female connector multiplexed by TTL level or contact closure at pin of PROGRAMMING connector for use with external digital voltmeter.

Accuracy:
- **Magnitude:** See Magnitude Dynamic Accuracy specification.
- **Phase:** ±1.5% (0 to ±170°), ±2% (±170° to ±180°).

Environmental:
- **Temperature:**
  - **Operating:** 0°C to +55°C except where noted
  - **Storage:** −40°C to +75°C
- **Power:** Selection of 100, 120, 220, and 240 Vac +5%, −10%; 48 to 66 Hz; 200 VA maximum
- **Dimensions:** 133 mm x 425 mm x 505 mm (5.25 in. x 16.75 in. x 19.875 in.)
- **Weight:** Net, 17.7 kg (39 lb); Shipping: 20 kg (44 lb)

Table 1-2. HP 8754A Performance Characteristics (1 of 2)

SOURCE

FREQUENCY CHARACTERISTICS

Sweep Width Accuracy:
500 to 1000 MHz: Typically ±2%
50 to 200 MHz: Typically ±5%
1 to 20 MHz: Typically ±8%

Stability:
Temperature: Typically ±400 kHz/°C
Time: Typically ±100 kHz/hour

OUTPUT CHARACTERISTICS

Impedance: 50Ω. Source match typically less than 1.4 SWR (>16 dB return loss).
Power Range: Uncalibrated to typically +13 dBm
Spectral Purity (at +10 dBm):
Harmonics: Typically −35 dBc
Spurious Signals:
4 to 500 MHz: Typically −75 dBc
500 to 1300 MHz: Typically −60 dBc

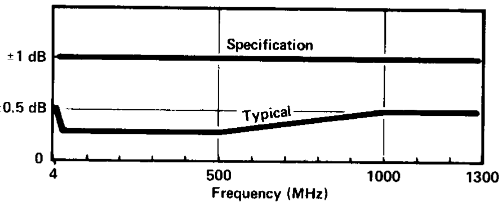
GENERAL CHARACTERISTICS

Sweep Time:
Approximately 10 ms to 500 ms in FAST mode
Approximately 1 sec to 50 sec in SLOW mode

RECEIVER

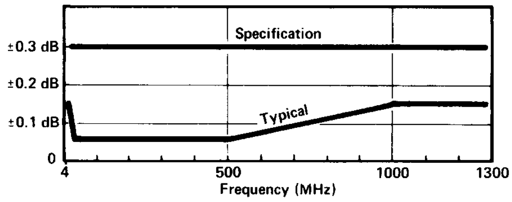
MAGNITUDE CHARACTERISTICS

Frequency Response (flatness): Absolute (A, B):

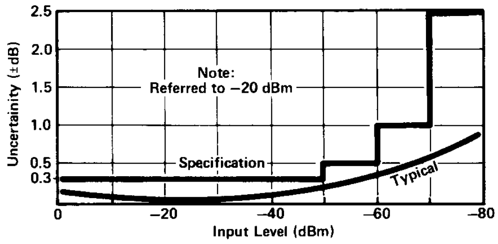


RECEIVER (Cont'd)

Frequency Response (Flatness): Ratio (A/R, B/R):



Dynamic Accuracy (+20° to +30°C): Typically less than 0.01 dB/dB from −10 dBm to −40 dBm



Reference Offset:
Accuracy: Typically less than ±0.1% of value.
Vernier Range: Typically ±80 dB of variable offset used for calibration of ratio measurements.

Error Resulting from Change in Harmonic Number:
Ratio (A/R and B/R): Typically ⩽0.05 dB
Absolute (A, B, and R): Typically ⩽0.2 dB

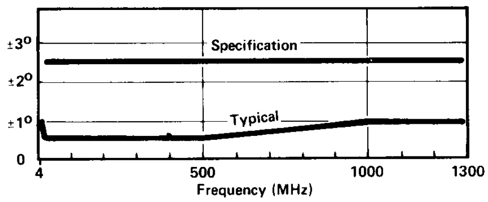
Absolute Power Measurements (A, B, and R):
Calibrated in dBm; typically <±0.5 dBm with 0 dBm, 50 MHz input

Table 1-2. HP 8754A Performance Characteristics (2 of 2)

RECEIVER (Cont'd)

PHASE CHARACTERISTICS

Frequency Response:



Reference Offset Range: Vernier provides typically ±20° of variable offset used for phase calibration.

Electrical Length Adjustment Range: Typically 160 mm.

Phase Error Resulting from Change in Harmonic Number: Typically ≤0.5°.

DISPLAY:

Video Filter: Typically 100 Hz (10 kHz without filter)

GENERAL CHARACTERISTICS

External Sweep Input: 0 to +10V nominal. BNC female connector used to sweep CRT display when receiver is used with an externally swept source or to remotely program the frequency of an internal RF source from an external digital-to-analog converter.

Sweep Output: −5V to +5V nominal, BNC female connector, used to frequency modulate (sweep) external generator.

GENERAL CHARACTERISTICS (Cont'd)

X-Y Recorder/External CRT Output:

Horizontal: 0.1V/Div. (0 to 1V).

Vertical: 0.1V/Div. (±0.4 full scale).

Penlift/Blanking: +5V Blanking and Penlift; −5V intensifies crystal markers.

Connectors: BNC female.

External Marker Input: typically −13 dBm RF signal into the External Marker Input will produce an amplitude (rectilinear) or intensity (polar) marker on the trace at the frequency of the RF signal. BNC female connector, 50Ω.

Probe Power: +15 Vdc and −12.6 Vdc, for use with 10855A Preamp or 1121A AC Probe. Two probe power jacks are available.

Storage-Normalizer Interfaces: directly compatible with both the HP 8750A Storage-Normalizer and the HP 8501A Storage-Normalizer. All 8501A features except CRT labels and graphics are available when the 8501A is used in conjunction with the 8754A.

Programming Connector:

Function: 25 pin Amphenol connector (with mating connector). Outputs include magnitude/phase and sweep outputs and inputs described above as well as measurement mode selection by TTL levels or contact closures.

POLAR CHARACTERISTICS

Electrical Length Adjustment Range:

Typically 160 mm, resulting in an 80-mm adjustment to the reference plane in a reflection measurement.

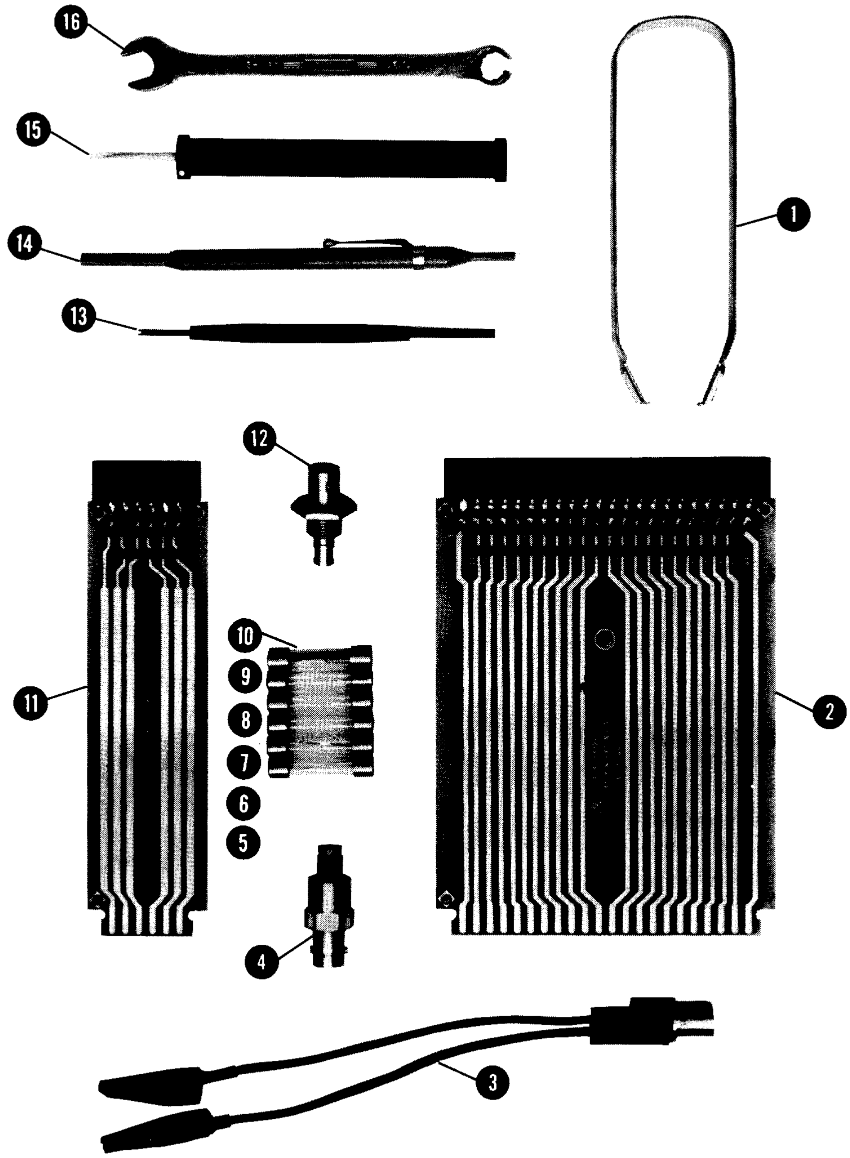


Figure 1-3. Service Accessories Package, HP Part Number 08754-60051 (1 of 2)

Item	Description	HP Part Number
1	Extractor for front-panel connectors	8710-0580
2	Extender board, 22 pin (44 conductors)	08565-60107
3	Test leads with alligator clips	8120-1292
4	Adapter, BNC female to SMA male (Quantity of 4)	1250-1200
5	Fuse, 2.5A, 250V	2110-0083
6	Fuse, 1.25A, 250V	2110-0094
7	Fuse, 1A, 250V	2110-0001
8	Fuse, .5A, 250V	2110-0012
9	Fuse, .25A, 250V	2110-0004
10	Fuse, .125A, 250V, slo-blo	2110-0318
11	Extender board, 6 pin (12 conductors)	08505-60109
12	Adapter, BNC female to SMB female, snap on	1250-1236
13	Alignment tool, slotted-blade, plastic	8710-0772
14	Alignment tool, stainless steel blades	8710-0630
15	Alignment tool, non-metallic	8710-0033
16	Wrench, 5/16 inch, open end	08555-20097

Figure 1-3. Service Accessories Package, HP Part Number 08754-60051 (2 of 2)

Table 1-3. Recommended Test Equipment (1 of 2)

Equipment	Critical Specifications	Recommended Model	Use*
Adapter	Type BNC female to Type SMB female, Snap-on	HP 1250-1236	A, T
Adapter	SMB to SMB Male	HP 1250-0669	A
Adapter	Type N female to Type N female	HP 1250-0777	P, O
Adapter	Type N male to Type N male	HP 1250-0778	P
Adapter (2 required)	Type N male to Type BNC female	HP 1250-0780	P
Attenuator, 10 dB	Frequency: 4 MHz to 1.3 GHz Accuracy: ±0.5 dB	HP 8491B, Opt 010	P
Attenuator, 20 dB	Frequency: 4 MHz to 1.3 GHz Accuracy: ±0.5 dB	HP 8491B, Opt 020	P, A
Attenuator, Step	Steps: 10 dB from 0 to 80 dB Frequency: 4 MHz to 1.3 GHz Accuracy: ±1.6% Connectors: Type N Female	HP 8496A, Opt 001	P, O, T
Attenuator, Step	Steps: 10 dB from 0 to 80 dB Calibrated to uncertainty of ± (0.02 dB + 0.01 dB/10 dB step) at 30 MHz	HP 355D, Opt H82	P, A
Cable Kit, Matched	4 Cables; Type N male, both ends Phase matched to 4 degrees at 1.3 GHz	HP 11851A	P, A, O, T
Connector, Test (For use with PROGRAMMING Connector)	24-Contact, 2 rows male. No substitute. (See Mag/ Phase Output Accuracy Test)	HP 1251-0063 with jumper	P, A
Directional Coupler	Frequency: 100 MHz to 1.3 GHz Directivity: 40 dB Coupling: 20 dB	HP 778D	P
Divider Probe, 10:1 (2 required)	Resistance: 10M Shunt Capacitance: 10 pF	HP 10004D	A, T
Frequency Counter	Frequency: 4 MHz to 1.3 GHz Sensitivity: −20 dBm	HP 5340A	P, A, T

Table 1-3. Recommended Test Equipment (2 of 2)

Equipment	Critical Specifications	Recommended Model	Use*
Low-Pass Filter	Cutoff Frequency: 10 kHz Impedance: 50 Ohms Type: S-Pole Butterworth	HP 08505-60155	P
Oscilloscope	Frequency: 100 MHz Sensitivity: 5 mV/div Dual Channel	HP 1740A	A, T
Power Meter	Power Range: −20 dBm to +10 dBm	HP 435A	P, A, T
Power Sensor	Frequency: 4 MHz to 1.3 GHz Impedance: 50 Ohms	HP 8482A	P, A, T
Power Splitter, 3-Way	Frequency: 4 MHz to 1.3 GHz Impedance: 50 Ohms Tracking between any two output ports: 0.1 dB magnitude, 1.5 degrees phase	HP 11850A	P, A, O
Power Supply, DC	0 to 10 Vdc, 0 to 1A	HP 6214A	A, T
Spectrum Analyzer	Frequency: 4 MHz to 1.3 GHz AUX A and AUX D outputs on mainframe	HP 8558B/181T	P, A, T
Termination (2 required)	Impedance: 50 Ohms Type N male	HP 909A, Opt 012	P, A, O, T
Termination, Feedthrough	Impedance: 50 Ohms	HP 10100C	P
Transmission/ Reflection Test Set	No substitute	HP 8502A	P, T
Voltmeter, Digital	Accuracy: 10V range ±(0.002% of reading + 1 digit)	HP 3455A	P, A, T
Voltmeter, RMS	True rms response Sensitivity: 1 mV	HP 3400A	P, A

*P = Performance Tests, A = Adjustments, O = Operation Verification, T = Troubleshooting

SECTION II INSTALLATION AND OPERATION VERIFICATION

2-1. INTRODUCTION

2-2. This section includes information on the initial inspection, preparation for use, storage and shipment, and operation verification of the HP Model 8754A Network Analyzer.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has received mechanical and electrical inspection. (Refer to the Operation Verification portion of this section for verification of electrical operation.) If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or if the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement without waiting for a claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP Model 8754A requires a power source of 100, 120, 220, or 240 Vac, +5 percent, −10 percent, 48 to 66 Hz. Power consumption is less than 200 volt-amperes.

2-8. Line Voltage and Fuse Selection

WARNING

BEFORE THE INSTRUMENT IS SWITCHED ON, its protective earth terminals must be connected to the protective conductor of the main power cable. The main plug shall be inserted only in a socket outlet provided with a protective earth contact. DO NOT negate the earth-grounding protection by the use of an extension cable, power cable, or autotransformer that does not have a protective ground conductor. Failure to ground the instrument properly can result in personal injury.

CAUTION

BEFORE THE INSTRUMENT IS SWITCHED ON, make sure it is adapted to the voltage of the ac power source by the proper positioning of the voltage selector card. Failure to set the ac power input of the instrument for the correct voltage level could cause damage to the instrument when it is switched on.

2-9. Select the line voltage and fuse as follows:

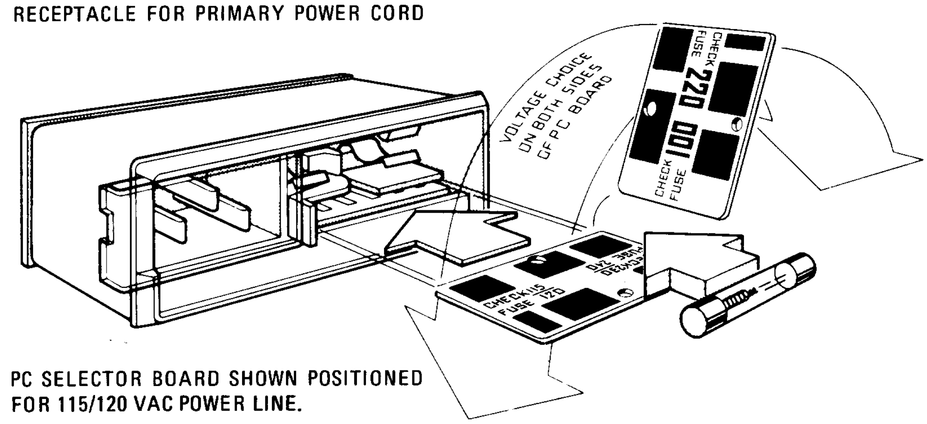
a. Measure the ac line voltage.

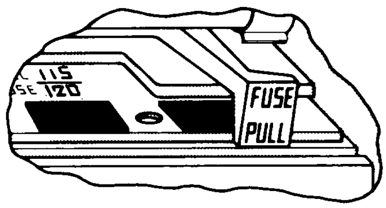
b. Position the printed-circuit board in the rear-panel power line module to select the line voltage that is closest to the voltage measured in step a. (See Figure 2-1.) The selected line voltage must be within +5 percent or −10 percent of the measured ac line voltage. If it is not, use an autotransformer between the ac source and the 8754A.

c. Make sure the correct fuse is installed in the fuse holder. A sticker providing the fuse ratings is affixed below the fuse holder.

2-10. Cable Connections

2-11. **Power Cable.** The instrument is equipped with a three-wire power cable in accordance with international safety standards. When connected to an appropriate power line outlet, the cable grounds the instrument cabinet. Table 2-1 includes illustrations of the main plug styles available on power cables supplied with Hewlett-Packard instrument. The part numbers are for complete power cables.



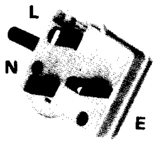
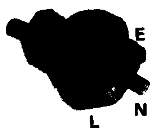
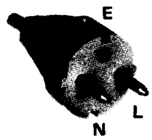
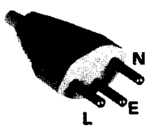
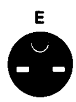
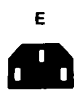


SELECTION OF OPERATING VOLTAGE

1. SLIDE OPEN POWER MODULE COVER DOOR AND PUSH FUSE-PULL LEVER TO LEFT TO REMOVE FUSE.
2. PULL OUT VOLTAGE-SELECTOR PC BOARD. POSITION PC BOARD SO THAT VOLTAGE NEAREST ACTUAL LINE VOLTAGE LEVEL WILL APPEAR IN MODULE WINDOW. PUSH BOARD BACK INTO ITS SLOT.
3. PUSH FUSE-PULL LEVER INTO ITS NORMAL RIGHT-HAND POSITION.
4. CHECK FUSE TO MAKE SURE IT IS OF CORRECT RATING AND TYPE FOR INPUT AC LINE VOLTAGE. FUSE RATINGS FOR DIFFERENT LINE VOLTAGES ARE INDICATED BELOW POWER MODULE.
5. INSERT CORRECT FUSE IN FUSEHOLDER.

Figure 2-1. Voltage Selection with Power Module PC Board

Table 2-1. AC Power Cables Available

Plug Type **	Cable HP Part Number	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	Straight*BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore, So. Africa, India
250V 	8120-1369 8120-0696	Straight*NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	Straight*CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754	Straight*NEMA5-15P 90° Straight*NEMA5-15P	80 80 36	Black Black Black	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
	8120-1378 8120-1521 8120-1676	Straight*NEMA5-15P 90° Straight*NEMA5-15P	80 80 36	Jade Gray Jade Gray Jade Gray	
250V 	8120-2104	Straight*SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	Straight*NEMA6-15P			
250V 	8120-1860	Straight*CEE22-VI			

* Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
E = Earth Ground; L = Line; N = Neutral

WARNING

If the instrument is to be energized through an autotransformer, make sure the common terminal of the autotransformer is connected to the protective earth contact of the power source outlet socket.

Any discontinuity in the protective ground, inside or outside the 8754A, is likely to create a safety hazard.

2-12. Mating Connectors. Front- and rear-panel connectors are listed in Table 2-2. An industry identification, Hewlett-Packard part number, and alternate source are given for the corresponding connector that mates with each connector on the instrument.

2-13. Operating Environment

2-14. Temperature. The instrument may be operated at temperatures from 0°C to +55°C.

2-15. Humidity. The instrument may be operated in environments with relative humidity of 5 percent to 95 percent at 0°C to +40°C. However, the instrument should also be protected from temperature extremes that cause internal condensation.

2-16. Altitude. The instrument may be operated at altitudes up to 4572 metres (approximately 15,000 feet).

2-17. Bench Operation

2-18. The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. The tilt stands raise the front of the instrument for easier viewing of the control panel. The plastic feet are shaped to make full-width modular instruments self-aligning when stacked.

2-19. A camera adapter is supplied with the instrument to allow the Tektronix C5B camera to be mounted on the CRT bezel. Figure 2-2 shows how to mount the adapter on the camera.

2-20. Rack Mounting (Options 908/909)

2-21. Instruments with Option 908 are equipped with a Rack Flange Kit, which supplies the hardware and instructions to install the instrument in a rack with a spacing of 482.6 mm (19 inches). Installation instructions are also given in Figure 2-3.

2-22. Instruments with Option 909 are equipped with a Rack Flange and Front Handle Kit, which supplies the hardware and instructions to install the instrument, with front handles, in a rack with a spacing of 482.6 mm (19 inches). Installation instructions are given in Figure 2-3.

2-23. Front Handles (Option 907)

2-24. Instruments with Option 907 are equipped with a Front Handle Kit, which supplies hardware and instructions to install front handles on the instrument. Installation instructions are also given in Figure 2-3.

2-25. STORAGE AND SHIPMENT

2-26. Environment

2-27. The instrument may be stored or shipped with the following environments:

Temperature: −40°C to +75°C

Relative Humidity: 5 to 95 percent at 0°C to +40° C

Altitude: To 15,240 metres (50,000 feet)

The instrument should be protected from temperature extremes that might cause condensation within the instrument.

2-28. Packaging

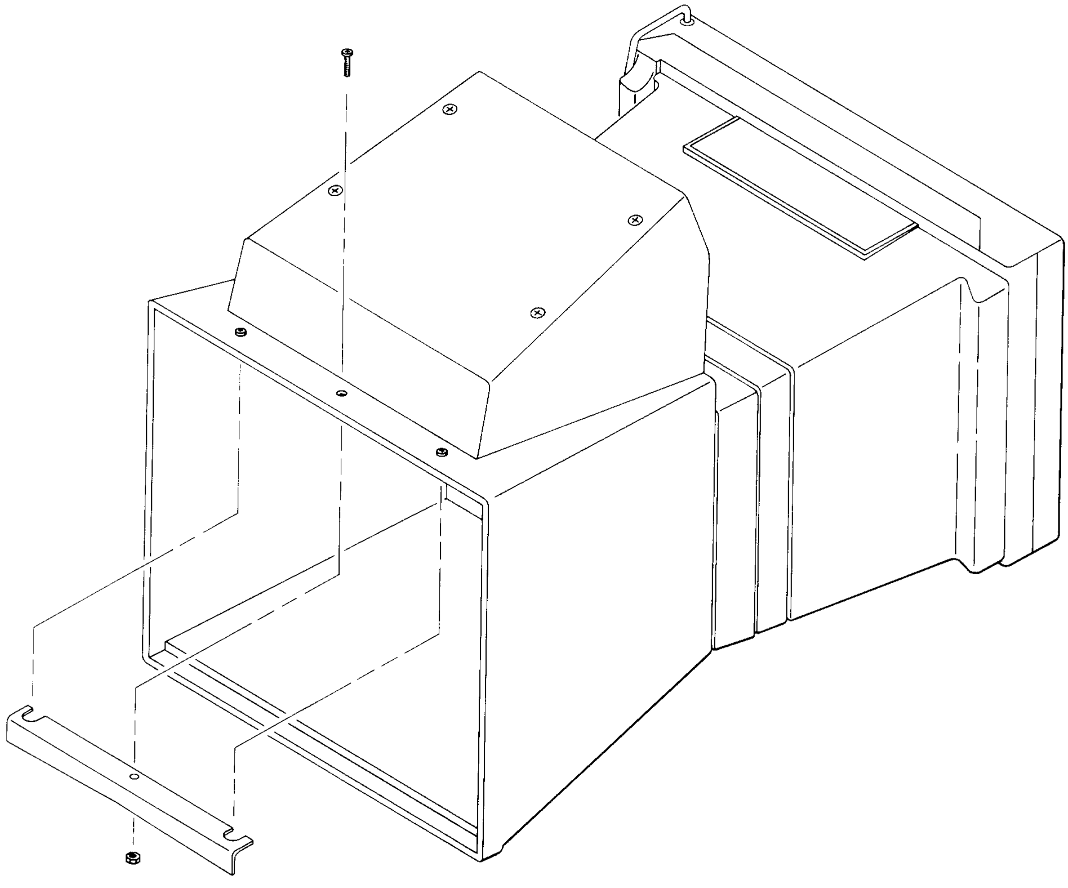
2-29. Original Packaging. It is recommended that the original factory packaging materials be retained for later use. If original packaging material is not retained, identical material is available through Hewlett-Packard offices.

2-30. Preparation for Shipment. Figure 2-4 illustrates the proper method of packaging the instrument for shipping using the original factory packaging materials. Part numbers and descriptions of the materials are presented in Figure 2-5.

Table 2-2. HP Model 8754A Mating Connectors

Connector on Instrument	Mating Connector*		
	Industry Identification	HP Part No.	Alternate Source
J1 RF OUTPUT J2 R INPUT J3 A INPUT J4 B INPUT	Type N male connector, U6-21G/U	1250-0882	Specialty Connector Co., Inc. The Bendix Corp. Microwave Devices
J5 PROBE POWER J6 PROBE POWER	Connector assembly, female Sleeve for above	5060-0466 5040-0494	None None
J7 EXT MARKER INPUT	Type BNC male connector, UG-88/U	1250-0256	Specialty Bendix
J8 NORMALIZER INTERCONNECT	Connector, R & P, 24-pin male	1251-2204	ITT Cannon Electric Co. TRW ELEK Components, Cinch Division
	Coaxial insert for subminiature D connector (5 required)	1251-0179	Cannon Cinch
A23J1 SWEEP OUTPUT A23J2 EXT SWEEP OUTPUT A23J3 BLANK/PEN A23J4 HORIZ A23J5 VERT A23J6 MAG/PHASE	Type BNC male connector, UG-88/U	1250-0256	Specialty Bendix
A23J7 PROGRAMMING	Connector, 25-pin male, D Series	1251-0063	Cannon Cinch

*Connector on external cable that mates with connector on HP 8754A.



1. REMOVE CENTER SCREW.
2. POSITION ADAPTER IN PLACE.
3. SECURE CENTER SCREW AS SHOWN.

Figure 2-2. Camera Adapter Installation

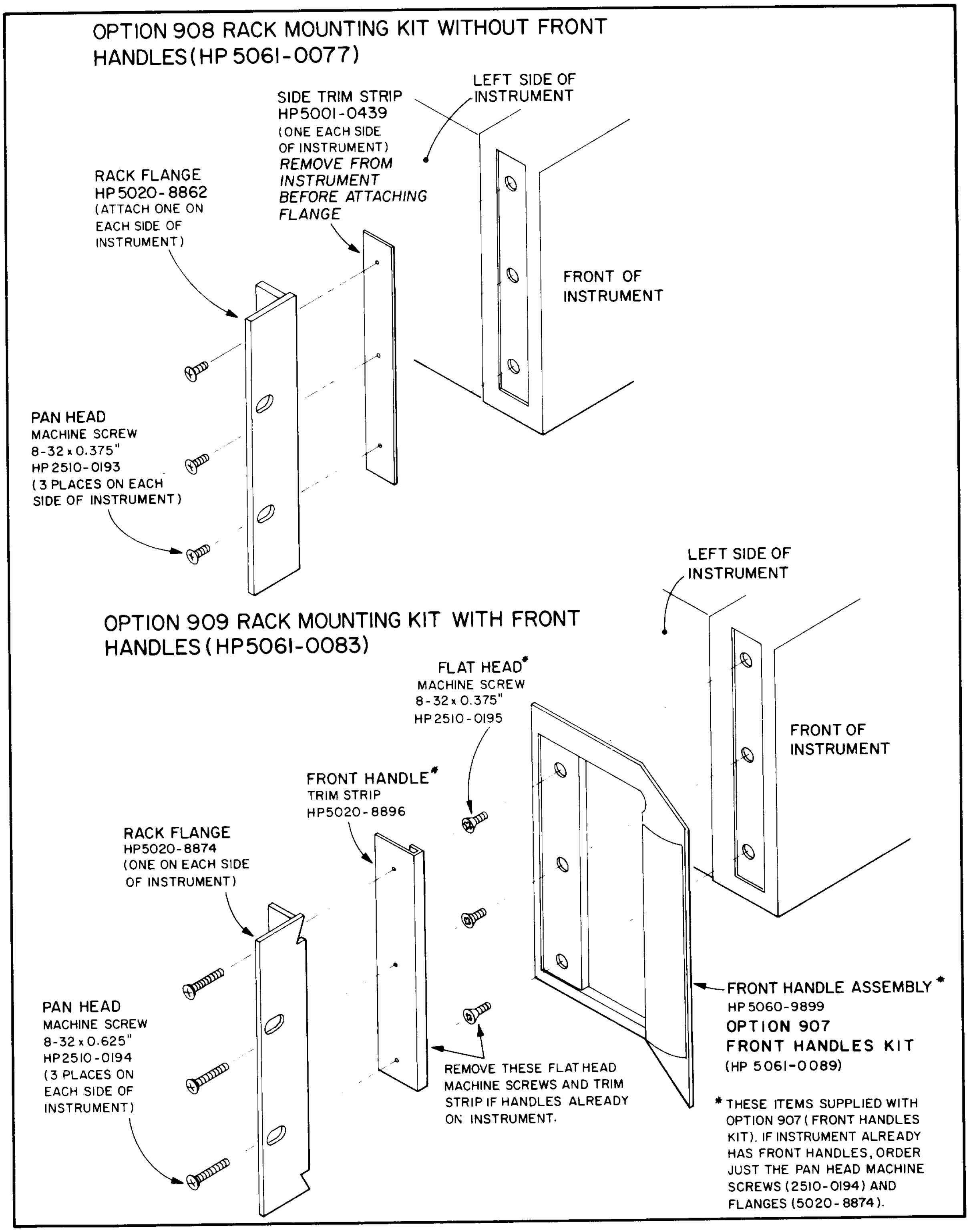
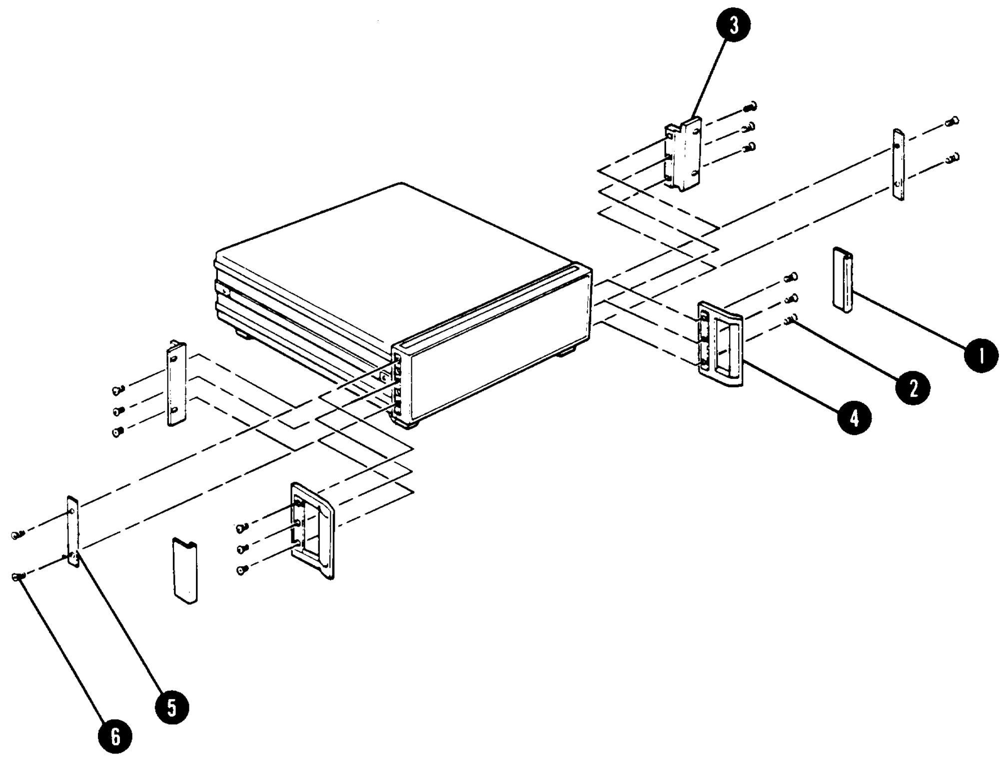


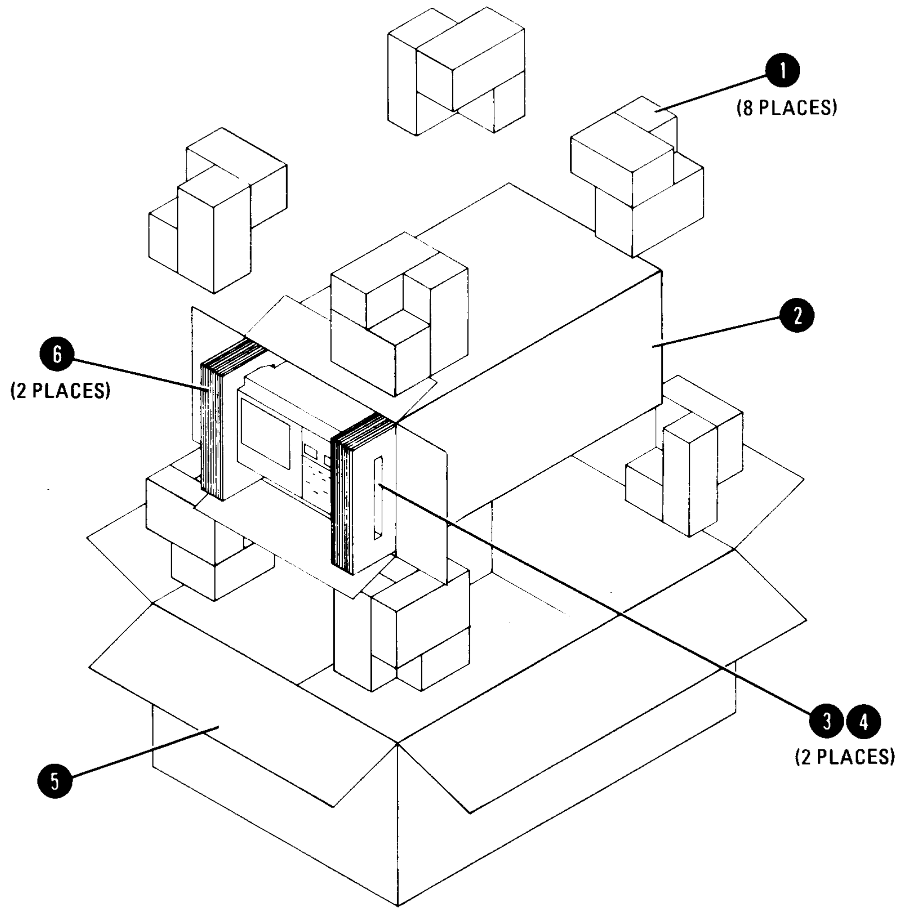
Figure 2-3. Installation of Rack-Mounting Hardware and Handles



1. IF FRONT HANDLES ARE INSTALLED, REMOVE TRIM ❶
2. REMOVE SCREWS ❷ THUS REMOVING RACK MOUNT FLANGES ❸ OR FRONT HANDLES ❹
3. ATTACH SHIPPING BARS* ❺ USING SCREWS* ❻

*Refer to Figure 2–5 for Part Numbers of Shipping Bars and Screws.

Figure 2-4. Preparation of Instrument for Shipment



Item	Qty	HP Part No.	Description
1	8	9220-2732	FOAM PADS–TOP CORNER; BOTTOM CORNER
2	1	9211-2729	CARTON–INNER
3	2	5021-1722	BARS–SHIPPING, ALUMINUM
4	4	2510-0061	SCREW–FOR ATTACHING SHIPPING BARS
5	1	9211-2730	CARTON–OUTER
6	2	9220-2775	SIDE PADS, CORRUGATED CARDBOARD

Figure 2-5. Packaging for Shipment Using Factory Packaging Materials

2-31. Other Packaging. If it is necessary to use materials different from the original factory packaging, the following general instructions should be observed:

a. Wrap the instrument in heavy paper or plastic.

b. Protect the front panel with double-wall corrugated board.

c. Place the instrument in a container with 8 to 10 cm (3 to 4 in.) of shock-absorbing material on each of the six sides to provide firm cushioning and to prevent movement inside the container. The container should be a double-wall corrugated carton of 125 kg (275 lb.) bursting strength.

d. Seal the container securely and mark FRAGILE.

2-32. Return for Servicing. If the instrument is being returned to Hewlett-Packard for servicing, a tag should be attached to the carton to indicate the type of service required, the return address, the model number, and the full serial number. In any correspondence, refer to the instrument by model number and full serial number.

2-33. OPERATION VERIFICATION

2-34. The following procedure is a means of checking the operation of the instrument without testing all the specifications listed in Table 1-1. Access to the interior or the instrument is not required.

2-35. OPERATION VERIFICATION TEST

NOTE

The Operation Verification procedure is not a valid test of the 8754A specifications, but is an overall check of instrument operation. If the 8754A does not meet tolerances in this procedure, do the related performance test indicated in this procedure to check instrument specifications.

DESCRIPTION:

The Operation Verification procedure checks the overall operation of the 8754A, and uses a minimum of test equipment. The procedure basically uses the 8754A to check itself.

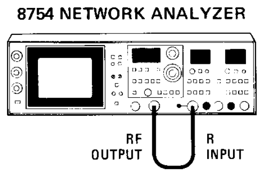


Figure 2-6. Absolute Measurement Test Setup

EQUIPMENT:

NOTE

Equipment listed is for more than one test setup.

3-Way Power Splitter . . . . HP 11850A
Matched Cable Kit . . . . HP 11851A
Step Attenuator . . . . HP 8496A Opt 001
Adapter, Type N Female to Type N Female . . . . HP 1250-0777
50 Ohm Termination . . . . HP 909A Option 012

2-35. OPERATION VERIFICATION TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 2-6. Set controls as follows:

Sweep Mode	CENTER
SWEEP	AUTO, FAST
TUNING	50 MHz
SWEEP WIDTH MHz	10 MHz
SWEEP WIDTH MHz Vernier	CAL
MARKERS MHz	50 MHz
OUTPUT dBm	Fully counterclockwise (0 dBm)
REFERENCE POSITION CH 1	on (in)
REFERENCE POSITION CH 2	off (out)
VIDEO FILTER	off (out)
POLAR A/R	off (out)
POLAR A/R LENGTH	Fully counterclockwise (0)
PHASE B/R LENGTH	Fully counterclockwise (0)
CHANNEL 1	
REFERENCE	−00
REFERENCE OFFSET button	off (out)
Measurement Select	OFF
Scale	1 dB/DIV
CHANNEL 2	
Measurement Select	OFF
SWEEP INT – EXT Switch (Rear Panel)	INT

2. Adjust REFERENCE POSTION CH1 ⬍ control to position CRT trace on center graticule line.

3. Select MAN SWEEP and set SWEEP vernier full counterclockwise. Adjust HORIZONTAL POSN screwdriver adjustment to align trace dot on left edge of graticule scale.

4. Set SWEEP vernier full clockwise. Adjust HORIZONTAL GAIN screwdriver adjustment to align trace dot on right edge of graticule scale.

5. Set SWEEP pushbuttons as shown in Table 2-3 and verify correct indication.

Table 2-3. Sweep Operation Check

SWEEP pushbuttons selected (in)	Indication
TRIG, SLOW	One sweep is triggered when SINGLE pushbutton is pressed.
AUTO, SLOW	Sweep time is variable from approximately 1 to 50 seconds with SWEEP Vernier.
AUTO, FAST	Sweep time is variable from approximately 10 to 500 milliseconds with SWEEP Vernier.

2-35. OPERATION VERIFICATION TEST (Cont'd)

6. Select AUTO, FAST SWEEP and set SWEEP vernier to midrange. Adjust TUNING to center 50 MHz marker on the center graticule line of the CRT. Adjust FREQUENCY MHz CAL for a FREQUENCY indication of 050 MHz.

7. Adjust TUNING to increase the frequency in 100 MHz intervals and center marker on CRT display at each interval (150 MHz, 250 MHz, 350 MHz . . . 1250 MHz). Check that the FREQUENCY MHz display indicates the marker frequency at each interval within ± 10 MHz.

8. Select 1 MHZ MARKERS and set SWEEP WIDTH MHz switch to 1 MHz. Adjust TUNING to 700 MHz and center marker on the CRT. The marker should be approximately 1 division wide and have a horizontal jitter of less than 0.3 major division. This check is for residual FM and any frequency drift should be ignored. If jittering is excessive, Performance Test 4-15 for Residual FM should be performed.

9. Adjust TUNING control to position the leading edge of the marker on the left edge of the graticule display. Use markers to check sweep width accuracy as shown in Table 2-4.

Table 2-4. Sweep Width Accuracy Check

MARKERS MHz	SWEEP WIDTH MHz	Marker Spacing (Major Divisions)	Typical Tolerance (Minor Divisions)
1	1	10 divisions	4
	2	5 divisions	2
	5	2 divisions	.8
	10	1 division	.4
10	20	5 divisions	2
	50	2 divisions	.5
	100	1 division	.25
50	200	2.5 divisions	.6
	500	1 division	.1
	1K	.5 division	.05

10. Press REFERENCE POSITION CH1 pushbutton to turn off reference trace. Press FULL 4 – 1300 button to select full sweep mode, and press MARKERS OFF button to turn off markers.

2-35. OPERATION VERIFICATION TEST (Cont'd)

11. The CRT trace should be near the middle of the CRT display and have a frequency response similar to the trace shown in Figure 2-7. If the trace variation is more than 2 dB peak-to-peak, Performance Tests 4-14 (RF Source Flatness) and 4-20 (Receiver Absolute Magnitude Response) should be performed.

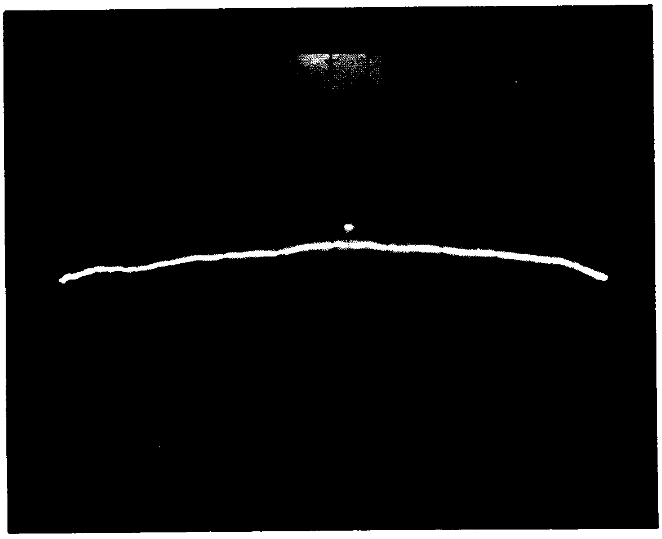


Figure 2-7. Full Sweep Display of R Absolute

12. Check the CRT display for the presence of the Full Marker. The marker position should be adjustable by the TUNING control and indicate the trace position of the frequency indicated by the FREQUENCY MHz display.

13. Note that the CRT trace moves up when the OUTPUT dBm control is adjusted clockwise. Non-linearities and overload occurs for power levels greater than approximately +2 dBm.

14. Set analyzer controls as follows:

SWEEP Vernier . . . . Midrange
OUTPUT dBm . . . . Full counterclockwise (0 dBm)
VIDEO FILTER . . . . On (in)
CHANNEL 1
  REFERENCE . . . . −80 dBm
  Measurement Select . . . . A
  Scale . . . . 2.5 dB/DIV

15. Check that the CRT trace is below the center graticule line. This indicates the Receiver noise level is less than −80 dBm.

2-35. OPERATION VERIFICATION TEST (Cont'd)

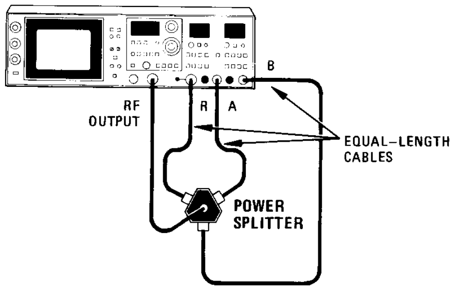


Figure 2-8. Ratio Measurement Test Setup

16. Connect equipment as shown in Figure 2-8. Set analyzer controls as follows:

Sweep Mode	FULL 4–1300
SWEEP	AUTO, FAST
SWEEP WIDTH MHz	0 CW
VIDEO FILTER	off (out)
CHANNEL 1	
REFERENCE	–00
REFERENCE OFFSET	off (out)
Measurement Select	A/R
Scale	.25 dB/DIV
CHANNEL 2	
REFERENCE	–00
REFERENCE OFFSET	off (out)
Measurement Select	OFF
Scale	.25 dB/DIV

17. Check that the CRT trace variation is less than 0.6 dB peak-to-peak (2.4 divisions).

18. Press CHANNEL 1 Measurement Select OFF button and press CHANNEL 2 Measurement Select B/R button.

19. Press REFERENCE POSITION CH2 button and adjust ⬍ control to position CRT trace on the center graticule line. Press button again to turn off reference trace.

20. Check that the CRT trace variation is less than 0.6 dB peak-to-peak (2.4 divisions).

2-35. OPERATION VERIFICATION TEST (Cont'd)

21. Press PHASE B/R Measurement Select button, and adjust PHASE B/R LENGTH control for a horizontal trace.

22. Check that the peak-to-peak deviation of the trace is ≤5 degrees (2 divisions).

23. Set analyzer controls as follows:

    Sweep Mode .... CENTER
    TUNING .... 50 MHz
    SWEEP WIDTH MHz .... 0 CW
    POLAR A/R .... on (in)
    CHANNEL 1
      REFERENCE .... −00
      REFERENCE OFFSET button .... on (in)
    CHANNEL 2
      REFERENCE .... −00
      REFERENCE OFFSET button .... on (in)

24. Press POLAR CENTER button and adjust ▲▼ and ◀▶ controls to set trace dot in the center of the graticule. Press button again to turn off reference trace.

25. Adjust CHANNEL 1 and CHANNEL 2 REFERENCE OFFSET controls to place trace dot on the 0 degree point of the outermost graticule circle (magnitude = 1.0). Note that CHANNEL 1 offsets magnitude and CHANNEL 2 offsets phase.

26. Set CHANNEL 2 REFERENCE to +90, −90, +180, and −180 degree settings. The trace dot at each setting should be within a circle of radius 2.5 mm centered on the appropriate phase point on the outermost graticule circle.

27. Set CHANNEL 2 REFERENCE to −00.

28. Set CHANNEL 1 REFERENCE as indicated in Table 2-5. At each setting, the trace dot should be within a circle of radius 2.5 mm centered on the point shown in the table.

Table 2-5. Polar Display Accuracy

CHANNEL 1 REFERENCE (dB)	Display Point Magnitude Phase = 0 degrees)	Polar Circle Radius
+00	1.00	4 cm
+06	0.50	2 cm
+12	0.25	1 cm
+20	0.10	.4 cm

2-35. OPERATION VERIFICATION TEST (Cont'd)

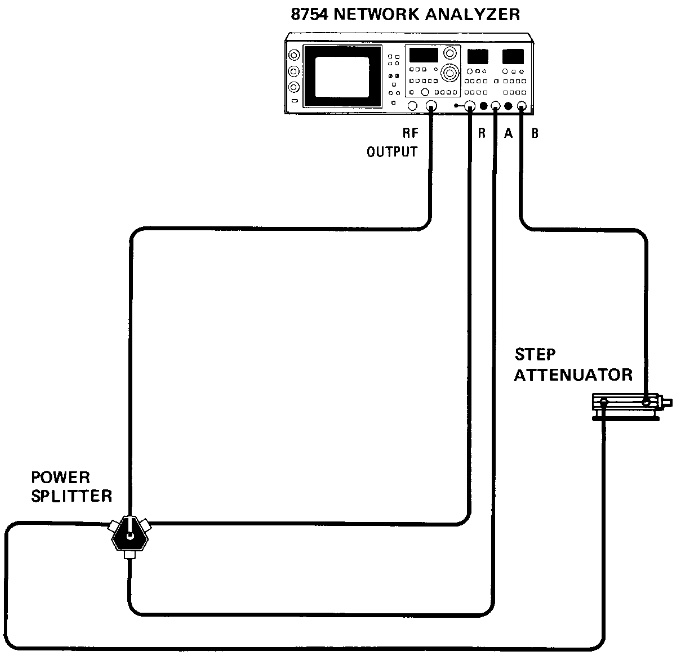


Figure 2-9. Magnitude Dynamic Accuracy Test Setup

29. Connect equipment as shown in Figure 2-9. Set analyzer controls as follows:

Sweep Mode	CENTER
TUNING	10 MHz
SWEEP WIDTH MHz	0 CW
OUTPUT dBm	+10
VIDEO FILTER	on (in)
POLAR A/R	off (out)
CHANNEL 1	
REFERENCE	−00
REFERENCE OFFSET	on (in)
Measurement Select	B/R
Scale	.25 dB/DIV
CHANNEL 2	
Measurement Select	OFF

30. Set step attenuator to 20 dB. Adjust CHANNEL 1 REFERENCE OFFSET vernier to position CRT trace on the center graticule line.

31. Set CHANNEL 1 Scale to 10 dB/DIV and check that the CRT trace remains on the center graticule line.

32. Set CHANNEL 1 REFERENCE lever switch to −20 dB and check that the CRT trace is two divisions above center graticule line (±0.1 division). Set CHANNEL 1 REFERENCE lever switch to +20 dB and check that the CRT trace is two divisions below the center graticule line (±0.1 division).

2-35. OPERATION VERIFICATION TEST (Cont'd)

NOTE

If the trace is within the Typical Limits listed in Tables 2-6 and 2-7, the 8754A probably meets the Magnitude Dynamic Accuracy specifications. If the trace is within the Maximum Limits listed in the tables, but not within the Typical Limits, the 8754A is operational, but the Performance Test in Paragraph 4-21 must be performed to verify specifications.

33. Set step attenuator and network analyzer controls according to Table 2-6. At each setting, note the deviation of the trace from the center graticule line (positive if above; negative if below). The allowable deviation for each setting is shown in Table 2-6.

Table 2-6. Magnitude Dynamic Accuracy, B Channel

Attenuator Setting (dB)	CHANNEL 1 Scale (dB/DIV)	CHANNEL 1 REFERENCE (dB)	Typical Allowable Deviation (dB)	Maximum Allowable Deviation (dB)
20 (ref.)	.25	+00	0 (ref.)	0 (ref.)
0	.25	+20	±0.4	±0.6
10	.25	+10	±0.4	±0.5
30	.25	-10	±0.4	±0.5
40	.25	-20	±0.4	±0.6
50	.25	-30	±0.5	±0.8
60	1	-40	±0.8	±1.1
70	1	-50	±1.5	±1.8
80	1	-60	±2.9	±3.3

34. Set analyzer controls as follows:

OUTPUT dBm . . . . +10
CHANNEL 1
  Measurement Select . . . . OFF
CHANNEL 2
  REFERENCE . . . . −00
  REFERENCE OFFSET . . . . on (in)
  Measurement Select . . . . PHASE B/R
  Scale . . . . 2.5 DEG/DIV

35. Set step attenuator to 20 dB. Adjust CHANNEL 2 REFERENCE OFFSET vernier to position the CRT trace on the center graticule line.

36. Step the step attenuator from 0 to 50 dB. The trace deviation from the center graticule line should be less than ±2 degrees.

2-35. OPERATION VERIFICATION TEST (Cont'd)

37. Step the attenuator to 60 and 70 dB. The trace deviation from the center graticule line should be less than ±4 degrees.

38. Switch the cables to the R and B INPUT ports so the attenuator is connected in the R path. Set the step attenuator to 20 dB and set analyzer controls as follows:

OUTPUT dBm . . . . +10
CHANNEL 1
REFERENCE . . . . −00
Measurement Select . . . . B/R
CHANNEL 2
Measurement Select . . . . OFF

39. Adjust CHANNEL 1 REFERENCE OFFST vernier to position CRT trace on the center graticule line. Set the step attenuator and network analyzer controls according to Table 2-7. At each setting, note the deviation of the trace from the center graticule line (positive if above; negative if below). The allowable deviation for each setting is shown in Table 2-7.

Table 2-7. Magnitude Dynamic Accuracy, R Channel

Attenuator Setting (dB)	CHANNEL 1 Scale (dB/DIV)	CHANNEL 1 REFERENCE (dB)	Typical Allowable Deviation (dB)	Maximum Allowable Deviation (dB)
20 (ref.)	.25	-00	0 (ref.)	0 (ref.)
0	.25	-20	±0.4	±0.6
10	.25	-10	±0.4	±0.5
30	.25	+10	±0.4	±0.5
40	.25	+20	±0.4	±0.6

40. Set step attenuator to 50 dB and check that the front-panel UNLOCKED indicator is on.

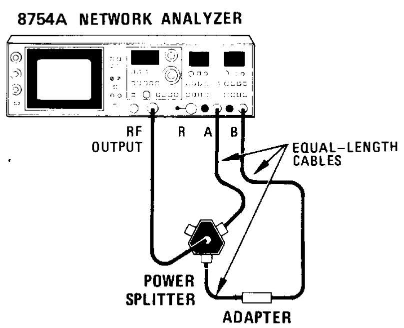


Figure 2-10. Phase Reference Accuracy Test Setup

2-35. OPERATION VERIFICATION TEST (Cont'd)

41. Connect equipment as shown in Figure 2-10. Set analyzer controls as follows:

Sweep Mode	FULL 4 – 1300
SWEEP	AUTO, FAST
SWEEP WIDTH MHz	0 CW
VIDEO FILTER	off (out)
CHANNEL 1	
Measurement Select	OFF
CHANNEL 2	
REFERENCE	– 180 DEG
REFERENCE OFFSET	off (out)
Measurement Select	PHASE B/R
Scale	90 DEG/DIV

42. Turn the PHASE B/R LENGTH control fully clockwise, then turn counterclockwise until the right-hand end of trace is at least 1 minor division below center graticule line and any noise present on the right-hand end of trace is gone.

43. Adjust TUNING to place the marker at the highest frequency at which the trace crosses the center graticule line. The trace should appear as in Figure 2-11.

44. Set analyzer controls as follows:

Sweep Mode	CENTER
CHANNEL 2	
Scale	2.5 DEG/DIV

45. Adjust TUNING to place the trace on the center graticule line.

46. Set CHANNEL 2 REFERENCE to + 180 DEG. The deviation of the trace from the center graticule line should be no more than ± 1.8 degrees (± 0.72 division).

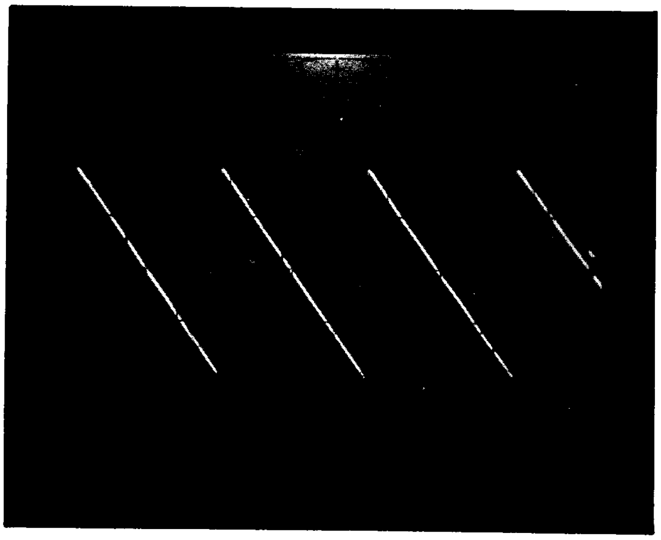


Figure 2-11. Phase Reference Test Display

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications in Table 1-1 as the performance standards. None of the tests requires access to the interior of the instrument.

4-3. If a test measurement is marginal, go to Section V and perform adjustment procedures.

4-4. EQUIPMENT REQUIRED

4-5. Equipment required for the performance tests is listed under Recommended Test Equipment, Table 1-3, in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

4-6. TEST RECORD

4-7. Results of the performance tests may be tabulated on the Test Record at the end of Section IV. The Test Record lists all of the tested specifications and their acceptable limits.

4-8. CALIBRATION CYCLE

4-9. This instrument requires periodic verification of performance. The instrument should be checked using the performance tests at least every six months.

4-10. OPERATION VERIFICATION

4-11. To assure that the instrument is operating properly without testing all of the specifications listed in Table 1-1, the Operation Verification procedure given in Section II may be used.

NOTE

Allow instrument to warm up for at least one half hour before doing performance tests.

Table 4-1. Performance Tests

Paragraph	Related Adjustment Paragraph	Performance Test
4-12	5-15	Frequency Readout Accuracy Test
4-13	5-17	Marker Accuracy Test
4-14	5-16	Source Output Power Test
4-15	5-16	Source Spectral Purity Test
4-16	NONE	Input Port Match Test
4-17	5-21	Receiver Noise Level Test
4-18	5-22	Minimum R Input Level Test
4-19	5-22	Crosstalk Isolation Test
4-20	5-22	Magnitude and Phase Frequency Response Test
4-21	5-11, 5-22, 5-21	Magnitude Dynamic Accuracy Test
4-22	5-11, 5-14	Magnitude Display Accuracy Test
4-23	5-23	Phase Dynamic Accuracy Test
4-24	5-11, 5-24	Phase Reference Accuracy Test
4-25	5-11, 5-24, 5-14	Phase Display Accuracy Test
4-26	5-11, 5-24, 5-14	Polar Display Accuracy Test
4-27	5-11, 5-22, 5-21, 5-24	MAG/PHASE Output Accuracy Test

PERFORMANCE TESTS

4-12. FREQUENCY READOUT ACCURACY TEST

SPECIFICATION:

± 10 MHz (20 to 30 °C)

DESCRIPTION:

The frequency readout is calibrated with an external frequency counter at 200 MHz. The readout is then compared with the counted output frequency at several frequencies over the 4 to 1300 MHz range.

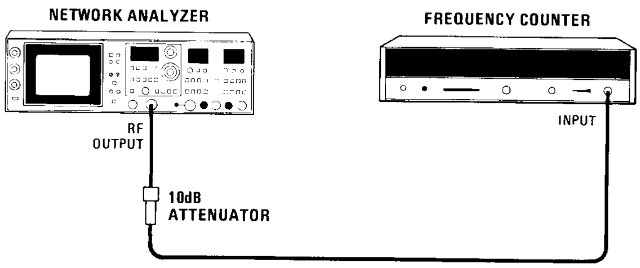


Figure 4-1. Frequency Readout Accuracy Test Setup

EQUIPMENT:

Frequency Counter .... HP 5340A
10 dB Attenuator .... HP 8491A Option 010

PROCEDURE:

1. Set controls as follows:

   Frequency Counter:
   RANGE .... 10 Hz — 18 GHz
   RESOLUTION .... 100 kHz

   Network Analyzer:
   Sweep Mode .... CENTER
   SWEEP WIDTH MHz .... 0 CW
   SWEEP WIDTH MHz Vernier .... CAL detent
   OUTPUT dBm .... 0 dBm

2. Connect equipment as shown in Figure 4-1.

3. Adjust TUNING so external frequency counter reads 200 (±0.1) MHz.

4. Adjust FREQ CAL so FREQUENCY readout indicates 200 MHz.

5. Set TUNING so the external frequency counter indicates 50.0 MHz. The FREQUENCY MHz readout should indicate 050 ± 10 MHz.

6. Set TUNING for external frequency counter indications of 4.0 MHz, 1000 MHz, and 1300 MHz. For each frequency setting, the FREQUENCY MHz readout should be within ± 10 MHz of the counted frequency.

PERFORMANCE TESTS

4-13. MARKER ACCURACY TEST

SPECIFICATION:

±0.01%

DESCRIPTION:

The analyzer is tuned to the 1300 MHz crystal marker and the RF output frequency is measured with an external counter.

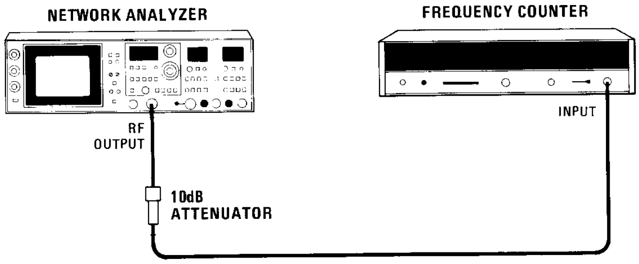


Figure 4-2. Marker Accuracy Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
10 dB Attenuator	HP 8491A Option 010

PROCEDURE:

Set controls as follows:

Frequency Counter:

RANGE	10 Hz — 18 GHz
RESOLUTION Hz	100 Hz

Network Analyzer:

Sweep Mode	CENTER
SWEEP	AUTO, FAST
SWEEP Vernier	clockwise
SWEEP WIDTH MHz	1 MHz
SWEEP WIDTH MHz Vernier	CAL
MARKERS MHz	50 MHz
OUTPUT dBm	0 dBm
REFERENCE POSITION CH 1	on (in)
REFERENCE POSITION CH 2	off (out)
POLAR A/R	off(out)
VIDEO FILTER	off (out)

4-13. MARKER ACCURACY TEST (Cont'd)

CHANNEL 1
Measurement Select .... OFF

CHANNEL 2
Measurement Select .... OFF

2. Connect equipment as shown in Figure 4-2.

3. Adjust REFERENCE POSITION CH 1 ⬍ control to place trace at the center graticule line.

4. Adjust TUNING for a FREQUENCY indication of 1300 MHz. Fine tune to place the 1300 MHz marker on the center graticule line. (The 1300-MHz marker might be off screen. If so, turn the TUNING control until it appears.)

5. Set SWEEP WIDTH MHz to 0 CW. The external frequency counter should indicate 1300.00 MHz ±0.13 MHz.

4-14. SOURCE OUTPUT POWER TEST

SPECIFICATIONS:

Power Accuracy: ±0.8 dB at 50 MHz
Flatness: ± 0.5 dB

DESCRIPTION:

The power output at 50 MHz is checked with a power meter at 0, + 5, and + 10 dBm. The flatness across the frequency range is tested by manually sweeping through the range in the CW mode and observing the change in power meter indication.

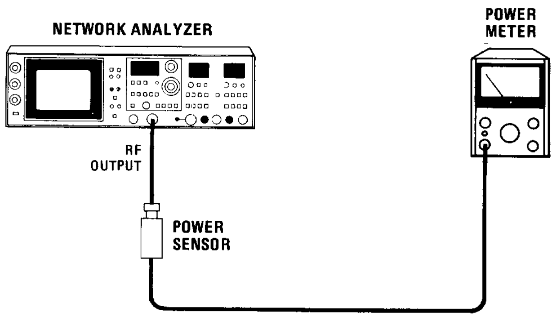


Figure 4-3. Source Output Power Test Setup

EQUIPMENT:

Power Meter .... HP 435A
Power Sensor .... HP 8482A

PERFORMANCE TESTS

4-14. SOURCE OUTPUT POWER TEST (Cont'd)

PROCEDURE:

Power Accuracy at 50 MHz

1. Calibrate power meter.
2. Set analyzer controls as follows:

Sweep Mode .... CENTER
SWEEP .... AUTO, FAST
SWEEP VERNIER .... fully clockwise
TUNING .... 050 MHz
SWEEP WIDTH MHz .... 1 MHz.
SWEEP WIDTH MHz Vernier .... CAL
MARKERS MHz .... 50 MHz
OUTPUT dBm .... 0 dBm
REFERENCE POSITION CH 1 .... on (in)
POLAR A/R .... off (out)

CHANNEL 1
Measurement Select .... OFF

CHANNEL 2
Measurement Select .... OFF

3. Adjust REFERENCE POSITION CH 1 ▲▼ control so that reference trace is at the center graticule line.
4. Adjust TUNING to center the 50 MHz marker on the center graticule line of the CRT.
5. Set SWEEP WIDTH MHz to 0 CW. Connect power meter to analyzer RF OUTPUT port as shown in Figure 4-3.
6. Measure the RF OUTPUT power. The meter indication should be 0 dBm ±0.8 dB.
7. Set OUTPUT dBm to 5 dBm. The power meter should indicate +5 dBm ±0.8 dB.
8. Set OUTPUT dBm to 10 dBm. The meter indication should be +10 dBm ±0.8 dB.

Flatness

9. Set analyzer controls as follows:

SWEEP WIDTH MHz .... 10 MHz
MARKERS MHz .... 1 MHz

10. Set TUNING to 004 MHz. Adjust TUNING until the display appears as in Figure 4-4. The 4 MHz marker is centered on the CRT and the trace is blanked below approximately 3 MHz.
11. Adjust FREQUENCY MHz CAL for a FREQUENCY indication of 004 MHz.

4-14. SOURCE OUTPUT POWER TEST (Cont'd)

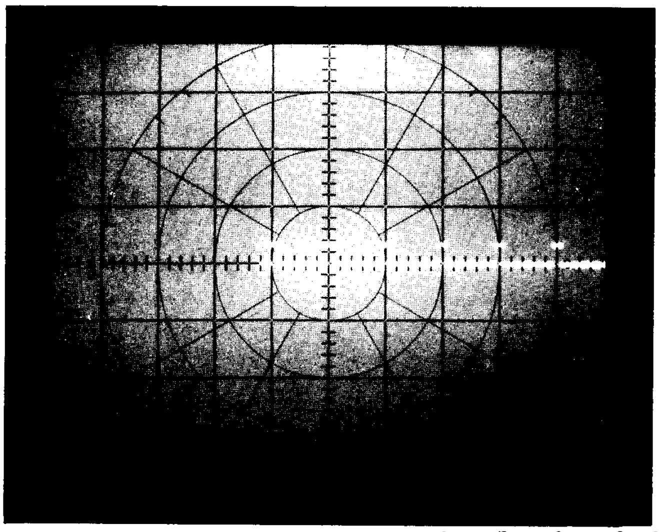


Figure 4-4. Network Analyzer Tuned to 4-MHz Marker

12. Set SWEEP WIDTH MHz to 0 CW.

13. Adjust OUTPUT dBm until the power meter indicates +9 dBm.

14. Adjust TUNING slowly through the range 004 MHz to 1300 MHz and note the maximum and minimum power meter readings. The difference between the two readings should not be greater than 1.0 dB.

4-15. SOURCE SPECTRAL PURITY TEST

SPECIFICATION:

(at +10 dBm)
Swept Residual FM: 7 kHz rms (10 Hz to 10 kHz bandwidth)

Harmonics: −28 dBc

Spurious: 4—500 MHz: −65 dBc
500—1300 MHz: −50 dBc

DESCRIPTION:

The CW output signal of the network analyzer is slope detected by using the linear portion of a spectrum analyzer resolution bandwidth filter in the zero-span mode. The residual FM of the signal is represented by the auxiliary vertical output voltage from the spectrum analyzer, which is filtered and then measured by an rms responding voltmeter.

Harmonics and spurious signals are checked by observing the source output on a spectrum analyzer.

4-15. SOURCE SPECTRAL PURITY TEST (Cont'd)

NOTE

This test uses the slope of the spectrum analyzer's 300 kHz resolution bandwidth filter to demodulate the residual FM into AM. A small, linear portion of the filter skirt about 14 dB down from the signal peak is used (see Figure 4-5). The system is calibrated by measuring the vertical output voltage produced by a 5 kHz/DIV sweep centered on the detection point of the filter slope (approximately 14 dB down from the peak).

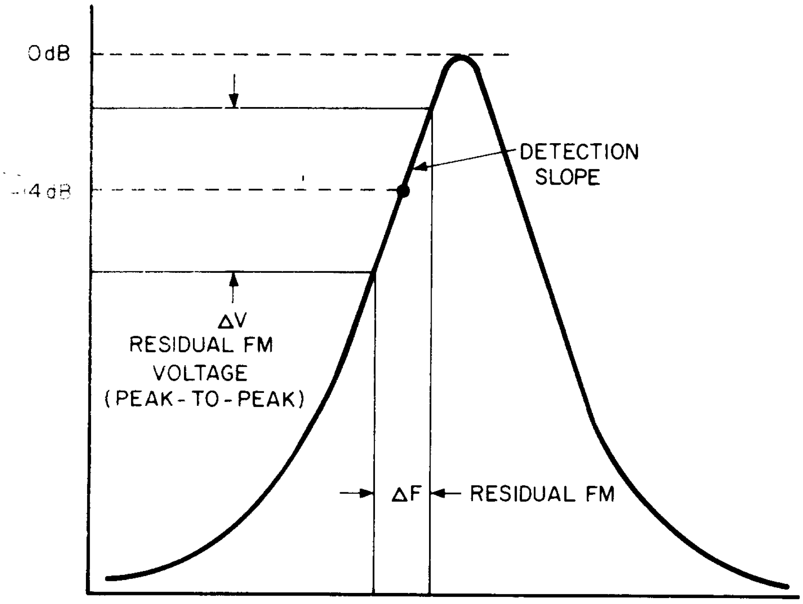
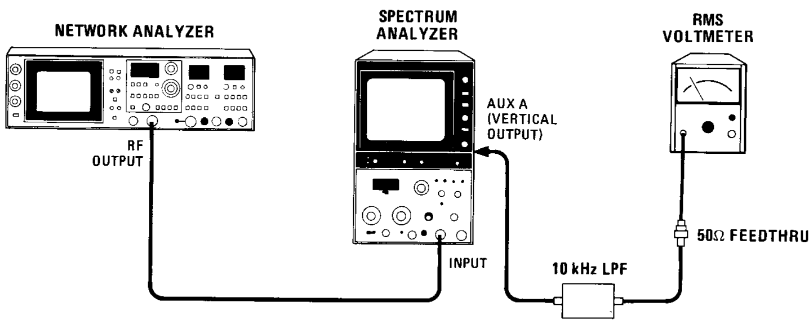


Figure 4-5. Bandwidth Filter Slope Used For FM Demodulation



PERFORMANCE TESTS

4-15. SOURCE SPECTRAL PURITY TEST (Cont'd)

EQUIPMENT:

Spectrum Analyzer . . . . HP 8558B/181T (or any 180-series mainframe with AUX A-AUX D outputs)
RMS Voltmeter . . . . HP 3400A
10 kHz Low-Pass Filter . . . . HP 8505 – 60155
50 Ohm Feedthrough Termination . . . . HP 10100C

PROCEDURE:

Residual FM

1. Set controls as follows:

Network Analyzer:

Sweep Mode	CENTER
SWEEP	AUTO, FAST
TUNING	050 MHz
SWEEP WIDTH MHz	0 CW
SWEEP WIDTH MHz Vernier	CAL
OUTPUT dBm	10 dBm
MARKERS MHz	OFF

Spectrum Analyzer:

START-CENTER	CENTER
TUNING	0.0 MHz
FREQ SPAN/DIV	500 kHz
RESOLUTION BW	300 kHz (uncoupled)
OPTIMUM INPUT	– 10 dBm (30 dB atten)
REFERENCE LEVEL dBm	+10 dBm
10 dB/DIV—1 dB/DIV—LIN	10 dB/DIV
TIME/DIV	1 msec/DIV
TRIGGER	FREE RUN
BASELINE CLIPPER	fully counterclockwise (OFF)
VIDEO FILTER	off (out)

2. Connect equipment as shown in Figure 4-6, but do not connect network analyzer at this point.
3. Adjust spectrum analyzer TUNING to center the L.O. feedthrough signal on the spectrum analyzer display.
4. Adjust spectrum analyzer REFERENCE LEVEL controls to place the peak of the signal trace at the reference level (top) graticule line.
5. Change the display scale to 1 dB/DIV and repeat step 4 if necessary.
6. Reduce FREQ SPAN/DIV to 5 kHz while keeping the signal centered with the TUNING control.

PERFORMANCE TESTS

4-15. SOURCE SPECTRAL PURITY TEST (Cont'd)

7. Decrease REFERENCE LEVEL by 10 dB and place trace at mid-screen by turning the TUNING control counterclockwise. A positive-slope ramp (a portion of the 300 kHz bandwidth filter trace) should now be centered on the display (see Figure 4-7).

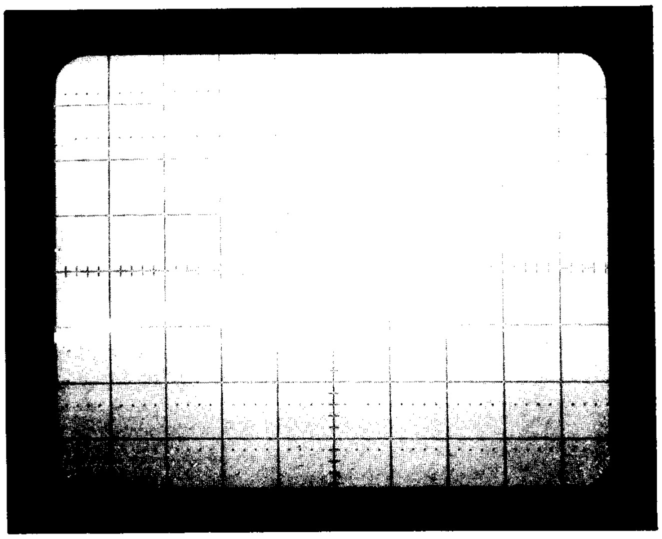


Figure 4-7. Detection Slope

8. Measure the filtered vertical output voltage from the spectrum analyzer with the RMS voltmeter (it should be approximately 60 to 70 mV). Record this voltage: _____ mV rms.

NOTE

The spectrum analyzer's vertical output in step 8 is a 100 Hz (1 msec/DIV sweep) sawtooth wave whose amplitude corresponds to a frequency modulation of 50 kHz peak-to-peak, or 14.4 kHz rms.

9. Connect network analyzer RF OUTPUT port to spectrum analyzer input.

10. Set spectrum analyzer controls as follows:

TUNING	50 MHz
FREQ SPAN/DIV	1 MHz
10 dB/DIV—1 dB/DIV—LIN	10 dB/DIV
REFERENCE LEVEL dBm	+10 dBm

11. Adjust spectrum analyzer TUNING to center the 50 MHz RF OUTPUT signal on the spectrum analyzer display.

12. Adjust spectrum analyzer REFERENCE LEVEL controls to place the peak of the signal trace at the reference level (top) graticule line.

13. Set spectrum analyzer display scale to 1 dB/DIV and repeat step 12 if necessary.

4-15. SOURCE SPECTRAL PURITY TEST (Cont'd)

14. Reduce FREQ SPAN/DIV to 0 while keeping the signal centered on the CRT with the TUNING control.

15. Decrease REFERENCE LEVEL by 10 dB and position trace at midscreen by turning TUNING control counterclockwise.

16. Measure the filtered vertical output voltage from the spectrum analyzer with the RMS voltmeter to obtain the residual FM voltage. Calculate residual FM as follows:

$$\text{Residual FM (kHz} = \frac{\text{residual FM voltage (mV rms)}}{\text{voltage from step 8 (mV rms}} \times 14.4 \text{ kHz}$$

$$= \underline{\qquad\qquad} \text{ kHz}$$

Residual FM should be less than 7 kHz.

17. Repeat steps 10 through 16 with spectrum and network analyzers tuned to 600 MHz.

18. Repeat steps 10 through 16 with spectrum and network analyzers tuned to 1300 MHz.

Harmonics

19. Disconnect 10 kHz filter from auxiliary output of spectrum analyzer to protect voltmeter from transients. Set controls as follows:

Network Analyzer:

Sweep Mode . . . . FULL 4 – 1300
SWEEP . . . . AUTO,MAN
OUTPUT dBm . . . . +10 dBm

Spectrum Analyzer:

START-CENTER . . . . CENTER
FREQ SPAN/DIV . . . . 100 MHz
RESOLUTION BW . . . . 1 MHz
OPTIMUM INPUT . . . . –10 dBm (30 dB atten.)
REFERENCE LEVEL dBm . . . . +10 dBm
TUNING . . . . 500 MHz
10 dB/DIV—1 dB/DIV—LIN . . . . 10 dB/DIV
VIDEO FILTER . . . . 12 O'clock

20. Tune network analyzer to 500 MHz (center of spectrum analyzer display) with SWEEP vernier. Adjust spectrum analyzer REFERENCE LEVEL to set peak of 500 MHz signal at the reference level line.

21. Manually tune network analyzer from 4 to 500 MHz with SWEEP vernier and observe the harmonics of the network analyzer signal. All harmonics should be ⩾28 dB below the peak of the fundamental signal.

4-15. SOURCE SPECTRAL PURITY TEST (Cont'd)

22. Set START-CENTER switch on spectrum analyzer to START. Tune network analyzer with SWEEP vernier from 500 MHz to 1300 MHz and observe the harmonics of the network analyzer signal. All harmonics should be ≥28 dB below the peak of the signal.

NOTE

The spectrum analyzer originates some mixing harmonics that may appear on the display. If a signal is in question, increase the spectrum analyzer input attenuation by 10 dB. Note if signal decreases in amplitude by 10 dB, then return the attenuator to the original position. If the signal in question comes from an external source, it will change by 10 dB. If the signal in question originates in the spectrum analyzer, the level will either change by greater or less than 10 dB or may not change at all.

Spurious Signals

23. Set START-CENTER switch on 8558B to CENTER. Manually tune the network analyzer from 4 to 500 MHz with the SWEEP vernier and check for spurious (non-harmonic) signals. Any spurious signals should be ≥65 dB below the peak of the fundamental.

24. Set START – CENTER switch to START. Manually tune the network analyzer from 4 to 500 MHz and check for spurious signals. Any spurious signals should be ≥65 dB below the peak of the fundamental.

25. Set START-CENTER switch to CENTER. Manually tune the network analyzer from 500 to 1300 MHz and check for spurious signals. Any spurious signals should be ≥50 dB below the peak of the fundamental.

26. Set START-CENTER switch to START. Manually tune the network analyzer from 500 to 1300 MHz and check for spurious signals. Any spurious signals should be ≥50 dB below the peak of the fundamental.

4-16. INPUT PORT MATCH TEST

SPECIFICATION:

≥20 dB return loss (≤ 1.22 SWR)

DESCRIPTION:

The return loss of the A, B, and R INPUT ports is measured with the aid of a transmission/reflection test set.

4-16. INPUT PORT MATCH TEST (Cont'd)

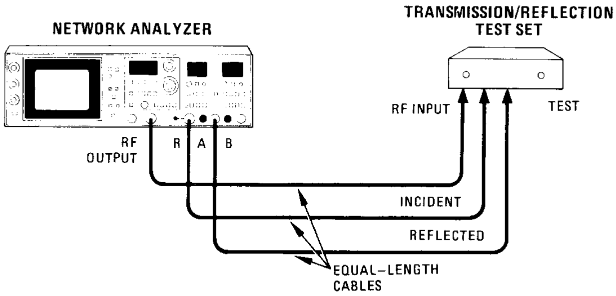


Figure 4-8. Input Port Match Test Setup (B and R INPUT Ports)

EQUIPMENT:

NOTE

Equipment listed is for two test setups, Figures 4-8 and 4-9.

Transmission/Reflection Test Set	HP 8502A
Matched Cable Kit	HP 11851A
Adapter, N male to N male	HP1250-0778

PROCEDURE:

1. Connect equipment as shown in Figure 4-8. Set the test set RF INPUT ATTENUATION dB switch to 10 and set the controls of the network analyzer as follows:

Sweep Mode	FULL 4–1300
SWEEP	AUTO, FAST
SWEEP VERNIER	midrange
MARKERS MHz	OFF
OUTPUT dBm	0 dBm
POLAR A/R	off (out)
VIDEO FILTER	off (out)

CHANNEL 1

REFERENCE	–00
REFERENCE OFFSET button	on (in)
Measurement Select	A
Scale	2.5 dB/DIV

CHANNEL 2

Measurement Select	OFF

2. Press the REFERENCE POSITION CH 1 button and adjust ♦ control to place the reference trace on the center graticule line. Press button again to turn off reference trace.

PERFORMANCE TESTS

4-16. INPUT PORT MATCH TEST (Cont'd)

3. Adjust CHANNEL 1 REFERENCE OFFSET control to center the trace on the center graticule line. (If trace is off screen, adjust control until it appears.)

NOTE

Do not make further adjustments of the CHANNEL 1 OFFSET control until instructed to do so.

4. With a grease pencil, draw the trace on the CRT.
5. Connect B INPUT port through N male adapter to the TEST port of 8502A. Set CHANNEL 1 REFERENCE to −20 dB. The trace should be at or below the grease line for a return loss of ⩾ 20 dB at the B INPUT port.
6. At the network analyzer, reverse the connections at the R and B inputs. Connect R INPUT port through N male adapter to TEST port of 8502A. The trace should be at or below the grease line for a return loss of ⩾20 dB at the R INPUT port.
7. Erase the grease line.
8. Connect 8502A to the network analyzer as shown in Figure 4-9.

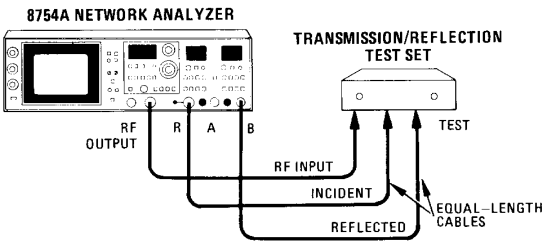


Figure 4-9. Input Port Match Test Setup (A INPUT Port)

9. Set analyzer controls as follows:

CHANNEL 1
REFERENCE . . . . −00
Measurement Select . . . . B/R

10. Adjust the CHANNEL 1 REFERENCE OFFSET control to center the trace on the center graticule line.

NOTE

Do not make further adjustments of the CHANNEL 1 OFFSET during this test.

PERFORMANCE TESTS

4-16. INPUT PORT MATCH TEST (Cont'd)

11. With a grease pencil, draw the trace on the CRT.

12. Connect A INPUT port through N male adapter to the TEST port of the 8502A. Set CHANNEL 1 REFERENCE to −20 dB. The trace should be at or below the grease line for a return loss of ⩾20 dB at the A INPUT port.

4-17. RECEIVER NOISE LEVEL TEST

SPECIFICATION:

−80 dBm at A and B inputs.

DESCRIPTION:

The average noise level at the A and B inputs is measured with these inputs terminated.

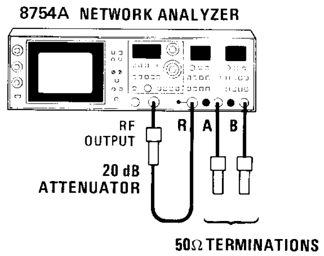


Figure 4-10. Receiver Noise Level Test Setup

EQUIPMENT:

20 dB Attenuator	HP 8491A Option 020
50 Ohm Termination (2)	HP 909A Option 012

PROCEDURE:

1. Connect equipment as shown in Figure 4-10. Set controls as follows:

Sweep Mode	FULL 4—1300 MHz
SWEEP	AUTO, FAST
SWEEP Vernier	midrange
MARKERS MHz	OFF
OUTPUT dBm	0
VIDEO FILTER	on (in)
POLAR A/R	off (out)

4-17. RECEIVER NOISE LEVEL TEST (Cont'd)

CHANNEL 1
- REFERENCE . . . . −80 dBm
- REFERENCE OFFSET button . . . . off (out)
- Measurement Select . . . . A
- Scale . . . . 2.5 dB/DIV

CHANNEL 2
- Measurement Select . . . . OFF

2. Press the REFERENCE POSITION CH 1 button and adjust ▲▼ control to place the reference trace on the center graticule line. Press the button again to turn off the reference trace.

3. The highest point of the noise trace should be at or below the center graticule line.

4. Set analyzer controls as follows:

CHANNEL 1
- Measurement Select . . . . OFF

CHANNEL 2
- REFERENCE . . . . −80 dBm
- REFERENCE OFFSET . . . . off (out)
- Measurement Select . . . . B
- Scale . . . . 2.5 dB/DIV

5. Press REFERENCE POSITION CH 2 button and adjust ▲▼ control to place the reference trace on the center graticule line. Press button again to turn off reference trace.

6. The highest point of the noise trace should be at or below the center graticule line.

4-18. MINIMUM R INPUT LEVEL TEST

SPECIFICATION:

−40 dBm (≥ −40 dBm required to operate reference channel phase lock)

DESCRIPTION:

The level of the R INPUT signal is reduced by an external attenuator until the reference channel phase lock will not operate. Then the level is increased to lock threshold and the input power is measured.

4-18. MINIMUM R INPUT LEVEL TEST (Cont'd)

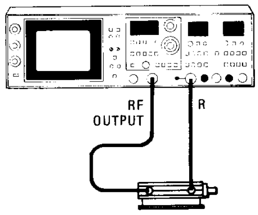


Figure 4-11. Minimum R Input Level Test Setup

EQUIPMENT:

0 to 110 dB Step Attenuator . . . . HP 8496A Option 001

PROCEDURE:

1. Connect equipment as shown in Figure 4-11. Set step attenuator to 0 dB.
2. Set analyzer controls as follows:

TUNING . . . . 1300 MHz
SWEEP WIDTH MHz. . . . . 0 CW
Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . midrange
MARKERS MHz . . . . OFF
OUTPUT dBm . . . . 0 dBm
VIDEO FILTER . . . . off (out)
POLAR A/R . . . . off (out)
CHANNEL 1
REFERENCE. . . . . −00 dBm
REFERENCE OFFSET button. . . . . off (out)
Measurement Select. . . . . OFF (display R)
Scale. . . . . 2.5 dB/DIV
CHANNEL 2
Measurement Select. . . . . OFF (display R)

3. Press the REFERENCE POSITION CH 1 button and adjust ⬍ control to place the reference trace on the center graticule line. Press button again to turn off the reference trace. The trace should be at or near the center graticule line.
4. Depress CHANNEL 1 REFERENCE OFFSET pushbutton and place right edge of trace on center horizontal graticule line using OFFSET control.
5. Set REFERENCE to −40 dB and Scale to 10 dB/DIV.
6. Increase attenuator in 10-dB steps until UNLOCKED light is on.

PERFORMANCE TESTS

4-18. MINIMUM R INPUT LEVEL TEST (Cont'd)

7. Increase OUTPUT dBm until UNLOCKED light is out.
8. Select 2.5 dB/DIV. Trace should be continuous (no dropouts, etc.) and should be below the CRT center line.

4-19. CROSSTALK ISOLATION TEST

SPECIFICATION:

> 83 dB isolation between ports.

DESCRIPTION:

The full band RF OUTPUT signal at +10 dBm is applied to the R input. The A and B inputs are terminated and the channel signal level is displayed. This signal level must be >83 dB below the level of the R input signal. To check the crosstalk between the A and B inputs, a directional coupler is used to provide the signal to both the R (for phase lock) and A or B inputs. The test channel input (A or B) is terminated and the signal level is displayed. This signal level must be >83 dB below the level at the other port.

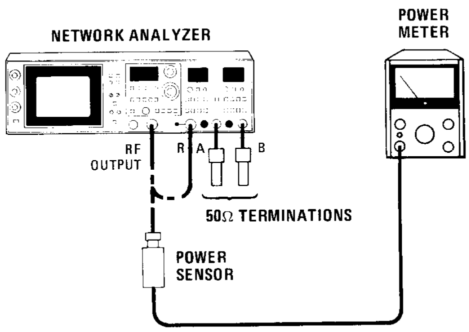


Figure 4-12. R-A and R-B Crosstalk Test Setup

NOTE

Equipment listed is for two test setups, Figures 4-12 and 4-13.

EQUIPMENT:

Power Meter	HP 435A
Power Sensor	HP 8482A
Directional Coupler	HP 778D
Matched Cable Kit	HP 11851A
50 Ohm Termination (2)	HP 909A Opt 012
Adapter, Type N Female to Type N Female	HP 1250-0777

NOTE

Crosstalk may be degraded if improperly shielded cables are used.

4-19. CROSSTALK ISOLATION TEST (Cont'd)

PROCEDURE:

R - A and R - B Crosstalk

1. Set analyzer controls as follows:

Sweep Mode	CENTER
SWEEP	AUTO, FAST
SWEEP Vernier	midrange
TUNING	50 MHz
SWEEP WIDTH MHz	10 MHz
SWEEP WIDTH MHz Vernier	CAL
MARKERS MHz	50 MHz
OUTPUT dBm	+10 dBm
REFERENCE POSITION CH 1	on (in)
REFERENCE POSITION CH 2	off (out)
VIDEO FILTER	on (in)
POLAR A/R	off (out)

CHANNEL 1

REFERENCE	−73 dBm
REFERENCE OFFSET button	off (out)
Measurement Select	A
Scale	2.5 dB/DIV

CHANNEL 2

Measurement Select	OFF

2. Adjust REFERENCE POSITION CH 1 ⬍ control to place reference trace on the center graticule line.

3. Adjust TUNING to place the 50 MHz marker at the center graticule line.

4. Calibrate power meter and sensor. Connect power sensor to analyzer RF OUTPUT as shown in Figure 4-12 and adjust OUTPUT dBm for a meter indication of +10 dBm.

NOTE

Do not make further adjustments of the OUTPUT dBm control during this test.

5. Disconnect power sensor from analyzer. Connect RF OUTPUT to the R INPUT port and terminate the A and B INPUT ports as shown in Figure 4-12.

6. Set analyzer controls as follows:

Sweep Mode	FULL 4-1300
SWEEP Vernier	fully counterclockwise
MARKERS MHz	OFF
REFERENCE POSITION CH 1	off (out)

4-19. CROSSTALK ISOLATION TEST (Cont'd)

7. The trace should be below the center graticule line (R-A isolation greater than 83 dB). (The trace might be off screen.)
8. Set controls on the network analyzer as follows:

CHANNEL 1
Measurement Select . . . . OFF

CHANNEL 2
REFERENCE . . . . −73 dBm
REFERENCE OFFSET button . . . . off (out)
Measurement Select . . . . B
Scale . . . . 2.5 dB/DIV

9. Press the REFERENCE POSITION CH 2 button and adjust ▲▼ control to place reference trace on the center graticule line. Press button again to turn off reference trace.
10. The trace should be below the center graticule line (R-B isolation greater than 83 dB).

A - B Crosstalk

11. Connect equipment as shown in Figure 4-13 with 50 ohm termination at B INPUT port.
12. The trace should be below the center graticule line (A-B isolation greater than 83dB).

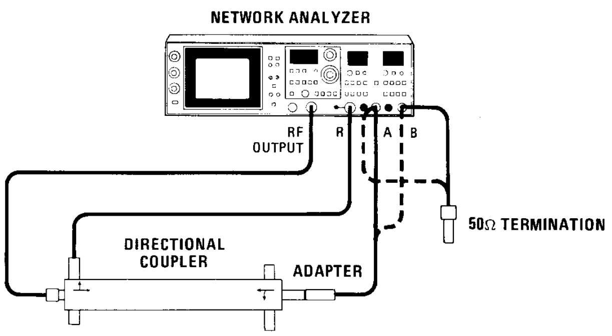


Figure 4-13. A-B Crosstalk Test Setup

13. Set controls as follows:

CHANNEL 1
Measurement Select . . . . A

CHANNEL 2
Measurement Select . . . . OFF

14. At the analyzer A and B INPUT ports, switch the 50 ohm termination and cable from the coupler.
15. The trace should be below the center graticule line (A-B isolation greater than 83 dB).

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST

SPECIFICATION:

Magnitude:

Absolute (A and B): ± 1 dB
Ratio (A/R and B/R): ±0.3 dB

Phase:

± 2.5 degrees

DESCRIPTION:

The receiver magnitude frequency response in the absolute mode is tested by applying the RF OUTPUT signal through a power splitter to the A or B INPUT port and a power meter. The power variations due to the source, as indicated on the meter, are subtracted from the variations of the analyzer CRT trace, giving a resultant variation due only to the receiver and display. The frequency response in the ratio modes is tested by applying the RF OUTPUT signal to all input ports and observing the A/R, B/R, PHASE B/R, and POLAR A/R traces directly on the display.

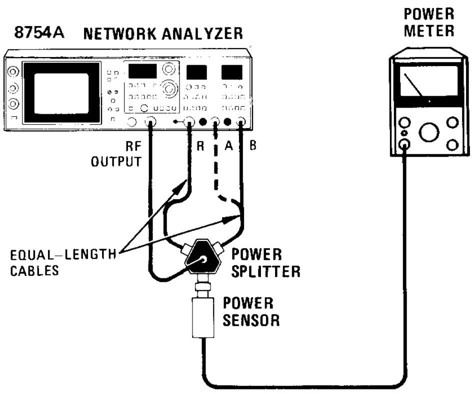


Figure 4-14. Absolute Frequency Response Test Setup

NOTE

Equipment listed is for two test setups, Figures 4-14 and 4-16.

EQUIPMENT:

Power Meter .... HP 435A
3-Way Power Splitter .... HP 11850A
Power Sensor .... HP 8482A
Matched Cable Kit .... HP 11851A

PERFORMANCE TESTS

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST (Cont'd)

PROCEDURE:

Absolute Magnitude

1. Calibrate power meter, then connect equipment as shown in Figure 4-14, with cable connected to the A INPUT port.

2. Set controls on the network analyzer as follows:

Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . Fully clockwise
TUNING . . . . 004 MHz
SWEEP WIDTH MHz . . . . 10 MHz
MARKERS MHz . . . . 1 MHz
OUTPUT dBm . . . . +8 dBm
POLAR A/R . . . . off (out)
VIDEO FILTER . . . . off (out)

CHANNEL 1
REFERENCE . . . . −02 dBm
REFERENCE OFFSET button . . . . off (out)
Measurement Select . . . . A
Scale . . . . 1 dB/DIV

CHANNEL 2
Measurement Select . . . . OFF

3. Press the REFERENCE POSITION CH 1 button and adjust ▲▼ control to place reference trace on the center graticule line.

4. Adjust TUNING until the 4 MHz marker is centered on the display. The trace is blanked below approximately 2.8 MHz, as shown in Figure 4-15.

5. Adjust FREQUENCY MHz CAL for a FREQUENCY indication of 004 MHz.

6. Set SWEEP WIDTH MHz to 0 CW and MARKERS MHz to OFF.

7. Press the REFERENCE POSITION CH 1 button again to turn off the reference trace.

8. Set power meter to the 0 dBm range. Adjust OUTPUT dBm on the analyzer until the power meter reads −2.0 dBm.

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST (Cont'd)

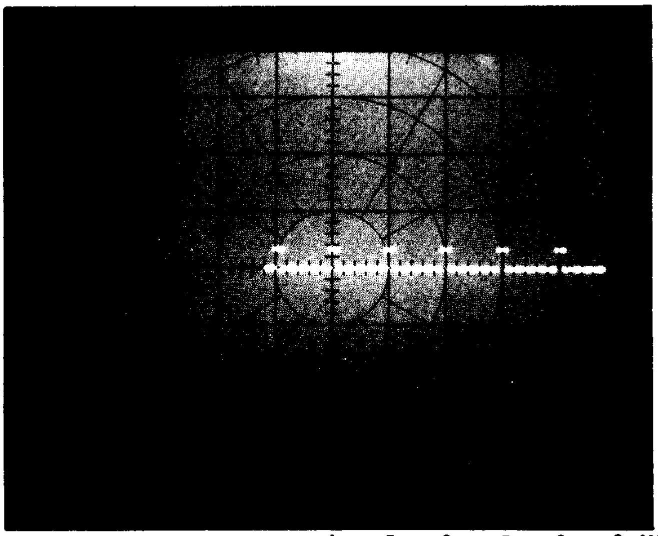


Figure 4-15. 4-MHz Marker Centered on CRT

9. Tune analyzer to points across the frequency band as indicated in Table 4-2. At each point record the power level indication from the analyzer display and the power meter reading under INPUT A in the table. Subtract the two readings to eliminate power variations due to the source. The difference reading in the last column of Table 4-2 should not vary more than ±1 dB (there should not be more than 2 dB difference between maximum and minimum values.)

10. Disconnect cable from the A INPUT port and connect this cable to the B INPUT port. Set controls as follows:

TUNING . . . . 004 MHz

CHANNEL 1
 Measurement Select . . . . OFF

CHANNEL 2
 REFERENCE. . . . . −02 dBm
 REFERENCE OFFSET Button . . . . off (out)
 Measurement Select . . . . B
 Scale. . . . . 1 dB/DIV

11. Adjust OUTPUT dBm for an indication of −2.0 dBm on the power meter.

12. Press REFERENCE POSITION CH 2 button and adjust ⬍ control to place the trace on the center graticule line. Press the button again to turn off the reference trace.

PERFORMANCE TESTS

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST (Cont'd)

Table 4-2. Absolute Magnitude Frequency Response

FREQUENCY MHz (LED Readout)	Analyzer Power Reading (dBm)		Power Meter Reading (dBm)		Difference in Readings (dB)	
	INPUT A	INPUT B	INPUT A	INPUT B	INPUT A	INPUT B
004						
010						
050						
100						
200						
300						
400						
500						
600						
700						
800						
900						
1000						
1100						
1200						
1300						

13. Tune analyzer to points across the frequency range as indicated in Table 4-2. At each point record the power reading from the analyzer display and the power meter reading. Subtract the two readings and record the result in the last column under INPUT B. The difference reading in the last column should not vary more than ± 1dB (there should not be more than 2 dB difference between the maximum and minimum values).

PERFORMANCE TESTS

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST (Cont'd)

Ratio Magnitude

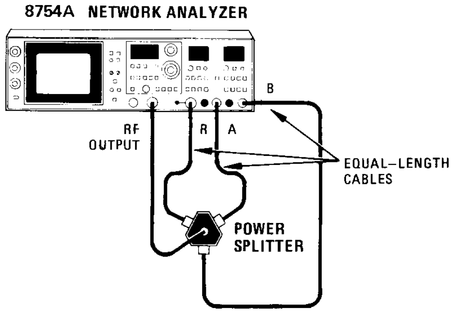


Figure 4-16. Ratio Magnitude and Phase Frequency Response Test Setup

14. Connect equipment as shown in Figure 4-16. Set analyzer controls as follows:

Sweep Mode . . . . FULL 4—1300
SWEEP . . . . AUTO, FAST
SWEEP Vernier. . . . . midrange
MARKERS MHz . . . . OFF
OUTPUT dBm. . . . . 0 dBm

CHANNEL 1
REFERENCE. . . . . −00
REFERENCE OFFSET button . . . . on (in)
Measurement Select . . . . A/R
Scale . . . . 0.25 dB/DIV

CHANNEL 2
Measurement Select . . . . OFF

15. Adjust CHANNEL 1 REFERENCE OFFSET control to place trace at mid-screen.

16. Note lowest and highest points on the trace. These points should not be separated by more than 0.6 dB (2.4 divisions) for a flatness of ±0.3 dB.

17. Set controls as follows:

CHANNEL 1
Measurement Select . . . . OFF

CHANNEL 2
REFERENCE. . . . . −00
REFERENCE OFFSET. . . . . on (in)
Measurement Select. . . . . B/R
Scale . . . . 0.25 dB/DIV

PERFORMANCE TESTS

4-20. MAGNITUDE AND PHASE FREQUENCY RESPONSE TEST (Cont'd)

18. Adjust CHANNEL 2 REFERENCE OFFSET control to place the trace at midscreen.

19. Note highest and lowest point on the trace. These points should not be separated by more than 0.6 dB (2.4 divisions) for a flatness of ±0.3 dB.

Phase

20. Set controls as follows:

    CHANNEL 2
    Measurement Select . . . . PHASE B/R
    Scale . . . . 2.5 DEG/DIV

21. Press REFERENCE POSITION CH 2 button and adjust the ▲▼ control to place the trace on the center graticule line. Press button again to turn off reference trace.

22. Adjust PHASE B/R LENGTH control to obtain a horizontal trace.

23. Adjust CHANNEL 2 REFERENCE OFFSET control to place the trace at the center graticule line.

24. Readjust PHASE B/R LENGTH control, if necessary, for a horizontal trace.

25. The peak-to-peak deviation of the trace should be ≤5 degrees (2 divisions).

26. Set controls as follows:

    POLAR A/R . . . . on (in)
    POLAR CENTER . . . . on (in)

27. Adjust POLAR CENTER ▲▼ and ◀▶ controls to place dot at center of graticule. Press POLAR CENTER button to return it to the off (out) position.

28. Adjust the POLAR LENGTH control to make the trace into as small a dot as possible.

29. Adust CHANNEL 1 and CHANNEL 2 REFERENCE OFFSET controls to place the trace dot on the outermost graticule circle at the zero degrees position (3 o'clock).

30. The peak-to-peak width of the dot should be ≤5 degrees (1/2 polar division).

4-21. MAGNITUDE DYNAMIC ACCURACY TEST

SPECIFICATION:

±0.3 dB from 0 to −50 dBm
±0.5 dB from −50 to −60 dBm
±1.0 dB from −60 to −70 dBm
±2.5 dB from −70 to −80 dBm

4-21. MAGNITUDE DYNAMIC ACCURACY TEST (Cont'd)

DESCRIPTION:

A CW signal from the analyzer source is input to the network analyzer in a ratio measurement mode. The signal is decreased in level with an external, calibrated attenuator and the deviation from the expected position of the trace is observed.

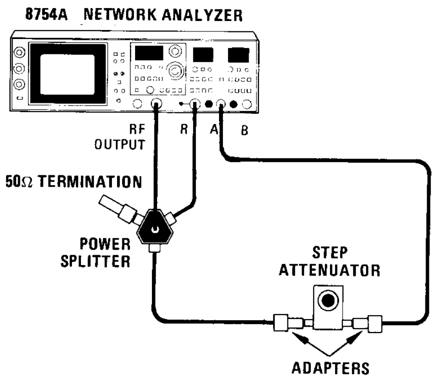


Figure 4-17. Magnitude Dynamic Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter	HP 11850A
Step Attenuator	HP 355D – H82
Matched Cable Kit	HP 11851A
Adapter, Type-N Female to BNC Male (2)	HP 1250 – 0077
50 Ohm Termination	HP 909A Opt 012

PROCEDURE:

1. Connect equipment as shown in Figure 4-17 with step attenuator set at 20 dB.

2. Set network analyzer controls as follows:

Sweep Mode	CENTER
TUNING	30 MHz
VIDEO FILTER	on (in)
SWEEP	AUTO, FAST
SWEEP Vernier	fully clockwise
OUTPUT dBm	+10 dBm
MARKERS MHz	OFF
SWEEP WIDTH MHz	0 CW
POLAR A/R	off (out)

PERFORMANCE TESTS

4-21. MAGNITUDE DYNAMIC ACCURACY TEST (Cont'd)

CHANNEL 1
REFERENCE level switches . . . . +00
REFERENCE OFFSET switch . . . . on (in)
Input Select. . . . . A/R
Scale . . . . .25 dB/DIV

CHANNEL 2
Measurement Select. . . . . OFF

3. Press REFERENCE POSITION CH 1 button and adjust ⬍ control to place trace on center graticule line. Press button again to turn off reference trace.

4. Set step attenuator to the 20 dB position. Set Channel 1 REFERENCE switch to −00 dB. Press Reference OFFSET pushbutton and adjust OFFSET control to place the CRT trace on the center graticule line. Do not change the OFFSET control setting during the test.

5. Step the attenuator and REFERENCE switch as shown in Table 4-3. At each attenuator-REFERENCE switch position, the trace should be at the reference line within the limits shown on the Table.

   (It may be necessary to change Channel 1 dB/DIV to a less sensitive setting if the trace is off screen.)

6. Switch the cables at the R and the A INPUT ports.

7. Repeat steps 4 and 5 to measure R-channel dynamic accuracy using Table 4-4 instead of Table 4-3.

4-22. MAGNITUDE DISPLAY ACCURACY TEST

SPECIFICATION:

Magnitude Display Accuracy: ±2% ±.05 division

DESCRIPTION:

A CW signal from the analyzer source is input to the network analyzer in a ratio measurement mode. The CRT trace is offset with the REFERENCE switch and the display accuracy is checked.

PERFORMANCE TESTS

Table 4-3. Magnitude Dynamic Accuracy, A Channel

External Attenuator Setting	REFERENCE Switch	CRT Trace Deviation from Reference Line (Plus attenuator tolerance)
0 dB	+ 20.0 dB	±0.3 dB
10 dB	+ 10.0 dB	±0.3 dB
20 dB (Reference)	–00.0 dB	±0.0 dB (Reference Line)
30 dB	–10.0 dB	±0.3 dB
40 dB	–20.0 dB	±0.3 dB
50 dB	–30.0 dB	±0.3 dB
60 dB	–40.0 dB	±0.5 dB
70 dB	–50.0 dB	±1.0 dB
80 dB	–60.0 dB	±2.5 dB

NOTE

This procedure uses the 20 dB position of the external attenuator as reference. Measurements at other positions should subtract the calibration tolerance of the attenuator at 20 dB from the expected reading.

Table 4-4. Magnitude Dynamic Accuracy, R Channel

External Attenuator Setting	REFERENCE Switch	CRT Trace Deviation from Reference Line (Plus attenuator tolerance)
0 dB	+20.0 dB	±0.3 dB
10 dB	+10.0 dB	±0.3 dB
20 dB (Reference)	–00.0 dB	±0.0 dB (Reference Line)
30 dB	+10.0 dB	±0.3 dB
40 dB	+20.0 dB	±0.3 dB

NOTE

This procedure uses the 20 dB position of the external attenuator as reference. Measurements at other positions should subtract the calibration tolerance of the attenuator at 20 dB from the expected reading.

PERFORMANCE TESTS

4-22. MAGNITUDE DISPLAY ACCURACY TEST (Cont'd)

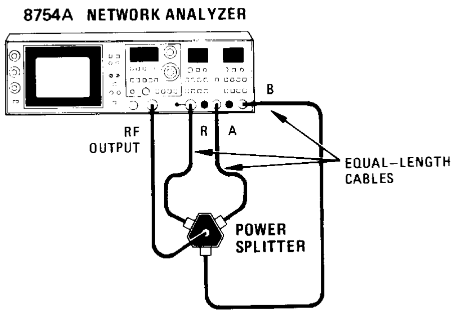


Figure 4-18. Magnitude Display Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
Matched Cable Kit. . . . . HP 11851A

PROCEDURE:

1. Connect equipment as shown in Figure 4-18.

2. Set network analyzer controls as follows:

Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . Fully clockwise
TUNING . . . . 50 MHz
SWEEP WIDTH MHz . . . . 0 (CW)
MARKERS MHz . . . . OFF
OUTPUT dBm. . . . . 0 dBm
POLAR A/R . . . . Off (out)
VIDEO FILTER. . . . . Off (out)

CHANNEL 1
REFERENCE. . . . . −00
REFERENCE OFFSET button. . . . . Off (out)
Measurement Select . . . . A/R
Scale . . . . .25 dB/DIV

PERFORMANCE TESTS

4-22. MAGNITUDE DISPLAY ACCURACY TEST (Cont'd)

CHANNEL 2
REFERENCE . . . . –00
REFERENCE OFFSET button . . . . Off (out)
Measurement Select . . . . OFF
Scale . . . . .25 dB/DIV

3. Press the REFERENCE POSITION CH 1 button and adjust ⬍ control to place the reference trace on the center graticule line. Press button again to turn off reference trace.

4. Press the CHANNEL 1 REFERENCE OFFSET button and adjust OFFSET vernier to position CRT trace on the center graticule line. Do not change OFFSET vernier setting during test.

5. Set CHANNEL 1 Scale and REFERENCE controls according to Table 4-5. At each setting, check that the trace position is within limits given in Table 4-5.

6. Set CHANNEL 1 Measurement Select to OFF and CHANNEL 2 Measurement Select to B/R.

7. Repeat steps 3 through 5, substituting "CH2" and "CHANNEL 2" for "CH 1" and "CHANNEL 1" in these steps.

Table 4-5. Magnitude Display Accuracy

Scale (dB/DIV)	REFERENCE (dB)	Trace Offset From Center (Div.)	Tolerance (Div.)
.25	+1	–4	±0.13
.25	–1	+4	±0.13
1	+4	–4	±0.13
1	–4	+4	±0.13
2.5	+10	–4	±0.13
2.5	–10	+4	±0.13
10	+40	–4	±0.13
10	–40	+4	±0.13

PERFORMANCE TESTS

4-23. PHASE DYNAMIC ACCURACY TEST

SPECIFICATION:

±2 degrees from 0 to −50 dBm
±4 degrees from −50 to −70 dBm

DESCRIPTION:

A phase reference level is established with a CW signal. Using a step attenuator, the signal level is decreased through the dynamic range of the instrument and the variation in the phase indication on the CRT is checked.

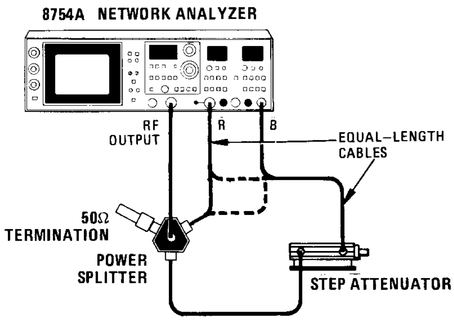


Figure 4-19. Phase Dynamic Accuracy Test Setup

EQUIPMENT:

Step Attenuator .... HP 8496A Opt 001
3-Way Power Splitter .... HP 11850A
50 Ohm Termination.................................. HP 909A Opt 012
Matched Cable Kit Cable (2) .... HP 11851A
Adapter, N male to N male .... HP 1250-0778

4-23. PHASE DYNAMIC ACCURACY TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-19 with step attenuator set at 20 dB.

2. Set network analyzer controls as follows:

Sweep Mode	CENTER
SWEEP	AUTO, FAST
SWEEP Vernier	midrange
TUNING	10 MHz
SWEEP WIDTH MHz	0 CW
MARKERS MHz	OFF
OUTPUT dBm	+10 dBm
VIDEO FILTER	on (in)

CHANNEL 1

Measurement Select	OFF

CHANNEL 2

REFERENCE	−00
REFERENCE OFFSET button	on (in)
Measurement Select	PHASE B/R
Scale	2.5 DEG/DIV
PHASE B/R LENGTH	fully clockwise

3. Press REFERENCE POSITION CH 2 button and adjust ⬍ control to place reference trace on the center graticule line. Press button again to turn off reference trace.

4. Adjust CHANNEL 2 REFERENCE OFFSET control to place trace on the center graticule line.

5. Step the 8496A from 0 dB to 70 dB as indicated in Table 4-6 and note the variation from the center graticule line.

6. Switch cables at B and R INPUT ports so that the step attenuator is connected to the R INPUT port. Set CHANNEL 2 scale to 2.5 DEG/DIV.

7. Set step attenuator to 20 dB and adjust CHANNEL 2 REFERENCE OFFSET control to place trace on center graticule line.

8. Step the attenuator from 0 dB to 40 dB. The variation of the trace from the center graticule line should be no more than ±2 degrees.

PERFORMANCE TESTS

4-23. PHASE DYNAMIC ACCURACY TEST (Cont'd)

Table 4-6. Phase Dynamic Accuracy

Step Attenuator Setting (dB)	Allowable Deviation (degrees)
20	0 (ref.)
0 10 30 40 50	±2
60 70	±4

4-24. PHASE REFERENCE ACCURACY TEST

SPECIFICATION:

±1% of value

DESCRIPTION:

The swept RF OUTPUT signal is fed to the B and R INPUT ports through paths of unequal length. The analyzer is tuned to each frequency for which there is a 180-degree phase difference between the B and R signals. The phase reference is switched from −180 degrees to +180 degrees at each frequency and the difference in the displayed phase between these two settings is measured.

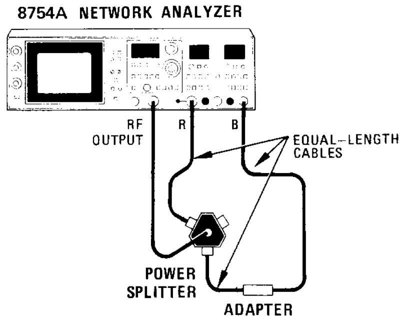


Figure 4-20. Phase Reference Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
Matched Cable Kit . . . . HP 11851A
Adapter, Type N Female to Type N Female . . . . HP 1250-0777

4-24. PHASE REFERENCE ACCURACY TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-20.

2. Set controls as follows:

Sweep Mode	FULL 4—1300
SWEEP	AUTO, FAST
SWEEP Vernier	midrange
MARKERS MHz	OFF
REFERENCE POSITION CH 2	off (out)
VIDEO FILTER	off (out)
CHANNEL 1	
Measurement Select	OFF
CHANNEL 2	
REFERENCE	−180 DEG
REFERENCE OFFSET button	off (out)
Measurement Select	PHASE B/R
Scale	90 DEG/DIV

3. Press the REFERENCE POSITION CH 2 button and adjust ⬍ control to place the reference trace on the center graticule line. Press button again to turn off reference trace.

4. Turn the PHASE B/R LENGTH control fully clockwise. Then turn counterclockwise until the right-hand end of trace is at least 1 minor division below center graticule line and any noise present on the right-hand end of trace is gone.

5. Adjust TUNING to place the marker at the highest frequency at which the trace crosses the center graticule line. The trace should appear as in Figure 4-21.

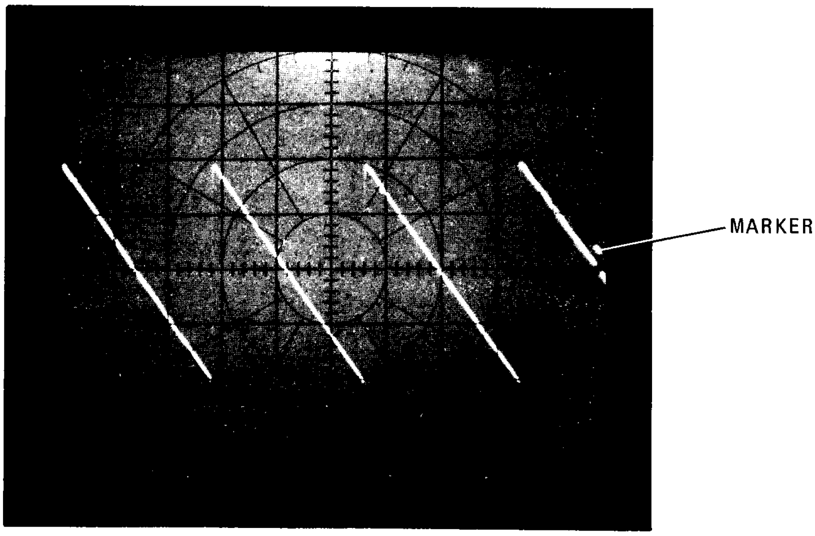


Figure 4-21. Phase Reference Test Display

4-24. PHASE REFERENCE ACCURACY TEST (Cont'd)

6. Set controls as follows:

Sweep Mode . . . . CENTER
SWEEP WIDTH MHz . . . . 0 CW

CHANNEL 2
Scale . . . . 2.5 DEG/DIV

7. Adjust TUNING to place the trace on the center graticule line.

8. Set CHANNEL 2 REFERENCE to +180 DEG. The deviation of the trace from the center graticule line should be no more than ±1.8 degree (±0.72 division).

9. Set controls as follows:

Sweep Mode. . . . . FULL 4–1300

CHANNEL 2
REFERENCE . . . . −180 DEG
Scale . . . . 90 DEG/DIV

10. Position the marker at each of the other three frequencies at which the trace crosses the center graticule line and repeat steps 6 through 9 at each frequency.

4-25. PHASE DISPLAY ACCURACY TEST

SPECIFICATION:

Phase Display Accuracy: ±2% ±.05 division

DESCRIPTION:

A CW signal from the analyzer source is input to the network analyzer in a phase measurement mode. The CRT trace is offset with the REFERENCE switch, and the display accuracy is checked.

4-25. PHASE DISPLAY ACCURACY TEST (Cont'd)

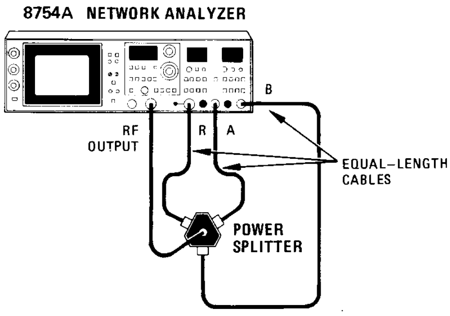


Figure 4-22. Phase Display Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
Matched Cable Kit . . . . HP 11851A

PROCEDURE:

1. Connect equipment as shown in Figure 4-22.

2. Set network analyzer controls as follows:

Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . Fully clockwise
TUNING . . . . 50 MHz
SWEEP WIDTH MHz . . . . 0 (CW)
MARKERS MHz . . . . OFF
OUTPUT dBm 0
POLAR A/R . . . . Off (out)
VIDEO FILTER . . . . Off (out)

CHANNEL 1
Measurement Select . . . . OFF

CHANNEL 2
REFERENCE . . . . −00
REFERENCE OFFSET button . . . . On (in)
Measurement Select . . . . PHASE B/R
Scale . . . . 2.5 DEG/DIV
PHASE B/R LENGTH . . . . Fully counterclockwise

3. Adjust REFERENCE POSITION CH2 ⇕ control to place the reference trace on the center graticule line. Press the REFERENCE POSITION CH 2 button to turn off reference trace.

PERFORMANCE TESTS

4-25. PHASE DISPLAY ACCURACY TEST (Cont'd)

4. Adjust CHANNEL 2 OFFSET vernier to position CRT trace on the center graticule line. Do not change OFFSET vernier setting during test.
5. Set CHANNEL 2 Scale and REFERENCE controls according to Table 4-7. At each setting check that the trace position is within limits given in Table 4-7.

Table 4-7. Phase Display Accuracy

Scale (DEG/DIV)	REFERENCE (DEG)	Trace Offset From Center (Div.)	Tolerance (Div.)
2.5	+5	−2	±0.1
2.5	−5	+2	±0.1
10	+20	−2	±0.1
10	−20	+2	±0.1
45	+90	−2	±0.1
45	−90	+2	±0.1
90	+90	−1	±0.07
90	−90	+1	±0.07

4-26. POLAR DISPLAY ACCURACY TEST

SPECIFICATION:

Displayed value is within 2.5 mm of actual value.

DESCRIPTION:

A polar reference point is established with a CW signal at the A and R INPUT ports. The phase and magnitude REFERENCEs are changed and the polar indication on the display is checked.

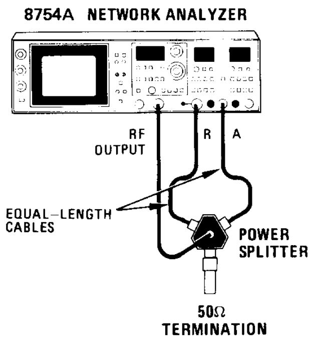


Figure 4-23. Polar Display Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
50 Ohm Termination . . . . HP 909A Option 012
Matched Cable Kit . . . . HP 11851A

4-26. POLAR DISPLAY ACCURACY TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-23.

2. Set analyzer controls as follows:

Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . midrange
TUNING . . . . 030 MHz
SWEEP WIDTH MHz . . . . 0 CW
MARKERS MHz . . . . OFF
OUTPUT dBm . . . . 0 dBm
POLAR A/R . . . . on (in)

CHANNEL 1
REFERENCE . . . . +00
REFERENCE OFFSET button . . . . on (in)

CHANNEL 2
REFERENCE . . . . +00
REFERENCE OFFSET button . . . . on (in)

3. Press POLAR CENTER button and adjust ▲▼ and ◀▶ controls to set trace dot in the center of the graticule. Press button again to turn off reference trace.

4. Adjust CHANNEL 1 and CHANNEL 2 REFERENCE OFFSET controls to place trace dot on the 0 degree point of the outermost graticule circle (magnitude = 1.0).

5. Set CHANNEL 2 REFERENCE to the +90, −90, +180, and −180 degree settings. At each setting, the trace-dot must be at the phase point on the outer graticule circle. The tolerance of the trace-dot position is inside a circle of 2.5 mm (1/4 major division) radius centered on the specified point on the graticule.

6. Set CHANNEL 2 REFERENCE to +00.

7. Set CHANNEL 1 REFERENCE as indicated in Table 4-8. At each setting, the trace dot should be within a circle of 2.5 mm (1/4 major division) radius centered on the point shown in the table.

Table 4-8. Polar Display Accuracy

CHANNEL 1 REFERENCE (dB)	Display Point Magnitude (Phase = 0 degrees)
+00	1.00
+06	0.50
+12	0.25
+20	0.10

4-27. MAG/PHASE OUTPUT ACCURACY TEST

SPECIFICATION:

Magnitude:
- 100 mV/dB
±0.3 dB (±30 mV) from 0 to −50 dBm
±0.5 dB (±50 mV) from −50 to −60 dBm
±1.0 db (±100 mV) from −60 to −70 dBm
±2.5 dB (±250 mV) from −70 to −80 dBm

Phase:
- 10 mV/degree
±1.5% of value (±170° range)
±2% of value (±180° range)

DESCRIPTION:

A CW signal from the network analyzer source is input to the analyzer in a ratio measurement mode. The signal is decreased in level with a calibrated, external attenuator, and the magnitude output voltage is measured.

The magnitude accuracy is calculated by subtracting attenuator errors from the measured output.

For phase measurement, the phase output voltage is selected. The CHANNEL 2 REFERENCE thumbwheels are used to offset the phase, and the output voltage is measured.

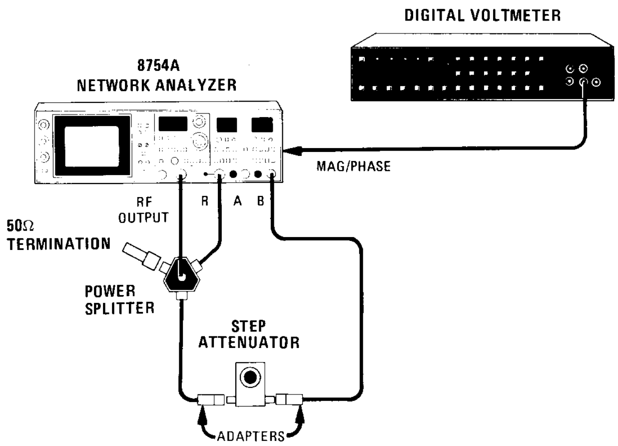


Figure 4-24. MAG/PHASE Output Accuracy Test Setup (Magnitude)

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

EQUIPMENT:

Digital Voltmeter . . . . HP 3455A
Step Attenuator . . . . HP 355D-H82
3-Way Power Splitter . . . . HP 11850A
Matched Cable Kit . . . . HP 11851A
50 Ohm Termination . . . . HP 909, Option 012
Adapter, Type N Female to BNC Male (2) . . . . HP 1250-0077
Test Connector; 24 contact, 2 rows; Male . . . . HP 1251-0063

PROCEDURE:

Magnitude

1. Connect equipment as shown in Figure 4-24 with step attenuator set at 20 dB.
2. Set network analyzer controls as follows:

Sweep Mode . . . . CENTER
SWEEP . . . . MAN
SWEEP Vernier . . . . Midrange
TUNING . . . . 030 MHz
SWEEP WIDTH MHz . . . . 0 CW
OUTPUT dBm . . . . 10 dBm

CHANNEL 1
Measurement Select . . . . B/R
REFERENCE . . . . −00 dB
REFERENCE OFFSET button . . . . Off (out)
Scale . . . . 10 dB/DIV

CHANNEL 2
Measurement Select . . . . OFF

3. Press the REFERENCE POSITION CH1 button and adjust ⇕ control to place the reference trace (dot) on the center graticule line. Press button again to turn off reference trace.

NOTE
Sheet 2 of Table 4-9 shows a sample of the B/R magnitude measurement.

4. Measure the Magnitude accuracy of B/R as follows:
   a. On Table 4-9, fill in the values for columns B, C, and D for your calibrated attenuator.
   b. Set the attenuator to 20 dB position, read the DVM indication and mark it into column F and G for 20 dB. Then calculate the value for column E. Put this value in all of the blanks in column E.
   c. Calculate the values for F and fill them in on the table.
   d. Measure the values for column G and fill them in on the table.
   e. Compare the values in column G with those in column F to see if the measurements are within tolerance.
5. Switch the cables at the R and B INPUT ports. Set the step attenuator to 20 dB.
6. Repeat step 4 to measure R-channel magnitude output accuracy using Table 4-10. Sheet 2 of Table 4-9 shows a sample measurement.

PERFORMANCE TESTS

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

7. Connect equipment as shown in Figure 4-25. Connect test connector, with jumper between pins 19 (REM MAG/PH) and 18 (ground), to rear-panel PROGRAMMING connector A23J7.

8. Set network analyzer controls as follows:

Sweep Mode	CENTER
SWEEP	MAN
SWEEP Vernier	Midrange
TUNING	30 MHz
SWEEP WIDTH MHz	0 CW
OUTPUT dBm	10 dBm

CHANNEL 1

Measurement Select	OFF

CHANNEL 2

Measurement Select	PHASE B/R
REFERENCE	−00 DEG
REFERENCE OFFSET button	Off (out)
Scale	45 DEG/DIV
PHASE B/R LENGTH	Fully counterclockwise

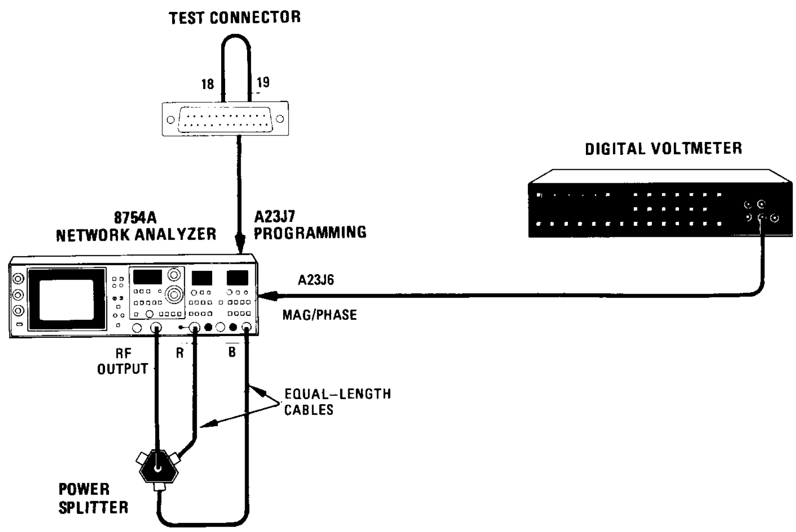


Figure 4-25. MAG/PHASE Output Accuracy Test Setup (Phase)

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

Table 4-9. MAG/PHASE Output Accuracy (B Channel, Magnitude) (Sheet 1 of 2)

A	B	C	D	E	F		G
					Expected DVM Reading (Vdc)		
External Attenuator Setting (dB)	Attenuator Calibration Value at Setting (dB)	Actual Attenuator Value (A + B) (dB)	Equivalent DVM Reading (C X 0.1 V/dB) (Vdc)	Offset Correction (See Note 1) (Vdc)	Expected Reading With Corrections (D + E)	Allowable Measurement Tolerance (See Note 2)	Measured DVM Value (Vdc)
0						± 0.030	
10						± 0.030	
20 (Reference)						(Reference)	(Ref.)
30						± 0.030	
40						± 0.030	
50						± 0.030	
60						± 0.050	
70						± 0.100	
80						± 0.250	

NOTES:

1. Column E Offset Correction is calculated as follows:
[(Actual DVM reading at 20 dB setting) − (Calculated Value of D at 20 dB setting)]
2. The Allowable Measurement Tolerance in Column F does not include the calibration uncertainty of the HP 355D attenuator.

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

Table 4-9. MAG/PHASE Output Accuracy (B Channel, Magnitude) (Sheet 2 of 2)

A	B	C	D	E	F			G
					Expected DVM Reading (Vdc)			
External Attenuator Setting (dB)	Attenuator Calibration Value at Setting (dB)	Actual Attenuator Value (A + B) (dB)	Equivalent DVM Reading (C X 0.1 V/dB) (Vdc)	Offset Correction (See Note 1) (Vdc)	Expected Reading With Corrections (D + E)		Allowable Measurement Tolerance (See Note 2)	Measured DVM Value (Vdc)
0	0	0	0	+.020	.020	±	0.030	.013
10	+.03	10.03	1.003	+.020	1.023	±	0.030	1.002
20 (Reference)	-0.12	19.88	1.988	+.020	2.008		(Reference)	2.008 (Ref.)
30	+.02	30.02	3.002	+.020	3.022	±	0.030	3.029
40	-.01	39.99	3.999	+.020	4.019	±	0.030	4.008
50	-.05	49.95	4.995	+.020	5.015	±	0.030	5.027
60	+0.10	60.10	6.010	+.020	6.030	±	0.050	6.102
70	+.03	70.03	7.003	+.020	7.023	±	0.100	7.139
80	+0.13	80.13	8.013	+.020	8.033	±	0.250	8.098

NOTES:

1. Column E Offset Correction is calculated as follows:
   [(Actual DVM reading at 20 dB setting) – (Calculated Value of D at 20 dB setting)]
2. The Allowable Measurement Tolerance in Column F does not include the calibration uncertainty of the HP 355D attenuator.

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

Table 4-10. MAG/PHASE Output Accuracy (R Channel, Magnitude) (Sheet 1 of 2)

A	B	C	D	E	F			G
					Expected DVM Reading (Vdc)			
External Attenuator Setting (dB)	Attenuator Calibration Value at Setting (dB)	Actual Attenuator Value (A + B) (dB)	Equivalent DVM Reading (C X 0.1 V/dB) (Vdc)	Offset Correction (See Note 1) (Vdc)	Expected Reading With Corrections (D + E)		Allowable Measurement Tolerance (See Note 2)	Measured DVM Value (Vdc)
0	______	______	______	______	______	±	0.030	______
10	______	______	______	______	______	±	0.030	______
20 (Reference)	______	______	______	______	______		(Reference)	______ (Ref.)
30	______	______	______	______	______	±	0.030	______
40	______	______	______	______	______	±	0.030	______

NOTES:

1. Column E Offset Correction is calculated as follows:
   [(Actual DVM reading at 20 dB setting) – (Calculated Value of D at 20 dB setting)]

2. The Allowable Measurement Tolerance in Column F does not include the calibration uncertainty of the HP 355D attenuator.

PERFORMANCE TESTS

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

Table 4-10. MAG/PHASE Output Accuracy (R Channel, Magnitude) (Sheet 2 of 2)

A	B	C	D	E	F			G
External Attenuator Setting (dB)	Attenuator Calibration Value at Setting (dB)	Actual Attenuator Value (A + B) (dB)	Equivalent DVM Reading (C X 0.1 V/dB) (Vdc)	Offset Correction (See Note 1) (Vdc)	Expected DVM Reading (Vdc): Expected Reading With Corrections (D + E)		Expected DVM Reading (Vdc): Allowable Measurement Tolerance (See Note 2)	Measured DVM Value (Vdc)
0	0	0	0	+.020	-.020	±	0.030	-.013
10	+.03	10.03	1.003	+.020	1.023	±	0.030	1.002
20 (Reference)	-0.12	19.88	1.988	+.020	2.008		(Reference)	2.008 (Ref.)
30	+.02	30.02	3.002	+.020	3.022	±	0.030	3.011
40	-.01	39.99	3.999	+.020	4.019	±	0.030	4.003

NOTES:

1. Column E Offset Correction is calculated as follows:
   [(Actual DVM reading at 20 dB setting) – (Calculated Value of D at 20 dB setting)]
2. The Allowable Measurement Tolerance in Column F does not include the calibration uncertainty of the HP 355D attenuator.

4-27. MAG/PHASE OUTPUT ACCURACY TEST (Cont'd)

9. Press the REFERENCE POSITION CH 2 button and adjust ⬍ control to place the reference trace (dot) on the center graticule line. Press button again to turn off reference trace.

10. Press CHANNEL 2 REFERENCE OFFSET button and adjust the OFFSET vernier for a DVM indication of 0.000 ±0.001V. Do not change OFFSET vernier setting during the test.

11. Set CHANNEL 2 REFERENCE as indicated in Table 4-11. At each setting, check that the DVM indication is within limits given in Table 4-11.

Table 4-11. MAG/PHASE Output Accuracy (PHASE B/R)

REFERENCE (degrees)	Ideal DVM Reading (Vdc)	Tolerance (Vdc)
-50	-0.500	±0.0075
-100	-1.000	±0.015
-180	±1.800*	±0.036
+180	±1.800*	±0.036
+100	+1.000	±0.015
+50	+0.500	±0.0075

*At the 180 degree transition point, this may be a positive or negative voltage.

Table 4-12. Performance Test Record (1 of 5)

Hewlett-Packard Company — Tested By ______

Model 8754A

Network Analyzer 4 – 1300 MHz

Serial No. ______ — Date ______

Para. No.	Test Description	Results Min.	Results Actual	Results Max.
4-12	**Frequency Readout Accuracy**			
	5. 50 MHz	40 MHz	______	60 MHz
	6. 4 MHz	−6 MHz	______	14 MHz
	1000 MHz	990 MHz	______	1010 MHz
	1300 MHz	1290 MHz	______	1310 MHz
4-13	**Marker Accuracy**			
	5. 1300 MHz	1299.87 MHz	______	1300.13 MHz
4-14	**Source Output Power**			
	Power Accuracy at 50 MHz			
	6. 0 dBm	−0.8 dBm	______	+ 0.8 dBm
	7. +5 dBm	+4.2 dBm	______	+ 5.8 dBm
	8. +10 dBm	+9.2 dBm	______	+10.8 dBm
	Flatness			
	14. 4 – 1300 MHz (peak-to-peak variation)		______	1.0 dB
4-15	**Source Spectral Purity**			
	Residual FM			
	16. 50 MHz		______	7 kHz
	17. 600 MHz		______	7 kHz
	18. 1300 MHz		______	7 kHz
	Harmonics			
	21. 4 – 500 MHz	28 dBc	______	
	22. 500 – 1300 MHz	28 dBc	______	
	Spurious			
	25. 4 – 500 MHz (CENTER)	65 dBc	______	
	26. 4 – 500 MHz (START)	65 dBc	______	
	27. 500 – 1300 MHz (CENTER)	50 dBc	______	
	28. 500 – 1300 MHz (START)	50 dBc	______	

Table 4-12. Performance Test Record (2 of 5)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-16	**Input Port Match**			
	Return Loss			
	5. B INPUT port	20 dB	________	
	6. R INPUT port	20 dB	________	
	12. A INPUT port	20 dB	________	
4-17	**Receiver Noise Level**			
	3. A INPUT		________	–80 dBm
	6. B INPUT		________	–80 dBm
4-18	**Minimum R Input Level**			
	8. Minimum level for phaselock		________	–40 dBm
4-19	**Crosstalk Isolation**			
	7. R–A isolation	83 dB	________	
	10. R–B isolation	83 dB	________	
	12. A–B isolation	83 dB	________	
	15. B–A isolation	83 dB	________	
4-20	**Magnitude and Phase Frequency Response**			
	Absolute Magnitude			
	9. A INPUT peak-to-peak variation		________	2 dB
	B INPUT peak-to-peak variation		________	2 dB
	Ratio Magnitude			
	16. A/R, peak-to-peak variation		________	0.6 dB
	19. B/R, peak-to-peak variation		________	0.6 dB
	Phase			
	25. PHASE B/R, peak-to-peak variation		________	5 degrees
	30. POLAR A/R, peak-to-peak variation		________	5 degrees (1/2 polar division)

Table 4-12. Performance Test Record (3 of 5)

Para. No.	Test Description	Results Min.	Actual	Max.
4-21	**Magnitude Dynamic Accuracy**			
	A Channel Deviation (–20 dBm reference)			
	5. 0 dBm	– .3 dB	________	+ .3 dB
	–10 dBm	– .3 dB	________	+ .3 dB
	–30 dBm	– .3 dB	________	+ .3 dB
	–40 dBm	– .3 dB	________	+ .3 dB
	–50 dBm	– .3 dB	________	+ .3 dB
	–60 dBm	– .5 dB	________	+ .5 dB
	–70 dBm	–1.0 dB	________	+1.0 dB
	–80 dBm	–2.5 dB	________	+2.5 dB
	R Channel Deviation (–20 dBm reference)			
	7. 0 dBm	–.3 dB	________	+.3 dB
	–10 dBm	–.3 dB	________	+.3 dB
	–30 dBm	–.3 dB	________	+.3 dB
	–40 dBm	–.3 dB	________	+.3 dB
4-22	**Magnitude Display Accuracy**			
	5. Channel 1 Accuracy (At ±4 divisions)			
	Scale (dB/DIV)			
	.25	–3.87 div.	________	–4.13 div.
	.25	+3.87 div.	________	+4.13 div.
	1	–3.87 div.	________	–4.13 div.
	1	+3.87 div.	________	+4.13 div.
	2.5	–3.87 div.	________	–4.13 div.
	2.5	+3.87 div.	________	+4.13 div.
	10	–3.87 div.	________	–4.13 div.
	10	+3.87 div.	________	+4.13 div.
	7. Channel 2 Accuracy (At ±4 divisions)			
	.25	–3.87 div.	________	–4.13 div.
	.25	+3.87 div.	________	+4.13 div.
	1	–3.87 div.	________	–4.13 div.
	1	+3.87 div.	________	+4.13 div.
	2.5	–3.87 div.	________	–4.13 div.
	2.5	+3.87 div.	________	+4.13 div.
	10	–3.87 div.	________	–4.13 div.
	10	+3.87 div.	________	+4.13 div.

Table 4-12. Performance Test Record (4 of 5)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-23	**Phase Dynamic Accuracy**			
	5. B INPUT Phase Deviation (-20 dBm Reference)			
	0 dBm	-2 degrees	______	+2 degrees
	-10 dBm	-2 degrees	______	+2 degrees
	-30 dBm	-2 degrees	______	+2 degrees
	-40 dBm	-2 degrees	______	+2 degrees
	-50 dBm	-2 degrees	______	+2 degrees
	-60 dBm	-4 degrees	______	+4 degrees
	-70 dBm	-4 degrees	______	+4 degrees
	8. R INPUT Phase Deviation (-20 dBm Reference)			
	0 dBm	-2 degrees	______	+2 degrees
	-10 dBm	-2 degrees	______	+2 degrees
	-30 dBm	-2 degrees	______	+2 degrees
	-40 dBm	-2 degrees	______	+2 degrees
4-24	**Phase Reference Accuracy**			
	8. +180° to -180° deviation	-1.8 degrees	______	+1.8 degrees
	10. +180° to -180° deviation	-1.8 degrees	______	+1.8 degrees
		-1.8 degrees	______	+1.8 degrees
		-1.8 degrees	______	+1.8 degrees
4-25	**Phase Display Accuracy**			
	5. Scale (DEG/DIV) / Trace Offset (divisions)			
	2.5 / -2	-1.9 div.	______	-2.1 div.
	2.5 / +2	+1.9 div.	______	+2.1 div.
	10 / -2	-1.9 div.	______	-2.1 div.
	10 / +2	+1.9 div.	______	+2.1 div.
	45 / -2	-1.9 div.	______	-2.1 div.
	45 / +2	+1.9 div.	______	+2.1 div.
	90 / -1	- .93 div.	______	-1.07 div.
	90 / +1	+ .93 div.	______	+1.07 div.

Table 4-12. Performance Test Record (5 of 5)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-26	**Polar Display Accuracy**			
	5. Phase			
	+90 degrees		________	2.5 mm
	-90 degrees		________	2.5 mm
	+180 degrees		________	2.5 mm
	-180 degrees		________	2.5 mm
	7. Magnitude (+00 dB Reference)			
	+06 dB		________	2.5 mm
	+12 dB		________	2.5 mm
	+20 dB		________	2.5 mm
4-27	**MAG/PHASE Output Accuracy**			
	4. B Channel Magnitude Deviation (-20 dBm Reference)			
	0 dBm	-.03 Vdc	________	+.03 Vdc
	-10 dBm	-.03 Vdc	________	+.03 Vdc
	-30 dBm	-.03 Vdc	________	+.03 Vdc
	-40 dBm	-.03 Vdc	________	+.03 Vdc
	-50 dBm	-.03 Vdc	________	+.03 Vdc
	-60 dBm	-.05 Vdc	________	+.05 Vdc
	-70 dBm	-.10 Vdc	________	+.10 Vdc
	-80 dBm	-.25 Vdc	________	+.25 Vdc
	6. R Channel Magnitude Deviation (-20 dBm Reference)			
	0 dBm	-.03 Vdc	________	+.03 Vdc
	-10 dBm	-.03 Vdc	________	+.03 Vdc
	-30 dBm	-.03 Vdc	________	+.03 Vdc
	-40 dBm	-.03 Vdc	________	+.03 Vdc
	11. Phase Output (0 Degree Reference)			
	-50 degrees	-.4925 Vdc	________	-.5075 Vdc
	-100 degrees	-.985 Vdc	________	-1.015 Vdc
	-180 degrees	±1.764 Vdc	________	±1.836 Vdc
	+180 degrees	±1.764 Vdc	________	±1.836 Vdc
	+100 degrees	+.985 Vdc	________	+1.015 Vdc
	+50 degrees	+.4925 Vdc	________	+.5075 Vdc

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments required to return the network analyzer to peak operating condition when repairs are required. Table 5-1 lists all of the adjustments by reference designation, adjustment name, adjustment paragraph, service sheet number, performance test paragraph, and description. Each procedure includes a test setup illustration and one or more adjustment location illustrations.

WARNING

With the covers removed, terminals are exposed that have voltages capable of causing death. The adjustments in this section should be performed only by a skilled person who knows the hazard involved.

NOTE

Before performing any adjustments, allow 1 hour warmup time for the instrument.

5-3. EQUIPMENT REQUIRED

5-4. A table of test equipment and test accessories required in the adjustment procedures is presented in Section I. The table includes the required minimum specifications and a suggested manufacturer's model number.

5-5. Alignment Tools

5-6. The recommended alignment tools are included in the Service Accessories Package, HP Part No. 08754-60051. Never try to force any adjustment control in the instrument. This is especially critical when adjusting slug-tuned inductors and variable capacitors.

5-7. FACTORY-SELECTED COMPONENTS

5-8. Table 5-2 contains a list of factory-selected components that includes the reference designation, the schematic diagram location, the related performance test, and the basis of selection. A factory-selected component is designated by an asterisk (*) on the schematic diagram. Table 5-5 provides a list of resistors and capacitors with HP Part Numbers for selection.

5-9. RELATED ADJUSTMENTS

5-10. Interactive adjustments are noted in the procedures. Table 5-3 indicates, by paragraph numbers, the adjustments that must be performed if an assembly has been replaced or repaired or if an adjustment has been made on an assembly. Table 5-4 lists the adjustment procedures included in this section.

Table 5-1. Adjustable Components (1 of 5)

Reference Designation	Adjustment Name	Adjustment Paragraph	Service Sheet	Performance Test	Description
A2R6	HF	5-15	6, 7	–	Calibrates SWEEP WIDTH MHz control.
A2R19	+6V ADJ	5-11	15, 20	4-21, 4-22, 4-24, 4-25, 4-26, 4-27	Adjusts +6V supply.
A2R118	CH 2 OFS	5-22	9	–	Balances CHANNEL 1 and CHANNEL 2 REFERENCE OFFSET.
A2R119	MTR-CAL	5-15	6, 7	4-12	Sets sensitivity of the DPM circuit.
A2R128	–6V ADJ	5-11	15, 20	4-21, 4-22, 4-24, 4-25, 4-26, 4-27	Adjusts –6V supply.
A2R129	R SLOPE	5-22	15	–	Adjusts for min. average slope.
A3R11	FB	5-22	9	4-20	Minimizes B Sampler response changes at harmonic lock points.
A3R16	IF	5-22	9	4-20, 4-21, 4-27	Adjusts B Sampler IF gain for absolute B calibration.
A3R23	BI	5-22	9	4-20	Adjusts B Sampler bias for maximum sampling efficiency.
A4R11	FB	5-22	9	4-20	Minimizes A Sampler response changes at harmonic lock points.
A4R16	IF	5-22	9	4-20, 4-21, 4-27	Adjusts A Sampler IF gain for absolute A calibration.
A4R23	BI	5-22	9	4-20	Adjusts A Sampler bias for maximum sampling efficiency.
A5R11	FB	5-22	9	4-20	Minimizes R Sampler response changes at harmonic lock points.
A5R16	IF	5-22	9	4-20, 4-21, 4-27	Adjusts R channel IF gain to center A/R and B/R responses.
A5R23	BI	5-22	9	4-20	Adjusts R Sampler bias for maximum sampling efficiency.
A6C19	OSCILLATOR	5-18	10, 11	–	Sets tuning voltage sensitivity of VTO.
A7R2	+5 dBm	5-16	7	4-14	Calibrates +5 dBm setting of OUTPUT dBm control.
A7R7	+10 dBm	5-16	7	4-14	Calibrates +10 dBm setting of OUTPUT dBm control.
A7R9	0 dBm	5-16	7	4-14	Calibrates 0 dBm setting of OUTPUT dBm control.
A7R32	HARM	5-16	7	4-15	Minimizes harmonics from RF source.
A8C12	1 MHz TRIM	5-20	12	–	Fine tunes the 1 MHz IF bandpass filters.

Table 5-1. Adjustable Components (2 of 5)

Reference Designation	Adjustment Name	Adjustment Paragraph	Service Sheet	Performance Test	Description
A8C24	NEG CAP	5-21	12	4-21, 4-27	Adjusts the rectifier linearity over the input range of -30 to -50 dBm.
A8C45	1 MHz TUNE	5-21	12	4-21, 4-27	Tunes the rectifier driver to 1 MHz.
A8L2	1MHz (L2)	5-20	12	–	Tunes the first stage of the 1 MHz bandpass filters to 1 MHz.
A8L3	1 MHz (L3)	5-20	12	–	Fine tunes the second stage of the 1 MHz IF bandpass filters to 1 MHz.
A8R50	LOG OFS	5-21	12	4-21, 4-27	Adjusts the output of the logger to 0V when a 1 MHz signal of 0.2236 Vrms is applied to the input.
A8R56	LOG GAIN	5-21	12	4-21, 4-27	Adjusts the slope of the logger output to 25 mV6dB.
A8R58	DET GAIN	5-21	12	4-21, 4-27	Adjusts the rectifier linearity over the input range of -60 to -70 dBm.
A8R82	DET BIAS	5-21	12	4-21, 4-27	Adjusts the quiescent bias of the rectifier.
A8R90	OFFSET	5-21	12	4-21, 4-27	Nulls the offset voltage of the log amplifier.
A8R94	ABS R OFS	5-22	9, 12	–	Sets absolute R channel level.
A9C38	LIM FLT	5-23	14	4-23	Minimizes phase error versus amplitude of A/B IF.
A9L13	1-MHz Filter*	5-23	14	4-23	Sets phase shift through the A/B IF limiters.
A9R1	POLAR OFS	5-24	14	4-26	Calibrates polar display at lower amplitudes.
A9R5	POLAR GAIN	5-24	14	4-26	Calibrates polar display at outer polar circle.
A9R39	POLAR MIN	5-24	14	4-26	Sets maximum range of polar amplitude response.
A9R45	RECT OFS	5-24	14	–	Sets offset of rectangular phase display.
A9R49	RECT GAIN	5-24	14	4-25, 4-27	Sets RF source rectangular phase display.
A9R55	POLAR ZERO	5-24	14	4-26	Sets zero phase point of polar display.
A10L13	1-MHz Filter*	5-23	14	4-23	Sets phase shift through R IF limiter.
A10R15	PH OFS	5-24	14	4-24	Sets zero phase point of phase offset circuit.
A10R20	TUNE**	–	14	–	Provides method of tuning VCO through its range.

Table 5-1. Adjustable Components (3 of 5)

Reference Designation	Adjustment Name	Adjustment Paragraph	Service Sheet	Performance Test	Description
A10R36	R BAL	5-23	14	4-23	Minimizes phase error versus amplitude of R IF.
A10R52	Y NULL	5-24	14	4-26	Nulls IF feedthrough in Y multiplier.
A10R72	X NULL	5-24	14	4-26	Nulls IF feedthrough in X multiplier.
A10R78	GAIN BAL	5-24	14	4-26	Adjusts X versus Y sensitivity of polar display.
A10R87	PH CAL	5-24	14	4-24, 4-27	Calibrates range of phase offset circuit.
A11C12	1 MHz TRIM	5-20	13	–	Fine tunes the 1 MHz IF bandpass filters.
A11C24	NEG CAP	5-21	13	4-21, 4-27	Adjusts the rectifier linearity over the input range of –30 to –50 dBm.
A11C45	1 MHz TUNE	5-21	13	4-21, 4-27	Tunes the rectifier driver to 1 MHz.
A11L2	1 MHz (L2)	5-20	13	–	Tunes the first stage of the 1 MHz bandpass filters to 1 MHz.
A11L3	1 MHz (L3)	5-20	13	–	Fine tunes the second stage of the 1 MHz IF bandpass filters to 1 MHz.
A11R50	LOG OFS	5-21	13	4-21, 4-27	Adjusts the output of the logger to 0V when a 1 MHz signal of 0.2236 Vrms is applied to the input.
A11R56	LOG GAIN	5-21	13	4-21, 4-27	Adjusts the slope of the logger output to 25 mV/dB.
A11R58	DET GAIN	5-21	13	4-21, 4-27	Adjusts the rectifier linearity over the input range of –60 to –70 dBm.
A11R82	DET BIAS	5-21	13	4-21, 4-27	Adjusts the quiescent bias of the rectifier.
A11R90	OFFSET	5-21	13	4-21, 4-27	Nulls the offset voltage of the log amplifier.
A11R94	DVM PH OFS	5-24	13, 14	–	Adjusts phase offset of DVM phase output to rear-panel MAG/PHASE connector.
A12C29	FREQ ADJ	5-17	8	4-13	Adjusts 50 MHz oscillator frequency.
A12R5	GAIN 1	5-17	8	–	Sets amplitude of 1 MHz marker birdies.
A12R12	BIAS 10, 50	5-17	8	–	Sets symmetry of 10 and 50 MHz marker birdies.
A12R13	BIAS 1	5-17	8	–	Sets symmetry of 1 MHz marker birdies.

Table 5-1. Adjustable Components (4 of 5)

Reference Designation	Adjustment Name	Adjustment Paragraph	Service Sheet	Performance Test	Description
A12R19	GAIN 50	5-17	8	–	Sets amplitude of 50 MHz marker birdies.
A12R26	GAIN 10	5-17	8	–	Sets amplitude of 10 MHz marker birdies.
A13C33	1 MHz ADJ	5-19	11	–	Sets 1 MHz IF reference oscillator frequency.
A13R79	PH OFS	5-19	11	–	Adjusts offset of phase detector.
A14R13	GAIN	5-19	11	–	Sets frequency-to-voltage relationship of discriminator.
A14R27	3 MHz	5-19	11	–	Adjusts display to blank below 3 MHz.
A14R47	8 MHz	5-18	11	–	Sets VTO pre-tune frequency to 8 MHz.
A14R78	BKSTEP	5-19	11	–	Adjusts amount of frequency backstep.
A15R49	30	5-15	6, 7	4-12	Adjusts RF source frequency at 30 MHz.
A15R50	100	5-15	6, 7	4-12	Adjusts RF source frequency at 100 MHz.
A15R51	200	5-15	6, 7	4-12	Adjusts RF source frequency at 200 MHz.
A15R52	300	5-15	6, 7	4-12	Adjusts RF source frequency at 300 MHz.
A15R53	400	5-15	6, 7	4-12	Adjusts RF source frequency at 400 MHz.
A15R54	500	5-15	6, 7	4-12	Adjusts RF source frequency at 500 MHz.
A15R55	600	5-15	6, 7	4-12	Adjusts RF source frequency at 600 MHz.
A15R56	800	5-15	6, 7	4-12	Adjusts RF source frequency at 800 MHz.
A15R57	900	5-15	6, 7	4-12	Adjusts RF source frequency at 900 MHz.
A15R58	1.0	5-15	6, 7	4-12	Adjusts RF source frequency at 1.0 GHz.
A15R59	1.1	5-15	6, 7	4-12	Adjusts RF source frequency at 1.1 GHz.
A15R60	1.2	5-15	6, 7	4-12	Adjusts RF source frequency at 1.2 GHz.
A15R61	1.3	5-15	6, 7	4-12	Adjusts RF source frequency at 1.3 GHz.

Table 5-1. Adjustable Components (5 of 5)

Reference Designation	Adjustment Name	Adjustment Paragraph	Service Sheet	Performance Test	Description
A15R98	1300	5-15	6, 7	4-12	Sets RF source local oscillator driver at 1300 MHz.
A15R100	0	5-15	6, 7	4-12	Sets offset of local oscillator driver.
A16R10	+20V ADJ	5-11	15, 20	–	Adjusts +20V supply.
A17R20	LF	5-12	5	–	Sets sweep ramp lower limit to 0V.
A17R24	HF	5-12	5	–	Sets sweep ramp upper limit to +10V.
A18R32	Y GAIN	5-14	15, 16	4-22, 4-25 4-26	Sets vertical RF source display.
A18R40	Y POSN	5-14	15, 16	–	Sets vertical offset of display.
A18R58	X GAIN	5-14	15, 16	4-26	Sets horizontal RF source display.
A18R64	X POSN	5-14	15, 16	–	Sets horizontal offset of display.
A21R28	INTEN LIMIT	5-13	17	–	Sets range of intensity control.
R5	TRACE ALIGN	5-13	17	–	Adjusts trace tilt.
R6	ASTIG	5-14	15, 16	–	Adjusts astigmatism of trace.

*No name on PC board.
**Used for troubleshooting only.

Table 5-2. Factory Selected Components

Reference Designator	Adjustment Paragraph	Service Sheet	Performance Test	Basis of Selection
A6C20	5-18	10		Selected so that A6C19 OSCILLATOR FREQ will adjust VTO frequency to make +10 V equal to 30 MHz.
A10C17	5-24	14	4-25	Selected for minimum eccentricity in polar circle.
A15R62	5-15	7	4-12	Selected so that A15R59 1.1 will adjust RF frequency to 1100 MHz when the FREQ REF voltage is +11.00 V.
A15R63	5-15	7	4-12	Selected so that A15R60 1.2 will adjust RF frequency to 1200 MHz when FREQ REF voltage is +12.00 V.
A15R64	5-15	7	4-12	Selected so that A15R61 1.3 will adjust RF frequency to 1300 MHz when FREQ REF voltage is +13.00 V.
A15R65		7		Selected to give best SWEEP WIDTH MHz accuracy at RF frequency of 1300 MHz.
A15R66	5-15	7	4-12	Selected so that A15R50 will adjust RF frequency to 100 MHz when FREQ REF voltage is +1.00 V.
A15R84		7		Selected to give +12.60 V at A15TP1.
A15A1R1 through A15A1R14	5-15	7	4-12	Selected to pre-shape source frequency to FREQ REF voltage. (Module supplied with A7U2.)

Table 5-3. Related Adjustments

Assembly Changed or Repaired		Related Assemblies	Perform the Following Paragraph Number
A1	Front Panel	A2, A7	5-15*, 5-16
A2	Analog Processor	A2	5-11, 5-15*, 5-22
A3	B Sampler	A3, A4, A5	5-22
A4	A Sampler	A3, A4, A5	5-22
A5	R Sampler	A3, A4, A5	5-22
A6	VTO and IF Switch	A6, A14, A3, A4, A5	5-18, 5-22
A7	Source (Board Only)	A7	5-16
A7U2	Source Microcircuit	A15, A2	5-15†
A7U3	Amplifier-Detector Microcircuit	A7	5-16
A8	A, B Detector	A3, A4, A5, A8, A10R15 "PH OFS"	5-20††, 5-21††, 5-22, 5-24
A9	Phase Detector	A9, A10	5-23††, 5-24
A10	Polar Converter	A9, A10	5-23††, 5-24
A11	R Detector	A3, A4, A5, A10R15 "PH OFS", A11	5-20††, 5-21††, 5-22, 5-24
A12	Marker Generator	A12	5-17
A13	Phase Lock	A13	5-19
A14	Phase Lock Control	A13	5-18, 5-19
A15	Shaper	A15, A2	5-15†
A16	DC Regulator	A16	5-11
A17	Sweep Generator	A17, A14R78 "BKSTEP"	5-12, 5-19
A18	Deflection Amplifiers	A18	5-14
A19	Rectifier	A16	5-11
A21	High Voltage Power Supply	A21	5-13
V1	CRT	A21	5-13

*Frequency Reference Adjustment Only.

†Pre-shaping assembly A15A1 is factory-matched to A7U2 Source and should be installed on A15 before adjustment is performed.

††Assembly has been factory-aligned. Adjustment is not necessary unless assembly has been altered or repaired.

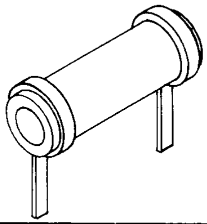
Table 5-4. Adjustments

Paragraph	Adjustment
5-11	Low Voltage Power Supply Check and Adjustment
5-12	Sweep Generator Adjustment
5-13	Intensity Limit and Trace Alignment Adjustment
5-14	Horizontal and Vertical Position and Gain Adjustment
5-15	Frequency Accuracy and Sweep Width Adjustment
5-16	OUTPUT dBm Calibration and Harmonics Adjustment
5-17	Markers Adjustment
5-18	VTO Frequency Adjustment
5-19	Phase-Lock Loop Adjustment
5-20	IF Filter Adjustment
5-21	Magnitude Detector Accuracy Adjustment
5-22	Samplers Adjustment
5-23	Phase Detector Limiters Adjustment
5-24	Phase Detector and Polar Converter Adjustment

Table 5-5. HP Part Numbers of Standard Value Replacement Components (1 of 3)

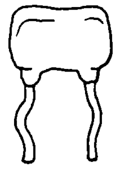
CAPACITORS

RANGE: 1 to 24 pF
TYPE: Tubular
TOLERANCE:
1 to 9.1 pF = ±.25 pF
10 to 24 pF = ±5%



Value (pF)	HP Part Number	C D
1.0	0160-2236	8
1.2	0160-2237	9
1.5	0150-0091	8
1.8	0160-2239	1
2.0	0160-2240	4
2.2	0160-2241	5
2.4	0160-2242	6
2.7	0160-2243	7
3.0	0160-2244	8
3.3	0150-0059	8
3.6	0160-2246	0
3.9	0160-2247	1
4.3	0160-2248	2
4.7	0160-2249	3
5.1	0160-2250	6
5.6	0160-2251	7
6.2	0160-2252	8
6.8	0160-2253	9
7.5	0160-2254	0
8.2	0160-2255	1
9.1	0160-2256	2
10.0	0160-2257	3
11.0	0160-2258	4
12.0	0160-2259	5
13.0	0160-2260	8
15.0	0160-2261	9
16.0	0160-2262	0
18.0	0160-2263	1
20.0	0160-2264	2
22.0	0160-2265	3
24.0	0160-2266	4

RANGE: 27 to 680 pF
TYPE: Dipped Mica
TOLERANCE: ±5%

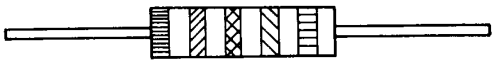


Value (pF)	HP Part Number	C D
27	0160-2306	3
30	0160-2199	2
33	0160-2150	5
36	0160-2308	5
39	0140-0190	7
43	0160-2200	6
47	0160-2307	4
51	0160-2201	7
56	0140-0191	8
62	0140-0205	5
68	0140-0192	9
75	0160-2202	8
82	0140-0193	0
91	0160-2203	9
100	0160-2204	0
110	0140-0194	1
120	0160-2205	1
130	0140-0195	2
150	0140-0196	3
160	0160-2206	2
180	0140-0197	4
200	0140-0198	5
220	0160-0134	1
240	0140-0199	6
270	0140-0210	2
300	0160-2207	3
330	0160-2208	4
360	0160-2209	5
390	0140-0200	0
430	0160-0939	4
470	0160-3533	0
510	0160-3534	1
560	0160-3535	2
620	0160-3536	3
680	0160-3537	4

Table 5-5. HP Part Numbers of Standard Value Replacement Components (2 of 3)

RESISTORS

RANGE: 10 to 464K Ohms
TYPE: Fixed-Film
WATTAGE: .125 at 125°C
TOLERANCE: ±1.0%



Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD
10.0	0757-0346	2	464	0698-0082	7	21.5K	0757-0199	3
11.0	0757-0378	0	511	0757-0416	7	23.7K	0698-3158	4
12.1	0757-0379	1	562	0757-0417	8	26.1K	0698-3159	5
13.3	0698-3427	0	619	0757-0418	9	28.7K	0698-3449	6
14.7	0698-3428	1	681	0757-0419	0	31.6K	0698-3160	8
16.2	0757-0382	6	750	0757-0420	3	34.8K	0757-0123	3
17.8	0757-0294	9	825	0757-0421	4	38.3K	0698-3161	9
19.6	0698-3429	2	909	0757-0422	5	42.2K	0698-3450	9
21.5	0698-3430	5	1.0K	0757-0280	3	46.4K	0698-3162	0
23.7	0698-3431	6	1.1K	0757-0424	7	51.1K	0757-0458	7
26.1	0698-3432	7	1.21K	0757-0274	5	56.2K	0757-0459	8
28.7	0698-3433	8	1.33K	0757-0317	7	61.9K	0757-0460	1
31.6	0757-0180	2	1.47K	0757-1094	9	68.1K	0757-0461	2
34.8	0698-3434	9	1.62K	0757-0428	1	75.0K	0757-0462	3
38.3	0698-3435	0	1.78K	0757-0278	9	82.5K	0757-0463	4
42.2	0757-0316	6	1.96K	0698-0083	8	90.9K	0757-0464	5
46.4	0698-4037	0	2.15K	0698-0084	9	100K	0757-0465	6
51.1	0757-0394	0	2.37K	0698-3150	6	110K	0757-0466	7
56.2	0757-0395	1	2.61K	0698-0085	0	121K	0757-0467	8
61.9	0757-0276	7	2.87K	0698-3151	7	133K	0698-3451	0
68.1	0757-0397	3	3.16K	0757-0279	0	147K	0698-3452	1
75.0	0757-0398	4	3.48K	0698-3152	8	162K	0757-0470	3
82.5	0757-0399	5	3.83K	0698-3153	9	178K	0698-3243	8
90.0	0757-0400	9	4.22K	0698-3154	0	196K	0698-3453	2
100	0757-0401	0	4.64K	0698-3155	1	215K	0698-3454	3
110	0757-0402	1	5.11K	0757-0438	3	237K	0698-3266	5
121	0757-0403	2	5.62K	0757-0200	7	261K	0698-3455	4
133	0698-3437	2	6.19K	0757-0290	5	287K	0698-3456	5
147	0698-3438	3	6.81K	0757-0439	4	316K	0698-3457	6
162	0757-0405	4	7.50K	0757-0440	7	348K	0698-3458	7
178	0698-3439	4	8.25K	0757-0441	8	383K	0698-3459	8
196	0698-3440	7	9.09K	0757-0288	1	422K	0698-3460	1
215	0698-3441	8	10.0K	0757-0442	9	464K	0698-3260	9
237	0698-3442	9	11.0K	0757-0443	0			
261	0698-3132	4	12.1K	0757-0444	1			
287	0698-3443	0	13.3K	0757-0289	2			
316	0698-3444	1	14.7K	0698-3156	2			
348	0698-3445	2	16.2K	0757-0447	4			
383	0698-3446	3	17.8K	0698-3136	8			
422	0698-3447	4	19.6K	0698-3157	3			

Table 5-5. HP Part Numbers of Standard Value Replacement Components (3 of 3)

RESISTORS

RANGE: 10 to 1.47M Ohms
TYPE: Fixed-Film
WATTAGE: .5 at 125°C
TOLERANCE: ±1%

Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD
10.0	0757-0984	4	215	0698-3401	0	4.64K	0698-3348	4	110K	0757-0859	2
11.0	0575-0985	5	237	0698-3102	8	5.11K	0757-0833	2	121K	0757-0860	5
12.1	0757-0986	6	261	0757-1090	5	5.62K	0757-0834	3	133K	0757-0310	0
13.3	0757-0001	6	287	0757-1092	7	6.19K	0757-0196	0	147K	0698-3175	5
14.7	0698-3388	2	316	0698-3402	1	6.81K	0757-0835	4	162K	0757-0130	2
16.2	0757-0989	9	348	0698-3403	2	7.50K	0757-0836	5	178K	0757-0129	9
17.8	0698-3389	3	383	0698-3404	3	8.25K	0757-0837	6	196K	0757-0063	0
19.6	0698-3390	6	422	0698-3405	4	9.09K	0757-0838	7	215K	0757-0127	7
21.5	0698-3391	7	464	0698-0090	7	10.0K	0757-0839	8	237K	0698-3424	7
23 7	0698-3392	8	511	0757-0814	9	12.1K	0757-0841	2	261K	0757-0064	1
26.1	0757-0003	8	562	0757-0815	0	13.3K	0698-3413	4	287K	0757-0154	0
28.7	0698-3393	9	619	0757-0158	4	14.7K	0698-3414	5	316K	0698-3425	8
31.6	0698-3394	0	681	0757-0816	1	16.2K	0757-0844	5	348K	0757-0195	9
34.8	0698-3395	1	750	0757-0817	2	17.8K	0698-0025	8	383K	0757-0133	5
38.3	0698-3396	2	825	0757-0818	3	19.6K	0698-3415	6	422K	0757-0134	6
42.2	0698-3397	3	909	0757-0819	4	21.5K	0698-3416	7	464K	0698-3426	9
46.4	0698-3398	4	1.00K	0757-0159	5	23.7K	0698-3417	8	511K	0757-0135	7
51.1	0757-1000	7	1.10K	0757-0820	7	26.1K	0698-3418	9	562K	0757-0868	3
56.2	0757-1001	8	1.21K	0757-0821	8	28.7K	0698-3103	9	619K	0757-0136	8
61.9	0757-1002	9	1.33K	0698-3406	5	31.6K	0698-3419	0	681K	0757-0869	4
68.1	0757-0794	4	1.47K	0757-1078	9	34.8K	0698-3420	3	750K	0757-0137	9
75.0	0757-0795	5	1.62K	0757-0873	0	38.3K	0698-3421	4	825K	0757-0870	7
82.5	0757-0796	6	1.78K	0698-0089	4	42.2K	0698-3422	5	909K	0757-0138	0
90.0	0757-0797	7	1.96K	0698-3407	6	46.4K	0698-3423	6	1M	0757-0059	4
100	0757-0198	2	2.15K	0698-3408	7	51.1K	0757-0853	6	1.1M	0757-0139	1
110	0757-0798	8	2.37K	0698-3409	8	56.2K	0757-0854	7	1.21M	0757-0871	8
121	0757-0799	9	2.61K	0698-0024	7	61.9K	0757-0309	7	1.33M	0757-0194	8
133	0698-3399	5	2.87K	0698-3101	7	68.1K	0757-0855	8	1.47M	0698-3464	5
147	0698-3400	9	3.16K	0698-3410	1	75.0K	0757-0856	9			
162	0757-0802	5	3.48K	0698-3411	2	82.5K	0757-0857	0			
178	0698-3334	8	3.83K	0698-3412	3	90.9K	0757-0858	1			
196	0757-1060	9	4.22K	0698-3346	2	100K	0757-0367	7			

ADJUSTMENTS

5-11. LOW VOLTAGE POWER SUPPLY CHECK AND ADJUSTMENTS

REFERENCE:

Service Sheets 15 and 20

DESCRIPTION

The +20V supply is adjusted for correct output and the remaining low voltage supplies are checked. The +6V and −6V reference supplies are adjusted for correct output. Figure 5-1 shows the Low Voltage Power Supply Adjustment Test Setup.

EQUIPMENT:

Digital Voltmeter . . . . HP 3455A

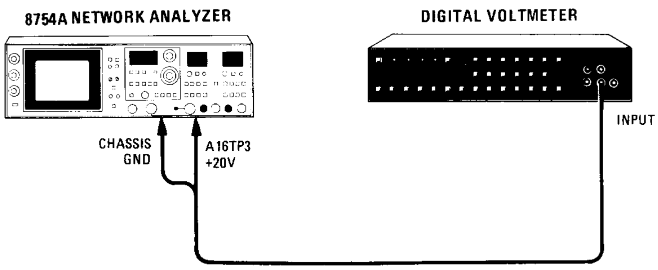


Figure 5-1. Low Voltage Power Supply Adjustment Test Setup

PROCEDURE:

a. Connect equipment as shown in Figure 5-1. Connect digital voltmeter to A16TP3 +20V.

b. Adjust A16R10 +20V ADJ for a digital voltmeter indication of +20.00 ± 0.001 V.

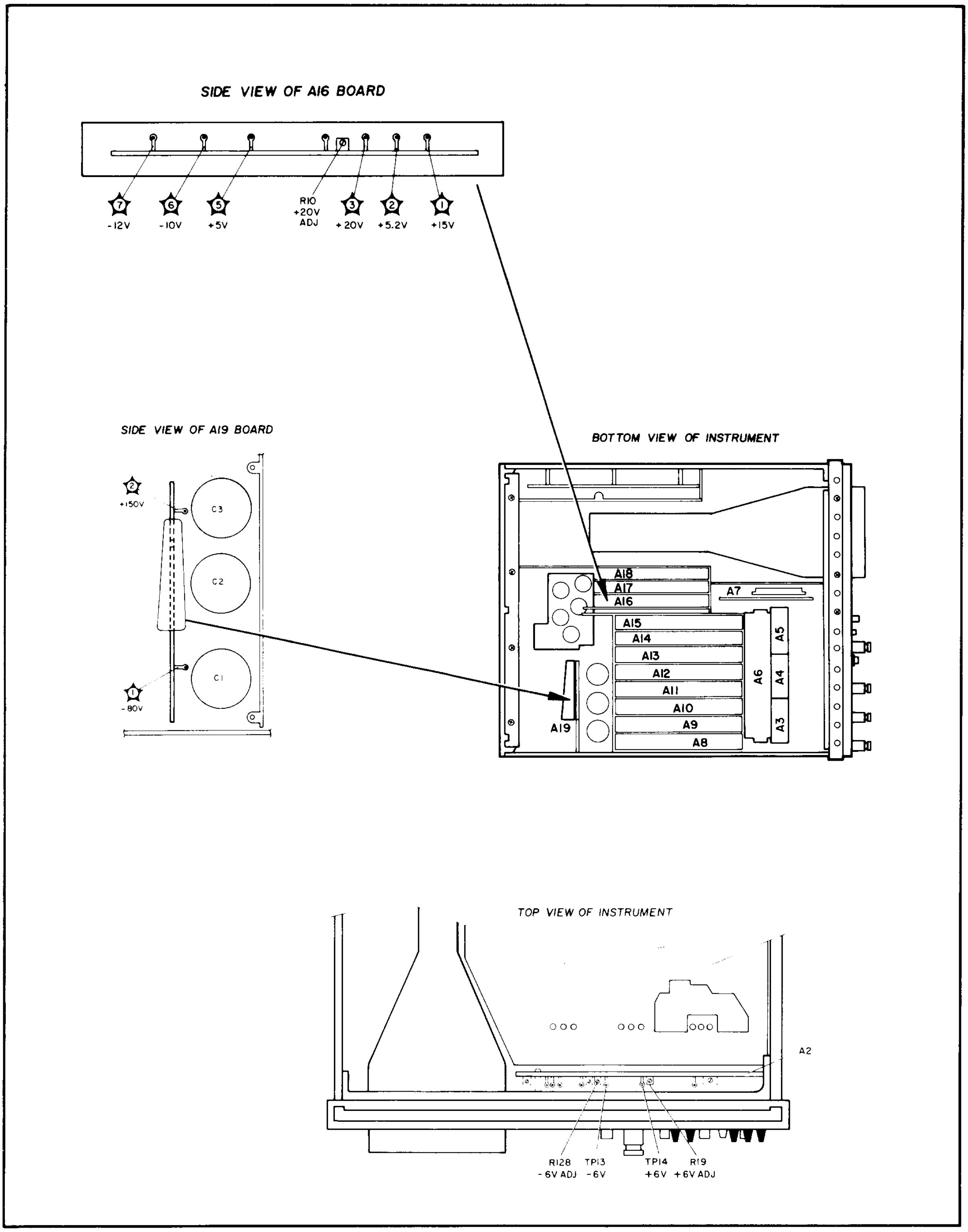


Figure 5-2. Low Voltage Power Supply Adjustment Locations

ADJUSTMENTS

5-11. LOW VOLTAGE POWER SUPPLY CHECK AND ADJUSTMENTS (Cont'd)

c. Check power supply voltages listed in Table 5-6.

Table 5-6. Power Supply Voltages

Test Point	Voltage (Vdc)	Limits (Vdc)
A16TP1	+15	+15 to +16*
A16TP2	+5.2	+4.95 to +5.45
A16TP5	+5	+4.75 to +5.25
A16TP6	−10	−9.975 to −10.035
A16TP7	−12	−11.4 to −12.6
A19TP1	−80 (−85 nom)	−72 to −98
A19TP2	+150 (+167 nom)	+142 to +192

*With no load on probe power jacks.

d. Connect digital voltmeter high input lead to A2TP14 +6V and adjust A2R19 for +6.000 ±.001 V.

e. Connect digital voltmeter high input lead to A2TP13 −6V and adjust A2R128 for −6.000 ± .001V.

f. Repeat steps d and e to optimize +6 and −6V adjustments.

5-12. SWEEP GENERATOR ADJUSTMENT

REFERENCE:

Service Sheet 5

DESCRIPTION:

The 8754A is operated in manual sweep mode and the Sweep Generator VSWP output endpoints are set for 0V and +10V.

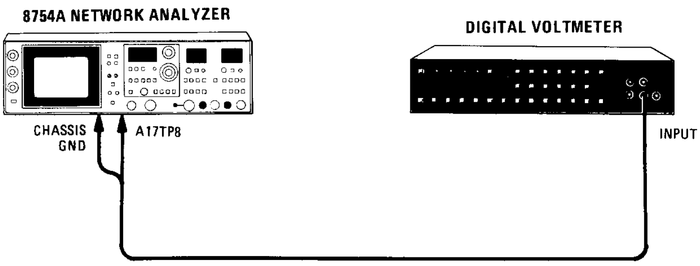


Figure 5-3. Sweep Generator Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 3455A

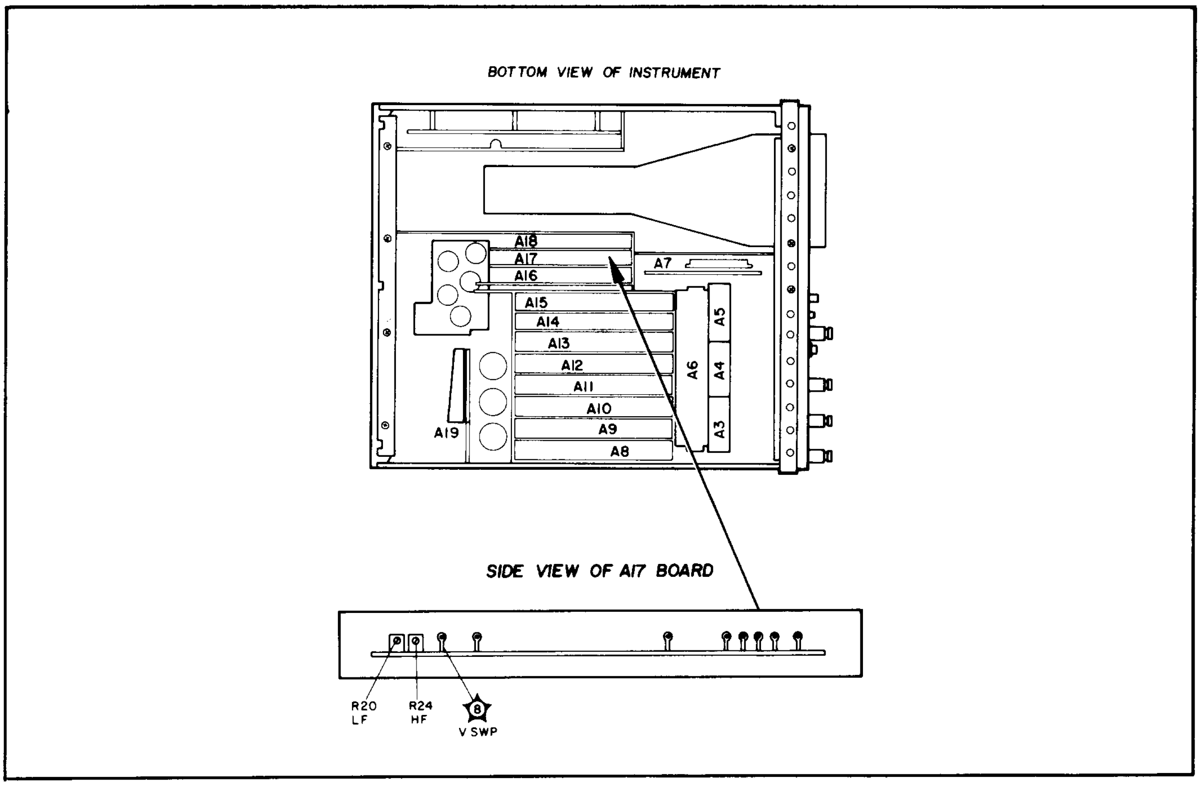


Figure 5-4. Sweep Generator Adjustment Locations

ADJUSTMENTS

5-12. SWEEP GENERATOR ADJUSTMENT (Cont'd)

PROCEDURE:

a. Connect equipment as shown in Figure 5-3.

b. Set 8754A controls as follows:

CHANNEL 1, CHANNEL 2	
Measurement Select pushbuttons	OFF
Sweep Mode	START
FREQUENCY MHz	500
SWEEP WIDTH	0 (CW)
REFERENCE POSITION CH 1	On (in)
REFERENCE POSITION CH 1 ▲▼ Control	Midrange
SWEEP	MAN
SWEEP Vernier	Fully counterclockwise
POLAR A/R	off (out)

c. Connect digital voltmeter to A17TP8 VSWP.

d. Adjust A17R20 LF adjustment for 0.000V at A17TP8.

e. Set front-panel SWEEP vernier fully clockwise.

f. Adjust A17R24 HF adjustment for +10.000V at A17TP8.

5-13. INTENSITY LIMIT ADJUSTMENT

REFERENCE:

Service Sheet 17

DESCRIPTION:

The voltage across A21TP3 and A21TP6 is proportional to the high voltage applied the CRT control grid. This voltage is measured to check the approximate voltage level of the High Voltage Power Supply. The Intensity Limit adjustment is then set to limit the CRT control grid voltage and, in effect, to limit the maximum CRT trace intensity. Trace Alignment is also adjusted.

ADJUSTMENTS

5-13. INTENSITY LIMIT ADJUSTMENT (Cont'd)

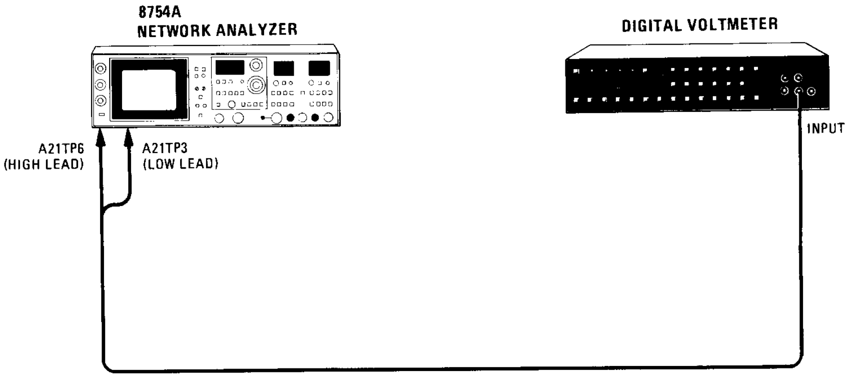


Figure 5-5. Intensity Limit Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter .... HP 3455A

WARNING

The following procedure probes near voltages that, if contacted, may cause personal injury or death.

To minimize shock hazard use a non-metallic screwdriver for adjustments on A21 High Voltage Power Supply.

After turning off the 8754A, allow a minimum of 30 seconds for High Voltage Power Supply discharge before removing High Voltage Power Supply protective cover.

a. Set LINE-OFF switch to OFF, remove 8754A side cover adjacent to A21 High Voltage Power Supply (see Figure 5-6). Connect equipment as shown in Figure 5-5. Connect digital voltmeter high input lead to A21TP6 and connect low input lead to A21TP3.

b. Set LINE switch on, and set SWEEP pushbuttons for AUTO, MAN.

c. Digital voltmeter should indicate approximately −2.85 ± .15V. If digital voltmeter indication is incorrect, refer to Service Sheet 17 and troubleshoot A21 High Voltage Power Supply.

d. Set LINE-OFF switch to OFF, remove Voltmeter Leads from A21TP6 and A21TP3.

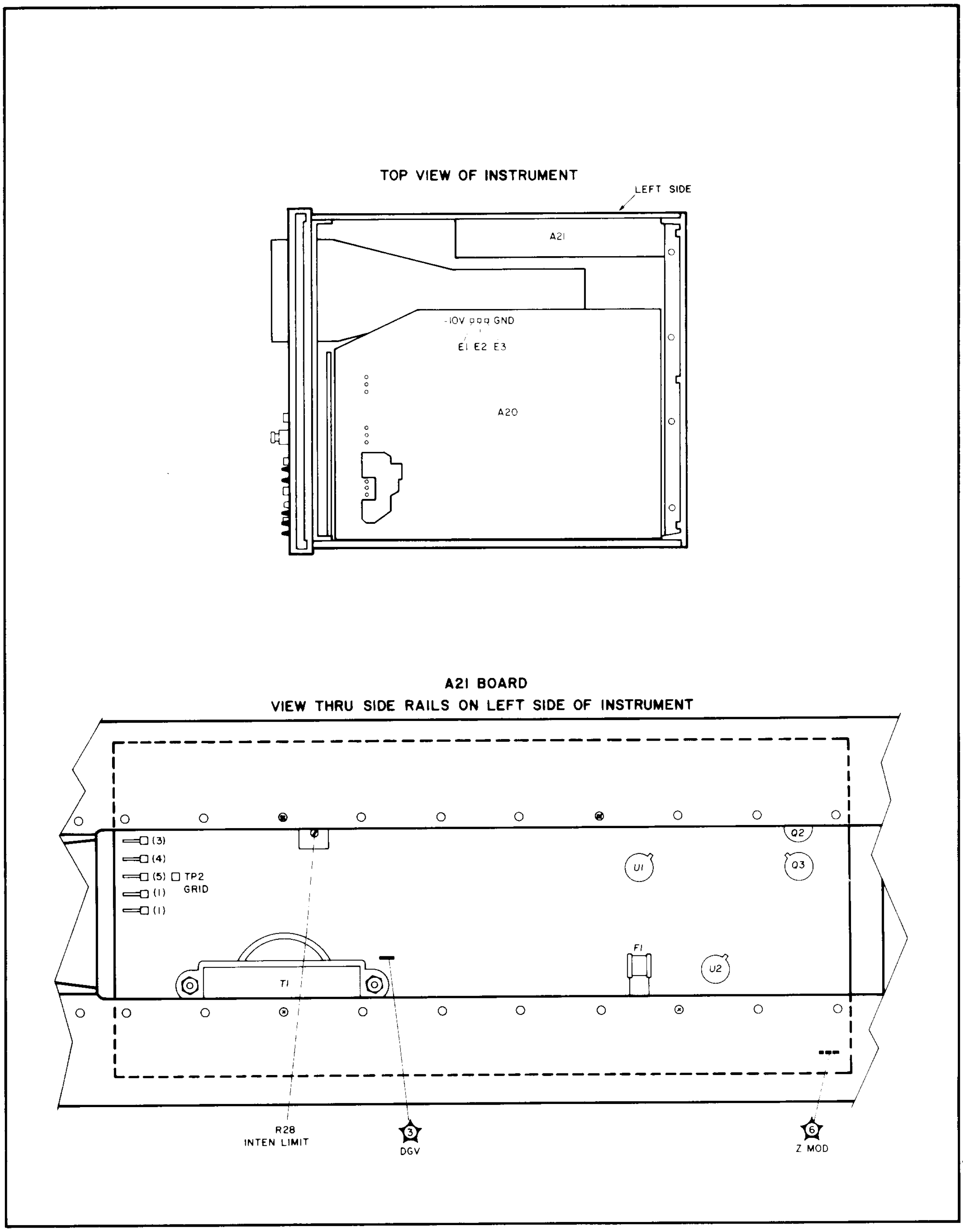


Figure 5-6. Intensity Limit Adjustment Locations and Trace Alignment Connections

ADJUSTMENTS

5-13. INTENSITY LIMIT ADJUSTMENT (Cont'd)

e. Set 8754A controls as follows:

LINE-OFF	LINE
Sweep Mode	FULL 4 – 1300
SWEEP	AUTO, FAST
SWEEP vernier	Mid-range
FREQUENCY MHz	400
MARKERS MHz	OFF
POLAR A/R	Out (off)
CHANNEL 1, CHANNEL 2 Measurement Select pushbutton	OFF
REFERENCE POSITION CH 1	In (on)

f. Adjust front-panel INTENSITY control to see a trace. Adjust REFERENCE POSITION CH 1 control so that trace is near the horizontal center line of the CRT.

NOTE

In step g, if TRACE ALIGN adjustment has insufficient range, proceed to step h.

g. Adjust rear-panel TRACE ALIGN screwdriver adjustment until trace is parallel with horizontal graticule lines.

h. If the TRACE ALIGN adjustment has insufficient range, readjust TRACE ALIGN for each of the Trace Align coil wire connections to the Motherboard (A20) listed below until adjustment range is sufficient. (See Figure 5-6 for location of Trace Align coil connections on the Motherboard.) Repeat step g.

1. Connect coil wires to A20E2 and A20E3.
2. Interchange wire connections on A20E2 and A20E3.
3. Connect wires to A20E2 and A20E1.
4. Interchange wire connections on A20E2 and A20E1.

i. Note horizontal position of full sweep marker. Select MANUAL sweep and place dot at center of marker using MANual SWEEP control. Dot should be approximately 0.3 division above normal trace level.

j. Set POLAR A/R on (in) and POLAR CENTER on (in). Note dot on CRT. Using horizontal and vertical POLAR CENTER controls (◂▸ and ▴▾), place dot at CRT center.

k. Reduce INTENSITY TO FULLY CCW. Shade CRT display from external glare and adjust A21R28 INTEN LIMIT so the dot is barely visible.

5-14. HORIZONTAL AND VERTICAL POSITION AND GAIN ADJUSTMENT

REFERENCE:

Service Sheets 15 and 16

DESCRIPTION:

The 8754A is operated in polar mode and the front panel POLAR CENTER controls are adjusted for 0V and ±1.2V POLAR X and POLAR Y deflection inputs to the Deflection Amplifiers (A18). With a 0V input, the CRT trace is centered by the position adjustments. With a ±1.2V input, the gain is adjusted to position the CRT trace on the outer polar graticule. Then the front-panel HORIZ POSN and HORIZ GAIN screwdriver adjustments are adjusted for a swept display that exactly aligns with the left- and right-hand graticules.

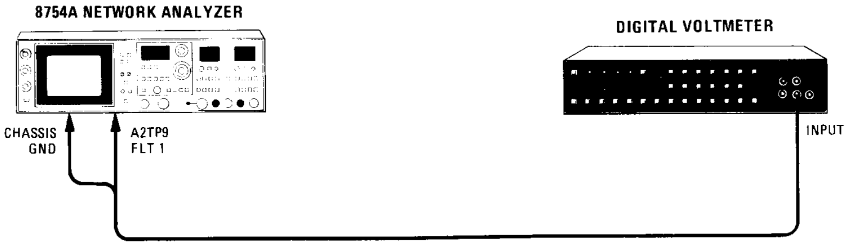


Figure 5-7. Horizontal and Vertical Position and Gain Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 3455A

PROCEDURE:

a. Connect equipment as shown in Figure 5-7.

b. Set 8754A controls as follows:

POLAR A/R . . . . On (in)
POLAR CENTER . . . . On (in)
SWEEP . . . . MAN
Sweep Mode . . . . START
FREQUENCY MHz 500
SWEEP WIDTH . . . . 0 (CW)

c. Connect digital voltmeter to A2TP9 FLT 1.

d. Adjust front panel POLAR CENTER ⬍ control for 0.00V at A2TP9. Adjust front-panel FOCUS control and rear-panel screwdriver adjustment ASTIG for sharp dot.

e. Adjust A18R40 Y POSN to position CRT dot on center horizontal graticule line.

ADJUSTMENTS

5-14. HORIZONTAL AND VERTICAL POSITION AND GAIN ADJUSTMENT (Cont'd)

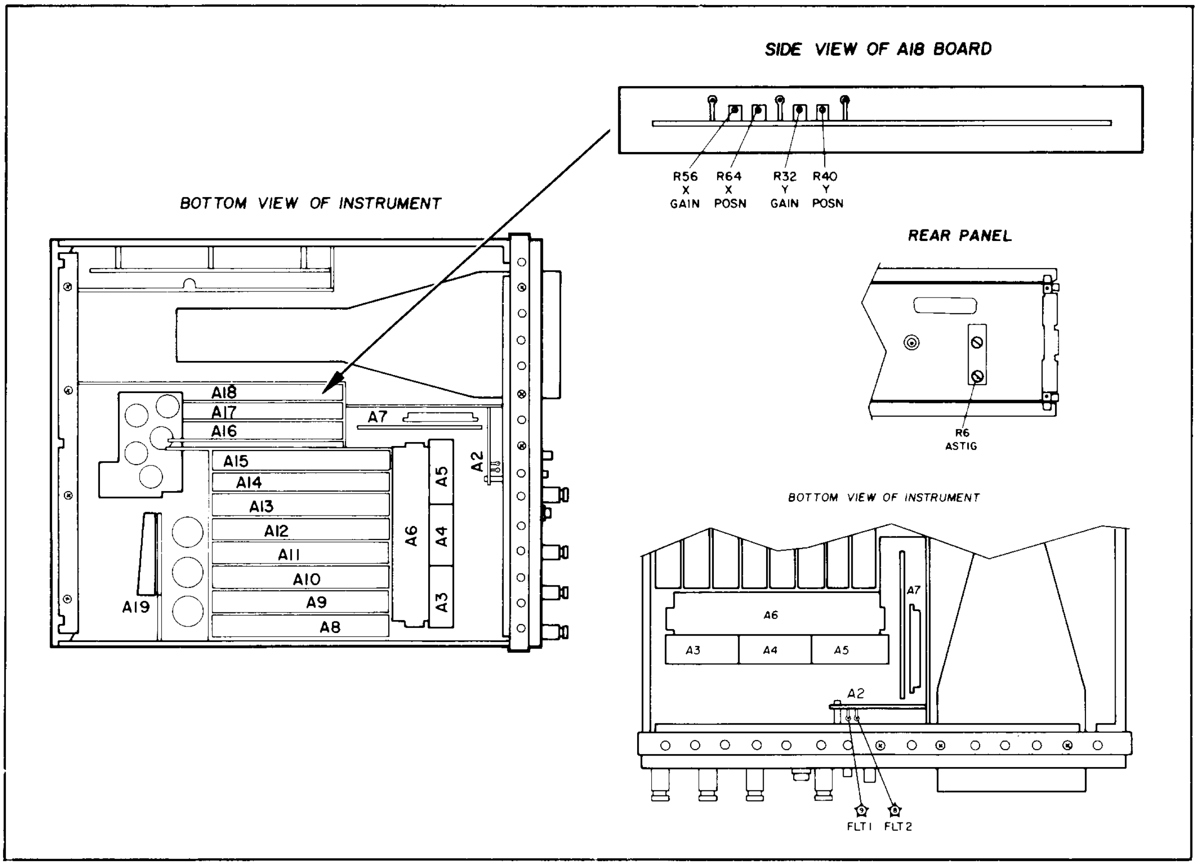


Figure 5-8. Horizontal and Vertical Position and Gain Adjustment Locations

f. Adjust front panel POLAR CENTER ▲▼ control for +1.20V at A2TP9 and adjust front panel POLAR CENTER ◀▶ control to position CRT dot on center vertical graticule line.

g. Adjust A18R32 Y GAIN to position CRT dot at intersection of center vertical line and outer polar graticule.

h. Adjust front panel POLAR CENTER ▲▼ control for −1.20V at A2TP9 and check that CRT dot is on the outer polar graticule. If not, compromise adjustment of A18R32 Y GAIN.

i. Adjust front panel POLAR CENTER ▲▼ control to position CRT dot on center horizontal graticule line.

j. Connect digital voltmeter to A2TP8 FLT 2.

k. Adjust front panel POLAR CENTER ◀▶ control for 0.00V at A2TP8.

ADJUSTMENTS

5-14. HORIZONTAL AND VERTICAL POSITION AND GAIN ADJUSTMENT (Cont'd)

l. Adjust A18R64 X POSN to position CRT dot on center vertical graticule line.

m. Adjust front panel POLAR CENTER ◂▸ control for +1.20V at A2TP8.

n. Adjust A18R56 X GAIN to position CRT dot on left edge of outer polar graticule.

o. Adjust front-panel POLAR CENTER ◂▸ control for −1.20V at A2TP8.

p. Check that CRT dot is on right edge of outer polar graticule. If not, compromise adjustment of A18R56 X GAIN.

HORIZONTAL POSN and GAIN

q. Set 8754A controls as follows.

SWEEP .... MAN
POLAR A/R .... out (off)
CHANNEL 1, CHANNEL 2 Measurement Select pushbuttons.......... OFF
CH 1 REFERENCE POSITION .... in (on)

r. Adjust CH 1 REFERENCE POSITION control to place dot at vertical center of CRT.

s. Set front-panel SWEEP vernier control fully counterclockwise and adjust front-panel HORIZONTAL POSN screwdriver adjustment to position CRT dot on left-hand graticule edge.

t. Set SWEEP vernier control fully clockwise and adjust front-panel HORIZONTAL GAIN screwdriver adjustment to position CRT dot on right-hand graticule edge.

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT

REFERENCE:

Service Sheets 6 and 7

DESCRIPTION:

The Frequency Reference voltage is first aligned by adjusting the front-panel FREQUENCY MHz readout and SWEEP WIDTH attenuator. Then the frequency of the RF source is made to track the Frequency Reference voltage by first adjusting the end points (0 and 1300 MHz) and then adjusting the frequency at 13 intermediate points.

NOTE

Resistor array A15A1 is matched with the A7U2 microcircuit. If A7U2 is replaced, a matching A15A1 resistor array (shipped with new A7U2) must be installed on A15 Shaper Assembly. (Refer to Service Sheet 7 for proper replacement of A15A1.) If A15 Shaper Assembly is replaced, the A15A1 resistor array from the original A15 assembly should be installed on the new A15 assembly.

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

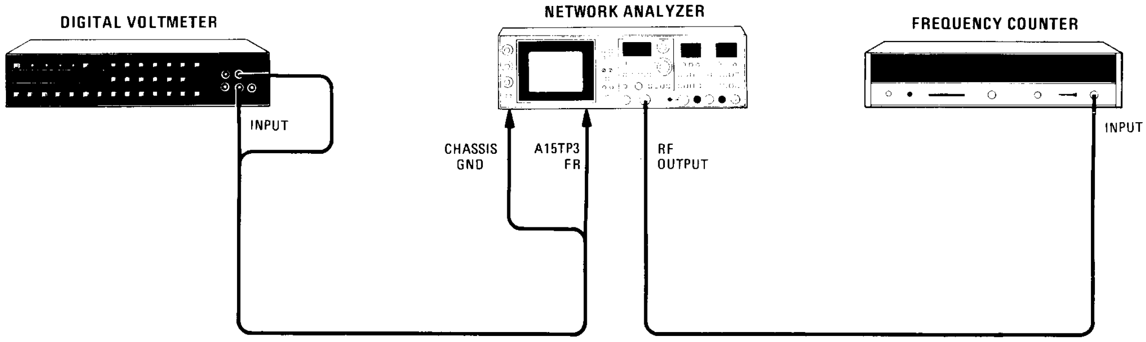


Figure 5-9. Frequency Accuracy and Sweep Width Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter .... HP 3455A
Frequency Counter .... HP 5340A

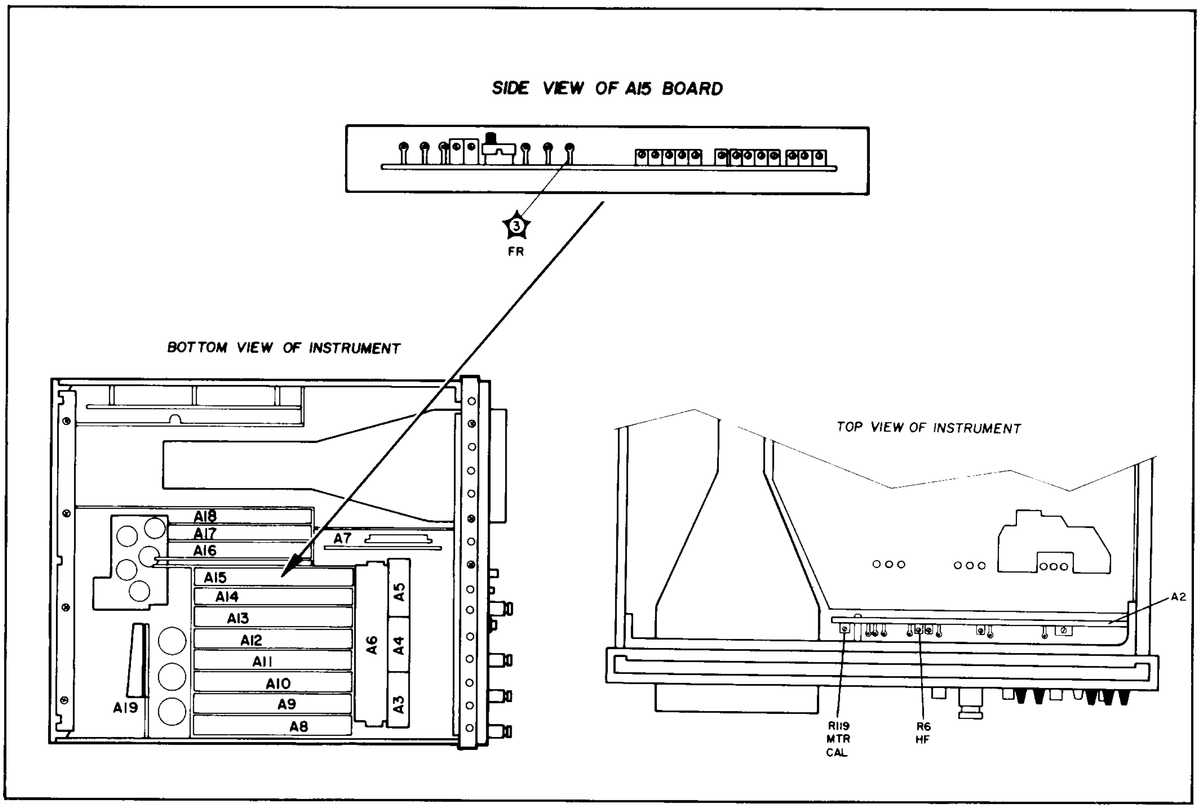


Figure 5-10. Frequency Accuracy and Sweep Width Adjustment Locations

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

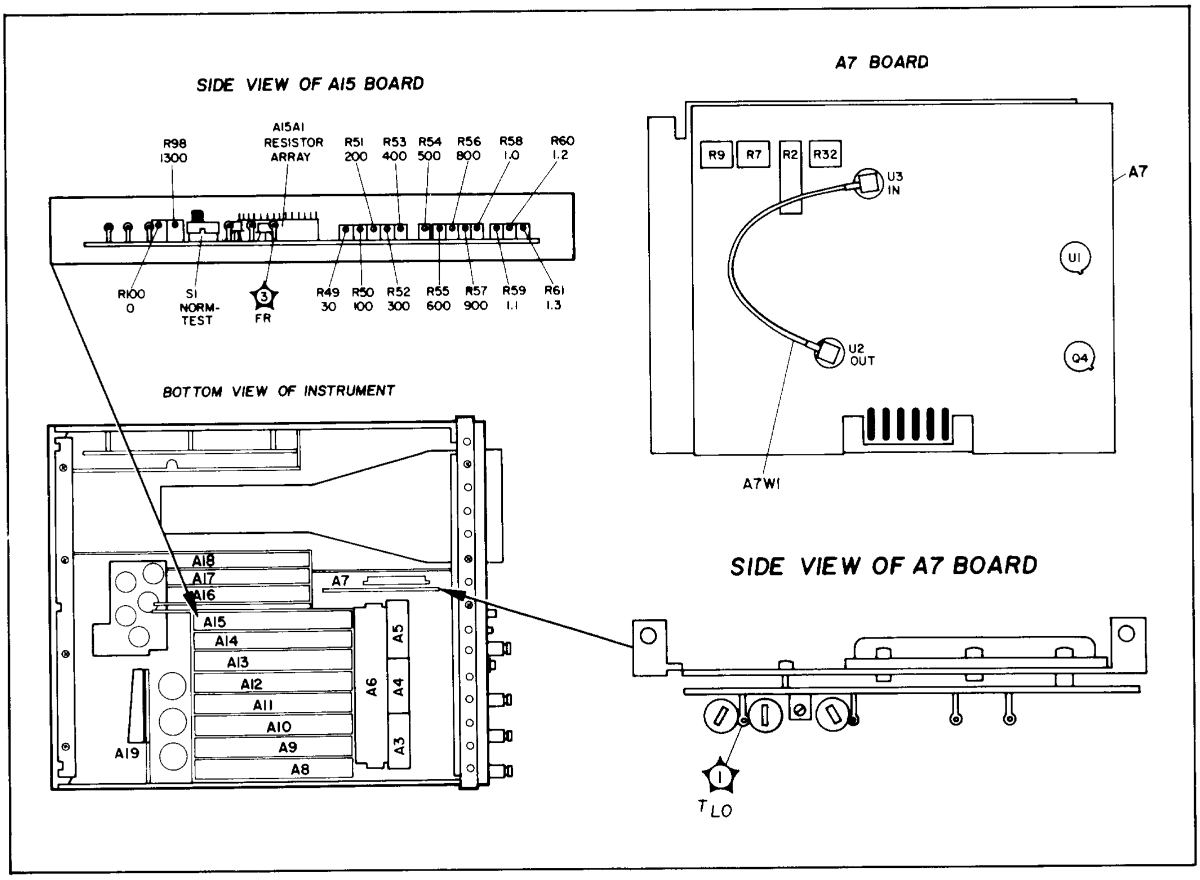


Figure 5-11. Frequency Reference Adjustment Locations

PROCEDURE:

Frequency Reference Adjustment

a. Connect equipment as shown in Figure 5-9.

b. Set 8754A controls as follows:

SWEEP WIDTH MHZ	1K
SWEEP WIDTH MHz vernier	CAL
Sweep Mode	START
SWEEP	MAN
SWEEP vernier	Fully counterclockwise
OUTPUT dBm	0

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

c. Connect digital voltmeter to A15TP3 FR.

d. Adjust front-panel TUNING control for 0.000V at A15TP3.

e. Set front-panel SWEEP vernier fully clockwise and adjust A2R6 HF for +10.000 ±0.010V at A15TP3.

f. Reduce SWEEP WIDTH to 0 (CW). If necessary, readjust TUNING for 0.000V at A15TP3.

g. Adjust front-panel FREQUENCY MHz CAL control for a FREQUENCY MHz indication of 000 MHz.

h. Adjust front-panel TUNING and FINE TUNING controls for + 13.000V at A15TP3.

i. Adjust A2R119 MTR-CAL adjustment for a front-panel FREQUENCY MHz indication of 1300 MHz.

RF Source Adjustment

NOTE

This procedure assumes that the resistor array A15A1, which is factory-selected to match the A7U2 source microcircuit, has been installed on A15. If this array is unavailable, proceed to Alternate RF Source adjustment.

j. Connect equipment as shown in Figure 5-9. Set A15S1 NORM-TEST switch to TEST position. Allow instrument warmup time of 30 minutes.

k. Set 8754A controls as follows:

SWEEP WIDTH MHz . . . . 0 (CW)
SWEEP WIDTH MHz vernier . . . . CAL
Sweep Mode . . . . CENTER
SWEEP . . . . AUTO, FAST

l. Adjust front-panel TUNING control for 0.000 ±0.001 V at A15TP3 FR.

m. Adjust A15R100 "0" adjustment for a frequency-counter indication of less than 1 MHz. (CRT should be blanked.)

n. Adjust front-panel TUNING control for + 13.000 ±0.001 V at A15TP3.

o. Adjust A15R98 "1300" adjustment for a frequency-counter indication of 1300.0 ±0.1 MHz.

p. Set A15S1 NORM-TEST switch to NORM position.

q. Adjust front-panel TUNING control for + 0.040 ±0.001V at A15TP3.

r. Adjust A15R100 "0" adjustment for a frequency-counter indication of 4.0 ± 0.1 MHz.

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

s. Adjust front-panel TUNING control for 0.300 ± 0.001 V at A15TP3.

t. Adjust A15R49 "30" for a frequency-counter indication of 30.0 ± 0.1 MHz.

u. Repeat steps q through t until no further adjustment is necessary.

NOTE

Adjust frequency shaping going from the lowest to the highest frequency. If it is necessary to readjust a potentiometer, adjustment of the remaining higher-frequency potentiometers is also necessary.

v. Adjust front-panel TUNING control for each voltage listed in Table 5-7 and adjust corresponding potentiometer on A15 Shaper Assembly for the frequency indicated.

Table 5-7. Frequency Linearity (Shaping) Adjustments

Adjust tuning for Vdc (A15TP3)	Then adjust Potentiometer		Adjust to MHz	If pot range is insufficient, change:
1.000	R50	100	100	A15R66*
2.000	R51	200	200	
3.000	R52	300	300	
4.000	R53	400	400	
5.000	R54	500	500	
6.000	R55	600	600	
8.000	R56	800	800	
9.000	R57	900	900	
10.000	R58	1.0	1000	
11.000	R59	1.1	1100	A15R62*
12.000	R60	1.2	1200	A15R63*
13.000	R61	1.3	1300	A15R64*

Alternate RF Source Adjustment

NOTE

This procedure is to be used ONLY if the resistor array A15A1, which is factory-selected to (and normally supplied with) the A7U2 source microcircuit is lost or missing. If this array is properly installed on A15, perform the normal RF Source Adjustment.

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

EQUIPMENT:

Adapter, SMB to SMB male .... HP 1250–0669
Adapter, BNC female to SMB female....................... HP 1250-1236
Frequency Counter .... HP 5340A
Resistor Header .... HP 0360-1933
22-Pin Extender Board....................... (Service Accessories Package)
6-Pin Extender Board....................... (Service Accessories Package)
Large supply of 1/8W, metal-film, 1% resistors in standard 10% values from 1K to 464K .... HP 0698-9100 spec
Soldering iron
Solder
Flux remover
Flux cleaner

WARNING

Boards on extenders have voltages of up to 80V. Turn off power before removal or installation of resistors.

CAUTION

Use square pad or numeral "1" on printed-circuit board as orientation for pin 1 of header. (See Figure 5-12.)

NOTE

When soldering resistors, make sure leads are all the way into slots on header.

PROCEDURE:

a. Set LINE-OFF switch to OFF.

b. Disconnect A7W1 cable from A7U3 (with long-nose pliers).

c. Install SMB to SMB male adapter and SBM to BNC adapter on the free end of cable A7W1.

d. Ground A7TP1 TLO to chassis.

e. Remove A15 board.

f. Install resistor-array header in socket A15XA1 of A15 board, carefully noting orientation of pin 1 (see Figure 5-12).

g. Install A15 board in instrument on 22-pin extender board.

h. Set LINE-OFF switch to LINE.

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

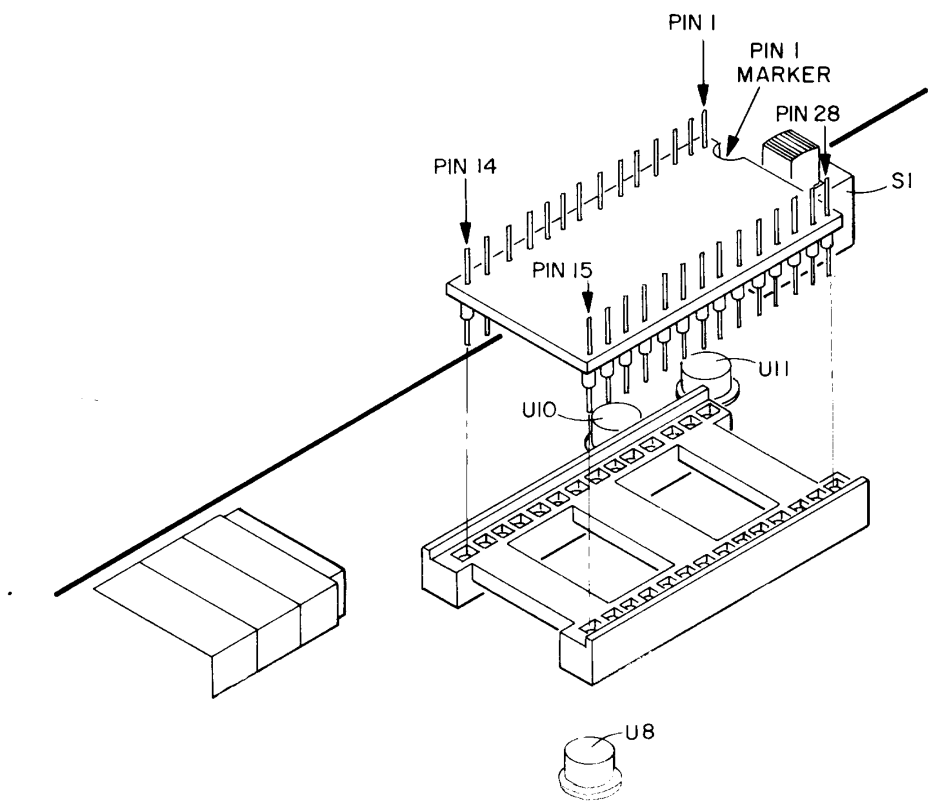


Figure 5-12. Orientation of Resistor Array Header

i. Connect digital voltmeter to A15TP3 FR and frequency counter to SMB to BNC adapter on the free end of cable A7W1 from A7U2J1.

j. Set A15S1 NORM-TEST switch to TEST.

k. Set 8754A controls as follows:

SWEEP WIDTH MHz	0 (CW)
SWEEP WIDTH vernier	CAL
Sweep Mode	CENTER
SWEEP	AUTO, FAST
FREQUENCY MHz	1300

l. Adjust front-panel TUNING control for 13.000 ±0.001 V at A15TP3 FR.

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

NOTE

The general procedure in choosing a factory-selected resistor is to pick a mid-range value (e. g., 46.4K), insert it, note counter reading while holding body of resistor against header to make contact. Then try other values to make counter reading converge to desired value. Do not solder until correct value is found; then solder resistor in place.

m. Select a resistor between pins 1 and 28 of header to give the counter reading closest to 3.000 ± 0.010 GHz.

n. Adjust front-panel TUNING control for 0.000 ± 0.001 V at A15TP3 FR.

o. Select a resistor between pins 2 and 27 of header to give the counter reading closest to 3.600 ±0.010 GHz.

p. Set LINE-OFF switch to OFF.

q. Re-install cable A7W1 as follows:

   1. Disconnect counter and adapter from A7W1.
   2. Remove ground from A7TP1 TLO.
   3. Reconnect A7W1 cable to A7U3.

NOTE

At this point the A15 board is still on the extender board.

r. Set LINE-OFF switch to LINE.

s. Connect frequency counter as shown in Figure 5-9.

NOTE

It is important that the sequence in the following procedure not be interrupted. Proceed through all adjustments without excessive time spent between them. If it is necessary to repeat an adjustment, all higher-frequency adjustments must be repeated.

t. For each voltage measured at A15TP3 FR (Table 5-8), adjust TUNING control to give the required voltage at A15TP3. Then pre-tune the designated potentiometer to mid-range by noting frequency counter reading versus potentiometer rotation. Select the resistor giving the counter reading closest to the required value; then solder the resistor and adjust the potentiometer to give the required counter reading.

u. As a final adjustment, perform the RF Source Adjustment procedure.

ADJUSTMENTS

5-15. FREQUENCY ACCURACY AND SWEEP WIDTH ADJUSTMENT (Cont'd)

Table 5-8. Frequency Shaping Adjustments

Set TUNING for Voltage at A15TP3 FR (Vdc)	A15S1 Switch Position	Select Resistor		Adjust Potentiometer		For Counter Reading ±0.1 MHz (MHz)	Notes
		Reference Designator	Between Pins	Reference Designator	Name		
0.000	TEST	A15A1R3	3-26	A15R100	0	<1	
13.000	TEST	None	None	A15R98	1300	1300	
0.040	NORM	None	None	A15R100	0	4	Repeat until 4 and 30 MHz are
0.300	NORM	A15A1R4	4-25	A15R49	30	30	±0.1 MHz.
1.000	NORM	A15R66	–	A15R50	100	100	If potentiometer has insufficient range, change A15R66*.
2.000	NORM	A15A1R5	5-24	A15R51	200	200	
3.000	NORM	A15A1R6	6-23	A15R52	300	300	
4.000	NORM	A15A1R7	7-22	A15R53	400	400	
5.000	NORM	A15A1R8	8-21	A15R54	500	500	
6.000	NORM	A15A1R9	9-20	A15R55	600	600	
8.000	NORM	A15A1R10	10-19	A15R56	800	800	If selection diverges, use pins 11
		A15A1R11	11-18				and 18 for A15A1R11.
9.000	NORM	A15A1R13	13-16	A15R57	900	900	If selection diverges, use pins 12
		A15A1R12	12-17				and 17 for A15A1R12.
10.000	NORM	A15A1R14	14-15	A15R58	1.0	1000	
11.000	NORM	A15R62	–	A15R59	1.1	1100	If potentiometer has insufficient range, change A15R62*.
12.000	NORM	A15R63	–	A15R60	1.2	1200	If potentiometer has insufficient range, change A15R63*.
13.000	NORM	A15R64	–	A15R61	1.3	1300	If potentiometer has insufficient range, change A15R64*.

5-16. OUTPUT dBm CALIBRATION AND HARMONICS ADJUSTMENT

REFERENCE:

Service Sheet 7

DESCRIPTION:

The 8754A is operated with a CW RF OUTPUT frequency and the RF OUTPUT power is measured with a power meter. Adjustments are performed to calibrate the front-panel OUTPUT dBm control at 0 dBm and +10 dBm. Control accuracy is chcked at +5 dBm and, if necessary, a resistor value is selected to optimize linearity of the OUTPUT dBm control. The RF OUTPUT harmonic separation is optimized by observing the full frequency range of the 8754A using a spectrum analyzer.

ADJUSTMENTS

5-16. OUTPUT dBm CALIBRATION AND HARMONICS ADJUSTMENT (Cont'd

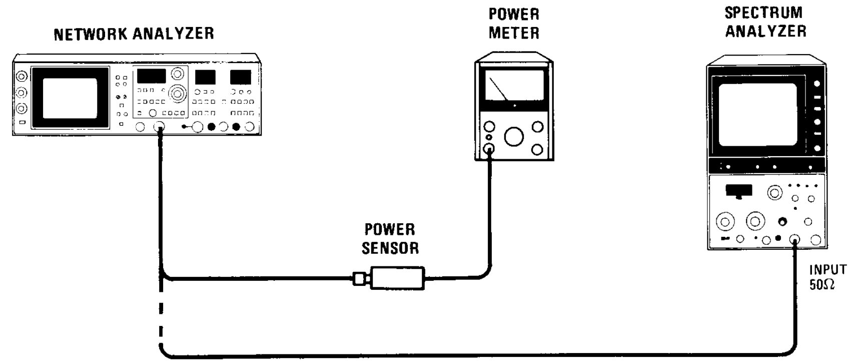


Figure 5-13. OUTPUT dBm Calibration and Harmonics Adjustment Test Setup

EQUIPMENT:

Power Meter . . . . HP 435A
Power Sensor . . . . HP 8482A
Spectrum Analyzer . . . . HP 8558B/181T

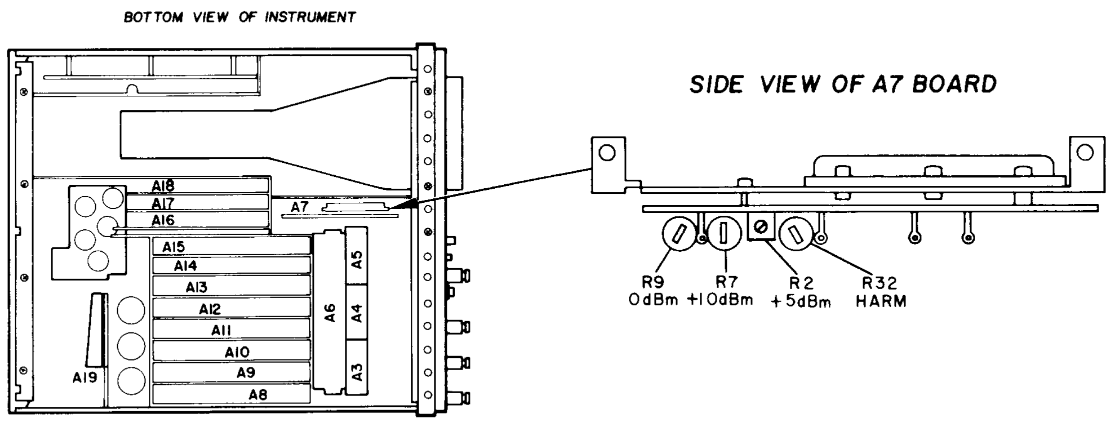


Figure 5-14. OUTPUT dBm Calibration and Harmonics Adjustment Locations

ADJUSTMENTS

5-16. OUTPUT dBm CALIBRATION AND HARMONICS ADJUSTMENT (Cont'd)

OUTPUT dBm Calibration

a. Connect equipment as shown in Figure 5-13 without connecting spectrum analyzer.

b. Calibrate power meter at 50 MHz using its own standard.

c. Set 8754A controls as follows:

SWEEP WIDTH MHz . . . . 0 (CW)
Sweep Mode . . . . CENTER
SWEEP . . . . AUTO
FREQUENCY MHz 50
OUTPUT dBm . . . . Fully counterclockwise

d. Note point at which power just starts to increase as the OUTPUT dBm control is turned CW from full CCW. If necessary, set knob on shaft to align with "0" on front panel.

e. Adjust A7R9 0 dBm adjustment for a power meter indication of 0 dBm.

f. Set front-panel OUTPUT dBm control to +10 dBm.

g. Adjust A7R7 +10 dBm adjustment for a power meter indication of +10 dBm.

h. Set front-panel OUTPUT dBm control to 0 dBm and repeat steps e through g until no further adjustment is necessary.

i. Set front-panel OUTPUT dBm control to +5 dBm and check that the power meter indicates +5 ± 0.5 dBm. If the meter reading is not within this range, adjust A7R2 for +5 dBm ± 0.5 dBm. Repeat steps e through i until no further adjustment is necessary.

5-16. OUTPUT dBm CALIBRATION AND HARMONICS ADJUSTMENT (Cont'd)

Harmonics Adjustment

j. Calibrate the spectrum analyzer using its own 280 MHz CAL OUTPUT signal.

k. Set 8558B controls as follows:

FREQUENCY SPAN/DIV	100 MHz
RESOLUTION BW	OPTIMUM (coupled)
SWEEP TIME/DIV	AUTO
SWEEP TRIGGER	FREE RUN
OPTIMUM INPUT	−10 dBm
REFERENCE LEVEL dBm	+10 dBm
TUNING	500 MHz
START – CENTER	CENTER
10 dB/DIV – 1 dB/DIV – LIN	10 dB/DIV

l. Connect 8754A RF OUTPUT to spectrum analyzer input. Set 8754A OUTPUT dBm to +10 dBm.

NOTE

In the following step, switch spectrum analyzer between CENTER and START to view full 0 to 1500 MHz frequency spectrum.

m. Tune the 8754A frequency from 0 to 1300 MHz. Harmonics and subharmonics should be greater than 32 dB down from fundamental at all TUNING frequencies. Adjust A7R32 HARM adjustment to optimize harmonic separation.

5-17. MARKER ADJUSTMENT

REFERENCE:

Service Sheet 8

DESCRIPTION:

The marker oscillator is adjusted for a 50 MHz output. The 50 MHz, 10 MHz, and 1 MHz marker birdies are then adjusted for optimum amplitude and symmetry.

ADJUSTMENTS

5-17. MARKER ADJUSTMENT (Cont'd)

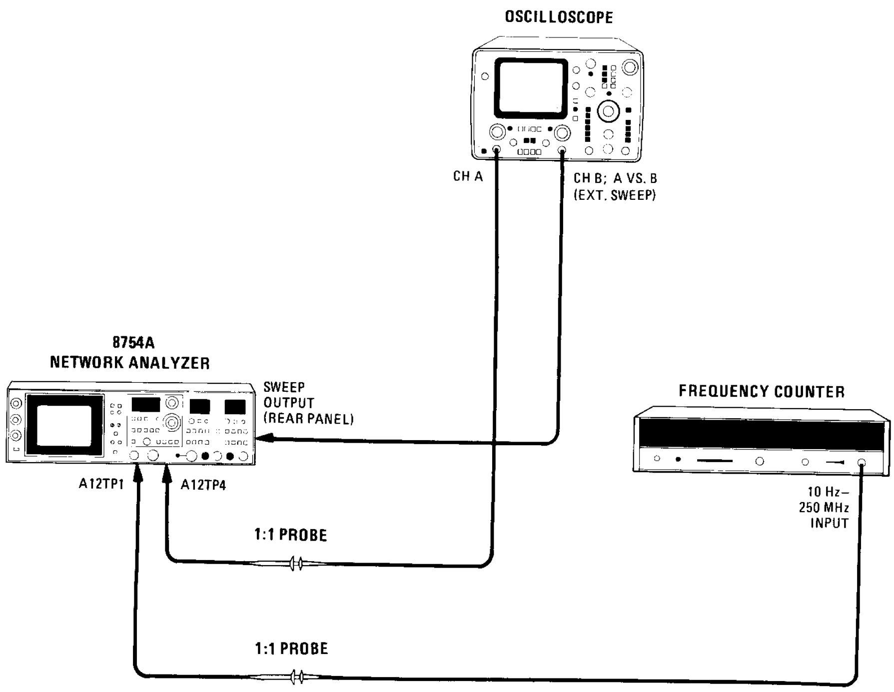


Figure 5-15. Marker Adjustment Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
Oscilloscope	HP 1740A
1:1 Divider Probe (2 required)	HP 10007B

ADJUSTMENTS

5-17. MARKER ADJUSTMENT (Cont'd)

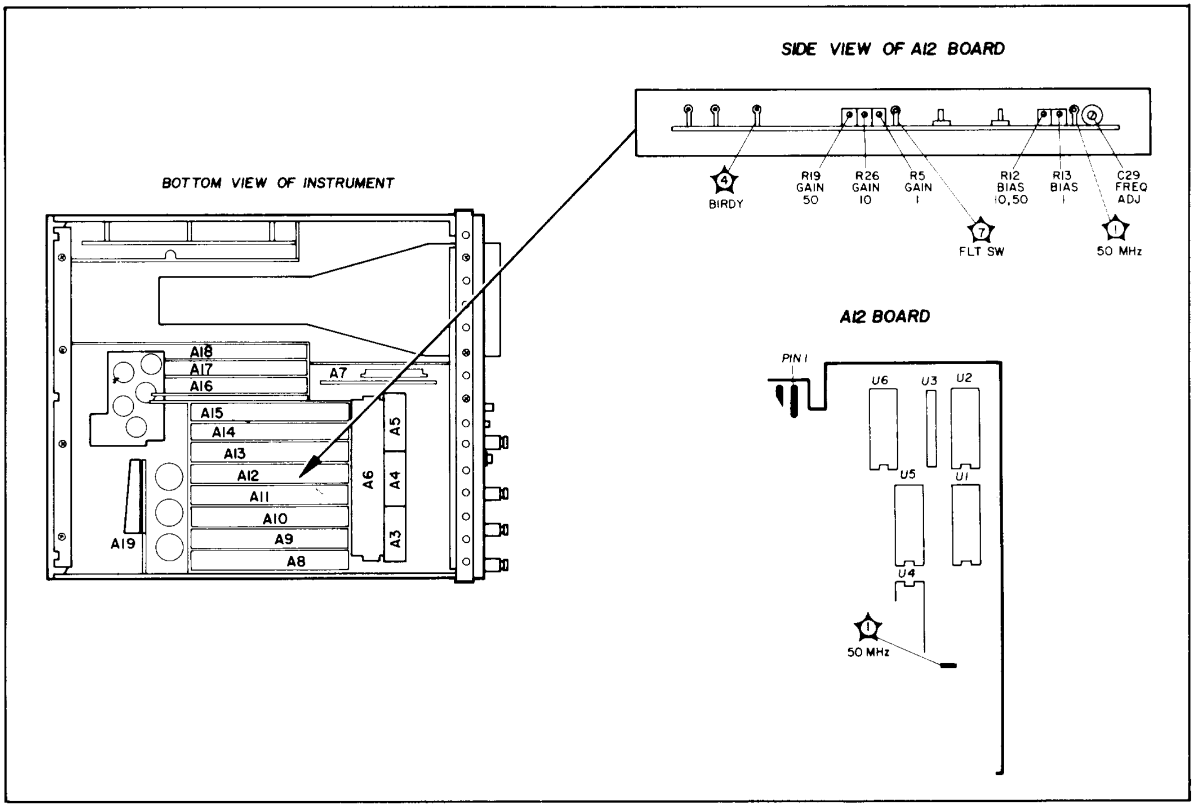


Figure 5-16. Marker Adjustment Locations

PROCEDURE:

a. Connect equipment as shown in Figure 5-15. Connect RF OUTPUT to R INPUT or load RF OUTPUT with a 50-ohm termination.

b. Set 8754A controls as follows:

FREQUENCY MHz	100
Sweep Mode	CENTER
SWEEP	AUTO, FAST
SWEEP Vernier	Fully clockwise
SWEEP WIDTH MHz	10 MHz
MARKERS MHz	50 MHz
OUTPUT dBm	0 dBm

c. Connect frequency counter through a 1:1 divider probe to A12TP1 50 MHz, and connect oscilloscope through a 1:1 divider probe to A12TP4 BIRDY.

ADJUSTMENTS

5-17. MARKER ADJUSTMENT (Cont'd)

d. Adjust A12C29 FREQ ADJ for 50.000000 ± .000010 MHz at A12TP1. Disconnect counter.

NOTE

To obtain EXTERNAL SWEEP on HP 1740A Oscilloscope, connect the external sweep signal into Channel B INPUT and select A vs. B mode. On other oscilloscopes, connect external sweep signal into EXTERNAL SWEEP INPUT and select EXTERNAL HORIZONTAL SWEEP mode.

e. At oscilloscope, select dc coupled Channel B input and A vs. B mode to obtain external horizontal sweep mode. Adjust oscilloscope horizontal position and gain for an oscilloscope trace that just fills the 10 – division graticule display. Connect oscilloscope (ac coupled) through a 1:1 probe to A12TP4 BIRDY and set oscilloscope sensitivity to 0.1V/DIV.

f. Adjust front panel TUNING control to center the "birdy" on the oscilloscope CRT display.

g. Ground A12TP7 FLT SW.

h. Adjust A12R19 GAIN 50 adjustment for a 0.6V peak – to – peak "birdie" amplitude. (See Figure 5-17.)

i. Adjust A12R12 BIAS 10,50 adjustment for approximately 0.4V peak-to-peak "birdie" amplitude at one division to the left and one division to the right of center. (See Figure 5-17.)

j. Repeat steps f through i until no further adjustment is necessary.

k. Tune the 8754A from 0 to 1300 MHz and note at what frequency the 50 MHz "birdie" amplitude is maximum. Set 8754A to this frequency. Repeat steps f through i.

l. Select 10 MHz marker and adjust front panel TUNING control to center "birdie" on oscilloscope CRT display.

m. Adjust A12R26 GAIN 10 for a 0.6V peak-to-peak "birdie" amplitude.

NOTE

Remove ground from A12TP7 FLT SW.

n. Select 1 MHz marker and set front panel SWEEP WIDTH MHz to 1. Remove ground from pin XA12-12 or XA12-34. Adjust front-panel TUNING control to center the "birdie" on the oscilloscope CRT display.

o. Adjust A12R5 GAIN 1 adjustment for a 0.6V peak-to-peak "birdie" amplitude. (See Figure 5-17.)

p. Adjust A12R13 BIAS 1 adjustment for approximately 0.4V peak-to-peak "birdie" amplitude at one division to the left and one division to the right of center. (See Figure 5-17.)

q. Repeat steps o and p, keeping the "birdie" centered on the oscilloscope display, until no further adjustment is necessary.

5-17. MARKER ADJUSTMENT (Cont'd)

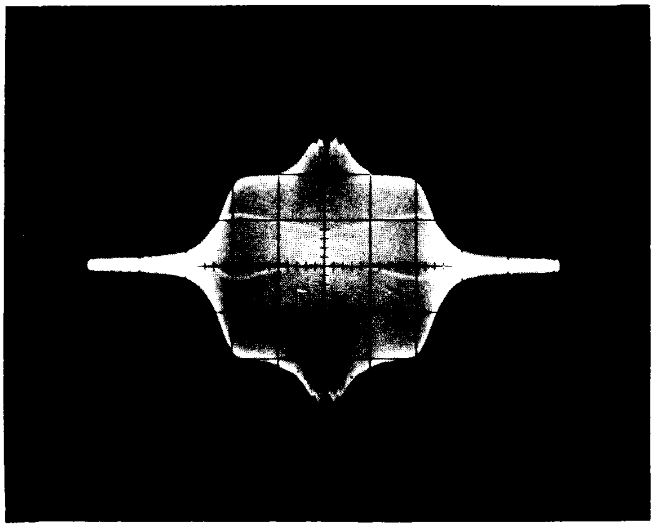


Figure 5-17. Oscilloscope Display of Marker Birdie

5-18. VTO FREQUENCY ADJUSTMENT

REFERENCE:

Service Sheets 10 and 11

DESCRIPTION:

The Voltage-Tuned Oscillator (VTO) is tuned for 30 MHz with +10V applied to its input. The VTO pretune voltage is adjusted for a VTO output frequency of 8 MHz.

5-18. VTO FREQUENCY ADJUSTMENT (Cont'd)

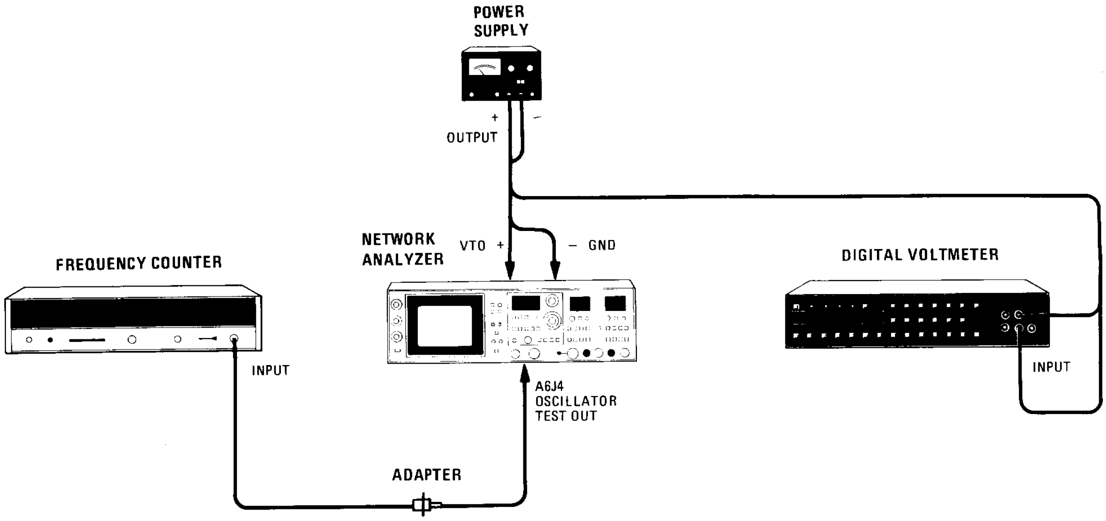


Figure 5-18. VTO Frequency Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 3455A
DC Power Supply . . . . HP 6205B
Frequency Counter . . . . HP 5340A
Adapter, BNC Female to SMB (subminiature
snap-on) Female . . . . HP 1250-1236
Non-metalic Tuning Tool . . . . HP 08710-0033

PROCEDURE:

a. Connect equipment as shown in Figure 5-18. Remove A13 Phase Lock Assembly.

b. Set 8754A controls as follows:

FREQUENCY MHz 50
Sweep Mode . . . . CENTER
SWEEP WIDTH MHz . . . . 0 CW

c. Connect positive (+) power supply lead to the center conductor of A20W1 VTO shielded cable (cable on Motherboard between XA14 pin 10 and XA6 pin 21/43; See Figure 5-19.) Connect negative (−) power supply lead to ground.

d. Adjust power supply for indication on digital voltmeter of +10.00 ± .01 V.

5-18. VTO FREQUENCY ADJUSTMENT (Cont'd)

NOTE

Use a non-metallic tuning tool (HP Part No. 08710-0033) for adjusting A6C19.

e. Adjust A6C19 OSCILLATOR FREQ adjustment for indication on frequency counter of 30.0 ±0.1 MHz.

NOTE

If A6C19 range is insufficient, value of A6C20* may need to be changed.

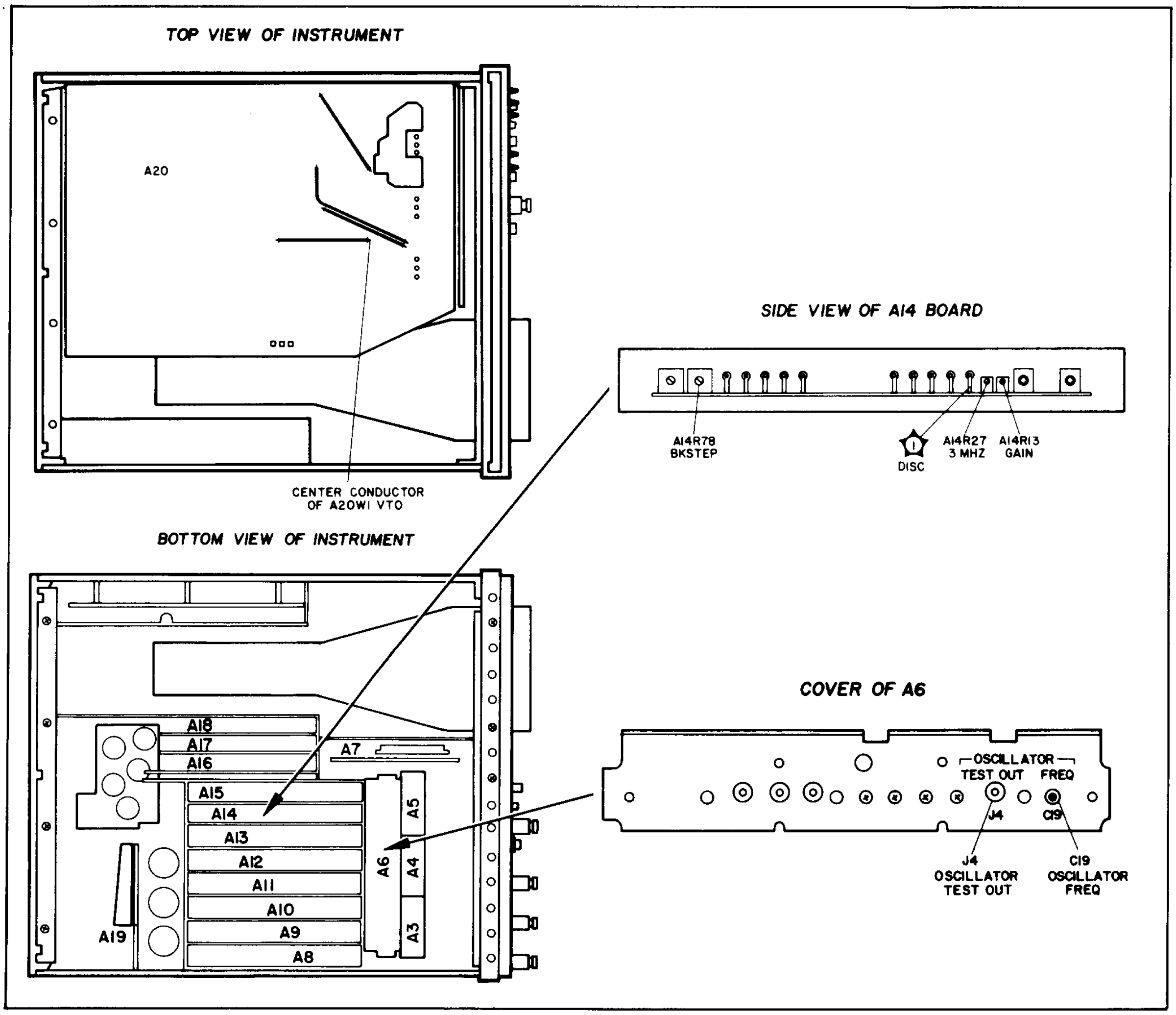


Figure 5-19. VTO Frequency Adjustment Locations

ADJUSTMENTS

5-18. VTO FREQUENCY ADJUSTMENT (Cont'd)

f. Turn LINE switch OFF. Disconnect dc power supply from 8754A. Reinstall A13 Phase Lock board. Turn LINE switch on.

g. Jumper A14TP8 EXT SET to GND.

h. Adjust front panel STABILITY control over its entire adjustment range and note frequency variation on frequency counter. Set STABILITY control to give a frequency counter indication at the center of this frequency range.

i. Adjust A14R47 8 MHz for 8.00 ± 0.01 MHz on frequency counter.

j. Disconnect jumper from A14TP8 and frequency counter from A6J4.

5-19. PHASE-LOCK LOOP ADJUSTMENT

REFERENCE:

Service Sheet 11

DESCRIPTION:

The frequency-to-voltage sensitivity of the discriminator used to sense the RF output frequency is adjusted. The intermediate frequency (IF) is adjusted to 1 MHz; then three adjustments affecting smoothness of display are made.

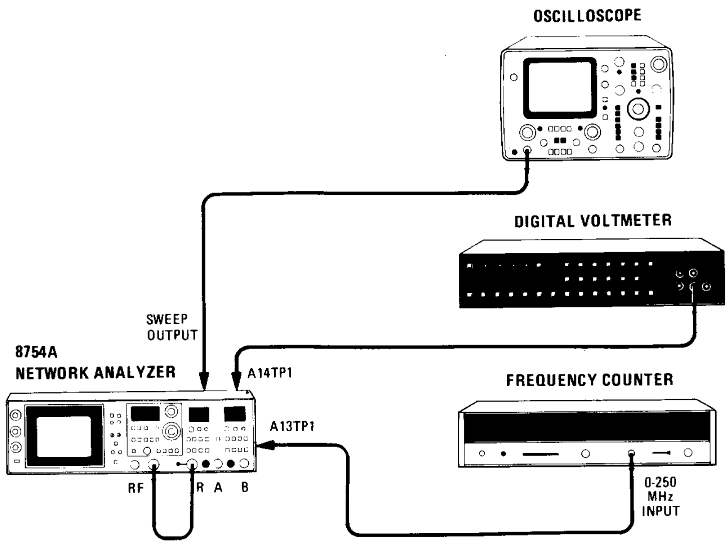


Figure 5-20. Phase-Lock Loop Adjustment Test Setup

ADJUSTMENTS

5-19. PHASE-LOCK LOOP ADJUSTMENT (Cont'd)

EQUIPMENT:

Frequency Counter	HP 5340A
Digital Voltmeter	HP 3455A
Oscilloscope	HP 1740A

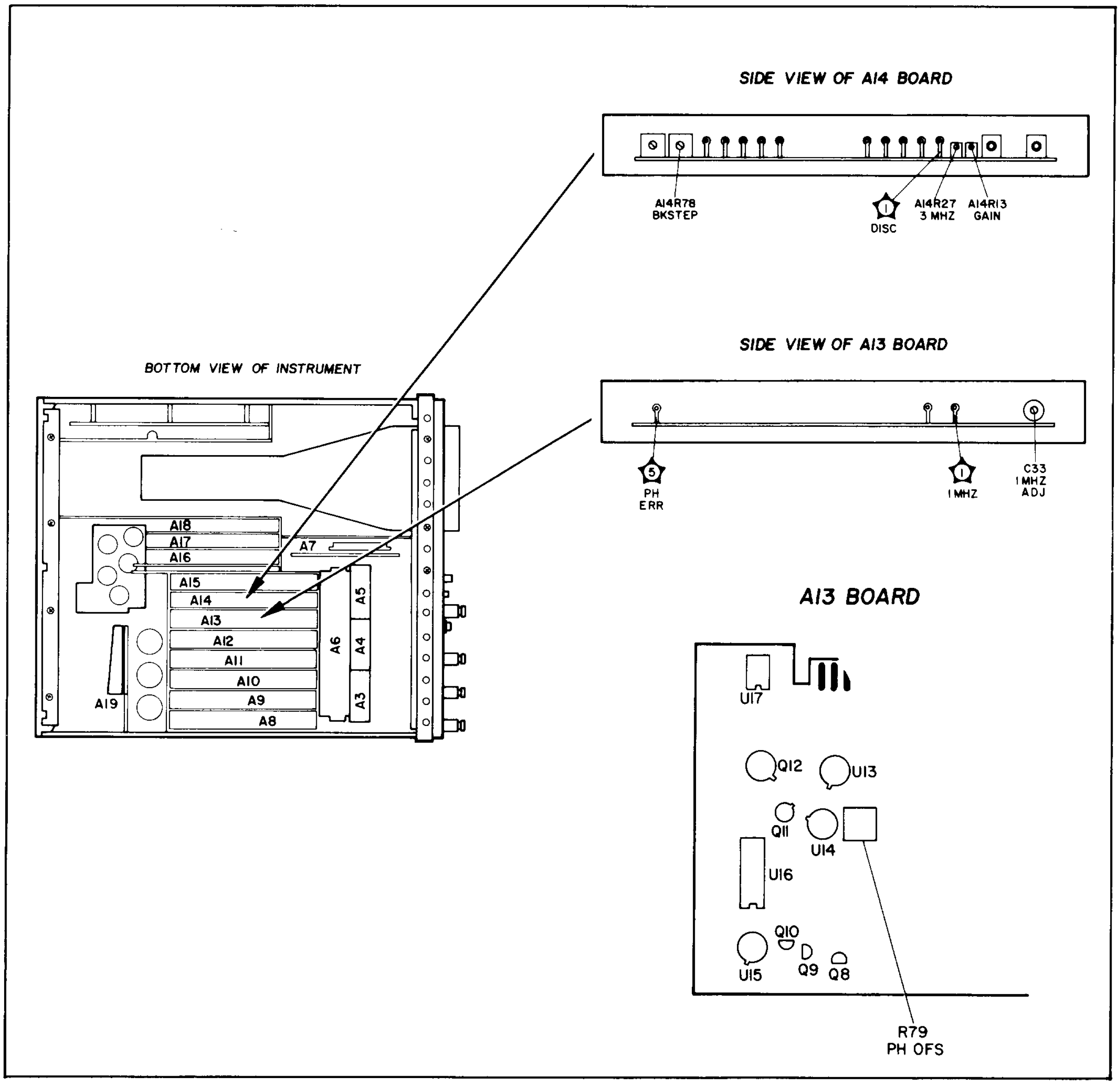


Figure 5-21. Phase-Lock Loop Adjustment Locations

ADJUSTMENTS

5-19. PHASE-LOCK LOOP ADJUSTMENT (Cont'd)

PROCEDURE:

a. Connect equipment as shown in Figure 5-20.

b. Set 8754A controls as follows:

Sweep Mode	CENTER
TUNING	50 MHz
SWEEP WIDTH MHz	50
MARKERS MHz	50
OUTPUT dBm	0
SWEEP	AUTO, FAST
SWEEP Vernier	Fully clockwise
CHANNEL 1 and CHANNEL 2 Measurement Select	OFF
REFERENCE POSITION CH 1	on (in)

c. Center trace on screen with REFERENCE POSITION CH 1 ⬍ control.

d. Using TUNING, center the 50 MHz marker on screen. Reduce sweep width to 0 (CW) while keeping marker centered.

e. Measure A14TP1 DISC with digital voltmeter. Adjust A14R13 GAIN for DVM reading of 0.50 ± 0.01V.

f. Adjust TUNING to 100 MHz and center marker on display. (Sweep width may have to be increased temporarily to do this.) DVM should now read 1.0 ± .2V.

g. Monitor A13TP1 1 MHz with frequency counter (INPUT 1 MΩ) and adjust A13C33 1 MHz ADJ for counter reading of 1.000 MHz ±10 Hz.

h. Select MANUAL sweep.

i. Place the A13 board on an extender board and monitor A13TP5 PH ERR with DVM.

j. Check that UNLOCKED indicator is OFF and that it lights when RF cable is disconnected from R INPUT. With cable connected to R INPUT, adjust A13R79 PH OFS for DVM reading of 0.0V ± 5 mV.

k. Set 8754A controls as follows:

SWEEP WIDTH MHz	10
Sweep Mode	START
FREQUENCY MHz	000
MARKERS MHz	10
SWEEP	AUTO, FAST

5-19. PHASE-LOCK LOOP ADJUSTMENT (Cont'd)

l. Adjust TUNE control to place 10 MHz marker at right edge of screen. Select 1 MHz markers and adjust A14R27 3 MHz so that display blanks just before the 3.0 MHz marker, as in Figure 5-22.

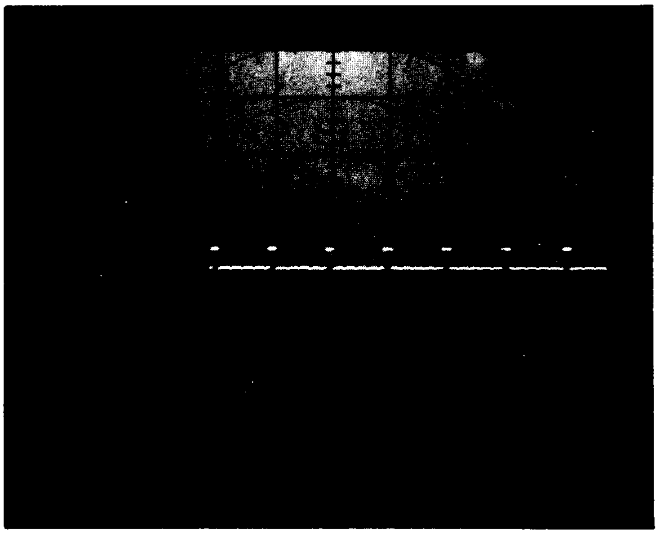


Figure 5-22. Display Blanked at 3-MHz Marker

NOTE

Steps m through p might require that samplers be roughly adjusted. (Refer to Samplers Adjustment.)

m. Set 8754A controls as follows:

Sweep Mode .... START
FREQUENCY MHz 200
SWEEP WIDTH MHz 1K
SWEEP .... AUTO, FAST
SWEEP Vernier .... Fully clockwise

n. Pre-adjust A14R78 BKSTEP fully counterclockwise.

ADJUSTMENTS

5-19. PHASE-LOCK LOOP ADJUSTMENT (Cont'd)

o. Connect rear-panel SWEEP OUTPUT to oscilloscope CHAN A input and internally trigger oscilloscope on CHAN A. Set oscilloscope to 0.2 volts/div (DC coupled), 0.5 msec/div, AC trigger on positive (+) slope. Adjust trigger level and vertical position to obtain a waveform similar to that shown in Figure 5-23. Note that the trace shows a voltage that increases, then backsteps, then is constant, and then increases again.

p. Adjust A14R78 BKSTEP until the backstep portion of the trace is 0.4V, or 2 divisions, as shown in Figure 5-23.

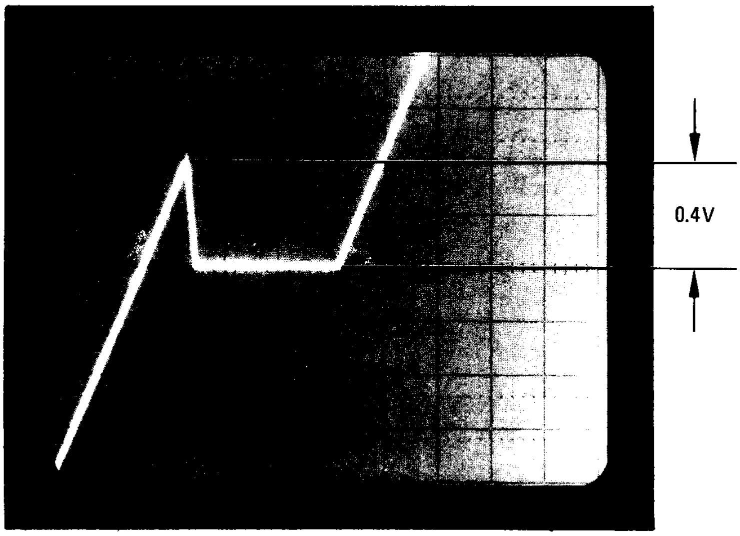


Figure 5-23. Oscilloscope Display of SWEEP OUTPUT Showing 0.4V Backstep

5-20. IF FILTER ADJUSTMENT

REFERENCE:

Service Sheets 12 and 13.

NOTE

The A, B, Detector (A8) and the R Detector (A11) are supplied from the factory with the adjustments in this section pre-aligned. Do not adjust A8 unless the A, B Bandpass Filter on A8 has been repaired or modified. Do not adjust A11 unless the R Bandpass Filter on A11 has been repaired or modified.

5-20. IF FILTER ADJUSTMENT (Cont'd)

NOTE

The Samplers (A3, A4, A5) might require rough alignment. Refer to Samplers Adjustment procedure.

DESCRIPTION:

A test is first performed to determine whether re-alignment is necessary. The phase is measured between two cables having equal electrical length; the displayed phase offset is due to instrument residual error. If the residual error exceeds 7.5 degrees, the IF filters on A8 and A11 are re-adjusted. The input and output waveforms are displayed on a two-channel oscilloscope. The phase relationship is adjusted to 0 degrees.

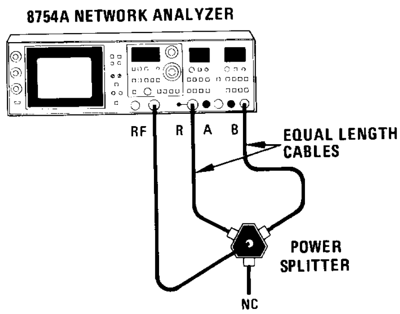


Figure 5-24. IF Filter Adjustment Test Setup

EQUIPMENT:

Oscilloscope	HP 1740A
10:1 Divider Probes (2)	HP 10004D
Power Splitter	HP 11850A
Matched Cable Kit	HP 11851A
Extender Board, 22-Pin	HP 08565-60107
Alignment Tool	HP 8710-0772

ADJUSTMENTS

5-20. IF FILTER ADJUSTMENT (Cont'd)

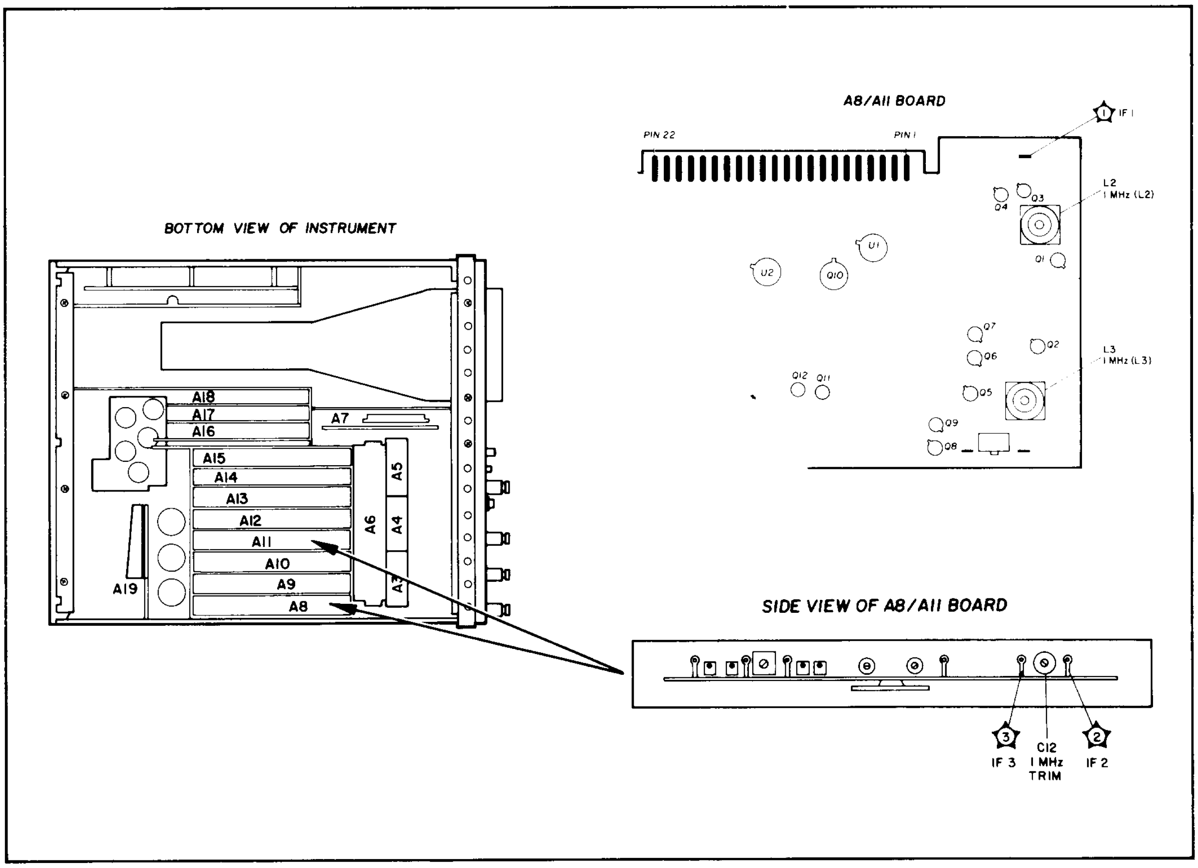


Figure 5-25. IF Filter Adjustment Locations

PROCEDURE:

Measurement of Absolute Phase Offset

a. Connect equipment as shown in Figure 5-24. Set 8754A controls as follows:

Sweep Mode	FULL 4-1300
SWEEP	AUTO, FAST
REFERENCE POSITION CH 2	Off (out)
VIDEO FILTER	Off (out)
POLAR A/R	Off (out)

CHANNEL 1

Measurement Select	OFF

5-20. IF FILTER ADJUSTMENT (Cont'd)

CHANNEL 2
Measurement Select .... PHASE B/R
REFERENCE... −00
REFERENCE OFFSET Pushbutton .... Off (out)
Scale .... 2.5 DEG/DIV

b. Press the REFERENCE CH 2 pushbutton and adjust ⬍ control to place the reference trace on the center graticule line. Press button again to turn off the reference trace.

c. Adjust PHASE B/R LENGTH for a horizontal trace.

NOTE

If indication in step d is out of tolerance, and A8 or A11 has not been repaired or modified, refer to Phase Detector and Polar Converter Adjustment procedure.

d. If the trace is within ±3 divisions (±7.5 degrees) of the center, do not perform the adjustments in this procedure. If the trace is more than ±3 divisions from the center, adjust the IF bandpass filters on A8 and A11 as described in the following steps.

Bandpass Filter Adjustment

NOTE

Steps e through k apply to both the A, B Detector (A8) and to the R Detector (A11). The procedure references A8; if A11 is to be adjusted, substitute A11 prefixes to the reference designations.

e. Turn LINE switch OFF. Remove A, B Detector (A8) and install on extender board.

f. Turn LINE switch on. Connect equipment as shown in Figure 5-24. Set 8754A controls as follows:

Sweep Mode .... CENTER
SWEEP.. MAN
SWEEP Vernier .... Midrange
FREQUENCY MHz 25
SWEEP WIDTH MHz .... 0 (CW)
SWEEP WIDTH MHz Vernier .... CAL (fully clockwise)
MARKERS MHz .... OFF
OUTPUT dBm .... +9
REFERENCE POSITION CH 2 .... Off (out)
VIDEO FILTER .... 100 Hz (in)
POLAR A/R .... Off (out)

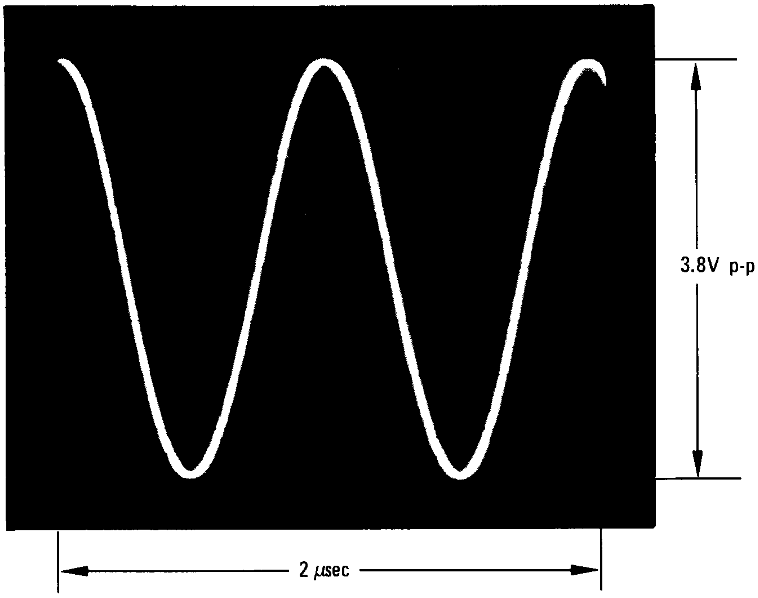
CHANNEL 1
Measurement Select .... OFF

CHANNEL 2
Measurement Select .... PHASE B/R

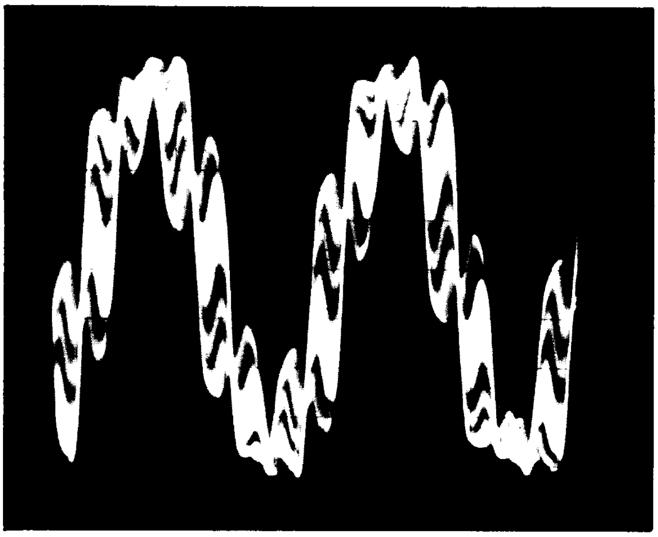
ADJUSTMENTS

5-20. IF FILTER ADJUSTMENT (Cont'd)

g. Connect oscilloscope Channel A to A8TP1 IF1 using a 10:1 divider probe. Set oscilloscope to .05V/DIV, AC coupled, 0.2 μSEC/DIV. Check for ripple-free sine wave (see Figure 5-26). If sine wave has ripples, set TUNING control fully counterclockwise and then slowly tune network analyzer back to 25 MHz.



a. Ripple-Free Sine Wave



b. Sine Wave with Ripples

Figure 5-26. Oscilloscope Display of Sine Wave at A8TP1

ADJUSTMENTS

5-20. IF FILTER ADJUSTMENT (Cont'd)

h. Connect oscilloscope Channel B to A8TP1 IF1 using a 10:1 divider probe. Set Channel B to .05V/DIV, AC coupled. Set oscilloscope for alternate sweep and trigger on Channel A. Adjust Channel B position controls so that Channel A and Channel B waveforms coincide. The signals must be exactly in phase (coincident). If not, another oscilloscope with identical phase characteristics for Channels A and B must be selected.

i. Move Channel B probe from A8TP1 IF1 to A8TP3 IF3. (The amplitude of the waveform will be approximately 2.5V peak-to-peak.)

j. Adjust A8C12 1 MHz TRIM for 0 degrees phase shift between Channel A and Channel B waveforms.

NOTE

If the range of A8C12 is insufficient, perform the following steps:

1. **Move the Channel B probe to A8TP2 IF2. The phase shift should be less than 3.6 degrees or 0.01 μsec. If it is not, adjust A8L2 1 MHz (L2) for 0 degrees phase shift. (Use alignment tool HP 8710-0772.) Total tuning range of L2 is about ± 50 degrees (0.14 μsec).**
2. **Connect oscilloscope Channel A to A8TP3 IF3. Adjust A8C12 1 MHz TRIM through its entire range and set it to the electrical center of its range (mid-range of phase shift on oscilloscope display).**
3. **Adjust A8L3 1 MHz (L3) for no phase difference between the two signals. Fine adjustment of phase can be made with A8C12.**

k. Turn LINE switch OFF. Install A8 in instrument.

NOTE

If the A8 or A11 IF filters are adjusted, perform the Phase Detector and Polar Converter Adjustment.

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT

REFERENCE:

Service Sheets 12 and 13

NOTE

The A, B Detector (A8) and the R Detector (R11) are supplied from the factory pre-aligned with a special fixture that guarantees alignment over the entire dynamic range. The following procedure should be used only after determining that adjustment of A8 or A11 is necessary.

NOTE

The Magnitude section of the MAG/PHASE Output Accuracy Test (Section IV) should be performed before proceeding with the adjustments in this section. If the instrument passes the performance test, do not adjust either A8 or A11, even if repairs have been made.

If A or B detector accuracy is faulty, then proceed with the following verification and (if necessary) realignment of A8.

ADJUSTMENTS

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)

If R detector accuracy is faulty, then remove A8 and A11 and interchange their positions. Then proceed with the following verification and (if necessary) realignment of the R magnitude detector in A8 position.

If the instrument fails the performance test, the verification section of the following procedure provides a means to determine whether adjustment of A8 or A11 is necessary.

DESCRIPTION:

The first portion of the procedure provides a voltage check to determine whether the detector installed in A8 position is properly adjusted. Verification or adjustment requires a specially selected and calibrated step attenuator (HP 355D, H82) and a high-accuracy, high-resolution, digital voltmeter as part of the test equipment. The voltage at A8TP8 is monitored, and, if necessary, the magnitude detector is adjusted for the proper voltage at A8TP8 for each given value of Channel B input level.

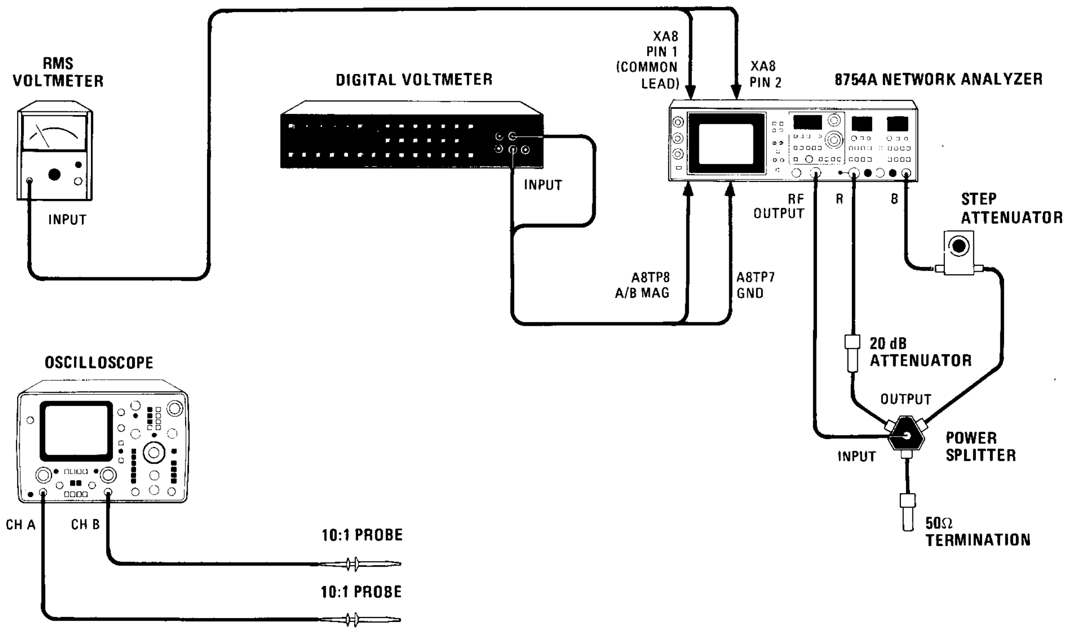


Figure 5-27. Magnitude Detector Accuracy Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3455A
RMS Voltmeter	HP 3400A
Oscilloscope	HP 1740A
Power Splitter (three-way)	HP 11850A
Step Attenuator (calibrated)	HP 355D, Option H82
20-dB Attenuator	HP 8491B, Option 020
50-Ohm Termination	HP 909A, Option 012
10:1 Divider Probe	HP 10004D
Extender Board, 22-pin	HP 08565-60107

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)

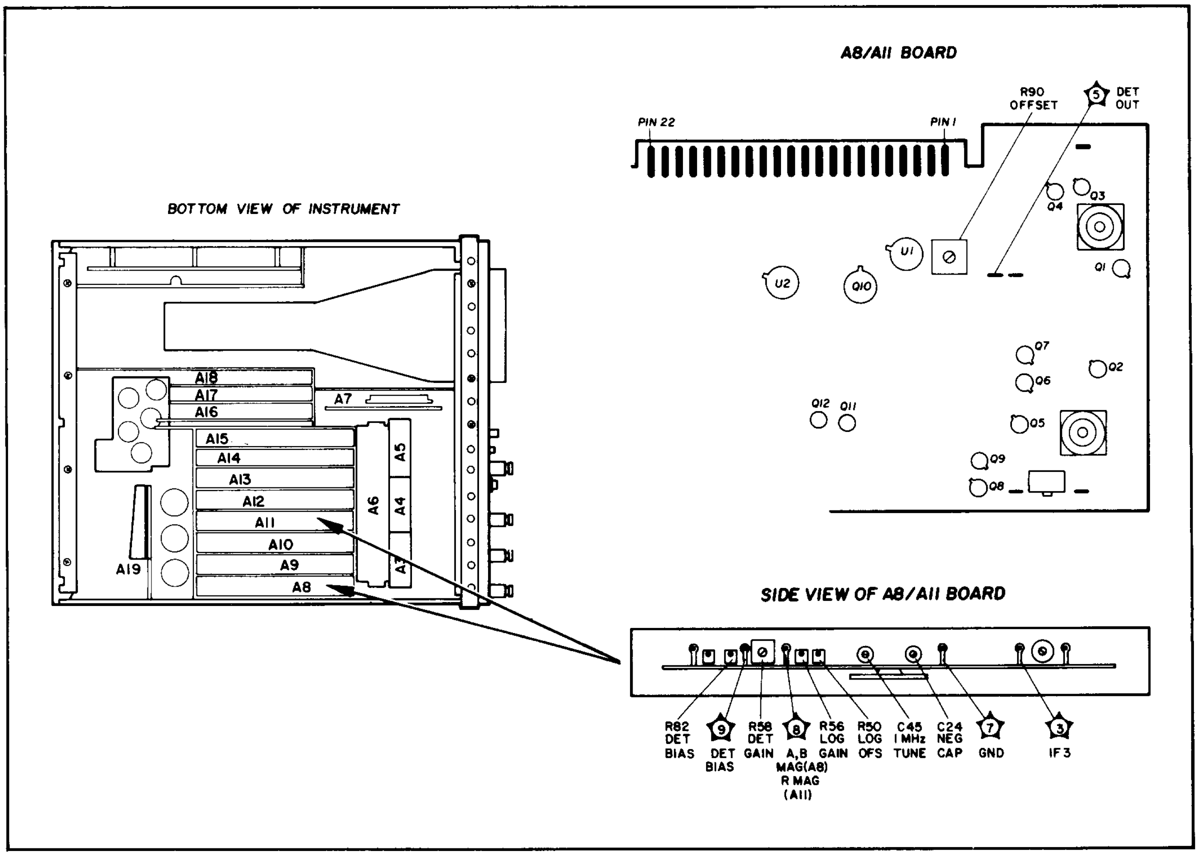


Figure 5-28. Magnitude Detector Accuracy Adjustment Locations

Verification

a. Connect equipment as shown in Figure 5-27.

b. Set 8754A controls as follows:

Sweep Mode	CENTER
SWEEP	MAN
SWEEP Vernier	Midrange
FREQUENCY MHz	25
SWEEP WIDTH MHz	0 (CW)
SWEEP WIDTH MHz Vernier	CAL (Fully clockwise)
MARKERS MHz	OFF
OUTPUT dBm	+9
REFERENCE POSITION CH 2	Off (out)
VIDEO FILTER	100 Hz (in)
POLAR A/R	Off (out)

ADJUSTMENTS

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)

CHANNEL 1

Measurement Select . . . . OFF

CHANNEL 2

REFERENCE . . . . +00
REFERENCE OFFSET Pushbutton . . . . On (in)
Measurement Select . . . . B/R
Scale 25dB/DIV

c. In Table 5-9, fill in the values for columns B, C, and D for your calibrated attenuator. (See Table 5-9 sheet 1 of 2 for a sample and sheet 2 of 2 for your measurements.)

d. Set the attenuator to 20 dB position, connect the DVM to A8TP8, then read the DVM indication. Calculate the value of Column E and fill in the value in all of the blanks in Column E.

e. Calculate the values of F.

f. Measure the value of G at each attenuator setting and record the value in Column G.

g. Compare the values in column G with those in Column F to see if the measurements are within tolerance.

h. If any of the measurements in step g were out of tolerance, proceed with the "Adjustment" paragraph following. If all of the measurements were within tolerance, the Magnitude Detector in A8 is correctly adjusted.

Adjustment

a. Turn LINE switch OFF. Install A8 Assembly on extender board. Turn LINE switch on.

b. Connect equipment as shown in Figure 5-27.

c. Set 8754A controls as shown in step b of the verification procedure. Disconnect the RF OUTPUT from the power splitter input and connect the digital voltmeter between A8TP5 DET OUT and ground. Adjust A8R90 OFFSET for digital voltmeter indication of 0.000 ± 0.001 V.

d. Turn LINE switch OFF. Remove assembly to be adjusted from the extender board and re-install it in the A8 location. Turn LINE switch on.

e. Connect digital voltmeter between A8TP9 DET BIAS and ground. Adjust A8R82 DET BIAS for indication on the digital voltmeter of +0.165 ± 0.005 V.

f. Re-connect RF OUTPUT to power splitter. Set step attenuator to 0 dB. Connect oscilloscope Channel A to XA8 pin 2 (A, B IF on Motherboard) using a 10:1 divider probe. Set oscilloscope to .01 V/DIV, AC coupled, 0.2 uSEC/DIV. Check for a ripple-free sine wave (see Figure 5-29). If the signal has ripple, set TUNING control fully counterclockwise and then slowly tune network analyzer back to 25 MHz.

ADJUSTMENTS

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)

g. Connect RMS voltmeter between XA8 pin 2 (A, B IF) and XA8 pin 1 (A, B IF RET) with common lead connected to XA8 pin 1. Adjust front-panel OUTPUT dBm control for a voltmeter indication of 0.224 ± 0.002 Vrms.

h. Connect oscilloscope Channel A, AC coupled, .05V/DIV to A8TP3 IF3 using a 10:1 divider probe. Check for 1-MHz sine wave of 2.5 ±0.3 V peak-to-peak. If the sine wave is not within limits, check the input amplifier and bandpass filters. (See Service Sheet 12 or 13).

i. Connect digital voltmeter to A8TP8 A/B MAG (or A11TP8 R MAG). Adjust A8R50 LOG OFS for digital voltmeter indication of 0.0000 ± 0.0002 V.

j. Set step attenuator to 30 dB. Adjust A8R56 LOG GAIN for calculated voltage (30-dB attenuator setting) recorded in Table 5-9 Column F, with a tolerance of ±0.0002V.

k. Set step attenuator to 50 dB. Adjust A8C24 NEG CAP for calculated voltage (50-dB attenuator setting) recorded in Table 5-9 Column F, with a tolerance of 0.0004V.

Table 5-9. A8 Magnitude Detector Accuracy Verification Table (1 of 2)

A	B	C	D	E	F Expected DVM Reading at A8TP8		G
External Attenuator Setting (dB)	Attenuator Calibration Value at Setting (dB)	Actual Attenuator Value at (A+B) (dB)	Equivalent DVM Reading (C×-.025/dB) (Vdc)	Offset Correction for A8TP8 (See Note 1) (Vdc)	Expected Reading (D+E) (Vdc)	Allowable Measurement Tolerance (Vdc)	Measured Value on DVM at A8TP8 (Vdc)
0	0	0	0	-.0200	-.0200	± .0060	-.0230
10	+.03	10.03	-0.2508	-.0200	-.2708	± .0025	-.2701
20 (Reference)	-0.12	19.88	-0.4970	-.0200	-.5170	(Reference)	-.5170 (Ref.)
30	+.02	30.02	-0.7505	-.0200	-.7705	± .0025	-.7725
40	-.01	39.99	-1.0000	-.0200	-1.0200	± .0050	-1.0199
50	-.05	49.95	-1.2488	-.0200	-1.2688	± .0060	-1.2699
60	+0.10	60.10	-1.5025	-.0200	-1.5225	± .0100	-1.5198
70	+.03	10.03	-1.7508	-.0200	-1.7708	± .0200	-1.7679
80	+0.13	80.13	-2.0033	-.0200	-2.0233	± .0500	-2.0712

NOTES: 1. Column E Offset Correction is calculated as follows:
[(Actual DVM reading at 20 dB Setting) – (Calculated Value of D at 20 dB setting)].
2. The "Allowable Measurement Tolerance" in column F does not include the calibration uncertainty of the HP 355D attenuator.

ADJUSTMENTS

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)

l. Set step attenuator to 60 dB. Adjust A8C45 1 MHz TUNE as follows:

1. Initial adjustment (first time on this step): Adjust for most negative voltage indication on digital meter.
2. Fine adjustment: Adjust for calculated voltage (60-dB attenuator setting) recorded in Table 5-9 Column F, with a tolerance of ±0.002V.

m. Set step attenuator to 0 dB. Repeat steps i through l twice.

n. Press CHANNEL 2 B/R pushbutton. Set step attenuator to 60 dB and CHANNEL 2 REFERENCE to −40 dB. Adjust OFFSET vernier to position 8754A CRT trace (dot) on center horizontal graticule line. Adjust A8R58 DET GAIN for minimum vertical peak-to-peak movement of 8754A CRT trace while rotating OUTPUT dBm control from +10 to 0. Typical trace movement is 0.15 dB.

o. Set OUTPUT dBm to +9. Repeat verification procedure steps f through i to verify that adjustment is satisfactory.

p. Turn LINE switch OFF. Remove A8 and A11 boards and interchange their positions, so the factory-adjusted board is in the A8 position.

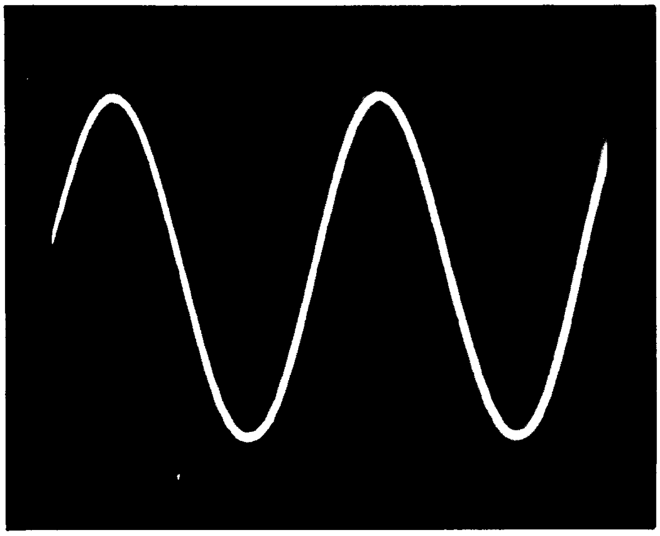
Table 5-9. A8 Magnitude Detector Accuracy Verification Table (2 of 2)

A External Attenuator Setting (dB)	B Attenuator Calibration Value at Setting (dB)	C Actual Attenuator Value at (A + B) (dB)	D Equivalent DVM Reading (C×-.025/dB) (Vdc)	E Offset Correction for A8TP8 (See Note 1) (Vdc)	F Expected DVM Reading at A8TP8		G Measured Value on DVM at A8TP8 (Vdc)
					Expected Reading (D + E) (Vdc)	Allowable Measurement Tolerance (Vdc)	
0	______	______	______	______	______	± .0060	______
10	______	______	______	______	______	± .0025	______
20 (Reference)	______	______	______	______	______	(Reference)	(Ref.)
30	______	______	______	______	______	± .0025	______
40	______	______	______	______	______	± .0050	______
50	______	______	______	______	______	± .0060	______
60	______	______	______	______	______	± .0100	______
70	______	______	______	______	______	± .0200	______
80	______	______	______	______	______	± .0500	______

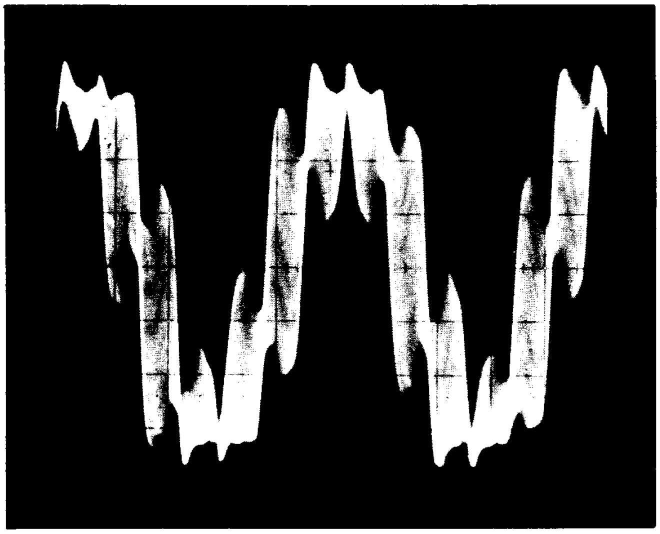
NOTES: 1. Column E Offset Correction is calculated as follows:
[(Actual DVM reading at 20 dB Setting) – (Calculated Value of D at 20 dB setting)].
2. The "Allowable Measurement Tolerance" in column F does not include the calibration uncertainty of the HP 355D attenuator.

ADJUSTMENTS

5-21. MAGNITUDE DETECTOR ACCURACY ADJUSTMENT (Cont'd)



a. Ripple-Free Sine Wave



b. Sine Wave with Ripples

Figure 5-29. Oscilloscope Display of Sine Wave at A8TP3

ADJUSTMENTS

5-22. SAMPLER ADJUSTMENTS

REFERENCE:

Service Sheet 9

DESCRIPTION:

Sampler Bias (BI) and feedback (FB) potentiometers on each of the three samplers (A3, A4, A5) are adjusted for a smooth transition at the phase lock acquisition points. The IF potentiometers are then adjusted to calibrate the R, A, and B IF with a 50 MHz, 0 dBm input.

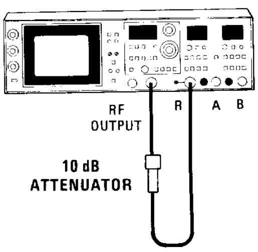


Figure 5-30. R Sampler Adjustment Test Setup

NOTE

Equipment is for two adjustment test setups, Figures 5-30 and 5-33.

EQUIPMENT:

Power Meter	HP 435A
Power Sensor	HP 8482A
10 dB Attenuator	HP 8491A, Option 010
Three-Way Power Splitter	HP 11850A
Matched Cable Set	HP 11851A

PROCEDURE:

a. Connect equipment as shown in Figure 5-30. The attenuator should be connected directly to R INPUT.

b. Set 8754A controls as follows:

SWEEP	AUTO, FAST
SWEEP Vernier	90% Fully Clockwise
REFERENCE POSITION CH 1	on(in)
OUTPUT dBm	+10 dBm
Sweep Mode	START
SWEEP WIDTH MHz	200 MHz
SWEEP WIDTH MHz Vernier	CAL
TUNING	000 MHz
MARKERS MHz	50 MHz
VIDEO FILTER	off (out)

ADJUSTMENTS

5-22. SAMPLERS ADJUSTMENT (Cont'd)

CHANNEL 1
REFERENCE . . . . −00 dB
REFERENCE OFFSET pushbutton . . . . off (out)
Measurement Select . . . . OFF
Scale . . . . .25 dB/DIV

CHANNEL 2
Measurement Select . . . . OFF
POLAR A/R . . . . off (out)

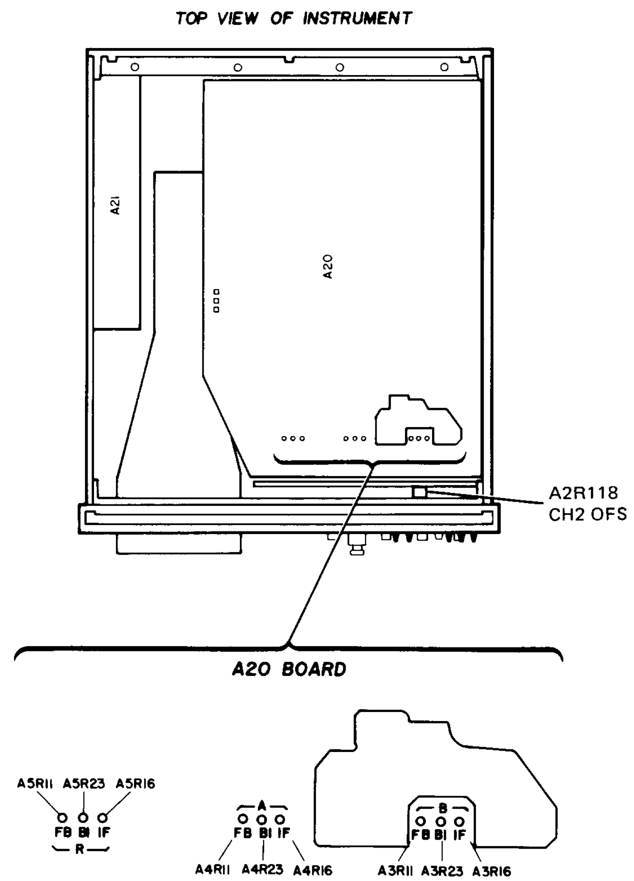
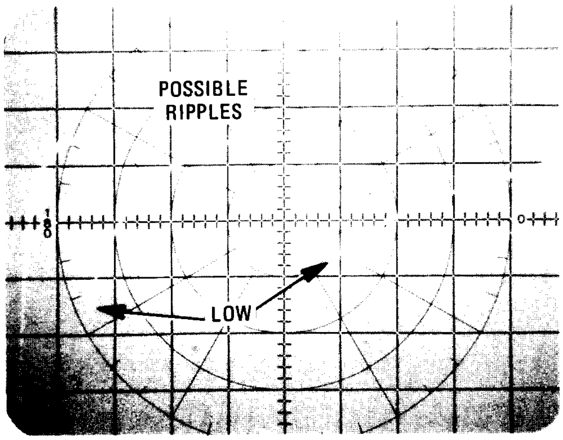


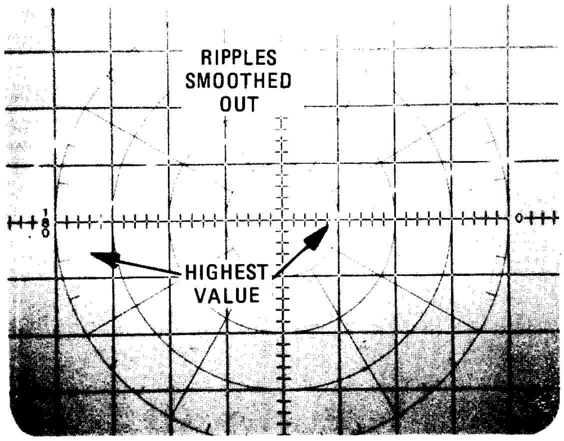
Figure 5-31. Sampler Adjustment Locations

ADJUSTMENTS

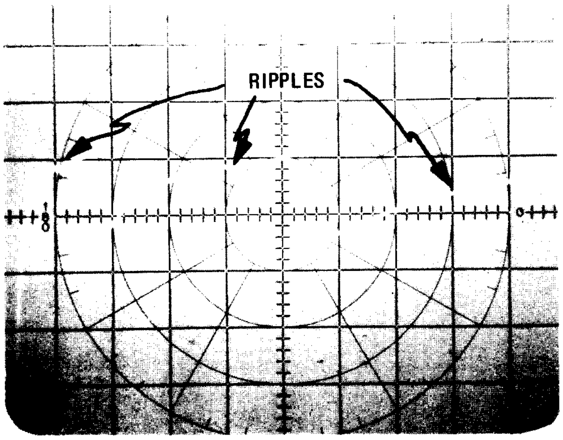
5-22. SAMPLERS ADJUSTMENT (Cont'd)



A. Fully clockwise



B. Optimum



C. Too far counterclockwise. Entire trace sags.

Figure 5-32. Effect of BI Adjustment on Display

5-22. SAMPLERS ADJUSTMENT (Cont'd)

c. Adjust REFERENCE POSITION CH 1 ⇕ control to place trace at the center graticule line.

d. Adjust TUNING to place 100 MHz marker at CRT center. (The first marker near left edge is 50 MHz and the second marker is 100 MHz.) Press MARKERS OFF pushbutton. Press REFERENCE POSITION CH 1 pushbutton to turn off reference trace.

R Sampler

e. Set R sampler A5R11 FB adjustment fully counterclockwise and A5R23 BI adjustment fully clockwise.

f. Adjust A5R16 IF potentiometer to display R Channel response similar to that shown in Figure 5-32.

g. Adjust A5R23 BI adjustment for a peak in overall response and minimum step size at the harmonic lock points, as shown in Figure 5-32B.

h. Set OUTPUT dBm control to 0 dBm and CHANNEL 1 REFERENCE to −10 dBm.

i. Adjust A5R11 FB adjustment to align the end points to the three trace segments. The resultant trace should be smooth with no apparent steps at harmonic lock points.

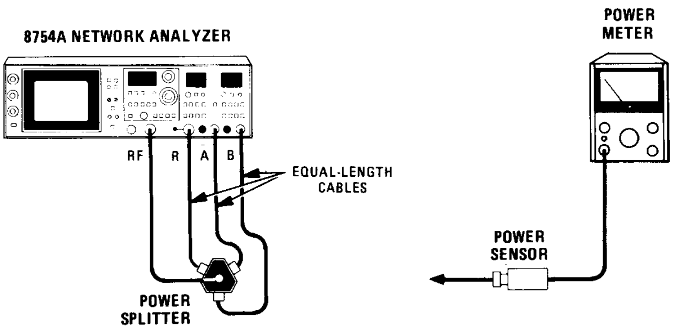


Figure 5-33. A and B Sampler Adjustment Test Setup

A Sampler

j. Set 8754A controls as follows:

OUTPUT dBm .... +10 dBm

CHANNEL 1
REFERENCE .... −00 dB
REFERENCE OFFSET .... OFF (out)
Measurement Select .... A/R

k. Remove 10 dB attenuator from R INPUT. Connect equipment as shown in Figure 5-33.

ADJUSTMENTS

5-22. SAMPLERS ADJUSTMENT (Cont'd)

l. Set A Sampler A4R23 BI adjustment fully clockwise and A4R11 FB adjustment fully counterclockwise. Adjust A4R16 IF potentiometer to position the display at approximately center screen.

m. Adjust A4R23 BI adjustment for a peak in overall response and minimum step size at the harmonic lock points, as shown in Figure 5-32B.

n. Change OUTPUT dBm to 0 dBm. Adjust A4R11 FB adjustment to align the ends of the trace segments at the harmonic lock points. The overall response should be a flat line.

B Sampler

o. Change OUTPUT dBm to +10 dBm. Change CHANNEL 1 Measurement Select to B/R. Set B Sampler A3R23 BI adjustment fully clockwise and A3R11 FB adjustment fully counterlockwise. Adjust A3R16 IF potentiometer to position the display at approximately center screen.

p. Adjust A3R23 BI adjustment for a peak in overall response and minimum step size at the harmonic lock points, as shown in Figure 5-32B.

q. Change OUTPUT dBm to 0 dBm. Adjust A3R11 FB adjustment to align the ends of the trace segments at the harmonic lock points. The overall response should be a flat line.

r. At CHANNEL 2 set REFERENCE switches to −00 dB, REFERENCE OFFSET pushbutton to OFF (out), Measurement Select to B/R, and CHANNEL 2 Scale to .25 dB/DIV. Press REFERENCE POSITION CH 1 and CH 2 pushbuttons on (in).

s. Adjust REFERENCE POSITION CH 1 and CH 2 ⬍ controls to place both reference traces exactly on center graticule line. Press REFERENCE POSITION CH 1 and CH 2 pushbuttons to turn off reference traces.

t. Adjust A2R118 CH 2 OFS adjustment (Figure 5-31) to align both traces at exactly the same position on the CRT display.

R SLOPE

u. Make trace align adjustment in Paragraph 5-13, steps g and h before proceeding with R slope adjustments.

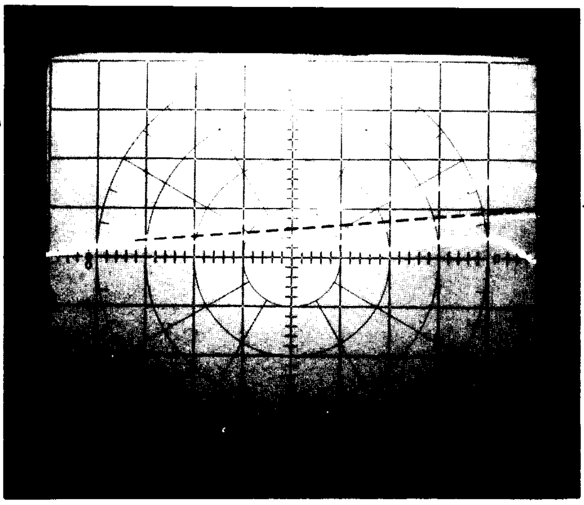
v. Select FULL 4-1300 mode. Change CHANNEL 1 to A/R Measurement Select.

w. Set REFERENCE OFFSET Channel 1 and 2 buttons on (IN).

x. Adjust CHANNEL 1 and CHANNEL 2 offset controls to place left edge of each trace on center graticule.

y. Adjust A2R129 "R SLOPE" to minimize ratio frequency response slope that is common to both display traces as shown in Figure 5-34, photo B.

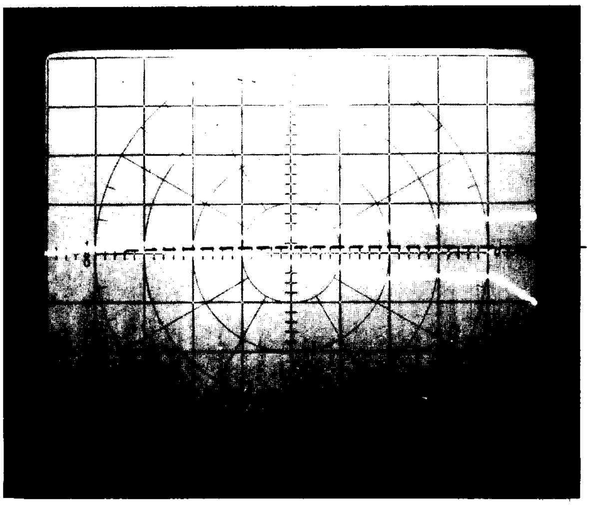
z. Change CHANNEL 1 to B/R Measurement Select and switch CHANNEL 1 and CHANNEL 2 REFERENCE OFFSET buttons off (out).



A

Average of ratio measurement slopes

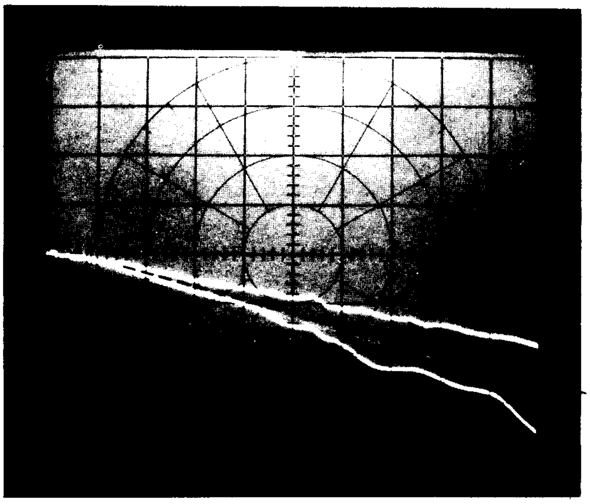
Increasing R SLOPE



B

Average of ratio measurement slopes

Correct Adjustment of R SLOPE



C

Average of ratio measurement slopes

Decreasing R SLOPE

Figure 5-34. R SLOPE Adjustment Trace

ADJUSTMENTS

5-22. SAMPLERS ADJUSTMENT (Cont'd)

Absolute-Power Calibration

aa. Select CENTER mode. Set MARKERS MHz switch to 50. Adjust TUNING to 50 MHz, then center marker on CRT. Reduce SWEEP WIDTH to 0 (CW).

ab. Set CHANNEL 2 Measurement Select, OFF; CHANNEL 1 Measurement Select, A; CHANNEL 1 REFERENCE, −00; CHANNEL 1 REFERENCE OFFSET, OFF (out).

ac. At power splitter, remove cable coming from A input and connect power meter to power splitter. Adjust OUTPUT dBm until power meter reads 0 dBm. Disconnect power meter and reconnect cable to power splitter.

ad. Adjust A4R16 IF adjustment (A Channel) until trace is at center (reference) line.

ae. Set CHANNEL 1 Measurement Select to A/R. Adjust A5R16 IF adjustment (R channel) until trace is at center screen.

af. Set CHANNEL 1 Measurement Select to B/R. Adjust A3R16 IF adjustment (B channel) until trace is at center screen.

ag. Set CHANNEL 1 and 2 Measurement Select to OFF (to display R). Adjust A8R94 ABS R OFS (pot closest to rear of 8754A) for trace at center screen.

5-23. PHASE DETECTOR LIMITERS ADJUSTMENT

REFERENCE:

Service Sheet 14

NOTE

A9 and A10 are supplied from the factory with the adjustments in this section pre-aligned. Do not adjust unless the limiters have been repaired or modified.

DESCRIPTION:

The A, B limiter (on A9) and the R limiter (on A10) are adjusted for a constant 180-degree phase shift from input to output, and to have minimum phase change with amplitude change.

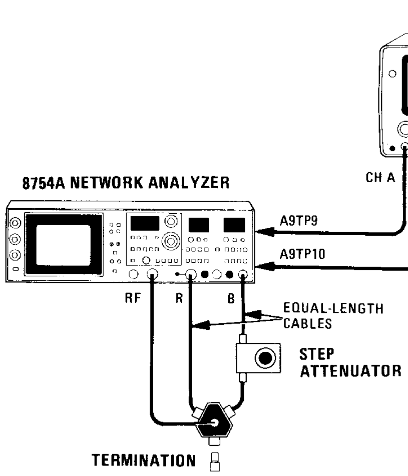


Figure 5-35. Phase Detector Limiters Adjustment Test Setup

ADJUSTMENTS

5-23. PHASE DETECTOR LIMITERS ADJUSTMENT (Cont'd)

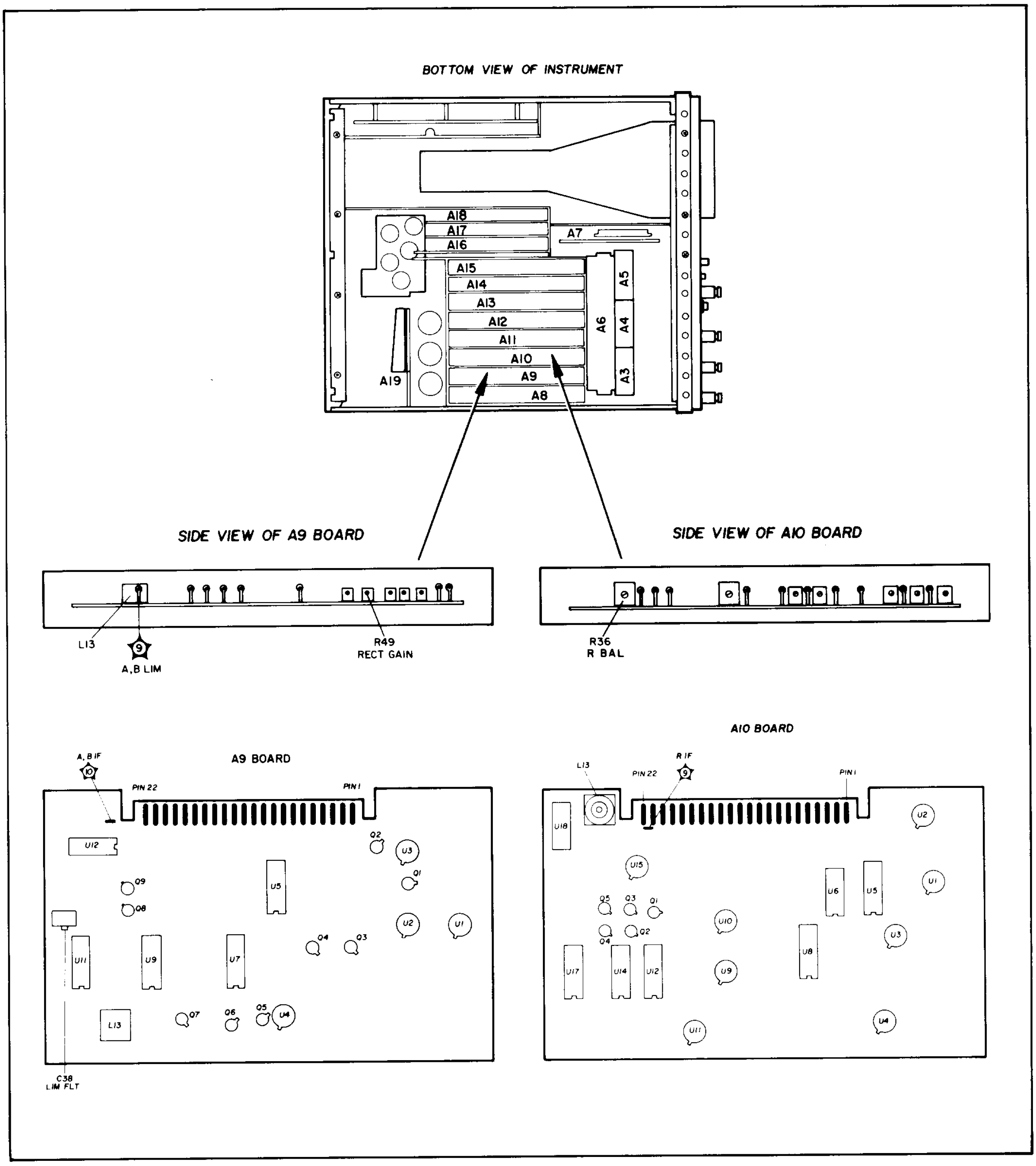


Figure 5-36. Phase Detector and Limiters Adjustment Locations

ADJUSTMENTS

5-23. PHASE DETECTOR LIMITERS ADJUSTMENT (Cont'd)

EQUIPMENT:

Oscilloscope	HP 1740A
10:1 Divider Probe(s)	HP 10004D
Step Attenuator (10 dB/Step)	HP 8495A, HP 8496A, B
Power Splitter (three-way)	HP 11850A
Matched Cable Kit (4 cables)	HP 11851A
22-Pin Extender Board	HP 08565-60107
Termination, 50-ohm, type N male	HP 909A, Option 012
Alignment Tool	HP 8710-0772

PROCEDURE:

A, B Limiter Adjustment

NOTE

A9 is supplied from the factory with the following steps (a through m) pre-aligned, and A9L13 adjustment secured with dope. Do not adjust steps a through m unless the A, B limiter on A9 has been repaired or altered (refer to Service Sheet 14).

a. Remove A9 Phase Detector assembly and place on 22-pin extender board. Connect equipment as shown in Figure 5-35. Connect oscilloscope CH A to A9TP9 A, B LIM using 10:1 probe. Connect oscilloscope CH B to A9TP10 A, B IF using 10:1 probe. Set attenuator to 10 dB.

b. Set controls as follows:

Oscilloscope:

CHAN A VOLTS/DIV	.02V/DIV, AC coupled
CHAN B VOLTS/DIV	.02V/DIV, AC coupled
DISPLAY	ALT
TIME/DIV	.2 μSEC/DIV
TRIGGER Source	Channel A
TRIGGER	POS (+), AC, INT

8754A:

FREQUENCY MHz	50
Sweep Mode	CENTER
SWEEP WIDTH MHz	0 (CW)
SWEEP	FAST, AUTO
SWEEP Vernier	Midrange
MARKERS MHz	OFF
OUTPUT dBm	+10

CHANNEL 1

Measurement Select	OFF

CHANNEL 2

Measurement Select	PHASE B/R
Scale	90 DEG/DIV
REFERENCE	−00 DEG
REFERENCE OFFSET pushbutton	off (out)
VIDEO FILTER	on (in)

ADJUSTMENTS

5-23. PHASE DETECTOR LIMITERS ADJUSTMENT (Cont'd)

c. Engage REFERENCE POSITION CH 2 button and position CRT trace to center screen using ▲▼ control. Release button.

d. Select GND on CH A and CH B inputs of oscilloscope. Position both traces to center oscilloscope graticule line. Select AC on both inputs.

e. Observe a square wave and a sine wave on oscilloscope. Adjust A9C38 LIM FLT over its range, observing phase relationship of square wave relative to sine wave. Adjust to center of its range.

f. Adjust A9L13 (pot core, underneath TP9) for a 180-degree difference between oscilloscope traces, as shown in Figure 5-37.

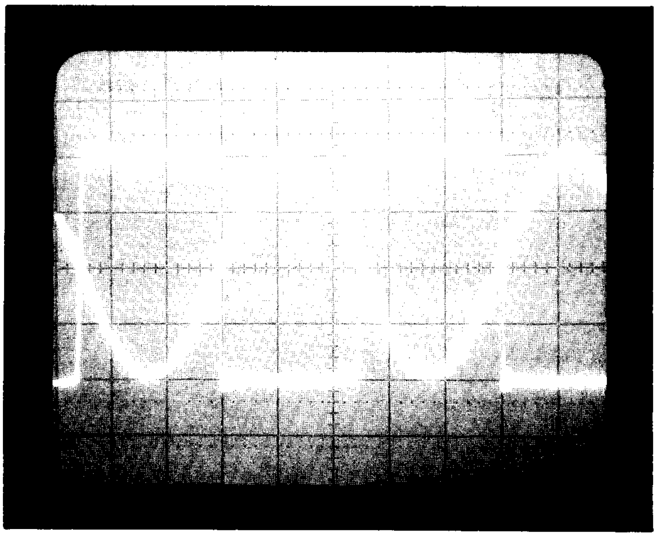


Figure 5-37. Zero Crossings Aligned for 180-Degree Difference Between Traces

g. Press CHANNEL 2 REFERENCE OFFSET pushbutton. Using CHANNEL 2 REFERENCE level switch, move trace to center graticule line.

h. Select CHANNEL 2, 2.5 DEG/DIV. Using OFFSET vernier, move trace to center line.

i. Verify that if REFERENCE is changed by 10 degrees, trace moves 4 divisions ±1 division. If not, preadjust A9R49 RECT GAIN.

j. Step attenuator from 0 to 50 dB, adjusting A9C38 LIM FLT to minimize vertical shift of 8754A trace over this amplitude range. Continue stepping attenuator down to 70 dB. Verify specification:

0 to 50 dB: ±2 degrees
50 to 70 dB: ±4 degrees

k. Return attenuator to 10 dB. If there is not a 180-degree difference between sine and square wave, as shown in Figure 5-37, repeat steps f through j.

5-23. PHASE DETECTOR LIMITERS ADJUSTMENT (Cont'd)

l. Secure pot core by applying a small amount of Hot Fuel Proof Dope (HP Part No. 6010-0011 or equivalent) to adjustable section.

m. Install A9 board in instrument.

R Limiter Adjustment

NOTE

A10 is supplied from the factory with the following steps (n through w) pre-aligned, and inductor A10L13 secured with dope. DO NOT perform steps n through w unless the R limiter on A10 has been repaired or modified (refer to Service Sheet 14).

n. Remove A10 Polar Converter assembly and place on 22-pin extender board. Connect equipment as shown in Figure 5-35, except that R and B inputs should be reversed (i.e., power splitter to B, step attenuator to R). Connect oscilloscope CH A to A10TP12 R LIM and CH B to A10TP9 R IF. Set attenuator to 10 dB.

o. Repeat steps b-d if necessary.

p. Adjust A10R36 R BAL to center of its mechanical rotation.

q. Adjust A10L13 (pot core) for a 180-degree difference between oscilloscope traces, as shown in Figure 5-36.

r. Using CHANNEL 2 REFERENCE lever switch, move trace to center graticule line.

s. Select CHANNEL 2, 2.5 DEG/DIV. Using OFFSET Vernier, move trace to center line.

t. Step attenuator from 0 to 40 dB. Adjust A10R36 R BAL to minimize vertical shift of 8754A trace over this amplitude range. Verify vertical shift is $\leq \pm 2$ degrees.

u. Return attenuator to 10 dB. If there is not a 180-degree difference between sine and square waves, as shown in Figure 5-36, repeat steps q through t.

v. Secure pot core by applying a small amount of Hot Fuel Proof Dope (HP Part No. 6010-0011 or equivalent) to adjustable section.

w. Install A10 board in instrument.

ADJUSTMENTS

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT

Service Sheet 14

REFERENCE:

Service Sheet 14

DESCRIPTION:

The scale factor of the phase reference is adjusted by making +180 degrees and −180 degrees coincide. Then, the reference is used as a standard to adjust the offset and gain of the rectangular phase detector. Last, the polar converter is adjusted so that the displayed amplitude and phase agree with the CH 1 and CH 2 references.

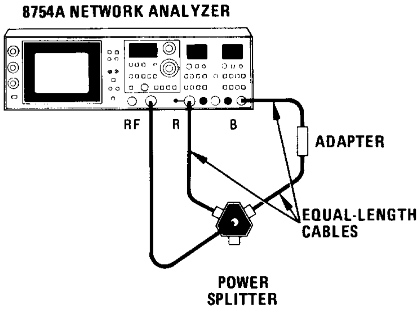


Figure 5-38. Reference Adjustment Test Setup

NOTE

Equipment is for two adjustment test setups, Figures 5-38 and 5-41.

EQUIPMENT:

Digital Voltmeter	HP 3455A
Power Splitter	HP 11850A
Matched Cable Kit	HP 11851A
Adapter, type N female to type N female	HP 1250-0777
Test Connector	HP 1251-0063
Oscilloscope	HP 1740A
10:1 Divider Prove	HP 10004D

ADJUSTMENTS

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

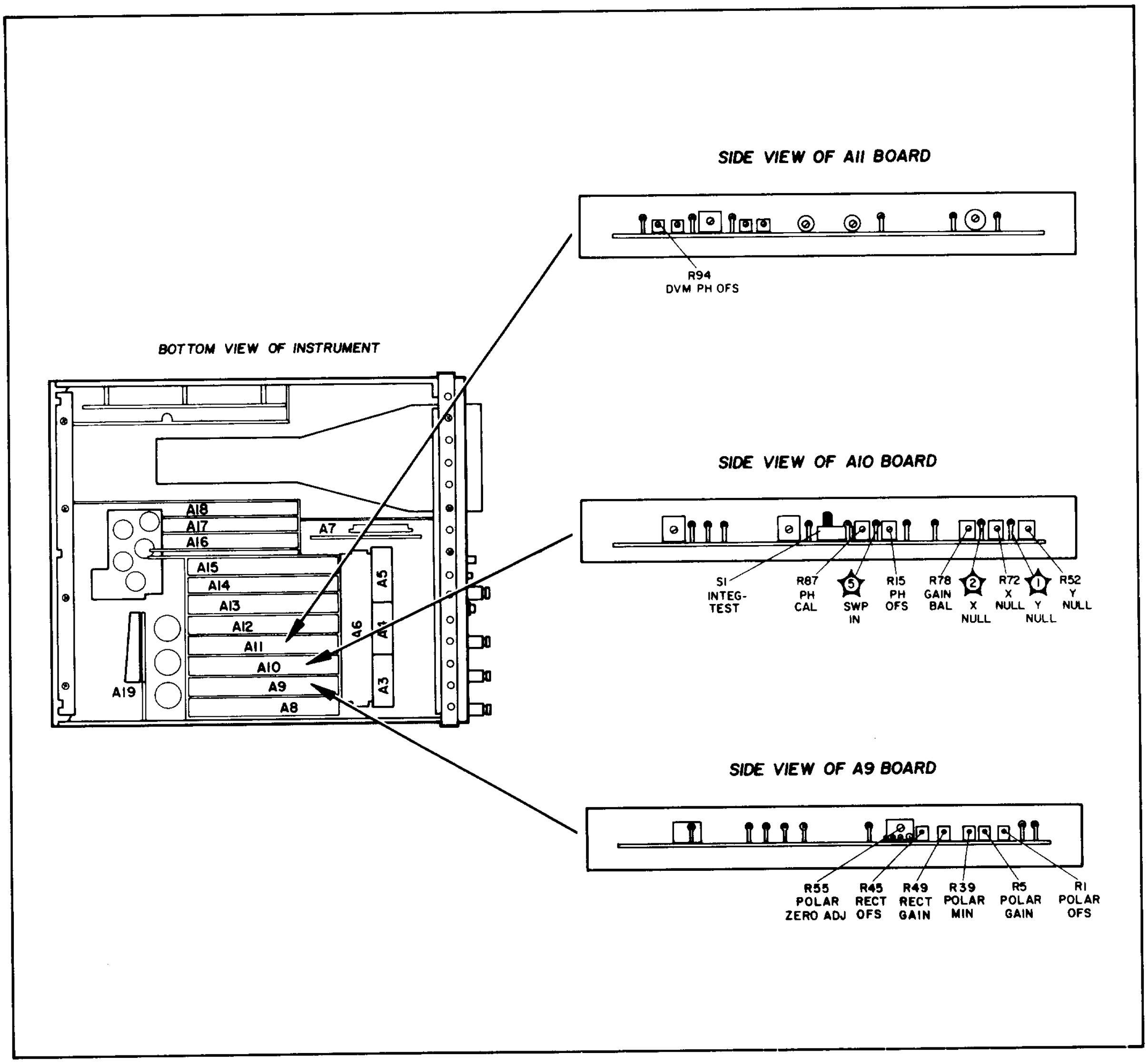


Figure 5-39. Phase Detector and Polar Converter Adjustment Locations

PROCEDURE:

Reference Adjustment

a. Connect equipment as shown in Figure 5-38. Verify that A10S1 INTEG-TEST switch is in the INTEG position.

ADJUSTMENTS

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

b. Set 8754A controls as follows:

Sweep Mode .... FULL 4-1300
SWEEP .... AUTO, FAST
SWEEP Vernier .... Midrange
MARKERS MHz .... OFF
REFERENCE POSITION CH 2 .... Off (out)
VIDEO FILTER .... Off (out)
POLAR A/R .... Off (out)

CHANNEL 1
Measurement Select .... OFF

CHANNEL 2
REFERENCE.......... −180
REFERENCE OFFSET pushbutton .... Off (out)
Measurement Select.......... PHASE B/R
Scale.......... 90 DEG/DIV

c. Press the REFERENCE POSITION CH 2 pushbutton and adjust ⬍ control to place the reference trace on the center graticule line. Press pushbutton again to turn off reference trace.

d. Turn the Phase B/R LENGTH control full clockwise. Then turn counterclockwise until right edge of trace is at least one minor division below the center graticule line, and any noise present on the right-hand side of trace is gone.

e. Adjust TUNING to place the marker at the lowest frequency at which the trace crosses the center graticule line. The trace should appear as in Figure 5-40.

f. Set 8754A controls as follows:

Sweep Mode .... CENTER
SWEEP WIDTH MHz .... 0 (CW)

CHANNEL 2
Scale .... 2.5 DEG/DIV

g. Adjust TUNING to place the trace on the center graticule line.

h. Switch CH 2 REFERENCE between −180 and +180 degrees, noting movement of trace. Adjust A10R87 PH CAL until there is no movement in the displayed trace.

i. Set 8754A controls as follows:

Sweep Mode .... FULL 4-1300
Scale .... 90 DEG/DIV

ADJUSTMENTS

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

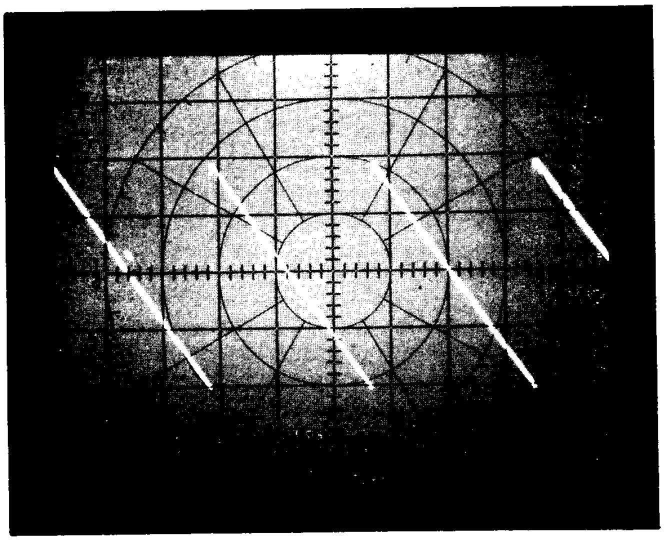


Figure 5-40. Oscilloscope Display for Reference Adjustment

j. At each of the other (three) zero crossings note the trace movement between −180 and +180 degrees as in steps f through i. At each crossing, the phase trace should move less than 1 degree. If necessary, compromise the adjustment of A10R87 PH CAL to minimize the trace movement between −180 and +180 degrees of all four points.

Phase Detector Adjustment

k. Connect equipment as shown in Figure 5-41. Connect test connector with jumper between pins 19 (MAG/PH) and 18 (GROUND) to rear panel PROGRAMMING connector J7.

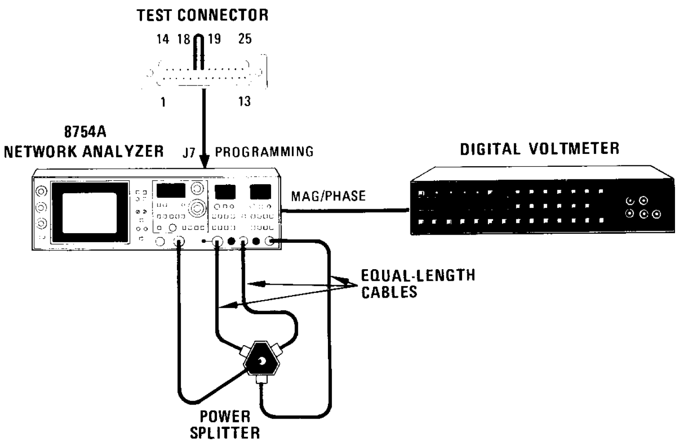


Figure 5-41. Phase Detector and Polar Converter Adjustment Test Setup

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

l. Set 8754A controls as follows:

Sweep Mode	CENTER
FREQUENCY MHz	050
SWEEP WIDTH MHz	0 (CW)
SWEEP	MAN
SWEEP Vernier	Midrange
CHANNEL 2	
REFERENCE	−00
REFERENCE OFFSET	on (in)
Scale	2.5 DEG/DIV
PHASE B/R LENGTH	Fully Counterclockwise

m. Press the REFERENCE POSITION CH 2 pushbutton and adjust ⬍ control to place the reference trace dot on the center graticule line. Press pushbutton again to turn off reference trace.

n. Adjust CH 2 OFFSET Vernier so that dot is at center graticule line. If range is not sufficient, adjust A10R15 PH OFS to place dot on center graticule line. (If necessary, temporarily select 10 DEG/DIV to locate dot.)

o. Adjust A11R94 DVM PH OFS (pot nearest rear of 8754) for 0.000 ± .001 reading on DVM.

p. Set CHANNEL 2 REFERENCE switch to +100 DEG; digital voltmeter should indicate +1.000 ±0.005V. Set CHANNEL 2 REFERENCE switch to −100 DEG; digital voltmeter should indicate −1.000 ±0.005V. Adjust A9R49 RECT GAIN for best compromise of digital voltmeter indications (i.e. +100 DEG = +1.002V, −100 DEG = −0.998V).

q. Set 8754A controls as follows:

SWEEP	AUTO, FAST
CHANNEL 2 Scale	45 DEG/DIV
CHANNEL 2 REFERENCE	−180

r. Connect rear panel SWEEP OUTPUT to A10TP5 SWP IN. Adjust A9R45 RECT OFS to center vertically the 180-degree phase transition on the CRT, as shown in Figure 5-42.

s. Select MANUAL sweep and sweep slowly through 180-degree transition in both forward and reverse directions. Note that in the reverse sweep direction, the transition point is above the top graticule line. Adjust A9R45 RECT OFS to equalize the distance below and above the graticule for the forward and reverse sweep directions respectively. Remove SWEEP from A10TP5.

t. Set 8754A controls as follows:

Sweep Mode	FULL 4-1300
SWEEP	AUTO, FAST

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

CHANNEL 2
REFERENCE . . . . –00 DEG
REFERENCE OFFSET pushbutton . . . . off (out)
Scale . . . . 2.5 DEG/DIV

NOTE

If adjustment range of A10R15 PH OFS is insufficient, the IF Bandpass Filters on A8 or A11 may require adjustment. See the IF Filters Adjustment procedure.

u. Adjust PHASE B/R LENGTH for flattest trace. Adjust A10R15 PH OFS to center trace on CRT graticule. (Note: p-p variation of trace should be <5 degrees.)

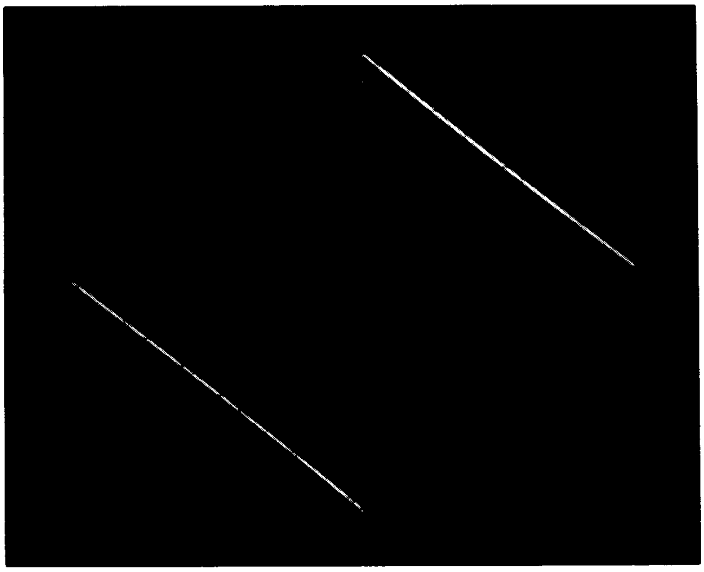


Figure 5-42. 180-Degree Phase Transition

Polar Converter Adjustments

a. Set 8754A controls as follows::

Sweep Mode . . . . CENTER
FREQUENCY MHz 50
SWEEP WIDTH MHz . . . . 0 (CW)
SWEEP . . . . AUTO, FAST
SWEEP Vernier . . . . Midrange

CHANNEL 1
Measurement Select . . . . A/R
REFERENCE . . . . –00
REFERENCE OFFSET . . . . On (in)
Scale . . . . .25 dB/DIV

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

CHANNEL 2
Measurement Select .... OFF
REFERENCE... −00
REFERENCE OFFSET .... Off (out)
POLAR A/R .... Off (out)

b. Press the REFERENCE POSITION CH 1 button and adjust the ▲▼ control to place the trace on the center graticule line. Press button again to turn off.

c. Adjust CHANNEL 1 REFERENCE OFFSET vernier until displayed trace is on the CRT center graticule line.

d. Set 8754A controls as follows:

POLAR A/R... On (in)
SWEEP.. MAN

e. With a 10:1 probe, monitor A10TP1 Y NULL with an AC coupled oscilloscope. Adjust A10R52 Y NULL for minimum signal at TP1. Repeat this procedure to adjust A10R72 X NULL while monitoring A10TP2 X NULL.

f. Press POLAR CENTER pushbutton. Center dot on CRT display with POLAR CENTER ▲▼ and ◄► controls. Press to release POLAR CENTER pushbutton.

g. Select SWEEP AUTO, FAST. Connect rear-panel SWEEP OUTPUT to A10TP5 SWP IN. A circle should now be displayed, with a gap. Adjust CHANNEL 2 REFERENCE lever switch until the gap is in the lower-left quadrant of the display, as shown in Figure 5-43.

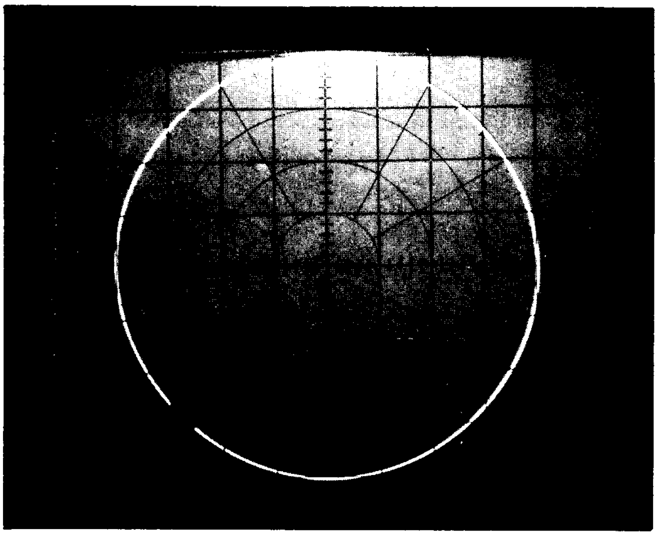


Figure 5-43. Gap at −135 Degrees

5-24. PHASE DETECTOR AND POLAR CONVERTER ADJUSTMENT (Cont'd)

h. Adjust A9R5 POLAR GAIN so that the vertical diameter of the trace is 8 divisions; i.e., that the trace intersects the outer graticule circle at the +90- and −90-degree points.

i. Adjust A10R78 GAIN BAL to set the displayed circle on the outer graticule circle at the 0- and 180-degree points. Note that the displayed circle varies less than 2.5 mm from the outer graticule circle at all points. If necessary, also select the value of A10C17 to set the trace on the outer graticule circle.

j. Turn A9R39 POLAR MIN control fully counterclockwise and set Channel 1 REFERENCE switch to +50 dB. Adjust FOCUS AND INTENSITY for smallest and sharpest dot. Turn POLAR MIN control clockwise until dot just starts to increase in size.

k. Switch Channel 1 REFERENCE switch between 00 dB and +20 dB and adjust A9R1 POLAR OFS and A9R5 POLAR GAIN so that displayed circle is on outer graticule circle with 00 dB OFFSET and has a radius of 2 minor divisions with +20 dB OFFSET. (Repetition of these two adjustments will be necessary.) Check the size of the displayed circle with the OFFSETS shown in Table 5-10.

Table 5-10. Polar Circle Radius Adjustments

Reference Offset	Polar Circle Radius (±1 mm)
00	4 major divisions (Outer Circle)
+06	2 major divisions
+12	1 major division
+20	2 minor divisions
+26	1 minor division

l. Disconnect SWEEP from A10TP5.

m. Set 8754A controls as follows:

Sweep Mode .... FULL 4-1300

CHANNEL 2
REFERENCE... −00
REFERENCE OFFSET .... Off (out)

n. Adjust POLAR A/R LENGTH control for smallest dot cluster. Adjust A9R55 POLAR ZERO ADJ so that cluster is at 0-degree point of polar display.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 is a list of exchange assemblies and Table 6-2 lists abbreviations used in the parts list. Table 6-3 lists replaceable parts in reference designator order. Table 6-4 contains names and addresses that correspond to the manufacturer's code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording considerable cost savings. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis, therefore the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number.

6-3. REPLACEABLE PARTS LIST

6-6. Table 6-3 is the list of replaceable parts, is organized as follows:

1. Electrical assemblies and their components in alpha-numerical order by reference designation.
2. Miscellaneous parts, at end of list for each major assembly.
3. Chassis-mounted parts, in alpha-numerical order by reference designation, at end of parts list.
4. Illustrated parts breakdown.

6-7. The information given for each part consists of the following:

1. The Hewlett-Packard part number.
2. Part number check digit (CD).
3. The total quantity (Qty) in the instrument. This quantity is given only once, at the first appearance of the part in the list.
4. The description of the part.
5. A typical manufacturer of the part in a five-digit code.
6. The manufacturer part number.

6-8. ORDERING INFORMATION

6-9. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

6-10. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 6-1. Assemblies Available for Module Exchange

Assembly	New Part No.	Exchange Part No.
A7U2	08754-60035	08754-60036
A7U3	5086-7235	5086-6235

*For module exchange procedure, see Paragraph 8-14.

Table 6-2. Reference Designations, Abbreviations, and Code List of Manufacturers (1 of 3)

REFERENCE DESIGNATIONS

A .... assembly
AT .. attenuator; isolator; termination
B .... fan; motor
BT .... battery
C .... capacitor
CP .... coupler
CR .... diode; diode thyristor; varactor
DC ... directional coupler
DL .... delay line
DS .... annunciator; signaling device (audible or visual); lamp; LED
E .... miscellaneous electrical part
F .... fuse
FL .... filter
H .... hardware
HY .... circulator
J ... electrical connector (stationary portion); jack
K .... relay
L .... coil; inductor
M .... meter
MP .... miscellaneous mechanical part
P ... electrical connector (movable portion); plug
Q ...... transistor: SCR; triode thyristor
R .... resistor
RT .... thermistor
S .... switch
T .... transformer
TB ...... terminal board
TC ...... thermocouple
TP .... test point
U ..... integrated circuit; microcircuit
V .... electron tube
VR .... voltage regulator; breakdown diode
W .... cable; transmission path; wire
X .... socket
Y .... crystal unit (piezo-electric or quartz)
Z .... tuned cavity; tuned circuit

ABBREVIATIONS

A

A.................... Across Flats, Acrylic, Air (Dry Method), Ampere
ADJ...................... Adjust, Adjustment
AL .... Aluminum
ALTNG................ Alternating
AMPL .... Amplifier
APC-N.................... N Type Connector (Amphenol)
ASSY .... Assembly
ASTBL .... Astable
AWG............... American Wire Gage

B

BCD................. Binary Coded Decimal
BLO .... Blow
BRDG..................... Bridge
BSC........................ Basic

C

CBL .... Cable
C-C..................... Center to Center
CC....................... Carbon Composition, Cubic Centimeter
CCP .... Carbon Composition Plastic
CER..................... Ceramic
CFM................ Cubic Feet Per Minute
CHAM .... Chamfer
CLR................. Clear, Collar, Color
CMOS .... Complementary Metal Oxide Semiconductor
CMPNT .... Component
CNDCT............... Conducting, Conductive, Conductivity, Conductor
CNTR.................. Container, Counter
CNTRL................... Control
CONN.................. Connect, Connection, Connector
CONT .... Contact, Continuous, Control, Controller
CONV .... Converter
CP .... Cadmium Plate, Candle Power, Centipoise, Conductive Plastic, Cone Point
CRT .... Cathode-Ray Tube, Crate
CTR .... Center

D

DA.................... Darlington
DARL .... Darlington
DBL...................... Double
DBM .... Decibels Referred to 1 Milliwatt
DCDR .... Decoder
DECD .... Decade
DIP.................. Dual In-Line Package
DIP-SLDR .... Dip Solder
DIVR..................... Divider
D-MODE................ Depletion Mode
D-M/S.................... D-Type Master/Slave
DO................. Package Type Designation
DPDT .... Double Pole Double Throw
DR .... Drive
DX....................... Duplex

E

ECL .... Emitter-Coupled Logic
E-MODE .... Enhancement Mode
ENCR .... Encoder
EXCL-OR .... Logic Exclusive OR
EYLT .... Eyelet

F

F..................... Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FDTHRU .... Feed Through
FEM...................... Female
FF .... Flange, Female Connection; Flip Flop
FL.................... Flash, Flat, Fluid
FLG .... Flange
FR......................... Folder
FT..................... Feet, Foot
FW .... Full Wave
FXD .... Fixed

G

GEN .... General, Generator
GP................ General Purpose
GRV .... Grooved
GY.......................... Gray

H

HD .... Head
HEX .... Hexadecimal, Hexagon, Hexagonal
HLCL .... Helical

I

IC .... Integrated Circuit
ID................. Inside Diameter
IEC.................. International Electrotechnical Commission
IF....................... Forward Current, Intermediate Frequency

Table 6-2. Reference Designations, Abbreviations, and Code List of Manufacturers (2 of 3)

IN . . . . Inch, Indium
INP . . . . Input
INT . . . . Integral, Intensity, Internal
INTL . . . . Internal, International
INV . . . . Invert, Inverter

J

J-FET . . . . Junction Field Effect Transistor
JG . . . . Jade Gray

K

K . . . . Kilo, Potassium
KVDC . . . . Kilovolts Direct Current

L

LED . . . . Light Emitting Diode
LG . . . . Length, Long
LIN . . . . Linear, Linear Taper, Linearity
LK . . . . Link, Lock
LS . . . . Low Power Schottky, Series Inductance
LUM . . . . Luminous

M

M . . . . Male, Maximum, Mega, Mil, Milli, Mode, Momentary, Mounting Hole Centers, Mounting Hole Diameter
MA . . . . Milliampere
MACH . . . . Machined
MCD . . . . Millicandela
MHZ . . . . Megahertz
MIN . . . . Miniature, Minimum, Minor, Minute
MINTR . . . . Miniature
MLD . . . . Mold, Molded
MM . . . . Millimeter
MO . . . . Metal Oxide, Millliounce, Molybdenum
MOD . . . . Model, Modified, Modular, Modulated, Modulator
MOM . . . . Momentary
MONO/ASTBL . . . . Monostable / Astable
MONOSTBL . . . . Monostable
MOSFET . . . . Metal Oxide Semiconductor Field Effect Transistor
MTG . . . . Mounting
MTLC . . . . Metallic
MUXR . . . . Multiplexer
MV . . . . Millivolt, Multivibrator
MW . . . . Milliwatt
MZ . . . . Milliounce Troy

N

NAND . . . . Logic Not-AND
NC . . . . National Coarse (Thread), No Connection, Normally Closed
N-CHAN . . . . N-Channel
NH . . . . Nanohenry
NO . . . . Normally Open, Number
NOM . . . . Nominal
NOR . . . . Logic Not-OR
NPN . . . . Negative Positive Negative (Transistor)
NS . . . . Nanosecond, Non-Shorting
NUM . . . . Numeric, Numerical
NYL . . . . Nylon (Polyamide)

O

OP AMP . . . . Operational Amplifier
OSC . . . . Oscillator, Overlap Slotted Container (All Flaps Same Length)
OVH . . . . Oval Head

P

PAN-HD . . . . Pan Head
PB . . . . Lead (Metal), Push Button
PC . . . . Picocoulomb, Piece, Printed Circuit
PCB . . . . Printed Circuit Board
P-CHAN . . . . P-Channel
PD . . . . Pad, Palladium, Pitch Diameter, Power Dissipation
PF . . . . Picofarad; Pipe, Female Connection; Power Factor
PHBRZ . . . . Phosphor Bronze
PIN . . . . Positive Intrinsic Negative (Transistor)
PKG . . . . Package
PL . . . . Phase Lock, Plain, Plate, Plug
PMOS . . . . P-Channel Metal Oxide Semiconductor
PNL . . . . Panel
PNP . . . . Positive Negative Positive (Transistor)
POLYC . . . . Polycarbonate
POLYE . . . . Polyester
POLYSTY . . . . Polystyrene
POS . . . . Position, Positive
POT . . . . Potentiometer
POZI . . . . Pozidriv Recess
PREC . . . . Precision
PRL . . . . Parallel
PRP . . . . Purple, Purpose
PS . . . . Picosecond, Poise, Polystyrene, Positive Shorting, Pressure Sensitive
PTR . . . . Pointer
PVC . . . . Polyvinyl Chloride
PWR . . . . Power

Q

Q . . . . Figure of Merit
QUAD . . . . Set of Four

R

RBN . . . . Ribbon
RCVR . . . . Receiver
RCVY . . . . Recovery
RECT . . . . Rectangle, Rectangular, Rectifier
RES . . . . Research, Resistance, Resistor
RETRIG . . . . Retriggerable
RF . . . . Radio Frequency
RGLTR . . . . Regulator
RGTR . . . . Register
RMS . . . . Root Mean Square
RND . . . . Round
R&P . . . . Rack and Panel
R-S . . . . Reset-Set
RVT . . . . Rivet, Riveted

S

SCR . . . . Screw, Silicon Controlled Rectifier
SEG . . . . Sealing
SEL . . . . Select, Selected
SEMITUB . . . . Semitubular
SER . . . . Series
SGL . . . . Single
SHF-RGTR . . . . Shift Register
SI . . . . Silicon, Square Inch
SIP . . . . Single In-Line Package
SKT . . . . Skirt, Socket
SL . . . . Slide, Slow
SLDR . . . . Solder
SM . . . . Samarium, Seam, Small, Square Meter, Sub Modular, Subminiature
SMA . . . . Subminiature, A Type (Threaded Connector)
SMB . . . . Subminiature, B Type (Snap-On Connector)
SMF . . . . Square Mil Foot
SNP . . . . Snap
SPCG . . . . Spacing
SPDT . . . . Single Pole Double Throw

Table 6-2. Reference Designations, Abbreviations, and Code List of Manufacturers (3 of 3)

SQ . . . . Square
SUBMIN . . . . Subminiature
SW . . . . Single Wall, Switch
SWP . . . . Shell White Panel (HP 6009-0026), Sweep
SZ . . . . Size

T

T . . . . Tab Width, Taper, Teeth, Temperature, Thermoplastic (Insulation), Thickness, Time, Timed, Tooth, Turns Ratio, Typical
TA . . . . Ambient Temperature, Tantalum
TBAX . . . . Tube Axial
TC . . . . Cast Temperature, Technetium, Temperature Coefficient, Temperature Compensating, Thermocouple, Tinned Copper
THD . . . . Thread, Threaded
THK . . . . Thick
TL . . . . Translucent (Color)
TPG . . . . Tapping
TPL . . . . Triple
TRIG . . . . Trigger, Triggerable, Triggering, Trigonometry
TRMR . . . . Trimmer
TRN . . . . Turn, Turns
TTL . . . . Tan Translucent, Transistor Transistor Logic

U

UA . . . . Microampere
UCD . . . . Microcandela
UF . . . . Microfarad
UH . . . . Microhenry
UL . . . . Microliter, Underwriters' Laboratories, Inc.
UNMTD . . . . Unmounted

V

V . . . . Vanadium, Variable, Violet, Volt, Voltage
VAC . . . . Vacuum; Volts, Alternating Current
VAR . . . . Variable
VDC . . . . Volts, Direct Current
VRRM . . . . Repetitive Peak Inverse Voltage
VSBL . . . . Visible
VTO . . . . Voltage Tuned Oscillator
VVC . . . . Voltage Variable Capacitor

W

W . . . . Watt, Wattage, White, Wide, Width, Wire
WDTH . . . . Width
WSHR . . . . Washer
WW . . . . Wire Wound

X

XSTR . . . . Transistor

Z

ZMAX . . . . Maximum Impedance
ZNR . . . . Zener

MULTIPLIERS

Abbreviation	Prefix	Multiple	Abbreviation	Prefix	Multiple	Abbreviation	Prefix	Multiple
T	tera	10^{12}	da	deka	10	n	nano	10^{-9}
G	giga	10^{9}	d	deci	10^{-1}	p	pico	10^{-12}
M	mega	10^{6}	c	centi	10^{-2}	f	femto	10^{-15}
k	kilo	10^{3}	m	milli	10^{-3}	a	atto	10^{-18}
			μ	micro	10^{-6}			

CODE LIST OF MANUFACTURERS

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
C0633	AKTIEBOLAGET RIFA	BROMMA	SE	
00000	ANY SATISFACTORY SUPPLIER			
00853	SANGAMO ELEC CO S CAROLINA DIV	PICKENS	SC	29671
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
01928	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02111	SPECTROL ELECTRONICS CORP	CITY OF IND	CA	91745
02114	FERROXCUBE CORP	SAUGERTIES	NY	12477
03888	KDI PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85062
04805	ILLINOIS TOOL WORKS INC	ELGIN	IL	60120
05245	CORCOM INC	CHICAGO	IL	60657
06001	GE CO ELEK CAP & BAT PROD DEPT	IRMO	SC	29063
06534	ETRI INC	BURR RIDGE	IL	60521
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
18324	SIGNETICS CORP	SUNNYVALE	CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
32293	INTERSIL INC	CUPERTINO	CA	95014
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
34335	ADVANCED MICRO DEVICES INC	SUNNYVALE	CA	94086
51167	ARIES ELECTRONICS INC	FRENCHTOWN	NJ	08825
52763	STETTNER-TRUSH INC	CAZENOVIA	NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC	CT	06226
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108
75915	LITTELFUSE INC	DES PLAINES	IL	60016
84411	TRW CAPACITOR DIV	OGALLALA	NE	69153

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08754-60001	0	1	BOARD ASSEMBLY, FRONT PANEL (DOES NOT INCLUDE A1DS1 A1R24 AND A1R51)	28480	08754-60001
A1C1	0180-1706	7	3	CAPACITOR-FXD 100UF+-20% 25VDC TA	06001	69F245G7
A1C2	0160-4084	8	126	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1C4	0160-0134	1		CAPACITOR-FXD 220 PF +-5% 300VDC MICA	28480	0160-0134
A1CR1				NOT ASSIGNED		
A1CR2	1901-0050	3	83	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1DS1	1990-0486	6		LED-VISIBLE LUM-INT=1MCD	28480	1990-0486
A1J1	1251-4833	9	2	CONNECTOR 34-PIN M POST TYPE	28480	1251-4833
A1J2	1251-4833	9		CONNECTOR 34-PIN M POST TYPE	28480	1251-4833
A1J3	1251-5244	8	2	CONNECTOR 6-PIN M POST TYPE	28480	1251-5244
A1J4	1251-5244	8	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5244
A1R1	0757-0442	9	119	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R2	0757-0280	3	116	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R3	0757-0416	7	39	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R4	0698-3444	1	35	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R8	0757-0199	3	7	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1R9	0757-0438	3	53	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1R10	0757-0441	8	5	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1R11				NOT ASSIGNED		
A1R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R13	2100-3672	4	1	RESISTOR-VAR DUAL 10K-10%-CP 500K-10%-CP	28480	2100-3672
A1R14				NOT ASSIGNED		
A1R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R16	2100-3745	2	1	RESISTOR-VAR CONTROL CCP 1K 10% LIN	01121	WP4N048S102UZ
A1R17	2100-3674	6	1	RESISTOR-VAR CONTROL CP 10K 10% LIN	28480	2100-3674
A1R18	0698-6624	5	14	RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A1R19	0698-6625	6	8	RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A1R20	0698-6360	6	37	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R21	0698-3194	8	1	RESISTOR 20K .25% .125W F TC=0+-50	03888	PME55-1/8-T2-2002-C
A1R22	0698-6629	0	3	RESISTOR 60K .1% .125W F TC=0+-25	28480	0698-6629
A1R23	0757-0440	7	17	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R24	2100-3192	3	2	RESISTOR-VAR PREC WW 10-TRN 5K 5%	28480	2100-3192
A1R25	0698-6631	4	7	RESISTOR 2.5K .1% .125W F TC=0+-25	28480	0698-6631
A1R26	0698-6358	2	2	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A1R27	0698-6627	8	2	RESISTOR 25K .1% .125W F TC=0+-25	28480	0698-6627
A1R28	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R29	2100-3807	7	7	RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R31	0757-0458	7	15	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R32	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R33	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R34	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R36	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R37	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R38	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R39	0698-6631	4		RESISTOR 2.5K .1% .125W F TC=0+-25	28480	0698-6631
A1R40	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A1R41	0698-6627	8		RESISTOR 25K .1% .125W F TC=0+-25	28480	0698-6627
A1R42	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R43	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A1R44	0698-7339	1	1	RESISTOR 72K .25% .125W F TC=0+-50	19701	MF4C1/8-T2-7202-C
A1R45	0698-8167	5	1	RESISTOR 18K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1802-B
A1R46	0698-6322	0	2	RESISTOR 4K .1% .125W F TC=0+-25	28480	0698-6322
A1R47	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R48	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R49				NOT ASSIGNED		
A1R50	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R51	2100-3192	3		RESISTOR-VAR PREC WW 10-TRN 5K 5%	28480	2100-3192
A1R52	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R53	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1 TRN	28480	2100-3807
A1R54				NOT ASSIGNED		
A1R55				NOT ASSIGNED		
A1R56	0699-0154	6	1	RESISTOR 7.2K .1% .125W F TC=0+-25	28480	0699-0154
A1R57	2100-3807	7		RESISTOR-VAR CONTROL C 10K 10% 1TRN	28480	2100-3807
A1R58				NOT ASSIGNED		
A1R59	2100-3744	1	2	RESISTOR-VAR CONTROLCCP 10K 10% LIN	28480	2100-3744
A1R60	2100-3744	1		RESISTOR-VAR CONTROLCCP 10K 10% LIN	28480	2100-3744

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R61				NOT ASSIGNED		
A1R62	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R64	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R65	0757-0317	7	3	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1R66	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	28480	0757-0442
A1S1	3101-2124	2	7	SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S2	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S3	3101-2186	6	2	SWITCH-PB 3-STATION 10MM C-C SPACING	28480	3101-2186
A1S4	3100-3451	8	1	SWITCH-ROTARY 0.812 STRUT CTR SPCG; 12	28480	3100-3451
A1S5	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S6	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S7	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S8	3101-2187	7	1	SWITCH-PB 2-STATION 10MM C-C SPACING	28480	3101-2187
A1S9	3101-2186	6		SWITCH-PB 3-STATION 10MM C-C SPACING	28480	3101-2186
A1S10	3101-2185	5	5	SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-2185
A1S11	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1S12	3101-2185	5		SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-2185
A1S13	3101-2189	9	1	SWITCH-PB DPDT MOM .125A 115VAC	28480	3101-2189
A1S14	3101-2185	5		SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-2185
A1S15	3101-2185	5		SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-2185
A1S16	3101-2185	5		SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-2185
A1S17	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A1VR1	1902-0041	4	9	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A1XDS1	1200-0010	9		SOCKET 2-CONT	28480	1200-0010
				A1 MISCELLANEOUS PARTS		
	0610-0001	4		NUT-HEX-DBL-CHAM 2-56 THD .062-IN-THK	28480	0610-0001
	1251-0688	4		CONN CONTACT F	28480	1251-0688
	1251-4834	1		CONN R&P 6 F2R	28480	1251-4834
	2190-0014	2		WSHR LK .089 ID	28480	2190-0014
	2190-0067	4		WSHR LK .256 ID	28480	2190-0067
	3050-0098	2		WSHR FL .094 ID	28480	3050-0098
	3050-0381	1		WSHR FL CLR PLASTIC .266 ID	28480	3050-0381
	8120-2525	2		CBL ASSY RBN 50C	28480	8120-2525
	08754-60034	1		HARNESS PROBE POWER	28480	08754-60053

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	08754-60002	1	1	ANALOG PROCESSOR ASSEMBLY (DOES NOT INCLUDE A2S1 AND A2S2)	28480	08754-60002
A2C1	0180-0291	3	29	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A2C2	0180-0197	8	61	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C5	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C8	0160-0945	2	3	CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A2C9	0160-0945	2		CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A2C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C13	0160-3456	6	23	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C14	0160-0168	1	1	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A2C15	0180-2207	5	1	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A2C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A2C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C18	0160-0573	2	2	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A2C19	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A2CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2J1	1251-4737	2	4	CONNECTOR 50-PIN M RECTANGULAR	28480	1251-4737
A2J2	1251-4737	2		CONNECTOR 50-PIN M RECTANGULAR	28480	1251-4737
A2J3	1200-0508	0	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A2L1	9100-1644	3	2	COIL-MLD 330UH 5% Q=65 .19DX.44LG-NOM	28480	9100-1644
A2Q1	1854-0404	0	20	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2Q2	1853-0281	9	3	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2Q3	1854-0477	7	8	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A2Q4	1853-0322	9	2	TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A2R1	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A2R2	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R3	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R4	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A2R5	0698-3151	7	6	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A2R6	2100-3154	7	4	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A2R7	0757-0419	0	5	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A2R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R9	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R10	0698-3633	0	1	RESISTOR 390 5% 2W MO TC=0+-200	28480	0698-3633

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R11	0698-3154	0	4	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A2R12	0757-0401	0	55	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R13	0757-0394	0	14	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R18	0757-0439	4	9	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A2R19	2100-3095	5	10	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	28480	2100-3095
A2R20	0698-3442	9		RESISTOR 237 1% .125W F TC0+-100	28480	0698-3442
A2R21	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A2R22	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A2R23	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A2R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R26	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A2R27	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R28	0757-0399	5	1	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A2R29	0698-3219	8	6	RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R30	0698-3219	8		RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R31	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A2R32	0698-3219	8		RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R33	0698-3234	7	2	RESISTOR 150K .25% .125W F TC=0+-50	28480	0698-3234
A2R34	0699-0272	9	2	RESISTOR 75K .1% .125W F TC=0+-25	28480	0699-0272
A2R35	0698-6629	0		RESISTOR 60K .1% .125W F TC=0+-25	28480	0698-6629
A2R36	0699-0279	6	2	RESISTOR 30K .05% .1W F TC=0+-15	28480	0699-0279
A2R37	0699-0278	5	2	RESISTOR 15K .05% .1W F TC=0+-15	28480	0699-0278
A2R38	0698-6614	3	3	RESISTOR 7.5K .1% .125W F TC=0+-25	28480	0698-6614
A2R39	0699-0276	3	4	RESISTOR 2.5K .02% .1W F TC=0+-15	28480	0699-0276
A2R40	0699-0276	3		RESISTOR 2.5K .02% .1W F TC=0+-15	28480	0699-0276
A2R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R42	0699-0277	4		RESISTOR 10K .02% .1W F TC=0+-15	28480	0699-0277
A2R43	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R44	0699-0277	4		RESISTOR 10K .02% .1W F TC=0+-15	28480	0699-0277
A2R45	0698-3243	8	1	RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A2R46	0698-5437	6	2	RESISTOR 12K .1% .125W F TC=0+-50	28480	0698-5437
A2R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R50	0699-0276	3		RESISTOR 2.5K .02% .1W F TC=0+-15	28480	0699-0276
A2R51	0699-0276	3		RESISTOR 2.5K .02% .1W F TC=0+-15	28480	0699-0276
A2R52	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R53	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R54	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R55	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R56	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R57	0757-0279	0	38	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R58	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R60	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A2R61	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R62	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R65	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R66	0757-0459	8	3	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A2R67	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R68	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R69	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A2R70	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R71	0698-3219	8		RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R72	0698-3219	8		RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R73	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A2R74	0698-3219	8		RESISTOR 300K .25% .125W F TC=0+-50	28480	0698-3219
A2R75	0698-3234	7		RESISTOR 150K .25% .125W F TC=0+-50	28480	0698-3234
A2R76	0699-0272	9		RESISTOR 75K .1% .125W F TC=0+-25	28480	0699-0272
A2R77	0698-6629	0		RESISTOR 60K .1% .125W F TC=0+-25	28480	0698-6629
A2R78	0699-0279	6		RESISTOR 30K .05% .1W F TC=0+-15	28480	0699-0279
A2R79	0699-0278	5		RESISTOR 15K .05% .1W F TC=0+-15	28480	0699-0278
A2R80	0698-6614	3		RESISTOR 7.5K .1% .125W F TC=0+-25	28480	0698-6614
A2R81	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R82	0699-0275	2	2	RESISTOR 1K .01% .1W F TC=0+-15	28480	0699-0275
A2R83	0699-0275	2		RESISTOR 1K .01% .1W F TC=0+-15	28480	0699-0275
A2R84	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2R85	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R86	0698-3460	1	2	RESISTOR 422K 1% .125W F TC=0+-100	28480	0698-3460
A2R87	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R88	0698-6614	3		RESISTOR 7.5K .1% .125W F TC=0+-25	28480	0698-6614
A2R89	0698-5437	6		RESISTOR 12K .1% .125W F TC=0+-50	28480	0698-5437
A2R90	0757-0447	4	4	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A2R91	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A2R92	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R93	0698-3150	6	5	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A2R94	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R95	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R96	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R97	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A2R98	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A2R99	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R100	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R101	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R102	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R103	0757-0470	3	3	RESISTOR 162K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1623-F
A2R104	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2R105	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A2R106	0698-3442	9	3	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2R107	0698-3457	6	3	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A2R108	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2R109	0698-0084	9	13	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A2R110	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2R111	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R112	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R113	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2R114	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2R115	0698-3260	9	8	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A2R116	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A2R117	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2R118	2100-3274	2	3	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A2R119	2100-3095	5	2	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	02111	43P201
A2R120	0698-3452	1	3	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A2R121	0757-0428	1	5	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A2R122	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2R123	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2R124	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2R125	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R126	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2R127	0698-8824	1	1	RESISTOR 562K 1% .125W F TC=0+-100	28480	0698-8826
A2R128	2100-3164	9	1	RESISTOR-TRMR 10 20% C SIDE-ADJ 17-TRN	02111	43P100
A2R129	2100-3355	0		RESISTOR 100K 10% C SIDE ADJ 1-TRN	28480	3100-3355
A2R130	0683-1065	7		RESISTOR 10M 5% .25W FC TC=-9001+1100	28480	3100-1065
A2R131	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A281	3100-3452	9	2	SWITCH-THUMBWHEEL MOD,LEVER ACTIVATED	28480	3100-3452
A282	3100-3452	9		SWITCH-THUMBWHEEL MOD, LEVER ACTIVATED	28480	3100-3452
A2TP1-A2TP18	0360-0535	0	3	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A2U1	1826-0431	4	1	IC CONV	04713	MC14433L
A2U2	1858-0047	5	1	TRANSISTOR ARRAY DA-PIN	13606	ULN-2003A
A2U3	1820-1413	2	1	IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	04713	MC14511BCP
A2U4	1810-0346	7	1	NETWORK-RES 16-PIN-DIP .1-PIN-SPCG	28480	1810-0346
A2U5	1820-1545	1	6	IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A2U6	1826-0304	0	8	IC OP AMP TO-99	27014	LF355H
A2U7	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A2U8	1826-0092	3	23	IC OP AMP TO-99	28480	1826-0092
A2U9	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A2U10	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A2U11	1826-0420	1		IC OP AMP GP DUAL 8-DIP-P	28480	1826-0092
A2U12	1826-0261	8	10	IC 741 OP AMP TO-99	28480	1826-0261
A2U13	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A2U14	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A2U15	1820-1201	6	2	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2U16	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A2U17	1820-1208	3	3	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A2U18	1820-1545	1		IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A2U19	1820-1197	9	9	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U20	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A2U21	1826-0261	8	2	IC 741 OP AMP TO-99 (RECOMMENDED REPLACEMENT)	28480	1826-0261
A2U22	1326-0261	8	2	IC 741 OP AMP TO-99 (RECOMMENDED REPLACEMENT)	28480	1826-0261
A2VR1	1902-0692	1	1	DIODE-ZNR 6.3V 1% DO-7 PD=.4W TC=+.001%	28480	1902-0692
A2VR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
				A2 MISCELLANEOUS PARTS		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	1251-3172	7	45	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
	0380-1069	9	7	SPACER-RVT-ON .875-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A3	5086-7233	2	1	SAMPLER	28480	5086-7233
A3C1	0160-3879	7	9	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C2	0160-0174	9	8	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C4	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C5	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3C7	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C10	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C11	0160-3875	3	1	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A3J1	1250-1001	5	1	CONNECTOR-RF SMA FEM 2-HOLE-FLG-FR	28480	1250-1001
A3J2	1250-1553	2	1	CONNECTOR-RF SMB M 2-HOLE-FLG-FR 50-OHM	28480	1250-1553
A3L1	9100-2247	4	5	COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3L2	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3L3	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3L4	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3L5	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A3Q2	1855-0260	8	1	TRANSISTOR-MOSFET DUAL N-CHAN E-MODE SI	28480	1855-0260
A3Q3	1853-0034	0	11	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3Q4	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3Q5	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A3R1	0757-0290	5	5	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R2	0757-0444	1	4	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R4	0698-3440	7	17	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3R5	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R6	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R7	0757-0420	3	5	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R9	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R10	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R11	2100-3095	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	02111	43P201
A3R12	0698-0083	8	30	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R14	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R15	0757-0316	6	5	RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A3R16	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A3R17	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3R18	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R19	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R20	0757-0316	6		RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A3R21	0698-8172	2	2	RESISTOR 4K .25% .125W F TC=0+-50	19701	MF4C1/8-T2-4001-C
A3R22	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-TO-619R-F
A3R23	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A3R24	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-TO-751-F
A3R25	0698-6624	5		RESISTOR 2K 1% .125W F TC=0+-100	28480	0698-6624
A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R27	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3U1				SAMPLER, NOT SEPARATELY REPLACEABLE		
				A3 MISCELLANEOUS PARTS		
	5021-0956	6	1	COVER, SAMPLER	28480	5021-0956
	0520-0127	6	3	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0103	2	7	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A4				SAMPLER, SAME AS A3, USE PREFIX A4		
A5				SAMPLER, SAME AS A3, USE PREFIX A5		
A6	08754-60006	5	1	VTO AND IF SWITCH	28480	08754-60006
A6C1	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C2	0160-2055	9	62	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C10	0160-0570	9	1	CAPACITOR-FXD 220PF +-20% 100VDC CER	28480	0160-0570
A6C11	0160-3878	6	8	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C14	0140-0205	5	1	CAPACITOR-FXD 62PF +-5% 300VDC MICA	72136	DM15E620J0300WV1CR
A6C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C16	0140-0221	5	1	CAPACITOR-FXD 220PF +-1% 300VDC MICA	72136	DM15F221F0300WV1C
A6C17	0160-2204	0	6	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A6C18	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C19	0121-0059	7	1	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A6C20*	0160-2306	3	2	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A6C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C22	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C25	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C27	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C28	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C29	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C30	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C31	0160-3873	1	4	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A6C32	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A6C33	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A6C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C35	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C36	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C37	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C39	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR14	1901-1068	5	10	DIODE-SCHOTTKY	28480	1901-1068
A6CR15	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A6CR16	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A6CR17	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A6CR18	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A6CR19	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A6CR20	1901-0827	2	1	DIODE-STEP-RECOVERY SILICON	28480	1901-0827
A6J1	1250-1512	3	4	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1512
A6J2	1250-1512	3		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1512
A6J3	1250-1512	3		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1512
A6J4	1250-1512	3		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1512
A6L1	9100-2562	6	6	COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A6L2	9100-2459	0	1	COIL-MLD 121UH 1% Q=60 .156DX.375LG-NOM	28480	9100-2459
A6L3	9140-0114	4	14	COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A6L4	9100-2258	7	3	COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A6L5	9100-2258	7		COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A6L6	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A6L7	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A6L8	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A6L9	9100-1618	1	1	COIL-MLD 5.6UH 10% Q=45 .155DX.375LG-NOM	28480	9100-1618
A6L10	9100-2258	7		COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A6Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A6Q2	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A6Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A6Q4	1854-0498	7	4	TRANSISTOR NPN SI TO-39 PD=1W 01921 61274	01928	2N5109
A6Q5	1854-0498	7		TRANSISTOR NPN SI TO-39 PD=1W 01921 61274	01928	2N5109
A6Q6	1854-0498	7		TRANSISTOR NPN SI TO-39 PD=1Q 01921 61274	01928	2N5109
A6Q7	1854-0498	7		TRANSISTOR NPN SI TO-39 PD=1Q 01921 61274	01928	2N5109
A6Q8	1853-0405	9	2	TRANSISTOR PNP 2N4209 SI TO-18 PD=300MW	28480	1853-0405
A6Q9	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A6Q10	1853-0405	9		TRANSISTOR PNP 2N4209 SI TO-18 PD=300MW	28480	1853-0405

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6Q11	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A6Q12	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A6Q13	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A6Q14	1854-0295	7	2	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A6Q15	1853-0451	5	16	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A6Q16	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A6R1	0757-0422	5	9	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A6R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R3	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R4	0698-3155	1	14	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R5	0757-0421	4	8	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A6R6	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A6R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R8	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R9	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R10	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A6R11	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A6R12	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A6R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R16	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R18	0698-3447	4	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R19	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R20	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R21	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A6R22	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A6R23	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R24	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A6R25	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A6R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R28	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A6R29	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A6R30	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R31	0757-0397	3	2	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R32	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R33	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R34	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R35	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R36	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R37	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R38	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R39	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A6R40	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R41	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R42	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A6R43	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R44	0698-3428	1	4	RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A6R45	0698-3428	1		RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A6R46	0698-3428	1		RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A6R47	0698-3428	1		RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A6R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R49	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R50	0698-7236	7	10	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R51	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R52	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R53	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R54	0698-3607	8	2	RESISTOR 18 5% 2W MO TC=0+-200	27167	FP42-2-T00-18R0-J
A6R55	0698-3607	8		RESISTOR 18 5% 2W MO TC=0+-200	27167	FP42-2-T00-18R0-J
A6R56	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R57	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R58	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6R59	0757-0158	4	2	RESISTOR 619 1% .5W F TC=0+-100	28480	0757-0158
A6R60	0698-3433	8	1	RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A6T1	08754-80001	2	1	TRANSFORMER, PULSE	28480	08754-80001
A6TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6U1	1826-0138	8	9	IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A6U2	1820-1308	4	9	IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A6U3	1810-0204	6	12	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6VR1	1902-3082	9	2	DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	28480	1902-3082
A6VR2	1902-3082	9		DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	28480	1902-3082
				A6 MISCELLANEOUS PARTS		
	1205-0329	3	4	HEAT SINK SGL TO-5/TO-39-PKG	28480	1205-0329
	2200-0164	5	4	SCREW-MACH 4-40 .188-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0124	4	4	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	4	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	1251-4666	6	10	CONNECTOR-SGL CONT PIN .03-IN-BSC-SZ RND	28480	1251-4666
A7	08754-60007	6	1	RF SOURCE ASSEMBLY (BOARD ASSEMBLY ONLY, DOES NOT INCLUDE A7U2, A7U3 OR A7W1)	28480	08754-60007
A7C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A7C2				NOT ASSIGNED		
A7C3				NOT ASSIGNED		
A7C4				NOT ASSIGNED		
A7C5				NOT ASSIGNED		
A7C6	0180-1746	5	4	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A7C7	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A7C8	0160-2204	0	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A7C9	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A7C10	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A7C11				NOT ASSIGNED		
A7C12	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7CR1				NOT ASSIGNED		
A7CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A7CR3	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A7CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A7CR5				NOT ASSIGNED		
A7CR6	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A7E1-A7E15	1251-3172	7		CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A7L1	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A7L2	9100-1625	0	1	COIL-MLD 33UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1625
A7L3	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A7L4	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A7Q1				NOT ASSIGNED		
A7Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A7Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A7Q4	1854-0637	1	1	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	28480	1854-0637
A7R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R2	2100-3056	8		RESISTOR-TRMR 5K 10% C-SIDE-ADJ 17 TRN	32997	3006P-1-502
A7R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R4				NOT ASSIGNED		
A7R5				NOT ASSIGNED		
A7R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R7	2100-1760	7	2	RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	28480	2100-1760
A7R8	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A7R9	2100-1760	7		RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	28480	2100-1760
A7R10	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A7R11	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A7R12	0757-1094	9	6	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A7R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R14	0698-3453	2	5	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A7R15	0757-0418	9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A7R16	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A7R17	0698-3408	7	2	RESISTOR 2.15K 1%.5W F TC=0+-100	28480	0698-3408
A7R18	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A7R19	0698-3396	2	2	RESISTOR 38.3 1% .5W F TC=0+-100	28480	0698-3396
A7R20	0757-0796	6	2	RESISTOR 82.5 1% .5W F TC=0+-100	28480	0757-0796
A7R21	0698-3400	9	1	RESISTOR 147 1% .5W F TC=0+-100	28480	0698-3400
A7R22	0757-0799	9	1	RESISTOR 121 1% .5W F TC=0+-100	28480	0757-0799
A7R23				NOT ASSIGNED		
A7R24	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A7R25	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A7R26	0698-3396	2		RESISTOR 38.3 1% .5W F TC=0+-100	28480	0698-3396
A7R27	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A7R28	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A7R29	0757-0796	6		RESISTOR 82.5 1% .5W F TC=0+-100	28480	0757-0796
A7R30	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7R31	0698-3443	0	2	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A7R32	2100-1753	8	1	RESISTOR-TRMR 20 5% WW SIDE-ADJ 1-TRN	28480	2100-1753
A7R33	0698-3408	7	7	RESISTOR 2.17K 1% .5W F TC=0+-100	28480	0698-3408
A7TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A7TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A7TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A7TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A7U1	1826-0371	1		OP AMP LOW NOISE	27014	LF 256H
A7U2	08754-60035	0		1-1300 MHZ SOURCE (INCLUDES MATCHED A15A1 RESISTOR ARRAY) (MUST BE ORDERED SEPARATELY)	28480	08754-60035
A7U2	08754-60036	1	2	(RESTORED 08754-60035; REQUIRES EXCHANGE)		
A7U3	5086-7235	4		AMPLIFIER-DETECTOR (MUST BE ORDERED SEPARATELY)	28480	5086-7235
A7U3	5086-6235	2		(RESTORED 5086-7235; REQUIRES EXCHANGE)		
A7W1	08505-60139	4	1	CABLE ASSEMBLY, RED	28480	08505-60139
				A7 MISCELLANEOUS PARTS		
	0380-0843	5	4	STANDOFF-RVT-ON .125-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
	1251-4666	6		CONNECTOR-SGL CONT PIN .03-IN-BSC-SZ RND	28480	1251-4666
A8	08754-60008	7	1	A,B DETECTOR ASSEMBLY	28480	08754-60008
A8C1	0160-0575	4	10	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A8C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C6	0160-3156	3	2	CAPACITOR-FXD 750PF +-1% 300VDC MICA	28480	0160-3156
A8C7	0160-4664	0	2	CAPACITOR-FXD 1600PF +-1% 63VDC POLYSTY	28480	0160-4664
A8C8	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C10	0160-3156	3		CAPACITOR-FXD 750PF +-1% 300VDC MICA	28480	0160-3156
A8C11	0160-4664	0		CAPACITOR-FXD 1600PF +-1% 63VDC POLYSTY	28480	0160-4664
A8C12	0121-0105	4	3	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A8C13	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C14	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C15	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C16	0140-0192	9	3	CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A8C17	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8C18	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C19	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A8C20	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A8C21	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C22	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A8C23	0160-3872	0	2	CAPACITOR-FXD 2.2PF +-.25PF 200VDC CER	28480	0160-3872
A8C24	0121-0444	4	2	CAPACITOR-V TRMR-CER 3-9PF 160V PC-MTG	28480	0121-0444
A8C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C26	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C27	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C28	0160-4298	6	14	CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C29	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C30	0160-2257	3	2	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A8C31	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C32	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C33	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C34	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A8C35	0160-2225	5	2	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A8C36	0160-2261	9	3	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A8C37	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A8C38	0160-3454	4	5	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A8C39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C40	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8C41	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C42	0160-3466	8	9	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A8C43	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A8C44	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A8C45	0121-0444	4		CAPACITOR-V TRMR-CER 3-9PF 160V PC-MTG	28480	0121-0444
A8C46	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A8C47	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8CR1	1901-0639	4	1	DIODE-PIN 110V	28480	5082-3080
A8CR2	1901-0539	3	6	DIODE-SCHOTTKY	28480	1901-0539
A8CR3	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539
A8CR4	1901-0040	1	6	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR10	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8CR11	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539
A8CR12	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539
A8CR13	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539
A8L1	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A8L2	08754-80002	3	4	INDUCTOR, VARIABLE	28480	08754-80002
A8L3	08754-80002	3		INDUCTOR, VARIABLE	28480	08754-80002
A8L4	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A8L5	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A8L6	9140-0210	1	34	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A8L7	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A8L8	9100-2573	9	1	COIL-MLD 1MH 10% Q=60 .156DX.375LG-NOM	28480	9100-2573
A8L9	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A8Q1	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A8Q2	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A8Q3	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A8Q5	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A8Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8Q8	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A8Q9	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8Q10	1854-0295	7		TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A8Q11	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8Q12	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A8R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R2	0757-0288	1	2	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A8R3	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A8R4	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R6	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R11	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A8R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R13	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A8R14	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R15	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A8R16	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R17	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R19	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R20	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R22	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A8R23	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A8R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R25	0757-0398	4	4	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R26	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R27	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R29	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A8R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R31	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R32	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R33	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A8R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R36	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R37	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R38	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A8R39	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R40	0757-0346	2	6	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R42	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R43	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R44	0698-3156	2	6	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A8R45	0811-3403	4	2	RESISTOR 1K 5% .25W PW TC=+3400+-300	28480	0811-3403
A8R46	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A8R47	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A8R48	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A8R49	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A8R50	2100-3056	8	5	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8R51	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A8R52	0757-0453	2	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A8R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R54	0698-0085	0	4	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A8R55	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A8R56	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A8R57	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R58	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A8R59	0698-3161	9	3	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A8R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R61	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A8R62	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A8R63	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R64	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R65	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R66	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R67	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R68	0698-6363	9	1	RESISTOR 40K .1% .125W F TC=0+-25	28480	0698-6363
A8R69	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R70	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A8R71	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A8R72	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A8R73	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R74	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A8R75	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R76	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A8R77	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A8R78	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R79	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R80	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A8R81	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A8R82	2100-3054	6	11	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A8R83	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A8R84	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R85	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R86	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R87	0698-8827	4	7	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A8R88	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A8R89	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A8R90	2100-3210	6	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A8R91	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A8R92	0698-8824	1	1	RESISTOR 562K 1% .125W F TC=0+-100	28480	0698-8824
A8R93	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A8R94	2100-3061	5	2	RESISTOR-TRMR 500K 10% C SIDE-ADJ 17-TRN	02111	43P504
A8TP1- A8TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A8U1	1813-0041	5	1	IC OP AMP TO-99	27014	LH0042CH
A8U2	1820-0223	0	1	IC 301 OP AMP TO-99	04713	MLM301AG
A8U3	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A8U4	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A8U5	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A8U6	1820-1973	9	5	IC SW PMOS ANALOG DUAL	01295	TL604CP
A8VR1	1902-0680	7	5	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	1N827
A8VR2	1902-0025	4	4	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
				A8 MISCELLANEOUS PARTS		
	5040-6853	4	1	BOARD EXTRACTOR, BROWN	28480	5040-6853
	5000-9043	6	10	PIN	28480	5000-9043
A9	08754-60009	8	1	PHASE DETECTOR ASSEMBLY	28480	08754-60009
A9C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A9C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C7	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A9C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C9	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A9C10	0160-3939	0	1	CAPACITOR-FXD 1400PF +-1% 100VDC MICA	28480	0160-3939

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9C11	0160-3536	3	1	CAPACITOR-FXD 620PF +-5% 100VDC MICA	28480	0160-3536
A9C12	0160-0839	3	1	CAPACITOR-FXD 110PF +-1% 300VDC MICA	28480	0160-0839
A9C13	0160-2543	0	1	CAPACITOR-FXD 500PF +-1% 300VDC MICA	28480	0160-2543
A9C14	0160-0218	2	3	CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A9C15	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C17	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C19	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C20	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C21	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C22	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C25	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A9C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C27	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C29	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A9C30	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A9C31	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C32	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A9C33	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C34	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C35	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C36	0140-0192	9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A9C37	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C38	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A9C39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C40	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C41	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C42	0160-3455	5	3	CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A9C43	0160-3455	5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A9C44	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A9C45	0140-0192	9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A9C46	0140-0220	4	1	CAPACITOR-FXD 200PF +-1% 300VDC MICA	72136	DM15F201F0300WV1CR
A9C47	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C48	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C49	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C50	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C51	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9L1	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A9L3	9140-0210	1		COIL-MLD 100UH10% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L4	9140-0181	5	2	COIL-MLD 22UH 5% Q=50 .095DX.25LG-NOM	28480	9140-0181
A9L5	9140-0155	3	3	COIL-MLD 28UH 1% Q=60 .156DX.375LG-NOM	28480	9140-0155
A9L6	9140-0181	5		COIL-MLD 22UH 5% Q=50 .095DX.25LG-NOM	28480	9140-0181
A9L7	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L8	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L9	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L10	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L11	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L12	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L13	08754-80002	3		INDUCTOR, VARIABLE	28480	08754-80002
A9L14	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A9L15	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9L16	9100-1638	5	1	COIL-MLD 130UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1638
A9L17	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A9Q1	1853-0316	1	3	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A9Q2	1855-0413	3	4	TRANSISTOR J-FET P-CHAN D-MODE TO-18 SI	27014	2N5116
A9Q3	1854-0485	7		TRANSISTOR NPN SI TO-104 PD=175 MW	28480	1854-0485
A9Q4	1854-0485	7		TRANSISTOR NPN SI TO-104 PD=175 MW	28480	1854-0485
A9Q5	1855-0413	3		TRANSISTOR J-FET P-CHAN D-MODE TO-18 SI	27014	2N5116
A9Q6	1853-0316	1		TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A9Q7	1854-0485	7		TRANSISTOR-NPN SI TO-104 PD=175 MW	28480	1854-0485
A9Q8	1853-0018	0	6	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A9Q9	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A9Q10	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD 400MW	28480	1853-0322
A9R1	2100-3161	6	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
A9R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R4	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A9R5	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R6	0757-0289	2	4	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A9R7	0811-3403	4		RESISTOR 1K 5% .25W PW TC=+3400+-300	28480	0811-3403
A9R8	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A9R9	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A9R10	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A9R12	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A9R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R14	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A9R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R18	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A9R19	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A9R20	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R21	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R28	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R29	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A9R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R31	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A9R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R35	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A9R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R37	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A9R38	0757-0463	4	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A9R39	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A9R40	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A9R41	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A9R42	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A9R43	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R44	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A9R45	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R46	0698-3445	2	4	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R48	0757-0274	5	7	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A9R49	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A9R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R52	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A9R53	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A9R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R55	2100-3273	1	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A9R56	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R57	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A9R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R59	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R60	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A9R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R64	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A9R65	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R66	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R67	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R68	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A9R69	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A9R70	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A9R71	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A9R72	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R73	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R74	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R75	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A9R76	0698-3136	8	2	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A9R77	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A9R78	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A9R79	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R80	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A9R81	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R82	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R83	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A9R84	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A9R85	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9R86	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R87	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R88	0757-0280	3		RESISTOR 1K 1% .125W F TC 0+-100	24546	C4-1/8-TO-1001-F
A9R89	0757-0465	6		RESISTOR 100K 1% .125W F TC 0+-100	24546	C4-1/8-TO-1003-F
A9TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9U1	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A9U2	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A9U3	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A9U4	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A9U5	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A9U6	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A9U7	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A9U8	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A9U9	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A9U10	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A9U11	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A9U12	1858-0032	8	3	TRANSISTOR ARRAY	01928	CA3146E
A9VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	1N827
A9VR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC .009	28480	1902-0041
A9Z1	9170-0847	3	9	CORE-SHIELDING BEAD	28480	9170-0847
A9Z2	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
				A9 MISCELLANEOUS PARTS		
	5040-6847	6	1	BOARD EXTRACTOR, RED	28480	5040-6847
	5000-9043	6		PIN	28480	5000-9043
	1251-4666	6		CONNECTOR-SGL CONT PIN .03-IN-BSC-SZ RND	28480	1251-4666
A10	08754-60010	1	1	POLAR CONVERTER ASSEMBLY	28480	08754-60010
A10C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C4	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C5	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C6	0160-4299	7	1	CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A10C7	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C12	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C13	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C14	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A10C15	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A10C16	0140-0191	8	2	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
A10C17*	0160-2241	5	1	CAPACITOR-FXD 2.2PF +-.25PF 500VDC CER	28480	0160-2241
A10C18	0160-3455	5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A10C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C25	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C27	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C28	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C29	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C30	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A10C31	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C32	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C33	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C34	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C35	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C36	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C37	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A10C38	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A10C39	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A10C40	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C42	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C43	0160-2101	6	1	CAPACITOR-FXD 27PF +-2% 300VDC MICA	28480	0160-2101
A10C44	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A10C45	0140-0191	8		CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10C46	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C47	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C48	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C49	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A10C50	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A10C51	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C52	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A10CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A10CR3	0122-0043	1	1	DIODE-VVC 39PF 2% C4/C25-MIN=1.9 BVR=30V	28480	0122-0043
A10L1	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A10L3	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L4	9100-1641	0	10	COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A10L5	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A10L6	9140-0144	0	4	COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A10L7	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L8	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A10L9	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L10	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L11	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A10L12	9140-0155	3		COIL-MLD 28UH 1% Q=60 .156DX.375LG-NOM	28480	9140-0155
A10L13	08754-80002	3		INDUCTOR, VARIABLE	28480	08754-80002
A10L14	9140-0155	3		COIL-MLD 28UH 1% Q=60 .156DX.375LG-NOM	28480	9140-0155
A10Q1	1853-0316	1		TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A10Q2	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A10Q3	1855-0413	3		TRANSISTOR J-FET P-CHAN D-MODE TO-18 SI	27014	2N5116
A10Q4	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A10Q5	1855-0413	3		TRANSISTOR J-FET P-CHAN D-MODE TO-18 SI	27014	2N5116
A10R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R2	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A10R3	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A10R4	0698-6317	3	2	RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B
A10R5	0698-6317	3		RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B
A10R6	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A10R7	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A10R8	0698-6740	6		RESISTOR 15K .1% .125W F TC=0+-50	28480	0698-6740
A10R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R12	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R13	0698-3454	3	3	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A10R14	0698-3459	8	1	RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A10R15	2100-3061	5		RESISTOR-TRMR 500K 10% C SIDE-ADJ 17-TRN	02111	43P504
A10R16	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A10R17	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R18	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A10R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R20	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A10R21	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R22	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A10R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R24	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R25	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R27	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R29	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R31	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R32	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R33	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R36	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A10R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R38	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A10R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R40	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A10R41	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R42	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R43	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A10R44	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R45	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R46	0757-0417	8	5	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10R47	0757-0278	9	6	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A10R48	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10R49	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A10R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R51	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R52	2100-3109	2	4	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A10R53	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R54	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R55	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R56	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R58	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R59	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R60	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A10R61	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A10R62	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R64	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R65	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R66	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10R67	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A10R68	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A10R69	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A10R70	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R71	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R72	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A10R73	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R74	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R75	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R76	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R77	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R78	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A10R79	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R80	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A10R81	0698-6625	6		RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A10R82	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R83	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R84	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R85	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R86	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R87	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A10R88	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R89	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A10R90	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A10R91	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10S1	3101-1273	0	1	SWITCH-SL DPDT-NS SUBMIN 2A 120VAC PC	28480	3101-1273
A10TP1-	0360-0535	0	109	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10U1	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A10U2	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A10U3	1820-0427	6	2	IC 1496 MODULATOR TO-100	04713	MC1496G
A10U4	1820-0427	6		IC 1496 MODULATOR TO-100	04713	MC1496G
A10U5	1820-0817	8	3	IC FF ECL D-M/S DUAL	04713	MC10131P
A10U6	1820-1119	5	1	IC OSC ECL	04713	MC1648L
A10U7	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A10U8	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A10U9	1826-0447	2	1	IC OP AMP TO-99	27014	LF257H
A10U10	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A10U11	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A10U12	1820-0802	1	2	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A10U13	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A10U14	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A10U15	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A10U16	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A10U17	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A10U18	1858-0032	8		TRANSISTOR ARRAY	01928	CA3146E
A10VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	1N827
				A10 MISCELLANEOUS PARTS		
	5040-6852	3	1	BOARD EXTRACTOR, ORANGE	28480	5040-6852
	5000-9043	6		PIN	28480	5000-9043

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11				DETECTOR, SAME AS A8, USE PREFIX A11		
A12	08754-60012	3	1	MARKER GENERATOR ASSEMBLY	28480	08754-60012
A12C1	0160-3877	5	1	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A12C2	0160-0572	1	1	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A12C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C4	0160-3872	0		CAPACITOR-FXD 2.2PF +-.25PF 200VDC CER	28480	0160-3872
A12C5	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A12C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C9	0160-2208	4	2	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A12C10	0160-0945	2		CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A12C11	0160-3539	6	1	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
A12C12	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A12C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C14	0160-2220	0	1	CAPACITOR-FXD 1200PF +-5% 300VDC MICA	28480	0160-2220
A12C15	0160-2230	2	1	CAPACITOR-FXD 3300PF +-5% 300VDC MICA	28480	0160-2230
A12C16	0160-2229	9	1	CAPACITOR-FXD 3000PF +-5% 300VDC MICA	28480	0160-2229
A12C17	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C19	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C20	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C22	0160-2306	3		CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A12C23	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A12C24	0160-2228	8	1	CAPACITOR-FXD 2700PF +-5% 300VDC MICA	28480	0160-2228
A12C25	0160-0157	8	2	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A12C26	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A12C27	0160-2203	9	1	CAPACITOR-FXD 91PF +-5% 300VDC MICA 0+70	28480	0160-2203
A12C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C29	0121-0036	0	1	CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A12C30	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C31	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C32	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C33	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C35	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C36	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A12C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C38	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C39	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C40	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C42	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C43	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C44	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12C45	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C46	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C47	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C48	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C49	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C50	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C51	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C52	0160-2265	3	1	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A12C53	0160-2264	2	2	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A12C54	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C55	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C56	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A12C57	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A12CR1	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A12CR2	1901-1068	5		DIODE-SCHOTTKY	28480	1901-1068
A12CR3	1901-0457	4	1	DIODE-STEP RCVY 30V DO-7	28480	1901-0457
A12CR4	1901-0179	7	5	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A12CR5	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A12CR6	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A12CR7	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A12CR8	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A12CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A12CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A12CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A12J1	1250-0257	1	2	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A12J2	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12L1	9100-2817	4	1	COIL-MLD 100NH 5% .095DX.25LG-NOM	28480	9100-2817
A12L2	9100-1620	5	1	COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A12L3	9100-1621	6	2	COIL-MLD 18UH 10% Q=75 .155DX.375LG-NOM	28480	9100-1621
A12L4	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L5	9100-1644	3		COIL-MLD 330UH 5% Q=65 .19DX.44LG-NOM	28480	9100-1644
A12L6	9100-1645	4	1	COIL-MLD 390UH 5% Q=65 .19DX.44LG-NOM	28480	9100-1645
A12L7	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L8	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L9	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L10	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L11	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L12	9140-0105	3	1	COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A12L13	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12L14	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A12Q1	1855-0406	4	3	TRANSISTOR J-FET P-CHAN D-MODE SI	32293	IT110
A12Q2	1855-0049	1	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A12Q3	1855-0049	1		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A12Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A12Q5	1854-0019	3	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A12Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A12Q7				NOT ASSIGNED		
A12Q8	1855-0406	4		TRANSISTOR J-FET P-CHAN D-MODE SI	32293	IT110
A12Q9	1855-0406	4		TRANSISTOR J-FET P-CHAN D-MODE SI	32293	IT110
A12R1	0698-7212	9	7	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A12R2	0698-3158	4	3	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A12R3	0698-7209	4	1	RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A12R4	0698-7197	9	1	RESISTOR 23.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-23R7-G
A12R5	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A12R6	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A12R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A12R8	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A12R9	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A12R10	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A12R11	0698-7260	7	2	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A12R12	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A12R13	2100-3162	7	1	RESISTOR-TRMR 200K 10% C SIDE-ADJ 17-TRN	02111	43P204
A12R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A12R15	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A12R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R17	0698-3438	3	2	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A12R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R19	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A12R20	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A12R21	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A12R22	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A12R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A12R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R26	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A12R27	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R29	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A12R30	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A12R31	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R32	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R33	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R34	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A12R35	0698-3441	8	6	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A12R36	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A12R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R38	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A12R39	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R41	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A12R42	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R43	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A12R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R45	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R46	0698-3455	4	1	RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A12R47	0683-1555	0	1	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A12R48	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A12R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R51	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R55	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R57	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A12R58	0757-0443	0	4	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A12R59	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A12R60	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A12R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R62	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R63				NOT ASSIGNED		
A12TP1- A12TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A12U1	1820-1383	5	3	IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A12U2	1820-1383	5		IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A12U3	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A12U4	1820-0809	8	1	IC RCVR ECL LINE RCVR QUAD 2-INP	04713	MC10115P
A12U5	1820-0829	2	1	IC MUXR/DATA-SEL ECL 8-TO-1-LINE 8-INP	04713	MC10164L
A12U6	1820-1545	1		IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A12U7	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A12U8	1826-0103	7	1	IC WIDEBAND AMPL TO-100	04713	MC1545G
A12U9	1826-0210	7	1	IC COMPARATOR 14-DIP-P	27014	LM361N
A12U10	1826-0036	5	1	IC MULTIPLIER 16-DIP-C	04713	MC1494L
A12U11	1820-1547	3	2	IC MUXR/DATA-SEL CMOS	04713	MC14051BCL
A12U12	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A12U13	1820-1112	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A12U14	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A12U15	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	18324	NE555V
A12VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A12VR2	1902-3059	0	1	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
A12Y1	0410-0594	8	1	CRYSTAL-QUARTZ 50 MHZ +-.001% WITH 36PF	28480	0410-0594
				A12 MISCELLANEOUS PARTS		
	5040-6848	7	1	BOARD EXTRACTOR, YELLOW	28480	5040-6848
	5000-9043	6		PIN	28480	5000-9043
A13	08754-60013	4	1	PHASE LOCK ASSEMBLY	28480	08754-60013
A13C1	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C2	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C5	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C8	0160-0134	1	1	CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A13C9	0160-3534	1	1	CAPACITOR-FXD 510PF +-5% 100VDC MICA	28480	0160-3534
A13C10	0160-0939	4	1	CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0939
A13C11	0160-2307	4	2	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A13C12	0140-0194	1	1	CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A13C13	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C14	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C15	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C17	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C19	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C20	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C24	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C25	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C26	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C29	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C31	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C32	0160-2307	4		CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A13C33	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A13C34	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C35	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A13C36	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A13C37	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C38	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C39	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C40	0160-0336	5	1	CAPACITOR-FXD 100PF +-1% 300VDC MICA	28480	0160-0336

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13C41	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C42	0140-0225	9	1	CAPACITOR-FXD 300PF +-1% 300VDC MICA	72136	DM15F301F0300WV1C
A13C43	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C44	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A13C45	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C46	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C47	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A13C48	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C49	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C50	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C51	0160-2225	5		CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A13C52	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A13C53	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C54	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C55	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C56	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C57	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C58	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C59	0160-0573	8		CAPACITOR-FXD 4700PF +-20% 50VDC CER	28480	0160-0573
A13C60	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C61	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C62	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C63	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C64	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C65	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C66	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C67	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13CR1	1901-0535	9	2	DIODE-SCHOTTKY 15V	28480	1901-0535
A13CR2	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A13CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR8	1901-0539	3	2	DIODE-SCHOTTKY 20V	28480	1901-0539
A13CR9		3		NOT ASSIGNED		
A13CR10	1901-0539	3		DIODE-SCHOTTKY 20V	28480	1901-0539
A13CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13L1	9100-1621	6		COIL-MLD 18UH 10% Q=75 .155DX.375LG-NOM	28480	9100-1621
A13L2	9140-0179	1	1	COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A13L3	9100-2262	3	1	COIL-MLD 3.9UH 10% Q=45 .095DX.25LG-NOM	28480	9100-2262
A13L4	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A13L5	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L6	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L7	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L8	9100-1629	4	3	COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L9	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L10	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A13L11	9140-0317	9	1	COIL-MLD 113UH 1% Q=60 .155DX.375LG-NOM	28480	9140-0317
A13L12	9140-0318	0	1	COIL-MLD 338UH 1% Q=65 .155DX.375LG-NOM	28480	9140-0318
A13L13	9100-1624	9	1	COIL-MLD 30UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1624
A13L14	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L15	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L16	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L17	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L18	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A13L19	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A13L20	9100-1788	6	4	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A13L21	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A13L22	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A13Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A13Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A13Q3	1854-0546	1	3	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A13Q4	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A13Q5	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A13Q6	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A13Q7	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A13Q8	1855-0062	8	3	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0062
A13Q9	1855-0062	8		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0062
A13Q10	1855-0062	8		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0062
A13Q11	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A13Q12	1853-0314	9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TU-1961-F
A13R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R3	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A13R4	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A13R5	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R6	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A13R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R9	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A13R10	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A13R11	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A13R12	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A13R13	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R16	0698-7239	0	1	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A13R17	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A13R18	0698-7237	8	4	RESISTOR 1.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1101-G
A13R19	0698-7243	6	1	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A13R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A13R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R22	0698-7237	8		RESISTOR 1.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1101-G
A13R23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R27	0698-7237	8		RESISTOR 1.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1101-G
A13R28	0698-7237	8		RESISTOR 1.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1101-G
A13R29	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A13R30	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A13R31	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A13R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R33	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R34	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A13R35	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A13R36	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A13R37	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A13R38	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A13R39	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R40	0698-7284	5	3	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A13R41	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A13R42	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A13R43	0698-7247	0	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-G
A13R44	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A13R45	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A13R46	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R47	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A13R48	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A13R49	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A13R50	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A13R51	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A13R52	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A13R53	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A13R54	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A13R55	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A13R56	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A13R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R59	0757-0814	9		RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A13R60	0757-0802	5	1	RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A13R61	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13R62	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R64	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R65	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R66	0757-0460	1	4	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A13R67	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R69	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R70	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R71	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A13R72	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R73	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R74	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R76	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R77	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R78	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R79	2100-0558	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A13R80	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A13R81-	0698-7205			RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TOO-56A2-6
A13R84	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TOO-56A2-6
A13TP1-	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
		0				
		0				
		0				
A13U1	1820-1973	9		IC SW PMOS ANALOG DUAL	01295	TL604CP
A13U2	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A13U3	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A13U4	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A13U5	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A13U6	1820-1383	5		IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A13U7	1810-0203	5	2	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R470
A13U8	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A13U9	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A13U10	1820-1344	8	1	IC PL LOOP 14-DIP-C	04713	MC12040L
A13U11	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A13U12	1810-0205	7	2	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R4.7K
A13U13	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A13U14	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A13U15	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A13U16	1820-1547	3		IC MUXR/DATA-SEL CMOS	04713	MC14051BCL
A13U17	1820-1973	9		IC SW PMOS ANALOG DUAL	01295	TL604CP
A13VR1	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A13VR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A13VR3	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A13Y1	0410-0109	1	1	CRYSTAL-QUARTZ 10 MHZ	28480	0410-0109
A13Z1	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
A13Z2	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
A13Z3	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
A13Z4	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
A13Z5	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
				A13 MISCELLANEOUS PARTS		
	5040-6851	2	1	BOARD EXTRACTOR, GREEN	28480	5040-6851
	5000-9043	6		PIN	28480	5000-9043
	1205-0011	0	3	HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
	1200-0185	9	3	INSULATOR-XSTR NYLON	28480	1200-0185
A14	08754-60014	5	1	PHASE LOCK CONTROL ASSEMBLY	28480	08754-60014
A14C1	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A14C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C3	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A14C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C5	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C9	0160-3490	8	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-3490
A14C10	0160-2308	5	1	CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A14C11	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A14C12	0140-0194	1		CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A14C13	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A14C14	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A14C15	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C18	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A14C19	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A14C20	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A14C21	0160-3134	7	4	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3134
A14C22	0160-3134	7		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3134
A14C23	0160-3134	7		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3134
A14C24	0160-3134	7		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3134
A14C25	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A14C26	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A14C27	0180-2206	4	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A14C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C29	0160-0161	4	1	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A14C30	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14C31	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A14C32	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A14C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C35	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A14C36	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C38	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C40	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C42	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C43	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C45	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C46	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14CR1	1901-0033	2	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR5	1901-0743	1	4	DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A14CR6	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A14CR7	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A14CR8	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A14DS1	1990-0487	7	3	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A14DS2	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A14DS3	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A14J1	1250-0543	8	2	CONNECTOR-RF SM-SNP M PC 50-OHM	28480	1250-0543
A14J2	1250-0543	8		CONNECTOR-RF SM-SNP M PC 50-OHM	28480	1250-0543
A14L1	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A14L2	9140-0158	6	1	COIL-MLD 1UH 10% Q=32 .095DX.25LG-NOM	28480	9140-0158
A14L3	9100-2258	7		COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A14L4	9100-2257	6	1	COIL-MLD 820NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2257
A14L5	9100-2585	3	1	COIL-MLD 10MH 10% Q=40 .156DX.375LG-NOM	28480	9100-2585
A14L6	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A14L7	9100-1618	1		COIL-MLD 5.6UH 10% Q=45 .155DX.375LG-NOM	28480	9100-1618
A14L8	9100-1618	1		COIL-MLD 5.6UH 10% Q=45 .155DX.375LG-NOM	28480	9100-1618
A14L9	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A14L10	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A14Q1	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A14Q2	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A14Q3	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A14Q4	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A14Q5	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A14Q6	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A14Q7	1855-0413	3		TRANSISTOR J-FET P-CHAN D-MODE TO-18 SI	27014	2N5116
A14Q8	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A14R1	0698-7214	1	1	RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G
A14R2	0698-7210	7	1	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-G
A14R3	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A14R4	0698-7196	8	1	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A14R5	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A14R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R7	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A14R8	0698-8821	8	1	RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A14R9	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A14R10	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A14R11	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A14R12	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-TO-215R-6
A14R13	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A14R14	0698-7250	5	1	RESISTOR 3.83K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3831-G
A14R15	0698-7223	2	3	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A14R16	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A14R17	0698-7260	9	1	RESISTOR 10K 1% .05W F TC=0+-100	24546	C4-1/8-TO-1002-F
A14R18	0698-7218	5	1	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A14R19	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-T0-215R-G
A14R20	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A14R21	0757-0280	3		RESISTOR 1K 1% .05W F TC=0+-100	24546	C4-1/8-TO-1001-F
A14R22	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A14R23	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A14R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R25	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R27	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A14R28	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A14R29	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A14R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R31	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A14R32	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R35	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A14R36	0698-3132	4	2	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A14R37	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R38	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R39	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R40	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R42	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A14R43	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A14R44	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A14R45	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A14R46	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A14R47	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A14R48	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A14R49	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A14R50	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R51	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A14R52	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A14R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R54	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A14R55	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R56	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A14R57	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A14R58	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A14R59	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A14R60	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A14R61	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A14R62	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A14R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R65	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R66	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A14R67	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A14R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R69	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R70	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R71	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R72	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R73	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R74	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A14R75	0698-3450	9	4	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A14R76	0757-0470	3		RESISTOR 162K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1623-F
A14R77	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R78	2100-3356	1	1	RESISTOR-TRMR 200K 10% C SIDE-ADJ 1-TRN	28480	2100-3356
A14R79	0757-0460	1		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A14R80	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R81	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R82	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R83	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R84	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R85	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R86	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A14R87	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A14R88	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R89	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R90	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A14R91	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R92	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R93	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R94	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R95	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R96	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R97	0757-0317	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1101-F
A14TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14U1	1820-1308	4		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116L
A14U2	1810-0203	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R470
A14U3	1820-1888	5	1	IC PRESCR ECL	04713	MC12013L
A14U4	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A14U5	1810-0205	7		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R4.7K
A14U6	1820-1851	2	1	IC ENCDR TTL LS	34335	AM74LS148N
A14U7	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A14U8	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A14U9	1820-1446	1	1	IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS395N
A14U10	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A14U11	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A14U12	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A14U13	1820-1437	0	3	IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A14U14	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A14U15	1820-1437	0		IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A14U16	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U17	1820-1202	7	3	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A14U18	1826-0497	2	1	IC COMPARATOR TO-99	27014	LF311H
A14U19	1820-1437	0		IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A14U20	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A14U21	1820-1415	4	1	IC SCHMITT-TRIG TTL LS NAND DUAL 4-INP	01295	SN74LS13N
A14U22	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14Z1	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
A14Z2	9170-0847	3		CORE-SHIELDING BEAD	28480	9170-0847
				A14 MISCELLANEOUS PARTS		
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6849	8	1	EXTRACTOR, P.C. BOARD	28480	5040-6849
A15	08754-60015	6	1	SHAPER ASSEMBLY (DOES NOT INCLUDE A15A1)	28480	08754-60015
A15C1	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C3	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C5	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C7	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A15C8	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A15C9	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A15C11	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C14	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A15C15	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A15C17	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C18	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15CR1- A15CR31	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A15L1	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A15L2	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A15L3	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A15Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A15Q2	1855-0386	9	4	TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A15Q3	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A15Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A15Q5	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A15Q6	1853-0038	4	2	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A15Q7	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A15Q8	1854-0234	4	2	TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	01928	2N3440
A15Q9	1854-0234	4		TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	01928	2N3440
A15R1	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A15R2				NOT ASSIGNED		
A15R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R4	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A15R5	0757-0460	1		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R7	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A15R8	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A15R9	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A15R10	0698-6631	4		RESISTOR 2.5K .1% .125W F TC=0+-25	28480	0698-6631
A15R11	0698-6321	9	1	RESISTOR 9.9K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-9901-B
A15R12	0698-5394	4	1	RESISTOR 105.5 .1% .125W F TC=0+-25	28480	0698-5394
A15R13	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A15R14	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A15R15	0698-6320	8	4	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A15R16	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A15R17	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A15R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R19	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A15R20	0698-7796	4	1	RESISTOR 14.7K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-1472-C
A15R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R23	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A15R24	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A15R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R26	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A15R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R30	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A15R31	0698-3434	9	2	RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A15R32	0698-3434	9		RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A15R33	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A15R34	0698-8172	2		RESISTOR 4K .25% .125W F TC=0+-50	19701	MF4C1/8-T2-4001-C
A15R35	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A15R36	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A15R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R38	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R39	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R40	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R41	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A15R42	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A15R43	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A15R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A15R45	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A15R46	0698-7396	0	2	RESISTOR 1.474K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1474R-B
A15R47	0698-7396	0		RESISTOR 1.474K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1474R-B
A15R48	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R49	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R50	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R51	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R52	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R53	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R54	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R55	2100-3094	4	4	RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A15R56	2100-3094	4		RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A15R57	2100-3094	4		RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A15R58	2100-3094	4		RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A15R59	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R60	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R61	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A15R62*	0698-3157	3	9	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A15R63*	0698-3160	8	6	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A15R64*	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A15R65*	0757-0465	6	17	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A15R66*	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A15R67	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A15R68	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A15R69	0698-4037	0	2	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A15R70	0698-3435	0	2	RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A15R71	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R72	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R73	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A15R74	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R75	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R76	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A15R77	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R78	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R79	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R80	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15R81	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A15R82	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A15R83	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A15R84*	0757-0467	8	1	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A15R85	0757-0158	4		RESISTOR 619 1% .5W F TC=0+-100	28480	0757-0158
A15R86	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A15R87	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A15R88	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A15R89	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A15R90	0757-0460	1		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A15R91	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R92	0698-6630	3	1	RESISTOR 20K .1% .125W F TC=0+-25	28480	0698-6630
A15R93	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R94	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R95	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A15R96	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15R97	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A15R98	2100-1660	6	2	RESISTOR-TRMR 10K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-103
A15R99	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A15R100	2100-1660	6		RESISTOR-TRMR 10K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-103
A15R101	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A15R102	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A15R103	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R104	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R105	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A15R106	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A15R107	0698-3451	0	5	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A15S1	3101-2199	1	1	SWITCH, SLIDE SPDT	28480	3101-2199
A15TP1- A15TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A15U1	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A15U2	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A15U3	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A15U4	1810-0215	9	4	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R75K
A15U5	1810-0215	9		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R75K
A15U6	1810-0215	9		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R75K
A15U7	1810-0215	9		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R75K
A15U8	1826-0371	1	5	IC OP AMP TO-99	27014	LF256H
A15U9	1820-1545	1		IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A15U10	1826-0229	8		IC OP AMP TO-99	06665	OP-05CJ
A15U11	1826-0371	1		IC OP AMP TO-99	27014	LF256H
A15U12	1826-0161	7	1	IC 324 OP AMP 14-DIP-P	18324	LM324-A
A15U13	1826-0175	3	1	IC COMPARATOR 14-DIP-P	27014	LM319N
A15U14	1826-0371	1		IC OP AMP TO-99	27014	LF256H
A15U15	1826-0371	1		IC OP AMP TO-99	27014	LF256H
A15U16	1826-0371	1		IC OP AMP TO-99	27014	LF256H
A15VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	1N827
A15VR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A15VR3	1902-3357	1	2	DIODE-ZNR 56.2V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3357
A15VR4	1902-3357	1		DIODE-ZNR 56.2V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3357
A15VR5	1902-3203	6	3	DIODE-ZNR 14.7V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3203
A15XA1	1200-0553	5	1	SOCKET-IC 28-CONT DIP-SLDR	28480	1200-0553
				A15 MISCELLANEOUS PARTS		
	5040-6850	1	1	BOARD EXTRACTOR, CLEAR	28480	5040-6850
	5000-9043	6		PIN	28480	5000-9043
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
	1200-0185	9		INSULATOR-XSTR NYLON	28480	1200-0185
A15A1	08754-60035	0		RESISTOR ARRAY(MATCHED WITH A7U2 INCLUDES A7U2)	28480	08754-60035
A15A1J1	0360-1933	4	1	CONNECTOR, 28-CONTACT, DIP	28480	0360-1933
A15A1R1*	0698-3162	0	23	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R2*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R3*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R4*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R5*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R6*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R7*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R8*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R9*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R10*	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R11*	0698-3162			RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A15A1R12*	0698-3162			RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16	08754-60016	7	1	DC REGULATOR ASSEMBLY	28480	08754-60016
A16C1	0180-2141	6	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A16C2	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A16C3				NOT ASSIGNED		
A16C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A16C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A16C6	0180-1706	7		CAPACITOR-FXD 100UF+-20% 25VDC TA	06001	69F245G7
A16C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A16C8				NOT ASSIGNED		
A16C9	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A16C10	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A16C11	0180-1706	7		CAPACITOR-FXD 100UF+-20% 25VDC TA	06001	69F245G7
A16C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A16C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A16C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A16C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A16CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16CR3	1901-0028	5	3	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A16CR4	1884-0018	5	5	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A16CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16CR8	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A16CR9	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A16CR10	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A16CR11	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A16CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A16DS1	1990-0485	5	9	LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16DS2	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16DS3	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16DS4	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16DS5	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16DS6	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A16F1	2110-0004	1	2	FUSE .25A 250V FAST-BLU 1.25X.25 UL IEC	28480	2110-0004
A16Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A16Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A16Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A16Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A16Q5	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	07263	2N2222A
A16Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A16R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A16R2	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A16R3	0811-1552	0	2	RESISTOR .56 5% 2W PW TC=0+-800	75042	BWH2-9/16-J
A16R4	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A16R5	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A16R6	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A16R7	0683-0275	9	2	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A16R8	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A16R9	0698-5674	3	1	RESISTOR 5.62K 1% .125W F TC=0+-25	28480	0698-5674
A16R10	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A16R11	0698-5553	7	1	RESISTOR 2.4K 1% .125W F TC=0+-25	28480	0698-5553
A16R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R13	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A16R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A16R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A16R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A16R17	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A16R18	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A16R19	0698-6322	0		RESISTOR 4K .1% .125W F TC=0+-25	28480	0698-6322
A16R20	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A16R21	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A16R22	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A16R23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A16R24	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A16R25	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A16R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A16R27	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A16R28	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A16R29	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R30	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16R31	0811-1552	0		RESISTOR .56 5% 2W PW TC=0+-800	75042	BWH2-9/16-J
A16R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A16R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A16R34	0757-0316	6		RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A16R35	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A16R36	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A16R37	0757-0316	6		RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A16R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A16R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A16R40	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A16R41	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A16R42	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A16R43	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A16R44	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R45	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A16U1	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A16U2	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A16VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	1N827
A16VR2	1902-3252	5	1	DIODE-ZNR 22.6V 2% DO-7 PD=.4W TC=+.073%	28480	1902-3252
A16VR3	1902-3203	6		DIODE-ZNR 14.7V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3203
A16VR4	1902-1291	8	1	DIODE-ZNR 1N5338B 5.1V 5% PD=5W IR=1UA	04713	1N5338B
A16VR5	1902-3171	7	1	DIODE-ZNR 11V 5% DO-7 PD=.4W TC=+.062%	28480	1902-3171
A16VR6	1902-0048	1	1	DIODE-ZNR 6.81V 5% DO-7 PD=.4W TC=+.043%	28480	1902-0048
A16VR7	1902-3110	4	2	DIODE-ZNR 5.9V 2% DO-7 PD=.4W TC=+.017%	28480	1902-3110
A16VR8	1902-3005	6	2	DIODE-ZNR 2.43V 5% DO-7 PD=.4W TC=-.076%	28480	1902-3005
A16VR9	1902-0064	1	1	DIODE-ZNR 7.5V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0064
A16VR10	1902-3110	4		DIODE-ZNR 5.9V 2% DO-7 PD=.4W TC=+.017%	28480	1902-3110
A16VR11	1902-3005	6		DIODE-ZNR 2.43V 5% DO-7 PD=.4W TC=-.076%	28480	1902-3005
A16VR12	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A16VR13	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
				A16 MISCELLANEOUS PARTS		
	5040-6846	5	1	BOARD EXTRACTOR, GRAY	28480	5040-6846
	5000-9043	6		PIN	28480	5000-9043
	2110-0269	0	18	FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A17	08754-60017	8	1	SWEEP GENERATOR ASSEMBLY	28480	08754-60017
A17C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A17C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C3	0160-3402	2	1	CAPACITOR-FXD 1UF +-5% 50VDC MET-POLYC	28480	0160-3402
A17C4				NOT ASSIGNED		
A17C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A17C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A17C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A17C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C12	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A17CR1				NOT ASSIGNED		
A17CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A17CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A17CR4	1901-0376	6	1	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A17CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A17CR6	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A17CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A17L1	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A17Q1	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A17Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A17Q3	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A17Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A17Q5				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A17Q7	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	28480	1854-0474
A17Q8	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A17Q9	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A17Q10	1854-0079	5	1	TRANSISTOR NPN 2N3439 SI TO-5 PD=1W	01928	2N3439
A17R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R2	0757-0279	0		RESISTOR 3,16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A17R3	0757-0440	7		RESISTOR 7,5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A17R4	0757-0289	2		RESISTOR 13,3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A17R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R6	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A17R7	0757-0439	4		RESISTOR 6,81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A17R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R9	0698-0084	9		RESISTOR 2,15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A17R10	0698-3450	9		RESISTOR 42,2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A17R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R14	0757-0279	0		RESISTOR 3,16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A17R15	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A17R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R17	0698-3153	9		RESISTOR 3,83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A17R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R19	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A17R20	2100-3103	6	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A17R21	0698-0083	8		RESISTOR 1,96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A17R22	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A17R23	0757-0274	5		RESISTOR 1,21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A17R24	2100-3095	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	02111	43P201
A17R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A17R26	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A17R27	0698-7421	2	2	RESISTOR 40K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-4002-C
A17R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R30	0757-0458	7		RESISTOR 51,1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A17R31	0698-7421	2		RESISTOR 40K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-4002-C
A17R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R33	0698-0083	8		RESISTOR 1,96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A17R34	0698-0083	8		RESISTOR 1,96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A17R35	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A17R36	0757-0394	0		RESISTOR 51,1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R37	0757-0316	6		RESISTOR 42,2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A17R38	0698-6956	6	1	RESISTOR 1,837K .1% .125W F TC=0+-50	28480	0698-6956
A17R39	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R40	0757-0394	0		RESISTOR 51,1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R42	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A17R43	0757-0394	0		RESISTOR 51,1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R45	0757-0394	0		RESISTOR 51,1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R46	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R47	0757-0278	9		RESISTOR 1,78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A17R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R50	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A17R51	0757-0458	7		RESISTOR 51,1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A17R52	0757-0438	3		RESISTOR 5,11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R55	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R56	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R60	0757-0458	7		RESISTOR 51,1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A17R61	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A17R62	0757-0438	3		RESISTOR 5,11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R63	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A17R64	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101
A17R65	0698-0083	8		RESISTOR 1,96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A17R66	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R69	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R70	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R72	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R73	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R74	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R76	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R77	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R78	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R79	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R80	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R81	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R82	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A17R83	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R84	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A17R85	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A17R86	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A17R87	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A17R88	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A17R89	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A17TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A17U1	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A17U2	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A17U3	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A17U4	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A17U5	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A17U6	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A17U7	1810-0206	8	3	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R10K
A17U8	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A17U9	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A17U10	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A17U11	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A17U12	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A17U13	1858-0032	8		TRANSISTOR ARRAY	01928	CA3146E
A17U14	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A17U15	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A17VR1	1902-3193	3	1	DIODE-ZNR 13.3V 5% DO-7 PD=.4W TC=+.059%	28480	1902-3193
				A17 MISCELLANEOUS PARTS		
	5040-6845	4	1	BOARD EXTRACTOR, WHITE	28480	5040-6845
	5000-9043	6		PIN	28480	5000-9043
A18	08754-60018	9	1	DEFLECTION AMPLIFIERS ASSEMBLY	28480	08754-60018
A18C1	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A18C2	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A18C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A18C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A18C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A18C6	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A18C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A18C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A18C9	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A18CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A18CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A18CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A18L1	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A18L2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A18L3	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A18L4	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A18Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A18Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A18Q3	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A18Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A18Q5	1854-0232	2	4	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A18Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A18Q7	1854-0232	2		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A18Q8	1854-0232	2		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A18Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A18Q10	1854-0232	2		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18Q11	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A18R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R3	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R5	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R6	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R7	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R8	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A18R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R10	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R11	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A18R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R13	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A18R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R17	0698-3460	1		RESISTOR 422K 1% .125W F TC=0+-100	28480	0698-3460
A18R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R20	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R22	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A18R23	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R25	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A18R26	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R27	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A18R28	0757-0855	8	4	RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A18R29	0698-3451	0		RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A18R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R31	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A18R32	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A18R33	0757-0855	8		RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A18R34	0698-3451	0		RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1335-F
A18R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R39	0698-3449	6	3	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A18R40	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A18R41	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A18R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A18R45	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R46	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A18R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R48	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A18R49	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A18R50	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A18R51	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A18R52	0757-0855	8		RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A18R53	0698-3451	0		RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A18R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R55	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A18R56	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A18R57	0757-0855	8		RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A18R58	0698-3451	0		RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A18R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R60	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18R61				NOT ASSIGNED		
A18R62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18R63	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A18R64	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A18R65	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A18R66	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R67	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A18R68	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A18R69	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R70	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A18R71	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A18R72	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A18R73	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R74	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A18R75	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18R76	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A18R77	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A18R78	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A18R79	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A18R80	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A18R81	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A18R82	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R83	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A18R84	0683-6235	5	1	RESISTOR 62K 5% .25W FC TC=-400/+800	01121	CB6235
A18R85	0684-6831	7	1	RESISTOR 68K 10% .25W FC TC=-400/+800	01121	CB6831
A18R86	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A18R87	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A18R88	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18R89	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18R90	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18R91	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18R92	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A18TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A18TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A18TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A18U1	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
A18U2	1810-0206	8		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R10K
A18U3	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A18U4	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A18U5	1820-1545	1		IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A18U6	1820-1545	1		IC MUXR/DATA-SEL CMOS TPL	01928	CD4053BY
A18U7	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A18U8	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A18U9	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A18U10	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A18VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A18VR2	1902-3203	6		DIODE-ZNR 14.7V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3203
				A18 MISCELLANEOUS PARTS		
	5040-6843	2	1	BOARD EXTRACTOR, BLACK	28480	5040-6843
	5000-9043	6		PIN	28480	5000-9043
A19	08754-60019	0	1	RECTIFIER ASSEMBLY	28480	08754-60019
A19C1	0170-0060	3	2	CAPACITOR-FXD .047UF +-10% 400VDC POLYE	84411	663UW47394W2
A19C2	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A19C3	0180-2213	3	1	CAPACITOR-FXD 80UF+50-10% 150VDC AL	56289	39D806F150FL4
A19C4	0170-0060	3		CAPACITOR-FXD .047UF +-10% 400VDC POLYE	84411	663UW47394W2
A19C5	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A19C6	0180-1748	7	1	CAPACITOR-FXD 45UF+50-10% 250VDC AL	56289	39D456F250FL4
A19C7	0160-0970	3	2	CAPACITOR-FXD .47UF +-10% 80VDC POLYE	28480	0160-0970
A19C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A19C9	0160-0970	3		CAPACITOR-FXD .47UF +-10% 80VDC POLYE	28480	0160-0970
A19C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A19C11	0160-2195	8	1	CAPACITOR-FXD .22UF +-5% 200VDC POLYE	28480	0160-2195
A19C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A19C13	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A19CR1	1901-0367	5	2	DIODE-FW BRDG 600V 1A	28480	1901-0367
A19CR2	1901-0367	5		DIODE-FW BRDG 600V 1A	28480	1901-0367
A19CR3				NOT ASSIGNED		
A19CR4				NOT ASSIGNED		
A19CR5				NOT ASSIGNED		
A19CR6	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A19CR7				NOT ASSIGNED		
A19CR8-19	1901-0662	3		DIODE-PWR RECT 100V 6A	28480	1901-0662
A19DS1	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A19DS2	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A19F1	2110-0318	0	2	FUSE .125A 250V SLO-BLO 1.25X.25 UL IEC	75915	313.125
A19F2	2110-0318	0		FUSE .125A 250V SLO-BLO 1.25X.25 UL IEC	75915	313.125
A19R1	0686-3335	4	1	RESISTOR 33K 5% .5W CC TC=0+765	01121	EB3335
A19R2	0690-6831	0	1	RESISTOR 68K 10% 1W CC TC=0+765	01121	GB6831
A19R3	0686-1025	5	2	RESISTOR 1K 5% .5W CC TC=0+647	01121	EB1025
A19R4	0686-1025	5		RESISTOR 1K 5% .5W CC TC=0+647	01121	EB1025
A19R5	0686-2725	4	1	RESISTOR 2.7K 5% .5W CC TC=0+647	01121	EB2725
A19R6	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R7	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R9	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R10	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19R11	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A19R12	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A19R13	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A19R14	0687-1001	9	2	RESISTOR 10 10% .5W CC TC=0+412	01121	EB1001
A19R15	0687-1001	9		RESISTOR 10 10% .5W CC TC=0+412	01121	EB1001
A19TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A19TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A19U1	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A19U2	1810-0206	8		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R10K
A19U3	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A19VR1	1902-0176	6	2	DIODE-ZNR 47.5V 5% DO-15 PD=1W TC=+.081%	28480	1902-0176
				A19 MISCELLANEOUS PARTS		
	2110-0269	0		FUSEHOLDER-CLIP TYPE.250-FUSE	28480	2110-0269
A20	08754-60020	3	1	MOTHER BOARD	28480	08754-60020
A20C1	0180-2603	5	1	CAPACITOR-FXD 7200UF+75-10% 50VDC AL	28480	0180-2603
A20C2	0180-0452	8	1	CAPACITOR-FXD .013F+75-10% 25VDC AL	28480	0180-0452
A20C3	0180-2650	2	1	CAPACITOR-FXD .022F+75-10% 15VDC AL	00853	500223U015AC2A
A20C4	0160-4082	6	6	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20C5	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20C6	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20C7	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20C8	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20C9	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A20E1	0360-1788	7	11	CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A20E2	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A20E3	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A20F1	2110-0083	6	3	FUSE 2.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0083
A20F2	2110-0083	6		FUSE 2.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0083
A20F3	2110-0012	1	1	FUSE .5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0012
A20F4	2110-0083	6		FUSE 2.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0083
A20F5	2110-0001	8	1	FUSE 1A 250V FAST-BLO 1.25X.25 UL IEC	75915	312001
A20J1	1251-3090	8		CONNECTOR 50-PIN	28480	1251-3090
A20J2	1251-3090	8		CONNECTOR 50-PIN	28480	1251-3090
A20J3	1251-5147	0	2	CONNECTOR 24-PIN M POST TYPE	28480	1251-5147
A20J4	1251-5147	0		CONNECTOR 24-PIN M POST TYPE	28480	1251-5147
A20J5	1200-0565	9	1	SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0565
A20Q1	1853-0351	4	1	TRANSISTOR PNP 2N6053 SI DARL TO-3	28480	1853-0351
A20Q2	1854-0611	1	1	TRANSISTOR NPN 2N6055 SI DARL TO-3	04713	2N6055
A20R1	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A20R2	0757-0382	6	1	RESISTOR 16.2 1% .125W F TC=0+-100	19701	MF4C1/8-T0-16R2-F
A20R3	0757-0294	9	1	RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A20U1	1826-0123	1	1	IC 7912 V RGLTR TO-3	04713	MC7912CK
A20U2	1826-0181	1	1	IC V RGLTR TO-3	27014	LM323K
A20U3	1820-0430	1	1	IC 309 V RGLTR TO-3	07263	LM309K
A20W1	08754-20041	4	3	CABLE, RF	28480	08754-20041
A20W2	08754-20041	4		CABLE, RF	28480	08754-20041
A20W3	08754-20041	4		CABLE, RF	28480	08754-20041
A20W4	08754-20042	5	1	CABLE, RF	28480	08754-20042
A20XA1				NOT ASSIGNED		
A20XA2				NOT ASSIGNED		
A20XA3	1251-5176	5	3	CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-5176
A20XA4	1251-5176	5		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-5176
A20XA5	1251-5176	5		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-5176
A20XA6	1251-1365	6	13	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA7	1251-0472	4	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A20XA8	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA9	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA10	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA11	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA12	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA13	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA14	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA15	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA16	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA17	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA18	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A20XA19	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A20 MISCELLANEOUS PARTS		
	2110-0269	0		FUSEHOLDER-CLIP TYPE.250-FUSE	28480	2110-0269
	0380-0383	8	6	STANDOFF-RVT-ON .125-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	0590-0970	4	10	THREADED INSERT-NUT 6-32 .062-LG STL	28480	0590-0970
	1251-2313	6	10	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
	0360-0353	0	4	TERMINAL-SLDR LUG EYLT-MTG FOR-#6-SCR	28480	0360-0353
	7120-4295	6	1	LBL S WARNING AA (HAZARDOUS VOLTAGE)	28480	7120-4295
	0361-0004	0	4	RIVET-SEMITUB OVH .146 DIA .188LG	00000	ORDER BY DESCRIPTION
	2190-0007	2	6	WASHER-LK INTL T NO. 6 .141-IN-ID	28480	2190-0007
A21	08754-60021	4	1	HIGH VOLTAGE POWER SUPPLY ASSEMBLY	28480	08754-60021
A21C1	0160-0678	8	2	CAPACITOR-FXD .01UF +-20% 6KVDC	28480	0160-0678
A21C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A21C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A21C4	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A21C5				NOT ASSIGNED		
A21C6	0180-0232	2	1	CAPACITOR-FXD 10UF+20-15% 100VDC TA	06001	69F294G7
A21C7				NOT ASSIGNED		
A21C8				NOT ASSIGNED		
A21C9	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A21C10	0160-4300	1	2	CAPACITOR-FXD .047UF +80-20% 100VDC CER	56289	C023F101L473ZS22-CDH
A21C11	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A21C12	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A21C13	0160-4300	1		CAPACITOR-FXD .047UF +80-20% 100VDC CER	56289	C023F101L473ZS22-CDH
A21C14	0160-0165	8	1	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A21C15	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A21C16	0160-2290	4	1	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A21C17	0160-0061	3	1	CAPACITOR-FXD 1500PF +-20% 6KVDC	28480	0160-0061
A21C18	0160-0036	2	4	CAPACITOR-FXD 4700PF +-20% 6KVDC	56289	184P472060
A21C19	0160-0678	8		CAPACITOR-FXD .01UF +-20% 6KVDC	28480	0160-0678
A21C20	0160-0036	2		CAPACITOR-FXD 4700PF +-20% 6KVDC	56289	184P472060
A21C21	0160-0036	2		CAPACITOR-FXD 4700PF +-20% 6KVDC	56289	184P472060
A21C22	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A21C23	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A21C24	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A21C25	0160-0036	2		CAPACITOR-FXD 4700PF +-20% 6KVDC	56289	184P472060
A21C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A21C27	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A21CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A21CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR6	1901-0341	5	2	DIODE-HV RECT 7.5KV 10MA 250NS	28480	1901-0341
A21CR7	1901-0341	5		DIODE-HV RECT 7.5KV 10MA 250NS	28480	1901-0341
A21CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A21DS1	2140-0014	6	1	LAMP-GLOW 4AB 135/70VDC 500UA T-2-BULB	28480	2140-0014
A21DS2	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A21E1	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E2	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E3	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E4	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E5	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E6	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E7	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21E8	0360-1788	7		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1788
A21F1	2110-0004	1		FUSE .25A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0004
A21J1	1251-5245	9		CONNECTOR 10-PIN M POST TYPE	28480	1251-5245
A21L1				NOT ASSIGNED		
A21L2	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A21L3	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A21L4	9140-0137	1	1	COIL-MLD 1MH 5% Q=60 .19DX.44LG-NOM	28480	9140-0137
A21L5	9100-2503	5	1	COIL-MLD 220UH 5% Q=38 .28DX.914LG-NOM	28480	9100-2503
A21L6	9100-1630	7	2	COIL-MLD 51UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1630
A21L7	9100-1630	7		COIL-MLD 51UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1630
A21Q1	1854-0311	8	1	TRANSISTOR NPN 2N4240 SI TO-66 PD=35W	01928	2N4240
A21Q2	1853-0037	3	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0037
A21Q3	1854-0022	8	1	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A21R1				NOT ASSIGNED		
A21R2				NOT ASSIGNED		
A21R3	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A21R4	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A21R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

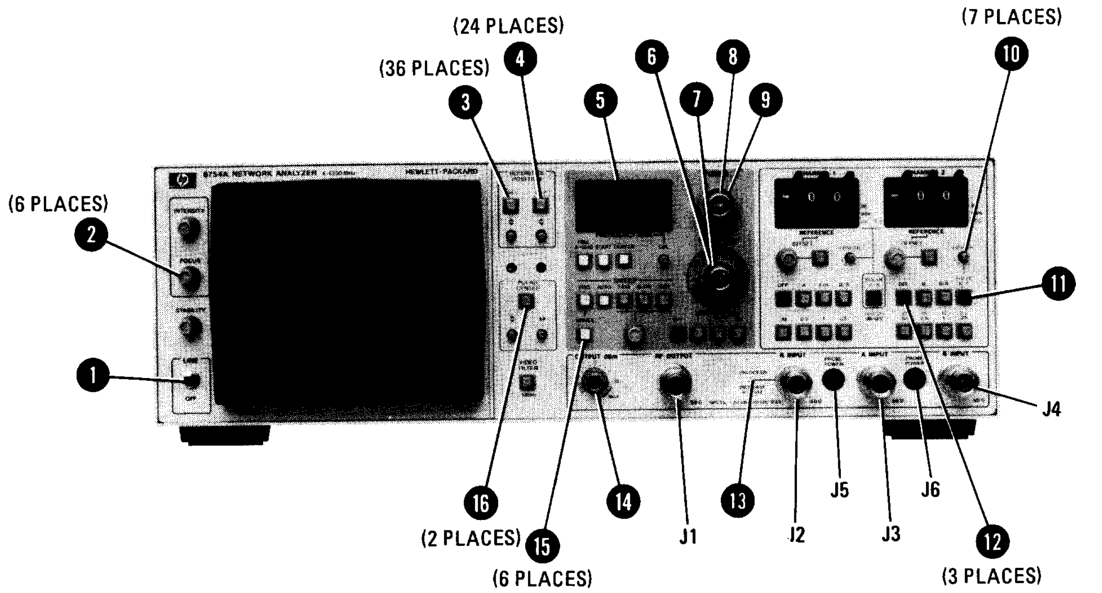
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21R6				NOT ASSIGNED		
A21R7	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A21R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A21R10	0698-3346	2	1	RESISTOR 4.22K 1% .5W F TC=0+-100	28480	0698-3346
A21R11	0698-3266	5	1	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A21R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R13	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A21R14	0683-1215	9	1	RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
A21R15	0683-0335	2	1	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A21R16	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A21R17	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A21R18	0757-0466	7	1	RESISTOR 110K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1103-F
A21R19				NOT ASSIGNED		
A21R20	0683-1055	5	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A21R21	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A21R22	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A21R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A21R24	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A21R25	0698-3458	7	1	RESISTOR 348K 1% .125W F TC=0+-100	28480	0698-3458
A21R26				NOT ASSIGNED		
A21R27	0698-3436	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A21R28	2100-0569	2	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN	28480	2100-0569
A21R29	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A21R30	0698-8427	0	2	RESISTOR 29M 10% 1W C TC=0+-250	28480	0698-8427
A21R31	0686-1055	1	1	RESISTOR 1M 5% .5W CC TC=0+1000	01121	EB1055
A21R32	0683-1635	7	1	RESISTOR 16K 5% .25W FC TC=-400/+800	01121	CB1635
A21R33	0686-2225	9	1	RESISTOR 2.2K 5% .5W CC TC=0+647	01121	EB2225
A21R34	0698-8018	5	1	RESISTOR 30M 1% 3W C TC=0+-100	03888	PVC175-3-T0-3004-F
A21R35	0686-3355	8	1	RESISTOR 3.3M 5% .5W CC TC=0+1000	01121	EB3355
A21R36	0698-8427	0		RESISTOR 29M 10% 1W C TC=0+-250	28480	0698-8427
A21R37	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A21R38				NOT ASSIGNED		
A21R39				NOT ASSIGNED		
A21R40				NOT ASSIGNED		
A21R41				NOT ASSIGNED		
A21R42				NOT ASSIGNED		
A21R43	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A21R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A21R45	0686-4725	8	1	RESISTOR 4.7K 5% .5W CC TC=0+647	01121	EB4725
A21T1	08412-80001	9		TRANSFORMER ASSEMBLY, HIGH VOLTAGE	28480	08412-80001
A21TP1				NOT ASSIGNED		
A21TP2				NOT ASSIGNED		
A21TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21U1	1826-0167	3	1	IC OP AMP TO-99	01928	CA3094AT
A21U2	1826-0304	0		IC OP AMP TO-99	27014	LF355H
A21VR1	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A21VR2	1902-0176	6		DIODE-ZNR 47.5V 5% DO-15 PD=1W TC=+.081%	28480	1902-0176
A21VR3	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
				A21 MISCELLANEOUS PARTS		
	5040-0402	7	1	MOUNT, TRANSFORMER	28480	5040-0402
	5040-0430	1	1	HOLDER, PLASTIC	28480	5040-0430
	2200-0125	8	2	SCREW-MACH 4-40 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2260-0001	5	2	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
	1205-0085	8	1	HEAT SINK TO-66-PKG	28480	1205-0085
	2360-0115	4	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0380-0157	4	3	STANDOFF-RVT-ON 1-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	0380-0342	9	2	STANDOFF-RVT-ON .125-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
	1251-3172	7		CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A22	08754-60022	5	1	FREQUENCY MHZ DISPLAY ASSEMBLY	28480	08754-60022
A22U1	1990-0619	7	4	DISPLAY-NUM-SEG 1-CHAR .3-H GA-ARSD-PPHD	28480	5082-7613
A22U2	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H GA-ARSD-PPHD	28480	5082-7613
A22U3	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H GA-ARSD-PPHD	28480	5082-7613
A22U4	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H GA-ARSD-PPHD	28480	5082-7613
A22W1	8120-2726	5	1	CABLE ASSY 28AWG 14-CNDCT UL-2771	28480	8120-2726

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

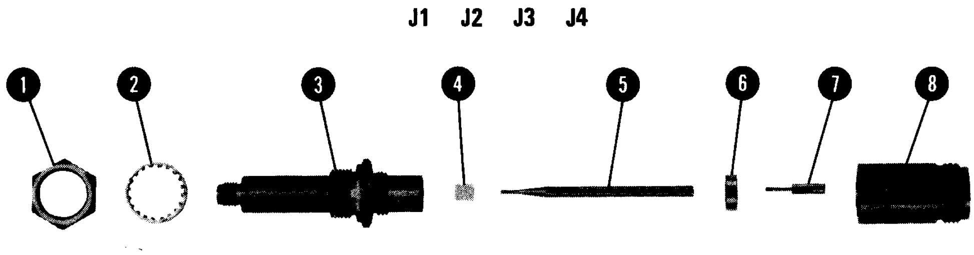
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A22XU1	1200-0693	4	4	SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A22XU2	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A22XU3	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A22XU4	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A,221	0380-0384	9	2	STD 1.2SL 6-32		
A23	08754-60023	6	1	REAR PANEL	28480	08754-60023
A23J1	1250-1163	0	6	CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J2	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J3	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J4	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J5	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J6	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A23J7	1251-2416	0	1	CONNECTOR 25-PIN F D SERIES	28480	1251-2416
A23S1	3101-1596	0	1	SWITCH-SL DPDT-NS MINTR 1A 125VAC PC	28480	3101-1596
A23W1	8120-2727	6	1	CABLE ASSY 28AWG 24-CNDCT UL-2771	28480	8120-2727
				A23 MISCELLANEOUS PARTS		
	1251-3153	4	25	CONNECTOR, MALE CONTACT	28480	1251-3153
				CHASSIS PARTS		
B1	3160-0273	2	1	FAN-TBAX 34-CFM 115V 50/60-HZ 1,496-THK	0653A	760-126LF-182-11115
C1	0160-4048	4	1	CAPACITOR-FXD ,022UF +-20% 250VAC(RMS)	C0633	PME 271 M 522
F1	2110-0083	6		FUSE 2.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0083
F1	2110-0094	9	1	FUSE 1.25A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0094
FL1	0960-0448	6	1	LINE MODULAR FILTER	05245	F1927
J1	08754-60040	7	4	CONNECTOR ASSEMBLY, TYPE N,RF OUTPUT	28480	08754-60040
J2	08754-60040	7		CONNECTOR ASSEMBLY, TYPE N,RF INPUT	28480	08754-60040
J3	08754-60040	7		CONNECTOR ASSEMBLY, TYPE N,A INPUT	28480	08754-60040
J4	08754-60040	7		CONNECTOR ASSEMBLY, TYPE N, B INPUT	28480	08754-60040
J5	5060-0467	6	2	CONNECTOR, MALE PROBE	28480	5060-0467
J6	5060-0467	6		CONNECTOR, MALE PROBE	28480	5060-0467
J7				P/O W12, EXT. MARKER INPUT		
J8	1251-2197	4	1	CONNECTOR 24-PIN F D SERIES	28480	1251-2197
L1	01200-66001	9	1	COIL ASSEMBLY, ALIGN	28480	01200-66001
R1	2100-3648	4	1	RESISTOR-VAR DUAL 5K-10%-WW/CP (TUNING)	28480	2100-3648
R2	2100-2847	3	1	RESISTOR-VAR CONTROL CC 5M 20% LIN (FOCUS)	28480	2100-2847
R3	2100-2733	6	1	RESISTOR-VAR CONTROL C 50K 20% LIN (TRACE ALIGN)	32997	3852K-A67-503A
R4	2100-2735	8	1	RESISTOR-VAR CONTROL C 250K 20% LIN (ASTIG)	32997	3852K-A67-254A
R5	2100-2661	9	1	RESISTOR-VAR CONTROL CCP 1K 20% LIN (INTENSITY) (RECOMMENDED REPLACEMENT)	28480	2100-2661
R6	2100-2756	3	1	RESISTOR-VAR CONTROL C 10K 20% LIN (STABILITY)	28480	2100-2756
S1	3101-2269	[illegible]	1	SWITCH, TOGGLE DPDT, FLAT	28480	3101-2269
S2	3103-0063	[illegible]	1	SWITCH, THERMAL, NC	28480	3103-0063
T1	9100-4065	8	1	TRANSFORMER, POWER 6.3/141	28480	9100-4065
V1	5083-1890	9	1	TUBE, CRT	28480	5083-1890
W1	08754-20032	3	1	CABLE ASSEMBLY, RF OUTPUT	28480	08754-20032
W2	08754-20031	2	1	CABLE ASSEMBLY, R INPUT	28480	08754-20031
W3	08754-20029	8	1	CABLE ASSEMBLY, A INPUT	28480	08754-20029
W4	08754-20030	1	1	CABLE ASSEMBLY, B INPUT	28480	08754-20030
W5	8120-2525	2	2	CABLE ASSEMBLY, FLAT RIBBON	28480	8120-2525
W6	8120-2525	2		CABLE ASSEMBLY, FLAT RIBBON	28480	8120-2525
W7	08754-60043	0	2	CABLE ASSEMBLY, SAMPLER PULSE	28480	08754-60043
W8	08754-60043	0		CABLE ASSEMBLY, SAMPLER PULSE	28480	08754-60043
W9	08754-60046	3	1	CABLE ASSEMBLY, SAMPLER PULSE	28480	08754-60046
W10	08754-60047	4	1	CABLE ASSEMBLY, ATTENUATOR RF (RECOMMENDED REPLACEMENT)	28480	08754-60047
W11	08754-60044	1	1	CABLE ASSEMBLY, INT MARKER, RF	28480	08754-60044
W12	08754-60045	2	1	CABLE ASSEMBLY, EXT. MARKER, RF	28480	08754-60045
W13	08754-60033	8	1	CABLE ASSEMBLY, NORMALIZER INTERCONNECT	28480	08754-60033
W14	08754-60030	5	1	CABLE ASSEMBLY, HIGH VOLTAGE	28480	08754-60030
W15				NOT ASSIGNED		
W16	08754-60042	9	1	CABLE ASSEMBLY, PRIMARY POWER	28480	08754-60042

See introduction to this section for ordering information
*Indicates factory selected value



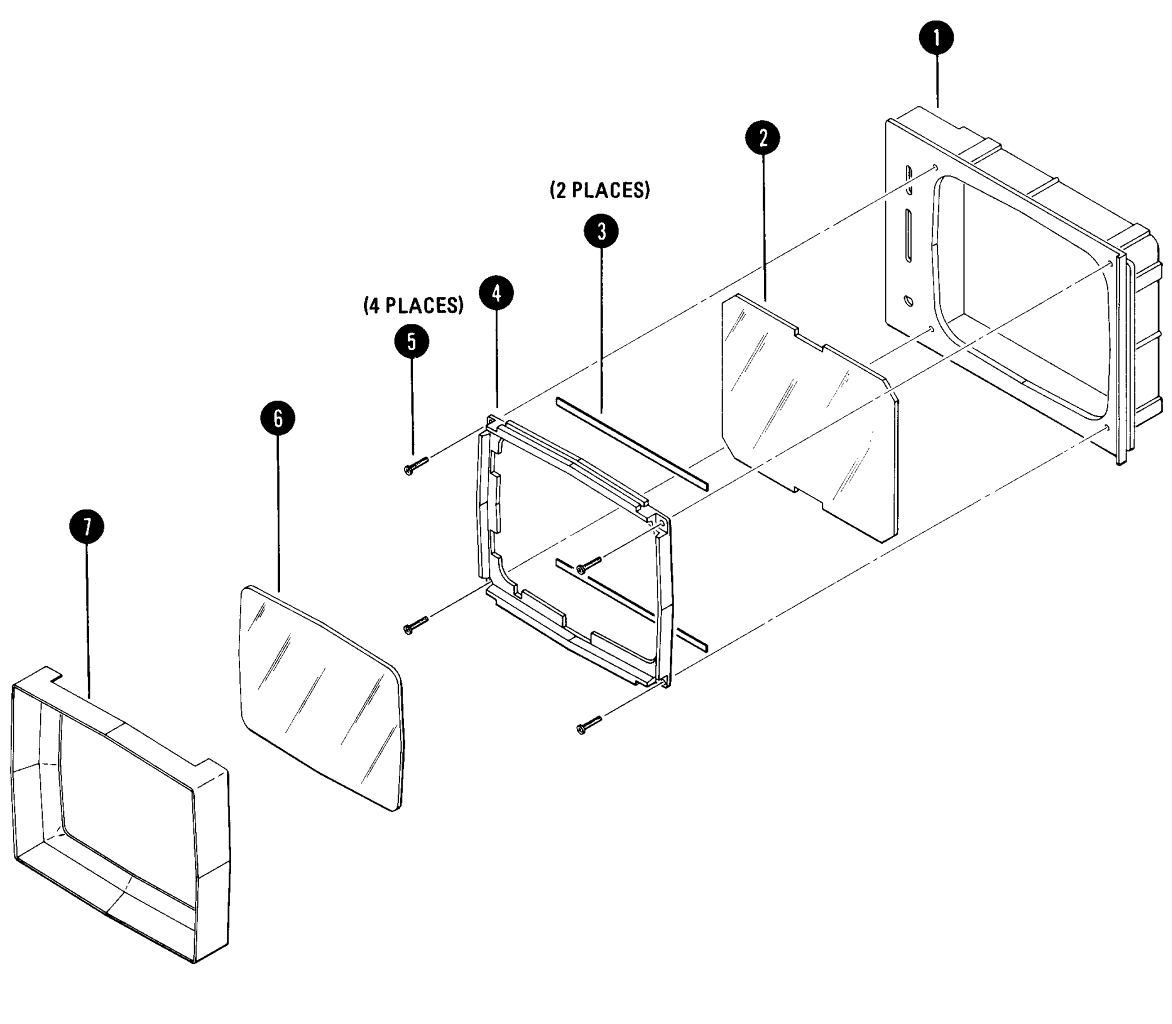
Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	0590-0836	1	1	NUT-HEX-SGL CHAM 1/4-40-THD .15-IN-THK (PART OF W16)	28480	0590-0836
2	5040-8806	1	6	KNOB, JADE GRAY 5/16-IN SERIES	28480	5040-8806
	3030-0051	9	21	SCREW-SET 4-40 .094-IN-LG SMALL CUP PT	00000	
	3050-1021	0	6	DECAL-KNOB	28480	0350-1021
3	0370-0606	7	36	BEZEL, PUSHBUTTON 0.330-IN SQ; JADE GRAY	28480	0370-0606
4	5040-8817	4	24	PUSHBUTTON SQ; JADE GRAY	28480	5040-8817
5	08754-40001	8	1	WINDOW-LED	28480	08754-40001
6	08754-00021	8	1	KNOB; SWEEP WIDTH MHZ	28480	08754-00021
7	0370-3006	7	1	KNOB-RND .625-IN-OD .125-IN-DIA SHAFT (FINE)	28480	0370-3006
8	0370-2981	5	1	KNOB-RND .625-IN-OD .078-IN-DIA SHAFT (CAL)	28480	0370-2981
9	0370-3004	5	1	KNOB-RND .250-ON DIA; JADE GRAY	28480	0370-3004
10	08754-40002		7	KNOB; JADE GRAY (PUSH ON)	28480	08754-40002
11	5040-8819	6	1	PUSHBUTTON SQ; WILLOW GREEN	28480	5040-8819
12	5040-8821	0	3	PUSHBUTTON SQ; OLIVE GRAY	28480	5040-8821
13	1450-0404	4	1	LENS CAP CLR-TL .125-DIA	28480	1450-0404
14	0370-1005	2	1	KNOB-BASE-PTR 3/8 .125-IN-ID (OUTPUT)	28480	0370-1005
15	5040-8816	3	6	PUSHBUTTON SQ; MINT GRAY	28480	5040-8816
16	5040-8818	5	2	PUSHBUTTON SQ; LEGEND BLUE	28480	5040-8818

Figure 6-1. Illustrated Parts Breakdown, Front View



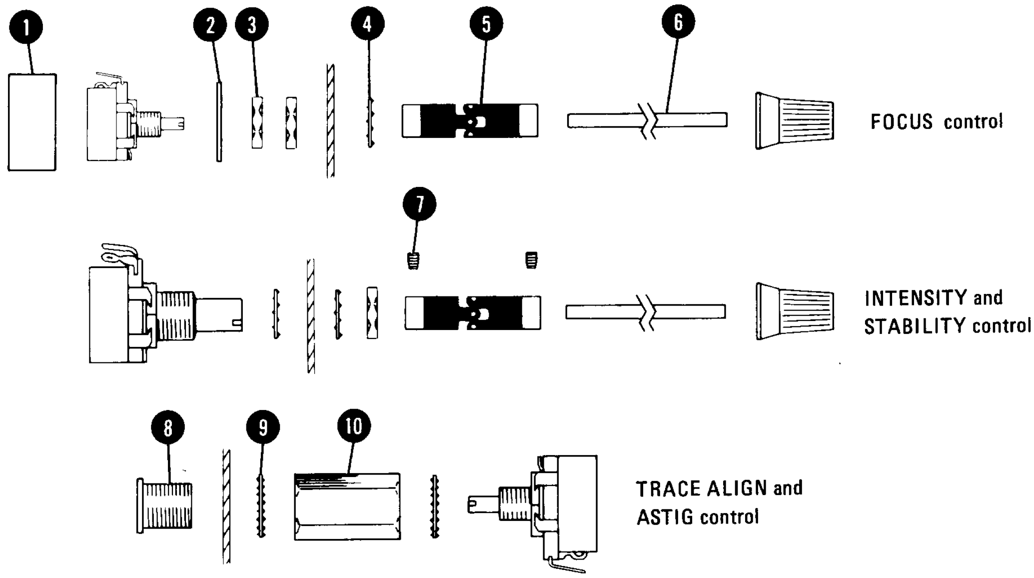
Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	2950-0054	8	4	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	
2	2190-0068	5	4	WASHER-LK INTL T 1/2 IN .505-IN-ID	04805	1924-02
3	08754-20039	0	4	BODY BULKHEAD	28480	08754-20039
4	08761-2027	4	4	INSULATOR	28480	08761-2027
5	08754-20038	9	4	CONTACT BULKHEAD	28480	08754-20038
6	5040-0306	0	4	INSULATOR	28480	5040-0306
7	1250-0915	8	4	CONTACT-RF CONNECTOR SER APC-N, FEMALE	05879	131-149
8	1250-0914	7	4	CONNECTOR-RF APC-N FEM UNMTD 50-OHM	05879	131-150

Figure 6-2. Type N 50-Ohm Connector Assembly, Exploded View



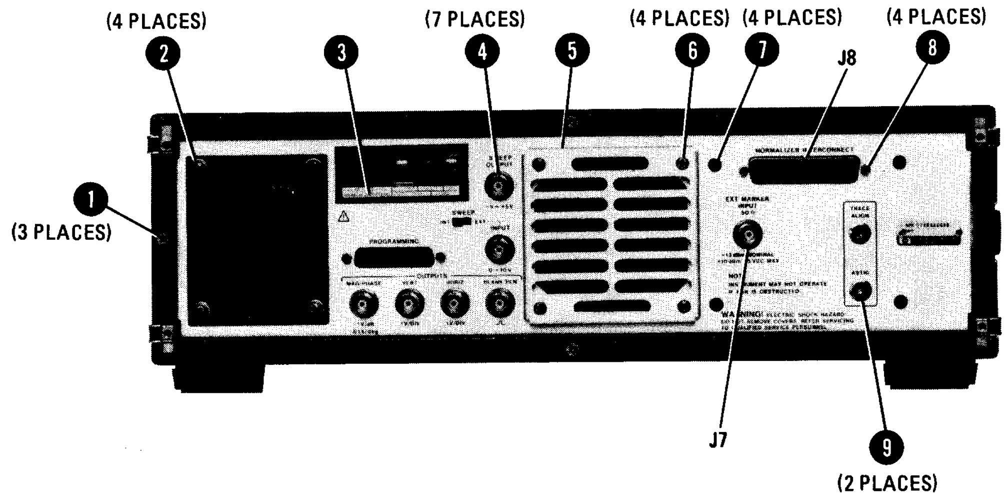
Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	08754-40003	0	1	PANEL – CRT	28480	08754-40003
2	5020-8728	4	1	SAFETY PLATE	28480	5020-8728
3	08754-00029	6	2	FELT PAD	28480	08754-00029
4	08754-20044	7	1	BEZEL	28480	08754-20044
5	2200-0111	2	4	SCREW MACH 4-40 X 0.5 LG PAN HD POZI	00000	
6	5060-0548	4	1	FILTER; CONTRAST, BLUE	28480	5060-0548
7	5040-0508	4	1	LIGHT SHIELD; SHORT	28480	5040-0508

Figure 6-3. Bezel, Exploded View



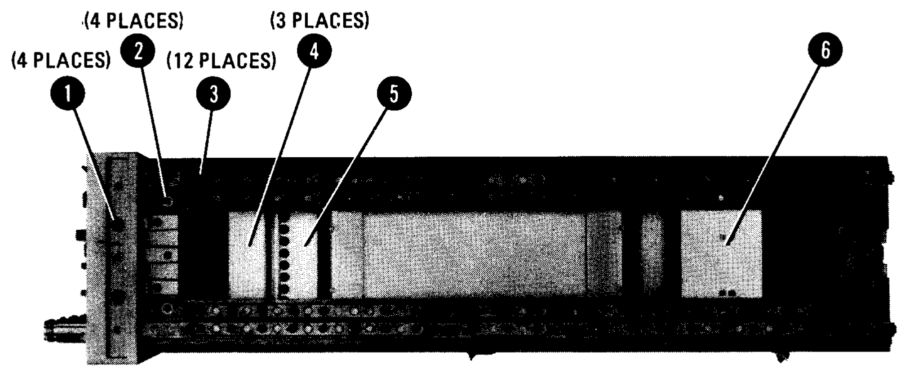
Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	5040-0453	8	1	POT COVER	28480	4050-0453
2	08412-00024	8	1	CAP FOCUS POT	28480	08412-00024
3	2950-0006	3	5	NUT HEX DBL-CHAM 1/4-32 .094-IN-THK	00000	
4	2190-0067	4	5	WASHER 1/4 LOCK INTERNAL TOOTH	00000	
5	1500-0431	4	3	COUPLER FLEX 1.05 LG	00000	
6	08754-20033	4	3	SHAFT .125 DIAMETER	28480	08754-20033
7	3030-0007	5	6	SET SCREW 4-40 THD 1/8 LG HEX CUP	00000	
8	1410-0052	4	2	BUSHING-PNL .271-ID .438-LG 3/8-32 THD	00000	
9	2190-0016	3	4	WASHER, INT LOCK 3/8 ID 1/2 OD PHBRZ	00000	
10	2950-0034	7	2	HEX NUT DBL-CHAM 3/8-32 .81-IN-THK	00000	

Figure 6-4. Control Assemblies, Exploded View



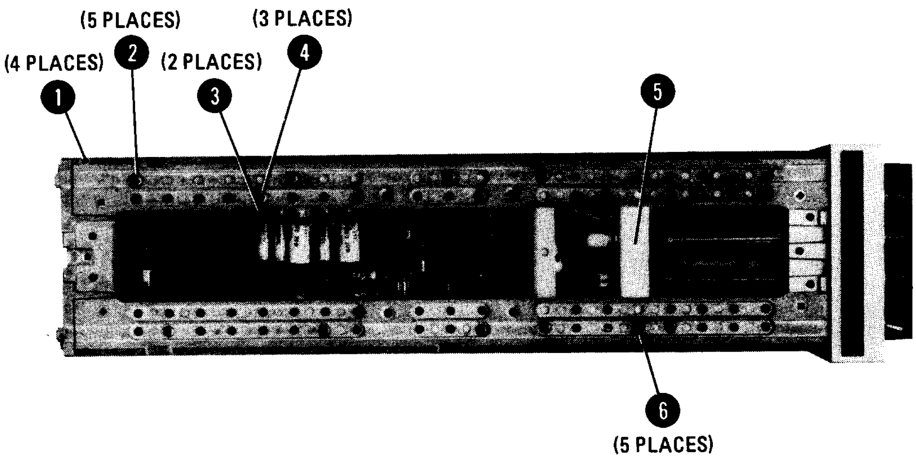
Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	0570-1171	7	3	SCREW; COVER; 6-32 THD; 0.460-IN-LG	28480	0570-1171
	0510-0043	4	3	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
2	2510-0137	9	4	SCREW-MACH 8-32 THD 2.75-IN-LG PAN-HD-POZI	00000	
	2190-0017	4	4	WASHER-LOCK HLCL NO. 8 .168-IN-ID	00000	
	3050-0139	6	8	WASHER-FLAT MTLC NO. 8 .172-IN-ID	00000	
	2580-0004	6	4	NUT-HEX-DBL-CHAM 8-32-THD .125-IN-THK	00000	
3	7120-7091	6	1	LABEL, LINE VOLTAGE	28480	7120-7091
4	0590-0012	5	7	NUT, KNURLED RND 15/32-THD .062-IN-THK	28480	0590-0012
5	08505-00135	4	1	HOUSING, FAN	28480	08505-00135
6	2360-0115	4	4	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	
7	2360-0330	5	4	SCREW-MACH 6-32 .188-IN-LG PAN-HD-POZI	00000	
8	1251-2942	7	4	LOCKPOST-SUBMIN D CONN	28480	1251-2942

Figure 6-5. Illustrated Parts Breakdown, Rear View



Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	2360-0333	8	4	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
2	2510-0192	6	8	SCREW-MACH 8-32 .625-IN-LG 100 DEG	28480	2510-0192
3	2360-0331	6	12	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	28480	2360-0331
4	08754-20027	6	3	EXTRUSION-SAMPLER	28480	08754-20027
5	08754-20043	6	1	EXTRUSION-VTO	28480	08754-20043
6	08754-00009	2	1	BOARD GUIDE-RECTIFIER	28480	08754-00009

Figure 6-6. Illustrated Parts Breakdown, Right Side View



Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	2510-0192	6	8	SCREW-MACH 8-32 .25-IN-LG 100 DEG	28480	2510-0192
2	2360-0331	6	5	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	28480	2360-0331
3	1400-0017	0	2	CLAMP-CABLE .312-DIA .375-W NYL	00000	
4	2360-0201	9	3	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	
	3050-0227	3	3	WASHER-FL MTLC NO. 6 .149-IN-ID	00000	
	2190-0006	1	3	WASHER-LK HLCL NO. 6 .141-IN-ID	00000	
	2420-0002	6	3	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	00000	
5	08754-00017	2	1	BRACKET-FOCUS POT	28480	08754-00017
6	2360-0031	3	5	SCREW-MACH 6-32 1.75-IN-LG RND-HD-SLT STL	00000	

Figure 6-7. Illustrated Parts Breakdown, Left Side View

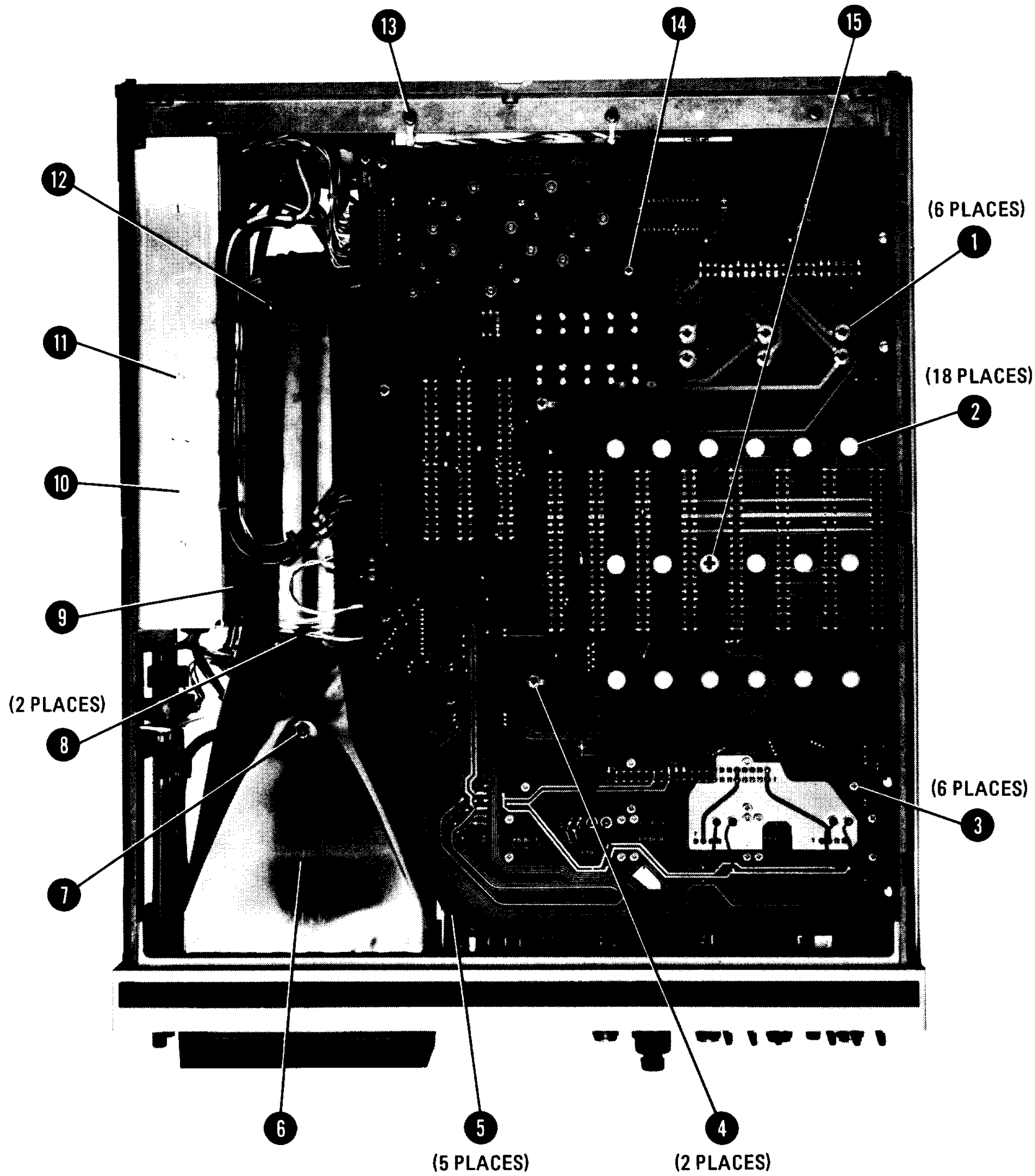


Figure 6-8. Illustrated Parts Breakdown, Top View (1 of 2)

Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	2680-0129	8	6	SCREW-MACH 10-32 .312-IN-LG PAN-HD-POZI	00000	
	2190-0011	8	6	WASHER-LK INTL T NO. 10 .195-IN-ID	00000	
2	0361-0655	7	17	RIVET-BLIND DR-PIN RNDH .136 DIA .437 LG	28480	0361-0655
3	0624-0099	1	18	SCREW-TPG 4-40 .375-IN-LG PAN-HD-POZI	00000	
4	0360-0037	7	2	TERMINAL-SLDR LUG FOR NO. 6 SCREW	00000	
	2190-0007	2	2	WASHER-LK INTL T NO. 6 .141-IN-ID	00000	
	2360-0331	6	3	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	
5	2360-0330	5	5	SCREW-MACH 6-32 .188-IN LG PAN-HD-POZI	00000	
6	08754-00026	3	1	SHIELD CRT	28480	08754-00026
7	2260-0009	3	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK (1 Other Side)	00000	
8	0400-0009	9	1	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	00000	
9	1400-0814	5	2	CLAMP-CABLE .188-DIA .75-WD PVC	00000	
10	08754-00011	6	1	HIGH VOLTAGE SHIELD	28480	08754-00011
11	0403-0302	1	3	GUIDE-PC BOARD NAT NYL .062-BD-THKNS	28480	0403-0302
12	2360-0207	5	1	SCREW-MACH 6-32 .875-IN-LG PAN-HD-POZI	00000	
	2190-0006	1	1	WASHER-LK HLCL NO. 6 .141-IN-ID	00000	
	3050-0227	3	1	WASHER-FL MTLC NO. 6 .149-IN-ID	00000	
	2420-0003	7	1	NUT-HEX DBL-CHAM 6-32-THD .094-IN-THK	00000	
13	2360-0332	7	3	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	
	0360-0001	5	2	TERMINAL-SLDR LUG FOR NO. 6 SCREW	00000	
14	2200-0103	2	1	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	
15	2360-0199	2	1	SCREW-MACH 6-32, 438 PAN-HD-POZI	00000	
	2190-0018	3	1	WASHER-SPLIT LOCK NO. 6	00000	
	3050-0003	1	1	WASHER-FLAT FIBER	00000	

Figure 6-8 Illustrated Parts Breakdown, Top View (2 of 2)

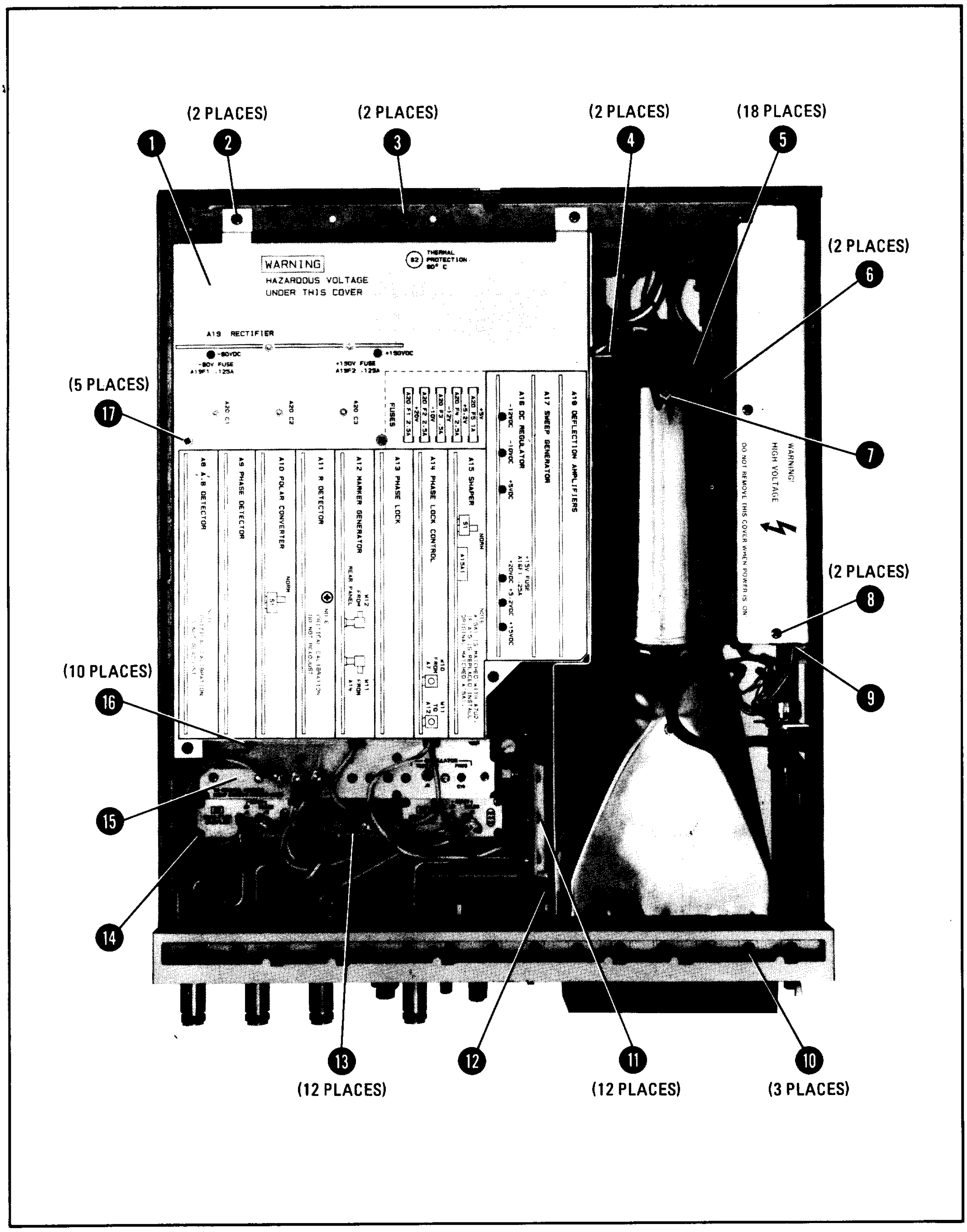


Figure 6-9. Illustrated Parts Breakdown, Bottom View With Cover On (1 of 2)

Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	08754-00045	6	1	COVER, SERVICE	28480	08754-00025
2	2360-0332	7	2	SCREW-MACH 6-32 0.312-IN-LG PAN-HD-POZI	00000	
3	2360-0331	6	2	SCREW-MACH 6-32 0.250-IN-LG PAN-HD-POZI	00000	
4	2200-0111	2	2	SCREW-MACH 4-40 0.5-IN-LG PAN-HD-POZI	00000	
	3050-0105	6	2	WASHER-FL MTLC NO. 4 0.125-IN-ID	00000	
5	01200-44701	0	1	SUPPORT BRACKET, CRT	28480	01200-44701
6	1400-0755	3	2	CLIP-CMPNT 0.25-DIA 0.75-WD PVC	28480	1400-0755
7	2360-0201	9	1	SCREW-MACH 6-32 0.5-IN-LG PAN-HD-POZI	00000	
	3050-0227	3	1	WASHER-LF MTLC NO. 6 0.149-IN-ID	00000	
	2190-0006	1	1	WASHER-LK HLCL NO. 6 0.141-IN-ID	00000	
	2420-0002	6	1	NUT-HEX-DBL-CHAM 6-32-THD 0.109-IN-THK	00000	
8	2360-0115	4	2	SCREW-MACH 6-32 0.312-IN-LG PAN-HD-POZI	00000	
9	0400-0010	2	1	GROMMET-RND 0.25-IN-ID 0.375-IN-GRV-OD	00000	
10	2360-0333	8	3	SCREW-MACH 6-32 0.25-IN-LG 100 DEG	00000	
11	2200-0103	2	6	SCREW-MACH 4-40 0.25-IN-LG PAN-HD-POZI	00000	
	2200-0107	6	1	SCREW-MACH 4-40 0.375-IN-LG PAN-HD-POZI	00000	
	2200-0111	2	3	SCREW-MACH 4-40 0.5-IN-LG PAN-HD-POZI	00000	
	2200-0113	4	2	SCREW-MACH 4-40 0.625-IN-LG PAN-HD-POZI	00000	
12	08754-00012	7	1	MOUNTING PLATE-SOURCE	28480	08754-00012
13	0520-0127	6	12	SCREW-MACH 2-56 0.188-IN-LG PAN-HD-POZI	00000	
14	0624-0077	5	18	SCREW-TPG 4-40 0.3 12-IN-LG PAN-HD-POZI	00000	
15	08754-00020	7	1	COVER PLATE – VTO	28480	08754-00020
16	2360-0331	6	8	SCREW-MACH 6-32 0.25-IN-LG PAN-HD-POZI	28480	2360-0331
17	2360-0190	5	5	SCREW-MACH 6-32 0.188-IN-LG 100 DEG	28480	2360-0190

Figure 6-9. Illustrated Parts Breakdown, Bottom View With Cover On (2 of 2)

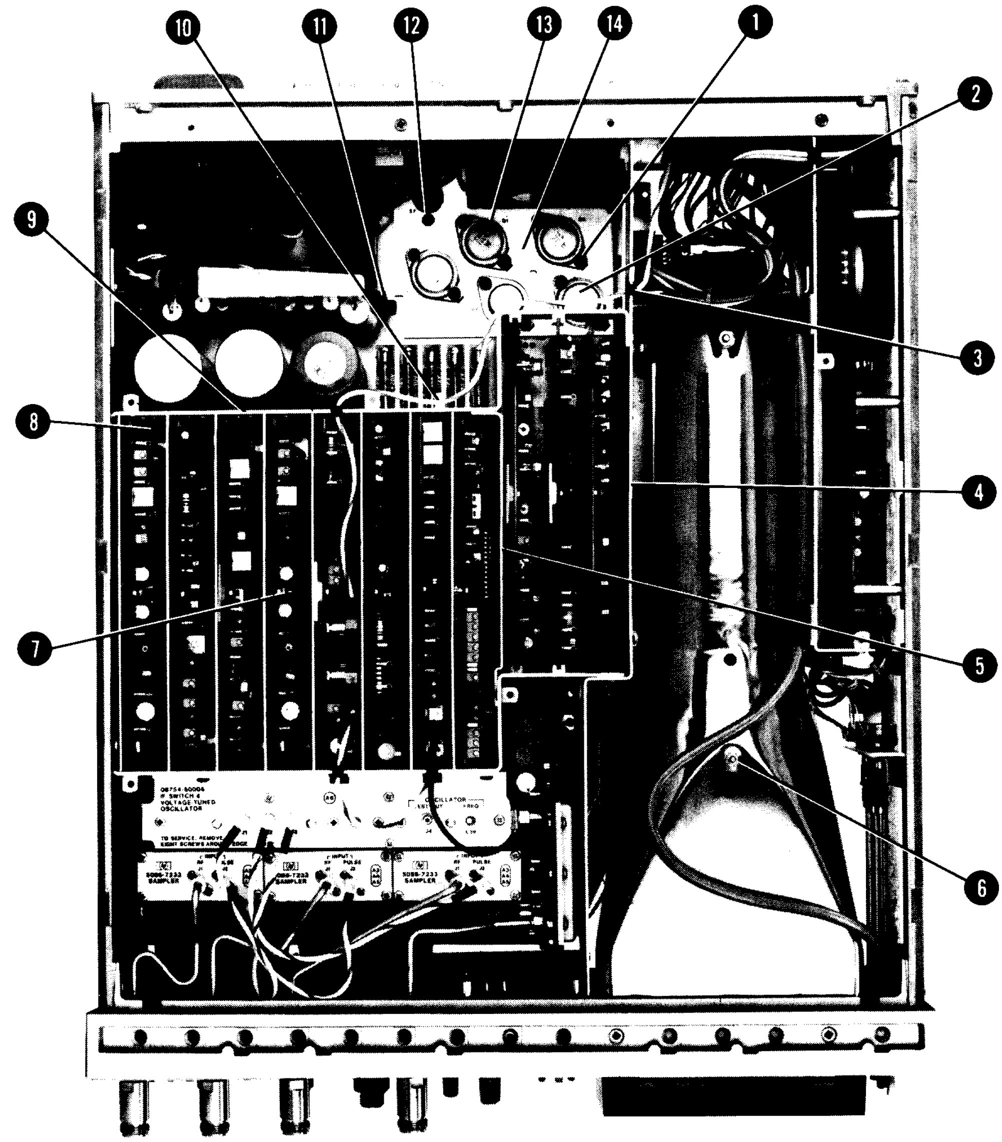


Figure 6-10. Illustrated Parts Breakdown, Bottom View With Cover Off (1 of 2)

Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	2360-0201	9	10	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	
	2190-0006	1	10	WASHER-LK HLCL NO. 6 .141-IN-ID	00000	
2	1400-0814	5	1	CLAMP-CABLE .199-DIA .75-WD PVC	00000	
3	0400-0009	9	1	GROMMET-RND .125-IN-ID .24-IN-GRV-OD	00000	
4	08754-00007	0	1	DIVIDER	28480	08754-00007
5	08754-00013	8	1	SUPPORT BRACKET	28480	08754-00013
6	2260-0009	3	1	NUT HEX-W/LKWR 4-40-THD .094-IN-THK (1 OTHER SIDE)	00000	
7	08754-60054	9	1	STAND OFF (INSULATED)	28480	08754-60045
8	0403-0101	8	16	CARD GUIDES, SNAP IN	28480	0403-0101
9	08754-00028	5	1	ENCLOSURE SHIELD	28480	08754-00028
10	1400-0866	7	1	CLAMP-CALBE .187-IN-DIA .24-IN-LG NYL	00000	
11	5040-0170	6	1	GUIDE-PC-BOARD	28480	5040-0170
12	2360-0330	5	2	SCREW-MACH 6-32 .188-IN-LG PAN-HD-POZI	00000	
13	0340-0503	0	10	INSULATOR-XSTR POLYE	00000	
	1200-0043	8	5	INSULATOR-XSTR ALUMINUM	00000	
	6040-0239	9		THERMAL COMPOUND (8 OZ. JAR) (Place a thin coating on each Insulator, 1200-0043)	28480	6040-0239
14	08754-00018	3	1	HEAT SINK-XSTR	28480	08754-00018

Figure 6-10. Illustrated Parts Breakdown, Bottom View With Cover Off (2 of 2)

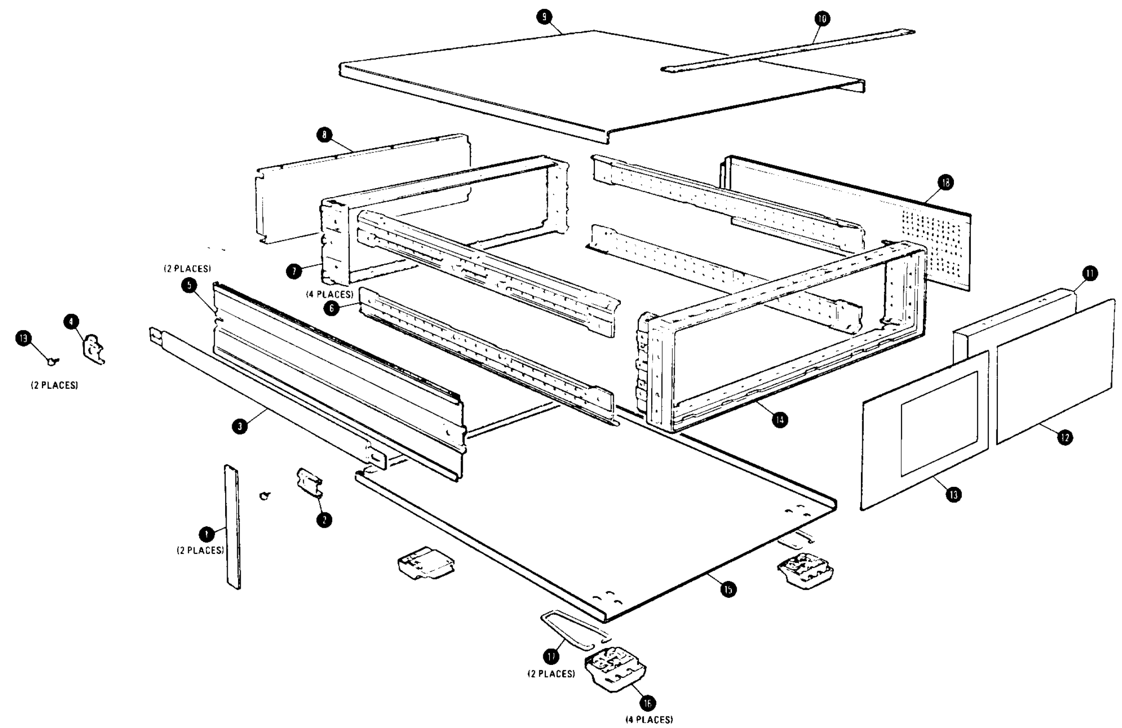


Figure 6-11. Chassis, Exploded View (1 of 2)

Item	HP Part Number	C D	Qty	Description	Mfr. Code	Manufacturer's Part Number
1	5001-0439	8	2	SIDE TRIM FRONT FRAME	28480	5001-0439
2	5040-7219	8	1	FRONT CAP, STRAP HANDLE	28480	5040-7219
3	5060-9804	3	1	STRAP HANDLE ASSEMBLY	28480	5060-9804
4	5040-7220	1	1	REAR CAP, STRAP HANDLE	28480	5040-7220
5	5060-9880	5	1	COVER ASSY SIDE	28480	5060-9880
6	5020-8837	6	4	STRUT CORNER 18"	28480	5020-8837
7	5020-8804	7	1	FRAME REAR	28480	5020-8804
8	08754-00004	7	1	REAR PANEL	28480	08754-00004
9	5060-9835	0	1	COVER TOP 18"	28480	5060-9835
10	5040-7202	9	1	TOP TRIM FRONT FRAME	28480	5040-7202
11	08754-00002	5	1	PANEL FRONT SUB CONTROL	28480	08754-00002
12	08754-00001	4	1	PANEL FRONT DRESS CONTROL	28480	08754-00001
13	08754-00003	6	1	PANEL FRONT DRESS CRT	28480	08754-00003
14	5020-8803	6	1	FRAME FRONT	28480	5020-8803
15	5060-9847	4	1	COVER BOTTOM 18"	28480	5060-9847
16	5040-7201	8	4	FOOT BOTTOM	28480	5040-7201
17	1460-1345	5	2	TILT STAND	28480	1460-1345
18	5061-1909	5	1	COVER SIDE	28480	5061-1909
19	0570-1170	6	4	SCREW, RETAINER, STRAP HANDLE	28480	5070-1170

Figure 6-11. Chassis, Exploded View (2 of 2)

SECTION VII
MANUAL BACKDATING CHANGES

7-1. INTRODUCTION

7-2. This manual has been written for and applies directly to instruments with serial numbers prefixed as indicated on the title page. Earlier versions of the instrument (serial number prefixes lower than the ones indicated on the title page) may be slightly different in design or appearance. The purpose of this section of the manual is to document these differences.

7-3. With the information provided in this section, this manual can be corrected so that it applies to any earlier version or configuration of the instrument. Later versions of the instrument (serial number prefixed higher than the ones indicated on the title page) are documented in a yellow Manual Changes supplement.

7-4. To adapt this manual to an earlier instrument, refer to Table 7-1 and make all of the manual backdating changes listed opposite your instrument serial number or serial number prefix. Perform these changes in the alphabetical sequence listed.

7-5. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY THE MANUAL in Section I.

Table 7-1. Manual Backdating Changes by Serial Number Prefix

Serial Prefix	Make Manual Changes
1908A	A
1825A	A and B
1812A	A, B, and C

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 5-2, Table 5-1:
Delete A7R2 +5 dBm.

Page 5-33, Paragraph 5-16:
Change step i to:

i. Set front-panel OUTPUT dBm control to +5 dBm and check that the power meter indicates +5 ±0.5 dBm. If the meter reading is not within this range, adjust OUTPUT dBm for +5 dBm indicated on the power meter. If the OUTPUT dBm control setting is lower than 5, decrease the value of factory-selected resistor A7R33*; if the control setting is higher than 5, increase the value of the resistor.

NOTE

Changing the value of factory-selected resistor A7R33* changes the linearity of the potentiometer. If the resistor is changed, repeat steps e through i.

CHANGE A (Cont'd)

Page 6-13, Table 6-3:
Change A7C7 to HP Part No. 0160-2204 CD0 CAPACITOR-FXD 100PF ±5% 300VDC MICA 28480 0160-2204.
Change A7C8 to HP Part No. 0160-3533 CD0 CAPACITOR-FXD 470PF ±5% 300V MICA 28480 0160-3533.
Change A7R1 to HP Part No. 0757-0442 CD9 RESISTOR 10K 1% .125W F TC=0±100 24546 C4-1/8-TO-1002-F.
Delete A7R2.
Change A7R17 to HP Part No. 0757-0814 CD9 RESISTOR 511 1% .5W F TC=0±100 28480 0757-0814.

Page 6-14, Table 6-3:
Change A7R31 to HP Part No. 0757-0405 CD4 RESISTOR 162 1% .125W F TC=0±100 24546 C4-1/8-TO-162R-F.
Change A7R33 to HP Part No. 0698-3153 CD9 RESISTOR 3.83K 1% .125W F TC=0±100 24546 C4-1/8-TO-3831-F.
Change A7U1 to HP Part No. 1826-0261 CD8 IC741 OP AMP TO-99 28480 1826-0261.

Page 6-16, Table 6-3:
Add to A8 MISCELLANEOUS PARTS 1251-4666 6 CONNECTOR-SGL CONT PIN .03-IN BSC-SZ RND 28480 08754-60009.

Page 6-24, Table 6-3:
Change A13C35 and A13C36 to HP Part No. 0160-0153 CD4 CAPACITOR-FXD 1000 PF ±10% 200VDC POLYE 28480 0160-0153.

Page 6-27, Table 6-27:
Delete A13R81, A13R82, A13R83, and A13R84.
Add A13Z6, A13Z7, A13Z8, A13Z9 HP Part No. 9170-0847 CD3 CORE-SHIELD BEAD. 28480 9170-0847

Page 6-51, Figure 6-8:
Increase Item 2 Qty to 18.
Delete Item 15.

Page 6-53, Figure 6-9:
Change Item 1 to HP Part No. 08754-00025
Decrease Item 17 Qty to 4.

Page 6-55, Figure 6-10:
Delete Item 7.

SERVICE SHEET 6

Page 8-68, Figure 8-26:
Move R66 to left of R48 (vertical).

SERVICE SHEET 7

Page 8-84, Figure 8-37:
Replace with Figure 7-2.

Page 8-87/8-88, Figure 8-39:
Replace ALC Block of Figure 8-39 with Figure 7-3.

CHANGE A (Cont'd)

SERVICE SHEET 11

Page 8-125, Figure 8-62:
Replace with attached Figure 7-4.

Page 8-129/8-130, Figure 8-65:
Replace PHASE/FREQUENCY DETECTOR Block of Figure 8-65 with attached Figure 7-5.

CHANGE B

Page 5-2, Table 5-1:
Delete entry A2R129.

Page 5-61, Paragraph 5-22:
Delete steps u–z and Note.

Page 5-62, Figure 5-34:
Delete Figure 5-34.

Page 6-5, Table 6-3:
Delete A1C4.
Delete A1DS1.
Change A1J4 to HP Part No. 1251-5245 CD9 CONNECTOR 10PIN M POST TYPE 28480 1251-5245.
Change A1R29, A1R33, A1R36, A1R47, A1R52, A1R53, and A1R57 to HP Part No. 2100-3741 CD9 RESISTOR-VAR CONTROL C 10K 10% LIN 28480 2100-3741

Page 6-6, Table 6-3:
Delete A1R66.
Delete A1XDS1.
Under A1 MISCELLANEOUS PARTS:
Add 1990-0486 CD1 LED-VSBL UNLOCKED 1 MCD 28480 1990-0486.
Change 08754-60053 to 08754-60034 CD1 HARNESS PROBE POWER 28480 08754 60034.

Page 6-8, Table 6-3:
Change A2R19 to HP Part No. 2100-3123 CD0 RESISTOR-TRMR 500 10% CSIDE-ADJ 17 TRN 02111 43P501.
Delete A2R20.

Page 6-9, Table 6-3:
Delete A2R129.
Delete A2R130.
Delete A2R131.

Page 6-17, Table 6-3:
Delete A9Q10.

Page 6-19, Table 6-3:
Delete A9R88.
Delete A9R89.
Delete A9VR2.

CHANGE B (Cont'd)

Page 6-23, Table 6-3:
Add A12 Q7 HP Part No. 1854-0404 CD0 TRANSISTOR NPN SI TO-18 PD 380MW 28480 1854-0404.

Page 6-24, Table 6-3:
Add A12 R63 HP Part No. 0698-3162 CD0 RESISTOR 46.4K 1% .125W F TC=0±100 24546 C4-1/8-TO-4842-F.

Page 6-29, Table 6-3:
Delete A14R97.

Page 6-35, Table 6-3:
Change A17R64 to HP Part No. 0698-0083 CD8 RESISTOR 1.96K 1% .125W F TC=0±100 24546 C4-1/8-TO-1961-F.

Page 6-37, Table 6-3:
Add A19CR3 HP Part No. 1901-0638 CD3 DIODE-FW BRDG 100V 4A 04713 MDA-970-2.
Add A19CR4 HP Part No. 1901-0638 CD3 DIODE-FW BRDG 100V 4A 04713 MDA-970-2.
Add A19CR5 HP Part No. 1901-0638 CD3 DIODE-FW BRDG 100V 4A 04713 MDA-970-2.
Delete A19CR8 through A19CR19.

Page 6-38, Table 6-3:
Change A20J1 and A20J2 to HP Part No. 1251-4737 CD2 CONNECTOR 50 MN M RECTANGULAR 28480 1251-4737.

Page 6-43, Figure 6-1:
Change item 10 HP Part No. to 5040-8823.

SERVICE SHEET 5

Page 8-51/8-52, Figure 8-14:
Replace with attached Figure 7-6.

Page 8-55/8-56, Figure 8-16:
Delete A1R66.
Change A1R64 to 1960 ohms.

SERVICE SHEET 6

Page 8-69, Figure 8-27:
Replace with attached Figure 7-7.

SERVICE SHEET 8

Page 8-93/8-94, Figure 8-43:
Replace with attached Figure 7-8.

Page 8-97/8-98, Figure 8-45:
Replace with attached Figure 7-9

SERVICE SHEET 11

Page 8-126, Figure 8-63:
Delete R97.

Page 8-131/8-132, Figure 8-66:
Delete A14R97.

CHANGE B (Cont'd)

SERVICE SHEET 14

Page 8-171, Figure 8-92:
Replace with attached Figure 7-10.

Page 8-177/8-178, Figure 8-95 (2 of 2):
Delete Polar Center Switch Block of Figure 8-95.

SERVICE SHEET 15:

Page 8-184, Figure 8-96:
Replace with attached Figure 7-11.

Page 8-185/8-186, Figure 8-97:
Replace with attached Figure 7-12.

Page 8-189/8-190, Figure 8-99 (1 of 2):
Delete A2R20 and in its place show a connection between A2R19 and A2R21.

Page 8-191/8-192, Figure 8-99 (2 of 2):
Replace with attached Figure 7-16.

SERVICE SHEET 19

Page 8-226, Figure 8-116:
Replace with attached Figure 7-13.

SERVICE SHEET 20

Page 8-237, Figure 8-123/8-124:
Replace with attached Figure 7-14 and 7-15.

Page 8-241/8-242, Figure 8-125 (2 of 2):
Replace with attached Figure 7-17.

CHANGE C

Page 5-2, Table 5-1:
Delete A2R128 –6V ADJ

Page 5-15, Paragraph 5-11:
Change steps d and e to read as follows:

d. Connect digital voltmeter high input lead to A2TP14 +6V and low input lead to A2TP13 –6V.

e. Adjust A2R19 +6V for +12.000 ±.001V.

Page 6-6, Table 6-3:
Delete A1R65.

Page 6-9, Table 6-3:
Delete A2R128.

CHANGE C (Cont'd)

Page 6-11, Table 6-3:
Change A6Q4 through A6Q7 to HP Part No. 1854-0378 CD 7 TRANSISTOR NPN 2N5109 SI TO-39 PD = 800MW, 1092B, 2N5109.

Page 6-41, Table 6-3:
Delete A21R43.

SERVICE SHEET 6

Page 8-69, Figure 8-27:
Delete A2R128.

SERVICE SHEET 15

Page 8-184, Figure 8-96:
Delete A1R65.

Page 8-185, Figure 8-97:
Delete A2R128.

Page 8-189/8-190, Figure 8-99, Sheet 1 of 2:
(N) POWER SUPPLIES: Delete A2R128 −6V ADJ and, in its place, show a connection between A2U14 pin 2, A2R22, and A2R23.

Page 8-191/8-192, Figure 8-99, Sheet 2 of 2:
(D) CHANNEL 2 SUMMING AMPLIFIER: Change A2S6-L CHANNEL 2 REFERENCE OFFSET pushbutton connections as shown in partial schematic Figure 7-1.

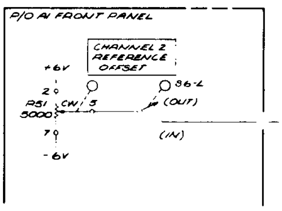


Figure 7-1. Channel 2 Summing Amplifier Partial Schematic

SERVICE SHEET 17

Page 8-205, Figure 8-104:
Delete A21R43.

Page 8-209, Figure 8-106:
(B) ERROR AMPLIFIER: Delete A21R43 and connect A21TP4 to the junction of A21R27 and A21L7.

CHANGE C (Cont'd)

SERVICE SHEET 19

Page 8-226, Figure 116:
Delete A1R65.

SERVICE SHEET 20

Page 8-241, Figure 8-125, Sheet 2 of 2:

(K) +20V POWER SUPPLY: Move A16TP3 +20V connection to the cathode of A16VR5 (+20V output to A16P1 3, 25).

(L) –10V POWER SUPPLY: Move A16TP6 –10V connection to the anode of A16VR6 (–10V output to A16P1 9, 31).

A7 BOARD

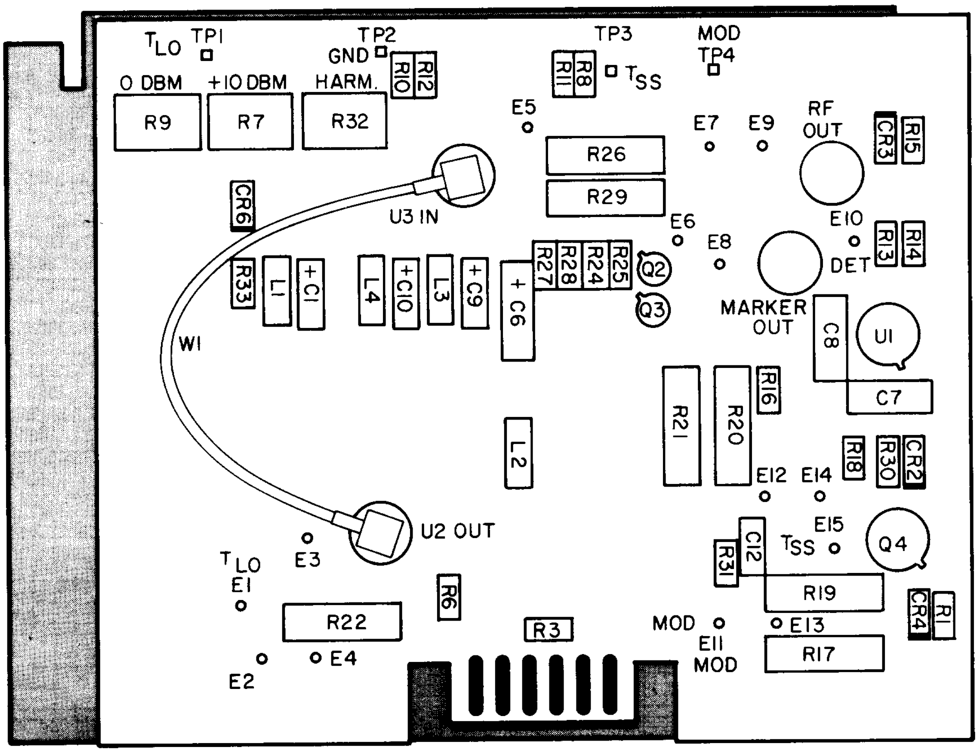
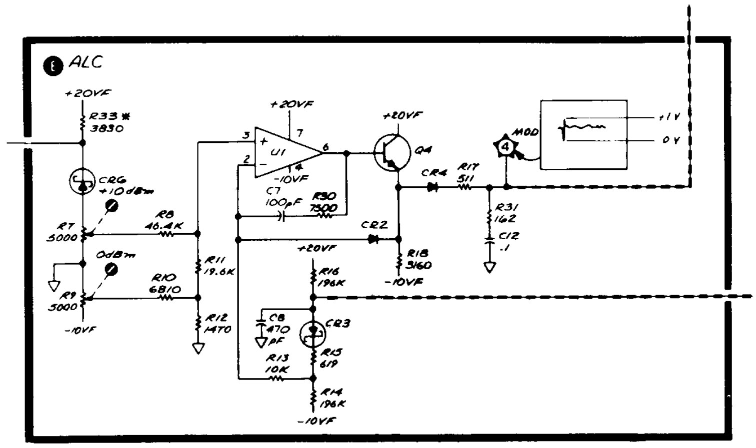


Figure 7-2. Source (A7), Component Locations (CHANGE A)



P/O Figure 7-3. Shaper (A15) and Source (A7), Schematic Diagram (CHANGE A)

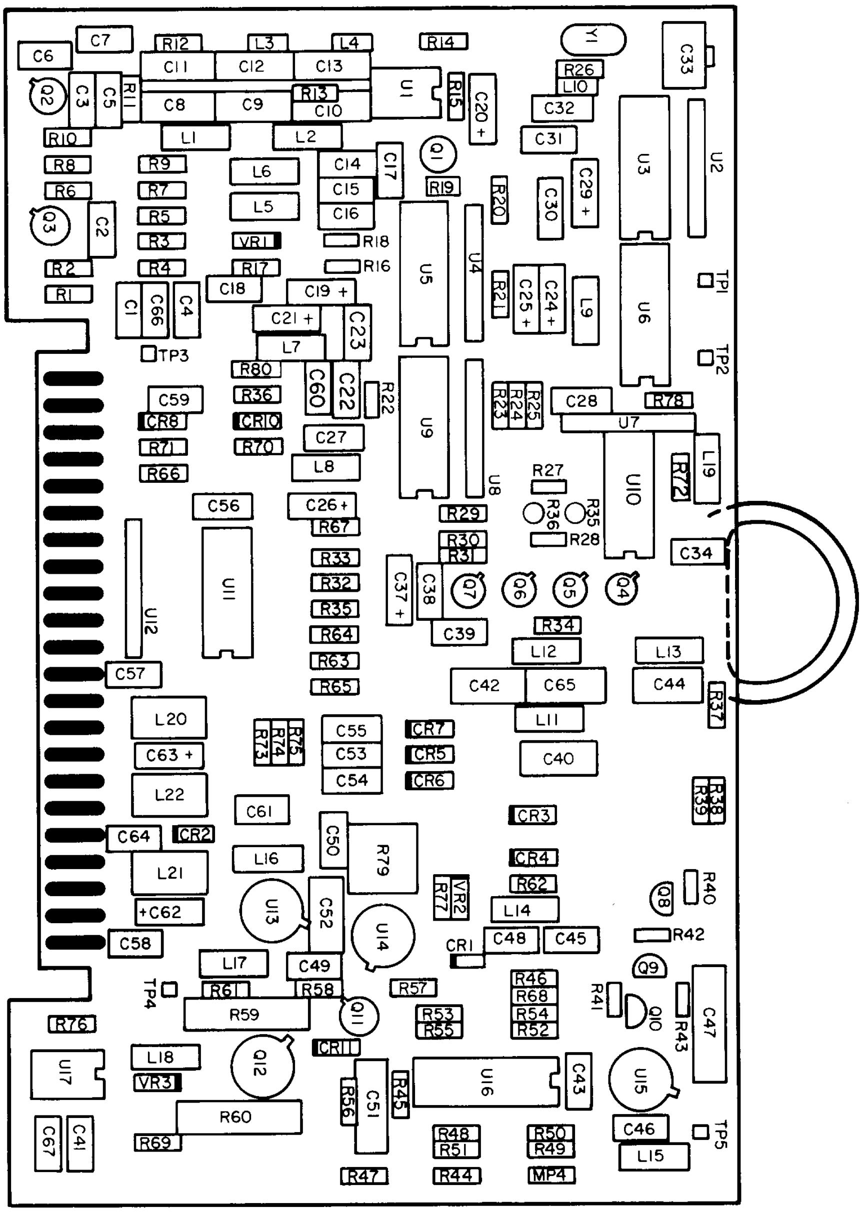
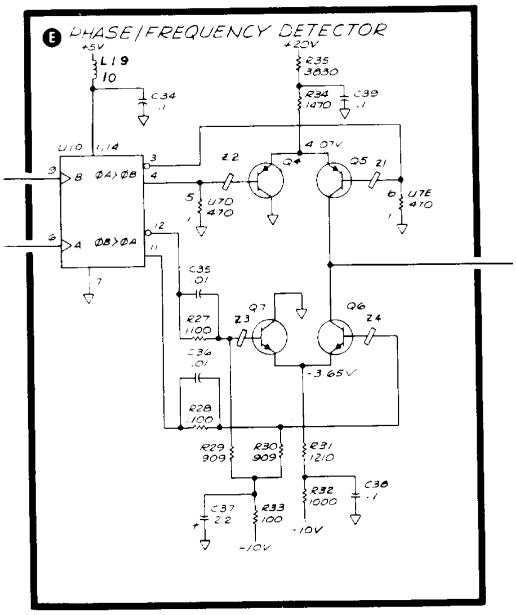


Figure 7-4. Phase Lock (A13), Component Locations (CHANGE A)



P/O Figure 7-5. Phase Lock (A13) Schematic Diagram (CHANGE A)

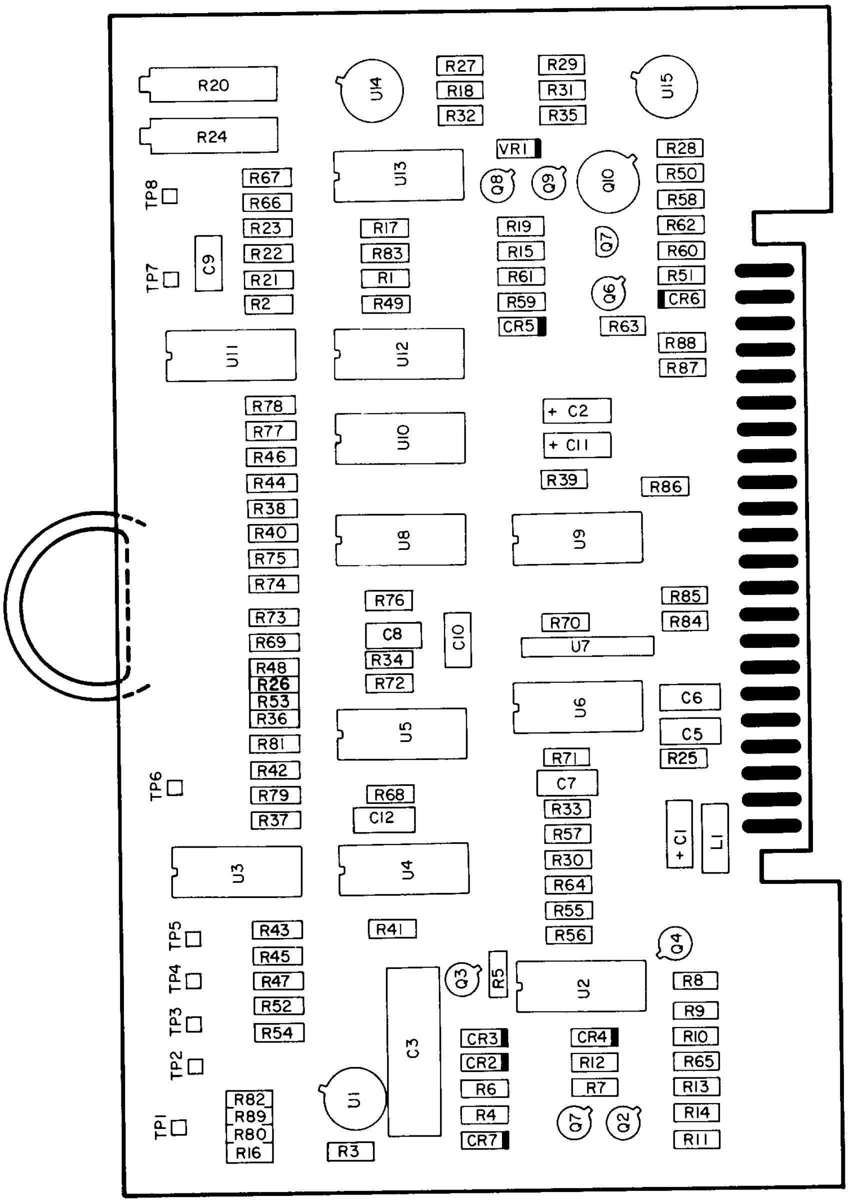


Figure 7-6. Sweep Generator (A17), Component Locations (CHANGE B)

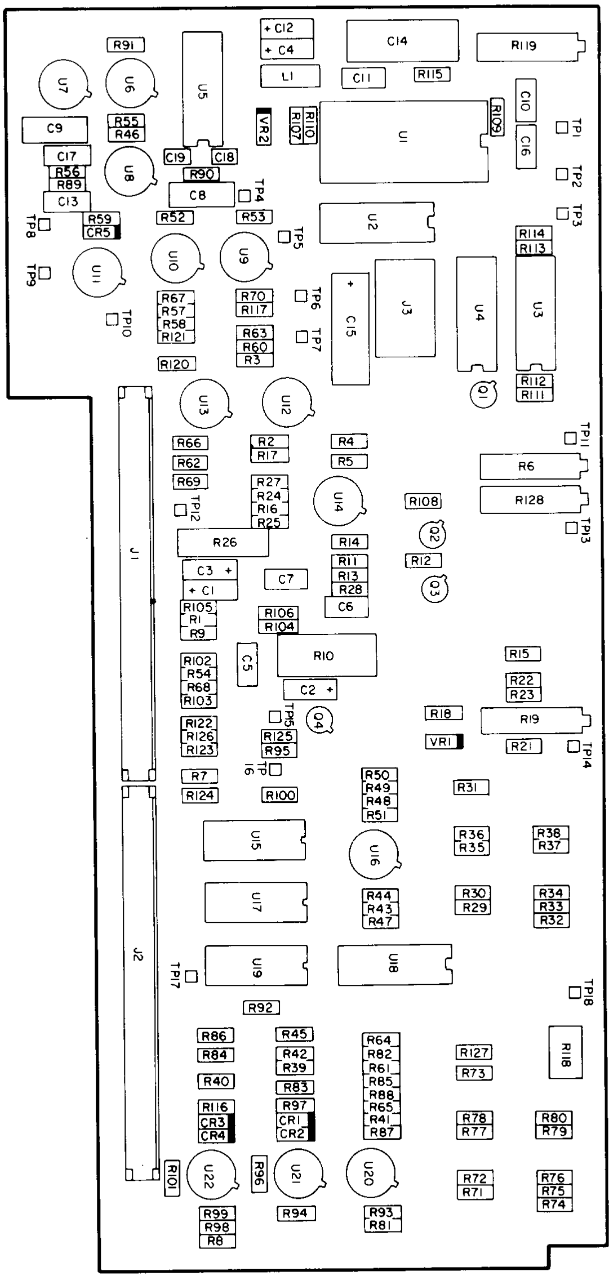


Figure 7-7. Analog Processor (A2), Component Locations (CHANGE B)

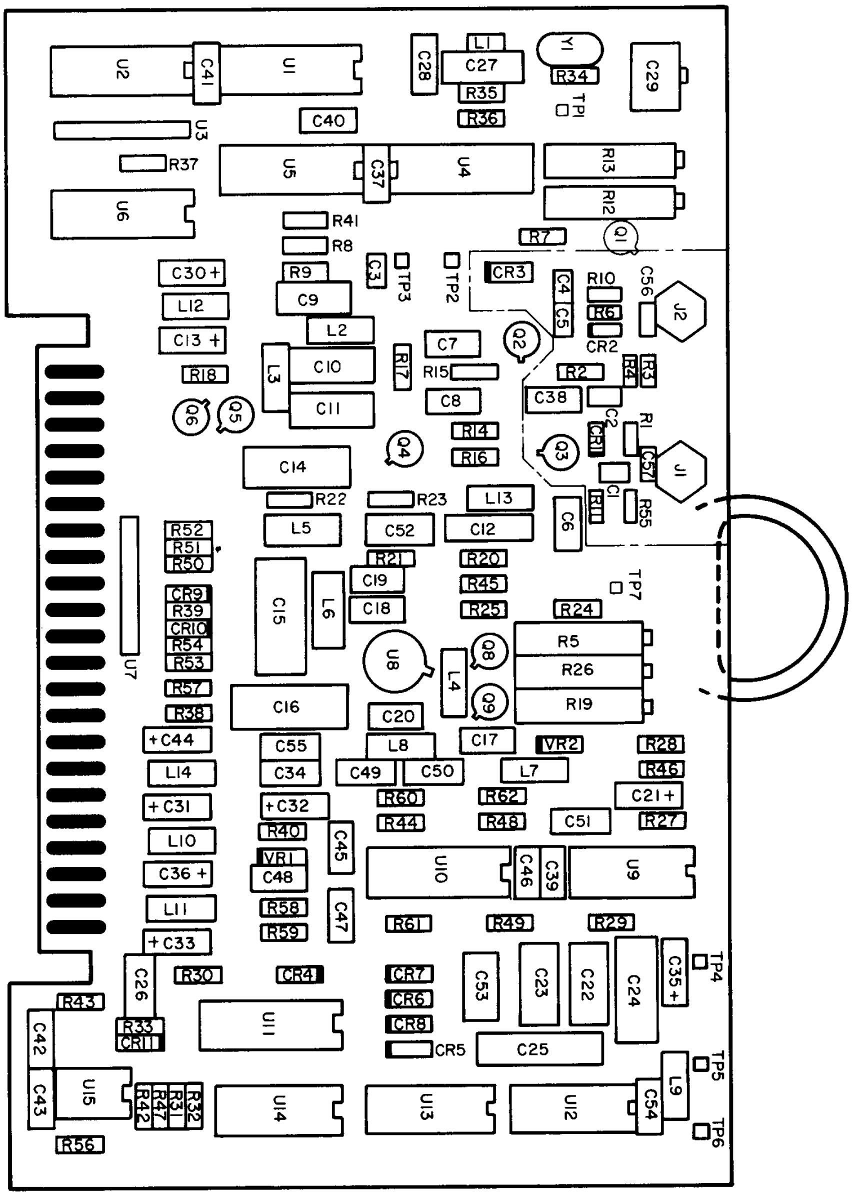
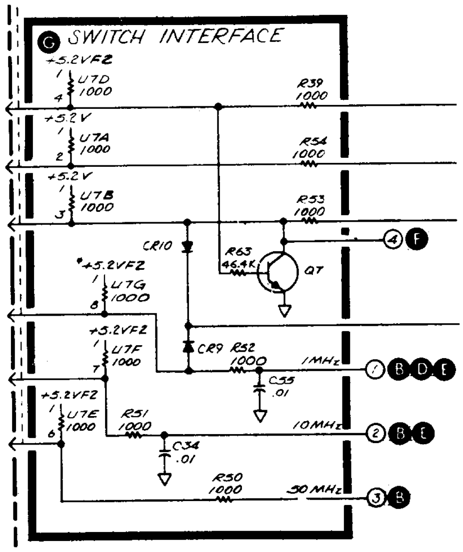


Figure 7-8. Marker Generator (A12), Component Locations (CHANGE B)



P/O Figure 7-9. Marker Generator (A12) Schematic Diagram (CHANGE B)

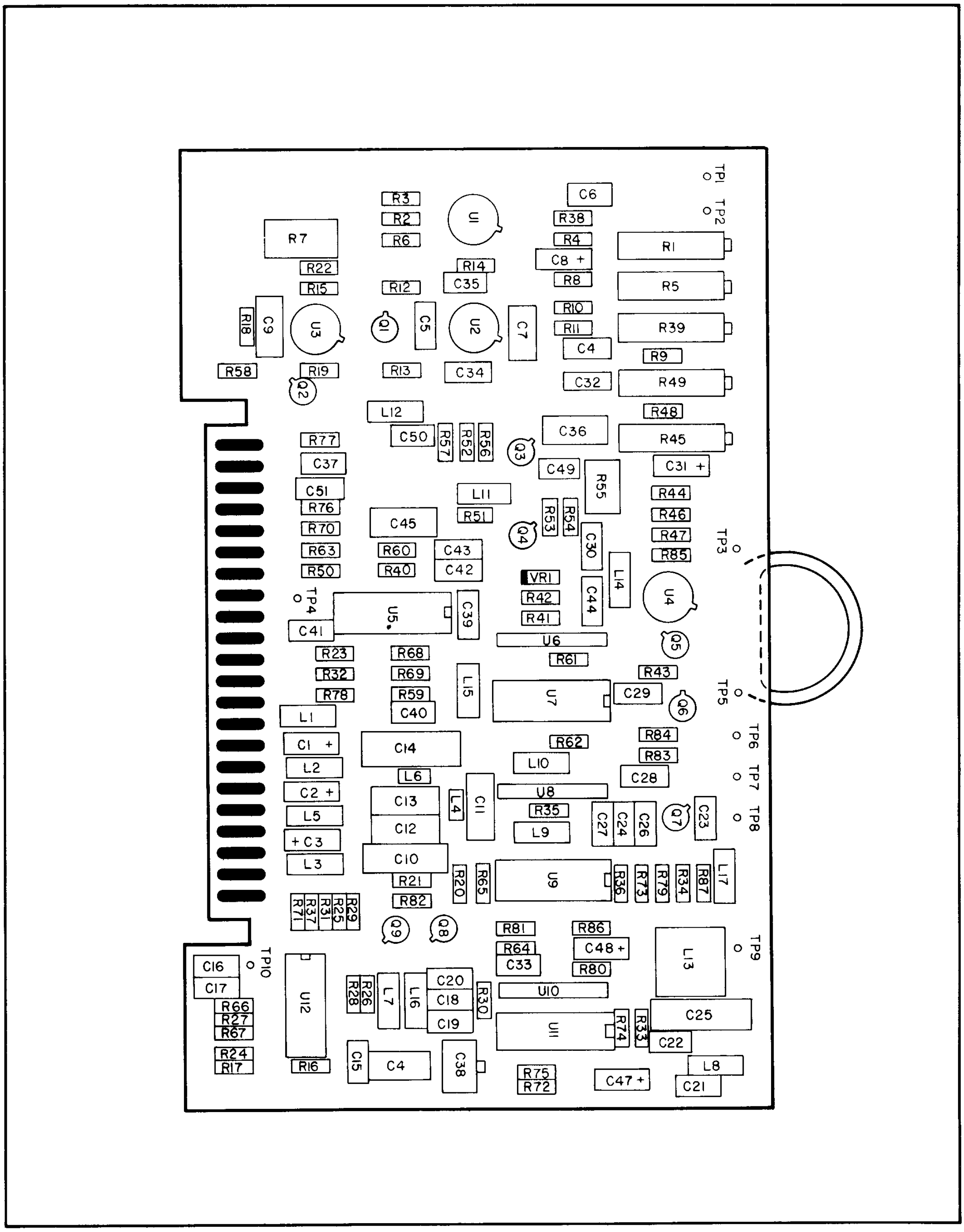


Figure 7-10. Detector (A9), Component Locations

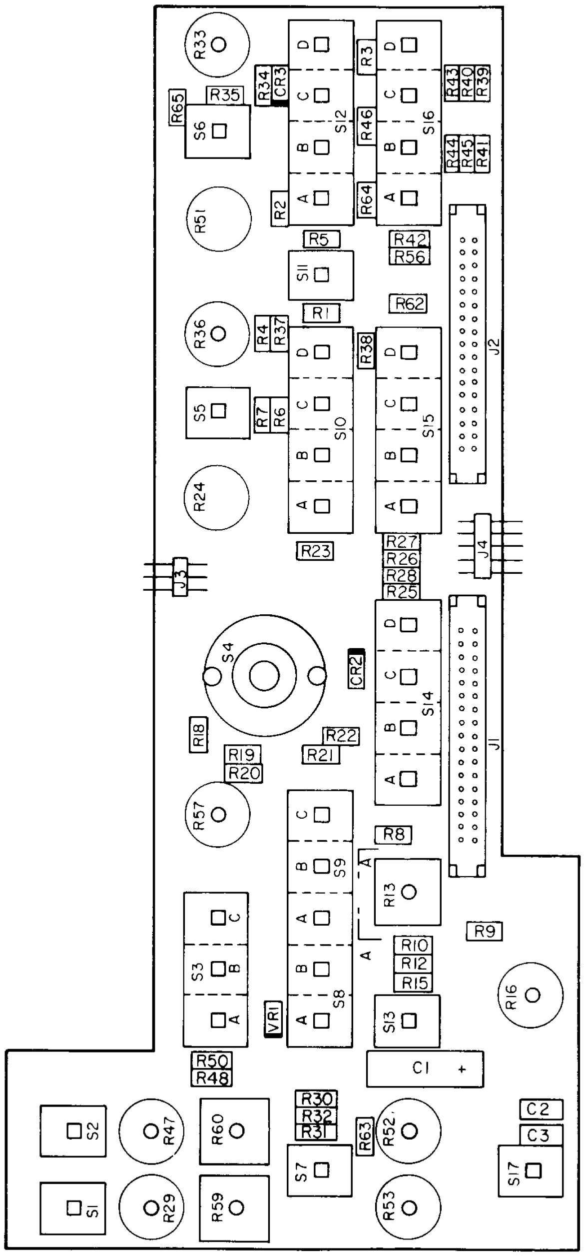


Figure 7-11. Front Panel (A1), Component Locations (CHANGE B)

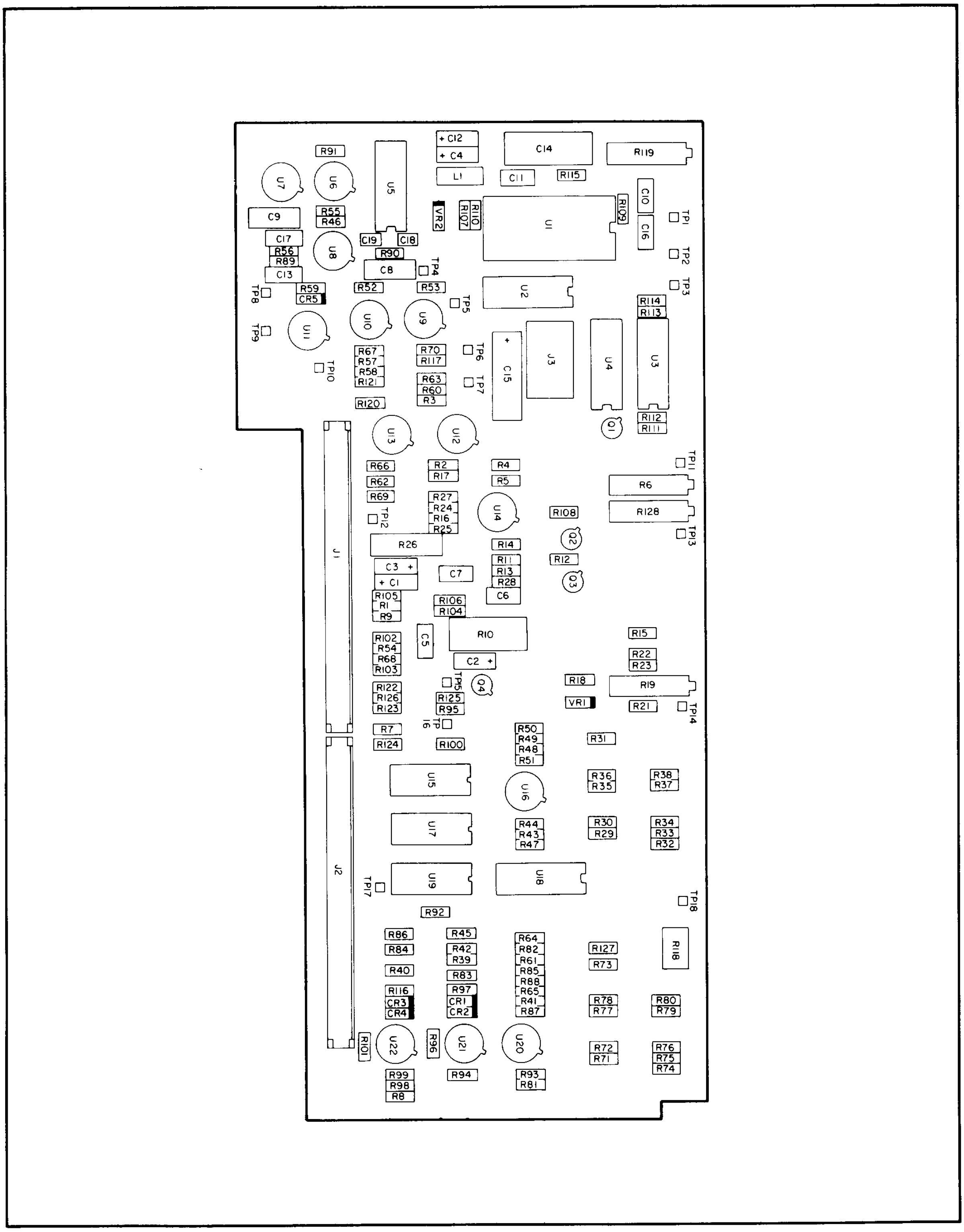


Figure 7-12. Analog Processor (A2), Component Locations (CHANGE B)

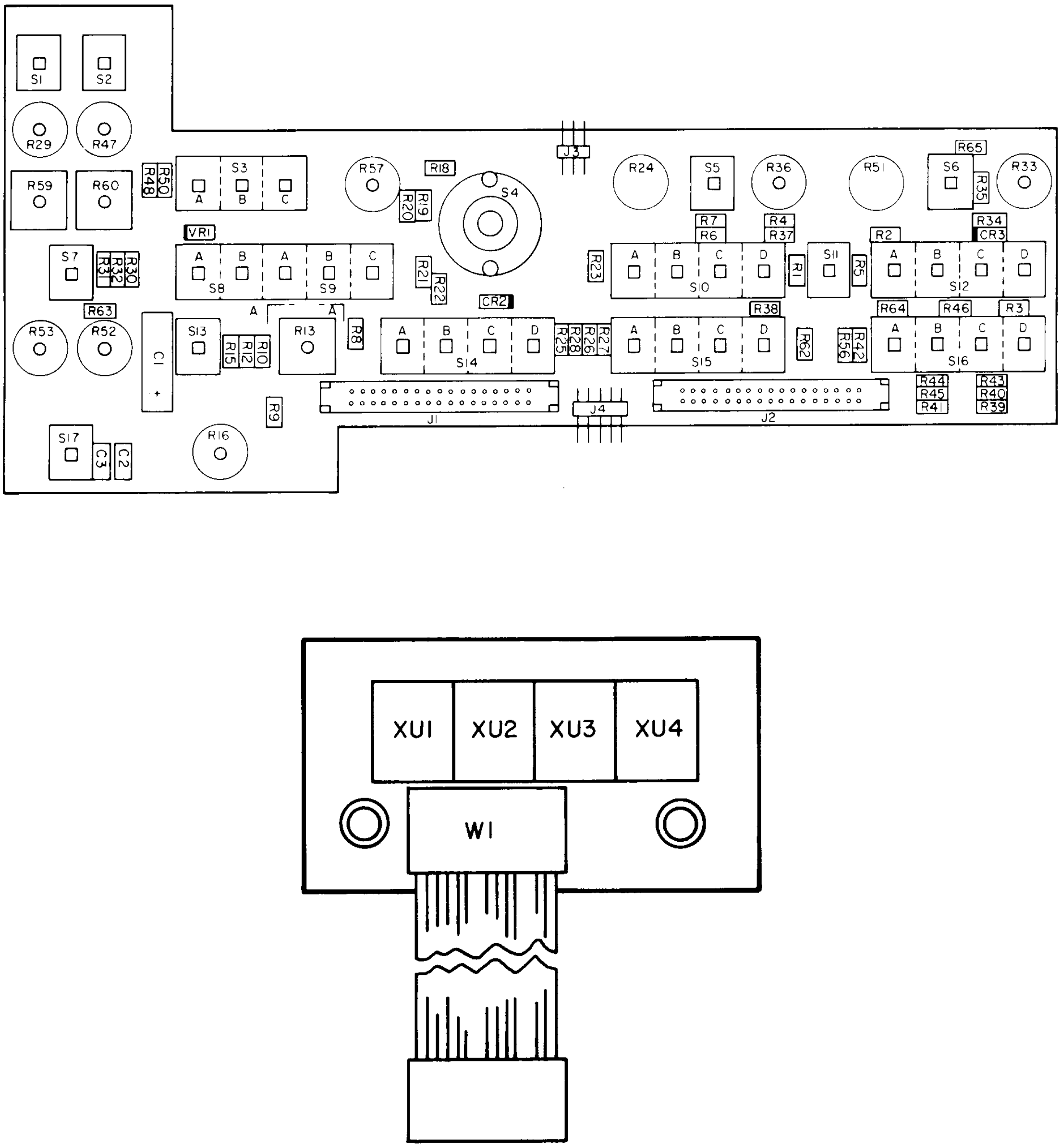


Figure 7-13. Front-Panel Controls and Indicators (A1, A22), Component Locations (CHANGE B)

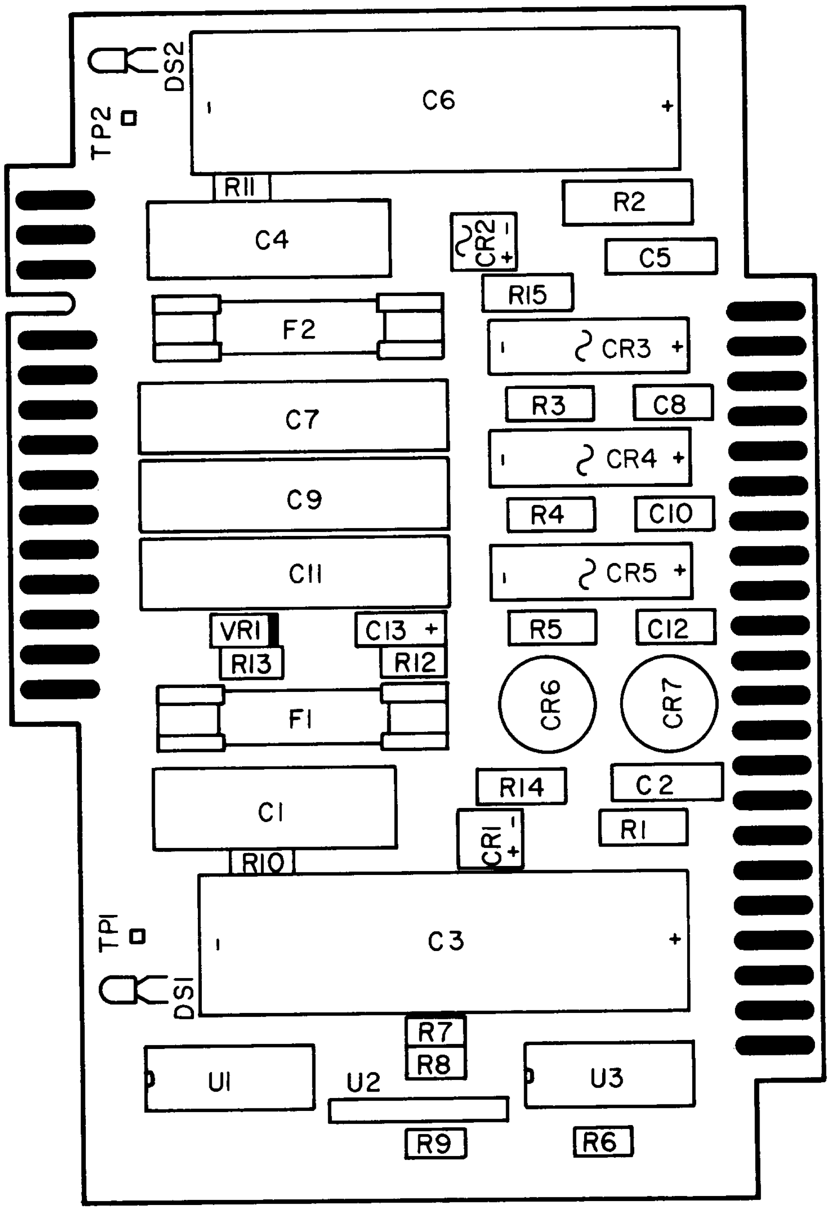


Figure 7-14. Figure Rectifier (A19), Component Locations (CHANGE B)

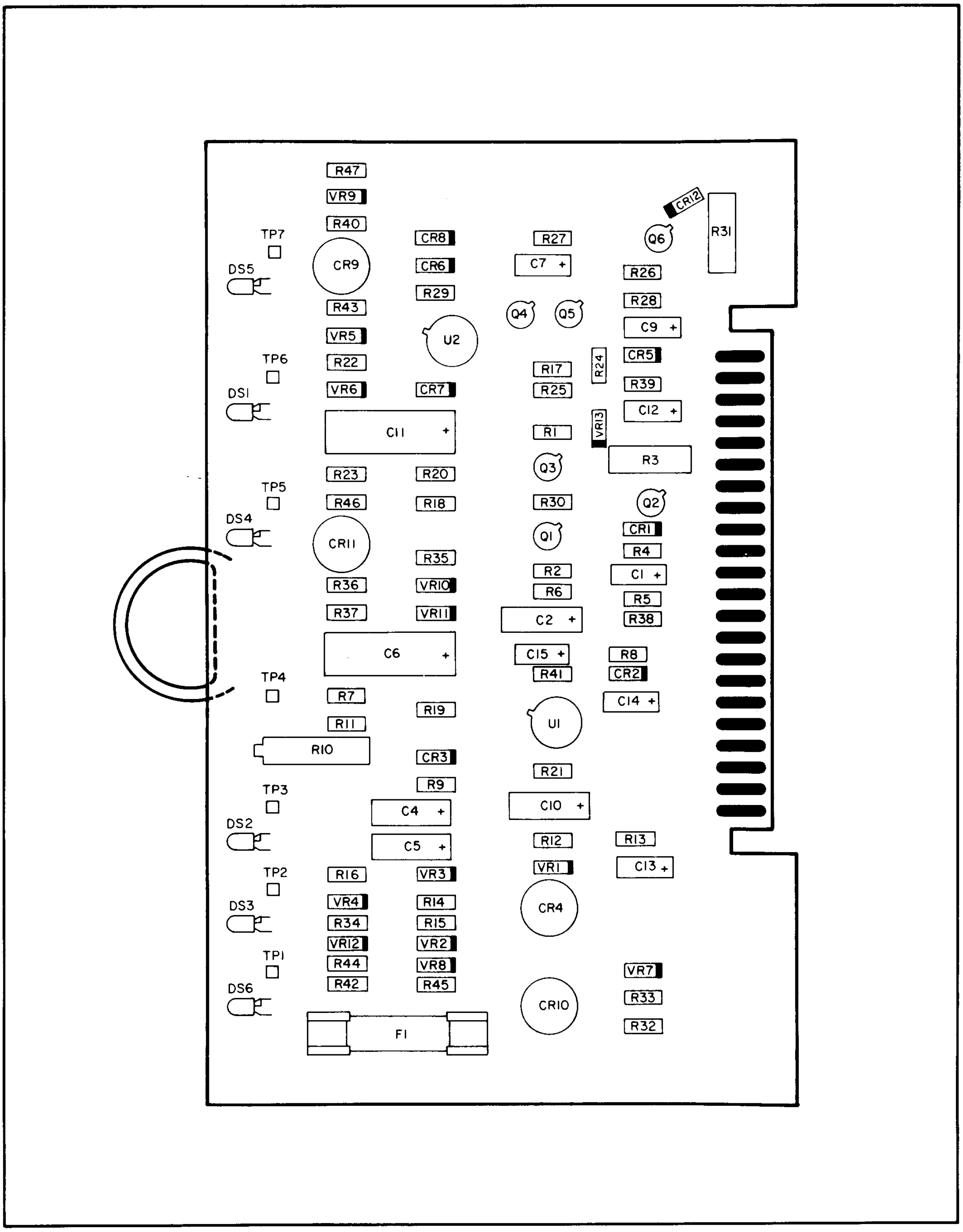
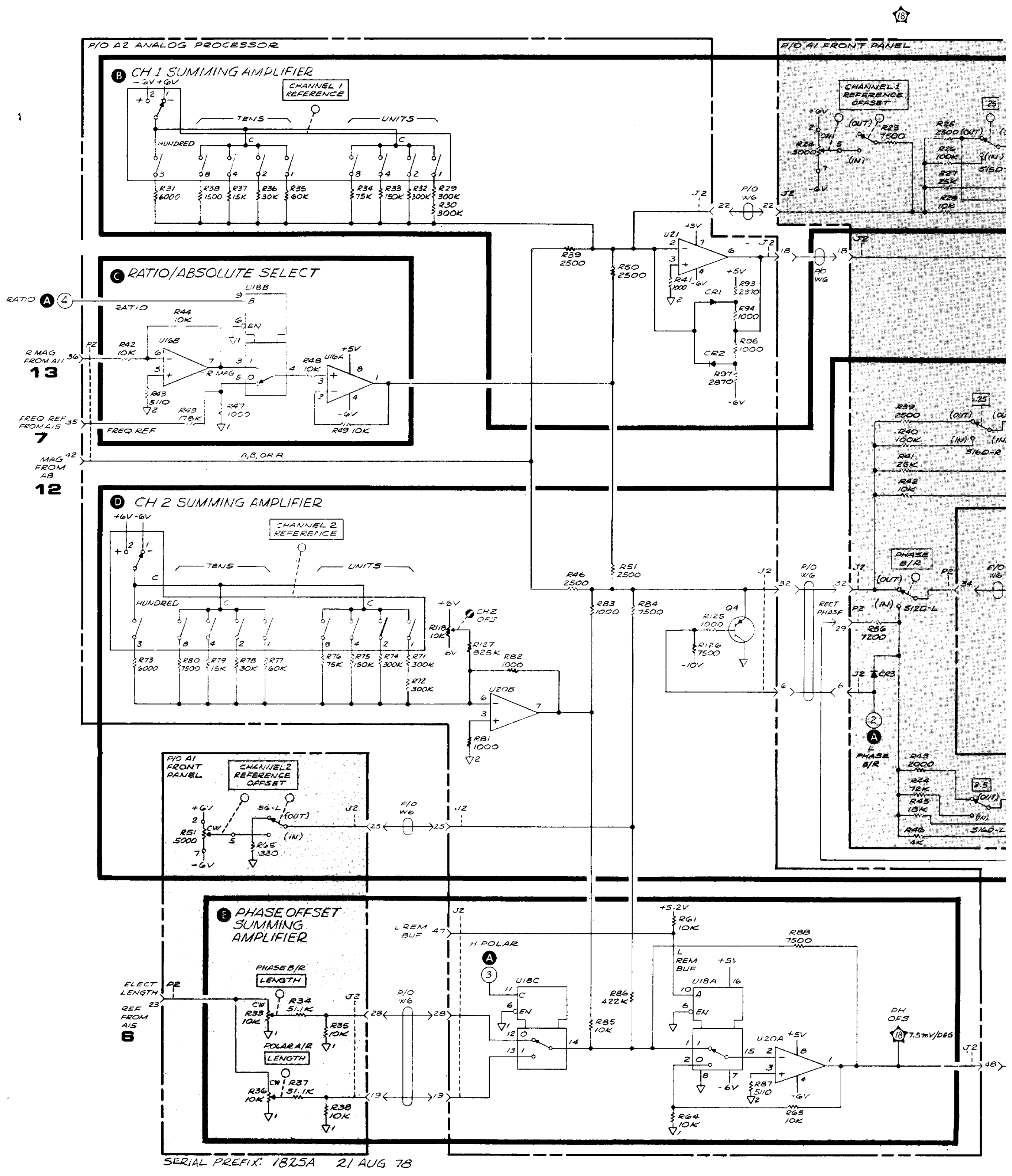
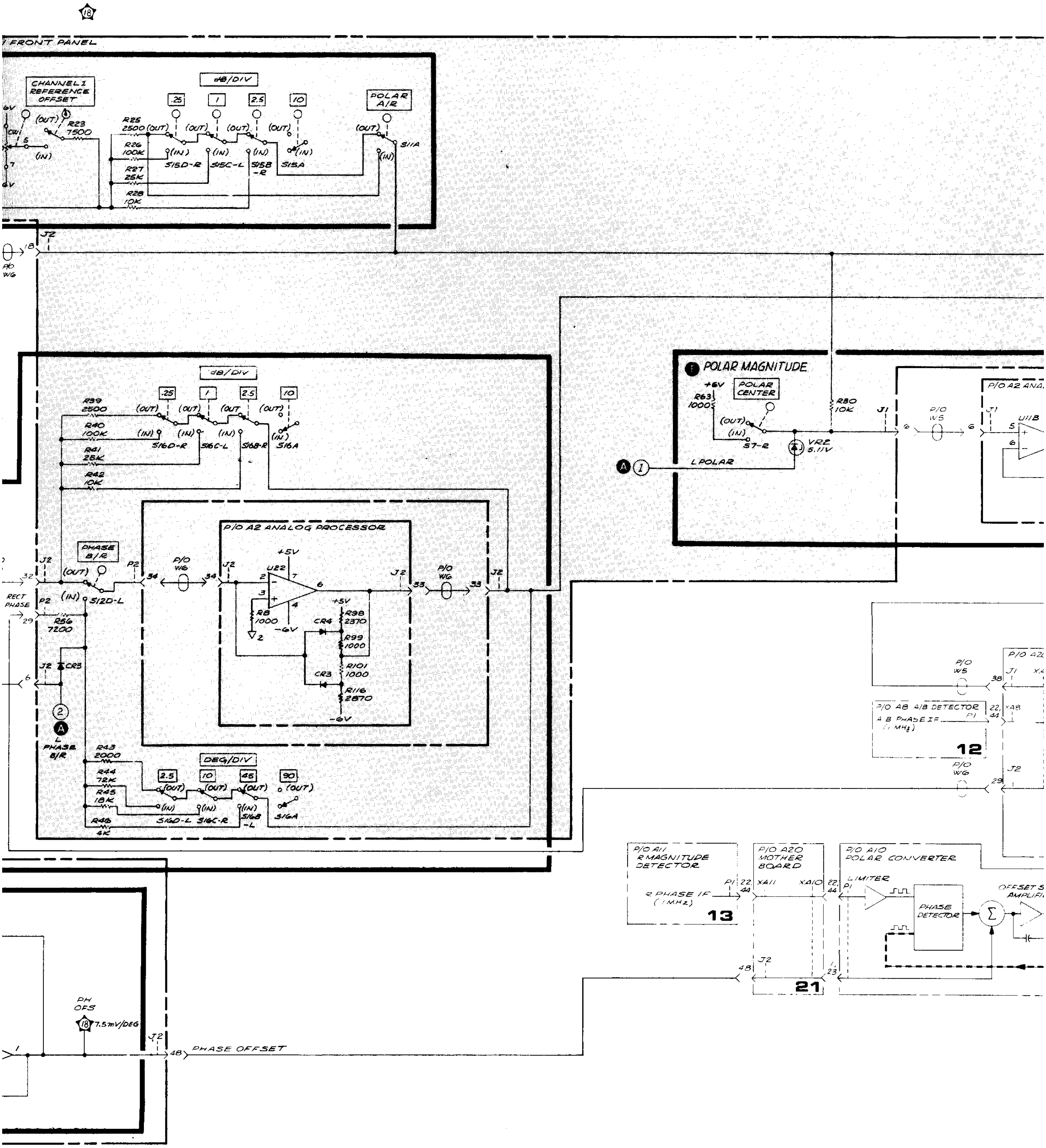
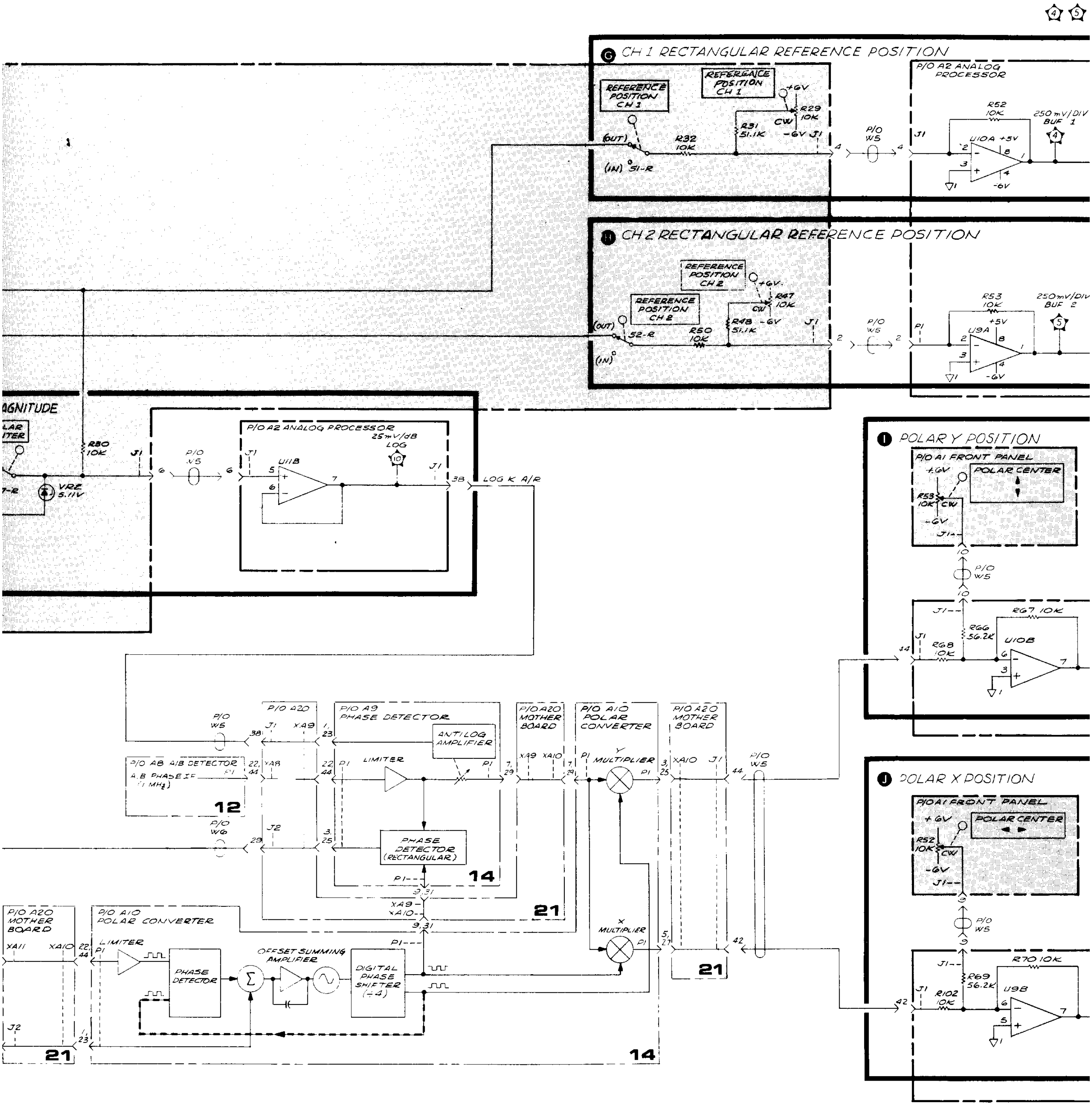


Figure 7-15. DC Regulator (A16), Component Locations


P/O A2 ANALOG PROCESSOR
CH 1 SUMMING AMPLIFIER
CHANNEL 1 REFERENCE
TENS
UNITS
HUNDRED
RATIO/ABSOLUTE SELECT
RATIO
R MAG FROM A11
13
FREQ REF FROM A15
7
FREQ REF
MAG FROM A8
12
A,B,OR R
CH 2 SUMMING AMPLIFIER
CHANNEL 2 REFERENCE
CH2 OFS
P/O A1 FRONT PANEL
CHANNEL2 REFERENCE OFFSET
PHASE OFFSET SUMMING AMPLIFIER
PHASE B/R LENGTH
POLAR A/R LENGTH
ELECT LENGTH REF FROM A15
6
L REM BUF
H POLAR
PH OFS
7.5mV/DEG
P/O A1 FRONT PANEL
CHANNEL 1 REFERENCE OFFSET
PHASE B/R
RECT PHASE
SERIAL PREFIX: 1825A 21 AUG 78



FRONT PANEL
CHANNEL 1 REFERENCE OFFSET
dB/DIV
.25
1
2.5
10
POLAR A/R
R23 7500
R25 2500
R26 100K
R27 25K
R28 10K
S15D-R
S15C-L
S15B-R
S15A
S11A
J2
P/O W6
POLAR MAGNITUDE
POLAR CENTER
R63 1000
R80 10K
S7-R
VR2 5.11V
L POLAR
P/O W5
P/O A2 ANALOG PROCESSOR
U22
U11B
R39 2500
R40 100K
R41 25K
R42 10K
S16D-R
S16C-L
S16B-R
S16A
PHASE B/R
S12D-L
RECT PHASE
R56 7200
CR3
CR4
R8 1000
R98 2370
R99 1000
R101 1000
R116 2870
L PHASE B/R
DEG/DIV
2.5
10
45
90
R43 2000
R44 72K
R45 18K
R46 4K
S16D-L
S16C-R
S16B-L
P/O A8 A/B DETECTOR
A B PHASE IF (1 MHz)
12
P/O A11 R MAGNITUDE DETECTOR
R PHASE IF (1 MHz)
13
P/O A20 MOTHER BOARD
21
P/O A10 POLAR CONVERTER
LIMITER
PHASE DETECTOR
OFFSET
PH OFS
7.5mV/DEG
PHASE OFFSET



CH 1 RECTANGULAR REFERENCE POSITION
REFERENCE POSITION CH 1
P/O A2 ANALOG PROCESSOR
R29 10K
R31 51.1K
R32 10K
S1-R
P/O W5
R52 10K
250mV/DIV BUF 1
U10A
CH 2 RECTANGULAR REFERENCE POSITION
REFERENCE POSITION CH 2
R47 10K
R48 51.1K
R50 10K
S2-R
R53 10K
250mV/DIV BUF 2
U9A
R80 10K
VR2 5.11V
P/O A2 ANALOG PROCESSOR
25mV/dB LOG
U11B
LOG K A/R
POLAR Y POSITION
P/O A1 FRONT PANEL
POLAR CENTER
R67 10K
R66 56.2K
R68 10K
U10B
POLAR X POSITION
R70 10K
R69 56.2K
R102 10K
U9B
P/O A20
P/O A9 PHASE DETECTOR
ANTILOG AMPLIFIER
LIMITER
PHASE DETECTOR (RECTANGULAR)
P/O A8 A/B DETECTOR
A,B PHASE IF (1 MHz)
P/O A20 MOTHER BOARD
P/O A10 POLAR CONVERTER
Y MULTIPLIER
X MULTIPLIER
OFFSET SUMMING AMPLIFIER
DIGITAL PHASE SHIFTER (÷4)
12
14
21

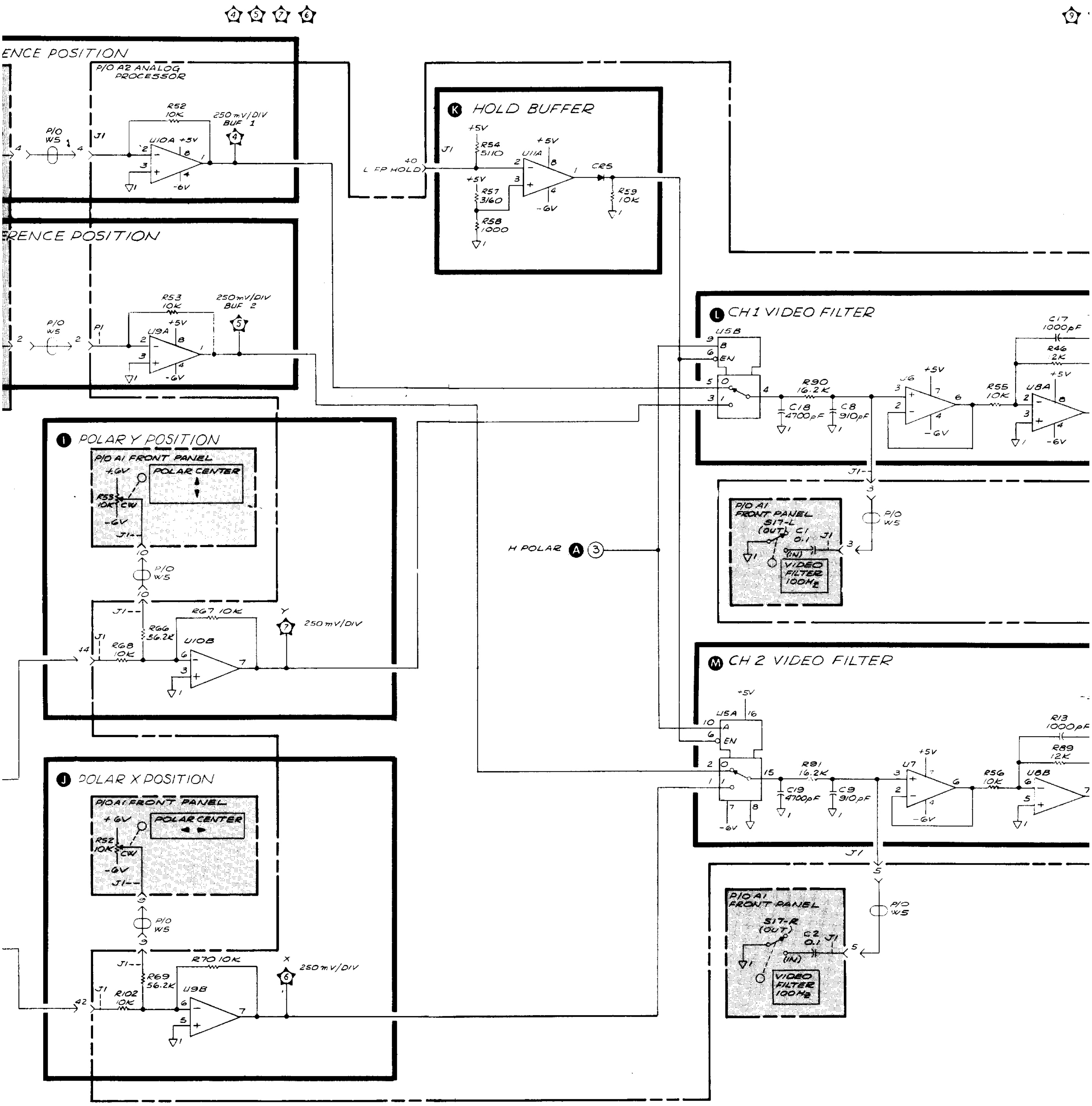


Figure 7-16. Front Panel (A1) and Analog Processor (A2),

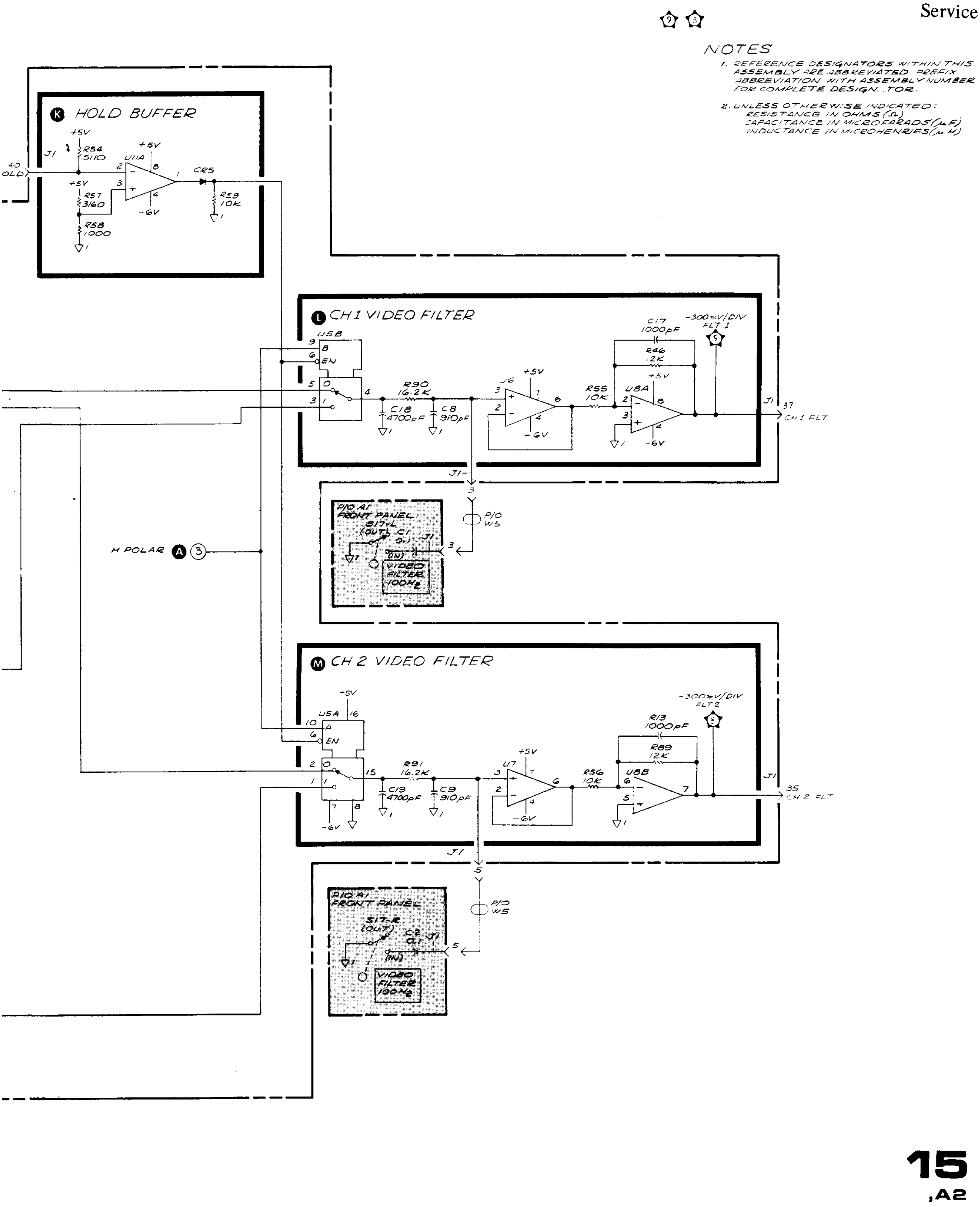


Figure 7-16. Front Panel (A1) and Analog Processor (A2), Schematic Diagram (CHANGE B)

A16 DC REGULATOR

J1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK
1	+5V STROBE POWER	A20 XA16-1	M
23	GROUND SENSE	A20 GND PLANE	K L
2	+20V SENSE	A20 XA15-14	K L
24	+20V SENSE	A20 XA15-14	K L
3	+20V	A20 XA16-3	M
25	+20V	A20 XA16-25	M
4	NC		
26	NC		
5	+5.2V	A20 U2-OUT	H
27	+5.2V	A20 U2-OUT	H
6	NC		
28	NC		
7	NC		
29	NC		
8	-10V SENSE	A20 XA15-18	L
30	-10V SENSE	A20 XA15-18	L
9	-10V	A20 XA16-9	L
31	-10V	A20 XA16-31	L
10	+5V	A20 U3-OUT	I
32	+5V	A20 U3-OUT	I
11	NC		
33	NC		
12	▽	A20 GND PLANE	
34	▽	A20 GND PLANE	
13	▽	A20 GND PLANE	
35	▽	A20 GND PLANE	
14	▽	A20 GND PLANE	
36	▽	A20 GND PLANE	
15	+20V REGULATOR CONTROL	A20 Q2-BASE	K
37	+20V REGULATOR CONTROL	A20 Q2-BASE	K
16	+20V UNREGULATED	A20 F1	K
38	+20V UNREGULATED	A20 F1	K
17	REG +20V	A20 Q2-EMITTER	K
39	REG +20V	A20 Q2 EMITTER	K
18	-10V UNREGULATED	A20 F2	L
40	-10V UNREGULATED	A20 F2	L
19	-12V	A20 U1-OUT	J
41	-12V	A20 U1-OUT	J
20	-10V REGULATOR CONTROL	A20 Q1-BASE	L
42	-10V REGULATOR CONTROL	A20 Q1-BASE	L
21	▽	A20 GND PLANE	
43	▽	A20 GND PLANE	
22	REGULATED -10V	A20 Q1-EMITTER	L
44	REGULATED -10V	A20 Q1-EMITTER	L

SERIAL PREFIX: 1825A 21 AUG 78

A19 RECTIFIER ASSEMBLY

P1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET
1	L B [illegible]	A2J1-45		18
23	L REV AB	A23J7-10		
2	L MAS [illegible]	A11-42		18
24	H MAS	A23J7-19		
3	L B [illegible]	A6-10,32		18
25	L B REM	A23J7-20		
4	L REM BUF	A17 P1-20 A2J2-47		18
26	L REM	A23J7-21		
5	NC			
27	NC			
6	NC			
28	NC			
7	+5.2V	A20U2 OUT		
29	+5.2V	A20U2OUT		
8	▽	A20 GND PLANE	F	
30	▽	A20 GND PLANE	F	
9	▽	A20 GND PLANE	F	
31	▽	A20 GND PLANE	F	
10	-80V	A20 XA19-10	F	
32	-80V	A20 XA19-32	F	
11	▽	A20 GND PLANE	F	
33	▽	A20 GND PLANE	F	
12	+20V UNREG COMMON	A20 C1 -	C	
34	+20V UNREG COMMON	A 20 C1 -	C	
13	+20V UNREGULATED	A20 C1 +	C	
35	+20V UNREGULATED	A20 C1 +	C	
14	▽	A20 GND PLANE	F	
36	▽	A20 GND PLANE	F	
15	-10V UNREG COMMON	A20 C2 +	D	
37	-10UNREG COMMON	A20 C2 +	D	
16	-10V UNREGULATED	A20 C2 -	E	
38	-10V UNREGULATED	A20 C2 -	E	
17	▽	A20 GND PLANE	F	
39	▽	A20 GND PLANE	F	
18	+5V UNREG COMMON	A20 C3 -	D	
40	+5V UNREG COMMON	A20 C3 -	D	
19	+5V UNREGULATED	A20 C3+	D	
41	+5V UNREGULATED	A20 C3+	D	
20	▽	A20 GND PLANE	F	
42	▽	A20 GND PLANE	F	
21	▽1	A20 GND PLANE	B	
43	▽1	A20 GND PLANE	B	
22	+150V UNREGULATED	A20 XA19 - 22	B	
44	+150V UNREGULATED	A20 XA19 - 44	B	

A19 RECTIFIE

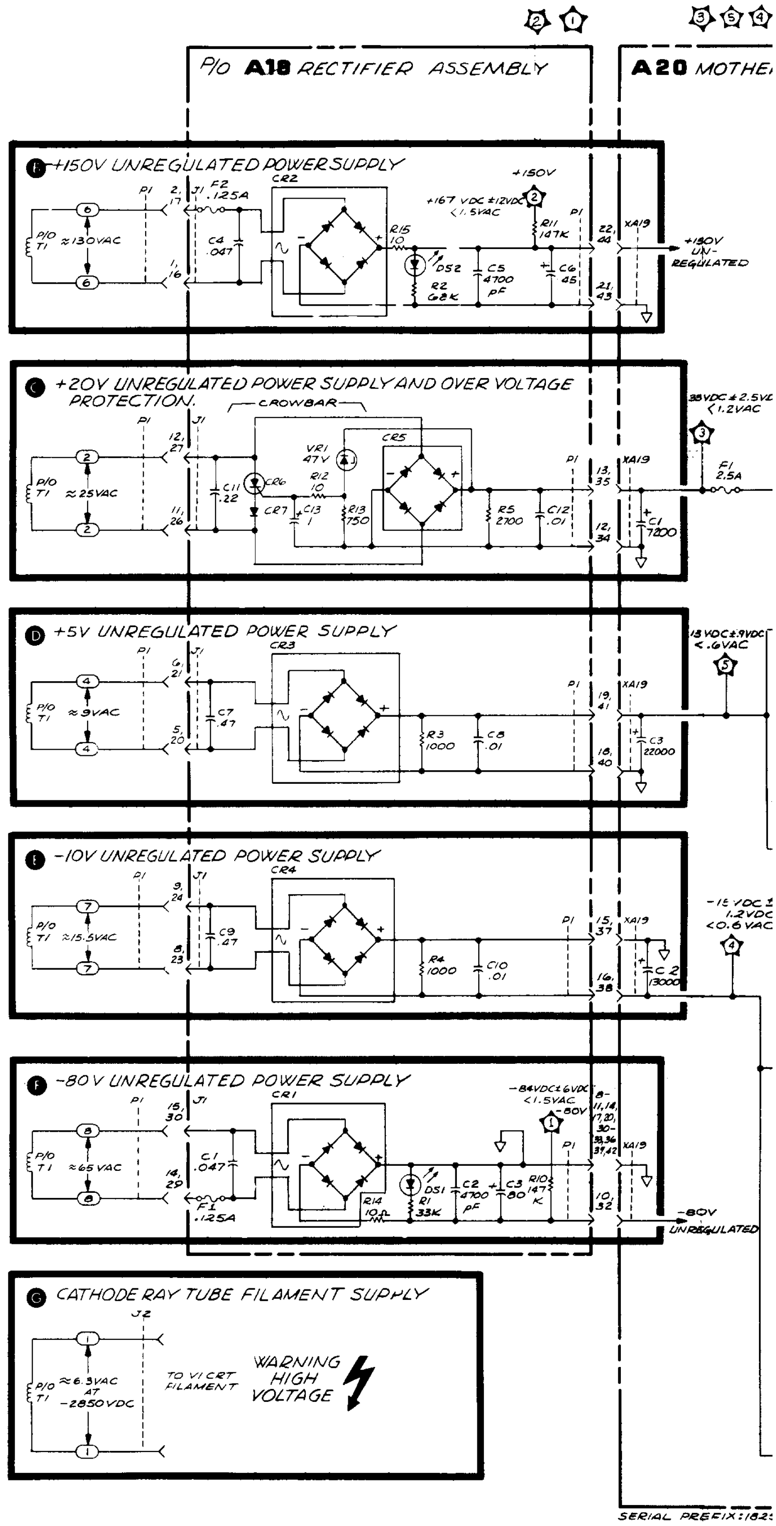
J1

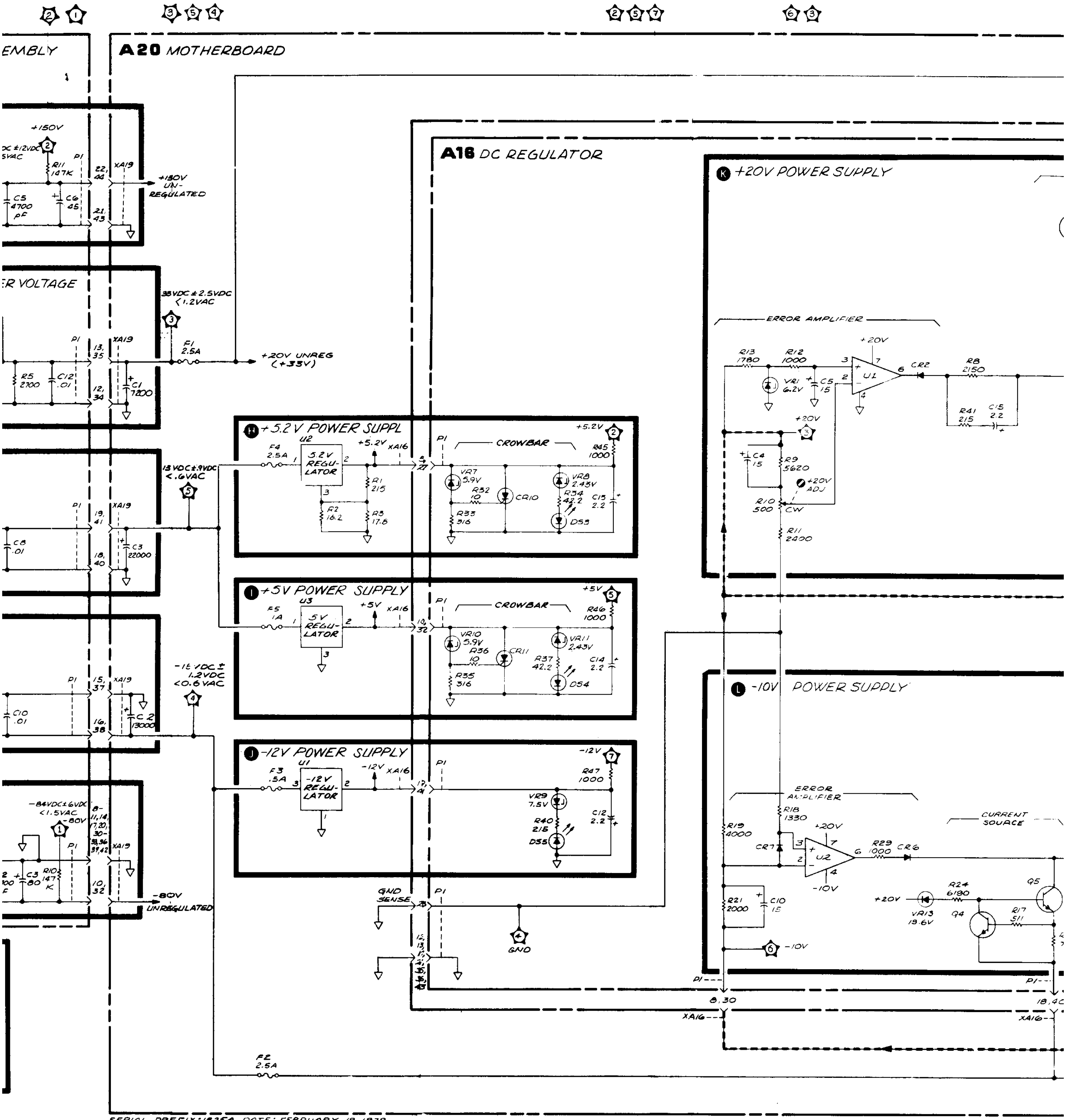
PIN NO	SIGNAL	TO/FROM
1	130VAC	T1
16	130VAC	T1
2	130VAC	T1
17	130VAC	T1
3	NC	
18	NC	
4	NC	
19	NC	
5	9VAC	T1
20	9VAC	T1
6	9VAC	T1
21	9VAC	T1
7	NC	
22	NC	
8	15.5 VAC	T1
23	15.5 VAC	T1
9	15.5 VAC	T1
[illegible]	15.5VAC	T1
10	NC	
25	NC	
11	25VAC	T1
26	25VAC	T1
12	25VAC	T1
27	25VAC	T1
13	NC	
28	NC	
14	65VAC	T1
29	65VAC	T1
15	65VAC	T1
30	65VAC	T1

A19 RECTIFIER ASSEMBLY

J1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK
1	30VAC	T1	B
16	130VAC	T1	B
2	30VAC	T1	B
17	30VAC	T1	B
3	NC		
18	NC		
4	NC		
19	NC		
5	9VAC	T1	D
20	9VAC	T1	D
6	9VAC	T1	D
21	9VAC	T1	D
7	NC		
22	NC		
8	15.5VAC	T1	E
23	15.5VAC	T1	E
9	15.5VAC	T1	E
24	15.5VAC	T1	E
10	NC		
25	NC		
11	25VAC	T1	C
26	25VAC	T1	C
12	25VAC	T1	C
27	25VAC	T1	C
13	NC		
28	NC		
14	65VAC	T1	F
29	65VAC	T1	F
15	65VAC	T1	F
30	65VAC	T1	F





SERIAL PREFIX: 1825A DATE: FEBRUARY 19, 1979

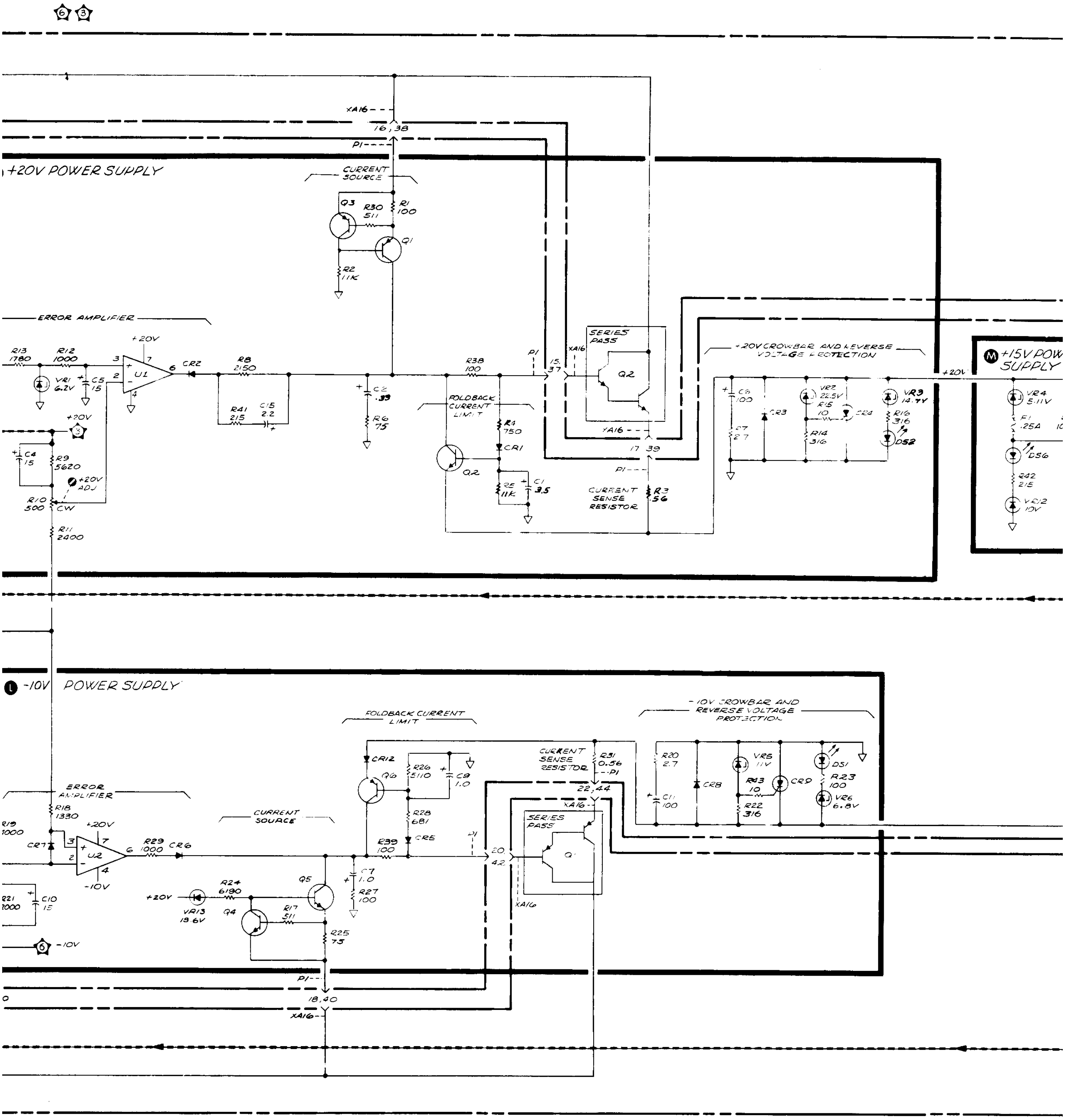


Figure 7-17. Low Voltag

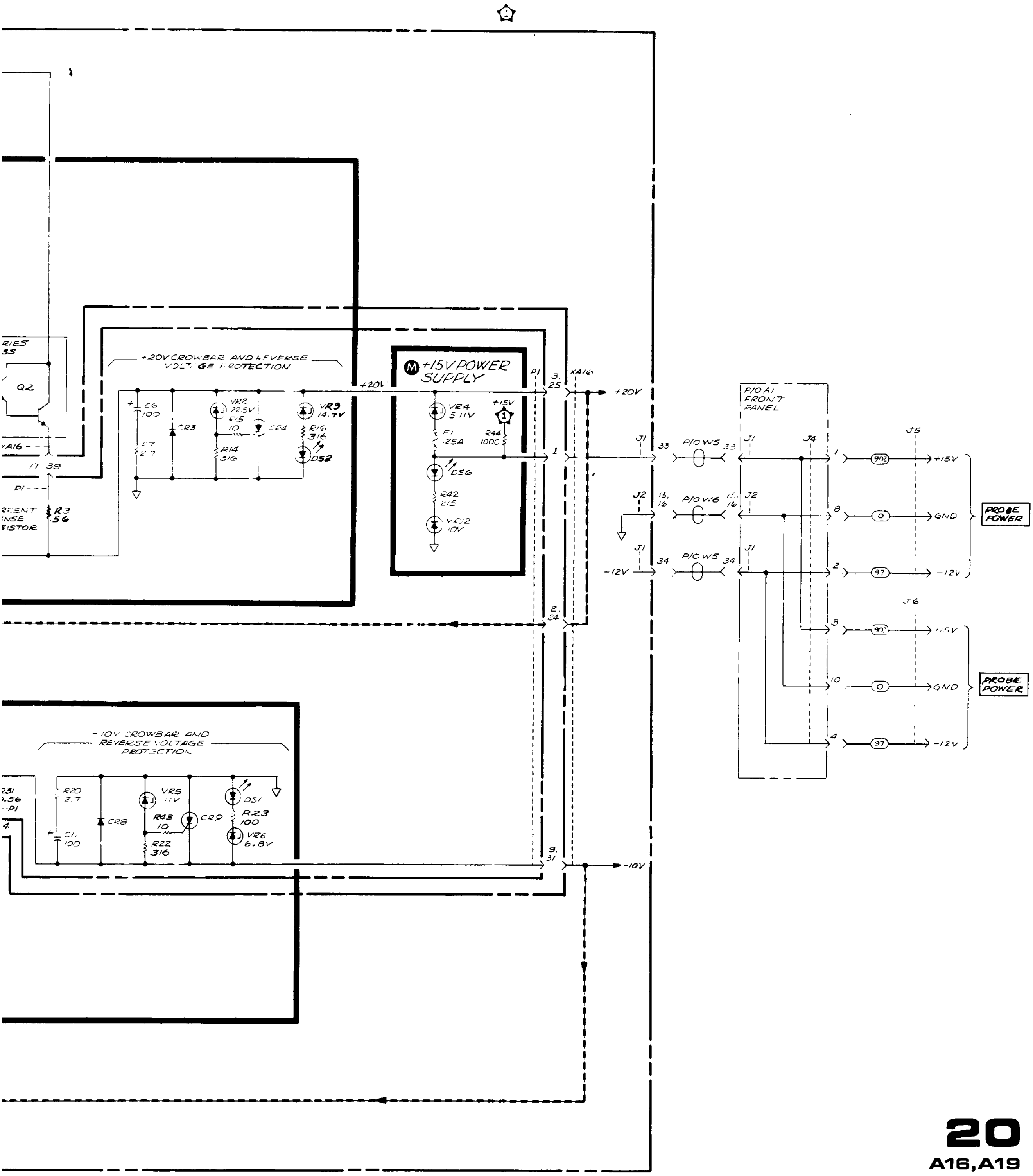


Figure 7-17. Low Voltage Power Supply (A19, A16), Schematic Diagram (CHANGE B)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for the troubleshooting and repair of the Model 8754A Network Analyzer. See Service Sheets 1–4 for Basic 8754A Troubleshooting. Circuit descriptions and simplified block diagrams are included with the schematic diagrams of the assemblies. Component location illustrations are also contained in this section. Schematic presentations in this manual show electrical circuit operation and are not intended to serve as wiring diagrams. Figure 8-1 presents schematic diagram notes. Figure 8-2 illustrates schematic symbols for digital integrated circuits.

8-3. ASSEMBLY SERVICE SHEETS

8-4. The schematics are arranged by service sheets, with each service sheet covering a functional area of the network analyzer. The service sheet numbers appear in the lower right-hand corner of the schematics (large number above assembly number). The service sheet includes the schematic, the accompanying circuit descriptions, a component-location diagram, a block diagram, and assembly-level troubleshooting. Table 8-1 lists the service sheets and describes their functional breakdown. Table 8-2 is a cross-reference of assemblies to service sheets, provided as an aid in finding the schematic of a particular assembly. This cross-reference is also on the back of each index tab.

8-5. CIRCUIT DESCRIPTIONS

8-6. A detailed circuit description is provided with each service sheet. This places material needed for component-level diagnosis in one location and allows easy correlation between function and specific circuitry.

8-7. TROUBLESHOOTING

WARNING

With the ac power cable connected, the ac line voltage is present at the terminals of power line module FL1 (mounted on rear panel) and at the LINE switch, whether the LINE switch is on or off. With the covers removed, these terminals are exposed. Care must be taken to avoid contact with these terminals.

With the covers removed, terminals are exposed that have voltages capable of causing death. Any maintenance or repair of the opened instrument under voltage should be carried out only by a skilled person who is aware of the hazard involved.

After disconnecting ac line power cord, allow a minimum of 30 seconds for High Voltage Power Supply to discharge before removing High Voltage Power Supply protective cover.

8-8. Troubleshooting is generally divided into two maintenance levels in this manual. The first level isolates a trouble to a circuit or assembly. This is done by using block diagrams that provide signal levels to isolate the cause of a malfunction and identify the defective assembly.

8-9. The second maintenance level isolates the trouble to the component. Schematic diagrams and circuit descriptions for each assembly aid in troubleshooting to the component level.

8-10. When troubleshooting a transistor stage, check for a forward bias condition of the base-emitter junction. If this condition exists, the next step is to remove this forward bias by shorting the base to the emitter and checking to see if the collector voltage rises to the approximate level of the supply. The next check that can be made, if it is known that the transistor is not operating in a saturated condition, is to check for a voltage drop between emitter and collector. These serve only as quick checks but will help in getting started with the problem.

GRAPHIC SYMBOLS USED ON SCHEMATIC AND BLOCK DIAGRAMS

BASIC COMPONENT SYMBOLS

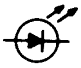
Symbol	Description	Symbol	Description
R, L, C	Resistance is in ohms, inductance is in microhenries, capacitance is in microfarads, unless otherwise noted.	A	Measurement Point: Used to indicate a convenient point for measurement. No terminal provided for test probe.
P/O	Part of.	946	Indicates wire or cable color code. Color code same as resistor color code. First number indicates base color, second and third numbers indicate colored stripes.
*	Indicates a factory selected component		
	Panel control.		Indicates shielding conductor for cables
	Screwdriver adjustment.		
	Encloses front panel designation.		Indicates a plug-in connection
	Encloses rear panel designation.		
	Circuit assembly borderline.		Indicates a soldered or mechanical connection
	Other assembly borderline.		
	Heavy line with arrows indicates path and direction of main signal.		Connection symbol indicating a male connection
	Heavy dashed line with arrows indicates path and direction of main feedback.		Connection symbol indicating a female connection
	Earth ground symbol	CW	Variable Resistor: CW indicates clockwise rotation of shaft moves wiper towards location of CW.
	Instrument chassis ground. May be accompanied by a number or letter to specify a particular ground.		General Purpose Diode
	Indicates "WARNING: HAZARDOUS VOLTAGE."		Breakdown Diode: Zener
1	Test Point: Terminal provided for test probe connection		Schottky Diode

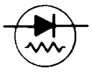
Figure 8-1. Schematic Diagram Notes (1 of 2)

GRAPHIC SYMBOLS USED ON SCHEMATIC AND BLOCK DIAGRAMS

BASIC COMPONENT SYMBOLS (Cont'd)

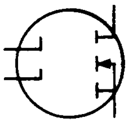

Varactor Diode (Varicap)

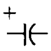

Light-Emitting Diode


PIN Diode

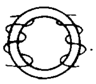

Step Recovery Diode

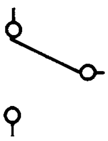

SCR (Silicon Controlled Rectifier)

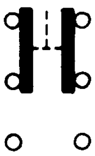

MOS FET Dual Gate N-Channel

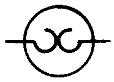

Electrolytic Capacitor


Feedthrough Capacitor

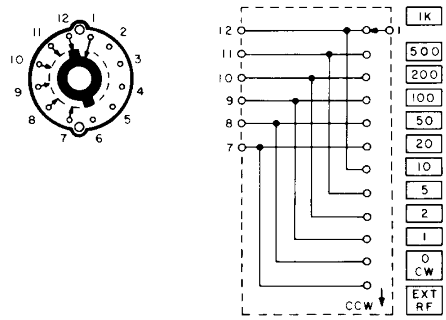

Toroidal Transformer

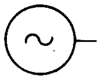

Pushbutton or Toggle, Switch

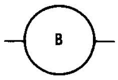

Slide Switch


Thermal Switch

ROTARY SWITCH:
FULLY CLOCKWISE
(1K POSITION)

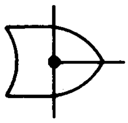



Oscillator.


Fan, Motor


Sampler.


Summing Point.


Wired OR.

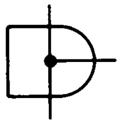

Wired AND.

Figure 8-1. Schematic Diagram Notes (2 of 2)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS

The following is a guide to the symbols used for digital or logic ICs in this manual. The symbology is based upon American National Standard ANSI Y32.14, *Graphic Symbols for Logic Diagrams (Two-State Devices)*, but does not strictly follow the standard. This figure should be consulted for the explanation of digital IC symbols used in Section VIII.

DEFINITIONS

Logic Element: The part or parts of a logic device symbol having a well-defined logic function (OR, AND, FLIP-FLOP, etc.) and one or more outputs. The inputs of a logic element may be data or control inputs; the outputs are data outputs.

Control Block: The part of a logic device symbol to which all logic lines common to a group of logic elements are connected. Lines connected to a control block are control lines.

Function Label: The notation within a logic device symbol that denotes its overall logic function (counter, shift register, multiplexer, etc.).

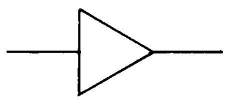
Line Label: The symbol or abbreviation associated with an output or input line that defines the action of the line.

Indicator Symbol: A symbol associated with an input or output line which defines the active state or special characteristics of the line.

BASIC LOGIC SYMBOLS

Distinctive-Shape Symbols

Amplifier/Buffer



AND Gate

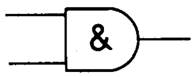
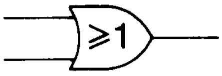


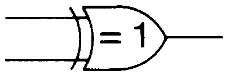
Figure 8-2. Schematic Symbols for Digital Integrated Circuits (1 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

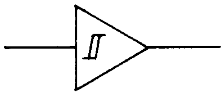
OR Gate



EXCLUSIVE OR Gate

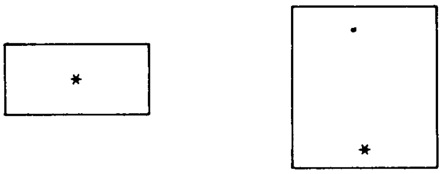


Schmitt Trigger



Rectangular Symbols

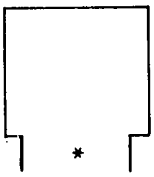
General Logic Element



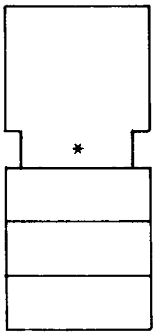
NOTE

The asterisk indicates where the function label is placed

Control Block



Logic Elements with Common Control Block



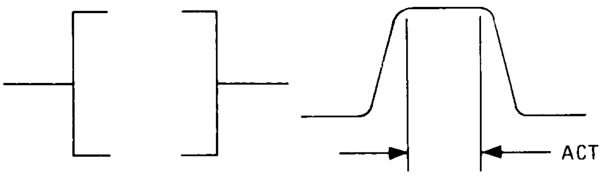
NOTE

If elements sharing control lines are widely separated, each element will have a control block.

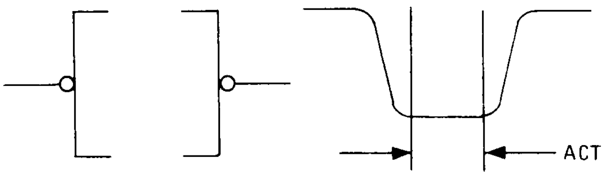
Figure 8-2. Schematic Symbols for Digital Integrated Circuits (2 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

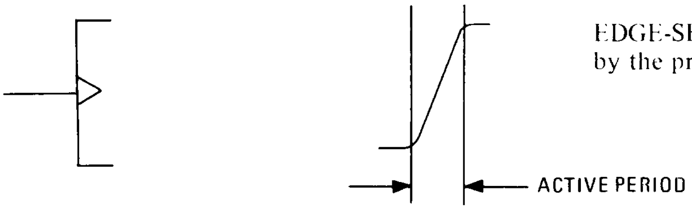
INDICATOR SYMBOLS (positive logic assumed)



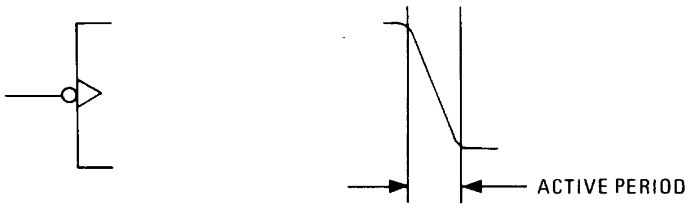
ACTIVE-HIGH inputs and outputs are indicated by the absence of the negation symbol, O.

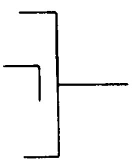


ACTIVE-LOW inputs and outputs are indicated by the presence of the negation symbol, O.

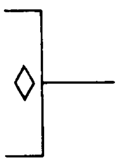


EDGE-SENSITIVE (Dynamic) inputs are indicated by the presence of the dynamic input symbol,





TRAILING-EDGE ACTIVATED outputs are indicated by the output delay symbol, ⏋. These outputs become active when the signal that initiates the change returns to its original state (example: the outputs of a J-K master-slave flip-flop).



OPEN-COLLECTOR outputs are indicated by the presence of the open-collector symbol, ◊

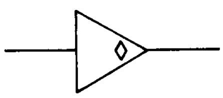


Figure 8-2. Schematic Symbols for Digital Integrated Circuits (3 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

NOTE

The logic negation symbol (O) alone gives no information about the actual voltage levels used in a digital circuit. For this reason the type of logic system (positive or negative) must be specified. In this manual, unless otherwise noted on the schematic, the logic system is positive; that is, the more positive voltage level is the HIGH or 1-state and the less positive level is the LOW or 0-state.

FUNCTION LABELS

Σ	ADDER
▷	AMPLIFIER/BUFFER
1 ⎍	MONOSTABLE MULTIVIBRATOR (ONE-SHOT)
&	AND GATE
≥1	OR GATE
=1	EXCLUSIVE OR GATE
X→Y	ENCODER, DECODER
XMAX→Y	PRIORITY ENCODER
⎎	SCHMITT TRIGGER
CTR	COUNTER
DEMUX	DEMULTIPLEXER
FF	FLIP-FLOP
MUX	MULTIPLEXER
REG	REGISTER
SR	SHIFT REGISTER

Figure 8-2. Schematic Symbols for Digital Integrated Circuits (4 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

LINE LABELS

←	SHIFT LEFT (OR UP)
→	SHIFT RIGHT (OR DOWN)
+1	COUNT UP
−1	COUNT DOWN
=0,−1	BORROW OUTPUT
=9,+1	CARRY OUTPUT (DECIMAL COUNTER)
=15,+1	CARRY OUTPUT (BINARY COUNTER)
C	CLOCK INPUT
D	DATA OR DELAY INPUT (FLIP-FLOP)
Dn	nth DATA BIT INPUT
EN	ENABLE
F	3-STATE ENABLE INPUT (SEE "DEPENDENCY")
G	GATING INPUT (SEE "DEPENDENCY")
J	J-K FLIP-FLOP J INPUT
K	J-K FLIP-FLOP K INPUT
LD	LOAD ENABLE INPUT (SYNCHRONOUS)
PS	PRESET INPUT (ASYNCHRONOUS)
R	RESET OR CLEAR INPUT
S	SET INPUT
SEL	LINE OR FUNCTION SELECT INPUT
SER	SERIAL DATA INPUT (SHIFT REGISTER)
T	TRIGGER INPUT (MONOSTABLE)
Yn	nth DATA BIT OUTPUT OR I/O
3-ST (placed by function label)	3-STATE

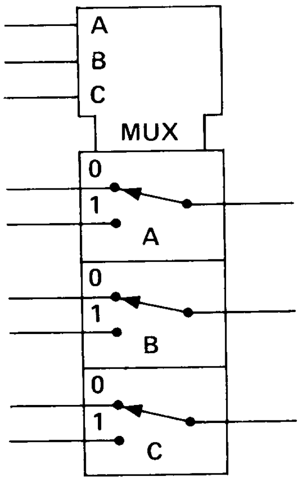
Figure 8-2. Schematic Symbols for Digital Integrated Circuits (5 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

NOTES

1. The suffix or subscript 0 denotes the least significant bit (LSB) of a data or address word.

2. Letters may be used to identify a line or logic element without indicating a specific logic function. For example:

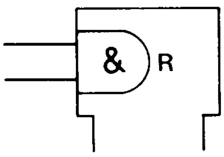


Triple 2-Channel Multiplexer

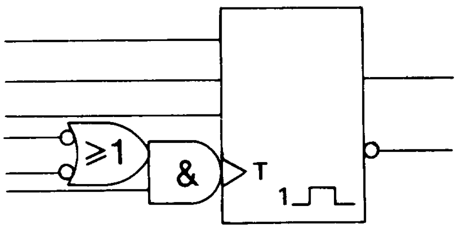
Letters are used to relate control inputs to logic elements. The numerals 0 and 1 indicate 0-state and 1-state, respectively, and relate the position of a "switch" to the logic state of the corresponding control line.

DEPENDENCY (G and F)

The dependency of inputs or outputs on an input is indicated with gate symbols or the G line label. Gate symbols are often used when the dependency exists between inputs. Two examples are:



Two inputs ANDed to produce a reset



Three inputs gated to produce a trigger

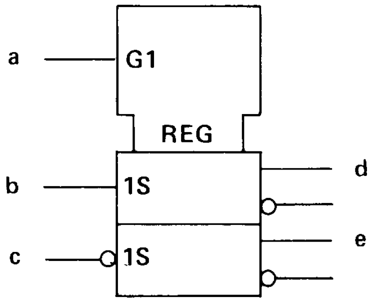
Figure 8-2. Schematic Symbols for Digital Integrated Circuits (6 of 8)

SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

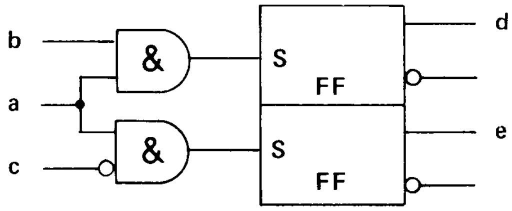
When the G label is used, the gating input is labelled with a G followed by a numeral or letter. The line labels of the gated inputs or outputs are prefixed with the same numeral or letter. Two examples are:

2-Bit Register

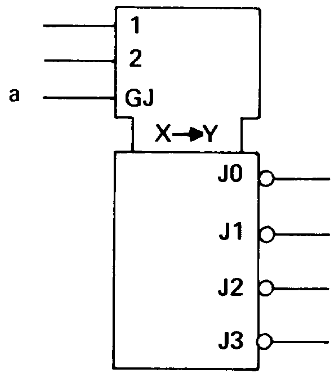
IC Symbol



Equivalent



2-to-4-Line Decoder



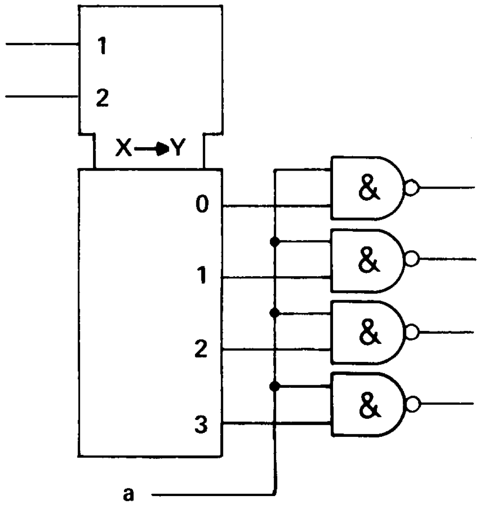
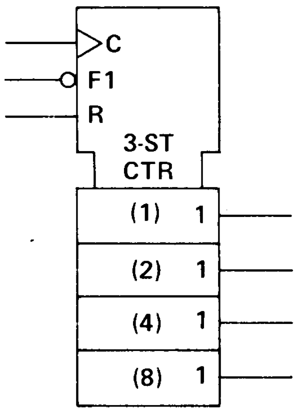


Figure 8-2. Schematic Symbols for Digital Integrated Circuits (7 of 8)

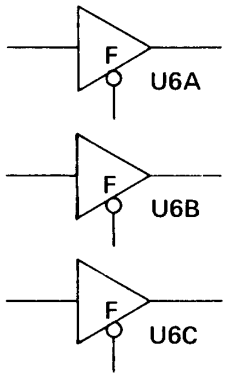
SCHEMATIC SYMBOLS FOR DIGITAL INTEGRATED CIRCUITS (Cont'd)

The F line label is used to indicate 3-state logic. The 3-state enable input is labelled with an F and numerals or letters are used as with the G label:

Counter with
3-State Outputs



3-State Buffers



WEIGHTING OF INPUT AND OUTPUT LINES

The coding of multiplexers, demultiplexers, encoders, and decoders is shown by decimal weighting. An example is the 2-to-4-line decoder shown on the previous page.

WEIGHTING OF FLIP-FLOPS

When the position of a flip-flop in an array is significant (as in counters and shift registers), the flip-flop is labelled with its decimal weight. An example is the "Counter with 3-State Outputs" shown above.

Figure 8-2. Schematic Symbols for Digital Integrated Circuits (8 of 8)

8-11. RECOMMENDED TEST EQUIPMENT

8-12. Test equipment required to maintain the Model 8754A is listed in Section I. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

8-13. REPAIR

8-14. Module Exchange Program

8-15. This instrument may be quickly repaired by replacing a defective module with a restored-exchange module. To support the modular repair concept, Hewlett-Packard has set up a module exchange program.

8-16. The procedure for using the module exchange program is given in Figure 8-3. When you locate the defective module, order a replacement module through the nearest Hewlett-Packard sales office. The restored-exchange module will be sent immediately directly from a customer service replacement parts center. When you receive the exchange module, return the defective module in the same special carton in which the exchange module was received. DO NOT return a defective module to Hewlett-Packard until you receive the exchange module.

8-17. If you are not going to return the defective module to Hewlett-Packard, or if you are ordering a module for spare parts stock, etc., order a new module using the new module part number listed in Table 6-3.

8-18. The Hewlett-Packard module exchange program allows you to obtain a fully tested and guaranteed restored-exchange module at a reduced price. (The reduced price is contingent upon return of the defective module to Hewlett-Packard.) Assemblies available for module exchange are listed in Table 6-1.

8-19. After-Service Product Safety Checks. Visually inspect interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy cause of any such condition.

8-20. Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cord plug. The reading must be less than one ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist.

8-21. Check resistance from instrument enclosure to line and neutral (tied together) with the line switch ON and the power source disconnected. The minimum acceptable resistance is 2 megohms. Replace any component which results in failure to meet this minimum.

8-22. Check line fuse to verify that a correctly rated fuse is installed.

The module exchange program described here is a fast, efficient, economical method of keeping your Hewlett-Packard instrument in service.

Locate defective module using troubleshooting procedures and service sheets in this manual.

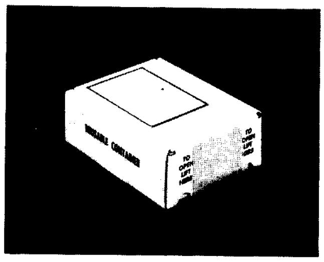
↓

Is a replacement module on hand?

YES → Install the replacement module. Keep the defective module for return to HP.
↓
Order restored-exchange module from HP. Refer to the Replaceable Parts Section for part numbers.
↓
Put restored-exchange module in spares stock.
↓
Return defective module to HP.

NO ↓
Order restored-exchange module from HP. Refer to the Replaceable Parts Section for part numbers.
↓
Swap replacement module and defective module.
↓
Return defective module to HP.

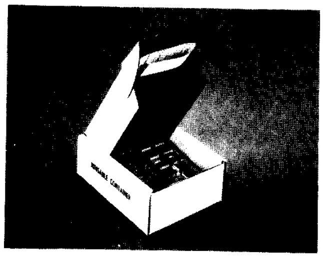
A.



Restored-exchange modules are shipped individually in boxes like this. In addition to the circuit module, the box contains:

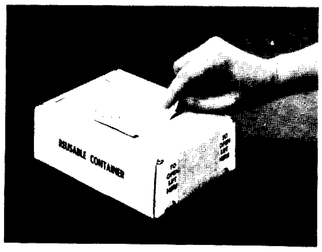
- Module repair report
- Return address label
- Tape for resealing box

B.



Open box carefully - it will be used to return defective module to HP. Complete repair report. Place it and defective module in box. Be sure to remove enclosed return address label.

C.



Seal box with tape provided. Inside U.S.A.*, stick preprinted return address label over label already on box, and return box to HP. Outside U.S.A., do not use address label: instead, address box to the nearest HP office.

*HP pays postage on boxes mailed in U.S.A.

Figure 8-3. Module Exchange Procedure

Table 8-1. Service Sheets (1 of 2)

SERVICE SHEET		DESCRIPTION
1	Overall Block Diagram	A1 Front Panel A2 Analog Processor A7 Source A12 Marker Generator A15 Shaper A17 Sweep Generator A22 Frequency MHz Display
3	Receiver Block Diagram	A1 Front Panel A2 Analog Processor A3 B Sampler A4 A Sampler A5 R Sampler A6 VTO and IF Switch A8 A, B Detector A9 Phase Detector A10 Polar Converter A11 R Detector A13 Phase Lock A14 Phase Lock Control
4	Display Block Diagram	A1 Front Panel A2 Analog Processor A18 Deflection Amplifiers A21 High Voltage Power Supply V1 Cathode Ray Tube
5	Sweep Generator	A1 Front Panel A17 Sweep Generator
6	Frequency Reference and Frequency Display	A1 Front Panel A2 Analog Processor A15 Shaper A22 Frequency MHz Display
7	RF Source	A1 Front Panel A7 Source A15 Shaper
8	Markers	A1 Front Panel A12 Marker Generator
9	Samplers	A3 B Sampler A4 A Sampler A5 R Sampler
10	Voltage Tuned Oscillator	A6 VTO and IF Switch
11	Phase Lock	A13 Phase Lock A14 Phase Lock Control

Table 8-1. Service Sheets (2 of 2)

SERVICE SHEET	DESCRIPTION
12 IF Switch and A, B Detector	A6 VTO and IF Switch A8 A, B Detector
13 R Detector	A11 R Detector
14 Phase Detection and Polar Conversion	A9 Phase Detector A10 Polar Converter
15 Analog Processor	A1 Front Panel A2 Analog Processor
16 Deflection Amplifiers	A1 Front Panel A2 Analog Processor A18 Deflection Amplifiers V1 Cathode Ray Tube
17 High Voltage Power Supply	A21 High Voltage Power Supply V1 Cathode Ray Tube
18 External Interface	A19 Rectifier A23 Rear Panel
19 Front Panel Troubleshooting	A1 Front Panel A2 Analog Processor
20 Low Voltage Power Supplies	A16 DC Regulator A19 Rectifier A20 Motherboard
21 Motherboard Wiring List	A20 Motherboard

Table 8-2. Cross Reference of Assemblies to Service Sheets

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and ±6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 1

OVERALL BLOCK DIAGRAM

The 8754A is divided into three main sections: Source, Receiver, and Display. More detailed block diagrams are in Service Sheets 2 through 4.

Source

The Source provides an RF OUTPUT signal in the frequency range 4 to 1300 MHz; the output power is leveled and adjustable from 0 to +10 dBm. The Source also provides a sweep ramp and blanking signal to the Display Section, as well as frequency information and control logic to the Receiver Section for phase lock operation.

The frequency of the RF Source is determined by the Frequency Reference voltage (0 to +13V), which has a tuning sensitivity of 100 MHz/volt. When the voltage is zero, the RF frequency is nominally zero (<10 MHz); when the voltage is +13V, the frequency is nominally 1300 MHz (1290 to 1310 MHz).

This Frequency Reference voltage is derived from the Sweep Generator Sweep Ramp output, and is controlled by the setting of TUNING and SWEEP WIDTH MHz controls. The sweep ramp may be either internally generated or supplied from an external input, depending on the position of the rear-panel INT/EXT SWEEP switch.

The Marker Generator samples the RF OUTPUT and generates a series of amplitude markers (intensity markers if viewing a polar display) every 1, 10, or 50 MHz, as selected.

Receiver

The Receiver provides dc voltages to the Display section which are proportional to the absolute magnitude of, and phase difference between, the three RF inputs: A INPUT, B INPUT, and R INPUT.

The inputs are first down-converted to three 1 MHz IF signals, while maintaining their magnitude and phase relationships. Samplers are used to mix the A, B, and R inputs with three phase-coherent pulsed outputs from the Voltage Tuned Oscillator, producing three IF outputs. An automatic phase-lock system tunes the Voltage-Tuned Oscillator to maintain a 1 MHz IF at the output of the R input Sampler.

The A,B Magnitude Detector produces a dc voltage proportional to the power level of the A or B input (−25 mV/dB). An IF switch selects the A or B input, and is controlled by either the front-panel or an external input through the rear-panel PROGRAMMING connector. The R Magnitude Detector produces a dc voltage proportional to the power level of the R input (−25 mV/dB). The magnitude detectors each contain a 2-pole, 1 MHz Bandpass filter with a 20 kHz Bandwidth, so only the 1 MHz component of the sampler outputs is detected.

The Bandpass-filtered IF signals are fed to limiters and a Phase Detector, to produce a dc voltage proportional to the phase difference between the A (or B) signal and the R signal, by −10 mV/degree. These IF signals are also processed to provide a Polar Display.

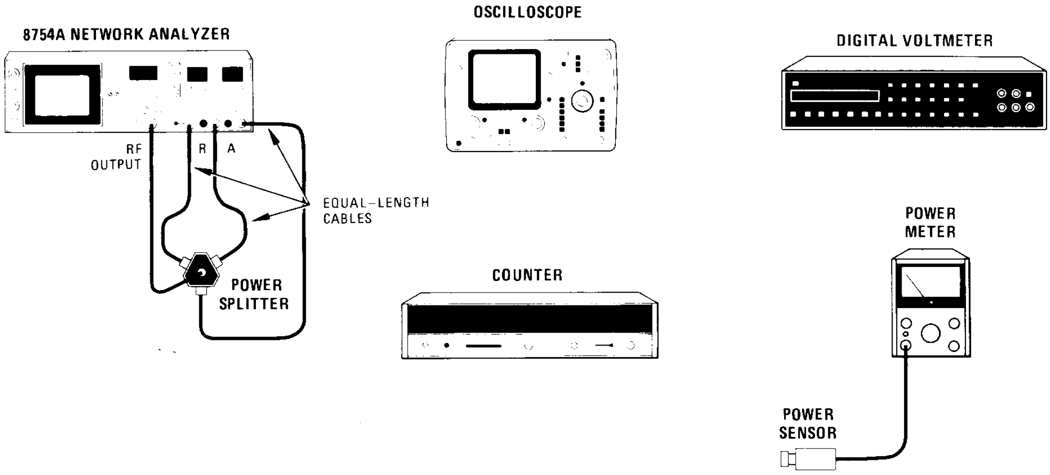
Display

The Display processes the dc voltages from the Receiver, as well as the Sweep, Marker, and Blanking signals from the Source, to provide a CRT display.

The Analog Processor produces two dc voltages proportional to the CRT trace vertical deflection for Channels 1 and 2 (−300 mV/division). In polar operation, the Channel 2 voltage is used for X deflection.

The Deflection Amplifiers provide X and Y CRT deflection, as well as providing the Z axis signal to the High Voltage Power Supply. In Rectangular operation, an alternate-sweep switch selects either the Channel 1 or Channel 2 vertical voltage from the Analog Processor.

The High Voltage Power Supply provides all CRT potentials, as determined by the Z axis input from the Deflection Amplifiers.



EQUIPMENT:

3-Way Power Splitter	HP 11850A
Matched Cable Kit	HP 11851A
Oscilloscope	HP 1740A
Digital Voltmeter	HP 3455A
Frequency Counter	HP 5340A
Power Meter	HP 435A
Power Sensor	HP 8482A

Figure 8-4. Troubleshooting Test Setup (1 of 2)

NOTE

Differences in control settings are called out in the Schematic Diagram Notes on each Service Sheet.

8754A CONTROL SETTINGS:

Sweep Mode	FULL 4–1300
SWEEP	AUTO, FAST
SWEEP Vernier	Fully clockwise
TUNING	500 MHz
SWEEP WIDTH MHz	0 CW
SWEEP WIDTH MHz Vernier	CAL
MARKERS MHz	OFF
OUTPUT dBm	0 dBm
REFERENCE POSITION CH 1	off (out)
REFERENCE POSITION CH 2	off (out)
POLAR CENTER	off (out)
POLAR A/R	off (out)
POLAR A/R LENGTH	fully counterclockwise
VIDEO FILTER	off (out)

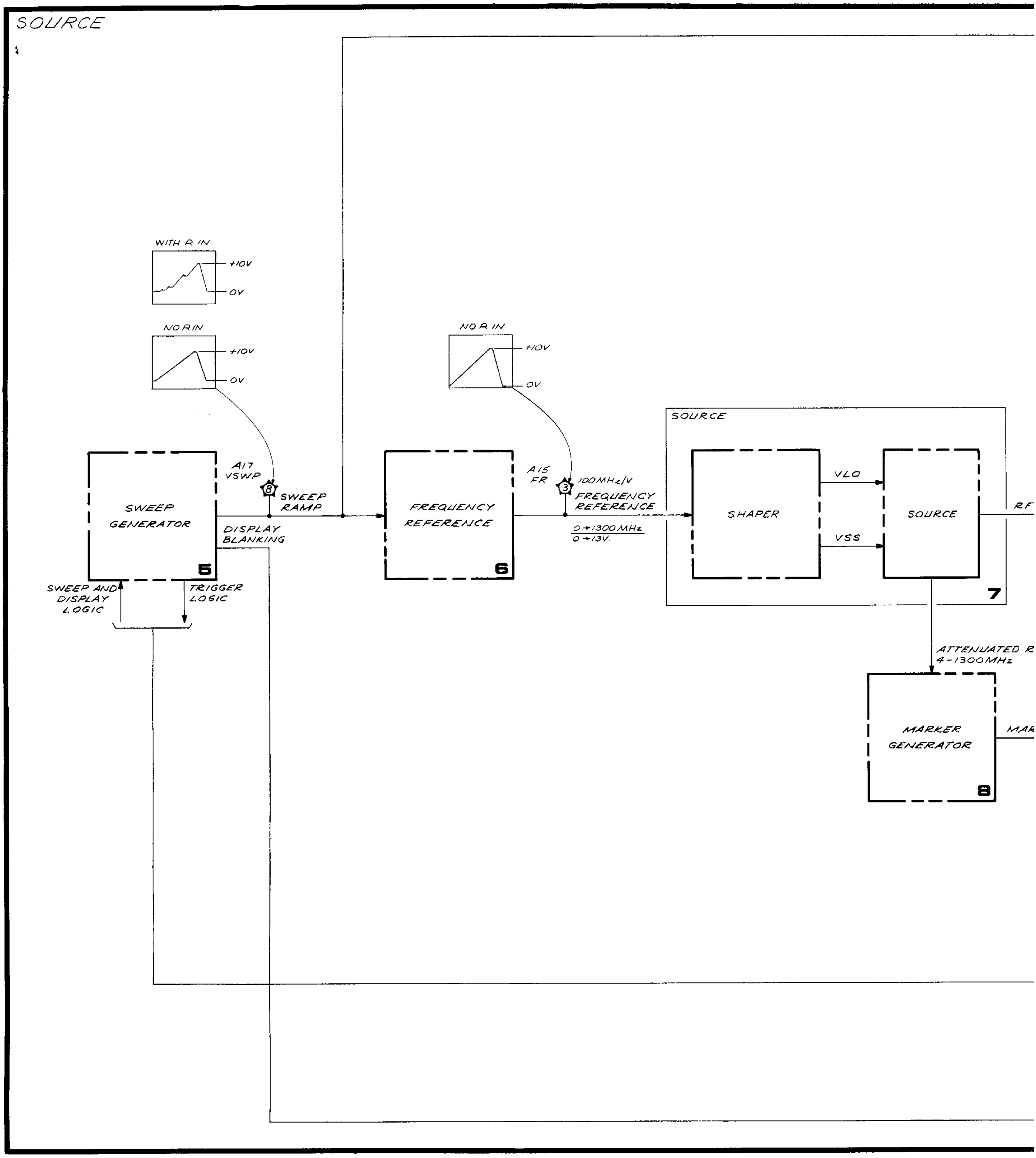
CHANNEL 1

REFERENCE	–00
REFERENCE OFFSET button	off (out)
Measurement Select	OFF
Scale	10 dB/DIV

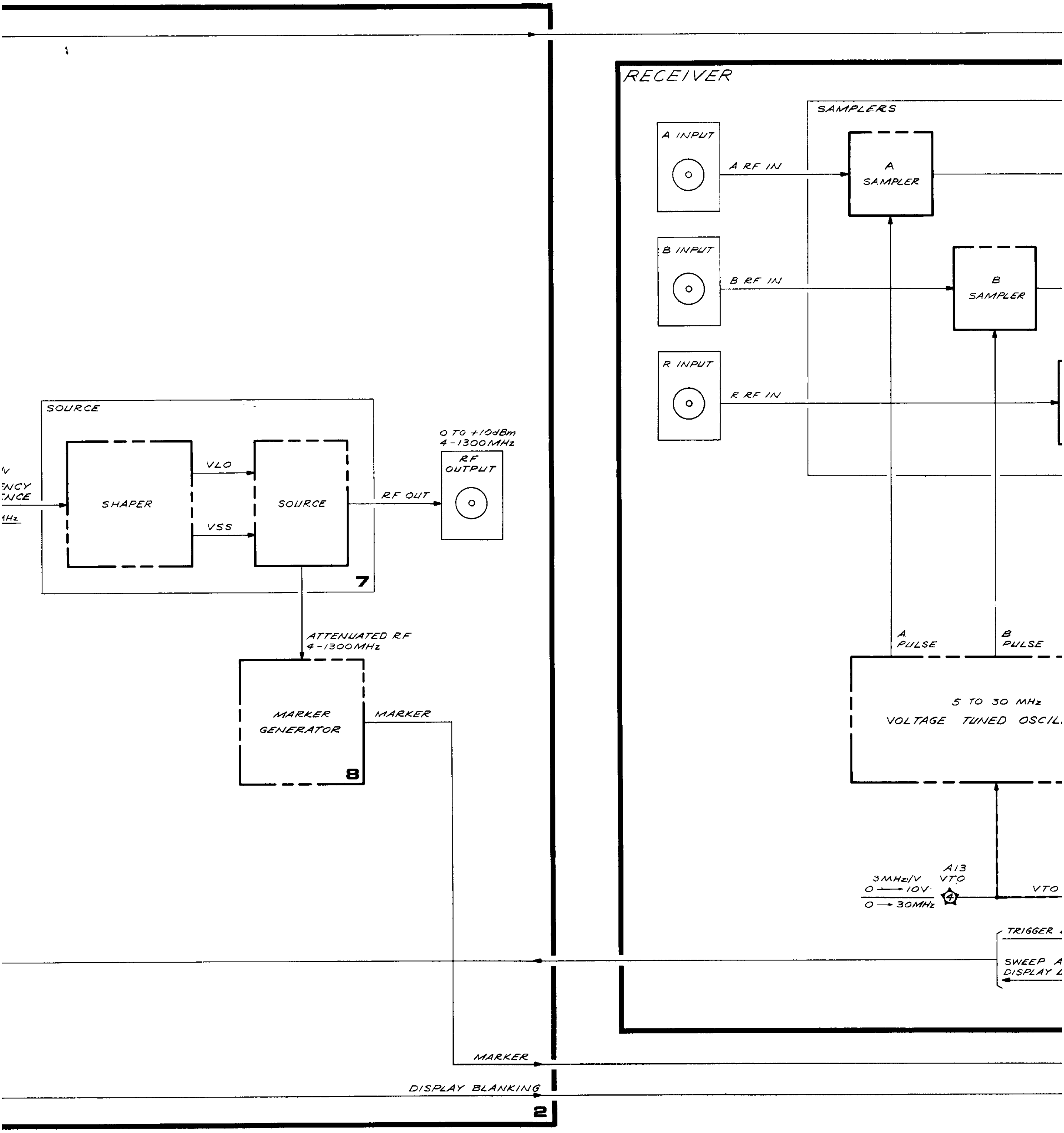
CHANNEL 2

REFERENCE	–00
REFERENCE OFFSET button	off (out)
Measurement Select	OFF
Scale	10 dB/DIV
PHASE B/R LENGTH	fully counterclockwise

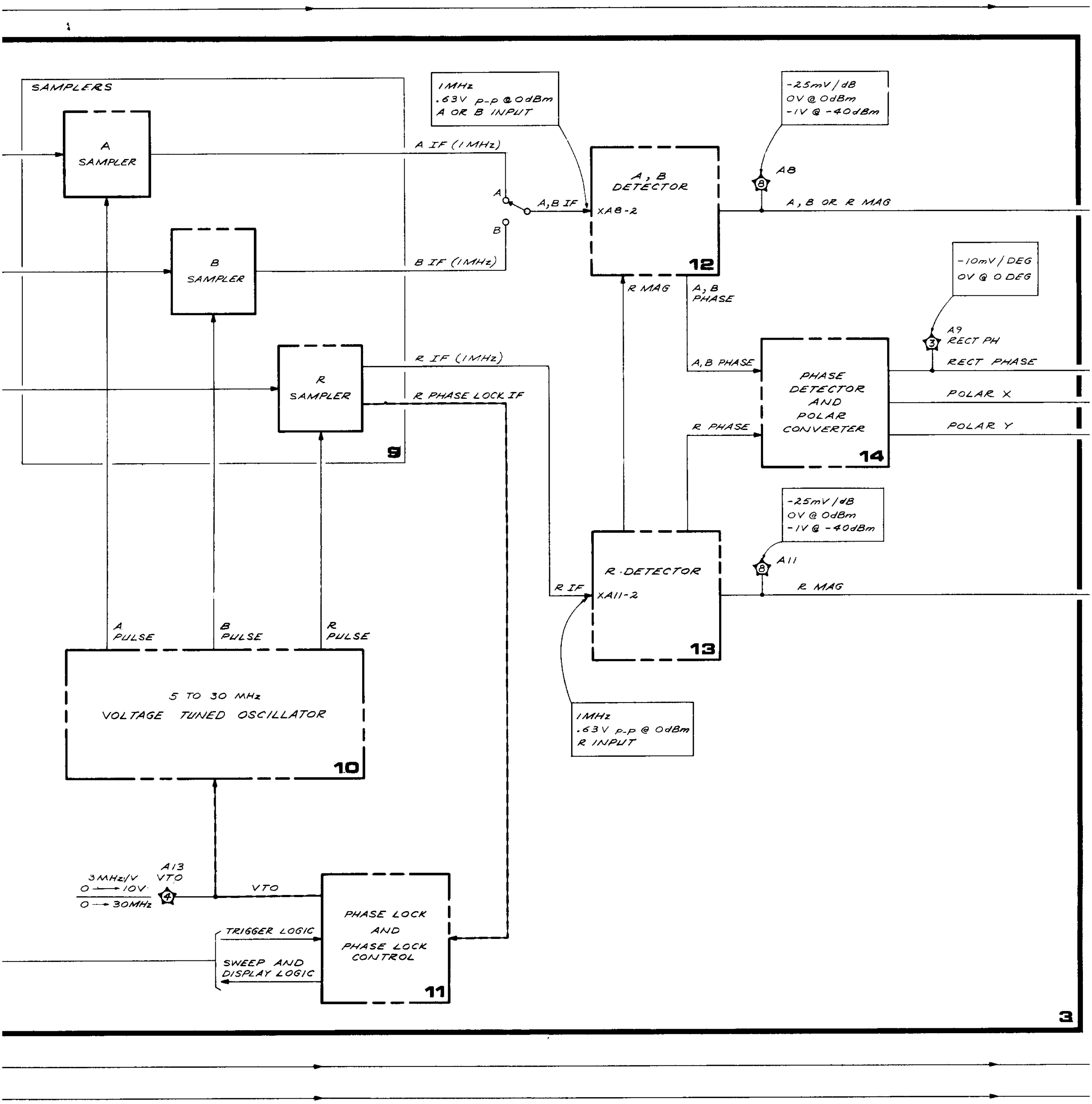
Figure 8-4. Troubleshooting Test Setup (2 of 2)



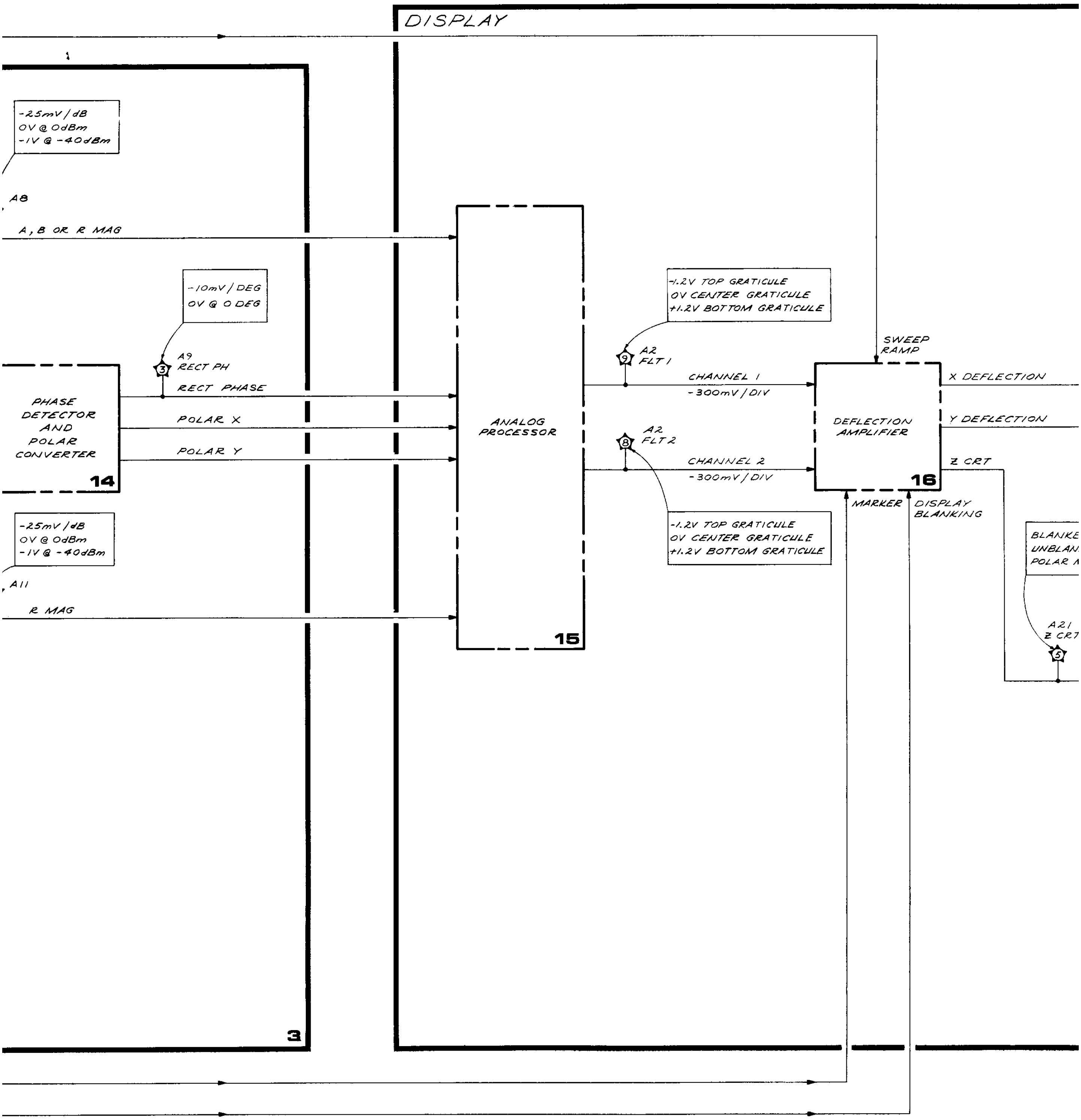
SOURCE
WITH R IN
+10V
0V
NO R IN
+10V
0V
NO R IN
+10V
0V
A17
VSWP
8
SWEEP
RAMP
SWEEP
GENERATOR
5
DISPLAY
BLANKING
SWEEP AND
DISPLAY
LOGIC
TRIGGER
LOGIC
FREQUENCY
REFERENCE
6
A15
FR
3
100MHz/V
FREQUENCY
REFERENCE
0→1300MHz
0→13V.
SOURCE
SHAPER
VLO
VSS
SOURCE
RF
7
ATTENUATED R
4-1300MHz
MARKER
GENERATOR
8

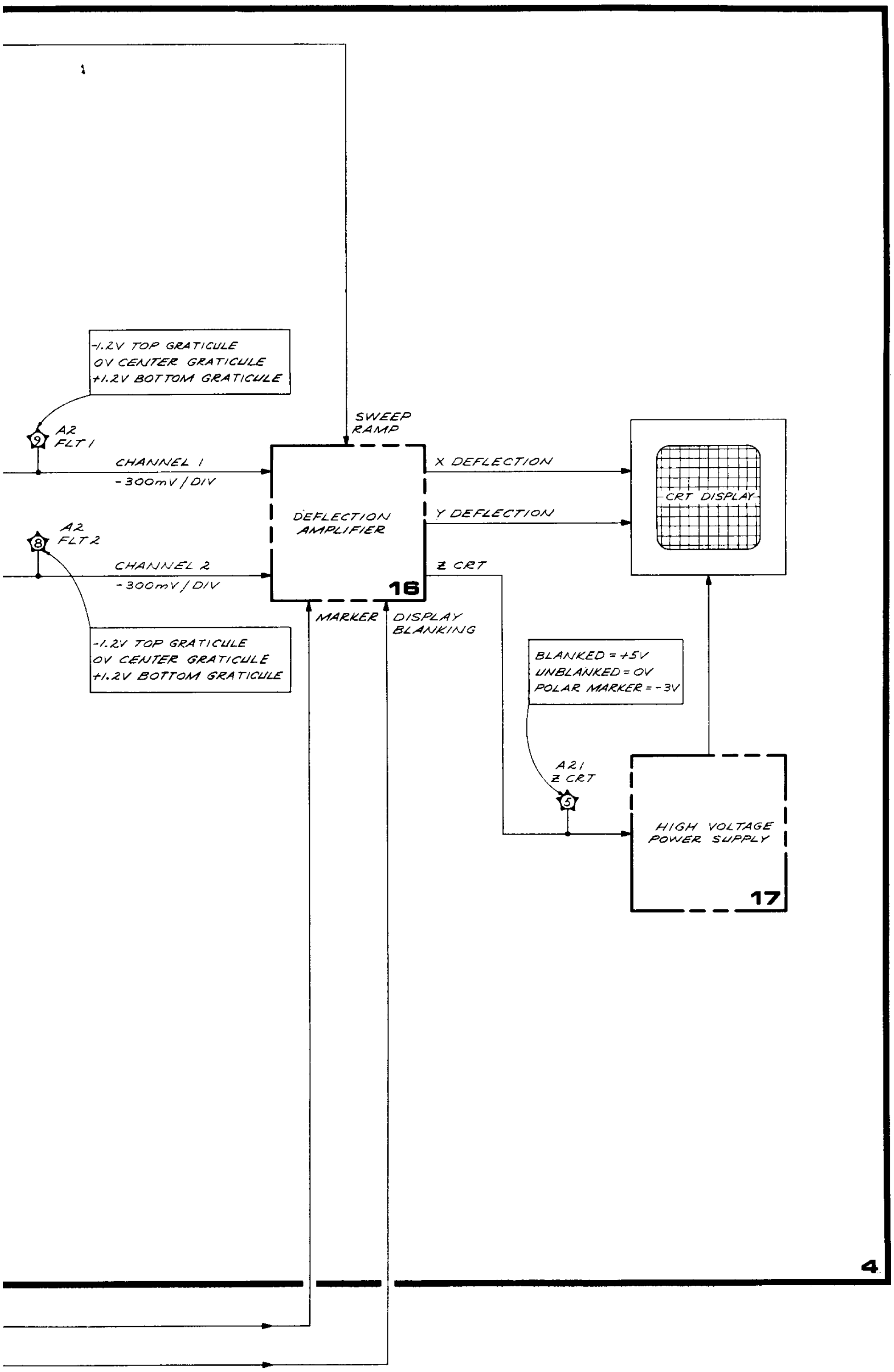


RECEIVER
SAMPLERS
A INPUT
A RF IN
A SAMPLER
B INPUT
B RF IN
B SAMPLER
R INPUT
R RF IN
SOURCE
SHAPER
VLO
VSS
SOURCE
RF OUT
0 TO +10dBm
4-1300MHz
RF OUTPUT
7
ATTENUATED RF
4-1300MHz
MARKER GENERATOR
MARKER
8
A PULSE
B PULSE
5 TO 30 MHz
3MHz/V
0 → 10V
0 → 30MHz
A13
VTO
VTO
TRIGGER
SWEEP
DISPLAY
MARKER
DISPLAY BLANKING
2



SAMPLERS
A SAMPLER
B SAMPLER
R SAMPLER
9
A IF (1MHz)
B IF (1MHz)
R IF (1MHz)
R PHASE LOCK IF
1MHz
.63V p-p @ 0dBm
A OR B INPUT
A
B
A,B IF
A, B DETECTOR
XA8-2
12
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A8
A, B OR R MAG
R MAG
A, B PHASE
A, B PHASE
-10mV/DEG
0V @ 0 DEG
A9
RECT PH
RECT PHASE
PHASE DETECTOR AND POLAR CONVERTER
14
POLAR X
POLAR Y
R PHASE
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A11
R MAG
R IF
R DETECTOR
XA11-2
13
1MHz
.63V p-p @ 0dBm
R INPUT
A PULSE
B PULSE
R PULSE
5 TO 30 MHz
VOLTAGE TUNED OSCILLATOR
10
A13
VTO
3MHz/V
0 → 10V
0 → 30MHz
VTO
PHASE LOCK AND PHASE LOCK CONTROL
11
TRIGGER LOGIC
SWEEP AND DISPLAY LOGIC
3


DISPLAY
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A8
A, B OR R MAG
-10mV/DEG
0V @ 0 DEG
A9
RECT PH
RECT PHASE
POLAR X
POLAR Y
PHASE DETECTOR AND POLAR CONVERTER
14
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A11
R MAG
3
ANALOG PROCESSOR
15
-1.2V TOP GRATICULE
0V CENTER GRATICULE
+1.2V BOTTOM GRATICULE
A2
FLT 1
CHANNEL 1
-300mV/DIV
A2
FLT 2
CHANNEL 2
-300mV/DIV
-1.2V TOP GRATICULE
0V CENTER GRATICULE
+1.2V BOTTOM GRATICULE
SWEEP RAMP
DEFLECTION AMPLIFIER
16
X DEFLECTION
Y DEFLECTION
Z CRT
MARKER
DISPLAY BLANKING
A21



NOTES
1. WAVEFORMS SHOWN ARE WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
R INPUT CONNECTOR: AS DESIGNATED
SWEEP MODE: FULL 4-1300
SWEEP AUTO, FAST

Figure 8-5. Overall Block Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 2

SOURCE BLOCK DIAGRAM

The Source provides an RF signal in the frequency range of 4 MHz to 1300 MHz; the leveled output power level is adjustable from 0 dBm to +10 dBm. The Source also provides a sweep ramp and blanking signal to the Display Section, as well as frequency information and control logic to the Receiver Section for phase lock operation.

Sweep Generator (Service Sheet 5)

The Sweep Generator (A17) produces a 0 to +10V sweep ramp which is used to tune the RF Source, and provide X axis deflection for rectangular (non-polar) measurements.

The Sawtooth Generator provides a −0.7V to +10.7V sawtooth waveform. Basically, it consists of two switch controlled current sources feeding an integrating capacitor. When the FWD (Forward) current source is switched on, the capacitor voltage increases at a rate determined by the magnitude of the current, which is controlled by the front-panel SWEEP vernier. When the RTC (Retrace) current source is switched on instead, the capacitor voltage decreases at a rate determined by the magnitude of the current. The currents are switched on and off by control logic which senses the sawtooth ramp voltage, the trigger inputs, and stop sweep and backstep inputs from the Receiver Section (A14, Phase Lock Control).

The sweep ramp (VSWP) which drives the source and display is dependent on the rear-panel INT /EXT SWEEP switch. In Internal, the sawtooth generator output is diode-clamped to 0 and +10V limits to provide a 0 to +10V waveform. In External, a voltage from a rear-panel SWEEP INPUT connector provides the sweep ramp signal.

Frequency Reference (Service Sheet 6)

The Frequency Reference portion of the Shaper (A15) provides a 0V to +13V FREQ REF signal whose magnitude is directly related to the RF Source frequency in the range 0 to 1300 MHz (100 MHz/volt). The FREQ REF signal is used to:(1) tune the RF Source; and (2) provide the Receiver with an analog representation of the source frequency, which controls the RF/IF phase lock loop (Service Sheet 11), provides a reference for electrical length compensation in phase measurements, and provides a reference for conversion loss compensation (sampler slope).

The 100 MHz/volt FREQ REF voltage is generated by one of two methods, depending on whether the instrument is in START/CENTER or FULL 4−1300 Sweep Mode.

In START/CENTER mode, the sweep ramp (VSWP) is attenuated by the SWEEP WIDTH MHz Control Network, and summed with the dc voltage from the front-panel TUNING control, to create a ramp output with a peak-to-peak amplitude dependent on SWEEP WIDTH MHz, and a dc offset level (start or center voltage) dependent on TUNING. This dc voltage from the TUNING control is digitized and read out on the front-panel FREQUENCY MHz display. Limiting circuitry senses the FREQ REF output voltage and holds it within the range −0.2 to +13.7V; the CRT is blanked when the FREQ REF voltage is being limited to this range.

In FULL 4−1300 mode, the sweep ramp from A17 (VSWP) is amplified by 1.3 to provide a 0 to +13V ramp. The dc voltage from the TUNING control is compared with the FREQ REF ramp; a zero-volt detector senses when they are coincedent and puts a marker on the CRT display at the frequency proportional to the TUNING voltage.

RF Source (Service Sheet 7)

This circuitry generates an RF signal in the frequency range 4 to 1300 MHz which is proportional to the 0 to +13V FREQ REF voltage by 100 MHz/volt. The RF Source consists of a part of the A15 Shaper assembly (Shaper circuit, and two driver amplifiers), and the A7 Source assembly which consists of the Source and Amplifier microcircuits plus bias and leveling circuitry.

The RF signal is generated by mixing the outputs of two varactor-tuned oscillators located in A7U2. As the FREQ REF voltage increases from 0 to +13V, the SS Oscillator is voltage-tuned from 3.6 GHz to 3.0 GHz and the LO Oscillator is voltage-tuned from 3.6 GHz to 4.3 GHz; this results in a mixer output (difference frequency) of 0 to 1.3 GHz.

The Amplifier/Detector microcircuit amplifies the low-level mixer output by 32 to 36 dB, to provide a maximum output signal of greater than +10 dBm. It also provides a low-level RF signal to the Phase Lock and Marker circuits, and a detected output dc voltage for leveling.

The Leveling Loop senses the detected output, compares it to the voltage from the front-panel OUTPUT dBm control, and feeds back an error voltage to a Modulator located in A7U2. This Modulator varies the SS (Small-Signal) drive to the mixer, and hence, varies the RF output level, to hold it constant.

The A15 Shaper contains a Shaper circuit and two driver amplifiers which convert the FREQ REF voltage (also generated on A15) into two signals which tune the oscillators on the A7 RF Source.

The function of the Shaper is to remove the nonlinear tuning characteristics of the oscillators in the RF Source (A7). The FREQ REF (FR) voltage at TP4 is linear, with a sensitivity of 100 MHz/V throughout the frequency range of 0 to 1300 MHz (0 to +13V). The sensitivity of the oscillators in A7, however, is non-linear; that is, the voltage representation of frequency is not constant throughout the tuning range. The Shaper yields a waveform (FS) at TP5 that compensates for the non-linearity of the oscillator output so that the RF signal out of the mixer is linear over the frequency range of 0 to 1300 MHz.

This FS waveform is fed to two drive amplifiers which provide opposing tuning voltages for the two oscillators.

Notes:

1. The Shaper contains a module of resistors which have been factory-selected for the particular oscillators tuning characteristics.
2. The oscillator tuning voltages corresponding to 3.0, 3.6, and 4.3 GHz vary depending on their characteristics.
3. Due to temperature and other effects, the actual RF frequency may differ as much as 10 MHz from the frequency calculated by the FREQ REF voltage (100 MHz/volt).

Marker Generator (Service Sheet 8)

The Marker Generator provides frequency markers to the CRT display, at 50, 10, or 1 MHz intervals. An external-input marker is also provided.

The low-level output from the RF Source (A7) is attenuated by the Phase Lock Control (A14) to provide a −25 to −35 dBm input signal to the Marker Generator.

A 50 MHz crystal oscillator and programmable divider provide a 1, 10, or 50 MHz square wave, which is shaped into an harmonic-rich pulse and mixed with the RF signal. Whenever the RF frequency is a multiple of the pulse rate, a "zero beat" mixer output is created, which is amplified to drive a digital frequency detector.

The digital frequency detector (discriminator) outputs a high (+5V marker pulse) whenever the mixer output is less than the inverse period of a one-shot. Thus, the one-shot period determines the marker width, and is programmed from the SWEEP WIDTH MHz switch, to provide markers which are narrow for most sweep widths.

An external RF input is applied to a single-diode mixer, where it is mixed with the low-level internal RF signal, to create a "zero beat" when the two frequencies coincide. This zero beat is summed with that of the harmonic markers.

TROUBLESHOOTING HINTS

The following Troubleshooting Hints assume that ac line power is applied to the 8754A and all power supplies are operational. These hints are provided as a troubleshooting aid in locating a problem. Several symptoms are listed with their most probable causes. For these Troubleshooting Hints, it is suggested that the instrument be set up as shown in Figure 8-4.

NOTE

Check that no cables are connected to rear-panel connectors.

Sweep Problems (A17). Symptoms are usually no sweep or display is blanked.

1. Check rear-panel SWEEP INT/EXT switch is in INT position.

2. Check Sweep Generator output at rear-panel SWEEP OUTPUT connector (−5V to +5V ramp). If sweep ramp is present, then A17 is functioning; refer to Z Axis Blanking troubleshooting hints on Service Sheet 4. If sweep ramp is not present, and returns when R INPUT signal to receiver is disconnected, or when A14 Phase Lock Control is removed, refer to Phase Lock troubleshooting on Service Sheet 3. If sweep ramp is still absent, refer to Service Sheet 5 (A17).

Sweep Width Inaccuracy (A1/A2). If inaccuracy is in START or CENTER sweep mode, but not in FULL 4−1300 sweep mode, check front-panel SWEEP WIDTH MHz switch. Also check that SWEEP WIDTH MHz Vernier is in CAL position (full clockwise). If all sweep widths are inaccurate by the same percentage, suspect Sweep Width Control circuit on A1/A2 Front Panel. If only one sweep width is inaccurate, suspect front-panel SWEEP WIDTH MHz switch. Refer to Service Sheet 6.

Non-linear Frequency Sweep (A15). 50 MHz markers not evenly spaced over a FULL 4−1300 sweep. Non-linearity may also cause phase lock problems; such as, latch up of back step, noisy trace, blanked display, etc.

1. Check A15 Shaper TEST/NORM switch is in NORM position.

2. Check resistor module A15A1 is installed correctly. If module is installed backwards, the CRT display may be partially blanked (See Service Sheet 7).

3. Refer to Service Sheet 7.

No Full Marker (A15). If harmonic markers are operational and no full marker is displayed, check for a low full marker pulse at A15TP7. If marker pulse is present the trouble is probably on the Marker Generator.

FREQUENCY MHz Display A2/A22). If the full marker is operational, the TUNE voltage from the A15 Shaper is probably correct. The LED display and driver circuits can be checked by grounding A2TP3 and checking for a display of 1888.

RF OUTPUT Power (A7). RF OUTPUT power is low or not present.

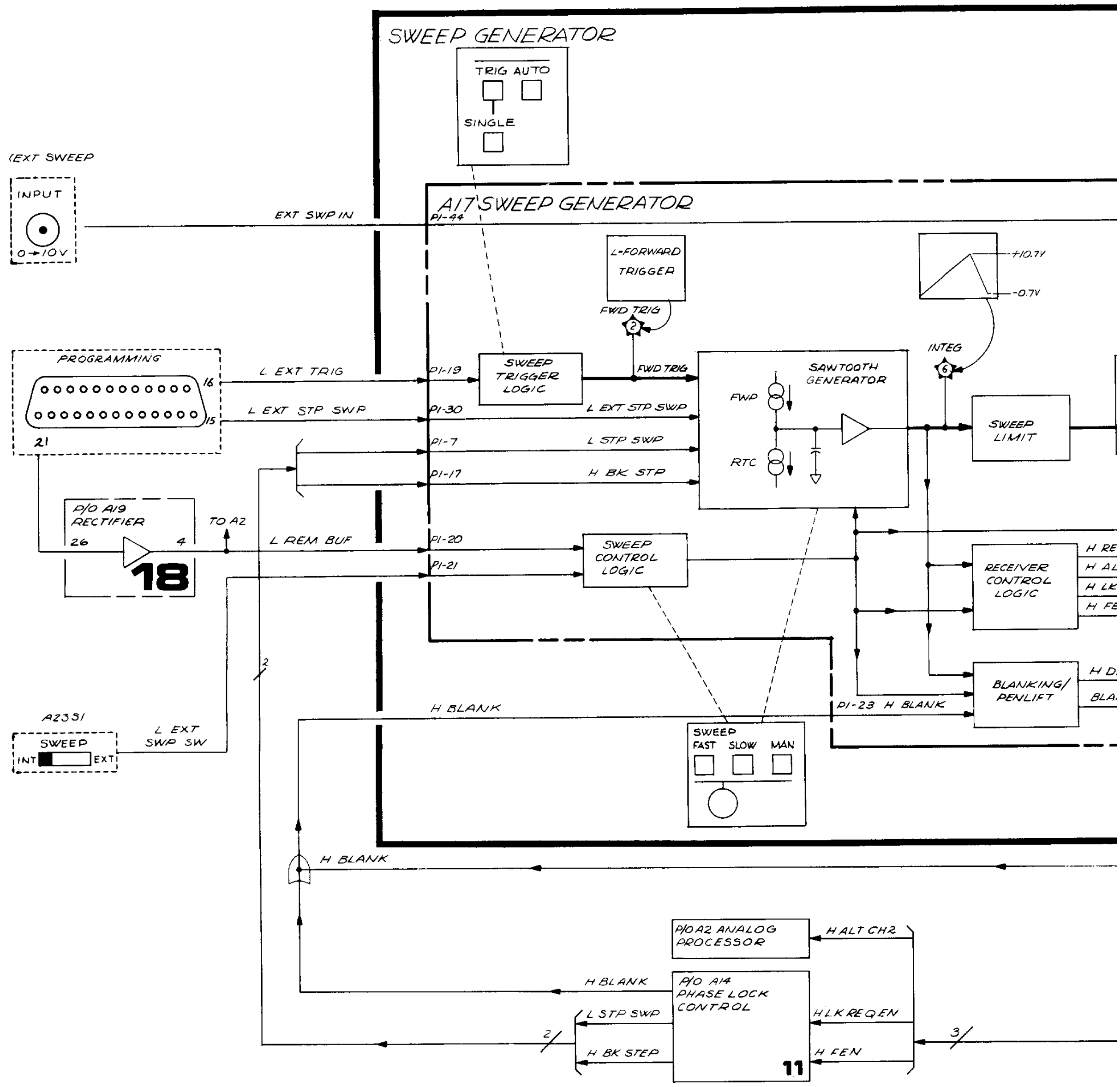
1. If 8754A serial prefix is 1908A or below, check for cracked or broken diode next to A7U3J3 (semi-rigid coax connection for RF OUTPUT).

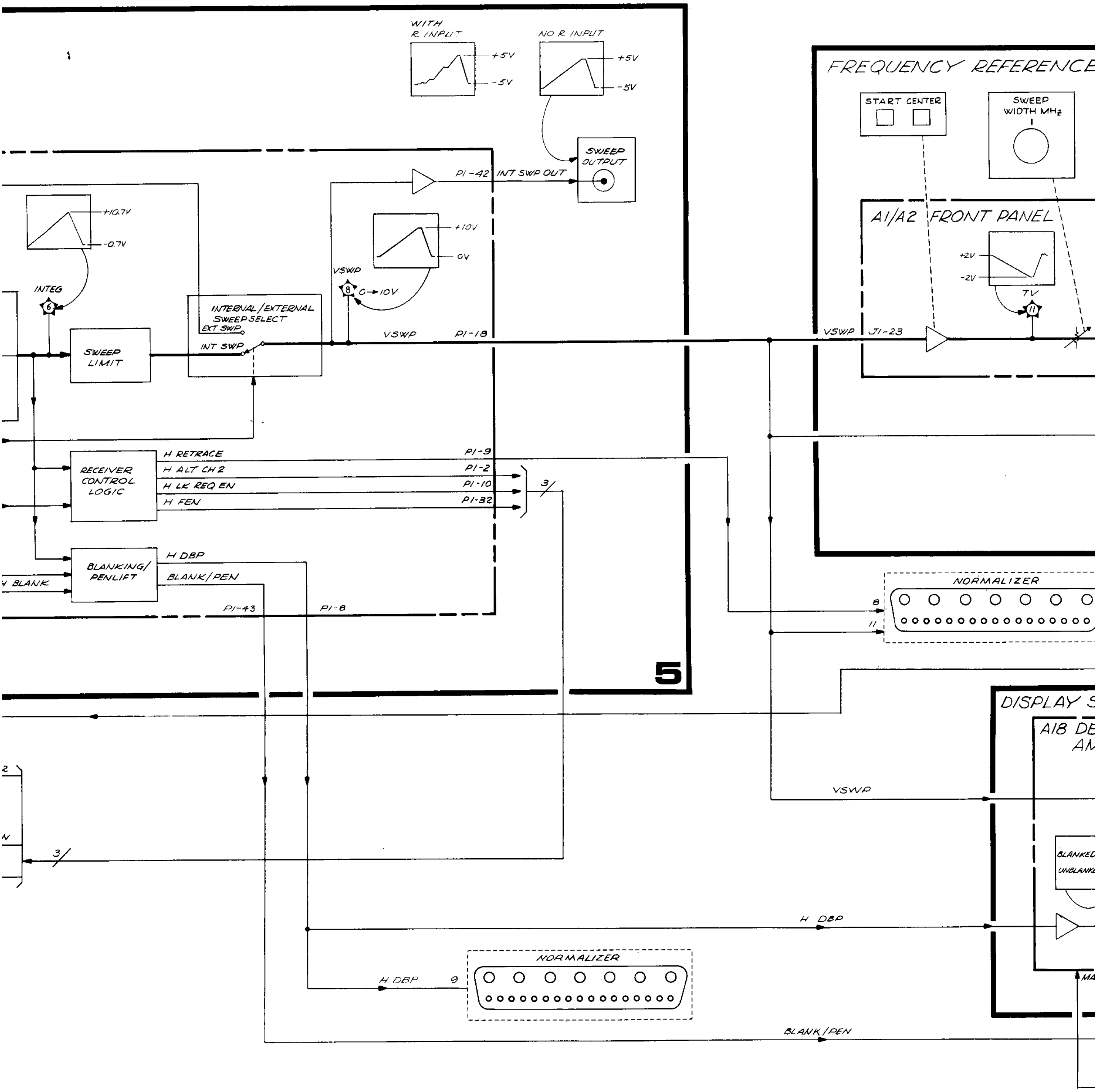
2. Check W1 (RF OUTPUT) and A7W1 cable connections.

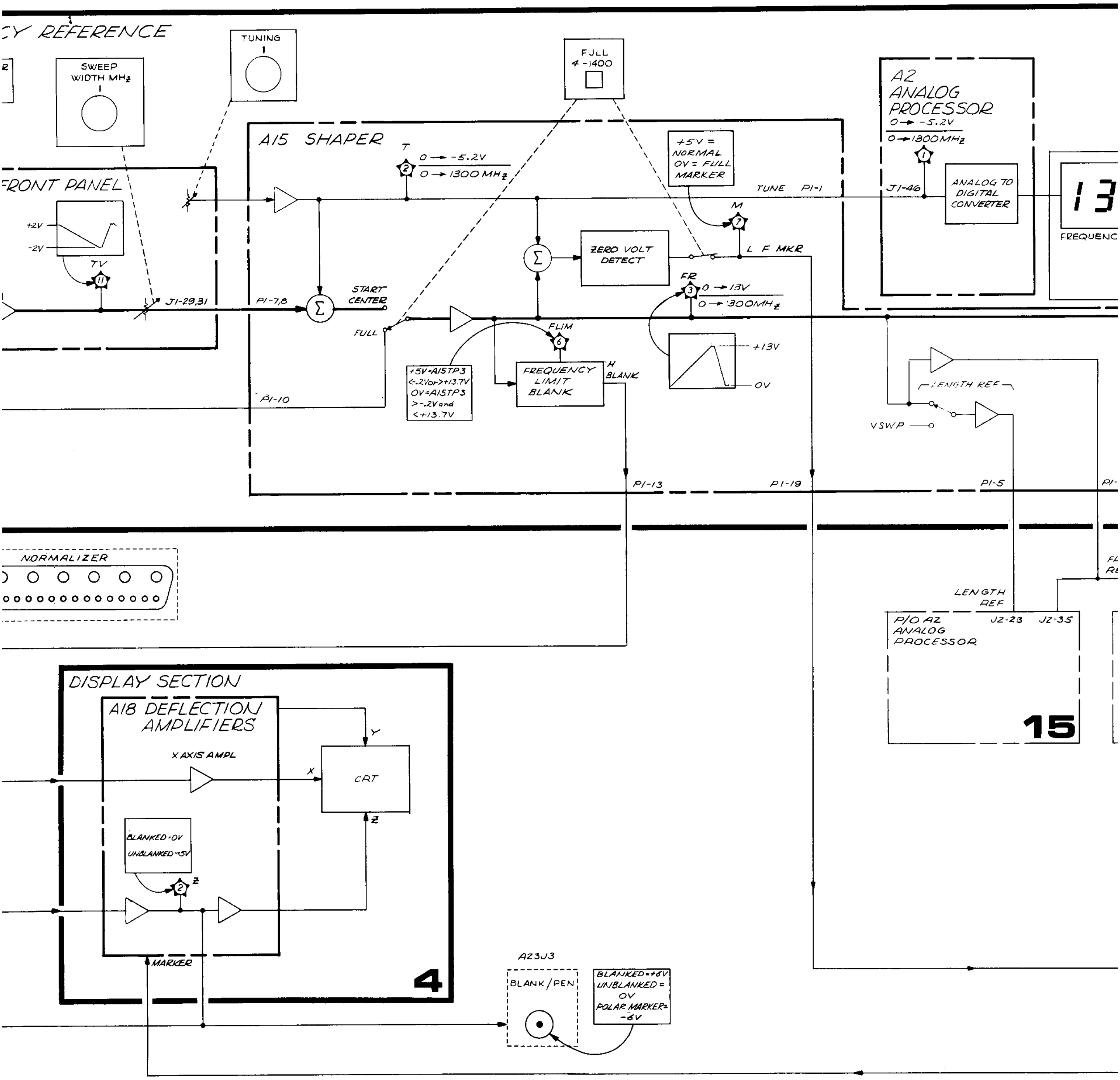
3. For instruments with serial number 1825A−00175 and below, check A7 Source mounting bracket is not shorting to A20 Motherboard or excessively bent mounting tabs are causing A7 to not properly mate with the Motherboard connector.

4. Disconnect A7W1 and check power at A7U2J1. If power is > −20 dBm, check ALC circuit and Amplifier Detector microcircuit on Service Sheet 7. If power is < −20 dBm, check RF Source microcircuit on Service Sheet 7.

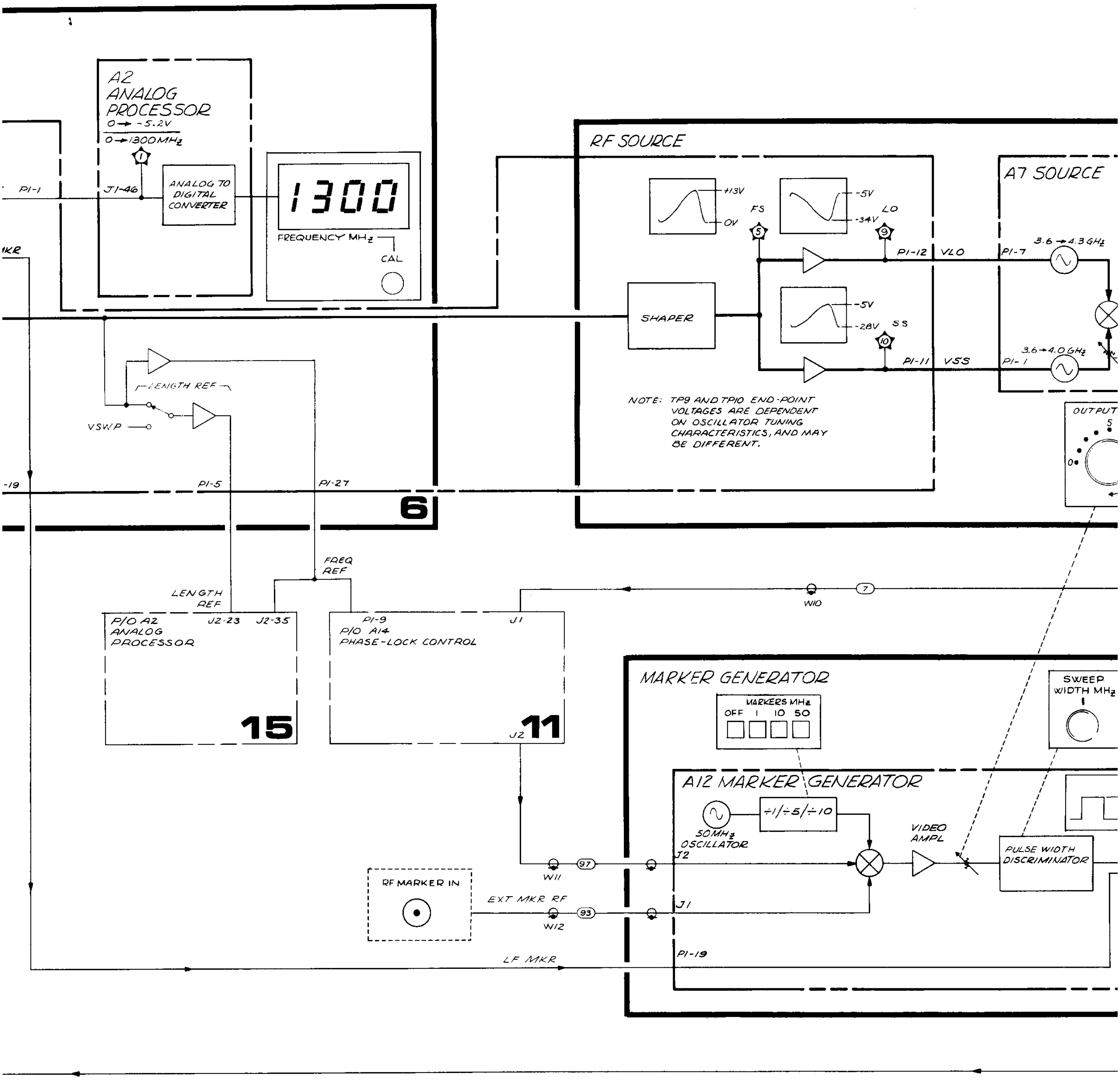
No Harmonic Markers (A12). If full marker is functioning and 8754A is otherwise functioning correctly, check cable connections of W10 (violet) and W11 (white/violet). If cable connections are correct, trouble is probably in the Marker Generator (Service Sheet 12). If phase lock problems at frequencies less than 60 MHz are also occuring, trouble is probably caused by low RF power (< −30 dBm) into A12.


SWEEP GENERATOR
TRIG AUTO
SINGLE
EXT SWEEP
INPUT
0→10V
EXT SWP IN
A17 SWEEP GENERATOR
P1-44
L-FORWARD TRIGGER
FWD TRIG
+10.7V
-0.7V
INTEG
PROGRAMMING
16
15
21
L EXT TRIG
L EXT STP SWP
P1-19
SWEEP TRIGGER LOGIC
FWD TRIG
SAWTOOTH GENERATOR
FWD
RTC
P1-30
L EXT STP SWP
P1-7
L STP SWP
P1-17
H BK STP
SWEEP LIMIT
P/O A19 RECTIFIER
26
4
18
TO A2
L REM BUF
P1-20
P1-21
SWEEP CONTROL LOGIC
RECEIVER CONTROL LOGIC
BLANKING/ PENLIFT
A23S1
SWEEP
INT
EXT
L EXT SWP SW
H BLANK
P1-23 H BLANK
SWEEP
FAST SLOW MAN
H BLANK
P/O A2 ANALOG PROCESSOR
H ALT CH2
H BLANK
P/O A14 PHASE LOCK CONTROL
L STP SWP
H BK STEP
H LK REQ EN
H FEN
11
2
3


WITH R INPUT
+5V
-5V
NO R INPUT
+5V
-5V
SWEEP OUTPUT
P1-42 INT SWP OUT
+10.7V
-0.7V
+10V
0V
INTEG
VSWP
0→10V
INTERNAL/EXTERNAL SWEEP SELECT
EXT SWP
INT SWP
SWEEP LIMIT
VSWP
P1-18
RECEIVER CONTROL LOGIC
H RETRACE
H ALT CH 2
H LK REQ EN
H FEN
P1-9
P1-2
P1-10
P1-32
3
BLANKING/ PENLIFT
H DBP
BLANK/PEN
P1-43
P1-8
5
FREQUENCY REFERENCE
START CENTER
SWEEP WIDTH MHz
A1/A2 FRONT PANEL
+2V
-2V
TV
VSWP
J1-23
NORMALIZER
8
11
DISPLAY
A18
VSWP
BLANKED
UNBLANKED
H DBP
NORMALIZER
H DBP
9
BLANK/PEN



CY REFERENCE
SWEEP WIDTH MHz
TUNING
FULL 4-1400
A15 SHAPER
T
0 → -5.2V
0 → 1300 MHz
+5V = NORMAL
0V = FULL MARKER
TUNE P1-1
M
L F MKR
ZERO VOLT DETECT
START
CENTER
FULL
FR
0 → 13V
0 → 300MHz
+13V
0V
FLIM
FREQUENCY LIMIT BLANK
H BLANK
+5V=A15TP3 <-.2V or >+13.7V
0V=A15TP3 >-.2V and <+13.7V
P1-10
FRONT PANEL
+2V
-2V
TV
J1-29,31
P1-7,8
A2 ANALOG PROCESSOR
0 → -5.2V
0 → 1800MHz
J1-46
ANALOG TO DIGITAL CONVERTER
13
FREQUENC
LENGTH REF
VSWP
P1-13
P1-19
P1-5
P1-
NORMALIZER
LENGTH REF
P/O A2 ANALOG PROCESSOR
J2-28
J2-35
15
DISPLAY SECTION
A18 DEFLECTION AMPLIFIERS
X AXIS AMPL
Y
X
CRT
Z
BLANKED=0V
UNBLANKED=+5V
MARKER
4
A23J3
BLANK/PEN
BLANKED=+6V
UNBLANKED=0V
POLAR MARKER=-6V


A2
ANALOG
PROCESSOR
0 → -5.2V
0 → 1300MHz
P1-1
J1-46
ANALOG TO DIGITAL CONVERTER
1300
FREQUENCY MHz
CAL
MKR
LENGTH REF
VSWP
-19
P1-5
P1-27
6
RF SOURCE
+13V
0V
FS
-5V
-34V
LO
P1-12
VLO
SHAPER
-5V
-28V
SS
P1-11
VSS
NOTE: TP9 AND TP10 END-POINT VOLTAGES ARE DEPENDENT ON OSCILLATOR TUNING CHARACTERISTICS, AND MAY BE DIFFERENT.
A7 SOURCE
P1-7
3.6 → 4.3 GHz
P1-1
3.6 → 4.0 GHz
OUTPUT
5
0
FREQ
REF
LENGTH
REF
P/O A2
ANALOG
PROCESSOR
J2-23
J2-35
15
P1-9
P/O A14
PHASE-LOCK CONTROL
J1
J2
11
W10
7
MARKER GENERATOR
MARKERS MHz
OFF 1 10 50
SWEEP
WIDTH MHz
A12 MARKER GENERATOR
÷1/÷5/÷10
50MHz
OSCILLATOR
J2
VIDEO
AMPL
PULSE WIDTH
DISCRIMINATOR
W11
97
RF MARKER IN
EXT MKR RF
W12
93
J1
P1-19
LF MKR

NOTES:
1. FOR WAVEFORMS SHOWN, SET FRONT PANEL CONTROLS AS FOLLOWS:
TUNING: 500 MHz
SWEEP MODE: FULL 4-1300
SWEEP: AUTO, FAST
SWEEP WIDTH MHz: 1K
SWEEP WIDTH MHz VERNIER: CAL
R INPUT CONNECTOR: NO RF INPUT

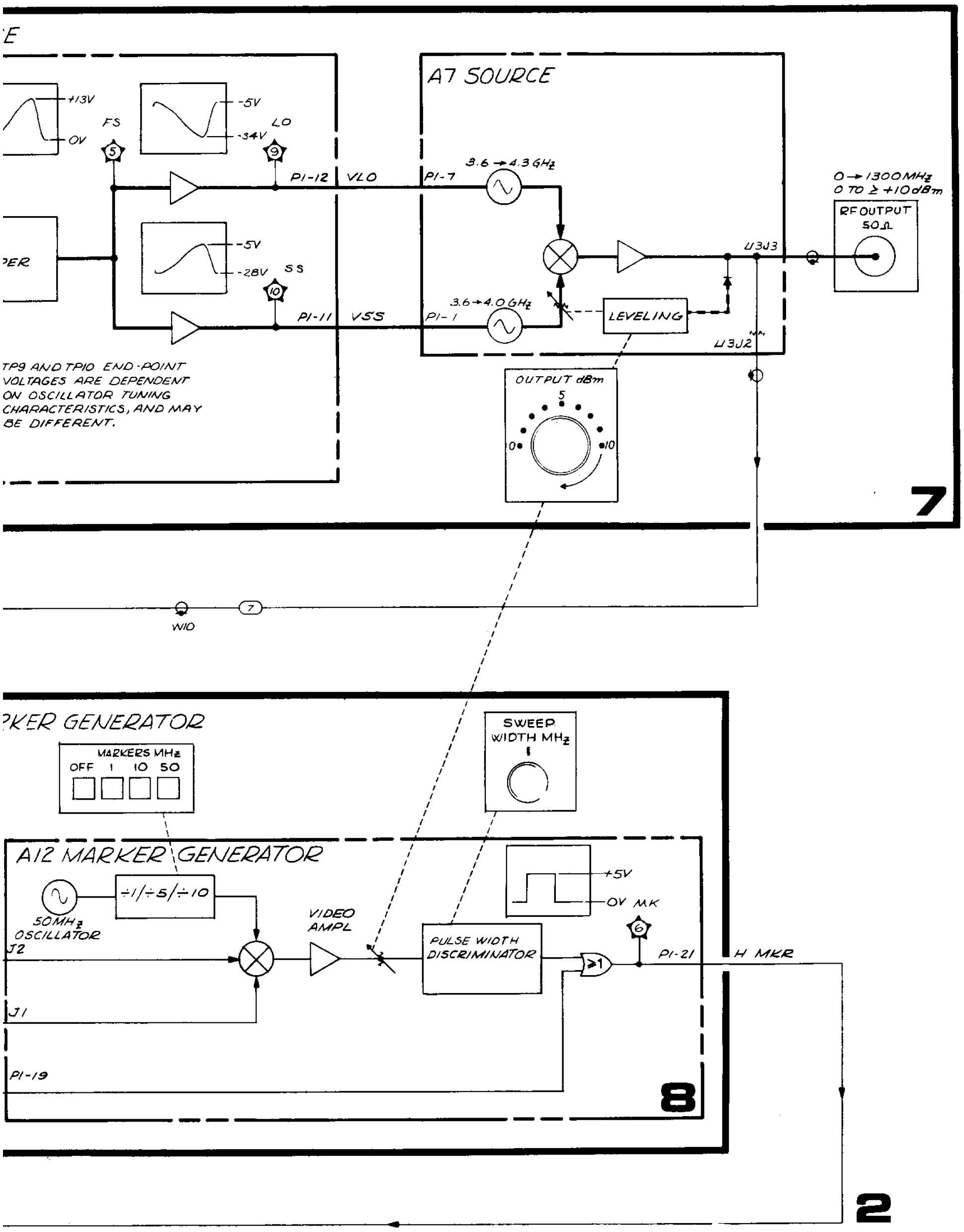


Figure 8-6. RF Source Section Block Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and ±6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 3

RECEIVER SECTION BLOCK DIAGRAM

The Receiver provides dc voltages to the Display section which are proportional to the absolute magnitudes of, and phase difference between, the three RF inputs: A INPUT, B INPUT, and R INPUT.

The RF inputs are first down-converted to three 1 MHz IF signals, while maintaining their magnitude and phase relationships. Samplers are used to mix the A, B, and R inputs with three phase-coherent pulse outputs from the Voltage-Tuned Oscillator, producing three IF outputs. An automatic phase lock system tunes the Voltage-Tuned Oscillator to maintain a 1 MHz IF at the output of the R Sampler.

The IF outputs are processed by the A,B and R Magnitude Detectors to provide dc levels proportional to power level in dB. The phase difference between the IF signals is detected, and processed to provide a rectangular as well as polar display.

Voltage-Tuned Oscillator (Service Sheet 10)

This circuitry, which is part of A6 VTO and IF Switch, provides three phase-coherent pulse outputs that drive the A, B, and R input samplers. The pulse repetition rate, or VTO frequency, is proportional to the tuning voltage input from the Phase Lock (A13) by 3 MHz/volt; that is, a 0 to +10V tuning voltage gives a 0 to 30 MHz frequency range. The VTO is normally tuned between 5 and 30 MHz.

The oscillator is a transistor multivibrator type which is tuned by a variable current source. It provides an ECL-compatable output signal which is limited and level-shifted to drive the pulse-generating circuitry and a TEST output.

The pulse-generating circuitry consists of a step-recovery diode which is driven by two differential amplifiers connected in parallel. A pulse of approximately 0.3 nanoseconds duration is created at the VTO repetition rate; this pulse is processed through three diode-isolation networks to provide three pulsed outputs approximately 6V in amplitude.

Note that the pulsed outputs are nominally equal, and can be interchanged for servicing; but their individual characteristics affect sampler alignment and electrical length (phase slope) margin.

Samplers (Service Sheet 9)

The Samplers act as harmonic mixers to down-convert their respective inputs (A3: B, A4: A, A5: R) to a low-frequency IF. They are electrically identical and may be interchanged for servicing, although realignment will be necessary due to Pulse input characteristics, IF Switch differences, etc.

A sampler receives an RF input, which is applied to a diode gate that is switched on and off by a pulse from the A6 VTO. The resultant IF output contains frequencies at the sum and difference of the RF frequency and every harmonic of the pulse repetition rate (VTO frequency).

The sampling process has an inherent low-pass characteristic; the main IF output frequency is the difference between the RF frequency and the closest multiple of the VTO frequency. For example, if the RF frequency is 99 MHz and the VTO is tuned to 10 MHz, then the tenth harmonic (100 MHz) mixes with the RF to produce a 1 MHz output signal.

Note that as the VTO changes frequency, the sampler output frequency changes in proportion to the harmonic number. For example, if the VTO frequency changes 1 kHz, then the tenth harmonic will change 10 kHz, resulting in a 10 kHz change in IF output frequency.

Phase Lock Loop (Service Sheet 11)

The Phase Lock Loop monitors the output of the R INPUT sampler and adjusts the frequency of the VTO to maintain a constant 1 MHz IF. The VTO is "locked" so that one of its harmonics is 1 MHz higher than the RF input frequency.

A13 contains the input filtering and limiting for the R sampler signal, a Frequency/Phase Detector which compares the limited signal to a 1 MHz reference, and two series integrators which drive the VTO. A14 contains a discriminator used to sense RF Source frequency, and the digital logic used to control the A13 analog circuitry, A17 Sweep Generator, and the CRT blanking.

In order to properly phase lock the VTO, A14 sends two signals to A13, which define three sequential operating modes: Pretune, Acquire, and Locked.

Pretune: Pretune is selected when the H SET VTO line is high (sweep stopped, display blanked). In this mode, the VTO tuning voltage is fed back to the input of the First Integrator and compared with a Pretune voltage. This feedback loop drives the VTO to approximately 8 MHz, or the RF frequency divided by 50, whichever is greater.

Acquire. Selected when H SET VTO line is low and H ACQ line is high (sweep stopped, display blanked). In this mode, the VTO is tuned away from its Pretune frequency until the R Sampler IF output is 1 MHz. The R IF signal is amplified and filtered to a 13 MHz bandwidth; the Frequency/Phase Detector compares this signal to a 1 MHz reference and sends an error voltage into the integrators. The integrators then tune the VTO away from the pretuned frequency until one of the VTO harmonics is 1 MHz higher than the R input RF frequency. Note that this mode is selected when A14 Phase Lock Control board is removed.

In general, the loop will lock to the closest harmonic that is not more than 1 MHz lower than the RF frequency. For example, say that the VTO is pretuned to 8 MHz, and the RF frequency is 90 MHz. The eleventh harmonic (at 88 MHz) is 2 MHz lower than the RF, while the twelfth harmonic (at 96 MHz) is 6 MHz higher than the RF; hence the loop tunes the twelfth harmonic of the VTO to be 1 MHz higher than the RF. Thus the VTO is tuned from its 8 MHz pretune frequency to a new frequency:

$$F_{VTO} = (F_{RF} + 1\text{ MHz})/\text{Harmonic Number}$$
$$= (90 + 1)/12 = 7.583\text{ MHz}$$

Due to the characteristic of the Frequency/Phase Detector, the loop will not lock on the opposite side-band, i.e. with the VTO harmonic lower than the RF.

Locked. Selected when H SET VTO line is low and H ACQ line is low. In this mode, the Input filter cutoff frequency is switched to 2.8 MHz to eliminate display "birdies"; an additional integrator is switched in to improve performance, and the RF sweep is allowed to continue.

A level detector on A13 senses when the R INPUT is less than −40 dBm, and lights a front-panel LED, telling the operator to INCREASE R LEVEL. When RF is applied, the light goes off, and the locking sequence (Pretune, Acquire, Locked) is initiated.

The locking sequence is also initiated when:

1. The RF sweep starts; trace at left edge of CRT.
2. The RF sweeps through 3 MHz.
3. The RF has been sweeping and VTO reaches 30 MHz.
4. Commanded by rear-panel H RELOCK or L RELOCK input.

An example of Phase Lock Loop operation is as follows: (For this example, the RF Source is set to sweep from 5 MHz to 105 MHz, and this signal is fed into the R input.) At the start of the sweep, the VTO is pretuned and the loop allowed to acquire; the VTO will lock at 6 MHz, on its first harmonic. When the RF sweep continues, the loop constantly adjusts the VTO frequency, making it "track" the RF signal, until the RF frequency reaches 29 MHz and the VTO frequency reaches 30 MHz.

At this point, the sweep is stopped, the display is blanked, and the VTO is pretuned to 8 MHz. Then the loop acquires, and the VTO locks on the closest harmonic that is no more than 1 MHz lower than the RF frequency. The third harmonic (24 MHz) is 5 MHz lower than the RF; the fourth harmonic (32 MHz) is 3 MHz high; hence, the loop adjusts the fourth harmonic of the VTO to 1 MHz higher than the RF frequency (29 MHz). Thus, the VTO frequency is now 7.50 MHz.

The sweep is again allowed to continue until the RF frequency equals 105 MHz, the end of the sweep. The sweep then retraces, and the cycle repeats.

During the Pretune and Acquire modes, the sweep is stopped and the display is blanked. In addition, for frequencies greater than 39 MHz, the sweep ramp (VSWP) is back-stepped approximately 4 percent during the pretune mode. When the sweep resumes during the locked mode, the CRT remains blanked until the sweep voltage reaches the old value. This improves the display appearance at the lock point.

The open-loop gain-bandwidth product, and hence the loop stability, depends on which VTO harmonic the loop locks. To compensate for this, an attenuator is inserted between the two integrators to keep loop bandwidth at 80 to 120 kHz for optimum speed versus stability.

Ideally, this attenuator is proportional to harmonic number, which is $(F_{RF} + 1)/F_{VTO}$. Actually, since the VTO frequency is pretuned to a constant value, the loop attenuator need only be controlled by the RF frequency. An Analog-to-Digital Converter (ADC) on A14 senses both the actual RF frequency (RF<100 MHz) and the FREQ REF voltage (RF>100 MHz). It outputs a three bit word to a switched resistor network on A13 which selects one of eight attenuator values.

A,B Magnitude Detector (Service Sheet 12)

The A,B Magnitude Detector (A8) produces a dc voltage which is logarithmically proportional to the magnitude of the IF signal from the A Sampler (A4) or the B Sampler (A3). This output voltage has a scale factor of −25 mV/dB and covers an 80 dB dynamic range. An IF switch (located on A6) selects the A or B input.

The IF switch consists of two diode gates which are switched off/on by a TTL logic line from the A19 Rectifier. This logic line is controlled either by the front panel (8754A in local) or by a remote input (8754A in remote) from the rear-panel PROGRAMMING connector.

On A8, the IF signal is first filtered by a 2-pole 1 MHz bandpass filter with 20 kHz bandwidth, so that the detectors will respond only to the 1 MHz component of the Sampler's IF output.

The filtered IF signal is then rectified to produce a dc current proportioal to the magnitude of the IF signal. This circuit contains an amplifier and two diodes connected in a negative-feedback loop, with added compensation to improve accuracy at low levels.

The dc current is then applied to a transistor logging amplifier to produce a voltage that, after scaling, has a scale factor of −25 mV/dB. This circuit employs negative feedback around a bipolar transistor whose collector current varies exponentially with emitter-base voltage.

A switch located on A8 selects either the A,B MAG voltage or the corresponding R MAG voltage from A11 for processing by the Analog Processor (A2).

R Magnitude Detector (Service Sheet 13)

The R Magnitude Detector (A11) produces a dc voltage which is logarithmically proportional to the magnitude of the R IF signal from the R Sampler (A5) by −25 mV/dB. This assembly is electrically identical with the A8 A,B Magnitude Detector and may be interchanged for servicing; the R IF signal only requires a 40 dB dynamic range.

The detector first filters the R IF signal to remove all but the desired 1 MHz component; it is then rectified to obtain a dc current which is proportional to the IF level. The logarithm of this current is then scaled to produce a −25 mV/dB dc output voltage.

A switch located on A11 selects either a magnitude ratio signal or a phase signal to provide the rear-panel MAG/PHASE output.

Phase and Polar Detectors (Service Sheet 14)

The Phase Detector (A9) and Polar Converter (A10) assemblies receive the filtered IF signals from the A8 and A11 Magnitude Detectors. They provide a dc voltage (RECT PHASE) corresponding to the phase difference between the R and A,B IF signals, and dc voltages corresponding to the X and Y components of a polar display.

The filtered R IF signal is limited to provide an ECL-compatible square wave over its 40 dB dynamic range. This square wave is then phase shifted by an amount proportional to a dc phase offset voltage from A2, by 7.5 mV/degree. This dc voltage is controlled by the front-panel Phase Reference and Electrical Length controls, and is discussed further in the Display Section (Service Sheet 4).

The filtered A,B IF signal is likewise limited to provide an ECL compatible square wave over its 80 dB dynamic range. The phase of this signal is compared with that of the Phase-shifted R IF signal to generate a dc voltage proportional to their phase difference, by 10 mV/degree over ±180 degrees.

A polar display is a vector representation of magnitude ratio and phase difference. A point on the CRT display is considered a vector, drawn from the origin (center) whose radius is proportional to magnitude, and whose angle is proportional to phase.

The Antilog Amplifier generates a voltage linearly proportional to magnitude ratio, by exponentiating the log signal from the A2 Analog Processor. This voltage drives a voltage-variable attenuator which modulates the peak-to-peak amplitude of the limited A,B IF square wave. This square wave is then filtered to provide a sinusoid which is phase-coherent with the A,B IF signal, and whose peak-to-peak amplitude is determined by the magnitude ratio of A,B with respect to R.

This sinusoid is applied to one input of two analog multipliers, used to generate a polar display. The other inputs are driven from the Phase-shifted R IF signals.

TROUBLESHOOTING HINTS

The following Troubleshooting Hints assume that ac line power is applied to the 8754A and all power supplies are operational. These hints are provided as a troubleshooting aid in locating a problem. Several symptoms are listed with their most probable causes. For these Troubleshooting Hints, it is suggested that the instrument be set up as shown in Figure 8-4.

NOTE

Check that no cables are connected to rear-panel connectors.

Receiver Phase Lock. A phase lock problem can appear on the CRT display in different forms. The trace could be totally blanked or the sweep stopped (partial sweep or dot on CRT). One or more segments of the trace (i.e. between lock points) could be missing, noisy, or intermittent. The trace could have excessive discontinuities or transients at the lock points.

1. If display is blanked, monitor rear-panel SWEEP OUT. Check for stop-sweeps and back steps at phase lock acquisition points. If the sweep ramp is normal, the trouble is probably further on in the Receiver or Display sections.

2. If sweep is locked up, disconnect RF power at the R INPUT and check if the sweep ramp at rear-panel SWEEP OUT returns. A narrow-band low power point in the R channel input power level may cause multiple back-steps (latch up of sweep), depending on frequency, sweep rate, and depth of power hole. With no R INPUT, the front-panel UNLOCKED indicator should be on; if not, check Peak Detector on A13 or the Reference Channel Power Detector on A14.

3. If a trace segment is missing (dropping into the noise level), the phase lock loop gain is not correct. This can be caused by an excessively non-linear RF frequency (see Service Sheet 2), A14 not pretuning VTO or controlling loop gain attenuator on A13, or the loop gain attenuator could be defective.

4. Excessive display discontinuities or transients that occur at the phase lock points are usually caused by the A14 Phase Lock Control. Refer to Service Sheet 11 and check timing of acquisition sequence. Also check operation of L HOLD, H BLANK, L STP SWP, and H BK STEP functions.

5. If no phase lock can be achieved, basic operation of A13 Phase Lock can be checked by removing A14 Phase Lock Control and checking if the instrument will phase lock at low frequencies (<100 Mz) and slow sweep speeds while displaying R. If any trace segment will lock, most of A13 is functional.

6. Basic operation of the R Sampler, VTO, IF detection and display sections can be checked by removing both A13 and A14 board assemblies. Display R at 10 dB/DIV and a slow sweep rate. A series of columns or spikes should be displayed on the CRT. These spikes are generated each time a harmonic of the VTO (which is tuned to about 12 MHz with A13 removed) is mixed with the RF to produce a ± 1 MHz IF mixing product. The amplitude of the spikes should correspond to the power level of the RF input. The A and B samplers, A,B Detector, and IF switch can be checked in a similar manner if the RF is connected to the A or B inputs.

A or B INPUT Display Inaccurate. Indication is the R input is properly displayed, but the A and/or B inputs are missing or incorrect. If either the A or B display is normal, the trouble is before the A8 A,B Detector.

1. VTO outputs are interchangeable; check if problem follows a particular output. Return cables to original connections or readjustment is necessary. The long pulse cable (white/blue) must be connected between A6J2 and A5J2 or electrical length problems may result.

2. Samplers can be interchanged. Check if problem follows Sampler. Return Samplers to original position or readjustment is necessary.

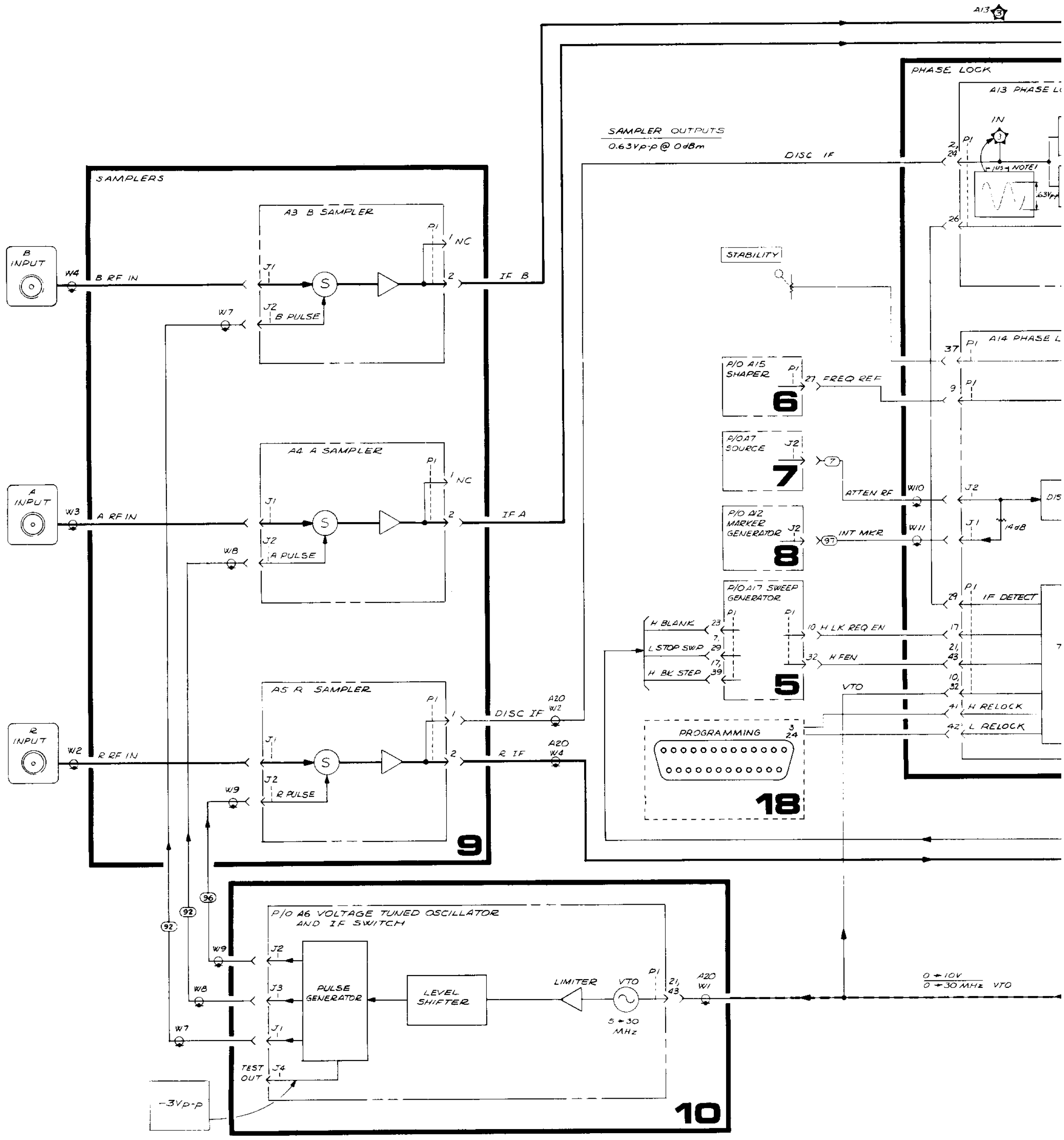
Magnitude Detectors (A8 or A11). If problem occurs for A and B displays, trouble is probably in A8. If trouble is in R display and ratio displays, the trouble is probably in A11. These boards are interchangeable for troubleshooting, but should be returned to their original position after servicing or readjustment is necessary.

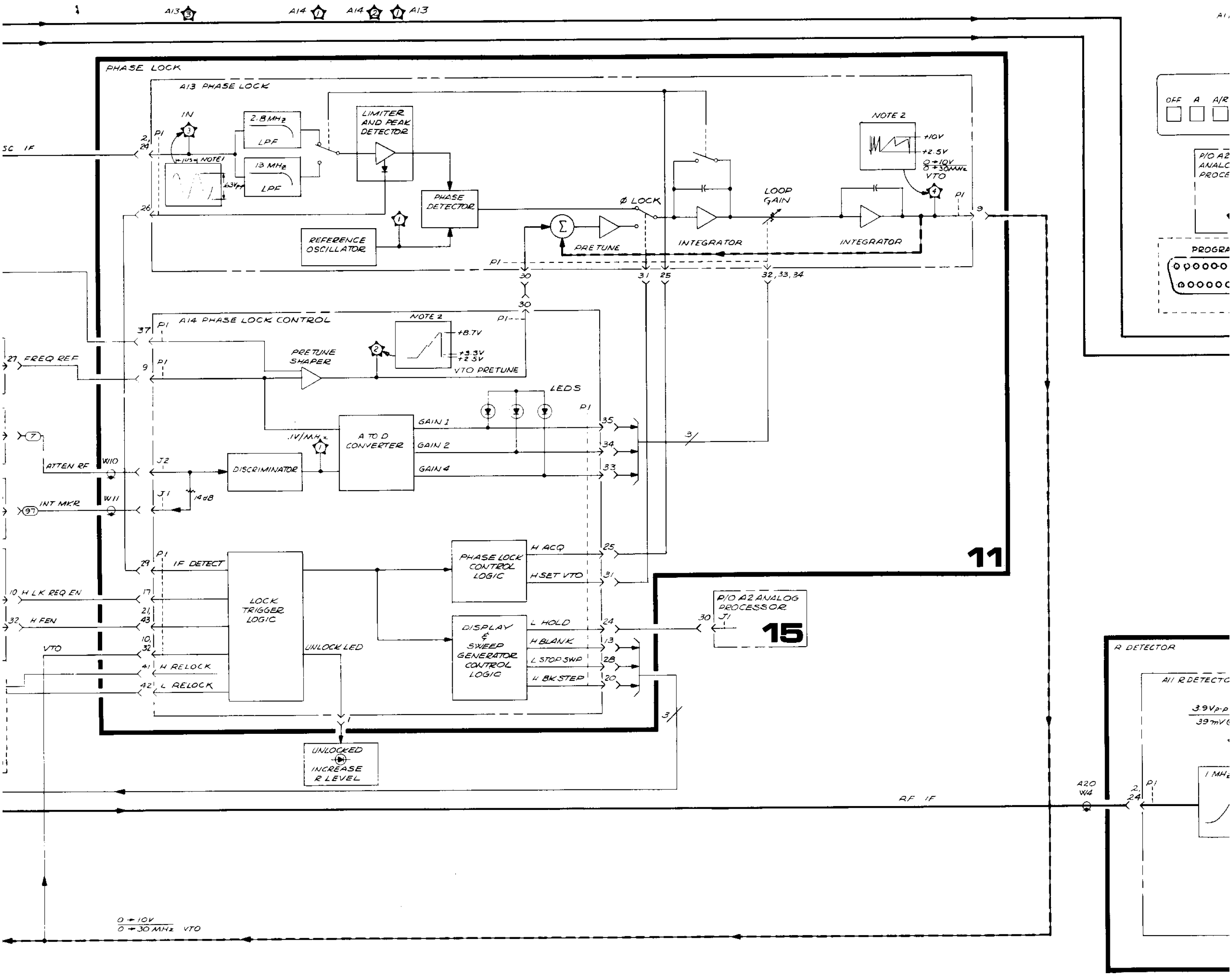
POLAR A/R Display. Check that trace can be centered with POLAR CENTER controls when POLAR A/R is selected. If not, check LOG K A/R input to A9. Ensure POLAR CENTER switch is off (out) before proceeding. Adjust POLAR A/R LENGTH control for a dot as the trace display. With equal magnitude A and R inputs, the trace should be near the outer polar circle.

1. Check that the CHANNEL 2 REFERENCE lever switch provides a calibrated phase offset. If not, the trouble is probably in the Variable Phase Shifter circuit on A10 Polar Converter.

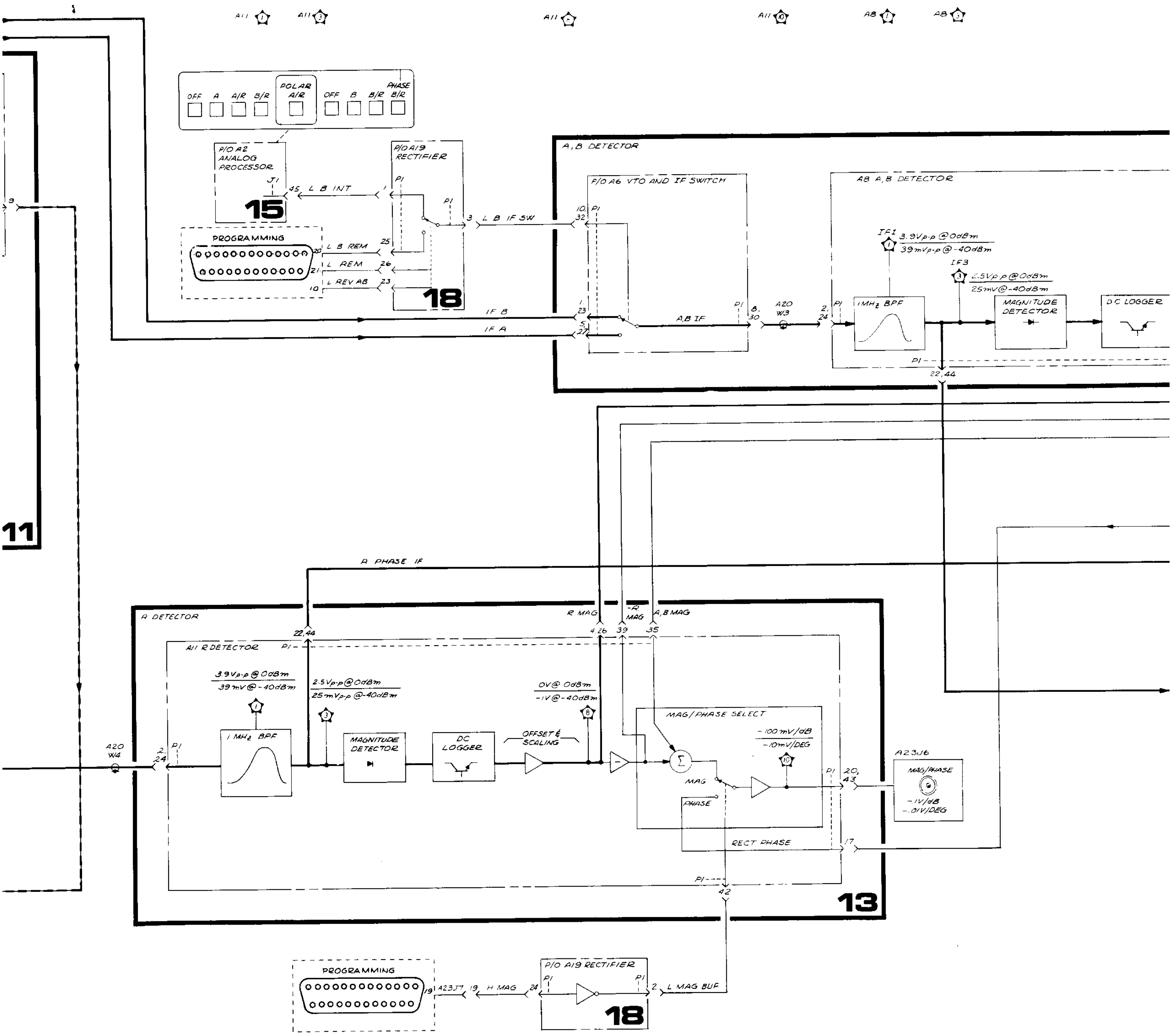
2. Check that a positive offset with CHANNEL 1 REFERENCE lever switch offsets trace towards center of display. If not, check LOG K A/R input to A9 Phase Detector.

PHASE B/R Display. If Polar A/R is operational, check Rectangular Phase Detector circuit on A9 by inputting a phase offset with the CHANNEL 2 REFERENCE lever switch and noting offset on the CRT display.

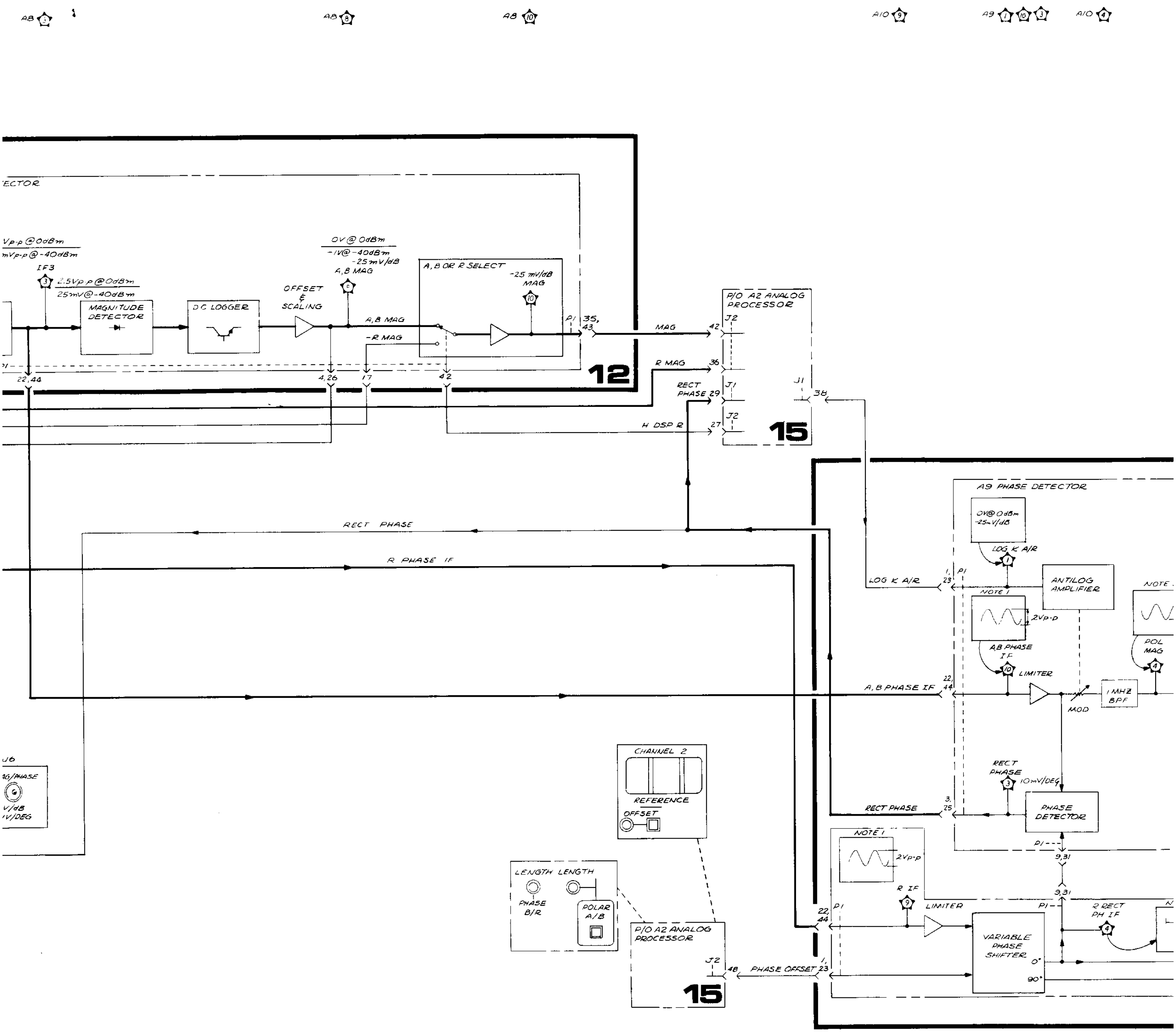

SAMPLERS
A3 B SAMPLER
A4 A SAMPLER
A5 R SAMPLER
B INPUT
A INPUT
R INPUT
B RF IN
A RF IN
R RF IN
B PULSE
A PULSE
R PULSE
IF B
IF A
R IF
DISC IF
NC
9
SAMPLER OUTPUTS
0.63Vp-p @ 0dBm
DISC IF
STABILITY
P/O A15 SHAPER
6
FREQ REF
P/O A7 SOURCE
7
ATTEN RF
P/O A12 MARKER GENERATOR
8
INT MKR
P/O A17 SWEEP GENERATOR
5
H BLANK
L STOP SWP
H BK STEP
H LK REQ EN
H FEN
VTO
H RELOCK
L RELOCK
PROGRAMMING
18
PHASE LOCK
A13 PHASE L
A14 PHASE L
IF DETECT
14dB
P/O A6 VOLTAGE TUNED OSCILLATOR AND IF SWITCH
PULSE GENERATOR
LEVEL SHIFTER
LIMITER
VTO
5→30 MHz
TEST OUT
-3Vp-p
10
0→10V
0→30 MHz VTO



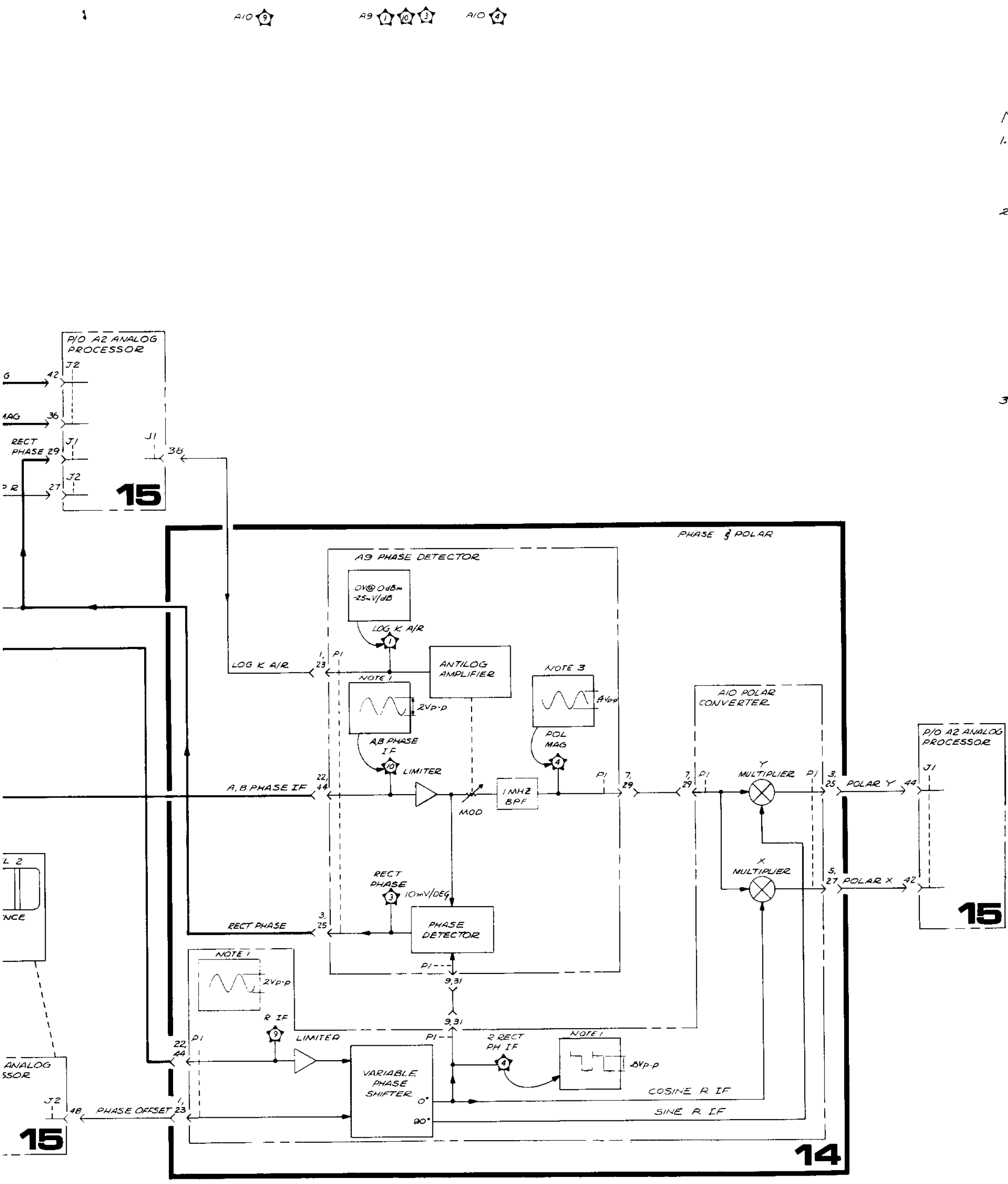
PHASE LOCK
A13 PHASE LOCK
IN
2.8 MHz LPF
13 MHz LPF
LIMITER AND PEAK DETECTOR
PHASE DETECTOR
REFERENCE OSCILLATOR
PRETUNE
Ø LOCK
INTEGRATOR
LOOP GAIN
INTEGRATOR
NOTE 2
+10V
+2.5V
VTO
A14 PHASE LOCK CONTROL
PRETUNE SHAPER
VTO PRETUNE
+8.7V
LEDS
A TO D CONVERTER
GAIN 1
GAIN 2
GAIN 4
DISCRIMINATOR
ATTEN RF
INT MKR
FREQ REF
IF DETECT
LOCK TRIGGER LOGIC
PHASE LOCK CONTROL LOGIC
H ACQ
H SET VTO
DISPLAY & SWEEP GENERATOR CONTROL LOGIC
L HOLD
H BLANK
L STOP SWP
H BK STEP
H LK REQ EN
H FEN
VTO
H RELOCK
L RELOCK
UNLOCK LED
UNLOCKED INCREASE R LEVEL
P/O A2 ANALOG PROCESSOR J1
15
11
R DETECTOR
A11 R DETECTOR
RF IF
PROGRA
0 → 10V
0 → 30 MHz VTO



OFF
A
A/R
B/R
POLAR A/R
OFF
B
B/R
PHASE B/R
P/O A2 ANALOG PROCESSOR
15
P/O A19 RECTIFIER
L B INT
L B IF SW
PROGRAMMING
L B REM
L REM
L REV AB
18
IF B
IF A
A, B DETECTOR
P/O A6 VTO AND IF SWITCH
A,B IF
A20 W3
A8 A,B DETECTOR
3.9Vp-p @ 0dBm
39mVp-p @ -40dBm
2.5Vp-p @ 0dBm
25mV @ -40dBm
1MHz BPF
MAGNITUDE DETECTOR
DC LOGGER
11
A PHASE IF
A DETECTOR
R MAG
-R MAG
A,B MAG
A11 R DETECTOR
3.9Vp-p @ 0dBm
39mV @ -40dBm
2.5Vp-p @ 0dBm
25mVp-p @ -40dBm
0V @ 0dBm
-1V @ -40dBm
OFFSET & SCALING
1MHz BPF
MAGNITUDE DETECTOR
DC LOGGER
MAG/PHASE SELECT
-100mV/dB
-10mV/DEG
MAG
PHASE
RECT PHASE
A20 W4
A23J6
MAG/PHASE
-1V/dB
-.01V/DEG
13
PROGRAMMING
P/O A19 RECTIFIER
H MAG
L MAG BUF
18



A, B OR R SELECT
MAGNITUDE DETECTOR
D.C. LOGGER
OFFSET & SCALING
A, B MAG
R MAG
MAG
P/O A2 ANALOG PROCESSOR
RECT PHASE
H DSP R
R PHASE IF
A9 PHASE DETECTOR
LOG K A/R
ANTILOG AMPLIFIER
AB PHASE IF
LIMITER
A, B PHASE IF
1 MHZ BPF
MOD
POL MAG
PHASE DETECTOR
CHANNEL 2
REFERENCE
OFFSET
LENGTH
PHASE B/R
POLAR A/B
R IF
VARIABLE PHASE SHIFTER
R RECT PH IF
PHASE OFFSET
12
15



NOTES

1. FOR WAVEFORMS SHOWN, SET FRONT PANEL CONTROLS AS FOLLOWS:

SWEEP MODE: FULL 4 - 1300
SWEEP : AUTO, FAST

2. FOR WAVEFORM SHOWN SET FRONT PANEL CONTROLS AS FOLLOWS:

TUNING = 10MHz
SWEEP MODE = CENTER
SWEEP = AUTO, MAN
SWEEP WIDTH MHz = 0 CW
SWEEP WIDTH MHz VERNIER = CAL
OUTPUT dBm : FOR 0dBm AT R AND B INPUTS

CHANNEL 1
MEASUREMENT SELECT : OFF

CHANNEL 2
REFERENCE : 00 DEG
REFERENCE OFFSET : OFF (OUT)
MEASUREMENT SELECT : PHASE B/R

3. FOR WAVEFORM SHOWN SET FRONT PANEL CONTROLS AS FOLLOWS:

TUNING = 10MHz
SWEEP MODE = CENTER
SWEEP = AUTO, MAN
SWEEP WIDTH MHz = 0 CW
SWEEP WIDTH MHz VERNIER = CAL
OUTPUT dBm : FOR 0dBm AT R AND A INPUTS

CHANNEL 1
REFERENCE : 00dB
REFERENCE OFFSET : OFF (OUT)

CHANNEL 2
REFERENCE : 00 DEG
REFERENCE OFFSET : OFF (OUT)
POLAR A/R : ON (IN)
POLAR CENTER : OFF (OUT)

Figure 8-7. Receiver Section Block Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 4

DISPLAY SECTION BLOCK DIAGRAM

The Display processes the dc voltages from the Receiver, as well as the Sweep, Marker, and Blanking signals from the Source, to provide a CRT display.

Analog Processor (Service Sheet 15)

For rectangular measurements, the Analog Processor (A1 and A2) produces two dc voltages proportional to the CRT trace vertical deflection for Channels 1 and 2 (300 mV/division). The two channels are independent; each contains an input summing amplifier, a vertical position summing amplifier, and an output video filter.

Absolute magnitude is processed by comparing the dc voltage from the A,B Detector with a reference dc voltage determined by the Channel 1 or 2 REFERENCE lever switch; the difference is amplified by the selected scale factor in dB/division. The FREQ REF voltage from the Source is added to compensate for the 2 to 3 dB roll-off of sampler conversion loss at 1300 MHz.

Magnitude Ratio measurements are processed by subtracting the R Detector dc level from the A,B Detector dc level, and then comparing this with a reference dc voltage determined from the Channel 1 or 2 REFERENCE lever switch; the difference is amplified by the selected scale factor in dB/division.

Phase measurements are processed in Channel 2 only. The dc voltage from the Rectangular Phase Detector is amplified by the selected scale factor in degrees/division. The Phase Reference comparison is accomplished by generating a PHASE OFFSET dc voltage proportional to phase shift (7.5 mV/degree) and sending this voltage to A10 Polar Converter where it drives a voltage-variable Phase Shifter in the R IF signal line.The PHASE OFFSET voltage includes the Channel 2 REFERENCE lever switch setting, and a portion of the FREQ REF voltage (from A15 Shaper) attenuated by the front-panel LENGTH controls. Thus, the phase of the R IF signal is made to change proportional to RF frequency, which compensates for electrical length differences between the A, B, and R inputs.

In each channel the summing amplifier output is added to a vertical position level. When the corresponding POSITION switch is open, the CRT displays the vertical position about which the scale factor expansion takes place. An RC network provides video filtering; the series resistor may be momentarily opened by a control line from A14, which "holds" the charge on the filter capacitor. The resultant output, after scaling, is −300 mV/division for each channel.

For Polar measurements, the X and Y outputs from the multipliers on A10 are processed similarly to the Rectangular Summing Amplifier outputs, by adding a position level to each, and providing video filtering. The Y component is considered Channel 1, the X component is considered Channel 2.

Front-panel Measurement Select pushbutton status (OFF, A, B, A/R, POLAR A/R, etc.) is decoded by the Control Logic into digital lines which control the A6 IF Switch, A18 Deflection Amplifiers, and A8 A,B Detector (for displaying absolute R).

Deflection Amplifiers (Service Sheet 16)

The Deflection Amplifiers (A18) provide X and Y CRT deflection, and a Z axis signal to the High Voltage Power Supply.

Vertical deflection is either from the rear-panel NORMALIZER INTERCONNECT input (if L NORM = 0) or from the CH 1 and CH 2 FLT signals from the A2 Analog Processor. If both front-panel display channels are used, an Alternate Sweep switch causes CH 1 FLT to be displayed on one RF sweep and CH 2 FLT to be displayed on the next RF sweep. The vertical signal drives the CRT vertical deflection plates and the rear-panel VERT output connector.

Horizontal deflection is either from the rear-panel NORMALIZER INTERCONNECT input (if L NORM =0), or from the sweep ramp signal from A17 when rectangular measurements are made, or from CH 2 FLT from A2 Analog Processor when POLAR A/R is selected. The horizontal signal drives the CRT horizontal deflection plates and the rear-panel HORIZ output connector.

Z axis (blanking) is either from the rear-panel NORMALIZER INTERCONNECT input (if L NORM = 0), or from the H DBP control line from A17 Sweep Generator. In Polar mode, a frequency marker is displayed as an intensified spot. The Z axis signal drives the A21 High Voltage Power Supply and a rear-panel Blanking connector.

High Voltage Power Supply (Service Sheet 17)

The High Voltage Power Supply receives the Z axis input from the A18 Deflection Amplifiers and provides all of the bias potentials for the Cathode Ray Tube (CRT).

A cathode potential of −2850 Vdc is produced by using a 60 kHz oscillator which drives a step-up transformer and a rectifier. A small portion of the rectified dc voltage is fed back and compared with the +20 Vdc supply; the error voltage is used to control the oscillator amplitude, regulating the supply.

The grid potential is approximately 50 to 100V more negative than the cathode, depending on the Z axis input and the front-panel INTENSITY control.

TROUBLESHOOTING HINTS

The following Troubleshooting Hints assume that ac line power is applied to the 8754A and all power supplies are operational. These hints are provided as a troubleshooting aid in locating a problem. Several symptoms are listed with their most probable causes. For these Troubleshooting Hints, it is suggested that the instrument be set up as shown in Figure 8-4.

NOTE

Check that no cables are connected to rear-panel connectors.

Horizontal Deflection (A18). CRT trace is not blanked, but does not sweep, check rear-panel INT/EXT SWEEP switch is in INT position. Manually sweep CRT trace and check voltage at rear-panel HORIZ connector and V RAMP at A2TP12.

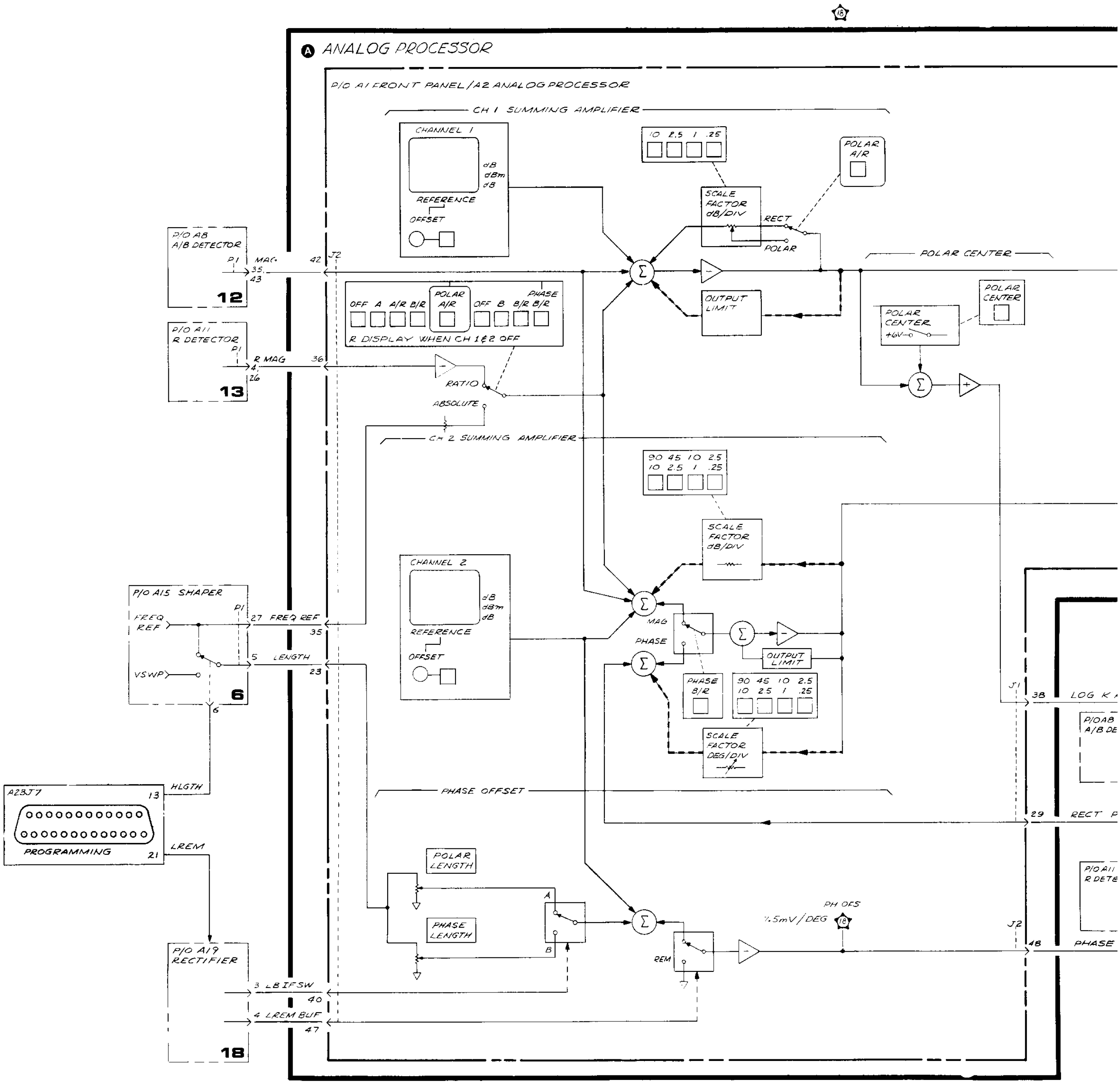
Vertical Deflection (A18). If amplitude markers can be displayed, the Y Deflection Amplifier is operational. Press REFERENCE POSITION CH1 and CH2 buttons. Check voltages at A2TP8 and A2TP9 (CH 1 FLT and CH 2 FLT). If these voltages can not be offset with REFERENCE POSITION controls, check L HOLD input from A14 Phase Lock Control.

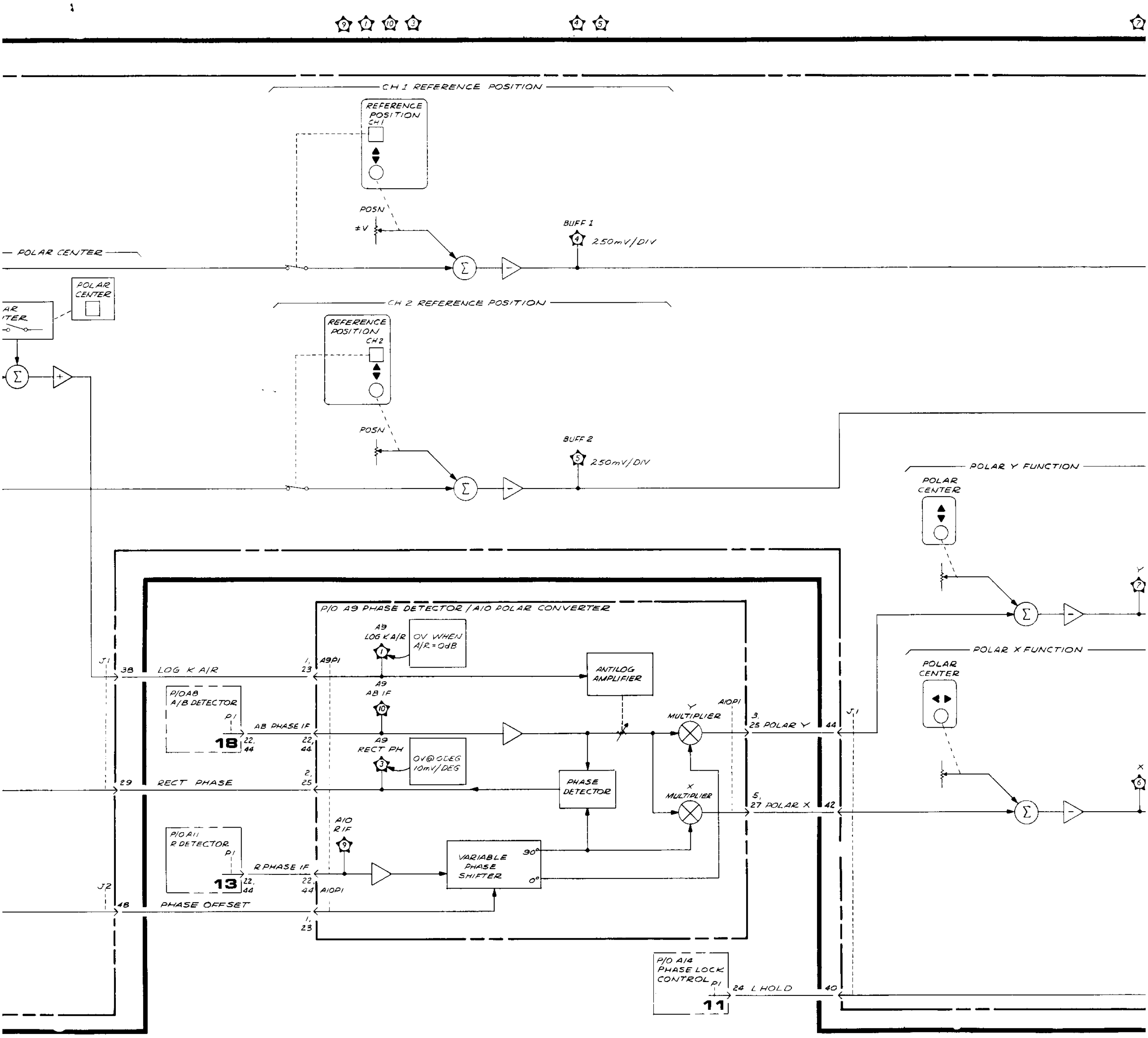
Z Axis Blanking (A18, A21). If any trace can be displayed and the FOCUS and INTENSITY controls are functioning, the A21 High Voltage Power Supply is operational. Check that the rear-panel INT/EXT SWEEP switch is in the INT position. The Z NORM input to A18 is used for blanking when a normalizer is connected. The H DBP input to A18 is controlled by three board assemblies and blanks the CRT trace for the following conditions:

A14: RF frequency <3 MHz and during phase lock acquisition.

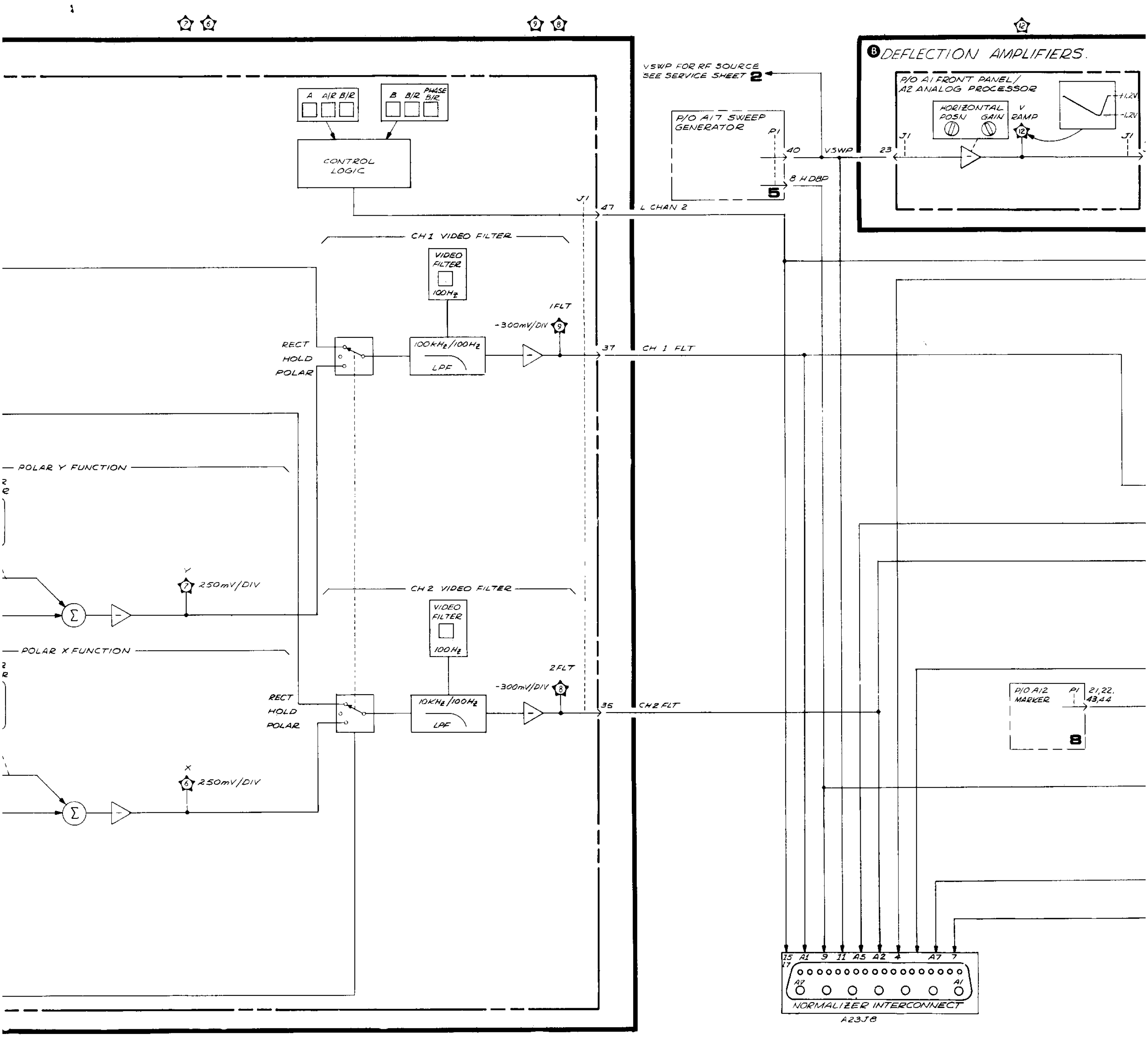
A15: RF frequency >1350 MHz or <-20 MHz.

A17: Sweep retrace blanking.

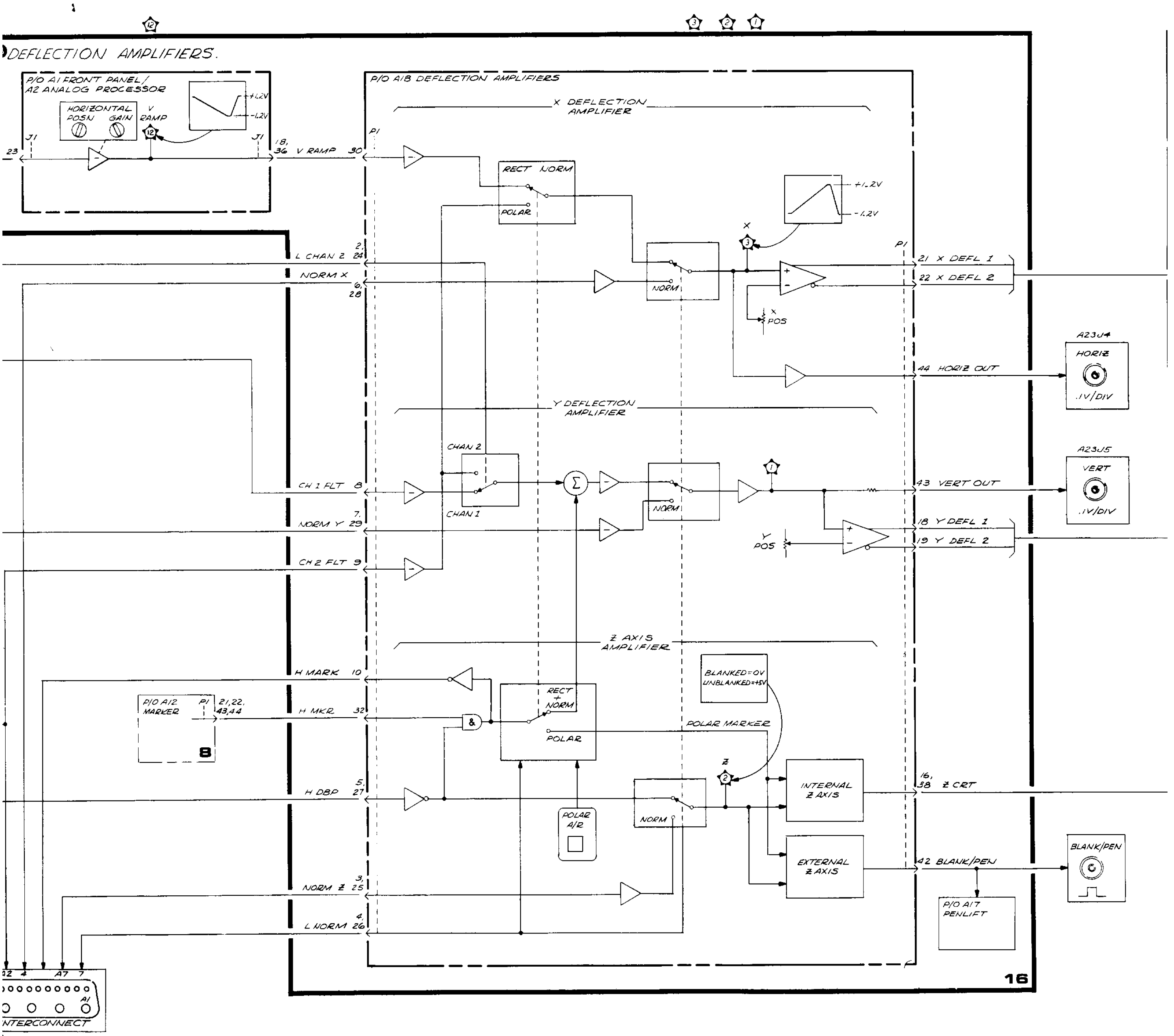

ANALOG PROCESSOR
P/O A1 FRONT PANEL/A2 ANALOG PROCESSOR
CH 1 SUMMING AMPLIFIER
CHANNEL 1
dB dBm dB
REFERENCE
OFFSET
10 2.5 1 .25
SCALE FACTOR dB/DIV
POLAR A/R
RECT
POLAR
POLAR CENTER
OUTPUT LIMIT
POLAR CENTER +6V
P/O A8 A/B DETECTOR
P1
MAG
35
43
42
J2
12
OFF A A/R B/R
POLAR A/R
OFF B B/R B/R
PHASE
R DISPLAY WHEN CH 1&2 OFF
P/O A11 R DETECTOR
R MAG
36
26
13
RATIO
ABSOLUTE
CH 2 SUMMING AMPLIFIER
90 45 10 2.5
10 2.5 1 .25
SCALE FACTOR dB/DIV
CHANNEL 2
P/O A15 SHAPER
FREQ REF
VSWP
27
FREQ REF
35
5
LENGTH
23
6
MAG
PHASE
PHASE B/R
SCALE FACTOR DEG/DIV
J1
38
LOG K
P/OA8 A/B DE
29
RECT
P/O A11 R DETE
A23J7
13
HLGTH
PROGRAMMING
21
LREM
PHASE OFFSET
POLAR LENGTH
PHASE LENGTH
A
B
REM
PH OFS
.5mV/DEG
48
PHASE
P/O A19 RECTIFIER
3 LB IF SW
40
4 LREM BUF
47
18



CH 1 REFERENCE POSITION
REFERENCE POSITION CH 1
POSN
±V
BUFF 1
2.50mV/DIV
POLAR CENTER
POLAR CENTER
CH 2 REFERENCE POSITION
REFERENCE POSITION CH 2
POSN
BUFF 2
2.50mV/DIV
POLAR Y FUNCTION
POLAR CENTER
POLAR X FUNCTION
POLAR CENTER
P/O A9 PHASE DETECTOR / A10 POLAR CONVERTER
A9 LOG K A/R
0V WHEN A/R = 0dB
A9 IF
A9 RECT PH
0V@0DEG 10mV/DEG
A10 R IF
J1
38
LOG K A/R
A9P1
P/O A8 A/B DETECTOR
P1
18
AB PHASE IF
29
RECT PHASE
P/O A11 R DETECTOR
P1
13
R PHASE IF
A10P1
J2
48
PHASE OFFSET
ANTILOG AMPLIFIER
PHASE DETECTOR
VARIABLE PHASE SHIFTER
90°
0°
Y MULTIPLIER
X MULTIPLIER
A10P1
3, 25 POLAR Y
5, 27 POLAR X
44
42
J1
P/O A14 PHASE LOCK CONTROL
P1
11
24 L HOLD
40



DEFLECTION AMPLIFIERS
VSWP FOR RF SOURCE SEE SERVICE SHEET 2
P/O A17 SWEEP GENERATOR
P1
40
VSWP
8 HDBP
5
P/O A1 FRONT PANEL/ A2 ANALOG PROCESSOR
HORIZONTAL
POSN
GAIN
V RAMP
+1.2V
-1.2V
23
J1
A
A/R
B/R
B
B/R
PHASE B/R
CONTROL LOGIC
J1
47
L CHAN 2
CH 1 VIDEO FILTER
VIDEO FILTER
100Hz
1FLT
-300mV/DIV
RECT
HOLD
POLAR
100kHz/100Hz
LPF
37
CH 1 FLT
POLAR Y FUNCTION
Y
250mV/DIV
CH 2 VIDEO FILTER
VIDEO FILTER
100Hz
2FLT
-300mV/DIV
RECT
HOLD
POLAR
10kHz/100Hz
LPF
35
CH2 FLT
POLAR X FUNCTION
X
250mV/DIV
P/O A12 MARKER
P1
21,22, 43,44
8
15 17
A1
9
11
A5
A2
4
A7
7
A9
A1
NORMALIZER INTERCONNECT
A23J8



DEFLECTION AMPLIFIERS.
P/O A1 FRONT PANEL/
A2 ANALOG PROCESSOR
HORIZONTAL
POSN GAIN
V RAMP
+1.2V
-1.2V
P/O A18 DEFLECTION AMPLIFIERS
X DEFLECTION AMPLIFIER
V RAMP 30
RECT NORM
POLAR
L CHAN 2 24
NORM X
NORM
21 X DEFL 1
22 X DEFL 2
X POS
44 HORIZ OUT
A23J4
HORIZ
.1V/DIV
Y DEFLECTION AMPLIFIER
CHAN 2
CHAN 1
CH 1 FLT 8
NORM Y 29
CH 2 FLT 9
43 VERT OUT
A23J5
VERT
.1V/DIV
18 Y DEFL 1
19 Y DEFL 2
Y POS
Z AXIS AMPLIFIER
BLANKED=0V
UNBLANKED=+5V
H MARK 10
P/O A12 MARKER
H MKR 32
RECT + NORM
POLAR
POLAR MARKER
8
H DBP 27
POLAR A/R
INTERNAL Z AXIS
EXTERNAL Z AXIS
16, 38 Z CRT
42 BLANK/PEN
BLANK/PEN
P/O A17 PENLIFT
NORM Z 25
L NORM 26
A1
INTERCONNECT
16

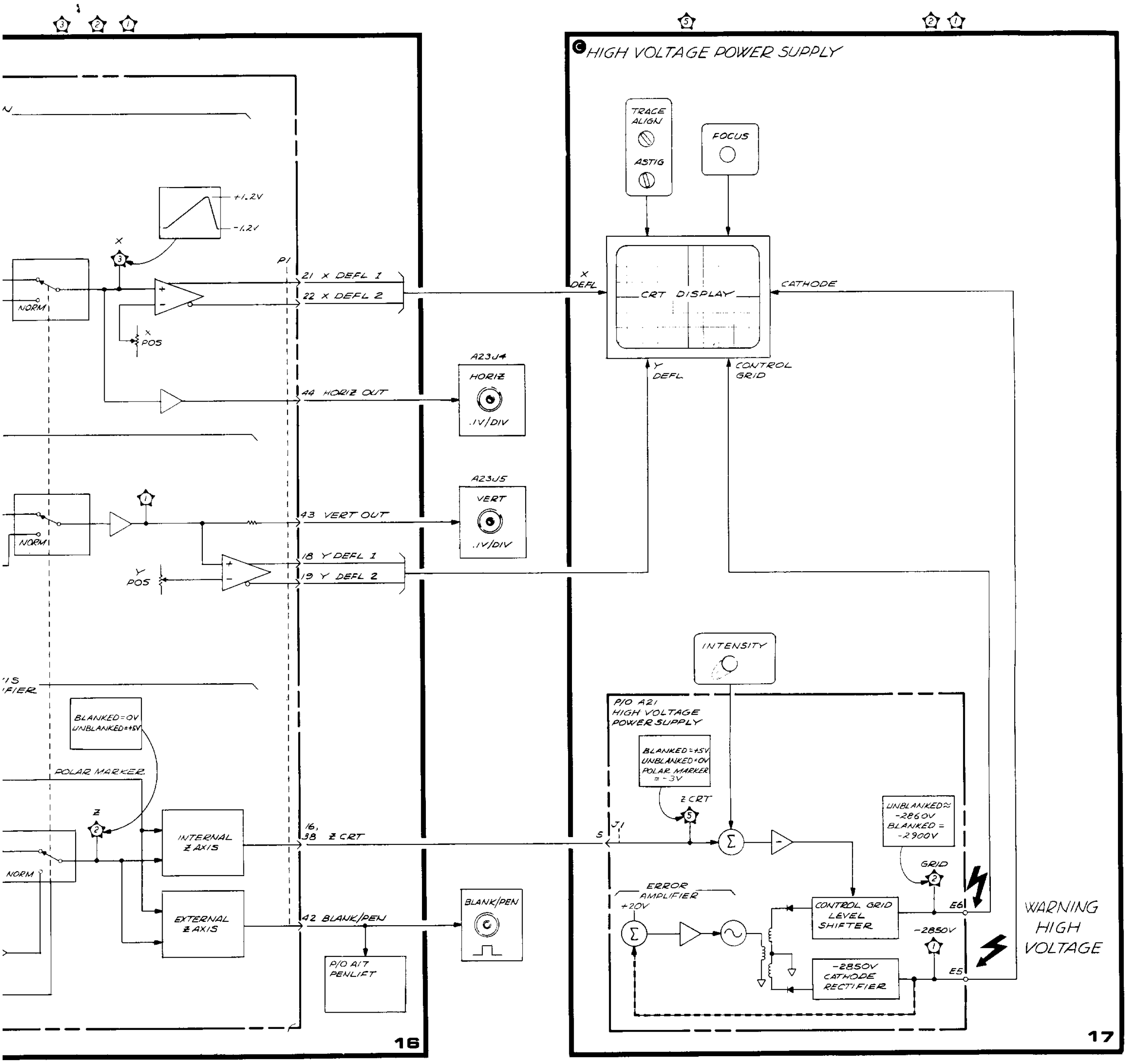


Figure 8-8. Display Section Block Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and ±6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 5

SWEEP GENERATOR (A17), CIRCUIT DESCRIPTION

The Sweep Generator (A17) has the following functions:

- To generate a linear ramp which is used to sweep the RF source and the X axis of the CRT display.
- To generate a blanking pulse, which is used to blank the CRT display during retrace and during the settling time of the RF and IF circuits.
- To generate a penlift pulse, which is similar to the blanking pulse but also allows for the response time of a plotter or recorder.
- To synchronize operation of the RF Source and Receiver sections of the network analyzer.
- To provide for special operational modes, such as manual sweep, external sweep, and external trigger.

Sawtooth Generator Functions (C)

The output of the Sawtooth Generator is a sawtooth waveform that consists of a trace ramp (−0.7V to +10.7V) and a retrace ramp (+10.7V to −0.7V).

The trace ramp is clamped to produce a 0V to +10V VSWP ramp to the Phase Lock Control (A14, Service Sheet 11), to the Shaper (A15, Service Sheet 6), and to the Analog Processor (A2, Service Sheet 16). The VSWP voltage is level-shifted in the Output Buffer circuit to provide a −5V to +5V INT SWP OUT voltage to the rear panel.

The Sawtooth Generator circuit generates two retrace signals: L RET, to the Sweep Trigger Logic, Receiver Control Logic, and Blanking/Penlift circuits; and H RET (a logic high) to the Receiver Control Logic circuit.

The Sawtooth Generator has two inputs from the Sweep Trigger Logic circuit. H FWD TRIG REQ (forward trigger request) triggers a sweep, and L RET REQ (retrace request) initiates a retrace.

The sweep may be stopped by any one of the following signals:

- L EXT STP SWP (external stop sweep) from the rear panel.
- L STP SWP (stop sweep) from the Phase Lock Control (A14, Service Sheet 11).
- L SWP INH (sweep inhibit) from the Sweep Control Logic circuit.

Sweep Trigger Logic Functions (A)

The Sweep Trigger Logic circuit generates two functions:

- H FWD TRIG REQ (forward trigger request), which causes the Sawtooth Generator to start a sweep
- L RET REQ (retrace request), which causes the Sawtooth Generator to start an immediate retrace

The H FWD TRIG REQ function requires that one or more of the following conditions be met:

- The instrument is in automatic sweep (AUTO) mode.
- The instrument is in triggered sweep (TRIG) mode and is externally triggered.
- The instrument is in triggered sweep (TRIG) mode and the front-panel SINGLE pushbutton is pressed.

The L RET REQ function requires that all three of the following conditions be met:

- The instrument is in triggered sweep (TRIG) mode.
- The front-panel SINGLE pushbutton is pressed.
- The L RET (retrace) line from the Sawtooth Generator is high (a retrace is not in progress).

Sweep Control Logic Functions (B)

The Sweep Control Logic circuit generates three functions:

- L SWP INH (sweep inhibit), which inhibits the sawtooth and allows acquisition of the receiver phase lock.
- L EXT SWP SEL (external sweep select), which controls selection of either an external or an internal sweep.
- H PNLFTR (penlift request), which requests the recorder or plotter to penlift.

Receiver Control Logic Functions (D)

The Receiver Control Logic circuit generates five functions:

- H RETRACE (retrace) to the External Interface (Service Sheet 18).
- H LK REQ EN (phase lock request enable) to the Phase Lock Control (A14, Service Sheet 11), where it enables a phase lock request, inhibits video hold, and initiates a phase lock request.
- H FEN (function enable) to the Phase Lock Control (A14, Service Sheet 11), where it enables a phase lock request and a back step.
- H ALT CH 2 (alternate Channel 2) to the Analog Processor (A2, Service Sheet 15), where it switches the display to Channel 2 when both channels are on.
- L DSP EN (display enable) to the Blanking/Penlift circuit.

Blanking/Penlift Functions (E)

The Blanking/Penlift circuit generates two functions:

- H DBP (display blanking pulse) to the Deflection Amplifiers (A18, Service Sheet 16), to blank the CRT display.
- H PNLFT (penlift) to the Penlift Driver circuit to provide a voltage to the penlift coil of a plotter or recorder.

Sweep Trigger Logic (A)

The Sweep Generator has two modes of operation, automatic and triggered, which are selected at the front panel by the mechanically interlocked pushbuttons AUTO and TRIG to provide inputs to the Sweep Trigger Logic circuit. This circuit also provides for single-sweep (SINGLE) triggering and for an external triggering signal (L EXT TRIG) from the rear panel through P1-19.

H FWD TRIG REQ, when high, allows a trace to be triggered at the completion of retrace. This line is high under any of the following conditions:

- AUTO mode is selected at the front panel (high level)TRIG mode is selected and L EXT TRIG line goes low (high pulses).
- TRIG mode is selected at the front panel and the SINGLE pushbutton is pressed (high pulses).

L RET REQ, when low, allows a retrace to be triggered when a trace is in progress. This line is low only when all of the following conditions are met:

- TRIG mode is selected at the front panel.
- The front-panel SINGLE pushbutton is pressed.
- The L RET line from the Sawtooth Generator circuit is high.

In AUTO sweep operation, the Trace and Retrace ramps are continuous. In triggered sweep operation, the Sawtooth Generator waits for a manual trigger (SINGLE) from the front panel or an external trigger (EXT TRIG) from the rear panel. Also in the triggered mode, if a trace is in progress, a pulse generated by pressing of the SINGLE pushbutton will initiate a retrace, after which the sawtooth generator will then wait for another trigger pulse.

All of the following conditions must be met to initiate a trace:

- The Sweep Trigger Logic circuit must provide either a high trigger level or a high trigger pulse to the Sawtooth Generator.

- The Sweep voltage must be more negative than −0.7V.
- The instrument must not be in either manual or external sweep mode.

When all of the above conditions are met, each of the three inputs to NAND gate U5B in the Sawtooth Generator will be at logic high. Note that U5B pin 4 will be low unless comparator U3A pulls that input high; that is, the sweep voltage goes more negative than −0.7V. The states of the other two inputs to U5B (pins 3 and 5) are determined by the Sweep Control Logic circuit.

AUTO Mode. When the AUTO pushbutton is pressed, both inputs to U6D are high and the output is low. U5A pin 2 is low, the output is high, and U5B pin 3 in the Sawtooth Generator is high. At the same time, in the Sweep Control Logic circuit, the L REM BUF and L EXT SWP lines are high, placing a high at the output of U9A, while the L MAN SWP is also high, placing a high at the output of U9B and at U5B pin 5 in the Sawtooth Generator. When the sweep voltage goes more negative than −0.7V, the output of comparator U3A goes high. At this point, all three inputs to U5B are high, the output goes low, and the Trace-Retrace flip-flop U4B is reset (pin 13) to initiate a trace. The trace is in progress when the RTRC signal is low, as shown in Figure 8-9, the Sweep Generator timing diagram.

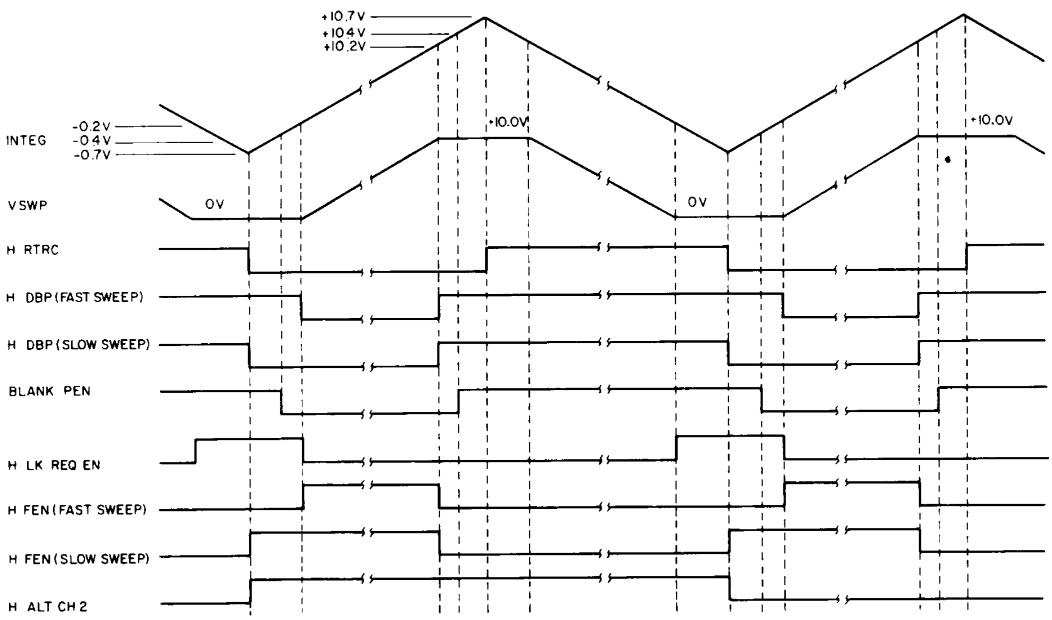


Figure 8-9. Sweep Generator Timing Diagram

TRIG Mode. When the TRIG pushbutton is pressed, the mechanically interlocked AUTO line is grounded, resulting in a high at U5A pin 2 and a low at U5B pin 3 in the Sawtooth Generator. The states of the other two inputs to U5B are as in AUTO mode; therefore, initiation of a trace depends on the states of the L EXT TRIG and L SNGL lines.

The H TRIG line is now high. If there is no external trigger, and if the SINGLE pushbutton is not pressed, all three inputs to U5A are high, U5B pin 3 is low, and no trace is initiated.

If an external trigger (L EXT TRIG) is received, U5A pin 1 goes low, placing a high on U5B pin 3. Since the sweep voltage went more negative than −0.7V at the end of the previous retrace, a new trace is initiated.

When the SINGLE pushbutton is pressed, a negative spike (caused by the discharge and recharge of C6) is coupled to U6B pin 5. The action of the one-shot multivibrator (consisting of the cross-connected two-input NAND gates U6A and U6B) debounces the SINGLE pushbutton and maintains the low input to U6B long enough (approximately 40 μs) to establish a definite logic high at U6B pin 6 (see Figure 8-10). Both inputs to U8B are now high, so U8B pin 6 goes low, resulting in a high at U5A pin 12 and U5B pin 3 in the Sawtooth Generator. Since U5B pin 4 and 5 were already high, U5B pin 6 goes low to initiate a trace.

If the SINGLE pushbutton is pressed while a trace is in progress, a retrace is initiated as follows: When the Trace-Retrace flip-flop U4B was cleared (initiation of the trace in progress), U4B pin 8 was

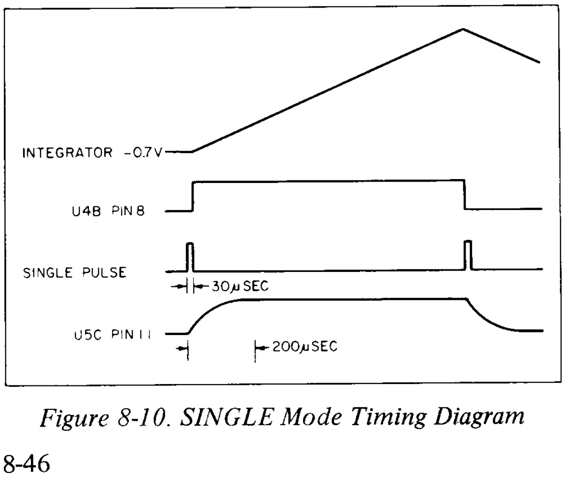


Figure 8-10. SINGLE Mode Timing Diagram

latched high. After 200 μs, essentially the same constant of R34 and C8, U5C pin 11 goes high, and pin 9 remains high. However, pin 10 is low because the output of U6B remained high for only 40 μs, the duration of the SINGLE pulse. When the SINGLE pushbutton is pressed again, U5C pin 10 goes high, a low is coupled through AND gate U9D to set the flip-flop, and U4B pin 9 goes high to initiate a retrace. The Sawtooth Generator is now set to initiate a new trace if the SINGLE pushbutton is pressed while a trace is in progress. Thus, traces and retraces are initiated by alternate SINGLE pulses.

Sweep Control Logic (B)

The Sweep Control Logic circuit generates three functions: L SWP INH, L EXT SWP SEL, and H PNLFTR. These functions are controlled by four input lines: L EXT SWP, L REM BUF, L MAN SWP, and L FAST SWP.

L SWP INH (sweep inhibit), when low, prevents the Sawtooth Generator from starting a sweep and forces H FEN (function enable) and H LK REQ EN (phase lock request enable), from the Receiver Control Logic circuit, to go high. This allows the Phase Lock (A13, Service Sheet 11) in the Receiver to acquire a lock when at least one of the following three control lines is low:

- L EXT SWP to U9A (rear-panel INT SWEEP/EXT SWEEP in EXT SWEEP).
- L REM BUF to U9A (contact closure to ground at P1-20, placing the instrument in remote control). See External Interface, Service Sheet 18.
- L MAN SWP to U9B (manual sweep mode selected at the front panel).

L EXT SWP SEL (external sweep select), when low, causes the Internal/External Sweep Select circuit to disconnect the sweep from the Sawtooth Generator and to pass an external sweep to the output buffer. The L EXT SWP SEL line goes low when either the L EXT SWP line is low (contact closure to ground at P1-21) or the L REM BUF line is low (contact closure to ground at P1-20).

H PNLFTR (penlift request), when high, causes the Blanking/Penlift circuit to generate a penlift signal (H PNLFT) to the Penlift Driver circuit. The H PNLFTR line goes high (open) when any input line to the Sweep Control Logic circuit (L EXT SWP, L REM BUF, L MAN SWP, or L FAST SWP) goes low.

The Sweep Control Logic circuit consists of two AND gates and one NAND gate whose switching operations depend on front-panel controls and external signals.

When manual (MAN) mode is not selected and there are no external signals to the Sweep Control Logic circuit, all inputs to AND gates U9A and U9B are at logic high, U5B pin 5 in the Sawtooth Generator is high, and traces are initiated as described in Sweep Trigger Logic.

When MAN is selected, U9B pin 5 is pulled low, U5B pin 5 is low, and the trace is controlled by the front-panel SWEEP vernier A1R13A.

When the FAST pushbutton (which is mechanically interlocked with MAN) is pressed, NAND gate U10C pins 10 and 11 are low, U10C pin 8 is high, and pin 9 of OR gate U12C (in the Blanking/Penlift circuit) is high, lifting the pen of the plotter or recorder, which will not respond to fast sweep operation. (Refer to the Blanking/Penlift circuit description.)

An external sweep may be provided from the rear panel or from a normalizer. Either L EXT SWP or L REM BUF will pull an input to U9A low, placing a low at U5B pin 3 and disabling the Sawtooth Generator.

Sawtooth Generator (C)

The Sawtooth Generator produces a sawtooth waveform with a linear change in amplitude with respect to time. The waveform, which may be monitored at TP5, consists of a positive-going ramp for sweep trace and a negative-going ramp for sweep retrace (see Figure 8-9). The trace portion of the sawtooth increases from −0.7V to +10.7V at a rate determined by the front-panel SWEEP vernier and the selection of FAST or SLOW sweep. The retrace portion decreases from +10.7V to −0.7V at a fixed rate determined only by the selection of FAST or SLOW sweep. Comparators monitor the sawtooth signal and provide timing pulses for blanking and control signals that are used throughout the instrument.

AUTO Mode. A simplified schematic of the Sawtooth Generator operating in the AUTO sweep mode is shown in Figure 8-11. The sawtooth waveform is generated by the charging and discharging of the integrating capacitor C3 on the positive input to buffer U1. During trace, C3 is charged by the Trace Current Source; during retrace, C3 is discharged through the Retrace Current Source.

Trace Current Source. R3, CR7, and R4 form a voltage divider that sets the Q1 base voltage at +12.3V and keeps Q1 turned on. When a trace is initiated, the Trace-Retrace flip-flop U4B is reset by a low at pin 13, and the active high output, pin 9, goes low. Since both inputs to NAND gate U6C are normally high, the inputs to OR gate U2D are low and U2D pin 11 goes low, turning off Q3. Current is now available through CR3 and CR4 to charge integrating capacitor C3. As C3 charges, Q1 conduction increases to maintain a constant voltage drop across R7 and A1R13B, providing a constant current to charge C3. The charge current is adjusted by the front-panel SWEEP vernier. The positive-going (trace) slope of the sawtooth waveform increases from −0.7V to +10.7V, at which point the output of comparator U11A goes low, setting the flip-flop U4B to initiate a retrace.

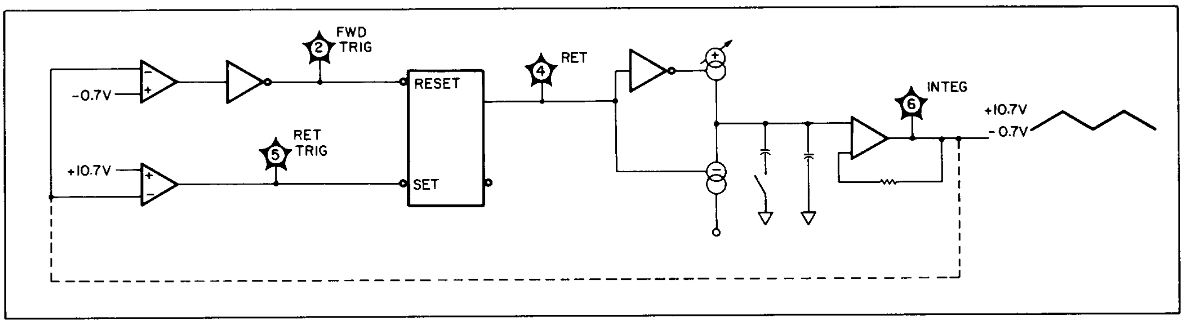


Figure 8-11. Sawtooth Generator, Simplified Schematic

Retrace Current Source. Transistor Q2 controls the switching of the Retrace Current Source. When a retrace trigger sets Trace-Retrace flip-flop U4B, the active high output (pin 9) goes high, turning on Q3 and shunting the Q1 current to ground. The logic high from U4B pin 9 is coupled through OR gate U2C to the emitter of Q2, biasing it into saturation. This pulls the base of Q4 to about +2V, turning the transistor on and providing a discharge path for the integrating capacitor C3. The discharge of C3 generates the negative-going slope of the sawtooth waveform. The signal decreases from +10.7V to −0.7V, at which point the output of comparator U3A goes high, resetting the flip-flop U4B to initiate a trace.

The Retrace Current Source is turned off when the active high output of the flip-flop, U4B pin 9, goes low. Q2 is biased off, and the base of Q4 is pulled to −10V through R10 to turn Q4 off.

Integrator Control. The switching of the Trace and Retrace Current Sources, and thus the charging and discharging of the integrating capacitor C3, is also controlled by the Stop Sweep (L STP SWP or L EXT STP SWP) and Back Step (H BK STEP) lines to the Sawtooth Generator.

If either L STP SWP or L EXT STP SWP goes low, flip-flop U4B is overridden and the Trace Current Source is inhibited to allow stabilization of the Receiver Phase Lock circuitry. The output of NAND gate U6C is normally low and the state of the active high output (pin 9) of the Trace-Retrace flip-flop U4B controls the Trace Current Source through OR gate U2D. If either input to U6C goes low, the high output is coupled through U2D to turn on Q3, shunting the Trace Current Source to ground and stopping the sweep.

The Retrace Current Source may be turned on by H BK STEP to remeasure a portion of the sweep when the Receiver has to change harmonic numbers. When the H BK STEP line goes high, Q2 and Q4 are turned on, and a retrace continues for the duration of the H BK STEP pulse.

The Stop Sweep and Back Step pulses occur simultaneously but have respective durations of 1.2 msec and approximately 70 μs. Thus, integrating capacitor C3 starts to discharge and the retrace continues for 70 μs, after which the Retrace Current Source is turned off. At the end of 1.2 msec, the Trace Current Source is again allowed to continue charging C3, and the trace is resumed.

Integrator/Buffer. The integrating capacitor C3 is connected to the positive input of buffer amplifier U1. When the Trace Current Source is switched on, the capacitor charges, and the input voltage to the buffer amplifier increases at a linear rate. When the Retrace Current Source is switched on, the capacitor discharges through the current source, and the input voltage to the buffer amplifier decreases at a linear rate. When the front-panel SLOW pushbutton is pressed, capacitor A1C1 is connected in parallel with C3, increasing the charge and discharge times of C3 and slowing the sweep time by a factor of 100.

Sweep Limit (G)

The Sweep Limit circuit limits the −0.7V to +10.7V output of the Integrator/Buffer to 0V to +10V. (See the VSWP waveform in Figure 8-10.) This is accomplished with a resistive voltage divider and a transistor array connected as diodes.

Transistors U13B and U13C are wired as diodes. U13C is reverse-biased when the Integrator/Buffer goes more negative than −0.2V. The lower limit of 0V is then set by R32.

U13A is connected as two diodes in parallel to set the upper limit of the voltage range at +10V and to provide temperature compensation. HF potentiometer R24 adjusts the upper voltage limit to +10V.

Internal/External Sweep Select (H)

The Internal/External Sweep Select circuit functions as a switch between internal and external sweeps. During normal (internal sweep) operation, comparator U11D biases Q9 on to couple the internal sweep to the Output Buffer. At the same time, the output of comparator U11C biases Q8 off. When the rear-panel INT−EXT SWEEP switch is grounded, Q9 is biased off, Q8 is biased on, and the internal sweep is inhibited while an external sweep from the rear panel may be coupled to the Output Buffer.

Output Buffer ❶

Buffer U14 receives the 0V to +10V sweep voltage from the Sweep Limit circuit to provide the VSWP voltage. LF adjustment R20 sets the lower limit to VSWP to 0V. Operational amplifier U15 functions as a voltage level shifter to provide a −5V to +5V SWP OUT voltage.

H ALT CH 2, when high, causes Channel 2 information to be displayed. This line changes state on every sweep.

The timing of the signals is shown in Figure 8-10.

When the Trace/Retrace flip-flop U4B in the Sawtooth Generator receives a Retrace trigger, the low at U4B pin 8 is inverted by U8A and the H RETRACE line goes high.

Receiver Control Logic Ⓓ

The Receiver Control Logic circuit synchronizes operation of the RF Source and Receiver sections of the network analyzer by means of the following output signals:

- H RETRACE (retrace)
- H LK REQ EN (phase lock request enable)
- L DSP EN (display enable)
- H FEN (function enable)
- H ALT CH 2 (alternate Channel 2)

H RETRACE, when high, sends a retrace signal to the normalizer via P1-9 and P1-31. (See External Interface, Service Sheet 18.) The H RETRACE line is high when the Sawtooth Generator is in retrace.

H LK REQ EN, when high, sends a phase lock request enable signal to the Phase Lock Control (A14, Service Sheet 11). The line is high when the sawtooth voltage from the Sweep Generator is more negative than +0.2V or when an L SWP INH (sweep inhibit) signal is received from the Sweep Control Logic circuit.

L DSP EN, when low, allows a display (refer to Blanking/Penlift). The line is low when the sawtooth voltage from the Sawtooth Generator is more positive than −0.2V and less positive than +10.2V, and the Sawtooth Generator is in trace.

H FEN, when high, enables lock request and back step in the Phase Lock Control (A14, Service Sheet 11). The line is high when the L DSP EN line is low or when there is an L SWP INH (sweep inhibit) signal from the Sweep Control Logic circuit.

H LK REQ EN sets the Phase Lock Control (A14, Service Sheet 11) for the start of a trace. When the retrace slope of the sawtooth voltage goes more negative than −0.2V (see Figure 8-9), the output of the comparator U3B goes low and U8D pin 11, the H LK REQ EN line, goes high. If L SWP INH (sweep inhibit) from the Sweep Control Logic circuit drives U8D pin 12 low, the H LK REQ EN line goes high.

The H FEN line is high when all inputs to NAND gate U10B are high; that is, when a retrace is not in progress and the trace slope of the sawtooth voltage is less negative than −0.2V but less positive than +10.2V. The H FEN line goes low if these conditions are not met or if one of the following signals is received from the Sweep Control Logic circuit: L MAN, L EXT SWP, or L REM BUF. Figure 8-9 shows the timing of the H FEN signal for both FAST and SLOW sweeps.

The active low output of Channel Select flip-flop U4A (pin 6) is fed back to pin 2, the data input, and the flip-flop is clocked by Retrace pulses from Trace/Retrace flip-flop U4B in the Sawtooth Generator. The H ALT CH 2 line changes states each time a clock pulse is received, causing the sweep to be displayed alternately on Channel 1 and Channel 2 (see Figure 8-9). An L MAN, L EXT SWP, or L REM BUF signal from the Sweep Control Logic circuit clears U4A, and the H ALT CH 2 line is pulled low.

Blanking/Penlift Ⓔ

The Blanking/Penlift circuit generates two functions: H DBP (display blanking pulse) and H PNLFT (penlift). H DBP blanks the CRT display, and H PNLFT causes the Penlift Driver circuit to generate a BLANK/PEN pulse, which may be used to blank an external CRT or to lift the pen of a plotter or recorder.

Display Blanking. (See Figure 8-12.) The CRT display is blanked whenever the H DBP line from the Blanking/Penlift circuit goes high. This occurs under one or more of the following conditions:

- No sweep inhibit signal is received from the Sweep Control Logic circuit (L SWP INH line is high) and no display enable signal is received from the Receiver Control Logic circuit (L DSP EN line is high)
- A backstep signal (H BK STEP) is received from Phase Lock Control (A14, Service Sheet 11).
- A source blank signal (H BLANK) is received from the Motherboard (A20, Service Sheet 21).
- The L SWP INH line, and therefore U9C pin 9, is normally high. During retrace, U9C pin 10 also goes high, coupling a logic high through U12B to the H DBP line, which goes to the Deflection Amplifiers (A18, Service Sheet 16).
- When the trace is backstepped, a high is coupled through U2A and U12B to the H DBP line.
- A high on the H BLANK line from the Motherboard is coupled through U2A and U12B to the H DBP line.

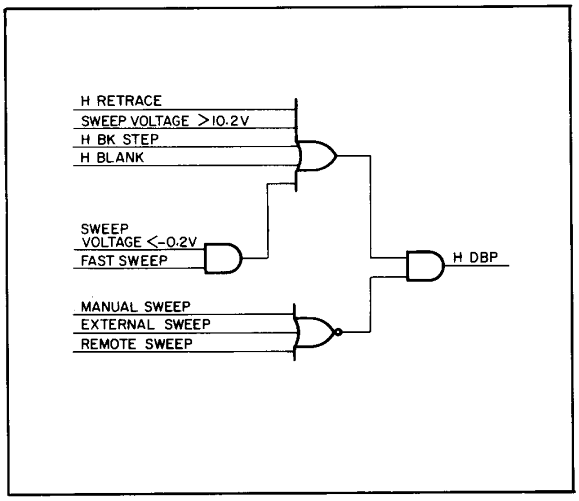


Figure 8-12. Display Blanking Pulse Logic

Penlift. (See the timing diagram, Figure 8-9.) The H PNLFT line to the Penlift Driver circuit is high under one or more of the following conditions, which are illustrated in Figure 8-13:

- The sawtooth voltage from the Sawtooth Generator is more negative than −0.4V
- The sawtooth voltage is more positive than +10.4V.
- A backstep signal (H BK STEP) is received from Phase Lock Control (A14, Service Sheet 11).
- A source blank signal (H BLANK) is received from the Motherboard (A20, Service Sheet 21).
- A retrace signal (L RET) is received from the Sawtooth Generator.
- A penlift request signal (H PNLFTR) is received from the Sweep Control Logic circuit

Penlift Driver (F)

When the H PNLFT line from the Blanking/Penlift circuit goes high, Q6 is turned on and Darlington pair Q7 and Q10 are turned off, deactivating the penlift relay in the plotter or recorder. When H PNLFT goes low, Q6 is turned off and Q7 and Q10 are turned on, grounding the penlift relay and causing the pen to set down.

The collector voltage of about +40V for the Darlington pair is supplied by the plotter or recorder. Diode CR6 turns off to protect the Darlington pair when voltage spikes are produced by the penlift coil of the plotter or recorder.

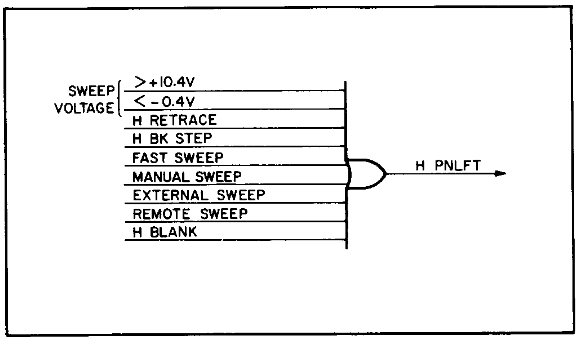


Figure 8-13. Pen Lift Logic

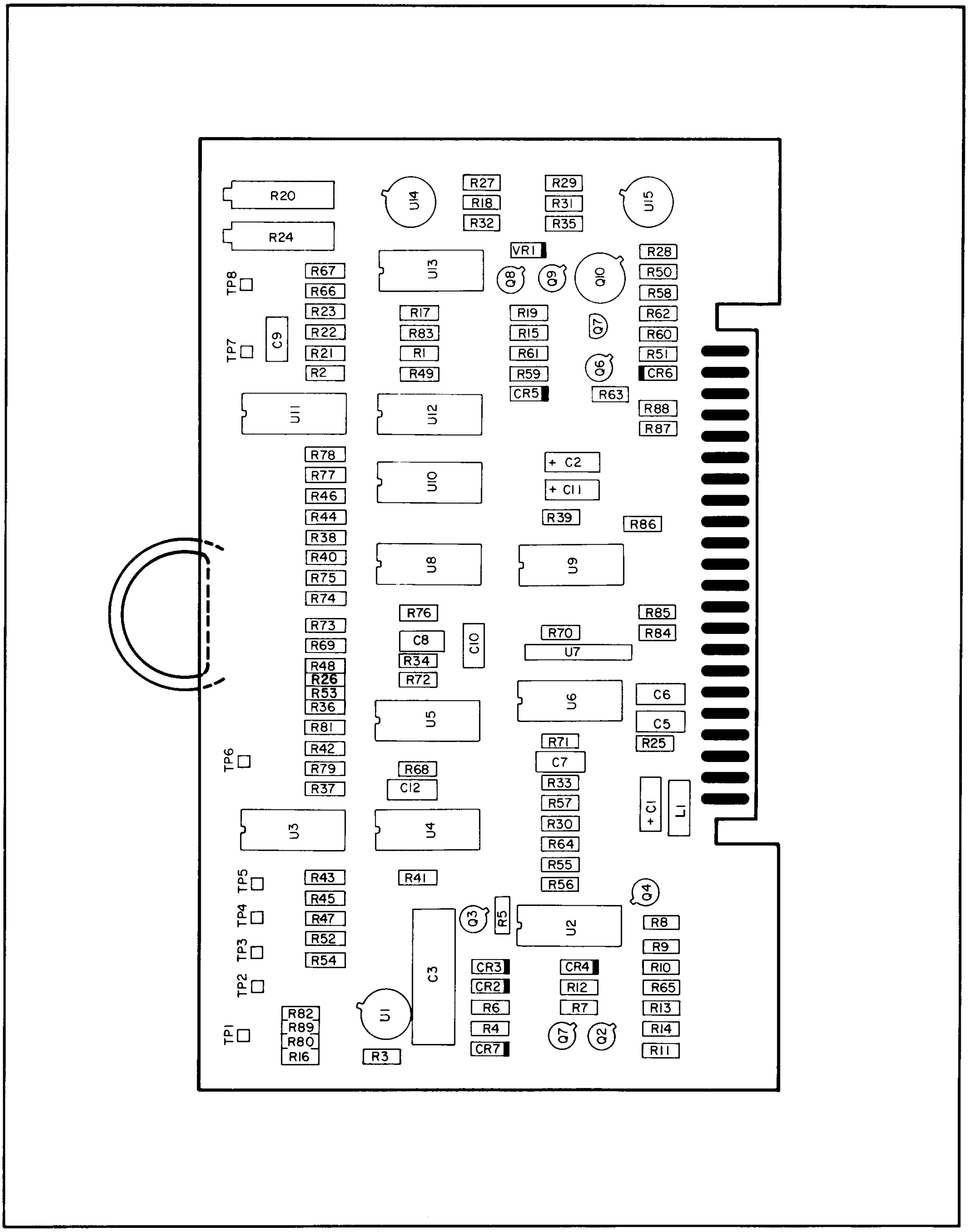
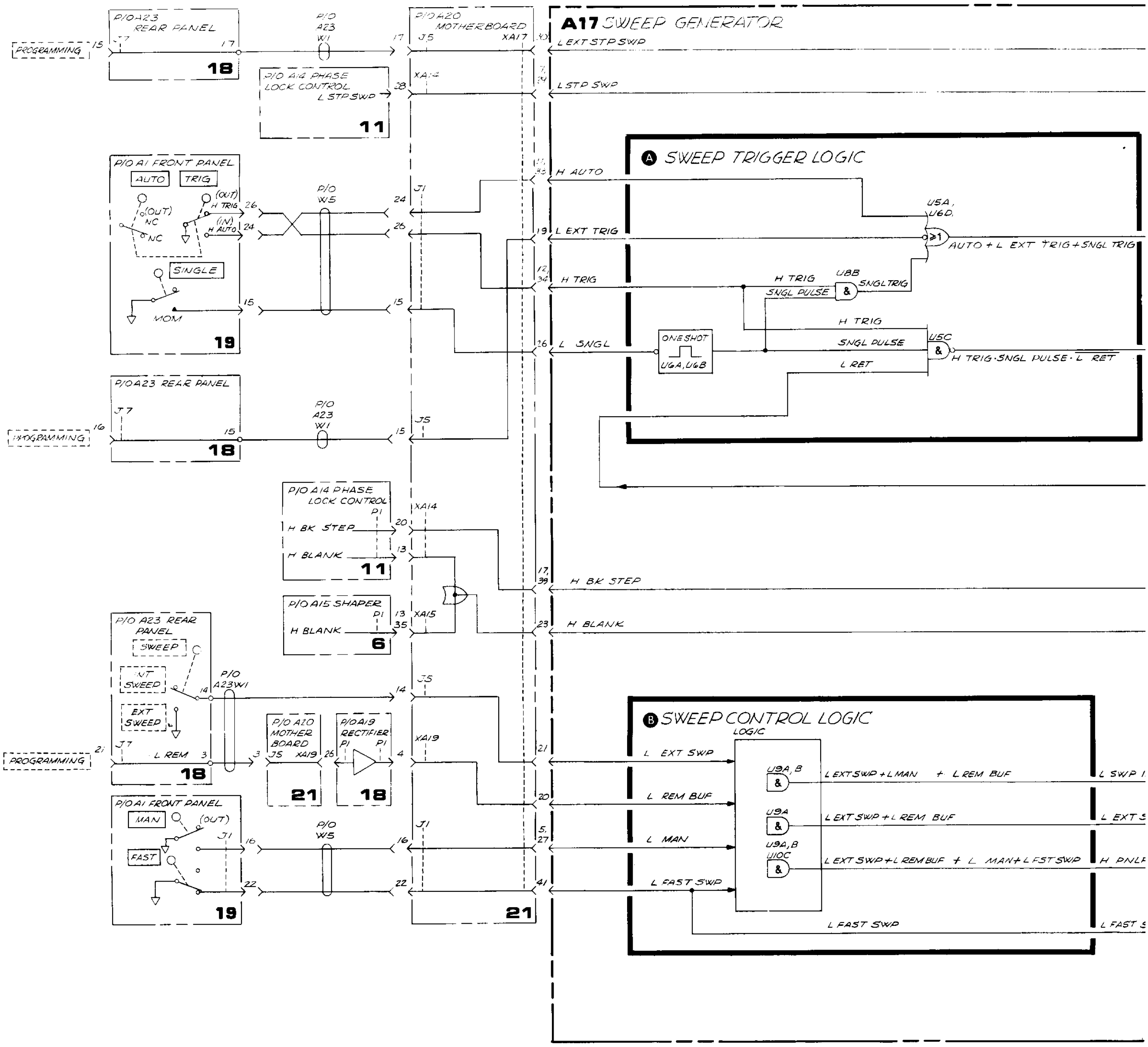
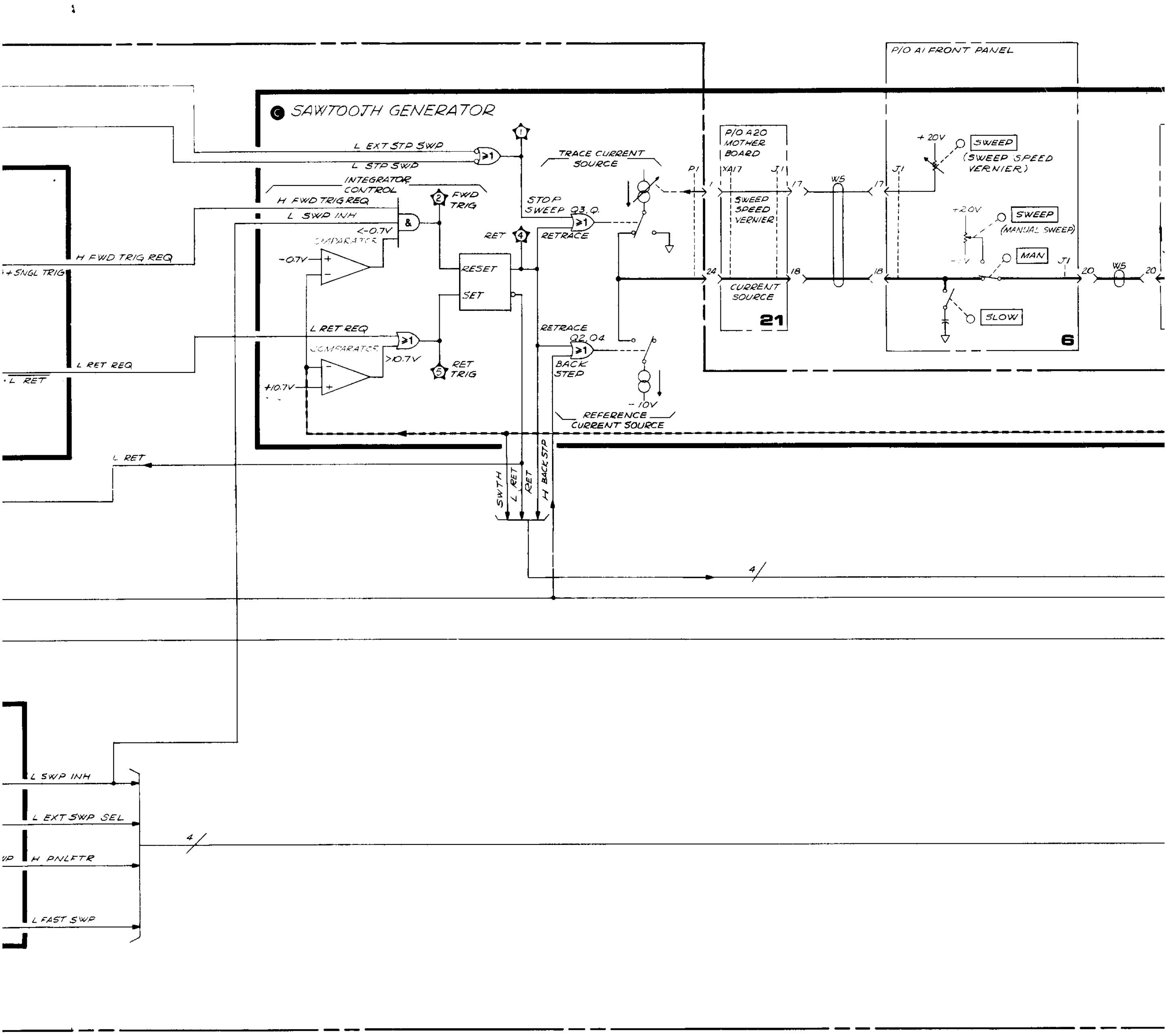
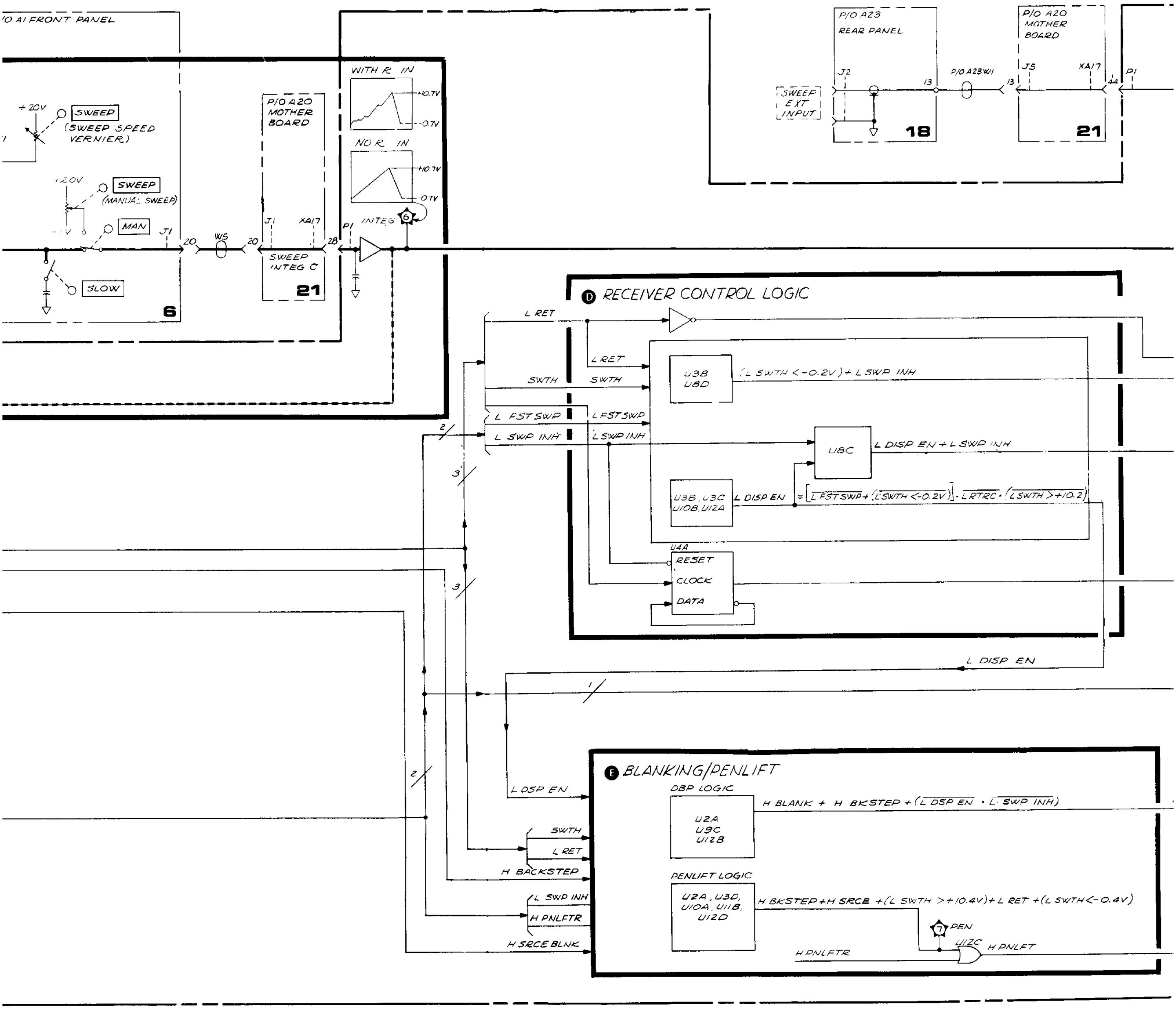


Figure 8-14. Sweep Generator (A17), Component Locations

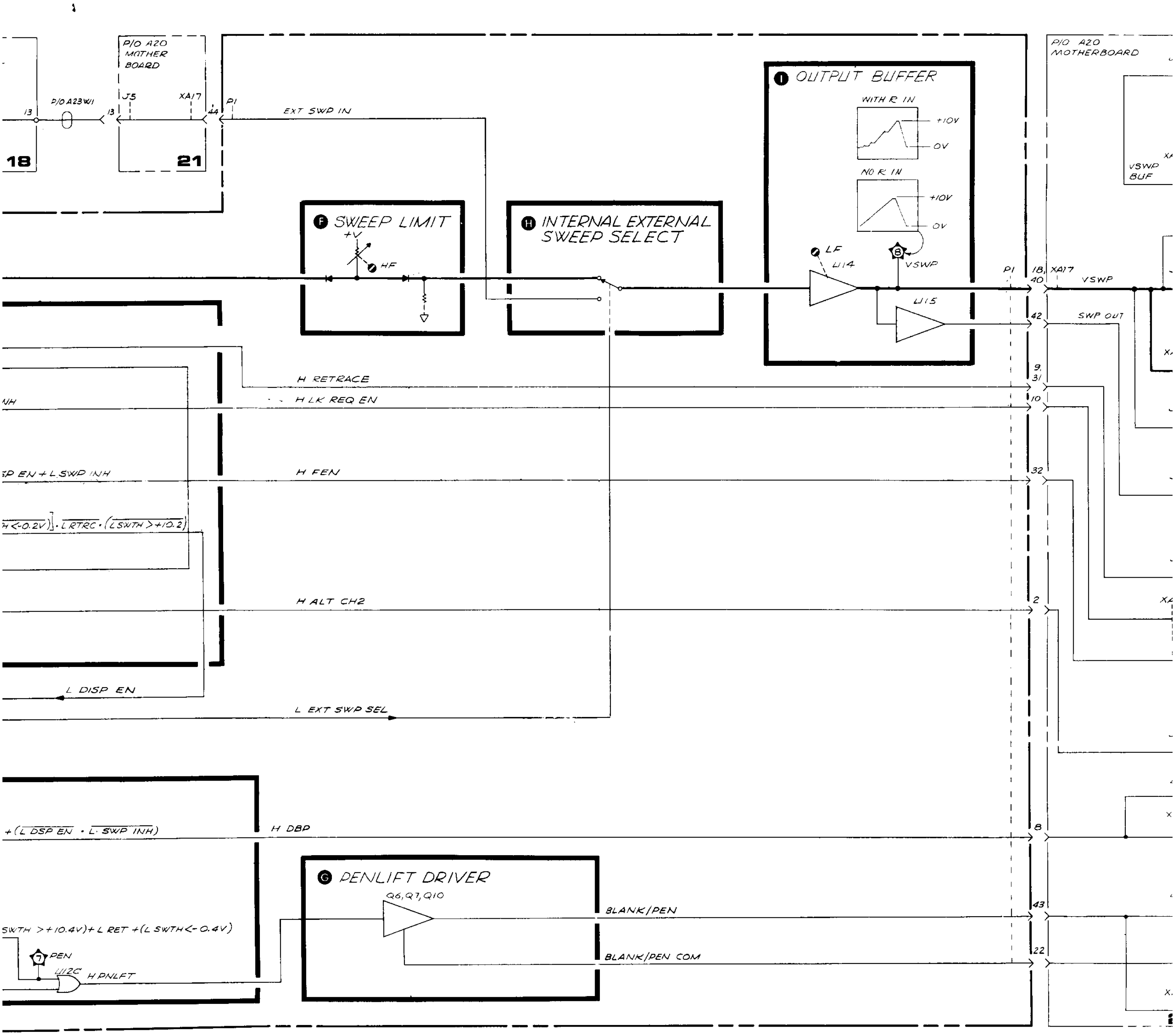

A17 SWEEP GENERATOR
SWEEP TRIGGER LOGIC
SWEEP CONTROL LOGIC
P/O A23 REAR PANEL
P/O A20 MOTHERBOARD
P/O A14 PHASE LOCK CONTROL
P/O A1 FRONT PANEL
P/O A15 SHAPER
P/O A19 RECTIFIER
PROGRAMMING
L EXT STP SWP
L STP SWP
H AUTO
L EXT TRIG
H TRIG
L SNGL
H BK STEP
H BLANK
L EXT SWP
L REM BUF
L MAN
L FAST SWP
AUTO + L EXT TRIG + SNGL TRIG
H TRIG · SNGL PULSE · L RET
ONE SHOT
AUTO
TRIG
SINGLE
MAN
FAST
SWEEP
INT SWEEP
EXT SWEEP



SAWTOOTH GENERATOR
L EXT STP SWP
L STP SWP
≥1
TRACE CURRENT SOURCE
INTEGRATOR CONTROL
H FWD TRIG REQ
L SWP INH
FWD TRIG
&
<-0.7V
COMPARATOR
-0.7V
STOP SWEEP Q3,Q
RET
RETRACE
RESET
SET
L RET REQ
COMPARATOR
>10.7V
+10.7V
RET TRIG
RETRACE Q2,Q4
BACK STEP
-10V
REFERENCE CURRENT SOURCE
H FWD TRIG REQ
+SNGL TRIG
L RET REQ
L RET
L RET
SWTH
L RET
RET
H BACK STP
P/O A20 MOTHER BOARD
XA17
J1
P1
SWEEP SPEED VERNIER
CURRENT SOURCE
21
W5
P/O A1 FRONT PANEL
+20V
SWEEP
(SWEEP SPEED VERNIER)
+20V
SWEEP
(MANUAL SWEEP)
MAN
SLOW
6
L SWP INH
L EXT SWP SEL
H PNLFTR
L FAST SWP



A1 FRONT PANEL
+20V
SWEEP
(SWEEP SPEED VERNIER)
SWEEP
(MANUAL SWEEP)
MAN
SLOW
J1
20
W5
20
6
P/O A20 MOTHER BOARD
J1
XA17
SWEEP INTEG C
21
28
P1
WITH R IN
+10.7V
-0.7V
NO R IN
+10.7V
-0.7V
INTEG
6
P/O A23 REAR PANEL
J2
SWEEP EXT INPUT
13
P/O A23W1
13
18
P/O A20 MOTHER BOARD
J5
XA17
P1
44
21
D RECEIVER CONTROL LOGIC
L RET
L RET
SWTH
SWTH
U3B U8D
(L SWTH < -0.2V) + L SWP INH
L FST SWP
L FST SWP
L SWP INH
L SWP INH
U8C
L DISP EN + L SWP INH
2
3
U3B, U3C U10B, U12A
L DISP EN
= [L FST SWP + (L SWTH < -0.2V)] · L RTRC · (L SWTH > +10.2)
U4A
RESET
CLOCK
DATA
3
L DISP EN
1
2
E BLANKING/PENLIFT
L DSP EN
DBP LOGIC
U2A U9C U12B
H BLANK + H BKSTEP + (L DSP EN · L SWP INH)
SWTH
L RET
H BACKSTEP
PENLIFT LOGIC
L SWP INH
H PNLFTR
U2A, U3D, U10A, U11B, U12D
H BKSTEP + H SRCE + (L SWTH > +10.4V) + L RET + (L SWTH < -0.4V)
7
PEN
H SRCE BLNK
H PNLFTR
U12C
H PNLFT



P/O A20 MOTHER BOARD
P/O A23W1
J5
XA17
P1
EXT SWP IN
18
21
OUTPUT BUFFER
WITH R IN
+10V
0V
NO R IN
SWEEP LIMIT
+V
HF
INTERNAL EXTERNAL SWEEP SELECT
LF
U14
VSWP
U15
P/O A20 MOTHERBOARD
VSWP BUF
SWP OUT
H RETRACE
H LK REQ EN
H FEN
H ALT CH2
L DISP EN
L EXT SWP SEL
H DBP
PENLIFT DRIVER
Q6,Q7,Q10
BLANK/PEN
BLANK/PEN COM
PEN
U12C
H PNLFT

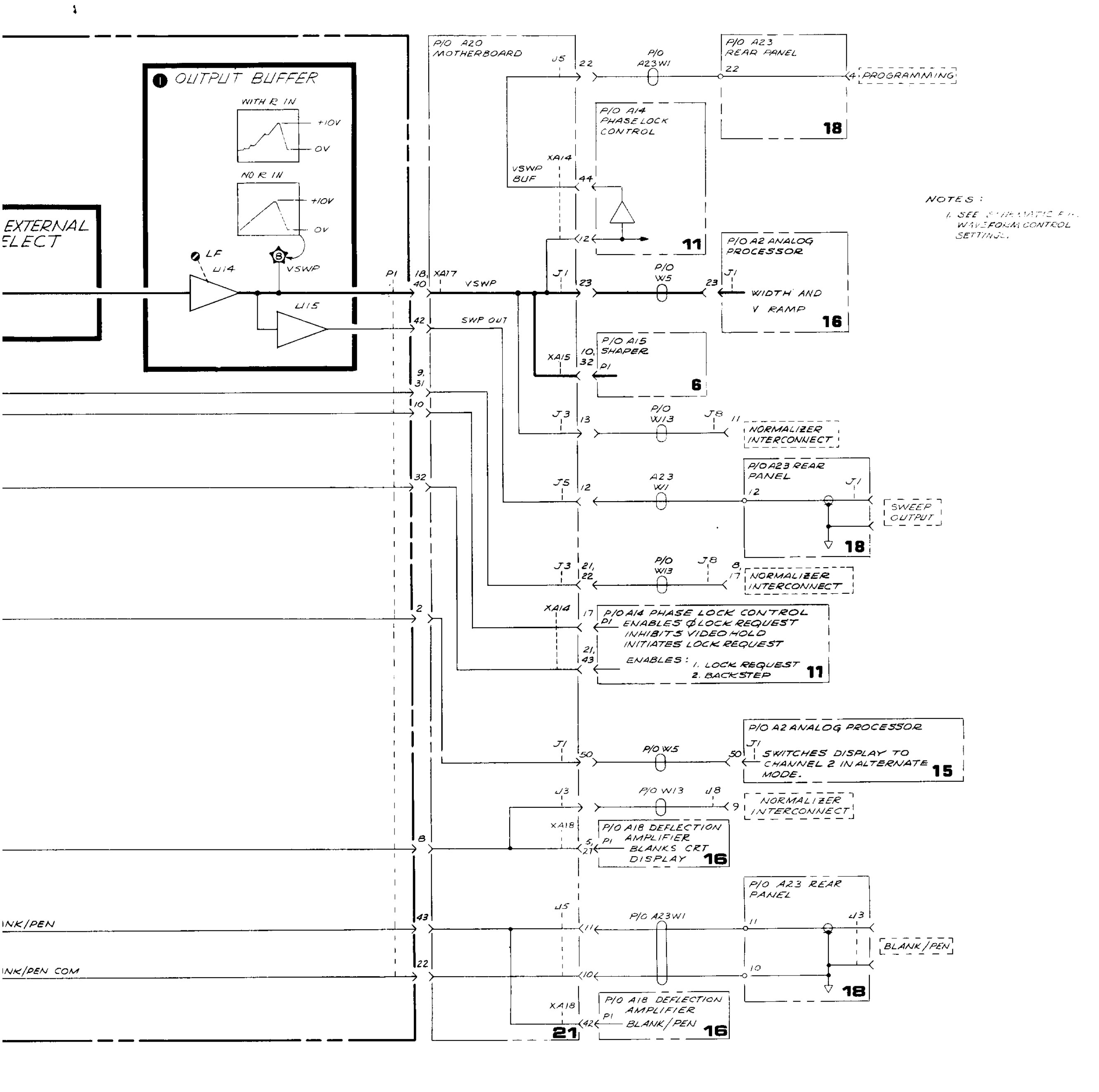
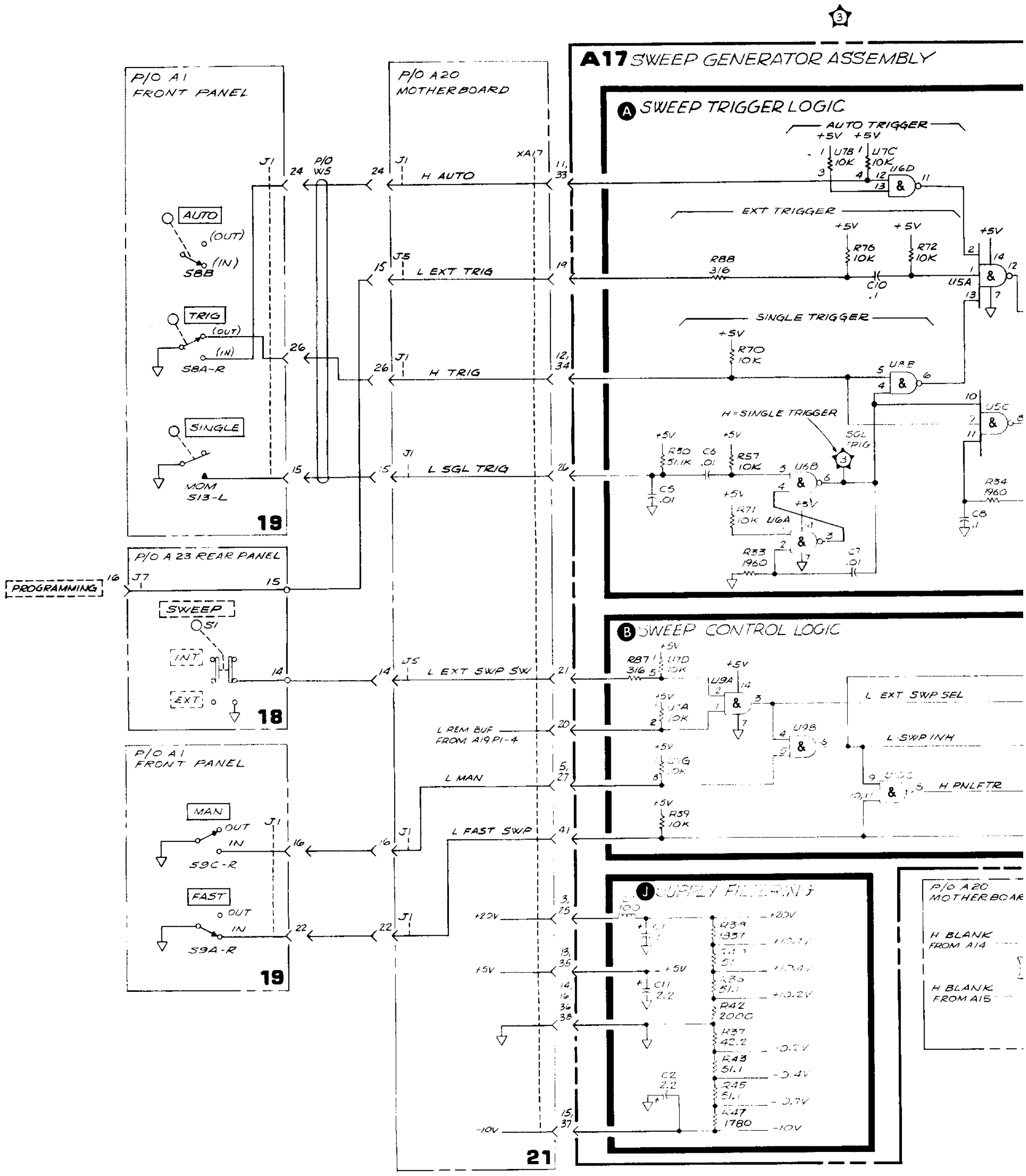


Figure 8-15. Sweep Generator (A17), Block Diagram

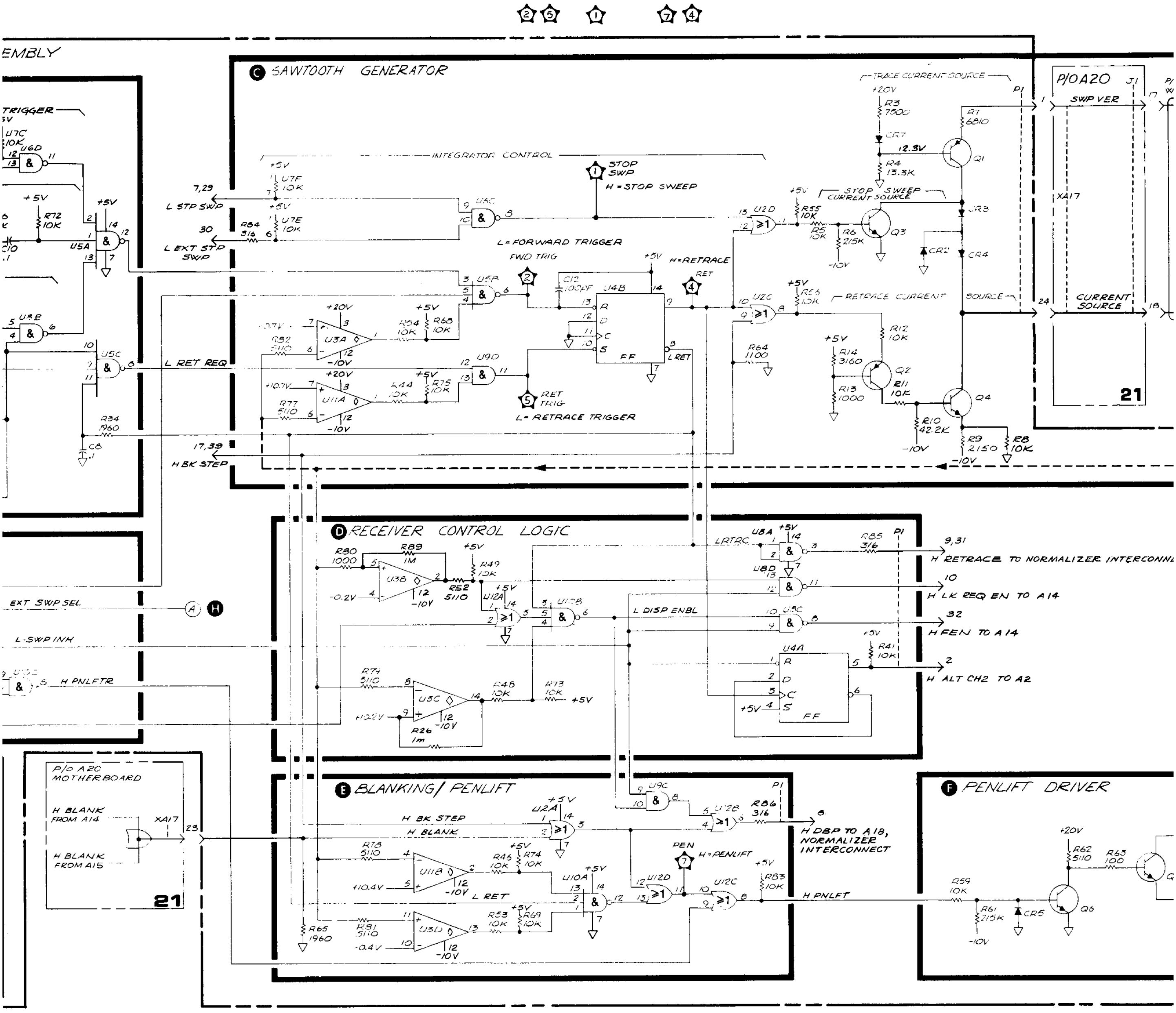
A17 SWEEP GENERATOR

P1

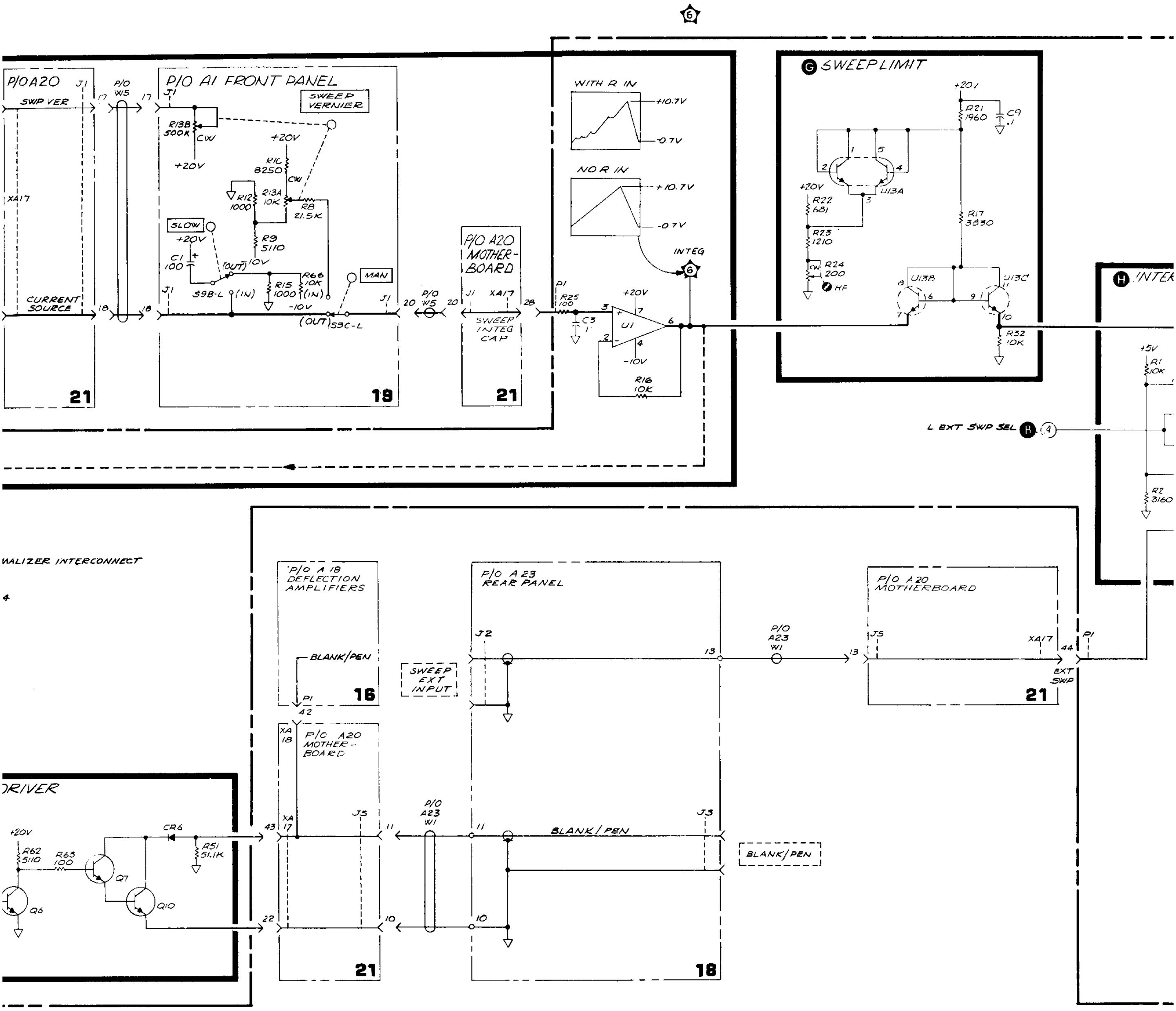
PIN	SIGNAL	TO / FROM	FUNCTION BLOCK
1	SWEEP SPEED VERNIER	A1J1-17	C
23	H BLANK	XA14-13 XA15-13,35	F
2	H ALT CH 2	A2J1-50	[illegible]
24	CURRENT SOURCE	A1J1-18	[illegible]
3	+20V	XA16-3,25	[illegible]
25	+20V	XA16-3,25	J
4	NC		
26	L SNGL	A1J1-15	A
5	L MAN	A1J1-16	B
27	L MAN	A1J1-16	B
6	NC		
28	SWP INTEG C	A1J1-20	C
7	L STP SWP	XA14-28	C
29	L STP SWP	XA14-28	C
8	H DBP	XA18-5,27 U8-9	E
30	L EXT STP SWP	A23J7-15	C
9	H RETRACE	U8-8,17	D
31	H RETRACE	U8-8,17	D
10	H LK REQ EN	XA14-17	D
32	H FEN	XA14-21,43	D
11	H AUTO	A1J1-24	A
33	H AUTO	A1J1-24	A
12	H TRIG	A1J1-26	A
34	H TRIG	A1J1-26	A
13	+5V	U3-OUT	J
35	+5V	U3-OUT	J
14	GND		
36	GND		
15	-10V	XA16-9,31	J
37	-10V	XA16-9,31	J
16	GND		
38	GND		
17	H BK STEP	XA14-20	C
39	H BK STEP	XA14-20	C
18	VSWP	A1J1-23, XA14-12, XA15-10,32	I
40	VSWP	U8-11	I
19	L EXT TRIG	A23J7-16	A
41	L FAST SWP	A1J1-22	B
20	L REM BUF	XA19-4	B
42	SWP OUT	A23J1 A23J7-17	[illegible]
21	L EXT SWP SW	A23S1	B
43	BLANK/PEN	A23J3 XA18-42	F
22	BLANK/PEN COM	A23J3	F
44	EXT SWP IN	A23J3	H



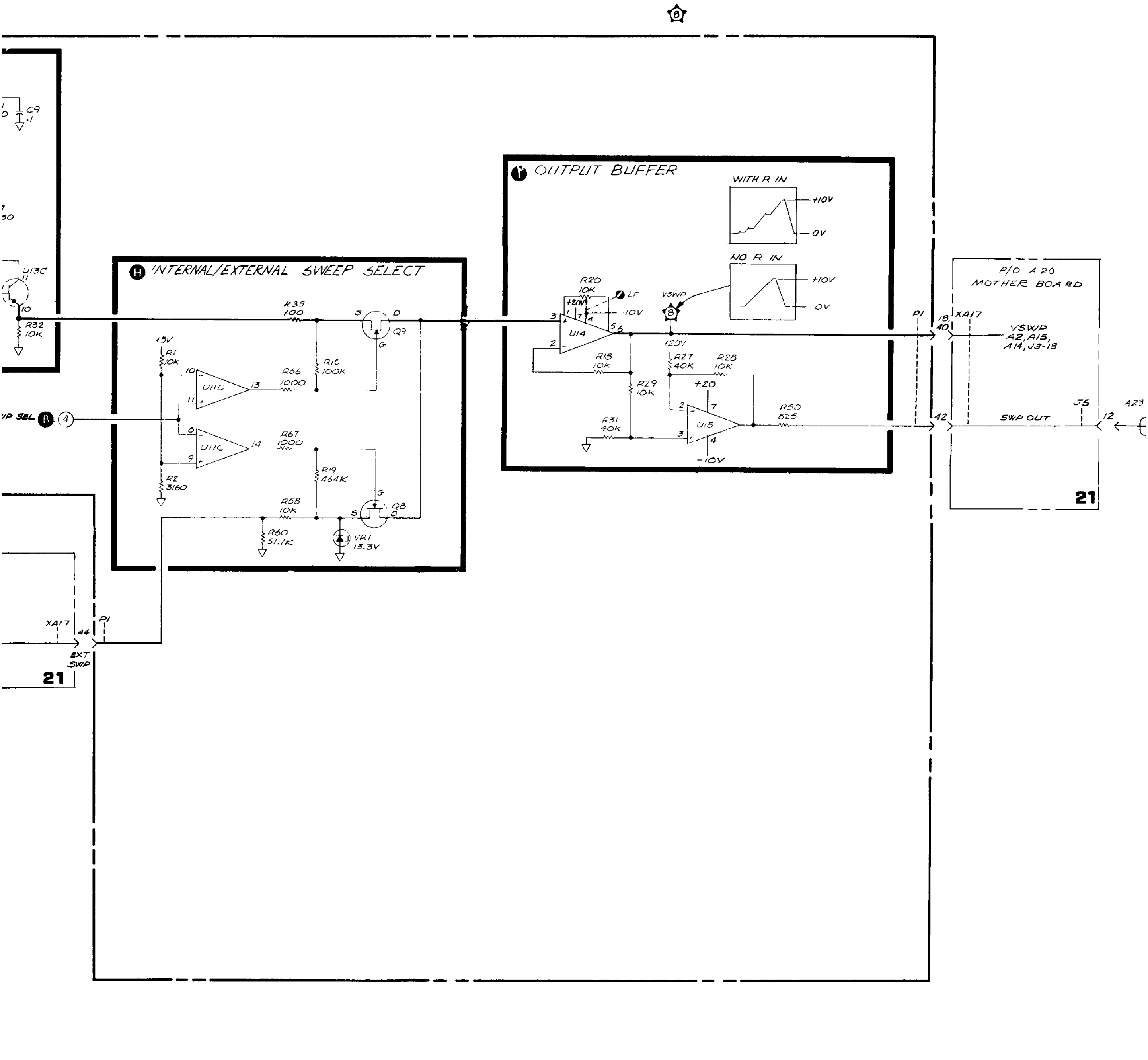
SERIAL PREFIX: 1908A DATE: APRIL 3, 1979



C SAWTOOTH GENERATOR
INTEGRATOR CONTROL
STOP SWP
H = STOP SWEEP
L STP SWP
L EXT STP SWP
L = FORWARD TRIGGER
FWD TRIG
H = RETRACE
RET
L RET REQ
L = RETRACE TRIGGER
RET TRIG
H BK STEP
TRACE CURRENT SOURCE
STOP SWEEP CURRENT SOURCE
RETRACE CURRENT
SOURCE
P/O A20
SWP VER
CURRENT SOURCE
XA17
D RECEIVER CONTROL LOGIC
H RETRACE TO NORMALIZER INTERCONN
H LK REQ EN TO A14
L DISP ENBL
H PEN TO A14
H ALT CH2 TO A2
EXT SWP SEL
L-SWP INH
H PNLFTR
E BLANKING/ PENLIFT
H BK STEP
H BLANK
H = PENLIFT
H DBP TO A18, NORMALIZER INTERCONNECT
H PNLFT
L RET
P/O A20 MOTHERBOARD
H BLANK FROM A14
H BLANK FROM A15
F PENLIFT DRIVER
21

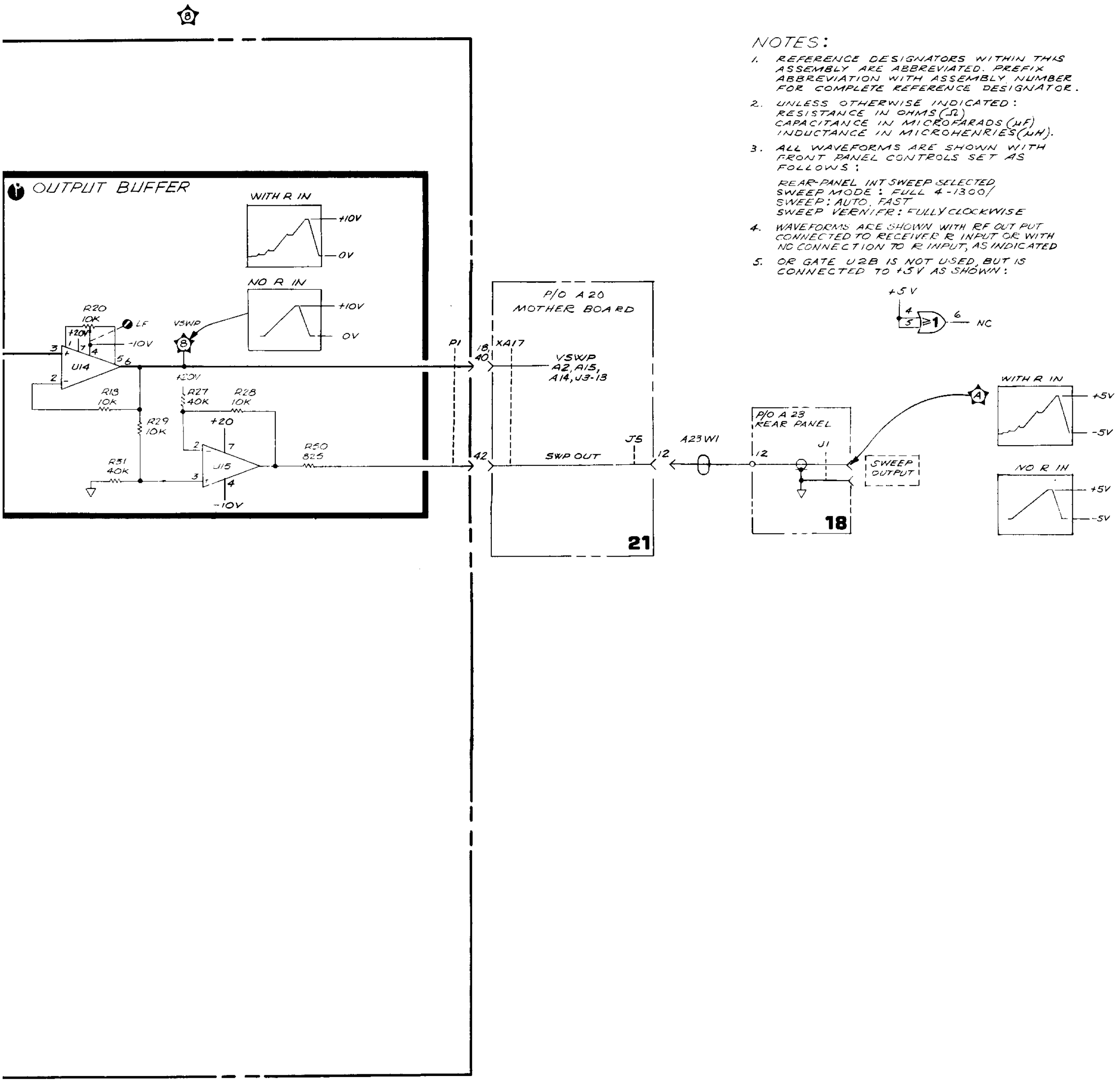


P/O A20
J1
SWP VER
XA17
CURRENT SOURCE
21
P/O W5
P/O A1 FRONT PANEL
SWEEP VERNIER
R13B 500K
CW
+20V
R10 8250
R13A 10K
R12 1000
R8 21.5K
R9 5110
SLOW
C1 100
(OUT)
S9B-L
(IN)
R15 1000
R66 10K
-10V
MAN
S9C-L
19
P/O A20 MOTHER-BOARD
XA17
SWEEP INTEG CAP
WITH R IN
+10.7V
-0.7V
NO R IN
INTEG
R25 100
C3
U1
R16 10K
SWEEP LIMIT
R21 1960
C9
R22 681
R23 1210
R24 200
HF
U13A
U13B
U13C
R17 3830
R32 10K
INTER
+5V
R1 10K
R2 3160
L EXT SWP SEL
ALIZER INTERCONNECT
P/O A18 DEFLECTION AMPLIFIERS
BLANK/PEN
16
P/O A20 MOTHER-BOARD
P/O A23 REAR PANEL
SWEEP EXT INPUT
P/O A23 W1
P/O A20 MOTHERBOARD
EXT SWP
18
DRIVER
R62 5110
R63 100
Q6
Q7
Q10
CR6
R51 51.1K



INTERNAL/EXTERNAL SWEEP SELECT
OUTPUT BUFFER
WITH R IN
+10V
0V
NO R IN
+10V
0V
VSWP
P/O A20
MOTHER BOARD
XA17
VSWP
A2, A15, A14, U3-13
SWP OUT
J5
A23
EXT SWP
21
21

Figure 8-16. S



5
A17

Figure 8-16. Sweep Generator (A17), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 6

FREQUENCY REFERENCE (A15), CIRCUIT DESCRIPTION

The Frequency Reference portion of the Shaper (A15) provides a 0V to +13V FREQ REF signal whose magnitude is directly related to the RF Source frequency in the range 0 to 1300 MHz (100 MHz/volt). The FREQ REF signal is used to:

- tune the RF Source; and
- provide the Receiver with an analog representation of the source frequency, which (1) controls the RF/IF phase lock loop (Service Sheet 11), (2) provides a reference for electrical length compensation in phase measurements, and (3) provides a reference for conversion loss compensation (sampler slope).

The 100 MHz/volt FREQ REF voltage is generated by one of two methods, depending on whether the instrument is in START/CENTER or FULL 4−1300 Sweep Mode. The FREQ REF voltage is derived for these sweep modes as shown in Figure 8-17.

In FULL 4−1300 mode, the sweep ramp from A17 (VSWP) is amplified by A15U8 to create a 0V to +13V ramp. In START/CENTER mode, the sweep ramp (VSWP) is attenuated by the SWEEP WIDTH MHz Control Network, and summed with the dc voltage from the front-panel TUNING control, to create a ramp output from A15U8 with a peak-to-peak amplitude dependent on SWEEP WIDTH MHz, and a dc offset level (start or center voltage) dependent on TUNING.

Start/Center Tune Ⓐ

Voltages from the coarse TUNING potentiometer R1A and FINE potentiometer R1B are summed through A15U2 to generate the TUNE voltage. The TUNE voltage range of 0V to −5.2V corresponds to the tuning range of 0 to 1300 MHz.

Zener diode A15VR1 provides a −6.2V reference voltage that is shared by TUNING potentiometers R1A and R1B. A15U2 is a differential amplifier with R1B output (FINE) connected to the inverting input and R1A output (TUNING) to the non-inverting input. The amplifier gain through the inverting input is about 0.016 to provide fine tuning control.

Sweep Width Control Ⓑ

Sweep Width Control is used only for START or CENTER sweep modes. This circuit scales the amplitude of the sweep ramp applied to the Frequency Reference circuit according to the front-panel SWEEP WIDTH MHz switch setting.

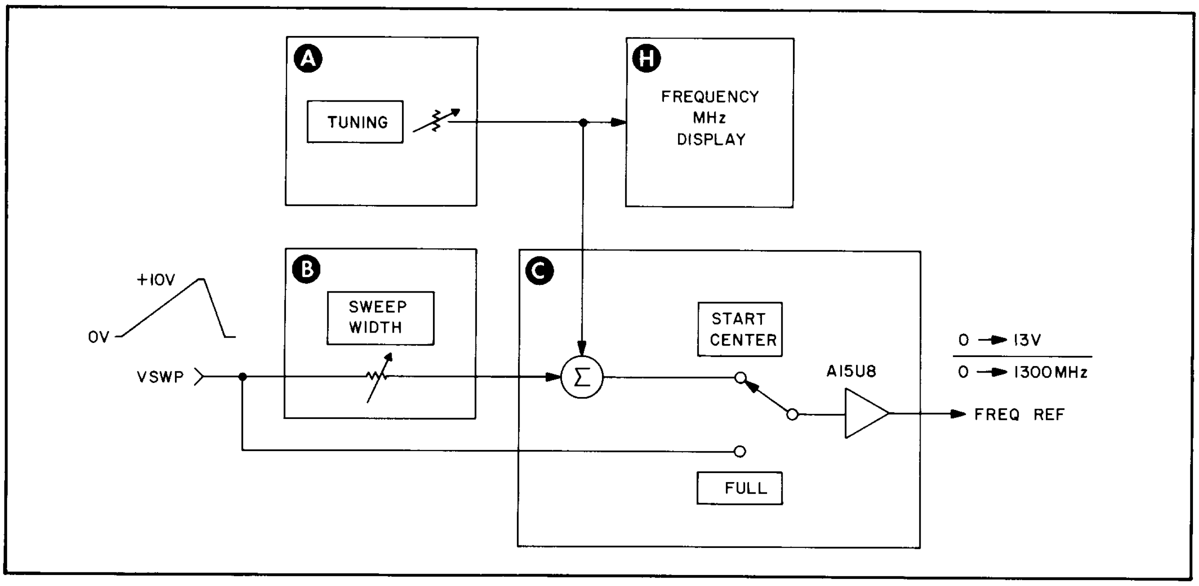


Figure 8-17. Derivation of FREQ REF Voltage.

The sweep ramp (VSWP) from the Sweep Generator (A17, Service Sheet 5) is applied to the inverting input of amplifier A2U12, which has a gain of 0.4 when the SWEEP WIDTH MHz CAL vernier is in the clockwise detent. In START mode, amplifier A2U12 inverts and scales the 0V to + 10V sweep ramp input to obtain a 0V to −4V ramp output. In CENTER mode, an offset current is applied through A2R1 and A2R2 to offset the amplifier output to a +2V to −2V ramp.

The gain of A2U12 is determined by feedback resistors A2R4 and A2R6, in parallel with A2R7 and A1R17 (SWEEP WIDTH MHz CAL). When the SWEEP WIDTH MHz CAL control is in the clockwise detent, potentiometer A2R6 is adjusted for an amplifier gain of 0.4; as the vernier is rotated counterclockwise, the gain decreases to approximately 0.062.

The output of A2U12 is applied to the inverting input of Frequency Reference amplifier A15U8 through series resistors A1R18 – R22. These resistors are switched in or out by the SWEEP WIDTH MHz switch (A1S4). Refer to Table 8-3.

When 0 CW or EXT RF is selected, no sweep ramp is applied to the Frequency Reference amplifier. When EXT RF is selected, A1CR2 overrides the selection of FULL 4 – 1300 sweep mode.

Frequency Reference (C)

Start/Center Mode. In START/CENTER mode, the FREQ REF voltage at A15TP3 is the sum of the dc tuning voltage from TUNING A and the sweep ramp from Sweep Width Control.

A simplified schematic is shown in Figure 8-18. When H FULL is low. A15U9 connects A15U8 as an inverting, virtual-ground summing amplifier.

The dc voltage from TUNING A is summed through A15R7 and A15R8 into A15U8, and is also applied to the Digital Panel Meter (G thru K). When the SWEEP WIDTH MHz switch is set to 0 CW, the tuning voltage is the only input to A15U8. Then, if the front-panel TUNING control is adjusted from 0 to 1300 MHz, the tuning voltage decreases from 0V to −5.2V, causing the FREQ REF voltage (A15TP3) to increase from 0V to +13V.

Table 8-3. Resistor Selection and Output Voltage of SWEEP WIDTH MHz Attenuator

SWEEP WIDTH MHz	SERIES RESISTORS SELECTED	SWEEP WIDTH CONTROL OUTPUT (V_{p-p})	
1K	None (direct connection)	4	XA15-8
500	R18	2	XA15-8
200	R18 + R19	.8	XA15-8
100	R18 + R19 + R20	.4	XA15-8
50	R18 + R19 + R20 + R21	.2	XA15-8
20	R18 + R19 + R20 + R21 + R22	.08	XA15-8
10	None (direct connection)	4	XA15-7
5	R18	2	XA15-7
2	R18 + R19	.8	XA15-7
1	R18 + R19 + R20	.4	XA15-7
0 CW	Open (no connection)	0	
EXT RF	Open (no connection)	0	

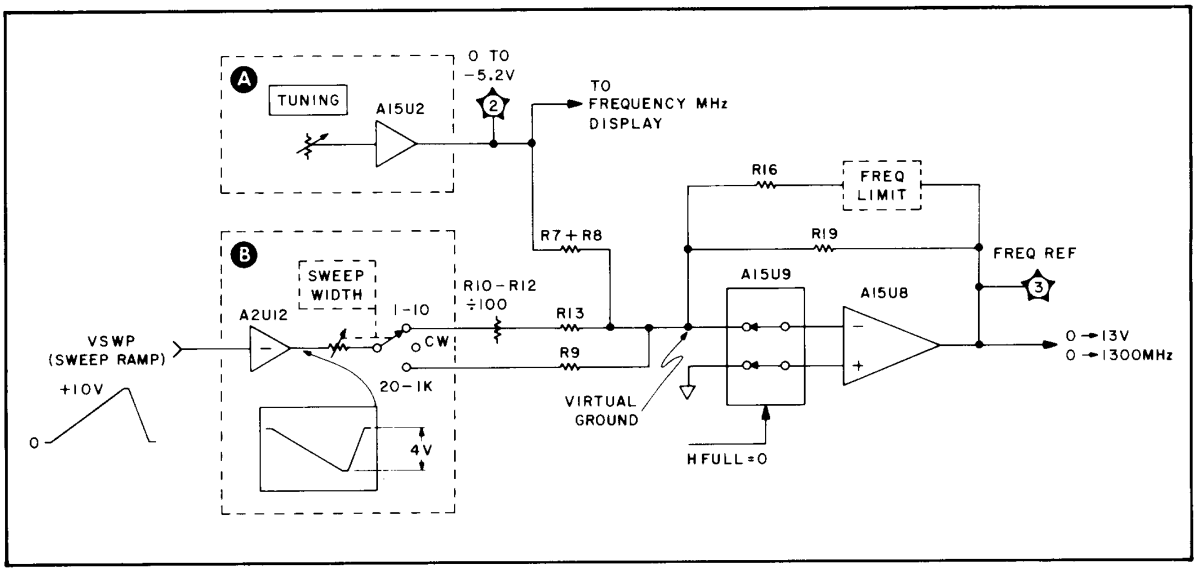


Figure 8-18. Frequency Reference Circuit in START/CENTER Mode, Simplified Schematic

For sweep widths 20 MHz to 1000 MHz, the sweep ramp is summed into A15U8 through A15R9 and the series resistor selected by the SWEEP WIDTH MHz switch. For example, if a 500 MHz sweep width is selected, a 4Vp-p negative-sloped ramp is present at A2TP11. This signal is applied to A15U8 through summing resistors A1R18 and A15R9. The gain of amplifier A15U8 is determined by these summing resistors and feedback resistor A15R19:

Gain = Feedback resistance/Summing resistance

= A15R19/(A1R18 + A15R9)

For a 500 MHz sweep width, this results in an amplifier gain of 1.25:

Gain = 5000/(2000 + 2000) = 1.25

Since A15U8 is an inverting amplifier, this results in a positive sloped 5Vp-p ramp at A15TP3 FR (1.25 X 4Vp-p = 5Vp-p).

For sweep widths from 1 MHz to 10 MHz, the sweep ramp is summed into A15U8 through A15R13, the series resistor selected by the SWEEP WIDTH MHz switch, and a divide by 100 resistive divider (pi attenuator A15R10 − R12). For example, if SWEEP WIDTH MHz is set to 5 MHz, the gain of amplifier A15U8 is calculated as follows:

Gain = A15R19/100 X (A1R18 + A15R13)
= 0.0125

Since A15U8 is an inverting amplifier, this results in a positive slope 0.05Vp-p ramp at A15TP3 FR.

Comparators A15U12C and A15U12B clamp the FREQ REF voltage to a range slightly greater than 0V to +13V. If the voltage at A15U12B pin 12 goes more positive than +13.7V, the output goes positive, diode A15CR4 conducts through A15R16, and a positive current is fed into the negative summing junction at A15U12B pin 12 until the inverting and non-inverting inputs to the comparator are equalized at +13.7V. In the same manner, comparator A15U12C acts with diode A15CR3 to equalize the inputs at −0.2V. Diode A15CR7 allows a faster response time for the clamping action. Resistor A15R18 and capacitor A15C8 stabilize the closed loop.

The comparators also drive the Frequency Limit Blank circuit, to blank the CRT when the FREQ REF voltage is out of limits.

FULL 4 − 1300 Mode. In FULL 4 − 1300 mode, the VSWP sweep ramp is amplified by 1.3 to generate the 0V to +13V FREQ REF signal. A simplified schematic of the Frequency Reference circuit for the FULL 4 − 1300 mode is shown in Figure 8-19.

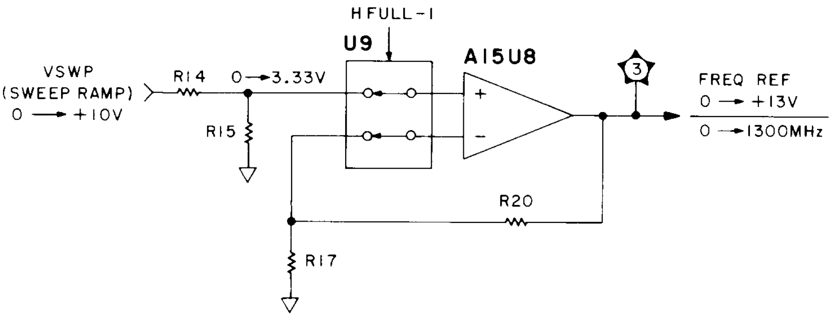


Figure 8-19. Frequency Reference Circuit in Full 4 – 1300 Mode, Simplified Schematic

When H FULL is high (+5V), A15U8 is connected as a non-inverting amplifier. Resistors A15R14 and A15R15 attenuate the VSWP input to a 0V to +3.33V ramp to avoid overloading switch A15U9A. A15U8 then amplifies this ramp by a factor of 3.94 Gain = 1 + (A15R20/A15R17), and the resulting FREQ REF output at A15TP3 FR is a 0V to +13.13V ramp.

Electrical Length Reference (D)

Amplifier A15U1B provides a reference voltage to the front-panel LENGTH controls to compensate for cable length differences when making a phase measurement. This reference voltage is proportional to either the RF OUTPUT frequency or the CRT trace sweep position. Table 8-4 shows the output of A15U1B for all combinations of control inputs.

Table 8-4. Selection of LENGTH REF Output

L EXT RF	H LGTH	A15U1B Output
H	L	FREQ REF (.01V/MHz) From ©
X	L	VSWP (1V/div) From A17
L	H	0 (Ground)

H = High (+5V)
L = Low (0 V)
X = Don't care (high or low)

When H LGTH is low, A15CR31 conducts, causing the output of A15U3A to go low, and turn off Field Effect Transistor (FET) A15Q2. The A15U3B output is high, which turns on FET A15Q3, and applies VSWP as the input to buffer amplifier A15U1B.

When H LGTH is high, the A15U3B output is low, and FET A15Q3 is turned off. If L EXT RF is low, A15CR30 conducts, causing A15U3A output to go low and turn off FET A15Q2. With both A15Q2 and A15Q3 turned off, no signal is applied to buffer amplifier A15U1B. If L EXT RF is high, A15U3A output is high, FET A15Q2 is turned on, and the FREQ REF voltage is applied to the input of buffer amplifier A15U1B.

Frequency Limit Blank (E)

The Frequency Limit Blank circuit blanks the CRT if the FREQ REF voltage is outside the operating range of 0V to +13V. If the non-inverting input to comparator A15U12C in the Frequency Reference circuit is more negative than −0.2V, its low output is inverted through A15U12D to place a positive voltage (limited by A15VR2) on the base of A15Q4, turning it on to pull the H BLANK line high. If the non-inverting input to comparator A15U12D is more positive than +13.7V, a high output is coupled through A15U12A to turn on A15Q4.

The H BLANK output is a WIRED OR line that blanks the CRT display when it is driven high (+5V). H BLANK is driven high by A15Q4 when the FREQ REF voltage is out of limits, or by the Phase Lock Control (A14, Service Sheet 11) when the receiver phase lock loop is reacquiring lock.

Frequency Reference Buffer (F)

The Frequency Reference Buffer circuit provides a buffered FREQ REF voltage to the Receiver through non-inverting amplifier A15U1A. The FREQ REF voltage is used by the Analog Processor (A2, Service Sheet 15) to compensate for input sampler frequency response. It is also used by the Phase Lock Control (A14, Service Sheet 11) to determine and set phase lock loop gain.

Full Marker Generator (G)

The Full Marker Generator circuit functions in the FULL 4 – 1300 mode to generate a marker pulse at the displayed frequency. The TUNE and FREQ REF voltages are summed at the inputs of two open-collector comparators: the non-inverting input of A15U13A and the inverting input of A15U3B. The summing resistors A15R34 and A15R35 adjust the scale factors of the two input voltage ranges. When the voltage at the summing junction is between −0.018V and +0.014V, the outputs of both comparators are high, turning on A15Q5 and pulling the L F MKR line low to generate a marker on the CRT. If the input voltage to the comparators is outside the operating "window," A15Q5 is biased off and the marker pulse is inhibited.

When the instrument is in either START or CENTER mode, A15U9B pin 15 is switched to ground, turning off A15Q5 to disable the Full Marker Generator circuit.

DIGITAL PANEL METER (A2,A22), CIRCUIT DESCRIPTION

The Digital Panel Meter (DPM) is essentially a dc digital voltmeter that measures a tuning voltage from the front-panel TUNING control and converts it to a front-panel frequency readout. The DPM circuitry is located on two printed-circuit boards: The Analog Processor (A2) and the Frequency MHz Display (A22).

The purpose of the DPM is to indicate the start or center frequency of the RF source frequency span or the location of the full band marker frequency.

As shown in Figure 8-20, voltages from coarse TUNING potentiometer R1A and FINE potentiometer R1B are summed through A15U2 to generate the TUNE voltage. TUNE is in turn summed with the voltage from the SWEEP WIDTH MHz switch A1S4 to provide the FREQ REF voltage. The FREQ REF voltage range of 0V to +13.0V corresponds to the frequency range 0 to 1300 MHz.

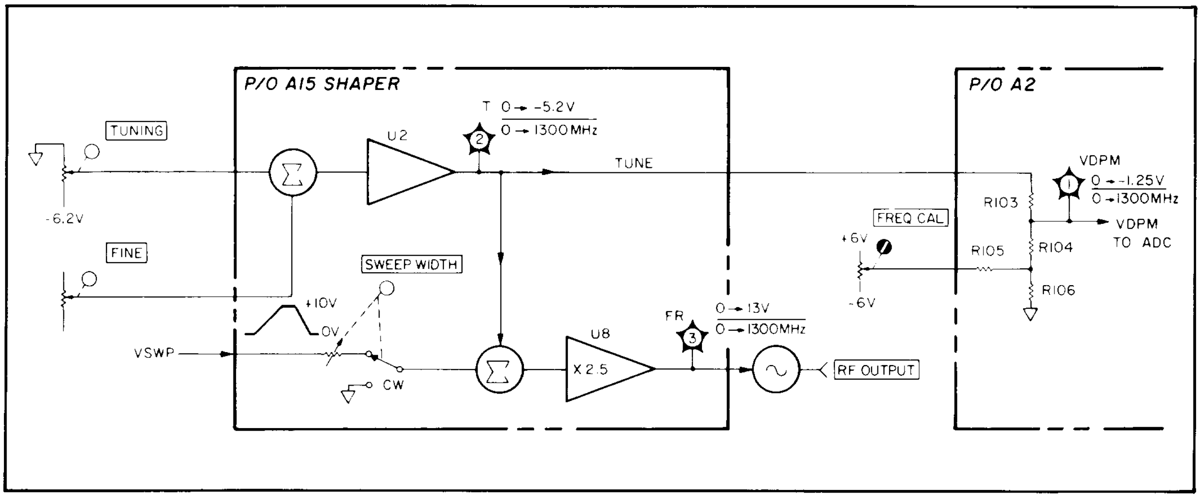


Figure 8-20. Tuning Voltage from A15 Shaper, Simplified Schematic

TUNE also goes to the DPM circuit, where it is attenuated by A2R103 and A2R64 and is summed with the output of FREQ CAL potentiometer A1R57 through A2R105 and A2R106. Adjustment of the FREQ CAL potentiometer compensates the DPM display for drift of the RF Source (A7). The TUNE voltage, after attenuation and correction, becomes the VDPM input to the ADC.

The DPM is divided into two sections. The Analog-to-Digital Converter (ADC) consists of A2U1 and associated circuitry. The Display Section consists of BCD-to-Seven-Segment Decoder/Driver A2U3, Digit Driver A2U2, and numeric displays A22U1 through A22U4.

Analog-to-Digital Converter (H)

A2U1 with its associated circuitry forms a dual-ramp, 3-1/2-digit Analog-to-Digital Converter (ADC) that converts an analog input voltage to a corresponding 8-4-2-1 BCD output once each measurement (conversion) cycle. The device contains CMOS digital logic providing counters, latches, and multiplexing circuitry as well as CMOS analog circuitry that provides the operational amplifiers and comparators required for a complete ADC.

During each measurement cycle, the offset voltages of the internal amplifiers and comparators are compensated for by the internal circuitry of A2U1.

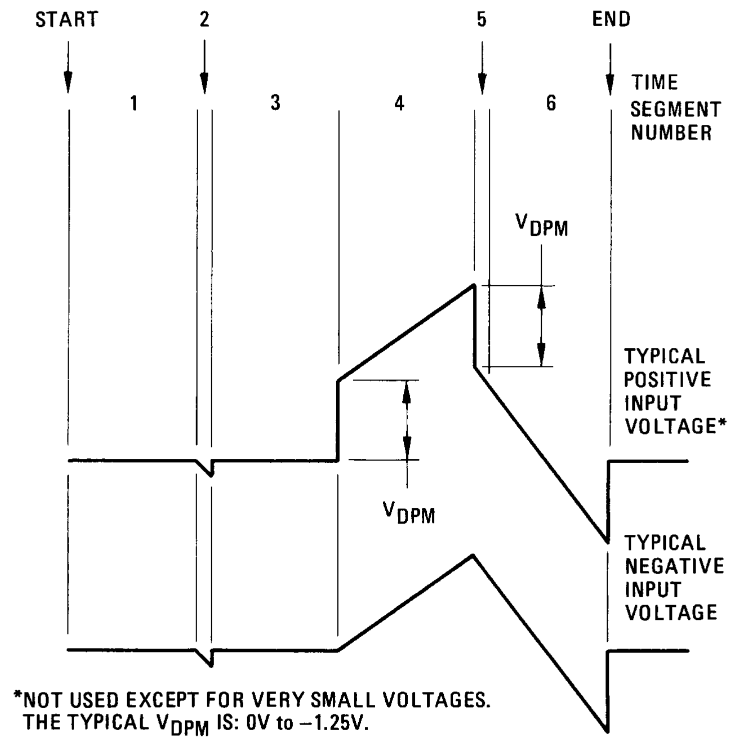


Figure 8-21. Integrator Waveforms

Clock. A2U1 has an internal clock whose frequency is set by A2R107 at about 66 kHz.

Measurement Cycle. The ADC A2U1 performs a ratiometric conversion; that is, the unknown input voltage V_{DPM} is measured as a ratio of the reference voltage V_{REF}. For a V_{DPM} of −1.25V, which corresponds to 1300 MHz, V_{REF} is 1.92V. The reference voltage is adjusted by MTR CAL potentiometer A2R119.

The reference input A2U1 pin 2 also functions as a reset for the ADC. When pin 2 is switched to V_{EE}, the system is reset by internal circuitry to the beginning of a measurement cycle.

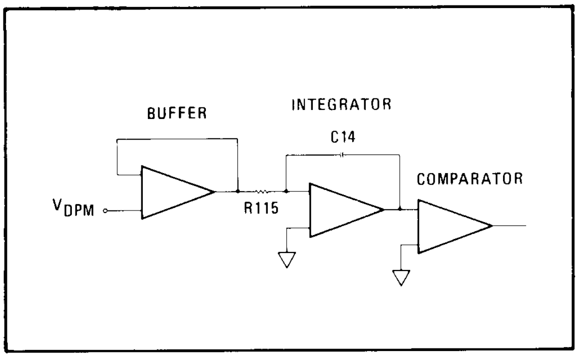


Figure 8-22. Equivalent Analog Circuitry Segment 4.

The entire measurement cycle requires slightly more than 16,000 clock periods (approximately 250 ms). Figure 8-21 shows the integrator waveforms at A2U1 pin 6 for typical positive and negative input voltages, with the cycle divided into six segments as described below.

Segment 1—Offset capacitor A2C11, which compensates for the input offset voltages of the buffer and integrator amplifiers, is charged during this period, and integrator capacitor A2C14 is shorted. This segment requires 4000 clock periods.

Segment 2—The Integrator output decreases to the comparator threshold voltage. At this time a number of counts equivalent to the input offset voltage of the comparator is stored in the offset latches for later use in the auto-zero process. The time for this segment is variable, but less than 800 clock periods.

Segment 3—This segment of the conversion cycle is identical to Segment 1.

Segment 4—This segment is an up-going ramp cycle with the input voltage V_{DPM} as the input to the integrator. Figure 8-22 shows the equivalent configuration of the analog circuitry of A2U1. The actual configuration depends on the polarity of the input voltage during the previous conversion cycle.

Segment 5—This segment is a down-going ramp period with the reference voltage V_{REF} as the input to the integrator. Segment 5 of the conversion cycle has a time equal to the number of counts stored in the offset storage latches during Segment 2. As a result, the system zeroes automatically.

Segment 6—This is an extension of Segment 5. The time period for this portion is 4000 clock periods. The results of the conversion cycle are determined in this portion.

End of Conversion. The end-of-conversion (EOC) output at A2U1 pin 14 produces a pulse at the end of each measurement cycle. The pulse width is one-half the period of the system clock, or 7.6 μs.

Display Update. If a positive edge is received at A2U1 pin 9 prior to the ramp-down cycle, new data will be strobed into the output latches during that conversion cycle. Since pin 9 is wired to the EOC output (pin 14), every conversion is displayed.

Digit Select. The digit select outputs of A2U1 are DS4 through DS1, pins 16 through 19. Each digit select output goes high as the correspondigg digit is selected. The most significant digit (the half digit) is turned on immediately after the EOC pulse, followed by the remaining digits in the sequence from the most significant digit (MSD) to the least significant digit (LSD); that is, DS1, DS2, DS3, DS4. A blanking time between digits of two clock periods is included to ensure that the BCD data has settled. Relative timing among digit select outputs and EOC signals is shown in Figure 8-23.

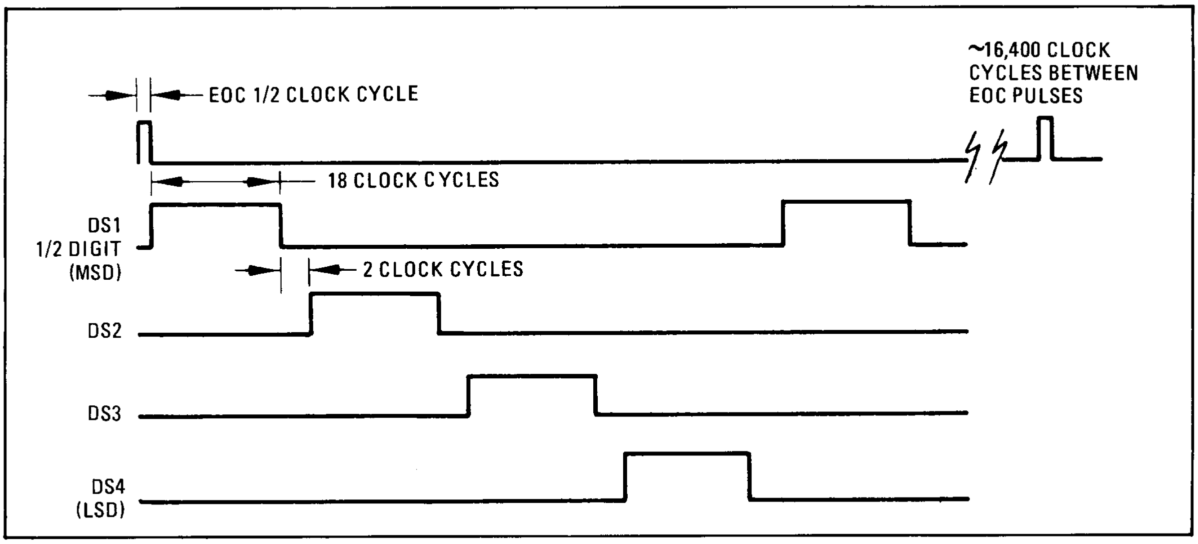


Figure 8-23. Digit Select Timing Diagram

BCD Data Outputs. The multiplexed BCD data outputs of A2U1 are Y_3, Y_2, Y_1, and Y_0. During the digit-select times DS2 through DS4, the numeric displays A22U2 through A22U4 display the full digits 0 through 9. The most significant digit is displayed on A22U1 during digit-select time DS1. However, only segments b, c, and g of that numeric display are connected, so A22U1 can display only a "1", a minus sign, or a blank. Note that segment g is not lighted by any decoded state of A2U4.

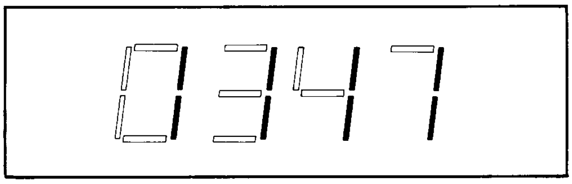


Figure 8-24 shows the pin connections to A2U3, the seven segments of a numeric display, and a truth table. The Latch Enable (HLE), pin 5, is wired to ground (logic low). The Blanking Input (LBI), pin 4, and the Lamp Test (LLT), pin 3, are always at logic high. A2TP2 (LT) may be grounded to test the numeric displays by lighting all seven segments of A22U2 through A22U4 and segments b and c (the numeral 1) of A22U1. The Lamp Test does not test the minus sign, segment g.

The minus sign is displayed on A22U1 only when V_{DPM} is positive, since the voltages corresponding to 0 through 1300 MHz are all negtive. When V DPM is positive, a logic high at Y_2 is applied through emitter-follower A2Q1 to A22U1 pin 3, which is the anode of segment g, and the minus sign is lit.

Display Section

The Display Section includes BCD-to-Seven-Segment Decoder/Driver A2U3, resistor package A2U4, Digit Driver A2U2, and numeric displays A22U1 through A22U4.

Segment Driver. I At the end of the measurement cycle, the BCD data in outputs Y_0 through Y_3 of A2U1 is transmitted to Decoder/Driver A2U3 as data inputs D_0 through D_3. The decoded outputs, A2U3 pins 9 through 15, are connected to the appropriate segment anodes to display the decoded numbers in numeric displays A22U1 through A22U4.

Digit Driver. J Digit Driver A2U2 is a Darlington transistor array that comprises seven Darlington pairs. (Each Darlington pair is shown as an inverter on the schematic, but a schematic of the actual configuration is shown in the schematic notes.)

The digits are selected in sequence, starting with the most significant digit (displayed on A22U1). A logic high on a digit-select output of A2U1 (DS1 through DS4) is inverted through A2U2 to place a low on the segment cathodes, pin 1 or pin 6, of the corresponding numeric display A22U1 through A22U4. (Pins 1 and 6 are connected internally; the schematic indicates the external connections.) Since the displays are of the common-cathode type, and the segment anodes corresponding to the decoded numbers receive logic highs from A2U3, the LEDs are lit to display the frequency corresponding to V_{DPM}.

Frequency MHz Display. (K) The Frequency MHz Display readout consists of four 7-segment numeric displays, A22U2 through A22U4. A22U1, the most significant digit (MSD), is connected to display only the numeral 1 or the minus sign (which is lit when V_{DPM} goes positive). "Negative" frequencies near zero are displayed to allow calibration of the frequency readout.

Figure 8-25 relates the decoded states of Y_0 through Y_3 to the FREQUENCY MHz readout for Digit Select Times DS1 through DS4. Note that Y_0 through Y_2 might be either high or low during DS1 since the decoded states 0, 3, 4, and 7 are all displayed as "1," as explained in the discussion of MSD codes.

MSD Codes. Only three segments of the MSD display A22U1 are connected. The anodes of segments b and c (the numeral 1) are driven by AU3, while segment g (the minus sign) is driven by A2Q1.

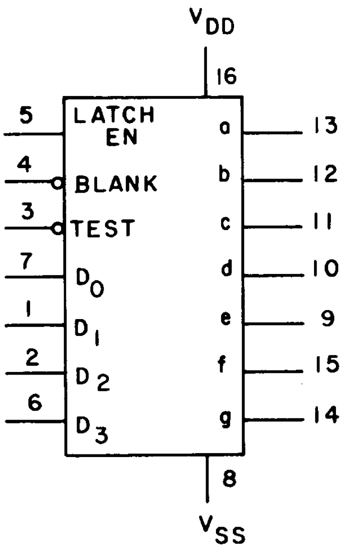
Only three segments of A22U1 are connected because of the limited logic in the Analog-to-Digital Converter, A2U1. As a result, four decoded outputs of Segment Driver A2U3 cause A22U1 to blank, and four decoded outputs cause A22U1 to display the numeral 1.

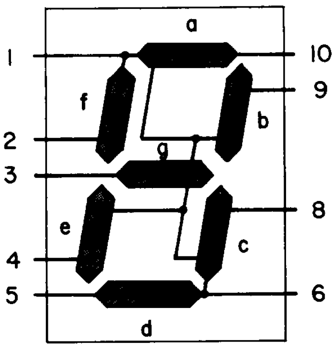
During digit-select time DS1 (Figure 8-23), when A22U1 is driven, outputs Y_3 through Y_0 of ADC A2U1 might be decoded as any one of eight states. The following states cause A22U1 to be blanked:

Y_3	Y_2	Y_1	Y_0	Decoded State	A22U1 Display
1	0	1	0	10	Blank
1	0	1	1	11	Blank
1	1	1	0	14	Blank
1	1	1	1	15	Blank

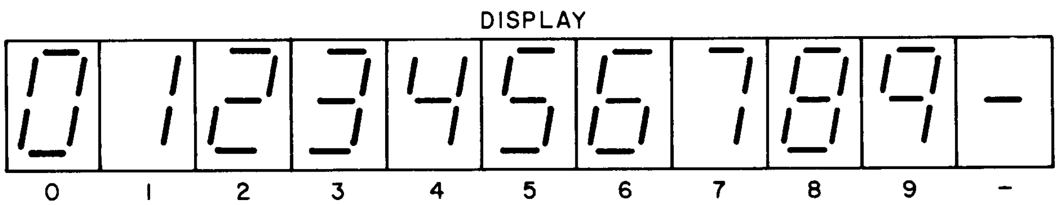
Since only segments b and c of A22U1 are connected, the decoded states 0, 3, 4, and 7 all appear as 1 as shown in Figure 8-23:

Y_3	Y_2	Y_1	Y_0	Decoded State	A22U1 Display
0	0	0	0	0	1
0	0	1	1	3	1
0	1	0	0	4	1
0	1	1	1	7	1





DISPLAY



TRUTH TABLE

Inputs				Outputs							
D_3	D_2	D_1	D_0	a	b	c	d	e	f	g	Display
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	0	0	1	1	9
1	0	1	0	0	0	0	0	0	0	0	Blank
1	0	1	1	0	0	0	0	0	0	0	Blank
1	1	0	0	0	0	0	0	0	0	0	Blank
1	1	0	1	0	0	0	0	0	0	0	Blank
1	1	1	0	0	0	0	0	0	0	0	Blank
1	1	1	1	0	0	0	0	0	0	0	Blank

Figure 8-24. Segment Driver

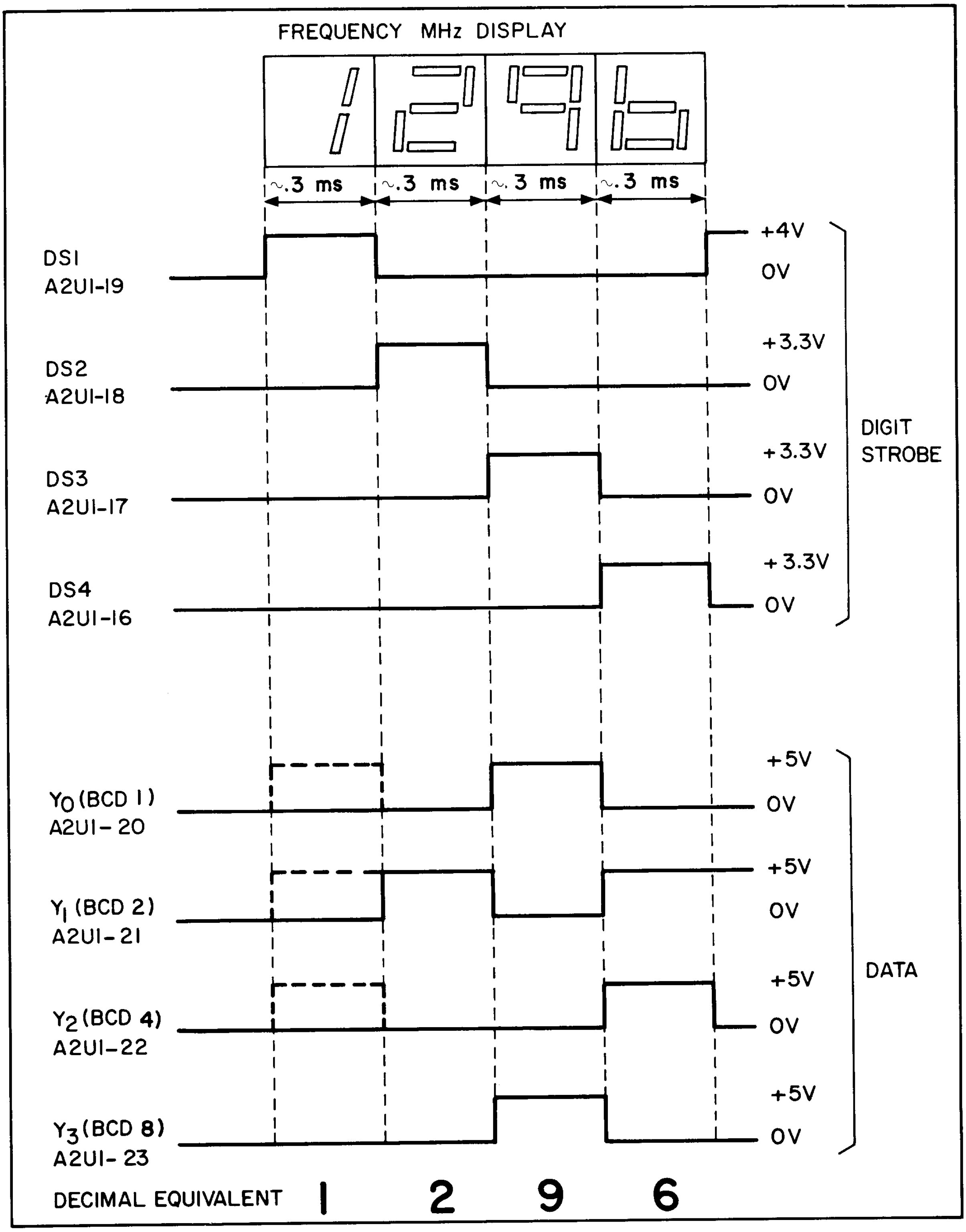


Figure 8-25. FREQUENCY MHz Display Timing

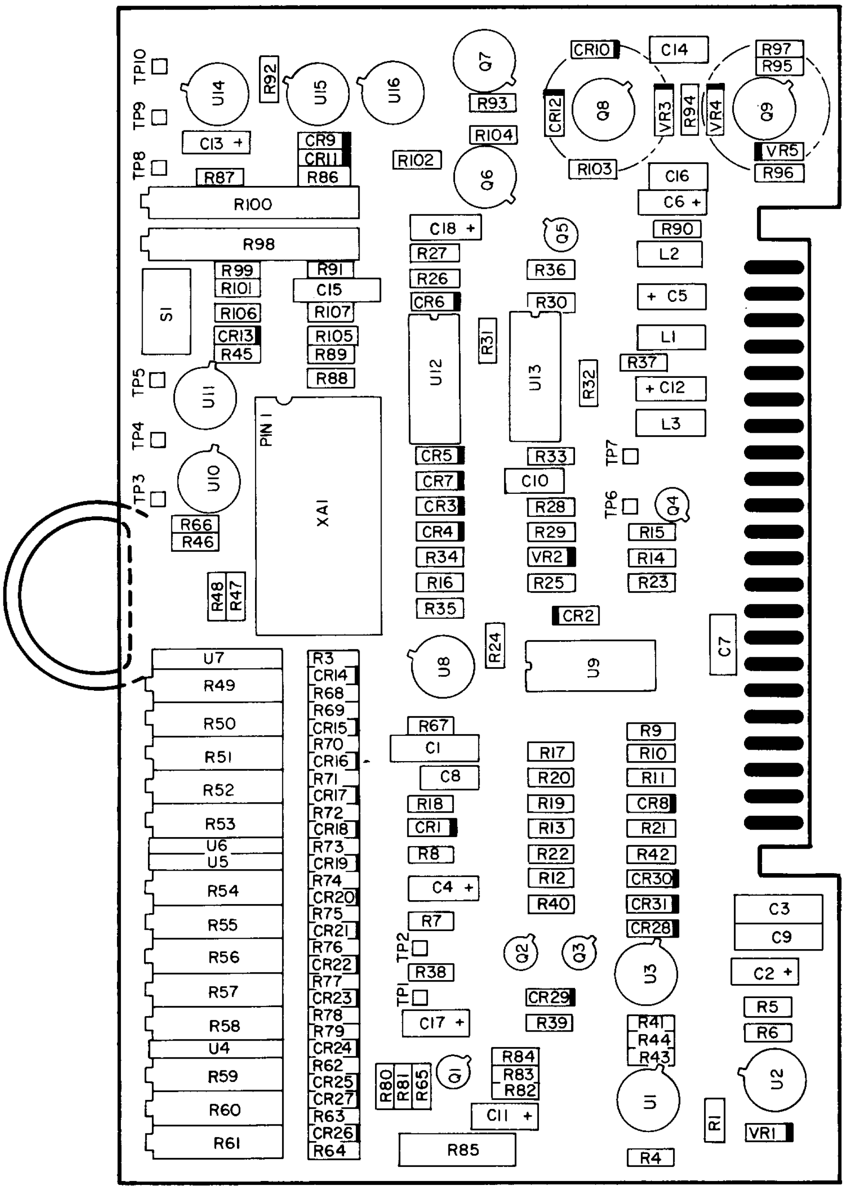


Figure 8-26. Frequency Reference (A15), Component Locations

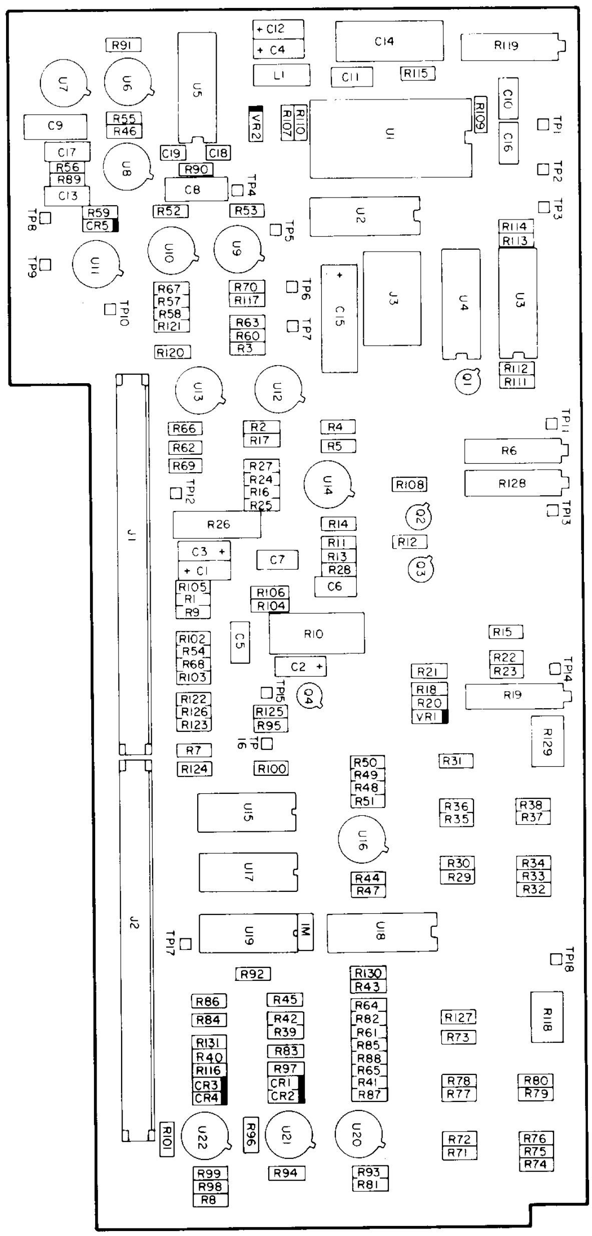


Figure 8-27. Analog Processor (A2), Component Locations

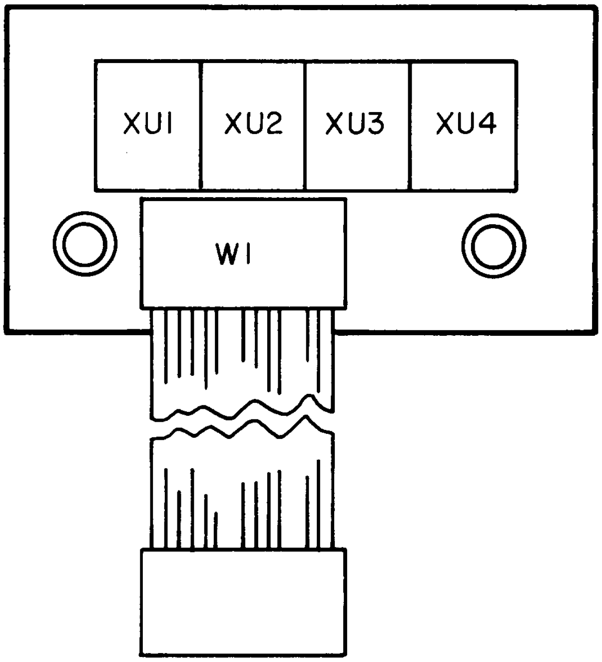
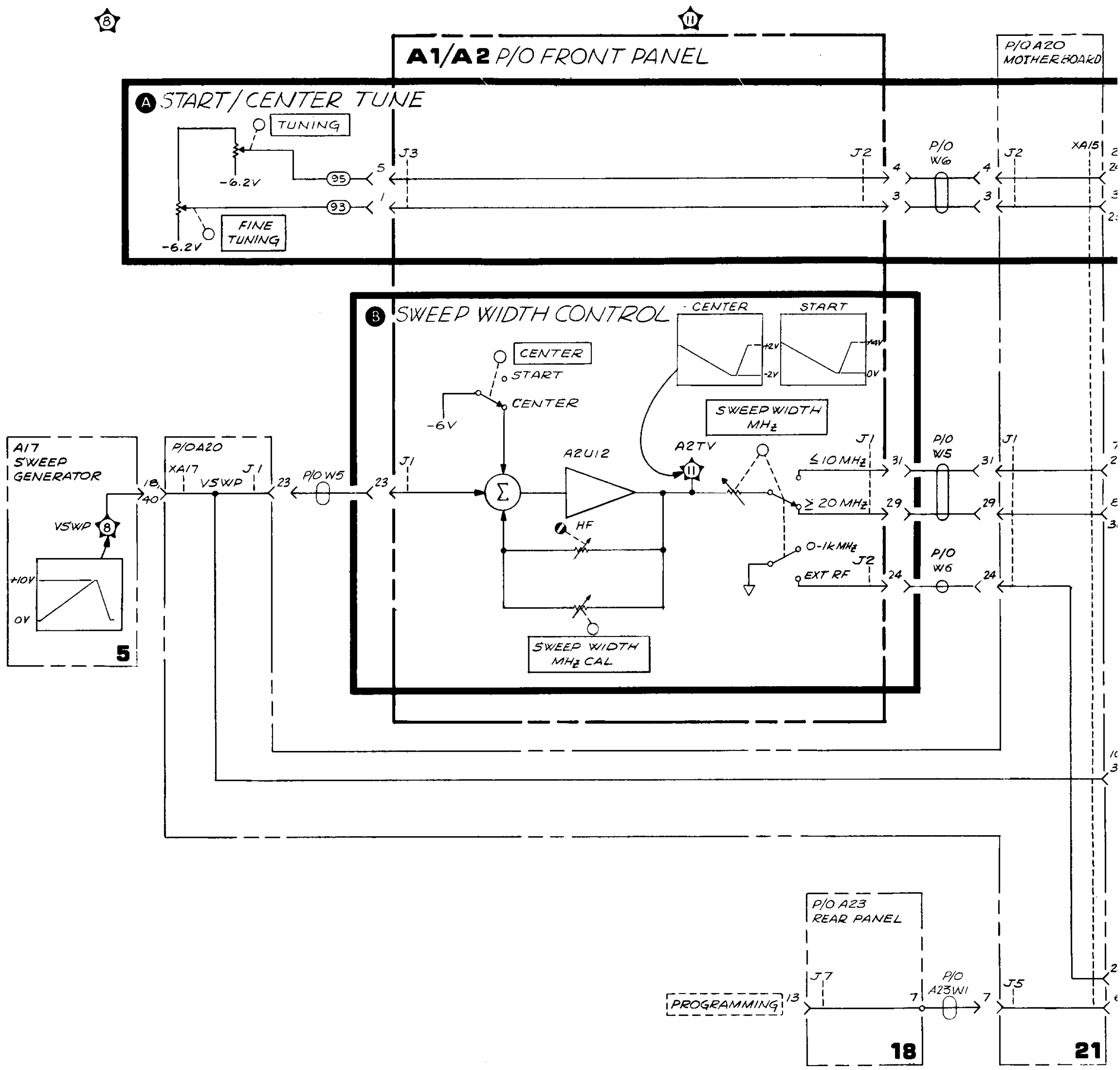
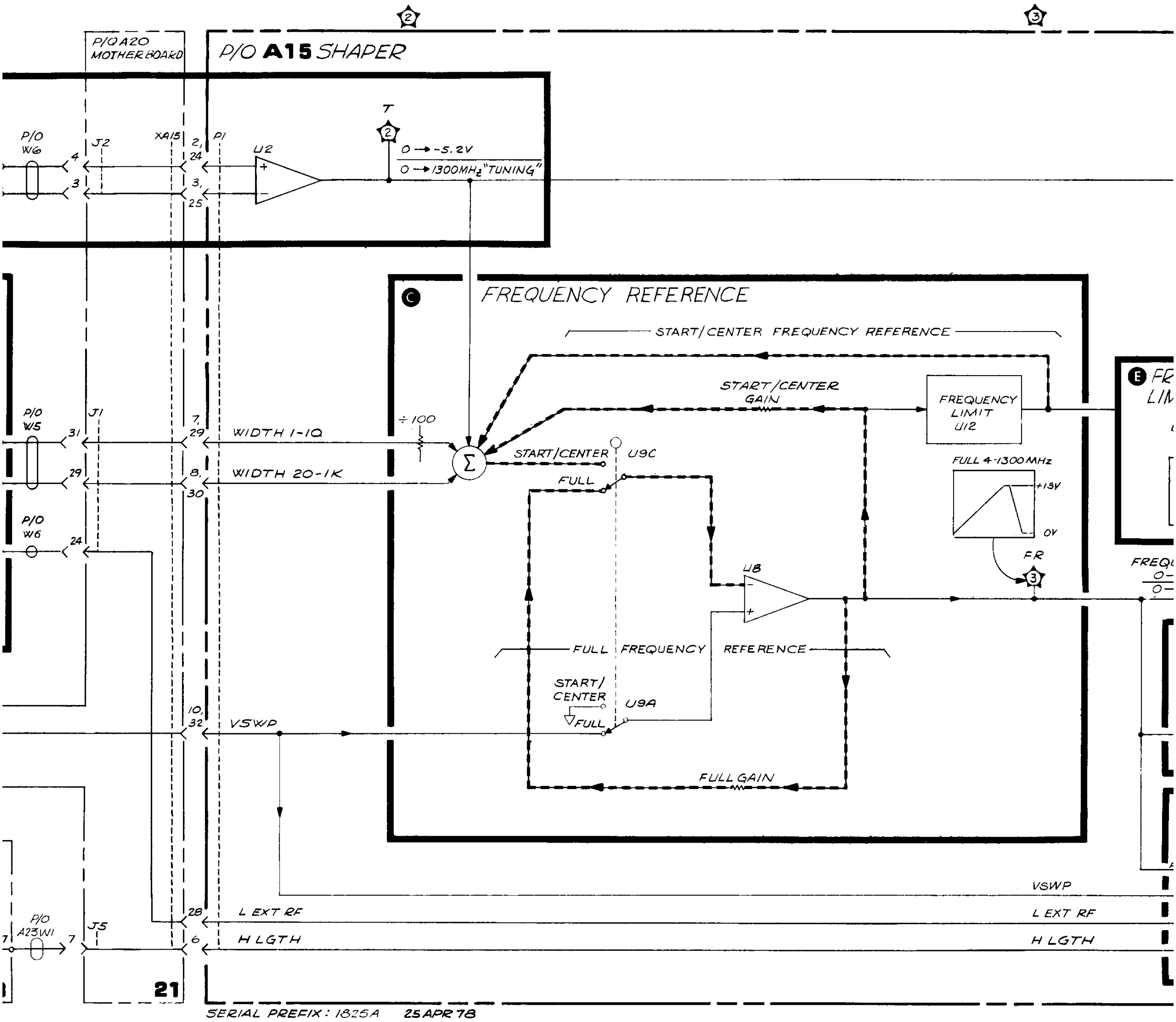


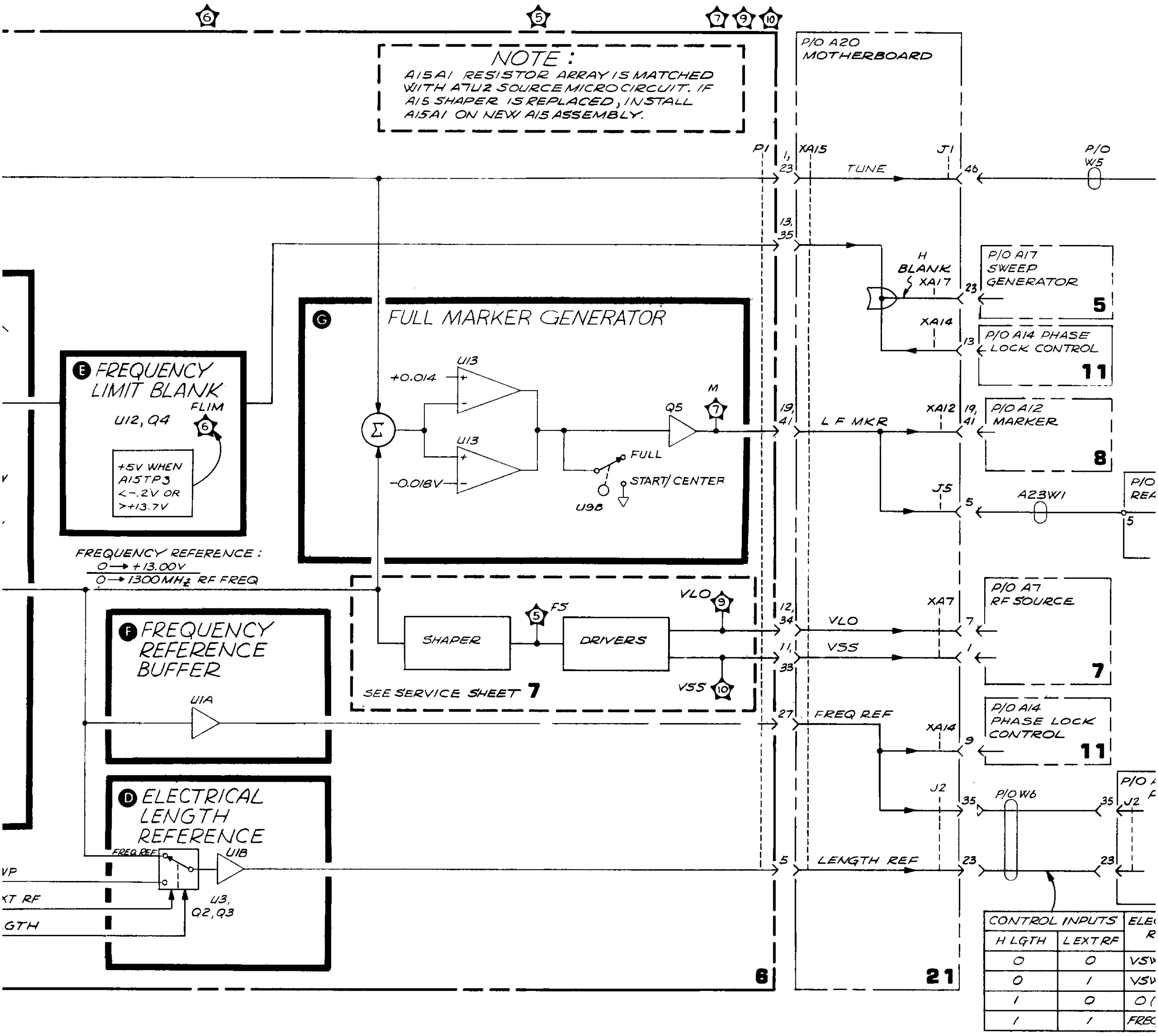
Figure 8-28. FREQUENCY MHz Display (A22), Component Locations



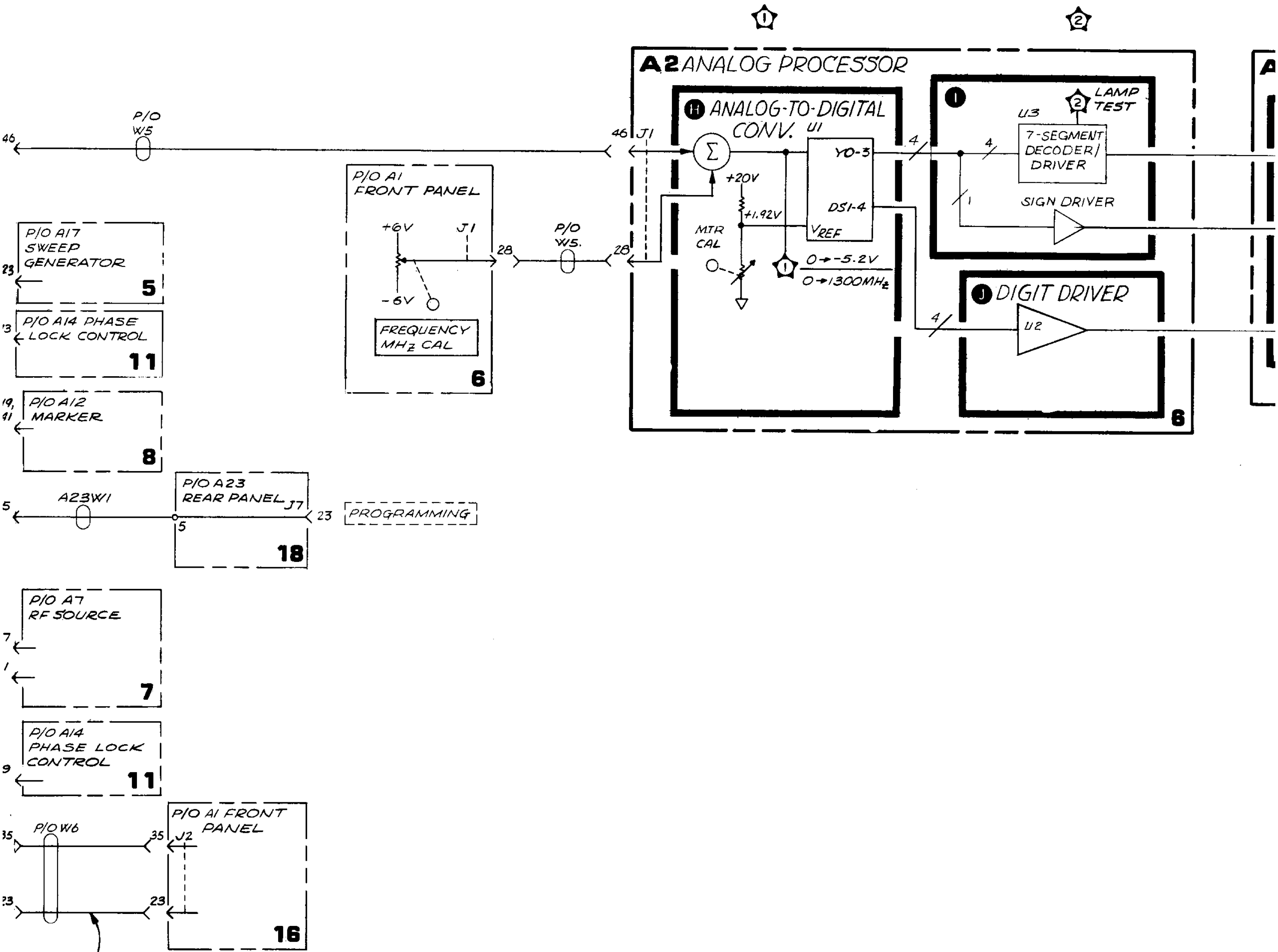
A1/A2 P/O FRONT PANEL
P/O A20 MOTHERBOARD
A START/CENTER TUNE
TUNING
-6.2V
FINE TUNING
J3
J2
P/O W6
XA15
B SWEEP WIDTH CONTROL
CENTER
START
CENTER
START
-6V
SWEEP WIDTH MHz
A2U12
A2TV
≤10 MHz
≥ 20 MHz
0-1k MHz
EXT RF
HF
SWEEP WIDTH MHz CAL
P/O W5
A17 SWEEP GENERATOR
VSWP
+10V
0V
5
P/O A20
XA17
VSWP
J1
P/O A23 REAR PANEL
J7
PROGRAMMING
P/O A23W1
J5
18
21



P/O A20 MOTHER BOARD
P/O A15 SHAPER
P/O W6
J2
XA15
P1
U2
T
0 → -5.2V
0 → 1300MHz "TUNING"
FREQUENCY REFERENCE
START/CENTER FREQUENCY REFERENCE
START/CENTER GAIN
FREQUENCY LIMIT U12
P/O W5
J1
WIDTH 1-10
WIDTH 20-1K
÷100
START/CENTER
U9C
FULL
FULL 4-1300MHz
+13V
0V
FR
U8
FULL FREQUENCY REFERENCE
START/CENTER
U9A
FULL
VSWP
FULL GAIN
P/O A23W1
J5
L EXT RF
H LGTH
21
SERIAL PREFIX: 1825A 25 APR 78



NOTE:
A15A1 RESISTOR ARRAY IS MATCHED WITH A7U2 SOURCE MICROCIRCUIT. IF A15 SHAPER IS REPLACED, INSTALL A15A1 ON NEW A15 ASSEMBLY.
P/O A20 MOTHERBOARD
P1
XA15
TUNE
J1
P/O W5
H BLANK
XA17
P/O A17 SWEEP GENERATOR
5
XA14
P/O A14 PHASE LOCK CONTROL
11
G FULL MARKER GENERATOR
U13
+0.014
-0.018V
Q5
M
FULL
START/CENTER
U9B
E FREQUENCY LIMIT BLANK
U12, Q4
FLIM
+5V WHEN A15TP3 <-.2V OR >+13.7V
L F MKR
XA12
P/O A12 MARKER
8
J5
A23W1
FREQUENCY REFERENCE:
0 → +13.00V
0 → 1300MHz RF FREQ
F FREQUENCY REFERENCE BUFFER
U1A
SHAPER
F5
DRIVERS
VLO
VSS
SEE SERVICE SHEET 7
XA7
P/O A7 RF SOURCE
7
FREQ REF
P/O A14 PHASE LOCK CONTROL
11
J2
P/O W6
D ELECTRICAL LENGTH REFERENCE
FREQ REF
U1B
U3, Q2, Q3
LENGTH REF
CONTROL INPUTS
H LGTH
L EXT RF
6
21



CONTROL INPUTS		ELECTRICAL LENGTH REFERENCE
H LGTH	L EXT RF	
0	0	VSWP (1 DIV/V)
0	1	VSWP (1 DIV/V)
1	0	0 (GND)
1	1	FREQ REF (100 MHz/V)

Figure 8-29. Frequency Reference (A15,

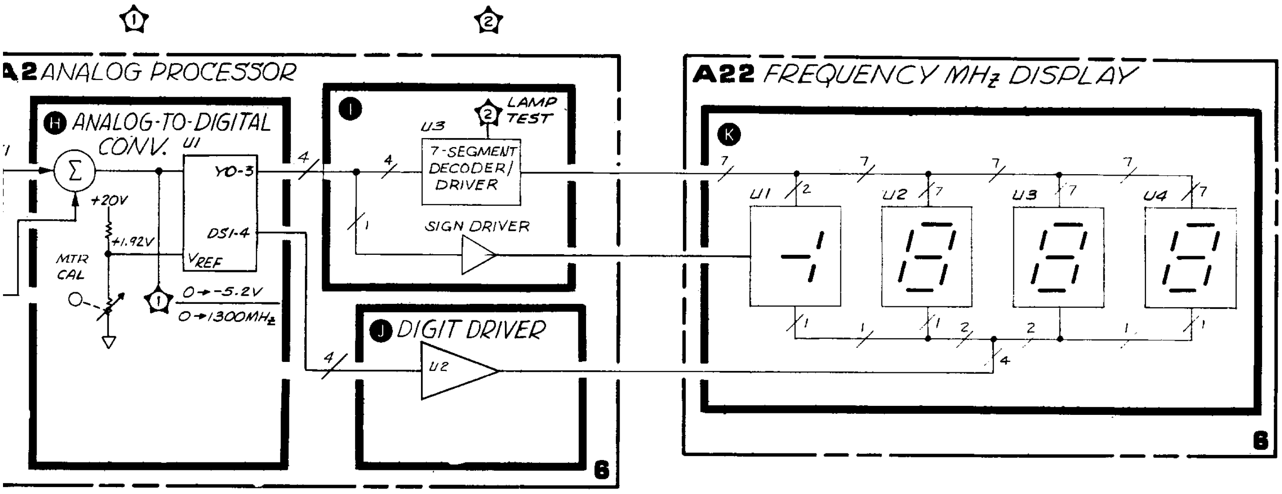
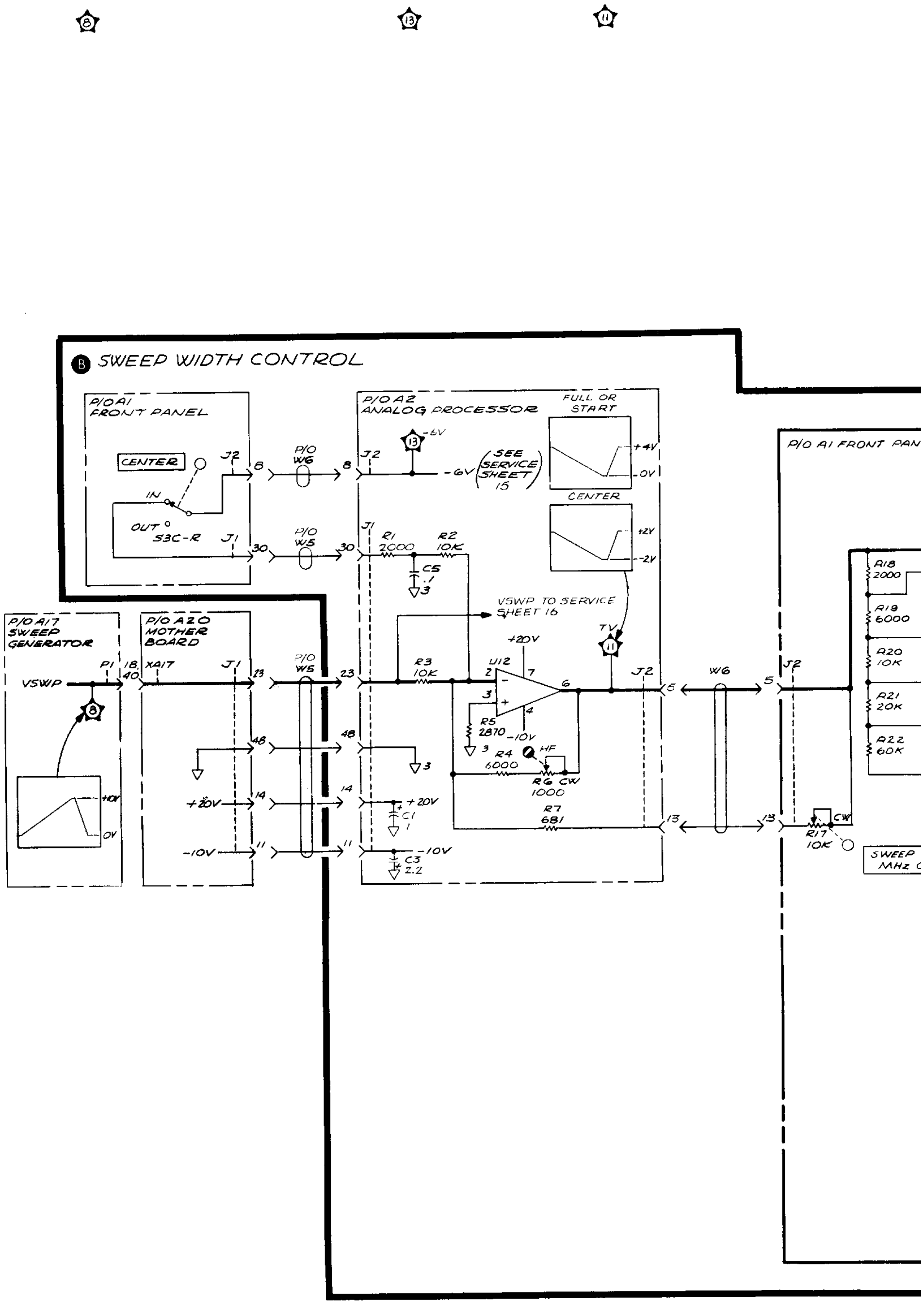


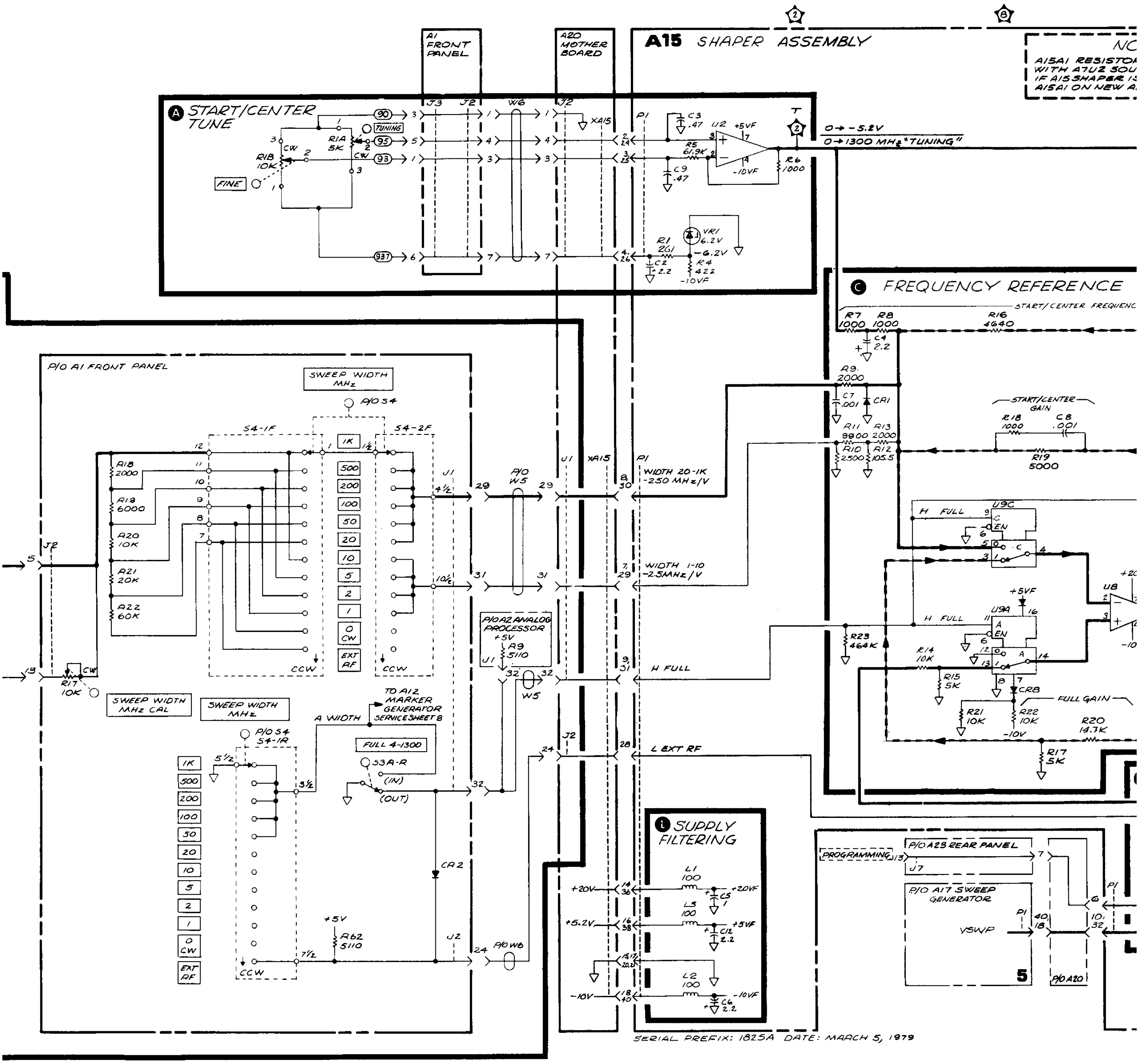
Figure 8-29. Frequency Reference (A15) and Digital Panel Meter (A2, A22), Block Diagram

A15

D1

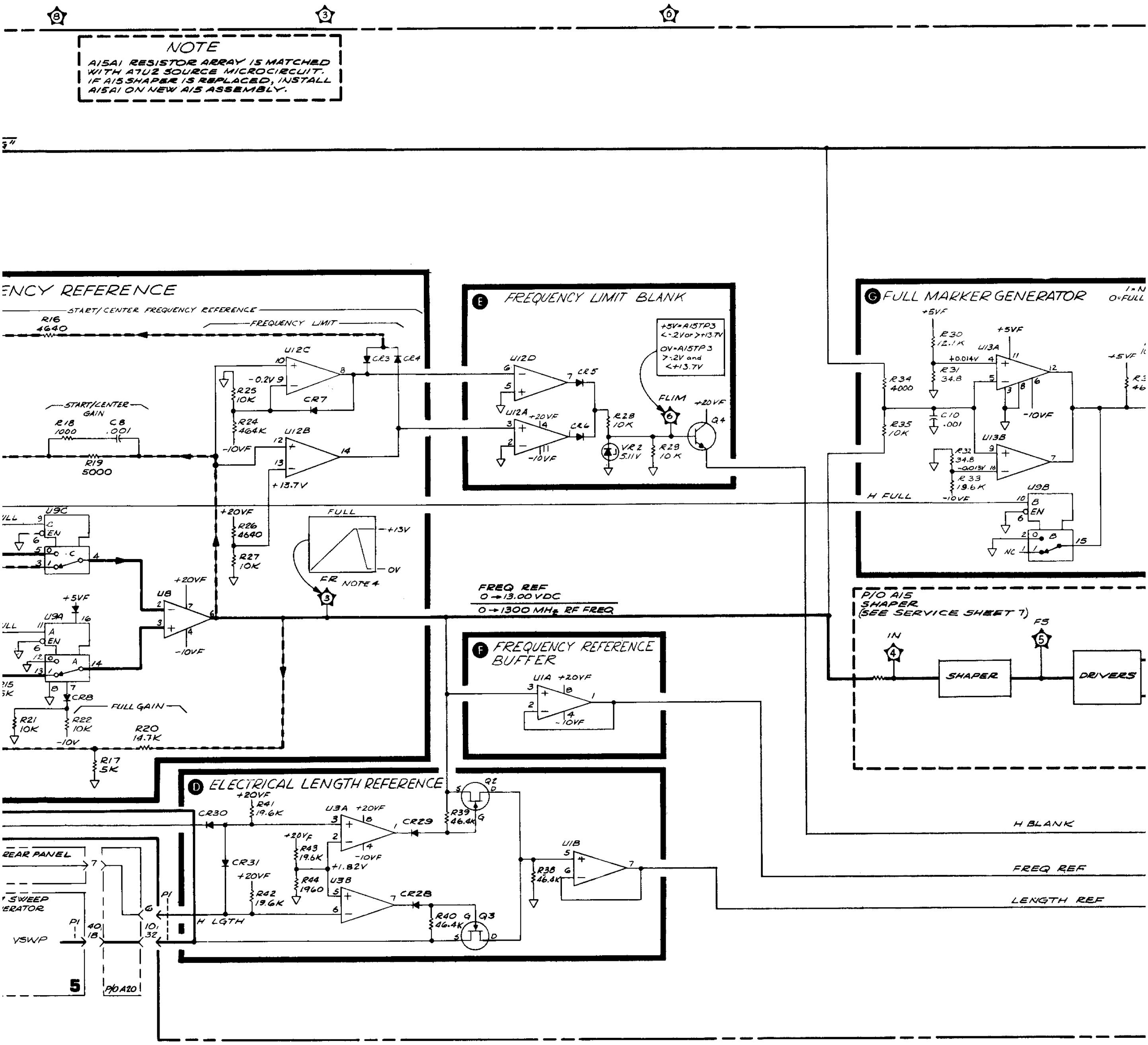
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SERVICE SHEET
1	TUNE	A2J1-46	A G	
23	TUNE	A2J1-46	A G	
2	TUNING WIPER	J2-4	A	
24	TUNING WIPER	J2-4	A	
3	FINE WIPER	J2-5	A	
25	FINE WIPER	J2-3		
4	TUNING V REF	J2-7	A	
26	TUNING V REF	J2-7	A	
5	LENGTH REF	A1J2-23	D	
27	FREQ REF	A2J2-35 XA14-9	F	
6	H LGTH	J5-7	D	
28	L EXT RF	A1J2-24	C D	
7	WIDTH 1-10	A1J1-31		
29	WIDTH 1-10	A1J1-31	C	
8	WIDTH 20-1K	A1J1-29	C	
30	WIDTH 20-1K	A1J1-29	C	
9	H FULL	A1J1-32	C	
31	H FULL	A1J1-32	C	
10	VSWP	XA17-40,18	D	
32	VSWP	XA17-40,18	D	
11	VSS	XA7-1		7
33	VSS	XA7-1		7
12	VLO	XA7-7		7
34	VLO	XA7-7		7
13	H BLANK	XA17-23	E	
35	H BLANK	XA17-23	E	
14	+20V		L	
36	+20V		L	
15	▽		L	
37	▽			
16	+5.2		L	
38	+5.2		L	
17	▽		L	
39	▽			
18	-10V		L	
40	-10V		L	
19	L F MKR	XA12-19,41	G	
41	L F MKR	XA12-19,41	G	
20	▽		L	
42	▽			
21	▽		L	
43	NC			
22	-80V	XA19-10,32		7
44	-80V	XA19-10,32		7





A1 FRONT PANEL
A20 MOTHER BOARD
A15 SHAPER ASSEMBLY
A15A1 RESISTOR
WITH A7U2 SOU
IF A15 SHAPER IS
A15A1 ON NEW A
START/CENTER TUNE
TUNING
FINE
R18 10K
R1A 5K
XA15
U2
R5 61.9K
R6 1000
C3 .47
C9 .47
VR1 6.2V
R1 261
R4 422
C2 2.2
0 → -5.2V
0 → 1300 MHz "TUNING"
FREQUENCY REFERENCE
START/CENTER FREQUENC
R7 1000
R8 1000
R16 4640
C4 2.2
R9 2000
C7 .001
CR1
START/CENTER GAIN
R18 1000
C8 .001
R19 5000
R11 9800
R13 2000
R10 2500
R12 105.5
P/O A1 FRONT PANEL
SWEEP WIDTH MHz
P/O S4
S4-1F
S4-2F
R18 2000
R19 6000
R20 10K
R21 20K
R22 60K
1K
500
200
100
50
20
10
5
2
1
0 CW
EXT RF
CCW
P/O W5
WIDTH 20-1K -250 MHz/V
WIDTH 1-10 -2.5MHz/V
H FULL
L EXT RF
R17 10K
SWEEP WIDTH MHz CAL
SWEEP WIDTH MHz
TO A12 MARKER GENERATOR SERVICE SHEET 8
A WIDTH
FULL 4-1300
S3A-R
(IN)
(OUT)
P/O A2 ANALOG PROCESSOR
R9 5110
W5
CR2
R62 5110
P/O W6
P/O S4 S4-1R
U9C
U9A
U8
R23 464K
R14 10K
R15 5K
CR8
FULL GAIN
R21 10K
R22 10K
R20 14.7K
R17 5K
SUPPLY FILTERING
L1 100
C5 1
L3 100
C12 2.2
L2 100
C6 2.2
+20V
+5.2V
-10V
+20VF
+5VF
-10VF
PROGRAMMING
P/O A23 REAR PANEL
P/O A17 SWEEP GENERATOR
VSWP
P/O A20
SERIAL PREFIX: 1825A DATE: MARCH 5, 1979

NOTE
A15A1 RESISTOR ARRAY IS MATCHED WITH A7U2 SOURCE MICROCIRCUIT. IF A15 SHAPER IS REPLACED, INSTALL A15A1 ON NEW A15 ASSEMBLY.



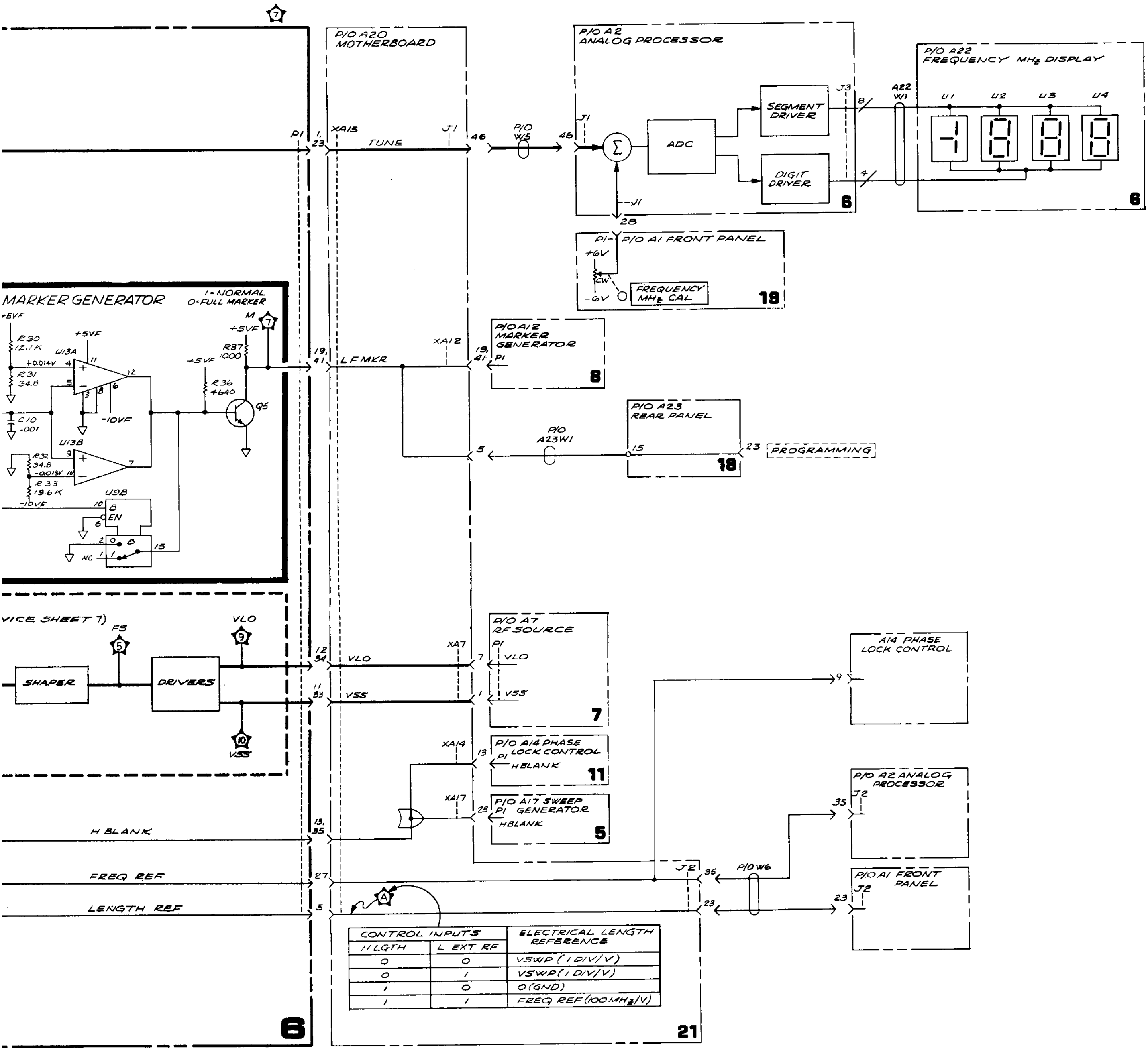
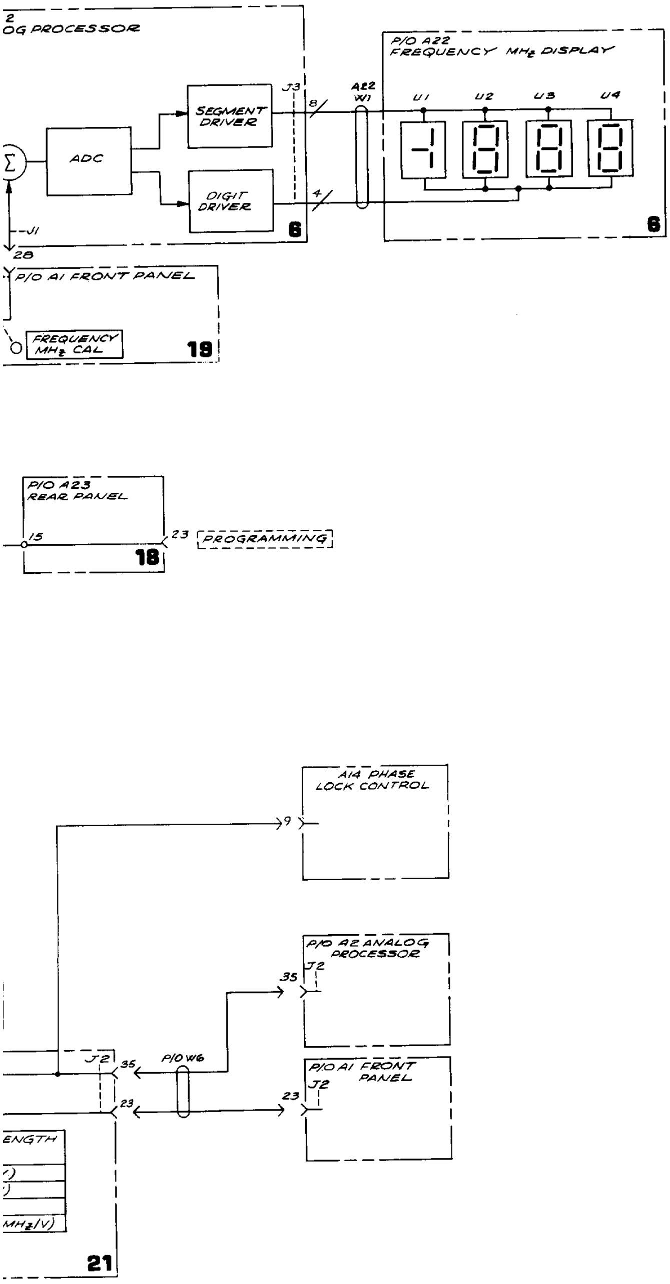
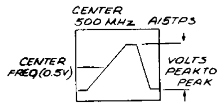


Figure 8-30. Frequency Reference (A15) and Digi



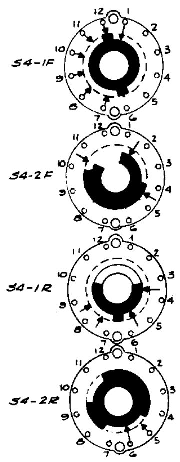
NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATIONS WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. ALL WAVEFORMS SHOWN ARE WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
   INPUT R CONNECTOR: NO RF INPUT
   SWEEP WIDTH MHz: 1000 MHz
   SWEEP WIDTH MHz VERNIER: CAL
   SWEEP: AUTO, FAST
   SWEEP MODE: FULL 4-1300
4. THE FREQUENCY REFERENCE WAVEFORMS AT A15TP3 (FOR A CENTER SWEEP MODE TUNING SET TO 500MHz, AND NO R INPUT) VARIES WITH SWEEP WIDTH MHz SWITCH SETTING AS FOLLOWS:

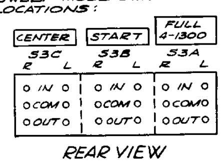


SWEEP WIDTH MHz	A15TP3 FR (VOLTS PEAK TO PEAK)
0 CW	0V p-p
1	.01V p-p
2	.02V p-p
5	.05V p-p
10	.1V p-p
20	.2V p-p
50	.5V p-p
100	1V p-p
200	2V p-p
500	5V p-p
1K	10V p-p

5. SWEEP WIDTH MHz SWITCH A1S4 WAFER AND PIN LOCATIONS:



6. SWEEP MODE SWITCH A1S3 SECTION AND PIN LOCATIONS:



6
A15

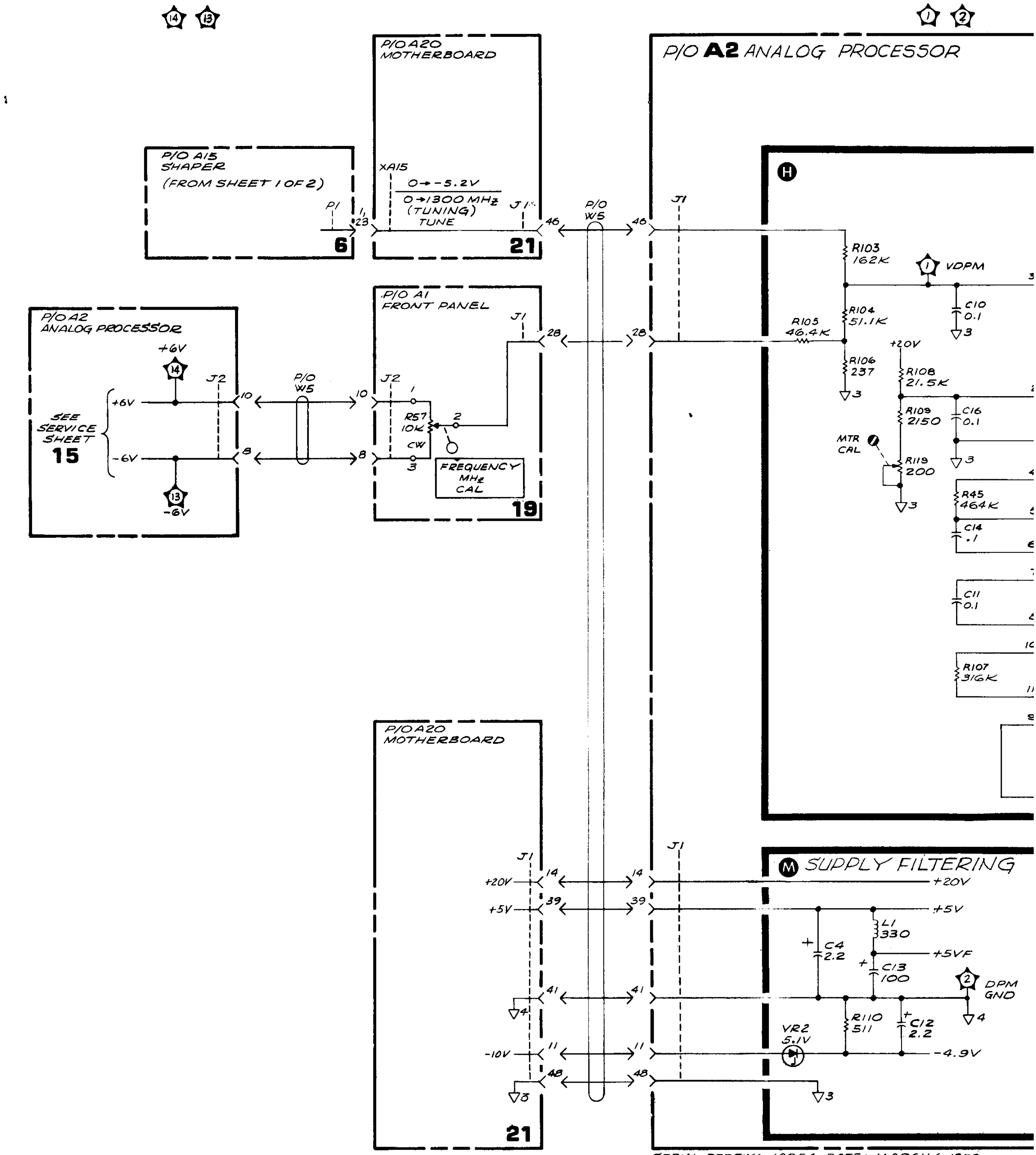
Figure 8-30. Frequency Reference (A15) and Digital Panel Meter (A2, A22), Schematic Diagram (1 of 2)

J1

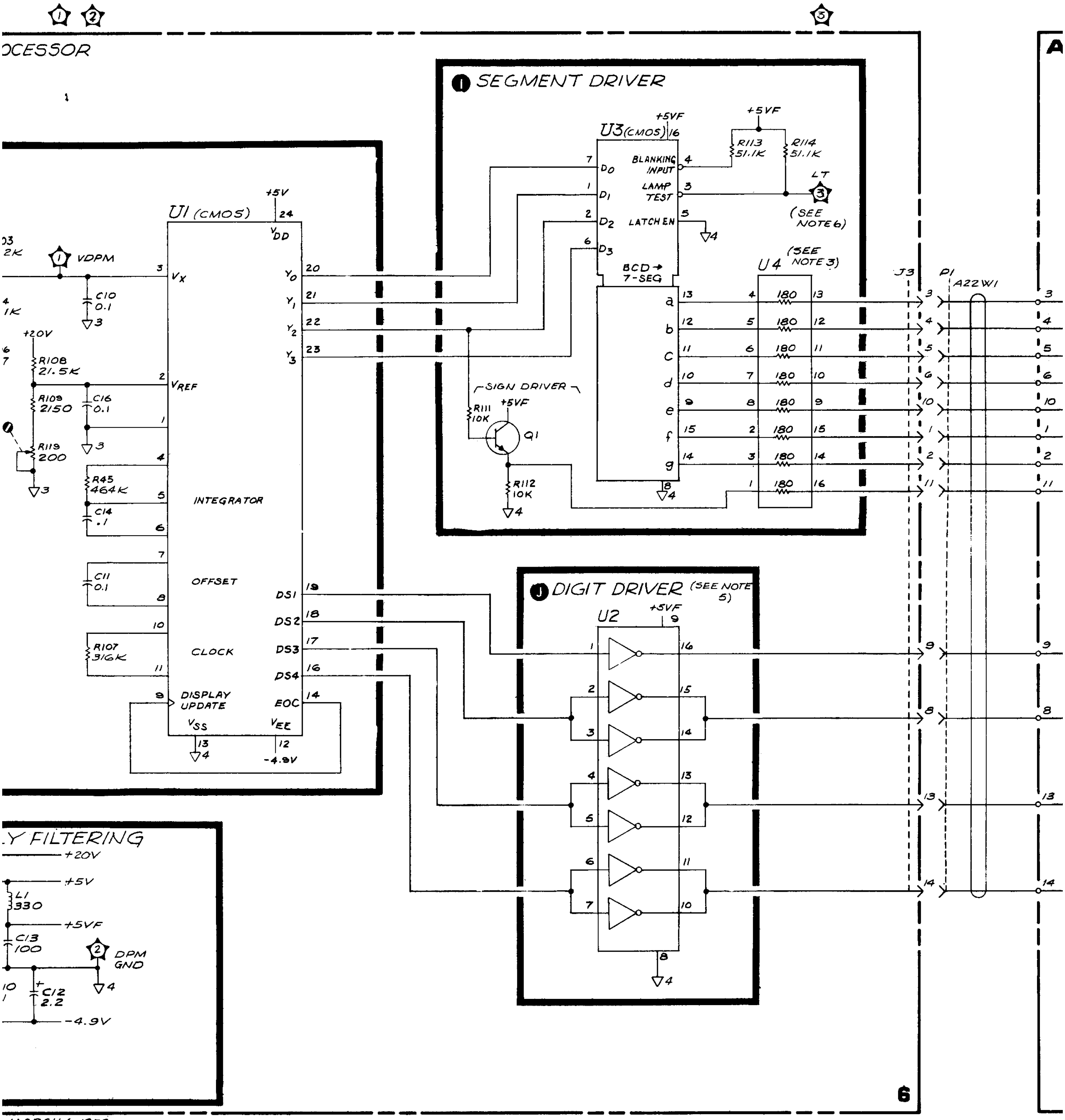
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SERVICE SHEET
1	HORIZ POSN	A1J1-1(W5)		16
2	POS 2	A1J1-2(W5)		15
3	CH1 VIDEO FLT	A1J1-3(W5)		15
4	POS 1	A1J1-4(W5)		15
5	CH2 VIDEO FLT	A1J1-5(W5)		15
6	POLAR CNTR	A1J1-6(W5)		15
7	H DBLR	NOT USED		11
8	HORIZ GAIN	A1J1-8(W5)		16
9	POLAR CNTR ◄►(X)	A1J1-9(W5)		15
10	POLAR CNTR ▲▼(Y)	A1J1-10(W5)		15
11	-10V	A16P1-9,31	M	15
12	RF LEVEL	A7P1-6,12 A12P1-1,33		7,8
13	UNLOCK LED	A14P1-1		11
14	+20V	A16P1-3,25	M	
15	L SNGL	A17P1-26		5
16	L MAN	A17P1-5,27		5
17	SWEEP SPEED VERNIER	A17P1-1		5
18	CURRENT SOURCE	A17P1-24		5
19	NC			
20	SWEEP INTEG C	A17P1-28		5
21	L MKR 1	A12P1-8,30		8
22	L FAST SWP	A17P1-41		5
23	VSWP	A17P1-18,40	B D	16
24	H AUTO	A17P1-11,33		5
25	L MKR 10	A12P1-9,31		8
26	H TRIG	A17P1-12,34		5
27	L MKR 50	A12P1-10,32		8
28	FREQ CAL	A1J1-28(W5)	H	
29	WIDTH 20-1K	A15P1-8,30	C	
30	CNTR FREQ	A1J1-30	B	
31	WIDTH 1-10	A15P1-7,29	C	
32	H FULL	A15P1-9,31 A12P1-7,29	C	
33	+15VPP	A16P1-1		20
34	-12VPP	A20U1-OUT		20
35	CH2 FLT	A18P1-35		15
36	V RAMP	A18P1-30		16
37	CH1 FLT	A18P1-37		15
38	LOG K A/R	A9P1-1,23		15
39	+5V	A20U3-OUT	M	
40	L FP HOLD	A14P1-24		15
41	▽4	A20J1 GND PLANE	M	
42	POLAR X	A10P1-5,27		15
43	L OFF 2	A23J3-6 (W13)		15
44	POLAR Y	A10P1-3,25		15
45	LB INT	A19P1-1		15
46	TUNE	A15P1-1,23	A H	
47	L CHAN 2	A18P1-2,24		15
48	▽3	GND PLANE	M	
49	L OFF 1	A23J3-3 (W13)		15
50	HALT CH2	A17P1-2		15

J3

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	SEG f	A22P1-1	I
2	SEG g	A22P1-2	I
3	SEG a	A22P1-3	I
4	SEG b	A22P1-4	I
5	SEG c	A22P1-5	I
6	SEG d	A22P1-6	I
7	NC		
8	L DIG 3	A22P1-8	J
9	L DIG 4	A22P1-9	J
10	SEG e	A22P1-10	I
11	SIGN	A22P1-11	I
12	NC		
13	L DIG 2	A22P1-13	J
14	L DIG 1	A22P1-14	J



SERIAL PREFIX: 1825A DATE: MARCH 6, 1979



OCESSOR
SEGMENT DRIVER
U3 (CMOS)
+5VF
BLANKING INPUT
LAMP TEST
LATCH EN
BCD → 7-SEG
R113 51.1K
R114 51.1K
LT
(SEE NOTE 6)
U4
(SEE NOTE 3)
SIGN DRIVER
R111 10K
R112 10K
Q1
J3
P1
A22W1
U1 (CMOS)
+5V
VDPM
INTEGRATOR
OFFSET
CLOCK
DISPLAY UPDATE
EOC
-4.9V
R108 21.5K
R109 2150
R119 200
R45 464K
R107 316K
C10 0.1
C16 0.1
C14 .1
C11 0.1
+20V
DIGIT DRIVER
(SEE NOTE 5)
U2
Y FILTERING
L1 330
C13 100
C12 2.2
DPM GND
+5VF
6

MARCH 6, 1979

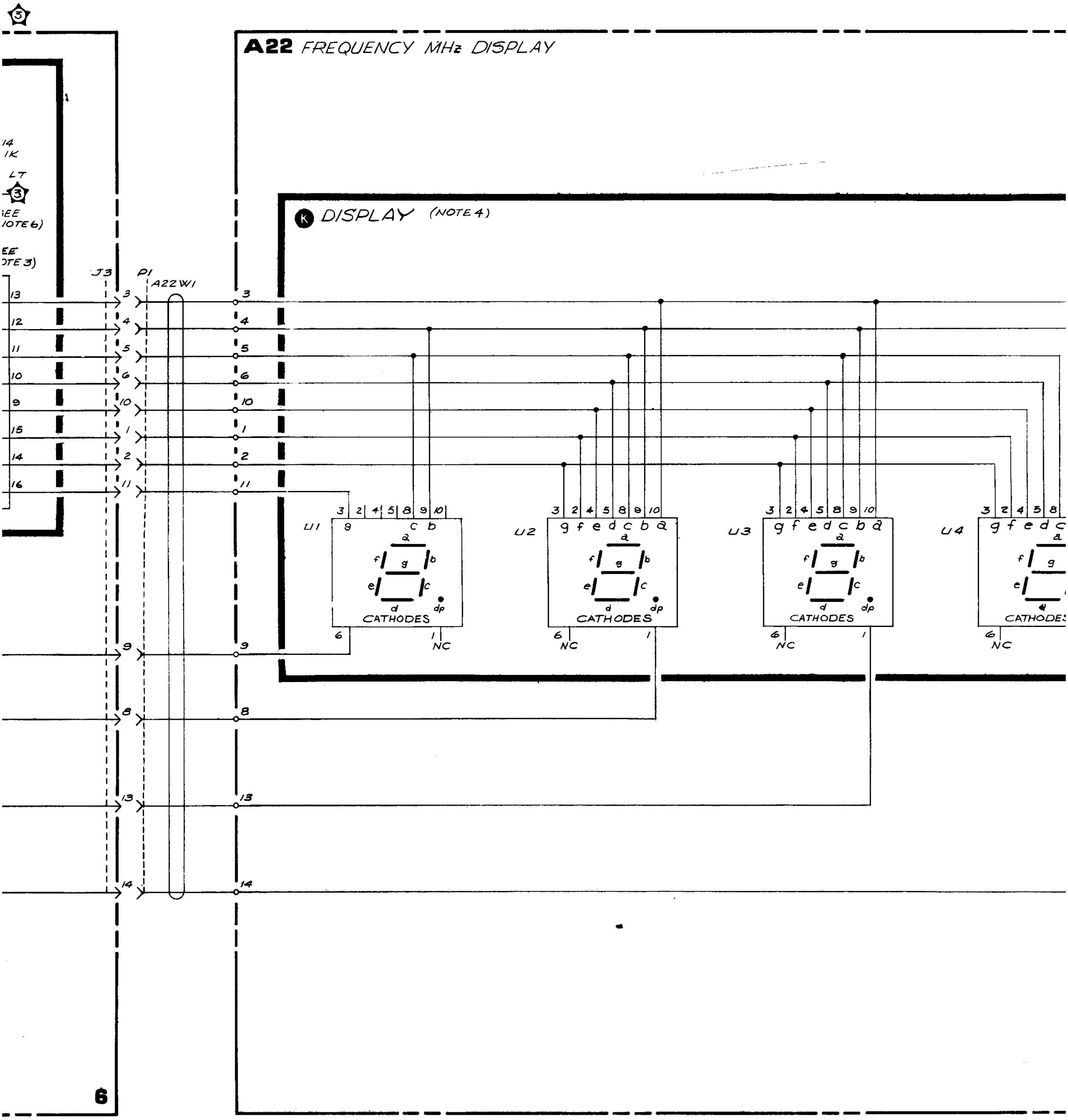
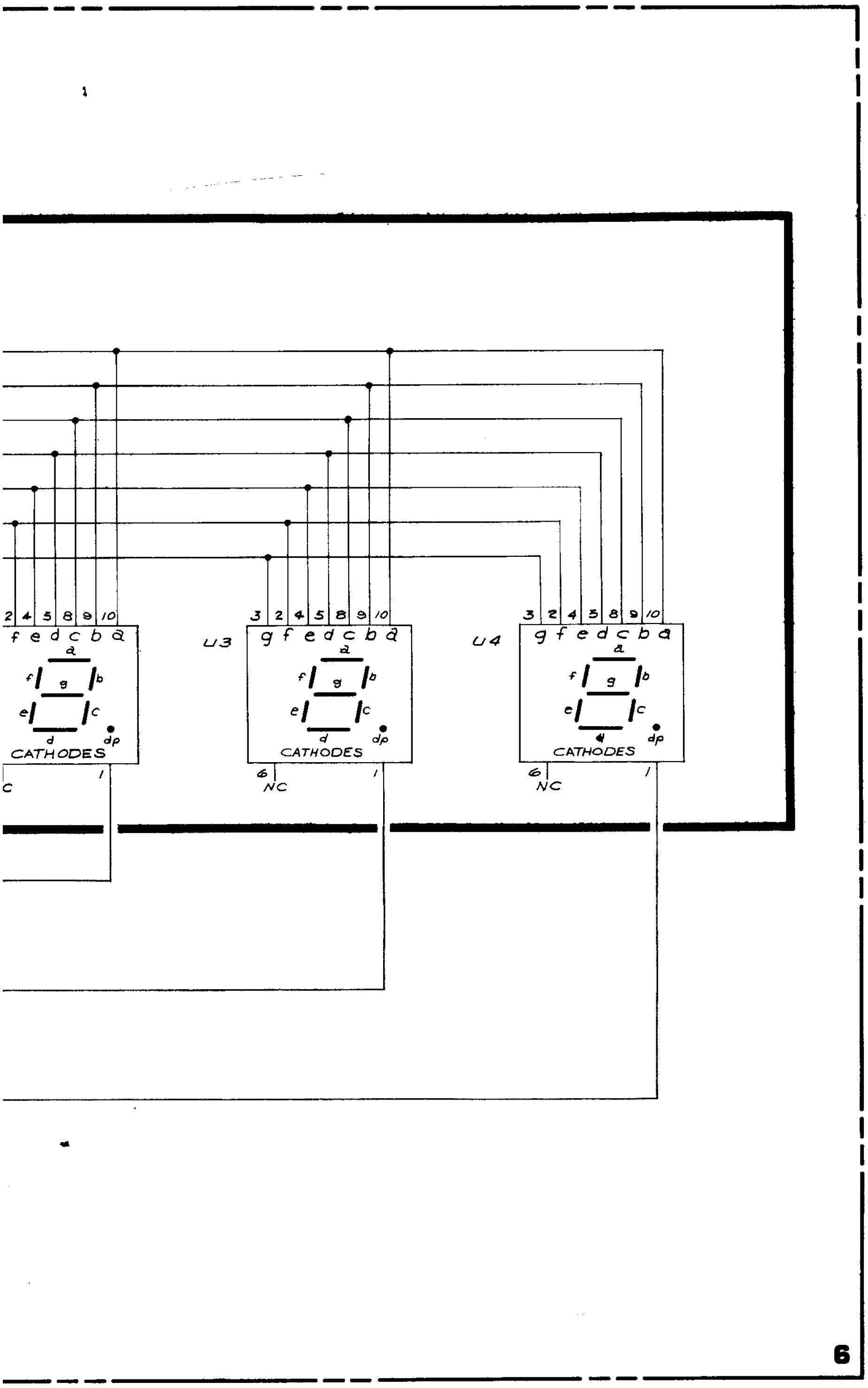
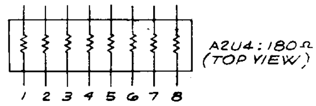


Figure 8-30. Frequency Reference (A15) and D



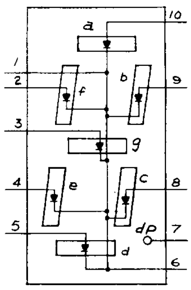
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. A2U4 PIN CONFIGURATION:



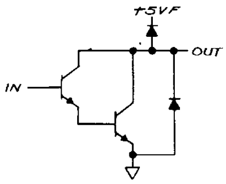
4. A22U1 – U4 SEGMENT CODE AND PIN CONFIGURATION:

SEGMENT CODE



5. A2U2 CONTAINS SEVEN DARLINGTON PAIRS SHOWN AS INVERTING DRIVERS.

DARLINGTON PAIR:



6. TROUBLESHOOTING HINTS:
   A. FREQUENCY MHz DISPLAY SHOULD INDICATE 1888 WHEN A2TP2 LT (LAMP TEST) IS JUMPERED TO GROUND.

6
A2,A22

Figure 8-30. Frequency Reference (A15) and Digital Panel Meter (A2, A22), Schematic Diagram (2 of 2)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 7

SHAPER (P/O A15) AND RF SOURCE (A7), CIRCUIT DESCRIPTION

This circuit receives as its primary input the FREQ REF voltage from the Frequency Reference circuit (P/O A15, Service Sheet 6). The function of the Shaper and RF Source is to generate a 4 MHz to 1300 MHz RF output that is related to the 0V to +13V FREQ REF voltage by 100 MHz/volt.

The RF signal is generated by mixing the outputs of two varactor-tuned oscillators. As the FREQ REF voltage increases from 0V to +13V, the SS Oscillator is voltage-tuned from 3.6 GHz to 3.0 GHz and the LO Oscillator is voltage-tuned from 3.6 GHz to 4.3 GHz; this results in a mixer output (difference frequency) of 0 to 1.3 GHz.

The A7 RF Source consists of a Source microcircuit (A7U2) that contains the oscillators and mixer, an Amplifier/Detector microcircuit (A7U3) which amplifies the difference frequency, and the Automatic Leveling Control (ALC) circuit on the printed circuit board for leveling the RF output.

The A15 Shaper contains a Shaper circuit and two driver amplifiers which convert the FREQ REF voltage (also generated on A15) into two signals which tune the oscillators on the A7 RF Source.

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A15. For example, the designation Q1 is actually A15Q1.

Shaper (A)

The function of the Shaper is to remove non-linear tuning characteristics of the oscillators in the RF Source (A7). The FREQ REF (FR) voltage at TP4 is linear, with a sensitivity of 100 MHz/V throughout the frequency range of 0 to 1300 MHz (0 to +13V). The sensitivity of the oscillators in A7, however, is non-linear; that is, the voltage representation of frequency is not constant throughout the tuning range. The Shaper yields a waveform (FS) at TP5 that compensates for the non-linearity of the oscillator outputs so that the RF signal out of the mixer is linear over the frequency range of 0 to 1300 MHz. Figure 8-31 shows the linear waveform FR and the compensating waveform FS.

In Figure 8-31, note the changing slope of the FS waveform compared to the linear slope of the FR waveform. As the FR voltage at TP4 ramps from 0 to +13V, the slope of the FS waveform (which starts gradually) increases until the FR voltage is approximately +7V; the slope of the FS

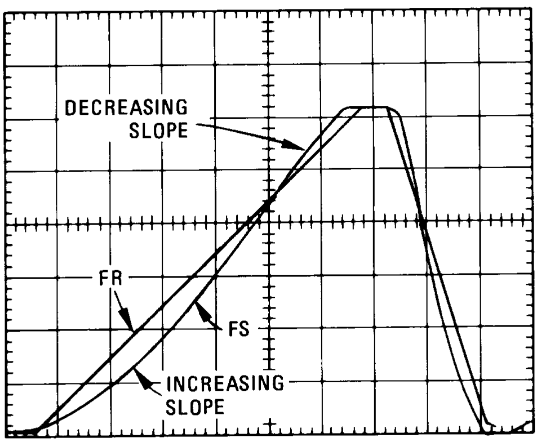


Figure 8-31. FR and FS Waveforms

waveform then gradually decreases until the FR voltage equals +13V. When the FREQ REF (FR) voltage is between 0V and approximately +7V, an increasing-slope shaper is required to linearize the source tuning characteristics, and a decreasing-slope shaper is required when the FR voltage is between approximately +7V and +13V.

Figure 8-32 shows a simplified schematic of the Shaper circuit. R_A and R_B are equivalent resistances which decrease in value as the FREQ REF voltage at TP4 increases; their action is discussed later.

Since the inputs of U10 and U11 draw negligible current, whatever voltage is at FR TP4 is also at the inverting inputs of U10 and U11. The direction of current flow is shown with arrows in Figure 8-32; note that the total current through R45 may be in either direction since it is the difference between the current from R46 and the current into R_A.

If R_A and R_B are infinite, no current flows through R45 (no voltage drop) and the output at TP5 follows the input at TP4, with a resulting amplifier gain of one.

The effect of R_A is to cause current to flow through R45 in the direction which causes the output of U11 to be larger than V_{FR}. This results in increased FS/FR gain (gain greater than one).

The effect of R_B is to cause current to flow through R47, which causes the output of U10 to be larger than V_{FR}. This causes current to flow through R46 and R45 in the direction which causes the output of U11 to be less than V_{FR}. This results in decreased FS/FR gain.

Note that R47 and R46 have the same voltage drop. Since they are equal resistances, the current through R_B is equal to the current through R46. When R_A equals R_B, the current from R46 balances the current into R_A, and there is no current flow through (or voltage drop across) R45. This results in a gain of one.

Resistor-diode Network. Figure 8-33 is a simplified schematic illustrating the action of the resistor-diode shaping network. When V_{FR} is less than V_1, no diodes are conducting; the current through R_0 causes the Shaper gain ($\Delta FS/\Delta FR$) to decrease to a value of less than one.

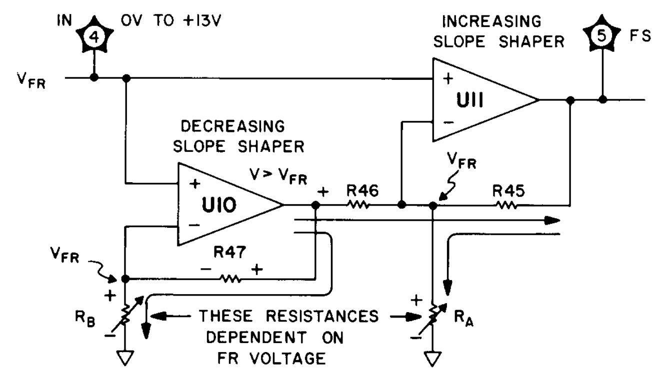


Figure 8-32. Shaper Circuit, Simplified Schematic

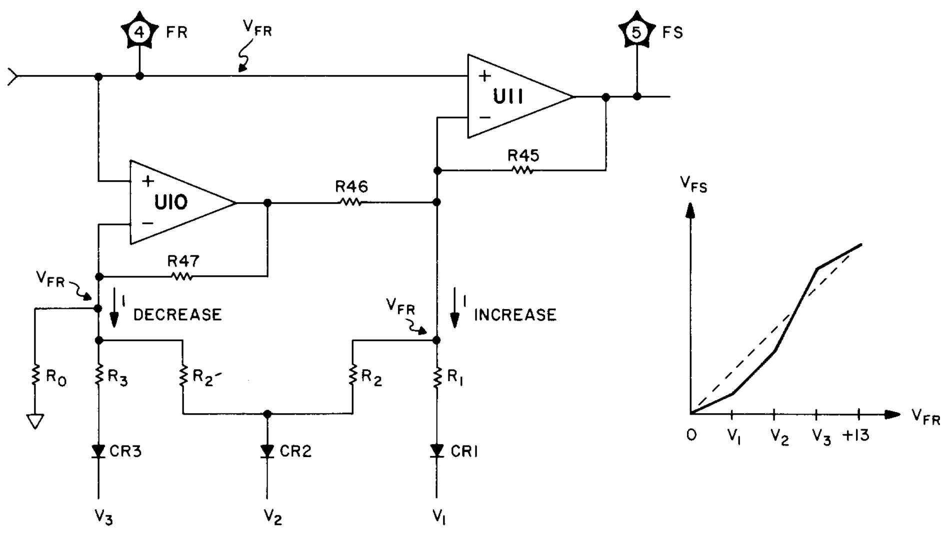


Figure 8-33. Simplified Schematic Showing Resistor-Diode Action

As V_{FR} increases, the anodes of diodes CR1 – 3 follow the voltage of V_{FR} until V_{FR} is 0.3V greater than V_1, which causes CR1 to conduct. As V_{FR} continues to increase, the anode of CR1 remains at (V_1 + 0.3V), and a current flows through R_1. This current causes the Shaper gain to increase, since the total resistance from U11 inverting input to ground is now lower (R_1 in parallel with R_0).

As V_{FR} increases to a voltage 0.3V greater than V_2, CR2 conducts, and currents flow through R_2 and R_2'. Current through R_2 causes the Shaper gain to increase; current flow through R_2' causes Shaper gain to decrease. If R_2 is smaller than R_2', more current flows through R_2 and there is a net increase in Shaper gain.

As V_{FR} increases to a voltage 0.3V greater than V_3, CR3 starts to conduct, and current flows through R_3; this causes the Shaper gain to decrease.

Table 8-5 shows the voltage levels at which each diode starts to conduct, and the resistors it connects to increase and decrease Shaper gain.

Breakpoint Voltages. Resistors R69 – 81 form a resistive string which divides the voltage from Q1 (TP1) to provide the voltage levels at which CR15 – 27 start to conduct.

Q1 is an emitter follower whose base voltage is determined by R82 – 84; its emitter voltage is approximately +12.6Vdc, measured at TP1. Approximately 19.5 mA flow from Q1, through R69 – 81,into CR14 (whose cathode is biased at –0.65V by R67 and R68). CR14 is used for temperature compensation. R85 reduces the power dissipation of Q1 by supplying some of the current into the resistive string (R69 – 81).

LO Driver (B)

The Local Oscillator Driver is an inverting amplifier which delivers a voltage ramp to the LO Oscillator in A7U2. As the FS waveform at TP5 increases from 0V to +13V, the LO drive voltage at TP9 changes from approximately –5V to –40V (depending on the particular LO oscillator tuning characteristics).This causes the oscillator to tune from 3.6 GHz to 4.3 GHz.

Table 8-5. Resistor - Diode Network Breakpoint Voltages

Diode (A15)	Diode Starts Conduction at V_{FR} Of: (Volts)	Resistors Added To Increase Gain (R_A) (A15)	Resistors Added To Decrease Gain (R_B)* (A15)	Gain Adjusted At V_{FR} Of: (Volts)
———	0	———	R48‖A1R4	+ 0.3
CR15	+ 0.5	R66	———	+ 1.0
CR16	+ 1.2	A1R5	———	+ 2.0
CR17	+ 2.2	A1R6	———	+ 3.0
CR18	+ 3.2	A1R7	———	+ 4.0
CR19	+ 4.2	A1R8	———	+ 5.0
CR20	+ 5.2	A1R9	———	+ 6.0
CR21	+ 6.2	A1R10	A1R11	+ 8.0
CR22	+ 8.2	A1R12	A1R13	+ 9.0
CR23	+ 9.2	———	A1R14	+10.0
CR24	+10.2	———	R59 and R62	+11.0
CR25	+11.2	———	R60 and R63	+12.0
CR26	+12.2	———	R61 and R64	+13.0
CR27	+12.9	———	R65	+13.0

* ‖ = Resistors in Parallel

U16, Q6, Q9, and R102 are connected as a virtual-ground negative-feedback amplifier whose output voltage is determined by the sum of currents through R99 and R101. When current flows into the amplifier, the output of U16 increases, causing less current to flow in Q6. This causes more current to flow through R102, since the sum of the Q6 and R102 currents flows into Q9, which is a constant-current source. Current flow through R102 increases until there is no current flow into U16 pin 3; then current flow through R102 is the sum of R99 and R101 currents.

When FS equals 0V, no current flows through R99 and the output voltage is determined by the current flow through A15A1R3, R100, and R101. As FS increases from 0V to +13V, the output voltage goes more negative by an amount determined by R98 and R99.

SS Driver (C)

The Small Signal Oscillator Driver is a non-inverting amplifier which delivers a voltage ramp to the Small Signal Oscillator in A7U2. As the FS waveform at TP5 increases from 0V to +13V, the SS driver voltage at TP10 changes from approximately −40V to −5V (depending on the particular SS oscillator tuning characteristics). This causes the oscillator to tune from 3.6 GHz to 3.0 GHz.

The FS signal is first inverted by U14. As the FS voltage increases from 0V to +13V, the output of U14 decreases from +13V to 0V.

U15, Q7, Q8, and R92 are connected as a virtual-ground negative-feedback amplifier, whose operation is similar to the LO Driver circuit. Its output voltage is determined by the sum of currents through R89 and R91.

When FS equals +13V, the U14 output is 0V, and no current flows through R88 or R89. The amplifier output is determined by the current flow through A15A1R1, R90, and R91 (which set the 3.6 GHz end point). As FS decreases from +13V to 0V, the SS output goes more negative by an amount determined by A15A1R2, R88, and R89 (which set the 3.0 GHz end point).

Note that the SS Oscillator frequency range is set by two factory-selected resistors on A15A1 Resistor Network. After these resistors are selected, the frequency range of the LO Oscillator is adjusted to provide the appropriate 4 to 1300 MHz output range.

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A7. For example, the designation Q1 is actually A7Q1.

RF Source D

The RF Source microcircuit (A7U2) consists of two oscillators, a modulator, and a mixer. Its function is to provide a low-level output at the difference frequency of the two oscillators in the range of 4 MHz to 1300 MHz.

The LO (Local Oscillator) is tuned by the LO Driver (P/O A15) from 3.6 GHz to 4.3 GHz as the FREQ REF voltage (A15TP3) increases from 0V to +13V. This signal is mixed with the SS (Small Signal) Oscillator output, which is tuned from 3.6 GHz to 3.0 GHz by the SS Driver (P/O A15). A low-level mixer output results at the difference frequency, 4 MHz to 1300 MHz.

The mixer output power level is controlled by a modulator, which attenuates the SS signal input to the mixer. PIN diodes are used as resistors, with their resistance dependent on the current flowing through them. As more current flows from ALC Amplifier A7Q4 into the diodes, less SS signal reaches the mixer, and the mixer output is smaller.

Figure 8-34 is a simplified schematic of one of the varactor oscillators used in the RF Source. A series L-C circuit is formed by the varactor diode and L1; oscillation is maintained due to the loading by Q1, which behaves as a negative resistance. The cathode of the varactor is biased at −0.7V due to its direct connection with the base of Q1. The varactor anode (input) is biased negative, and draws negligible current.

Amplifier/Detector E

The Amplifier/Detector consists of a microcircuit (A7U3) and some associated biasing circuitry (A7Q2 and A7Q3). Its function is to amplify the low-level mixer output of the RF Source (A7U2) to provide a maximum output signal of greater than +10 dBm. It also provides a detected output that is used by ALC Amplifier A7U1, and a low-level RF output to the Phase Lock Control (A14, Service Sheet 11).

A7Q2, A7Q3, and associated circuitry provide the bias required for proper operation of the amplifier A7U3Q1 and A7U3Q2, which are in the microcircuit. The operation of the two bias circuits is similar, except that current flow through the two amplifier transistors is different because of different values of the current sense resistors. The biasing of A7U3Q1 is described.

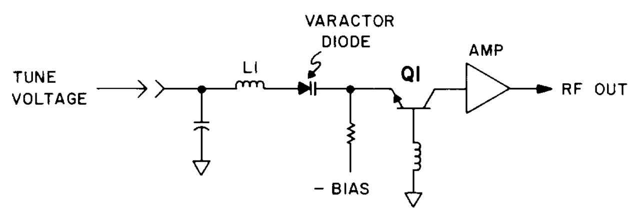


Figure 8-34. Varactor Oscillator, Simplified Schematic

Figure 8-35 shows a simplified schematic and equivalent circuit of Q2, U3Q1, and associated circuitry. Q2 effectively functions as an error amplifier with a reference voltage (V_{REF}) of about +16V at the inverting input (base). The voltage at the non-inverting input of the error amplifier (emitter of Q2) is the difference between +20VF and the voltage drop across R29. When the two inputs to the error amplifier are equal, a constant current is established through U3Q1. This current may be calculated by the equation.

$$I = (+20V - V_{REF})/R29$$

A7L3, A7L4, A7C9, and A7C10 provide power supply decoupling.

The Detector in A7U3 is a half-wave rectifier which delivers a negative voltage to A7U1 that is proportional to the output level.

Automatic Leveling Control (F)

The Automatic Leveling Control (ALC) circuit modulates the output of the Small Signal Oscillator to level the power output over the frequency range. The power output level is established by the OUTPUT dBm control on the front panel.

A reference voltage at the non-inverting input of error amplifier A7U1 is set by the front-panel OUTPUT dBm control. The reference voltage is adjusted by +10 dBm potentiometer A7R7 and 0 dBm potentiometer A7R9.

The detected voltage from A7U3 is fed back through R13 to the inverting input of U1. CR3 is used for temperature compensation; R14–16 supply bias current to CR3 and the detector diode in A7U3.

The output of U1 is applied to emitter follower Q4. As the output of U1 increases, more current flows from Q4, through CR4 and R17 and through the modulator PIN diodes in A7U2. Thus, if the RF output power increases, the detected voltage from U2 decrases below the reference voltage at the A7U1 non-inverting input. This causes the output of U1 to increase, and more current flow through the PIN modulator, which results in a lower output power. This negative feedback results in a constant output power from A7U3.

C7, R30, R31, and C12 provide frequency compensation for the ALC loop. CR2 limits the output of U1 from being excessively negative.

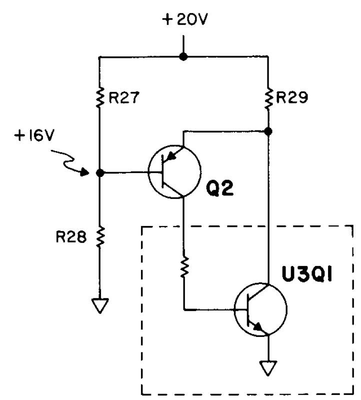


Figure 8-35. A7U3Q1 Bias, Simplified Schematic and Equivalent Circuit

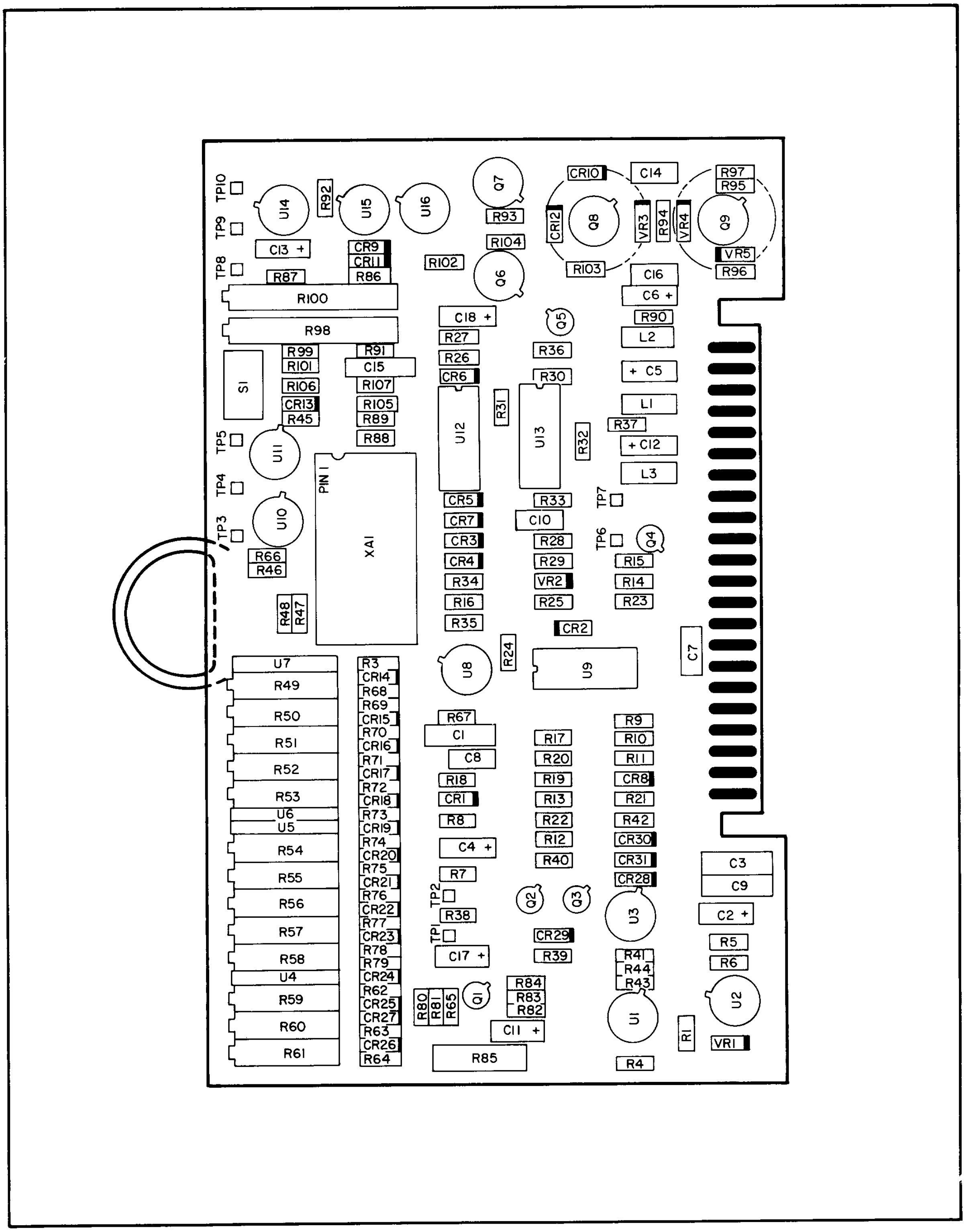


Figure 8-36. Shaper (A15), Component Locations

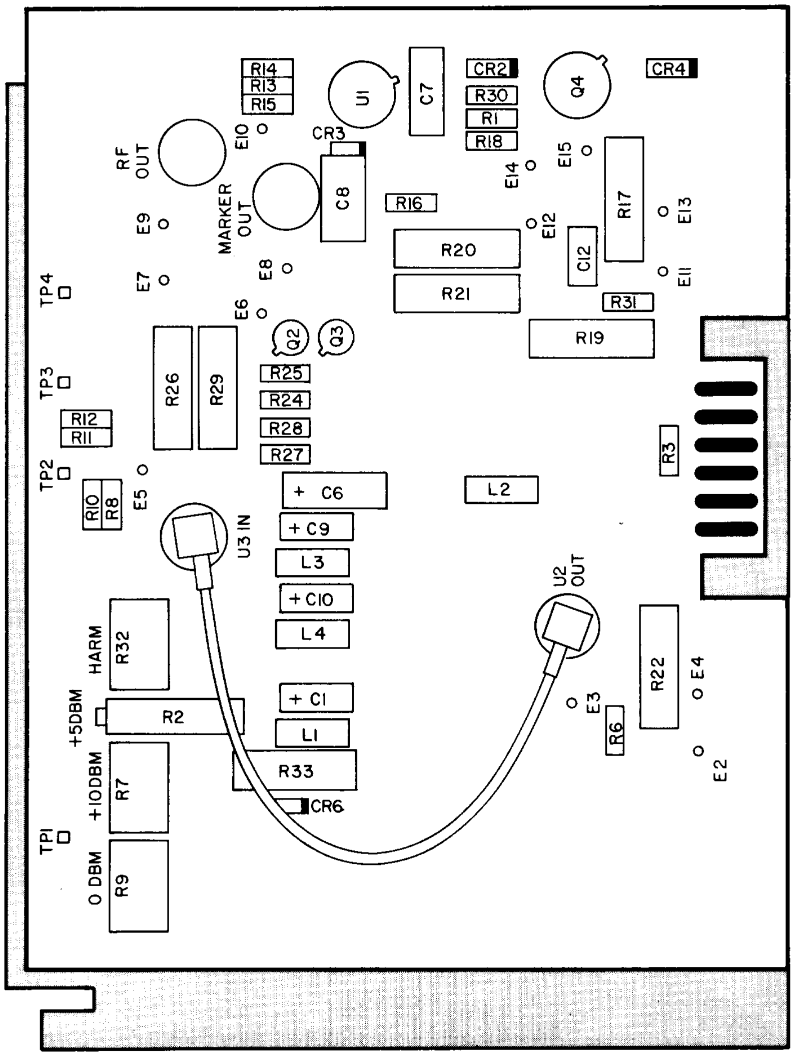
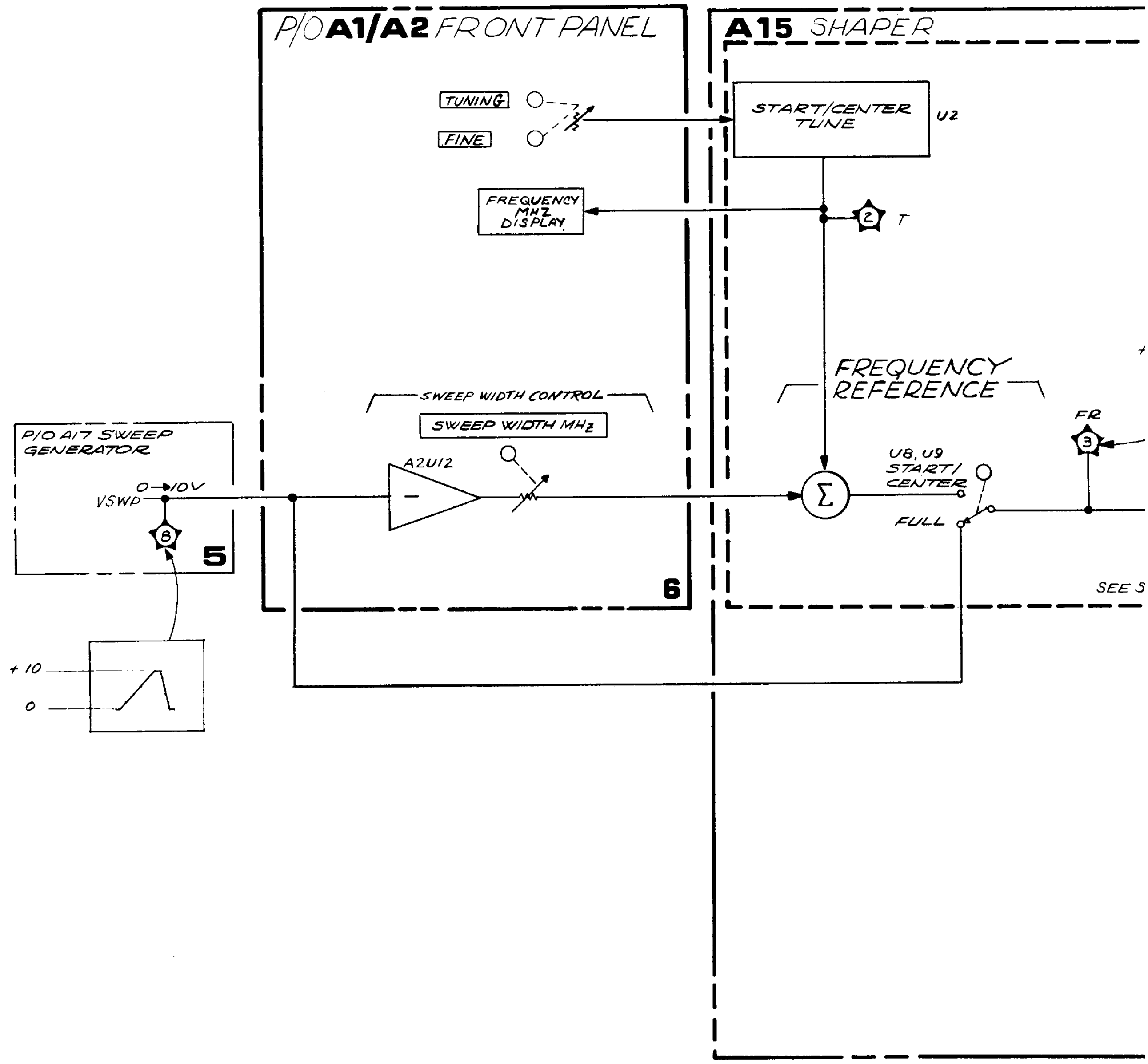
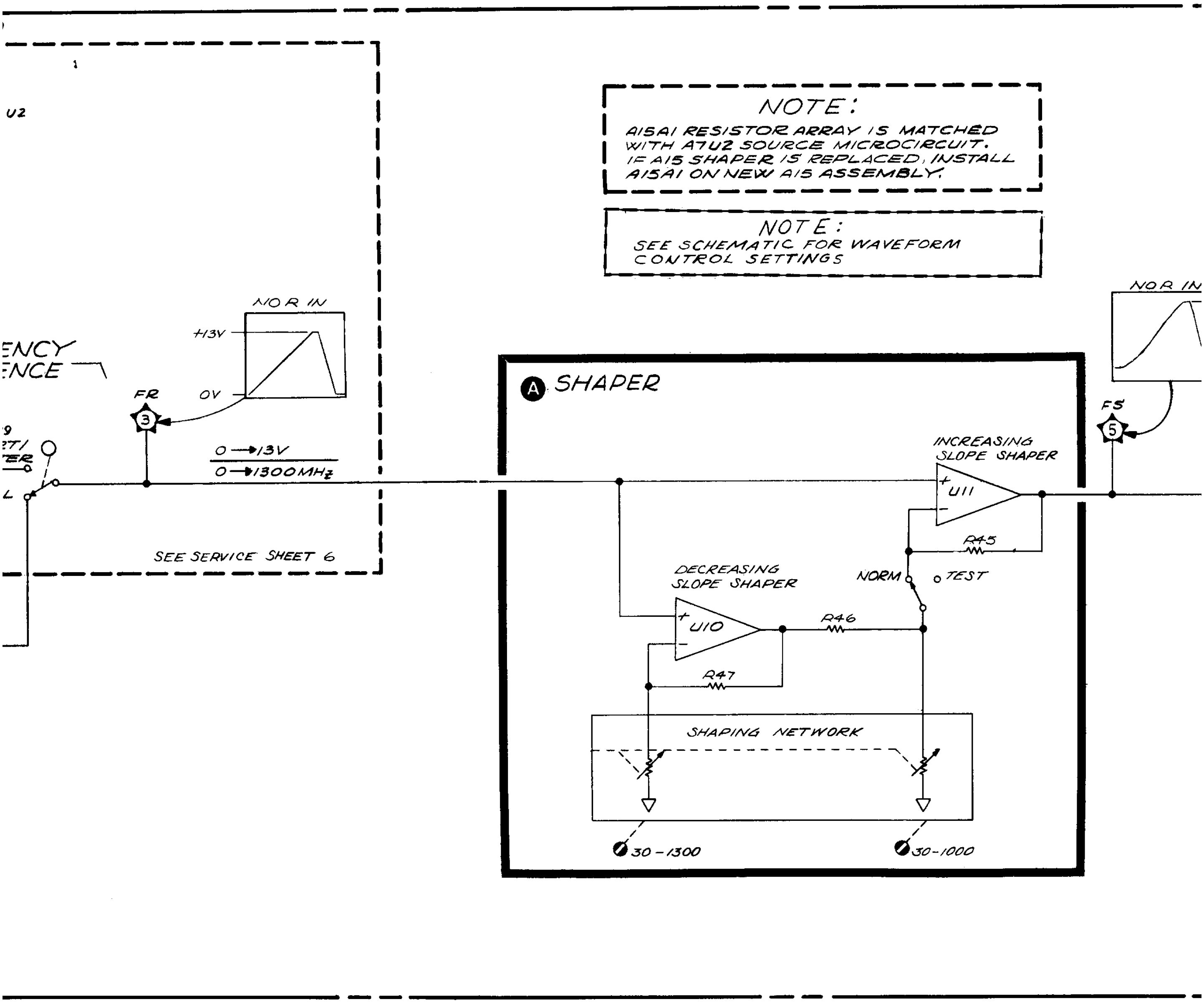
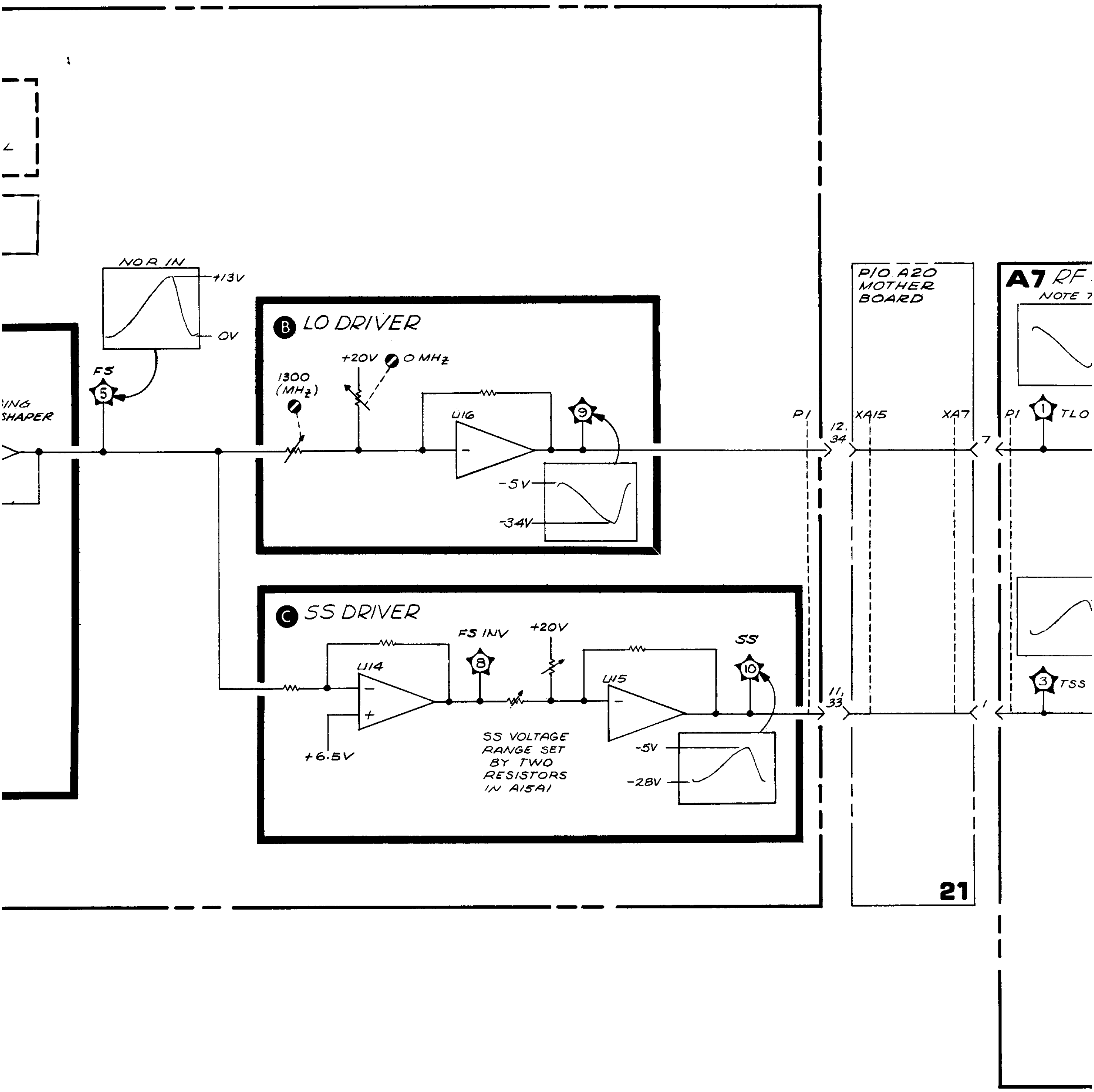


Figure 8-37. Source (A7), Component Locations

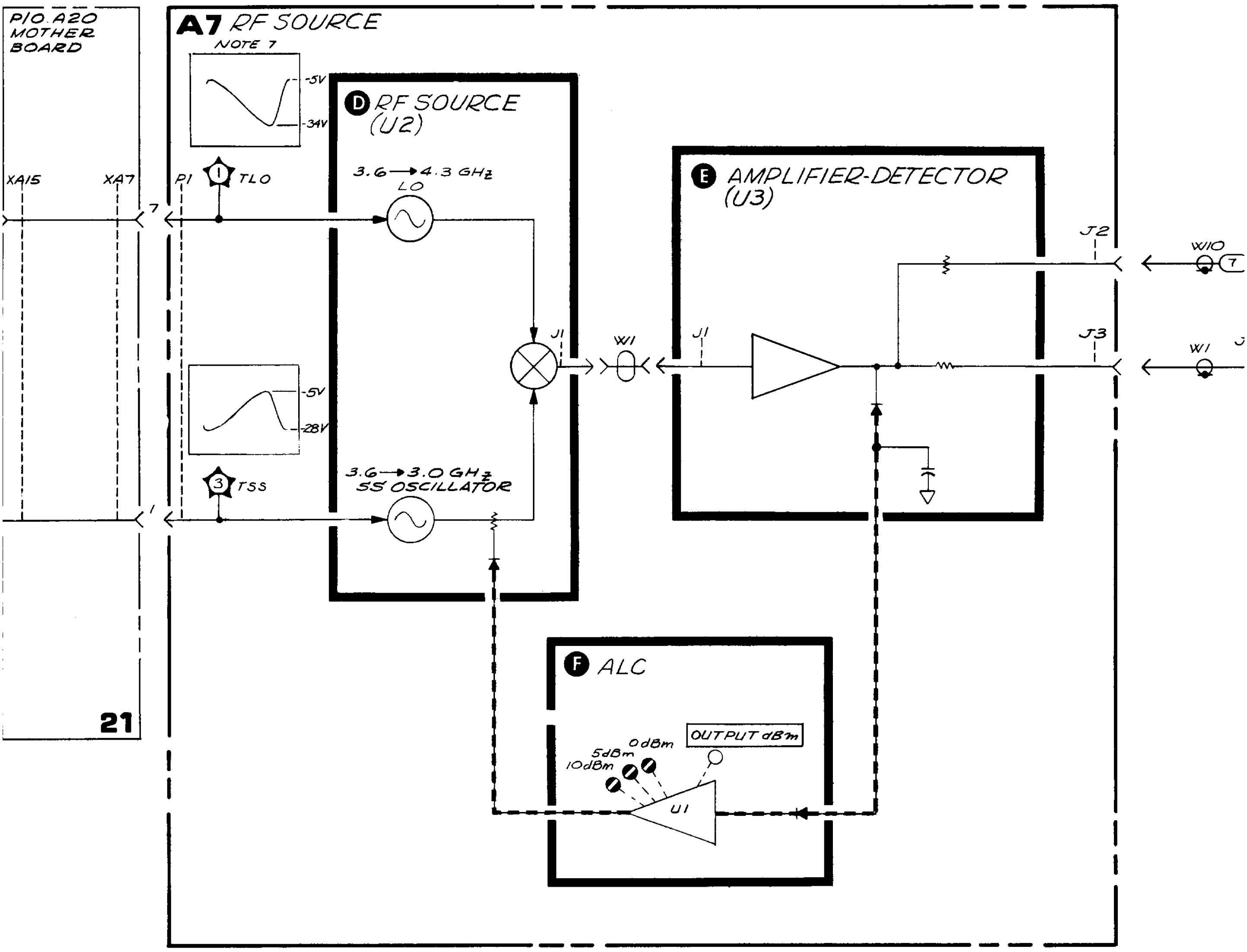

P/O A1/A2 FRONT PANEL
TUNING
FINE
FREQUENCY MHZ DISPLAY
SWEEP WIDTH CONTROL
SWEEP WIDTH MHz
A2U12
6
A15 SHAPER
START/CENTER TUNE
U2
2
T
FREQUENCY REFERENCE
FR
3
U8, U9
START/ CENTER
FULL
SEE S
P/O A17 SWEEP GENERATOR
0→10V
VSWP
8
5
+10
0



NOTE:
A15A1 RESISTOR ARRAY IS MATCHED WITH A7U2 SOURCE MICROCIRCUIT. IF A15 SHAPER IS REPLACED, INSTALL A15A1 ON NEW A15 ASSEMBLY.
NOTE:
SEE SCHEMATIC FOR WAVEFORM CONTROL SETTINGS
U2
NOR IN
+13V
0V
FR
3
0 → 13V
0 → 1300MHz
SEE SERVICE SHEET 6
A SHAPER
INCREASING SLOPE SHAPER
U11
R45
NORM
TEST
DECREASING SLOPE SHAPER
U10
R46
R47
SHAPING NETWORK
30 - 1300
30-1000
FS
5
NOR IN



NOR IN
+13V
0V
FS
5
ING
SHAPER
B LO DRIVER
+20V
0 MHz
1300 (MHz)
U16
9
-5V
-34V
C SS DRIVER
FS INV
8
+20V
SS
10
U14
U15
+6.5V
SS VOLTAGE RANGE SET BY TWO RESISTORS IN A15A1
-5V
-28V
P1
12, 34
11, 33
XA15
XA7
7
1
P/O A20 MOTHER BOARD
21
A7 RF
NOTE 7
P1
1
TLO
3
TSS


P/O A20
MOTHER
BOARD
XA15
XA7
21
A7 RF SOURCE
NOTE 7
-5V
-34V
-28V
P1
1 TLO
3 TSS
D RF SOURCE
(U2)
3.6→4.3 GHz
LO
3.6→3.0 GHz
SS OSCILLATOR
J1
W1
E AMPLIFIER-DETECTOR
(U3)
J2
J3
W10
F ALC
OUTPUT dBm
0dBm
5dBm
10dBm
U1

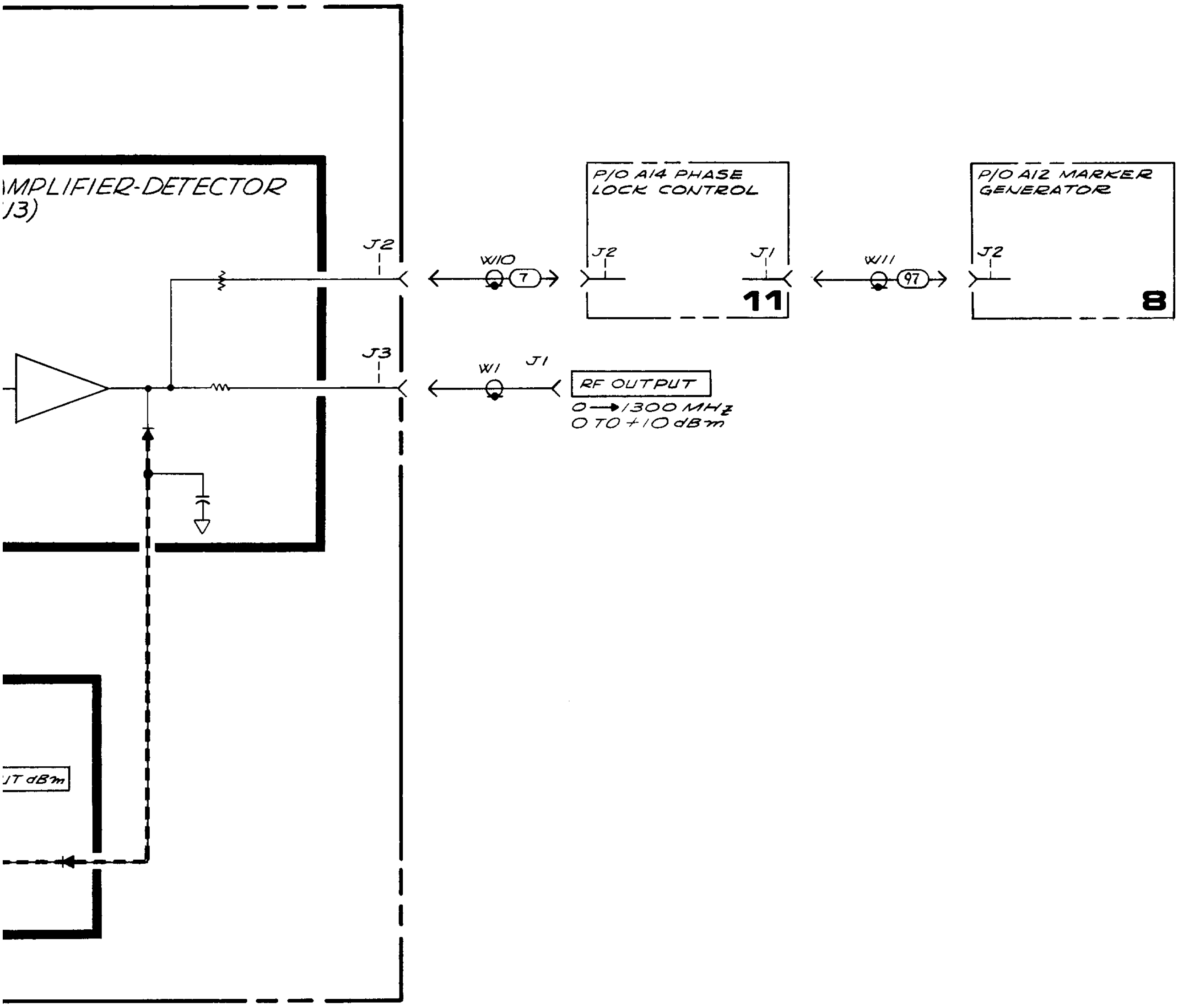


Figure 8-38. Shaper (A15) and Source (A7), Block Diagram

A15

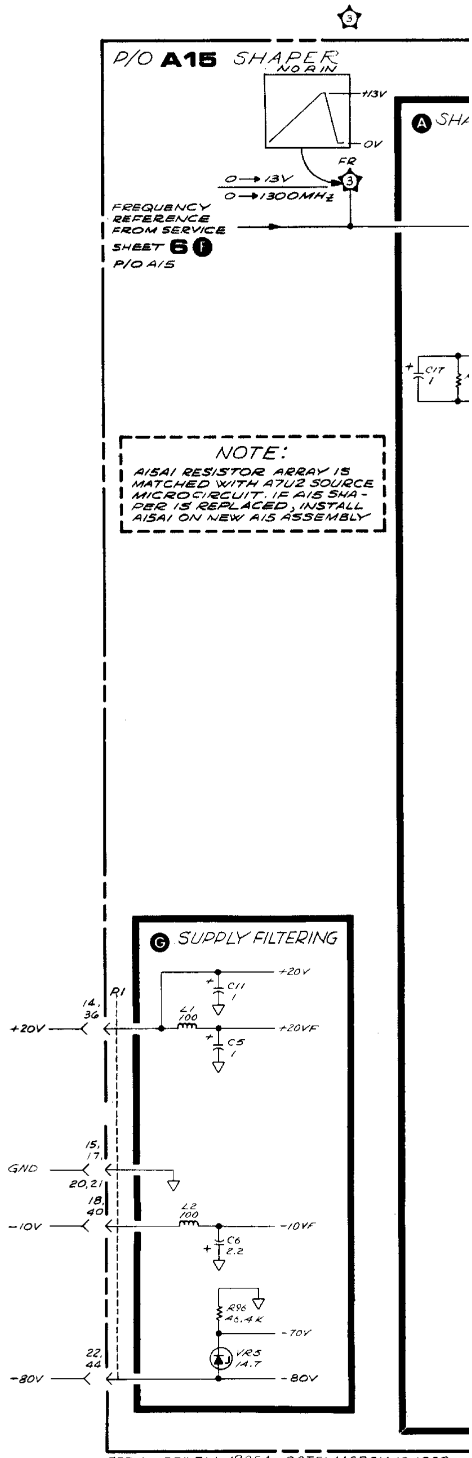
P1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SERVICE SHEET
1	TUNE	J1-46		6
23	TUNE	J1-46		6
2	TUNING WIPER	J2- 4		6
24	TUNING WIPER	J2- 4		6
3	FINE WIPER	J2-3		6
25	FINE WIPER	J2-3		6
4	TUNING V REF	J2-7		6
26	TUNING V REF	J2-7		6
5	LENGTH REF	J2-23		6
27	FREQ REF	XA14-9 J2-35		6
6	H LGTH	J5-7		6
28	L EXT RF	J2-24		6
7	WIDTH 1-10	J1-31		6
29	WIDTH 1-10	J1-31		6
8	WIDTH 20-1K	J1-29		6
30	WIDTH 20-1K	J1-29		6
9	H FULL	J1-32		6
31	H FULL	J1-32		6
10	VSWP	XA17-18,40		6
32	VSWP	XA17-18,40		6
11	VSS	XA7-1	C	
33	VSS	XA7-1	C	
12	VLO	XA7-7	B	
34	VLO	XA7-7	B	
13	H BLANK	XA17-23		6
35	H BLANK	XA17-23		6
14	+20V		G	
36	+20V		G	
15	▽		G	
37	▽		G	
16	+5.2V			6
38	+5.2V			6
17	▽		G	
39	▽		G	
18	-10V		G	
40	-10V		G	
19	LF MARKER	XA12-19,41		6
41	LF MARKER	XA12-19,41		6
20	▽		G	
42	▽		G	
21	▽		G	
43	N.C.			
22	-80V	XA19-10,32	G	
44	-80V	XA19-10,32	G	

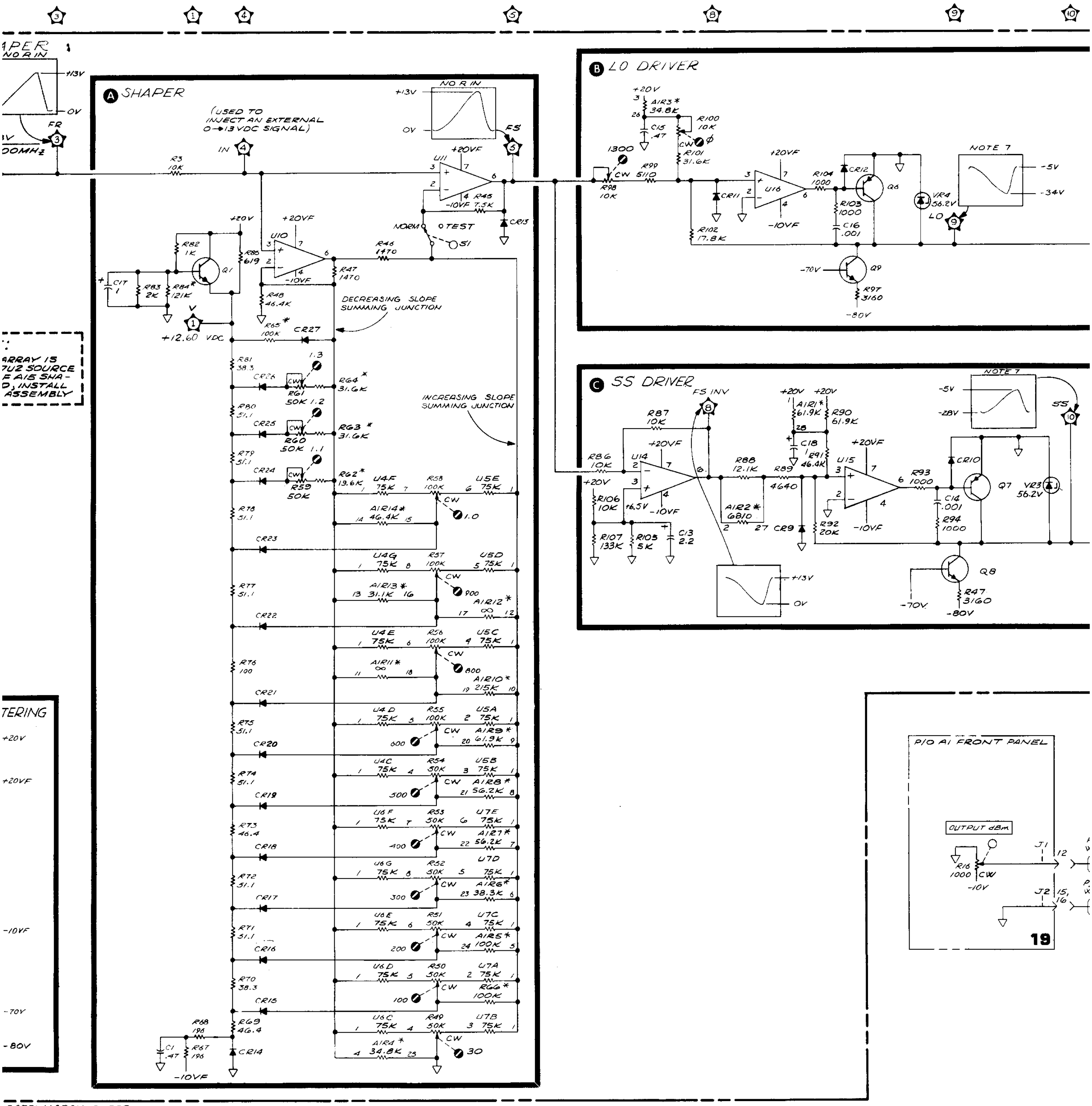
A7

P1

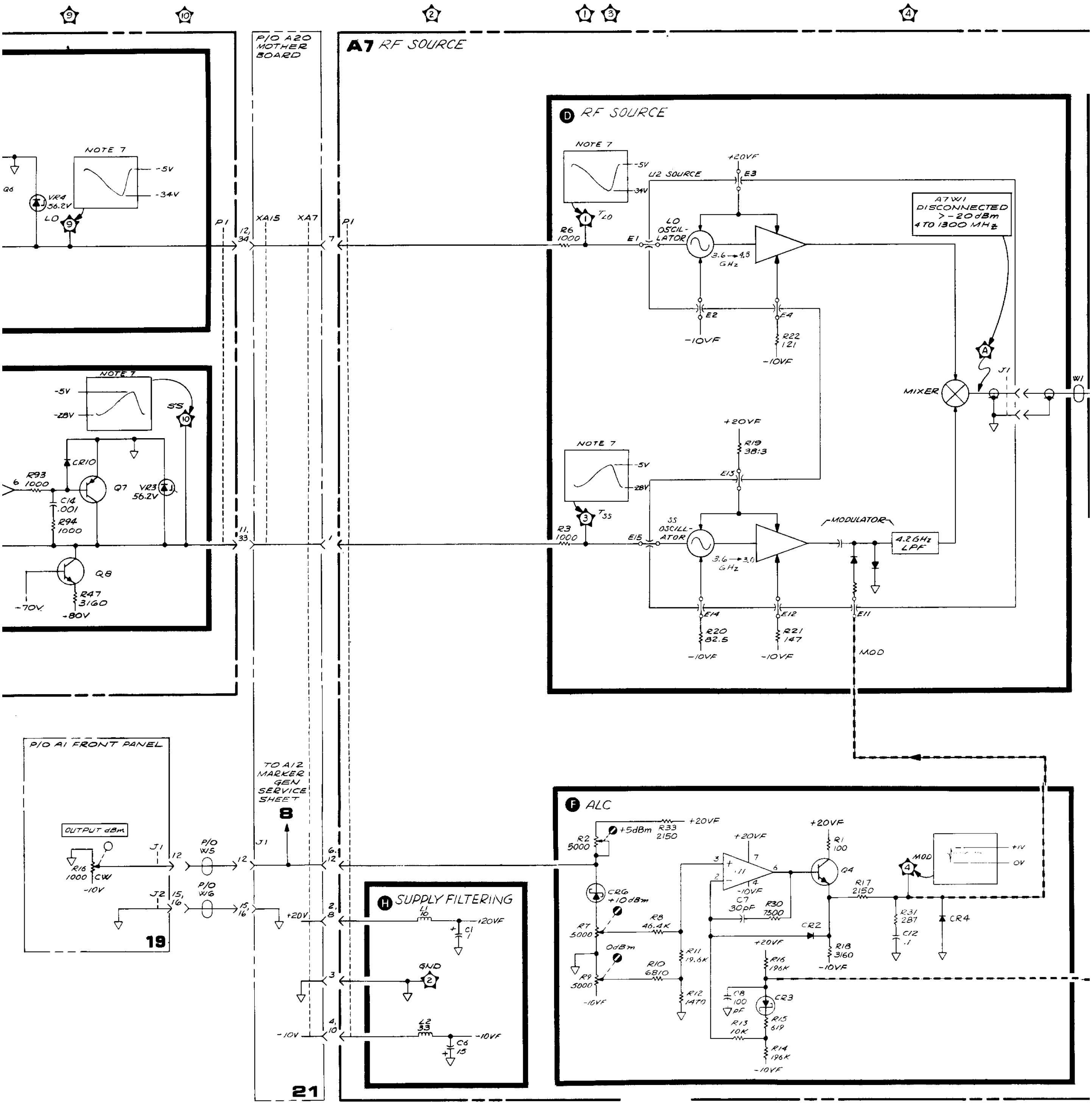
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	VSS	XA15-11,33	D
7	VLO	XA15-12,34	D
2	+20V		H
8	+20V		H
3	▽		H
9	▽		H
4	-10V		H
10	-10V		H
5	NC		
11	NC		
6	OUTPUT DBM	A1J1-12	E
12	OUTPUT DBM	A1J1-12	E

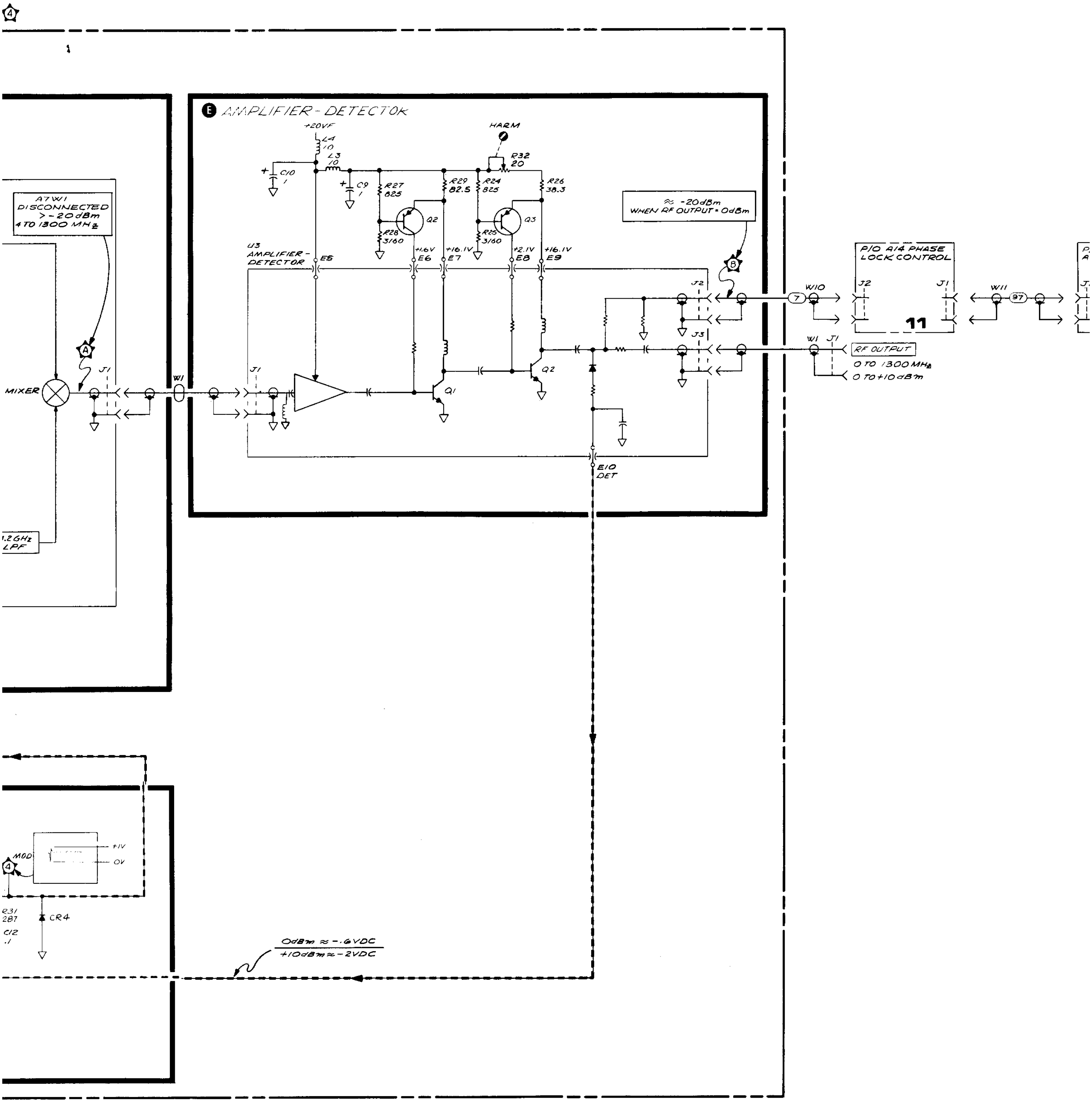


SERIAL PREFIX 1925A DATE: MARCH 12, 1979



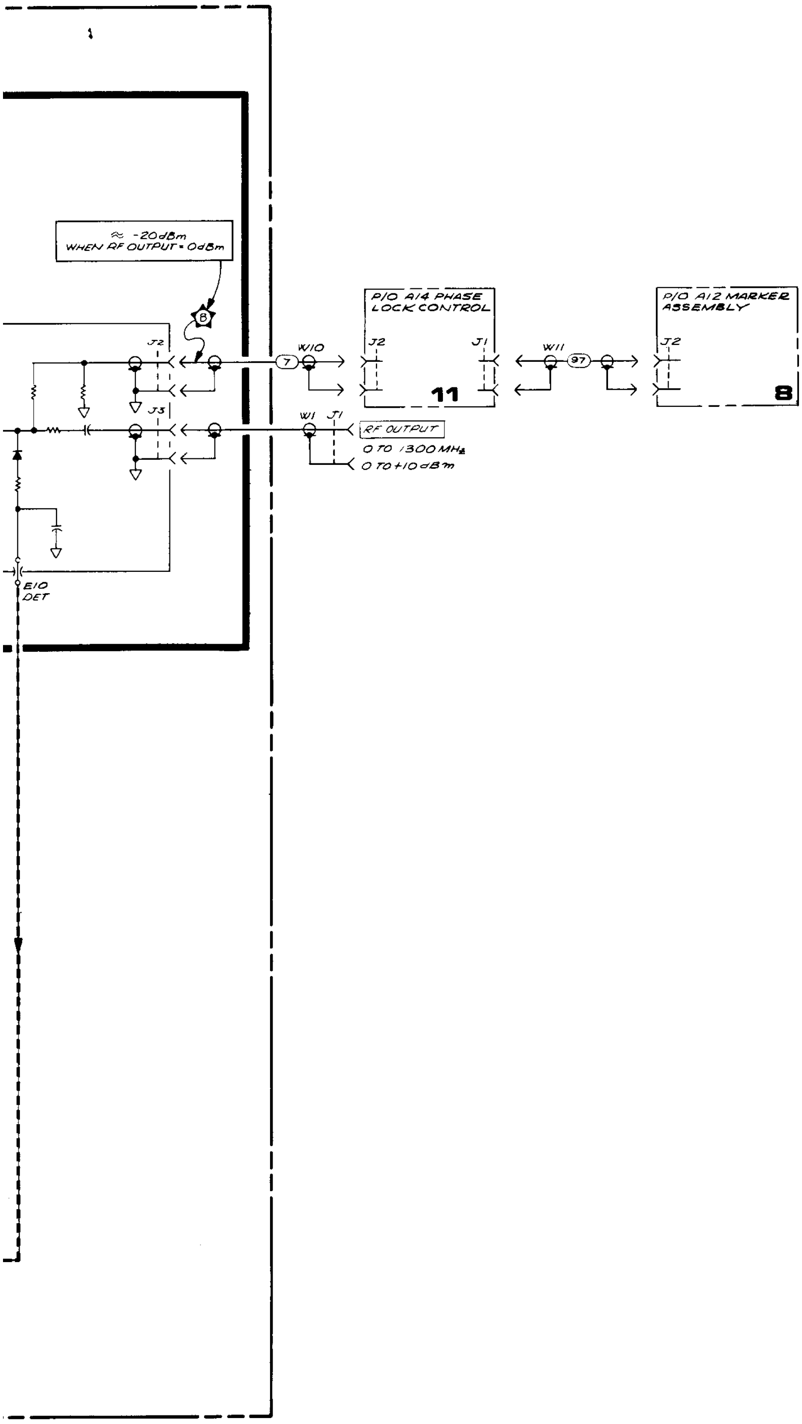
DATE: MARCH 12, 1979


A7 RF SOURCE
P/O A20 MOTHER BOARD
D RF SOURCE
NOTE 7
U2 SOURCE
+20VF
LO OSCIL-LATOR
3.6 → 4.5 GHz
A7W1 DISCONNECTED > -20dBm 4 TO 1300 MHz
MIXER
SS OSCIL-LATOR
3.6 → 3.0 GHz
MODULATOR
4.2GHz LPF
MOD
-10VF
P/O A1 FRONT PANEL
OUTPUT dBm
TO A12 MARKER GEN SERVICE SHEET
8
F ALC
+5dBm
+10dBm
0dBm
H SUPPLY FILTERING
GND
19
21



4
E AMPLIFIER - DETECTOR
+20VF
L4 10
L3 10
C10 1
C9 1
R27 825
R28 3160
Q2
R29 82.5
R24 825
R25 3160
Q3
HARM
R32 20
R26 38.3
U3 AMPLIFIER - DETECTOR
E5
+1.6V E6
+16.1V E7
+2.1V E8
+16.1V E9
≈ -20dBm WHEN RF OUTPUT = 0dBm
B
J2
J3
W10
7
P/O A14 PHASE LOCK CONTROL
J2
J1
11
W11
97
W1
J1
RF OUTPUT
0 TO 1300 MHz
0 TO +10dBm
A7W1 DISCONNECTED >-20dBm 4 TO 1300 MHz
A
MIXER
J1
W1
J1
Q1
Q2
E10 DET
1.2 GHz LPF
MOD
4
+1V
0V
R31 287
C12 .1
CR4
0dBm ≈ -.6VDC
+10dBm ≈ -2VDC

Figure



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

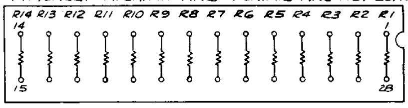
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

3. * ASTERISK DENOTES A FACTORY-SELECTED VALUE. VALUE SHOWN IS TYPICAL.

4. ALL WAVEFORMS SHOWN ARE WITH FRONT PANEL CONTROLS AS FOLLOWS:

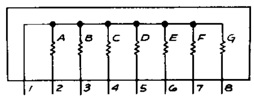
   INPUT R: NO RF INPUT
   SWEEP: INT (REAR PANEL)
   SWEEP MODE: FULL 4-1300
   OUTPUT dBm: +10
   SWEEP: AUTO, FAST.

5. A15A1 RESISTOR AND PIN LOCATIONS: TYPICALLY A15A1R11 AND A15A1R12 ARE NOT LOADED



TOP VIEW

6. A15U4-7 PIN LOCATIONS:



7. WAVEFORMS SHOWN ARE TYPICAL, BUT MAY VARY, DUE TO THE PARTICULAR TUNING CHARACTERISTICS OF THE 3.3 AND LO OSCILLATORS.

8. TROUBLESHOOTING HINTS:

   A. A15A1 RESISTOR ARRAY IS MATCHED WITH A7U2 SOURCE MICROCIRCUIT. IF A15 SHAPER IS REPLACED, INSTALL A15A1 ON NEW A15 ASSEMBLY. IF A7U2 SOURCE MICROCIRCUIT IS REPLACED, INSTALL A15A1 SUPPLIED WITH MICROCIRCUIT BEFORE PERFORMING ADJUSTMENTS.

   B. WAVEFORM IRREGULARITIES DUE TO PHASE LOCK ACQUISITIONS CAN BE REMOVED BY DISCONNECTING THE RF INPUT TO THE FRONT PANEL INPUT R CONNECTOR.

7
A15,A7

Figure 8-39. Shaper (A15) and Source (A7), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 8

MARKER GENERATOR (A12), CIRCUIT DESCRIPTION

The Marker Generator (A12) provides frequency markers at 50-, 10-, or 1-MHz intervals over the instrument frequency range. The RF signal is mixed with harmonics of a crystal-controlled, 50-MHz oscillator to produce the 50-MHz markers. The 10-and 1-MHz markers are produced in the same way, except that the output of the 50-MHz oscillator is first divided by 5 or 50. The H MKR output signal is sent to the Deflection Amplifiers (A18, Service Sheet 16).

The network analyzer has a provision for external markers, in which case a signal from an external oscillator is mixed with the RF signal to produce a marker.

Marker Oscillator (B)

The Marker Oscillator circuit includes the crystal-controlled, 50-MHz oscillator, frequency dividers, and a means to select the 50-, 10-, and 1-MHz markers.

50-MHz Oscillator. The 50-MHz Oscillator consists of amplifier U4D and associated circuitry. The frequency-determining network is formed by crystal Y1, tank circuit L1 and C27, and FREQ ADJ capacitor C29. R35 provides a low load impedance to Y1. Amplifier U4C is a buffer stage. R34 and R36 provide the pulldown necessary for emitter-coupled logic (ECL) at the outputs of U4D and U4C.

NOTE

An ECL logical low (0) is about +3.3V and a high (1) is about +4.1V. A change in ECL state is represented by a voltage change of about 0.8V.

The signal at TP1 is a 50-MHz square wave whose amplitude varies between +3.3V and +4.1 V.

Divide by 5. The ECL counter U1 is connected in a configuration to divide by 5 when the front-panel MARKERS MHz switch is set to 1 or 10. The input at U1 pin 7 is a 50-MHz square wave, and the output at U1 pin 4 is a 10-MHz square wave. If either 1- or 10-MHz markers are selected, demultiplexer U6A or U6C pulls U1 pin 9 (reset) low, effectively enabling the counter. When the MARKERS MHz switch is set to OFF or 50, U1 pin 9 is high and the counter does not count.

Divide by 10. When the MARKERS MHz switch is set to 1, ECL counter U2 pin 9 is pulled low, inhibiting the reset. The 10-MHz square wave from U1 pin 4 is the ÷5 clock input at U2 pin 7. The 2-MHz square wave output at U2 pin 2 is fed back to the ÷2 clock input at U2 pin 12. The final output at U2 pin 15 is a 1-MHz square wave. When the MARKERS MHz switch is set to OFF, 50, or 10, U2 pin 9 is high and the counter does not count.

Marker Select. Marker Select multiplexer U5 selects the 1-MHz square wave from U2 pin 15, the 10-MHz square wave from U1 pin 4, or the 50-MHz square wave from U4C pin 14 and sends the output at U5 pin 15 to the Harmonic Generator.

Harmonic Generator (A)

The square wave from the Marker Oscillator circuit is applied to non-inverting amplifier U4B and to inverting amplifier U4A, whose outputs are of opposite polarity. This provides a logic level change of 1.6V (twice the normal ECL output) across the step-recovery diode CR3, alternately turning it on and off. When the diode is turned on, however, the reversal of current flow is resisted by the trace inductances. The collapsing inductive field produces negative spikes with a frequency spectrum containing harmonics of the Marker Oscillator frequency.

Internal Marker Sampler and Bias (D)

The sampler diode CR2 produces a zero-frequency beat output each time the RF INPUT frequency equals a harmonic of the Marker Oscillator. This difference frequency is gated through source follower Q2A, Q2B to the Step Gain Amplifier. (The RF Source signal is routed through A14 Phase Lock Control, where it is attenuated, before it is sent to the Marker Generator.)

When either 10- or 50-MHz markers are selected, FET Q1 is turned on, and the sampling efficiency is adjusted by BIAS 10, 50 potentiometer R12. When 1-MHz markers are selected, a low at pin 10 of demultiplexer U6B switches +5.2V to the gate of Q1, turning it off and adding BIAS 1 potentiometer R13 to the circuit. This allows independent adjustment of the 1-MHz sampling efficiency.

External Marker Mixer (C)

The operation of the External Marker Mixer circuit is similar to that of the Internal Marker Sampler. Diode CR1 mixes the RF Source frequency (from A7) with the frequency of the rear-panel EXT RF MKR signal. The difference frequency is gated through source follower Q3A, Q3B to the Step Gain Amplifier. If only the external marker is desired, the front-panel MARKERS MHz switch should be in OFF.

Step-Gain Amplifier (E)

The sampler differenc frequencies are passed to amplifier Q5, Q6 through buffer Q4 and a 3.4-MHz low-pass filter. The gain of the amplifiers for the 1-, 10-, and 50-MHz markers is set by GAIN 50 potentiometer R19, GAIN 10 potentiometer R26, and GAIN 1 potentiometer R5. Q7 is turned on, placing R5 in the circuit, when its gate is pulled low by selection of 1-MHz markers. Selection of 10-MHz markers places R26 in the circuit through Q8 in the same manner. (GAIN 50 affects GAIN 10 and GAIN 1.)

Gated Amplifiers (F)

The signal from the Step-Gain Amplifier (a birdie pattern similar to that shown in Figure 8-41) is gated to pass through the 400-kHz low-pass filter when the front-panel SWEEP WIDTH MHz is set to a sweep width of 20 MHz or less and when START or CENTER mode is selected. For SWEEP WIDTH MHz settings of 50 or greater, or in FULL 4—1300 mode, the 400-kHz low-pass filter is bypassed. VR2 establishes the correct negative supply voltage.

Modulator (H)

The Modulator, which consists of multiplier U10 and associated circuitry, establishes a fairly constant amplitude birdie (BIRDY) signal at TP4 regardless of the RF source power established by the front-panel OUTPUT dBm control.

Comparator (J)

Figure 8-40. compares the birdie (BIRDY) monitored at TP4 with the PULSE monitored at TP5. A positive voltage at the non-inverting input of the comparator in U9 sets the threshold that must be exceeded at the inverting input to change the logic state at the output. When the amplitude of the birdie signal goes sufficiently positive, the output of the comparator (TP5) goes low, generating a negative-going, square-wave pulse. The amplitude of the birdie signal varies at a frequency-modulated rate corresponding to the changing difference frequency obtained from the Internal Sampler and Bias circuit or from the External Mixer circuit. R29 provides the required amount of hysteresis for noise immunity. The result is a frequency-modulated pulse train in which the pulse width increases as the difference frequency approaches zero. (See Figure 8-41).

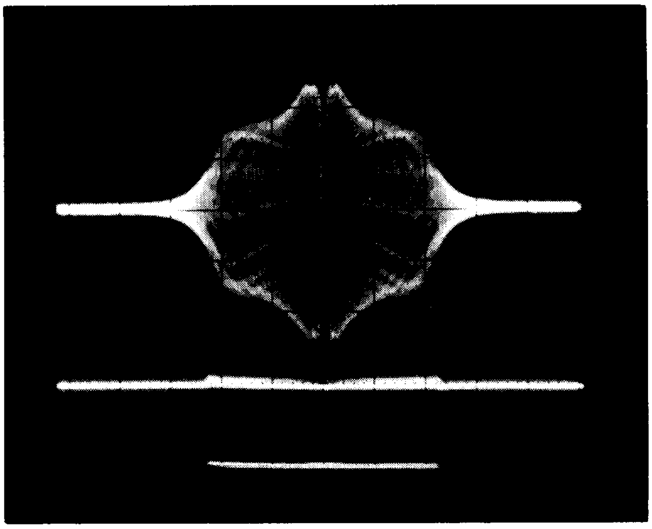


Figure 8-40. BIRDY and PULSE Waveforms

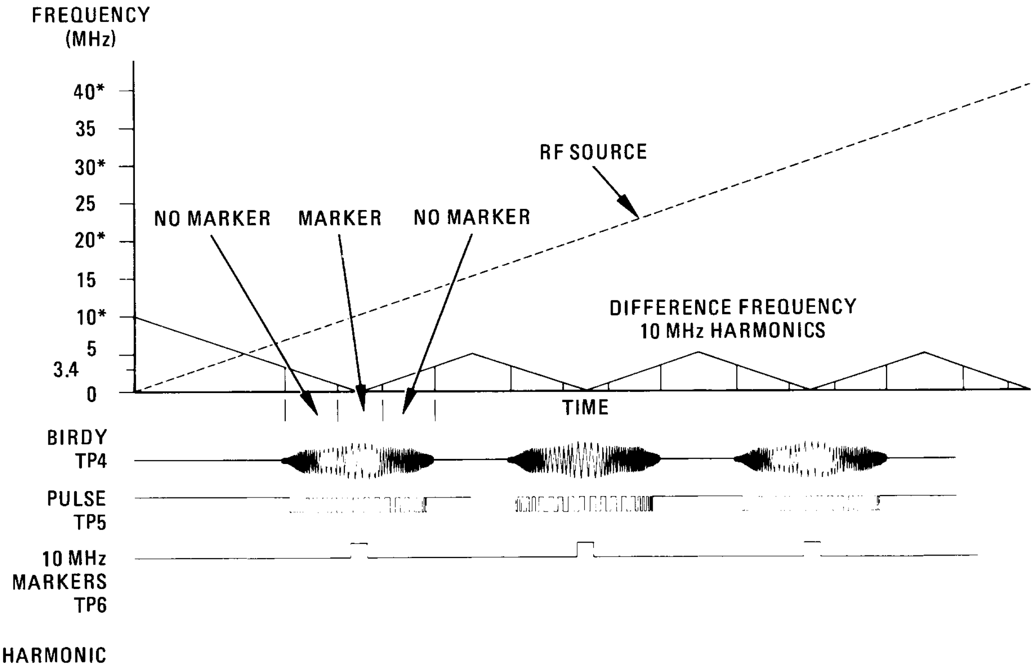


Figure 8-41. Pulse Width Discrimination

Pulse Width Discriminator (K)

The Pulse Width Discriminator detects birdie pulses that are wide enough to produce an acceptable display on the CRT (see Figure 8-41). The width of the pulses thus detected depends on the setting of the front-panel SWEEP WIDTH MHz switch.

Essentially, the square-wave birdie (PULSE) signal is compared with the output pulse generated by a one-shot multivibrator. The output pulse width is controlled by the three lines from the SWEEP WIDTH MHz switch via the Switch Interface circuit.

One-Shot Multivibrator U12 is triggered on the negative edge of the PULSE signal at pin 1. At this time the output (pin 8) goes high. The output remains high until one of the following events occurs: (1) U12 is reset (low at pin 5), or (2) U12 is "timed out" at the end of a period determined by the RC time constant of R30 and capacitor C22, C23, C24, C25, or C53, as selected by multiplexer U11 (see table on schematic). When either of these conditions is met, the output pulse is terminated (U12 pin 8 goes low).

As shown in Figure 8-42, a marker is displayed on the CRT when the birdie pulse width is greater than the output pulse of U12.

NAND gate U14D controls the reset of U12. Since U14 pin 13 is high when U12 is triggered, a low at U14D pin 11 can occur, resetting the multivibrator, only if the PULSE signal goes high before the end of the RC time period (see Figure 8-42).

The D input (pin 2) of Marker Flip-Flop U13 is transferred and latched at the output (pin 5) when the clock input (pin 3) transitions from low to high. When U13 pin 5 is low, a marker is displayed on the CRT.

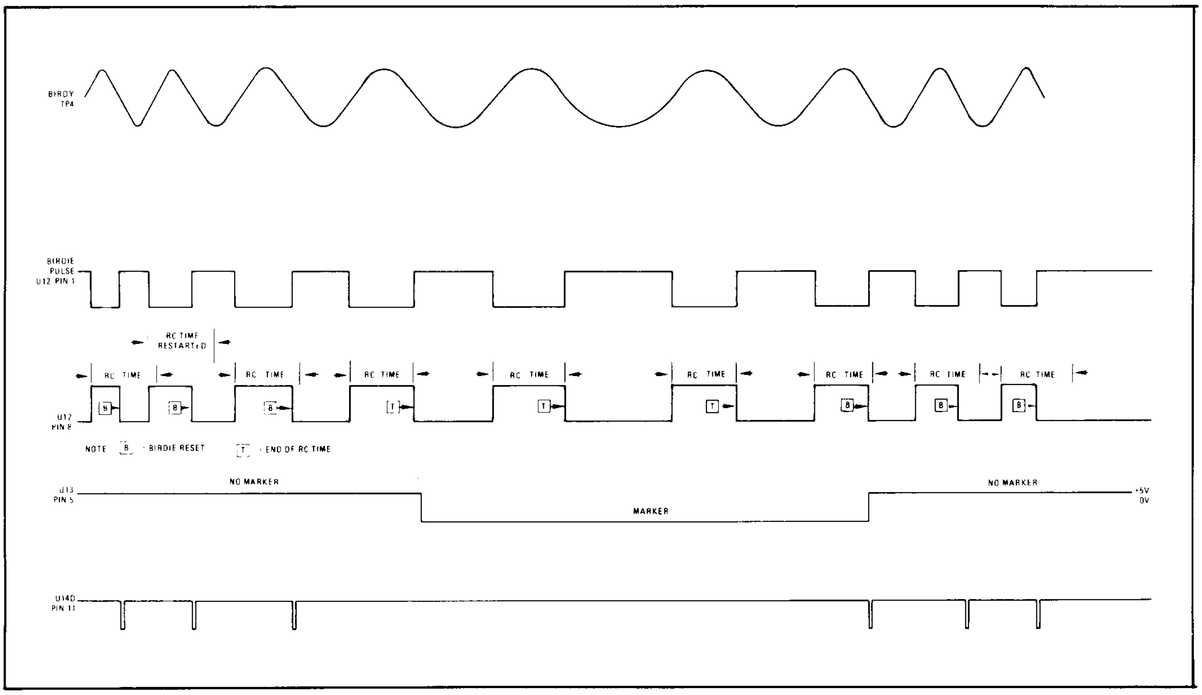


Figure 8-42. Pulse Width Discriminator Timing

Marker Summing (L)

NAND gate U14C functions as an OR gate that sends a marker signal (H MKR) to A18 Deflection Amplifiers when either pin 10 or pin 11 is low (or when both inputs are low). The positive-going MK signal is monitored at TP6 and (as H MKR) is sent to the Deflection Amplifiers (A18, Service Sheet 16).

When the LF MKR line from the Frequency Reference (A15) goes low, a marker is displayed on the CRT that is centered about the frequency to which the network analyzer is tuned. A marker is generated in A15 only in the FULL 4—1300 mode.

Marker Reset (I)

The Marker Reset circuit sets the output of flip-flop U13 high (the no-marker state) at regular intervals. A voltage transient could clock an undesired low logic level through the flip-flop, causing a marker to be displayed until the next normal clock pulse. The Marker Reset circuit removes such random markers by a negative pulse to U13 pin 4 at intervals of about 15 ms.

Multivibrator U15 free-runs at a frequency of about 68 Hz, generating 10-μs negative pulses. In the FULL 4—1300 mode, in SWEEP WIDTH MHz settings of 50 through 1000, or in the MARKERS MHz setting of 1, U13 pin 4 (reset) is held low and U15 pin 3 remains high.

C42 charges through R47 and R56 but discharges through R56 only. The duty cycle of U15 is set by the ratio of the two resistors. Therefore, the output at U15 pin 3 is high for about 15 ms and low for 10 μs. The negative pulse is inverted through U14B and again through U14A to set U13 pin 5 high.

The H MK EN input to U14B (from A14 Phase Lock Control) is high during trace, if RF frequency is greater than 3 MHz, and low during retrace. Thus, U13 pin 5 is held high during the retrace time, and the effect of a transient is nullified throughout retrace.

Switch Interface (G)

The Switch Interface circuit provides inputs to other circuits in the Marker Generator that depend on the front-panel settings. The effect of each switch or control setting is described as part of the pertinent circuit description.

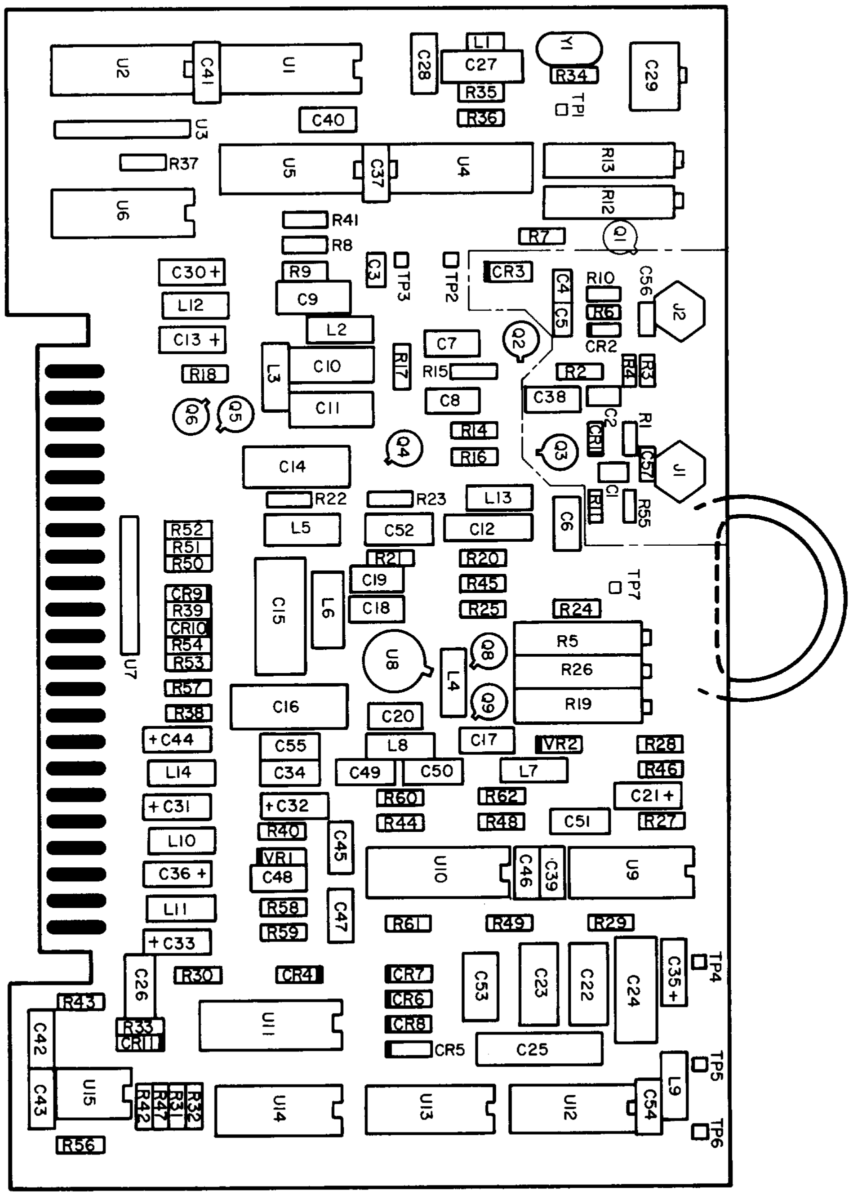
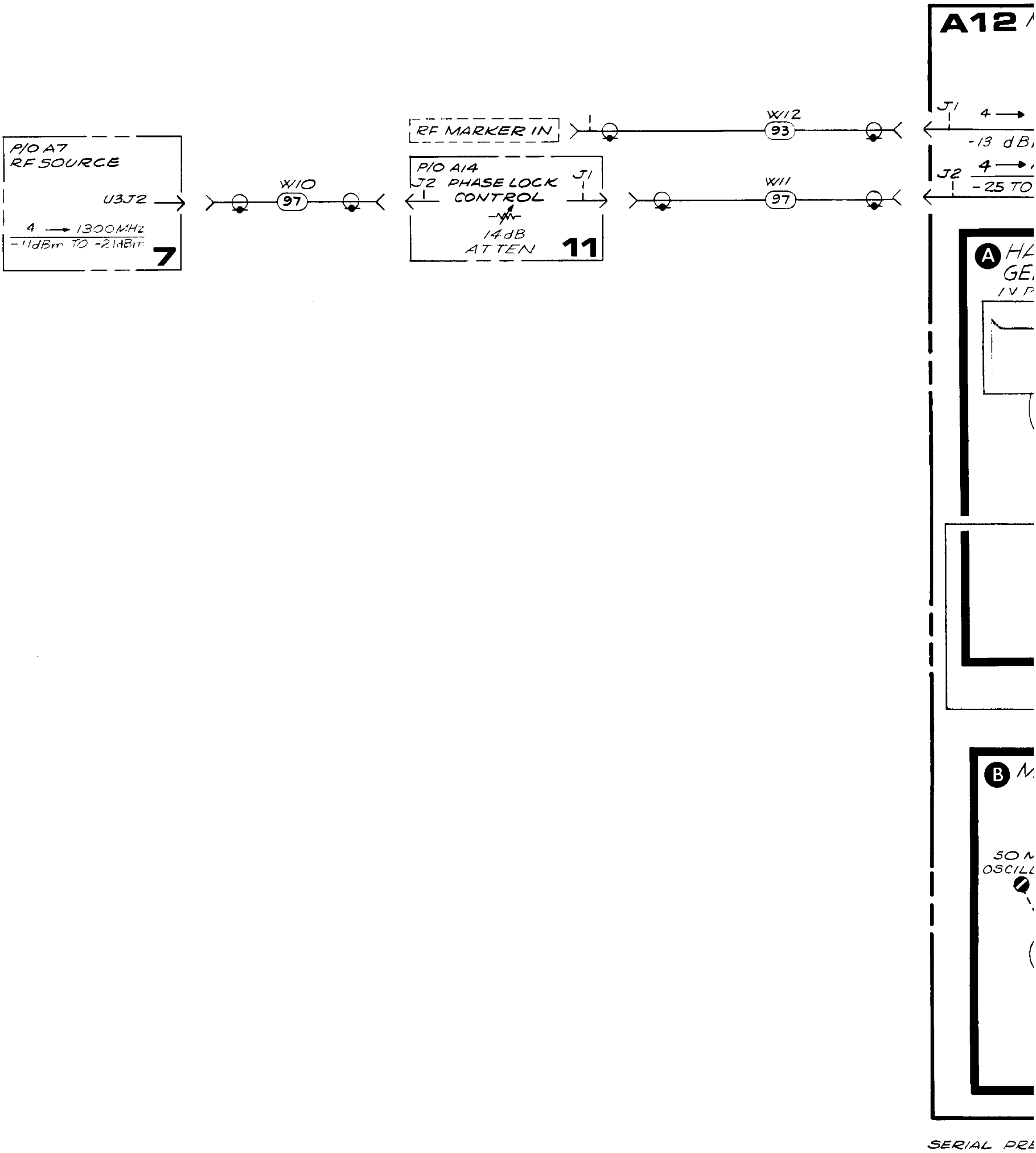
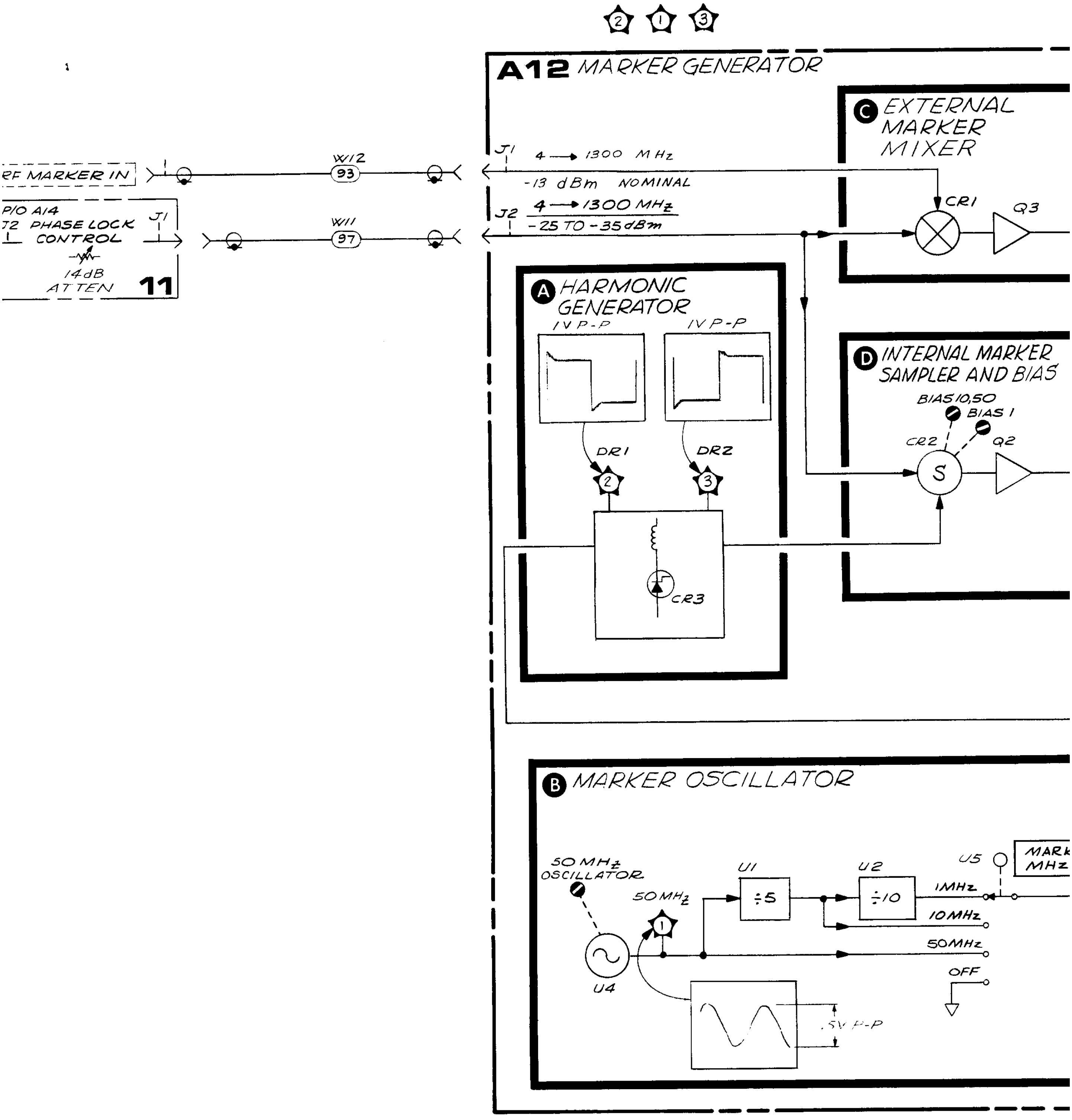
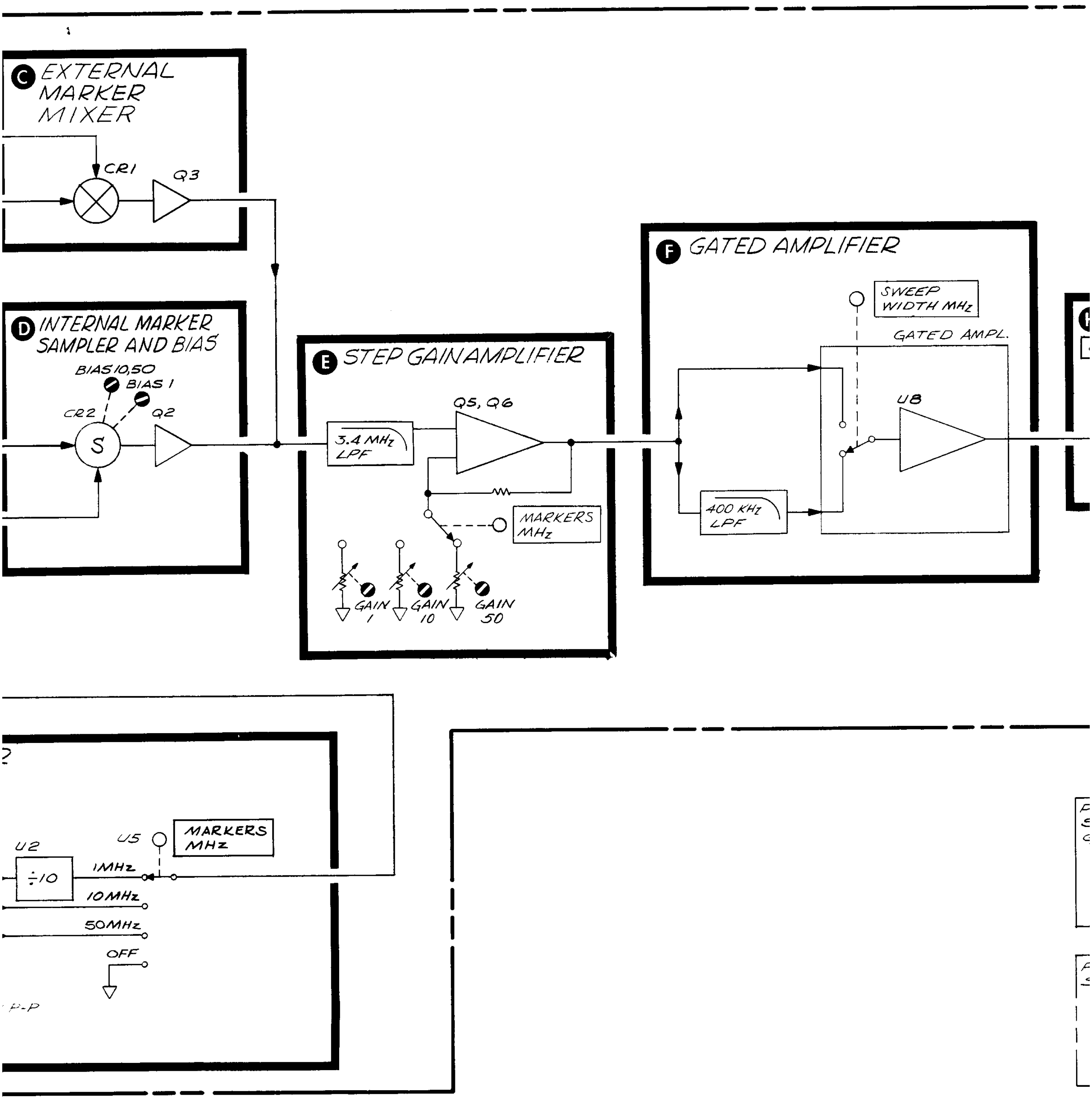


Figure 8-43. Marker Generator (A12), Component Locations

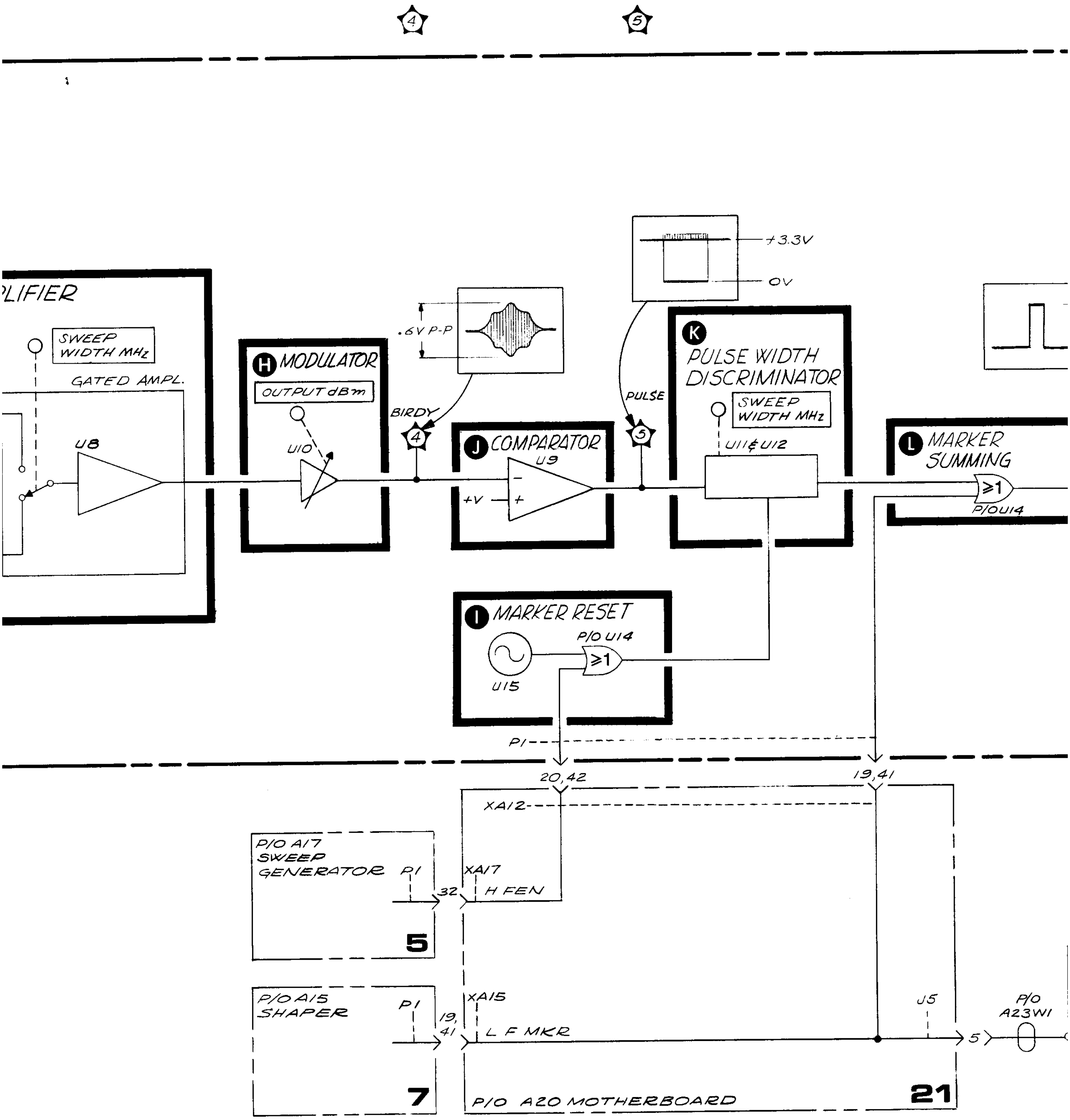

P/O A7
RF SOURCE
U3J2
4 → 1300MHz
-11dBm TO -21dBm
7
W10
97
RF MARKER IN
W12
93
P/O A14
J2 PHASE LOCK
CONTROL
J1
14dB
ATTEN
11
W11
97
A12
J1
4 →
-13 dB
J2
4 →
-25 TO
A
B
SERIAL PRE



SERIAL PREFIX: 1825A 16 AUG. 78



C EXTERNAL MARKER MIXER
CR1
Q3
D INTERNAL MARKER SAMPLER AND BIAS
BIAS 10,50
BIAS 1
CR2
Q2
S
E STEP GAIN AMPLIFIER
Q5, Q6
3.4 MHz LPF
MARKERS MHz
GAIN 1
GAIN 10
GAIN 50
F GATED AMPLIFIER
SWEEP WIDTH MHz
GATED AMPL.
U8
400 KHz LPF
U2
÷10
U5
MARKERS MHz
1MHz
10MHz
50MHz
OFF



4
5
PLIFIER
SWEEP WIDTH MHz
GATED AMPL.
U8
H MODULATOR
OUTPUT dBm
U10
.6V P-P
BIRDY
4
J COMPARATOR
U9
+V
+3.3V
0V
PULSE
5
K PULSE WIDTH DISCRIMINATOR
SWEEP WIDTH MHz
U11 & U12
L MARKER SUMMING
≥1
P/O U14
I MARKER RESET
P/O U14
≥1
U15
P1
20,42
19,41
XA12
P/O A17 SWEEP GENERATOR
P1
32
XA17
H FEN
5
P/O A15 SHAPER
P1
19, 41
XA15
L F MKR
J5
5
P/O A23W1
7
P/O A20 MOTHERBOARD
21

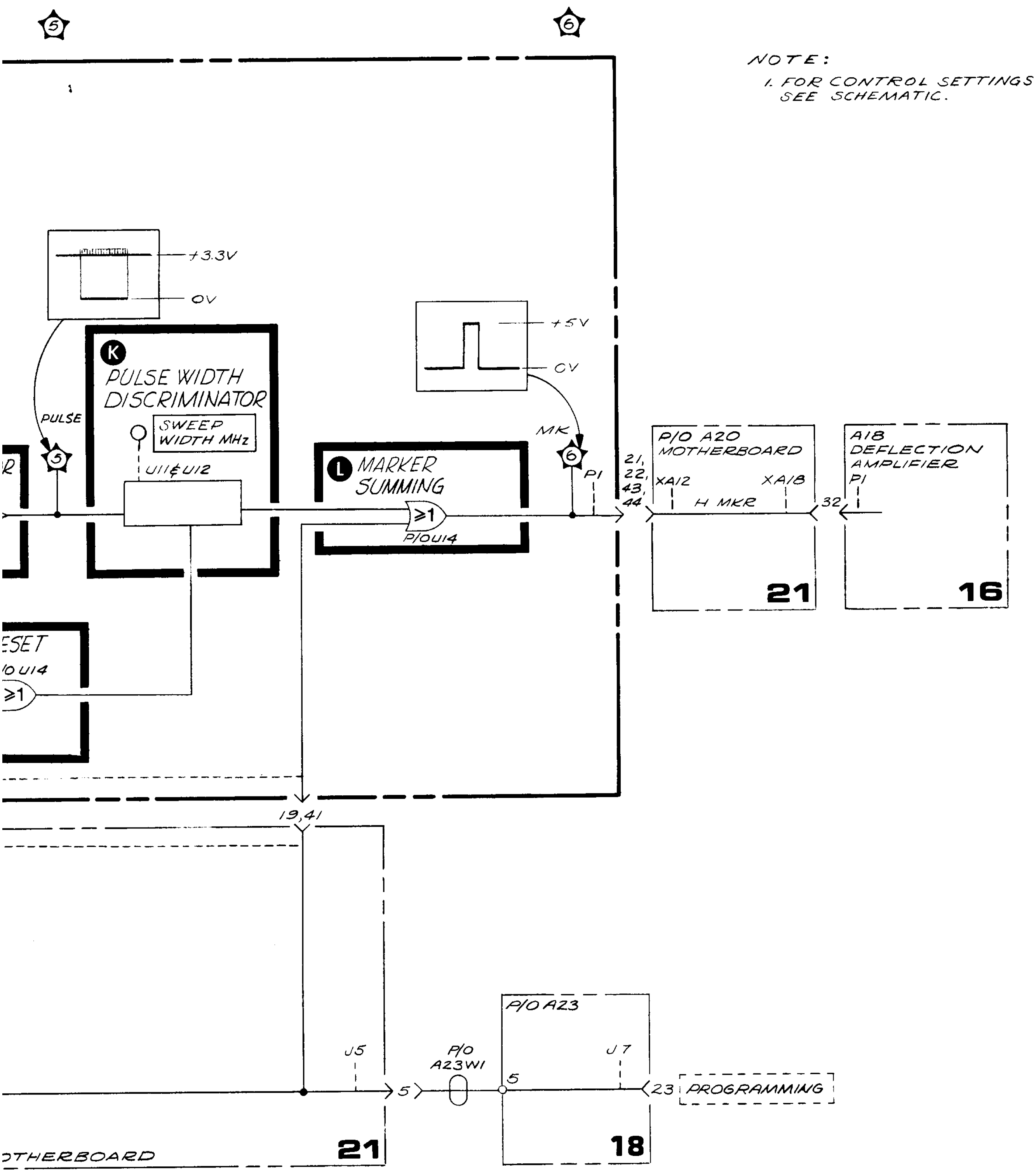


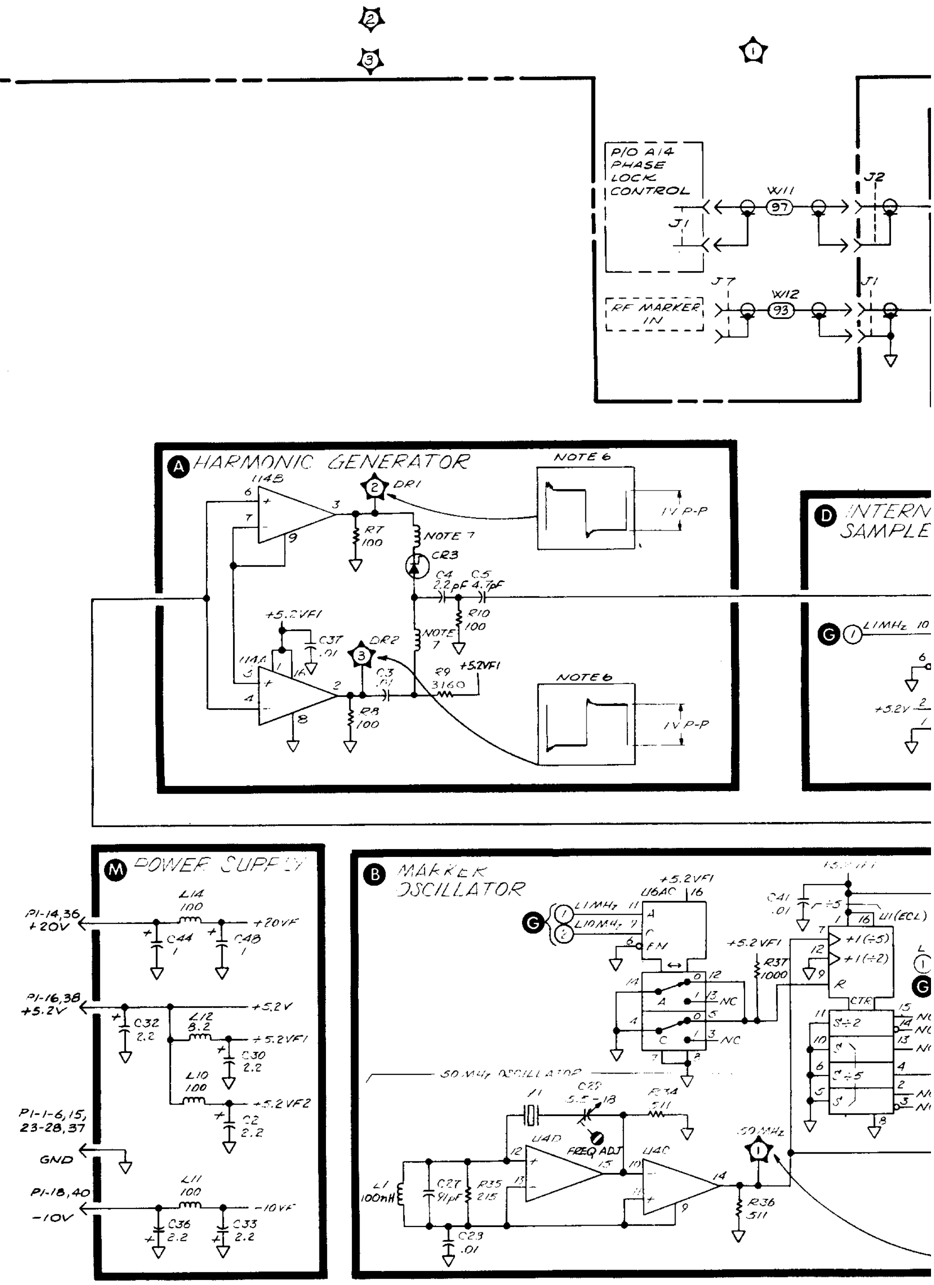
Figure 8-44. Marker Generator (A12), Block Diagram

18754A

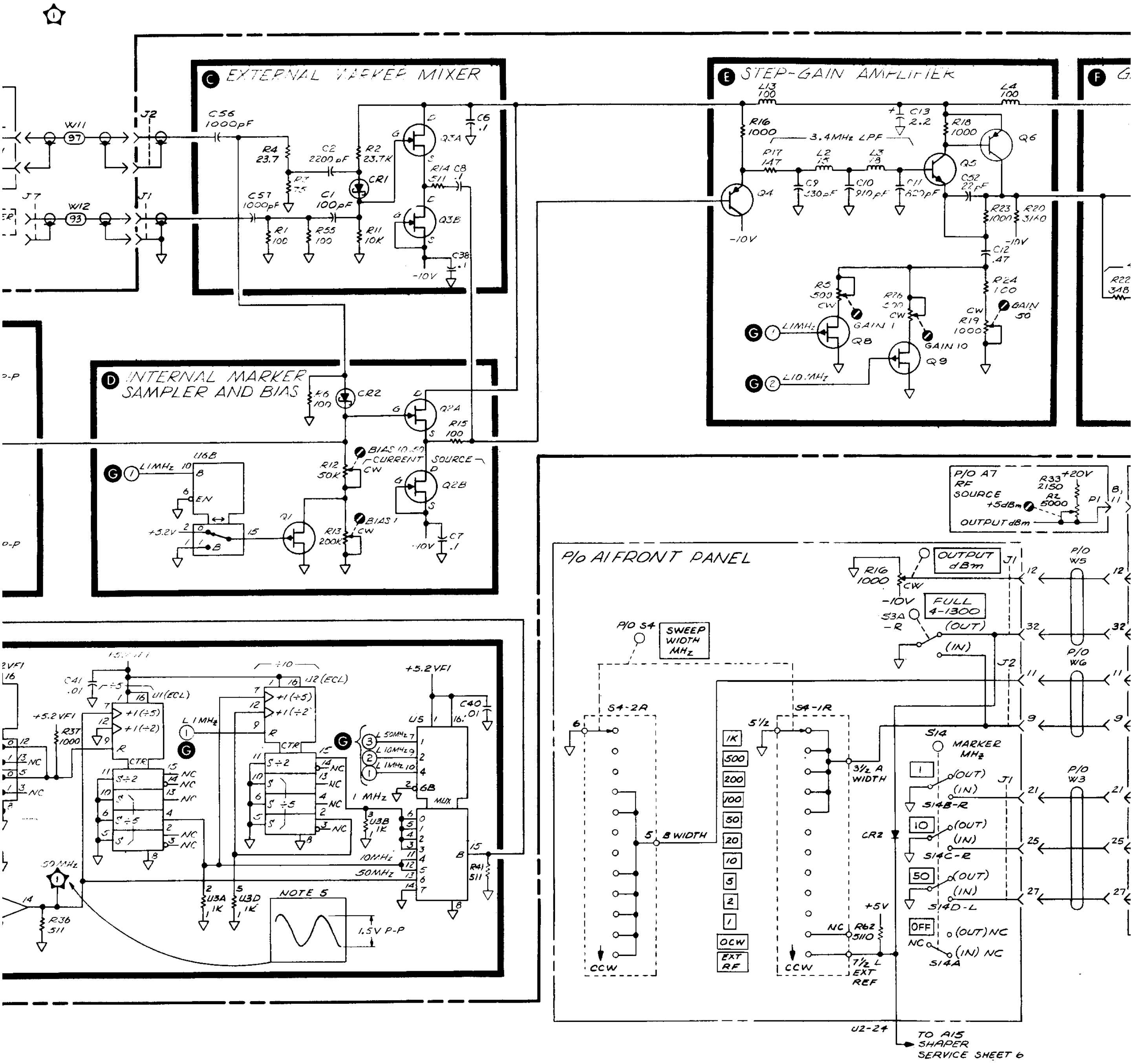
A12 MARKER GENERAL

P1

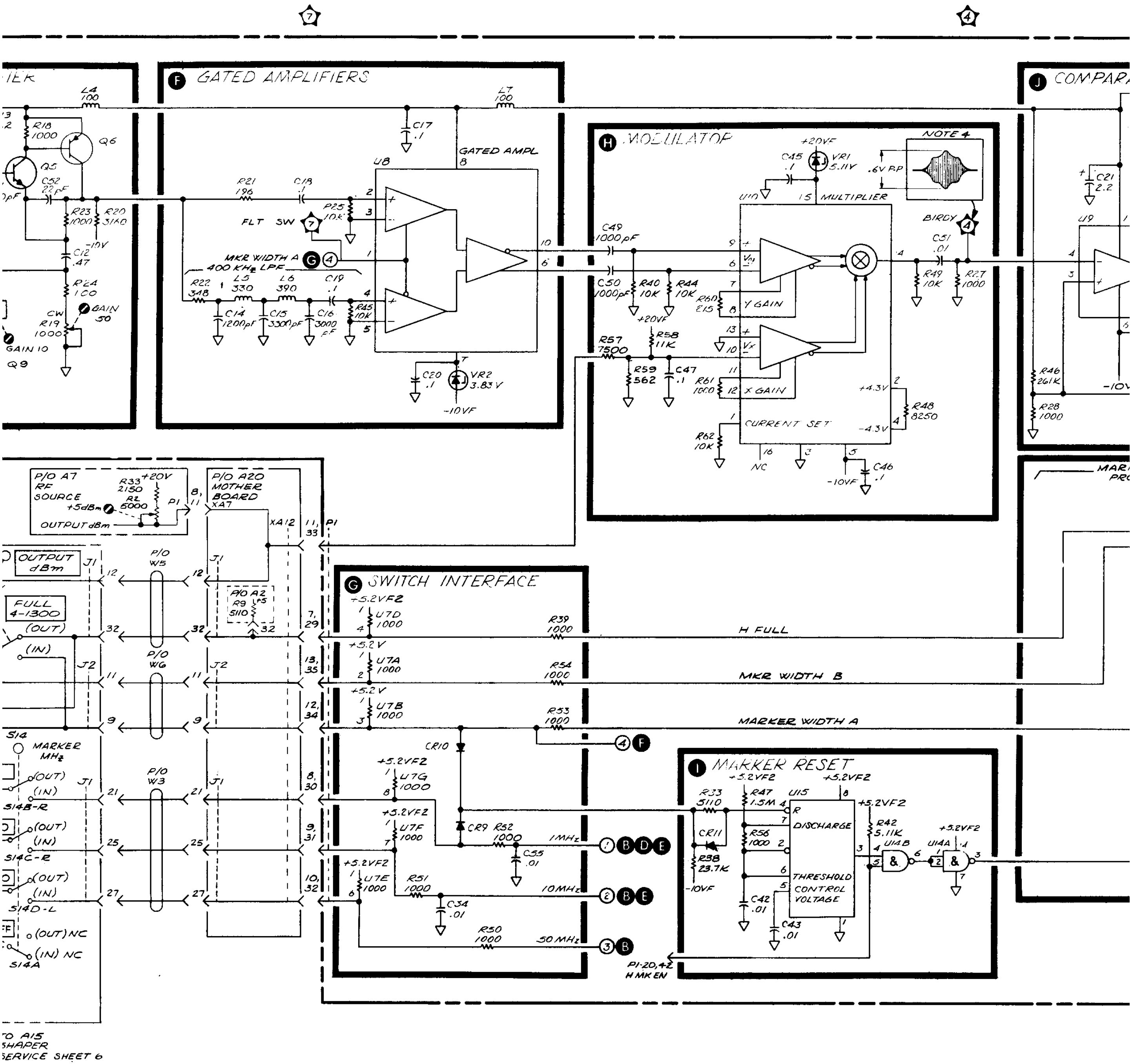
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	▽		
23	▽		
2	▽		
24	▽		
3	▽		
25	▽		
4	▽		
26	▽		
5	▽		
27	▽		
6	▽		
28	▽		
7	H FULL	A1J1-32	G
29	H FULL	A1J1-32	G
8	L MKR 1	A1J1-21	G
30	L MKR 1	A1J1-21	G
9	L MKR 10	A1J1-25	G
31	L MKR 10	A1J1-25	G
10	L MKR 50	A1J1-27	G
32	L MKR 50	A1J1-27	G
11	OUTPUT dBm	A1J1-12	H
33	OUTPUT dBm	A1J1-12	H
12	MKR WIDTH A	A1J2-9	G
34	MKR WIDTH A	A1J2-9	G
13	MKR WIDTH B	A1J2-11	G
35	MKR WIDTH B	A1J2-11	G
14	+20V	XA16-3,25	M
36	+20V	XA16-3,25	M
15	▽		
37	▽		
16	+5.2V	U2-OUT	M
38	+5.2V	U2-OUT	M
17	NC		
39	NC		
18	-10V	XA16-9,31	M
40	-10V	XA16-9,31	M
19	LF MKR	XA15-19,41	L
41	LF MKR	XA15-19,41	L
20	H MKEN	XA14-43	I
42	H MKEN	XA14-43	I
21	H MKR	XA18-32	L
43	H MKR	XA18-32	L
22	H MKR	XA18-32	L
44	H MKR	XA18-32	L



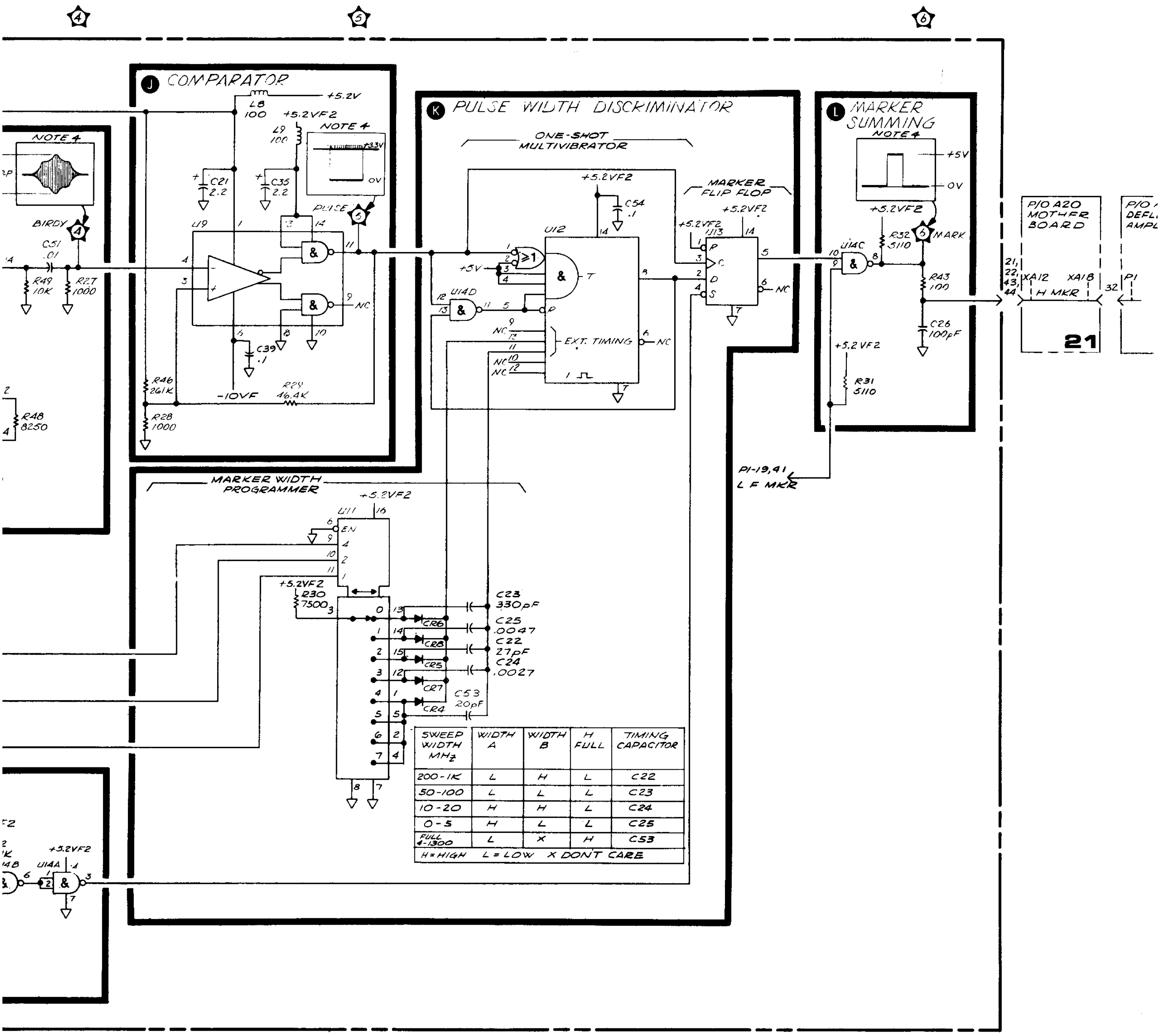
SERIAL PREFIX: 1908A DATE: APRIL 3, 1979



EXTERNAL MARKER MIXER
STEP-GAIN AMPLIFIER
INTERNAL MARKER SAMPLER AND BIAS
P/O A1 FRONT PANEL
P/O A7 RF SOURCE
SWEEP WIDTH MHz
OUTPUT dBm
FULL 4-1300
MARKER MHz
3.4MHz LPF
NOTE 5
1.5V P-P
TO A15 SHAPER SERVICE SHEET 6



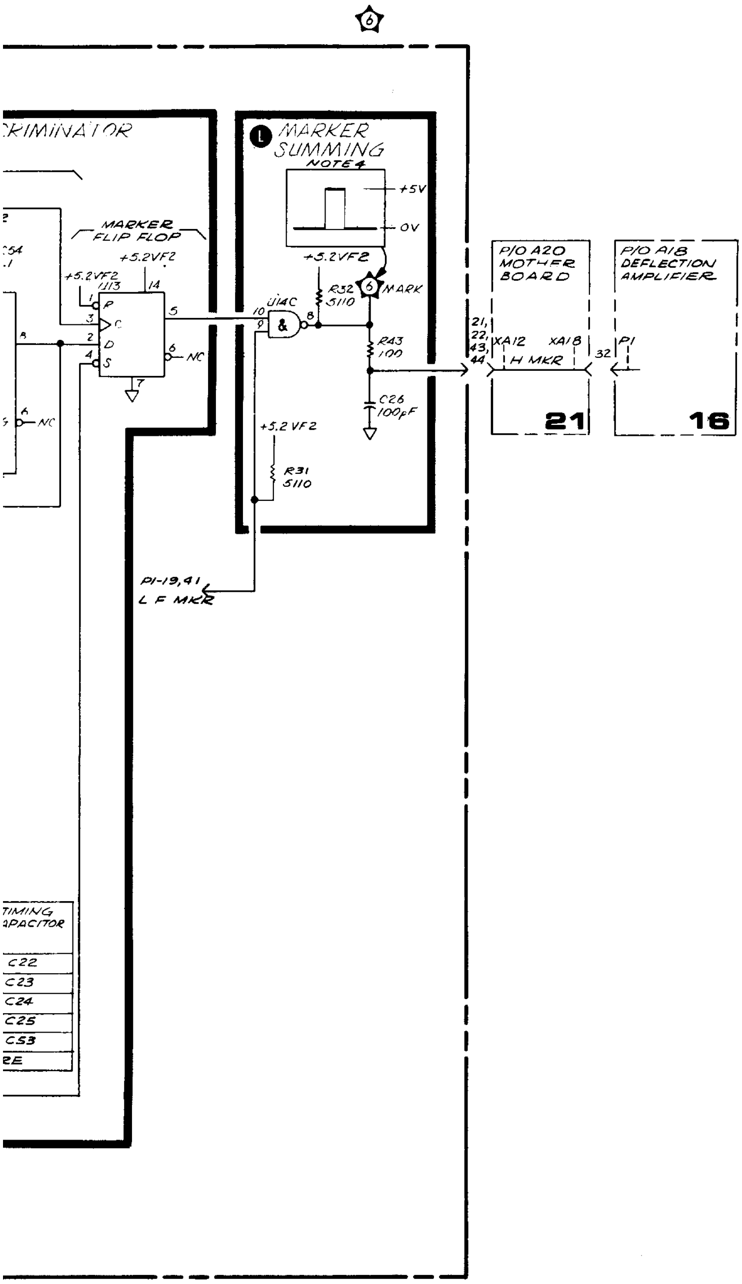
F GATED AMPLIFIERS
H MODULATOR
J COMPAR
G SWITCH INTERFACE
I MARKER RESET
GATED AMPL
MULTIPLIER
NOTE 4
BIRDY
.6V P-P
400 KHz LPF
MKR WIDTH A
FLT SW
Y GAIN
X GAIN
CURRENT SET
DISCHARGE
THRESHOLD CONTROL VOLTAGE
P/O A7 RF SOURCE
P/O A20 MOTHER BOARD
P/O A2
OUTPUT dBm
H FULL
MKR WIDTH B
MARKER WIDTH A
1MHz
10MHz
50MHz
P1-20,42 HMKEN
TO A15 SHAPER SERVICE SHEET 6



SWEEP WIDTH MHz	WIDTH A	WIDTH B	H FULL	TIMING CAPACITOR
200-1K	L	H	L	C22
50-100	L	L	L	C23
10-20	H	H	L	C24
0-5	H	L	L	C25
FULL 4-1300	L	X	H	C53

H=HIGH L=LOW X DONT CARE

F.



NOTES

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

3. ALL WAVEFORMS ARE SHOWN WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
   TUNING: 50MHz
   SWEEP MODE: CENTER
   SWEEP: AUTO, FAST
   SWEEP WIDTH MHz: 10 MHz
   SWITCH IS SHOWN IN SCHEMATIC IN 1K POSN.
   MARKERS MHz: 10MHz (FOR TP1-3)
   50MHz (FOR TP4-5)
   OUTPUT dBm: 0dBm

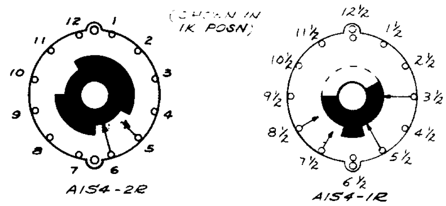
4. GROUND TP7 FOR WAVEFORMS AT TP4-6.
   EXTERNALLY SWEEP OSCILLOSCOPE WITH 8754A SWEEP OUTPUT.

5. SIGNAL AT TP1 IS ACTUALLY A SQUARE WAVE, BUT IS DISTORTED BY OSCILLOSCOPES WITH A BANDWIDTH OF < 100 MHz

6. A SHORT PROBE GROUND LEAD IS REQUIRED TO MINIMIZE RINGING.

7. INDUCTANCE SHOWN REPRESENTS PRINTED CIRCUIT BOARD TRACE INDUCTANCE.

8. SWEEP WIDTH MHz SWITCH A1S4-1R & 2R WAFER AND PIN LOCATIONS.



9. TROUBLESHOOTING HINTS:
   A. THE MODULATOR ⓜ CAN BE CHECKED BY MONITORING THE BIRDY AMPLITUDE AT A12 TP4 BIRDY. A CHANGE IN OUTPUT dBm FROM 0 TO +10dBm SHOULD APPROXIMATELY DOUBLE THE BIRDY AMPLITUDE.

8
A12

Figure 8-45. Marker Generator (A12), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 9

SAMPLERS (A3, A4, A5)

The Samplers (A5: R, A4: A, and A3: B) act as frequency converters, to produce three 1 MHz IF signals with the same amplitude and phase relationship as the R, A, and B RF inputs. The Samplers are identical and the following discussion applies to all of them.

The Sampler receives an RF input from the front panel and a repetitive sampling pulse from the Voltage-Tuned Oscillator (A6, Service Sheet 6). The RF input is applied to a diode gate that is switched on and off by the narrow sampling pulse from the VTO. The IF output is obtained by accumulating amplitude samples of the RF input which are taken at progressively later points in each RF cycle. The time taken to collect enough samples to reconstruct a cycle of the RF input is much longer than the cycle period of the RF. Thus, the RF input is time-stretched to a low frequency waveform.

Figure 8-46 shows the development of an IF frequency for more than one RF Source frequency with the VTO repetition rate held constant. In this example, the VTO is operating at 10 MHz and a 1 MHz IF output is produced for RF frequencies of 9 MHz and 29 MHz. Actually, an IF ouput is produced for each RF frequency that is 1 MHz higher or lower than a multiple of the VTO repetition rate. In general, the relationship between the input and output frequencies of a sampler can be calculated as follows:

$$F_{IF} = F_{RF} \pm N \cdot F_{VTO}$$

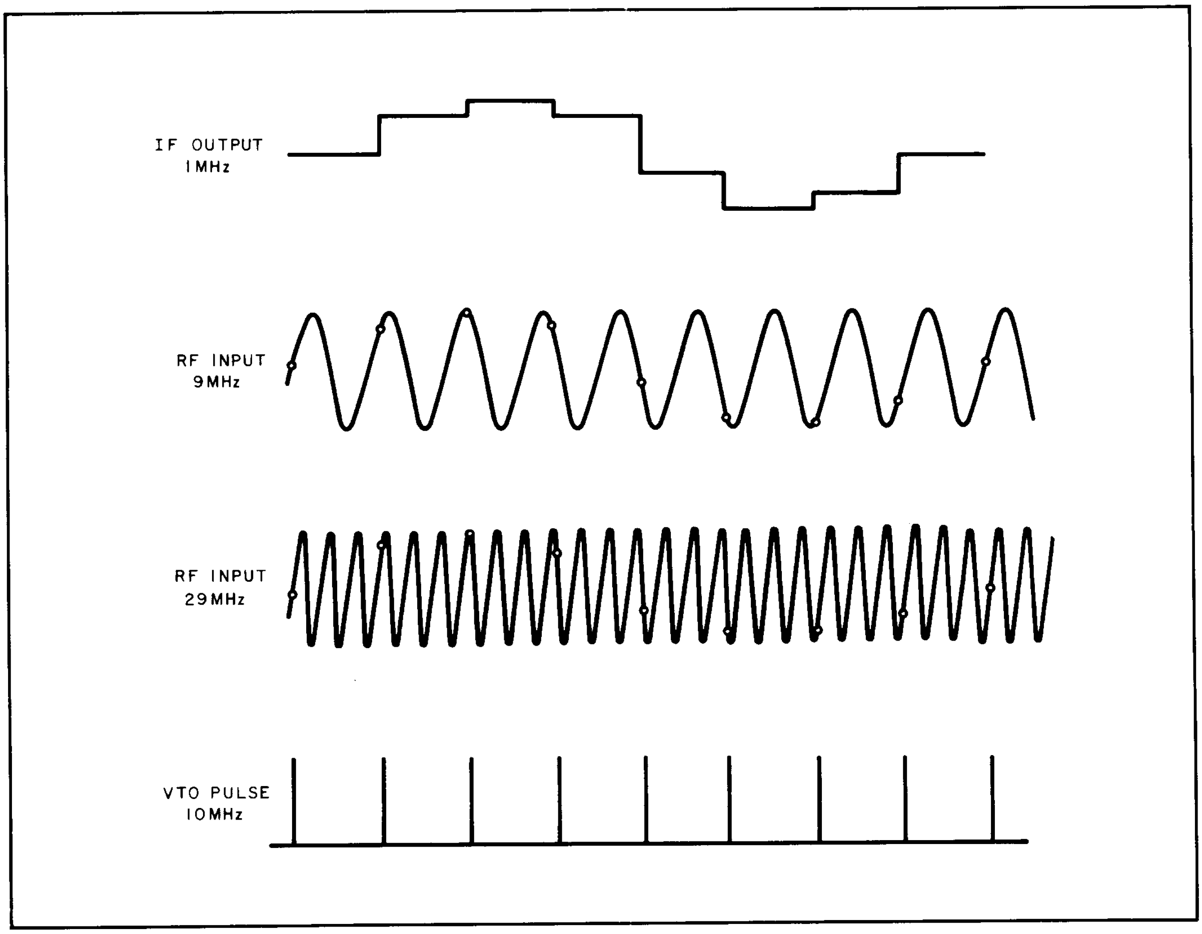
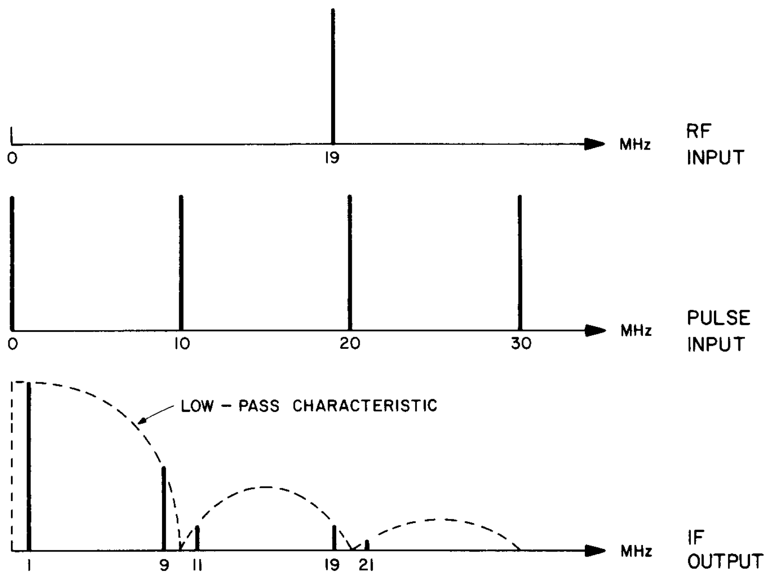


Figure 8-46. Developing an IF Output With Sampling

N is a multiple of the VTO repetition rate and can be considered the harmonic number of the VTO. For example,if the VTO frequency is 10 MHz:

- An RF frequency of 9 or 11 MHz mixes with the 10 MHz pulse to produce a 1 MHz IF.
- An RF frequency of 29 or 31 MHz mixes with the third harmonic of the VTO to produce a 1 MHz IF (See Figure 8-46).
- An RF frequency of 499 or 501 MHz mixes with the fiftieth pulse harmonic to produce a 1 MHz IF.

The Sampler IF output is very similar to that produced by a harmonic mixer. The sampler output contains frequencies at the sum and difference of the RF frequency and every harmonic of the sampling pulse rate, but due to an inherent low pass filter characreristic, the predominate IF output is produced by the RF mixing with the closest VTO harmonic. Figure 8-47 shows a spectral representation of the RF and pulse inputs, and the sampler IF output. The power contained in the pulse output is equally divided between every harmonic of its repetition rate, which is also shown as 10 MHz. Each pulse harmonic mixes with the RF signal, shown as 19 MHz, to produce two frequencies (sum and difference) at the sampler output.



Pulse Harmonic	RF Frequency	VTO Harmonic Frequency	Sampler Output Frequencies
1	19 MHz	10 MHz	9 and 29 MHz
2	19 MHz	20 MHz	1 and 39 MHz
3	19 MHz	30 MHz	11 and 49 MHz

Figure 8-47. Frequency Relation Between Sampler Inputs and Output

The sampler output frequencies for the first three pulse harmonics in this example are shown in Figure 8-47. Note that the 20 MHz second harmonic mixes with the 19 MHz RF to produce a 1 MHz IF output. The higher output frequencies are present, but attenuated.

This low-pass characteristic has a theoretical null at every harmonic of the pulse frequency. In practice, some of the 10, 20, 20 MHz pulse harmonics feed through to the output, due to imbalances in the sampler diode switch.

If the RF input contains a small amount of second harmonic, it will mix to produce a small IF signal at 2 MHz. This IF signal will appear on the Sampler output, but will be rejected by IF filters further on in the Receiver.

The Sampler operates for pulse repetition rates of 5 Mz to 30 MHz. A transistor input amplifier and sample and hold circuit are contained in a microcircuit which is mounted on a printed circuit board. The board contains a preamplifier, output amplifier, and biasing circuitry for the diode switch.

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to apply to A3, A4, and A5. For example, the designation Q1 applies to A3Q1, A4Q1, and A5Q1.

Input Buffer Ⓐ

A high-frequency transistor in U1 is connected as a common-base amplifier with unity voltage gain. This stage provides isolation between the diode switch and the RF input. The transistor is biased at approximately 20.7 milliamperes by R26; R4 lowers the power dissipated by the transistor to improve reliability.

Sample and Hold Ⓑ

This circuit, located in U1, performs the sampling process to provide a low-frequency replica of the RF input. The Sample and Hold circuit consists of a diode switch and a holding capacitor; its operation is illustrated in Figure 8-48.

Each time the switch closes, the capacitor charges to the voltage of the input signal; when the switch opens, the capacitor holds this voltage until the switch closes again. The waveform on the capacitor is a series of voltage steps which approximate a sinusoidal signal at a lower frequency than the RF input.

In Figure 8-48, the RF input frequency is shown slightly less than twice the pulse repetition rate. Thus, Figure 8-48 is the time-domain representation of the same conditions as shown in Figure 8-47 spectrum representation. The timing illustration shows each consecutive sampling pulse occurring progressively sooner on the RF waveform.

The diode switch, in microcircuit U1, is a bridge of four fast-switching hot carrier diodes which are normally reverse biased by the Diode Bias circuit. This reverse bias prevents the RF input from forward biasing the diodes. The RF signal is sampled when a negative-voltage input pulse of very short duration (0.3 nanosecond) is applied to the balun transformer, where it is converted into two equal pulses of opposite polarity. These two pulses drive the diode bridge to momentarily overcome its reverse bias and switch it into conduction. When the diode switch opens, there is no discharge path to drain away the charge, and the voltage remains constant until the next pulse.

Preamplifier Ⓓ

The voltage across the holding capacitor in U1 is the input to the preamplifier (Q2 and Q3) which is connected as a non-inverting feedback amplifier with a voltage gair of two. Q2 is an enhancement mode Field Effect Transistor (FET) with a very high input impedance (limited by R27).

Feedback Amplifier Ⓔ

The Preamplifier output is applied to emitter follower Q1, and fed back to the holding capacitor network in U1. The effect of this feedback is to fully charge the holding capacitor between consecutive samples. This is illustrated in Figure 8-49.

During the 0.3 nanosecond time that the sampling pulse forward biases the diode switch, the capacitor network (for this example C_X, C_Y, and C_Z) is charged from the previously sampled voltage, towards the new value of the RF input signal at the instant of sampling. Since the pulse is

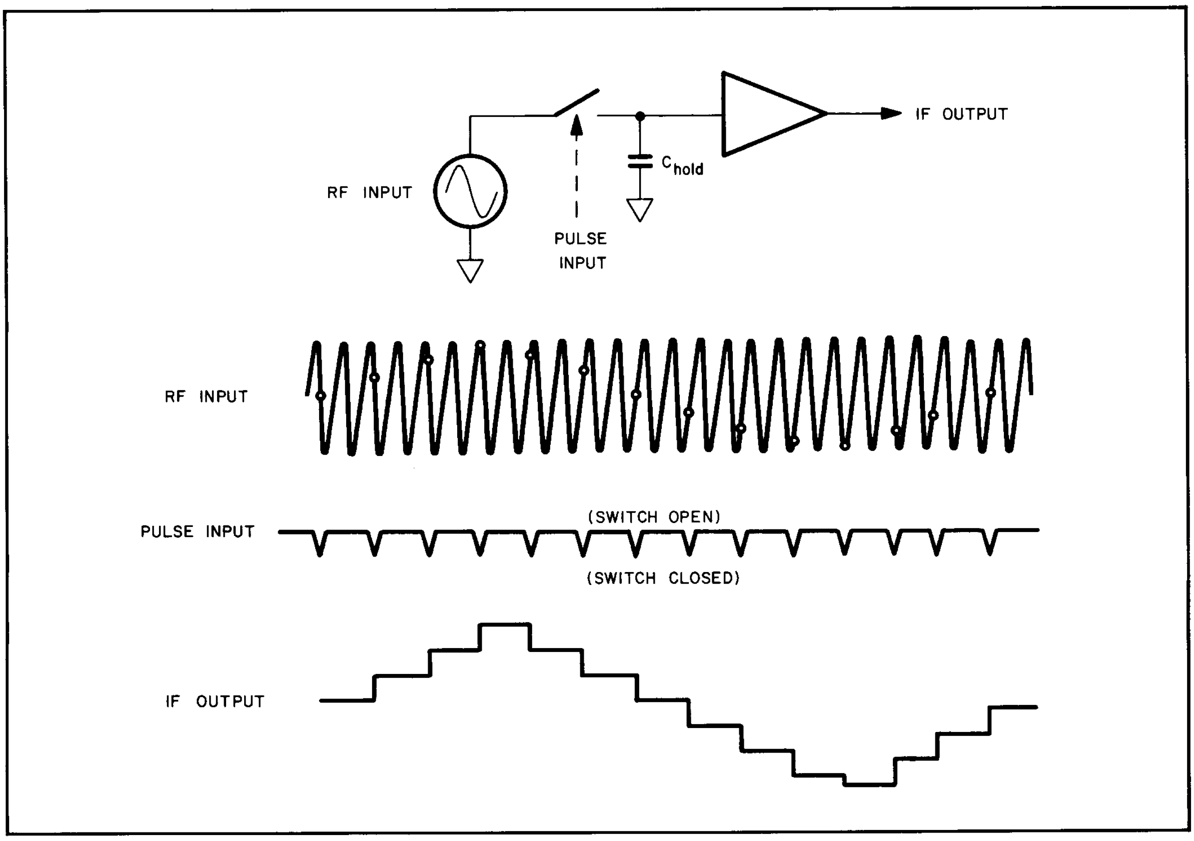


Figure 8-48. Timing Representation of Sampler

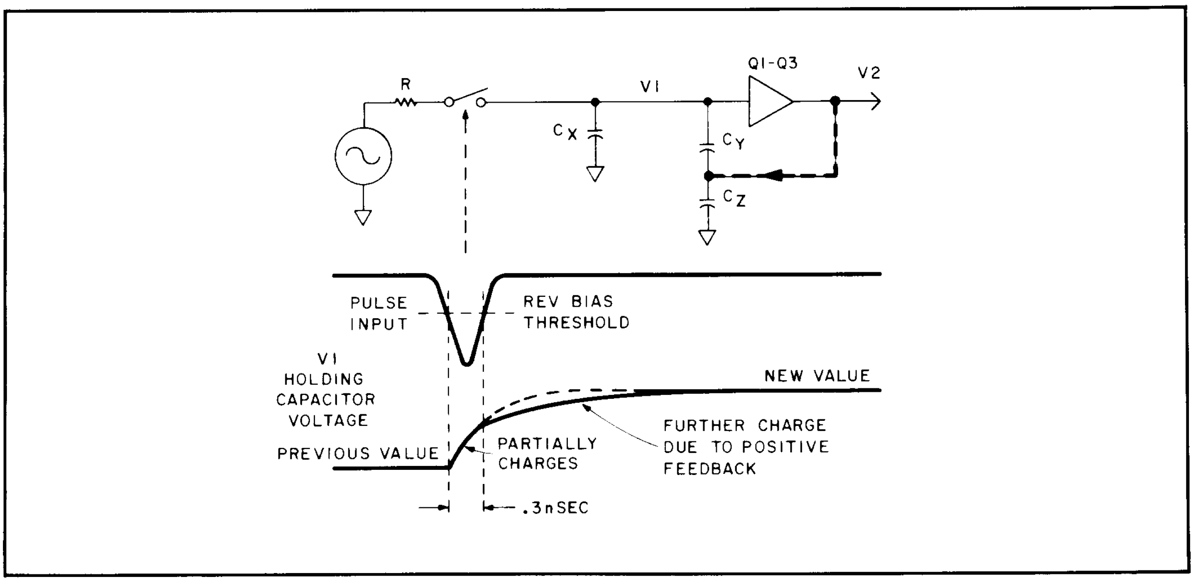


Figure 8-49. Feedback Employed to Boost Charge on Holding Capacitor

of short duration, the voltage changes only a fraction of the final required value. This fraction is a constant, determined by pulse duration, series resistance, and the capacitor network.

Positive feedback is used to complete the charging of the holding capacitor before the next sampling pulse occurs. During a sampling pulse, the amplifier does not have enough time to respond to the new value stored on C_X (due to its limited bandwidth). Gradually its output starts to change; this change is fed back to the amplifier input through a capacitive divider formed by C_X and C_Y. This causes the amplifier output, and therefore C_X, to charge further until a stable output voltage is reached. This final value is reached before the next pulse, and is determined by C_X, C_Y and amplifier gain, which is adjusted by FB potentiometer R11.

If the holding capacitor voltage does not track the input (does not fully charge to the RF input level at the instant of sampling), then more samples are required to accurately reconstruct the RF waveform at the IF frequency. The IF output (amplitude and phase) becomes dependent on how many samples are taken, and therefore, it becomes dependent on the pulse repetition rate. FB potentiometer R11 is adjusted to minimize the dependency of the IF output on the pulse repetition rate, which appears as a trace discontinuity (magnitude or phase) at the phase lock acquisition points when the receiver sweeps a broad frequency range.

Figure 8-50 illustrates why the holding capacitor must be 100 percent charged for the IF output to be independent of the pulse repetition rate. Four examples are given; each illustrates the "ideal" IF signal that the sampler is attempting to reconstruct, and the actual sampler output.

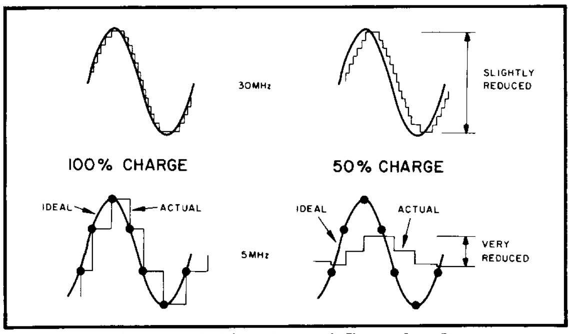


Figure 8-50. Actual Sampler IF Output Compared to Ideal Output

When the pulse repetition rate is high (30 MHz) a very accurate reconstruction is possible since many (30) samples are taken for every IF cycle. If the capacitor only charges to 50 percent of the new voltage on each sample, the peak-to-peak amplitude of the actual sampler output is only slightly reduced from the ideal.

When the pulse repetition rate is low (5 MHz), very few (5) samples are taken for every IF cycle. If the holding capacitor charges 100 percent to the new value every sample, the peak-to-peak amplitude of the actual sampler output is very accurate. If the holding capacitor is only 50 percent charged, it is always trying to "catch up", and never reaches the new value. This results in an IF output that is greatly reduced in peak-to-peak amplitude from the ideal.

Diode Bias (C)

The reverse biasing of the diode switch is critical for proper sampler operation. This bias must prevent a 0 dBm RF input from forward biasing the diode switch, yet allow the sampling pulse to forward bias the diode switch during a sampling interval.

The pulse waveform that drives the diode switch is shaped similar to one-half of a sinewave. If the diode reverse-bias voltage increases, the pulse must overcome more reverse voltage before the diodes conduct. Thus, sampling time is dependent on the bias level, and sampling time is reduced as the bias level is increased.

Resistors R22 – 25 form a resistive divider network that delivers two equal voltages of opposite polarity to the diode switch in U1.

Output Amplifier (F)

Q4 and Q5 form a non-inverting adjustable gain amplifier, that is adjusted for overall Sampler unity voltage gain (from RF input to IF output).

R13 and R14 attenuate the input signal and set the Q4 base voltage. Q4 and Q5 are connected in a negative feedback loop. Amplifier gain is adjusted by potentiometer R16.

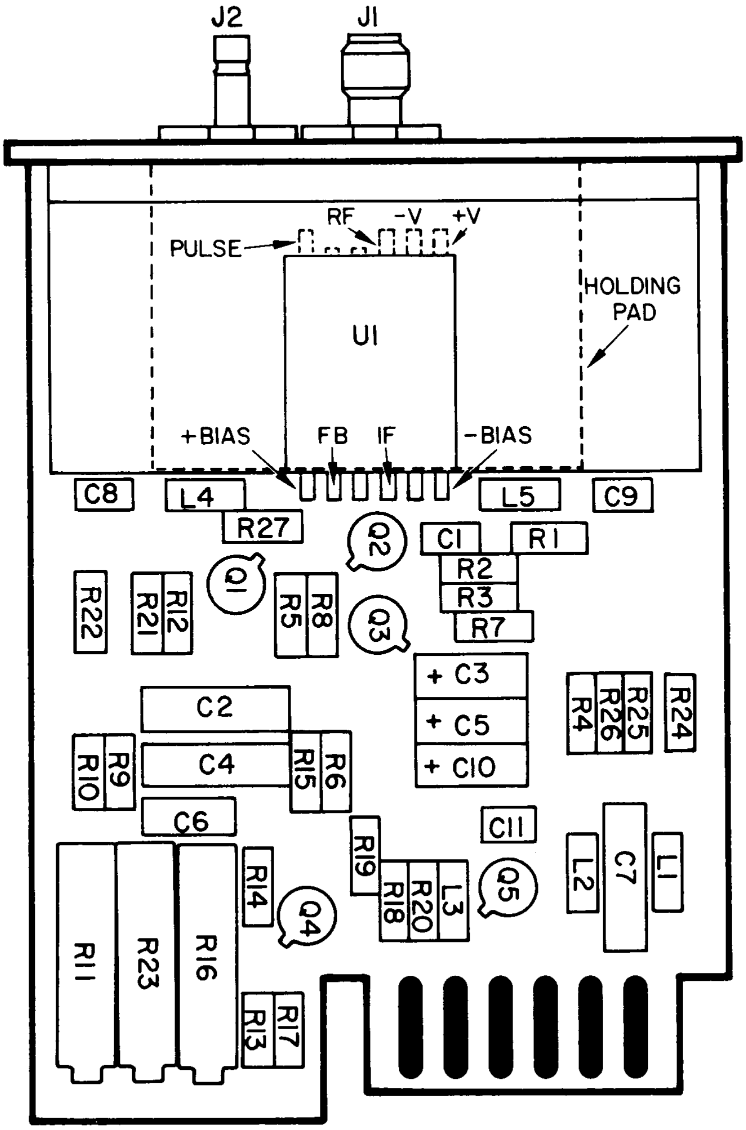
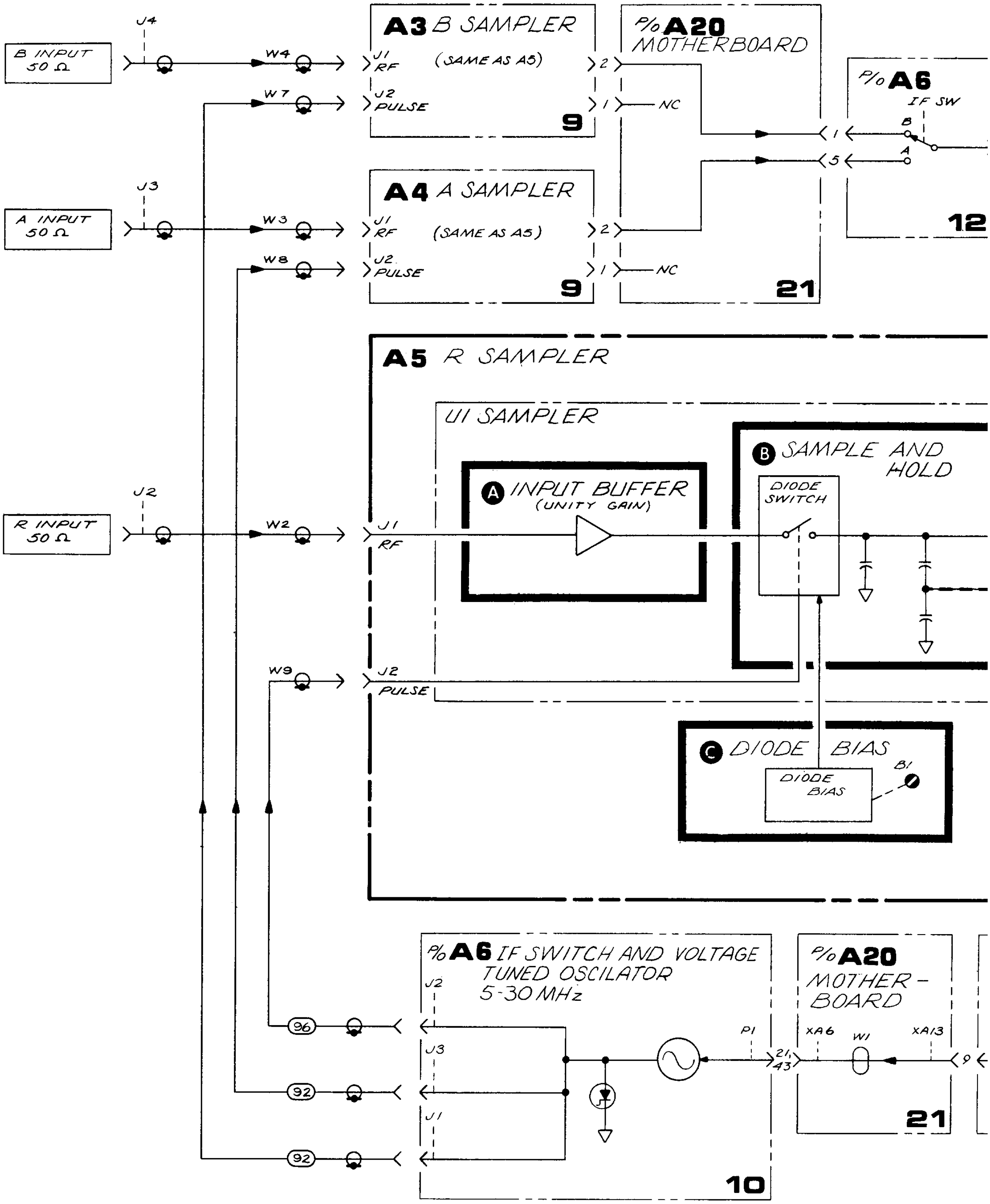
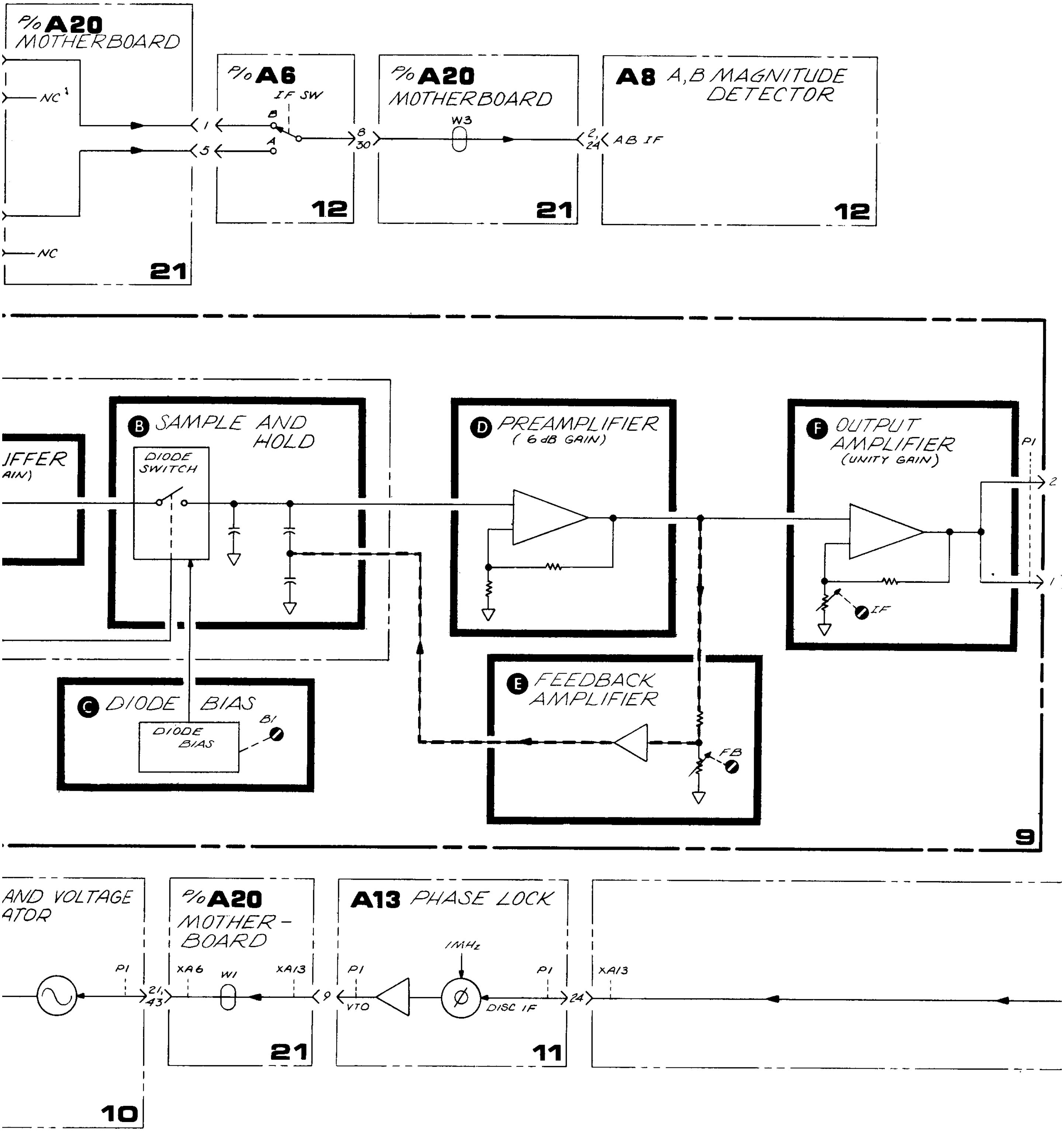


Figure 8-51. Samplers (A3, A4, A5), Component Locations



B INPUT 50 Ω
J4
W4
A3 B SAMPLER
J1 RF
(SAME AS A5)
J2 PULSE
W7
9
P/O A20 MOTHERBOARD
NC
P/O A6
IF SW
12
A INPUT 50 Ω
J3
W3
A4 A SAMPLER
J1 RF
(SAME AS A5)
W8
J2 PULSE
9
21
A5 R SAMPLER
U1 SAMPLER
B SAMPLE AND HOLD
A INPUT BUFFER (UNITY GAIN)
DIODE SWITCH
R INPUT 50 Ω
J2
W2
J1 RF
W9
J2 PULSE
C DIODE BIAS
DIODE BIAS
B1
P/O A6 IF SWITCH AND VOLTAGE TUNED OSCILATOR 5-30 MHz
J2
J3
J1
96
92
92
P1
21, 43
10
P/O A20 MOTHER-BOARD
XA6
W1
XA13
21



P/o A20
MOTHERBOARD
NC
NC
21
P/o A6
IF SW
B
A
1
5
12
8
30
P/o A20
MOTHERBOARD
W3
21
2,
24
A8 A,B MAGNITUDE
DETECTOR
AB IF
12
IFFER
AIN)
B SAMPLE AND
HOLD
DIODE
SWITCH
D PREAMPLIFIER
(6 dB GAIN)
F OUTPUT
AMPLIFIER
(UNITY GAIN)
P1
2
1
IF
C DIODE BIAS
DIODE
BIAS
B1
E FEEDBACK
AMPLIFIER
FB
9
AND VOLTAGE
ATOR
P1
21,
43
10
P/o A20
MOTHER-
BOARD
XA6
W1
XA13
9
21
A13 PHASE LOCK
1MHz
P1
VTO
P1
DISC IF
24
11
XA13

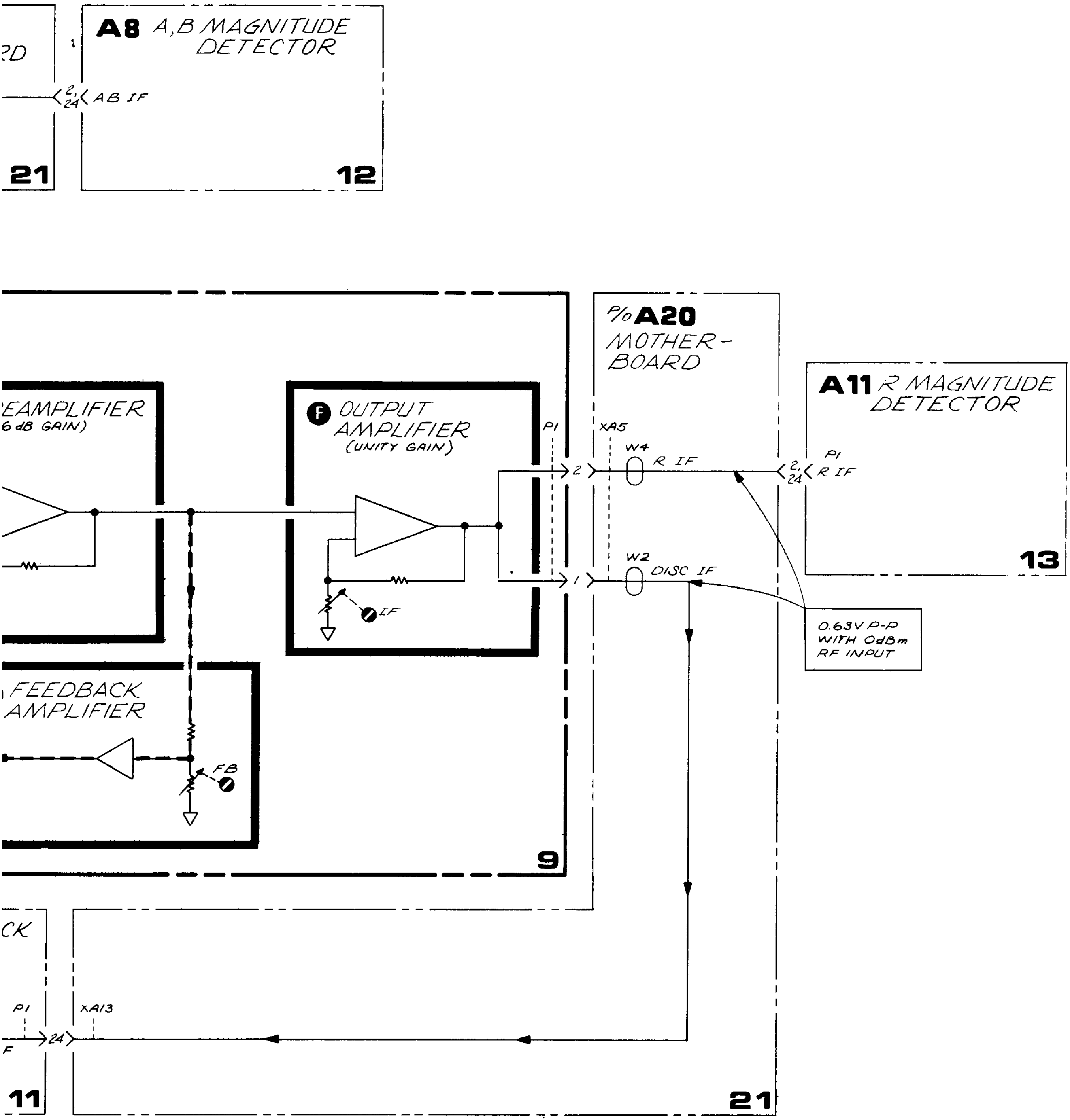


Figure 8-52. Samplers (A3, A4, A5), Block Diagram

A3 SAMPLER

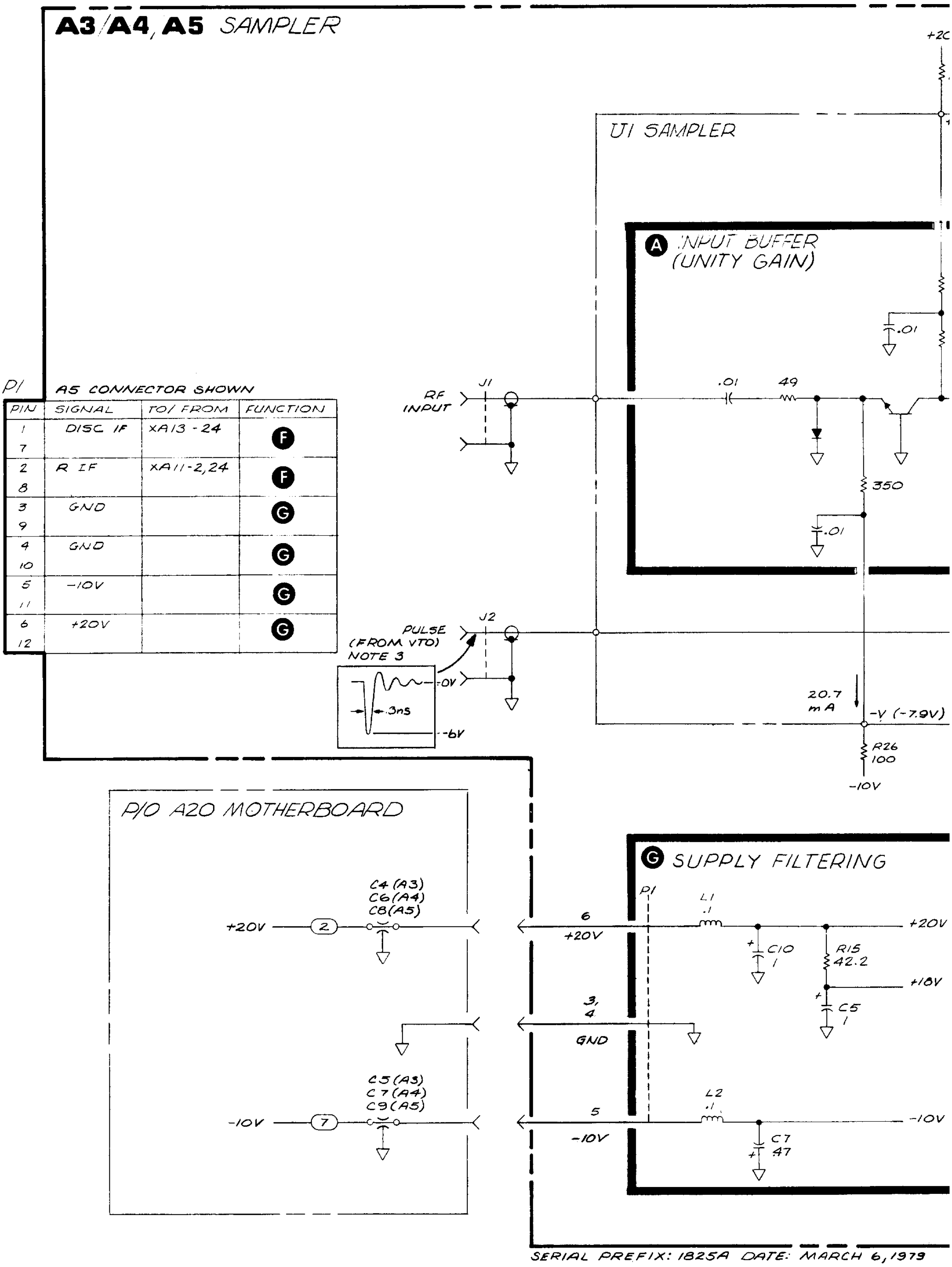
P1 A3 CONNECTOR SHOWN

PIN	SIGNAL	TO/FROM	FUNCTION
1 7			F
2 8	IF B	XA6-1	F
3 9	GND		G
4 10	GND		G
5 11	-10V		G
6 12	+20V		G

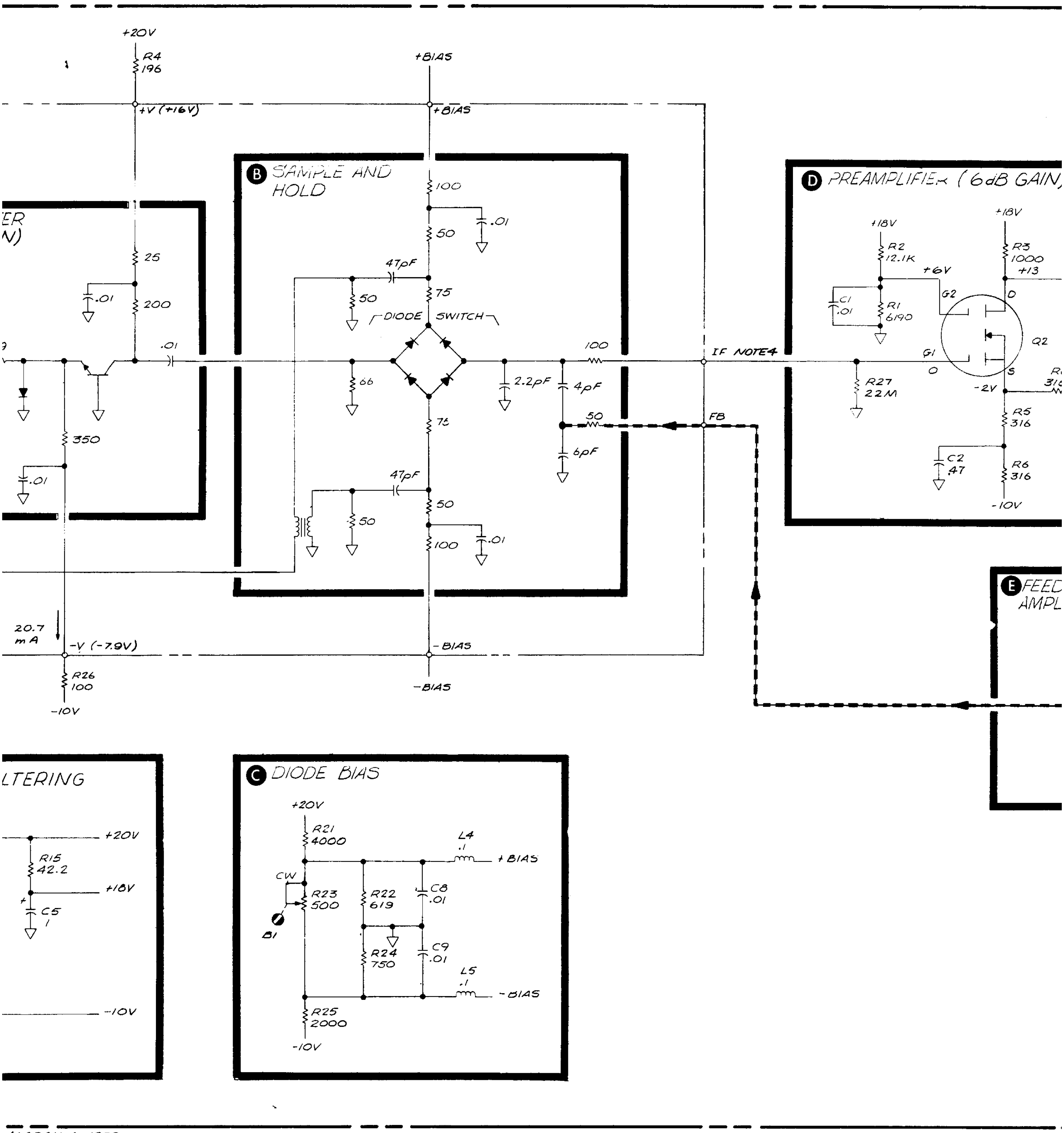
A4 SAMPLER

P1 A4 CONNECTOR SHOWN

PIN	SIGNAL	TO/FROM	FUN
1 7			
2 8	IF A	XA6-5	
3 9	GND		
4 10	GND		
5 11	-10 V		
6 12	+20V		



PIN	SIGNAL	TO/ FROM	FUNCTION
1, 7	DISC IF	XA13 - 24	F
2, 8	R IF	XA11-2,24	F
3, 9	GND		G
4, 10	GND		G
5, 11	-10V		G
6, 12	+20V		G



+20V
R4
196
+BIAS
+V (+16V)
+BIAS
B SAMPLE AND HOLD
D PREAMPLIFIER (6dB GAIN,
ER
N)
100
.01
50
+18V
+18V
R2
12.1K
R3
1000
+13
+6V
25
47pF
.01
200
50
75
DIODE SWITCH
C1
.01
R1
6190
G2
D
Q2
.01
66
100
2.2pF
4pF
IF NOTE4
G1
O
S
R27
22M
-2V
350
75
50
FB
R5
316
.01
47pF
6pF
C2
47
R6
316
50
50
100
.01
-10V
E FEED
AMPL
20.7 mA
-V (-7.9V)
-BIAS
R26
100
-BIAS
-10V
LTERING
C DIODE BIAS
+20V
R21
4000
+20V
L4
.1
+BIAS
R15
42.2
CW
+18V
R23
500
R22
619
C8
.01
C5
1
B1
R24
750
C9
.01
L5
.1
-BIAS
-10V
R25
2000
-10V

MARCH 6, 1979

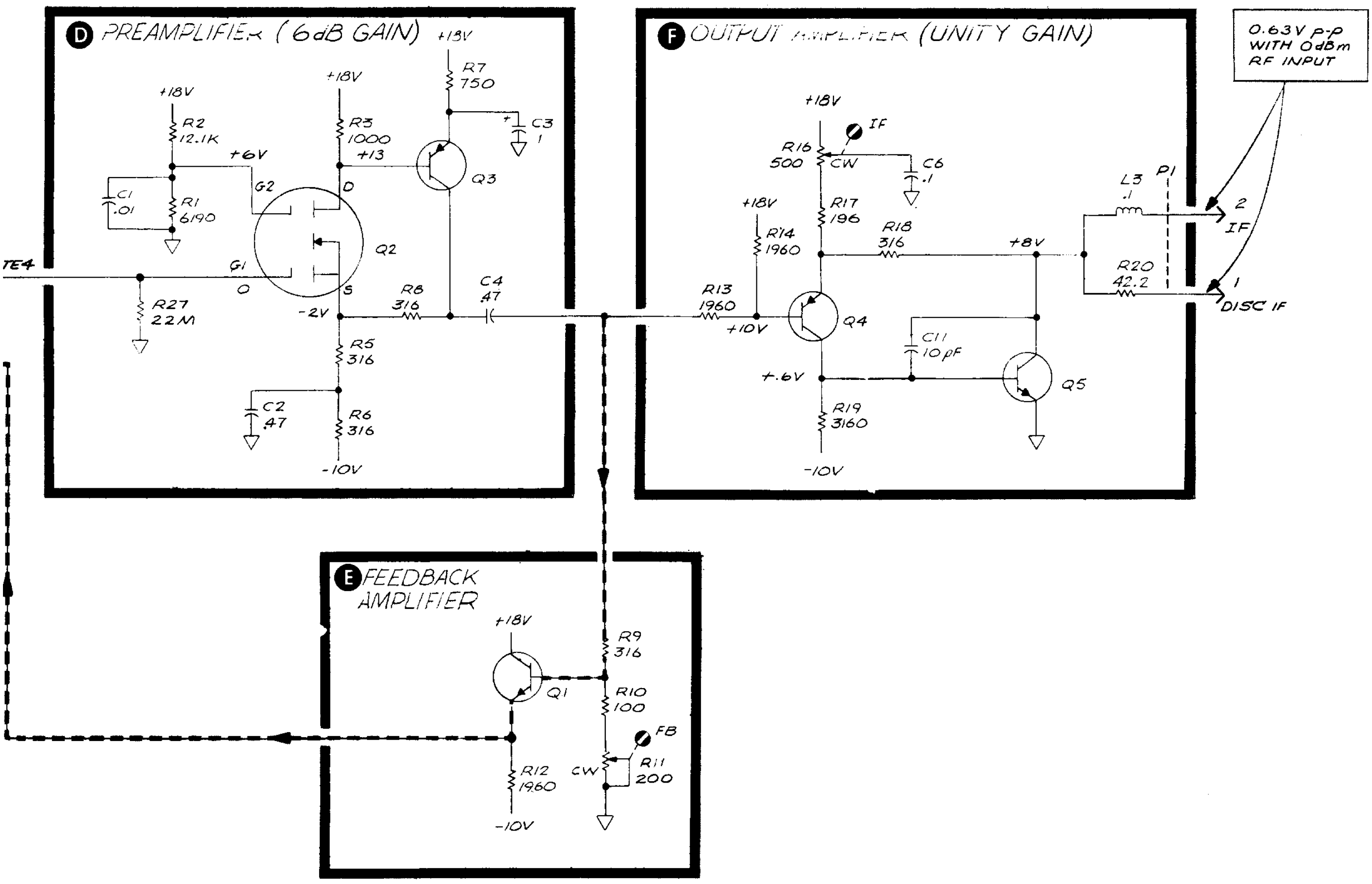
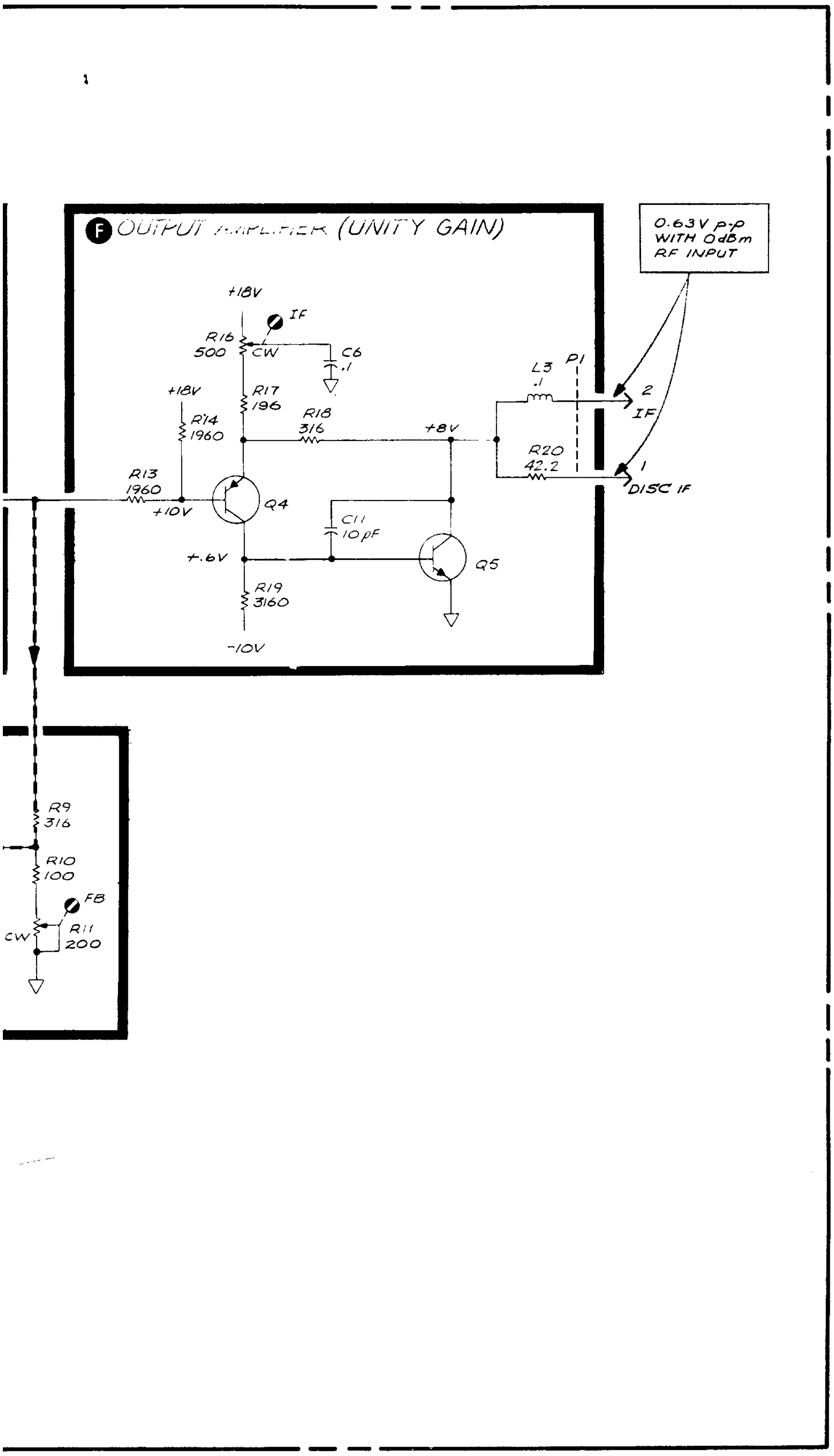


Figure 8-53. Sam



NOTES

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBERS FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS (Ω) CAPACITANCE IN MICROFARADS (μF) INDUCTANCE IN MICROHENRIES (μH)
3. DUE TO THE NARROW PULSE WIDTH OF THIS SIGNAL, A HIGH FREQUENCY OSCILLOSCOPE IS REQUIRED FOR THIS WAVEFORM (BW ≥ 275 MHz)
4. THE IF OUTPUT OF RF SAMPLER U1 REQUIRES A HIGH IMPEDANCE. ANY MEASUREMENT TAKEN AT THIS POINT WILL DEGRADE THE IF SIGNAL.

9
A3,A4,A5

Figure 8-53. Samplers (A3, A4, A5), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 10

IF SWITCH AND VOLTAGE-TUNED OSCILLATOR (A6), CIRCUIT DESCRIPTION

The major function of the Voltage-Tuned Oscillator (VTO) is to produce the pulses that drive the R Sampler (A5), the A Sampler (A4), and the B Sampler (A3), all on Service Sheet 9. The pulse repetition rate (or VTO frequency) is proportional to the 0V to +10V tune voltage from the Phase Lock (A13, Service Sheet 11).

The function of the IF Switch is to select the output of either the A Sampler (A4) or the B Sampler (A3) as the 1-MHz IF input signal to the A,B Detector (A8, Service Sheet 12). The IF Switch is included in the description of A8.

400-kHz Low-Pass Filter Ⓐ

The 400-kHz Low-Pass filter includes two notch filters: L1/C14, which rejects 2 MHz, and L2/C16, which rejects 1 MHz.

Voltage-Tuned Oscillator Ⓑ

The function of the Voltage-Tuned Oscillator (VTO) is to deliver an ECL-compatible square wave at a frequency of 0 to 30 MHz, corresponding to VTO tune voltage of 0V to +10V from the Phase Lock (A13).

The VTO is actually a current-tuned oscillator whose operation is controlled by a Current Source. Transistors Q12, Q13, Q14A, and Q14B and their associated circuitry form a regenerative (astable) multivibrator whose two halves are alternately on (active) and off. Q12 and Q14A form one half, and Q13 and Q14B, the other.

The oscillator is primarily tuned by varying the charge current through C19 and C20. As the charge current (from either Q15 or Q16) is increased, less time is required for C19 and C20 to charge to the upper-threshold voltage; the frequency therefore increases.

For the purpose of the circuit description, operation of the oscillator begins with Q12 and Q14A off while Q13 and Q14B are on (active). At the end of one half cycle of operation, Q13 and Q14B are turned off, and Q12 and Q14A become active. Simplified waveforms are shown in Figure 8-54.

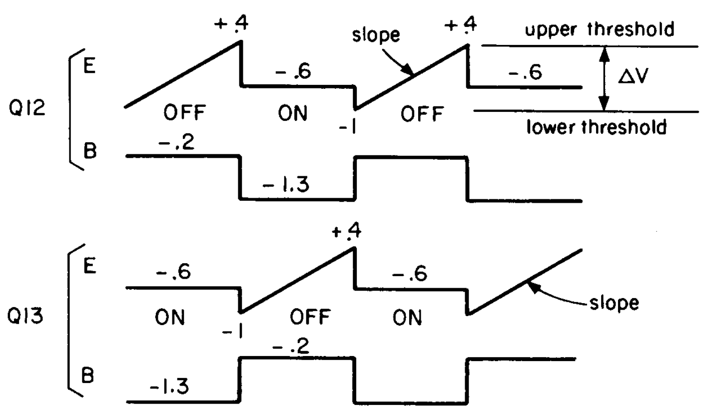


Figure 8-54. VTO Operation at 3 MHz

The voltage at the base of Q12 is high since there is no current through Q14A. Therefore, the entire current through R28 and R29 flows through Q14B, applying a negative voltage to the Q13 base and holding the Q13 emitter at a constant −0.6V.

Since Q12 is turned off, all the current from Q16 in the Current Source is available to charge C20 and FREQ adjustment C19. This current, with the current from Q15, flows into the Q13 emitter, ensuring that Q13 remains on. As shown in Figure 8-54, the voltage at the Q12 emitter increases at a linear rate as the capacitors are charged until the threshold of +0.4V is reached. The rate is proportional to the current from Q16 divided by the capacitance of C19 and C20.

When the Q12 emitter voltage reaches approximately +0.4V (the upper threshold), Q12 starts to conduct, and the Q14A base voltage begins to increase. Current starts to flow through Q14A, which causes the current through Q14B to decrease proportionately, since Q14A and Q14B are connected as a differential pair.

As the current through Q14B decreases, the Q13 base voltage increases until Q13 is turned off. Because of this regenerative action, Q12 and Q14A are now on (active), and Q13 and Q14B are turned off, completing a half cycle of operation.

The second half cycle operation of the VTO is identical, except that the active transistors are reversed and the charge current to C19 and C20 comes from Q15 in the Current Source.

The Current Source includes Q15 and Q16, whose bases are biased at +9.3V by R37, R38, CR11, and CR12. This sets the emitter voltages at +10V. The current flowing into Q15 or Q16 is the difference between the 5-mA current through R25 or R24 and the current through R21 or R22. As the input voltage is tuned from 0V to +10V, the current through R21 or R22 decreases from 5 mA to 0 mA, causing the collectors of Q15 and Q16 to produce outputs of 0 mA to 5 mA.

However, if the oscillator were tuned only by varying the charge current, as described above, the correlation between the tune voltage from A13 and the output frequency of the oscillator would not be linear because of the propagation delays inherent in the transistors. To linearize the frequency, the lower threshold voltage is also varied; this varies the time required for C19 and C20 to charge to the upper threshold voltage of about +0.4V, assuming the slope remains constant. The lower threshold is set by current in Q14A or Q14B, which is partially supplied through R28, to which the input voltage is applied.

Buffer (C)

The Buffer circuit isolates the output of the VTO from the loading effects of the Diode Driver and shapes the signal into a fast-rising square wave. The circuit consists of three ECL line receivers, U2A, U2B, and U2C, and associated circuitry.

Level Shifter (D)

The Level Shifter circuit provides the apppropriate signal level to the Diode Driver. It consists of a differential pair, Q8 and Q10, operating as a current-mode switch, and associated circuitry.

Q8 and Q10 conduct on alternate half cycles of the input signal so that the approximately 5 mA of current through R39 develops an output voltage across R41 and R40, respectively.

Diode Driver (E)

The function of the Diode Driver is to deliver approximately 360 mA of current to the Pulse Generator. The polarity of the current is switched by alternate half cycles of the input square-wave signal.

The Diode Driver includes two current-mode switches, Q4/Q5 and Q6/Q7, whose inputs and outputs are paralleled. When Q4 and Q6 are off, Q5 and Q7 are on, and approximately −200 mA flows through each collector into T1B. This causes approximately +360 mA to flow into the step recovery diode CR20 in the Pulse Generator.

On the alternate half cycle, Q5 and Q7 are off, and Q4 and Q6 are on. Each collector then supplies approximately −200 mA into T1A. This causes approximately −360 mA to flow into CR20.

Q9 and Q11 are used to establish the proper voltage levels at the bases of transistors Q4 through Q7. The signal used to drive these transistors may be monitored at TEST OUT connector J4.

Pulse Generator (F)

The Pulse Generator converts current from the Diode Driver into pulses to drive the A Sampler (A4), B Sampler (A3), and R Sampler (A5). The pulses (A PULSE, B PULSE, and R PULSE) are generated at the repetition rate of the VTO. The pulse width is approximately 0.3 ns and the pulse amplitude is about −6V.

Step recovery diode CR20 accumulates a stored charge as the 360-mA current flows into it from the Diode Driver. On the next half cycle of the square-wave VTO signal, the Diode Driver current changes polarity and current flows out of CR20, reducing the charge stored. CR20 remains on until the charge has been removed, and then it abruptly shuts off. The current, which has been flowing through an inductive trace on the printed-circuit board, must then flow through C31, C32, and C33, and an output pulse is generated.

CR13 clamps the input voltage level after CR20 shuts off. C10 helps to maintain the pulse at a constant amplitude for the VTO frequency range of 3 MHz to 30 MHz.

The pulse is coupled to three outputs through diode networks. These networks limit the signal from CR20, allowing only the first large negative pulse to pass. These networks also contribute to RF channel isolation, since they prevent leakage of an RF signal from one sampler through the pulse lines to another sampler. CR15, CR17, and CR19 are normally on and are biased by R50 through R52. CR24, CR16, and CR18 are normally partially off. A pulse turns on CR14, CR16, and CR18 and turns off CR15, CR17, and CR19.

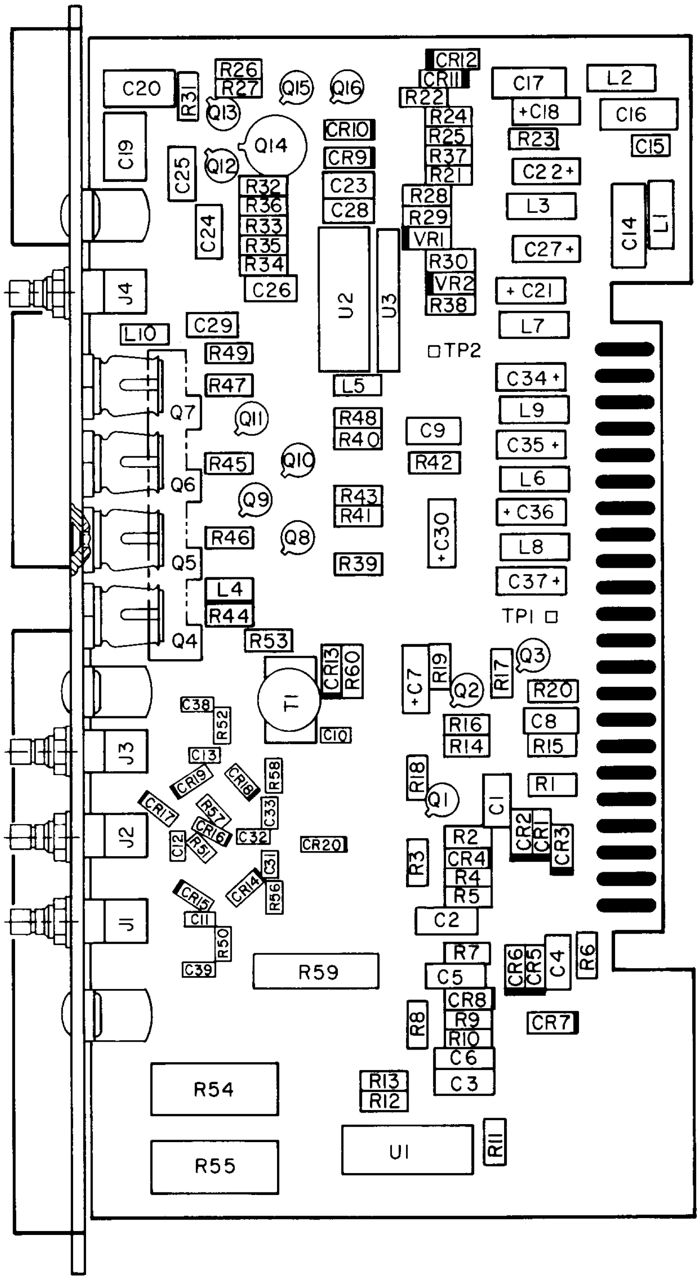
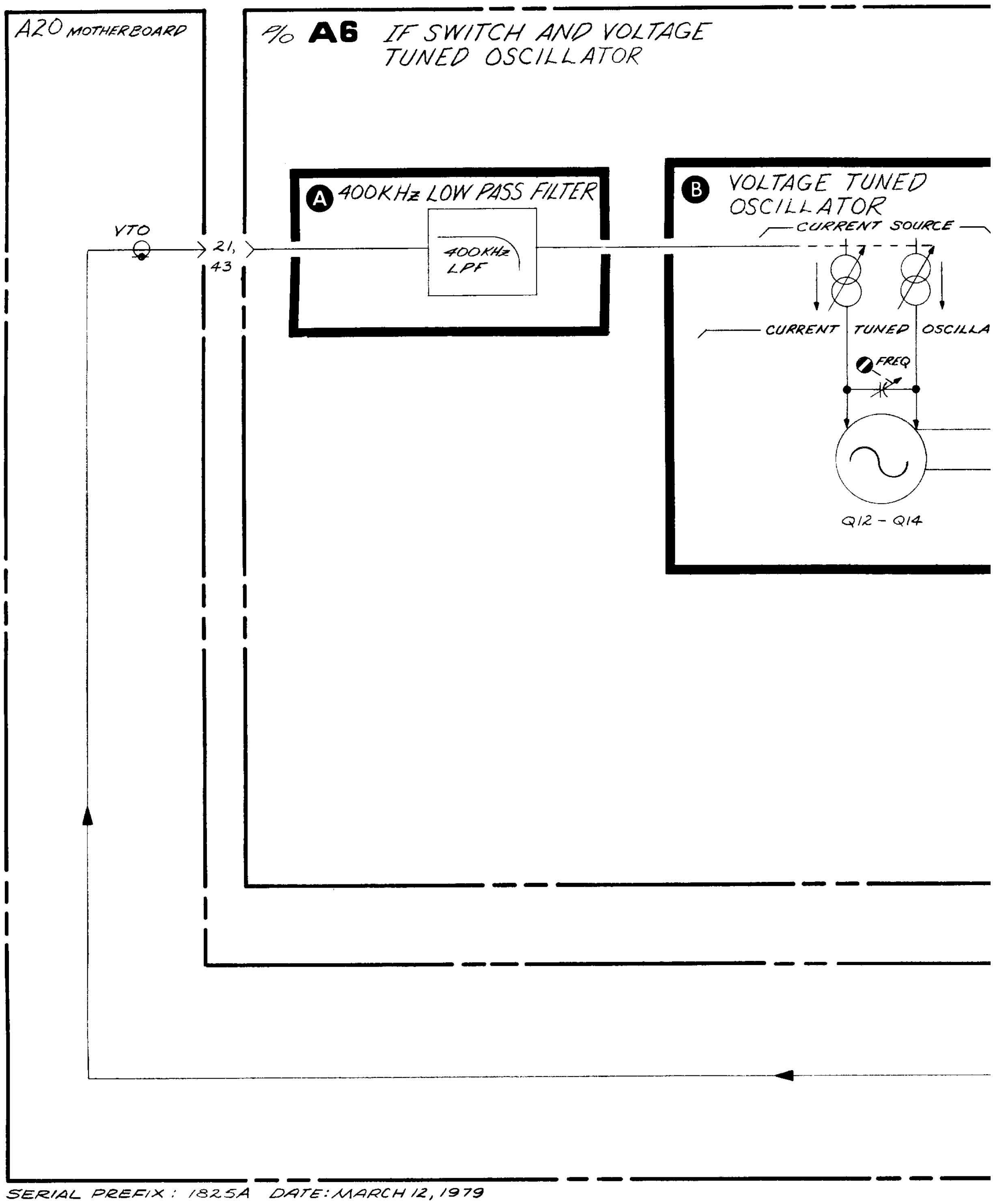
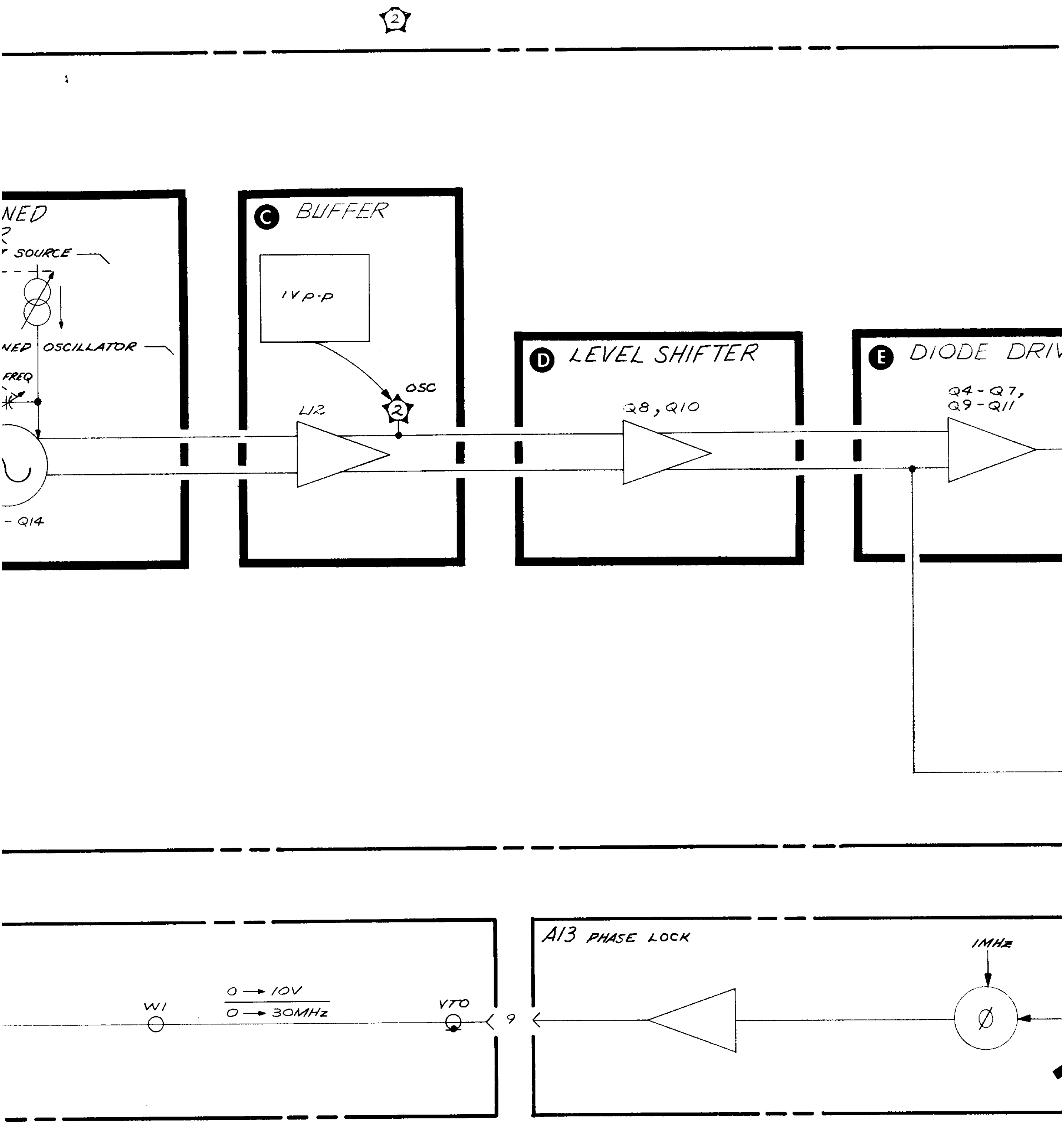
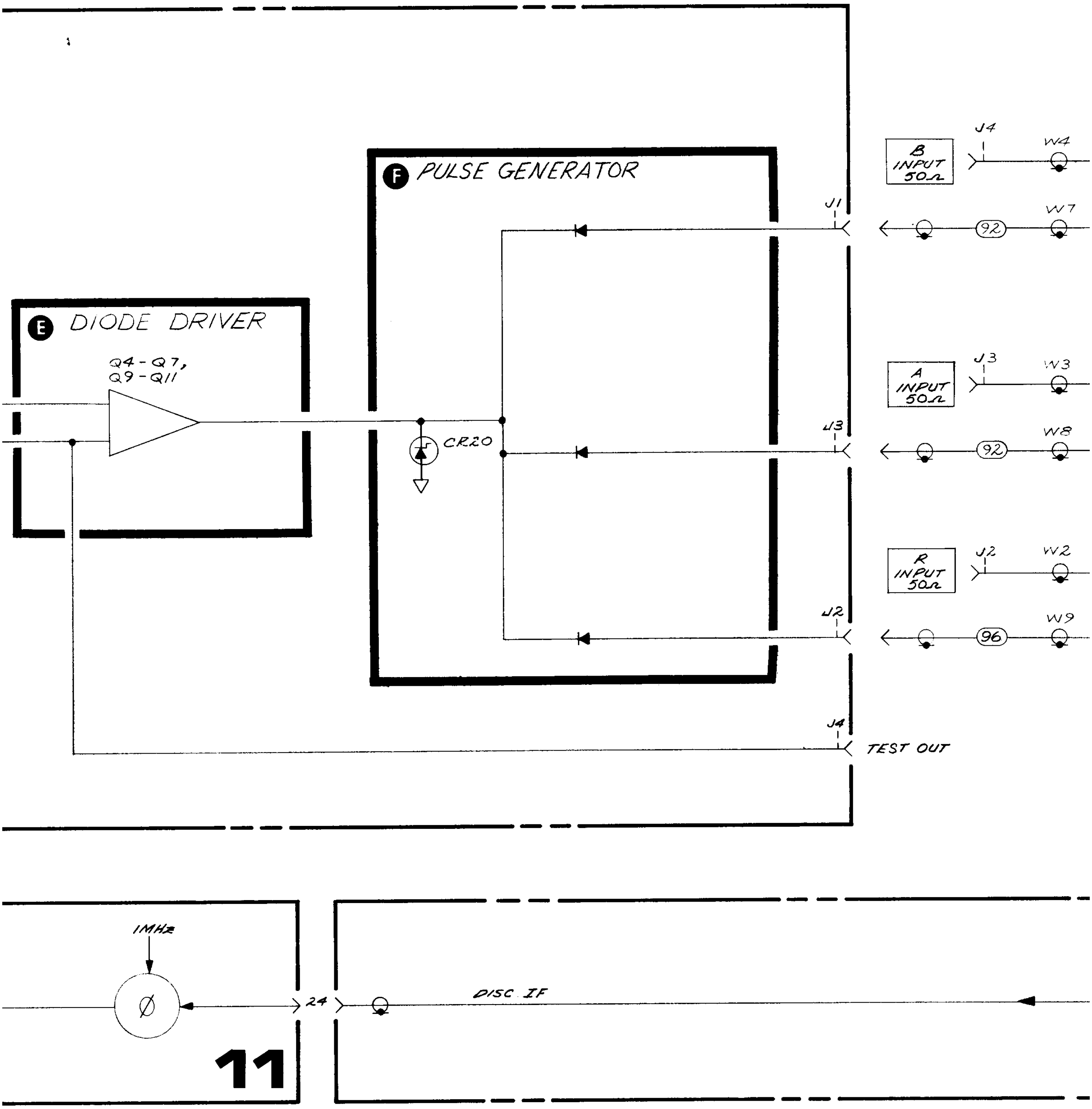


Figure 8-55. Voltage-Tuned Oscillator (A6), Component Locations

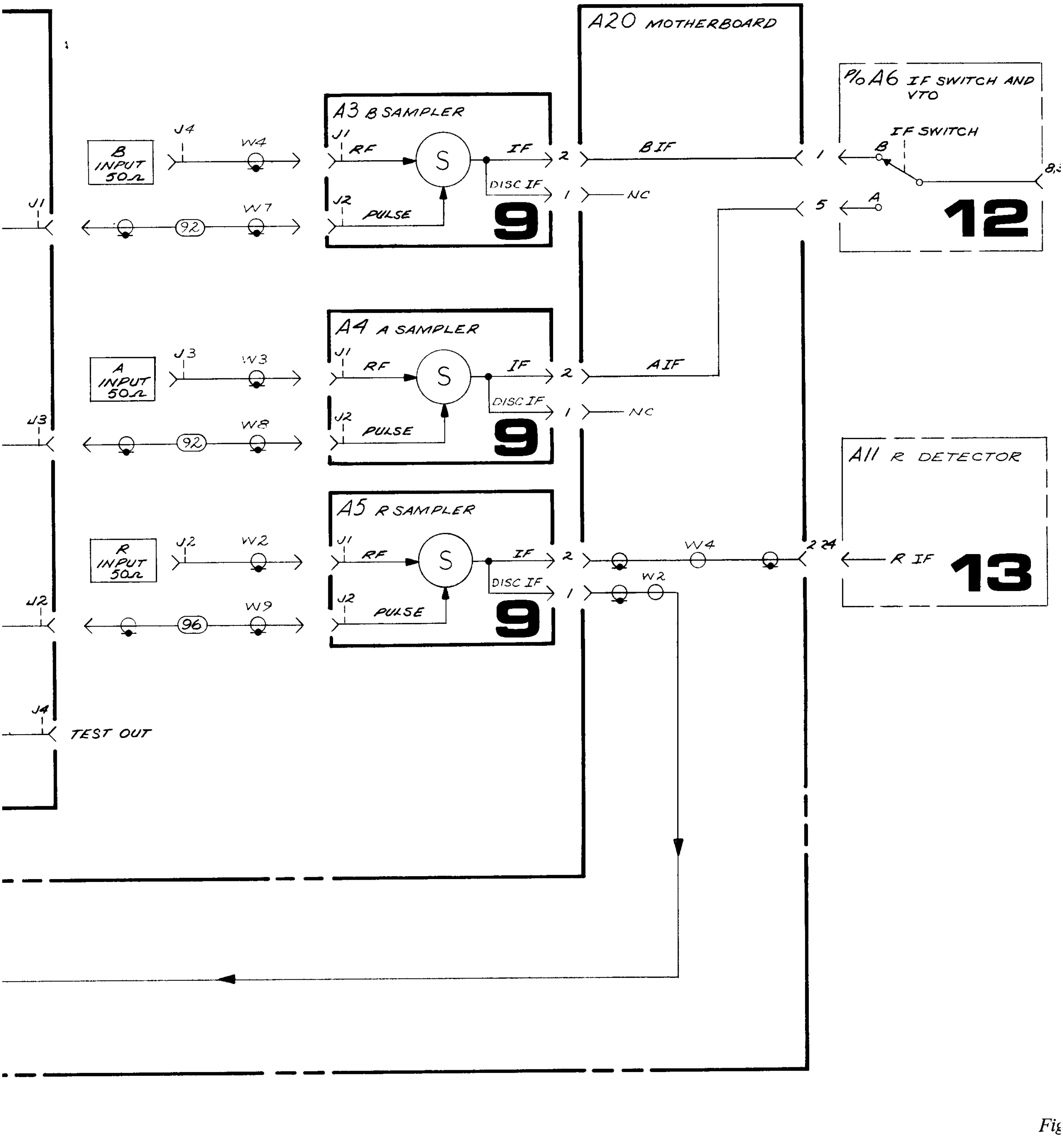

A20 MOTHERBOARD
P/O A6 IF SWITCH AND VOLTAGE TUNED OSCILLATOR
A 400KHz LOW PASS FILTER
400KHz LPF
B VOLTAGE TUNED OSCILLATOR
CURRENT SOURCE
CURRENT TUNED OSCILLA
FREQ
Q12 - Q14
VTO
21, 43
SERIAL PREFIX: 1825A DATE: MARCH 12, 1979



2
NED
SOURCE
NED OSCILLATOR
FREQ
- Q14
C BUFFER
1V p-p
OSC
2
U12
D LEVEL SHIFTER
Q8, Q10
E DIODE DRIV
Q4-Q7,
Q9-Q11
W1
0 → 10V
0 → 30MHz
VTO
9
A13 PHASE LOCK
1MHz
Ø



E DIODE DRIVER
Q4-Q7,
Q9-Q11
F PULSE GENERATOR
CR20
J1
J3
J2
J4
TEST OUT
B INPUT 50Ω
J4
W4
W7
92
A INPUT 50Ω
J3
W3
W8
92
R INPUT 50Ω
J2
W2
W9
96
1MHz
24
DISC IF
11


A20 MOTHERBOARD
P/O A6 IF SWITCH AND VTO
IF SWITCH
12
A3 B SAMPLER
9
A4 A SAMPLER
9
A5 R SAMPLER
9
A11 R DETECTOR
13
B INPUT 50Ω
A INPUT 50Ω
R INPUT 50Ω
RF
IF
PULSE
DISC IF
B IF
A IF
R IF
NC
TEST OUT
W4
W7
W3
W8
W2
W9
92
96

Fig

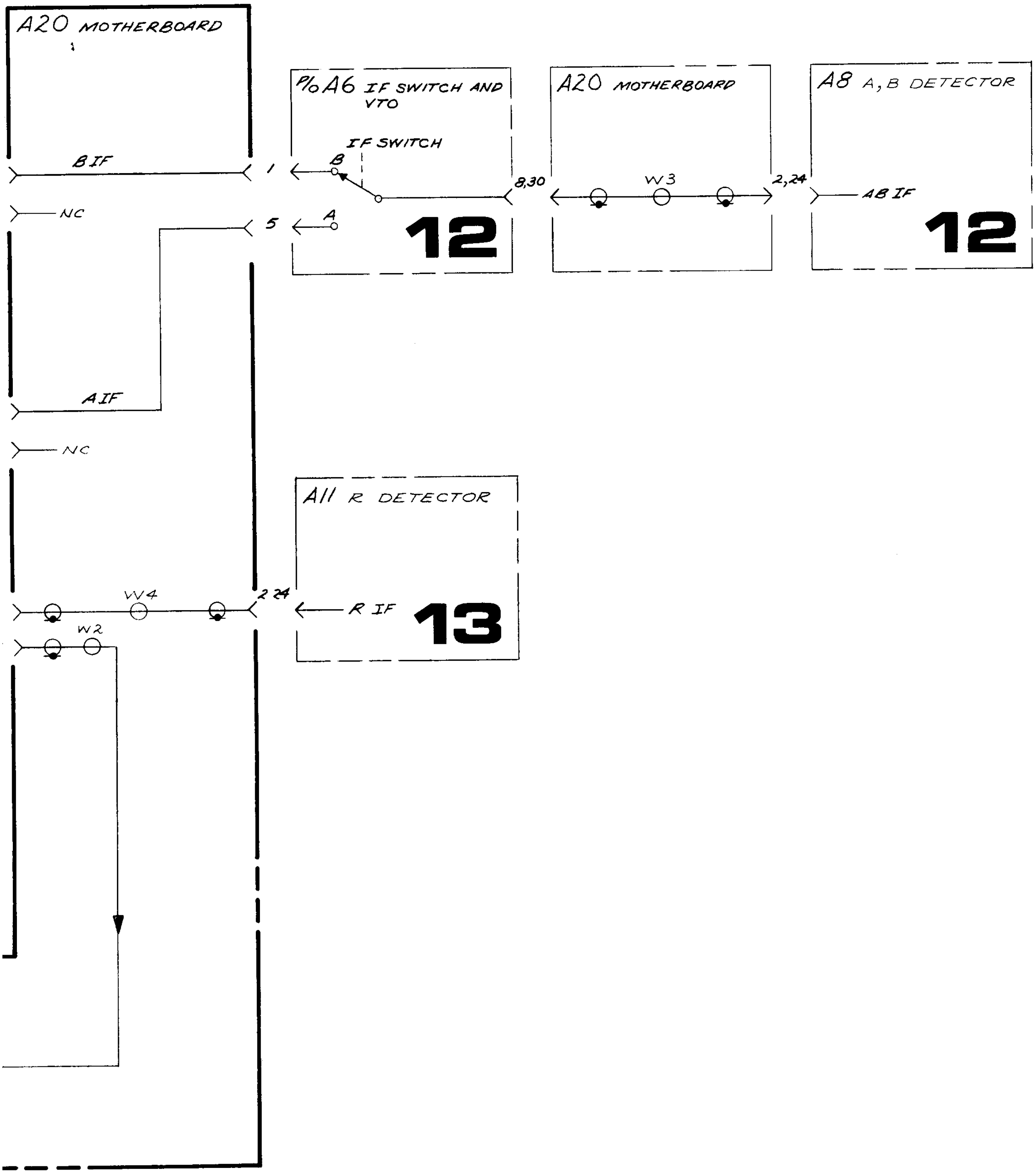
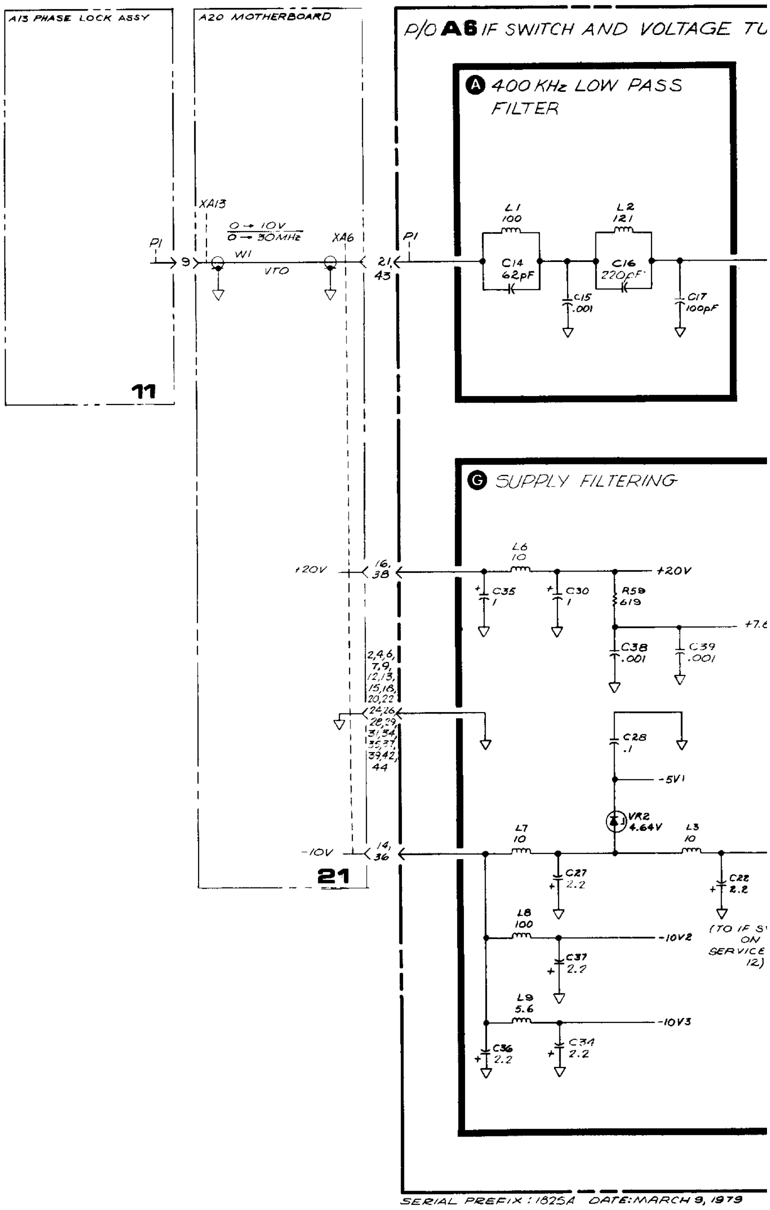


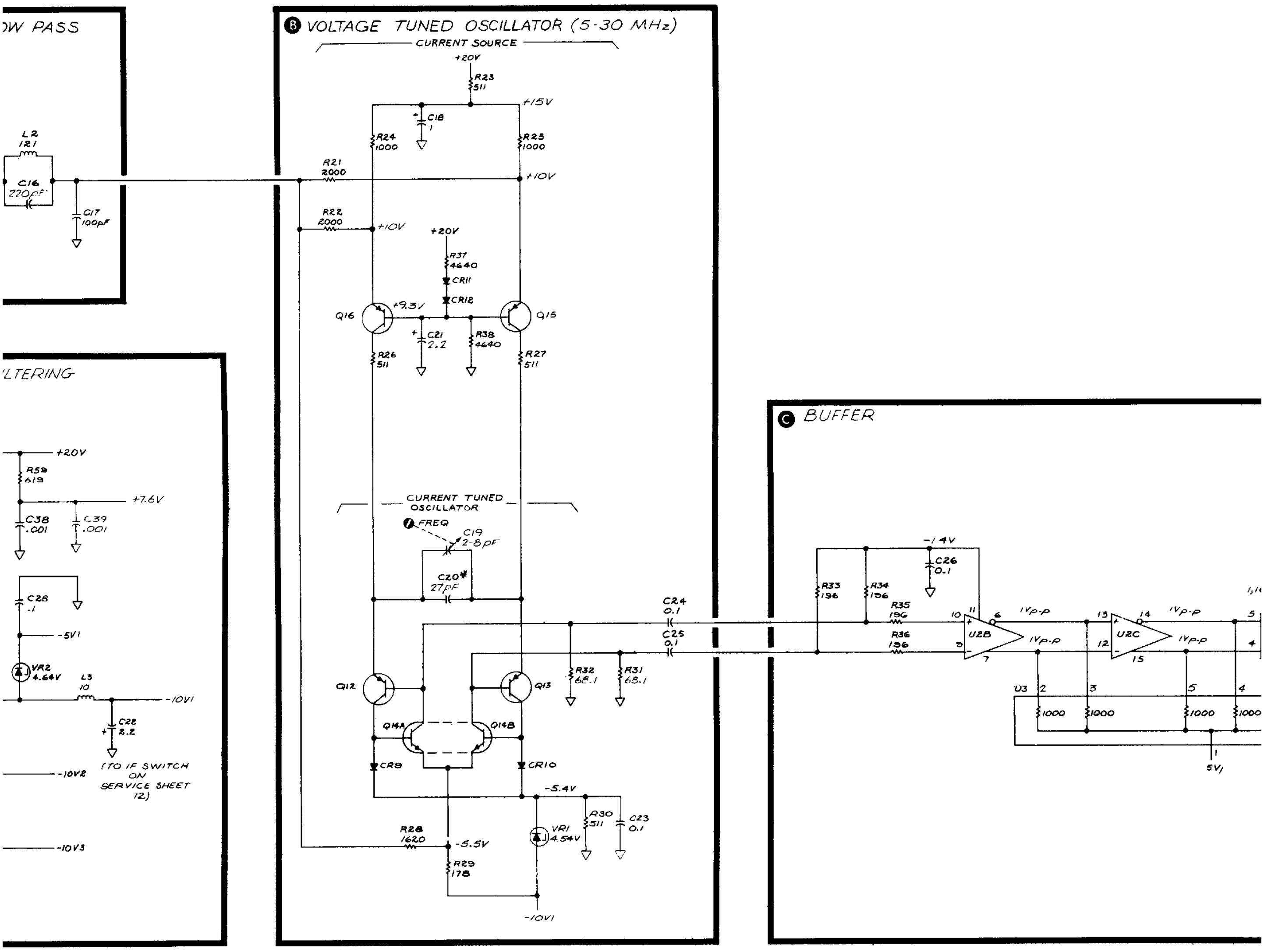
Figure 8-56. Voltage-Tuned Oscillator (A6), Block Diagram

P1

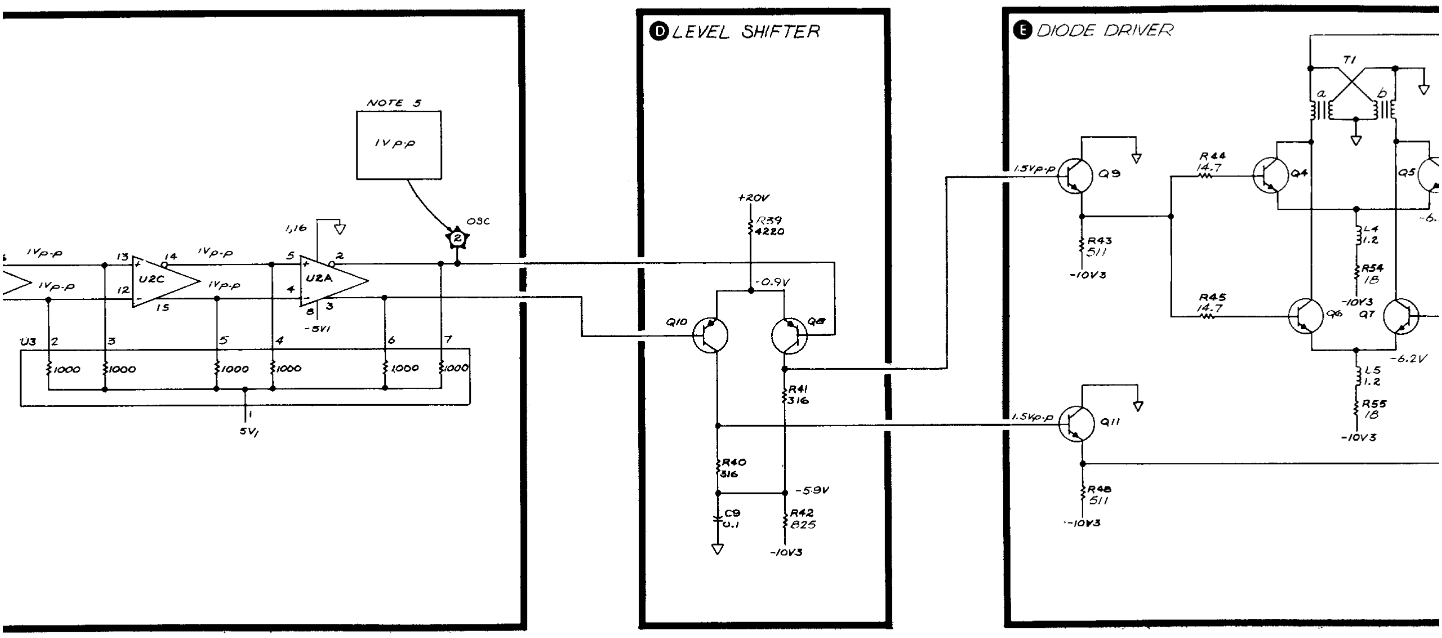
PIN	SIGNAL	TO/FROM	FUNCTION	SER. SHT.
1	IF B	XA3-2		12
23	IF B	XA3-2		
2	GND		G	
24	GND		G	
3	GND		G	
25	GND		G	
4	GND		G	
26	GND		G	
5	IF A	XA4-2		12
27	IF A	XA4-2		
6	GND		G	
28	GND		G	
7	GND		G	
29	GND		G	
8	A,B IF	XA8-2,24		12
30	A,B IF	XA8-2,24		
9	GND		G	
31	GND		G	
10	LB IF SW	XA19-3		12
32	LB IF SW	XA19-3		
11	NC			
33	NC			
12	GND		G	
34	GND		G	
13	GND		G	
35	GND		G	
14	-10V	XA16-9,31	G	
36	-10V	XA16-9,31	G	
15	GND		G	
37	GND		G	
16	+20V	XA16-3,25	G	
38	+20V	XA16-3,25	G	
17	GND		G	
39	GND		G	
18	GND		G	
40	GND		G	
19	GND		G	
41	GND		G	
20	GND		G	
42	GND		G	
21	VTO	XA13-9	A	
43	VTO	XA13-9		
22	GND		G	
44	GND		G	



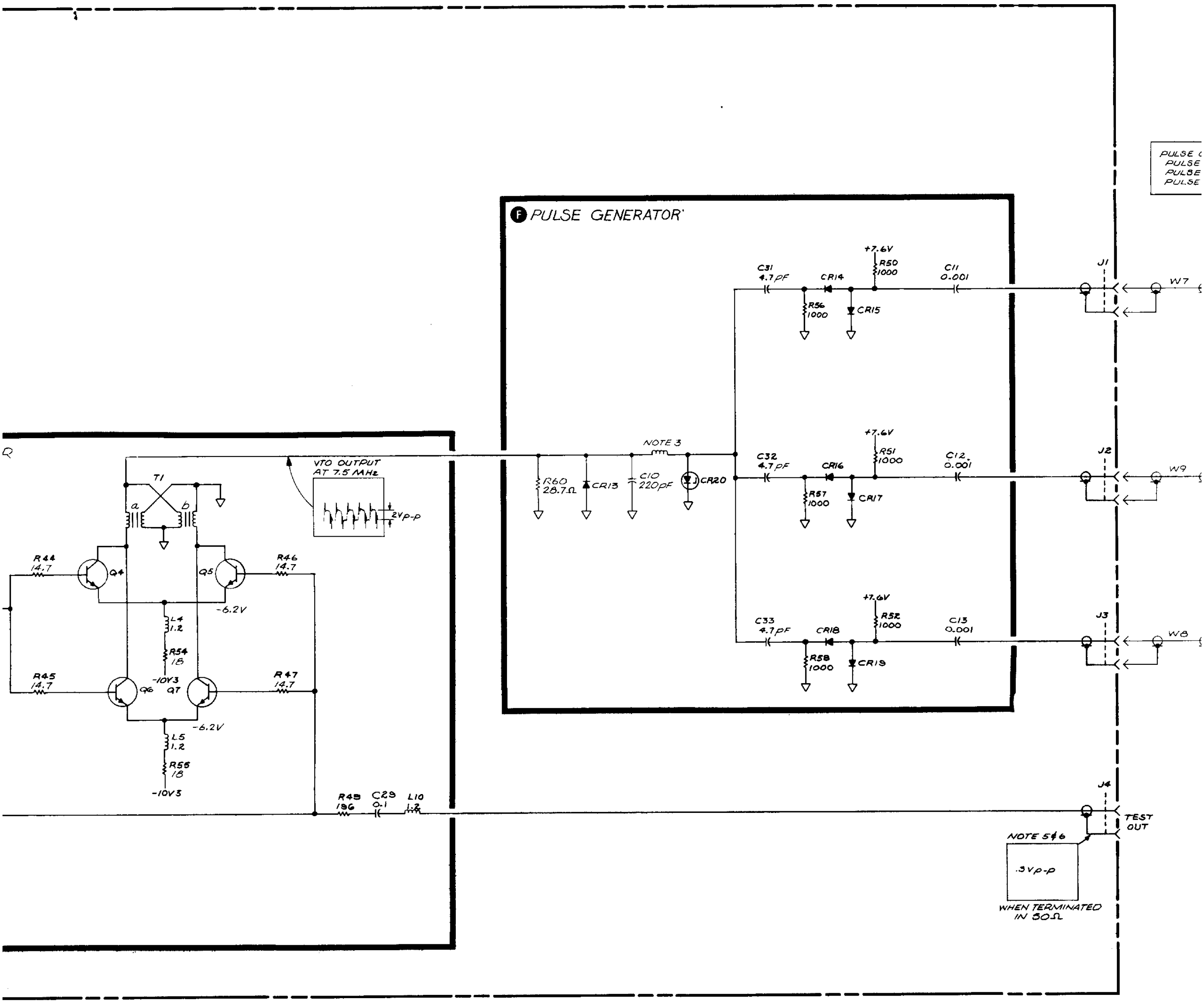
ND VOLTAGE TUNED OSCILLATOR



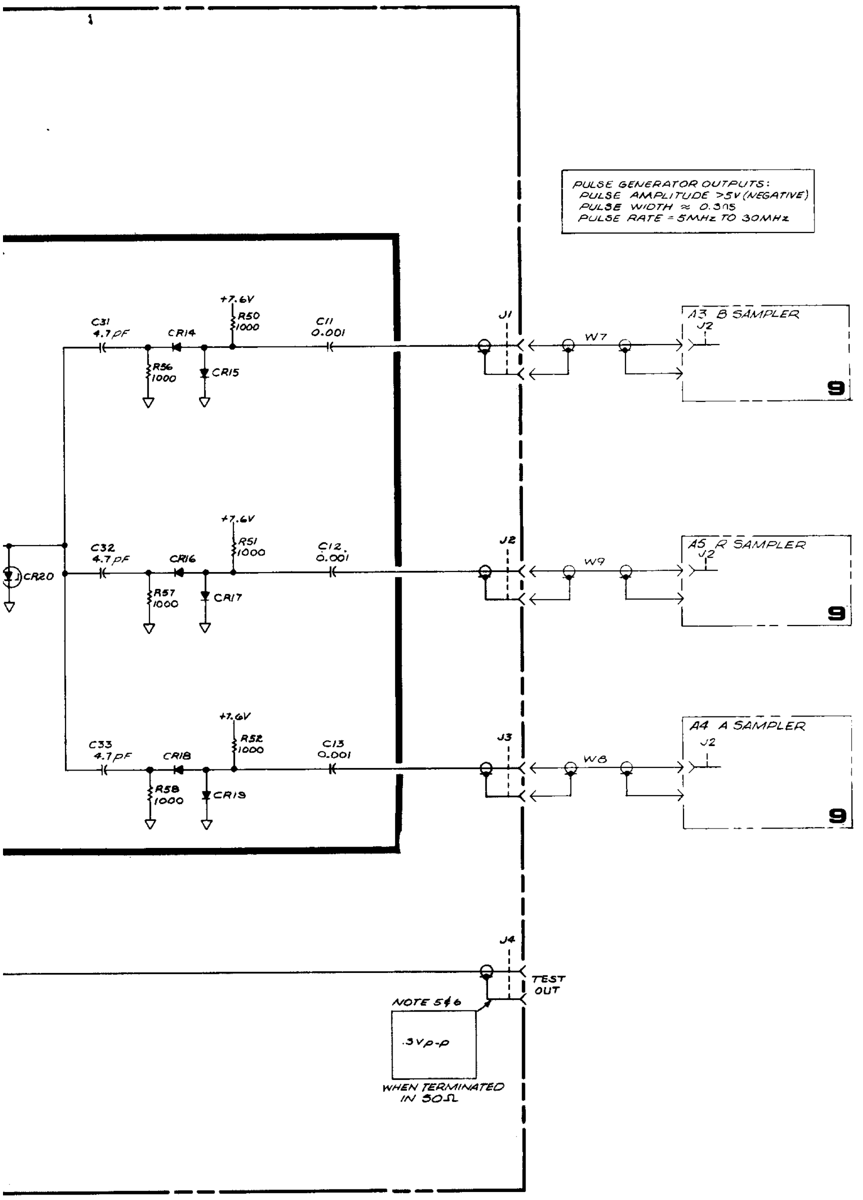
DATE: MARCH 9, 1979



D LEVEL SHIFTER
E DIODE DRIVER
NOTE 5
1Vp-p
OSC
U2C
U2A
U3
1000
5V1
-5V1
+20V
R39 4220
-0.9V
Q10
Q8
R41 316
R40 316
-5.9V
C9 0.1
R42 825
-10V3
1.5Vp-p
Q9
Q11
R43 511
R48 511
R44 14.7
R45 14.7
Q4
Q5
Q6
Q7
T1
L4 1.2
R54 18
L5 1.2
R55 18
-6.2V


PULSE GENERATOR
VTO OUTPUT AT 7.5 MHz
2Vp-p
NOTE 3
R60 28.7Ω
CR13
C10 220pF
CR20
C31 4.7pF
CR14
+7.6V
R50 1000
C11 0.001
R56 1000
CR15
C32 4.7pF
CR16
R51 1000
C12 0.001
R57 1000
CR17
C33 4.7pF
CR18
R52 1000
C13 0.001
R58 1000
CR19
J1
J2
J3
J4
W7
W9
W8
TEST OUT
NOTE 5&6
.3Vp-p
WHEN TERMINATED IN 50Ω
T1
R44 14.7
Q4
Q5
R46 14.7
-6.2V
L4 1.2
R54 18
-10V3
R45 14.7
Q6
Q7
R47 14.7
L5 1.2
R55 18
R48 196
C29 0.1
L10 1.2

Figu



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. INDUCTANCE SHOWN REPRESENTS PRINTED CIRCUIT BOARD TRACE INDUCTANCE (≈ 15nH)
4. RF CABLES W7-W9 ARE NORMALLY CONNECTED AS SHOWN. DUE TO DIFFERENCES IN ELECTRICAL LENGTH, CONNECTIONS MAY BE DIFFERENT. SEE SECTION V ADJUSTMENTS.
5. CHECK VTO FREQUENCY AS FOLLOWS:
   REMOVE: A13 PHASE LOCK
   A14 PHASE LOCK CONTROL

   JUMPER A17TP8 (VSWP) TO XA6-21 (A20W1).

   SET 8754A CONTROLS AS FOLLOWS:
   REFERENCE POSITION CH 1: ON (IN)
   REFERENCE POSITION CH 1 ⬍: MIDRANGE
   REFERENCE POSITION CH 2: ON (IN)
   REFERENCE POSITION CH 2 ⬍: MIDRANGE
   SWEEP: TRIG, MAN
   POLAR A/R: OFF (OUT)

   ADJUST SWEEP VERNIER TO OBTAIN VSWP VOLTAGES IN TABLE BELOW; USE FREQUENCY COUNTER TO MEASURE THE CORRESPONDING VTO FREQUENCIES (AT A6TP2 AND A6J4).

VSWP (A17TP8)	VTO FREQUENCY (A6TP2 OR A6J4)
2.5V	7.5 MHz
5V	15 MHz
7.5V	22.5 MHz
10V	30 MHz

6. THE HP MODEL 1740A OSCILLOSCOPE CAN BE SWITCHED TO A 50 OHM INPUT IMPEDANCE. IF A HIGH INPUT IMPEDANCE OSCILLOSCOPE IS USED, CONNECT A 50 OHM LOAD IN PARALLEL WITH THE OSCILLOSCOPE INPUT (i.e. WITH A BNC TEE.
7. THE PULSE OUTPUT J1-J3 ARE FUNCTIONALLY EQUAL AND MAY BE INTERCHANGED WHEN SERVICING, ALTHOUGH SAMPLER ALLIGNMENT MAY BE AFFECTED.

10
A6

Figure 8-57. Voltage-Tuned Oscillator (A6), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 11

RECEIVER PHASE LOCK

General Description

The purpose of the Receiver Phase Lock is to maintain a 1 MHz receiver IF over the full operating frequency range of the RF Source (4 MHz to 1300 MHz).

The Receiver section of the 8754A is a single conversion superhetrodyne system with a 1 MHz IF whose bandwidth is approximately 10 kHz. A Voltage-Tuned Oscillator (VTO), with a tuning range of 5 MHz to 30 MHz, is the local oscillator for the three receiver samplers. The VTO generates very narrow sampling pulses that contain wide-band harmonics. For any RF Source frequency there is at least one VTO harmonic that will mix in the samplers to produce a 1 MHz IF. The Phase Lock Loop monitors the R Sampler output and adjusts the VTO frequency to maintain a constant 1 MHz IF. The VTO is always phase locked with one of its harmonics 1 MHz higher than the RF input frequency.

Figure 8-58 is a simplified block diagram showing how the Receiver Phase Lock monitors the R Sampler IF and tunes the VTO to maintain phase lock. Note that the VTO can be tuned by either of two closed loops, Phase Lock or Pretune. The Phase Lock Loop tunes the VTO while the Receiver is phase locked. When locked, the R Sampler IF output is passed through a 2.8 MHz low pass filter which is used to eliminate noise and high-order mixing products. The IF is then compared with a fixed 1 MHz signal in the Phase-Frequency Detector. When the IF equals 1 MHz, the Phase-Frequency Detector output is proportional to the phase difference of its two inputs. The phase detector output is integrated, attenuated by a programmable attenuator which is used to set loop gain, then integrated again before being applied to the VTO. This double integration provides a high loop sensitivity to maintain a constant 1 MHz IF during all locked conditions, including fast sweeps.

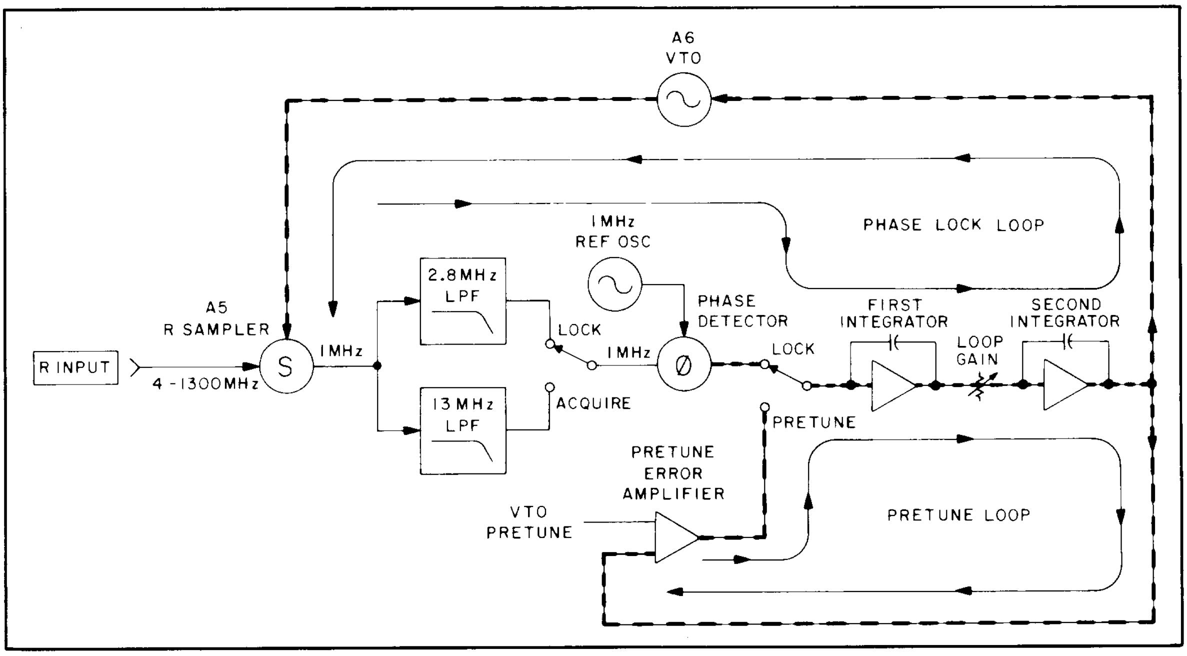


Figure 8-58. Receiver Phase Lock Signal Flow, Simplified Block Diagram

To maintain overall Phase Lock Loop stability, the Phase Lock Loop gain is changed according to which VTO harmonic the Receiver is phase locked. The tuning sensitivity of the VTO for its fundamental frequency (5 MHz to 30 MHz) is 3 MHz/volt. However, when a VTO harmonic is used for phase lock, there is a proportional change in the VTO tuning sensitivity. For example, a 1V tuning voltage change causes the VTO fundamental to change 3 MHz, but causes the 50th harmonic to change 150 MHz. The Phase Lock Loop determines the VTO harmonic number from the RF Source and VTO frequencies.

The RF Source frequency is determined from the FREQ REF voltage from the Shaper (P/O A15, Service Sheet 6). For frequencies below 100 MHz, where the tuning error of the Source is significant, a frequency-to-voltage converter (discriminator) is used to convert the RF Source frequency to a proportional voltage. Both the FREQ REF voltage and Discriminator output go to an Analog-to-Digital Converter (ADC) which programs the loop gain attenuator.

Once locked, the Phase Lock Loop remains locked until either the VTO runs out of tuning range while tracking a swept frequency or the R INPUT power falls too low (approximately −40 dBm). Relock is accomplished by a sequence of events called an Acquisition sequence. This sequence is controlled by A14 Phase Lock Control, and occurs in three sequential intervals: Pretune, Acquire, and Locked.

Pretune. The Pretune interval starts the acquisition sequence, and pretunes the VTO frequency in prepartion for phase lock. The Pretune interval is approximately .3 milliseconds long and is initiated when the H SET VTO and H ACQ lines from A14 go high (+5V). Both the RF and CRT trace sweeps are stopped and the CRT display is blanked. The H SET VTO line activates the Pretune Loop to tune the VTO to a known frequency. The desired pretune frequency is a function of the RF Source frequency as shown in Figure 8-59. This function is generated by the Pretune Shaper, which uses as its inputs the FREQ REF voltage from the Shaper (A15, Service Sheet 6) and the F > 14 MHz control line from the ADC on A14. The VTO Pretune voltage is applied to the Pretune Error Amplifier, where it is compared with the VTO tuning voltage. The error amplifier output is applied to the First Integrator during the Pretune interval to drive the VTO tuning voltage until it is equal to the VTO Pretune voltage. As a result, the VTO gets pretuned to a known frequency that is a function of the RF Source frequency. If the RF Source frequency is such that phase lock may occur on either of two harmonics, trace jitter may occur. The front-panel STABILITY control varies the Pretune voltage slightly so that phase lock occurs on the same harmonic for each repetitive sweep.

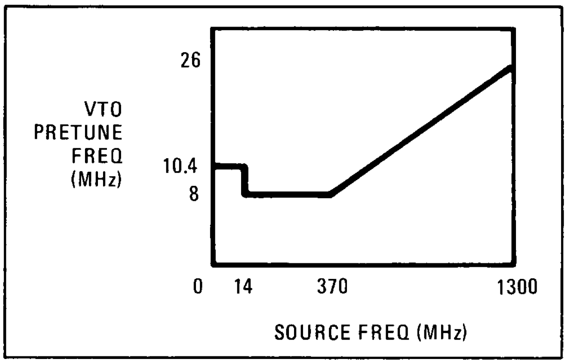


Figure 8-59. VTO Pretune as a Function of Source Frequency

Acquire. The Acquire interval is intiated when the H SET VTO line goes low at the end of a Pretune interval. The Acquire interval lasts about .8 milliseconds and is terminated when the H ACQ line goes low. When the H SET VTO line goes low, the Phase Lock Loop is activated to tune the VTO. The H ACQ line went high during the Pretune interval to select the 13 MHz low pass filter for the R IF input to the Phase Lock Loop. This allows the Phase Lock Loop to respond to IF frequencies as high as 13 MHz, and tune the VTO in the proper direction to return the IF frequency to 1 MHz.

Locked. The Locked interval is selected when the H SET VTO line is low and the H ACQ line is also low. In this mode, the Input Filter cutoff frequency is switched to 2.8 MHz to eliminate display "birdies"; an additional integrator is switched in to improve performance, and the RF and CRT trace sweeps are allowed to continue.

An acquisition sequence is triggered by a lock trigger pulse on the A14 Phase Lock Control. This trigger pulse is inhibited by any of the following conditions.

- Sweep Retrace
- RF Source frequency less than 3 MHz
- R INPUT power less than −40 dBm.
- Rear-panel L RELOCK signal from the PROGRAMMING connector held low (0V).
- Rear-panel H RELOCK signal from PROGRAMMING connector held high (+5V).

A trigger pulse is generated upon removal of all these inhibiting conditions. If none of the inhibiting conditions are present, a trigger pulse is generated if the VTO slews out of range while tracking a sweep, or if lock is lost for some other reason. Figure 8-60 shows typical phase lock timing for a sweep from 5 MHz to 205 MHz.

When the sweep starts after the acquisition interval, a transient is produced as the Phase Lock Loop begins tracking the sweep. Depending on the Source frequency, one of two methods is used to hide this transient from the CRT display. If the Source frequency is greater than 39 MHz, the lock trigger pulse triggers a .1 millisecond backstep pulse. This pulse goes to the Sweep Generator (A17, Service Sheet 5) where it causes the sweep

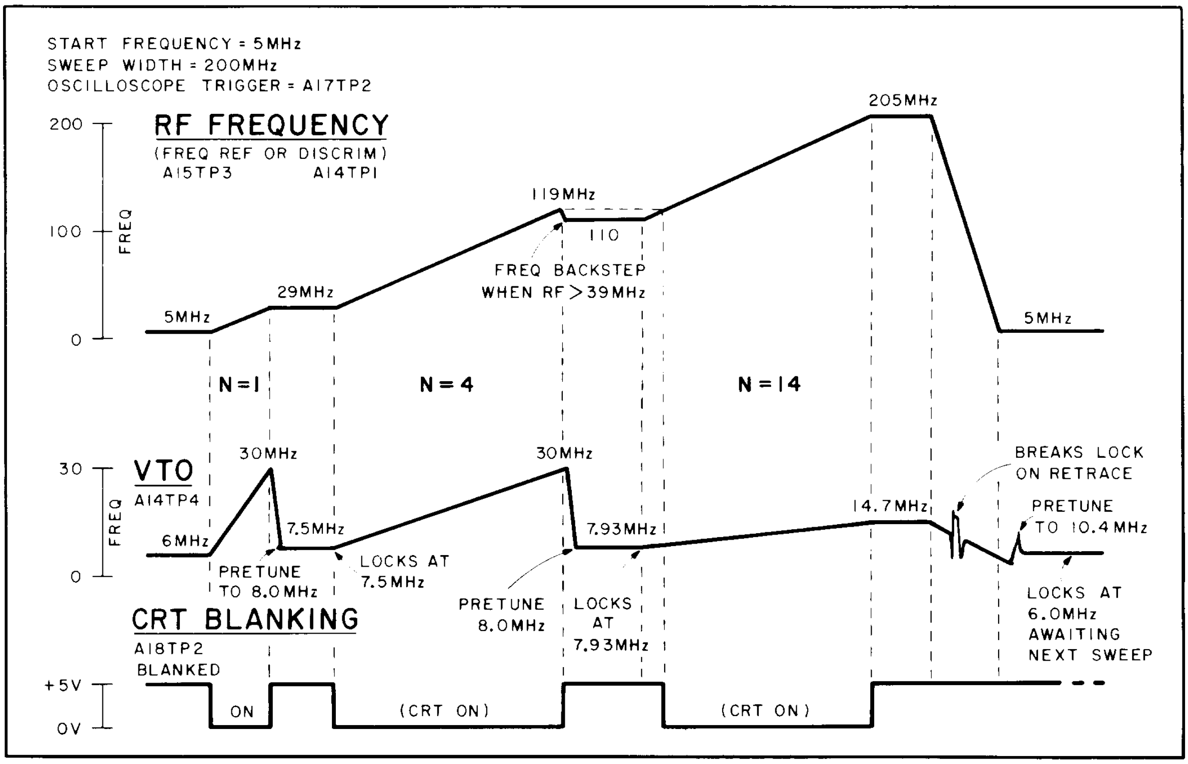


Figure 8-60. Phase Lock Timing for a Sweep of 5 MHz to 205 MHz

ramp (VSWP) to retrace approximately .4V, where it remains until the stop sweep interval has ended. When the sweep starts, the Backstep circuitry keeps the CRT display blanked until the VSWP voltage returns to the level at which the trigger pulse occurred. Thus, the CRT display is blanked during the startup transient, but there is no blank hole in the CRT trace because this segment overlaps the end of the previous portion of the trace.

To eliminate the possibility of backstepping through 0 MHz, backstep pulses are inhibited for Source frequencies below 39 MHz. Since there is no backstep, the startup transient occurs during a portion of the trace that was not previously covered, so blanking is unacceptable. A less objectionable solution is to activate a sample and hold for .2 milliseconds following the start of sweep. This holds a constant value of video information during the startup transient, and results in a short straight line on the CRT display.

PHASE LOCK (A13)

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A13. For example, the designation Q1 is actually A13Q1.

Input Buffer and Filters (A)

The 1 MHz IF (DISC IF) from the R Sampler is amplified by Q3 and Q2. This amplifier has 7.2 dB of voltage gain, a high input impedance, and a low output impedance. The amplifier gain is determined by feedback resistors R6 – R8. The buffer drives two low pass filters in parallel. Analog switch U1 selects the output of one of the filters, as controlled by the H ACQ input from the Phase Lock Control (A14). The 2.8 MHz LPF is selected when the receiver is phase locked, and the 13 MHz LPF is selected during phase lock acquisition.

Limiters (B)

U5 and U9 are packages of differential line receivers that are cascaded to form a limiting amplifier. Negative feedback, from U5A through R21 to U5B, keeps U5B biased in the middle of its active region for maximum sensitivity.

The output from U5C is of sufficient amplitude that bias stabilization is not required in the following stage. Positive feedback, from U9A through R25 to U9B, greatly reduces the rise – fall times of the U9A output. This assures clean triggering in the Phase Detector. Hysteresis at the U9B input, resulting from the positive feedback, prevents the amplification and clipping of noise in the absence of an input signal.

Peak Detector (C)

Reference IF, from the R Sampler, is detected by CR8. CR9 generates forward bias to improve detector sensitivity. The detector output is filtered by C59 and goes to the Reference Level Power Detector on the Phase Lock Control (A14). This signal is used to determine if the front-panel R INPUT signal is less than −40 dBm to control the front-panel UNLOCKED indicator and Phase Lock Control acquisition logic.

Reference Oscillator (D)

The 10 MHz crystal (Y1) and line receiver U3B form a 10 MHz oscillator. U3C and U3A amplify and limit the signal, to drive decade divider U6. The 1 MHz output is the reference signal for the Phase Lock Loop.

Phase/Frequency Detector (E)

The Phase Detector is a digital circuit which outputs pulse trains whose duty cycle is a function of the phase relationship of the input pulses. The "A" input is the Reference Oscillator 1 MHz, and the "B" input is the Reference channel 1 MHz IF from U9.

If the R IF phase lags the reference oscillator phase, U10 pin 11 goes low and U10 pin 12 goes high to turn off Q6. U10 pin 4 outputs a positive pulse train at a 1 MHz rate, and U10 pin 3 outputs an inverted pulse train. This pulses Q5 on, with the pulse width proportional to the phase difference between the two inputs. Thus, the average output current from the collector of Q5 is proportional to the phase angle that "B" lags "A". If "A" lags "B", Q6 provides a negative current proportional to the phase difference. A positive output current is amplified by the integrators and causes the VTO frequency to increase until the phase of the IF catches up with the 1 MHz reference.

If the IF frequency differs from 1 MHz, the output pulse trains are complicated, but the average output current is non-zero and tunes the VTO in the proper direction.

Phase Detector Filter (F)

C40, C42, C44, L11, L12, and L13 form a 3 MHz Low Pass Filter with notches at .5 MHz and 1.5 MHz. The pulses from Q5 and Q6 are filtered to provide a steady dc output to the following stages.

Switch Level Shifter (G), Pretune Switch (I)

Comparator U11C translates its TTL logic input (H SET VTO) to the voltage levels required to drive FET switch Q8. A logic high (+5V) at U11 pin 10 causes the comparator output to go to approximately −10V. This forward biases CR7, and biases the gate of Q8 to approximately −9V, switching Q8 off. A logic low (0V) input to U11C, causes its output to go to +20V, back biasing CR7. The Q8 gate is biased by its source through R40, and the FET switch is turned on. Comparator U11B operation is similar, except that its inputs are switched. Thus, when the H SET VTO line from the Phase Lock Control is high, Q8 is turned off and Q10 is turned on. This opens the connection from the Phase Detector to disable the Phase Lock Loop. Instead, the input to the first integrator is connected to the Pretune Amplifier output (U13), and the Pretune Loop is closed.

Comparator U11A translates the H ACQ input from the Phase Lock Control to drive Q9. Its operation is the same as U11B.

First Integrator (J)

U15 is connected as an integrator. Its output ramps down in response to a positive input, and ramps up in response to a negative input. During the acquisiton interval of a lock sequence, FET switch Q9 is turned on to short across integrator capacitor C47. This converts U15 to a flat gain stage, with gain determined by R43.

Second Integrator (L), Frequency Doubler Switch (K)

The output from the First Integrator passes through programmable attenuator U16, and into the second integrator U14. U16 decodes the three bit binary (4,2,1) Loop Gain input to select one of eight attenuating resistors (R48−55).

The Frequency Doubler circuit is not used, but is connected for possible future use with an external frequency doubler. If the H DBLR input is high, switch U17 connects R47 to ground. This loads R44, doubling its voltage drop to reduce the Loop Gain by 6 dB.

U14, C51, and R56 form an integrator. Q12 buffers the U14 output and provides the high current required to tune the VTO. CR11 is a clamp, preventing the output from going below −0.7V. Similarly, if the output goes above +10.7V, Q11 turns on and its collector current cancels any input current which would otherwise make the output rise higher.

Pretune Error Amplifier (H)

Error Amplifier U13 compares the VTO tuning voltage with the Pretune voltage from the Phase Lock Control. This Pretune Loop forces the VTO voltage to equal the Pretune voltage. If the Pretune Loop is enabled by the H SET VTO input to the Switch Level Shifter, the output of U13 is applied through Q10 to the input of the first integrator, and is used to tune the VTO.

PHASE LOCK CONTROL (A14)

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A14. For example, the designation Q1 is actually A14Q1.

Pretune Shaper (A)

The Pretune Shaper generates the VTO PRETUNE voltage for the VTO as a function of the Source FREQ REF voltage from the Shaper (P/O A15, Service Sheet 6). A voltage of approximately +2.5V is generated at the junction of R45 and R46. This is applied through R49 to the input of voltage follower U12A, which supplies the VTO PRETUNE voltage to the VTO. When the RF Source frequency is less than 14 MHz, the output of U10F is high, forward biasing CR4. This raises the VTO PRETUNE voltage to +3.3V. The FREQ REF input from the Shaper (P/O A15, Service Sheet 6) is proportional to RF Source frequency (1V/100 MHz). When the RF Source frequency reaches 370 MHz, the FREQ REF voltage forward biases CR3, and the VTO PRETUNE voltage increases with frequency (reaching +8.7V at 1300 MHz).

Discriminator (B)

The Source frequency (ATTN RF) is supplied from the RF Source (A7, Service Sheet 7); its power level varies from −10 dBm to −20 dBm, depending on the front-panel OUTPUT dBm control setting. R1 and R2 form a 14 dB attenuator to provide the INT MKR RF to the Marker Generator (A12, Service Sheet 8). Buffer Q1 preserves input impedance match up to 1300 MHz. U1A, U1B, U1C, and U1E are differential line receivers that are cascaded to form a limiting amplifier. Negative feedback through R10 keeps U1B biased in the middle of its active region, for maximum sensitivity. Positive feedback through R12 gives fast switching and prevents amplification of noise when no input signal is present. U1A drives the input of decade divider U3 which divides the RF input frequency by ten. A positive edge at the output of U3 (pin 2) propagates immediately through U4A and U4B to the base of Q3, turning it on. That same positive edge propagates through the 32 nanosecond delay line (L2−4, C10−12) to U4B, and turns Q3 off again. Thus, each positive edge output from U3 produces a 32 nanosecond current pulse at the collector of Q3. C13, C14, and L5 form a filter to smooth the pulsed output of Q3, and provide a pure dc current to flow through R22 and R34 to ground. This current, and therefore the voltage across R34, is proportional to the pulse duty cycle. Since the pulse width is fixed (32 nanoseconds), and the pulse repetition rate is a function of RF input frequency, the output current is proportional to frequency.

The voltage drop across R22 is used to drive the Low Frequency Detector, because its hysteresis precludes the use of a less sensitive signal. That voltage drop would quickly saturate Q3 were it not for CR1 and CR2 which clamp that voltage to a low level. Note that all of the current still flows through R34, so its voltage drop is not affected by the clamp.

Low Frequency Detector (C)

Voltage developed across R22 in the Discriminator feeds comparator U11A, which is set to trip at approximately .5V. This corresponds to an RF Source frequency of 3 MHz. R23 through R25 form a hysteresis loop around U11A. When the frequency is greater than 3 MHz, U11A pin 1 is high. This makes the output of U14C go high if its other two inputs (pins 10 and 11) are also high. The F>3 MHz output goes low if any of the following conditions exist:

- H RELOCK line from the rear panel is high.
- The L RELOCK line from the rear panel is low.
- The RF Source frequency goes below 3 MHz.

This blanks the CRT display, and when F>3 MHz goes high again, a lock sequence is initiated. CR5−8, R29, and R31 provide overvoltage protection for the rear panel L RELOCK and H RELOCK inputs.

Loop Gain Control (D)

The Discriminator output voltage is applied to five comparators (U7A, U7B, U8A, U8B, and U8D) that are set to trip at the logarithmic progression of frequencies shown on their outputs. At frequencies greater than 100 MHz, the FREQ REF voltage from the Shaper is used, tripping the last three comparators (U8C, U7C, and U7D). Since the Discriminator does not work above 200 MHz, Q4 is turned on to hold the Discriminator output high whenever the F>109 MHz comparator (U8C) is tripped. The comparator outputs are applied to priority encoder U6, which generates a three bit binary number representitive of the highest comparator tripped. This number is used to program loop gain on the Phase Lock Assembly (A13). To prevent the loop gain from changing during a sweep, the data is latched in U9. The latch is updated during a lock sequence, at the end of the VTO Pretune interval. A high H SET VTO input to U9 pin 9 (F1) switches U9 into an open collector state during the Pretune interval. This allows three pulldown resistors on the Phase Lock Assembly to pull all three lines low and set the proper loop gain for a Pretune interval.

Reference Channel Power Detector (E)

The IF DETECT input from Phase Lock Assembly (A13) is the input to comparator U11C. This comparator trips at approximately +.26V, which corresponds to an R INPUT level of approximately −42 dBm. If the power is greater than this, the comparator output is high. Positive feedback through R40 generates hysteresis, preventing comparator oscillation.

Acquisition Logic (F)

The Acquisition Logic monitors several instrument parameters, and generates, when appropriate, a string of pulses which accomplish a phase lock acquisition. The conditions monitored are:

- VTO frequency
- Source frequency
- R INPUT power
- Sweep status

U21A monitors conditions necessary for a lock attempt. U21 pin 1 is high if the Sweep Generator (A17, Service Sheet 5) is not retracing, U21 pin 2 is high if the R INPUT power is greater than −40 dBm, U21 pin 4 is high if the RF Source frequency is greater than 3 MHz, and U21 pin 5 goes high .1 second after power is turned on. When all four of these inputs go high, the output of U22D also goes high.

The VTO Range Detector (U11B, U11D) monitors the VTO tuning voltage to determine if the VTO is out of its tuning range. The output of U11D goes low if the VTO tuning voltage is greater than +10V, corresponding to a 30 MHz VTO frequency. The output of U11B goes low if the VTO tuning voltage goes below +1.67V, corresponding to a 5.5 MHz VTO frequency. Both U11B and U11D have open collector outputs, which are connected in parallel. This output is high when the VTO is within the 5.5 MHz to 30 MHz frequency range, and is low when the VTO is out of this range. If the RF Source goes below 7 MHz, the F>7 MHz input to U11B goes low to reduce the comparator trip point to 0V. This allows the VTO to follow the RF Source frequency down to 0 MHz.

A lock sequence is triggered by a negative edge on the output of U21B (pin 8). The U21B output goes low if all its inputs are high. The input to U21B pin 12 serves as a "retrigger holdoff", and is low if a lock sequence is in progress. This prevents a lock sequence from being started before another one is finished. Thus, pin 12 is normally high. U21 pin 9 is high if all the conditions monitored by U21A are satisfactory. If the loop is locked, the VTO is in its proper range and the output of the VTO Range Detector (U11B, U11D) is high; since Q8 is biased off, this causes U21B pin 13 to be low. If the VTO goes out of range while tracking a sweep, pin 13 goes high to trigger a relock. If U21B pin 9 is low when the VTO goes out of range, a lock sequence will not be triggered. However, the negative edge from the VTO comparators will couple through C46 and U20 to trigger the SET VTO TIMER (U19A) and trigger a Pretune interval. At the end of the Pretune interval, the VTO will begin to slew again and try to relock. If the relock attempt is unsuccessful, the above sequence is repeated. This improves the probability of the loop remaining locked under low R INPUT power conditions.

If, while the receiver is phase locked, an external lock request is received (H RELOCK or L RELOCK from the rear panel), or if the R INPUT power sweeps through a brief low power region, U22D pin 8 pulses low, then high again. This should trigger a relock, but cannot if U21B pin 13 is low (as it is if the receiver is phase locked). Therefore, the positive edge from U22D pin 8 is coupled to Q8 to briefly pull U16D pin 12 low. This pulses U21B pin 13 high coincident with U21B pin 9 and a lock sequence is triggered.

The negative edge of the U21B lock trigger output triggers three one shots:

- Backstep Timer (U13B) – 50 to 140 microsecond pulse output.
- Set VTO Timer (U19A) – Generates the .29 millisecond pulse H SET VTO pulse to time the Pretune interval.
- Acquisition Timer (U15B) – Generates the 1.1 millisecond pulse to time the acquisition interval. The acquisition pulse also stops the sweep through its input to U20B pin 4. At the end of the acquistion interval, U15A is triggered which produces a .29 millisecond pulse, extending the stop sweep by this length of time. At the end of the stop sweep interval, U19B is triggered, producing the .22 millisecond L HOLD output to hold the video level. The L HOLD output is also low during the 1.1 millisecond acquisition interval due to the input to U20D pin 12. This eases the display settling time, since the lockup transients are not seen by the Deflection Amplifiers (A18, Service Sheet 16).

Aside from the normal lock sequence, the H SET VTO (Pretune interval) output may be activated by grounding TP8. This is necessary during instrument alignment. Since the H ACQ output must be activated during the Pretune interval, H SET VTO is routed through U22E to U17A pin 1 to activate the H ACQ output. The R> −40 dBm input to U17A pin 2 activates the H ACQ output whenever the R INPUT power falls below −40 dBm. This also lights the front-panel UNLOCKED lamp. R85 and C30 prevent the UNLOCKED lamp from flickering due to brief low power conditions.

The H BLANK output blanks the CRT display, and is activated by any one of the three inputs to U17C. The CRT display is blanked during a stop sweep, when the RF Source frequency is below 3 MHz, and during the Backstep interval.

Backstep (G)

The Backstep circuit briefly retraces the sweep, and blanks the CRT display during this retrace. Figure 8-61 shows a typical Backstep timing sequence. The circuit is disabled if any of the following conditions occur:

- R INPUT power is less than −40 dBm
- SWEEP WIDTH MHz switch set to 0 CW or MANual SWEEP selected.
- At the beginning of a sweep.

Any of these conditions cause the U14A output (pin 12) to go low, disabling one-shot U13B; the low output also forces U17B pin 6 high (unblanked) regardless of the U17B inputs to pins 3 and 5.

During the quiescient state of one-shot U13B, its pin 12 output is high, holding U16A pin 1 high. Since U16A pin 2 is held high by U17B pin 6, the U16A pin 3 output is low. This low output forces the output of U17B to remain high (regardless of U17B inputs on pin 4 and 5), and turns Q7 on. With Q7 turned on, U18A pin 3 is clamped to ground, and C29 charges as the VSWP input increases. A lock trigger pulse fires one-shot U13B (if U14A pin 12 is high), and simultaneously stops the forward sweep. The negative pulse on U13B pin 12 forces U16A pin 3 high, turning Q7 off. The simultaneous positive output on U13B pin 5 (H BK STEP) goes to the Sweep Generator (A17, Service Sheet 5) to cause a short retrace of approximately .4V. Since Q7 is off, the negative going VSWP couples through C29 to the inverting input of U18A, causing its output to go high. Since the three inputs to U17B are now high, its output goes low to blank the CRT display. The low output from U17B holds the U16A output high, even after one-shot U13B has finished its pulse, so the gates

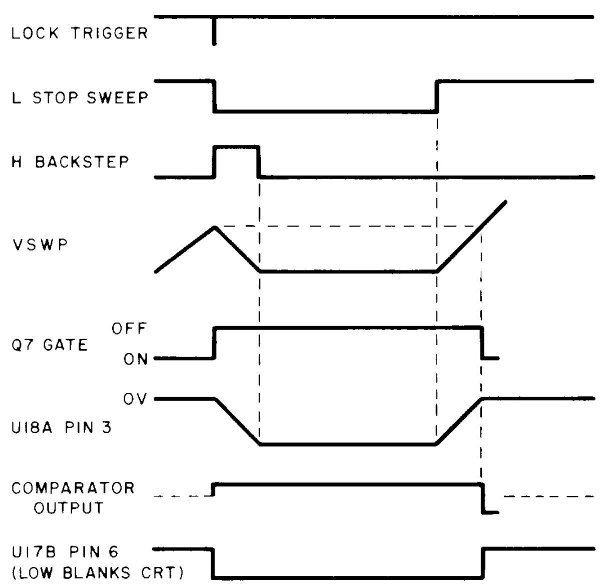


Figure 8-61. Back Step Timing Diagram

remain in this state until comparator U17B changes state. When the sweep starts forward again, U18A pin 3 passes through zero when the VSWP level is the same as when the lock trigger occurred. At that point, U18A pin 7 goes low, forcing the U17B output high (unblanked). Since U13B pin 12 has switched high again, U16A pin 3 goes low to turn on Q7; U17B pin 3 is also held low so that the state of U17B pin 5 is no longer important. (The output of comparator U18A is undefined when Q7 shorts its inputs together.)

If the backstep carries the RF Source frequency below 39 MHz, the F>39 MHz input goes low, terminating the backstep pulse by resetting oneshot U13B.

Buffer U12B supplies a buffered VSWP to the rear panel PROGRAMMING connector (A23J7, Service Sheet 18).

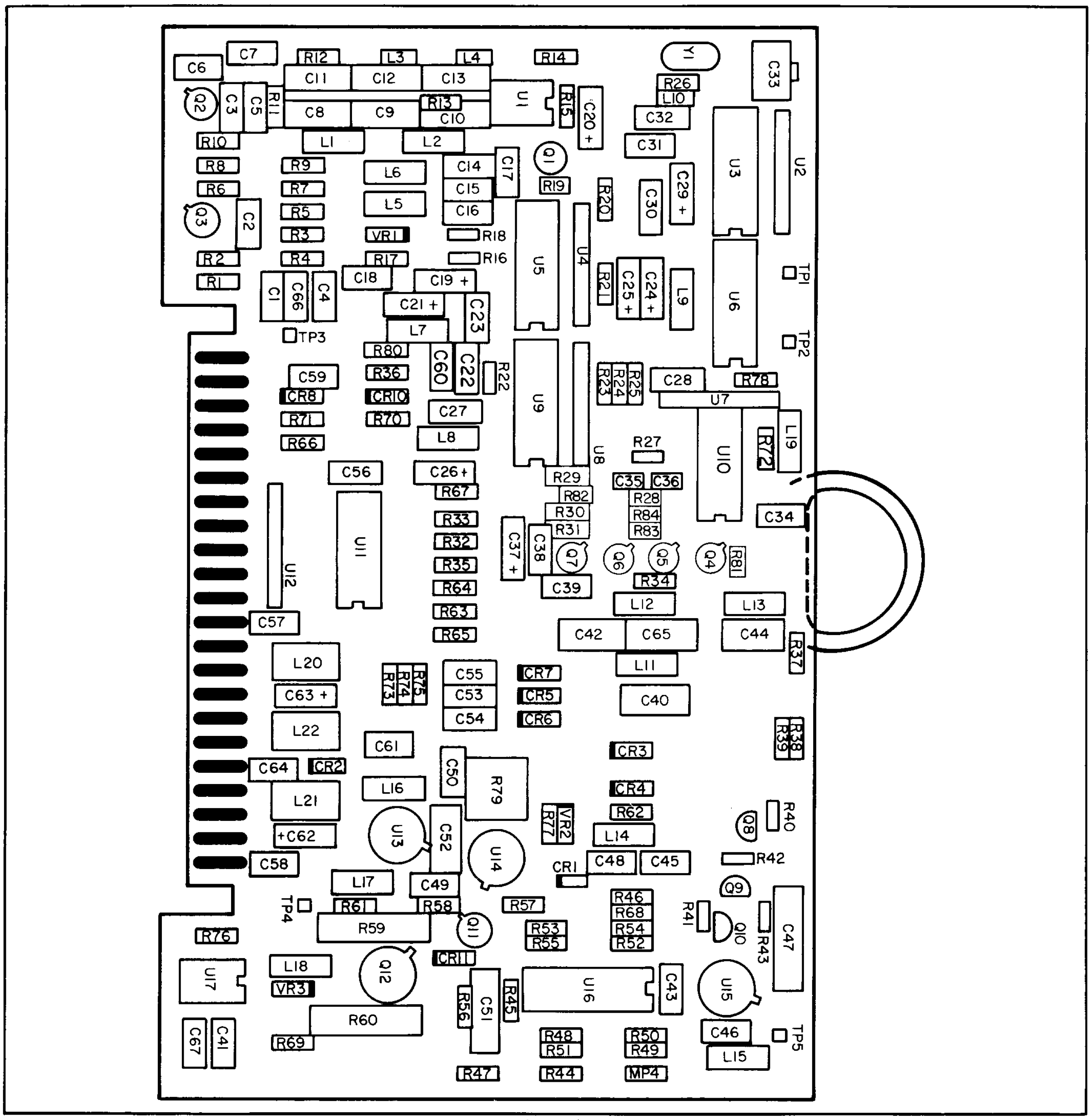


Figure 8-62. Phase Lock (A13), Component Locations

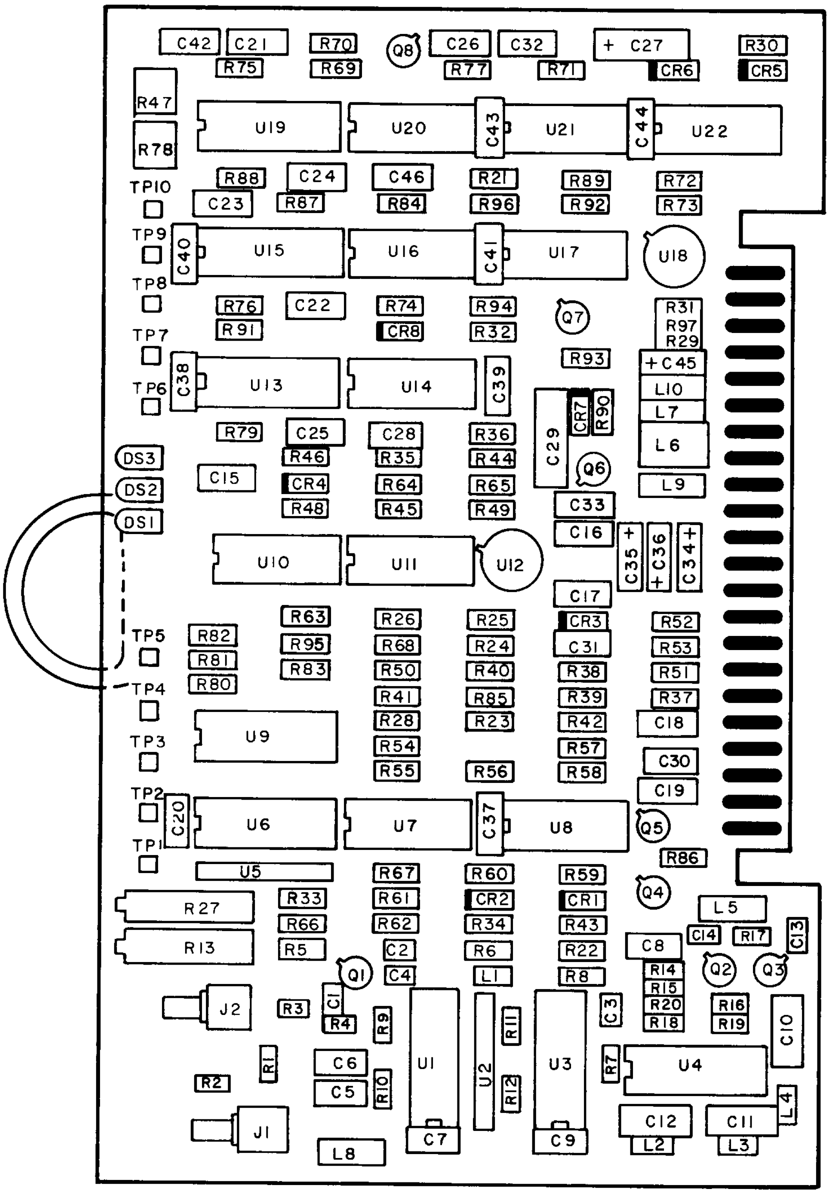
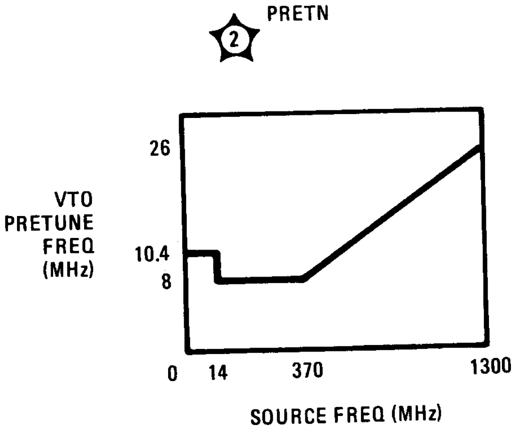
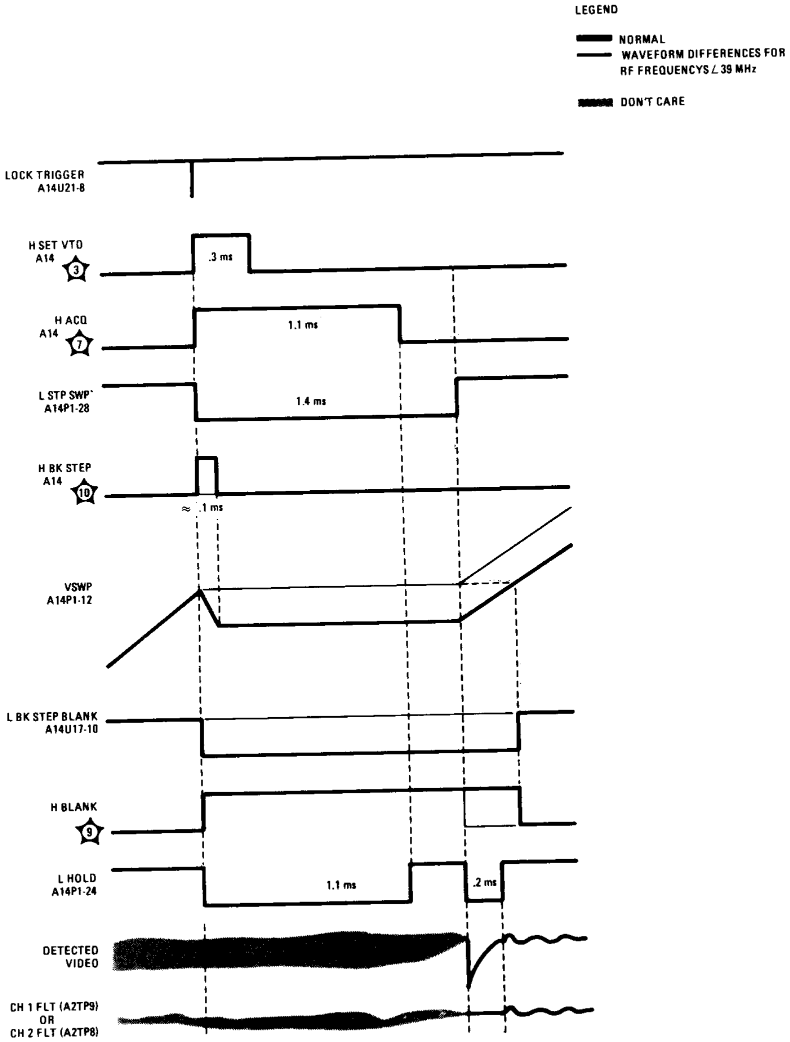
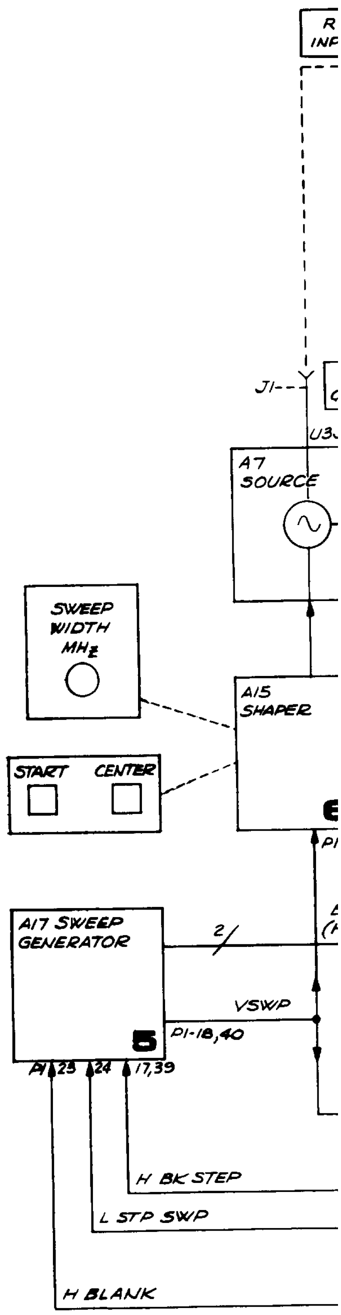


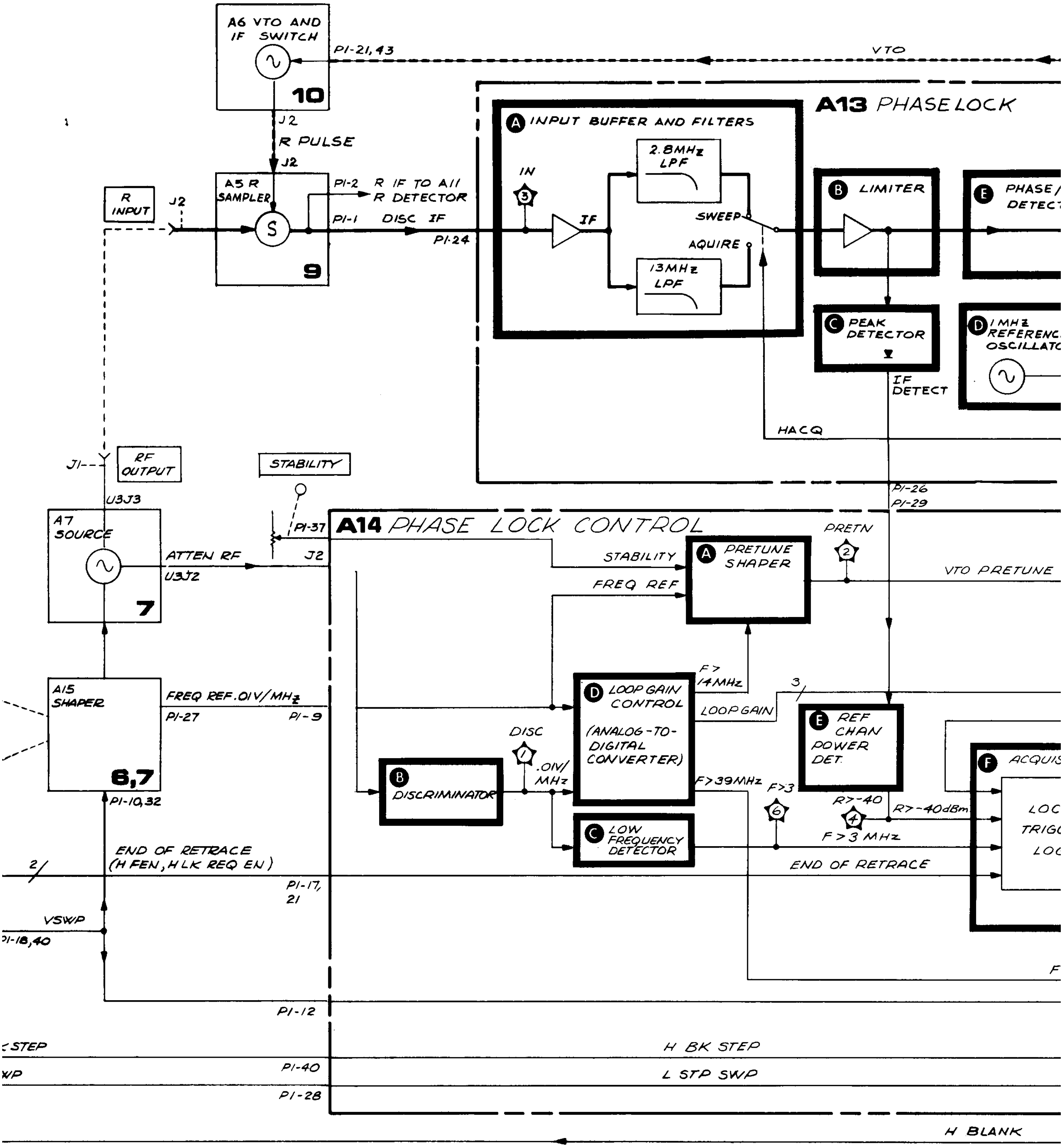
Figure 8-63. Phase Lock Control (A14), Component Locations

4A


PRETN
2
VTO
PRETUNE
FREQ
(MHz)
26
10.4
8
0
14
370
1300
SOURCE FREQ (MHz)


LEGEND
NORMAL
WAVEFORM DIFFERENCES FOR RF FREQUENCYS ∠ 39 MHz
DON'T CARE
LOCK TRIGGER
A14U21-8
H SET VTO
A14
3
.3 ms
H ACQ
A14
7
1.1 ms
L STP SWP
A14P1-28
1.4 ms
H BK STEP
A14
10
≈ .1 ms
VSWP
A14P1-12
L BK STEP BLANK
A14U17-10
H BLANK
9
L HOLD
A14P1-24
1.1 ms
.2 ms
DETECTED
VIDEO
CH 1 FLT (A2TP9)
OR
CH 2 FLT (A2TP8)


J1-
A7
SOURCE
SWEEP
WIDTH
MHz
A15
SHAPER
START
CENTER
A17 SWEEP
GENERATOR
5
2
VSWP
P1-18,40
P1 23
24
17,39
H BK STEP
L STP SWP
H BLANK


A6 VTO AND IF SWITCH
10
P1-21,43
VTO
A13 PHASE LOCK
J2
R PULSE
J2
A5 R SAMPLER
9
R INPUT
J2
P1-2
R IF TO A11 R DETECTOR
P1-1
DISC IF
P1-24
A INPUT BUFFER AND FILTERS
IN
3
IF
2.8MHz LPF
13MHz LPF
SWEEP
AQUIRE
B LIMITER
E PHASE/ DETECT
C PEAK DETECTOR
D 1MHz REFERENCE OSCILLATOR
IF DETECT
HACQ
J1
RF OUTPUT
STABILITY
U3J3
A7 SOURCE
7
P1-37
A14 PHASE LOCK CONTROL
P1-26
P1-29
ATTEN RF
U3J2
J2
STABILITY
FREQ REF
A PRETUNE SHAPER
PRETN
2
VTO PRETUNE
A15 SHAPER
6,7
FREQ REF .01V/MHz
P1-27
P1-9
F>14MHz
D LOOP GAIN CONTROL (ANALOG-TO-DIGITAL CONVERTER)
LOOP GAIN
3
E REF CHAN POWER DET.
DISC
1
.01V/MHz
B DISCRIMINATOR
F>39MHz
F>3
6
R>-40
4
R>-40dBm
F>3 MHz
F ACQUIS
LOC TRIG LOC
C LOW FREQUENCY DETECTOR
P1-10,32
END OF RETRACE (H FEN, H LK REQ EN)
2
P1-17, 21
END OF RETRACE
VSWP
P1-18,40
F
P1-12
STEP
H BK STEP
WP
P1-40
L STP SWP
P1-28
H BLANK

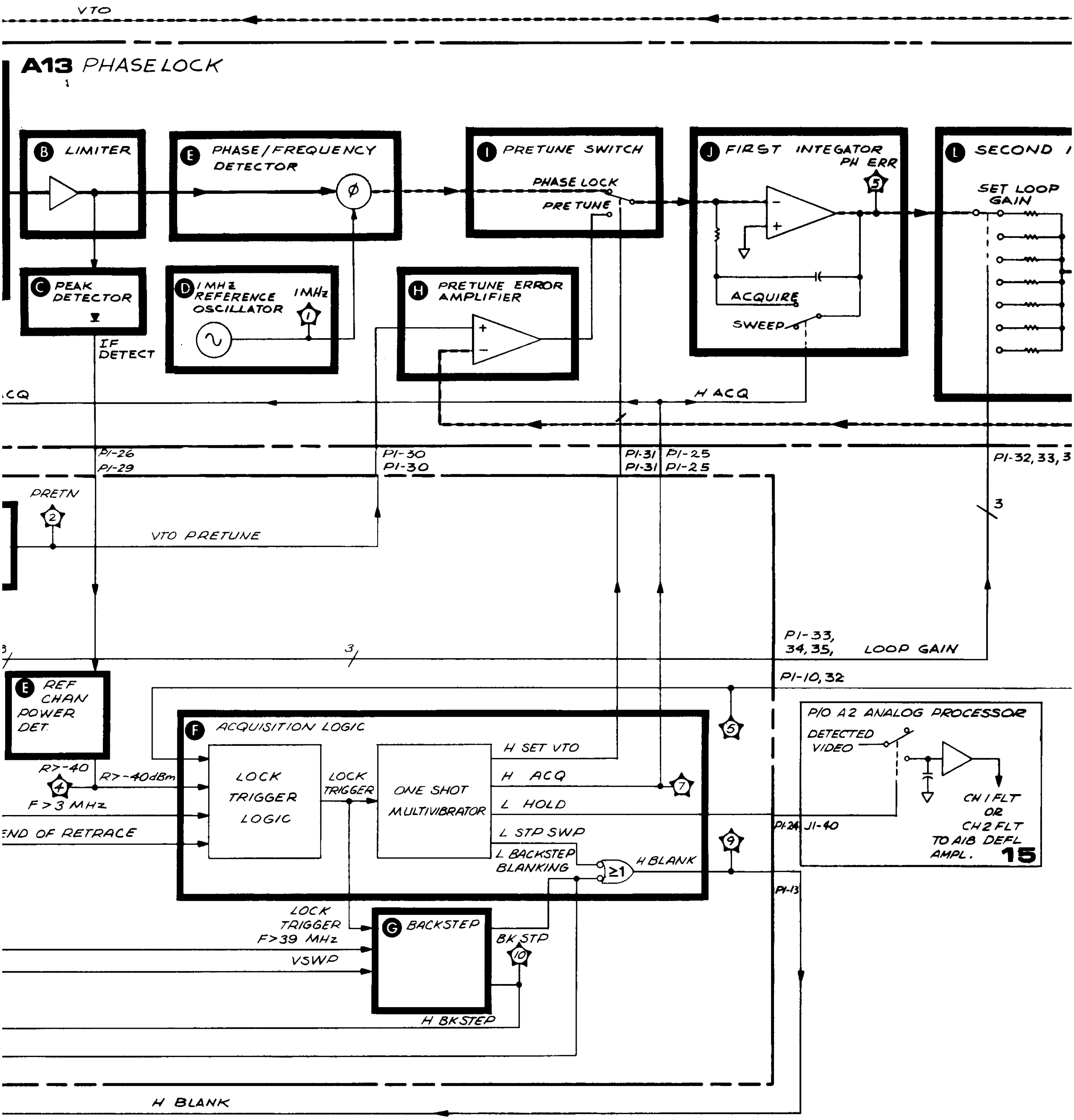


Figure 8-64. Phase Lock (A13) and Phase L

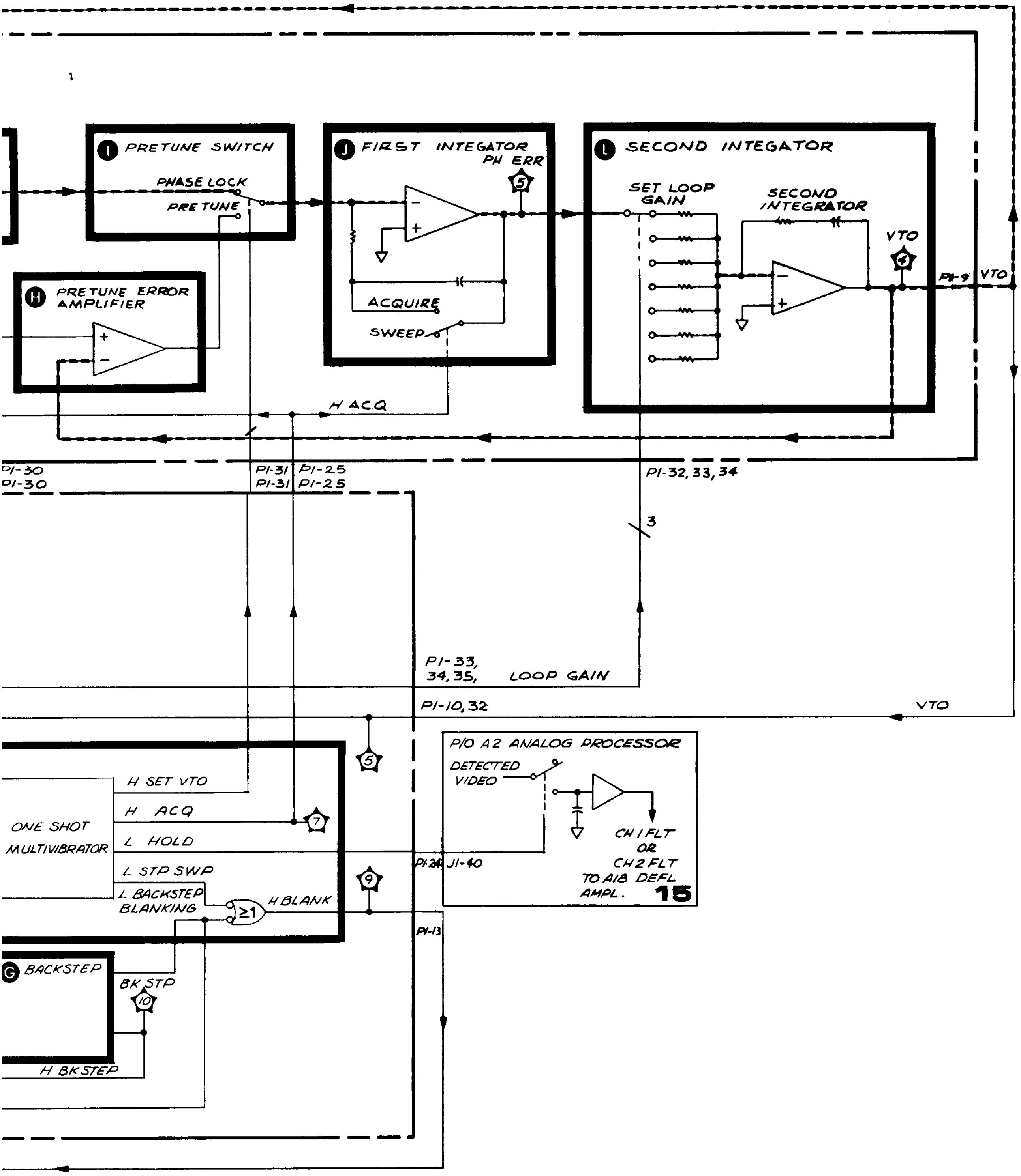
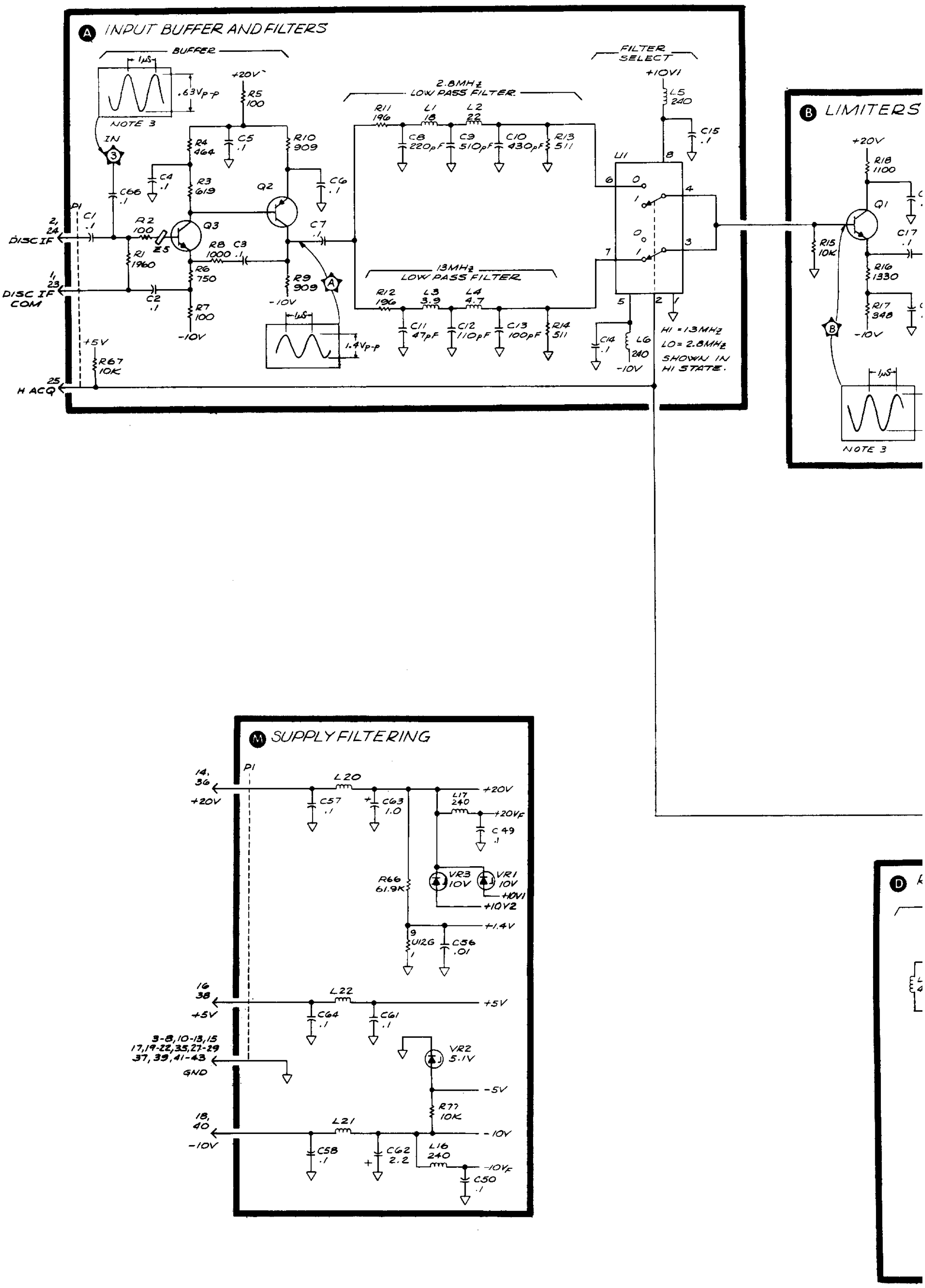


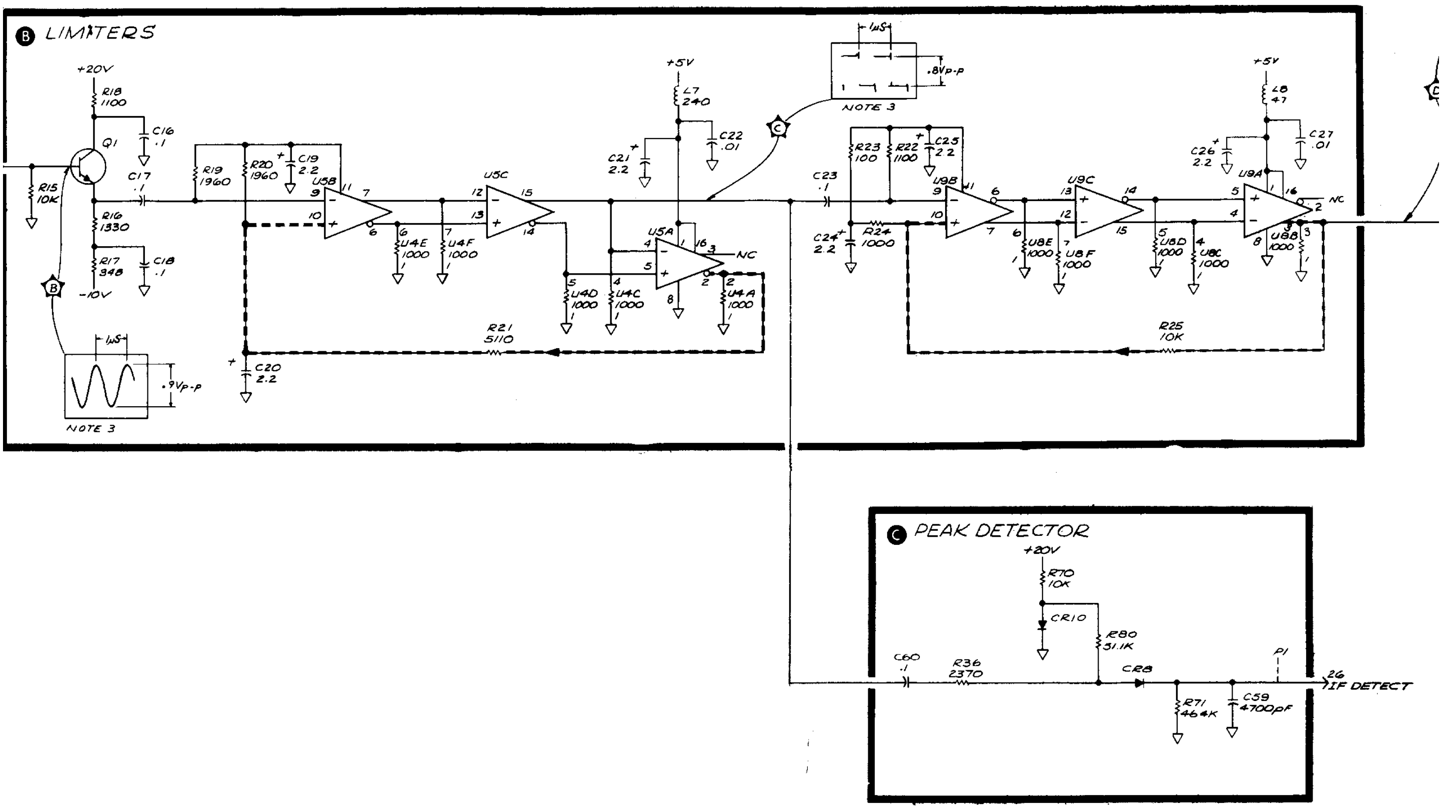
Figure 8-64. Phase Lock (A13) and Phase Lock Control (A14), Block Diagram

A13 *PHASE LOCK ASSEMBLY*

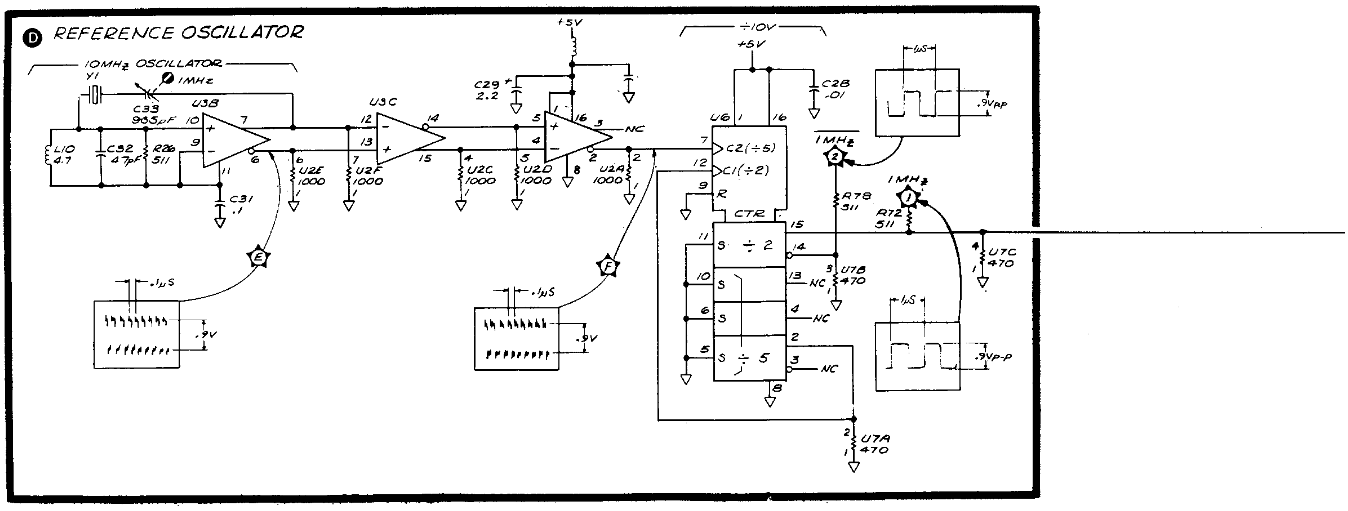
P1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	DISC IF COM	▽	A
23	DISC IF COM	▽	[illegible]
2	DISC IF	A5-1	A
24	DISC IF	A5-1	[illegible]
3	▽		
25	HACQ	A14-25	[illegible]
4	▽		
26	IF DETECT	A14-29	[illegible]
5	▽		
27	▽		
6	▽		
28	▽		
7	▽		
29	▽		
8	▽		
30	VTO PRETUNE	A14-30	H
9	VTO	A6-21, 43 A14-10,32	[illegible]
31	H SET VTO	A14-31	[illegible]
10	▽		
32	GAIN 4	A14-33	[illegible]
11	▽		
33	GAIN 2	A14-34	[illegible]
12	▽		
34	GAIN 1	A14-35	[illegible]
13	▽		
35	▽		
14	+20V		M
36	+20V		M
15	▽		
37	▽		
16	+5V		M
38	+5V		M
17	▽		
39	▽		
18	-10V		M
40	-10V		M
19	▽		
41	▽		
20	▽		
42	▽		
21	▽		
43	▽		
22	▽		
44	H DBLR	NOT USED	[illegible]

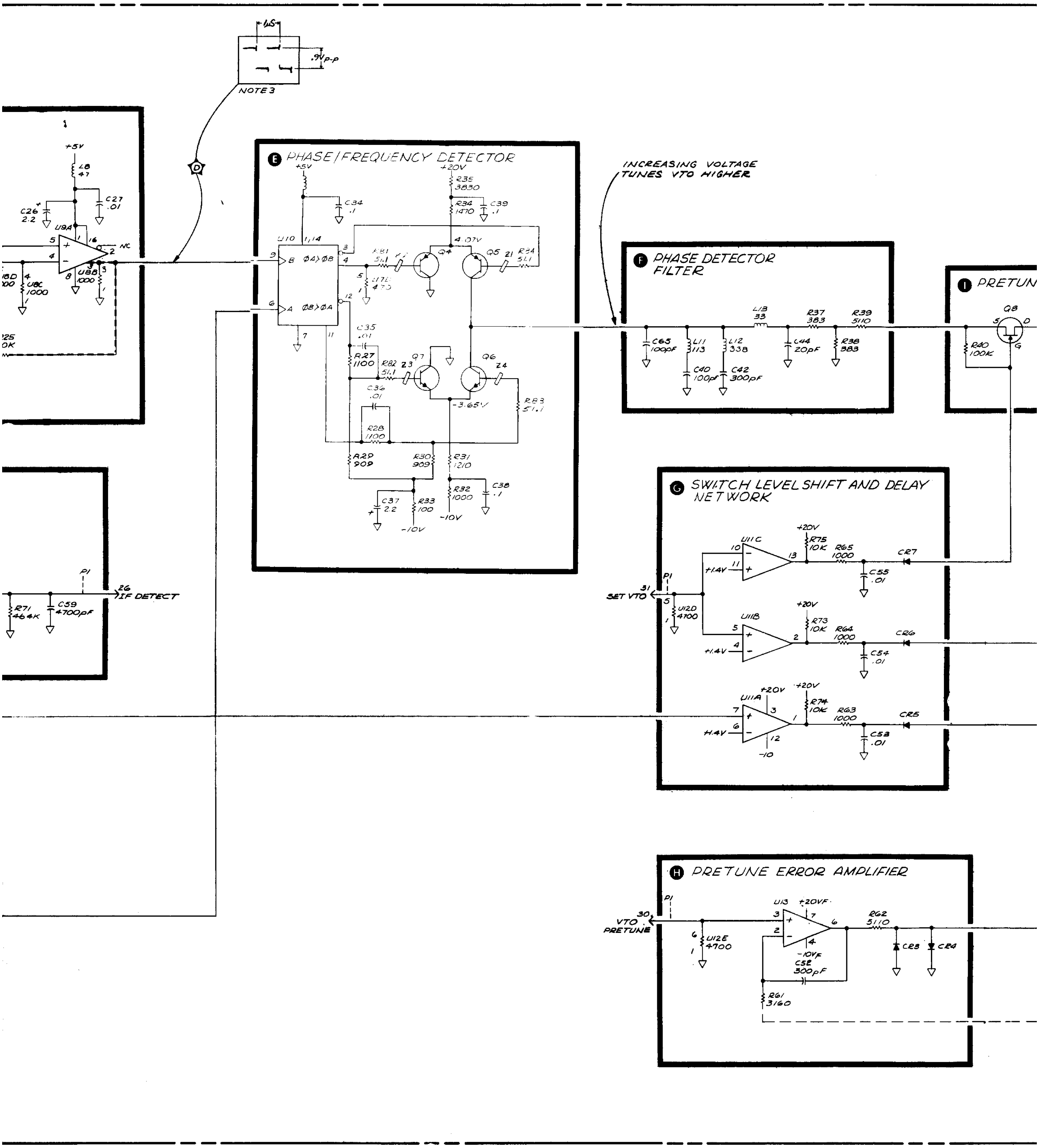


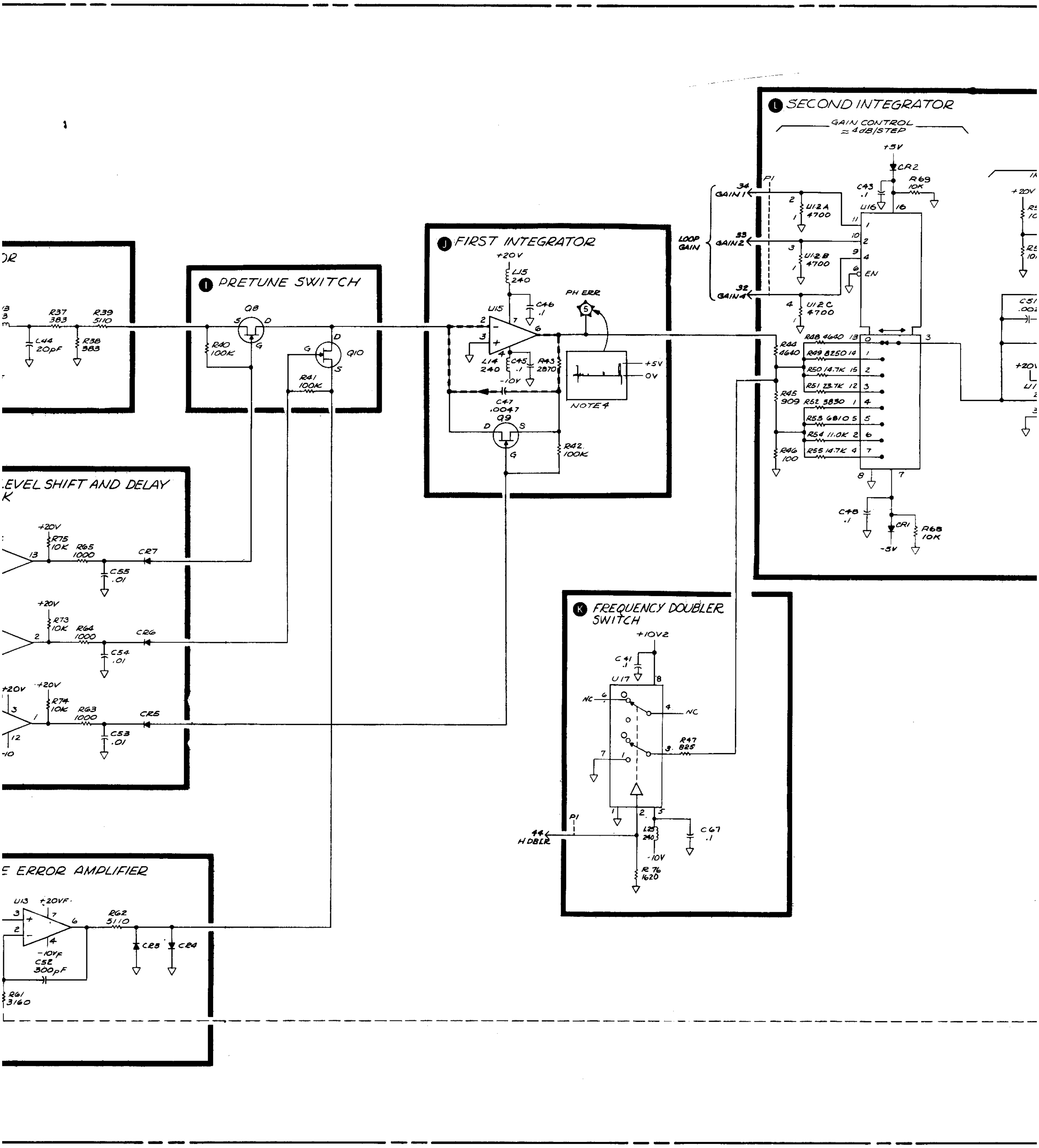


B LIMITERS
+20V
R18 1100
C16 .1
Q1
R15 10K
C17 .1
R16 1330
R17 348
C18 .1
-10V
R19 1960
R20 1960
C19 2.2
U5B
U5C
U4E 1000
U4F 1000
+5V
L7 240
C21 2.2
C22 .01
U5A
NC
U4D 1000
U4C 1000
U4A 1000
R21 5110
C20 2.2
1µS
.9Vp-p
NOTE 3
.8Vp-p
C23 .1
R23 100
R22 1100
C25 2.2
C24 2.2
R24 1000
U9B
U9C
U8E 1000
U8F 1000
U8D 1000
U8C 1000
L8 47
C26 2.2
C27 .01
U9A
U8B 1000
R25 10K
C PEAK DETECTOR
+20V
R70 10K
CR10
R80 51.1K
C60 .1
R36 2370
CR8
P1
R71 464K
C59 4700pF
26 IF DETECT

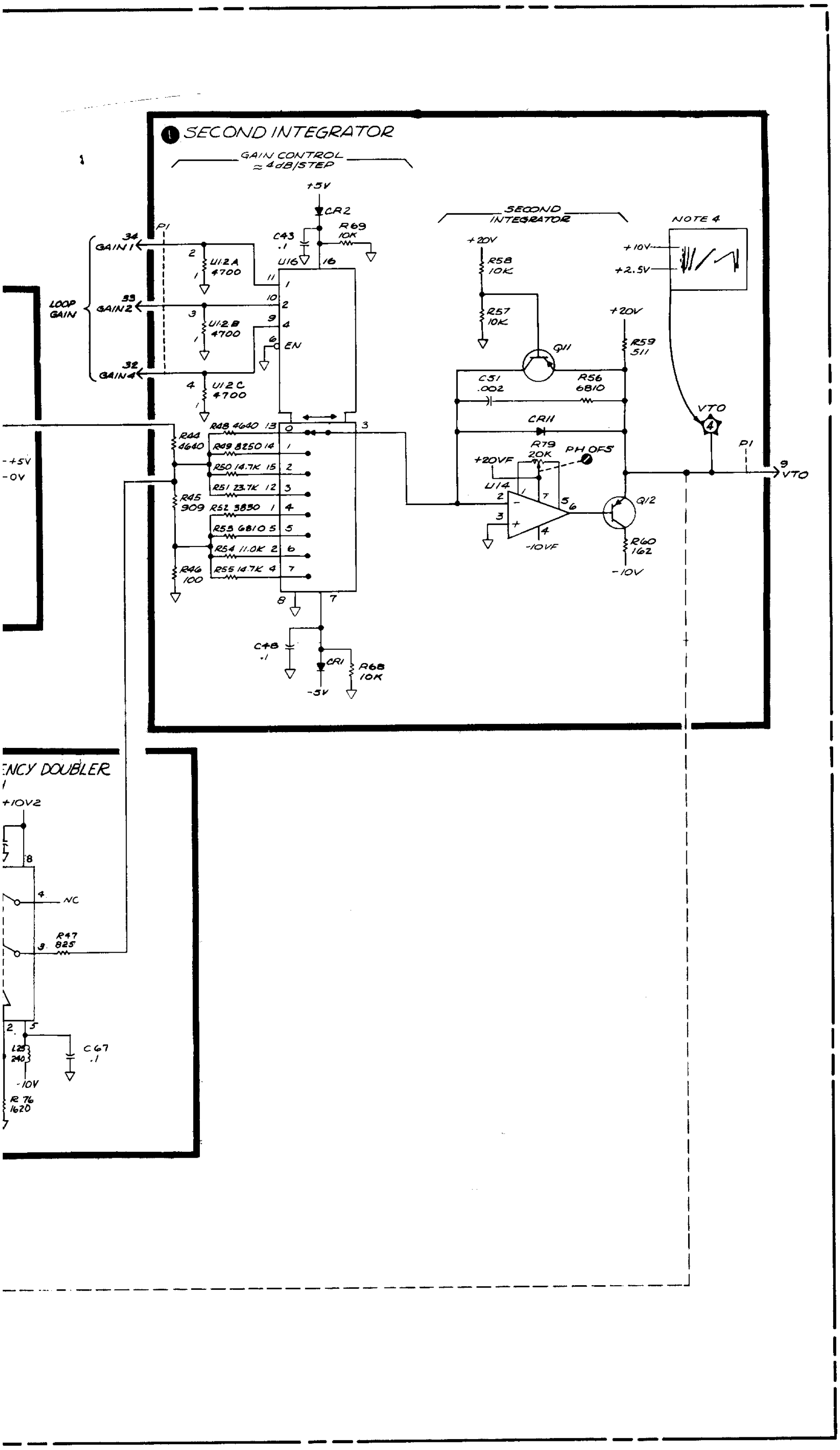


D REFERENCE OSCILLATOR
10MHz OSCILLATOR
Y1
1MHz
C33 965pF
U3B
L10 4.7
C32 47pF
R26 511
C31 .1
U2E 1000
U2F 1000
U3C
+5V
C29 2.2
U2C 1000
U2D 1000
U2A 1000
NC
÷10V
C28 .01
U6
C2(÷5)
C1(÷2)
R
CTR
÷ 2
÷ 5
1MHz
R78 511
R72 511
U7B 470
U7C 470
U7A 470
.1µS
.9V
1µS
.9Vpp
.9Vp-p


NOTE 3
.9Vp-p
E PHASE/FREQUENCY DETECTOR
INCREASING VOLTAGE TUNES VTO HIGHER
F PHASE DETECTOR FILTER
I PRETUN
G SWITCH LEVEL SHIFT AND DELAY NETWORK
26 IF DETECT
31 SET VTO
H PRETUNE ERROR AMPLIFIER
30 VTO PRETUNE



SECOND INTEGRATOR
GAIN CONTROL ≈ 4dB/STEP
LOOP GAIN
GAIN 1
GAIN 2
GAIN 4
PRETUNE SWITCH
FIRST INTEGRATOR
PH ERR
NOTE 4
LEVEL SHIFT AND DELAY
FREQUENCY DOUBLER SWITCH
HDBLR
ERROR AMPLIFIER



NOTES

1. REFERENCE DESIGNATO THIS ASSEMBLY ARE ABBR PREFIX ABBREVIATION WITH ASSEMBLY NUMBERS FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. FOR WAVEFORMS SHOWN, SET FRONT PANEL CONTROLS AS FOLLOWS:

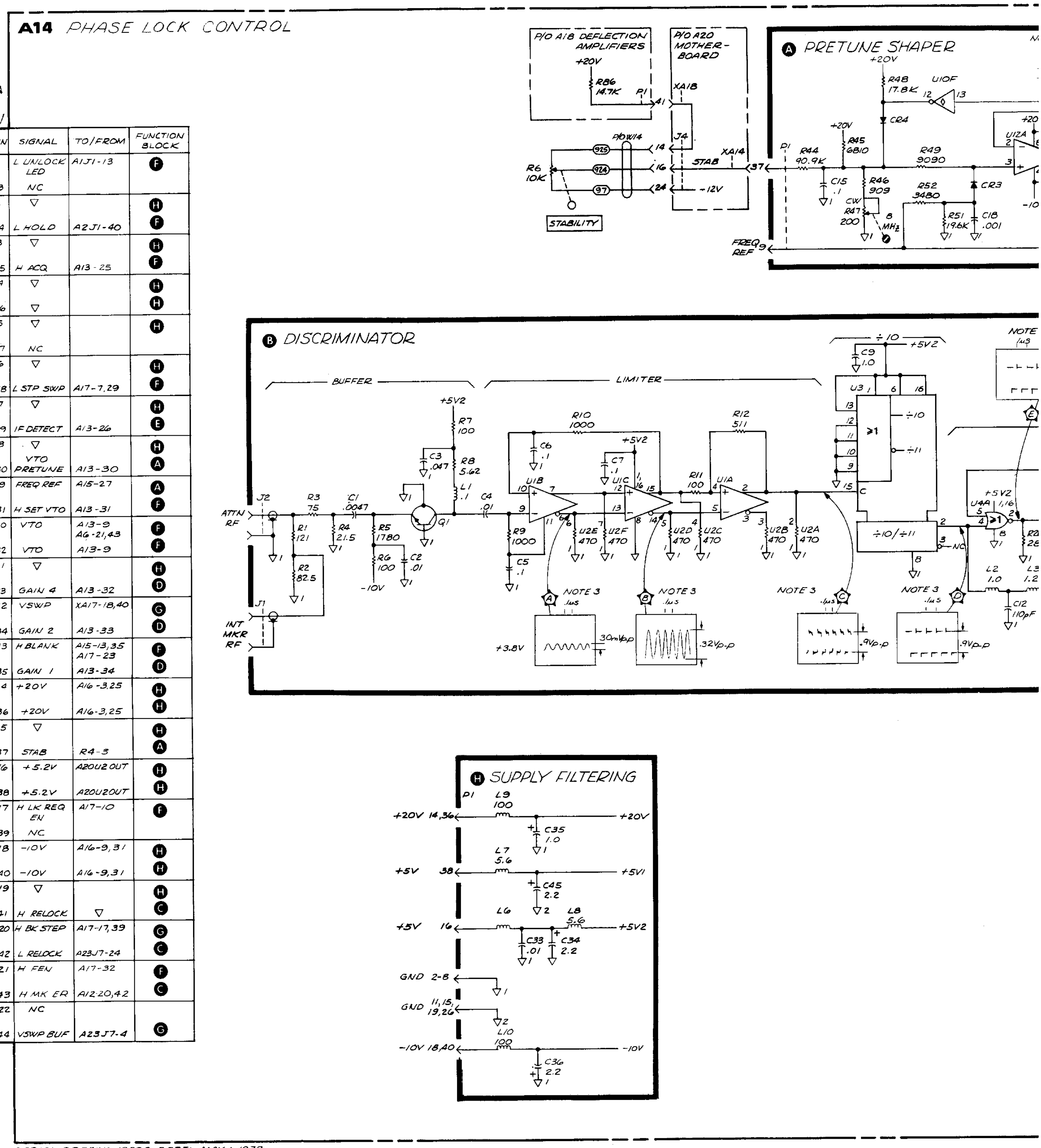
   SWEEP MODE: CENTER
   SWEEP: AUTO, MAN
   SWEEP WIDTH MHz: 0 CW
   TUNING: SET TO 0MHz, THEN SLOWLY TUNE TO 25MHz (THIS REMOVES SINEWAVE RIPPLE)
   OUTPUT dBm: ADJUST FOR 0.63Vp-p AT A13TP3
4. FOR WAVEFORMS SHOWN, SET FRONT PANEL CONTROLS AS FOLLOWS:

   SWEEP MODE: FULL 4-1300
   SWEEP: AUTO, FAST

11
A13

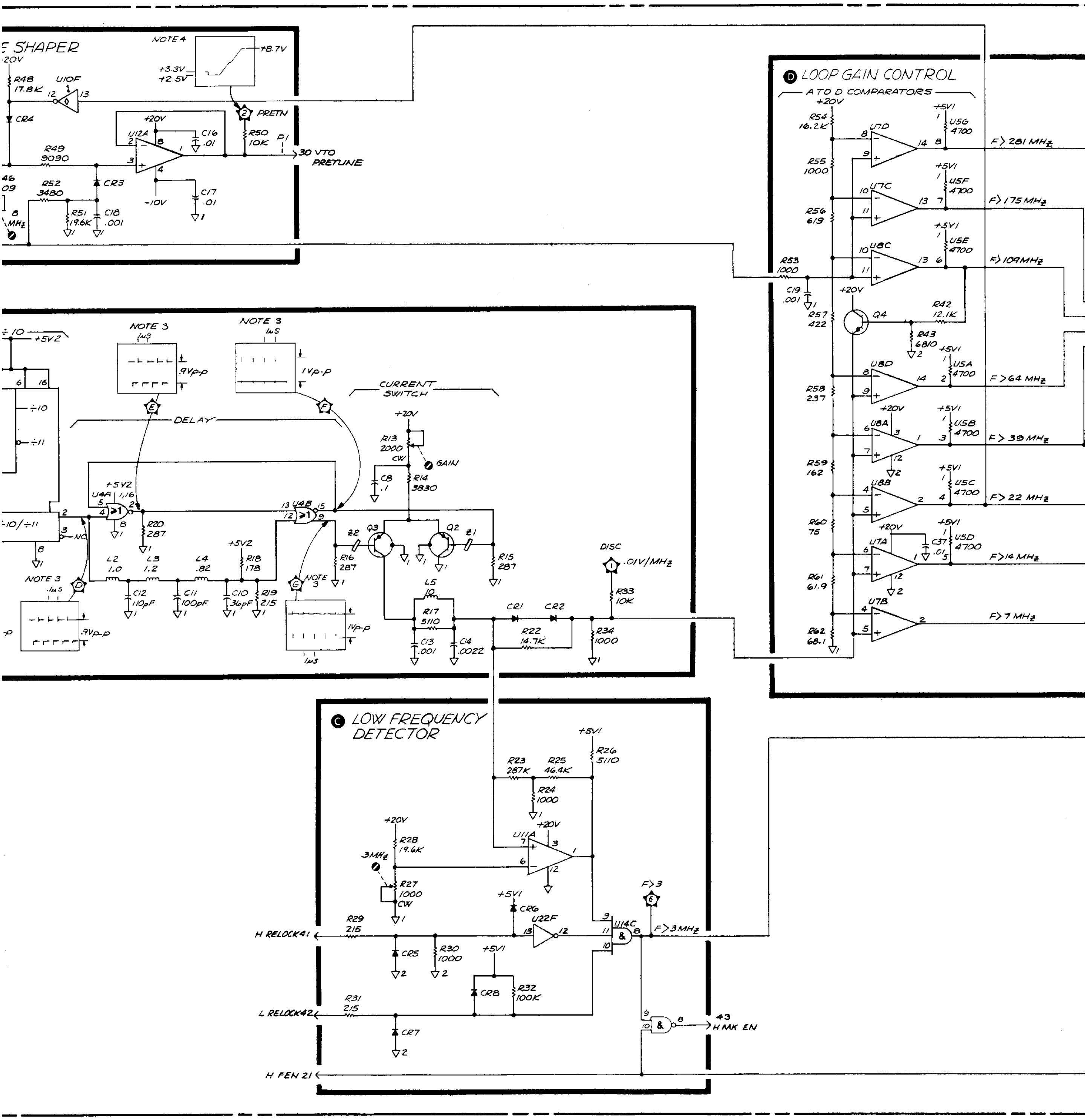
Figure 8-65. Phase Lock (A13), Schematic Diagram

A14 PHASE LOCK CONTROL

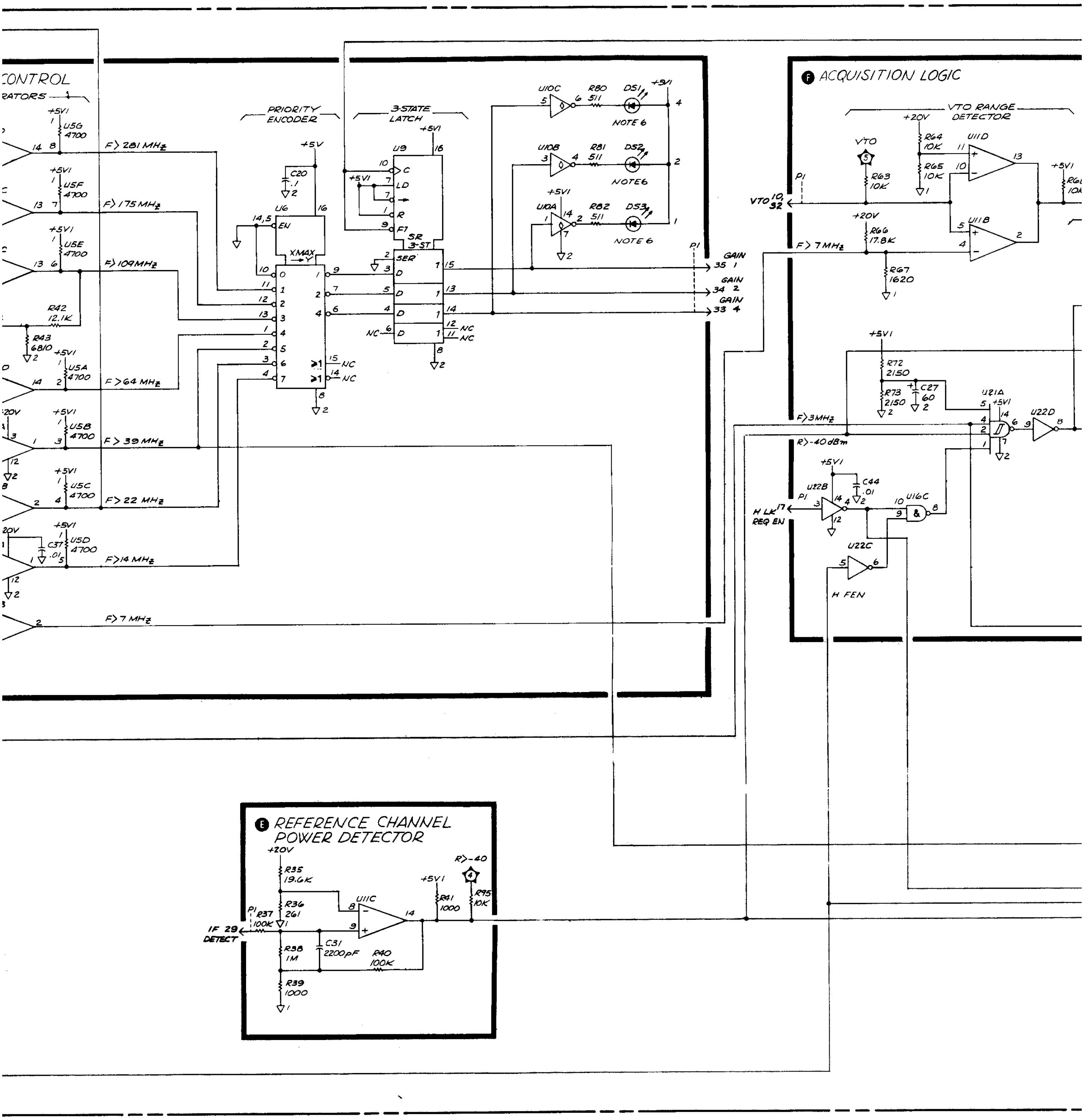


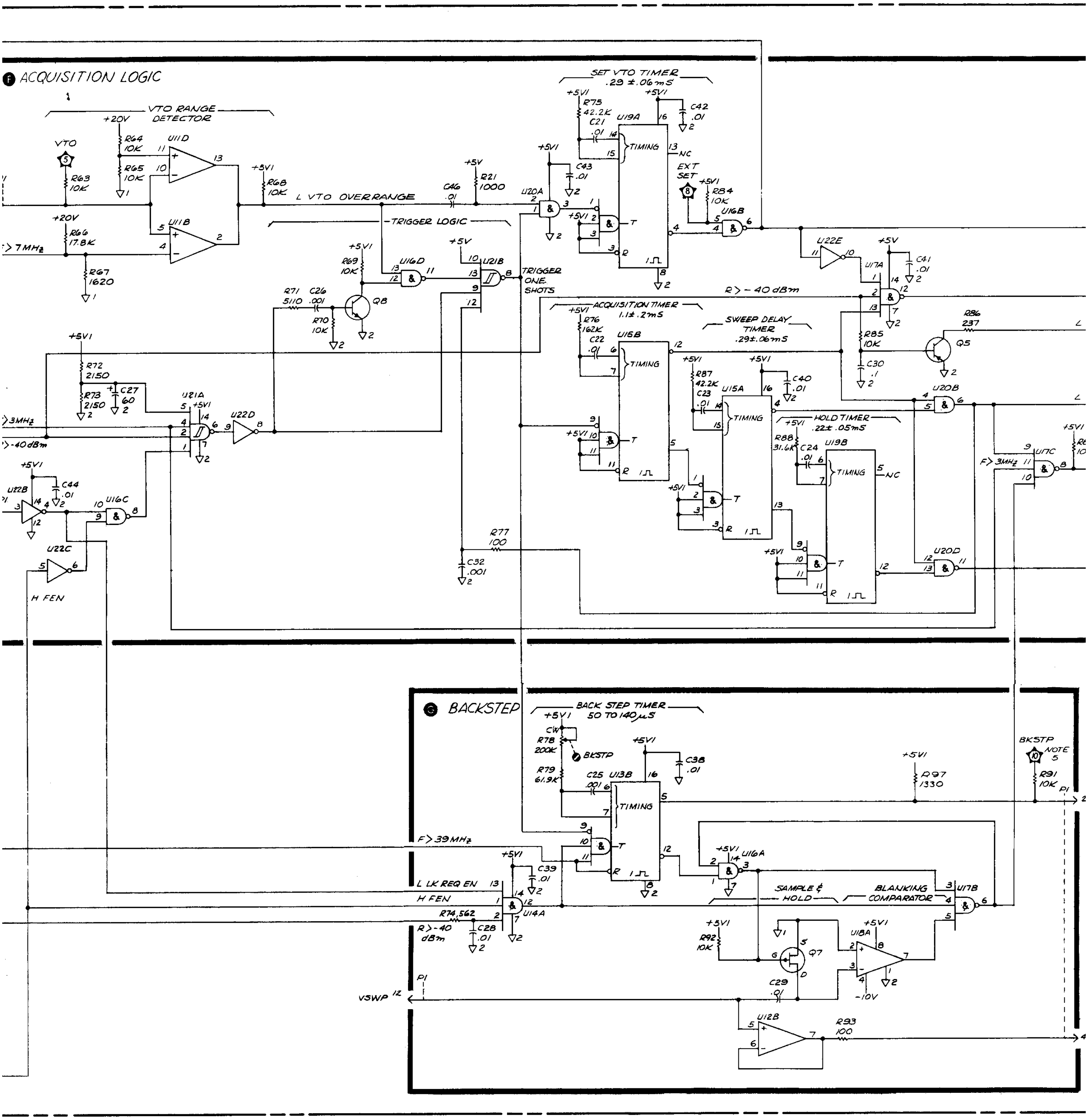
P1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	L UNLOCK LED	A1J1-13	F
23	NC		
2	▽		H
24	L HOLD	A2J1-40	F
3	▽		H
25	H ACQ	A13-25	F
4	▽		H
26	▽		H
5	▽		H
27	NC		
6	▽		H
28	L STP SWP	A17-7,29	F
7	▽		H
29	IF DETECT	A13-26	E
8	▽		H
30	VTO PRETUNE	A13-30	A
9	FREQ REF	A15-27	A
31	H SET VTO	A13-31	F
10	VTO	A13-9 A6-21,43	F
32	VTO	A13-9	F
11	▽		H
33	GAIN 4	A13-32	D
12	VSWP	XA17-18,40	G
34	GAIN 2	A13-33	D
13	H BLANK	A15-13,35 A17-23	F
35	GAIN 1	A13-34	D
14	+20V	A16-3,25	H
36	+20V	A16-3,25	H
15	▽		H
37	STAB	R4-3	A
16	+5.2V	A20U2 OUT	H
38	+5.2V	A20U2OUT	H
17	H LK REQ EN	A17-10	F
39	NC		
18	-10V	A16-9,31	H
40	-10V	A16-9,31	H
19	▽		H
41	H RELOCK	▽	C
20	H BK STEP	A17-17,39	G
42	L RELOCK	A23J7-24	C
21	H FEN	A17-32	F
43	H MK ER	A12-20,42	C
22	NC		
44	VSWP BUF	A23J7-4	G

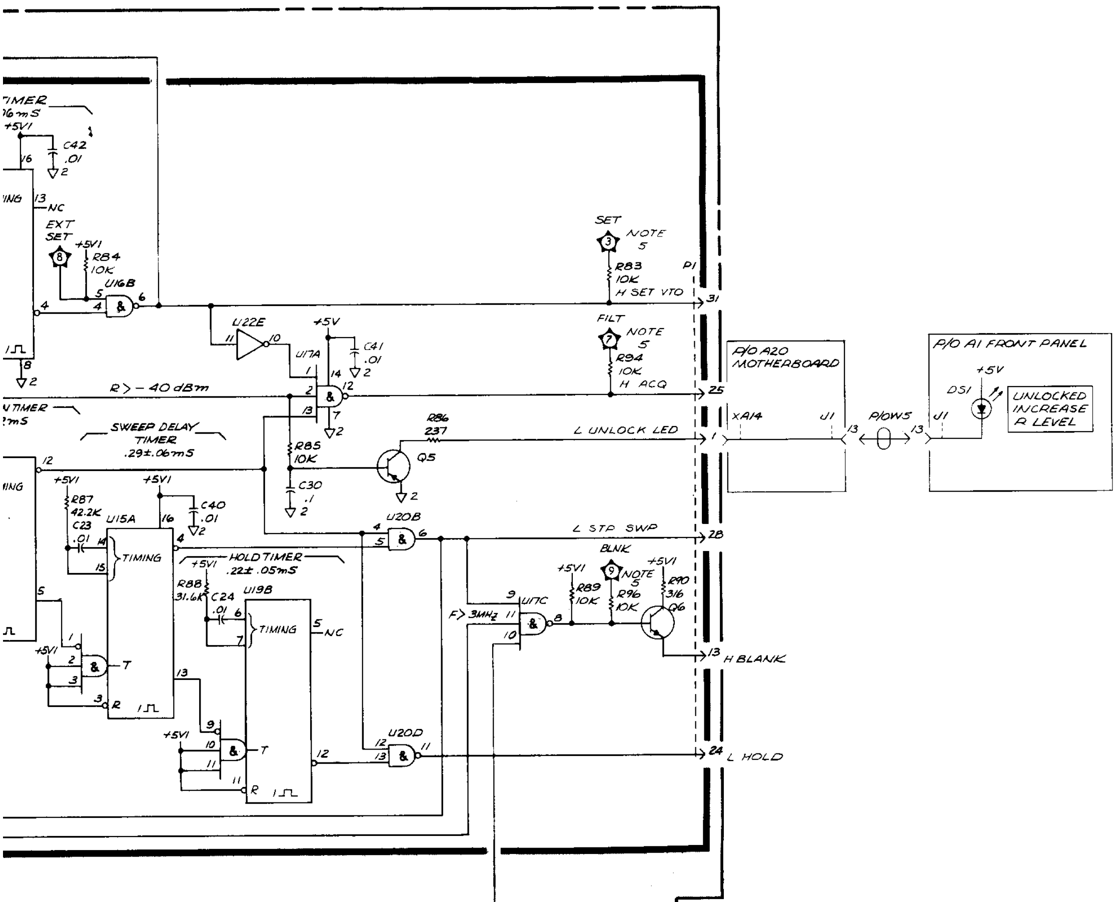


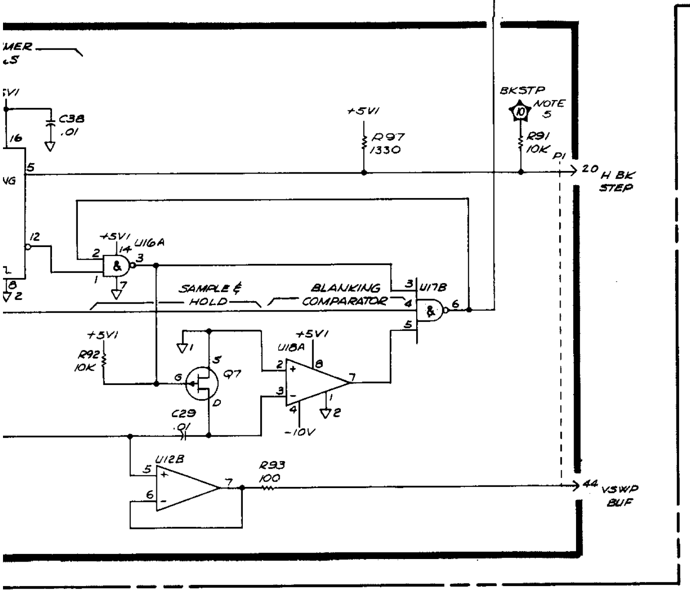
SHAPER
NOTE 4
+8.7V
+3.3V
+2.5V
PRETN
30 VTO
PRETUNE
D LOOP GAIN CONTROL
A TO D COMPARATORS
F> 281 MHz
F> 175 MHz
F> 109 MHz
F> 64 MHz
F> 39 MHz
F> 22 MHz
F> 14 MHz
F> 7 MHz
NOTE 3
.9Vp-p
1Vp-p
CURRENT
SWITCH
DELAY
GAIN
DISC
.01V/MHz
C LOW FREQUENCY
DETECTOR
3MHz
F>3
F>3MHz
H RELOCK 41
L RELOCK 42
43
H MK EN
H FEN 21


CONTROL
PRIORITY ENCODER
3-STATE LATCH
ACQUISITION LOGIC
VTO RANGE DETECTOR
F > 281 MHz
F > 175 MHz
F > 109 MHz
F > 64 MHz
F > 39 MHz
F > 22 MHz
F > 14 MHz
F > 7 MHz
F > 3MHz
R > -40 dBm
GAIN 1
GAIN 2
GAIN 4
NOTE 6
VTO
H LK REQ EN
H FEN
REFERENCE CHANNEL POWER DETECTOR
IF DETECT
R > -40



F ACQUISITION LOGIC
VTO RANGE DETECTOR
TRIGGER LOGIC
SET VTO TIMER .29 ±.06mS
ACQUISITION TIMER 1.1±.2mS
SWEEP DELAY TIMER .29±.06mS
HOLD TIMER .22±.05mS
L VTO OVERRANGE
TRIGGER ONE SHOTS
EXT SET
R > -40 dBm
H FEN
G BACKSTEP
BACK STEP TIMER 50 TO 140µS
SAMPLE & HOLD
BLANKING COMPARATOR
F > 39MHz
L LK REQ EN
VSWP
BKSTP NOTE 5





NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. FOR WAVEFORMS SHOWN, SET FRONT PANEL CONTROLS AS FOLLOWS:
   TUNING: 10 MHz
   SWEEP MODE: CENTER
   SWEEP: AUTO, MAN
   SWEEP WIDTH MHz: 0 CW
   OUTPUT dBm: 0 dBm AT R INPUT
4. FOR WAVEFORM SHOWN, EXTERNALLY TRIGGER OSCILLOSCOPE WITH SIGNAL AT A17TP2 (FWD TRIG), AND SET 8754A FRONT PANEL CONTPOLS AS FOLLOWS:
   SWEEP MODE: FULL 4-1300
   SWEEP: AUTO, FAST
5. SEE TIMING DIAGRAM ON PHASE LOCK LOOP BLOCK DIAGRAM FOR WAVEFORMS.
6. TO CHECK LOOP GAIN OUTPUTS, SET FRONT PANEL CONTROLS AS FOLLOWS:
   SWEEP: CENTER
   SWEEP MODE: AUTO, FAST
   SWEEP WIDTH MHz: 0 CW
   SLOWLY TUNE 8754A FROM 0 MHz TO 1300 MHz. CHECK THAT DS1 THROUGH DS3 OPERATE AS SHOWN IN FOLLOWING TABLE.

FREQUENCY RANGE (APPROXIMATE)	GAIN 4 (DS1)	GAIN 2 (DS 2)	GAIN 1 (DS3)
0 TO 14 MHz	OFF	OFF	OFF
14 TO 22 MHz	OFF	OFF	ON
22 TO 39 MHz	OFF	ON	OFF
39 TO 64 MHz	OFF	ON	ON
64 TO 109 MHz	ON	OFF	OFF
109 TO 175 MHz	ON	OFF	ON
175 TO 281 MHz	ON	ON	OFF
281 TO 1300 MHz	ON	ON	ON

11

A14

Figure 8-66. Phase Lock Control (A14), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 12

IF SWITCH (A6) AND A, B DETECTOR (A8), CIRCUIT DESCRIPTION

The function of the IF Switch, which is part of the Voltage-Tuned Oscillator and IF Switch (A6), is to select the output of either the A Sampler (A4, Service Sheet 9) or the B Sampler (A3) as the 1-MHz IF input signal to the A, B Detector (A8). The position of the IF Switch is controlled by the logic circuitry in the Rectifier (A19, Service Sheet 18).

The primary purpose of the A, B Detector is to produce a dc voltage that varies logarithmically with the magnitude of the selected 1-MHz IF input signal (IF A or IF B). It does this by first filtering the input signal to isolate the 1-MHz component from the output spectrum of the sampler. (This processed IF signal is the input to the Phase Detector, A9, Service Sheet 14.) After filtering, the input signal is rectified to obtain a dc current. A dc logger then converts this current to a logarithmically varying voltage (A, B MAG), which represents the absolute magnitude of the A, B IF signal.

A switch selects either the A, B MAG voltage or the corresponding R MAG voltage (R Detector, A11, Service Sheet 13) for processing in the Analog Processor (A2, Service Sheet 15).

IF SWITCH (A6), CIRCUIT DESCRIPTION

The IF Switch (A6) selects the 1-MHz IF signal from either the A Sampler (A4) or the B Sampler (A3) as the input signal to the A, B Magnitude Detector (A8). The input selected depends on the states of the front panel and remote programming lines, which when decoded control the L B IF SW line from the Rectifier (A19, Service Sheet 18). When the L B IF SW line is high (+5V), the signal from the A Sampler is selected; when the line is low (0V), the signal from the B Sampler is selected.

The state of L B IF SW is controlled either by the front panel (8754A in local) or by a remote input (8754A in remote); then that selected state may be inverted by a remote control input, L REV AB.

When the instrument is operated without remote programming input, the front panel L B INT line along controls the position of the IF Switch. Table 8-6 lists the 16 combinations of the front-panel display-select switches that control the state of the L B INT line from A2. Figure 8-67 illustrates the IF Switch control logic and includes a truth table.

Table 8-6. Front-Panel Control of IF Switch

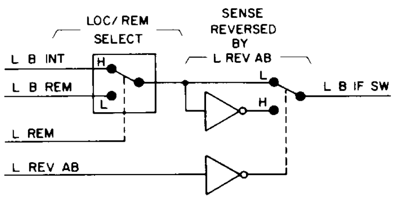
Selected Display	L B INT
POLAR A/R A only A/R only	HIGH
B/R, Channel 1 only B/R, Channel 2 only B/R, Channels 1 and 2 B/R and PHASE B/R B only PHASE B/R only R (Both OFF switches in)	LOW
A and B A and B/R A and PHASE B/R A/R and B A/R and B/R A/R and PHASE B/R	Alternates between HIGH and LOW on successive sweeps

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A6. For example, the designation Q1 is actually A6Q1.

IF Switch (A)

The IF Switch is an electronic switch comprising two sections, one for each input. Each section has two series-shunt-connected diode pairs in series with the signal input. The wired-OR outputs of the two sections form the bias and signal input to the common base amplifier Q1. The voltages at the anode and cathode of each diode (shown on the schematic) are determined by the comparators in U1. When the potential difference at the cathode of any diode is more negative than −0.6V, the diode is biased into conduction.



	REMOTE				LOCAL			
L REM	L				H			
L B REM	L		H		DON'T CARE			
L B INT	DON'T CARE				L		H	
L REV AB	H	L	H	L	H	L	H	L
IF SW POSITION	B	A	A	B	B	A	A	B

Figure 8-67. IF Switch Control Logic

When the L B IF SW line from A19 is high (+5V), series diodes CR2 and CR4 are turned on and shunt diodes CR1 and CR3 are turned off, providing a current path between the A Sampler and Q1. At this time, there is no input to Q1 from the B Sampler because the series diodes CR6 and CR8 in that path are turned off, while shunt diodes CR5 and CR7 are turned on.

When the L B IF SW line from A19 is low (0V), polarities on all diodes are reversed, providing a current path between the B Sampler and Q1.

Transistors Q2 and Q3 are a complementary feedback pair serving as a Buffer Amplifier whose gain of approximately 6 dB is determined by R16 and R17. The output, monitored at TP1, has an amplitude (at 1 MHz, with RF power applied to the selected input port) of 632 mV peak-to-peak at 0 dBm or 6.32 mV peak-to-peak at −40 dBm.

The diodes in the two sections of the IF Switch are biased by two complementary pairs of parallel-connected, open-collector comparators whose outputs are controlled by the state of the control line L B IF SW.

The single-pole, double-throw action of the two sections is accomplished by turning on the series diodes, completing the signal path from an input to the emitter of the common-base amplifier Q1. At the same time, the shunt diodes are turned off, effectively removing them from the circuit of one section. The shunt diodes of the other section are turned on, shunting the input signal to ground, and the series diodes are turned off, effectively removing them from the circuit.

The schematic is drawn to show Channel 1 selected. The A section shunt diodes CR1 and CR3 are biased off, and the series diodes CR2 and CR4 are biased on; while the B section has its shunt diodes CR5 and CR7 biased on and its series diodes CR6 and CR8 biased off.

The selected section provides, via the output series diode CR4, bias current for Q1 of about 3.9 mA. Because of the impedance of the collector circuit of Q1 versus the input impedance of R1 and series diodes CR2 and CR4, the net gain of the IF Switch is about −6 dB.

A, B DETECTOR (A8), CIRCUIT DESCRIPTION

The primary purpose of the A, B Detector is to produce a dc voltage that varies logarithmically with the magnitude of the 1-MHz IF input signal from the IF Switch (A6, Service Sheet 12).

The detector first amplifies and then filters the 1-MHz input signal to provide the necessary 20-kHz IF bandwidth. This processed signal is sent to the Phase Detector (A9, Service Sheet 14) for phase measurements. It is also rectified to obtain a dc current that is proportional to the IF level. The logarithm of this dc current is then scaled and offset to produce a dc voltage that represents the absolute magnitude of the IF signal and varies logarithmically with a linear change in IF magnitude. This signal (A, B MAG) is selected and sent to the Analog Processor (A2, Service Sheet 15) for display processing.

The A, B Detector has three outputs:

- A 1-MHz IF signal to the Phase Detector (A9, Service Sheet 14)
- A dc voltage (whose amplitude is −25 mV/dB) to the R Detector (A11, Service Sheet 13)
- A dc voltage (whose amplitude is −25 mV/dB to the Analog Processor (A2, Service Sheet 15)

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A8. For example, the designation Q4 is actually A8Q4.

1-MHz Bandpass Filters (B)

The IF bandpass is determined by two parallel-resonant LC circuits to provide an overall 3-dB bandwidth of 20 kHz centered at the IF frequency of 1 MHz.

The 1-MHz IF input signal (A, B IF) selected by the IF Switch (A6) is amplified by the feedback pair Q3 and Q4, whose gain is 6.2 or 16 dB as determined by the ratio of R7 to R3. The output (IF 1) monitored at TP1, is 3.9V peak-to-peak with an RF input power level of 0 dBm. IF 1 is filtered by a parallel resonant circuit consisting of C6, C7, and a variable inductor (1 MHz L2), which is tuned for resonance at 1 MHz by adjusting L2 for the phase shift of the 1-MHz signal between TP1 and TP2. The gain through the bandpass filter stage, TP1 to TP2, is 0.8, −2 dB. The bandwidth of this filter is 28 kHz.

The output of the tank circuit is buffered by emitter-follower Q1, whose output (IF 2), monitored at TP2, is about 3.2V peak-to-peak. IF 2 is then filtered by another parallel resonant circuit consisting of C10, C11, 1 MHz TRIM capacitor C12, and a variable inductor, 1 MHz (L3), which also has a bandwidth of 28 kHz. This filter is coarsely tuned by L3 for the phase shift between TP1 and TP3, with fine tuning by C12. The gain from TP2 to TP3 is about 0.8, −2 dB.

Buffers (C)

The Buffers are two emitter-follower amplifiers, Q2 and Q5, that provide isolation between the signal paths out of the 1-MHz IF signal to the Phase Detector (A9), and A8Q2 drives the Rectifier circuit. The output of the Buffers (IF 3), monitored at TP3, is about 2.45V peak-to-peak at 0 dBm.

Rectifier (E)

The Rectifier converts the 1-MHz input volage to a dc output current. As shown in the equivalent circuit (Figure 8-68), the Rectifier is basically an amplifier and a pair of diodes in the negative feedback loop. Compensation for the rectifier diode capacitance is provided by the negative capacitance circuit. The gain of the amplifier is varied to compensate for the change in rectifier impedance with signal level. Temperature-dependent diode bias is provided to reduce the impedance of the diode at low levels.

At the 1-MHz input frequency, the impedance of capacitors C_A is small compared to that of resistors R_A, so the ac components of I_1 and I_2 combine to form the feedback current I_F, which is 180 degrees out of phase with the input current I_{IN}. Because the amplifier has a large gain, I_F is equal in amplitude to I_{IN}.

The dc component of I_1 is sent to the virtual ground at the input of the DC Logger, while the dc component of I_2 develops a dc voltage to the High Level Compensation circuit of the DC Output Amplifier across resistor R_B in that output line and is returned to the output of the diode bias circuit.

Resistors R_A and capacitors C_B filter out the 1-MHz IF from the dc outputs to the DC logger and to the High Level Compensation circuit.

The input stage to the Rectifier circuit is common-base amplifier Q6, whose gain is varied by the action of PIN diode CR1 in the collector circuit. Emitter-follower Q7 is a buffer stage that drives the common-emitter complementary pair Q11 and Q12, a unity-gain, inverting amplifier whose output drives the diodes CR2 and CR3.

A parallel-resonant tank circuit at the collectors of Q11 and Q12 consists of L1, L8, 1 MHz TUNE capacitor C45, and the inter-element capacitances of Q11 and Q12. It is tuned to provide high impedance at 1 MHz to improve the performance of the rectifier at low input levels.

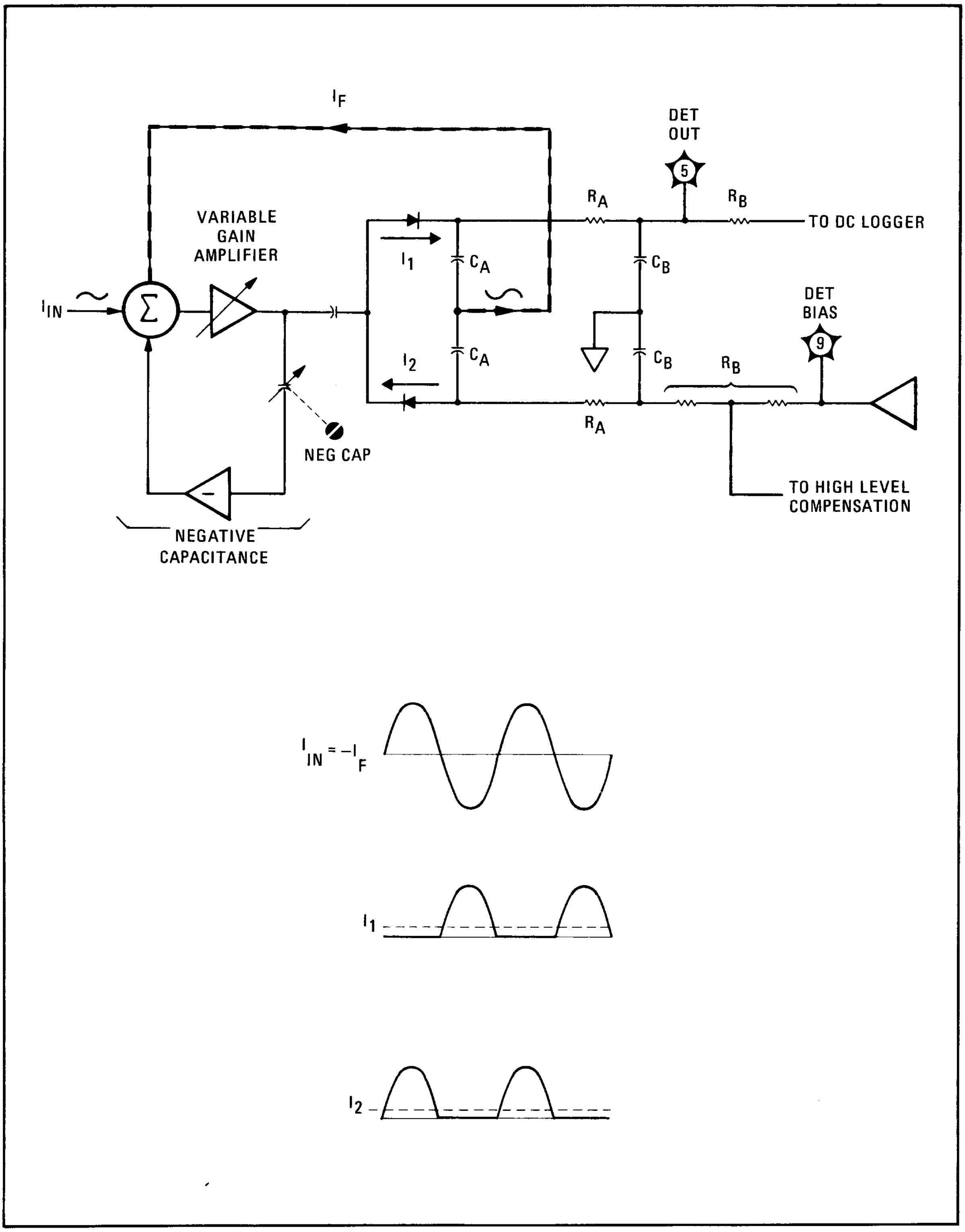


Figure 8-68. A8 Rectifier, Equivalent Circuit

The inductors in the tank circuit also provide a dc bias point for the collectors of Q11 and Q12.

The capacitance of the diodes CR2 and CR3 causes the negative feedback current I_F to contain a capacitive as well as a resistive component. This causes a non-linearity in the rectifier output. To compensate for this undesirable effect, C23, NEG CAP capacitor C24, and unity-gain, inverting amplifier Q8, Q9 cause a current to appear at the summing junction (the emitter of Q6) that is 180 degrees out of phase with the capacitive component of I_F.

Diode CR11 provides a temperature-dependent reference voltage (DET BIAS) for the Diode Bias stage, U4B and associated circuitry. This voltage, measured at TP9, is about +165 mV at ambient temperature and varies at −2 mV/deg C. The Diode Bias Network also applies a slight bias to the rectifier diodes to improve their sensitivity.

DC Logger (F)

The DC Logger produces an output voltage that varies with the log of the input current (−1.9V at 0 dBm, −0.04V at −40 dBm, +1.85V at −80 dBm). It consists of two operational amplifiers, U1 and U2, each of which has a transistor base-emitter junction in its feedback loop and one of which is used as a reference. An equivalent circuit is shown in Figure 8-69.

The basic logging function of the circuit is performed by Q10A, whose base-emitter voltage (V_{be_1}) varies with the log of the input current to U1. However, this basic logging circuit is temperature-dependent, because V_{be_1} also varies with temperature. Therefore, stability is achieved by the addition of Q10B and operational amplifier U2.

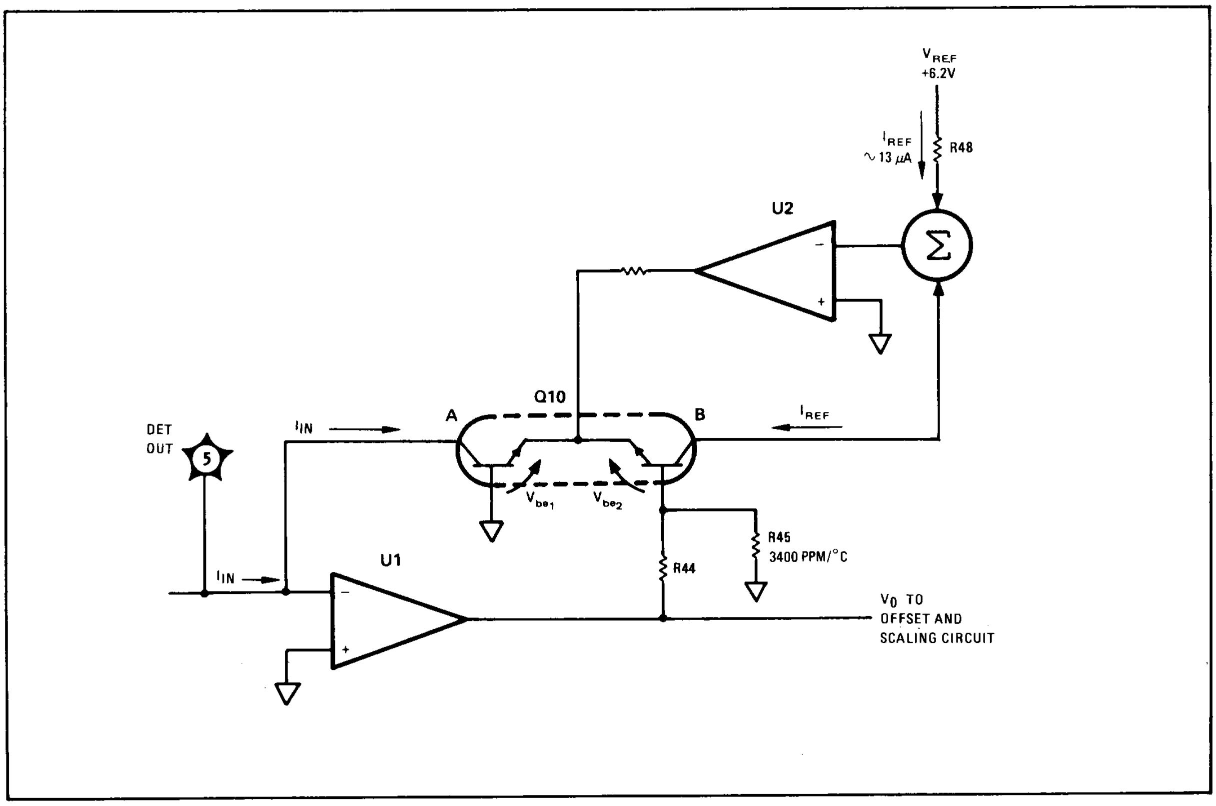


Figure 8-69. A8 DC Logger, Equivalent Circuit

U2 operates to maintain equality between the currents into and out of the summing junction at its inverting input (pin 2). The resulting constant current I_{REF} establishes a reference voltage V_{be_2} that varies only with temperature. Since temperature variations have an equal effect on the two base-emitter voltages, their algebraic sum represents a temperature-stable output voltage V_o that is directly proportional to the log of the input current to U1 pin 2 (1.5 mA to 0.15 mA) over the entire operating range of about 80 dB.

The value of I_{REF} (about 13μA) is determined by the reference voltage (+6.2V) and the value of R48.

R45 compensates for changes in the logging characteristics of Q10A (as distinguished from the variation of V_{be_1} as a function of temperature.

Offset and Scaling (G)

The dc output voltage from the DC Logger is inverted by operational amplifier U3B and scaled to a factor of 25 mV/dB by the GAIN adjustment R56. LOG OFS adjustment R50 provides the absolute level calibration. That is, when the equivalent of 0 dBm at the RF input is 632 mV peak-to-peak at the input to the magnitude detector, the output is 0V. The output of the Offset and Scaling circuit is the A, B MAG signal to the Analog Processor (A2).

Clamp. A voltage divider consisting of R91 and R39 establishes a reference of +0.07V, equivalent to >2.7 dBm RF power at the inverting input to operational amplifier U4A. When the voltage at the non-inverting input exceeds +0.07V the output of the op amp is coupled through CR12 to the inverting input of U3B. This limits the output of U4A to prevent expansion on the CRT display when the A, B Detector is overdriven. Diode CR13 keeps op amp U4A in the linear region when it is not functioning as a clamp.

High Level Compensation. The High Level Compensation stage, consisting of CR10, R87, and R54, compensates for linear errors related to the emitter resistance of the logging transistor Q10A, which causes expansion of the DC Logger output at high collector current levels. This occurs when the input to A, B Detector is greater than the equivalent of −10 dBm. A linear signal from the Rectifier output is coupled to the non-inverting input of U3B via CR10 and voltage divider R87, R54. This tends to cancel the error at current levels greater than 0.3 mA (−14 dBm).

Inverter (H)

Operational amplifier U5A inverts the A, B MAG signal from the Offset and Scaling circuit and sends a −A or −B signal to the A, B or R Select circuit.

Detector Gain Amplifier (D)

The purpose of the Detector Gain Amplifier is to control the gain of amplifier Q6 in the Rectifier circuit. This is accomplished by varying the conduction of PIN diode CR1 in the collector circuit of Q6 as a function of the output voltage of the scaling and offset amplifier U3B.

DET GAIN adjustment R58 sets the output of U3A, the bias for the PIN diode via R18, for one diode drop (+0.4V) when the input level is equivalent to −80 dBm or −2V at TP8. As the voltage at TP8 goes positive, the detector gain bias also goes positive, but with a slope of about 30 mV/dB as determined by R61 and R62. When the input level reaches about −64 dBm (−1.6V at TP8), CR5 begins to conduct, placing R60 and R88 in parallel with R61, causing the slope of the U3A output to increase to about 0.2V/dB.

A, B or R Select ❶

The function of the A, B or R Select circuit is to select either the on-board, inverted A, B MAG signal or the – R MAG signal from the R Detector (A11) as the output to the Analog Processor (A2). Signal selection is controlled by the front-panel switch settings. The – R MAG signal is selected when the H DSP R line is high. (Refer to the description of front-panel control logic in Service Sheet 15.)

Analog switch U6 is a unity-gain, inverting amplifier with two switch-selectable summing junctions. The inputs to one summing junction are the inverted A, B MAG signal and the inverted feedback from the amplifier. The inputs to the other summing junction are the – R MAG signal from the R Detector (A11), the offset from R94, and the inverted feedback from the amplifier.

R OFS potentiometer R94 adjusts the absolute value of R when the – R MAG signal from A11 is selected.

Each of the diode pairs CR6, CR7 and CR8, CR9 is used to limit the voltage to analog switch U6 when the summing junction with which it is associated is not selected.

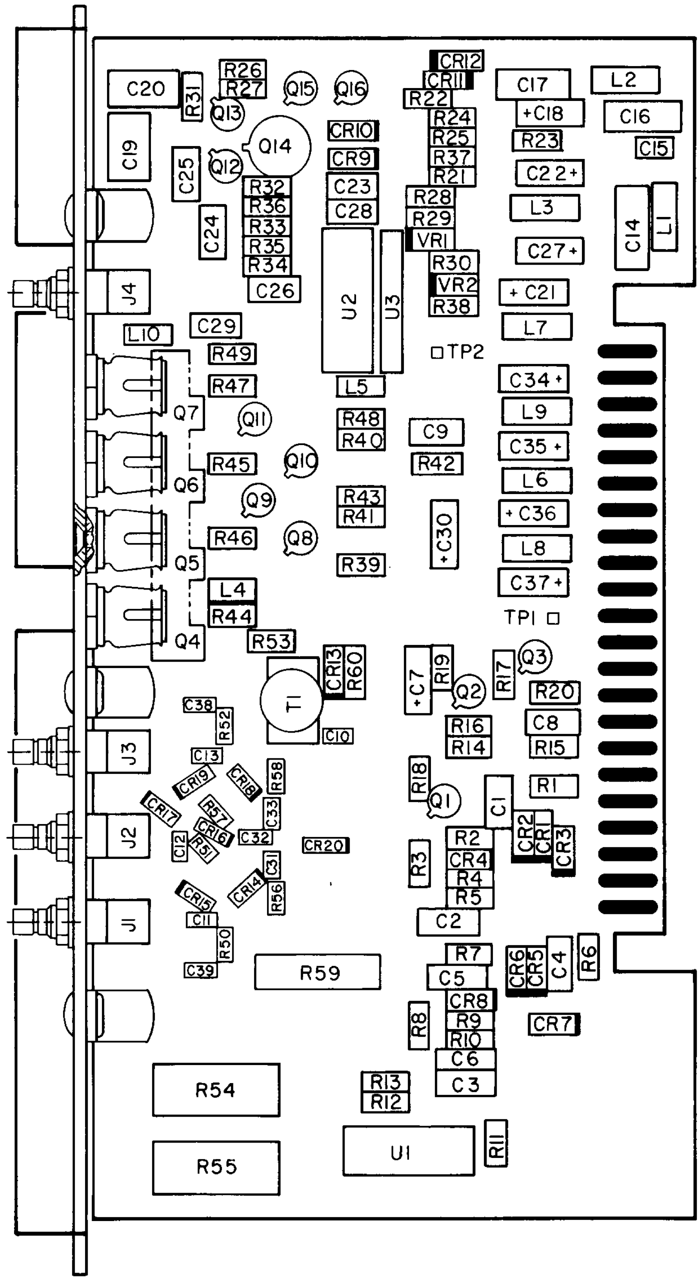


Figure 8-70. IF Switch (A6), Component Locations

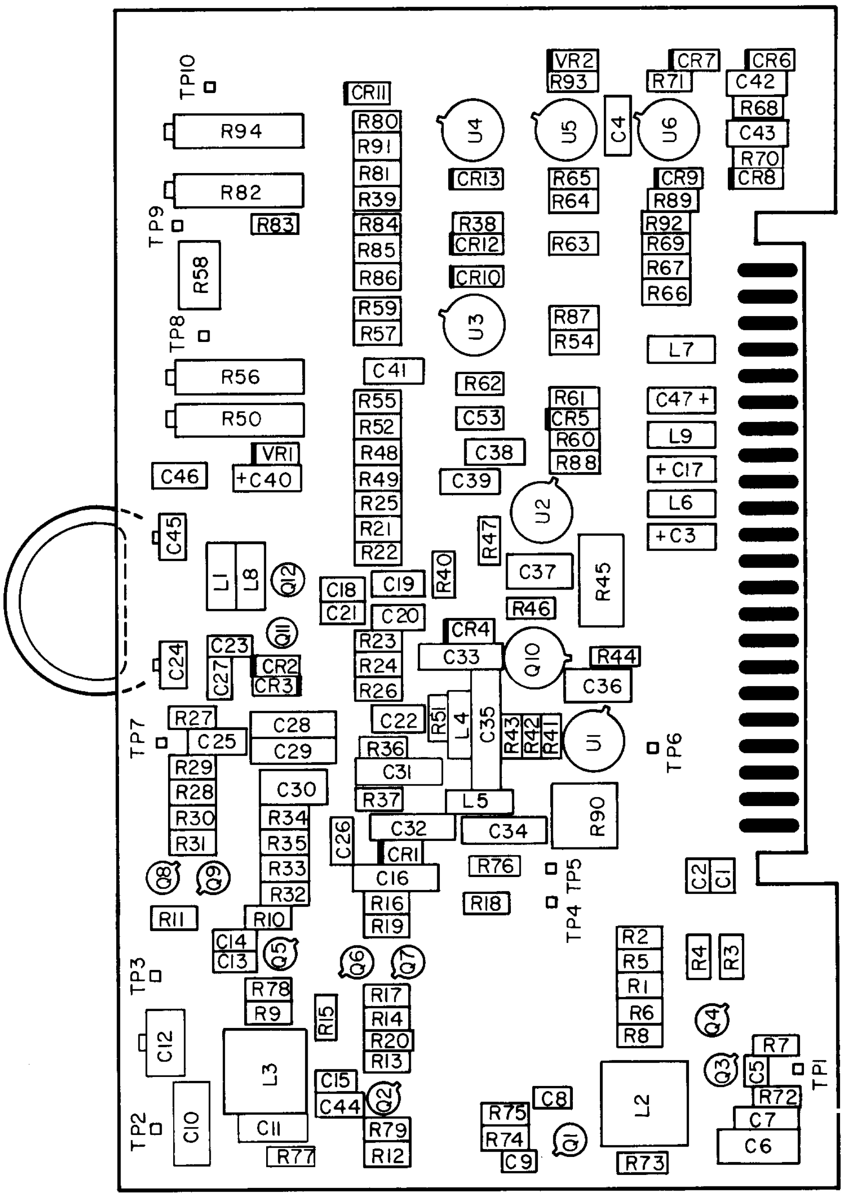
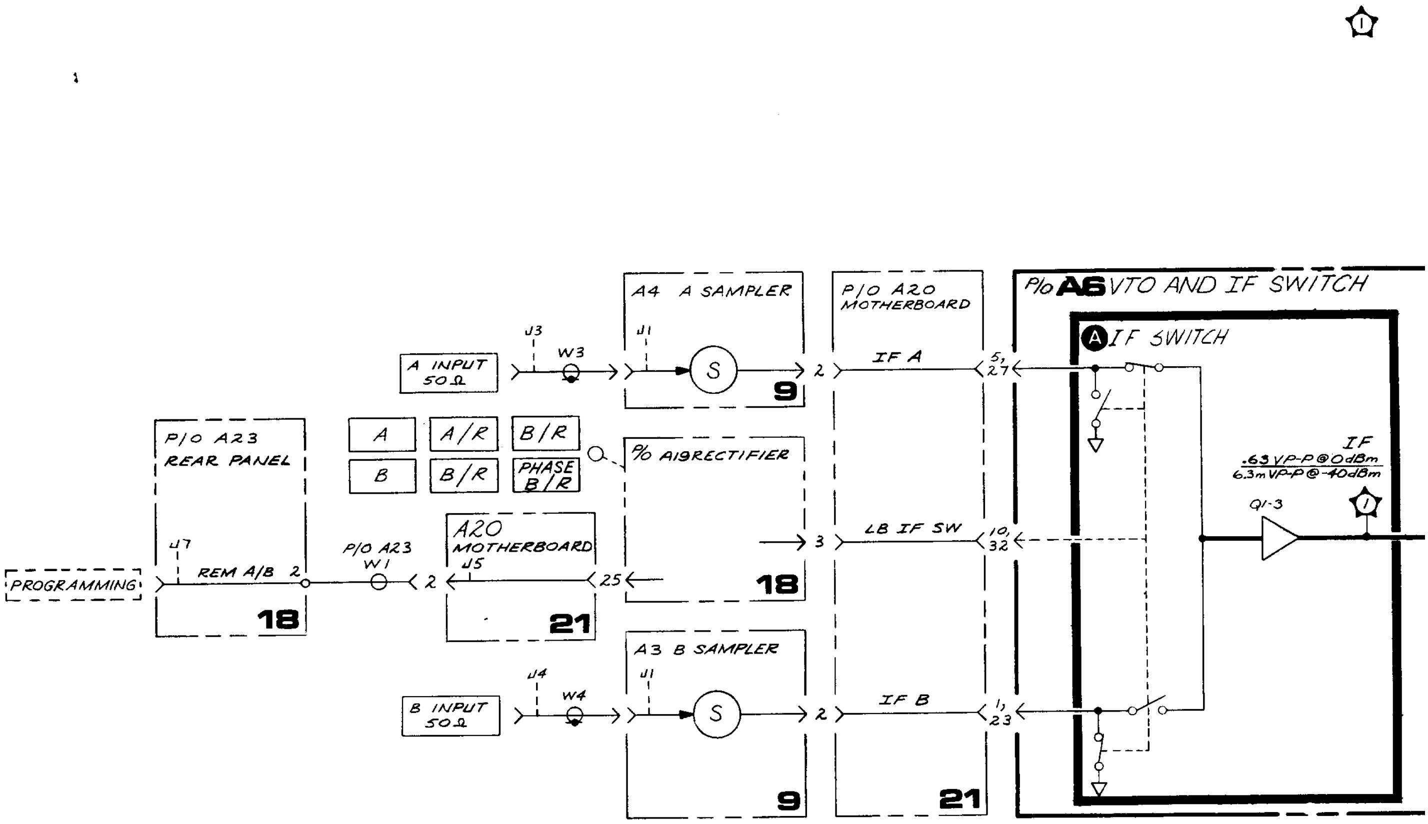
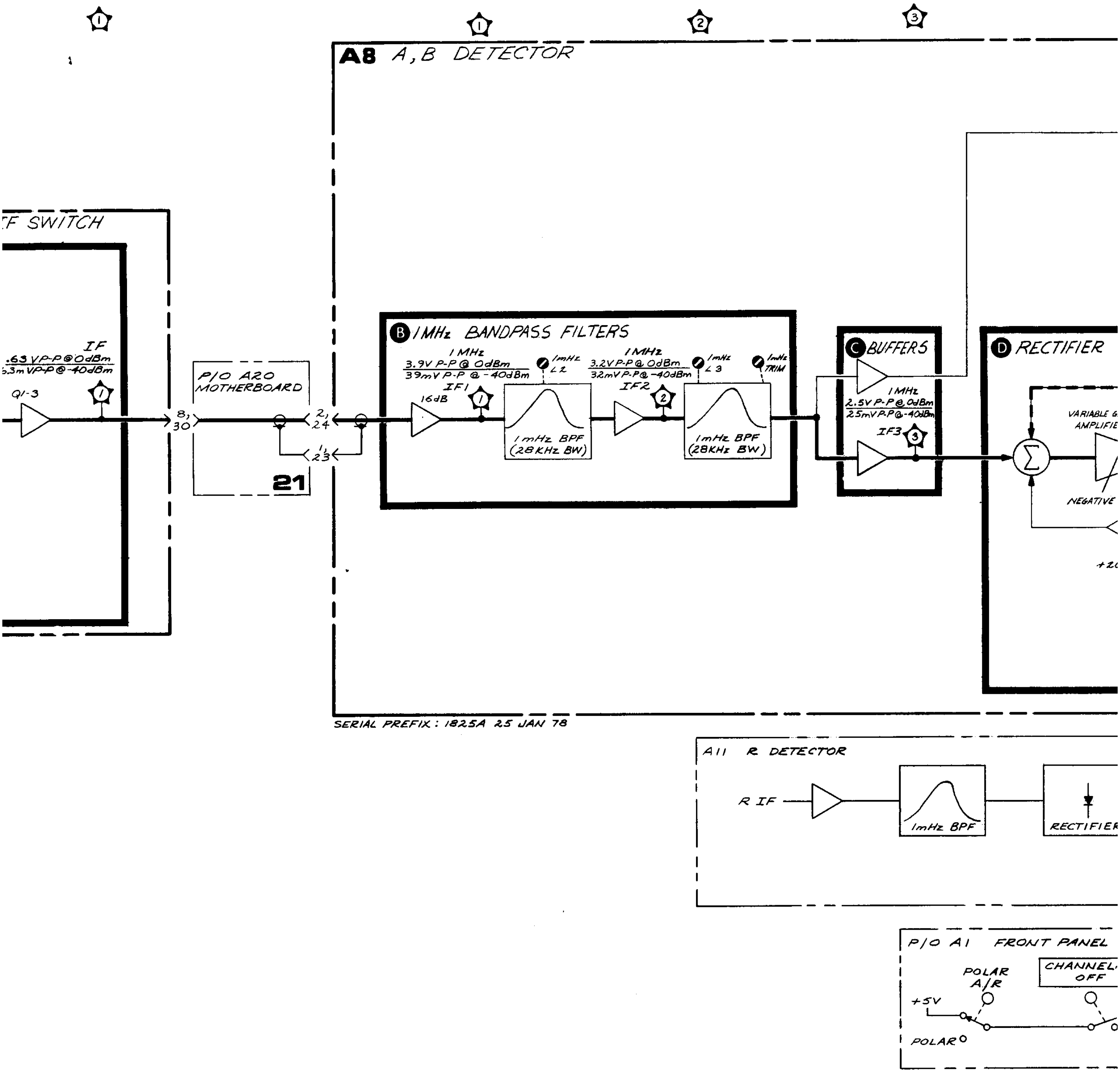
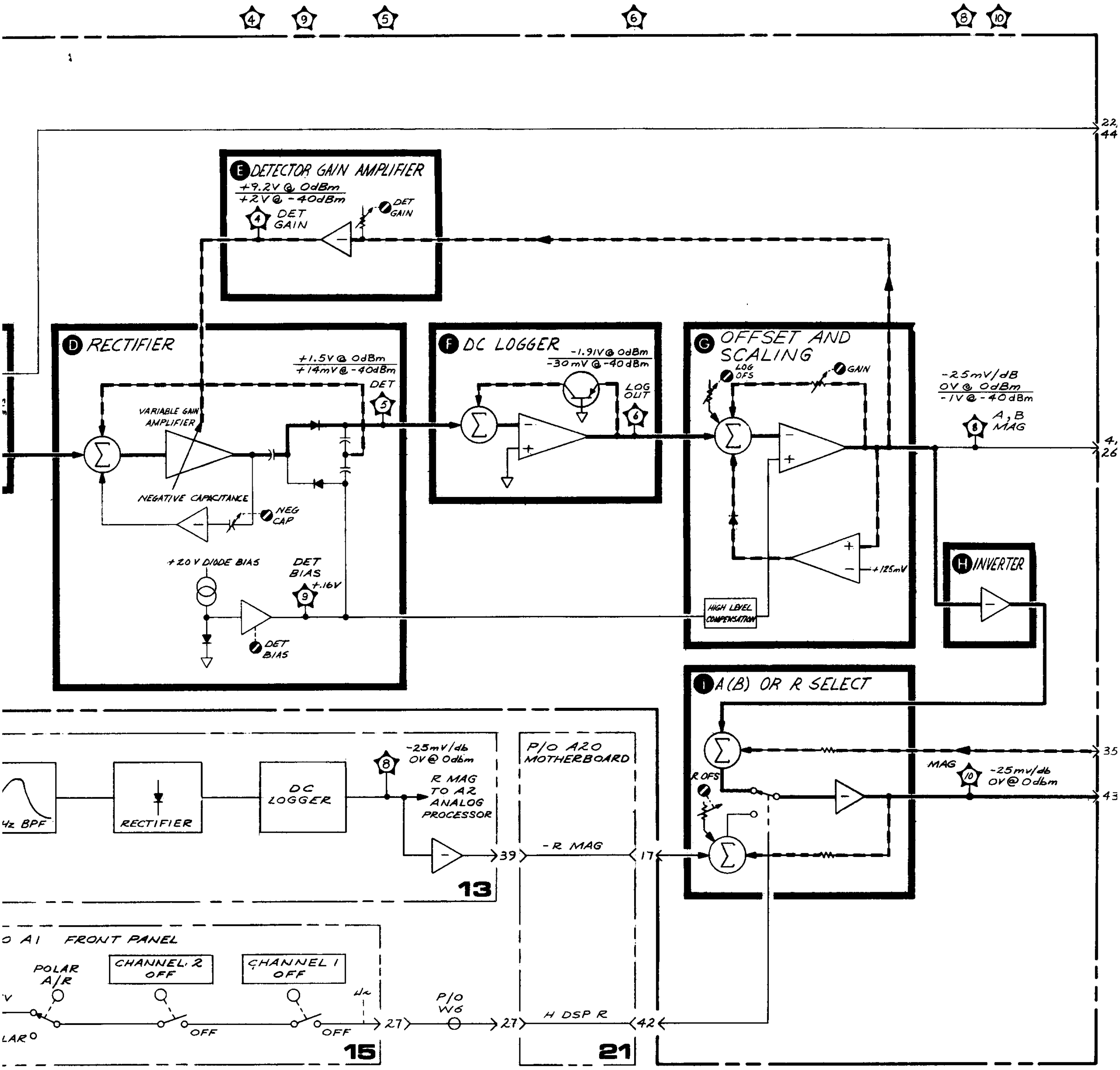


Figure 8-71. A, B, Detector, Component Locations

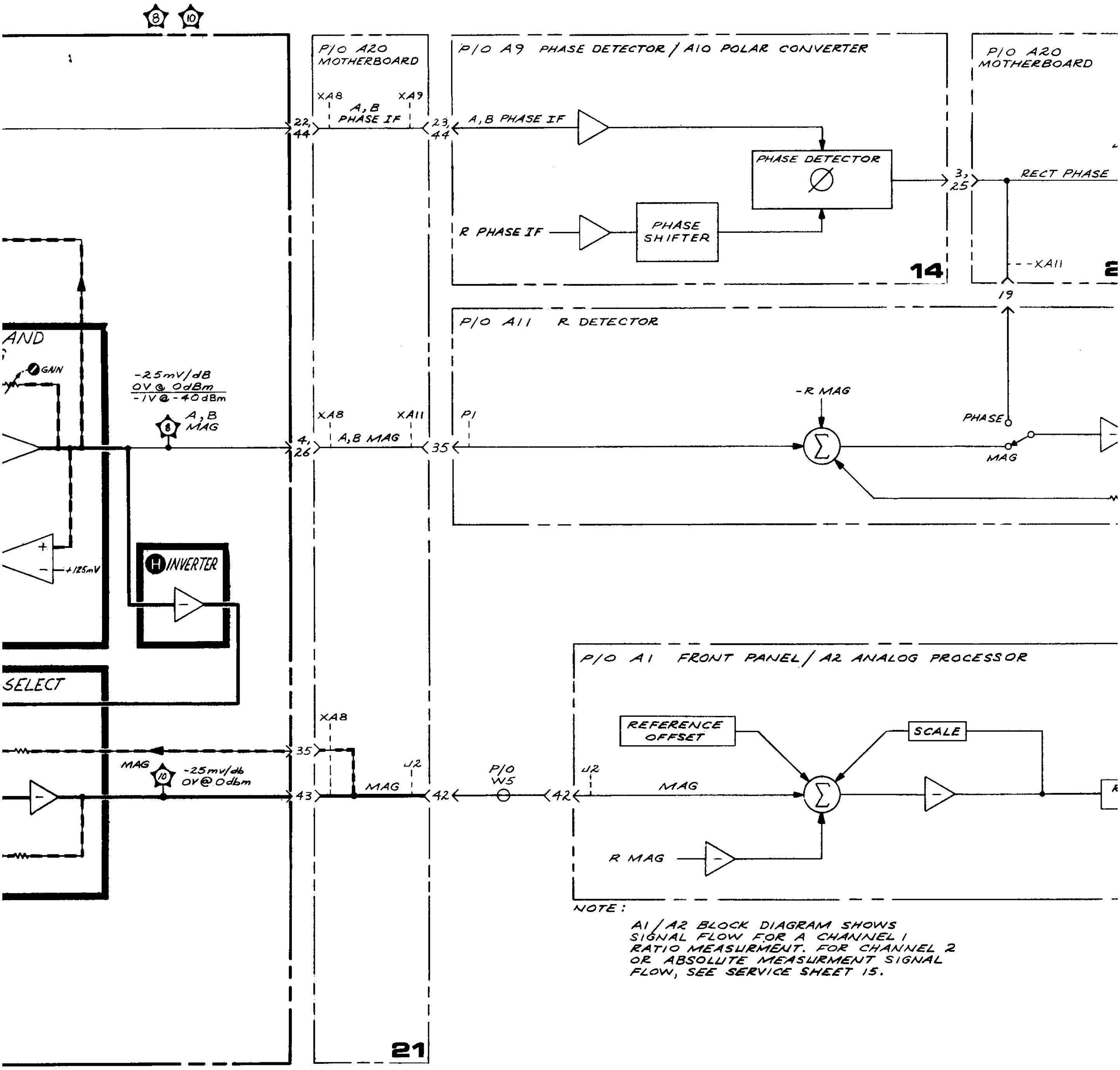

A INPUT 50Ω
J3
W3
A4 A SAMPLER
J1
S
9
P/O A20 MOTHERBOARD
IF A
P/O A6 VTO AND IF SWITCH
A IF SWITCH
IF
.63 VP-P @ 0dBm
6.3mVP-P @ -40dBm
Q1-3
P/O A23 REAR PANEL
J7
REM A/B
18
PROGRAMMING
P/O A23
W1
A
A/R
B/R
B
B/R
PHASE B/R
P/O A19 RECTIFIER
18
A20 MOTHERBOARD
J5
21
LB IF SW
B INPUT 50Ω
J4
W4
A3 B SAMPLER
J1
IF B
9
21



A8 A, B DETECTOR
F SWITCH
IF
.63 VP-P @ 0dBm
6.3mVP-P @ -40dBm
Q1-3
P/O A20 MOTHERBOARD
21
B 1MHz BANDPASS FILTERS
1MHz
3.9V P-P @ 0dBm
39mV P-P @ -40dBm
IF1
16dB
1mHz L2
1mHz BPF (28KHz BW)
1MHz
3.2V P-P @ 0dBm
32mV P-P @ -40dBm
IF2
1mHz L3
1mHz TRIM
1mHz BPF (28KHz BW)
C BUFFERS
1MHz
2.5V P-P @ 0dBm
25mV P-P @ -40dBm
IF3
D RECTIFIER
NEGATIVE
SERIAL PREFIX: 1825A 25 JAN 78
A11 R DETECTOR
R IF
1mHz BPF
P/O A1 FRONT PANEL
POLAR A/R
+5V
POLAR



E DETECTOR GAIN AMPLIFIER
+9.2V @ 0dBm
+2V @ -40dBm
DET GAIN
DET GAIN
D RECTIFIER
+1.5V @ 0dBm
+14mV @ -40dBm
DET
VARIABLE GAIN AMPLIFIER
NEGATIVE CAPACITANCE
NEG CAP
+20V DIODE BIAS
DET BIAS
+.16V
DET BIAS
F DC LOGGER
-1.91V @ 0dBm
-30mV @ -40dBm
LOG OUT
G OFFSET AND SCALING
LOG OFS
GAIN
+125mV
HIGH LEVEL COMPENSATION
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A,B MAG
22, 44
4, 26
H INVERTER
I A(B) OR R SELECT
R OFS
MAG
-25mv/db
0V @ 0dbm
35
43
Hz BPF
RECTIFIER
DC LOGGER
-25mV/db
0V @ 0dbm
R MAG TO A2 ANALOG PROCESSOR
39
13
P/O A20 MOTHERBOARD
-R MAG
17
H DSP R
42
21
A1 FRONT PANEL
POLAR A/R
CHANNEL 2 OFF
CHANNEL 1 OFF
OFF
OFF
27
P/O W6
27
15



P/O A20 MOTHERBOARD
XA8
XA9
A,B PHASE IF
22, 44
23, 44
P/O A9 PHASE DETECTOR / A10 POLAR CONVERTER
A,B PHASE IF
PHASE DETECTOR
R PHASE IF
PHASE SHIFTER
3, 25
14
P/O A20 MOTHERBOARD
RECT PHASE
XA11
19
P/O A11 R DETECTOR
-R MAG
PHASE
MAG
AND
GAIN
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
A,B MAG
XA8
XA11
A,B MAG
P1
4, 26
35
+125mV
INVERTER
SELECT
XA8
35
MAG
-25mv/db
0V @ 0dbm
43
MAG
J2
42
P/O W5
42
J2
P/O A1 FRONT PANEL / A2 ANALOG PROCESSOR
REFERENCE OFFSET
SCALE
MAG
R MAG
21
NOTE:
A1/A2 BLOCK DIAGRAM SHOWS SIGNAL FLOW FOR A CHANNEL 1 RATIO MEASURMENT. FOR CHANNEL 2 OR ABSOLUTE MEASURMENT SIGNAL FLOW, SEE SERVICE SHEET 15.

Fi

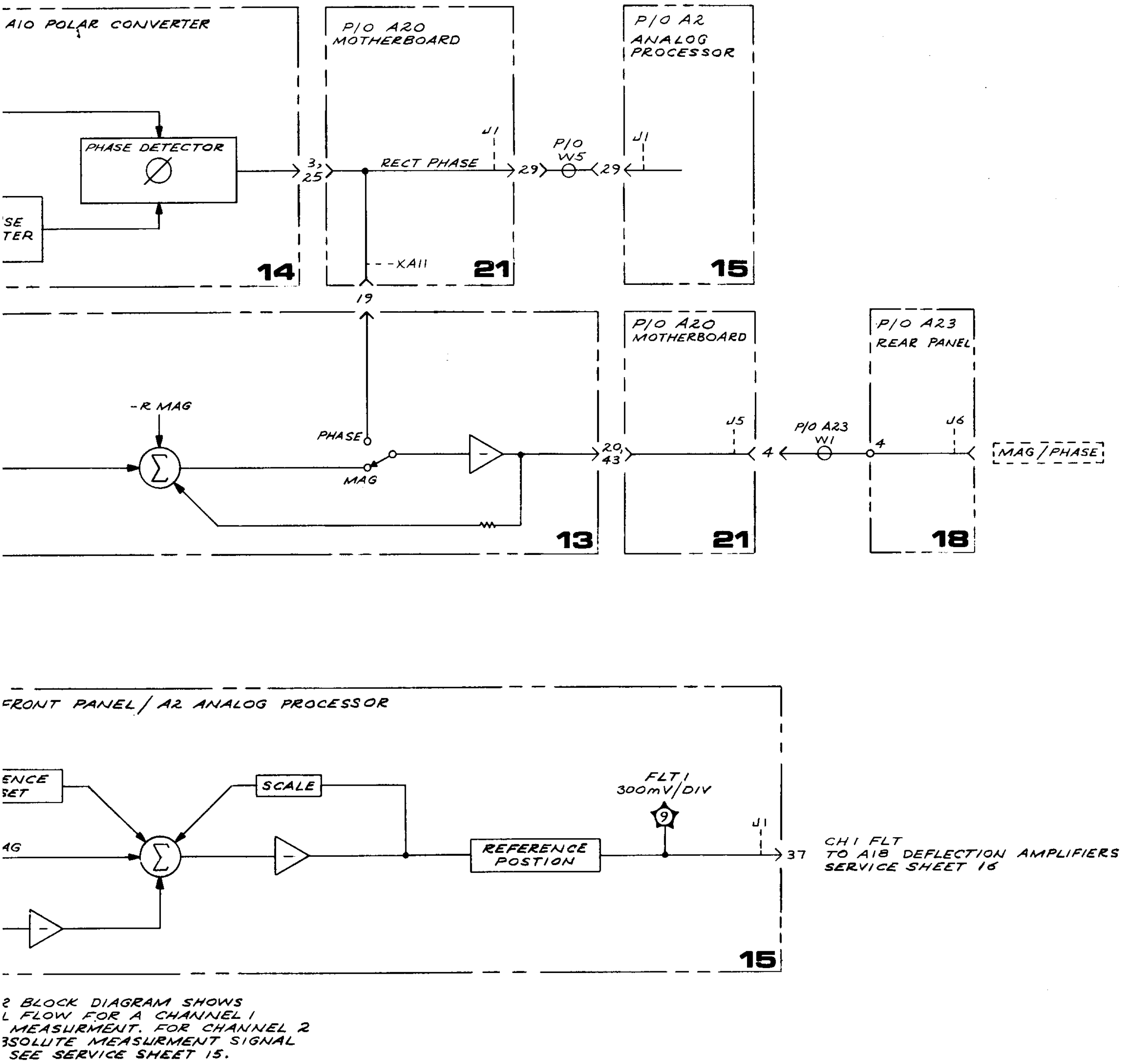


Figure 8-72. IF Switch (A6) and A,B Detector (A8), Block Diagram

A6

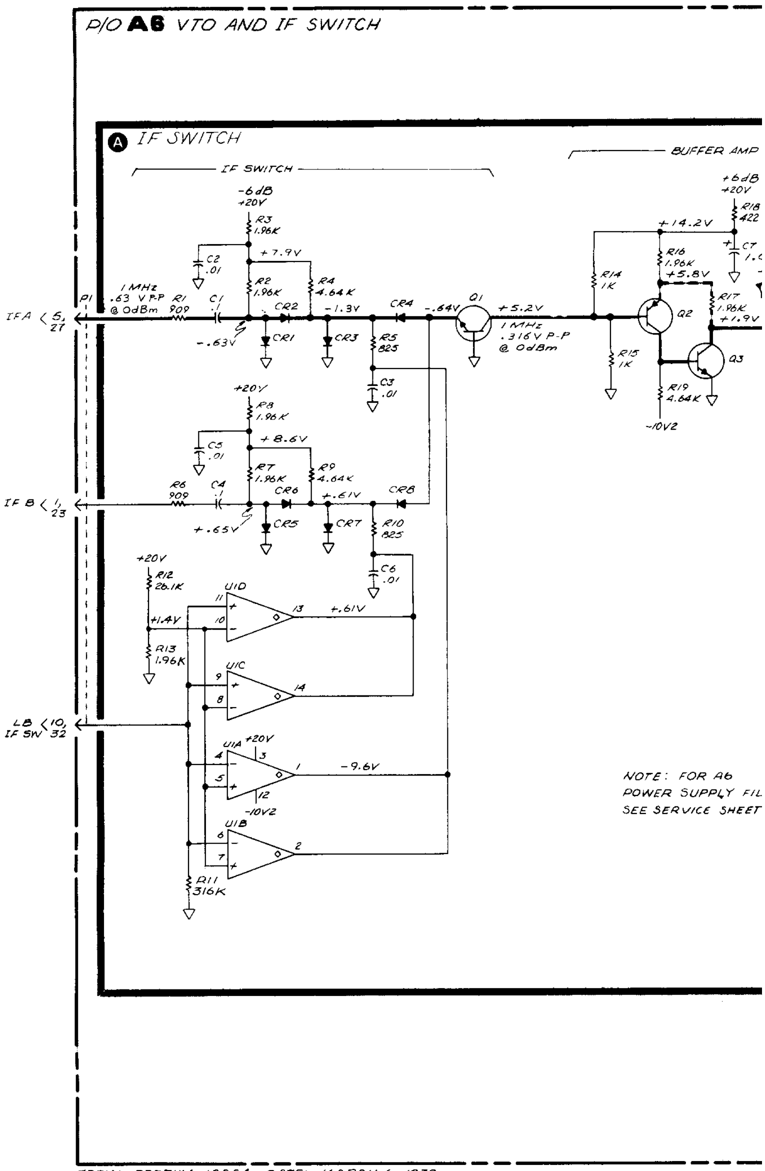
P1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SERVICE SHEET
1	IF B	XA3-2	A	
23	IF B	XA3-2	A	
2	GND			10
24	GND			10
3	GND			10
25	GND			10
4	GND			10
26	GND			10
5	IF A	XA4-2	A	
27	IF A	XA4-2	A	
6	GND			10
28	GND			10
7	GND			10
29	GND			10
8	A,B IF	XA8-2,24	A	
30	A,B IF	XA8-2,24	A	
9	GND			10
31	GND			10
10	L B IF SW	XA19-3	A	
32	L B IF SW	XA19-3	A	
11	NC			
33	NC			
12	GND			10
34	GND			10
13	GND			10
35	GND			10
14	-10V			10
36	-10V			10
15	GND			10
37	GND			10
16	+20V			10
38	+20V			10
17	GND			10
39	GND			10
18	GND			10
40	GND			10
19	GND			10
41	GND			10
20	GND			10
42	GND			10
21	VTO			10
43	VTO			10
22	GND			10
44	GND			10

A8

P2

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	A,B IF COM	GND PLANE	B
23	A,B IF COM	GND PLANE	B
2	A,B IF	XA6-8,30	B
24	A,B IF	XA6-8,30	B
3	GND		J
25	GND		J
4	A,B MAG	XA11-35	H
26	A,B MAG	XA11-35	H
5	GND		J
27	GND		J
6	GND		J
28	GND		J
7	NC		
29	NC		
8	GND		J
30	GND		J
9	GND		J
31	GND		J
10	GND		J
32	GND		J
11	GND		J
33	GND		J
12	NC		
34	NC		
13	NC		
35	MAG	U2-42	I
14	+20V	XA9-14,36	J
36	+20V	XA9-14,36	J
15	GND		J
37	GND		J
16	+5.2V	XA9-16,38	J
38	+5.2V	XA9-16,38	J
17	-R MAG	XA11-39	I
39	NC		H
18	-10V	XA7-4,10	J
40	-10V	XA7-4,10	J
19	NC		
41	NC		
20	NC		I
42	H DSP R	U2-27	I
21	GND		J
43	MAG	U2-42	I
22	A,B PHASE IF	XA9-22,44	C
44	A,B PHASE IF	XA9-22,44	C



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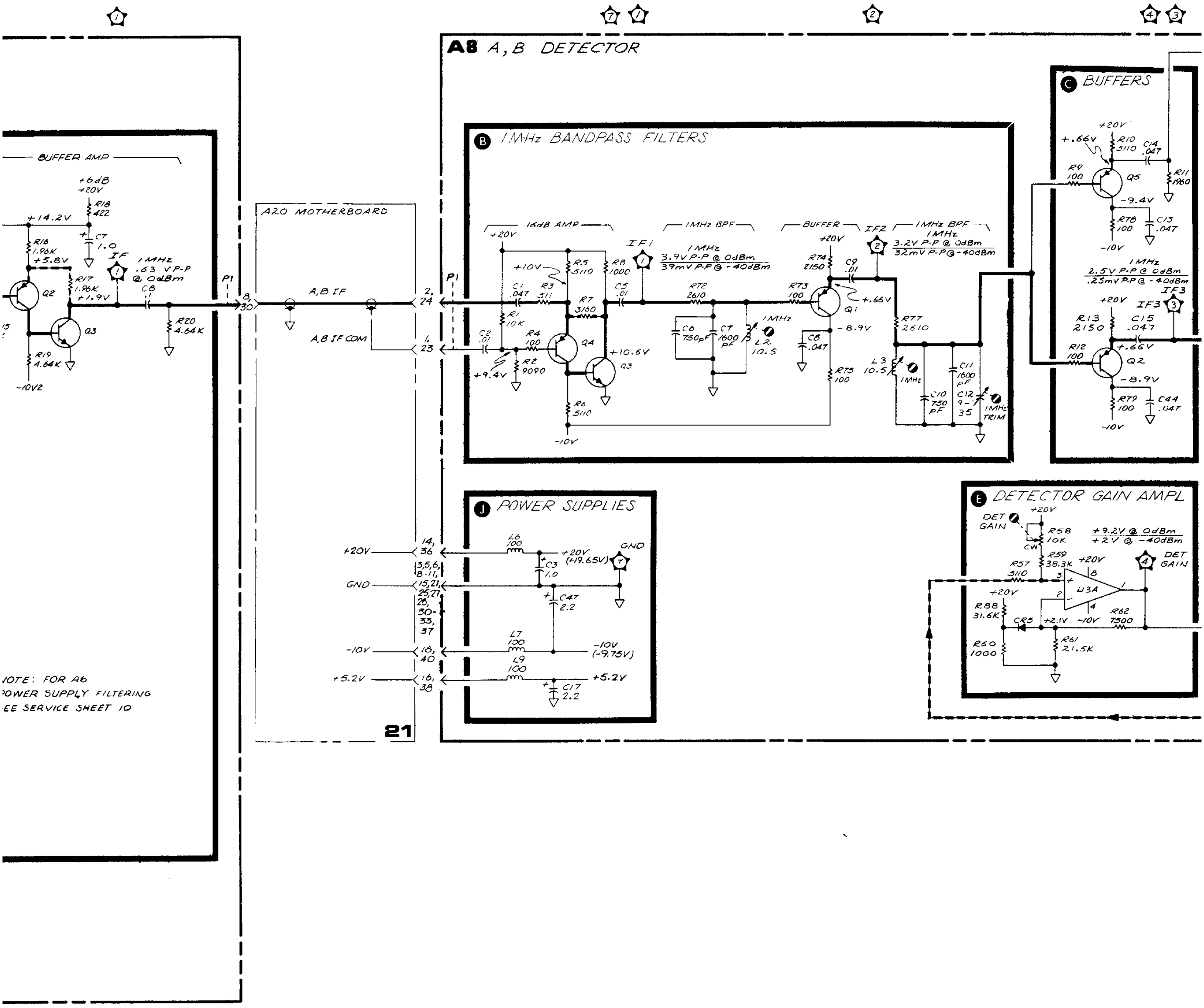
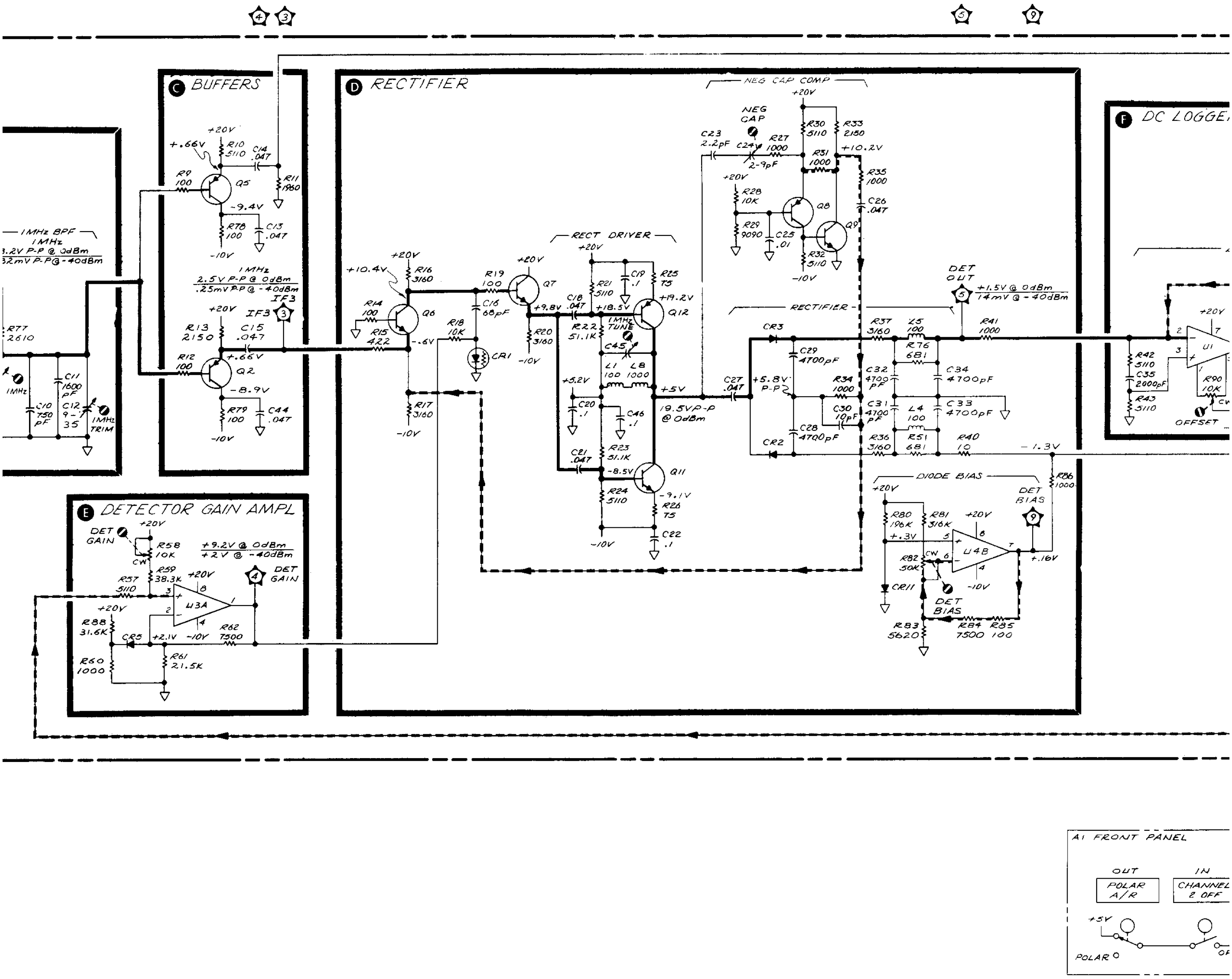
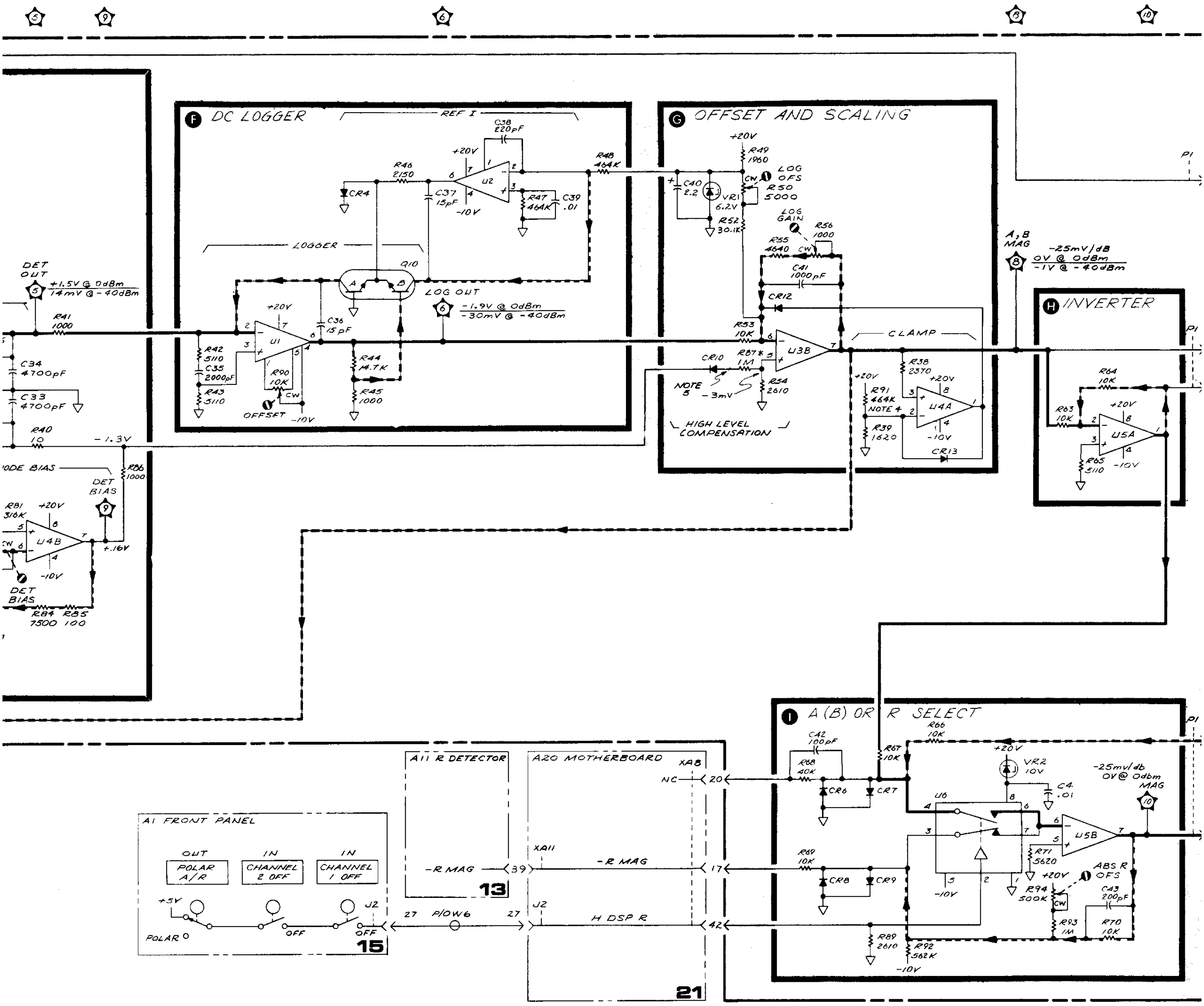
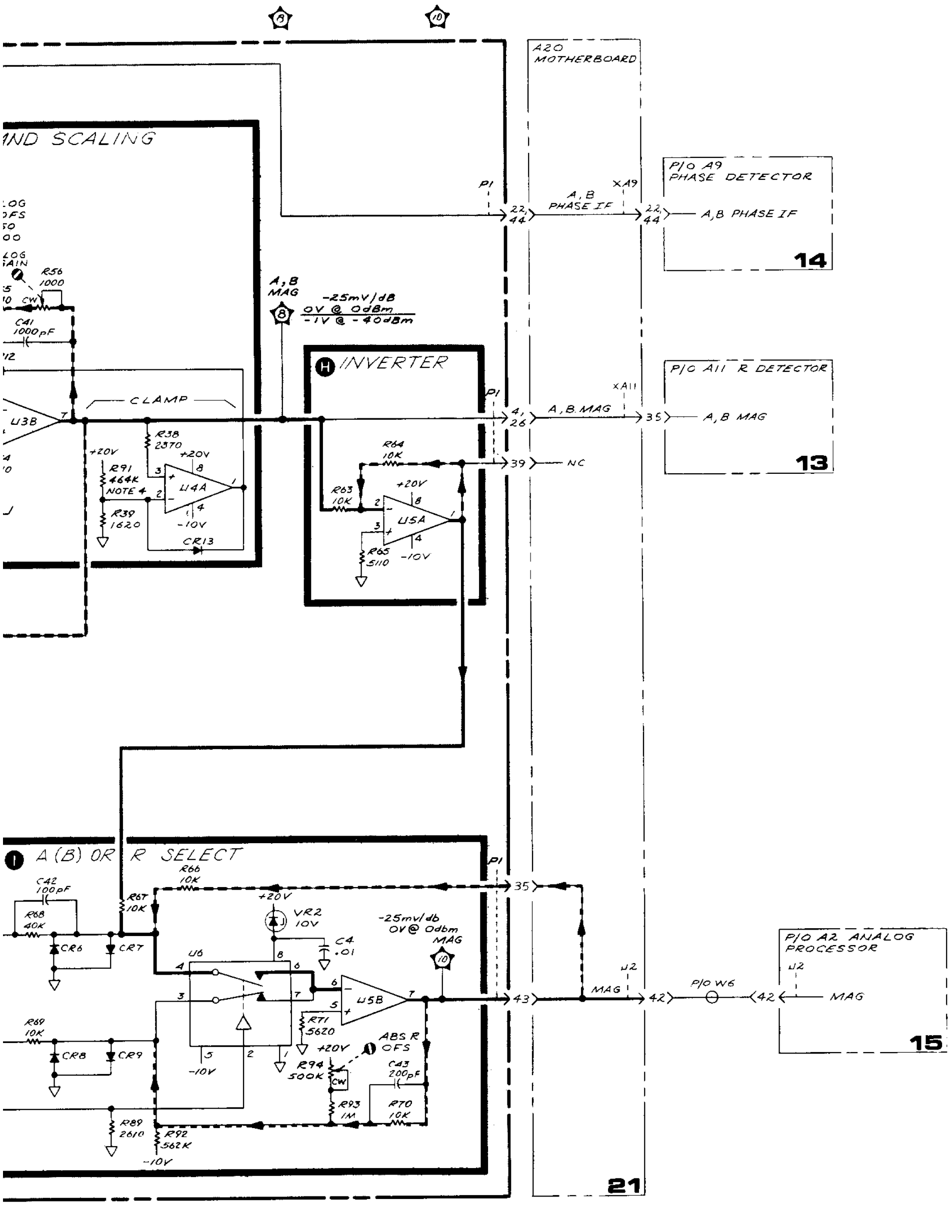

A8 A, B DETECTOR
1MHz BANDPASS FILTERS
16dB AMP
1MHz BPF
BUFFER
1MHz BPF
IF1
IF2
IF3
1MHz
3.9V P-P @ 0dBm
39mV P-P @ -40dBm
3.2V P-P @ 0dBm
32mV P-P @ -40dBm
BUFFERS
2.5V P-P @ 0dBm
.25mV P-P @ -40dBm
DETECTOR GAIN AMPL
DET GAIN
+9.2V @ 0dBm
+2V @ -40dBm
U3A
POWER SUPPLIES
+20V
GND
-10V
+5.2V
+20V (+19.65V)
-10V (-9.75V)
A20 MOTHERBOARD
A,B IF
A,B IF COM
P1
BUFFER AMP
IF
1MHz
.63 V P-P
@ 0dBm
1MHz TRIM
NOTE: FOR A6
POWER SUPPLY FILTERING
SEE SERVICE SHEET 10
21



C BUFFERS
D RECTIFIER
E DETECTOR GAIN AMPL
F DC LOGGE
NEG CAP COMP
RECT DRIVER
RECTIFIER
DIODE BIAS
1MHz BPF
1MHz
2.5V P-P @ 0dBm
.25mV P-P @ -40dBm
IF3
DET OUT
+1.5V @ 0dBm
14mV @ -40dBm
19.5VP-P @ 0dBm
+9.2V @ 0dBm
+2V @ -40dBm
DET GAIN
DET BIAS
NEG CAP
1MHz TUNE
1MHz TRIM
OFFSET
A1 FRONT PANEL
OUT
IN
POLAR A/R
CHANNEL 2 OFF
POLAR


DC LOGGER
REF I
LOGGER
LOG OUT
-1.9V @ 0dBm
-30mV @ -40dBm
DET OUT
+1.5V @ 0dBm
14mV @ -40dBm
OFFSET
DET BIAS
OFFSET AND SCALING
LOG OFS
LOG GAIN
CLAMP
HIGH LEVEL COMPENSATION
NOTE 5
A,B MAG
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
INVERTER
A(B) OR R SELECT
ABS R OFS
-25mV/db
0V@ 0dbm
MAG
A1 FRONT PANEL
POLAR A/R
CHANNEL 2 OFF
CHANNEL 1 OFF
POLAR
A11 R DETECTOR
-R MAG
13
15
A20 MOTHERBOARD
XA8
XA11
H DSP R
P/OW6
21



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBERS FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. UNLESS OTHERWISE NOTED, ALL VOLTAGES GIVEN ARE FOR A 0dBm (.632V P-P) A,B IF INPUT AT A8 PIN 2 WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
   SWEEP WIDTH MHz : 0MHz
   SWEEP MODE : CENTER
   SWEEP : MAN
   CHANNEL 1 : A/R
   CHANNEL 2 : OFF
4. VOLTAGE AT JUNCTION OF A8R91 AND A8R39 IS +.06V WHEN THE CLAMP CIRCUIT IS TURNED ON.
5. R87 IS SELECTED TO OPTIMIZE 0dBm AMPLITUDE ACCURACY (COMPENSATES FOR Q10).

12
A8,A6

Figure 8-73. IF Switch (A6) and A,B Detector (A8), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and $\pm$6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 13

R DETECTOR (A11), CIRCUIT DESCRIPTION

The primary purpose of the R Detector (A11) is to produce a dc voltage that varies logarithmically with the magnitude of the 1-MHz R IF input signal from the R Sampler (A5, Service Sheet 9).

The detector first amplifies and then filters the R IF signal to provide the necessary 20-kHz IF bandwidth. This processed signal is sent to the Polar Converter (A10, Service Sheet 14) for phase measurements. It is also rectified to obtain a dc current that is proportional to the IF level. The logarithm of this dc current is then offset and scaled to produce a dc voltage that represents the absolute magnitude of the IF signal and varies logarithmically with a linear change in IF magnitude. This signal (R MAG) is sent to the Analog Processor (A2, Service Sheet 15) for display processing.

The R Detector (A11) has four outputs:

- A 1-MHz IF signal to the Polar Converter (A10, Service Sheet 14)
- A dc voltage (whose amplitude is −25 mV/dB) to the A, B Detector (A8, Service Sheet 12)
- A dc voltage (whose amplitude is −25 mV/dB) to the Analog Processor (A2, Service Sheet 15)
- A dc voltage to the rear panel MAG/PHASE output connector

NOTE

All reference designations in this circuit description, unless otherwise specified, are assumed to have the prefix A11. For example, the designation Q4 is actually A11Q4.

1-MHz Bandpass Filters (A)

The IF bandpass is determined by two parallel-resonant LC circuits to provide an overall 3-dB bandwidth of 20 kHz centered at the IF frequency of 1 MHz.

The 1-MHz IF input signal (R IF) from the R Sampler (A5) is amplified by the feedback pair Q3 and Q4, whose gain is 6.2 or 16 dB as determined by the ratio of R7 to R3. The output (IF 1), monitored at TP1, is 3.9V peak-to-peak with an RF input power level of 0 dBm. IF 1 is filtered by a parallel resonant circuit consisting of C6, C7, and a variable inductor (1 MHz L2), which is tuned for resonance at 1 MHz by adjusting L2 for the phase shift of the 1-MHz signal between TP1 and TP2. The gain through the bandpass filter stage, TP1 to TP2, is 0.8, −2 dB. The bandwidth of this filter is 28 kHz.

The output of the tank circuit is buffered by emitter-follower Q1, whose output (IF 2) monitored at TP2, is about 3.2V peak-to-peak. IF 2 is then filtered by another parallel resonant circuit consisting of C10, C11, 1 MHz TRIM capacitor C12, and a variable inductor, 1 MHz (L3), which also has a bandwidth of 28 kHz. This filter is coarsely tuned by L3 for the phase shift between TP1 and TP3, with fine tuning by C12. The gain from TP2 to TP3 is about 0.8, −2 dB.

Buffers (C)

The Buffers are two emitter-follower amplifiers, Q2 and Q5, that provide isolation between the signal paths out of the 1-MHz Bandpass Filters. Q5 supplies the 1-MHz IF signal to the Polar Converter (A10), and Q2 drives the Rectifier circuit. The output of the Buffers (IF 3), monitored at TP3, is about 2.45V peak-to-peak at 0 dBm.

Rectifier (D)

The Rectifier converts the 1-MHz input voltage to a dc output current. As shown in the equivalent circuit Figure 8-74, the Rectifier is basically an amplifier and a pair of diodes in the negative feedback loop. Compensation for the rectifier diode capacitance is provided by the negative capacitance circuit. The gain of the amplifier is varied to compensate for the change in rectifier impedance with signal level. Temperature-dependent diode bias is provided to reduce the impedance of the diode at low levels.

At the 1-MHz input frequency, the impedance of capacitors C_A is small compared to that of resistors R_A, so the ac components of I_1 and I_2 combine to form the feedback current I_F, which is 180 degrees out of phase with the input current I_{IN}. Because the amplifier has a large gain, I_F is equal in amplitude to I_{IN}.

The dc component of I_1 is sent to the virtual ground at the input of the DC Logger, while the dc component of I_2 develops a dc voltage to the High Level Compensation stage of the Offset and Scaling circuit across resistor R_B in that output line and is returned to the output of the diode bias circuit.

Resistors R_A and capacitors C_B filter out the 1-MHz IF from the dc outputs to the DC logger and to the High Level Compensation stage of the Offset and Scaling circuit.

The input stage to the Rectifier circuit is common-base amplifier Q6, whose gain is varied by the action of PIN diode CR1 in the collector circuit. Emitter-follower Q7 is a buffer stage that drives the common-emitter complementary pair Q11 and Q12, a unity-gain, inverting amplifier whose output drives the diodes CR2 and CR3.

A parallel-resonant tank circuit at the collectors of Q11 and Q12 consists of L1, L8, 1 MHz TUNE capacitor C45, and the inter-element capacitances of Q11 and Q12. It is tuned to provide high impedance at 1 MHz to improve the performance of the rectifier at low input levels.

The inductors in the tank circuit also provide a dc bias point for the collectors of Q11 and Q12.

The capacitance of the diodes CR2 and CR3 causes the negative feedback current I_F to contain a capacitive as well as a resistive component. This causes a non-linearity in the rectifier output. To compensate for this undesirable effect, C23, NEG CAP capacitor C24, and unity-gain, inverting amplifier Q8, Q9 cause a current to appear at the summing junction (the emitter of Q6) that is 180 degrees out of phase with the capacitive component of I_F.

Diode CR11 provides a temperature-dependent reference voltage (DET BIAS) for the Diode Bias stage, U4B and associated circuitry. This voltage, measured at TP9, is about +165 mV at ambient temperature and varies at -2 mV/°C. The Diode Bias network also applies a slight bias to the rectifier diodes to improve their sensitivity.

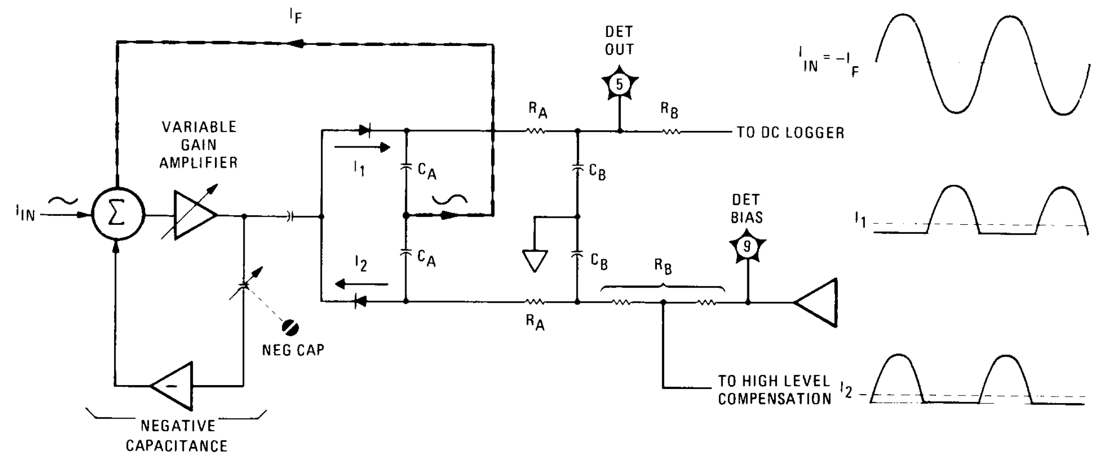


Figure 8-74. A11 Rectifier, Equivalent Circuit

DC Logger (E)

The DC Logger produces an output voltage that varies with the log of the input current (−1.9V at 0 dBm, −0.04V at −40 dBm, +1.85V at −80 dBm). It consists of two operational amplifiers, U1 and U2, each of which has a transistor base-emitter junction in its feedback loop and one of which is used as a reference. An equivalent circuit is shown in Figure 8-75.

The basic logging function of the circuit is performed by Q10A, whose base-emitter voltage (V_{be_1}) varies with the log of the input current to U1. However, this basic logging circuit is temperature-dependent, because V_{be_1} also varies with temperature. Therefore, stability is achieved by the addition of Q10B and operational amplifier U2. U2 operates to maintain equality between the currents into and out of the summing junction at its inverting input (pin 2). The resulting constant current I_{REF} establishes a reference voltage V_{be_2} that varies only with temperature. Since temperature variations have an equal effect on the two base-emitter voltages, their algebraic sum represents a temperature-stable output voltage V_O that is directly proportional to the log of the input current to U1 pin 2 (1.5 mA to 0.15 mA) over the entire operating range of about 80 dB.

The value of I_{REF} (about 13 μA) is determined by the reference voltage (+6.2V) and the value of R48.

R45 compensates for changes in the logging characteristics of Q10A (as distinguished from the variation of V_{be_1}) as a function of temperature.

Offset and Scaling (F)

The dc output voltage from the DC Logger is inverted by operational amplifier U3B and scaled to a factor of 25 mV/dB by the GAIN adjustment R56. LOG OFS adjustment R50 provides the absolute level calibration. That is, when the equivalent of 0 dBm at the RF input is 632 mV

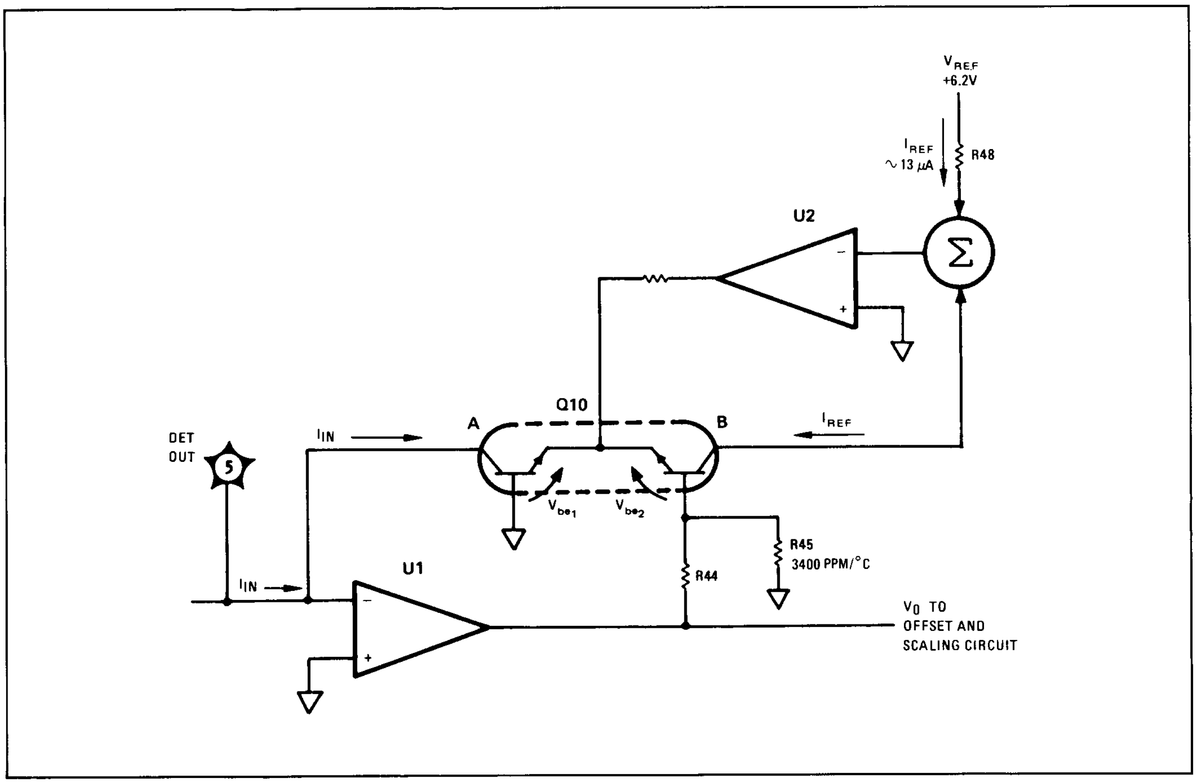


Figure 8-75. A11 DC Logger, Equivalent Circuit

peak-to-peak at the input to the magnitude detector, the output is 0V. The output of the Offset and Scaling circuit is the R MAG signal to the Analog Processor (A2).

Clamp. A voltage divider consisting of R91 and R39 establishes a reference of +0.07V, equivalent to >2.7 dBm RF power at the inverting input to operational amplifier U4A. When the voltage at the non-inverting input exceeds +0.07V the output of the op amp is coupled through CR12 to the inverting input of U3B. This limits the output of U4A to prevent expansion on the CRT display when the R Detector is overdriven. Diode CR13 keeps op amp U4A in the linear region when it is not functioning as a clamp.

High Level Compensation. The High Level Compensation stage, consisting of CR10, R87, and R54, compensates for linear errors related to the emitter resistance of the logging transistor Q10A, which causes expansion of the DC Logger output at high collector current levels. This occurs when the input to the R Detector is greater than the equivalent of −10 dBm. A linear signal from the Rectifier output is coupled to the noninverting input of U3B via CR10 and voltage divider R87, R54. This tends to cancel the error at current levels greater than 0.3 mA (−14 dBm).

Inverter (G)

Operational amplifier U5A inverts the R MAG signal from the Offset and Scaling circuit and sends a −R MAG signal to the Mag/Phase Select circuit.

Detector Gain Amplifier (B)

The purpose of the Detector Gain Amplifier is to control the gain of amplifier Q6 in the Rectifier circuit. This is accomplished by varying the conduction of PIN diode CR1 in the collector circuit of Q6 as a function of the output voltage of the scaling and offset amplifier U3B.

DET GAIN adjustment R58 sets the output of U3A, the bias for the PIN diode via R18, for one diode drop (+0.4V) when the input level is equivalent to −80 dBm or −2V at TP8. As the voltage at TP8 goes positive, the detector gain bias also goes positive, but with a slope of about 30 mV/dB as determined by R61 and R62. When the input level reaches about −64 dBm (−1.6V at TP8), CR5 begins to conduct, placing R60 and R88 in parallel with R61, causing the slope of the U3A output to increase to about 0.2V/dB.

Mag/Phase Select (H)

The function of the Mag/Phase Select circuit is to select either a magnitude or a phase signal to provide the MAG/PH OUT signal to the rear-panel MAG/PHASE connector. WHEN THE L MAG BUF line from the Rectifier (A19, Service Sheet 18) is low, the analog switch U6 selects the sum of the on-board −R MAG signal and the A, B MAG signal from the A, B Detector (A8). When L MAG BUF is high, the RECT PHASE signal from the Phase Detector (A9) is selected, and its offset is adjusted by DVM PH OFS potentiometer R94. Signal selection is controlled by the state of the H MAG line from the rear-panel PROGRAMMING connector.

Analog switch U6 is a unity-gain, inverting amplifier with two switch-selectable summing junctions. The inputs to one summing junction are the on-board − R MAG signal, the A, B, MAG signal from A8, and the inverted feedback from the amplifier. The inputs to the other summing junction are the RECT PHASE signal from A9, the offset from R94, and the inverted feedback from the amplifier.

Each of the diode pairs CR6, CR7 and CR8, CR9 is used to limit the voltage to the analog switch U6 when the summing junction with which it is associated is not selected.

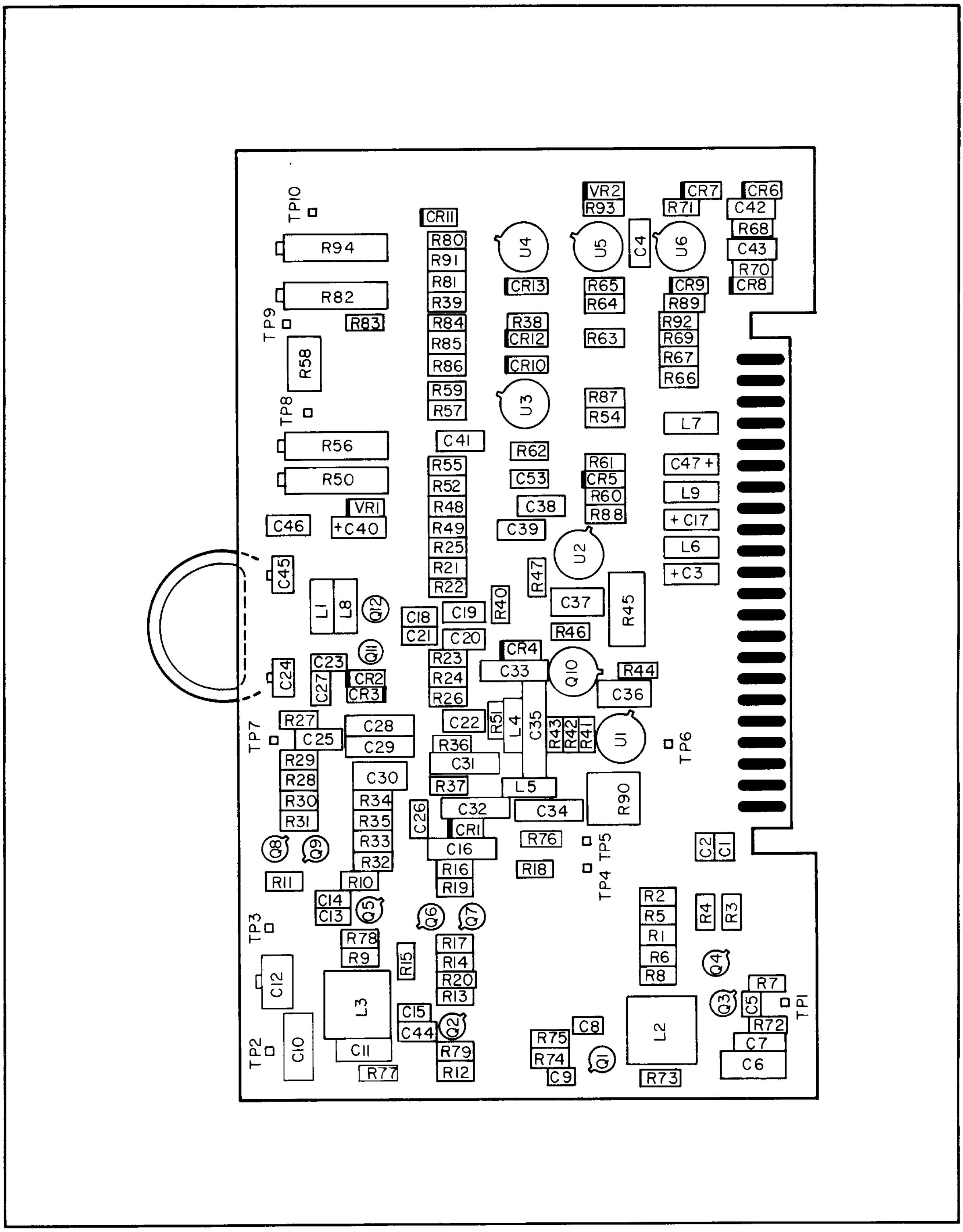
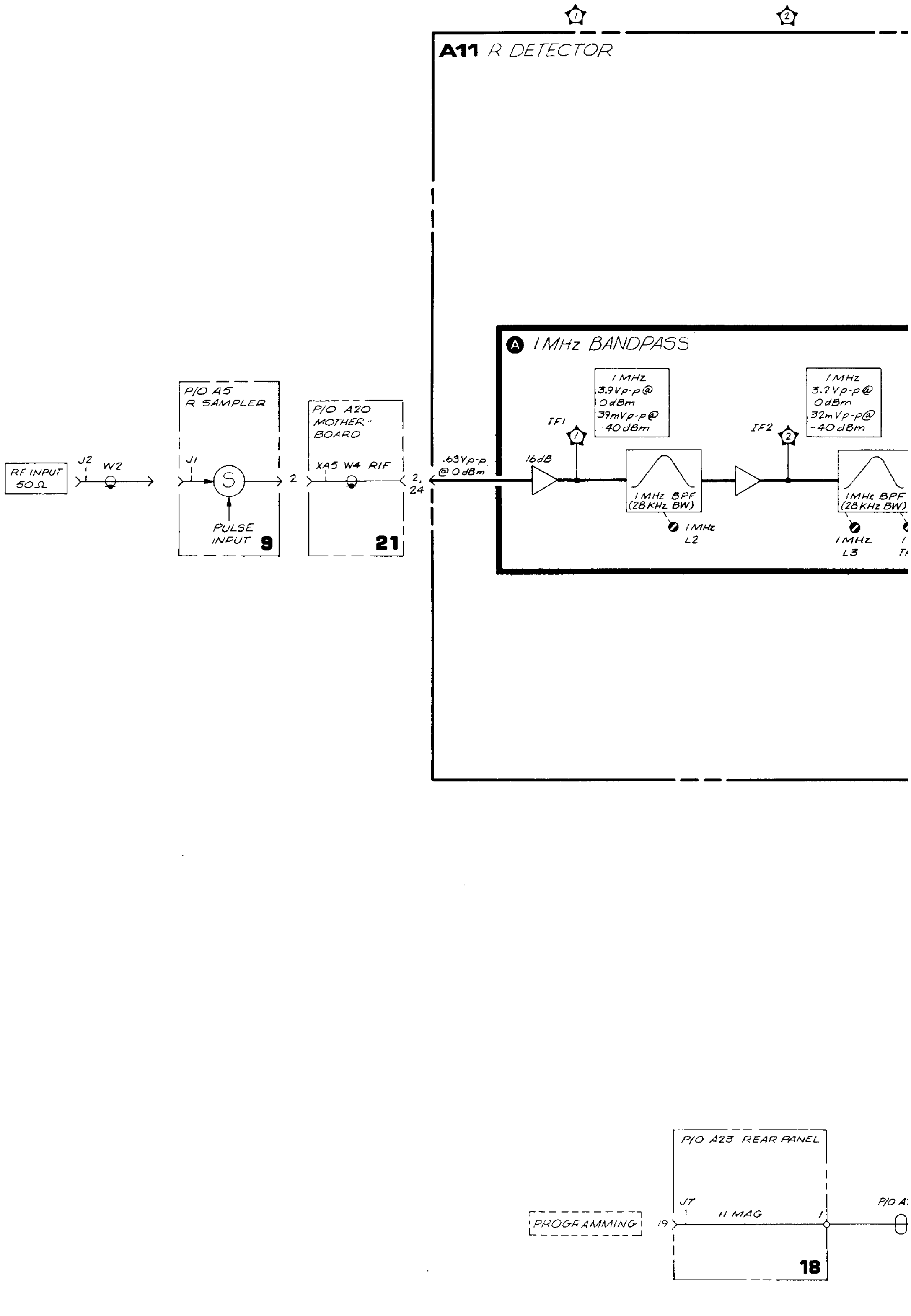
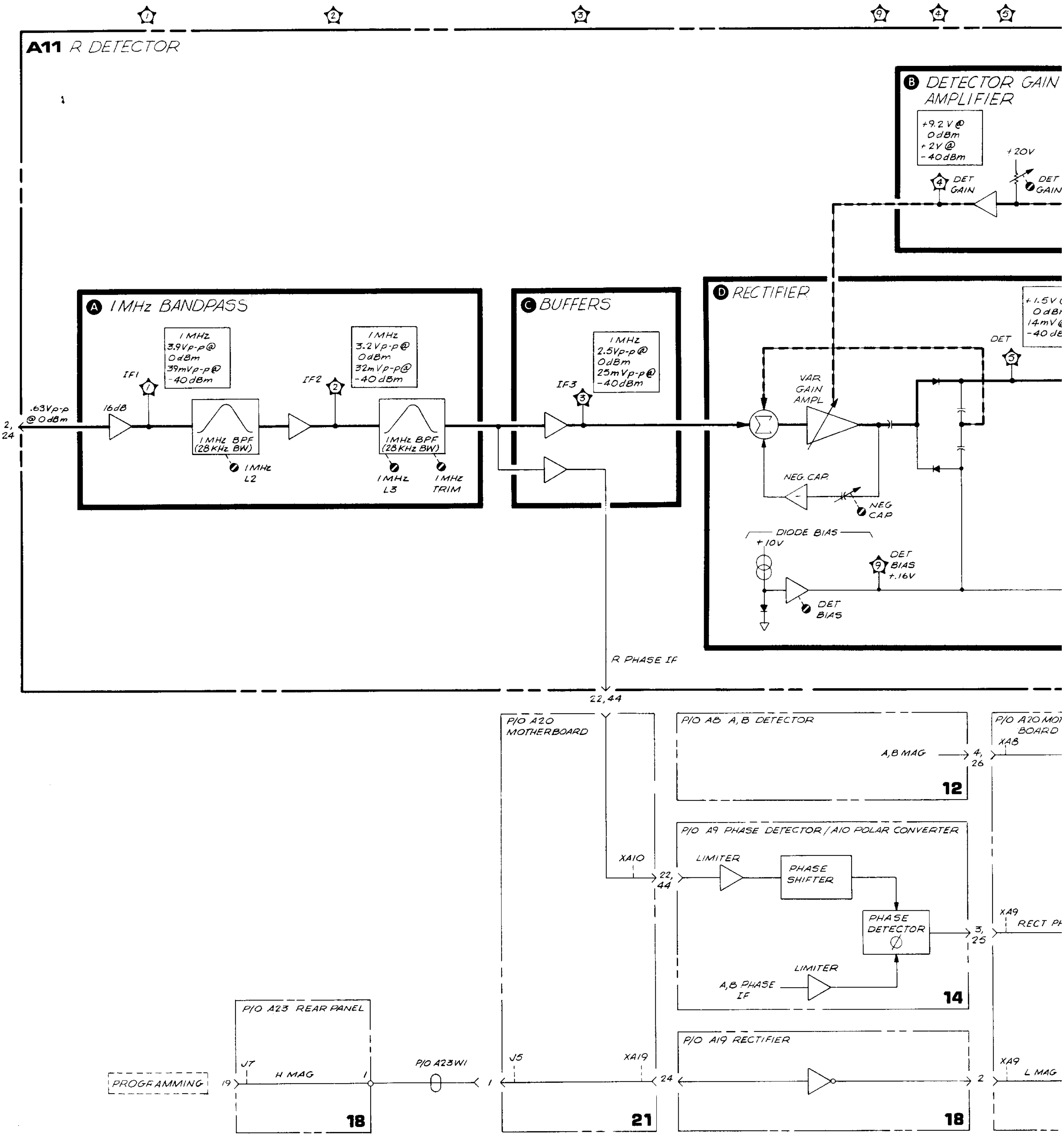
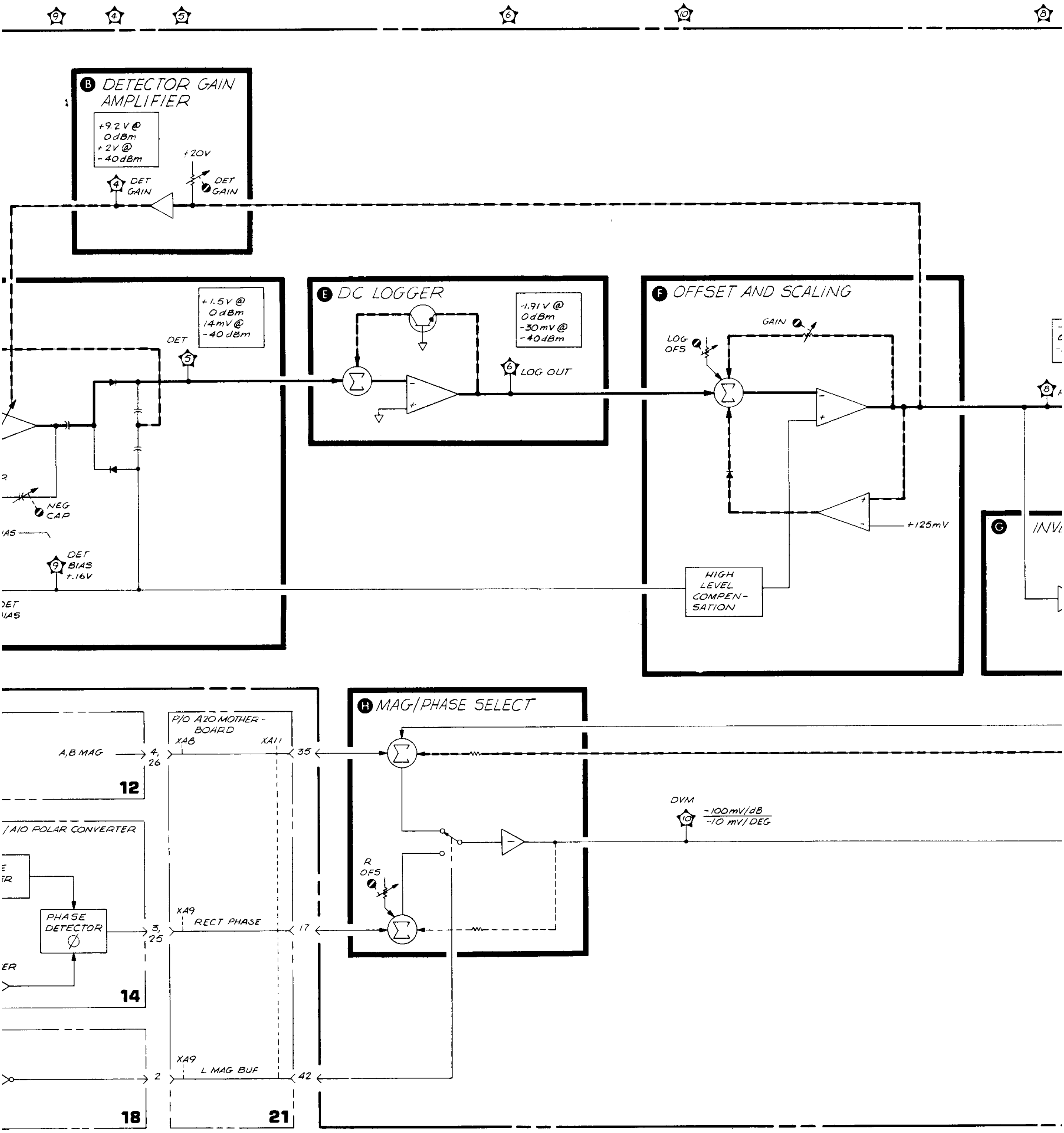


Figure 8-76. R Detector (A11), Component Locations

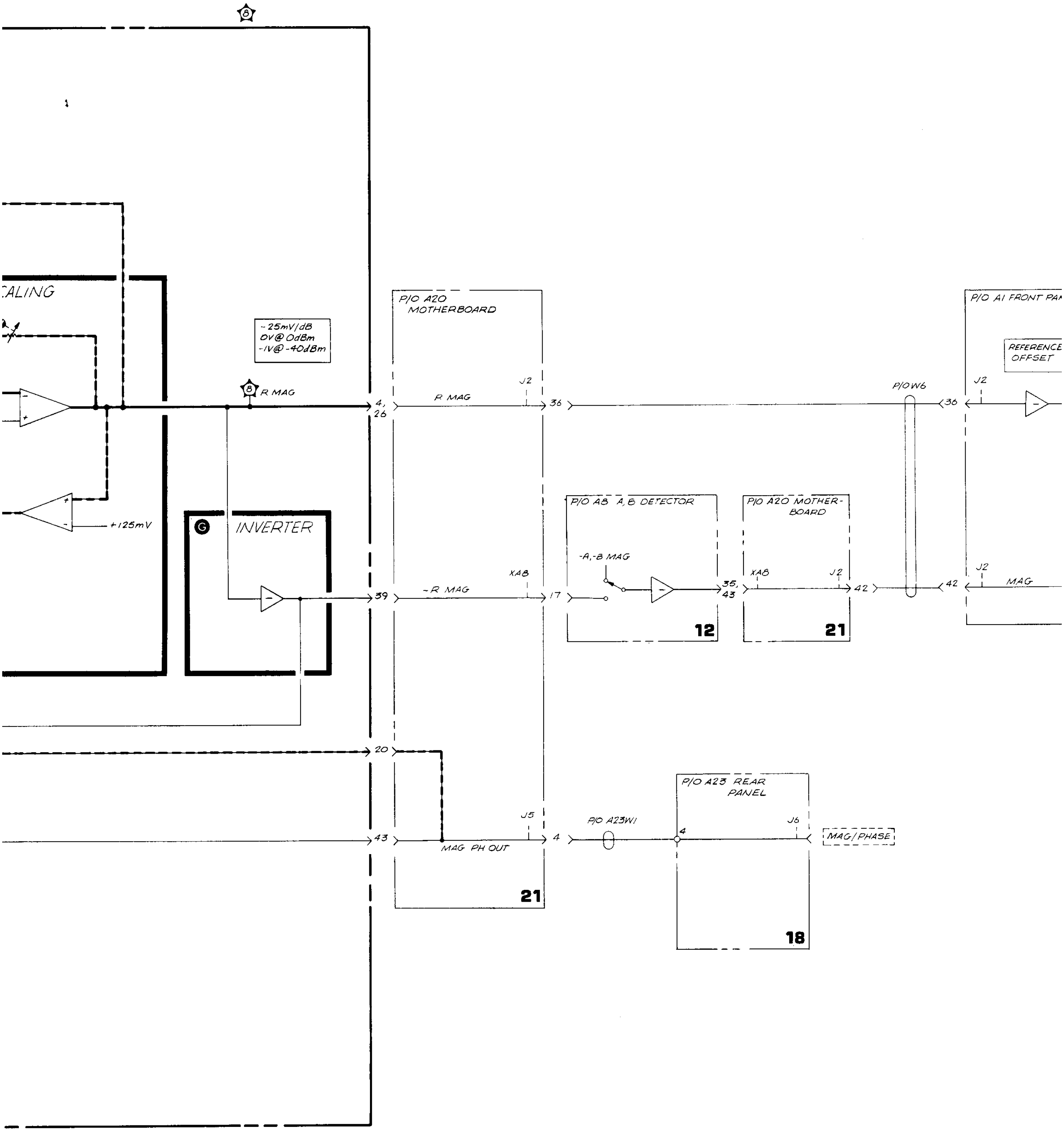

A11 R DETECTOR
A 1MHz BANDPASS
RF INPUT 50Ω
J2
W2
P/O A5 R SAMPLER
J1
S
PULSE INPUT
9
2
P/O A20 MOTHER-BOARD
XA5 W4 RIF
21
2, 24
.63Vp-p @ 0dBm
IF1
16dB
1MHz 3.9Vp-p@ 0dBm 39mVp-p@ -40dBm
1MHz BPF (28KHz BW)
1MHz L2
IF2
1MHz 3.2Vp-p@ 0dBm 32mVp-p@ -40dBm
1MHz BPF (28KHz BW)
1MHz L3
P/O A23 REAR PANEL
J7
H MAG
PROGRAMMING
19
1
18



A11 R DETECTOR
A 1MHz BANDPASS
1MHz 3.9Vp-p@ 0dBm 39mVp-p@ -40dBm
1MHz 3.2Vp-p@ 0dBm 32mVp-p@ -40dBm
IF1
IF2
16dB
.63Vp-p @0dBm
2, 24
1MHz BPF (28KHz BW)
1MHz L2
1MHz L3
1MHz TRIM
C BUFFERS
1MHz 2.5Vp-p@ 0dBm 25mVp-p@ -40dBm
IF3
B DETECTOR GAIN AMPLIFIER
+9.2V@ 0dBm +2V@ -40dBm
+20V
DET GAIN
D RECTIFIER
VAR GAIN AMPL
NEG. CAP.
NEG CAP
DET
DIODE BIAS
+10V
DET BIAS +.16V
DET BIAS
R PHASE IF
22,44
P/O A20 MOTHERBOARD
P/O A8 A,B DETECTOR
A,B MAG
4, 26
12
XA8
P/O A9 PHASE DETECTOR / A10 POLAR CONVERTER
XA10
22, 44
LIMITER
PHASE SHIFTER
PHASE DETECTOR
3, 25
XA9
RECT PH
A,B PHASE IF
14
P/O A23 REAR PANEL
J7
H MAG
PROGRAMMING
19
18
P/O A23W1
J5
XA19
24
21
P/O A19 RECTIFIER
2
XA9
L MAG
18



B DETECTOR GAIN AMPLIFIER
+9.2 V @ 0 dBm
+2 V @ -40 dBm
+20V
DET GAIN
DET GAIN
DET
+1.5 V @ 0 dBm
14 mV @ -40 dBm
NEG CAP
DET BIAS +.16V
E DC LOGGER
-1.91 V @ 0 dBm
-30 mV @ -40 dBm
LOG OUT
F OFFSET AND SCALING
GAIN
LOG OFS
+125mV
HIGH LEVEL COMPEN-SATION
G INV
H MAG/PHASE SELECT
P/O A20 MOTHER-BOARD
XA8
XA11
A,B MAG
4, 26
35
12
/A10 POLAR CONVERTER
PHASE DETECTOR
XA9
RECT PHASE
3, 25
17
14
R OFS
DVM
-100 mV/dB
-10 mV/DEG
XA9
L MAG BUF
2
42
18
21



SCALING
INVERTER
-25mV/dB
0V@0dBm
-1V@-40dBm
R MAG
+125mV
P/O A20 MOTHERBOARD
J2
R MAG
-R MAG
XA8
J5
MAG PH OUT
21
P/O A8 A,B DETECTOR
-A,-B MAG
12
P/O A20 MOTHER-BOARD
XA8
J2
21
P/O W6
P/O A1 FRONT PA
REFERENCE OFFSET
J2
MAG
P/O A23W1
P/O A23 REAR PANEL
J6
MAG/PHASE
18

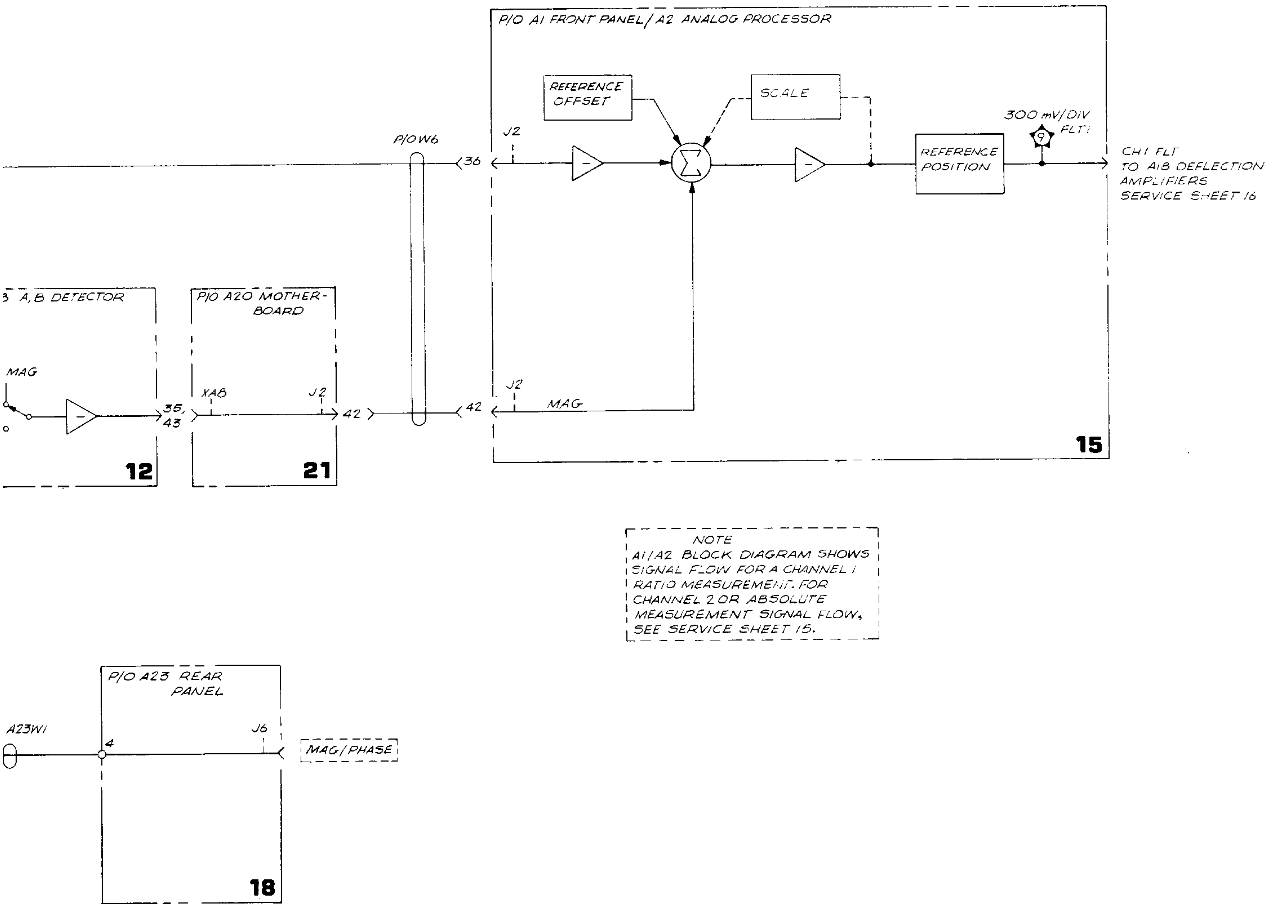


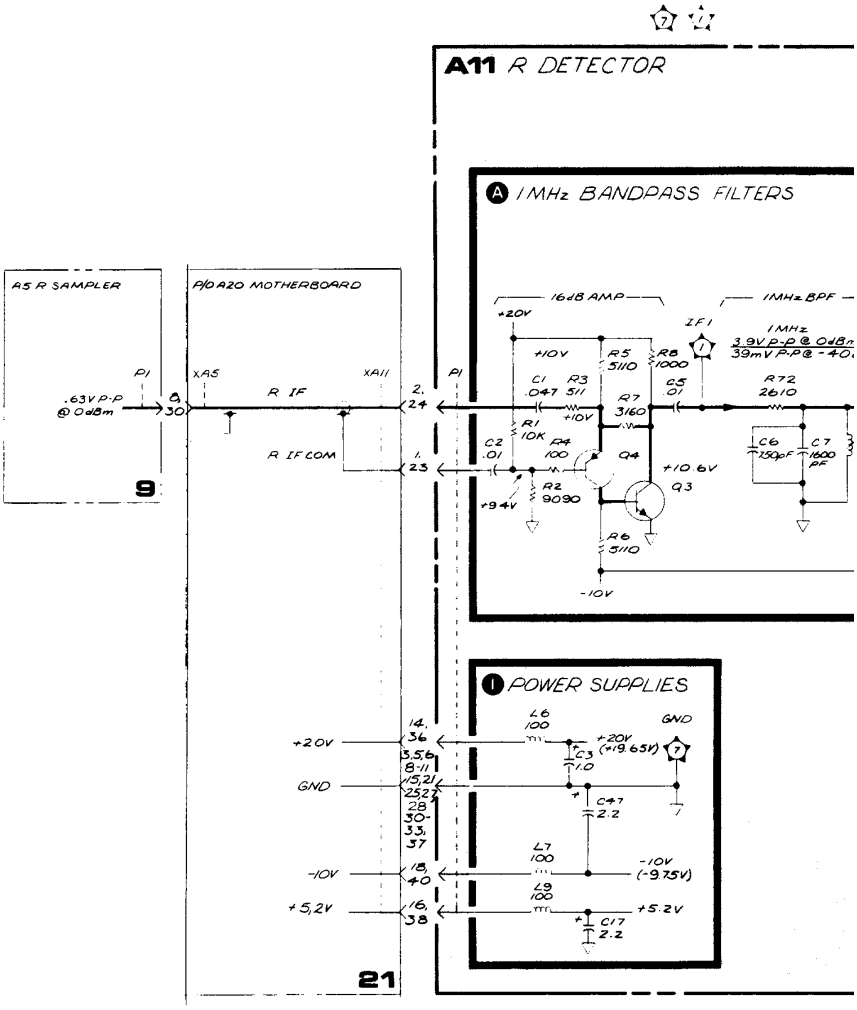
Figure 8-77. R Detector (A11), Block Diagram

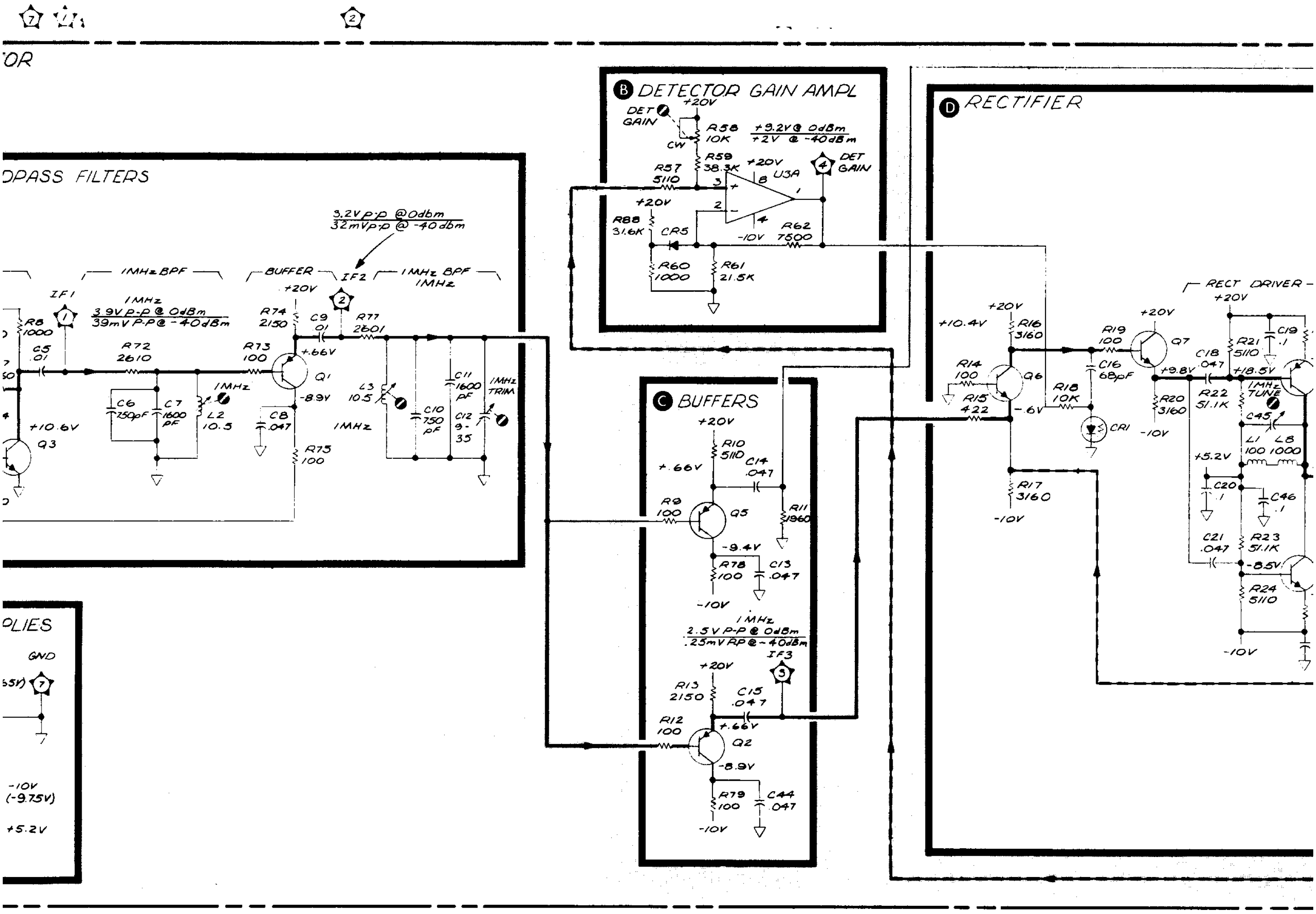
A11

P1

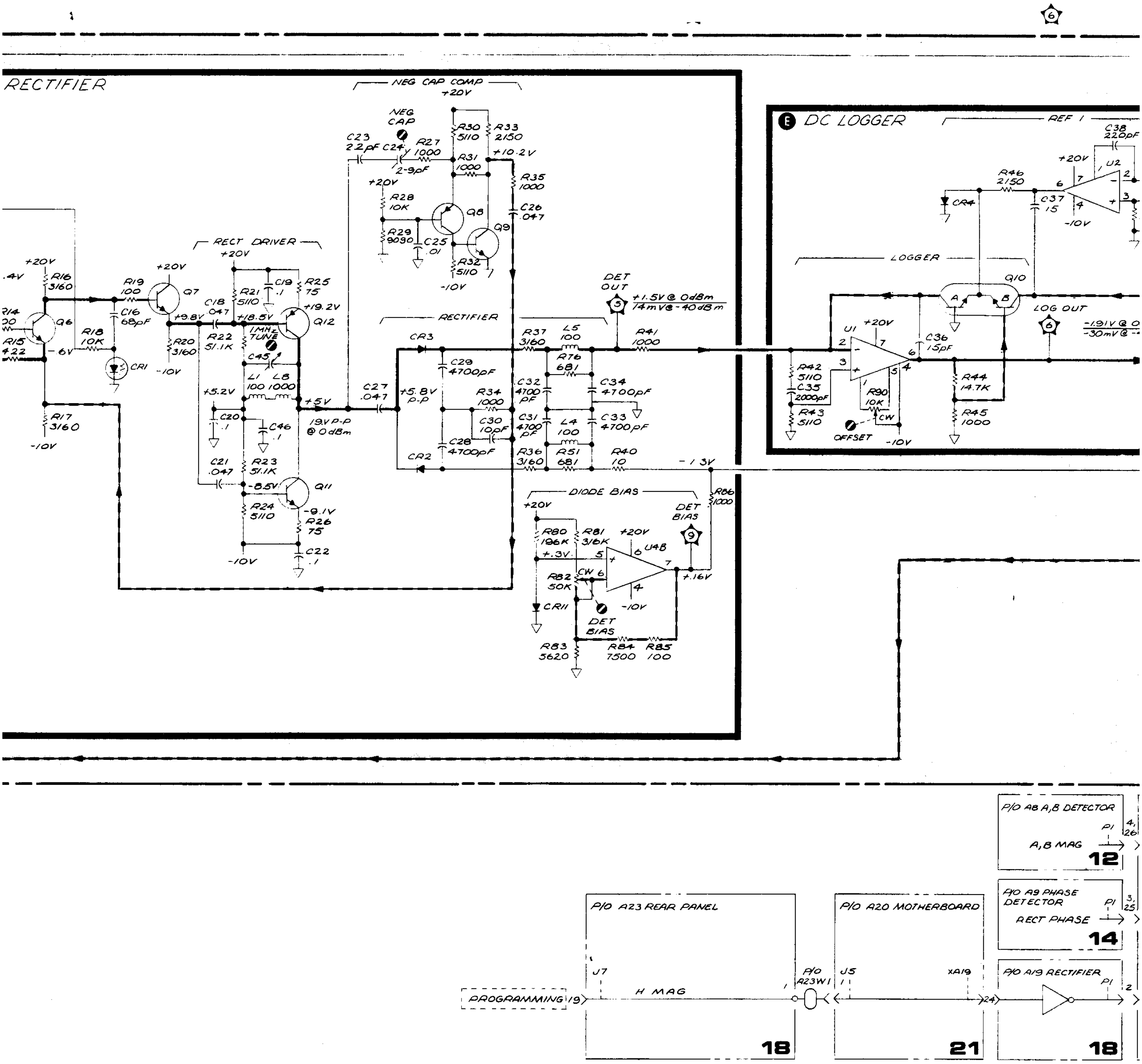
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1 23	R IF COM R IF COM	▽ ▽	A A
2 24	R IF R IF	A5P1-8,30 A5P1-8,30	A A
3 25	▽ ▽		I I
4 26	R MAG R MAG	A2J2-36 A2J2-36	G G
5 27	▽ ▽		I I
6 28	▽ ▽		I I
7 29		NO CONNECTION NO CONNECTION	
8 30	▽ ▽		A I A I
9 31		NO CONNECTION NO CONNECTION	
10 32		NO CONNECTION NO CONNECTION	
11 33	▽ ▽		I I
12 34		NO CONNECTION NO CONNECTION	
13 35	 A,B MAG	NO CONNECTION A8-4,26	 H
14 36	+20V +20V	A16-3,25 A16-3,25	I I
15 37	▽ ▽		I I
16 38	+5.2V +5.2V	U2 OUT U2 OUT	I I
17 39	RECT PHASE -R MAG	A9-3,25 A8P1-17	H G
18 40	-10V -10V	A16-9,31 A16-9,31	I I
19 41		NO CONNECTION NO CONNECTION	
20 42	MAG/PH-OUT MAG BUF	A20J5-4 A19-2	H H
21 43	▽ MAG/PH-OUT	 A20J5-4	I H
22 44	R PHASE IF R PHASE IF	A11-22-44 A11-22-44	C C

SERIAL PREFIX: 1825A DATE: MARCH 6, 1979

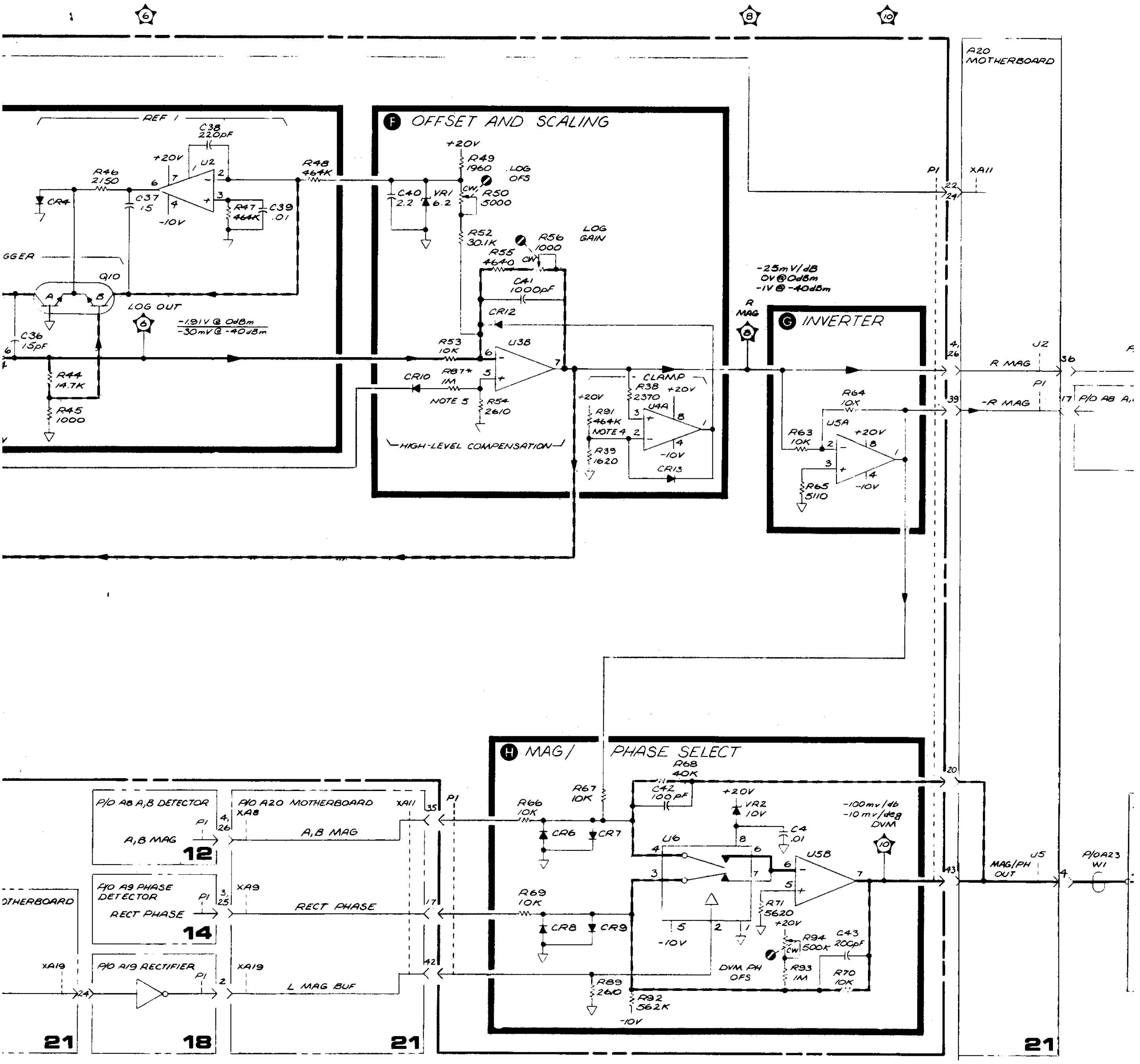




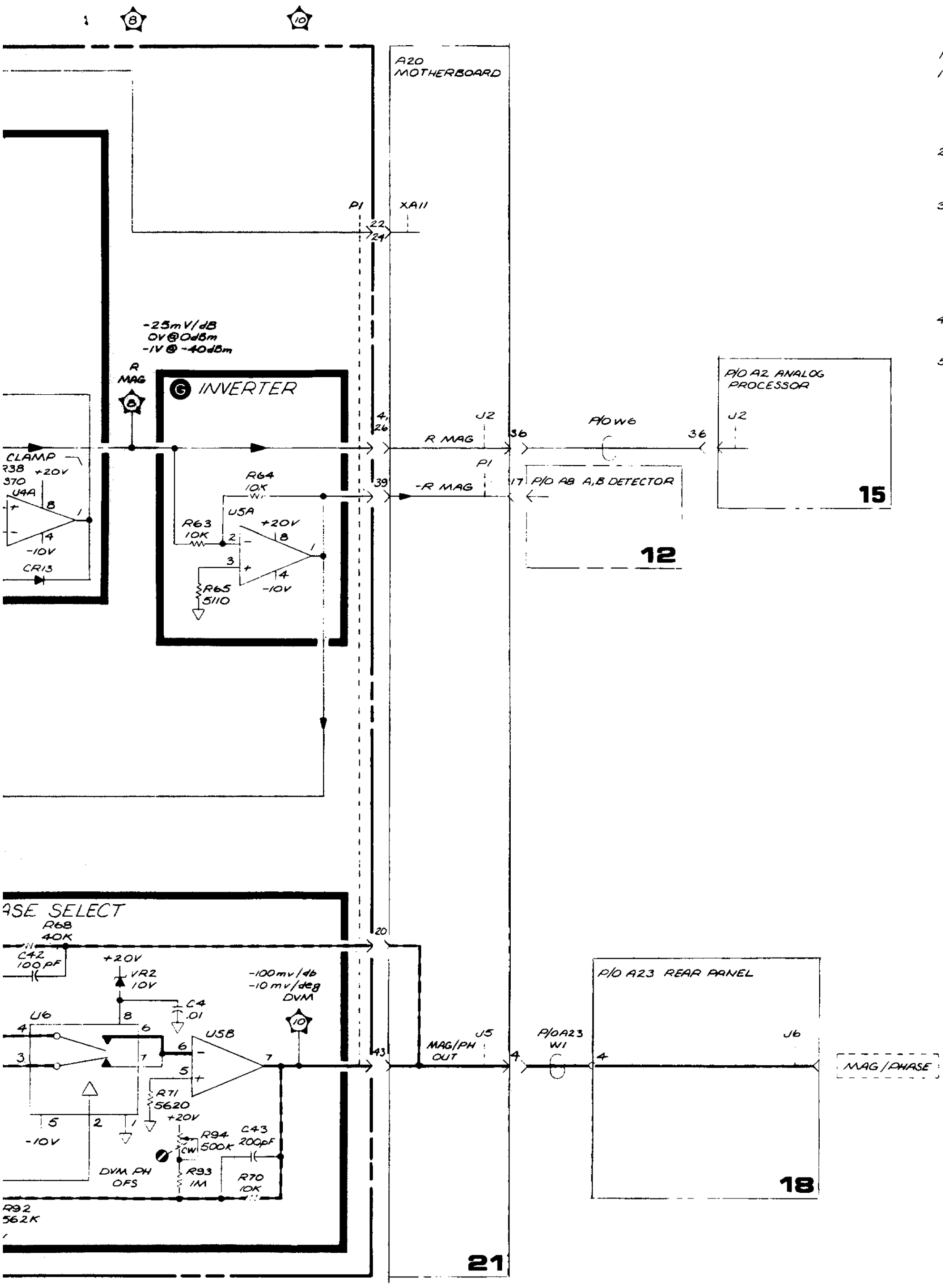
OR
OPASS FILTERS
B DETECTOR GAIN AMPL
DET GAIN
CW
R58 10K
R59 38.3K
R57 5110
+9.2V @ 0dBm
+2V @ -40dBm
U3A
DET GAIN
R88 31.6K
CR5
R62 7500
R60 1000
R61 21.5K
D RECTIFIER
3.2V p-p @ 0dbm
32mVp-p @ -40dbm
1MHz BPF
BUFFER
IF2
1MHz BPF
IF1
R8 1000
C5 .01
R72 2610
3.9V p-p @ 0dBm
39mV P-P @ -40dBm
R74 2150
C9 .01
R77 2601
R73 100
Q1
+.66V
-8.9V
C6 250pF
C7 1600 pF
L2 10.5
C8 .047
R75 100
L3 10.5
C10 750 pF
C11 1600 pF
C12 9-35
1MHz TRIM
+10.6V
Q3
C BUFFERS
R10 5110
C14 .047
R9 100
Q5
R11 1960
-9.4V
R78 100
C13 .047
2.5V P-P @ 0dBm
.25mV P-P @ -40dBm
IF3
R13 2150
C15 .047
R12 100
Q2
-8.9V
R79 100
C44 .047
PLIES
GND
-10V
(-9.75V)
+5.2V
+10.4V
R16 3160
R19 100
Q7
RECT DRIVER
R14 100
Q6
R15 422
R18 10K
C16 68pF
CR1
R17 3160
R20 3160
C18 .047
R21 5110
C19 .1
+9.8V
+18.5V
R22 51.1K
1MHz TUNE
C45
L1 100
L8 1000
C20 .1
C46 .1
C21 .047
R23 51.1K
-8.5V
R24 5110



RECTIFIER
NEG CAP COMP
+20V
NEG CAP
C23 2.2pF
C24 2-9pF
R27 1000
R30 5110
R33 2150
R31 1000
+10.2V
R35 1000
C26 .047
R28 10K
R29 9090
C25 .01
Q8
Q9
R32 5110
-10V
RECT DRIVER
+20V
R16 3160
R19 100
Q7
C16 68pF
Q6
R18 10K
-6V
CR1
R20 3160
+9.8V
C18 .047
R21 5110
C19 .1
R25 75
+18.5V
+19.2V
Q12
R22 51.1K
1MHz TUNE
C45
L1 100
L8 1000
+5.2V
C20 .1
C46 .1
+5V
19V P-P @ 0dBm
C21 .047
R23 51.1K
-8.5V
Q11
-9.1V
R24 5110
R26 75
C22 .1
R17 3160
RECTIFIER
CR3
C27 .047
+5.8V P-P
C29 4700pF
R34 1000
C30 10pF
C28 4700pF
CR2
R37 3160
L5 100
R76 681
C32 4700pF
C31 4700pF
L4 100
C34 4700pF
C33 4700pF
R36 3160
R51 681
R40 10
-1.3V
DET OUT
+1.5V @ 0dBm
14mV @ -40dBm
R41 1000
DIODE BIAS
R86 1000
+20V
R80 196K
R81 3.16K
+.3V
U4B
DET BIAS
R82 50K
CW
CR11
+.16V
R83 5620
R84 7500
R85 100
E DC LOGGER
REF 1
C38 220pF
R46 2150
CR4
C37 15
U2
-10V
LOGGER
Q10
LOG OUT
-1.91V @ 0
-30mV @
U1
+20V
C36 15pF
R42 5110
C35 2000pF
R43 5110
R90 10K
OFFSET
R44 14.7K
R45 1000
P/O A8 A,B DETECTOR
A,B MAG
12
P/O A9 PHASE DETECTOR
RECT PHASE
14
P/O A23 REAR PANEL
J7
H MAG
PROGRAMMING
18
P/O A23W1
P/O A20 MOTHERBOARD
J5
XA19
21
P/O A19 RECTIFIER
18



A20 MOTHERBOARD
REF 1
F OFFSET AND SCALING
LOG OFS
LOG GAIN
LOG OUT
-1.91V @ 0dBm
-30mV @ -40dBm
-25mV/dB
0V @ 0dBm
-1V @ -40dBm
R MAG
G INVERTER
CLAMP
HIGH-LEVEL COMPENSATION
NOTE 5
NOTE 4
R MAG
-R MAG
H MAG/PHASE SELECT
-100mv/db
-10mv/deg
DVM
DVM PH OFS
MAG/PH OUT
P/O A8 A,B DETECTOR
A,B MAG
12
P/O A20 MOTHERBOARD
P/O A9 PHASE DETECTOR
RECT PHASE
14
P/O A19 RECTIFIER
L MAG BUF
18
21
21
21
P/O A23 W1



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBERS FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS (Ω) CAPACITANCE IN MICROFARADS (μF) INDUCTANCE IN MICROHENRIES (μH)
3. UNLESS OTHERWISE NOTED, VOLTAGES. GIVEN ARE FOR A 0dBm (.632Vp-p) R IF INPUT TO A11 PIN 2 WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
   - SWEEP WIDTH MHz: 0(CW)
   - SWEEP MODE: CENTER
   - SWEEP: MAN
   - CHANNEL 1: A/R
   - CHANNEL 2: OFF
4. VOLTAGE AT JUNCTION OF A11R91 AND A11R39 IS +.06V WHEN THE CLAMP CIRCUIT IS TURNED ON.
5. R87 IS SELECTED TO OPTIMIZE 0dBm AMPLITUDE ACCURACY (COMPENSATES FOR Q10).

13
A11

Figure 8-78. R Detector (A11), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 14
PHASE DETECTOR (A9) AND POLAR CONVERTER (A10), CIRCUIT DESCRIPTION

General Description

The 8754A can display the phase difference between the B INPUT and the R INPUT in rectangular format (phase angle versus frequency), or the phase and magnitude differences of the A INPUT and R INPUT in a polar format (phase angle and amplitude as a vector). The Phase Detector (A9) and Polar Converter (A10) work together to provide the dc outputs necessary for a rectangular phase display or a polar display.

The circuitry used to provide the rectangular phase and polar outputs is mixed between the two board assemblies (A9 and A10). Figure 8-79 is a simplified block diagram that shows how the rectangular phase (RECT PHASE) and polar (POLAR X and POLAR Y) outputs are developed.

The A,B PHASE IF and R PHASE IF inputs are amplified and limited to provide square wave signals (LIM A,B IF and LIM R PHASE IF) that are phase related to the IF inputs. The fast rise time of the square wave signals provides an accurate trigger point when making phase comparisons.

The Variable Phase Shifter provides phase offset control from the front-panel, and applies this offset to the R Phase IF. This provides a calibrated phase offset and electrical length compensation when making a phase measurement. The Variable Phase Shifter provides an offset R IF (R RECT PHASE) to the Rectangular Phase Detector for the PHASE B/R measurement, and also supplies the Cosine R IF and Sine R IF outputs to the X and Y Multipliers for the POLAR A/R measurement.

The Rectangular Phase Detector compares the offset R RECT PHASE with the B PHASE IF and produces a dc output (RECT PHASE) that is proportional to the phase difference between the B INPUT and the R INPUT plus front-panel offsets. This output is displayed only when PHASE B/R is selected on the front panel.

For a polar display, the 8754A displays a polar plot of the relative magnitude and phase of the A and R input signals. Instead of displaying magnitude, or phase, versus frequency, the polar display represents magnitude versus phase, where magnitude is the radial distance (M) from the center of the display and phase is the angular rotation (θ) from the horizontal zero degree axis. The magnitude and phase of the polar signal must be resolved into X (horizontal) and Y (vertical) components as shown in Figure 8-80. These X and Y signals are applied to the horizontal and vertical deflection plates producing a dot on the CRT representing the arrowhead of the vector.

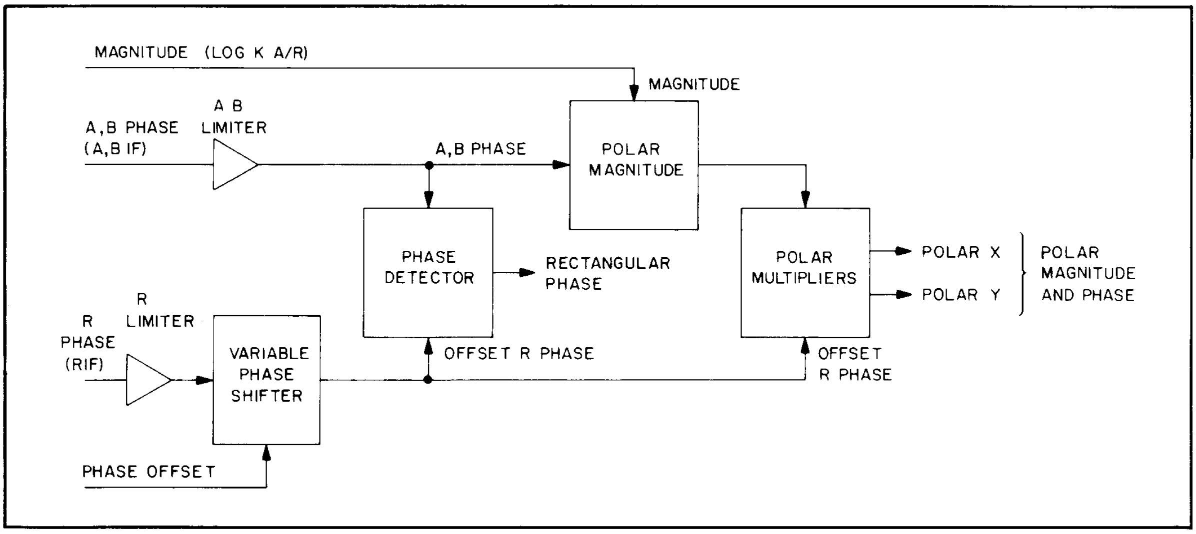


Figure 8-79. Phase Detector (A9) and Polar Converter (A10), Simplified Block Diagram

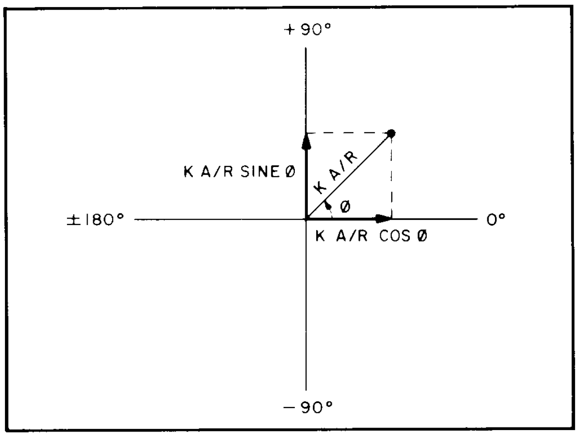


Figure 8-80. Polar Display

Magnitude information for the polar vector is supplied by the Analog Processor (A2, Service Sheet 15) and is used to amplitude modulate the A Phase IF to produce a 1 MHz output that is phase related to the A INPUT, and has an amplitude proportional to the magnitude difference of the A INPUT and R INPUT. This amplitude modulated signal is applied to both the X and Y Multipliers where it is mixed with Cosine R IF to produce the POLAR X output, and mixed with the Sine R IF to produce the POLAR Y output.

The Variable Phase Shifter supplies two pairs of differential signals that are separated by 90 degrees (Sine R IF, and Cosine R IF). Since the Cosine of an angle is equal to the Sine of the angle plus 90 degrees (Cos θ = Sin θ + 90°), the Y Multiplier becomes a Sine detector and the X Multiplier a Cosine detector. The KA/R∠A signal is common to both multipliers, therefore, the output of the Y Multiplier (POLAR Y) is KA/R Sine θ and the X Multiplier output (POLAR X) is KA/R Cos θ (where θ is the phase difference between the R IF and A,B IF inputs, and K is the Channel 1 offset). The polar outputs are used only for a POLAR A/R measurement.

R Limiter (E) (P/O A10)

The R Limiter circuit provides the necessary gain, limiting, and filtering of the R PHASE IF signal from the R Magnitude Detector (A11, Service Sheet 13) – over the R Channel RF input range of 0 to −40 dBm – to drive the Variable Phase Shifter. The R limiter consists of two basic stages, a Tuned Amplifier and a Limiter.

The Tuned Amplifier is a transistor array connected as a differential amplifier (U18A and U18B) with a 2 mA current source (U18E) in the emitter circuit and two emitter-followers (U18C and U18D) to buffer the tuned collector circuit. L13 and C30 tune the stage to 1 MHz, and R72 sets the bandwidth at 300 kHz. The gain of the stage is 6 dB.

The Limiter consists of three ECL line receivers (U17A, U17B, and U17C) connected differentially. The inputs to the first stage, U17B, are biased at about +3.75V via R88 and R34 from the internal bias supply (pin 11). The output of each line receiver is approximately 0.8V peak-to-peak centered around the bias voltage of +3.75V. Symmetry of the output waveform is set by R BAL potentiometer R30. Negative feedback is used to maintain symmetry, which is averaged by R27 and C52 and summed with the fixed bias voltage at the inverting input to the first stage. The gain of the limiter is about 40 dB.

A,B Limiter (A) (P/O A9)

The A,B Limiter circuit provides the necessary gain, limiting, and filtering of the A,B PHASE IF signal from the A,B Magnitude Detector (A8, Service Sheet 12) – over the A or B channel RF input range of 0 to −80 dBm – to drive the Digital Phase detector in the Rectangular Phase Detector circuit and the modulator in the Polar Converter.

The Tuned amplifier and First Limiter are identical to the corresponding circuits in the R limiter. The additional circuits are a 1 MHz Bandpass Filter with a bandwidth of 200 kHz, a Second Limiter, and a Schmitt Trigger Amplifier.

The 1 MHz Bandpass Filter (L13, C20, and C25) removes the broadband noise component of the preceding limiting stage. The Second Limiter adds 26 dB of limiting, after which the limited signal is used by the Polar Converter for the A INPUT phase information. A Schmitt Trigger with 0.25 mV hysteresis is used to insure fast transition (approximately 3 ns rise and fall times) to clock the Digital Phase Detector.

VARIABLE PHASE SHIFTER (C) (D) (F) (G)

Figure 8-81 is a simplified block diagram of the Variable Shifter. The Variable Phase Shifter produces two differential pairs of 1 MHz output signals (Cosine R IF, and Sine R IF) that are

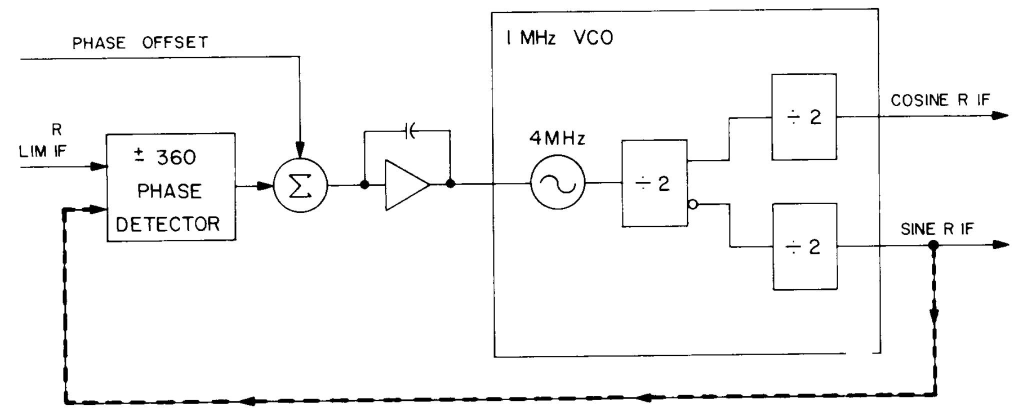


Figure 8-81. Variable Phase Shifter, Simplified Block Diagram

related to both the R LIM (Limiter R IF) signal and the PHASE OFFSET voltage inputs. The Cosine R IF output is referenced to the R LIM IF plus front-panel offset (PHASE OFFSET). The Sine R IF output is displaced 90 degrees from the Cosine R IF output. The ±360 Phase Detector compares the phase difference between the reference signal (R LIM IF) and the 1 MHz output from the Voltage-Controlled Oscillator (VCO) to generate an error voltage of −4.3 mV/degree. This error voltage is summed with the PHASE OFFSET voltage from the Analog Processor (A2, Service Sheet 15) to generate the tune voltage that phase locks the VCO.

The Sine R IF (−90 degree) signal is used to phase lock the VCO. This offsets the ±360 Degree Phase Detector by −90 degrees. An additional −45 degree offset is supplied by an adjustable dc offset which is summed with the PHASE OFFSET voltage, to give an actual range of −225 degrees to +495 degrees. This allows the Variable Phase Shifter to cover the ±220 degree range of the front-panel REFERENCE switch and OFFSET vernier plus the +250 degree range of LENGTH compensation (for a total required range of +470 to −220 degrees). PHASE OFFSET potentiometer R15 is adjusted for an accurate IF phase signal (R RECT PHASE) to the Rectangular Phase Detector.

Phase Offset Summing C (P/O A10)

The Phase Offset circuit is the controlling element in the VCO phase lock loop of the Variable Phase Shifter. Included in the circuit are an integrator and a test switch to aid in troubleshooting the phase lock loop.

The purpose of the Phase Offset Summing circuit is to control the difference between the phase of the signal from the 1 MHz VCO and the phase of R LIM so that the phase difference is equal to the value set by the PHASE OFFSET voltage from the Analog Processor (A2, Service Sheet 15). This is accomplished by summing the PHASE OFFSET voltage with the negative-feedback voltage from the ±360 Phase Detector (TP6). The difference is amplified by integrator U9. The output is a correction voltage which is used to tune the 1 MHz VCO to correct for any phase difference.

TEST/INTEG Switch. An aid to diagnosis of a defective phase lock loop is the TEST/INTEG switch S1. When the switch is in TEST, the oscillator tuning comes from TUNE potentiometer R20, so the oscillator can be manually tuned. Simultaneously, the switch bypasses C16 and converts the Integrator to an inverting amplifier.

When S1 is in TEST, the TUNE pot can manually vary the tuning voltage from +4V to +16V, which corresponds to 3.8 MHz to 4.2 MHz at the output of the VCO, U6, or 0.95 MHz to 1.05 MHz at TP4. The mean tuning voltage is approximately +10V. The only requirements for proper operation are that the frequency at TP4 can be tuned to 1.000±0.002 MHz and varied by 100 kHz.

Troubleshooting Note: Basic operation of the Variable Phase Shifter can be checked by setting the TEST/INTEG switch to the TEST position, and tuning the VCO and Phase Shifter with TUNE potentiometer R20. If the 8754A is phase locked (R INPUT connected and front-panel UNLOCKED indicator off), and MAN SWEEP is selected, the ±360 Degree Phase Detector output at TP6 should be a ramp whose slope and period is adjusted by the TUNE potentiometer. If the TUNE potentiometer is adjusted for a VCO and Phase Shifter output at TP4 of less than 1 MHz, the ±360 Phase Detector output at TP6 should be a negative ramp of approximately 0V to −1.4V with an adjustable time period and slope. If the TUNE potentiometer is adjusted for a frequency greater than 1 MHz at TP4, the signal at TP6 should be a positive ramp of approximately 0V to +1.4V amplitude with an adjustable time period and slope.

Search Ⓓ (P/O A10)

When phase lock is lost, the voltage-tuned oscillator (U6) in the 4 MHz VCO circuit must be tuned through 4 MHz (1 MHz after the frequency is divided) to reacquire lock. The need for this is determined by detecting when the VTUNE voltage is out of the range +4V to +16V. This is accomplished by two Limit Detectors, the comparators U11A and U11B. When VTUNE is out of range, a correction current is added to the summing junction to cause the VTUNE to slew towards the other limit. When the loop is locked (VTUNE between +4V and +16V), the output of comparator U11B is high, reverse biasing CR2, and U11A is low, reverse biasing CR1. Thus, the Search circuit is essentially disconnected from the summing junction.

If the VTUNE voltage should exceed its upper limit of +16V, a correction current is generated when comparator U11A goes high, charging C18 through CR1. This causes a current to flow through R16 to the summing junction, forcing VTUNE to decrease.

If VTUNE is too low, a correction current is generated when comparator U11B goes low, charging C18 through CR2. This causes current to flow through R16, forcing VTUNE to increase.

Voltage-Controlled Oscillator (VCO) and Phase Shifter Ⓕ (P/O A10)

The Voltage-Controlled Oscillator (VCO) and Phase Shifter circuit generates two differential 1 MHz signals which are displaced 90 degrees in phase. The frequency and phase of the signals are controlled by the VTUNE voltage of +4V to +16V for a tuning range of ±200 kHz.

The VCO and Phase Shifter circuit consists of a varactor-tuned, emitter-coupled oscillator U6, whose frequency is 4 MHz, and a 90 degree digital phase shifter made up of three ECL D flip-flops: U5B, U8A, and U8B.

The 4 MHz oscillator consists of emitter-coupled oscillator U6, which is tuned by the 4 MHz parallel resonant combination of L12, C43, and varactor diode CR5. The series combination of L14 and C39 (also resonant at 4 MHz) completes the parallel connection of CR5 across C43. The VCO internal bias voltage is at U6 pin 10, and C53 is a bypass capacitor. C51 bypasses the internal AGC circuitry to ground. The output of the oscillator at U6 pin 3 is 3.8 MHz to 4.2 MHz and 0.8V peak-to-peak.

The 90 Degree Digital Phase Shifter converts the 4 MHz output of U6 to two differential 1 MHz outputs which are displaced 90 degrees in phase (see timing diagram in Figure 8-82). The 4 MHz from U6 pin 3 is divided by 2 through ECL flip-flop U5B, providing complementary 2 MHz outputs at U5B pins 14 and 15. These outputs are divided by 2 through ECL flip-flops U8A and U8B to provide complementary 1 MHz signals (180 degrees out of phase) at U8A pins 2 and 3, and also at U8B pins 14 and 15. The non-inverted outputs of the two flip-flops are 90 degrees out of phase, and the inverted outputs are 90 degrees out of phase. For simplicity, the outputs of the 1 MHz VCO circuit are regarded as two 1 MHz signals displaced 90 degrees in phase.

The inverted output at U5B pin 14 is fed back to the D input, pin 10, so that the flip-flop toggles each time the clock input transitions from low to high. The two outputs of U5B in turn clock the flip-flops U8A and U8B. Since the clock pulses

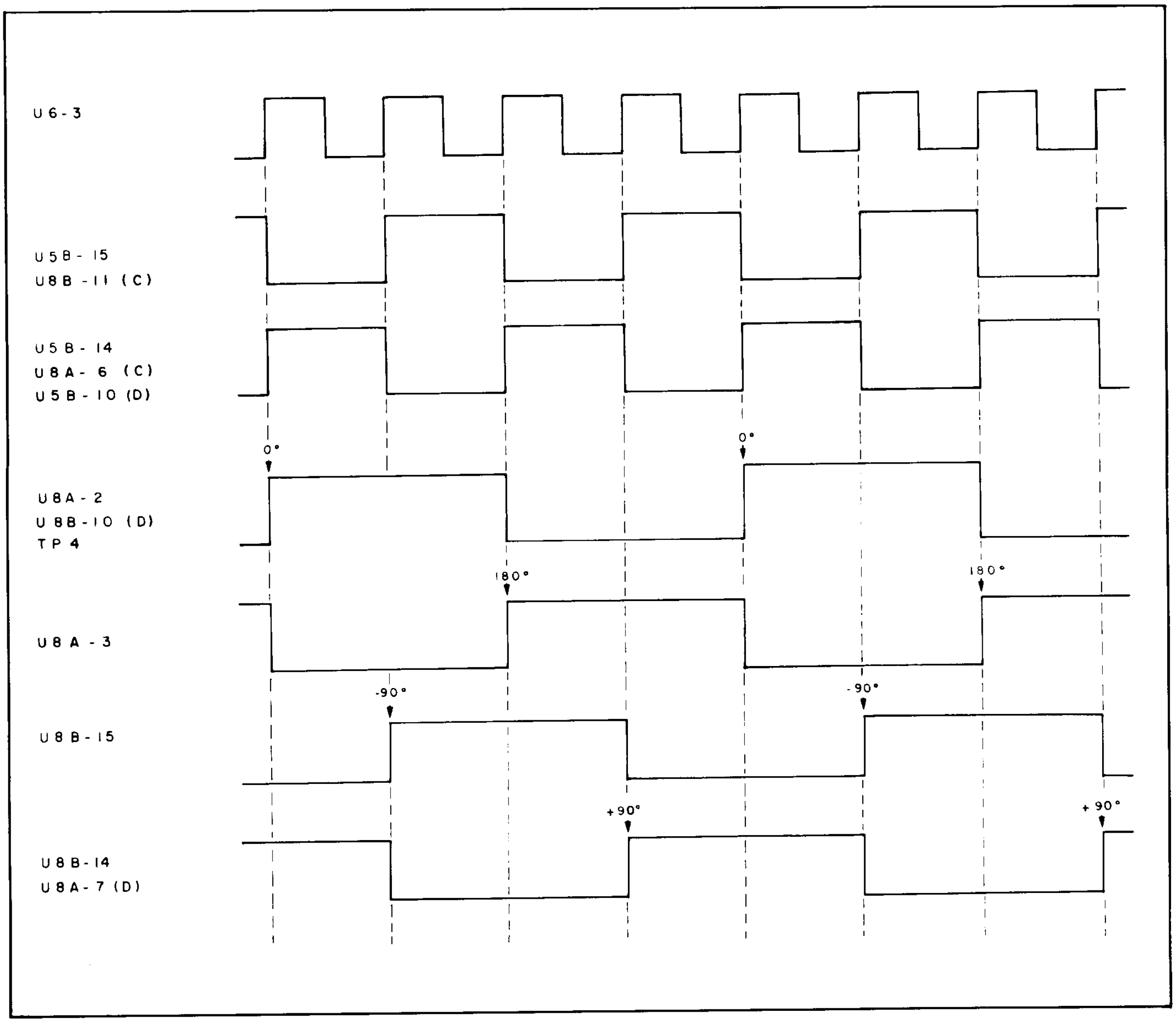


Figure 8-82. 90-Degree Digital Phase Shifter, Timing Diagram

for U8A and U8B are 180 degrees apart at 2 MHz, the outputs of the two flip-flops are 90 degrees apart at 1 MHz. The cross-coupling of U8A and U8B ensures that the U8A output leads the U8B output.

The Digital Phase Shifter has two differential pairs of 1 MHz outputs, Sine R IF and Cosine R IF. Their phase relationships to the R LIM IF input (with no PHASE OFFSET) and signal distribution is as follows:

Cosine R IF:

0 degrees – From U8A pin 2 to the X Multiplier circuit of the Polar Converter. As R RECT PHASE, the signal also goes to the

180 degrees – From U8A pin 3 to the X Multiplier on the Polar Converter. The two 1 MHz inputs to the X Multiplier are 180 degrees out of phase.

Sine R IF:

–90 degrees – From U8B pin 15 to the Y Multiplier on the Polar Converter. Also used as feedback to the ±360 Degree Phase Detector.

Rectangular Phase Detector circuit on the Phase Detector.

+90 degrees – From U8B pin 14 to the Y Multiplier circuit on the Polar Converter. The two 1 MHz inputs to the Y Multiplier are 180 degrees out of phase.

± 360 Degree Phase Detector (G) (P/O A10)

The ±360 Degree Phase Detector circuit generates an output voltage at TP6 that is proportional to the phase difference between R LIM and the −90 degree output (from U8B pin 15) of the 1 MHz VCO. The phase information in the following discussion is given relative to R LIM. The range of the ±360 Degree Phase Detector is ±360 degrees corresponding to ±1.55V output voltage at TP6.

The ±360 Degree Phase Detector circuit consists essentially of a Digital Phase Detector, two Pulse Width Modulators, and a Current-to-Voltage Converter.

Digital Phase Detector. The Digital Phase Detector, U14A and U14B, has two outputs. The output at U14A pin 2 (TP10) is active for leading phase, and the output at U14B pin 15 (TP11) is active for lagging phase. The pulse width of the appropriate output is proportional to the difference in phase between the two signals. U14A ad U14B are ECL D flip-flops whose D inputs are tied high, so that when the clock input of either flip-flop transitions from low to high, the active high output of that flip-flop is set high. Feedback through NOR gate U12 resets the flip-flops when the active high outputs are both set high.

Pulse Width Modulators. There are two Pulse Width Modulators, one for the leading phase and one for the lagging phase. The output of each flip-flop, U14A and U14B, differentially drives one of the Pulse Width Modulators, which generates an average current proportional to the variable phase width from the flip-flop.

The Pulse Width Modulator for the leading phase is described. A simplified schematic is shown in Figure 8-83. The Pulse Width Modulator consists of a fixed current source (U15A, Q3, VR1) and a differential Current Switch (Q1A, Q2)

A constant current of 3.1 mA from the drain of Q3 is generated when U15A controlss the conduction of Q3 so as to maintain a fixed voltage drop across R2. This voltage is equal to the reference voltage of +6.2V.

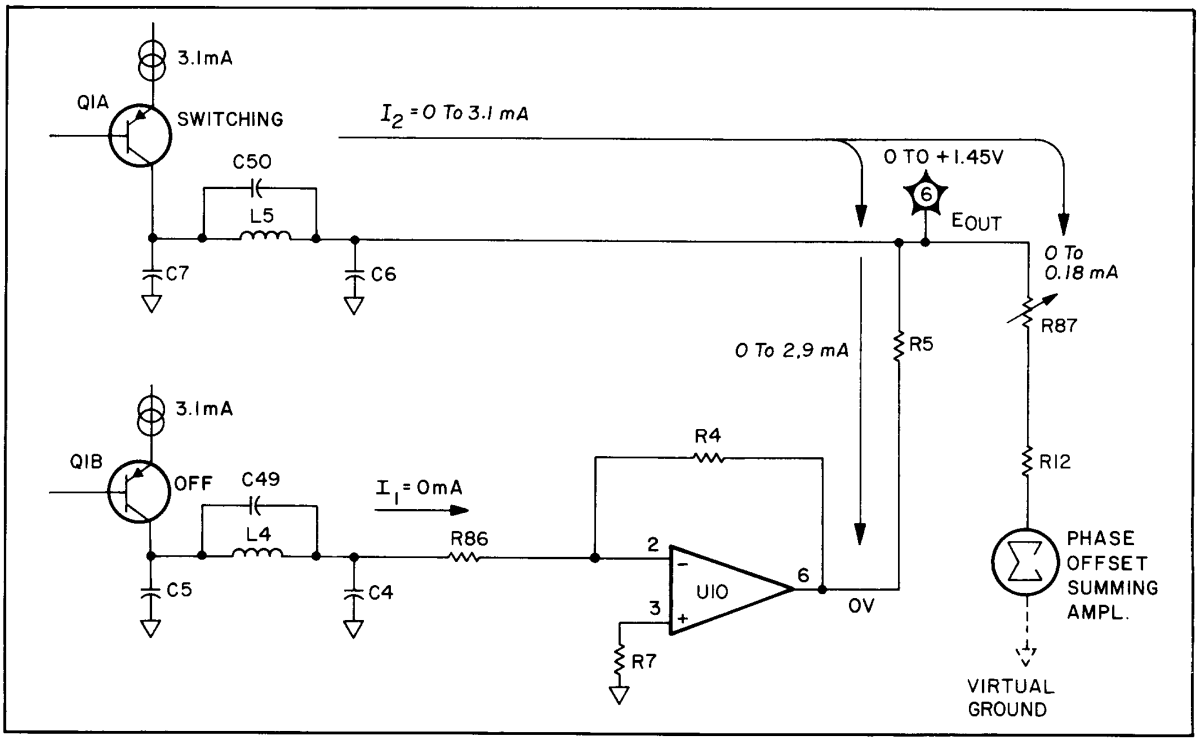


Figure 8-83. Pulse Width Modulator for Leading Phase, Simplified Schematic

The differential Current Switch directs the control current either to ground via Q2 and R9 when U14A is reset or to the output circuit via Q1A when U14A is set. The average current is then equal to the ratio of the set time to the total (set plus reset) time multiplied by the value of the current from the current source. Therefore, the magnitude of the output current (I_2) can vary from 0 (when set time is zero) to +3.1 mA (when reset time is zero).

The Pulse Width Modulator for the lagging phase (Figure 8-84) is the same as that for the leading phase. It shares the same reference voltage and also produces an output current (I_1) of 0 to +3.1 mA.

The fundamental frequency component (1 MHz pulse rate) of the currents I_1 and I_2 is filtered out by their respective 1 MHz Notch Filters and then converted to a voltage.

Current-to-Voltage Converter. To understand the current-to voltage conversion, it is helpful to remember that for any given phase relationship, only one of the output currents exists; that is, I_1 for the lagging phase and I_2 for the leading phase.

Consider first the conversion of I_1 (lagging phase) to E_{out}. The current I_1 into the inverting input of operational amplifier U10 must be opposed by the current through R4 from the output (pin 6). The output voltage is then equal to the value I_1 times the resistance of R4. When the input signal from the VCO is lagging almost 360 degrees, Q1B of the Current Switch is on nearly 100 percent and I_1 is about +3.1 mA. Since the value of R4 is 500 ohms, the output of U10 is −1.55V. This voltage is coupled to the Phase Offset Summing Amplifier through R5, with scaling by PHASE CAL potentiometer R87 and R12. Because of the voltage drop across R5, the voltage at TP6 ranges from 0 to −1.45V, which is equal to a current of 0.5 μA/degree from the summing junction U9 pin 2.

The circuitry associated with I_2 is effectively out of the circuit for dc signals, since the Current Switch Q1A is off when the input phase is lagging. When the input phase leads, the lagging phase

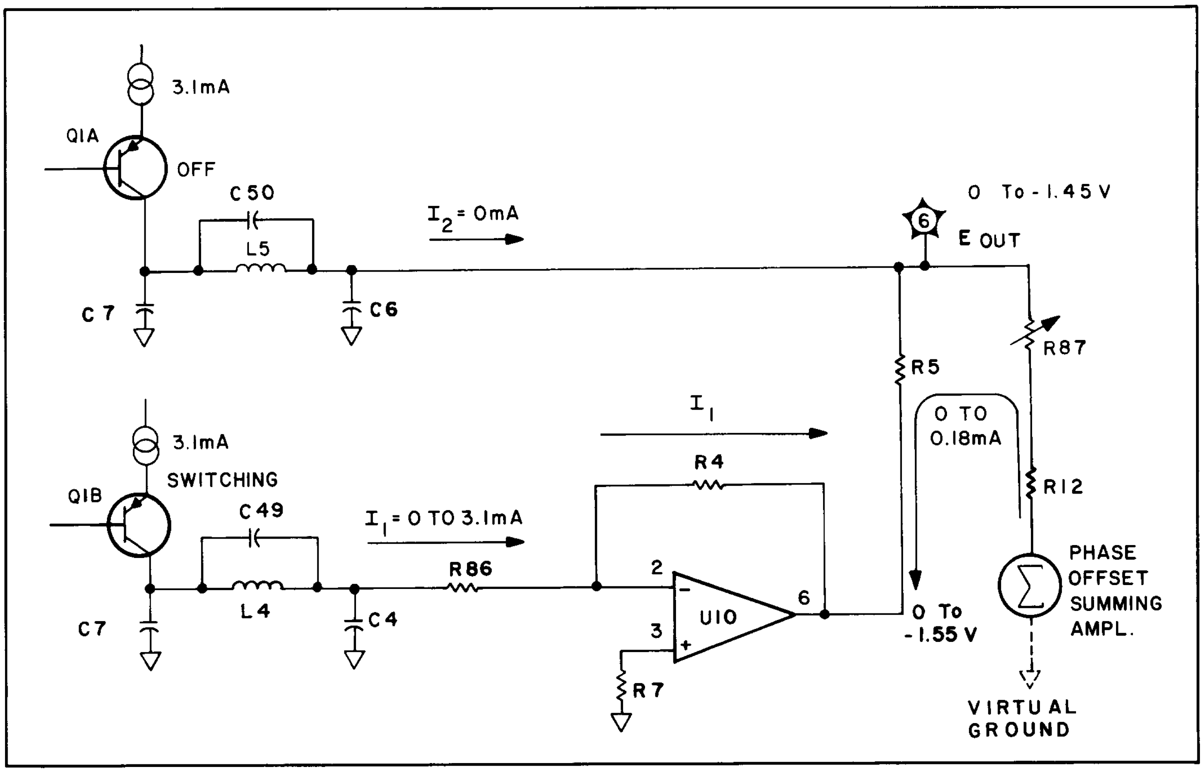


Figure 8-84. Pulse Width Modulator for Lagging Phase, Simplified Schematic

Current Switch stays off. With no current into the negative input of U10, the output of U10 goes to 0V (virtual ground).

In the I_2-to-E_{out} conversion (leading phase), the voltage developed across R5 (in parallel with the series combination of R12 and R87) is due to current I_2 flowing from Q1A of the Current Switch to ground. This gives a voltage range at TP6 of 0 to +1.45V, which is equivalent to a current of 0.5 μA/degree into the summing junction.

Rectangular Phase Detector (B) (P/O A9)

Figure 8-85 is a simplified block diagram of the Rectangular Phase Detector. This circuit provides a dc output (RECT PHASE) that is proportional to the phase difference between its inputs, LIM A PHASE IF and R RECT PHASE (which includes front-panel offsets). The Rectangular Phase detector is made up of four main stages:

- ±180 Degree Phase Detector, which converts the phase difference between the B channel IF and the R RECT PHASE output of the Variable Phase Shifter to a pulse whose width is proportional to the phase difference.
- Pulse Width Modulator (consisting of a Current Source and a Current Switch), which converts the pulse width to a proportional current.
- Low Pass Filter, which filters the high-frequency IF components from the output of the Pulse Width Modulator.
- Current-to-Voltage Converter, which converts the current output from the Pulse Width Modulator to a voltage, then scales and offsets this voltage to provide a voltage-to-phase relationship of ±1.8V/±180 degrees.

A secondary circuit, the Hysteresis Summing stage, prevents the output of the Rectangular Phase Detector from oscillating between the +180- and −180-degree output states when the phase difference between the B and R signals is near 180 degrees.

±180-Degree Phase Detector. The ±180-Degree Phase Detector converts the phase displacement of the rising edges of the two input signals to an output pulse whose width is proportional to the phase difference. The circuit, shown

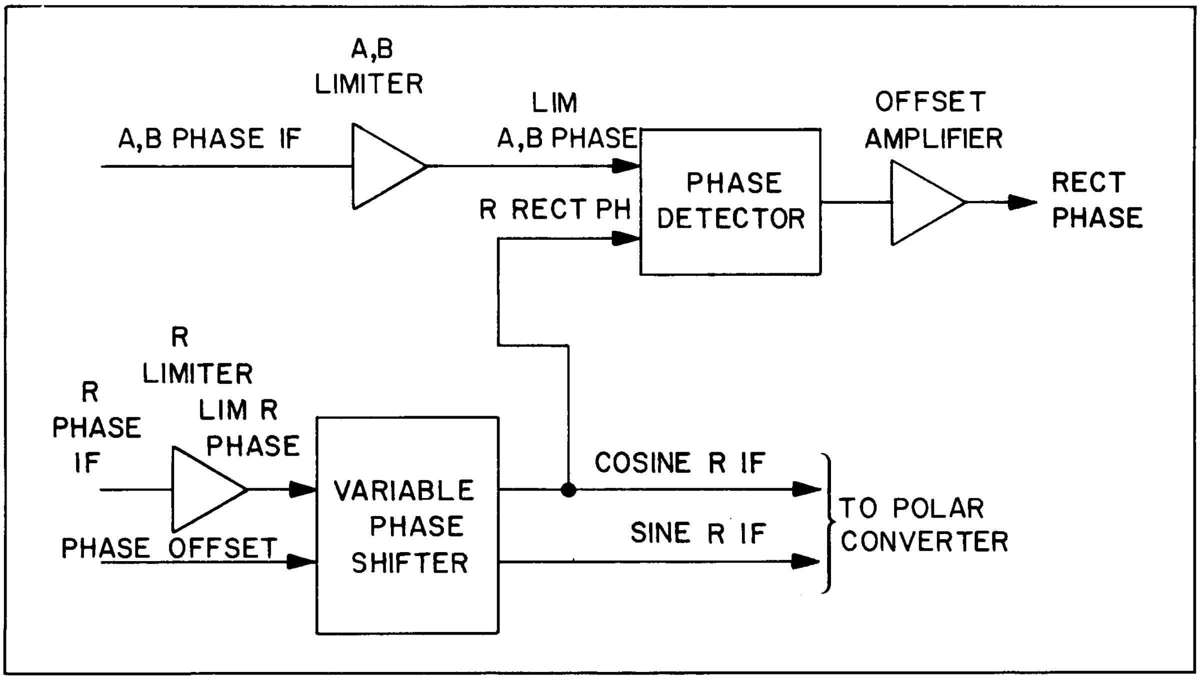


Figure 8-85. Rectangular Phase Detector, Simplified Block Diagram

in Figure 8-86, is made up of two cross-coupled, ECL, D flip-flops (U7B and U7A) whose D inputs are connected high through pull-up resistors R62 and R61. Therefore, whenever a rising edge appears at the clock input, the flip-flop is set. The cross-coupling causes U7A to be cleared whenever U7B is set, and vice versa.

The output pulse of U7A is initiated by the rising edge of R_S (phase shifted R IF) and is terminated via U7B by the rising edge of A/B (see the timing diagram in Figure 8-87). The duration of the output pulse of U7A represents the phase difference between the two signals.

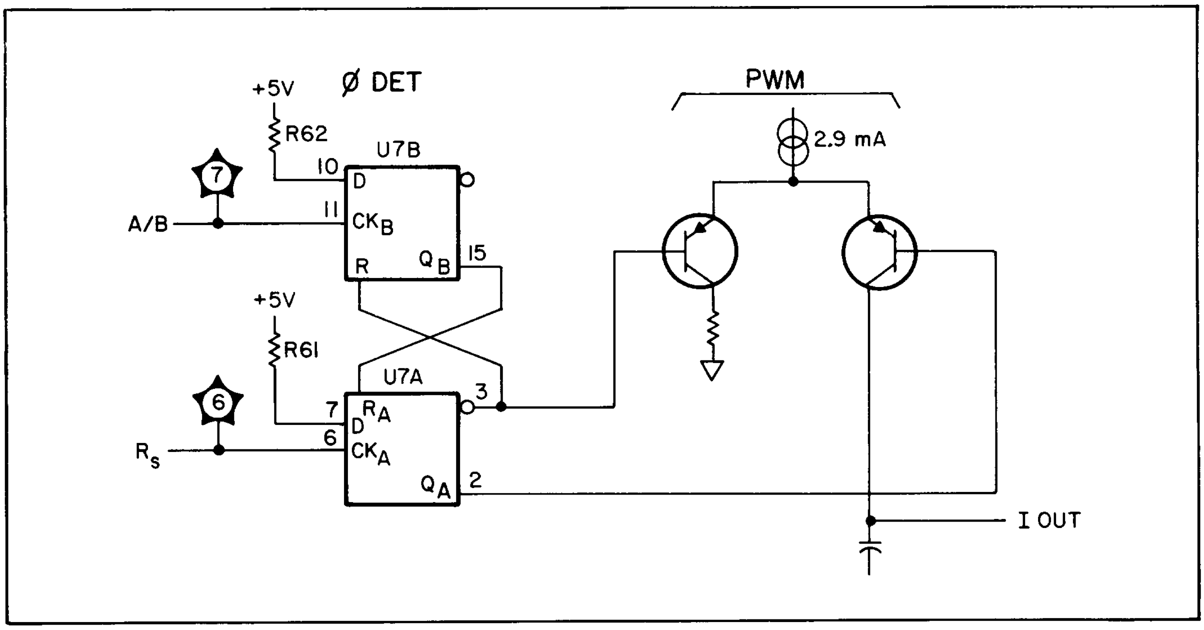


Figure 8-86. ±180-Degree Phase Detector and Pulse Width Modulator, Simplified Schematic

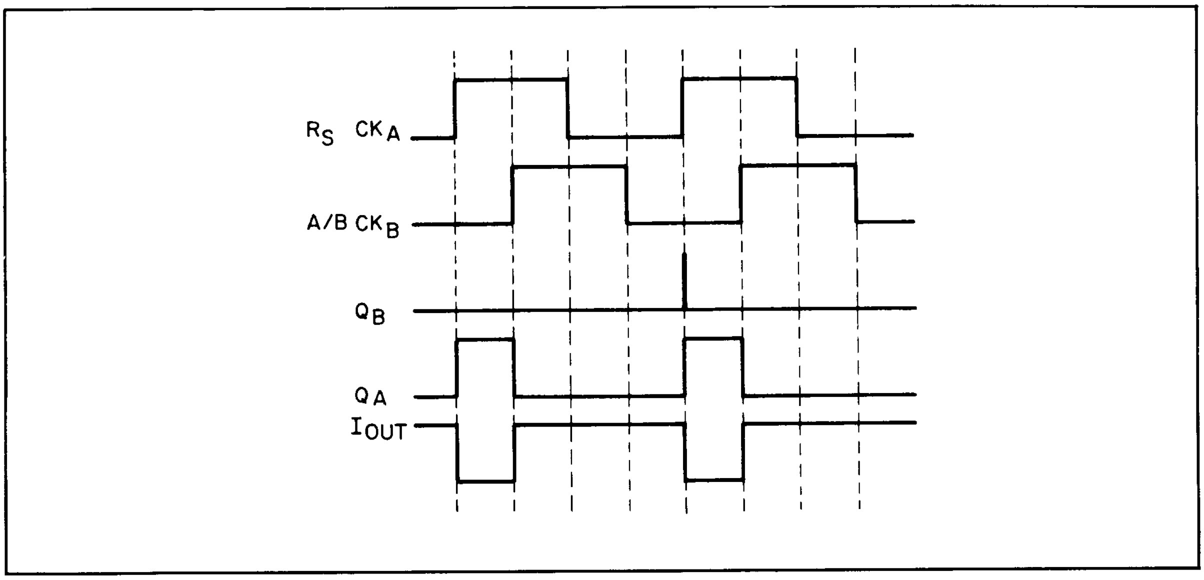


Figure 8-87. ±180-Degree Phase Detector and Pulse Width Modulator, Timing Diagram

The purpose of U7B is to reset U7A whenever the rising edge of A/B occurs. Initially assume that U7A is reset. Then the active low output of U7A is high and the active high output of U7B is low, which leaves the R input of U7A inactive. Then the rising edge of R_S sets U7A. The active low output of U7A goes low, which leaves the R input of U7B inactive, so U7B is free to be set when the rising edge of A/B occurs. On the rising edge of A/B, U7B is set; the active high output of U7B is high, resetting U7A. The active low output of U7A is then high, resetting U7B.

Pulse Width Modulator. The ±180-Degree Phase Detector differentially drives a Pulse Width Modulator that generates an average current proportional to the pulse width out of the Phase Detector. The phase difference is derived by switching the 2.9 mA constant current source either to ground via Q7A or to the output circuit via Q7B. The average output current varies from about 0 to 2.9 mA, which corresponds to a 0 to 360 degree phase difference.

Current-to-Voltage Converter. The Pulse Width Modulator output current (0 to 2.9 mA) is converted to a voltage by U4, RECT GAIN potentiometer R42, and R43. To convert the 0 to 360 degree phase information to an output voltage of ±1.8V/±180 degrees, a negative offset current of 1.44 mA is applied to the summing junction at U4 pin 2. The RECT PHASE signal at U4 pin 1 goes to the Analog Processor (A2, Service Sheet 15) for scaling and display. It also goes to the rear-panel MAG/PHASE connector via the Mag/Phase Output Select Switch on the R Detector (A11, Service Sheet 13). the output of U4 is also fed back to the Hysteresis Summing circuit to provide hysteresis at the ±180 degree switch points.

Hysteresis Summing. The Hysteresis Summing circuit (Figure 8-88) in the R channel is essentially a ±4 degree voltage-controlled phase shifter whose phase shift is controlled by the output of the Rectangular Phase Detector to provide ±4 degrees of hysteresis at the +180 and −180 degree switch points. The R_S is further limited by U5B to provide a symmetrical square wave to the low pass

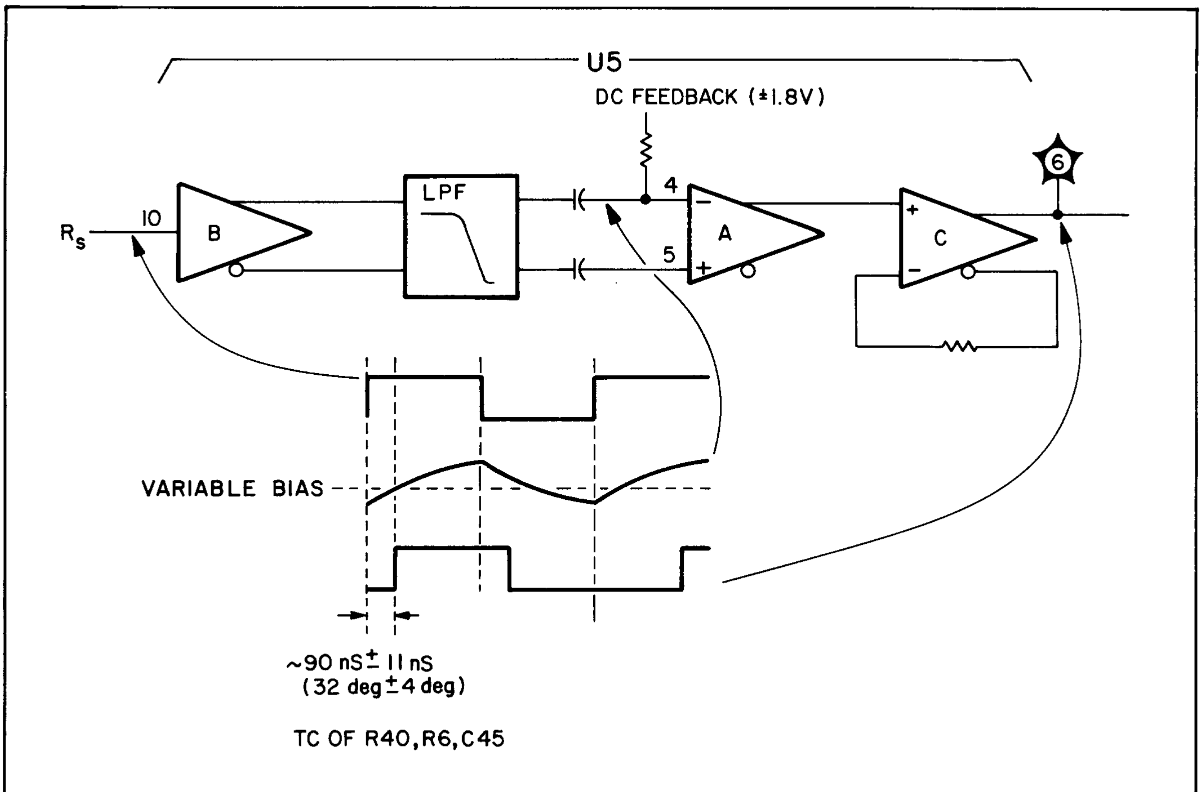


Figure 8-88. Hysteresis Summing, Simplified Block Diagram

filter (C45, R40, and R50). This provides a waveform with slow rise and fall times. This signal is applied to the non-inverting input of U5A, whose bias voltage is controlled by the output of the Rectangular Phase Detector. This ±1.8V signal changes the bias voltage approximately ±40 mV The change in bias changes the time at which the input waveform is equal to the threshold voltage, which is equal to V_{BB}, since the inverting input of U5B is connected to V_{BB} through R69. The slow rise input causes the circuit to have a nominal delay of about 34 degrees. The variable bias voltage changes the delay about ±4 degrees. The output of U5A, which has rather slow rise and fall times, is fed to the Schmitt Trigger, U5C to square up the waveform so that the clock input of the ±180-Degree Phase Detector is driven with a rapid, positive-going edge.

POLAR CONVERTER (H) Through (P)

Figure 8-89 is a simplified block diagram of the Polar Converter circuits. The LOG K A/R input provides polar magnitude (M) information. The K in the mnemonic is a constant that is set by the front-panel CHANNEL 1 REFERENCE switch and OFFSET vernier. By changing the REFERENCE switch setting (and therefore the value of K), the CRT polar display magnitude scale can be changed for use with expanded or compressed Smith Chart overlays. This logarithmic signal (LOG K A/R.) is scaled, offset and antilogged to produce a linear representation of the difference in magnitude of the A channel and R channel inputs.

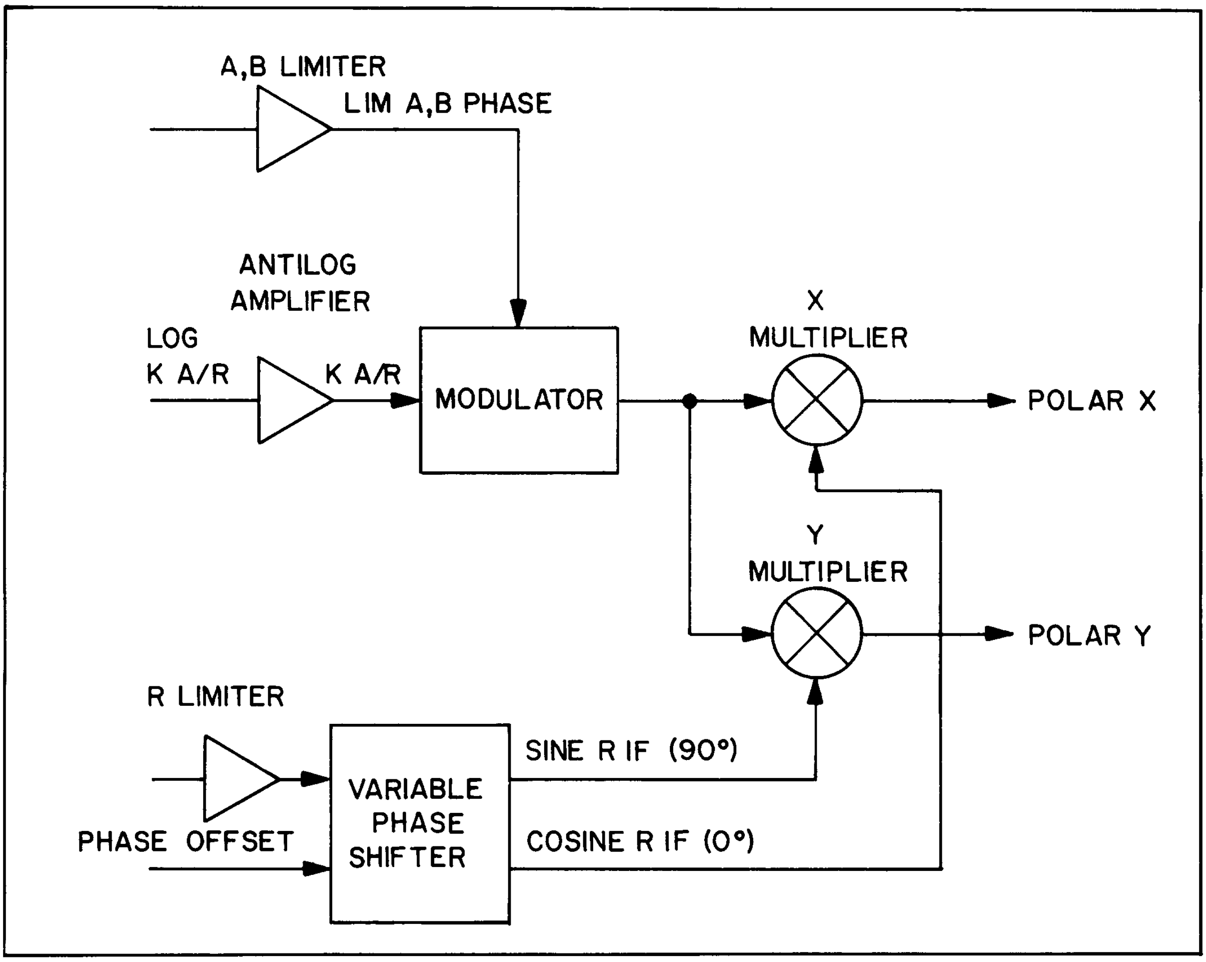


Figure 8-89. Polar Converter, Simplified Block Diagram

The linear K A/R output from the Antilog Amplifier is used to amplitude modulate the LIM A IF signal and develop a 1 MHz POL MAG signal that contains both the KA/R magnitude and A channel phase information. This POL MAG signal is then mixed with the Cosine R IF signal (from the Variable Phase Shifter) in the X Multiplier to produce the POLAR X (M Cos θ) output. The POL MAG signal is also mixed with the Sine R IF signal (from the Variable Phase Shifter) in the Y Multiplier to produce the POLAR Y (M Sine θ) output.

Polar Gain and Offset (H) and Polar Center Switch (M) (P/O A9)

The Polar Gain and Offset circuit offsets and scales the LOG K A/R signal from the Analog Processor (A2, Service Sheet 15) to provide the proper linear output of the Antilog Amplifier. When the LOG K A/R voltage from A2 is zero, the Antilog Amplifier has an output current of about 1.24 mA. This corresponds to the outer circle (unity radius) on the CRT, which indicates that the A and R magnitudes are equal. A change of −6 dB in the LOG K A/R signal changes the output current of the Antilog Amplifier by a factor of 0.5; that is, 0.62 mA. (The change of LOG K A/R is −25 mV/dB.) The gain of amplifier U1 required to produce the correct linear output of the Antilog Amplifier is about 1.75. This gain is set by R4 and POLAR GAIN potentiometer R5 versus R2. The offset when LOG K A/R is zero is about +2.05V, which is set by POLAR OFFSET potentiometer R1 and R38. When the front-panel POLAR CENTER switch is engaged, the output of U1 saturates negative (about −8V) which turns on the Polar Center Switch (A9Q10). When A9Q10 is turned on, it shorts out the input to the Phase Shifter to effectively turn off the POL MAG signal.

Antilog Amplifier (I) (P/O A9)

The Antilog Amplifier converts the logarithmically scaled LOG K A/R voltage to a linear current. The conversion takes place in Q1B, the antilogging element of the circuit. This is possible because of the exponential relationship between the base-emitter voltage of a transistor and its collector current. The conversion requires a reference transistor, Q1A, in which the collector current is set by the voltage divider R9, R10 in series with R11. The collector current is maintained at 5.8 μA by U2 for temperature compensation of the base-emitter voltage. The input network R6, R7 compensates the log to linear scale factor change with temperature.

Linear Offset (J) (P/O A9)

The Linear Offset circuit sets the bias for the Voltage-Controlled Current Source of the Modulator to adjust for maximum operating range of the modulator. The bias is set by the resistor string R14, R8, and POLAR MIN potentiometer R39 between −10V and the virtual ground at U3 pin 2 and by the gain resistor R15. The output current from the Antilog Amplifier is converted to the required control voltage for the Voltage-Controlled Current Source (+5.11V/mA) as set by R15.

Modulator (K) (P/O A9)

The Modulator circuit, consisting of U3, Q2, and Q9, adds linearized magnitude information (K A/R) to the 1 MHz A/B LIM signal, which contains the test channel phase information. This is accomplished by a Voltage-Controlled Current Source and a differential Current Switch. The magnitude of the current is controlled by the K A/R signal (the linearized LOG K A/R signal). The current is switched by the A,B LIM (test channel) signal. The output taken from the collector of Q9 is a 1 MHz signal whose amplitude is about 1.2V peak-to-peak when the A and R magnitudes are equal and there are no front-panel magnitude offsets. This condition corresponds to a display on the unity-gain (outer) circle on the CRT.

The Voltage-Controlled Current Source is made up of U3, Q2, and the resistive divider R19 and R38. U3 controls the conduction of Q2 to maintain a current through R19 and R38 to produce a voltage at the junction of R19 and R38 equal to that set by the non-inverting input of U3B.

1-MHz Bandpass Filter (L) (P/O A9)

The 1-MHz Bandpass Filter reduces the harmonic components of the 1-MHz variable-amplitude square wave from the Modulator circuit to produce a clean 1-MHz signal.

Phase Shifter (N) (P/O A9)

The Phase Shifter provides a means to calibrate the Polar Phase Offset. This is accomplished by

Q4, which provides two outputs 180 degrees out of phase. The two output signals are summed by a reactive component, C36, and a variable resistive component, R54 and POL ZERO potentiometer R55. The resultant is a phase shift which can be adjusted by R55 approximately ±30 degrees to correct for delays in the polar system.

Y Multiplier Ⓟ (P/O A10)

The Y Multiplier converts the 1 MHz KA/R∠A signal from the Phase Shifter circuit of the Phase Detector (A9) and the 1 MHz Sine R IF signal from the Variable Phase Shifter to the POLAR Y vertical deflection signal to the CRT. The output of the Y Multiplier is obtained by converting a differential current to a voltage and then filtering the resulting signal to attenuate the 1 MHz and higher order mixing products. A simplified schematic of the Y Multiplier is shown in Figure 8-90.

Multiplier. The Multiplier stage is essentially an externally-biased balanced modulator, U3, which has two differential voltage input ports and a differential current output port. Circuitry is provided to set the gain between the signal inputs and the external ports and to set the quiescent output current.

The carrier, or switching input, is driven differentially from the Sine R IF output of the Variable Phase Shifter (reference channel phase information). Resistors R45 through R49 attenuate the 0.9V peak-to-peak square wave signal to about 0.2V peak-to-peak and bias the port to about −2.4V. Amplitude variation in this port will have little effect on the output.

The signal port is operated in the linear mode and is driven single-endedly from the Phase Shifter in the Phase Detector (A9). The signal amplitude is dependent on the ratio of the A/R magnitudes and the phase of the A test channel. Resistors R51 through R55 (including Y NULL potentiometer R52) and R2 attenuate the input signal to provide a 0.28V peak-to-peak sinusoidal waveform at the non-inverting input, U3 pin 1, when the A magnitude is equal to the R magnitude. The resistor network also biases the port to about −5.7V. The non-inverting input is placed at IF ground through C33. Y NULL potentiometer R52 adjusts the differential bias to balance the output of the Multiplier, which minimizes the carrier feedthrough.

The quiescent magnitude of the two output currents from U3 is about 1.1 mA as determined by the bias resistor R58 and the −10V at U3 pin 10. The product of the two complex input signals, magnitude and phase, causes a differential current change in the two outputs of U3.

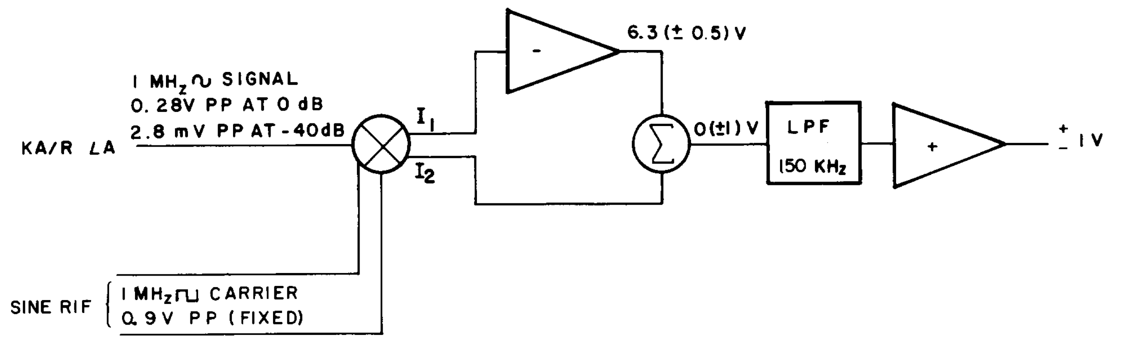


Figure 8-90. Y Multiplier, Simplified Schematic

Current-to-Voltage Converter. The differential output currents from the Multiplier are converted to a voltage. This is accomplished by adding the two voltages in series opposition, which cancels the voltage generated because of the quiescent current of the Multiplier. A simplified schematic of the Current-to-Voltage Converter is shown in Figure 8-91.

The currents I_1 and I_2 into the two Multiplier outputs are equal in the quiescent state; that is, the no-signal condition. I_1 is converted to voltage E_1 by the inverting op amp U1B, whose gain is set by R60. Because of the inverting configuration of U1B, its output at pin 7 moves to a potential that causes a current through R60 into U1B pin 6. This current is equal and opposite to I_1 maintaining the virtual ground at pin 6 as defined by the grounding of U1B pin 5 through R59.

With the conditions shown in Figure 8-90, I_1 is 1.05 mA, and E_1 is +6.3V. I_2 flows through R61, and the voltage drop across the resistor is E_2. Since E_2 is referenced to E_1, the two voltages are subtracted. Hence, when $I_1 = I_2$, $E_1 = E_2$, and E_{out} is 0V; that is, $6.3 - 6.3 = 0$.

The mixing of the signals produces differential current changes in I_1 and I_2. When I_1 (and thus E_1) increases, I_2 (and thus E_2) decreases, resulting in a change of E_{out} from 0V. For example, if I_1 increases by 83 μA, E_1 increases to +6.8V. At the same time, I_2 must have increased by 83μA, so E_2 has decreased to −5.8V. Therefore, E_{out} is +1V, since $6.8 - 5.8 = 1$.

Low Pass Filter. The Low Pass Filter, which consists of U1A and its associated circuitry, further attenuates the high-frequency components present in the output.

X Multiplier ⓞ (P/O A10)

The X Multiplier converts the 1-MHz KA/R ∠A signal from the Phase Shifter circuit of the Phase Detector (A9) and the 1 MHz Cosine R IF signal from the Variable Phase Shifter to the POLAR X horizontal deflection signal to the CRT.

The circuitry of the X Multiplier is identical to that of the Y Multiplier except for the addition of GAIN BAL potentiometer R78 in series with R77.

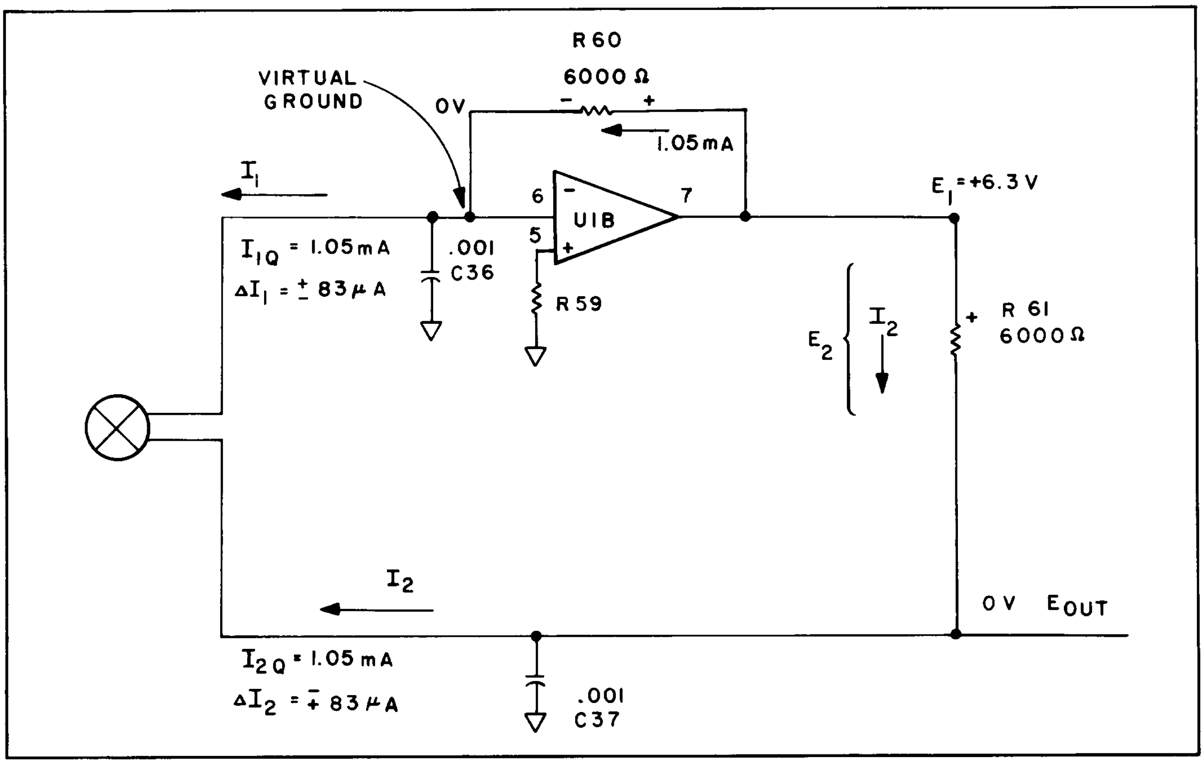


Figure 8-91. Current-to-Voltage Converter, Simplified Schematic

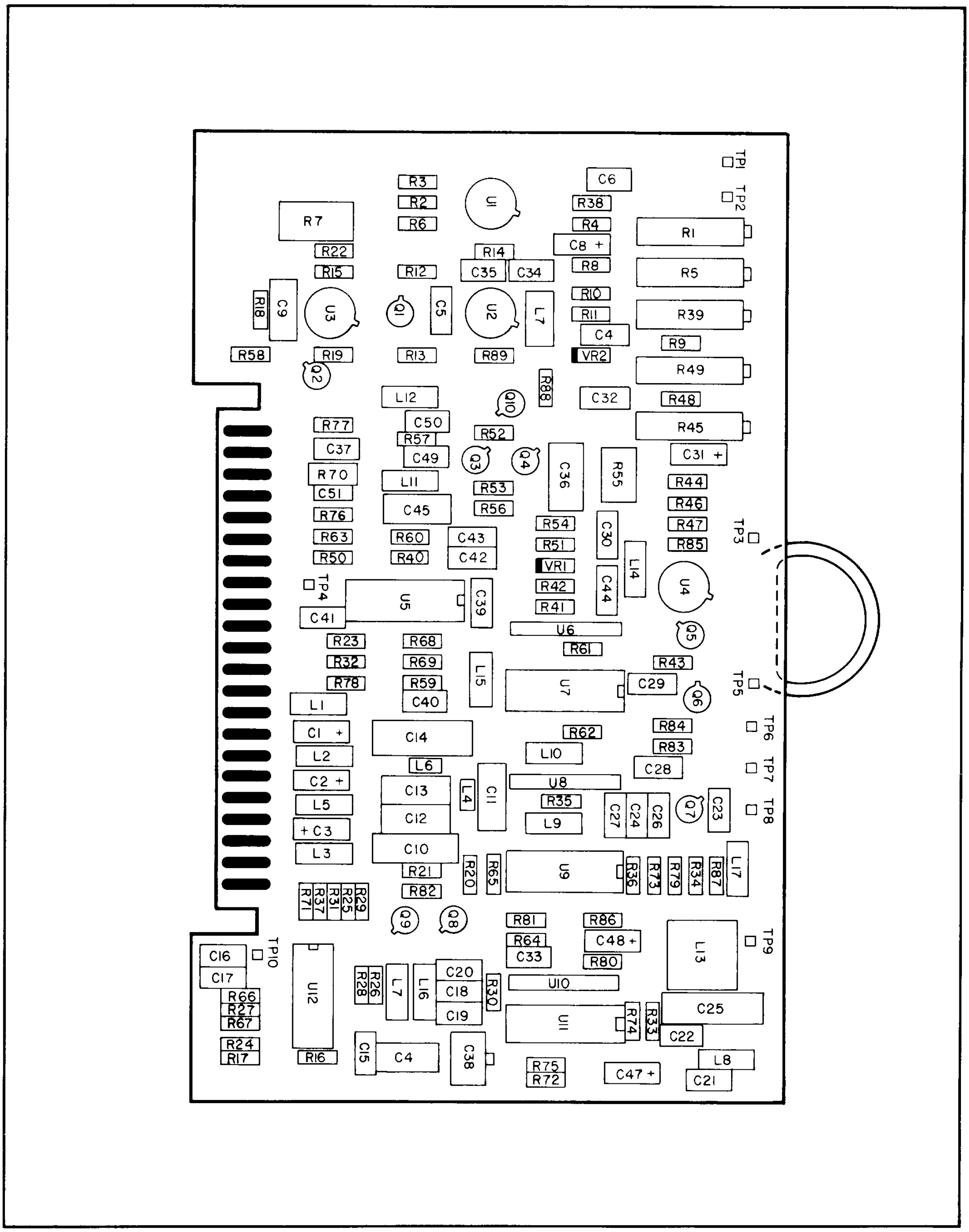


Figure 8-92. Phase Detector (A9), Component Locations

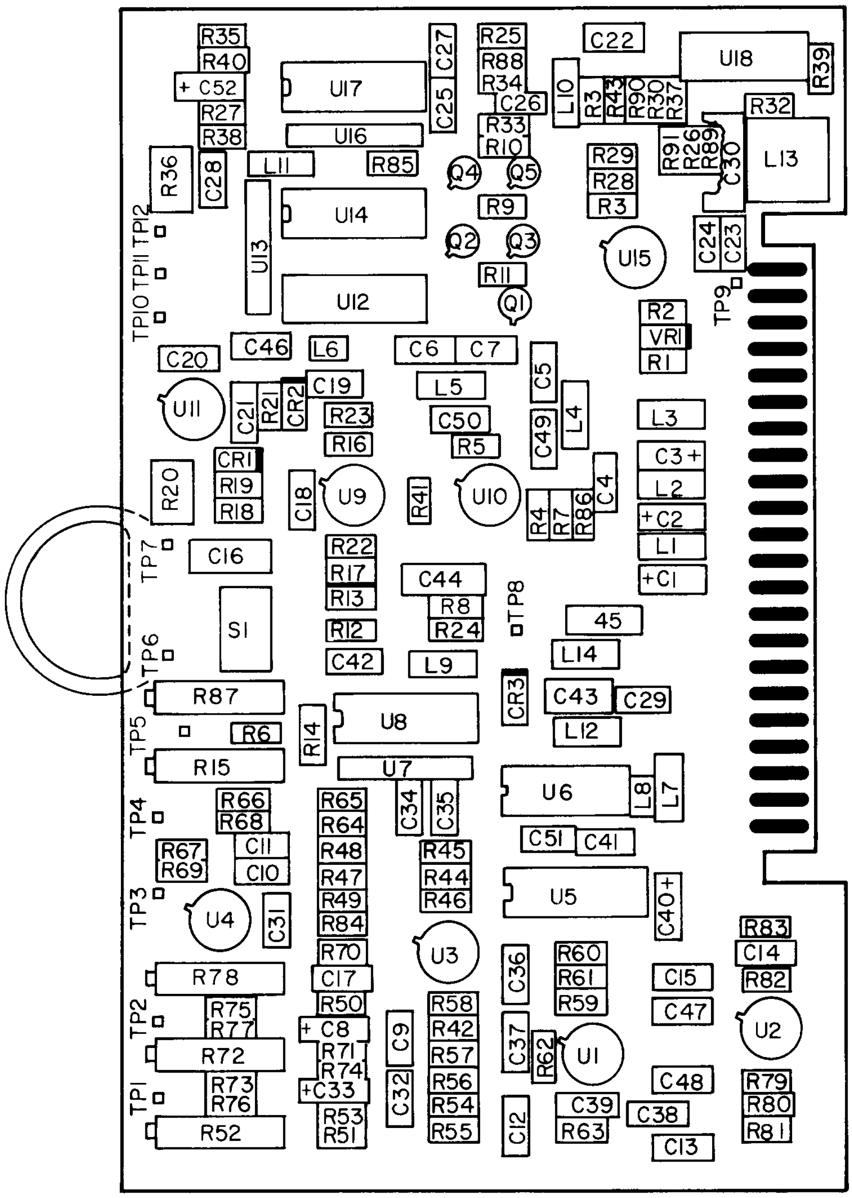
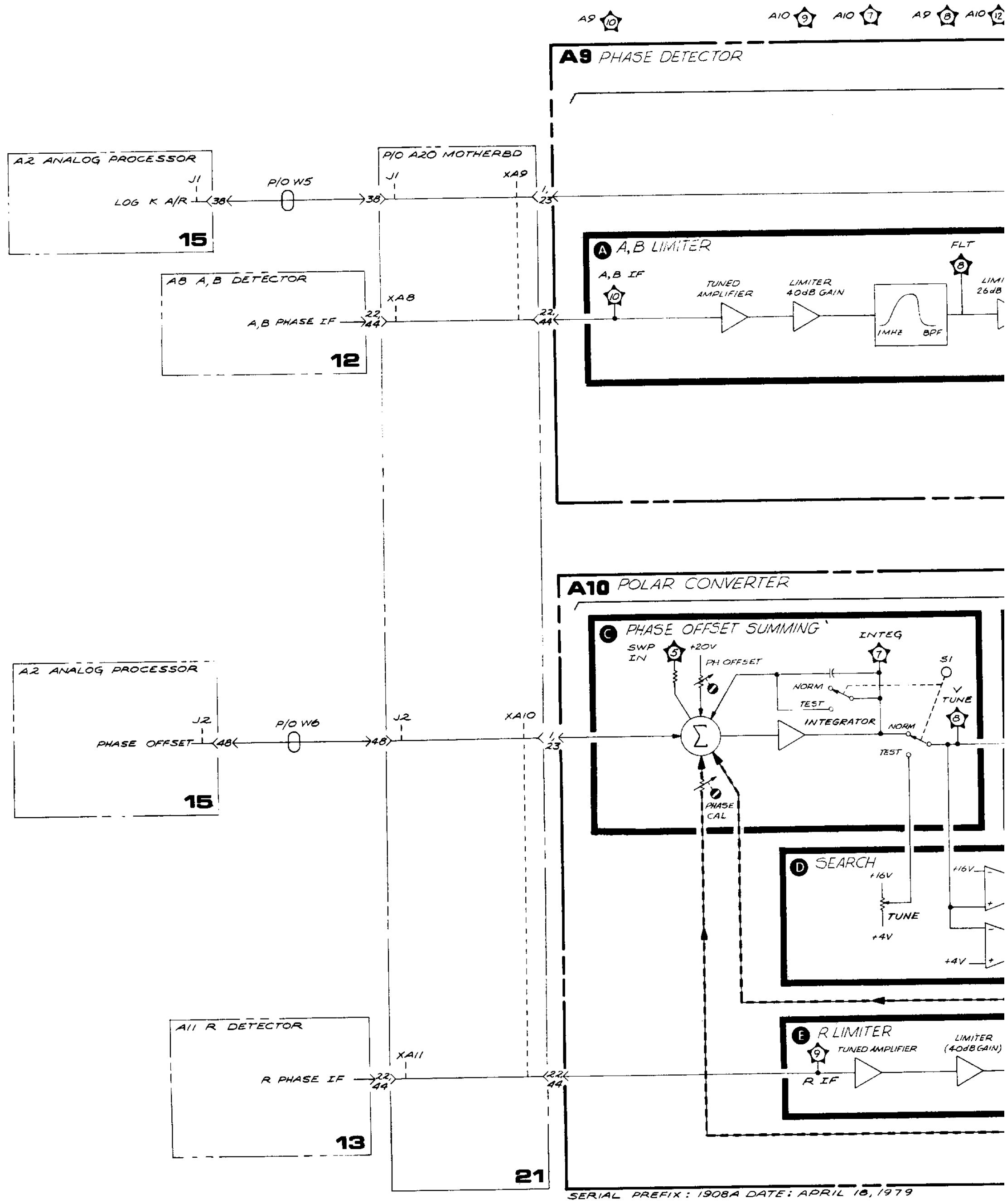
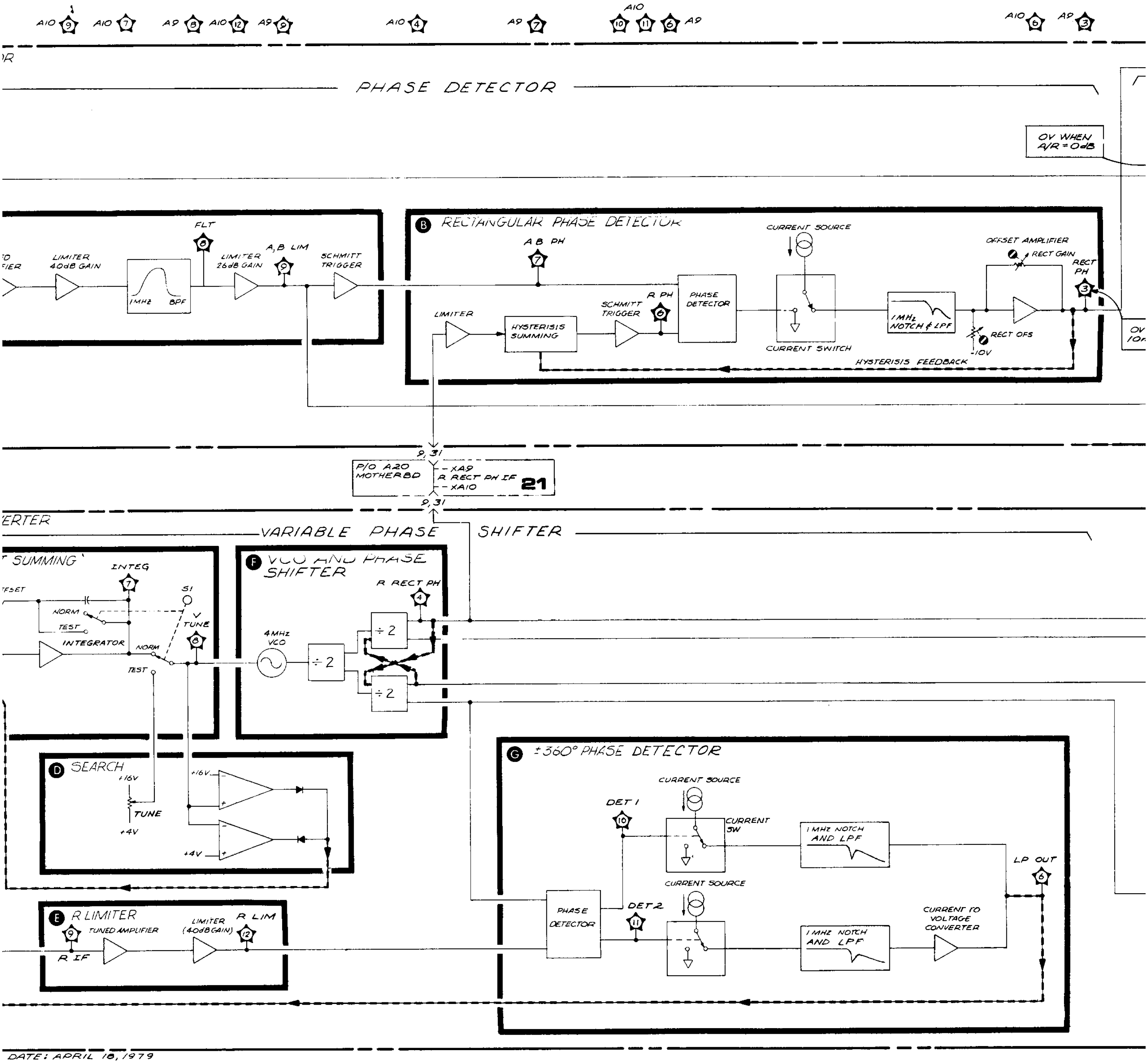
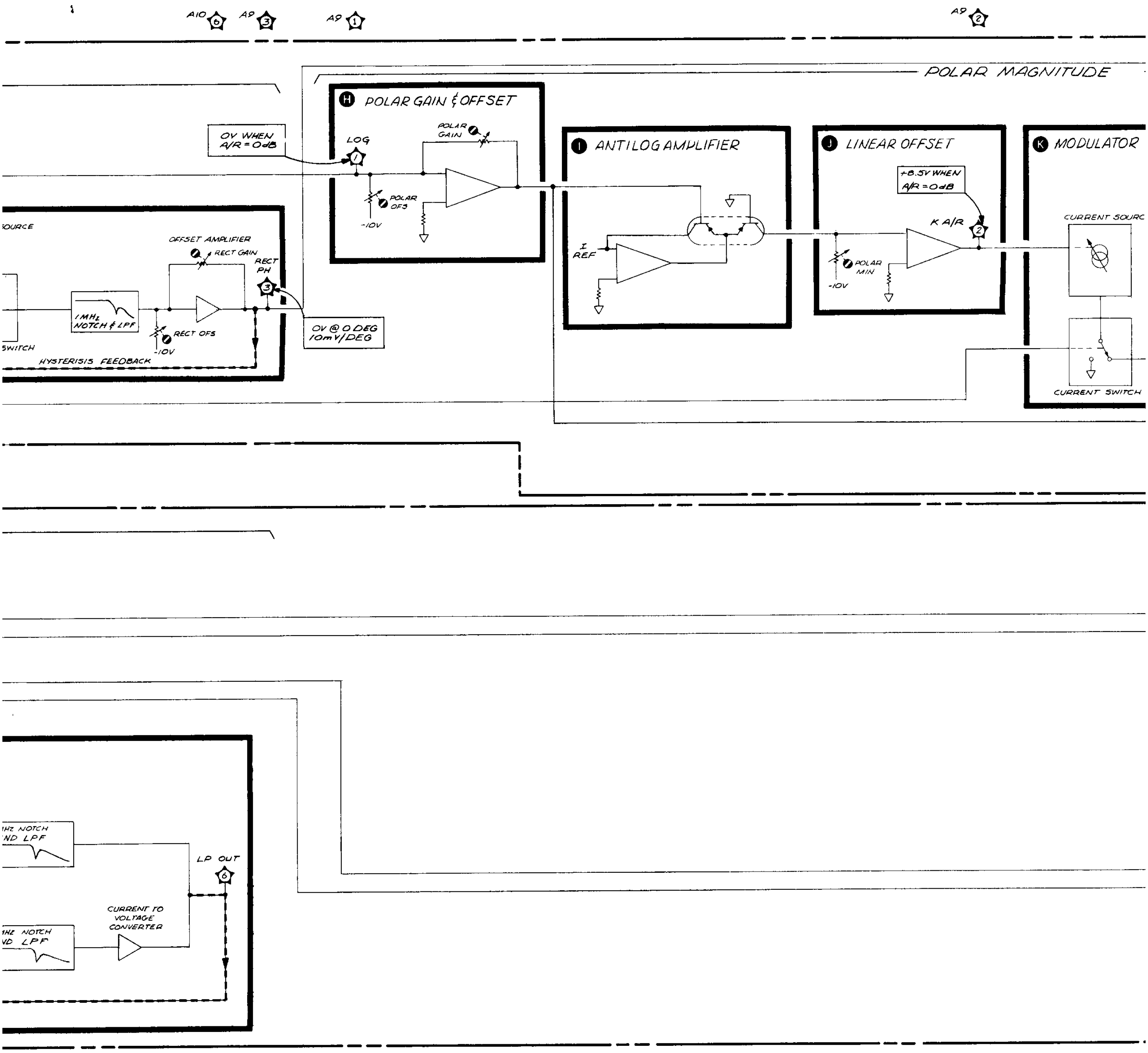


Figure 8-93. Polar Converter (A10), Component Locations


A9 10
A10 9
A10 7
A9 8
A10 12
A9 PHASE DETECTOR
A2 ANALOG PROCESSOR
J1
LOG K A/R
38
15
P/O W5
P/O A20 MOTHERBD
XA9
A8 A,B DETECTOR
XA8
A,B PHASE IF
22
44
12
A A,B LIMITER
A,B IF
TUNED AMPLIFIER
LIMITER 40dB GAIN
FLT
1MHz BPF
A10 POLAR CONVERTER
C PHASE OFFSET SUMMING
SWP IN
+20V
PH OFFSET
INTEG
S1
NORM
TEST
INTEGRATOR
TUNE
PHASE CAL
A2 ANALOG PROCESSOR
J2
PHASE OFFSET
48
P/O W6
XA10
23
15
D SEARCH
+16V
TUNE
+4V
A11 R DETECTOR
XA11
R PHASE IF
13
21
E R LIMITER
TUNED AMPLIFIER
LIMITER (40dB GAIN)
R IF
SERIAL PREFIX: 1908A DATE: APRIL 18, 1979



PHASE DETECTOR
0V WHEN A/R = 0dB
RECTANGULAR PHASE DETECTOR
LIMITER 40dB GAIN
FLT
1MHz BPF
LIMITER 26dB GAIN
A,B LIM
SCHMITT TRIGGER
A B PH
CURRENT SOURCE
OFFSET AMPLIFIER
RECT GAIN
RECT PH
LIMITER
HYSTERISIS SUMMING
SCHMITT TRIGGER
R PH
PHASE DETECTOR
CURRENT SWITCH
1MHz NOTCH & LPF
RECT OFS
-10V
HYSTERISIS FEEDBACK
P/O A20 MOTHERBD
XA9
R RECT PH IF
XA10
21
9,31
VARIABLE PHASE SHIFTER
VCO AND PHASE SHIFTER
INTEG
NORM
TEST
INTEGRATOR
S1
V TUNE
R RECT PH
4MHz VCO
÷ 2
SEARCH
+16V
TUNE
+4V
±360° PHASE DETECTOR
CURRENT SOURCE
DET 1
CURRENT SW
1 MHz NOTCH AND LPF
DET 2
LP OUT
CURRENT TO VOLTAGE CONVERTER
R LIMITER
TUNED AMPLIFIER
LIMITER (40dB GAIN)
R LIM
R IF
DATE: APRIL 18, 1979



A10 6
A9 3
A9 1
A9 2
POLAR MAGNITUDE
H POLAR GAIN & OFFSET
0V WHEN A/R = 0dB
LOG 1
POLAR GAIN
POLAR OFS
-10V
I ANTILOG AMPLIFIER
I REF
J LINEAR OFFSET
+8.5V WHEN A/R = 0dB
K A/R 2
POLAR MIN
-10V
K MODULATOR
CURRENT SWITCH
OFFSET AMPLIFIER
RECT GAIN
RECT PH 3
1MHz NOTCH & LPF
RECT OFS
-10V
HYSTERISIS FEEDBACK
0V @ 0 DEG 10mV/DEG
LP OUT 6
CURRENT TO VOLTAGE CONVERTER

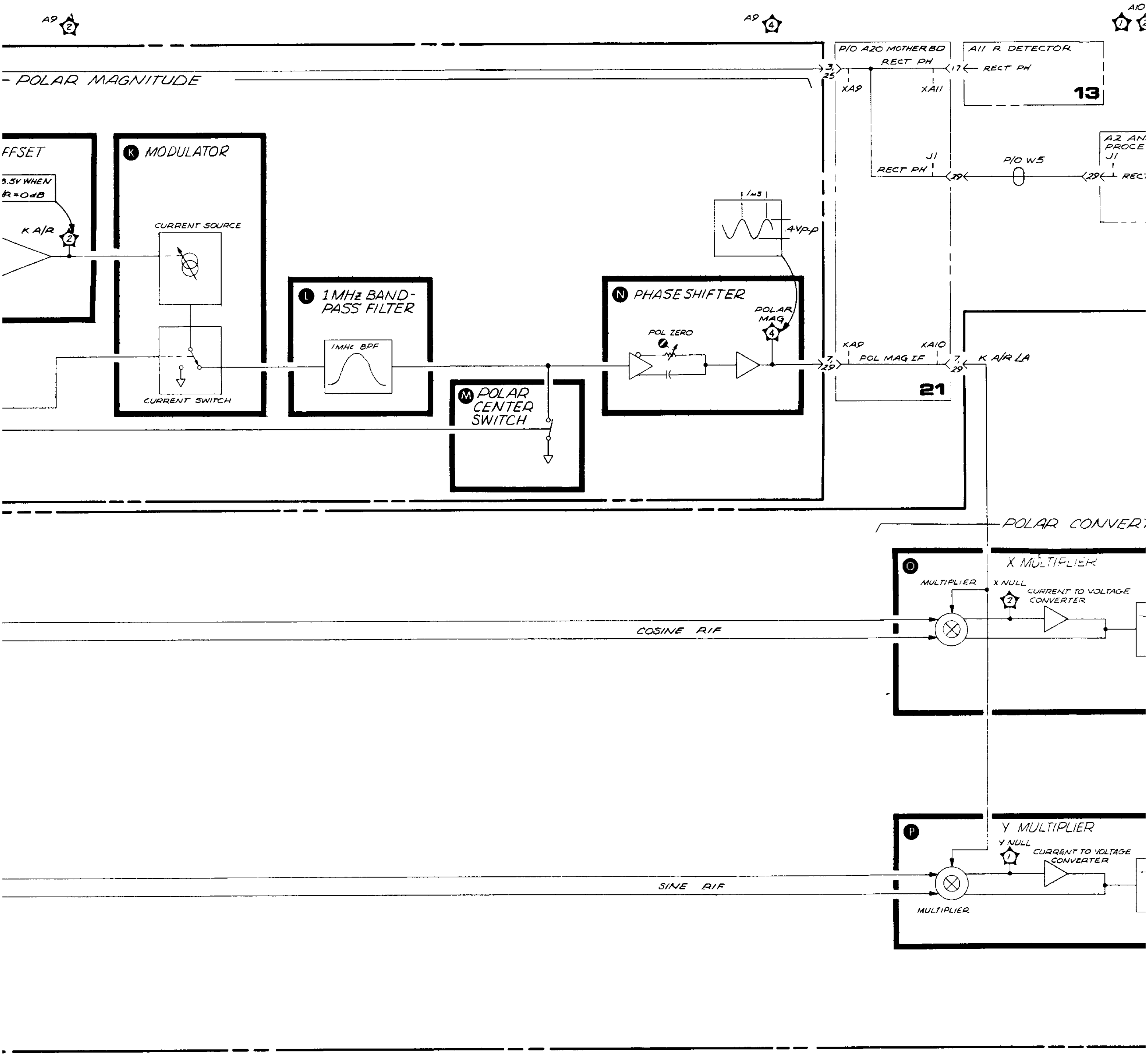


Figure 8-94. Pl

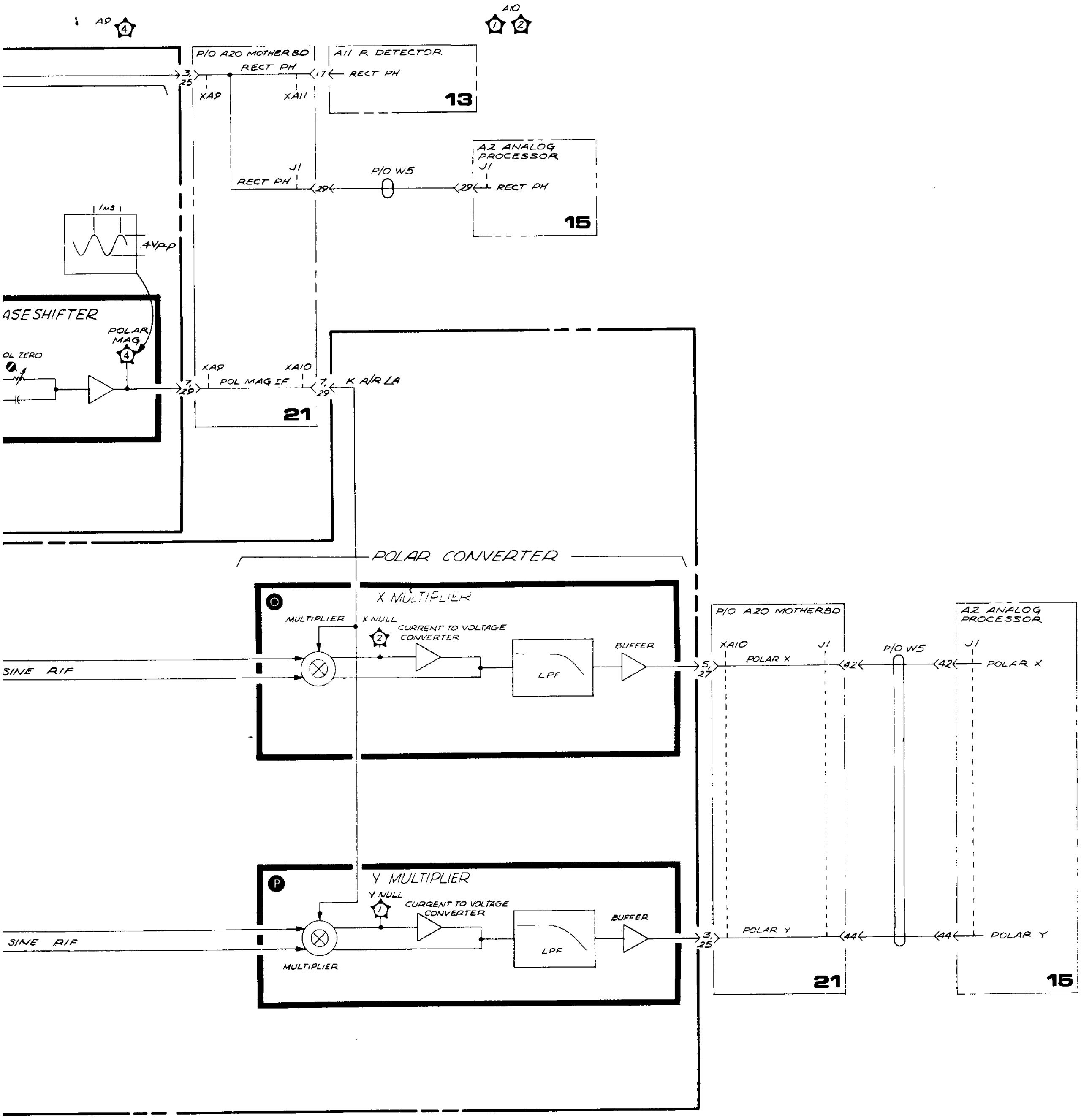


Figure 8-94. Phase Detector (A9) and Polar Converter (A10), Block Diagram

A9

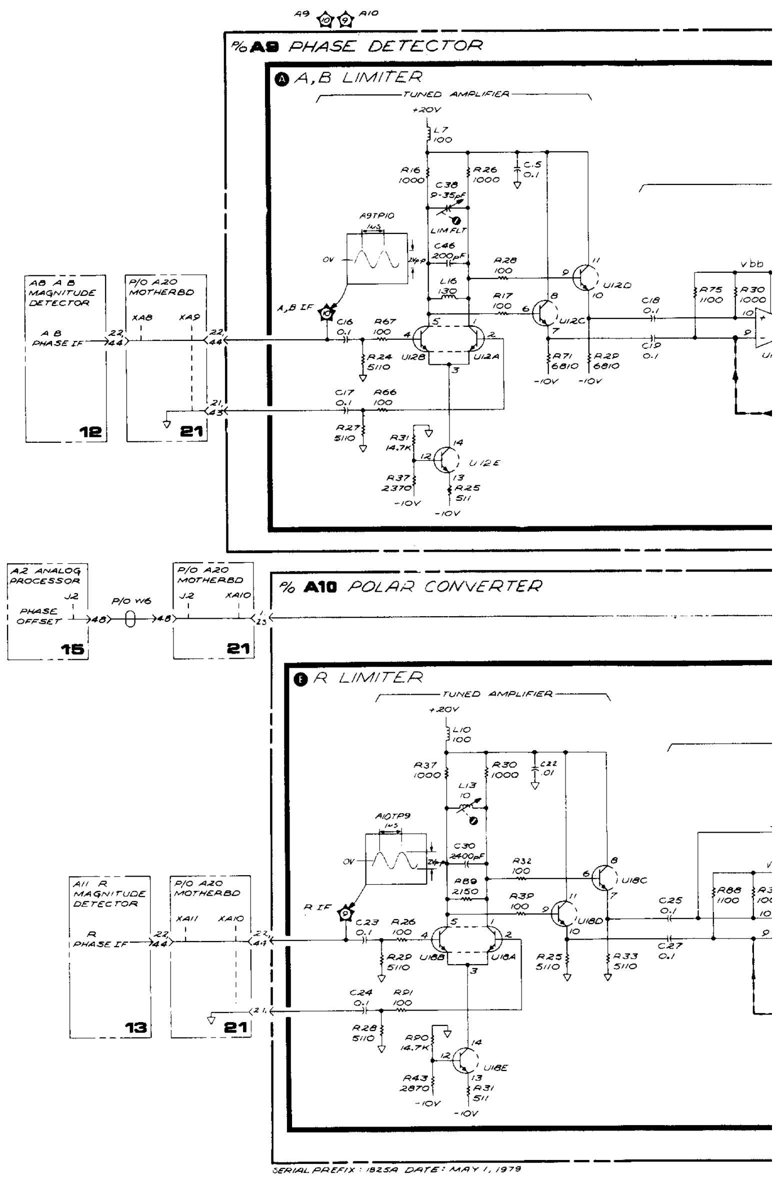
P1

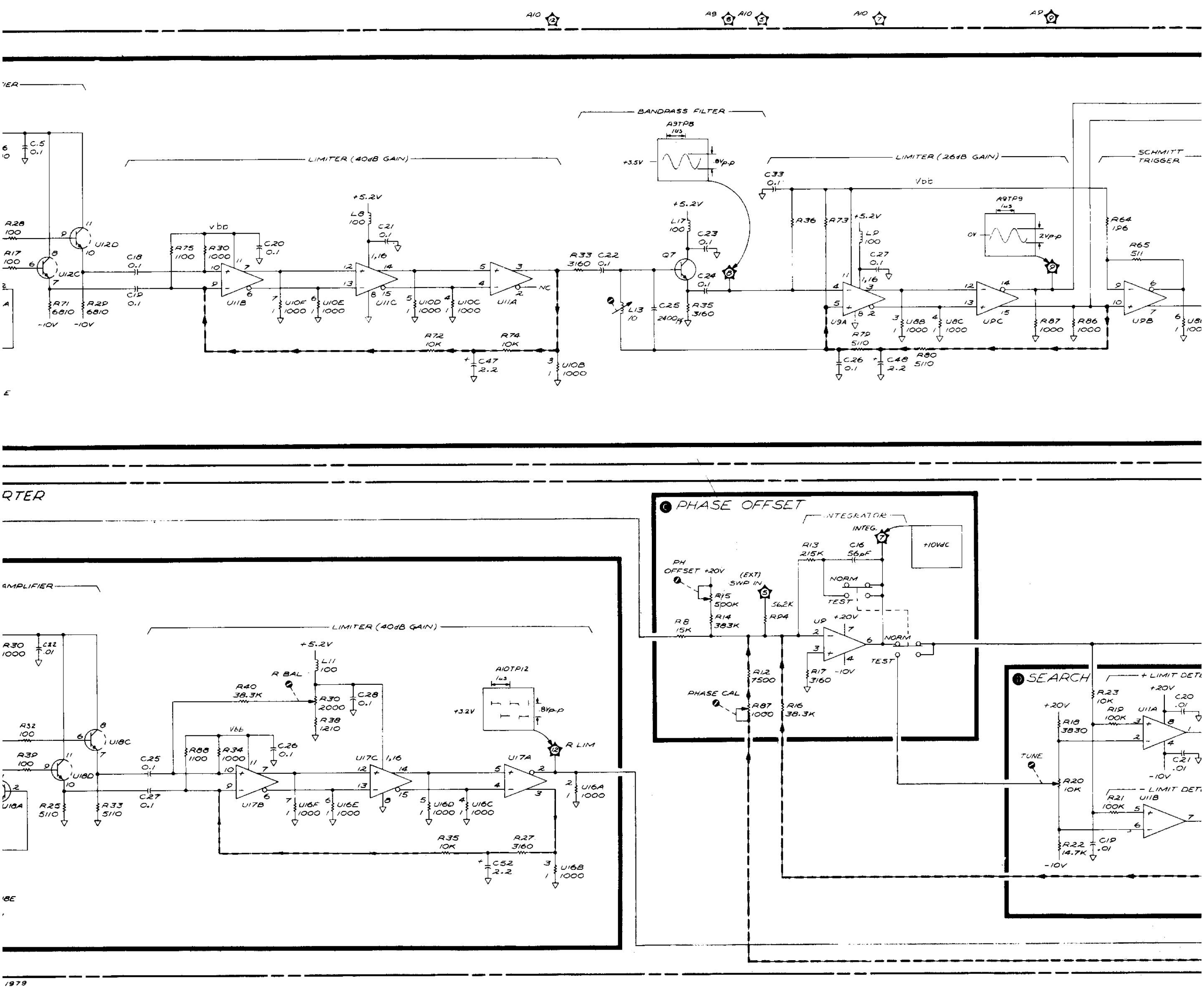
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	LOG K A/R	A2J1-38	H
23	LOG K A/R	A2J1-38	H
2	GND	GND	P
24	GND	PLANE	P
3	RECT PHASE	A2J 2-29	B
25	RECT PHASE		B
4	GND	GND	P
26	GND	PLANE	P
5	GND	GND	P
27	GND	PLANE	P
6	GND	GND	P
28	GND	PLANE	P
7	POL MAG IF	A10P1-7,29	M
29	POL MAG IF	A10P1-7,29	M
8	GND		P
30	GND		P
9	R RECT PH IF	A10P1-9,31	B
31	R RECT PH IF	A10P1-9,31	B
10	GND	GND	P
32	GND	PLANE	P
11	GND	GND	P
33	GND	PLANE	P
12	GND	GND	P
34	GND	PLANE	P
13	GND	GND	P
35	GND	PLANE	P
14	+20V	A16P1-3,25	P
36	+20V	A16P1-3,25	P
15	GND	GND	P
37	GND	PLANE	P
16	+5.2V	A20U2-OUT	P
38	+5.2V	A20U2-OUT	P
17	GND	GND	P
39	GND	PLANE	P
18	-10V	A16P1-9,31	P
40	-10V	A16P1-9,31	P
19	NC		P
41			P
20	GND	GND	P
42	GND	PLANE	P
21	A,B PHASE IF COMMON	GND	A
43		PLANE	A
22	A,B PHASE IF	A8P1-22,44	A
44	A,B PHASE IF	A8P1-22,44	A

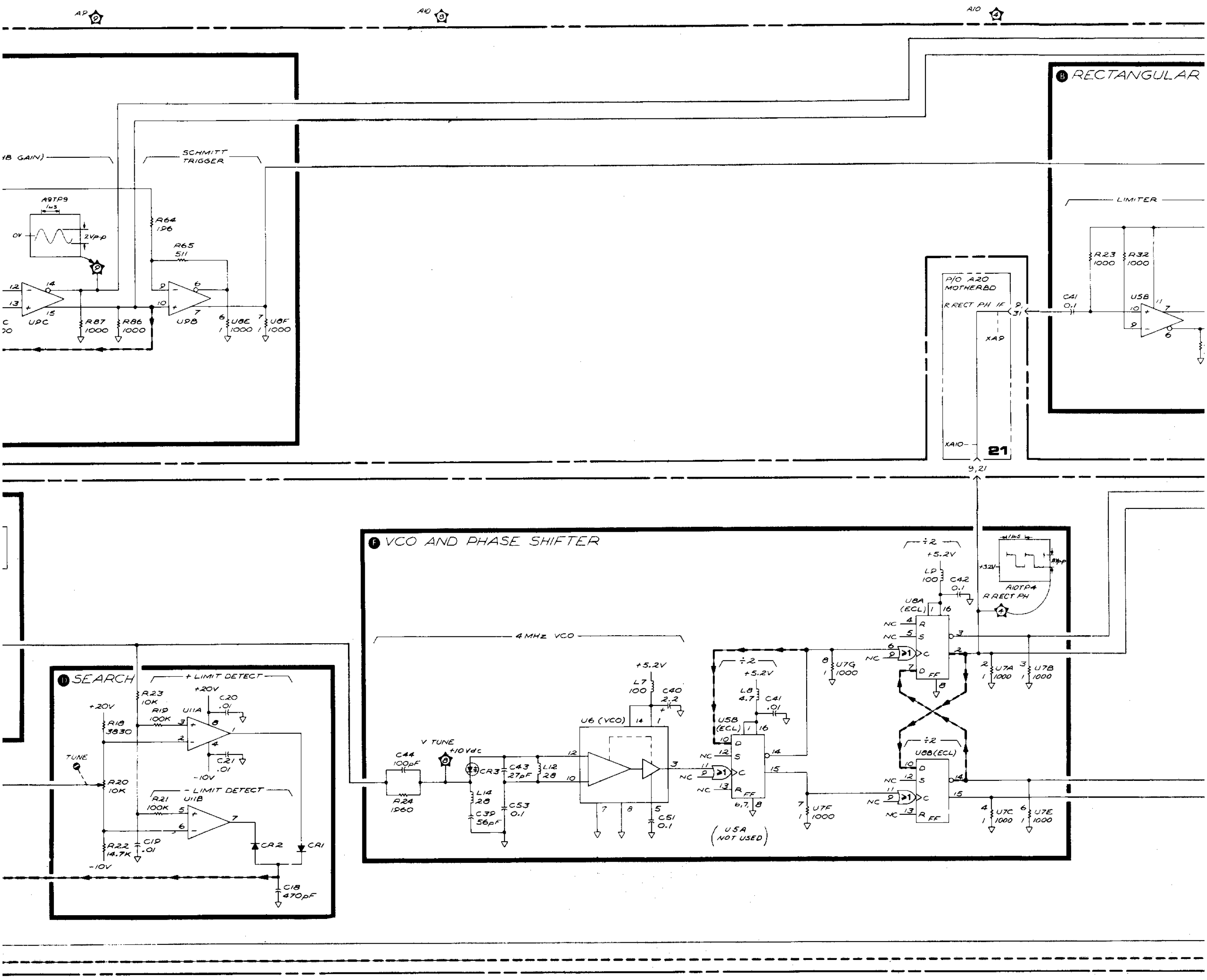
A10

P1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	NC		
23	PHASE OFFSET	A2J2-48	C
2	GND	GND	Q
24	GND	PLANE	Q
3	POLAR Y	A2J1-44	Q
25	POLAR Y		Q
4	GND	GND	Q
26	GND	PLANE	Q
5	POLAR X	A2J1-42	N
27	POLAR X		N
6	GND	GND	Q
28	GND	PLANE	Q
7	POL MAG IF	A9P1-7,29	Q
29	POL MAG IF	A9P1-7,29	Q
8	GND	GND	Q
30	GND	PLANE	Q
9	R RECT PH IF	A9P1-9,31	F
31	R RECT PH IF	A9P1-9,31	F
10	GND	GND	Q
32	GND	PLANE	Q
11	GND	GND	Q
33	GND	PLANE	Q
12	GND	GND	Q
34	GND	PLANE	Q
13	GND	GND	Q
35	GND	PLANE	Q
14	+20V	A16P1-3,25	Q
36	+20V	A16P1-3,25	Q
15	GND	GND	Q
37	GND	PLANE	Q
16	+5.2V	A20U2-OUT	Q
38	+5.2V	A20U2-OUT	Q
17	NC		Q
39			Q
18	-10V	A16P1-9,31	Q
40	-10V	A16P1-9,31	Q
19	GND	GND	Q
41	GND	PLANE	Q
20	GND	GND	Q
42	GND	PLANE	Q
21	R PHASE IF COMMON	GND	E
43		PLANE	E
22	R PHASE IF	A11P1-22,44	E
44	R PHASE IF	A11P1-22,44	E




BANDPASS FILTER
LIMITER (40dB GAIN)
LIMITER (26dB GAIN)
SCHMITT TRIGGER
PHASE OFFSET
INTEGRATOR
SEARCH
+ LIMIT DET
− LIMIT DET
AMPLIFIER
PH OFFSET
(EXT) SWP IN
PHASE CAL
R BAL
R LIM
TUNE
NORM
TEST
1979



SCHMITT TRIGGER
A9TP9
R64 196
R65 511
U9C
U9B
R87 1000
R86 1000
U8E 1000
U8F 1000
RECTANGULAR
LIMITER
R23 1000
R32 1000
C41 0.1
P/O A20 MOTHERBD
R RECT PH IF
XA9
XA10
21
VCO AND PHASE SHIFTER
4 MHz VCO
SEARCH
+ LIMIT DETECT
- LIMIT DETECT
R23 10K
R19 100K
U11A
U11B
R18 3830
R20 10K
R21 100K
R22 14.7K
C19 .01
C20 .01
C21 .01
CR2
CR1
C18 470pF
TUNE
+20V
-10V
C44 100pF
R24 1960
V TUNE
+10Vdc
CR3
C43 27pF
L12 28
L14 28
C39 56pF
C53 0.1
U6 (VCO)
+5.2V
L7 100
C40 2.2
C51 0.1
U5B (ECL)
L8 4.7
C41 .01
U5A (NOT USED)
U7G 1000
U7F 1000
U8A (ECL)
L9 100
C42 0.1
A10TP4
R RECT PH
U8B (ECL)
U7A 1000
U7B 1000
U7C 1000
U7E 1000

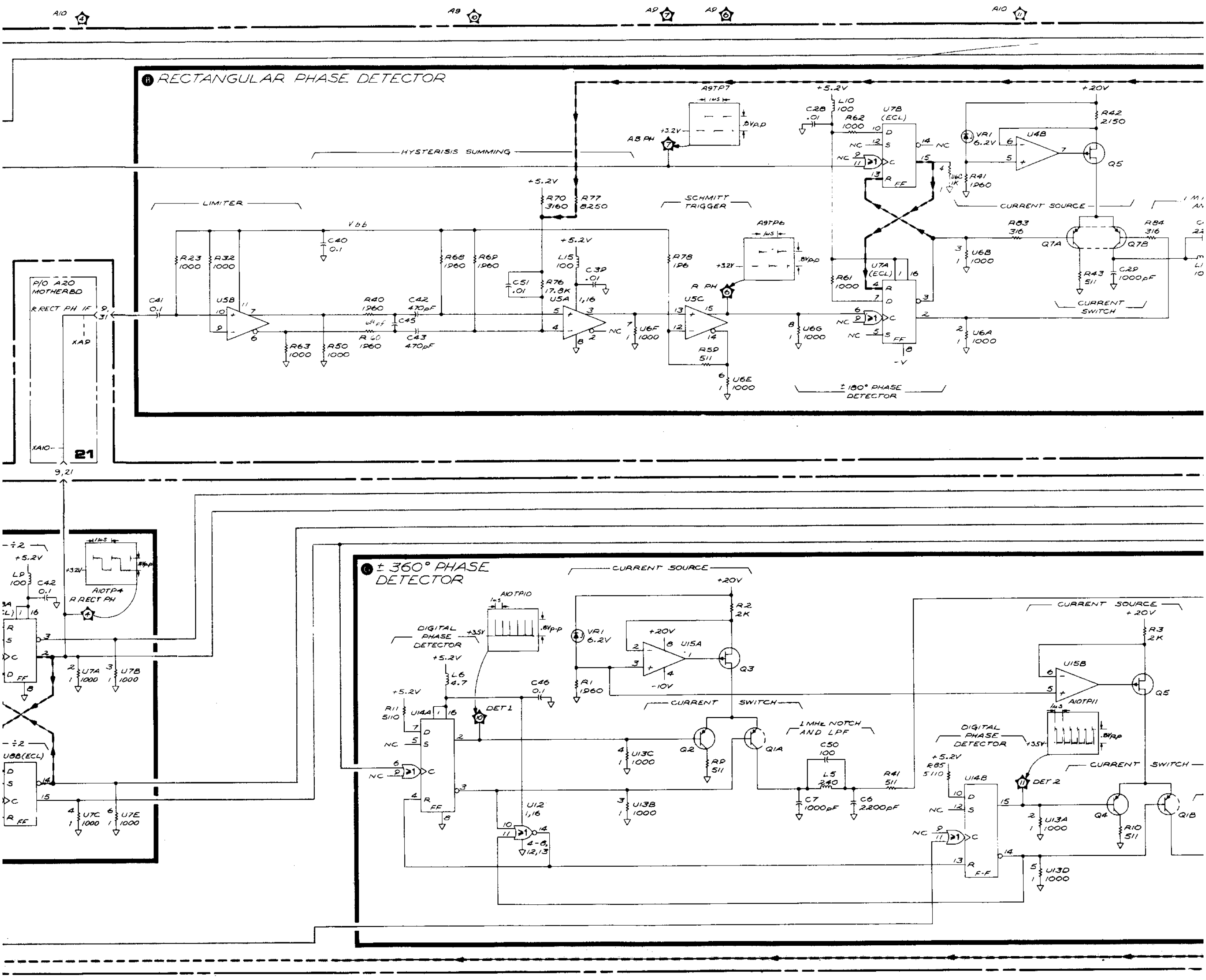
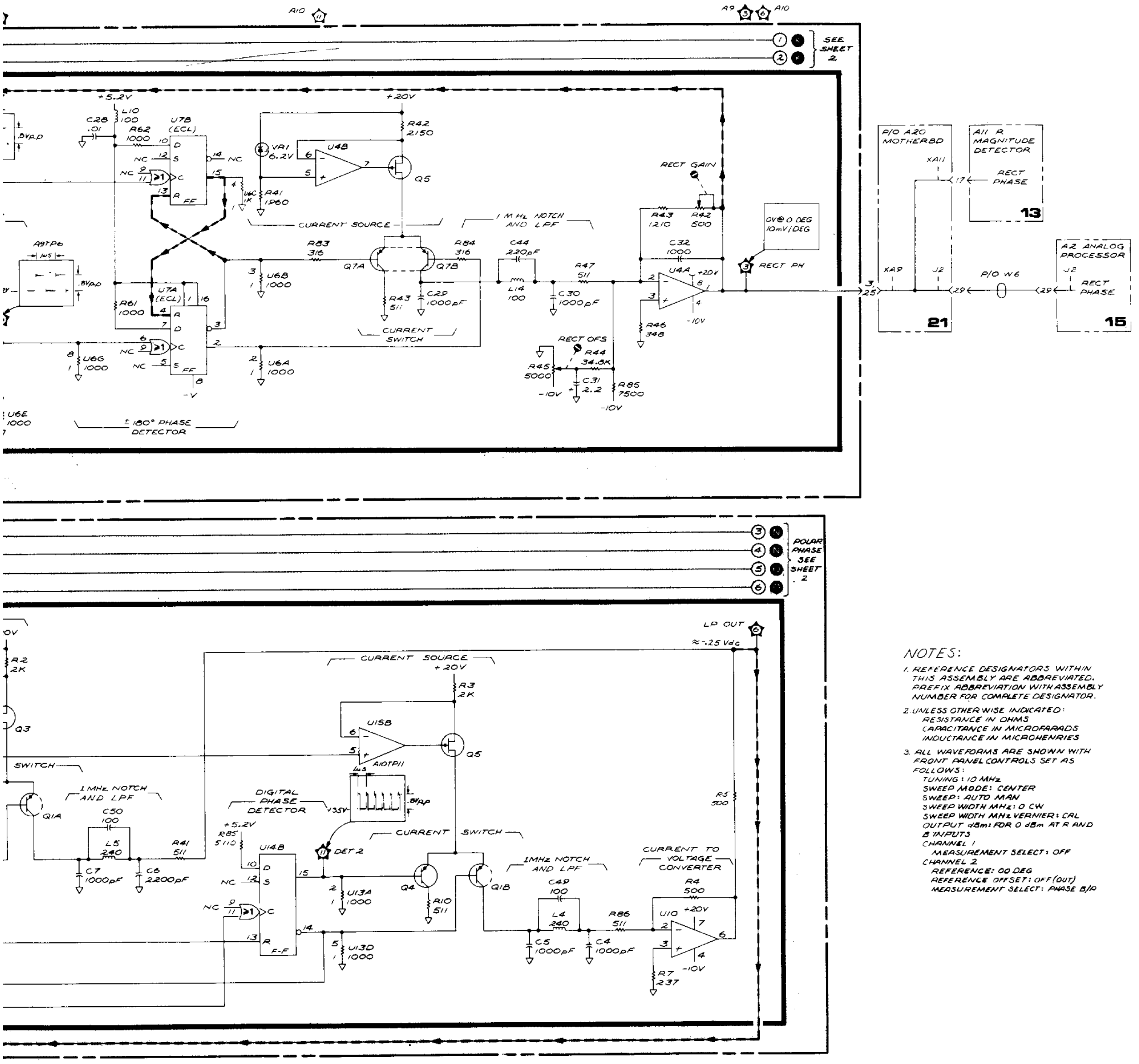


Figure 8-95. Phase Detec

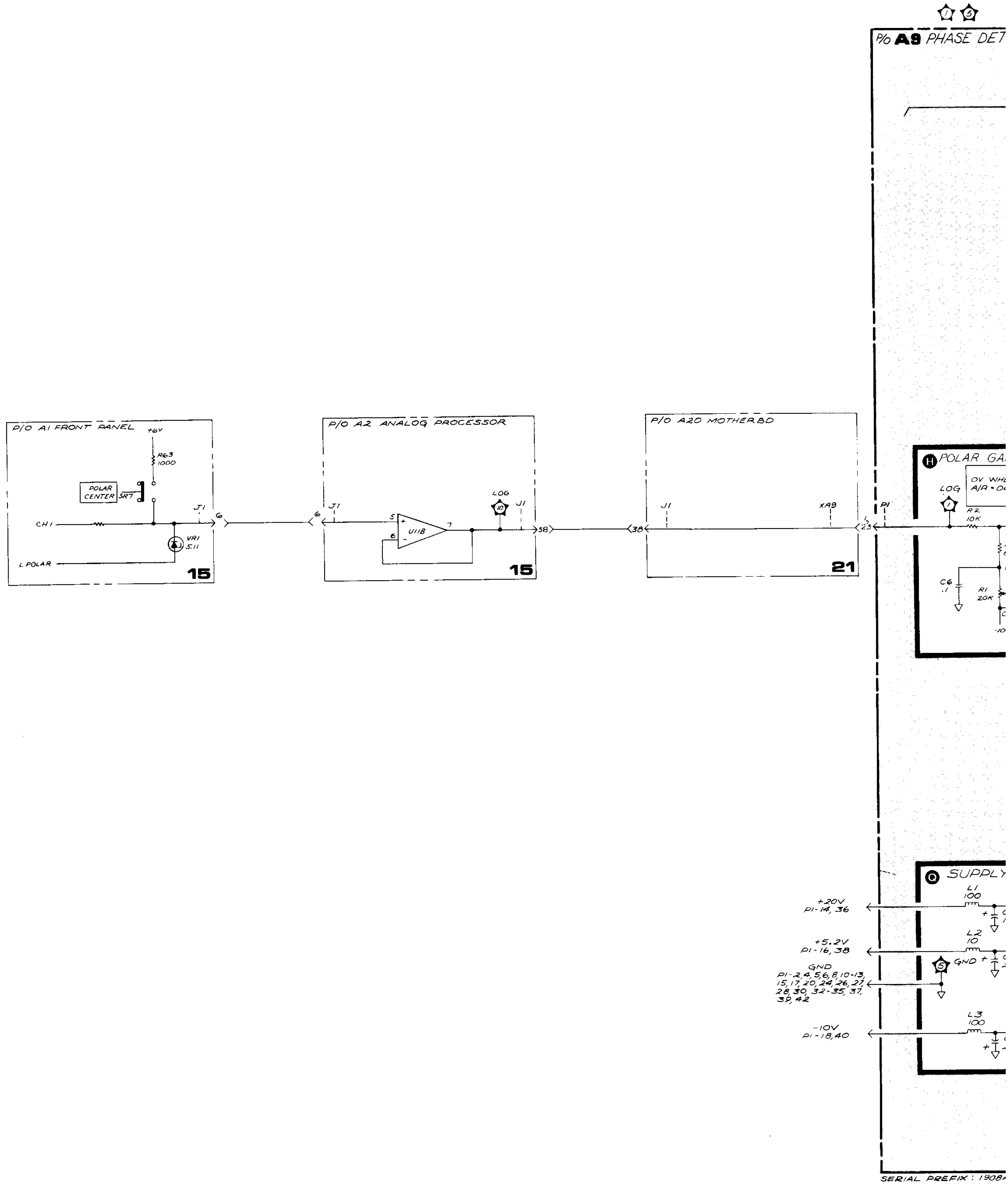


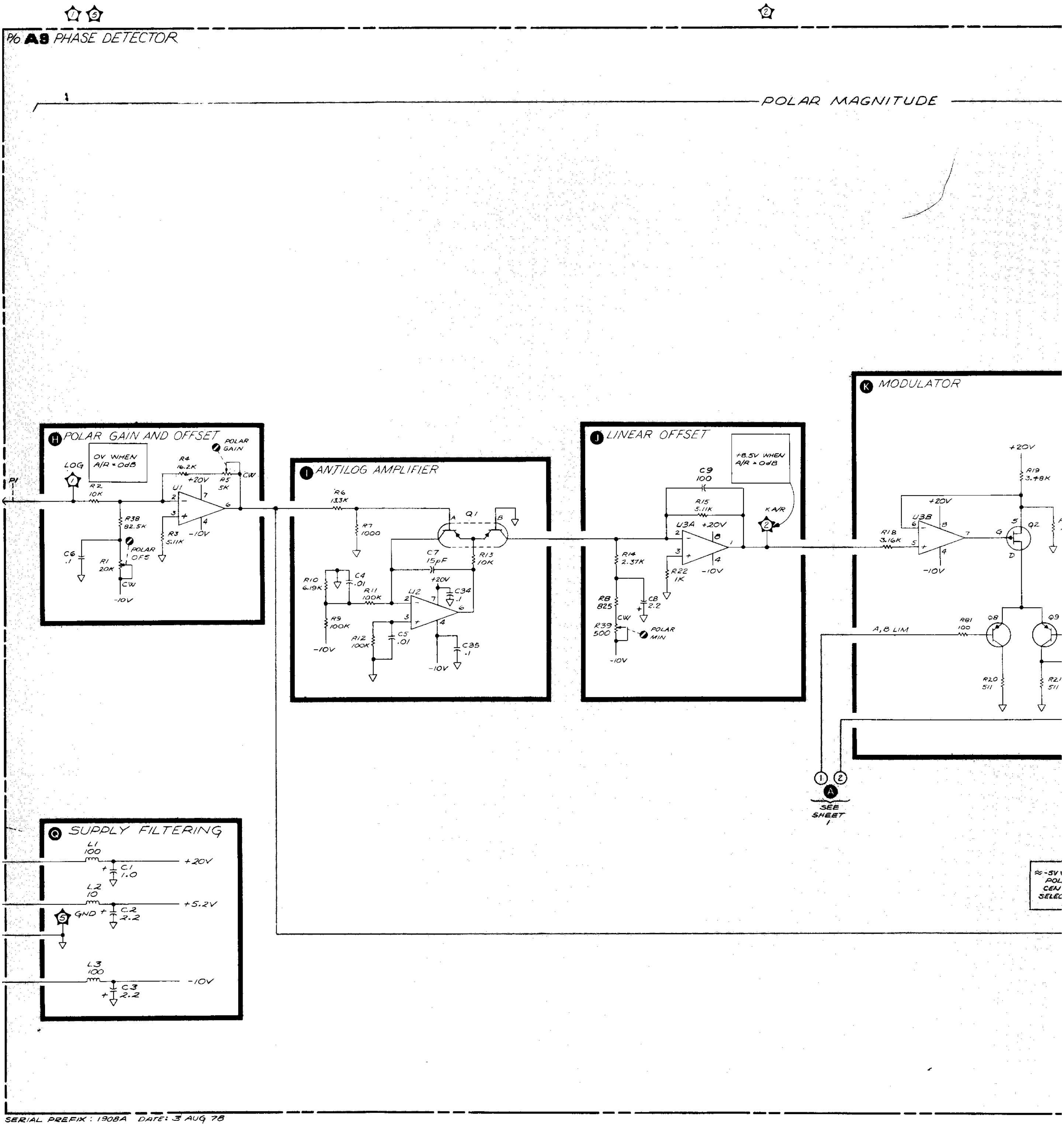
NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN MICROHENRIES
3. ALL WAVEFORMS ARE SHOWN WITH FRONT PANEL CONTROLS SET AS FOLLOWS:
   TUNING: 10 MHz
   SWEEP MODE: CENTER
   SWEEP: AUTO MAN
   SWEEP WIDTH MHz: 0 CW
   SWEEP WIDTH MHz VERNIER: CAL
   OUTPUT dBm: FOR 0 dBm AT R AND B INPUTS
   CHANNEL 1
     MEASUREMENT SELECT: OFF
   CHANNEL 2
     REFERENCE: 00 DEG
     REFERENCE OFFSET: OFF (OUT)
     MEASUREMENT SELECT: PHASE B/R

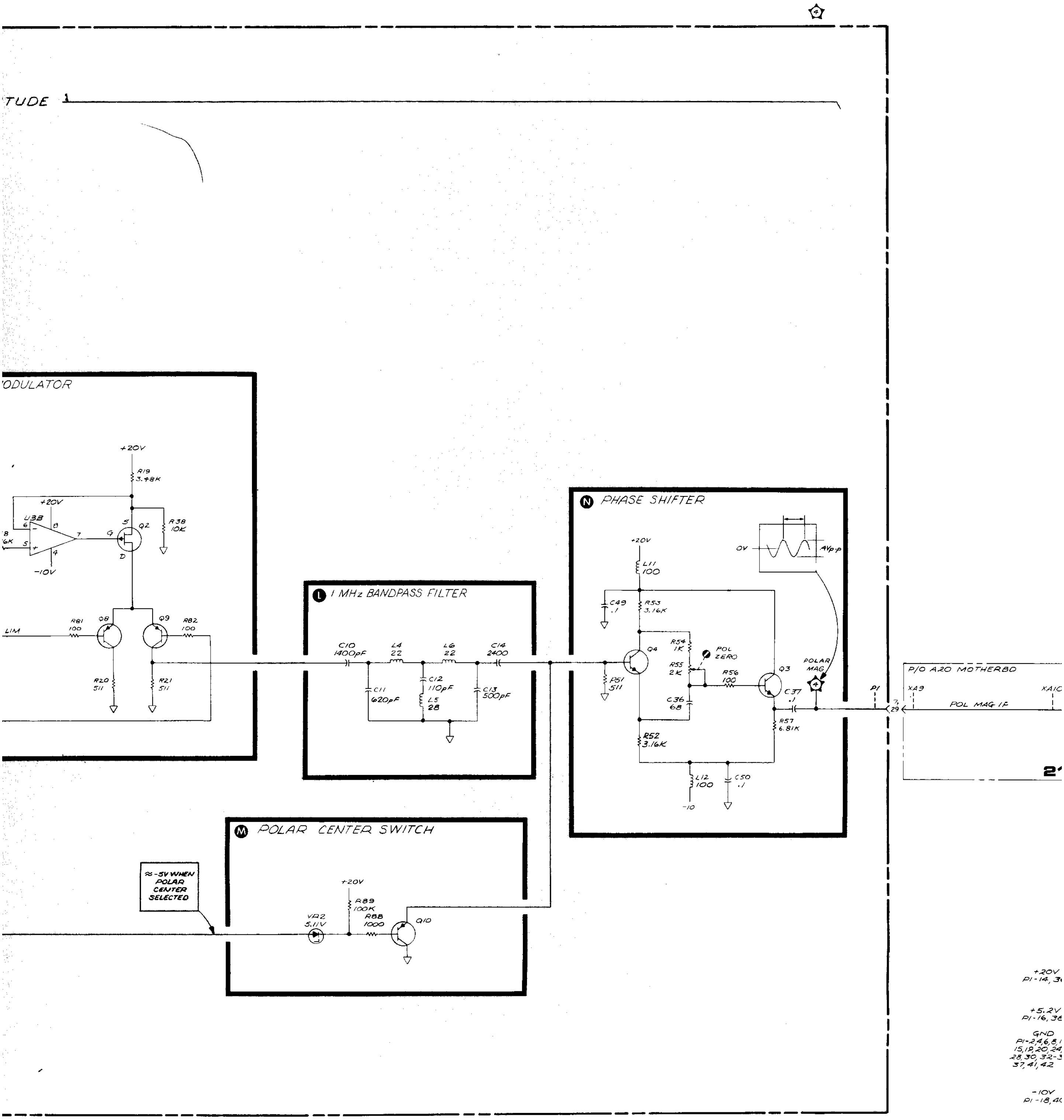
14
A9,A10

Figure 8-95. Phase Detector (A9) and Polar Converter (A10), Schematic Diagram (1 of 2)


P/O A9 PHASE DET
P/O A1 FRONT PANEL
R63 1000
POLAR CENTER SR7
CH1
L POLAR
VR1 5.11
J1
15
P/O A2 ANALOG PROCESSOR
U11B
LOG
15
P/O A20 MOTHER BD
J1
XA9
21
P1
POLAR GA
LOG
R2 10K
C6 .1
R1 20K
SUPPLY
+20V P1-14, 36
+5.2V P1-16, 38
GND P1-2,4,5,6,8,10-13, 15,17,20,24,26,27, 28,30,32-35,37, 39,42
-10V P1-18,40
L1 100
L2 10
L3 100
GND
SERIAL PREFIX : 1908



SERIAL PREFIX: 1908A DATE: 3 AUG 78



TUDE
ODULATOR
+20V
R19 3.48K
U3B
R38 10K
Q2
-10V
LIM
R81 100
Q8
Q9
R82 100
R20 511
R21 511
L 1 MHz BANDPASS FILTER
C10 1400pF
L4 22
L6 22
C14 2400
C11 620pF
C12 110pF
L5 28
C13 500pF
N PHASE SHIFTER
+20V
L11 100
C49 .1
R53 3.16K
Q4
R54 1K
POL ZERO
R55 2K
R56 100
Q3
C36 68
R51 511
C37 .1
R57 6.81K
R52 3.16K
L12 100
C50 .1
-10
0V
4Vp-p
POLAR MAG
P1
P/O A20 MOTHERBD
XA9
XA10
POL MAG IF
M POLAR CENTER SWITCH
≈-5V WHEN POLAR CENTER SELECTED
+20V
R89 100K
VR2 5.11V
R88 1000
Q10
+20V P1-14, 3
+5.2V P1-16, 38
GND P1-2,4,6,8, 15,19,20,24, 28,30,32-3 37,41,42
-10V P1-18,4

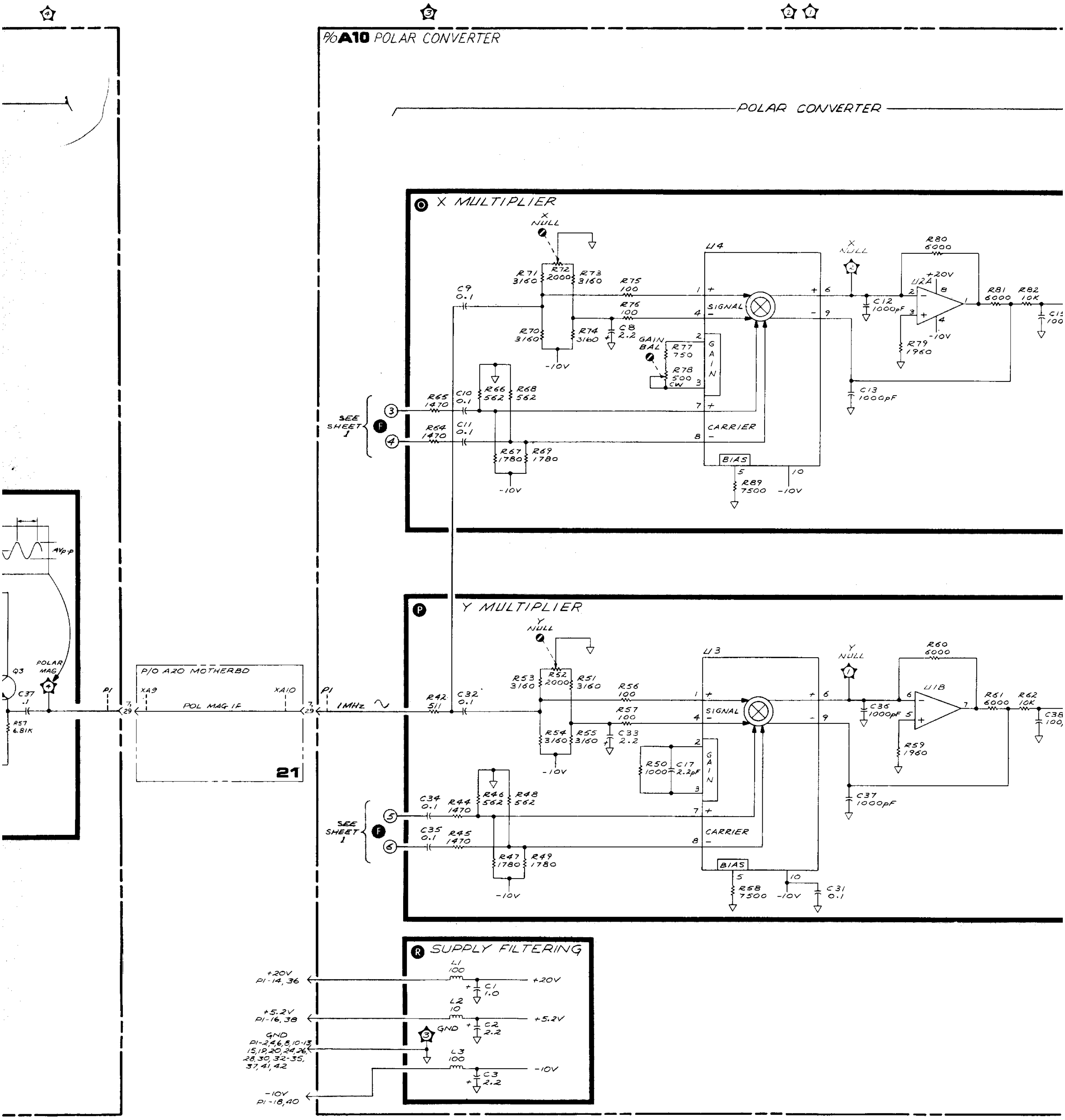


Figure 8-95. Phase Detec

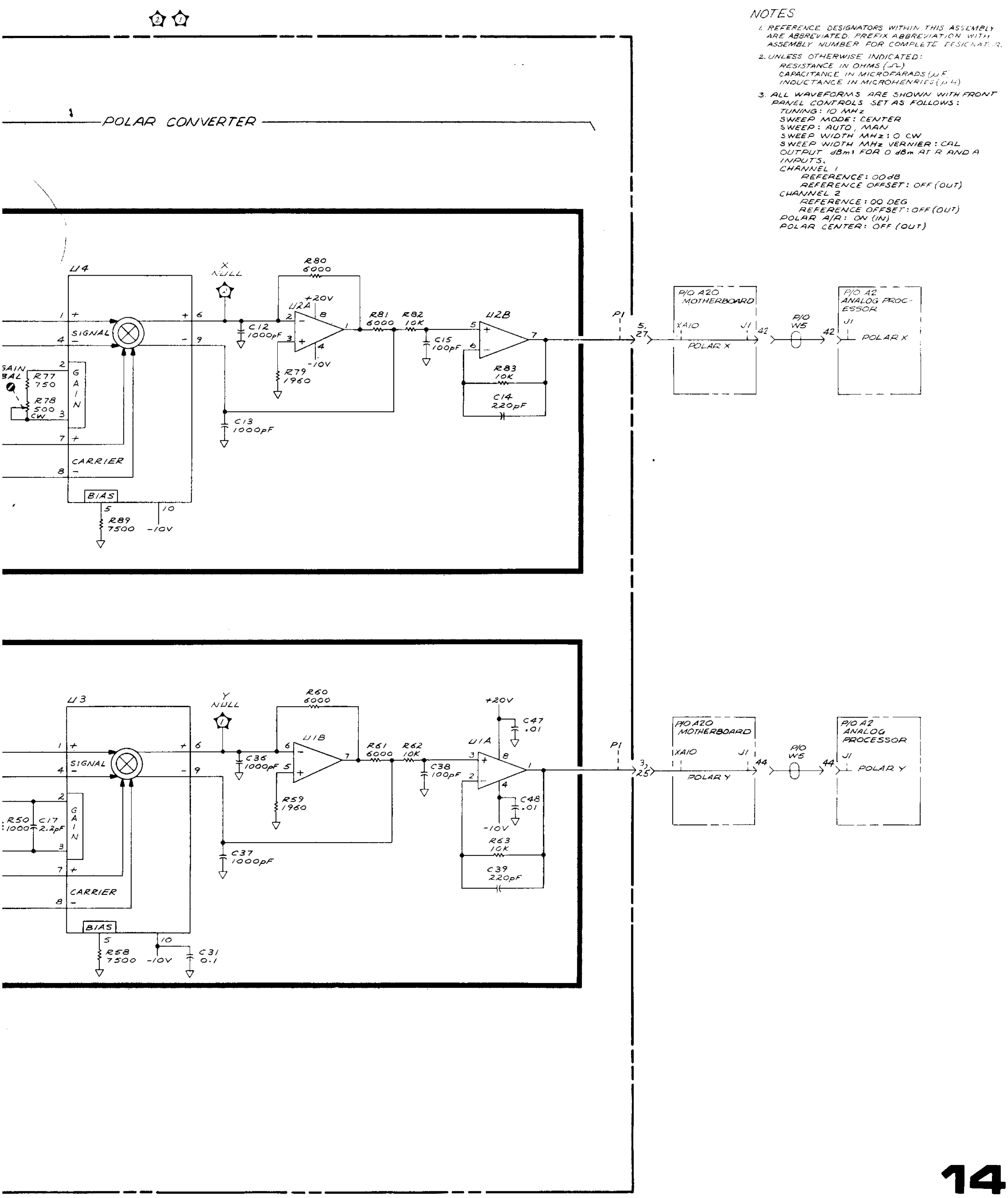


Figure 8-95. Phase Detector (A9) and Polar Converter (A10), Schematic Diagram (2 of 2)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 15

FRONT-PANEL CONTROL (A1) AND ANALOG PROCESSOR (A2), CIRCUIT DESCRIPTION

The Front-Panel Control (A1) and the Analog Processor (A2) together provide for the display of both absolute magnitude and ratio measurements in either Polar or Rectangular mode. Table 8-7 lists the possible selected displays, either alone or in combination, and Table 8-8 gives the switch positions for each measurement displayed.

NOTE

Descriptions of several front-panel circuits are not included in this circuit description. Refer to the following service sheets for that information: SWEEP, Sweep Generator, Service Sheet 5; FREQUENCY MHz, Digital Panel Meter, Service Sheet 6; TUNING and SWEEP WIDTH MHz, Frequency Reference, Service Sheet 6; OUTPUT dBm, RF Source, Service Sheet 7; MARKERS MHz, Marker Generator, Service Sheet 8, HORIZONTAL POSN and GAIN, Deflection Amplifiers, Service Sheet 16.

The Analog Processor (A2) receives the following input signals:

- H POLAR, L POLAR, and data for RATIO from the Front-Panel Control (A1)
- MAG from the A, B Detector (A8, Service Sheet 12)
- POLAR X and POLAR Y from the Polar Converter (A10, Service Sheet 14)
- R MAG from the R Detector (A11, Service Sheet 13)
- FREQ REF and LENGTH REF from the Frequency Reference (part of A15, Service Sheet 6)
- H ALT CH 2 from the Sweep Generator (A17, Service Sheet 5)
- L REM BUF from the Rectifier (A19, Service Sheet 18)
- L HOLD from the Phase Lock Control (A14, Service Sheet 11)

The Analog Processor (A2) provides the following output signals:

- CH 1 FLT and CH 2 FLT to the Deflection Amplifiers (A18) and to the rear-panel NORMALIZER INTERCONNECT.
- L CHAN 2 to the Deflection Amplifiers (A18)
- L OFF 1 and L OFF 2 to the rear-panel NORMALIZER INTERCONNECT
- PHASE OFFSET to the Polar Converter (A10)
- LOG K A/R to the Phase Detector (A9)
- L B INT to the Rectifier (A19)

Control Logic (A)

The purpose of the Control Logic circuit is to decode the Front-Panel Control (A1) switch positions, providing the appropriate signal outputs to other circuits of the Analog Processor (A2) and to other assemblies for display of the selected measurement or combination of measurements. The control logic is also affected by the state of the H ALT CH 2 signal from the Sweep Generator (A17). The output signals from the Control Logic circuit and their logic states for each selected display are shown in Table 8-7.

The Logic Control circuit is described for display of A magnitude only. For display of this measurement, the A switch A1S10B is closed (in). The other seven measurement select switches are in the position shown on the schematic. Since the A magnitude is displayed in the Rectangular Mode, the POLAR A/R switch A1S11 is open (out). OR gate A2U17A pin 2 is grounded through switch A1S10B-R, and pin 1 is either high or low, passing a high or low to AND gate A2U15A pin 1. Since the Channel 2 B, B/R, and PHASE B/R switches are all open, pin 2 is low; therefore, the output of the AND gate (pin 3) is also low. NAND

Table 8-7. Control Logic Summary

SELECTED DISPLAY	H ALT CH 2[1]	❶	❷	H DSP R[2]	H POLAR[3]	L CHAN 2[4]	L OFF 1[5]	L OFF 2[5]	RATIO[6]	L B INT[7]
R (Both OFF switches in)	X	+5V	+5V	HIGH	LOW	HIGH	HIGH	LOW	LOW	LOW
A only	X	+5V	+5V	LOW	LOW	HIGH	HIGH	LOW	LOW	HIGH
A and B	HIGH	+5V	+5V	LOW	LOW	LOW	HIGH	HIGH	LOW	LOW
	LOW	+5V	+5V	LOW	LOW	HIGH	HIGH	HIGH	LOW	HIGH
A and B/R	HIGH	+5V	+5V	LOW	LOW	HIGH	HIGH	HIGH	LOW	HIGH
	LOW	+5V	+5V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
A and PHASE B/R	HIGH	+5V	0V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
	LOW	+5V	0V	LOW	LOW	HIGH	HIGH	HIGH	LOW	HIGH
A/R only	X	+5V	+5V	LOW	LOW	HIGH	HIGH	LOW	HIGH	HIGH
A/R and B	HIGH	+5V	+5V	LOW	LOW	LOW	HIGH	HIGH	LOW	LOW
	LOW	+5V	+5V	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
A/R and B/R	HIGH	+5V	+5V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
	LOW	+5V	+5V	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
A/R and PHASE B/R	HIGH	+5V	0V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
	LOW	+5V	0V	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
B/R, Channel 1 only	X	+5V	+5V	LOW	LOW	HIGH	HIGH	LOW	HIGH	LOW
B/R, Channel 2 only	X	+5V	+5V	LOW	LOW	LOW	LOW	HIGH	HIGH	LOW
B/R, Channels 1 and 2	HIGH	+5V	+5V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
	LOW	+5V	+5V	LOW	LOW	HIGH	HIGH	HIGH	HIGH	LOW
B/R and PHASE B/R	HIGH	+5V	0V	LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW
	LOW	+5V	0V	LOW	LOW	HIGH	HIGH	HIGH	HIGH	LOW
B only	X	+5V	+5V	LOW	LOW	LOW	LOW	HIGH	LOW	LOW
PHASE B/R only	X	+5V	0V	LOW	LOW	LOW	LOW	HIGH	HIGH	LOW
POLAR A/R	X	0V	+5V	LOW	HIGH	HIGH	HIGH	LOW	HIGH	HIGH

[1] From Sweep Generator (A17)

[2] To A, B Detector (A8). High only when R is selected.

[3] To Phase Offset circuit and to Deflection Amplifiers (A18). High only when POLAR A/R is selected.

[4] To Deflection Amplifiers **(A18)**. High selects Channel 1; low selects Channel 2.

[5] To rear-panel NORMALIZER INTERCONNECT.

[6] To A2U18B in Ratio Absolute Select circuit.

[7] To Rectifier (A19). High selects A and low selects B on IF Switch (A6).

❶ To Polar Center and Video Filter circuits. +5V for all Rectangular displays; 0V only when POLAR A/R is selected.

❷ To CH 2 Summing Amplifier circuit. 0V when PHASE B/R is selected.

gate A2U19A pin 1 is low, and pin 2 is high because of the +5V through switch A1S11-R. The output of the NAND gate is high, so the L CHAN 2 signal to the Deflection Amplifiers (A18) is high, selecting Channel 1. (Refer to the circuit description of A18.)

NAND gate A2U19D pin 12 is low and pin 13 is high, so the high output is applied to OR gate A2U17D pin 12 (pin 13 is low), placing a high on the L OFF 1 line to the NORMALIZER INTERCONNECT and activating Channel 1 in the Normalizer.

AND gate A2U15B pins 4 and 5 are high and low, respectively, so the L OFF 2 line to the Normalizer is low, turning off Channel 2.

OR gate A2U17B pin 4 is high (from A2U19A pin 3) and NAND gate A2U19B pin 5 is low (switch A1S10B – L is open). Therefore, pin 6 is high, so the high at AND gate A2U15C pin 8 is applied to NAND gate A2U19C pin 10. Pin 9 is also high (+5V through POLAR A/R switch A1S11 – R), so the RATIO line to the Ratio/Absolute Select circuit is low.

Switch A1S12D-R is open, so +5V is applied to the CH 2 Summing Amplifier circuit, clamping any phase signal that might be present. Switch A1S11-R is open, so +5V is applied to the Polar Center circuit clamping the LOG K A/R signal; the H POLAR line to the Phase Offset circuit and to A18 is low. The H DSP R (R Display) line to A8 is low because of the open OFF switches. (This line is high only when both OFF switches are closed and the POLAR A/R switch is open.)

Table 8-8. Display Switching

Switch	Channel 1				Ch 1, Ch 2	Channel 2		
	A	A/R	B/R	R*	POLAR A/R	B	B/R	PHASE B/R
IF Switch (P/O A6)	A	A	B	X	A	B	B	B
A, B or R Select (P/O A8)	A,B	A,B	A,B	R	A,B	A,B	A,B	A,B
Ratio/Absolute Select (A2U18A)	Abs.	Ratio	Ratio	Abs.	Ratio	Abs.	Ratio	Ratio
Ch 1 OFFSET (A1S5-L)	Closed (In)	Closed (In)	Closed (In)	Closed (In)	Closed (In)	X	X	X
POLAR A/R (A1S11-L)	Rect (Out)	Rect (Out)	Rect (Out)	Rect (Out)	Polar (In)	Rect (Out)	Rect (Out)	Rect (Out)
REFERENCE POSITION Ch 1 (A1S1-R)	Closed (Out)	Closed (Out)	Closed (Out)	Closed (Out)	X	X	X	X
Rect/Hold/Polar Ch 1 (A2U5B)	Rect	Rect	Rect	Rect	Polar	Rect (X)	Rect (X)	Rect (X)
Ch 2 OFFSET (A1S6-L)	X	X	X	X	Closed (In)	Closed (In)	Closed (In)	Closed (In)
Rect/Polar Select (A2U18B)	Rect	Rect	Rect	Rect	Polar	Rect	Rect	Rect
PHASE B/R (A1S12D-L)	Mag (Out)	Mag (Out)	Mag (Out)	Mag (Out)	X	Mag (Out)	Mag (Out)	Phase (In)
REFERENCE POSITION Ch 2 (A1S2-R)	X	X	X	X	X	Closed (Out)	Closed (Out)	Closed (Out)
Rect/Hold/Polar Ch 2 (A2U5A)	Rect (X)	Rect (X)	Rect (X)	Rect (X)	Polar	Rect	Rect	Rect

*Both OFF pushbuttons depressed and POLAR A/R in Rectangular (out).
Note: X means function is not affected by switch position.

Both inputs to AND gate A2U15D are high (+5V through the A switch A1S10B – L and a high from A2U19A pin 3), so a high through OR gate A2U17C places a high on the L B INT line to the Rectifier Board (A19). This eventually selects the A input to the A(B) Detector (A8) via the IF Switch (part of A6). (Refer to the IF Switch descriptions in Service Sheets 12 and 18.)

Ratio/Absolute Select ©

When the RATIO line to A2U18B pin 9 is high, the R signal from the R Detector (A11) is passed through operational amplifiers A2U16B (inverting) and A2U16A (non-inverting) to the Ch 1 and Ch 2 Summing Amplifiers. When the RATIO line is low, the FREQ REF signal from the Frequency Reference (part of A15) is passed through the non-inverting op amp only. The FREQ REF signal helps to compensate for the slope of the A and B magnitude inputs to the A, B Detector (A8).

Ch 1 Summing Amplifier B

The CHANNEL 1 REFERENCE level is set by lever switch A2S1. The level is in dB/division for A/R and POLAR A/R or in dBm/division for A or R. The CHANNEL 1 REFERENCE, CHANNEL 1 REFERENCE OFFSET (from A1), the output of the Ratio/Absolute Select circuit, and the MAG signal from A8 are summed at the inverting input to op amp A2U21. Display scaling of the Ch 1 Summing Amplifier is determined by the setting of switch A1S15.

When the -R signal is selected by A2U18B and the A magnitude (for example) is represented by MAG, the sum is A−R. Since the signals are logarithmic, this is equivalent to the ratio A/R.

The feedback circuit limits the output of A2U21, which is sent to the Polar Center circuit and to the Ch 1 Rectangular Reference Position circuit. In Polar mode, the gain is set for 10 dB/div by A1S11A.

Ch 2 Summing Amplifier D

The Ch 2 Summing Amplifier circuit is similar to the CH 1 Summing Amplifier circuit with two exceptions. In PHASE B/R operation, switch A1S12D–L disconnects the MAG input to op amp A2U22 and connects the RECT PHASE signal from the Phase Detector (A9). The Control Logic circuit removes +5V from the base of A2Q4, turning it on and providing a path to ground for the MAG signal. This eliminates interaction between the CHANNEL 1 lever switch and CHANNEL 2 REFERENCE OFFSET in PHASE B/R.

Phase Offset E

The Phase Offset circuit provides not only a calibrated offset but also an electrical length compensation during phase measurements. PHASE B/R LENGTH potentiometer A1R33 and POLAR A/R LENGTH potentiometer A1R36 scale the LENGTH REF signal from the Frequency Reference (part of A15). The signal that is passed through switch A2U18C is determined by the state of the H POLAR line from the Control Logic circuit. The length compensation signal and the Channel 2 Reference Offset signal from A2U20B are summed in A2U20A to provide the PHASE OFFSET signal to the Polar Converter (A10).

When the L REM BUF line from the Rectifier Board (A19) is low, switch A2U18A disconnects the input to A2U20A to disable the output from the Phase Offset circuit.

Polar Magnitude F

The Polar Magnitude circuit allows amplitude information to be passed to the Phase Detector (A9, Service Sheet 14) in Polar operation only. Depressing the POLAR CENTER switch turns off the amplitude information by driving amplifier A2U11B into saturation. This causes a dot to be placed in the center of the CRT for proper positioning of the display.

In Rectangular operation, +5V is applied to the zener diode A1VR1 to prevent interaction between the phase offset and the LOG K A/R signal.

In Polar operation the gain of CH 1 Summing Amplifier is set to 10 dB/div by A1S11A. The zener diode is turned off, and A2U11B acts as a buffer to pass the LOG K A/R signal (amplitude information) to the Phase Detector (A9), where the log signal is converted to a linear signal. After processing in the Polar Converter (A10), the dc POLAR X and POLAR Y signals are sent to the POLAR X and Y Position circuits. (Refer to the circuit descriptions of A9 and A10.)

POLAR Y Position I

The POLAR Y Position circuit sums the vertical centering information (adjusted by POLAR CENTER potentiometer A1R53) with the POLAR Y signal, applies the summed signal to operational amplifier A2U10B, and sends a Y signal to the Ch 1 Video Filter circuit.

POLAR X Position J

The POLAR X Position circuit is identical to the POLAR Y Position circuit. The output signal X is sent to the Ch 2 Video Filter circuit.

Ch 1 Rectangular Reference Position G

When the REFERENCE POSITION CH 1 switch A1S1-R is opened, the reference level may be established by REFERENCE POSITION CH 1 potentiometer A1R29. When the switch is closed (out), the reference information is summed with the input signal and amplified by A2U10A to produce the BUFF 1 signal to the Ch 1 Video Filter circuit.

Ch 2 Rectangular Reference Position (H)

This circuit is identical to the CH 1 Rectangular Reference Position circuit. The output, BUFF 2, is sent to the CH 2 Video Filter circuit.

Hold Buffer (K)

The Hold Buffer circuit normally enables analog switches A2U5A and A2U5B, allowing either Rectangular or Polar information to be passed. During the phase lock loop acquisition sequence, the L FP HOLD line from the Phase Lock Control (A14) goes low. This causes the output of A2U11A to go high, diode A2CR5 is turned on, and new information is not allowed to pass through the switches A2U5A and A2U5B. The signal level at the time the phase lock loop was unlocked is held on the CRT until the loop acquisition sequence is complete.

Ch 1 Video Filter (L)

This circuit provides video filtering and also provides the means to hold a signal during the acquisition sequence. Rect/Hold/Polar switch A2U5B is normally enabled, and the state of the H POLAR line determines the source of the input signal.

Video Filtering is accomplished by A2C8, A2C18, A2R90, A2C17, and A2R46. Rolloff is at about 10 kHz. VIDEO FILTER 100 Hz switch S17-L provides rolloff at about 100 Hz to improve signal definition when the instrument noise level is high; e.g., at low signal levels.

The output signal, CH 1 FLT, is sent to the Deflection Amplifiers (A18).

Ch 2 Video Filter (M)

The operation of this circuit is identical to that of the Ch 1 Video Filter circuit. The output, CH 2 FLT, is sent to the Deflection Amplifiers (A18).

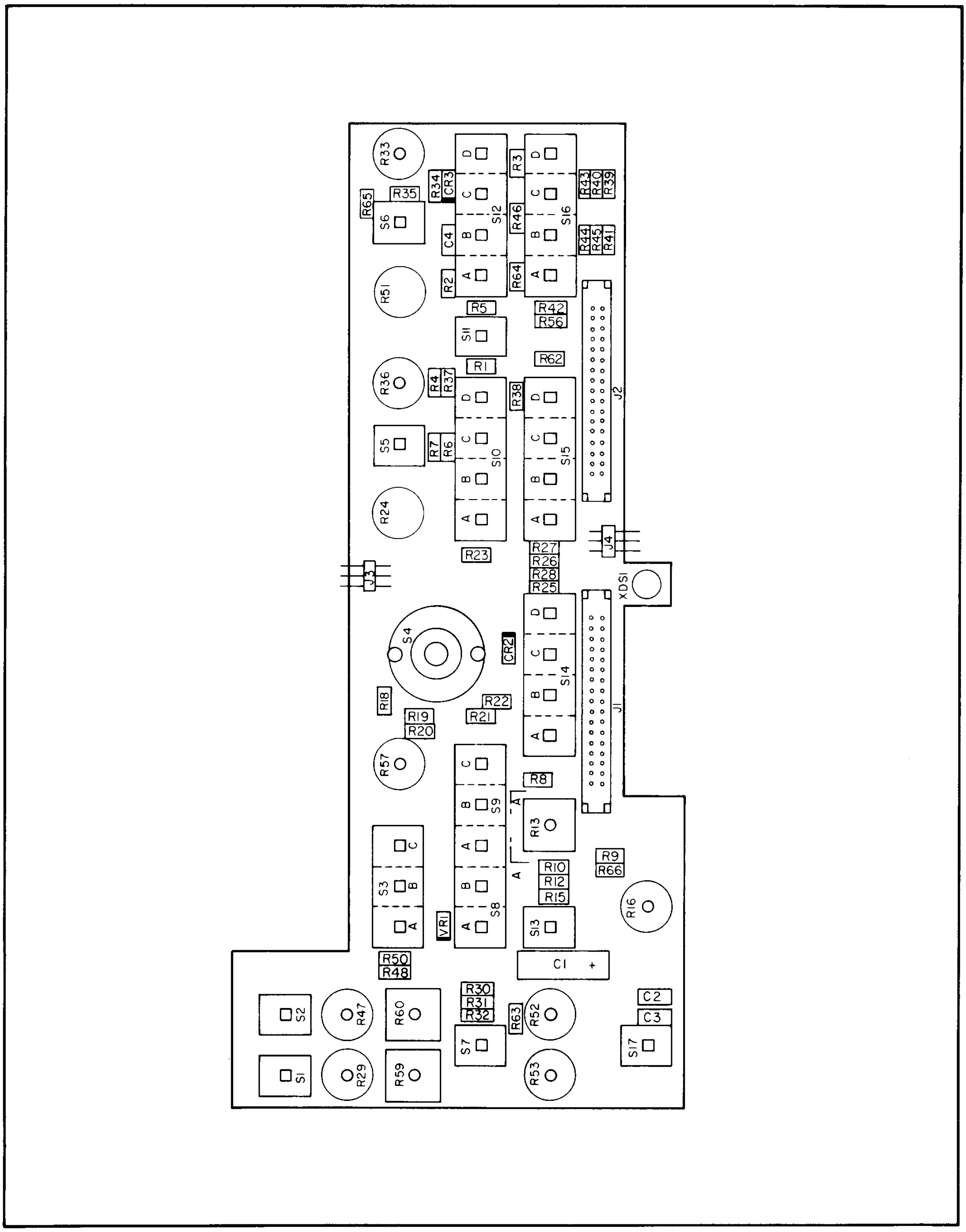


Figure 8-96. Front Panel (A1), Component Locations

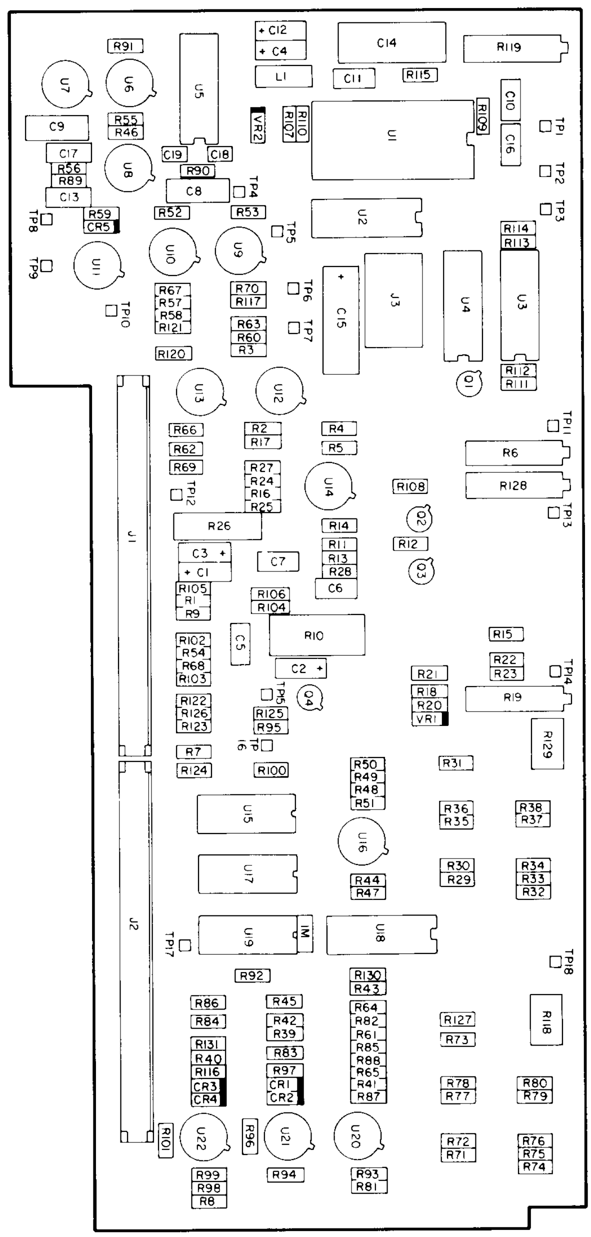
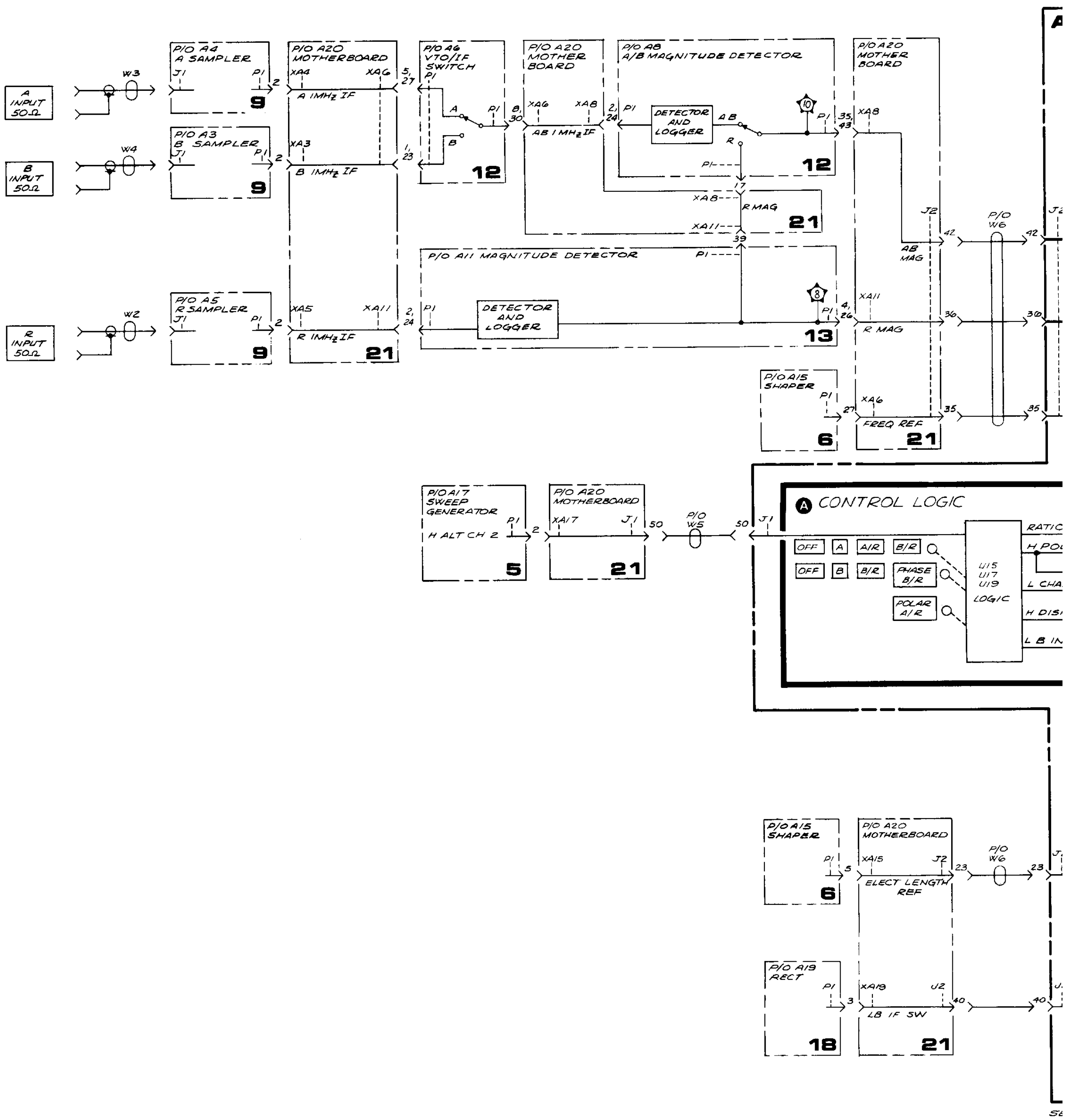
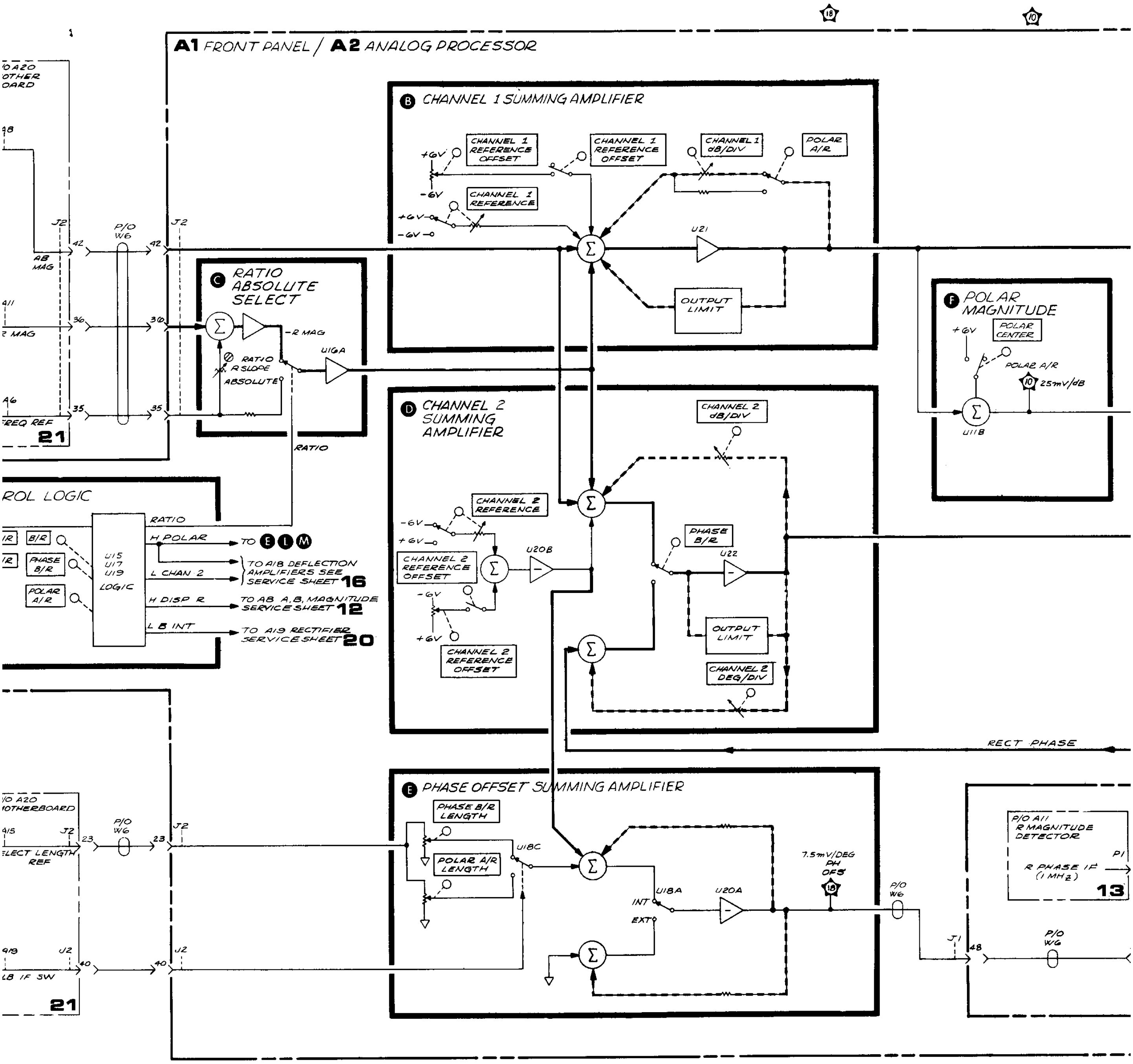


Figure 8-97. Analog Processor (A2), Component Locations

del 8754A



A INPUT 50Ω
B INPUT 50Ω
R INPUT 50Ω
W3
W4
W2
P/O A4 A SAMPLER
P/O A3 B SAMPLER
P/O A5 R SAMPLER
P/O A20 MOTHERBOARD
A 1MHz IF
B 1MHz IF
R 1MHz IF
P/O A6 V70/IF SWITCH
P/O A20 MOTHER BOARD
AB 1MHz IF
P/O A8 A/B MAGNITUDE DETECTOR
DETECTOR AND LOGGER
R MAG
P/O A11 MAGNITUDE DETECTOR
AB MAG
FREQ REF
P/O A15 SHAPER
P/O A17 SWEEP GENERATOR
H ALT CH 2
P/O W5
P/O W6
CONTROL LOGIC
OFF
A
A/R
B/R
B
PHASE B/R
POLAR A/R
U15 U17 U19 LOGIC
ELECT LENGTH REF
P/O A19 RECT
LB IF SW



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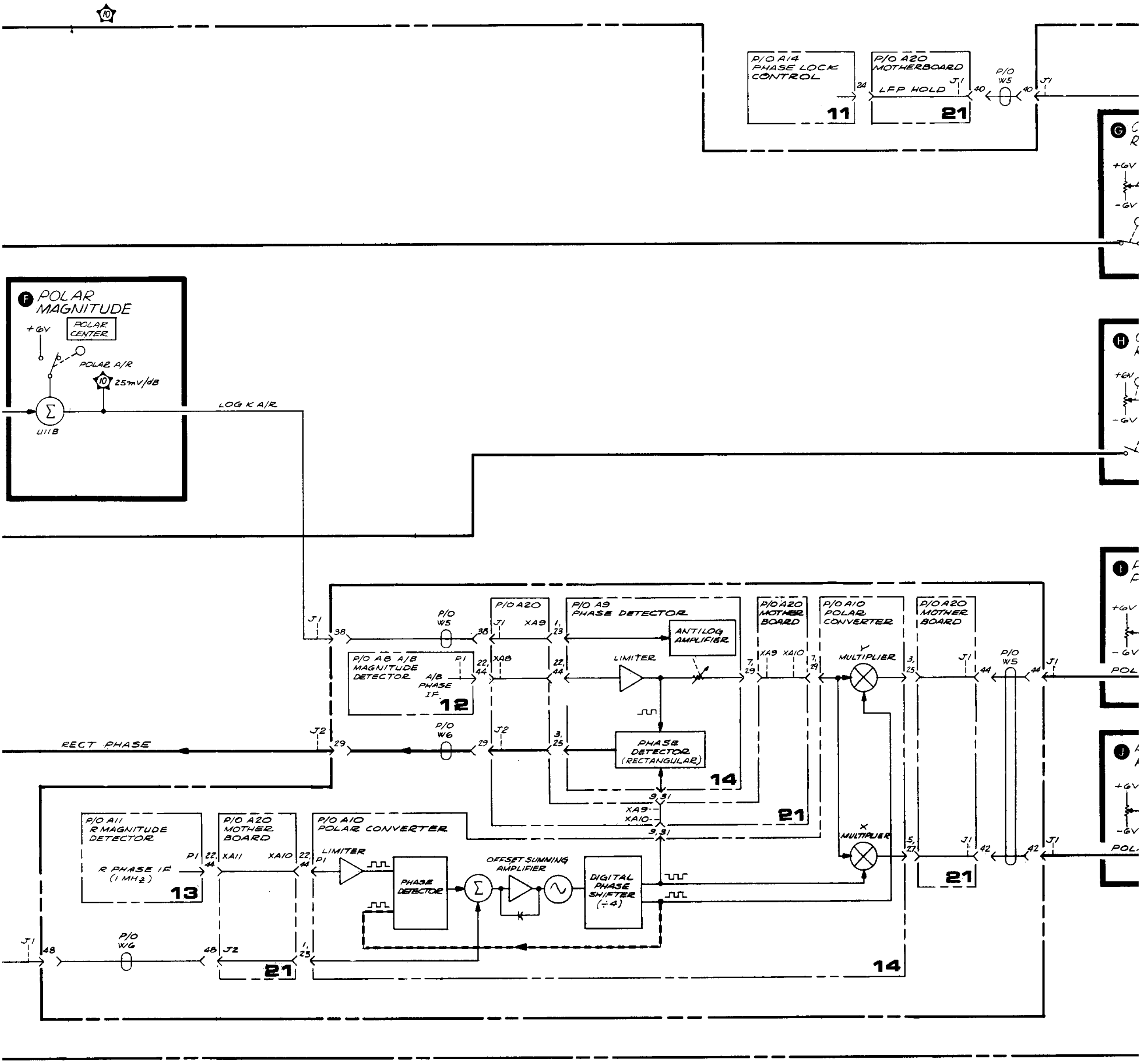

P/O A14 PHASE LOCK CONTROL
11
P/O A20 MOTHERBOARD
LFP HOLD
21
P/O W5
J1
POLAR MAGNITUDE
+6V
POLAR CENTER
POLAR A/R
25mV/dB
U11B
LOG K A/R
RECT PHASE
P/O W5
P/O A20
XA9
P/O A9 PHASE DETECTOR
ANTILOG AMPLIFIER
P/O A8 A/B MAGNITUDE DETECTOR
A/B PHASE IF
12
LIMITER
PHASE DETECTOR (RECTANGULAR)
14
P/O W6
J2
P/O A20 MOTHER BOARD
XA9 XA10
21
P/O A10 POLAR CONVERTER
Y MULTIPLIER
X MULTIPLIER
P/O A20 MOTHER BOARD
21
P/O A11 R MAGNITUDE DETECTOR
R PHASE IF (1 MHz)
13
P/O A20 MOTHER BOARD
XA11 XA10
P/O A10 POLAR CONVERTER
LIMITER
PHASE DETECTOR
OFFSET SUMMING AMPLIFIER
K
DIGITAL PHASE SHIFTER (÷4)
14
P/O W6
21

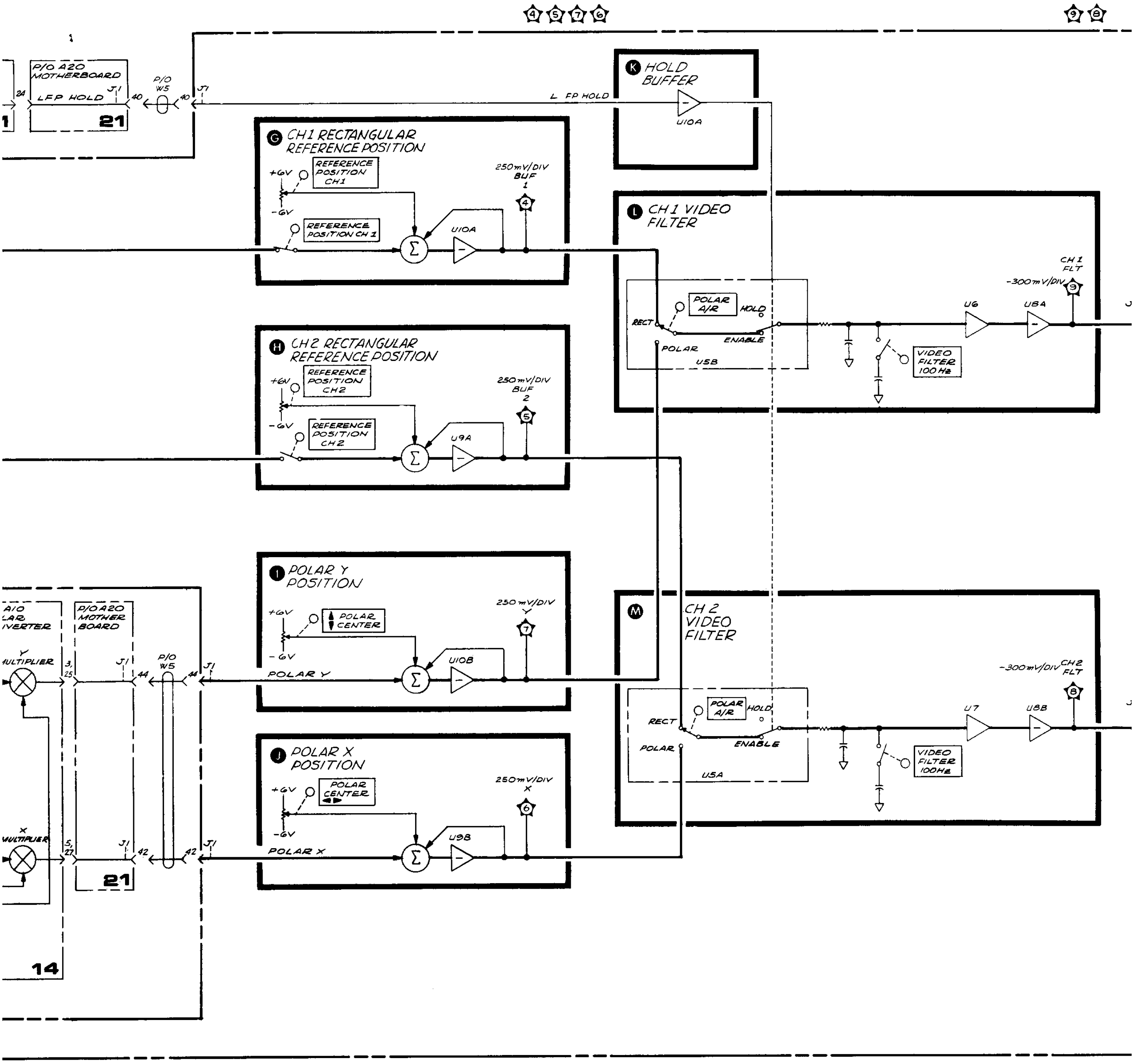
P/O A20 MOTHERBOARD
LFP HOLD
21
P/O W5
L FP HOLD
HOLD BUFFER
U10A
CH1 RECTANGULAR REFERENCE POSITION
REFERENCE POSITION CH1
+6V
-6V
250mV/DIV BUF 1
CH1 VIDEO FILTER
POLAR A/R
HOLD
RECT
ENABLE
POLAR
U5B
U6
U8A
CH1 FLT
-300mV/DIV
VIDEO FILTER 100 Hz
CH2 RECTANGULAR REFERENCE POSITION
REFERENCE POSITION CH2
250mV/DIV BUF 2
U9A
POLAR Y POSITION
POLAR CENTER
250mV/DIV Y
U10B
POLAR Y
CH 2 VIDEO FILTER
CH2 FLT
U7
U8B
U5A
POLAR X POSITION
250mV/DIV X
U9B
POLAR X
P/O A20 MOTHER BOARD
MULTIPLIER
14

Figure 8-9

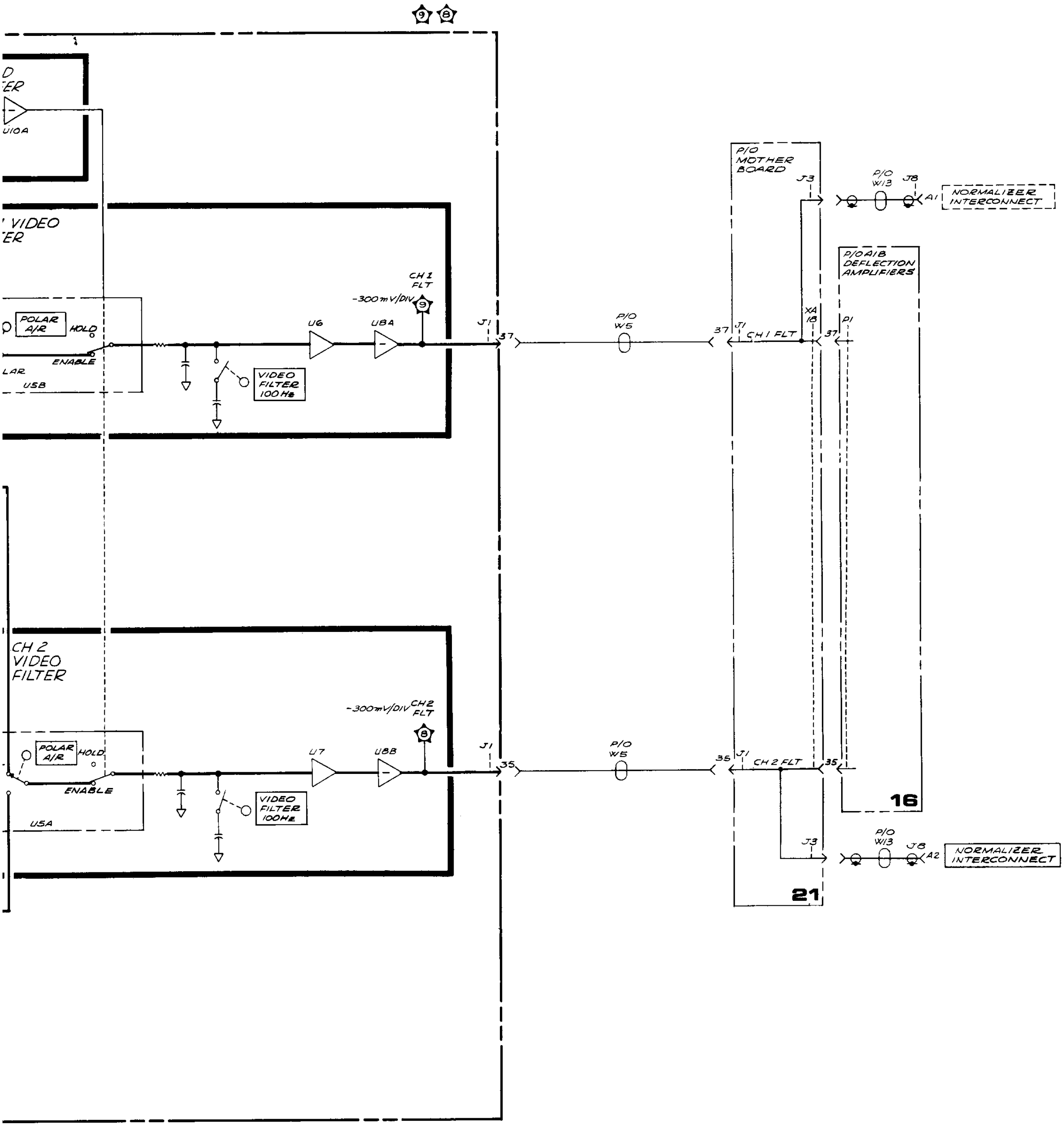

Figure 8-98. Front Panel (A1) and Analog Processor (A2), Block Diagram

A1 FRONT PANEL

J1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET
1	HORIZ POSN	A2J1-1		16
2	POS 2	A2J1-2(W5)	H	
3	CH 1 VIDEO FLT	A2J1-3(W5)	L	
4	POS 1	A2J1-4(W5)	G	
5	CH 2 VIDEO FLT	A2J1-5(W5)	M	
6	POLAR CNTR	A2J1-6(W5)	F	
7	H DBLR	A13P1-44		11
8	HORIZ GAIN	A2J1-8		16
9	POLAR CNTR ◀▶ (X)	A2J1-9(W5)	J	
10	POLAR CNTR ▲▼ (Y)	A2J1-10(W5)	I	
11	-10V	A16P1-9,31	N	
12	OUTPUT dBm	A7P1-6,12 A12P1-11,35		7,8
13	L UNLOCK LED	A14P1-1		11
14	+20V	A16P1-3,25	N	
15	L SNGL	A17P1-26		5
16	L MAN	A17P1-5,27		5
17	SWEEP SPEED VERNIER	A17P1-1		5
18	CURRENT SOURCE	A17P1-24		5
19	NC			
20	SWEEP INTEG C	A17P1-28		5
21	L MKR 1	A12P1-8,30		8
22	L FAST SWP	A17P1-41		5
23	VSWP	A17P1-18,40		5
24	H AUTO	A17P1-11,33		5
25	L MKR 10	A12P1-9,31		8
26	H TRIG	A17P1-12-34		5
27	L MKR 50	A12P1-10,32		8
28	FREQ CAL	A2J1-28		6
29	WIDTH 20-1K	A15P1-8,30		6
30	CNTR FREQ	A2J1-30		6
31	WIDTH 1-10	A15P1-7,29		6
32	H FULL	A15P1-9,31 A12P1-7,29		6,8
33	+15V PP	A16P1-1		20
34	-12V PP	A20U1 OUT		20

J2

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET
1	▽	TUNING POT (GND PLANE)		6
2	▽2	GND PLANE	N	
3	FINE WIPER	A15P1-3,25		6
4	TUNING WIPER	A15P1-2,24		6
5	FREQ WIDTH VOLTAGE	A2J2-5		6
6	L PH B/R	A2J2-6(W6)	D	
7	TUNING V REF	A15P1-4,26		6
8	-6V	A2J2-8	N	
9	MKR WIDTH A	A12P1-12,34		8
10	+6V	A2J2-10	N	
11	MKR WIDTH B	A12P1-13,35		8
12	H A	A2J2-14(W6)	A	
13	FREQ WIDTH VERN	A2J2-13		6
14	H CH 1 RATIO	A2J2-14(W6)	A	
15	▽1	GND PLANE	N	
16	▽1	GND PLANE	N	
17	L CH 1 ON	A2J2-17(W6)	A	
18	SCALED CH 1	A2J2-18(W6)	B	
19	POLAR LENGTH	A2J2-19(W6)	E	
20	L POLAR	A2J2-20(W6)	A	
21	H POLAR	A18P1-1	A	
22	CH 1 SUM	A2J2-22(W6)	B	
23	LENGTH REF	A15P1-5	E	
24	L EXT RF	A15P1-28		6
25	CH 2 VERNIER	A2J2-25(W6)	D	
26	H B ABS	A2J2-26(W6)	A	
27	H DSP R	A8P1-42	A	
28	RECT LENGTH	A2J2-28(W6)	E	
29	RECT PHASE	A9P1-3,29	D	
30	+5V	A2J1-30		
31	H CH 2 MAG	A2J2-31(W6)	A	
32	CH 2 MAG SUM	A2J2-32		
33	CH 2 SCALED	A2J2-33(W6)	D	
34	CH 2 SUM	A2J2-34(W6)	D	

NOTE: A1J1 AND A1J2 PINS 1-34 ARE DUPLICATED ON A2J1 AND A2J2.

A2 ANALOG P

J1

PIN	SIGNAL
1	HORIZ POSN
2	POS 2
3	CH 1 VIDE FLT
4	POS 1
5	CH 2 VIDE FLT
6	POLAR CNTR
7	(H DOUBLE
8	HORIZ GAI
9	POLAR CN ◀▶ (X)
10	POLAR CN ▲▼ (Y
11	-10V
12	RF LEVEL
13	UNLOCK LED
14	+20V
15	L SNGL
16	L MAN
17	SWEEP SPEE VERNIER
18	CURRENT SOURCE
19	NC
20	SWEEP INTE C
21	L MKR 1
22	L FAST SW
23	VSWP
24	H AUTO
25	L MKR 10
26	H TRIG
27	L MKR 50
28	FREQ CAL
29	WIDTH 20-1K
30	CNTR FREC
31	WIDTH 1-10
32	H FULL
33	+15VPP
34	-12VPP
35	CH 2 FLT
36	V RAMP
37	CH 1 FLT
38	LOG K A/
39	+5V
40	L FP HOL
41	▽4
42	POLAR X
43	L OFF 2
44	POLAR Y
45	L B INT
46	TUNE
47	L CHAN 2
48	▽3
49	L OFF 1
50	H ALT CH 2

...CTION ...OCK	SEE SERVICE SHEET
	6
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	8
A	
	6
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N	
N	
A	
B	
E	
A	
A	
B	
E	
	6
D	
A	
A	
E	
D	
A	
D	
D	

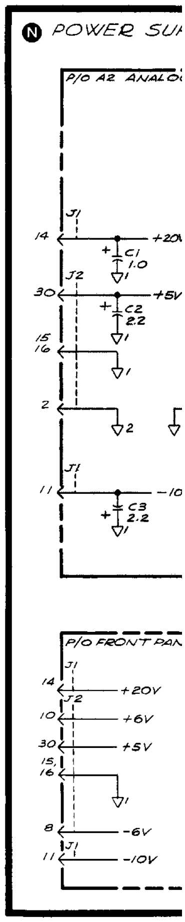
A2 ANALOG PROCESSOR

J1

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET
1	HORIZ POSN	A1J1-1		16
2	POS 2	A1J1-2(W5)	H	
3	CH 1 VIDEO FLT	A1J1-3(W5)	L	
4	POS 1	A1J1-4(W5)	G	
5	CH 2 VIDEO FLT	A1J1-5(W5)	M	
6	POLAR CNTR	A1J1-6(W5)	F	
7	(H DOUBLER)	A1U1-7		11
8	HORIZ GAIN	A1J1-8		16
9	POLAR CNTR ◂▸ (X)	A1J1-9	J	
10	POLAR CNTR ▴▾ (Y)	A1J1-10	I	
11	-10V	A16P1-9,31	N	
12	RF LEVEL	A7P1-6,12 A12P1-11,33		7,8
13	UNLOCK LED	A14P1-1		11
14	+20V	A16P1-3,25	N	
15	L SNGL	A17P1-26		5
16	L MAN	A17P1-5,27		5
17	SWEEP SPEED VERNIER	A17P1-1		5
18	CURRENT SOURCE	A17P1-24		5
19	NC			
20	SWEEP INTEG C	A17P1-28		5
21	L MKR 1	A12P1-8,30		8
22	L FAST SWP	A17P1-41		5
23	VSWP	A17P1-18,40		6,16
24	H AUTO	A17P1-11,33		5
25	L MKR 10	A12P1-9,31		8
26	H TRIG	A17P1-12,34		5
27	L MKR 50	A12P1-10,32		8
28	FREQ CAL	A1J1-28		6
29	WIDTH 20-1K	A15P1-8,30		6
30	CNTR FREQ	A1J1-30		6
31	WIDTH 1-10	A15P1-7,29		6
32	H FULL	A15P1-9,31 A12P1-7,29		6 8
33	+15VPP	A16P1-1		20
34	-12VPP	A20U1 OUT		20
35	CH 2 FLT	A18P1-9	M	
36	V RAMP	A18P1-30		16
37	CH 1 FLT	A18P1-8	L	
38	LOG K A/R	A9P1-1,23	F	
39	+5V	A20U3 OUT		6
40	L FP HOLD	A14P1-24	K	
41	▽4	A20J1-GND PLANE		6
42	POLAR X	A10P1-5,27	J	
43	L OFF 2	A23J3-6(W13)	A	
44	POLAR Y	A10P1-3,25 (W5)	I	
45	L B INT	A19P1-1(W5)	A	
46	TUNE	A15P1-1,23		6
47	L CHAN 2	A18P1-2,24	A	
48	▽3	GND PLANE		6
49	L OFF 1	A23J3-3(W13)	A	
50	H ALT CH 2	A17P1-2(W5)	A	

J2

PIN	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET NO:
1	▽	TUNING POT (GND PLANE)		6
2	▽2		N	
3	FINE WIPER	A15P1-3,25		6
4	TUNING WIPER	A15P1-2,24		6
5	FREQ WIDTH VOLTAGE	A2U2-5		6
6	L PH B/R	A1J2-6(W6)	D	
7	TUNING V REF	A15P1-4,26		6
8	-6V	A1U2-8	N	
9	MKR WIDTH A	A12P1-12,34		8
10	+6V	A1U2-10	N	
11	MKR WIDTH B	A12P1-13,35		8
12	H A	A1J2-12(W6)	A	
13	FREQ WIDTH VERN	A1J2-13		6
14	H CH 1 RATIO	A1J2-14(W6)	A	
15	▽1	A1J1-15	N	
16	▽1	A1J1-16	N	
17	L CH 1 ON	A1J2-17(W6)	A	
18	SCALED CH 1	A1J2-18(W6)	B	
19	POLAR LENGTH	A1J2-19(W6)	E	
20	L POLAR	A1J2-20(W6)	A	
21	H POLAR	A1J2-21(W6)	A	
22	CH 1 SUM	A2J2-22(W6)	B	
23	LENGTH REF	A15P1-5	E	
24	L EXT RF	A15P1-28		6
25	CH 2 VERN	A1J2-25(W6)	D	
26	H B ABS	A1J2-26(W6)	A	
27	H DSP R	A1J2-27(W6)	A	
28	RECT LENGTH	A1J2-28(W6)	E	
29	RECT PHASE	A1J2-29	D	
30	+5V	A20U3-OUT	N	
31	H CH2 MAG	A1J2-31(W6)	A	
32	CH 2 MAG SUM	A1J2-32(W6)	D	
33	CH 2 SCALED	A1J2-33(W6)	D	
34	CH 2 SUM	A1J2-34(W6)	D	
35	FREQ REF	A15P1-27	C	
36	R MAG	A11P1-4,26	C	
37	NC			
38	NC			
39	NC			
40	L B IF SW	A19P1-3	E	
41	NC			
42	MAG	A8P1-35,43	B D	
43	NC			
44	NC			
45	NC			
46	NC			
47	L REM BUF	A19P1-4	E	
48	PHASE OFFSET	A10P1-1,23	E	
49	NC			
50	NC			



14 13

...CTION ...OCK	SEE SERVICE SHEET NO:
	6
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	6
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D	
	6
N	
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N	
	8
A	
	6
A	
N	
N	
A	
B	
E	
A	
A	
B	
E	
	6
D	
A	
A	
E	
D	
N	
A	
D	
D	
D	
C	
C	
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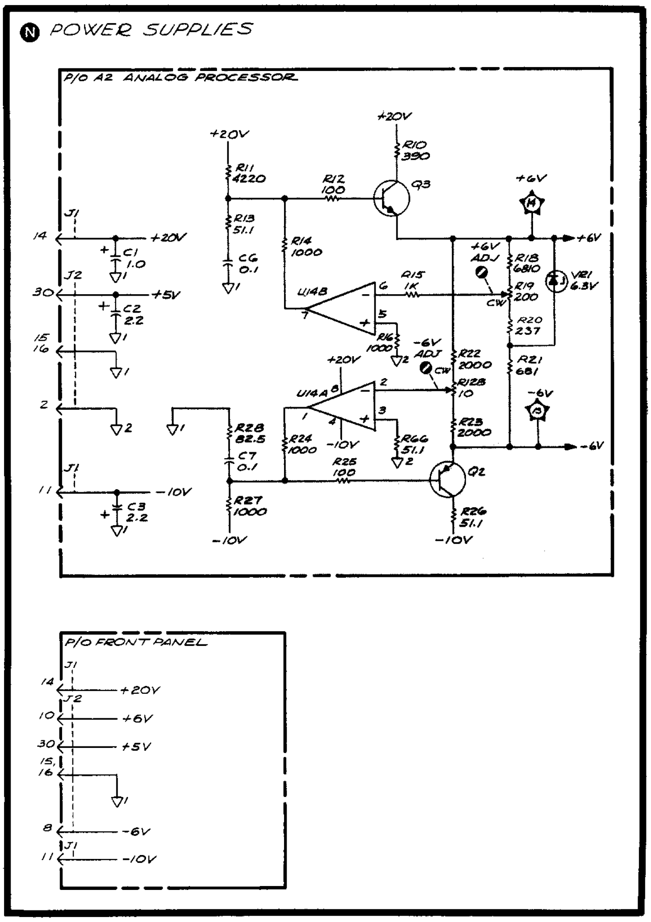
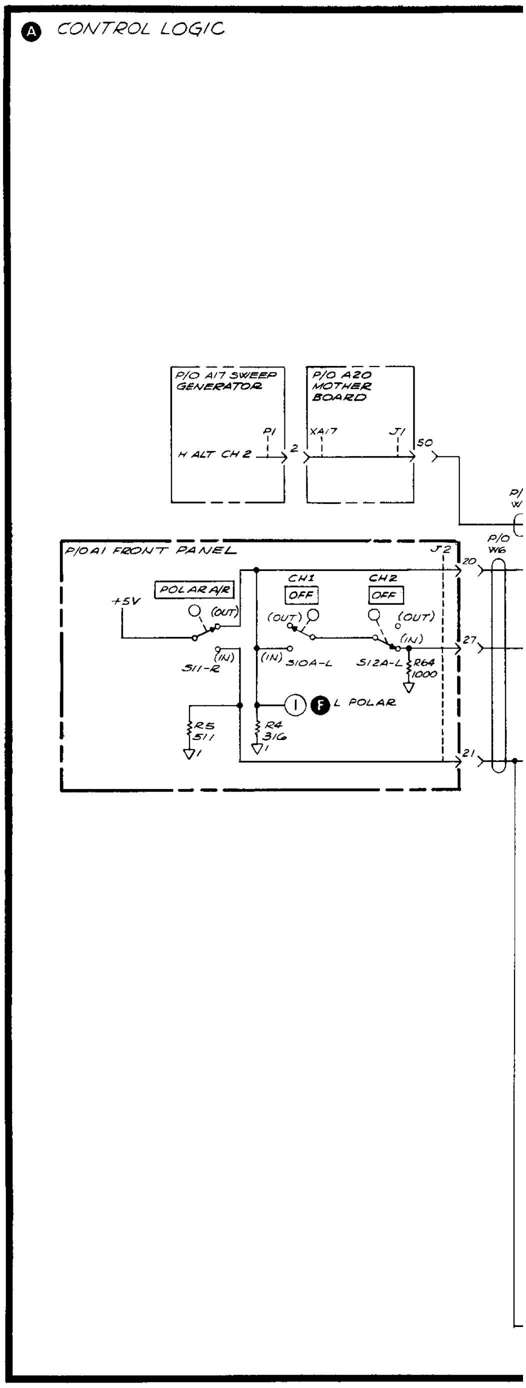
D	
E	
E	





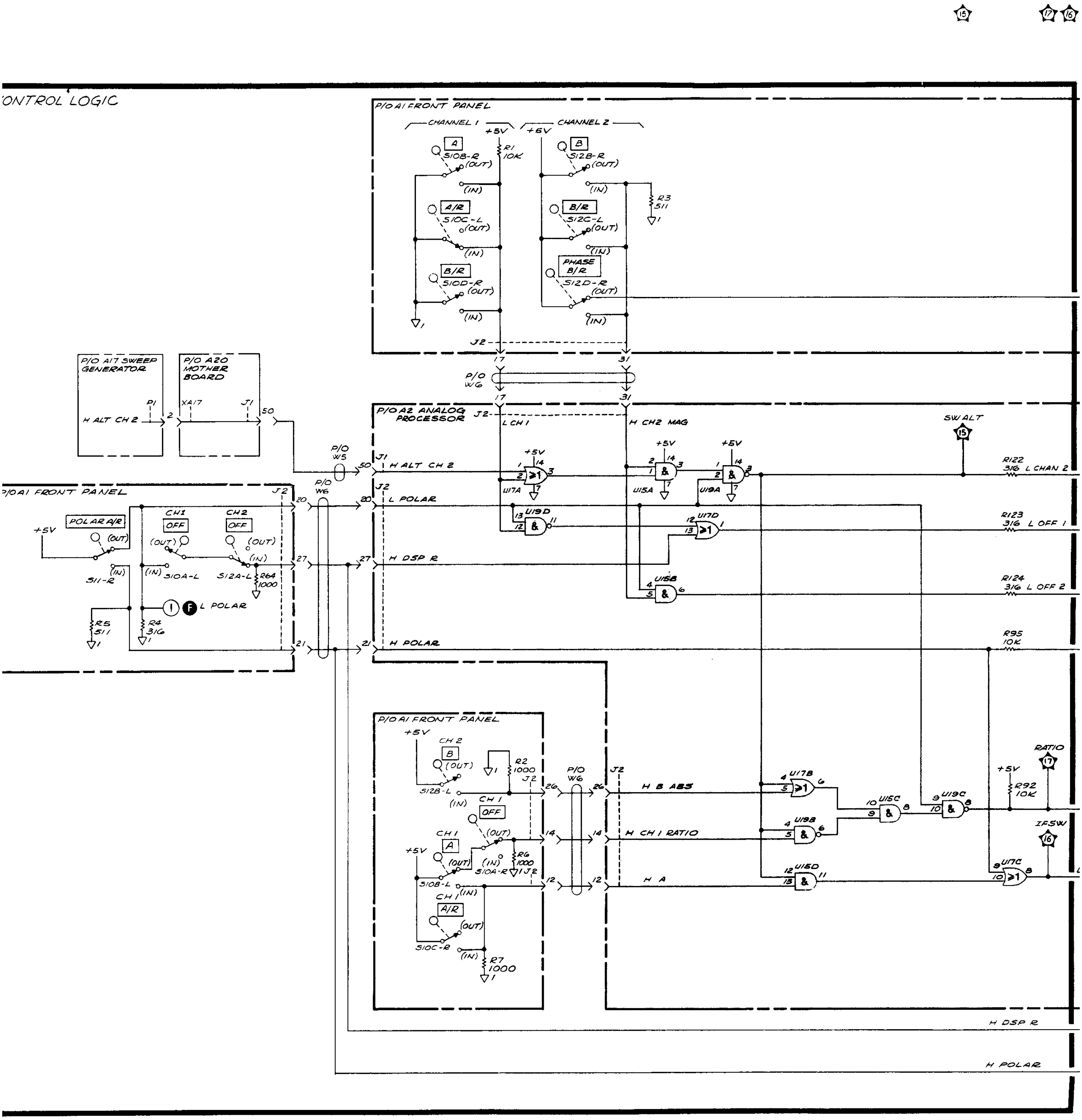


Figure 8-99. Front I

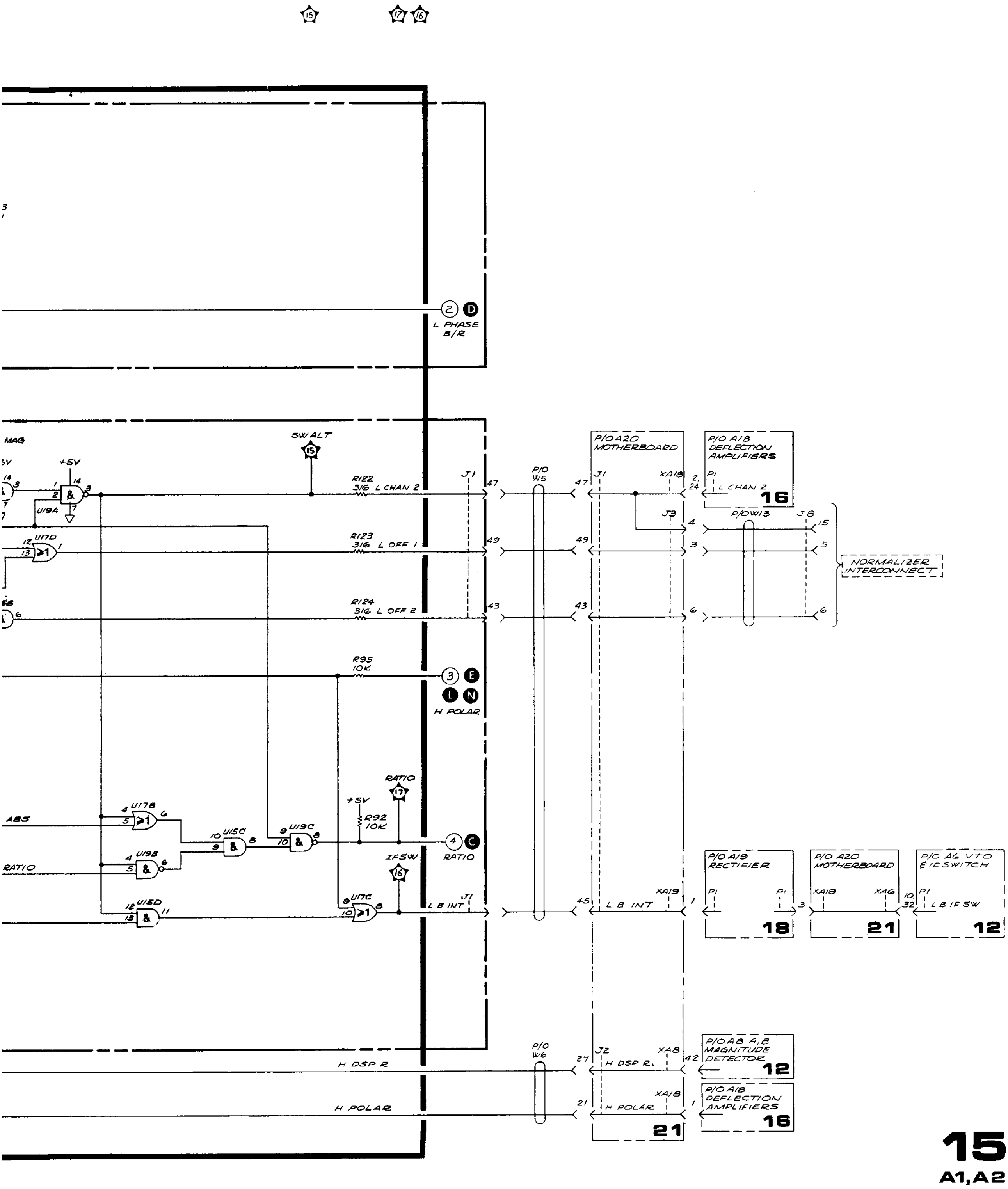
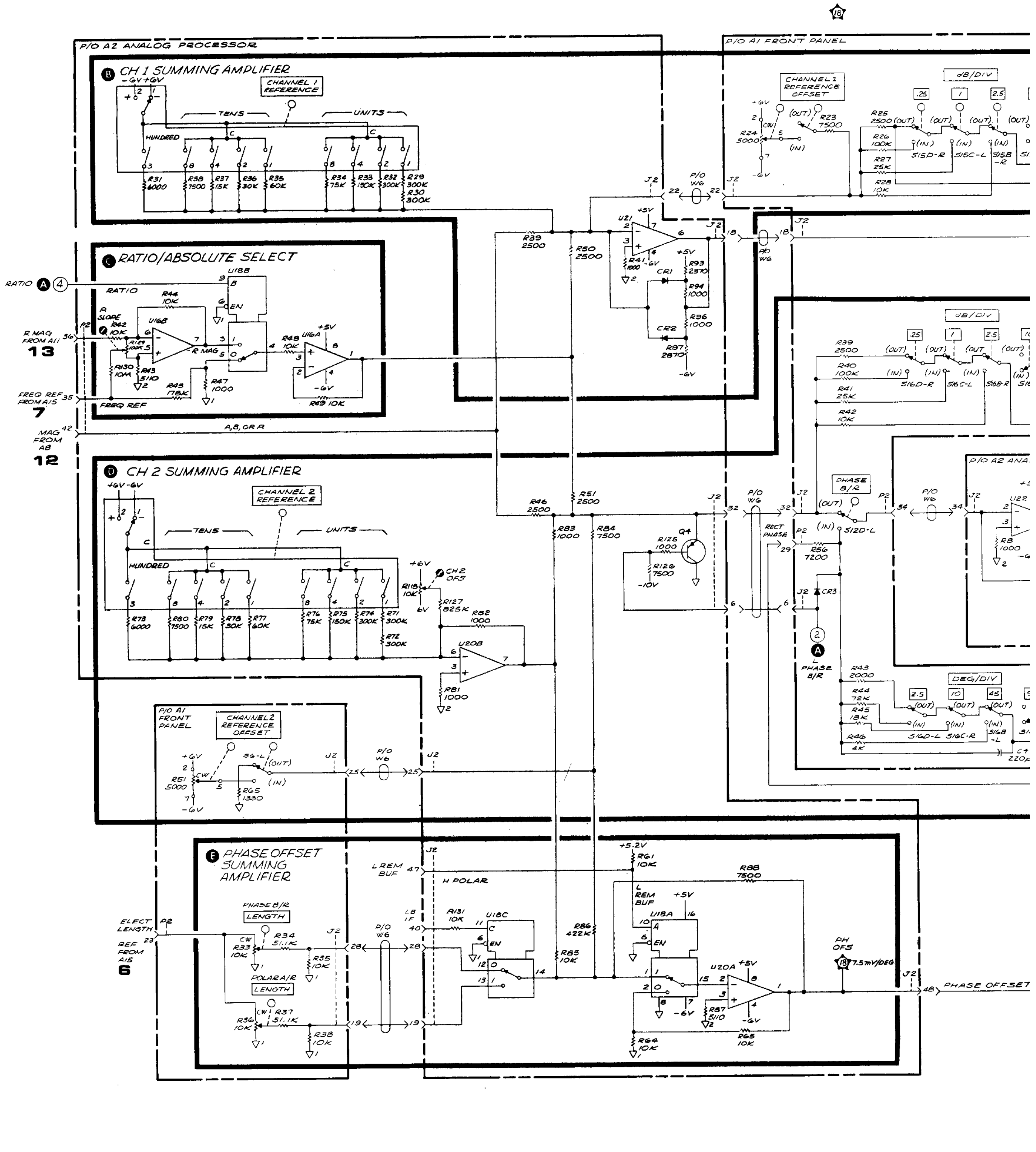
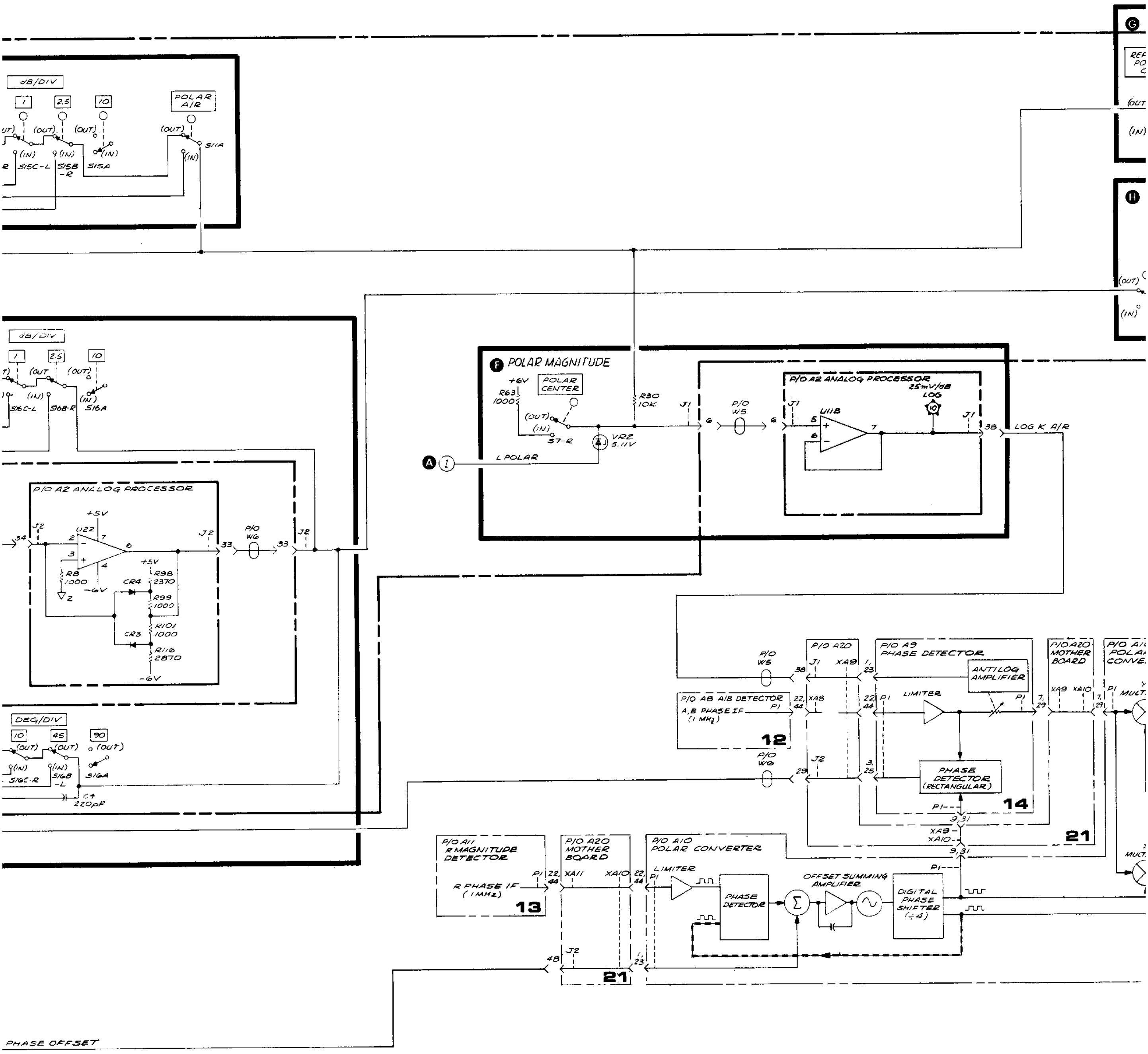


Figure 8-99. Front Panel (A1) and Analog Processor (A2), Schematic Diagram (1 of 2)



P/O A2 ANALOG PROCESSOR
P/O A1 FRONT PANEL
CH 1 SUMMING AMPLIFIER
CHANNEL 1 REFERENCE
TENS
UNITS
HUNDRED
CHANNEL 1 REFERENCE OFFSET
dB/DIV
RATIO/ABSOLUTE SELECT
RATIO
R SLOPE
R MAG FROM A11
13
FREQ REF FROM A15
7
FREQ REF
MAG FROM A8
12
A,B, OR R
CH 2 SUMMING AMPLIFIER
CHANNEL 2 REFERENCE
CH2 OFS
PHASE B/R
RECT PHASE
DEG/DIV
P/O A2 ANA
P/O A1 FRONT PANEL
CHANNEL2 REFERENCE OFFSET
PHASE OFFSET SUMMING AMPLIFIER
PHASE B/R LENGTH
POLAR A/R LENGTH
ELECT LENGTH REF FROM A15
6
L REM BUF
H POLAR
LB IF
L REM BUF
PH OFS
7.5mV/DEG
PHASE OFFSET



dB/DIV
1
2.5
10
POLAR A/R
(OUT)
(IN)
S15C-L
S15B -R
S15A
S11A
S16C-L
S16B-R
S16A
P/O A2 ANALOG PROCESSOR
+5V
U22
-6V
R8 1000
CR4
CR3
R98 2370
R99 1000
R101 1000
R116 2870
J2
P/O W6
DEG/DIV
45
90
S16C-R
S16B -L
S16A
C4 220pF
POLAR MAGNITUDE
+6V
R63 1000
POLAR CENTER
S7-R
VR2 5.11V
R30 10K
L POLAR
J1
P/O W5
U11B
25mV/dB
LOG
LOG K A/R
P/O A20
XA9
P/O A9 PHASE DETECTOR
ANTILOG AMPLIFIER
LIMITER
PHASE DETECTOR (RECTANGULAR)
P/O A8 A/B DETECTOR
A,B PHASE IF (1 MHz)
12
14
21
P/O A20 MOTHER BOARD
XA10
XA8
P/O A11 R MAGNITUDE DETECTOR
R PHASE IF (1 MHz)
13
XA11
P/O A10 POLAR CONVERTER
PHASE DETECTOR
OFFSET SUMMING AMPLIFIER
DIGITAL PHASE SHIFTER (÷4)
PHASE OFFSET
MULT

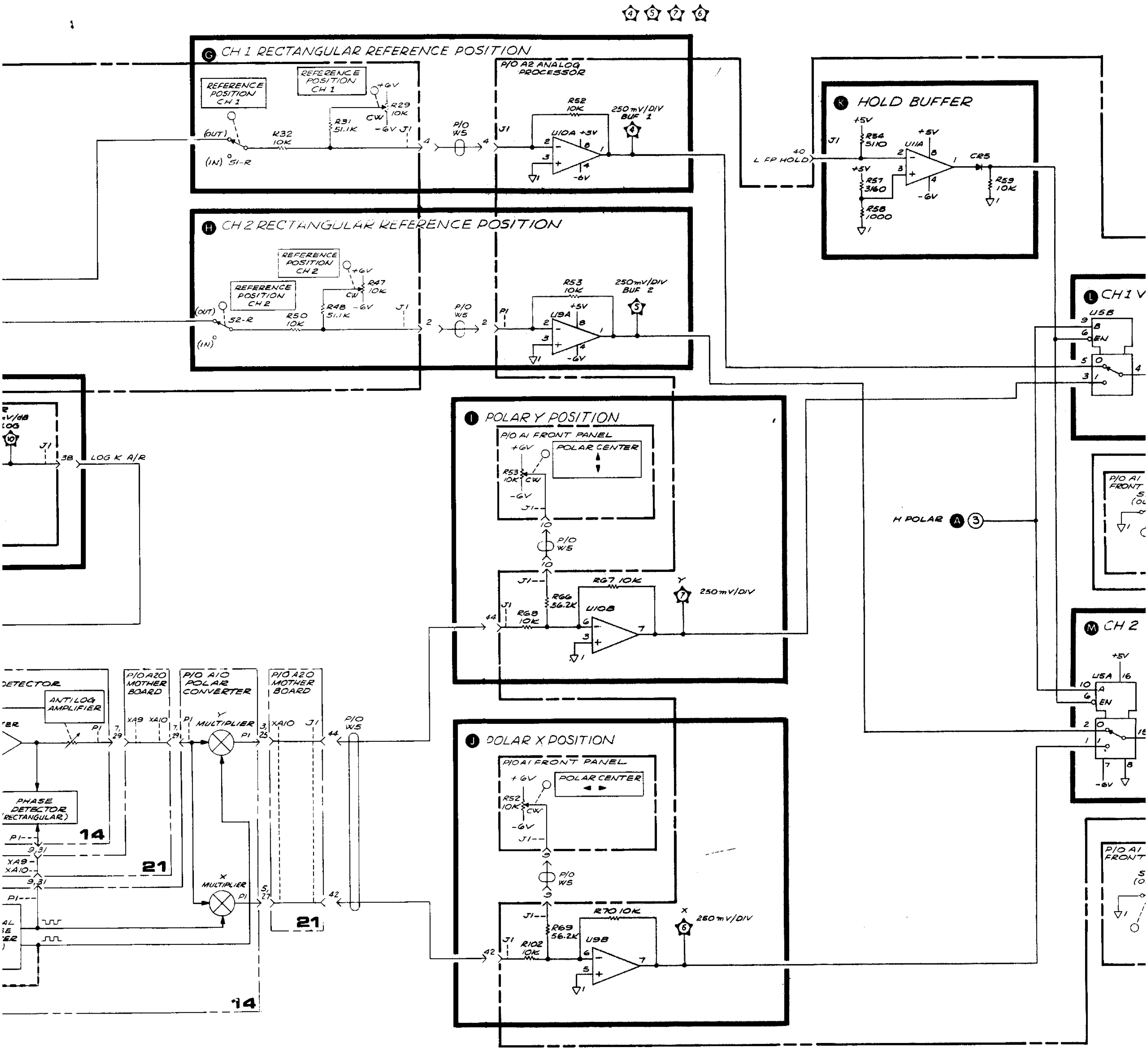
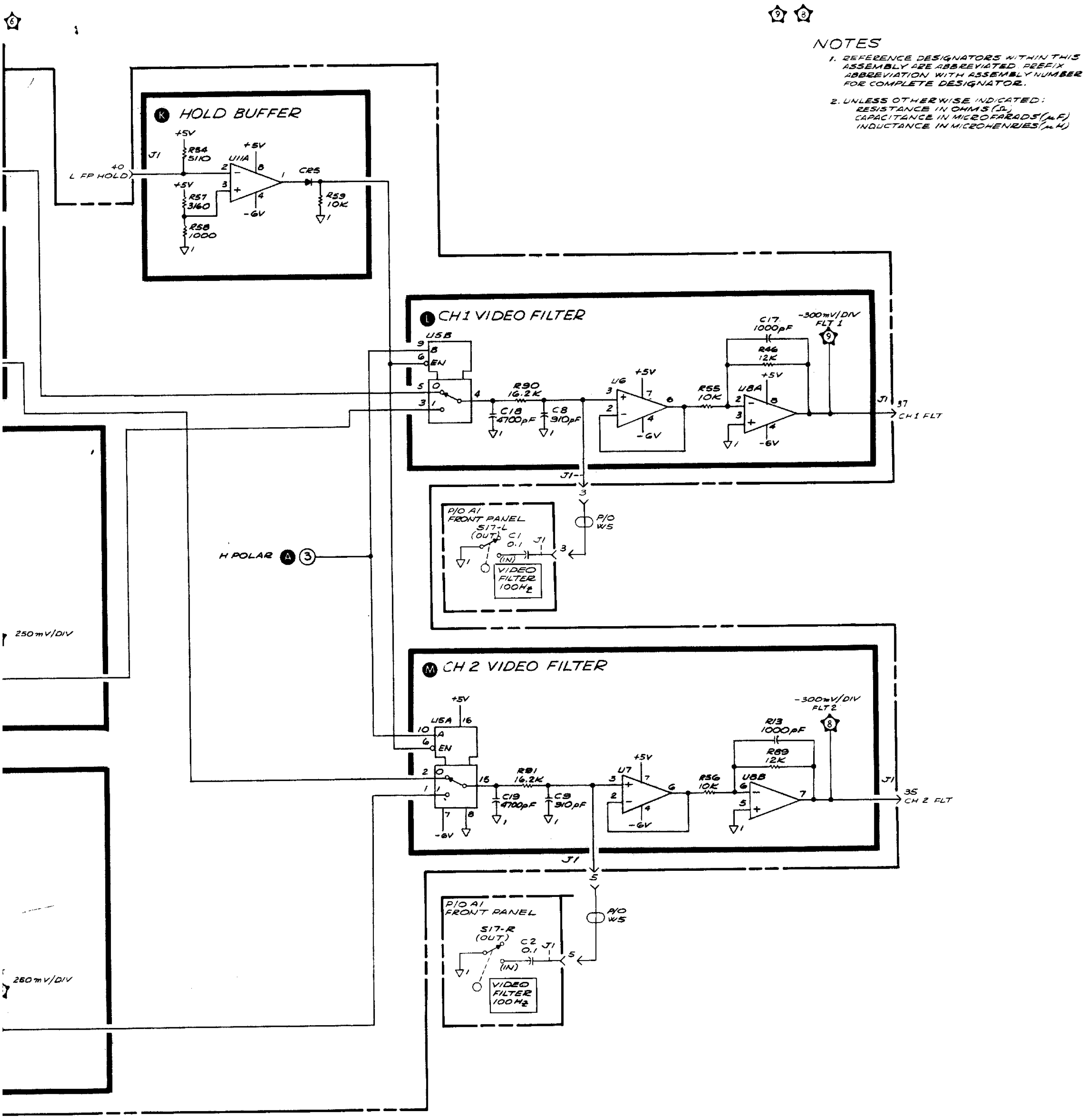


Figure 8-99. Front Pa



15

A1,A2

Figure 8-99. Front Panel (A1) and Analog Processor (A2), Schematic Diagram (2 of 2)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and ±6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 16

DEFLECTION AMPLIFIERS (A18), CIRCUIT DESCRIPTION

WARNING

Because of the hazardous voltages found in this assembly, servicing should be accomplished only by qualified personnel.

The Deflection Amplifiers (A18) provide signal multiplexing for rectangular and polar operation as well as the signals to the CRT that generate the display. A18 also provides interfacing circuits for use of the instrument with a normalizer.

The following output signals are provided by the Deflection Amplifiers:

- The horizontal and vertical deflection signals (X DEFL 1, X DEFL 2, Y DEFL 1, and Y DEFL 2) to the CRT.
- HORIZ OUT to the rear-panel HORIZ connector.
- VERT OUT to the rear-panel VERT connector.
- BLANK/PEN to the rear-panel BLANK/PEN connector.
- Z CRT to the High-Voltage Power Supply (A21, Service Sheet 17).
- H MARK and L POLAR to the rear-panel NORMALIZER INTERCONNECT connector.

The Deflection Amplifiers receive the following input signals:

- H POLAR from the Front-Panel Control (A1, Service Sheet 15).
- L CHAN 2, VRAMP, CH 1 FLT, and CH 2 FLT from the Analog Processor (A2, Service Sheet 15).
- H MKR from the Marker Generator (A12, Service Sheet 8).
- H DBP from the Sweep Generator (A17, Service Sheet 5).
- X NORM, Y NORM, Z NORM, and L NORM from the rear-panel NORMALIZER INTERCONNECT connector.

The assembly consists of the Switching Logic, the X Deflection Amplifier, the Y Deflection Amplifier, and the Z Axis Amplifier.

The Switching Logic circuit controls the X Deflection Amplifier, the Y Deflection Amplifier, and the Z Axis Amplifier in accordance with the states of the input lines H POLAR, L NORM, L CHAN 2, H MKR, and H DBP. It also generates an L POLAR signal to the rear-panel NORMALIZER INTERCONNECT connector.

The X Deflection Amplifier is controlled by the Switching Logic as well as the VRAMP and X NORM input signals. It provides horizontal deflection voltages to the CRT and to the rear-panel HORIZ output connector.

The Y Deflection Amplifier is controlled by the Switching Logic as well as the CH 2 FLT, CH 1 FLT, and Y NORM input signals. It provides vertical deflection voltages to the CRT and to the rear-panel VERT connector. It also sends an H MARK signal to the rear-panel NORMALIZER INTERCONNECT connector.

The Z Axis Amplifier is controlled by the Switching Logic as well as the Z NORM input signal. It provides a voltage (Z CRT) that controls the intensity of the CRT display (blanked, normal display, and polar marker identification). A BLANK/PEN (blanking/penlift) signal is also sent to the rear panel BLANK/PEN connector.

Rectangular X Gain and Position (A)

The 0V to +10V VSWP signal from the Sweep Generator (A17, Service Sheet 5) is processed by inverting operational amplifier A2U13 to produce the +1.5V to −1.5V VRAMP signal to the Deflection Amplifiers (A18).

The range of the front-panel screwdriver adjustments, HORIZONTAL GAIN (A1R59) and HORIZONTAL POSN (A1R60), is sufficient to convert an external sweep to a +1.5V to −1.5V VRAMP signal provided the start of the sweep is approximately 0V and the end of the sweep is between +6V and +13V.

Switching Logic Ⓐ

The signals to the X Deflection, Y Deflection, and Z Axis Amplifiers and to the NORMALIZER INTERCONNECT connector depend on the states of the input lines to the Switching Logic circuit.

When Polar operation is selected by the Front-Panel Control (A1), the H POLAR line from A1 is high. The H POLAR signal is inverted through U4A to send an L POLAR signal to the NORMALIZER INTERCONNECT connector. In the case of the HP 8750A Normalizer, the L POLAR signal, when low, causes the normalizer to be held in its BYPASS mode. When the HP 8750A is in BYPASS, it has no effect on the operation of the network analyzer.

When the H POLAR input to U4C is high, its output depends on the state of the L NORM line from the Normalizer. When the H POLAR input is low, the output of U4C is high, but the A18 board might be in either Rectangular or Normalizer mode, depending on the state of the L NORM line. A18 is in the Rectangular mode only when the H POLAR line is low and the L NORM line is high. The following truth table gives the mode of A18 for all states of the H POLAR and L NORM lines.

H POLAR	L NORM	A18 Mode
H	H	Polar
H	L	Normalizer
L	L	Normalizer
L	H	Rectangular

As indicated in the truth table, A18 is in the Normalizer mode whenever the L NORM line is low. This is because the L NORM signal is inverted through U3B. The high NORM signal at the output of U3B causes the selection of the X NORM, Y NORM, and Z NORM signals from the Normalizer. The Normalizer Select functions are described later.

When the L CHAN 2 line to U4B from the Analog Processor (A2) goes high, Channel 1 is selected; when L CHAN 2 is low, Channel 2 is selected. If both channels are selected, L CHAN 2 goes high and low on alternate sweeps. (Refer to the description of the Channel Select circuit in the Y Deflection Amplifier.)

The H DBP signal from the Sweep Generator (A17, Service Sheet 5) is inverted through U3A to provide the L DBP signal to U3C pin 10 and to the Z Axis Amplifier.

When the H MKR from the Marker Generator (A12, Service Sheet 8) is high and H DBP is low (U3A pin 3 is high), the low output of U3C is inverted through U3D to provide the H MARK signal to the rear-panel NORMALIZER INTERCONNECT connector. The low output of U3C is also inverted through U4D to provide the MARKER signal to the Y Deflection Amplifier.

X Deflection Amplifier Ⓒ

The X Deflection Amplifier selects, amplifies, and sends to the CRT the signal that controls horizontal deflection of the display in each mode of operation of the A18 assembly. A horizontal deflection signal is also sent to the rear-panel HORIZ OUT connector. Table 8-9 lists the signal processed by the X Deflection Amplifier for each of the three display modes.

Table 8-9. Signal Selection and Display

Amplifier	Input Signal		
	Rectangular	Polar	Normalizer
X Deflection	VRAMP	CH 2 FLT	X NORM
Y Deflection	CH 1 FLT or CH 2 FLT and	CH 1 FLT	Y NORM
Z Axis	H DBP	H DBP or H MKR	Z NORM

Rectangular Mode. When the front-panel POLAR A/R switch is open (out), the network analyzer is in the Rectangular mode. The VRAMP signal from the Analog Processor (A2) is inverted through operational amplifier U9A and selected by VRAMP/CH 2 FLT Select switch U6B, because the RECT + NORM line from the Switching Logic circuit is high. Since the NORM line to Normalizer Select switch U5C is low, the inverted VRAMP signal is passed as the X signal to the Amplifier/Driver circuit, whose outputs are the X DEFL 1 and X DEFL 2 signals to the horizontal deflection plates of the CRT. The X signal is also applied to the non-inverting operational amplifier U7A, whose output is the HORIZ OUT signal to the rear-panel HORIZ output connector.

The Amplifier/Driver circuit consists of two differentially connected feedback pairs, Q13/Q11 and Q10/Q9, connected as common-base amplifiers. Q13/Q11 has a high-impedance input and a gain that is determined by R53 and the series combination of R55 and X GAIN potentiometer R56. The gain of Q10/Q9 is determined by R58, R55, and R56. X POS potentiometer adjusts the horizontal position of the CRT display. The gain of the Amplifier/Driver circuit is approximately 25. The X DEFL 1 and X DEFL 2 dc voltages to the horizontal deflection plates of the CRT are both approximately +50V for center screen. The deflection sensitivity of the CRT is approximately 16 volts/cm.

Polar Mode. When the front-panel POLAR A/R switch is depressed, the network analyzer is in the Polar mode. Since the RECT + NORM line from the Switching Logic circuit is low, the CH 2 signal from the Y Deflection Amplifier is passed through VRAMP/CH 2 Select switch U6B. The NORM line to Normalizer Select switch U5C is low, so CH 2 is passed to the Amplifier/Driver circuit and, through the non-inverting operational amplifier U7A, to the rear panel as the HORIZ OUT signal.

Normalizer Mode. The X NORM signal from the rear-panel NORMALIZER INTERCONNECT connector is inverted through operational amplifier U8A and sent to Normalizer Select switch U5C. Since the NORM line to U5C is high, X NORM is passed through the switch to the Amplifier/Driver circuit and, through the non-inverting operational amplifier U7A, to the rear panel as the HORIZ OUT signal.

Y Deflection Amplifier (D)

The Y Deflection Amplifier selects, amplifies, and sends to the CRT the signal that controls vertical deflection of the display in each mode of operation of the A18 assembly. A vertical deflection signal is also sent to the rear-panel VERT OUT connector. Table 8-9 lists the signals processed by the Y Deflection Amplifier for each of the display modes.

Rectangular Mode. CH 2 FLT and CH 1 FLT are applied to operational amplifiers U9B and U10B, respectively. The inverted signal CH 2 and CH 1 are sent to Channel Select switch U6A, where they are selected in accordance with the state of the CH 2 SELECT line from the Switching Logic circuit. (Refer to the Switching Logic circuit description.)

The MARKER signal from the Switching Logic circuit is sent through Marker Select switch U6C and summed with either CH 1 or CH 2 at the inverting input to operational amplifier U10A. Since the NORM line to Normalizer Select switch U5A is low, the output of U10A is passed to the inverting operational amplifier U7B. The Y signal from U7B is sent to the Amplifier/Driver stage and also, as VERT OUT, to the rear-panel VERT output connector. The outputs of the Amplifier/Driver stage, whose operation is identical to that of the corresponding circuit in the X Deflection Amplifier, are the Y DEFL 1 and Y DEFL 2 signals to the vertical deflection plates of the CRT.

Polar Mode. In Polar operation of the network analyzer, the only signal affecting the outputs of the Y Deflection Amplifier is CH 1 FLT. CH 2 is never selected by Channel Select switch U6A because the L CHAN 2 line to the Switching Logic circuit is held high in the Polar mode. (Refer to the Analog Processor circuit description.) The processing of the CH 1 signal out of U6A is the same as in the Rectangular mode.

The MARKER signal to Marker Select switch U6C is sent to the Z Axis Amplifier, because the RECT + NORM line to U6C is low, to produce intensity markers.

Normalizer Mode. The Y NORM signal from the rear-panel NORMALIZER INTERCONNECT connector is inverted through the operational amplifier U8B and sent to Normalizer Select switch U5A. Since the NORM line to U5A is high, Y NORM is passed through the switch to the Amplifier/Driver circuit and to the rear-panel VERT connector as the VERT OUT signal.

Z Axis Amplifier E

The Z Axis Amplifier selects, amplifies, and sends to the High-Voltage Power Supply (A21, Service Sheet 17) the Z CRT signal, which blanks, unblanks, or intensifies the trace on the CRT, depending on the voltage level. The output of the External Z Axis stage is summed with the PENLIFT signal from the Sweep Generator (A17, Service Sheet 5) and sent to the rear panel as the BLANK/PEN signal. Table 8-6 lists the signals processed by the Z Axis Amplifier for each of the three display modes.

Rectangular Mode. When the H DBP (display blanking pulse) line from the Sweep Generator (A17) is low, the L DBP signal from the Switching Logic circuit is high (+5V). The signal is applied through Normalizer Select switch U5B to open-collector comparator U1B in the Internal Z Axis stage.

When +5V is applied to U1B pin 4, pin 2 is pulled to −10V and −7.3V from voltage divider R48 and R49 is applied to the base of emitter-follower Q2, turning the transistor off. When there is no input from the other open-collector comparator, U1C, the emitter of Q2 is at OV, the unblanking voltage level.

When the output of U1B is at OV (H DBP line is high), +7V is applied through R44 to the base of Q2. Since the collector is at +5V, Q2 is saturated, pulling the emitter to +5V, the blanking voltage level. The voltages applied to the Internal Z Axis circuit are also applied to emitter-follower Q1 in the External Z Axis circuit. During unblanking, −7.3V at the base of Q1 places −8.0V at the emitter (assuming a 0.7-volt base-emitter drop). CR3 is reversed-biased, so the unblanking voltage level out is 0V. With +7.0V applied to the base of Q1, the emitter is at +6.3V and the blanking voltage level is +5.6, producing a signal to the rear-panel BLANK/PEN connector as an external blanking signal.

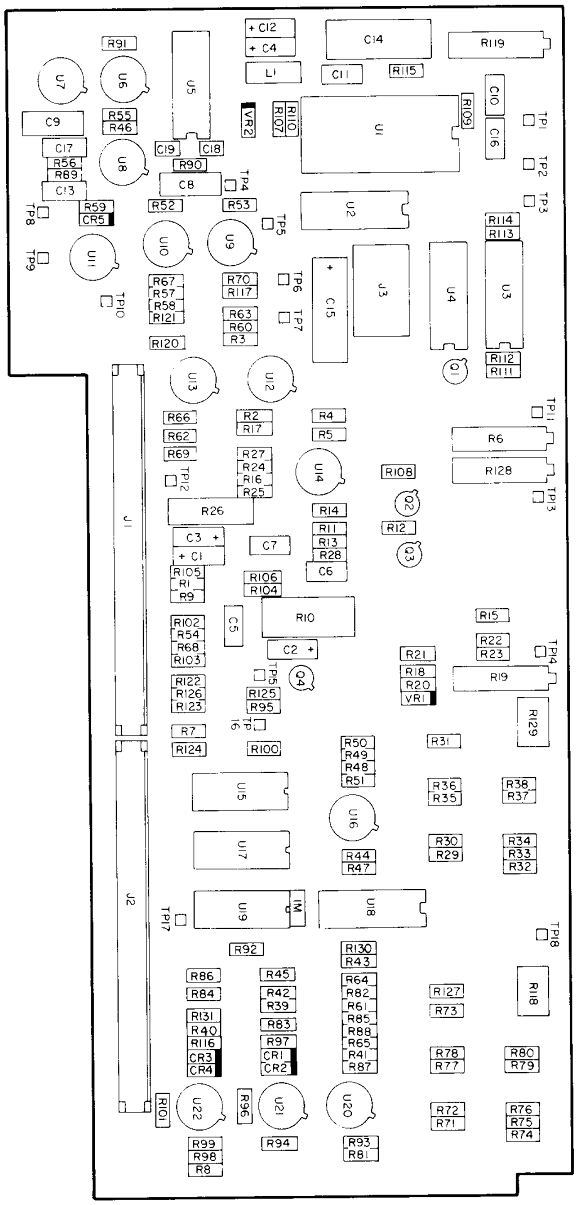
The effect of the MARKER input signal on the Internal Z Axis and External Z Axis stages is discussed in the Polar Mode description.

Polar Mode. In the Polar mode, the trace is intensified to produce a marker when the MARKER line to the Y Deflection Amplifier is high and the L DBP line to the Z Axis Amplifier is low. (Refer to the description of the Rectangular mode for the operation of the Internal Z Axis and External Z Axis stages when the MARKER line is low.)

A POLAR MARKER pulse at U1C pin 8 pulls the output of this open-collector comparator to −10V. The potential at the emitter of Q2, which is turned off during unblanking, is −3V because of the loading effect of a resistor in the High Voltage Power Supply (A21, Service Sheet 17). Therefore, the Z CRT line to A21 has three possible states: +5V for blanking, 0V for unblanking, and −3V for marker intensification in the Polar mode.

During unblanking and in the absence of the POLAR MARKER pulse, −4.5V is applied to the base of Q3 through voltage divider R75, R76. The emitter is at ground, and Q3 is turned off. When the POLAR MARKER pulse is applied to the open-collector comparator U1D, the emitter of Q3 is pulled low and the transistor is turned on. A voltage divider consisting of R46, R77, and R74 is connected through Q3 to the −10V from U1D, yielding an output of −6.2V at the cathode of CR3. Therefore, the BLANK/PEN line to the rear-panel BLANK/PEN connector has three possible states: +5.6V for blanking, 0V for unblanking, and −6.2V for marker intensification in the Polar mode.

Normalizer Mode. The Z NORM signal is sent through the open-collector comparator U1A and Normalizer Select switch U5B as the Z signal to the open-collector comparator U1B in the Internal Z Axis circuit, which has been described for the Rectangular mode.



8-100. Analog Processor (A2), Component Locations

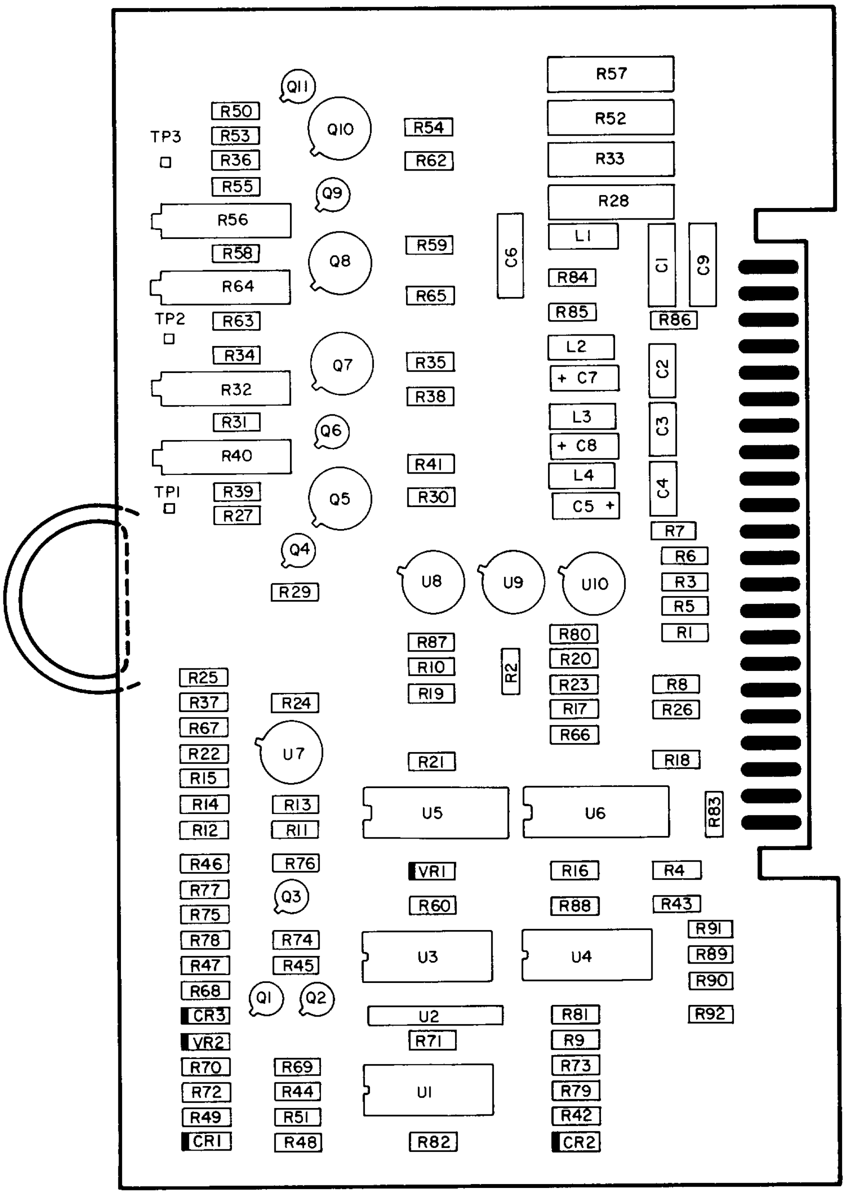
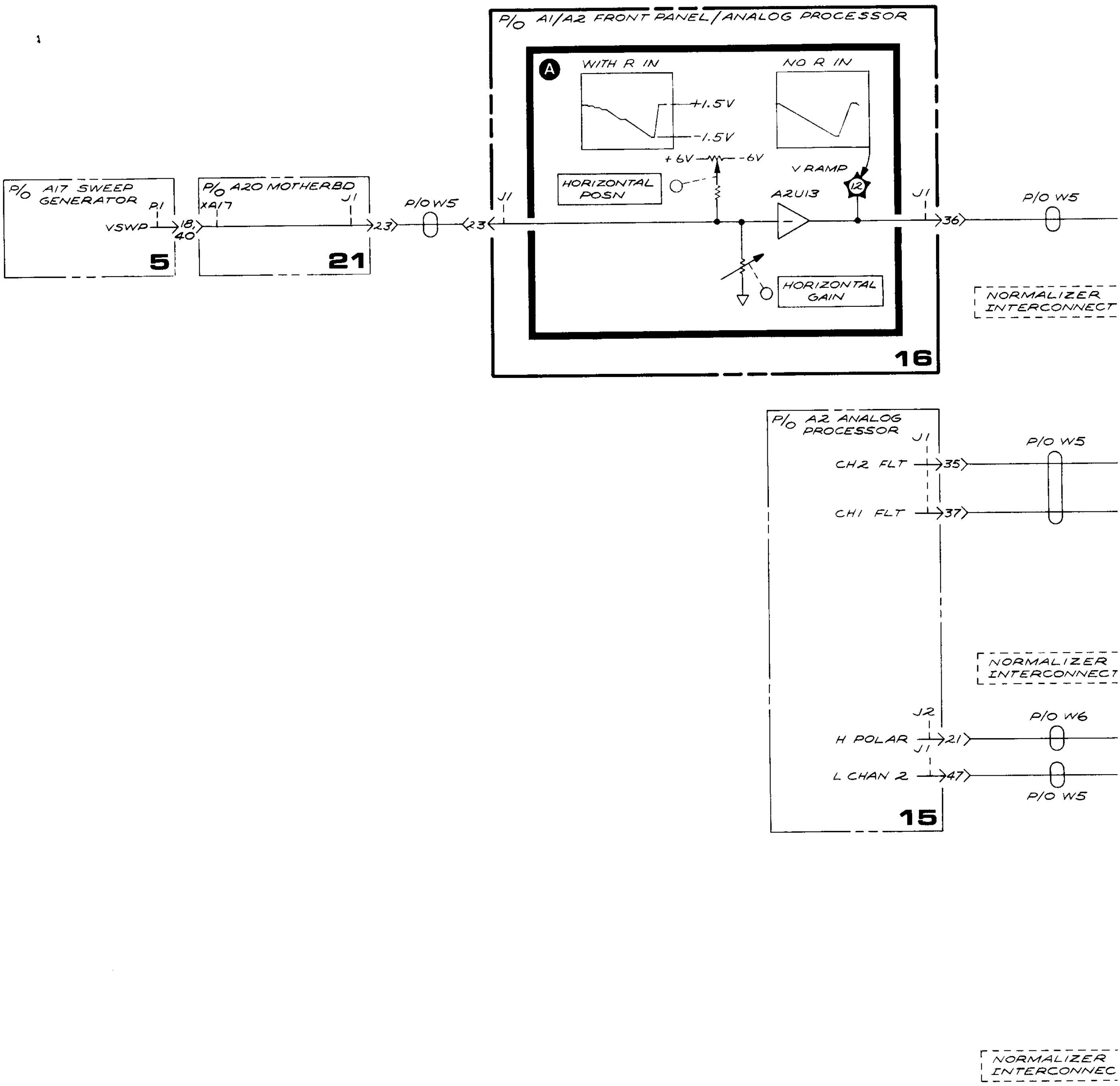
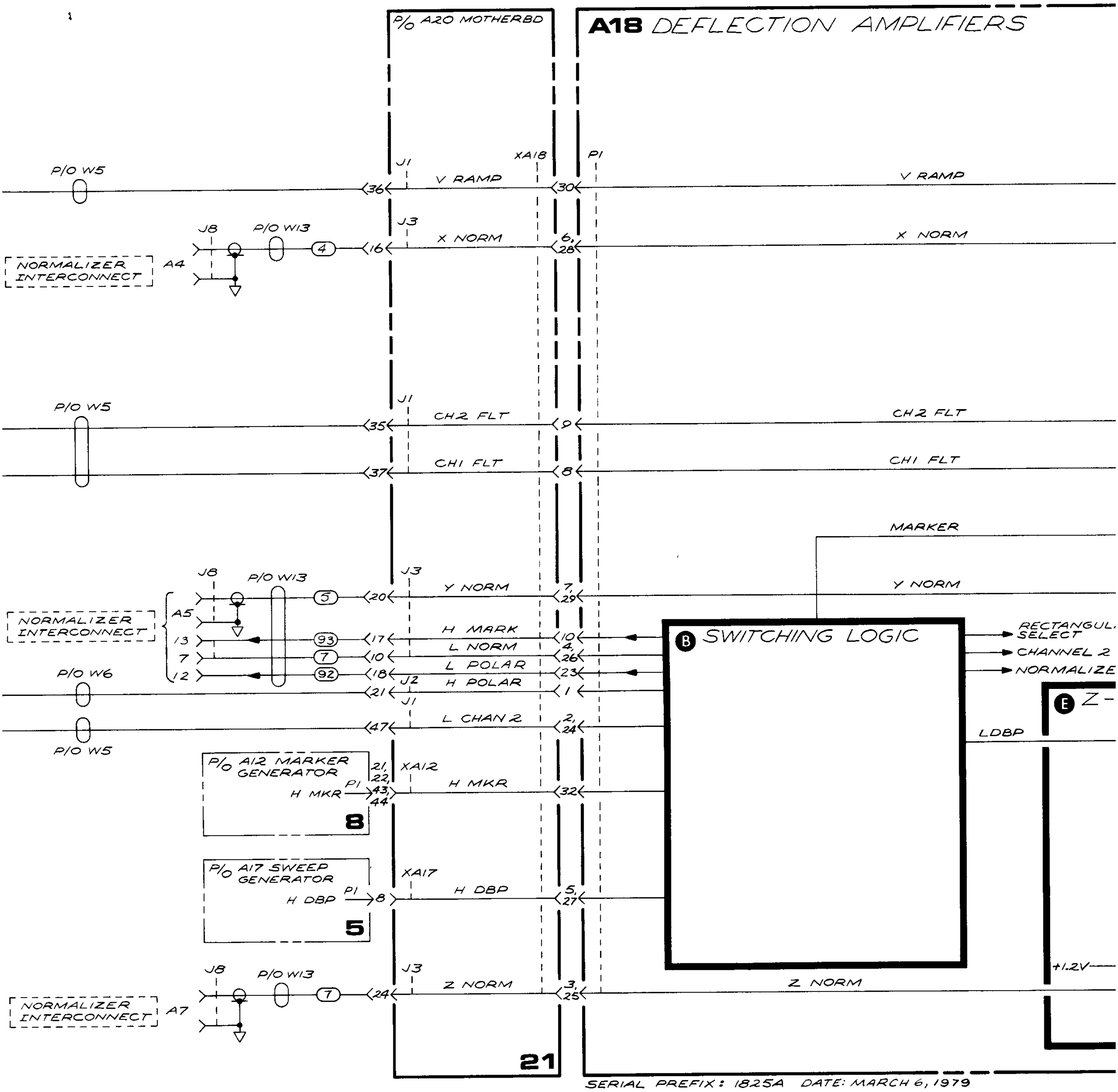
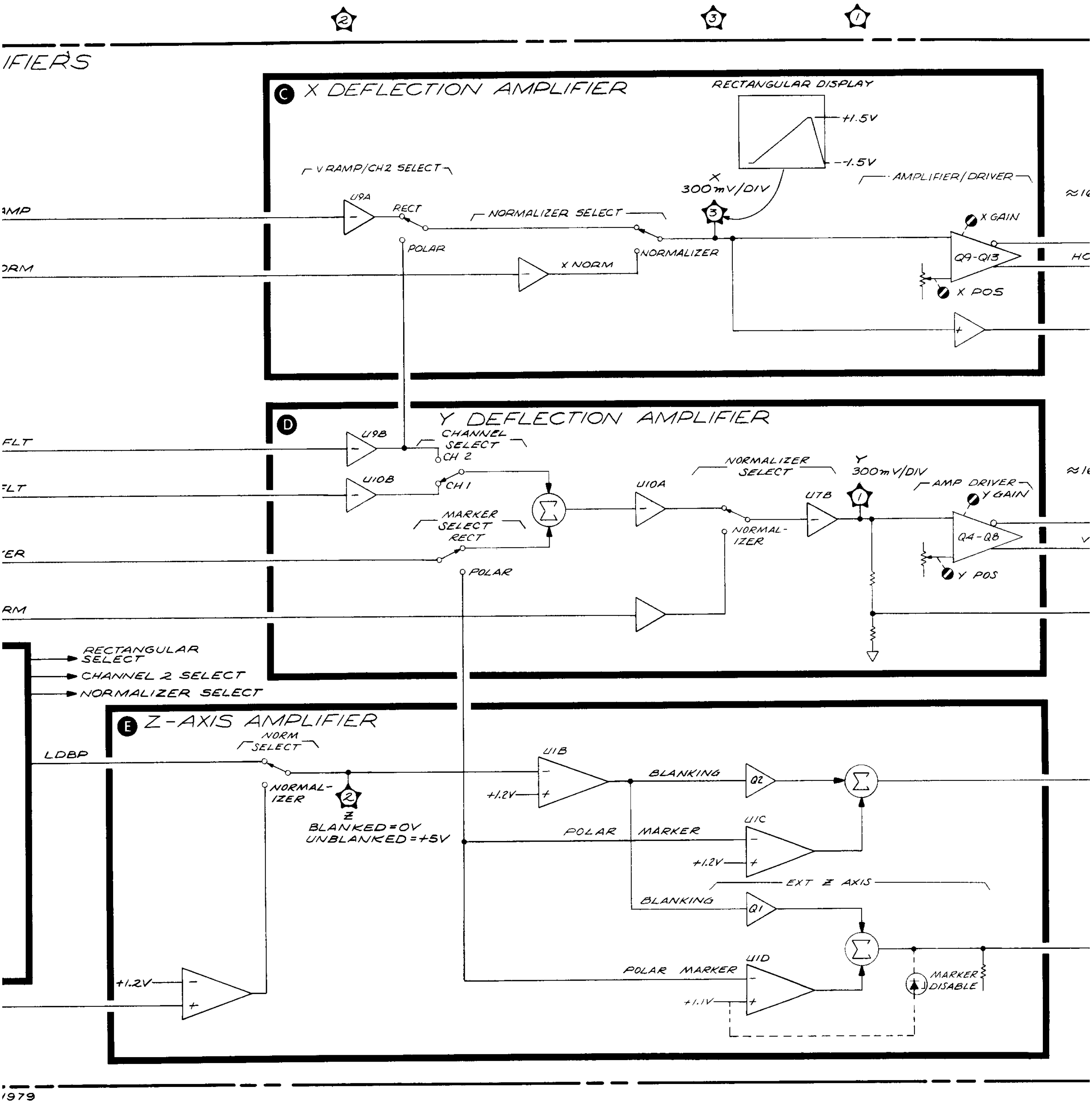


Figure 8-101. Deflection Amplifiers (A18), Component Locations

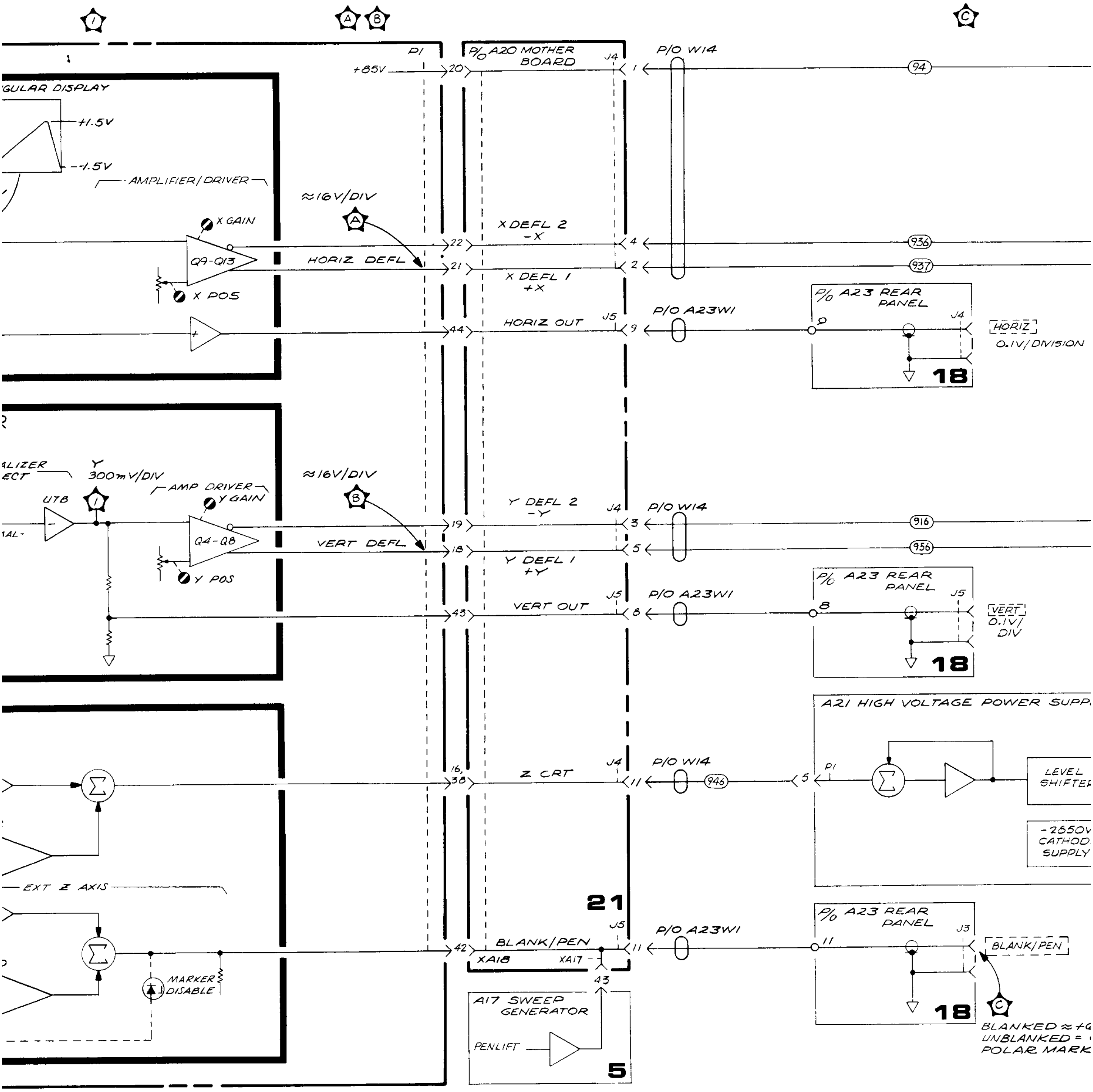

P/O A17 SWEEP GENERATOR
P1
VSWP
18, 40
5
P/O A20 MOTHERBD
XA17
J1
23
21
P/O W5
23
P/O A1/A2 FRONT PANEL/ANALOG PROCESSOR
A
WITH R IN
+1.5V
-1.5V
NO R IN
+6V
-6V
V RAMP
HORIZONTAL POSN
12
A2U13
J1
J1
36
HORIZONTAL GAIN
16
P/O W5
NORMALIZER INTERCONNECT
P/O A2 ANALOG PROCESSOR
J1
CH2 FLT
35
CH1 FLT
37
P/O W5
NORMALIZER INTERCONNECT
J2
H POLAR
21
J1
L CHAN 2
47
P/O W6
P/O W5
15
NORMALIZER INTERCONNEC



SERIAL PREFIX: 1825A DATE: MARCH 6, 1979



IFIERS
X DEFLECTION AMPLIFIER
RECTANGULAR DISPLAY
+1.5V
-1.5V
V RAMP/CH2 SELECT
X 300mV/DIV
AMPLIFIER/DRIVER
U9A
RECT
NORMALIZER SELECT
X GAIN
POLAR
NORMALIZER
X NORM
Q9-Q13
X POS
Y DEFLECTION AMPLIFIER
U9B
CHANNEL SELECT
CH 2
U10B
CH 1
NORMALIZER SELECT
Y 300mV/DIV
U10A
U7B
AMP DRIVER
Y GAIN
MARKER SELECT
RECT
NORMAL-IZER
Q4-Q8
POLAR
Y POS
RECTANGULAR SELECT
CHANNEL 2 SELECT
NORMALIZER SELECT
Z-AXIS AMPLIFIER
NORM SELECT
LDBP
U1B
BLANKING
Q2
NORMAL-IZER
+1.2V
Z
BLANKED=0V
UNBLANKED=+5V
POLAR
MARKER
U1C
+1.2V
EXT Z AXIS
BLANKING
Q1
POLAR MARKER
U1D
MARKER DISABLE
+1.2V
+1.1V
1979



P/O A20 MOTHER BOARD
P/O W14
+85V
GULAR DISPLAY
+1.5V
-1.5V
AMPLIFIER/DRIVER
≈16V/DIV
X GAIN
Q9-Q13
HORIZ DEFL
X POS
XDEFL 2 -X
X DEFL 1 +X
HORIZ OUT
P/O A23W1
P/O A23 REAR PANEL
HORIZ
0.1V/DIVISION
18
ALIZER ECT
Y 300mV/DIV
AMP DRIVER
Y GAIN
U7B
Q4-Q8
VERT DEFL
Y POS
Y DEFL 2 -Y
Y DEFL 1 +Y
VERT OUT
VERT 0.1V/DIV
A21 HIGH VOLTAGE POWER SUPP
Z CRT
LEVEL SHIFTER
-2650V CATHOD SUPPLY
EXT Z AXIS
21
BLANK/PEN
XA18
XA17
MARKER DISABLE
A17 SWEEP GENERATOR
PENLIFT
5
BLANKED ≈ +
UNBLANKED =
POLAR MARK

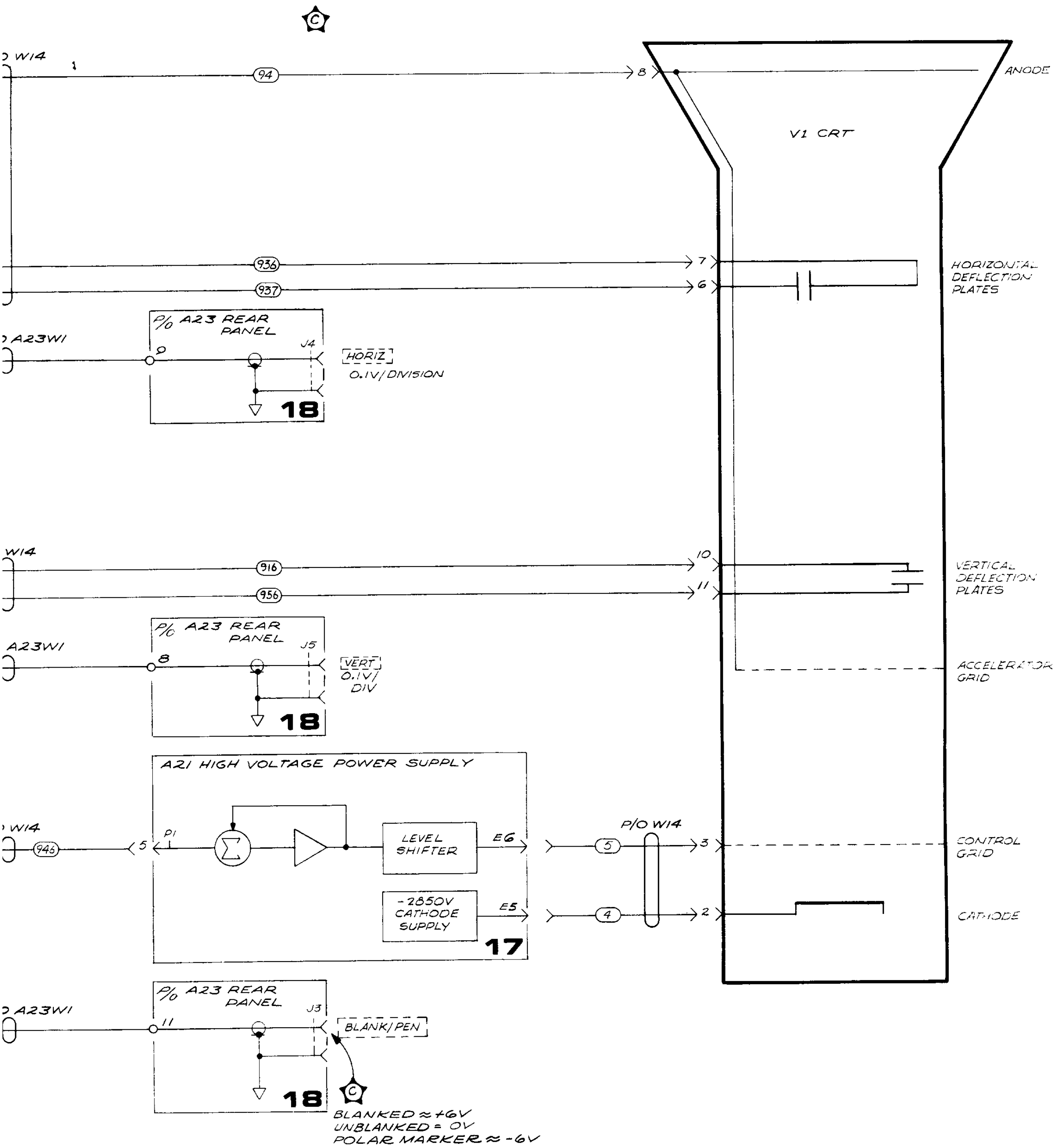
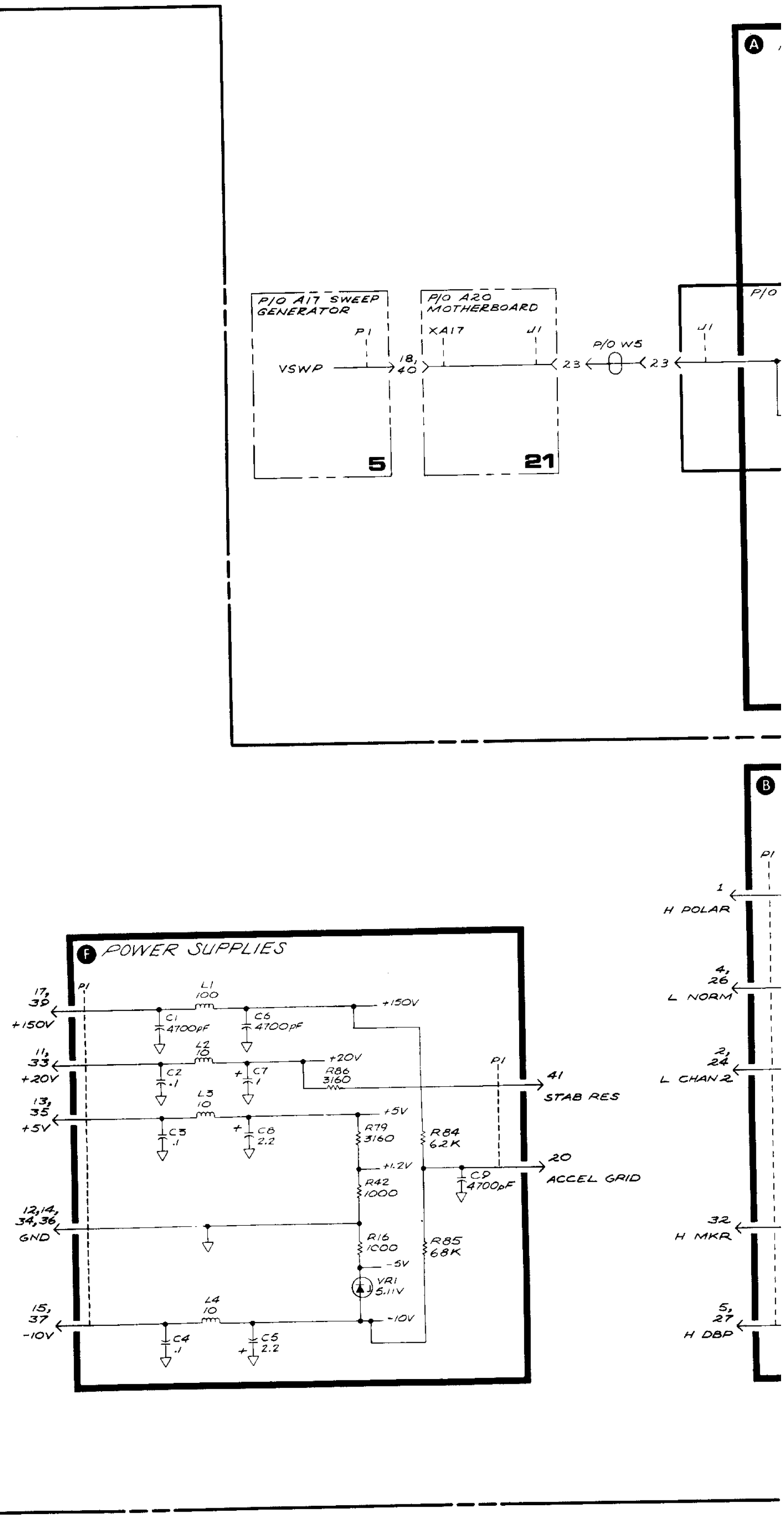


Figure 8-102. Deflection Amplifiers (A18), Block Diagram

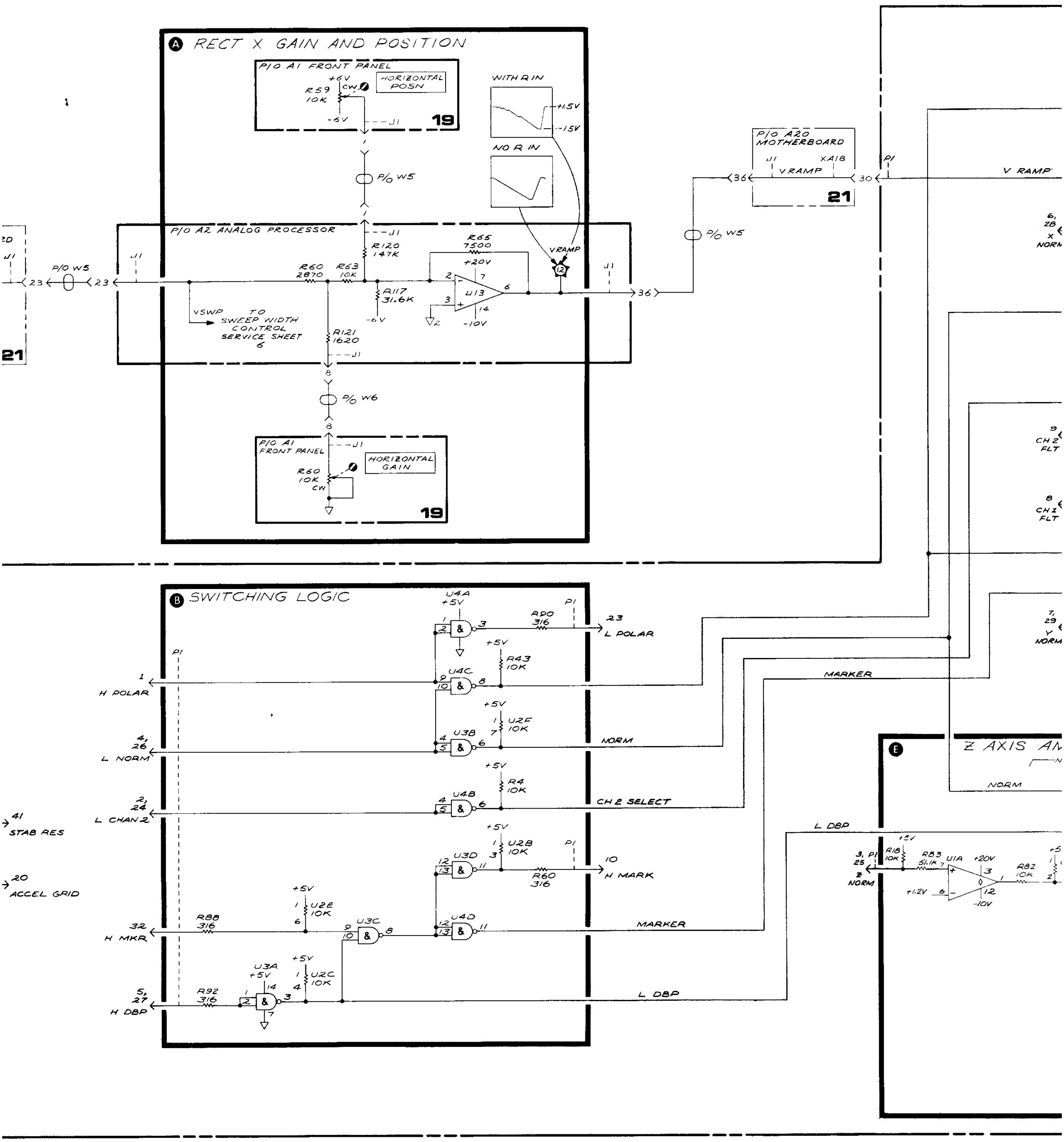
A18 DEFLECTION AMPLIFIER
08754-60018

P1

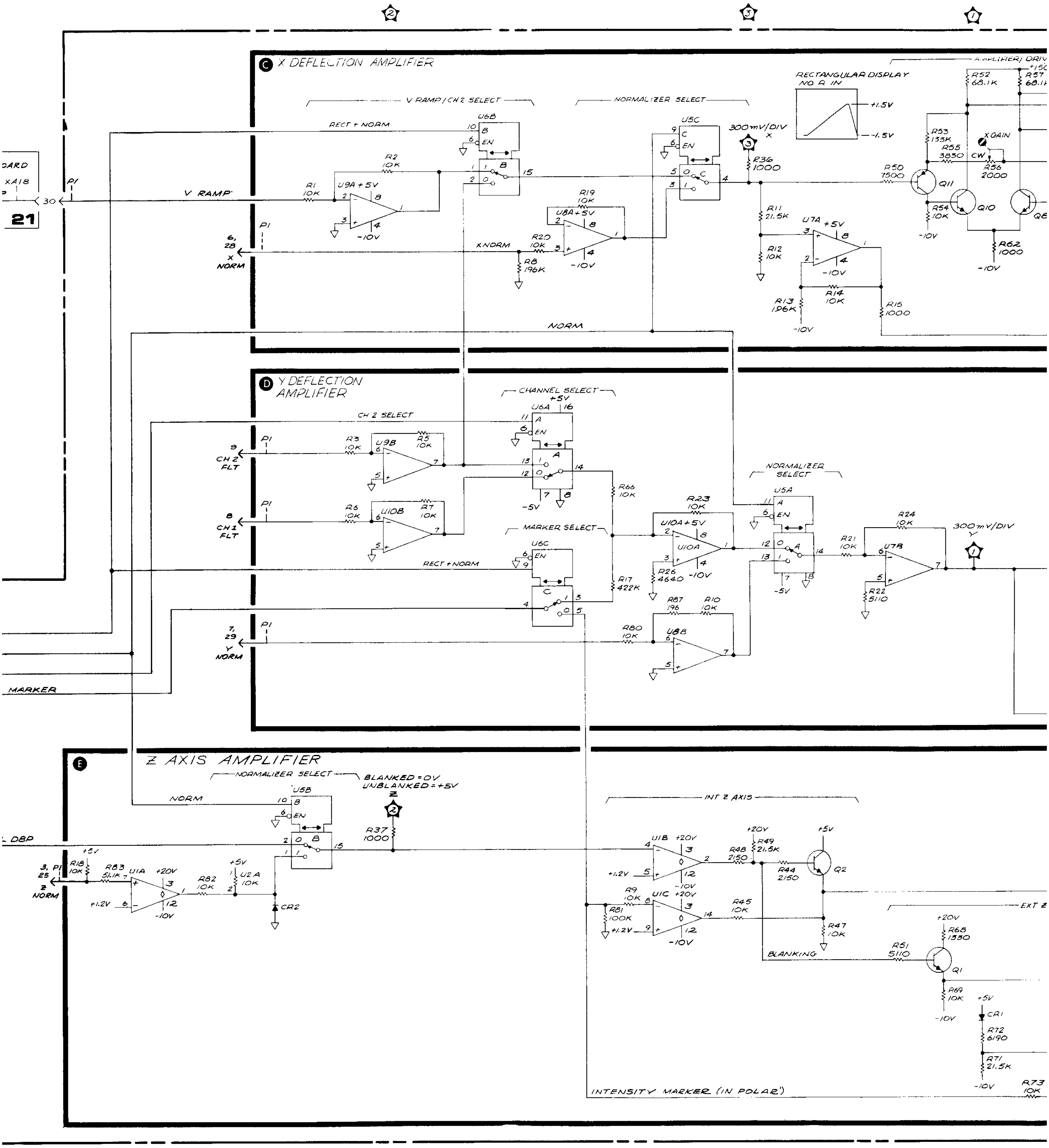
PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	POLAR	A2J2-21	B
23	L POLAR	J8-12	B
2	L CHAN 2	A2J1-47	B
24	L CHAN 2	J8-15	B
3	Z NORM	J8-7A (COAX)	E
25	Z NORM	J8-7A (COAX)	E
4	L NORM	J8-7	B
26	L NORM	J8-7	B
5	H DBP	A17J1-8	B
27	H DBP	J8-9	B
6	X NORM	J8-4A (COAX)	C
28	X NORM	J8-4A (COAX)	C
7	Y NORM	J8-5A (COAX)	D
29	Y NORM	J8-5A (COAX)	D
8	CH 1 FLT	A2J1-37 J8-1A	D
30	V RAMP	A2J1-36	C
9	CH 2 FLT	A2J1-35 J8-2A	D
31	NOT USED	A20J4-12	
10	H MARK	J8-13	B
32	H MKR	A2J1-21,22, 43,44	B
11	+20V	A16J1-3,25	F
33	+20V	A16J1-3,25	F
12	▽	GROUND PLANE	F
34	▽	GROUND PLANE	F
13	+5V	U3 OUTPUT	F
35	+5V	U3 OUTPUT	F
14	▽	GROUND PLANE	F
36	▽	GROUND PLANE	F
15	-10V	A1J1-9,31	F
37	-10V	A1J1-9,31	F
16	Z CRT	A21J1-5	E
38	Z CRT	A21J1-5	E
17	+150V	A19J1-22,44	F
39	+150V	A19J1-22,44	F
18	Y DEFL 1	XV1-11	D
40	NC		
19	Y DEFL 2	XV1-10	D
41	STABILITY RES	R4	F
20	ACCEL GRID	XV1-8	F
42	PENLIFT/2	J3	E
21	X DEFL 1	XV1-6	C
43	VERT OUT	J5	D
22	X DEFL 2	XV1-7	C
44	HORIZ OUT	J4	C



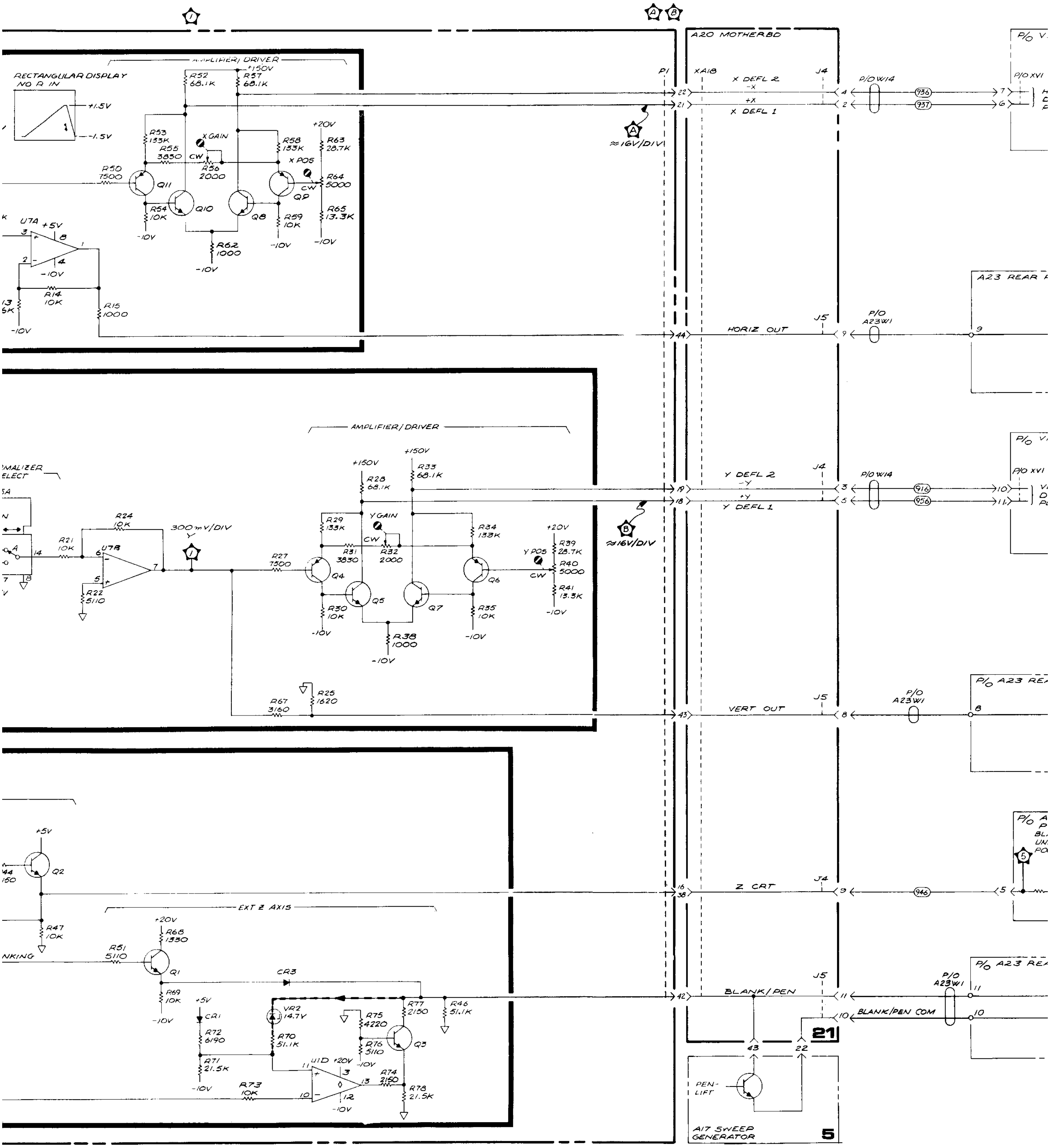
SERIAL PREFIX: 1825A DATE: MARCH 6, 1979

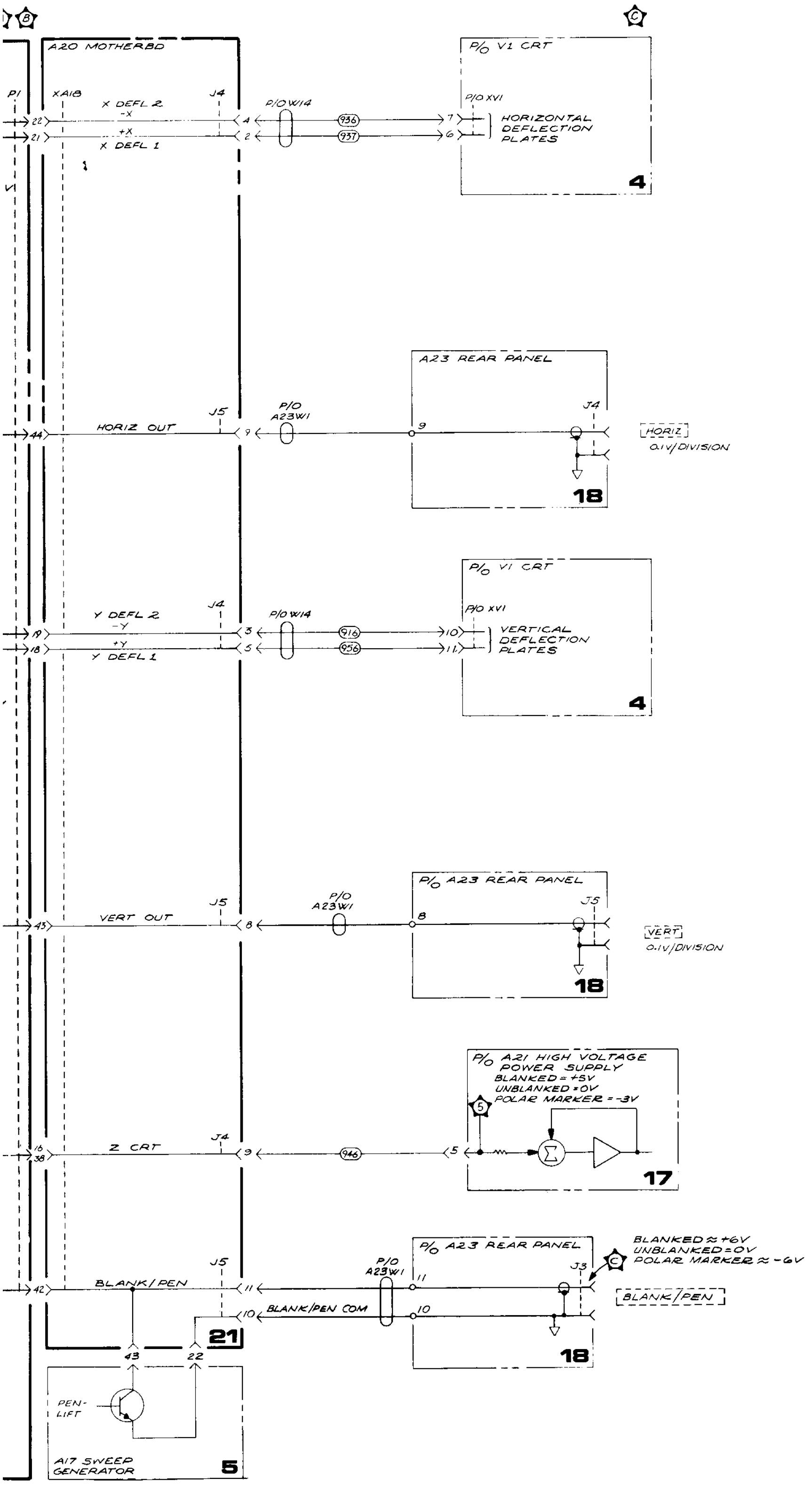


A RECT X GAIN AND POSITION
P/O A1 FRONT PANEL
HORIZONTAL POSN
R59 10K
19
WITH R IN
NO R IN
+1.5V
-1.5V
P/O W5
P/O A2 ANALOG PROCESSOR
R65 7500
R120 147K
R60 2870
R63 10K
R117 31.6K
U13
VRAMP
VSWP TO SWEEP WIDTH CONTROL SERVICE SHEET 6
R121 1620
P/O W6
P/O A1 FRONT PANEL
HORIZONTAL GAIN
R60 10K
P/O A20 MOTHERBOARD
V RAMP
21
B SWITCHING LOGIC
U4A
R90 316
L POLAR
R43 10K
U4C
H POLAR
U3B
U2F 10K
NORM
L NORM
R4 10K
U4B
CH 2 SELECT
L CHAN 2
STAB RES
ACCEL GRID
U3D
U2B 10K
R60 316
H MARK
R88 316
U2E 10K
U3C
U4D
MARKER
H MKR
U3A
U2C 10K
R92 316
L DBP
H DBP
E Z AXIS AM
CH 2 FLT
CH 1 FLT
X NORM
Y NORM
R18 10K
R83 51.1K
U1A
R82 10K



X DEFLECTION AMPLIFIER
V RAMP / CH 2 SELECT
NORMALIZER SELECT
RECTANGULAR DISPLAY
NO R IN
+1.5V
-1.5V
300mV/DIV
X
RECT + NORM
V RAMP
X NORM
NORM
X GAIN
Y DEFLECTION
AMPLIFIER
CHANNEL SELECT
CH 2 SELECT
CH 2
FLT
CH 1
FLT
MARKER SELECT
RECT + NORM
NORMALIZER
SELECT
300mV/DIV
Y
Y
NORM
MARKER
Z AXIS AMPLIFIER
NORMALIZER SELECT
BLANKED = 0V
UNBLANKED = +5V
Z
NORM
DBP
INT Z AXIS
BLANKING
EXT Z
INTENSITY MARKER (IN POLAR)
XA18
21


A20 MOTHERBD
AMPLIFIER/DRIVER
RECTANGULAR DISPLAY NO R IN
X DEFL 2
X DEFL 1
HORIZ OUT
Y DEFL 2
Y DEFL 1
VERT OUT
Z CRT
BLANK/PEN
BLANK/PEN COM
EXT Z AXIS
X GAIN
X POS
Y GAIN
Y POS
300mV/DIV
≈16V/DIV
A23 REAR
A17 SWEEP GENERATOR
PEN-LIFT
21
5



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. ALL WAVEFORMS ARE SHOWN WITH 8754A CONTROLS SET AS FOLLOWS:
   REAR PANEL INT SWEEP SELECTED
   SWEEP MODE: FULL 4-1300
   SWEEP: AUTO FAST
   SWEEP VERNIER: FULLY CLOCKWISE

16
A18

Figure 8-103. Deflection Amplifiers (A18), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 17

HIGH VOLTAGE POWER SUPPLY (A21), CIRCUIT DESCRIPTION

WARNING

The High Voltage Power Supply (A21) operates at voltages of up to −2900 Vdc and approximately 6000 Vac peak-to-peak. These voltages, if contacted, could cause personal injury or death.

NOTE

All reference designations in this circuit description refer to components of the High Voltage Power Supply (A21) unless chassis-mounted components are specifically designated or the prefix of another assembly is added. The reference designation T1 refers to A21T1 except where it is identified as the line transformer.

The High Voltage Power Supply (A21) provides the bias potentials for CRT V1. It also converts the blanking and intensity control inputs to voltage levels capable of controlling the beam intensity of the CRT.

The −2850V Rectifier provides a regulated −2850 Vdc, and the CRT anode/accelerator grid voltage is an unregulated +84 Vdc provided by a voltage divider string in the Deflection Amplifiers (A18). These voltages provide a 2934-volt difference between the anode and the cathode to generate the CRT electron beam. The control grid potential provides for retrace blanking and polar marker intensification.

Resolution and alignment of the CRT beam are adjusted by the front-panel FOCUS control and by the rear-panel ASTIG and TRACE ALIGN screwdriver adjustments. The 6.3-Vac filament voltage, provided by the chassis-mounted line transformer T1, is biased at −2850 Vdc to prevent arcing to the cathode.

Horizontal and vertical deflection potentials are provided by the Deflection Amplifiers (A18).

High Voltage Oscillator, −2850V Rectifier, and Error Amplifier (C) (E) (B)

The −2850V regulated cathode supply is generated by a high-frequency oscillator that produces an approximately 63-Vac peak-to-peak, 57-kHz voltage whose amplitude is controlled by varying the dc bias of the oscillator. The 63-Vac signal is stepped up by T1 to 5800 Vac peak-to-peak, which is half-wave rectified and filtered to produce the −2850-Vdc cathode potential. Part of this voltage is fed back to the Error Amplifier where it is compared with a positive reference voltage. Any voltage difference is amplified by the Error Amplifier to adjust the oscillator bias current, thereby correcting the oscillator output voltage.

High Voltage Oscillator. The High Voltage Oscillator consists of transistor Q1, operating as a class C amplifier, and the primary winding of T1 (pins 1 to 2), whose capacitance and inductance set the frequency of oscillation at 57 kHz. The T1 primary is the collector load of Q1. The T1 feedback winding (pins 3 to 4), provides the positive feedback necessary to sustain oscillations and couples the dc bias from the Error Amplifier to the base of Q1 to vary the amplitude of oscillations. L7 and C16 are series resonant at the oscillator frequency and provide the ac return path for the feedback current.

−2850V Rectifier. The 5800 Vac peak-to-peak across the secondary of T1 (pins 5 to 8) is rectified by CR7 and filtered by R32 and C1 to provide the −2850 Vdc cathode potential. This voltage is also fed back to the Error Amplifier to provide regulation.

Error Amplifier. The Error Amplifier regulates the dc level of the CRT cathode voltage by controlling the base bias of Q1 and therefore the oscillation amplitude.

Regulation is provided by feeding back the −2850 Vdc across the feedback resistor R34 and summing it with the +20-Vdc reference from the DC Regulator (A16)) across R17 and R18 to provide an input of 0 Vdc to the amplifer U1. Any deviation from 0 Vdc is amplified by U1 and varies the bias of the oscillator to maintain the cathode potential of the CRT at about −2850 Vdc. The open-loop gain of U1 is set by R20, while R23, R25, and C15 limit the bandwidth of the control loop. The output current of the Error Amplifier is limited by R21.

Z-Axis Amplifier (A)

The Z-Axis Amplifier, consisting of U2, Q2 and Q3, has two external inputs: Z CRT from the Deflection Amplifiers (A18) and INTENSITY from the front-panel INTENSITY control.

The Z CRT input is +5V for blanking, OV for normal intensity, and −3V for polar marker intensification. The 0 to +5V analog INTENSITY signal is used to control trace intensity when the Z CRT voltage is zero.

The Z CRT and INTENSITY signals are summed at the input to amplifier U2. Complementary transistors Q2 and Q3 invert the output of U2 and provide the capability for an increased voltage swing. The output of U2 is fed back to provide a gain of 8.3 for the Z CRT signal and 10 for the INTENSITY signal.

The output of the Z-Axis Amplifier (TP5) is prevented from going more positive than ground by CR2, and the negative voltage swing is limited by the −47V supply. With the front-panel INTENSITY control set to midrange, the signal at TP3 is typically −16V (normal intensity), −47V (blanked), or OV (polar marker intensification). This signal is coupled to the control grid of the CRT through the Control Grid Level Shifter.

Control Grid Level Shifter (D)

The Control Grid Level Shifter shifts the output of the Z-Axis Amplifier by −2850 Vdc to create a −2850V to −2897V control grid voltage that is more negative than the cathode voltage. Transformer T1 steps up the output of the High Voltage Oscillator. The 6010 Vac peak-to-peak across the secondary winding of T1 (pins 6 to 7) is rectified by CR6 and filtered by C18. The rectified 2910 Vdc is then applied across the voltage divider R28 through R30. The voltage drop across R30 provides a level shift of −2850 Vdc for the output of the Z-Axis Amplifier and is adjusted by INTEN LIMIT potentiometer R28. The voltage drop across R29 (between TP5 and TP3) is about 1/1000 of the shift voltage, or −2.8 Vdc.

The neon indicator DS1 is a protective device to prevent arcing within the CRT. If the difference of potential between the control grid (TP2) and cathode (TP1) exceeds 135V, the lamp fires and conducts until the difference of potential returns to a safe value. Diode CR8 prevents the control grid from going more positive than the cathode.

Focus (F)

The focus voltage is set by a voltage divider network at the cathode. The front-panel FOCUS control provides a focus voltage adjustment of approximately −2215 Vdc to −2600 Vdc.

Astigmatism, Trace Alignment, and Anode/Accelerator Grid Voltages

The rear panel ASTIG adjustment provides an astigmatism control range of −12 Vdc to −150 Vdc. It is adjusted in conjunction with the front-panel FOCUS control for best resolution of the CRT trace.

The rear panel TRACE ALIGN adjustment provides a variable current through the CRT trace alignment coil. Either end of the trace alignment coil may be connected to A20E2 on the Motherboard, while the other end is connected to either A20E1 or A20E3.

The CRT anode/accelerator grid voltage (approximately +84 Vdc) is supplied by a voltage divider network in the Deflection Amplifers (A18).

CRT Filament Supply

WARNING

The 6.3 Vac CRT filament voltage is biased at a potential of −2850 Vdc. This voltage, if contacted, could cause personal injury or death.

Chassis-mounted line transformer T1 supplies 6.3 Vac to the CRT filament. This winding is connected to the cathode through R37 to prevent arcing from the cathode to the filament.

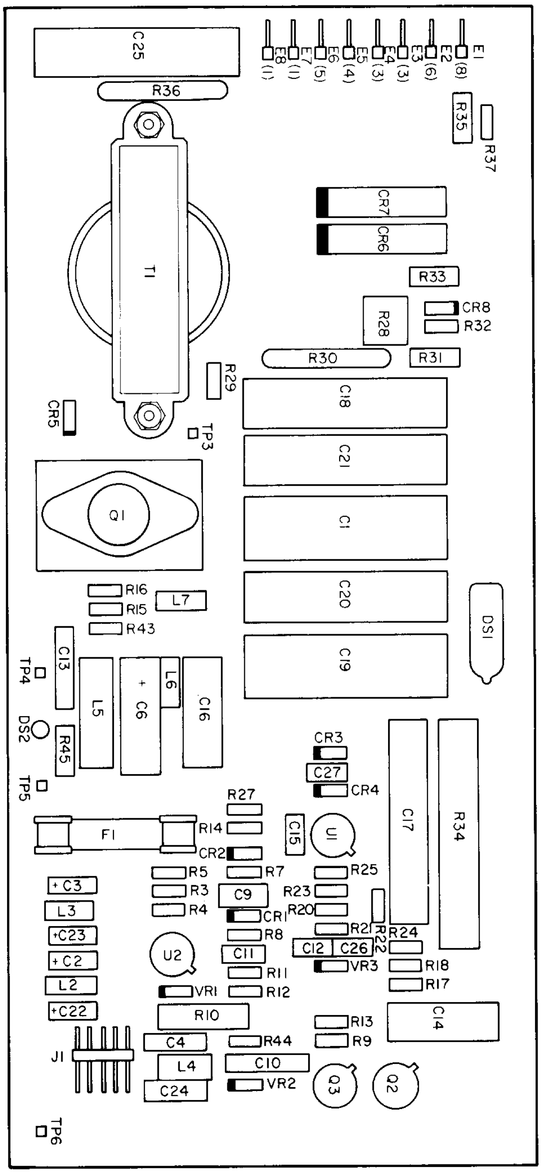
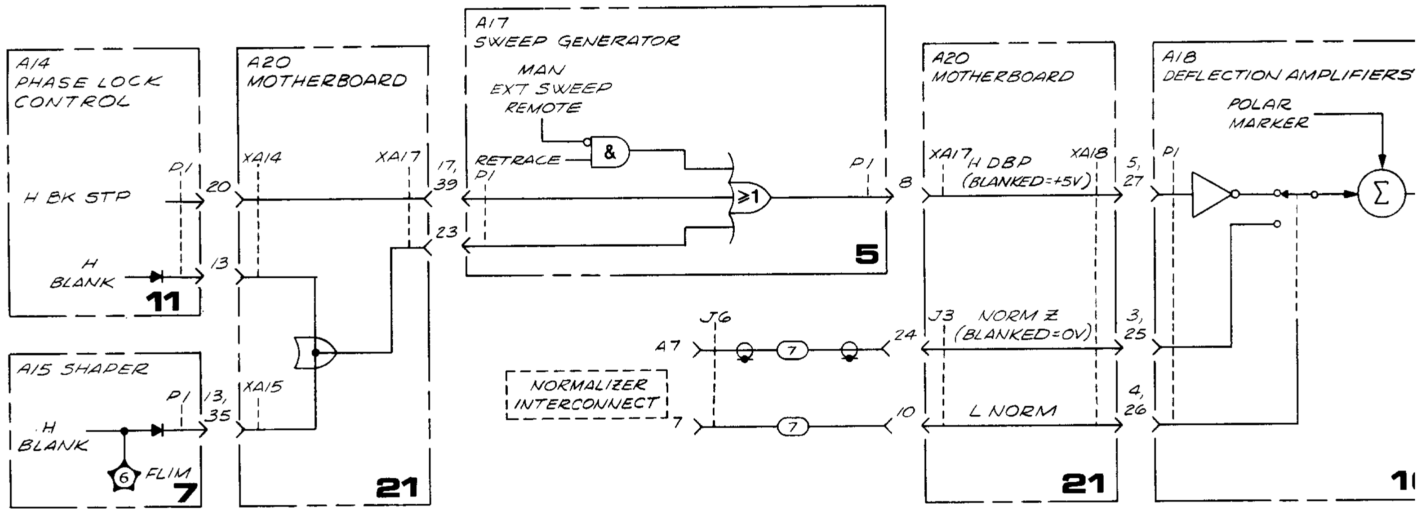
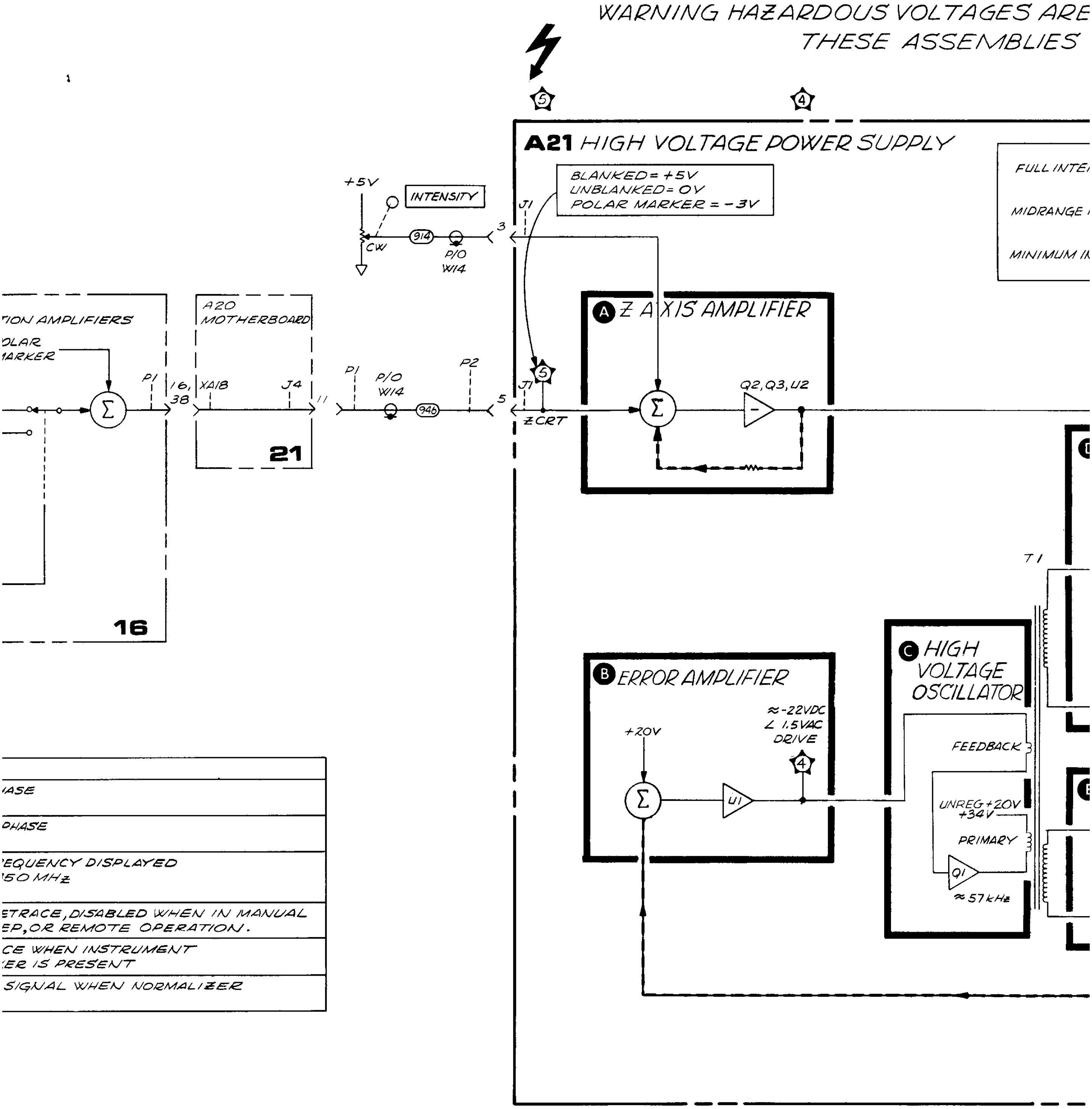


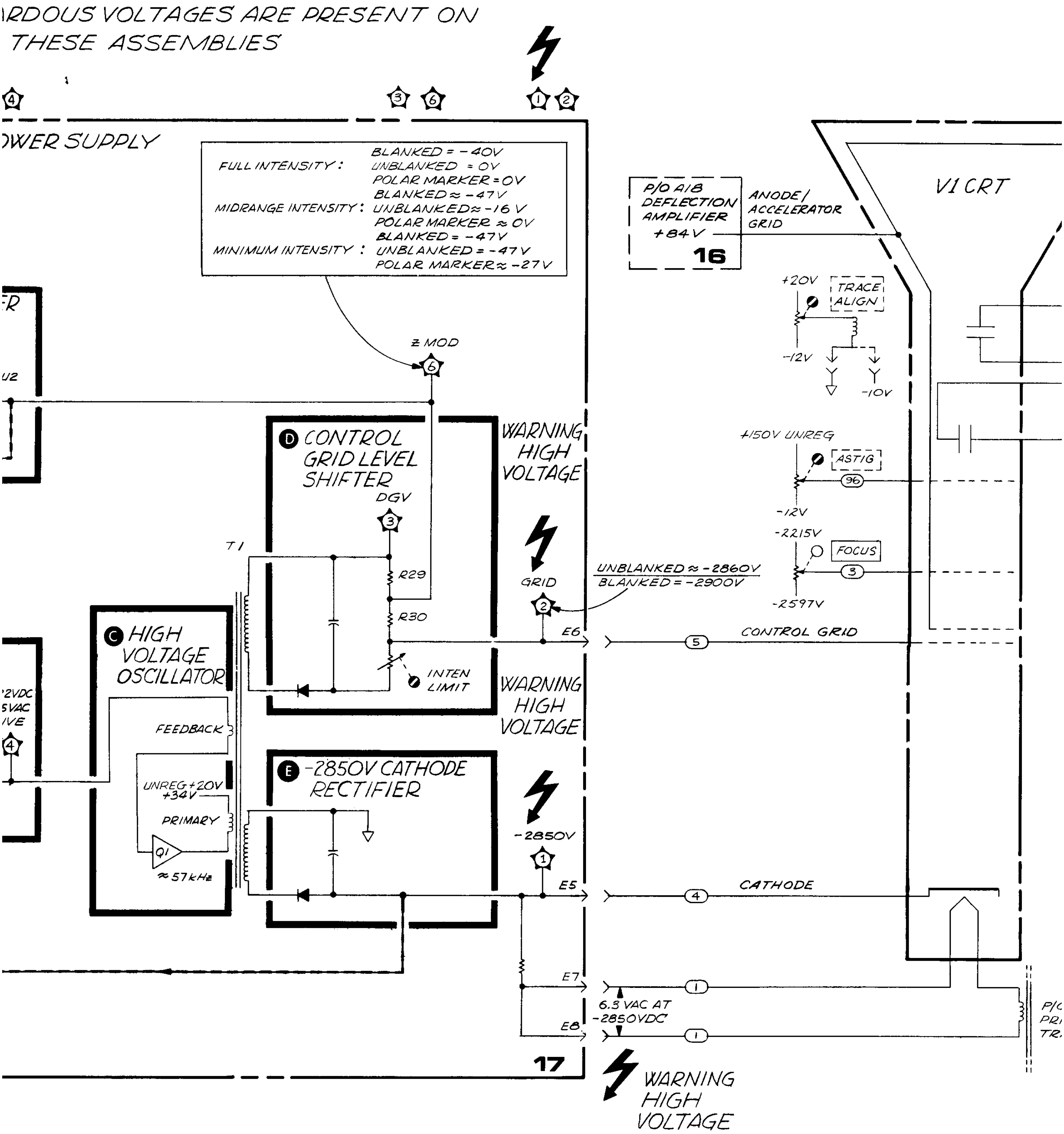
Figure 8-104. High Voltage Power Supply (A21), Component Locations



SIGNAL FLOW			DESCRIPTION
Z CRT (CRT BLANKING AND INTENSITY CONTROL) (A20J4-11)	DBP (DISPLAY BLANKING PULSE) (XA17-8)	BACKSTEP (A14TP3)	BLANKS CRT DURING PHASE LOCK ACQUISITION.
		H BLANK (XA14-13)	BLANKS CRT DURING PHASE LOCK ACQUISITION.
		FREQUENCY LIMIT BLANK (XA15-13,35)	BLANKS CRT WHEN FREQUENCY DISPL IS < -10MHz OR > 1350 MHz
		RETRACE (A17TP3)	BLANKS CRT DURING RETRACE, DISABLE SWEEP, EXTERNAL SWEEP, OR REMOTE
	POLAR MARKER (A18U6-5)		INTENSIFIES CRT TRACE WHEN INSTR IS IN POLAR AND MARKER IS PRESENT
	Z NORM (XA18-3,25)		DISPLAY BLANKING SIGNAL WHEN IS CONNECTED.

WARNING HAZARDOUS VOLTAGES ARE
THESE ASSEMBLIES





ARDOUS VOLTAGES ARE PRESENT ON
THESE ASSEMBLIES
OWER SUPPLY
FULL INTENSITY: BLANKED = -40V
UNBLANKED = 0V
POLAR MARKER = 0V
MIDRANGE INTENSITY: BLANKED ≈ -47V
UNBLANKED ≈ -16 V
POLAR MARKER ≈ 0V
MINIMUM INTENSITY: BLANKED = -47V
UNBLANKED = -47V
POLAR MARKER ≈ -27V
P/O A18 DEFLECTION AMPLIFIER
+84V
16
ANODE/ ACCELERATOR GRID
V1 CRT
+20V
TRACE ALIGN
-12V
-10V
Z MOD
D CONTROL GRID LEVEL SHIFTER
DGV
WARNING HIGH VOLTAGE
+150V UNREG
ASTIG
96
-12V
-2215V
FOCUS
3
-2597V
T1
R29
R30
GRID
UNBLANKED ≈ -2860V
BLANKED = -2900V
C HIGH VOLTAGE OSCILLATOR
E6
5
CONTROL GRID
INTEN LIMIT
WARNING HIGH VOLTAGE
FEEDBACK
UNREG +20V +34V
PRIMARY
Q1
≈ 57 kHz
E -2850V CATHODE RECTIFIER
-2850V
E5
4
CATHODE
E7
6.3 VAC AT -2850VDC
E8
17
WARNING HIGH VOLTAGE

Figure 8-105.

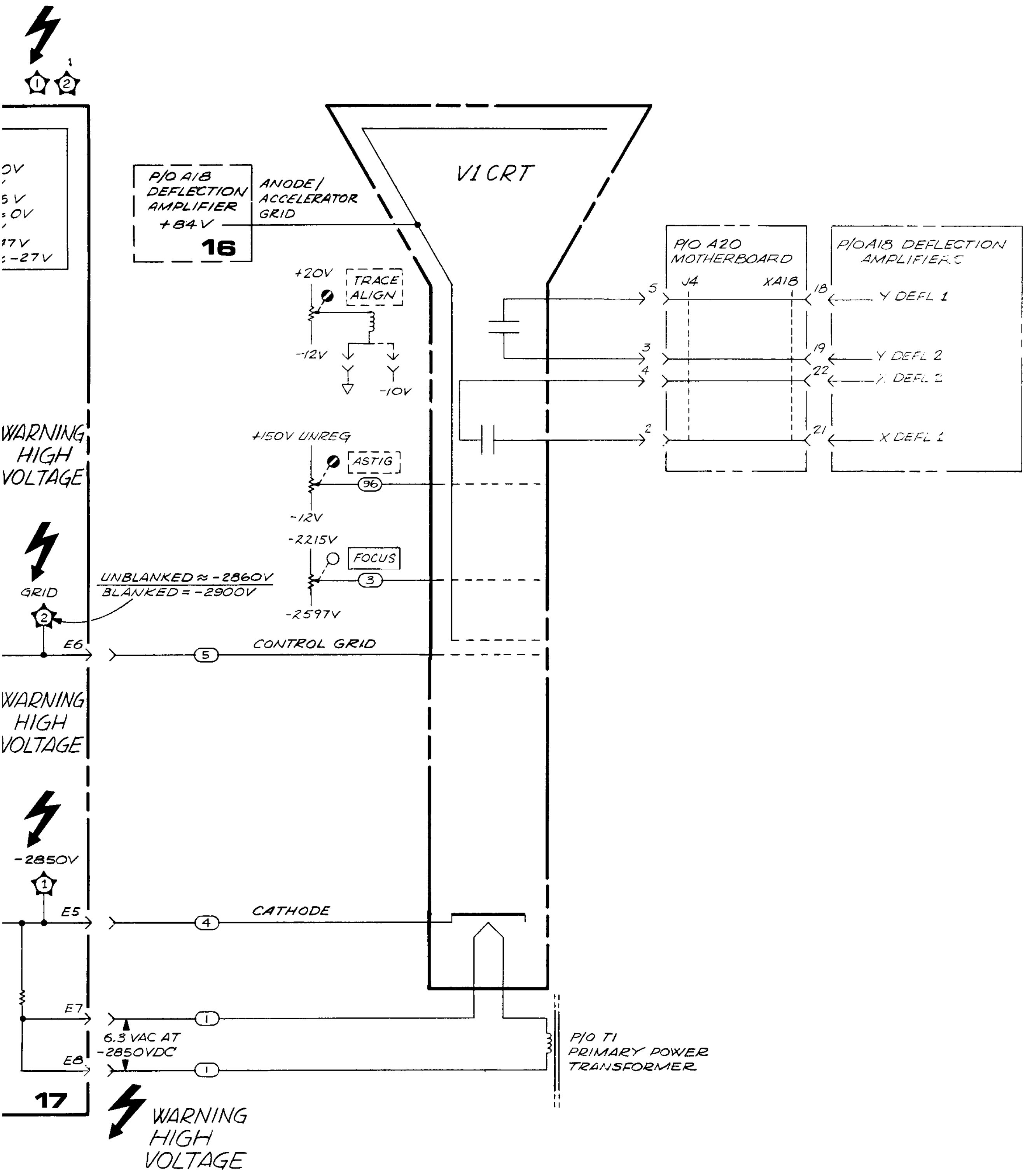
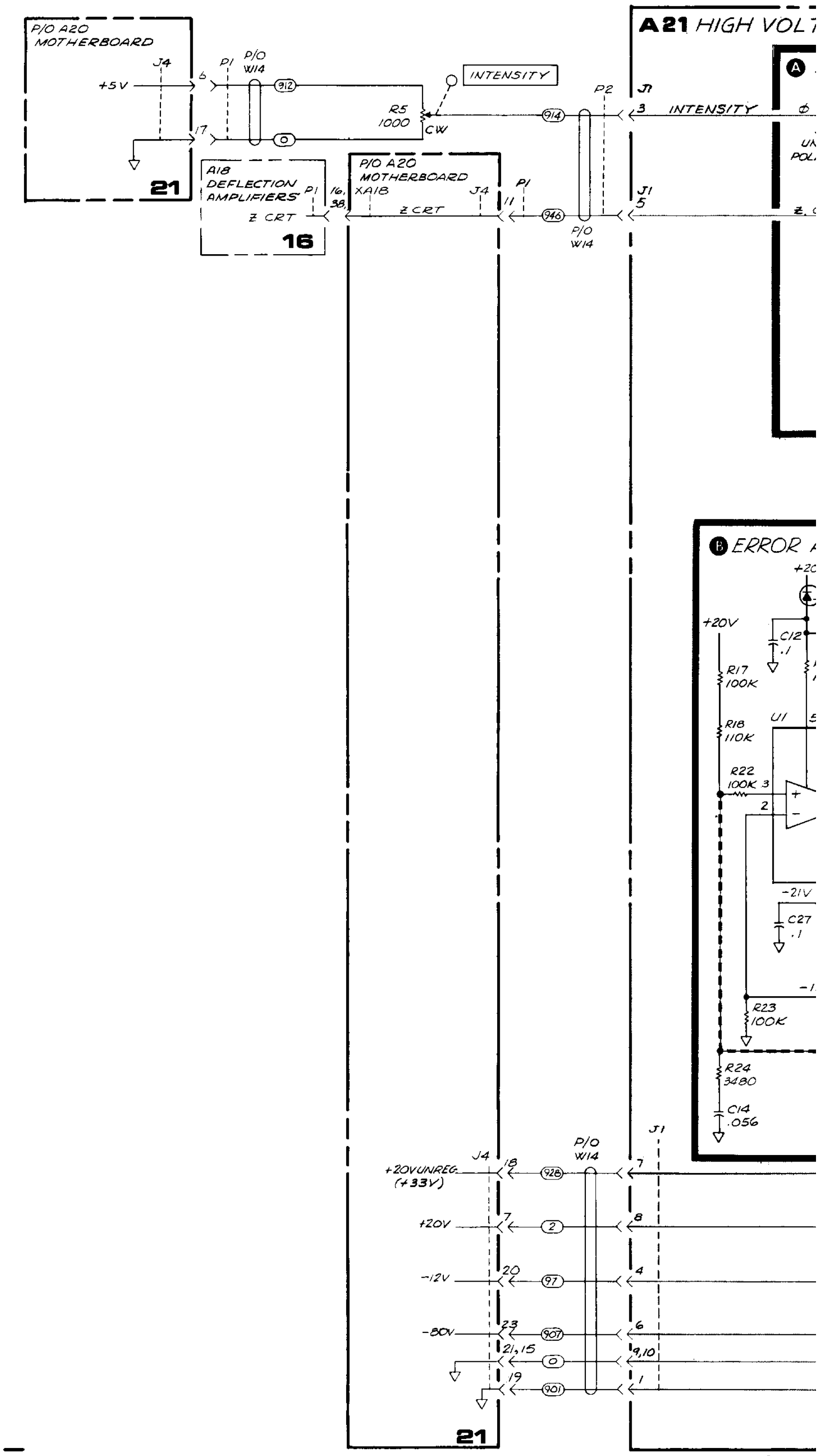


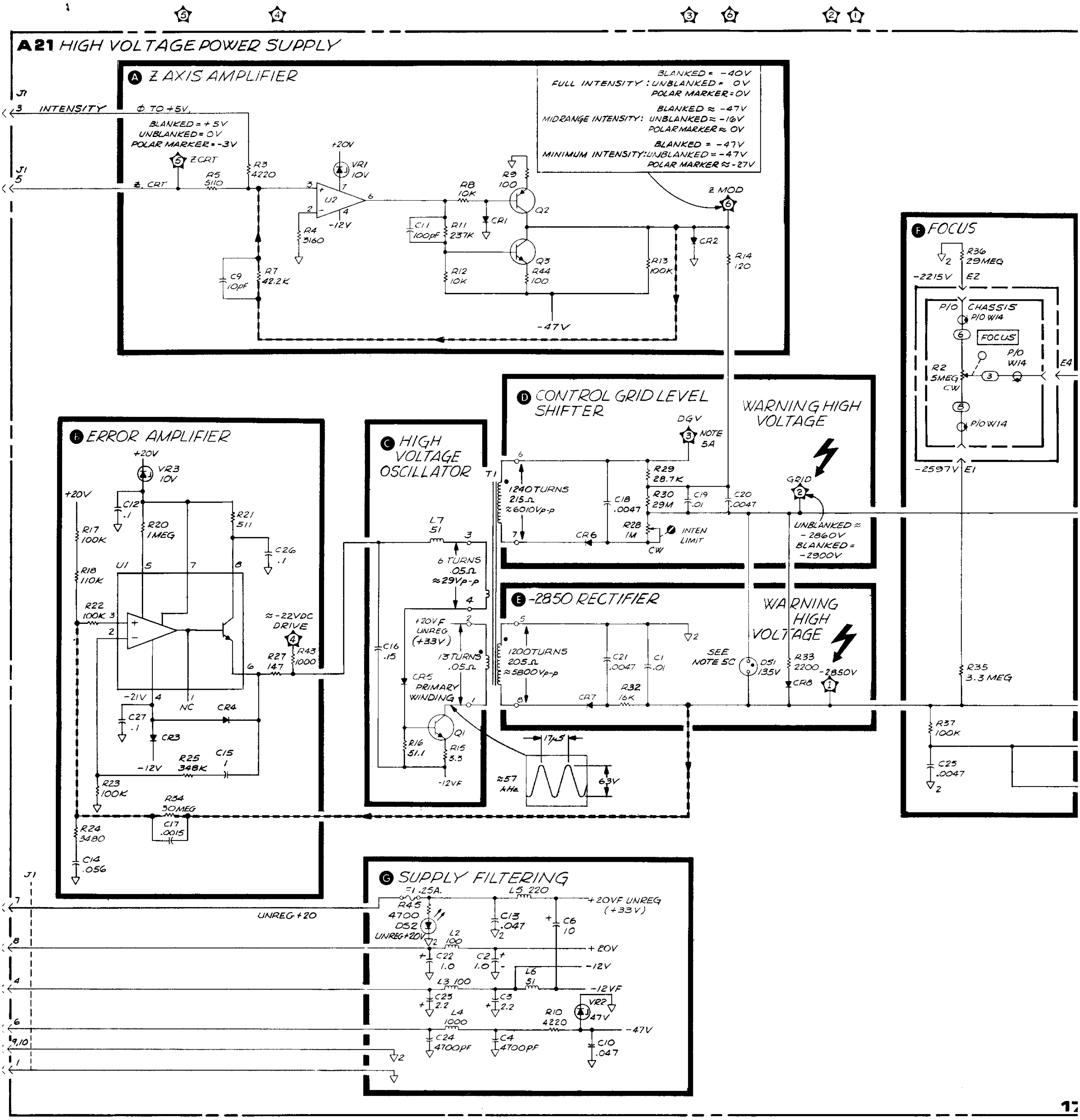
Figure 8-105. High Voltage Power Supply (A21), Block Diagram

A21

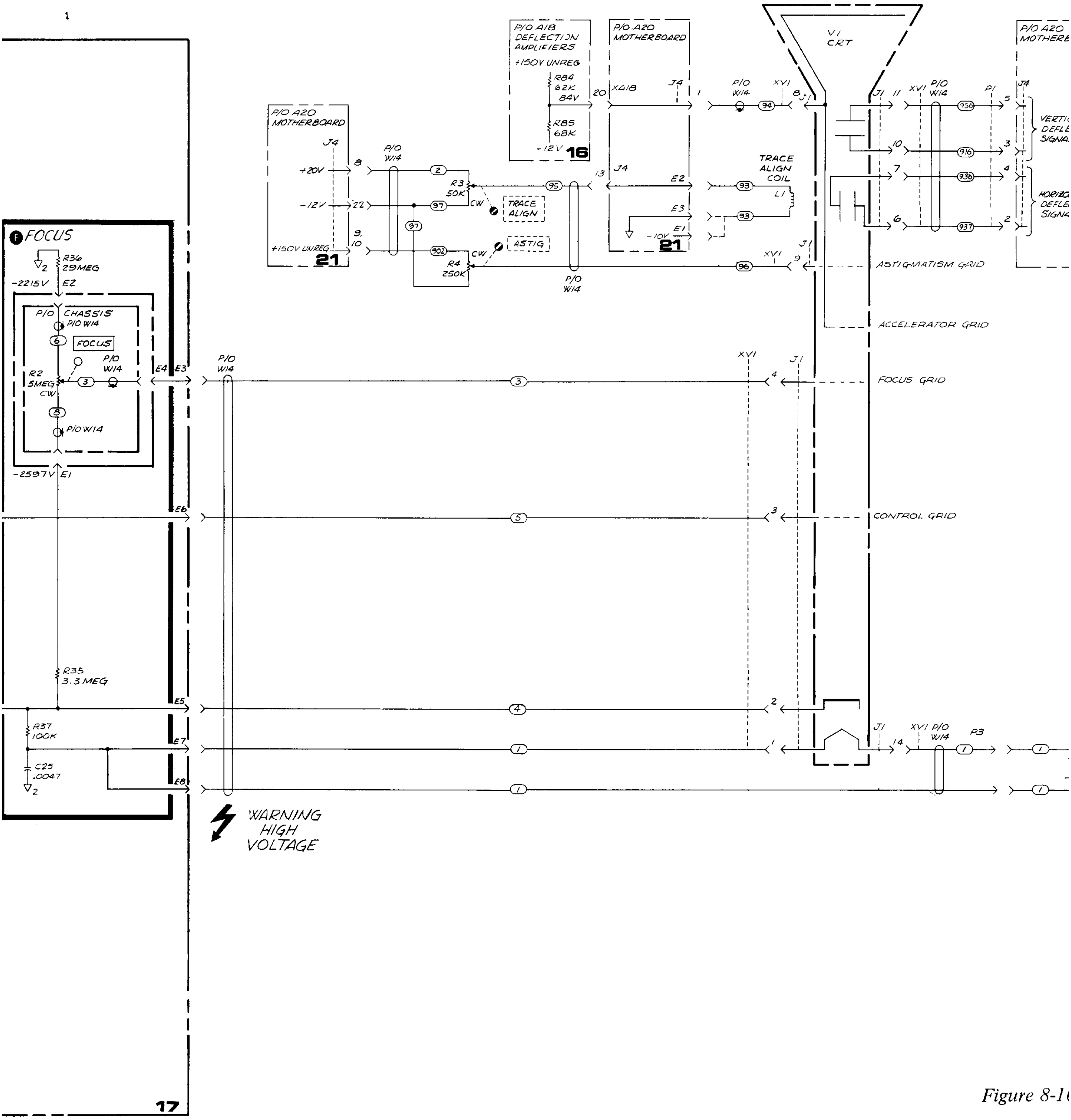
J1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK
1	▽	A20J4-15 (901)	G
2	NC		
3	INTENSITY	R1-2 (914)	A
4	-12V	A20J4-24 (97)	G
5	Z CRT	A20J4-11 (946)	A
6	-80V	A20J4-23 (907)	G
7	+20V UNREG (+33V)	A20J4-18 (928)	G
8	+20V	A20J4-7 (2)	G
9	▽2	A20J4-19 (0)	G
10	▽2	A20J4-21 (0)	G



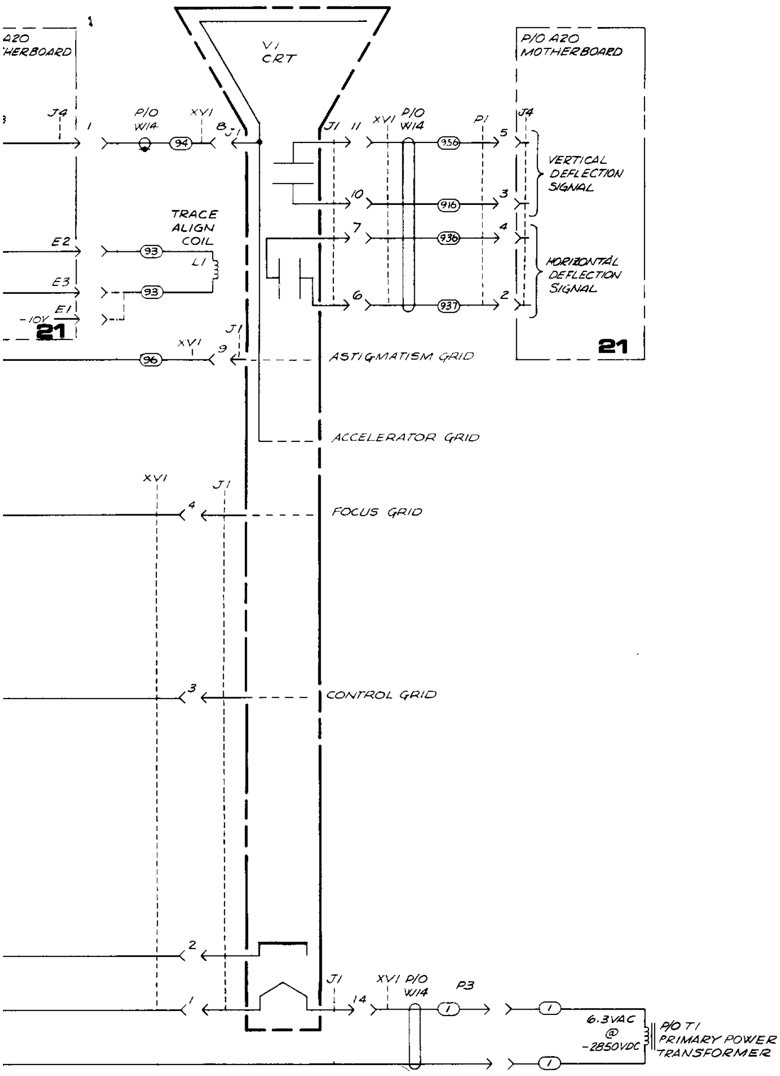


SERIAL PREFIX: 1825A 21 JUNE 1978



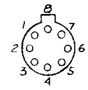
F FOCUS
R36
29MEG
-2215V
E2
P/O CHASSIS
P/O W14
FOCUS
R2
5MEG
CW
P/O W14
-2597V
E1
R35
3.3MEG
R37
100K
C25
.0047
E3
E4
E5
E6
E7
E8
17
WARNING
HIGH
VOLTAGE
P/O A20
MOTHERBOARD
J4
+20V
-12V
+150V UNREG
21
P/O W14
R3
50K
R4
250K
CW
TRACE
ALIGN
ASTIG
P/O A18
DEFLECTION
AMPLIFIERS
+150V UNREG
R84
62K
84V
R85
68K
-12V
16
P/O A20
MOTHERBOARD
XA18
E2
E3
E1
-10V
21
TRACE
ALIGN
COIL
L1
V1
CRT
XV1
J1
ASTIGMATISM GRID
ACCELERATOR GRID
FOCUS GRID
CONTROL GRID
P3
P/O A20
MOTHERB
VERTI
DEFLE
SIGNA
HORIZO
DEFLE
SIGNA

Figure 8-1

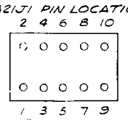


NOTES

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATIONS WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. A21U1 PIN LOCATIONS:



4. A21J1 PIN LOCATIONS (FRONT VIEW):



(PIN # 2 NOT USED)

5. TROUBLESHOOTING HINTS:
   A. THE CONTROL GRID VOLTAGE AT A21TP2 CAN BE INDIRECTLY MEASURED BY MEASURING THE VOLTAGE DROP ACROSS A21R29 (A21TP5 TO A21TP3). THE SCALE FACTOR IS 1V/1KV GRID VOLTAGE.
   B. IF THE VOLTAGE DIFFERENCE BETWEEN THE CONTROL GRID (A21TP2) AND CATHODE (A21TP1) IS GREATER THAN 135V. NEON LAMP A21DS1 CONDUCTS TO MAINTAIN AN 80V DIFFERENCE BETWEEN THE TWO TUBE ELEMENTS.
   C. RETURN SIDE OF TRACE ALIGN COIL L1 CAN BE CONNECTED TO EITHER GROUND (A20E3) OR -10V (A20E1). CHANGING THE RETURN SIDE CONNECTION OFFSETS THE TRACE ALIGN POTENTIOMETER R3 ADJUSTMENT RANGE. SEE SECTION V ADJUSTMENTS FOR SELECTING TRACE ALIGN COIL RETURN SIDE CONNECTION.

17
A21

Figure 8-106. High Voltage Power Supply (A21), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 18

EXTERNAL INTERFACE (A23, NORMALIZER INTERCONNECT) CIRCUIT DESCRIPTION

The External Interface includes all signals received from or sent to the rear panel (A23) and the NORMALIZER INTERCONNECT connector. Also included are the logic circuits on the Rectifier (A19).

Slide Switch and BNC Connectors

INT/EXT SWEEP Switch. When the switch is set to the EXT position, A17 pin 21 is grounded. This disables the internal sweep circuit, and enables the circuit for an external sweep input. (See Service Sheet 5.)

EXT SWEEP IN. When the external sweep mode is selected, a 0V to +10V input will sweep the RF Source and the CRT Display.(See Service Sheet 5.)

EXT MARKER INPUT. The nominal input signal is a CW frequency (between 4 MHz and 1300 MHz) at a power level of approximately −13 dBm. This signal is mixed with the internal RF Source signal, and when the two frequencies are equal, a marker is generated. (See Service Sheet 8.)

SWEEP OUTPUT. Provides a sweep ramp voltage (−5V to +5V) from the Sweep Generator (A17, Service Sheet 5).

VERT OUT. Vertical out. From Deflection Amplifiers (A18, Service Sheet 16). Provides 0.1V/div vertical deflection signal for use with an external oscilloscope or X−Y recorder.

HORIZ OUT. Horizontal out. From Deflection Amplifiers (A18, Service Sheet 16). Provides 0.1V/div horizontal deflection signal for use with an external oscilloscope or X−Y recorder.

BLANK/PEN. Blanking/penlift. From Sweep Generator (A17, Service Sheet 5) and Deflection Amplifiers (A18, Service Sheet 16). Provides Z axis signals (+6V for blanking or −3V to intensify markers) from A18 for use with external oscilloscope. Also provides a penlift signal from the Sweep Generator (A17, Service Sheet 5) for an X−Y plotter or recorder. The penlift (actually a pen set-down) is enabled only during the slow sweep mode.

MAG/PHASE OUTPUT. From R Detector (A11, Service Sheet 13). Provides a dc voltage proportional to the magnitude ratio (0.1V/dB) or the phase difference (.01V/deg). Either phase or magnitude is selected by the H MAG input to PROGRAMMING connector A23J7. This magnitude or phase information is also applied to A23J7 pins 11 and 22.

PROGRAMMING CONNECTOR (A23J7) INPUTS

For the following signals, a high equals +5V (open), and a low equals 0V (ground).

H MAG. (J7−19) High Magnitude. Selects magnitude ratio or phase difference voltage at A23J6. When high, the output of EXCLUSIVE OR gate A19U1C is low, which causes the R Detector (A11, Service Sheet 13) to output a magnitude ratio voltage to A23J6. When low, A19U1C is high, causing the R Detector to output a phase difference voltage to A23J6.

L RELOCK. (J7−24). To Phase Lock Control (A14, Service Sheet 11). When low, CRT display is blanked; Transition from low to high causes CRT to blank for an additional 1.5 milliseconds (while receiver is reacquiring phase lock).

H RELOCK. (J7−3). Same function as L RELOCK except it is the opposite polarity (normally low).

H LGTH. (J7−13). High length. To Frequency Reference (A15, Service Sheet 6). When high, FREQ REF is selected as the reference for electrical length compensation during phase measurements. When low, VSWP is selected as the reference, allowing greater electrical length compensation on narrow sweep widths.

L EXT STP SWP. (J7−15). Low external stop sweep. To Sweep Generator (A17, Service Sheet 5). When low, stops sweep.

L F MKR. (J7−23). Low full marker. From Shaper (A15, Serviice Sheet 6) to the Marker Generator (A12, Service Sheet 8). When low, the CRT displays a marker. In FULL 4−1300 sweep mode, the Shaper grounds this line when the swept RF frequency equals the tuning frequency.

L EXT TRIG. (J7 – 16). Low external sweep trigger to the Sweep Generator (A17, Service Sheet 5). When low, a sweep will be triggered if the front-panel TRIG button is selected and the Sweep Generator has completed its retrace cycle.

L REM. (J7 – 21). Low remote enable. When low, the output of EXCLUSIVE OR gate A19U1A is low. This causes –

- The Sweep Generator (A17, Service Sheet 5) to enable the external sweep input mode.
- The Phase Offset/Length circuit on the Analog Processor (A2, Service Sheet 15) to be disabled.
- The selection of the A or B inputs on the IF Switch (P/O A6, Service Sheet 12) to be controlled by the L B REM input from the PROGRAMMING connector A23J7.

IF SWITCH LOGIC (P/O A19).

The position of the IF Switch (A6, Service Sheet 12) is controlled by four lines: L REM, L B INT, L B REM, and L REV AB. Table 8-10 is a truth table that shows the state of the L B IF SW line for each combination of logic states of the four input lines. Figure 8-107 is an equivalent circuit of the IF Switch control logic.

Table 8-10. IF Switch Control Logic

	REMOTE				LOCAL			
L REM	L				H			
L B REM	L		H		DON'T CARE			
L B INT	DON'T CARE				L		H	
L REV AB	H	L	H	L	H	L	H	L
L B IF SW	L	H	H	L	L	H	H	L

When the instrument is operated with no external connections, the L REM, L B REM, and L REV AB lines are all held high, while the L B INT line alone controls the state of the L B IF SW line, and thus the position of the IF Switch. When L B INT is low, L B IF SW is also low, and test channel B is selected by the IF Switch. Test channel A is selected when L B IF SW is high.

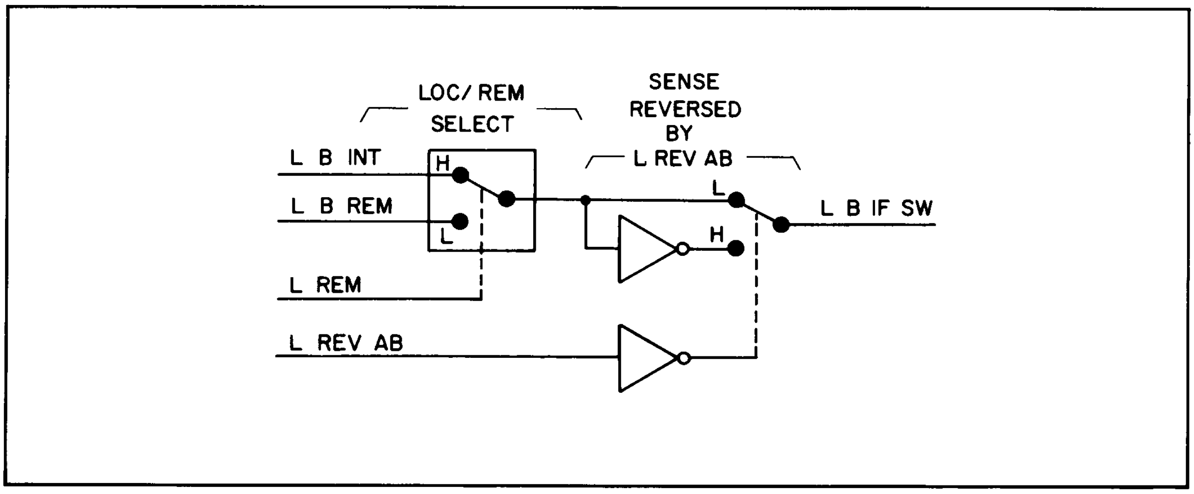


Figure 8-107. IF Switch Control Logic, Equivalent Circuit

As indicated in Table 8-10, the instrument is in the local (internal) mode of operation when L REM is high. When L REM is low, the instrument is in remote operation. In local operation, L B REM has no effect on the IF Switch; in remote operation, L B INT has no effect.

Reverse AB. The L REV AB line is normally high. When the line is pulled low (grounded), the state of the L B IF SW line (as determined by L REM, L B REM, and L B INT) is reversed. The output of the EXCLUSIVE OR gate A19U1B is normally low because both inputs are high. When L REV AB is pulled low, however, pin 13 of EXCLUSIVE OR gate A19U1D goes high. This causes A19U1D to function as an inverter, reversing the state of the L B IF SW line.

NORMALIZER INTERCONNECT Connector (J8) Outputs

CH 1 FLT. Channel 1 filtered. From Analog Processor (A2, Service Sheet 15). Provides a −300 mV/div signal to the normalizer. Also goes to Deflection Amplifiers (A18, Service Sheet 16).

CH 2 FLT. Channel 2 filtered. From Analog Processor (A2, Service Sheet 15). Provides a −300 mV/div signal to the normalizer. Also goes to Deflection Amplifiers (A18, Service Sheet 16).

L OFF 1. Low Channel 1 off. From Analog Processor(A2, Service Sheet 15). When low, turns normalizer Channel 1 off. When both Channel 1 and Channel 2 are off, L OFF 1 goes high to enable the normalizer to display the R channel.

L OFF 2. Low Channel 2 off. From Analog Processor (A2, Service Sheet 15). When low, turns normalizer Channel 2 off.

L CHAN 2. Low Channel 2. From Analog Processor (A2, Service Sheet 15). When low, selects normalizer Channel 2; when high, Channel 1. Also goes to Deflection Amplifiers (A18, Service Sheet 16).

VSWP. Sweep voltage. From Sweep Generator (A17, Service Sheet 5). Provides 0V to +10V sweep voltage to normalizer.

H DBP. High display blanking pulse. From Sweep Generator (A17, Service Sheet 5). When high, provides display blanking pulse to normalizer.

H RETRACE. High retrace. From Sweep Generator (A17, Service Sheet 5). When high, indicates to normalizer that 8754A is retracing.

L POLAR. Low polar. From Deflection Amplifiers (A18, Service Sheet 16). Indicates to normalizer that 8754A is in Polar mode. Also causes HP 8750A Normalizer to be held in BYPASS.

H MARK. High marker. From Deflection Amplifiers (A18, Service Sheet 16). When high, provides marker signal to normalizer.

NORMALIZER INTERCONNECT Connector (J8) Outputs

NORM X. Normalizer X. To Deflection Amplifiers (A18, Service Sheet 16). When L NORM is low, the NORM X signal from the normalizer is selected to produce the HORIZ OUT output signal and the X information for the display.

NORM Y. Normalizer Y. To Deflection Amplifiers (A18, Service Sheet 16). When L NORM is low, the NORM Y signal from the normalizer is selected to produce the VERT OUT output signal, and the Y information for the display.

NORM Z. Normalizer Z. To Deflection Amplifiers (A18, Service Sheet 16). When L NORM is low, the NORM Z signal from the normalizer is selected to produce the blanking for the diplay.

L NORM. Low normalizer. To Deflection Amplifiers (A18, Service Sheet 16). When low, causes selection of the NORM X, NORM Y, and NORM Z input signals.

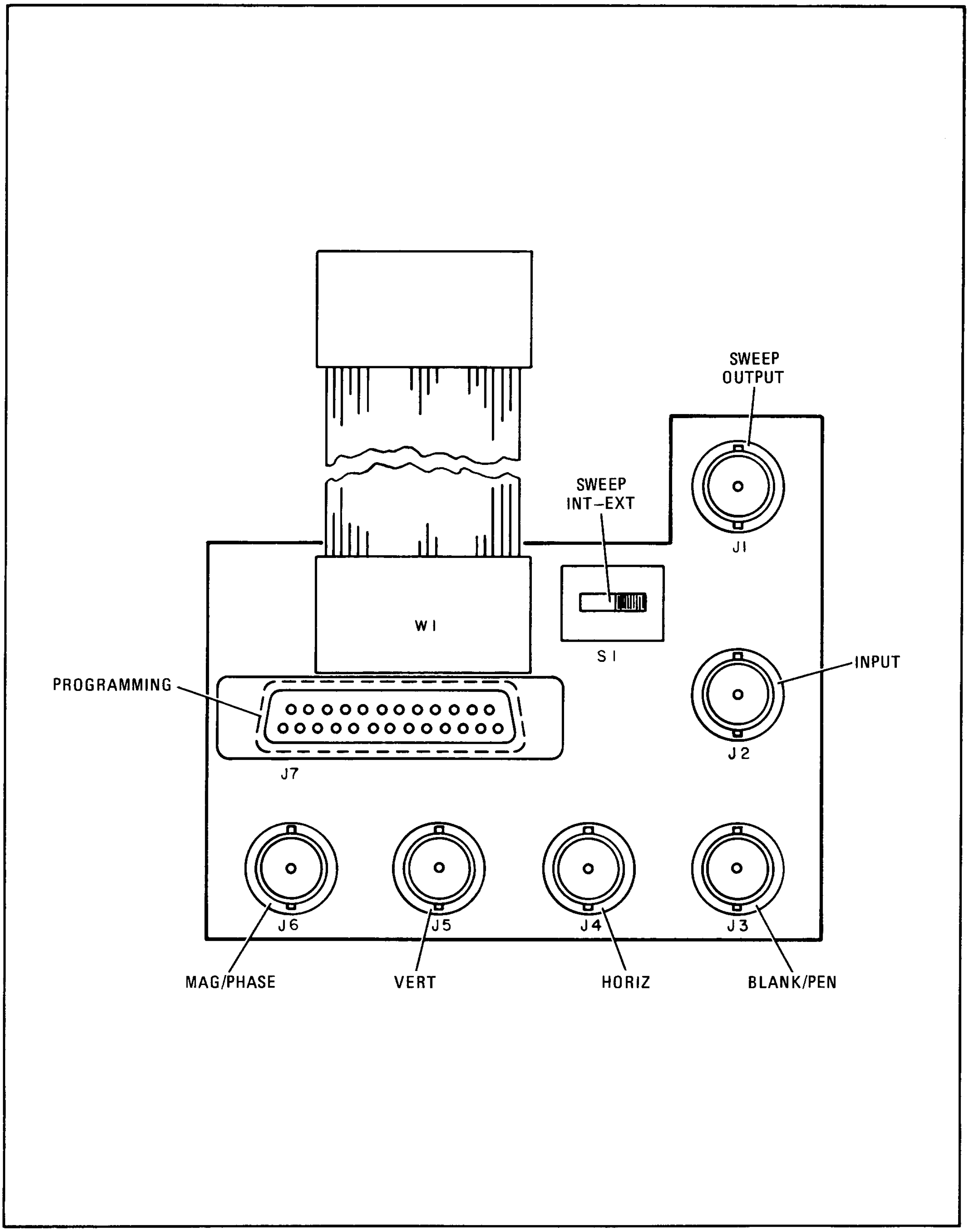


Figure 8-108. External Interface (A23, Rear Panel), Component Locations

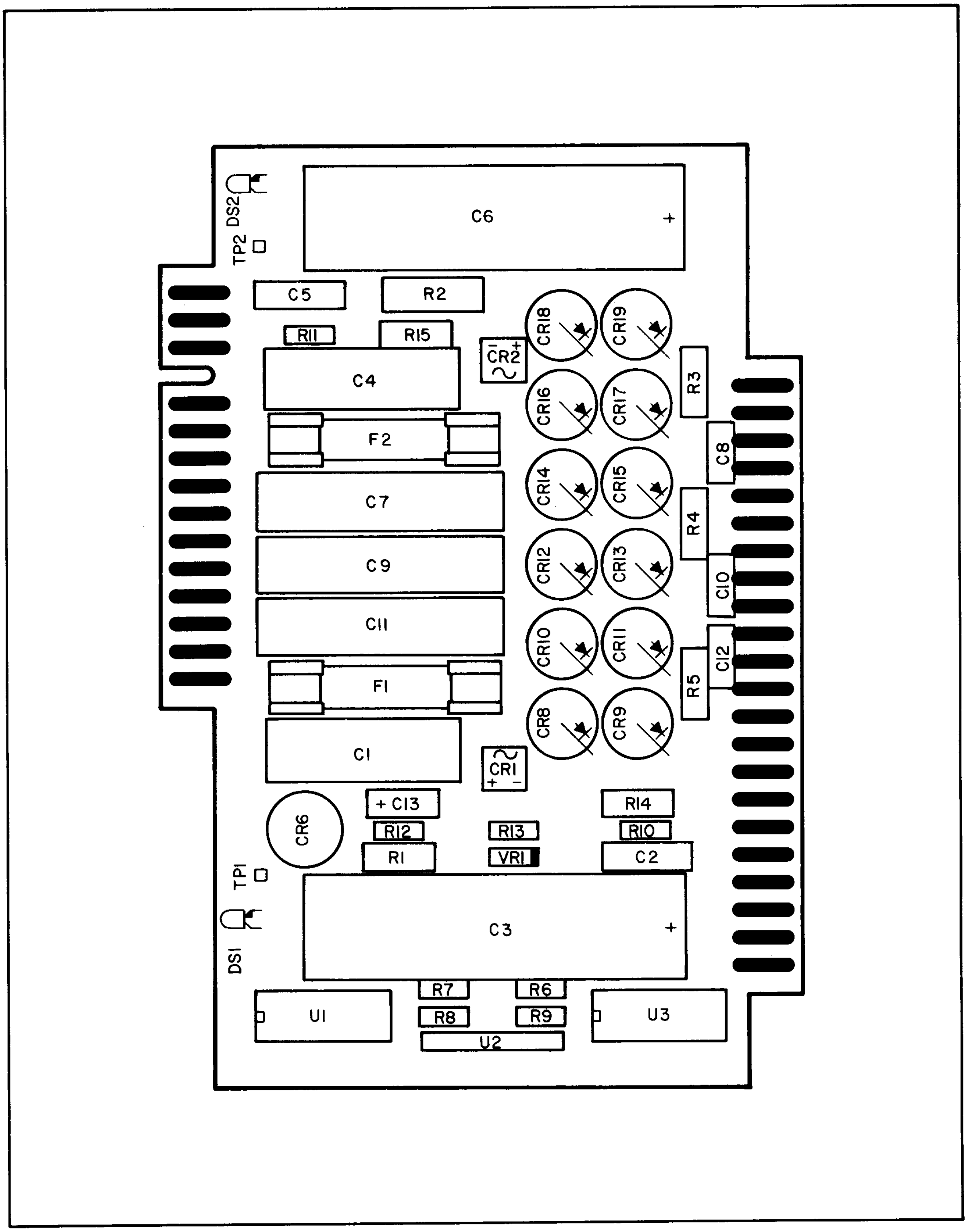
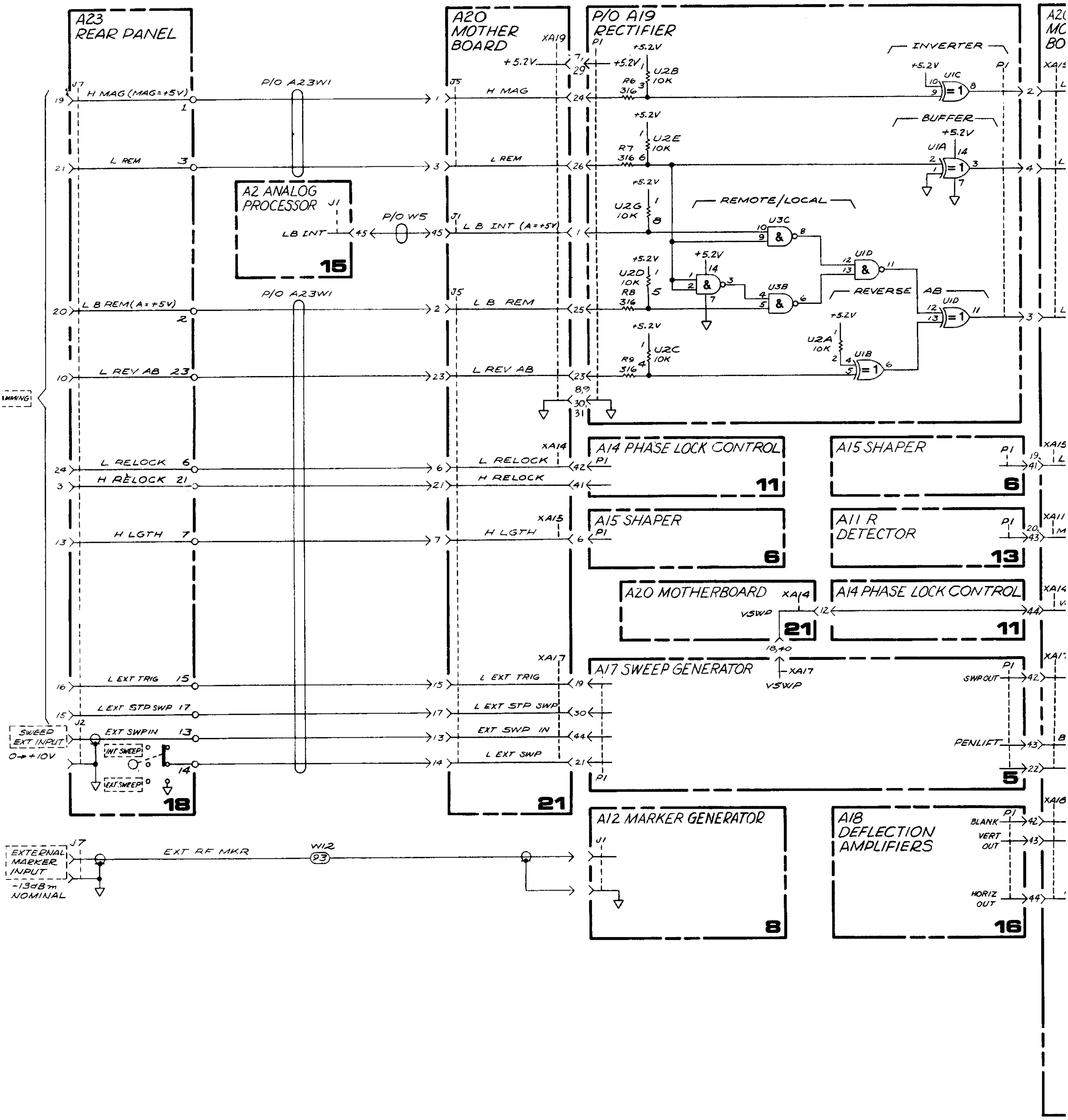
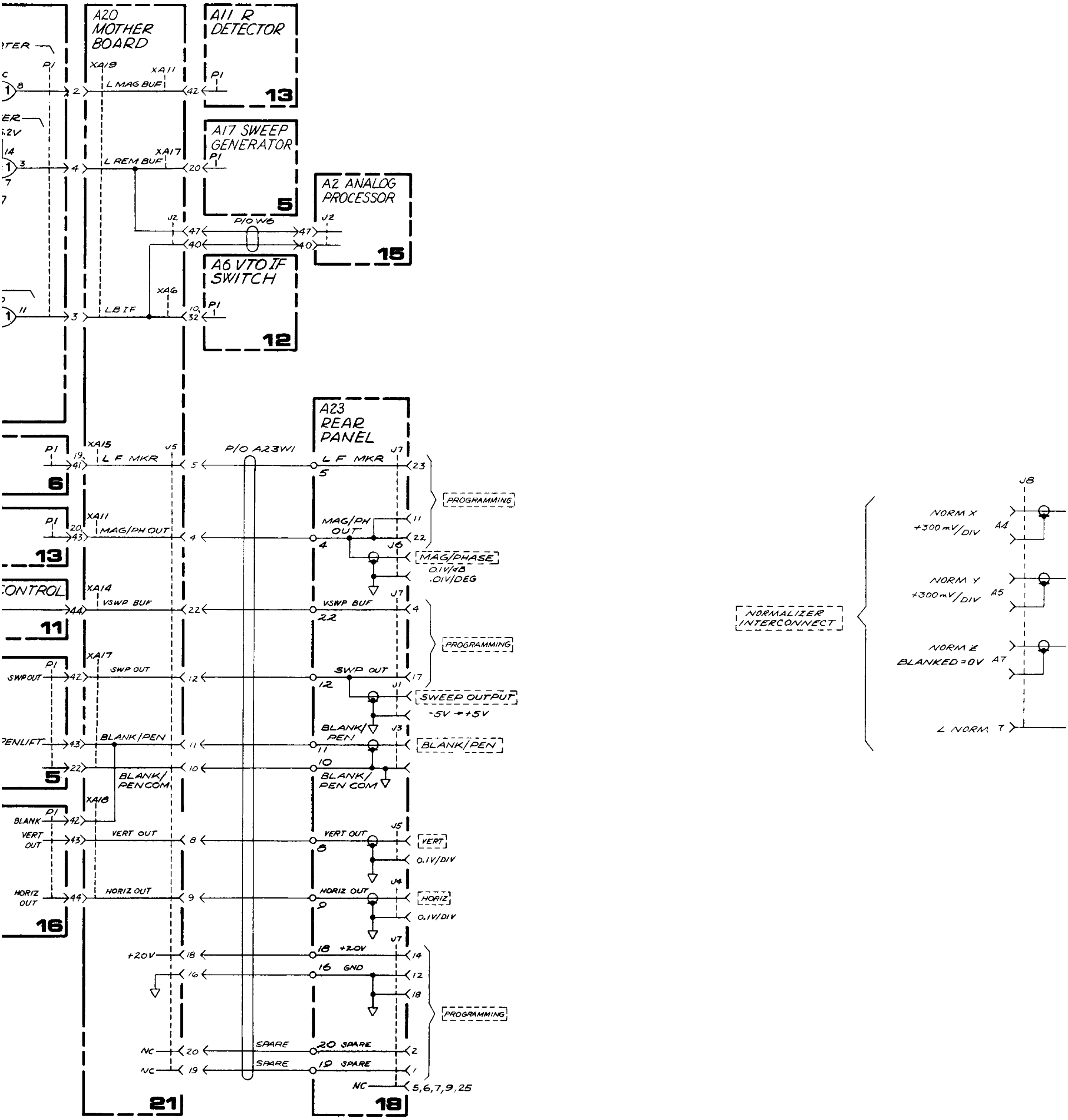


Figure 8-109. Rectifier (A19), Component Locations



SERIAL PREFIX: 1825A DATE: MARCH 6, 1979


A20 MOTHER BOARD
A11 R DETECTOR
13
A17 SWEEP GENERATOR
5
A2 ANALOG PROCESSOR
15
A6 VTO IF SWITCH
12
L MAG BUF
L REM BUF
LB IF
P/O W6
A23 REAR PANEL
P/O A23W1
L F MKR
MAG/PH OUT
VSWP BUF
SWP OUT
BLANK/PEN
BLANK/PEN COM
VERT OUT
HORIZ OUT
+20V
GND
SPARE
NC
PROGRAMMING
MAG/PHASE
0.1V/dB
.01V/DEG
SWEEP OUTPUT
-5V → +5V
BLANK/PEN
VERT
0.1V/DIV
HORIZ
0.1V/DIV
5,6,7,9,25
CONTROL
SWP OUT
PENLIFT
BLANK
VERT OUT
HORIZ OUT
6
13
11
5
16
21
18
NORMALIZER INTERCONNECT
J8
NORM X
+300 mV/DIV
A4
NORM Y
+300 mV/DIV
A5
NORM Z
BLANKED = 0V
A7
∠ NORM

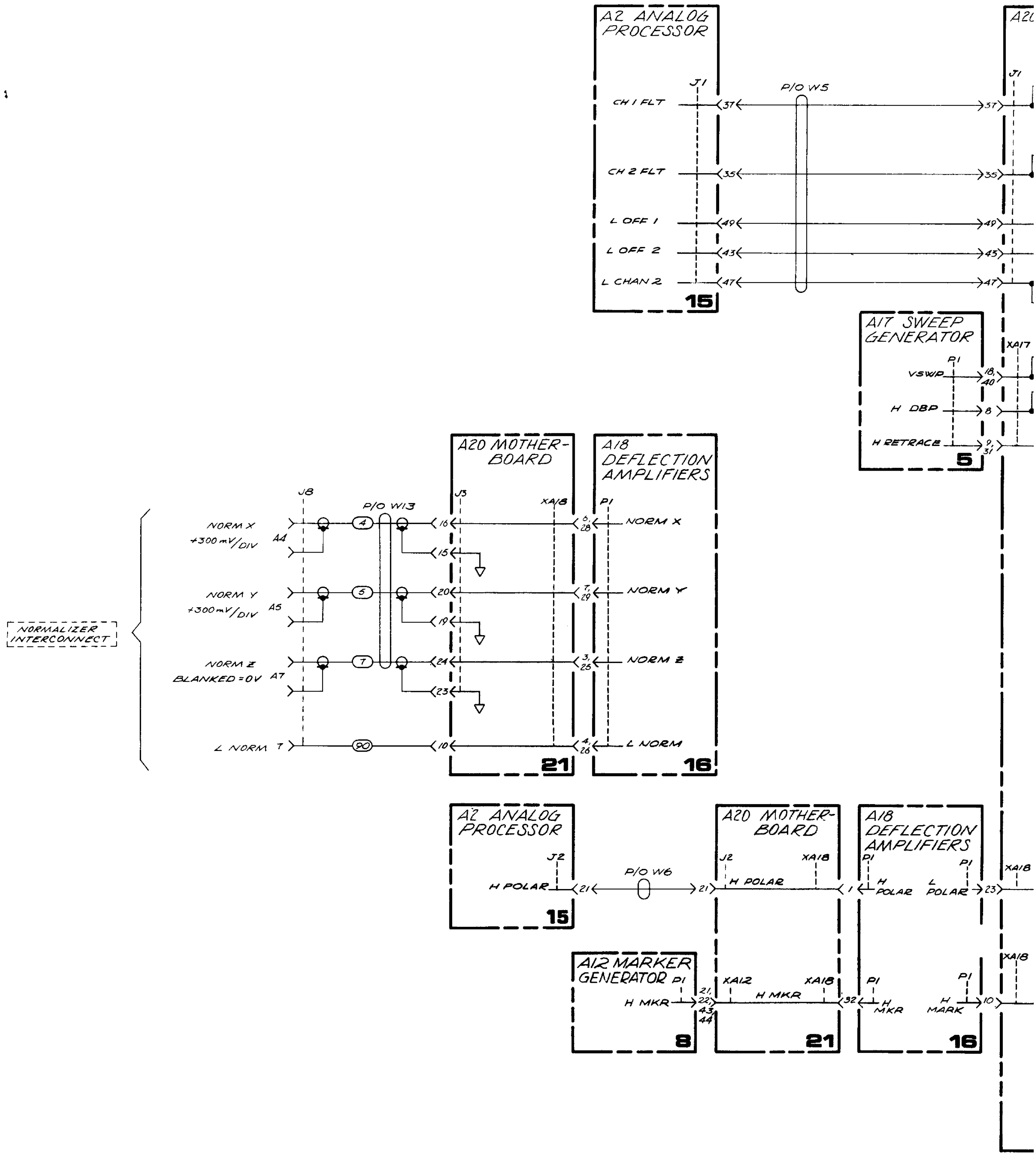

A2 ANALOG PROCESSOR
J1
P/O W5
CH 1 FLT
CH 2 FLT
L OFF 1
L OFF 2
L CHAN 2
15
A17 SWEEP GENERATOR
P1
XA17
VSWP
H DBP
H RETRACE
5
A20 MOTHER-BOARD
A18 DEFLECTION AMPLIFIERS
J8
P/O W13
J3
XA18
P1
NORM X
+300 mV/DIV
A4
NORM Y
+300 mV/DIV
A5
NORM Z
BLANKED = 0V
A7
L NORM
NORMALIZER INTERCONNECT
21
16
A2 ANALOG PROCESSOR
J2
H POLAR
P/O W6
15
A20 MOTHER-BOARD
J2
XA18
H POLAR
A18 DEFLECTION AMPLIFIERS
L POLAR
A12 MARKER GENERATOR
H MKR
XA12
8
21
H MARK
16

Figure 8-110.

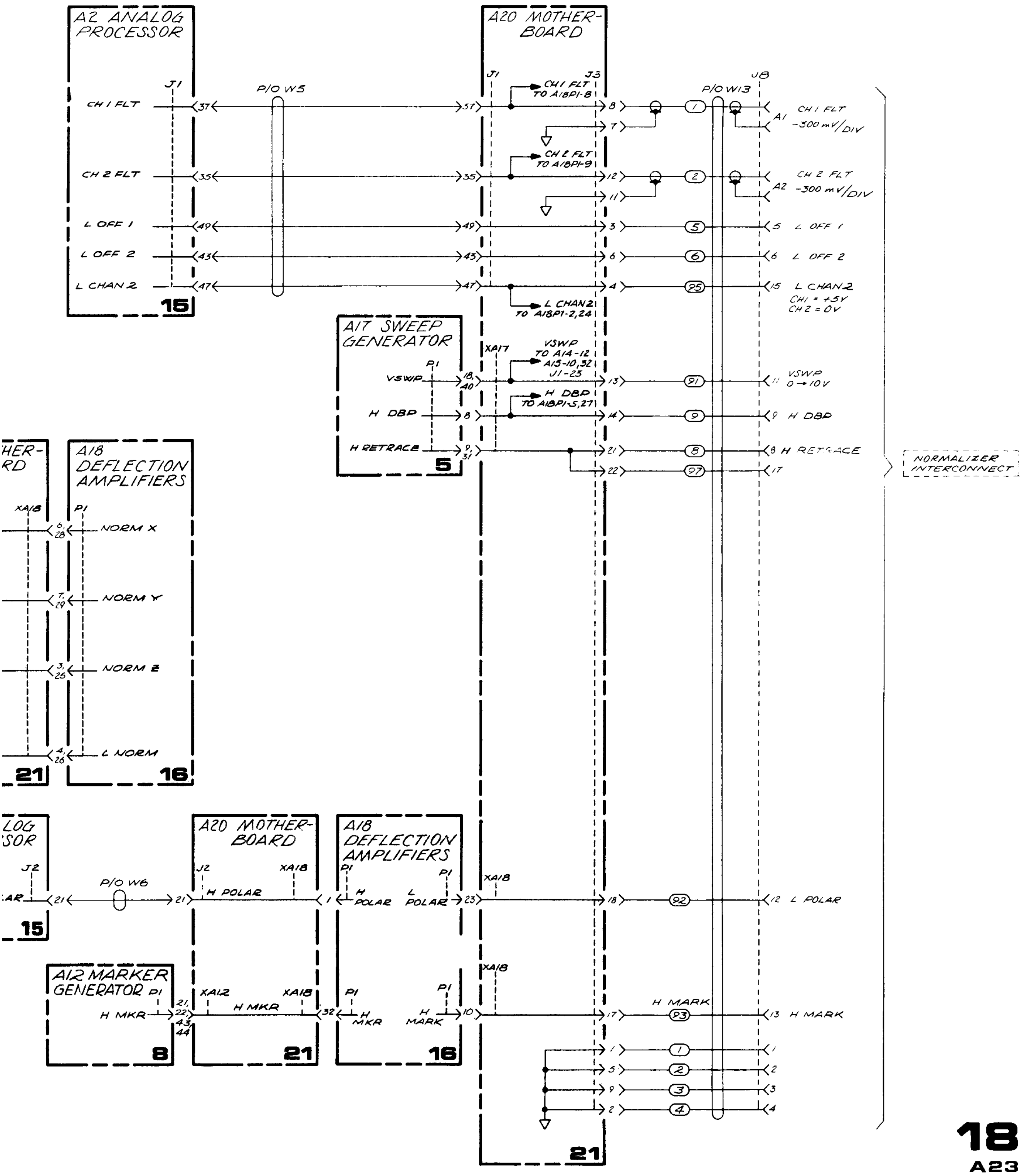


Figure 8-110. External Interface (A23, Rear Panel), Schematic Diagram

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5	SWEEP pushbuttons
	6	Sweep Mode pushbuttons and SWEEP WIDTH MHz switch
	7	OUTPUT dBm control
	8	MARKERS MHz pushbuttons
	11	UNLOCKED indicator
	12	Absolute R measurement select
	15	CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER
	16	HORIZONTAL POSN and GAIN controls
	19	All front panel controls
A2 Analog Processor	6	Analog-to-digital converter for FREQUENCY MHz display.
	15	Analog processor, switch control logic, and ±6V power supplies
	16	V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10	Voltage Tuned Oscillator
	12	IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6	Sweep width, tuning, frequency reference, and frequency display.
	7	Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18	External Interface
	20	Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 19

FRONT PANEL DISASSEMBLY PROCEDURES

Removal of Front Panel Assembly From Frame

1. Remove top cover.

2. Remove top trim strip from front frame using a small, flat-blade screwdriver. (See Figure 8-111.)

3. Remove one 6-32 x 1/8 inch flat-head Pozi-Driv screw from top trim strip channel adjacent to REFERENCE POSITION switches.

4. Remove trim strip from right side of front frame or (if instrument has Option 907 installed) from right handle. (See Figure 8-111.)

5. If instrument has Option 907, remove right handle.

6. Remove two 6-32 x 1/8 inch flat-head Pozi-Driv screws from right side of front frame. (See Figure 8-111.)

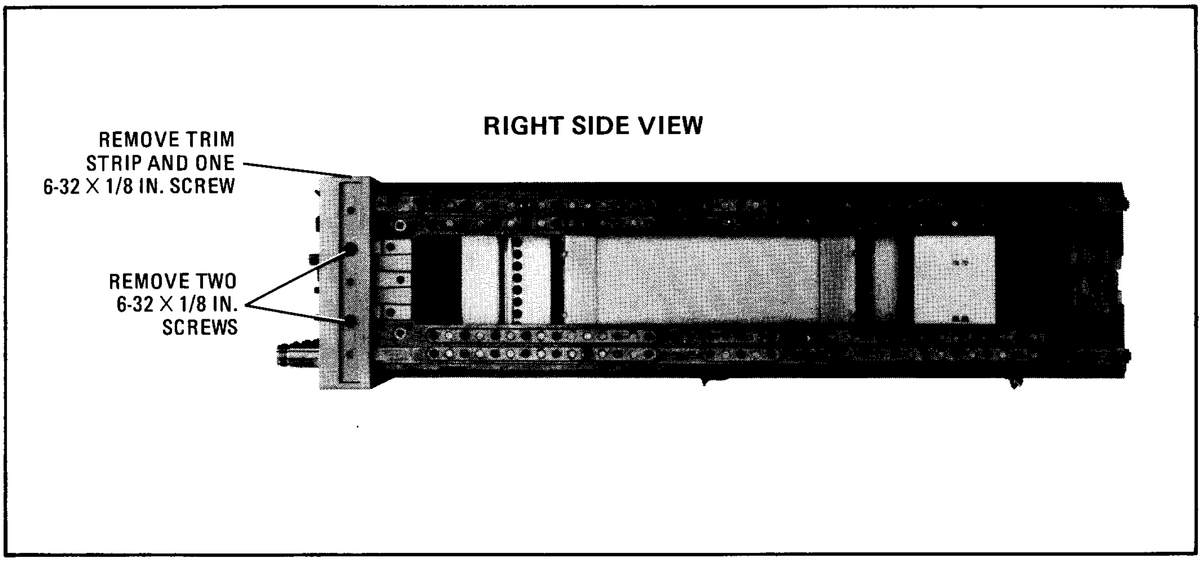


Figure 8-111. Right Side View Showing Front Panel Retaining Hardware

BOTTOM VIEW

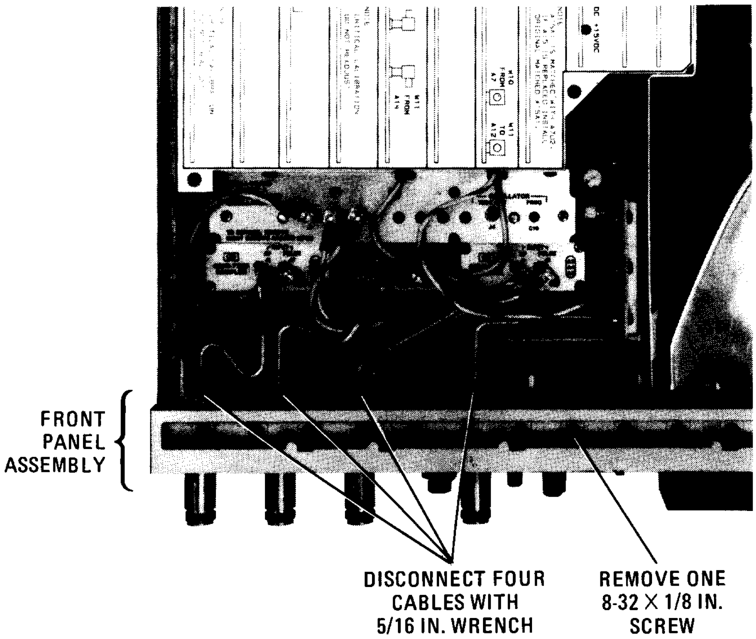


Figure 8-112. Bottom View Showing Disassembly of Front Panel Assembly from Instrument

7. Remove bottom cover.

8. Remove one 6-32 x 1/8 inch flat-head Pozi-Driv screw from bottom of front frame adjacent to front-panel OUTPUT dBm control. (See Figure 8-112.)

9. With 5/16 inch wrench, remove B INPUT, A INPUT, R INPUT, and RF OUTPUT cables from rear side of front-panel connectors. (See Figure 8-112)

10. Carefully pull Front Panel assembly forward out of the instrument frame.

11. Using connector puller tool (HP Part No. 8710-0580 or 3M Tool No. 3438), disconnect the two front-panel ribbon cables from A20 Motherboard.

Replacement of FREQUENCY MHz Display LED

1. Remove the Front Panel Assembly as described in paragraph heading "Removal of Front Panel Assembly from Frame", steps 1 through 10.

2. Remove two 6-32 x 1/4 inch Pozi-Driv screws securing A22 LED Display to A2 Analog Processor. (See Figure 8-113.)

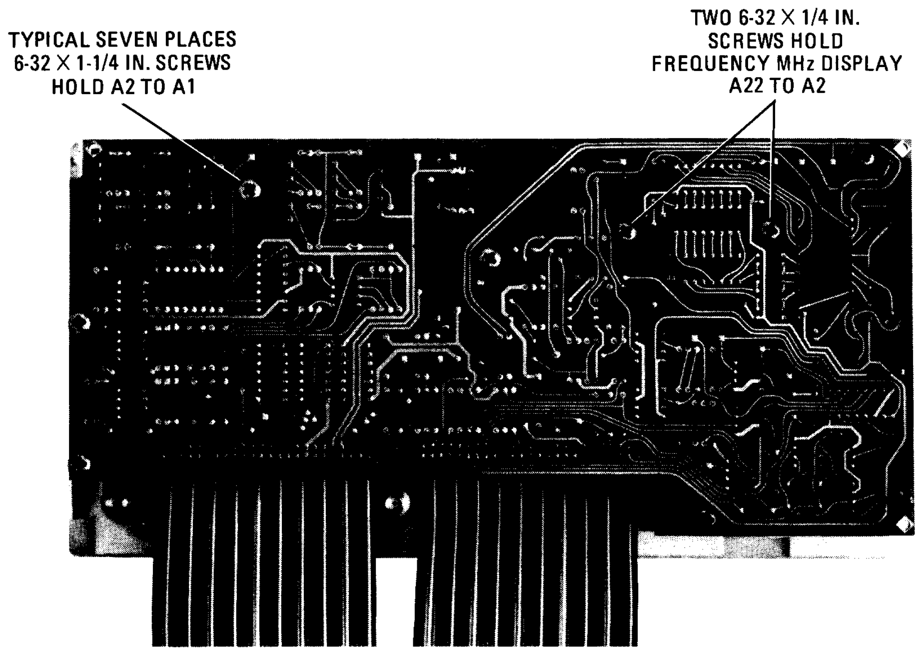


Figure 8-113. Back Side of Front Panel Assembly

3. Carefully slide A22 LED Display out from the top. Do not disconnect ribbon cable from A2J3.
4. Unplug defective LED and install new LED.
5. Slide A22 LED Display back into place and loosely secure with the two screws removed in step 2.
6. Align LED Display in the center of front-panel FREQUENCY MHz display window and tighten two screws securing LED display to A2 Analog Processor.

Removal of A2 Analog Processor Assembly From A1 Front Panel

1. Remove Front Panel Assembly as described in paragraph heading "Removal of Front Panel Assembly From Frame".
2. Remove seven 6-32 x 1-1/4 inch Pozi-Driv screws securing A2 Analog Processor to the Front Panel Board Assembly. (See Figure 8-113.) Do not remove the two screws that secure LED display to A2 Analog Processor.
3. Set Channel 1 and 2 REFERENCE switches to +44 position.
4. Separate A2 Analog Processor from A1 Front Panel board as shown in Figure 8-114. (A1 and A2 will still be connected by the ribbon cables.)
5. Using connector puller tool (HP Part No. 8710-0580 or 3M Tool No. 3438), disconnect the two ribbon cables from A2 Analog Processor.

Removal of A1 Front Panel Board Assembly From Sub-panel

1. Remove Front Panel Assembly as described in paragraph heading "Removal of Front Panel Assembly From Frame".
2. Remove A2 Analog Processor as described in paragraph heading "Removal of A2 Analog Processor Assembly From A1 Front Panel".
3. Remove the following front-panel knobs: SWEEP vernier, SWEEP WIDTH MHz CAL, SWEEP WIDTH MHz, CHANNEL 1 REFERENCE OFFSET vernier, CHANNEL 2 REFERENCE OFFSET vernier, and OUTPUT dBm.
4. Unplug probe-power wiring harness from A1J4.
5. Remove five 6-32 x 1-1/4 Pozi-Driv screws securing A1 Front Panel to sub-panel. (See Figure 8-114.)
6. Carefully remove A1 Front Panel and unplug TUNING potentiometer wiring harness from A1J3. (LED may unplug from LED socket and remain in LED lens in front sub-panel.)

Replacement of Front Panel UNLOCKED LED

1. Remove front panel assembly from frame as described in paragraph heading "Removal of Front Panel Assembly From Frame".
2. Remove A2 Analog Processor from A1 front panel as described in paragraph heading "Removal of A2 Analog Processor Assembly From A1 Front Panel".
3. Remove A1 Front Panel Board Assembly from front panel sub-panel as described in paragraph heading "Removal of A1 Front Panel Board Assembly From Sub-panel".

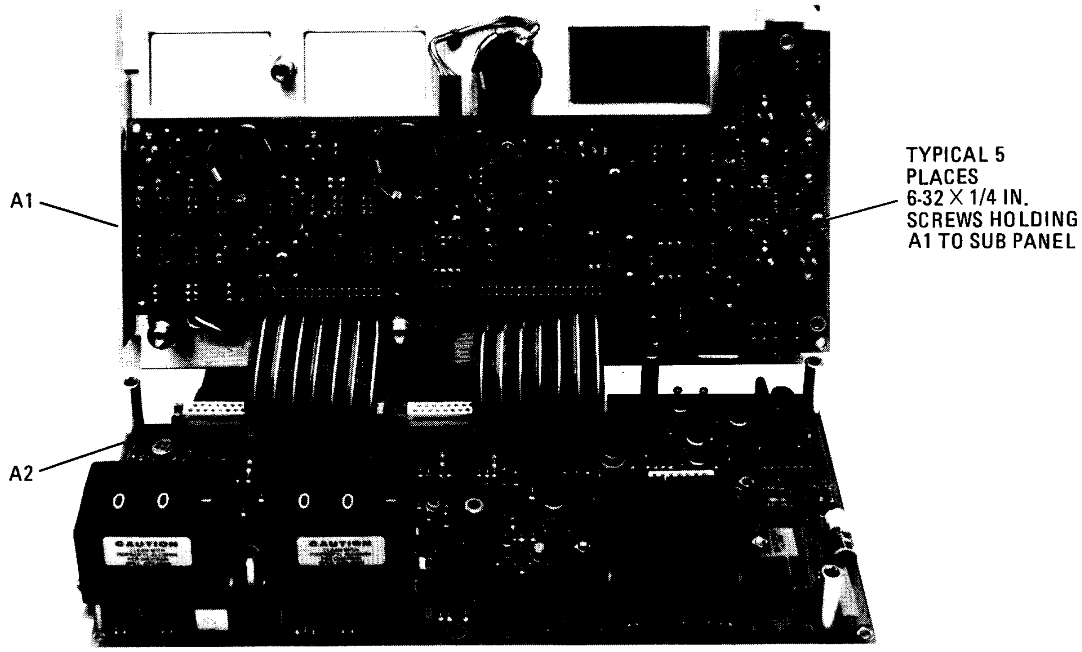


Figure 8-114. Front Panel Assembly With A1 and A2 Separated

4. Remove old LED from socket on A1.
5. Trim both leads of new LED to 1.5 cm (0.6 inches). (See Figure 8-115.)

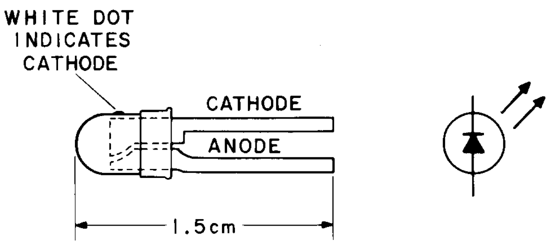


Figure 8-115. Identification of Leads on UNLOCKED LED

6. Install new LED in LED socket mounted on A1. Be sure the LED is installed so the white cathode on the new LED matches the position of the cathode on the LED symbol next to LED socket.

7. Reassemble A1 to the front panel as instructed in the paragraph heading "Installation of Front Dress Panel to A1 Front Panel Board Assembly", reassemble A2 to A1 as described in the paragraph heading "Installation of A2 Analog Processor to A1 Front Panel Board Assembly".

8. Mount front panel assembly into instrument front frame as instructed in the paragraph entitled "Installation of Front Panel Assembly Into Instrument Frame".

Replacement of Front Dress Panel

1. Remove front panel assembly from frame as described in paragraph entitled "Removal of Front Panel Assembly From Frame".

2. Remove A2 Analog Processor from A1 front panel as described in paragraph heading "Removal of A2 Analog Processor Assembly From A1 Front Panel".

3. Remove A1 Front Panel Board Assembly from front panel sub-panel as described in paragraph entitled "Removal of A1 Front Panel Board Assembly From Sub-panel".

4. Remove the four front-panel RF connectors.

5. Remove TUNING and FINE knobs.

6. Remove nut securing TUNING potentiometer.

7. Remove front dress panel.

8. Install new front dress panel and reassemble front panel as described in paragraphs under major heading "FRONT PANEL ASSEMBLY PROCEDURES".

FRONT PANEL ASSEMBLY PROCEDURES

Installation of Front Dress Panel to A1 Front Panel Board Assembly

1. Install 36 bezels and the FREQUENCY MHz display lens into dress panel.

2. Install the UNLOCKED light lens into front sub-panel.

3. Place dress panel on sub-panel and loosely install four front-panel RF connectors. Make sure panel fits over PROBE POWER connectors.

4. Install A1 Front Panel Board Assembly on front panel sub-panel. Install five 6-32 x 1/4 inch Pozi-Driv screws to secure A1 board to front sub-panel. (See Figure 8-114.)

5. Install TUNING potentiometer assembly and secure with retaining nut.

6. Tighten four front-panel RF connectors.

7. Plug tuning potentiometer wiring harness connector into A1J3.

8. Plug probe-power wiring harness connector into A1J4.

9. Install the following front-panel knobs: SWEEP vernier, SWEEP WIDTH MHz CAL, SWEEP WIDTH MHz, CHANNEL 1 REFERENCE OFFSET vernier, CHANNEL 2 REFERENCE OFFSET vernier, OUTPUT dBm, TUNING, and FINE tune.

10. Install A2 Analog Processor Assembly to A1 Front Panel Board Assembly as described in paragraph titled "Installation of A2 Analog Processor to A1 Front Panel Board Assembly".

11. Install Front Panel Assembly into instrument frame as instructed in paragraph titled "Installation of Front Panel Assembly Into Instrument Frame".

Installation of A2 Analog Processor to A1 Front Panel Board Assembly

1. Position A2 adjacent to A1 Front Panel. Connect the two ribbon cables from A1 into the matching ribbon cable connectors on A2.

2. Set Channel 1 and 2 REFERENCE switches to +44 position.

3. Mate A1 and A2, then install seven 6-32 x 1-1/4 inch Pozi-Driv screws to secure the two boards together. (See Figure 8-112.)

Installation of Front Panel Assembly Into Instrument Frame

1. Connect the two front-panel ribbon cables into the two connectors on A20 Motherboard.

2. Carefully mount the front panel assembly in the instrument frame.

3. Mate front panel connectors B INPUT, A INPUT, R INPUT, and RF OUTPUT to the corresponding RF cables (Figure 8-112). (It may be necessary to loosen the RF cables on the opposite end.)

4. Install one 6-32 x 1/8 inch flat-head Pozi-Driv screw into bottom of front frame adjacent to front-panel OUTPUT dBm control.

5. Install two 6-32 x 1/8 inch flat-head Pozi-Driv screws at the right side of front frame. (See Figure 8-111.)

6. If instrument has Option 907, install right handle.

7. Install trim strip on right side of front frame or (if instrument has Option 907) on right handle.

8. Install one 6-32 x 1/8 inch flat-head Pozi-Driv screw into top trim strip channel adjacent to REFERENCE POSITION switches. (See Figure 8-111.)

9. Install top trim strip on front frame.

10. Install top and bottom covers.

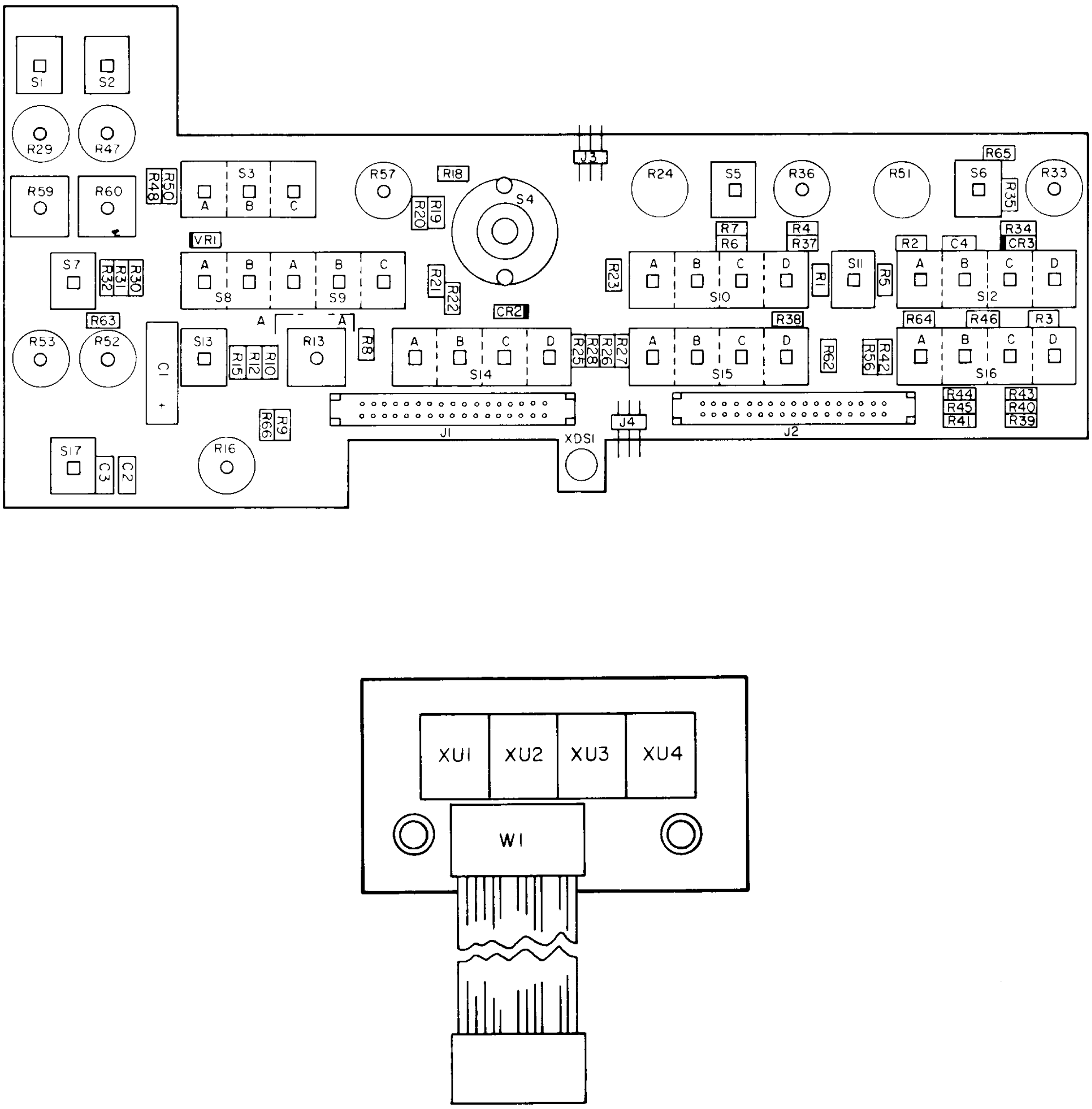
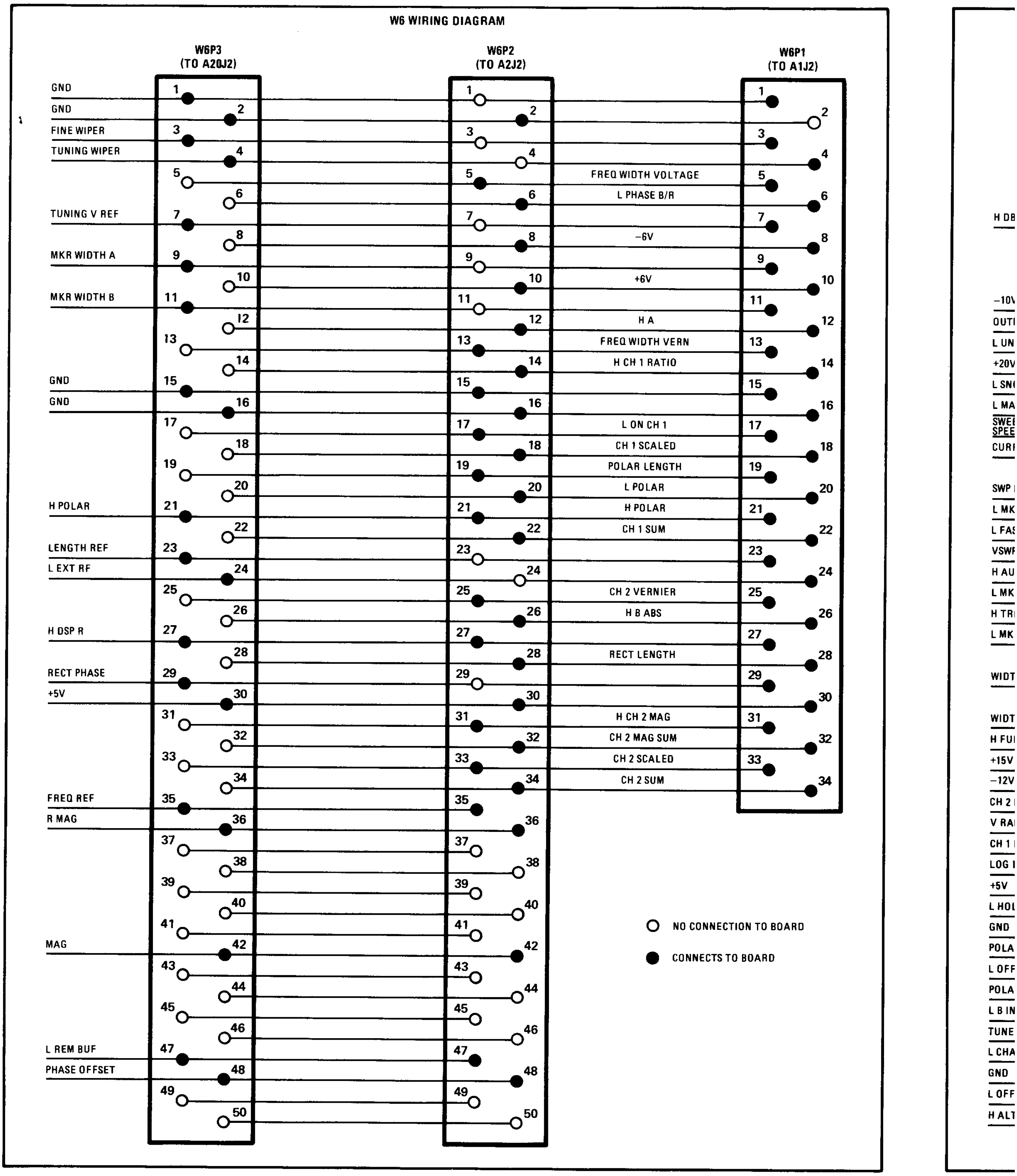
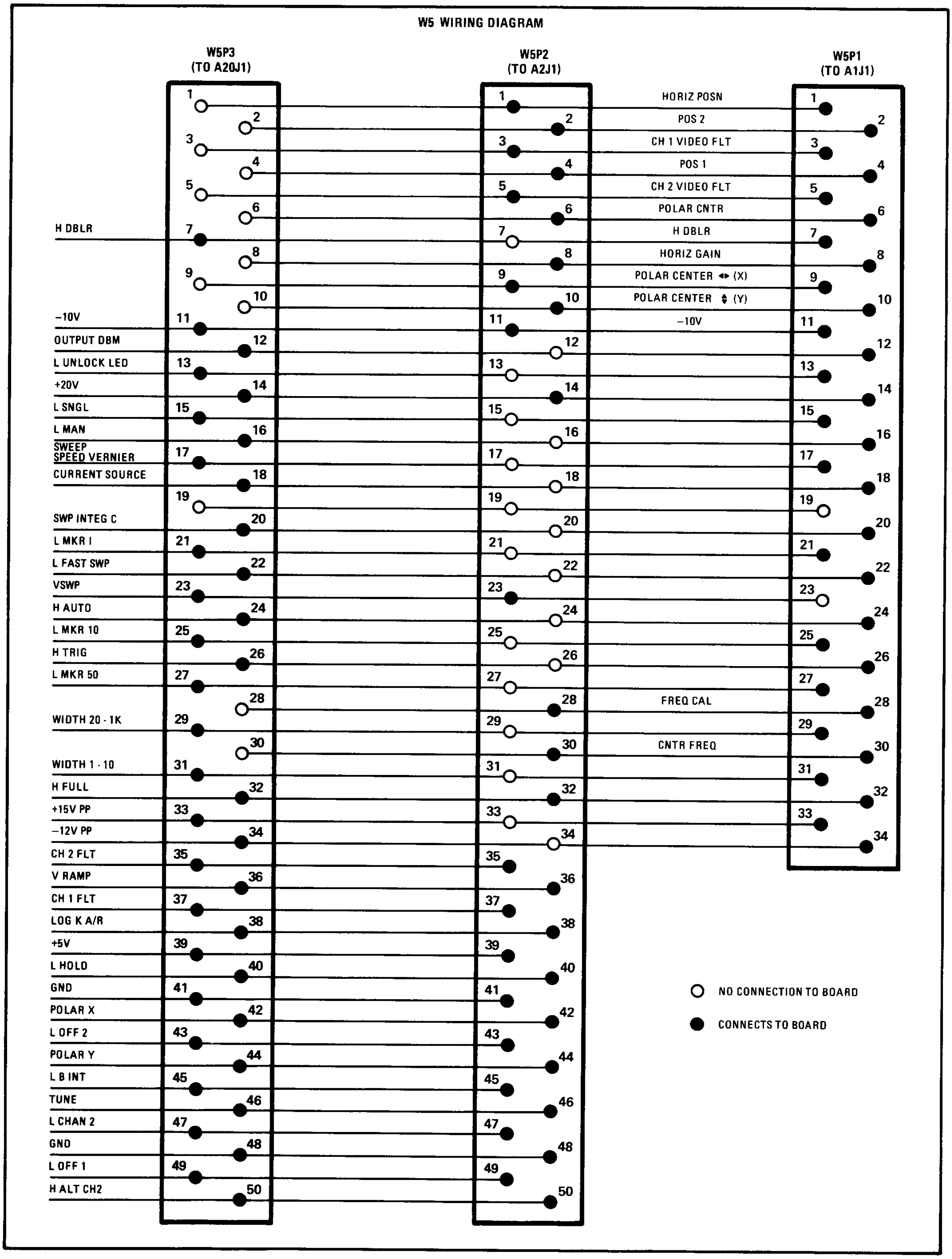
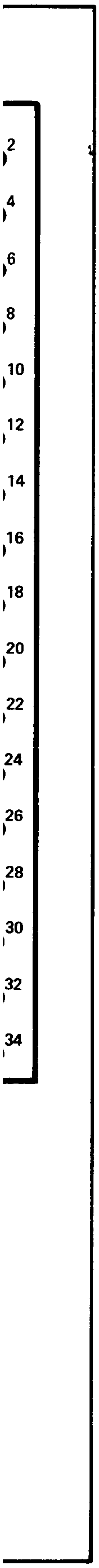


Figure 8-116. Front-Panel Controls and Indicators (A1, A22), Component Locations



W6 WIRING DIAGRAM
W6P3 (TO A20J2)
W6P2 (TO A2J2)
W6P1 (TO A1J2)
GND
GND
FINE WIPER
TUNING WIPER
TUNING V REF
MKR WIDTH A
MKR WIDTH B
GND
GND
H POLAR
LENGTH REF
L EXT RF
H DSP R
RECT PHASE
+5V
FREQ REF
R MAG
MAG
L REM BUF
PHASE OFFSET
FREQ WIDTH VOLTAGE
L PHASE B/R
−6V
+6V
H A
FREQ WIDTH VERN
H CH 1 RATIO
L ON CH 1
CH 1 SCALED
POLAR LENGTH
L POLAR
H POLAR
CH 1 SUM
CH 2 VERNIER
H B ABS
RECT LENGTH
H CH 2 MAG
CH 2 MAG SUM
CH 2 SCALED
CH 2 SUM
NO CONNECTION TO BOARD
CONNECTS TO BOARD


W5 WIRING DIAGRAM
W5P3 (TO A20J1)
W5P2 (TO A2J1)
W5P1 (TO A1J1)
H DBLR
−10V
OUTPUT DBM
L UNLOCK LED
+20V
L SNGL
L MAN
SWEEP SPEED VERNIER
CURRENT SOURCE
SWP INTEG C
L MKR I
L FAST SWP
VSWP
H AUTO
L MKR 10
H TRIG
L MKR 50
WIDTH 20 - 1K
WIDTH 1 - 10
H FULL
+15V PP
−12V PP
CH 2 FLT
V RAMP
CH 1 FLT
LOG K A/R
+5V
L HOLD
GND
POLAR X
L OFF 2
POLAR Y
L B INT
TUNE
L CHAN 2
GND
L OFF 1
H ALT CH2
HORIZ POSN
POS 2
CH 1 VIDEO FLT
POS 1
CH 2 VIDEO FLT
POLAR CNTR
H DBLR
HORIZ GAIN
POLAR CENTER ◂▸ (X)
POLAR CENTER ▴▾ (Y)
−10V
FREQ CAL
CNTR FREQ
NO CONNECTION TO BOARD
CONNECTS TO BOARD



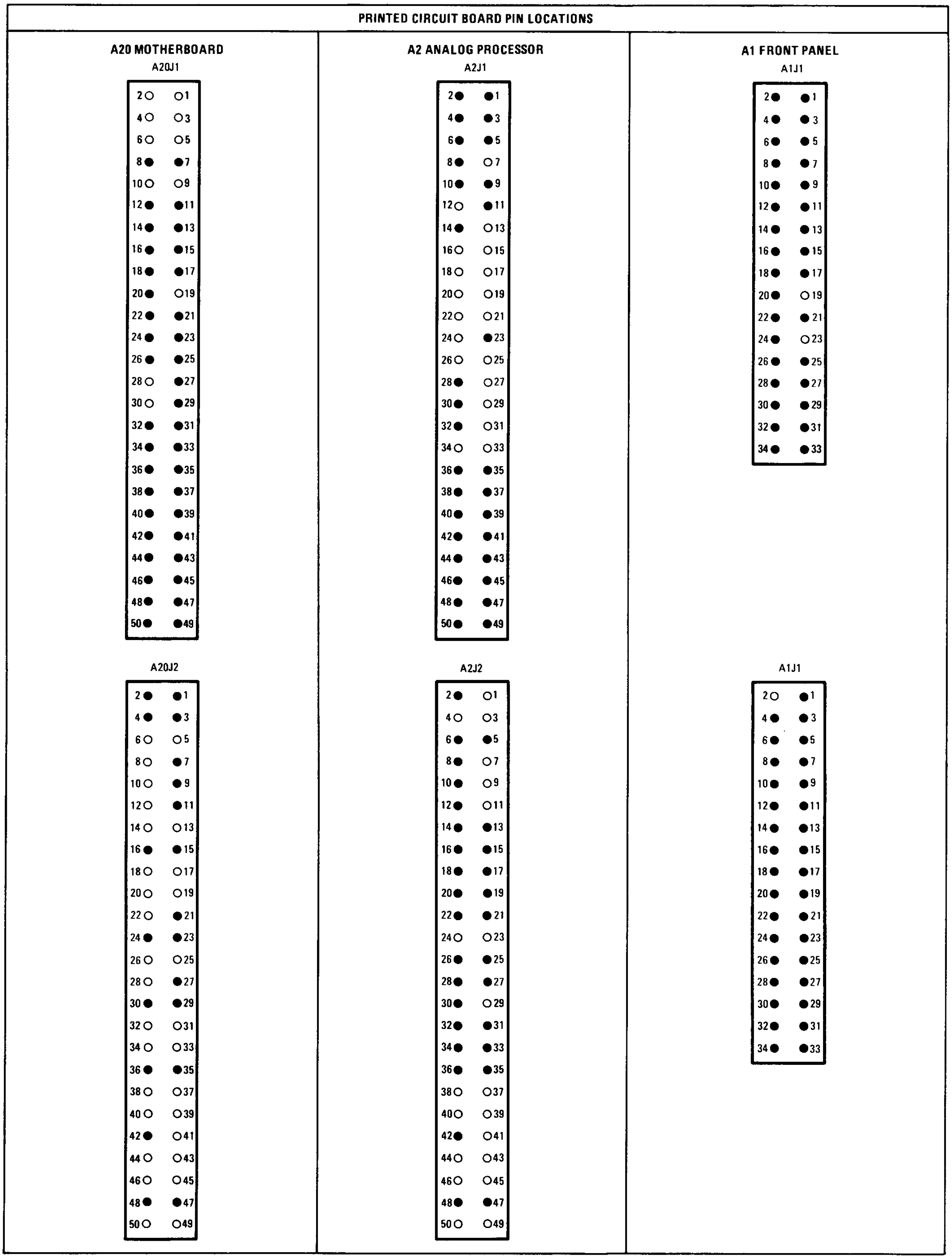
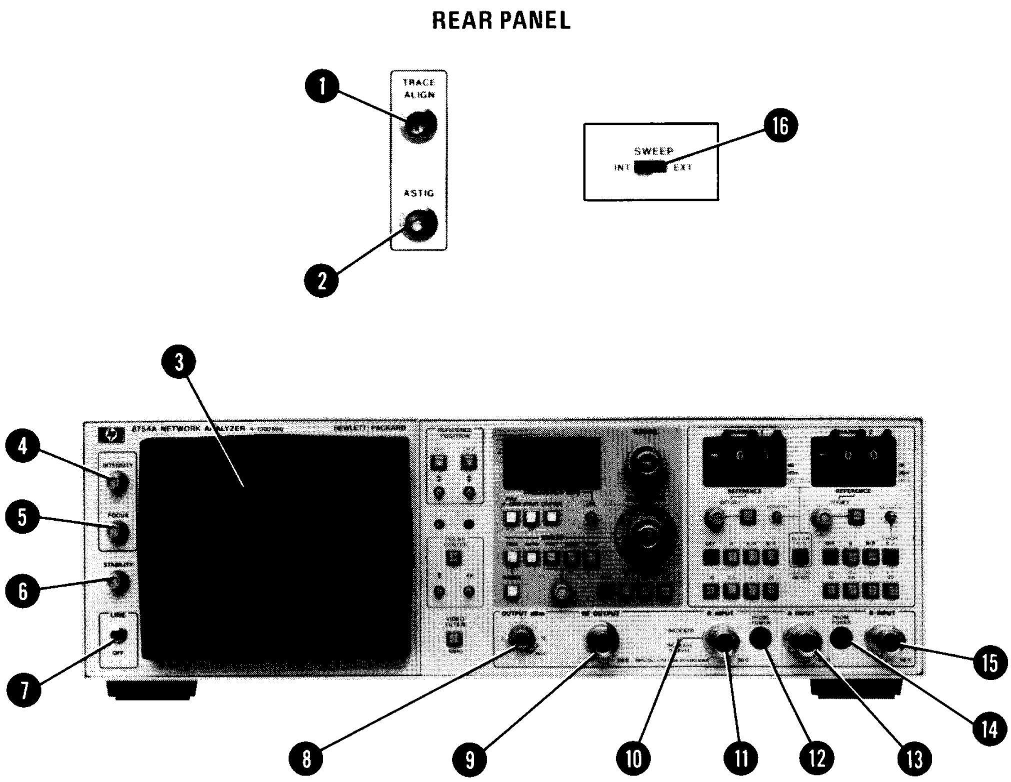
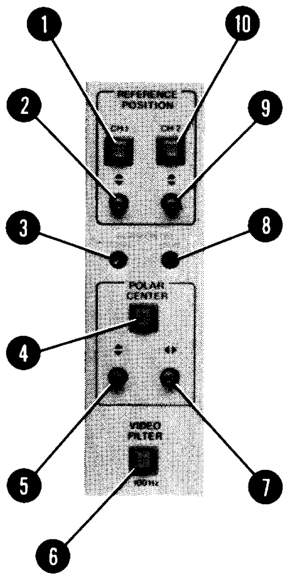


Figure 8-117. Front Panel Ribbon Cables, Wiring Diagram



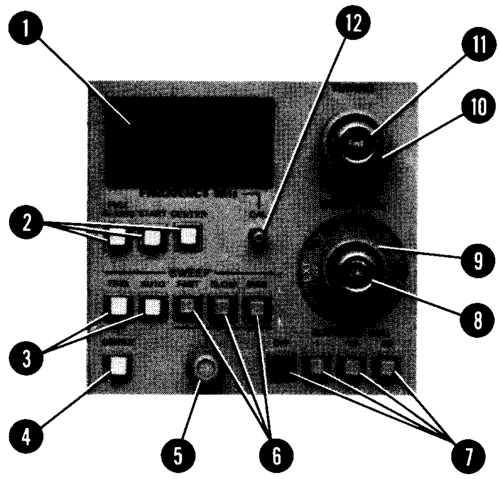
Item	Reference Designation	Description	Instrument Section	Service Sheet
1	R3	TRACE ALIGN Adjustment	Display	17
2	R4	ASTIG Adjustment	Display	17
3	V1	Cathode Ray Tube (CRT)	Display	17
4	R5	INTENSITY Control	Display	17
5	R2	FOCUS Control	Display	17 F
6	R6	STABILITY Control	Receiver	11
7	S1	LINE Power Switch		20
8	A1R16	OUTPUT dBm Control	Source	7, 8
9	J1	RF OUTPUT Connector	Source	7
10	A1DS1	UNLOCKED INCREASE R LEVEL	Receiver	11
11	J2	R INPUT Connector	Receiver	9
12	J5	PROBE POWER		16
13	J3	A INPUT Connector	Receiver	9
14	J6	PROBE POWER		20
15	J4	B INPUT Connector	Receiver	9
16	A23S1	INT/EXT SWEEP Switch	Source	5, 18

Figure 8-118. Front-Panel Controls and Indicators, Service Sheet Locations (1 of 4)



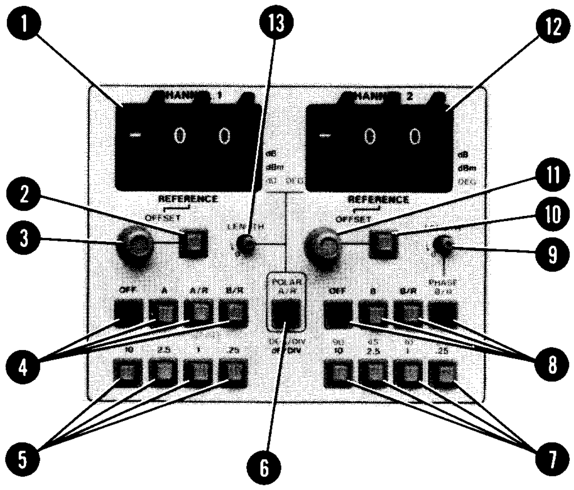
Item	Reference Designation	Description	Instrument Section	Service Sheet
1	A1S1	REFERENCE POSITION CH 1 Switch	Display	15 G
2	A1R29	REFERENCE POSITION CH1 ⬍ Control	Display	15 G
3	A1R59	HORIZONTAL POSITION Adjustment	Display	16 A
4	A1S7	POLAR CENTER Switch	Display	15 F
5	A1R53	POLAR CENTER ⬍ Control	Display	15 L
6	A1S17	VIDEO FILTER Switch	Display	15 L, M
7	A1S2	REFERENCE POSITION CH 2 Switch	Display	15 H
8	A1R60	HORIZONTAL GAIN Adjustment	Display	16 A
9	A1R47	REFERENCE POSITION CH 2 ⬍ Control	Display	15 H
10	A1R52	POLAR CENTER ◂▸ Control	Display	15 J

Figure 8-118. Front-Panel Controls and Indicators, Service Sheet Locations (2 of 4)



Item	Reference Designation	Description	Instrument Section	Service Sheet
❶	A22	FREQUENCY MHz Display	Source	6Ⓚ
❷	A1S3	Sweep Mode Switch	Source	5
	A1S3A	FULL 4-1300	Source	6Ⓑ, 8
	A1S3B	START	Source	6Ⓑ
	A1S3C	CENTER	Source	6Ⓑ
❸	A1S8	SWEEP Trigger	Source	6Ⓑ
	A1S8A	TRIG	Source	5
	A1S8B	AUTO	Source	5
❹	A1S13	SINGLE SWEEP Switch	Source	5
❺	A1R13	SWEEP Vernier	Source	5Ⓒ
❻	A1S9	SWEEP	Source	5
	A1S9A	FAST	Source	5
	A1S9B	SLOW	Source	5Ⓒ
	A1S9C	MAN	Source	5Ⓒ
❼	A1S14	MARKERS MHz	Source	8
	A1S14A	OFF	Source	8
	A1S14B	1	Source	8
	A1S14C	10	Source	8
	A1S14D	50	Source	8
❽	A1R17	SWEEP WIDTH MHz CAL	Source	6Ⓑ
❾	A1S4	SWEEP WIDTH MHz Switch	Source	6Ⓑ, 8
❿	R1A	TUNING Control	Source	6Ⓐ
⓫	R1B	FINE TUNING Control	Source	6Ⓐ
⓬	A1R57	FREQUENCY MHz CAL	Source	6

Figure 8-118. Front-Panel Controls and Indicators, Service Sheet Locations (3 of 4)



Item	Reference Designation	Description	Instrument Section	Service Sheet
1	A2S1	CHANNEL 1 REFERENCE Switch	Display	15Ⓑ
2	A1S5	CHANNEL 1 REFERENCE OFFSET Switch	Display	15Ⓑ
3	A1R24	CHANNEL 1 REFERENCE OFFSET Control	Display	15Ⓑ
4	A1S10	Measurement Select Switch	Display	15
	A1S10A	OFF	Display	15Ⓐ
	A1S10B	A	Display	15Ⓐ
	A1S10C	A/R	Display	15Ⓐ
	A1S10D	B/R	Display	15Ⓐ
5	A1S15	Scale Switch	Display	15
	A1S15A	10 dB/DIV	Display	15Ⓑ
	A1S15B	2.5 dB/DIV	Display	15Ⓑ
	A1S15C	1 dB/DIV	Display	15Ⓑ
	A1S15D	.25 dB/DIV	Display	15Ⓑ
6	A1S11	POLAR A/R Switch	Display	15Ⓐ,Ⓑ
7	A1S16	Scale Switch	Display	15
	A1S16A	10 dB/DIV	Display	15Ⓓ
	A1S16B	2.5 dB/DIV	Display	15Ⓓ
	A1S16C	1 dB/DIV	Display	15Ⓓ
	A1S16D	.25 dB/DIV	Display	15Ⓓ
8	A1S12	Measurement Select Switch	Display	15
	A1S12A	OFF	Display	15Ⓐ
	A1S12B	B	Display	15Ⓐ
	A1S12C	B/R	Display	15Ⓐ
	A1S12D	PHASE B/R	Display	15Ⓐ,Ⓓ
9	A1R33	PHASE B/R LENGTH Control	Display	15Ⓔ
10	A1S6	CHANNEL 2 REFERENCE OFFSET Switch	Display	15Ⓓ
11	A1R51	CHANNEL 2 REFERENCE OFFSET Control	Display	15Ⓓ
12	A2S2	CHANNEL 2 REFERENCE Switch	Display	15Ⓓ
13	A1R36	POLAR A/R LENGTH Control	Display	15Ⓔ

Figure 8-118. Front-Panel Controls and Indicators, Service Sheet Locations (4 of 4)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

SERVICE SHEET 20

RECTIFIER (A19) AND DC REGULATOR (A16), CIRCUIT DESCRIPTION

The input line voltage is applied to the primary windings of transformer T1 through Power Line Module FL1. The secondary windings of T1 supply five ac voltages to the Rectifier (A19) for conversion to unregulated dc voltages. A sixth secondary winding provides 6.3 Vac, biased at −2850 Vdc by the High Voltage Power Supply (A21), for the CRT filament voltage.

The Rectifier (A19) provides the following unregulated dc outputs:

- +150V UNREG for distribution
- +20V UNREG for distribution and development of a regulated +20V. (A +15V supply is developed from the regulated +20V.)
- +5V UNREG for development of +5.2V and +5V regulated supplies
- −10V UNREG for development of −10V and −12V regulated supplies
- −80V UNREG for distribution

Regulated supplies are provided by three-terminal regulators mounted on the Motherboard (A20) and by the DC Regulator (A16). The Motherboard (A20) provides the following regulated supplies:

- +5.2V (A20U2)
- +5V (A20U3)
- −12V (A20U1)

The DC Regulator (A16) provides the following regulated supplies:

- + 20V
- +15V
- −10V

Primary power overvoltage protection is provided by a crowbar circuit in the +20V Unregulated Power Supply of the Rectifier (A19). If the instrument overheats, a chassis-mounted thermal switch removes primary power from the transformer T1. Overvoltage protection and "power on" LED indicators for all regulated supplies are in the DC Regulator (A16).

NOTE

Logic circuitry for the control of the IF Switch (A6) is included on the printed-circuit board for A19. However, the schematic of this circuitry is included in the External Interface, Service Sheet 18.

Primary Power Ⓐ

Primary power is supplied to the primary of T1 through Power Line Module FL1, which includes a voltage-selector PC board. The voltage-selector board is positioned to provide correct power connections to T1 for operation with line voltages of 100 Vac, 120 Vac, 220 Vac, or 240 Vac. (See Figure 2-1 for correct installation of the voltage-selector PC board.) Transformer primary connections for the various input line voltages are shown in Figure 8-119.

If the input line voltage exceeds the selected line voltage by approximately 40 percent, the crowbar circuit in the +20V Unregulated Power Supply of A19 fires to short across the secondary of T1 that provides the unregulated +20V. The resulting excessive current blows fuse F1 in the Power Line Module. Thermal switch S2 senses the temperature of the chassis-mounted heat sink. It opens to shut down primary power if the heat sink temperature exceeds 90°C.

The transformer T1 supplies 120 Vac through the Power Line Module to the fan B1. Suppression of radio frequency interference (RFI) is provided by the LC filter in FL1. The front−panel LINE/OFF switch S1 turns the line power on or off.

RECTIFIER (A19), CIRCUIT DESCRIPTION

NOTE

Whenever unregulated power supply output voltages are given, it is assumed that the actual input line voltage is equal to the voltage indicated on the voltage−selection PC board. Any variation in the input line voltage results in a proportional variation of unregulated power supply output voltages.

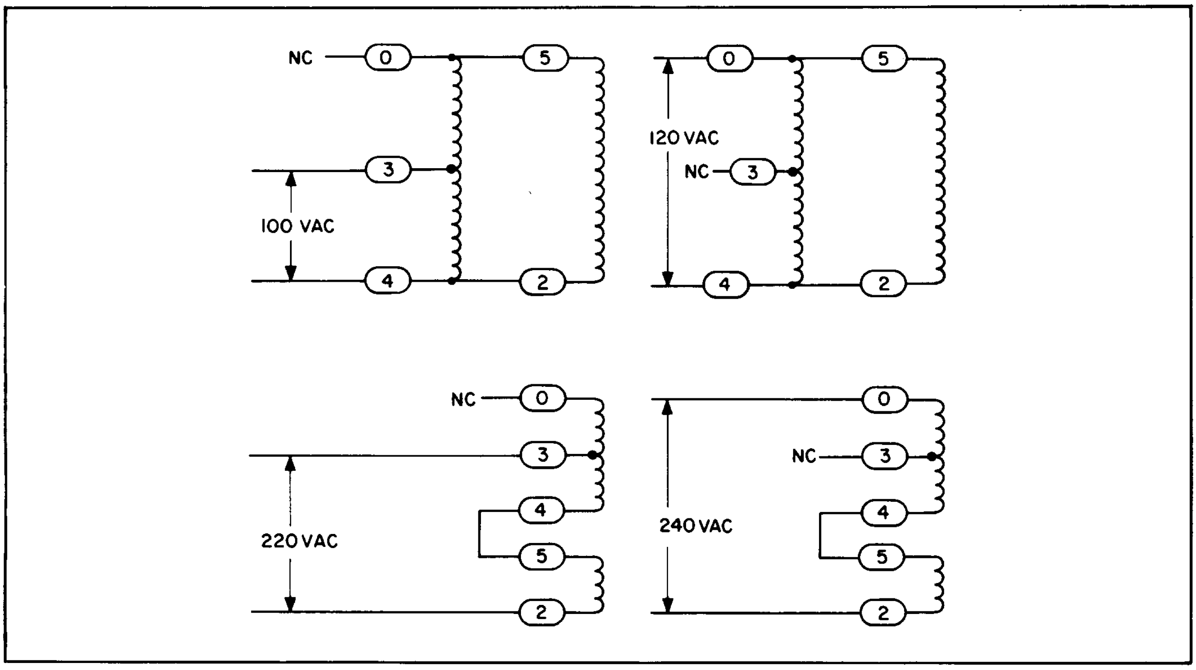


Figure 8-119. Transformer Primary Connections for Selected Line Voltages

The + 150V Unregulated Power Supply B

The +150V Unregulated Power Supply has an output of approximately +167V, which is distributed throughout the instrument by the Motherboard (A20).

Full-wave bridge rectifier A19CR2 converts the approximately 130-Vac output from T1 to +167 ±12Vdc. Overcurrent protection is provided by fuse A19F2. Capacitor A19C6 filters ac line ripple to approximately 1 Vac peak-to-peak. Capacitor A19C4 suppresses conducted RFI and A19C5 filters switching transients. Resistor A19R2 limits current to the +150V indicator LED A19DS2 and provides a discharge path for A19C6 when the power is turned off.

+ 20V Unregulated Power Supply C

The +20V Unregulated Power Supply has an output of approximately +33 Vdc, which is distributed throughout the instrument by the Motherboard (A20) and is also regulated in the DC Regulator (A16) to provide a regulated +20V. The +20V Unregulated Power Supply also provides primary power overvoltage protection against excessive input line voltage.

Full-wave bridge rectifier A19CR8-11 converts the approximately 25-Vac output from T1 to +33 ±2.5 Vdc. Overcurrent protection is provided by fuse A20F1. Capacitor A20C1 filters ac line ripple to approximately 1 Vac peak-to-peak. Capacitor A10C11 suppresses conducted RFI, and A19C12 filters switching transients. Bleeder resistor A19R5 provides a discharge path for A20C1 when the power is turned off.

Primary power overvoltage protection is provided by the crowbar circuit across the secondary winding of T1. An overvoltage condition exists if the input line voltage exceeds the selected value by approximately 40 percent; e.g., +120 Vac selected, +220 Vac applied. This excessive line voltage causes the +20V Unregulated Power Supply output to exceed the breakdown voltage of zener diode A19VR1, which then conducts and turns on silicon-controlled rectifier (SCR) A19CR6. This places a short across the secondary of T1 that provides the unregulated +20V, blowing fuse F1 in the Power Line Module.

+ 5V Unregulated Power Supply D

The +5V Unregulated Power Supply has an output of approximately +11 Vdc, which is regulated on the Motherboard (A20) by three-terminal regulators to provide the +5.2V and +5V regulated supply voltages.

Full-wave bridge rectifier A19CR16–19 converts the approximately 10-Vac output from T1 to +11 ±0.8 Vdc. Capacitor A20C3 filters ac line ripple to approximately 0.5 Vac peak-to-peak. Capacitor A19C7 suppresses conducted RFI, and A19C8 filters switching transients. Bleeder resistor A19R3 provides a discharge path for A20C3 when the power is turned off.

– 80V Unregulated Power Supply (F)

The –80V Unregulated Power Supply has an output of approximately –84 Vdc, which is distributed throughout the instrument by the Motherboard (A20).

Full-wave rectifier A19CR1 converts the approximately 65-Vac output from T1 to –84 ±6 Vdc. Overcurrent protection is provided by fuse A19F1. Capacitor A19C3 filters ac line ripple to approximately 1 Vac peak-to-peak. Capacitor A19C1 suppresses conducted RFI, and A19C2 filters switching transients. Resistor A19R1 limits current to the –80V indicator LED A19DS1 and provides a discharge path for A19C3 when power is turned off.

6.3 Vac CRT Filament Supply (G)

WARNING

The 6.3 Vac CRT filament voltage is biased at a potential of –2850 Vdc by the High Voltage Power Supply (A21). This voltage, if contacted, could cause personal injury or death.

Transformer T1 supplies a 6.3-Vac filament voltage to CRT V1. The filament voltage is biased, to prevent arcing, near the CRT cathode potential by the High Voltage Power Supply (A21).

DC REGULATOR (A16), CIRCUIT DESCRIPTION

+ 5.2V Power Supply (H)

The +5.2V Power Supply regulates the +11-Vdc output of the +5V Unregulated Power Supply in A19 to produce a regulated +5.2V supply voltage. Regulator A20U2 on the Motherboard is a three-terminal +5V regulator that is referenced 0.2V above ground by resistors A20R1 through A20R3 to produce the regulated +5.2V. Overcurrent protection is provided by fuse A20F4. If regulator A20U2 fails, overvoltage protection is provided by the crowbar circuit in the DC Voltage Regulator (A16). Zener diode A16VR7 conducts if the power supply output is greater than approximately +6.5V. SCR A16CR10 then turns on and shorts the +5.2V supply to ground, blowing fuse A20F4. The +5.2V indicator LED A16DS3 is lit when the power supply output is greater than approximately 4 Vdc.

+ 5V Power Supply (I)

The +5V Power Supply regulates the +11-Vdc output of the +5V Unregulated Power Supply in A19 to produce a regulated +5V supply voltage. Regulator A20U3 on the Motherboard is a three-terminal +5V regulator that is referenced to ground. Overvoltage protection is provided by the crowbar circuit in the DC Regulator (A16). Zener diode A16VR10 conducts if the power supply output is greater than approximately +6.5V. SCR A16CR11 then turns on and shorts the +5.2V supply to ground, blowing fuse A20F5. The +5V indicator LED A16DS4 is lit when the power supply output is greater than approximately 4 Vdc

– 12V Power Supply (J)

The –12V Power Supply regulates the –18-Vdc output of the –10V Unregulated Power Supply in A19 to produce a regulated –12V supply voltage. Regulator A20U1 on the Motherboard is a three-pin –12V regulator that is referenced to ground. Overcurrent protection is provided by fuse A20F3. The –12V indicator LED A16DS5 is lit when the power supply output is greater than approximately –9 Vdc.

+ 20V Power Supply (K)

The +20V Power Supply regulates the +33-Vdc output of the +20V Unregulated Power Supply in A19 to produce a regulated +20V supply voltage. Figure 8-120 is a simplified block diagram of the +20V Power Supply.

Current Source. The current source supplies a constant current large enough to drive a series pass transistor, providing an output voltage greater than +20V. This output voltage is fed back to an error amplifier, where the output voltage is compared with a reference voltage. The error amplifier draws the extra current from the current source to lower the output voltage to a regulated +20V. The

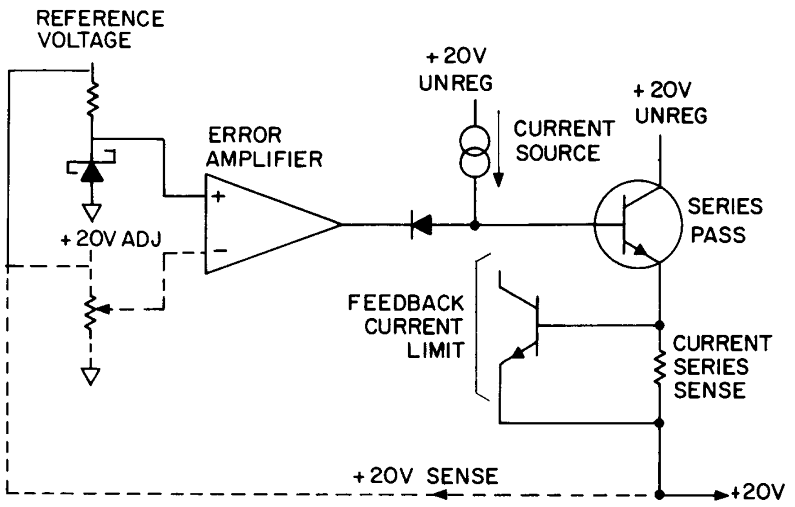


Figure 8-120. +20V Power Supply, Simplified Block Diagram

Foldback Current Limit circuit and the series sense resistor monitor the output current. If the output current is excessive in relation to the output voltage, the Foldback Current Limit circuit draws current from the current source to limit the current output.

Transistors A16Q1 and A16Q3 form a constant current source to drive the series pass transistor A20Q2. Transistor A16Q1 is normally biased on with A16Q3 monitoring the voltage drop across A16R1. If the voltage drop across A16R1 is greater than 0.65V, A16Q3 is biased on. This reduces the base-emitter bias of A16Q1 to maintain a constant current of 6.5 mA through A16R1. The current source drives series pass transistor A20Q2 to provide the supply output voltage, which is fed back to the error amplifier A16U1.

Error Amplifier. Zener diode A16VR1 maintains a +6.2V reference at the positive input to A16U1. The negative input to A16U1 is scaled by the voltage divider consisting of A16R9, +20V ADJ potentiometer A16R10, and A16R11. A16R10 is adjusted so that the reference and the +20V sense inputs to the error amplifier are equal when the power supply output is +20V. If the power supply output is greater than +20V, the error amplifier sinks more current from the current source, which reduces the series pass base drive to maintain a regulated +20V power supply output.

Foldback Current Limit. The Foldback Current Limit circuit is shown in Figure 8-121 with voltages given for a load current of 2A. Current limiting transistor A16Q2, with voltage divider A16R4, A16CR1, and A16R5 on its base, monitors the voltage drop E_1. As the load draws more current, E_1 increases because of the larger voltage drop across current sense resistor A16R3. The voltage drop E_2 is determined by resistor A16R5 and by the magnitude of the voltage drop E_1 in relation to the output voltage. When the load draws approximately 2.4A and the power supply output is +20V, E_2 becomes large enough to turn on the current limiting transistor A16Q2 to draw current from the constant current source. This causes a lower base drive voltage to A20Q2 and results in a lower power supply output voltage. If the load continues to draw excessive current in proportion to the output voltage, current limiting transistor A16Q2 remains turned on, and the power supply is effectively shut down. The current limiting operation can be checked by momentarily grounding the +20V output (A16TP3) to A16TP4 and observing that the +20V indicator A16DS2 turns back on when the ground is removed.

+20V Crowbar and Reverse Voltage Protection. Overvoltage protection is provided by the crowbar circuit consisting of zener diode A16VR2 and SCR A16CR4. If the power supply output is greater than approximately +24V, A16VR2 con-

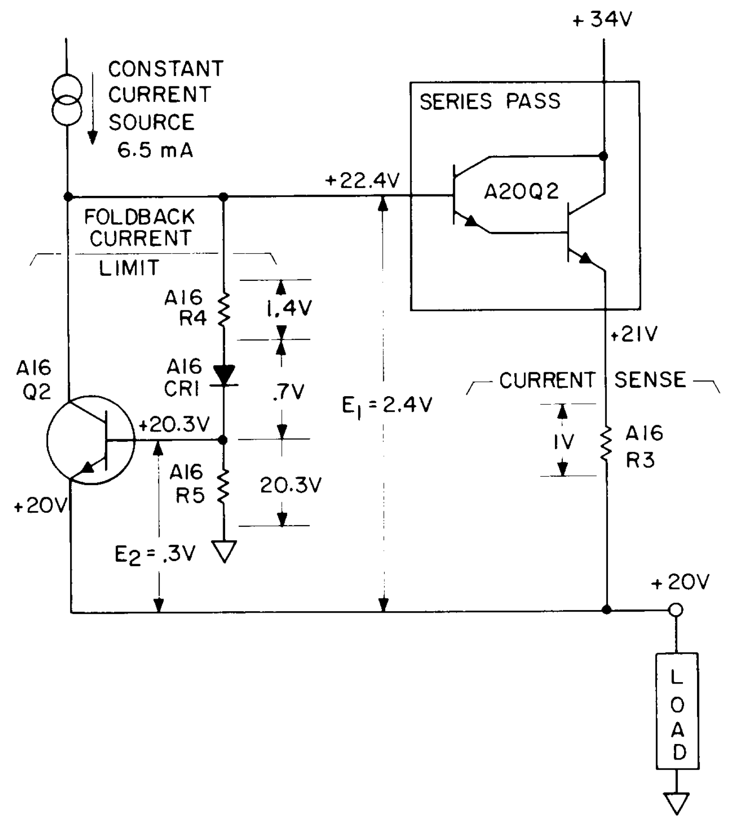


Figure 8-121. Foldback Current Limit, Simplified Schematic

ducts and A26CR4 turns on, shorting the +20V supply to ground and causing the power supply to current limit. Diode A16CR3 is a reverse voltage protection diode that prohibits the supply from being pulled negative. (The crowbar circuit protects against positive overvoltage only.) The +20V indicator LED A16DS3 is lit when the power supply output is greater than approximately +16 Vdc.

– 10V Power Supply Ⓛ

The –10V Power Supply regulates the –18 Vdc output of the –10V Unregulated Power Supply in A19 to produce a regulated –10V supply voltage. Figure 8-122 is a simplified block diagram of the –10V Power Supply.

Transistors A16Q4 and A16Q5 form a constant current source that drives series pass transistor A20Q1 to provide the power supply output voltage. This voltage is fed back to the negative input of error amplifier A16U2, where it is summed with the regulated +20V power supply output. Summing resistors A16R19 and A16R21 are scaled for a zero input to error amplifier A16U2 when the power supply output is –10V. If the power supply output is more negative than –10V, the error amplifier sources more current from the current source, which reduces the series pass base drive to maintain a regulated –10V power supply output. The operation of the current source is similar to that described for the +20V Power Supply circuit. However, if the +20V supply is not on, the current source is turned off, preventing the –10V supply from turning on.

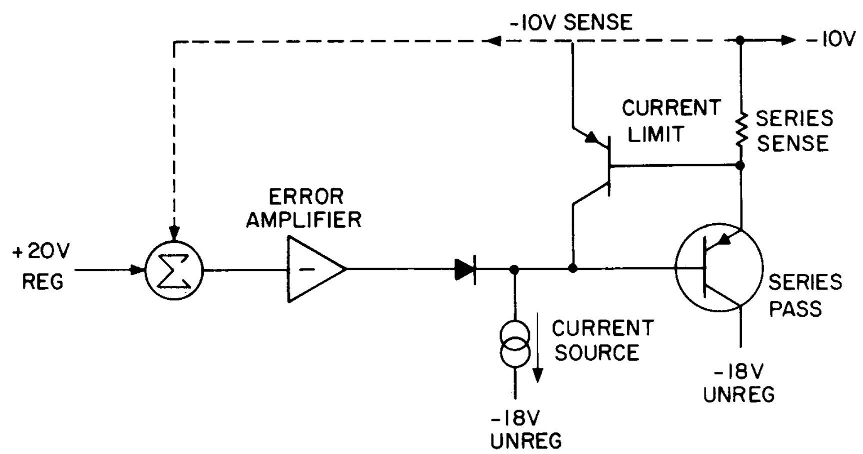


Figure 8-122. −10V Power Supply, Simplified Block Diagram

Current limiting transistor A16Q6 provides overcurrent. Its operation is similar to that of the Foldback Current Limit circuit described for the +20V Power Supply.

Overvoltage protection is provided by the crowbar circuit, which consists of zener diode A16VR5 and SCR A16CR9. When the power supply output is greater than approximately −12V, A16VR5 conducts, and SCR A16CR9 turns on, shorting the −10V supply to ground and causing it to current limit.

Reverse voltage protection is provided by diode A16CR8, which prohibits the supply from being pulled positive. (The crowbar circuit protects against negative overvoltage only.) The −10V indicator LED A16DS1 is lit when the power supply output is greater than approximately −8 Vdc.

+15V Power Supply Ⓜ

The +15V Power Supply output is derived by dropping the output of the +20V Power Supply across zener diode A16VR4. Overcurrent protection is provided by fuse A16F1. The +15V indicator LED A16DS6 is lit when the power supply output is greater than approximately +11 Vdc.

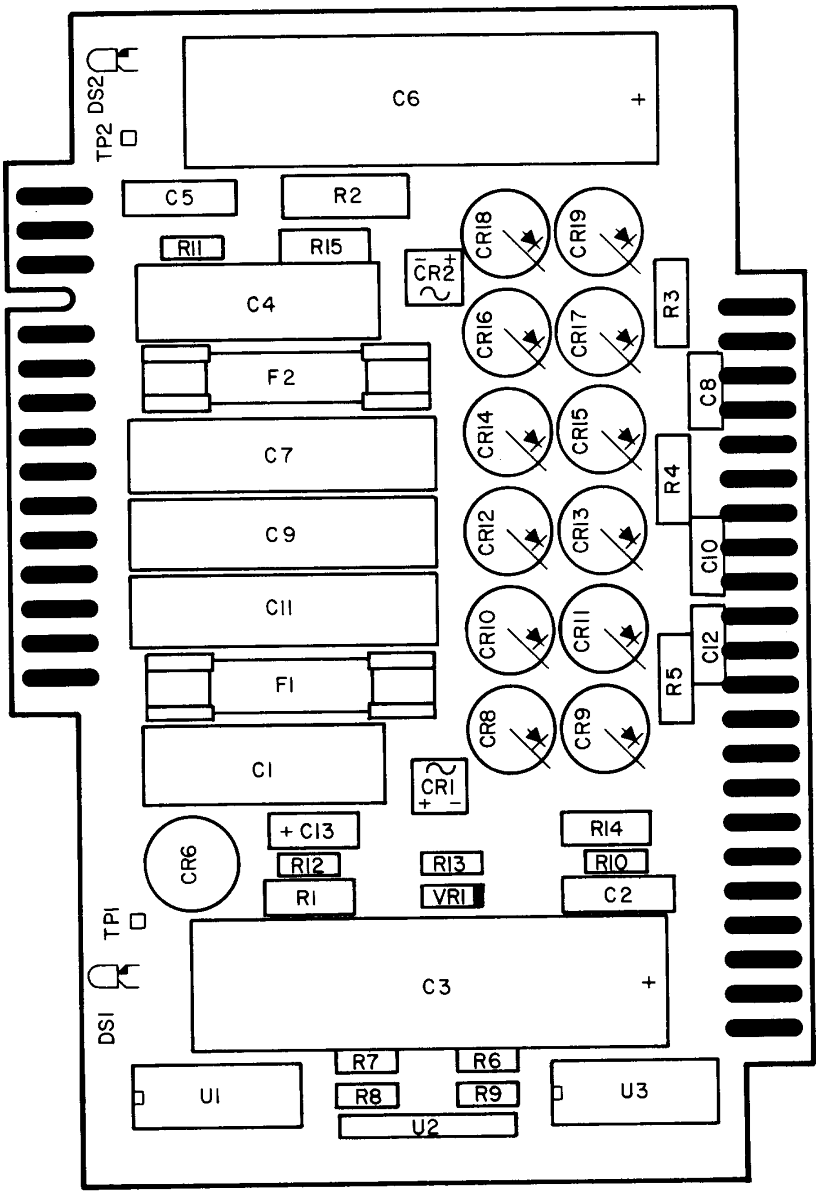


Figure 8-123. Rectifier (A19), Component Locations

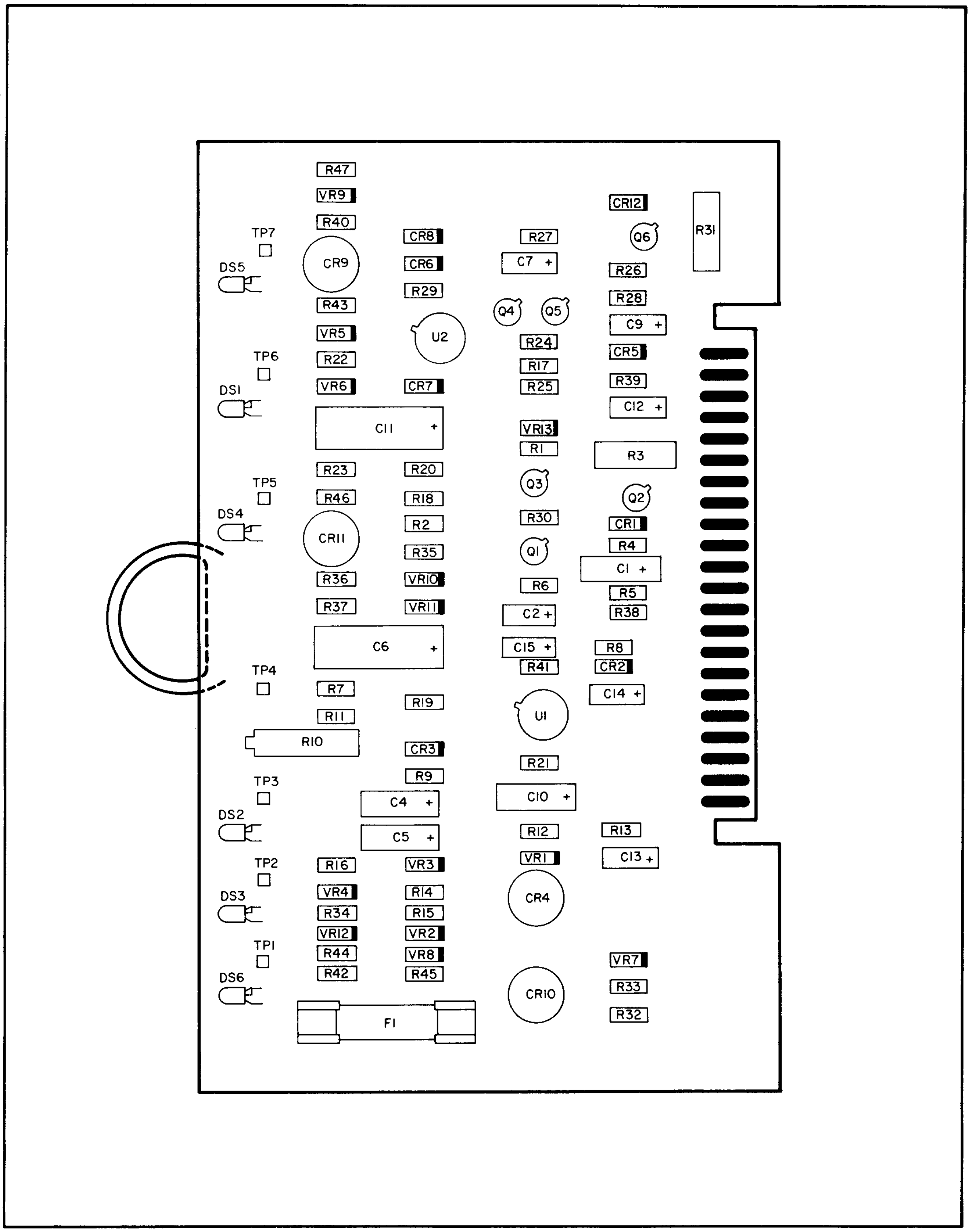
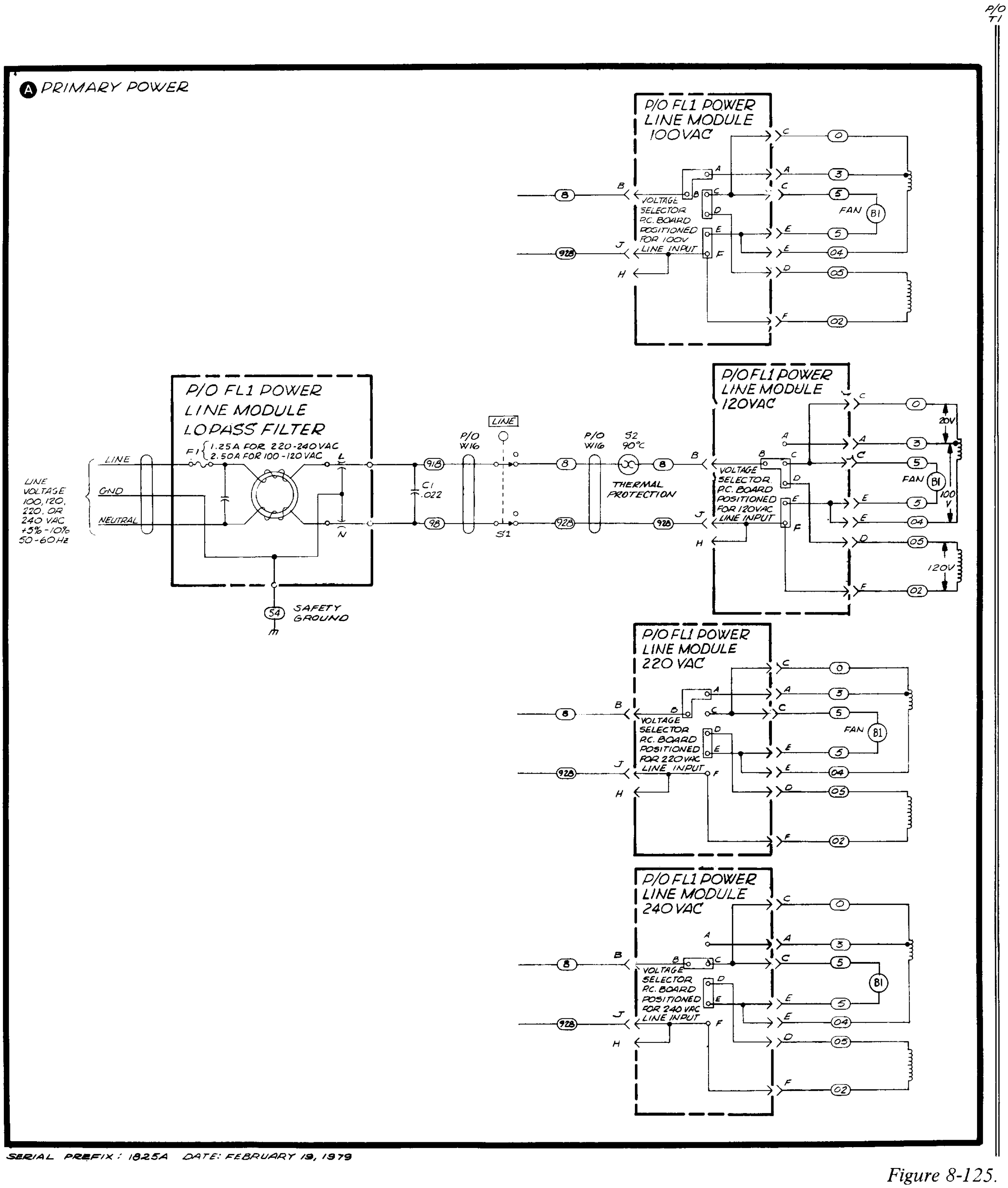
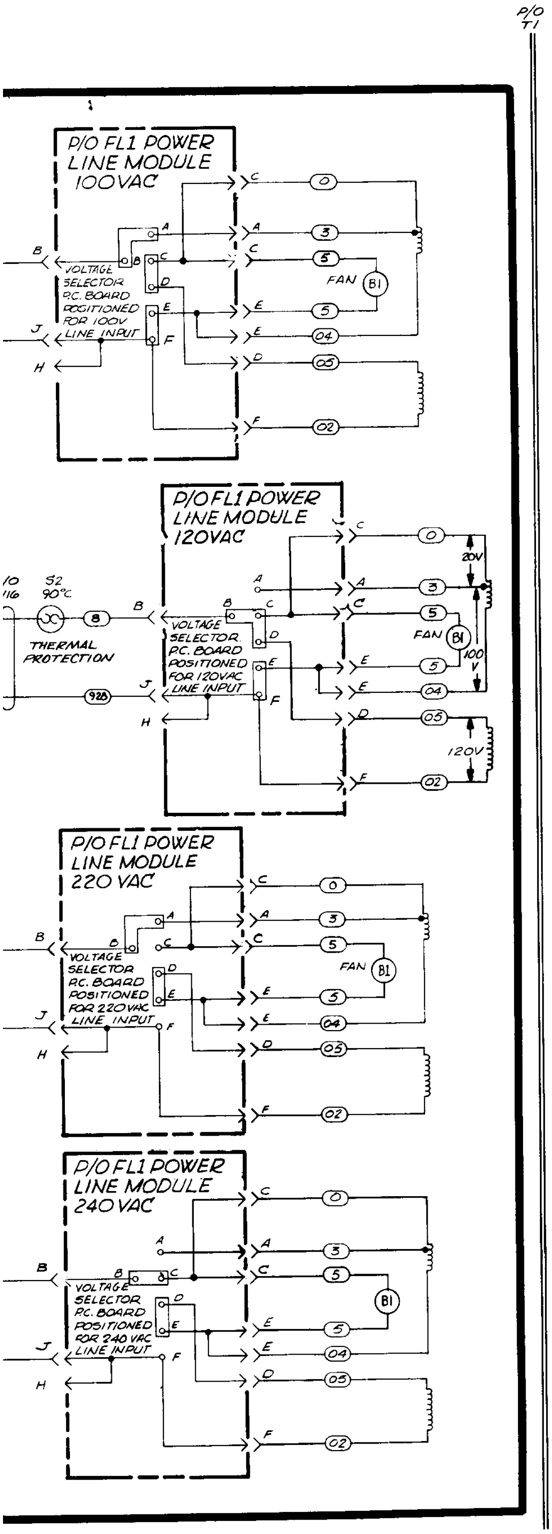


Figure 8-124. DC Regulator (A16), Component Locations



SERIAL PREFIX: 1825A DATE: FEBRUARY 19, 1979

Figure 8-125. Lo



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. PRIMARY TRANSFORMER T1 OUTPUT VOLTAGES ARE AS FOLLOWS:

TRANSFORMER T1 OUTPUT	VOLTAGE (±10%)(1)	
	LOADED(2)	UNLOADED(3)
J1 PINS 2,17 TO J1 PINS 1,16	130VAC	142VAC
J1 PINS 12,27 TO J1 PINS 11,26	25VAC	29VAC
J1 PINS 6,21 TO J1 PINS 5,20	9VAC	11VAC
J1 PINS 9,24 TO J1 PINS 8,23	15.5VAC	17.5VAC
J1 PINS 15,30 TO J1 PINS 14,21	65VAC	73VAC

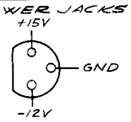
(1) LINE VOLTAGE & LINE MODULE SECTION = 120 VAC.
(2) TRANSFORMER OUTPUTS CONNECTED TO A19 RECTIFIER & ALL BOARDS INSTALLED.
(3) TRANSFORMER OUTPUTS NOT CONNECTED TO A19 RECTIFIER.

4. POWER SUPPLY DISTRIBUTION IS AS FOLLOWS:

POWER SUPPLY	TEST POINT	FUSE	VOLTAGE(1)	DISTRIBUTION
+150V UNREGULATED	A19TP2	A19F2	+167V±12V	A18, A20J4
+20V UNREGULATED	A20F1	A20F1	+33V± 2.5V	A16, A20J4, A20Q2
+20V REGULATED	A16TP3	A20F1	+20V±10mV	A3–A18, A20J1, A20J2, A20J4, A20J5
+15V REGULATED	A16TP1	A16F1	+15V±1.5V	A20J1
+5.2V REGULATED	A16TP2	A20F4	+5.2V± .3V	A8 THRU A16, A19
+5V REGULATED	A16TP5	A20F5	+5V± .3V	A16, A17, A18, A20J1 A20J2, A20J4
−10V REGULATED	A16TP6	A20F2	−10V± 20mV	A3 THRU A18, A20J1
−12V REGULATED	A16TP7	A20F3	−12V± .6V	A16, A20J1 A20J4
−80V UNREGULATED	A19TP1	A19F1	−84V±6V	A15, A20J4

(1) VOLTAGES MEASURED RELATIVE TO A16TP4 GND. WITH LINE VOLTAGE EQUAL TO LINE MODULE VOLTAGE SELECTION.

5. FRONT PANEL PROBE POWER JACKS, FRONT VIEW



6. TROUBLE SHOOTING HINTS:
   A. THERE ARE EIGHT POWER ON INDICATORS THAT ARE LIT WHEN POWER SUPPLIES ARE OPERATIONAL. (TWO ON A19 RECTIFIER AND SIX ON A16 LOW VOLTAGE POWER SUPPLY).
   B. IF ALL POWER IS SHUT DOWN, AND LINE FUSE IN POWER LINE MODULE FL1 IS NOT BLOWN, CHECK FOR OVERHEATING, SET LINE SWITCH OFF AND LET CHASSIS MOUNTED THERMAL PROTECTION SWITCH (FUNCTIONAL BLOCK **A**) COOL OFF BEFORE RE-APPLYING POWER.
   C. IF LINE FUSE IN POWER LINE MODULE BLOWS, CHECK THAT CORRECT LINE VOLTAGE IS SELECTED IN POWER LINE MODULE. THEN CHECK OVERVOLTAGE CROWBAR CIRCUITRY, (FUNCTIONAL BLOCK **C**)
   D. ONLY THE +20V AND −10V REGULATED POWER SUPPLIES MAY BE GROUNDED WITHOUT BLOWING ANY FUSES.

20

A16, A19

Figure 8-125. Low Voltage Power Supply (A19, A16), Schematic Diagram (1 of 2)

A18 DC REGULATOR

J1

PIN NO	SIGNAL	TO / FROM	FUNCTION BLOCK
1	+15V PROBE POWER	A20 XA16-1	M
23	GROUND SENSE	A20 GND PLANE	K L
2	+20V SENSE	A20 XA15-14	K L
24	+20V SENSE	A20 XA15-14	K L
3	+20V	A20 XA16-3	M
25	+20V	A20 XA16-25	M
4	NC		
26	NC		
5	+5.2V	A20 U2-OUT	H
27	+5.2V	A20 U2-OUT	H
6	NC		
28	NC		
7	NC		
29	NC		
8	−10V SENSE	A20 XA15-18	L
30	−10V SENSE	A20 XA15-18	L
9	−10V	A20 XA16-9	L
31	−10V	A20 XA16-31	L
10	+5V	A20 U3-OUT	I
32	+5V	A20 U3-OUT	I
11	NC		
33	NC		
12	▽	A20 GND PLANE	
34	▽	A20 GND PLANE	
13	▽	A20 GND PLANE	
35	▽	A20 GND PLANE	
14	▽	A20 GND PLANE	
36	▽	A20 GND PLANE	
15	+20V REGUL-ATOR CONTROL	A20 Q2-BASE	K
37	+20V REGUL-ATOR CONTROL	A20 Q2-BASE	K
16	+20V UNREG-ULATED	A20 F1	K
38	+20V UNREG-ULATED	A20 F1	K
17	REG +20V	A20 Q2-EMITTER	K
39	REG +20V	A20 Q2-EMITTER	K
18	−10V UNREG-ULATED	A20 F2	L
40	−10V UNREG-ULATED	A20 F2	L
19	−12V	A20 U1-OUT	J
41	−12V	A20 U1-OUT	J
20	−10V REGULA-TOR CONTROL	A20 Q1-BASE	L
42	−10V REGULA-TOR CONTROL	A20 Q1-BASE	L
21	▽	A20 GND PLANE	
43	▽	A20 GND PLANE	
22	REGULATED −10V	A20 Q1-EMITTER	L
44	REGULATED −10V	A20 Q1-EMITTER	L

A19 RECTIFIER ASSEMBLY

P1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK	SEE SERVICE SHEET
1	L B INT	A2J1-45		18
23	L REV AB	A23J7-10		
2	L MAG BUF	A11-42		18
24	H MAG	A23J7-19		
3	L B IF SW	A6-10,32		18
25	L B REM	A23J7-20		
4	L REM BUF	A17 P1-20 A2J2-47		18
26	L REM	A23J7-21		
5	NC			
27	NC			
6	NC			
28	NC			
7	+5.2V	A20U2 OUT		
29	+5.2V	A20U2OUT		
8	▽	A20 GND PLANE	F	
30	▽	A20 GND PLANE	F	
9	▽	A20 GND PLANE	F	
31	▽	A20 GND PLANE	F	
10	−80V	A20 XA19-10	F	
32	−80V	A20 XA19-32	F	
11	▽	A20 GND PLANE	F	
33	▽	A20 GND PLANE	F	
12	+20V UNREG COMMON	A20 C1 −	C	
34	+20V UNREG COMMON	A 20 C1 −	C	
13	+20V UN-REGULATED	A20 C1 +	C	
35	+20V UN-REGULATED	A20 C1 +	C	
14	▽	A20 GND PLANE	F	
36	▽	A20 GND PLANE	F	
15	−10 V UNREG COMMON	A20 C2 +	D	
37	−10UNREG COMMON	A20 C2 +	D	
16	−10V UN-REGULATED	A20 C2 −	E	
38	−10V UN-REGULATED	A20 C2 −	E	
17	▽	A20 GND PLANE	F	
39	▽	A20 GND PLANE	F	
18	+5V UNREG COMMON	A20 C3 −	D	
40	+5V UNREG COMMON	A20 C3 −	D	
19	+5V UN-REGULATED	A20 C3+	D	
41	+5V UN-REGULATED	A20 C3+	D	
20	▽	A20 GND PLANE	F	
42	▽	A20 GND PLANE	F	
21	▽1	A20 GND PLANE	B	
43	▽1	A20 GND PLANE	B	
22	+150V UN-REGULATED	A20 XA19-22	B	
44	+150V UN-REGULATED	A20 XA19-44	B	

A19

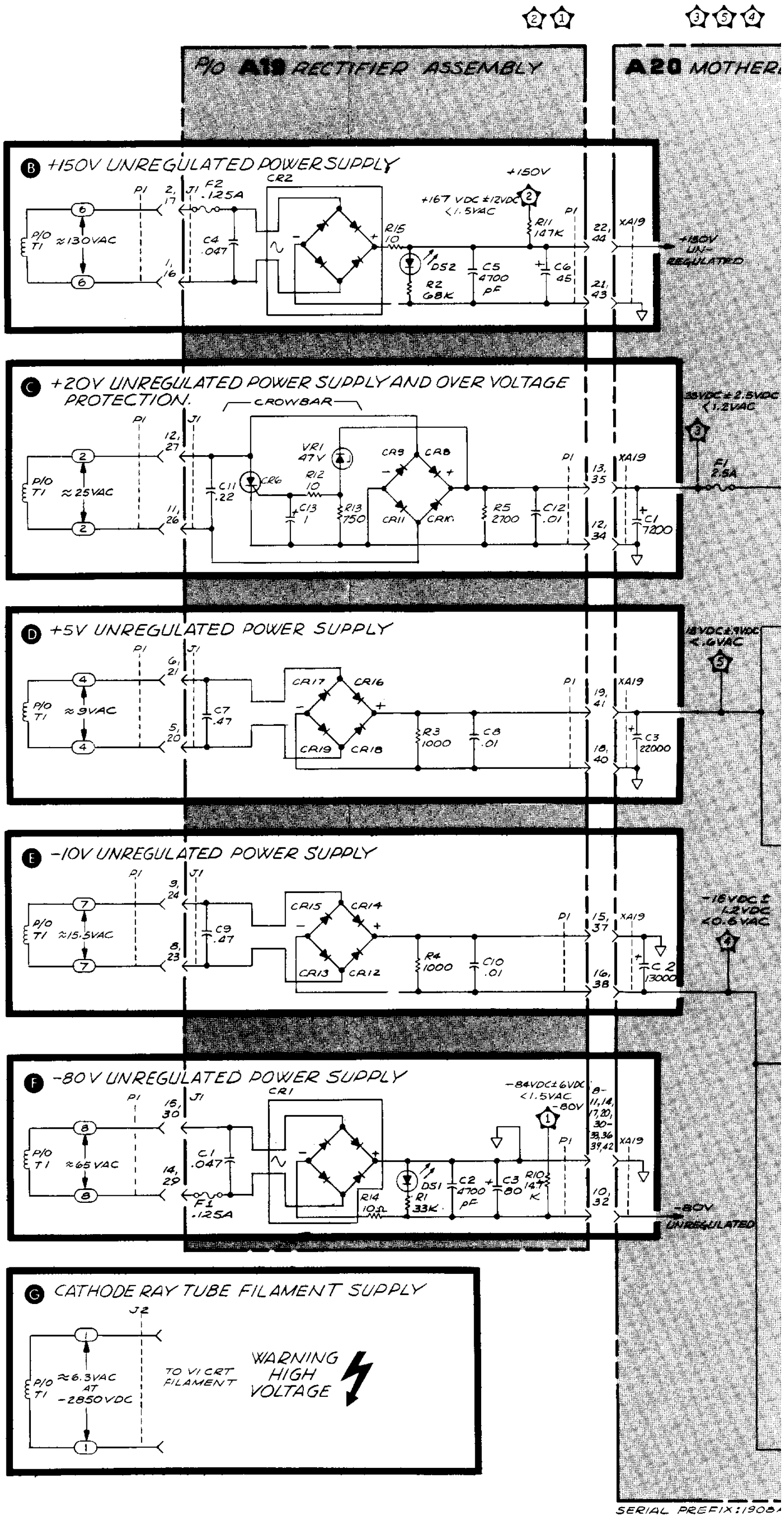
J1

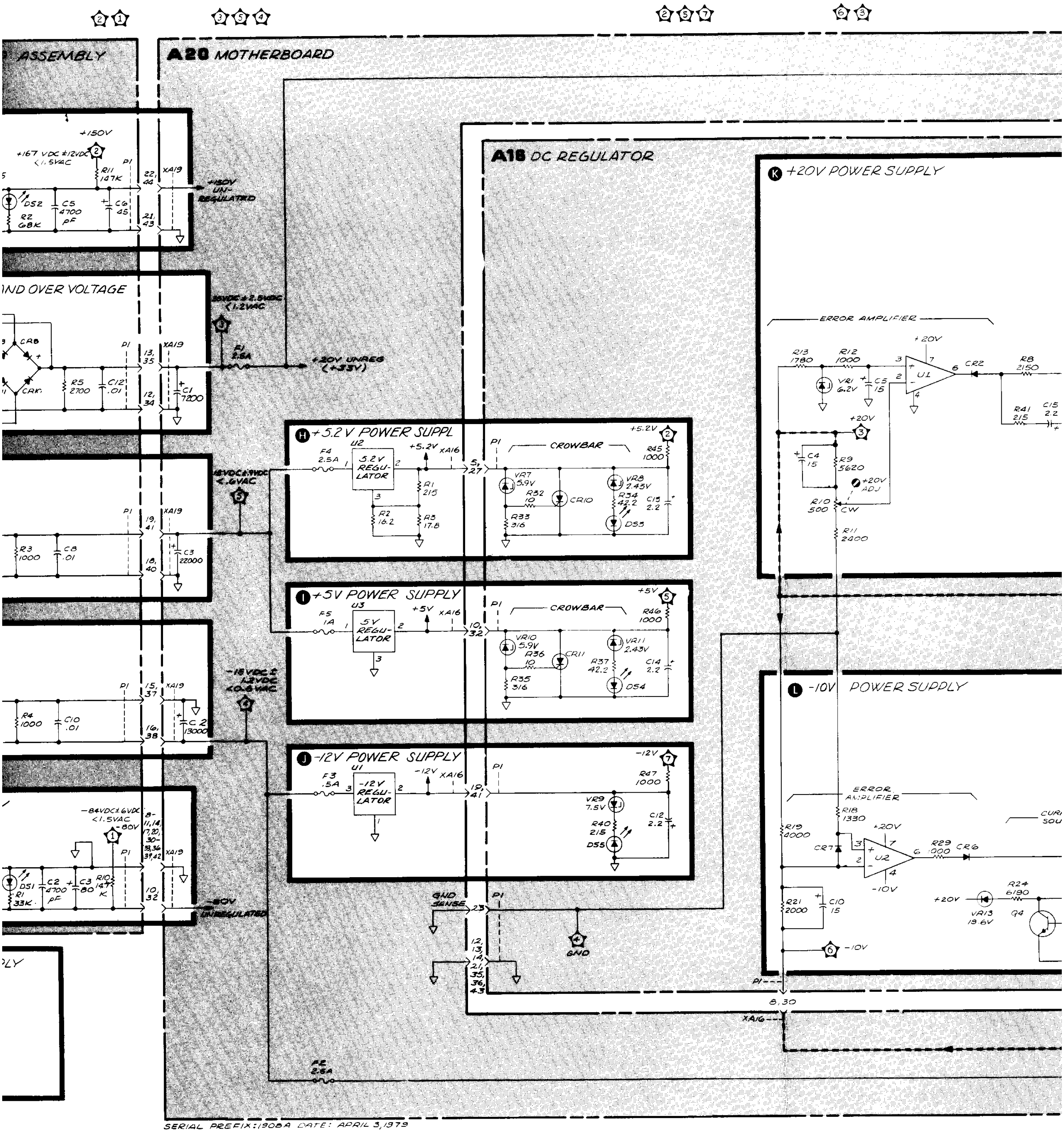
PIN NO	SIGNAL
1	130VA
16	130VA
2	130VA
17	130VA
3	NC
18	NC
4	NC
19	NC
5	9VAC
20	9VAC
6	9VAC
21	9VAC
7	NC
22	NC
8	15.5V
23	15.5V
9	15.5V
24	15.5V
10	NC
25	NC
11	25VA
26	25VA
12	25VA
27	25VA
13	NC
28	NC
14	65VA
29	65VA
15	65VA
30	65VA

A19 RECTIFIER ASSEMBLY

J1

PIN NO	SIGNAL	TO/FROM	FUNCTION BLOCK
1	130 VAC	T1	B
16	130 VAC	T1	B
2	130 VAC	T1	B
17	130 VAC	T1	B
3	NC		
18	NC		
4	NC		
19	NC		
5	9 VAC	T1	D
20	9 VAC	T1	D
6	9 VAC	T1	D
21	9 VAC	T1	D
7	NC		
22	NC		
8	15.5 VAC	T1	E
23	15.5 VAC	T1	E
9	15.5 VAC	T1	E
24	15.5 VAC	T1	E
10	NC		
25	NC		
11	25 VAC	T1	C
26	25 VAC	T1	C
12	25 VAC	T1	C
27	25 VAC	T1	C
13	NC		
28	NC		
14	65 VAC	T1	F
29	65 VAC	T1	F
15	65 VAC	T1	F
30	65 VAC	T1	F





ASSEMBLY
A20 MOTHERBOARD
A16 DC REGULATOR
+20V POWER SUPPLY
ERROR AMPLIFIER
+5.2V POWER SUPPL
CROWBAR
+5V POWER SUPPLY
-12V POWER SUPPLY
-10V POWER SUPPLY
+150V UN-REGULATED
+20V UNREG (+33V)
-80V UNREGULATED
GND SENSE
GND
SERIAL PREFIX: 1908A DATE: APRIL 3, 1979

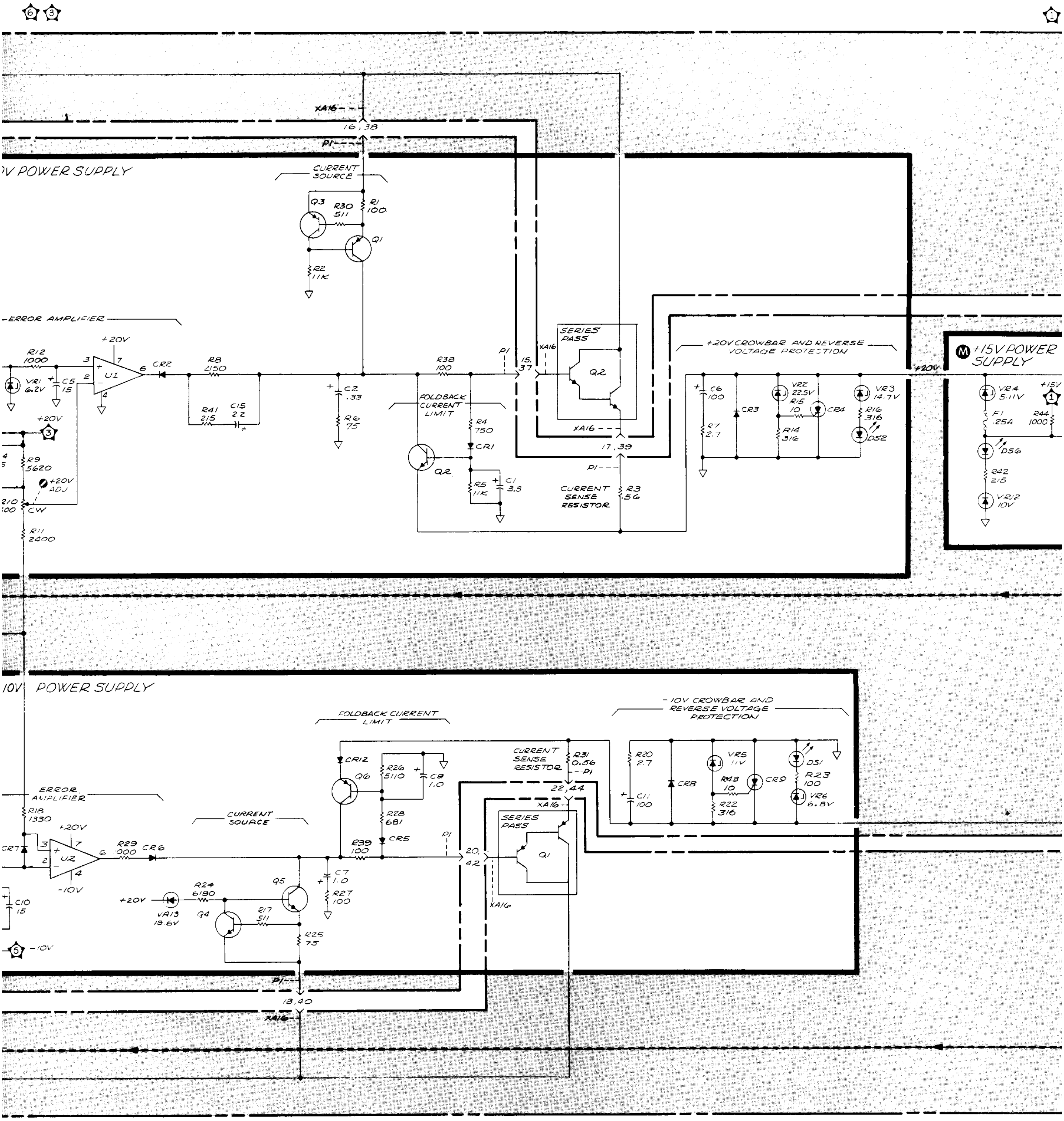


Figure 8-125. Low Vol

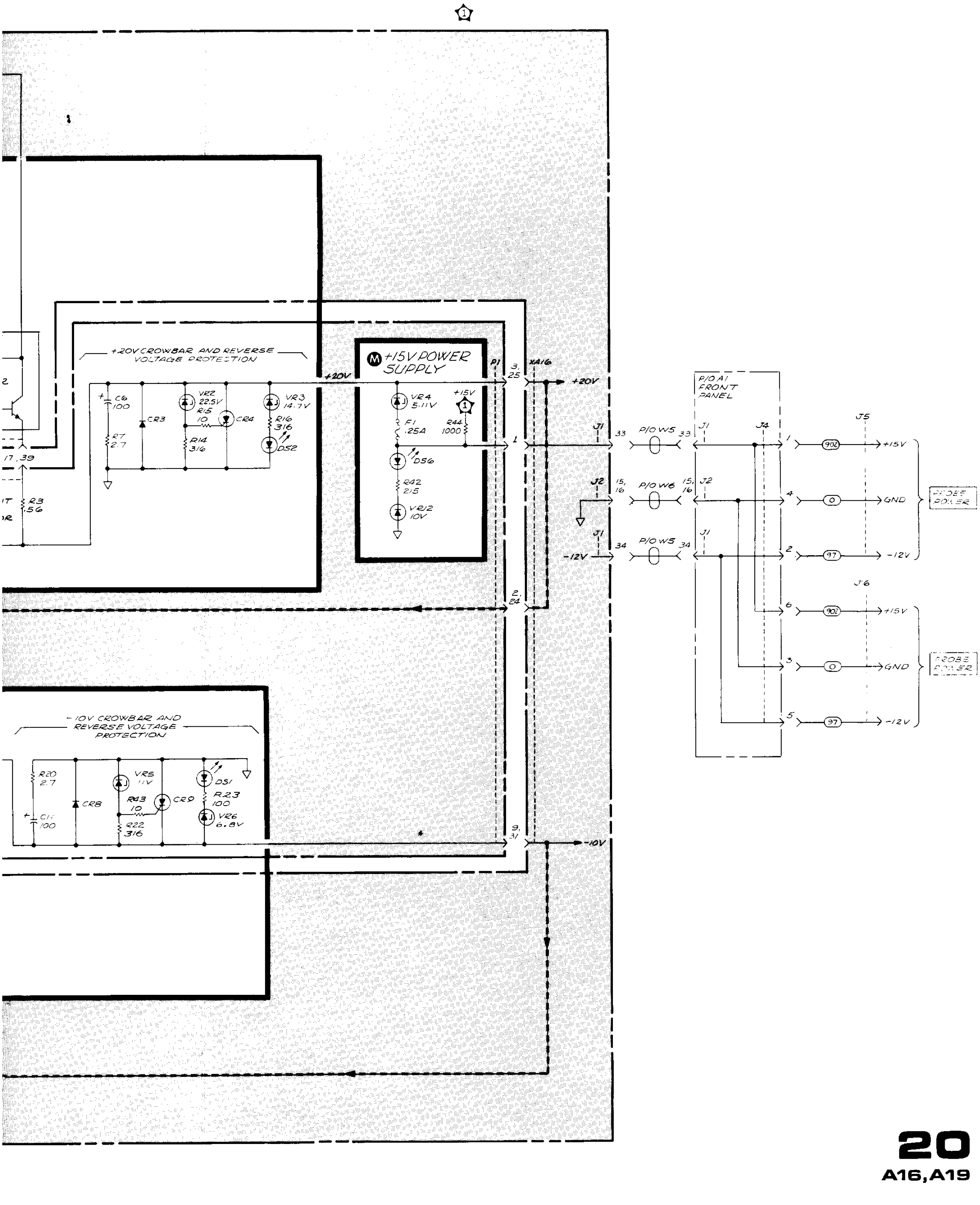


Figure 8-125. Low Voltage Power Supply (A19, A16), Schematic Diagram (2 of 2)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

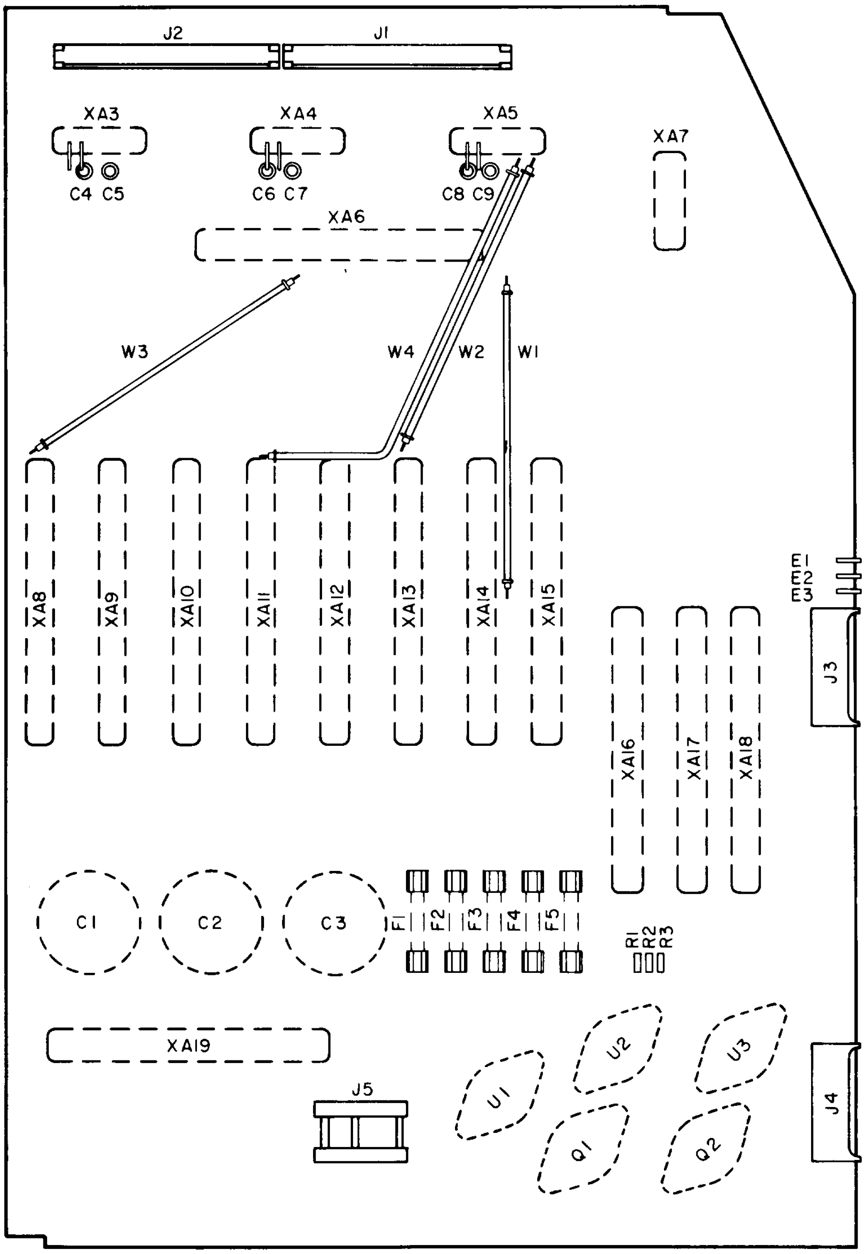


Figure 8-126. Motherboard (A20), Component Locations

ACTIVE STATE	MNEMONIC	SOURCE	DESCRIPTION	FRONT PANEL CONNECTORS	FRONT PANEL A1	ANALOG PROCESSOR A2	CABLE	RIBBON CONNECTOR A20J1	RIBBON CONNECTOR A20J2	B SAMPLER A3
	A,B IF	XA6-8,30	A OR B 1MHz IF (0dBm RF=.2236 VRMS=.632V p-p)				A20W3			
	A,B IF COM		A,B IF COMMON							
	A,B MAG	XA8-4,26	A OR B MAGNITUDE (-25mV/dB, 0V=0dBm RF)							
	A,B PHASE IF	XA8-22,44	A OR B IF BANDPASS FILTERED FOR PHASE DETECTOR							
	ACCEL GRID	XA18-20	ACCELERATOR GRID (+84V)							
H	ACQ	XA14-25	1=PHASE LOCK ACQUISITION							
H	ALT CH2	XA17-2	1=PROCESS CHANNEL 2, 0=PROCESS CHANNEL 1			J1-50	W5	50		
	A PULSE	A6J2	VTO PULSE OUTPUT TO A SAMPLER				W8			
	A RF IN	J3	A PORT RF INPUT	J3			W3			
	ATTEN RF	A7U3J2	ATTENUATED RF FOR PHASELOCK CONTROL (RF-21dB)							
H	AUTO	A1J1-24	1=AUTO SWEEP		J1-24		W5	24		
L	B IF SW	XA19-3	1=SELECT A IF 0=SELECT B IF			J2-40	W6			
L	B INT	A2J1-45	1=SELECT A IF 0=SELECT B IF			J1-45	W5	45		
H	BK STEP	XA14-20	1=BACK STEP SWEEP RAMP							
H	BLANK	XA14-13 XA15-13,35	1=BLANK DISPLAY (PHASE LOCK ACQ OR FREQ > 1350MHz)							
	BLANK/PEN	XA17-43 XA18-42	BLANK/PENLIFT OUTPUT TO REAR PANEL							
	BLANK/PEN COM	XA17-22	BLANK/PENLIFT COMMON							
	B PULSE	A6J1	VTO PULSE OUTPUT TO B SAMPLER				W7			J2(W7)
L	B REM	A23J7-20	REMOTE OPERATION 1=DISPLAY A 0=DISPLAY B							
	B RF IN	J4	B PORT RF INPUT	J4			W4			J1(W4)
	CH1 FLT	A2J1-37	CHANNEL 1 FILTERED TO Y DEFL. AMPL 300mV/MAJOR DIV			J1-37	W5	37		
	CH2 FLT	A2J1-35	CHANNEL 2 FILTERED TO Y DEFL AMPL 300mV/MAJOR DIV			J1-35	W5	35		
L	CHAN 2	A2J1-47	1=DISPLAY CHANNEL 1 0=DISPLAY CHANNEL 2			J1-47	W5	47		
	CURRENT SOURCE	XA17-24	CURRENT SOURCE (SWEEP RAMP)		J1-18		W5	18		
H	DBLR	A1J1-7	NOT USED		J1-7		W5	7		
H	DBP	XA17-8	1=DISPLAY BLANKING PULSE							
	DISC IF	XA5-1	R SAMPLER IF TO PHASE LOCK DISCRIMINATOR				A20W2			
	DISC IF COM		DISCRIMINATOR IF COMMON							
H	DSP R	A1J2-27	1=DISPLAY R ABSOLUTE MAGNITUDE		J2-27		W6		27	
	EXT MKR RF	J7	4 TO 1300mHz -13dBm NOMINAL							
L	EXT RF	A1J2-24	0=EXTERNAL RF SOURCE		J2-24		W6		24	
L	EXT STP SWP	A23J7-15	0=STOP SWEEP RAMP (PROGRAMMING INPUT)							
	EXT SWP IN	A23J2	EXTERNAL SWEEP IN (0 — +10V)							
L	EXT SWP SW	A23S1	0=EXTERNAL SWEEP ENABLED							
L	EXT TRIG	A23J7-16	0=EXTERNAL TRIGGER (PROGRAMMING INPUT)							
L	FAST SWP	A1J1-22	0=FAST SWEEP SPEED		J1-22		W5	22		
H	FEN	XA17-32	1=ENABLE FOR PHASE LOCK							
	FINE WIPER	A1J2-3	FINE TUNING VOLTAGE		J2-3		W6		3	
L	F MKR	XA15-19,41	0=FULL MARKER							
	FREQ REF	XA15-27	FREQUENCY REFERENCE (10mV/MHz)			J2-35	W6		35	
H	FULL	A1J1-32	1=FULL 4-1300MHz SWEEP MODE		J1-32		W5	32		
	GAIN 1	XA14-35	PHASE LOCK LOOP GAIN CONTROL (BCD 1)							
	GAIN 2	XA14-34	PHASE LOCK LOOP GAIN CONTROL (BCD 2)							
	GAIN 4	XA14-33	PHASE LOCK LOOP GAIN CONTROL (BCD 4)							
L	HOLD	XA14-24	0=HOLD SIGNAL LEVEL OF CH1 FLT AND CH2 FLT			J1-40	W5	40		
	HORIZ OUT	XA18-44	HORIZONTAL OUTPUT (.1V/DIV)							
	IF A	XA4-2	A SAMPLER IF OUTPUT (1MHz)							
	IF B	XA3-2	B SAMPLER IF OUTPUT (1MHz)							2
	IF DETECT	XA13-26	DETECTED R IF							
	INT MKR RF		INTERNAL MARKER RF 4 TO 1300MHz -25dBm TO -35dBm							
	LENGTH REF	XA15-5	ELECTRICAL LENGTH REFERENCE		J2-23		W6		23	

...ON CONNECTOR	RIBBON CONNECTOR	B SAMPLER	A SAMPLER	R SAMPLER	VTO and IF SWITCH	SOURCE	A,B DETECTOR	PHASE DETECTOR	POLAR CONVERTER	R DETECTOR	MARKER GENERATOR	PHASE LOCK	PHASE LOCK CONTROL	SHAPER	DC REGULATOR	SWEEP GEN...
J1	A20J2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
					8,30 ←	COAX	→ 2,24									
							→ 1,23									
							4,26			35						
							22,44	22,44								
												25	25			
																2
			J2(W8)		J3(W8)											
			J1(W3)													
						U3J2(W10)							J2(W10)			
																11,33
					10,32											
													20			17,39
													13	13,35		23
																43
																22
		J2(W7)			J1(W7)											
		J1(W4)														
																24
												44				
																8
				1 ←				COAX				→ 24				
												→ 1,23				
	27						42									
											J1(W12)					
	24													28		
																30
																44
																21
																19
																41
													21			32
	3													3,25		
											19,41			19,41		
	35												9	27		
											7,29			9,31		
												34	35			
												33	34			
												32	33			
													24			
			2		5,27											
		2			1,23											
												26	29			
											J2(W11)		J1(W11)			
	23													5		

ER	DC REGULATOR A16	SWEEP GENERATOR A17	DEFLECTION AMPLIFIERS A18	RECTIFIER A19	MOTHERBOARD (Miscellaneous Connections) A20	To J8 NORMALIZER INTERCONNECT A20J3	To A21J1 and CHASSIS COMPONENTS A20J4	To A23 REAR PANEL A20J5	CABLE	HIGH VOLTAGE POWER SUPPLY A21J1	REAR PANEL A23	CHASSIS COMPONENTS
			20				1		W14			XV1-8
		2										
		11,33										
				3								
				1								
		17,39										
		23										
		43	42					11	A23W1		J3	
		22						10	A23W1		J3(COM)	
				25				2	A23W1		J7-20	
			8			8			W13			J8-A1
			9			12			W13			J8-A2
			2,24			4			W13			J8-15
		24										
		8	5,27			14			W13			J8-9
					GROUND PLANE							
									W12			J7
		30						17	A23W1		J7-15	
		44						13	A23W1		J2	
		21						14	A23W1		S1	
		19						15	A23W1		J7-16	
		41										
		32										
								5	A23W1		J7-23	
			44					9	A23W1		J4	

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Figure 8-127. Motherboard (A20), Wire List (1 of 4)

ACTIVE STATE	MNEMONIC	SOURCE	DESCRIPTION	FRONT PANEL CONNECTORS	FRONT PANEL A1	ANALOG PROCESSOR A2	CABLE	RIBBON CONNECTOR A20J1	RIBBON CONNECTOR A20J2	B SAMPLER A3	A SA… A4
H	LGTH	J5-7	PROGRAMMING INPUT TO SELECT ELECTRICAL LENGTH REF.								
H	LK REQ EN	XA17-10	1=PHASE LOCK REQUEST ENABLE								
	LOG K A/R	A2J1-38	MAGNITUDE INFORMATION IN POLAR MODE			J1-38	W5	38			
	MAG	XA8-35,43	A, B, or R ABSOLUTE MAGNITUDE (-25mV/dB)			J2-42	W6		42		
H	MAG	A23J7-19	1=MAGNITUDE 0=PHASE (PROGRAMMING INPUT TO SELECT MAG/PHASE OUT)								
L	MAG BUF	XA19-2	1=PHASE 0=MAGNITUDE								
	MAG/PH OUT	XA11-20,43	MAGNITUDE/PHASE OUTPUT (-100mV/dB; 10mV/deg)								
L	MAN	A1J1-16	0=MANUAL SWEEP		J1-16		W5	16			
H	MARK	XA18-10	1=MARKER (NORMALIZER INTERCONNECT)								
H	MKR	XA12-21,22,43,44	1=DISPLAY MARKER								
H		XA14-43	1=MARKER ENABLE								
L	MKR 1	A1J1-21	0=1MHz MARKERS ENABLED		J1-21		W5	21			
L	MKR 10	A1J1-25	0=10 MHz MARKERS ENABLED		J1-25		W5	25			
L	MKR 50	A1J1-27	0=50 MHz MARKERS ENABLED		J1-27		W5	27			
	MKR WIDTH A	A1J2-9	1=SWEEP WIDTH 0 To 20MHz		J2-9		W6		9		
	MKR WIDTH B	A1J2-11	1=SWEEP WIDTH 10 To 20MHz or 200 To 1K MHz		J2-11		W6		11		
L	NORM	J8-7	0=NORMALIZED DISPLAY ENABLED								
	NORM X	J8-A4	NORMALIZED X AXIS								
	NORM Y	J8-A5	NORMALIZED Y AXIS								
	NORM Z	J8-A7	NORMALIZED Z AXIS								
L	OFF 1	A2J1-49	0=CHANNEL 1 OFF			J1-49	W5	49			
L	OFF 2	A2J1-43	0=CHANNEL 2 OFF			J1-43	W5	43			
	OUTPUT DBM	A1J1-12	OUTPUT dBM CONTROL VOLTAGE (0 To -10V)		J1-12		W5	12			
	PHASE OFFSET	A2J2-48	PHASE OFFSET VOLTAGE (7.5mV/DEGREE)			J2-48	W6		48		
H	POLAR	A1J2-21	1=POLAR A/R DISPLAY		J2-21		W6		21		
L	POLAR	XA18-23	0=POLAR A/R DISPLAY								
	POLAR X	XA10-5,27	POLAR CONVERTER OUTPUT X AXIS			J1-42	W5	42			
	POLAR Y	XA10-3,25	POLAR CONVERTER OUTPUT Y AXIS			J1-44	W5	44			
	POL MAG IF	XA9-7,29	POLAR MAGNITUDE IF (1MHz)								
	RECT PHASE	XA9-3,25	RECTANGULAR PHASE (-10mV/deg)		J2-29		W6		29		
L	RELOCK	A23J7-24	0=REACQUIRE PHASE LOCK (PROGRAMMING INPUT)								
H	RELOCK	A23J7-3	1=REACQUIRE PHASE LOCK (PROGRAMMING INPUT)								
L	REM	A23J7-21	0=REMOTE (PROGRAMMING INPUT)								
L	REM BUF	XA19-4	0=REMOTE			J2-47	W6		47		
H	RETRACE	XA17-9,31	1=SWEEP RETRACE								
L	REV AB	A23J7-10	0=REVERSE A and B								
	R IF	XA5-2	R SAMPLER IF OUTPUT (1MHz)				A20W4				
	R IF COM		R IF COMMON								
	R MAG	XA11-4,26	R MAGNITUDE (-25mV/dB, 0V=0dBm RF)			J2-36	W6		36		
	-R MAG	XA11-39	INVERTED R MAGNITUDE (25mV/dB)								
	R PHASE IF	XA11-22,44	R IF BANDPASS FILTERED FOR PHASE DETECTOR								
	R PULSE	A6J2	VTO PULSE OUTPUT To R SAMPLER				W9				
	R RECT PH IF	XA10-9,31	R RECTANGULAR PHASE IF (1MHz)								
	R RF IN	J2	R PORT RF INPUT	J2			W2				
	RF OUT	A7U3J3	SOURCE RF OUTPUT (4 To 1300 MHz, 0 To +10dBm)	J1			W1				
H	SET VTO	XA14-31	1=SET VTO FREQUENCY FOR PHASE LOCK ACQUISITION								
L	SNGL	A1J1-15	0=TRIGGER SINGLE SWEEP		J1-15		W5	15			
	STAB	R6-3	STABILITY CONTROL VOLTAGE FOR PHASE LOCK								
	STAB RES	XA18-41	STABILITY RESISTOR REFERENCE								
L	STP SWP	XA14-28	0=STOP SWEEP RAMP								
	SWP OUT	XA17-42	SWEEP RAMP OUTPUT (-5V To +5V)								

NNECTOR

B SAMPLER A3	A SAMPLER A4	R SAMPLER A5	VTO and IF SWITCH A6	SOURCE A7	A,B DETECTOR A8	PHASE DETECTOR A9	POLAR CONVERTER A10	R DETECTOR A11	MARKER GENERATOR A12	PHASE LOCK A13	PHASE LOCK CONTROL A14	SHAPER A15	DC REGULATOR A16	SWEEP GENERATOR A17	DEFLECTION AMPLI… A18
												6			
											17			10	
						1,23									
					35,43										
								42							
								20,43							
														5,27	
															10
									21,22,43,44						32
									20,42		43				
									8,30						
									9,31						
									10,32						
									12,34						
									13,35						
															4,26
															6,28
															7,29
															3,25
				6,12					11,33						
							1,23								
															1
															23
							5,27								
							3,25								
						7,29	7,29								
						3,25		17							
											42				
											41				
														20	
														9,31	
		2 ←			COAX			→ 2,24							
								→ 1,23							
								4,26							
					17			39							
							22,44	22,44							
		J2(W9)	J2(W9)												
						9,31	9,31								
		J1(W2)													
				U3J3											
										31	31				
														26	
											37				
															41
											28			7,29	
														42	

ER	DC REGULATOR A16	SWEEP GENERATOR A17	DEFLECTION AMPLIFIERS A18	RECTIFIER A19	MOTHERBOARD (Miscellaneous Connections) A20	To J8 NORMALIZER INTERCONNECT A20J3	To A21J1 and CHASSIS COMPONENTS A20J4	To A23 REAR PANEL A20J5	CABLE	HIGH VOLTAGE POWER SUPPLY A21J1	REAR PANEL A23	CHASSIS COMPONENTS
								7	A23W1		J7-13	
		10										
				24				1	A23W1		J7-19	
				2								
								4	A23W1		J6,J7-11,22	
		5,27										
			10			17			W13			J8-13
			32									
			4,26			10			W13			J8-7
			6,28			16			W13			J8-A4
			7,29			20			W13			J8-A5
			3,25			24			W13			J8-A7
						3			W13			J8-5
						6			W13			J8-6
			1									
			23			18			W13			J8-12
								6	A23W1		J7-24	
								21	A23W1		J7-3	
				26				3	A23W1		J7-21	
		20		4								
		9,31				21,22			W13			J8-8,17
				23				23	A23W1		J7-10	
					GROUND PLANE							
		26										
							16		W14			R6-3
			41				14		W14			R6-1
		7,29										
		42						12	A23W1		J1,J7-17	

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Figure 8-127. Motherboard (A20), Wire List (2 of 4)

ACTIVE STATE	MNEMONIC	SOURCE	DESCRIPTION	FRONT PANEL CONNECTORS	FRONT PANEL A1	ANALOG PROCESSOR A2	CABLE	RIBBON CONNECTOR A20J1	RIBBON CONNECTOR A20J2	B SAMPLER A3	A… A4
	SWEEP SPEED VERNIER	A1J1-17	SWEEP SPEED CONTROL CURRENT		J1-17		W5	17			
	SWP INTEG C	A1J1-20	INPUT VOLTAGE TO SWEEP INTEGRATOR CAPACITOR		J1-20		W5	20			
	TRACE ALIGN ADJ	R3-3	TRACE ALIGNMENT CONTROL VOLTAGE								
H	TRIG	A1J1-26	1=SWEEP TRIGGER		J1-26		W5	26			
	TUNE	XA15-1,23	LED DISPLAY VOLTAGE (0 TO -5.2V → 0 TO 1300 MHz)			J1-46	W5	46			
	TUNING V REF	XA15-4,26	TUNING VOLTAGE REFERENCE (-6.2V)		J2-7		W6		7		
	TUNING WIPER	A1J2-4	TUNING VOLTAGE		J2-4		W6		4		
L	UNLOCK LED	XA14-1	0=R INPUT <-40 dBm (LIGHTS UNLOCK INDICATOR)		J1-13		W5	13			
	VERT OUT	XA18-43	VERTICAL OUTPUT (.1V/DIV)								
	VLO	XA15-12,34	DRIVE VOLTAGE FOR 3.6 → 4.3 GHz OSCILLATOR								
	V RAMP	A2J1-36	VOLTAGE RAMP (+1.5V → -1.5V)			J1-36	W5	36			
	VSS	XA15-11,33	DRIVE VOLTAGE FOR 4.3 → 3.6 GHz OSCILLATOR								
	VSWP	XA17-18,40	VOLTAGE SWEEP RAMP (0V → +10V)			J1-23	W5	23			
	VSWP BUF	XA14-44	VOLTAGE SWEEP RAMP BUFFERED (0 → +10V)								
	VTO	XA13-9	VOLTAGE TUNED OSCILLATOR (0 TO +10V → 0 TO 30 MHz)				A20W1				
	VTO COM		VOLTAGE TUNED OSCILLATOR COMMON (GROUND PLANE)								
	VTO PRETUNE	XA14-30	PHASE LOCK ACQUISITION VTO PRETUNE VOLTAGE								
	WIDTH 1-10	A1J1-31	SWEEP WIDTH RAMP 1 TO 10 MHz (-400 mV/MHz)		J1-31		W5	31			
	WIDTH 20-1K	A1J1-29	SWEEP WIDTH RAMP 20 TO 1K MHz (-4 mV/MHz)		J1-29		W5	29			
	X DEFL 1	XA18-21	X AXIS DEFLECTION VOLTAGE (≈+20V TO +100V)								
	X DEFL 2	XA18-22	X AXIS DEFLECTION VOLTAGE (≈+100V TO +20V)								
	Y DEFL 1	XA18-18	Y AXIS DEFLECTION VOLTAGE (≈+27V TO +91V)								
	Y DEFL 2	XA18-19	Y AXIS DEFLECTION VOLTAGE (≈+91V TO +27V)								
	Z CRT	XA18-16,38	Z AXIS BLANKING & INTENSITY CONTROL (+5V=BLANK, -3V=INTENSITY)								
	+5V	A20U3-OUT	+5V REGULATED		J1-39	J1-39, J2-30	W5, W6	39	30		
	+5V UNREG	XA19-19,41	+5V UNREGULATED								
	+5V UNREG COM		+5V UNREGULATED COMMON								
	+5V UNREG FSD	A20F5	+5V UNREGULATED FUSED								
	+5.2V	A20U2-OUT	+5.2V REGULATED								
	+5.2V COM	A20U2-CASE	+5.2V COMMON								
	+5.2V UNREG FSD	A20F4	+5.2V UNREGULATED FUSED								
	-10V	XA16-9,31	-10V REGULATED		J1-11	J1-11	W5	11		5(C5)	5(C7
	-10V REG		-10V REGULATOR								
	-10V REG CNTRL		DRIVE TO SERIES REGULATOR								
	-10V SENSE		SENSE POINT FOR -10V REFERENCE								
	-10V UNREG	XA19-16,38	-10V UNREGULATED								
	-10V UNREG COM		-10V UNREGULATED COMMON								
	-10V UNREG FSD	A20F2	-10V UNREGULATED FUSED								
	-12V PP	A20U1-OUT	-12V PROBE POWER		J1-34		W5	34			
	-12V UNREG FSD	A20F3	-12V UNREGULATED FUSED								
	+15V PP	XA16-1	+15V PROBE POWER		J1-33		W5	33			
	+20V	XA16-3,25	+20V REGULATED		J1-14	J1-14	W5	14		6(C4)	6(C6)
	+20V REG		+20V REGULATOR								
	+20V REG CNTRL		DRIVE TO SERIES REGULATOR								
	+20V SENSE		SENSE POINT FOR +20V REFERENCE								

NNECTOR	RIBBON CONNECTOR A20J2	B SAMPLER A3	A SAMPLER A4	R SAMPLER A5	VTO and IF SWITCH A6	SOURCE A7	A,B DETECTOR A8	PHASE DETECTOR A9	POLAR CONVERTER A10	R DETECTOR A11	MARKER GENERATOR A12	PHASE LOCK A13	PHASE LOCK CONTROL A14	SHAPER A15	DC REGULATOR A16	SWEEP GENE A17
																1
																28
																12,34
														1,23		
	7													4,26		
	4													2,24		
													1			
						7								12,34		
						1								11,33		
													12	10,32		18,40
													44			
					21,43							9	10,32			
												30	30			
														7,29		
														8,30		
	30														10,32	13,35
							16,38	16,38	16,38	16,38	16,38	16,38	16,38	16,38	5,27	
		5(C5)	5(C7)	5(C9)	14,36	4,10	18,40	18,40	18,40	18,40	18,40	18,40	18,40	18,40	9,31	15,37
															22,44	
															20,42	
														18	8,30	
															18,40	
															19,41	
															1	
		6(C4)	6(C6)	6(C8)	16,38	2,8	14,36	14,36	14,36	14,36	14,36	14,36	14,36	14,36	3,25	3,25
															17,39	
															15,37	
														14	2,24	

DC REGULATOR A16	SWEEP GENERATOR A17	DEFLECTION AMPLIFIERS A18	RECTIFIER A19	MOTHERBOARD (Miscellaneous Connections) A20	To J8 NORMALIZER INTERCONNECT A20J3	To A21J1 and CHASSIS COMPONENTS A20J4	To A23 REAR PANEL A20J5	CABLE	HIGH VOLTAGE POWER SUPPLY A21J1	REAR PANEL A23	CHASSIS COMPONENTS
	1										
	28										
				E2		13					R3-3, L1
	12,34										
		43					8	A23W1		J5	
		30									
	18,40				13			W13			J8-11
							22	A23W1		J7-4	
		21				2		W14			XV1-6
		22				4		W14			XV1-7
		18				5		W14			XV1-11
		19				3		W14			XV1-10
		16,38				11		W14	5		
10,32	13,35	13,35		U3-OUT		6		W14			R5-2
			19,41	C3+, F4, F5							
			18,40	C3-, GROUND PLANE							
				F5, U3-IN							
5,27			7,29	R1, U2-OUT							
				R1, R2, R3, U2 CASE							
				F4, U2-IN							
9,31	15,37	15,37		E1, C5, C7, C9							
22,44				Q1-E							
20,42				Q1-B							
8,30											
			16,38	C2-, F2, F3							
			15,37	C2+, GROUND PLANE							
18,40				F2, Q1-C							
19,41				U1-OUT		20,22,24		W14	4		R3-1, R4-2
				F3, U1-IN							
1											
3,25	3,25	11,33		C4, C6, C8		7,8	18	W14/A23W1	8	J7-14	R3-2
17,39				Q2-E							
15,37				Q2-B							
2,24											

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Figure 8-127. Motherboard (A20), Wire List (3 of 4)

ACTIVE STATE	MNEMONIC	SOURCE	DESCRIPTION	FRONT PANEL CONNECTORS	FRONT PANEL A1	ANALOG PROCESSOR A2	CABLE	RIBBON CONNECTOR A20J1	RIBBON CONNECTOR A20J2	B SAMPLER A3	A
	+20V UNREG	XA19-13,35	+20V UNREGULATED								
	+20V UNREG COM		+20V UNREGULATED COMMON								
	+20V UNREG FSD	A20F1	+20V UNREGULATED FUSED								
	-80V	XA19-10,32	-80V UNREGULATED SUPPLY								
	+150V	XA19-22,44	+150V UNREGULATED SUPPLY								
	GND		GROUND PLANE			J1-41,48	W5	41,48	1,2	3,4	3,
	GND		GROUND PLANE		J2-1,15,16	J2-2,15,16	W6		15,16		
	GND		GROUND PLANE								
	GND		GROUND PLANE								
	GND		GROUND PLANE								
	GND SENSE										

RIBBON CONNECTOR A20J2	B SAMPLER A3	A SAMPLER A4	R SAMPLER A5	VTO and IF SWITCH A6	SOURCE A7	A, B DETECTOR A8	PHASE DETECTOR A9	POLAR CONVERTER A10	R DETECTOR A11	MARKER GENERATOR A12	PHASE LOCK A13	PHASE LOCK CONTROL A14	SHAPER A15	DC REGULATOR A16	SWEEP GENE[RATOR] A17
														16,38	
													22,44		
1,2	3,4	3,4	3,4	2-4,6,7,9	3,9	3,5,6	2,4-6,8	2,4,6,8	3,5,6	1-6,15,17	2-8,10-13,15	2-5,7,8	15,17,20	12-14,21	14,16
15,16				11-13,15		8-11,15,21	10-13,15,17	10-13,15,17	8-11,15,21	23-28,37	17,19-22	11,15,19	37,39,42	34-36	36,38
				17-20,22		25,27,28	19-21,24	19-21,24,26	25,27,28	39	27-29,35,37	26,41		43	
				24-26,28,29		30-33,37	26-28,30	28,30,32-35	30-33,37		39,41-43				
				31,33-35,37,			32-35,37,39,	39,41-43							
				39-42,44			41-43								
														23	

5 SHAPER	A16 DC REGULATOR	A17 SWEEP GENERATOR	A18 DEFLECTION AMPLIFIERS	A19 RECTIFIER	A20 MOTHERBOARD (Miscellaneous Connections)	A20J3 To J8 NORMALIZER INTERCONNECT	A20J4 To A21J1 and CHASSIS COMPONENTS	A20J5 To A23 REAR PANEL	CABLE	A21J1 HIGH VOLTAGE POWER SUPPLY	A23 REAR PANEL	CHASSIS COMPONENTS
				13,35	C1+, F1							
				12,34	C1- GROUND PLANE							
	16,38				F1 Q2-C		18		W14	7		
14				10,32			23		W14	6		
			17,39	22,44			9,10		W14			R4-1
20	12-14, 21	14,16	12,14	8,9,11,14	E3,R2,R3,U3-CASE	1,2,5,7,9	15,17	16	W13,W14	1,9,10	J7-12,18	R5-1,J8-1,2,3,4
42	34-36	36,38	34,36	17,20,21,30	U1-COM	11,15,19	19,21		A23W1			
	43			31,33,36		23						
				39,42,43								
	23				GROUND PLANE							

21
A20

Figure 8-127. Motherboard (A20), Wire List (4 of 4)

CROSS REFERENCE OF ASSEMBLIES TO SERVICE SHEETS

ASSEMBLY	SERVICE SHEET	DESCRIPTION
A1 Front Panel	5 6 7 8 11 12 15 16 19	SWEEP pushbuttons Sweep Mode pushbuttons and SWEEP WIDTH MHz switch OUTPUT dBm control MARKERS MHz pushbuttons UNLOCKED indicator Absolute R measurement select CHANNEL 1, CHANNEL 2, REFERENCE POSITION, POLAR CENTER, and VIDEO FILTER HORIZONTAL POSN and GAIN controls All front panel controls
A2 Analog Processor	6 15 16	Analog-to-digital converter for FREQUENCY MHz display. Analog processor, switch control logic, and ±6V power supplies V RAMP amplifier
A3 B Sampler	9	RF to IF down-conversion
A4 A Sampler	9	RF to IF down-conversion
A5 R Sampler	9	RF to IF down-conversion
A6 VTO and IF Switch	10 12	Voltage Tuned Oscillator IF Switch
A7 Source	7	RF Source
A8 A,B Detector	12	A INPUT AND B INPUT, magnitude detector
A9 Phase Detector	14	Phase Detector
A10 Polar Converter	14	Polar Converter
A11 R Detector	13	R INPUT, magnitude detector
A12 Marker Generator	8	Markers
A13 Phase Lock	11	Phase Lock
A14 Phase Lock Control	11	Phase Lock loop control
A15 Shaper	6 7	Sweep width, tuning, frequency reference, and frequency display. Shaping and RF Source drive.
A16 DC Regulator	20	Low Voltage Power Supplies
A17 Sweep Generator	5	Sweep Generator
A18 Deflection Amplifiers	16	Deflection Amplifiers
A19 Rectifier	18 20	External Interface Low Voltage Power Supplies
A20 Motherboard	21	Motherboard wiring list
A21 High Voltage Power Supply	17	CRT bias and blanking control
A22 Frequency MHz Display	6	Frequency display
A23 Rear Panel	18	External Interface and Rear Panel (A23)

TOP VIEW

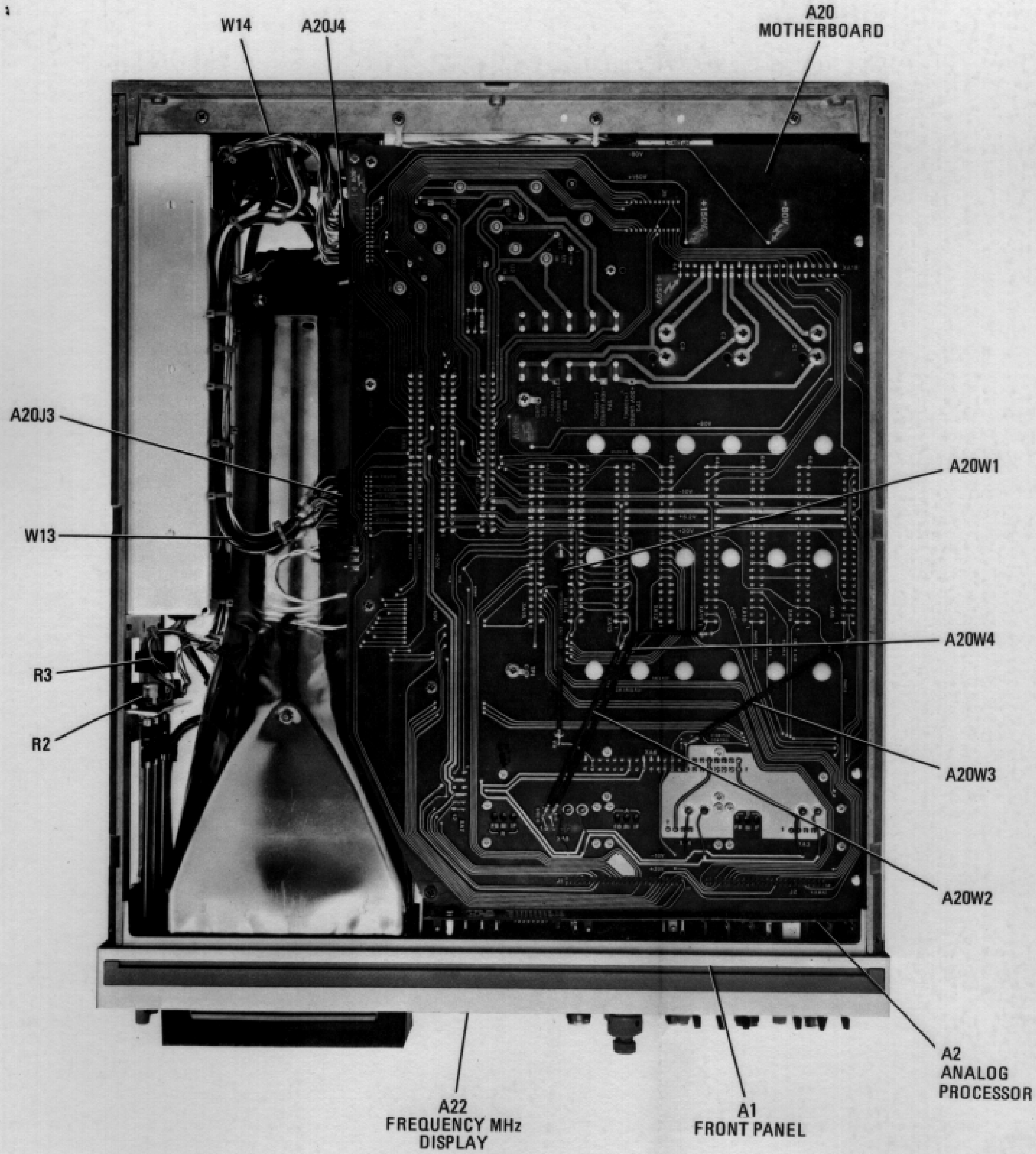

Figure 8-128. Major Assembly Locations, Top View

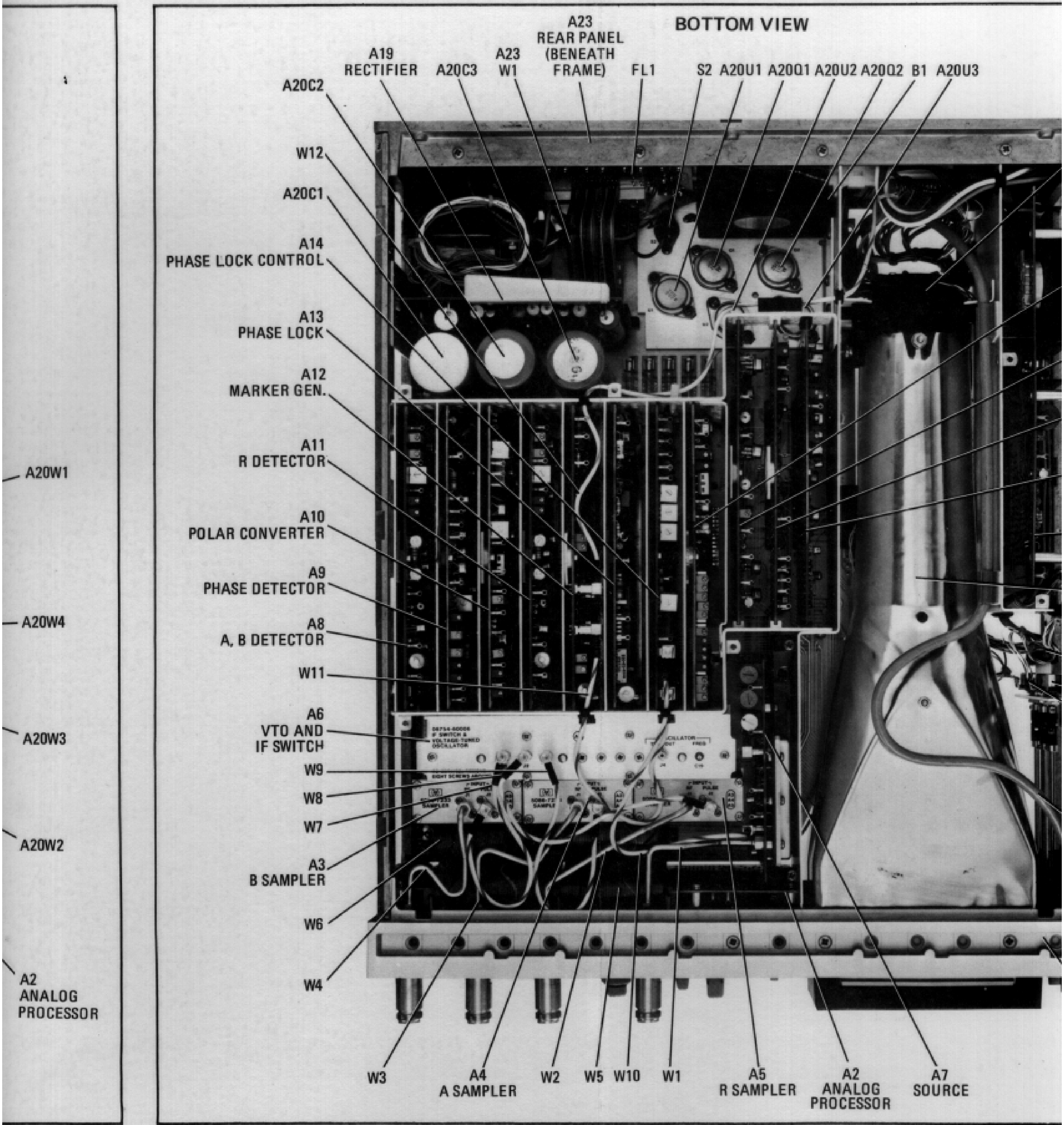

Figure 8-129. Major Assembly Locations, Bottom View

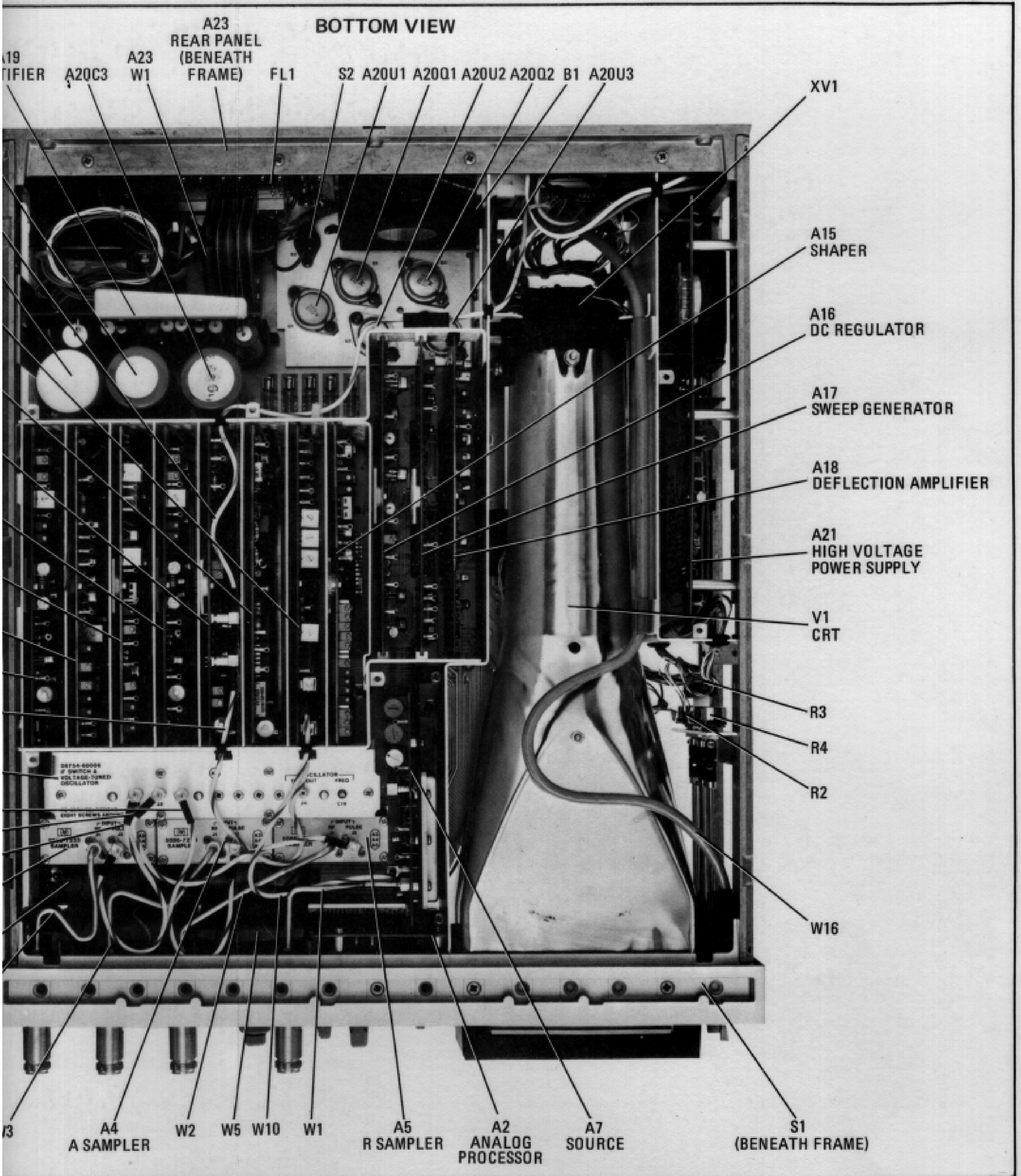

Figure 8-129. Major Assembly Locations, Bottom View