Errata

Title & Document Type: **8410A Network Analyzer 8411A Harmonic Frequency Converter Operating and Service Manual**

Manual Part Number: **08410-90020**

Revision Date: **December 1971**

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HP References in this Manual

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Agilent Technologies

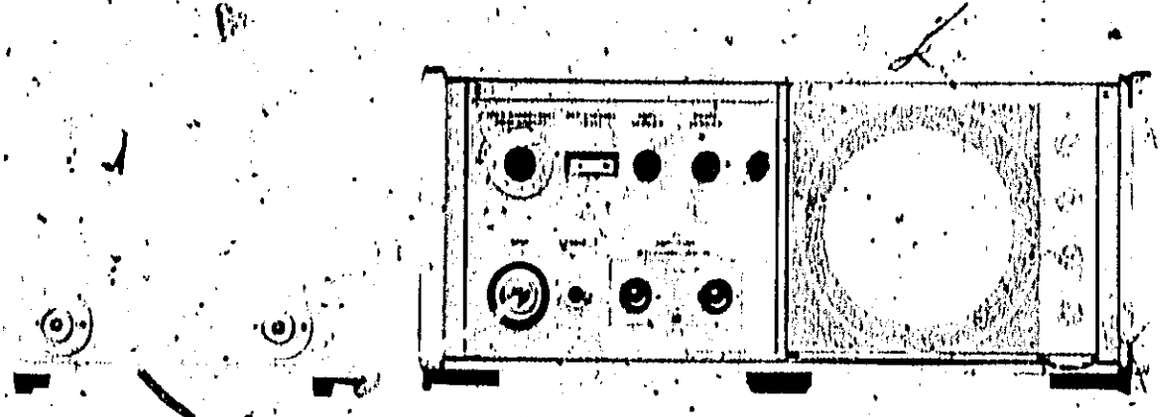
OPERATING AND SERVICE MANUAL

NETWORK ANALYZER

8410A

HARMONIC FREQUENCY CONVERTER

8411A



HEWLETT hp PACKARD

HP 8410A/8411A

CERTIFICATION

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

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NETWORK ANALYZER
8410A

SERIALS PREFIXED: 1144A-

For instruments with prefixes higher than 1144A, see "Manual Changes" sheet included with this manual. For prefixes below 1144A, see backdating in Appendix I. This manual does not apply to prefixes below 801.

HARMONIC FREQUENCY CONVERTER
8411A

SERIALS PREFIXED: 1144A-

For instruments with prefixes higher than 1144A, see "Manual Changes" sheet included with this manual. For instruments with serial prefixes from 603- to 934-, see Appendix I. This manual does not apply to prefixes below 603.

Manual Part No. 08410-90020
Microfiche Part No. 08410-90021

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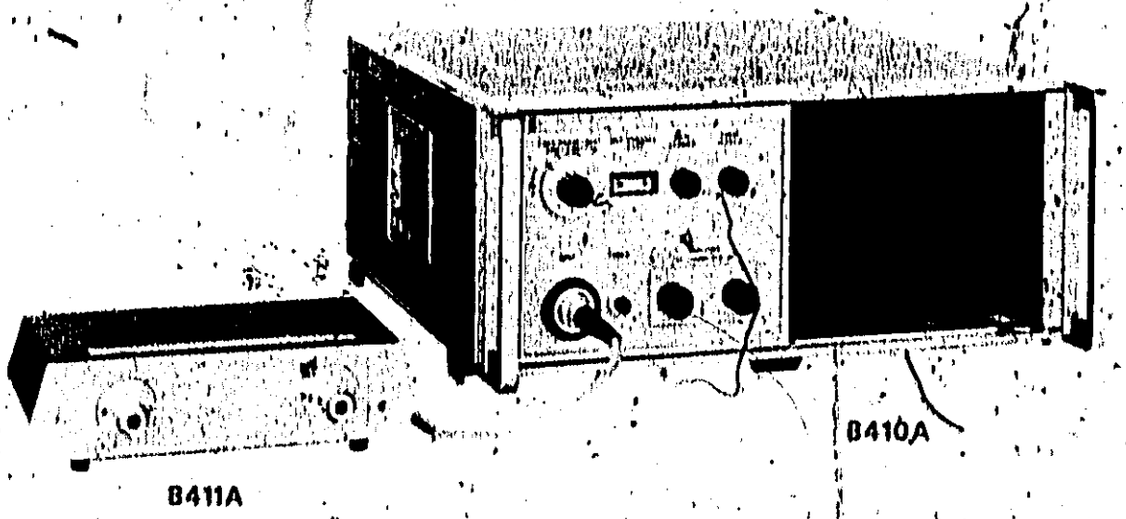

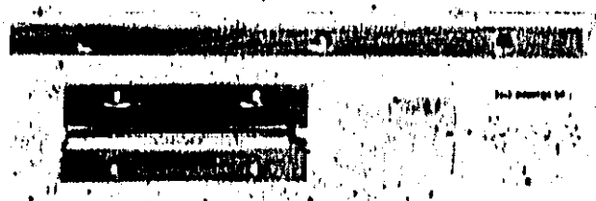

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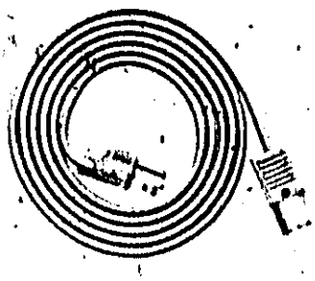

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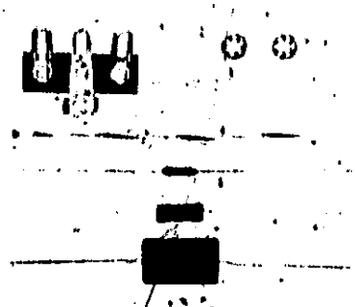

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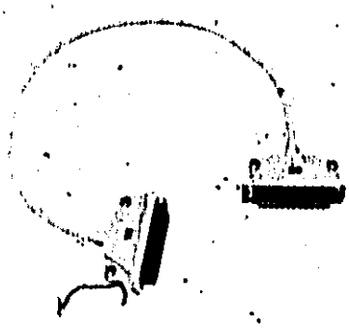


SERVICE CABLE

Figure 1-1. Models 8410A, 8411A, and Supplied Accessories

SECTION I

OPERATION

1-1. DESCRIPTION.

1-2. The combination of Model 8410A Network Analyzer, Model 8411A Frequency Converter, and a display unit for the Model 8410A, function as a phasemeter and a ratiometer for direct, continuous, simultaneous phase and amplitude ratio measurement on RF voltages. The complete instrument measures phase angles from 0 to 360° and amplitude ratios in decibels over a dynamic range of 60 dB. These measurements can be made on single frequencies and on swept frequencies in overlapping octave bands from 110 MHz to 12.4 GHz.

1-3. Measurements possible with the network analyzer include: direct determination of scattering (s) parameters; swept-frequency response measurements of phase sensitive systems; analysis of parameters relating to the use of solid state devices in wideband circuits; group delay measurements for communications systems; analysis of phase distortion in filters, amplifiers, and preamplifiers; antenna testing; and performance testing of components of sophisticated radars. Although the network analyzer is intended primarily for wideband coaxial measurements, it can also be used with waveguides within the limits imposed by waveguide bandwidths and the characteristics of waveguide-to-coax adapters.

1-4. The Models 8410A and 8411A convert the two RF signals being measured to two 278-kHz signals that have the same relative amplitudes and phase. The phase and amplitude information provided by the display unit used with the Model 8410A is derived from these 278-kHz signals. External monitoring points for the 278-kHz signals are provided on the Model 8410A. Operating power for the display unit and for the Model 8411A is furnished by the Model 8410A.

1-5. The Model 8411A automatically tracks the frequency of the signal applied to the reference input. This automatic tuning and tracking takes place over the octave frequency band preselected by a front panel control. In addition to the band selector, there is a control that permits the search and hold range of the automatic tuning to be adjusted for best performance with the selected band. For swept-frequency measurements at faster rates, a rear-panel input accepts a sweep reference voltage proportional to the frequency of the input signals. For a discussion of swept signal source requirements, see paragraph 1-67.

1-6. The signal applied to the reference input of the Model 8411A is used as the reference for both phase and amplitude measurements. Since it actuates the automatic tuning, its level is critical. A meter on the Model 8410A continuously monitors the reference channel signal level and indicates whether it is in the range required for making measurements.

1-7. Controls on the Model 8410A include phase and precision step-action amplitude offset controls. The vernier controls are for convenience in setting reference and calibration phase and amplitude indications. The amplitude offset controls allow large amplitude differences to be measured with greater resolution.

1-8. Complete specifications for the Model 8410A/8411A combination are given in Table 1-1. Specifications that include display unit performance are given in the Operating and Service Manuals for the display units.

OPERATING PRECAUTIONS

MAXIMUM RF POWER. Do not apply more than 50 milliwatts of RF power to the Model 8411A inputs. Power in excess of 50 milliwatts may damage the frequency converter units.

MAXIMUM DC ON RF LINE. Steady state (dc) voltage on the inner conductor of the transmission line carrying signals to the Model 8411A must not exceed ±3 volts. Greater dc voltage prevents normal operation of the Model 8411A, and may damage the converter units.

This dc voltage limitation also applies when input signals are obtained from the Model 8740A Transmission Test Unit. With the Model 8741A and 8742A Reflection Test Units, however, the limitation does not apply because there is dc isolation between the main and secondary lines of the internal directional couplers.

STATIC DISCHARGE. Static electrical charge on cables being connected to the Model 8411A inputs can damage the converter units. Before a cable is connected to the Model 8411A it should be discharged by momentarily touching its inner conductor to the outer parts of the Model 8411A input connector. Another way to prevent static discharge is to first connect the input end of the cable to a discharge path such as that provided by the output termination of a signal source. There is no risk of static discharge when connections are made directly to Model 8740A, 8741A, or 8742A Test Units because internal terminations provide discharge paths.

Table 1-1. Models 8410A and 8411A Specifications

BASIC NETWORK ANALYZER SYSTEM (8410A/8411A)

Instrument Type: Measures relative amplitude and phase of two RF input signals; choice of two plug-in display modules for meter readout (8413A) or for CRT polar display (8414A).

Frequency Range: 0.11 to 12.4 GHz.

Tuning: Automatic over octave band selected by front panel switch.

Swept Frequency Measurements: Automatically tunes to input frequency and tracks over octave bands. Sweep reference input accepts voltage proportional to input frequency for best tracking.*

Input Impedance: 50Ω SWR < 1.5, 0.11 to 6.0 GHz; < 2.0, 6.0 to 12.4 GHz; connectors precision 7 mm coax (APC-7).®

Channel Isolation: > 65 dB, 0.11 to 6.0 GHz; > 60 dB, 6.0 to 12.4 GHz.

Drift:
With 8413A
Amplitude:
Log: < ±0.05 dB/°C
Linear: < ±5 mV/°C
Phase: < ±0.1°/°C
With 8414A
CRT, < ±0.2 mm/°C; auxiliary outputs, < ±10 mV/°C

AMPLITUDE

Range:
Reference Channel: 20 dB range between -16 to -44 dBm (≈22 to 2.2 mV); meter indicates proper range. 20 dB variation causes less than 1.5 dB and 4° change in amplitude and phase readings.
Test Channel: -10 to -76 dBm (≈71 mV to 18 μV); not to exceed reference channel power by more than 20 dB.

Maximum RF Input to Either Channel: 50 mW (damage level).

Maximum dc on RF Line: ±3V (damage level).

Amplitude Control: Adjusts gain of test channel relative to reference channel.

Range: 60 dB total in 10- and 1-dB steps; vernier provides continuous adjustment over at least 2 dB.

Accuracy: ±0.1 dB per 10-dB step. ±0.05 dB per 1-dB step. Maximum cumulative ±0.2 dB.

Frequency Response: Reference and test channels typically track within ±0.3 dB in any octave 0.11 to 6.0 GHz; ±0.4 dB, 6.0 to 12.4 GHz.

Noise: Less than -70 dBm equivalent input noise (measured on 8413A Meter).

Drift: ±0.05 dB per degree C.

PHASE

Range: 0 to 360°.

Control: Vernier provides continuous phase reference adjustment over at least 90°.

Frequency Response: Reference and test channels typically track within ±1° in any octave 0.11 to 12.4 GHz within ±2°, 6.0 to 12.4 GHz. (Includes 8410A/8411A response only.)

Drift: < ±0.1° phase per degree C.

GENERAL

Outputs: Two rear-panel auxiliary outputs provide 270-kHz IF signals; outputs may be used for signal analysis, special applications, and convenient test points; modulation bandwidth nominally 10 kHz.

Reference Channel IF: 2 volts peak-to-peak.

Test Channel IF: 10 volts peak-to-peak or less, depending on signal level and test channel gain setting.

Sweep Reference Input: Accepts dc voltage proportional to frequency for optimum swept-frequency operation; compatible with 0- to 40-volt per octave (nominal) sweep reference output of 8690-series Sweep Oscillators.*

Power: 115 or 230 volts ±10%, 50 to 60 Hz, 70 watts (includes 8411A).

Weight: 8410A, 34 lb. (15,2 kg); 8411A, 6-1/4 lb. (2,8 kg).

Dimensions: 8410A, 7 in. high, 6-3/8 in deep, 16-3/4 in. wide (17,8 x 21,3 x 42,5 cm); 8411A, 2-5/8 in. high, 5-5/8 in. deep, 9 in. wide (6,6 x 14,3 x 22,9 cm), exclusive of connectors; 5-ft. cable permanently attached for connection to 8410A.

*HP 690- and 8690-series Sweep Oscillators supply sweep reference voltage. 8690 voltage is useable directly, 690-series Oscillators require a simple resistive divider. See Paragraph 1-69.

®Registered trademark, Amphenol RF Div., Danbury, Connecticut.

1-9. INSTRUCTIONS FOR MAKING MEASUREMENTS.

1-10. Step-by-step instructions for making basic transmission and reflection measurements with display and test units are included in the Operating and Service Manuals for the Model 8413A Phase-Gain Indicator and the Model 8414A Polar Display.

1-11. NETWORK ANALYZER APPLICATIONS.

1-12. Use of the network analyzer system for various kinds of transmission and reflection measurements is described in Hewlett-Packard Application Note 02, Network Analysis at Microwave Frequencies. Complimentary copies of this note are available at all Hewlett-Packard offices.

1-13. DESCRIPTIONS OF PANEL FEATURES.

1-14. Front and rear panel controls, connectors, and indicators are described in Figures 1-2 and 1-3. In these figures the numbers on the illustrations match the description numbers.

1-15. ACCESSORIES FURNISHED.

1-16. A detachable power cable, rack-mounting kit, servicing cable, and a sweep oscillator modification kit are supplied with Model 8410A. No accessories are furnished with the Model 8411A.

1-17. HELIX FILTER KIT.

1-18. Each modification kit contains parts and instructions for a simple component addition to HP 690- and 8690-series Sweep Oscillators. The modification improves network analyzer tracking stability for swept-frequency measurements and is intended for oscillators that operate in the 1- to 12.4-GHz range.

1-19. RACK-MOUNTING KIT.

1-20. The rack-mounting kit contains all the hardware needed for adapting the Model 8410A cabinet for installation in equipment racks having standard 19-inch spacing. Instructions for conversion to rack-mounting are included with the kit.

1-21. SERVICING CABLE.

1-22. The servicing cable permits all necessary interconnections to be made between the Model 8410A and a plug-in display unit with the unit outside the plug-in compartment.

1-23. ACCESSORIES AVAILABLE.

1-24. ACCESSORY KIT.

1-25. A kit containing an assortment of the line sections, adapters, shorts, and attenuators, together with special APC-7 connector tools and replacement inner conductor contacts, is available from Hewlett-Packard as Accessory No. 11667A. (See Figure 1-4.) The kit consists of the items listed in Table 1-2 and is housed in a sturdy plastic container that has storage space for additional accessories.

Table 1-2. Components of Accessory Kit No. 11667A

Quantity	Description	HP Part Number
1	10-cm Air Line	11666A
1	20-cm Air line	11667A
2	APC-7 to N Female Adapter	11524A
2	APC-7 to N Male Adapter	11525A
2	10-dB Fixed Coaxial Attenuators	8492A Option 10
1	30-dB Fixed Coaxial Attenuators	8492A Option 30
1	N Female Coaxial Short	11511A
1	N Male Coaxial Short	11512A
1	Open End Wrench 9/16" x 1/2"*	8710-0877
1	Contact Extractor Tool*	5060-0236
1	Spanner Wrench*	5060-0237
5	Replacement APC-7 Inner Conductor Contacts	1250-0007
*APC-7 Connector Tools		

1-26. APC-7 CONNECTOR TOOL KIT.

1-27. The APC-7 Connector Tool Kit No. 11591A contains all of the special tools needed to service APC-7 connectors. The kit is housed in a durable plastic container and consists of the items listed in Table 1-3.

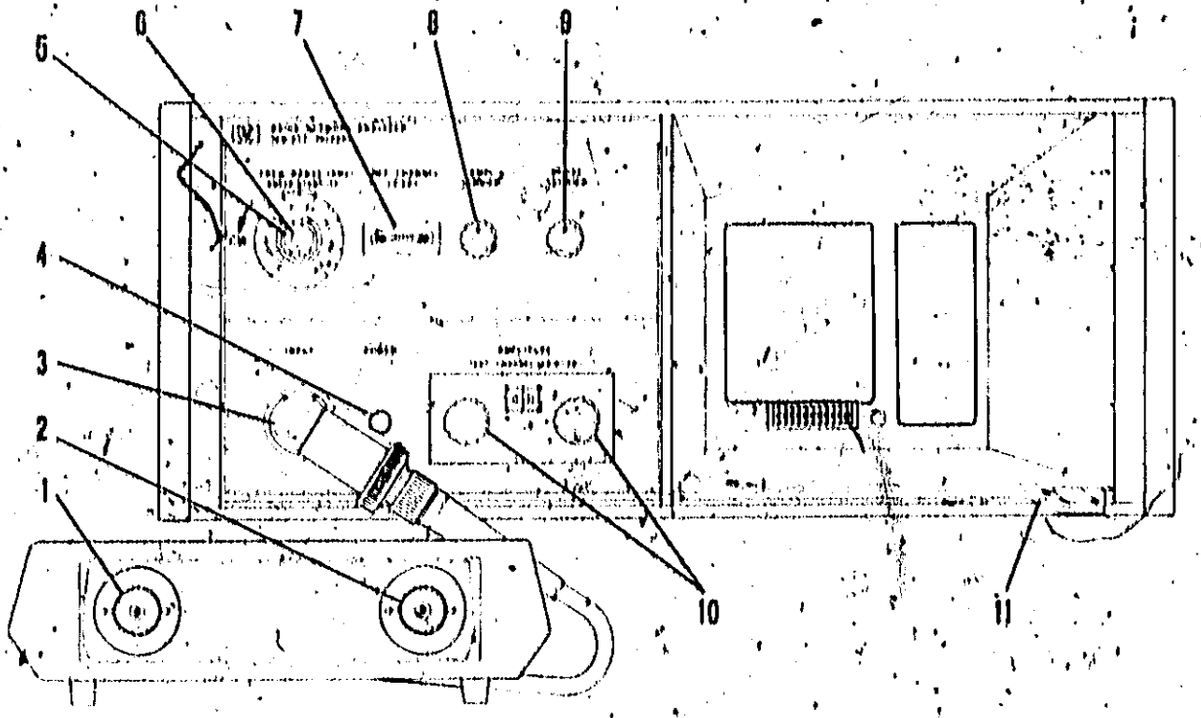
1-28. ADAPTERS.

1-29. Table 1-4 lists adapters available to accommodate some of the most common connector types.

Table 1-3. Components of APC-7 Connector Tool Kit No. 11591A

Quantity	Description	HP Part Number
1	Contact Extractor	5060-0236
1	Spanner Wrench	5060-0237
2	1/2" x 9/16" Open End Wrench	8710-0877
2	Pin Vise	8710-0032
5	Inner Conductor Contact	1250-0007

FRONT PANEL CONTROLS



1. TEST. Test channel input. Impedance 50 ohms. Frequency range: 0.11-12.4 GHz. Input power: -10 dBm maximum, not to exceed reference channel power by more than 20 dB. Dynamic range: at least 60 dB. Admits frequency to which reference channel is tuned. Connector is Amphenol precision APC-7. [1,2]

2. REFERENCE. Reference channel input. Impedance: 50 ohms. Frequency range: 0.11-12.4 GHz. Internal auto-tuning tunes and tracks REFERENCE and TEST channel inputs to the frequency of the REFERENCE input over octave bands. Required input levels lie in a 20 dB range between -16 and -44 dBm. Input power is in this range when the REF CHANNEL LEVEL meter indicates in the OPERATE region. Range of OPERATE region is between 12 and 20 dB. Connector is Amphenol precision APC-7. [1,2]

INPUT PRECAUTIONS

- Maximum input power: 50 mW (damage level).
- Maximum dc on RF line: ±3 volts (damage level).
- Static Discharge: Static charge on cables being connected to the input can damage the Model 8411A.
- Do not twist the inner conductor.

Figure 1-2. Front Panel Features (Sheet 1 of 2)

3. INPUT, 8410A connector mates with 8411A Harmonic Frequency Converter cable.

4. POWER. Combination line power switch and power indicator. Pushbutton glows when instrument is on. Pushbutton retainer unscrews for lamp replacement (Paragraph 1-110).

5. FREQ RANGE (GHz). Coarse tuning control. Sets range of the automatic tuning to the frequency range selected. Selected range must include the frequency (or frequencies) at which measurements are to be made.

6. SWEEP STABILITY. Fine tuning control. Adjusts for best automatic tuning. A CW detent at the fully counterclockwise position gives best auto-tuning for single frequency CW-mode operation.

7. REF CHANNEL LEVEL. Meter indicates amplitude of signal applied to Model 8411A reference channel input. Pointer should be in OPERATE region for all phase and amplitude measurements.

8. AMPLITUDE VERNIER. Uncalibrated test channel gain vernier with at least 2 dB continuous range. Gain increases with clockwise rotation.

9. PHASE VERNIER. Continuous control for changing relative phase of reference and test channel signals. Range is at least 90°, uncalibrated.

10. AMPLITUDE. Precision 60 dB test channel gain control. Left hand control has 0 to 60 dB range in 10-dB steps. Right hand control has 0 to 9 dB range in 1-dB steps.

11. Pivoting lever installs, retains, and extracts plug-in display units.

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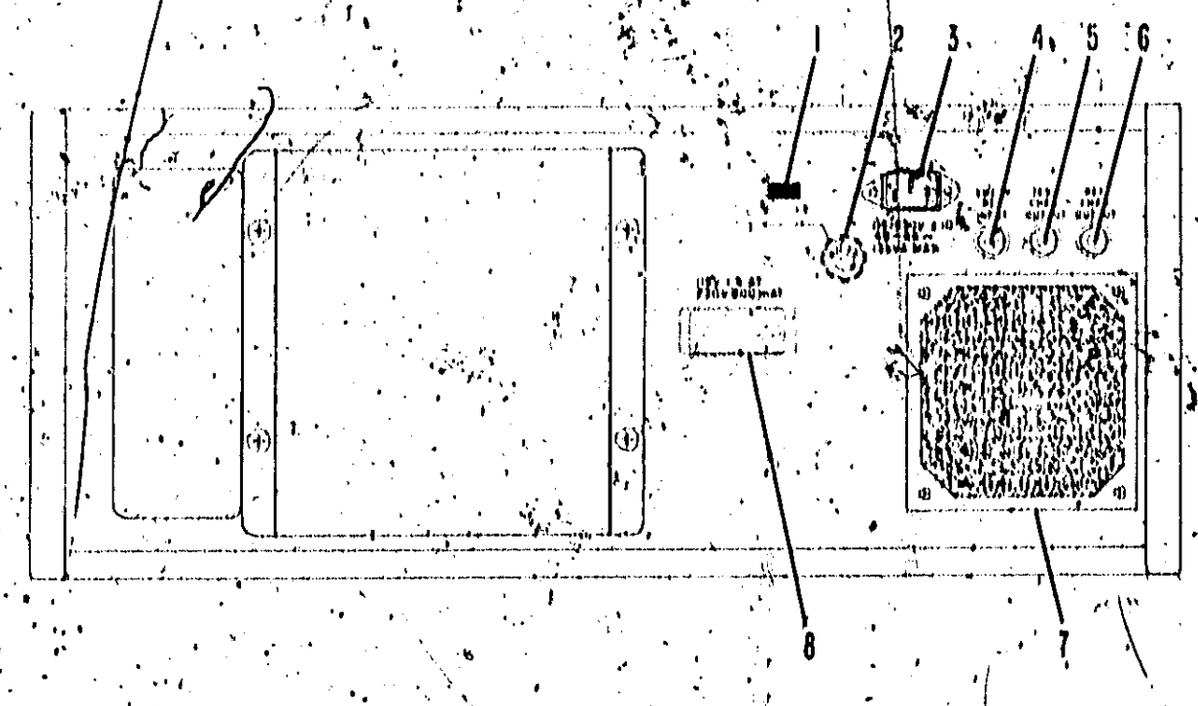
[1] See Paragraph 1-107 for important instructions and information on the use and care of APC-7 connectors.

[2] Protect critical contacting surfaces by leaving the coupling sleeve extended when connectors are not in use.

Figure 1-2. Front Panel Features (Sheet 2 of 2)

REAR PANEL FEATURES



1. Line Voltage Selector. Permits operation from 115 or 230 Vac. Number showing on slider is selected operating voltage. Adjacent number on panel is correct line fuse rating.

2. Power line fuseholder. Fuse should have rating shown adjacent to number on line voltage selector.

3. Power Cable Connector. NEMA type with offset pin connected to 8410A cabinet. Power requirements: 115 or 230 Vac ±10%, 48 to 66 Hz, approximately 85 watts with HP 8413A, 105 watts with HP 8414A.

4. SWEEP REF INPUT. Accepts a voltage proportional to reference channel input frequency. Voltage enables auto-tuning to track fast sweeping input frequencies. Nominal 0 to +40 volts per octave[1] from 20K ohms ±20% source impedance required. The lower voltage must coincide with the lowest input frequency. HP 690 and 8690 Sweep Oscillators furnish suitable reference voltages.[2] SWEEP REF INPUT voltage must be provided when sweep mode selected is from high frequency to low frequency at any sweep speed.

5. TEST CHAN OUTPUT. 278 kHz sine wave. Amplitude depends upon the amplitude of the test channel RF input and the settings of the front-panel TEST CHANNEL GAIN (dB) and AMPL VERNIER controls. Amplitude range is 0 to about 10 volts p-p.

6. REF CHAN OUTPUT. 278 kHz sine wave with amplitude fixed at about 2 volts p-p nominal when REF CHANNEL LEVEL meter reads in the OPERATE region.

7. Air Intake Filter. Clean regularly. Do not obstruct air flow.

8. Serial Number Plate. Eight-digit serial number should be included in any correspondence concerning the Model 8410A.

[1] Swept frequency measurements can be made over somewhat wider frequency ranges than indicated by the FREQ RANGE (GHz) selector provided the sweep reference voltages cover the required ranges. See Tables 1-6 and 1-7 for details.

[2] 600-series Oscillators need dividers for sweep reference output, and internal dividers of 8690 Oscillators should be checked. See Tables 1-6 and 1-7.

Figure 1-3. Model 8410A Rear Panel Features

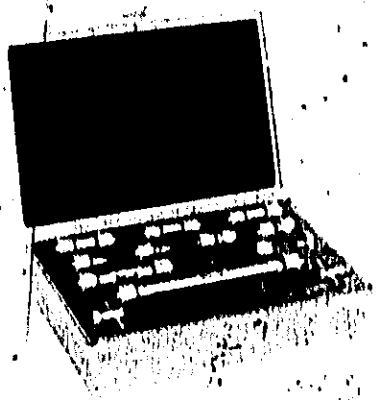


Figure 1-4. Accessory Kit No. 11667A

Table 1-4. Adapters

Adapter	Manufacturer	Model Number
APC-7 to N female	1	11524A
APC-7 to N male	1	11525A
APC-7 to OSM male	1	11533A
APC-7 to OSM female	1	11534A
APC-7 to BNC	2	
APC-7 to TNC	2	
APC-7 to GR900	2	
APC-7 to GR874	2	
APC-7 to NPM	3	

1. Hewlett-Packard
2. Amphenol RF Division, Danbury, Connecticut
3. Narda Microwave Corp., Long Island, N.Y.

1-30. FIXED COAXIAL ATTENUATORS.

1-31. Fixed coaxial attenuators are useful for reducing mismatch ambiguities, reducing power to safe levels for power-sensitive devices, and improving signal-to-noise ratio for wide range attenuation measurements.

1-32. 8402A Series. These attenuators have APC-7 connectors, and can be used from dc to 18 GHz. Their nominal attenuation values are listed in Table 1-5.

1-33. 8491A Series. These attenuators have one male and one female type N connector, and can be used from dc to 12.4 GHz. Their nominal attenuation values are the same as listed in Table 1-5 for the 8402A series.

Table 1-5. HP 8402A Series Attenuators

Option Number	Attenuation	SWR (up to 12.4 GHz)
003	3 dB	1.31
006	6 dB	1.31
010	10 dB	1.20:1
020	20 dB	1.35:1
030	30 dB	1.25:1

1-34. LINE LENGTHS.

1-35. Rigid, air dielectric, coaxial line sections of 10 and 20 centimeters are available for making transmission measurements on devices physically longer than the 10-cm extension of the Model 8740A. These line sections, designated 11666A for the 10-cm length and 11667A for the 20-cm length, have APC-7 connectors.

1-36. LOADS.

1-37. Fixed Load. The Model 909A or 909B is a 50-ohm coaxial termination with APC-7 connector for use with the Models 8741A and 8743A Reflection Test Units.

1-38. Sliding Load. The Model 905A or 907A is a movable load in a 50-ohm coaxial line that has an APC-7 connector. The load is useful for improving the accuracy of reflection measurements above 1.0 GHz.

1-39. SHORTS.

1-40. The 11511A Type N Shorting Jack, the 11512A Type N Shorting Plug, and 11666A APC-7 short can be used with the reflection test units for calibrating reflectometer measurements.

1-41. DISPLAY UNITS.

1-42. All plug-in display units designated for use with the Model 8410A are completely interchangeable. These units are powered by the Model 8410A with all necessary interconnections made automatically when the unit is properly installed.

1-43. Model 8412A Phase-Magnitude Display. Intended for fixed- and swept-frequency transmission or reflection measurement, the Model 8412A provides phase and amplitude information on an oscilloscope. Phase can be displayed at 1, 10, 45, and 90 DEG Division. A phase offset switch offsets the display in 20 degree steps from -180 degrees to +180 degrees. Magnitude can be displayed at 0.25, 1, 0, 2.5, and 10 dB Division. Analog voltages for both phase and magnitude are available at rear output jacks. The analog voltages can be used to obtain calibrated plots of phase angle and amplitude ratio against frequency on graphic recorders.

1-44. Model 8413A Phase-Gain Indicator. Intended for fixed- and swept-frequency transmission or re-

function measurements, the Model 8413A provides phase and amplitude information in two forms: meter indication, and analog voltage. The meter indicates phase or amplitude according to the function selected, while the analog voltages continuously monitor both phase and amplitude. The meter has center-zero scales with phase ranges of ±5°, ±10°, ±60°, and ±180° and amplitude ranges of ±3, ±10, and ±30 dB. Calibrated phase offsets in 10 degree steps allow any phase angle to be read on the most-resolution-range of ±5°. The analog voltages can be used to obtain calibrated plots of phase angle and amplitude ratio against frequency on conventional two-trace oscilloscopes or graphic recorders.

1-45. Model 8414A Polar Display. The Model 8414A is used for transmission (gain, attenuation) and for reflection measurements (impedance, admittance, reflection coefficient, return loss). It displays amplitude and phase in polar form on a built-in cathode ray tube, and provides simultaneous voltages proportional to the amplitude and phase components of the display. Frequency marker and blanking signals from HP 8690- and 800-series Sweep Oscillators can be applied to the Model 8414A. Marker signals spot-intensify the trace for frequency reference, while blanking signals eliminate the trace in-between sweep intervals when there is no RF power. Supplied Smith Chart graticule overlays permit impedance and admittance to be read directly from the display.

1-46. A ground modification has been made on the Model 8414A plug-in that affects interchangeability between the units. Table 1-5A shows the units that will work together. As shown in the table, modification kit no. HP 08414-6022 may be added to the 8414A with serial numbers 740-00215 and below to make it compatible with any 8410A.

Table 1-5A. Models 8410A and 8414A Compatibility by Serial Number

8414A	Mates with 8410A
802-00216 and above	All
740-00215 and below	804-00100 and below only
740-00215 and below with HP Part No. 8414-6022 Modification Kit installed.	All

1-47. AUXILIARY EQUIPMENT

1-48. TRANSMISSION AND REFLECTION TEST UNITS.

1-49. For added convenience in making transmission and reflection measurements, auxiliary signal-separating units are available. These compact, portable modules contain the passive devices required to divide a test signal into two signals for amplitude and phase comparison.

1-50. Model 8740A Transmission Test Unit. The transmission test unit divides a test signal into the two channels required for transmission measurements. It includes a calibrated line stretcher and a calibrated extension line with separate digital counters for measuring the mechanical and electrical lengths of the network being tested. APC-7 output connectors on the measuring channels are spaced to match the inputs of the Model 8411A Harmonic Frequency Converter. The test unit covers the entire frequency range of the network analyzer.

1-51. Models 8741A and 8742A Reflection Test Units. Two reflection test units cover the frequency range of the network analyzer. Model 8741A spans 0.11 to 2 GHz, and the Model 8742A covers 2 to 12.4 GHz. They contain broadband directional couplers and a calibrated line stretcher. The line stretcher is for equalizing the electrical distance from the test signal input to the incident and reflected signal outputs. It can also be used to move the plane of measurement as much as 14 cm for the Model 8741A and 16.5 cm for the Model 8742A. A digital counter registers line length with 0.1 mm resolution. APC-7 connectors are used on the test unit output ports, compatible type N are the input port. An HP Stock No. 11505A APC-7 short is furnished accessory with each 8741A and 8742A.

1-52. Model 8749A Reflection-Transmission Test Unit. This reflection-transmission test unit divides a signal into two channels for amplitude and phase comparison. Pushbuttons select either transmission or reflection measurement. It includes a line stretcher with a digital counter. This unit covers the frequency range from 2.0 to 12.4 GHz.

1-53. Models X8747A/P8747A Transmission and Reflection Test Unit. This waveguide transmission and reflection test unit divides a test signal into two channels for amplitude and phase comparison. This unit permits testing waveguide components with the coaxial network analyzer. It includes a calibrated line stretcher. The X8747A covers from 8.2 to 12.4 GHz, while the P8747A covers from 12.4 to 18.0 GHz. A special option 8410A is necessary to operate in P-band.

1-54. Models K8747A/R8747A Transmission and Reflection Test Unit. This waveguide transmission and reflection test unit divides a test signal into two channels for amplitude and phase comparison. This unit permits testing waveguide components with the coaxial network analyzer. It includes a calibrated line-stretcher. The K8747A covers the 18 to 26.5 GHz band in frequency segments up to 2 GHz wide, while the R8747A covers the 26.5 to 40 GHz band in 2 GHz segments.

1-55. Model 8745A S-Parameter Test Set. The most convenient way to measure s-parameters in the 0.1 to 2 GHz frequency range is with the HP Model 8745A S-Parameter Test Set. This test set combines in one unit all the coaxial switches, directional couplers, bias networks, and signal-path-length compensators (line stretchers) that are required for s-parameter meas-

arrangements. Initially, the device being tested, an RF cable(s), and a detector such as the network analyzer must be connected to the test set. After a simple calibration, all four s-parameters can be measured without disconnecting and reconnecting the device under test. Measurement circuits are automatically connected and powered by pressing the appropriate front-panel pushbutton or by applying the appropriate digital remote control signal. This remote control capability makes the test set completely programmable for automatic testing.

1-56. Model 87401D S-Parameter Test Set. The HP Model 87401D contains the necessary microwave circuits for measuring all four s-parameters of an active or passive two-port device from 0.5 to 12.4 GHz. The Model 87401D is designed primarily to be used with the Hewlett-Packard Model 11608A Transistor Fixture, however, measurements on other microwave devices may also be made by inserting the necessary coaxial line-lengths in the rear panel reference line. Measuring circuits for each s-parameter are automatically set with front-panel pushbuttons or with remote-contact closures. Attenuation of the incident RF signals, in 10-dB steps, can also be set with front-panel pushbuttons or with remote contact closures.

1-57. Accessories are available which suit various kinds of two-port devices. The 11604A Universal Extension, with its pivoting air-line extensions and swivelling connectors, allows many kinds of non-axial connector devices to be connected to the test set. The 11600B and 11602B Transistor Fixtures adapt the test set ports for measurements of transistors. The 11600B is for TO-18/TO-72 base patterns, and the 11602B is for TO-5/TO-12 base patterns. The fixtures mount on the front of the test set. Measurements can be made on both bipolar and FET transistors in all of their common operating configurations, using the snap-on dials furnished with the fixture to accomodate the various lead orientations. Terminals are provided on the test set to apply and sense dc bias. The fixtures and their dials can also be used to make measurements on components such as capacitors, inductors, and diodes.

1-58. SIGNAL SOURCE REQUIREMENTS.

1-59. OUTPUT POWER.

1-60. RANGE. About -6 to +16 dBm (0.1 to 50 mW) is adequate for both wide range attenuation measurements and reflection measurements.

1-61. STABILITY. Output power must be constant enough across the frequency range being swept to hold an OPERATE indication on the REF CHANNEL LEVEL meter. The REF CHANNEL LEVEL meter gives an OPERATE indication over a range of 12 to 20 dB, depending on the 8410A. The power limits of this range vary from analyzer to analyzer but lie between -16 and -44 dBm.

1-62. SIGNAL PURITY.

1-63. To prevent the analyzer from mistuning, spurious signal output should be at least 20 dB below the desired frequency.

1-64. FREQUENCY STABILITY.

1-65. Of chief importance to the tuning and tracking of the network analyzer are the influences on frequency stability and rate of change of frequency. Among these are residual FM and susceptibility to radiated interference, power line conducted interference, and power line transients.

1-66. SWEEP CHARACTERISTICS.

1-67. Swept signal sources should have uniform tuning rate and sweeping time that is variable between about 15 and 150 MHz per millisecond. RF blanking should not be used in order to keep the network analyzer in phase lock during retrace. An additional important requirement is a pause between sweeps. There should be at least a 3 millisecond pause at the start frequency prior to each sweep in order to allow the network analyzer to lock initially.

1-68. FREQUENCY-RELATED VOLTAGE OUTPUT.

1-69. For fastest swept-frequency measurements, the signal source should furnish a voltage proportional to output frequency. This voltage enables the network analyzer to track at its highest rate, and is particularly important for down-sweeping and for sweeping wider frequency ranges than those marked on the FREQ RANGE (GHz) selector. Requirements for the voltage are positive polarity and range of 40 volts per frequency octave with the lowest voltage corresponding to the lowest frequency. Hewlett-Packard 600- and 8600- series Sweep Oscillators furnish frequency-related voltage that is adaptable for use with the network analyzer. See Paragraph 1-71 for details.

1-70. ADAPTING HEWLETT-PACKARD SWEEP OSCILLATORS FOR USE WITH THE NETWORK ANALYZER.

1-71. SWEEP REFERENCE OUTPUT DIVIDERS.

1-72. Hewlett-Packard 600- and 8600-series Sweep Oscillators furnish a voltage proportional to output frequency that is required by the Model 8410A for fast swept-frequency measurements. With 600-series Oscillators, a simple resistive divider is required to reduce the voltage range to that required by the Model 8410A. This divider can be permanently installed in the oscillator or used externally. HP8600-series Oscillators have built-in dividers, but the values of resistance should be checked. This check is especially important for oscillators that do not cover standard frequency ranges. The details of wiring and resistance values for internal and external dividers to be used with 600-series oscillators and correct values for the internal resistors in 8600-series Oscillators are given in Tables 1-6 and 1-7.

1-73. EXTERNAL LOW-PASS FILTER.

1-74. Low-pass or bandpass filters should be connected to the RF output of 600- and 8600-series Sweep Oscillators to eliminate the possibility of harmonics interfering with measurements.

Table 1-6. Sweep Reference Output Voltage Requirements from HP 8600-series Sweep Oscillators

To ensure proper sweep reference output, the HP 8600-series Sweep Oscillators should be disconnected from 8410A and checked at the high-frequency end for the open circuit voltage listed. If the voltage is incorrect, change A1R36 and A1R37 to the values listed.

Model	Frequency Range (GHz)	Voltage Divider Values	Open Circuit Voltage Required at High-Frequency End
8601A 8601B	1 - 2	A1R36: 42.2K A1R37: 56.2K	+40V
8602A 8602B	2 - 4	A1R36: 42.2K A1R37: 56.2K	+40V
8602C	2 - 4	A1R32: 61.1K A1R34: 42.2K	+41 to +42V
8609B	2 - 4 (no sweep ref. 1-2)	A1R32: 61.1K A1R34: 42.2K	+41 to +42V
8602B Opt. 100	1.7 - 4.2	A1R36: 34.0K A1R37: 90.0K	+50V
8603A 8603B	4 - 8	A1R36: 42.2K A1R37: 56.2K	+40V
HP1-8603B	3.7 - 8.3	A1R36: 36.3K A1R37: 76.0K	+46V
8604A 8604B	8 - 12.4	A1R36: 82.5K A1R37: 36.3K	+22V
8604A Opt. 100 8604B Opt. 100	7 - 12.4	A1R36: 56.2K A1R37: 46.4K	+31V
8604A Opt. 200 8604B Opt. 200	7 - 11	A1R36: 76.0K A1R37: 36.3K	+23V

1-75. HELIX FILTER.

1-76. A simple, easily installed filter for the BWO tube helix circuit of all 680- and 8600-series Sweep Oscillators improves tracking stability for swept-frequency measurements. One filter kit, HP Stock Number 08600-6020, is shipped with each 8410A instrument.

1-77. POWER-LINE FILTER.

1-78. An external filter connected in series with the ac power cable is recommended for all Sweep Oscillators to reduce susceptibility to power line conducted interference that can cause frequency modulation on the RF output.

1-79. INITIAL MECHANICAL INSPECTION.

1-80. If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the instrument for external damage such as broken controls or connectors, and dents or scratches on the panel surface. If damage is evident, refer to Paragraph 1-83 for recommended claim procedure and repackaging information. If the shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. If the instrument appears undamaged, check for all supplied accessories, then perform the electrical check (paragraph 1-81).

1-81. INITIAL ELECTRICAL INSPECTION.

1-82. Check the electrical performance of the network analyzer as soon as possible after receipt by performing the Calibration Test (Figure 2-1). The Calibration Test procedure compares the electrical performance to the specifications of Table 1-1. This test is also suitable for incoming quality control inspection. If the network analyzer does not perform within the specifications when received, refer to Paragraph 1-83 for recommended claim procedure and Paragraph 1-85 for repackaging information.

1-83. CLAIMS.

1-84. If physical damage is evident, or if the instrument does not meet specifications when received, notify the carrier and the nearest Hewlett-Packard Sales and Service Office. (See list at rear of manual.) The Sales and Service Office will arrange for repair or replacement without waiting for settlement of a claim with the carrier.

Table 1-7. Sweep Reference Output Voltage Requirements from HP 690-series Sweep Oscillators

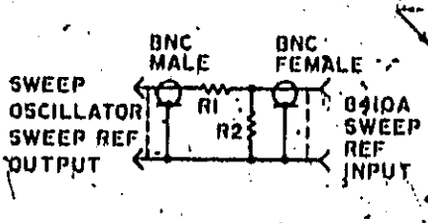
Sweep Reference output voltage from the HP 690-series Sweep Oscillators should be disconnected from 8410A and checked at the high-frequency end for the open-circuit voltage listed. If the voltage is incorrect, add either the external or internal voltage divider shown in the note.

Model	Frequency Range (GHz)	Voltage Divider Values (see note)	Open Circuit Voltage Required at High-Frequency End
691A 691B 691C 691D	1 - 2	R1: 42.2K R2: 46.2K	+40V
692A 692B 692C 692D	2 - 4	R1: 42.2K R2: 56.2K	+40V
H01-692A H01-692B H01-692D	1.7 - 4.2	R1: 34.0K R2: 60.0K	+30V
693A 693B 693C 693D	4 - 8	R1: 42.2K R2: 56.2K	+40V
H01-693A H01-693B H01-693D	3.7 - 8.3	R1: 38.3K R2: 75.0K	+40V
694A 694B 694C 694D	8 - 12.4	R1: 82.5K R2: 30.3K	+22V
H01-694A H01-694B H01-694C H01-694D	7 - 12.4	R1: 56.2K R2: 46.4K	+31V

NOTE

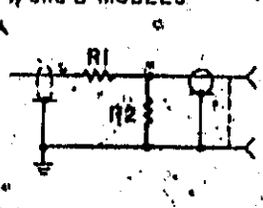
Details of Sweep Reference Output Dividers for 690 series Sweep Oscillators. Resistor designators are for correlation with above table only. Resistors are 1/8W 1% metal film.

EXTERNAL DIVIDER

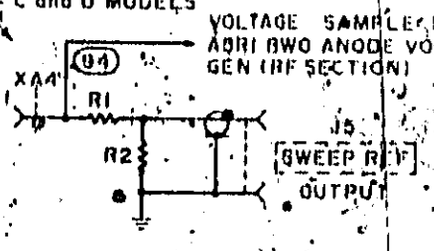


INTERNAL DIVIDERS (shaded areas show added parts)

A and B MODELS



C and D MODELS



1-85. REPACKAGING FOR SHIPMENT.

1-86. USING ORIGINAL PACKAGING.

1-87. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard offices listed at the rear of this manual. If the Model 8410A or Model 8411A is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

1-88. USING OTHER PACKAGING.

1-89. The following general instructions should be used when repackaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard service office or center, attach a tag indicating the type of service required, the return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely, and mark it FRAGILE to assure careful handling.

e. In any correspondence refer to the instrument by model number and full serial number.

1-90. PREPARATION FOR USE.

1-91. POWER REQUIREMENTS.

1-92. The Model 8410A - 8411A combination requires a power source of 115 or 230 volts ac ±10%, 50 to 60 Hz, single phase, that can supply approximately 65 watts when the Model 8413A Phase-Gain Indicator plug-in is installed, approximately 105 watts when the Model 8414A Polar Display plug-in is installed.

1-93. SELECTING 115- OR 230-VOLT OPERATION.

1-94. A two-position slide switch on the rear panel of the Model 8410A permits operation from either a 115- or 230-volt power source. The number showing on the switch slider indicates the voltage for which the instrument is connected. The correct line fuse rating for each line voltage is marked next to the switch.

1-95. To prepare the Model 8410A for operation, position the 115-230 volt switch so that the number showing on the slider corresponds to the available line voltage, and install a line fuse of correct rating. "Slo-Blo" fuses should be used. Hewlett-Packard stock numbers for these fuses are given under F1 in the Table of Replaceable Parts.

CAUTION

To avoid damage to the instrument, set the 115-230 switch to the line voltage to be used before connecting the power cable.

1-96. POWER CABLE.

1-97. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. Accordingly, the Model 8410A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds panel and cabinet. The offset pin of the three-prong connector is the grounding pin.

1-98. When operating the Model 8410A from a two-contact outlet, the protecting feature may be preserved by using a three-prong to two-prong adapter (HP Stock No. 1251-0048) and connecting the green wire of the adapter to ground.

1-99. BENCH OPERATION.

1-100. The Model 8410A cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The stand inclines the instrument enough to make the panel features easy to see. The plastic feet provide clearance for air circulation and make the Model 8410A self-aligning when stacked on other Hewlett-Packard full rack-width modular instruments.

1-101. RACK MOUNTING.

1-102. Preparation for rack-mounting is illustrated in Figure 1-5. All necessary hardware is contained in the supplied rack-mounting kit (HP Stock No. 5060-0776).

1-103. CONNECTING THE MODEL 8411A.

1-104. To connect the Model 8411A to the Model 8410A:

a. Set the Model 8410A LINE to off (push-button not lighted).

b. Hold the Model 8411A cable connector so that the head of the screw in the connector body enters the slot in the top of the Model 8410A INPUT connector and push the connectors firmly together.

c. Tighten the coupling ring securely.

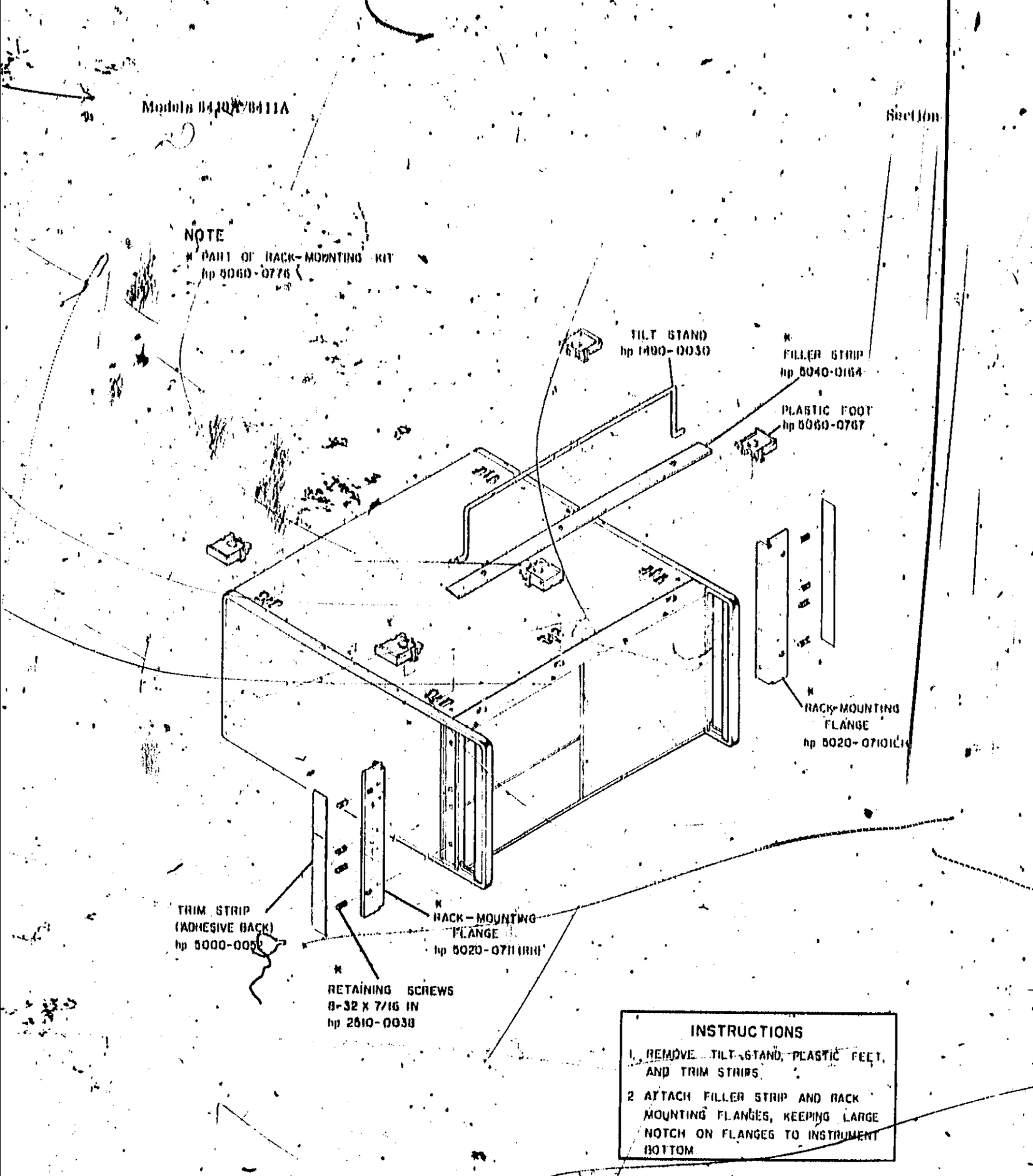


Figure 1-6. Rack-Mounting Kit Installation

1-105. INSTALLING A DISPLAY UNIT.

1-106. To install a plug-in display unit:

a. Set Model 8410A LINE switch to off (push-button not lighted).

b. Press down on the extractor-retainer lever latch and swing the lever outward to its mechanical stop.

c. Rest the rear feet of the display unit on the bottom of the plug-in compartment, then slide the plug-in toward the back of the compartment until the extractor-retainer lever starts to move.

d. Pivot the extractor-retainer lever back to its closed and latched position. All necessary electrical connections between the display unit and Model 8410A are made automatically.

1-107. CARE OF INPUT CONNECTORS.

1-108. RF signals are coupled into the Model 8411A through 50-ohm, 7-mm Amphenol APC-7 coaxial connectors. These connectors should be handled with particular care for two main reasons: (1) continuity through APC-7 connectors is obtained by end-to-end contact of the inner and outer conductors; consequently, the electrical performance of the connector is largely dependent upon the condition of these exposed surfaces, and (2) the critical contacting surfaces are directly attached to the vital frequency converter units inside the Model 8411A and are not separately replaceable.

1-109. Important recommendations for the handling and care of the input connectors are given in Figure 1-6. The part of an input connector that is most likely to be damaged is the inner conductor contact. Since it protrudes slightly beyond the plane of electrical contact, any wiping action of one connector across the other can damage the contact enough to cause a discontinuity. The risk of this kind of damage can be minimized by always having the coupling sleeves on the Model 8411A connectors fully extended.

1-110. CONTACT REPLACEMENT.

1-111. Replacement inner conductor contacts are available from Hewlett-Packard (Stock Number 1250-0007), and from Amphenol RF Division, Danbury, Connecticut (Part Number 131-129).

1-112. The following important precautions apply to the replacement of inner conductor contacts:

a. Do not apply more than slight inward pressure to the inner conductor.

b. Do not apply ANY twisting force to the inner conductor.

c. Do not attempt to repair contacts.

d. Do not re-use contacts.

CAUTION

Inward pressure or twisting force applied to the inner conductor can render the Model 8411A inoperative.

1-113. Because of the above considerations, contact removal should not be attempted with ordinary hand tools. Only the Hewlett-Packard self-positioning, hypodermic-action contact extractor tool (Stock No. 5060-0236) should be used. This tool exerts no appreciable inward pressure and no twisting force on the inner conductor. Instructions for removing contacts are supplied with the tool.

1-114. No tool is required for installing a replacement contact. Insert the contact gently by hand, applying only enough inward pressure to snap it into place. Then check for proper installation by inspecting the contact for even spacing of its four segments. Also, test for normal spring action by applying light inward pressure against the end of the contact with a pencil eraser. As the pressure is released the spring action of the contact should cause it to move outward. If not, the contact is defective and should be replaced.

1-115. COUPLING MECHANISMS.

1-116. The coupling mechanism includes the coupling nut and the two-piece coupling sleeve assembly shown in Figure 1-6. Both of these parts can be replaced without access to the inside of the Model 8411A, and without disturbing either of the conductors. A special spanner wrench, HP Stock Number 5060-0237, is required. This wrench is included in Accessory Kit 11607A and APC-7 Connector Tool Kit 11601A.

1-117. To remove a coupling mechanism:

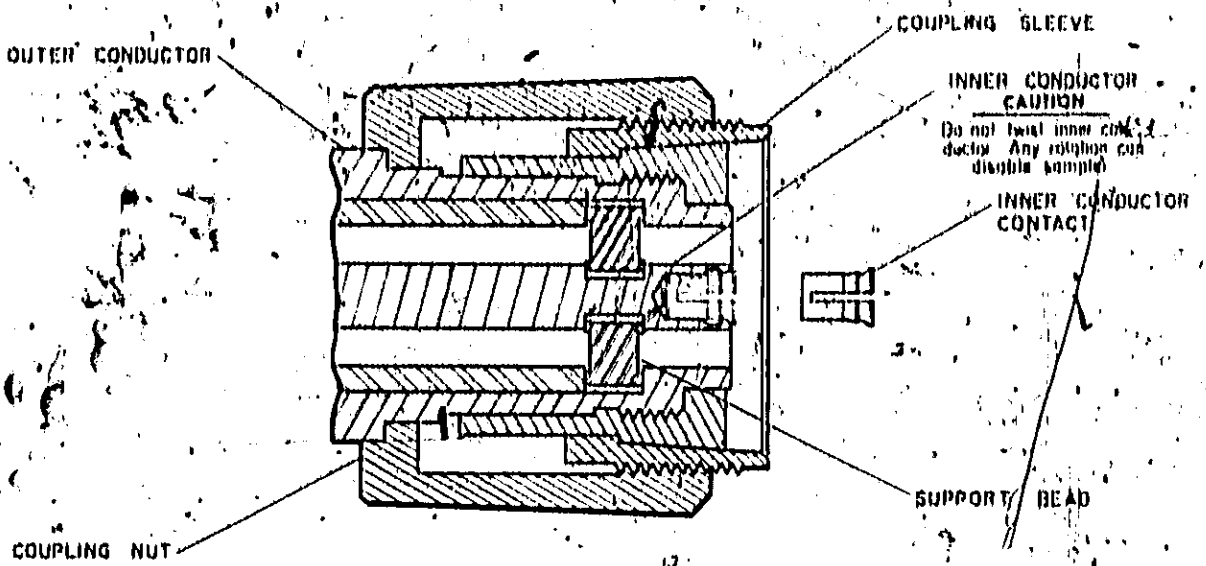
a. Fully extend the coupling sleeve to provide a guide for the spanner wrench.

b. Align the wrench so both pegs engage the holes in the end of the coupling sleeve assembly.

c. Pressing the wrench firmly against the connector, unscrew the sleeve assembly by turning the wrench counterclockwise.

1-118. When installing a coupling mechanism, set the coupling nut in place on the connector first, then thread on the coupling sleeve assembly and tighten it firmly with the spanner wrench. (Extending the coupling sleeve helps to keep the spanner in position during the final tightening.)

APC-7 CONNECTORS



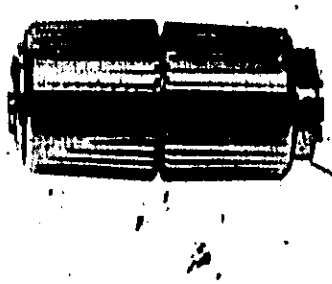
USE

To Connect:

1. On one connector, retract the coupling sleeve by turning the coupling nut counterclockwise until the sleeve and nut disengage.
2. On the other connector, fully extend the coupling sleeve by turning the coupling nut clockwise. To engage coupling sleeve and coupling nut when the sleeve is fully retracted, press back lightly on the nut while turning it clockwise.
3. Push the connectors firmly together, and thread the coupling nut of the connector with retracted sleeve over the extended sleeve. Leave the other coupling nut in the original position; closing the gap between coupling nuts tends to loosen the electrical connection.

To Disconnect:

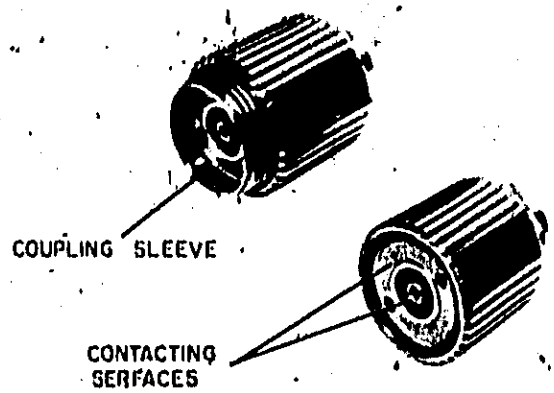
1. Loosen the coupling nut of the connector showing the wider gold band.



2. IMPORTANT: Part the connectors carefully to prevent striking the inner conductor contact.

CARE

1. Keep contacting surfaces smooth and clean. Irregularities and foreign particles can degrade electrical performance.



2. Protect the contacting surfaces when the connector is not in use by leaving the coupling sleeve extended.
3. Use lintless material and/or firm-bristled brush such as tooth brush for cleaning. If a cleaning fluid is needed use isopropyl alcohol. IMPORTANT: Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones, or ether-alcohols such as benzene, toluene, turpentine, dioxanne, gasoline, cellosolve acetate, or carbon tetrachloride. Keep exposure of the connectors parts to both the cleaning fluid and its vapors as brief as possible.

Figure 1-6. APC-7 Connectors

1-119. POWER SWITCH LAMP REPLACEMENT.

1-120. The lamp housed in the POWER switch push-button indicates that line power is applied to the Model 8410A. To replace the lamp, unscrew the retaining ring near the front panel, pull out the pushbutton, and remove the lamp. The HP Stock Number for a replacement lamp is listed under DS1 in the Table of Replaceable Parts.

1-121. INSTRUMENTS COVERED BY MANUAL.

1-122. Each Model 8410A and Model 8411A carries a two-section serial number. The two sections are separated by either a hyphen or a letter. The numbers in the first section are a prefix. The contents of this manual apply directly to the Models 8410A and 8411A which have the same serial number prefix(es) as listed after SERIALS PREFIXED on the title page.

1-123. Revisions required to adapt this manual to other serial number prefixes are given in a yellow Manual Changes insert supplied with the manual. For information concerning serial number prefixes not listed on the title page or in an insert, contact the nearest Hewlett-Packard office listed at the rear of this manual.

1-124. WARRANTY.

1-125. Terms of the warranty on the 8410A and all supplied accessories are described in the warranty on the front cover of this manual. For any additional information concerning warranty, contact the nearest Hewlett-Packard field office listed at the rear of this manual.

1-126. OPERATORS QUICK-CHECK PROCEDURE.

1-127. The following procedure checks the overall functional operation of the 8410A and 8411A system, but does not check calibration.

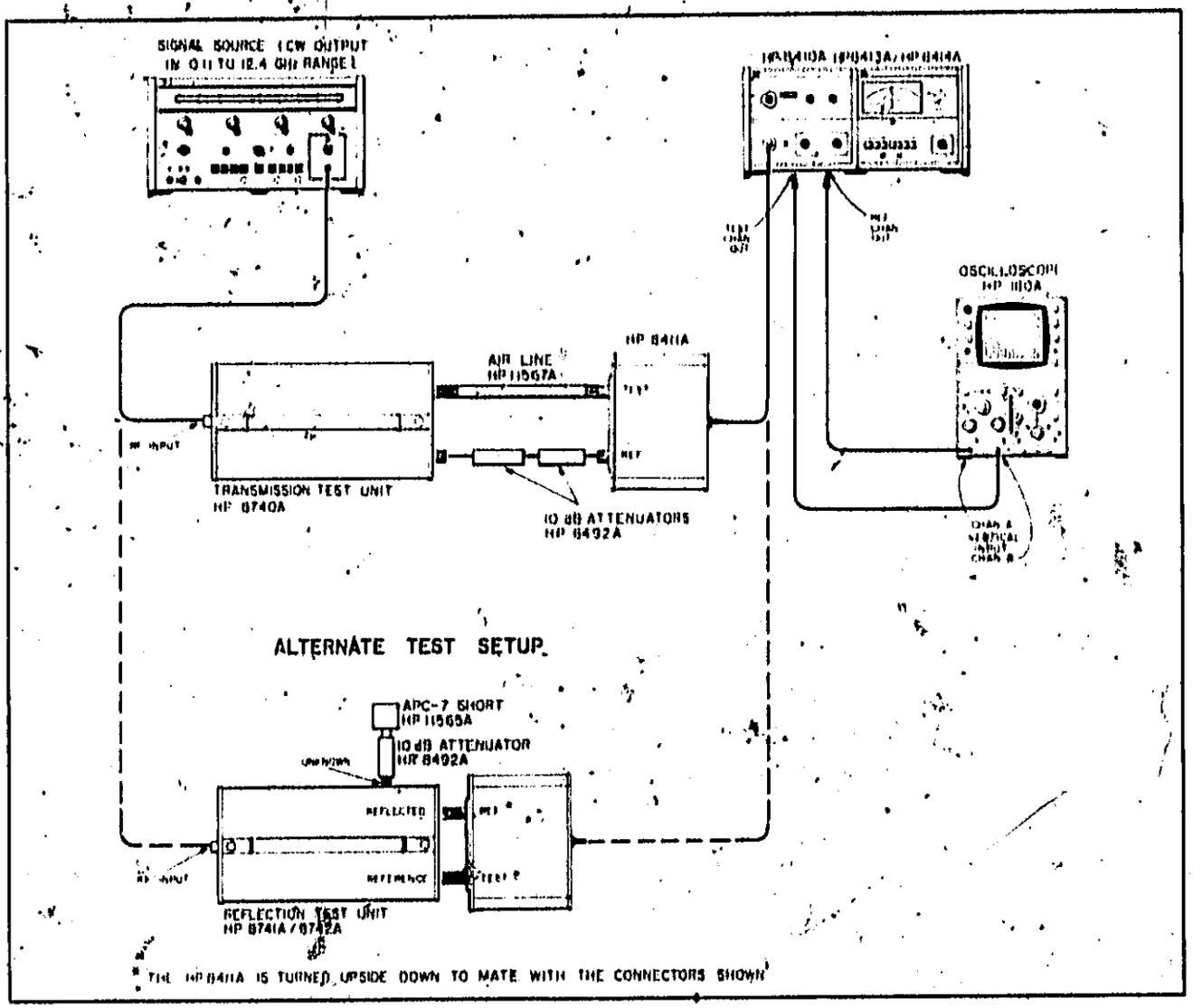


Figure 1-7. Test Setup For Operators Quick Check

a. Confect equipment as shown in Figure 1-7.

b. Set signal source for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz.

c. Set the 8410A FREQ RANGE switch to a position that includes the signal source frequency.

d. Set 8410A SWEEP STABILITY control to CW detent position.

e. Slowly increase signal source power until the 8410A REF CHANNEL LEVEL meter indicates in the OPERATE range.

f. Set TEST CHANNEL GAIN for a convenient TEST CHAN indication on the oscilloscope.

g. With the dual trace oscilloscope set for chopped mode, display channel A on the top of the screen, and channel B at the bottom. Adjust 8410A PHASE VERNIER control through it's range. One of the waveforms should move smoothly in a horizontal direction on the screen. (This indicates that the 8410A is phase locked to the input signal.)

PERFORMANCE CHECK

SECTION II

CALIBRATION TEST

2-1. INTRODUCTION.

2-2. This section provides instructions for checking calibration and performance of the 8410A Network Analyzer and 8411A Harmonic Frequency Converter.

OPERATING PRECAUTIONS

STATIC DISCHARGE. The sampling diodes in the 8411A may be damaged by a discharge of static electricity. Momentarily ground the short connectors prior to making connection to 8411A input connectors.

MAXIMUM RF POWER. Maximum RF input at 8411A before damage occurs is 50 mW. RF levels above -10 dBm in the test channel and -16 dBm in the reference channel will cause distortion in the 8411A preamplifiers.

MAGNETIC FIELDS. When using 8414A Polar Display plug-in, do not place the 8410A near a sweep generator containing a BWO which has an unshielded permanent magnet or the CRT will be permanently magnetized, causing poor focus. Separate 8414A from any magnetic source by a distance of at least two feet.

2-3. LINE VOLTAGE REQUIREMENTS.

2-4. During the calibration test, the network analyzer must be connected to a source of power which is 50 to 60 Hz and 115 or 230 Vac ±10%. If source power is not within tolerance, the network analyzer should be connected through a variable auto transformer to the ac power source. The line voltage at the input of the 8410A should then be adjusted to 115 or 230 Vac ±10%.

2-5. CALIBRATION TEST.

2-6. PURPOSE.

2-7. The procedure in Figure 2-1 checks the 8410A and 8411A calibration. This procedure may be used during incoming inspection, periodic evaluation, or after repair or alignment. The tests can be performed without access to the instrument interior. The specifications of Table 1-1 are the calibration standards.

2-8. Figure 2-2 is a calibration test record. This may be used during the test to record the test values obtained. This provides a permanent record of the test values for use at a later time during calibration or periodic evaluation.

2-9. If the 8410A-8411A system fails to meet any of the calibration tests, and a circuit malfunction is not suspected, proceed to the appropriate adjustment procedure in Figure 3-11. If a circuit malfunction is suspected, perform troubleshooting procedures in Section III.

2-10. TEST EQUIPMENT REQUIRED.

2-11. The test instruments and accessories required to make the calibration test are listed in Table 2-1. Test instruments other than the ones listed can be used, provided their performance equals or exceeds the Critical Specifications listed. Other Test Units such as HP Model 8743A, 8745A, or 8746B may be substituted for a Transmission or Reflection Test Unit in these test procedures. However, power levels to the 8411A Harmonic Frequency Converter must be the same as when using the Test Unit shown in each Test Setup.

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

Ref. No.	Instrument	Critical Specifications	Recommended HP Model
1	Signal Source	Frequency Range: 0.11 to 12.4 GHz Output Power: 25 mW into 50Ω Amplitude Modulation: square wave, 950 to 1050 Hz	3200B/11515A 241A (0.11 to 1.0 GHz) 8690A 8691A/B (1 to 2 GHz) 8690A 8692A/B (2 to 4 GHz) 8690A/8693A/B (4 to 8 GHz) 8690A 8694A/B (8 to 12.4 GHz) 8690A/8699A (0.11 to 4 GHz)

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

Ref. No.	Instrument	Critical Specifications	Recommended HP Model
2	Power Meter & Thermistor Mount	Frequency Range: 0.11 to 12.4 GHz Power Range: +5 to -15 dBm Instrument Accuracy: ±3% Input Impedance: 50 ohms SWR: 1.35 maximum Connector: APC-7	431C with 8478B Option 11 Thermistor Mount
3	AC Voltmeter	Accuracy: ±1% Range: 500 μV to 10 VRMS Meter Scale: dB Input Impedance: 10 megohms Frequency: 278 kHz	400EL 400FL
4	Directional Coupler or Slotted Line	Any frequency in range 0.11 to 12.4 GHz Minimum Directivity: 30 dB	8741A 8742A 776D 817A
5	Transmission or Reflection Test Unit	No substitute may be used	8740A 8741A 8742A
6	Dual Trace Oscilloscope with 10pF 10:1 Probes	Vertical Amplifier: Dual trace Bandwidth: 20 MHz minimum Horizontal Sweep Rate: 200 ns/cm expanded to 20 ns/cm Vertical Sensitivity: 5 mV/cm	175A/1755A/1760A 140A/1402A/1423A 180A/1801A/1821A 181A/1801A/1821A
7	Wave Analyzer	Frequency Range: 270 through 200 kHz Selectivity: Bandwidth selectable 200 Hz and 3000 Hz Dynamic Range: 75 dB Meter Scale: dB	310A 312A
8	SWR Meter	Input Impedance: 2.5K to 200K Input Frequency: 1000 Hz Range: 70 dB in 10 dB steps Sensitivity: 1 μV for full scale deflection Accuracy: ±0.1 dB/10 dB step	415C, D, or E
9	Frequency Counter	Frequency Range: 0 to 155 MHz	5245L/5253B
10	Crystal Detector	Frequency Range: 0.11 to 12.4 GHz Frequency Response: ±1 dB overall SWR: 1.7 maximum Connector: APC-7	8470A

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

Ref. No.	Instrument	Critical Specifications	Recommended HP Model
11	Variable Attenuator (Calibrated)	Attenuation: 0 and 60 dB Input and Output Impedance: 50Ω nominal Calibration: at 60 dB setting referenced from 0 dB setting Calibration Accuracy: ±0.3 dB Calibration Frequency: 1.0 GHz	364A calibrated by Standards Laboratory
12	DC Digital Voltmeter	Accuracy: 0.05% Input Impedance: 10 megohms minimum Automatic Range Selection: 1 range to 100 V	3440A with 3442A Automatic Range Selector Plug-in
13	Type N Tee	50-ohm adapter tee Connectors: Type N Female	1250-0846
14	30-dB Fixed Attenuator	Attenuation: 30 dB nominal Frequency Range: 0.11 to 12.4 GHz SWR: 1.3 maximum	8492A, Option 030 (Note 1)
15	10-dB Fixed Attenuator (2 required)	Attenuation: 10 dB nominal Frequency Range: 0.11 to 12.4 GHz SWR: 1.25 maximum	8402A, Option 010 (Note 1)
16	Fixed Air Line	50-ohm, 20 cm air line extension with APC-7 connectors	11567A (Note 1)
17	50-ohm Load	50-ohm termination with APC-7 connector	909A
18	Adapters	50-ohm adapter (APC-7 to male type N	11525A (Note 1)
		50-ohm adapter (APC-7 to female type N)	11524A (Note 1)
19	Short	50-ohm short (APC-7 connector)	11565A (Note 2)
20	Phase-Gain Indicator Plug-in for 8410A	Alternate readout instead of 8413A can be wave analyzer (HP Model 310A or equivalent) connected to 8410A TEST CHAN OUT port	8413A Phase-Gain Indicator Plug-in for 8410A
21	Variable Attenuator	Attenuation: 0 to 50 dB	355A and 355B or 3742A with two 281A's

NOTES: 1. Part of HP 11667A Accessory Kit. 2. Furnished with 8741A and 8742A.

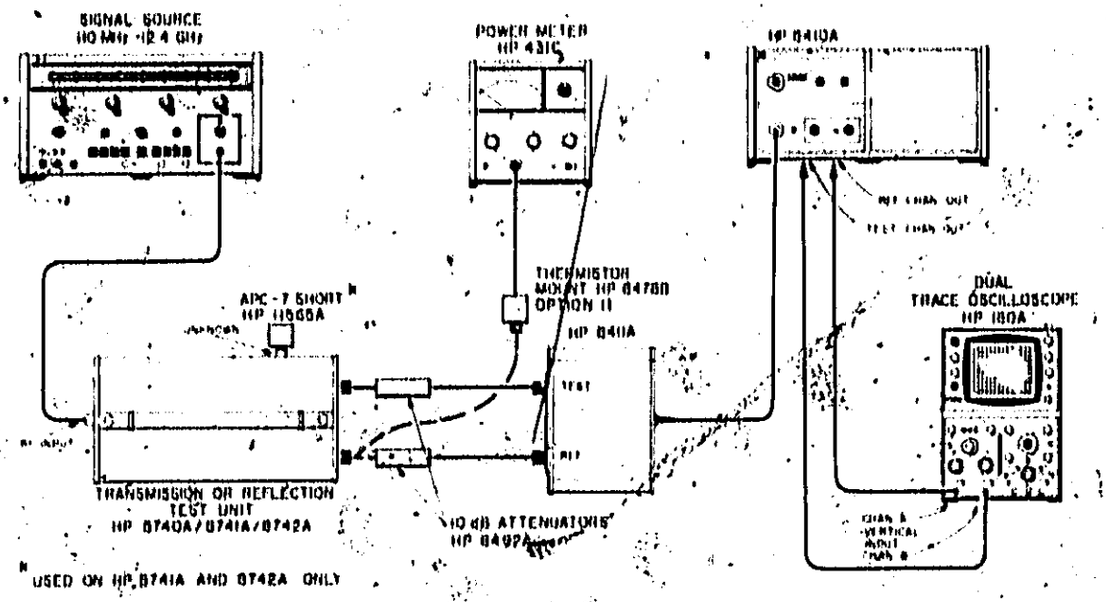
TEST	DESCRIPTION AND PROCEDURE
1	**SPECIFICATION TESTED** Automatic Tuning
	TEST DESCRIPTION Sets up initial test conditions and checks for phase lock of the system.
	TEST SETUP  EQUIPMENT: Items 1, 2, 5, 6, 15, and 10, Table 2-1.
	PROCEDURE a. Connect equipment as shown in test setup above. b. Check that line voltage at input of 8410A is 115 or 230 Vac ±10%. c. Set signal source for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz. d. Connect thermistor mount to transmission or reflection test unit REFERENCE channel output and adjust signal source output level for -20 dBm power meter indication. e. Disconnect thermistor mount and reconnect 10-dB attenuator to transmission or reflection test unit. f. Set Model 8410A FREQ RANGE switch to a position that includes the signal source frequency. Note Steps g through l, following, are performed to be certain that the 8410A is locked for best signal-to-noise ratio and widest dynamic range.

Figure 2-1. Calibration Test (Sheet 1 of 12)

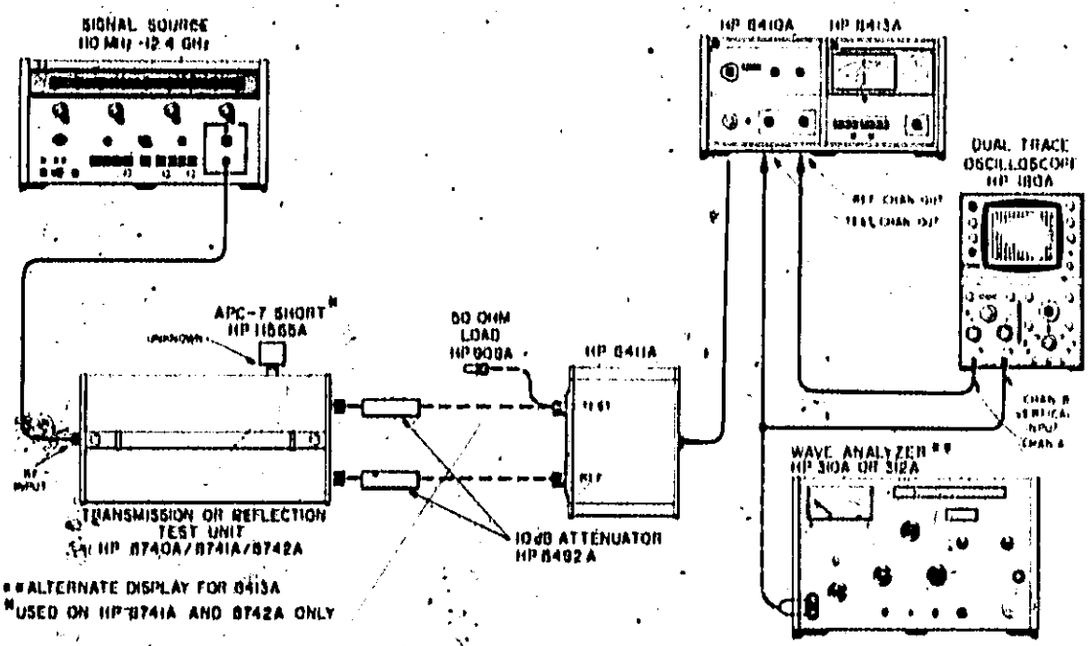
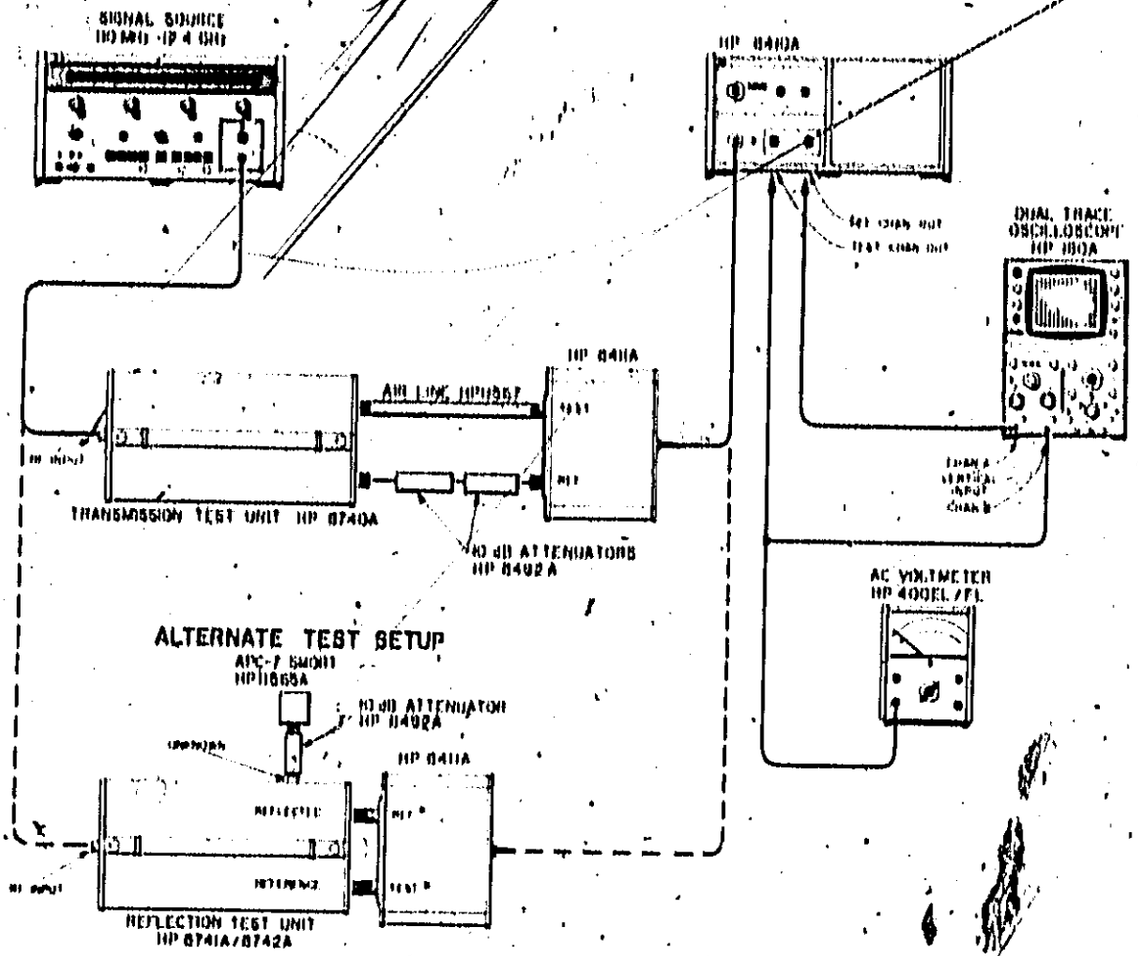
TEST	DESCRIPTION AND PROCEDURE
1 (Cont.)	g. Set Model 8410 SWEEP STABILITY control to CW position. h. Momentarily turn off power to signal source, then turn on power. An indication on the REF CHANNEL LEVEL meter in the OPERATE range should occur. i. With dual trace oscilloscope set for chopped mode, display channel A on the top of the screen and channel B at the bottom. Adjust 8410A PHASE VERNIER control: one of the waveforms should move smoothly in a horizontal direction on the screen. (This indicates that the 8410A is phase locked to the input signal.)
2	**SPECIFICATION TESTED** TEST CHANNEL NOISE: Less than -78 dBm. **TEST DESCRIPTION** The -30 dBm signal at the TEST input of the 8411A is used to set a reference at the 8413A or Wave Analyzer. The RF signal at TEST input of 8411A is terminated, leaving only TEST CHANNEL noise to be measured at the 8413A or Wave Analyzer. Noise level of -78 dBm is 48 dB lower than the -30 dBm reference level. 40 dB of gain is added in the TEST CHANNEL GAIN control and -8 dB from zero reference is indicated on the 8413A or Wave Analyzer, totaling 48 dB. **TEST SETUP**  EQUIPMENT: Items 1, 3, 5, 6, 15, 17, 19, 20, Table 2-1. Alternate readout instead of 8413A: Wave Analyzer, HP 310A or 312A.

Figure 2-1. Calibration Test (Sheet 2 of 12)

TEST	DESCRIPTION AND PROCEDURE
2 (Cont.)	**PROCEDURE** a. Change equipment test setup as shown. Install 8413A in 8410A. If an 8413A is not available, use as an alternate display a Wave Analyzer such as HP Model 310A and select 3000 Hz bandwidth. b. Disconnect 10-dB attenuator from 8411A TEST port and check for -30 dBm signal level at 10-dB attenuator. If necessary, adjust Signal Source for -30 dBm indication on power meter. Reconnect 10-dB attenuator to 8411A TEST port. c. Check that REF CHANNEL LEVEL meter indicates in the OPERATE range. d. Adjust the PHASE VERNIER control; one of the oscilloscope waveforms should move smoothly in a horizontal direction on the screen indicating 8410A phase lock. e. Set AMPL TEST CHANNEL GAIN controls to 20 dB. f. Select 10 dB range on 8413A. Adjust 8410A AMPL VERNIER and TEST CHANNEL GAIN 1 dB/step controls to obtain a zero indication (center of scale) on 8413A. If an 8413A is not available, a wave analyzer may be used for the readout. Select 3000 Hz bandwidth and select range which allows zero scale indication. g. Disconnect 10-dB attenuator from 8411A TEST channel input and connect 50-ohm termination to 8411A TEST input. h. Increase 8410A TEST CHANNEL GAIN control by 40 dB. The 8413A or wave analyzer should indicate in the negative direction at least -8 dB. (This indicates less than -78 dBm equivalent input noise.)
3	**SPECIFICATION TESTED** AMPLITUDE RANGE: 60 dB total in 10- and 1-dB steps; vernier provides continuous adjustment over at least 2 dB. AMPLITUDE ACCURACY: ±0.1 dB per 10-dB step, not to exceed ±0.2 dB cumulative; ±0.05 dB per 1-dB step, not to exceed ±0.1 dB cumulative.
	TEST DESCRIPTION The TEST CHANNEL GAIN attenuators are tested for accuracy and the AMPL VERNIER control operation is checked. This is done by feeding a constant RF signal through the test channel and monitoring the 270-kHz signal on an ac voltmeter. The attenuators are set at each position and the resultant change in signal level is read on the ac voltmeter.

Figure 2-1. Calibration Test (Sheet 3 of 12)

TEST	DESCRIPTION AND PROCEDURE
3 (Cont.)	**TEST SETUP**



EQUIPMENT: Items 1, 3, 5, 6, 15, 16, 19; Table 2-1.

PROCEDURE

a. Change equipment test setup as shown above.

b. Check for phase-locked condition in the 8410A as follows:

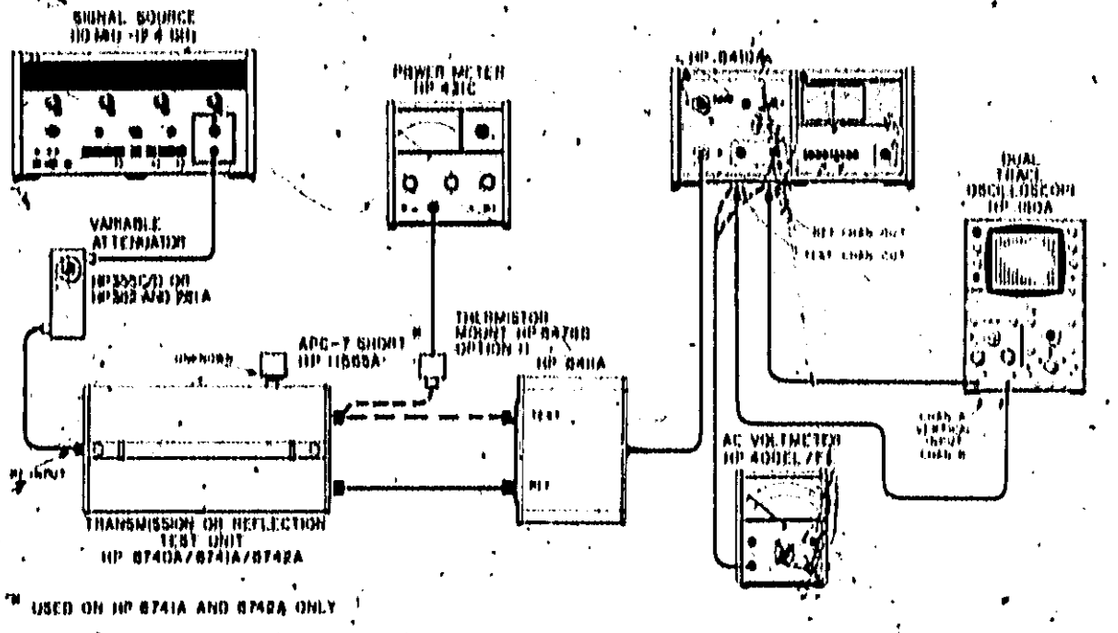
(1) REF CHANNEL LEVEL meter should indicate in the OPERATE range. If not, adjust signal source power output to obtain OPERATE indication on meter.

(2) Adjust the PHASE VERNIER control: one of the oscilloscope waveforms should move smoothly in a horizontal direction on the screen.

c. Set Model 8410A TEST CHANNEL GAIN 10 dB/step control to 0 dB.

Figure 2-1. Calibration Test (Sheet 4 of 12)

TEST	DESCRIPTION AND PROCEDURE
4 (Cont.)	**TEST SETUP**



* USED ON HP 8741A AND 8742A ONLY

EQUIPMENT: Items 1, 2, 3, 5, 6, 10, 21, Table 2-1.

PROCEDURE

a. Change equipment test setup as shown above.

b. Check for phase-locked condition in the 8410A as follows:

(1) REF CHANNEL LEVEL meter should indicate in the OPERATE range. If not, adjust signal source power output to obtain OPERATE indication on meter.

(2) Adjust the PHASE VERNIER control; one of the oscilloscope waveforms should move smoothly in a horizontal direction on the screen.

c. Connect the ac voltmeter to the 8410A REF CHANNEL OUTPUT connector. Increase power from signal source until the ac voltmeter indication starts to increase. This indicates that the upper limit of the AGC range is reached. Disconnect TEST port of 8411A from transmission or reflection test unit and connect power meter thermistor mount to transmission or reflection test unit TEST channel output. Note and record meter indication.

d. Disconnect power meter thermistor mount and reconnect the 8411A to the transmission or reflection test unit. Reduce RF input power by inserting attenuation with the variable attenuator until the ac voltmeter indication starts to decrease. This indicates that the lower limit of the AGC range is reached. Subtract the amount of attenuation inserted with the variable attenuator from the power meter indication obtained in step c. The power meter reading and the power calculated above define the AGC range. With normal AGC action there should be at least a 20 dB range between -16 dBm and -44 dBm where the ac voltmeter indication stays constant. Note the limits of the AGC range.

Figure 2-1. Calibration Test (Sheet 6 of 12)

TEST	DESCRIPTION AND PROCEDURE
3 (Cont.)	d. Adjust Model 8410A AMPL VERNIER control and TEST CHANNEL GAIN 1 dB/step control for a -50 dB reference indication on the ac voltmeter. (Set ac voltmeter to -50 dB range and adjust 8410A AMPLITUDE VERNIER control and TEST CHANNEL GAIN 1 dB/step control for zero dB meter indication.) e. Increase Model 8410A TEST CHANNEL GAIN in 10-dB steps and check accuracy as indicated below.

Model 8410A TEST CHANNEL GAIN Tens Control Setting	AC Voltmeter Range Setting	AC Voltmeter Indication
10 dB	-40 dB	0 (±0.1) dB ± voltmeter error
20 dB	-30 dB	0 (±0.2) dB ± voltmeter error
30 dB	-20 dB	0 (±0.2) dB ± voltmeter error
40 dB	-10 dB	0 (±0.2) dB ± voltmeter error
50 dB	0 dB	0 (±0.2) dB ± voltmeter error
60 dB	+10 dB	0 (±0.2) dB ± voltmeter error

f. Set ac voltmeter to -30 dB range, set 8410A TEST CHANNEL GAIN 10 dB/step control to 20 dB, and set 1 dB/step control to zero dB. Adjust AMPL VERNIER control for a scale reference on AC Voltmeter at zero dB or any one-dB scale division.

g. Increase 8410A TEST CHANNEL GAIN 1 dB/step control in 1-dB steps; ac voltmeter indications should increase in corresponding 1-dB steps. If necessary, change ac voltmeter range to a higher or lower scale. Each meter indication must be within ±0.1 dB of a 1-dB major scale division on the meter, ± the tolerance of the voltmeter.

h. Using the ac voltmeter, check AMPL VERNIER range. It should be at least 2 dB.

4

SPECIFICATION TESTED

REFERENCE CHANNEL INPUT POWER RANGE: 20 dB variation causes less than ±0.75 dB amplitude and ±2° phase change at output. The 20-dB range will be between -10 dBm and -44 dBm.

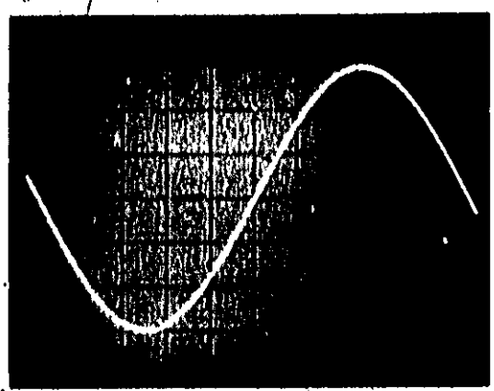
TEST DESCRIPTION

The AGC circuit is checked for a 20-dB range within the input power range of -10 dBm and -44 dBm. This is done by changing RF input power levels to the two operating extremes of the AGC circuit and still maintaining constant reference channel output.

Phase and amplitude are then monitored through the 20 dB AGC range to determine that they remain within specifications through the entire range.

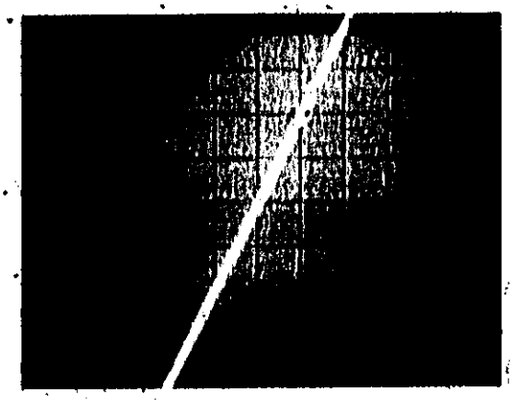
Figure 2-1. Calibration Test (Sheet 5 of 12)

TEST	DESCRIPTION AND PROCEDURE
4 (Cont.)	e. Adjust the variable attenuator for the upper limit of the AGC range noted in preceding step d. Disconnect the ac voltmeter from the 8410A REF CHAN OUTPUT and connect it to the 8410A TEST CHAN OUTPUT. f. Adjust the ac voltmeter range control and the 8410A AMP VERNIER control and TEST CHANNEL GAIN 1 dB/step control to obtain a zero dB voltmeter indication on the scale selected. g. Adjust Oscilloscope, 8410A PHASE VERNIER, and 8740A REFERENCE PLANE EXTENSION controls to superimpose one waveform on the other. Expand one cycle of trace so that the zero degree point of the sine wave is at the left edge, the 180 degree point is at the center, and the 360 degree point is at the right edge of the graticule (Waveform A). (With an oscilloscope with 10 cm graticule width, each cm is 36 degrees.) Expand the oscilloscope waveform horizontally by a factor of ten so that each cm represents 3.6 degrees. Adjust oscilloscope to position the center of the waveform on the screen (Waveform B). h. Adjust the variable attenuator toward the lower limit of the AGC range. As power to the Network Analyzer is decreased observe the ac voltmeter indication and oscilloscope waveforms. The phase and amplitude indications should have maximum and minimum indications not greater than four degrees or 1.5 dB apart over a 20 dB range.



Waveform A

Oscilloscope trace of one 270 Kiz sine-wave cycle showing in-phase condition with channel A superimposed on channel B. (Horizontal scale is 36 degrees/cm.)



Waveform B

Trace A expanded horizontally and vertically x 10. (Horizontal scale is 3.6 degrees/cm.)

Figure 2-1. Calibration Test (Sheet 7 of 12)

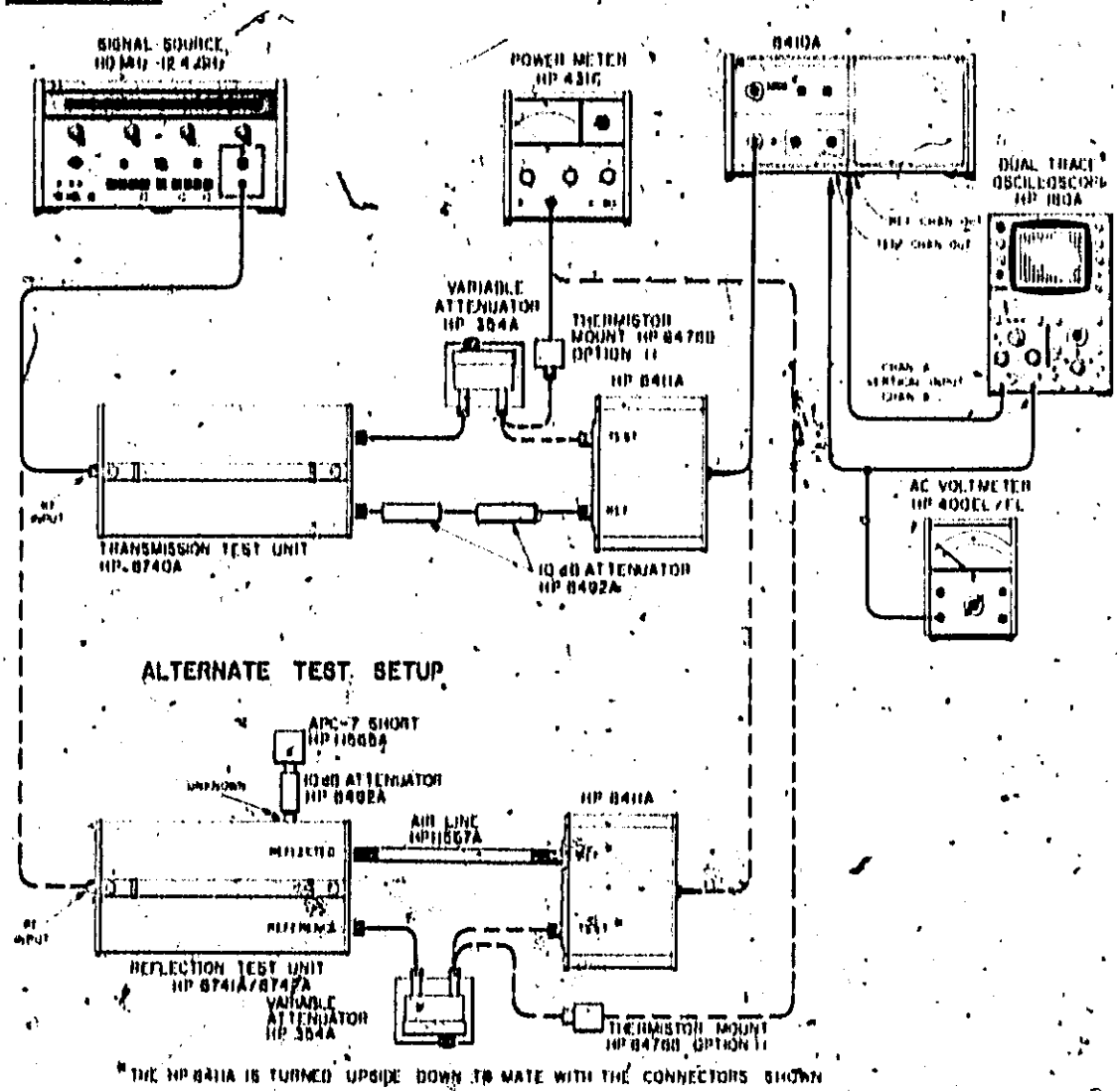
TEST	DESCRIPTION AND PROCEDURE
6	**SPECIFICATION TESTED** TEST CHANNEL DYNAMIC RANGE: 60 dB or more.
	TEST DESCRIPTION A known signal level of -10 dBm is applied to the 8411A TEST channel RF input. The corresponding 278-kHz output signal level at the 8410A TEST CHAN OUT jack is noted on an ac voltmeter. This represents the top of the test channel input power range. A variable attenuator is used to reduce the RF signal at the input of the 8411A to -70 dBm. The corresponding 278-kHz output signal is then read on the ac voltmeter. The ac voltmeter indication is corrected by accounting for the ambiguity due to noise at this low signal level, and by using the calibration data from the variable attenuator.
	TEST SETUP  **EQUIPMENT:** Items 1, 2, 3, 5, 6, 11, 16, 19, Table 2-1.

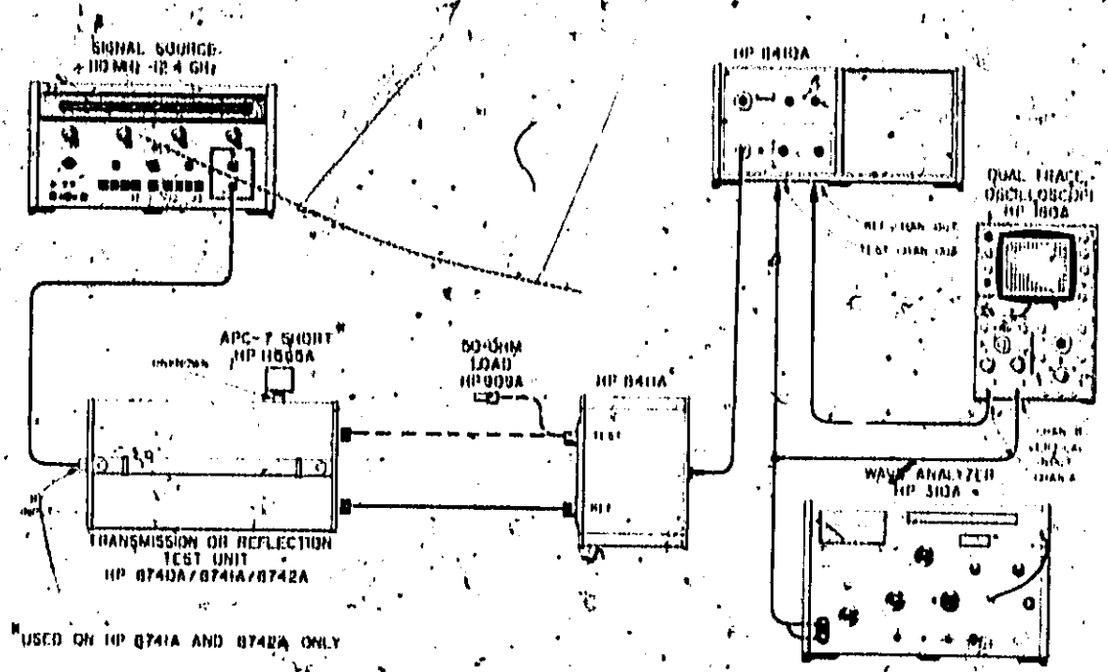
Figure 2-1. Calibration Test (Sheet 6 of 12)

TEST	DESCRIPTION AND PROCEDURE
5 (Cont.)	PROCEDURE a. Change equipment test setup as shown above. b. Check for phase-locked condition in the 8410A as follows: (1) REF CHANNEL LEVEL meter should indicate in the OPERATE range. If not, adjust signal source power output to obtain OPERATE indication on meter. (2) Adjust the PHASE VERNIER control and the oscilloscope waveform should move smoothly in a horizontal direction on the screen. c. Connect thermistor mount to variable attenuator output. d. Set variable attenuator and 8410A TEST CHANNEL GAIN controls to zero dB. e. Adjust signal source for -10 dBm indication on power meter. Signal source output power should not be adjusted again during the remainder of the test. Disconnect thermistor mount from variable attenuator and connect variable attenuator output to 8411A TEST input. f. Adjust 8410A AMPLITUDE VERNIER control, TEST CHANNEL GAIN units (0-9 dB) control, and ac voltmeter range control for zero indication on ac voltmeter on the range selected. g. Set variable attenuator to 60 dB then set 8410A TEST CHANNEL GAIN tens (10 dB/step) control to 60 dB. The ac voltmeter indication should remain at zero. Any deviation should be due only to the effect of signal-to-noise ratio, cross talk, TEST CHANNEL GAIN control error, and variable attenuator error. The deviation limits due to these factors can be calculated as follows: (1) Maximum ac voltmeter indication = 0.6 dB noise + 0.2 dB TEST CHANNEL GAIN tolerance - actual attenuation of variable attenuator at 60 dB setting + 60 dB. (2) Minimum ac voltmeter indication = -0.2 dB TEST CHANNEL GAIN tolerance - actual attenuation of variable attenuator at 60 dB setting - 60 dB. For example, if the calibration on the variable attenuator at the 60 dB position is 59.1 dB, then for this example: Maximum = +0.6 dB + 0.2 dB - 59.1 dB + 60 dB = +1.7 dB Minimum = -0.2 dB - 59.1 dB + 60 dB = +0.7 dB Therefore, the ac voltmeter indication should be between +1.7 and +0.7 dB.
6	SPECIFICATION TESTED CHANNEL ISOLATION: Greater than 65 dB, 0.11 to 6.0 GHz; greater than 60 dB, 6.0 to 12.4 GHz.
	TEST DESCRIPTION The 270-Hz test-channel signal is monitored by a wave analyzer with 200 Hz bandwidth. This rejects incoming noise and indicates only the test channel signal level. After a reference level

Figure 2-1. Calibration Test (Sheet 9 of 12)

TEST	DESCRIPTION AND PROCEDURE
6 (Cont.)	is established at the wave analyzer, the RF signal to the 8411A test channel is disconnected, and the input is terminated with a 50-ohm load. With the RF signal applied only to the reference channel, any signal present in the test channel is due to signal leakage between channels. Isolation between channels is calculated taking the signal level below zero indicated on the wave analyzer plus the test channel gain added at the 8410A.

TEST SETUP



EQUIPMENT: Items 1, 5, 6, 7, 17, 19, Table 2-1.

PROCEDURE

a. Change equipment test setup as shown above.

b. Check for phase-locked condition in the 8410A as follows:

(1) Adjust the signal source for a REF CHANNEL LEVEL meter indication at the right edge of the OPERATE range.

(2) Adjust the PHASE VERNIER control: one of the oscilloscope waveforms should move smoothly in a horizontal direction on the screen.

c. Set 8410A TEST CHANNEL GAIN control to zero. Adjust wave analyzer for maximum output at 278 kHz, select automatic frequency control mode, and select 200 Hz bandwidth. Adjust 8410A AMPLITUDE VERNIER control for zero dB wave analyzer meter indication on the meter range selected.

Figure 2-1. Calibration Test (Sheet 10 of 12)

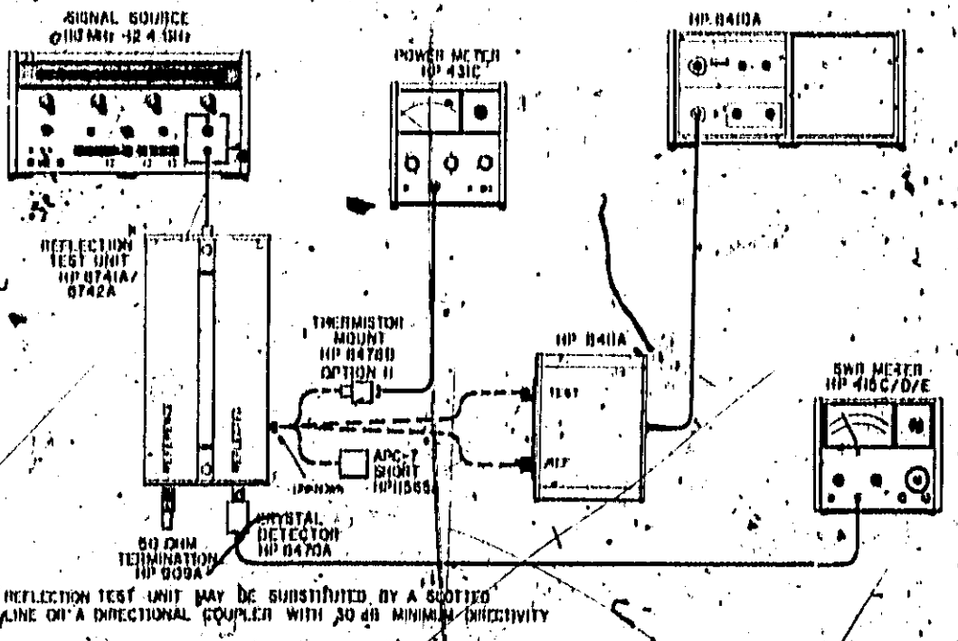
TEST	DESCRIPTION AND PROCEDURE
6 (Cont.)	d. Disconnect TEST input of Model 8411A and connect 50-ohm termination to 8411A TEST input. e. Compare the 8410A TEST CHANNEL GAIN control setting by 65 dB if signal source frequency is 0.11 to 6.0 GHz, or 60 dB if frequency is 6.0 to 12.4 GHz. The indication on the wave analyzer meter should be zero dB or lower on the meter range selected.
7	**SPECIFICATION TESTED** INPUT IMPEDANCE: 50 Ohms; SWR: Less than 1.5, 0.11 to 6 GHz; Less than 2.0, 6 to 12.4 GHz.
	TEST DESCRIPTION The input impedance of the REFERENCE and TEST input ports on the 8411A is tested by measuring the reflected RF signal from the ports, using an SWR Meter and a directional coupler. Connecting an APC-7 short to the UNKNOWN port of the reflection-test unit provides a reference at the SWR Meter. The short completely reflects the RF signal back to the measurement coupler. The REFERENCE and TEST ports of the 8411A are connected and the amplitude of reflection, compared to reference, is measured on the SWR meter.
	TEST SETUP  EQUIPMENT: 1, 2, 4, 8, 10, 11, 16, Table 2-1.

Figure 2-1. Calibration Test (Sheet 11 of 12)

TEST	DESCRIPTION AND PROCEDURE
7. (Cont.)	PROCEDURE a. Change equipment test setup as shown above. Connect thermistor mount to UNKNOWN port of reflection test unit. b. Set signal source for single-frequency CW operation at any frequency in the range of the reflection test unit in use and adjust output power for -10 dBm power meter indication. Signal source output power should not be adjusted throughout the remainder of this test. (If slotted line used, adjust power to 0 dBm in order not to place probe too deep in slotted line.) c. Disconnect thermistor mount from UNKNOWN port of reflection test unit and connect APC-7 short to UNKNOWN port. d. At signal source select square-wave modulation and adjust square-wave frequency to peak SWR meter indication. Adjust SWR meter gain controls to obtain zero dB meter indication. e. Remove short from reflection test unit and connect REF input of 8411A to unknown port of Reflection Test Unit (or to mainline port of directional coupler, if used). f. SWR meter should indicate (a) at least 12.7 dB below zero dB reference level (or SWR of 1.6) at a frequency of 0.11 to 8.0 GHz, or (b) at least -8.7 dB below zero dB reference level (or SWR of 2.2) at a frequency of 8.0 to 12.4 GHz. (These test limits include ambiguity due to 30 dB directivity in reflection test unit or directional coupler.) g. Disconnect 8411A REF input from Reflection test unit UNKNOWN port and connect 8411A TEST input to UNKNOWN port (or to mainline port of directional coupler, if used). h. SWR meter should indicate (a) at least 12.7 dB below zero dB reference level at a frequency of 0.11 to 8.0 GHz, or (b) at least -8.7 dB below zero dB reference level at a frequency of 8.0 to 12.4 GHz. (These test limits include ambiguity due to 30 dB directivity in reflection test unit or directional coupler.)

Figure 2-1. Calibration Test (Sheet 12 of 12)

STEP FROM FIG. 6-3	PROCEDURE	INDICATION MIN.	ACT.	MAX.
1	Power line voltage input	103.5 or 207 VAC	_____	126.5 or 253 VAC
	Automatic tuning	Phase-lock	_____	
2	Test channel noise		_____	-70 dBm
3	TEST CHANNEL GAIN 10 dB/step			
	Attenuators at setting: 10 dB		_____	0(±0.1) dB
	20 dB		_____	0(±0.2) dB
	30 dB		_____	0(±0.2) dB
	40 dB		_____	0(±0.2) dB
	50 dB		_____	0(±0.2) dB
	60 dB		_____	0(±0.2) dB
				plus voltmeter error
	TEST CHANNEL GAIN 1 dB/step			
	Attenuators at setting: 1 dB		_____	±0.1 dB of a 1-dB major scale division on meter, plus voltmeter error.
	2 dB		_____	
	3 dB		_____	
	4 dB		_____	
	5 dB		_____	
	6 dB		_____	
	7 dB		_____	
	8 dB		_____	
	9 dB		_____	
	AMPL VERNIER range	2 dB		
4	20 dB variation in reference channel produces constant output		_____	Amplitude: min & max. 1.5 dB apart
			_____	Phase: Min. & max. 4° apart
5	Test channel operates over 60 dB range. Calibration value of 60 dB attenuator is _____	-60.2 dB + Cal. value of 60 dB attenuator	_____	-59.2 dB + Cal. value of 60 dB attenuator

Figure 2-2. Calibration Test Record (Sheet 1 of 2)

STEP FROM FIG. 6-3	PROCEDURE	INDICATION MIN.	ACT.	MAX.
6	Channel isolation 65 dB or greater in 0.11 to 8.0 GHz range, and 60 dB or greater in 8.0 to 12.4 GHz range.			0 dB on range selected
7	SWR of 8411A REFERENCE and TEST ports, 1.5 or less in 0.11 to 8 GHz range, and 2.0 or less in 8 to 12.4 GHz range. (Indication in return loss.)		REFERENCE PORT	
				-12.7 dB (0.11 to 8.0 GHz)
				-8.7 dB (8 to 12.4 GHz)
			TEST PORT	
				-12.7 dB (0.11 to 8.0 GHz)
				-8.7 dB (8.0 to 12.4 GHz)

Figure 2-2. Calibration Test Record (Sheet 2 of 2)

SERVICE

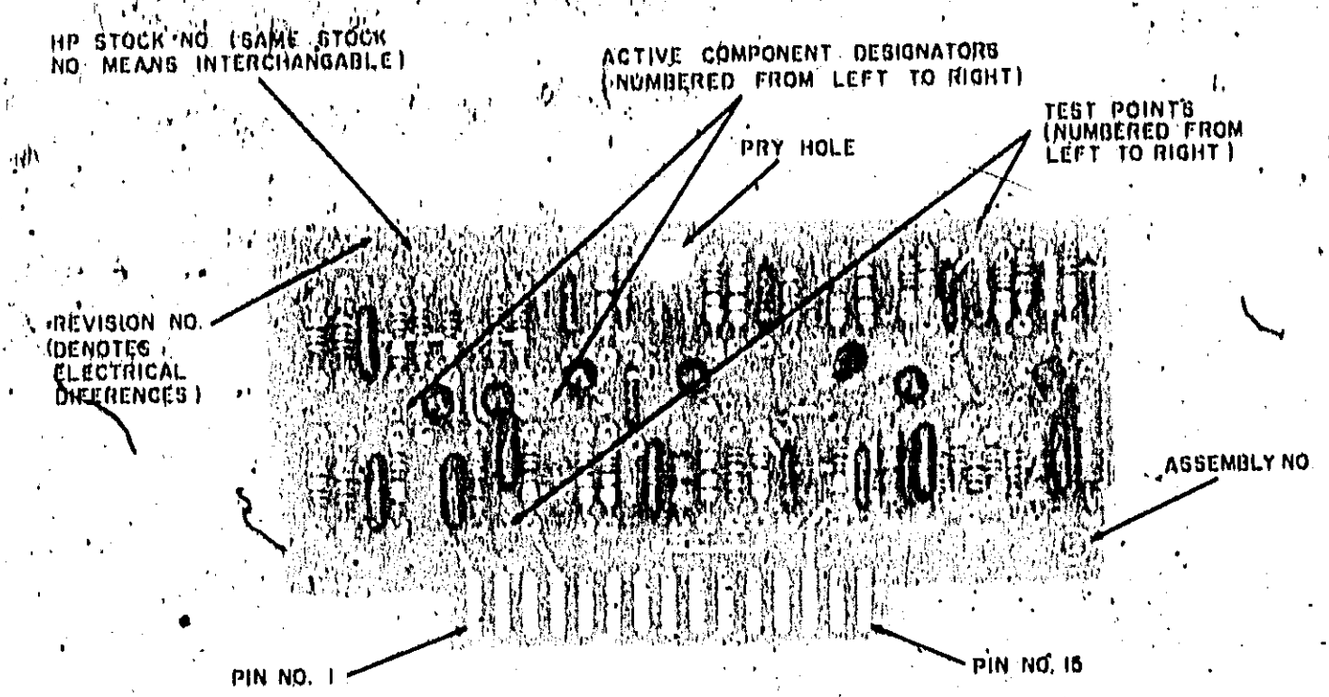


Figure 3-1. Servicing Aids on Circuit Boards

3-15. ADJUSTMENTS.

3-16. PURPOSE.

3-17. The procedures in Figure 3-11 provide adjustment instructions for the 8410A and 8411A. The adjustment procedure should not be performed as a routine maintenance procedure but should only be used (1) after replacement of a part or component, (2) when the calibration test shows that the specifications of Table 1-1 cannot be met, or (3) when instructed to do so in the troubleshooting procedure. Before attempting any adjustment, allow 30 minutes warm-up time for the 8410A and 8411A.

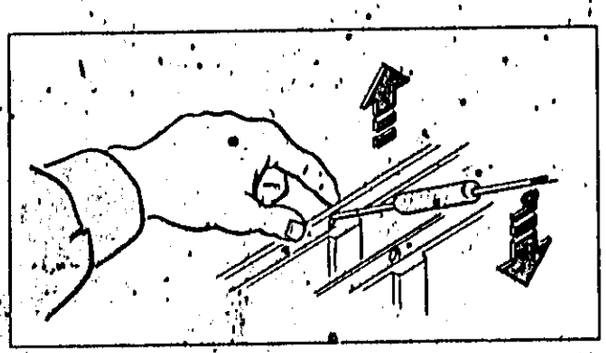


Figure 3-2. Printed Circuit Board Removal

3-18. The procedure consists of adjusting variable controls or selecting the value of specific components. A list of controls and their functions is presented in Table 3-2. Table 3-3 is a list of factory-selected components. The procedure for selecting the correct values of each factory-selected component is referenced in the table.

3-19. TEST EQUIPMENT REQUIRED.

3-20. Test equipment required for each adjustment procedure is referenced at the bottom of the test setup and is listed in the Equipment List, Table 3-1. Test instruments other than the ones listed can be used, provided their performance equals or exceeds the Critical Specifications listed.

3-21. TROUBLESHOOTING.

3-22. GENERAL PROCEDURE.

3-23. The troubleshooting procedure is divided into three maintenance levels. The first level of troubleshooting isolates trouble to either the 8410A or 8411A. (See Figure 3-23.) The next level of troubleshooting further isolates trouble to a single printed circuit board, where possible. (See Figure 3-26 and 3-29.) The last level of troubleshooting isolates trouble to a circuit within the printed circuit board. Procedures for this level are located on the page facing the schematic diagram of each printed circuit board. Normal test point waveforms and voltages used in these procedures are shown on the schematic diagrams and are obtained, using the standard test conditions described in Figure 3-10.

Table 3-1. Recommended Test Equipment for Adjustment, Troubleshooting, and Repair (Sheet 2 of 3)

Ref. No.	Instrument	Critical Specifications	Use (Note 1)	Recommended HP Model
7	SWR Meter	Input Impedance: 2.5K to 200 K Input Frequency: 1000 Hz Range: 70 dB in 10 dB steps Sensitivity: 1 μV for full scale deflection Accuracy: ±0.1 dB/10 dB step	T	415C, D, or E
8	Frequency Counter	Frequency Range: 0 to 155 MHz Accuracy: ±0.2% Display: 4 digits minimum	A, T	5245L/5263B
9	Dual DC Power Supply	Outputs: 0 to 40 Vdc (Note 4), 0 - 300 mVdc	A, T	6205B
10	Crystal Detector	Frequency Range: 0.11 to 12.4 GHz Frequency Response: ±1 dB overall SWR: 1.7 maximum Connector: APC-7	T	8470A
11	DC Digital Voltmeter	Accuracy: 0.05% Input Impedance: 10 megohms minimum Automatic Range Selection: range to 100V	A, T	3440A with 3442A Automatic Range Selector Plug-in
12	DC Electronic Voltmeter	Accuracy: ±3% of full scale Input Impedance: 10 megohms minimum Ranges: ±1 Volt to ±50 Volts	A, T	412A
13	Low Frequency Signal Source (270 kHz)	Frequency Range: 200 to 400 kHz Output Impedance: 600 ohms Calibration Accuracy: ±2% Output Power: 1.5 mW minimum	A, T	200 CD 606B
14	Type N Tee	50-ohm adapter tee Connectors: Type N Female	A, T	1250-0846

Table 3-1. Recommended Test Equipment for Adjustment, Troubleshooting, and Repair (Sheet 3 of 3)

Ref. No.	Instrument	Critical Specifications	Use (Note 1)	Recommended HP Model
16	30-dB Fixed Attenuator	Attenuation: 30 dB nominal Frequency Range: 0.11 to 12.4 GHz SWR: 1.3 maximum Connectors: APC-7	A, T	8402A, Option 30 (Note 2)
16	10-dB Fixed Attenuator (2 required)	Attenuation: 10 dB nominal Frequency Range: 0.11 to 12.4 GHz SWR: 1.25 maximum Connectors: APC-7	A, T	8402A, Option 10 (Note 2)
17	Fixed Air Line	50-ohm, 20 cm air line with APC-7 connectors	A, T	11567A (Note 2)
18	50-ohm Load	50-ohm termination with APC-7 connector	A, T	909A
19	Adapters	50-ohm adapter (APC-7 to male type N) 50-ohm adapter (APC-7 to female type N)	A, T A, T	11525A (Note 2) 11524A (Note 2)
20	Short	50-ohm short (APC-7 connector)	A, T	11565A (Note 3)
21	50-ohm Feedthru	50-ohm termination Connectors, male BNC and female subminiature.	A	11048B (with adapter 1250-0831)
22	APC-7 Contact Extractor Tool	No substitute may be used.	R	5060-0236 (Notes 2 & 5)
23	APC-7 Spanner Wrench	No substitute may be used.	R	5060-0237 (Notes 2 & 5)
24	Open End Wrench 9/16" x 1/2"	Thickness: 3/32" maximum	R	8710-0877 (Notes 2 & 5)
25	Burndy Extractor Tool	Burndy Part No. Rx 20-25 V2	R	None

Notes

1. A = Adjustment; T = Troubleshooting; R = Repair
2. Part of HP 11567A Accessory Kit.
3. Furnished with HP 8741A and 8742A.
4. One 0 to 40 Vdc supply can be obtained from the SWEEP REF output of any HP 600 or 8690 series Sweep Oscillator.
5. Part of HP 11591A APC-7 Connector Tool Kit.

Table 3-2. Alignment Controls

REFERENCE DESIGNATOR	FUNCTION AFFECTED	COMPONENT LOCATION FIGURE	ADJUSTMENT PROCEDURE FIGURE 3-11
	8410A		
A7R10	DC voltage from A7 to control VTO frequency, CW operation	3-73	8
A10A1R9	+20 Vdc	3-70	1
A10A1R22	+20 Vdc and -11 Vdc	3-70	1
A12L2	Phase change with change in input power	3-45	7
A13C7	Frequency of second IF	3-53	4
A14L2	Phase change with change in input power	3-45	7
	8411A		
A4R3	Reference channel sampler bias, channel isolation and tracking	3-37	11, 13
A4R5	Reference channel sampler bias, channel isolation and tracking	3-37	11, 13
A5C13	Channel isolation	3-37	13
A5R3	Test channel sampler bias, channel isolation and tracking	3-37	11, 13
A5R5	Test channel sampler bias, channel isolation and tracking	3-37	11
A5R20	Test channel preamplifier gain	3-37	11
A5R21	Channel phase balance	3-37	14
A6R2	VTO loop gain	3-41	12
A6R6	VTO loop gain	3-41	12
A6R7	VTO loop gain	3-41	12
A6R8	VTO loop gain	3-41	12
A6R14	Power amplifier bias	3-41	11
A6R16	VTO upper frequency limit	3-41	10
A7R19	Low Frequency clamp adjust	3-41	10

Table 3-3. Factory Selected Components

REFERENCE DESIGNATOR	FUNCTION AFFECTED	NORMAL RANGE OF VALUES	COMPONENT LOCATION FIGURE	ADJUSTMENT PROCEDURE FIGURE 8-11
	8410A			
A5R3	Phase detector A static output level	16.2 - 23.7KΩ	3-60	2
A5R6	Phase detector B static output level	16.2 - 23.7KΩ	3-60	2
A9R2	Triggering point of positive Schmitt trigger	68 - 100Ω	3-73	3
A9R3	Triggering point of negative Schmitt trigger	82 - 121Ω	3-73	3
A11C1	Phase relation of output signals	180 - 360 pF	3-61	9
A11C6	Test channel 270 kHz bandpass filter tuning	0 - 680 pF	3-61	9
A11C7	Phase relation of output signals	220 - 370 pF	3-61	9
A11R4	All circuit assembly gain	363 - 464Ω	3-61	9
A15R21	AGC loop gain, 2nd mixer output	2.15 - 5.62KΩ	3-57	5
A15R32	M1 OPERATE region	68.1K to 75KΩ	3-57	5
A16C10	Reference channel 270-kHz bandpass filter tuning	0 - 680 pF	3-49	6
A16R13	A16 circuit assembly gain	1.1 - 1.62KΩ	3-49	6
	8411A			
A4R21	Reference channel preamplifier gain	75 - 100Ω	3-37	11
A5C2	Channel isolation	24 - 51.1 pF	3-37	13
A6R12	VTO loop gain	50 - 90.0Ω	3-41	12

3-24. After a trouble has been located and corrected, either by performing an adjustment procedure or by replacing an assembly or component, the calibration test procedure in Figure 2-1 should be performed. This ensures that all circuits in the instrument are operating within specifications.

3-25. TRANSISTOR IN-CIRCUIT TESTING.

3-26. The common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing, the most important consideration is the transistor base-to-emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct, the diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base-emitter junction. The B part of Figure 3-3 shows transistor symbols with terminals labeled. Notice that the emitter arrow points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in NPN and PNP transistors. If the transistor base-emitter diode (junction) is forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased the transistor is cut off (open). The voltage drop across a forward-biased, emitter-base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2 - 0.3 volt when collector current is 1-10 mA, and 0.3-0.5 volt when collector current is 10-100 mA. In contrast, forward-bias voltage for silicon transistors is about twice that for germanium types; about 0.5-0.6 volt when collector current is low, and about 0.8-0.9 volt when collector current is high.

3-27. Figure 3-3, part A, shows simplified versions of the three basic transistor circuits and gives the characteristics of each. When examining a transistor stage, first determine if the emitter-base diode is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure each voltage separately with respect to a voltage common point (e.g., chassis). If the emitter-base diode is forward-biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then shift to near the supply voltage. Any difference is due to leakage current through the transistor and, in general, the smaller this current, the better the transistor. If collector voltage does not change, the transistor has either an emitter-collector short circuit or emitter-base open circuit.

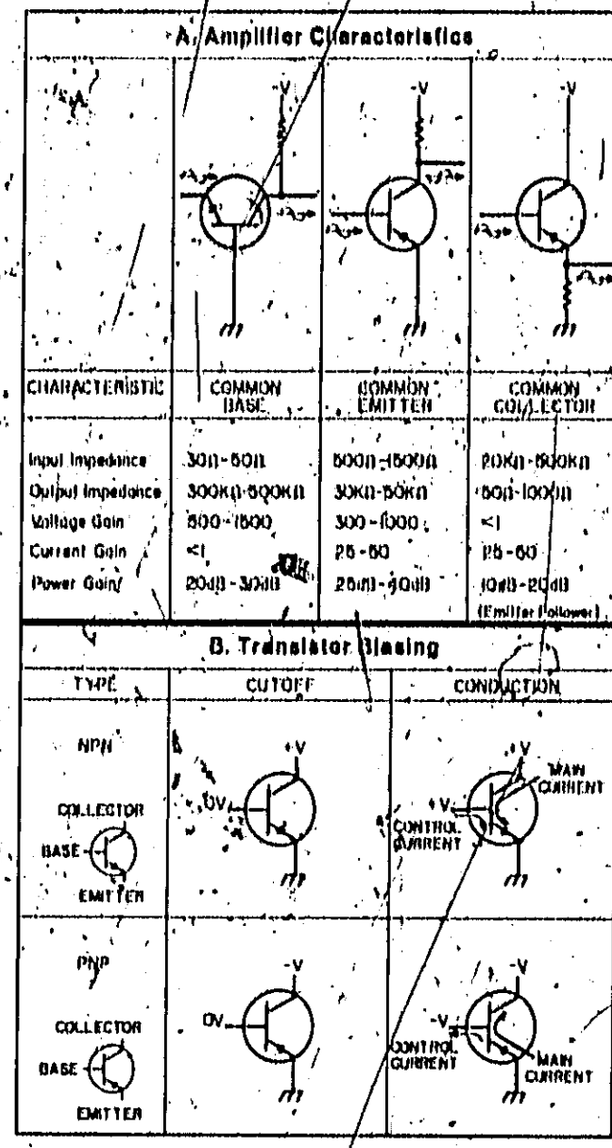


Figure 3-3. Transistor Operation

3-26. TRANSISTOR OUT-OF-CIRCUIT TESTING.

3-29. The two common causes of transistor failure are internal short and open circuits. Remove the transistor from the circuit and use an ohmmeter to measure internal resistance. See Table 3-4 for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check its open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 volts and short-circuit current must be less than 3 mA. See Table 3-5 for safe resistance ranges for some common ohmmeters.

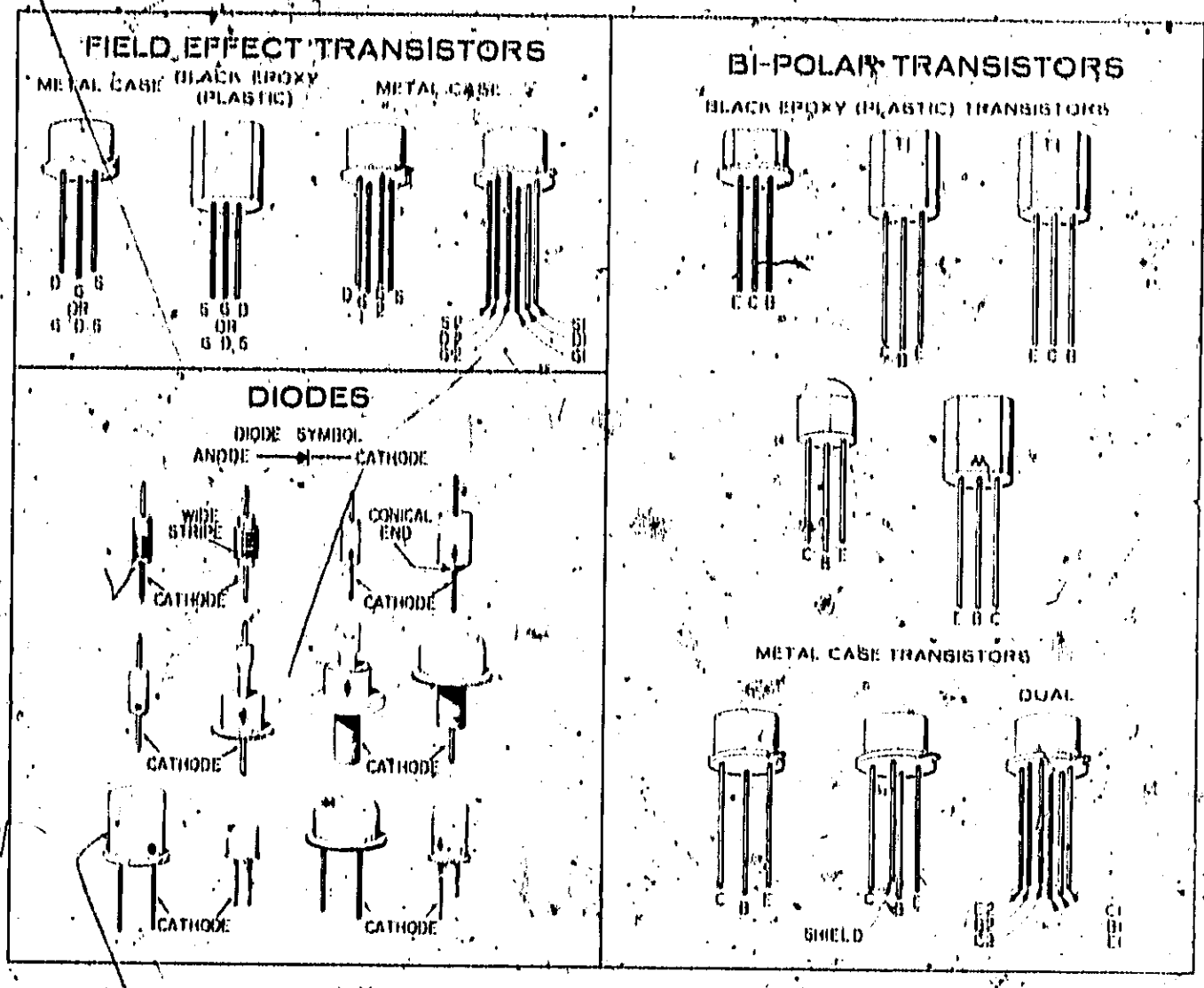


Figure 3-4. Examples of Diode and Transistor Marking Methods

3-30. STANDARD CIRCUITS.

3-31. Diode Limiter or Clipper. The limiter or clipper is a circuit which removes positive or negative peaks from a waveform. It can be used either as a waveform shaping circuit or as a protective device to prevent excessive voltages. Figure 3-5, Schematic A, shows a limiter which prevents the negative peak of the pulse from exceeding about -0.6 volt. Note that for a conducting silicon diode the cathode voltage is about 0.6 to 0.8 volt more negative than the anode. A typical diode limiter circuits is 8410A-A15CR2.

3-32. Diode Clamp. The clamper is a circuit which establishes either the positive or negative peak of a waveform at a particular dc reference voltage; in other words, it provides a definite baseline voltage for the waveform. Figure 3-5, Schematic B, shows a clamper which provides a baseline of about +20 volts for a negative pulse. A typical diode clamper circuit is 8410A-A7CR1.

3-33. Diode Regulator. A diode regulator uses either the constant reverse-bias breakdown voltage characteristic of a breakdown diode or the constant forward-bias voltage drop characteristic of a silicon diode. Power supply reference voltages are generally provided by breakdown diodes which maintain a constant voltage when supplied with a reverse-bias voltage greater than their specified breakdown voltage. Regulated voltages can also be provided by a forward-biased silicon diode which maintains a constant 0.6- to 0.8-volt drop. Figure 3-5, Schematic C, shows connections for both types of diodes. A typical circuit of this type is 8410A-A10VR3.

3-34. Transistor Amplifiers. There are three basic amplifier configurations (Figure 3-3, Part A). These amplifiers may be used alone or in combination to form complex circuits.

Table 3-4. Out-of-Circuit Transistor Testing

Transistor Type		Connect Ohmmeter: Pos. lead to	Neg. lead to	Measure Resistance (ohms)
PNP Germanium	Small Signal	emitter	base*	200-250
		emitter	collector	10K-100K
	Power	emitter	base*	30-50
		emitter	collector	several hundred
PNP Silicon	Small Signal	emitter	base*	10K-100K
		emitter	collector	very high (might read open)
NPN Silicon	Small Signal	base	emitter	1K-3K
		collector	emitter	very high (might read open)
	Power	base	emitter	200-1000
		collector	emitter	high, often greater than 1M

*To test for transistor action, add collector-base short. Measured resistance should decrease.

Table 3-5. Ohmmeters Used for Transistor Testing

Ohmmeter	Range(s)	Open Circuit Voltage	Short Circuit Current	Lead Color	Lead Polarity
HP 412A HP 427A	R x 1K R x 10K R x 100K R x 1M R x 10M	1.0V 1.0V 1.0V 1.0V 1.0V	1mA 100μA 10μA 1μA 0.1μA	Red Black	+ -
HP 410C	R x 1K R x 10K R x 100K R x 1M R x 10M	1.3V 1.3V 1.3V 1.3V 1.3V	0.57mA 57μA 5.7μA 0.5μA 0.05μA	Red Black	+ -
HP 410B	R x 100 R x 1K R x 10K R x 100K R x 1M	1.1V 1.1V 1.1V 1.1V 1.1V	1.1mA 110μA 11μA 1.1μA 0.11μA	Black Red	+ -
Simpson 260	R x 100	1.5V	1mA	Red Black	+ -
Simpson 269	R x 1K	1.5V	0.82mA	Black Red	+ -
Triplett 630	R x 100 R x 1K	1.5V 1.5V	3.25mA 325μA	Varies with Serial Number	
Triplett 310	R x 10 R x 100	1.5V 1.5V	750μA 75μA		

3-35. Transistor Biasing And Conduction. In a transistor a small base-to-emitter current controls a large collector-to-emitter current. Typical NPN transistor and PNP transistor operation is shown in Figure 3-3, Part B; indicated current represents conventional flow of positive charges external to the transistor and is not intended to indicate flow of carriers inside the transistor structure. Notice that the effect of emitter-base-collector voltages is totally reversed between NPN and PNP transistors; circuits which are arranged for an NPN transistor usually function normally for a PNP transistor if supply voltages are reversed.

3-36. Trigger Circuit. The trigger circuit (Figure 3-6, Schematic A) is a limiter or squaring circuit which produces an output waveform with very fast rise and fall times. The trigger circuit is similar to the flip-flop except that the RC network in one half is replaced by the input signal. Capacitor C1 bypasses R3 to couple fast changes in voltage at the Q1 collector to the base of Q2. Either Q1 or Q2 can conduct depending on the voltage at the input. Note that there is a slight difference in input voltage (called hysteresis) between switching with a negative-going input (time t_1) and switching with a positive-going input (time t_2). A typical circuit of this type is 8410A-A8Q1 and Q2.

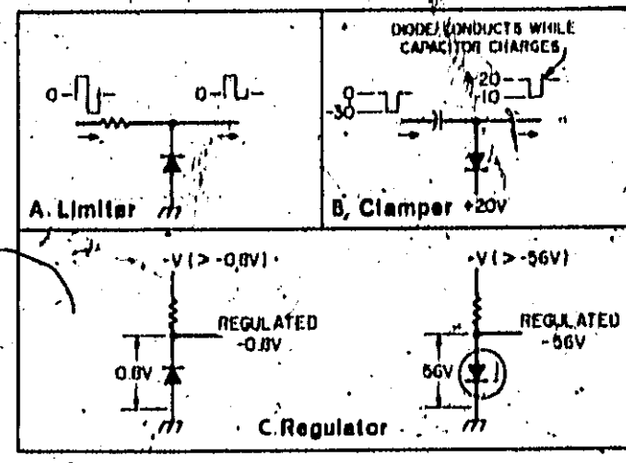


Figure 3-6. Basic Diode Circuits

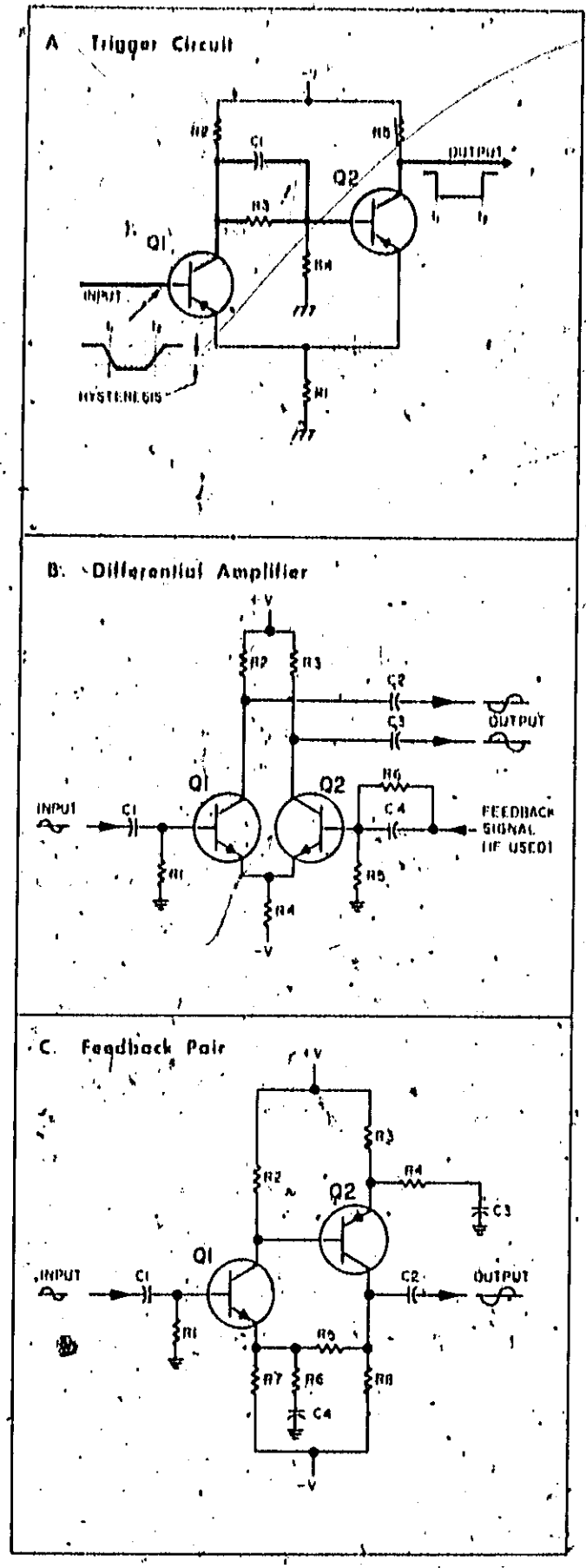


Figure 3-6. Basic Transistor Circuits

3-37. Differential Amplifier. The differential amplifier (Figure 3-6, Schematic B) is composed of two transistor stages coupled together in the emitter circuit. Signals at the output of the two collectors are 180 degrees out of phase, inverse feedback may be applied to the base of Q2, as shown. As voltage at the emitter of Q1 changes, the emitter of Q2 also changes by the same amount. This changes the base-to-emitter bias of Q2. If a more negative voltage were applied to the base of Q1, current through Q1 would decrease, causing the emitter of Q1 to go in the negative direction. A negative-going voltage at the emitter of Q2 increases the effective forward bias between base and emitter of Q2, causing it to conduct more heavily. Therefore, when current through Q1 decreases, current through Q2 increases. A typical circuit of this type is 8401A-A14Q1 and Q2.

3-38. Feedback-Pair Amplifier. The feedback-pair amplifier (Figure 3-6, Schematic C) is a high-gain direct-coupled amplifier stage composed of an NPN and a PNP transistor cascaded together. Feedback in the pair is accomplished by an RC network between the collector of Q2 and the emitter of Q1. Voltage gain of the stage may be calculated by the formula R5 plus R6 divided by R6. Gain through the amplifier may be changed by selecting either R5 or R6. A typical circuit of this type is 8410A-A4Q5 and Q6.

3-39. Field Effect Transistor (FET). Field effect transistors (Figure 3-7) have three terminals: source, drain, and gate which correspond in function to emitter, collector, and base of junction transistors. Source and drain leads are attached to the same block (channel) of N or P semiconductor material. A band of oppositely doped material around the channel (between the source and drain leads) is connected to the gate lead.

3-40. In normal FET operation, the gate-source voltage reverse-biases the PN junction, causing an electric field that creates a depletion region in the source-drain channel. In the depletion region the number of available current carriers is reduced as the reverse-biasing voltage increases, making source-drain current a function of gate-source voltage. With the input (gate-source) circuit reverse-biased, the FET presents a high impedance to its signal source (as compared with the low impedance of the forward-biased junction transistor base-emitter circuit). Because there is no input current, FET's have less noise than junction transistors. Figure 3-7 shows the schematic symbol and biasing for N channel and P channel field effect transistors.

3-41. REPAIR

3-42. PART LOCATION AIDS.

3-43. The locations of chassis-mounted parts and major assemblies is shown in Figures 3-19 and 3-20. The locations of individual components mounted on a printed circuit board are shown opposite the appropriate schematic diagram. The part reference designator may be found from the schematic diagram.

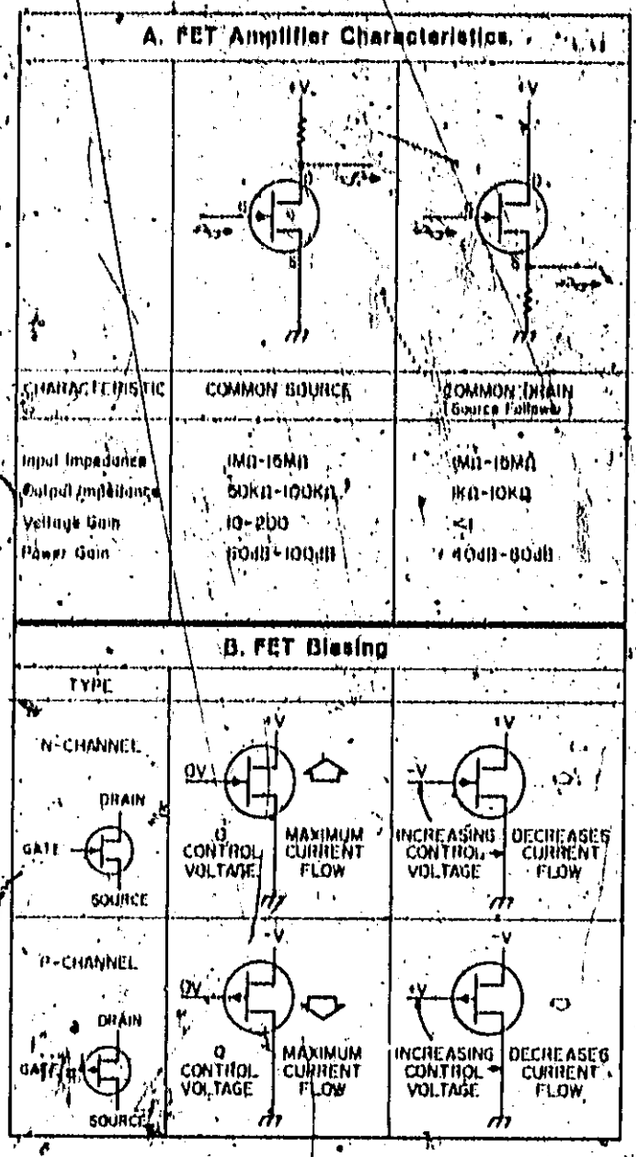


Figure 3-7. Field Effect Transistor Operation

then located on the board. For specific component description and ordering information refer to the Table of Replaceable Parts, Tables 3-8 and 3-9.

3-44. REPLACING FACTORY-SELECTED COMPONENTS.

3-45. The value of some components in the 8410A and 8411A is selected at the factory according to its affect in the circuit. A list of Factory-Selected components is presented in Table 3-3. This table describes the function affected by the component, the range of values used, and the adjustment procedure for selecting the correct value. The recommended procedure for replacing a Factory-Selected part is as follows:

a. Try original value, then perform calibration test for that circuit.

b. If calibration test cannot be passed, try typical value listed in Table of Replaceable Parts, Table 3-8 or 3-9.

c. If calibration test still cannot be passed, perform adjustment procedure for that circuit using component values in the range given in Table 3-3, "RANGE OF VALUES" column.

3-46. SPECIAL INSTALLATION INSTRUCTIONS.

3-47. Replacement of certain components in the 8410A and 8411A requires special procedures to prevent damage to parts and to complete proper installation. Components which require special procedures are the following:

a. Cable 8411A-W1.
b. Samplers 8411A-A1 and A2.
c. Power Amplifier 8411A-A3.
d. 8411A Heliline.
e. Step Generator Diode 8411A-CR1.
f. Connector 8410A-J1.

3-48. 8411A cable W1, HP Part No. 08411-6013, includes a kit which contains additional parts required to install the cable.

Parts Included in the Cable Replacement Kit

Qty	Description	HP Part No.
1	Cable Assembly	08411-6013
3	Coax Feed-thru	08411-2017
1	Service Note	P-08411-6013

To replace cable W1 perform the following:

a. Preparation of 8411A.

(1) Cut off old wires and coaxial leads where they enter the 8411A casting (inside).

(2) Remove boot and old cable.

b. Installation of Cable.

Note

New cable has braid pulled over wires and coaxial leads. Braid is pointed to allow easy installation into 8411A.

(1) Carefully insert cable (with clamp-washer and boot installed on cable) into 8411A casting hole.

(2) When three to four inches of braided cable are inside casting, cut braid away from cable at a point about 1/4 inch from clamp-washer.

Note

Clamp-washer must be firmly against cable jacket.

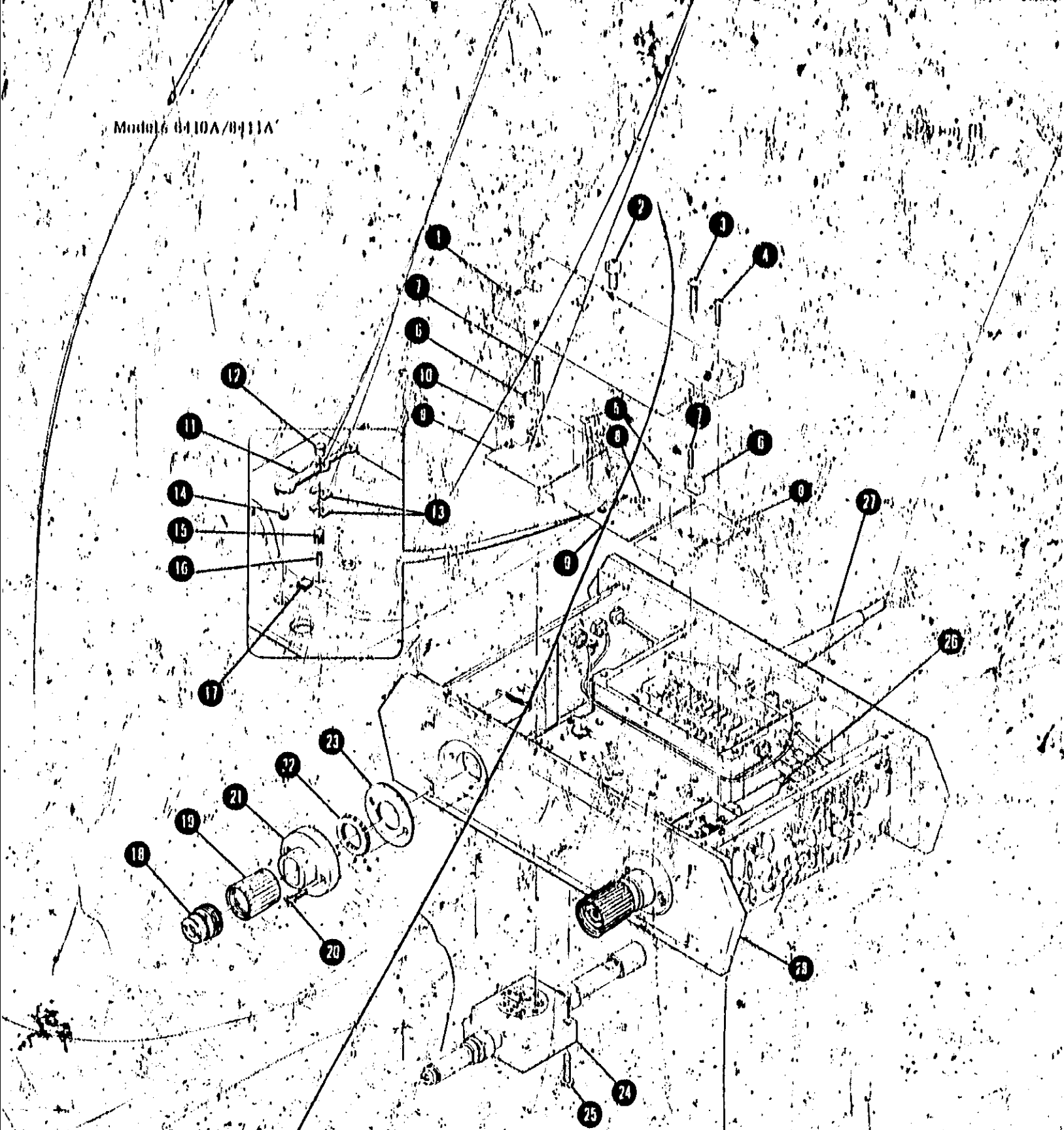
(3) Flare braid over clamp-washer and trim at largest diameter shoulder of clamp-washer.

(4) Carefully insert cable with clamp-washer as far as possible into casting.

(5) Rotate cable until black wire is uppermost.

Note

Boot must be tightened enough to cut rubber washer.



1. Stripline Cover
2. Nylon Screw, 0-32 x 5/16
3. Screw, 0-32 x 7/16
4. Screw, 2-56 x 3/8
5. Stripline Jumper
6. Mixer Coaxial Clamp
7. Nylon Screw, 2-56 x 3/8
8. Stripline Resistor R1 and R2
9. Stripline Assy (end sections plus 5, 8 and 17)
10. Screw, 2-56 x 3/8
11. Step Recovery Diode Contact
12. Step Recovery Diode CR1
13. Mylar Shim
14. Pellet Resistor R3
15. Sliding Contact
16. Compression Spring
17. Stripline Capacitor C1
18. Coupling Sleeve, Type APC-7
19. Coupling Nut, Type APC-7
20. Screw, 4-40 x 1 2
21. RFI Front Cover
22. RF Shielding Gasket
23. RF Front Gasket
24. Sampler Assembly A1
25. Screw, 0-32 x 5 8
26. Sampler Assembly A2
27. Interconnect Cable Assy A1-A2
28. Bottom

Figure 3-8. 8411A Exploded View

(16) Hold wires firmly in place while moving boot against casting and tighten in place.

(17) One at a time remove the old unshielded color-coded wires in the 8411A and replace with same color-coded wires from new cable. Insert white wire with red strip thru hole in casting. This wire will be connected later.

(18) Remove old white coaxial cable and install center conductor with ferrite beads and shield of new white coaxial line.

(19) Loosen mounting screws of 8411A-A4 circuit board and disconnect center conductor of red lead.

(20) Remove old red coaxial lead and old metal feed-thru from casting wall.

(21) Insert new red coaxial lead through right casting hole.

Note

Before installing new metal feed-thru in second casting wall, red coaxial lead wire should be installed and shield should be soldered to get sufficient heat on solder joint. Center conductor dielectric is teflon and will not be damaged by solder-ing held applied to metal feed-thru.

(22) Put center conductor lead through metal feed-thru. Extend shield over the new metal feed-thru and solder shield to feed-thru.

(23) Install, metal feed-through in second casting wall and tighten in place with nut from original feed-thru.

(24) Tighten mounting screws of 8411A-A4 circuit board and connect conductor of red coaxial lead.

(25) Using above procedure, steps (8) thru (24), install blue coaxial lead in other casting wall and connect to 8411A-A5.

(26) Turn 8411A over, remove A7 Assy mounting screws and carefully lift end of A7 Assy closest to cable end of 8411A to expose wires under the assembly.

Note

The brown coax cable and white wire with red strip are used in automatic systems only. For standard systems they may be cut off where they enter the 8411A. However, the old cable must be removed to prevent ground loop problems. If the brown coax is to be connected the outer conductor (shield) between the circuit board and feed-thru will be re-installed on the new center conductor.

(27) Unsolder, brown coax center conductor and shield from A7 Assy and cut off exposed center conductor to prevent damage to shield when removing center conductor.

(28) Remove feed-thru retaining nut, feed-thru and old center conductor from casting.

(29) Put new center conductor lead thru metal feed-thru. Extend shield over new metal feed-thru and solder shield to feed-thru.

(30) Insert center conductor and feed-thru in casting. Carefully insert center conductor thru old outer conductor, install outer conductor ground lug and feed-thru retaining nut on feed-thru and tighten nut.

(31) Connect center conductor and outer conductor to A7 Assembly.

(32) Replace old white wire with red strip with wire from new cable.

(33) Replace A7 Assembly mounting screws.

3-40. Sampler Assemblies 8411A-A1 and A2. To replace sampler, perform the following:

a. HANDLING PRECAUTIONS.

(1) When attaching leads to the diode posts exert as little pressure as possible. Excessive pressure will break the diode.

(2) Do not allow the sampler to rest on the diode posts.

(3) The sampler diodes are sensitive to transients. When connecting leads to diode posts, always (a) connect the ground lead first, (b) discharge any energy stored in the other lead by grounding it, and (c) make connection to diode post.

(4) Diodes may be damaged if placed in presence of large electrostatic fields.

b. REMOVAL PROCEDURE.

(1) Remove APC-7 connector (Figure 3-6, Items 18 and 19) using spanner wrench, HP Stock Number 5060-0237 (supplied in Accessory Kit 11667A and APC-7 Connector Tool Kit 11501A).

(2) Remove the two Phillips-head screws (20) holding the cover (21) located behind the APC-7 connector. Remove the cover and the parts under the cover, noting the order of removal.

(3) Remove clip-on leads from both sides of sampler (24) and push leads into hole in casting.

Note

When plastic stripline cover, Figure 3-6, Item 1, is removed, step recovery diode (12), Mylar shims (13), and pellet resistor (14) are loose and should be removed to prevent loss.

(4) Remove metal screws (3 and 4) from plastic stripline cover (1) and remove cover.

CAUTION

End section of stripline board is held by the stripline resistor only. Excessive movement will damage resistor.

(5) Remove mixer coax clamp (6) and two metal screws (10) from end section of stripline board.

(6) Unsolder one end of stripline jumper (5) and remove end section stripline board.

(7) Remove the four Phillips-head screws (25) holding the sampler in place and lift sampler from casting.

c. INSTALLATION PROCEDURE.

(1) Insert new sampler into casting and install the four Phillips-head screws (25) to hold sampler in place. Do not tighten screws.

(2) Install cover (21) and other parts removed in Removal Instructions, Step b-2, in reverse order of removal. Tighten the two Phillips-head screws (20) evenly.

(3) Install the APC-7 connector (18 and 19).

(4) Align the sampler mechanically so that the distance from center to center of the two APC-7 connectors is 4.750 inches. Tighten the four screws (25) to secure the sampler. To check mechanical alignment of the sampler, connect the 8411A to an 8740A, 8741A, or 8742A.

CAUTION

Center conductor will break with excessive bending.

(5) Insert 0.005-inch-diameter center conductor of sampler drive coax through hole in end section of stripline.

(6) Install the two metal screws (10) holding the end section of stripline in place. Do not tighten screws.

Note

Use a microscope with vertical illuminator to center the hole over the outer conductor of the sampler drive coax.

(7) Carefully center the 0.016-inch-diameter hole in the stripline over the outer conductor of the sampler drive coax and tighten the two metal screws (10) to secure the end section of the stripline.

(8) Cut center conductor of drive coax about 1/8 inch above stripline.

(9) Bend center conductor of drive coax to place it along center of stripline.

(10) Carefully install plastic clamp (6) and tighten screw (7).

(11) Resolder stripline jumper (5).

(12) Install step-recovery diode (12), Mylar spacers (13), and pellet resistor (14) if removed.

(13) Install plastic stripline cover (1).

(14) Ground each clip of clip-on leads to casting, then connect clip-on leads to each side of sampler.

(15) Perform adjustment Procedures 11 and 13 of Figure 3-11 then Calibration Test, Figure 2-1.

3-50. Power Amplifier Assembly 8411A-A3. To replace power amplifier, perform the following:

a. POWER AMPLIFIER REMOVAL.

(1) Remove six Phillips-head screws from base of power amplifier.

(2) Turn the 8411A upsidedown and remove plastic stripline cover (Figure 3-8, Item 1).

(3) Remove step generator diode (12) and Mylar shims (13) under diode.

Note

Apply minimum amount of heat to avoid damage to stripline.

(4) Unsolder connection of stripline from step generator to power amplifier.

(5) Disconnect leads and remove power amplifier assembly from casting.

b. POWER AMPLIFIER INSTALLATION.

(1) Clean solder from hole in stripline board (Figure 3-8, Item 9).

(2) Place the power amplifier assembly in the casting.

(3) Install and tighten the six Phillips-head screws in the base of the power amplifier.

(4) Solder the power amplifier connection to the stripline board.

(5) Reinstall step generator diode (12) and Mylar shims (13).

(6) Remove plastic screw (2) from the plastic stripline cover (1), and install cover.

(7) Install plastic screw (2) in stripline cover (1).

(8) Reconnect all leads to the power amplifier.

(9) Adjust 8411A-A6R14 (power amplifier bias adjust). See adjustment procedure Figure 3-11, Test 11.

(10) Check alignment of 8411A tuning voltage shaping amplifier, Figure 3-11, Test 12.

3-51. Step Generator Diode 8411A-CR1. To replace step generator, perform the following:

a. Remove plastic stripline cover (Figure 3-8, Item 1).

b. Remove step-generator diode (12).

c. Install new diode, with Mylar shims (13) positioned as shown in Figure 3-8.

d. Remove plastic screw (2) from the plastic stripline cover (1) and replace cover.

CAUTION

Overtightening plastic screw (2) may damage stripline capacitor C1.

e. Insert plastic screw (2) in stripline cover (1). Tighten only until finger tight.

f. Check alignment of 8411A Tuning Voltage Shaping Amplifier, Figure 3-9, Test 12.

3-52. STRIPLINE in 8411A. To replace stripline, perform the following:

a. Remove metal screws from plastic stripline cover (Figure 3-8, Items 3 and 4) and remove cover.

b. Remove step-recovery diode (12) and Mylar shims (13) under diode.

c. To replace stripline end section:

(1) Remove plastic mixer coax clamp (6) and two metal screws (10) from end section of stripline.

(2) Unsolder one end of stripline jumper (5) and remove end section of stripline.

(3) Insert 0.005-inch-diameter center conductor of drive coax through hole in end section of stripline

CAUTION

Center conductor will break with excessive bending.

(4) Insert the two metal screws (10) to hold the end section of stripline in place. Do not tighten screws.

Note

Use a microscope with vertical illuminator to center the hole over the outer conductor of the drive coax.

(5) Carefully center the 0.018-inch-diameter hole in the stripline over the outer conductor of the drive coax and tighten the two metal screws (10) to secure the end section of the stripline.

(6) Bend center conductor of drive coax, placing it along center of stripline.

(7) Carefully install plastic mixer coax clamp (6) and tighten screw (7).

(8) Resolder stripline resistor (8).

d. To replace stripline center section:

(1) Unsolder one end of each stripline jumper (5).

NOTE

The step-recovery diode contact (11) is soldered to both the power-amplifier connection and the stripline capacitor (17). Applying heat to the power-amplifier connection will most likely unsolder the connection at the stripline capacitor, if not, apply a minimum amount of heat to unsolder the stripline capacitor connection to avoid damaging the capacitor.

(2) Unsolder power amplifier connection to stripline and remove step-recovery diode contact (15 and 16) and stripline center section.

(3) Remove pellet resistor (14) from old stripline center section and install on new stripline center section.

(4) Insert new stripline center section and hold in place temporarily with three short screws (3).

NOTE

To prevent damage to the stripline capacitor the step-recovery diode contact is soldered to the stripline capacitor. The solder provides a flat surface on the capacitor. Any force applied to the contact will then be evenly distributed over the capacitor's top surface.

(5) Tin the step-recovery diode contact where it will connect to the stripline capacitor. Solder the contact at the power amplifier connection. If necessary, apply a minimum amount of heat at the stripline capacitor connection to allow the solder to flow over the top surface of the capacitor.

e. Install step recovery diode (12) with Mylar shims (13) under diode.

f. Remove plastic screw (2) from stripline cover (1).

g. Install plastic stripline cover.

h. Insert plastic screw (2) in stripline cover (1).

i. Perform Adjustment Procedures 11 and 13 of Figure 3-11, then Calibration Test, Figure 2-1.

3-53. Input Connector 8410A-J1. To replace connector J1, perform the following:

a. To replace an individual cable to 8410A-J1, perform the following procedure:

(1) Insert Burndy[1] Tool RX20-26V2 into Connector J1 over pin of cable to be replaced.

(2) Force the pin out the rear of the connector.

(3) Insert the new pin (with cable attached) into the rear of the connector and force the pin into the connector until it is locked in position.

b. To replace the connector body of 8410A-J1, perform the following procedure:

(1) Remove knurled nut on front panel side of connector.

[1] Burndy Corporation, Norwalk, Connecticut.

3-54. PRINTED CIRCUIT BOARDS.

3-55. The printed circuit boards in the 8410A and 8411A are of the plated through type consisting of metallic conductors bonded to both sides of insulating material. Soldering can be done from either side of the board with equally good results. Table 3-6 lists required tools and materials. Following are recommendations and precautions pertinent to printed circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and adjacent components.

b. Do not use a high-power soldering iron. Excessive heat may lift a conductor or damage the board.

c. Use a suction device (Table 3-6) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered area and apply a protective coating to prevent contamination and corrosion. See Table 3-6 for recommendations.

3-56. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

3-57. Component Replacement. A general procedure for replacing a component is as follows:

a. Remove defective component from circuit board.

b. Remove solder from mounting holes using a suction desoldering aid (Table 3-6) or wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

Table 3-6. Printed Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage ratings: 37.5 Tip Temp: 750 - 800° F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip general purpose	Soldering Unsoldering	Shape: chisel Size: 1/8"	Ungar #PL113
De-soldering aid	Unsoldering multi-connection components (e.g., sockets)	Suction device to remove molten solder from connection	Soldapullt by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Acetone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	GE Dri-Film 88 General Electric Co. Silicone Products Div. Waterford, N.Y.

d. Insert component leads into mounting holes and position component as original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp lead ends may damage plated-through conductor.

Note

Axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

3-58. Transistor Replacement. A general procedure for replacing a transistor is as follows:

a. Do not apply excessive heat. See Table 3-6 for soldering tool specifications.

b. Use a heat sink such as pliers or hemostat between transistor body and hot soldering iron.

c. When installing a replacement transistor, ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for original transistor.

3-59. Diode Replacement. Solid state diodes are in many physical forms. This sometimes results in confusion as to which lead or connection is for the cathode (negative) or anode (positive), since not all diodes are marked with the standard symbols. Figure 3-4 shows examples of some diode marking methods. If doubt exists as to polarity, an ohmmeter may be used to determine the proper connection. It is necessary to know the polarity of the ohms lead with respect to the common lead for the ohmmeter used. Ohms lead polarities for some common ohmmeters are shown in Table 3-5. When the ohmmeter indicates the least diode resistance, the cathode of the diode is connected to the ohmmeter lead which is negative with respect to the other lead.

Note

Diode replacement instructions are the same as those for transistor replacement.

3-60. REPLACEABLE PARTS.

3-61. INTRODUCTION.

3-62. Model 8410A parts are listed in Tables 3-8 and 3-10. Model 8411A parts are listed in Tables 3-9 and 3-11. Parts in Tables 3-8 and 3-9 are listed in alpha-numerical order by reference designation together with their HP stock numbers and descriptions. Miscellaneous and cabinet parts not indexed by reference designation are listed at the ends of the tables. Tables 3-10 and 3-11 list parts in alpha-numerical order of the HP stock number and provides the following information on each part:

a. Description of the part. (Refer to list of abbreviations in Table 3-7.).

b. Typical manufacturer of the part in a five-digit code. (Refer to code list of manufacturers in Table 3-12.)

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

Table 3-7 lists reference designators and abbreviations used in Tables 3-8 through 3-11.

3-63. ORDERING INFORMATION.

3-64. When ordering a replacement part listed in Table 3-8 through 3-11:

a. Quote the Hewlett-Packard stock number for the part.

b. Address the order or inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

To order a part not listed in the tables:

a. Give a complete description of the part including its function and location.

b. Give the instrument model number and complete serial number.

c. Address the order or inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

3-65. SCHEMATIC DIAGRAMS.

3-66. The schematic diagrams in this section represent the circuits electrically. They are not wiring diagrams, though wire colors are given where practical.

3-67. The circuits are arranged according to signal flow; consequently, some switch and circuit assemblies may be shown in part on more than one diagram. If so, the reference designation is preceded by P/O, for "Part Of", and is followed by a notation of the number of parts into which the assembly has been divided.

3-68. The large numbers in the lower right corners of the schematics are the schematic numbers. These numbers are used to cross reference connections between schematics.

3-69. Some of the general information obtainable from the schematic diagrams is shown in Figure 3-9. Notes and explanations of symbols pertaining to all the diagrams are contained in Figure 3-10. Figure 3-10 also contains the test setup and measurement conditions required to obtain the normal test point waveforms and voltages noted on the schematic diagrams. Notes about specific components, circuits, or conditions are given on the diagram to which they apply.

3-70. As an aid to finding components and assemblies in the set of diagrams, each diagram has a box labelled Reference Designations that contains all the reference designations appearing on the diagram.

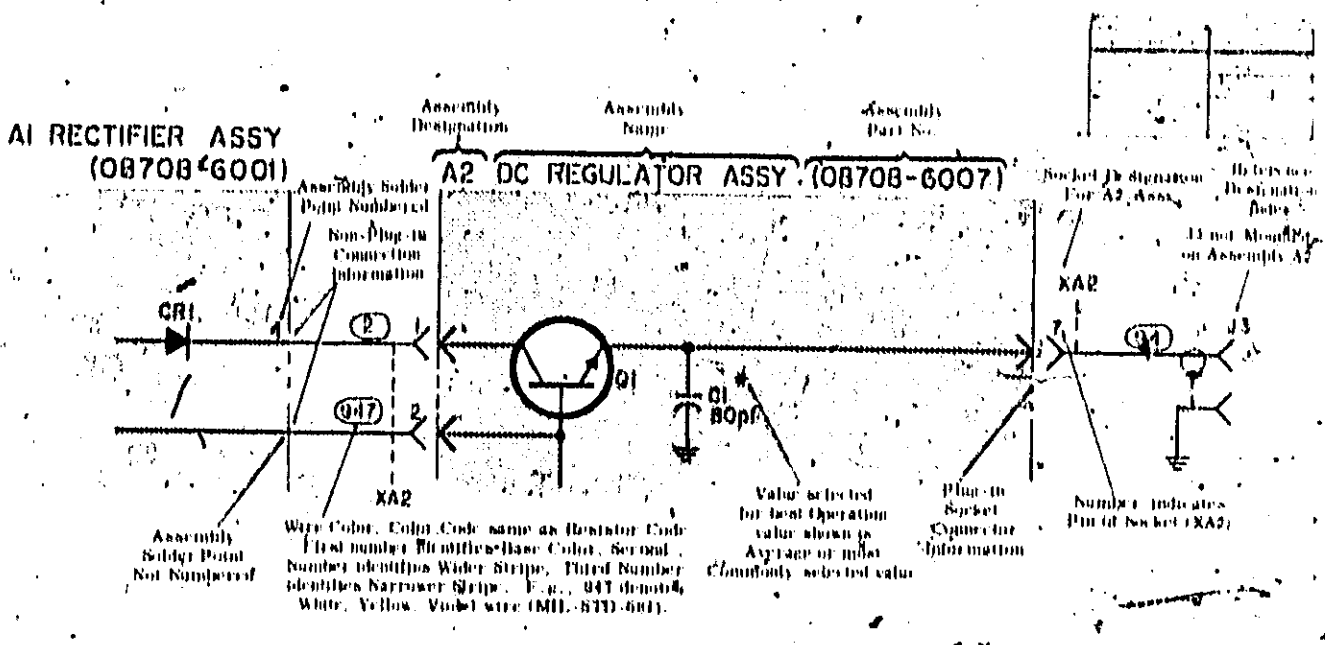
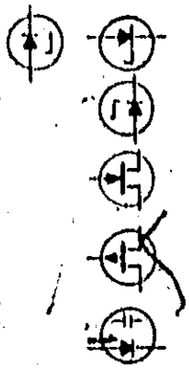


Figure 3-9. General Information on Schematic Diagrams

1. Resistance is in ohms and capacitance is in microfarads unless otherwise noted.
2. P/O = part of.
3. *Asterisk denotes a factory-selected value. Value shown is typical. Capacitors may be omitted or resistors jumpered.
4. Screwdriver adjustment.
5. Panel control.
6. Encloses front panel designations.
7. Encloses rear panel designation.
8. Circuit assembly borderline.
9. Other assembly borderline.
10. Heavy line with arrows indicates path and direction of main signal.
11. Heavy dashed line with arrows indicates path and direction of main feedback.
12. CW Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
13. Numbers in circles on circuit assemblies show locations of test points.
14. Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number indentifies the base color, second number the wider stripe, and the third number identifies the narrower stripe, E.g., (947) denotes white base, yellow wide stripe, violet narrow stripe.

Figure 3-10. Schematic Diagram Notes (Sheet 1 of 3)

11. 

Voltage regulator (breakdown diode).

Step recovery diode.

Field effect transistor with N-type base.

Field effect transistor with P-type base.

Capacitive diode (Varicap, varactor).

12. CONDITIONS FOR DC VOLTAGE AND WAVEFORM MEASUREMENT

a. LINE VOLTAGE: 115 VAC ±10% or 230 VAC ±10%, 50-60 Hz.

b. 8410A CONTROL SETTINGS

FREQ RANGE (GHz)	to include frequency applied to 8411A inputs
SWEEP STABILITY	CW detent
TEST CHANNEL GAIN	60
AMPL VERNIER	max. clockwise
PHASE VERNIER	centered (approximately)

c. Connect equipment as shown in standard test setup. Adjust signal source for a power level of -30 dBm at the 8411A REFERENCE port and -10 dBm at the 8411A TEST port. Amplitudes given throughout the 8410A and 8411A assume these power levels at the 8411A input ports.

d. To check SEARCH waveforms, disconnect RF input from signal source and set 8410A FREQ RANGE switch to maximum clockwise position (0.1-0.25 GHz).

e. To view most waveforms in the 8411A, a Sampling Oscilloscope or Spectrum Analyzer must be used. Waveforms shown on the 8411A schematics are obtained using Sampling Oscilloscope HP Model 140A with HP 1411A, 1424A, and 1430A plug-in units. Waveforms at the stripline are taken using 10:1 divider probe HP 10201B; waveforms at the power amplifier and VTO are taken using 100:1 divider probe HP 10201D and blocking capacitor HP 10217A. Information is also given in the troubleshooting procedure for using SPECTRUM Analyzer HP Model 851B and 8551B with 10:1 divider probe HP 10003A.

f. DC voltages shown on the schematic diagrams should be taken with a digital voltmeter with 10 megohm input impedance and 0.05% accuracy.

g. Some of the dc voltages in 8410A-A7 and 8410A-A8 are shown as fractions. The numerator is the voltage during search conditions (no RF input signal to 8411A). The denominator is the voltage during phase-locked condition.

h. DC voltages at 8410A-A4 and 8410A-A5 are taken with 8411A disconnected from 8410A.

Figure 3-10. Schematic Diagram Notes (Sheet 2 of 3)

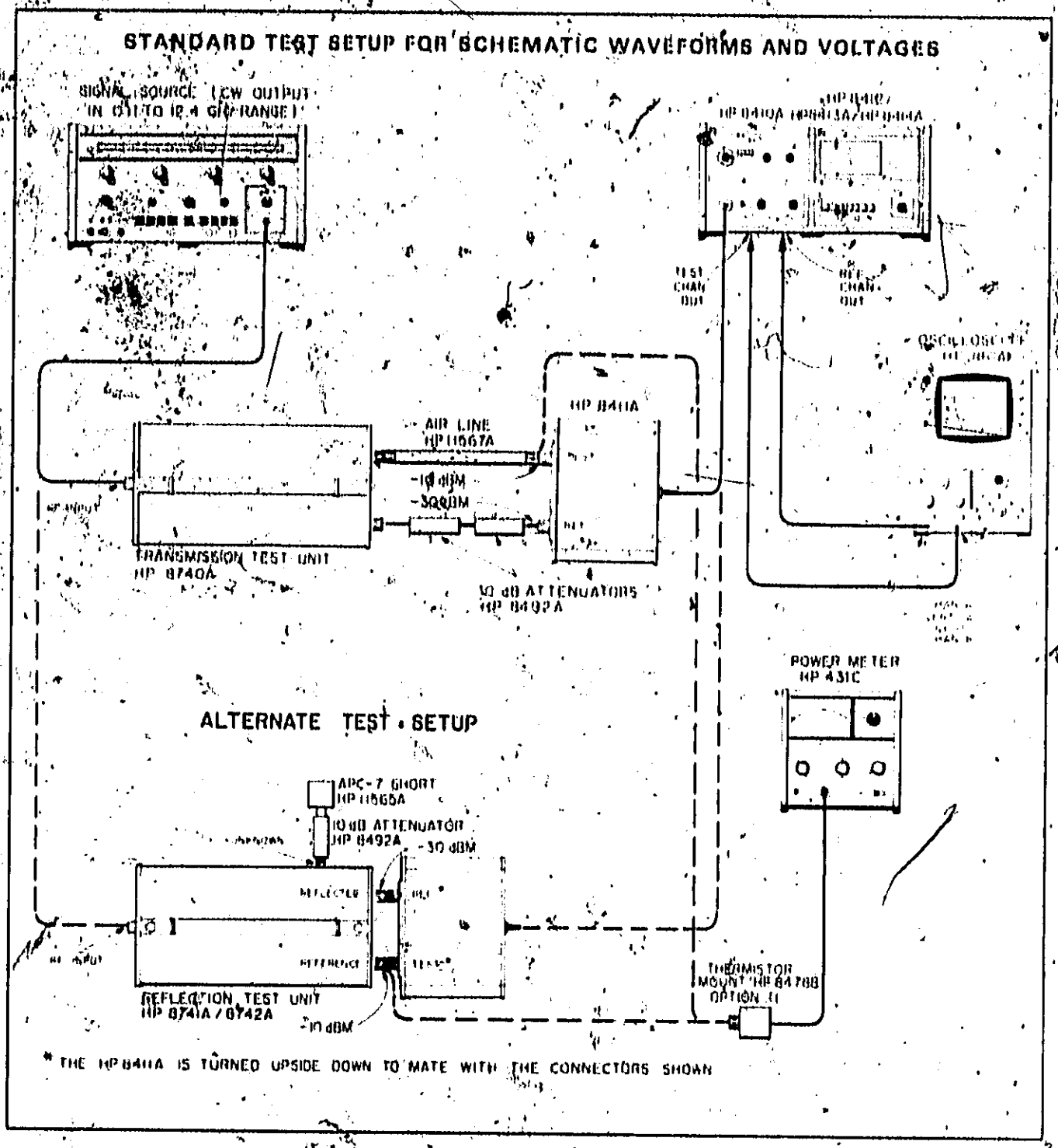


Figure 3-10. Schematic Diagram Notes (Sheet 3 of 3)

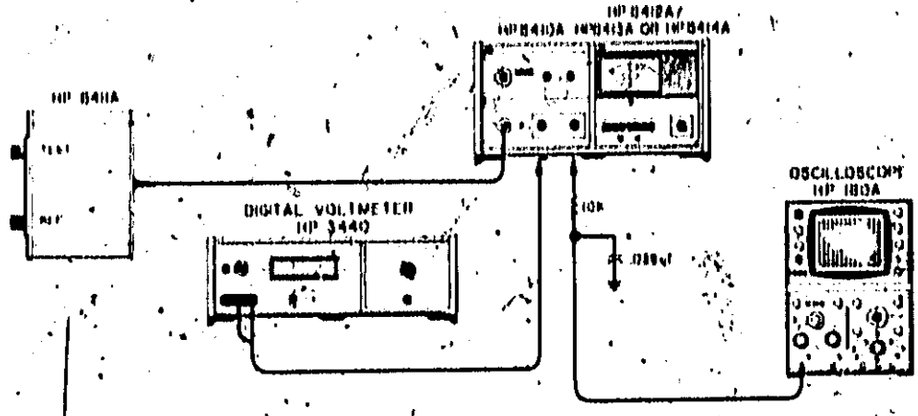
TEST	DESCRIPTION AND PROCEDURE
	Note Before any adjustments are made, (1) allow 30 minutes warmup to obtain normal operating temperature on all components, and (2) check that AC input power is 115 or 230 Vac ±10%.
1	**CIRCUIT** 8410A POWER SUPPLY ASSEMBLY A10A1. (Adjust A10A1R9 and A10A1R22.)
	DESCRIPTION The 8410A's +20 and -20 volt power supplies are each measured with a dc voltmeter and adjusted to ±20.00 volts. The ac ripple is monitored on an oscilloscope to check for proper filtering.
	TEST SETUP  TEST EQUIPMENT: Items 5 and 11, Table 3-1.
	PROCEDURE a. Connect equipment as shown in test setup above. Connect a 400 Hz low-pass filter consisting of a 10 Kilohm resistor and a 0.039 µF capacitor to oscilloscope input as shown in test setup. b. Remove 8410A top cover. c. Turn on 8410A power. d. Connect oscilloscope and dc voltmeter to test points below and make adjustments if necessary. **Note** Power supply voltages should not be adjusted unless very accurate measurement indicated that they are out of tolerance.

Figure 3-11. Adjustment Procedure (Sheet 1 of 25)

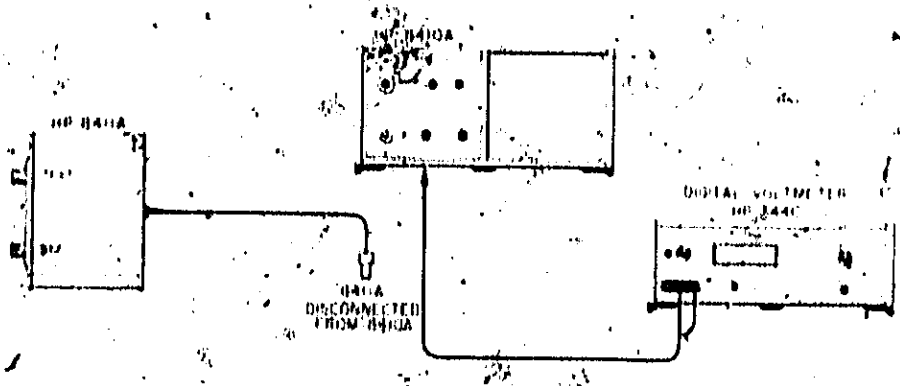
TEST	DESCRIPTION AND PROCEDURE			
1 (Cont.)	TEST POINT	DC VOLTMETER INDICATION	OSCILLOSCOPE WAVEFORM	ADJUSTMENT
	A10A1TP2	-20.00 ±0.01 Vdc*	2.5 mV p-p max.	A10A1R32*
	A10A1TP1	-20.00 ±0.01 Vdc*	2.5 mV p-p max.	A10A1R8*
	* If either supply cannot be adjusted, get as close as possible to -20.00 V.			
2	CIRCUIT 8410A PHASE DETECTOR ASSEMBLY A5. (Select A5R3 and A5R6). DESCRIPTION The phase error signals at the output of phase detector assembly A5 (A5TP1 and A5TP2) should be zero with no RF signal applied to the 8410A input from the 8411A. The phase error signals from phase detectors A and B should be zero Vdc and are checked at the base of emitter followers A5Q1 and A5Q2. The zero-Vdc signal produces a negative voltage at the emitters of A5Q1 and A5Q2. The emitters are connected to output test points A5TP1 and A5TP2 through diodes A5CR9 and A5CR10 which offset the negative voltage back to zero. Conduction through the diodes is adjusted to obtain zero dc output by selecting the resistance values of A5R3 and A5R6. TEST SETUP  TEST EQUIPMENT: Item 11, Table 3-1. PROCEDURE Select A5R3 a. Connect dc voltmeter to A5TP1. If indication is zero ±50 mV, phase detector A is operating correctly and no adjustment of A5R3 is necessary; proceed to step d and check phase detector B.			

Figure 3-11. Adjustment Procedure (Sheet 2 of 26)

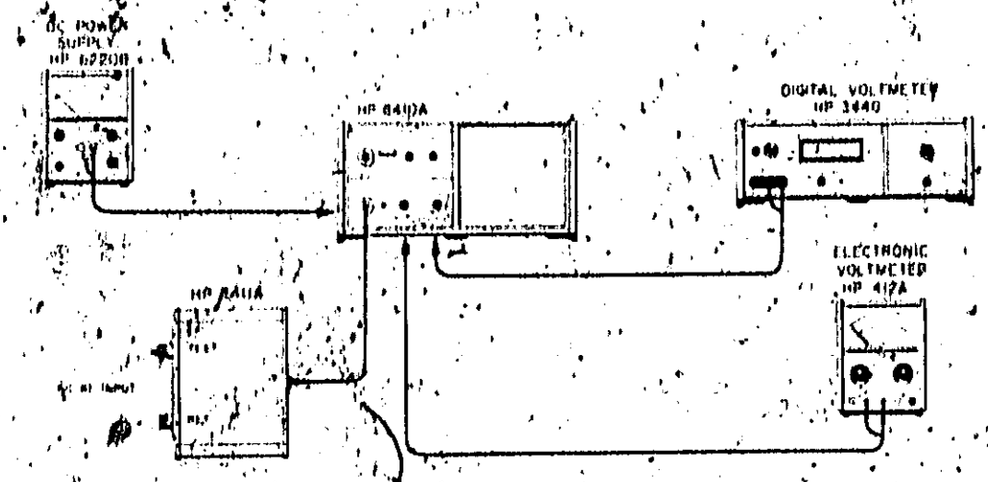
TEST	DESCRIPTION AND PROCEDURE
2 (Cont.)	b. Connect dc voltmeter to A6Q1 base. If indication is zero ± 25 mV, proceed to step c. If indication is not zero ± 25 mV, troubleshoot phase detector A using procedures in Figure 3-6B. c. Connect dc voltmeter to A5TP1 and select the value of A6R3 for zero ± 50 mV indication. Typical range of values for A6R3 is 16.2 Kilohm to 23.7 Kilohm. Select A6R6 d. Connect dc voltmeter to A5TP3. If indication is zero ± 50 mV, no adjustment of A6R6 is necessary and adjustment of phase detector assembly A6 is complete. If indication is not zero ± 50 mV, proceed to step e. e. Connect dc voltmeter to A6Q2 base. If indication is zero ± 25 mV, proceed to step f. If indication is not zero ± 25 mV, troubleshoot phase detector B using procedures in Figure 3-6B. f. Connect dc voltmeter to A5TP3 and select the value of A6R6 for zero ± 50 mV indication. Typical range of values for A6R6 is 16.2 Kilohm to 23.7 Kilohm.
3	CIRCUIT 8410A SEARCH ASSEMBLY A6. (Select A6R2 and A6R30). DESCRIPTION Negative Schmitt trigger A6Q8-A6Q9 should trigger and reset on a phase-error signal between -150 mV and -200 mV. The trigger and reset points are positioned in this range by selecting the value of A6R30. Decreasing resistance of A6R30 shifts the trigger and reset points in the negative direction. Positive Schmitt trigger A6Q1-A6Q2 should trigger and reset on a phase-error signal between + 136 and + 215 mV. The trigger and reset points are positioned in this range by selecting the value of A6R2. Decreasing resistance of A6R2 shifts the trigger and reset points in the positive direction. TEST SETUP  TEST EQUIPMENT: Items 9, 11, and 12, Table 3-1.

Figure 3-11. Adjustment Procedure (Sheet 3 of 25)

TEST	DESCRIPTION AND PROCEDURE
3 (Cont.)	**PROCEDURE** a. Set external power supply to zero Vdc. Connect negative lead to A8TP1 and positive lead to ground. Connect digital voltmeter across power supply. b. Connect dc voltmeter between A8TP5 and ground. c. Slowly adjust power supply from zero to -250 mV and back to zero. Note trigger and reset points of Schmitt trigger on digital voltmeter by observing change on dc voltmeter. Dc voltmeter readings should range from about -3 Vdc to about -18 Vdc and back to -3Vdc. If both trigger and reset points are in the range of -150 mV to -200 mV, no selection of A8R39 is necessary; proceed to step e. If both trigger and reset points are not in the range of -150 mV to -200 mV, selection of A8R39 is necessary; proceed to step d. d. Select value of A8R39 for both trigger and reset points in the range of -150 mV to -200 mV. Typical range of values for A8R39 is 82 to 121 ohms. Decreasing resistance of A8R39 shifts trigger point in the negative direction. e. Set power supply to zero Vdc. Connect positive lead to A8TP1 and negative lead to ground. Connect digital voltmeter across power supply. f. Connect dc voltmeter between A8TP2 and ground. g. Slowly adjust power supply from zero to + 250 mV and back to zero. Note trigger and circuit reset points of Schmitt trigger on digital voltmeter by observing change on dc voltmeter. Dc voltmeter readings should range from about +9 Vdc to about + 19 Vdc and back to + 9 Vdc. If both trigger and reset points are in the range of + 135 mV to + 215 mV, no selection of A8R2 is necessary; alignment procedure for search assembly A8 is complete. If both trigger and reset points are not + 135 mV to + 215 mV, selection of A8R2 is necessary; proceed to step h. h. Select value of A8R2 for both trigger and reset points in the range of + 135 mV to + 215 mV. Typical range of values for A8R2 is 68 to 100 ohms. Decreasing resistance of A8R2 shifts trigger points in the positive direction.
4	**CIRCUIT** 8410A 20-MHz OSCILLATOR ASSEMBLY A13. (Adjust A13C7)
	DESCRIPTION With the 8410 phase-locked, the frequency of the 20-MHz second local oscillator is adjusted to produce a second IF of 277.778 kHz ± 0.077 kHz.

Figure 3-11. Adjustment Procedure (Sheet 4 of 25)

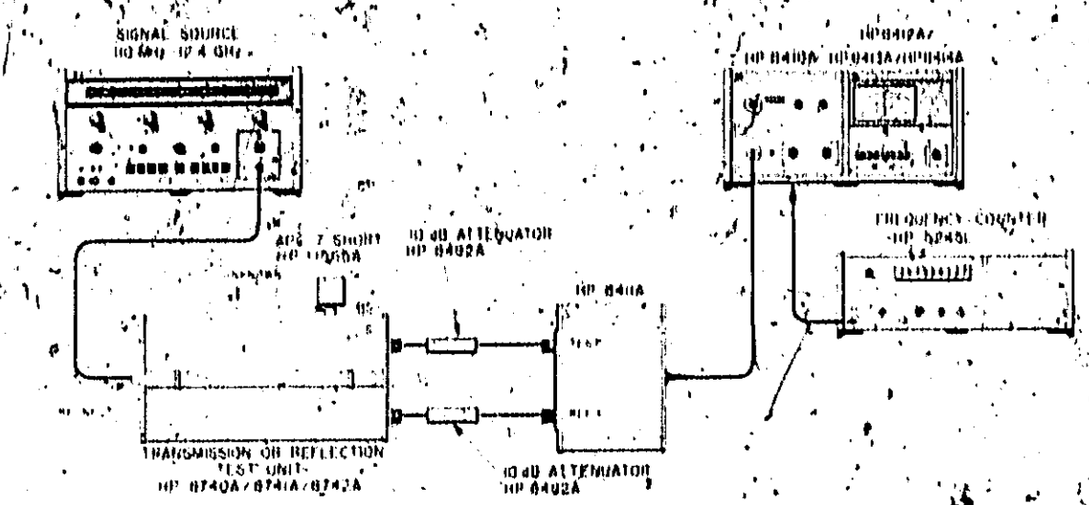
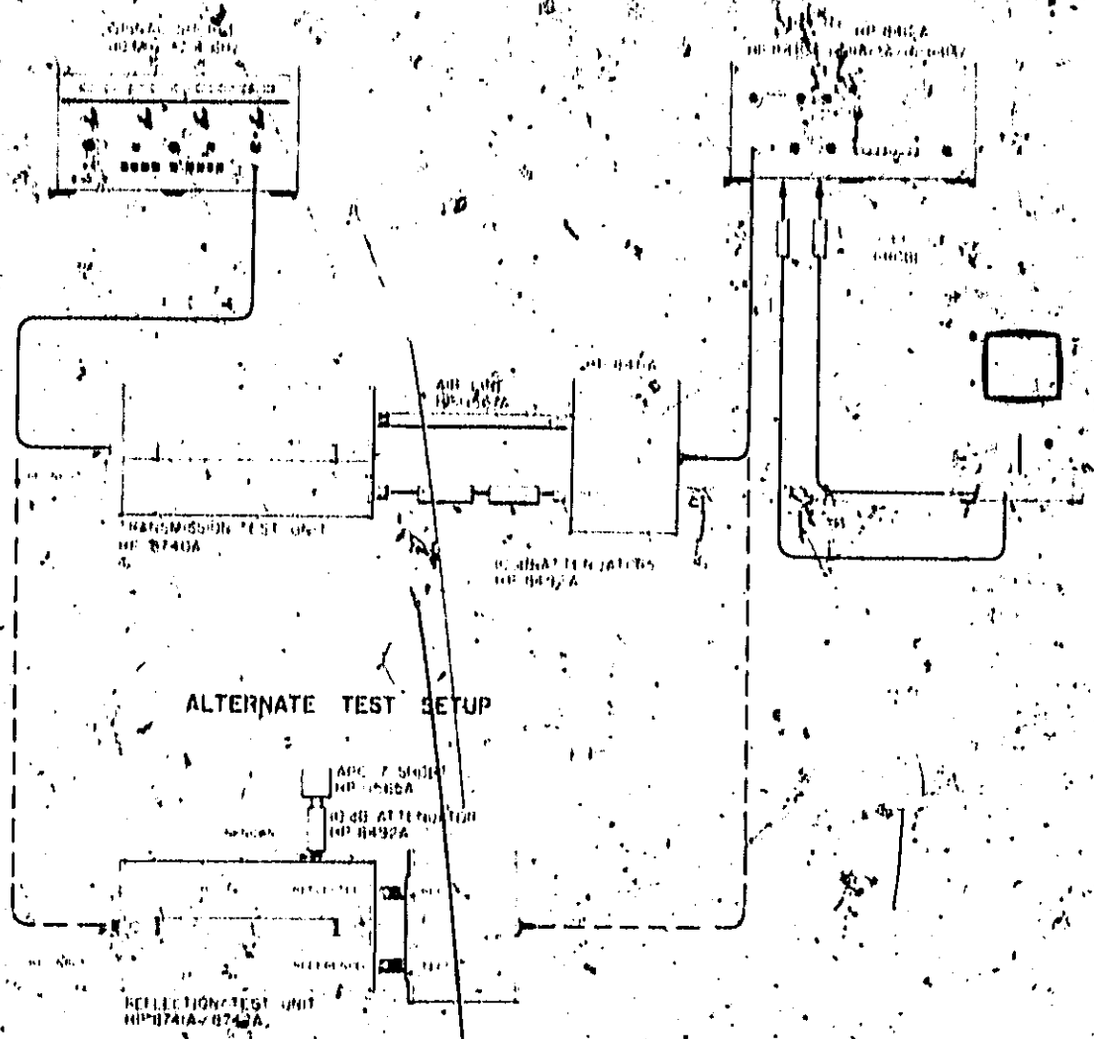
TEST	DESCRIPTION AND PROCEDURE
4 (Cont.)	TEST SETUP  *Used on 8741A and 8742A only. TEST EQUIPMENT: Items 1, 4, 8, 16, and 20, Table 3-1.
	PROCEDURE a. Phase-lock 8410A as follows: 1. Set signal source for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz. 2. Set FREQ RANGE switch on 8410A to a position that includes the signal source frequency. 3. Set SWEEP STABILITY control to the CW position. 4. Adjust RF power from the signal source for REF CHANNEL LEVEL meter indication in the OPERATE range. 5. Adjust 8410A PHASE VERNIER control. Phase indication on 8413A or 8414A should move smoothly, indicating the 8410A is phase-locked. b. Connect frequency counter to 8410A REF CHAN OUTPUT. c. Adjust A13C7 for a frequency counter indication of 277.770 kHz ±0.077 kHz. d. Check phase balance, Test 9 of this procedure.
5	CIRCUIT 8410A AGC AMPLIFIER ASSEMBLY A15. (Select A15R21)

Figure 3-11. Adjustment Procedure (Sheet 5 of 25)

TEST	DESCRIPTION AND PROCEDURE
6 (Cont.)	**DESCRIPTION**

Loop gain through the AGC circuit is adjusted by monitoring overall gain through the reference channel IF amplifier A14. With the 8410A phase-locked, a reference signal level is set at the input of A14. The value of A15R21 is then selected to produce a specific signal amplitude at the outputs of A12 and A14.

TEST SETUP



* THE HP 8410A IS TURNED UPSIDE DOWN TO MATE WITH THE CONNECTORS SHOWN.

TEST EQUIPMENT: Items 4, 5, 16, 17, and 20, Table 3-1.

PROCEDURE

a. Phase-lock 8410A as follows:

1. Set signal source for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz.

Figure 3-11. Adjustment Procedure (Sheet 6 of 25)

TEST	DESCRIPTION AND PROCEDURE
5 (Cont.)	2. Set FREQ RANGE switch on 8410A to a position that includes the signal source frequency. 3. Set SWEEP STABILITY control to the CW position. 4. Adjust RF power from the signal source for REF CHANNEL LEVEL meter deflection in the OPERATE range. 5. Adjust 8410A PHASE VERNIER control. Phase indication on 8413A or 8414A should move smoothly, indicating 8410A is phase-locked. b. Connect oscilloscope X10 divider probe to A14TP4. c. Adjust signal source output level for 100 mV ± 5 mV peak-to-peak at oscilloscope. d. Connect oscilloscope X10 divider probes to A12TP1 and A14TP1. e. Select value of resistor A15R21 which produces a 220 mV ± 30 mV peak-to-trough ring-wave signal on oscilloscope at both test points. Typical range of values for A15R21 is 2.15 Kilohm to 5.62 Kilohm. f. Check the REF. CHANNEL LEVEL meter (M1) indication. Select values of resistor A15R32 which produces an indication at the high end of OPERATE region. Typical range of values for A15R32 is 68.1K to 75K ohms.
6	CIRCUIT 8410A REFERENCE 270-kHz AMPLIFIER ASSEMBLY A16. (Select A16C10 and A16R13.)
	DESCRIPTION Bandpass filter at the output of A16 is adjusted for center frequency of 270 kHz by selecting the value of A16C10. Gain through A16 is adjusted by selecting the value of A16C10. Gain through A16 is adjusted by selecting the value of A16R13. Gain is determined by comparing a known 270 kHz signal applied to A16 input to the signal amplitude at the output of A16.

Figure 3-11. Adjustment Procedure (Sheet 7 of 26)

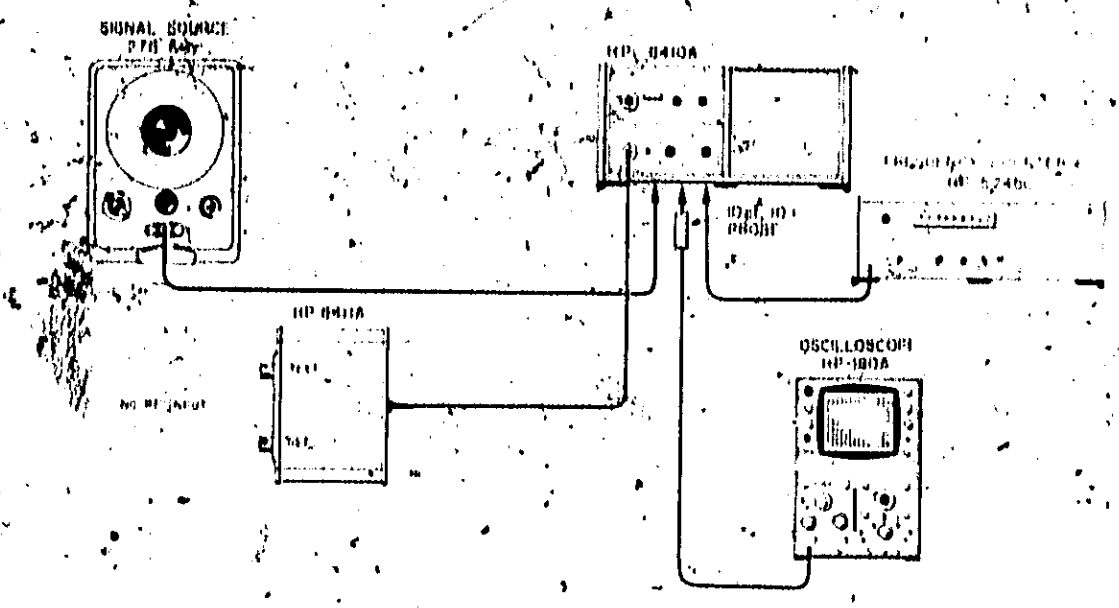
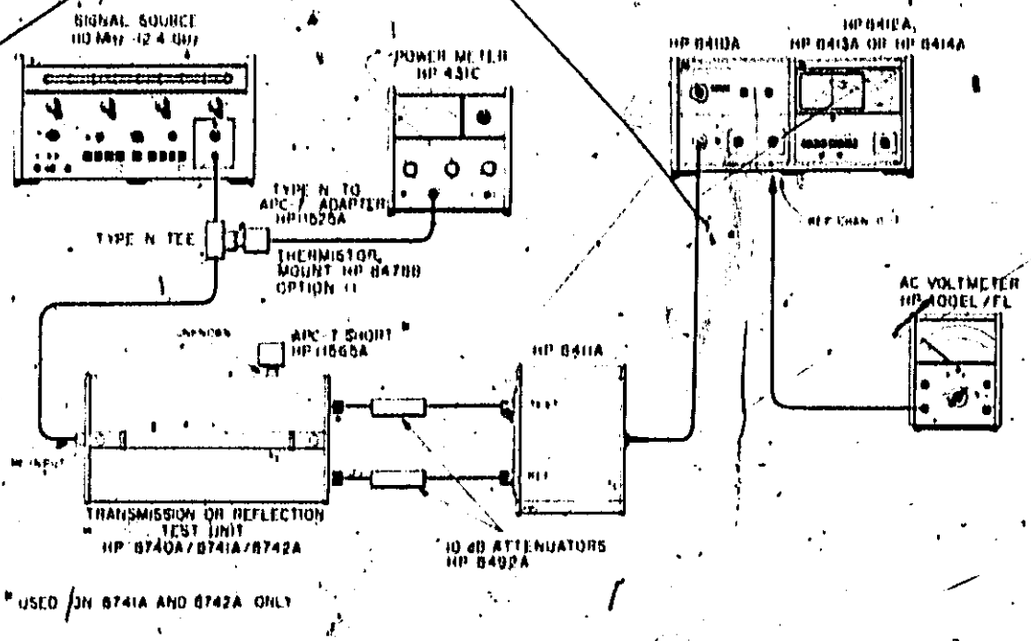
TEST	DESCRIPTION AND PROCEDURE
6 (Cont.)	**TEST SETUP**  **TEST EQUIPMENT:** Items 5, 6, and 13, Table 3-1. **PROCEDURE** a. Remove A12 and A14 circuit board assemblies. b. Connect 278-kHz signal source and oscilloscope to A11TP1 and A16TP1. Adjust signal source output to 220 mV peak to peak as displayed on oscilloscope. c. Connect oscilloscope to A16TP3, and frequency counter to rear-panel TEST CHAN OUTPUT connector. Adjust 8410A AMPLITUDE VERNIER and TEST CHANNEL GAIN controls for adequate input signal to counter. d. Adjust signal source through 278 kHz and note if maximum signal on oscilloscope occurs at 278 kHz ± 2 kHz. If not, select the value of A16C10 for maximum signal at 278 kHz ± 2 kHz. Typical range of values for A16C10 is zero to 680 pF. e. Check if signal amplitude at A16TP3 is 2.3 volts ± 0.3 volts peak to peak. If not, select the value of A16R13 for correct amplitude. Typical range of values for A16R13 is 1.1 Kilohm to 1.62 Kilohm. f. Disconnect signal source and reinstall A12 and A14 circuit board assemblies.
7	**CIRCUIT** 8410A CHANNEL PHASE VARIATION OVER AGC RANGE. (Adjust A12L2 and A14L2.) **DESCRIPTION** The input RF signal at the 8411A is changed by 20 dB while the reference channel output is monitored for a constant output. The lower limit of the reference channel dynamic range is

Figure 3-11. Adjustment Procedure (Sheet 8 of 25)

TEST	DESCRIPTION AND PROCEDURE
7 (Cont.)	found by reducing the RF input signal until the AGC circuit in the reference channel can no longer maintain a constant output. From this point the RF signal is increased by 20 dB, and the 278 kHz output signal should remain constant through the 20-dB range. A14L2 and A12L2 are adjusted for minimum phase change over the AGC range.

TEST SETUP



TEST EQUIPMENT: Items 1, 2, 3, 4, 5, 14, 16, and 20, Table 3-1.

PROCEDURE

a. Phase-lock 8410A as follows:

1. Set signal source for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz.
2. Set FREQ RANGE switch on 8410A to a position that includes the signal source frequency.
3. Set SWEEP STABILITY control to the CW position.
4. Adjust RF power from the signal source for REF CHANNEL LEVEL meter indication in the OPERATE range.
5. Adjust 8410 PHASE VERNIER control. Phase indication on 8413A or 8414A should move smoothly, indicating 8410A is phase-locked.

Figure 3-11. Adjustment Procedure (Sheet 9 of 25)

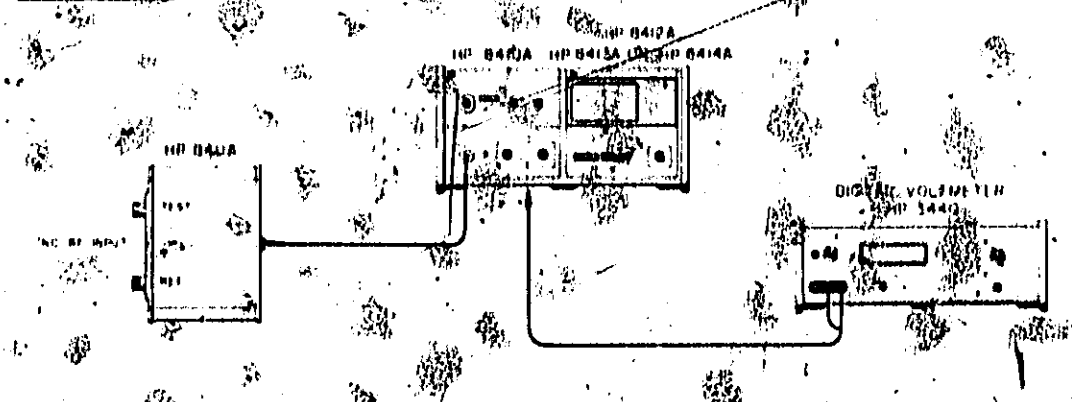
TEST	DESCRIPTION AND PROCEDURE
7 (Cont.)	b. Connect the ac voltmeter to the 8410A rear-panel REF CHANNEL OUTPUT connector. Set the RF input power level to the lower limit of the AGC range by observing the ac voltmeter indication and decreasing signal source power output until the voltmeter reading starts to decrease rapidly. Then increase signal source power until the voltmeter indication just stabilizes, signifying AGC action has started. This procedure should be done more than once to assure that the lower limit of the AGC range has been determined accurately. c. Slowly increase signal source power 20 dB as indicated on the power meter. As power is increased, observe 8413A or 8414A phase indication. Adjust A12L2 and A14L2 for minimum phase change. Adjust signal source power through the 20 dB range several times while adjusting A12L2 and A14L2 to find adjustment that produces minimum phase change.
8	**CIRCUIT** 8410A Sweep Stability Circuit in CW Mode. (Adjust A7R10). **DESCRIPTION** In CW operation, the SWEEP STABILITY control is set to CW position, placing a fixed voltage on the VTO, centering the VTO frequency for proper search tuning. A7R10 is adjusted for a VTO control voltage of +10.7 Vdc at A7TP6. **TEST SETUP**  **TEST EQUIPMENT:** Item 11, Table 3-1. **PROCEDURE** a. Connect dc voltmeter to 8410A-A7TP6. b. Set FREQ RANGE, switch to 8.0 to 12.4 GHz. c. Set SWEEP STABILITY control to CW (continuous wave) position. d. Adjust A7R10 for +10.7 Vdc ±0.01 Vdc indication on dc voltmeter.

Figure 3-11. Adjustment Procedure (Sheet 10 of 25)

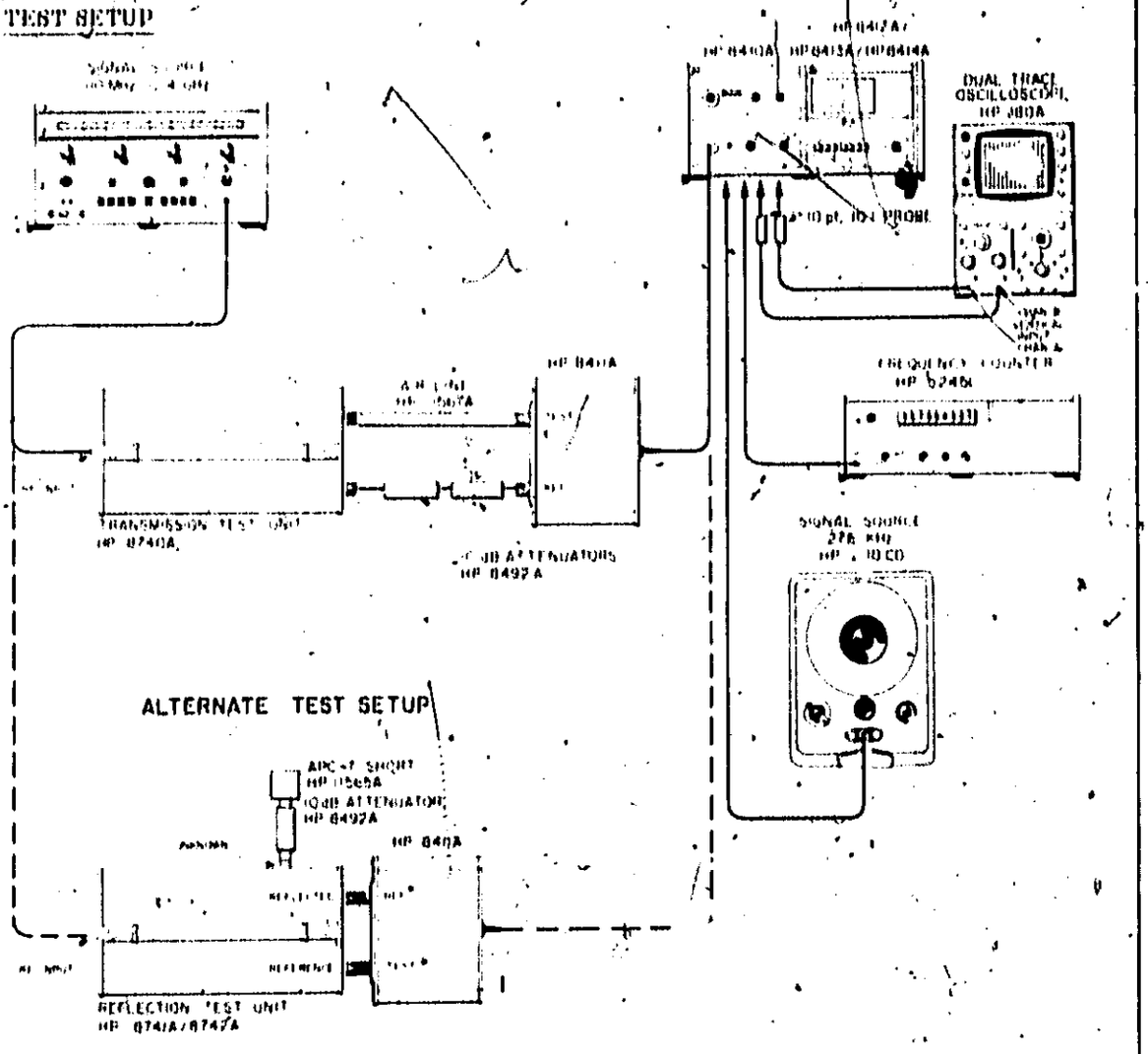
TEST	DESCRIPTION AND PROCEDURE
0	**CIRCUIT** 8410A AMPLITUDE ATTENUATOR AMPLIFIER ASSEMBLY A11. (Select A11C1, A11C6, A11C7, and A11R4.) **DESCRIPTION** The 270 kHz bandpass filter in A11 is adjusted by selecting the value of A11C6. Gain through A11 is adjusted by selecting the value of A11R4. With in-phase signals applied to the 8410A and with the PHASE VERNIER control at mid-range, the output of the test channel should lead the reference channel by +60 degrees. The +60 degree phase difference is adjusted by selecting the values of A11C1 and A11C7. **TEST SETUP**  * THE HP 8410A IS TURNED UPSIDE DOWN TO MATE WITH THE CONNECTORS SHOWN TEST EQUIPMENT: Items 1, 4, 5, 8, 13, 16, 17, and 20, Table 3-1.

Figure 3-11. Adjustment Procedure (Sheet 11 of 25)

TEST	DESCRIPTION AND PROCEDURE
0 (Cont.)	PROCEDURE a. Phase lock 8410A as follows: 1. Set signal source for single-frequency CW operation and frequency from 110 MHz to 12.4 GHz. 2. Set FREQ RANGE switch on 8410A to a position that includes the signal source frequency. 3. Set SWEEP STABILITY control to CW position. 4. Adjust RF power from the signal source for REF CHANNEL LEVEL meter indication in the OPERATE range. 5. Adjust 8410A PHASE VERNIER control. Phase indication on 8413A or 8414A should move smoothly, indicating the 8410A is phase-locked. Tune 276-kHz Bandpass Filter b. Remove A12 circuit board assembly. c. Connect 276-kHz signal source and oscilloscope to A11TP1. Adjust signal source to 220 mV ± 5 mV peak to peak as displayed on oscilloscope. d. Connect oscilloscope 10:1 probe to A11TP3, and connect frequency counter to rear-panel TEST CHAN OUTPUT. Set TEST CHANNEL GAIN and AMPL VERNIER controls for sufficient signal to operate counter. e. Adjust signal source through 276 kHz and note if maximum signal on oscilloscope occurs at 276 kHz ± 2 kHz. If not, select the value of A11C6 for maximum signal at 276 kHz. Typical range of values for A11C6 is zero to 360 pF. Adjust Gain through A11 f. Check if signal amplitude at A11TP3 is 10 volts ± 1 volt peak to peak. If not, select the value of A11R4 for correct amplitude. Typical range of values for A11R4 is 383 to 464 ohms. g. Disconnect signal source and reinstall A12 Circuit Board Assembly. Adjust Phase Shift through A11 h. Connect 10:1 probes of dual trace oscilloscope to 8410A at A12TP4 and A14TP4. i. Adjust 8740A REFERENCE PLANE EXTENSION to superimpose the two waveforms on the oscilloscope. j. Set the PHASE VERNIER control to mid-range as follows: 1. Turn PHASE VERNIER to maximum counterclockwise position and note phase indication of 8413A or 8414A. 2. Turn PHASE VERNIER to maximum clockwise position and note phase indication on 8413A or 8414A. 3. Set PHASE VERNIER for phase indication on 8413A or 8414A midway between the points noted in steps (1) and (2) above.

Figure 3-11. Adjustment Procedure (Sheet 12 of 26)

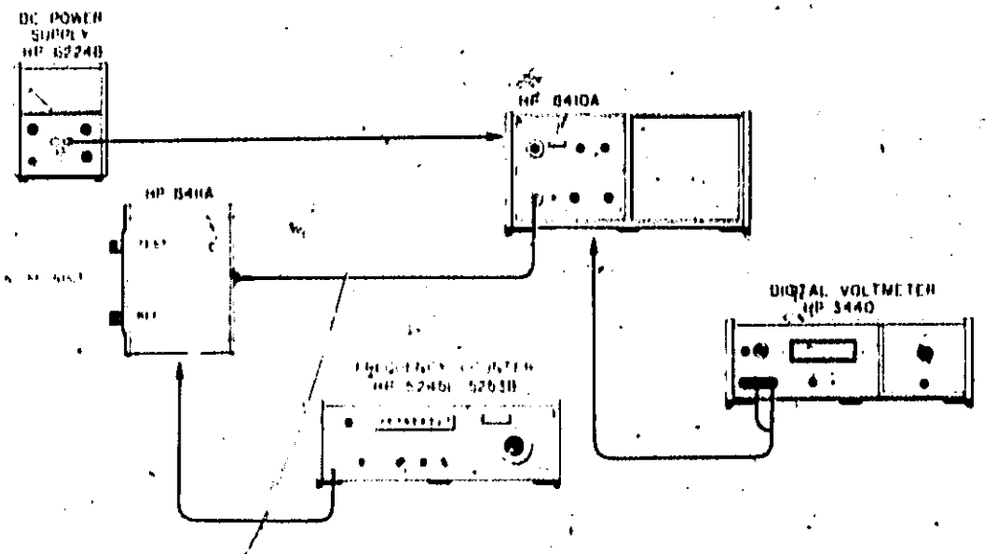
TEST	DESCRIPTION AND PROCEDURE
9 (Cont'd)	k. Phase indication on 8413A or 8414A should be + 90 degrees ± 15 degrees. If not, select the values of A11C1 and A11C7 for indication of + 90 degrees ± 15 degrees. Typical range of values for A11C1 is 180 to 360 pF, and for A11C17 is 220 to 360 pF. m. Recheck gain by performing steps b through g.
10	**CIRCUIT** 8411A A7 VTO ASSEMBLY.(Adjust A6R16 and A7R5, and select A7R3.) **DESCRIPTION** The VTO upper and lower limits are adjusted by clamping the minimum and maximum dc control voltage that is applied to the VTO. The upper-frequency VTO limit is controlled by BIAS ADJUST A6R16, and the lower limit is adjusted by selecting A7R3. With a 0.4 Vdc VTO control signal at 8410A-A7TP6, the 65 MHz ADJUST control 8411A-A7R5 is adjusted for a VTO frequency of 65 MHz. **TEST SETUP**  TEST EQUIPMENT: Items 8, 9, and 11, Table 3-1. **PROCEDURE** a. Remove 8410A-A8 circuit board assembly. Connect ground jumper to 8410A-A7TP1. (The VTO tuning voltage may now be controlled by the SWEEP STABILITY control.) b. Connect dc voltmeter to 8410A-A7TP6 and adjust the SWEEP STABILITY control for + 0.40 Vdc ± 0.02 Vdc.

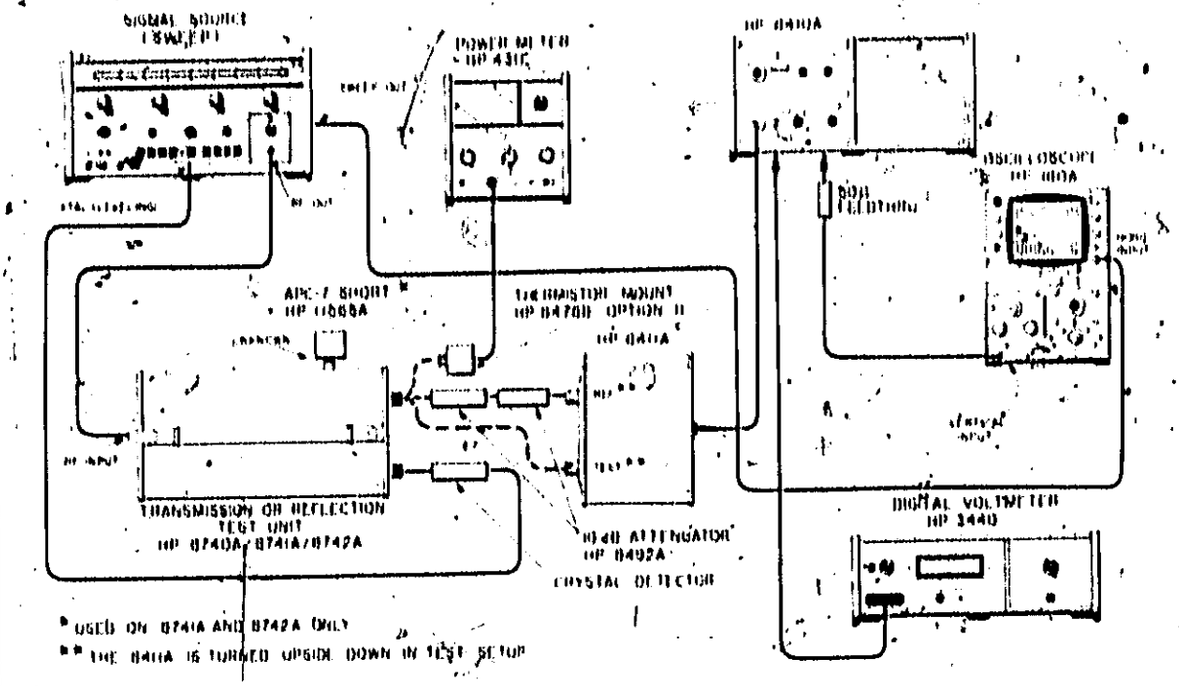
Figure 3-11. Adjustment Procedure (Sheet 13 of 25)

TEST	DESCRIPTION AND PROCEDURE
10 (Cont.)	c. Connect dc voltmeter to 8411A -A6TP3. Indication should be +11.2 Vdc ±0.05 Vdc. Adjust 8411A-A6R2 only if indication is out of tolerance. d. Check adjustment of A7R5 (65 MHz ADJUST) and A7R10 (LOW FREQUENCY CLAMP ADJUST) as follows: NOTE These two controls interact; therefore, make adjustments only if indication is out of tolerance. 1. Connect frequency counter to 8411A-A3TP7 and connect dc voltmeter to 8410A-A7TP6. 2. Adjust SWEEP STABILITY control for 9.40 Vdc ±0.02 Vdc at 8410A-A6TP6. Frequency counter should indicate 65 MHz ±0.2 MHz. 3. Adjust SWEEP STABILITY control for lowest VTO frequency. Connect -10 Vdc to 8410A SWEEP REF input. Adjust negative voltage to obtain 8.00 Vdc ±0.02 Vdc at 8410A-A7TP6. Frequency counter should indicate 62.5 MHz ±0.2 MHz. 4. If either indication is only slightly out of tolerance repeat steps d (2) and d (3). Adjust A7R5 for 65 MHz and A7R10 for 62.5 MHz. If unable to obtain proper indications, adjust A7R10 fully cew, obtain 9.40 Vdc at 8410A-A7TP6 and adjust A7R5 for 68 MHz. Obtain 8.00 Vdc at 8410A-A7TP6 and adjust A7R10 for 62.5 MHz. Recheck for 65 MHz. e. Adjust the SWEEP STABILITY control for voltage at 8410A-A7TP6 of +11.6 Vdc ±0.01 Vdc. If +11.6 Vdc ±0.01 Vdc cannot be obtained, connect -10 Vdc to 8410A SWEEP REF input. f. Adjust 8411A-A6R16 BIAS ADJUST (VTO upper limit control) for 155 MHz ±1 MHz at frequency counter. g. Remove the ground jumper from A7TP1 and reinstall 8410A-A8 circuit assembly. h. Check alignment of 8411A VTO Tuning Voltage Shaping Amplifier, Test No. 12 in this procedure.
11	CIRCUIT 8411A SAMPLING DIODES, PREAMPLIFIERS A4 and A5, and POWER AMPLIFIER A3. (Adjust A4R3, A4R5, A5R3, A5R5, and A6R14, and select A4R21 and A5R8.) DESCRIPTION With the phase lock loop disabled and the VTO frequency fixed at about 155 MHz a 2-to 4-GHz swept signal is applied first to the reference channel input (at -30 dBm), then to the test channel input (at +10 dBm). Using the zero-beat birdies that occur every 155 MHz as indicators, the gains of the IF preamplifiers are optimized and the sampling diode bias and centering controls are adjusted for best conversion efficiency.

Figure 3-11. Adjustment Procedure (Sheet 14 of 25)

TEST	DESCRIPTION AND PROCEDURE
11 (Cont.)	

TEST SETUP



TEST EQUIPMENT: Items 1, 2, 4, 5, 10, 11, 16, 20, and 21, Table 3-1.

PROCEDURE

a. Connect power meter to 8740A TEST output. At sweep oscillator, select sweep frequency from 2 to 4 GHz and adjust output for leveled power of -10.0 dBm ± 1 dBm at power meter.

b. Disconnect power meter from 8740A and connect 8740A TEST output to 8411A REF input through two 10-dB attenuators.

c. Disconnect 8410A reference channel 20.278 MHz IF cable W1 (Figure 3-10) at 8410A-J7 and connect cable W1 to oscilloscope through a 50-ohm feedthrough.

d. Remove 8410A-A8 Circuit Board and connect ground jumper to 8410A-A7TP1.

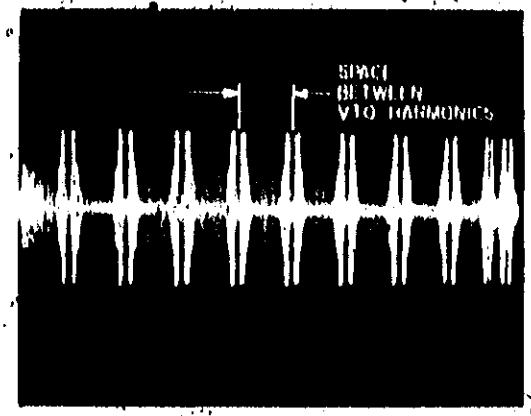
e. Adjust SWEEP STABILITY control for maximum amplitude oscilloscope presentation. (VTO frequency of approximately 155 MHz).

f. Adjust 8411A-A4R5 fully clockwise for maximum birdie amplitude on oscilloscope.

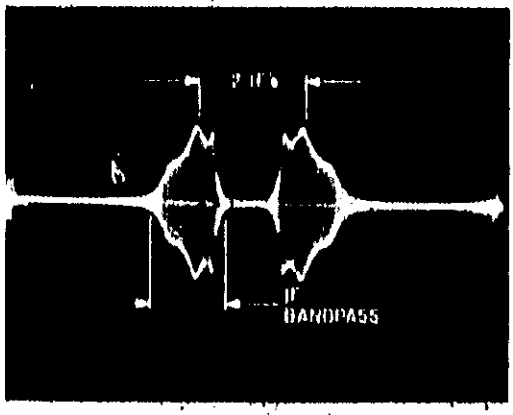
g. Adjust the oscilloscope for the following display A.

Figure 3-11. Adjustment Procedure (Sheet 15 of 25)

TEST	DESCRIPTION AND PROCEDURE
11 (Cont.)	



DISPLAY A. Series of Birdie Pairs



DISPLAY B. Single Birdie Pair

Note

Each "birdie" is the 20.278 MHz IF beat between the swept RF and a particular harmonic of the VTO. The birdies occur in pairs with 2 IF spacing between birdies. The left-hand response occurs when the RF is lower than the VTO harmonic by the IF, and the right-hand response occurs when the RF is higher than the VTO harmonic by the IF. The centers of the birdie pairs are spaced by the VTO fundamental frequency, since successive pairs are produced by successive VTO harmonics. Each birdie, if looked at in detail, has the frequency response, or "shape" of the IF bandpass filter. (See waveforms A and B.)

h. Adjust 8411A-A4R6 counterclockwise until the oscilloscope display is approximately 20 of the peak-to-peak amplitude obtained in step f.

i. Adjust BIAS CENTERING, A4R3 for minimum birdie amplitude. If the signal goes into noise, increase signal level by adjusting A4R5.

j. Adjust 8411A-A3R14 (Power Amp Bias Adjust) for maximum birdie amplitude. Connect digital voltmeter to A3TP7 and indication should be -6.2 Vdc ±0.7 Vdc.

k. Adjust A4R5 fully clockwise for maximum birdie amplitude.

m. Select the value of 8411A-A3R21 that gives peak-to-peak birdie amplitude of 50 mV ±8 mV. (Typical range of values for A3R21 is 66 to 133 ohms.)

n. Adjust oscilloscope vertical gain for 6 cm of peak-to-peak display. (Do not change gain control on oscilloscope, as this reference amplitude will be used to check amplitude balance of reference and test channels.)

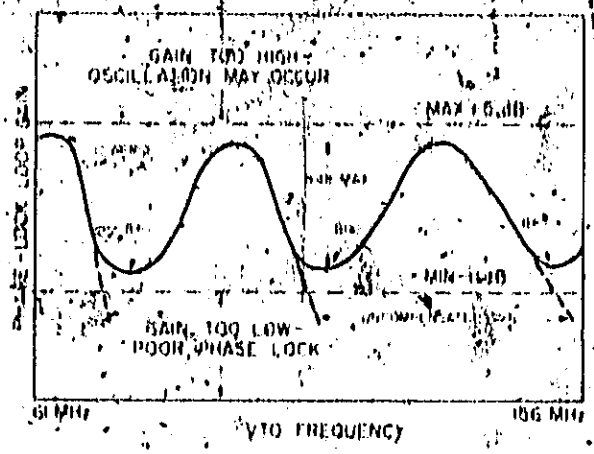
p. Disconnect 8410A test channel 20.278 MHz IF cable W3 (Figure 3-15) at 8410A-J8 and connect cable W3 to oscilloscope through a 50-ohm feedthrough.

Figure 3-11. Adjustment Procedure (Sheet 11 of 12)

TEST	DESCRIPTION AND PROCEDURE
11 (Cont.)	p. Disconnect 8740A TEST output from 10-dB attenuator and connect TEST output to 8411A TEST input (without the two 10-dB attenuators). q. Adjust 8411A-A5R6 fully clockwise for maximum birdie amplitude on oscilloscope. **Note** This display differs from the REFERENCE channel display, in appearance, because the IF bandpass filter has a single-peak response rather than a three-peak response. s. Adjust 8411A-A5R6 counterclockwise until the oscilloscope display is approximately 20% of the peak-to-peak amplitude obtained in step r. t. Adjust BIAS CENTERING A6R3 for minimum birdie amplitude. u. Adjust A6R6 fully clockwise for maximum birdie amplitude. v. Adjust 8411A-A5R20 for peak-to-peak birdie amplitude of 5.3 cm (0.7 cm (47 mV, 6 mV). This indicates proper channel balance. If A5R20 range is insufficient, select A6R8 to extend the range of A5R20 (birdie amplitude too large--increase the value of A6R8). Typical range of values for A6R8 is 287 to 750 ohms. w. Reconnect cable W1 to 8410A-J7 and cable W3 to 8410A-J8. x. Remove jumper from 8410A-A7TP1 and reinstall 8410A-A8 Circuit Board.
12	**CIRCUIT** 8411A VTO TUNING VOLTAGE SHAPING AMPLIFIER A6. (Adjust A6R2, A6R6, A6R7, A6R8, and select A6R12.) **DESCRIPTION** **CAUTION** Adjustment of the shaping amplifier should not be performed during routine maintenance, but only after replacement of a circuit component or if it has been determined that the phase-lock loop gain is incorrect. The VTO loop gain is adjusted to provide sufficient gain to maintain phase lock throughout an octave input RF range, using a 4- to 8-GHz sweep oscillator. Phase lock is also checked through the 8- to 12.4-GHz range to be certain oscillations do not occur at the high-frequency end of the instrument range. Operation of the phase lock loop is determined by observing the trace on either the 8414A Polar Display or an oscilloscope connected to the 8413A AMPLITUDE 50 MV/DB output. A typical graph of phase-lock loop gain versus VTO frequency is shown in the following illustration. This shows that gain must not be adjusted below the minimum gain level or proper phase lock will not be obtained. Also gain must not be adjusted too high or the phase-lock loop will oscillate.

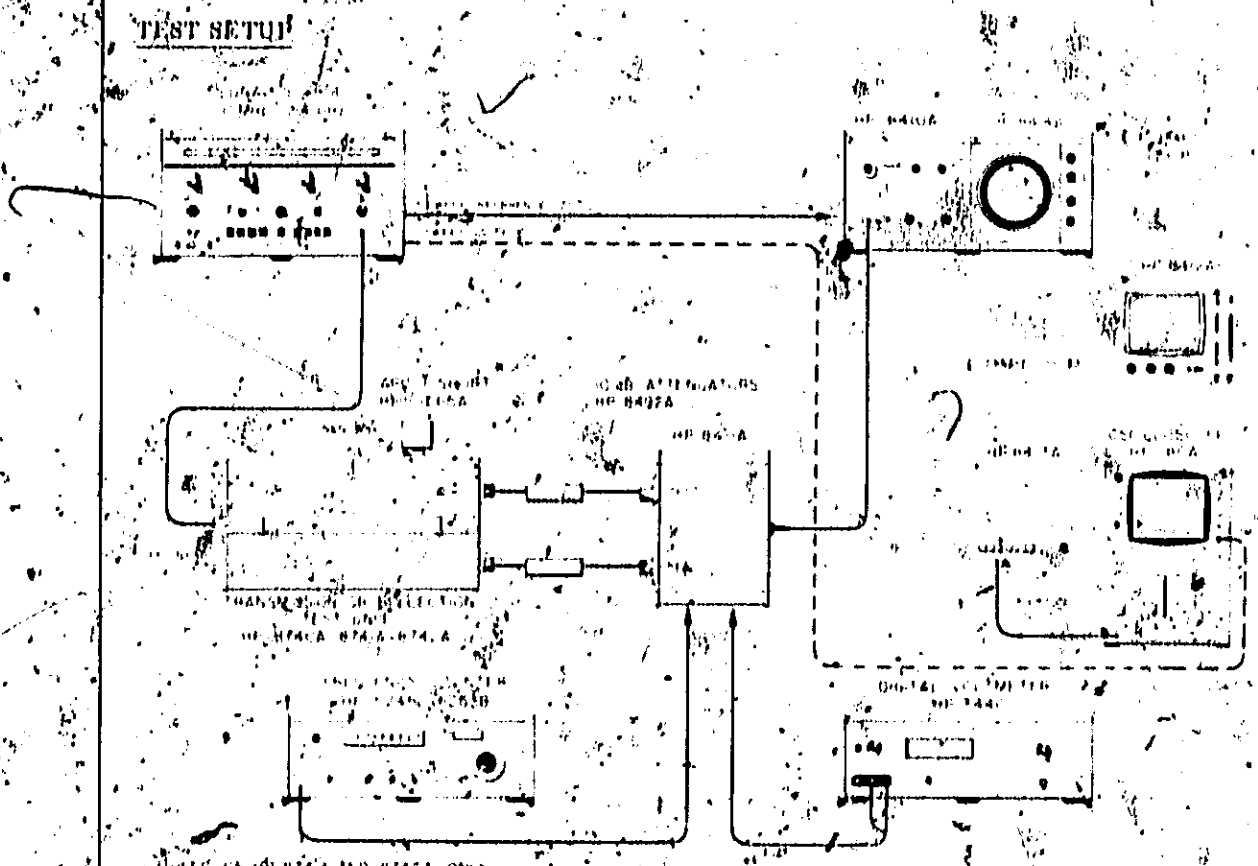
Figure 3-11. Adjustment Procedure (Sheet 17 of 25)

TEST	DESCRIPTION AND PROCEDURE
12 (Cont.)	



Typical Graph of Phase-Lock Loop Gain

TEST SETUP



TEST EQUIPMENT: Items 1, 4, 5, 8, 11, 16, and 20, Table 3-1.

Figure 3-11. Adjustment Procedure (Sheet 16 of 20)

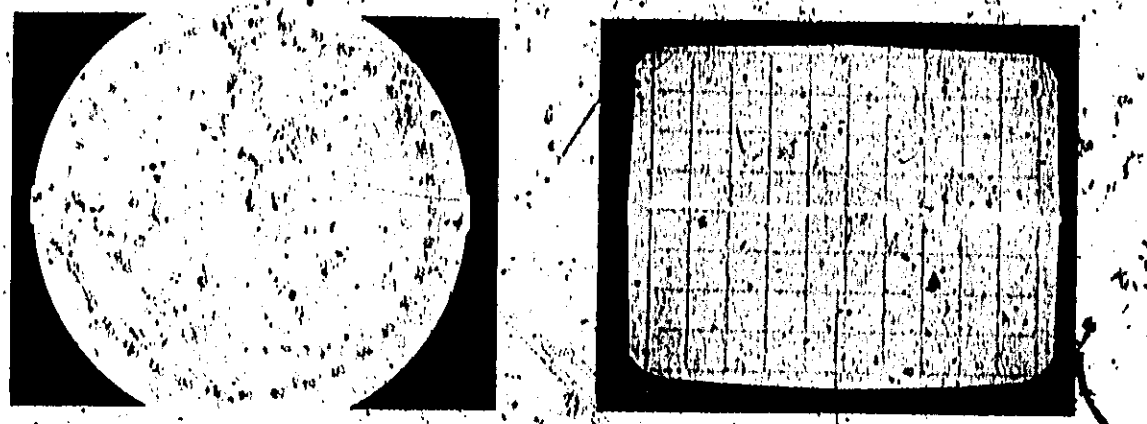
TEST	DESCRIPTION AND PROCEDURE
12 (Cont.)	PROCEDURE a. Check VTO frequency limits as follows: 1. Connect 8411A to 8410A and apply power. 2. Remove 8410A-A6 search assembly circuit board. 3. Connect jumper between 8410A-A7TP1 and ground. 4. Connect frequency counter to 8411A-A3TP6. 5. Adjust SWEEP STABILITY control for minimum VTO frequency (62 MHz ± 1 MHz). If minimum VTO frequency is out of tolerance, perform VTO alignment, Test 10 of this procedure. 6. Adjust SWEEP STABILITY control for maximum VTO frequency (155 MHz ± 1 MHz). If maximum VTO frequency is less than 154 MHz, apply approximately +40 Vdc to 8410A SWEEP REF input to drive the VTO to its upper limit. If maximum VTO frequency is out of tolerance, perform VTO alignment, Test 10 of this procedure. 7. Install 8410A-A6 circuit assembly and remove ground jumper from A7TP1. b. Set break point controls BP1, BP2, and BP3 to mid range. c. Connect dc-digital voltmeter to 8411A-A6TP3 and adjust break point limit control BPL (A6R2) for +11.2 Vdc ±0.05 Vdc. d. Phase lock 8410A as follows: 1. Set sweep oscillator to sweep between 4.0 GHz and 8.0 GHz. 2. Set FREQ RANGE switch on 8410A to a position that includes the sweep range. 3. Slowly increase sweep oscillator RF power while adjusting 8410A SWEEP STABILITY control until the REF CHANNEL LEVEL meter indicates in the middle of the OPERATE range. Readjust SWEEP STABILITY control for best lock across band. It may be necessary to reduce sweep time to approximately 25 msec to obtain lock across entire band. (See Waveform A.). e. Adjust FREQ RANGE switch one position clockwise (3.0 - 6.0 GHz). Note VTO loop gain increases as the FREQ RANGE switch is set to a lower frequency range. As loop gain is increased to the point of oscillation, the smooth trace on the display appears to lose amplitude at the oscillation point. The trace on the 8414A pulls in toward the center of the polar display or, if the 8413A (alternate display) is used, the oscilloscope trace pulls negative. (See Waveform B.). As alignment adjustments are made to eliminate loop gain oscillations, the trace returns to a circle (8414A) or a straight line (8413A and oscilloscope).

Figure 3-11. Adjustment Procedure (Sheet 19 of 25)

TEST	DESCRIPTION AND PROCEDURE
12 (Cont.)	

8414A POLAR DISPLAY

8413A AND OSCILLOSCOPE

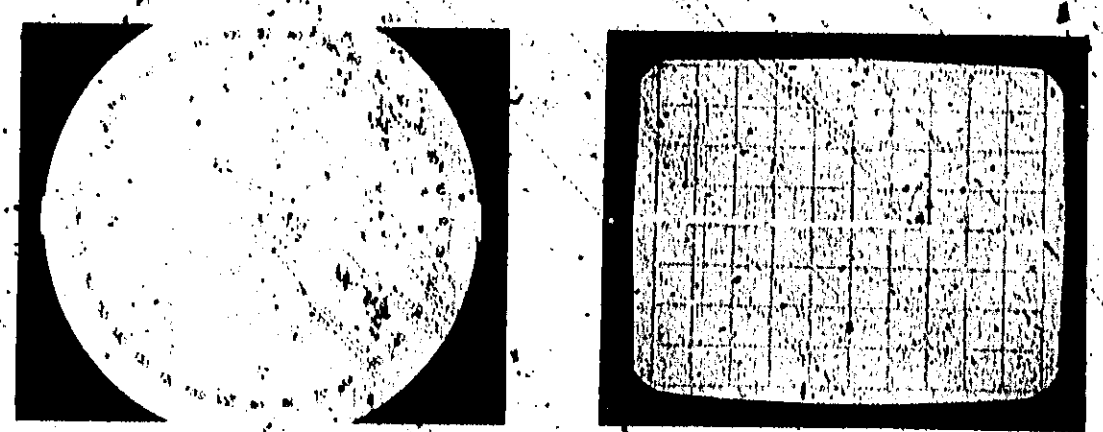


WAVEFORM A

Typical display sweeping 4 to 8 GHz with FREQ RANGE switch set to bracket 4 to 8 GHz and also set one step clockwise and one step counterclockwise from 4 to 8-GHz position.

8414A POLAR DISPLAY

8413A AND OSCILLOSCOPE



WAVEFORM B

Typical display sweeping 4 to 8 GHz showing either of following:

(1) FREQ RANGE switch two steps clockwise from 4- to 8-GHz position, with BP1, BP2, and BP3 correctly adjusted for proper phase-lock loop gain.

(2) FREQ RANGE switch one step clockwise from 4- to 8-GHz position with BP1, BP2, and BP3 misadjusted too far clockwise, showing phase-lock loop gain too high.

Figure 3-11. Adjustment Procedures (Sheet 20 of 25)

TEST	DESCRIPTION AND PROCEDURES
12 (Cont.)	i. Adjust BP1 clockwise until the presentation distorts from a smooth line near the low-frequency end of the trace. This indicates that loop gain is too high at the frequency represented by the distorted trace. See Waveform B for typical 8414A and oscilloscope displays. j. Adjust BP1 counterclockwise until oscillation point disappears and the trace returns to a circle (8414A) or a straight line (8413A and oscilloscope). k. If oscillations occur at the beginning of the trace and the oscillations cannot be eliminated by adjusting BP1, select a lower value of A6R12 to stop oscillations. Select the largest value that does not cause oscillations. (Typical range of values for A6R12 is 50 to 90.9 ohms.) l. Adjust BP2 clockwise until the trace distorts, then counterclockwise until trace returns to a circle (8414A) or straight line (8413A and oscilloscope). m. Adjust FREQ RANGE switch clockwise to second position from 4-8 GHz range (2-4 GHz position). CRT display should indicate oscillations as shown in Waveform B. Note Phase-lock loop should oscillate when the FREQ RANGE switch is set two positions clockwise from correct range, but should not oscillate one position clockwise. This indicates sufficient gain. Also, one position counterclockwise from the 4- to 8-GHz position, gain should be high enough to maintain phase-lock. n. Adjust FREQ RANGE switch to one position clockwise from the 4- to 8-GHz position. Rotate the SWEEP STABILITY control clockwise until only half of the display shows phase lock, or to the stop, whichever occurs first. The display should not show any oscillation on the phase-locked part. If oscillation occurs, adjust BP1 or BP2 slightly counterclockwise to eliminate the oscillation. o. Rotate the SWEEP STABILITY control counterclockwise until the other half of the display shows phase lock, or to the stop, whichever occurs first. No oscillation should show on the phase-locked half. Adjust BP3 clockwise until oscillation occurs, then counter-clockwise until oscillation disappears. If an oscillation point does not occur when BP3 is adjusted fully clockwise, leave BP3 in the fully clockwise position. p. Check operation of the VTO Loop using an 8 to 12.4 GHz sweep oscillator. The display should stay locked and not oscillate (Waveform A) with the FREQ RANGE switch set to 8 to 12.4 GHz position and to one position clockwise.
13	CIRCUIT 8411A CHANNEL ISOLATION AND TRACKING. (Adjust A4R3, A4R5, A5C13, and A5R3. Select A5C2.)

Figure 3-11. Adjustment Procedure (Sheet 21 of 25)

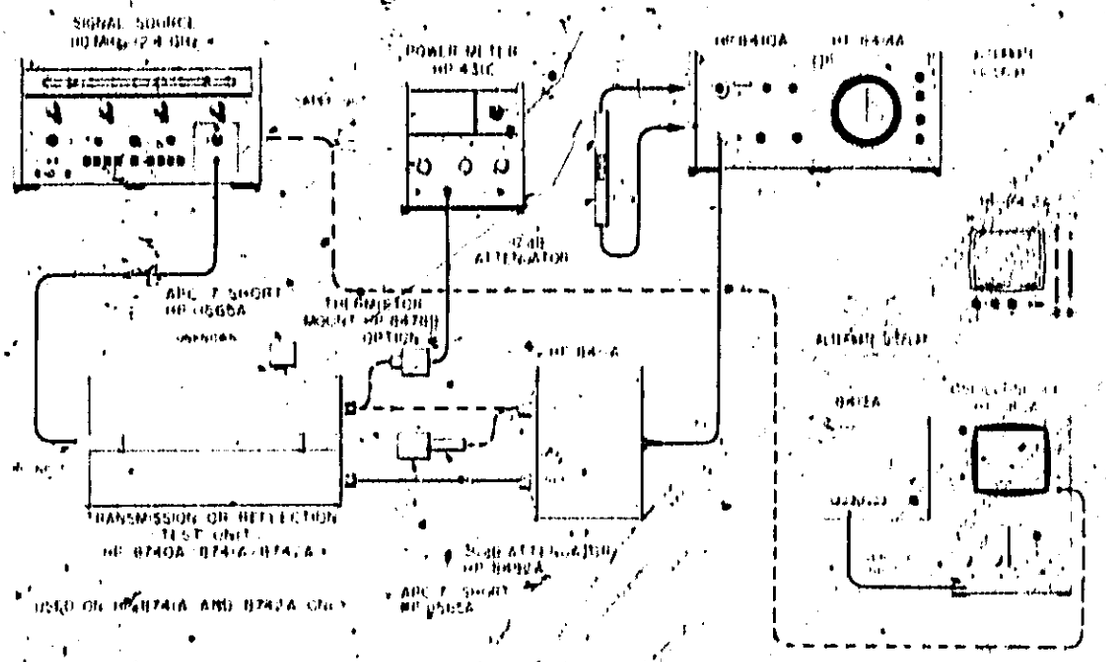
TEST	DESCRIPTION AND PROCEDURE
13 (Cont.)	**DESCRIPTION** Poor isolation is most likely to occur at the higher frequencies, therefore the adjustments are made for the 8 to 12.4 GHz band and checked from 4 to 8 GHz. A -5 dBm signal is applied to both 8411A inputs. A 20-dB attenuator is inserted in the 20.278 MHz section of the reference channel to maintain proper AGC operation. A reference level is established on the 8414A, or, if an 8413A is used, on an oscilloscope connected to the 8410A AMPLITUDE 50 mV/dB front-panel output. The input signal to the 8411A TEST channel is removed and the TEST CHANNEL GAIN control settings are increased until the presentation returns to the original reference. A4R3, A5C13, and A5R3 are adjusted and A5C2 is selected for best isolation.
	TEST SETUP  TEST EQUIPMENT: Items 1, 2, 4, 5, 15, 16, and 20, Table 3-1.
	PROCEDURE a. Connect power meter thermistor mount to 8740A TEST port. b. Adjust sweep oscillator power level for -5 dBm on power meter. c. Disconnect power meter from 8740A and connect 8740A to 8411A. d. Disconnect reference channel 20.278 MHz IF cable W1 (Figure 3-19) at 8410A-J7 and insert the two 10-dB attenuators.

Figure 3-11. Adjustment Procedure (Sheet 22 of 26)

TEST	DESCRIPTION AND PROCEDURE
13 (Cont.)	e. Set 8410A TEST CHANNEL GAIN to 0 dB. f. For 8414A, adjust the 8414A centering controls and the 8740A REF PLANE EXTENSION for a circular trace on the 8414A CRT. This display will be the reference. g. For 8413A (alternate display), connect oscilloscope to 8413A AMPLITUDE 50 mV/dB output. Establish a reference on the oscilloscope (0.2 V/cm). h. Disconnect the 8411A TEST input and terminate the 8411A TEST input with the 30-dB pad and short. i. Increase TEST CHANNEL GAIN until presentation returns to the original reference. The change in TEST CHANNEL GAIN is the channel isolation. If channel isolation is greater than 60 dB, no adjustment of 8411A-A4R3, A5C13, or A5R3 is necessary. If channel isolation is less than 60 dB, make the following adjustments: Note Make all adjustments with covers in place, and make final check with covers securely fastened. 1. Adjust 8411A-A5C13 for maximum isolation across the band. If isolation greater than 60 dB is obtained, no further adjustment is necessary. If 60 dB of isolation is not obtained, adjust 8411A-A5R3. If 60 dB of isolation is still not obtained adjust 8411A-A4R3. 2. If 60 dB of isolation cannot be obtained and coax clamps (see page 3-81, Table 3-9, Item 6) are installed with suppressor bead up, remove the coax clamps and re-install the clamps with suppressor bead down. With the suppressor beads down sampler drive will be reduced which may adversely affect channel tracking. Channel Tracking j. Remove RF input to 8411A. Disconnect the two 10-dB attenuators and reconnect cable W1 to 8410A-P1. k. Reconnect 8411A TEST input to 8740A. m. Adjust RF power from sweep oscillator for REF CHANNEL LEVEL meter indication in the middle of the OPERATE range. n. For 8414A, adjust TEST CHANNEL GAIN and AMPL VERNIER for a large circular display. Calibrate display with TEST CHANNEL GAIN 1-dB step control. If the minimum radius differs from the maximum radius by more than 1 dB, adjust 8411A-A4R5 for constant radius. p. For 8413A (alternate display), increase oscilloscope gain to 50 mV/cm. Each cm represents 1 dB. If trace varies more than 1 cm, adjust 8411A-A4R5 for best horizontal trace. q. If adjustment of A4R5 was necessary, recheck channel isolation, steps a through i. r. If adjustment of A4R3, A4R5, or A5R3 was necessary, recheck preamplifier gain and balance by performing Test 11, Steps a through e, m through q, and v through x.

Figure 3-11. Adjustment Procedure (Sheet 23 of 25)

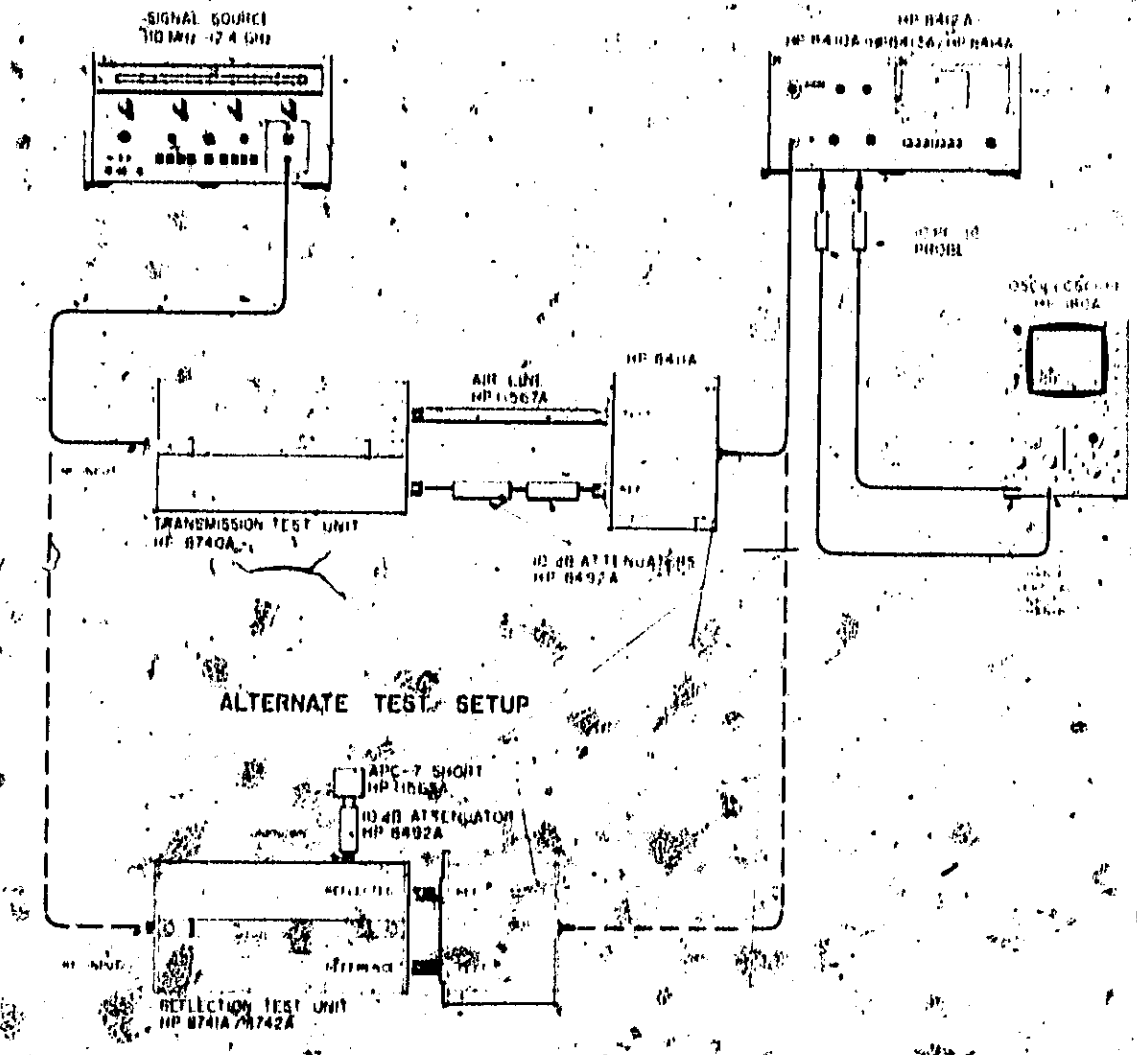
TEST	DESCRIPTION AND PROCEDURE
14	**CIRCUIT** 8411A PHASE TRANSFER (Select A5R19 and A5L1).
	DESCRIPTION In-phase RF signals are applied to the 8411A inputs. The value of 8411A-A5R21 is adjusted to produce a zero-degree indication on the DISPLAY readout. This adjustment changes the phase shift through 8411A-A5, maintaining the phase relationship between the two 20,278 MHz channels required by the 8410A.
	TEST SETUP  **TEST EQUIPMENT:** Items 1, 4, 5, 16, 17, and 20, Table 3-1.

Figure 3-14. Adjustment Procedure (Sheet 24 of 25)

TEST	DESCRIPTION AND PROCEDURE
14 (Cont.)	PROCEDURE a. Phase lock 8410A as follows: 1. Set sweep oscillator for single-frequency CW operation, any frequency from 110 MHz to 12.4 GHz. 2. Set FREQ RANGE switch on 8410A to a position that includes the sweep oscillator frequency. 3. Set SWEEP STABILITY control to the CW position. 4. Adjust RF power from the sweep oscillator for REF CHANNEL LEVEL meter indication in the middle of the OPERATE range. 5. Adjust 8410A PHASE VERNIER control; phase indication on 8413A or 8414A should change smoothly, indicating the 8410A is phase-locked. b. Connect 10:1 probes of dual trace oscilloscope to 8410A-A12TP4 and A14TP4. Adjust 8740A REFERENCE PLANE EXTENSION to superimpose the two waveforms on the oscilloscope. This sets the two 20.278 MHz IF signals from the 8411A in phase. c. Adjust the PHASE VERNIER control for a +60° indication on the 8413A or 8414A. Do not adjust PHASE VERNIER through the remainder of this test. d. Disconnect oscilloscope probes from 8410A-A12TP4 and A14TP4. If 8413A display UNR is used, connect oscilloscope to 8413A PHASE 10 mV/DEG. e. Set sweep oscillator for automatic repetitive full-band sweep as follows: 1. Manually tune the sweep oscillator through the range to be swept and adjust the SWEEP STABILITY control and sweep oscillator output level so that the REF CHANNEL LEVEL meter indicates in the OPERATE region through the entire sweep range. 2. Set the sweep oscillator for swept operation and readjust SWEEP STABILITY, as required, to obtain continuous phase display (no momentary losses of information that indicate the tuning system is unable to follow the input frequency). f. Adjust 8740A REFERENCE PLANE EXTENSION to cancel out the linear phase error. (For 8413A, a horizontal display on oscilloscope; for 8414A, smallest dot or cluster.) g. Set sweep oscillator to CW operation. If the Display indicates zero ±15°, adjustment of 8411A-A5R21 is not necessary. h. Adjust 8411A-A5R21 for zero ±15° phase indication.

Figure 3-11. Adjustment Procedure (Sheet 25 of 25)

Table 3-7. Reference Designators and Abbreviations Used in Replaceable Parts List

REFERENCE DESIGNATORS

A	assembly	F	fuse	MP	mechanical part	U	integrated circuit
B	motor	FL	filter	P	plug	V	vacuum, tube, neon bulb, photocell, etc.
BT	battery	IC	integrated circuit	Q	transistor		
C	capacitor	J	jack	R	resistor	VR	voltage regulator
CP	coupler	K	relay	RT	thermistor	W	cable
CR	diode	L	inductor	S	switch	X	socket
DL	delay line	LS	loud speaker	T	transformer	Y	crystal
DS	device signaling (lamp)	M	meter	TB	terminal board	Z	tuned cavity, network
E	misc electronic part	MK	microphone	TP	test point		

ABBREVIATIONS

A	amperes	H	henries	N/O	normally open	RMO	rack mount only
AFC	automatic frequency control	HDW	hardware	NOM	(nominal)	RMS	root-mean square
AMPL	amplifier	HEX	hexagonal	NPO	negative positive zero (zero temperature coefficient)	RWV	reverse working voltage
		HG	mercury				
BFO	beat frequency oscillator	HR	hour(s)			S-B	slow-blow
BE CU	beryllium copper	HZ	hertz	NPN	negative-positive-negative	SCR	screw
BH	binder head					SE	selenium
BP	bandpass	IF	intermediate freq	NRFR	not recommended for field replacement	SECT	section(s)
BRS	brass	IMPG	impregnated			SEMICON	semiconductor
BWO	backward wave oscillator	INCD	incandescent	NSR	not separately replaceable	SI	silicon
		INCL	include(s)			SIL	silver
CCW	counter-clockwise	INS	insulation(s)			SL	slide
CER	ceramic	INT	internal	OBD	order by description	SPG	spring
CMO	cabinet mount only	K	kilo = 1000	OH	oval head	SPL	special
COEF	coefficient			OX	oxide	SST	stainless steel
COM	common	LH	left hand	P	peak	SW	split ring
COMP	composition	LIN	linear taper	PC	printed circuit	STL	steel
COMPL	complete	LK WASH	lock washer	PF	picofarads = 10^{-12} farads	TA	tantalum
CONN	connector	LOG	logarithmic taper			TD	time delay
CP	cadmium plate	LPF	low pass filter	PH BRZ	phosphor bronze	TGL	toggle
CRT	cathode-ray tube			PHIL	Phillips	THD	thread
CW	clockwise	M	milli = 10^{-3}	PIV	peak inverse voltage	TI	titanium
		MEG	meg = 10^{6}	PNP	positive-negative-positive	TOL	tolerance
DEPC	deposited carbon	MET FLM	metal film			TRIM	trimmer
DR	drive	MET OX	metallic oxide	P/O	part of	TWT	traveling wave tube
ELECT	electrolytic	MFR	manufacturer	POLY	polystyrene	U	micro = 10^{-6}
ENCAP	encapsulated	MHZ	mega hertz	PORC	porcelain		
EXT	external	MINAT	miniature	POS	position(s)	VAR	variable
F	farads	MOM	momentary	POT	potentiometer	VDCW	dc working volts
FH	flat head	MOS	metal oxide substrate	PP	peak-to-peak		
FIL H	fillister head	MTG	mounting	PT	point	W	with
FXD	fixed	MY	"mylar"	PWV	peak working voltage	W	watts
G	giga (10^{9})	N	nano (10^{-9})	RECT	rectifier	WIV	working inverse voltage
GE	germanium	N/C	normally closed	RF	radio frequency		
GL	glass	NE	Neon	RH	round head or right hand	WW	wirewound
GRD	ground(ed)	NI PL	nickel plate			W/O	without

PARTS LIST

* MODEL 8410A

Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08410-6013	1	ASSY:SPRUNG HANDLE SWITCH	28480	08410-6013
A1R1	0757-0290	1	RESISTOR 464 OHM 1% 1/8W	28480	0757-0290
A1R2	0757-0438	26	RESISTOR 511 OHM 1% 1/8W	28480	0757-0438
A1R3	0757-0279	12	RESISTOR 1.96K OHM 1% 1/8W	28480	0757-0279
A1R4	0698-3150	9	RESISTOR 2.37K OHM 1% 1/8W	28480	0698-3150
A1R5	0757-0438	9	RESISTOR 511 OHM 1% 1/8W	28480	0757-0438
A1R6	0757-0274	7	RESISTOR 1.21K OHM 1% 1/8W	28480	0757-0274
A1R7	0757-0420	7	RESISTOR 100 OHM 1% 1/8W	28480	0757-0420
A1R8	0757-0419	7	RESISTOR 82.5 OHM 1% 1/8W	28480	0757-0419
A1R9	0698-3447	7	RESISTOR 422 OHM 1% 1/8W	28480	0698-3447
A1R10	0698-3444	9	RESISTOR 316 OHM 1% 1/8W	28480	0698-3444
A1R11	0757-0402	1	RESISTOR 110 OHM 1% 1/8W	28480	0757-0402
A1R12	0698-4037	1	RESISTOR 46.4 OHM 1% 1/8W	28480	0698-4037
A1R13	0757-0346	3	RESISTOR 10 OHM 1% 1/8W	28480	0757-0346
A1R14	0757-0397	1	RESISTOR 68.1 OHM 1% 1/8W	28480	0757-0397
A1R15	0757-0399	2	RESISTOR 82.5 OHM 1% 1/8W	28480	0757-0399
A1R16	0757-0401	47	RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R17	0698-3437	1	RESISTOR 133 OHM 1% 1/8W	28480	0698-3437
A1R18	0757-0405	1	RESISTOR 162 OHM 1% 1/8W	28480	0757-0405
A1R19	0698-3441	1	RESISTOR 215 OHM 1% 1/8W	28480	0698-3441
A1R20	0698-3443	4	RESISTOR 287 OHM 1% 1/8W	28480	0698-3443
A1R21	0698-3444	1	RESISTOR 316 OHM 1% 1/8W	28480	0698-3444
A1R22	0757-0416	16	RESISTOR 511 OHM 1% 1/8W	28480	0757-0416
A1R23	0757-0419	7	RESISTOR 681 OHM 1% 1/8W	28480	0757-0419
A1R24	0757-0274		RESISTOR 1.21K OHM 1% 1/8W	28480	0757-0274
A1R25	0757-0278	4	RESISTOR 1.78K OHM 1% 1/8W	28480	0757-0278
A1R26	0698-3153	16	RESISTOR 3.83K OHM 1% 1/8W	28480	0698-3153
A1R27	2100-2603	1	RESISTOR TRMR 20K OHM 20% LIN 2.5W	28480	2100-2603
A1R28	0757-0467	1	RESISTOR 1.21K OHM 1% 1/8W	28480	0757-0467
A1S1	3100-2015	1	SWITCH:ROTARY	28480	3100-2015
A2	08410-6014	1	ASSY:ATTENUATOR 0-40DB	28480	08410-6014
	08410-0006	2	COVER:ATTENUATOR	28480	08410-0006
	08410-0019	2	CLAMP/PLATE ATTENUATOR COVER	28480	08410-0019
	08410-6027	1	CABLE ASSY:AMPLIFIER VERNIER	28480	08410-6027
A2A1	0811-1771	1	RESISTOR MW 210.484 OHM 0.1% 1/4DW	28480	0811-1771
A2A2	0811-1778	4	RESISTOR MW 2209.71 OHM 0.1% 1/4DW	28480	0811-1778
A2A3	0811-1778		RESISTOR MW 2209.71 OHM 0.1% 1/4DW	28480	0811-1778
A2A4	0811-1773		RESISTOR MW 210.484 OHM 0.1% 1/4DW	28480	0811-1773
A2A5	0811-1778		RESISTOR MW 2209.71 OHM 0.1% 1/4DW	28480	0811-1778
A2A6	0811-1778		RESISTOR MW 2209.71 OHM 0.1% 1/4DW	28480	0811-1778
A2A7	0811-1772	2	RESISTOR MW 110.149 OHM 0.1% 1/4DW	28480	0811-1772
A2A8	0811-1781	4	RESISTOR MW 4362.17 OHM 0.1% 1/4DW	28480	0811-1781
A2A9	0811-1781		RESISTOR MW 4362.17 OHM 0.1% 1/4DW	28480	0811-1781
A2A10	0811-1772		RESISTOR MW 110.149 OHM 0.1% 1/4DW	28480	0811-1772
A2A11	0811-1781		RESISTOR MW 4362.17 OHM 0.1% 1/4DW	28480	0811-1781
A2A12	0811-1781		RESISTOR MW 4362.17 OHM 0.1% 1/4DW	28480	0811-1781
A2A13	0811-1771	1	RESISTOR MW 97.69 OHM 0.1% 1/4DW	28480	0811-1771
A2A14	0811-1782	2	RESISTOR MW 8695.48 OHM 0.1% 1/4DW	28480	0811-1782
A2A15	0811-1782		RESISTOR MW 8695.48 OHM 0.1% 1/4DW	28480	0811-1782
A2S1	3100-2014	1	SWITCH:ROTARY	28480	3100-2014
A3	08410-6015	1	ASSY:ATTENUATOR 0-60DB	28480	08410-6015
	08410-0006		COVER:ATTENUATOR	28480	08410-0006
	08410-0019		CLAMP/PLATE ATTENUATOR COVER	28480	08410-0019
A3C1	0160-7804	1	CAPAC FXD CERM 1000PF 5%	72136	RDM15F102J3C
A3L1	9100-1660	1	COIL/CHOKE 2000 UH 5%	28480	9100-1660
A3R1	0811-1779	3	RESISTOR MW 2475 OHM 0.1% 1/4DW	28480	0811-1779
A3R2	0811-1775	4	RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R3	0811-1775		RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R4	0811-1776	1	RESISTOR MW 731.910 OHM 0.1% 1/4DW	28480	0811-1776
A3R5	0811-1777	4	RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R6	0811-1777		RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R7	0811-1779		RESISTOR MW 2475 OHM 0.1% 1/4DW	28480	0811-1779
A3R8	0811-1775		RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R9	0811-1775		RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R10	0811-1776		RESISTOR MW 731.910 OHM 0.1% 1/4DW	28480	0811-1776
A3R11	0811-1777		RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R12	0811-1777		RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R13	0811-1779		RESISTOR MW 2475 OHM 0.1% 1/4DW	28480	0811-1779
A3R14	0811-1775		RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R15	0811-1775		RESISTOR MW 611.111 OHM 0.1% 1/4DW	28480	0811-1775
A3R16	0811-1776		RESISTOR MW 731.910 OHM 0.1% 1/4DW	28480	0811-1776
A3R17	0811-1777		RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R18	0811-1777		RESISTOR MW 962.479 OHM 0.1% 1/4DW	28480	0811-1777
A3R19	0811-1774	1	RESISTOR MW 500 OHM 0.1% 1/4DW	28480	0811-1774
A3S1	3100-2006	1	SWITCH:ROTARY	28480	3100-2006

See introduction to this section for ordering information

MODEL 8410A

Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6	08410-6003	1	ASSY:PHASE DET AMPLIFIER BOARD	28480	08410-6003
A6C1	0160-2055	11	CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C2	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C3	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C4	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C5	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C6	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C7	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C8	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C9	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C10	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C11	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C12	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C13	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C14	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6Q1	1854-0071	24	TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6Q2	1854-0071		TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6Q3	1853-0034		TRANSISTOR:PNP(SELECTED FROM 2N3251)	28480	1853-0034
A6Q4	1854-0071		TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6Q5	1853-0034		TRANSISTOR:PNP(SELECTED FROM 2N3251)	28480	1853-0034
A6Q6	1854-0071		TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6R1	0757-0442	19	RESISTOR:MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R2	0757-0438		RESISTOR:MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R3	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R4	0757-0280	24	RESISTOR:MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R5	0698-3151		RESISTOR:MET FLM 3.83K OHM 1% 1/8W	28480	0698-3151
A6R6	0698-0083	16	RESISTOR:MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A6R7	0698-0085	7	RESISTOR:MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A6R8	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R9	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R10	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R11	0698-3132	4	RESISTOR:MET FLM 261 OHM 1% 1/8W	28480	0698-3132
A6R12	0757-0279	4	RESISTOR:MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A6R13	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R14	0757-0438		RESISTOR:MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R15	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R16	0757-0280		RESISTOR:MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R17	0757-0418		RESISTOR:MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A6R18	0757-0422	4	RESISTOR:MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A6R19	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R20	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R21	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R22	0757-0438		RESISTOR:MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R23	0698-1186	5	RESISTOR:MET FLM 14.7K OHM 1% 1/8W	28480	0698-1186
A6R24	0757-0279		RESISTOR:MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A6R25	0698-3440	24	RESISTOR:MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A6R26	0698-3446	3	RESISTOR:MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A6R27	0757-0279		RESISTOR:MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A6R28	0757-0401		RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R29	0757-0438		RESISTOR:MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R30	0698-1186		RESISTOR:MET FLM 14.7K OHM 1% 1/8W	28480	0698-1186
A6	08410-6037	1	ASSY:PHASE DETECTOR BOARD	28480	08410-6037
A6C1			DELETED		
A6C2	0160-2255	1	CAPACITOR-FXD 6.8 PF 500VDCW	72982	301-000-COG-0680
A6C3	0140-0191	1	CAPACITOR-FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A6C4	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C5	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C6	0160-0170	1	CAPACITOR-FXD MICA 20 PF 5%	28480	0160-0170
A6C7	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C8	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C9	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C10	0160-2307	4	CAPACITOR-FXD MICA 47 PF 5%	28480	0160-2307
A6C11	0160-2307		CAPACITOR-FXD MICA 47 PF 5%	28480	0160-2307
A6C12	0160-2307		CAPACITOR-FXD MICA 47 PF 5%	28480	0160-2307
A6C13	0160-2307		CAPACITOR-FXD MICA 47 PF 5%	28480	0160-2307
A6C14	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C15	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDCW	56289	C023F101E1032S22-C00
A6C16	0160-0155	1	CAPACITOR-FXD MY 0.0033UF 10% 200VDCW	56289	192P33292-M15
A6C17			DELETED		
A6CR1	1901-0179	8	DIODE:SILICON 15MV	28480	1901-0179
A6CR2	1901-0179		DIODE:SILICON 15MV	28480	1901-0179
A6CR3	1901-0179		DIODE:SILICON 15MV	28480	1901-0179
A6CR4	1901-0179		DIODE:SILICON 15MV	28480	1901-0179
A6CR5	1901-0179		DIODE:SILICON 15MV	28480	1901-0179
A6CR6	1901-0179		DIODE:SILICON 15MV	28480	1901-0179

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5CR7	1901-0179		DIODE-SILICON 15NV	28480	1901-0179
A5CR8	1901-0179		DIODE-SILICON 15NV	28480	1901-0179
A5CR9	1901-0027		DIODE-SILICON 0.46V AT 1 MA	28480	1901-0027
A5CR10	1901-0027		DIODE-SILICON 0.46V AT 1 MA	28480	1901-0027
A5L1			DELETED		
A5L2	9140-0108	1	COIL/CHOKE 0.20 UH 10%	28480	9140-0108
A5L3	9100-1614	1	COIL/CHOKE 0.82 UH 10%	28480	9100-1614
A5L4	9140-0121	1	COIL,FXD 1.0 UH	28480	9140-0121
A5L5			DELETED		
A5Q1	1854-0071	14	TRANSISTOR NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q2	1854-0071		TRANSISTOR NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q3	1854-0071		TRANSISTOR NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q4	1854-0073		TRANSISTOR NPN(SELECTED FROM 2N2857)	28480	1854-0073
A5Q5	1854-0073		TRANSISTOR NPN(SELECTED FROM 2N2857)	28480	1854-0073
A5Q6	1854-0071		TRANSISTOR NPN(SELECTED FROM 2N2857)	28480	1854-0073
A5R1	0757-0416		RESISTOR 1K OHM 1% 1/8W	28480	0757-0416
A5R2	0757-0438		RESISTOR 9.31K OHM 1% 1/8W	28480	0757-0438
A5R3	0698-3157		RESISTOR 19.6K OHM 1% 1/8W	28480	0698-3157
A5R4	0757-0416		FACTORY SELECTED PART RESISTOR 1K OHM 1% 1/8W	28480	0757-0416
A5R5	0757-0438		RESISTOR 9.31K OHM 1% 1/8W	28480	0757-0438
A5R6	0698-3157		RESISTOR 19.6K OHM 1% 1/8W	28480	0698-3157
A5R7	0757-0421		FACTORY SELECTED PART RESISTOR 825 OHM 1% 1/8W	28480	0757-0421
A5R8	0757-0199		RESISTOR 21.0K OHM 1% 1/8W	28480	0757-0199
A5R9	0757-0199		RESISTOR 21.0K OHM 1% 1/8W	28480	0757-0199
A5R10	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A5R11	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A5R12	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A5R13	0698-3438		RESISTOR 147 OHM 1% 1/8W	28480	0698-3438
A5R14	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A5R15	0757-0438		RESISTOR 9.31K OHM 1% 1/8W	28480	0757-0438
A5R16	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A5R17	0698-3443		RESISTOR 287 OHM 1% 1/8W	28480	0698-3443
A5R18	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A5R19	0698-3443		RESISTOR 287 OHM 1% 1/8W	28480	0698-3443
A5R20	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A5R21	0698-3155		RESISTOR 6.04K OHM 1% 1/8W	28480	0698-3155
A5R22	0757-0438		RESISTOR 9.31K OHM 1% 1/8W	28480	0757-0438
A5R23	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A5R24	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A5R25	0698-3154		RESISTOR 4.22K OHM 1% 1/8W	28480	0698-3154
A5R26	0698-3154		RESISTOR 4.22K OHM 1% 1/8W	28480	0698-3154
A5R27	0698-3154		RESISTOR 4.22K OHM 1% 1/8W	28480	0698-3154
A5R28	0698-3154		RESISTOR 4.22K OHM 1% 1/8W	28480	0698-3154
A5R29	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A5R30	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A6	08410-6009	1	ZONE OSCILLATOR ASSY DOES NOT INCLUDE A7	28480	08410-6009
A6C1*	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C2	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C3	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C4	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C5	0140-0199		CAPACITOR-FXD MICA 240 PF 5%	28480	0140-0199
A6C6	0160-1166		CAPACITOR-FXD CER 24 PF 5% 500VDCM	28480	0160-1166
A6C6			FACTORY SELECTED PART		
A6C7	0140-0218		CAPACITOR-FXD MICA 1000 PF 5%	28480	0140-0218
A6C8	0140-0205		CAPACITOR-FXD MICA 62 PF 5% 500VDCM	00853	RDM19E620J3C
A6C9	0160-2204		CAPACITOR-FXD MICA 100PF 5%	72136	RDM19F101J3C
A6C10	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C11	0160-2204		CAPACITOR-FXD MICA 100PF 5%	72136	RDM19F101J3C
A6C12	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C13	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6C14	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCM	56289	C023F101F103Z5Z2-CDH
A6CR1	1910-0022	6	DIODE-SBE SM1V	14433	G401
A6CR2*	1910-0022		DIODE-SBE SM1V	14433	G401
A6L1	9100-1631	2	COIL/CHOKE 56 UH 10%	28480	9100-1631
A6Q1	1854-0071		TRANSISTOR NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6Q2	1854-0071		TRANSISTOR NPN(SELECTED FROM 2N2857)	28480	1854-0071
A6Q3	1853-0034		TRANSISTOR PNP(SELECTED FROM 2N3251)	28480	1853-0034
A6R1	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A6R2	0757-0447	5	RESISTOR 16.2K OHM 1% 1/8W	28480	0757-0447
A6R3	0698-3157		RESISTOR 19.6K OHM 1% 1/8W	28480	0698-3157
A6R4	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A6R5	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280

See introduction to this section for ordering information.

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8A6	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A8A7	0757-0279		RESD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A8A8	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A8A9	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8A10	0757-0438		RESD MET FLM 9.11K OHM 1% 1/8W	28480	0757-0438
A8A11	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A8A12	0757-0477		RESD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A8A13	0698-3153		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A8A14	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A8A15	0698-0083		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A8A16	0698-3150		RESD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A8A17	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A8A18	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A8A19	0757-0279		RESD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A8A21	1200-0149	1	SOCKET IC 8 CONTACT	91506	8004-107
A8Y1	0410-0121	1	CRYSTAL QUARTZ (MATCHED TO A8A21)	28480	0410-0121
A7	08410-6041	1	ASSY VTO-DC AMPLIFIER BOARD	28480	08410-6041
A7L1	0160-2730	1	CAPACITOR-FXD MICA 3300 PF 5%	28480	0160-2730
A7L2	0180-0100	1	CAPACITOR-FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A7C1	0160-2709	2	CAPACITOR-FXD MICA 300 PF 5%	72136	RDM19FX301J3C
A7C4	0180-0374	1	CAPACITOR-FXD TANT 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A7L5	0160-0121	14	CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A7L6	0160-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A7C7	0160-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A7C8	0141-0154	1	CAPACITOR-FXD MY 0.0068 UF 10% 200VDCW	56289	192P6802-P15
A7C9	0160-0167	1	CAPACITOR-FXD MY .082 UF 10% 200VDCW	56289	192P8239-P15
A7C10	0160-0160	1	CAPACITOR-FXD MY 0.0082 UF 10% 200VDCW	56289	192P8229-P15
A7CR1	1901-0028	4	DIODE-SILICON 100MA/1V	07263	FD 2387
A7CR2	1901-0028		DIODE-SILICON 100MA/1V	07263	FD 2387
A7Q1	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7Q2	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7Q3	1853-0020	12	TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020
A7Q4	1855-0078	1	JFET-SI FET	28480	1855-0078
A7Q5	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7Q6	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7Q7	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7Q8	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A7R1	0698-3260	1	RESD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A7R2	0757-0461	2	RESD MET FLM 40.2K OHM 1% 1/8W	28480	0757-0461
A7R3	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R4	0698-3451	1	RESD MET FLM 133K OHM 1% 1/8W	28480	0698-3451
A7R5	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A7R6	0757-0421		RESD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A7R7	0757-0274	1	RESD MET FLM 91.9 OHM 1% 1/8W	28480	0757-0274
A7R8	0757-0458	2	RESD MET FLM 91.1K OHM 1% 1/8W	28480	0757-0458
A7R9	0757-0438	1	RESD MET FLM 9.11K OHM 1% 1/8W	28480	0757-0438
A7R10	2100-0942	1	RESD VAR FLM 50K OHM 20% 1/4W	28480	2100-0942
A7R11	0698-3153		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A7R12	0698-3438		RESD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A7R13	0757-0288	3	RESD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A7R14	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R15	0698-3438		RESD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A7R16	0698-3450	2	RESD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A7R17	0698-3155		RESD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A7R18	0757-0461	1	RESD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0461
A7R19	0757-0467	2	RESD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0467
A7R20	0757-0447		RESD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A7R21	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A7R22	0698-3154		RESD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A7R23	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R24	0698-3444		RESD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A7R25	0698-3444		RESD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A7R26	0757-0419		RESD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A7R27	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A7R28	0698-0082	4	RESD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A8	08410-6007	1	SEARCH GENERATOR ASSY	28480	08410-6007
A8C1	0160-0168	1	CAPACITOR-FXD MY 0.1 UF 10% 200VDCW	56289	192P1042-P15
A8Q1	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A8Q2	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A8Q3	1853-0020		TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020
A8Q4	1853-0020		TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020
A8Q5	1853-0020		TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020
A8Q6	1854-0071		TSTR-SI NPN SELECTED FROM 2N3704	28480	1854-0071
A8Q7	1853-0020		TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020
A8Q8	1853-0020		TSTR-SI PNP SELECTED FROM 2N3702	28480	1853-0020

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8Q9	1853-0020		TSTR:SI PNP:SELECTED FROM 2N3702	28480	1853-0020
A8Q10	1853-0020		TSTR:SI PNP:SELECTED FROM 2N3702	28480	1853-0020
A8R1	0757-0417	4	RESISTOR 9.09K OHM 1% 1/8W	28480	0757-0417
A8R2	0757-0399		RESISTOR 82.5 OHM 1% 1/8W	28480	0757-0399
A8R3			FACTORY SELECTED PART		
A8R4	0757-0428		RESISTOR 1.62K OHM 1% 1/8W	28480	0757-0428
A8R5	0757-0402		RESISTOR 110 OHM 1% 1/8W	28480	0757-0402
A8R6	0698-3446		RESISTOR 383 OHM 1% 1/8W	28480	0698-3446
A8R7	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A8R8	0698-3156		RESISTOR 14.7K OHM 1% 1/8W	28480	0698-3156
A8R9	0757-0424	3	RESISTOR 1.10K OHM 1% 1/8W	28480	0757-0424
A8R10			NOT ASSIGNED		
A8R11			NOT ASSIGNED		
A8R12	0757-0200	3	RESISTOR 5.62K OHM 1% 1/8W	28480	0757-0200
A8R13	0757-0279		RESISTOR 8.16K OHM 1% 1/8W	28480	0757-0279
A8R14	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A8R15	0757-0424		RESISTOR 1.10K OHM 1% 1/8W	28480	0757-0424
A8R16	0757-0443	5	RESISTOR 11.0K OHM 1% 1/8W	28480	0757-0443
A8R17	0698-3151	1	RESISTOR 2.87K OHM 1% 1/8W	28480	0698-3151
A8R18	0698-3443		RESISTOR 287 OHM 1% 1/8W	28480	0698-3443
A8R19	0757-0278		RESISTOR 1.78K OHM 1% 1/8W	28480	0757-0278
A8R20	0757-0441	2	RESISTOR 8.25K OHM 1% 1/8W	28480	0757-0441
A8R21	0757-0199		RESISTOR 21.5K OHM 1% 1/8W	28480	0757-0199
A8R22	0757-0199		RESISTOR 21.5K OHM 1% 1/8W	28480	0757-0199
A8R23	0757-0199		RESISTOR 21.5K OHM 1% 1/8W	28480	0757-0199
A8R24	0757-0290		RESISTOR 6.19K OHM 1% 1/8W	28480	0757-0290
A8R25	0757-0290		RESISTOR 6.19K OHM 1% 1/8W	28480	0757-0290
A8R26	0757-0458		RESISTOR 51.1K OHM 1% 1/8W	28480	0757-0458
A8R27	0698-3159	4	RESISTOR 26.1K OHM 1% 1/8W	28480	0698-3159
A8R28	0698-3159		RESISTOR 26.1K OHM 1% 1/8W	28480	0698-3159
A8R29			NOT ASSIGNED		
A8R30	0757-0278		RESISTOR 1.78K OHM 1% 1/8W	28480	0757-0278
A8R31			NOT ASSIGNED		
A8R32	0698-3136	1	RESISTOR 17.8K OHM 1% 1/8W	28480	0698-3136
A8R33	0698-3450		RESISTOR 49.9K OHM 1% 1/8W	28480	0698-3450
A8R34	0757-0447		RESISTOR 16.2K OHM 1% 1/8W	28480	0757-0447
A8R35	0698-3446		RESISTOR 383 OHM 1% 1/8W	28480	0698-3446
A8R36	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A8R37	0757-0402		RESISTOR 110 OHM 1% 1/8W	28480	0757-0402
A8R38	0757-0428		RESISTOR 1.62K OHM 1% 1/8W	28480	0757-0428
A8R39	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A8R39			FACTORY SELECTED PART		
A8R40	0757-0417		RESISTOR 9.09K OHM 1% 1/8W	28480	0757-0417
A9	08410-6018	1	ASSY:EXTENDER BOARD	28480	08410-6018

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1D	08410-6049	1	ASSY:WIRING INTERCONNECT BOARD INCLUDES ONLY 8A1, CR1 THRU 8	28480	08410-6049
A1C61	0180-2292	3	C:FXD ELECT 3900 UF +75-10% 50VDCW	56289	5AD/49F6050A2A-D08
A1C62	0180-2292		C:FXD ELECT 3900 UF +75-10% 50VDCW	56289	5AD197G050A2A-D08
A1C63	0180-2292		C:FXD ELECT 3900 UF +75-10% 50VDCW	56289	5AD197G050A2A-D08
A1C64	0180-0050	1	C:FXD ELECT 40 UF +75-10% 50VDCW	28480	0180-0050
A1C65			NOT ASSIGNED		
A1C66			NOT ASSIGNED		
A1C67	0180-0094	2	C:FXD ELECT 100 UF +75-10% 25VDCW	56289	300D107G025DD2-DSM
A1C68	0180-0094		C:FXD ELECT 100 UF +75-10% 25VDCW	56289	300D107G025DD2-DSM
A1C69	0180-0374		C:FXD TANT, 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A1C610	0180-0374		C:FXD TANT, 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A1C611	0140-0210	2	C:FXD MICA 270 PF 5%	28480	0140-0210
A1C612	0140-0210		C:FXD MICA 270 PF 5%	28480	0140-0210
A1CR1	1901-0028	8	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR2	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR3	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR4	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR5	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR6	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR7	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR8	1901-0028		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1Q1	1854-0063	8	TSTR:SI NPN	80131	2N3055
A1Q2	1854-0063		TSTR:SI NPN	80131	2N3055
A1Q3	1854-0063		TSTR:SI NPN	80131	2N3055
A1Q4	1200-0043	3	INSULATOR:STR MOUNTING TO-31	71785	295011
A1Q5	1200-0147	1	SLEEVE:INSULATOR NYLON	26365	974-302
A1QR41	1251-1884	1	CONNPC 30-CONTACT (2X15)	71785	252-15-30-340
A1R41	08410-60050	1	ASSY:POWER SUPPLY BOARD	28480	08410-6050
A1R41C1	0180-2705	1	C:FXD ELECT 0.33 UF 10% 35VDCW	56289	150D334X9035A2-DYS
A1R41C2	0160-2917	4	C:FXD CER 0.05 UF +80-20% 100VDCW	84411	TYPE TA
A1R41C3	0160-2917		C:FXD CER 0.05 UF +80-20% 100VDCW	84411	TYPE TA
A1R41C4	0180-0291	7	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A1R41C5	0180-0229	1	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A1R41C6	0160-2917		C:FXD CER 0.05 UF +80-20% 100VDCW	84411	TYPE TA
A1R41C7	0160-2917		C:FXD CER 0.05 UF +80-20% 100VDCW	84411	TYPE TA
A1R41CR1	1901-0029		DIODE:SILICON 100MA/1V	07263	FD 2387
A1R41CR2	1901-0029		DIODE:SILICON 100MA/1V	07263	FD 2387
A1R41CR3	1901-0029		DIODE:SILICON 100MA/1V	07263	FD 2387
A1R41U1	1853-0001	3	TSTR:SI PNP:SELECTED FROM 2N1132	28480	1853-0001
A1R41U2	1853-0001		TSTR:SI PNP:SELECTED FROM 2N1132	28480	1853-0001
A1R41U3	1853-0020		TSTR:SI PNP:SELECTED FROM 2N3702	28480	1853-0020
A1R41U4	1853-0020		TSTR:SI PNP:SELECTED FROM 2N3702	28480	1853-0020
A1R41U5	1853-0001		TSTR:SI PNP:SELECTED FROM 2N1132	28480	1853-0001
A1R41R1	0757-0180	1	R:FXD MET FLM 31.6 OHM 1% 1/8W	28480	0757-0180
A1R41R2	0757-0180		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R41R3	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R41R4	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R41R5	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A1R41R6	0811-1552	1	R:FXD WW 0.56 OHM 5% 2W	28480	0811-1552
A1R41R7	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A1R41R8	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1R41R9	2100-2632	1	R:VAR FLW 100 OHM 10% LIN 1/2W	28480	2100-2632
A1R41R10	0698-3153		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3153
A1R41R11	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A1R41R12	0698-0084	2	R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A1R41R13	0698-3444		R:FXD MET FLM 3M OHM 1% 1/8W	28480	0698-3444
A1R41R14	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R41R15	0764-0015	1	R:FXD MET FLM 960 OHM 5% 2W	28480	0764-0015
A1R41R16	0811-1662	2	R:FXD WW 0.47 OHM 5% 2W	28480	0811-1662
A1R41R17	0683-0275	1	R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A1R41R18	0698-3160	3	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R41R19	0698-3162	2	R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A1R41R20	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R41R21	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R41R22	2100-1756	1	R:VAR WW 200 OHM 5% TYPE V 1W	28480	2100-1756
A1R41R23	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A1R41R24	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R41R25	0698-3611	1	R:FXD MET FLM 330 OHM 5% 2W	28480	0698-3611
A1R41R26	0811-1662		R:FXD WW 0.47 OHM 5% 2W	28480	0811-1662
A1R41R27	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R41R28	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A1R41R29	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A1R41R30	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1R41R31	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1DS1,A1	0757-0288		RESD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A1DS2,3	1820-0196	3	IC(L)(NEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A1DS4,U7	1820-0196		IC(L)(NEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A1DS5,U9	1820-0196		IC(L)(NEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A11	08410-6011	1	ASSY:AMPLIFIER(DC) ATTEN AMPLIFIER BOARD	28480	08410-6011
A11C1	0160-0154	1	CAPACITOR-FXD MICA 220PF 5% 300VDCW	14655	RDM19FD221J3C
A11C2			FACTORY SELECTED PART		
A11C3			FACTORY SELECTED PART		
A11C4	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11C5	0160-0174	2	CAPACITOR-FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7E-CM1
A11C6	0160-3076	2	CAPACITOR-FXD CER 470 PF 5% 300VDCW	71590	DDD
A11C7			FACTORY SELECTED PART		
A11C8			FACTORY SELECTED PART		
A11C9	0140-0199	1	CAPACITOR-FXD MICA 430 PF 5% 300 VDCW	28480	0140-0199
A11C10			FACTORY SELECTED PART		
A11C11	0160-0184	2	CAPACITOR-FXD MICA 6200 PF 1% 300VDCW	28480	0160-0184
A11C12	0160-2207	1	CAPACITOR-FXD MICA 300 PF 5%	28480	0160-2207
A11C13			FACTORY SELECTED PART		
A11C14	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11C15	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11C16	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11C17	0160-0174		CAPACITOR-FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7E-CM1
A11C18	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11C19	0150-0121		CAPACITOR-FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1E-CM1
A11L1	9100-2209	2	INDUCTOR:RF(4 LM) 5%	284	9100-2209
A11L2	9140-0131	1	COIL:FXD RF 10 MH	28480	9140-0131
A11Q1	1854-0071		TRANSI NPN:SELECTED FROM 2N3704	28480	1854-0071
A11Q2	1854-0071		TRANSI NPN:SELECTED FROM 2N3704	28480	1854-0071
A11Q3	1854-0071		TRANSI NPN:SELECTED FROM 2N3704	28480	1854-0071
A11Q4	1853-0017	1	TRANSI PNP	80131	2N2904A
A11R1	0757-0279		RESD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A11R2	0698-3159		RESD MET FLM 20.1K OHM 1% 1/8W	28480	0698-3159
A11R3	0757-0424		RESD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A11R4	0698-0082		RESD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A11R5			FACTORY SELECTED PART		
A11R6	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A11R7	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A11R8	0698-0083		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R9	0698-3154		RESD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A11R10	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R11	0698-0084		RESD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A11R12	0698-3153		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A11R13	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A11R14	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A11R15	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A11R16	0698-3447		RESD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A11R17	0757-0420		RESD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A11R18	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A11R19	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A12	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A12C1	08410-6038	1	ASSY:TEST AUC AMPLIFIER BOARD	28480	08410-6038
A12C2	0160-2204		CAPACITOR-FXD MICA 100PF 5%	72136	RDM19FD101J3C
A12C3	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C4	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C5	0140-0194	4	CAPACITOR-FXD MICA 110 PF 5%	72136	RDM19FD111J3C
A12C6	0140-0194		CAPACITOR-FXD MICA 110 PF 5%	72136	RDM19FD111J3C
A12C7	0140-0194		CAPACITOR-FXD MICA 110 PF 5%	72136	RDM19FD111J3C
A12C8	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C9	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C10	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C11	0160-2201	1	CAPACITOR-FXD MICA 91 PF 5%	72136	RDM19FD910J3C
A12C12	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C13	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C14	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C15	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C16	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C17	0140-0177	1	CAPACITOR-FXD MICA 400 PF 1%	28480	0140-0177
A12C18	0170-0066	2	CAPACITOR-FXD MY 0.022 UF 10% 200VDCW	56289	192P27392-P16
A12C19	0180-2127	2	CAPACITOR-FXD ELECT 0.15 UF 5% 35VDCW	28480	0180-2127
A12C20	0160-2055		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5S2-CDH
A12C21	0160-2279	2	CAPACITOR-FXD MICA 3000 PF 5%	28480	0160-2279
A12CR1	1901-0050	4	DIODE:SI 200 MA AT 1V	07263	FDA 6300
A12CR2	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6300
A12CR3	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6300
A12CR4	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6300
A12CR5	08410-6005	1	DIODE:SI MATCHED QUAD	28480	08410-6005

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1[illegible]			MATCHED TO A1[illegible] & A1[illegible] & A		
A1[illegible]			A1[illegible] & B DELETED		
A1C1	9100-0348	2	COILCORD 1.0 UH 10	28480	9100-0348
A1C2	9100-2516	2	INDUCTOR-VAR 0.15 UH	04790	18-808
A1C3			DELETED		
A1Q1	1854-0071		TRANSISTOR NPN SELECTED FROM 2N2857	28480	1854-0071
A1Q2	1854-0071		TRANSISTOR NPN SELECTED FROM 2N2857	28480	1854-0071
A1Q3	1854-0071		TRANSISTOR NPN SELECTED FROM 2N2857	28480	1854-0071
A1Q4	1854-0071		TRANSISTOR NPN SELECTED FROM 2N2857	28480	1854-0071
A1Q5	08410-8003	1	TRANSISTOR PAIR MATCHED	28480	08410-8003
A1Q6			MATCHED TO A1Q5		
A1Q6	1854-0071		TRANSISTOR NPN SELECTED FROM 2N2857	28480	1854-0071
A1Q7	08410-8001	10	TRANSISTOR PAIR MATCHED	28480	08410-8001
A1Q8			MATCHED TO A1Q7		
A1R1	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R2	0757-0416	1	RESISTOR MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R3	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R4	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R5	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R6	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R7	0698-0082		RESISTOR MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A1R8	0757-0416		RESISTOR MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R9	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R10	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R11	0698-0083		RESISTOR MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A1R12	0757-0400		RESISTOR MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A1R13	0698-3156		RESISTOR MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A1R14	0757-0438		RESISTOR MET FLM 95.1K OHM 1% 1/8W	28480	0757-0438
A1R15	0757-0458		RESISTOR MET FLM 1.62K OHM 1% 1/8W	28480	0757-0458
A1R16	0698-3440		RESISTOR MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R17	0698-3440		RESISTOR MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R18	0757-0444		RESISTOR MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A1R19	0757-0442		RESISTOR MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R20	0698-3153		RESISTOR MET FLM 5.62K OHM 1% 1/8W	28480	0698-3153
A1R21			DELETED		
A1R22	0757-0438		RESISTOR MET FLM 9.31K OHM 1% 1/8W	28480	0757-0438
A1R23	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R24	0698-3153		RESISTOR MET FLM 5.62K OHM 1% 1/8W	28480	0698-3153
A1R25	0757-0438		RESISTOR MET FLM 9.31K OHM 1% 1/8W	28480	0757-0438
A1R26	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R27	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R28	0757-0394		RESISTOR MET FLM 93.1 OHM 1% 1/8W	28480	0757-0394
A1R29	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R30	0757-0280		RESISTOR MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R31	0757-0417		RESISTOR MET FLM 562 OHM 1% 1/8W	28480	0757-0417
A1R32	0757-0416		RESISTOR MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R33	0698-3442		RESISTOR MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A1R34	0757-0401		RESISTOR MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1S	08410-6008		ASSY:20.270MHz OSCILLATOR BOARD (DOES NOT INCLUDE Y1)	28480	08410-6008
A1C1	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C2	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C3	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C4	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C5	0140-0199		CAPACITOR MICA 240 PF 5%	28480	0140-0199
A1C6	0160-2210		CAPACITOR MICA 1000 PF 5%	28480	0160-2210
A1C7	0121-0105		CAPACITOR-VAR 4-35 PF NPO	28480	0121-0105
A1C8	0160-2266		CAPACITOR CER 3.6pF-0.25 PF 500VDCW	72982	301-000-C0J0R6B9E
A1C9	0140-0205		CAPACITOR MICA 62 PF 5% 300VDCW	00853	RDM15E620J3L
A1C10	0160-2204		CAPACITOR MICA 100PF 5%	72136	RDM15F101J3C
A1C11	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C12	0160-2204		CAPACITOR MICA 100PF 5%	72136	RDM15F101J3C
A1C13	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C14	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C15	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C16	0160-0919		CAPACITOR MICA 430 PF 5% 300 VDCW	28480	0160-0919
A1C17	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C18	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C19	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C20	0160-2055		CAPACITOR CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U7-C06
A1C21	0160-2202	1	CAPACITOR MICA 75 PF 5%	28480	0160-2202
A1D1A1	1910-0032		DIODE:GE SW1V	14433	0401
A1D2A2	1910-0032		DIODE:GE SW1V	14433	0401
A1L1	9100-1631		COIL:CHOKE 56 UH 5%	28480	9100-1631
A1L2	9140-0094	1	COIL:FXD RFC 0.68UH	99800	1537-08

See Introduction to this section for ordering information

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1	1853-0034		TRANSISTOR PNP SELECTED FROM 2N3251	28480	1853-0034
A1A2	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1A3	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1A4	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1A5	1853-0034		TRANSISTOR PNP SELECTED FROM 2N3251	28480	1853-0034
A1R1	0757-0289	1	RESISTOR 1.33K OHM 1% 1/8W	28480	0757-0289
A1R2	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A1R3	0698-3187		RESISTOR 9.88 OHM 1% 1/8W	28480	0698-3187
A1R4	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A1R5	0757-0280		RESISTOR 1K OHM 1% 1/8W	28480	0757-0280
A1R6	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A1R7	0757-0279		RESISTOR 681 OHM 1% 1/8W	28480	0757-0279
A1R8	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R9	0757-0442		RESISTOR 10.0K OHM 1% 1/8W	28480	0757-0442
A1R10	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A1R11	0698-3153		RESISTOR 3.83 OHM 1% 1/8W	28480	0698-3153
A1R12	0757-0438		RESISTOR 681 OHM 1% 1/8W	28480	0757-0438
A1R13	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R14	0757-0477		RESISTOR 909 OHM 1% 1/8W	28480	0757-0477
A1R15	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A1R16	0698-3150		RESISTOR 2.37K OHM 1% 1/8W	28480	0698-3150
A1R17	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A1R18	0757-1094		RESISTOR 1.47K OHM 1% 1/8W	28480	0757-1094
A1R19	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R20	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A1R21	0698-3153		RESISTOR 3.83K OHM 1% 1/8W	28480	0698-3153
A1R22	0757-0438		RESISTOR 681 OHM 1% 1/8W	28480	0757-0438
A1R23	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R24	0698-3440		RESISTOR 196 OHM 1% 1/8W	28480	0698-3440
A1R25	0757-0477		RESISTOR 909 OHM 1% 1/8W	28480	0757-0477
A1R26	0698-0083		RESISTOR 1.96K OHM 1% 1/8W	28480	0698-0083
A1R27	0698-3150		RESISTOR 2.37K OHM 1% 1/8W	28480	0698-3150
A1R28	0757-0279		RESISTOR 681 OHM 1% 1/8W	28480	0757-0279
A1R29	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1R30	0757-0401		RESISTOR 100 OHM 1% 1/8W	28480	0757-0401
A1XY1	1200-0191		SOCKET-CRYSTAL	91506	8004-167
A1Y1			NSR PART OF A6Y1		
A1A	08410-6039	1	ASSY-REF, AGC AMPLIFIER BOARD	28480	08410-6039
A1C1	0160-2204		CAPACITOR-FXD MICA 100PF 5%	72136	RDM15FD101J3C
A1C2	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C3	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C4	0160-0154		CAPACITOR-FXD MICA 110 PF 5%	72136	RDM15FD111J3C
A1C5	0160-0154		CAPACITOR-FXD MICA 110 PF 5%	72136	RDM15FD111J3C
A1C6	0160-0154		CAPACITOR-FXD MICA 110 PF 5%	72136	RDM15FD111J3C
A1C7	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C8	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C9	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C10	0160-2150	1	CAPACITOR-FXD MICA 33 PF 5%	28480	0160-2150
A1C11	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C12	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C13	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C14	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C15	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C16	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C17	0160-0177		CAPACITOR-FXD MICA 400 PF 1%	28480	0160-0177
A1C18	0170-0064		CAPACITOR-FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-P15
A1C19	0180-2127		CAPACITOR-FXD ELECT 0.15 UF 5% 35VDCW	28480	0180-2127
A1C20	0160-2055		CAPACITOR-FXD CER DI 0.01UF +80-20% 100VDCW	56289	C023F101F103Z5B2-CDH
A1C21			DELETED		
A1CR1	1901-0050		DIODE-SI 200 MA AT 1V	07263	FDA 6308
A1CR2	1901-0050		DIODE-SI 200 MA AT 1V	07263	FDA 6308
A1CR3	1901-0050		DIODE-SI 200 MA AT 1V	07263	FDA 6308
A1CR4			PART OF A1CR5		
A1CR5			PART OF A1CR5		
A1CR6			DELETED		
A1CR7			DELETED		
A1L1	9100-0348		COIL-FXD 1.5 UH 5%	28480	9100-0348
A1L2	9100-2516		INDUCTOR-VAR 0.15 UH	09730	18-808
A1L3			DELETED		
A1Q1	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1Q2	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1Q3	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1Q4	1854-0071		TRANSISTOR NPN SELECTED FROM 2N4871	28480	1854-0071
A1Q5			PART OF A1Q4,REPLACE IN PAIRS		

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1Q6	1854-0071		TSTR:SI NPN SELECTED FROM 2N3947	28480	1854-0071
A1Q6			PART OF A1Q6, REPLACE AS PAIR		
A1R1	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R2	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R3	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R4	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R5	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R6	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R7	0698-0082		RESD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A1R8	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R9	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R10	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R11	0698-0083		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A1R12	0757-0400		RESD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A1R13	0698-3156		RESD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A1R14	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R15	0757-0428		RESD MET FLM 1.47K OHM 1% 1/8W	28480	0757-0428
A1R16	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R17	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R18	0757-0444		RESD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A1R19	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R20	0698-3151		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3151
A1R21			DELETED		
A1R22	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R23	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R24	0698-3151		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3151
A1R25	0757-0418		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0418
A1R26	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R27	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R28	0757-0394		RESD MET FLM 81.1 OHM 1% 1/8W	28480	0757-0394
A1R29	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R30	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R31	0757-0417		RESD MET FLM 562 OHM 1% 1/8W	28480	0757-0417
A1R32	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R33	0698-3447		RESD MET FLM 237 OHM 1% 1/8W	28480	0698-3447
A1R34	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1T1	9170-0816		MAGNETIC SHIELDING	02114	56-590-65/38
A1	08410-6060	1	ASSY:AGC-DC AMPLIFIER BOARD	28480	08410-6060
A1C1	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C2	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C3	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C4	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C5	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C6	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C7	0160-2218		CAPRD MICA 1000 PF 5%	28480	0160-2218
A1C8	0160-2218		CAPRD MICA 1000 PF 5%	28480	0160-2218
A1C9	0180-1735	1	CAPRD ELECT 0.22 UF 10% 35VDCW	28480	0180-1735
A1C10	0150-0121		CAPRD CER 0.1 UF +80-20% 50VDCW	56289	5C50B15-CM0
A1C11	0160-2055		CAPRD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z5U-CDH
A1C12	0160-2209		CAPRD MICA 360 PF 5%	72136	RDM15FF361J3C
A1C13	0150-0121		CAPRD CER 0.1 UF +80-20% 50VDCW	56289	5C50B15-CM0
A1C14	0150-0121		CAPRD CER 0.1 UF +80-20% 50VDCW	56289	5C50B15-CM0
A1C15	0160-2229		CAPRD MICA 3000 PF 5%	28480	0160-2229
A1C16	0160-2228	1	CAPRD MICA 2700 PF 5%	28480	0160-2228
A1C17	0160-0136	1	CAPRD MICA 2500 PF 1%	04062	RDM20FF252F1C
A1CR1	1910-0022		DIODE:GE 5W1V	14433	0401
A1CR2	1910-0022		DIODE:GE 5W1V	14433	0401
A1CR3	1901-0033		DIODE:SILICON 100NA 180WV	07263	FD1369
A1CR4	1901-0033		DIODE:SILICON 100NA 180WV	07263	FD1369
A1CR5	1901-0033		DIODE:SILICON 100NA 180WV	07263	FD1369
A1L1	9100-1621	1	COIL/CHOKE 10.0 UH 10%	99800	1537-42
A1L2	9100-1638	1	COIL/CHOKE 130.0 UH 5%	28480	9100-1638
A1Q1	1854-0071		TSTR:SI NPN SELECTED FROM 2N3947	28480	1854-0071
A1Q2	1853-0034		TSTR:SI PNP SELECTED FROM 2N3251	28480	1853-0034
A1Q3	1854-0071		TSTR:SI NPN SELECTED FROM 2N3947	28480	1854-0071
A1Q4	1854-0221	1	TSTR:SI NPN SELECTED FROM 2N4044	28480	1854-0221
A1Q5			PART OF A1Q4A AND B		
A1Q6	1853-0009	1	TSTR:SI PNP	28480	1853-0009
A1Q7	1854-0071		TSTR:SI NPN SELECTED FROM 2N3904	28480	1854-0071
A1Q8	1853-0020		TSTR:SI PNP SELECTED FROM 2N3702	28480	1853-0020
A1R1	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R2	0698-3151		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3151
A1R3	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R4	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R5	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280

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Table 3-8, Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R46	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R47	0698-0083		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A1R48	0698-0085		RESD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A1R49	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R50	0757-0443		RESD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R51	0757-0288		RESD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A1R52	0698-3150		RESD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A1R53	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R54	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R55	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R56	0757-0443		RESD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R57	0698-3435	1	RESD MET FLM 38.3 OHM 1% 1/8W	28480	0698-3435
A1R58	0757-0441		RESD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A1R59	0757-0443		RESD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R60	0698-3460		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3460
A1R61	0698-3159		RESD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3159
A1R62			FACTORY SELECTED PART		
A1R63	0698-3160		RESD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R64	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R65	0757-0488	1	RESD MET FLM 909K OHM 1% 1/8W	28480	0757-0488
A1R66	0757-0400		RESD MET FLM 10.0 OHM 1% 1/8W	28480	0757-0400
A1R67	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R68	0757-0416	1	RESD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0416
A1R69	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R70	0757-0443		RESD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A1R71	0757-0278		RESD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A1R72	0698-3159		RESD MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159
A1R73	0757-0461		RESD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A1R74			FACTORY SELECTED PART		
A1R75	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R76	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R77	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R78	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R79	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A1R80	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1VR1	1902-3171	1	DIODE BREAKDOWN=11.0V 5%	28480	1902-3171
A1	[illegible]	1	ASSY,FREQ REF, AMPLIFIER BOARD	28480	[illegible]
A1C1	0160-2227		C:FXD MICA 2400 PF 5%	28480	0160-2227
A1C2	0160-2227		C:FXD MICA 2400 PF 5%	28480	0160-2227
A1C3	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCM	56289	5C50BF5-CML
A1C4	0140-0291		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCM	56289	5C50BF5-CML
A1C6	0140-0291		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCM	56289	5C50BF5-CML
A1C8	0140-0184		C:FXD MICA 6200 PF 1% 100VDCM	28480	0140-0184
A1C9	0160-1076		C:FXD CER 470 PF 5% 200VDCM	11540	DNB
A1C10	0160-0919		C:FXD MICA 430 PF 5% 300 VDCM	28480	0160-0919
A1C11			FACTORY SELECTED PART		
A1C12	0140-0291		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1C13 THRU	0140-0291		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1C15	[illegible]		C:FXD CER 0.1 UF +80-20% 50VDCM	56289	5C50BF5-CML
A1C16	0140-0291		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1C17	[illegible]		C:FXD ELECT 1.0 UF 10% 35VDCM	56289	150D105X9035A2-DYS
A1L1	9100-2209		INDUCTOR=37.0 UH 5%	28480	9100-2209
A1Q1	1854-0071		TSTR=SI NPN SELECTED FROM 2N3704	28480	1854-0071
A1Q2	1854-0071		TSTR=SI NPN SELECTED FROM 2N3704	28480	1854-0071
A1Q3	1854-0071		TSTR=SI NPN SELECTED FROM 2N3704	28480	1854-0071
A1Q4	1853-0020		TSTR=SI PNP SELECTED FROM 2N3702	28480	1853-0020
A1Q5	1854-0071		TSTR=SI NPN SELECTED FROM 2N3704	28480	1854-0071
A1R1	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R2	0757-0442		RESD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R3	0698-3160		RESD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R4	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R5	0698-3154		RESD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1R6	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R7	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A1R8	0757-0400		RESD MET FLM 10.0 OHM 1% 1/8W	28480	0757-0400
A1R9	0698-3153		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1R10	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R11	0757-0401		RESD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R12	0757-0317	1	RESD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A1R13			FACTORY SELECTED PART		
A1R14	0698-3153		RESD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1R15	0757-0438		RESD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1R16	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16A17	0757-0416		RESD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A16A18 thru A16A21	0698-3440		RESD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A16A22	0757-0442		RESD MET FLM 10K OHM 1% 1/8W	28480	[illegible]
A16A23	0757-0442		RESD MET FLM 10K OHM 1% 1/8W	28480	[illegible]
			CHASSIS PARTS		
B1	3160-0004	1	FAN,TUBEAXIAL 405-420V,50-60HZ	4PA77	4PA77
B2			DELETED		
B3			DELETED		
C1	0160-2438	10	CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C4	0160-2437	17	CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C5	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C6	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C7	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C8	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C9	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C10	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C11	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C12	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C13	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C14	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C15	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C16	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C17	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C18	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C19	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C20	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C21	0160-2438		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-001-X5V0-502P
C22	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C23	0160-2436	6	CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C24	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C25	0160-2436		CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C26	0160-2436		CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C27	0160-2436		CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C28	0160-2436		CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C29	0160-2436		CAPRD CER 10 PF 20% 200VDCW	72982	2425-000-X5P-100D
C30	0160-2437		CAPRD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
C31	0160-3043	1	CAPRD CER 2 X 0.005 UF 20% 250VAC	56289	295C15A2EC00
C32	0140-0177		CAPRD MICA 400 PF 1%	28480	0140-0177
C33	0160-2199	1	CAPRD MICA 30 PF 5% 300VDCW	28480	0160-2199
C34	0160-2700	1	CAPRD MICA 47 PF 5%	72136	DM15E470J03C
C35	0180-0116	4	CAPFXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
C36	0180-0116		CAPFXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
C37	0180-0116		CAPFXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
C38	0180-0116		CAPFXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
DS1	2140-0144	1	LAMP,GLOW MINIATURE 95V	07014	A1A
F1	2110-0336	1	FUSE,6A [illegible]	71400	MDL 6/10
J1	2110-0304	1	FUSEHOLDER,CARTRIDGE 1.5 AMP,250V [illegible]	71400	HDH-1-172A
J1	1251-1359	1	BODY,RECEPTACLE	28480	5070-1251
J1	1251-1359	1	CONTACT,MALE CONNECTOR #16 CRIMP TYPE	00779	AMP,AN-9
J1	1251-1359	1	INSERT,CONNECTOR,COAX JACK ASSY(REF)	09922	BNC[illegible]-1
J1	5060-0226		INSULATOR	28480	5060-0226
J1	5020-1259	1	NUT,KNURLED	28480	5020-1259
J1	5020-1258	1	NUT,HEX	28480	5020-1258
J2	08410-2029	1	CONNECTOR,FEMALE BOD	28480	08410-2029
J3	1250-0083	4	CONNECTOR,BNC	02660	31-221-1020
J4	1250-0083		CONNECTOR,BNC	02660	31-221-1020
J5	1250-0083		CONNECTOR,BNC	02660	31-221-1020
J6	1250-0829	8	CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J7	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J8	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J9	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J10	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J11	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J12	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J13	1250-0829		CONNECTOR,RF 50-OHM SCREW-ON TYPE	98291	50-065-4610
J14	1251-0148	1	CONNECTOR,POWER 3 PIN MALE	00779	1004-1
J15	1250-0083		CONNECTOR,BNC	02660	31-221-1020
J16	1250-0083		CONNECTOR,BNC	02660	31-221-1020
J17	1250-0083		CONNECTOR,BNC	02660	31-221-1020
J19	1910-0009	1	BINDING POST,BLACK	28480	1910-0009
L1	9140-0114	10	COIL,FXD RF 10 UH	28480	9140-0114
L2	9140-0114		COIL,FXD RF 10 UH	28480	9140-0114
L3	9140-0114		COIL,FXD RF 10 UH	28480	9140-0114
L4	9140-0114		COIL,FXD RF 10 UH	28480	9140-0114

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Table 6-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
L5	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L6	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L7	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L8	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L9	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L10	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
L11	9100-2210	1	COIL/CHOKE 15 UH 5%	82142	4519-10
L12	9140-0098	1	COIL/CHOKE 2.20 UH 10%	99800	1537-20
M1	1120-1279	1	METER:0-1MA	28480	1120-1279
P1	1251-0160	13	CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
Q1	1854-0063		TSTR:SI NPN	80131	2N1893
Q1	1200-0043		INSULATOR:TSTR MOUNTING(TO-5)	71785	293011
Q2	1854-0063		TSTR:SI NPN	80131	2N1893
Q2	1200-0043		INSULATOR:TSTR MOUNTING(TO-5)	71785	293011
R1	2100-0079	1	R:VAR COMP 250 OHM LIN 2W	28480	2100-0079
R2	2100-2498	1	R:VAR COMP DUAL 1K/100 OHM 10%SPEC TAP	28480	2100-2498
R3	0698-3162		R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
R4	0813-0050	1	R:FXD WW 20 OHM 5% 5W	28480	0813-0050
R5	0757-0462		R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462
S1	3101-1248	1	SWITCH:PUSHBUTTON SPDT ILLUMINATED	87034	91-55580-121/410
S2	3101-0033	1	SWITCH:SLIDE DPDT 0.5A 125AC/DC	82389	11A-1009A
T1	9100-2884	1	TRANSFORMER:POWER	28480	9100-2884
TB1	0360-0014	1	BOARD:TERMINAL	28480	0360-0014
VR1	1902-1227	1	DIODE BREAKDOWN:8.26V 5% AT 30 MA	28480	1902-1227
	1200-0080	1	INSULATOR:TRANSISTOR MTG.	71785	294036
W1	08410-6022	1	CABLE ASSY:REFERENCE	28480	08410-6022
W1P1	1250-0880	8	CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W2	08410-6017	1	CABLE ASSY:20MHZ IF	28480	08410-6017
W2P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W3	08410-6023	1	CABLE ASSY:TEST	28480	08410-6023
W3P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W4	08410-6020	1	CABLE ASSY:PHASE	28480	08410-6020
W4P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W5	08410-6025	1	CABLE ASSY:AMPLIFIER VERNIER(LIN)	28480	08410-6025
W5P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W6	08410-6019	1	CABLE ASSY:AMPLITUDE	28480	08410-6019
W6P1	1250-0824	1	CONNECTOR:RF FOR RG-188U CABLE	98291	50-026-0000
W7	08410-6024	1	CABLE ASSY:VID	28480	08410-6024
W7P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W8	8120-1348	1	CABLE ASSY:POWER, DETACHABLE	70903	KH-7041
W9	08410-6021	1	CABLE ASSY:REFERENCE (STRAIGHT)	28480	08410-6021
W9P1	1250-0880		CONNECTOR:RF FOR RG-188/U CABLE	98291	50-028-0139
W10	08410-6026	1	CABLE ASSY:ATTENUATOR	28480	08410-6026
W10P1	1250-0879	1	CONNECTOR:RF FOR RG-188/U CABLE	98291	50-026-0000
W11	08410-6035	1	CABLE ASSY:POWER SUPPLY	28480	08410-6035
W12	08410-60058		CABLE ASSY:GRAY-BLACK(OPT 005)	28480	08410-60058
W13	08410-60059		CABLE ASSY:GRAY-YELLOW(OPT 005)	28480	08410-60059
W14	08410-60060		CABLE ASSY:GRAY-BROWN(OPT 005)	28480	08410-60060
XA1			NOT ASSIGNED		
XA2			NOT ASSIGNED		
XA3	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA4	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA5	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA6	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA8	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA9	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA10	1251-2261	1	CONNECTOR:PC EDGE 1 ROW 18 CONTACT	71785	250-18-30-210
XA11	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA12	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA13	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA14	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA15	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XA16	1251-0160		CONNECTOR:PC EDGE 1 ROW 15 CONTACT	71785	250-15-30-210
XF1	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
			MISCELLANEOUS		
	08410-61024	1	CABLE ASSY:SERVICE(LITE GRAY)(OPT 026/495)	28480	08410-61024
	08410-6032	1	CABLE ASSY:SERVICE(LITE GRAY)(OPT 495)	28480	08410-6032
	08410-61032	1	CABLE ASSY:SERVICE(JADE GRAY)(OPT 026/510)	28480	08410-61032
	08410-61025		CABLE ASSY:SERVICE(LITE GRAY)(OPT 026/495)	28480	08410-61025
	08410-60067	1	CABLE ASSY:SERVICE(JADE GRAY)STANDARD	28480	08410-60067
	08410-0004	1	COVER:FIXED HOUSING BOARD	28480	08410-0004
	08410-0005	1	COVER:MOVABLE HOUSING BOARD	28480	08410-0005
	08410-0010	1	COVER:FIXED HOUSING CONNECTOR	28480	08410-0010
	08410-0011	1	COVER:MOVABLE HOUSING CONNECTOR	28480	08410-0011

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Replaceable Parts

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	08410-0012	1	DIAL:10-TUR	28480	08410-0012
	08410-0013	1	DIAL:10-4000	28480	08410-0013
	0370-0103	2	KNOB:BLK W/ARROW 5/8" OD 1/4" SHAFT	28480	0370-0103
	0370-0363	1	KNOB:BLACK 1/4" SHAFT	28480	0370-0363
	0370-0103		KNOB:BLK W/ARROW 5/8" OD 1/4" SHAFT	28480	0370-0103
	0370-0114	1	KNOB:RED W/ARROW 5/8" OD 1/4" SHAFT	28480	0370-0114
	0340-0170	1	GUIDE:PLUNGER PC BOARD	28480	0340-0170
	08410-0009	1	KNOB:BLACK 3/4" W/DIAL	28480	08410-0009
	08410-0033	1	FILTER	28480	08410-0033
	08410-00310	1	FRAME:FILTER	28480	08410-00310
	08410-2036	1	HEAT SINK:POWER SUPPLY TRANSISTOR	28480	08410-2036

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Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number

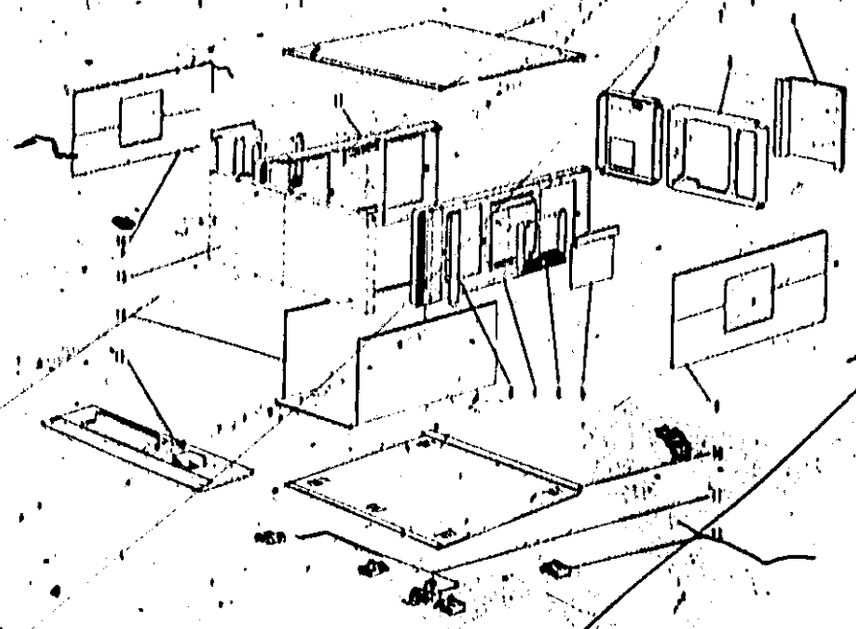

FIGURE 3-17. MODEL 8410A CABINET PARTS

NOTE

THE FOLLOWING DESCRIBES A DIFFERENT COLOR SCHEME FOR THE STANDARD COLOR INSTRUMENT. REFER TO THE LISTING BELOW FOR ESTORAFELLA COLOR SCHEME. STANDARD COLOR - INDICATES A MINT GRAY PANEL WITH OLIVE GRAY TOP AND BOTTOM COVERS. OPTION A99 - INDICATES OLIVE GRAY FRONT PANEL ONLY, NORMALLY USED WITH BLUE-GRAY TOP AND BOTTOM COVERS. OPTION 890 - INDICATES COMPLETE COLOR SCHEME INCLUDING OLIVE GRAY FRONT PANEL AND BLUE-GRAY TOP AND BOTTOM COVERS.

	5060-0767	1	COVER ASSY:TOP(OLIVE GRAY)STD,OPT H26/005	28480	5060-0767
	5060-0777		COVER ASSY:TOP(BLUE GRAY) OPT 890	28480	5060-0777
	2170-0015	2	SCREW:SST FLAT HD PHL DR 6-32 X 3/8	28480	2170-0015
	08410-00042	1	PANEL:REAR(FAN SIDE)STANDARD	28480	08410-00042
	08410-00043		PANEL:REAR(FAN SIDE)OPT 005 ONLY	28480	08410-00043
	2510-0044	1	SCREW:SST FH POZI DR 6-32 X 0.375" LG	00000	ORD
	2510-0103	2	SCREW:SST PAN HD POZI DR 8-32 X 0.375"	00000	ORD
	08410-0029	1	PANEL:REAR, PLUG-IN SIDE	28480	08410-0029
	2510-0103		SCREW:SST PAN HD POZI DR 8-32 X 0.375"	00000	ORD
	2190-0013	2	WASHER:SPLIT LOCK #8	00000	ORD
	2360-0196	1	SCREW:SST FH POZI DR 6-32 X 0.312"LG	00000	ORD
	2420-0001	1	NUT:HEX SF MP 6-32 X 5/16 W/LOCKWASHER	78189	ORDB
	08410-0029	1	COVER:REAR PANEL	28480	08410-0029
	3050-0081	1	WASHER:FELT 1/2" OD X 1/4" ID	00000	ORD
	2510-0099	1	SCREW:SST PAN HD POZI DR 8-32 X 0.750"	00000	ORD
	2190-0009	4	WASHER:LOCK INTERNAL #8	00000	ORD
	5060-0735	1	RETAINER:HANDLE(OLIVE GRAY)STD,OPT H26/005	28480	5060-0735
	5060-0745	1	RETAINER:HANDLE(BLUE GRAY)OPT 890	28480	5060-0745
	2950-0013	1	SCREW:SST HD 8-32 X 5/16	28480	2950-0013
	2190-0013		WASHER:SPLIT LOCK #8	00000	ORD
	5060-0732	1	HANDLE ASSY:RH SIDE	28480	5060-0732
	5060-0737	1	FRAME ASSY:MODIFIED	28480	5060-0737
	5002-0052	1	PLATE:FLUTED ALUMINUM	28480	5000-0052
	5000-0719	1	COVER:SIDE,7 X 18(OLIVE GRAY)STD,OPT H26/005	28480	5000-0719
	5000-0743		COVER:SIDE(BLUE GRAY)OPT 890	28480	5000-0743
	2170-0020	2	SCREW:SST FH PHIL DR 6-32 X 3/16	00000	ORD
	5060-0748	1	COVER:BOTTOM,OLIVE GRAY)STD,OPT H26/005	28480	5060-0748
	5060-0778		COVER ASSY:BOTTOM(BLUE GRAY)OPT 890	28480	5060-0778
	2170-0017		SCREW:SST FLAT HD PHL DR 6-32 X 3/8	28480	2170-0015
	1490-0010	1	STANDOFF,I	28480	1490-0010
	5060-0767	5	FOOT ASSY:RH	28480	5060-0767
	5060-8741	1	RETRACK MOUNT,MINT GRAY,STD,OPT H26/005	28480	5060-8741
	5060-0776		RETRACK MOUNT(LIGHT GRAY)OPT 890	28480	5060-0776
	08410-00044	1	DECAL:IDENTIFICATION(OLIVE GRAY)STD, OPT H26/005	28480	08410-00044
	08410-0037	1	DECAL:LISTING(BLUE GRAY)OPT 890	28480	08410-0037
	2160-0066	1	SCREW:SST FH PHL 6-32 X 1/4	00000	ORD
			PANEL ASSY:FRONT, SEE FIG. 3-13.		
	5000-8717	1	COVER:SIDE(OLIVE GRAY)STD,OPT H26/005	28480	5000-8717
	5000-0743		COVER:SIDE(BLUE GRAY)OPT 890	28480	5000-0743
	2170-0020		SCREW:SST FH PHIL DR 6-32 X 3/16	00000	ORD
	08410-0034	1	LEFT FRAME ASSY:MODIFIED 8.16 FM	28480	08410-0034

See introduction to this section for ordering information

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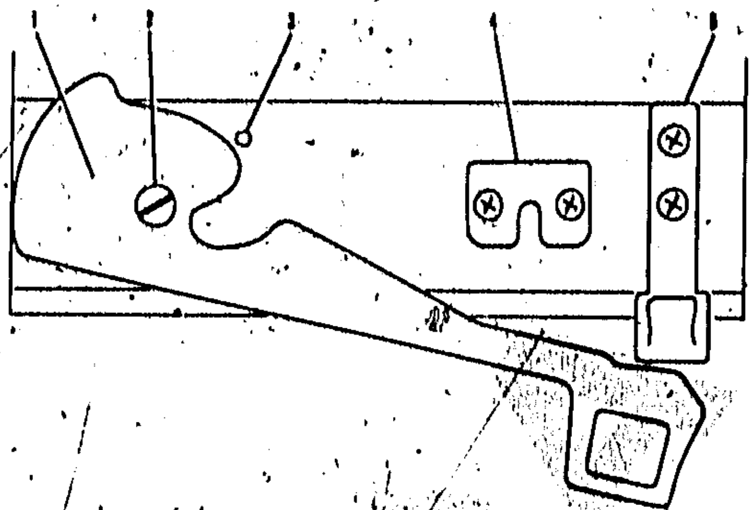
Table 3-8. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			FIG. 3-13. MODEL 8410A FRONT PANEL ASSY		
1	7120-1256	1	TRADEMARK	28480	7120-1256
2	7120-1972	1	PLATE:IDENTIFICATION	28480	7120-1972
3	5020-3281	1	TRIM,NAMEPLATE	28480	5020-3281
4	08410-00045	1	PANEL:FRONT(MINT GRAY)STD,OPT H26/005	28480	08410-00045
4	08410-00041		PANEL:FRONT(LIGHT GRAY)OPT A85, 895	28480	08410-00041
5	08410-2023	1	SUB-PANEL:FRONT	28480	08410-2023
6	2370-0001	8	SCREW:SST FLAT HD 6-32 X 0.250	28480	2370-0001
7	08410-2021	1	BRACKET:FRONT PANEL MTG(BOTTOM)	28480	08410-2021
8	2370-0003	2	SCREW:SST FLAT HD 6-32 X 0.500	28480	2370-0003
9	0590-0305	2	NUT:INCH STL 6-32 W/INT LOCK	00000	ORD
10	08410-2022	1	BRACKET:FRONT PANEL MTG(TOP)	28480	08410-2022
11	2370-0003	2	SCREW:SST FLAT HD 6-32 X 0.500	28480	2370-0003
	0590-0305		NUT:INCH STL 6-32 W/INT LOCK	00000	ORD
12	08410-20092	1	FRAME:SUPPER(MINT GRAY)STD, H26/005	28480	08410-20092
	08410-2014		FRAME:SUPPER(LIGHT GRAY)OPT A85, 895	28480	08410-2014
13	2510-0011	2	SCREW:SST FLAT HD 8-32 X 3/8	76189	ORDR
14	08410-20094	1	DIVIDER:FRAME SUPP(MINT GRAY)STD, H26, 005	28480	08410-20094
	08410-2025		DIVIDER:FRAME SUPP(LIGHT GRAY)OPT A85,895	28480	08410-2025
	2190-0004	1	SCREW:SST FH SLOT DR 4-40 X 0.500"	00000	ORD
15	5020-7977	1	TRIM:UPPER FRAME(MINT GRAY)STD,H26/005	28480	5020-7977
	5020-3275		TRIM:UPPER FRAME(LIGHT GRAY)OPT A85, 895	28480	5020-3275
16	08410-20093	1	FRAME:LOWER,(MINT GRAY)STD, H26/005	28480	08410-20093
	08410-2019		FRAME:LOWER(LIGHT GRAY)OPT A85/895	28480	08410-2019
	2510-0011		SCREW:SST FLAT HD 8-32 X 3/8	76189	ORDR
17	2510-0013	14	SCREW:SST FLAT HD 8-32	00000	ORD
18	5020-7978	1	TRIM:LOWER FRAME(MINT GRAY)STD, H26/005	28480	5020-7978
	5020-3276		TRIM:LOWER FRAME(LIGHT GRAY)OPT A85/895	28480	5020-3276

MODEL 8410A

Table 3-8. Replaceable Parts



Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			FIG. 3-14, 8410A EXTRACTOR-RETAINER PTS		
1	5020-3286	1	EXTRACTOR	28480	5020-3286
2	5020-3287	1	PIN:PIVOT	28480	5020-3287
3	08410-2027	1	PIN:STOP	28480	08410-2027
4	5020-3266	1	GUIDE-PLUG-IN	28480	5020-3266
	2360-0049	2	SCREW:SST FIL SLOT DR 6-32 X 3/16"	00000	OBD
5	5040-0361	1	LOCK:EXTRACTOR,MINT GRAY(510, H16/001)	28480	5040-0361
	5040-0272		LOCK:EXTRACTOR(LIGHT GRAY)(PT ABS, 555	28480	5040-0272
	2360-0049		SCREW:SST FH SLOT DR 6-32 X 3/16"	00000	OBD

* See introduction to this section for ordering information

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Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08411-60003	1	MIDRAND SAMPLER ASSY(REF, CHANNEL)	28480	08411-60003
	5080-0749		REBUILT 08411-60003, REQUIRES EXCHANGE	28480	5080-0749
A1A1			NOT SEPARATELY REPLACEABLE		
A1A2			NOT SEPARATELY REPLACEABLE		
A1J1			NOT SEPARATELY REPLACEABLE		
A1J2			NOT SEPARATELY REPLACEABLE		
A1MP1	1250-0907	1	CONTACTOR CONNECTOR TYPE APC-7	02660	131-129
A1W1			NOT SEPARATELY REPLACEABLE		
A1W2			NOT SEPARATELY REPLACEABLE		
A1W3			LOAD CARTRIDGE(NSR		
A2	08411-60004	1	MIDRAND SAMPLER ASSY(TEST CHANNEL)	28480	08411-60004
	5080-0744		REBUILT 08411-60004, REQUIRES EXCHANGE	28480	5080-0744
A2A1			NOT SEPARATELY REPLACEABLE		
A2A2			NOT SEPARATELY REPLACEABLE		
A2J1			NOT SEPARATELY REPLACEABLE		
A2J2			NOT SEPARATELY REPLACEABLE		
A2MP1	1250-0907		CONTACTOR CONNECTOR TYPE APC-7	02660	131-129
A2W1			NOT SEPARATELY REPLACEABLE		
A2W2			NOT SEPARATELY REPLACEABLE		
A2W3			LOAD CARTRIDGE(NSR		
A3	08411-60005	1	POWER AMPLIFIER ASSY	28480	08411-60005
A3C1			DELETED		
A3C2	0160-7910	10	C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C3	0160-0345	10	C(FXD CER FEED-THRU 1000 PF 500VDCW	01121	FA20-102M
A3C4	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C5	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C6	0160-7180	11	C(FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A3C7	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C8	0160-7180		C(FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A3C9	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C10	0160-7180		C(FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A3C11	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C12	0160-0140		C(FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A3C13	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C14	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C15	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3C16	0160-7910		C(FXD CER 1000 PF +100-0% 1250VDCW	01121	SR4-A
A3L1	9140-0170	1	COIL(FXD 0.10 UH 20%	82142	10179-4
A3Q1	1854-0498	8	T(STR(SI NPN	86684	1854-0498
A3Q2	1854-0498		T(STR(SI NPN	86684	1854-0498
A3Q3	1854-0498		T(STR(SI NPN	86684	1854-0498
A3Q4	1854-0498		T(STR(SI NPN	86684	1854-0498
A3Q5	1854-0498		T(STR(SI NPN	86684	1854-0498
A3Q6	1854-0498		T(STR(SI NPN	86684	1854-0498
A3Q7	1854-0498		T(STR(SI NPN	86684	1854-0498
A3R1	0757-0746	2	R(FXD MET FLM 82.5 OHM 1% 1/2W	28480	0757-0746
A3R2	0757-0198	1	R(FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
A3R3	0757-0274	1	R(FXD MET FLM 1.21K OHM 1% 1/4W	28480	0757-0274
A3R4	0698-3696	2	R(FXD MET OX 39 OHM 5% 1W	28480	0698-3696
A3R5	0698-3697	4	R(FXD MET OX 47 OHM 5% 1W	28480	0698-3697
A3R6	0698-3697		R(FXD MET OX 47 OHM 5% 1W	28480	0698-3697
A3R7	0698-3696		R(FXD MET OX 39 OHM 5% 1W	28480	0698-3696
A3R8	0698-3697		R(FXD MET OX 47 OHM 5% 1W	28480	0698-3697
A3R9	0698-3697		R(FXD MET OX 47 OHM 5% 1W	28480	0698-3697
A3T1	9170-0016	24	READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T2	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T3	08411-60009	6	COIL/CHOKE FERRITE	28480	08411-60009
A3T4	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T5	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T6	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T7	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T8	08411-60009		COIL/CHOKE FERRITE	28480	08411-60009
A3T9	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T10	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T11	08411-60009		COIL/CHOKE FERRITE	28480	08411-60009
A3T12	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T13	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T14	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T15	08411-60009		COIL/CHOKE FERRITE	28480	08411-60009
A3T16	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T17	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T18	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T19	08411-60009		COIL/CHOKE FERRITE	28480	08411-60009
A3T20	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38
A3T21	9170-0016		READ(MAGNETIC SHIELDING	02114	56-590-65/38

See introduction to this section for ordering information

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Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1???	08411-6009		COIL/CHOKE FERRITE	28480	08411-6009
A1?1	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A1?4	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A1?5	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A1?A	9100-1???	1	COIL/CHOKE FERRITE	02114	VK-200-09/4B
A1??	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A1?B	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A4	08411-6003	1	BOARD ASSY:REFERENCE PREAMP	28480	08411-6003
A4C1	0160-2059	#?	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4L?	0140-0198	8	C:FXD MICA 200 PF 5%	?P136	RDM19F201J3C
A4L3	0140-0198		C:FXD MICA 200 PF 5%	?P136	RDM19F201J3C
A4L4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C5	0160-2253	1	C:FXD CER 4.8 PF 500VDCW	?P982	301-NP0-4.8 PF
A4L6	0140-2240	1	C:FXD CER 2.0 PF 500VDCW	?P982	301-000-C0H0-209C
A4L7	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C8	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C9	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C10	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C11	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C12	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C13	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C14	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C15	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C16	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4C17	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A4L1	9140-0114	6	C:FXD RF 10 UH	28480	9140-0114
A4L2	9100-2462	1	COIL/CHOKE 3.90 UH 5%	02?42	080
A4L3	9100-2464	1	C:FXD RF 10 UH 10%	02?42	080
A4L4	9140-0114		C:FXD RF 10 UH	28480	9140-0114
A4L5	9100-2461	1	COIL/CHOKE 0.68 UH 5%	02?42	4436-20
A4Q1	1854-0071	5	T:SI:N:EA NPN:SELECTED FROM 2N2857	28480	1854-0071
A4Q2	1853-0034	3	T:SI:N:EA PNP:SELECTED FROM 2N3251	28480	1853-0034
A4Q3	1854-0071		T:SI:N:EA NPN:SELECTED FROM 2N2857	28480	1854-0071
A4Q4	1853-0034		T:SI:N:EA PNP:SELECTED FROM 2N3251	28480	1853-0034
A4Q5	1854-0071		T:SI:N:EA NPN:SELECTED FROM 2N2857	28480	1854-0071
A4R1	0698-3157	4	R:FXD MET FLM 14.6K OHM 1% 1/8W	28480	0698-3157
A4R2	0698-3157		R:FXD MET FLM 14.6K OHM 1% 1/8W	28480	0698-3157
A4R3	2100-1???	5	R:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1???
A4R4	0698-3159	2	R:FXD MET FLM 20.5K OHM 1% 1/8W	28480	0698-3159
A4R5	2100-1???		R:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1???
A4R6	0698-3449	2	R:FXD MET FLM 24.7K OHM 1% 1/8W	28480	0698-3449
A4R7	0757-0280	4	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4R8	0698-3161	2	R:FXD MET FLM 34.8K OHM 1% 1/8W	28480	0698-3161
A4R9	0757-0458	2	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A4R10	0698-3440	7	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4R11	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4R12	0698-3163	4	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3163
A4R13	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4R14	0757-0394	1	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4R15	0698-3430	3	R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A4R16	0757-0438	4	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A4R17	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A4R18	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A4R19	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4R20	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4R21	0757-0403	1	R:FXD MET FLM 121 OHM 1% 1/8W FACTORY SELECTED PART	28480	0757-0403
A4R22	0757-0417	2	R:FXD MET FLM 348 OHM 1% 1/8W	28480	0757-0417
A4R23	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A4R24	0698-3441	1	R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4R25	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A4R26	0698-0085	2	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A4R27	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A4?1	9170-0016		READ:MAGNETIC SHIELDING	02114	96-590-65/38
A5	08411-6004	1	BOARD ASSY:TEST PREAMP	28480	08411-6004
A5C1	0160-??A1	1	C:FXD CER 15 PF +5% 500VDCW	?P982	301-NP0-15 PF
A5L2	0160-2306	1	C:FXD MICA 36 PF 5% FACTORY SELECTED PART	28480	0160-2306
A5C3	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW NOT ASSIGNED	56289	C023F101F103?6?-C06
A5C4					
A5C5	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A5C6	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A5C7	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A5C8	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06
A5C9	0160-2059		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103?6?-C06

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Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5L10	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDC	56289	C023F101F1032A22-CDH
A5L11	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDC	56289	C023F101F1032A22-CDH
A5L12	0160-2055		CAPACITOR-FXD 0.01 UF +80-20% 100VDC	56289	C023F101F1032A22-CDH
A5L13	0110-0017	1	CAPACITOR-VAR 4-50 PF	28480	0110-0017
A5L1	9140-0111	1	COIL:CHOKE 3.30 UH 10%	99800	1537-04
			FACTORY SELECTED PART		
A5L2	9140-0114		COIL:FXD 47 UH	28480	9140-0114
A5L3	9140-0114		COIL:FXD 47 UH	28480	9140-0114
A5Q1	1854-0073		TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0073
A5Q2	1853-0034		TRANSISTOR:PNP(SELECTED FROM 2N3251)	28480	1853-0034
A5Q3	1854-0073		TRANSISTOR:NPN(SELECTED FROM 2N2857)	28480	1854-0073
A5R1	0698-3157		RESISTOR:MET FLM 14.6K OHM 1% 1/8W	28480	0698-3157
A5R2	0698-3157		RESISTOR:MET FLM 14.6K OHM 1% 1/8W	28480	0698-3157
A5R3	2100-1775		RESISTOR:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A5R4	0698-3159		RESISTOR:MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159
A5R5	2100-1775		RESISTOR:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A5R6	0698-3449		RESISTOR:MET FLM 28.7K OHM 1% 1/8W	28480	0698-3449
A5R7	0757-0317	1	RESISTOR:MET FLM 3.13K OHM 1% 1/8W	28480	0757-0317
A5R8	0698-3441	1	RESISTOR:MET FLM 287 OHM 1% 1/8W	28480	0698-3441
A5R9			FACTORY SELECTED PART		
A5R10	0757-0458		RESISTOR:MET FLM 81.1K OHM 1% 1/8W	28480	0757-0458
A5R11	0757-0417		RESISTOR:MET FLM 562 OHM 1% 1/8W	28480	0757-0417
A5R12	0698-3161		RESISTOR:MET FLM 18.2K OHM 1% 1/8W	28480	0698-3161
A5R13	0698-3153		RESISTOR:MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A5R14	0757-0416	1	RESISTOR:MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A5R15	0698-3440		RESISTOR:MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A5R16	0698-0085		RESISTOR:MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A5R17	0757-0438		RESISTOR:MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A5R18	0698-3440		RESISTOR:MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A5R19			NOT ASSIGNED		
A5R20	0698-3430		RESISTOR:MET FLM 71.5 OHM 1% 1/8W	28480	0698-3430
A5R21			FACTORY SELECTED PART		
A5R22	2100-1773	1	RESISTOR:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A5R23	2100-1771	1	RESISTOR:VAR WW 200 OHM 5% TYPE H 1W	28480	2100-1771
A5	08411-6001	1	BOARD ASSY:SWEEPING AMPLIFIER	28480	08411-6001
A6C1	0180-0100	1	CAPACITOR-FXD ELECT 4.7 UF 10% 35VDC	56289	150D475X9035B2-DY5
A6C2	0180-0100		CAPACITOR-FXD ELECT 4.7 UF 10% 35VDC	56289	150D475X9035B2-DY5
A6C3	0160-0158	1	CAPACITOR-FXD MY 0.0056 UF 10% 200VDC	56289	192P5625?2-P15
A6C5	0140-0198		CAPACITOR-FXD MICA 200 PF 5%	72136	RDM15FZ201J3C
A6C9	0180-0100		CAPACITOR-FXD ELECT 4.7 UF 10% 35VDC	56289	150D475X9035B2-DY5
A6CR1	1902-0761	1	DIODE:SILICON 11.7V 5%	02735	1N962
A6CR2	1901-0025	4	DIODE:SILICON 100MA/3V	07263	FD 2387
A6CR3	1901-0025		DIODE:SILICON 100MA/3V	07263	FD 2387
A6CR4	1901-0025		DIODE:SILICON 100MA/3V	07263	FD 2387
A6CR5	1910-0016	1	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	02361
A6CR6	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	02361
A6CR7	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	02361
A6CR8	1901-0025		DIODE:SILICON 100MA/3V	07263	FD 2387
A6L1	9100-1617	1	COIL:FXD RF 0.33 UH 20%	28480	9100-1617
A6Q1	1853-0012	1	TRANSISTOR:PNP	80131	2N2904A
A6R1	0698-3401	1	RESISTOR:MET FLM 215 OHM 1% 1/2W	28480	0698-3401
A6R2	2100-1769	1	RESISTOR:VAR WW 50 OHM 5% TYPE H 1W	28480	2100-1769
A6R3	0757-0387	2	RESISTOR:MET FLM 16.2 OHM 1% 1/8W	28480	0757-0387
A6R4	0757-0387		RESISTOR:MET FLM 16.2 OHM 1% 1/8W	28480	0757-0387
A6R5	0698-3402	1	RESISTOR:MET FLM 316 OHM 1% 1/2W	28480	0698-3402
A6R6	2100-1773		RESISTOR:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A6R7	2100-1774	2	RESISTOR:VAR WW 2K OHM 5% TYPE H 1W	28480	2100-1774
A6R8	2100-1775		RESISTOR:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A6R9	0698-3447	1	RESISTOR:MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A6R10	0757-0279	1	RESISTOR:MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A6R11	0757-0288	1	RESISTOR:MET FLM 4.09K OHM 1% 1/8W	28480	0757-0288
A6R12	0757-0400	3	RESISTOR:MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A6R13	0757-0401	1	RESISTOR:MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R14	2100-1773		RESISTOR:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A6R15	0757-0416		RESISTOR:MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A6R16	2100-1774		RESISTOR:VAR WW 2K OHM 5% TYPE H 1W	28480	2100-1774
A7	08411-6024	1	BOARD ASSY:VTO	28480	08411-6024
A7C1	0180-1741	1	CAPACITOR-FXD ELECT 0.1 UF 10% 35VDC	56289	150D104X9035A2-DY5
A7L2	9100-2140		CAPACITOR-FXD CER 470 PF +80-20% 1000VDC	91418	TYPE B
A7C3	0160-2140		CAPACITOR-FXD CER 470 PF +80-20% 1000VDC	91418	TYPE B
A7C4	0160-2143	2	CAPACITOR-FXD CER 2000 PF +80-20% 1000VDC	91418	TYPE B
A7C5	0160-2143		CAPACITOR-FXD CER 2000 PF +80-20% 1000VDC	91418	TYPE B
A7C6	0180-0116	2	CAPACITOR-FXD ELECT 6.8 UF 10% 35VDC	56289	150D685X9035B2-DY5
A7C7	0180-0116		CAPACITOR-FXD ELECT 6.8 UF 10% 35VDC	56289	150D685X9035B2-DY5
A7C8	0160-2140		CAPACITOR-FXD CER 470 PF +80-20% 1000VDC	91418	TYPE B

MODEL 11A

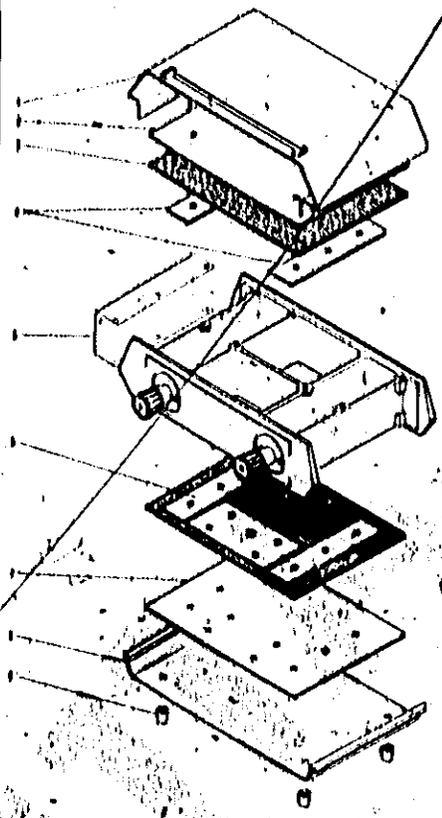
Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1	0160-2160		CAPAC CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1A10	0160-2160		CAPAC CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1A11	0160-2160		CAPAC CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1A12	0160-2160		CAPAC CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1A13	0160-2190	1	CAPAC MICA 20 PF 5%	72136	DM15E200J03C
			FACTORY SELECTED PART		
A1A14	0160-2139	1	CAPAC-CER 220 PF +80-20% 1000VDCW	91418	TYPE B
A1A15	0160-2139		CAPAC CER 220 PF +80-20% 1000VDCW	91418	TYPE B
A1A16	0160-2139		CAPAC CER 220 PF +80-20% 1000VDCW	91418	TYPE B
A1A41	0122-0014		CRYSTAL VAR 20 PF 5% AT -4V	28480	0122-0038
A1A42	0122-0038		CRYSTAL VAR 20 PF 5% AT -4V	28480	0122-0038
A1A43	1901-0029		DIODE-SILICON 200MA/1V	07263	FD 2387
A1A44			NOT ASSIGNED		
A1CR3	1901-0044	1	DIODE-SILICON 20MA/1V	28480	1901-0044
A1CR4	1901-0047	1	DIODE JUNCTION-SILICON 20PIV	28480	1901-0047
A1Q1	1854-0393	7	TSTR-SI NPN	07139	2N2857
A1Q2	1854-0393		TSTR-SI NPN	07139	2N2857
A1Q3	1854-0267	1	TSTR-SI NPN	28480	1854-0267
A1Q4	1854-0498	1	TSTR-SI NPN	80686	2N5486
A1Q5	1854-0071	1	TSTR-SI NPN(SELECTED FROM 2N3904)	28480	1854-0071
A1R1	0698-3429	1	RESD MET FLM 39.2 OHM 1% 1/8W	28480	0698-3429
A1R2	0757-0200	1	RESD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A1R3	0757-0279		RESD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R4	0698-0084	1	RESD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A1R5	2100-1772	1	RESVAR WW 500 OHM 5% TYPE H LN	28480	2100-1772
A1R6	0757-0424	1	RESD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A1R7	0698-3447		RESD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1R8	0757-0400		RESD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A1R9	0698-3407		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-3407
A1R10	0698-0083	1	RESD MET FLM 1.40K OHM 1% 1/8W	28480	0698-0083
A1R11	0757-0400		RESD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A1R12	0698-3407		RESD MET FLM 1.96K OHM 1% 1/8W	28480	0698-3407
A1R13	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R14	0757-0279		RESD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R15	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R16	0757-0419	1	RESD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A1R17	0760-0024	1	RESD MET OX 100 OHM 5% 1W	28480	0760-0024
A1R18	0757-0796		RESD MET FLM 82.5 OHM 1% 1/2W	28480	0757-0796
A1R19	2100-1777	1	RESVAR WW 200 OHM 5% TYPE H LN	28480	2100-1777
A1R20	0698-3447		RESD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1R21	0757-0280		RESD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1T1	08411-60008	4	CHOKE-FERRITE	28480	08411-60008
A1T2	08411-60008		CHOKE-FERRITE	28480	08411-60008
A1T3	08411-60008		CHOKE-FERRITE	28480	08411-60008
A1T4	08411-60008		CHOKE-FERRITE	28480	08411-60008
A1W1	9170-0016		BEAD-MAGNETIC SHIELDING	02114	56-590-65/3B
A1Z1	9100-1788	2	COIL-CHOKE	02114	VK200-10/4B
A1Z2	9100-1788		COIL-CHOKE	02114	VK200-10/4B
C1			CHASSIS PARTS NOT SEPARATELY REPLACEABLE		
C2	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C3	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C4	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C5	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C6	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C7	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C8	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C9	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
C11	0160-0349		CAPAC CER FEED-THRU 1000 PF 500VDCW	01121	FA2A-102M
CR1	1901-0349		DIODE-SILICON	28480	1901-0349
L1			NOT SEPARATELY REPLACEABLE		
L2			NOT SEPARATELY REPLACEABLE		
L3	9140-0114		COIL-FXD RF 10 UH	28480	9140-0114
L4	9140-0114		COIL-FXD RF 10 UH	28480	9140-0114
P1	1250-0260	4	CONTACT-CONNECTOR-CENTER CONTACT-FEMALE	28480	1250-0260
P2	1250-0260		CONTACT-CONNECTOR-CENTER CONTACT-FEMALE	28480	1250-0260
P3	1250-0260		CONTACT-CONNECTOR-CENTER CONTACT-FEMALE	28480	1250-0260
P4	1250-0260		CONTACT-CONNECTOR-CENTER CONTACT-FEMALE	28480	1250-0260
P5			NOT SEPARATELY REPLACEABLE		
P6			NOT SEPARATELY REPLACEABLE		
W1			NOT SEPARATELY REPLACEABLE		
W2	08411-6000	1	INTERCONNECT CABLE ASSY-COMPLETE	28480	08411-6000
W3			NOT SEPARATELY REPLACEABLE		
Z1	9170-0016		BEAD-MAGNETIC SHIELDING	02114	56-590-65/3B
Z2	9170-1643		CORE-FERRITE	02114	45-000-90/7B

See introduction to this section for ordering information

MODEL 8411A

Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty.	Description	Mfr Code	Mfr Part Number
					
			FIGURE 3-15. MODEL 8411A CABINET PARTS		
			NOTE THE FOLLOWING IMPLEMENTS A DIFFERENT COLOR SCHEME FOR THE STANDARD COLOR INSTRUMENT. REFER TO THE LISTING BELOW FOR 8410A/8411A COLOR SCHEMES. STANDARD COLOR - INDICATES A OLIVE GRAY TOP AND BOTTOM COVERS. OPTION 995 - INDICATES A BLUE GRAY TOP COVER AND A BLACK BOTTOM COVER.		
1	08411-00013	1	COVER:TOP(OLIVE GRAY)STD, HYG/005	28480	08411-00013
	08411-0007	1	COVER:TOP(BLUE GRAY)OPT A05, 995	28480	08411-0007
2	08411-0005	1	COVER:RF| TOP	28480	08411-0005
3	08411-0010	1	GASKET:RF| 9	28480	08411-0010
4	08411-4002	1	ABSORBER:RF-LONG	28480	08411-4002
5	08411-0011	1	SHIELD:PANAM	28480	08411-0011
6	08411-4001	1	ABSORBER:RF-SHORT	28480	08411-4001
7	08411-0004	1	COVER:RFI BOTTOM,	28480	08411-0004
8	08411-00014	1	COVER:BOTTOM(OLIVE GRAY)STD, OPT H25/005	28480	08411-00014
	08411-0008	1	COVER:BOTTOM(BLACK)OPT A05, 995	28480	08411-0008
9	08411-4003	1	FOOT	28480	08411-4003

MODEL 8111A

Table 3-9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			FIGURE 3-16. MODEL 8111A EXPLODED VIEW		
			NOTE		
			THE FOLLOWING IMPLEMENTS A DIFFERENT COLOR SCHEME FOR THE STANDARD INSTRUMENT / COLORS PRIOR TO THIS CHANGE ARE NOW AVAILABLE AS OPTIONS. REFER TO THE LISTING BELOW FOR 8108A/8111A COLOR SCHEMES.		
			STANDARD COLOR - INDICATES A MINT GRAY HOUSING.		
			OPTION 295 - INDICATES A LITE GRAY HOUSING.		
	08411-20031	1	COVER:STRIPLINE	28480	08411-20031
2	2510-0140	1	SCR:MINYLON FIL HD SLOT NO 4-32 X 5/16"	00000	000
3	2160-0114	7	SCR:MISST PAN HD POZ DR 6-32 X 7/16"	00000	000
4	0520-0430	4	SCR:MISST PAN HD POZ DR 2-56 X 3/8"	00000	000
5	08411-60015	1	JUMPER:STRIPLINE(SEE ITEM 9 TO DESCRIPTION)	28480	08411-60015
6	08411-2026	2	CLAMP:INNER CONDUCTOR SUPPRESSOR BEAD)	28480	08411-2026
7	0520-0893	1	SCR:MINYLON MINI HD SLOT NO 2-56	00000	000
8	0698-8138	2	RSTR:FXD ALUMINA-CER 20 OHM 10% 0.075WATT 8%	28480	0698-8138
9	08411-60024	1	STRIPLINE ASSY:INCLUDES SECTIONS 85,86,87	28480	08411-60024
10	0520-0130		SCR:MISST PAN HD POZ DR 2-56 X 3/8"	00000	000
11	08411-2021	1	CONTACT:STEP RECOVERY DIODE	28480	08411-2021
12	1901-0349	1	DIODE:SILICON	28480	1901-0349
13	1530-0078	2	SHIELD:0.0078" THICK	28480	1530-0078
14	0698-5849	1	RSTR:FXD CERMET FILM 20 OHM 10% 0.5WATT	28480	0698-5849
15	08411-2014	1	CONTACT:SLIDING	28480	08411-2014
16	1460-0268	1	SPRING:COMPRESSION	28480	1460-0268
17	0160-1854	1	CL STRIPLINE, SEE ITEM 9	28480	0160-1854
18	1250-0870	2	CONN:RF SERVE COUPLING TYPE APC 7.	02660	131-131
19	1250-0819	2	NUT:RF CONNECTOR	02660	131-176
20	2200-0097	4	SCR:MISST FLAT HD PHIL NO 4-40 X 1/2"	00000	000
	0624-0703	10	SCR:MISST FH POZI DR 4-40 X 5/16"	00000	000
21	08411-20018	2	COVER:RF FRONT	28480	08411-20018
22	8160-0074	2	GASKET:RF SHIELDING	1PB01	000
23	08411-2011	1	SHIELD:PREAMP	28480	08411-20011
24	08411-60003		W/DBAND SAMPLER ASSY(REF. CHANNEL)	28480	08411-60003
	5080-0749		REBUILT 08411-60003, REQUIRES EXCHANGE	28480	5080-0749
25	2160-0173	8	SCR:MISST PAN HD POZ DR 6-32 X 5/8".	00000	000
26	08411-60004		W/DBAND SAMPLER ASSY(TEST CHANNEL)	28480	08411-60004
	5080-0746		REBUILT 08411-60004, REQUIRES EXCHANGE	28480	5080-0746
27	08411-60011		INTERCONNECT CABLE ASSY:COMPLETE	28480	08411-60011
28	08411-20028	1	HOUSING:(SEE MINT GRAY) STANDARD	28480	08411-20028
	08411-2023	1	HOUSING:(SEE GRAY) OPT 295	28480	08411-2023

See introduction to this section for ordering information

Table 3-9. Model 8411A Reference Designation Index (Cont'd)

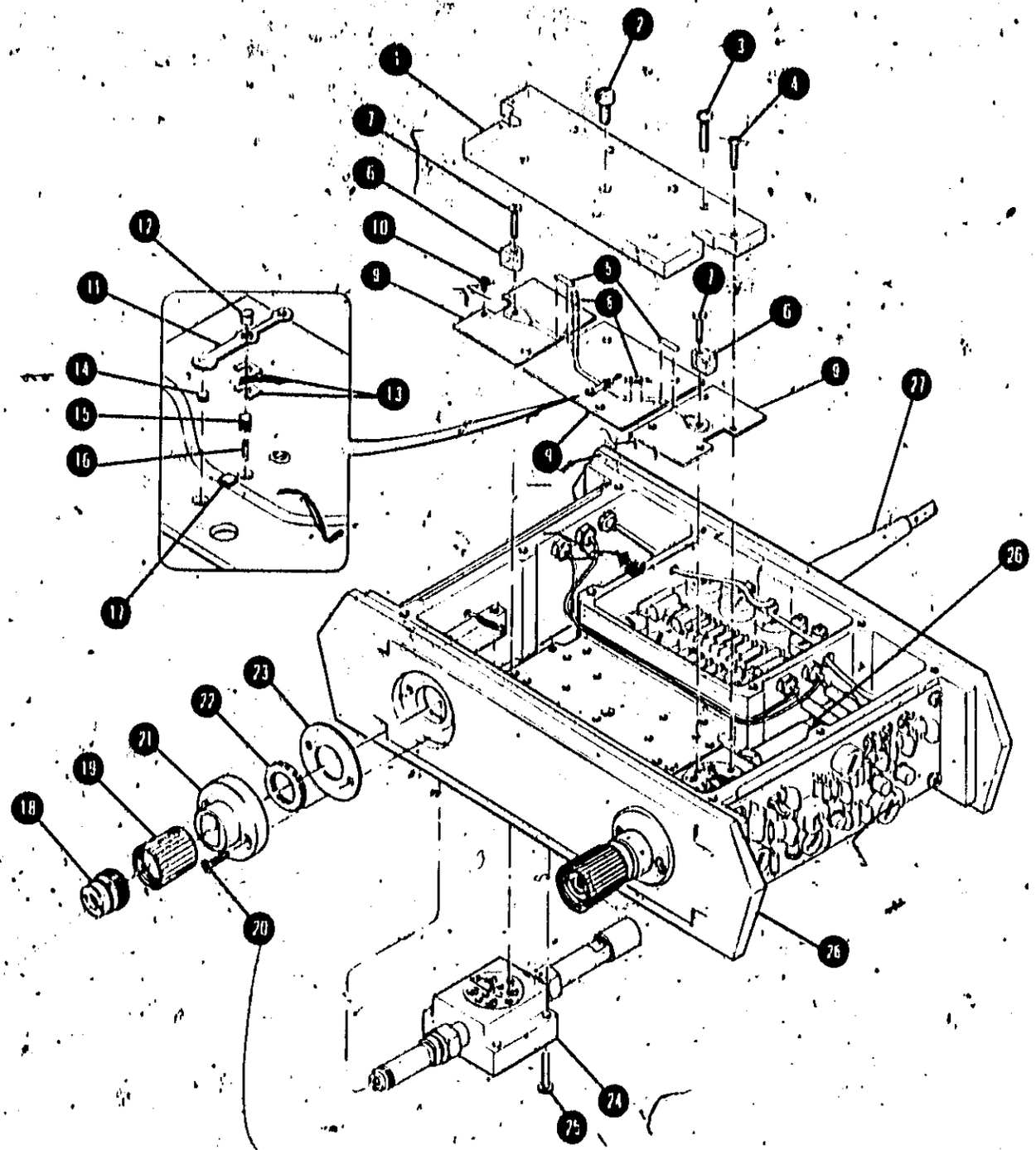


Figure 3-16. Model 8411A Exploded View

Table 3-10. Code List of Manufacturers

MODEL 8410A

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SUPPLIER	ANY SUPPLIER OF U.S.A.	
00353	G.E.A. CONNOR	PICKENS, S.C.	29671
00656	STANDARD ELECTRIC CO,PICKENS DIV.	MILWAUKEE, WIS.	53204
01121	ALLEN BRADLEY CO.	SAUGERTIES, N.Y.	12477
02114	FERROXCUBE CORP.	BROADVIEW, ILL.	60153
02660	AMPHENOL CORP.		
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
07933	ELECTRO ASSEMBLIES INC.	CHICAGO, ILL.	60641
09922	BURNDY CORP.	NORWALK, CONN.	06852
14433	ITT SEMICONDUCTOR DIV. ITT CORP.	W. PALM BEACH, FLA.	33401
14483	CORNELL DUBILIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07108
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.	76067
26433	SPRUCE SEMICONDUCTOR CORP.	NEW ROCHELLE, N.Y.	10802
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.	94304
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71433	BUSSMANN MFG. DIV. OF MCGRAW-EDISON CO.	ST. LOUIS, MO.	63107
71453	GLOBE UNION INC. CENTRALAB DIV.	MILWAUKEE, WISC.	53201
71785	CINCH MFG. CO. DIV IPW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73005	ILLINOIS INC.	HOFFMAN ESTATES, ILL.	60172
73168	SHAWMIGAN DIV. ILLINOIS TOOL WORKS	ELGIN, ILL.	60120
74193	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
75042	BIRCO SPEER FLEET. CORP.	DU BOIS, PA.	15801
75380	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
75915	LITTELFUSE INC.	WOODSIDE, N.Y.	11448
76493	IRC CAPACITOR DIV.	OSCEOLA, NEBR.	68651
77342	MARCONI INDUSTRIES	ANAHEIM, CALIF.	92803
77933	POWER MFG. CORP.	PROVIDENCE, R.I.	02901
91506	AUGAT INC.	ATTLEBORO, MASS.	02703
98791	STAELECTRO CORP.	HAMMONDTON, N.Y.	10546
99800	DELEVAN ELECTRONICS CORP.	E. AURORA, N.Y.	14052

MODEL 8411A

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SUPPLIER	ANY SUPPLIER OF U.S.A.	
00353	U.S.A. CONNOR	MILWAUKEE, WIS.	53204
01121	ALLEN BRADLEY CO.	SAUGERTIES, N.Y.	12477
02114	FERROXCUBE CORP.	BROADVIEW, ILL.	60153
02660	AMPHENOL CORP.	SOMERVILLE, N.J.	08876
02735	RCA SOLID STATE & RECEIVING TUBE DIV.	MOUNTAIN VIEW, CALIF.	94040
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	EDISON, N.J.	08817
19701	MEPCO CORP.	PALO ALTO, CALIF.	94304
28480	HEWLETT-PACKARD COMPANY	N. ADAMS, MASS.	01247
56289	SPRAGUE ELECTRIC CO.	MILLIMANTIC, CONN.	06226
72136	ELECTRO MOTIVE MFG. CO. INC.	ERIE, PA.	16512
72982	ERIE TECHNOLOGICAL PROD. INC.	WASHINGTON D.C.	20006
74193	ELECTRONIC INDUSTRIES ASSOCIATION	DU BOIS, PA.	15801
75042	BIRCO SPEER FLEET. CORP.	HARRISON, N.J.	07029
86684	RCA ELECTRONIC COMPONENTS	CHICAGO, ILL.	60656
91418	RADIO MATERIALS CO.	WORUPN, MASS.	01601
93332	SYLVANIA ELECTRIC PROD. INC. SEMICONDUCTOR DIV.	E. AURORA, N.Y.	14052
99800	DELEVAN ELECTRONICS CORP.		

See introduction to this section for ordering information

SCHEMATIC DIAGRAMS TROUBLE-SHOOTING

FIRST CONVERTER

First Mixer. Any two input RF signals of the same fundamental frequency in the 0.11- to 12.4-GHz range are converted to two 20.278-MHz IF signals. The IF signals have the same amplitude relationship as the fundamental components of the input RF signals. The phase relationship at this point is reversed in sign because the local oscillator frequency is above the RF input frequency. High-frequency harmonics of the self-tuning local oscillator are applied to the first mixers to obtain 20.278 MHz IF difference frequency signals.

Auto-Tuning Local Oscillator. The auto-tuning local oscillator contains a voltage-tuned oscillator (VTO) and a frequency and phase control system or phase-lock loop. The VTO signals (65 to 145 MHz) are applied to a pulse generator to obtain harmonics in the 0.12 to 13 GHz range, which are mixed with the RF input signal. A harmonic 20.278 MHz above the RF input signal is used to phase-lock the VTO to the RF input signal. The phase-lock loop supplies tuning control voltage to the VTO, performing the following functions:

1. Initially sweeps VTO to search for RF input frequency.
2. Phase locks reference channel high IF to 20.278 MHz crystal oscillator reference.
3. Always locks so that the locking harmonic of the VTO is 20.278 MHz above the RF input signal frequency.
4. Tracks the VTO to a sweeping RF input signal.

AUTOMATIC GAIN CONTROL

The automatic gain control system enables the network analyzer to make continuous, broadband measurements despite common-mode amplitude variations in the two RF input signals as great as 20 dB. The AGC loop compensates for common-mode IF amplitude variations by automatically holding the output amplitude of both IF amplifiers constant. The same gain-controlling signal that is applied to the reference channel IF amplifier is also applied to the test channel amplifier. Since these amplifiers are electrically the same, their gain variations track and the amplitude ratio display is unaffected by common-mode RF amplitude variations. The REF CHANNEL LEVEL meter monitors the gain-controlling signal, indicating when the amplitude of reference channel RF input is within the range of the AGC.

SECOND CONVERTER

Twenty MHz from a crystal oscillator mixes with both the reference and the test channel 20.278 MHz high IF signals in the Second Mixers. The output from the Second Mixers is the 278 KHz difference frequency. The two 278 KHz second IF signals have the same amplitude ratio and phase information as the RF signals at the 8411A input.

PHASE AND AMPLITUDE OFFSET

Phase. The PHASE VERNIER control gives continuous ±10 to ±100 degree phase shift of the reference channel 278 KHz low IF signal. This allows convenient reference settings for phase measurements.

Amplitude. The AMPL VERNIER and AMPLITUDE TEST CHANNEL GAIN controls form a series attenuator in the test channel 278 KHz low IF signal path. The AMPL VERNIER control gives 2-dB of continuous attenuation, the the TEST CHANNEL GAIN controls provide zero to 60 dB of attenuation in 1-dB steps. Attenuation is maximum at the 00 dB setting and minimum at the 60 dB setting. Convenient measurement references can be set with the vernier and gain controls. Also, the gain controls may be used for accurate substitution and scale factoring during measurements.

Figure 3-17. Talking Block Diagram

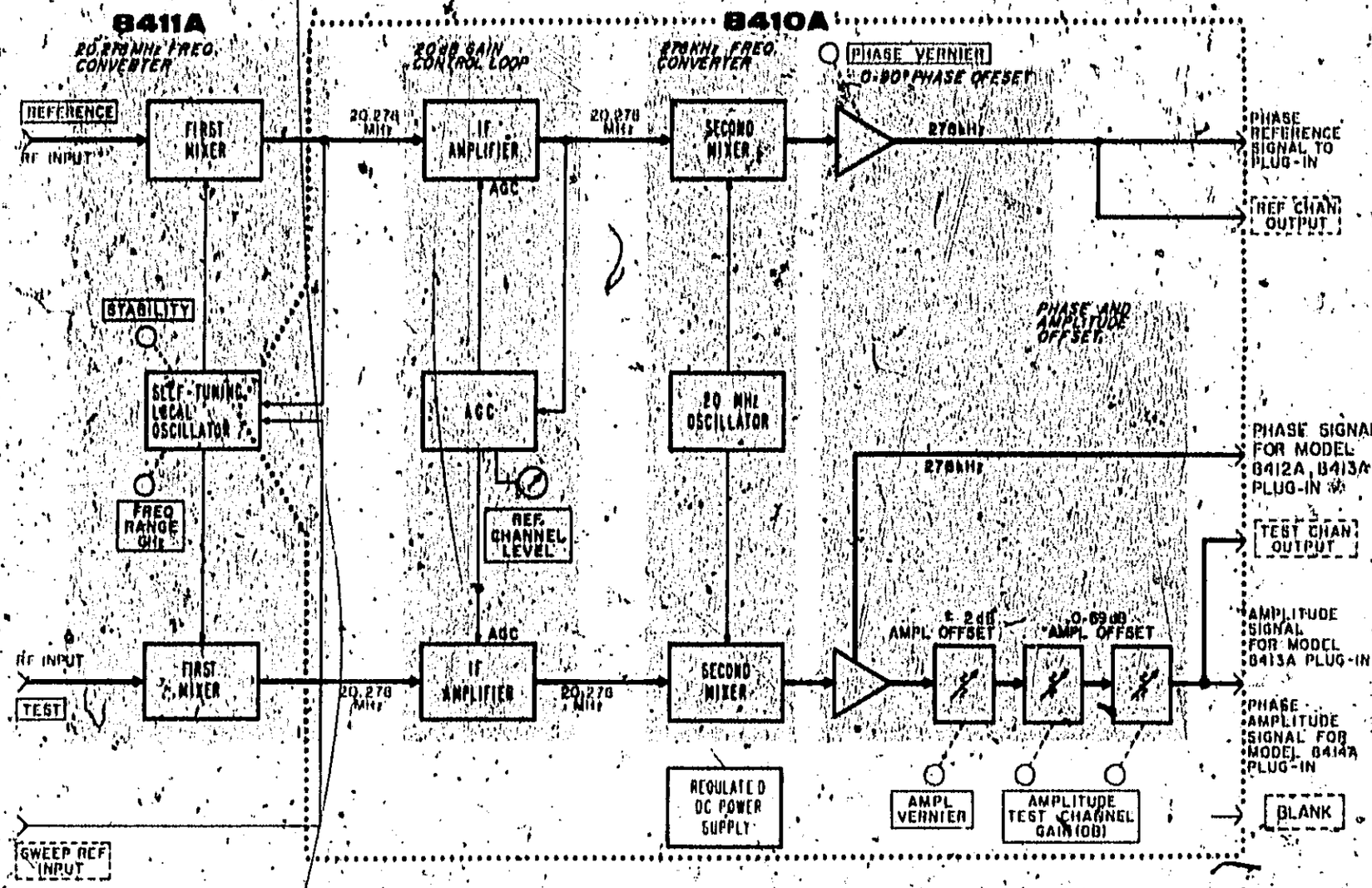
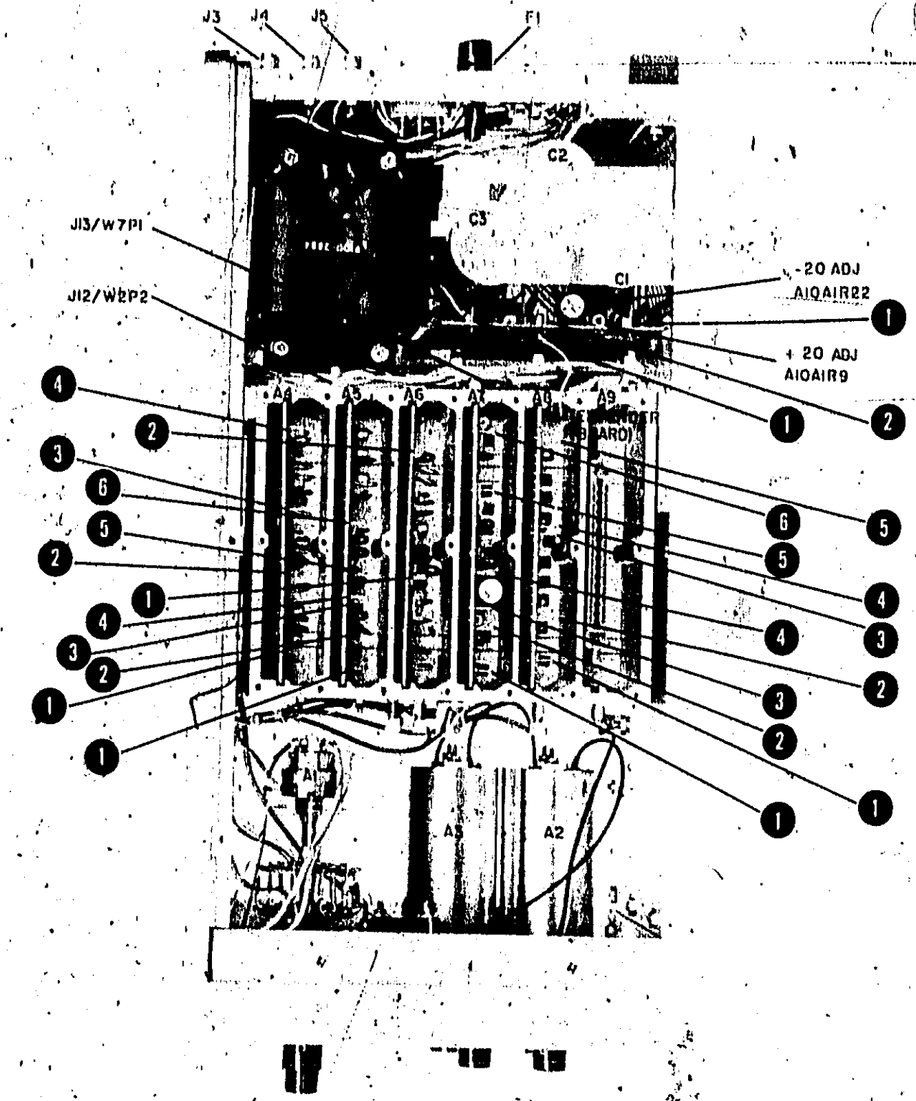
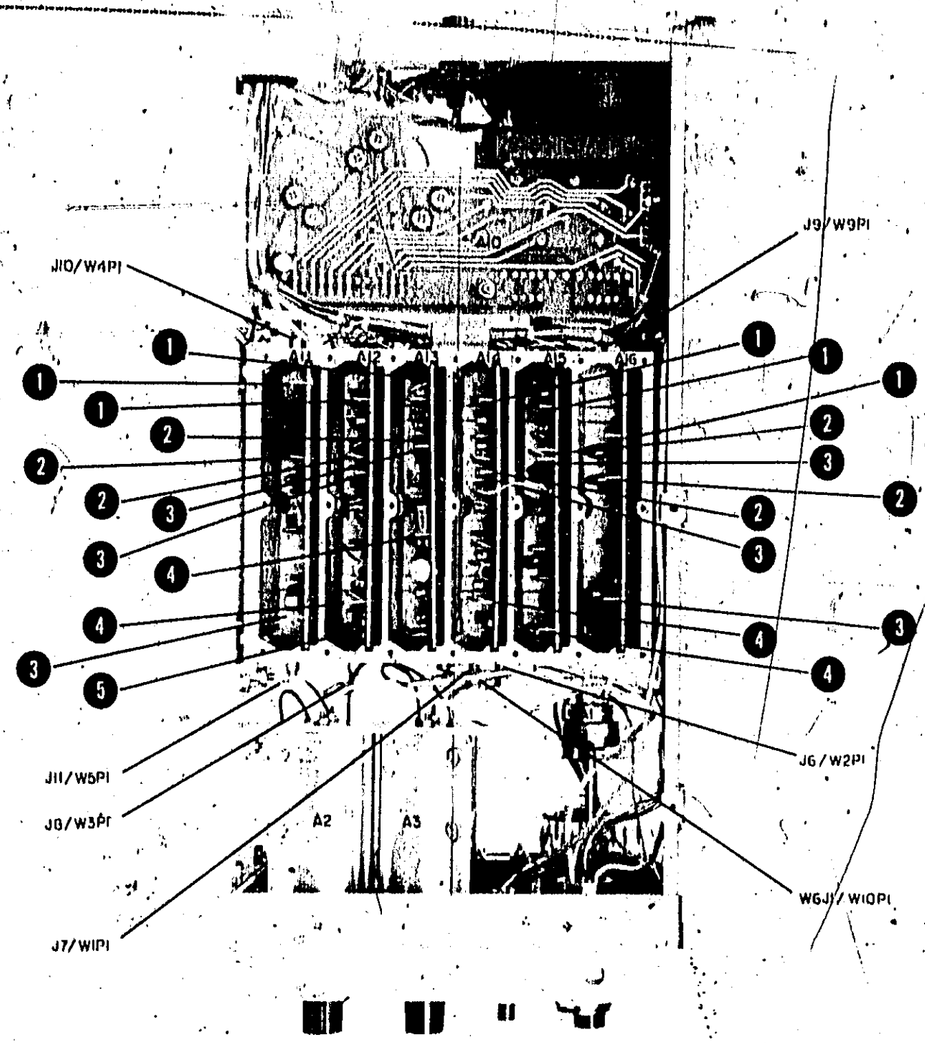


Figure 3-18. Basic Block Diagram



TOP VIEW

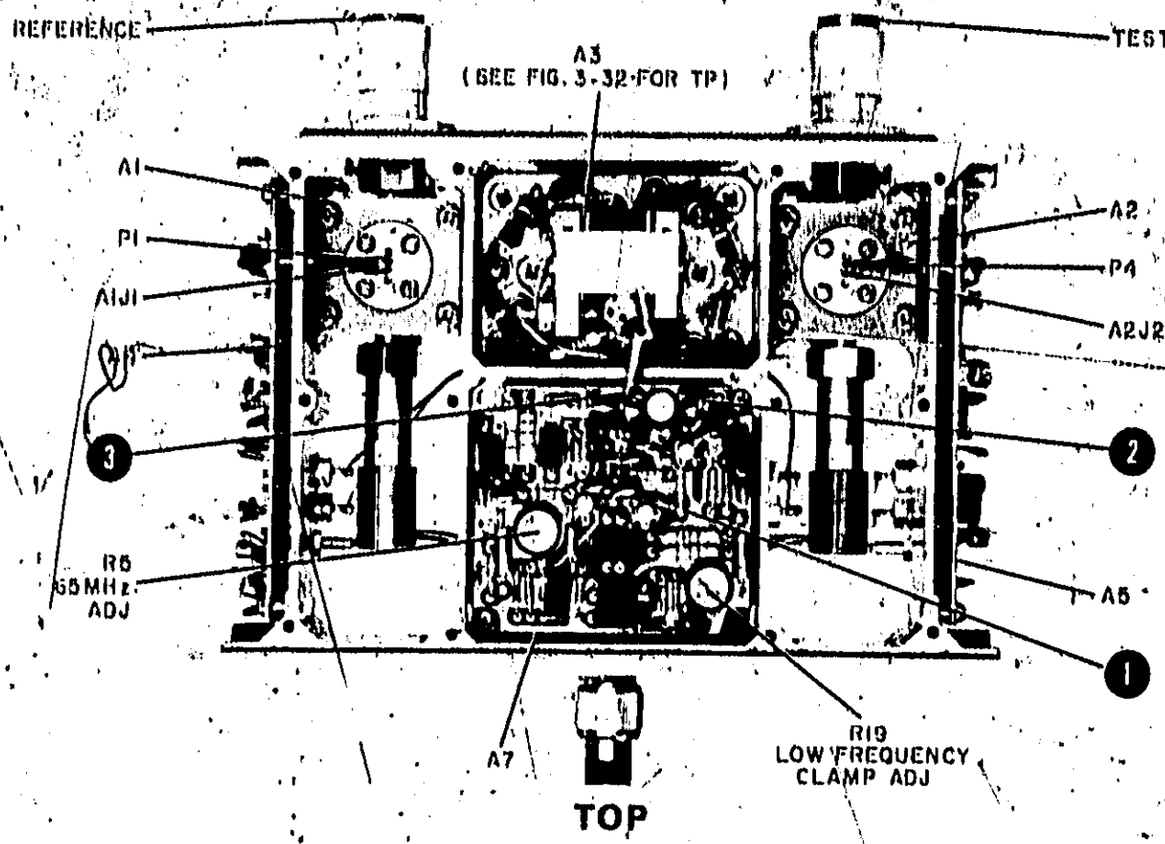
Figure 3-19. Model 8410A Test Points (Sheet 1 of 2)



BOTTOM VIEW

Figure 3-19. Model 8410A Test Points (Sheet 2 of 2)

Figures 3-17 thru 3-20.
TALKING BLOCK DIAGRAM;
8410A/8411A TEST POINTS



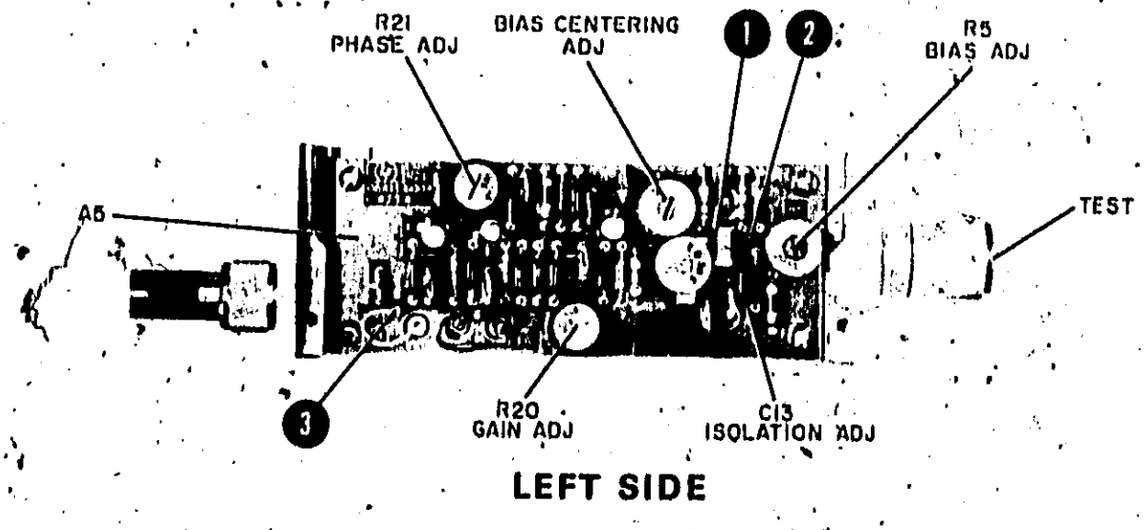
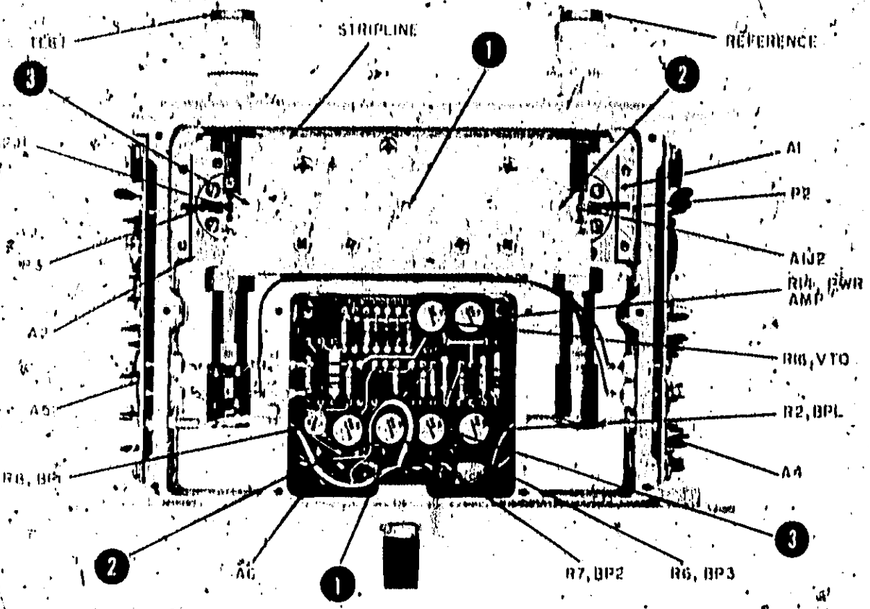


Figure 3-20. Model 8411A Test Points (Sheet 1 of 2)



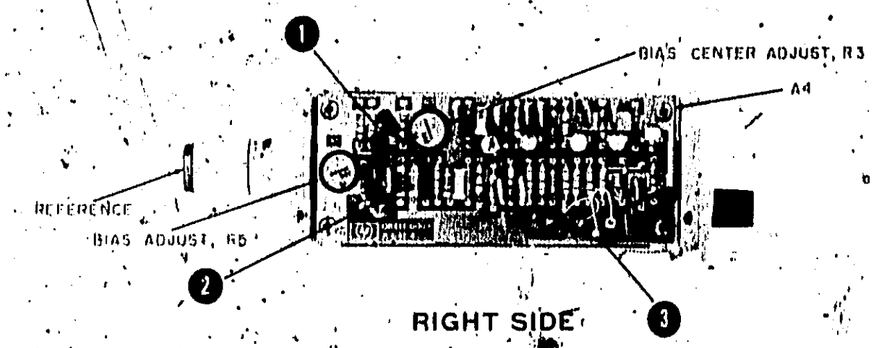
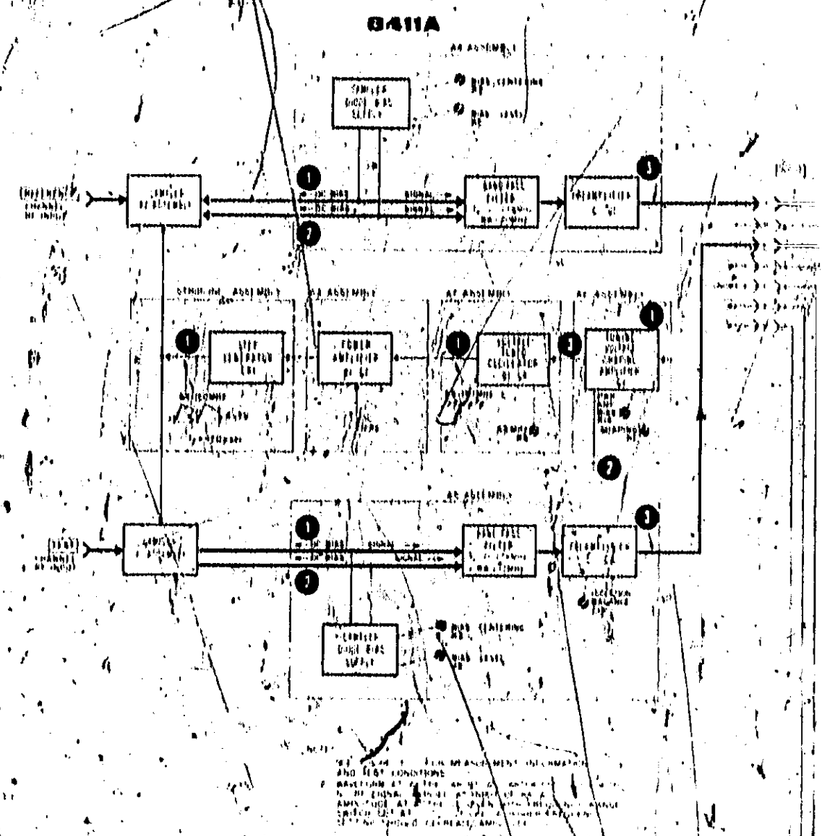


Figure 3-20. Model 8411A Test Points (Sheet 2 of 2)



8410A

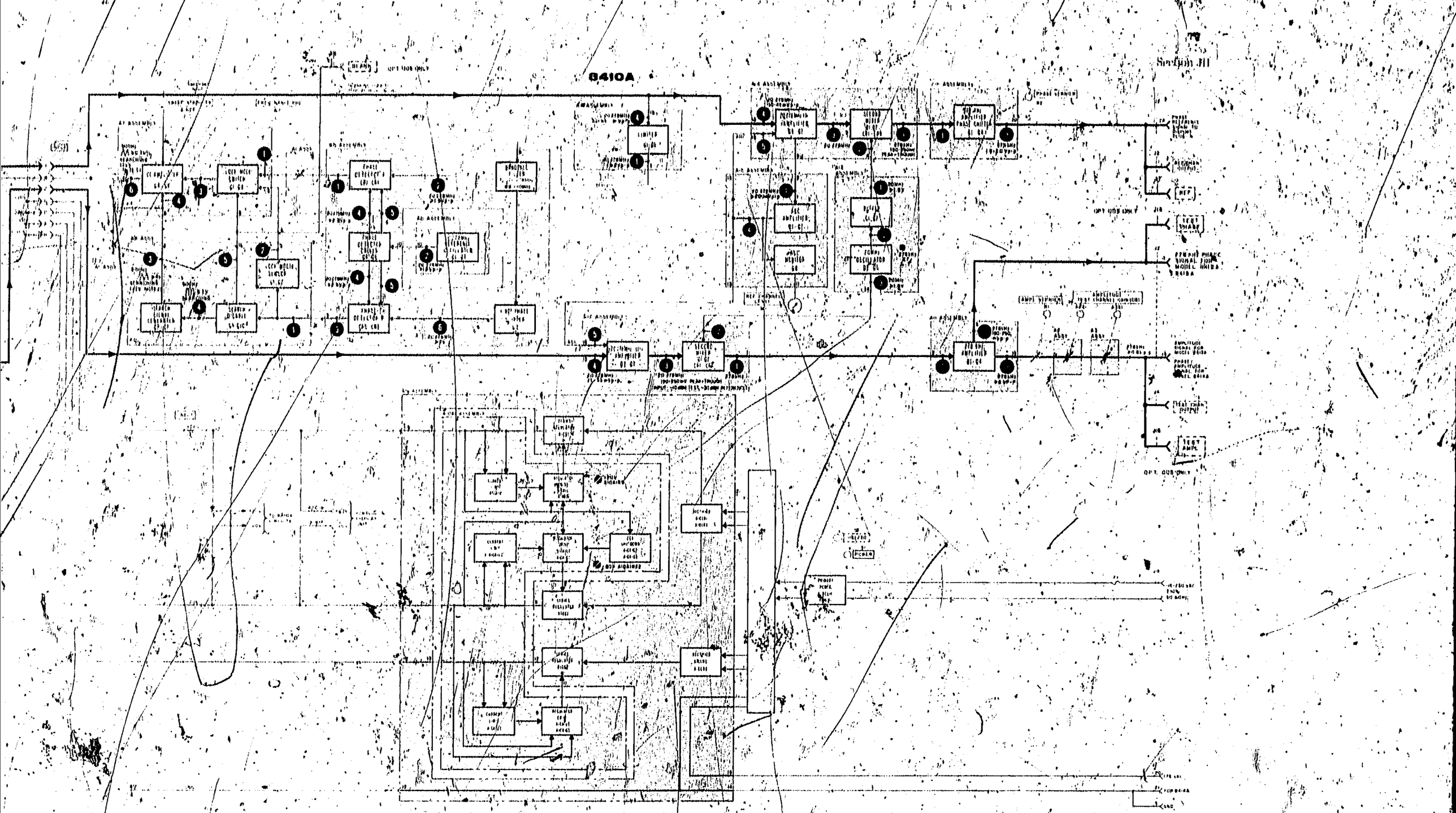
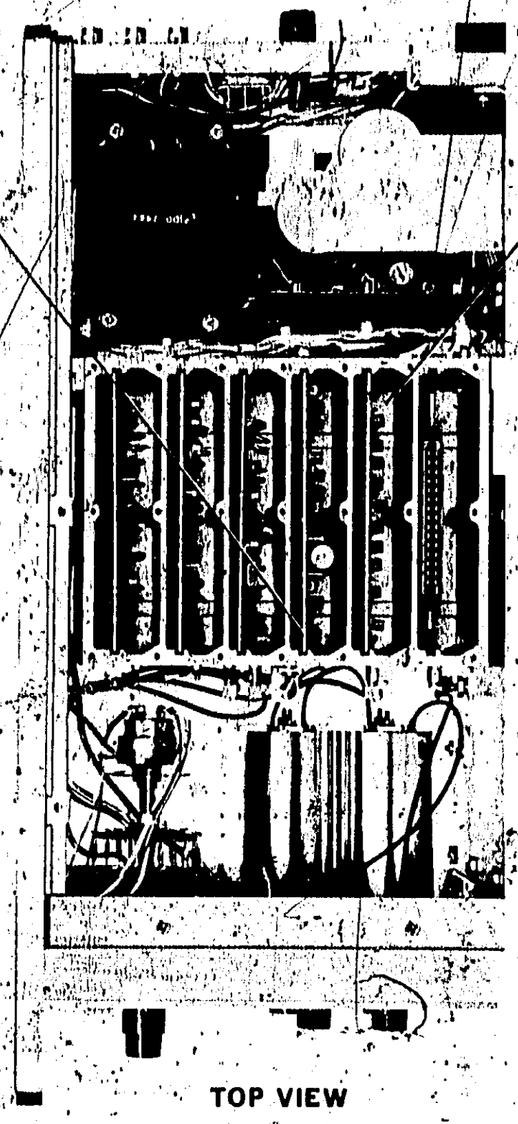
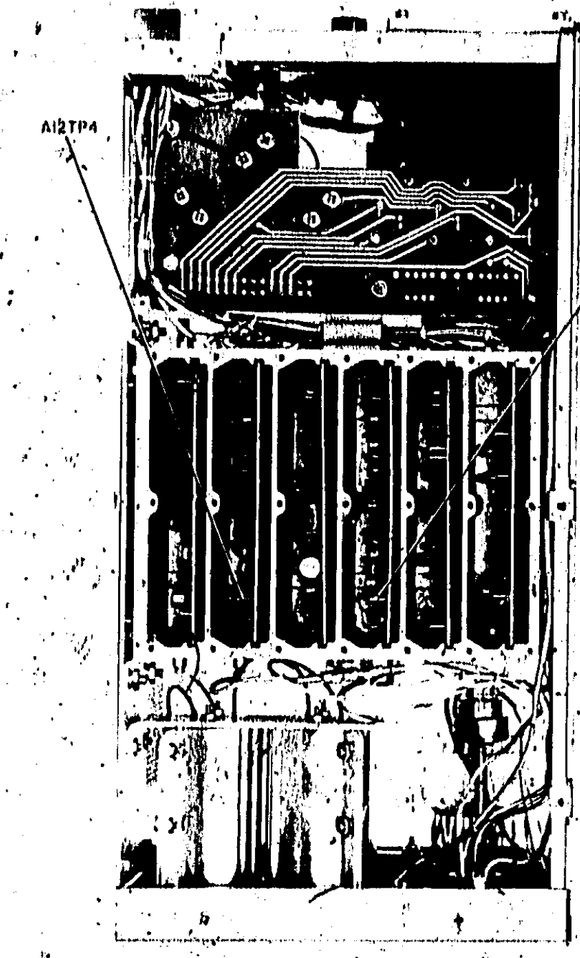


Figure 3-21. Detail Block Diagram



TOP VIEW



BOTTOM VIEW

Figure 3-22. Models 8410A/8411A Interface Test Points

TEST SETUP

SIGNAL SOURCE (CW OUTPUT IN 0.01 TO 12.4 GHz RANGE)

DIGITAL VOLTMETER HP 3440

AMP 8412A/ HP 8410A/HP 8413A/HP 8414A

DC POWER SUPPLY HP 6224B

OSCILLOSCOPE HP 180A

HP 8411A

AIR LINE HP 11567A

10 dBM

30 dBM

TRANSMISSION TEST UNIT HP 8740A

10 dB ATTENUATORS HP 8492A

POWER METER HP 431C

ALTERNATE TEST SETUP

APC-7 SHORT HP 11565A

10 dB ATTENUATOR HP 8492A

30 dBM

REFLECTION TEST UNIT HP 8741A / 8742A

-10 dBM

THERMISTOR MOUNT HP 8478B OPTION 11

* THE HP 8411A IS TURNED UPSIDE DOWN TO MATE WITH THE CONNECTORS SHOWN

EQUIPMENT SETUP

1. Connect equipment as shown in test setup.

2. Connect thermistor mount to air line (8740A) or in alternate setup, to REFERENCE port of 8741A/8742A. Adjust signal source for -10 dBm power meter indication.

3. Disconnect thermistor mount. Reconnect air line to 8411A or in alternate setup, reconnect 8741A/8742A REFERENCE port to 8411A TEST port.

8410A POWER SUPPLY TEST

Connect digital voltmeter (DVM) to A10A1TP2. Indication should be +20.0 Vdc ±0.025 Vdc. If not, adjust to +20.0 Vdc with 8410A-A10A1R22.

NO → ±20 volt supply defective, or ±20 volt bus overloaded. Go to Figure 3-75.

YES

Connect DVM to 8410A-A10A1TP1. Indication should be +20.0 Vdc ±0.025 Vdc. If not, adjust to +20.0 Vdc with A10A1R9.

NO → +20 volt supply defective, or +20 volt bus overloaded. Go to Figure 3-75, step 4.

YES

Connect DVM to A10A1TP3. Indication should be -11.0 Vdc ±0.5 Vdc.

NO → -11 Volt supply defective. Go to Figure 3-70.

YES

CW MODE OPERATION

Remove 8410A-A8. Ground 8410A-A7TP1. Connect DVM to 8410A-A7TP6. Adjust 8410A SWEEP STABILITY control through its range. DVM should indicate range of at least +8.9 to +9.9 Vdc.

NO → 8410A defective. Troubleshoot 8410A using procedure in Figure 3-26.

YES

Connect oscilloscope to 8410A-A14TP4. Adjust SWEEP STABILITY control for maximum waveform amplitude at oscilloscope. Amplitude should be 30 to 45 mV P-P.

NO → 8411A Defective. Troubleshoot 8411A using procedures in Figure 3-29.

YES

Connect Oscilloscope to 8410A-A12TP4. Adjust SWEEP STABILITY control for maximum waveform amplitude at oscilloscope. Amplitude should be 25 to 45 mV P-P.

NO → 8411A defective. Troubleshoot 8411A using procedures in Figure 3-29.

YES

Remove ground from 8410A-A7TP1. Reinstall 8410A-A8. Set SWEEP STABILITY control to CW position. Install 8413A or 8414A plug-in in 8410A. Check for phase-lock by adjusting 8410A PHASE VERNIER control. Indication on 8413A or 8414A should be phase change of approximately 90 degrees.

NO → 8410A defective. Troubleshoot 8410A using procedures in Figure 3-26.

YES

SWEPT MODE OPERATION

If 8413A is used, connect oscilloscope to AMPLITUDE output. Set signal source to sweep octave band. Adjust SWEEP STABILITY for best phase lock across band. Adjust REFERENCE PLANE EXTENSION on 8740B, 8741A, or 8742A for trace as shown below. Readout indicates phase lock across octave band as shown below.

8413 AND OSCILLOSCOPE 8414

NO → Set signal source for CW mode, Set 8410A SWEEP STABILITY control to CW position. Check 8413A or 8414A plug-in for phase lock. Check for normal waveform at 8410A-A5TP2. 20.278 MHz, 1.8V.

NO → Trouble in 8410A-A6. Go to Figure 3-68.

YES

Check for normal waveform at 8410A-A5TP2. 20.278 MHz, 1.5V.

NO → Trouble in 8410A-A4. Go to Figure 3-64.

YES

Reduce signal source RF signal to 10 mV P-P at A14TP4. Signal at 8410A-A5TP2 should be greater than 1.5 volts P-P.

NO → Trouble in 8410A-A4. Go to Figure 3-64.

YES

Remove 8411A cable from 8410A-J1 input. Check for zero ±50 mV at 8410A-A5TP1 and A5TP3.

NO → Trouble in 8410A-A5. Go to Figure 3-68.

YES

8410A/8411A interface operating correctly. If trouble is still present troubleshoot 8410A using procedures in Figure 3-26.

Figure 3-23. Model 8410A/8413A Int

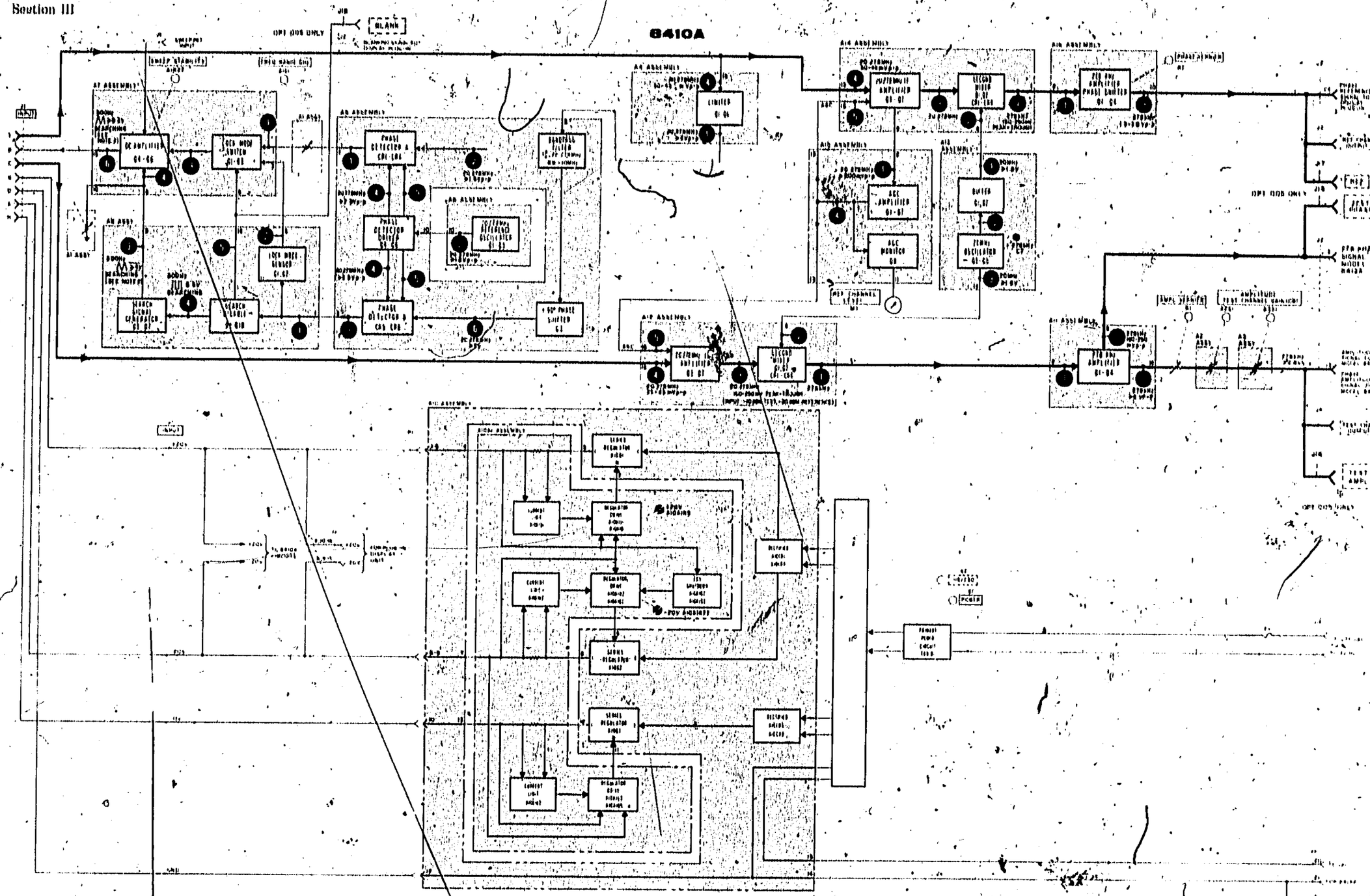
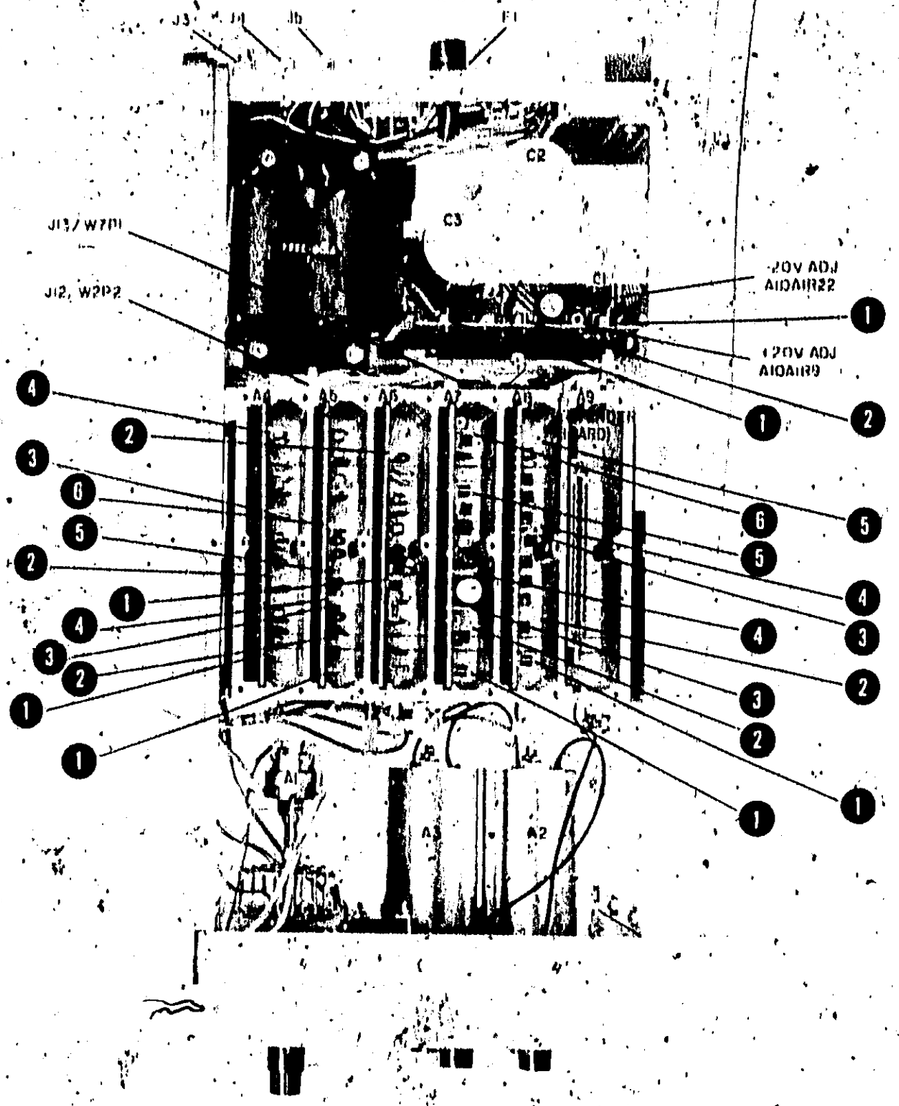
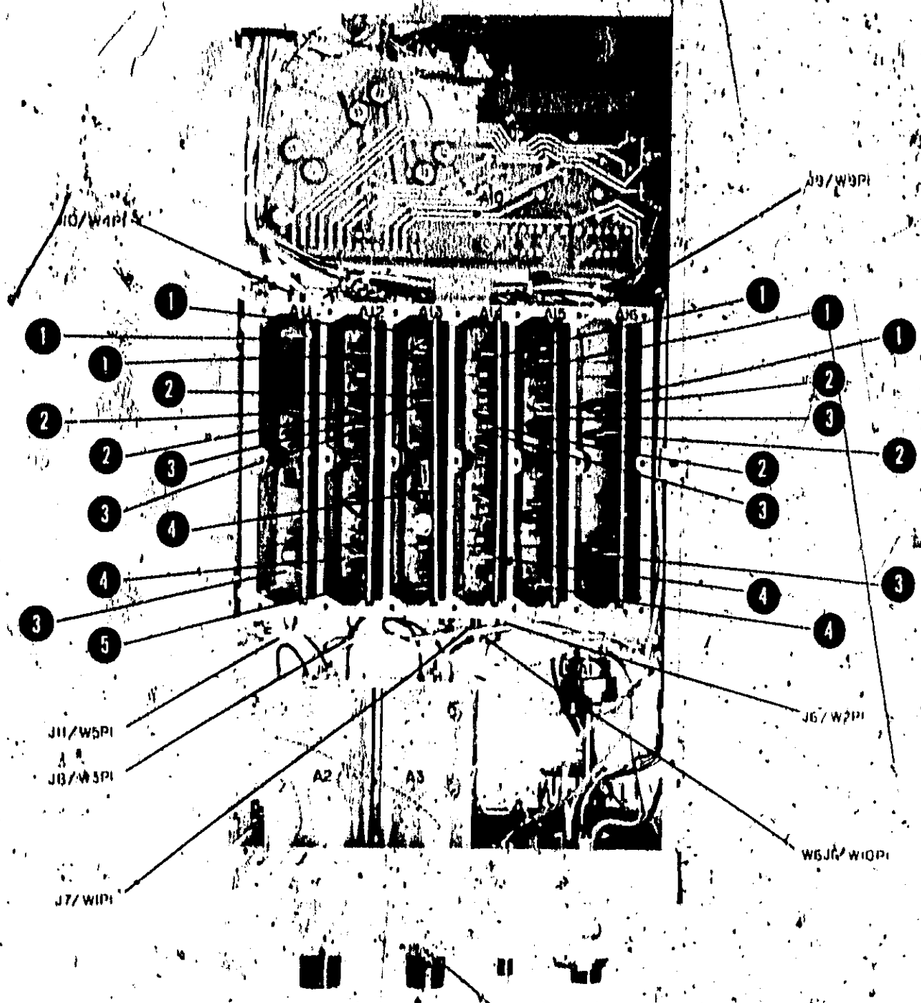


Figure 3-24. Model 8410A Detailed Block Diagram



TOP VIEW

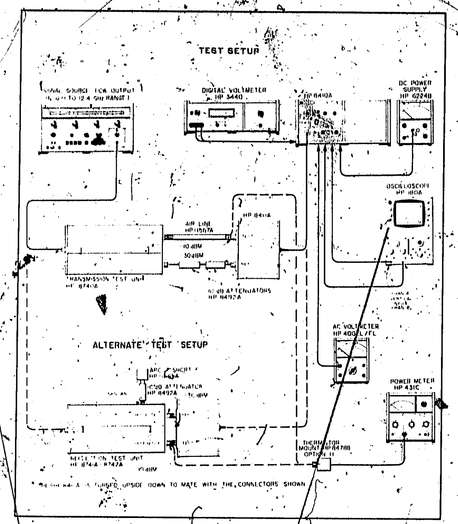


BOTTOM VIEW

Figure 3-25. Model 8410A Test Points (Sheet 1 of 2)

Figure 3-22 thru 3-25
INTERFACE TROUBLESHOOTING;
8410A BLOCK DIAGRAM;
8410A TEST POINTS

Figure 3-25. Model 8410A Test Points (Sheet 2 of 2)



From 8410A/8411A interface test, Figure 3-23.

SET UP TEST CONDITIONS

1. Using one of the test setups above, set input RF power to 8411A (-10 dBm at TEST, -30 dBm at REF).
2. Set 8410A FREQ. RANGE to signal source frequency, SWEEP STABILITY to CW detent, TEST CHANNEL GAIN to 60 dB, and AMPL VERNIER control maximum clockwise.

PHASE-LOCK AND SEARCH CIRCUIT

Disconnect 8411A cable from 8410A-J1 input. Connect oscilloscope to A7TP6, sawtooth search waveform should be present. 500 Hz, 1 V, >0.2V

Note

Amplitude depends on freq. range switch setting.

NO → Check for normal waveform at A6TP5. 500 Hz, >4V

NO → Check for zero ±50 mVDC at A8TP1.

NO → Trouble in A5. Go to Figure 3-66.

YES → Trouble in A8. Go to Figure 3-72.

YES → Trouble in DC amplifier of A7. Go to Figure 3-72.

YES → Reconnect 8411A cable to 8410A-J1 input. Sawtooth waveform at A7TP6 should disappear (indicating phase-lock).

NO → Check for normal waveform at A6TP2. 20.278 MHz, 1.5 to 2.5 V

NO → Trouble in A6. Go to Figure 3-66.

YES → Disconnect 8411A cable from 8410A-J1 input. Check for zero ±50 mVDC at A8TP1.

NO → 1. Trouble could be in A5. Go to Figure 3-66.
2. Trouble could be A7Q3 shorted. Go to Figure 3-72.

YES → Reconnect 8411A cable to 8410A-J1 input. Remove A8, Ground A7TP1. Connect oscilloscope to A8TP1. Adjust 8410A SWEEP STABILITY control for maximum amplitude waveform on oscilloscope. 20.278 MHz, 41.6V

NO → Trouble in A4. Go to Figure 3-64.

YES → Install A6 and remove ground from A7TP1. Remove A5. Apply -500 mV DC to A8TP1. Connect Oscilloscope to A8TP2. If search waveform is present, trouble in A8. (Go to Figure 3-72.) If no search waveform is present, A5 is defective. (Go to Figure 3-66.)

PEAK-MODE SWITCH

Remove A5. With external DC power supply, apply +500 mVDC to A8TP1 and apply -500 mVDC to A7TP1. DC voltage at A7TP3 should be zero.

NO → Check for approximately +10 Vdc at A8TP2

NO → Trouble in A6. Go to Figure 3-72.

YES → Trouble in A7. Go to Figure 3-72.

YES → Reduce voltage at A8TP1 to zero Vdc. DC voltage at A7TP3 should be -500 mVDC.

NO → Check for approximately +0 Vdc at A8TP2.

NO → Trouble in A8. Go to Figure 3-72.

YES → Trouble in A7. Go to Figure 3-72.

YES → Reinstall A5 and disconnect external power supplies from 8410A.

YES → **REFERENCE CHANNEL MIXER AMPLIFIER AND AGC**

Connect oscilloscope to A14TP4. Decrease signal source power until waveform is 10 mV P-P. Remove A15. Waveform at A14TP1 should be 22 mV ±3 mV P-P.

NO → Check for normal waveform at A13TP1. 20 MHz, 1.5V

NO → Trouble in A13. Go to Figure 3-52.

YES → Trouble in A14. Go to Figure 3-44.

YES → Reinstall A15. Waveform at A14TP1 should be 220 mV ±30 mV P-P.

NO → Set external DC power supply to zero VDC. Connect positive lead to A15TP4 and negative lead to ground. Increase power supply voltage to +2.1 Vdc. Waveform at A14TP1 should increase to 220 mV ±30 mV P-P.

NO → Trouble in A14. Go to Figure 3-44.

YES → Trouble in A15. Go to Figure 3-56.

YES → Adjust signal source RF power for 100 mV ±5 mV P-P at A14TP4. Waveform at A14TP1 should be 220 mV ±30 mV P-P.

NO → Remove A15. Waveform at A14TP1 should be 220 mV ±30 mV P-P.

NO → Trouble in A14. Go to Figure 3-44.

YES → Trouble in A15. Go to Figure 3-56.

YES → Check for normal waveform at rear-panel RF CHAN OUTPUT J5. (No readout plug-in installed in 8410A.) 278 kHz, 2 to 2.6 V

NO → Trouble in A16. Go to Figure 3-46.

YES → **TEST CHANNEL MIXER & AMPLIFIER**

Check for normal waveform at A12TP2. 20 MHz, 1.8V

NO → Trouble in A13. Go to Figure 3-52.

YES → Check for normal waveform at A12TP1. 278 kHz, 700 to 1250 mV P-P

NO → Trouble in A12. Go to Figure 3-44.

YES → Decrease signal source RF power for 10 mV P-P at A12TP4. Output at A12TP1 should be 220 mV ±30 mV P-P.

NO → Trouble in A12. Go to Figure 3-44.

YES → Adjust signal source power for 100 mV P-P at A12TP4. Check for normal waveform at A11TP2. 278 kHz, 0V

NO → Trouble in A11. Go to Figure 3-60.

YES → Check for normal waveform at rear panel TEST CHAN OUTPUT, J4. 278 kHz, 0V

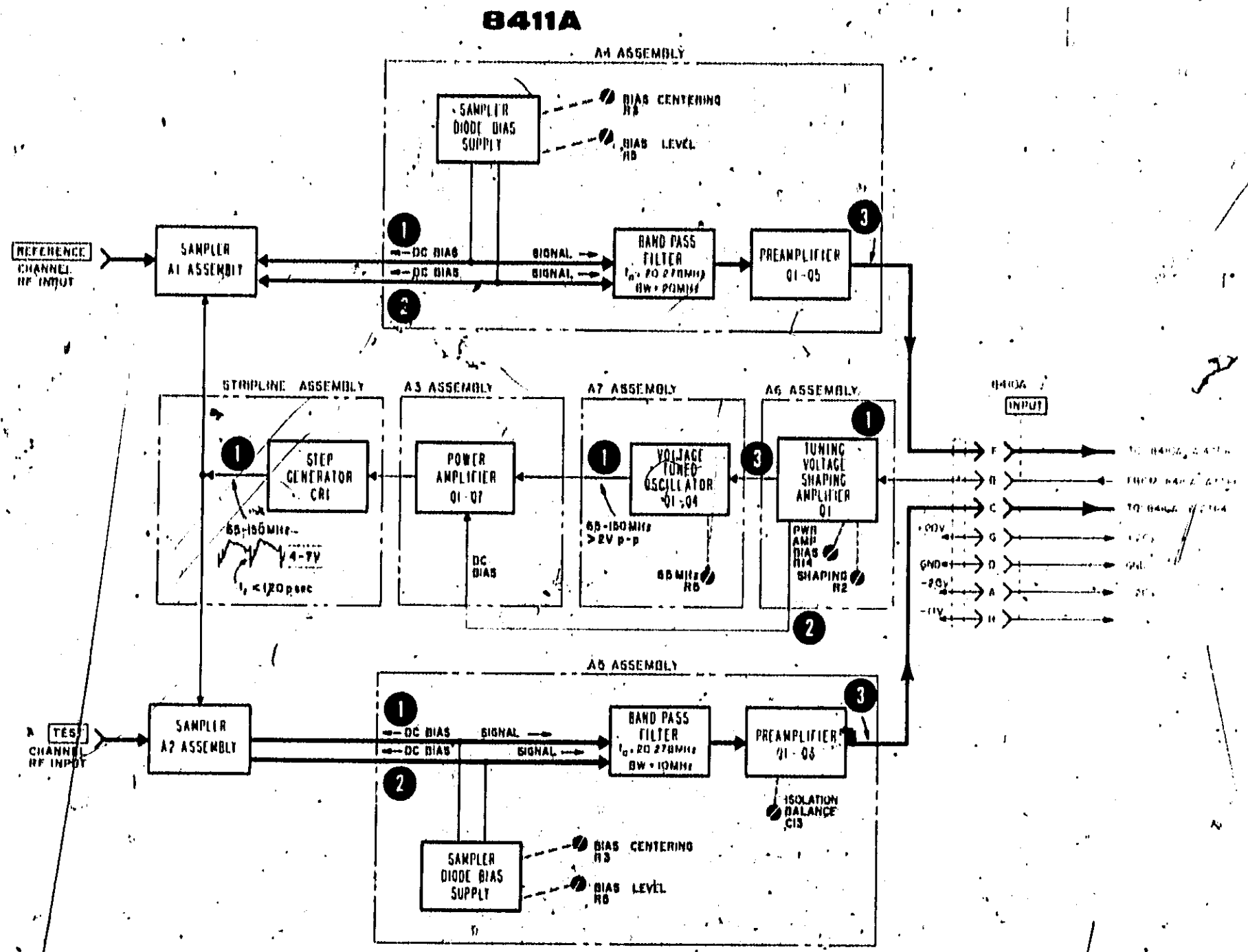
NO → Trouble in AMPL VERNIER H or TEST CHANNEL GAIN attenuators A2 or A3.

YES → Connect VTVM between J2-20 and J2-21. Indication should be 115 VAC ±10 VAC.

NO → Trouble in Transformer T1.

YES → 8410 checkout complete.

Figure 3-26. Model 8410A Troubleshooting



NOTE

SEE FIGURE 3-10 FOR MEASUREMENT INFORMATION AND TEST CONDITIONS

Figure 3-27. Model 8411A Block Diagram

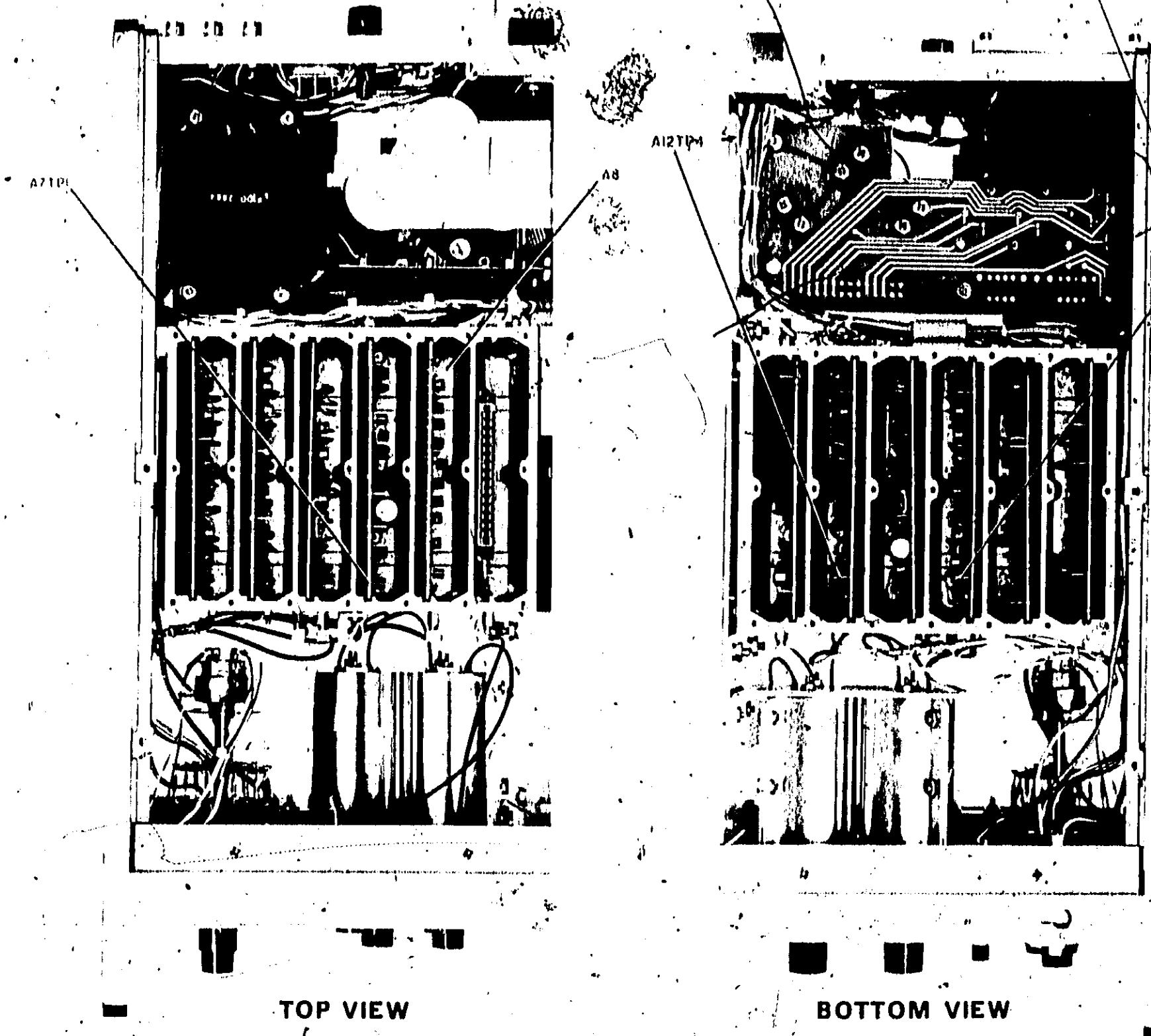
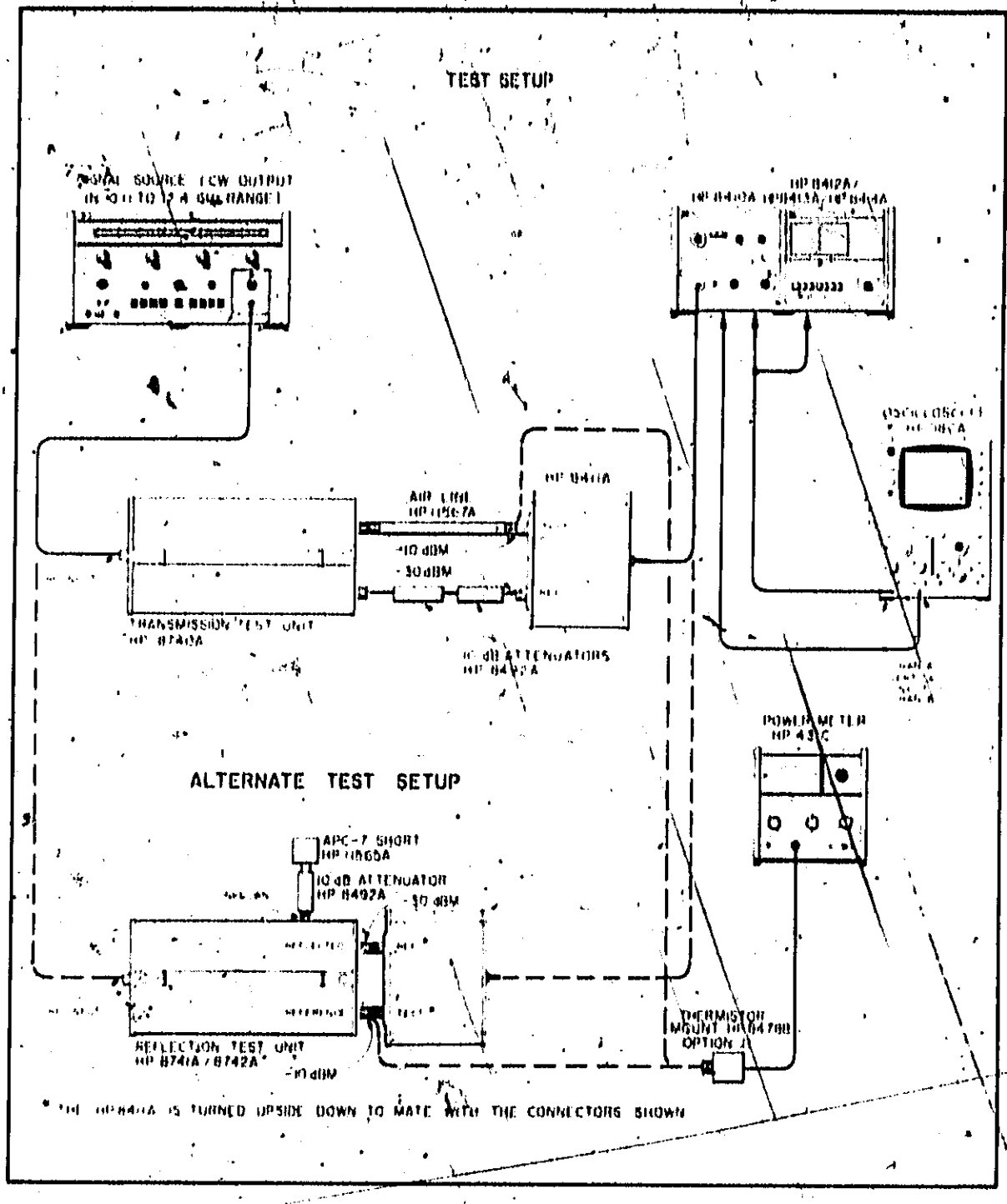


Figure 3-28. Test Points for 8411A Troubleshooting (Shows 8410A TPs)


TEST SETUP
SIGNAL SOURCE (CW OUTPUT
HP 8412A/
AIR LINE
HP 11851A
+10 dBM
-30 dBM
HP 8411A
TRANSMISSION TEST UNIT
HP 8741A
ALTERNATE TEST SETUP
APC-7 SHORT
HP 11650A
10 dB ATTENUATOR
HP 8492A
-30 dBM
REFLECTION TEST UNIT
HP 8741A / 8742A*
-10 dBM
POWER METER
HP 432C
THERMISTOR
MOUNT HP 8478B
OPTION 1
* THE HP 8411A IS TURNED UPSIDE DOWN TO MATE WITH THE CONNECTORS SHOWN

From 8410A/8411A interface test, Figure 3-23.

CW MODE

Using one of the test setups above, check CW input RF power to 8411A (-10 dBm at TEST and +30 dBm at REF).

Set 8410A FREQ RANGE to signal source freq., and TEST CHANNEL GAIN to 60 dB.

Remove 8410A-A6, Ground A7TP1. Connect the two vertical inputs of dual trace Oscilloscope to A12TP4 and A14TP4. Adjust SWEEP STABILITY control for maximum amplitude on oscilloscope. Both waveforms should be 25 to 45 mV, P-P.

NO

1. If both waveforms are incorrect, trouble probably is step generator or drive to the step generator. Go to Figure 3-31.

2. If only one waveform is incorrect, trouble probably is in stripline, sampler, or preamplifier in affected channel. Go to Figure 3-30 and check preamplifier. If preamplifier checks correctly, go to Figure 3-31 and check sampler and stripline.

YES

SWEPT MODE

Reinstall 8410A-A6 and remove ground from 8410A-A7TP1. Install 8413A or 8414A in 8410A. (If 8413A is used, connect oscilloscope to amplitude output.) Set signal source to sweep entire band. Adjust 8410A SWEEP STABILITY control for best phase-lock across band. Adjust REFERENCE PLANE EXTENSION on 8740A, 8741A, or 8742A for trace as shown below. Readout indicates phase-lock over entire band, and smooth trace as shown.

8413A & OSCILLOSCOPE 8414A

NO

IDENTIFY TROUBLE FROM ONE OF THE FOLLOWING WAVEFORMS		
8413A & OSCILLOSCOPE.	8414A	TROUBLE AND CORRECTIVE PROCEDURE
		Phase-lock loop gain too low. Go to 8411A-A6 shaping amplifier adjustment, Figure 3-41, Test 12.
		Phase-lock loop gain too high. Go to 8411A-A6 shaping amplifier adjustment, Figure 3-41, Test 12.
		Insufficient frequency response at high or low frequency. 1. If the amplitude of the trace changes on the low-frequency end when the SWEEP STABILITY control is adjusted, trouble is incorrect drive pulse from the stripline to the sampler. Go to Figure 3-31 and troubleshoot stripline, step generator, power amplifier and VTO. 2. If SWEEP STABILITY control does not affect waveform, trouble is in one of the samplers. Check sampler, Figure 3-31.

Figure 3-29. Model 8411A Troubleshooting

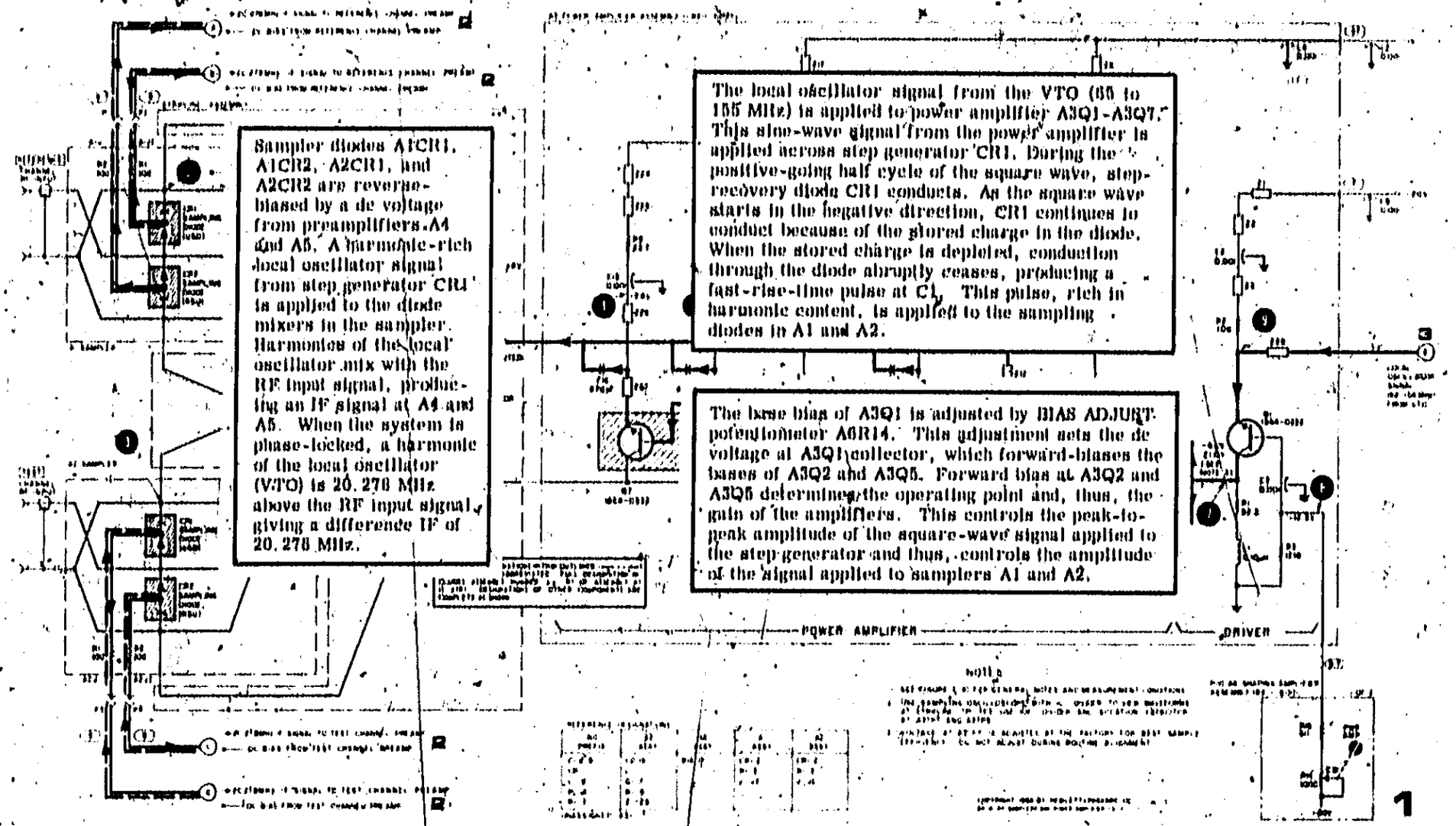


Figure 3-30. 8411A-A1, A2, A3 and Stripline Talking Schematic (Use with Figure 3-31)

8411A-A3 POWER AMP, STRIPLINE, AND SAMPLERS A1 AND A2

NOTE

Because of the frequencies present, complete trouble isolation in the power amplifier, stripline, samplers, and VTO circuits is not possible without the aid of a sampling oscilloscope or spectrum analyzer. If neither instrument is available, some trouble isolation can be done with common test equipment. (See Figure 3-33.)

Connect equipment and setup test conditions described in Figure 3-10. Remove 8410A-A8 circuit board and connect a coax jumper to 8410A-A7TP1. Connect dual-trace oscilloscope to A12TP4 and A14TP4, and adjust 8410A SWEEP STABILITY control for maximum amplitude on oscilloscope. Waveforms should be normal.

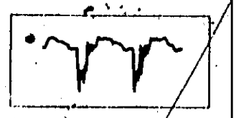
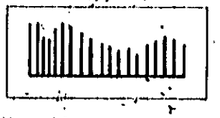
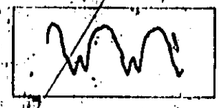
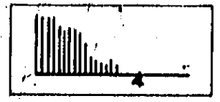
1. If waveform is not present at both A12TP4 and A14TP4, trouble is probably in the common stripline, step generator, power amplifier, or VTO.
2. If only one of the waveforms is missing or is not correct, trouble is probably in the associated stripline, sampler, or preamplifier circuit for the channel. Go to Figure 3-36 and check preamplifier, then proceed.

ONE WAVEFORM BAD

BOTH WAVEFORMS BAD

A. STEP GENERATOR

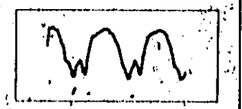
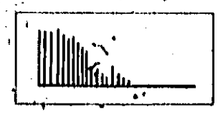
1. Check waveform at Stripline TP1, using sampling oscilloscope and 10:1 probe or spectrum analyzer and 10:1 oscilloscope probe. (See display A.) If waveform is correct or missing, check power amplifier A3. If step generator circuit is not operating, waveform will be similar to display B. If trouble is in solder connection between power amplifier and stripline, probe contact may cause circuit to operate. Resolder connection.
2. Check resistance from stripline assembly TP1 to ground. Resistance should be 20 ohms. If resistance is approximately 0 ohms, stripline capacitor C1 is probably shorted. If resistance is infinite, tighten nylon screw shown in Figure 3-6, Item 2.
3. If unable to obtain correct waveform, and resistance from TP1 to ground is 20 ohms, replace step generator CR1.

SAMPLING OSCILLOSCOPE	SPECTRUM ANALYZER
DISPLAY A. STRIPLINE TP1, STEP GENERATOR OPERATING NORMALLY	
 Normal pulse has steep leading edge.	 Normal frequency spectrum shows high-order harmonics present.
DISPLAY B. STRIPLINE TP1, STEP GENERATOR NOT OPERATING	
 Abnormal pulse has rounded leading edge.	 Frequency spectrum of abnormal pulse lacks high order harmonics.

CORRECT WAVEFORM OR NO WAVEFORM AT STRIPLINE TP1

B. POWER AMPLIFIER A3

1. Check waveform at A3TP9, using sampling oscilloscope with 10:1 probe and blocking capacitor, or spectrum analyzer and 10:1 probe. (SEE DISPLAY.) If waveform is incorrect, troubleshoot VTO assembly A7 with procedure of Figure 3-40.
2. Check waveform at A3TP7. (See Display.) If waveform is incorrect, troubleshoot A3Q1 circuit.
3. Check dc voltage at A3TP7. If voltage is incorrect, adjust A6R14 to obtain correct voltage. If adjustment of A6R14 is necessary, Alignment procedure in Figure 3-11, Test 11 must be performed after troubleshooting the circuit.
4. Check dc voltage at A3TP3 and A3TP6. If dc voltage is not ±10% of the correct value, troubleshoot associated circuit.
5. Check dc voltage at A3TP1, A3TP2, A3TP4 and A3TP5. If dc voltage is not ±10% of the correct value, troubleshoot associated circuit.

SAMPLING OSCILLOSCOPE	SPECTRUM ANALYZER
8411A-A3TP7 AND A3TP9	
	

C. STRIPLINE

NOTE

Before troubleshooting stripline, try to clear trouble by tightening all screws in stripline top cover and on the two mixer coax clamps.

CAUTION

Do not move mixer coax center conductor when probing stripline or conductor may break.

Remove mixer coax clamp (Figure 3-6, Item 6) for malfunctioning channel and check waveform at stripline TP2 or TP3. (See display)

a. If waveform is correct, trouble is in either the sampler or the preamplifier of defective channel. Proceed to step D.
b. If waveform is incorrect, trouble is in stripline or sampler. A short in the sampler drive coax may give the same indication as a short at the end of the stripline. Check sampler drive coax, step D-6.

CORRECT WAVEFORM AT STRIPLINE TP2 AND TP3

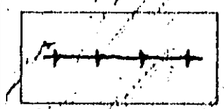
SAMPLING OSCILLOSCOPE	SPECTRUM ANALYZER
STRIPLINE TP2 AND TP3 STEP GENERATOR OPERATING NORMALLY	
 Normal pulse is narrow, has steep sides.	 Frequency spectrum shows high-order harmonics present.

Figure 3-33. 8411A A1, A2, A3 and Stripline Troubleshooting

D. SAMPLER A1 AND A2

1. Check for open RF input connector or 50 ohm load as follows. Resistance from APC-7 inner conductor to outer conductor should be 50 ohms ± 5 ohms. If not, replace sampler.

2. Remove input signal and connect sampling oscilloscope or spectrum analyzer (with no divider probe) to 8411A APC-7 RF input connector. If any unbalance exists due to abnormal biasing or defective diodes, the drive signals from the step generator will not cancel in the sampler cavity and a signal will be present at the input connector. The signal amplitude will depend upon the amount of unbalance. (See display A and B.)

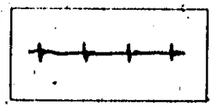
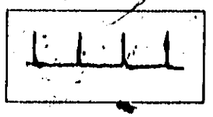
3. Adjust A4R3 or A5R3, as appropriate, through minimum amplitude on sampling oscilloscope (Display A). If a null is obtained, the sampler diodes and the bias supply in A4 or A5 are working normally. Proceed to Step 5. If a null cannot be obtained, trouble is either shorted or open sampler diodes, or defective bias supply in A4 or A5. Proceed to Step 4.

4. Check bias supply with dc voltmeter as follows. Set A4R3 or A5R3, as appropriate, to midposition, and set A4R5 or A5R5 maximum counterclockwise. Remove both clip-on leads from the sampler. Measure dc voltage at end of each lead. If the voltages are approximately equal in magnitude and opposite in polarity, the bias network is operating properly, and the sampler is faulty. Replace sampler.

5. To check for open drive coax, measure resistance from Stripline TP2 or TP3 to ground. Be sure center conductor of drive coax is making contact with stripline when taking resistance measurement. Resistance should be zero ohms. If resistance is about 40 ohms, the drive coax is open. Replace sampler.

6. To check for shorted drive coax, disconnect all four clip-on leads to sampler diodes. Connect sampling oscilloscope to the APC-7 RF input connectors one at a time. Normal indication is a low amplitude signal. If the signal at the suspected sampler is much lower in amplitude than the other signal, the drive coax is probably shorted. The short could be inside the sampler or at the ground plane of the stripline. Gently move the drive coax center conductor to relocate its position in the hole through the stripline. If moving the drive coax does not remove the short, remove the end-section of stripline and examine the stripline and drive coax visually. Reinstall the end-section of stripline and recheck for short. If the indication is still the same (short still present), replace the sampler.

CORRECT WAVE FORM AT STRIPLINE TP2 AND TP3

SAMPLING OSCILLOSCOPE	SPECTRUM ANALYZER
DISPLAY A, 8411A APC-7 RF INPUT CONNECTOR, SAMPLER DIODE CONDUCTION BALANCED.	
 Amplitude of pulse minimum and balanced when A4R3 or A5R3 adjusted correctly.	 Tops of all harmonics close to same amplitude when A4R3 or A5R3 adjusted correctly.
DISPLAY B, 8411A APC-7 RF INPUT CONNECTOR SAMPLING DIODE CONDUCTION UNBALANCED.	
 A4R3 or A5R3 not adjusted for minimum amplitude, or one of sampler diodes shorted or open.	 A4R3 or A5R3 not adjusted correctly or sampler diode shorted or open. Low-number harmonics high in amplitude and high-number harmonics low in amplitude. All should be the same.

Figures 3-29 thru 3-32

8411A TROUBLESHOOTING; 8411A-A1, A2, A3, AND STRIPLINE TROUBLESHOOTING

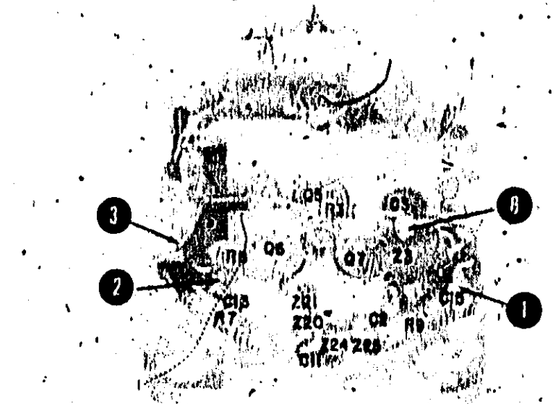


Figure 3-32. 8411A-A3 Parts Location

8411A-A3 POWER AMP, STRIPLINE, AND SAMPLERS A1 AND A2 ALTERNATE PROCEDURE USING COMMON TEST EQUIPMENT

NOTE

If a sampling oscilloscope or a spectrum analyzer is not available, use this procedure and standard test equipment. This procedure does not check operation of all circuits.

NOTE

If only one preamplifier output is incorrect, check the preamplifier in the defective channel first as instructed in Figure 3-36, before performing this procedure.

A. STEP GENERATOR

1. Check resistance from stripline TP1 to ground. Resistance should be 20 ohms. If resistance is approximately 6 ohms, stripline capacitor C1 is probably shorted. If resistance is infinite, tighten nylon screw shown in Figure 3-8, Item 2.

2. If trouble is in solder connection between power amplifier and stripline, probe contact may cause circuit to momentarily connect, giving correct indication. Resolder connection.

B. POWER AMPLIFIER A3

1. Check dc voltage at A3TP7. If incorrect, adjust A6R14 to obtain correct voltage.

NOTE

If A6R14 is adjusted, perform test 11 of the adjustment procedure (Figure 3-11).

2. Check dc voltage at A3TP3 and A3TP6. If dc voltage is not ±10% of the correct value troubleshoot associated circuit.

3. Check dc voltage at A3TP1, A3TP2, A3TP4, and A3TP5. If dc voltage is not ±10% of the correct value, troubleshoot associated circuit.

C. STRIPLINE

1. Try to correct trouble by tightening all screws on stripline top cover and on the two mixer coax clamps.

D. SAMPLERS A1 AND A2

1. With power off, check for open circuit at RF input connector or 50-ohm load. Resistance from APC-7 connector inner conductor to outer conductor should be 50 ohms ± 5 ohms. If not, replace sampler.

2. Connect 8411A to 8410A and apply power. Adjust R3 (BIAS CENTERING ADJUST) to approximately mid-position.

3. Adjust R5 (BIAS ADJUST) fully counterclockwise to bias off sampler.

4. Remove both clip-on loads from the sampler. Measure dc voltage at the end of each load. If the voltages are approximately equal in magnitude and opposite in polarity, the bias network is operating properly.

5. To check for a shorted sampler diode, attach dc voltmeter probe to the end of the clip-on load, note the magnitude of voltage and make contact with the sampler terminal. If the voltage decreases more than 10%, diode is shorted. Replace sampler.

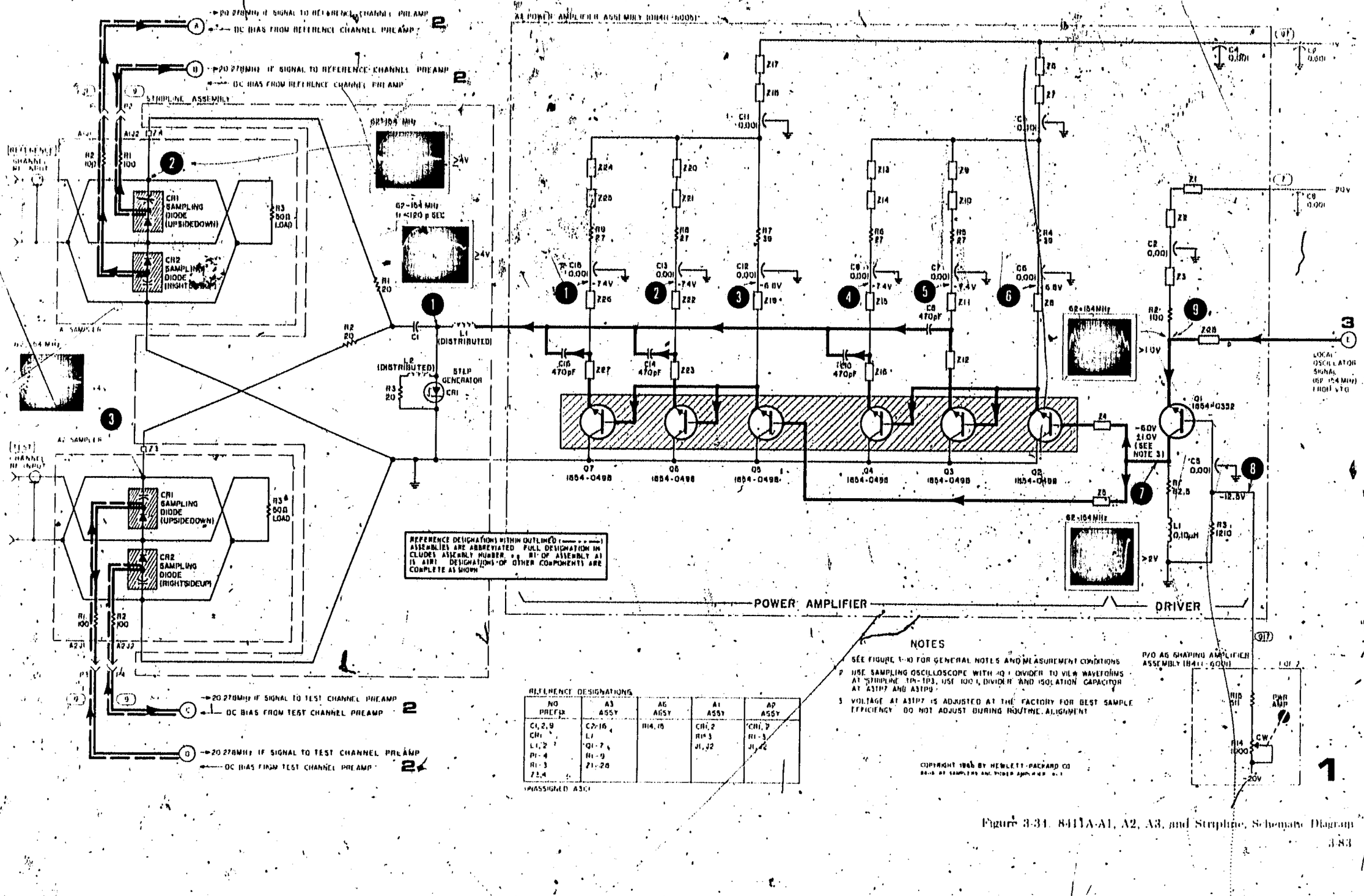
6. To check for open diode, connect both clip-on loads to sampler. Turn R5 fully clockwise. Connect oscilloscope to either A12TP4 or A14TP4 (whichever channel is being tested). Disconnect one sampler clip-on load at a time. If the good diode is disconnected and the other diode is open, no signal will be present on the oscilloscope. If the other diode is good, the oscilloscope amplitude will be at least 50% of the original amplitude with both loads connected.

CAUTION

Do not move mixer coax center conductor when connecting probe to stripline. Conductor may break.

7. Turn off power. Measure resistance from stripline TP2 or TP3 to ground. Be sure center conductor of mixer coax is making contact with stripline when taking resistance measurements. Resistance should be zero. If resistance is 40 ohms, the drive coax is open. Replace sampler.

Figure 3-33. 8411A-A1, A2, A3, and Stripline Troubleshooting Using Common Test Equipment



REFERENCE DESIGNATIONS

NO PREFIX	A3 ASSY	A6 ASSY	A1 ASSY	A2 ASSY
C1, 2, 9	C2-16	R14, 15	CR1, 2	CR1, 2
CR1	L1		R1-3	R1-3
L1, 2	Q1-7		J1, J2	J1, J2
R1-4	R1-9			
R1-3	Z1-26			
Z3, 4				

(UNASSIGNED A3C)

NOTES

1. SEE FIGURE 1-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS.
2. USE SAMPLING OSCILLOSCOPE WITH 10:1 DIVIDER TO VIEW WAVEFORMS AT STRIPLINE TP1-TP3, USE 100:1 DIVIDER AND ISOLATION CAPACITOR AT A3TP2 AND A3TP3.
3. VOLTAGE AT A3TP2 IS ADJUSTED AT THE FACTORY FOR BEST SAMPLE EFFICIENCY. DO NOT ADJUST DURING ROUTINE ALIGNMENT.

Figure 3-31. 8411A-A1, A2, A3, and Stripline, Schematic Diagram

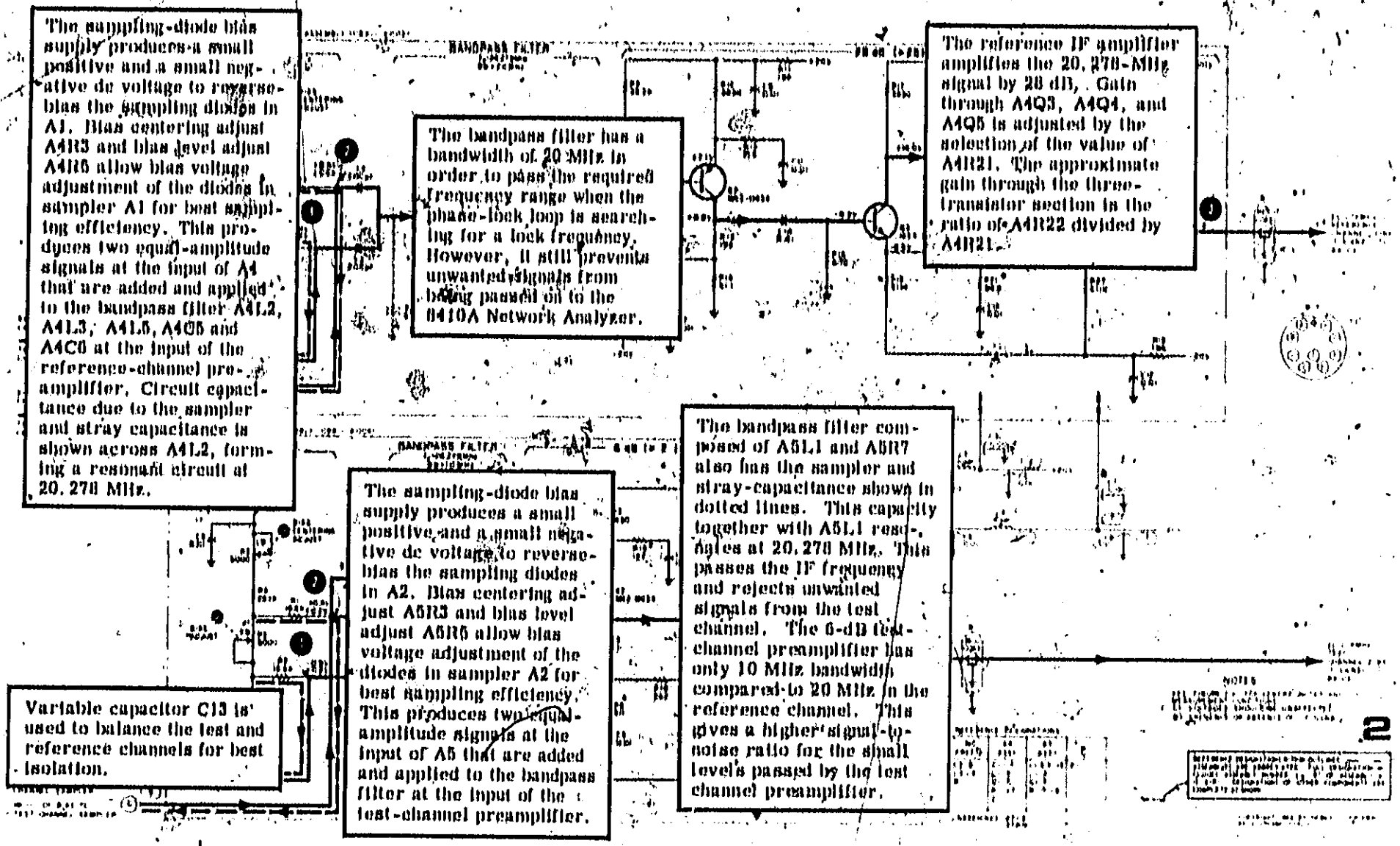


Figure 3-35. 8411A-A1 and A5 Talking Schematic

8411A-A4 AND -A6 PREAMPLIFIER

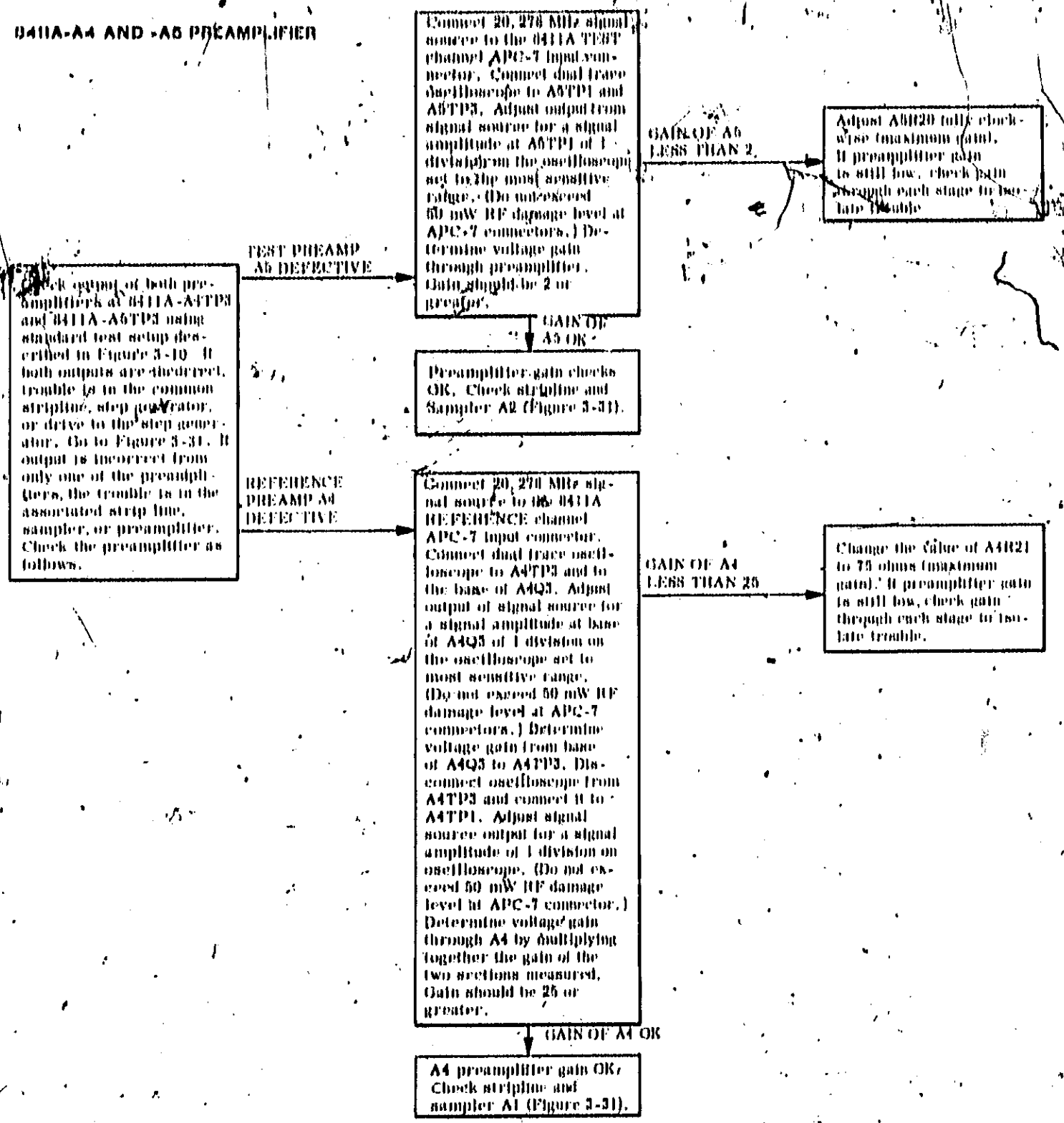


Figure 3-36. 8411A-A4 and A6 Troubleshooting

Figures 3-33 thru 3-36

8411A-A1, A2, A3, AND STRIPLINE TROUBLESHOOTING; 8411A-A4 AND A6 TROUBLESHOOTING

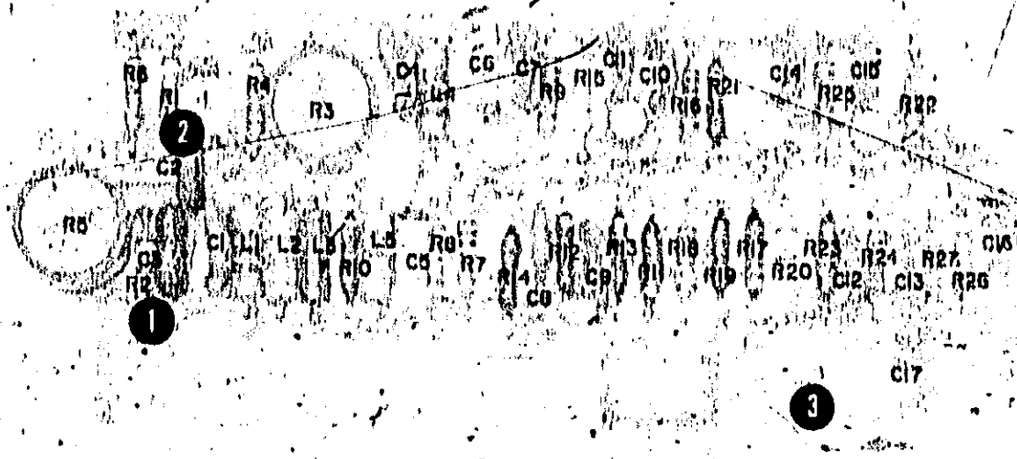


Figure 3-37. 8411A-A4 and A5 Parts Location

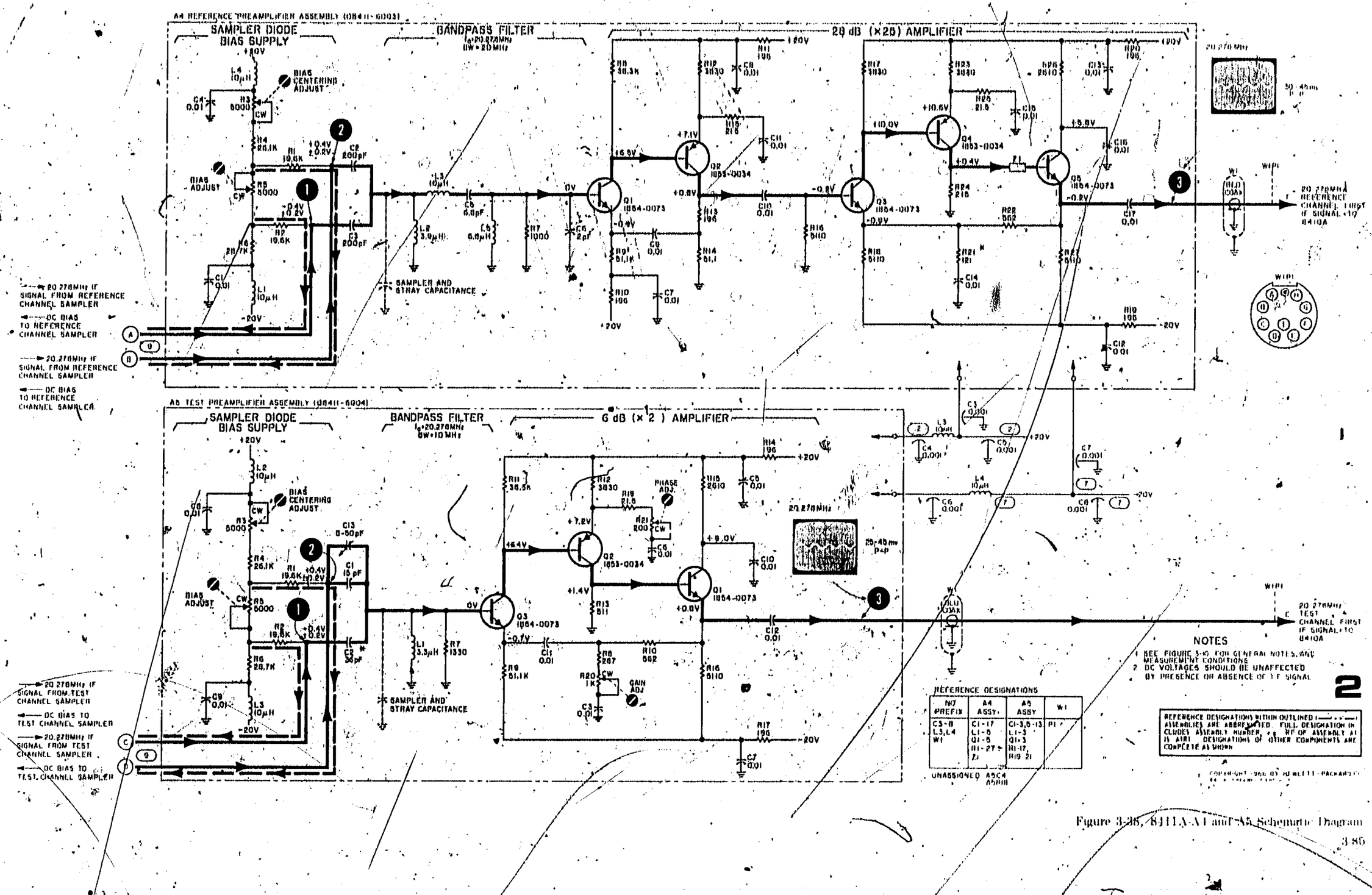


Figure 3-25. 8411A-A4 and -A5 Schematic Diagram

Variable gain amplifier A6Q1 converts the error-voltage range produced by the 8410A phase-lock section to the range required to tune the VTO in the range of 65 to 155 MHz. The network composed of A6R1 through A6R5 and A6CR1 through A6CR4 in the emitter circuit of A6Q1, shapes the output voltage characteristics so that the VTO tunes linearly with changing input voltage to A6. This allows the voltage-tuned-oscillator frequency to track with the RF input signal at the 8411A, obtaining the most stable phase-lock during swept-frequency operation. A6R6 affects the high-frequency section, A6R7 affects the mid-frequency section, and A6R8 affects the low-frequency section. A6CR8 sets the upper VTO frequency limit by clamping the maximum negative tuning voltage to the voltage set at A6R16.

The voltage-tuned oscillator (VTO), A7Q1 and A7Q2 is a free-running multivibrator with a frequency range of 65 to 155 MHz. The frequency of the multivibrator is controlled by voltage-variable capacitive diodes, A7CR1 and A7CR2. DC control voltage from collector of A6Q1 is applied to the junction of A7CR1 and A7CR2, providing voltage control of the oscillator frequency. Increasing the reverse bias applied to A7CR1 and A7CR2 reduces the capacitance of the diodes, thus increasing the frequency of the multivibrator.

With an input control voltage of approximately +6.5 Vdc from the collector of A6Q1, A7R5 is adjusted for an oscillator frequency of 65 MHz. A7R3 is adjusted to clamp the upper-voltage limit of the control-voltage line to a voltage (approximately +6.6 Vdc) that limits the lowest frequency of the VTO to 62 ±1 MHz. The upper frequency VTO limit of 164 ±1 MHz is controlled through clamping-diode A6CR8 and A6R16.

Figure 3-39. 8411A-A6 and A7 Talking Schematic

8411A-A6 SHAPING AMPLIFIER AND 8411A-A7 VOLTAGE TUNED OSCILLATOR

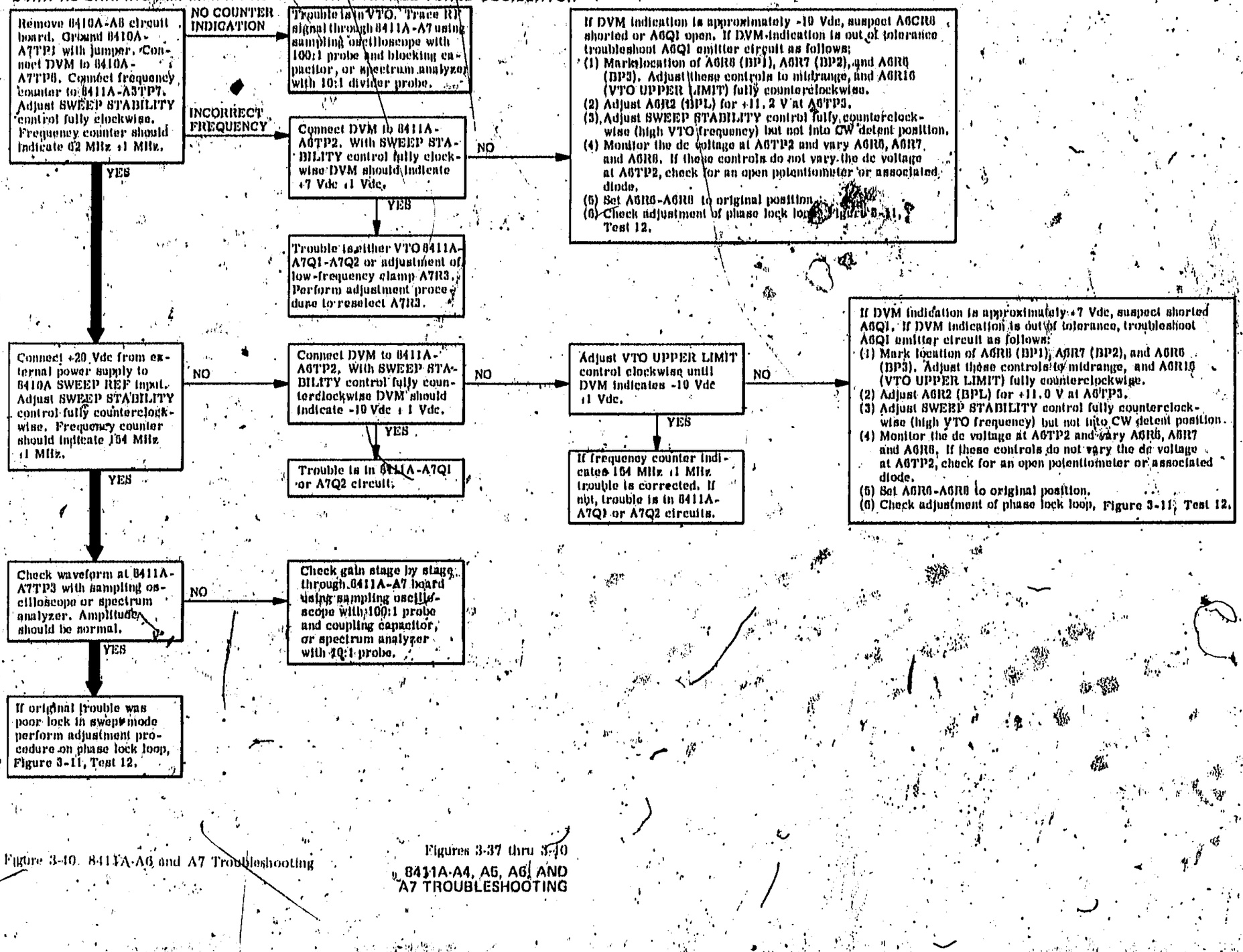


Figure 3-40. 8411A-A6 and A7 Troubleshooting

Figures 3-37 thru 3-40
8411A-A4, A5, A6, AND A7 TROUBLESHOOTING

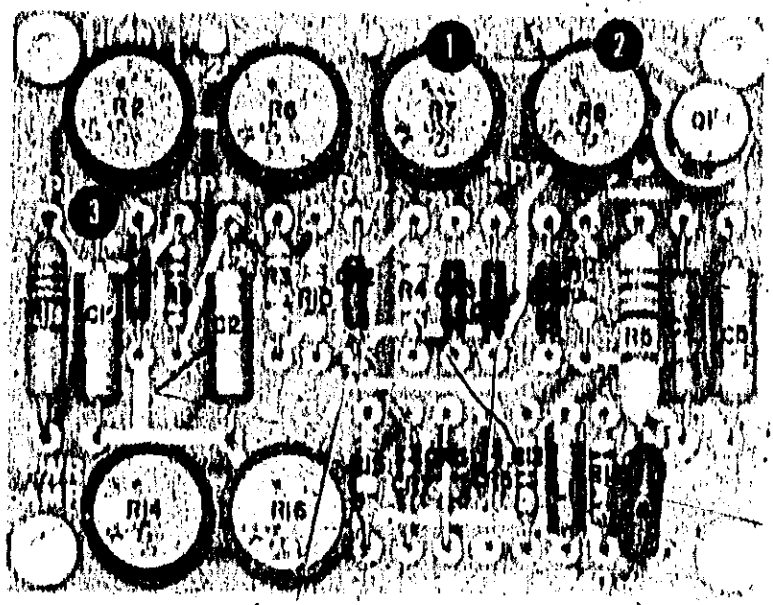
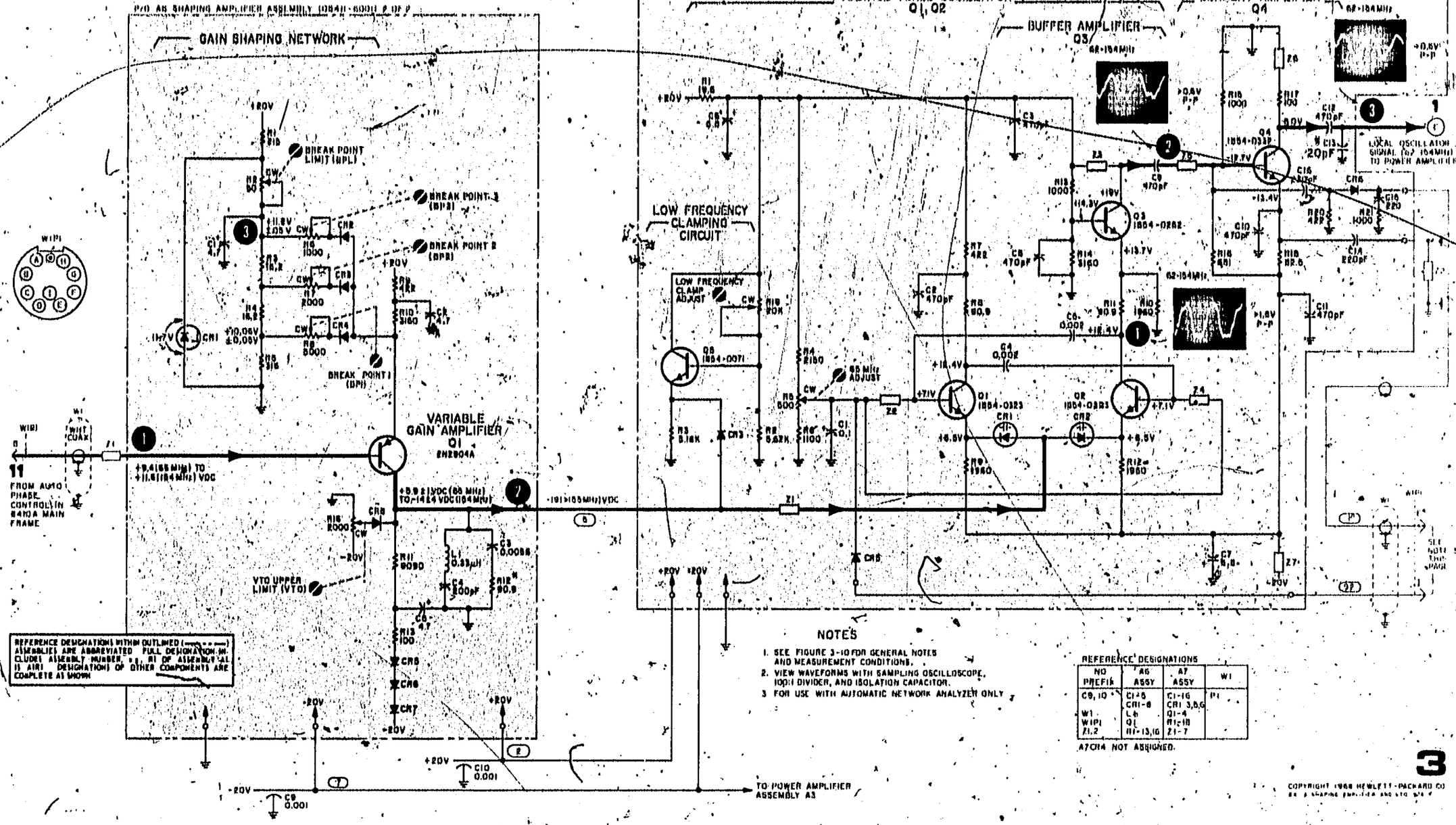


Figure 3-11. 8411A-A6 and A7 Parts Location



NOTES

1. SEE FIGURE 3-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS.
2. VIEW WAVEFORMS WITH SAMPLING OSCILLOSCOPE, 100:1 DIVIDER, AND ISOLATION CAPACITOR.
3. FOR USE WITH AUTOMATIC NETWORK ANALYZER ONLY

REFERENCE DESIGNATIONS

NO PREFIX	A6 ASSY	A7 ASSY	W1
C9, 10	C1-5	C1-16	P1
W1	CR1-6	CR1 3,5,6	
W1P1	L5	Q1-4	
J1,2	Q1	R1-18	
	R1-13,16	Z1-7	

A7CR4 NOT ASSIGNED.

Figure 3-42. 8411A-A6 and A7 Schematic Diagram

8410A-A12 TEST AND 8410A-A14 REFERENCE 20.278 MHz IF AMPLIFIERS

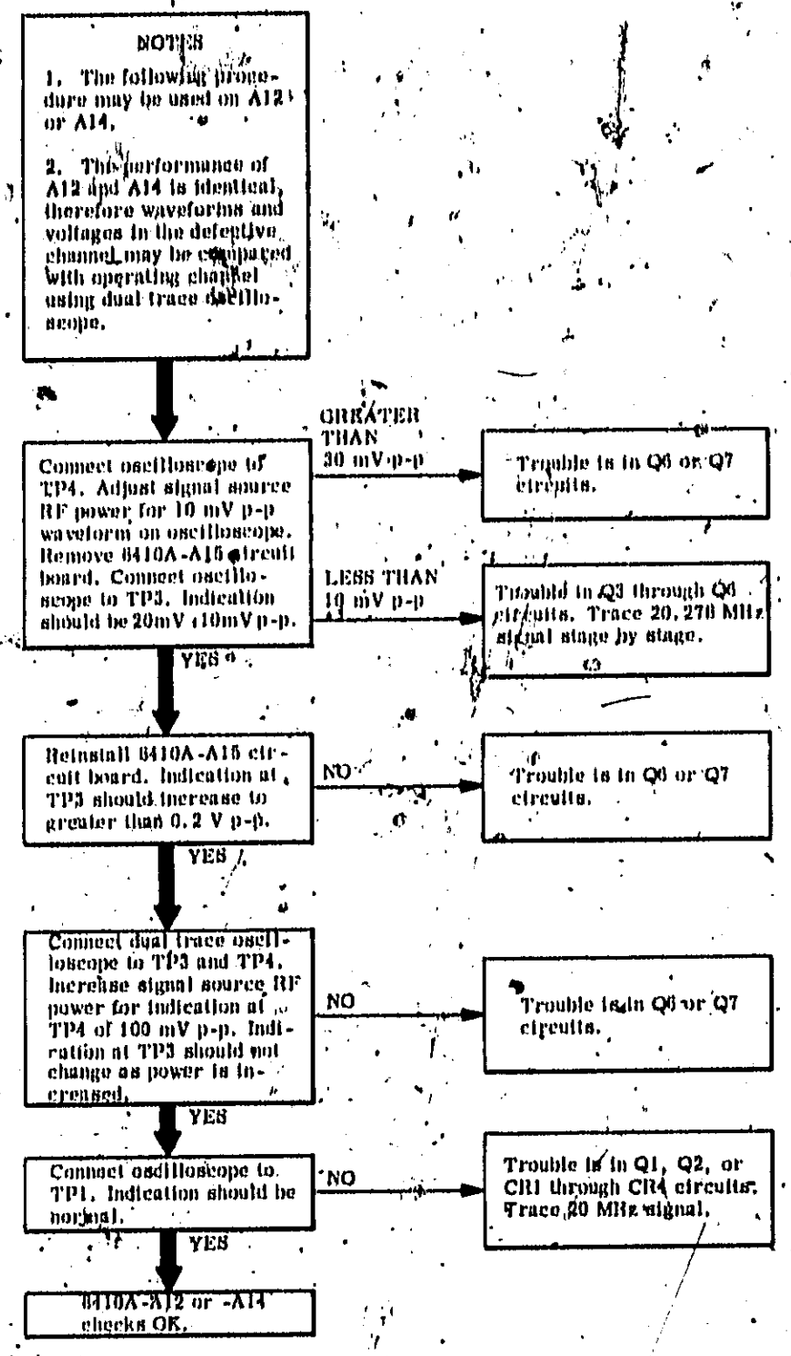
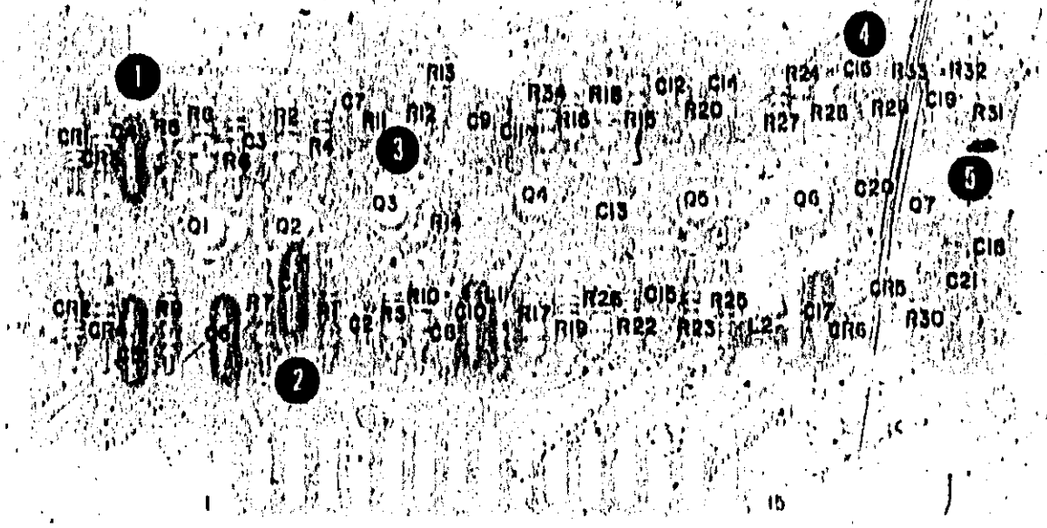


Figure 3-4d. 8410A-A12 and A14 Troubleshooting



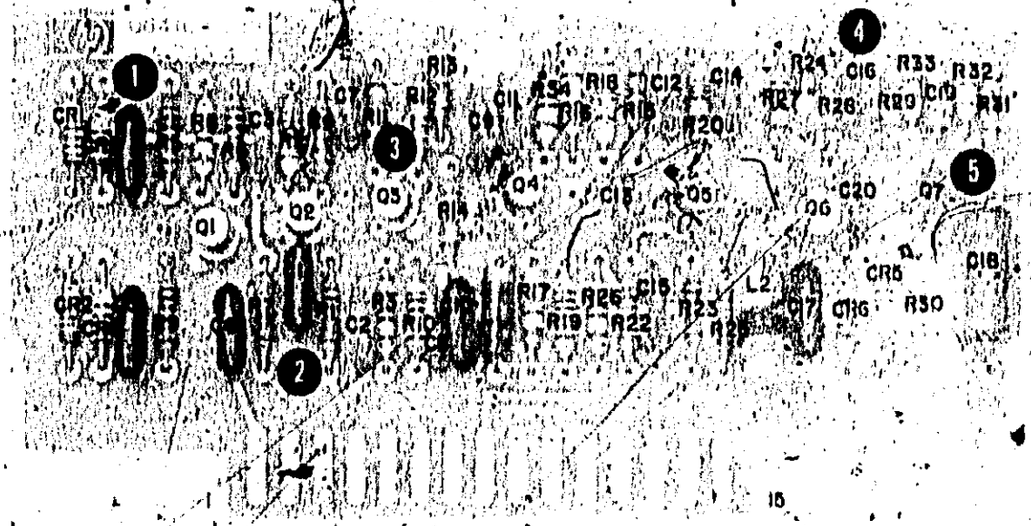


Figure 3-46. 8410A-A12 and A14 Parts Location

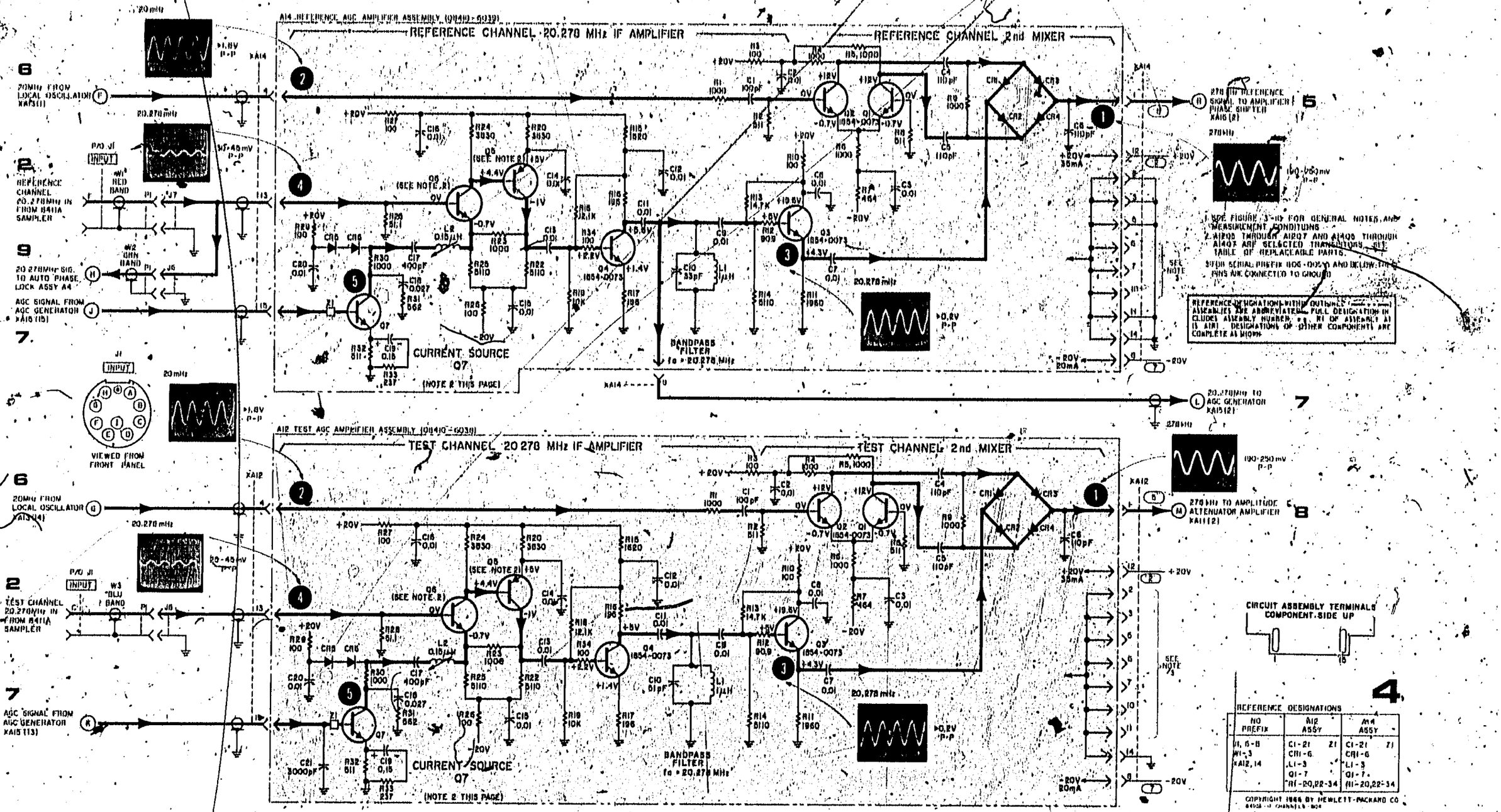


Figure 3-46. 8410A-A12 and A14 Schematic Diagram

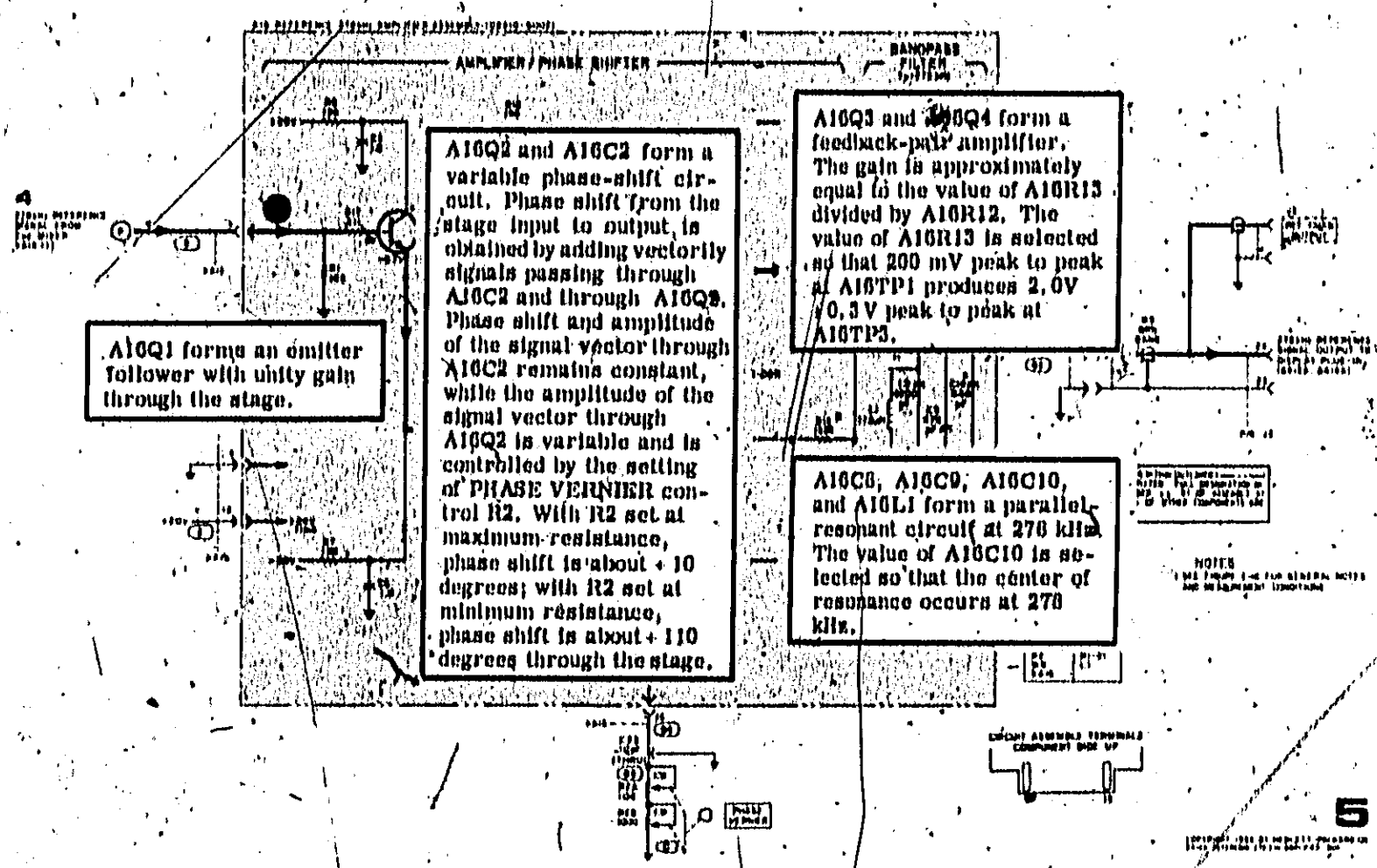


Figure 3-47. 8410A-A16 Talking Schematic

8410A-A16 REFERENCE 270 KHZ AMPLIFIER

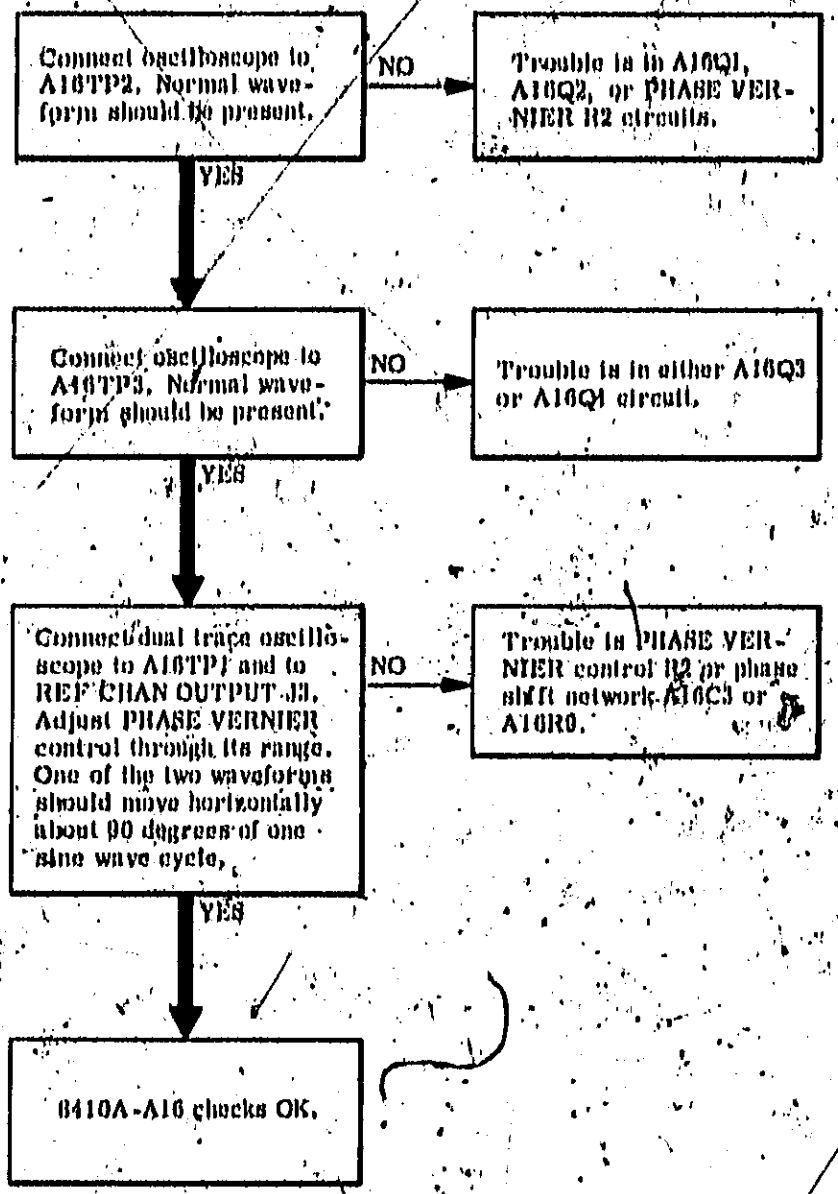


Figure 3-48. 8410A-A16 Troubleshooting

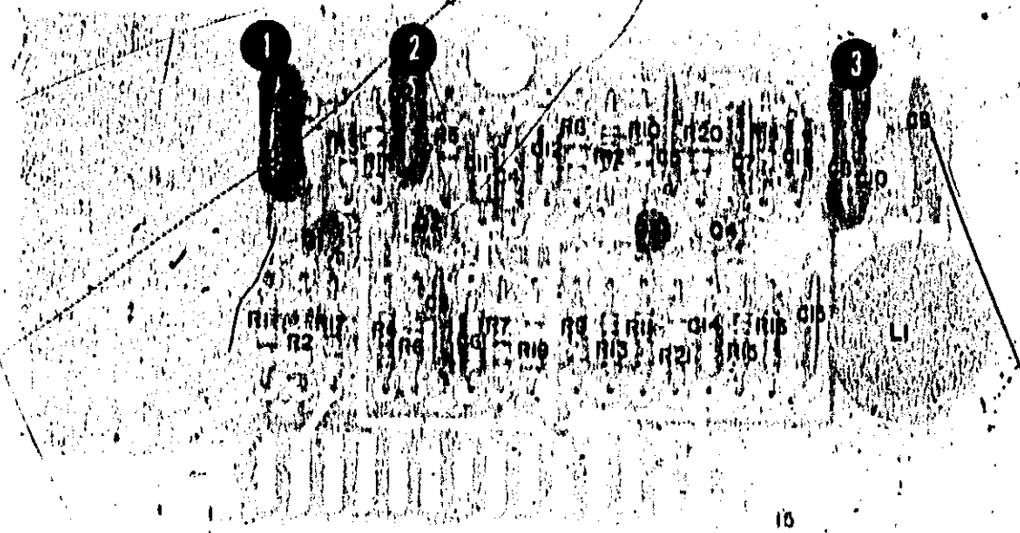


Figure 3-49. 8410A-A16 Parts Location

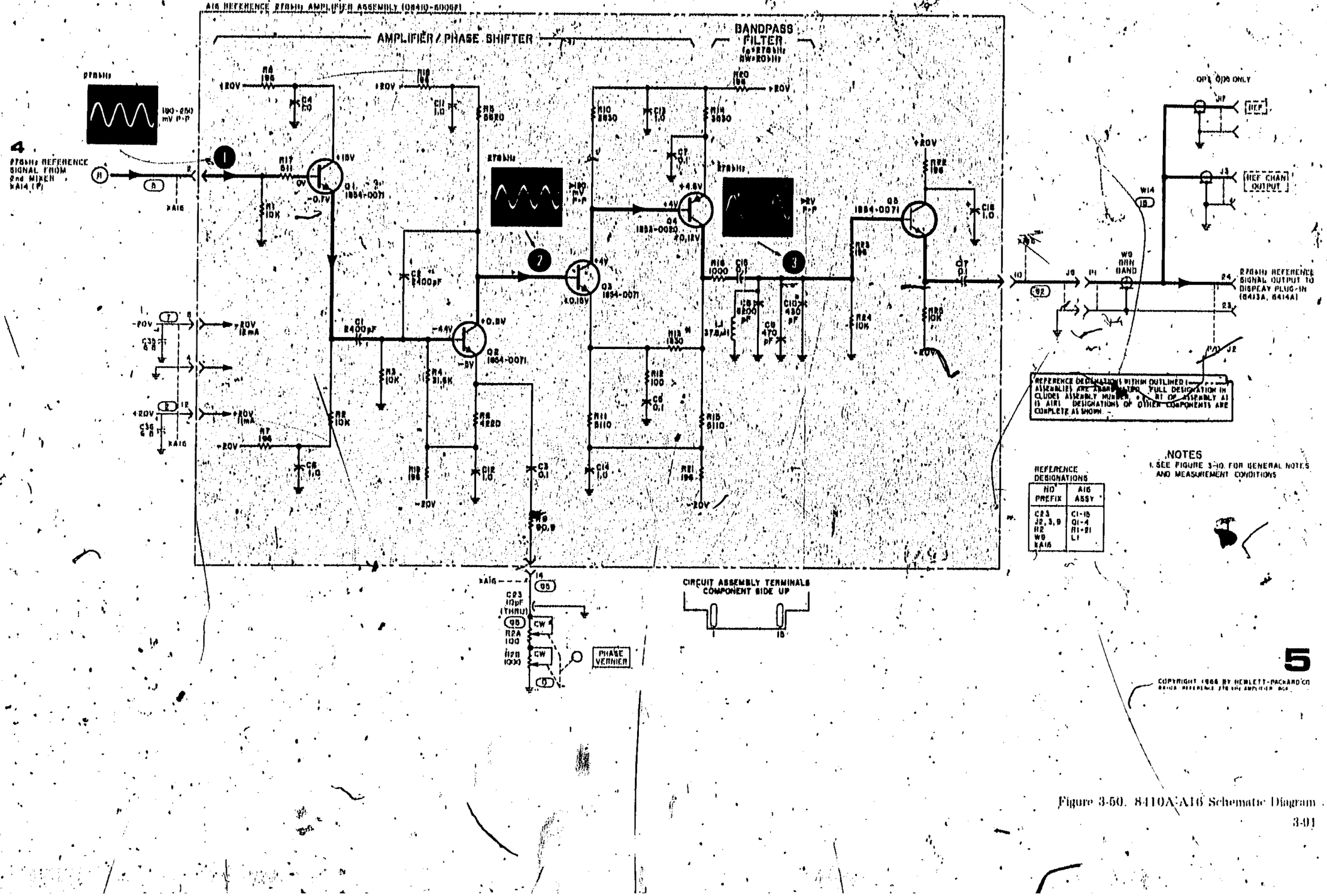


Figure 3-50. 8410A A16 Schematic Diagram

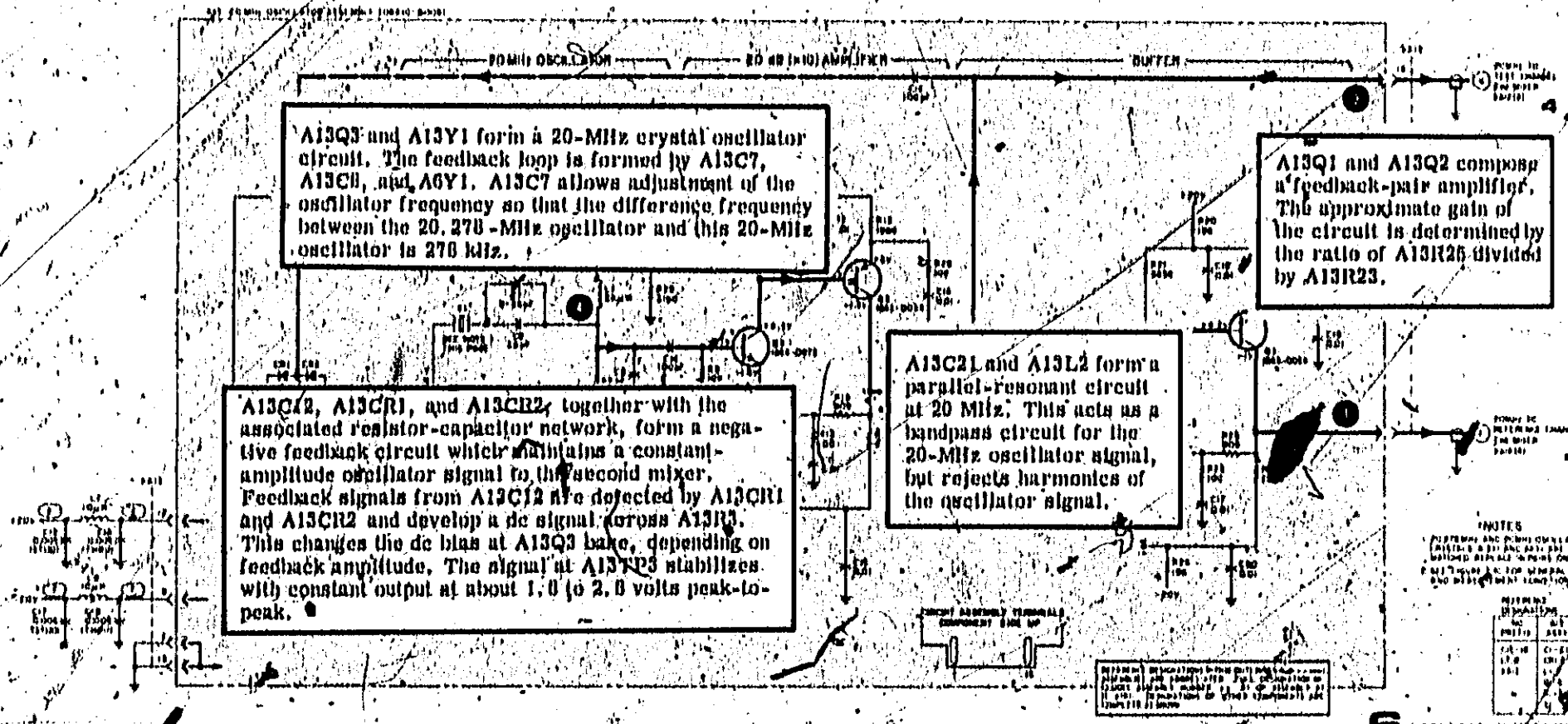


Figure 3-61. 8410A-A13 Talking Schematic

8410A-A13 20-MHZ OSCILLATOR-BUFFER

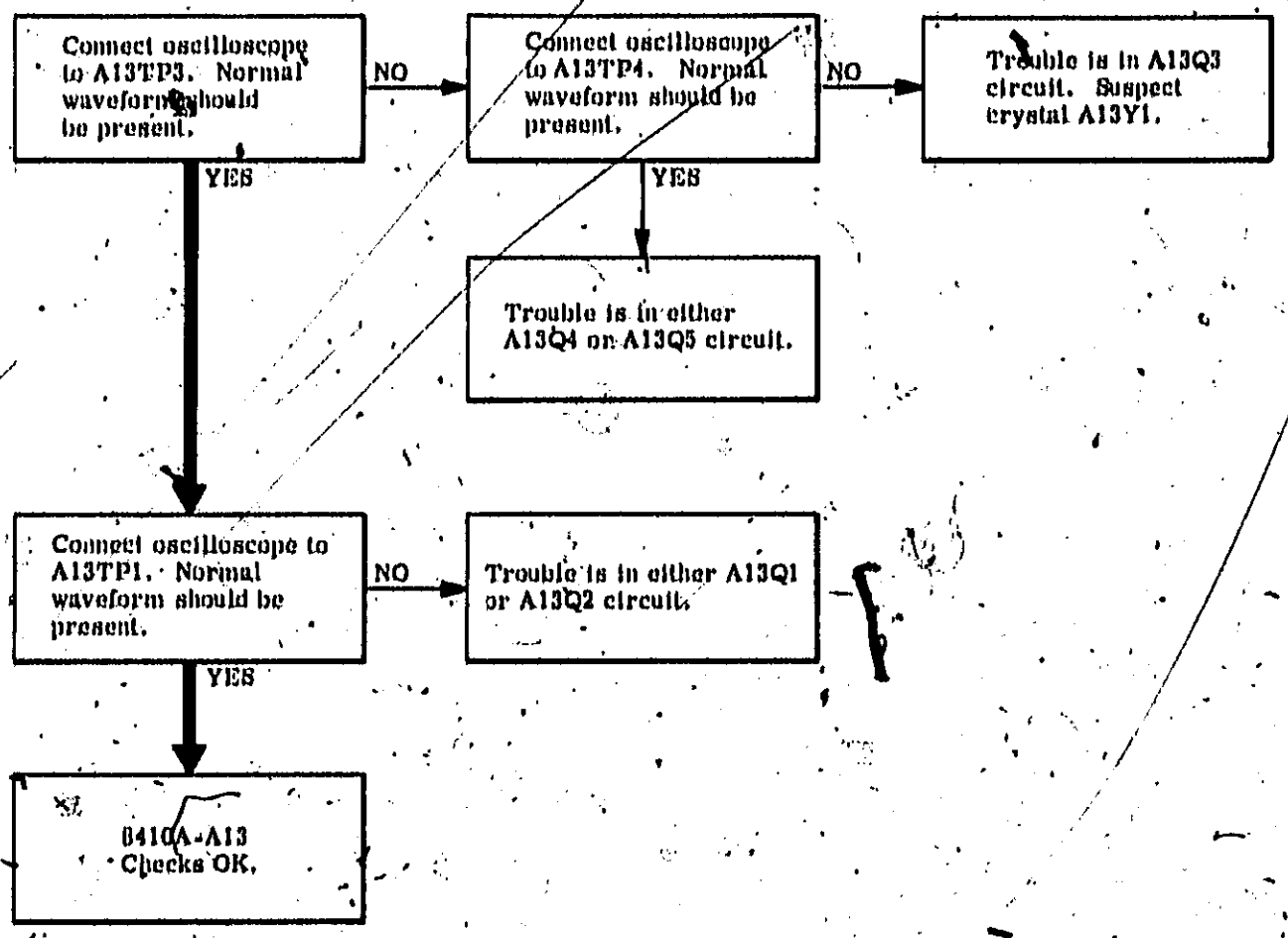


Figure 3-52. 8410A-A13 Troubleshooting

Figures 3-49 thru 3-52
8410-A1[illegible]AND
A16 TROUBLESHOOTING

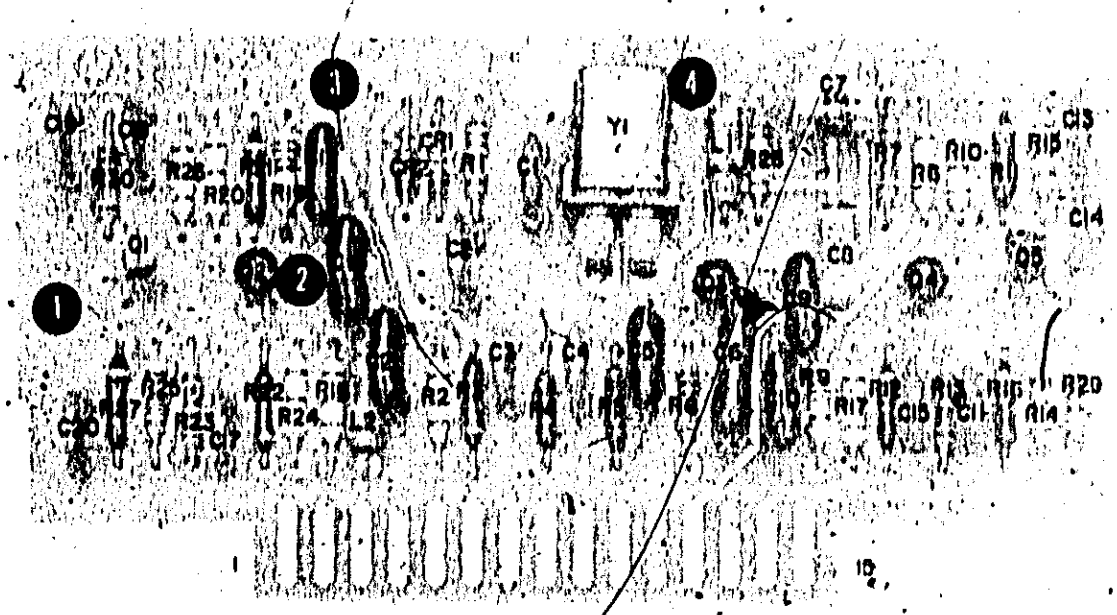


Figure 3-53. 8410A-A13 Parts Location

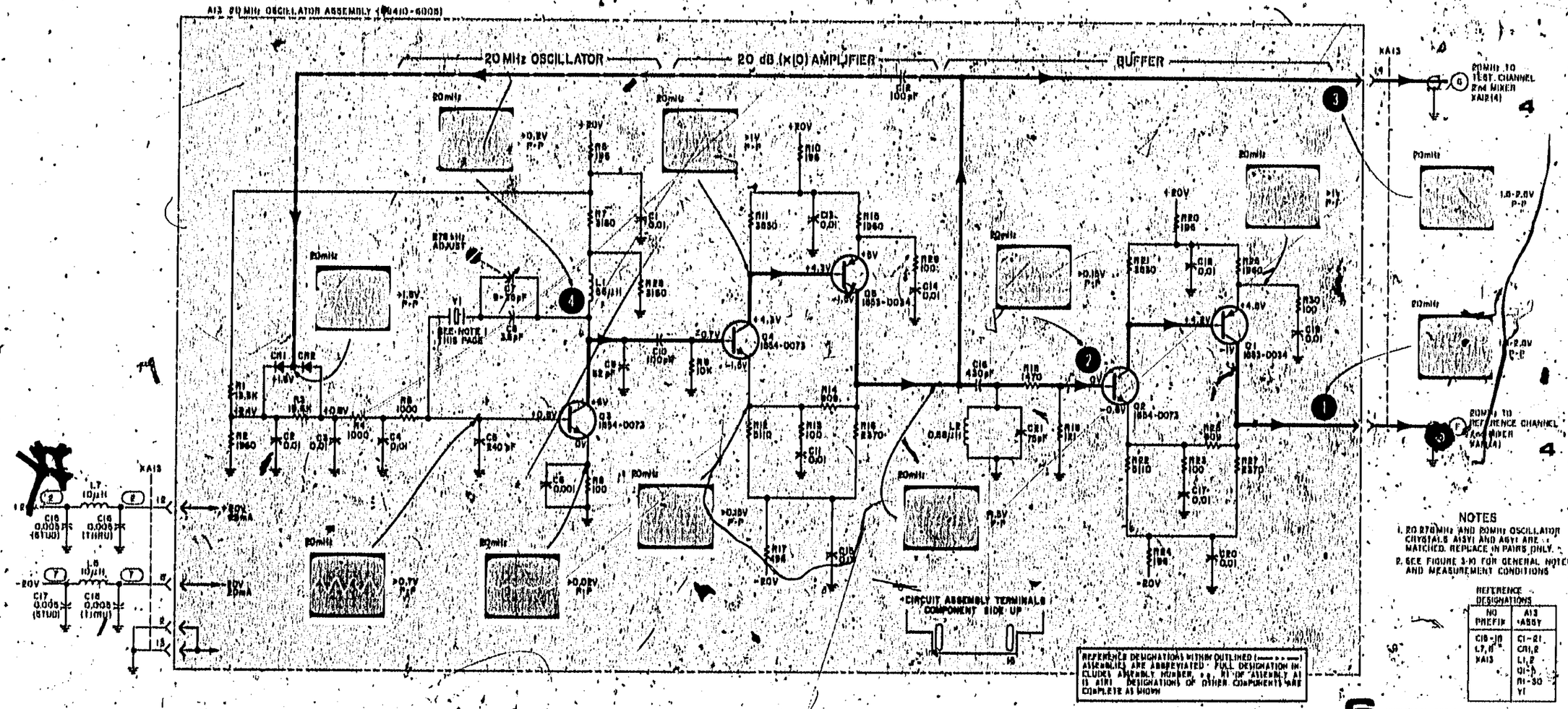


Figure 3-54. 8410A-A13 Schematic Diagram

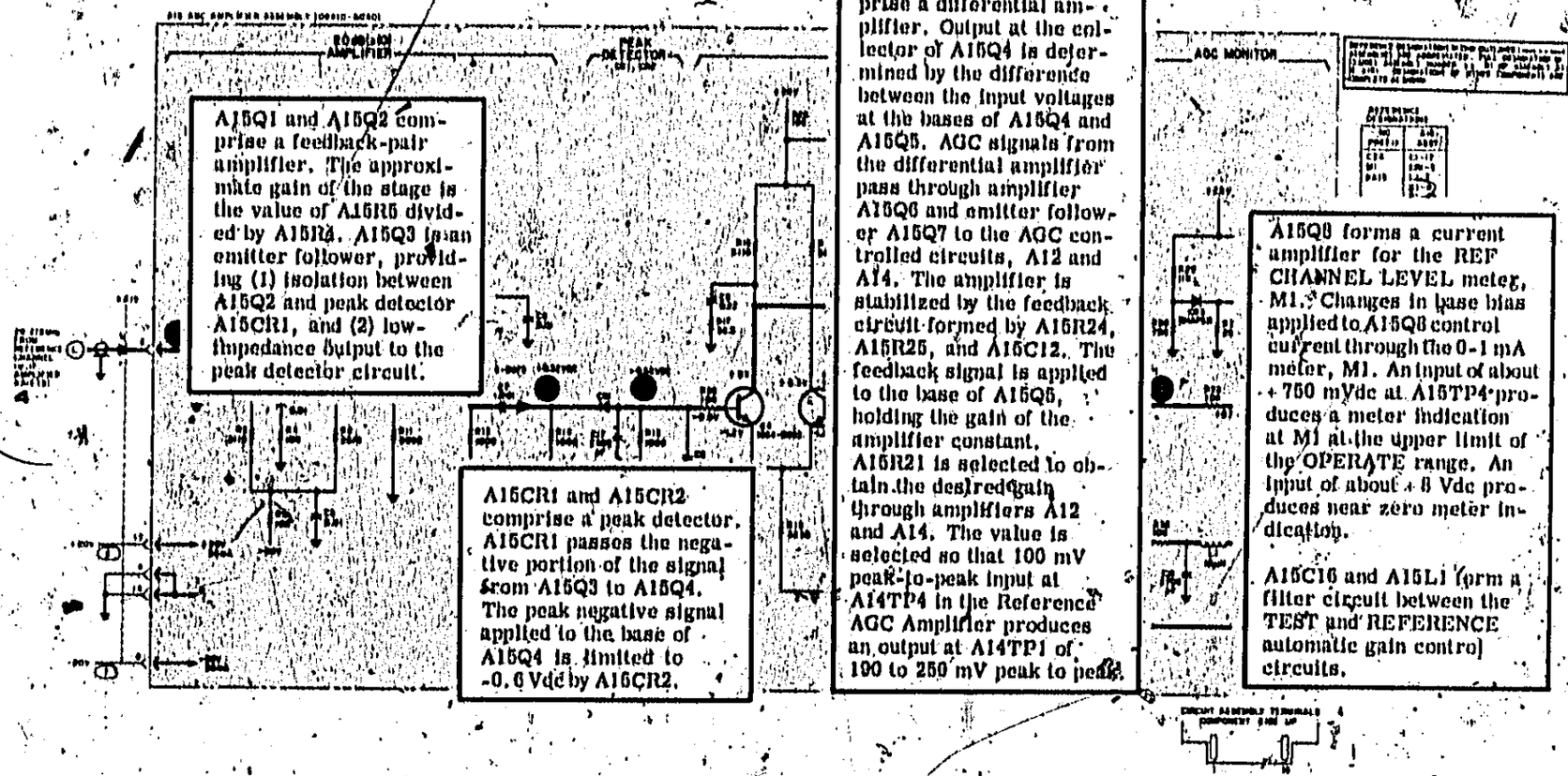


Figure 3-55. 8410A-A15 Talking Schematic

8410A-A15 AGC AMPLIFIER

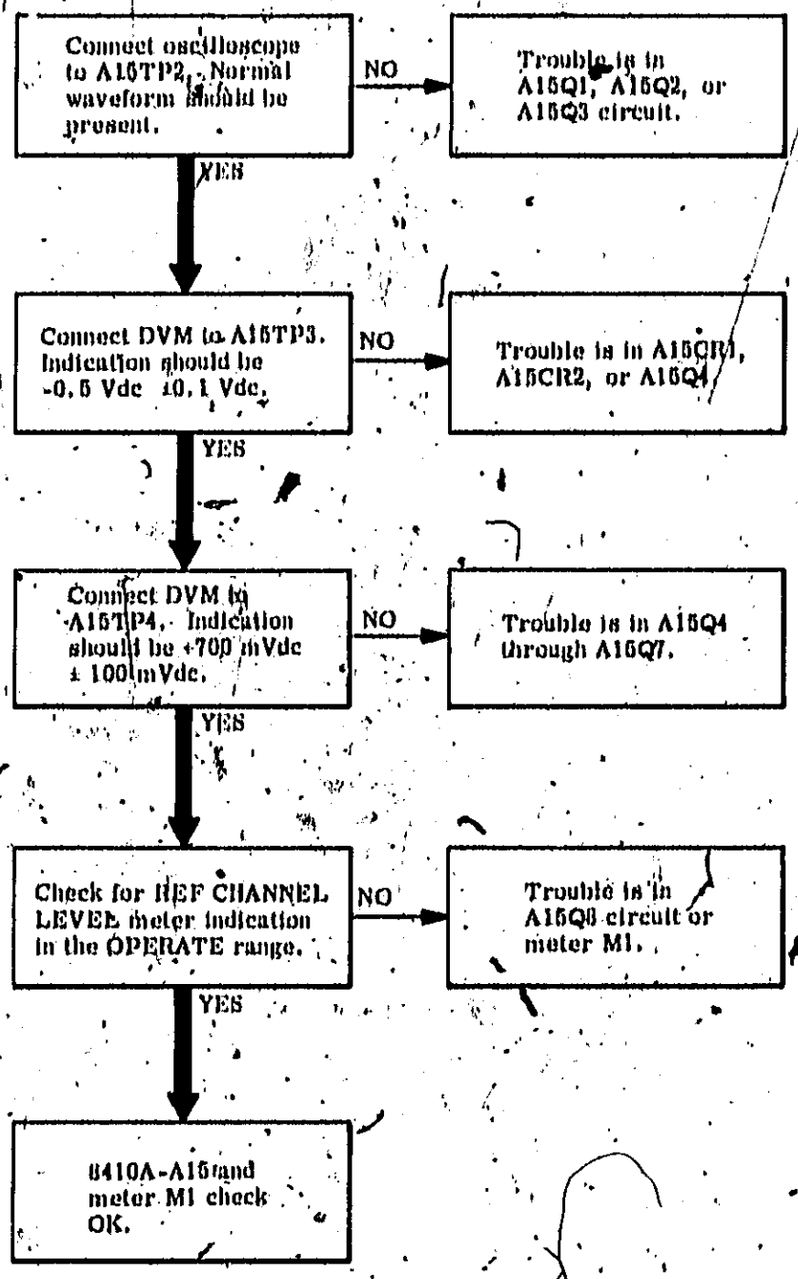
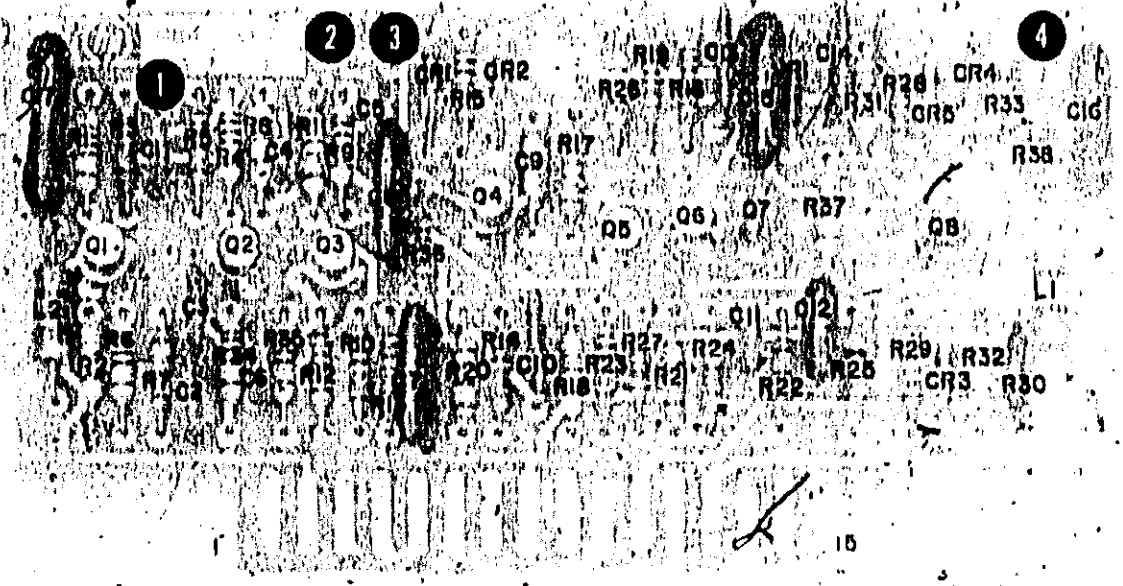


Figure 3-56. 8410A-A15 Troubleshooting

es 3-53 thru 3-56
8410A-A13 AND
UBLESHOOTING

SCHEMATIC DIAGRAMS CON'T



NOTE

For A15 Assemblies with HP Part No. 08410-6040 revision B, Q1 and Q5 have been replaced with a dual transistor (Q1A, B).

Figure 8-57. 8410A-A15 Parts Location

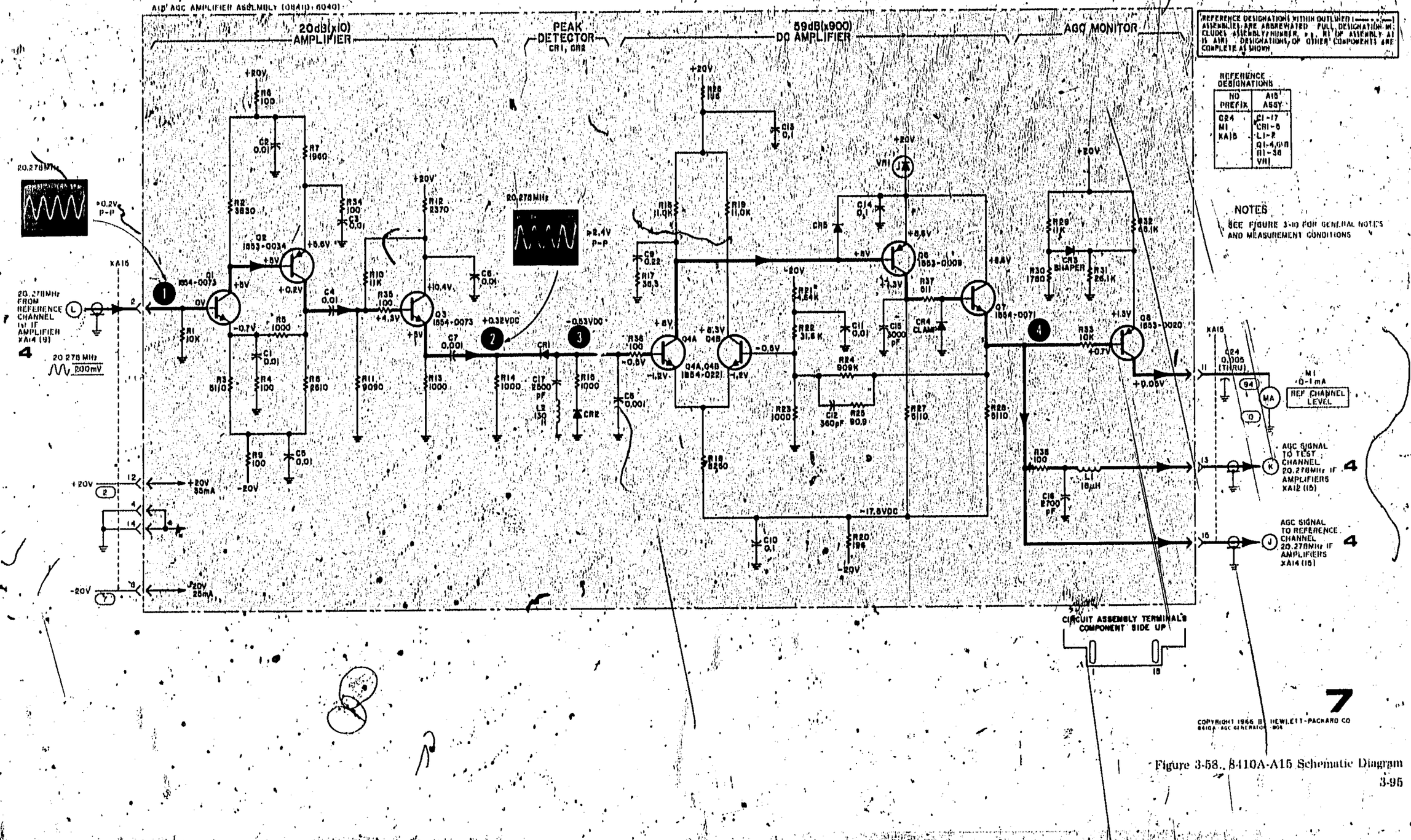


Figure 3-58. 8410A-A15 Schematic Diagram

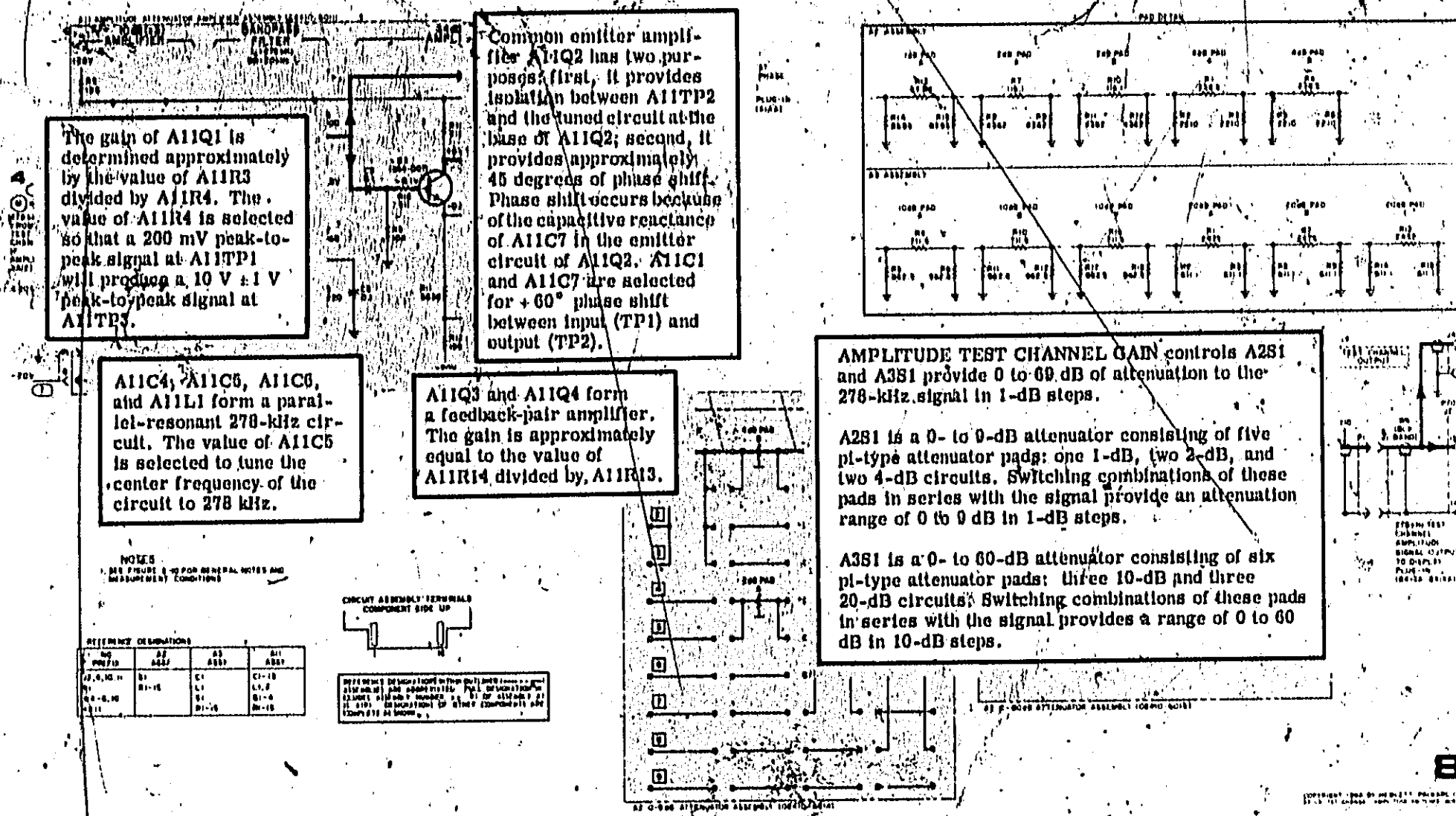


Figure 3-59. 8410A-A11 Talking Schematic

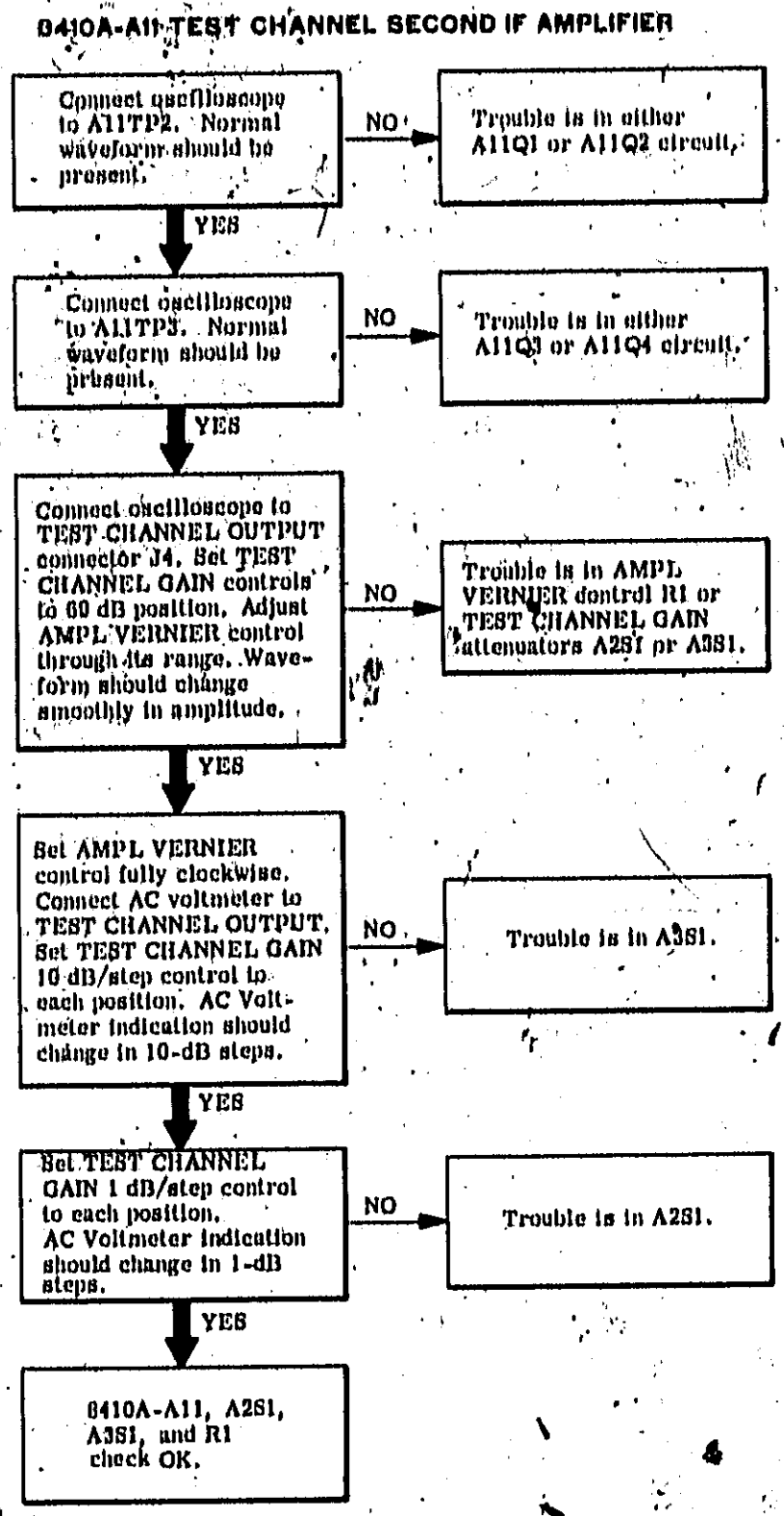
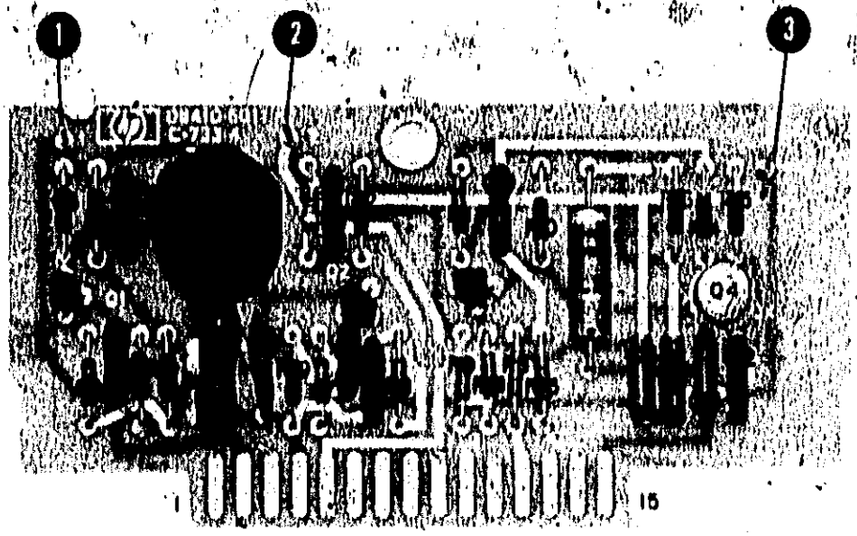


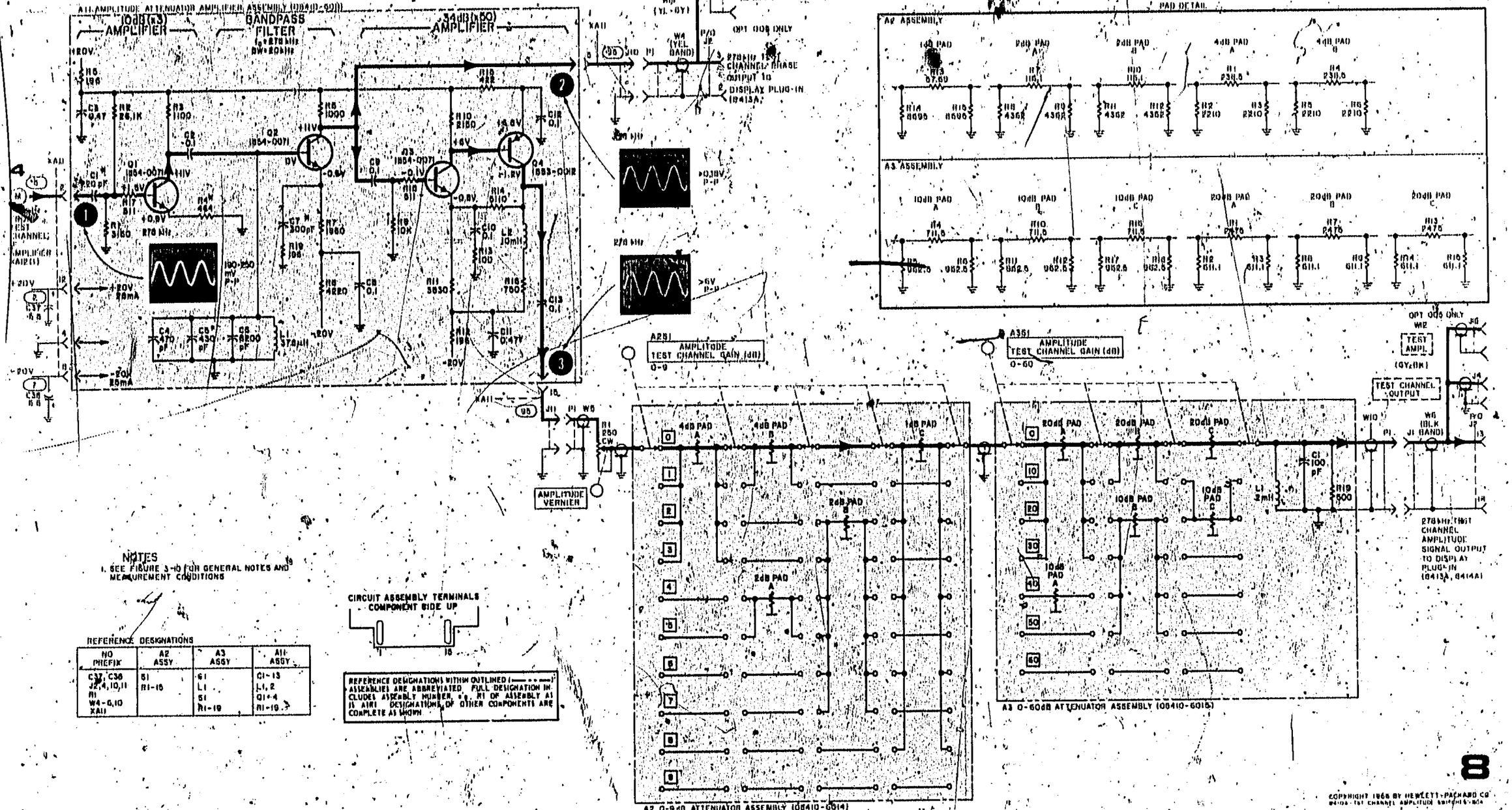
Figure 3-60. 8410A-A11 Troubleshooting

Figures 3-57 thru 3-60
8410A-A11 AND
A15 TROUBLESHOOTING



A11

Figure 3-61. 8410A-A11 Parts Location



NOTES
1. SEE FIGURE 3-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS

REFERENCE DESIGNATIONS

NO PREFIX	A2 ASSY	A3 ASSY	A11 ASSY
C37, C38	S1	S1	C1-13
J2,4,10,11	R1-15	L1	L1, 2
R1		S1	Q1-4
W4-6,10		R1-19	R1-19
XA11			

CIRCUIT ASSEMBLY TERMINALS COMPONENT SIDE UP

REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Figure 3-62. 8410A-A11 Schematic Diagram

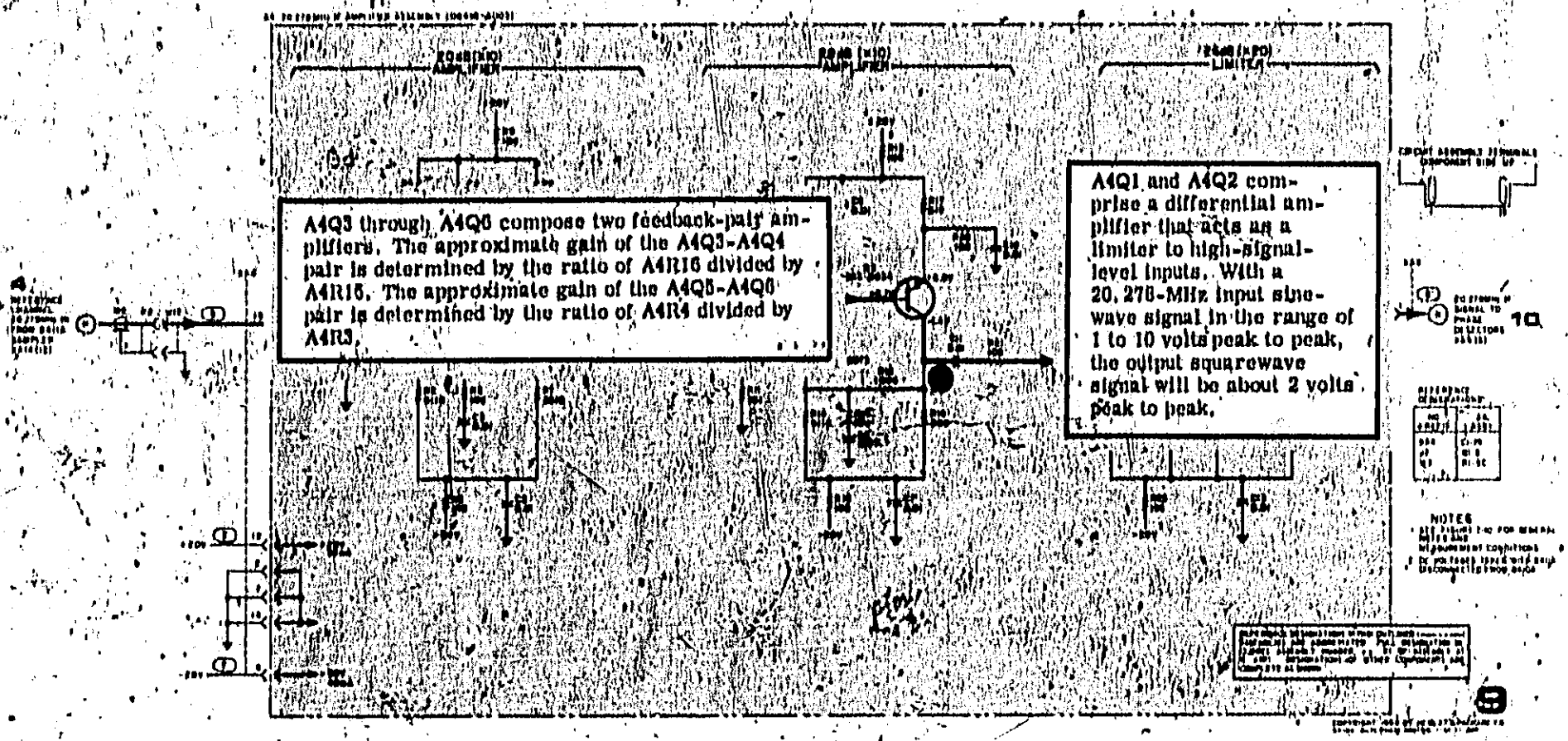


Figure 3-63. 8410A-A4 Talking Schematic

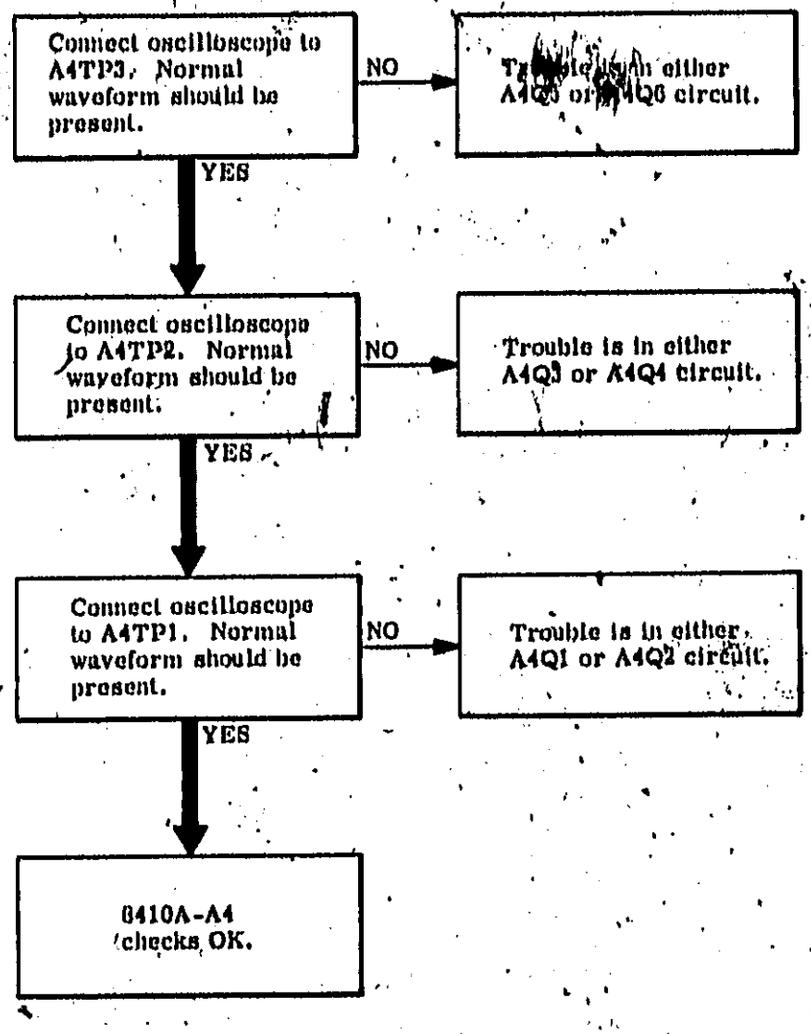


Figure 3-64. 8410A-A4 Troubleshooting

Figures 3-61 thru 3-64
8410A-A4 AND
A11 TROUBLESHOOTING

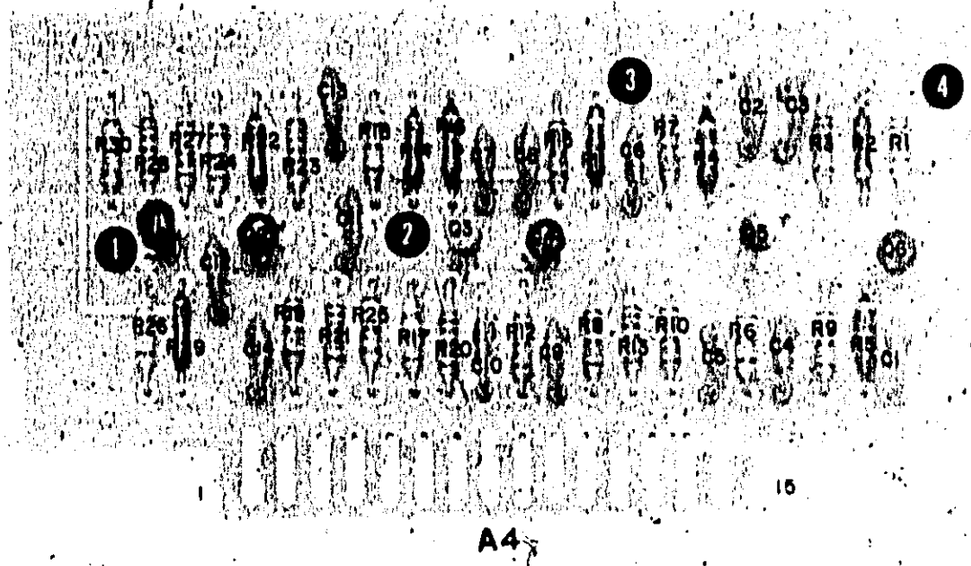


Figure 3-65. 8410A-A4 Parts Location

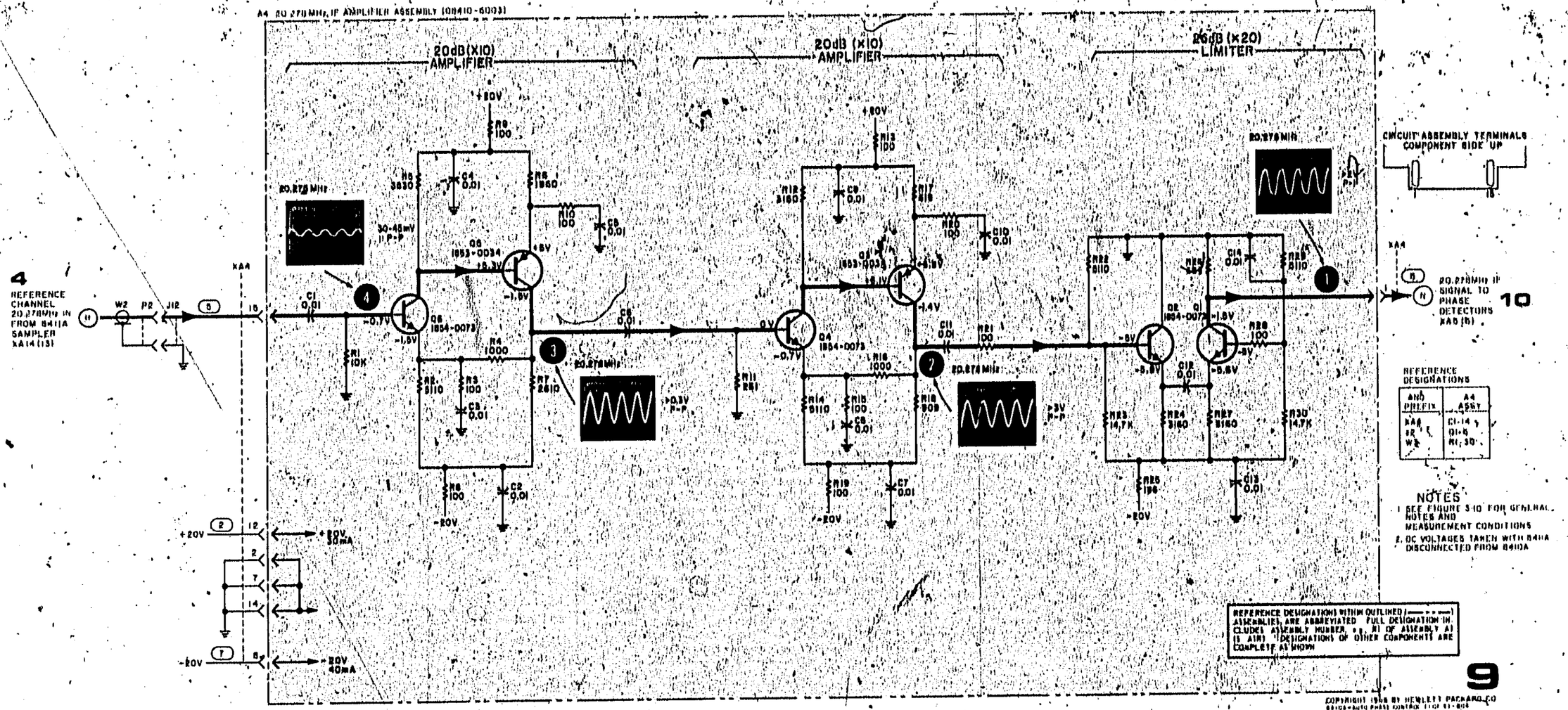


Figure 3-66. 8410A-A4 Schematic Diagram

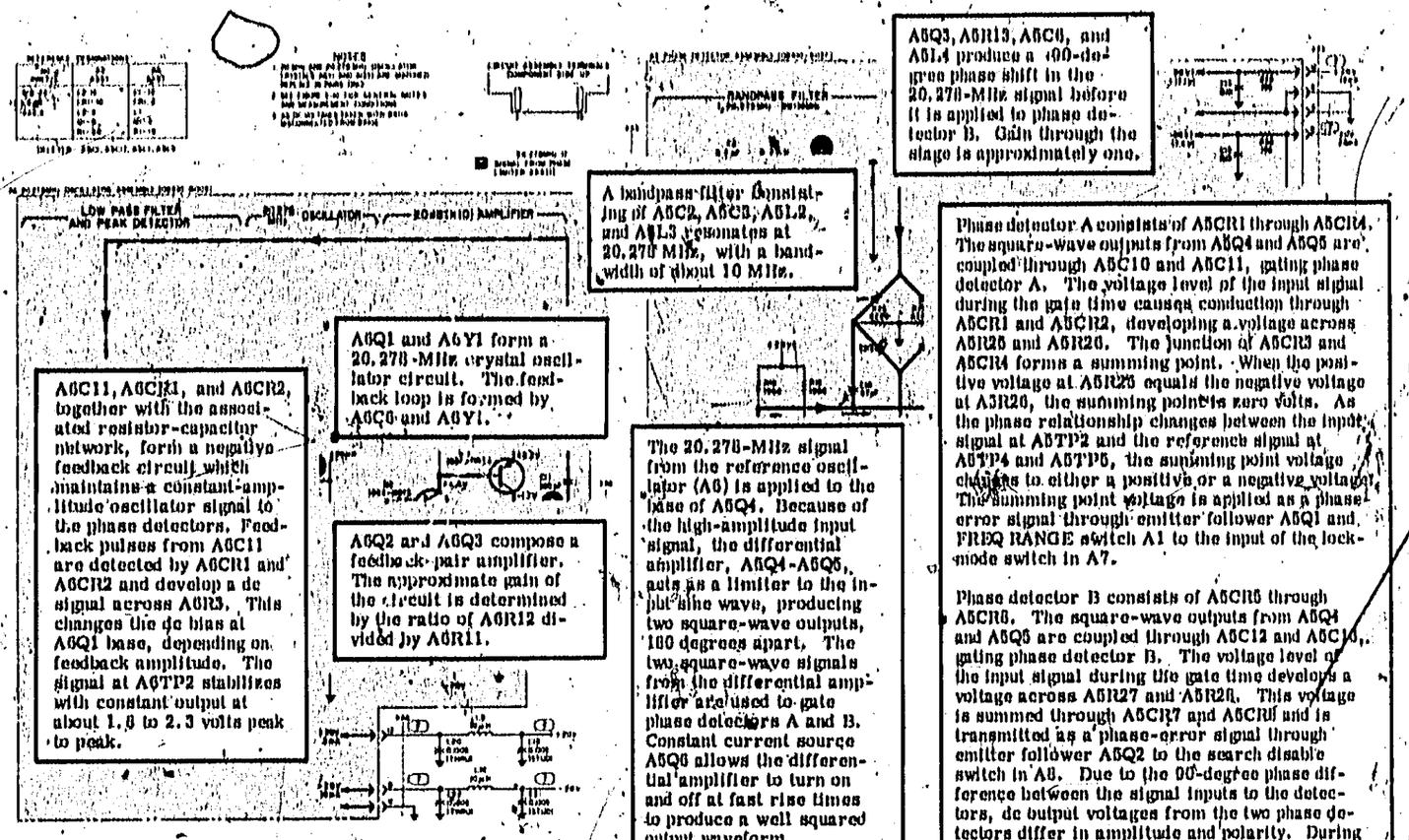
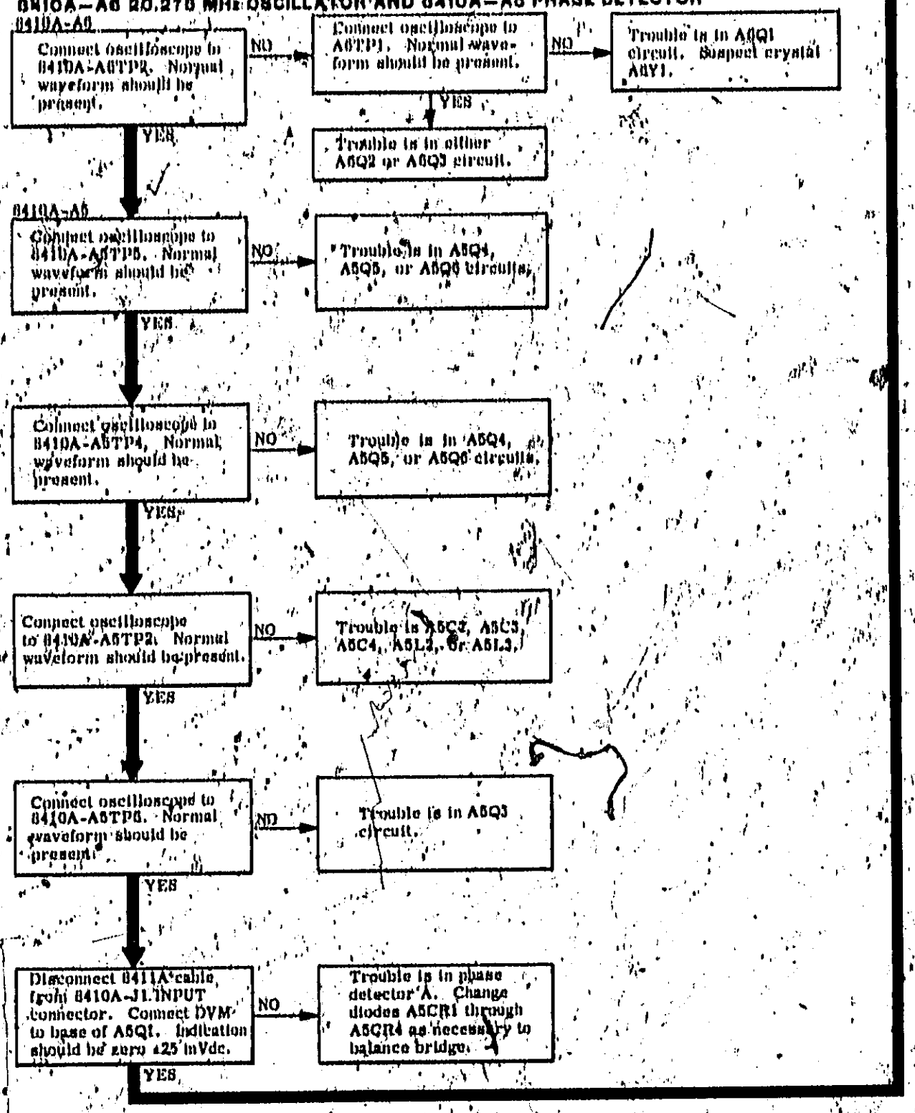
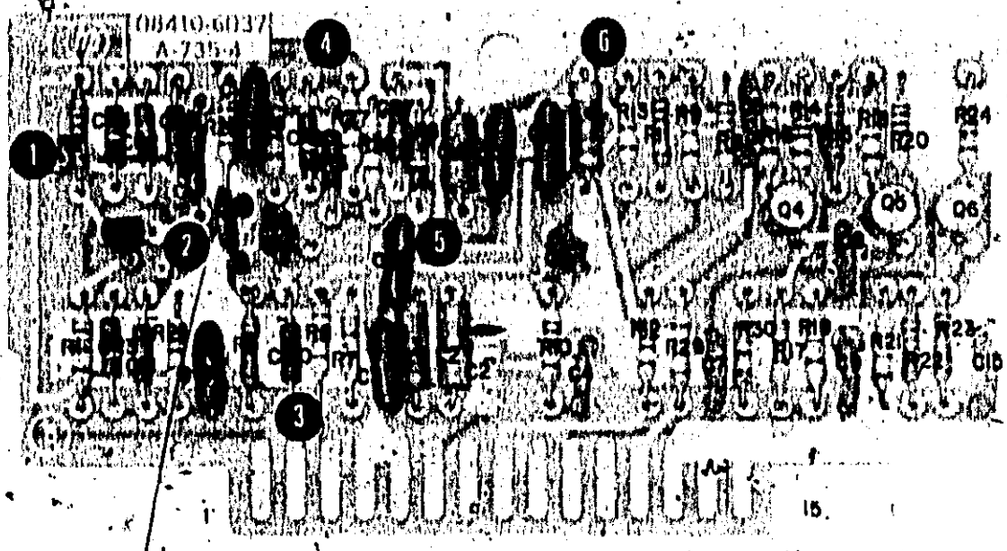


Figure 3-67. 5410A-A5 and A6 Talking Schematic



Figures 3-65 thru 3-68
8410A A4, A5, AND A6 TROUBLESHOOTING

Figure 3-68. 8410A-A5 and A6 Troubleshooting



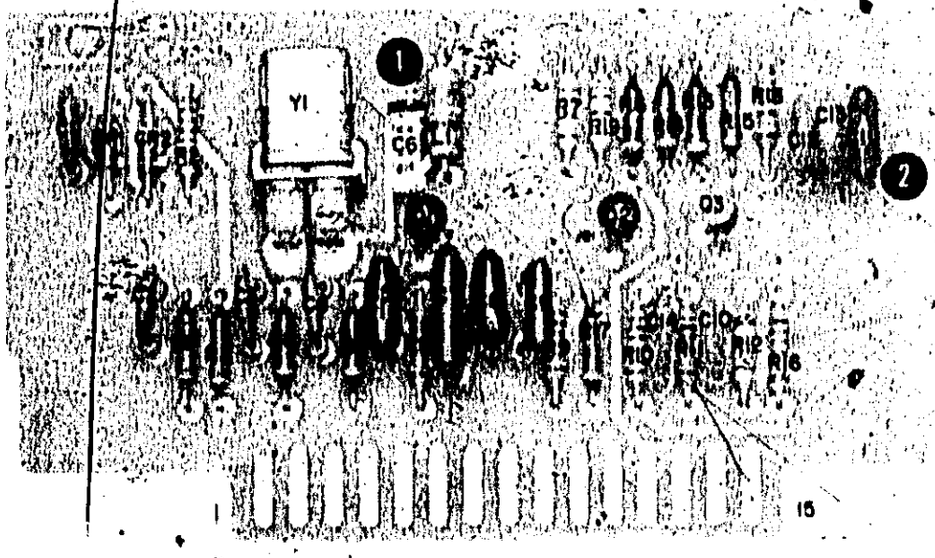


Figure 3-69. 8410A-A5 and A6 Parts Location

REFERENCE DESIGNATIONS

NO PREFIX	A5 ASSY	A6 ASSY
C19-22,34 L9,10 XA5,6	C2-16 CR1-10 L2-4 Q1-5 R1-30	C1-14 CR1, 2 L1 Q1-3 R1-19

DELETED: A5C1, A5C17, A5L1, A5L5

NOTES

1. 20 MHz AND 20.278 MHz OSCILLATOR CRYSTALS A5Y1 AND A5Y2 ARE MATCHED. REPLACE IN PAIRS ONLY.
2. SEE FIGURE 3-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS.
3. A5 DC VOLTAGES TAKEN WITH R41A DISCONNECTED FROM 8410A

CIRCUIT ASSEMBLY TERMINALS COMPONENT SIDE UP

A6 20.278MHz OSCILLATOR ASSEMBLY (08410-6008)

LOW PASS FILTER AND PEAK DETECTOR — 20.278 MHz OSCILLATOR — 20dB (x10) AMPLIFIER

A5 PHASE DETECTOR ASSEMBLY (08410-6057)

BANDPASS FILTER fo 20.278MHz BW=10MHz — +90° PHASE SHIFTER

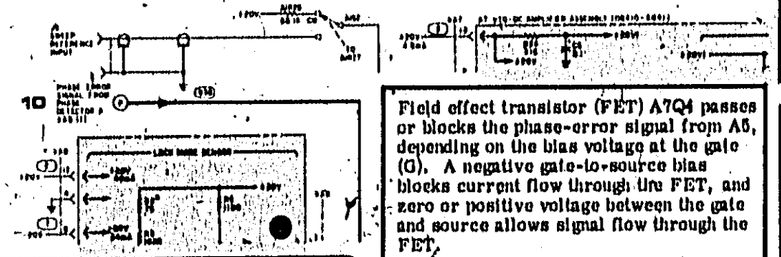
PHASE DETECTOR A — PHASE DETECTOR B — EMITTER FOLLOWER Q2 1854-0071 — EMITTER FOLLOWER Q1 1854-0071 — CONSTANT CURRENT SOURCE Q6 1854-0073 — PHASE DETECTOR DRIVER

20.278MHz IF SIGNAL FROM PHASE LOCK LIMITER XA4(1)

PHASE ERROR SIGNAL TO SEARCH SECTION XA8(1)

PHASE ERROR SIGNAL TO FREQ RANGE SW. A1S1

Figure 3-70. 8410A-A5 and A6 Schematic Diagram



The correct phase-lock condition is obtained when the system locks to a VTO harmonic that is 20.278 MHz higher in frequency than the input RF signal from the signal source. If the phase-lock loop attempts to lock on a VTO harmonic below the input RF frequency, an incorrect lock mode is detected, and the search mode continues until a new lock point is found. This is accomplished as follows. Phase detector B in A5 produces a positive dc voltage which triggers Schmidt trigger A8Q1-A8Q2. The output of A8Q2 turns off A7Q3 which, in turn, turns off lock-mode switch A7Q4. This opens the phase-lock loop and allows the search sequence to continue until the proper VTO harmonic is found. Trigger and reset points for A8Q1-A8Q2 are adjusted by selecting the value of A8R2. The circuit should trigger and reset with input voltages in the range of 135 to 215 mV.

When the phase-lock loop locks in the correct mode, phase detector B of A5 produces a negative signal which triggers and holds Schmitt trigger A8Q8-A8Q9. With A8Q9 turned off, A8Q10 turns on and clamps A8Q5 collector near ground, stopping the search signal generator from oscillating.

The value of resistor A8R39 is selected to ensure that the turn-on and reset potentials for A8Q8 are between -150 and -200 mVdc.

Field effect transistor (FET) A7Q4 passes or blocks the phase-error signal from A5, depending on the bias voltage at the gate (G). A negative gate-to-source bias blocks current flow through the FET, and zero or positive voltage between the gate and source allows signal flow through the FET.

When an incorrect lock mode is sensed, a +10 Vdc signal is applied to the base of A7Q3. This (1) turns off A7Q3, biasing off A7Q4, and breaking the phase-lock loop; and (2) turns on A7Q1 and A7Q2, clamping to ground the base circuit of A7Q6 through A7Q2.

When the phase-lock loop looses lock, a positive-going pulse from the collector of A8Q9 passes through A7C1 to the bases of A7Q1 and A7Q3, causing A7Q1 to turn on and A7Q3 to turn off. This turns A7Q2 on and turns A7Q4 off. The effect is to ground A7Q6 base, establishing a center frequency for the VTO search, depending on the setting of the SWEEP STABILITY control.

A8Q3-A8Q7 form the search-signal generator. A feedback loop from the output of A8Q6-A8Q7 passes through emitter follower A8Q3 and triggers Schmitt Trigger A8Q4-A8Q5, initiating another cycle of search signal. The output of the Schmitt Trigger is amplified by A8Q6-A8Q7. The sawtooth waveform is formed by the charging and discharging of A8C1. The output frequency at A8TP3 is about 500 Hz and is determined by the RC time constant of A8C1 and A8R27. When the system phase locks, the search signal is stopped by grounding the collector of A8Q5 through the conduction of A8Q10.

A7Q5 and A7Q6 comprise a differential amplifier. The output at A7TP5 is the difference between signals at A7TP3 and A7TP4.

A7Q7 is a common-base amplifier for the sweep-reference signal from the external sweep generator. The common-base amplifier configuration provides a low-impedance input circuit. A7C8 couples the high-frequency component of the sweep-reference signal.

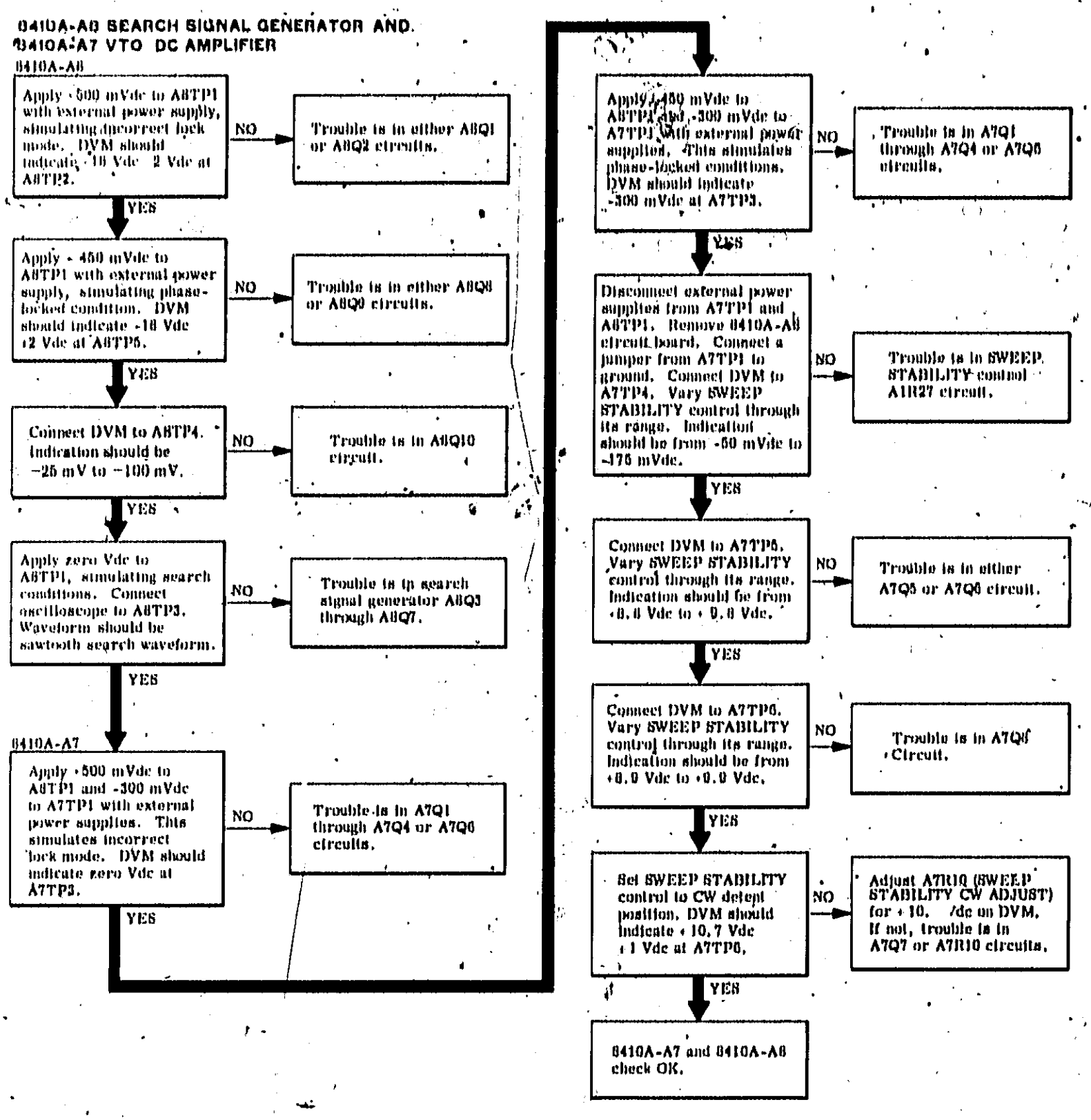
A7Q8 comprises an emitter follower circuit. The dc voltage at A7TP6 is controlled by SWEEP STABILITY control, A1R27 and A1S1. During search mode, the search waveform rides on the dc level present at A7TP6. At A7TP6 the waveform is 2 V peak to peak or greater with the FREQ. RANGE switch set at 0.1-0.25 GHz position. With the FREQ. RANGE switch set at 8-12.4 GHz, the waveform is about 20 mV peak to peak.

The SWEEP STABILITY control A1R27 controls the dc reference level at A7TP6. During search mode this control selects the center frequency of the VTO capture range. In swept-frequency operation this control is adjusted for best phase lock over the entire band. A CW position on the control supplies a fixed dc voltage of approximately 10.7 Vdc at A7TP6 that is applied to the VTO.

Resistors A1R1-A1R13 and FREQUENCY RANGE switch A1S1 form an attenuator in the phase-error signal path between A5 and the VTO DC amplifier. This changes the phase-lock loop gain. A smaller correction voltage at the VTO is required when using a high harmonic of the VTO than is required at a lower harmonic frequency. For instance, for a specific VTO frequency change of 1 MHz, the frequency change at the VTO second harmonic is 2 MHz and at the VTO 100th harmonic the change is 100 MHz. The FREQUENCY RANGE switch keeps the phase-lock loop gain constant over the entire input frequency range. That is, with a given correction voltage from phase detector A in 8410A-A5, the resultant change in frequency of the VTO harmonic being used is always approximately the same.

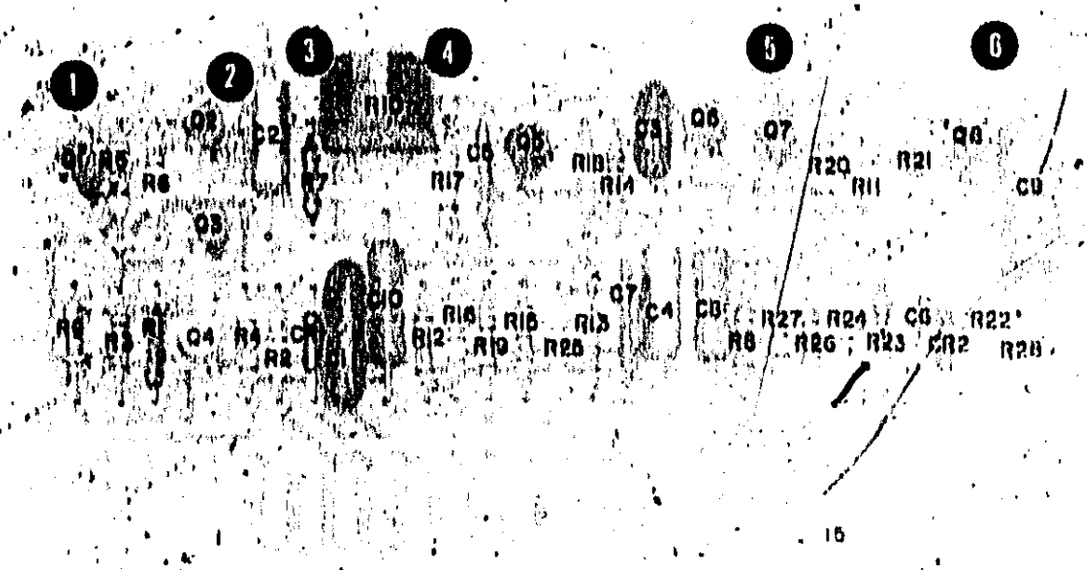
Resistors A1R14-A1R26 and FREQUENCY RANGE switch A1S1 control the peak-to-peak voltage sweep of the sawtooth search signal. As the selected harmonic number of the VTO frequency gets larger, the number of possible lock points multiplies. In order to limit the possible lock points to two or three frequencies, a voltage divider controls the peak-to-peak amplitude of the search waveform. At the lower input RF frequencies the search waveform is high in amplitude in order to sweep a wide VTO range, and at the higher input RF frequencies the search waveform is low in amplitude producing a very narrow VTO sweep range.

Figure 3-71. 8410A-A7 and A8 Talking Schematic



3-72. 8410A-A7 and A8 Troubleshooting

Figures 3-69 thru 3-72
8410A-A5, A6, A7, AND A8 TROUBLESHOOTING



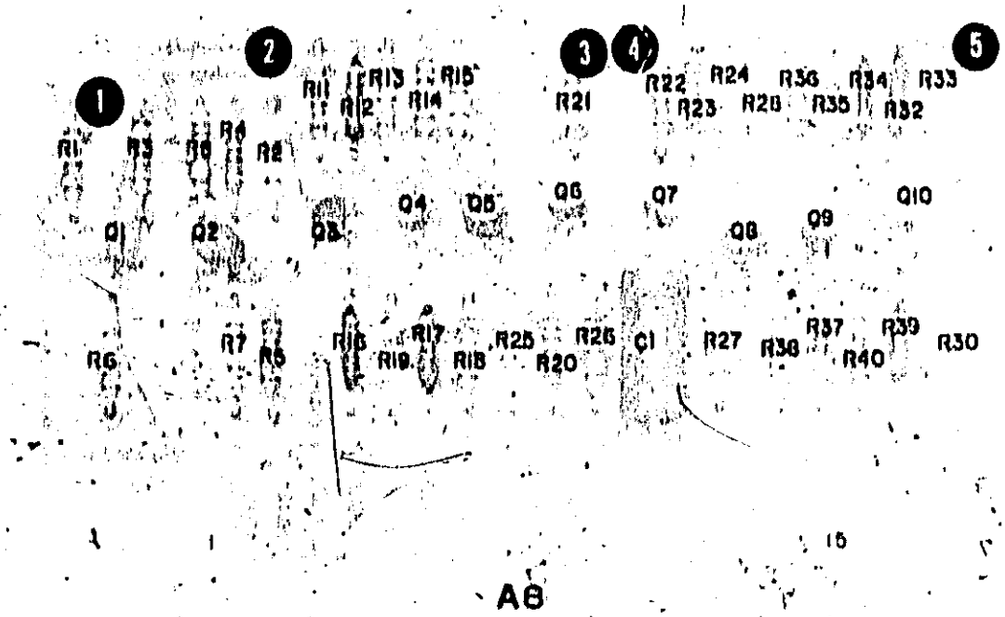


Figure 3-73. 8410A-A7 and A8 Parts Location

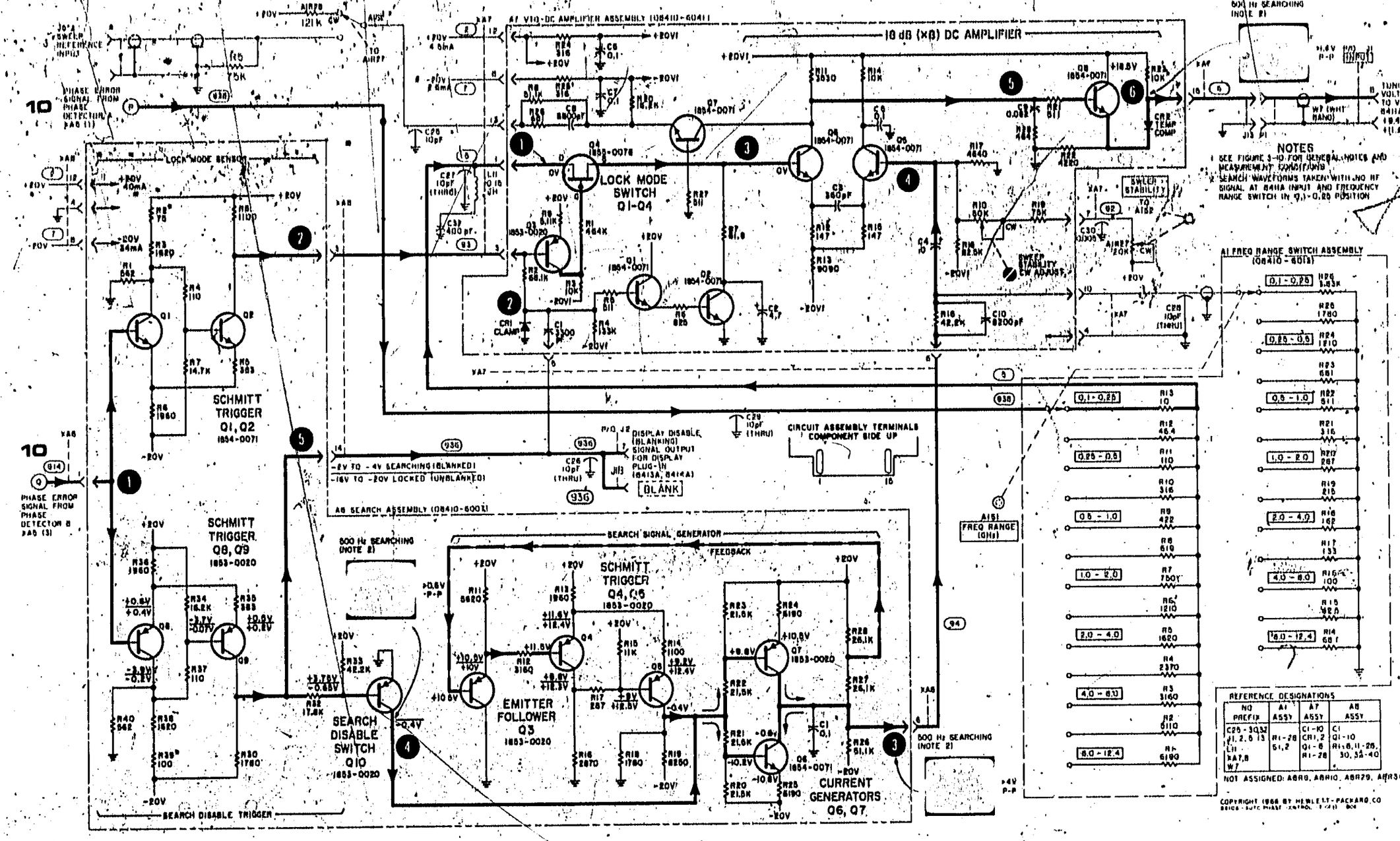


Figure 3-74. 8410A-A7 and A8 Schematic Diagram

8410A-A10, A10A1 POWER SUPPLY −20V AND +20V SECTION

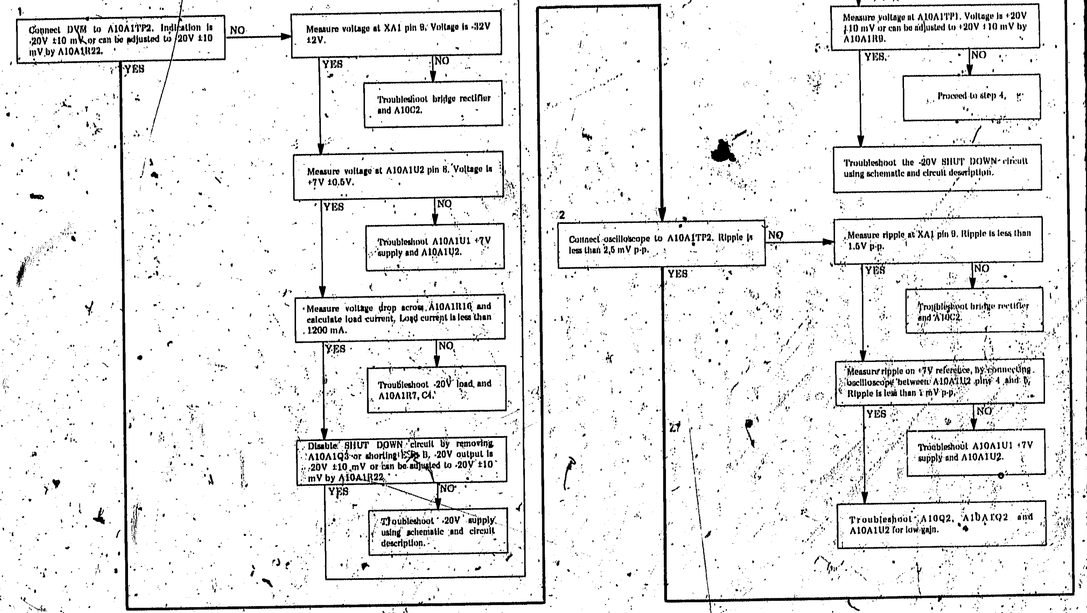


Figure 3-75. 8410A-A10, A10A1 +20V and −20V Power Supply Troubleshooting

+20V SUPPLY

A10A1U1

+7V SUPPLY. Used in -20V and -11V supplies.

DIFFERENTIAL AMPLIFIER. Compares voltage at U1 pin 2 and pin 3 and amplifies the difference. If +20V output goes more positive pin 2 goes more positive than pin 3 resulting in a positive at the inverting input, causing the amplifier's output to go negative.

VOLTAGE AMPLIFIER. Amplifies error signal from the Differential Amplifier. A negative input from Diff. Amp. causes output to go positive.

CURRENT LIMITER. Resistor A10A1R6 senses load current. As load current approaches 1200 mA, voltage drop across R6 turns on the current limiter causing a negative-going input to U1's voltage amplifier which decreases the supply's output voltage and limits current to about 300 mA.

DRIVER A10A1Q1. Q1 is a voltage amplifier. A positive input from U1's voltage amplifier causes output to go negative.

SERIES REGULATOR A10Q1. The regulator acts as a variable resistor whose resistance varies inversely with collector current, i.e., a negative voltage from its driver decreases collector current, resistance increases, dropping more voltage across the regulator, decreasing output voltage.

VOLTAGE DIVIDER A10A1R11 and R12. Samples output voltage. With output at +20V, U1 pin 3 is at about +2V.

VOLTAGE DIVIDER A10A1R8, R9 and R10. Compares +20V supply against -20V supply. The -20V supply's output must be adjusted before adjusting the +20V output.

A10A1C1, R1. Frequency compensation to prevent the supply from oscillating.

-20V SUPPLY

A10A1U2

VOLTAGE REFERENCE. Establishes a reference voltage for the -20V supply. U2 pin 5 samples the supply's output voltage. Pin 4 is always about 7V more positive than pin 5. Current through pin 4 is negligible so pin 3 is at nearly the same voltage as pin 4. The reference voltage at pin 3 follows any change in the supply's output.

DIFFERENTIAL VOLTAGE AMPLIFIER. Compares the voltage at U2 pin 3 and pin 2 and amplifies the difference. If the -20V output goes more negative, pin 3 goes more negative than pin 2 resulting in a negative at the non-inverting input, causing the amplifier's output to go negative.

CURRENT AMPLIFIER. A negative input from the differential amplifier decreases the current amplifier's conduction which is also the conduction of A10A1Q2.

CURRENT LIMITER. Resistor A10A1R16 senses load current. As load current approaches 1200 mA, voltage drop across R16 turns on the current limiter causing a negative-going input to U1's current amplifier decreasing its conduction, which will shut down the supply's output voltage.

DRIVER A10A1Q2. Conduction of Q2 varies directly with U1's current amplifier conduction. If conduction of Q2 decreases base drive to series regulator A10Q2 decreases.

SERIES REGULATOR A10Q2. The regulator acts as a variable resistor whose resistance varies inversely with collector current, i.e., a decrease in base drive from A10A1Q2 decreases the regulator's collector current, resistance increases, dropping more voltage across the regulator, causing the output voltage to go less negative or in a positive direction.

SHUT DOWN A10A1Q3, Q4. Shuts down the -20V supply when the +20V supply is shorted. Q4 is normally conducting holding Q3 cut off. If the +20V output goes to zero, Q4 shuts off causing Q3 to conduct. Q3 conducting presents a positive-going signal at U2 pin 2, the inverting input. U2's differential amplifier's output goes negative which shuts down the -20V output. Because of the 7V difference between U2 pin 4 and pin 5, the output shuts down to about -7V.

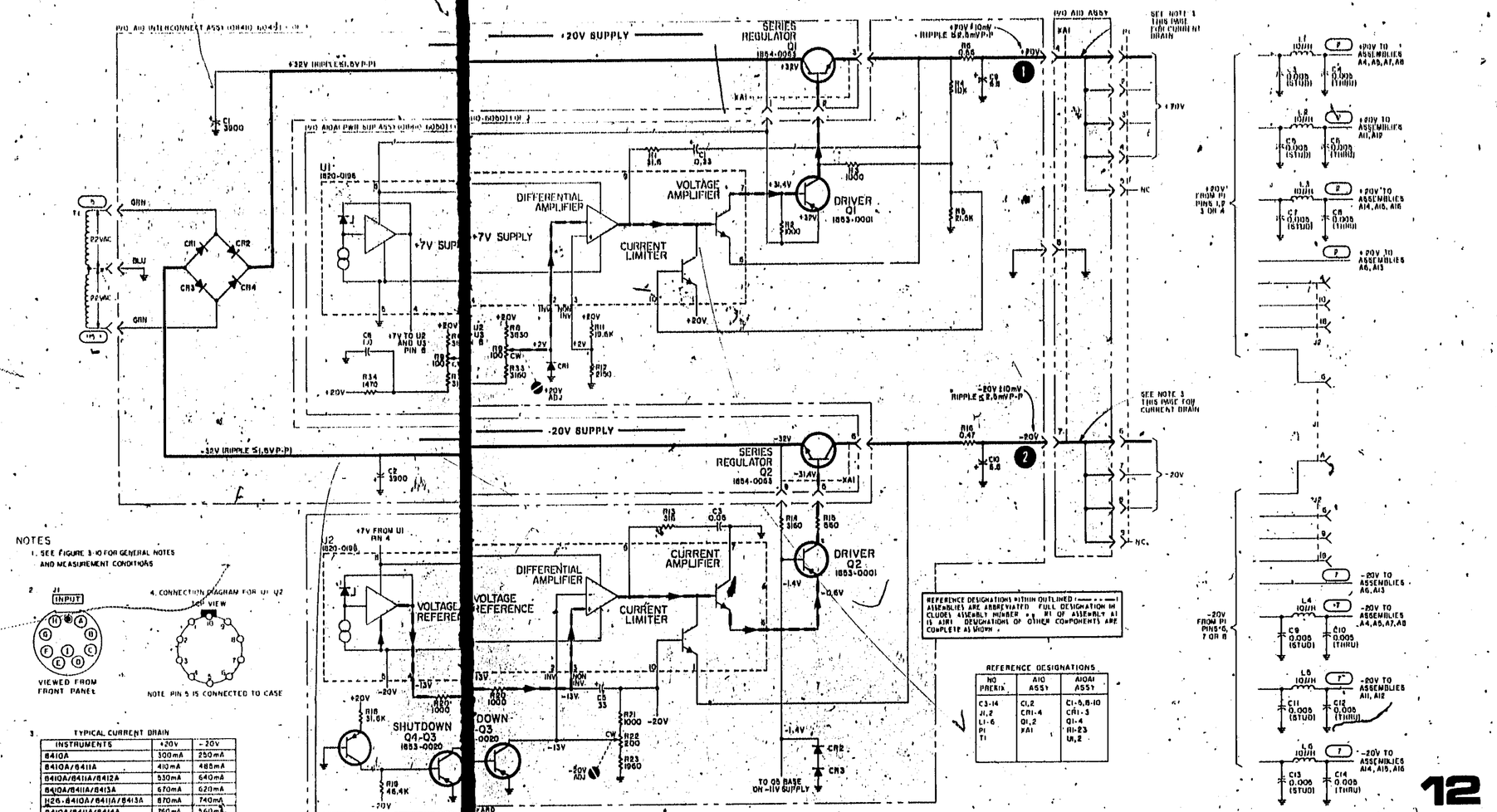
VOLTAGE DIVIDER A10A1R21, R22, R23. Samples output voltage. With output at -20V, U2 pin 2 is at about -13V.

A10A1CR2 and CR3. Develops base bias for A10A1Q2 and Q5.

NOTE

The -20V output is the reference voltage for the +20V and -11V supplies. If the -20V output goes more negative, the +11V output follows and the +20V output goes more positive.

Figure 3-76. 8410A-A10, A10A1 +20V and —20V Power Supply Circuit Description



NOTES

1. SEE FIGURE 3-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS

2 J1 INPUT — 4. CONNECTION DIAGRAM FOR U1 U2 TOP VIEW

VIEWED FROM FRONT PANEL

NOTE: PIN 5 IS CONNECTED TO CASE

3. TYPICAL CURRENT DRAIN

INSTRUMENTS	+20V	−20V
8410A	300mA	250mA
8410A/841IA	410mA	485mA
8410A/841IA/8412A	530mA	640mA
8410A/841IA/8413A	670mA	620mA
H26-8410A/841IA/8413A	870mA	740mA
8410A/841IA/8414A	760mA	560mA

REFERENCE DESIGNATIONS

NO PREFIX	A10 ASSY	A10A1 ASSY
C3-14	C1,2	C1-5,8-10
J1,2	CR1-4	CR1-3
L1-6	Q1,2	Q1-4
P1	R41	R1-23
T1		U1,2

Figures 3-76 thru 3-77
8410A-A10 AND A10A1 TROUBLESHOOTING

Figure 3-77. 8410A +20V and −20V Power-Supply Schematic Diagram

8410A-A10, A10A1 POWER SUPPLY –11V SECTION

Perform –20V and +20V Power Supply troubleshooting (Figure 3-75) and then continue below.

1

Connect DVM to A10A1TP3. Indication is –11V ±0.6V.

NO → Measure voltage at A10C3. Voltage is –18V ±2V.

YES

YES → NO → Troubleshoot bridge rectifier and A10C3.

YES → Measure voltage at A10A1U3 pin 8. Voltage is +7V ±0.5V.

YES → NO → Troubleshoot A10A1U1 +7V supply.

2

Connect oscilloscope to A10A1TP3. Ripple is less than 2.5 mV p-p.
NOTE: Ripple on –20V supply checked ok in step 2.

NO → Measure ripple at A10C3. Ripple is less than 1.5V p-p.

YES → NO → Troubleshoot bridge rectifier and A10C3.

YES → Measure voltage drop across A10A1R26 and calculate load current. Load current is less than 1200 mA.

YES → Troubleshoot –11V supply using schematic and circuit description.

NO → Troubleshoot –11V load and A10A1R28, C7.

YES → Troubleshoot A10Q3, A10A1Q5 and A10A1U3 for low gain.

3

Connect DVM to A10A1TP3. Vary line voltage ±10% from 115 Vac or 230 Vac. Voltage at A10A1TP3 varies less than ±10 mV.
NOTE: –20V supply checked ok in step 3.

NO → Troubleshoot A10Q3, A10A1Q5 and A10A1U3 for low gain.

Power Supplies OK

Figure 3-78. 8410A-A10, A10A1 –11V Power Supply Troubleshooting

-11V SUPPLY

A10A1U3

DIFFERENTIAL AMPLIFIER. Compares voltage at U3 pin 2 and pin 3 and amplifies the difference. If the -11V output goes more negative pin 3 goes more negative than pin 2 resulting in a negative at the noninverting input, causing the amplifier's output to go negative.

CURRENT AMPLIFIER. A negative input from the differential amplifier decreases the current amplifier's conduction which is also the conduction of A10A1Q6.

CURRENT LIMITER. Resistor A10A1R26 senses load current. As load current approaches 1200 mA, voltage drop across R26 turns on the current limiter causing a negative going input to U3's current amplifier decreasing its conduction which will shut down the supply's output voltage. The -11V supply will supply about 1200 mA to a short circuit.

DRIVER A10A1Q5. Conduction of Q5 varies directly with U3's current amplifier conduction. If conduction of Q5 decreases base drive to series regulator A10Q3 decreases.

SERIES REGULATOR A10Q3. The regulator acts as a variable resistor whose resistance varies inversely with collector current, i.e., a decrease in base drive from A10A1Q5 decreases the regulator's collector current, resistance increases, dropping more voltage across the regulator, causing the output voltage to go less negative or in a positive direction.

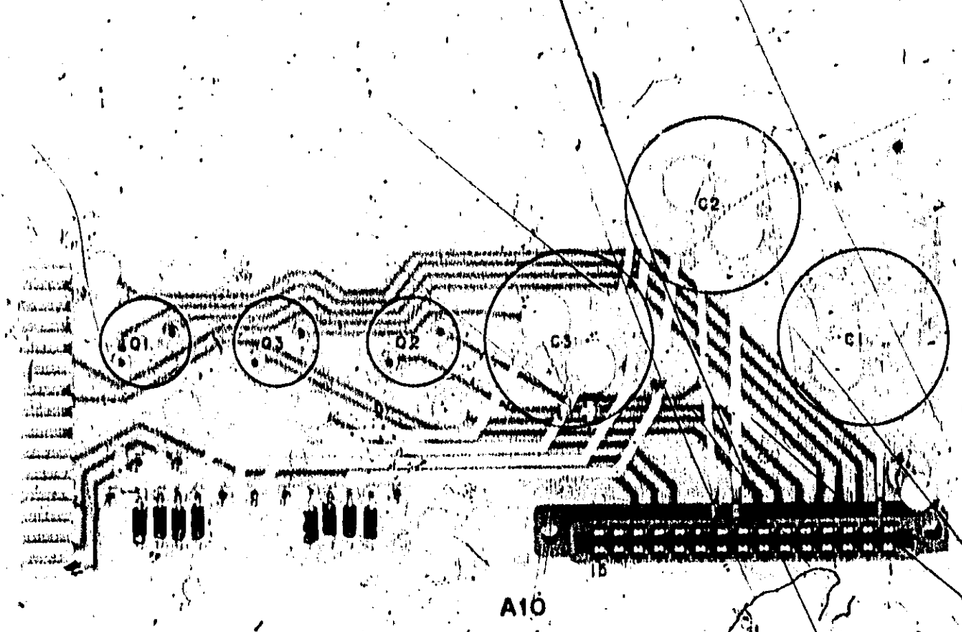
VOLTAGE DIVIDER A10A1R31 and R32. Samples output voltage. With output at -11V, U3 pin 3 is at about -8V.

VOLTAGE DIVIDER A10A1R29 and R30. Samples the -20V reference. With the -20V supply operating normally, the voltage at U3 pin 2 is about -8V and equal to the voltage at U3 pin 3. The -11V output follows any change in the -20V output, and if the -20V output is shorted, the -11V supply shuts down.

NOTE

If the -11V output is shorted the +20V supplies are not affected.

Figure 3-79. 8410A-A10 -11V Power Supply Circuit Description



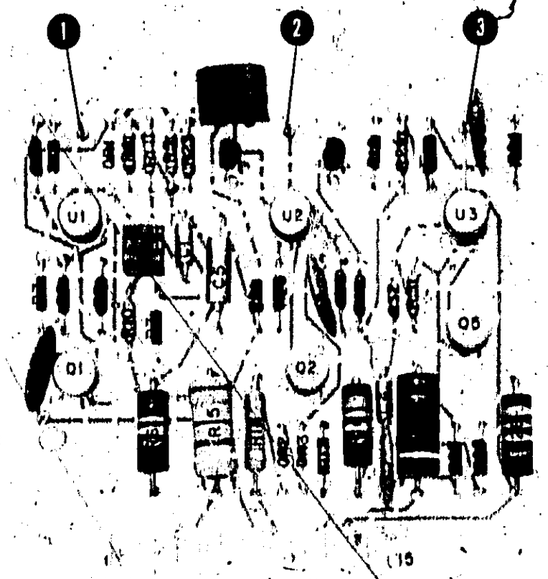
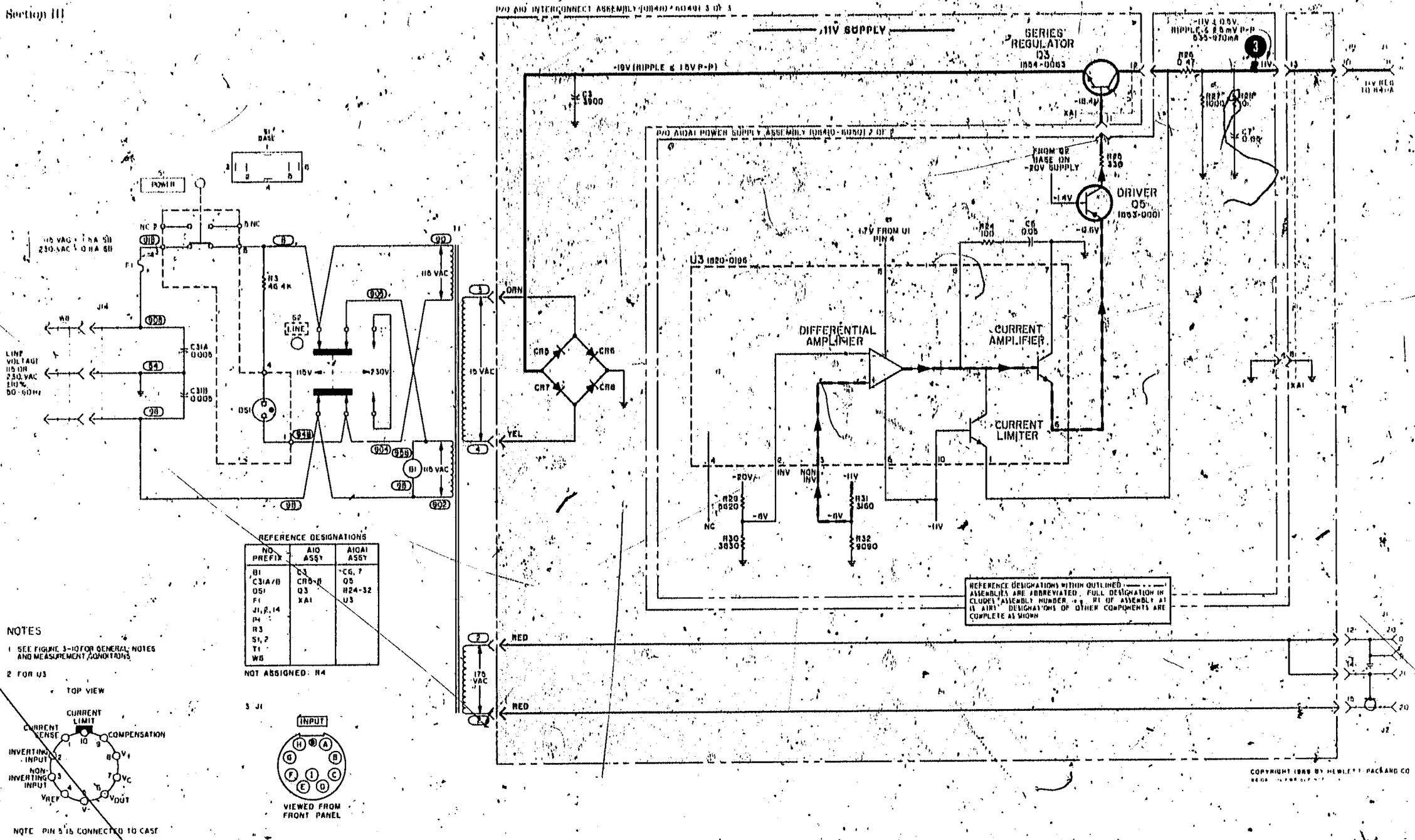


Figure 3-80. 8410A-A10A1 Parts Location



REFERENCE DESIGNATIONS

NO. PREFIX	A10 ASSY	A10A1 ASSY
B1	C3	*C6, 7
C31A/B	CR5-8	Q5
DS1	Q3	R24-32
F1	XA1	U3
J1, 2, 14		
P4		
R3		
S1, 2		
T1		
W8		

NOT ASSIGNED: R4

NOTES

1 SEE FIGURE 3-10 FOR GENERAL NOTES AND MEASUREMENT CONDITIONS.

2 FOR U3

TOP VIEW

NOTE: PIN 5 IS CONNECTED TO CASE

3 J1

Figure 3-81. 8410A —11V Power Supply Schematic Diagram

MANUAL CHANGES

APPENDIX I
MANUAL CHANGES

To adapt this manual to instruments with Serial Numbers listed in the table below, make the indicated manual changes.

Information for adapting this manual to instruments with Serial Numbers not listed below may be included in a yellow MANUAL CHANGES insert supplied with this manual. Information about Serial Numbers not covered in any of these ways can be obtained from the nearest Hewlett-Packard office.

8410A

Serial Prefix or Number	Make Manual Changes
801- thru 806-00565	B, D, E, F, G, H, I
806-00566 thru 806-00750	B, D, E, F, G, H,
848-	B, D, E, F, G
916-	B, D, E, F
932-00946 thru 932-01100	B, D, E
932-01101 thru 932-00130	B, D
935-	A, B, C
955-	A, B
0987A01531 thru 0987A01570	A
0987A01571 thru 0987A01870	No electrical changes. Instrument color changes only.

8411A

Serial Prefix or Number	Make Manual Changes
803-	J, K, L, M, N
821-	J, K, L, M
850-	J, K, L
905-	J, K
930-	J
0934A	No electrical changes, Instrument color changes only.

Table I-1. Model 8410A Summary of Changes

Serial Number	A1 Assy	Chg.	A5 Assy	Chg.	A6 Assy	Chg.	A10 Assy	Chg.	A12 Assy	Chg.
801-* thru 806-00665	R28	G	C6, R13	H	C6	E	Assembly Stock No. C1 and 2 XQ1 and 2	D H D	C10	G
806-00666* thru 806-00750	R28	G	C6, R13	H	C6	E	Assembly Stock No. C1 and 2 XQ1 and 2	D H D D	C10	G
848-*	R28	G			C6	E	Assembly C1 and 2 XQ1 and 2	D D	C10	G
916-*					C6	E	Assembly C1 and 2 XQ1 and 2	D D D		
932-00946* thru 932-01100					C6	E	Assembly C1 and 2 XQ1 and 2	D D D		
932-01101* thru 932-00130							Assembly C1 and 2 XQ1 and 2	D D D		
935-*							Primary Circuit A1R21, 23	C A		
955-*							A1R21, 23	A		
0987A01531 thru 0987A01570							A1R21, 23	A		
0987A01571 thru 0987A01870										

*A16 Assembly Change B: Delete A16Q5 and associated components. Change A16, HP Part No. to 08410-6002.

Table I-1. Model 8410A Summary of Changes (cont'd)

Serial Number	A14 Assy.	Chg.	A15 Assy	Chg.	Chassis Parts	Chg.
801- thru * 806-00555	C19	C	Q4A,B/Q5 R16, 18, 19, 32 R32	F F E	C34, R5 Front Panel Rear Panel Power Supply J12 & 13, W2P1, W7P1	C C D D I
806-00556* thru 806-00750	C19	C	Q4A,B/Q5 R16, 18, 19, 32 R32	F F E	C34, R5 Front Panel Rear Panel Power Supply	C C D D
848- *	C19	C	Q4A,B/Q5 R16, 18, 19, 32 R32	F E	C34, R5 Front Panel Rear Panel Power Supply	C C D D
916- *			Q4A,B/Q5 R16, 18, 19 R32	F F E	Front Panel Rear Panel Power Supply	C D D
932-00945* thru 932-01100			R32	E	Front Panel Rear Panel Power Supply	C D D
932-01101 * thru 932-00130					Front Panel Rear Panel Power Supply	C D D
935- *					F1(20 S1, W8 Front Panel Rear Panel Primary Ckt.	C C C C
955- *						
0987A01531 thru 0987A01570						
0987A01571 thru 0987A01870					No electrical changes. Instrument color change only.	

CHANGE D (cont'd)

MODEL 8410A

Page 3-53, Table 3-8:
Delete 8410A A10 and A10A1 in Assembly Reference Designation Index and insert the following note: Use A10 Assembly Reference Designation Index Parts List in Table 1-3 in this Appendix.

Page 3-59, Table 3-8:
Add C1 0160-0369 C: FXD-ELECT 2800 UF +75 -10% 60 VDCW.
Add C2 0160-0369 C: FXD ELECT 2800 UF +75 -10% 60 VDCW.

Page 3-60, Table 3-8:
Add XQ1 1200-0041 SOCKET: TRANSISTOR.
Add XQ2 1200-0041 SOCKET: TRANSISTOR.

Page 3-62, Table 3-8:
To Table 3-8 add NOTE: Use Figure 1-4 and associated parts list for cabinet parts.

Page 3-74, Figure 3-19, 1 of 2:
Replace Figure 3-19, 1 of 2, in the manual with Figure 1-5 in this Appendix.

Page 3-75/3-76, Figure 3-21:
Replace power supply portion of Figure 3-21 in the manual with partial block diagram 1-7 in this Appendix.

Page 3-77, Figure 3-22:
Replace Figure 3-22 in the manual with Figure 1-8 in this Appendix.

Page 3-77, Figure 3-23:
Replace Figure 3-23, 8410 POWER SUPPLY TEST in the manual with Figure 1-9 in this Appendix.

Page 3-78, Figure 3-24:
Replace power supply portion of Figure 3-24 in the manual with partial block diagram 1-10 in this Appendix.

Page 3-91, Figure 3-50:
On Figure 3-50 in the manual under C35 and C36 add the following:
NOTE: C35 and C36 may not be installed in your instrument. Installation of these capacitors will improve channel isolation.

Page 3-97, Figure 3-62:
On Figure 3-62 in the manual under C37 and C38 add the following:
NOTE: C37 and C38 may not be installed in your instrument. Installation of these capacitors will improve channel isolation.

Pages 3-105 through 3-108:
Delete Power Supply information in the Manual, Figures 3-75 through 3-81, and use the Power Supply information in this Appendix, Figures 1-16 through 1-20.

CHANGE E

Page 3-50, Table 3-8:
Change A6C6 to HP Part No. 0160-2263 C: FXD CER 18 PF 5% 500 VDCW.

Page 3-58, Table 3-8:
Change A15R32 to HP Part No. 0757-0460 R: FXD MET FLM 61.9K OHM 1% 1/8W.

Page 3-89, Figure 3-46, add the following NOTE:
3. A12Z1 and A14Z1 may not be installed on your instrument. Installation of these beads is recommended to reduce spurious responses.

Page 3-95, Figure 3-58:
Change A15R32 to 61.9K ohms.

Page 3-101, Figure 3-70:
Change A6C6 to 18 pF.

CHANGE A

MODEL 8410A

Page 3-51, Table 3-8:
Change A10A1R21 to HP Part No. 0757-0428 R: FXD MET FLM 1.62K 1% 1/8W.
Change A10A1R23 to HP Part No. 0698-3440 R: FXD MET FLM 3.16K OHM 1% 1/2W.

Page 3-106, Figure 3-76:
Change A10A1R21 to 1620 ohms.
Change A10A1R23 to 1960 ohms.

CHANGE B

Page 3-91, Figure 3-50:
A16 Preferred Replacement is HP Part No. 08410-60062. If you have A16 assembly HP Part No. 08410-6002, make the following change to your manual:
Delete A16Q8 and associated components. Connect A16C15 directly to pin 16 of P16 (mates with XA16).

CHANGE C

Page 1-6, Figure 1-3:
Replace Figure 1-3 in the manual with Figure 1-1 in this Appendix.

Page 3-59, Table 3-8:
Delete F1 HP Part No. 2110-0336.
Add F1 2110-0016 FUSE: CARTRIDGE 0.6 AMP SLOW BLOW (115V).
Delete F1 HP Part No. 2110-0304.
Add F1 2110-0021 FUSE: CARTRIDGE 1.25 AMP SLOW BLOW (230V).

Page 3-60, Table 3-8:
Delete S1 HP Part No. 3101-1248.
Add S1 3101-0100 SWITCH: PUSHBUTTON SPDT.
Delete W8 HP Part No. 8120-1348.
Add W8 8120-0078 CABLE ASSY: POWER CORD.

Page 3-60, Table 3-8:
Add 08410-6033 CABLE ASSY: POWER SUPPLY.

Page 3-62, Table 3-8:
Change Item 2 to HP Part No. 08410-0035.

Page 3-63, Table 3-8:
Change Item 4 to HP Part No. 08410-0017.

Page 3-108, Figure 3-81:
Replace Figure 3-81 power supply primary circuit in the manual with Figure 1-16 in this appendix.

CHANGE D

Page 1-6, Figure 1-3:
Replace Figure 1-3 in the manual with Figure 1-2 in this Appendix.

Page 3-6, Table 3-2, Alignment Controls:
Change REFERENCE DESIGNATOR A10A1R9 to A10R17, FUNCTION AFFECTED +20 Vdc, COMPONENT LOCATION - Figure 1-16 in this Appendix.

Change REFERENCE DESIGNATOR A10A1R22 to A10R20, FUNCTION AFFECTED −20 Vdc, COMPONENT LOCATION, Figure 1-16 in this Appendix.

Page 3-22, Figure 3-11, Adjustment Procedure:
Replace Figure 3-11 Adjustment Procedure Test 1 in the manual with Adjustment Procedure Test 1, Figure 1-3 in this Appendix.

MODEL 8410A

CHANGE F

Page 3-57, Table 3-8:
Delete A15Q4A,B.

Add A15Q4 and 5, HP Part No. 1854-0023 TRANSISTOR: SILICON NPN.

Page 3-58, Table 3-8:
Change A15R16 to HP Part No. 0757-0438 R: FXD MET FLM 5.11K OHM 1% 1/8W.
Change A15R18 to HP Part No. 0698-3153 R: FXD MET FLM 3.83K OHM 1% 1/8W.
Change A15R19 to HP Part No. 0757-0438 R: FXD MET FLM 5.11K OHM 1% 1/8W.

CHANGE G

Page 3-48, Table 3-8:
Change A1R28 to HP Part No. 0757-0461 R: FXD MET FLM 68.1K OHM 1% 1/8W.

Page 3-54, Table 3-8:
Change A12C19 to HP Part No. 0180-0195 C: FXD ELECT 0.33 UF 20%, 35 VDCW.

Page 3-56, Table 3-8:
Change A14C19 to HP Part No. 0180-0195 C: FXD ELECT 0.33 UF 20% 35 VDCW.

Page 3-89, Figure 3-46:
Change A12C19 to 0.33 UF (lower left corner of each assembly).

Change A14C19 to 0.33 UF.

Page 3-101, Figure 3-70:
Delete C34, 43 pF from XA5-1 to ground (lower right corner).

Page 3-103/3-104, Figure 3-74:
Delete R5, 75.0K from J5, SWEEP REFERENCE INPUT BND, to ground (upper left corner of schematic).

Change A1R28 to 68.1K (upper left corner of schematic).

CHANGE H

Page 3-49, Table 3-8:
Change A5C6 to HP Part No. 0160-2306 C: FXD MICA 27 pF 5%.

Page 3-50, Table 3-8:
Change A5R13 to HP Part No. 0698-3439 R: FXD MET FLM 178 OHM 1% 1/8W.

Page 3-101, Figure 3-70:
Change A5C6 to 27 pF.

Change A5R13 to 178 ohms.

Page I-11/I-12, Table I-3:
Change A10 HP Part No. to 08410-6012.

Page I-46, Figure I-19:
Change A10 Assembly Part No. to 08410-6012.

CHANGE I

Page 3-59, Table 3-8:
Change J12 and J13 to HP Part No. 1250-0830.

Page 3-60, Table 3-8:
Change W2P1 to HP Part No. 1250-0824.

Change W7P1 to HP Part No. 1250-0824.

Table I-2. Model 8411A Summary of Changes

Serial Number	A3 Assy.	Chg.	A5 Assy.	Chg.	A7 Assy	Chg.	Chassis Parts	Chg.
803-	R4, 5, 6, 7 8, 9	N N	C13, L1 R8 10, 20, 21	N N N	C14, 15, 16 CR4, 5, 6, Q5 R2, 3, 19, 20, 21 Assembly	L L L L L	Z2 Interconnect Cable Housing Z3, 4	J J J J K
821-	The only additional change (Change M) is the use of standard screws instead of self-tapping screws in the housing.				C14, 15, 16 CR4, 5, 6, Q5 R2, 3, 19, 20, 21 Assembly	L L L L L	Z2 Interconnect Cable Housing Z3, 4	J J J J, M K
850-					C14, 15, 16 CR4, 5, 6, Q5 R2, 3, 19, 20, 21 Assembly	L L L L L	Z2 Interconnect Cable Housing Z3, 4	J J J J K
905-					Cable Z3, 4	J	Z2 Interconnect Cable Housing Z3, 4	J J J J K
930-					Cable	J	Z2 Interconnect Cable Housing	J J J J
0934A	No electrical changes. Instrument color change only.							

CHANGE J

MODEL 8411A

Page 3-68, Table 3-9:
Delete Z2, HP Part No. 9170-1046 listing.

Page 3-70, Table 3-9:
Change Item 27 to HP Part No. 08411-6006 INTERCONNECT CABLE ASSY: COMPLETE.

Change Item 28 to HP Part No. 08411-2022 HOUSING.

Page 3-87, Figure 3-42:
Replace Figure 3-42 A7 Schematic Diagram in the manual with Figure I-13 in this Appendix.

CHANGE K

Page 3-70, Table 3-9:
Under Reference Designation 6, add:
RECOMMENDED REPLACEMENT
The coaxial clamp on your instrument may not have suppressor beads. Recommended replacement clamps include a suppressor bead.

CHANGE L

Page 3-6, Table 3-2:
Delete 8411A-A7R19 listing.

Page 3-7, Table 3-3:
Add 8411A-A7R3 FUNCTION AFFECTED VTO lower frequency limit, NORMAL RANGE OF VALUES 10-196Ω, COMPONENT LOCATION FIGURE 3-41, ADJUSTMENT PROCEDURE 10.

Page 3-65, TEST 10:
Change step d to read: Connect frequency counter to 8411A-A3TP7 and adjust 8411A-A7R5 (65 MHz ADJUST) for a VTO frequency of 65.0 MHz ±0.2 MHz. (If 65.0 MHz ±0.2 MHz cannot be obtained, remove 8411A-A7R3 to disable the low-frequency clamping action of A7CR4).

Add the following step after step d and reletter the remaining steps: Adjust SWEEP STABILITY control for lowest VTO frequency. The VTO frequency should be 62 MHz ±1 MHz. If not, select the value of 8411A-A7R3 as follows:

1. Remove A7R3.
2. Adjust SWEEP STABILITY control for VTO frequency below 60 MHz.
3. Select a value of A7R3 that shifts the VTO frequency to 62 MHz ±1 MHz. (Typical range of values for A7R3 is 10 to 196 ohms.)

Page 3-67, Table 3-9:
Change A7 to HP Part No. 08411-6002.

Page 3-68, Table 3-9:
Delete A7C14, A7C15, and A7C16 listings.

Add A7CR4, HP Part No. 1902-0041 DIODE: BREAKDOWN 5.11V 5% 400 MW.

Delete A7CR5, A7CR6, and A7Q5 listings.

Change A7R2 to HP Part No. 0757-0317 R: FXD MET FLM 1.33K OHM 1% 1/8W.

Change A7R3 to HP Part No. 0757-0401 R: FXD MET FLM 100 OHM 1% 1/8W.

Delete A7R19, A7R20, and A7R21 listings.

Page 3-75/3-76, Figure 3-20 (Sheet 1 of 2):
Replace Figure 3-20 TOP view in the manual with Figure I-6 in this Appendix.

Page 3-87, Figure 3-41:
Replace Figure 3-41, A7 Parts Location Illustration in the manual with Figure I-12 in this Appendix.

Page 3-87, Figure 3-42:
Replace Figure 3-42, A7 Schematic Diagram in the manual with Figure I-14 in this Appendix.

CHANGE M

MODEL 8411A

Page 3-70, Table 3-9:
Change Item 20 to HP Part No. 2200-0057 SCREW: 88T FH POS DR 4-40 x 5/16.

CHANGE N

Page 3-6, Table 3-2:
Delete 8411A-A5R20 listing.
Delete 8411A-A5R21 listing.

Page 3-7, Table 3-3:
Add 8411A-A5L1, FUNCTION AFFECTED Channel phase balance, NORMAL RANGE OF VALUES 3.3 – 4.7 μH, COMPONENT LOCATION FIGURE 3-37, ADJUSTMENT PROCEDURE 14:

Add 8411A-A5R8, FUNCTION AFFECTED Test channel preamplifier gain, NORMAL RANGE OF VALUES 343-900Ω, COMPONENT LOCATION FIGURE 3-37, ADJUSTMENT PROCEDURE 13.

Add 8411A-A5R19, FUNCTION AFFECTED Channel phase balance, NORMAL RANGE OF VALUES 21.5-196Ω, COMPONENT LOCATION FIGURE 3-37, ADJUSTMENT PROCEDURE 14.

Page 3-38, Figure 3-11:
Change step v to read: Select the value of 8411A-A5R8 that gives peak-to-peak birdie amplitude of 5.3 cm (0.7 cm (92 mV – 14 mV). This indicates proper channel balance. (Typical range of values for A5R8 is 343 to 900 ohms.)

Page 3-46, Figure 3-11, TEST 14:
Change step b to read: Select 8411A-A5R19 and, if necessary, A5L1 for zero 115° phase indication. (Typical range of values for A5R19 is 21.5 to 196 ohms, and for A5L1 is 3.3 μH to 4.7 μH.)

Page 3-65, Table 3-9:
Change A3R4 and A3R7 to HP Part No. 0698-3396, R: FXD MET FLM 38.3 OHM 1% 1/2 W.

Change A3R5, A3R6, A3R8 and A3R9 to HP Part No. 0698-3392, R: FXD MET FLM 23.7 OHM 1% 1/2W.

Page 3-67, Table 3-9:
Add FACTORY SELECTED PART to A5L1 description.

Change A5R8 to HP Part No. 0757-0416 R: FXD MET FLM 511 OHM 1% 1/8W.

Change A5R19 to HP Part No. 0698-3438 R: FXD MET FLM 147 OHM 1% 1/8W FACTORY SELECTED PART.

Delete A5R20 and A5R21 listings.

Page 3-74, Figure 3-20 (Sheet 1 of 2):
Replace Figure 3-20 (LEFT SIDE view) in the manual with Figure I-6 in this Appendix.

Page 3-83, Figure 3-34:
Change A3R5, A3R6, A3R8 and A3R9 to 23.7 ohms.

Change A3R4 and A3R7 to 38.3 ohms.

Page 3-84, Figure 3-36:
Change upper right box to read: Change the value of A5R8 to 343 ohms (maximum gain). If pre-amplifier gain is still low; check gain through each stage to isolate trouble.

Page 3-86, Figure 3-37:
Replace Figure 3-37, A5 Parts Location in the manual with the Figure I-11 in this Appendix.

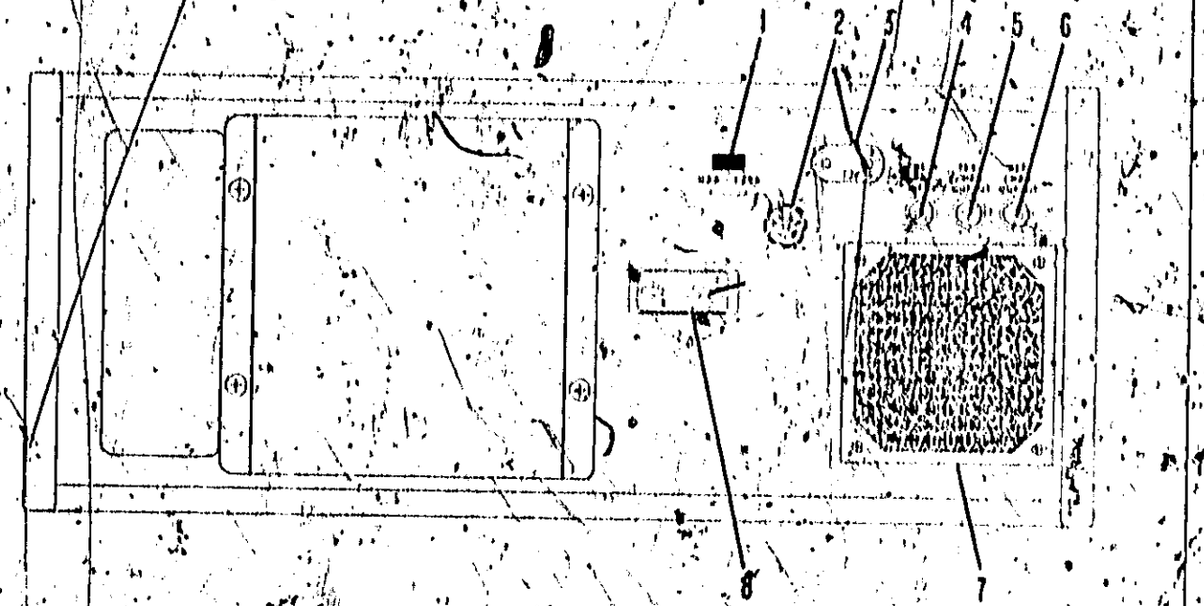
Page 3-86, Figure 3-38:
Change A5C13 to 9-35 pF.
Add asterisk (*) alongside of A5L1.
Change A5R8 to 511 ohms (typical value).
Change A5R19 to 147 ohms and add asterisk (*).
Delete R20 and R21; replace with shorts.

Table I-3. Reference Designation Index

Reference Designation	HP Part No.	Description #	Note
A10	08410-6006	ASSY:POWER SUPPLY BOARD	
A10C1		NOT ASSIGNED	
A10C2		NOT ASSIGNED	
A10C3	0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	
A10C4	0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	
A10C5	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A10C6	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A10C7	0180-0094	C:FXD ELECT 100 UF +75-10% 25VDCW	
A10C8	0180-0094	C:FXD ELECT 100 UF +75-10% 25VDCW	
A10C9	0180-0374	C:FXD ELECT 10.0 UF 10% 20VDCW	
A10C10	0180-0374	C:FXD ELECT 10.0 UF 10% 20VDCW	
A10C11	0140-0210	C:FXD MICA 270 PF 5%	
A10C12	0140-0210	C:FXD MICA 270 PF 5%	
A10CR1	1901-0200	DIODE:SILICON 100 PIV 3A	
A10CR2	1901-0200	DIODE:SILICON 100 PIV 3A	
A10CR3	1901-0200	DIODE:SILICON 100 PIV 3A	
A10CR4	1901-0200	DIODE:SILICON 100 PIV 3A	
A10Q1	1854-0071	O:SI NPN(SELECTED FROM 2N3704)	
A10Q2	1853-0020	O:SI PNP(SELECTED FROM 2N3702)	
A10Q3	1854-0062	O:SI NPN	
A10Q4	1853-0020	O:SI PNP(SELECTED FROM 2N3702)	
A10Q5	1854-0071	O:SI NPN(SELECTED FROM 2N3704)	
A10Q6	1853-0020	O:SI PNP(SELECTED FROM 2N3702)	
A10Q7	1854-0062	O:SI NPN	
A10Q8	1853-0020	O:SI PNP(SELECTED FROM 2N3702)	
A10Q9		NOT ASSIGNED	
A10R2	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R3	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R4	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R5	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R6	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A10R7	0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	
A10R8	0698-3157	R:FXD MET FLM 19.6K 1% 1/8W	
A10R9	0698-3157	R:FXD MET FLM 19.6K 1% 1/8W	
A10R10	0812-0017	R:FXD WW 0.25 OHM 5% 3W	
A10R11	0812-0017	R:FXD WW 0.25 OHM 5% 3W	
A10R12	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R13	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R14	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A10R15	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A10R16	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A10R17	2100-1756	R:VAR WW 200 OHM 5% TYPE V 1W	
A10R18	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A10R19	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A10R20	2100-1756	R:VAR WW 200 OHM 5% TYPE V 1W	
A10R21	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A10VR1	1902-0126	DIODE:BREAKDOWN 2.61V 5%	
A10VR2	1902-0126	DIODE:BREAKDOWN 2.61V 5%	
A10VR3	1902-0588	DIODE BREAKDOWN 16.19V 1%	
A10VR4	1902-0588	DIODE BREAKDOWN 16.19V 1%	

See introduction to this section for ordering information

REAR PANEL FEATURES



1. Line Voltage Selector. Permits operation from 115 or 230 Vac. Number showing on slider is selected operating voltage. Adjacent number on panel is correct line fuse rating.

2. Power line fuseholder. Fuse should have rating shown adjacent to number on line voltage selector.

3. Power Cable Connector. NEMA type with offset pin connected to 8410A cabinet. Power requirements 115 or 230 Vac ±10%, 50 to 60 Hz, approximately 65 watts with HP 8413A, 300 watts with HP 8414A.

4. SWEEP REF INPUT. Accepts a voltage proportional to reference channel input frequency. Voltage enables auto-tuning to track fast sweeping input frequencies. Nominal 0 to +10 volts per octave[1] from 20K ohms ±20% source impedance required. The lower voltage must coincide with the lowest input frequency. HP 690 and 8690 Sweep Oscillators furnish suitable reference voltages.[2] SWEEP REF INPUT voltage must be provided when sweep mode selected is from high frequency to low frequency at any sweep speed.

5. TEST CHAN OUTPUT. 278 kHz sine wave. Amplitude depends upon the amplitude of the test channel RF input and the settings of the front-panel TEST CHANNEL GAIN dB and AMPL VERNIER controls. Amplitude range is 0 to about 10 volts p-p.

6. REF CHAN OUTPUT. 278 kHz sine wave with amplitude fixed at about 2 volts p-p nominal when REF CHANNEL LEVEL meter reads in the OPERATE region.

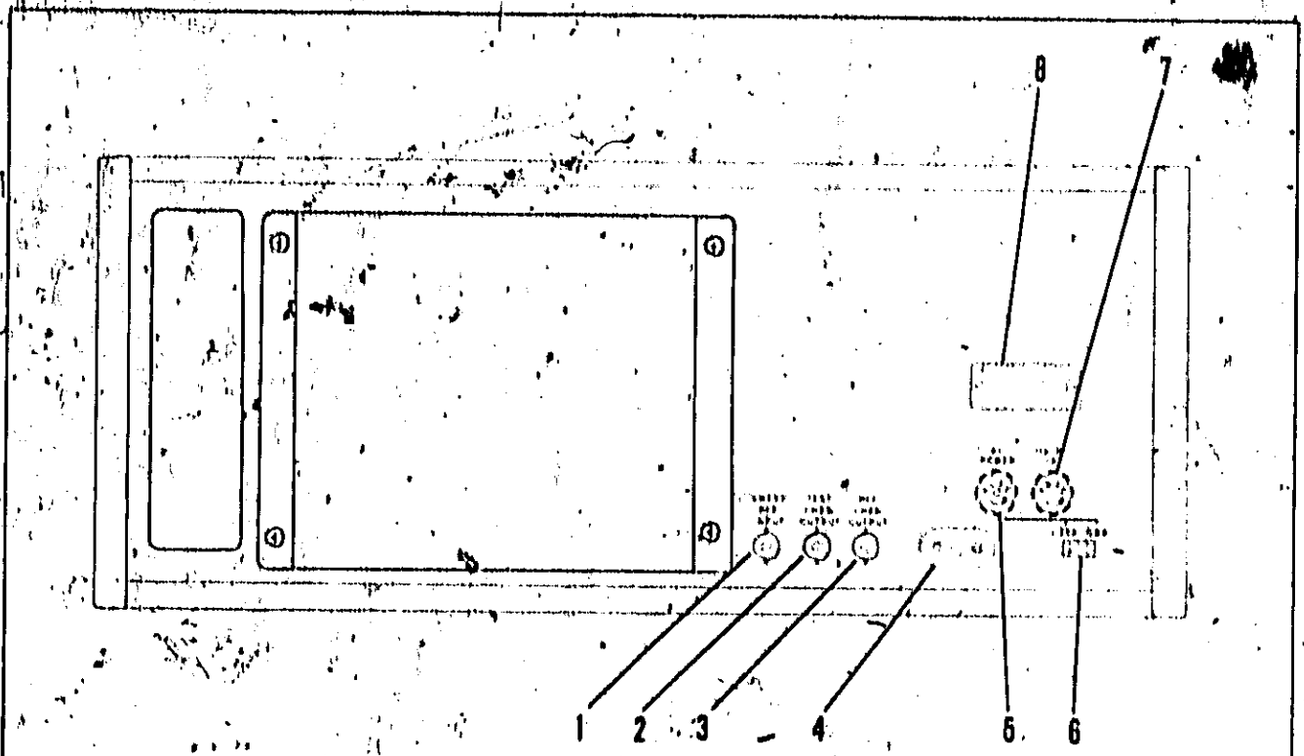
7. Air Intake Filter. Clean regularly. Do not obstruct air flow.

8. Serial Number Plate. Eight-digit serial number should be included in any correspondence concerning the Model 8410A.

[1] Swept frequency measurements can be made over somewhat wider frequency ranges than indicated by the FREQ RANGE (GHz) selector provided the sweep reference voltages cover the required ranges. See Tables 1-6 and 1-7 in manual for details.

[2] 690-series Oscillators need dividers for sweep reference output, and internal dividers of 8690 Oscillators should be checked. See Tables 1-6 and 1-7 in manual.

Figure I-1. Model 8410A Rear Panel Features



1. SWEEP REF INPUT. Accepts a voltage proportional to reference channel input frequency. Voltage enables auto-tuning to track fast-sweeping input frequencies. Nominal 0 to +40 volts per octave from 20 k ohms ±20%. Source impedance required. The lower voltage must coincide with the lowest input frequency. HP 690 and 8690 Sweep Oscillators furnish suitable reference voltages.[2] SWEEP REF INPUT voltage must be provided when sweep mode selected is from high frequency to low frequency at any sweep speed.

2. TEST CHAN OUTPUT. 278 kHz sine wave. Amplitude depends upon the amplitude of the test channel RF input and the settings of the front-panel TEST CHANNEL GAIN (dB) and AMPL VERNIER controls. Amplitude range is 0 to about 10 volts p-p.

3. REF CHAN OUTPUT. 278 kHz sine wave with amplitude fixed at about 2 volts p-p nominal when REF CHANNEL LEVEL meter reads in the OPERATE region.

4. Power Cable Connector. NEMA type with offset pin connected to 8410A cabinet. Power requirements: 115 or 230 Vac ±10%, 50 to 60 Hz, approximately 95 watts with HP 8413A, 105 watts with HP 8414A.

5. AC POWER. Power line fuseholder. Fuse should have rating shown adjacent to number on line voltage selector.

6. Line Voltage Selector. Permits operation from 115 or 230 Vac. Number showing on slider is selected operating voltage. Adjacent number on panel is correct line fuse rating.

7. -11 V PS Fuseholder. 1 amp fuse is overcurrent protection for internal -11 volt dc supply.

8. Serial Number Plate. Eight-digit serial number should be included in any correspondence concerning the Model 8410A.

[1] Swept frequency measurements can be made over somewhat wider frequency ranges than indicated by the FREQ RANGE (GHz) selector provided the sweep reference voltages cover the required ranges. See Tables 1-6 and 1-7 for details.

[2] 690-series Oscillators need dividers for sweep reference output, and internal dividers of 8690 Oscillators should be checked. See Tables 1-6 and 1-7.

Figure 1-2. Model 8410A Rear Panel Features

TEST	DESCRIPTION AND PROCEDURE

Note

Before any adjustments are made, (1) allow 30 minutes warmup to obtain normal operating temperature on all components, and (2) check that AC input power is 115 or 230 Vac ±10%.

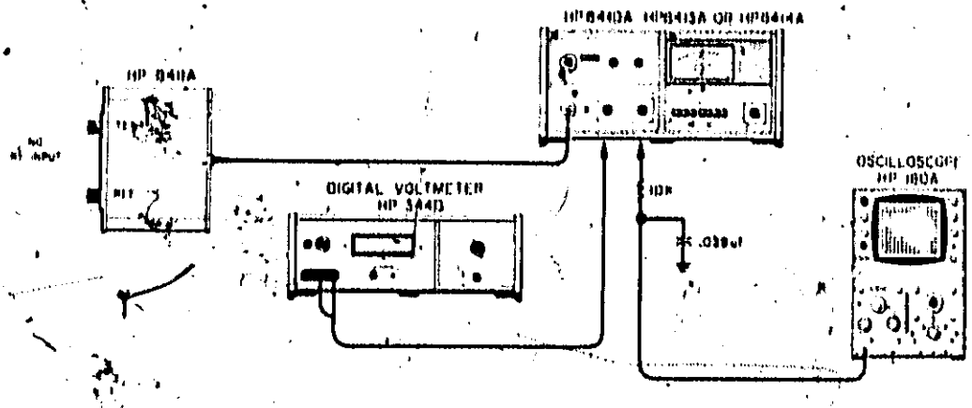
1 CIRCUIT

8410A POWER SUPPLY ASSEMBLY A10. (Adjust A10R17 and A10R20.)

DESCRIPTION

The 8410A +20 and -20 volt power supplies are each measured with a dc voltmeter and adjusted to ±20.00 volts. The dc ripple is monitored on an oscilloscope to check for proper filtering.

TEST SETUP



TEST EQUIPMENT: Items 5 and 11, Table 3-1.

PROCEDURE

a. Connect equipment as shown in test setup above. Connect a 400 Hz low-pass filter consisting of a 10 Kilohm resistor and a 0.039 µF capacitor to oscilloscope input as shown in test setup.

b. Remove 8440A top cover.

c. Turn on 8410A power.

d. Connect oscilloscope and dc voltmeter to test points below and make adjustments if necessary.

Note

Power supply voltages should not be adjusted unless very accurate measurement indicates that they are out of tolerance.

TEST POINT	DC VOLTMETER INDICATION	OSCILLOSCOPE WAVEFORM	ADJUSTMENT
A10TP4	+20.00 ±0.02 Vdc*	3 mV p-p max.	A10R17*
A10TP2	-20.00 ±0.02 Vdc*	3 mV p-p max.	A10R20*

* If either supply has to be adjusted, set as close as possible to ±20.00 V.

Figure I-3. Adjustment Procedure

Table 8-8. Model 8410A Reference Designation Index (Cont'd)

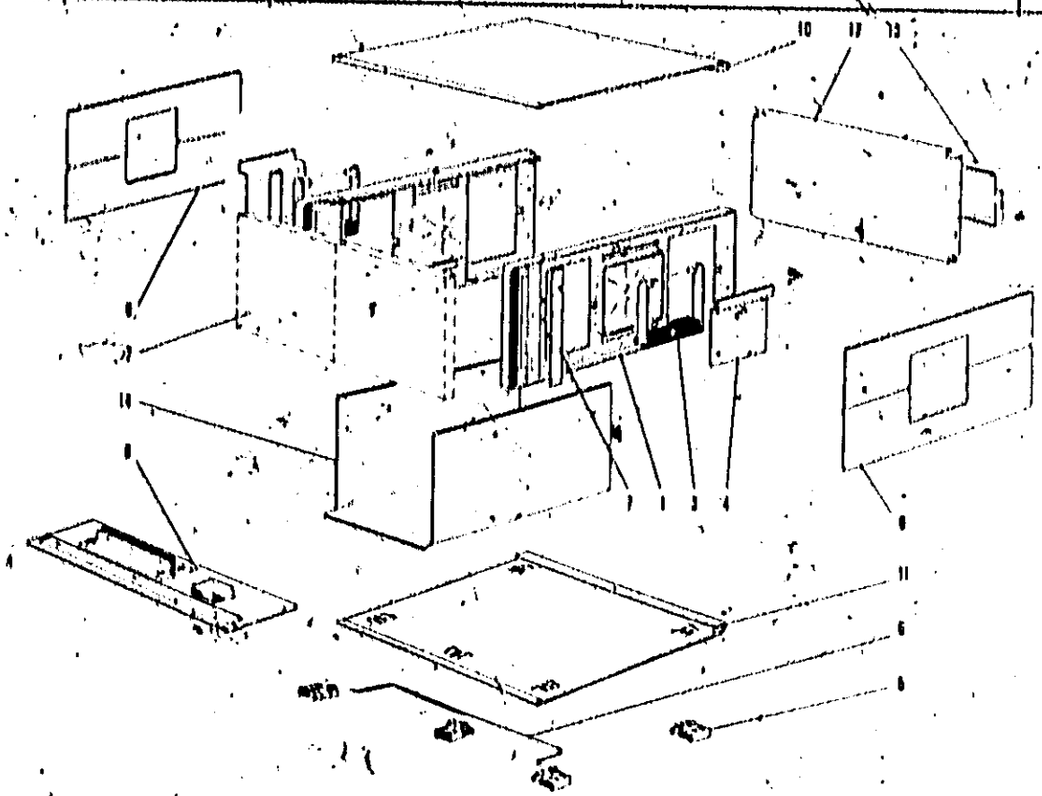
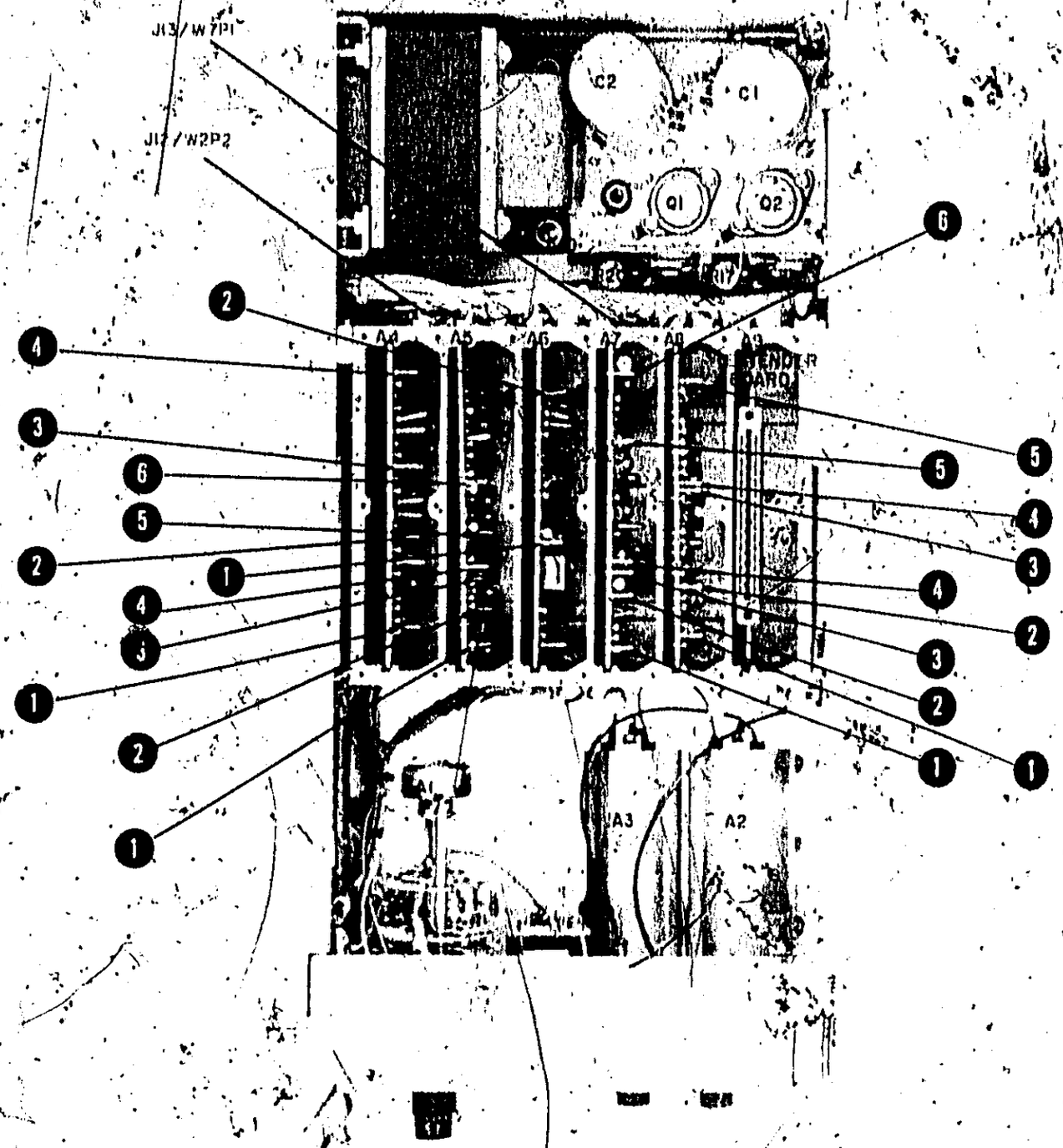


Figure I-4. Model 8410A Cabinet Parts

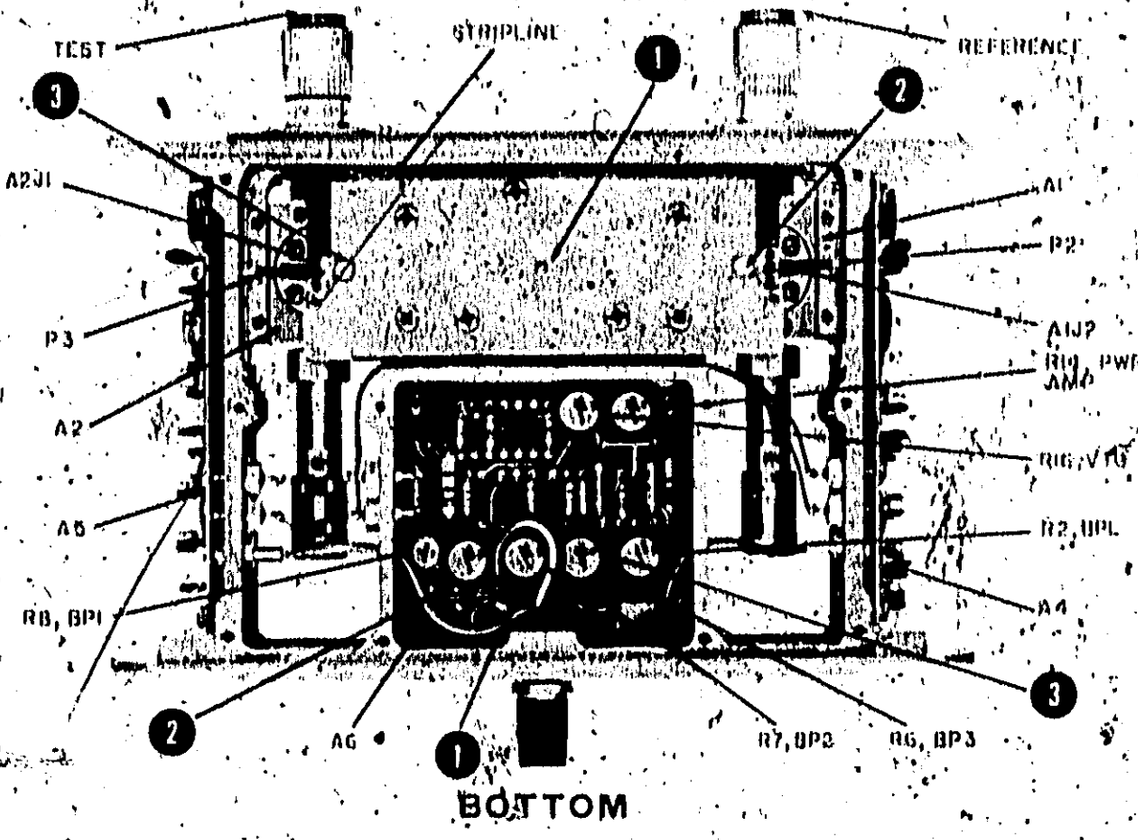
Reference Designation	Part No.	Description #	Note
1	5060-0232	FRAME ASSY:MODIFIED 7 X 16 FH	
2	5060-0763	HANDLE ASSY-SIDE	
3	5060-0765	RETAINER-HANDLE ASSY.	
4	2550-0013	SCREW:SST BH 6-32 X 5/16	
5	5060-0767	FOOT ASSY:FH	
6	1490-0030	STAND:TILT	
7	5000-0052	PLATE:FLUTED ALUMINUM	
8	5060-0776	KIT:7H RACK MOUNT	
9	5000-0743	COVER:SIDE 7 X 16 FH	
9	2370-0020	SCREW:SST FH PHIL DR 6-32 X 3/16	
10	5060-0227	COVER ASSY:TOP	
	2370-0013	SCREW:SST FLAT HD PHL DR 6-32 X 3/8	
11	5060-0228	COVER ASSY:BOTTOM	
	2370-0013	SCREW:SST FLAT HD PHL DR 6-32 X 3/8	
12	08410-0026	PANEL:REAR	
	2360-0004	SCREW:MRS NI PL PHL 6-32 X 5/16"	
	2190-0067	WASHER:LOCK SST FOR #8 SCREW	
13	08410-0027	COVER:REAR PANEL	
	2360-0005	SCREW:SST RD HD 6-32 X 3/8	
	2190-0321	WASHER:LOCK SST FOR #8 SCREW	
14	08410-0015	DECK:SLIDING	
	2360-0066	SCREW:SST FH PHL 6-32 X 1/4	
	2390-0028	SCREW:SST SLOT DR 6-32 X 0.250"	
	0590-0305	NUT:HEX STL 6-32 W/EXT LOCK	

See introduction to this section for ordering information.



TOP VIEW

Figure I-5. Model 8410A Test Points



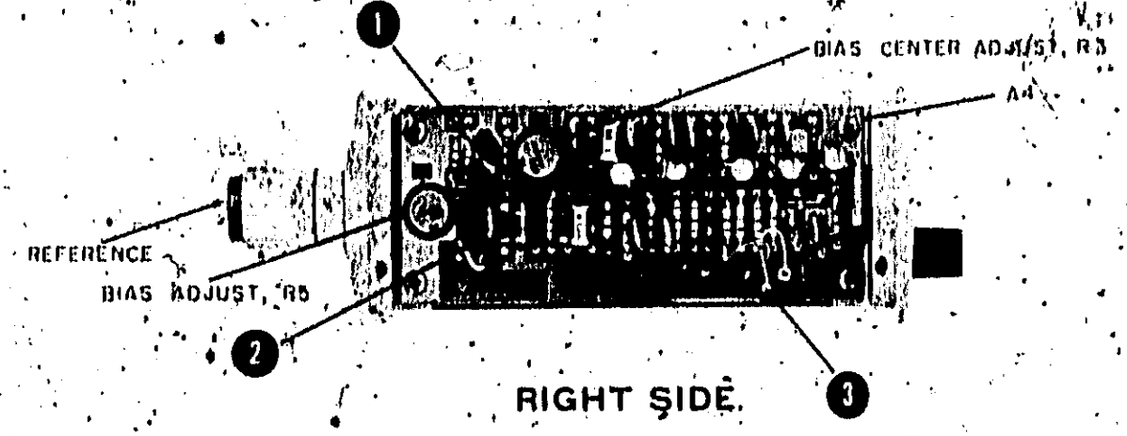


Figure I-9. Model 8411A Test Points

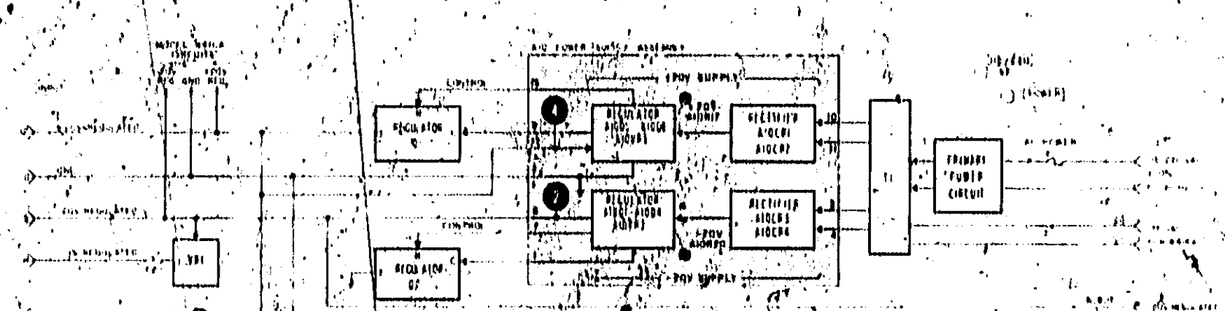


Figure I-7. Detail Block Diagram

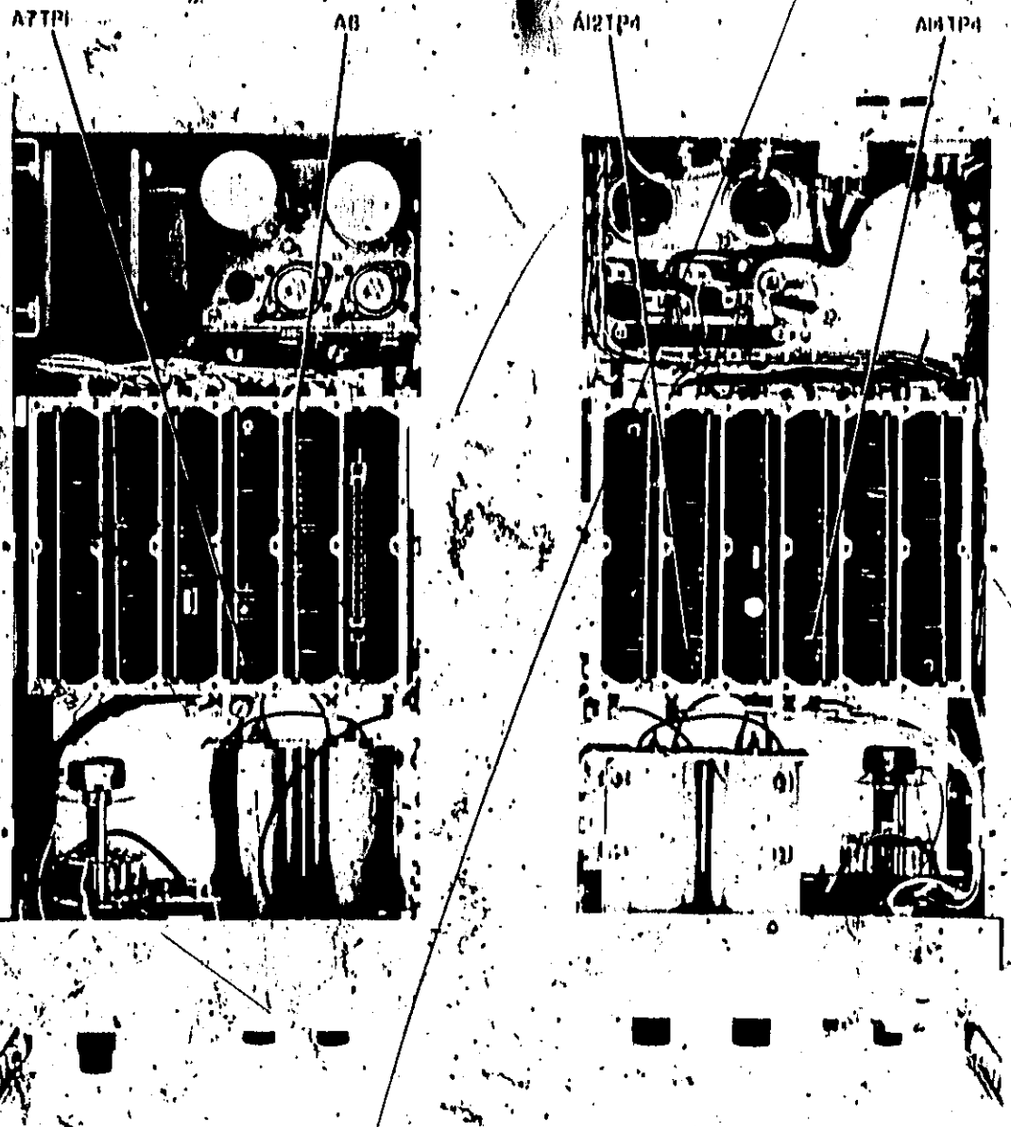


Figure I-8. Models 8410A 8411A Interface Test Points

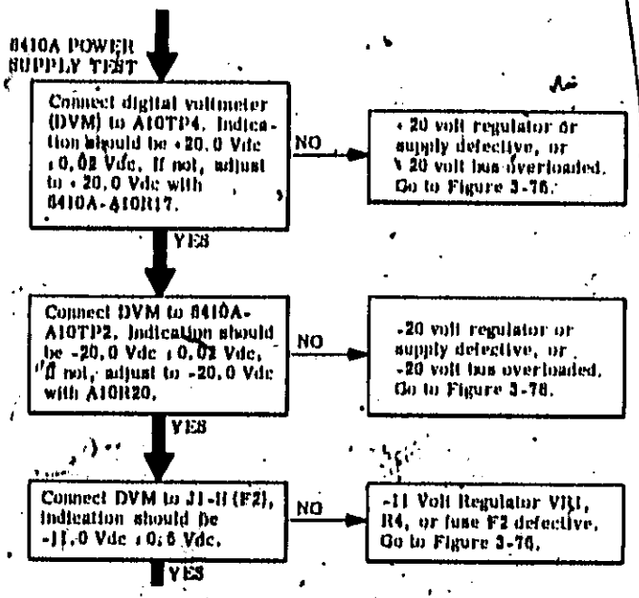


Figure I-0. Model 8410A/8411A Interface Troubleshooting

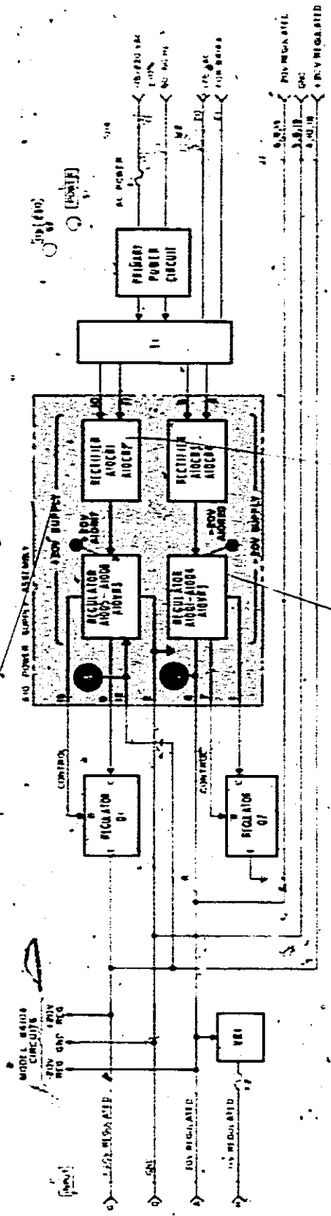
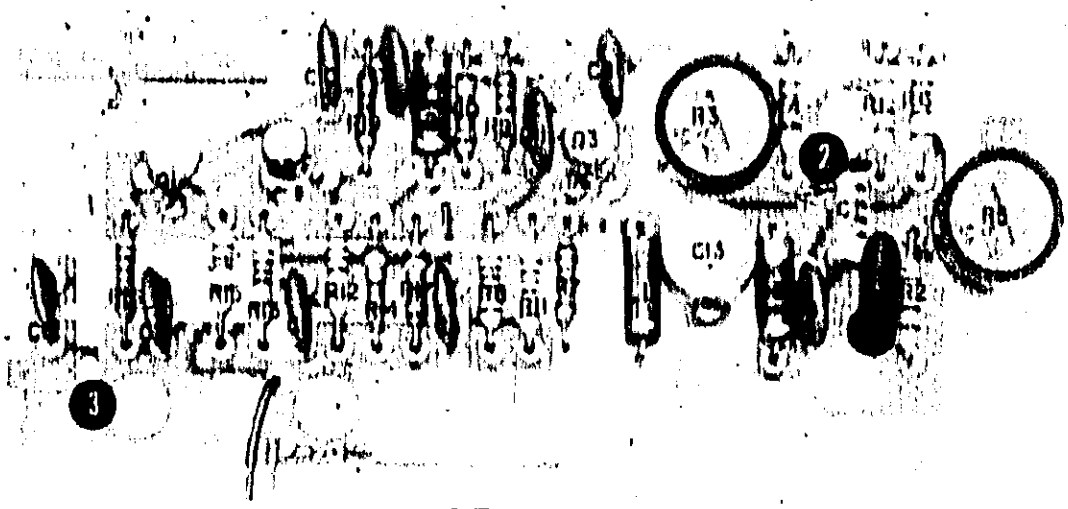
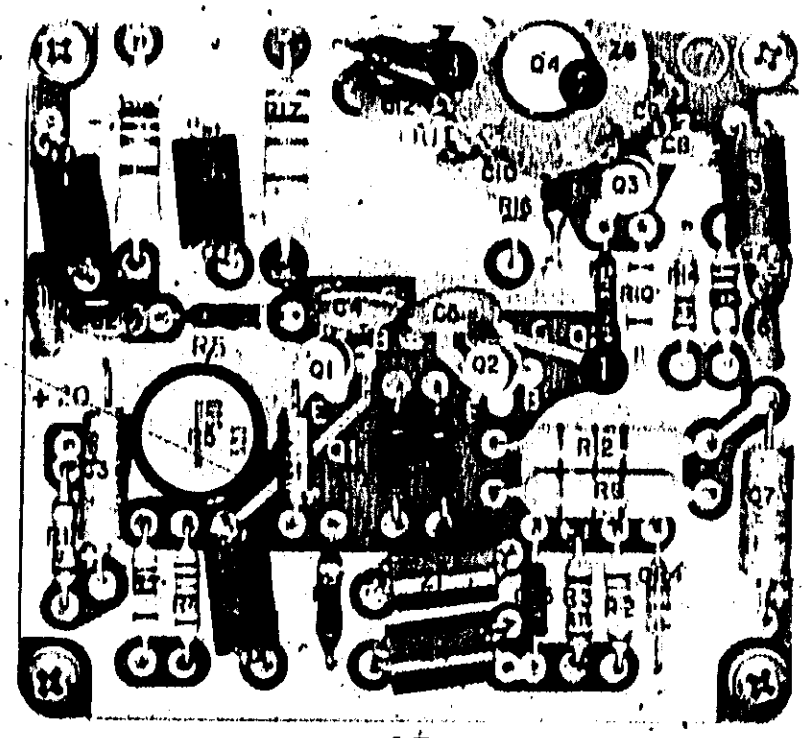


Figure 1-10. Model 8410A Partial Block Diagram



A5

Figure I-11. 8411A-A5 Parts Location



A7

Figure I-12. 8411A-A7 Parts Location

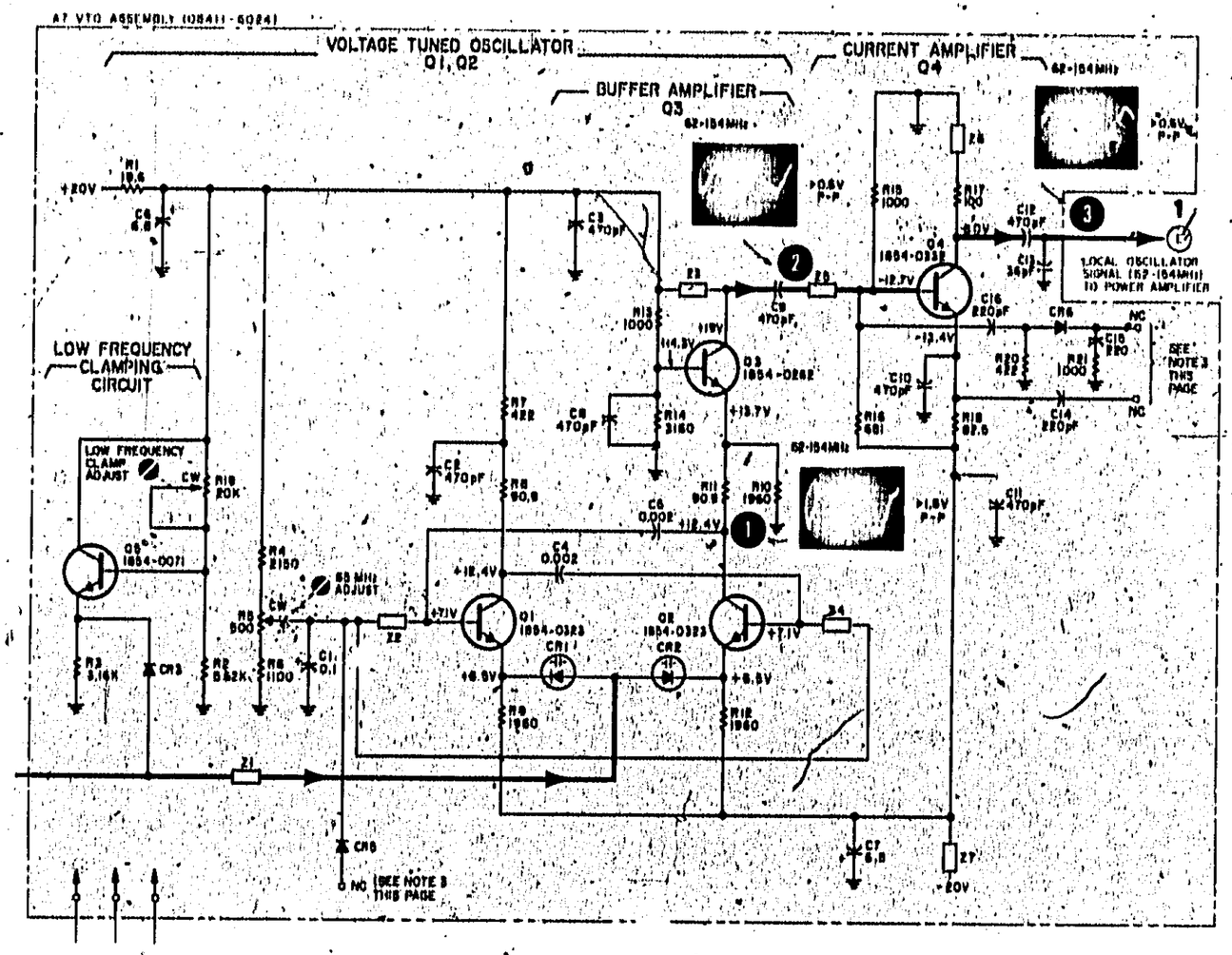


Figure 1-13. 8411A-A7 Schematic Diagram (For prefix 905- and 930-)

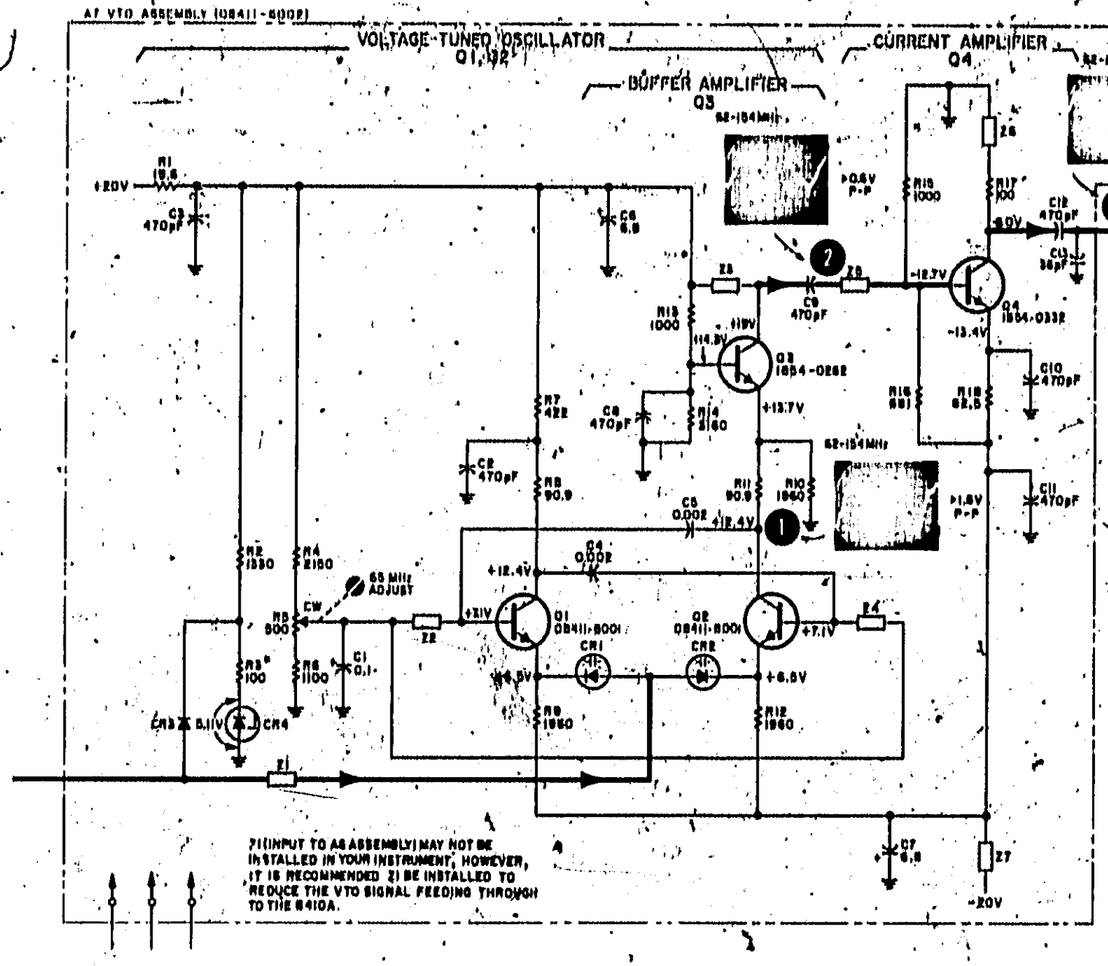


Figure 1-14. 8411A-A7 Schematic Diagram (Serials prefixed 850- and below)

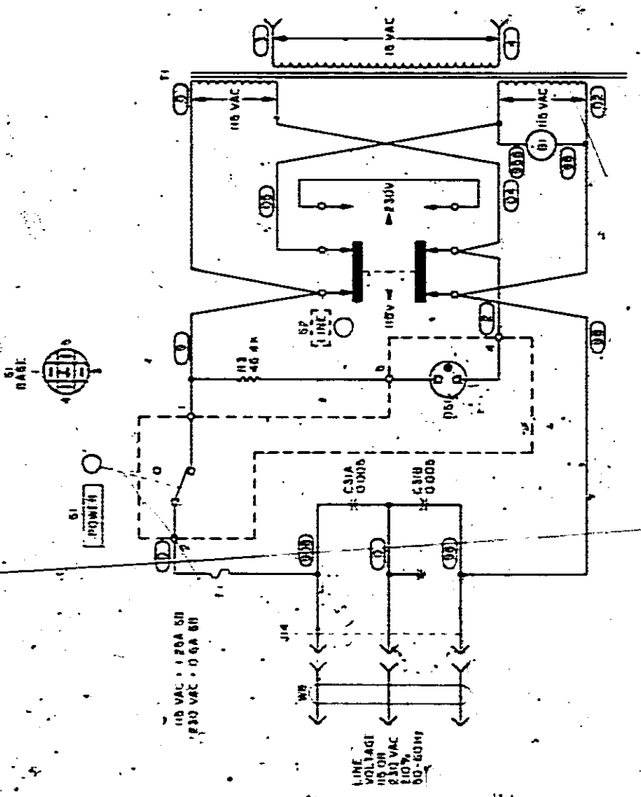


Figure I-15. -11V Power Supply Schematic

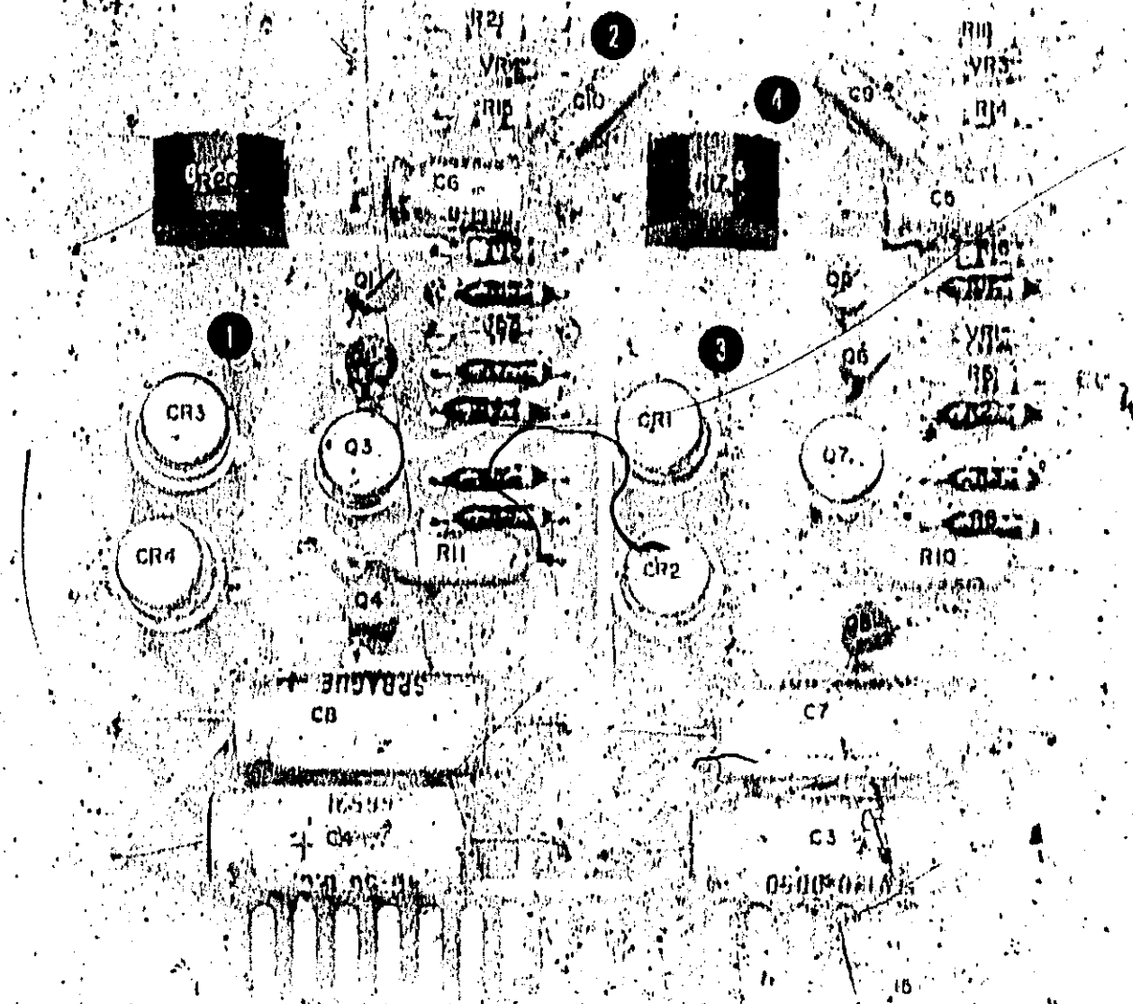


Figure I-16. 8410A-A10 Parts Location

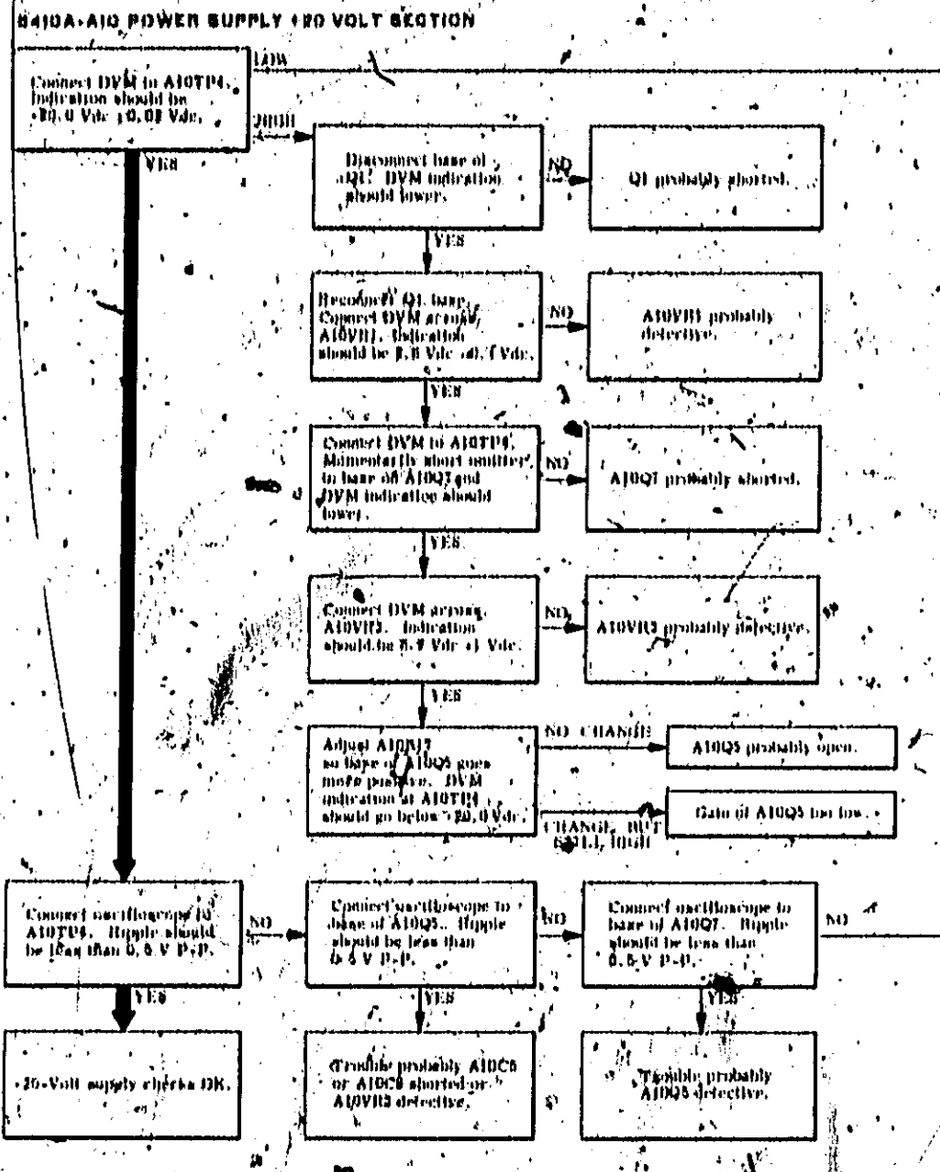


Figure I-17. 8410A-A10 +20V and -11V Power Supply Troubleshooting (Page 1 of 2)

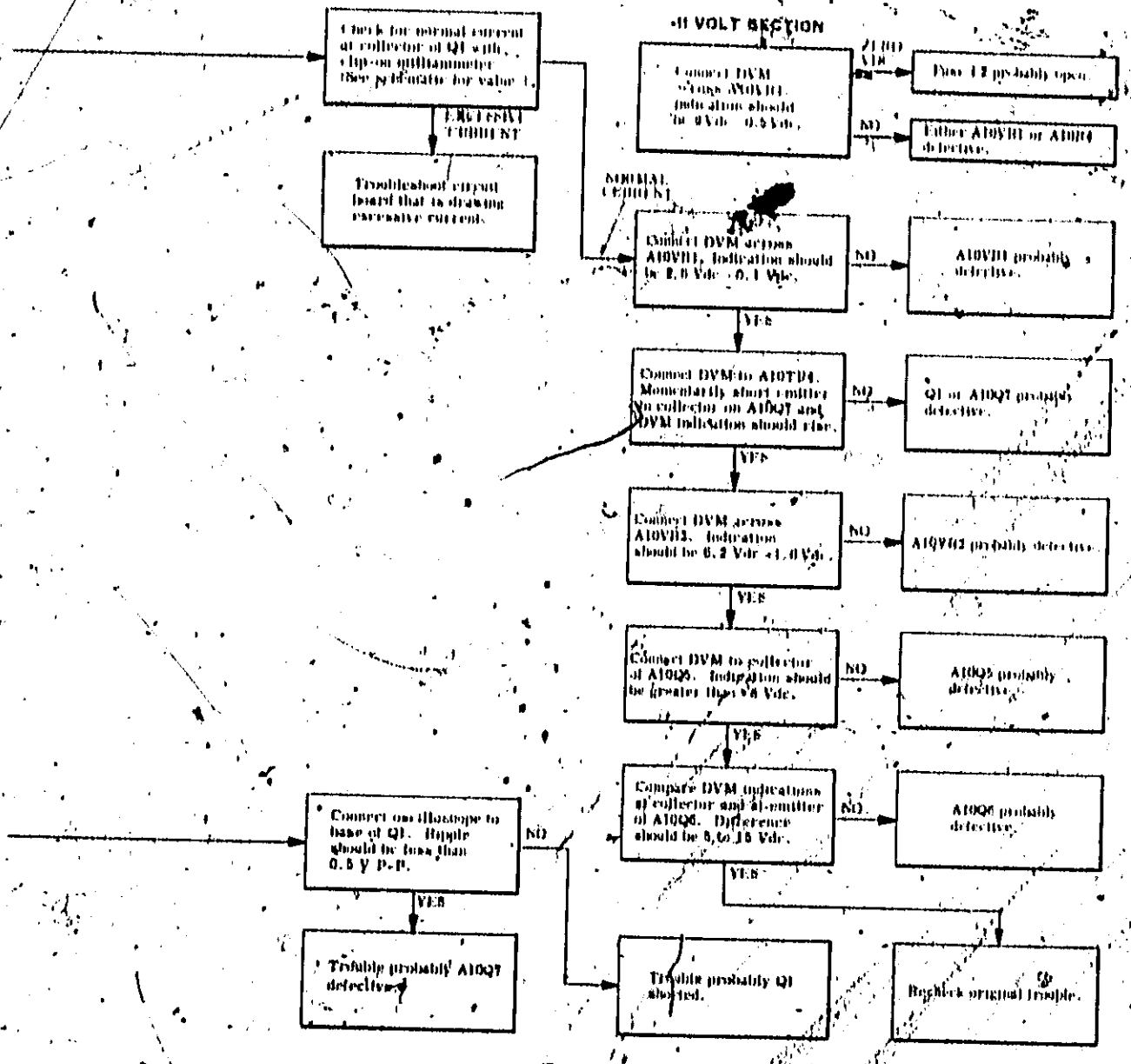


Figure-I-17. 8410A-A10 +20V and +11V Power Supply Troubleshooting (Page 2 of 2)

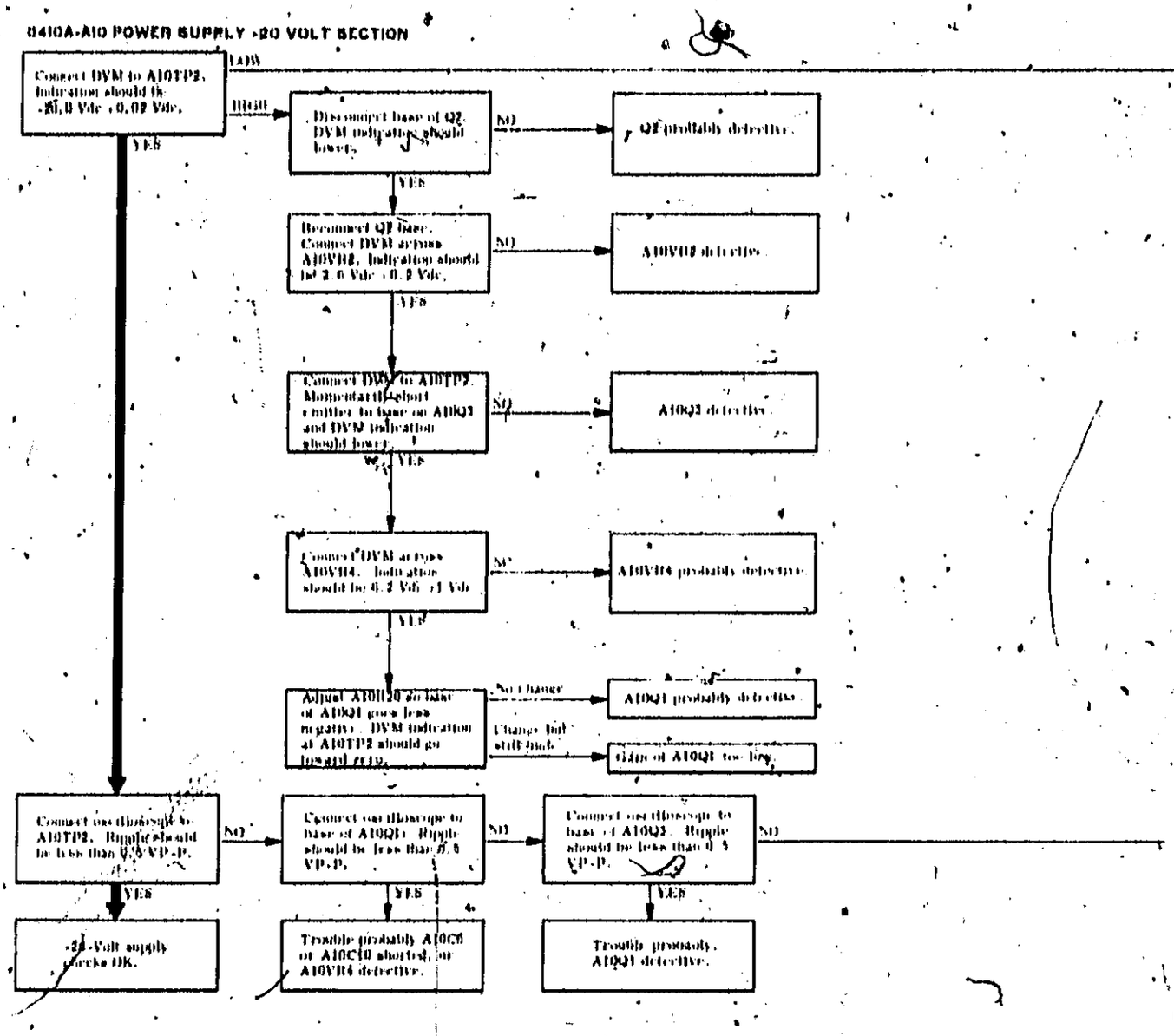


Figure 1-18. 8410A -20V Power Supply Troubleshooting (Page 1 of 2)

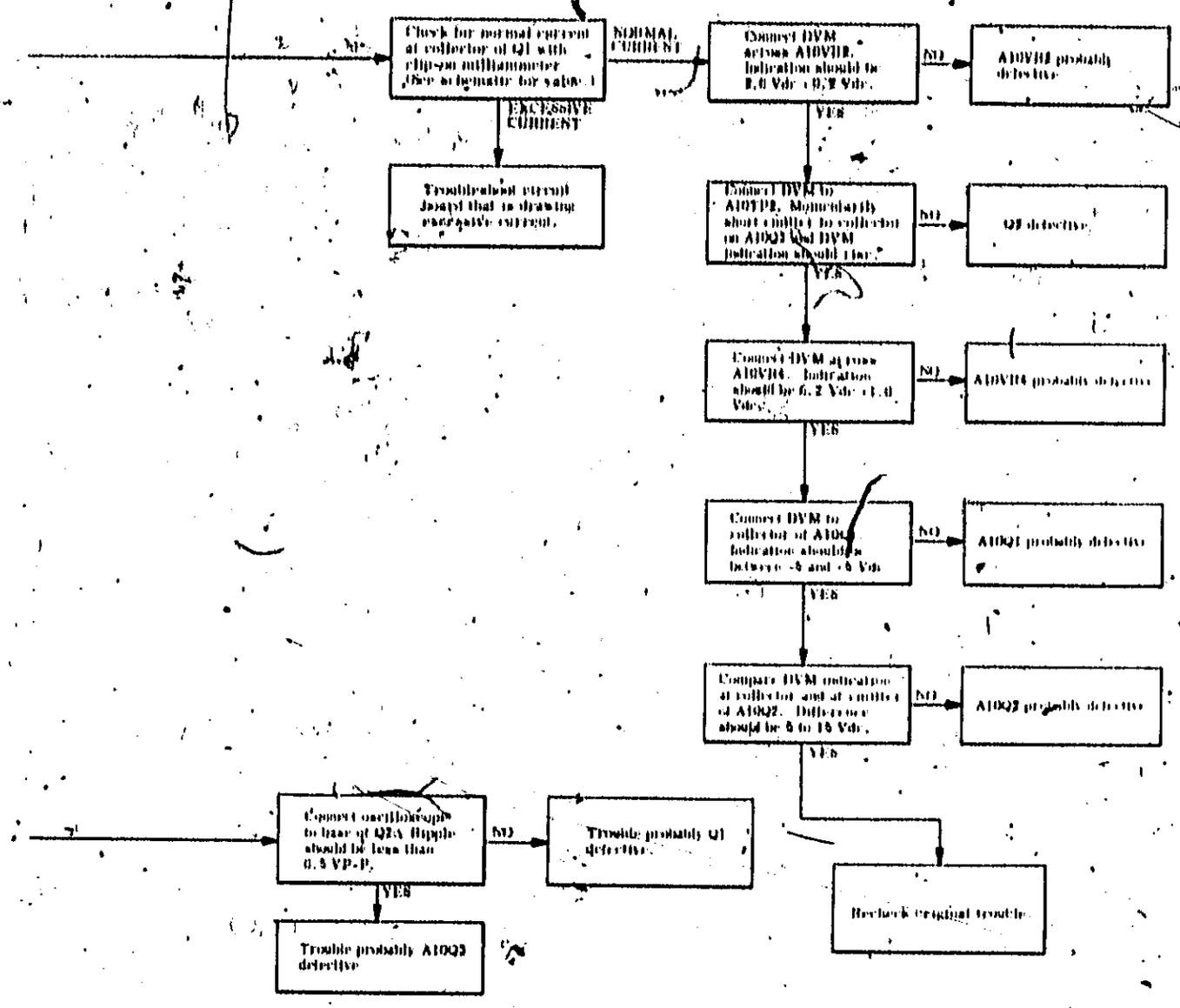


Figure I-18. 8410A -20V Power Supply Troubleshooting (Page 2 of 2)

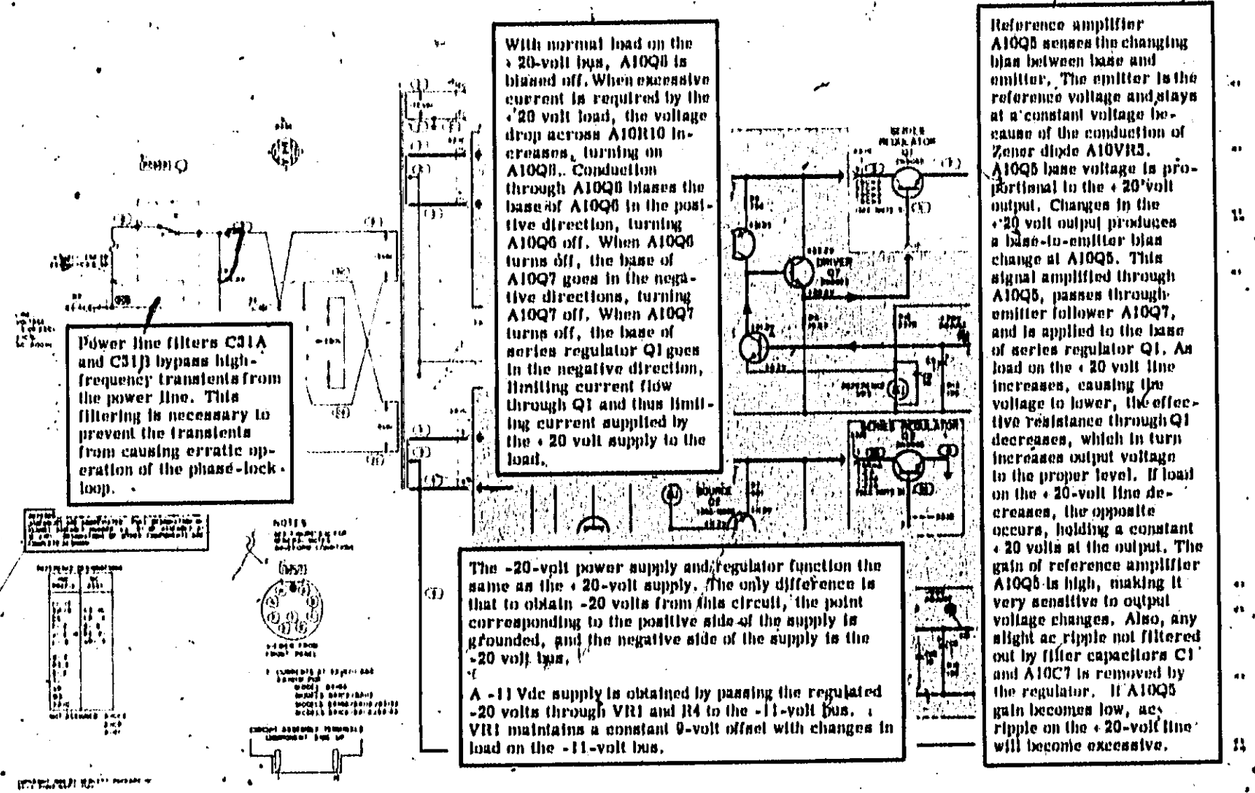


Figure 1-19. 8410A-A10 Talking Schematic

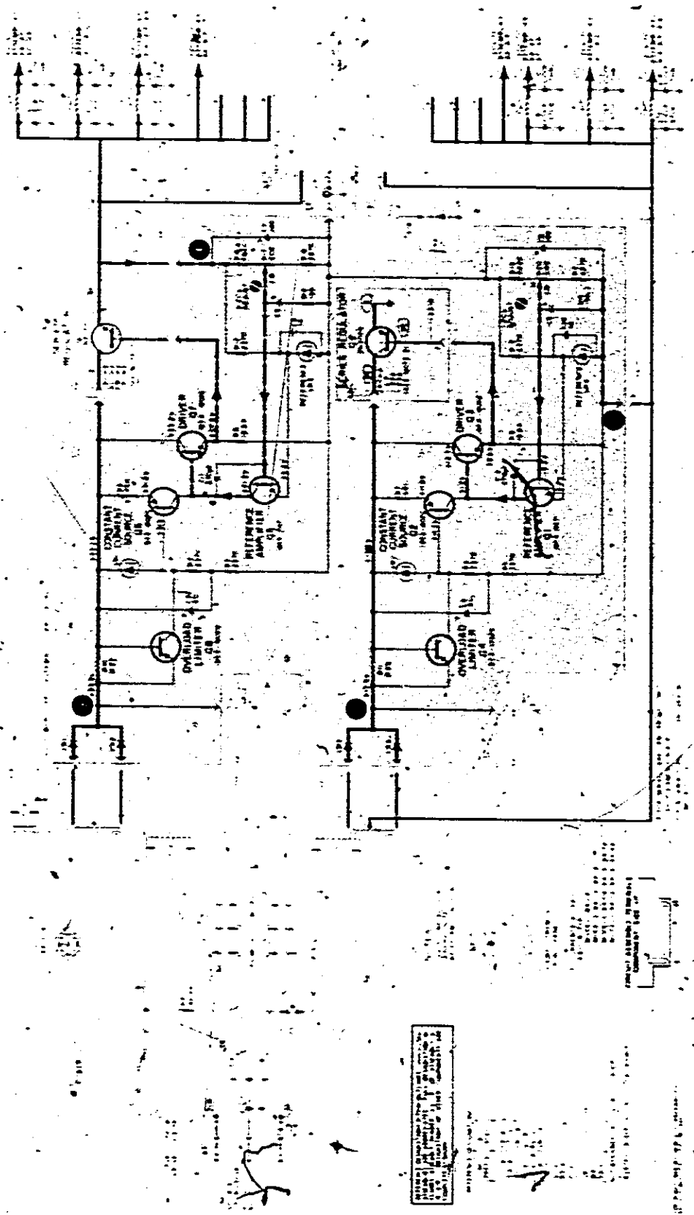


Figure I-20. 8410A-A10 Schematic Diagram

OPTIONS

APPENDIX II
OPTION 005

The Option 005 Model 8410A/8411A Network Analyzer consists of a standard Model 8410A/8411A with four additional connectors on the 8410A rear panel. Three of these connectors, labeled REF, TEST PHASE, and TEST AMPL are coaxial BNC jacks. The fourth connector is labeled BLANK and is a Black, single-terminal, banana-plug jack.

The REF jack is connected in parallel with the 8410A REF CHAN OUTPUT jack.

The TEST AMPL jack is connected in parallel with the 8410A TEST CHAN OUTPUT jack. The TEST CHAN PHASE jack is connected to the 8410A in parallel with the test channel phase signal to the Display Indicator used with the Model 8410A.

The BLANK jack is connected in parallel with a blanking signal from the 8410A which goes to the Display Indicator used with the Model 8410A.

These extra jacks, found only on the Option 005, are used to operate the Model 8418A Auxiliary Display Holder. Refer to the operating note for the Model 8418A for connection details. The additional jacks are shown on the schematics in this manual and are labeled "For Option 005 Only".

HP 8410A
Option 018
HP 8411A
Option 018

MANUAL SUPPLEMENT

NETWORK ANALYZER
8410A
OPTION 018

HARMONIC FREQUENCY CONVERTER
8411A
OPTION 018

SUPPLEMENT PART NO. 08410-90024

USE THIS SUPPLEMENT WITH
MANUAL PART NO. 08410-90020
PRINTED DEC. 1971

FEBRUARY 1973

HEWLETT hp PACKARD.

HP 8410A
Option 018
HP 8411A
Option 018

INTRODUCTION

This supplement describes the differences between the standard Model 8410A/8411A, and the Model 8410A Option 018 and Model 8411A Option 018. In addition, the supplement describes the changes necessary to the 8410A/8411A Operating and Service Manual (08410-90020) to document Option 018.

DESCRIPTION FOR THE MODEL 8411A OPTION 018

The Model 8411A Option 018 contains special samplers tested for operation to 18 GHz. For best operation in the 12.4 GHz to 18 GHz band, the Model 8411A Option 018 should be used with the Model 8410A Option 018.

DESCRIPTION FOR THE MODEL 8410A OPTION 018

The Model 8410A Option 018 is a standard 8410A with two extra FREQ RANGE switch positions to allow operation in the 12.4 GHz to 18 GHz range.

MANUAL CHANGES

Make the following manual changes to Model 8410A/8411A Operating and Service Manual (08410-90020) to incorporate the Model 8410A Option 018 and the Model 8411A Option 018:

Page 1-2, Table 1-1, SPECIFICATIONS: Change the following specifications in this table to read as follows:

Frequency Range: 0.11 to 18 GHz.

Input Impedance: 50Ω. SWR < 1.5, 0.11 to 8.0 GHz; < 2.0, 8.0 to 12.4 GHz; *typically increases to ~10:1 at 18 GHz.*

Channel Isolation: ≥ 65 dB, 0.11 to 6.0 GHz; >60 dB, 6.0 to 12.4 GHz; *>50 dB, 12.4 GHz to 18 GHz.*

AMPLITUDE

Range:

Reference Channel: Any 20 dB range between −10 dBm to −44 dBm (~36 mV to ~1.4 mV), 0.11 to 12.4 GHz; *any 15 dB range between −10 dBm to −36 dBm (~71 mV to ~4.0 mV), 12.4 to 18 GHz;* REF CHANNEL LEVEL meter indicates proper range. A 20-dB *(15-dB, 12.4 to 18 GHz)* variation in level causes ≤1.5 dB change in amplitude indication and <4° change in phase indication.

Frequency Response:

Reference and test channels typically track within ±0.3dB in any octave 0.11 to 8.0 GHz; ±0.4 dB, 8.0 to 12.4 GHz; *±1.5 dB, 12.4 to 18 GHz.*

Noise:

Less than −78 dBm equivalent input noise (measured on HP Model 8413A Phase-Gain Indicator), 0.11 to 12.4 GHz; *<−68 dBm, 12.4 GHz to 18 GHz.*

PHASE

Frequency Response:

Reference and test channels typically track within ±1° in any octave 0.11 GHz to 8.0 GHz; within ±2°, 8.0 GHz to 12.4 GHz; *within ±10°, 12.4 GHz to 18 GHz.*

Page 1-4, Figure 1-2, Front Panel Features (Sheet 1 of 2), Change step 2 as follows for the Option 018:

2. REFERENCE: Reference channel input. Impedance 50 ohms. Frequency Range: 0.11 to 18 GHz. Required input levels lie in a 20-dB range between −16 dBm and −44 Dbm, 0.11 GHz to 12.4 GHz; *15-dB range between −10 dBm and −36 dBm, 12.4 GHz to 18 GHz.* Input power is in this range when the REF CHANNEL LEVEL meter indicates in the OPERATE region. Range of the OPERATE region is approximately 16 dB ±4 dB. Connector is Amphenol precision APC-7.[1,2]

Page 1-5, Figure 1-2, Front-Panel Features (Sheet 2 of 2), 5. FREQ RANGE (GHz), Add the following note to step 5:

NOTE

For Option 018, two additional ranges are added to the SWEEP FREQ (GHz) switch to permit operation in the range 12.4 to 18 GHz. Operation is identical to operation of the standard 8410A with these two additional FREQ RANGE (GHz) ranges.

For operation in the 12.4 GHz to 18 GHz range using the 8411A Option 018 with a standard 8410A, make the following changes in the manual:

Page 1-5, Figure 1-2, Front Panel Features (Sheet 2 of 2), Change steps 5 and 6 to read:

5. FREQ RANGE (GHz). Coarse tuning control. Sets range of the automatic tuning to the frequency range selected. Selected range must

include frequency (or frequencies) at which measurements are to be made. For operation in the band 12.4 GHz to 18 GHz, set this control fully counterclockwise.

6. SWEEP STABILITY. Fine-tuning control. Adjusts for best automatic tuning. A CW-detent position at the fully counterclockwise position gives best auto-tuning for single-frequency CW-mode operation.

For 12.4 to 18 GHz operation, the best position of this control is usually fully counterclockwise, but not in the CW-detent position. If the above control settings do not provide stable operation in the 12.4 GHz to 18 GHz band, resistor A1R1 should be changed as described in the following paragraph of this supplement.

NOTE

For operation in the band from 12.4 GHz to 18 GHz, allow at least 30 minutes warmup time for stable Model 8411A operation.

Changes To Be Made To The Standard 8410A For Operation At 18 GHz

Page 3-103, Figure 3-74:

If the Model 8411A Option 018 is to be used with a standard Model 8410A, the SWEEP STABILITY control adjustment may not be sufficient to provide stable operation in the range 12.4 to 18 GHz. In this case resistor A1R1 must be changed.

Replace A1R1 (6.19KΩ) on the FREQ RANGE switch assembly with one of the following resistors. Use the 9090Ω value for the high-frequency end of the 12.4 to 18 GHz band, and the 7500Ω value for the low-frequency end.

HP Part No. 0757-0288, R: FXD MET FLM 9090 OHM 1% 1/8W.

HP Part No. 0757-0440, R: FXD MET FLM 7500 OHM 1% 1/8W.

If the resistor chosen will also operate satisfactorily in the 8 to 12.4 GHz band, it may be installed permanently. The Model 8410A Option 018 has both of these resistors permanently installed on two extra FREQ RANGE switch positions.

If the resistor chosen will not operate satisfactorily on the 8 to 12.4 GHz band, this resistor must be changed when changing bands.

Changes To The Calibration Test Procedure For Option 018

Page 2-5, Figure 2-1, Test 2, add the following:

Test channel noise should be less than −68 dBm for the 12.4 GHz to 18 GHz band.

Page 2-8, Figure 2-1, Test 4, add the following:

A 15-dB variation between −10 dBm and −35 dBm in the 12.4 GHz to 18 GHz range will cause less than ±0.75 dB amplitude and ±2° phase change.

Changes to the Adjustment Procedures for the Model 8411A Option 018

NOTE

Allow the Model 8411A Option 018 to warm up for at least 30 minutes before testing.

1. Perform all of the adjustments given in the Model 8410A/8411A Operating and Service Manual in Section III.

2. Repeat Test 11 on page 3-36 while sweeping signal source from 12.4 GHz to 18 GHz. With a VTO of 155 MHz, adjust A4R5 and A5R5 individually for maximum "birdie" channel output at 18 GHz, without significantly reducing the output at 12.4 GHz.

3. Perform Test 13 on page 3-43, Figure 3-11, making the following changes:

CHANNEL ISOLATION

Use a frequency range of 8 GHz to 12.4 GHz to make adjustments and then check the 12.4 GHz to 18 GHz and 4 GHz to 8 GHz ranges.

Test Limits: >50 dB, 12.4 GHz to 18 GHz.
>60 dB, 6 GHz to 12.4 GHz.

CHANNEL TRACKING:

Measure the amplitude frequency response variation in the 12.4 GHz to 18 GHz band. Variation should not exceed 3.0 dB peak-to-peak.

Rotate the SWEEP STABILITY control through its entire range while noting the vertical variation in the amplitude trace at 18 GHz. Variation should not exceed 0.5

dB. Adjust A6R6, if necessary. Do not adjust A4R5 as it was set up for maximum "birdie" amplitude at 18 GHz.

Check amplitude frequency response in the 8 GHz to 12.4 GHz band.

Measure phase frequency-response variation. Variation should not exceed:
20° peak-to-peak, 12.4 GHz to 18 GHz.

Replacement Parts for Both Models 8410A and 8411A Option 018

On page 3-48, Table 3-8, change the following to read:

A1 08410-62123 1 ASSY: FREQ RANGE SWITCH 28480 08410-62123.

On page 3-48, Table 3-8, add the following:

A1R1A 0757-0440 1 R: FXD MET FLM 7500 OHM 1% 1/8W 28480 0757-0440
A1R1B 0757-0288 1 R: FXD MET FLM 9090 OHM 1% 1/8W 28480 0757-0288.
A1R14A 0757-0276 1 R: FXD MET FLM 61.9 OHM 1% 1/8W 28480 0757-0276.
A1R14B 0757-0394 1 R: FXD MET FLM 61.1 OHM 1% 1/8W 28480 0757-0394

On page 3-65, Table 3-8, change the following to read:

A1 08411-60102 1 WIDEBAND SAMPLER ASSY (REF CHANNEL) 28480 08411-60102.

A1 08411-60103 1 WIDEBAND SAMPLER ASSY (TEST CHANNEL) 28480 08411-60103.

and add the following:

NOTE

Do not attempt to repair these samplers or the diodes in them. Repairs should only be made by replacing the complete sampler or by returning the Model 8411A Option 018 to Hewlett-Packard.

On page 3-103, Figure 3-74:
Use the attached Schematic A for the MP6 FREQ RANGE ASSEMBLY.

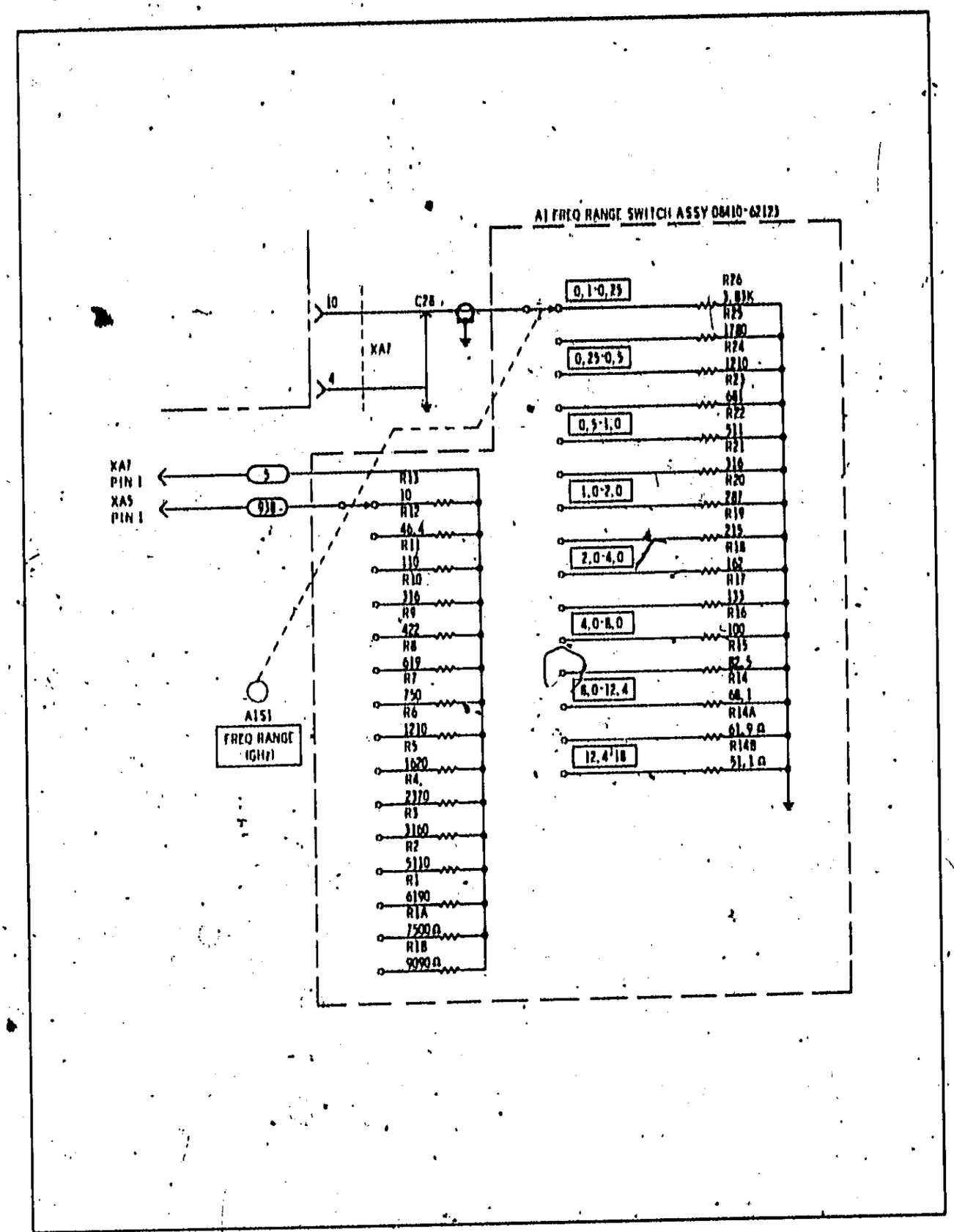


Figure A. A1 FREQ RANGE Switch for Model 8410A Option 018

SCHEMATIC DIAGRAMS

8411A

SAMPLER DIODE BIAS SUPPLY
REFERENCE PREAMPLIFIER

PHASE LOCK

NOTES

FOR COMPLETE NOTES AND MEASUREMENTS CONDITIONS
SEE FIGURE 3-10.

AMPLIFIER-LIMITER

GENERATOR

POWER AMPLIFIER

SAMPLERS

PHASE DETECTORS

REFERENCE OSCILLATOR

VOLTAGE-TUNED OSCILLATOR

VOLTAGE-TUNED OSCILLATOR

20 MHz SECOND LOCAL OSCILLATOR

TEST PREAMPLIFIER

20.278 MHz

8410A

20.278 MHz IF AMPLIFIER
AND SECOND MIXER

PHASE VERNIER

AUTOMATIC GAIN CONTROL

SEARCH, LOCK, TRACK

TEST CHANNEL GAIN

78 MHz IF AMPLIFIER AND SECOND MIXER

DIAGRAM

X 1144A

MODEL 8410A/8411A OVERALL SCHEMATIC DIAGR

8410A SERIAL PREFIX 1144A-/8411A SERIAL PREFIX 1144A

POWER SUPPLIES NOT INCLUDED

08410—90022

SERVICE NOTES

SERVICE NOTE

SUPERSEDES: None

HP MODEL 8410A NETWORK ANALYZERS
Serials 750-00280 and Below

IMPROVED AGC/PHASE LOCK CIRCUITRY

Operation of the Hewlett-Packard Model 8410A Network Analyzers have been improved by redesign of five circuit board assemblies. When replacing circuit board assemblies in Model 8410A Network Analyzers, serials 750-00280 and below, order the recommended replacements listed below:

Reference Designator	Original Part No.	Recommended Replacement
A5 Phase Detector	08410-6006	08410-6043
A12 Test AGC Amplifier	08410-6010	08410-6044 (includes three new assemblies: A12, A14, and A15 circuit boards)
and/or		
A14 Ref. AGC Amplifier	08410-6001	
and/or		
A15 AGC-DC Amplifier	08410-6004	
A7 VTO DC Amplifier	08410-6005	08410-6041

AD/lp

10/68-4

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For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

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SERVICE NOTE

SUPERSEDES

NEW TOP COVERS

HP Model 8410A Network Analyzer.
Serials 806-00680 and below
and
HP Model 8414A Polar Display
Serials 835-00640 and below

1. The top covers formerly used have been improved. The new covers increase operating reliability by allowing better ventilation.

2. The original, or "old-style", covers were solid, while the "new-style" covers are perforated. For the Model 8410A Network Analyzer, the new cover is available under HP Part Number 5060-0241. For the Model 8414A Polar Display, the new cover is available under HP Part Number 5060-0239.

3. These new covers may be obtained free of charge from any Hewlett-Packard Sales or Service Office using the following procedure:

   a. Contact your local Hewlett-Packard office and give them the serial number of each instrument requiring a new cover.

   b. The Hewlett-Packard office will supply these new covers at no charge to you.

NOTE

The original solid-covers should not be returned to Hewlett-Packard.

AD/mh/wa

4/69-4

Customer Service • 333 Logue Avenue, Mountain View, California 94040 Tel. (415) 968-9200
Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable "HEWPACKSA" Tel. (022) 42.81.50

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SERVICE NOTE

SUPERSEDES
None

RECOMMENDED POWER SUPPLY MODIFICATION

HP MODEL 8410A NETWORK ANALYZERS
Serials 806-00750 and below

1. Reliability of the Hewlett-Packard Model 8410A Network Analyzers (Serial Numbers 806-00750 and below) can be improved by modification of the dc Power Supply. This modification to power supply circuit HP Part Number 08410-6012, increases current handling and short circuit protection.

2. Parts Required for Modification.

Qty	Part Description	HP Part Number
2	Capacitor: Fxd Mica 270 pf 5% 600 VDCW	0140-0210
2	Transistor: Silicon NPN (2N1701)	1854-0062

3. MODIFICATION PROCEDURE.

   a. Remove top cover from 8410A Network Analyzer and remove A10 Power Supply Circuit board Assy.

   b. Refer to Figure 1 and remove R14, R15, C5, C6, Q3, and Q7.

   c. Install new transistors (2N1701) in place of removed Q3 and Q7 (see Figure 2).

   NOTE

   New transistors are larger than original Q3 and Q7. It is necessary to push transistors Q2 and Q6 slightly to side. Also, it is necessary to bend new transistor leads slightly in-ward.

   d. Install new capacitors (270 pf) on reverse side of circuit board assembly (see Figure 3).

   f. Re-adjust power supply as directed in Operating and Service Manual for Model 8410A (Adjustment Procedure).

   NOTE

   Maximum peak-peak ripple for modified power supply is changed to 5 mV.

4. PARTS LIST. A complete parts list for the modified circuit board assembly is attached to this Service Note.

5. SCHEMATIC DIAGRAM. A complete schematic diagram is attach to this Service Note.

AD/jr/wa

5/69-4

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Europe: 54 Route Des Acacias, Geneva, Switzerland. Cable: "HEWPACKSA" Tel: (022) 42 81 50

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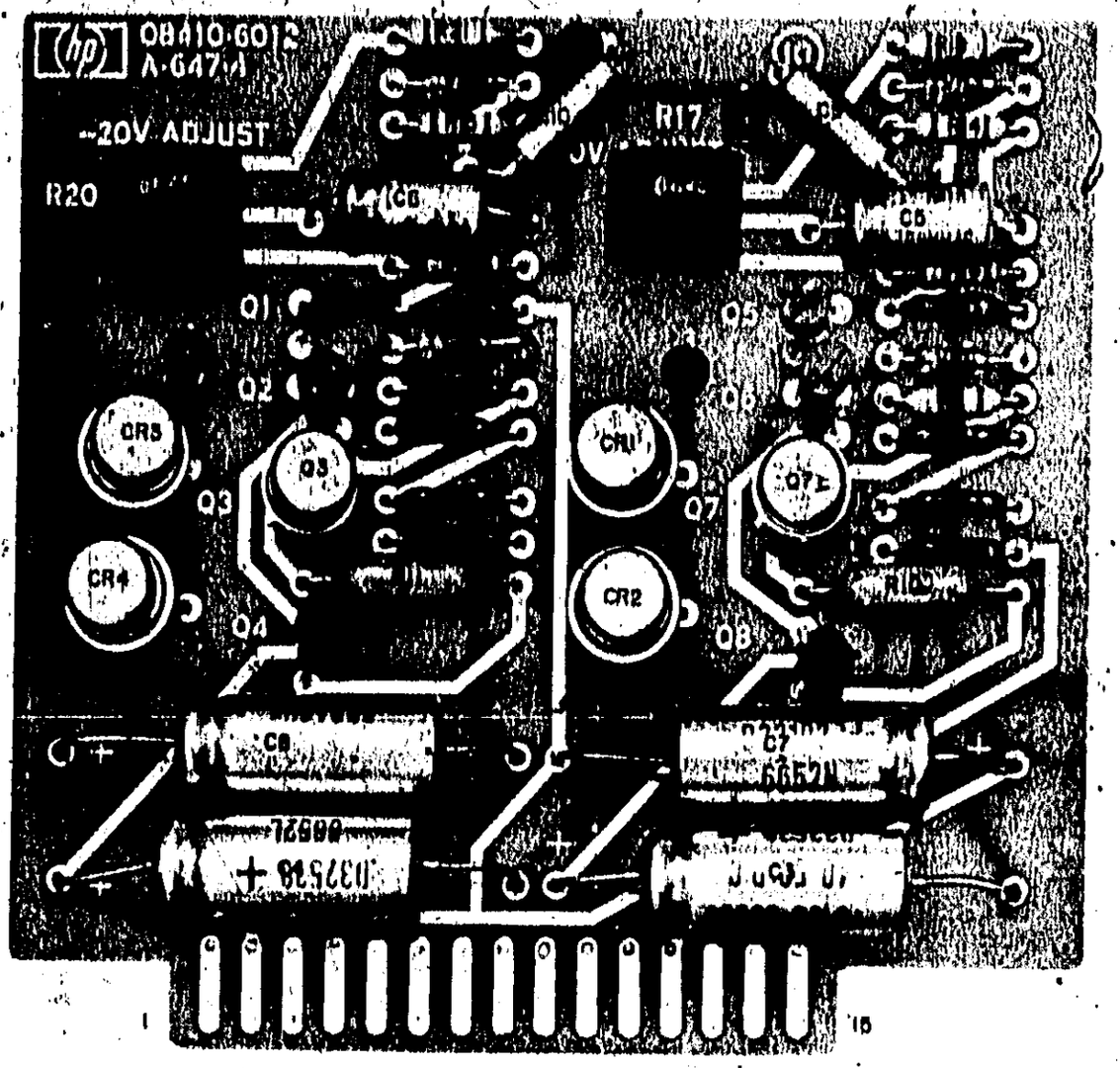


Figure 1. 8410A Original Assembly Before Modification

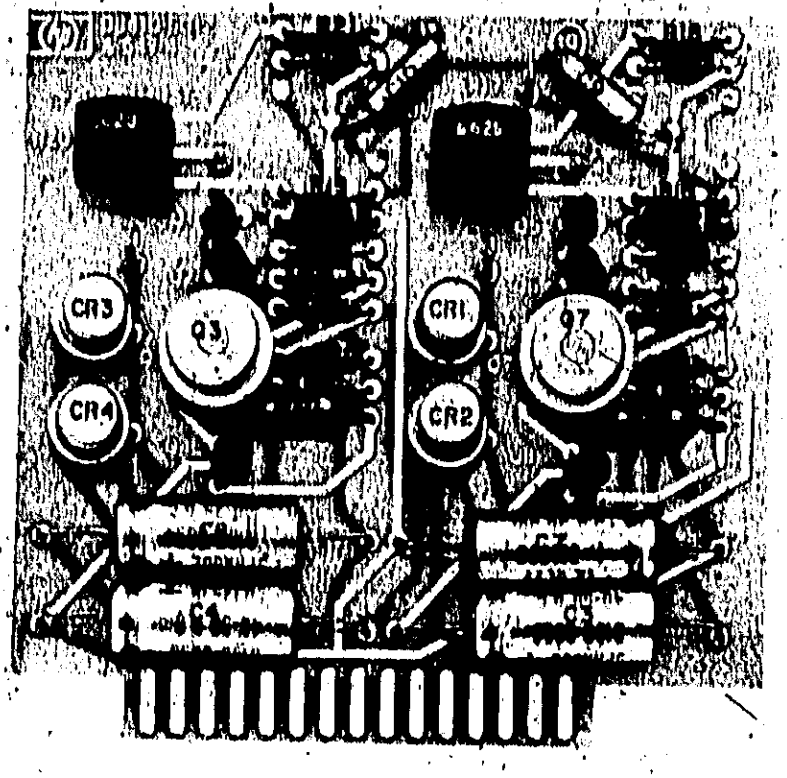


Figure 2. Modification Power Supply (Top view)

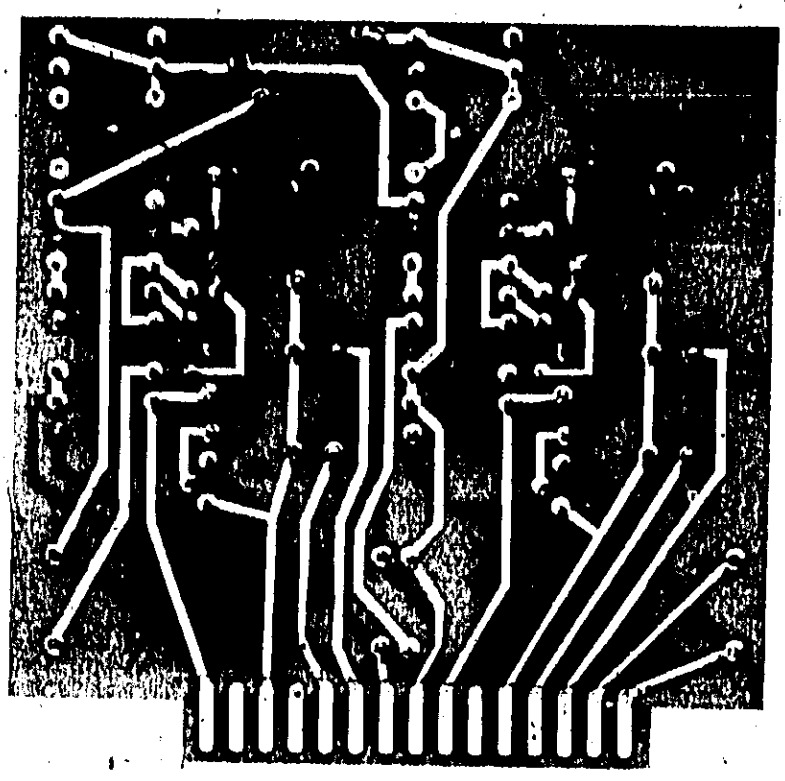
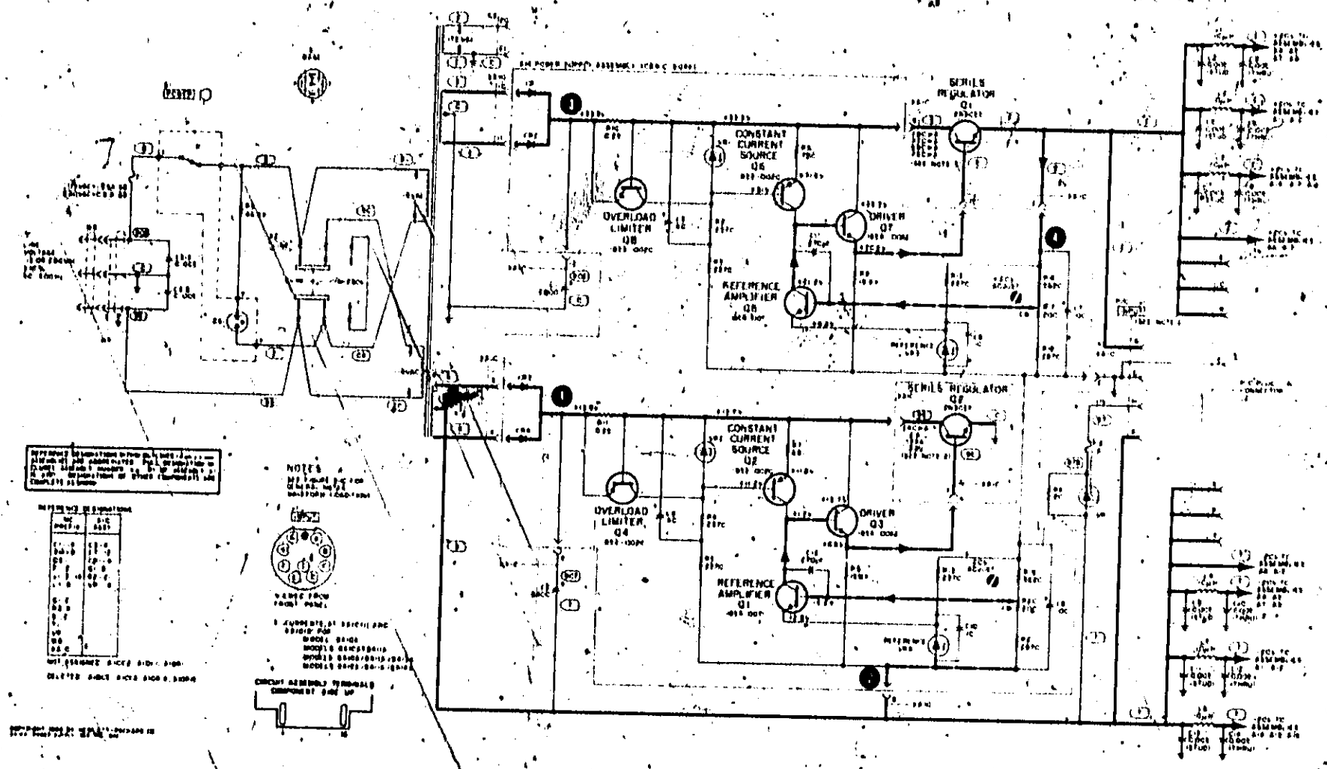


Figure 3. Modification Power Supply (Bottom view)



Power Supply Circuit (Modified 08410-6012)

Table 1. Reference Designation Index

Reference Designation	Part No.	Description #	Note
A10	08410-6046	ASSY:POWER SUPPLY BOARD (MODIFIED 08410-6012)	
A10C1	--	NOT ASSIGNED	
A10C2	--	NOT ASSIGNED	
A10C3	0180-0050	C:FXD ELECT 40 UF +75-10% 50 VDCW	
A10C4	0180-0050	C:FXD ELECT 40 UF +75-10% 50 VDCW	
A10C5	--	NOT ASSIGNED	
A10C6	--	NOT ASSIGNED	
A10C7	0180-0094	C:FXD ELECT 100 UF 25 VDCW	
A10C8	0180-0094	C:FXD ELECT 100 UF 25 VDCW	
A10C9	0180-0374	C:FXD ELECT 10 UF 10% 20 VDCW	
A10C10	0180-0374	C:FXD ELECT 10 UF 10% 20 VDCW	
A10C11	0140-0210	C:FXD MICA 270 PF 5% 500 VDCW	
A10C12	0140-0210	C:FXD MICA 270 PF 5% 500 VDCW	
A10CR1	1901-0200	DIODE:SILICON 100 PIV 3A (1N4998)	
A10CR2	1901-0200	DIODE:SILICON 100 PIV 3A	
A10CR3	1901-0200	DIODE:SILICON 100 PIV 3A	
A10CR4	1901-0200	DIODE:SILICON 100 PIV 3A	
A10Q1	1854-0071	TRANSISTOR:SILICON NPN (2N3901-G.E./SPRAGUE)	
A10Q2	1853-0020	TRANSISTOR:SILICON PNP (SKA-1123-TEXAS INST.)	
A10Q3	1854-0062	TRANSISTOR:SILICON 2N1701 (RCA)	
A10Q4	1853-0020	TRANSISTOR:SILICON PNP	
A10Q5	1854-0071	TRANSISTOR:SILICON NPN	
A10Q6	1853-0020	TRANSISTOR:SILICON PNP	
A10Q7	1854-0062	TRANSISTOR:SILICON 2N1701 (RCA)	
A10Q8	1853-0020	TRANSISTOR:SILICON PNP	
A10R1	--	NOT ASSIGNED	
A10R2	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R3	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R4	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R5	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R6	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A10R7	0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	
A10R8	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A10R9	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A10R10	0812-0017	R:FXD WW 0.25 OHM 5% 3W	
A10R11	0812-0017	R:FXD WW 0.25 OHM 5% 3W	
A10R12	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R13	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A10R14	--	NOT ASSIGNED	
A10R15	--	NOT ASSIGNED	
A10R16	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A10R17	2100-1756	R:VAR WW 200 OHM 10% LIN 1/2W	
A10R18	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A10R19	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A10R20	2100-1756	R:VAR WW 200 OHM 10% LIN 1/2W	
A10R21	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A10VR1	1902-0126	DIODE BREAKDOWN:2.61V 5%	
A10VR2	1902-0126	DIODE BREAKDOWN:2.61V 5%	
A10VR3	1902-0588	DIODE BREAKDOWN:6.19V 1%	
A10VR4	1902-0588	DIODE BREAKDOWN:6.19V 1%	

See introduction to this section for ordering information

SERVICE NOTE

SUPERSEDES

None

HP MODEL 8410A NETWORK ANALYZERS
Serial Prefix 087- and above
COMPATIBILITY WITH 8413A PHASE-GAIN INDICATORS

Model 8410A Network Analyzers serial prefixed 087- and above may not be compatible with some 8413A Phase-Gain Indicators. Phase-Gain Indicators which have been aligned using Network Analyzer mainframes with A16 Assembly HP Part No. 08410-6002 may require realignment. Network Analyzers prefixed 087- and above have a new A16 Assembly, HP Part No. 08410-60062. This difference in A16 Assemblies may result in 8413A Phase Offset Polarity unbalance.

To determine if your 8413A requires realignment, adjust phase relationship of the input signals to obtain a zero phase indication on the 8413A set to the 6 degree range and switch between (+) and (-) zero phase offset. The difference in meter indications should be less than 0.05 degrees. If not, perform the Alignment Procedure in the 8413A Operating and Service Manual.

If several Model 8410A Network Analyzer systems are operated in the same organization, A16 Assembly HP Part No. 08410-60062, which is a direct replacement, should be installed in each 8410A to insure that all Model 8413A Phase-Gain Indicators will be adjusted correctly when installed in any 8410A mainframe.

HP/mkh/WO

8/70-4

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SERVICE NOTE

SUPERSEDES

NONE

HP MODEL 8410A NETWORK ANALYZER

Serial Number 932-01130 and below if modified to include fan

Serial Numbers 935-01131 through 1144A02227

NEW REPLACEMENT HARDWARE FOR MOUNTING FAN

The hardware used to mount the fan, finger guard, air filter, and filter frame to the rear panel of the HP 8410A Network Analyzer serial number 1144A02228 and above has been changed to that listed in Table 1. The hardware listed in Table 1 is the recommended replacement when replacing the mounting hardware in 8410A's with serial number 935-01131 through 1144A02227 and also 932-01130 and below if the 8410A has been modified to include a fan.

Table 1.

QTY	DESCRIPTION	HP PART NUMBER
4	Nut Cap 6-32 x .312	0510-0110
8	Washer, Lock .141 ID	2190-0018
4	Screw, Mach 6-32 x .750	2360-0205
4	Nut, Hex 6-32 x .312	2420-0001
4	Washer .281 OD	3050-0016

INSTALLATION PROCEDURE

1. Disconnect 8410A from power line.
2. Remove left side and bottom covers.
3. Remove air filter and filter frame.
4. Remove old hardware and replace with new hardware (see Figure 1), one screw at a time so fan and finger guard remain in place.
5. Replace air filter and filter frame using cap nuts as shown in Figure 1.
6. Replace side and bottom covers.

AS/RH/WN

6/73-4

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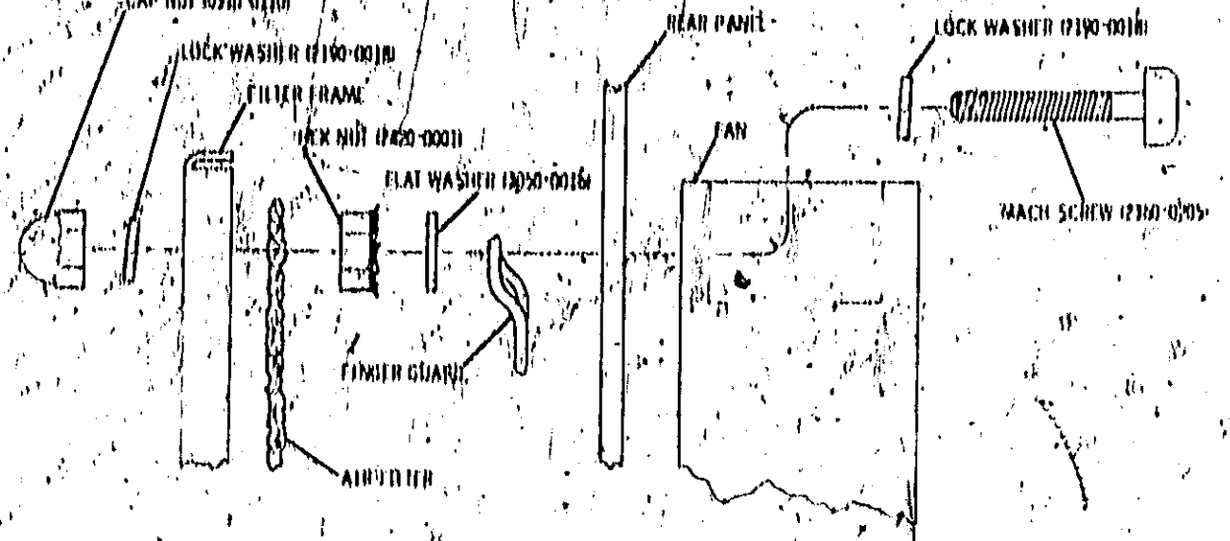

Figure 1. Exploded View

SERVICE NOTE

Supersedes

None

HP MODEL 8411A HARMONIC FREQUENCY CONVERTERS
SERIAL PREFIX 850 and below

REDUCING VTO FEEDTHROUGH

Four magnetic beads installed on 8411A W1 at input to the A6 Assembly.

VTO signal, feeding through to the 8410A, can mix with the 20 MHz oscillator signal producing spurious signals or beat notes on the displayed trace. Installing magnetic beads on W1 reduces the VTO signal leading through to the 8410A and thus reduces the spurious signals. Beads should be installed on all units even though spurious signals are not evident.

INSTALLATION.

Install Z1 (HP Part No. 0170-0016, 4) on 8411A W1 center conductor at input to A6 Assembly.

The addition of Z1 does not required adjustment of the 8411A.

Make the following changes to the 8410A/8411A Operating and Service Manual:

Page 3-78, Table 3-9:
Add Z1 HP Part No. 0170-0016 BEAD, MAGNETIC SHIELDING (4)

Page 3-109, Figure 3-12:
Add Z1 on cable W1 at input to A6 Assembly.

HP/ab/WO

1-70

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MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 8410A/8411A
Date Printed: December, 1971
Part Number: 08410-90020

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number 8410A	Make Manual Changes
1310A02346 02371 02372 02373	2
1310A02411 and above	2, 3
1310A03271 and above 1422A	2, 3
► 1450A, 1625A	2, 3, 4

Serial Prefix or Number 8411A	Make Manual Changes
1344A02086 and above	1

► NEW ITEM

ERRATA

Inside front cover:

Insert new information regarding SAFETY, CERTIFICATION, and WARRANTY AND ASSISTANCE immediately inside front cover of manual (new information sheet supplied in this Manual Changes Supplement).

Page 1-1, General Information:

Add the following information preceding Paragraph 1-1:

1-A. SAFETY CONSIDERATIONS

General

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in safe condition. This is a Safety Class I instrument.

Operation

BEFORE APPLYING POWER, make sure the instrument's ac input is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken.

Service

Although the instrument has been designed in

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

13 MAY 1976
7 Pages

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HEWLETT hp PACKARD

ERRATA (Cont'd)

accordance with international safety standards, the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. Service and adjustments should be performed only by qualified service personnel.

Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when inevitable, should be performed only by a skilled person who knows the hazard involved.

Capacitors inside the instrument may still be charged even though the instrument has been disconnected from its source of supply.

Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short circuit the fuse holders.

Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

WARNING

If this instrument is to be energized through an autotransformer (for voltage reduction), make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall only be inserted in a socket outlet provided with protective earth contact. The protection must not be negated by using an extension cord (power cable) without a protective grounding conductor.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

With the ac power cable connected, the ac line voltage is present at the terminals of the power line module and at the LINE power switch. Be very careful. Bodily contact with this voltage can be fatal.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument's ac input is set to the voltage of the ac power source.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure that all devices connected to the instrument are connected to the protective earth ground.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the ac line fuse is of the required current rating and type (normal-blow, time-delay, etc.).

SAFETY

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring apparatus," and has been supplied in safe condition. This is a Safety Class I instrument. To ensure safe operation and to keep the instrument safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this instrument.

CERTIFICATION

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

WARRANTY AND ASSISTANCE

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

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

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

ERRATA (Cont'd)

Page 1-2, Table 1-1. Models 8410A and 8411A Specifications:
AMPLITUDE, Range:
Change Reference Channel to read as follows:
Any 20 dB range between −16 dBm to −44 dBm (≅36 mV to ≅1.4 mV); REF CHANNEL LEVEL meter indicates proper range. A 20 dB variation in level causes ≤1.5 dB change in amplitude reading and ≤4° change in phase reading.

PHASE, Frequency Response:
Change to read as follows:
Reference and test channels typically track within ±1° in any octave 0.11 to 8 GHz; within ±2°, 8.0 to 12.4 GHz. (Includes 8410A/8411A response only.)

Page 1-9, paragraph 1-67:
Add the following:
The rate of change of frequency must not exceed the tracking ability of the Network Analyzer. The Network Analyzer should remain phase-locked (track) with sweep speeds of about 300 milliseconds/octave from 0.11 to 8 GHz (300 milliseconds from 8 to 12.4 GHz). With proper sweep reference voltage (see paragraph 1-69), the network analyzer should remain phase-locked with sweep speeds of about 25 milliseconds/octave from 0.11 to 8 GHz (25 milliseconds from 8 to 12.4 GHz).

Page 3-16, Paragraph 3-52, step d(5):
Change last sentence to read:
Use the minimum amount of heat and low-temperature solder, HP Part No. 8090-0298, to solder the capacitor.

Page 3-52, Table 3-8:
Change part number of A9 to HP Part No. 08410-61018.

Page 3-54, Table 3-8:
Change A11 to HP Part No. 08410-60073.

Page 3-57, Table 3-8:
Change A15Q4 and A14Q5 to HP Part No. 1854-0475 Preferred Replacement, HP Part No. 1854-0221 Alternate Replacement.

Continued . . .

ERRATA: (Cont'd)

Page 3-58, Table 3-8:
Change A16C17 to HP Part No. 0150-0121 C: FXD CER 0.1 μF +80 −20% 50 VDCW.

Page 3-85, Figure 3-38:
Add asterisks to A5A8 and A5R19.

Page 3-87, Figure 3-42:
Change HP Part No. of A7Q4 to 1854-0498.

Page 3-89, Figure 3-46:
Change Note 2 to read: A12Q5 and A12Q7 and A14Q5 and A14Q7 are matched transistors. Replace in pairs. See Table of Replaceable Parts.

Page 3-91, Figure 3-50:
Change polarity of C35.

Page 3-106, Figure 3-76:
Connect bottom of A10A1R33 to −20V and relabel R33 as R10 4640 ohms.
Delete A10A1C8 and A10A1R34.
Add A10A1R7 10 ohms and A10A1C2 0.05 μF in series in place of C9.
Add A10A1R 7 2.7 ohms and A10A1C4 1 μF in series in place of C10.

CHANGE 1

Page 3-70, Table 3-9:
Change Item 8 to:
HP Part No. 0698-7105 Rs FXD METFLM 10.6 OHM 2% 1/8W. Mfg. Code 28480, HP Part No. 0698-7105.

NOTE

This resistor is being used as a temporary measure until a more suitable replacement is available. When replacing these resistors, order by Model Number and Reference Designator to obtain the most recent resistors available.

CHANGE 2

Page 3-59, Table 3-8:
Change J3 and J4 to HP Part Number 1250-0102, CONNECTOR: BNC, Mfg. Code 28480, 1250-0102.
Change J16 to HP Part Number 1250-0102, CONNECTOR: BNC (OPT 005), Mfg Code 28480, 1250-0102.
Change J17 to HP Part Number 1250-0102, CONNECTOR: BNC (OPT 005, H26), Mfg. Code 28480, 1250-0102.

Page 3-60, Table 3-8:
Change W6P1 to HP Part Number 1250-0887 (Same description).
Change W10P1 to HP Part Number 1250-0892 (Same description).
Change W12 to HP Part No. 08410-60068 CABLE ASSY:TEST AMPL (OPTION 005) Mfg. Code 28480, HP Part No. 08410-60068.
Change W14 to HP Part No. 08410-60069 CABLE ASSY:REF-REF CHAN OUTPUT (OPTION 005) Mfg. Code 28480, HP Part No. 08410-60069.
Add W15 HP Part Number 08410-60071 CABLE ASSY:TEST CHAN OUTPUT-J2 CONN. Mfg. Code 28480, HP Part No. 08410-60071.
Add W16 HP Part Number 08410-60072 CABLE ASSY:REF CHAN OUTPUT-J2 CONN. Mfg Code 28480, HP Part No. 08410-60072.

CHANGE 3

Page 1-6:
Replace Figure 1-3 with new Figure 1-3a. Delete all manual references to OPT 005 (OPT 005 is incorporated in the standard instrument).

Page 3-59, Table 3-8:
Change J16 to HP Part Number, 1250-0102, CONNECTOR:BNC, Mfg. Code 28480, 1250-0102.
Change J17 to HP Part Number, 1250-0102, CONNECTOR:BNC, Mfg. Code 28480, 1250-0102.
Add J18 HP Part Number, 1510-0009, BINDING POST:FOR BANANA PLUG, Mfg. Code 28480, 1510-0009.
Add (under J18) HP Part Number 0340-0710, INSULATOR:BINDING POST, Mfg. Code 28480, 0340-0710.

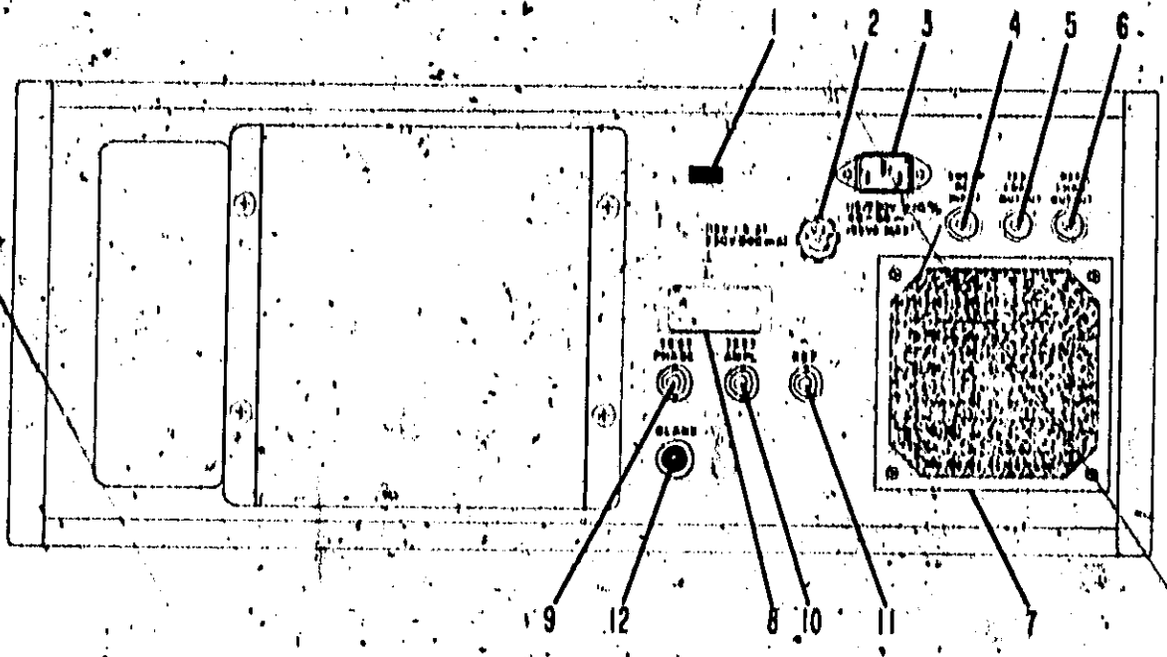
Page 3-60, Table 3-8:
Change W12 to HP Part Number 08410-60068 CABLE ASSY:TEST AMPL., Mfg. Code 28480, 08410-60068.
Change W13 to HP Part Number 08410-60059 CABLE ASSY:TEST PHASE, Mfg. Code 28480, 08410-60059.
Change W14 to HP Part Number 08410-60069 CABLE ASSY:REF, Mfg. Code 28480, 08410-60069.

Page 3-62, Table 3-8:
Change Item 2 to HP Part Number 08410-00043 PANEL:REAR (FAN SIDE), Mfg. Code 28480, 08410-00043.

►CHANGE 4

Addition of 8410B. Include Manual Supplement 08410-90048

REAR PANEL FEATURES



1. Line Voltage Selector. (Permits operation from 115 or 230 Vac.) Number showing on slider is selected operating voltage. Adjacent number on panel is correct line fuse rating.

2. Power line fuseholder. Fuse should have rating shown adjacent to number on line voltage selector.

3. Power Cable Connector. (NEMA type with offset pin connected to 8410A cabinet). Power requirements: 115 or 230 Vac ±10%, 48 to 66 Hz, approximately 85 watts with HP 8413A, 105 watts with HP 8414A.

4. SWEEP REF INPUT. Accepts a voltage proportional to reference channel input frequency. Voltage enables auto-tuning to trace fast sweeping input frequencies. Nominal 0 to +40 volts per octave from 20K ohms ±20% source impedance required. The lower voltage must coincide with the lowest input frequency. HP 690 and 8690 Sweep Oscillators furnish suitable reference voltages.[2] SWEEP REF INPUT voltage must be provided when sweep mode selected is from high frequency to low frequency at any sweep speed.

5. TEST CHAN OUTPUT. (278 kHz sine wave.) Amplitude depends upon the amplitude of the test channel RF input and the settings of the front-panel TEST CHANNEL GAIN (dB) and AMPL VERNIER controls. Amplitude range is 0 to about 10 volts p-p.

6. REF CHAN OUTPUT is a 278 kHz sinewave with amplitude fixed at about 2 volts p-p nominal when REF CHANNEL LEVEL meter reads in the OPERATE region.

7. Air Intake Filter. Clean regularly. Do not obstruct air flow.

8. Serial Number Plate. Eight-digit serial number should be included in any correspondence concerning the Model 8410A.

9. TEST PHASE Output is a 278 kHz phase signal for additional display unit. Amplitude is 0.18 volts p-p minimum.

10. TEST AMPL Output. (For additional display unit.) Parallels item 5.

11. REF Output. (For additional display unit.) Parallels item 6.

12. BLANK Output. Blanking signal (−2 to −4 volts blanked, −16 to −20 volts unblanked) for additional display unit.

[1] Swept frequency measurements can be made over somewhat wider frequency ranges than indicated by the FREQ RANGE (GHz) selector provided the sweep reference voltages cover the required ranges. See Tables 1-6 and 1-7 for details.

[2] 680-series Oscillators need dividers for sweep reference output, and internal dividers of 8690 Oscillators should be checked. See Tables 1-6 and 1-7.

Figure 1-3a. Model 8410A Rear Panel Features