HP 11661A

OPERATING AND SERVICE MANUAL

FREQUENCY EXTENSION MODULE

11661A

HEWLETT hp PACKARD

HP 11661A

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Thanks

Dave & Lynn Henderson

Dave & Lynn Henderson
Artek Media

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

FREQUENCY EXTENSION MODULE
11661A

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1433A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1216A, 1244A, 1248A, 1250A, 1339A, 1409A, 1412A, and 1430A.

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

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MANUAL PART NO. 11661-90015
Microfiche Part No. 11661-90016

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WARNINGS

SAFETY

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to retain the instrument in safe condition. Be sure to read and follow the safety information in Sections II, V, and VIII.

BEFORE CONNECTING THIS SYSTEM TO LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

HIGH VOLTAGE

To avoid contact with the line voltage, remove the line (main) power cable from the power outlet before removing or connecting the Frequency Extension Module.

Capacitors inside the instrument may still be charged even if the system has been disconnected from its source of supply.

Adjustments and troubleshooting are often performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

The multi-pin plug connector (on mainframe), which provides interconnection to the Extension Module will expose power supply voltages which may remain on the pins after the Extension Module is removed and after the (Mains) power cable is disconnected from the mainframe. Be careful to avoid contact with the pins during interconnection with the Extension Module.

CAUTIONS

PERFORMANCE TESTING

To avoid the possibility of damage to the instrument or test equipment, read completely through each test before starting it. Then make any preliminary control settings necessary before continuing with the procedure.

PLUG-IN REMOVAL

Before removing the Frequency Extension Module plug-in from the mainframe, remove the line (Mains) voltage by disconnecting the power cable from the power outlet.

NOTE: See ACCESSORIES SUPPLIED in Section I for part number information.

Figure 1-1. Model 11661A and Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard 11661A Frequency Extension Module plug-in, hereinafter referred to as the Extension Module. For more information on related instruments such as the Model 8660-series mainframes, 86600-series RF Section plug-ins, or 86630-series Modulation Section plug-ins, refer to the appropriate manual.

1-3. This manual is divided into eight sections which provide information as follows:

a. SECTION I, GENERAL INFORMATION, contains the instrument description as well as the accessory and recommended test equipment test.

b. SECTION II, INSTALLATION, contains information relative to receiving inspection, preparation for use, mounting, packing, and shipping.

c. SECTION III, OPERATION, provides information relative to instrument operation.

d. SECTION IV, PERFORMANCE TESTS, provides information required to ascertain that the instrument is performing in accordance with published specifications.

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

f. SECTION VI, REPLACEABLE PARTS, contains information required to order all parts and assemblies or effect exchange of assemblies.

g. SECTION VII, MANUAL CHANGES, normally contains backdating information to make this manual compatible with earlier equipment configurations.

h. SECTION VIII, SERVICE, contains descriptions of the circuits, schematic diagrams, parts location diagrams, and troubleshooting procedures to aid the user in maintaining the instrument.

1-4. Figure 1-1 shows the Extension Module with included accessories.

1-5. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4x6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-6. SPECIFICATIONS

1-7. Specifications for the Extension Module and RF Section plug-ins are combined. Refer to the RF Section manual for the combined specifications.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-10. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-11. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-12. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-13. DESCRIPTION

1-14. The HP Model 11661A Frequency Extension Module plug-in extends the output frequency range of the mainframe to meet the input requirements of high-frequency RF Section plug-ins (>160 MHz). The Extension Module contains two high-frequency phase-locked loops which receive digital tuning signals, variable synthesized signals, and fixed synthesized signals from the mainframe. The phase-locked loops use the mainframe signals in conjunction with a 4.43 GHz oscillator output that is common to both loops to produce two high-frequency output signals. One output signal is generated by a phase-locked summing loop using a Voltage Controlled Oscillator (VCO) that is tuneable in 1 Hz steps (100 Hz steps for option 004 mainframe) over the 3.95 to 4.05 GHz range. The other output signal is generated by a phase-locked loop using a Yittrium-Iron-Garnet (YIG) oscillator that is tunable in 100 MHz steps over the 2.75 to 3.95 GHz range. Since both phase-locked loops use the same 4.43 GHz oscillator, variations in the oscillator frequency do not affect the frequency difference between the summing loop and YIG loop outputs. The two output signals from the Extension Module are coupled to the RF Section plug-ins for mixing, amplification of the converted signal, and final output power level control.

1-15. Frequency modulation (FM) of the YIG loop output can be effected by supplying a frequency modulated reference signal instead of a fixed reference signal, to a phase detector in the phase-locked YIG loop. Thus, as the frequency modulated reference signal varies, the YIG loop output frequency varies accordingly.

1-16. ACCESSORIES SUPPLIED

1-17. Two coaxial cables, HP Part Numbers 11661-60026 (Gray-blue) and 11661-60028 (Gray), are supplied with the Extension Module. The cables are used to interconnect the YIG and SUM loop outputs to the RF Section inputs. The accessories are shown with the Extension Module in Figure 1-1.

1-18. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-19. Each Frequency Extension Module is installed in a plug-in cavity within an 8660-series mainframe. Logic control inputs, RF inputs, and power supply inputs are connected directly from the mainframe or through a compatible 86600-series RF Section plug-in to the Extension Module. The Extension Module outputs are connected to the RF Section.

1-20. The Synthesized Signal Generator System requires installation of an Auxiliary or Modulation Section. The only direct interaction between a Modulation Section and the Extension Module occurs when a frequency modulated RF output is selected. A 86630-series plug-in with FM capability couples a frequency modulated RF signal to the Extension Module. The FM portion of this signal is superimposed on an RF output to the RF Section.

1-21. EQUIPMENT AVAILABLE

1-22. An extender cable, HP Part Number 11672-60002, is required to extend the Extension Module for maintenance purposes. The extender cable is part of the HP 11672A Service Kit but may be ordered separately.

1-23. Extender cards used in servicing the Extension Module are contained in the HP Rack Mount Kit, HP Part Number 08660-60070, which is supplied with the mainframe.

1-24. RECOMMENDED TEST EQUIPMENT

1-25. Table 1-1 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the Extension Module. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

1-26. SAFETY CONSIDERATIONS

1-27. This instrument has been designed in accordance with international safety standards and has been supplied in safe condition.

1-28. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to retain the instrument in safe condition. Be sure to read and follow the safety information in Sections II, V, and VIII.

Table 1-1. Recommended Test Equipment

Item	Critical Specifications	Suggested Model	Use*
Digital Voltmeter	Accuracy: ±0.2% Range: 0.00 to 60 Volts	HP 34740 with HP 34702A	A,T
Oscilloscope	Vertical: Bandwidth 50 MHz with sensitivity of 5 mV/division minimum Horizontal: Sweep time 10 ns to 1s Delayed sweep External triggering to 100 MHz	HP 180A with HP 1801A and HP 1821A plug-ins	A.T
10:1 divider probe	10:1 divider 10 Megohm 10 pF	HP 10004	A,T
Spectrum Analyzer	Absolute Accuracy ±1.6 dB from 10 MHz to 1.3 GHz Measurement Accuracy ±2.6 dB from 10 MHz to 1.3 GHz	HP 8555A with HP 8552B and HP 140T	A,T
Test Oscillator	1 kHz to 20 kHz 0.2 to 2.0 Vrms into 50Ω	HP 651B	A
Microwave Frequency Counter	Range: 0.2 - 1300 MHz Resolution: 1 Hz	HP 5340A	A,T
Frequency Synthesizer	20 to 30 MHz settable in 1 Hz increments Phase Modulation ±3 radians deviation	HP 5105A/5110B	A
VHF Oscillator	10 to 30 MHz Leveled Output	HP 8654A	A
Extender Board	24 Contact (2 x 12 pins) Supplied with mainframe rack mounting kit.	HP 5060-0258	A,T
Step Attenuator (10 dB)	0 to 120 dB in 10 dB steps Range: 10 to 550 MHz Accuracy: ±1.5 dB to 90 dB	HP 355D	A
Service Kit	Interconnect cables, adaptors coaxial cables compatible to 8660-series plugs and jacks	HP 11672A (see Operating Note or mainframe manual for parts list)	A,T

*A = Adjustments; T = Troubleshooting

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information related to the initial inspection, preparation for use, and storage and shipping instructions for the Frequency Extension Module.

2-3. INITIAL INSPECTION

NOTE

If the Extension Module has been received as part of a signal generator system (8660-series Option 100), for mechanical inspection purposes the module should be considered part of the mainframe. Refer to the RF Section manual for information related to electrical inspection.

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1, and procedures for checking electrical performance are given in the RF Section manual. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The power consumed by the Frequency Extension Module during normal operation is 50 VA maximum.

2-8. Interconnections

2-9. Installing the Extension Module into the mainframe plug-in cavity ensures all necessary connections are made to the mainframe and the Modulation Section plug-in. Two coaxial cable accessories also must be installed to complete necessary connections to the RF Section plug-in.

2-10. Operating Environment

2-11. The Extension Module is designed to operate a mainframe which is operating within the following environment conditions:

Temperature	0 to 55°C (+32 to +131°F)
Humidity	less than 95% relative
Altitude	less than 15,000 feet

2-12. Installation Instructions

2-13. Safety Considerations. During installation of the Extension Module, the top and bottom protective covers of the mainframe are removed. Energy available at many points may, if contacted, result in personal injury.

WARNINGS

1. Disconnect line (Mains) power cable from mainframe to remove available energy.

2. Capacitors inside the instrument may still be charged even if the system has been disconnected from its source of supply.

3. The multi-pin connector (mounted on mainframe) which provides interconnection to the Extension Module exposes power supply voltages which may remain after the power cable is disconnected from mainframe.

2-14. Order of Installation Procedures. If the Extension Module is being installed in the mainframe for the first time, perform the following procedures in the order listed. To reinstall the Extension Module, perform only the Extension Module Installation.

a. Accessory Cable Installation, Figure 2-1.

b. Extension Module Installation, Figure 2-2.

c. Abbreviated Adjustment procedure in Section V.

2-15. STORAGE AND SHIPMENT

2-16. Environment

2-17. The storage and shipping environment of the Extension Module should not exceed the following limits:

Temperature	−40° to +75°C (−40° to +167°F)
Humidity	less than 95%, relative
Altitude	less than 25,000 feet

2-18. Packaging

2-19. Original Type Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument 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.

2-20. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

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

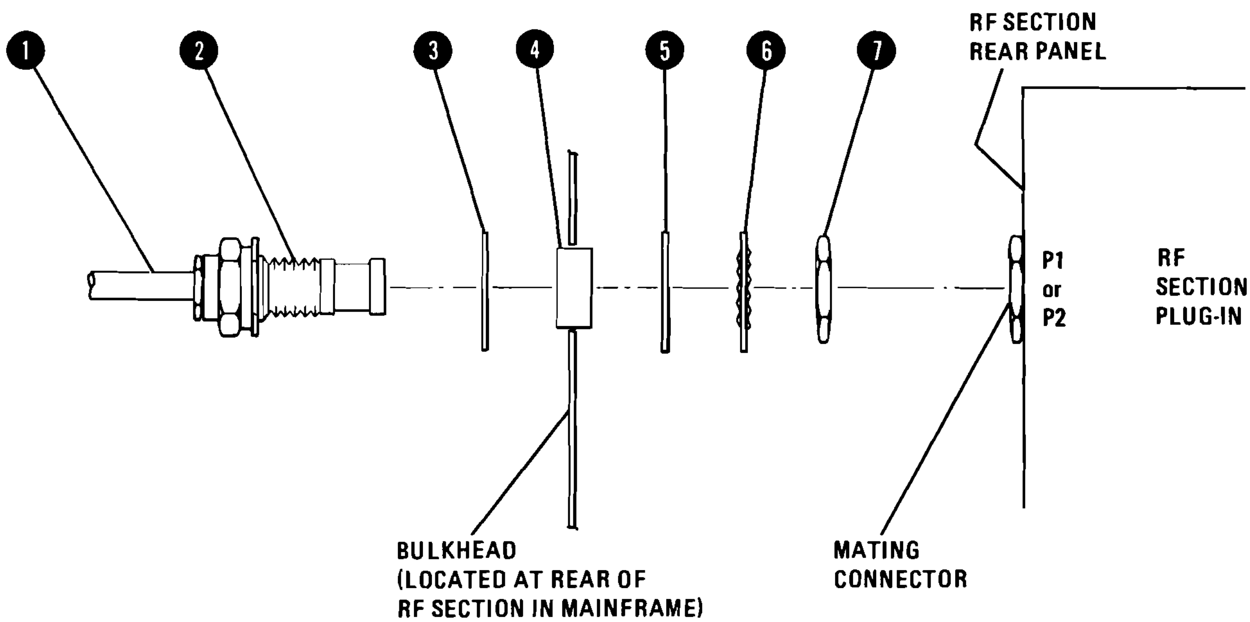
b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

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

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

BULKHEAD MOUNTING OF ACCESSORY CABLES



WARNING

Before installing the cables, read the paragraphs under the heading "Installation Instructions" in this section.

a. Take the grey Coaxial Cable 1 and place the Flat Washer 3 on the Sealectro Bulkhead Connector 2.

b. Insert the connector through the Spacer 4 which is mounted in a hole on the Bulkhead. The grey cable is mounted below the multi-pin connector (refer to Figure 2-2).

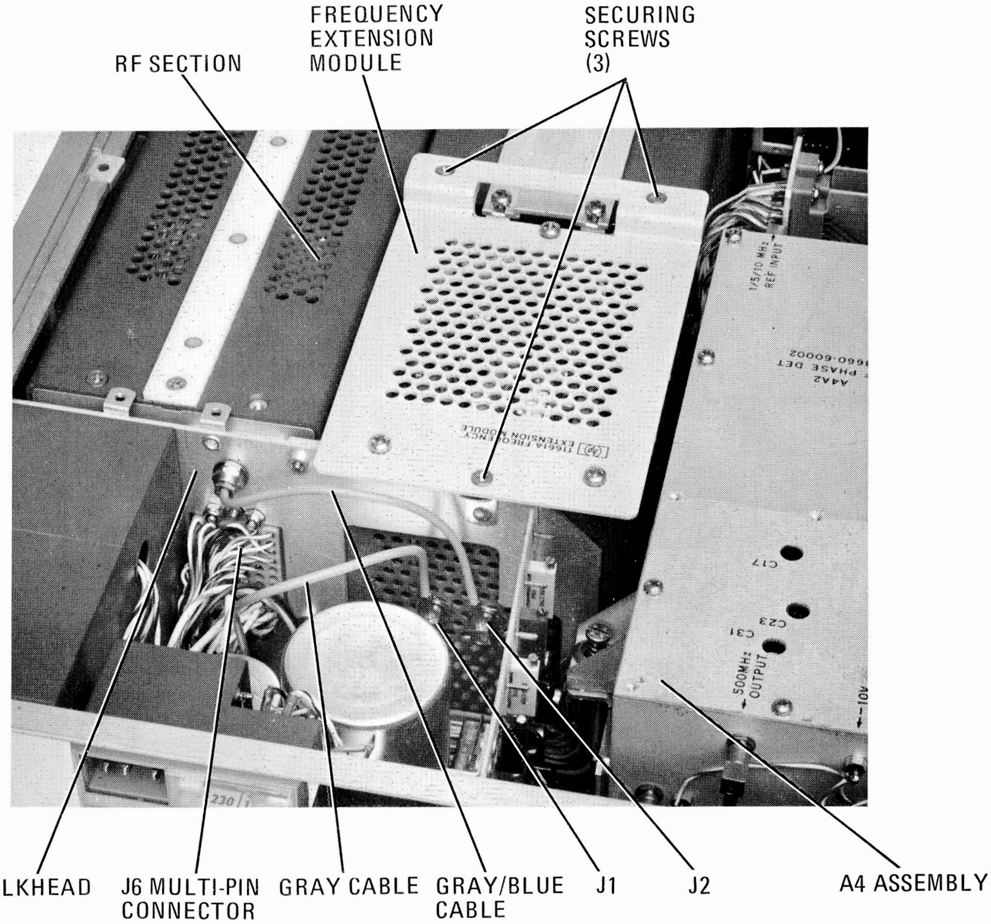
c. Place the Flat Washer 5 and the Lock Washer 6 over the protruding end of the Bulkhead Connector.

d. Secure the connector by threading and tightening the Hex Nut 7 onto the connector. The connector should have approximately 1/32-inch play in all directions.

e. Follow steps a. through d. in mounting the grey-blue cable in the Bulkhead above the multi-pin connector.

Figure 2-1. Accessory Cable Installation

EXTENSION MODULE INSTALLED IN MAINFRAME



WARNING

Before installing the Extension Module read the paragraphs under the heading "Installation Instructions" in this Section.

a. Position the Frequency Extension Module above the plug-in cavity with the multi-pin connector of the Extension Module below and on the right (as viewed from rear of mainframe). J1 and J2 should face the rear of the mainframe (refer to figure).

b. Lower the Extension Module into place in the mainframe.

c. Make sure the multi-pin connector mates properly with the mainframe connector and press the Extension Module into place.

d. Secure the Module in place with 5 Pozi-driv screws, 3 from the top as shown in the figure and 2 from the bottom of the mainframe.

e. Press the free end of the grey accessory cable into J1 and the grey-blue cable into J2 as shown in the figure.

Figure 2-2. Extension Module Installation

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. The operation of the Frequency Extension Module is dependent on the Model 8660-series mainframe (frequency control) and the Model 86630-series Modulation Section plug-in. Refer to Section III of the appropriate manual for operating information.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The performance of RF Sections which have a high frequency limit greater than 160 MHz is dependent on the performance of the Frequency Extension Module. Refer to Section IV of the appropriate RF Section Operating and Service Manual for combined performance tests.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section contains adjustment procedures which will return the Frequency Extension Module to peak operating condition. An abbreviated procedure is included to adjust an Extension Module the first time it is used with a mainframe so they will operate with each other in the system.

5-3. The Extension Module should be adjusted after any repair or if the unit, in conjunction with the RF Section, fails to meet the performance tests of Section IV in the RF Section manual. Prior to making any adjustment, let the complete system warm up for 30 minutes.

5-4. The order in which the adjustments are made is critical. Perform the adjustments in sequence and under the conditions presented in this section. DO NOT attempt to make random adjustments to the instrument. The Abbreviated Adjustments are independent and are to be performed only under special conditions. Prior to making any adjustments to the Frequency Extension Module, refer to the paragraph entitled Related Adjustments.

5-5. EQUIPMENT REQUIRED

5-6. Each adjustment procedure in this section contains a list of test equipment and accessories required to perform the adjustment. The test equipment is also identified by callouts in the test setup diagrams included with each procedure.

5-7. If substitutions must be made for the specified test equipment, refer to Table 1-1 for the minimum specifications of the test equipment to be used in the adjustment procedures. Since the Synthesized Signal Generator System is extremely accurate, it is particularly important that the test equipment used in the adjustment procedures meets the critical specifications listed in Table 1-1.

5-8. The HP 11672A Service Kit is an accessory item available from Hewlett-Packard for use in maintaining the Frequency Extension Module. A detailed listing of the items contained in the service kit is provided in the HP 11672A Operating Note and the mainframe manual. Each item may be ordered separately.

5-9. Extender cards used in servicing the Extension Module are contained in the HP Rack Mount Kit, HP Part Number 08660-60070, which is supplied with the mainframe.

5-10. SAFETY CONSIDERATIONS

5-11. Although this instrument has been designed in accordance with international safety standards, this manual and the system mainframe manual contain information, cautions, and warnings which must be followed to ensure safe operation and to retain the complete system in safe condition. Service adjustments should be performed only by qualified service personnel.

NOTE

Refer to the mainframe manual for safety information relating to ac line (Mains) voltage, fuses, protective earth grounding, etc.

5-12. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

5-13. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNINGS

1. Adjustments described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

2. The multi-pin plug connector (on mainframe), which provides interconnection to the Extension Module will expose power supply voltages which may remain on the pins after the Extension Module is removed and after the (Mains) power cable is disconnected from the mainframe. Be careful to avoid contact with the pins during interconnection with the Extension Module.

5-14. FACTORY-SELECTED COMPONENTS

5-15. Factory-selected components are identified on the schematics and parts list by an asterisk which follows the reference designator. The nominal value of the components are normally shown. The manual change sheets will provide updated information pertaining to the selected components. Table 5-1 lists the reference designator, the criterion used for selecting a particular value, the normal value range, and the service sheet where the component part is shown.

5-16. RELATED ADJUSTMENTS

5-17. The adjustment procedures found in this section are normally performed in sequence. The Abbreviated Adjustment procedure is independent and is performed only when an Extension Module is being used with a mainframe for the first time.

5-18. If the 4.43 GHz Oscillator is adjusted, the procedures which follow must all be performed.

5-19. If the 20 MHz IF Amplifier Adjustment is performed, the YIG Pretune Driver Adjustment, the YIG Loop Phase Detector Adjustment, and the YIG Loop Gain and Bandwidth Adjustment must be performed in sequence.

5-20. If the 3.95 to 4.05 GHz VCO Bias Adjustment is performed, the Sum Loop Pretune Adjustment and the Sum Loop Bandwidth Adjustment must be performed in sequence.

5-21. Only the Abbreviated Adjustment, the YIG Loop Gain Bandwidth Adjustment, and the Sum Loop Bandwidth Adjustment are independent of other procedures. The final checks of the Abbreviated Adjustment procedure indicate if the other procedures need to be performed.

5-22. ADJUSTMENT LOCATIONS

5-23. The last foldout in this manual contains a table which cross-references all pictorial and schematic locations of the adjustable controls. The figure accompanying the table shows the locations of assemblies, chassis mounted parts, adjustable components, and test points.

5-24. ADJUSTMENTS

5-25. Prior to performing the adjustments on the Extension Module, remove the mainframe and Extension Module top covers. Refer to the disassembly procedures found on the lefthand foldout page which preceeds the last foldout in this manual.

5-26. Prior to performing the COMPLETE adjustment procedures remove the five circuit board assemblies (A3 through A7).

Table 5-1. Factory Selected Components

Reference Designator	Selected for	Normal Value Range	Service Sheet
A4C8*	Sum Loop Bandwidth (3 dB down) of 500 ±150 kHz with center frequency set to 1.095 GHz. Increasing capacitance increases bandwidth.	200 to 330 pF	7
A3L2	Phase lock with an increase in center frequency (10 MHz steps). Monitor A3TP1 with an oscilloscope. A dc level is observed if Sum Loop is phase locked as opposed to an ac signel when unlocked. The dc level should be observed in each of the following cases: Set system center frequency to 99.9 MHz; then to 109.9 MHz. Set to 299.9 MHz; then 309.9 MHz. Set to 399.9 MHz; then 409.9 MHz. Set to 799.9 MHz; then 809.9 MHz.	5.6 to 12.0 μH	6

*Selection of A4C8 is part of the Sum Loop Bandwidth Adjustment procedure.

ADJUSTMENTS

5-27. ABBREVIATED ADJUSTMENT OF FREQUENCY EXTENSION MODULE

REFERENCE:

Service Sheets 5 and 7.

DESCRIPTION:

Each time a Frequency Extension Module is inserted into a different mainframe, minor adjustments must be made to the Extension Module to ensure proper operation of the entire signal generator system. Mainframe power supplies are checked and adjustments are made if necessary. An adjustment of the 4.43 GHz oscillator is done. The Sum Loop Pretune Assembly Outputs are adjusted and rechecked along with the 4.43 GHz oscillator. The dc voltage levels at A6TP1 of the YIG Loop Pretune Assembly are measured at specific preset frequencies.

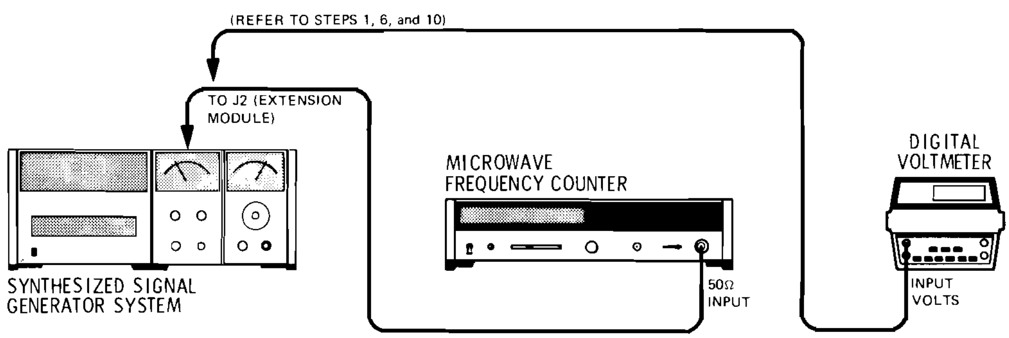


Figure 5-1. Abbreviated Adjustment Test Setup

EQUIPMENT:

Microwave Frequency Counter . . . . HP 5340A
Digital Voltmeter . . . . HP 34740A/34702A

PROCEDURE:

1. Check the regulated power supply voltages in the mainframe (refer to Section VIII of the mainframe manual for the figure entitled Assembly Locations).

NOTE

DO NOT adjust the voltages if they are within tolerance.

Mainframe Test Point	Voltage and Tolerance (Vdc)
A5TP1	−40.00 ± 0.02
A5TP2	−10.00 ± 0.01
A5TP3	+20.000 ± 0.005
A5TP4	+ 5.25 ± 0.02

ADJUSTMENTS

5-27. ABBREVIATED ADJUSTMENT OF FREQUENCY EXTENSION MODULE (Cont'd)

2. Connect the RF SIGNAL OUTPUT from J2 of the Extension Module to the high frequency input of the microwave frequency counter.

3. Set the mainframe center frequency to 1200 MHz.

4. Set the R1 Control for an output from J2 (monitored by the microwave frequency counter) of 2750.000 ±0.100 MHz. (This indirectly sets the frequency of the 4.43 GHz Oscillator.)

5. Set the mainframe LINE switch control to STNDBY and place the A4 Assembly on an extender board.

6. Return the LINE switch to ON and Monitor the dc voltage on A3TP1 with a digital voltmeter.

7. As shown by the table, set the center frequency and adjust the appropriate control for a reading of 10 ± 1 Vdc on the digital voltmeter.

Center Frequency	Adjustable Control	
	Name	Reference Designator
5 MHz	B Adj	A4R6
15 MHz	1 Adj	A4R10
25 MHz	2 Adj	A4R16
35 MHz	3 Adj	A4R20
45 MHz	4 Adj	A4R23
55 MHz	5 Adj	A4R26
65 MHz	6 Adj	A4R29
75 MHz	7 Adj	A4R32
85 MHz	8 Adj	A4R35
95 MHz	9 Adj	A4R38

8. Recheck the voltage readings at each center frequency setting (step 7).

9. Recheck the 4.43 GHz Oscillator frequency (see steps 3 and 4). If necessary, repeat steps 3 through 9.

10. Monitor the dc voltage on A6TP1 with the digital voltmeter while programming in 100 MHz steps from 0 (zero) to 1200 MHz (i.e., 0 MHz, 100 MHz, 100 MHz, . . . 1200 MHz). The dc voltage should be 0.0 ± 0.5 Vdc for each center frequency setting.

NOTE

If the voltage at any frequency setting is >± 0.5 Vdc, perform the rest of the adjustment procedures in this section.

ADJUSTMENTS

5-28. 4.43 GHz OSCILLATOR ADJUSTMENT

REFERENCE:

Service Sheet 3

DESCRIPTION:

The 443 GHz Oscillator output is monitored by a frequency counter while the frequency is adjusted.

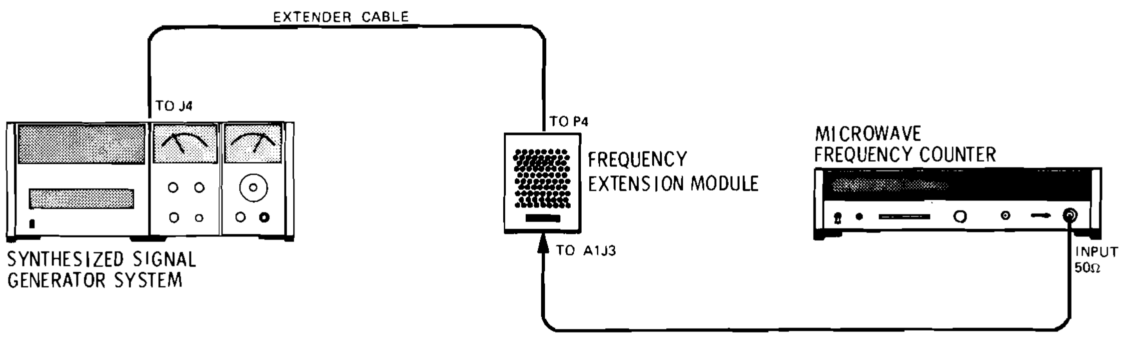


Figure 5-2. 4.43 GHz Oscillator Adjustment Test Setup

EQUIPMENT:

Microwave Frequency Counter	HP 5240A
Extender Cable	HP 11672-60002

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 5-2.
2. Connect microwave frequency counter input to the 4.43 GHz OUT connector A1J3.
3. Adjust potentiometer R1 for 4.4300 ± 0.0005 GHz as indicated by the microwave frequency counter.

5-29. 20 MHz IF AMPLIFIER ADJUSTMENT

REFERENCE:

Service Sheet 3

DESCRIPTION:

A 20 MHz signal from the mainframe is attenuated and injected at the input of the 20 MHz IF amplifier. The output is monitored with an oscilloscope and the 20 MHz ADJ control is set for the peak signal output.

ADJUSTMENTS

5-29. 20 MHz IF AMPLIFIER ADJUSTMENT (Cont'd)

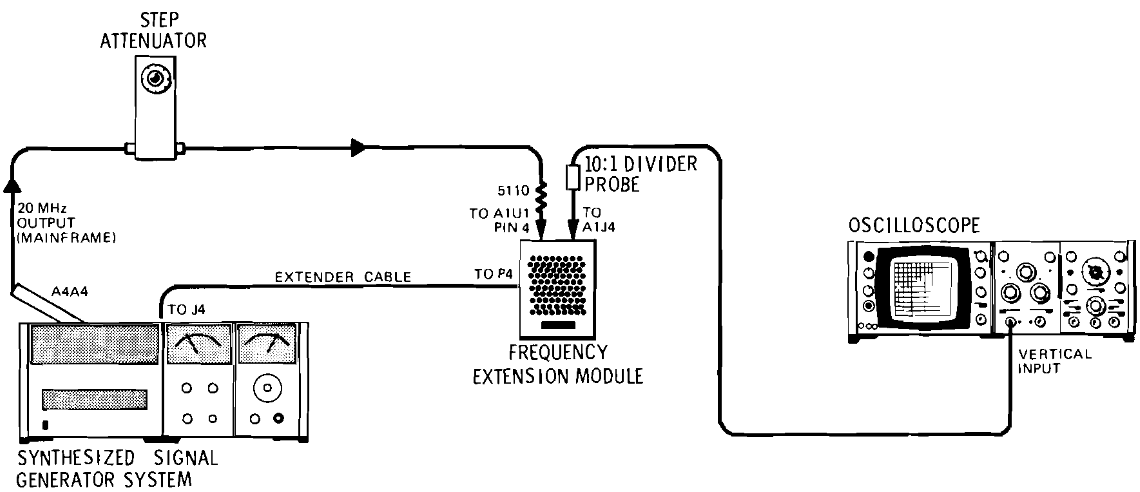


Figure 5-3. 20 MHz IF Amplifier Adjustment Test Setup

EQUIPMENT:

Oscilloscope	HP 180A/1801A/1821A
10:1 Divider Probe	HP 10004
Step Attenuator (10 dB)	HP 355D
Extender Cable	HP 11672-60002
5110 Ohm 1/4 Watt Resistor	HP 0757-0438

PROCEDURE:

1. Remove the A1A1, A1A3, and A1A4 Assemblies' cover. Refer to the disassembly procedures on the lefthand foldout page which preceeds the last foldout.
2. Disconnect W4 from A1J4; W3 from A1J2.
3. Set the step attenuator controls for 20 dB attenuation.
4. Connect the equipment together as shown in Figure 5-3.
5. Set the oscilloscope controls to monitor the 20 MHz signal (amplitude normally about 1 Vp-p).
6. Peak the 20 MHz output as seen on the oscilloscope display by adjusting the A1A1C1 control.
7. Disconnect the equipment, connect W4 to A1J4, connect W3 to A1J2, and replace the A1A1, A1A3, and A1A4 Assemblies' cover. Reconnect the correct cable to the 20 MHz OUTPUT on the mainframe A4A4 Assembly.

ADJUSTMENTS

5-30. 3.95 to 4.05 GHz VCO BIAS ADJUSTMENT

REFERENCE:

Service Sheet 3

DESCRIPTION:

The VCO Bias Adj control sets the bias voltage of the 3.95 to 4.05 GHz oscillator.

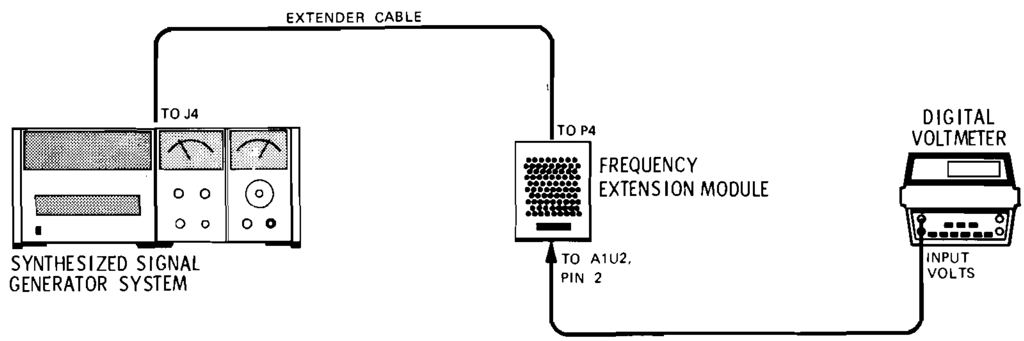


Figure 5-4. 3.95 to 4.05 GHz VCO Bias Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 34740A/34702A
Extender Cable . . . . HP 11672-60002

PROCEDURE:

1. Remove the top cover from the A1A2 Assembly.
2. Connect Digital Voltmeter to pin 2 of A1U2. Refer to the Extension Module Troubleshooting Block Diagram in Section VIII for A1U2 pin locations.
3. Adjust the VCO bias potentiometer A1A2R3 for +10.0 Vdc as indicated on the Digital Voltmeter.
4. Replace the top cover of the A1A2 Assembly.

ADJUSTMENTS

5-31. YIG PRETUNE DRIVER ADJUSTMENT

REFERENCE:

Service Sheet 2.

DESCRIPTION:

Adjustments are made to the YIG Pretune Driver controls while the YIG drive voltage and YIG output are monitored by a DVM and an oscilloscope respectively. The GAIN ADJ control sets the range of the YIG drive voltage with the mainframe center frequency set to 0.0 GHz (less significant digits do not affect the adjustment). The digital-to-analog converter controls are then adjusted for specific YIG oscillator output frequencies which correspond to preset center frequencies.

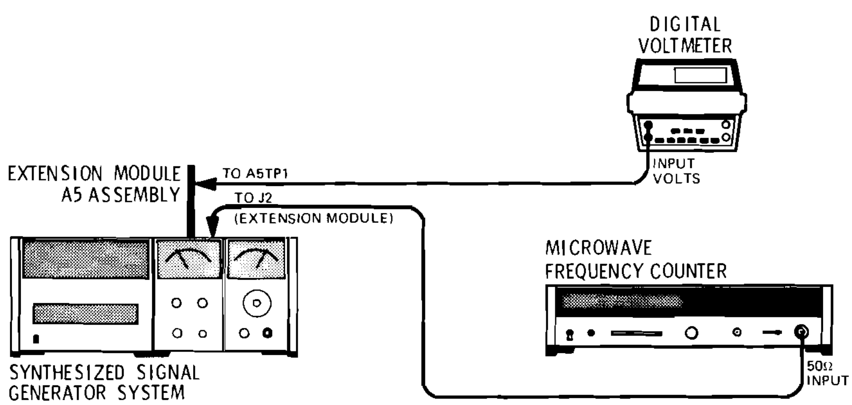


Figure 5-5. YIG Pretune Driver Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 34740A/34702A
Microwave Frequency Counter . . . . HP 5340A

PROCEDURE:

1. Prior to installing the A5 YIG Pretune Driver Assembly into the Extension Module, center the adjustment potentiometers so the DVM indicates resistance values in accordance with those listed in Table 5-2. Measure the resistance on the resistance scales of the DVM.

ADJUSTMENTS

5-31. YIG PRETUNE DRIVER ADJUSTMENT (Cont'd)

Table 5-2. Preliminary Resistance Settings of YIG Pretune Driver Adjustment Potentiometers

Potentiometer	Function	Centered Value
A5R39	Gain Adj	100 Ohms
A5R29	Offset Adj	100 Ohms
A5R13	"1" Adj	1000 Ohms
A5R15	"2" Adj	500 Ohms
A5R17	"4" Adj	250 Ohms
A5R19	"8" Adj	100 Ohms
A5R21	"10" Adj	100 Ohms

2. Install the A5 circuit board in the Extension Module (A6 should NOT be installed at this time).

3. Connect the microwave frequency counter to the Extension Module output jack J2.

4. Set the system center frequency to 0 (zero) GHz.

5. Adjust the Gain Adj. control A5R39 for an output frequency from J2 of 3.950 ± 0.001 GHz. Record the frequency to 5 significant digits.

___________ GHz

6. Set the center frequency to 1 GHz and record the J2 output frequency to 5 significant digits.

___________ GHz

7. Calculate the difference frequency from the recorded values of steps 5 and 6. If the frequency is 1.0000 ± 0.0005 GHz, proceed to the step 11.

8. If the tolerance of the difference frequency is not achieved, set the Offset control A5R29 for a frequency output of 2.950 ± 0.001 GHz. Record the frequency to 5 significant figures.

___________ GHz

9. Set the Center frequency back to 0 (zero) GHz. Record the difference frequency to five significant figures.

___________ GHz

10. Calculate the difference frequency from those recorded in steps 8 and 9. If the frequency difference is 1.0000 ± 0.0005 GHz proceed to step 11. If the difference frequency tolerance is not achieved, repeat steps 5 through 9 until the tolerance is achieved.

NOTE

The following series of adjustments must be performed in the exact manner stated in order to eliminate errors due to YIG hysteresis.

ADJUSTMENTS

5-31. YIG PRETUNE DRIVER ADJUSTMENT (Cont'd)

11. Set the system center frequency to 0 (zero) MHz.

12. Set the center frequency to 100 MHz and adjust the appropriate control for the correct output frequency from J2 (refer to Table 5-3). Repeat this process at 200, 400, and 800 MHz ALWAYS INCREASING the frequency to the next setting. Record the frequency to five significant digits.

NOTE

If any one of the "1" through "8" controls needs more range (set full CW or CCW) the "10 Adj" control, which is normally centered, may be reset to bring the frequencies within the required tolerance. (To increase the frequency, the "10 Adj" control A5R21 should be set more CCW.) If the "10 Adj" Control is reset, repeat steps 11 and 12.

Table 5-3. YIG Pretune Drive Digital-To-Analog Convertor Adjustments

Center Frequency (MHz)	Adjust	J2 Output Frequency and Tolerance (GHz)	Actual Frequency in GHz
100	A5R13	3.8500 ± 0.0010	______
200	A5R15	3.7500 ± 0.0010	______
400	A5R17	3.5500 ± 0.0010	______
800	A5R19	3.1500 ± 0.0010	______
1100	A5R13	2.8500 ± 0.0010	______
1200	A5R15	2.7500 ± 0.0010	______

13. INCREASE the center frequency to 1100 MHz. If the frequency is close to the tolerance limit or out of tolerance, set the A5R13 control for a frequency closer to the desired frequency shown in Table 5-3.

14. Set the center frequency to 0 (zero) MHz; then to 100 MHz. Check the frequency from J2. Knowing how much the frequency changed from the original 100 MHz setting, reset the A6R13 control so the actual frequency is as close to the desired frequency (Table 5-3) as possible for both the 100 and 1100 MHz center frequencies.

15. Set the center frequency to 1200 MHz. Repeat steps 13 and 14 for the 200 and 1200 MHz center frequencies.

16. Set the system center frequency to 0 MHz, then to the frequencies listed in Table 5-4. Verify the output frequency from J2 is within tolerance. If any of the frequencies are not within tolerance, repeat this entire procedure.

5-31. YIG PRETUNE DRIVER ADJUSTMENT (Cont'd)

Table 5-4. Center Frequency versus YIG Loop Output

Center Frequency (MHz)	YIG Loop Output Frequency From J2 (GHz)
0	3.9500 ± 0.0015
100	3.8500 ± 0.0015
200	3.7500 ± 0.0015
300	3.6500 ± 0.0015
400	3.5500 ± 0.0015
500	3.4500 ± 0.0015
600	3.3500 ± 0.0015
700	3.2500 ± 0.0015
800	3.1500 ± 0.0015
900	3.0500 ± 0.0015
1000	2.9500 ± 0.0015
1100	2.8500 ± 0.0015
1200	2.7500 ± 0.0015

5-32. YIG LOOP PHASE DETECTOR ADJUSTMENTS

REFERENCE:

Service Sheets 4 and 5.

DESCRIPTION:

The YIG phase lock loop feedback path is opened by removing the 20 MHz signal (which is obtained by mixing and sampling the YIG Oscillator output). The YIG Feedback Loop Gain control is centered, the Phase Ref Adj control is set to trigger the search signal on, and the DC Offset Adj centers the search waveform about 0 Vdc. The feedback path is closed and the Offset Adj on the YIG Pretune Driver Assembly sets the locked search output (a dc level) as close to ground potential as possible. The phase Adj control is set to obtain 90° phase shift between the 20 MHz REF signal and the 20 MHz IF signal. (The quadrature phase detector output is at a maximum negative dc level at 90° phase shift).

The 4.43 GHz Oscillator frequency control is readjusted to obtain a 3.95 GHz output from the YIG Oscillator with the center frequency set to 0.0 GHz (less significant digits do not affect the adjustment).

ADJUSTMENTS

5-32. YIG LOOP PHASE DETECTOR ADJUSTMENTS (Cont'd)

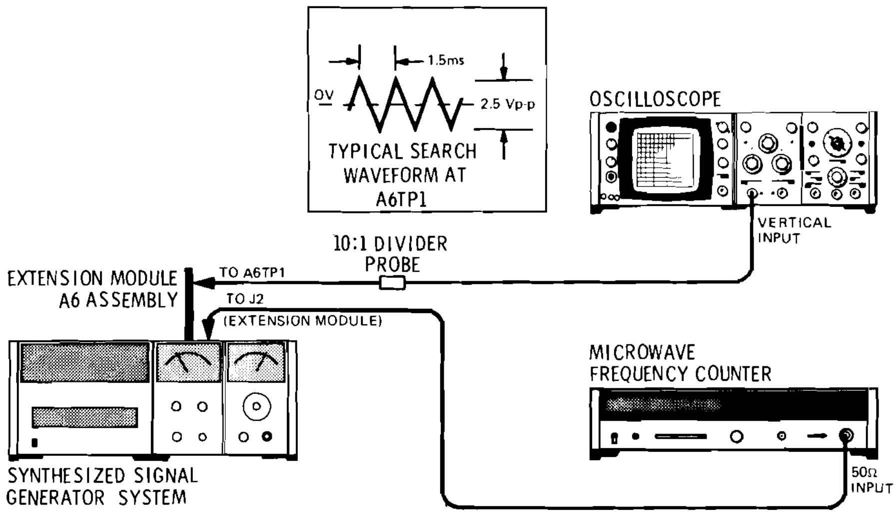


Figure 5-6. YIG Loop Phase Detector Adjustment Test Setup

EQUIPMENT:

Microwave Frequency Counter	HP 5340A
Oscilloscope	HP 180A/1801A/1821A
10:1 Divider Probe	HP 10004

PROCEDURE:

1. Connect YIG FM Driver board assembly A6 to an extender board and insert into the Extension Module.
2. Adjust YIG loop gain potentiometer A7R20 to the center of its range.
3. Insert the YIG Loop Phase Detector board assembly A7 into place.
4. Connect oscilloscope probe to A7TP1 and adjust A7C2 for most negative dc voltage (typically —10.0 Vdc) as observed on the oscilloscope.
5. Disconnect 20 MHz output cable W4 from A1J4.
6. Connect oscilloscope probe to A6TP1. Adjust oscilloscope to display a triangular waveform of approximately 2.5 volts peak-to-peak with a period of approximately 1.5 milliseconds. If waveform is not present, rotate potentiometer A7R17 ccw, and then, cw as necessary to turn search waveform generator (located on A6) on. When search waveform generator is turned on, oscilloscope should display typical waveform illustrated in Figure 5-6.
7. Adjust potentiometer A7R17 until search waveform generator is just triggered to produce waveform illustrated in Figure 5-6.

ADJUSTMENTS

5-32. YIG LOOP PHASE DETECTOR ADJUSTMENTS (Cont'd)

8. Adjust DC Offset potentiometer A6R6 so triangular search waveform is centered across 0 Vdc reference line on oscilloscope.

9. Reconnect 20 MHz output cable W4 A1J4. The triangular waveform displayed on oscilloscope should change to 0 ± 0.5 Vdc.

10. Set the system center frequency to 0 (zero) MHz. Then step the frequency in 100 MHz steps to 1200 MHz and verify correct adjustment of A7R17, (that the loop remains locked). If loop unlocks or false locks, slightly readjust A7R17 cw until loop again locks at all frequencies (0 to 1200 MHz in 100 MHz steps). Then turn A7R17 1/8 turn cw for safety margin.

NOTE

When false lock occurs, the output is locked and stable but the output frequency is incorrect.

11. Set the center frequency to 0 (zero) MHz. Then step the frequency in 100 MHz steps to 1200 MHz to verify that loop remains locked at all frequencies. If loop unlocks or false locks readjust A7R17 cw until loop again locks.

12. Set the center frequency to 0 (zero) MHz. While monitoring the YIG loop output at J1 with frequency counter, adjust R1 so the YIG loop output frequency is 3.9500 ± 0.0005 GHz.

13. Set the center frequency to 0 (zero) MHz and then to 1200 MHz while monitoring dc level at A6TP1. Adjust offset potentiometer A5R29 for best compromise setting that makes A6TP1 level as close to 0 volts as possible for all center frequency settings of 0 to 1200 MHz (100 MHz steps).

5-33. YIG LOOP GAIN AND BANDWIDTH ADJUSTMENT

REFERENCE:

Service Sheet 4

DESCRIPTION:

To simulate frequency modulation, a manually swept 19 to 21 MHz signal is superimposed on the 20 MHz second IF signal. The output signal from the RF Section plug-in is monitored by a Spectrum Analyzer. The YIG loop Gain is set for the maximum flatness across the 1 MHz bandwidth.

ADJUSTMENTS

5-33. YIG LOOP GAIN AND BANDWIDTH ADJUSTMENT (Cont'd)

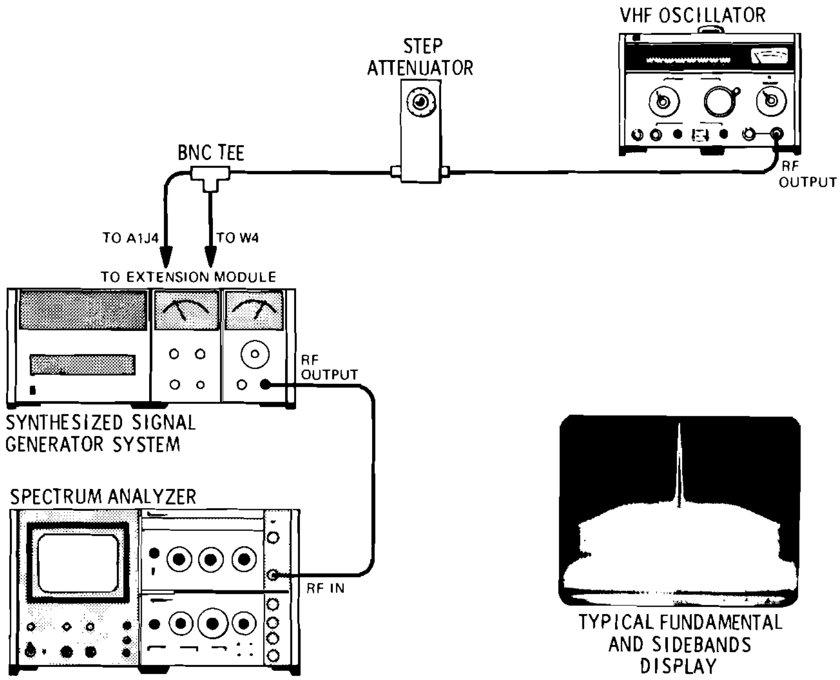


Figure 5-7. YIG Loop Gain and Bandwidth Adjustment Test Setup

EQUIPMENT:

VHF Oscillator	HP 8654A
Step Attenuator (10 dB)	HP 355D
Spectrum Analyzer	HP 8555A/8552B/140T

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 5-7. The TEE connection is made as follows:

   a. disconnect W4 from A1J4.

   b. connect W4 to one port of TEE connector.

   c. connect one port of TEE connector to A1J4.

   d. connect variable attenuator to remaining port of TEE connector.

2. Set Step Attenuator for 60 dB attenuation.

3. Adjust VHF Oscillator output to 19 MHz and set output Vernier to mid-range.

4. Adjust Synthesized Signal Generator mainframe and RF Section output to 400 MHz at —10 dBm.

5. Calibrate Spectrum Analyzer to make attenuation measurement.

ADJUSTMENTS

5-33. YIG LOOP GAIN AND BANDWIDTH ADJUSTMENT (Cont'd)

6. Adjust Spectrum Analyzer for logarithmic display of 400 MHz fundamental plus both sidebands out to 500 kHz from fundamental. Adjust Spectrum Analyzer as follows: BANDWIDTH, 10 kHz; SCAN WIDTH, 200 kHz; SCAN TIME, 5 microseconds; and INPUT ATTENUATION, 20 dB. Use Spectrum Analyzer level controls to adjust display so fundamental peak is near top reference level line.

7. Vary signal generator output frequency from 19 to 21 MHz.

8. Adjust YIG loop gain potentiometer A7R20 until flatness of sidebands (about 40 dB below fundamental) is $\leqslant$ 3 dB within ±500 kHz of fundamental. Refer to Figure 5-7 for illustration of typical waveform.

5-34. SUM LOOP PRETUNE ADJUSTMENT

REFERENCE

Service Sheet 6

DESCRIPTION:

The Sum Loop PHase Error output voltage is set by adjusting the Sum Loop Pretune resistance ladder controls (part of the digital-to-analog convertor).

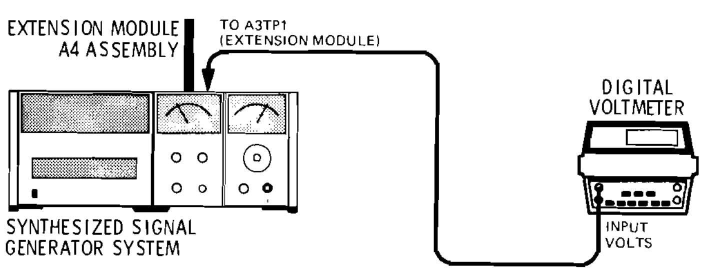


Figure 5-8. Sum Loop Pretune Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter . . . . HP 34740A/34702A

PROCEDURE:

1. Install Sum Loop Phase Detector board assembly A3 into the Extension Module.

2. Center all adjustment potentiometers, including "B" potentiometer, on the A4 Assembly.

3. Connect the A4 Assembly circuit board to an extender board and install it into the Extension Module.

4. Connect Digital voltmeter to A3TP1.

ADJUSTMENTS

5-34. SUM LOOP PRETUNE ADJUSTMENT (Cont'd)

5. Set Synthesized Signal Generator System center frequency to 5 MHz and adjust A4R5 for a voltage at A3TP1 of +10.0 ± 1.0 Vdc.

6. Set the center frequency in 10 MHz steps from 5 to 95 MHz. Adjust appropriate potentiometer for +10.0 volts level at A3TP1 in accordance with Table 5-5. Adjust potentiometers as close to +10.0 volts as possible.

Table 5-5. Sum Loop Pretune Potentiometer Adjustment

Center Frequency (MHz)	Potentiometer	Function	A3TP1 Level*
05	A4R5	0 Adj	+10.0 ± 1.0 volts
15	A4R11	1 Adj	+10.0 ± 1.0 volts
25	A4R16	2 Adj	+10.0 ± 1.0 volts
35	A4R20	3 Adj	+10.0 ± 1.0 volts
45	A4R23	4 Adj	+10.0 ± 1.0 volts
55	A4R26	5 Adj	+10.0 ± 1.0 volts
65	A4R29	6 Adj	+10.0 ± 1.0 volts
75	A4R32	7 Adj	+10.0 ± 1.0 volts
85	A4R35	8 Adj	+10.0 ± 1.0 volts
95	A4R38	9 Adj	+10.0 ± 1.0 volts

*If the range of any of the controls is not enough to bring the voltage into the tolerance shown, repeat the 3.95 to 4.05 GHz VCO Adjustment procedure.

7. Repeat step 6 to verify that all adjustments are within voltage level tolerance.

5-35. SUM LOOP BANDWIDTH ADJUSTMENT

REFERENCE:

Service Sheets 3 and 6.

DESCRIPTION:

A Spectrum Analyzer is used to monitor the RF Section RF OUTPUT while a 25 MHz phase-modulated (100 kHz to 1 MHz) signal is injected at the 20 to 30 MHz input on the Frequency Extension Module. "0" potentiometer A4R5 is adjusted to obtain a 3 dB bandwidth of 500 kHz ± 150 kHz, as observed on the Spectrum Analyzer. Then, "B" potentiometer A4R6 is adjusted to maintain approximately +10 volts at A3TP1. The phase-modulated 25 MHz signal is removed from the 20 to 30 MHz input and 20 to 30 MHz signal from the mainframe is reconnected. With the mainframe center frequency set to 1.005 GHz, potentiometer R1 is adjusted to vary the 4.43 GHz oscillator frequency until the VCO output frequency is 3.9550 ± 0.0001 GHz. The "B" potentiometer A4R6 is readjusted to obtain +10.0 ± 1.0 volts at A3TP1. Finally, the center frequency is stepped from 1.005 GHz to 1.095 GHz in 0.01 GHZ (10 MHz) steps and the appropriate potentiometers listed in Table 5-5 are set to maintain the A3TP1 voltage at +10.0 Vdc at each frequency.

5-35. SUM LOOP BANDWIDTH ADJUSTMENT (Cont'd)

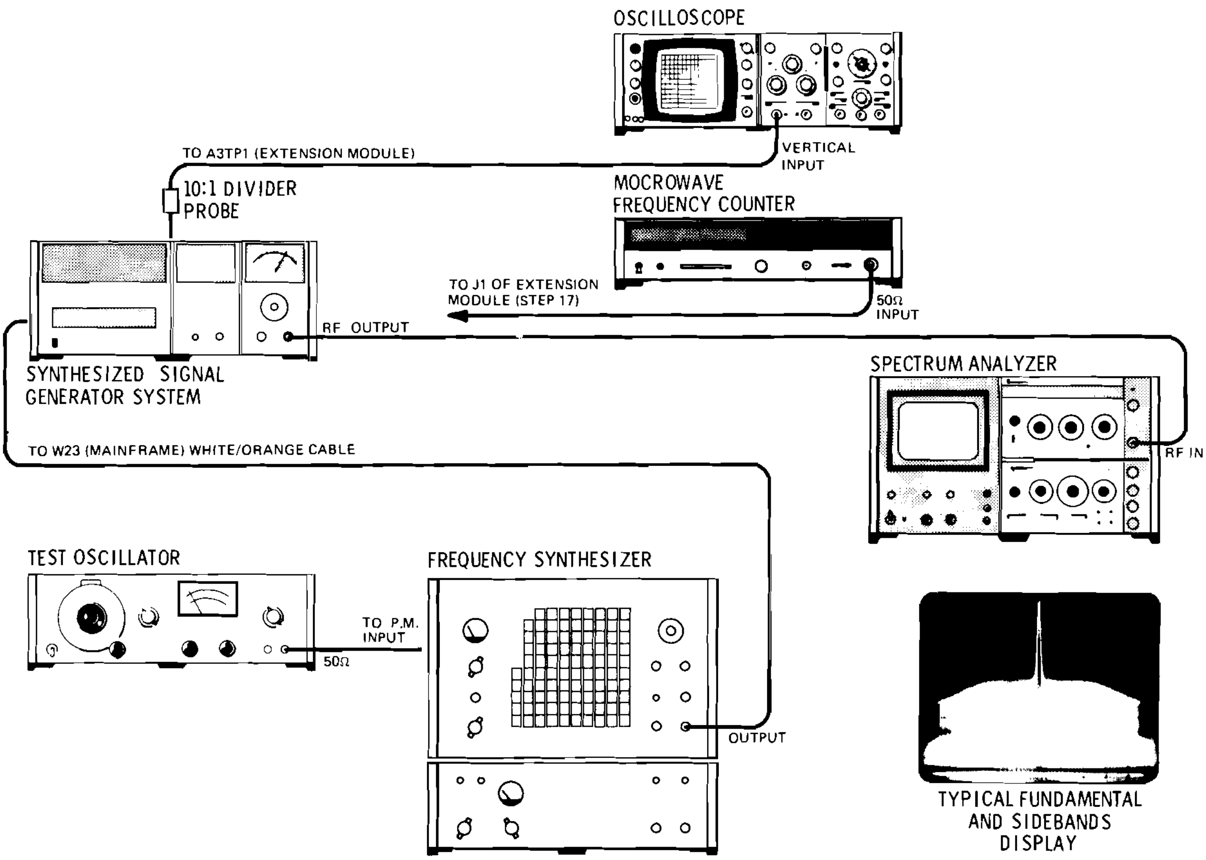


Figure 5-9. Sum Loop Bandwidth Adjustment Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
Spectrum Analyzer	HP 8555A/8552B/140T
Microwave Frequency Counter	HP 5340A
Oscilloscope	HP 180A/1801A/1821A
10:1 Divider Probe	HP 10004
Frequency Synthesizer	HP 5105A/5110B

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 5-9.
2. Remove left side cover from mainframe and disconnect white/orange cable W23 from the A2 Assembly connector in mainframe.
3. Connect Frequency Synthesizer (5105A) output to W23.

5-35. SUM LOOP BANDWIDTH ADJUSTMENT (Cont'd)

4. Connect Test Oscillator 50 Ohm output to Phase Modulation input on rear panel of Frequency Synthesizer (5105A).

5. Place the A4 Assembly on an extender board and insert it into A2XA4.

6. Adjust the Frequency Synthesizer (5105A) for a 25.000000 MHz output. The VERNIER should be in CAL. position.

7. Adjust Test Oscillator for a 100 kHz output frequency at −30 dBm.

8. Set mainframe center frequency to 1.095 GHz, RF Section OUTPUT RANGE switch to 0 dBm, and adjust VERNIER for a 0 dB indication on meter scale.

9. Adjust Spectrum Analyzer as follows: FREQUENCY, 1.095 GHz; BANDWIDTH, 30 kHz; SCAN WIDTH, 0.2 MHz/div.; SCAN TIME, 1 mSec/div.; INPUT ATTENUATION, 20 dB; LOG REF, 10 dBm; VIDEO FILTER, OFF; SCAN MODE, INT; TRIGGER, AUTO; MODE, 10 dB LOG.

10. Vary Test Oscillator output frequency from 100 kHz to 1 MHz and observe sidebands displayed on Spectrum Analyzer. Sidebands should be down 3 dB at 500 kHz ± 150 kHz. If 3 dB bandwidth of sidebands is not within 500 ± 150 kHz of carrier, select A4C8 value for correct response. Normal range of A4C8 value is 200 pF to 330 pF (increasing capacitance increases bandwidth).

11. Set mainframe center frequency to 1.005 GHz.

12. Adjust Spectrum Analyzer FREQUENCY to 1.005 GHz.

13. Connect Oscilloscope to A3TP1.

14. Vary Test Oscillator output frequency from 100 kHz to 1 MHz and observe sidebands displayed on Spectrum Analyzer. Adjust "0" potentiometer A4R5 to obtain a sideband 3 dB bandwidth of 500 ± 150 kHz. In order to meet bandwidth requirements it may be necessary to adjust "B" potentiometer A4R6 for +10.0 ± 1.0 volts as indicated on Oscilloscope.

15. Adjust "B" potentiometer A4R6 for +10.0 ± 1.0 volts at A3TP1, as indicated on Oscilloscope.

16. Disconnect white/orange cable W12 from Frequency Synthesizer (5105A) output and reconnect white/orange cable to the jack on the A2 Assembly in the mainframe.

17. Disconnect gray cable from J1. Connect Microwave Frequency Counter to Sum Loop Output con- J1.

18. Adjust potentiometer R1 to vary the 4.43 GHz oscillator frequency until the Sum Loop Output frequency is 3.9550 ± 0.0001 GHz as indicated on Digital Frequency Counter. Disconnect Microwave Frequency Counter from J1 and reconnect gray cable.

19. Adjust "B" potentiometer A4R6 to obtain +10.0 ± 1.0 volts at A3TP1, as indicated on Oscilloscope.

20. Step the center frequency from 1.005 to 1.095 GHz in 0.01 GHz (10 MHz) steps. Adjust appropriate potentiometer for +10.0 Vdc at A3TP1 in accordance with Table 5-5.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts for the HP Model 11661A Frequency Extension Module. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacturer's code number.

6-3. ABBREVIATIONS

6-4. Table 6-1 gives a list of abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviations are given, one all capital letters and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numeric order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdown.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) used in the instrument.

c. The description of the part.

d. Typical manufacturer of the part in a five-digit code.

e. Manufacturer code number for the part.

The total quantity for each part is given only once; at the first appearance of the part number in the list.

6-7. ORDERING INSTRUCTIONS

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-10. PARTS PROVISIONING

6-11. Stocking spare parts for an instrument is often done to insure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data, and parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request, and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

Table 6-1. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A ... assembly
AT ... attenuator; isolator; termination
B ... fan; motor
BT ... battery
C ... capacitor
CP ... coupler
CR ... diode; diode thyristor; varactor
DC ... directional coupler
DL ... delay line
DS ... annunciator; signaling device (audible or visual); lamp; LED
E ... miscellaneous electrical part
F ... fuse
FL ... filter
H ... hardware
HY ... circulator
J ... electrical connector (stationary portion); jack
K ... relay
L ... coil; inductor
M ... meter
MP ... miscellaneous mechanical part
P ... electrical connector (movable portion); plug
Q ... transistor: SCR; triode thyristor
R ... resistor
RT ... thermistor
S ... switch
T ... transformer
TB ... terminal board
TC ... thermocouple
TP ... test point
U ... integrated circuit; microcircuit
V ... electron tube
VR ... voltage regulator; breakdown diode
W ... cable; transmission path; wire
X ... socket
Y ... crystal unit (piezo-electric or quartz)
Z ... tuned cavity; tuned circuit

ABBREVIATIONS

A ... ampere
ac ... alternating current
ACCESS ... accessory
ADJ ... adjustment
A/D ... analog-to-digital
AF ... audio frequency
AFC ... automatic frequency control
AGC ... automatic gain control
AL ... aluminum
ALC ... automatic level control
AM ... amplitude modulation
AMPL ... amplifier
APC ... automatic phase control
ASSY ... assembly
AUX ... auxiliary
avg ... average
AWG ... American wire gauge
BAL ... balance
BCD ... binary coded decimal
BD ... board
BE CU ... beryllium copper
BFO ... beat frequency oscillator
BH ... binder head
BKDN ... breakdown
BP ... bandpass
BPF ... bandpass filter
BRS ... brass
BWO ... backward-wave oscillator
CAL ... calibrate
ccw ... counter-clockwise
CER ... ceramic
CHAN ... channel
cm ... centimeter
CMO ... cabinet mount only
COAX ... coaxial
COEF ... coefficient
COM ... common
COMP ... composition
COMPL ... complete
CONN ... connector
CP ... cadmium plate
CRT ... cathode-ray tube
CTL ... complementary transistor logic
CW ... continuous wave
cw ... clockwise
cm ... centimeter
D/A ... digital-to-analog
dB ... decibel
dBm ... decibel referred to 1 mW
dc ... direct current
deg ... degree (temperature interval or difference)
° ... degree (plane angle)
°C ... degree Celsius (centigrade)
°F ... degree Fahrenheit
°K ... degree Kelvin
DEPC ... deposited carbon
DET ... detector
diam ... diameter
DIA ... diameter (used in parts list)
DIFF AMPL ... differential amplifier
div ... division
DPDT ... double-pole, double-throw
DR ... drive
DSB ... double sideband
DTL ... diode transistor logic
DVM ... digital voltmeter
ECL ... emitter coupled logic
EMF ... electromotive force
EDP ... electronic data processing
ELECT ... electrolytic
ENCAP ... encapsulated
EXT ... external
F ... farad
FET ... field-effect transistor
F/F ... flip-flop
FH ... flat head
FIL H ... fillister head
FM ... frequency modulation
FP ... front panel
FREQ ... frequency
FXD ... fixed
g ... gram
GE ... germanium
GHz ... gigahertz
GL ... glass
GRD ... ground(ed)
H ... henry
h ... hour
HET ... heterodyne
HEX ... hexagonal
HD ... head
HDW ... hardware
HF ... high frequency
HG ... mercury
HI ... high
HP ... Hewlett-Packard
HPF ... high pass filter
HR ... hour (used in parts list)
HV ... high voltage
Hz ... Hertz
IC ... integrated circuit
ID ... inside diameter
IF ... intermediate frequency
IMPG ... impregnated
in ... inch
INCD ... incandescent
INCL ... include(s)
INP ... input
INS ... insulation
INT ... internal
kg ... kilogram
kHz ... kilohertz
kΩ ... kilohm
kV ... kilovolt
lb ... pound
LC ... inductance-capacitance
LED ... light-emitting diode
LF ... low frequency
LG ... long
LH ... left hand
LIM ... limit
LIN ... linear taper (used in parts list)
lin ... linear
LK WASH ... lock washer
LO ... low; local oscillator
LOG ... logarithmic taper (used in parts list)
log ... logrithm(ic)
LPF ... low pass filter
LV ... low voltage
m ... meter (distance)
mA ... milliampere
MAX ... maximum
MΩ ... megohm
MEG ... meg (10^6) (used in parts list)
MET FLM ... metal film
MET OX ... metallic oxide
MF ... medium frequency; microfarad (used in parts list)
MFR ... manufacturer
mg ... milligram
MHz ... megahertz
mH ... millihenry
mho ... mho
MIN ... minimum
min ... minute (time)
...' ... minute (plane angle)
MINAT ... miniature
mm ... millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-1. Reference Designations and Abbreviations (2 of 2)

MOD	modulator
MOM	momentary
MOS	metal-oxide semiconductor
ms	millisecond
MTG	mounting
MTR	meter (indicating device)
mV	millivolt
mVac	millivolt, ac
mVdc	millivolt, dc
mVpk	millivolt, peak
mVp-p	millivolt, peak-to-peak
mVrms	millivolt, rms
mW	milliwatt
MUX	multiplex
MY	mylar
µA	microampere
µF	microfarad
µH	microhenry
µmho	micromho
µs	microsecond
µV	microvolt
µVac	microvolt, ac
µVdc	microvolt, dc
µVpk	microvolt, peak
µVp-p	microvolt, peak-to-peak
µVrms	microvolt, rms
µW	microwatt
nA	nanoampere
NC	no connection
N/C	normally closed
NE	neon
NEG	negative
nF	nanofarad
NI PL	nickel plate
N/O	normally open
NOM	nominal
NORM	normal
NPN	negative-positive-negative
NPO	negative-positive zero (zero temperature coefficient)
NRFR	not recommended for field replacement
NSR	not separately replaceable
ns	nanosecond
nW	nanowatt
OBD	order by description
OD	outside diameter
OH	oval head
OP AMPL	operational amplifier
OPT	option
OSC	oscillator
OX	oxide
oz	ounce
Ω	ohm
P	peak (used in parts list)
PAM	pulse-amplitude modulation
PC	printed circuit
PCM	pulse-code modulation; pulse-count modulation
PDM	pulse-duration modulation
pF	picofarad
PH BRZ	phosphor bronze
PHL	Phillips
PIN	positive-intrinsic-negative
PIV	peak inverse voltage
pk	peak
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
PNP	positive-negative-positive
P/O	part of
POLY	polystyrene
PORC	porcelain
POS	positive; position(s) (used in parts list)
POSN	position
POT	potentiometer
p-p	peak-to-peak
PP	peak-to-peak (used in parts list)
PPM	pulse-position modulation
PREAMPL	preamplifier
PRF	pulse-repetition frequency
PRR	pulse repetition rate
ps	picosecond
PT	point
PTM	pulse-time modulation
PWM	pulse-width modulation
PWV	peak working voltage
RC	resistance-capacitance
RECT	rectifier
REF	reference
REG	regulated
REPL	replaceable
RF	radio frequency
RFI	radio frequency interference
RH	round head; right hand
RLC	resistance-inductance-capacitance
RMO	rack mount only
rms	root-mean-square
RND	round
ROM	read-only memory
R&P	rack and panel
RWV	reverse working voltage
S	scattering parameter
s	second (time)
..."	second (plane angle)
S-B	slow-blow (fuse) (used in parts list)
SCR	silicon controlled rectifier; screw
SE	selenium
SECT	sections
SEMICON	semiconductor
SHF	superhigh frequency
SI	silicon
SIL	silver
SL	slide
SNR	signal-to-noise ratio
SPDT	single-pole, double-throw
SPG	spring
SR	split ring
SPST	single-pole, single-throw
SSB	single sideband
SST	stainless steel
STL	steel
SQ	square
SWR	standing-wave ratio
SYNC	synchronize
T	timed (slow-blow fuse)
TA	tantalum
TC	temperature compensating
TD	time delay
TERM	terminal
TFT	thin-film transistor
TGL	toggle
THD	thread
THRU	through
TI	titanium
TOL	tolerance
TRIM	trimmer
TSTR	transistor
TTL	transistor-transistor logic
TV	television
TVI	television interference
TWT	traveling wave tube
U	micro (10^{-6}) (used in parts list)
UF	microfarad (used in parts list)
UHF	ultrahigh frequency
UNREG	unregulated
V	volt
VA	voltampere
Vac	volts, ac
VAR	variable
VCO	voltage-controlled oscillator
Vdc	volts, dc
VDCW	volts, dc, working (used in parts list)
V(F)	volts, filtered
VFO	variable-frequency oscillator
VHF	very-high frequency
Vpk	volts, peak
Vp-p	volts, peak-to-peak
Vrms	volts, rms
VSWR	voltage standing wave ratio
VTO	voltage-tuned oscillator
VTVM	vacuum-tube voltmeter
V(X)	volts, switched
W	watt
W/	with
WIV	working inverse voltage
WW	wirewound
W/O	without
YIG	yttrium-iron-garnet
Z_o	characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	11661-60019	1	OSCILLATOR/MIXER HOUSING ASSY	28480	11661-60019
A1C1	0160-2437	6	CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1C2	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1C3	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1C4	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1C5	0160-4023	1	CAPACITOR-FXD 680PF +-20% 500WVDC CER	28480	0160-4023
	0360-1155	2	TERMINAL, SLDR LUG, 12 SCR, .25/.093 ID	79963	110
A1C6	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1C7	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A1J1	1250-0901	7	CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J2	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J3	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J4	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J5	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J6	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1J7	1250-0901		CONNECTOR-RF SMB M SGL HOLE FR	2K497	700166
A1R1	0757-0401	3	RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A1R2	0698-7192	1	RESISTOR 14.7 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-14R7-G
A1R3	0698-7217	2	RESISTOR 162 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-162R-G
A1U1	5086-7055	1	SAMPLER, 1.8 GHZ LOW PASS FILTER ASSY	28480	5086-7055
A1U2	5086-7054	1	VCO/MIXER ASSY	28480	5086-7054
A1U3	5086-7053	1	4.43 GHZ OSC/MIXER ASSY	28480	5086-7053
			A1 MISCELLANEOUS		
	0360-1155		TERMINAL, SLDR LUG, 12 SCR, .25/.093 ID	79963	110
	11661-00004	1	COVER, SUM LOOP	28480	11661-00004
	11661-00006	2	CLAMP,MICROCIRCUIT OSCILLATOR	28480	11661-00006
	11661-00016	1	COVER, FILTER	28480	11661-00016
	11661-00008	1	CLMP, SAMPLER-FILTER	28480	11661-00008
	11661-00009	1	COVER, YIG LOOP	28480	11661-00009
	0380-0793	2	SPACER-RND .156-LG .093-ID .125-OD BRS	76854	15525-610
A1A1	11661-60007	1	20 MHZ IF AMPLIFIER ASSY	28480	11661-60007
A1A1C1	0121-0448	1	CAPACITOR; VAR; TRMR; CER; 2.5/5PF	0086S	5S-TRIKO-03, 2.5
A1A1C2	0160-3878	10	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C3	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C4	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C5	0160-3879	18	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C8	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C9	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1CR1	1901-0040	11	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1L1	9140-0144	5	COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A1A1L2	9100-1618	1	COIL; FXD; MOLDED RF CHOKE; 5.6UH 10%	24226	15/561
A1A1L3 †	9140-0144		COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A1A1Q1	1853-0015	1	TRANSISTOR PNP SI CHIP PD=200MW	28480	1853-0015
A1A1Q2	1854-0009	1	TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	28480	1854-0009
A1A1Q3	1855-0081	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A1A1R1	0698-7260	7	RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A1A1R2	0698-7236	11	RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A1A1R3	0698-7243	5	RESISTOR 1.96K 2% .05W F TUBULAR	24546	C3-1/8-T0-1961-G
A1A1R4	0698-7212	6	RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A1A1R5	0698-7243		RESISTOR 1.96K 2% .05W F TUBULAR	24546	C3-1/8-T0-1961-G
A1A1R6	0698-7247	2	RESISTOR 2.87K 2% .05W F TUBULAR	24546	C3-1/8-T0-2871-G
A1A1R7	0698-7195	2	RESISTOR 19.6 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-19R6-G
A1A1R8	0698-7234	1	RESISTOR 825 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-825R-G
A1A1R9	0698-7219	8	RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A1A1R10	0698-7245	2	RESISTOR 2.37K 2% .05W F TUBULAR	24546	C3-1/8-T0-2371-G
A1A1R11	0698-7205	3	RESISTOR 51.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-51R1-G
A1A2	11661-60008	1	380-480 MHZ IF AMPLIFIER ASSY	28480	11661-60008
A1A2C1	0180-0197	7	CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A2C2	0180-1746	1	CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A1A2C3	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A2C4	0160-2266	2	CAPACITOR-FXD 24PF +-5% 500WVDC CER 0+	28480	0160-2266
A1A2C5	0160-2266		CAPACITOR-FXD 24PF +-5% 500WVDC CER 0+	28480	0160-2266
A1A2C6	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A2C7	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A2C8	0160-2257	1	CAPACITOR-FXD 10PF +-5% 500WVDC CER 0+	28480	0160-2257

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A2L1	9140-0144		COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A1A2L2	08660-80009	2	INDUCTOR	28480	08660-80009
A1A2L3	08660-80009		INDUCTOR	28480	08660-80009
A1A2Q1†	1854-0540	2	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0540
A1A2Q2	1854-0540		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0540
A1A2R1	0698-3440	4	RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A1A2R2	0698-3429	1	RESISTOR 19.6 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-19R6-F
A1A2R3	2100-1984	1	RESISTOR; VAR; TRMR; 100 OHM 10% C	30983	ET50W101
A1A2R4	0698-7256	2	RESISTOR 6.81K 2% .05W F TUBULAR	24546	C3-1/8-T0-6811-G
A1A2R5	0698-7248	3	RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-T0-3161-G
A1A2R6	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A1A2R7	0698-7256		RESISTOR 6.81K 2% .05W F TUBULAR	24546	C3-1/8-T0-6811-G
A1A2R8	0698-7248		RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-T0-3161-G
A1A2R9	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A1A3	11661-60014	1	4 GHZ LOW PASS FILTER ASSY	28480	11661-60014
A1A4	11661-60012	1	4.43 GHZ OSCILLATOR TUNING ASSY	28480	11661-60012
A1A4C1	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A4C2	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A4C3	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A4R1	0698-7195		RESISTOR 19.6 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-19R6-G
A1A4R2	0757-0405	1	RESISTOR 162 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-162R-F
A1A4VR1	1901-1034	1	DIODE-STABISTOR 90V	03508	MPD400
A2	11661-60006	1	MOTHER BOARD ASSY	28480	11661-60006
A2C1	0160-2055	9	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A2C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A2C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A2J1	1250-1377	5	CONNECTOR-RF SMB FEM PC	2K497	700214
A2J2	1250-1377		CONNECTOR-RF SMB FEM PC	2K497	700214
A2J3	1250-1377		CONNECTOR-RF SMB FEM PC	2K497	700214
A2J4	1250-1377		CONNECTOR-RF SMB FEM PC	2K497	700214
A2J5	1250-1377		CONNECTOR-RF SMB FEM PC	2K497	700214
A2XA3	1251-1626	5	CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A2XA4	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A2XA5	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A2XA6	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A2XA7	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A3	11661-60004	1	SUM LOOP PHASE DETECTOR ASSY	28480	11661-60004
A3C1	0180-2208	2	CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A3C2	0180-2208		CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A3C3	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C4	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C6	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3C7	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3C8	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C9	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3C10	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C11	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3C12	0160-3873	3	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A3C13	0160-3873		CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A3C14	0160-3873		CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A3C15	0160-3875	4	CAPACITOR-FXD 22PF +-5% 200WVDC CER 0+	28480	0160-3875
A3C16	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER 0+	28480	0160-3875
A3C17	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER 0+	28480	0160-3875
A3C18	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER 0+	28480	0160-3875
A3C19	0160-3548	2	CAPACITOR-FXD .01UF +-1% 100WVDC MICA	28480	0160-3548
A3C20	0160-3094	8	CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A3C21	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A3C22	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C23	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A3C24	0160-2306	1	CAPACITOR-FXD 27PF +-5% 300WVDC MICA	28480	0160-2306
A3C25	0160-3548		CAPACITOR-FXD .01UF +-1% 100WVDC MICA	28480	0160-3548
A3L1	9140-0179	1	COIL; FXD; MOLDED RF CHOKE; 22UH 10%	24226	15/222
A3L2*	9140-0105	1	COIL; FXD; MOLDED RF CHOKE; 8.2UH 10%	24226	15/821
			*FACTORY SELECTED PART		
A3L3	9100-2551	1	COIL; FXD; MOLDED RF CHOKE; 12UH 10%	06560	15S-120K
A3L4	9140-0238	2	COIL; FXD; MOLDED RF CHOKE; 82UH 5%	24226	15/822

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3L5	9140-0238		COIL; FXD; MOLDED RF CHOKE; 82UH 5%	24226	15/822
A3Q1	1853-0007	15	TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A3Q2	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A3Q3	1854-0221	2	TRANSISTOR NPN DUAL 200%-HFE 10MV-VBE	28480	1854-0221
A3Q4	1855-0049	1	TRANSISTOR; JFET;DUAL; N-CHAN D-MODE SI	28480	1855-0049
A3Q5	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A3R1	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A3R2	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A3R3	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A3R4	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A3R5	0698-7224	10	RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3R6	0698-7222	3	RESISTOR 261 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-261R-G
A3R7	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3R8	0698-7222		RESISTOR 261 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-261R-G
A3R9	0698-7225	4	RESISTOR 348 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-348R-G
A3R10	0698-7225		RESISTOR 348 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-348R-G
A3R11	0698-7218	2	RESISTOR 178 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-178R-G
A3R12	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3R13 †	0698-7253		RESISTOR 5.11 K 2% .05W F TUBULAR	24546	C3-1/8-T0-5111-G
A3R14	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3R15	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3R16 †	0698-7253		RESISTOR 5.11 K 2% .05W F TUBULAR	24546	C3-1/8-T0-5111-G
A3R17 †	0698-7244	7	RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R18	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R19 †	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R20	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R21 †	0698-7253	2	RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-T0-5111-G
A3R22	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R23	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A3R24	0698-7188	5	RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A3R25	0698-7277	2	RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-T0-5112-G
A3R26	0698-7188		RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A3R27	0698-7205		RESISTOR 51.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-51R1-G
A3R28	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A3R29	0698-7249	2	RESISTOR 3.48K 2% .05W F TUBULAR	24546	C3-1/8-T0-3481-G
A3R30	0698-7205		RESISTOR 51.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-51R1-G
A3R31	0698-7241	2	RESISTOR 1.62K 2% .05W F TUBULAR	16299	C3-1/8-T0-1621-G
A3R32	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-T0-5112-G
A3R33	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-T0-5111-G
A3R34	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A3R35	0698-3154	1	RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A3U1	1820-0681	2	IC DGTL SN74S 00 N GATE	01295	SN74S00N
A3U2	1820-0685	1	IC DGTL SN74S 10 N GATE	01295	SN74S10N
A3U3	1820-0681		IC DGTL SN74S 00 N GATE	01295	SN74S00N
			A3 MISCELLANEOUS		
	0360-0124	2	TERMINAL, STUD .040 "	97300	SIZE A
	1480-0073	10	PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748	5	EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	4040-0753	1	EXTRACTOR-PC BOARD, GREEN	28480	4040-0753
A4	11661-60005	1	SUM LOOP PRETUNE ASSY	28480	11661-60005
A4C1	0160-0127	6	CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A4C2	0160-0127		CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A4C3	0180-0183	1	CAPACITOR-FXD; 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A4C4	0160-2254	1	CAPACITOR-FXD 7.5PF +-.25PF 500WVDC CER	28480	0160-2254
A4C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A4C6	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A4C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A4C8*	0140-0199	1	CAPACITOR-FXD 240PF +-5% 300WVDC MICA *FACTORY SELECTED PART	72136	DM15F241J0300WV1CR
A4CR1	1901-0050	1	DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A4L1	9140-0138	1	COIL; FXD; MOLDED RF CHOKE; 180UH 5%	24226	15/183
A4L2	9100-2261	1	COIL; FXD; MOLDED RF CHOKE; 2.7UH 10%	99800	1025-30
A4Q1	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q2	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q3	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q4	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q5	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q6	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q7	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q8	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q9	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q10	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4Q11	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4Q12	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A4R1	0698-7188		RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A4R2	0757-0441	1	RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-T0-8251-F
A4R3	0698-7217		RESISTOR 162 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-162R-G
A4R4	0698-7240	2	RESISTOR 1.47K 2% .05W F TUBULAR	24546	C3-1/8-T0-1471-G
A4R5	2100-1986	5	RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A4R6	2100-1986		RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A4R7	0698-3101	1	RESISTOR 2.87K 1% .5W F TUBULAR	03888	PME65-1/2-T0-2871-F
A4R8	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A4R9	0698-7218		RESISTOR 178 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-178R-G
A4R10	0698-7241		RESISTOR 1.62K 2% .05W F TUBULAR	16299	C3-1/8-T0-1621-G
A4R11	2100-2061	4	RESISTOR; VAR; TRMR; 200 OHM 10% C	30983	ET50W201
A4R12	0698-7258	1	RESISTOR 8.25K 2% .05W F TUBULAR	24546	C3-1/8-T0-8251-G
A4R13	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A4R14	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A4R15	0698-7242	1	RESISTOR 1.78K 2% .05W F TUBULAR	24546	C3-1/8-T0-1781-G
A4R16	2100-2061		RESISTOR; VAR; TRMR; 200 OHM 10% C	30983	ET50W201
A4R17	0698-7276	1	RESISTOR 46.4K 2% .05W F TUBULAR	24546	C3-1/8-T0-4642-G
A4R18	0698-7220	1	RESISTOR 215 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-215R-G
A4R19	0698-7243		RESISTOR 1.96K 2% .05W F TUBULAR	24546	C3-1/8-T0-1961-G
A4R20	2100-2061		RESISTOR; VAR; TRMR; 200 OHM 10% C	30983	ET50W201
A4R21	0698-7221	1	RESISTOR 237 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-237R-G
A4R22	0698-7244		RESISTOR 2.15K 2% .05W F TUBULAR	24546	C3-1/8-T0-2151-G
A4R23	2100-1788	2	RESISTOR; VAR; TRMR; 500 OHM 10% C	30983	ET50W501
A4R24	0698-7222		RESISTOR 261 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-261R-G
A4R25	0698-7245		RESISTOR 2.37K 2% .05W F TUBULAR	24546	C3-1/8-T0-2371-G
A4R26	2100-1788		RESISTOR; VAR; TRMR; 500 OHM 10% C	30983	ET50W501
A4R27	0698-7223	2	RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-287R-G
A4R28	0698-7246	1	RESISTOR 2.61K 2% .05W F TUBULAR	24546	C3-1/8-T0-2611-G
A4R29	2100-1986		RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A4R30	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A4R31	0698-7247		RESISTOR 2.87K 2% .05W F TUBULAR	24546	C3-1/8-T0-2871-G
A4R32	2100-1986		RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A4R33	0698-7225		RESISTOR 348 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-348R-G
A4R34	0698-7248		RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-T0-3161-G
A4R35	2100-1986		RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A4R36	0698-7226	1	RESISTOR 383 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-383R-G
A4R37	0698-7249		RESISTOR 3.48K 2% .05W F TUBULAR	24546	C3-1/8-T0-3481-G
A4R38	2100-2497	1	RESISTOR; VAR; TRMR; 2KOHM 10% C	19701	ET50W202
A4U1	1820-0214	1	IC DGTL SN74 42 N DECODER	01295	SN7442N
			A4 MISCELLANEOUS		
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	4040-0752	1	EXTRACTOR-PC BOARD, YELLOW	28480	4040-0752
A5	11661-60001	1	YIG LOOP PRETUNE ASSY	28480	11661-60001
A5C1	0180-2207	1	CAPACITOR-FXD; 100UF+-10% 10VDC TA	56289	150D107X9010R2
A5C2	0180-2206	2	CAPACITOR-FXD; 60UF+-10% 6VDC TA-SOLID	56289	150D606X9006B2
A5C3	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A5C4	0160-3456	1	CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A5C5	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A5C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A5C7	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A5C8 †	0180-0291	8	CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5CR1	1901-0376	2	DIODE-GEN PRP 35V 50MA	28480	1901-0376
A5CR2 †	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A5Q1	1854-0071	5	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q6	1854-0221		TRANSISTOR NPN DUAL 200%-HFE 10MV-VBE	28480	1854-0221
A5Q7	1855-0020	2	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0020
A5Q8	1854-0062	2	TRANSISTOR NPN 2N1701 SI PD=25W	04713	2N3055
A5Q9	1854-0062		TRANSISTOR NPN 2N1701 SI PD=25W	04713	2N3055
A5R1	0757-0421	1	RESISTOR 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A5R2	0698-7229	5	RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G
A5R3	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G
A5R4	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G
A5R5	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R6	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G
A5R7	0698-7272	5	RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-T0-3162-G
A5R8	0698-7272		RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-T0-3162-G
A5R9	0698-7272		RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-T0-3162-G
A5R10	0698-7272		RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-T0-3162-G
A5R11	0698-7272		RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-T0-3162-G
A5R12	0757-0280	2	RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A5R13	2100-3109	1	RESISTOR-VAR TRMR 2KOHM 10% C SIDE ADJ	32997	3006P-1-202
A5R14	0811-3158	2	RESISTOR 40K .25% .025W PWW TUBULAR	14140	1409-1/40-4002-25
A5R15 †	2100-3154	2	RESISTOR-VAR TRMR 1KOHM 10% C SIDE ADJ	32997	3006P-1-102
A5R16 †	0811-3159	2	RESISTOR 20K .25% .025W PWW TUBULAR	14140	1409-1/40-2002-C
A5R17 †	2100-3154		RESISTOR-VAR TRMR 1K OHM 10% C SIDE ADJ	32997	3006P-1-102
A5R18	0811-3160	2	RESISTOR 10K .25% .025W PWW TUBULAR	14140	1409-1/40-1002-C
A5R19 †	2100-3123	2	RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A5R20	0811-3161	2	RESISTOR 5K .25% .025W PWW TUBULAR	14140	1409-1/40-5001-C
A5R21 †	2100-3123		RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A5R22	0811-3162	2	RESISTOR 4K .25% .025W PWW TUBULAR	14140	1409-1/40-4001-C
A5R23	0811-3158		RESISTOR 40K .25% .025W PWW TUBULAR	14140	1409-1/40-4002-25
A5R24	0811-3159		RESISTOR 20K .25% .025W PWW TUBULAR	14140	1409-1/40-2002-C
A5R25	0811-3160		RESISTOR 10K .25% .025W PWW TUBULAR	14140	1409-1/40-1002-C
A5R26	0811-3161		RESISTOR 5K .25% .025W PWW TUBULAR	14140	1409-1/40-5001-C
A5R27	0811-3162		RESISTOR 4K .25% .025W PWW TUBULAR	14140	1409-1/40-4001-C
A5R28	0811-3163	2	RESISTOR 1K .25% .025W PWW TUBULAR	14140	1409-1/40-1001-C
A5R29	2100-3229	2	RESISTOR-VAR TRMR 200 OHM 10% C SIDE ADJ	32997	3006P-1-201
A5R30	0811-3163		RESISTOR 1K .25% .025W PWW TUBULAR	14140	1409-1/40-1001-C
A5R31	0698-0024	1	RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-T0-2611-F
A5R32	0698-3457	2	RESISTOR 316K 1% .125W F TUBULAR	19701	MF4C1/8-T0-3163-F
A5R33	0698-7284	4	RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-T0-1003-G
A5R34	0698-3457		RESISTOR 316K 1% .125W F TUBULAR	19701	MF4C1/8-T0-3163-F
A5R35	0698-7284		RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-T0-1003-G
A5R36	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A5R37	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A5R38	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A5R39	2100-3229		RESISTOR-VAR TRMR 200 OHM 10% C SIDE ADJ	32997	3006P-1-201
A5R40	0811-3164	1	RESISTOR 2.1K .25% .025W PWW TUBULAR	14140	1409-1/40-2101-C
A5R41	0698-7188		RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A5R42	0698-7243		RESISTOR 1.96K 2% .05W F TUBULAR	24546	C3-1/8-T0-1961-G
A5R43 †	0811-3256	2	RESISTOR 100 OHM .25% 3W PW TUBULAR	00213	1200S
A5R44	0698-7188		RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A5R45 †	0811-3256		RESISTOR 100 OHM .25% 3W PW TUBULAR	00213	1200S
A5U1	1820-0174	1	IC DGTL SN74 04 N INVERTER	01295	SN7404N
A5U2	1820-0223	2	IC LIN LM301AH AMPLIFIER	27014	LM301AH
A5VR1	1902-1216	2	DIODE; ZENER; 9V VZ; .5W MAX PD	12954	1N938A
A5VR2	1902-0202	2	DIODE; ZENER; 15V VZ; 1W MAX PD	04713	SZ11213-191
A5VR3	1902-1216		DIODE; ZENER; 9V VZ; .5W MAX PD	12954	1N938A
A5VR4 †	1902-0202		DIODE; ZENER; 15V VZ; 1W MAX PD	04713	SZ11213-191
			A5 MISCELLANEOUS		
	0360-0124		TERMINAL, STUD .040 "	97300	SIZE A
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	4040-0751	1	EXTRACTOR-PC BD ORN LEXAN .062 BD THKNS	28480	4040-0751
A6	11661-60002	1	FM DRIVER ASSY	28480	11661-60002
A6C1	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6C2	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A6C3	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6C4	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C5	0180-2141	2	CAPACITOR-FXD; 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A6C6	0180-2141		CAPACITOR-FXD; 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A6C7	0160-0153	1	CAPACITOR-FXD 1000PF +-10% 200WVDC POLYE	56289	292P10292
A6C8	0180-2206		CAPACITOR-FXD; 60UF+-10% 6VDC TA-SOLID	56289	150D606X9006B2
A6C9	0160-0166	1	CAPACITOR-FXD .068UF +-10% 200WVDC POLYE	56289	292P68392
A6C10	0160-3536	1	CAPACITOR-FXD 620PF +-5% 100WVDC MICA	28480	0160-3536
A6C11	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C12	0160-3451	1	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A6C13	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6C14	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6C15	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A6C16	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A6C17	0160-0127		CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A6C18	0160-0127		CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A6C19	0160-0127		CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A6C20	0160-0158	1	CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6C21	0160-0127		CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A6CR1	1910-0022	2	DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A6CR2	1910-0022		DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A6CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR6	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR9	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR10	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6CR12	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A6L1	9140-0144		COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A6Q1	1853-0034	1	TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A6Q2	1854-0053	1	TRANSISTOR NPN 2N2218 SI PD=800MW	04713	2N2218
A6Q3	1854-0039	1	TRANSISTOR NPN 2N3053 SI PD=1W	04713	2N3053
	1205-0011	3	HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
A6Q4	1853-0209	1	TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0209
	1205-0011		HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
A6Q5	1853-0020	1	TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A6Q6	1855-0020		TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0020
A6R1	0698-7215	2	RESISTOR 133 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-133R-G
A6R2	0698-7215		RESISTOR 133 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-133R-G
A6R3	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A6R4	0698-3405	1	RESISTOR 422 OHM 1% .5W F TUBULAR	19701	MF7C1/2-T0-422R-F
A6R5	0698-7209	1	RESISTOR 75 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-75R0-G
A6R6	2100-2520	1	RESISTOR; VAR; TRMR; 50 OHM 20% C	19701	ET50X500
A6R7	0698-7211	1	RESISTOR 90.9 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-90R9-G
A6R8	0698-7230	2	RESISTOR 562 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-562R-G
A6R9	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A6R10	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R11	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-T0-1002-G
A6R12	0698-7264	2	RESISTOR 14.7K 2% .05W F TUBULAR	24546	C3-1/8-T0-1472-G
A6R13	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-287R-G
A6R14	0698-7284		RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-T0-1003-G
A6R15	0698-7252	1	RESISTOR 4.64K 2% .05W F TUBULAR	24546	C3-1/8-T0-4641-G
A6R16	0698-7284		RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-T0-1003-G
A6R17	0698-7264		RESISTOR 14.7K 2% .05W F TUBULAR	24546	C3-1/8-T0-1472-G
A6R18	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A6R19	0698-7240		RESISTOR 1.47K 2% .05W F TUBULAR	24546	C3-1/8-T0-1471-G
A6R20	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R21	0698-7230		RESISTOR 562 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-562R-G
A6R22	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R23	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A6R24	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A6R25	0757-1094	1	RESISTOR 1.47K 1% .125W F TUBULAR	24546	C4-1/8-T0-1471-F
A6R26	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R27	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R28	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A6R29	0698-7243		RESISTOR 1.96K 2% .05W F TUBULAR	24546	C3-1/8-T0-1961-G
A6R30	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A6R31	0698-7236		RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-T0-1001-G
A6R32	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A6R33	0683-0475	2	RESISTOR 4.7 OHM 5% .25W CC TUBULAR	01121	CB47G5
A6R34	0683-0475		RESISTOR 4.7 OHM 5% .25W CC TUBULAR	01121	CB47G5
A6R35	0683-0275	1	RESISTOR 2.7 OHM 5% .25W CC TUBULAR	01121	CB27G5
A6R36	0698-3427	3	RESISTOR 13.3 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-13R3-F
A6R37	0757-0346	1	RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A6R38	0698-3427		RESISTOR 13.3 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-13R3-F
A6R39	0698-3427		RESISTOR 13.3 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-13R3-F
A6R40	0757-0795	1	RESISTOR 75 OHM 1% .5W F TUBULAR	19701	MF-1/2-T0-75R0-F
A6U1	1821-0001	1	IC LIN CA3046 TRANSISTOR ARRAY	02735	CA3046
A6U2	1820-0054	1	IC DGTL SN74 00 N GATE	01295	SN7400N
A6VR1	1902-3048	1	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=	04713	SZ 10939-50
A6VR2	1902-3002	1	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
			A6 MISCELLANEOUS		
	0360-1514	4	TERMINAL; SLDR STUD	28480	0360-1514
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	4040-0750	1	EXTRACTOR-PC BOARD, RED	28480	4040-0750

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7	11661-60003	1	YIG LOOP PHASE DETECTOR ASSY	28480	11661-60003
A7C1	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A7C2	0121-0036	1	CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	DV11PR18A
A7C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A7C4	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A7C5	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A7C7	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A7C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A7C9	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A7C10	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A7C11	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A7C12	0180-0374	1	CAPACITOR-FXD; 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A7C13	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A7C14	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A7C15	0160-0161	1	CAPACITOR-FXD .01UF +-10% 200WVDC POLYE	56289	292P10392
A7C16	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A7C17	0160-0945	2	CAPACITOR-FXD 910PF +-5% 100WVDC MICA	28480	0160-0945
A7C18	0160-0939	1	CAPACITOR-FXD 430PF +-5% 300WVDC MICA	28480	0160-0939
A7C19	0140-0194	1	CAPACITOR-FXD 110PF +-5% 300WVDC MICA	72136	DM15F111J0300WV1CR
A7C20	0160-0945		CAPACITOR-FXD 910PF +-5% 100WVDC MICA	28480	0160-0945
A7CR1	1901-0025	1	DIODE-GEN PRP 100V 200MA	28480	1901-0025
A7L1	9140-0144		COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A7L2	9140-0142	1	COIL; FXD; MOLDED RF CHOKE; 2.2UH 10%	24226	10/221
A7Q1	1854-0019	4	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A7Q2	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A7Q3	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A7Q4	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A7Q5	1853-0001	1	TRANSISTOR PNP SI CHIP TO-39 PD=600MW	28480	1853-0001
	1205-0011		HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
A7R1	0757-0416	2	RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A7R2	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A7R3	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A7R4	0698-3444	4	RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-316R-F
A7R5	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A7R6	0698-7227	1	RESISTOR 422 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-422R-G
A7R7	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A7R8	0698-3388	1	RESISTOR 14.7 OHM 1% .5W F TUBULAR	07716	CEC1/2-T0-14R7-F
A7R9	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A7R10	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A7R11	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A7R12	0698-3447	1	RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A7R13	0698-3444		RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-316R-F
A7R14	0698-3444		RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-316R-F
A7R15	0698-7232	1	RESISTOR 681 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-681R-G
A7R16	0698-7225		RESISTOR 348 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-348R-G
A7R17	2100-2574	1	RESISTOR; VAR; TRMR; 500 OHM 10% C	19701	ET50X501
A7R18	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-196R-G
A7R19	0698-3444		RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-316R-F
A7R20	2100-2061		RESISTOR; VAR; TRMR; 200 OHM 10% C	30983	ET50W201
A7T1	08552-6024	1	TRANSFORMER, RF YELLOW	28480	08552-6024
A7U1	1820-0253	3	IC DGTL MC 1035P SCHMITT TRIGGER	04713	MC1035P
A7U2	1820-0253		IC DGTL MC 1035P SCHMITT TRIGGER	04713	MC1035P
A7U3	1820-0253		IC DGTL MC 1035P SCHMITT TRIGGER	04713	MC1035P
A7U4	1820-0145	1	IC DGTL MC 1010P GATE	04713	MC1010P
A7U5	1820-0223		IC LIN LM301AH AMPLIFIER	27014	LM301AH
A7U6	10534C	1		28480	10534C
A7VR1	1902-0025	1	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A7VR2	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=	04713	SZ 10939-98
A7VR3	1902-3059	1	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=	04713	SZ 10939-62
			A7 MISCELLANEOUS		
	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	4040-0749	1	EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
A8	11661-60038	1	50 MHZ FILTER ASSY (NON-REPAIRABLE)	28480	11661-60038
A9	11661-60037	1	20 MHZ FILTER ASSY (NON-REPAIRABLE)	28480	11661-60037

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10	5086-7023	1	YIG OSCILLATOR ASSY	28480	5086-7023
A10J1			NSR, MATES WITH A13P1		
A11	11661-60036	1	2.6-4.1 GHZ BAND PASS FILTER ASSY	28480	11661-60036
A11MP1	1250-1295	1	CONNECTOR, RF SMA M (PART OF A11W1)	16179	OSM531-3
A11W1			NSR, YIG OUTPUT CABLE,BLACK(INCL A11MP1)		
A11W2			NSR, YIG LOOP OUTPUT CABLE,BLACK(INCL J2		
A11W3			NSR,YIG LOOP FEEDBACK CABLE, GRAY/GREEN (INCLUDES MP2)		
A12	11661-60035	1	4.43 GHZ BAND PASS FILTER ASSY	28480	11661-60035
A12W1			NSR,4.43GHZ BPF INPT,GRAY/RED(INCL MP2)		
A12W2			NSR,4.43GHZ BPF OUPT,GRAY/ORG,(INCL MP2)		
A13	11661-60049	1	YIG WIRING HARNESS ASSY	28480	11661-60049
A13MP1	1251-2570	7	CONTACT, CONN, U/W MICRO SER, MALE	71468	031-9540-000
A13P1	1251-2581	1	HOUSING STRIP:9 MALE CONTACT	71468	CTA4-1P-9
			CHASSIS PARTS		
J1	1250-1221	2	SUM LOOP OUTPUT JACK (P/O W10)	24931	33JS118-1
J2	1250-1221		YIG LOOP OUTPUT JACK (P/O A11W2)	24931	33JS118-1
MP1	1251-0546	1	CONTACT:R & P CONNECTOR, RECTANGULAR (P/O W1, W3, W6, &W8; 1 EACH)	81312	III17054S
MP2	1250-1193	1	CONNECTOR-RF SM SLD FEM (P/O A11W3, A12W1, A12W2, AND W1, W3, W6, W7, W8, W9, W10, W12, W13; 1 EACH & P/O W2, W4, W5; 2 EACH)	98291	52-328-0019
MP3	1250-0885	1	CONNECTOR, RF SMB FEM (P/O W7)	2K497	700405
P4	11661-60018	1	CONNECTOR ASSY(INCL W1, W3, W6 & W8)	28480	11661-60018
	5040-0380	1	CONNECTOR BODY	28480	5040-0380
	5040-0381	1	CONNECTOR FACE	28480	5040-0381
	1251-3087	1	CONTACT, CONN, U/W RECTANGULAR SER, FEM	81312	100-0908S
R1	2100-2646	1	RESISTOR-VAR TRMR 100 OHM 10% C SIDE ADJ	32997	3059Y-1-101
W1†	11661-60020	2	CABLE ASSY, 20 MHZ FM/CW REFERENCE INPUT WHITE/RED (P/O P4, INCLUDES MP1 & MP2)	28480	11661-60020
W2	11661-60021	1	CABLE ASSY,20 MHZ FILTER OUTPUT, RED (INCLUDES MP2)	28480	11661-60021
W3†	11661-60029	1	CABLE ASSY, 100 MHZ REFERENCE INPUT, WHITE/BROWN(P/O P4, INCLUDES MP1 & MP2)	28480	11661-60029
W4	11661-60031	1	CABLE ASSY, 20 MHZ FILTER INPUT, WHITE (INCLUDES MP2)	28480	11661-60031
W5	11661-60032	1	CABLE ASSY, 50 MHZ FILTER INPUT(INCL MP2	28480	11661-60032
W6†	11661-60030	1	CABLE ASSY, 360 TO 450 MHZ INPUT, WHITE/ YELLOW (P/O P4; INCLUDES MP1 & MP2)	28480	11661-60030
W7	11661-60022	1	CABLE ASSY,50 MHZ FILTER OUTPUT, YELLOW (INCLUDES MP2 AND MP3)	28480	11661-60022
W8†	11661-60023	1	CABLE ASSY, 20 TO 30 MHZ INPUT, WHITE/ ORANGE (P/O P4; INCLUDES MP1 & MP2)	28480	11661-60023
W9	11661-60024	1	CABLE ASSY, VCO CONTROL SIGNAL, BLUE (INCLUDES MP2)	28480	11661-60024
W10	11661-60050		CABLE ASSY, SUM LOOP OUTPUT, GRAY (INCLUDES MP2 AND J1)	28480	11661-60050
W11*	11661-60053	1	CABLE ASSY, ATTENUATOR, GRAY *FACTORY SELECTED PART	28480	11661-60053
W12	11661-60028	1	CABLE ASSY, SUM LOOP INTERCONNECT, GRAY (INCLUDES MP2)	28480	11661-60028
W12	1250-1375	1	CONNECTOR	28480	1250-1375
W13	11661-60026	1	CABLE ASSY, YIG LOOP INTERCONNECT, GRAY/BLUE (INCLUDES MP2)	28480	11661-60026
W13	1250-1373	1	CONNECTOR	28480	1250-1373
			CHASSIS MISCELLANEOUS		
	2360-0055	3	SCREW-MACH 6-32 BDG HD SLT REC NYL-NAT	95987	N-632-3/16
	6960-0016	11	PLUG; HOLE; TRUSS HD; .125 DIA NYLON	28480	6960-0016
	11661-00001	1	FRAME	28480	11661-00001
	11661-00002	1	BRACKET, CONNECTOR	28480	11661-00002
	11661-00003	1	CLAMP, YIG OSCILLATOR	28480	11661-00003
	11661-00005	1	PANEL, TOP	28480	11661-00005
	11661-20022	1	GUIDE, PC BOARD	28480	11661-20022

See introduction to this section for ordering information

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A.COMMON	ANY SUPPLIER OF USA	
00213	SAGE ELECTRONICS CORP	ROCHESTER NY	14610
0086S	STETTNER-TRUSH INC	CAZENOVIA NY	13035
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE NY	13201
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06560	AIRCO SPEER ELEK DIV AIR RDCN CO	NOGALES AZ	85621
07716	TRW INC BURLINGTON DIV	BURLINGTON IA	52601
12954	DICKSON ELECTRONICS CORP	SCOTTSDALE AZ	85252
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER NH	03130
16179	OMNI SPECTRA INC	FARMINGTON MI	48024
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
2K497	CABLEWAVE SYSTEMS INC	NORTH HAVEN CT	06473
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71468	ITT CANNON ELECTRIC CO	SANTA ANA CA	92702
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC CT	06226
73899	J F D ELECTRONICS CORP	BROOKLYN NY	11219
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
79963	ZIERICK MFG CO	MT KISCO NY	10549
81312	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	06779
95987	WECKESSER CO INC	CHICAGO IL	60641
97300	ART WIRE & STAMPING CO	CEDAR KNOLLS NJ	07927
98291	SEALECTRO CORP	MAMARONECK NY	10544
99800	AMER PRCN IND INC DELEVAN DIV	AURORA NY	14052

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains manual change instructions for backdating this manual for HP Model 11661A Frequency Extension Modules that have serial number prefixes that are lower than the prefix listed on the title page. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your generator.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B; Change B should be made after Change C; etc. Table 7-2 is a summary of changes by component.

7-5. If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes By Serial Number

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1216A00100 to 00171	I, H, G, F, E, D, C, B, A	1339A	I, H, G, F
1216A00171 to 00190	I, H, G, F, E, D, C, B	1409A	I, H, G
1216A00191 to 00205	I, H, G, F, E, D, C	1412A	I, H
1244A	I, H, G, F, E, D	1430A	I
1248A	I, H, G, F, E		
1250A	I, H, G, F		

Table 7-2. Summary of Changes by Component

Change	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	No Prefix
A									R2 R3 R5 R7				
B	A2Q1												
C	A1L3							C1					
D					R15 R16 R43 R45								
													W1, W3, W6, W8
F					C8 CR2 VR4								
G	A2R10												
H					CR2 VR4								
I			R13 R16 R17 R19 R21										

*Instrument modification recommended, see paragraph 7-7.

MANUAL CHANGES

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-3:
- Change A9R2 and A9R3 to 0698-7231 RESISTOR FXD 619 OHM 2% 1/8W 28480 0698-7231.
- Change A9R5 to 0698-7202 RESISTOR FXD 38.3 OHM 2% 1/8W 28480 0698-7202.
- Change A9R7 to 0698-7220 RESISTOR FXD 215 OHM 2% 1/8W 28480 0698-7220.

Service Sheet 4, A9 Assembly Schematic:
- Change R2 and R3 value to 619 ohms.
- Change R5 value to 38.3 ohms.
- Change R7 value to 215 ohms.

CHANGE B

Table 6-3:
- Change A1A2Q1 and A1A2Q2 to 1854-0345 TRANSISTOR SILICON NPN 80131 2N5179.

Service Sheet 3, A1A2 Assembly Schematic:
- Change Q1 and Q2 part numbers to 1854-0345.

CHANGE C

Table 6-3:
- Delete A1A1L3, A1A2C8, and A1A2R10.
- Change A8C1 to 0160-3877 CAPACITOR FXD CER 100 PF 80031 CV2059X7R101M.

Service Sheet 3:
- Delete C8, L3, and R10 (complete circuit where C8 and L3 were removed).
- Change C2 on A8A1 assembly to C1.
- Change C3 on A8A1 assembly to C2.
- Delete C1, 22pf in A8A1 assembly between U1/L1 junction and ground.

CHANGE D

Table 6-3:
- Change A5R43 to 0811-3171 RESISTOR BXD 50 OHM 1/4% 3W 28480 0811-3171.
- Delete A5R45.
- Change A7R15 and R16 to 0757-0416 RESISTOR FXD MET FLM 511 OHM 1% 1/8W 28480 0757-0416.
- Change A9C4 and A9C5 to 0160-2208 CAPACITOR FXD MICA 330 PF 5% 300 VDCW 28480 0160-2208.
- Change A9C7 to 0140-0205 CAPACITOR FXD MICA 62 PF 5% 300 VDCW 00853 RDM15E620J3C.
- Change A9C8 to 0160-2206 CAPACITOR FXD MICA 160 PF 5% 28480 0160-2206.

Service Sheet 2:
- Change value of A5R43 to 50 ohms.
- Delete A5R45, 100 ohms.

Service Sheet 4:
- Change value of A7R15 and A7R16 to 511 ohms

MANUAL CHANGES

CHANGE E

Table 6-3:
Change W1, 3, 6 & 8 1251-0546 to 1251-2040 CONTACT: 81312 111-17054S.

CHANGE F

Table 6-3:
Delete A5C8.
Add A5CR2 1901-0376 DIODE:SILICON 35V 28480 1901-0376.
Add A5VR4 1902-0202 DIODE:BREAKDOWN 15.0V 5% 1W 28480 1902-0202.

Service Sheet 2:
Delete A5C8.
Add A5CR2 and A5VR4 as shown (daggers indicate these parts have been changed, in this case deleted normally).

CHANGE G

Table 6-3:
Add A1A2R10 0689-7209 RESISTOR:FXD FLM 75 OHM 2% 1/8W 28480 0698-7209.

Service Sheet 3:
Add R10, 75 to A1A2 assembly between L3/C8 junction and ground.

CHANGE H

Table 6-3:
Delete A5CR2 and A5VR4.

Service Sheet 2:
Delete A5CR2 and A5VR4.

CHANGE I

Table 6-3:
Change A3R13 and A3R16 to 0698-7224 RESISTOR: FXD 316 OHM 2% 1/8W 28480 0698-7224.
Change A5R17 to 2100-3123, RESISTOR — VAR TRMR 500 OHM 10% SIDE ADJ, 32997, 3006P-1-501.
Change A5R19 and A5R21 to 2100-3095, RESISTOR — VAR TRMR 200 OHM 10% SIDE ADJ, 32997, 3006P-1-201.
Service Sheet 6:
Change value of A3R13 and 16 to 316 ohms.

7-7. INSTRUMENT IMPROVEMENT MODIFICATIONS

7-8. Hewlett-Packard has developed certain recommended instrument modifications that can be used to improve the performance and reliability of earlier versions of the instrument. In some cases, replacing certain parts requires a modification to make these instruments compatible with parts now in use (if the original part is no longer available). These modifications are outlined in the following procedures and are keyed to instruments by serial number or serial number prefix.

7-9. A7 YIG Loop Phase Detector Assembly Improvement (Serial Numbers 1216A00250 and Below)

7-10. On instruments with serial numbers 1216A00250 and below the Search Threshold Range may be increased by changing the resistor network for A7R17. Perform this modification if the A7R17 adjustment does not have sufficient range. The following parts are required:

Qty	Description	HP Part Number
1	348 Ohm Resistor	0698-7225
1	681 Ohm Resistor	0698-7232

7-11. Remove the 11661A from the mainframe (refer to the last foldout of this manual for procedure) and continue as follows:

1. Unplug the 11661A, A7 circuit board. Refer to Figure 8-8 on Service Sheet 4, locate and replace A7R15 with the new 681 ohm resistor (0698-7232).

2. Locate and replace A7R16 with the new 348 ohm resistor (0698-7225). This completes the modification.

3. Perform the YIG Loop Phase Detector Adjustments given in paragraph 5-32 of this manual.

7-12. Winchester Connector Improvement (Serial Prefixes 1248A and Below)

7-13. On instruments with serial prefixes 1248A and below the 44 pin Winchester RF socket connectors may be strengthened with new retainer clips. These retainer clips, HP part number 1251-3044, significantly reduce the possibility of pushing out the RF sockets when the Extension Module is being installed. The RF socket hole in the Winchester connector must be drilled with a #34 drill so that the new, larger retainer clip will fit properly. If ordering a replacement cable for instruments with serial prefix 1248A and below, the Winchester connector RF socket hole must be drilled out.

7-14. If an RF socket is pushed out of the connector, perform the following modification. The following parts are required:

Qty	Description	HP Part No.
3 (2 spares)	Retainer Clip	1251-3044

Proceed as follows:

1. Push the defective RF socket out of the Winchester connector. Use pin removal tool, HP part number 8830-0025. Replace the socket retainer clip with a new retainer clip, HP part number 1251-3044 as shown in Figure 7-1.

2. In the Winchester connector, drill out the socket hole with a #34 drill. Be careful not to make the hole too large. Reinstall the RF socket into the connector. Use pin insertion tool, HP part number 8830-0025.

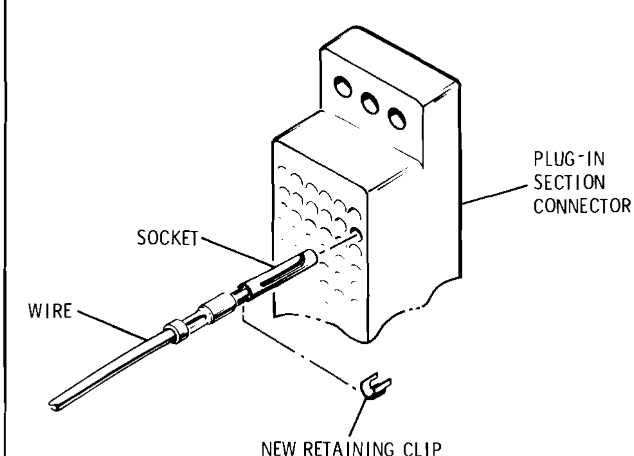


Figure 7-1. Connector Modification

7-15. YIG Pretune Driver Improvement (Serial Prefixes 1412A and Below)

7-16. On instruments with serial prefixes 1412A and below, improve protection to A5Q7 from transients on the +20V power supply can be achieved by making one minor circuit modification. This change consists of adding a 1 μF capacitor to the +20V supply line and replacing two diodes that may have been removed in a previous modification.

7-17. To modify the instrument the following parts are required:

Qty	Description	HP Part No.
1	A5C8, 1 μF 35 V capacitor	0180-0291
1	A5VR4 Diode Breakdown 15.0V 5% 1W	1902-0202
1	A5CR2 Diode Silicon 30 MA 30 WV	1901-0040

7-18. To install the parts proceed as follows:

1. Remove A5 from the 11661A Frequency Module.

2. Form the leads of the 1 μF capacitor, C8, to fit through the plated-through holes at edge connector pins 9 and 12 (see Figure 7-2). The capacitor leads should be long enough to keep the capacitor body completely clear of the edge connector.

3. Install the capacitor with the positive end connected to pin 9. Solder it very carefully to avoid bleeding solder onto the edge connector pins.

4. If diodes A5CR2 and A5VR4 have been removed due to a previous modification, reinstall them in their original locations by removing the 1 μF capacitor that was installed where A5VR4 was located

5. Remove the jumper wire that would have been added in the previous modification.

6. This completes the modification. No recalibration is necessary. Update your 11661A Operating and Service Manual parts list and A5 Schematic Diagram.

7-19. Improved SUM Loop Locking (Serial Prefixes 1431A and Below)

7-20. On instruments with serial prefixes 1431A and below the performance of the Sum Loop phase detector may be improved by changing the value of inductor A3L2. The propagation delay of integrated circuits A3U3 and A3U1 may vary slightly and allow the loop to become unlocked when the center frequency is stepped *up* from 99.9 MHz, 199.9 MHz, 299.9 MHz, etc., to 109.9 MHz, 209.9 MHz, 309.9 MHz, etc. Loop operation when stepping *down* in frequency will be normal.

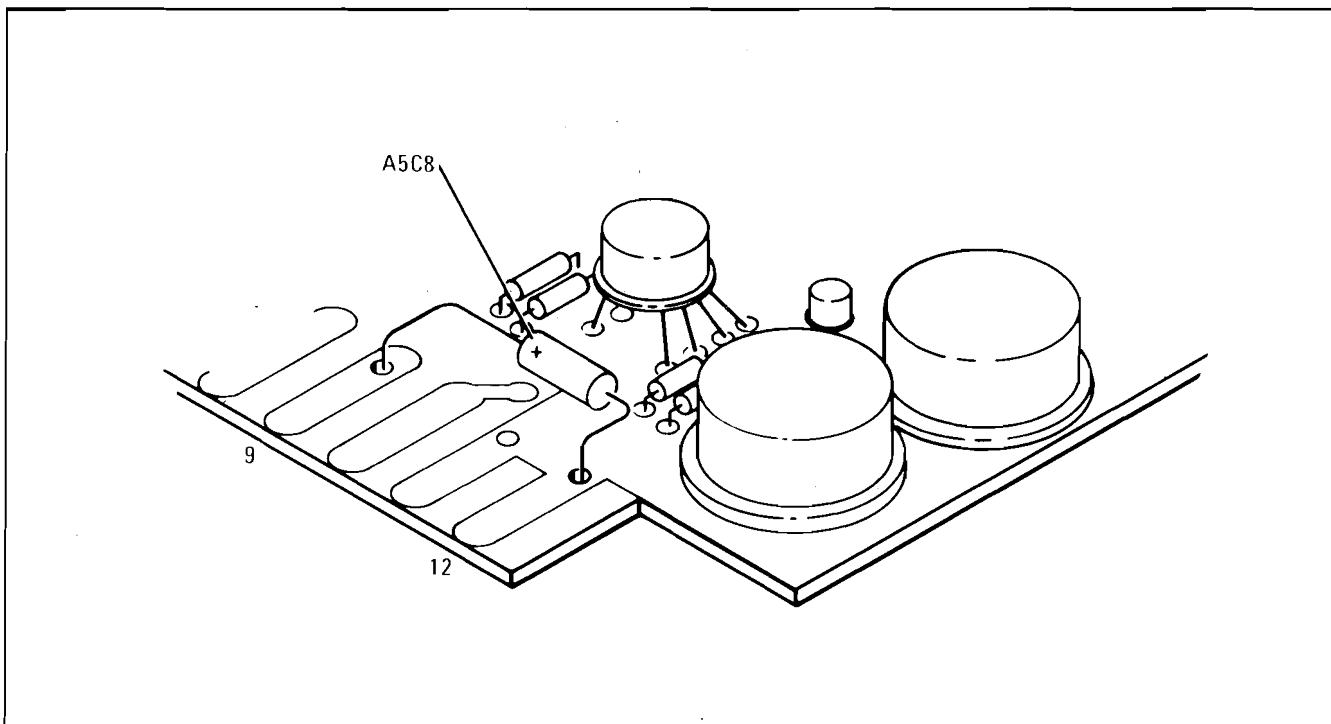


Figure 7-2. Capacitor Installation

NOTE

Important — do not make this change if loop operation is normal when stepping up.

7-21. The value of A3L2 is changed from the 5.6 μH to a 8.2 μH *nominal* (HP part number 9140-0105) but the exact value must be determined by trial and error to obtain proper loop operation. The following parts are required:

Inductance	HP Part Number
5.6 μH ± 10%	9100-1618
6.8 μH ± 10%	9100-1619
8.2 μH ± 10%	9140-0105
10.0 μH ± 10%	9140-0114
12.0 μH ± 10%	9140-0178

NOTE

In instruments with serial prefixes below 1412A this inductor was 12 μH.

7-22. Remove the mainframe top cover and the cover of the 11661A Frequency Extension Module (refer to the last foldout of this manual for procedure) and proceed as follows:

1. Unplug the A3 (green extractor) circuit board.

2. Locate A3L2 (see Service Sheet 6) and replace with one of the new value.

3. Reintall the circuit board and observe the RF output signal on a spectrum analyzer while stepping from 99.9 MHz to 109.9 MHz, etc., to determine if the loop is reliably locking. If the loop is not locking properly, select values from the table below until proper operation is achieved.

4. After reliable locking is achieved when stepping, cycle the instrument off and then on to assure the loop locks at the turn-on.

MANUAL IDENTIFICATION

Model Number: 11661A
Date Printed: August, 1972
Part Number: 11661-90003

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	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1216A00171 to 00190	1	1248A	1, 2, 3, 4
1216A00191 to 00205	1,2	► 1250A	1, 2, 3, 4, 5
1244A	1,2,3		

► NEW ITEM

CHANGE 1

Page 4-11, Table 4-3:
Change A9A1R2 to 0698-7226 R:FXD FLM 383 OHM 2% 1/8W 28480 0698-7226.
Change A9A1R3 to 0698-7233 R:FXD FLM 750 OHM 2% 1/8W 28480 0698-7233.
Change A9A1R5 to 0698-7196 R:FXD FLM 21.5 OHM 2% 1/8W 28480 0698-7196.
Change A9A1R7 to 0698-7228 R:FXD FLM 464 OHM 2% 1/8W 28480 0698-7228.

Service Sheet 3, A9A1 Assembly Schematic:
Change R2 value to 383.
Change R3 value to 750.
Change R5 value to 21.5.
Change R7 value to 464.

CHANGE 2

Page 4-5, Table 4-3:
Change A1A2Q1 to 1854-0540 TSTR: SI NPN 04713 MM 8006.
Change A1A2Q2 to 1854-0540 TSTR: SI NPN 04713 MM 8006.

Service Sheet 2, A2A2 Assembly Schematic:
Change Q1 part number to 1854-0540.
Change Q2 part number to 1854-0540.

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.

CHANGE 3

Page 4-5, Table 4-3:
Add A1A1L3 9140-0144 COIL: FXD RF 4.7 UH 28480 9140-0144.
Add A1A2C8 0160-2257 C:FXD CER 10 PF 5% 500 VDCW 72982 301-000-COHO-100J.
Add A1A2R10 0698-7209 R:FXD FLM 75 OHM 2% 1/8W 28480 0698-7209.

Page 4-11, Table 4-3:
Change A8A1C1 to A8A1C2 0160-3877 C:FXD CER 100 PF 20% 200 VDCW 80031 CV2059X7R101M.
Change A8A1C2 to A8A1C3 0160-3877 C:FXD CER 100 PF 20% 200 VDCW 80031 CV2059X7R101M.
Add A8A1C1 0160-3875 C:FXD CER 22 PF 5% 200 VDCW 72982 8121-8227-COG-200J.

Service Sheet 2:
Add L3, 4.7 to A1A1 assembly in series with $-10V_1$ input line.
Add C8, 10 to A1A2 assembly between L3 and A1J8 on 380-480 MHz output line.
Add R10, 75 to A1A2 assembly between L3/C8 junction and ground.
Change C1 on A8A1 assembly to C2.
Change C2 on A8A1 assembly to C3.
Add C1, 22 pF to A8A1 assembly between U1/L1 junction and ground.

CHANGE 4

Page 4-9, Table 4-3:
Change A5R43 to 0811-3256 R:FXD WW 100 OHM 0.25% 3W 28480 0811-3256.
Add A5R45 0811-3256 R:FXD WW 100 OHM 0.25% 3W 28480 0811-3256.

Page 4-11, Table 4-3:
Change A7R15 to 0698-7232 R:FXD FLM 681 OHM 2% 1/8W 28480 0698-7232.
Change A7R15 to 0698-7225 R:FXD FLM 348 OHM 2% 1/8W 28480 0698-7225.
Change A9A1C4 to 0160-2012 C:FXD MICA 330 PF 5% 500 VDCW 28480 0160-2012.
Change A9A1C5 to 0160-2012 C:FXD MICA 330 PF 5% 500 VDCW 28480 0160-2012.
Change A9A1C6 to 0160-2029 C:FXD MICA 36 PF 5% 500 VDCW 28480 0160-2029.
Change A9A1C7 to 0160-2016 C:FXD MICA 62 PF 5% 500 VDCW 14655 RDM15E620J5S.
Change A9A1C8 to 0160-2529 C:FXD MICA 160 PF 5% 500 VDCW 28480 0160-2529.

Service Sheet 1:
Change R43 value to 100.
Add R45, 100 in parallel with R43.

Service Sheet 3, A7 Assembly Schematic:
Change R15 value to 681.
Change R16 value to 348.

► CHANGE 5

Page 4-12, Table 4-3:
Change W1 1251-2040 to 1251-0546 CONTACT: R—P CONNECTOR (PIN A of P1) 81312 111-17054S.
Change W3 1251-2040 to 1251-0546 CONTACT: R—P CONNECTOR (PIN D of P1) 81312 111-17054S.
Change W6 1251-2040 to 1251-0546 CONTACT: R—P CONNECTOR (PIN C of P1) 81312 111-17054S.
Change W8 1251-2040 to 1251-0546 CONTACT: R—P CONNECTOR (PIN B of P1) 81312 111-17054S.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information for the HP Model 11661A Frequency Extension Module. Safety considerations, principles of operation, and recommended test equipment are included.

8-3. The service sheets normally include principles of operation and troubleshooting information, a component location diagram, and a schematic, all relating to a specific portion of circuitry within the instrument.

8-4. Service Sheet 1 includes an overview of the instrument operation, troubleshooting to an assembly or stage level, and a troubleshooting block diagram. The block diagram also serves as an "index" for the other service sheets.

8-5. The last foldout in this section gives disassembly procedures, adjustment locations, test point locations, and a table which cross-references pictorial and schematic locations of each assembly and chassis mounted component.

8-6. SAFETY CONSIDERATIONS

8-7. Although this instrument has been designed in accordance with international safety standards, this manual contains information, catuions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition (see Sections II, III, and V). Service and adjustments should be performed only by qualified service personnel.

8-8. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

8-9. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNING

The service information is often used with power supplied and protective covers removed from the instrument. Energy available at many points may, if contacted, result in personal injury.

8-10. PRINCIPLES OF OPERATION

8-11. Instrument operation is described under the Principles of Operation on the service sheets. Service Sheet 1, in conjunction with the Troubleshooting Block Diagram, describes overall operation of the Frequency Extension Module. Service Sheets 2 through 7 explain the function of each circuit within the unit. The particular circuit described is shown in schematic form on the accompanying circuit diagram.

8-12. TROUBLESHOOTING

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

8-13. Because feedback circuits extend over several assemblies for each of the phase lock loops, the major troubleshooting tests are on Service Sheet 1 with the Troubleshooting Block Diagram. Once the fault is localized, additional tests on the remaining Service Sheets help locate the defective component.

8-14. Troubleshooting Aids

8-15. Circuit Board Aids. Test points are physically located on the circuit boards as metal posts or circuit pads and usually have either a reference designator (such as TP1) or a label which relates to the function (+20V, 20 MHz IN, etc.) Transistor emitters, diode cathodes, the positive lead of electrolytic capacitors, and pin 1 of integrated circuits are indicated by some special symbol such as E, a diode symbol, +, a teardrop shape or square circuit pad.

8-16. Service Sheet Aids. Signal levels, dc voltages, and logic states are shown as an aid in troubleshooting on the schematic diagrams. Individual circuit areas are given descriptive names to identify functions and provide easy means for reference. Where needed, notes are used to explain circuits or mechanical configurations not easily shown on the schematic.

8-17. The locations of individual components mounted on printed circuit boards are shown on the pictorial representation of the circuit boards of the related service sheet. Chassis mounted parts, major assemblies, and adjustment locations are found on the last foldout in this manual.

8-18. Figure 8-1, Schematic Diagram Notes, provides information relative to symbols shown on the schematic diagrams.

8-19. Service Kit and Extender Boards. The HP 11672A Service Kit contains interconnect cables, RF cables, various coaxial adaptors, and an adjustment tool, all of which are useful in servicing the Frequency Extension Module. Refer to the HP 11672A Operating Note and the 8660-series mainframe manual for a listing and pictorial representation of the contents.

8-20. Circuit board extenders are provided with the mainframe. These extender boards enable the technician to extend plug-in boards clear of the assembly to provide easy access to components and test points.

8-21. RECOMMENDED TEST EQUIPMENT

8-22. Table 1-1 lists the test equipment and accessories recommended for use in servicing the instrument. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

8-23. REPAIR

8-24. Non-Repairable Assemblies

8-25. Repairs should not be attempted on the following assemblies if any is found to be defective during troubleshooting:

A1A3	4 GHz Low Pass Filter Assy
A1U1	Sampler/1.8 GHz Low Pass Filter Assy
A1U2	VCO/Mixer Assy
A1U3	4.43 GHz Oscillator/Mixer Assembly
A8	50 MHz Filter Assy
A9	20 MHz Filter Assy
A10	YIG Oscillator Assy
A11	2.6 — 4.1 GHz Bandpass Filter Assy
A12	4.43 GHz Bandpass Filter Assy

8-26. Removal and Disassembly Procedures

8-27. The procedures for removing the Frequency Extension Module from the mainframe, removing the cover, and gaining access to internal assemblies are found on the left hand foldout page which faces the last foldout in this manual.

8-28. The machine screws used throughout the Frequency Extension Module have a Pozidriv head. Pozidriv is very similar in appearance to the Phillips head, but using a Phillips screwdriver may damage the Pozidriv screw head. A Pozidriv screwdriver is recommended.

Resistance in ohms, capacitance in microfarads, inductance in microhenries unless otherwise noted.

* Asterisk denotes a factory-selected value. Value shown is typical. Part might be omitted. See Table 5-1.

Tool-aided adjustment.

Manual control.

Encloses front-panel designation.

Encloses rear-panel designation.

Circuit assembly borderline.

Other assembly borderline. Also used to indicate mechanical interconnection (ganging) and RF shielding.

Heavy line with arrows indicates path and direction of main signal.

Heavy dashed line with arrows indicates path and direction of main feedback.

CW Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).

1 Numbered Test point. Measurement aid (metal post, circuit pad, etc.) provided.

A Lettered Test point. No measurement aid provided.

Encloses wire color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, third number identifies the narrower stripe. E.G., 947 denotes white base, yellow wide stripe, violet narrow stripe.

Stabistor

Coaxial or shielded cable.

Stripline (i.e., RF transmission line above ground).

Figure 8-1. Schematic Diagram Notes (1 of 2)

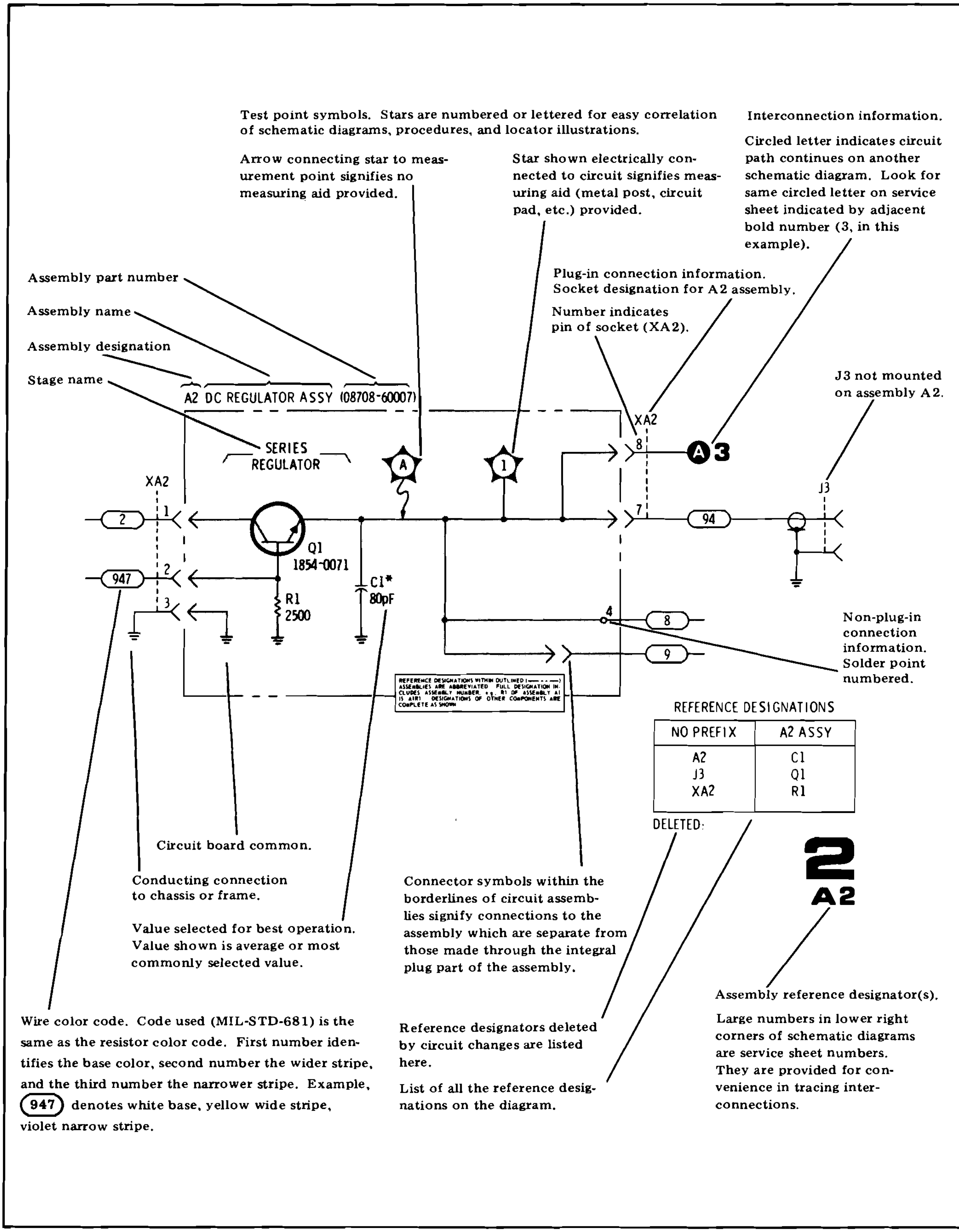


Figure 8-1. Schematic Diagram Notes (2 of 2)

SERVICE SHEET 1

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, this Service Sheet contains troubleshooting procedures for isolating the problem to a circuit board or module.

FREQUENCY EXTENSION MODULE

TROUBLESHOOTING TESTS

Malfunctions in the Frequency Extension Module generally fall into one of the following three catagories as observed at the RF Section front panel output: no output; an unwanted FM or sluggish frequency change; wrong output frequency. The tests on this service sheet are designed for a logical sequence of tests to determine the part or parts that need replacement. It is therefore recommended that the tests be performed in the order given. Refer to the Simplified Block Diagram for the functional relationship of the Frequency Extension Module circuits.

a. **No RF Output.** After verifying that the power supply voltages are correct, troubleshooting begins by verifying that both RF outputs are present. If the Sum Loop voltage controlled oscillator (VCO), the YIG oscillator, or the 4.43 GHz local oscillator are not working, there will be no output at the RF Section output port. This is checked in Tests 2 and 3.

b. **Unwanted FM or sluggish change of frequency.** If the YIG Loop search circuits do not turn off, the output will include an FM sweep of about 40 MHz at one kilohertz rate. If the search circuit is inoperative, a change of frequency will appear sluggish. The search circuit is checked in Test 7.

c. **Wrong Frequency.** If only certain frequencies are wrong the fault is probably in one of the pretune sections. If these are among the 100 MHz steps (100 to 1200 MHz), the fault is probably in the YIG Loop Pretune Section, for smaller steps the fault is probably in the Sum Loop Pretune Section. Frequency problems are checked in tests 5 through 12 for the YIG Loop and tests 13 through 16 for the Sum Loop.

TROUBLESHOOTING BLOCK DIAGRAM

The troubleshooting block diagram on this Service Sheet shows the relationship between all printed circuit board assemblies and all modules. Use the block diagram and troubleshooting procedures following the principles of operation to isolate a trouble to a specific assembly. Then turn to the Service Sheet for that assembly and isolate the trouble to a specific component.

The large numbers in the lower right corner of each of the major blocks identify the Service Sheet which provides schematics and principles of operation for that particular assembly.

PRINCIPLES OF OPERATION

General

The Hewlett-Packard Model 11661A Frequency Extension Module (with a suitable RF Section) increases the frequency range of the Model 8660 mainframe above 160 MHz while maintaining 1 Hz frequency resolution. Four input signals from the mainframe are used to produce two output signals for the RF Section. These output signals are up-converted in frequency to ensure low spurious sidebands in the final output but still contain all frequency information selected in the mainframe.

A SUM phase lock loop combines 1 Hz step information, 10 MHz step information (from mainframe RF regerence signal and BCD coded logic), and the 4.43 GHz free-running internal local oscillator. A YIG phase lock loop combines a 100 MHz reference, 100 MHz steps from BCD coded logic, a 20 MHz reference (frequency modulated if FM is present), and the 4.43 GHz internal local oscillator frequency. Note that both output signals contain the 4.43 GHz oscillator frequency. This frequency component (including any drift) is cancelled in the RF Section mixer.

Power supply and RF interconnections between the Frequency Extension Module and the mainframe pass through the RF Section. The RF

Section also contains a 20 MHz amplifier for the 20 MHz FM/CW reference signal. Digit 8, 9, and 10 BCD logic input lines do not pass through the RF Section but connect directly to the mainframe.

4.43 GHz Oscillator

The 4.43 GHz oscillator circuit is divided between the A1U3 and the A1A4 assemblies. The oscillator itself is located on the A1U3 module and receives two inputs from the A1A4 Oscillator Tuning Assembly: −10 Vdc filtered and an adjustable supply source derived from +20 Vdc whose value is adjusted by R1 to control the frequency of the oscillator. This oscillator is not phase locked as the 4.43 GHz frequency drift is cancelled out in the RF Section mixer.

Sum Loop

The Sum Loop inputs from the mainframe include 30 to 20 MHz (1 Hz steps), 450 to 360 MHz (10 MHz steps), and Digit 8 BCD code logic. The Digit 8 input logic to the A4 Sum Loop Pretune Assembly is converted to an analog voltage and then combined with a phase error signal to tune the Sum Loop VCO (voltage controlled oscillator). The 450 to 360 MHz is mixed in the A8 module with the Sum Loop 1st IF to produce a 30 to 20 MHz Sum Loop 2nd IF. This signal goes to the A3 Sum Loop Phase Detector Assembly where it is compared with the 30 to 20 MHz signal from the mainframe as part of the phase lock loop. The Sum Loop therefore contains all frequencies up to and including the first eight digits (0 to 99.999 999 MHz in 1 Hz steps).

YIG Loop

The YIG Loop inputs from the mainframe include 20 MHz FM/CW reference, 100 MHz reference, and Digits 9 and 10 BCD code logic. The Digits 9 and 10 input logic to the A5 YIG Loop Pretune Assembly is converted to an analog current and used to drive the coarse tuning coil of the YIG oscillator. Part of the YIG output is fed back to the first mixer to produce YIG Loop 1st IF. The difference frequency between the 4.43 GHz oscillator and the YIG oscillator will be in the range of 480 MHz to 1680 MHz in 100 MHz steps. The step recovery diode on the A1U1 assembly generates harmonics of the 100 MHz reference input. The difference between one of these harmonics and the 1st IF will be 20 MHz which is the 2nd IF. For example, if the 1st IF is 680 MHz, the 7th harmonic of 100 MHz will produce the 20 MHz 2nd IF. This 20 MHz 2nd IF is locked to the 20 MHz FM/CW reference from the mainframe in the YIG loop phase detector circuits. If phase locked, the phase difference produces a dc error for fine tuning the YIG oscillator. If not phase locked, logic circuit activates the search waveform generator in the FM Driver Assembly. The YIG loop output is frequency dependent on the 100 MHz reference harmonic, the 4.43 GHz oscillator, and the 20 MHz FM/CW reference.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Frequency Extension Module as a result of using the System Troubleshooting Guide found in Section VIII of the HP Model 8660-series mainframe Operating and Service Manual and the Systems Troubleshooting information preceeding Service Sheet 1 in the RF Section manual. Troubleshoot the Frequency Extension Module using the test equipment, information, and procedures which follow.

Test Equipment

Microwave Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8555A/8552B/140T
Oscilloscope	HP 180C/1801A/1821A
10:1 Divider Probe	HP 10004
Digital Voltmeter	HP 34740A/34702A
Extender Cable	HP 11672-60002
Extender Board	HP 5060-0258

Test 1. First check the power supply inputs to the Frequency Extension Module by removing the A3 printed circuit assembly (green extractor) and replacing it with the extender board. Check the voltages as listed below; the tolerance is ±0.1 volt:

Power Supply Voltages at A3 Connector

Pin	C	E	F	H	J
Volts	Ground	+5.25	−40.0	−10.0	+20.0

Replace the A3 printed circuit assembly.

CAUTION

Always turn instrument power off before removing or installing any assembly.

Test 2. Turn the instrument off, remove the Frequency Extension Module from the mainframe, and reconnect using the extender cable.

Unplug the 20 MHz output cable (W4) from the A1J4. Connect an oscilloscope to test point A6TP1 and check for a +2.5 Vpk sawtooth ramp. Adjust A7R17 so the ramp just turns on. Reconnect the 20 MHz output cable. The signal at A6TP1 should now be 0.0 ± 0.1 Vdc.

Tune mainframe from 0 to 1200 MHz center frequency in 100 MHz steps. Verify that the signal at A6TP1 remains at 0.0 ± 0.1 Vdc. If the signals at A6TP1 are correct, check the YIG loop output frequencies at J1 as given in Table 8-1. If these frequencies are correct go to test 3 to continue testing, if not, go to test 5.

Test 3. If the YIG loop is operating at the correct output frequencies (Test 2), reconnect the counter to J1 and check the SUM loop output frequencies as follows: Tune mainframe from 0 to 90 MHz in 10 MHz steps and verify that the SUM loop output steps up from 3.95 GHz to 4.05 GHz matching the mainframe 10 MHz steps. If these frequencies are correct go to test 4 to continue testing, if not, go to test 13.

Test 4. If the results of tests 2 and 3 are good, use the spectrum analyzer to measure the power output as follows:

Power Outputs to RF Section

Output	Connector	Power Level
SUM LOOP	J1	⩾ −4 dBm
YIG LOOP	J2	⩾ +10 dBm

If the SUM loop power output is low go to Service Sheet 3 and troubleshoot the VCO circuit. If the YIG loop power output is low go to Service Sheet 5 and check the YIG oscillator output. If no problem has been encountered as a result of these tests, check the interconnecting cables to the RF Section as the Frequency Extension Module is working properly.

Test 5. Remove the A6 printed circuit assembly (red extractor). Tune the mainframe 0 to 1200 MHz center frequency as shown in Table 8-1 to check the YIG Pretune Driver circuits. Use the tolerance values for YIG Loop Pretune.

If the YIG loop frequencies are within tolerance, proceed to test 6, if not check the pretune input logic levels as shown on the block diagram for A5 pins 1 through 5. If the logic levels are correct go to SS2, if incorrect check interconnections and signals from the mainframe.

Test 6. Replace the A7 printed circuit assembly (brown extractor) with the extender card. Measure the 20 MHz FM/CW reference from the mainframe using the frequency counter (with the counter locked to the 10 MHz mainframe reference). Also check the 100 MHz reference from the W3 cable at connector A1J2. If incorrect check interconnections and signals from the mainframe. If correct proceed to test 7.

Test 7. Check the YIG Loop Phase Detector circuits by connecting the 20 MHz FM/CW reference into both A7 Assembly inputs. The simplest

*Table 8-1. YIG Loop Output Frequency Versus Mainframe Tuning**

Center Frequency	YIG Loop Output Frequency	YIG Loop Pretune Tolerance	YIG Loop Locked Tolerance
0000 MHz	3.950 GHz	±5 MHz	±1.5 MHz
0100 MHz	3.850 GHz	±5 MHz	±1.5 MHz
0200 MHz	3.750 GHz	±5 MHz	±1.5 MHz
0300 MHz	3.650 GHz	±5 MHz	±1.5 MHz
0400 MHz	3.550 GHz	±5 MHz	±1.5 MHz
0500 MHz	3.450 GHz	±5 MHz	±1.5 MHz
0600 MHz	3.350 GHz	±5 MHz	±1.5 MHz
0700 MHz	3.250 GHz	±5 MHz	±1.5 MHz
0800 MHz	3.150 GHz	±5 MHz	±1.5 MHz
0900 MHz	3.050 GHz	±5 MHz	±1.5 MHz
1000 MHz	2.950 GHz	±5 MHz	±1.5 MHz
1100 MHz	2.850 GHz	±5 MHz	±1.5 MHz
1200 MHz	2.750 GHz	±5 MHz	±1.5 MHz

*Lock frequency counter to mainframe reference.

way to do this is to extend the A7 Assembly using the test board described on the last foldout of this section. Place test board switch A in the test position. Reinstall the A6 Assembly. Use a digital voltmeter to check A6TP1 for 0.0 ±0.1 Vdc. If incorrect proceed to test 8, if correct proceed to test 10.

Test 8. Check the dc voltage at A7 pin J (search control output) for 0 Vdc (not +3 Vdc). If correct proceed to Service Sheet 5, if incorrect go to Service Sheet 4 and troubleshoot the A7 Assembly.

Test 9. Move the digital voltmeter probe to A7TP2 which should also give a reading of 0.0 ± 0.1 Vdc. If this voltage is correct proceed to Service Sheet 5 and troubleshoot the A6 Assembly, if incorrect, proceed to Service Sheet 4 and troubleshoot the A7Assembly.

Test 10. Connect the spectrum analyzer to A1J4 and measure the amplitude of the signal at 20 MHz. If the signal is less than −17 dBm, adjust A1A1C1 to peak signal. If the signal is equal or greater than −17 dBm proceed to test 12, if not go to test 11.

Test 11. Set the mainframe center frequency to 500 MHz. Disconnect cable A11W3 at A1J1 and connect the cable to the spectrum analyzer. Check the signal at 3.45 GHz for an amplitude of −5 dBm or greater. Also check the high and low band edges for frequency and levels shown on the block diagram. If these signals are correct proceed to Service Sheet 3 and troubleshoot the A1 Assembly. If the signal level is incorrect, check the A10 output level at 3.45 GHz. If the level is +10 dBm or greater replace A11; if less proceed to Service Sheet 5 and troubleshoot the A10 Assembly.

Test 12. Connect the spectrum analyzer to the end of cable W2 where it connects to A2J4 and measure the 20 MHz output of the A9 Assembly. If the level is −6 dBm or more check for intermittant or poor connections in the 2nd IF line. If the signal is less than −6 dBm replace the A9 assembly.

Test 13. If the frequencies measured in Test 3 were incorrect, check the digital pretune logic levels at A4 pins K, L, M, and N. If correct, disconnect W8 from A2J2 and connect the cable to the spectrum analyzer and check for the 20 to 30 MHz signal level of −5 to −8 dBm. Connect the spectrum analyzer to W6 by disconnecting the cable at A8 J2 and check for an input level of from +13 to +15 dBm. If any measurement in this test is incorrect, trace the line back through the RF Section to the mainframe for continuity.

Test 14. Check the SUM Loop Phase Detector circuits by connecting the 20-30 MHz input into both A3 Assembly inputs. The simplest way to do this is to extend the A3 Assembly using the test board described on the last foldout of this section. Place test board switch B in the test position. Use a digital voltmeter to check A3TP1 for +10 ±1 Vdc. If this is out of range, proceed to Service Sheet 6 and troubleshoot the A3 Assembly. If the voltage is correct, remove the extender board and continue with test 15.

Test 15. Connect the spectrum analyzer to A1J6. If the 480-380 MHz signal has an amplitude of −6 dBm or more, replace the A8 Assembly. If the signal is incorrect go to test 16.

Test 16. Use an extender board to gain access to the edge connector of the A4 Sum Loop Pretune Assembly. Connect a digital voltmeter to pin 1 of the extender board and measure the dc voltage while tuning the mainframe from 0 to 90 MHz in 10 MHz steps. The voltage should change from −10 Vdc to −26 Vdc as the frequency is stepped. If voltages are correct proceed to Service Sheet 2 and troubleshoot A1U2 and A1A2. If they are incorrect go to Service Sheet 7 and troubleshoot the A4 Sum Loop Pretune Assembly.

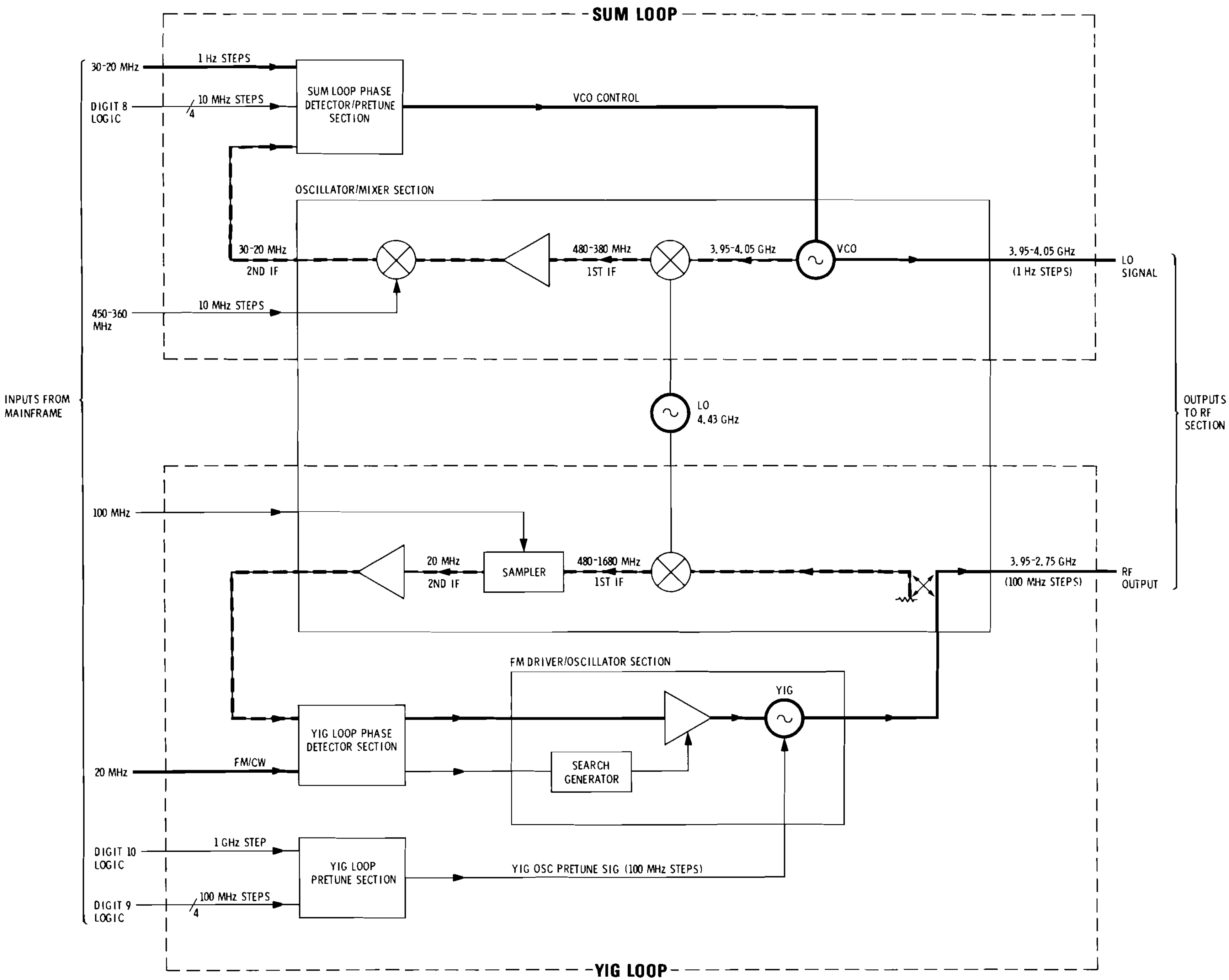
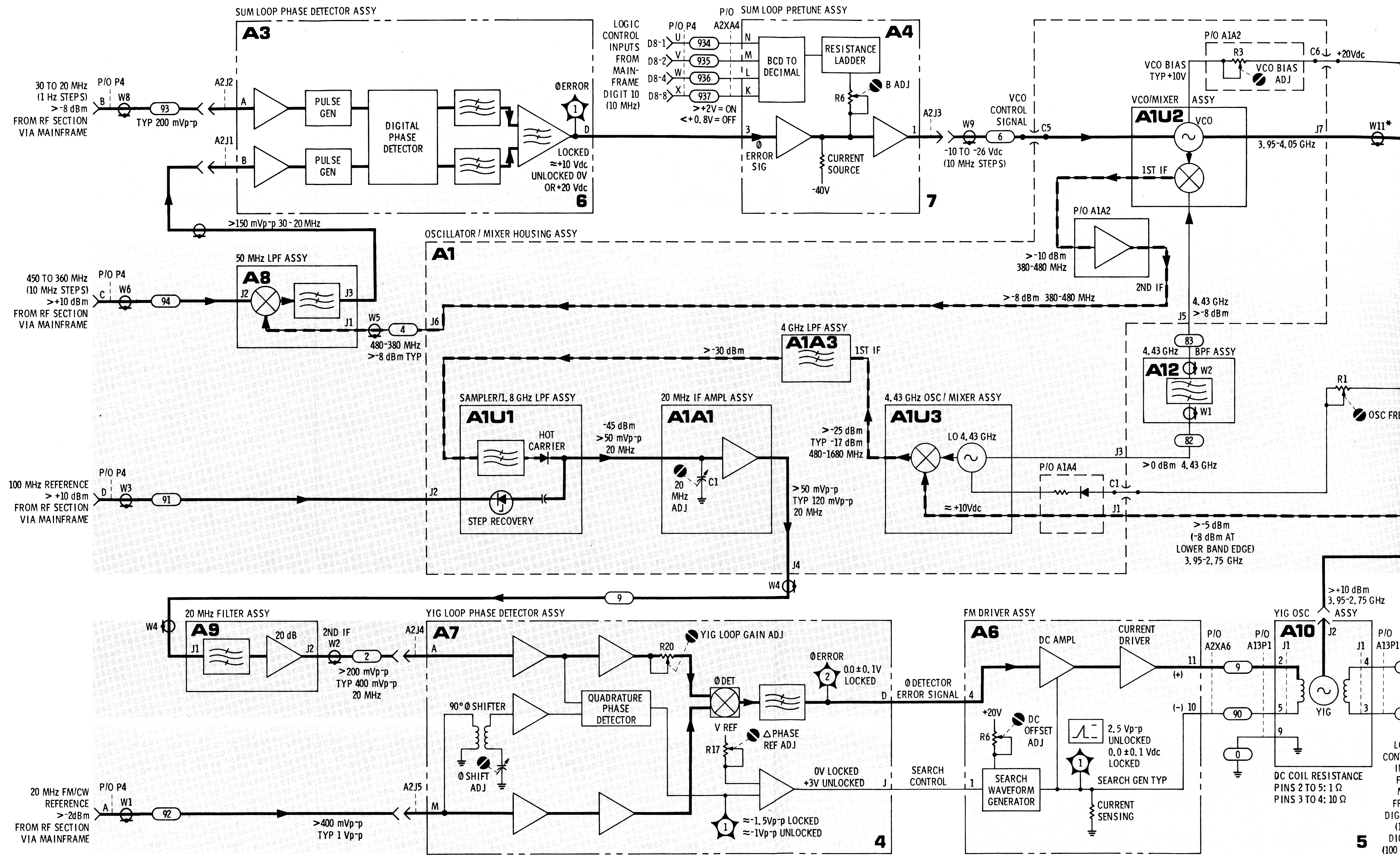


Figure 8-2. Simplified Block Diagram



SUM LOOP PHASE DETECTOR ASSY
A3
PULSE GEN
DIGITAL PHASE DETECTOR
ØERROR
LOCKED ≈+10 Vdc
UNLOCKED 0V OR +20 Vdc
6
30 TO 20 MHz (1 Hz STEPS) >-8 dBm FROM RF SECTION VIA MAINFRAME
P/O P4
W8
93
TYP 200 mVp-p
A2J2
A2J1
>150 mVp-p 30-20 MHz
LOGIC CONTROL INPUTS FROM MAIN-FRAME DIGIT 10 (10 MHz)
P/O P4
P/O A2XA4
SUM LOOP PRETUNE ASSY
A4
934
935
936
937
>+2V = ON
<+0.8V = OFF
BCD TO DECIMAL
RESISTANCE LADDER
R6
B ADJ
Ø ERROR SIG
CURRENT SOURCE
-40V
7
A2J3
W9
VCO CONTROL SIGNAL
-10 TO -26 Vdc (10 MHz STEPS)
C5
P/O A1A2
R3
VCO BIAS ADJ
VCO BIAS TYP +10V
C6
+20Vdc
VCO/MIXER ASSY
A1U2
VCO
1ST IF
3.95-4.05 GHz
J7
W11*
OSCILLATOR / MIXER HOUSING ASSY
A1
P/O A1A2
>-10 dBm 380-480 MHz
2ND IF
>-8 dBm 380-480 MHz
4.43 GHz >-8 dBm
J5
450 TO 360 MHz (10 MHz STEPS) >+10 dBm FROM RF SECTION VIA MAINFRAME
P/O P4
W6
94
50 MHz LPF ASSY
A8
W5
480-380 MHz >-8 dBm TYP
J6
4 GHz LPF ASSY
A1A3
>-30 dBm
1ST IF
83
4.43 GHz BPF ASSY
A12
W2
W1
82
R1
OSC FRE
SAMPLER/1.8 GHz LPF ASSY
A1U1
HOT CARRIER
STEP RECOVERY
-45 dBm >50 mVp-p 20 MHz
20 MHz IF AMPL ASSY
A1A1
20 MHz ADJ
C1
>-25 dBm TYP -17 dBm 480-1680 MHz
4.43 GHz OSC / MIXER ASSY
A1U3
LO 4.43 GHz
P/O A1A4
C1
≈+10Vdc
J1
J3
>0 dBm 4.43 GHz
>-5 dBm (-8 dBm AT LOWER BAND EDGE) 3.95-2.75 GHz
100 MHz REFERENCE >+10 dBm FROM RF SECTION VIA MAINFRAME
P/O P4
W3
91
J2
>50 mVp-p TYP 120 mVp-p 20 MHz
J4
W4
9
20 MHz FILTER ASSY
A9
20 dB
2ND IF
W2
2
>200 mVp-p TYP 400 mVp-p 20 MHz
A2J4
YIG LOOP PHASE DETECTOR ASSY
A7
YIG LOOP GAIN ADJ
R20
ØERROR
0.0±0.1V LOCKED
Ø DET
QUADRATURE PHASE DETECTOR
90° Ø SHIFTER
Ø SHIFT ADJ
V REF
R17
Δ PHASE REF ADJ
0V LOCKED +3V UNLOCKED
≈-1.5Vp-p LOCKED
≈-1Vp-p UNLOCKED
4
Ø DETECTOR ERROR SIGNAL
SEARCH CONTROL
20 MHz FM/CW REFERENCE >-2dBm FROM RF SECTION VIA MAINFRAME
P/O P4
W1
92
>400 mVp-p TYP 1 Vp-p
A2J5
FM DRIVER ASSY
A6
DC AMPL
CURRENT DRIVER
+20V
R6
DC OFFSET ADJ
SEARCH WAVEFORM GENERATOR
2.5 Vp-p UNLOCKED
0.0±0.1 Vdc LOCKED
SEARCH GEN TYP
CURRENT SENSING
P/O A2XA6
P/O A13P1
9
90
0
>+10 dBm 3.95-2.75 GHz
YIG OSC ASSY
A10
YIG
DC COIL RESISTANCE
PINS 2 TO 5: 1 Ω
PINS 3 TO 4: 10 Ω
5

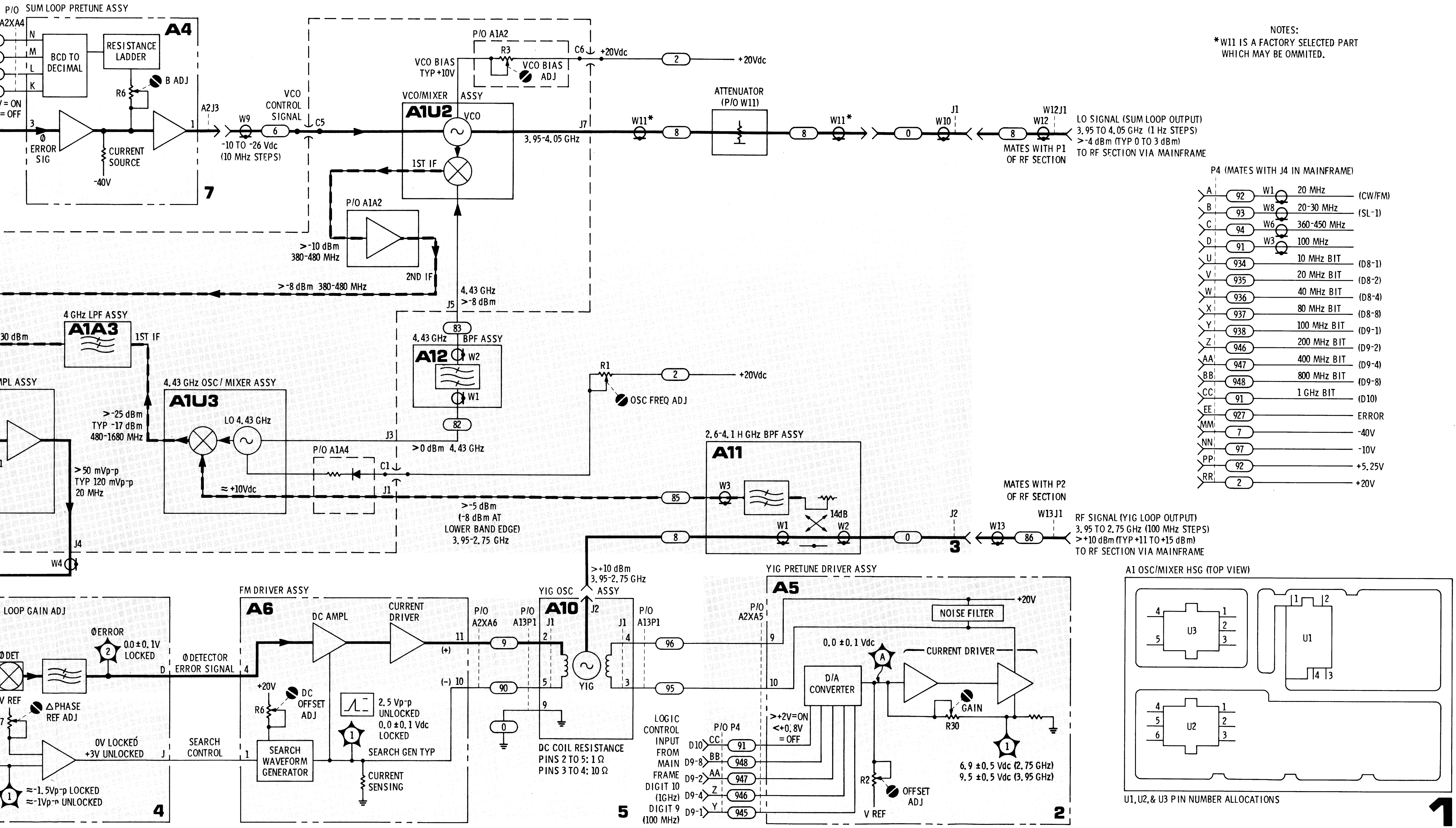


Figure 8-3. Troubleshooting Block Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

A5 YIG PRETUNE DRIVER ASSEMBLY

PRINCIPLES OF OPERATION

The A5 YIG Pretune Driver Assembly converts the binary logic of the 0000 MHz, 0100 MHz . . . 1200 MHz (digits 9 and 10) to a dc current to pretune the YIG oscillator. The assembly includes a digital to analog converter, current driver, and reference voltages for the converter.

Digital/Analog Converter

Five potentiometers are provided to adjust each logic line for binary weighted current necessary to correctly tune the YIG pretune circuit.

For example if 1 GHz is entered on the mainframe, a logic high will be present on XA5 pin 5 of the YIG Pretune Driver Assembly. The output of A5U1C pin 8 is at a logic low turning off A5Q5 which depletes current from the node at A5TP2.

Current Summing Node (A5TP2)

The sum of the current from the D/A converter and the feedback from the Current Sense Resistor is constant at summing node A5TP2. The magnitude of this sum is set by Offset Adjustment A5R29. The higher the frequency entered on the mainframe, the higher the D/A current into the node and therefore the lower the feedback current.

Current Driver

A5Q6, A5U2, and A5Q7 form an operational amplifier circuit. The non-inverting input at A5Q6 pin 6 is grounded and inverting input pin 2 connects to the current node. A5U2 provides high

Troubleshooting Block Diagram
◄ SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

open loop gain and source follower A5Q7 ensures little loading of the integrated circuit by the output amplifier.

Output Amplifier

Parallel transistors A5Q8 and A5Q9 drive the YIG main tuning coil. A5C6, A5C7 and A5R42 prevent noise from reaching the YIG coil. VR4, CR2, and A5C8 suppress switching transients from the YIG coil, preventing them from reaching the current driver amplifiers or power supplies. Resistors A5R43 and A5R45 sense the current through the YIG coil and provide the source for the current feedback.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies or cables shown on the accompanying diagram. Troubleshoot the YIG Pretune Driver Assembly by using the test equipment and procedures given below.

Test Equipment	Model
Spectrum Analyzer . .	HP 8555A/8552B/140T
Digital Voltmeter . . .	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A5 Assembly (+20V, −10V, and −40V). Also check the +9 VF, +5V, and the anode of A5CR3 (−9 Vdc). If correct, proceed to Test 2. Otherwise check for continuity of interconnections to mainframe or an A5 Assembly defect.

Test 2. If only one of the stepping codes gives improper tuning to the YIG oscillator, the problem is probably in one of the input inverter-transistor circuits. Enter the frequency indicated on the input line and check the output of the inverter for a logic low. The associated transistor should be conducting (collector-emitter = about 0.2 Vdc). Note that in this application the transistor collector acts as an emitter.

Test 3. If all steps give improper tuning, check the current driver section of the board. The collectors of A5Q6 and A5Q7 should be about +5 Vdc. At 0 GHz A5TP1 should be about 9.48 Vdc; A5Q8 and A5Q9 should be about +10.2 Vdc on their bases; A5Q7 should be about +11 Vdc at the gate and about +20 Vdc at the drain. The most likely components in this circuit to fail are operational amplifier A5U2 or FET A5Q7.

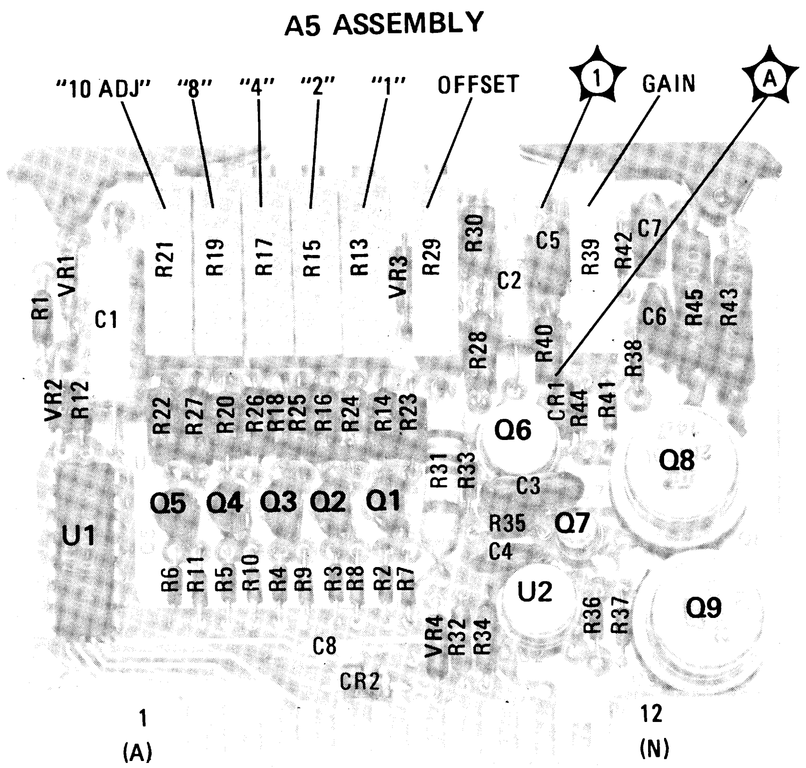
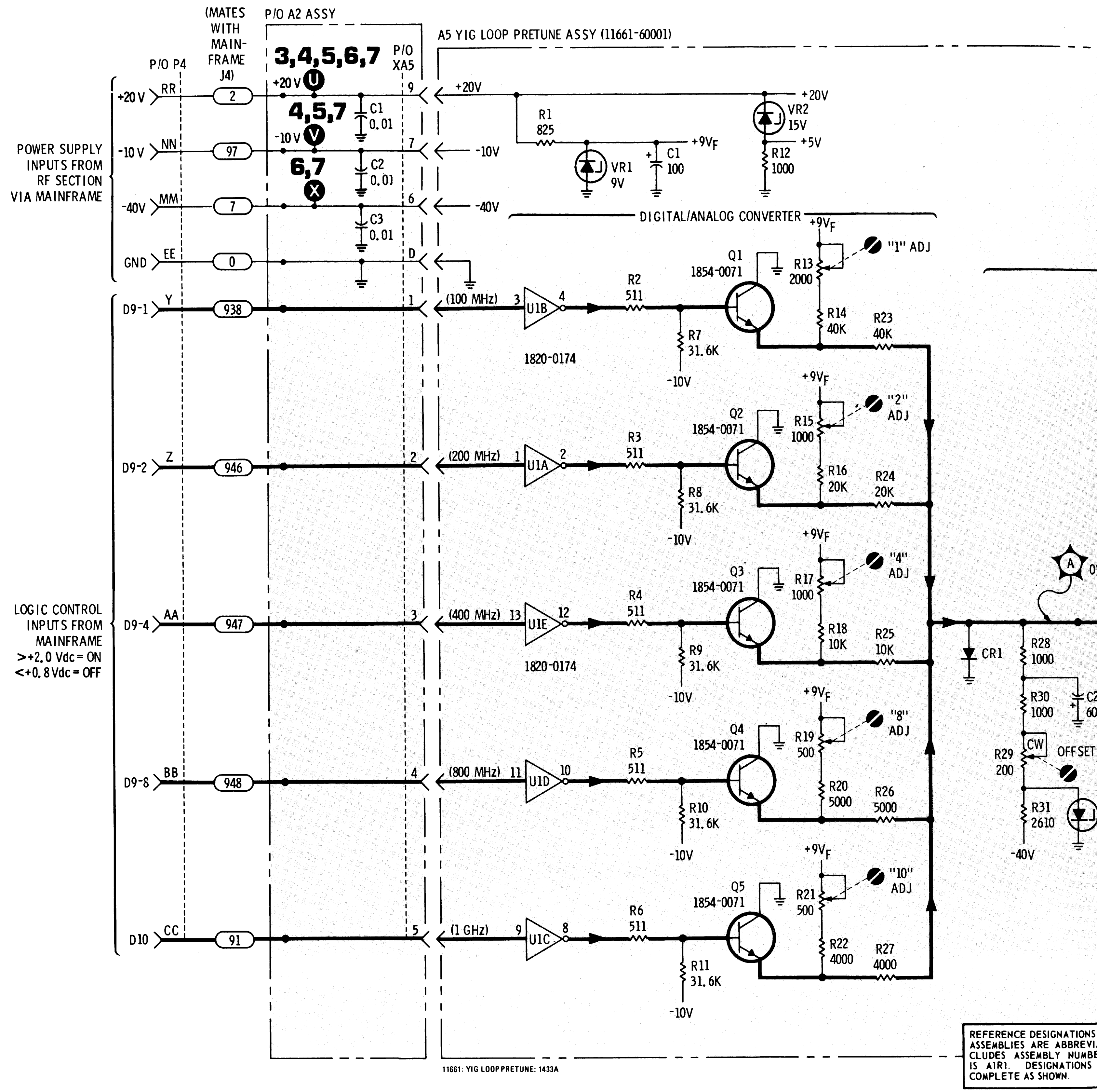


Figure 8-4. A5 YIG Loop Pretune Assembly Component and Test Point Locations



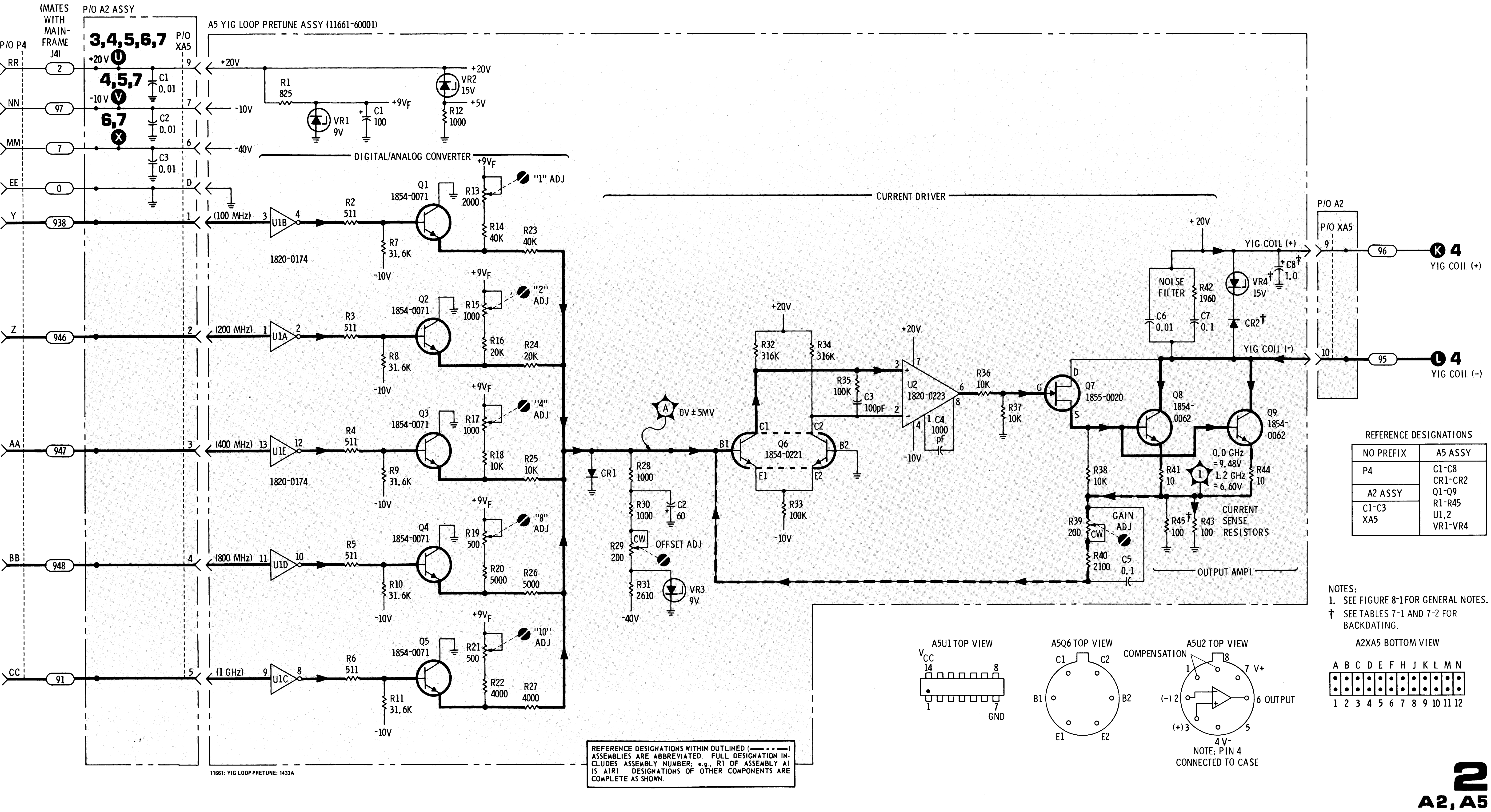


Figure 8-5. YIG Loop Pretune Section Schematic Diagram

SERVICE SHEET 3

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

OSCILLATOR/MIXER SECTION

PRINCIPLES OF OPERATION

The 4.43 GHz oscillator, IF filters, IF amplifiers, and the VCO for the SUM loop are included on this Service Sheet. Both outputs to the RF Section are also shown.

A11 2.6 – 4.1 GHz Bandpass Filter Assembly

This is a non-repairable unit which includes a directional coupler and a bandpass filter. The 3.95 - 2.75 GHz signal passes through this unit to the RF Section. Part of this signal is filtered and sent to the mixer in the 4.43 GHz Oscillator Assembly.

A1A4 4.43 GHz Oscillator Tuning Assembly

This assembly provides interface connections for the A1U3 microcircuit oscillator and YIG Loop 1st IF mixer. Supply voltage for the 4.43 GHz oscillator is obtained from frequency adjustment potentiometer R1 which is mounted on the Frequency Extension Module frame. The voltage from R1 is filtered by A1A4C1, A1A4R2, and A1A4C3.

The oscillator frequency adjustment potentiometer R1 is mounted on the main Frequency Extension Module housing. This adjustment determines the dc supply voltage to set A1U3 microcircuit oscillator frequency to 4.43 GHz. The 4.43 GHz Oscillator Tuning Assembly contains filtering for this voltage and the oscillator −10 Vdc supply.

Microcircuit A1U3 contains the 4.43 GHz oscillator and the mixer for the Sum Loop. The 4.43 GHz oscillator is free-running (not phase locked), but as this frequency is part of both the Sum and YIG loops any drift is exactly cancelled in the RF Section mixer. The microcircuit is mechanically attached to the A1 housing but interfaces electrically with the A1A4 assembly.

SERVICE SHEET 3 (Cont'd)

A1U3 4.43 GHz Oscillator/Mixer Assembly

This unit is a non-repairable microcircuit containing the 4.43 GHz oscillator and the YIG Loop 1st IF Mixer. An output of this oscillator is also used to drive SUM Loop 1st IF mixer which is part of the A1U2 microcircuit.

A1A3 4 GHz Low Pass Filter Assembly

This unit attenuates the level of the 4.43 GHz contained in the ouput of the YIG Loop 1st IF Mixer. It is a non-repairable assembly.

A1U1 Sampler/1.8 GHz Low Pass Filter Assembly

The output of the 4 GHz Low Pass Filter Assembly next passes through the 1.8 GHz Low Pass Filter in the A1U1 microcircuit. This attenuates the level of the 3.95 to 2.75 GHz decoupler RF contained in the YIG Loop 1st IF. A sampler generates the YIG Loop 2nd IF. It may be visualized as a harmonic mixer, in which a step recovery diode generates harmonics of the mainframe 100 MHz reference signal. This is combined with the 1st IF to produce many frequency products including the 20 MHz 2nd IF frequency.

A1A1 20 MHz IF Amplifier Assembly

This assembly is a printed circuit board which serves as an interface for the A1U1 microcircuit and the YIG Loop 20 MHz second IF amplifier. Adjustable capacitor A1A1C1 with inductor A1A1L2 provides a 20 MHz parallel resonant filter circuit. In spite of this, the output of the 20 MHz IF amplifier contains considerable 100 MHz feedthrough. Therefore the amplitude of the 20 MHz signal should be determined using a spectrum analyzer.

A1U2 VCO/Mixer Assembly

This unit is a non-repairable microcircuit containing the 3.950/4.050 GHz VCO and the Sum Loop 1st IF mixer. The output of the VCO is the Sum loop output to the RF Section (in the RF Section it serves as the local oscillator signal). The mixer combines the VCO signal with the 4.43 GHz signal from the A1U3 microcircuit to form the Sum Loop 1st IF.

A1A2 380-480 MHz IF Amplifier Assembly

This assembly is a printed circuit board which serves an interface for the A1U2 microcircuit and the Sum Loop 1st IF amplifier. A1A2R3 provides adjustment for the A1U2 VCO bias.

A12 4.43 GHz Bandpass Filter Assembly

This filter is a non-repairable assembly used to couple the 4.43 GHz oscillator output to the Sum Loop 1st IF mixer. This filter reduces spurious outputs between the two units.

A5 Yig Loop Pretune Assembly
◆ SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

A8 50 MHz Filter Assembly

This is also a non-repairable assembly and uses the Sum Loop 1st IF and the 450 to 360 MHz input from the mainframe to produce the Sum Loop 2nd IF. The 2nd IF will be in the range of 30 to 20 MHz and contains the 1 Hz step information.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies or cables shown on the accompanying diagram. Troubleshoot the circuits using the test equipment and procedures given below.

Test Equipment	Model
Spectrum Analyzer	HP 8555A/8552B/140T
Digital Voltmeter	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to assemblies where a defect has been indicated.

Test 2. If a problem is indicated in A1U2 SUM loop VCO (Service Sheet 1) check the inputs and outputs as shown on the schematic diagram including the dc voltages. If all inputs are correct and either output incorrect replace the unit.

Test 3. If the A1U2 SUM loop VCO is operating properly but a problem exists in the 1st or 2nd IF, first check the associated dc voltage levels and then the signal levels as indicated on the schematic diagram.

Test 4. If the A1U3 4.43 GHz oscillator has no output or cannot be properly adjusted, check the dc voltage inputs to the microcircuit. If there is no tuning voltage at pin 2 of A1U3, use a voltmeter to trace the circuit back to R1.

Test 5. Sampler/1.8 GHz Low Pass Filter Assembly A1U1 is also a non-repairable assembly. If the inputs are correct and no or low output, the unit must be replaced. The output at pin 4 of A1U1 should be greater than 50 millivolts peak-to-peak.

Test 6. If the signal into the A1A1 assembly is correct but the output at A1J4 is incorrect, use an oscilloscope to trace the signal through the amplifier. The output at A1J4 may have considerable 100 MHz signal present which is normal and should not cause a problem.

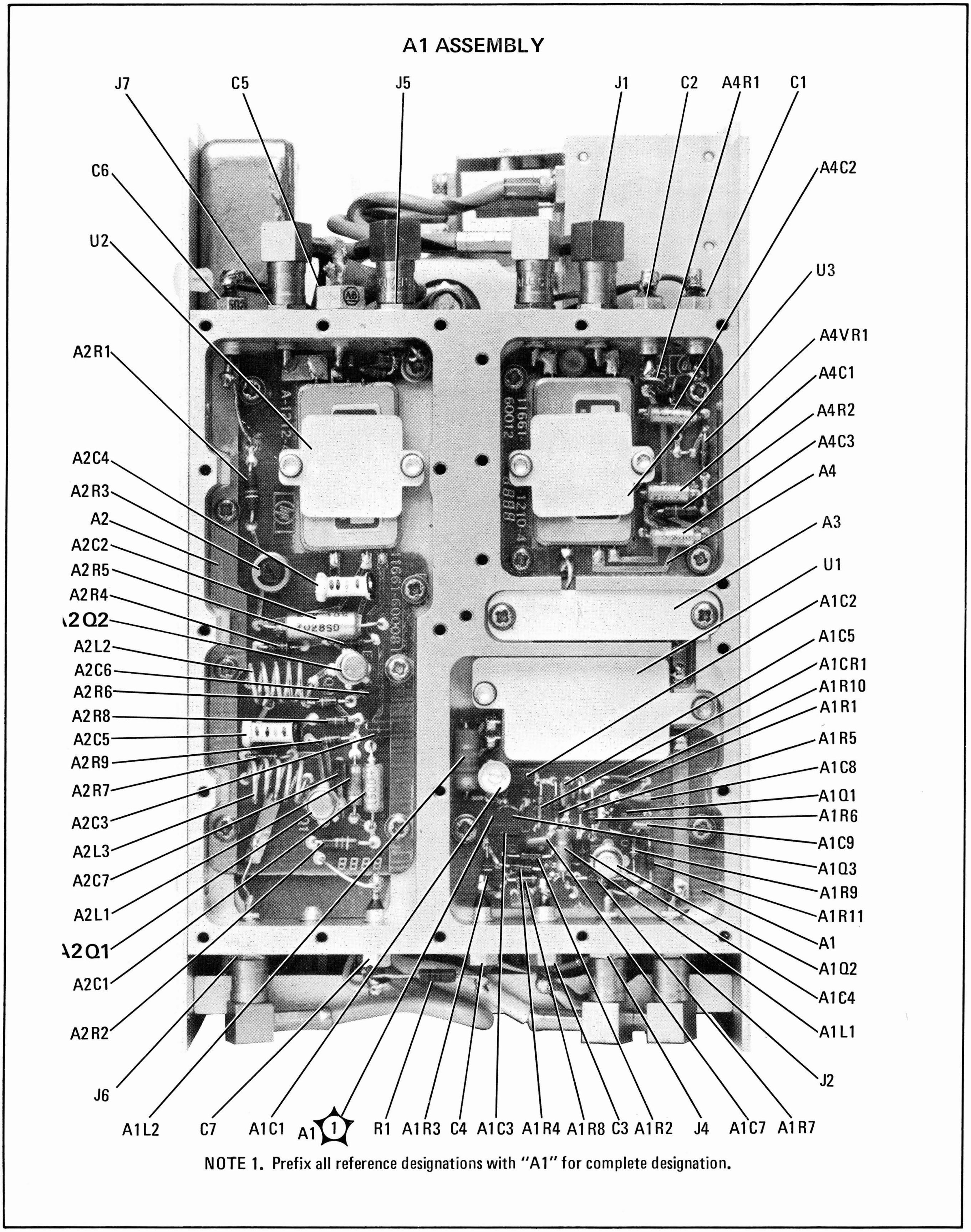
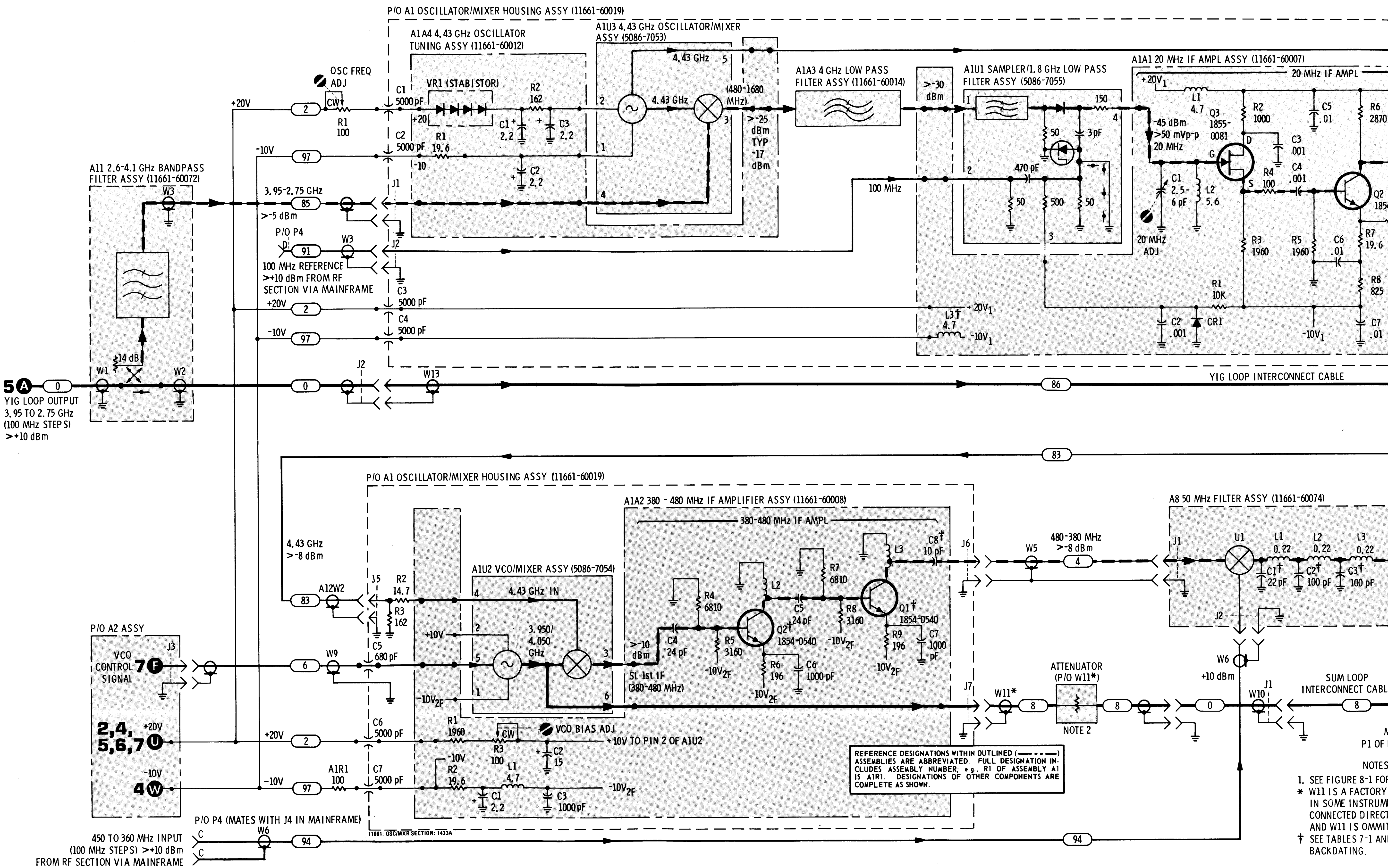
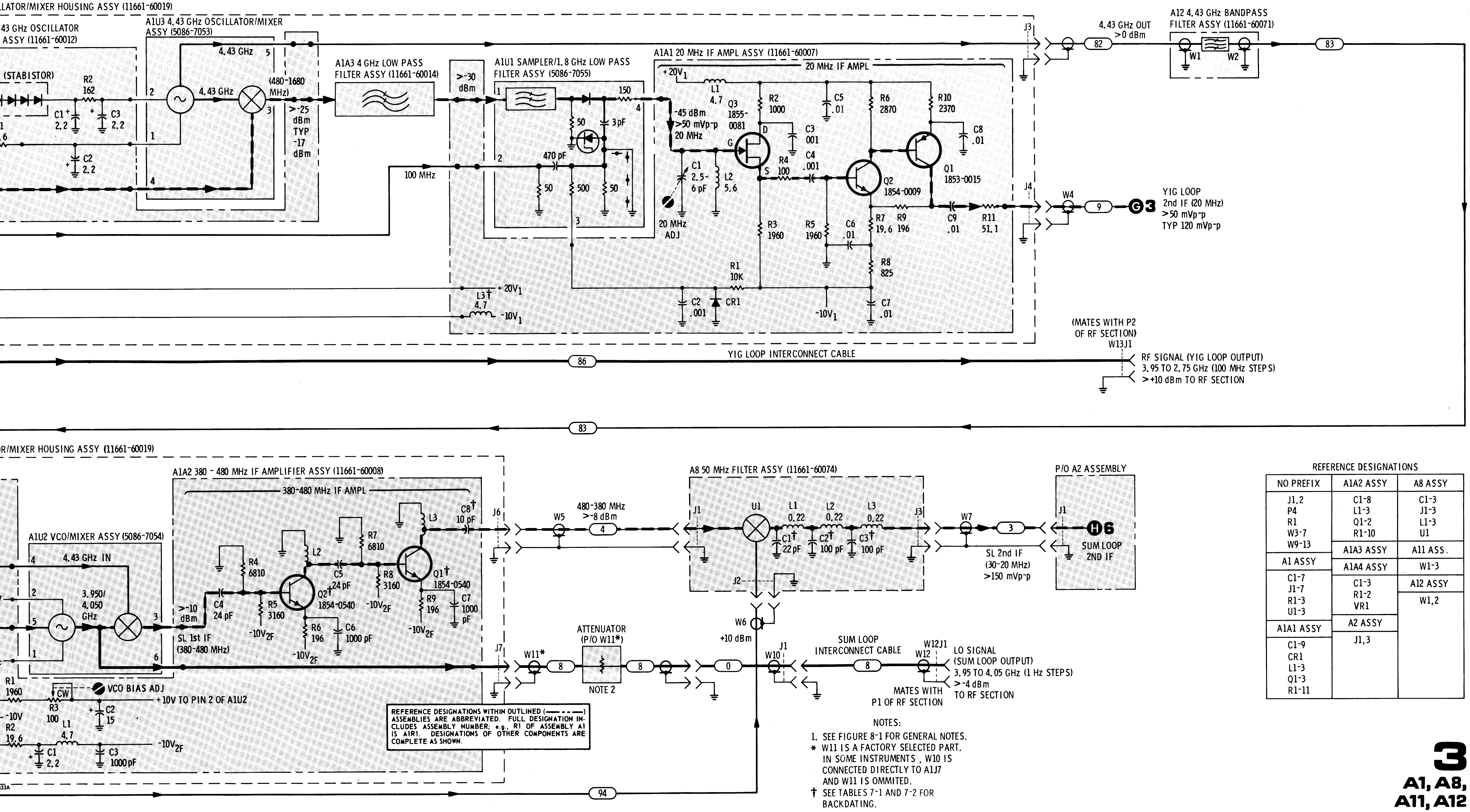


Figure 8-6. A1 Oscillator/Mixer Housing Assembly Component and Test Point Locations


P/O A1 OSCILLATOR/MIXER HOUSING ASSY (11661-60019)
A1A4 4.43 GHz OSCILLATOR TUNING ASSY (11661-60012)
A1U3 4.43 GHz OSCILLATOR/MIXER ASSY (5086-7053)
A1A3 4 GHz LOW PASS FILTER ASSY (11661-60014)
A1U1 SAMPLER/1.8 GHz LOW PASS FILTER ASSY (5086-7055)
A1A1 20 MHz IF AMPL ASSY (11661-60007)
20 MHz IF AMPL
OSC FREQ ADJ
VR1 (STABISTOR)
4.43 GHz
(480-1680 MHz)
>-25 dBm TYP -17 dBm
>-30 dBm
100 MHz
-45 dBm
>50 mVp-p
20 MHz
20 MHz ADJ
A11 2.6-4.1 GHz BANDPASS FILTER ASSY (11661-60072)
3.95-2.75 GHz
>-5 dBm
P/O P4
100 MHz REFERENCE
>+10 dBm FROM RF SECTION VIA MAINFRAME
YIG LOOP OUTPUT
3.95 TO 2.75 GHz
(100 MHz STEPS)
>+10 dBm
YIG LOOP INTERCONNECT CABLE
4.43 GHz
>-8 dBm
A1A2 380 - 480 MHz IF AMPLIFIER ASSY (11661-60008)
380-480 MHz IF AMPL
A1U2 VCO/MIXER ASSY (5086-7054)
4.43 GHz IN
3.950/ 4.050 GHz
SL 1st IF (380-480 MHz)
P/O A2 ASSY
VCO CONTROL SIGNAL
VCO BIAS ADJ
+10V TO PIN 2 OF A1U2
480-380 MHz
>-8 dBm
A8 50 MHz FILTER ASSY (11661-60074)
ATTENUATOR (P/O W11*)
NOTE 2
SUM LOOP INTERCONNECT CABL
+10 dBm
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.
P/O P4 (MATES WITH J4 IN MAINFRAME)
450 TO 360 MHz INPUT
(100 MHz STEPS) >+10 dBm
FROM RF SECTION VIA MAINFRAME
11661: OSC/MXR SECTION: 1433A
NOTES
1. SEE FIGURE 8-1 FOR
* W11 IS A FACTORY
IN SOME INSTRUM
CONNECTED DIRECT
AND W11 IS OMITT
† SEE TABLES 7-1 AN
BACKDATING.



REFERENCE DESIGNATIONS

NO PREFIX	A1A2 ASSY	A8 ASSY
J1,2 P4 R1 W3-7 W9-13	C1-8 L1-3 Q1-2 R1-10	C1-3 J1-3 L1-3 U1
A1 ASSY	A1A3 ASSY	A11 ASS.
C1-7 J1-7 R1-3 U1-3	A1A4 ASSY	W1-3
	C1-3 R1-2 VR1	A12 ASSY
A1A1 ASSY	A2 ASSY	W1,2
C1-9 CR1 L1-3 Q1-3 R1-11	J1,3	

NOTES:

1. SEE FIGURE 8-1 FOR GENERAL NOTES.

* W11 IS A FACTORY SELECTED PART. IN SOME INSTRUMENTS, W10 IS CONNECTED DIRECTLY TO A1J7 AND W11 IS OMMITED.

† SEE TABLES 7-1 AND 7-2 FOR BACKDATING.

3
A1, A8, A11, A12

Figure 8-7. Oscillator/Mixer Section Schematic Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

YIG LOOP PHASE DETECTOR SECTION

This Service Sheet includes the YIG loop 2nd IF filter and two phase detectors. A quadrature phase detector supplies a search control output when loss of phase lock occurs. Another phase detector supplies a dc voltage (A7TP2) proportional to the phase error between the 20 MHz 2nd IF and the 20 MHz FM/CW reference signal.

A9 20 MHz Filter Assembly

This is a non-repairable assembly whose purpose is to remove the unwanted 100 MHz and other spurious signals on the YIG Loop 2nd IF signal. The 2nd IF signal is first processed by a 50 MHz low pass filter, then a 20 MHz bandpass filter, and then amplified by about 20 dB. The output of this assembly is an emitter follower which drives one input of the YIG Loop phase detector assembly.

A7 YIG Loop Phase Detector Assembly

The YIG Loop phase detector compares the 20 MHz 2nd IF with the 20 MHz reference input from the mainframe. The output of this assembly includes a dc error signal during phase lock and a search control command during an unlocked condition.

90° Phase Shifter. The input circuit to A7Q4 shifts the phase of the 20 MHz reference signal about 90°. Capacitor A7C2 is used to adjust the exact phase so that the search command will not be turned on when the YIG loop is phase locked.

20 MHz Limiter/Amplifiers. Three integrated circuits are used to amplify and limit the 20 MHz signals: one for the 20 MHz reference, one for the 90° phase shifted 20 MHz reference, and one 20 MHz 2nd IF.

SERVICE SHEET 4 (Cont'd)

Quadrature Phase Detector. The quadrature phase detector circuit compares the 20 MHz 2nd IF with the 90° phase shifted 20 MHz reference to detect an unlocked condition. Two gates on A7U4 form an exclusive OR gate where the output is low only when the inputs are out of phase.

20 MHz Phase Detector. Phase Detector A7U6 is a balanced mixer type detector which compares the 20 MHz 2nd IF with the 20 MHz reference. The output of the detector passes through a low pass filter to produce a dc voltage proportional to the phase difference.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assembly or cables shown in the accompanying diagram. Troubleshoot the A7 YIG Loop Phase Detector Assembly by using the test equipment and procedures given below.

Test Equipment	Model
Oscilloscope	HP 180C/1801A/1821A
10:1 Divider Probe	HP 10004
Digital Voltmeter	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A7 Assembly (+20 Vdc and —10 Vdc). Also check the +10 Vdc from the zener diode A7VR1 and the regulated —5 Vdc. If incorrect troubleshoot these circuits. If correct proceed to Test 2.

Test 2. If there is either no or low output at J2 of the A9 Assembly, check the input, cables, and —10 Vdc power supply input at A9C1. If no fault is found, replace the A9 Assembly.

Test 3. If the search control output was found faulty on Service Sheet 1, proceed as follows: With both RF inputs of the A7 Assembly driven from the 20 MHz reference, check pin 2 of A7U5 for about —1.2 Vdc. Pin 3 of A7U5 (or A7TP1) should be about —1.5 Vdc. (ECL logic levels are: on = —0.7 Vdc, off = —1.5 Vdc). If these inputs are correct A7U5 or A7VR3 is bad. If the voltage at A7TP1 is incorrect use an oscilloscope to check back to the RF inputs. The output of the Limiter Amplifiers (U1A pins 1 and 2, U3A pins 1 and 2) should be about 0.8 Vp-p.

Test 4. If the search control is working properly, compare the REF 20 MHz LIMITER/AMPL voltages and waveforms with the PHASE-SHIFTED 20 MHz LIMITER/AMPL voltages and waveforms. If one of the 20 MHz inputs is unplugged, the loop will be unlocked and the can be used for signal tracing through the phase detector and elliptic filter.

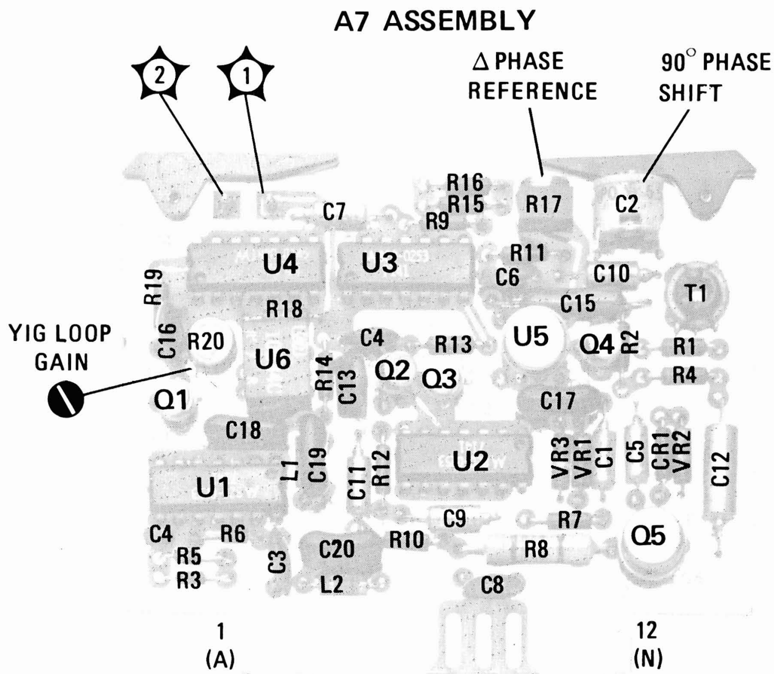
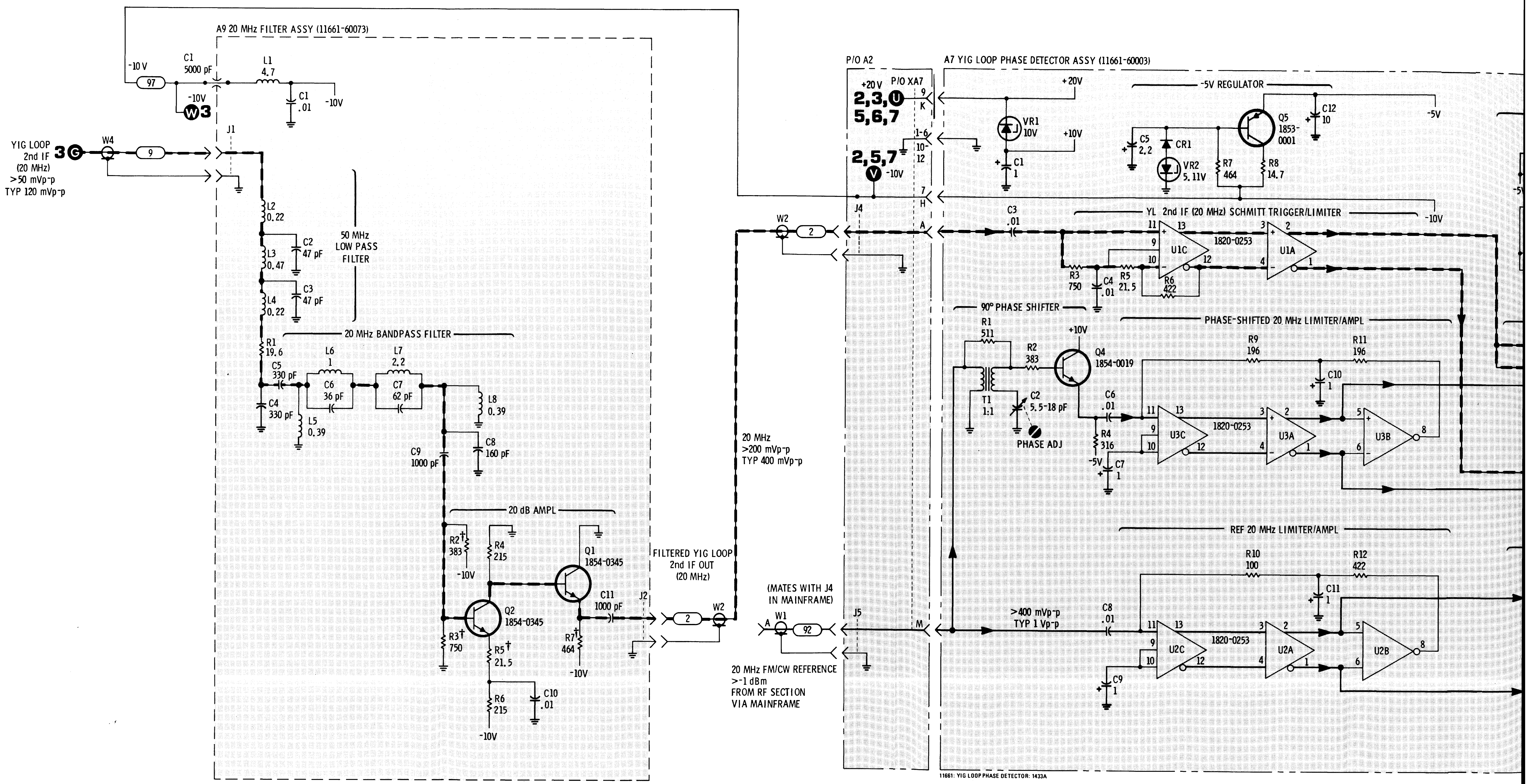


Figure 8-8. A7 YIG Loop Phase Detector Assembly Component and Test Point Locations


A9 20 MHz FILTER ASSY (11661-60073)
YIG LOOP 2nd IF (20 MHz) >50 mVp-p TYP 120 mVp-p
50 MHz LOW PASS FILTER
20 MHz BANDPASS FILTER
20 dB AMPL
FILTERED YIG LOOP 2nd IF OUT (20 MHz)
20 MHz >200 mVp-p TYP 400 mVp-p
(MATES WITH J4 IN MAINFRAME)
20 MHz FM/CW REFERENCE >-1 dBm FROM RF SECTION VIA MAINFRAME
P/O A2
P/O XA7
A7 YIG LOOP PHASE DETECTOR ASSY (11661-60003)
-5V REGULATOR
YL 2nd IF (20 MHz) SCHMITT TRIGGER/LIMITER
90° PHASE SHIFTER
PHASE-SHIFTED 20 MHz LIMITER/AMPL
PHASE ADJ
REF 20 MHz LIMITER/AMPL
>400 mVp-p TYP 1 Vp-p
11661: YIG LOOP PHASE DETECTOR: 1433A

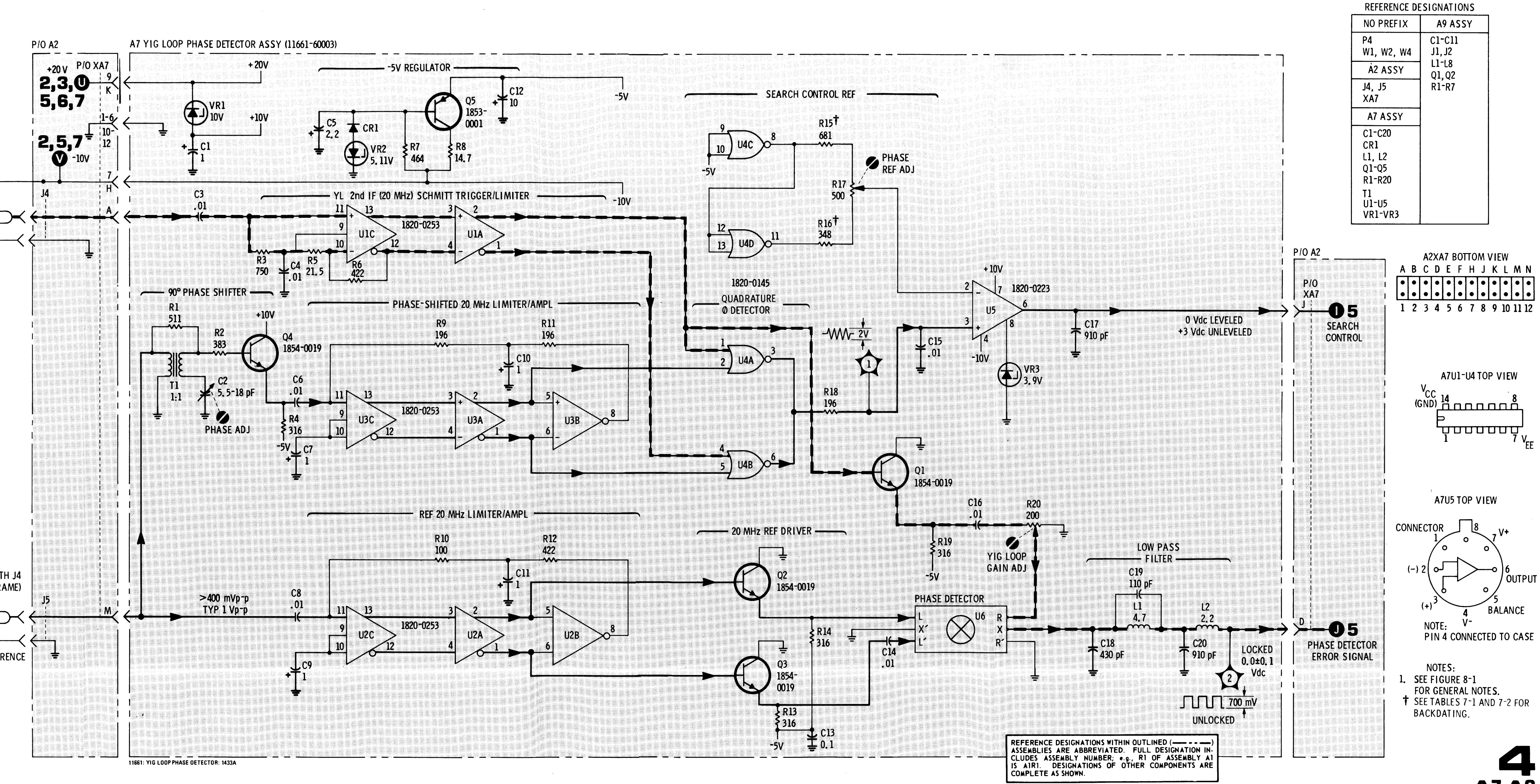


Figure 8-9. YIG Loop Phase Detector Section Schematic Diagram

SERVICE SHEET 5

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

A6 FM DRIVER ASSEMBLY

PRINCIPLES OF OPERATION

The FM Driver converts the dc error signal derived from the phase detector section to drive current for the YIG FM coil. In the FM mode, FM is added to the 20 MHz reference signal in the Modulation Section, routed through an amplifier in the RF Section, and is present on the YIG FM coil. If phase lock with the 20 MHz 2nd IF is lost, the search control turns on the Search Waveform Generator.

DC Amplifier and Output Driver

Transistors A6U1, A6Q1, 2, 3, and 4 function as an operational amplifier. The non-inverting input is A6U1 pin 4 and the inverting input is A6U1 pin 2. The phase detector error signal from the YIG loop phase detector is connected to the non-inverting input. The output of this amplifier drives the FM coil in the YIG oscillator. Current sense resistor A6R37 developes a voltage proportional to the FM coil current. This voltage is fed back to the amplifier input at A6U1 pin 2.

Search Waveform Generator

When the YIG is unlocked, the search control input (+3 Vdc) enables the search waveform oscillator A6U2B and A6U2C. Gate A6U2A acts as an inverter turning on A6Q5 and FET A6Q6. The output of the search waveform oscillator is a squarewave and is connected to the FET drain through gate A6U2D. Resistor A6R18 and capacitor A6C11 convert the squarewave to a sawtooth for driving the inverting input to the amplifier section. The fine tune winding of the YIG will then sweep until the quaerature phase detector (search control) goes to zero. FET A6Q6 will then be cutoff but capacitor A6C11 will hold its charge long enough for the loop to lock.

A7 YIG Loop Phase Detector Assembly
A9 20 MHz Filter Assembly
◀ SERVICE SHEET 4

SERVICE SHEET 5 (Cont'd)

A10 YIG Oscillator Assembly

The YIG Oscillator Assembly is non-repairable. The larger of two tuning coils is connected to the pretune circuit on the A5 Assembly. The smaller FM coil is connected to the A6 YIG FM Driver Assembly and is driven by the YIG phase detected error signal. The output of the YIG oscillator is therefore phase locked to the frequency digits 9 and 10 (100 MHz - 1200 MHz) and contains the FM if present.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies or cables shown on the accompanying diagram. Troubleshoot the circuits using the test equipment and procedures given below.

Test Equipment	Model
Spectrum Analyzer	HP 8555A/8552B/140T
Oscilloscope	HP 180C/1801A/1821A
Digital Voltmeter	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A6 Assembly on the board. If any are missing, check for continuity of interconnections to the mainframe.

Test 2. To check the Search Waveform Generator proceed as follows. If the Search Control input is at a logic high, U2 pin 3 is low and A6Q5 will be turned ON. The output at U2 pin 11 will be a square wave, alternating between about 0 and 3.5 Vdc. The oscillator formed by A6U2B and A6U2C is ON at all times and has a period of about 5 milliseconds.

Test 3. Troubleshoot the amplifiers using the ramp waveform. With the search control active, use the oscilloscope to trace the ramp from U1 pin 2 (about 10 mV) to the output of the Output Driver. The signal amplitude at the base of A6Q3 should be about 10 Vp-p.

Test 4. If the tests on Service Sheet 1 shows that the YIG oscillator is far off frequency or has a low output signal amplitude, check the power supply voltages and interconnecting cables using the schematic diagram. If the inputs to the A10 YIG Oscillator Assembly are good, replace the entire assembly.

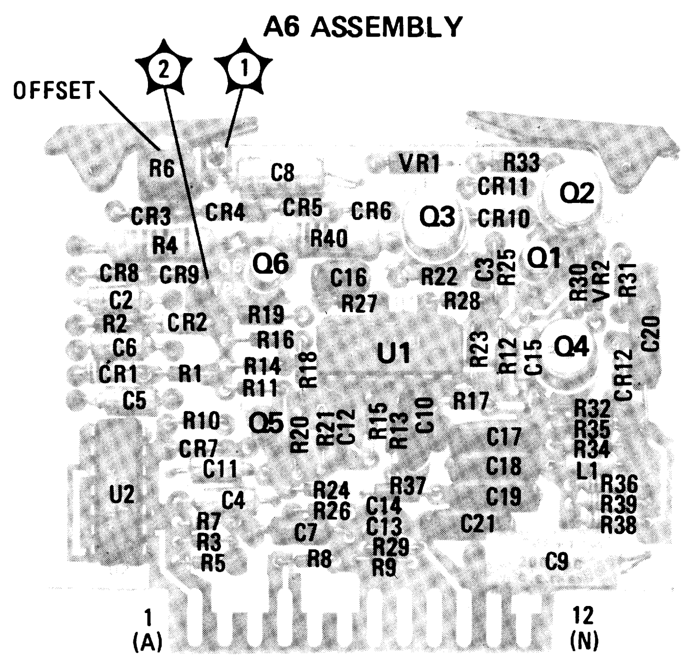
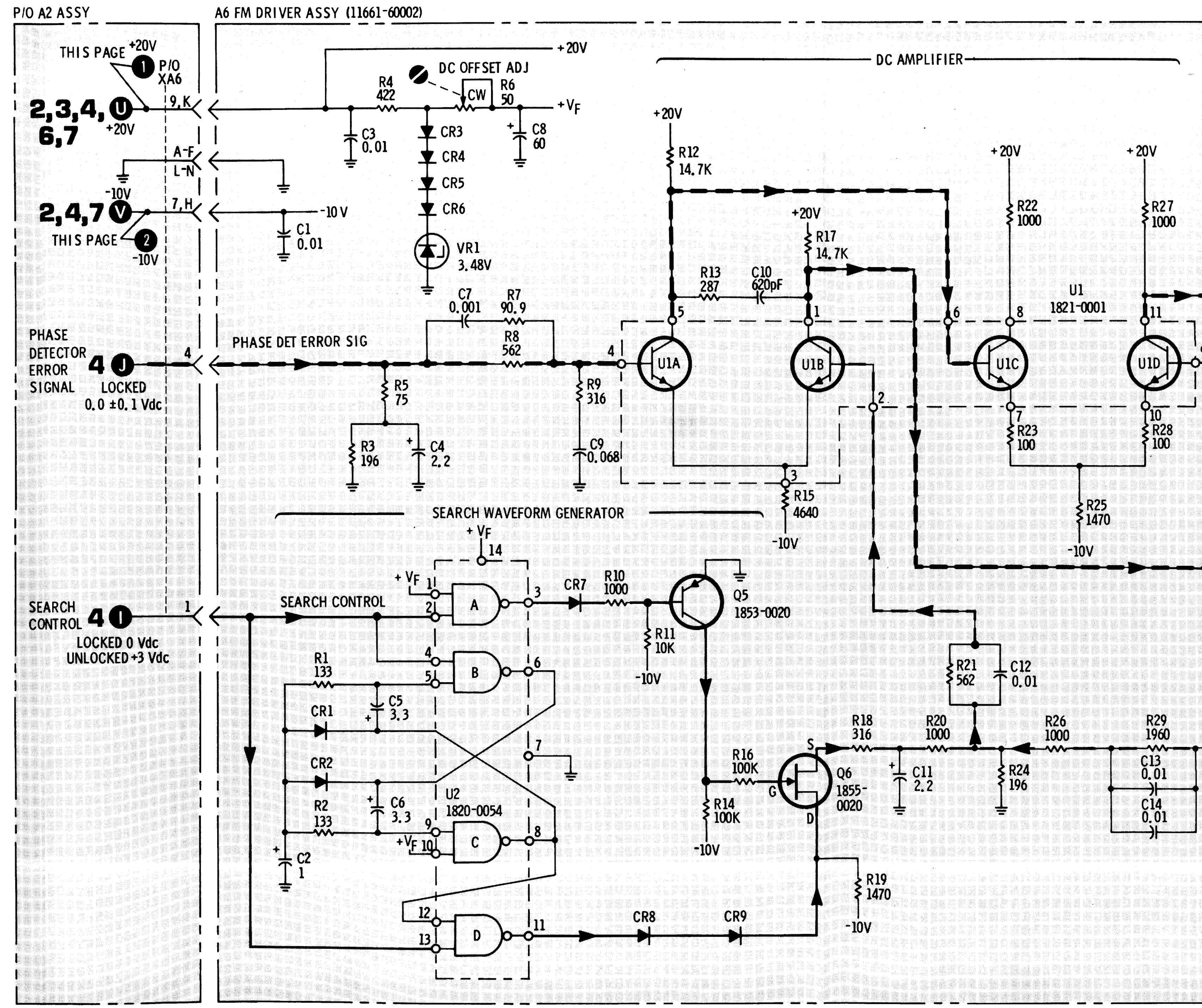


Figure 8-10. A6 FM Driver Assembly Component and Test Point Locations



A2XA6 BOTTOM VIEW

1	• •	A
2	• •	B
3	• •	C
4	• •	D
5	• •	E
6	• •	F
7	• •	H
8	• •	J
9	• •	K
10	• •	L
11	• •	M
12	• •	N

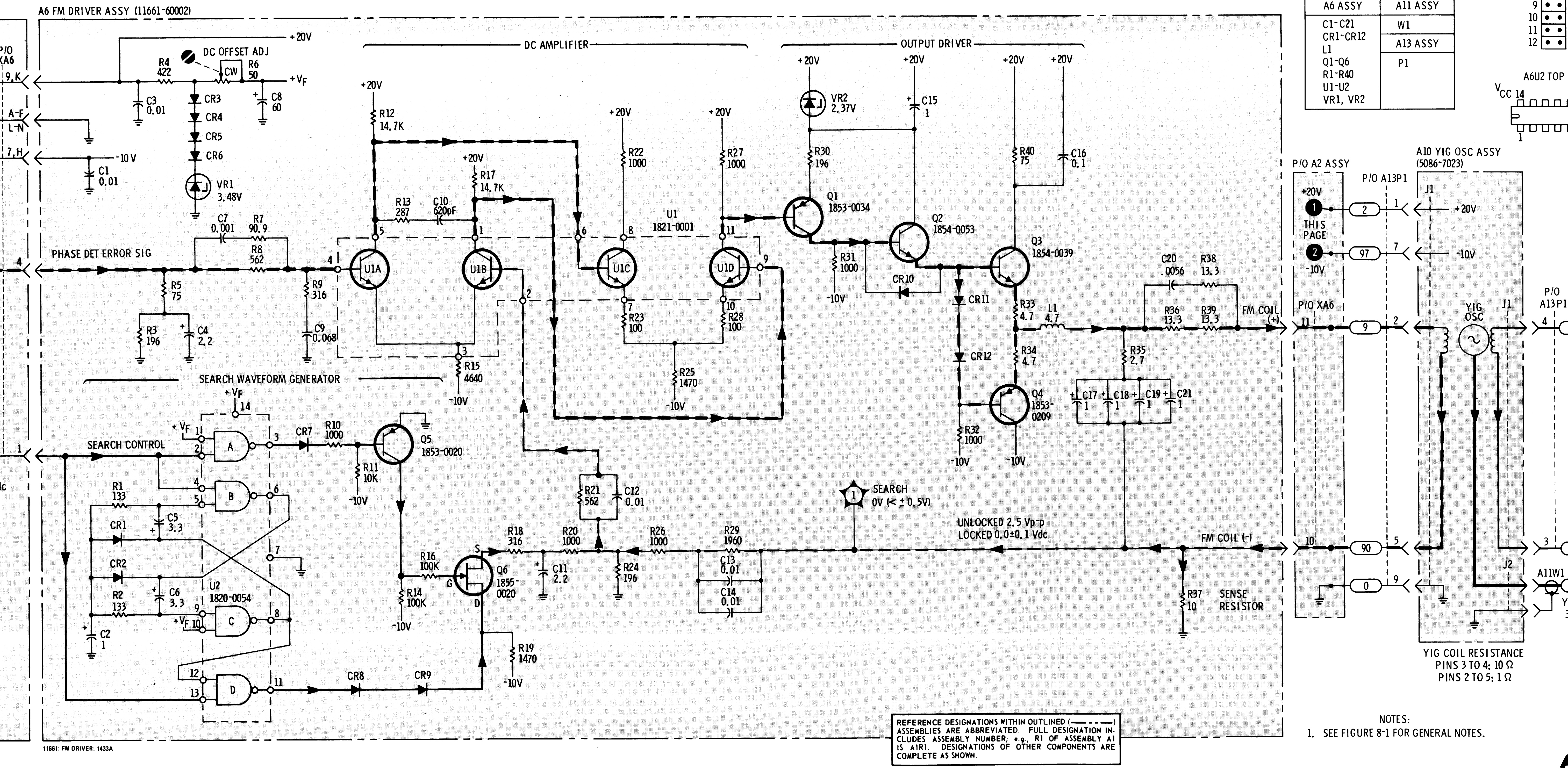
REFERENCE DESIGNATORS

A2 ASSY	A10 ASSY
XA6	J1, J2
A6 ASSY	A11 ASSY
C1-C21 CR1-CR12 L1 Q1-Q6 R1-R40 U1-U2 VR1, VR2	W1 A13 ASSY P1

A6U2 TOP VIEW

V_{CC} 14 8

1 7 GND



5

A6, A10

Figure 8-11. YIG Loop FM Driver/Oscillator Section Schematic Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in thc RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

A3 SUM LOOP PHASE DETECTOR ASSEMBLY

PRINCIPLES OF OPERATION

The A3 Sum Loop Phase Detector compares the 30-20 MHz (1 Hz steps) signal from the mainframe and the 30-20 MHz Sum Loop 2nd IF signal and provides a phase error signal to the A4 assembly to accomplish phase lock.

Pulse Generators

The Sum Loop 2nd IF signal input is amplified by A3Q5. The output of A3Q5 drives the pulse forming circuit A3U3A to speed up the rise and fall time for the logic elements. Feedback inductor A3L2 allows gate A3U3A to operate more in its linear region and convert the small signal input to logic level pulses. A similar circuit is used for the 20 to 30 MHz input signal from the mainframe.

Digital Phase Detector and Low Pass Filters

The digital phase detector compares the phase relationship of two signals in the 20 to 30 MHz range and produces a dc error voltage proportional to the difference. Gates A3U3C and A3U2A are connected to form a flip-flop circuit. The output of gate A3U3C pin 8 is set to a logic high by the input signal. The 2nd IF flip-flop is reset by A3U2C only after both input signals have set their respective flip-flops. The duration of the logic high at the phase detector outputs therefore depends on the phase of the input signals. The dc level output of one lowpass filter will then be proportional to the phase difference of the input signals, while the other output is a constant low dc level. If in phase, both flip-flops reset immediately and both outputs will be a constant low dc level.

Active Filter/Integrator

The output circuit forms a differential amplifier. The two outputs of the phase detector are connected to the two inputs of this amplifier. Further filtering of the phase detector signal is accomplished by feedback resistor A3R21 and capacitor A3C19. If the loop is locked the amplifier output will be about +10 Vdc. If the 2nd IF is absent, for example, the output of the assembly will be about +20 Vdc.

A6 FM Driver Assembly
A10 YIG Oscillator Assembly
◀ SERVICE SHEET 5

SERVICE SHEET 6 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies or cables shown on the accompanying diagram. Troubleshoot the circuits using the test equipment and procedures given below.

Test Equipment	Model
Oscilloscope	HP 180C/1801A/1821A
Digital Voltmeter	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A3 Assembly on the board (+20, +5.25 and —40 Vdc). Also check the +5 Vdc filtered. If any voltages are incorrect, check continuity back to the mainframe. If correct proceed to test 2.

Test 2. Connect the two signal inputs to the 30-20 MHz input from the mainframe as described in Test 14 on Service Sheet 1. Connect oscilloscope probe first to U3C pin 10 and then to U1B pin 4 comparing the waveforms (30-20 MHz pulses). If either of these two signals are missing, check back to the common input with the oscilloscope probe to identify the problem.

Test 3. Move the oscilloscope probe first to U3C pin 8 and then to U1B pin 6. If pulses are missing from either point, use a digital voltmeter to locate the problem.

Test 4. Use a digital voltmeter to compare the two halves of the output circuit. If the inputs are balanced, similar points should have the same dc voltage. Note that A3TP1 is about +10 Vdc for phase lock.

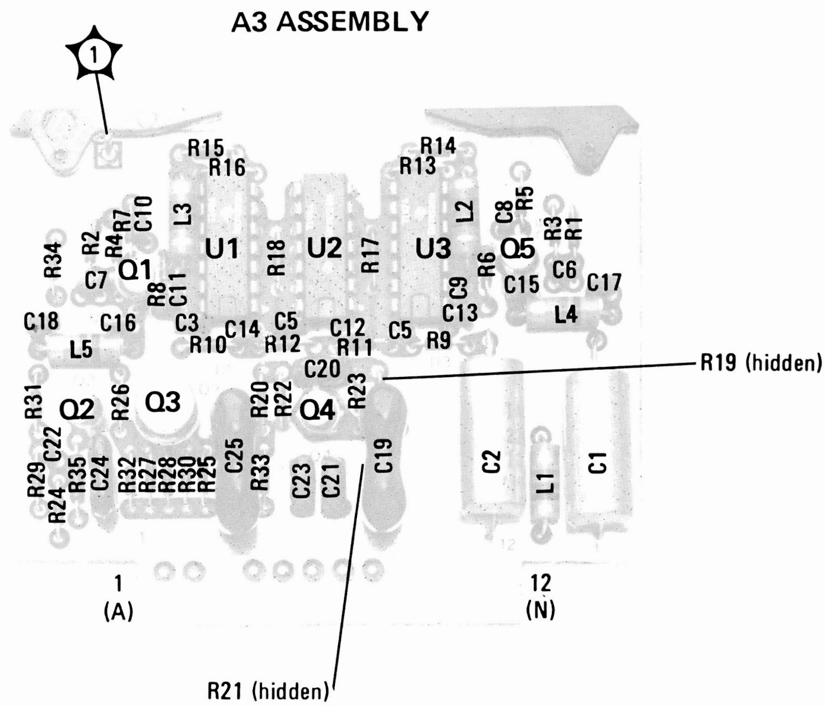
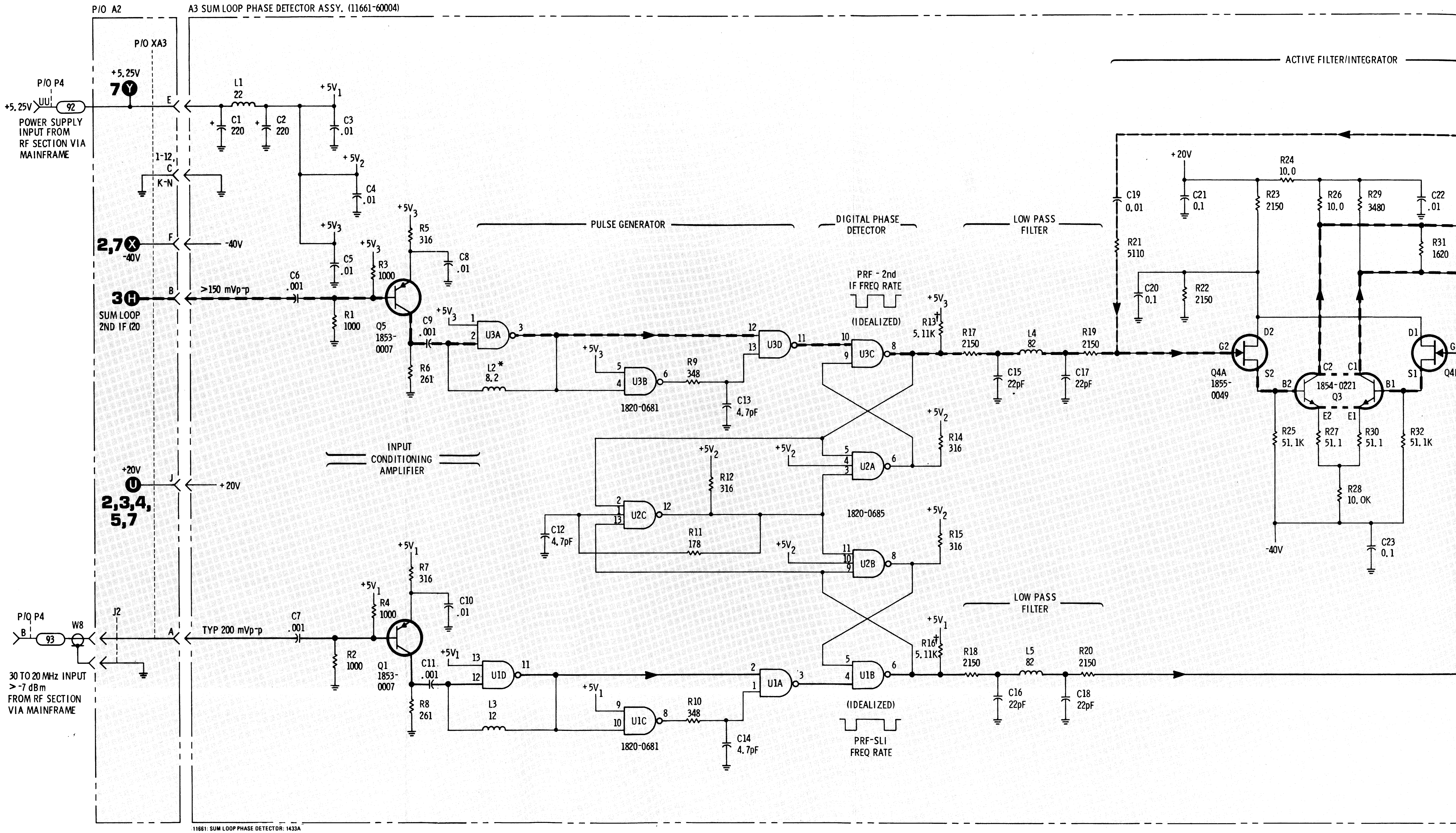


Figure 8-12. A3 Sum Loop Phase Detector Assembly Component Locations


P/O A2
A3 SUM LOOP PHASE DETECTOR ASSY. (11661-60004)
P/O XA3
P/O P4
+5.25V
POWER SUPPLY INPUT FROM RF SECTION VIA MAINFRAME
SUM LOOP 2ND IF (20
30 TO 20 MHz INPUT >-7 dBm FROM RF SECTION VIA MAINFRAME
INPUT CONDITIONING AMPLIFIER
PULSE GENERATOR
DIGITAL PHASE DETECTOR
PRF - 2nd IF FREQ RATE
(IDEALIZED)
PRF-SLI FREQ RATE
LOW PASS FILTER
ACTIVE FILTER/INTEGRATOR
>150 mVp-p
TYP 200 mVp-p
1820-0681
1820-0685
1854-0221
11661: SUM LOOP PHASE DETECTOR: 1433A

Figur

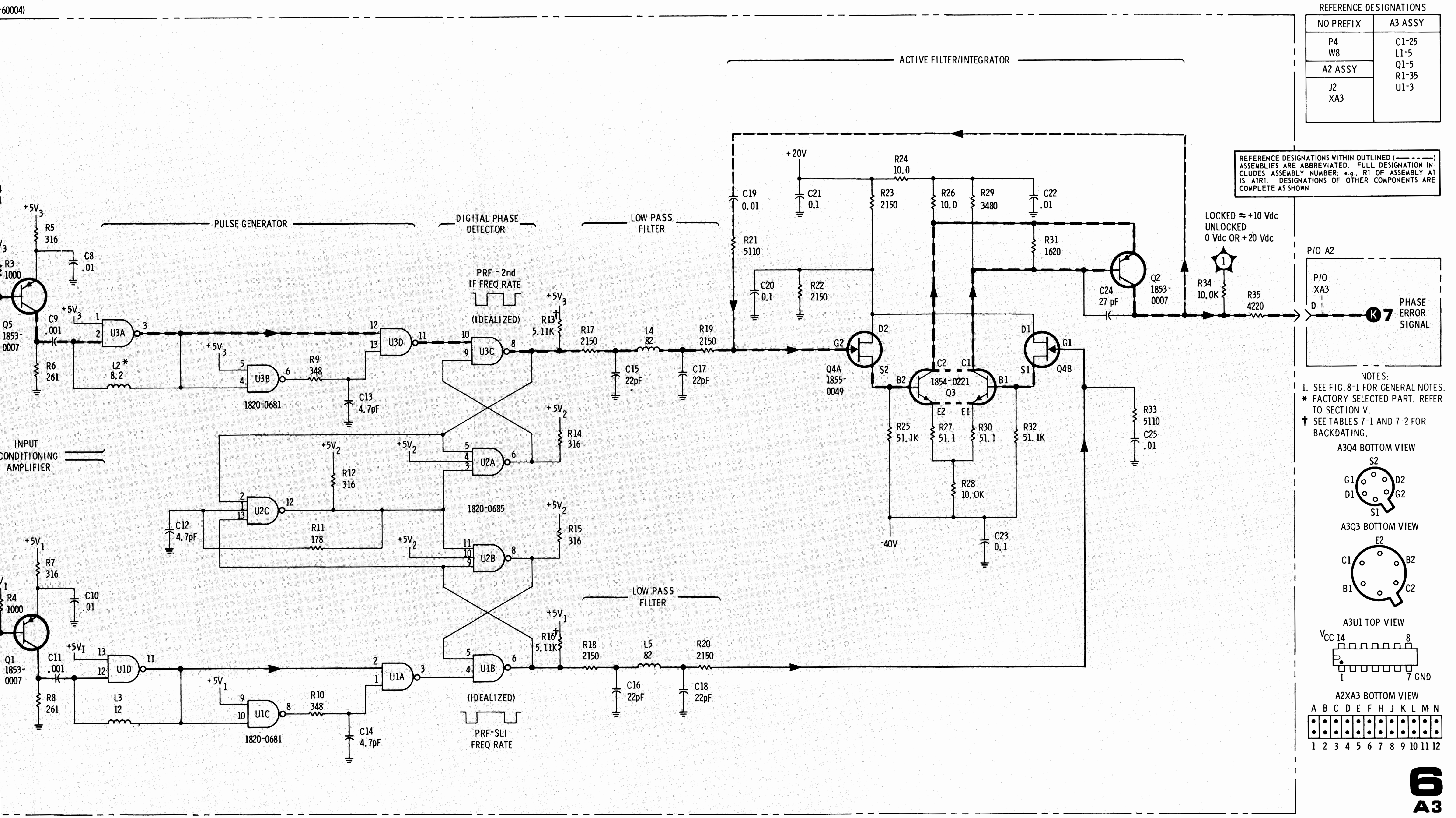


Figure 8-13. Sum Loop Phase Detector Section Schematic Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (see System Troubleshooting Guide). Then, if that information does not isolate the problem to a definite instrument, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in the RF Section manual. This information may be used to isolate the defect to the Frequency Extension Module, another plug-in, or the mainframe. If the problem is in this module, refer to Service Sheet 1 for further troubleshooting information.

A4 SUM LOOP PRETUNE ASSEMBLY

PRINCIPLES OF OPERATION

The A4 Sum Loop Pretune Assembly converts the binary logic of the 10 MHz steps (digit 8) to a dc bias for coarse tuning of the VCO. This assembly includes a BCD to decimal decoder, a 4.05-3.95 GHz resistance ladder, and associated amplifiers. The pretune current is combined with the phase error signal from the A3 Assembly to produce the VCO control signal.

Logic Input

Inputs to XA4 pins N, M, L, and K are BCD code from the mainframe for digit 8 (10 MHz). Integrated circuit U1 converts the input from BCD to 10 line decimal. U1 also acts as a logic inverter so that only one line is ON (near ground) at any one time. The remaining lines will be above 3 Vdc. The digit selected will turn on one of the transistors Q1 through Q10. An adjustment for each transistor is provided for weighting the current for each digit.

Phase Error Signal

Transistor Q12 provides coupling of the phase error signal from the A3 Sum Loop Phase Detector Assembly. Potentiometer R6 provides an adjustment for controlling loop bandwidth at the low frequency end of the VCO range. Note that the higher the selected frequency, the lower the VCO tuning voltage. Transistor Q11 improves the high frequency response of the phase error signal. The voltage range of the tuning is from about —10 Vdc to about —16 Vdc.

A3 Sum Loop Phase Detector Assembly
◀ SERVICE SHEET 6

SERVICE SHEET 7 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assembly or cables shown in the accompanying diagram. Troubleshoot the A4 Sum Loop Pretune Assembly by using the test equipment and procedures given below.

Test Equipment	Model
Digital Voltmeter . . .	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A4 Assembly (+20V, +5V, —10V, and —40V). If incorrect check for continuity back to the mainframe. If correct proceed to test 2.

Test 2. If a fault lies with the pretune logic decoding, check the collector of transistors A4Q1 through A4Q10 while exercising the digit 8 tuning on the mainframe (0 through 9). Each line should pull up to about 0 Vdc when the matching number is selected. If there is no change in the output of the A4 Assembly (pin 1) for the entire range of tuning, probably A4U1 is bad.

Test 3. The output of the A4 Assembly (pin 1) should be at about —10 Vdc for 4.05 GHz and —26 Vdc for 3.95 GHz tuning of the VCO. If the voltages fall much outside of this range check A4Q11 and A4Q12 and associated components for short or open failures.

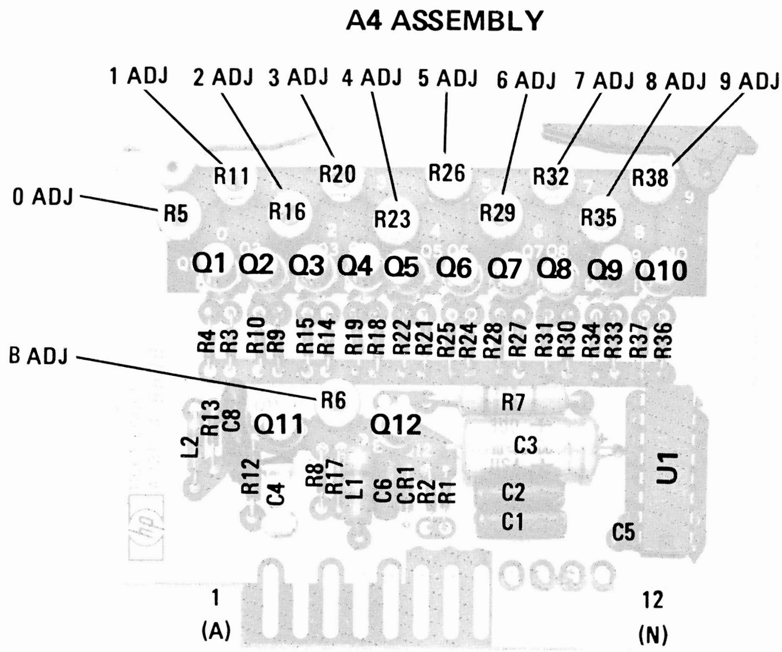
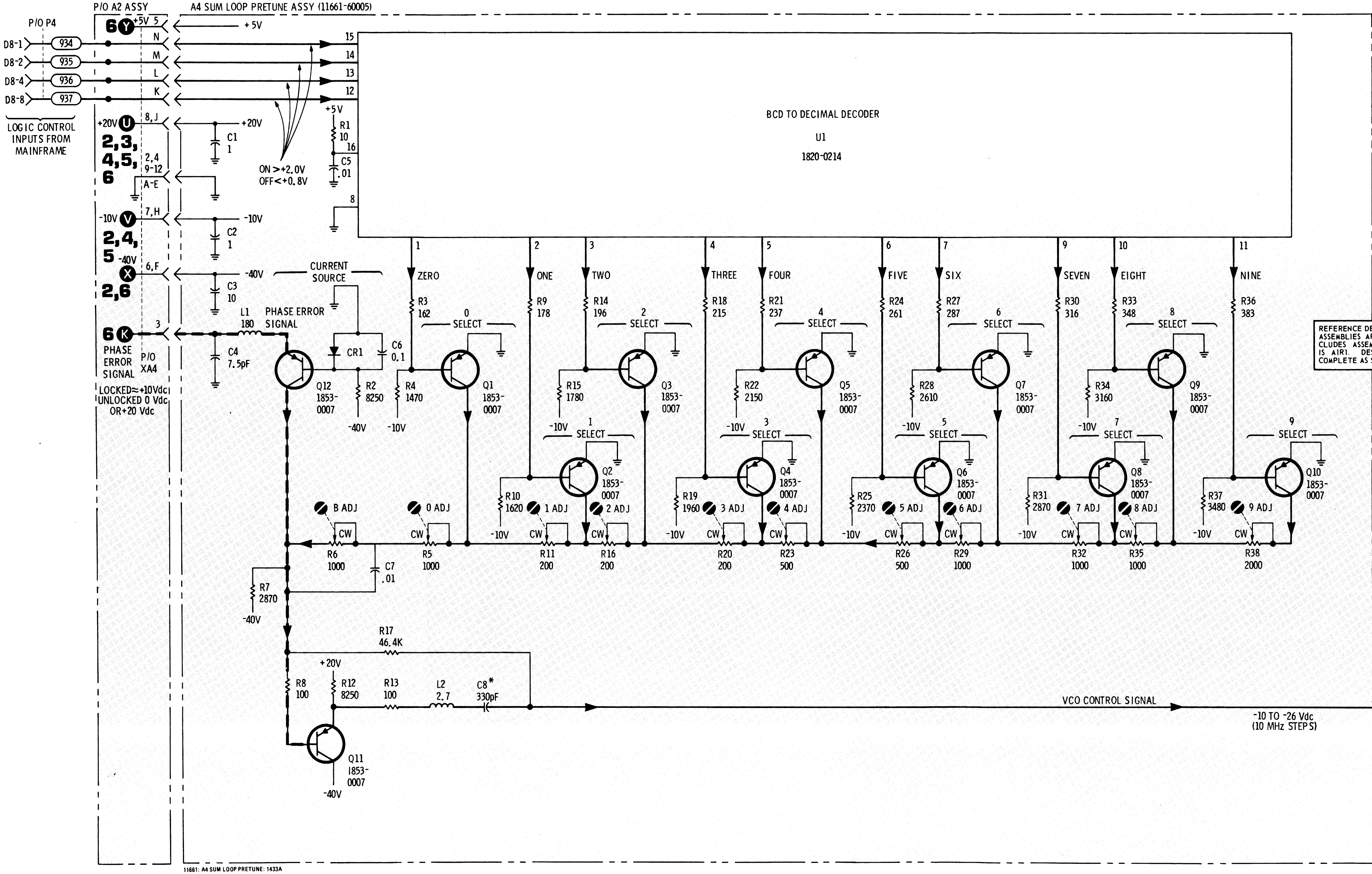


Figure 8-14. A4 Sum Loop Pretune Assembly Component Locations



REFERENCE DESIGNATORS

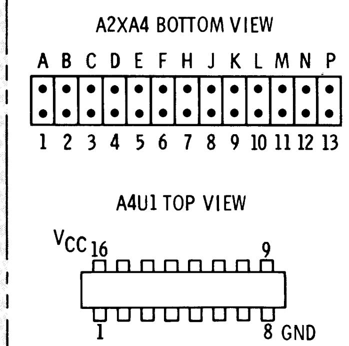
NO PREFIX	A4 ASSY
P4	C1-C8 CR1 L1, L2 Q1-Q12 R1-R38 U1
A2 ASSY	
XA4	

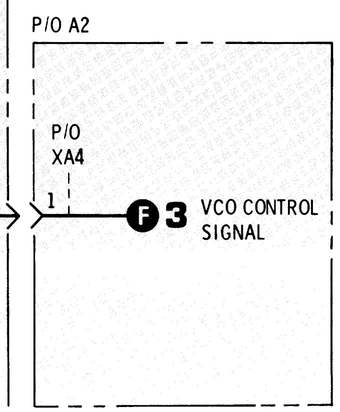
NOTES

1. SEE FIGURE 8-1 FOR GENERAL NOTES.

*INDICATES FACTORY-SELECTED PART. NOMINAL VALUE SHOWN.

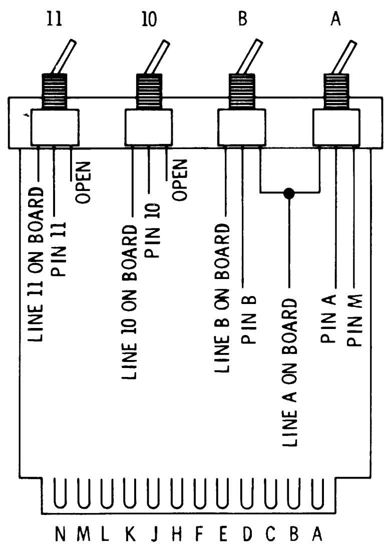
REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.





7
A4

Figure 8-15. Sum Loop Pretune Section Schematic Diagram



NOTE

To show switch positions, make a label as shown below and attach to lettered side of the test board.

Switch	11	10	B	A
Normal	/	/	/	/
Test A3 (Green)	/	/	\	/
Test A7 Brown)	/	/	/	\
Test A6 (Red)	\	\	/	/

Figure 8-16. 11661 Test Board

GENERAL REMOVAL AND DISASSEMBLY PROCEDURE

WARNING

To avoid contact with the line voltage, remove the line (Mains) power cable from the power outlet before removing or connecting cables to the Frequency Extension Module.

a. Remove the mainframe top cover by first removing the four Pozidriv screws; then slide the cover back and off the mainframe side rails.

b. If the Frequency Extension Module is to be removed from the mainframe, remove the bottom cover in a similar manner.

Model 11661A Module Removal

a. Remove the two cables connected to J1 and J2 as shown in Figure 2-2.

b. Remove the three securing screws shown in Figure 2-2 holding the Frequency Extension Module cover to the mainframe.

c. Remove the two bottom screws holding the Frequency Extension Module. These screws are accessible from the bottom of the mainframe.

d. Lift straight up with a slight rotating action.

Interconnection of the Frequency Extension Module to the Mainframe for Troubleshooting Purposes

WARNING

With the mainframe top cover removed, power is supplied to the system during troubleshooting. Energy available at many points may, if contacted, result in personal injury.

a. Use extender cable HP 11672-60002 to connect J4 on the mainframe to P4 on the Frequency Extension Module.

b. Reconnect the RF connecting cables to J1 and J2 on the rear of the Frequency Extension Module. Refer to Figure 2-2 for cable color code.

NOTE

The interconnect cables and adaptors are found in the HP 11672A Service Kit. They may all be ordered in the kit or as individual pieces. Refer to the 11672A Operating Note or the Mainframe Manual for a pictorial cross reference.

GENERAL REMOVAL AND DISASSEMBLY PROCEDURE (Cont'd)

c. Reconnect the mainframe line (Mains) power cable to the power outlet and set the mainframe line switch to ON.

Access To Internal Assemblies

For access to the circuit boards, remove the three screws securing the cover to the case. Circuit boards A3, A4, A5, A6, and A7 may be unplugged by simultaneously pulling up on both plastic arms associated with that board.

Reassembly Procedure

Reassembly in reverse order of disassembly. Replace the top cover after verifying all boards are in place and then install in mainframe. Before replacing the instrument cover, verify that the two RF cables to J1 and J2 are properly installed as shown in Figure 2-2.

11661 TEST BOARD

Troubleshooting the 11661 phase lock loop circuit boards A3, A6, and A7 can be aided by constructing a special test board. This board uses a standard extender board, Hewlett-Packard part number 5060-0258, and four small SPDT toggle switches, HP part number 3101-0163 or equivalent.

Instructions For Construction

a. Open connections to blue ribbon (edge) connector pins A, B, 10, and 11 from extender board traces.

b. Mount switches on lettered side of board.

c. Wire as shown in Figure 8-16.

d. Add label to show switch position.

Application

With A3 Extended: In the test position the two 20-30 MHz inputs are tied together and to the SL1 mainframe signal. In this state, A3TP1 should be approximately 20 Vdc.

With A6 Extended: The switches open the output lines to the YIG oscillator's FM coil.

With A7 Extended: The switches connect both YIG loop phase detector inputs to the 20 MHz mainframe reference. In this state A7TP2 should be 0 ± 0.1 Vdc.

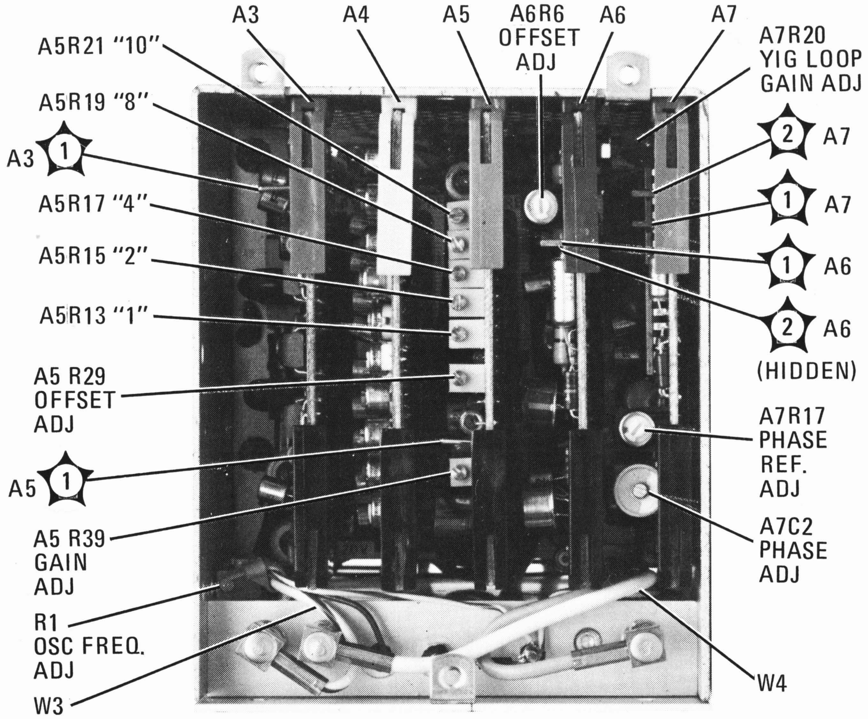
Table 8-2. Assemblies, Chassis Mounted Parts, and Adjustment Locations (1 of 2)

Reference Designator	Service Sheet(s)	Figure(s)
A1 Assembly	3	8-6, 8-17
A1A1 Assembly	3	8-6, 8-17
A1A1C1 20 MHz Adj	3	8-6, 8-17
A1A2 Assembly	3	8-6, 8-17
A1A2R3 VCO Bias Adj	3	8-6, 8-17
A1A3 Assembly	3	8-6, 8-17
A1A4 Assembly	3	8-6, 8-17
A2 Assembly	2,3,4,5,6	8-17
A3 Assembly	6	8-12, 8-17
A4 Assembly	7	8-14, 8-17
A4R5 O Adj	7	8-14
A4R6 B Adj	7	8-14
A4R11 1 Adj	7	8-14
A4R16 2 Adj	7	8-14
A4R20 3 Adj	7	8-14
A4R23 4 Adj	7	8-14
A4R26 5 Adj	7	8-14
A4R29 6 Adj	7	8-14
A4R32 7 Adj	7	8-14
A4R35 8 Adj	7	8-14
A4R38 9 Adj	7	8-14
A5 Assembly	2	8-4, 8-17
A5R13 "1" Adj	2	8-4, 8-17
A5R15 "2" Adj	2	8-4, 8-17
A5R17 "4" Adj	2	8-4, 8-17
A5R19 "8" Adj	2	8-4, 8-17
A5R21 "10" Adj	2	8-4, 8-17
A5R29 OFFSET Adj	2	8-4, 8-17
A5R39 GAIN Adj	2	8-4, 8-17
A6 Assembly	5	8-10, 8-17
A6R6 DC OFFSET Adj	5	8-10, 8-17
A7 Assembly	4	8-8, 8-17
A7C2 Phase Adj	4	8-8, 8-17
A7R17 Phase Ref Adj	4	8-8, 8-17
A7R20 YIG Loop Gain Adj	4	8-8, 8-17

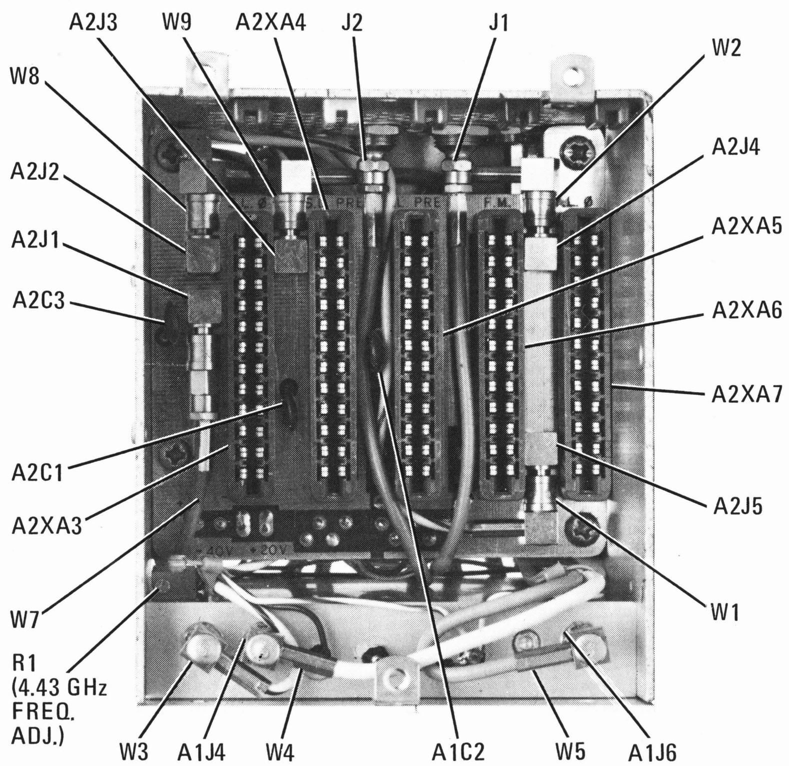
Table 8-2. Assemblies, Chassis Mounted Parts, and Adjustment Locations (2 of 2)

Reference Designator	Service Sheet(s)	Figure(s)
A8 Assembly	3	8-17
A9 Assembly	4	8-17
A10 Assembly	5	8-17
A11 Assembly	3	8-17
A12 Assembly	3	8-17
A13 Assembly	—	—
J1	3	2-2, 8-17
J2	3	2-2, 8-17
P4	2,3,4,5,6,7	8-17
W1, 2	4	8-17
W3	3	8-17
W4	3, 4	8-17
W5	3	8-17
W6	3	—
W7	3	8-17
W8	6	8-17
W9-12	3	8-17
W13	3	—

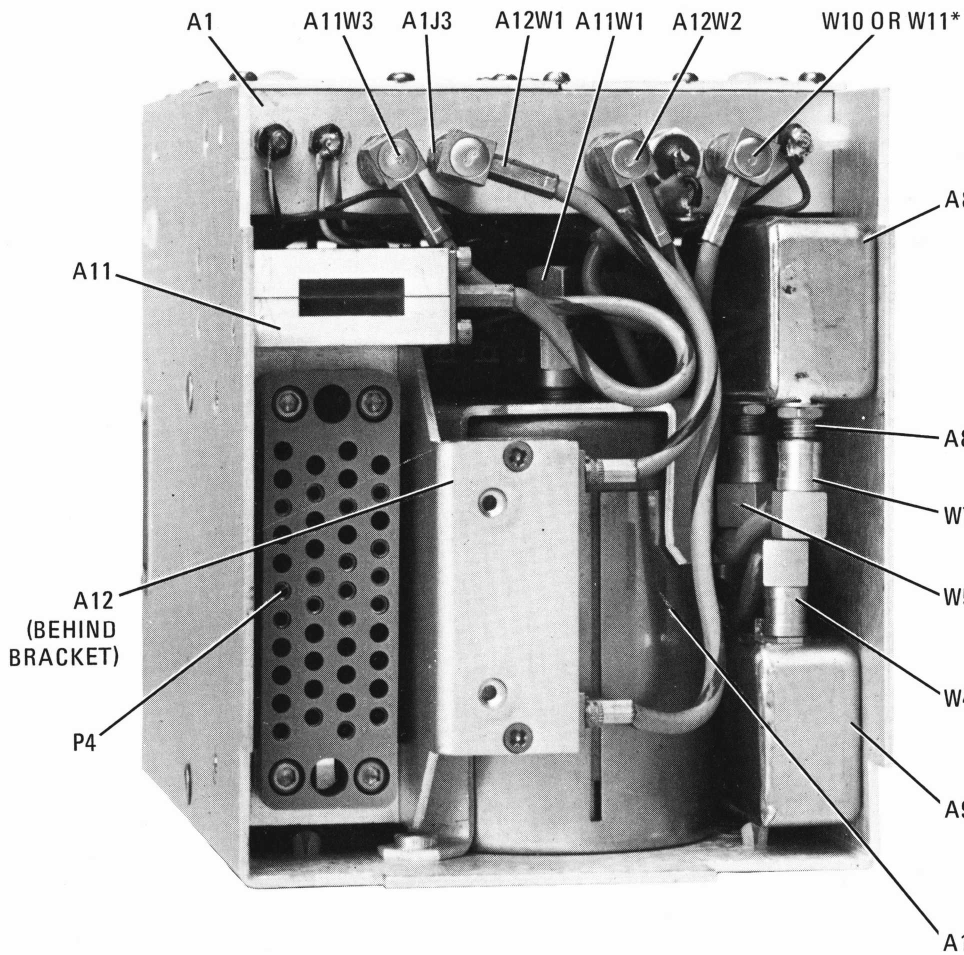
TOP VIEW



A2 ASSEMBLY



BOTTOM VIEW



A1 ASSEMBLY

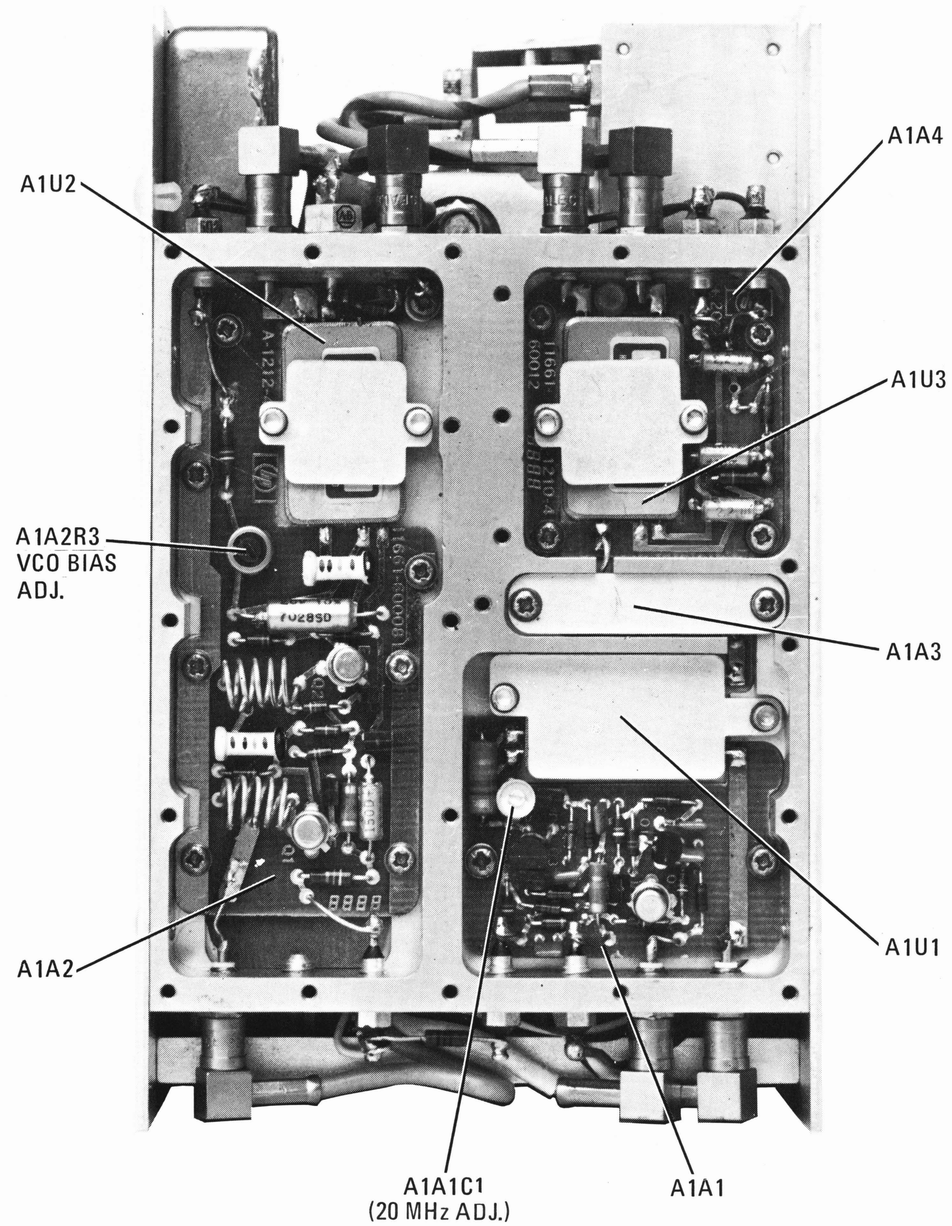


Figure 8-17. Assemblies, Chassis Mounted Parts, Adjustment Locations and Test Point Locations