HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

RF SECTION 1-1300 MHz
86602B

Including Options 001 and 002

SERIAL NUMBERS

This Manual applies directly to instruments with serial numbers prefixed 1519A.

With the changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1433A.

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

MANUAL PART NO. 86602-90015
Manual Microfiche Part No. 86602-90017
Operating Information Supplement Part No. 86602-90016

Printed: October 1975

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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, III, 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

Adjustments and troubleshooting are often performed with power supplied to the instrument while protective covers are removed. Energy available at many points may constitute a shock hazard.

The multi-pin plug connector which provides interconnection from mainframe to RF Section, will be exposed with the RF Section removed from the right-hand mainframe cavity. With the Line (Mains) Voltage off and power cord disconnected, power supply voltages may still remain and may constitute a shock hazard.

CAUTIONS

COMPATIBILITY

Damage to the synthesized signal generator system may result if an option 002 RF Section is used with unmodified Model 8660A or 8660B mainframes with serial prefixes 1349A and below.

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 RF Section plug-in from the mainframe, remove the line (Mains) voltage by disconnecting the power cable from the power outlet.

SEMI-RIGID COAX

Slight but repeated bending of the semi-rigid coaxial cable will damage them very quickly. Bend the cables as litte as possible. If necessary, loosen the assembly to release the cable.

MODEL 86602B

Figure 1-1. HP Model 86602B RF Section (Option 002 Shown)

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 Model 86602B RF Section plug-in, hereinafter referred to as the RF Section. For information concerning related equipment, such as the Hewlett-Packard Model 8660-series mainframes or the Model 11661 Frequency Extension Module, refer to the appropriate manual or manuals.

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

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

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

c. SECTION III, OPERATION, contains operating instructions for the instrument.

d. SECTION IV, PERFORMANCE TESTS, contains information required to verify that instrument performance is 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 replacement parts and assemblies.

g. SECTION VII, MANUAL CHANGES, is reserved to provide backdating and for modification information in late editions of this manual.

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 Option 002 RF Section.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information Supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4 x 6-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.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1. These specifications are the performance standards, or limits against which the instrument may be tested.

1-9. INSTRUMENTS COVERED BY MANUAL

1-10. 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.

1-11. 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.

1-12. MANUAL CHANGE SUPPLEMENTS

1-13. 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

Table 1-1. Models 86602B/11661 Specifications (1 of 3)

SPECIFICATIONS

FREQUENCY CHARACTERISTICS

Range: 1.0 to 1299.999999 MHz selectable in 1 Hz steps. Frequencies from 200 kHz to 1 MHz may also be selected with some degradation in specifications.

Accuracy and Stability[1]: CW frequency accuracy and long term stability are determined by the aging rate of the time base (internal or external) and its sensitivity to changes in temperature and line voltage. Internal reference oscillator accuracy = ± aging rate $\pm 3 \times 10^{-10}/^{\circ}C \pm 3 \times 10^{-10}/1\%$ change in line voltage.

Switching Time: 6 ms to be within 50 Hz of any new frequency selected; 100 ms to be within 5 Hz of any new frequency selected.

Largest Digit Changed	Error at:	
	1 ms	1 ms
1 Hz 10 Hz	<1 Hz	<1 Hz
100 Hz	<100 Hz	<1 Hz
1 kHz 10 kHz	<500 Hz	<10 Hz
100 kHz 1 MHz	<500 Hz	<50 Hz
10 MHz	<500 Hz	<50 Hz
100 MHz, 1 GHz	Undefined	<50 Hz

Typical 86602B/11661
Frequency Switching Characteristics

Harmonic Signals:
All harmonically related signals are at least 30 dB below the desired output signal for output levels ⩽+3 dBm. (25 dB down for output levels above +3 dBm.)

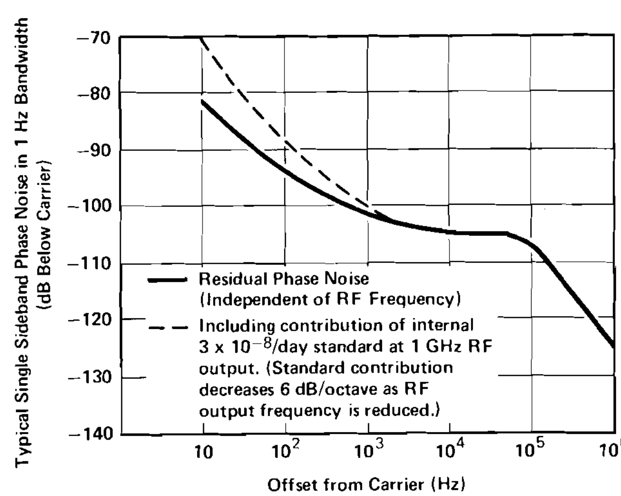
Spurious Signals (CW, AM, and ϕM only):
80 dB down from carrier at frequencies <700 MHz
80 dB down from carrier within 45 MHz of the carrier at frequencies ⩾700 MHz
70 dB down from carrier >45 MHz from carrier at frequencies ⩾700 MHz
50 dB down from carrier on the +10 dBm range.

All Power Line Related spurious signals are 70 dB down from carrier.

Residual FM (CW, AM, and 2nd ϕM only):
<1.5 Hz-rms in 2 kHz band centered on the carrier.

Signal-to-Phase Noise Ratio (CW, AM, and ϕM only):
Greater than 45 dB in a 30 kHz band centered on the carrier and excluding a 1 Hz band centered on the carrier.

Typical SSB Phase Noise Curve:



Typical 86602B Phase Noise

Signal-to-AM Noise Ratio: Greater than 65 dB down in a 30 kHz bandwidth centered on the carrier and excluding a 1 Hz band centered on the carrier

[1] Aging rate for the time base of standard mainframes is 3×10^{-8}/day; for option 001 mainframes, 3×10^{-9}/day.

Table 1-1. Models 86602B/11661 Specifications (2 of 3)

OUTPUT CHARACTERISTICS

Level: Continuously adjustable from +10 to −146 dBm (0.7 Vrms to 0.01 μVrms) into a 50Ω resistive load. Output attenuator calibrated in 10 dB steps from 1.0V full scale (+10 dBm range) to 0.03 μVrms full scale (−140 dBm range). Vernier provides continuous adjustment between attenuator ranges. Output level indicated on output level meter calibrated in volts and dBm into 50 ohms.

Accuracy: (Local and remote modes) ± 1.5 dB to −76 dBm; ± 2.0 dB to −146 dBm at meter readings between +3 and −6 dB.

Flatness: Output level variation with frequency is less than ±1.0 dB from 1−1300 MHz at meter readings between +3 and −6 dB.

Level Switching Time: In the remote mode any level change can be accomplished in less than 50 ms. Any change to another level on the same attenuator range can be accomplished in less than 5 ms.

Impedance: 50Ω.

VSWR: <2.0 on +10 and 0 dBm range; <1.3 on −10 dBm range and below.

MODULATION CHARACTERISTICS
(With compatible Modulation Sections)

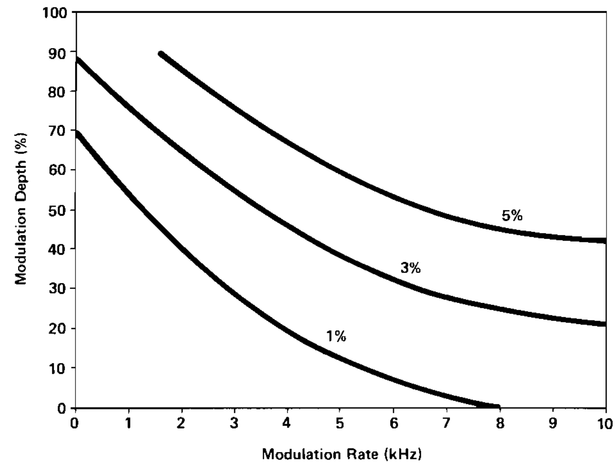
Amplitude Modulation:

Depth: 0 - 90% for RF output level meter readings from +3 to −6 dB and only at +3 dBm and below.

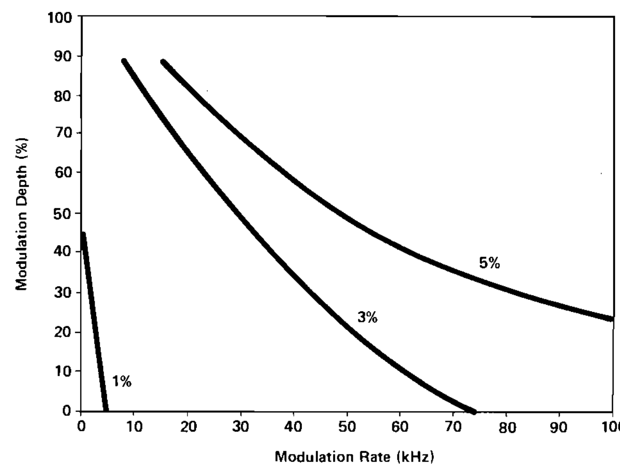
AM 3 dB Bandwidth:

Center Frequency	AM 3 dB Bandwidth		
	0 to 30% AM	0 to 70% AM	0 to 90% AM
<10 MHz	10 kHz	6 kHz	5 kHz
⩾10 MHz	100 kHz	60 kHz	50 kHz

AM Total Harmonic Distortion[2]		
AT 30% AM	AT 70% AM	AT 90% AM
<1%	<3%	<5%



Typical AM Distortion (Center Frequency <10 MHz)



Typical AM Distortion (Center Frequency ⩾10 MHz)

Incidental PM: Less than 0.2 radians peak at 30% AM.

Incidental FM: Less than 0.2 times the frequency of modulation (Hz) at 30% AM.

[2] Applies only at 400 Hz and 1 kHz rates with the RF Section front panel meter indicating from 0 to +3 dBm. At a meter indication of −6 dB the distortion approximately doubles. The modulating signal distortion must be ⩽0.3% for the system performance to meet these specifications.

Table 1-1. Models 86602B/11661 Specifications (3 of 3)

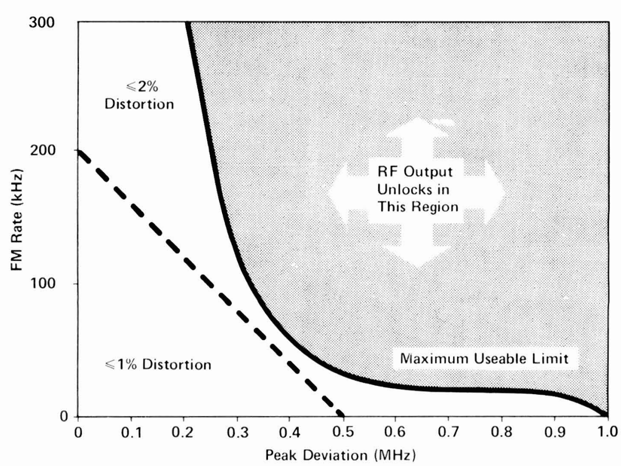
FREQUENCY MODULATION

Rate: DC to 200 kHz with the 86632B and 86635A. 20 Hz to 100 kHz with the 86633B.

Maximum Deviation (peak):
200 kHz with the 86632B and 86635A
100 kHz with the 86633B

Incidental AM: AM sidebands are greater than 60 dB down from the carrier with 75 kHz peak deviation at a 1 kHz rate.

FM Total Harmonic Distortion (at rates up to 20 kHz); <1% up to 200 kHz deviation. (External modulating signal distoriton must be less than 0.3%.)



Typical FM Distortion Curve

PULSE MODULATION
(With the 86631B Auxiliary Section only)

Source: External

Rise/Fall Time: 50 ns.

ON/OFF Ratio: At least 40 dB.

Input Level Required: 8 to 10V negative voltage turns RF on.

PHASE MODULATION
(Option 002 Instruments only)

Rate:
with 86635A dc to 1 MHz
with 86634A
dc to 1 MHz at center frequencies less than 100 MHz
dc to 10 MHz at center frequencies greater or equal to 100 MHz.

Maximum Peak Deviation:
0 to 100 degrees peak. May be overdriven to 2 radians (115°) in the Modulation Section's external dc mode.

ϕM Distortion:
<5% up to 1 MHz rates
<7% up to 5 MHz rates
<15% up to 10 MHz rates

(External modulation signal distortion must be less than 0.3% to meet this specification.)

REMOTE PROGRAMMING
(Through the 8660-series mainframes)

Frequency: Programmable in 1 Hz steps.

Output Level: Programmable in 1 dB steps from +10 to −146 dBm.

Modulation: See specifications for modulation section installed.

GENERAL

Leakage: Meets radiated and conducted limits of MIL-I-6181D.

Size: Plug-in to fit 8660-series mainframe.
Weight: Net 9 lb (3.9 kg).

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.

1-14. 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.

1-15. DESCRIPTION

1-16. The HP Model 86602B RF Section is one of several RF Sections available for use in an 8660-series Synthesized Signal Generator System. This RF Section plug-in is used with an option 100 8660-series mainframe (Frequency Extension Module installed). The RF Section provides precisely tuned RF output frequenices over the 1 to 1300 MHz range with 1 Hz frequency resolution (8660-series option 004 instruments have resolutions of 100 Hz.) Frequencies from 200 kHz to 1 MHz can also be generated with some degradation in the amplitude leveling and other related specifications.

1-17. The output power can be set to any level between +10 and −146 dBm by means of the front panel VERNIER and calibrated OUTPUT RANGE controls. A front panel-mounted meter and the OUTPUT RANGE switch indicate the output power and voltage levels delivered by the RF Section to any external load having a characteristic impedance of 50 ohms. Output power levels are maintained within ± 1 dB of selected values through internal leveling of the output signal over the full frequency range of the instrument.

1-18. Amplitude, frequency, phase, or pulse modulation of the RF OUTPUT signal can be accomplished within the RF Section by using the appropriate Auxiliary or Modulation Section plug-in.

1-19. External programming permits remote selection of the output signal frequency in 1 Hz steps (100 Hz for option 004 mainframes) and the output power in 1 dB steps over the full operating range of the instrument. External programming is accomplished via the mainframe computer-compatible interface and digital control unit circuits.

1-20. OPTIONS

1-21. This RF Section has two options available. They affect the instrument's RF output level, and phase modulation capabilities.

1-22. **Option 001.** The RF output attenuator is removed. This limits the RF output level range from +10 to −6 dBm.

1-23. **Option 002.** Circuits are added to provide the phase modulation capability. A compatible modulation section is required.

1-24. COMPATIBILITY

1-25. Except for Option 002 instruments, the Model 86602B is compatible with all 8660-series option 100 mainframes, all AM-FM Modulation Sections and the Auxiliary Section. This RF Section is partially compatible with the FM/ϕM Modulation Section.

CAUTION

Damage to the signal generator system may result if an option 002 RF Section is used with Model 8660A or 8660B mainframes with serial prefixes 1349A and below.

1-26. Option 002 instruments are compatible with all instruments which are part of the Model 8660-series Synthesized Signal Generator System except early model 8660A and 8660B Mainframes. Refer to the paragraph entitled Modifications in Section II of this manual for further information.

1-27. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-28. System Mainframe

1-29. The mainframe uses phase-locked loops to accurately generate clock, reference, and tuning signals required for operation of the Synthesized Signal Generator System. Front panel-mounted mainframe controls are used to digitally tune two phase-locked loops in the Frequency Extension Module which, in turn, produce two high-frequency output signals that are applied to the RF Section. The RF Section mixes the two signals and presents their frequency difference at the front panel OUTPUT jack. The output frequency is either the value selected by the mainframe front panel controls or external programming.

1-30. The mainframe power supply provides all dc operating voltages required by the RF Section, Frequency Extension Module, and Modulation Section plug-ins. Remote programming of the plug-ins is accomplished via the mainframe interface and digital control unit circuits.

1-31. Frequency Extension Module

1-32. The Frequency Extension Module plug-in extends the output frequency range of the mainframe to meet the input requirements of the RF Section. The Frequency Extension Module plug-in 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 the output frequency from a 4.43 GHz oscillator that is common to both loops, to produce two high-frequency output signals that are supplied to the RF Section. One output signal is generated by a phase-locked 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 3.95 to 2.75 GHz range. The two outputs from the Frequency Extension Module plug-in are applied to the RF Section for mixing, amplification of the converted signal, and final output power level control.

1-33. Auxiliary Section

1-34. The Auxiliary Section plug-in provides a means of applying externally generated amplitude or pulse modulation drive signals to modulate the RF Section's output carrier.

1-35. Modulation Section Plug-ins

1-36. The Model 86630-series Modulation Section plug-ins can accept external modulation drive signals or generate internal drive signals to amplitude, frequency, phase or pulse modulate the RF Sections output signal.

1-37. EQUIPMENT AVAILABLE

1-38. Extender cables, coaxial adapters, and an adjustment tool are available for use in performance testing, adjusting, and maintaining the RF Section. Each piece may be ordered separately or as part of the 11672A Service Kit.

1-39. Extender cards for use in servicing the RF Section and a type N to BNC adapter for use on the front panel RF OUTPUT connector are contained in the HP Rack Mount Kit, Part Number 08660-60070, that is supplied with the mainframe.

1-40. SAFETY CONSIDERATIONS

1-41. This instrument has been designed in accordance with international safety standards and has been supplied in safe condition.

1-42. 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, III, V, and VIII.

1-43. RECOMMENDED TEST EQUIPMENT

1-44. Table 1-2 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the RF Section. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

Table 1-2. Recommended Test Equipment (1 of 4)

Item	Critical Specifications	Suggested Model	Use*
Adapter (Male Type N to GR874)	Frequency range 100 MHz to 1.3 GHz	HP 1250-0847	P
Adapter, SMA-to-BNC	2 required	OSM 21190	P
Adapter, SMA-to-OSM Right Angle		OSM 219	P
Adapter, Type N-to-SMA		OSM 21040	P
Amplifier, 20 dB	≈20 dB gain at 30 MHz Input SWR <1.7	HP 8447A	P
Amplifier, 40 dB	Special	(see Figure 1-2)	P
Analyzer, Distortion	20 Hz to 20 kHz; must measure <0.1% distortion	HP 333A	P
Analyzer, Spectrum	Measurement Accuracy ±2.0 dB from 1 kHz to 110 MHz	HP 8553B with HP 8552B and HP 140T	P, A
Analyzer, Spectrum	Measurement Accuracy ±2.0 dB from 10 MHz to 8 GHz	HP 8555A with HP 8552B and HP 140T	P, A, T
Analyzer, Wave	Center frequencies 20 to 40 kHz Resolution bandwidth ⩽3 Hz Bandpass shape factor 10:1 Analog output 0 to 5V Noise level (at 11 kHz center frequency with a 3 Hz bandwidth) <−150 dBV	HP 3581A	P
Attenuator, 3 dB Fixed	3 dB	HP 8491A Option 003	P
Attenuator, 10 dB Step	Calibrated at 30 MHz; refer to calibration curve	HP 355D-H38 (only)	P, A
Attenuator, 40 dB Fixed	40 dB	HP 8491A Option 040	P
Cables, Double Shielded	Minimum input ⩽300 mVrms (5 required)	HP 08708-6033	P
Capacitor, 1500 pF		HP 0160-2222	P
Capacitor, 100 μF		HP 0180-2207	P
Connector, BNC Panel Mount		HP 1250-0118	T

*Use: P=Performance Tests, A=Adjustments, T=Troubleshooting

Table 1-2. Recommended Test Equipment (2 of 4)

Item	Critical Specifications	Suggested Model	Use*
Counter, Computing	50 kHz to 50 MHz with a 1 ms gate time and external trigger; 1 Hz resolution	HP 5360A with HP 5365A plug-in	P
Counter, Frequency	Range: 0.2-1300 MHz Resolution: 1Hz 10 MHz external reference output 7.2 Vrms output into 170 ohms	HP 5340A	P
Coupler, Directional	Frequency range 100 MHz to 1.3 GHz	HP 778D Option 12	P
Detector, Crystal	1 to 1200 MHz	HP 8471A	P
Detector, Crystal	10 MHz to 1.3 GHz	HP 423A	P, A
FM Discriminator	Input frequency 100 kHz to 10 MHz Linear Analog Output 1V full scale	HP 5210A	P, A
Filter, Low Pass, 15 kHz	Special	(see Figure 1-3)	P
Filter, Low Pass, 4 MHz	Cutoff frequency: 4 MHz	CIR-Q-TEL FLT/21B-4-3/50-3A/3B	P
Filter, Low Pass, 2200 MHz	Cutoff frequency: 2200 MHz	HP 360C	P
Filters, Low Pass, 100 kHz	100 kHz at 50 and 600 ohms	Specials (See Figure 1-4)	A
Filters, Low Pass, 1 MHz	1 MHz-50 and 600 ohms	Specials (See Figures 1-4)	P, A
Filters, Low Pass, 5 and 10 MHz	5 and 10 MHz-50 ohms	Specials (See Figure 1-4)	P
Generator, Function	Distortion less than 0.3% Range: 0.5 Hz to 20 kHz Output level: 0.1 to 2.0 Vrms into 600 ohms	HP 203A	P
Generator, Pulse	Output −10 Vpk with ≤10 ns risetime in 600 ohms	HP 8013B	P
Generator, Sweep	Sweep Width 0.1 to 100 MHz Output Level +20 to −80 dBm Flatness ±0,25 dB	HP 8601A	A
Generator, Synthesized Signal	+1 Hz from 1 MHz to 1300 MHz +7 dBm output 10 MHz Reference output >0.5V into 170 ohms	HP 8660 with HP 86631B and HP 86602B plug-ins	P, A

*Use: P=Performance Tests, A=Adjustments, T=Troubleshooting

Table 1-2. Recommended Test Equipment (3 of 4)

Item	Critical Specifications	Suggested Model	Use*
Mixer, Double Balanced	1 MHz to 110 MHz	HP 10514A	A
Mixer, Double Balanced	300 to 1300 MHz	Watkins-Johnson M1J	P
Oscillator, Test	1 kHz to 10 MHz 1.0 to 2.0 Vrms into 600 or 50 ohms	HP 651B	P, A
Oscilloscope	Vertical: Bandwidth 50 MHz with sensitivity of 5mV/ division minimum Horizontal: Sweep time 10 ns to 1 s Delayed sweep External triggering to 100 MHz	HP 180C with HP 1801A and HP 1821A plug-ins	P, A, T
Oscilloscope, 10:1 divider probes	Input impedance 10 megohm shunted by 10 pF	HP 10004	P, A, T
Power Meter/Sensor	Range: —10 to +10 dBm from 10 MHz to 1.3 GHz	HP 435A/8481A	P, A, T
Power Supply, DC	0—10 volts	HP 721A	P
Programmer, Marked Card	Capable of programming BCD or HP-IB data	HP 3260A Option 001	P, A
Probe, Logic	TTL Compatible	HP 10525T	T
Resistor, 1000 ohm	±2%	HP 0757-0280	P, A
Resistor, 10K ohm	±2%	HP 0757-0442	P
Resistor, 100K ohm	±2%	HP 0698-7284	P
Service Kit	Interconnect cables, adaptors, and coaxial cables compatible to 8660-series plus and jacks	HP 11672A (See Operating Note or mainframe manual for parts list)	A, T
Stub, Adjustable	Frequency range 100 MHz to 1.3 GHz	General Radio 874-D50L	P
Tee, Coaxial	2 required	HP 1250-0781 (BNC)	P, A
Termination, 50 ohm Feed Thru	50 ohm	HP 11048C	P

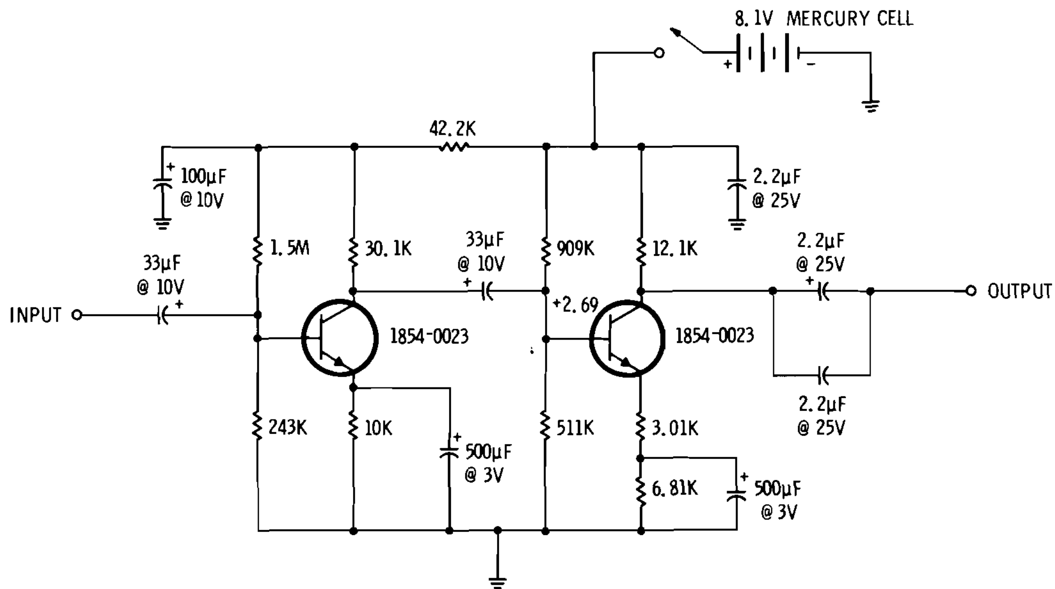
*Use: P=Performance, A=Adjustments, T=Troubleshooting

Table 1-2. Recommended Test Equipment (4 of 4)

Item	Critical Specifications	Suggested Model	Use*
Termination, 50 ohm	50 ohm, (2 required)	HP 11593A	P
Test Set, Phase Modulation	Input Frequency Range 250 to 950 MHz Distortion <2% up to 2 MHz rates <3.5% up to 5 MHz <5.0% up to 10 MHz	HP 8660C-K10 (only)	P, A
Voltmeter, AC	Accuracy ±2% of full scale from 1 Hz to 1 MHz 1 mVrms to 10 Vrms full scale	HP 403B	P, A, T
Voltmeter, Digital	Range 0.00 to 60.00 volts DC Accuracy ±(0.3% of reading +0.01% of range) AC Accuracy ±(0.25% of reading +0.05% of range) 45 Hz to 20 kHz	HP 34740A/34702A	P, A, T
Voltmeter, Vector	Frequency range 5 to 15 MHz Input level 100 mVrms to 1 Vrms Analog output: ±0.5 Vdc for ±180°	HP 8405A	P

*Use: P=Performance Tests, A=Adjustments, T=Troubleshooting

40 dB TEST AMPLIFIER



Amplifier Specifications

Gain	44 dB at 25°C
Bandwidth	100 kHz (3 dB down)
Noise Bandwidth	157 kHz
Input Impedance	75K Ohms
Output Impedance	12K Ohms
Current Drain	260 Microamperes
Output (Maximum)	1 Volt
Dynamic Range	66 dB

Figure 1-2. 40 dB Test Amplifier

15 kHz LPF

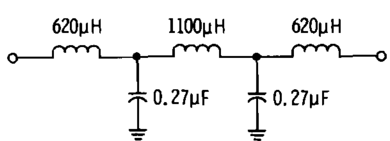
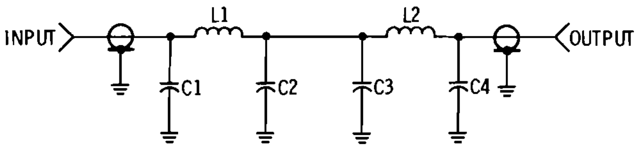


Figure 1-3. 15 kHz Low Pass Filter

LOW PASS FILTERS



100 kHz – 50 ohms

C1, C4	0.015 μF	Mylar	0160-0194
C2	0.027 μF	Mylar	0170-0066
C3	0.022 μF	Mylar	0160-0162
L1, L2	100 μH		9140-0210

100 kHz – 600 ohms

C1, C4	1300 pF	0160-2221
C2	3000 pF	0160-2229
C3	1100 pF	0160-2219
L1, L2	1200 μH	9100-1655

1 MHz – 50 ohms

C1, C4	1500 pF	0160-2222
C2	3300 pF	0160-2230
C3	1600 pF	0160-2223
L1, L2	10 μH ±10%	9140-0114

1 MHz – 600 ohms

C1, C4	130 pF	0140-0195
C2	300 pF	0160-2207
C3	110 pF	0140-0194
L1, L2	120 μH	9100-1637

5 MHz – 50 ohms

C1, C2, C4	300 pF	0160-2207
C3	680 pF	0160-3537
L1, L2	2 μH	9100-3345

10 MHz – 50 ohms

C1, C4	150 pF	0140-0196
C2	330 pF	0160-2208
C3	160 pF	0160-2206
L1, L2	1 μH ±10%	9140-0096

NOTE

Unless otherwise noted, tolerance of components is ±5% and capacitors are mica. Part numbers are Hewlett-Packard

Figure 1-4. Low Pass Filters

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information relative to initial inspection, preparation for use, and storage and shipment of the Model 86602B RF Section plug-in. Initial Inspection provides instructions to be followed when an instrument is received in a damaged condition. Preparation For Use gives all necessary interconnection and installation instructions. Storage and Shipment provides instructions and environmental limitations pertaining to instrument storage. Also provided are packing and packaging instructions which should be followed in preparing the instrument for shipment.

2-3. INITIAL 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 Section IV. 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 repiacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. All power required for operation of the RF Section is furnished by the mainframe. This RF Section requires approximately 40 volt-amperes.

2-8. Interconnections

2-9. Prior to installing the RF Section plug-in into the mainframe, verify that the Frequency Extension Module plug-in and interconnecting cable assemblies have been installed in accordance with the instructions contained in the Frequency Extension Module manual.

2-10. Modifications

2-11. A power supply modification to older versions of Model 8660A and 8660B mainframes are required if they are to be used with the option 002 RF Section.

CAUTION

Damage to the synthesized signal generator system may result if an option 002 RF Section is used with an older 8660A or 8660B mainframe.

2-12. Due to the increased power consumption of the option 002 instrument, mainframes with serial prefixes 1349A and below must be modified by installing a Field Update Kit. For mainframe configurations other than option 003 (60 Hz line operation), order kit number 08660-60273. For option 003 mainframes (50 — 400 Hz line operation) order kit number 08660-60274.

NOTE

Verify that a new higher current fuse, HP Part Number 2110-0365, 4A Slow Blow, is used in mainframes with the power supply modification.

2-13. Operating Environment

2-14. The RF Section is designed to operate within the following environmental conditions:

Temperature . . . . 0° to +55°C
Humidity . . . . less than 95% relative
Altitude . . . . less than 15,000 feet

2-15. Installation Instructions

WARNING

The multi-pin plug connector which provides interconnection from mainframe to RF Section, will be exposed with the RF Section removed from the right-hand mainframe cavity. With the Line (Mains) Voltage off and power cord disconnected, power supply voltages may still remain which, if contacted, may constitute a shock hazard.

2-16. Insert the plug-in approximately half-way into the right cavity of the mainframe. Rotate the latch (lower right corner) to the left until it protrudes perpendicular to the front panel. Refer to Figure 2-1, which shows the plug-in partially inserted into the mainframe and the latch rotated to a position that is perpendicular to the plug-in front panel. Push the plug-in all the way into the mainframe cavity and then rotate the latch to the right until it snaps into position.

2-17. STORAGE AND SHIPMENT

2-18. Environment

2-19. The storage and shipping environment of the RF Section should not exceed the following limits:

Temperature	40° to +75°C
Humidity	less than 95% relative
Altitude	less than 25,000 feet

2-20. Packaging

2-21. 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.

2-22. 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 the sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

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

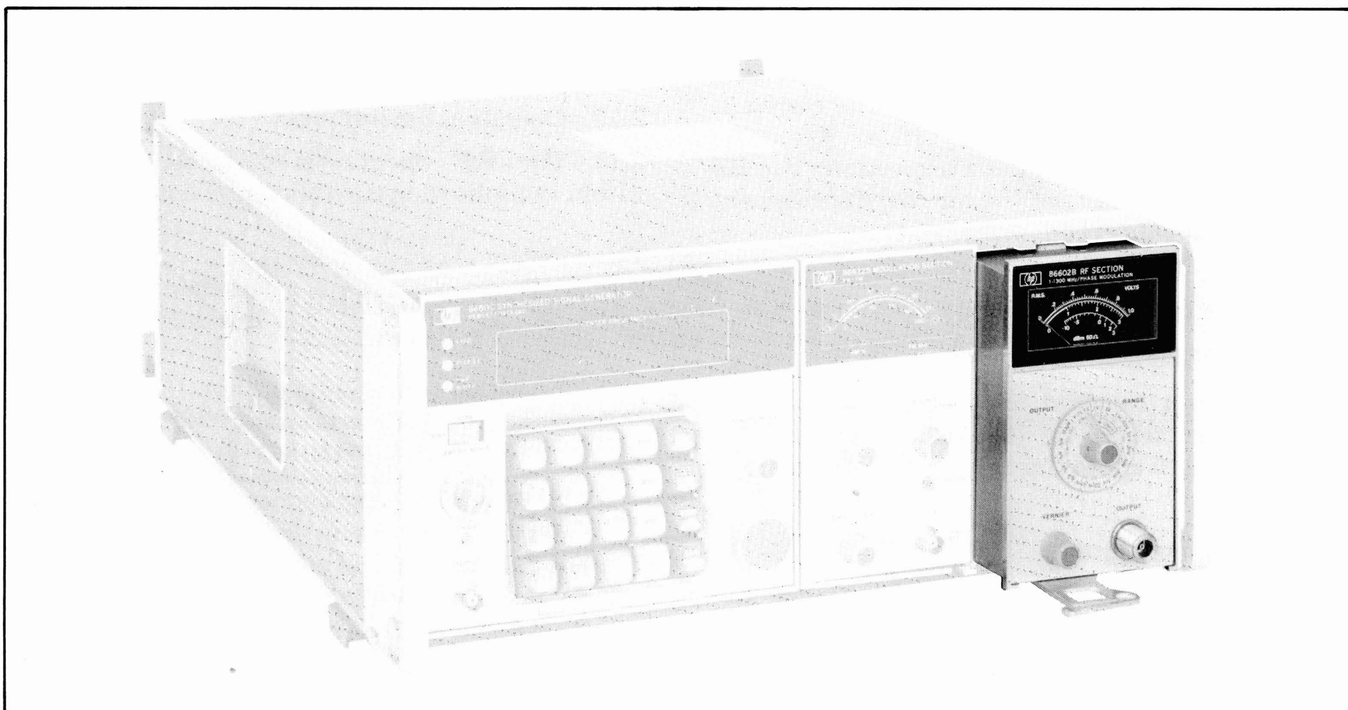


Figure 2-1. RF Section Partially Inserted into Mainframe

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains information which will enable the operator to learn to operate and quickly check for proper operation of the RF Section plug-in as part of the Synthesized Signal Generator System.

3-3. PANEL FEATURES

3-4. The front and rear panel controls, connectors, and indicators of the RF Section and its options are described by Figure 3-1 and 3-2.

3-5. OPERATOR'S CHECKS

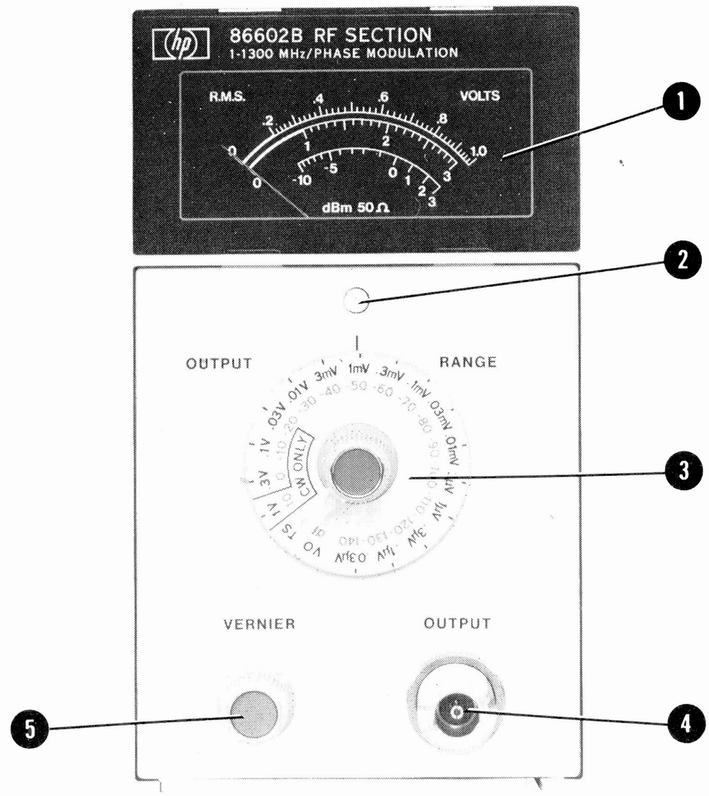
3-6. The RF Section, as part of the Synthesized Signal Generator System, accepts inputs from the rest of the system but controls only the RF output level. Even though the controlled circuits for most other functions are within the RF Section, the actual checks are found in the manual of the instrument which controls that function.

3-7. The Operator's Checks in this manual are intended to verify proper operation of the circuits which control and are controlled by the RF output level controls. This includes the meter, the VERNIER control, the OUTPUT RANGE switch, and the Output Range Attenuator when operating in the local mode. When the system is being remotely controlled, the 1 dB and 10 dB remote step attentator switches are checked in place of the VERNIER control and OUTPUT RANGE switch. Refer to Figure 3-3.

3-8. OPERATING INSTRUCTIONS

3-9. In this system, the mainframe and plug-ins contain the controls for frequency, modulation, and RF level selection. The mainframe controls frequency, the Modulation Section plug-in controls modulation type and level, and the RF Section plug-in controls RF output level. The Operating Instructions for the RF Section plug-in are included in Table 3-1.

FRONT PANEL FEATURES



NOTE

The front panel of the option 002 instrument is shown. The standard instrument does not have the term PHASE MODULATION after 1–1300 MHz. The option 001 instrument has an OUTPUT RANGE switch which shows only the +10 and 0 dBm ranges.

❶ **Meter.** Indicates the RF Output level in Vrms and dBm (50Ω) with the scale reference indicated by the OUTPUT RANGE switch.

❷ **Mechanical Meter Zero Control.** Sets the Panel Meter indicator to zero when the mainframe LINE Switch is set to STBY.

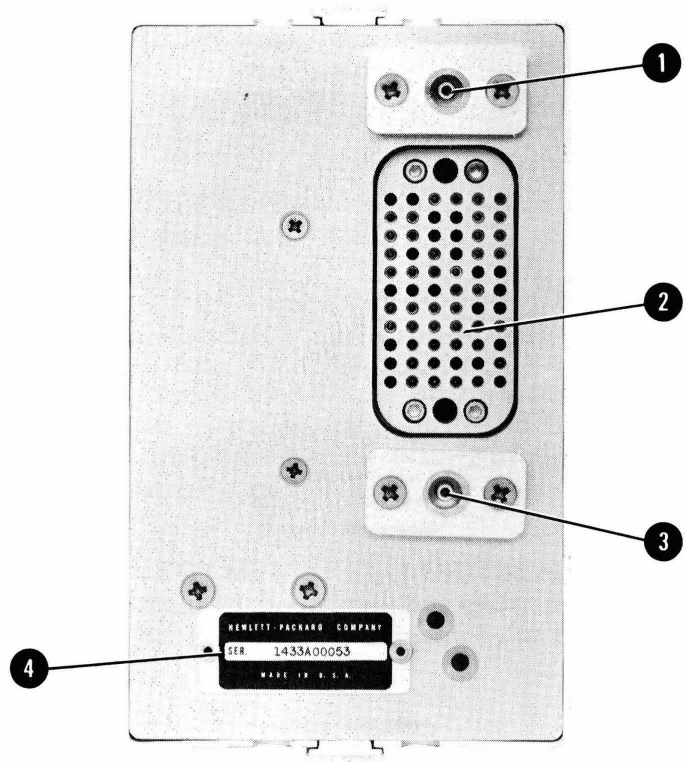
❸ **OUTPUT RANGE Switch.** Sets the output level range of all except option 001 instruments from +10 to −140 dBm (50Ω) in 10 dB steps. For option 001 instruments, +10 and 0 dBm ranges only.

❹ **OUTPUT Jack.** Type-N female coaxial connector. RF Output level +10 to −146 dBm (0.7 Vrms to 0.01 μVrms) into a 50Ω load. Frequency range is 1 to 1299.999 999 MHz in 1 Hz steps.

❺ **VERNIER Control.** RF Output continuously variable within the useable range (+3 to −6 dB) as indicated by the meter.

Figure 3-1. Front Panel Controls, Connectors, and Indicators

REAR PANEL FEATURES



1 Coaxial Plug. Connects the 3.95 to 2.75 GHz RF Input signal to the RF Section from the Frequency Extension Module.

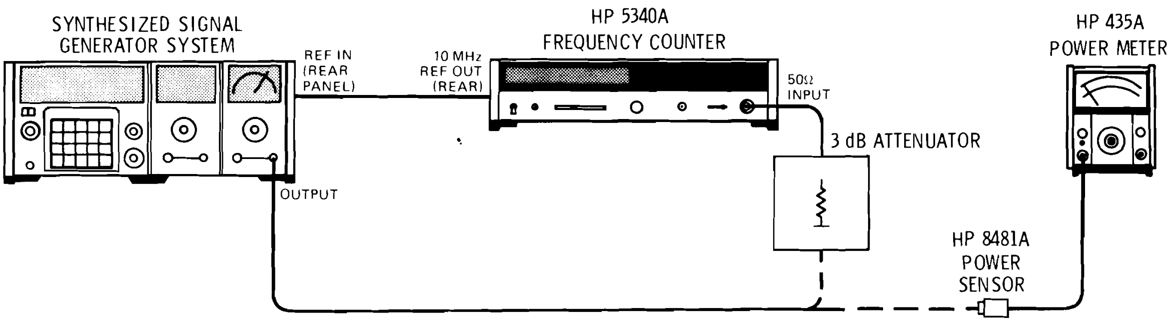
2 Interconnect Plug. Provides interconnection of power supply voltages; RF and control signals between the RF Section plug-in and the Mainframe, Frequency Extension Module, and Modulation Section plug-in.

3 Coaxial Plug. Connects the 3.95 to 4.05 GHz LO Input signal to the RF Section plug-in from the Frequency Extension Module.

4 Serial Number Plate. Metal plate with stamped serial number. Four-digit and letter for prefix. Suffix is unique to an instrument.

Figure 3-2. Rear Panel Connectors and Indicators

OPERATOR'S CHECKS



WARNING

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.

CAUTION

Damage to the signal generator system may occur if option 002 RF Sections are used with unmodified 8660A and 8660B mainframes with serial prefixes 1349A and below. See the paragraph entitled Modifications in Section II.

NOTE

Refer to Section II for RF Section Installation instructions.

1. Set the System controls as follows:

Mainframe
- LINE Switch . . . . ON
- REFERENCE SELECTOR . . . . EXT
- CENTER FREQUENCY . . . . 500 MHz

Modulation Section plug-in
- MODE Switch . . . . OFF

RF Section plug-in
- OUTPUT RANGE Switch . . . . 0 dBm
- VERNIER Control . . . . +3 dB meter reading

Figure 3-3. Operator's Checks (1 of 2)

OPERATOR'S CHECKS

2. Connect the RF Section OUTPUT to the power sensor input. Verify that the amplitude of the 500 MHz signal is approximately +3 dBm.

3. Set the OUTPUT RANGE Switch to +10 dBm and adjust the VERNIER control for a −3 dB meter reading. Verify that the output level is approximately +7 dBm.

4. Connect the RF Section OUTPUT to the frequency counter input through the 3 dB attenuator. Verify that the signal is accurate within ±1 Hz.

5. To check the remote control capabilities of the RF Section, connect a control unit to the mainframe. Repeat steps 1 through 4 while the system is remotely programmed from an external source. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides the information needed for remote BCD operation of this system. Application Note 164-2 "Calculator Control of the 8660A/B/C Synthesized Signal Generator" provides the information needed for calculator control of the system using the HP-IB (option 005). Section III of the mainframe manual contains the same information in abridged form.

Figure 3-3. Operator's Checks (2 of 2)

Table 3-1. Operating Instructions (1 of 2)

OPERATING INSTRUCTIONS

TURN ON

WARNING

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

CAUTION

Damage to the signal generator system may occur if option 002 RF Sections are used with unmodified 8660A and 8660B mainframes with serial prefixes 1349A and below. See the paragraph entitled Modifications in Section II.

NOTE

Refer to Section II for RF Section Installation Instructions.

1. Set the mainframe's LINE Switch to ON and the rear panel REFERENCE SELECTOR Switch to INT. Wait for the mainframe "oven" indication to go out.

FREQUENCY SELECTION

2. Refer to Section III of the mainframe operating and service manual for information on system frequency selection.

RF OUTPUT LEVEL

3. dBm. Set the OUTPUT RANGE switch to within +3 and −6 dB of the desired output level. Adjust the VERNIER control for a meter reading which when added to the OUTPUT RANGE switch indication equals the desired output level.

4. VOLTS. To set the RF output level in rms volts, the OUTPUT RANGE switch selected the full scale meter reading and the VERNIER control is adjusted for the correct voltage reading on the meter. The voltage level for meter scale 1.0 should not be set below 0.32 of full scale. The voltage level should not be set below 1 when using the meter scale of 3.

NOTE

In order to achieve the output level accuracy specified, the level selected must be $\leqslant$+10 dBm and the RF Section front panel meter reading must be as stated above.

5. Connect the RF Output to the Device Under Test. The front panel meter reading of RF Output level will be correct only if the input impedance of the Device Under Test is 50Ω.

Table 3-1. Operating Instructions (2 of 2)

MODULATION SELECTION

6. Refer to Section III of the Modulation Section plug-in operating and service manual for information relating to selection of modulation type and level.

REMOTE OPERATION

7. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides most of the information needed for remote BCD operation of this system. AN 164-2 "Calculator Control of the 8660A/B/C Synthesized Signal Generator" provides information for remote HP-IB operation of this system. In abridged form, Section III of the mainframe manuals contain the same information.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of these procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting, and after repairs or adjustments.

4-7. PERFORMANCE TESTS

4-8. For each test, the specifications are written exactly as they appear in the specification table in Section I. Next, a description of the test and any special instructions or problem areas are included. Most tests that require test equipment have a setup drawing; each has a list of required equipment. The initial steps of each procedure give control settings required for that particular list.

CAUTION

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 before continuing with the procedure.

4-9. FREQUENCY RANGE

SPECIFICATION:

1 to 1299.999999 MHz selectable in 1 Hz steps. Frequencies from 200 to kHz to 1 MHz may also be selected with some degradation in specifications.

DESCRIPTION:

The Synthesized Signal Generator System RF OUTPUT is monitored by a frequency counter which supplies a common time base reference signal. The frequencies are checked at the extremes. Any specified frequency may be checked.

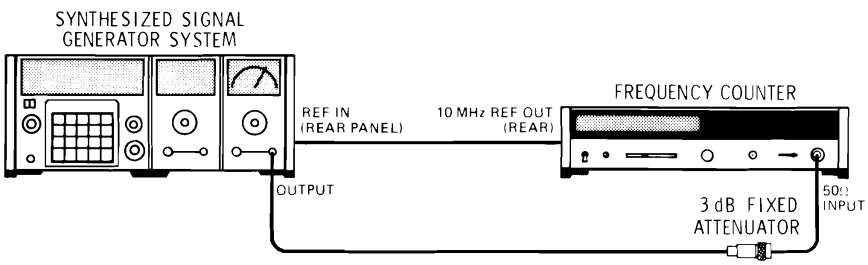


Figure 4-1. Frequency Range Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
10 dB Fixed Attenuator	HP 8491A Opt 003

NOTE

In the following procedure, allow for accuracy of counter used. Model recommended is specified at ±1 count.

1. Connect frequency counter 10 MHz output reference signal to mainframe EXT REF input as shown in Figure 4-1 and set mainframe rear panel REF switch to EXT.

2. Set the RF Section OUTPUT RANGE switch to 0 dBm; set the VERNIER control full CW.

3. Set mainframe center frequency to 1.000 000 MHz and check RF section output frequency with counter. Record the frequency.

   0.999999_______________1.000001 MHz

4. Set mainframe center frequency to 1299.999 999 MHz (Option 004 mainframe set to 1299.9999 MHz) and check RF Section output frequency with counter. Record the frequency.

   1299.999 998________1300.000 000 MHz

PERFORMANCE TESTS

4-10. FREQUENCY ACCURACY AND STABILITY

SPECIFICATION:

CW frequency accuracy and long term stability are determined by the aging rate of the time base (internal or external) and its sensitivity to changes in temperature and line voltage. Internal reference oscillator accuracy = ± aging rate $\pm 3 \times 10^{-10}/^\circ C \pm 3 \times 10^{-10}/1\%$ change in line voltage. (Aging rate for the time base in the standard mainframe is 3×10^{-8}/day; for option 001 mainframes, 3×10^{-9}/day.)

NOTE

If there is any reason to doubt the mainframe crystal oscillator accuracy or stability, refer to the performance test in Section IV of the mainframe manual.

4-11. FREQUENCY SWITCHING TIME

SPECIFICATION:

6 ms to be within 50 Hz of any new frequency selected; 100 ms to be within 0.5 Hz of any new frequency selected.

DESCRIPTION:

A change in the Synthesized Signal Generator System's frequency is remotely programmed; after a preset time interval the frequency is measured. A trigger pulse from the programming device is first coupled to the oscilloscope. The pulse is delayed a preset interval by the oscilloscope and then coupled to the computing counter at which time the frequency is measured.

NOTE

The frequencies in this test were selected for worst-case conditions (longest switching time).

PERFORMANCE TESTS

4-11. FREQUENCY SWITCHING TIME (Cont'd)

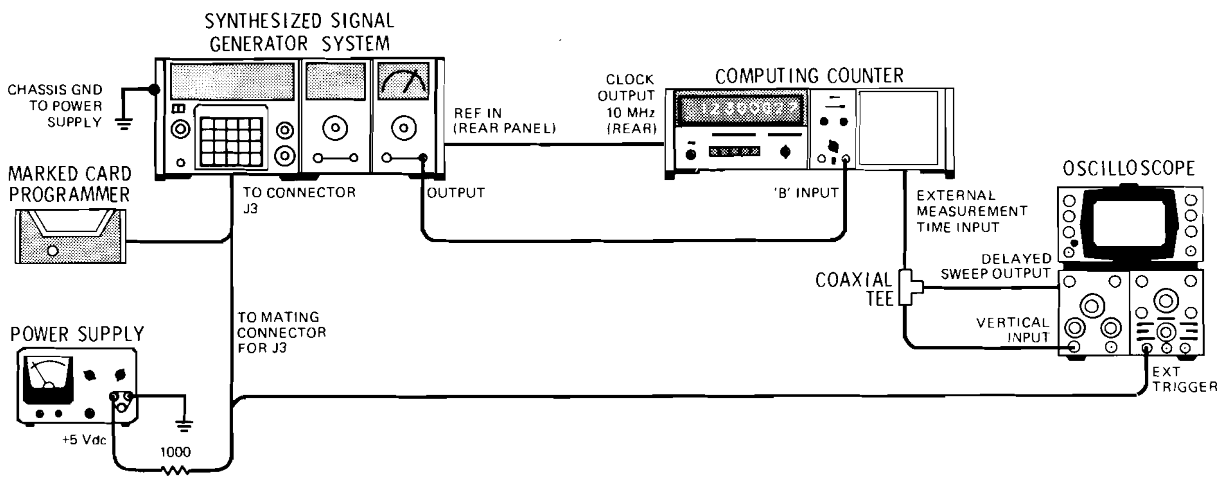


Figure 4-2. Frequency Switching Time Test Setup

EQUIPMENT:

DC Power Supply	HP 721A
Computing Counter	HP 5360A/5365A
Marked Card Programmer	HP 3260A Opt 001
Oscilloscope	HP 180C/1801A/1821A
Coaxial Tee	HP 1250-0781

PROCEDURE:

1. Connect the dc power supply +5 volt output through a 1000 ohm resistor to pin 17 of the mating connector for J3. Pin 17 (flag) of the Marked Card Programmer output connector is also connected to the oscilloscope ext trigger input.

2. Connect the marked card programmer to mainframe rear panel connector J3.

3. Connect oscilloscope delayed sweep output through a BNC TEE to oscilloscope channel A vertical input and to computing counter rear panel external time measurement input.

4. Set counter controls as follows: rear panel switch to trigger; "B" channel to X1 sensitivity; module switch pressed; digits displayed for necessary resolution; measurement time to 1; counter gate time to 1 ms.

5. Program the System for 29.999 999 MHz. Set the mainframe rear panel reference switch to external.

6. Set oscilloscope controls as follows: trigger to ac slow; ext, negative slope, trigger level at about 9:00 o'clock; sweep mode auto; delay trigger auto; main sweep 1 ms; delay sweep 0.1 μs; main sweep mode.

7. Set oscilloscope trace to start at left vertical graticule line. Use oscilloscope delay control to delay spike 5.5 divisions from CRT left graticule line.

8. Switch oscilloscope sweep mode from auto to normal.

4-11. FREQUENCY SWITCHING TIME (Cont'd)

9. Program the system for 30.000 000 MHz. Frequency displayed on computing counter should be 30 MHz ± 50 Hz. Record the frequency.

29.999950 ______________ 30.000050 MHz

10. Program the system for 29.999 999 MHz. Frequency displayed on counter should be within ± 50 Hz of 29.999 999 MHz.

29.999949 ______________ 30.000049 MHz

11. Set Oscilloscope normal sweep for 10 ms and delay sweep to 1 μs.

12. Set Oscilloscope sweep mode to auto and delay control for delay spike 9.5 divisions from the CRT left graticule line.

13. Set Oscilloscope main trigger to normal and computing counter gate time to 10 ms.

14. Program the System for 30.000 000 MHz. Frequency displayed on computing counter should be within ± 5 Hz or programmed frequency.

29.999995 ______________ 30.000005 MHz

15. Program the System for 29.999 999 MHz. Frequency Displayed on computing counter should be within ± 5 Hz of programmed frequency.

29.999994 ______________ 30.000004 MHz

NOTE

To reduce the effect of random errors, steps 5 through 10 and 13 through 15 may be repeated several times (5 minimum). Record the average frequency.

4-12. OUTPUT LEVEL SWITCHING TIME

SPECIFICATION:

In remote mode, any level change can be accomplished in less than 50 ms. Any change to another level on the same attenuator range can be accomplished in 5 ms.

DESCRIPTION:

The Synthesized Signal Generator System RF OUTPUT level (attenuation) is remotely programmed while the RF OUTPUT is detected and monitored by an oscilloscope. Because the oscilloscope is triggered by the programming device, the time needed to effect the level change may be measured directly on the oscilloscope CRT.

4-12. OUTPUT LEVEL SWITCHING TIME (Cont'd)

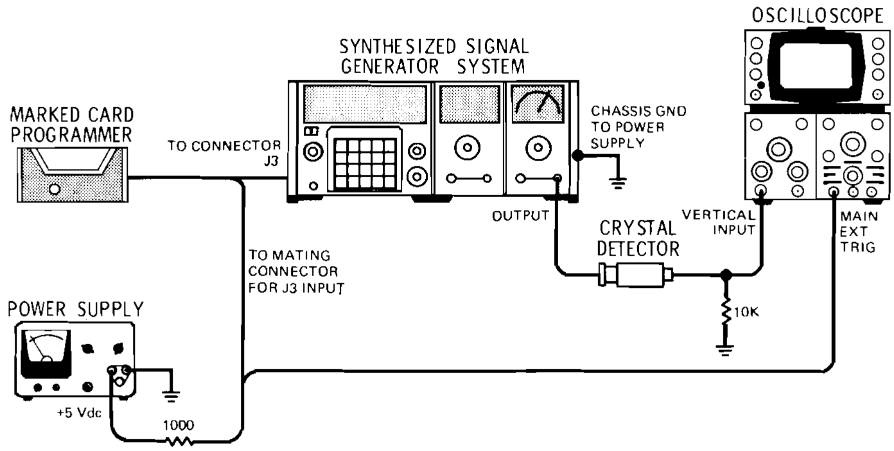


Figure 4-3. Output Level Switching Time Test Setup

EQUIPMENT:

Marked Card Programmer	HP 3260A Opt 001
Oscilloscope	HP 180C/1801A/1821A
Crystal Detector	HP 8471A
Power Supply	HP 721A

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-3. Note that ± 5 volt output from DC Power Supply is connected through a 1000 ohm resistor to pin 17 of mating connector to J3 and to Oscilloscope external trigger input.

2. Connect RF Section OUTPUT through crystal detector to oscilloscope Channel A input.

3. Set Oscilloscope controls as follows: Main Time/Div, 5 ms; Vertical input, dc coupled, 0.2 V/Div; Normal Sweep; Ext Trigger, negative slope, AC slow Trigger level about 9:00 o'clock.

4. Program the System's center frequency for 500 MHz and 10 dB attenuation of the RF output signal. Reprogram for 19 dB attenuation. Switching time should be less than 5 ms. Record switching time.

   10 to 19 dB________________ 5 ms

5. Program RF Section attenuation for 10 dB, then for 30 dB. Switching time should be less than 50 ms.

   10 to 30 dB________________ 50 ms

4-12. OUTPUT LEVEL SWITCHING TIME (Cont'd)

6. Repeat steps 4 and 5 with center frequency set to 1 MHz.

10 to 19 dB ____________ 5 ms

4-13A. OUTPUT ACCURACY

SPECIFICATION: (for local and remote modes)

±1.5 dB to −76 dBm; ±2.0 dB to −146 dBm at meter readings between +3 and −6 dB.

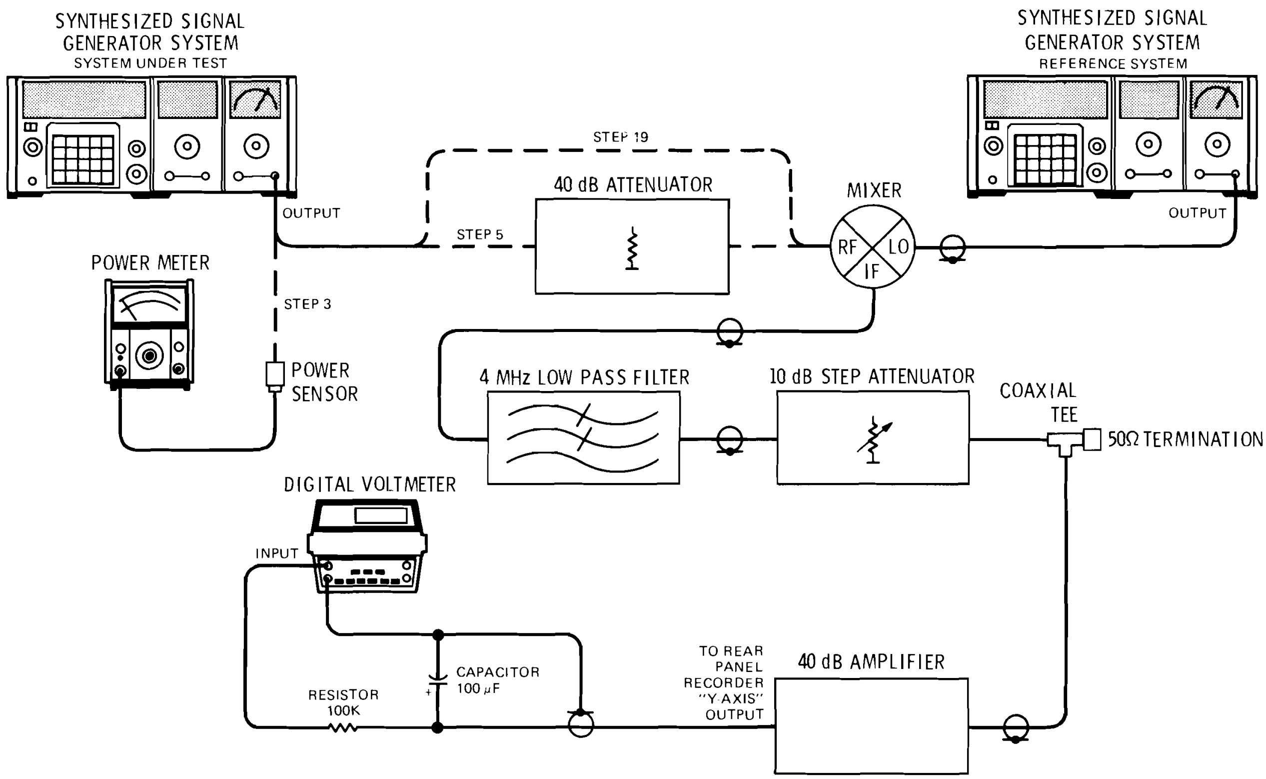
DESCRIPTION:

The RF level accuracy for the +10 and 0 dBm ranges is measured with a power meter. For the lower ranges, an IF substitution measurement technique is used.

RF level (attenuation) measurements using IF substitution is accomplished by 1) converting the RF output to a low frequency IF signal, 2) offsetting the decrease in RF level (increase in attenuation) by an equal decrease in IF attenuation. This maintains a fairly constant output level at the IF load. The intermediate frequency is selected on the basis of availability of a precision attenuator. Therefore, any variation in output level from an established reference is primarily due to the RF attenuator.

PERFORMANCE TESTS

4-13A. OUTPUT ACCURACY (Cont'd)



4-4A. Output Accuracy Test Setup.

EQUIPMENT:

Power Meter/Sensor	HP 435A/8481A
Synthesized Signal Generator	HP 8660C/86602B/86631B
40 dB Attenuator	HP 8491A Option 040
Mixer	Watkins-Johnson M1J
4 MHz Low Pass Filter	CIRC-Q-TEL FLT/21B-4-3/50-3A/3B
Coaxial Tee	1250-0781 (BNC)
50 Ohm Termination	HP 11593A
40 dB Amplifier	(See Figure 1-2)
Double Shielded Cables (5 required) . .	HP 08708-6033
Capacitor, 100 μF	HP 0180-2207
Resistor, 100 kΩ	HP 0698-7284
Type N-to SMA Adaptor	OSM 21040
SMA-to-OSM Right Angle Adapter . . .	OSM 219
SMA-to-BNC Adapter (2)	OSM 21190
10 dB Step Attenuator	HP 355D Option H38
Wave Analyzer	HP 3581A

PERFORMANCE TESTS

4-13A. OUTPUT ACCURACY (Cont'd)

PROCEDURE:

1. Set the System Under Test Controls for a center frequency of 1000.000000 MHz and an output level of +10 dBm.

2. Set the power meter controls for the +15 dBm range.

3. Connect the power sensor to the RF Section OUTPUT jack of the System Under Test.

4. Set the RF Section controls as shown in the table below and verify that the RF output level is within the specified tolerance.

Synthesized Signal Generator System		Power Meter Reading (dBm)
OUTPUT RANGE Switch (dBm)	Panel Meter Reading (dB)	
+10	0	+8.5 ______ +11.5
+10	–3	+5.5 ______ + 8.5
+10	–6	+2.5 ______ + 5.5
0	–6	–7.5 ______ – 4.5
0	–3	–4.5 ______ – 1.5
0	0	–1.5 ______ + 1.5
0	+3	+1.5 ______ + 4.5

NOTE

Be careful not to vary the RF Section's VERNIER control setting throughout the rest of this procedure.

5. Connect the 40 dB attenuator directly to the OUTPUT jack of the RF Section in place of the power sensor.

6. Connect the "R" port of the mixer directly to the 40 dB attenuator using the Type N-to SMA adapter and the SMA-to-OSM right angle adapter.

7. Connect the 4 MHz Low Pass Filter to the "I" port of the mixer with a SMA-to-BNC adapter.

8. Connect the cable from the Reference System output to the "L" port of the mixer with a SMA-to-BNC adapter.

NOTE

Be sure all connections are tight to prevent RF leakage.

9. Set the reference system controls for a center frequency of 1000.011000 and an output level of +7 dBm. Set the rear panel reference selector to external.

10. Set the 10 dB Step Attenuator to 50 dB.

PERFORMANCE TESTS

4-13A. OUTPUT ACCURACY (Cont'd)

11. Set the wave analyzer controls as follows: frequency 11 kHz, resolution bandwidth 3 Hz, sweep mode off, dBv/LIN - dBm 600Ω switch to dBv/LIN, amplitude reference level —40 dB, AFC switch unlock and scale 10 dB.

12. Connect the other equipment which follows the 4 MHz Low Pass Filter as shown in Figure 4-4A.

13. Tune the wave analyzer frequency control for the maximum meter reading. Adjust the input sensitivity and vernier controls for a midscale meter reading. Press the AFC control for frequency lock.

14. Wait 30 seconds for the DVM reading to stabilize. Record the DVM reading. This is the reference level equivalent to the last power meter reading ($\approx$+3 dBm).

15. Use the following formula to calculate the obsolute RF output level from the System Under Test:

$$dBm = dBm_1 - \Delta\ dB + 2(V - V_{ref})$$

dBm is the RF output level

dBm^1 is the actual RF level measured at the +3 dBm (0 dBm OUTPUT RANGE setting) in Step 4.

Δ dB is the difference in 10 dB step attenuator setting.

V is the DVM reading for each individual OUTPUT RANGE.

V_{ref} is the reference DVM reading.

NOTE

The wave analyzer recorder output sensitivity is 2dB/volt.

16. Set the RF Section OUTPUT RANGE switch to —10 dBm; set the 10 dB step attenuator to the 40 dB. Wait 30 seconds for the reading to stabilize. Record the DVM reading in the table following step 17. Calculate and record the RF level in the table.

EXAMPLE:

$$dBm = dBm_1 - (\Delta dB) + 2\ (V_1 - V_{ref})$$

dBm_1 = 2.8 dBm

ΔdB = 10 dB

V_1 = 2.388 Vdc

V_{ref} = 2.433 Vdc (from step 14)

$$dBm = 2.8 - (10) + 2(2.388 - 2.433)$$
$$= 2.8 - 10 + 2(-0.045)$$
$$= -7.29\ dBm$$

PERFORMANCE TESTS

4-13A. OUTPUT ACCURACY (Cont'd)

17. Continue as in step 16, to measure, record and calculate the DVM reading and RF level for each OUTPUT RANGE setting as shown in the following table.

OUTPUT RANGE Switch (dBm)	10 dB Step Attenuator (dB)	DVM Reading (Vdc)	Absolute RF Output Level (dBm)		
			Min.	Actual	Max.
0	50	______	+ 1.5	______	+ 4.5
–10	40	______	– 8.5	______	– 5.5
–20	30	______	–18.5	______	–15.5
–30	20	______	–28.5	______	–25.5
–40	10	______	–38.5	______	–35.5
–50	0	______	–48.5	______	–45.5

18. Set the 10 dB step attenuator to 50 dB.

19. Remove the 40 dB attenuator and connect the mixer directly to the OUTPUT jack of the system under test.

20. Increase the wave analyzer's input sensitivity by 10 dB. If necessary, adjust the input sensitivity vernier for a midscale meter reading.

21. Transfer the last calculated RF output level on the preceding table to the first line on the following table. Wait 30 seconds and record the new DVM reading (V_{ref}).

22. Use the formula and the new V_{ref} level to calculate the RF level for each range shown in the following table.

OUTPUT RANGE Switch (dBm)	10 dB Step Attenuator (dB)	DVM Reading (Vdc)	Absolute RF Output Level (dBm)		
			Min.	Actual	Max.
– 50	50	______	–48.5	______	–45.5
– 60	40	______	–58.5	______	–55.5
– 70	30	______	–68.5	______	–65.5
– 80	20	______	–79.0	______	–75.0
– 90	10	______	–89.0	______	–85.0
–100	0	______	–99.0	______	–95.0

23. Set the wave analyzer's AFC switch to unlock (OFF). Adjust the frequency control for the peak reading equal to the last recorded DVM reading on the previous table.

24. Set the 10 dB step attenuator to 30 dB.

4-13A. OUTPUT ACCURACY (Cont'd)

25. Set the wave analyzer amplitude reference level to –60 dB. Increase the input sensitivity 10 dB.

26. Transfer the last RF output level reading on the preceding table to the first line of the following table. After 30 seconds record the new DVM reference on the first line of the following table.

27. Measure, calculate, and record the DVM reading and RF level for each OUTPUT RANGE Setting as shown in the following table. Due to the high noise levels evident on this test, there is appreciable deviation in the wave analyzer and DVM readings. Record the average reading.

OUTPUT RANGE Switch (dBm)	10 dB Step Attenuator (dB)	DVM Reading (Vdc)	Absolute RF Output Level (dBm)		
			Min.	Actual	Max.
–100	30	______	– 99.0	______	– 95.0
–110	20	______	–109.0	______	–105.0
–120	10	______	–119.0	______	–115.0
–130	0	______	–129.0	______	–125.0

NOTE

Output level accuracy may be checked at any frequency between 300 and 2000 MHz using this procedure. This procedure may also be used at the frequency extremes if a well shielded mixer specified for the desired frequency range is used in place of the Watkins-Johnson M1J.

4-13B. OUTPUT ACCURACY – ALTERNATE PROCEDURE

SPECIFICATION:

±1.5 dB to –76 dBm; ±2.0 dB to –146 dBm at meter readings between +3 and –6 dB.

DESCRIPTION:

The RF Level Accuracy for the +10 and 0 dBm ranges is measured with a power meter. A reference level is established and accuracy is checked from 0 dBm to –80 dBm by comparing the RF Section attenuation against a calibrated 10 dB step attenuator.

NOTE

This procedure checks all sections of the RF Section Attenuator separately. Also, the 10 dB, 20 dB, and 40 dB sections are checked in all possible combinations. The sum of the –70 dBm inaccuracy at –80 dBm shall not exceed +1.0 dB.

PERFORMANCE TESTS

4-13B. OUTPUT ACCURACY – ALTERNATE PROCEDURE (Cont'd)

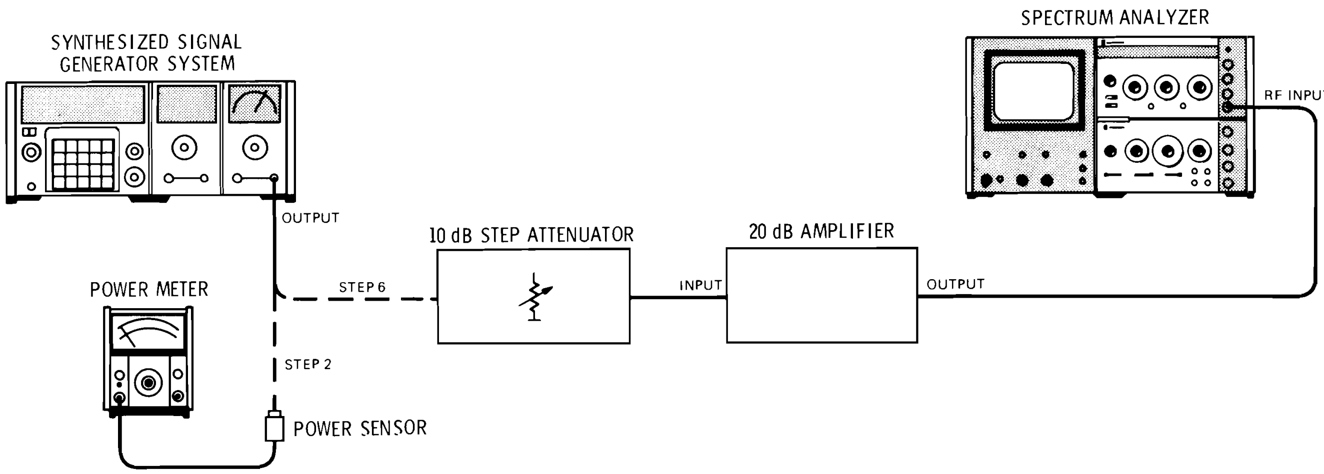


Figure 4-4B. Output Accuracy Test Setup (Alternate Procedure)

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140T
Power Meter/Sensor . . . . HP 435A/8481A
10 dB Step Attenuator . . . . HP 355D Option H38
20 dB Amplifier . . . . HP 8447A

PROCEDURE:

1. Set the system controls for a frequency of 30 MHz and an output level of +10 dBm.

2. Connect the power sensor to the RF Section's OUTPUT jack.

3. Set the RF Output Level as shown in the table below and verify that the level is within the specified tolerance.

Synthesized Signal Generator System		Power Meter Reading (dBm)
OUTPUT RANGE Switch (dBm)	Panel Meter Reading (dB)	
+10	0	+8.5 ______ +11.5
+10	–3	+5.5 ______ + 8.5
+10	–6	+2.5 ______ + 5.5
0	–6	–7.5 ______ – 4.5
0	–3	–4.5 ______ – 1.5
0	0	–1.5 ______ + 1.5
0	+ 3	+1.5 ______ + 4.5

4-13B. OUTPUT ACCURACY – ALTERNATE PROCEDURE (Cont'd)

NOTE

Do not change the RF Section VERNIER Control Setting until this procedure is completed.

4. Set the spectrum analyzer controls as follows: center frequency 30 MHz, frequency span per division 5 kHz, resolution bandwidth 3 kHz, input attenutation 10 dB, vertical sensitivity per division 2 dB, and sweep time per division 5 ms.

5. Set the 10 dB Step attenuator switch to the 80 dB range.

6. Connect the equipment as shown in Figure 4-4B.

7. Adjust the reference level range and vernier to extablish a reference level on the analyzer display.

8. On the first line of the following table, record the power meter reading shown on the preceding table for the OUTPUT RANGE Setting of 0 dBm and the panel meter reading of +3 dB. This is the absolute RF level which corresponds to the display reference.

9. Set the OUTPUT RANGE switch and the 10 dB step attenuator range switch settings as shown on each line of the following table. Record the display variation from the established reference.

10. Calculate the RF level using the following formula:

$$\text{dBm} = \text{dBm}^1 - \Delta\text{dB}_{10} + \Delta\text{dB}$$

dBm is the RF output level

dBm^1 is the RF level measured at +3 dBm (0 dBm OUTPUT RANGE setting) in step 3.

$\Delta\ \text{dB}_{10}$ is the change in 10 dB Step Attenuator level

Δ dB is the variation from the established display reference for each OUTPUT RANGE setting.

For example, results of the first step are:

$\text{dBm}_1 = +2.8$

$\Delta\ \text{dB}_{10} = 10$

$\Delta\ \text{dB} = -0.2$

$\text{dBm} = +2.8\ \text{dBm} - 10\ \text{dB} + (-0.2)\ \text{dB}$

$= -7.4\ \text{dBm}$

PERFORMANCE TESTS

4-13B. OUTPUT ACCURACY – ALTERNATE PROCEDURE (Cont'd)

OUTPUT RANGE Switch (dBm)	10 dB Step Attenuator (dB)	RF Output Level (dBm)		
		Min.	Measured	Max.
0	80	+ 1.5	______	+ 4.5
–10	70	– 8.5	______	– 5.5
–20	60	–18.5	______	–15.5
–30	50	–28.5	______	–25.5
–40	40	–38.5	______	–35.5
–50	30	–48.5	______	–45.5
–60	20	–58.5	______	–55.5
–70	10	–68.5	______	–65.5
–80	0	–79.0	______	–75.0

11. Subtract the two levels obtained for OUTPUT RANGES of –70 and --80 dBm. The level change should be 10 ± 1 dB.

9 dB ____________ 11 dB

4-14. OUTPUT FLATNESS

SPECIFICATION:

Output level variation with frequency is less than ±1.0 dB from 1—1300 MHz at front panel meter readings between +3 and –6 dB.

DESCRIPTION:

After an output level reference is established, power level measurements are made at various frequencies across the range of the Synthesized Signal Generator System. The Output levels must fall within the limits specified.

EQUIPMENT:

Power Meter/Sensor . . . . HP 435A/8481A

PROCEDURE:

1. Zero the Power Meter.

2. Set the system center frequency to 1000 MHz.

3. Set the Power Meter range switch to 0 dBm; set the RF Section OUTPUT RANGE Switch and VERNIER Control for an output level of –1.0 dBm as read on the power meter.

PERFORMANCE TESTS

4-14. OUTPUT FLATNESS (Cont'd)

4. Measure and record the power level indicated by the Power Meter at the following center frequencies: 1 MHz, 10 MHz, 100 MHz, 200, 400, 600, 800, and 1299 MHz.

1 MHz	–2.0	________	0.0 dBm
10 MHz	–2.0	________	0.0 dBm
100 MHz	–2.0	________	0.0 dBm
200 MHz	–2.0	________	0.0 dBm
400 MHz	–2.0	________	0.0 dBm
600 MHz	–2.0	________	0.0 dBm
800 MHz	–2.0	________	0.0 dBm
1299 MHz	–2.0	________	0.0 dBm

4-15. HARMONIC SIGNALS

SPECIFICATION:

All harmonically related signals are at least 30 dB below the desired output signal for output levels ⩽ +3 dBm. (25 dB down for output levels above +3 dBm.)

DESCRIPTION:

A spectrum analyzer is used to measure the relative levels of the second and third carrier harmonics with respect to the carrier fundamental at various center frequencies.

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140T

PROCEDURE:

1. Set the system center frequency to 1299 MHz; set the RF Section OUTPUT RANGE switch and VERNIER control for an output level of +10 dBm.
2. Connect the power meter/sensor to the system RF OUTPUT jack.
3. Readjust the VERNIER control for a power meter reading of +10 dBm.
4. Set the spectrum analyzer input attenuation to 30 dB. Connect the RF Section OUTPUT jack to the spectrum analyzer RF input.
5. Set the other spectrum analyzer controls for convenient viewing of the carrier. Adjust the controls as necessary to view the second and third harmonics. Record the harmonic levels relative to the fundamental signal.

		Second	Third
1299 MHz	⩾25 dB down	______	______

PERFORMANCE TESTS

4-15. HARMONIC SIGNALS (Cont'd)

6. Repeat steps 1 through 5 at the other frequencies listed. Record the levels.

		Second	Third
1000 MHz	⩾25 dB down	______	______
500 MHz	⩾25 dB down	______	______
100 MHz	⩾25 dB down	______	______
10 MHz	⩾25 dB down	______	______

7. Set the system center frequency to 100 MHz; set the RF Section OUTPUT RANGE switch to 0 dBm and the VERNIER control for a front panel meter reading of +3 dB. Record the harmonic levels.

		Second	Third
100 MHz	⩾30 dB down	______	______

4-16. PULSE MODULATION RISETIME

SPECIFICATION:

50 nanoseconds.

DESCRIPTION:

The external pulse generator output is coupled to the RF Section plug-in through the Model 86631B Auxiliary Section. The pulse modulated signal is detected and the rise time measured with an oscilloscope.

PERFORMANCE TESTS

4-16. PULSE MODULATION RISETIME (Cont'd)

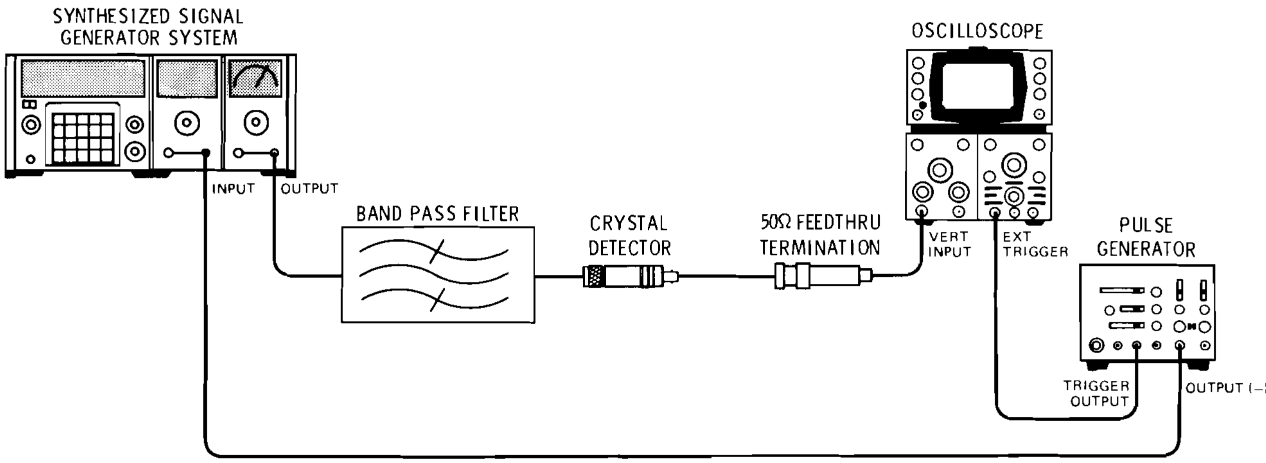


Figure 4-5. Pulse Modulation Risetime Test Setup

EQUIPMENT:

Pulse Generator	HP 8013A
Oscilloscope	HP 180C/1801A/1821A
Crystal Detector	HP 423A
Termination, 50Ω Feedthru	HP 11048C
Band Pass Filter	HP 8430A

PROCEDURE:

1. Set System center frequency to 1200 MHz.

2. Set the RF Section OUTPUT RANGE switch and VERNIER control for an output of +10 dBm.

3. Set the Auxiliary Section external modulation switch to pulse; set pulse level control full cw.

4. Adjust pulse generator output for –10 Vpk (into 50Ω) with risetime ⩽10 ns; set pulse repetition rate and width to convenient values.

5. Connect equipment as illustrated in Figure 4-5.

6. Adjust oscilloscope to display leading edge of detected pulse modulated RF signal. Risetime, as measured between the 10% and 90% amplitude points on leading edge, should be 50 nanoseconds or less.

__________ 50 ns

4-17. PULSE MODULATION ON/OFF RATIO

SPECIFICATION:

At least 40 dB.

DESCRIPTION:

An HP Model 86631B Auxiliary Section is inserted in the left drawer of the Synthesized Signal Generator System. The RF Section OUTPUT is monitored by a spectrum analyzer. The carrier reference is set on the display with the Auxiliary Section external modulation switch set first to Off (equivalent to pulse-on). Then the modulation switch is set to Pulse (equivalent to pulse-off without an external pulse input). The ratio of the pulse-off level to the carrier reference is the on/off ratio.

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140T

PROCEDURE:

1. Set System center frequency to 500 MHz, RF Section OUTPUT RANGE Switch and VERNIER control for an output level of +10 dBm, and Auxiliary Section external modulation switch to off.

2. Set the spectrum analyzer input attenuation to 30 dB; connect the RF Section OUTPUT to the analyzer RF input.

3. Adjust the analyzer controls for a CRT display of the carrier. Establish the reference by positioning the carrier peak on the top horizontal graticule line.

4. Set the Auxiliary Section external modulation switch to Pulse and the Pulse Level control fully clockwise. The signal displayed on Spectrum Analyzer should be >40 dB down with respect to the reference. Record the indication.

40 dB down ______

4-18. AMPLITUDE MODULATION DEPTH AND 3 dB BANDWIDTH

SPECIFICATION:

Depth: 0-90% for RF output level meter readings from +3 to –6 dB and only at +3 dBm and below. 3 dB Bandwidth:

At center frequencies <10 MHz
10 kHz from 0 – 30% AM
6 kHz from 0 – 70% AM
5 kHz from 0 – 90% AM

At center frequencies ≥10 MHz
100 kHz from 0 – 30% AM
60 kHz from 0 – 70% AM
50 kHz from 0 – 90% AM

NOTE

To check AM accuracy, refer to section IV of the appropriate modulation section Operating and Service manual.

4-18. AMPLITUDE MODULATION DEPTH AND 3 dB BANDWIDTH (Cont'd)

DESCRIPTION:

The system Rf output is amplitude modulated. The signal is demodulated by a peak detector in a spectrum analyzer (the frequency span width is set to zero). The ac and dc components are measured with a voltmeter at the detector (vertical) output. First, the dc component is set to –283 mVdc plus a detector offset correction. Then, the ac component is measured. The AM level (%) is 1/2 (one half) the rms output.

Because of the required measurement accuracy, the accuracy of the spectrum analyzer's detector offset must be known to ±2 mVdc. The offset voltage is calculated by measuring the change in the detector output for a change in the RF input and assuming a linear detector over the range of the levels used.

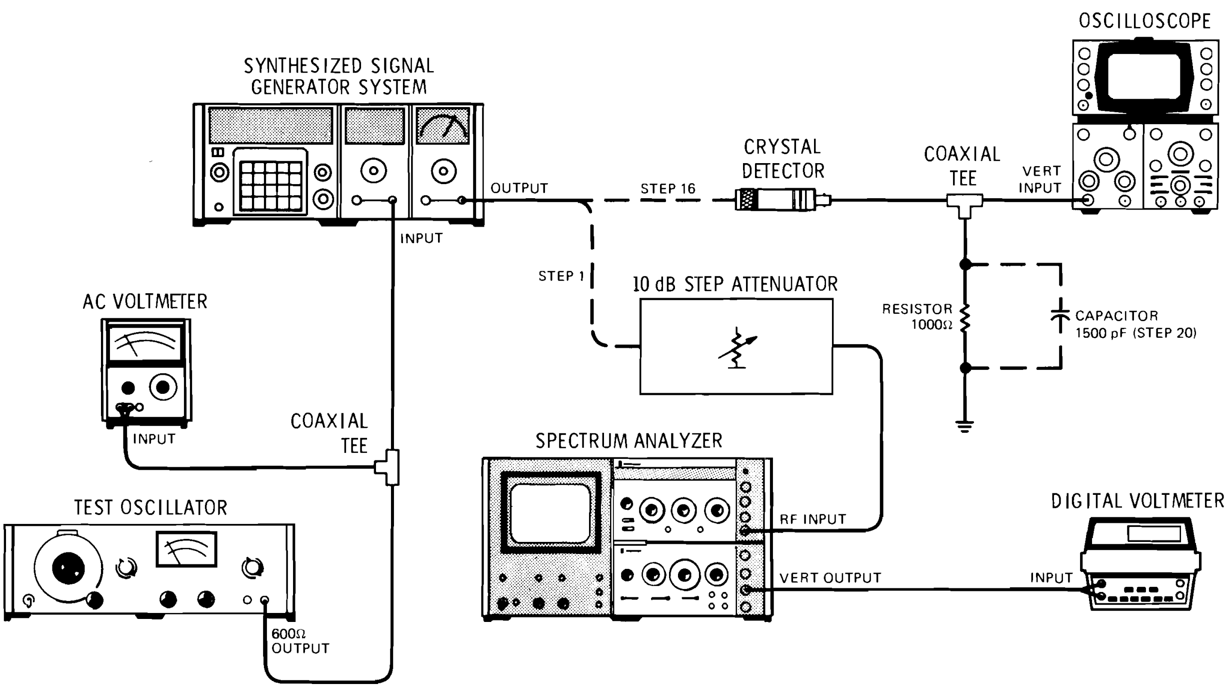


Figure 4-6. Amplitude Modulation Depth and 3 dB Bandwidth Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
AC Voltmeter	HP 403B
10 dB Step Attenuator	HP 3550 Option H38
Spectrum Analyzer	HP 8555A/8552B/140T
Digital Voltmeter	HP 34740A/34702A
Coaxial Tee (2 required)	HP 1250-0781
Crystal Detector	HP 423A
Oscilloscope	HP 180C/1801A/1821A
Resistor 1K	HP 0757-0280

4-18. AMPLITUDE MODULATION DEPTH AND 3 dB BANDWIDTH (Cont'd)

PROCEDURE:

1. Connect the equipment as shown in Figure 4-6 (step 1).
2. Set the synthesized signal generator controls as follows: center frequency 30 MHz, OUTPUT RANGE –10 dBm, VERNIER control for a panel meter reading of 0 dB, and AM off.
3. Let the spectrum analyzer warm up for 1 hour to minimize drift of the spectrum analyzer detector output. Set 10 dB step attenuator to 10 dB attenuation.
4. Set the spectrum analyzer center frequency to 30 MHz, frequency span per division 5 MHz, resolution bandwidth 300 kHz; input attenuation to 20 dB, and vertical sensitivity per division 10 dB. Adjust the center frequency control to center the display. Set the frequency span to zero and tune to peak the trace.

NOTE

Throughout this test, continually check that the signal is peaked for maximum deflection. Tune the center frequency control for maximum signal deflection.

5. Set the vertical scale to linear and adjust the reference level vernier for a digital voltmeter reading of –200 mVdc.
6. Set the 10 dB step attenuator to 0 dB and record the digital voltmeter reading.

 ____________ mVdc

7. Set the 10 dB Step Attenuator to 20 dB and record the digital voltmeter reading.

 ____________ mVdc

8. Calculate the offset voltage using the following formula:

$$V_{off} = \frac{mVdc + 200\alpha}{1 - \alpha}$$

Where V_{off} is the offset voltage in millivolts
mVdc is the DVM reading in millivolts
α is 3.16 (step 5) or 0.316 (step 6).

For example:

mVdc = –687 in step 5

$$\text{therefore } V_{off} = \frac{-687 + 200\,(3.16)}{1 - (3.16)} = +25.5 \text{ mVdc}$$

9. Find the value of V_{off} for step 6. The difference between the two should be $<$ 4 m Vdc. Use the average value of V_{off}.
10. Set the 10 dB step Attenuator to 10 dB.

4-18. AMPLITUDE MODULATION DEPTH AND 3 dB BANDWIDTH (Cont'd)

11. Set the system center frequency to 500 MHz, the modulation mode to AM, the modulation source to external, and a modulation level of 30% (0.3 Vrms input to an Auxiliary Section; 1.5 Vrms to a Modulation Section) at a 1 kHz rate.

12. Set the spectrum analyzer center frequency control to 500 MHz, frequency span to zero, and peak the trace. Set the reference level vernier for a digital voltmeter reading of −283 mVdc + V_{off}. See Steps 8 and 9.

13. Set the DVM controls to measure the peak detector's ac component. The modulation level (%) is 1/2 (one-half) the DVM reading (Vrms). Record the reading for 30% AM.

50 mVrms ________________ 70 mVrms

14. Set the modulation section (test oscillator) controls for 70% AM. Record the DVM reading.

130 mVrms ________________ 150 mVrms

15. Set the modulation section (test oscillator) controls for 90% AM. Record the DVM reading

170 mVrms ________________ 190 mVrms

16. Connect the crystal detector to the RF Section OUTPUT jack.

17. Set the modulation section and test oscillator controls for an AM level of 30% (0.3 Vrms input to an auxiliary section; 1.5 Vrms to a modulation section) at a 5 kHz rate.

18. Set the oscilloscope controls for a 5 division peak-to-peak display of the demodulated signal.

19. Increase the test oscillator frequency to 100 kHz. The signal amplitude should be ⩾3.5 divisions peak-to-peak.

3.5 div. p-p________________

20. Install the 1500 Pf capacitor as shown in Figure 4—6.

21. Repeat steps 17 through 19 with center frequency set to 9 MHz. Increase the test oscillator frequency from 5 to 10 kHz. Record the signal amplitude.

3.5 div. p-p________________

4-19. FREQUENCY MODULATION RATE AND DEVIATION

SPECIFICATION:

Rate: DC to 200 kHz with the 86632B or 86635A.
20 Hz to 100 kHz with the 86633B.

Maximum Deviation (Peak):
200 kHz with the 86632B and 86635A.
100 kHz with the 86633B.

NOTE

To check the frequency modulation rate and deviation, refer to the performance test in Section IV of the applicable modulation section manual.

4-20. OUTPUT IMPEDANCE AND VSWR

SPECIFICATION:

Impedance: 50Ω
VSWR: <2.0 on +10 and 0 dBm ranges; <1.3 on –10 dBm range and below.

DESCRIPTION:

The Synthesized Signal Generator System's output signal is reflected back into the RF OUTPUT jack by a coaxial short at the end of an adjustable stub (a variable length of air-line). This reflected signal is re-reflected by any mismatch at the jack. The re-reflected signal combines with the output signal according to the relative phase and magnitude of the two signals. The combined signal is monitored by a directional coupler and then measured by a voltmeter or spectrum analyzer. Maximum and minimum power levels are noted as the electrical length of the stub is varied (i.e. the electrical distance from the RF OUTPUT jack to the coaxial short is varied). The maximum allowable change in voltage or dB is calculated from the following formulas.

$$VSWR = \frac{V_{max}}{V_{min}}$$

$$V_{max} = (VSWR)\,(V_{min})$$

$$dB = 20 \log \left(\frac{V_{max}}{V_{min}}\right)$$

$$dB = 20 \log (VSWR)$$

PERFORMANCE TESTS

4-20. OUTPUT IMPEDANCE AND VSWR (Cont'd)

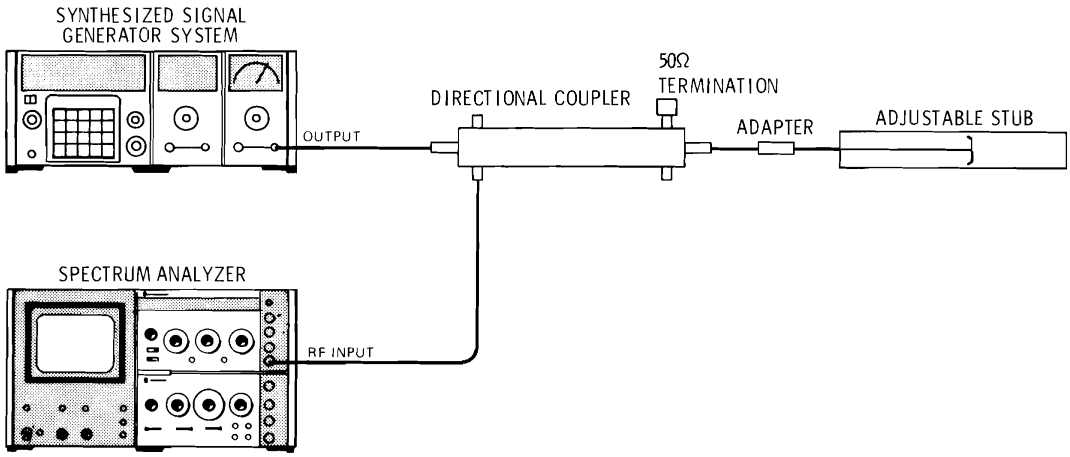


Figure 4-7. Output Impedance Test Setup

EQUIPMENT:

Directional Coupler	HP 778D Opt 12
Adapter (Male Type N to GR 874)	HP 1250-0847
Adjustable Stub	General Radio 874-D50L
Spectrum Analyzer	HP 8555/8552B/140T
50Ω Termination	HP 11593A

PROCEDURE:

1. Set the Synthesized Signal Generator system center frequency to 500 MHz, the OUTPUT RANGE switch to +10 dBm, and the VERNIER control for a panel meter reading of 0 dB.

2. Set up the equipment as shown in Figure 4-7.

3. Set the spectrum analyzer controls for a convenient display of the signal. Set the vertical sensitivity to 2 dB per division.

4. Adjust the stub for a minimum indication on the spectrum analyzer display. Adjust the reference level range and vernier controls for a convenient reference level.

5. Adjust the stub for a maximum indication on the display. The signal level increase should be <6 dB (VSWR <2.0).

_______ 6 dB

6. Set the system's OUTPUT RANGE switch to 0 dBm. Adjust the VERNIER control for a panel meter reading of +3 dB.

7. Repeat steps 3 and 4. The signal level increase should be <6 dB (VSWR <2.0).

_______ 6 dB

8. Set the system's OUTPUT RANGE switch to –10 dBm.

PERFORMANCE TESTS

4-20. OUTPUT IMPEDANCE AND VSWR (Cont'd)

9. Repeat steps 3 and 4. The signal level increase should be <2.3 dB (VSWR <1.3).

10. If desired, repeat at other frequencies between 100 MHz and 1 GHz.

__________2.3 dB

NOTE

The steps given above effectively check VSWR at all settings of the output attenuator.

4-21. SIGNAL-TO-PHASE NOISE RATIO

SPECIFICATION: (For AM, CW, and ϕM modes only)

Greater than 45 dB in a 30 kHz band centered on the carrier and excluding a 1 Hz band centered on the carrier.

DESCRIPTION:

AC voltage measurements proportional to carrier amplitude and residual carrier phase deviation are compared for the signal-to-phase noise ratio. The Synthesized Signal Generator System's reference and RF output (carrier) signals are mixed and the difference frequency is monitored by an oscilloscope and ac voltmeter. The mixer output (proportional to the carrier amplitude) is noted. The two signals are then frequency synchronized with phase difference of 180°. (This phase difference provides maximum resolution for voltage measurements at the mixer output which are proportional to the change of phase of the RF output signal.) This ac voltage is proportional to the phase noise and when compared to the carrier voltage yields the signal-to-phase noise ratio.

NOTE

A 3 dB correction factor takes into account the non-correlated noise contribution of the reference system. The noise levels of the reference system and the system under test are assumed to be equal.

PERFORMANCE TESTS

4-21. SIGNAL-TO-PHASE NOISE RATIO (Cont'd)

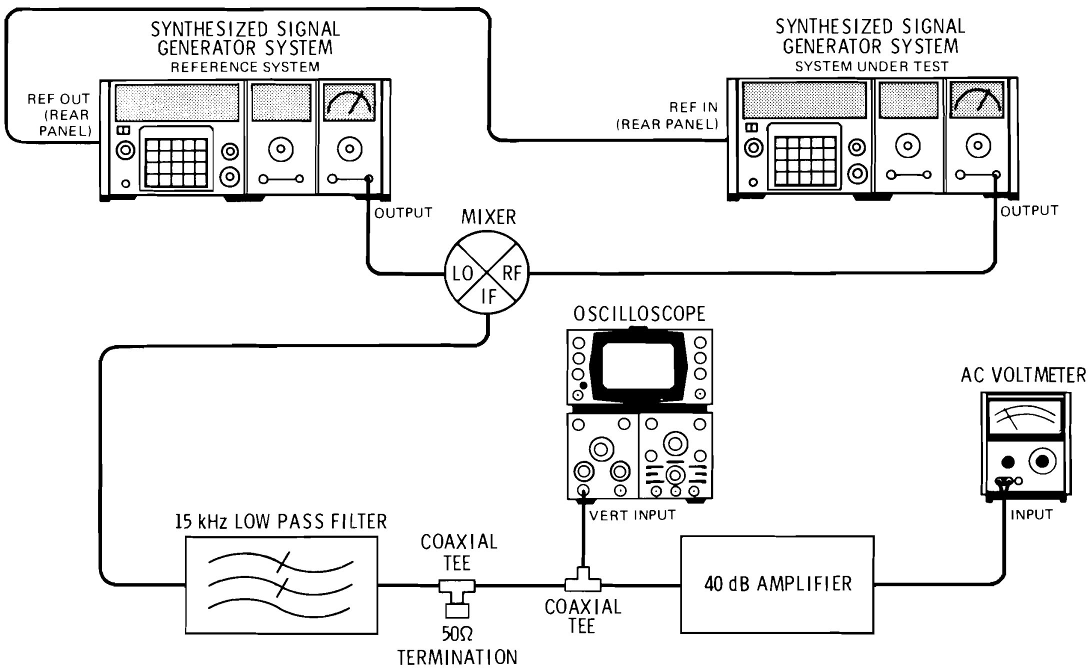


Figure 4-8. Signal-to-Phase Noise Ratio Test Setup

EQUIPMENT:

Synthesized Signal Generator System	HP 8660C/86602B/86631B
Oscilloscope	HP 180C/1801A/1821A
Coaxial Tee	HP 1250-0781 (BNC)
Double Balanced Mixer	Watkins-Johnson M1J
AC Voltmeter	HP 403B
40 dB Amplifier	(See Figure 1-2)
15 kHz Low Pass Filter	(See Figure 1-3)
50Ω Termination	HP 11593A

PROCEDURE:

1. Set the controls of the system under test as follows: center frequency 500.001000 MHz and the output level to –47 dBm (OUTPUT RANGE switch set to –50 dBm).

2. Set the controls of the reference system as follows: center frequency 500.000000 MHz and the output level to +7 dBm.

3. Connect the equipment as shown in Figure 4-8.

4. Record the relative ac voltmeter reading.

__________ dB

PERFORMANCE TESTS

4-21. SIGNAL-TO-PHASE NOISE RATIO (Cont'd)

5. Set the system under test OUTPUT RANGE switch to –10 dBm (–7 dBm output level).

6. Adjust the oscilloscope display of the 1 kHz signal for an amplitude of eight divisions. Set the oscilloscope vertical input to ground and adjust the vertical position control so the trace lies over the center horizontal line of the graticule. Set the vertical input to dc coupled.

7. Set the system under test center frequency to 500.000001 MHz and note that oscilloscope baseline trace alternately rises and falls over eight-division display. (510.0001 MHz; Option 004).

8. Reset the center frequency to 500.000000 MHz at a time that causes the oscilloscope baseline trace to stop within ± 1/10 division of the center horizontal line of the graticule.

9. Read the noise level on the ac voltmeter. Signal-to-phase noise ratio equals the sum of the attenuator change and the reference system noise contribution minus the change in voltmeter reading (in dB). Signal-to-phase noise ratio = 40 dB +3 dB – (±Δ dB). For example, the voltmeter reading is 8 dB below the reference (–8 dB). Therefore, the signal-to-phase noise ratio = 40 + 3 – (–8) = 51 dB down.

10. Record the ratio.

45 dB down ________

4-22. SIGNAL-TO-AM NOISE RATIO

SPECIFICATION:

Greater than 65 dB in a 30 kHz bandwidth centered on the carrier excluding a 1 Hz band centered on the carrier.

DESCRIPTION:

A comparison of ac voltage measurements proportional to carrier amplitude and AM noise yields the signal-to-AM noise ratio. First, a carrier reference level is determined by measuring the detected ac voltage for 30% AM (the detected signal is 10.5 dB below the carrier level). Then the AM noise level is measured and the signal-to-AM noise ratio is determined.

PERFORMANCE TESTS

4-22. SIGNAL-TO-AM NOISE RATIO (Cont'd)

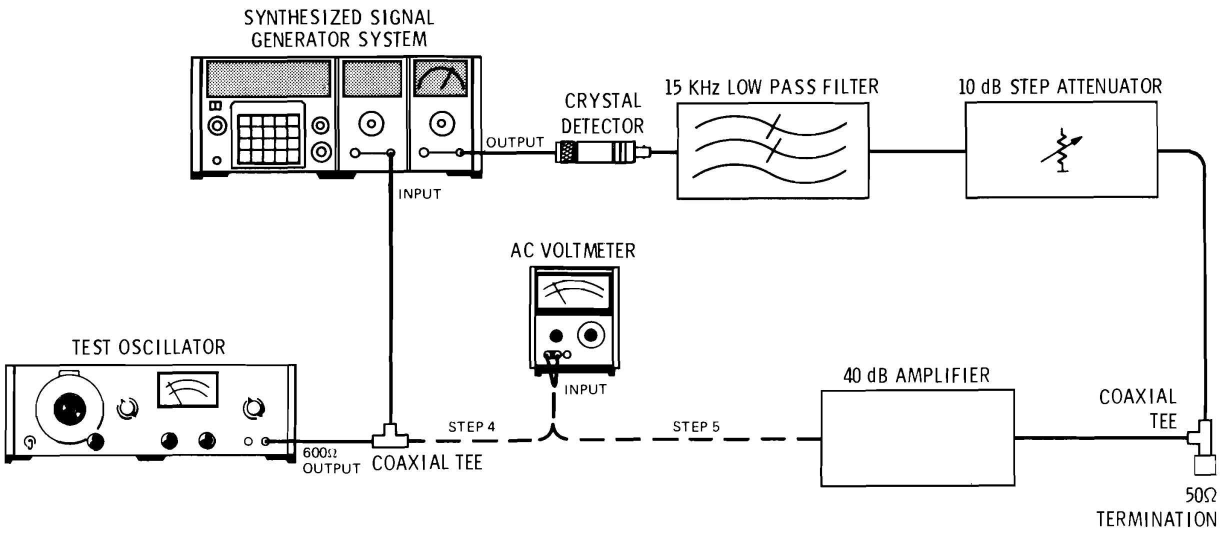


Figure 4-9. Signal-to-AM Noise Ratio Test Setup.

EQUIPMENT:

10 dB Step Attenuator	HP 355D Option H38
40 dB Amplifier	Special (See figure 1-2)
Crystal Detector	HP 423A
15 kHz Low Pass Filter	Special (See figure 1-3)
Test Oscillator	HP 651B
50Ω Termination	HP 11593A
Coaxial Tee	HP 1250-0781
AC Voltmeter	HP 403B

PROCEDURE:

1. Set the 10 dB step attenuator to 50 dB.

2. Set the system center frequency to 500 MHz and the RF output level to +3 dBm (0 dBm OUTPUT RANGE).

3. Connect the equipment as shown in Figure 4-9.

4. Set the system's modulation section controls for the AM mode and an external modulation source. The modulation level control and/or the test oscillator controls are set for a modulation level of 30% (0.3 Vrms to an auxiliary section; 1.5 Vrms to a modulation section) at a 1 kHz rate.

NOTE

The ac voltmeter can be used to monitor the modulation or auxiliary section input voltage while it is being set.

5. Record the ac voltmeter reading of the 40 dB amplifier output in dB.

____________ dB

4-22. SIGNAL-TO-AM NOISE RATIO (Cont'd)

6. Set the system's modulation mode to off.

7. Set the 10 dB step attenuator to 0 dB.

8. Record the ac voltmeter reading.

_______ dB

9. The signal-to-AM noise ratio is equal to the sum of the change in attenuation level and the level of the 30% AM level relative to the carrier minus the change in ac voltmeter reading in dB. Therefore, signal-to-AM noise ratio = 50 dB + 10.5 dB – (±Δ dB). For example, the ac voltmeter reading is 12 dB down (below) the reference level and the signal-to-AM noise ratio = 50 + 10.5 – (–12) or 72.5 dB down.

10. Record the ratio.

65 dB down _______

4-23. RESIDUAL FM

SPECIFICATION:

In the CW, AM, and ∅M modes, less than 1.5 Hz-rms in a 2 kHz band centered on the carrier.

DESCRIPTION:

Because residual FM and Phase Noise cannot be measured separately and because the Residual FM is the smaller part of the total measurement (≈1/4), this measurement is indirectly made in the Signal-to-Phase Noise Ratio test.

4-24. AMPLITUDE MODULATION DISTORTION

SPECIFICATION:

AM distortion at 30% AM is < 1%, at 70% AM is < 3%, and at 90% AM is < 5%.

NOTES

1. *The AM distortion specification applies only at 400 and 1000 Hz rates, with a front panel meter indication of 0 to +3 dB, and at OUTPUT RANGE switch settings of ⩽ 0 dBm. At a meter indication of –6 dB, the distortion approximately doubles. The modulating signal distortion must be < 0.3% for the system performance to meet the specifications.*

4-24. AMPLITUDE MODULATION DISTORTION (Cont'd)

Notes (Cont'd)

2. *If the signal generator system does not meet the AM distortion specification, refer to the Systems Troubleshooting information in Section VIII (Service Sheet 1) in this manual.*

DESCRIPTION:

To measure AM distortion, a distortion analyzer is connected to the video output of a spectrum analyzer. In the zero frequency-span mode, the video output of the spectrum analyzer is the detected RF signal. The signal generator system controls are set for a specific AM level and the distortion level is measured.

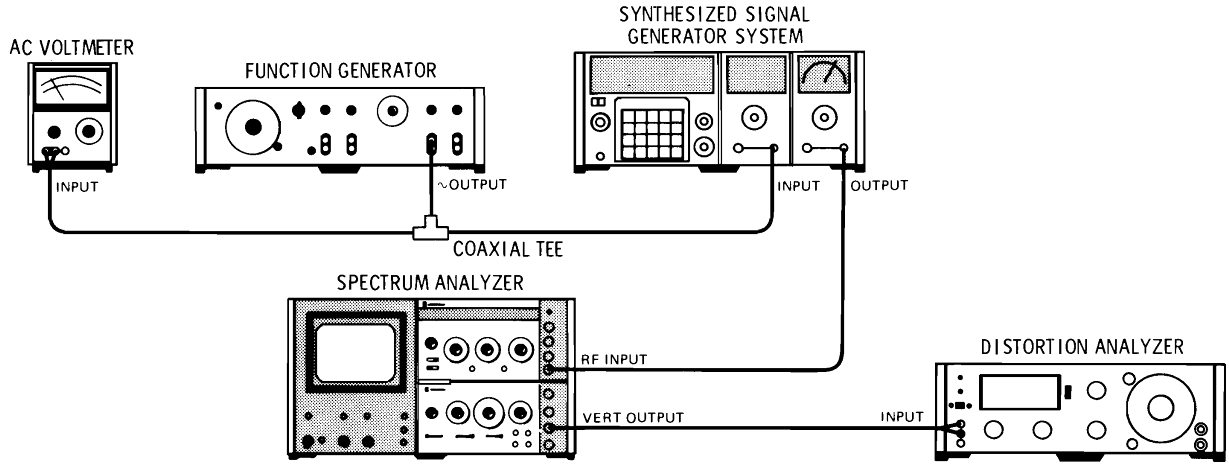


Figure 4-10. Amplitude Modulation Distortion Test Setup.

EQUIPMENT:

Distortion Analyzer	HP 333A
Spectrum Analyzer	HP 8555A/8552B/140T
Function Generator	HP 203A
AC Voltmeter	HP 403B

PROCEDURE:

1. Set the signal generator system controls for a center frequency of 1000 MHz, the output level to –20 dBm (OUTPUT RANGE –20 dBm), and the modulation mode to off.

2. Set the spectrum analyzer center frequency to 1000 MHz, frequency span per division 1 MHz, resolution bandwidth 300 kHz, input attenuation 20 dB, and vertical sensitivity per division 10 dB.

3. Connect the equipment as shown in Figure 4-10.

4-24. AMPLITUDE MODULATION DISTORTION (Cont'd)

4. Set the spectrum analyzer's tuning stabilizer to on. Adjust the center frequency fine tune to center the signal on the display. Set the reference switch and vernier to center the trace vertically.

5. Set the frequency span per division to zero, and the vertical scale to linear. Peak the trace by adjusting the fine tune center frequency control. Center the trace vertically with the vertical sensitivity and vernier controls.

6. Set the signal generator system's modulation mode to AM, the source to external, and set the modulation level to 30%. If a modulation section plug-in is installed in the Signal Generator mainframe, set the test oscillator controls to 1.5 Vrms at 1000 Hz. If an auxiliary section plug-in is installed, set the test oscillator controls to 0.3 Vrms at 1000 Hz.

7. Measure the total harmonic distortion. With the trace peaked on the display, the distortion should be less than 1%.

_________ 1%

8. Set the System modulation level to 70% AM. If the Auxiliary Section plug-in is being used, set the test oscillator to an output of 0.7 Vrms.

9. Measure the total harmonic distortion. With the trace peaked on the display, the distortion should be less than 3%.

10. Set the system modulation level to 90% AM. _________ 3%

10. Set the system modulation level to 90% AM. If the Auxiliary Section plug-in is being used, set the test oscillator to an output of 0.9 Vrms.

11. Measure the total harmonic distortion. With the trace peaked on the display, the distortion should be less than 5%.

_________ 5%

4-25. INCIDENTAL PHASE MODULATION

SPECIFICATION:

At 30% AM $<$ 0.2 radians

DESCRIPTION:

The phase difference between the signal generators is monitored with a vector voltmeter. Amplitude modulation is applied to the system under test. The peak-to-peak phase variation incidental to the amplitude modulation is read on the vector voltmeter.

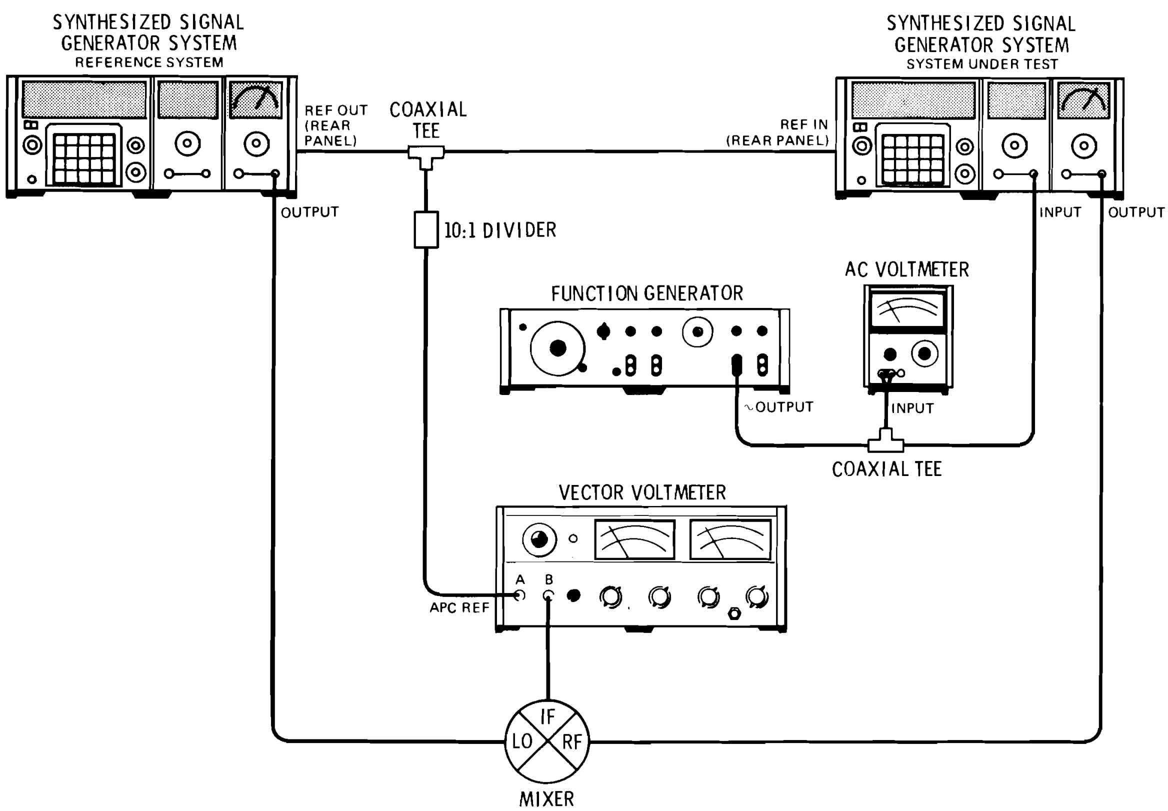


Figure 4-11. Incidental Phase Modulation Test Setup.

EQUIPMENT:

Synthesized Signal Generator	HP 8660C/86602B/86631B
Function Generator	HP 203A
Vector Voltmeter (with 10:1 voltage divider probe)	HP 8405A
AC Voltmeter	HP 403B
Mixer	Watkins-Johnson M1J

PERFORMANCE TESTS

4-25. INCIDENTAL PHASE MODULATION (Cont'd)

PROCEDURE:

1. Set the system under test rear panel reference selector to external, center frequency 500 MHz, output level –10 dBm (OUTPUT RANGE –10 dBm) and AM mode to off.

2. Set the reference system center frequency to 510 MHz and the output level to +7 dBm (OUTPUT RANGE +10 dBm).

3. Connect the equipment as shown in Figure 4-11.

4. Adjust the vector voltmeter's frequency range control to 10 MHz, phase range switch to ±18°, and the phase meter offset switch for a near or on scale phase reading (Phase reading will drift somewhat due to phase drift in the synthesized signal generator outputs).

5. Set the system under test modulation mode to AM, the source to external, and the modulation level to 30%. Set the input level to 0.3 Vrms at 1 kHz if an auxiliary section is inserted into the mainframe of the system under test. If a modulation section is used, the input level should be 1.5 Vrms at 1 kHz. Use the external dc source if an 86632B or 86633B Modulation Section is used.

6. Set the function generator controls for a modulation rate of 0.5 Hz. (The low rate is necessary for the vector voltmeter's metering circuitry. The modulation level is still 30%.)

7. The phase reading will vary at a 0.5 Hz rate. If necessary, readjust the vector voltmeter's phase meter offset switch for an on scale reading.

8. Note the peak-to-peak phase variation caused by the 0.5 Hz AM. Visually disregard the random phase variations caused by phase drift in the synthesized signal generator outputs. Divide the reading by 2 to obtain the peak phase deviation. The phase deviation should be less than 11.5° - peak (0.2 radians-peak)

________ 11.5° - pk

4-26. FREQUENCY MODULATION DISTORTION

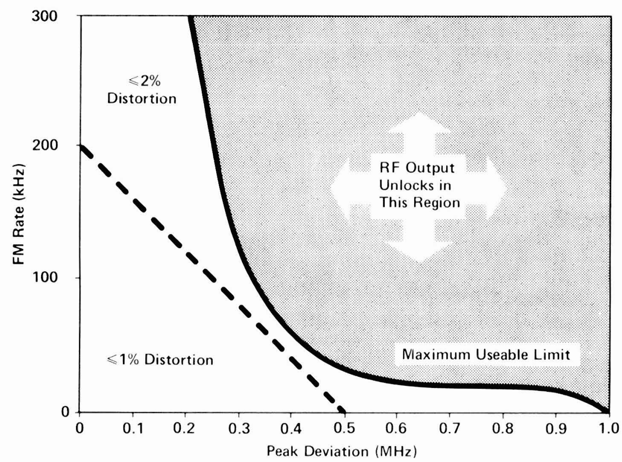
SPECIFICATION:

Total harmonic distortion for modulation rates up to 20 kHz, < 1% up to 200 kHz peak deviation. Distortion from an external source must be < 0.3% to meet these specifications.

NOTES

1. *In the FM mode, typical Residual FM in a 0.3 to 3 kHz audio bandwidth is <15 Hz and may limit minimum Noise and Distortion measurements at deviations <2 kHz peak.*

2. *If the signal generator system does not meet the FM distortion specification, refer to the System's Troubleshooting information in Section VIII (Service Sheet 1) in this manual.*



Typical FM Distortion Curve

DESCRIPTION:

A test oscillator input is used to frequency modulate the RF OUTPUT of the Synthesized Signal Generator System. The output is connected to a FM discriminator. To eliminate the carrier, the demodulated signal is passed through a 100 kHz lowpass filter at the discriminator output. The amplitude of the first harmonic is established as the reference level on the wave analyzer. The levels of the second and third harmonics are measured, added, and the total is compared to the reference level to indicate the level of FM distortion.

NOTE

This procedure is valid only if the HP 86635A is used.

4-26. FREQUENCY MODULATION DISTORTION (Cont'd)

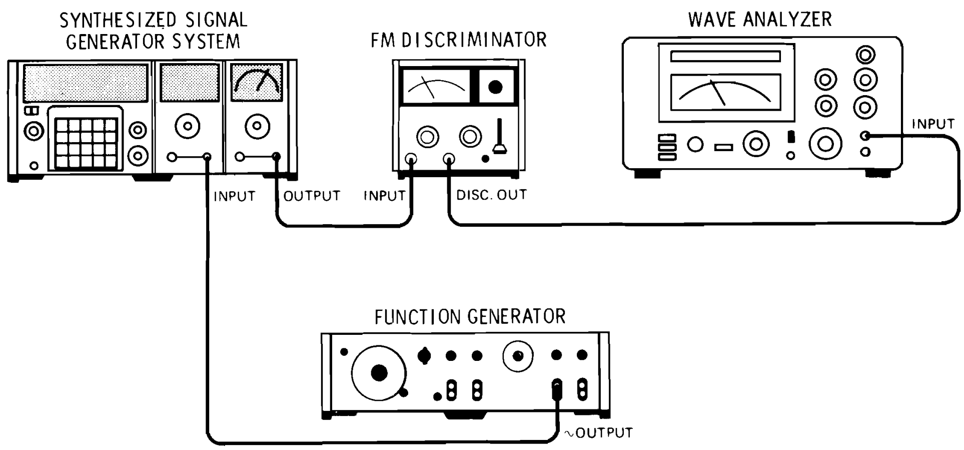


Figure 4-12. Frequency Modulation Distortion Test Setup.

EQUIPMENT:

FM Discriminator	HP 5210A
Wave Analyzer	HP 3581A
Function Generator	HP 203A

NOTE

This performance test is normally performed with either an HP model 86632B or 86635A Modulation Section inserted into the signal generator mainframe. Control settings in parenthesis apply only to the Model 86633B.

1. Set the signal generator system center frequency to 8.5 MHz and set the OUTPUT RANGE switch to +10 dBm. Adjust the VERNIER control for a –3 dB meter reading.

2. Connect equipment as illustrated in Figure 4-12.

3. Set Modulation Section MODE to FM X10 (FM X1) and source switch to EXTERNAL AC. Adjust Modulation Section modulation level control for 200 kHz (100 kHz) peak deviation and press FM CF CAL switch.

NOTE

The 86633B does not have an FM CF CAL switch.

4. Set the function generator output for 10 kHz at 1.5 Vrms.

5. Install a 100 kHz low pass filter in the FM Discriminator. (Refer to the FM Discriminator Operating and Service Manual for details).

4-26. FREQUENCY MODULATION DISTORTION (Cont'd)

6. Adjust the FM Discriminator for 1 volt rms input sensitivity. Set the controls for the 10 MHz range.

7. Set the wave analyzer scale switch to 90 dB, reference level to normal, resolution bandwidth 30 Hz, sweep mode off, and AFC on.

8. Peak the meter reading near 10 kHz with the frequency control. Verify that the AFC locks and the amplitude is ≈–37 dBV (14.4 mVrms). Use the input sensitivity switch and vernier control and the amplitude reference level control to establish a reference level at 0 dB.

9. Set the frequency to ≈ 20 kHz (second harmonic) and peak the meter reading. Record the meter reading.

_______________dB

10. Set the frequency to ≈ 30 kHz (third harmonic) and peak the meter reading. Record the meter reading.

_______________dB

11. Use Table 4-1 to obtain power ratios for the levels recorded in steps 8 and 9. Then use Table 4-1 to find the dB level corresponding to the sum of the ratios. The resultant level should be ⩾ 40 dB down from the fundamental frequency level. Record the level.

40 dB down___________

4-26. FREQUENCY MODULATION DISTORTION (Cont'd)

Table 4-1. dB To Power Ratio Conversion

dB	Power Ratio X10^{-4}	dB	Power Ratio X10^{-4}
20	100.00000	46	.25119
21	79.43282	47	.19953
22	63.09573	48	.15849
23	50.11872	49	.12589
24	39.81072	50	.10000
25	31.62278	51	.07943
26	25.11886	52	.06310
27	19.95262	53	.05012
28	15.84893	54	.03981
29	12.58925	55	.03162
30	10.00000	56	.02512
31	7.94328	57	.01995
32	6.30957	58	.01585
33	5.01187	59	.01259
34	3.98107	60	.01000
35	3.16228	61	.00794
36	2.51189	62	.00631
37	1.99526	63	.00501
38	1.58489	64	.00398
39	1.25893	65	.00316
40	1.00000	66	.00251
41	.79433	67	.00200
42	.63096	68	.00158
43	.50119	69	.00126
44	.39811	70	.00100
45	.31623		

4-27. INCIDENTAL AM

SPECIFICATION:

AM sidebands > 60 dB down from carrier with FM peak deviation of 75 kHz at a 1 kHz rate.

DESCRIPTION:

A reference is established on the wave analyzer by detecting an AM signal of known modulation level and rate from the Synthesized Signal Generator System. The output is frequency modulated at a specified rate and level. The incidental AM level is detected during frequency modulation and compared to the carrier amplitude.

PERFORMANCE TESTS

4-27. INCIDENTAL AM (Cont'd)

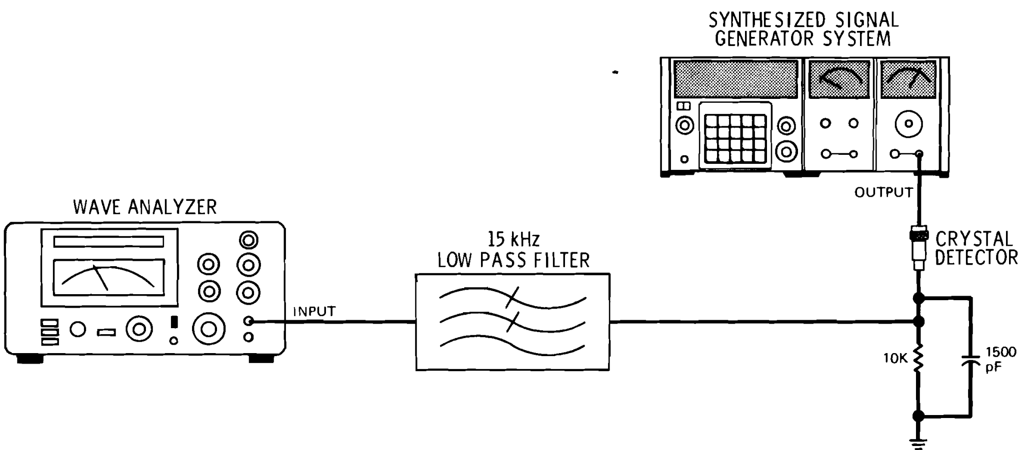


Figure 4-13. Incidental AM Test Setup

EQUIPMENT:

Wave Analyzer	HP 3581A
Crystal Detector	HP 8471A
15 kHz Low Pass Filter	(See Figure 1-3)
Resistor 10K	HP 0757-0442
Capacitor 1500 pF	HP 0160-2222

PROCEDURE:

1. Set the signal generator system controls for a center frequency of 100 MHz, a +3 dBm output level, the amplitude modulation mode, an internal source at 1 kHz rate, and a modulation level of 50%.

2. Connect the equipment together as shown in Figure 4-13.

3. Set the wave analyzer controls for the 90 dB scale, AFC on, and resolution bandwidth 30 Hz. Tune the wave analyzer for a peak meter indication near 1 kHz. Set a reference level of 0 dB using the input sensitivity switch and the amplitude reference switch. This reference level (AM sidebands) is 12 dB down from carrier signal (50% AM).

4. Set the system modulation section controls for FM mode, and a modulation level of 75 kHz peak deviation.

5. The meter reading should be > 48 dB down (> 60 dB down from carrier).

60 dB down________

4-28. SPURIOUS SIGNALS, NARROWBAND

SPECIFICATION:

All narrowband spurious signals in the CW, AM, and ϕM modes are:
80 dB down from carrier at frequencies $<$ 700 MHz
80 dB down from carrier within 45 MHz of the carrier at frequencies $\geqslant$ 700 MHz
50 dB down from carrier on the +10 dBm range.

ALL power line related spurious signals are 70 dB down from the carrier.

DESCRIPTION:

The outputs of two Synthesized Signal Generator Systems which use the same time base reference are mixed and the difference frequency is amplified and coupled to the wave analyzer. A reference level is established, various selected frequencies are then set on the two generator systems, and the spurious signal levels are measured.

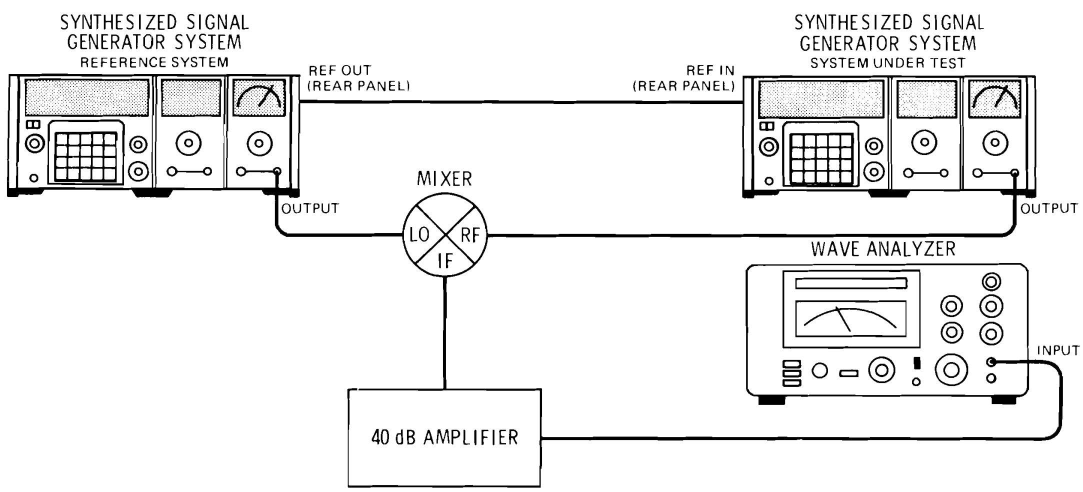


Figure 4-14. Narrowband Spurious Signal Test Setup.

EQUIPMENT:

Synthesized Signal Generator	HP 8660C/86602B/86631B
Double Balanced Mixer	Watkins Johnson M1J
Wave Analyzer	HP 3581A
40 dB Amplifier	See Figure 1-2

PROCEDURE:

1. Connect the equipment as illustrated in Figure 4-14.

2. Connect rear panel REFERENCE OUTPUT from reference system to rear panel REFERENCE INPUT of system under test. Set REFERENCE SELECTOR of system under test to EXT.

3. On reference system, set the mainframe center frequency to 500.001 MHz, the OUTPUT RANGE switch to +10 dBm, and adjust VERNIER control to a –3 dB meter reading.

PERFORMANCE TESTS

4-28. SPURIOUS SIGNALS, NARROWBAND (Cont'd)

4. On system under test, set mainframe center frequency to 500 MHz, the RF Section OUTPUT RANGE switch to –80 dBm, and adjust VERNIER control to 0 dB indication on meter scale.

5. Set the wave analyzer scale switch to 90 dB, amplitude reference to –60, dBV mode, resolution bandwidth 3 Hz, display smoothing to max, and AFC on.

6. Set wave analyzer frequency control to 1 kHz and adjust the input sensitivity for a 0 dB indication on meter scale.

7. On system under test, set the OUTPUT RANGE switch to –10 dBm and adjust VERNIER to 0 dB indication on meter scale.

8. On reference system and system under test, set mainframe center frequency values to those listed in Table 4-2 and verify that levels of corresponding spurious signals are in accordance with specification. The corrected reading of spurious level relative to carrier is 70 dB – (± difference level), therefore a reading of –13 dB relative to the reference level (step 6) gives the spurious signal level. 70 dB – (–13 dB) = 83 dB down.

NOTE

It may be necessary to slightly readjust the Wave Analyzer Frequency control to locate the spurious signal.

Table 4-2. Narrowband Spurious Signals Checks

System Under Test	Reference System	Level Measured (dB down)
100.280000 MHz	100.561000 MHz	80 dB ________
200.280000 MHz	200.561000 MHz	80 dB ________
409.720000 MHz	409.441000 MHz	80 dB ________
509.720000 MHz	509.441000 MHz	80 dB ________
1109.720000 MHz	1109.441000 MHz	80 dB ________
1209.720000 MHz	1209.441000 MHz	80 dB ________

4-29. SPURIOUS SIGNALS, WIDEBAND

SPECIFICATION:

All wideband non-harmonically related spurious signals in the CW, AM, and ϕM modes are:
- 80 dB down from carrier at frequencies $<$ 700 MHz
- 80 dB down from carrier $>$ 45 MHz from carrier at frequencies $\geqslant$ 700 MHz
- 50 dB down from carrier on the +10 dBm range.

PERFORMANCE TESTS

4-29. SPURIOUS SIGNALS, WIDEBAND (Cont'd)

DESCRIPTION:

The RF OUTPUT of the Synthesized Signal Generator System is monitored by a spectrum analyzer after being passed through a 2200 MHz low pass filter. Selected signals which fall within the specified range are measured.

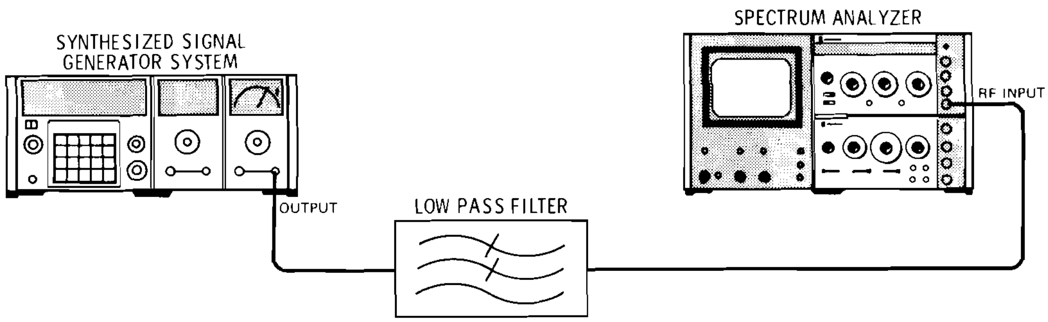


Figure 4-15. Wideband Spurious Signal Test Setup

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140T
Low Pass Filter (2200 MHz) . . . . HP 360C

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-15.

2. With the RF Section OUTPUT RANGE switch set to +10 dBm and VERNIER control adjusted for 0 dB meter indication, set mainframe center frequency to those values listed in Table 4-3 and adjust the Spectrum Analyzer to measure corresponding spurious signal level relative to the carrier.

Table 4-3. Wideband Spurious Signals Checks

Mainframe Frequency	Spurious Frequency	Level Measured
1299.9 MHz	150 MHz	50 dB down ________
	1150 MHz	50 dB down ________
	1450 MHz	50 dB down ________
1000 MHz	950 MHz	50 dB down ________
	1050 MHz	50 dB down ________
999.9 MHz	950 MHz	50 dB down ________
	1050 MHz	50 dB down ________
800.0 MHz	750 MHz	50 dB down ________
799.9 MHz	850 MHz	50 dB down ________

4-30. PHASE MODULATION PEAK DEVIATION

SPECIFICATION:

0 to 100 degrees peak. May be overdriven to 2 radians (115°) in Modulation Section external dc mode.

NOTE

To check Phase Modulation peak deviation, refer to Section IV of the appropriate Modulation Section Operating and Service Manual.

4-31A. PHASE MODULATION DISTORTION

SPECIFICATION:

<5% up to 1 MHz rates, <7% up to 5 MHz rates, and <15% up to 10 MHz rates
External modulation signal distortion must be <0.3% to meet this specification.

NOTES

1. *Using this procedure, the proof of performance for phase modulation distortion is valid only when the HP 86635A Modulation Section is being used in the signal generator system. The change in distortion level from the 20 Hz rate as used in this procedure to the maximum 1 MHz rate is minimal. This procedure is, however, not a complete check for the Model 86634A which can use modulation rates up to 10 MHz.*

2. *If the signal generator system does not meet the ϕM distortion specification, refer to the System's Troubleshooting information in Section VIII (Service Sheet 1) in this manual.*

DESCRIPTION:

The phase modulated output of the System Under Test is demodulated using a vector voltmeter. The vector voltmeter output is set to a linear portion of its operating range and the total harmonic distortion of the demodulated signal is measured.

PERFORMANCE TESTS

4-31A. PHASE MODULATION DISTORTION (Cont'd)

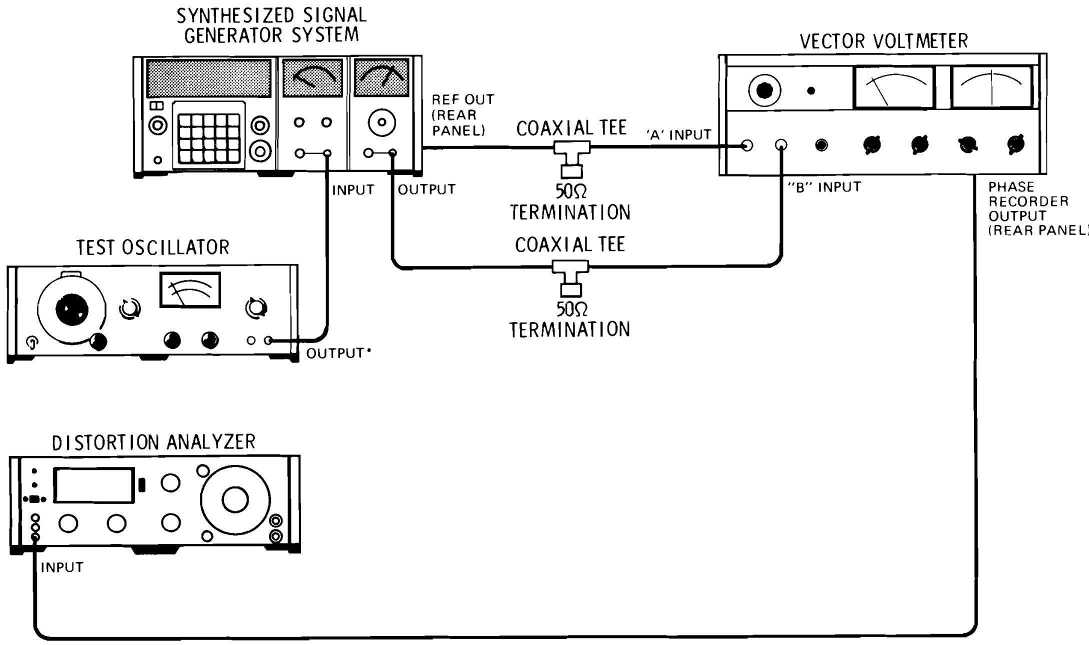


Figure 4-16A. Phase Modulation Distortion Test Setup

EQUIPMENT:

Vector Voltmeter	HP 8405A
Test Oscillator	HP 651B
Distortion Analyzer	HP 333A
50Ω Termination	HP 11593A
Coaxial Tee	HP 1250-0781

PROCEDURE:

1. Set the Synthesized Signal Generator System controls for a center frequency of 10.000 000 MHz and an output level of +3 dBm (0 dBm range).
2. Set the test oscillator output to 1.5 Vrms at 20 Hz. Set the signal generator system's modulation mode to off.
3. Connect the instruments as shown in Figure 4-16A.
4. Set the vector voltmeter's phase range switch to ±180°. Set the meter offset switch for a phase meter reading of 0 ±10°.
5. Set the modulation section controls for the ϕM mode and a modulation level of 100° as indicated by the front panel meter.

* In Figure 4-16A, the test oscillator output is 50 ohms when the modulation section is a Model 86634A and 600 ohms when used with a Model 86635A.

4-31A. PHASE MODULATION DISTORTION (Cont'd)

6. Measure the total harmonic distortion of the 20 Hz demodulated signal using the distortion analyzer. Distortion should be <5%.

_____________ 5%

4-31B. PHASE MODULATION DISTORTION – ALTERNATE PROCEDURE

SPECIFICATION:

< 5% up to 1 MHz rates
< 7% up to 5 MHz rates
< 15% up to 10 MHz rates

NOTES

1. *The HP Model 86635A Modulation Section has a maximum specified phase modulation rate of 1 MHz. Therefore, only the < 5% distortion specification is applicable. Because the maximum modulation rate of the Model 86634A is 10 MHz, all the specified distortion levels apply.*

2. *If the signal generator system does not meet the ϕM distortion specification, refer to the System's Troubleshooting information in Section VIII (Service Sheet 1) in this manual.*

DESCRIPTION:

The phase modulated output of the System Under Test is demodulated using a phase modulation test set. The harmonic levels are measured with a spectrum analyzer and the total harmonic distortion is calculated. A low pass filter is used between test oscillator and modulation section to insure that the modulation drive signal has less than 0.3% distortion.

PERFORMANCE TESTS

4-31B. PHASE MODULATION DISTORTION – ALTERNATE PROCEDURE (Cont'd)

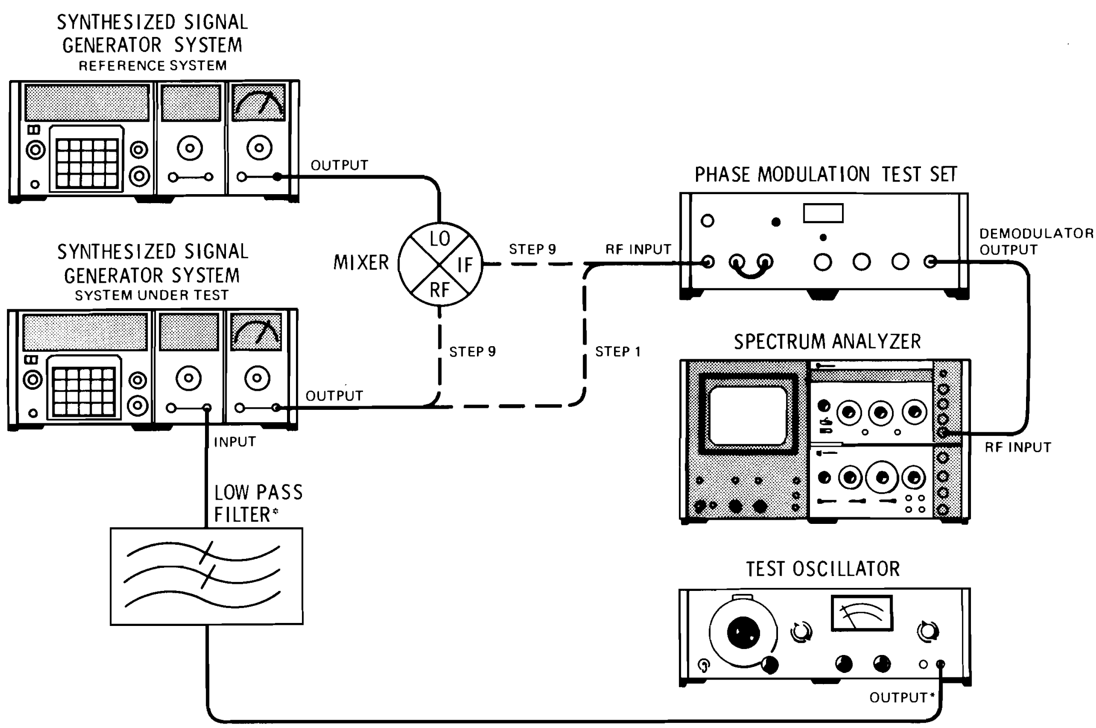


Figure 4-16B. Phase Modulation Distortion Test Setup (Alternate Procedure)

EQUIPMENT:

Synthesized Signal Generator	HP 8660C/86602B/86631B
Test Oscillator	HP 651B
Mixer	Watkins Johnson M1J
Phase Modulation Test Set	HP 8660C-K10
Spectrum Analyzer	HP 8553B/8552B/140T
Low Pass Filters (1 MHz 600Ω; 1, 5, and 10 MHz — 50Ω)	Specials (See Figure 1-4)

PROCEDURE:

1. Set the Test Oscillator to 1 MHz, connect a 1 MHz low pass filter (50 ohm for 86634A, 600 ohm for 86635A) to appropriate test oscillator output and adjust for 1.7 Vrms output. Connect the rest of the equipment as shown in Figure 4-16B.

2. Set the system under test for 300 MHz center frequency and +3 dBm output (0 dBm range). Connect the RF output jack directly to the RF input of the phase modulation test set.

3. Set the system under test controls for ϕM with a modulation level of 100° peak deviation.

* In Figure 4-16B, the test oscillator output impedance and Low Pass Filter impedance is 50 ohms when the modulation section is a Model 86634A and 600 ohms with a Model 86635A.

PERFORMANCE TESTS

4-31B. PHASE MODULATION DISTORTION – ALTERNATE PROCEDURE (Cont'd)

4. View the signal generator output on the spectrum analyzer display. Record the level of the second and third harmonics of the demodulated output signal with respect to the fundamental.

5. Use Table 4-1 to obtain power ratios of the harmonics. Then use Table 4-1 to find the dB level corresponding to sum of the two ratios. The resultant level should be < 5% or ⩾ 26 dB down.

   86634A 26 dB down ____________
   86635A 26 dB down ____________

6. Set the center frequency of the system under test to 299.9 MHz.

7. Set the test oscillator to 1 MHz (10 MHz), connect the 1 MHz (10 MHz) low pass filter to the appropriate oscillator output (50 or 600Ω) and adjust for an output of 1.7 Vrms.

8. Repeat steps 3-5. Total harmonic distortion should be < 5% or ⩾ 26 dB down (< 15% or ⩾ 16.5 dB down).

   86634A 16.5 dB down ____________
   86635A 26 dB down ____________

9. Set the center frequency of the system under test to 1200 MHz. Connect the mixer and the reference system as shown in Figure 4-18b.

10. Set the reference system center frequency to 900 MHz with an RF output level of +7 dBm.

11. Increase the RF output level of the system under test (if necessary) until the Phase Modulation Test Set phase locks.

12. Set the test oscillator frequency to 1 MHz (5 MHz). Connect the 1 MHz (5 MHz) low pass filter (50 or 600Ω) to the oscillator output. Adjust the test oscillator output level to 1.7 Vrms. Set the system under test modulation level to 100° peak deviation.

13. Repeat steps 3-5. Total harmonic distortion should be < 5% or ⩾ 26 dB down (< 7% or ⩾ 23.1 dB down).

   86634A 23.1 dB down ____________
   86635A 26 dB down ____________

Table 4-4. Performance Test Record (1 of 6)

Hewlett-Packard
Models 86602B/11661
RF Section/Frequency Extension Module

Tested By ______________________

Serial No. ______________________ Date ______________________

Para. No.	Test	Results		
		Min.	Actual	Max.
4-9.	FREQUENCY RANGE			
	1.000 000 MHz	–1 Hz	______	+1 Hz
	1299.999 999 MHz	–1 Hz	______	+1 Hz
4-11.	FREQUENCY SWITCHING TIME 6 ms to be within 50 Hz of any new frequency			
	Step 9 - 30.000 000 MHz ± 50 Hz	–50 Hz	______	+50 Hz
	Step 10 - 29.999 999 MHz ± 50 Hz	–50 Hz	______	+50 Hz
	100 ms to be within 5 Hz of any new frequency			
	Step 14 - 30.000 000 MHz ± 5 Hz	–5 Hz	______	+5 Hz
	Step 15 - 29.999 999 MHz ± 5 Hz	–5 Hz	______	+5 Hz
4-12.	OUTPUT LEVEL SWITCHING TIME Remote programming of level change on same range accomplished in 5 ms, maximum, at 50 MHz.			
	Step 4 - 10 to 19 dB		______	5 ms
	Level change to another range accomplished in 50 ms, maximum at 50 MHz.			
	Step 5 - 10 to 30 dB		______	50 ms
	Remote programming of level change on same range accomplished in 5 ms, maximum, at 1 MHz.			
	Step 6 - 10 to 19 dB		______	5 ms

Table 4-4. Performance Test Record (2 of 6)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-13A.	OUTPUT ACCURACY				
	OUTPUT RANGE	Front Panel Meter Reading			
	+10 dBm	0 dB	+ 8.5 dBm	________	+ 11.5 dBm
	+10 dBm	–3 dB	+ 5.5 dBm	________	+ 8.5 dBm
	+10 dBm	–6 dB	+ 2.5 dBm	________	+ 5.5 dBm
	0 dBm	–6 dB	– 7.5 dBm	________	– 4.5 dBm
	0 dBm	–3 dB	– 4.5 dBm	________	– 1.5 dBm
	0 dBm	0 dB	– 1.5 dBm	________	+ 1.5 dBm
	0 dBm	+3 dB	+ 1.5 dBm	________	+ 4.5 dBm
	– 10 dBm	+3 dB	– 8.5 dBm	________	– 5.5 dBm
	– 20 dBm	+3 dB	– 18.5 dBm	________	– 15.5 dBm
	– 30 dBm	+3 dB	– 28.5 dBm	________	– 25.5 dBm
	– 40 dBm	+3 dB	– 38.5 dBm	________	– 35.5 dBm
	– 50 dBm	+3 dB	– 48.5 dBm	________	– 45.5 dBm
	– 60 dBm	+3 dB	– 58.5 dBm	________	– 55.5 dBm
	– 70 dBm	+3 dB	– 68.5 dBm	________	– 65.5 dBm
	– 80 dBm	+3 dB	– 79.0 dBm	________	– 75.0 dBm
	– 90 dBm	+3 dB	– 89.0 dBm	________	– 85.0 dBm
	–100 dBm	+3 dB	– 99.0 dBm	________	– 95.0 dBm
	–110 dBm	+3 dB	–109.0 dBm	________	–105.0 dBm
	–120 dBm	+3 dB	–119.0 dBm	________	–115.0 dBm
	–130 dBm	+3 dB	–129.0 dBm	________	–125.0 dBm
4-13B.	OUTPUT ACCURACY – ALTERNATE PROCEDURE				
	OUTPUT RANGE	Front Panel Meter Reading			
	10 dBm	0 dB	+ 8.5 dBm	________	+ 11.5 dBm
	10 dBm	–3 dB	+ 5.5 dBm	________	+ 8.5 dBm
	10 dBm	–6 dB	+ 2.5 dBm	________	+ 5.5 dBm
	0 dBm	–6 dB	– 7.5 dBm	________	– 4.5 dBm
	0 dBm	–3 dB	– 4.5 dBm	________	– 1.5 dBm
	0 dBm	0 dB	– 1.5 dBm	________	+ 1.5 dBm
	0 dBm	3 dB	+ 1.5 dBm	________	+ 4.5 dBm
	– 10 dBm	3 dB	– 8.5 dBm	________	– 5.5 dBm
	– 20 dBm	3 dB	– 18.5 dBm	________	– 15.5 dBm
	– 30 dBm	3 dB	– 28.5 dBm	________	– 25.5 dBm
	– 40 dBm	3 dB	– 38.5 dBm	________	– 35.5 dBm
	– 50 dBm	3 dB	– 48.5 dBm	________	– 45.5 dBm
	– 60 dBm	3 dB	– 58.5 dBm	________	– 55.5 dBm
	– 70 dBm	3 dB	– 68.5 dBm	________	– 65.5 dBm
	– 80 dBm	3 dB	– 79.0 dBm	________	– 75.0 dBm
	Level change from the –70 to –80 dBm OUTPUT RANGE		9.0 dB	________	11.0 dB

Table 4-4. Performance Test Record (3 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-14.	OUTPUT FLATNESS Reference Level is –1.0 dBm at 1000 MHz.			
	1 MHz	– 2.0 dBm	_______	0.0 dBm
	10 MHz	– 2.0 dBm	_______	0.0 dBm
	100 MHz	– 2.0 dBm	_______	0.0 dBm
	200 MHz	– 2.0 dBm	_______	0.0 dBm
	400 MHz	– 2.0 dBm	_______	0.0 dBm
	600 MHz	– 2.0 dBm	_______	0.0 dBm
	800 MHz	– 2.0 dBm	_______	0.0 dBm
	1299 MHz	– 2.0 dBm	_______	0.0 dBm
4-15.	HARMONIC SIGNALS OUTPUT RANGE = +10 dBm			
	Step 5 - 1299 MHz			
	Second Harmonic	25 dB down	_______	
	Third Harmonic	25 dB down	_______	
	Step 6 - 1000 MHz			
	Second Harmonic	25 dB down	_______	
	Third Harmonic	25 dB down	_______	
	Step 6 - 500 MHz			
	Second Harmonic	25 dB down	_______	
	Third Harmonic	25 dB down	_______	
	Step 6 - 100 MHz			
	Second Harmonic	25 dB down	_______	
	Third Harmonic	25 dB down	_______	
	Step 6 - 10 MHz			
	Second Harmonic	25 dB down	_______	
	Third Harmonic	25 dB down	_______	
	OUTPUT RANGE = 0 dBm			
	Step 7 - 100 MHz			
	Second Harmonic	30 dB down	_______	
	Third Harmonic	30 dB down	_______	
4-16.	PULSE MODULATION RISETIME Risetime (10% to 90% amplitude points)		_______	50 ns
4-17.	PULSE MODULATION ON/OFF RATIO On/Off Ratio	40 dB	_______	

Table 4-4. Performance Test Record (4 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-18.	**AMPLITUDE MODULATION DEPTH AND 3 dB BANDWIDTH**			
	Frequency = 500 MHz			
	OUTPUT RANGE = –10 dBm			
	Rate = 1 kHz			
	Step 13 - 30% AM	50 mVrms	______	70 mVrms
	Step 14 - 70% AM	130 mVrms	______	150 mVrms
	Step 15 - 90% AM	170 mVrms	______	190 mVrms
	Frequency = 500 MHz			
	OUTPUT RANGE = –10 dBm			
	AM = 30%			
	Step 19 - 5 kHz rate (reference 5 div. p-p)			
	AM less than 3 dB down (<3.5 div. p-p) at 100 kHz	3.5 div. p-p	______	
	Frequency - 1 - 9 MHz			
	OUTPUT RANGE = –10 dBm			
	AM - 30%			
	Step 21 - 5 kHz rate (reference 5 div. p-p)			
	AM less than 3 dB down (>3.5 div. p-p) at 10 kHz	3.5 div. p-p	______	
4-20.	**OUTPUT IMPEDANCE**			
	Center Frequency 500 MHz			
	OUTPUT RANGE +10 dBm			
	dB = 20 log (VSWR)			
	dB = 6.0 for VSWR = 2.0		______	6 dB
	OUTPUT RANGE dBm			
	dB = 6.0 for VSWR = 2.0			
	OUTPUT RANGE –10 dBm		______	6 dB
	dB = 2.3 for VSWR = 1.3		______	2.3 dB
4-21.	**SIGNAL-TO-PHASE NOISE RATIO**			
	Noise Level	45 dB down	______	
4-22.	**SIGNAL-TO-AM NOISE RATIO**			
	Noise Level	65 dB down	______	

Table 4-4. Performance Test Record (5 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-24.	**AMPLITUDE MODULATION DISTORTION**			
	Step 7 - 30% AM			
	Total Distortion (<1%)		______	1%
	Step 9 - 70% AM			
	Total Distortion (<3%)		______	3%
	Step 11 - 90% AM			
	Total Distortion (<5%)		______	5%
4-25.	**INCIDENTAL PHASE MODULATION**			
	Step 8 - <0.2 radians peak (<11.5° peak)		______	
4-26.	**FREQUENCY MODULATION DISTORTION**			
	Total Distortion <2%	37 dB down	______	
4-27.	**INCIDENTAL AM**			
	Incidental AM	60 dB down	______	
4-28.	**SPURIOUS SIGNALS, NARROWBAND**			
	(All spurious signals down from carrier 80 dB minimum.)			
	Spurious Response			
	System Under Test — Reference Unit			
	100.280000 MHz — 100.561000 MHz	80 dB down	______	
	200.280000 MHz — 200.561000 MHz	80 dB down	______	
	409.720000 MHz — 409.441000 MHz	80 dB down	______	
	509.720000 MHz — 509.441000 MHz	80 dB down	______	
	1109.720000 MHz — 1109.441000 MHz	80 dB down	______	
	1209.720000 MHz — 1209.441000 MHz	80 dB down	______	
4-29.	**SPURIOUS SIGNALS, WIDEBAND**			
	(All spurious signals down from carrier 50 dB, minimum.)			
	Spurious Response			
	Mainframe Frequency — Spur Frequency			
	1299 MHz — 150 MHz	50 dB down	______	
	1150 MHz	50 dB down	______	
	1450 MHz	50 dB down	______	
	1000 MHz — 950 MHz	50 dB down	______	
	1050 MHz	50 dB down	______	
	999.9 MHz — 950 MHz	50 dB down	______	
	1050 MHz	50 dB down	______	
	800.0 MHz — 750 MHz	50 dB down	______	
	799.9 MHz — 850 MHz	50 dB down	______	

Table 4-4. Performance Test Record (6 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-31A.	**PHASE MODULATION DISTORTION** Step 6 - Distortion (<5%) ≤ 1 MHz rate	<5%	________	
4-31B.	**PHASE MODULATION DISTORTION – ALTERNATE PROCEDURE**			
	Step 5 - 300 MHz at			
	1 MHz rate 86634A <5%	26 dB down	________	
	1 MHz rate 86635A <5%	26 dB down	________	
	Step 6 - 299.9 MHz at			
	10 MHz rate 86634A <15%	16.5 dB down	________	
	1 MHz rate 86635A <5%	26 dB down	________	
	Step 13 - 1900 MHz at			
	5 MHz rate 86634A <7%	23.1 dB down	________	
	1 MHz rate 86635A <5%	26 dB down	________	

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section contains adjustment procedures required to assure peak performance of the Model 86602B RF Section. The RF Section should be adjusted after any repair or if the unit, in conjunction with the Frequency Extension Module, fails to meet the specifications listed in Section IV of this manual. Prior to making any adjustments, allow the RF Section warmup for 30 minutes.

5-3. The order in which some adjustments are made to the RF Section is critical. Perform the adjustments under the conditions presented in this section. Do not attempt to make adjustments randomly to the instrument. Prior to making any adjustments to the RF Section, refer to the paragraph entitled Related Adjustments.

5-4. EQUIPMENT REQUIRED

5-5. 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.

5-6. If substitutions must be made for the specified test equipment, refer to Table 1-2 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 the table.

5-7. The HP 11672A Service Kit is an accessory item available from Hewlett-Packard for use in maintaining the RF Section. A detailed listing of the items contained in the service kit is provided in the 11672A Operating Note and in Section I of the mainframe manuals. Any item in the kit may be ordered separately.

5-8. SAFETY CONSIDERATIONS

5-9. 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.

5-10. 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.

5-11. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNING

Adjustments described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may constitute a shock hazard.

5-12. FACTORY SELECTED COMPONENTS

5-13. Factory selected components are identified on the schematics and parts list by an asterisk which follows the reference designator. The normal value of the components are 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.

5-14. RELATED ADJUSTMENTS

5-15. The RF Output Level and 1 dB Step Attenuator Adjustments interact. The Amplitude Modulation Input Circuit Adjustment is dependent on and should be performed after the previous mentioned adjustments. The Phase Modulation Level and Distortion Adjustment is affected by and should be performed after the Phase Modulator Driver Frequency Response Adjustment. All other adjustments are independent.

5-16. If the RF Output Level Adjustment is performed, the 1 dB Step Attenuator Adjustment should follow immediately. Repeat these procedures until the RF levels are within the stated limits without further adjustment. Then perform the Amplitude Modulation Input Circuit Adjustment. If the Phase Modulator Driver Frequency Response Adjustment is performed, the Phase Modulation Level and Distortion Adjustment should be performed.

5-17. If the RF Output Level and 1 dB Step Attenuator Adjustments are not performed, the Amplitude Modulation Input Circuit Adjustment may be considered independent. If the Phase Modulator Driver Frequency Response Adjustment is not performed, the Phase Modulation Level and Distortion Adjustment may be considered independent.

5-18. ADJUSTMENT LOCATIONS

5-19. The last foldout in this manual contains a table which cross-references pictorial and schematic locations of the adjustable controls. The figure accompanying the table shows the locations of adjustable controls, assemblies, and chassis-mounted parts.

5-20. ADJUSTMENTS

5-21. Before performing the adjustment procedures (1) disconnect the mainframe (Mains) Power Cable, (2) remove the RF Section from the mainframe, and (3) remove the RF Section covers. At this point, the RF Section is either reinserted into the mainframe or connected to the mainframe with interconnection cables supplied in the Service Kit. If the RF Section is reinserted into the mainframe for adjustments, the mainframe top and/or right side covers must be removed. Refer to the left-hand foldout page immediately preceding the last foldout in this manual for procedures explaining how to remove the RF Section from the mainframe, the RF Section cover removal, and how to interconnect the RF Section and mainframe for adjustments.

NOTE

It may be necessary to remove the upper guide rail to gain access to some of the adjustable components.

5-22. POST ADJUSTMENT TESTS

5-23. After adjustments are performed verify that the system performance is within the parameters specified for the RF Section and Frequency Extension Module. Perform the applicable performance test(s) found in Section IV.

WARNING

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

Table 5-1. Factory Selected Components

Reference Designator	Selected For	Normal Value Range	Service Sheet
A4R17	Accurately sets the 10 dB difference in the power output between OUTPUT RANGE switch settings of +10 and 0 dBm (the VERNIER control is not moved).	237Ω	6
A16R5	Sets the adjustment range of the Gain Tracking Control A16R4. Refer to the Phase Modulator Driver Adjustments procedure.	10 to 316Ω	5

5-24. RF OUTPUT LEVEL ADJUSTMENT

REFERENCE:

Service Sheet 6.

DESCRIPTION:

The Meter and Detector Bias controls are adjusted alternately at specific RF Output levels until the VERNIER'S control of the RF Output is linear across the control range.

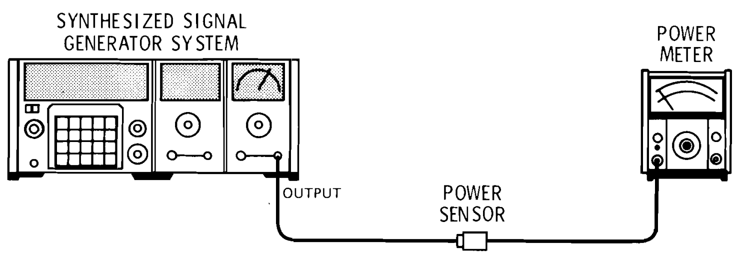


Figure 5-1. RF Output Level Adjustment Test Setup

EQUIPMENT:

Power Meter/Sensor . . . . HP 435A/8481A

PROCEDURE:

NOTE

Prior to performing the procedure, clean the meter face with antistatic glass cleaner. *

1. Extract the RF Section from the mainframe. Remove the mainframe top cover and the RF Section covers. Insert the RF Section into the mainframe.
2. Zero the external Power Meter.
3. Interconnect the equipment as illustrated in Figure 5-1.
4. Set the system's center frequency to 1000 MHz and the RF Section's OUTPUT RANGE switch to the 0 dBm position.
5. Adjust the VERNIER control for a +3.0 dBm indication on the external Power Meter.
6. Adjust MTR potentiometer A4R26 for a +3.0 dB indication on the front panel meter.
7. Adjust the VERNIER control for a front panel meter indication of —6.0 dB.
8. Adjust the BIAS potentiometer A4R13 for a —6.0 dBm indication on external Power Meter.
9. Repeat steps 5 through 8 until the RF Section's front panel meter indicates power levels that are within ±0.3 dB of the external Power Meter indications with no further adjustment.

*STATNUL by Weston Instrument Inc., Newark, New Jersey

5-25. 1 dB STEP ATTENUATOR ADJUSTMENT

REFERENCE:

Service Sheet 7.

DESCRIPTION:

RF Level and RF Linearity controls are adjusted alternately at specific RF Output levels until the programmed 1 dB step control of RF Output is linear across the range (10 dB).

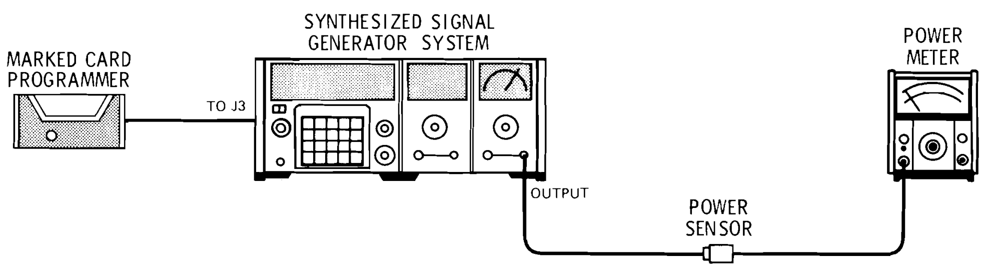


Figure 5-2. 1 dB Step Attenuator Adjustment Test Setup

EQUIPMENT:

Marked Card Programmer	HP 3260A Opt 001
Power Meter/Sensor	HP 435A/8481A

PROCEDURE:

1. Connect the equipment as illustrated in Figure 5-2.
2. Zero the external Power Meter.
3. Use a Marked Card Programmer to program the mainframe for a center frequency of 1000 MHz and the RF Section for an output power level of +3 dBm.
4. Adjust the RF Section's RF Level Control A10R7 for a +3.0 dBm indication on the power meter.
5. Use the Marked Card Programmer to program the RF Section for an output power level of —6 dBm.
6. Adjust the Linearity control A3R4 for a —6.0 dBm indication on the power meter.
7. Repeat steps 3 through 6 until the programmed output power levels are within ±0.3 dB of the required power meter indication.
8. Recheck the power meter readings for the RF Output Level Adjustments. If necessary, perform the adjustments again. Then check the power meter readings for this procedure. Alternately perform one procedure and check the power meter readings on the other until the RF levels are within tolerance without further adjustment.

5-25. 1 dB STEP ATTENUATOR ADJUSTMENT (Cont'd)

9. Perform the Amplitude Modulation Input Circuit Adjustments.

5-26. AMPLITUDE MODULATION INPUT CIRCUIT ADJUSTMENT

REFERENCE:

Service Sheet 7.

DESCRIPTION:

A specific modulation drive level is coupled to the RF Section. The RF output signal is demodulated by a peak detector in a spectrum analyzer (when the frequency-span width is set to zero). The ac and dc components are measured with a voltmeter at the detector (vertical) output. First, the dc component is set to −283 mVdc plus the detector offset correction. Then, the ac component is measured. The AM level (%) is 1/2 (one half) the rms output.

Because of the required measurement accuracy, the accuracy of the spectrum analyzer's detector offset must be known to ±2 mVdc. The offset voltage is calculated by measuring the change in the detector output for a change in the RF input and assuming a linear detector over the range of the levels used.

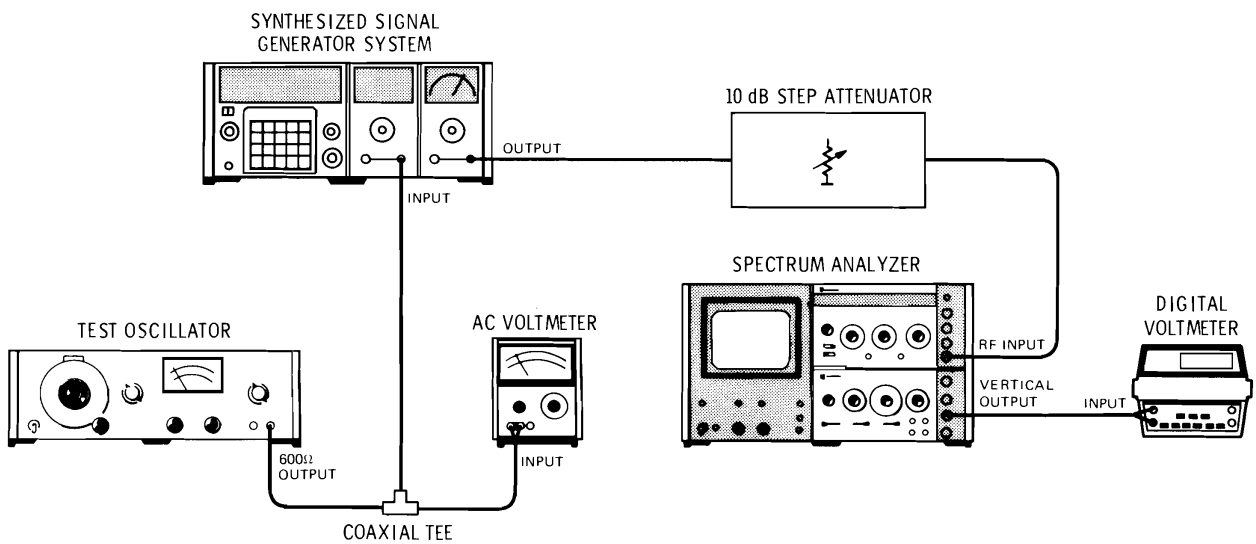


Figure 5-3. Amplitude Modulation Input Circuit Adjustment Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
AC Voltmeter	HP 403B
10 dB Step Attenuator	HP H38-355D
Spectrum Analyzer	HP 8555A/8552B/140T
Digital Voltmeter	HP 34740A/34702A
Coaxial Tee (2 required)	HP 1250-0781
Crystal Detector	HP 423A
Oscilloscope	HP 180C/1801A/1821A
Resistor, 1K	HP 0757-0280

ADJUSTMENTS

5-26. AMPLITUDE MODULATION INPUT CIRCUIT ADJUSTMENT (Cont'd)

PROCEDURE:

1. Remove the RF Section from the mainframe. Remove the mainframe top cover and the RF Section covers. Insert the RF Section into the mainframe.

2. Connect the equipment as shown in Figure 5-3.

3. Set the synthesized signal generator controls as follows: center frequency 30 MHz, OUTPUT RANGE 0 dBm. VERNIER control for a panel meter reading of +3 dB, and AM off.

4. Let the spectrum analyzer warm up for 1 hour to minimize drift of the spectrum analyzer detector output. Set the 10 dB step attenuator to 10 dB attenuation.

5. Set the spectrum analyzer center frequency to 30 MHz, frequency span per division 5 MHz, resolution bandwidth 300 kHz; input attenuation to 20 dB, and vertical sensitivity per division 10 dB. Adjust the center frequency control to center the display. Set the frequency span to zero and tune to peak the trace.

NOTE

Throughout this test, continually check that the signal is peaked for maximum deflection. Tune the center frequency control for maximum signal deflection.

6. Set the vertical scale to linear and adjust the reference level vernier for a digital voltmeter reading of −200 mVdc.

7. Set the 10 dB step attenuator to 0 dB and record the digital voltmeter reading.

   ______________mVdc

8. Set the 10 dB Step Attenuator to 20 dB and record the digital voltmeter reading.

   ______________mVdc

9. Calculate the offset voltage using the following formula:

$$V_{off} = \frac{mVdc + 200\alpha}{1 - \alpha}$$

Where V_{off} is the offset voltage in millivolts
mVdc is the DVM reading in millivolts.
α is 3.16 (step 7) and 0.316 (step 8).

For example:

mVdc = −687 in step 7

Therefore $V_{off} = \frac{-687 + 200\,(3.16)}{1 - (3.16)} = +25.5$ mVdc

10. Find the value of V_{off} for step 8. The difference between the two should be <4 mVdc. Use the average value of V_{off}.

   V_{off} = ____________mVdc

ADJUSTMENTS

5-26. AMPLITUDE MODULATION INPUT CIRCUIT ADJUSTMENT (Cont'd)

11. Set the 10 dB step attenuator to 10 dB.

12. Set the system center frequency to 1000 MHz, the modulation mode to AM, the modulation source to external, and a modulation level of 50% (0.5 Vrms input to an Auxiliary Section) at a 1 kHz rate.

13. Set the spectrum analyzer center frequency control to 1000 MHz, and set the reference level vernier for digital voltmeter reading of −283 mVdc + V_{off}. See Step 10.

14. Set the DVM controls to measure the peak detector's ac component. The modulation level (%) is 1/2 (one-half) the DVM reading (Vrms). Adjust the AM CAL Control A10R5 for a reading of 100 mVrms.

15. Set the RF Section's VERNIER control for a front panel meter reading of −6 dB.

16. Set the DVM to monitor the dc vertical output. Reset the DVM reading of −283 mVdc + V_{off}.

17. Set the DVM to monitor the ac vertical output. Adjust the AM Linearity control A10R2 for a DVM reading of 100 mVrms.

18. Repeat steps 13 through 17 until the DVM reading is 100 ±2 mVrms at RF Section meter readings of +3 and −6 dB without further adjustment.

5-27. PHASE MODULATOR DRIVER FREQUENCY RESPONSE ADJUSTMENTS

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The output of a sweep generator is connected to the A16 Phase Modulator Driver Assembly input while a spectrum analyzer monitors the system's phase modulated RF output. The frequency response control is adjusted for maximum flatness to ±40 MHz and for minimum peaking at 80 MHz.

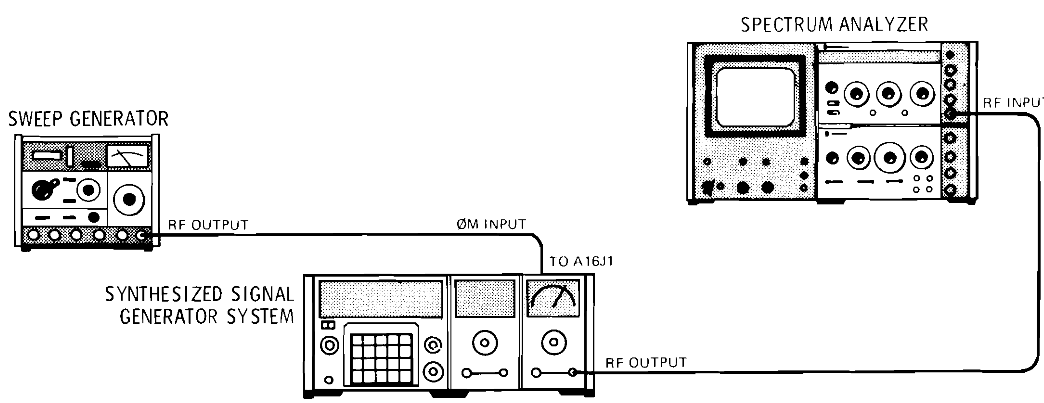


Figure 5-4. Phase Modulator Driver Frequency Response Adjustment Test Setup

5-27. PHASE MODULATOR DRIVER FREQUENCY RESPONSE ADJUSTMENTS (Cont'd)

EQUIPMENT:

Sweep Generator . . . . HP 8601A
Spectrum Analyzer . . . . HP 8555A/8552B/140T

PROCEDURE:

1. Remove the RF Section from the mainframe. Remove the mainframe top cover and the RF Section covers and top guide rail.

2. Remove cable W12 from the ϕM Input A16J1 and wrap the connector with insulating tape. Connect 11672-60005 (from the Service Kit) to A16J1. Route the BNC end of cable into the cavity and out through the top of the mainframe. Carefully reinstall the RF Section so as not to damage the cables.

3. Set the sweep generator controls as follows: sweep range 110 MHz, frequency 80 MHz, output level —10 dBm, sweep video, sweep mode free; slow.

4. Connect the equipment as shown in Figure 5-6.

5. Set the synthesized signal generator controls for a center frequency of 1.05 GHz and an output level of 0 dBm.

6. Set the spectrum analyzer controls for center frequency of 1.05 GHz, frequency span per division 20 MHz, resolution bandwidth 300 kHz. input attenuation 30 dB, vertical sensitivity per division 10 dB, and sweep time per division 2 ms.

7. Adjust the sweep generator output level so the sidebands are approximately 34 dB below the carrier level.

8. Set the spectrum analyzer vertical sensitivity per division to 2 dB.

9. Adjust the Frequency Response Control A16C8 for maximum flatness within 40 MHz of the carrier and for the minimum peaking at 80 MHz.

10. Disconnect the sweep generator from the A16 Assembly and set the signal generator LINE switch to STBY.

11. Carefully remove the RF Section. Be careful not to damage the cables. Reconnect W12 to A16J1.

5-28A. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The phase modulated signal from the synthesized signal generator is monitored by a spectrum analyzer and is adjusted to the modulation level indicated by the modulation level meter. The phase modulated signal is then mixed down, the difference frequency is connected to an FM discriminator, and the detected output is connected to the spectrum analyzer. The adjustments are set to minimize harmonic distortion. The modulation level and distortion adjustments are repeated until both are within the required accuracy.

ADJUSTMENTS

5-28A. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS (Cont'd)

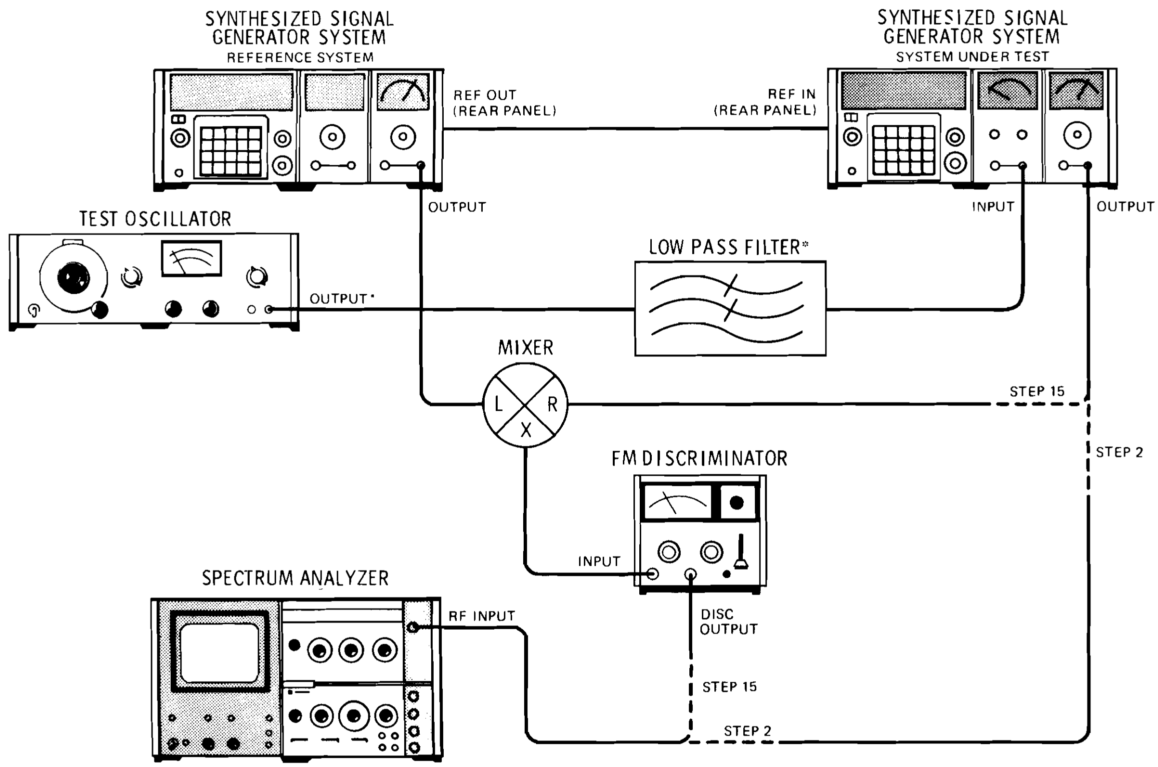


Figure 5-5A. Phase Modulation Level and Distortion Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8553B/8552B/140T
Synthesized Signal Generator System	HP 8660C/86603A/86631B
Test Oscillator	HP 651B
FM Discriminator	HP 5210A
Mixer, Doubler Balanced	HP 10514A
Low Pass Filters (100 kHz at 50Ω or 600Ω) . .	Special (See Figure 1-4)

PROCEDURE:

1. Extract the RF Section from mainframe. Remove the mainframe top cover, the RF Section covers, and the top guide rail. Insert the RF Section back into the mainframe.

2. Connect the equipment as shown in Figure 5-5A. Connect the output of the System Under Test directly to the spectrum analyzer RF input. Be sure to use the correct test oscillator output and the correct low pass filter.

3. Set the test oscillator output to 100 kHz at 1.5 Vrms.

4. Set the System Under Test center frequency to 100 MHz with a 0 dBm OUTPUT level.

*In Figure 5-5A, the test oscillator output and low pass filter impedances are 50Ω when the modulation section being used is a Model 86634A and 600Ω when used with an 86635A.

5-28A. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS (Cont'd)

5. Set the spectrum analyzer controls for a center frequency of 100 MHz, resolution bandwidth of 10 kHz, frequency span per division of 0.5 MHz, sweep time per division of 10 ms, input attenuation of 30 dB, vertical scale per division to 2 dB and adjust the reference level to a readable level.

6. Set the Modulation Section controls for ϕM mode, external AC source, and a modulation level of exactly 82° as read on the front panel meter.

7. Adjust A16R2 so the carrier and first sidebands are of equal amplitude.

8. Step the System Under Test center frequency down 1 Hz to 99.999999 MHz. The carrier and first sidebands should be within 0.5 dB. If the difference is less than or equal to 0.4 dB, proceed to step 11. If the difference is greater than 0.5 dB and if the ϕM deviation is <82° (first sideband is of lower amplitude than the carrier) proceed to step 9. If the ϕM deviation is >82° proceed to step 10.

9. Adjust A16R4 one-eighth turn ccw. If A16R4 is in contact with the ccw stop, increase the value of A16R5. (The normal value range is 10 to 316Ω.) Set the frequency of the System Under Test to 100 MHz and repeat steps 7 and 8.

10. Adjust A16R4 one-eighth turn cw. If A16R4 is in contact with the cw stop, decrease the value of A16R5. (The normal value range is 10 to 316Ω.) Set the frequency of the System Under Test to 100 MHz and repeat steps 7 and 8.

11. Set the FM discriminator controls for the 10 MHz range and the 0.1V sensitivity, and insert an internal 1 MHz low-pass filter.

12. Set the spectrum analyzer controls for a center frequency of 200 kHz, resolution bandwidth to 3 kHz, frequency span per division to 50 kHz, input attenuation to 0 dB, log reference level to a convenient level, vertical sensitivity per division to 10 dB, and scan time per division to 10 ms.

13. Set the Reference System controls for a center frequency of 309 MHz and an output level of +7 dBm.

14. Set the System Under Test center frequency to 300 MHz with a modulation level of 100° as read on the front panel meter.

15. Refer to Figure 5-5A and connect the System Under Test OUTPUT to the "RF" input of the mixer. Connect the FM Discriminator output to the spectrum analyzer RF input.

16. Adjust the spectrum analyzer's reference level control so the peak of the fundamental 100 kHz signal is viewed on the CRT display at the log reference graticule line.

17. Adjust A16R3 to null the second harmonic level; adjust A16R1 to null the third harmonic level.

NOTE

Observing harmonic distortion of a ϕM signal after passing it through an FM discriminator results in an increase in level of 6 dB per octave. Therefore, the second harmonic will be 6 dB higher and the third harmonic 9.5 dB higher than with a phase demodulator.

ADJUSTMENTS

5-28A. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS (Cont'd)

18. Step the System Under Test center frequency down 1 Hz. Note the direction and amount of readjustment of A16R3 and R1 necessary to null the second and third harmonics.

19. Set A16R3 and R1 for the best compromise (minimum second and third harmonic levels) at both center frequency settings of 299.999999 and 300 MHz.

20. Repeat steps 4 through 20 until all the conditions below are met without further adjustment.

    a. Carrier and first sidebands are equal within 0.5 dB when changing Center Frequency of System Under Test between 100 and 99.999999 MHz (Steps 7-8).

    b. Second harmonic levels are equal within 4 dB or >40 dB down from the fundamental as indicated by the spectrum analyzer at center frequencies of 300 and 299.999999 MHz (Step 19).

    c. Third harmonic levels are equal within 4 dB or >35 dB down from the fundamental as indicated by the spectrum analyzer frequencies of 300 and 299.999999 MHz (Step 19).

21. Replace the mainframe cover and wait 10 minutes. Check to see if the conditions outlined in step 21 are still met. If not repeat steps 4 through 21.

5-28B. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS - ALTERNATE PROCEDURE

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The phase modulated signal from the synthesized signal generator is monitored by a spectrum analyzer and is adjusted to the modulation level indicated by the modulation level meter. The phase modulated signal is then mixed down, the difference frequency is connected to a phase demodulator, and the detected output is connected to the spectrum analyzer. The adjustments are set to minimize harmonic distortion. The modulation level and distortion adjustments are repeated until both are within the required accuracy.

ADJUSTMENTS

5-28B. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS - ALTERNATE PROCEDURE (Cont'd)

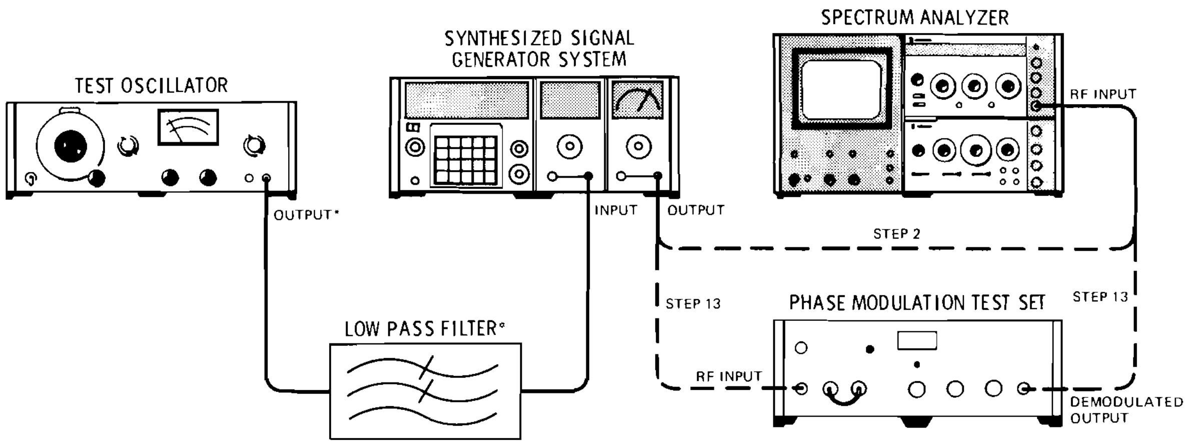


Figure 5-5B. Phase Modulation Level and Distortion Adjustment Test Setup (Alternate Procedure)

EQUIPMENT:

Spectrum Analyzer	HP 8553B/8552B/140T
Test Oscillator	HP 651B
Low Pass Filters (1 MHz at 50Ω or 600Ω) . . .	Special (See Figure 1-4)
Phase Modulation Test Set	HP 8660C-K10

PROCEDURE:

1. Extract the RF Section from mainframe. Remove the mainframe top cover, the RF Section covers, and the top guide rail. Insert the RF Section back into the mainframe.

2. Connect the equipment as shown in Figure 5-5B. Connect the output of the System Under Test directly to the spectrum analyzer RF input. Be sure to use the correct test oscillator output and the correct low pass filter.

3. Set the test oscillator output to 100 kHz at 1.5 Vrms.

4. Set the System Under Test center frequency to 100 MHz with a 0 dBm OUTPUT level.

5. Set the spectrum analzer controls for a center frequency of 100 MHz, resolution bandwidth of 10 kHz, frequency span per division of 0.5 MHz, sweep time per division of 10 ms, input attenuation of 30 dB, vertical scale per division of 2 dB, and adjust the reference level to a readable level.

6. Set the Modulation Section controls for ϕM mode, external AC source, and a modulation level of exactly 82° as read on the front panel meter.

*In Figure 5-5B, the test oscillator output and low pass filter impedances are 50 ohms when the modulation section being used is a Model 86634A and 600 ohm when used with an 86635A.

5-28B. PHASE MODULATION LEVEL AND DISTORTION ADJUSTMENTS - ALTERNATE PROCEDURE (Cont'd)

7. Adjust A16R2 so the carrier and first sidebands are of equal amplitude.

8. Step the System Under Test center frequency down 1 Hz to 99.999999 MHz. The carrier and first sidebands should be within 0.5 dB. If the difference is less than or equal to 0.5 dB, proceed to Step 11. If the difference is greater than 0.5 dB and if the ϕM deviation is <82° (first sideband is of lower amplitude than the carrier) proceed to Step 9. If the ϕM deviation is >82° proceed to Step 10.

9. Adjust A16R4 one-eighth turn ccw. If A16R4 is in contact with the ccw stop, increase the value of A16R5. (The normal value range is 10 to 316 ohms.) Set the frequency of the System Under Test to 100 MHz and repeat Steps 7 and 8.

10. Adjust A16R4 one-eighth turn cw. If A16R4 is in contact with the cw stop, decrease the value of A16R5. (The normal value range is 10 to 316 ohms.) Set the frequency of the System Under Test to 100 MHz and repeat Steps 7 and 8.

11. Set the spectrum analyzer controls for a center frequency of 2 MHz, resolution bandwidth to 30 kHz, frequency span per division to 0.5 MHz input attenuation to 0 dB, log reference level to a convenient level, vertical sensitivity per division to 10 dB, and scan time per division to 10 ms.

12. Set the System Under Test center frequency to 300 MHz with a modulation level of 100° as read on the front panel meter.

13. Connect the phase modulation test set between the signal generator output and the spectrum analyzer input as shown in Figure 5-5B.

14. Adjust the spectrum analyzer's reference level so the peak of the fundamental 1 MHz signal is viewed on the CRT display at the log reference graticule line.

15. Adjust A16R3 to null the second harmonic level; adjust A16R1 to null the third harmonic level.

16. Step the System Under Test center frequency down 1 Hz. Note the direction and amount of readjustment of A16R3 and R1 necessary to null the second and third harmonics.

17. Set A16R3 and R1 for the best compromise (minimum second and third harmonic levels) at both center frequency settings of 299.999999 and 300 MHz.

18. Repeat steps 4 through 20 until all the conditions below are met without further adjustment.

    a. Carrier and first sidebands are equal within 0.5 dB when changing Center Frequency of System Under Test between 100 and 99.999999 MHz (Steps 7-8).

    b. Second harmonic levels are equal within 4 dB or >40 dB down from the fundamental at center frequencies of 300 and 299.999999 MHz (Step 17).

    c. Third harmonic levels are equal within 4 dB or >35 dB down from the fundamental at center frequencies of 300 and 299.999999 MHz (Step 17).

19. Replace the mainframe cover and wait 10 minutes. Check to see if the conditions outlined in step 18 are still met. If not repeat steps 4 through 19.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designation order. Table 6-3 contains the names and addresses that correspond with the manufacturers' code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. The A13 Attenuator Assembly may be replaced on an exchange basis, thus affording a considerable cost saving. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis; therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number. The A13 assembly exchange part number is 86601-60109.

6-5. ABBREVIATIONS

6-6. Table 6-1 lists abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviation are used, one all in 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.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-2 is the list of replaceable parts and is organized as follows:

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

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

c. Miscellaneous parts.

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. A typical manufacturer of the part in a five-digit code.

e. The manufacturer's number for the part.

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

6-9. ORDERING INFORMATION

6-10. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-11. 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.

6-12. SPARE PARTS KIT

6-13. Stocking spare parts for an instrument is often done to ensure 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 Recommended Spares list or the Spare Parts Kit (which contains the list) may be ordered through your nearest Hewlett-Packard office.

6-14. DIRECT MAIL ORDER SYSTEM

6-15. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices — to provide these advantages, a check or money order must accompany each order.

6-16. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

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	86602-60002	1	MODULATOR FILTER ASSY	28480	86602-60002
A1C1	0160-3874	1	CAPACITOR-FXD 10PF +-.5PF 200WVDC CER	28480	0160-3874
A1J1	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1J2	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1L1	9140-0158	2	COIL-FXD MOLDED RF CHOKE 1UH 10%	24226	10/101
A1L2	9140-0158		COIL-FXD MOLDED RF CHOKE 1UH 10%	24226	10/101
A1L3	9100-2247	1	COIL-FXD MOLDED RF CHOKE .1UH 10%	24226	10/100
A1P1	1251-3172	5	CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P2	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P3	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P4	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P5	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A2	86603-60001	1	ALC MOTHER BOARD ASSY	28480	86603-60001
A2C1	0160-2204	2	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A2C2	0160-3457	1	CAPACITOR-FXD 2000PF +-10% 250WVDC CER	28480	0160-3457
A2J1	1250-1255	1	CONNECTOR-RF SMB M PC	98291	51-051-0000
A2K1	0490-0916	3	RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A2Q1	1854-0404	5	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2R1	0698-0084	1	RESISTOR 2.15K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2151-F
A2R2	0757-1060	1	RESISTOR 196 1% .5W F TC=0+-100	19701	MF7C1/2-T0-196R-F
A2R3	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A2R4	0698-3405	1	RESISTOR 422 1% .5W F TC=0+-100	19701	MF7C1/2-T0-422R-F
A2R5	0757-0438	11	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R6	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R7	0757-0401	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R8	0698-3403	1	RESISTOR 348 1% .5W F TC=0+-100	24546	NA6
A2R9	0757-0276	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A2VR1	1902-3139	1	DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	04713	SZ 10939-158
A2XA3	1251-1626	3	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	71785	252-12-30-300
A2XA4	1251-1626		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	71785	252-12-30-300
A2XA16	1251-1626		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	71785	252-12-30-300
			A2 MISCELLANEOUS		
	0360-1514	6	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3	86602-60001	1	ALC AMPLIFIER ASSY	28480	86602-60001
A3C1	0180-0058	2	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C2	0180-0058		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C3	0160-2199	2	CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A3C4	0160-2199		CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A3C5	0160-0302	1	CAPACITOR-FXD .018UF +-10% 200WVDC POLYE	56289	292P18392
A3C6	0160-3468	1	CAPACITOR-FXD .12UF +-10% 80WVDC POLYE	56289	292P1249R8
A3C7	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A3CR1	1901-0047	3	DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR2	1901-0047		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR3	1901-0047		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR4	1901-0050	2	DIODE-SWITCHING 80V 200NA 2NS DO-7	28480	1901-0050
A3K1	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A3L1	9140-0237	4	COIL-FXD MOLDED RF CHOKE 200UH 5%	24226	15/203
A3L2	9140-0237		COIL-FXD MOLDED RF CHOKE 200UH 5%	24226	15/203
A3L3	9140-0105	1	COIL-FXD MOLDED RF CHOKE 8.2UH 10%	24226	15/821
A3Q1	1853-0020	3	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q3	1855-0020	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A3Q4	1853-0034	5	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3Q5	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3Q6	1853-0034		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3Q7	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q8	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q9	1853-0034		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3Q10	1854-0221	2	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A3Q11	1854-0053	1	TRANSISTOR NPN 2N2218 SI TO-5 PD=800MW	04713	2N2218

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
A3R1	0698-3154	2	RESISTOR 4.22K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4221-F
A3R2	0757-0394	3	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R3	0698-0083	5	RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A3R4	2100-2517	2	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TURN	30983	ET50X503
A3R5	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R6	0757-0482	1	RESISTOR 511K 1% .125W F TC=0+-100	24546	NA4
A3R7	0757-0416	2	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R8	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R9	0757-0465	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R10	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R11	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R12	0698-3440	3	RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A3R13	0698-3450	1	RESISTOR 42.2K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4222-F
A3R14	0757-0399	2	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3R15	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A3R16	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4221-F
A3R17	0757-0280	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R18	0757-0346	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3R19	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R20	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R21	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R22	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A3R23	0757-0442	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R24	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3R25	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A3R26	0757-0198	1	RESISTOR 100 1% .5W F TC=0+-100	19701	MF7C1/2-T0-101-F
A3R27	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R28	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R29	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R30	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R31	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3VR1	1902-3036	1	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	04713	SZ 10939-38
			A3 MISCELLANEOUS		
	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748	2	EXTRACTOR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
	4040-0749	1	EXTRACTOR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
A4	86602-60003	1	DETECTOR AMPLIFIER ASSY	28480	86602-60003
A4C1	0180-0116	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C2	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C3	0160-2207	1	CAPACITOR-FXD 300PF +-5% 300WVDC MICA	28480	0160-2207
A4C4	0160-2244	2	CAPACITOR-FXD 3PF +-.25PF 500WVDC CER	28480	0160-2244
A4C5	0180-1743	1	CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A4C6	0160-2244		CAPACITOR-FXD 3PF +-.25PF 500WVDC CER	28480	0160-2244
A4CR1	1901-0050		DIODE-SWITCHING 80V 200NA 2NS DO-7	28480	1901-0050
A4K1	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A4L1	9140-0237		COIL-FXD MOLDED RF CHOKE 200UH 5%	24226	15/203
A4L2	9140-0237		COIL-FXD MOLDED RF CHOKE 200UH 5%	24226	15/203
A4Q1	1853-0034		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A4Q2	1853-0034		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A4Q3	1854-0221		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
A4Q4	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4Q5	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4R1	0698-3453	4	RESISTOR 196K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1963-F
A4R2	0698-3453		RESISTOR 196K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1963-F
A4R3	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R4	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R5	0698-3453		RESISTOR 196K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1963-F
A4R6	0698-3155	1	RESISTOR 4.64K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4641-F
A4R7	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R8	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R9	0698-5844	1	RESISTOR 4.3M 5% .25W FC TC=-900/+1100	01121	CB4355
A4R10	0698-3159	1	RESISTOR 26.1K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2612-F
A4R11	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A4R12	0698-3453		RESISTOR 196K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1963-F
A4R13	2100-2517		RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TURN	30983	ET50X503
A4R14	0757-0420	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R15	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F

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
A4R16	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A4R17*	0698-3442	1	RESISTOR 237 1% .125W F TC=0+-100 *FACTORY SELECTED PART	16299	C4-1/8-T0-237R-F
A4R18	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R19	0698-3447	2	RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A4R20	0698-0082	2	RESISTOR 464 1% .125W F TC=0+-100	16299	C4-1/8-T0-4640-F
A4R21	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A4R22	0698-3157	1	RESISTOR 19.6K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1962-F
A4R23	0698-3455	1	RESISTOR 261K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2613-F
A4R24	0757-0439	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4R25	0698-0082		RESISTOR 464 1% .125W F TC=0+-100	16299	C4-1/8-T0-4640-F
A4R26	2100-2489	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TURN	19701	ET50X502
A4S1	3101-0973	1	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC PC	79727	GF126-0018
A4TP1	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP2	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4U1	1826-0013	1	IC OP AMP	28480	1826-0013
			A4 MISCELLANEOUS		
	4040-0748		EXTRACTOR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
	1480-0073	4	PIN:DRIVE 0.250" LG	00000	OBD
	4040-0751	1	EXTRACTOR-PC BD ORN POLYC .062-BD-THKNS	28480	4040-0751
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A5	5086-7049	1	MODULATOR ASSY	28480	5086-7049
A5J1			NSR		
A5J2			NSR		
A5J3			NSR		
A5J4			NSR		
A5J5			NSR		
A5J6			NSR		
A6	5086-7048	1	AMPLIFIER DETECTOR ASSEMBLY	28480	5086-7048
A6J1			NSR		
A6J2			NSR		
A6J3			NSR		
A6J4			NSR		
A6J5			NSR		
A6J6			NSR		
A7	86602-60044	1	MIXER ASSY (EXCEPT OPTION 002)	28480	86602-60044
A7J1	86602-20022	3	CONNECTOR, BULKHEAD	28480	86602-20022
A7J2	86602-20022		CONNECTOR, BULKHEAD	28480	86602-20022
A7J3	86602-20022		CONNECTOR, BULKHEAD	28480	86602-20022
			A7 MISCELLANEOUS		
	0360-0124	3	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
	5001-0002	1	COVER, FILTER	28480	5001-0002
	86602-00003	1	COVER, MIXER, SMALL	28480	86602-00003
	86602-20026	1	BUSHING	28480	86602-20026
	86602-20029	1	SUPPRESSOR	28480	86602-20029
	86603-00005	1	COVER, MIXER, LARGE	28480	86603-00005
	86603-20024	1	HOUSING, MIXER	28480	86603-20024
A7A1	86602-20009	1	BALUN MIXER ASSY	28480	86602-20009
A7A2	86602-60008	1	BALANCE MIXER ASSY	28480	86602-60008
A7A2CR1	5080-0271	1	DIODE, SILICON, MATCHED QUAD	28480	5080-0271
A7A3	5086-7066	1	LOW PASS FILTER ASSY,1.45GHZ	28480	5086-7066
A7A4	86603-20023	1	TRANSITION ASSY	28480	86603-20023
A7A5	86602-20044	1	TRANSITION ASSY	28480	86602-20044

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	86603-60023	1	MIXER ASSY (OPTION 002 ONLY)	28480	86603-60023
A7 C1	0160-4082	1	CAPACITOR-FXD 1000PF +-20% 200WVDC CER	28480	0160-4082
A7 J1	86602-20022	3	CONNECTOR, BULKHEAD	28480	86602-20022
A7 J2	86602-20022		CONNECTOR, BULKHEAD	28480	86602-20022
A7 J3	86602-20022		CONNECTOR, BULKHEAD	28480	86602-20022
A7 L1	9100-1666	1	COIL-FXD MOLDED RF CHOKE 3.6MH 5%	24226	22/364
			A7 MISCELLANEOUS		
	0340-0044	1	TERMINAL-STUD DBL-TUR PRESS MTG	83330	92-1500
	0360-0124	1	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
	5001-0002	1	COVER, FILTER	28480	5001-0002
	86602-00003	1	COVER, MIXER, SMALL	28480	86602-00003
	86602-20026	1	BUSHING	28480	86602-20026
	86602-20029	1	SUPPRESSOR	28480	86602-20029
	86603-00005	1	COVER, MIXER, LARGE	28480	86603-00005
	86603-20024	1	HOUSING, MIXER	28480	86603-20024
A7A1	86602-20009	1	BALUN MIXER ASSY	28480	86602-20009
A7A2	86602-60008	1	BALANCE MIXER ASSY	28480	86602-60008
A7A2CR1	5080-0271	1	DIODE, SILICON, MATCHED QUAD	28480	5080-0271
A7A3	5086-7066	1	LOW PASS FILTER ASSY,1.45GHZ	28480	5086-7066
A7A4	86603-20023	1	TRANSITION ASSY	28480	86603-20023
A7A5	86603-60010	1	LOW PASS FILTER ASSY,50 MHZ(OPT 002 ONLY)	28480	86603-60010
A7A5 C1	0160-4303	2	CAPACITOR-FXD .027UF +-10% 50WVDC CER	26654	3BX050S273K
A7A5 C2	0160-4305	2	CAPACITOR-FXD 47PF +-10% 100WVDC CER	28480	0160-4305
A7A5 C3	0160-4308	1	CAPACITOR-FXD 33PF +-10% 100WVDC CER	26654	2BN100S330K
A7A5 C4	0160-4247		CAPACITOR-FXD .047 UF+-10% 100WVDC CER	28480	0160-4247
A7A5 C5	0160-4303		CAPACITOR-FXD .027UF +-10% 50WVDC CER	26654	3BX050S273K
A7A5 C6	0160-4305	1	CAPACITOR-FXD 47 PF +-10% 100WVDC CER	28480	0160-4305
A7A5 CR1	1901-0639	2	DIODE-PIN 110V	28480	1901-0639
A7A5 CR2	1901-0639		DIODE-PIN 110V	28480	1901-0639
A7A5 L1	86603-80001	2	INDUCTOR, TOROID	28480	86603-80001
A7A5 L2	86603-80001		INDUCTOR, TOROID	28480	86603-80001
A7A5 R1	0698-7222	2	RESISTOR 261 2% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A7A5 R2	0698-7222		RESISTOR 261 2% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A7A5 R3	0698-7229	1	RESISTOR 511 2% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A8	86603-67003	1	4 GHZ AMPLIFIER ASSY(EXCEPT OPTION 002)	28480	86603-67003
A8	86603-67001	1	4 GHZ AMPLIFIER ASSY(OPTION 002 ONLY)	28480	86603-67001
A8J1			NSR		
A8J2			NSR		
A9	86602-60040	1	ATTENUATOR DRIVER ASSY (EXCEPT OPTION 001)	28480	86602-60040
A9CR1	1901-0025	8	DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR2	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR3	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR4	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR5	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR6	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR7	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9CR8	1901-0025		DIODE-GEN PRP 100V 200NA DO-7	28480	1901-0025
A9Q1	1853-0213	4	TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A9Q2	1854-0361	4	TRANSISTOR NPN 2N4239 SI TO-5 PD=800MW	04713	2N4239
A9Q3	1853-0020	17	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q4	1854-0071	4	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q5	1854-0404	5	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q6	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q7	1853-0213		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A9Q8	1854-0361		TRANSISTOR NPN 2N4239 SI TO-5 PD=800MW	04713	2N4239
A9Q9	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q10	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q11	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q12	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q13	1853-0213		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A9Q14	1854-0361		TRANSISTOR NPN 2N4239 SI TO-5 PD=800MW	04713	2N4239
A9Q15	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020

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
A9Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q17	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q18	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q19	1853-0213		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A9Q20	1854-0361		TRANSISTOR NPN 2N4239 SI TO-5 PD=800MW	04713	2N4239
A9Q21	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9Q22	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q23	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q24	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A9R1	0757-0280	11	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R2	0757-0159	8	RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R3	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R4	0698-3440	4	RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A9R5	0683-0335	6	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R6	0683-0335		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R7	0757-0401	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R8	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R9	0698-4002	8	RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R10	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R11	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R12	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R13	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R14	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A9R15	0683-0335		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R16	0683-0335		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R17	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R18	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R19	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R20	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R21	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R22	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R23	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R24	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A9R25	0683-0335		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R26	0683-0335		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A9R27	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R28	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R29	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R30	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R31	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R32	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R33	0757-0159		RESISTOR 1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1R0-F
A9R34	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	16299	C4-1/8-T0-196R-F
A9R35	0811-2815	2	RESISTOR 1.5 5% .75W PW TC=0+-50	91637	FS1/2-T2-1R5-J
A9R36	0811-2815		RESISTOR 1.5 5% .75W PW TC=0+-50	91637	FS1/2-T2-1R5-J
A9R37	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R38	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R39	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9R40	0698-4002		RESISTOR 5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-5001-F
A9VR1	1902-3002	4	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	04713	SZ 10939-2
A9VR2	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	04713	SZ 10939-2
A9VR3	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	04713	SZ 10939-2
A9VR4	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	04713	SZ 10939-2
			A9 MISCELLANEOUS		
	1480-0073	7	PIN:DRIVE 0.250" LG	00000	OBD
	4040-0752	2	EXTRACTOR-PC BD YEL POLYC .062-BD-THKNS	28480	4040-0752
A10	86602-60006	1	REFERENCE ASSY	28480	86602-60006
A10C1			NOT ASSIGNED		
A10C2	0180-0291	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10K1	0490-0916	6	RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10K2	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10K3	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10K4	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10K5	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10K6	0490-0916		RELAY-REED 1A .5A 50V CONT 5V-COIL	28480	0490-0916
A10Q1	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q2	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q3	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q4	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q5	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020

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
A10Q6	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q7	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q8	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q9	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A10Q10	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A10Q11	1855-0082	1	TRANSISTOR MOSFET P-CHAN D-MODE SI	28480	1855-0082
A10R1	0757-0279	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R2	2100-2517	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TURN	30983	ET50X503
A10R3	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R4	0757-0817	1	RESISTOR 750 1% .5W F TC=0+-100	19701	MF7C1/2-T0-751-F
A10R5	2100-2633	3	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TURN	30983	ET50X102
A10R6	0757-0443	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A10R7	2100-2633		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TURN	30983	ET50X102
A10R8	0757-0416	2	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R9	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R10	0698-3260	2	RESISTOR 464K 1% .125W F TC=0+-100	03888	PME55S
A10R11	0698-3260		RESISTOR 464K 1% .125W F TC=0+-100	03888	PME55S
A10R12	0698-3453	1	RESISTOR 196K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1963-F
A10R13	0757-0439	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A10R14	0683-1065	1	RESISTOR 10M 5% .25W FC TC=-900/+1100	01121	CB1065
A10R15	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R16	0698-3450	1	RESISTOR 42.2K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4222-F
A10R17	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R18	0698-0083	10	RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R19	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R20	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R21	0698-4406	2	RESISTOR 115 1% .125W F TC=0+-100	16299	C4-1/8-T0-115R-F
A10R22	0698-4482	1	RESISTOR 17.4K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-1742-F
A10R23	0698-4406		RESISTOR 115 1% .125W F TC=0+-100	16299	C4-1/8-T0-115R-F
A10R24	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R25	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R26	0698-3486	2	RESISTOR 232 1% .125W F TC=0+-100	16299	C4-1/8-T0-232R-F
A10R27	0698-3498	1	RESISTOR 8.66K 1% .125W F TC=0+-100	16299	C4-1/8-T0-866R-F
A10R28	0698-3486		RESISTOR 232 1% .125W F TC=0+-100	16299	C4-1/8-T0-232R-F
A10R29	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R30	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R31	0698-3510	2	RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-T0-453R-F
A10R32	0698-3154	1	RESISTOR 4.22K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4221-F
A10R33	0698-3510		RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-T0-453R-F
A10R34	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R35	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A10R36	0698-3495	2	RESISTOR 866 1% .125W F TC=0+-100	16299	C4-1/8-T0-866R-F
A10R37	0698-4430	1	RESISTOR 1.91K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1911-F
A10R38	0698-3495		RESISTOR 866 1% .125W F TC=0+-100	16299	C4-1/8-T0-866R-F
A10R39	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R40	0757-0442	3	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R41	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10U1	1826-0081	1	IC LM 318 OP AMP	27014	LM318H
A10VR1	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	04713	SZ 10939-98
			A10 MISCELLANEOUS		
	4040-0753	2	EXTRACTOR-PC BD GRN POLYC .062-BD-THKNS	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0753		EXTRACTOR-PC BD GRN POLYC .062-BD-THKNS	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A11	86603-60029	1	LOGIC ASSY	28480	86603-60029
A11C1	0180-2206	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X900682
A11L1	9140-0105	1	COIL-FXD MOLDED RF CHOKE 8.2UH 10%	24226	15/821
A11U1	1820-0508	1	IC N8202N RGTR	18324	N8202N
A11U2	1820-0077	1	IC SN74 74 N FLIP-FLOP	01295	SN7474N
A11U3	1820-0069	1	IC SN74 20 N GATE	01295	SN7420N
A11U4	1820-0305	1	IC:TTL 4-BIT BINARY FULL ADDER	01295	SN7483N
A11U5	1820-0054	4	IC SN74 00 N GATE	01295	SN7400N
A11U6	1820-0054		IC SN74 00 N GATE	01295	SN7400N
A11U7	1820-0639	1	IC MC 4001P CONV	04713	MC4001P
A11U8	1820-0174	2	IC SN74 04 N INV	01295	SN7404N
A11U9	1820-0054		IC SN74 00 N GATE	01295	SN7400N
A11U10	1820-0054		IC SN74 00 N GATE	01295	SN7400N

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
			A11 MISCELLANEOUS		
	4040-0754	1	EXTRACTOR-PC BD BLU POLYC .062-BD-THKNS	28480	4040-0754
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	86603-00007	1	INSULATOR	28480	86603-00007
	0380-0803	4	STANDOFF-RND .094LG .091ID .125OD BRS CD	C6540	9200-6-B-091
A12	86602-60038	1	LOGIC MOTHER BOARD ASSY	28480	86602-60038
A12C1	0160-2055	2	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A12C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A12L1	9140-0144	2	COIL-FXD MOLDED RF CHOKE 4.7UH 10%	24226	10/471
A12L2	9140-0144		COIL-FXD MOLDED RF CHOKE 4.7UH 10%	24226	10/471
A12XA9	1251-1626	1	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	71785	252-12-30-300
A12XA10	1251-2034	1	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	71785	252-10-30-300
A12XA11	1251-1388	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-008
A13	86601-60039	1	ATTENUATOR ASSY(EXCEPT OPTION 001)	28480	86601-60039
A13J1			NSR		
A13J2			NSR		
A14	86602-60041	1	WIRING HARNESS,MAIN(EXCEPT OPT'S 001-002 (INCLUDES P5, P7, P8, P13 & P14)	28480	86602-60041
A14	86602-60042		WIRING HARNESS,MAIN(OPTION 001 ONLY) (INCLUDES P5, P7, P8, P13 & P14)	28480	86602-60042
A14	86602-60045		WIRING HARNESS,MAIN(OPTION 002 ONLY) (INCLUDES P5, P7, P8, P13 & P14)	28480	86602-60045
A15	86602-60035	1	20 MHZ AMPLIFIER ASSY	28480	86602-60035
A15C1	0160-2437	7	CAPACITOR-FXD 5000PF +80-20% 200WVDC CER NSR	28480	0160-2437
A15J1	1250-1194	3	CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM NSR	28480	1250-1194
A15J2	1250-1194		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM NSR	28480	1250-1194
A16	86603-60002	1	PHASE MODULATOR DRIVER ASSY (OPTION 002 ONLY)	28480	86603-60002
A16C1	0160-4247		CAPACITOR-FXD .047UF +-20% 50WVDC CER	28480	0160-4247
A16C2	0160-0127	1	CAPACITOR-FXD 1UF +-20% 25WVDC CER	28480	0160-0127
A16C3	0160-4247		CAPACITOR-FXD .047UF +-20% 50WVDC CER	28480	0160-4247
A16C4	0180-0374	4	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A16C5	0160-3874	1	CAPACITOR-FXD 10PF +-.5PF 200WVDC CER	28480	0160-3874
A16C6	0160-3879	1	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A16C7	0180-0228	2	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A16C8	0121-0447	1	CAPACITOR-V TRMR-CER 1.5/2.5PF 63V	0086S	5S-TRIKO-04
A16C9	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A16C10	0180-0228		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A16CR1	1901-0179	2	DIODE-SWITCHING 15V 50NA 750PS DO-7	28480	1901-0179
A16CR2	1901-0179		DIODE-SWITCHING 15V 50NA 750PS DO-7	28480	1901-0179
A16CR3	1901-0033	1	DIODE-GEN PRP 180V 200NA DO-7	28480	1901-0033
A16E1	0410-0184	1	OVEN:COMPONENT	01295	5ST1-2
A16J1	1250-1377	2	CONNECTOR-RF SMB FEM PC	2K497	700214
A16J2	1250-1377		CONNECTOR-RF SMB FEM PC	2K497	700214
A16L1	9140-0158	1	COIL-FXD MOLDED RF CHOKE 1UH 10%	24226	10/101
A16Q1	1855-0327	1	TRANSISTOR J-FET 2N4416 N-CHAN D-MODE	01295	2N4416
A16Q2	1854-0023	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A16Q3	1853-0050	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A16Q4	1853-0018	2	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A16Q5	1853-0018		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A16Q6	1854-0345	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A16Q7	1854-0345		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A16Q8	1853-0034	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A16Q9	1855-0081	1	TRANSISTOR J-FET 2N5245 N-CHAN D-MODE SI	01295	2N5245
A16Q10	1854-0247	1	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A16Q11	1854-0023		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A16R1	2100-3123	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TURN	32997	3006P-1-501
A16R2	2100-3095	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TURN	32997	3006P-1-201
A16R3	2100-3154	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TURN	32997	3006P-1-102
A16R4	2100-2633		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TURN	30983	ET50X102
A16R5	0698-7216	1	RESISTOR 147 2% .05W F TC=0+-100	24546	C3-1/8-TO-147R-G

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
A16R6	0698-7260	4	RESISTOR 10K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A16R7	0698-7253	1	RESISTOR 8.25K 2% .05W F TC=0+-100	24546	C3-1/8-T0-8251-G
A16R8	0698-7260		RESISTOR 10K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A16R9	0698-7250	1	RESISTOR 3.83K 2% .05W F TC=0+-100	24546	C3-1/8-T0-3831-G
A16R10	0698-7260		RESISTOR 10K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A16R11	0698-7243	1	RESISTOR 1.96K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A16R12	0698-7260		RESISTOR 10K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A16R13	0698-7236	3	RESISTOR 1K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A16R14	0698-7244	3	RESISTOR 2.15K 2% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16R15	0698-7244		RESISTOR 2.15K 2% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16R16	0698-7244		RESISTOR 2.15K 2% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A16R17	0698-7219	2	RESISTOR 196 2% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A16R18	0698-7219		RESISTOR 196 2% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A16R19	0698-7248	1	RESISTOR 3.16K 2% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A16R20	0757-0418	2	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A16R21	0757-0418		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A16R22	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A16R23	0698-7212	4	RESISTOR 100 2% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A16R24	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A16R25	0698-7212		RESISTOR 100 2% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A16R26	0698-7236		RESISTOR 1K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A16R27	0698-7188	2	RESISTOR 10 2% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A16R28	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R29	0698-7212		RESISTOR 100 2% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A16R30	0698-7188		RESISTOR 10 2% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A16R31	0698-7195	3	RESISTOR 19.6 2% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A16R32	0698-7195		RESISTOR 19.6 2% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A16R33	0698-7212		RESISTOR 100 2% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A16R34	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R35	0698-3633	1	RESISTOR 390 5% 2W MO TC=0+-200	24546	FP42-2-T00-390R-J
A16R36	0698-7236		RESISTOR 1K 2% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A16R37	0698-7195		RESISTOR 19.6 2% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A16U1	1858-0032	1	IC CA3146E XSTR ARRAY	02735	CA3146E
A16U2	1820-0174		IC SN74 04 N INV	01295	SN7404N
			A16 MISCELLANEOUS		
	1200-0173	1	INSULATOR-XSTR TO-5 .075-THK	28480	1200-0173
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0748	1	EXTRACTOR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
	4040-0750	1	EXTRACTOR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A17	86603-60019	1	PHASE MODULATOR ASSY(OPTION 002 ONLY)	28480	86603-60019
	86603-00004	1	COVER, PHASE MODULATOR HOUSING	28480	86603-00004
	86603-20011	1	HOUSING, PHASE MODULATOR	28480	86603-20011
A17J1	1250-1194		CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
A17P1	1250-0563	2	CONNECTOR-RF SMA M 4 HOLE FLG FR	28480	1250-0563
A17P2	1250-0563		CONNECTOR-RF SMA M 4 HOLE FLG FR	28480	1250-0563
A17A1	86603-60003	1	PHASE MODULATOR BOARD ASSY	28480	86603-60003
A17A1C1	0160-0559	3	CAPACITOR-FXD 10PF +-10% 100WVDC CER	28480	0160-0559
A17A1C2	0160-0559		CAPACITOR-FXD 10PF +-10% 100WVDC CER	28480	0160-0559
A17A1C3	0160-0559		CAPACITOR-FXD 10PF +-10% 100WVDC CER	28480	0160-0559
A17A1CR1	0122-0074	2	DIODE-VVC .7PF 10% CO/C25-MIN=4 BVR=40V	96341	MA45644
A17A1CR2	0122-0074		DIODE-VVC .7PF 10% CO/C25-MIN=4 BVR=40V	96341	MA45644
A18	0955-0045	1	CIRCULATOR 4-PORT (OPTION 002 ONLY)	28480	0955-0045
A19	0960-0426	1	ISOLATOR ASSEMBLY, 3.9-4.1 GHZ(OPT 002)	28480	0960-0426
A20	86602-60043	1	FILTER CONTROL ASSY(OPTION 002 ONLY)	28480	86602-60043
A20C1	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A20C2	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A20C3	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A20L1	9140-0210	1	COIL-FXD MOLDED RF CHOKE 100UH 5%	24226	15/103
A20R1	0757-1094	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A20R2	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R3	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A20U1	1820-0661	1	IC SN74 32 N GATE	01295	SN7432N
A20U2	1826-0013	1	IC OP AMP	28480	1826-0013

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
			A20 MISCELLANEOUS		
	1400-0263	1	BRACKET-MTG RTANG .375-W	28480	1400-0263
			CHASSIS PARTS		
AT1	0960-0084	1	ISOLATOR	28480	0960-0084
AT2	0955-0058	1	COAXIAL ATTENUATOR,30DB(OPTION 002 ONLY)	28480	0955-0058
C1	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
C2	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C3	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C4	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C5	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C6	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
C7	0160-2436	1	CAPACITOR-FXD 10PF +-20% 200WVDC CER	28480	0160-2436
C8	0180-0116	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C9	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
FL1	9135-0009	1	FILTER, 4 GHZ	28480	9135-0009
J1			OUTPUT JACK,TYPE N (EXCEPT OPTION 001; P/O A13; SEE MP1)		
J1			OUTPUT JACK,TYPE N (OPTION 001 ONLY; SEE MP2 THRU MP9)		
L1	9100-1640	2	COIL-FXD MOLDED RF CHOKE 160UH 5%	24226	15/163
L2	9100-1640		COIL-FXD MOLDED RF CHOKE 160UH 5%	24226	15/163
M1	1120-0543	1	METER, 1MA, WINDOW MOUNT	32171	820723
MP1	08731-210	1	NUT, LOCK(EXCEPT OPT 001, P/O J1)	28480	08731-210
MP2	2950-0132	1	NUT-HEX-DBL-CHAM 7/16-28-THD .094-THK (OPTION 001 ONLY, P/O J1)	73734	76500NP
MP3	1250-0914	1	CONNECTOR-RF APC-N FEM UNMTD (OPTION 001 ONLY, P/O J1)	9D949	131-150
MP4	1250-0915	1	CONTACT, RF CONNECTOR, FEMALE CENTER (OPTION 001 ONLY, P/O J1)	71785	131-149
MP5	5040-0306	1	INSULATOR (OPT 001 ONLY, P/O J1)	28480	5040-0306
MP6	08555-20093	1	CONTACT, JACK(OPT 001 ONLY, P/O J1)	28480	08555-20093
MP7	08761-2027	1	INSULATOR (OPT 001 ONLY, P/O J1)	28480	08761-2027
MP8	08555-20094	1	BODY, BULKHEAD(OPT 001 ONLY, P/O J1)	28480	08555-20094
MP9	2190-0104	1	WASHER-LK INTL T NO.-7/16 .439-IN-ID (OPTION 001 ONLY, P/O J1)	78189	1922-04
MP10	1251-0546	11	CONTACT:R & P CONNECTOR, RECTANGULAR (P/O W8,W9,W12, W15 & W19; 1 EACH) (INCLUDE WITH W16, W17, & W18; 2 EACH)	81312	III17054S
MP11	1250-1193	3	CONNECTOR-RF SM SLD FEM UNMTD (P/O W9,W15, W19; 1 EACH)	98291	52-328-0019
MP12	1250-1221	2	CONNECTOR-RF SM SLD M SGL HOLE REC (INCLUDES P1, P2; P/O W3 & W11, 1 EACH	24931	33JS118-1
MP13	1250-0872	3	CONNECTOR-RF SMB FEM UNMTD (P/O W12, 1EA.; P/O W14, 2 EACH)	24931	32P101-1
MP14	1250-1227	2	CONNECTOR-RF SMA M UNMTD (P/O W3, W11; 1 EACH)	28480	1250-1227
			NSR, P/O MP12		
			NSR, P/O MP12		
P3	1251-2293	5	CONNECTOR-SGL CONT SKT .032-DIA	00779	60373-2
P4	1251-2293		CONNECTOR-SGL CONT SKT .032-DIA	00779	60373-2
P5	1251-2293		CONNECTOR-SGL CONT SKT .032-DIA (PART OF A14)	00779	60373-2
P6	86602-60020	1	CONNECTOR ASSY(INCL W8, W9, W15 THRU W19	28480	86602-60020
	5040-0382		CONNECTOR BODY	28480	5040-0382
	5040-0383		CONNECTOR FACE	28480	5040-0383
	1251-1911	5	CONTACT-CONN FEM CRP .062-CONT-SZ	95238	RC2500-S6A16
	1251-3087	17	CONTACT-CONN FEM CRP .062-CONT-SZ (EXCEPT OPTION 002)	81312	100-0908S
P6	1251-3087	26	CONTACT-CONN FEM CRP .062-CONT-SZ (OPTION 002 ONLY)	81312	100-0908S
P7	1251-2293		CONNECTOR-SGL CONT SKT .032-DIA (PART OF A14)	00779	60373-2
P8	1251-2293		CONNECTOR-SGL CONT SKT .032-DIA (PART OF A14)	00779	60373-2
P9-P12			NOT ASSIGNED		

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
P13	1251-2262	1	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS (PART OF A14)	71785	251-10-30-400
P14	1251-2500	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS (PART OF A14)	71785	251-06-30-400
R1	2100-3113	1	RESISTOR-VAR CONTROL CC 2.5K 10% 10CW	01121	WA4G036S252AZ
R2	0698-3430	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PMF55-1/8-T0-21R5-F
S1	3100-3088	1	SWITCH, ROTARY (OPTION 001 ONLY)	28480	3100-3088
S1	3100-3050	1	SWITCH, ROTARY (EXCEPT OPTION 001)	28480	3100-3050
TB1	0360-1780	1	TERMINAL; STRIP; 5-TERM	71002	1355B
W1	86603-20038	1	CABLE ASSY, FILTER OUTPUT(EXCEPT OPT 002)	28480	86603-20038
W1	86603-20012	1	CABLE ASSY, FILTER OUTPUT(OPT 002 ONLY)	28480	86603-20012
W2	86603-20037	1	CABLE ASSY,MIXER LO INPT(EXCEPT OPT 002)	28480	86603-20037
W2	86603-20014	1	CABLE ASSY,MIXER LO INPT(OPT 002 ONLY)	28480	86603-20014
W3	86603-60013	1	CABLE ASSY,RF INPT(INCL MP12 & MP14)	28480	86603-60013
W4	86603-20016	1	CABLE ASSY, ISOLATOR OUTPUT	28480	86603-20016
W5	86603-20015	1	CABLE, MIXER, RF INPUT	28480	86603-20015
W6	86603-20017	1	CABLE ASSY, MIXER OUTPUT	28480	86603-20017
W7	86602-20021	1	CABLE ASSY,OUTPUT (EXCEPT OPT 001)	28480	86602-20021
W7	86602-20016	1	CABLE ASSY,OUTPUT (OPTION 001 ONLY)	28480	86602-20016
W8	86602-60012	1	CABLE ASSY,AM INPT, GRAY/YELLOW (INCLUDES MP10, P/O P6)	28480	86602-60012
W9	86602-60023	1	CABLE ASSY,PULSE INPT, WHITE/GREEN (INCLUDES MP10 & MP11, P/O P6)	28480	86602-60023
W10	86603-20013	1	CABLE, CIRCULATOR OUTPUT(OPTION 002 ONLY)	28480	86603-20013
W11	86603-60014	1	CABLE ASSY,LO INPT (INCLUDES MP12 &MP14)	28480	86603-60014
W12	86603-60015	1	CABLE,PHASE MOD DRIVER INPT(OPT 002 ONLY; INCLUDES MP10 & MP13)	28480	86603-60015
W13	86603-20036	1	CABLE ASSY, CIRCULATOR INPT(OPT 002 ONLY	28480	86603-20036
W14	86603-60012	1	CABLE,PHASE MOD DRIVER OUTPUT(OPT 002 ONLY; INCLUDES MP13)	28480	86603-60012
W15	86602-60033	1	CABLE ASSY,20MHZ INPT, WHITE/BLUE (INCLUDES MP10 & MP11, P/O P6)	28480	86602-60033
W16	8120-1126	1	CABLE ASSY,20/30MHZ, WHITE/ORANGE (P/O P6; SEE MP10)	28480	8120-1126
W17	8120-1129	1	CABLE ASSY,360/450MHZ, WHITE/YELLOW (P/O P6; SEE MP10)	28480	8120-1129
W18	8120-1128	1	CABLE ASSY,100MHZ, WHITE/BROWN (P/O P6; SEE MP10)	28480	8120-1128
W19	86602-60034	1	CABLE ASSY, 20MHZ OUTPUT, WHITE/RED (INCLUDES MP10 & MP11, P/O P6)	28480	86602-60034
			MISCELLANEOUS PARTS		
	0370-1089	1	KNOB-BASE-RND .5 IN JGK SGI-DECAL	28480	0370-1089
	0370-1107	1	KNOB-BASE-PTR AND BAR .5 IN JGK (OPTION 001 ONLY)	28480	0370-1107
	0370-2386	1	KNOB(EXCEPT OPTION 001)	28480	0370-2386
	3050-0029	1	WASHER-FL MTLC NO.-3/8 .378-IN-ID	28480	3050-0029
	3050-0090	1	WASHER-SPR WAVY NO.-5/8 .64-IN-ID (EXCEPT OPTION 001)	78189	3564-28-01
	86601-00013	1	LATCH	28480	86601-00013
	86601-00014	1	BRACKET,ATTENUATOR(EXCEPT OPTION 001)	28480	86601-00014
	86601-00034	1	PANEL,FRONT(EXCEPT OPTION 001)	28480	86601-00034
	86601-00036	1	MOUNT, METER	28480	86601-00036
	86601-00052	2	COVER, HALF	28480	86601-00052
	86601-20017	1	HOUSING, FRONT	28480	86601-20017
	86601-20018	1	PANEL, REAR	28480	86601-20018
	86601-20019	1	STUD LATCH	28480	86601-20019
	86601-20020	1	WASHER LATCH	28480	86601-20020
	86601-20069	1	FRAME, FRONT PANEL	28480	86601-20069
	86601-20080	2	GUIDE, PLUG-IN	28480	86601-20080
	86601-40018	1	SCREW, METER ADJUST	28480	86601-40018
	86602-00005	1	SUPPORT, TOP	28480	86602-00005
	86602-00006	1	SUPPORT, BOTTOM	28480	86602-00006
	86602-00007	1	PANEL, FRONT (OPTION 001 ONLY)	28480	86602-00007
	86602-20019	2	PLATE, FRONT SUPPORT	28480	86602-20019
	86603-20028	1	PLATE, REAR SUPPORT	28480	86603-20028
	86602-20028	2	GUIDE, CONNECTOR	28480	86602-20028
	86603-00001	1	SUPPORT, RIGHT FRONT	28480	86603-00001
	86603-00002	1	SUPPORT, RIGHT REAR	28480	86603-00002
	86603-00003	1	SUPPORT, MIXER	28480	86603-00003
	86603-00008	1	SUPPORT, LEFT	28480	86603-00008
	86602-20041	1	WINDOW (EXCEPT OPTION 002)	28480	86602-20041
	86602-20042	1	WINDOW (OPTION 002 ONLY)	28480	86602-20042

See introduction to this section for ordering information

Table 6-3. Code List of Manufactures

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.A.	
00779	AMP INC	HARRISBURG PA	17105
00865	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
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06540	AMATOM ELEK HARDWARE DIV OF MITE	NEW ROCHELLE NY	10802
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
18324	SIGNETICS CORP	SUNNYVALE CA	94086
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)	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
26654	VARADYNE INC	SANTA MONICA CA	90403
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
32171	MODUTEC INC	NORWALK CT	06854
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71002	BIRNBACK CO INC	FREEPORT LI NY	11520
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
79727	C-W INDUSTRIES	WARMINSTER PA	18974
81312	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	06779
90949	AMPHENOL SALES DIV OF BUNKER-RAMO	HAZELWOOD MO	63042
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
95236	CONTINENTAL CONNECTOR CORP	WOODSIDE NY	11377
96341	MICROWAVE ASSOCIATES INC	BURLINGTON MA	01801
98291	SEALECTRO CORP	MAMARONECK NY	10544

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to instruments for which the content does not apply directly.

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 serial number. Perform these changes in the sequence listed.

7-5. If your instrument serial number is not listed on the title page of this manual or in Table 7-1 below, 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
1433A	A

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-3:
Change A9R5, R6, R15, R16, R25, and R26 to 0811-2815, RESISTOR 1.5 OHM 5% 0.5W PW TUBULAR, 91637, RS1/2-T2-IR5-J.

Service Sheet 10:
Change the value of A9R5, R6, R15, R16, R25, and R26 to 1.5 OHM.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information for the RF Section plug-in. Safety of technical personnel is considered. Circuit operation and troubleshooting on system, plug-in and assembly levels is provided.

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

8-4. Information related to operation of the RF Section plug-in as part of the 8660-series Synthesized Signal Generator System is provided in Service Sheet 1.

8-5. Service Sheets 2 and 3 include an overview of RF Section operation, troubleshooting on an assembly or stage level, and a troubleshooting block diagram. The block diagrams also serve as an index for the remaining service sheets.

8-6. The Schematic Diagram Notes, Figure 8-3, aid in interpreting the schematics.

8-7. The last foldout in the manual includes a table which cross-references all pictorial and schematic locations of each assembly, chassis mounted component, and adjustable component. The figure is a pictorial representation of the RF Section and shows location of the aforementioned parts.

8-8. SAFETY CONSIDERATIONS

8-9. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, 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.

8-10. 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.

8-11. 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 constitute a shock hazard.

8-12. PRINCIPLES OF OPERATION

8-13. The Principles of System Operation explains how the RF Section operates within the Synthesized Signal Generator System, i.e., how other sections affect the RF Section and in turn how they are affected by the RF Section. Control functions in both local and remote modes are also explained.

8-14. Service Sheet 1 includes a block diagram and an explanation of system operation with respect to the RF Section.

8-15. Overall operation of the RF Section is discussed in Service Sheet 2 and 3. The remaining service sheets are concerned only with sections and/or circuit assemblies within the RF Section plug-in.

8-16. TROUBLESHOOTING

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems Troubleshooting information in Service Sheet 1. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, turn to Service Sheet 2 for further troubleshooting information.

8-17. System Troubleshooting

8-18. The System Troubleshooting information in Section VIII of the HP 8660-series mainframe manual should be used when first attempting to isolate a circuit defect. If the defect cannot be isolated to an individual instrument in the system, the technician is normally directed to the System Troubleshooting in the RF Section manual (Service Sheet 1). The problem may then be isolated to the RF Section, Modulation Section, Frequency Extension Module, or the mainframe.

8-19. RF Section Troubleshooting

8-20. When the defect has been isolated to the RF Section, refer to Service Sheet 2. This information is used to isolate the problem to a section or assembly.

8-21. Troubleshooting Aids

8-22. **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 (AM, Pulse, ID, etc.). Transistor emitters, diode cathodes, the positive lead of electrolytic capacitors, and pin 1 of integrated circuits are indicated by a variety of symbols such as E, a diode symbol, +, and a tear-drop shape respectively. Also, a square circuit pad (as opposed to the round pad) may be used in place of any of the previously mentioned symbols.

8-23. **Service Sheet Aids.** RF levels, ac voltages, and dc voltages are often shown on schematic diagrams. Integrated circuit connection diagrams plus diagrams of relays and printed circuit connectors help to locate specific inputs and outputs. Notes are used to explain certain circuits or mechanical configurations not easily shown on the schematic.

8-24. The locations of individual components mounted on printed circuit boards are found on individual service sheets on the pictorial representation of the circuit boards. Chassis mounted parts, major assemblies, and adjustable components locations are found on the last foldout in this manual.

8-25. Table 8-3, Schematic Diagram Notes, provides information relative to symbols and values shown on the schematic diagrams.

8-26. **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 RF Section plug-in. Refer to the HP 11672A Operating Note for a listing and pictorial representation of the contents. A list of the service kit contents is also found in the Test Equipment and accessories list in Section I of the mainframe manual.

8-27. 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. Refer to the list found under Accessories Supplied in Section I of the mainframe manual.

8-28. RECOMMENDED TEST EQUIPMENT

8-29. Table 1-2 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.

8-30. REPAIR

8-31. General Disassembly Procedures

8-32. Procedures for removing the RF Section plug-in from the mainframe and the covers from the plug-in are found on the left-hand foldout page immediately preceding the last foldout in the manual.

8-33. The machine screws used throughout the plug-in 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.

8-34. Non-Repairable Assemblies

8-35. Repairs should not be attempted on the following assemblies if any is found to be defective during troubleshooting:

A5 Modulator Assembly
A6 1-1300 MHz Amplifier Assembly
A8 4 GHz Amplifier Assembly
A13 Attenuator Assembly
A15 20 MHz Amplifier Assembly
A18 Circulator Assembly
A19 3.9 - 4.1 GHz Isolator Assembly
AT1 Isolator
AT2 3 dB Attenuator
FL1 4 GHz Band Pass Filter

8-36. Module Exchange Program

8-37. Only the A13 Attenuator is available as a restored assembly. It may be ordered as a replacement under the Module Exchange Program. Refer to Section VI for ordering information.

8-38. Repair Procedures

8-39. LO Signal Circuits Repair Procedure. Refer to Figure 8-1. This procedure is used in conjunction with Service Sheet 2 for isolating circuit defects which are evident as a phase modulation problem or an incorrect LO signal level (option 002 instruments only). Perform the procedure if one of the following components is suspected of being defective: W1, W2, W10, W13, W14, A7, A8, A17, A18, A19, or AT2.

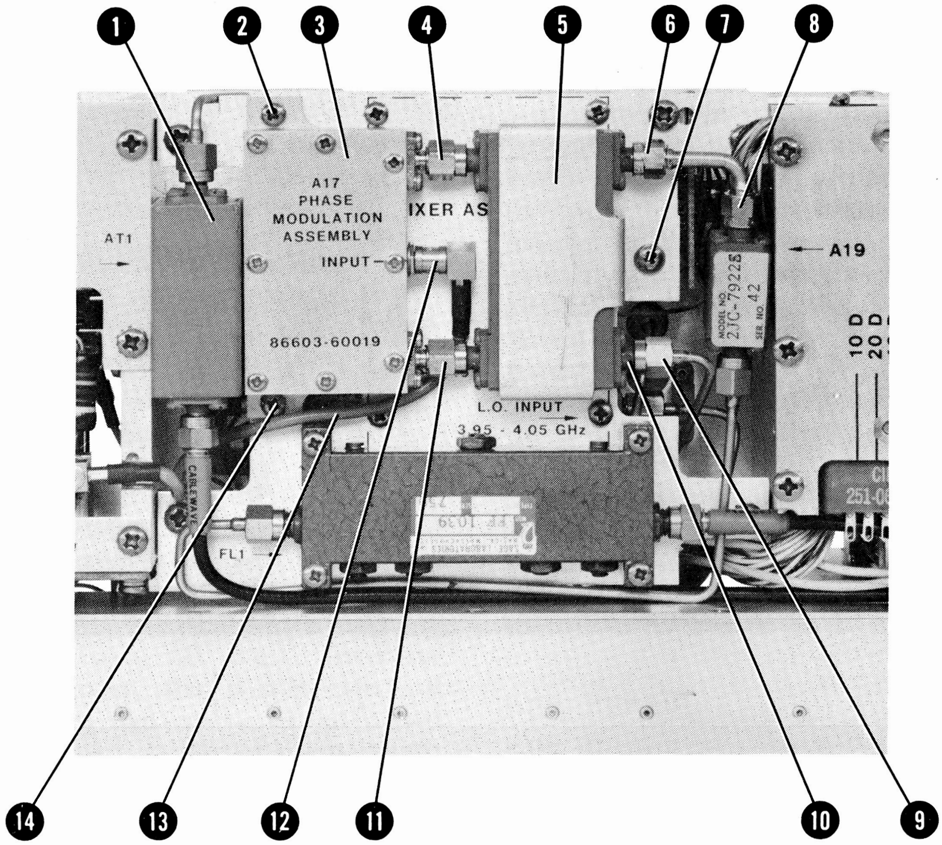
8-40. Front Panel Housing Disassembly and Repair Procedure. Circuits and parts located in the front Panel Housing are the meter, output range switch, and vernier control. Perform the procedure in Table 8-1 to gain access to these circuits for purposes of repair.

8-41. Rear Panel Disassembly Procedure. To gain access to assemblies and parts mounted on or behind the rear panel, refer to Figure 8-2. The A12 Logic Mother Board, A15 20 MHz Amplifier, and the P6 Interconnect Plug are accessible only after removing the panel.

8-42. Post Repair Adjustments

8-43. After a defective circuit is repaired, refer to Section V and perform the adjustment procedure(s) for circuits which *may be affected* by the change. Consider the instructions under paragraphs entitled Related Adjustments and Post Adjustment Tests.

LO SIGNAL CIRCUITS REPAIR



NOTE

In conjunction with this procedure, use the troubleshooting information on Service Sheet 2 to isolate a circuit malfunction to one of the following assemblies, circuits, or cables: A7, A8, A18, A19, AT2, W1, W2, W10, or W13 (RF problem); A17 or W14 (phase modulation problem). The procedure applies for option 002 instruments only.

a. Set the System Line switch to Standby.

b. Remove screws 2, 7, and 14 to release the A17 Phase Modulator 3 and A18 Circulator 5 Assemblies.

c. With a 5/16" open end wrench, loosen the SMA connectors 6, 8, and 9. Carefully pull the assemblies 3 and 5 away from the aluminum decking until A17 3 slips past AT1 1.

Figure 8-1. LO Signal Circuits Repair (1 of 3)

d. **Phase Modulation Problems.** Separate A17 and A18 at connectors 4 and 11. Set the system LINE switch to ON. Measure the output of W14 at connector 12.

e. Set the system LINE switch to Standby, replace the defective part of assembly. Reassemble the items in the reverse order given for disassembly.

Be sure W14 13 runs under connector 11 and is not crushed under A17 7.

f. **RF Problems.** To measure the LO signal at the output of A18 10, remove the SMA connectors 6 and 8, and set the System LINE switch to ON.

g. If the output from A18 is correct, proceed to step h. Otherwise, determine which of A18, W13, A19, or W1 is defective by measuring the outputs of W13, A19, and W1. Refer to Service Sheet 2.

h. Disconnect the System's line (Mains) power. Release the A20 Assembly by removing the screws (one each where circuit board and aluminum decking meet). Lift the assembly straight up. Connect a ground lead from the chassis to the angle bracket which is connected to the ground point on the circuit board.

i. Remove cable W2 at the A8 Assembly output. (The A8 output jack is closer to the top of the RF Section).

j. Reconnect the System's line (Mains) power. Measure the output level from A8 (refer to Service Sheet 2). If the output level is correct, determine if cable W2 or the A7 Mixer Assembly is defective. If the level is incorrect, proceed to step k.

k. Remove the three screws which secure the A8 Assembly. Remove the cable connector 9 at the output of A18. Carefully pull A8 away from the decking so the end of AT2 (connected to the input of A8) is exposed.

l. With the wrench, loosen and remove AT2 from A8. Carefully remove W10 and AT2 from between the decking.

m. Reconnect the cable to the output of A18 10. Check the outputs from AT2 and W10 to determine if AT2, W10, or A8 is defective (refer to Service Sheet 2).

Figure 8-1. LO Signal Circuits Repair (2 of 3)

n. Discard the defective part or assembly. Reassemble the items removed in the reverse order (leave A20 till last).

CAUTION

When tightening the coaxial connectors, be sure the other end of the cable can be connected without bending the cable. Be sure all connectors are tightened but only enough to ensure a good connection. Excessive bending of semi-rigid coax or excessive tightening of the connectors may damage the cables and/or connectors beyond repair.

Figure 8-1. LO Signal Circuits Repair (3 of 3)

Table 8-1. Front Panel Housing Repair

FRONT PANEL HOUSING DISASSEMBLY AND REPAIR

a. Place the RF Section in the normal upright position.

b. With a Pozidriv screwdriver, remove the two screws which hold the top of the front panel to the housing.

c. Turn the plug-in over with the bottom up. Remove the screw which is seen through the curved cutout slot in the latch when it is in the closed or latched position.

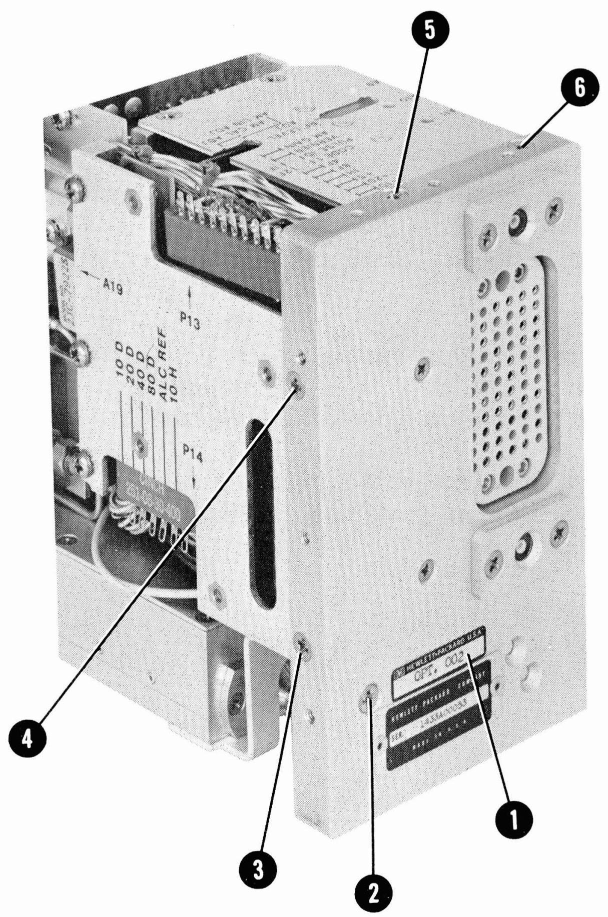
d. With a knurled nut wrench, loosen the knurled nut on the OUTPUT jack. Remove the nut by hand.

e. Pull the front panel away from the housing.

f. Determine what part or assembly is defective and replace it.

g. Reinstall the front panel by following the preceding steps in the reverse order. Be careful not to crush any wires between the front panel and the chassis.

REAR PANEL DISASSEMBLY



a. On the rear panel, remove screws 1 and 2 which hold the A13 Assembly in place. Screw 1 is located under the Option 002 sticker.

b. Remove the screws 5 and 6 which hold the top rear deck to the rear panel.

c. Remove the screws and 4 which hold the rear panel to the left rear deck. Carefully pull the rear panel back and away to expose the assemblies and parts.

Figure 8-2. Rear Panel Disassembly

SCHEMATIC DIAGRAM NOTES

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

* Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.

† Indicates backdating. Refer to Table 7-2.

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).

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 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 strip, third number identifies the narrower stripe. E.g., 947 denotes white base, yellow wide stripe, violet narrow stripe.

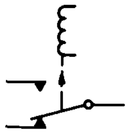
A direct conducting connection to the earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).

Coaxial or shielded cable.

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

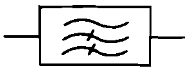
Figure 8-2. Schematic Diagram Notes (1 of 2)

SCHEMATIC DIAGRAM NOTES



Arrows on relays indicate direction of arm movement when energized.

Filters. Specific type indicated by crosses on curved lines.



Example of Highpass Filter.

SWITCH DESIGNATIONS

EXAMPLE: A3S1AR(2-1/2)

A3S1 = SWITCH S1 WITHIN ASSEMBLY A3

A = 1ST WAFER FROM FRONT (A=1ST, ETC)

R = REAR OF WAFER (F=FRONT)

(2-1/2) = TERMINAL LOCATION (2-1/2) (VIEWED FROM FRONT)

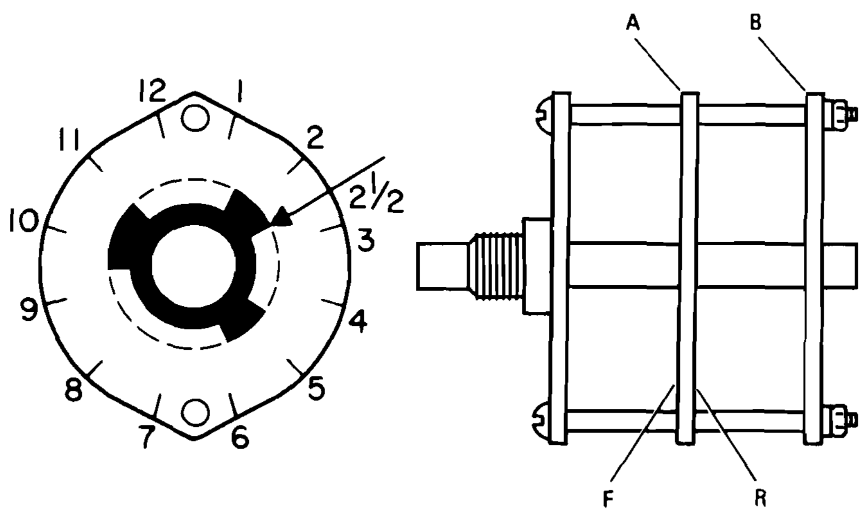


Figure 8-3. Schematic Diagram Notes (2 of 3)

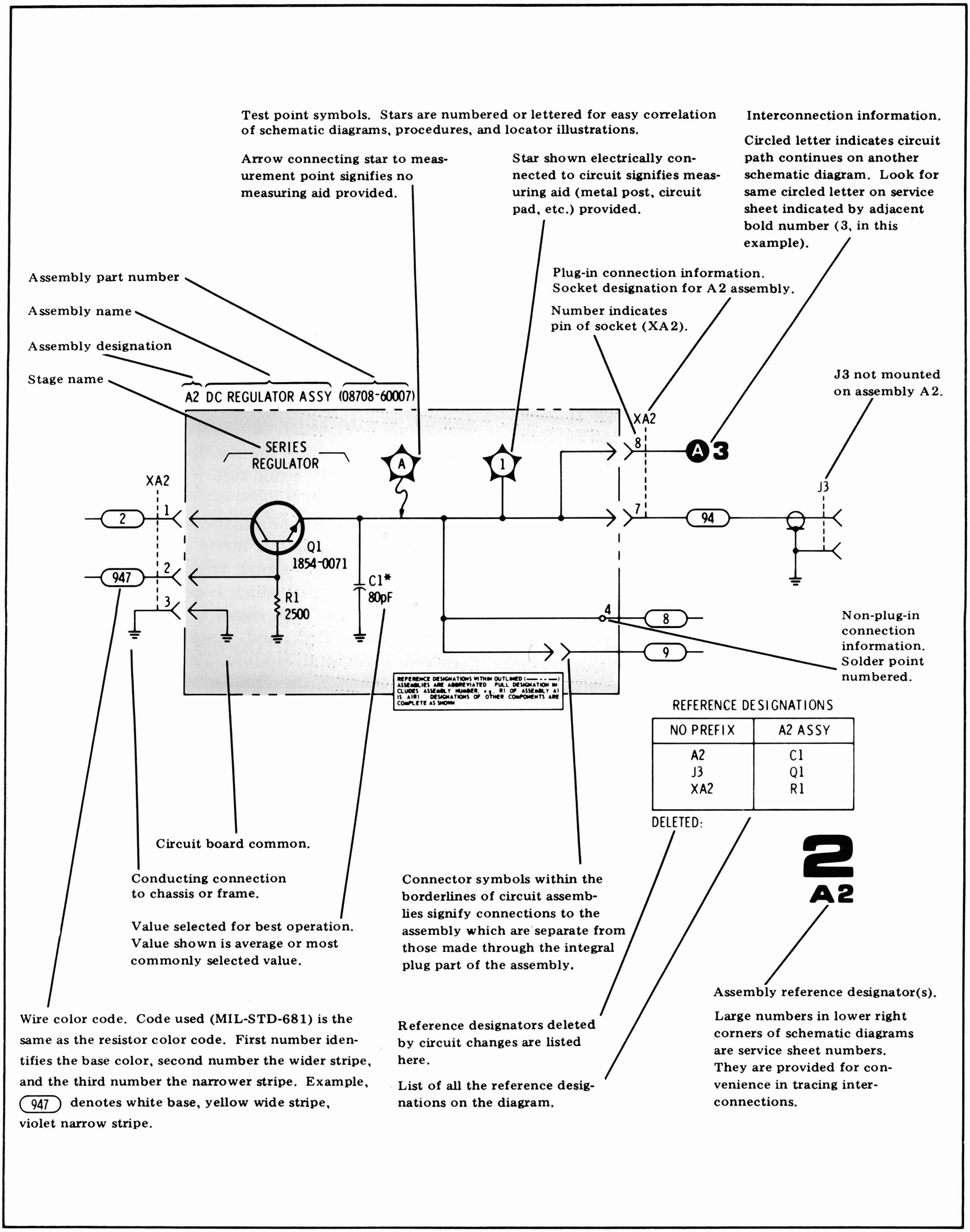


Figure 8-3. Schematic Diagram Notes (3 of 3)

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 (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems Troubleshooting information in this manual (Service Sheet 1). This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for further troubleshooting information.

RF SECTION OPERATION IN THE SYNTHESIZED SIGNAL GENERATOR SYSTEM

In order to understand the operation of the RF Section or to effectively troubleshoot it, the entire Synthesized Signal Generator System must be understood. The emphasis here is on the RF Section and its relationship with the other units which make up the system.

PRINCIPLES OF OPERATION

The HP Model 86602B RF Section Plug-in (as part of the HP 8660-series Synthesized Signal Generator System, has an RF Output of +10 to –146 dBm across 50Ω from 1 to 1299.999999 MHz. The RF signals coupled from mainframe to the Frequency Extension Module are converted to two phase-locked outputs which are coupled to the RF Section. The signals are mixed, amplified, and coupled to the OUTPUT jack through the RF Attenuator.

The RF detector produces a dc output proportional to the RF output signal. The dc output is compared to a reference voltage. Any difference in dc levels produces an error current which drives the PIN diode modulator. The current flow through the PIN diodes controls the RF output level. The negative feedback loop described, is an ALC loop which holds the RF output level constant.

Output Frequency Selection

The desired output frequency is selected by the Digital Control Unit (DCU) in the mainframe. Control logic levels to the mainframe RF circuits set the frequencies of the signals to the Frequency Extension Module. Other logic levels are coupled to the extension module from the mainframe to set the frequency of the generated RF outputs which are coupled to RF Section. The signals are mixed and the converted signal is coupled to the OUTPUT jack.

Modulation Selection

Depending on the Auxiliary or Modulation Section, amplitude, frequency, phase, or pulse modulation may be selected.

a. The amplitude modulation drive signal is coupled to the RF Section from the Modulation Section. The drive signal is superimposed on the reference level which controls the ALC loop. Thus, the ALC loop causes the RF output level to change at the modulation signal rate.

b. Frequency modulation is accomplished by setting the modulation mode control to FM. The modulation drive signal frequency modulates a 20 MHz VCO signal which is generated in the Modulation Section. This signal is coupled to the RF Section, amplified, and coupled on to the Frequency Extension Module. The extension module circuits transfer the frequency modulation information from the 20 MHz signal to the 3.95 to 2.75 GHz oscillator signal. This signal is then coupled to the RF Section circuits.

c. Phase modulation occurs when the selected modulation mode is set to ∅M. The modulation drive signal from the modulation section is applied to the LO signal so its phase deviation varies with the drive signal amplitude.

d. The Pulse ID logic input opens the ALC loop so there is no RF output without a pulse modulation drive signal. A –10 volt peak pulse will momentarily bias the RF output on.

RF Output Level Selection

The RF output level is selected by the front panel OUTPUT RANGE switch and the VERNIER control. The VERNIER control (in conjunction with the front panel meter) is used to set the output within a usable range of 10 dB. The OUTPUT RANGE switch controls the output level range by inserting attenuation in 10 dB steps to 150 dB.

SERVICE SHEET 1 (Cont'd)

Remote Operation

In remote mode the frequency, modulation, and RF output levels are programmed into the DCU. Through parallel BCD PI (plug-in) control lines, an input is sent to the various storage registers. A one-of-six address selects the register which will accept the information. Frequency information is routed into one of 3 registers: center frequency, step (except 8660A), and sweep (except 8660A). Modulation information is routed to either the Modulation Mode/Source register or the Modulation Level register. RF output level (attenuation) information is routed to the attenuation storage register in the RF Section by addressing the ATTN CLK.

The attenuation information is stored in the register until new data is received. Until that time the stored information is connected through various logic and decoding circuits and applied to the relays and switches which set the RF output level to the desired value. The RF Section front panel controls are inoperative in the remote mode.

SYSTEM TROUBLESHOOTING

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, return to this service sheet and perform the following tests which may help isolate the problem to an instrument (mainframe or a plug-in).

Preparing the RF Section for Troubleshooting

Follow the Removal and Disassembly Procedures on the foldout page which just preceeds the last foldout in the manual. Follow the directions for removing the RF Section from mainframe, removing its covers, and making the interconnections from mainframe to RF Section for troubleshooting purposes.

Output Level Incorrect

The following steps check the signal levels input to the RF Section from the Frequency Extension Module. Also, the attenuation data input to the RF Section must be checked if the instrument is being operated in the remote mode.

a. Disconnect the RF cable connected to P2 (on rear panel above the multi-pin connector P6). Measure the level of the 3.95 to 2.75 GHz signal from the cable with a spectrum analyzer (>+10 dBm). Reconnect the cable to P2.

b. Disconnect the RF cable connected to P1 (on rear panel below the multi-pin connector). Measure the level of the 3.95 to 4.05 GHz signal from the cable with a spectrum analyzer (>−4 dBm). Reconnect the cable to P1.

c. If either signal level from the extension module is incorrect, the problem is either in the extension module or the interconnections to the RF Section. Check the continuity of the cables and, if necessary, refer to the extension module manual for further troubleshooting information.

d. If both signal levels are correct and the system is being operated in the remote mode, switch to local (front panel) control. If the problem is still evident, refer to Service Sheet 2 for further troubleshooting information.

e. If the problem disappears, check continuity of the input data lines (PI-1, PI-2, PI-4, and PI-8) and the ATTN CLK input to the mainframe. If continuity exists, proceed to Section VIII of the mainframe manual and troubleshoot the DCU. Otherwise, refer to Service Sheet 3.

Frequency Problems

The mainframe center frequency readout is correct but the frequency at the RF Section's front panel jack is incorrect. The mainframe, and the frequency Extension Module contain the only controlled frequency sections. If the RF frequencies to the extension module are incorrect or if the levels are too low, the circuit defect is in the mainframe or the interconnections to the extension module (including the A15 20 MHz Amplifier Assembly). If these levels and frequencies are all correct, the extension module is malfunctioning or the data input from the mainframe DCU is incorrect.

NOTE

If the coaxial test cable 11672-60008 (for checking outputs from the multi-pin connector J6) is not available, proceed to step b.

SERVICE SHEET 1 (Cont'd)

RF Signal Levels

Pin Numbers J6 (Mainframe) or Interconnect Cable	Frequency* (MHz)	Signal Level (dBm)
62	20 MHz ± 1 Hz	>−7 dBm
63	20 to 30 MHz ± 1 Hz	>−7 dBm
64	360 to 450 MHz ± 1 Hz	>+10 dBm
65	100 MHz ± 1 Hz	>+10 dBm

*To achieve the ± 1 Hz tolerance, the System mainframe and the frequency counter must share a common timebase.

a. Check the low frequency RF inputs to the RF Section. Set the mainframe Line switch to standby (STBY), disconnect the interconnect cable from the multi-pin connector P6 on the RF Section rear panel. Return the mainframe line switch to the ON position. Check the frequencies and levels according to the tables with a spectrum analyzer and a frequency counter. If the levels and frequencies are all correct, the same signals must be checked to ensure continuity into the Frequency Extension Module. Refer to the Troubleshooting Information in the extension module manual. Otherwise, proceed to step b.

b. Check the RF signal levels and frequencies at their assembly outputs in the mainframe. Refer to the Section VIII of the mainframe manual. Check the 20 MHz FM/CW signal at A4J7, 100 MHz at A4J8, and 360 to 450 MHz at A4J12. The 20 to 30 MHz signal is found on the A2 Mother Board Assembly which is located directly beneath the A4 Assembly. The tables of frequencies and levels still apply for these measurements. If any of the outputs are incorrect, refer to the appropriate troubleshooting information relating to the circuits which generate that particular frequency in Section VIII of the mainframe manual.

c. If all inputs (step b) are correct and if any of the J6 outputs (step a) were incorrect, check continuity of the interconnections to the RF Section. In the case of problems with the 20 MHz CW/FM signal, refer to the Modulation Section manual. If all inputs (step b) are correct and the J6 outputs to the RF Section were not checked, proceed to the extension module for further troubleshooting information.

Center Frequency Versus Frequency of 360 to 450 MHz Signal

Center Frequency Readout	Actual Frequency (350 to 450 MHz Signal)
0.00 GHz	450 MHz
0.01	440
0.02	430
0.03	420
0.04	410
0.05	400
0.06	390
0.07	380
0.08	370
0.09	360
0.10	450

NOTE

If the problem is not in the RF Section or interconnections, the information in the Frequency Extension Module will determine if the problem is in the digit 8, 9, and 10 logic control inputs from the mainframe or the frequency controlled circuits in the extension module.

Modulation Problems

Amplitude, Frequency, and Phase Modulation. Defects in modulation circuits can usually be classed as either accuracy or distortion problems. In each case it must be determined if the problem is in the Modulation Section, RF Section, or (in FM mode only), the Frequency Extension Module.

a. System modulation accuracy is checked by performing the appropriate performance test in Section IV of the modulation section manual. If the results indicate a problem exists, check the modulation section output with a full scale level setting. The table indicates where to make the measurement, the type of measurement, and the normal signal measured. A coaxial cable from the 11672A Service Kit (11672-60008) connects to the appropriate signal on J6 (the mainframe-to-RF Section interconnect jack).

If the measured signal shows the output modulation signal is incorrect, perform the appropriate adjustment in Section V of the modulation section manual. If the signal cannot be properly adjusted, refer to Section VIII of the modulation section

SERVICE SHEET 1 (Cont'd)

Assembly (refer to the last foldout for its location). If either the signal or dc voltage is not present, check continuity back to the Auxiliary Section. If necessary, refer to the HP Model 86631B Operating Note and troubleshoot the Auxiliary Section. Otherwise, refer to Service Sheet 1 for more troubleshooting information.

Center Frequency Versus Frequency of 20 to 30 MHz Signal

Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)	Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)	Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)
0.000000	30.000000	0.000400	29.999600	0.080000	29.920000
0.000001	29.999999	0.000500	29.999500	0.090000	29.910000
0.000002	29.999998	0.000600	29.999400	0.100000	29.900000
0.000003	29.999997	0.000700	29.999300	0.200000	29.800000
0.000004	29.999996	0.000800	29.999200	0.300000	29.700000
0.000005	29.999995	0.000900	29.999100	0.400000	29.600000
0.000006	29.999994	0.001000	29.999000	0.500000	29.500000
0.000007	29.999993	0.002000	29.998000	0.600000	29.400000
0.000008	29.999992	0.003000	29.997000	0.700000	29.300000
0.000009	29.999991	0.004000	29.996000	0.800000	29.200000
0.000010	29.999990	0.005000	29.995000	0.900000	29.100000
0.000020	29.999980	0.006000	29.994000	1.000000	29.000000
0.000030	29.999970	0.007000	29.993000	2.000000	28.000000
0.000040	29.999960	0.008000	19.992000	3.000000	27.000000
0.000050	29.999950	0.009000	29.991000	4.000000	26.000000
0.000060	29.999940	0.010000	29.990000	5.000000	25.000000
0.000070	29.999930	0.020000	29.980000	6.000000	24.000000
0.000080	29.999920	0.030000	29.970000	7.000000	23.000000
0.000090	29.999910	0.040000	29.960000	8.000000	22.000000
0.000100	29.999900	0.050000	29.950000	9.000000	21.000000
0.000200	29.999800	0.060000	29.940000	9.999999	20.000001
0.000300	29.999700	0.070000	29.930000		

SERVICE SHEET 1 (Cont'd)

manual for further troubleshooting information. Once the adjustment is satisfactorily made, recheck the system modulation accuracy.

If the system accuracy is still incorrect, perform the appropriate adjustment procedure in Section V of the RF Section manual. If this adjustment cannot satisfactorily be made, refer to the troubleshooting information of Service Sheet 2.

b. Modulation distortion problems are verified by performing the appropriate distortion test determined by the modulation type (refer to Section IV of this manual). If the test indicates an excessive distortion level is present in the RF output signal, the source of the distortion must be determined.

Measurements of the signals from the Modulation Section may be made at the J6 connector after the RF Section has been removed. For each modulation type, the output distortion is typically <1%. If the distortion is excessive, refer to the troubleshooting information in Section VIII of the modulation section manual. Otherwise, perform the appropriate adjustment procedures in Section V of the RF Section manual.

Recheck the performance test in Section IV of this manual. If necessary, refer to the troubleshooting information in Service Sheet 2.

Unusual Phase Modulation Level Problems. If phase modulation level accuracy varies excessively with system center frequency, check the gain tracking inputs (Digit 8) for the correct logic level for the selected center frequency. If the logic levels are incorrect, refer to the mainframe manual for further troubleshooting information. If the inputs are correct, refer to Service Sheet 2.

Pulse Modulation Problems. Pulse Modulation of the Signal Generator System is accomplished by using the HP Model 86631B Auxiliary Section and an external pulse generator.

a. Set the Auxiliary Section external modulation control to Pulse. To the input jack couple an external pulse of –10 Vpk with the "pulse off" voltage set to 0 Vdc.

b. Measure the voltage on the test point labeled PULSE (located on a circuit board at the right side rear of the plug-in). This voltage should be about +5 Vdc. Also, check the pulse input from the white-green cable where it enters the A2 Assembly. If either the signal or dc voltage is not present, check continuity back to the Auxiliary Section. If necessary, refer to the HP Model 86631B Operating Note and troubleshoot the Auxiliary Section. Otherwise, refer to Service Sheet 2 for more troubleshooting information.

Modulation Accuracy Test Levels

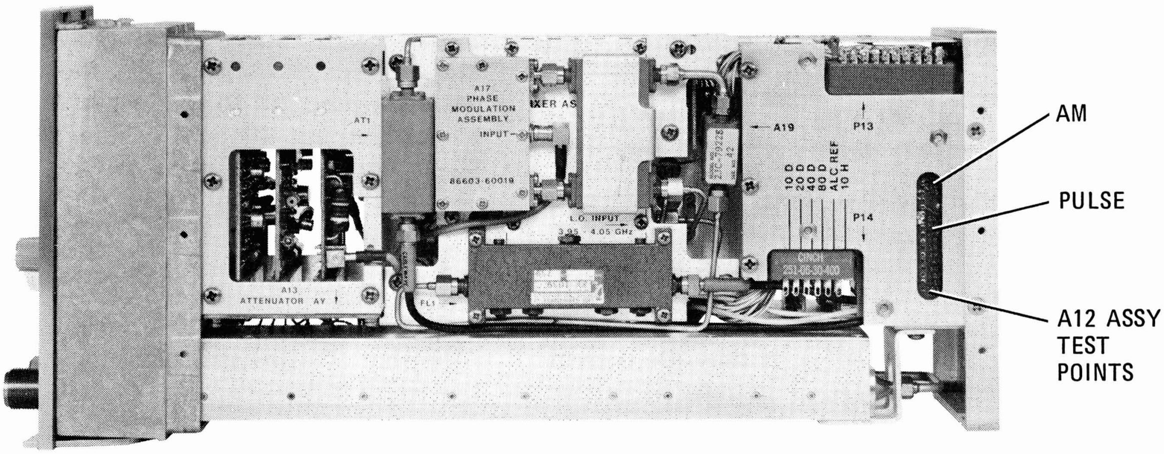
Modulation Type	Measurement Location	Signal Parameter Measured	Measured Signal (for Full Scale) Modulation Level
Amplitude[1]	A12 Assembly at test point labeled AM. (Right side rear of plug-in or J6 pin 55.	AC Voltage	2.8 Vp-p (1.0 Vrms) at 1 kHz rate
Frequency[2]	Pin 62 of J6	Frequency Deviation (peak)	20 MHz ±10 kHz (FM x 1 range) at 1 kHz rate
Phase[1]	A16 Assembly input (white/green cable) or J6 pin 59	AC Voltage	4.2 Vp-p (1.5 Vrms) at 1 kHz rate

[1] If the input is very low or non-existant, verify that continuity of the input exists back to the modulation section. If continuity exists, refer to Service Sheet 2.

[2] If no frequency modulation of the RF Signal is present or if the RF signal is incorrect only in the FM mode, refer to Section VIII of the modulation section manual for further troubleshooting information.

RF SECTION TEST POINTS

RIGHT SIDE VIEW



LEFT SIDE VIEW

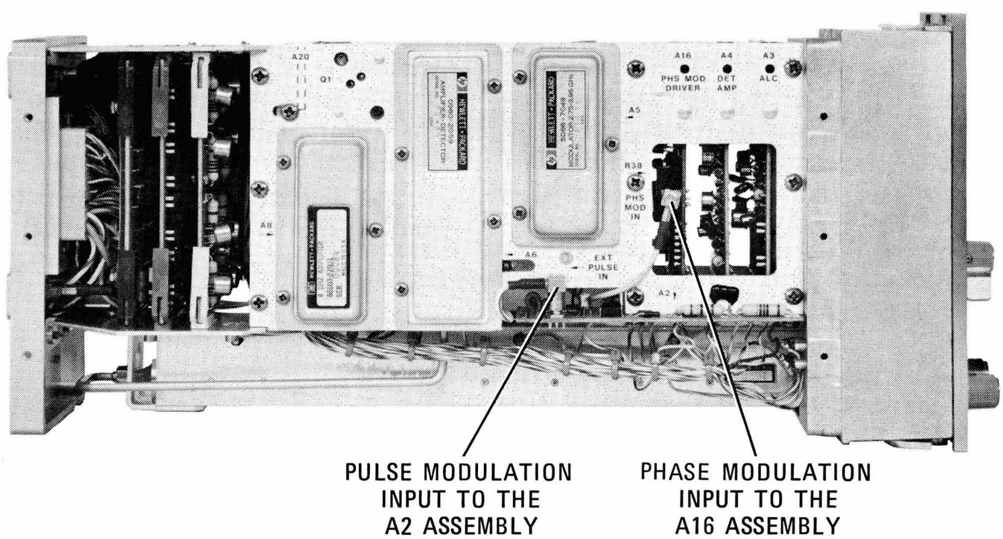


Figure 8-4. System Test Point Locations

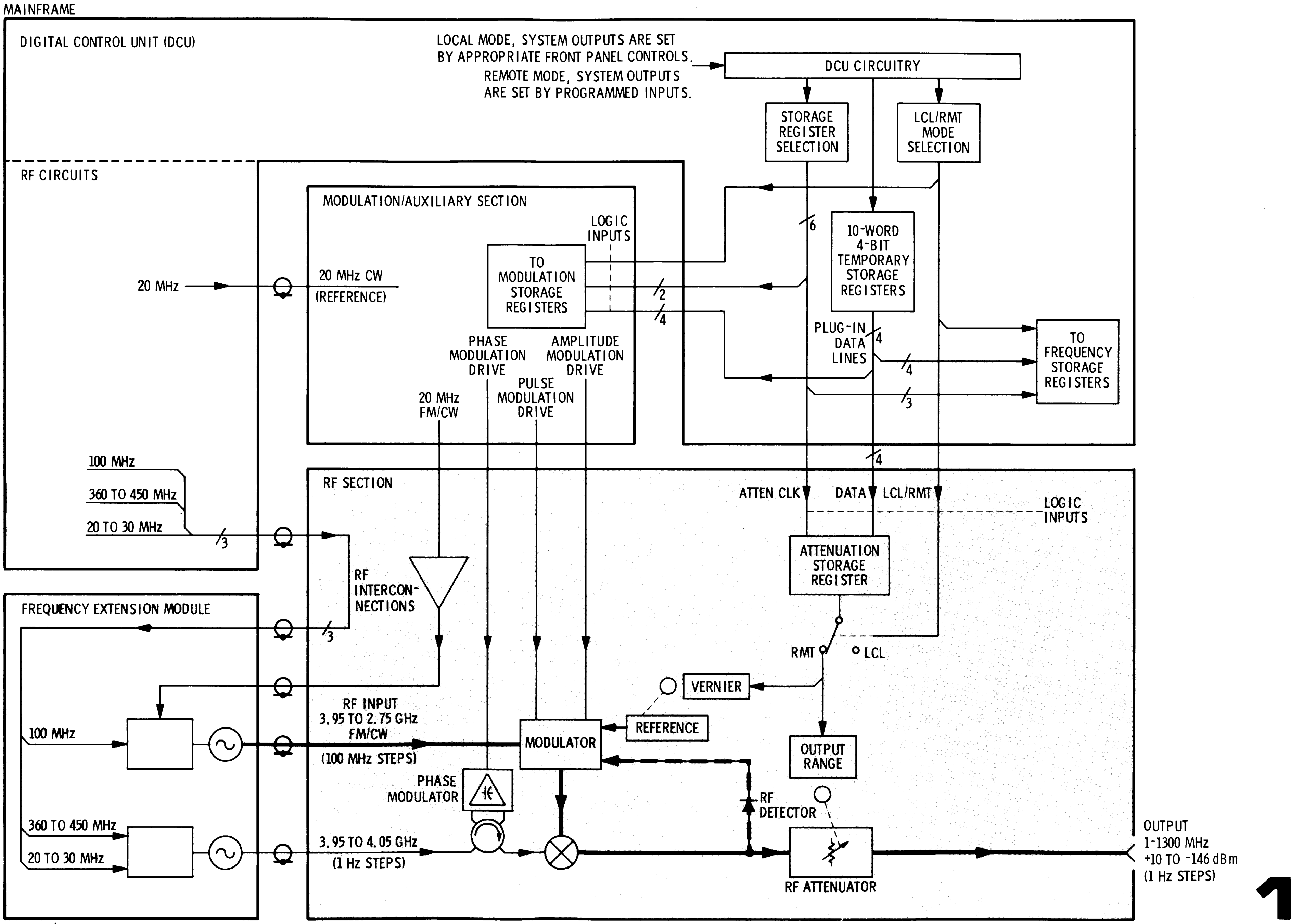


Figure 8-6. System Troubleshooting Block Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the System Troubleshooting information (Service Sheet 1) in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, return to this service sheet for further troubleshooting information.

ANALOG CIRCUITS

PRINCIPLES OF OPERATION

General

The LO and RF input signals from the frequency Extension Module are mixed and the difference frequency output is amplified and coupled to the OUTPUT jack. Thus, frequencies between 1 and 1300 MHz may be selected in 1 Hz steps.

The RF output voltage level is detected and compared to a stable reference. The resultant error voltage is used to control the level of the RF signal as it is passed through the Modulator assembly. This ALC (Automatic Level Control) loop, therefore, maintains a relatively constant output level across the system's specified output range.

The RF output level may be either locally controlled (front panel operation) or remotely controlled (programmed input). In either case, the logic control input is coupled to the Logic Section. This input data is manipulated so it selects the level of attenuation of the RF output signal by controlling the 10 and/or 1 dB Step Attenuators.

A power supply, RF interconnections, and a 20 MHz amplifier are contained in the RF Section. They supply the power and RF signals which operate the Frequency Extension Module.

Phase Modulator Section

The phase modulation drive signal from the Modulation section is coupled to the A16 Phase Modulation Driver Assembly where it passes through a gain tracking circuit (frequency variable attenuator). This circuit keeps the phase deviation constant with change in system center frequency because the sensitivity of the phase modulator circuitry changes with respect to the LO frequency. The signal is then amplified and coupled to the Phase Modulator Assembly.

Phase modulation of the LO signal occurs when the signal (which passes through the Circulator Assembly to the Phase Modulator Assembly) is reflected back into the circulator. The phase of the reflected signal with respect to the incident signal is dependent on the instantaneous modulation drive voltage present at the phase modulator. The LO signal is first passed through the isolator, through port 1 (J1) to port 2 (J2) of the circulator, and on to the phase modulator. The reflected signal is

passed from port 2 to port 3 (J3) where it is again reflected from the phase modulator with additional phase shift approximately equal to that which occurred at port 2. The signal is passed from port 3 to port 4 (J4) and through the 3 dB attenuator to the 4 GHz Amplifier Assembly.

In other than option 002 instruments (no phase modulation circuits), the LO signal is coupled directly from FL1 to the A8 4.0 GHz Amplifier Assembly.

Mixer Section

The mixer output is derived from mixing the LO and RF inputs. The phase modulated or cw LO signal is amplified and coupled to the Mixer Assembly. The RF signal passes through the Isolator (20 dB reverse isolation) to the Modulator Assembly where it encounters variable series attenuation. The series attenuation is controlled by the bias signal from the ALC feedback loop. The modulator's RF output signal is coupled directly to the Mixer where it is mixed with the LO signal. The difference frequency output is coupled to the Amplifier/Detector Assembly.

Amplifier/Detector Section

The RF input to the Amplifier/Detector Assembly is amplified 41 dB. This high level signal is coupled to the 10 dB Step Attenuator.

The Amplifier/Detector Assembly also contains the RF Detector circuit. It produces a dc voltage which is proportional to the peak RF output voltage. This signal, which is amplified to drive the front panel meter and the AM Gain compensation circuits in the Reference Assembly, is also coupled to the ALC Amplifier Assembly.

ALC Section

Reference Assembly. In the Local Mode, the RF output level is set by the front panel controls. The unmodulated RF level to the 10 dB Attenuator is set by the ALC loop's dc bias voltage which, in turn, is controlled by the VERNIER setting.

In the AM mode the modulation drive signal is superimposed on the reference voltage. The average amplitude of the RF output is dependent on the average dc level (which is equal to the dc reference voltage) while the instantaneous RF output voltage and its rate of change (modulation characteristics) are dependent on the superimposed modulation drive signal.

In the remote mode, the entire system responds to programmed inputs; the front panel controls of all instruments are inhibited. In the RF Section, the reference output is coupled to the ALC Assembly through the 1 dB Step Attenuator. Therefore, the vernier function is controlled by the 1 dB Step Attenuator.

ALC Amplifier. The ALC Amplifier compares the Detector Amplifier Assembly output to the Reference Assembly output. Any change

in the detected RF level or the reference level is immediately reflected at the ALC assembly output. This output is coupled to the A5 Modulator Assembly as the Modulator Bias signal. Because the RF input to the 10 dB Step Attenuator is directly proportional to the Modulator RF output level (which is controlled by the Modulation Bias Signal), the ALC feedback loop is completed.

Pulse Modulation Circuits. During Pulse Modulation, the ALC loop is opened at the ALC Amplifier output. With no signal input, a positive bias voltage to the A5 Modulation Assembly causes the RF signal output to be at least 40 dB down (60 dB down at center frequencies ⩾1300 MHz) from the "on-condition". A –10 Vdc pulse biases the RF "on".

Attenuation Section

The Attenuator Section operates identically in local and remote modes. The inputs from the Logic Section (10D, 20D, 40D, and 80D) select the level of attenuation of the RF signal passing through the 10 dB Step Attenuator.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the RF Section 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 information entitled System Troubleshooting on Service Sheet 1. Troubleshoot the RF Section using the test equipment, information, and procedures which follow.

Test Equipment

Spectrum Analyzer . . . . HP 8555A/8552B/140T
Oscilloscope . . . . HP 180C/1801A/1821A
Digital Voltmeter . . . . HP 34740A/34702A

Test 1. It is good practice to first check the power supply inputs to the RF Section and at the same time, it may help to check AM, Pulse ID or any other inputs which relate to the problem. The inputs may be checked at the A12 Assembly test points on the right-side rear of this plug-in.

A12 Assembly Test Points

–10V	–10.0 ± 0.1 Vdc
+20V	+20.0 ± 0.1 Vdc
$-20V_\mu$	–21.0 ± 0.2 Vdc
$+20V_\mu$	+20.0 ± 0.2 Vdc

Test 2. If the problem is related to incorrect output level, proceed to Test 3. If it is a unique type problem such as amplitude modulation, noise, etc., refer to the following items for additional troubleshooting hints.

a. **Frequency Problems.** Normally not caused by RF Section. Refer to Section VIII of the mainframe manual or Service Sheet 1 of this manual.

in the detected RF level or the reference level is immediately reflected at the ALC assembly output. This output is coupled to the A5 Modulator Assembly as the Modulator Bias signal. Because the RF input to the 10 dB Step Attenuator is directly proportional to the Modulator RF output level (which is controlled by the Modulation Bias Signal), the ALC feedback loop is completed.

Pulse Modulation Circuits. During Pulse Modulation, the ALC loop is opened at the ALC Amplifier output. With no signal input, a positive bias voltage to the A5 Modulation Assembly causes the RF signal output to be at least 40 dB down (60 dB down at center frequencies ⩾1300 MHz) from the "on-condition". A –10 Vdc pulse biases the RF "on".

Attenuation Section

The Attenuator Section operates identically in local and remote modes. The inputs from the Logic Section (10D, 20D, 40D, and 80D) select the level of attenuation of the RF signal passing through the 10 dB Step Attenuator.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the RF Section 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 information entitled System Troubleshooting on Service Sheet 1. Troubleshoot the RF Section using the test equipment, information, and procedures which follow.

Test Equipment

Spectrum Analyzer	HP 8555A/8552B/140T
Oscilloscope	HP 180C/1801A/1821A
Digital Voltmeter	HP 34740A/34702A

Test 1. It is good practice to first check the power supply inputs to the RF Section and at the same time, it may help to check AM, Pulse ID or any other inputs which relate to the problem. The inputs may be checked at the A12 Assembly test points on the right-side rear of this plug-in.

A12 Assembly Test Points

–10V	–10.0 ± 0.1 Vdc
+20V	+20.0 ± 0.1 Vdc
$-20V_\mu$	–21.0 ± 0.2 Vdc
$+20V_\mu$	+20.0 ± 0.2 Vdc

Test 2. If the problem is related to incorrect output level, proceed to Test 3. If it is a unique type problem such as amplitude modulation, noise, etc., refer to the following items for additional troubleshooting hints.

a. **Frequency Problems.** Normally not caused by RF Section. Refer to Section VIII of the mainframe manual or Service Sheet 1 of this manual.

SERVICE SHEET 2 (Cont'd)

b. **Spurious Signals.** May be isolated by checking for signal at various locations in the RF Section. Setting the A4S1 switch to Test may help to isolate the problem to the RF circuitry or ALC loop.

c. **Noise.** Generally, noise originates in Frequency Extension Module or the A15 20 MHz Amplifier Assembly.

d. **Amplitude Modulation.** Verify that the AM signal reaches the A10 Reference Assembly.

If amplitude modulation level changes with an RF level change, check the RF Section front panel meter reading versus measured RF OUTPUT level. If the panel meter reading is correct, refer to Service Sheet 7 (check AM Gain input and related circuits). Otherwise, check the meter driver amplifier and related components shown on Service Sheet 6.

Distortion problems may be caused by defective components associated with the ALC Bandwidth Input. Check the logic inputs from Service Sheet 3. Then refer to Service Sheet 3, 6, or 7.

If the amplitude modulation level differs from the level shown, perform the related adjustment procedures in Section V to see if the error is corrected. Be sure the fault isn't in the Modulation Section. An input of 1.0 Vrms to the A10 Reference Assembly should equal 100% AM level.

e. **Phase Modulation.** The output of the A16 Phase Modulator Driver Assembly is a distorted sinusoidal waveform of approximately 7.5 V_{p-p} for a full scale Modulation Section meter indication. If the output is incorrect, check the output of the cable, W12, to determine if W12 or A16 is defective. The output should be 1.5 Vrms. If the output of the A16 assembly is correct, either W14 or A17 is defective. Refer to the paragraph entitled LO Signal Circuits Repair procedure in Section VIII of this manual for disassembly and repair procedures.

Phase modulation distortion problems in the RF section will generally be caused by the A16 Phase Modulator Driver Assembly or the A17 Phase Modulator Assembly. Refer to Service Sheet 5.

NOTE

Excessive incidental AM during phase modulation may be caused by incorrect operation of the 50 MHz Low Pass Filter. Check the control input and the RF output level of the filter. Refer to Service Sheet 4.

f. **Pulse Modulation.** Problems may be isolated by checking Pulse In and Pulse ID inputs. Also, check continuity from A5 Modulator Assembly inputs from Auxiliary Section.

g. **Incorrect Front Panel Meter Reading.** Refer to Test 3.

Test 3. If the RF output level is incorrect by more than 1 or 2 dB, proceed to Test 4. Otherwise check the 10H input to the A10

SERVICE SHEET 2 (Cont'd)

Assembly related components. Refer to Service Sheet 3 if the input is incorrect. If necessary refer to Section V and perform the RF

Output Level and 1 dB Step Attenuator Adjustment procedures. If the Adjustments cannot be done or do not correct the tracking across the VERNIER range, check the Meter Driver and meter circuitry, and the AM Gain circuits. Refer to Service Sheets 6 and 7 respectively. Also check the circuits in the A4 Assembly which are influenced by the 10H input.

Test 4. Proceed to Test 5 if the RF output level is higher than normal. The RF outputs listed in each step of this test (4) are lower than normal. The voltages enclosed in parenthesis are Modulator Bias Signal ranges. They indicate that the ALC loop is (1) holding the RF output low, (2) is trying to increase the RF output or (3) that a quiescent level, although incorrect, has been reached. Refer to the block diagram for the normal range of Modulator Bias Signal levels.

a. **The RF output is low but the ALC loop is trying to increase the level (⩾–3 Vdc).** Check the RF outputs of FL1, A7, and A6 to isolate the problem to Service Sheets 4 (for other than option 002 instruments), Service Sheets 4 or 5 (option 002 instruments only), or Service Sheet 6 respectively.

If the output of FL1 is correct and the output of A7 is incorrect, the problem may be on either Service Sheets 4 or 5 in option 002 instruments. In this case, refer to the LO Signal Circuits Repair procedure and the Troubleshooting Block Diagram to isolate the problem to an assembly or cable.

On other than option 002 instruments, if the output of A7 is defective, refer to Service Sheet 4.

Each of these assemblies and circuits, if defective, must be replaced as a unit with the exception of A7. If A7 is defective, refer to Service Sheet 4 for further troubleshooting information.

b. **The RF output is low and the ALC loop is holding the Modulator Bias Signal level low (⩾+10 Vdc).** First, check the A10 Reference Assembly output with the VERNIER control set to the cw and ccw position with A4S1 in the Normal position. If the output is abnormal, refer to the troubleshooting information on Service Sheet 7. A normal output indicates the defect is either on the A3 ALC Assembly, or the A4 Detector Amplifier Assembly.

Set the A4S1 switch to the Test position. If the Modulator Bias Signal exhibits the same response as shown in the following table, the problem is probably in the A4 Detector Amplifier Assembly. (Check the Detector Signal input at A4 pin 11.)

System Troubleshooting Block Diagram
◀ SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

Modulator Bias Signal

A4S1 Switch	Vernier Control Settings			
	CW		CCW	
	904	907	904	907
Normal	+0.2 Vdc	+0.4 Vdc	+1 to +11 Vdc	+0.8 Vdc
Test	−4 Vdc	−3.0 Vdc	+0.3 Vdc	+0.5 Vdc

c. **The Modulator Bias Signal is at a quiescent level but is lower (more positive) than normal.** Check the A10 Reference Assembly output level. If the output is lower (more positive than normal), check the 1A, 2A, 4A, and 8A inputs to the A10 Assembly (remote mode only). If they are correct or the instrument is in local mode, refer to Service Sheet 7. If the remote inputs are incorrect or the problem is associated with the 10 dB Step Attenuator, refer to troubleshooting information on Service Sheet 3. Otherwise, check the detector output and reference at A4 pin 10 and 11. Refer to Service Sheet 6.

Test 5. The RF outputs listed in each step of this test are higher than normal. The voltages enclosed in parentheses are Modulator Bias Signal ranges. They indicate that the ALC loop (1) is holding the RF output high, (2) is trying to decrease the output level or (3) that a quiescent level, although incorrect, has been reached. Refer to the block diagram for normal values of Modulator Bias Signal.

a. **High RF output level; the ALC has increased the level (⩾−3 Vdc).** Check the A10 Reference Assembly output. If the response to VERNIER control settings is abnormal, refer to Service Sheet 7 and troubleshoot the A10 Assembly. If the response is normal, set the A4S1 switch to test. If the Modulator Bias Signal responds to the VERNIER control settings as indicated by the table of Test 4b, check that the detector output responds properly to the increased RF signal level (check A4 pin 10 and 11) and refer to Service Sheet 6. Otherwise, turn to Service Sheet 7 and continue troubleshooting.

b. **High RF output level; the ALC is trying to decrease the level (⩾+10 Vdc).** The A5 Modulator Assembly or associated circuitry is probably defective (refer to Service Sheet 4).

c. **The Modulator Bias Signal is at a quiescent level but higher (more negative) than normal.** Check the A10 Reference Assembly output. If the A10 output is more negative than normal, check the 1A, 2A, 4A, and 8A inputs to the A10 assembly (remote mode only). If the A10 outputs are correct or the instrument is in local mode, refer to Service sheet 7. If the remote inputs are incorrect or the problem is associated with the 10 dB Step Attenuator, refer to the troubleshooting information on Service Sheet 3. Otherwise, check that the detector output responds properly to the increased RF signal level (check A4 pins 10 and 11). Refer to Service Sheet 6.

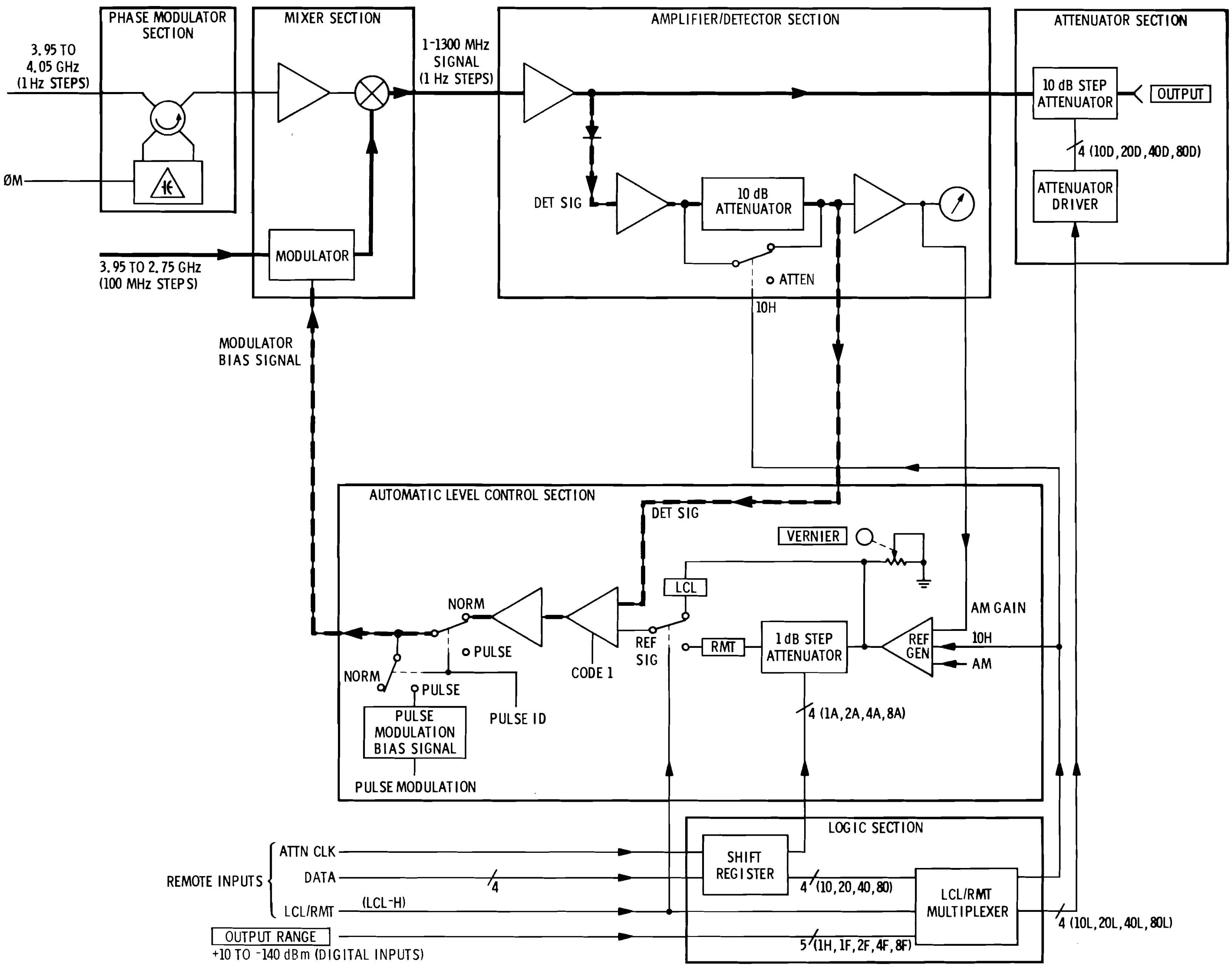
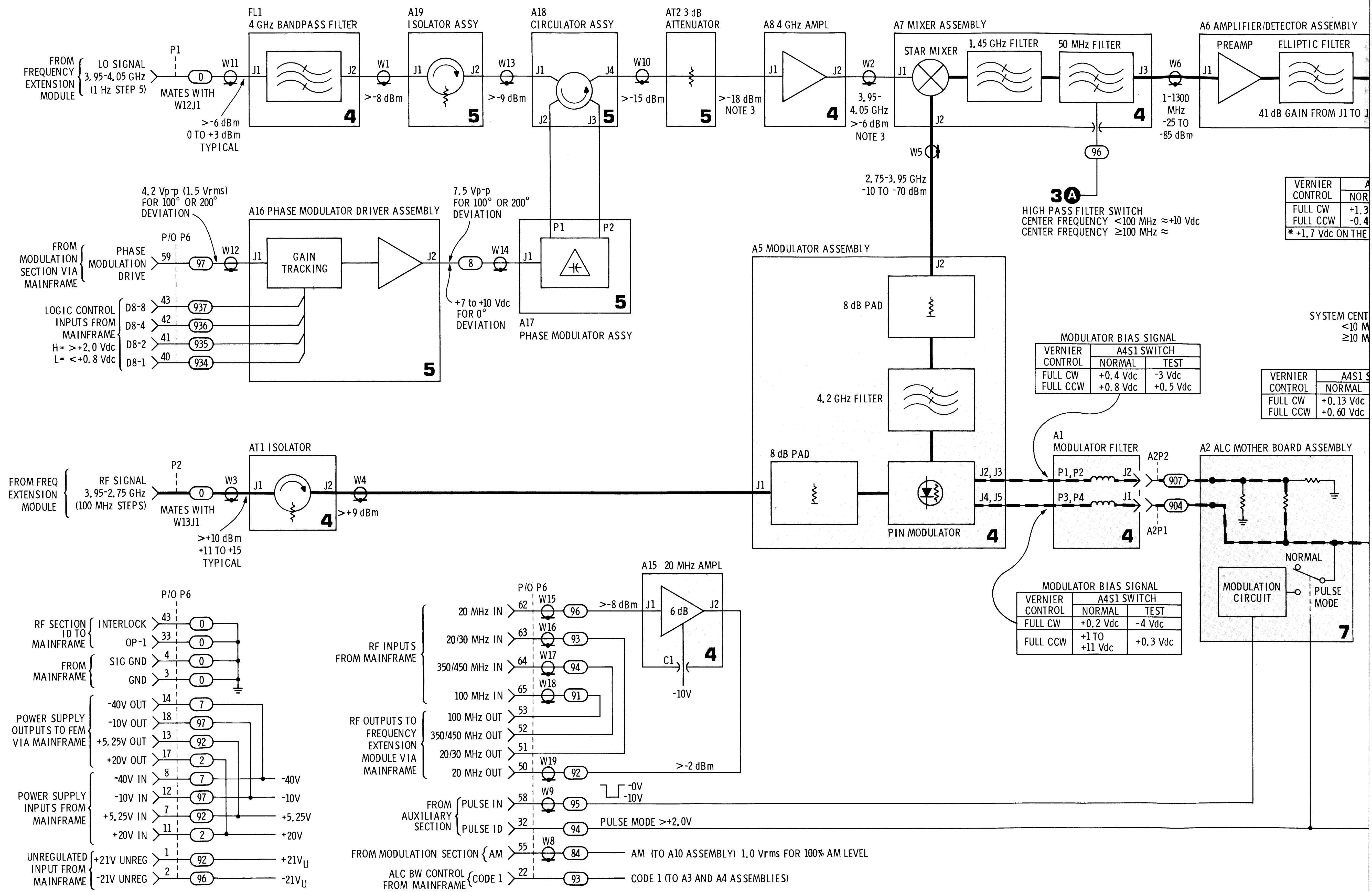
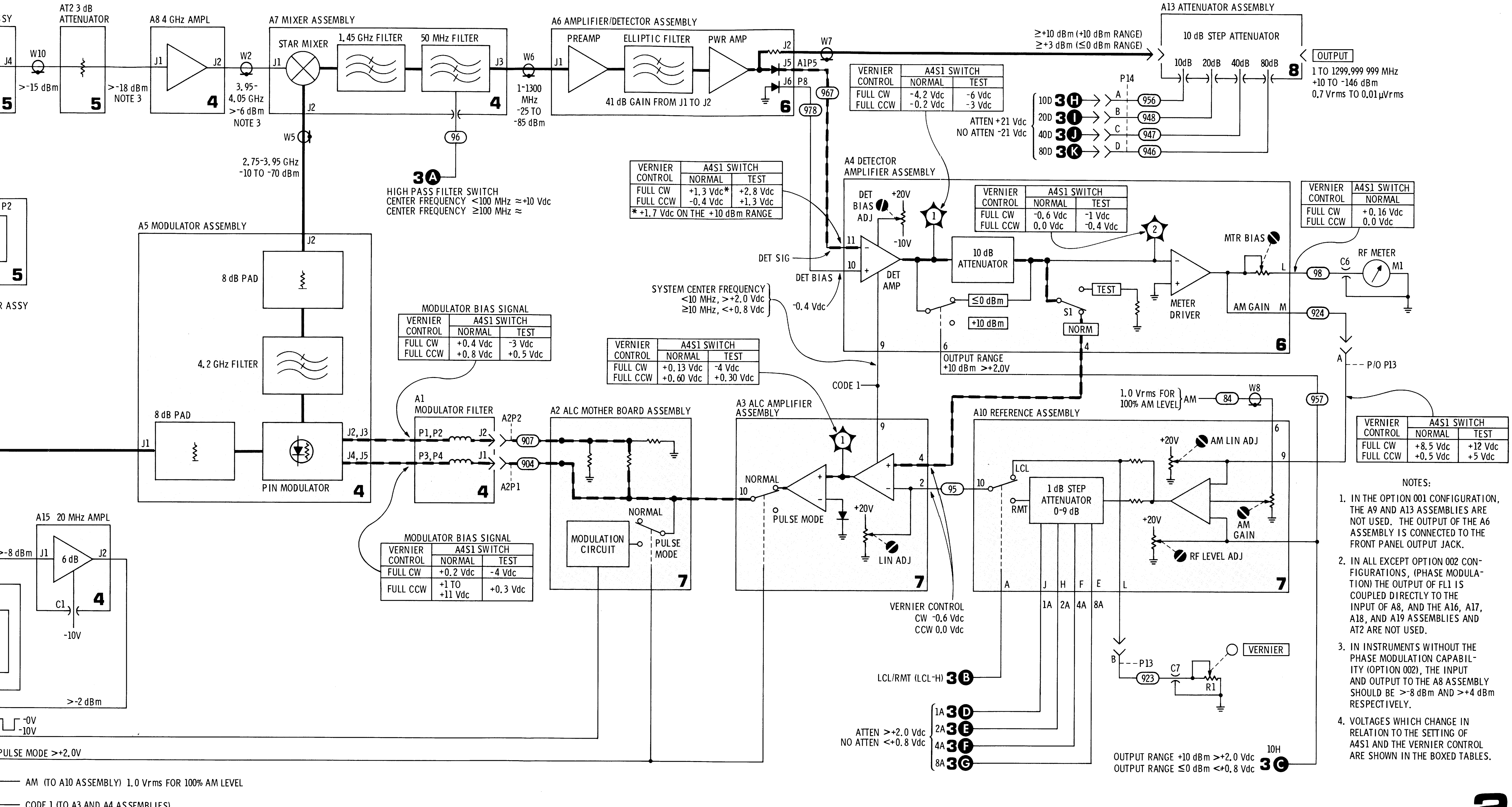


Figure 8-7. RF Section Simplified Block Diagram


FROM FREQUENCY EXTENSION MODULE
LO SIGNAL 3.95-4.05 GHz (1 Hz STEP 5)
P1
MATES WITH W12J1
>-6 dBm 0 TO +3 dBm TYPICAL
W11
FL1 4 GHz BANDPASS FILTER
>-8 dBm
W1
A19 ISOLATOR ASSY
>-9 dBm
W13
A18 CIRCULATOR ASSY
>-15 dBm
W10
AT2 3 dB ATTENUATOR
>-18 dBm NOTE 3
A8 4 GHz AMPL
W2
3.95-4.05 GHz >-6 dBm NOTE 3
A7 MIXER ASSEMBLY
STAR MIXER
1.45 GHz FILTER
50 MHz FILTER
W6
1-1300 MHz -25 TO -85 dBm
A6 AMPLIFIER/DETECTOR ASSEMBLY
PREAMP
ELLIPTIC FILTER
41 dB GAIN FROM J1 TO J
W5
2.75-3.95 GHz -10 TO -70 dBm
HIGH PASS FILTER SWITCH
CENTER FREQUENCY <100 MHz ≈+10 Vdc
CENTER FREQUENCY ≥100 MHz ≈
VERNIER CONTROL
FULL CW +1.3
FULL CCW -0.4
* +1.7 Vdc ON THE
4.2 Vp-p (1.5 Vrms) FOR 100° OR 200° DEVIATION
FROM MODULATION SECTION VIA MAINFRAME
PHASE MODULATION DRIVE
P/O P6
W12
A16 PHASE MODULATOR DRIVER ASSEMBLY
GAIN TRACKING
7.5 Vp-p FOR 100° OR 200° DEVIATION
+7 to +10 Vdc FOR 0° DEVIATION
W14
A17 PHASE MODULATOR ASSY
LOGIC CONTROL INPUTS FROM MAINFRAME H= >+2.0 Vdc L= <+0.8 Vdc
D8-8
D8-4
D8-2
D8-1
A5 MODULATOR ASSEMBLY
8 dB PAD
4.2 GHz FILTER
8 dB PAD
PIN MODULATOR
SYSTEM CENT <10 M ≥10 M
MODULATOR BIAS SIGNAL
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +0.4 Vdc | -3 Vdc
FULL CCW | +0.8 Vdc | +0.5 Vdc
VERNIER CONTROL | A4S1 NORMAL
FULL CW | +0.13 Vdc
FULL CCW | +0.60 Vdc
FROM FREQ EXTENSION MODULE
RF SIGNAL 3.95-2.75 GHz (100 MHz STEPS)
P2
MATES WITH W13J1
>+10 dBm +11 TO +15 TYPICAL
W3
AT1 ISOLATOR
W4
>+9 dBm
A1 MODULATOR FILTER
A2P2
A2P1
A2 ALC MOTHER BOARD ASSEMBLY
NORMAL
PULSE MODE
MODULATION CIRCUIT
MODULATOR BIAS SIGNAL
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +0.2 Vdc | -4 Vdc
FULL CCW | +1 TO +11 Vdc | +0.3 Vdc
A15 20 MHz AMPL
6 dB
>-8 dBm
-10V
RF SECTION ID TO MAINFRAME
INTERLOCK
OP-1
FROM MAINFRAME
SIG GND
GND
POWER SUPPLY OUTPUTS TO FEM VIA MAINFRAME
-40V OUT
-10V OUT
+5.25V OUT
+20V OUT
POWER SUPPLY INPUTS FROM MAINFRAME
-40V IN
-10V IN
+5.25V IN
+20V IN
-40V
-10V
+5.25V
+20V
UNREGULATED INPUT FROM MAINFRAME
+21V UNREG
-21V UNREG
+21VU
-21VU
RF INPUTS FROM MAINFRAME
20 MHz IN
20/30 MHz IN
350/450 MHz IN
100 MHz IN
RF OUTPUTS TO FREQUENCY EXTENSION MODULE VIA MAINFRAME
100 MHz OUT
350/450 MHz OUT
20/30 MHz OUT
20 MHz OUT
>-2 dBm
FROM AUXILIARY SECTION
PULSE IN
PULSE ID
-0V -10V
PULSE MODE >+2.0V
FROM MODULATION SECTION AM
AM (TO A10 ASSEMBLY) 1.0 Vrms FOR 100% AM LEVEL
ALC BW CONTROL FROM MAINFRAME CODE 1
CODE 1 (TO A3 AND A4 ASSEMBLIES)



NOTES:

1. IN THE OPTION 001 CONFIGURATION, THE A9 AND A13 ASSEMBLIES ARE NOT USED. THE OUTPUT OF THE A6 ASSEMBLY IS CONNECTED TO THE FRONT PANEL OUTPUT JACK.
2. IN ALL EXCEPT OPTION 002 CONFIGURATIONS, (PHASE MODULATION) THE OUTPUT OF FL1 IS COUPLED DIRECTLY TO THE INPUT OF A8, AND THE A16, A17, A18, AND A19 ASSEMBLIES AND AT2 ARE NOT USED.
3. IN INSTRUMENTS WITHOUT THE PHASE MODULATION CAPABILITY (OPTION 002), THE INPUT AND OUTPUT TO THE A8 ASSEMBLY SHOULD BE >-8 dBm AND >+4 dBm RESPECTIVELY.
4. VOLTAGES WHICH CHANGE IN RELATION TO THE SETTING OF A4S1 AND THE VERNIER CONTROL ARE SHOWN IN THE BOXED TABLES.

2

Figure 8-8. Main Troubleshooting Block 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 (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the System Troubleshooting information in Service Sheet 1. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, return to Service Sheet 2 for further troubleshooting information.

LOGIC CIRCUITRY

PRINCIPLES OF OPERATION

General

In this instrument, logic inputs to the analog circuits control functions such as 1 dB and 10 dB steps of attenuation of the RF output signal. These inputs also influence the phase modulation signal.

In the remote mode, all control signals are external to the RF Section. In the local mode, the OUTPUT RANGE switch selects the range by using a binary coded hexadecimal output with an extra overrange line. Also, the VERNIER control is analog in nature.

Filter Control Assembly

The ninth and tenth digit BCD inputs from the mainframe (100 MHz and 1 GHz) are used to control the A7A5 50 MHz Low Pass Filter.

The decoder circuit determines when the frequency output from the A7 Assembly is greater than 100 MHz. The A7A5 50 MHz High Pass Filter is switched on which effectively traps any low frequency phase modulation drive signals which would otherwise be amplified and passed on to the RF output.

Logic Assembly

Local operation of the 10 dB Step Attenuator is selected by a logic high on the LCL/RMT input. Thus, control of the 10 dB Step Attenuator by the inputs from the front panel OUTPUT RANGE switch is enabled while the remote inputs are inhibited.

In Remote mode, a logic low in the LCL/RMT inputs inhibits front panel control and enables data information flow from the mainframe to the Logic Assembly. The ATTN CLK controls the actual data input on the PI-1, PI-2, PI-4, and PI-8 lines. The OUTPUTS to the 10 dB Step Attenuator (10L, 20L, 40L, 80L), the over-range (10H), and the 1 dB Step Attenuator outputs (1A, 2A, 4A, 8A) are all controlled by external programming in the Remote Mode. A safety

feature, the RESET input, sets the 10 dB Step Attenuator to the maximum attenuation when the Remote mode is first initiated.

Attenuator Driver Assembly

The inputs from the Logic Assembly (10L, 20L, 40L, and 80L) switch the equivalent attenuator drive outputs (10D, 20D, 40D, and 80D). These outputs provide the higher voltages and current needed to drive the relays in the A13 Attenuator Assembly.

TROUBLESHOOTING

Malfunctions in the RF Section which appear to be a logic problem may be an analog circuit problem. Refer to Service Sheet 2 to begin troubleshooting and return here if necessary.

Test Equipment

Oscilloscope	HP 180C/1801A/1821A
Digital Voltmeter	HP 34740A/34702A
Logic Probe	HP 10525T

General

If the malfunction is isolated to the logic circuits, the related inputs must be checked before an attempt is made to troubleshoot the individual circuit assemblies. The control levels are fixed and may change when a new center frequency or mode of operation (local or remote) has been selected. The clocked or momentary inputs, PI (plug-in), ATTN CLK, and RESET occur only at the instant the center frequency or mode change is made.

Local Mode

In local mode, the inputs mentioned in the preceding paragraph are not used. The 1A, 2A, 4A, and 8A outputs are also not used. (VERNIER control replaces the 1 dB step attenuator.) Check the 1F, 2F, 4F, 8F, and 1H inputs against the levels shown for the S1 switch in the diagram.

Remote Mode

Check the Logic Assembly PI, ATTN CLK, and RESET inputs. Switch to the local mode and then back to the remote mode of operation. Verify that the attenuation level has reset to 150 dB by checking the 10L, 20L, 40L, 80L, and 10H outputs [10H and 10L should be low (<+0.8 Vdc) while 20L, 40L, and 80L outputs should be high (>+2.0 Vdc)]. The momentary low input (0 Vdc as compared to the normal +5 Vdc) may be observed on an oscilloscope at the instant of switching. A logic probe may also be used to verify the presence of the reset pulse. To verify that the PI (data) and ATTN CLK inputs are correct, program the information shown in the table at the

◀ Main Troubleshooting Block Diagram
SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

bottom of this page. Check each output for the correct level. If any level is incorrect, the presence of the data and/or the ATTN CLK inputs may be checked at the instant of programming with an oscilloscope or logic probe.

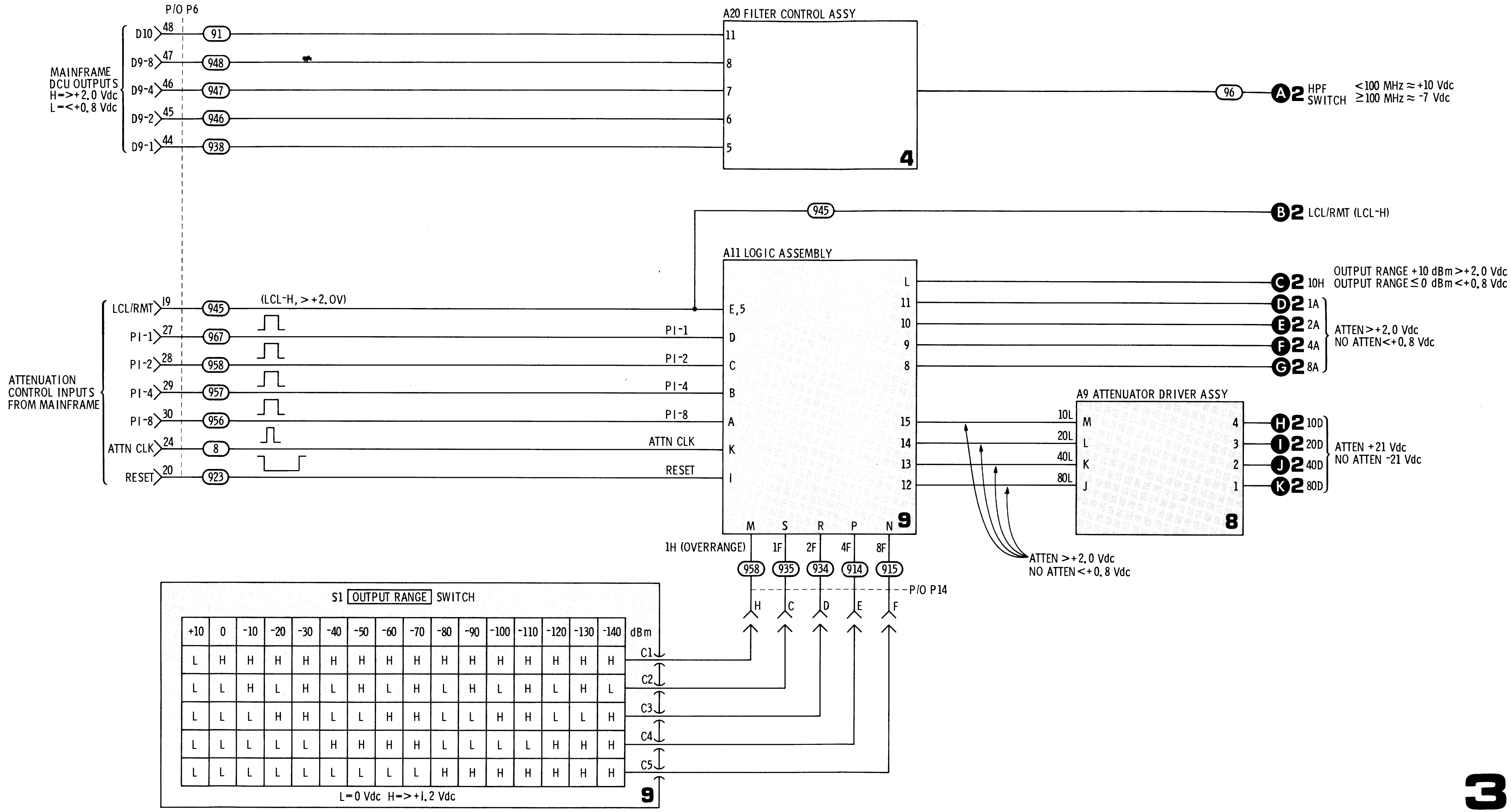
Check the A9 Attenuator Driver Assembly outputs against the inputs.

NOTE

If the problem is isolated between the inputs and outputs of an assembly, refer to the appropriate Service Sheet as indicated on the diagram.

Programmed Attenuation	RF Output Level	Outputs								
		1A 1 dB	2A 2 dB	4A 4 dB	8A 8 dB	10L 10 dB	20L 20 dB	40L 40 dB	80L 80 dB	10H 10 dB
7 dB	+6 dBm	H	H	H	L	L	L	L	L	L
87 dB	−74 dBm	H	H	H	L	H	H	H	L	H
98 dB	−85 dBm	L	L	L	H	L	L	L	H	H

H = Attenuation = >+2.0 Vdc
L = No Attenuation = <+0.8 Vdc



	+10	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100	-110	-120	-130	-140 dBm
C1	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
C2	L	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
C3	L	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H
C4	L	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H
C5	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H

3

Figure 8-9. Logic Troubleshooting Block Diagram

SERVICE SHEET 4

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems Troubleshooting information (Service Sheet 1). This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for further troubleshooting information.

MIXER SECTION

PRINCIPLES OF OPERATION

General

The LO signal is filtered and amplified to drive the mixer. The RF signal is leveled and may be amplitude modulated at the A5 Modulator Assembly. After passing through the Modulator, the RF Signal and LO Signal are mixed; the difference frequency is passed on for further amplification.

4 GHz Bandpass Filter/Amplifier

Unwanted sidebands are eliminated from the LO signal by passing the signal through a bandpass filter. In option 002 instruments, the LO signal is coupled to the phase modulation circuits before being input to the 4 GHz Amplifier. The signal is amplified to a high level to drive the mixer.

Isolator

The 3.95 to 2.75 GHz RF Signal is passed through the Isolator to the Modulator Assembly. Reverse signal attenuation is about 20 dB.

Modulator Assembly

The effect of the PIN diode Modulator on the RF Signal is that of a variable attenuator. The level of attenuation and therefore the modulator RF output is dependent on the Modulator Bias Signal dc level.

The PIN Diode Modulator has dynamic attenuation range of >50 dB. A more positive modulator bias signal turns off the series diodes while the shunt diodes are forward biased. The shunt diodes and the series resistor form a voltage divider which attenuates the RF Signal. As the bias voltage goes more negative, the impedance of the shunt diodes increases while the series diodes impedance decreases. Therefore, the RF signal attenuation decreases. The shunt diodes effectively control the attenuation from 12 to >50 dB down while the series diodes are effective only to about 12 dB down.

Logic Troubleshooting Block Diagram
SERVICE SHEET 3

SERVICE SHEET 4 (Cont'd)

The RF output level at the front panel jack is directly proportional to the Modulator Assembly RF output. The Modulator Bias Signal controls the A5 Modulator Assembly output and is dependent on an error voltage derived from comparing the RF detector output to the reference dc level.

Mixer Assembly

The RF Signal is passed through a low pass filter and attenuator before leaving the Modulator Assembly. Then the RF signal is mixed with the LO signal in the Mixer Assembly, the mixer output passes through a low pass filter, and the difference frequency is a 1-1300 MHz phase-locked signal with frequency resolution of 1 Hz.

At center frequencies ⩾ 100 MHz, the High Pass Filter Control input from the A20 Filter Control Assembly to the A7A5 Assembly causes the mixer output to pass through the 50 MHz High Pass Filter. This reduces incidental AM distortion generated by the phase modulated signal in the balanced mixer.

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 Mixer Section by using the test equipment and procedures given below.

NOTE

In Option 002 instruments, a defect cannot easily be isolated to circuits shown on this schematic diagram. Refer to Service Sheet 2 and the repair procedure entitled LO Signal Circuits Repair.

Test Equipment

Spectrum Analyzer . .	HP 8555A/8552B/140T
Power Meter.	HP 435A/8481A
Digital Voltmeter . . .	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A8 Assembly (+20V and −10V). If correct, proceed to Test 2. Otherwise check for continuity of interconnections to mainframe or an A8 Assembly defect.

CAUTION

Slight but repeated bending of semi-rigid coaxial cables will damage them very quickly. Bend the cables as little as possible. If necessary, loosen the assembly to release the cable.

Test 2. If the RF power output is greater than normal (refer to the schematic), the A5 Modulator Assembly is probably defective. If the power output is less than normal, checking the difference assembly outputs will quickly isolate the defective assembly or cable.

NOTE

Defects in the A15 20 MHz Amplifier Assembly and RF interconnections from mainframe to Frequency Extension Module (through the RF Section) normally will be isolated by using the Systems Troubleshooting (Service Sheet 1).

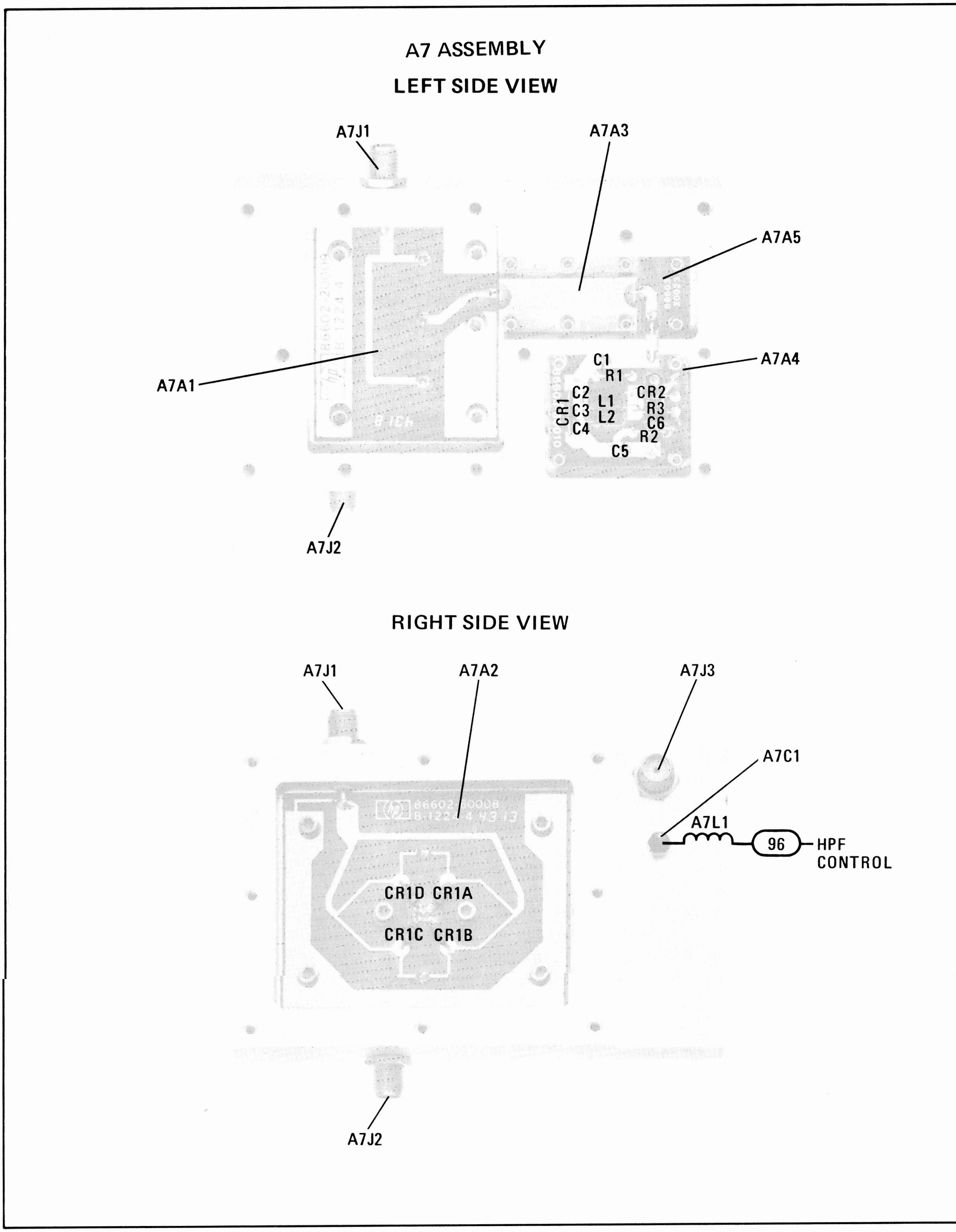
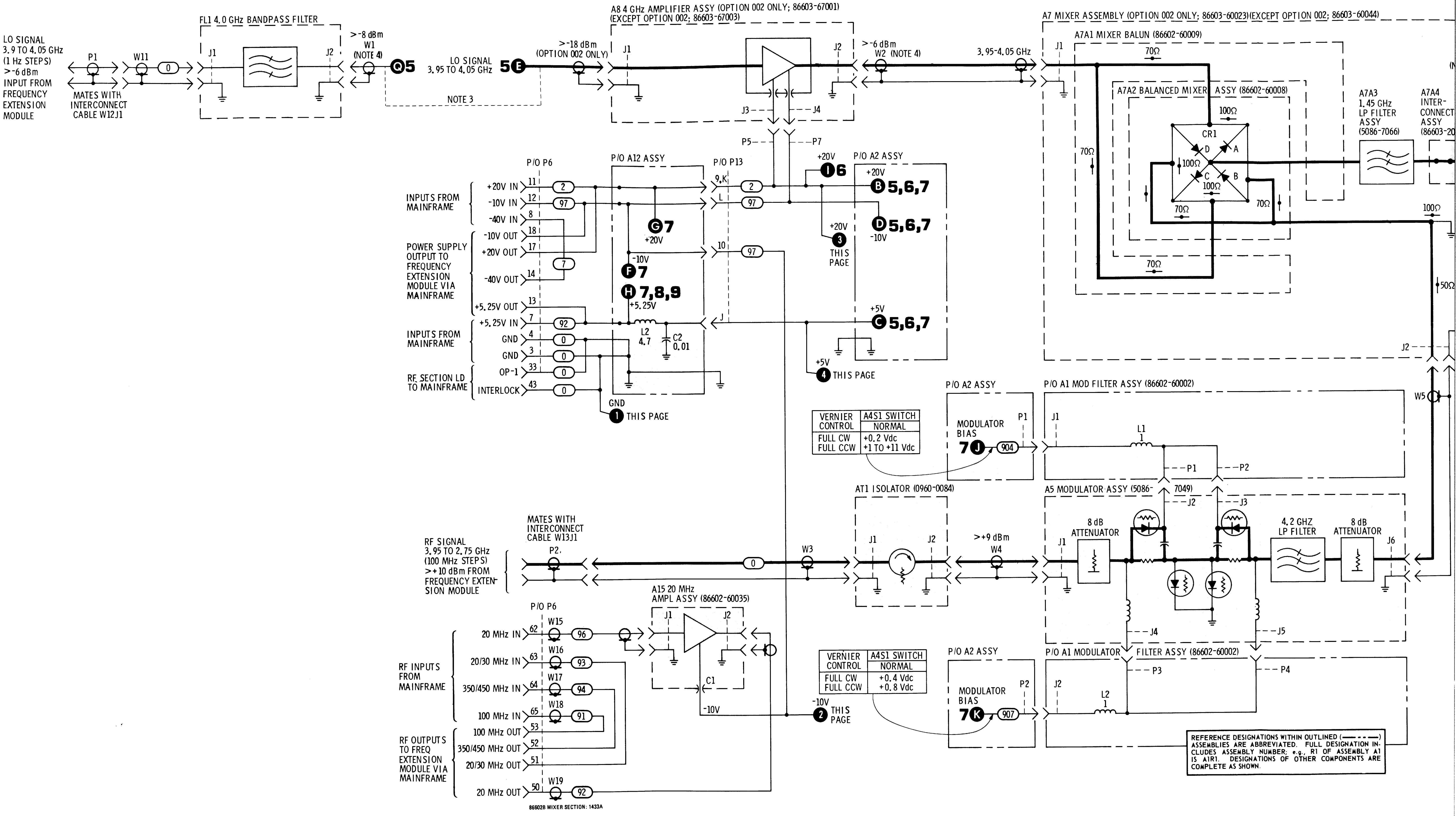
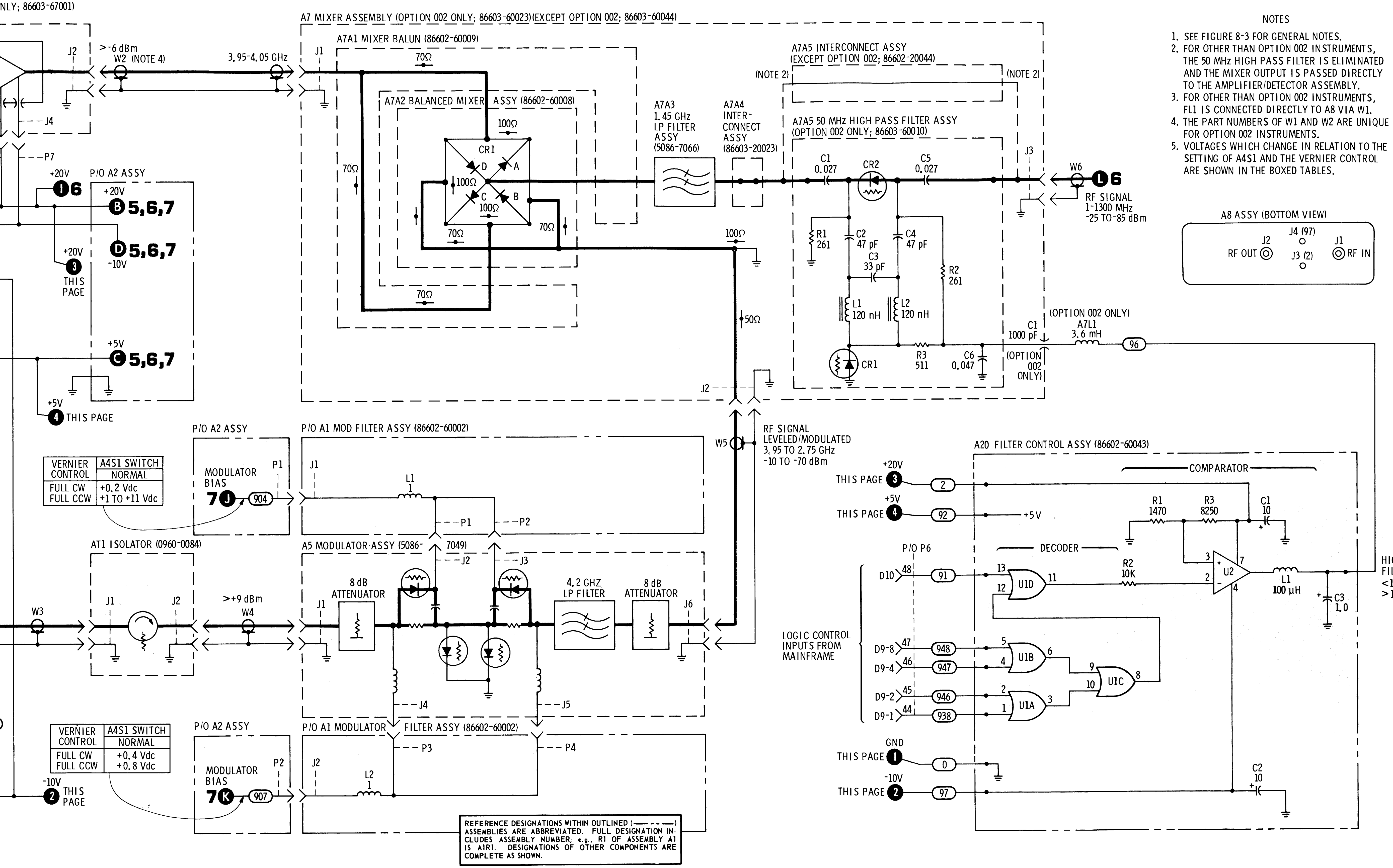


Figure 8-10. A7 Mixer Assembly's subAssembly and Component Locations


LO SIGNAL
3.9 TO 4.05 GHz
(1 Hz STEPS)
>-6 dBm
INPUT FROM
FREQUENCY
EXTENSION
MODULE
P1
W11
MATES WITH
INTERCONNECT
CABLE W12J1
FL1 4.0 GHz BANDPASS FILTER
J1
J2
>-8 dBm
W1
(NOTE 4)
Q5
LO SIGNAL
3.95 TO 4.05 GHz
5E
NOTE 3
>-18 dBm
(OPTION 002 ONLY)
A8 4 GHz AMPLIFIER ASSY (OPTION 002 ONLY; 86603-67001)
(EXCEPT OPTION 002; 86603-67003)
J3
J4
P5
P7
>-6 dBm
W2 (NOTE 4)
3.95-4.05 GHz
A7 MIXER ASSEMBLY (OPTION 002 ONLY; 86603-60023)(EXCEPT OPTION 002; 86603-60044)
A7A1 MIXER BALUN (86602-60009)
A7A2 BALANCED MIXER ASSY (86602-60008)
CR1
70Ω
100Ω
A7A3
1.45 GHz
LP FILTER
ASSY
(5086-7066)
A7A4
INTER-
CONNECT
ASSY
50Ω
P/O P6
P/O A12 ASSY
P/O P13
P/O A2 ASSY
INPUTS FROM
MAINFRAME
+20V IN
-10V IN
-40V IN
POWER SUPPLY
OUTPUT TO
FREQUENCY
EXTENSION
MODULE VIA
MAINFRAME
-10V OUT
+20V OUT
-40V OUT
+5.25V OUT
INPUTS FROM
MAINFRAME
+5.25V IN
GND
GND
RF SECTION LD
TO MAINFRAME
OP-1
INTERLOCK
G7
+20V
-10V
F7
H7,8,9
+5.25V
L2
4.7
C2
0.01
+20V
I6
B5,6,7
D5,6,7
-10V
+20V
3
THIS
PAGE
+5V
C5,6,7
+5V
4 THIS PAGE
GND
1 THIS PAGE
VERNIER CONTROL
A4S1 SWITCH NORMAL
FULL CW +0.2 Vdc
FULL CCW +1 TO +11 Vdc
P/O A2 ASSY
MODULATOR
BIAS
7J
P1
P/O A1 MOD FILTER ASSY (86602-60002)
L1
P2
W5
AT1 ISOLATOR (0960-0084)
A5 MODULATOR ASSY (5086-7049)
8 dB
ATTENUATOR
4.2 GHZ
LP FILTER
8 dB
ATTENUATOR
J6
J5
RF SIGNAL
3.95 TO 2.75 GHz
(100 MHz STEPS)
>+10 dBm FROM
FREQUENCY EXTEN-
SION MODULE
MATES WITH
INTERCONNECT
CABLE W13J1
P2.
W3
>+9 dBm
W4
A15 20 MHz
AMPL ASSY (86602-60035)
C1
-10V
2 THIS
PAGE
RF INPUTS
FROM
MAINFRAME
20 MHz IN
20/30 MHz IN
350/450 MHz IN
100 MHz IN
RF OUTPUTS
TO FREQ
EXTENSION
MODULE VIA
MAINFRAME
100 MHz OUT
350/450 MHz OUT
20/30 MHz OUT
20 MHz OUT
W15
W16
W17
W18
W19
VERNIER CONTROL
A4S1 SWITCH NORMAL
FULL CW +0.4 Vdc
FULL CCW +0.8 Vdc
P/O A2 ASSY
MODULATOR
BIAS
7K
P/O A1 MODULATOR FILTER ASSY (86602-60002)
P3
P4
L2
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.
86602B MIXER SECTION: 1433A



NOTES

1. SEE FIGURE 8-3 FOR GENERAL NOTES.
2. FOR OTHER THAN OPTION 002 INSTRUMENTS, THE 50 MHz HIGH PASS FILTER IS ELIMINATED AND THE MIXER OUTPUT IS PASSED DIRECTLY TO THE AMPLIFIER/DETECTOR ASSEMBLY.
3. FOR OTHER THAN OPTION 002 INSTRUMENTS, FL1 IS CONNECTED DIRECTLY TO A8 VIA W1.
4. THE PART NUMBERS OF W1 AND W2 ARE UNIQUE FOR OPTION 002 INSTRUMENTS.
5. VOLTAGES WHICH CHANGE IN RELATION TO THE SETTING OF A4S1 AND THE VERNIER CONTROL ARE SHOWN IN THE BOXED TABLES.

REFERENCE DESIGNATIONS

NO PREFIX	A7A5 ASSY
AT1 FL1 P1,2,5-7,13 W1-6,11, 15-19	C1-6 CR1,2 L1,2 R1-3
	A12 ASSY
A1 ASSY	C2 L2
J1,2 L1,2 P1-4	A20 ASSY
A7 ASSY	C1-3 L1 R1-3 U1,2
C1 J1-3 L1	
A7A2 ASSY	
CR1	

4

A1,A5,A7,A8, A12,A15,A20,AT1,FL1

Figure 8-11. 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 (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems Troubleshooting information in Service Sheet 1. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for further troubleshooting information.

PRINCIPLES OF OPERATION

General

The phase modulation drive signal from the modulation section is coupled to the A16 Phase Modulation Driver Assembly. The signal is predistorted and the overall gain is varied (with respect to LO frequency) to compensate for the frequency characteristics of the A17 Phase Modulator Assembly. The signal is amplified before being connected to the phase modulator.

With minimal loss, the LO signal passes through the A19 3.9-4.1 Isolator Assembly to the A18 Circulator Assembly. The signal passes from port 1 to port 2 and on to the phase modulator.

In the phase modulator, the varactor diode, A17A1CR1 reactively terminates the stripline transmission line which reflects the LO signal. Changing the bias voltage applied to the varactor diode changes the termination reactance. This causes the reflected signal to shift in phase with respect to the incident input signal.

The reflected LO signal travels back down the transmission line and through port 2 to port 3, where it again enters the phase modulator. The same sequence of events occurs. Thus, the phase shift of the LO signal reflected back to port 3 is approximately doubled.

The phase modulated LO signal continues from port 3 to port 4, through the AT2 3 dB Attenuator and on to the A8 4 GHz Amplifier Assembly. Due to the high input reflection coefficient of the 4 GHz Amplifier, a large portion of the signal is reflected back to port 4, through to port 1, and on to the Frequency Extension Module. The AT2 3 dB Attenuator and A19 3.9-4.1 GHz Isolator Assemblies reduce the level of the reflected signal to prevent it from interfering with the extension module VCO circuits.

A16 Phase Modulator Driver Assembly

The cable capacitance of W12 and A16L1 form a low pass filter which improves the frequency response of the input modulation drive signal up to 10 MHz.

Diode Shaping Network. The shaping network introduces third order distortion to higher level input signals (when the A16CR2

diode begins to conduct). The level of distortion is adjusted to compensate for the third order distortion inherent in the phase modulator transfer characteristics. The demodulated third order phase modulation sidebands are minimized by adjusting A16R1, the Third Harmonic Adjust control.

Gain Tracking. Gain tracking of the modulation drive signal is introduced to compensate for the phase modulator's inability to produce a constant phase deviation at different LO frequencies. At higher LO frequencies, the phase modulator sensitivity is lower and a higher level modulation drive signal is required to produce the same phase deviation. At system center frequencies where digit 8 (10 MHz steps) is zero (LO frequency is 3.95 MHz), logic lows (<+0.8 Vdc) are coupled to the U2 inverters. The outputs are high (>+2.0 Vdc) which bias the U1 transistors on, and current flows from the modulation drive signal path through A16R7, R9, R11 and R13 to ground. This causes maximum attenuation of the drive signal. Conversely, at center frequencies where digit 8 is other than zero, logic highs are input to one or more of the inverters and the low outputs bias the transistors off. This cuts off current flow through the shunt resistors and reduces the attenuation. Minimum attenuation occurs when digit 8 is nine (digits 8-1 and 8-8 are high) and current flow through A16R7 and R13 is cut off.

The Gain control, A16R2, sets the absolute modulation signal level with minimum attenuation (at 4.05 GHz). The Gain Tracking control adjusts the rate of change of attenuation with respect to the LO frequency by setting the modulation signal level with minimum attenuation (at 3.95 GHz).

J-FET Shaping Circuit. The J-FET A16Q1 is biased so it introduces second order distortion to the modulation drive signal. This distortion compensates for the second order distortion in the transfer characteristics of the phase modulator. The transfer characteristics of the phase modulator are varied by changing the dc output from the A16 Assembly. The Second Harmonic Adjust Control A16R3 sets the second order distortion level of A16Q1 (by controlling the drain current flow) and the dc output from A16 (which is proportional to the A16Q1 drain voltage). The distortion level is minimized by demodulating the system's RF output and nulling the second order phase modulation sidebands.

Modulation Driver Amplifier. The J-FET output is coupled to the discrete component operational amplifier made up of A16Q4 through Q10 and their associated components. The input is coupled directly to the inverting input A16Q4. Any noise generated in the reference supply circuit, A16Q11, is coupled equally to both inverting and non-inverting inputs and is therefore cancelled. The amplifier's high frequency rolloff is set by A16C8. The gain of approximately 10 is determined primarily by A16R36, 1000Ω, and A16R25, 100Ω.

Reference Supply. A16Q5, the non-inverting input to the Modulation Driver Amplifier, is a PNP transistor and thus is biased opposite to NPN A16Q11. Any change in voltage across the base emitter junction of A16Q11 due to temperature is compensated for, by an equal and opposite change across the base-emitter junction of A16Q5. Therefore, the voltage at the emitter of A16Q5 is temperature stabilized. In similar fashion, the voltage on the emitter of A16Q4 is also temperature stabilized. The voltage at the base of A16Q7 is temperature stabilized except for the influence of A16CR3. The temperature related change in current flow through this diode appears as a change in voltage on A16Q7 and is amplified by the Modulation Driver Amplifier. This voltage change compensates for temperature related change in sensitivity of the varactor diodes in the A17 Assembly.

A17 Phase Modulator Assembly

In the phase modulator, the LO signal passes through the blocking capacitors and down the stripline transmission lines to the varactor diode terminations, A17A1CR1 and CR2. The amount of phase shift between the incident and reflected signals is determined by the varactor capacitance.

The varactor capacitance is voltage variable. The dc bias input sets the quiescent phase shift. The instantaneous phase shift is dependent on the sum of the dc bias and the ac modulation drive signal input to the phase modulator.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 2 and the LO Signal Circuits Repair procedure were used to isolate the defect to one of the Assemblies. Troubleshoot the A16 or A17 Assemblies by using the following procedure.

Test Equipment

Digital Voltmeter	HP 34740A/34702A
Oscilloscope	HP 180C/1801A/1821A
Spectrum Analyzer	HP 8555A/8552B/140T

A16 and A17 Assembly circuit malfunctions usually result in incorrect or no modulation drive, incorrect gain tracking, or unwanted distortion. Distortion may be due to misadjusted or defective components.

Set the system's modulation section switches for ØM mode, internal

A1 Modulator Filter Assembly
A2 ALC Mother Board Assembly
A5 Modulator Assembly
A7 Mixer Assembly
A8 4 GHz Amplifier Assembly
A12 Logic Mother Board Assembly
A15 20 MHz Amplifier Assembly
A20 Filter Control Assembly
AT1 Isolator
FL1 4 GHz Band Pass Filter

diode begins to conduct). The level of distortion is adjusted to compensate for the third order distortion inherent in the phase modulator transfer characteristics. The demodulated third order phase modulation sidebands are minimized by adjusting A16R1, the Third Harmonic Adjust control.

Gain Tracking. Gain tracking of the modulation drive signal is introduced to compensate for the phase modulator's inability to produce a constant phase deviation at different LO frequencies. At higher LO frequencies, the phase modulator sensitivity is lower and a higher level modulation drive signal is required to produce the same phase deviation. At system center frequencies where digit 8 (10 MHz steps) is zero (LO frequency is 3.95 MHz), logic lows (<+0.8 Vdc) are coupled to the U2 inverters. The outputs are high (>+2.0 Vdc) which bias the U1 transistors on, and current flows from the modulation drive signal path through A16R7, R9, R11 and R13 to ground. This causes maximum attenuation of the drive signal. Conversely, at center frequencies where digit 8 is other than zero, logic highs are input to one or more of the inverters and the low outputs bias the transistors off. This cuts off current flow through the shunt resistors and reduces the attenuation. Minimum attenuation occurs when digit 8 is nine (digits 8-1 and 8-8 are high) and current flow through A16R7 and R13 is cut off.

The Gain control, A16R2, sets the absolute modulation signal level with minimum attenuation (at 4.05 GHz). The Gain Tracking control adjusts the rate of change of attenuation with respect to the LO frequency by setting the modulation signal level with minimum attenuation (at 3.95 GHz).

J-FET Shaping Circuit. The J-FET A16Q1 is biased so it introduces second order distortion to the modulation drive signal. This distortion compensates for the second order distortion in the transfer characteristics of the phase modulator. The transfer characteristics of the phase modulator are varied by changing the dc output from the A16 Assembly. The Second Harmonic Adjust Control A16R3 sets the second order distortion level of A16Q1 (by controlling the drain current flow) and the dc output from A16 (which is proportional to the A16Q1 drain voltage). The distortion level is minimized by demodulating the system's RF output and nulling the second order phase modulation sidebands.

Modulation Driver Amplifier. The J-FET output is coupled to the discrete component operational amplifier made up of A16Q4 through Q10 and their associated components. The input is coupled directly to the inverting input A16Q4. Any noise generated in the reference supply circuit, A16Q11, is coupled equally to both inverting and non-inverting inputs and is therefore cancelled. The amplifier's high frequency rolloff is set by A16C8. The gain of approximately 10 is determined primarily by A16R36, 1000Ω, and A16R25, 100Ω.

Reference Supply. A16Q5, the non-inverting input to the Modulation Driver Amplifier, is a PNP transistor and thus is biased opposite to NPN A16Q11. Any change in voltage across the base emitter junction of A16Q11 due to temperature is compensated for, by an equal and opposite change across the base-emitter junction of A16Q5. Therefore, the voltage at the emitter of A16Q5 is temperature stabilized. In similar fashion, the voltage on the emitter of A16Q4 is also temperature stabilized. The voltage at the base of A16Q7 is temperature stabilized except for the influence of A16CR3. The temperature related change in current flow through this diode appears as a change in voltage on A16Q7 and is amplified by the Modulation Driver Amplifier. This voltage change compensates for temperature related change in sensitivity of the varactor diodes in the A17 Assembly.

A17 Phase Modulator Assembly

In the phase modulator, the LO signal passes through the blocking capacitors and down the stripline transmission lines to the varactor diode terminations, A17A1CR1 and CR2. The amount of phase shift between the incident and reflected signals is determined by the varactor capacitance.

The varactor capacitance is voltage variable. The dc bias input sets the quiescent phase shift. The instantaneous phase shift is dependent on the sum of the dc bias and the ac modulation drive signal input to the phase modulator.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 2 and the LO Signal Circuits Repair procedure were used to isolate the defect to one of the Assemblies. Troubleshoot the A16 or A17 Assemblies by using the following procedure.

Test Equipment

Digital Voltmeter	HP 34740A/34702A
Oscilloscope	HP 180C/1801A/1821A
Spectrum Analyzer	HP 8555A/8552B/140T

A16 and A17 Assembly circuit malfunctions usually result in incorrect or no modulation drive, incorrect gain tracking, or unwanted distortion. Distortion may be due to misadjusted or defective components.

Set the system's modulation section switches for ØM mode, internal

- A1 Modulator Filter Assembly
- A2 ALC Mother Board Assembly
- A5 Modulator Assembly
- A7 Mixer Assembly
- A8 4 GHz Amplifier Assembly
- A12 Logic Mother Board Assembly
- A15 20 MHz Amplifier Assembly
- A20 Filter Control Assembly
- AT1 Isolator
- FL1 4 GHz Band Pass Filter

SERVICE SHEET 4

SERVICE SHEET 5 (Cont'd)

1 kHz source, and adjust the modulation level control for a full scale meter reading (100° or 200°). Refer to the schematics for the typical voltages.

A16 Assembly

Test 1. Check the power supply inputs to the A16 Assembly.

Test 2. Check the peak-to-peak ac voltages at the various points as indicated on the schematic. If all seem to be correct, refer to Section V and readjust the phase modulation circuits.

Test 3. If the output of the discrete component operational amplifier is defective, check the dc output and compare it to the dc inputs. If the change in dc output voltage from normal does not follow the change in input dc voltage, the problem is probably in Q4 through Q10 or their associated components. For example, the output voltage is more positive than normal.

Test 4. Check the dc voltages on A16Q1 through Q3 and Q11.

Test 5. If the gain tracking is incorrect, check and compare the inputs and outputs of A16U1 and U2.

A17 Assembly

Test 1. Remove the assembly cover. Check for the presence of the dc bias and ac voltage on the varactor diodes, A17CR1 and CR2.

Test 2. Verify that A17C1 and C3 are not defective.

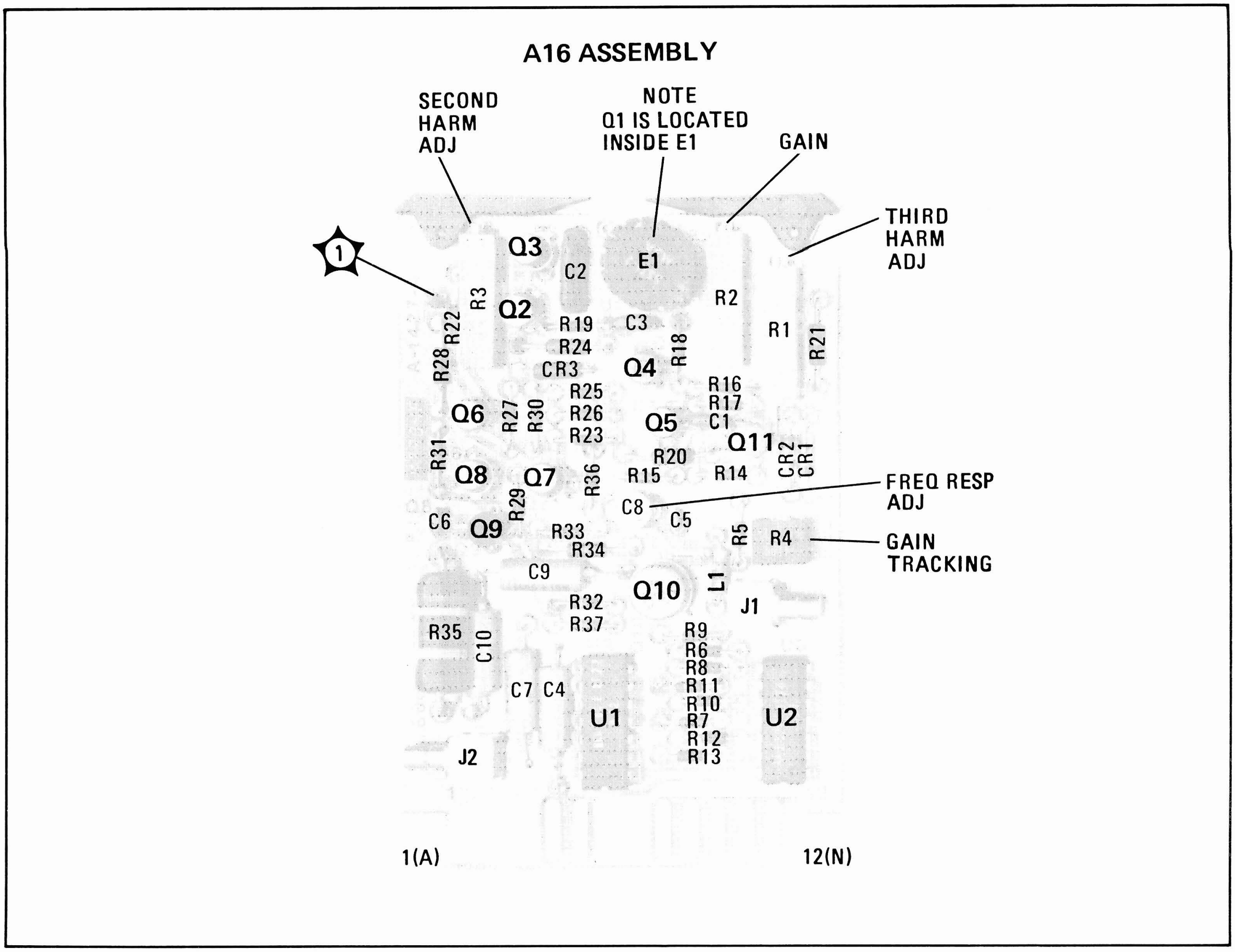


Figure 8-12. A16 Phase Modulator Driver Assembly Component and Test Point Locations

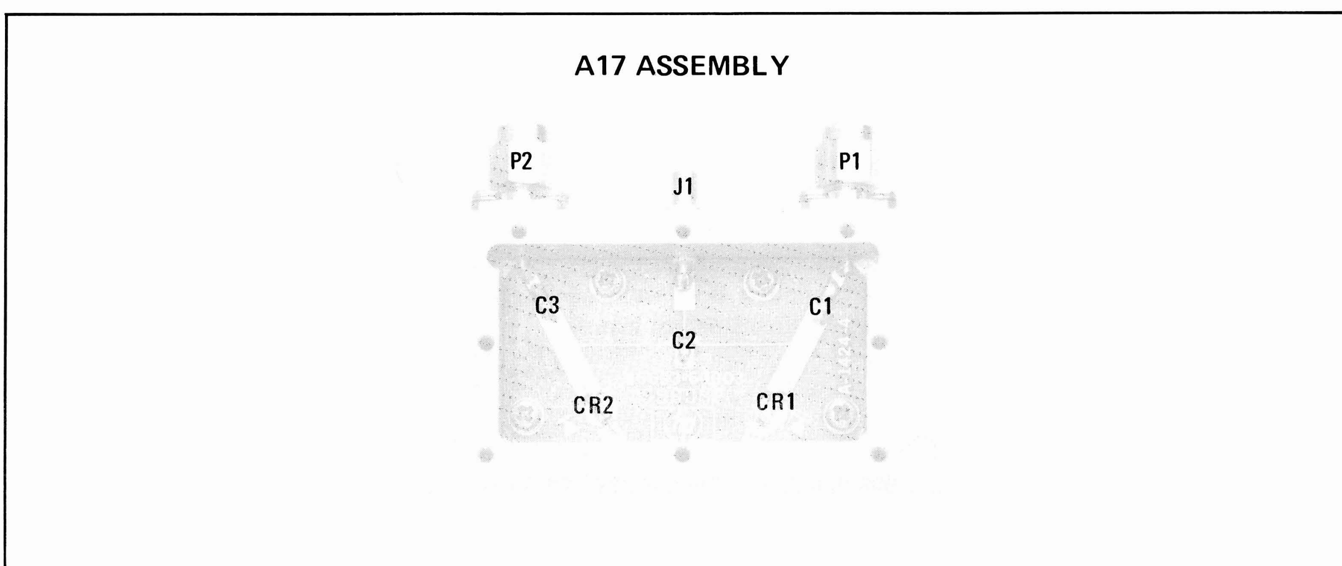


Figure 8-13. A17 Phase Modulator Assembly Component Locations

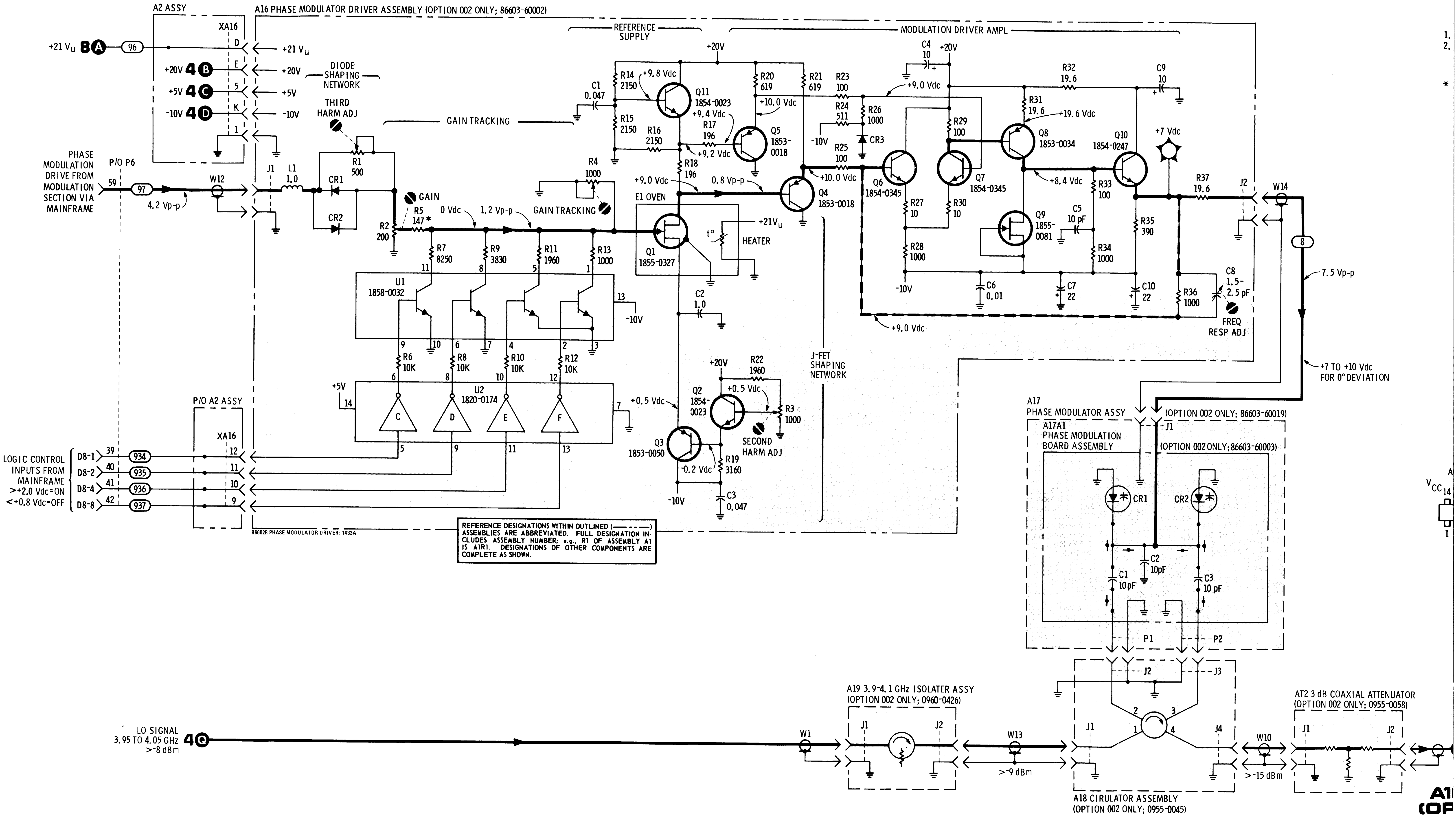
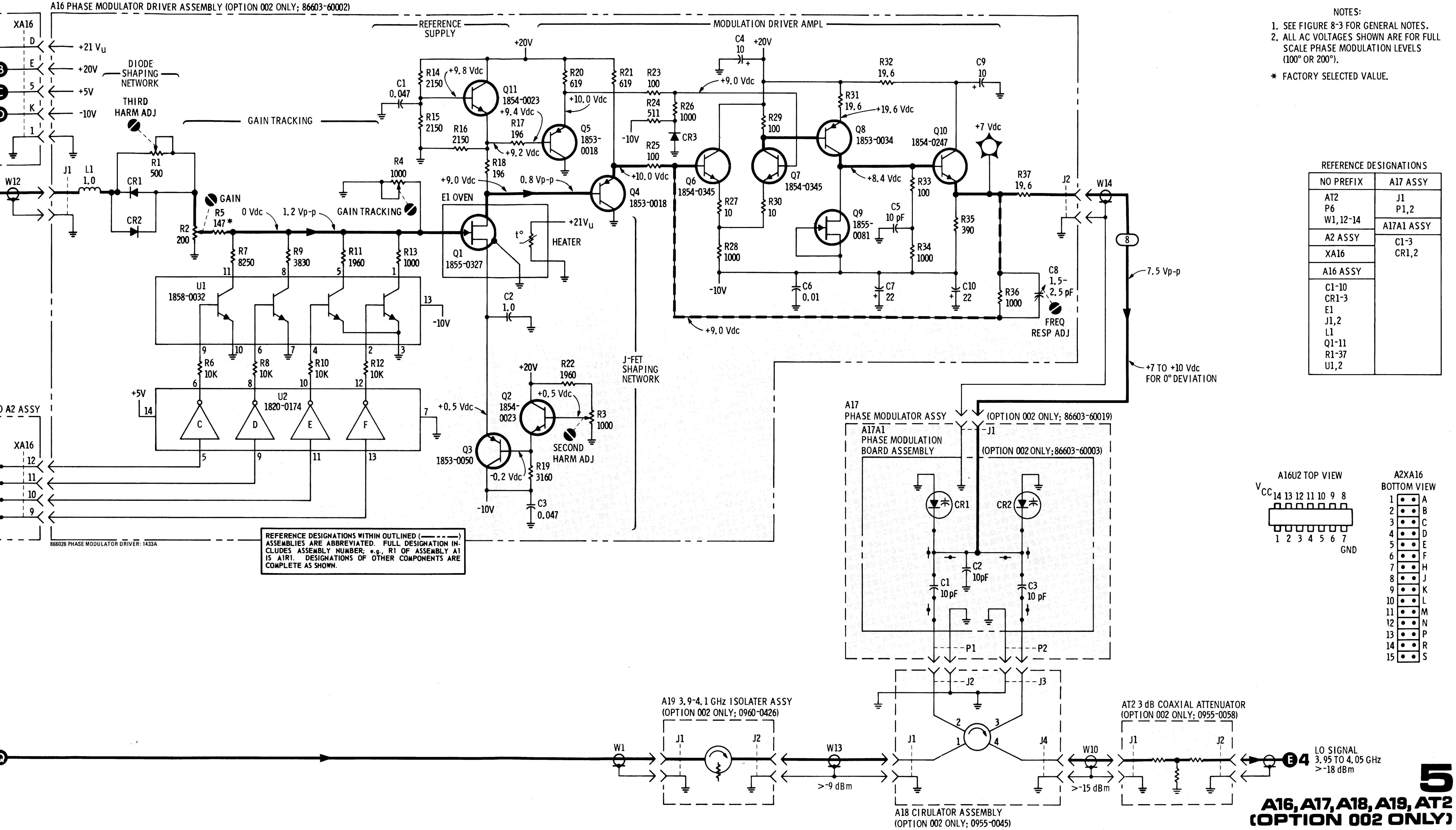


Figure 8-14. Phase Modulation Section Sch



NOTES:

1. SEE FIGURE 8-3 FOR GENERAL NOTES.
2. ALL AC VOLTAGES SHOWN ARE FOR FULL SCALE PHASE MODULATION LEVELS (100° OR 200°).

* FACTORY SELECTED VALUE.

REFERENCE DESIGNATIONS

NO PREFIX	A17 ASSY
AT2 P6 W1, 12-14	J1 P1,2
	A17A1 ASSY
A2 ASSY	C1-3 CR1,2
XA16	
A16 ASSY	
C1-10 CR1-3 E1 J1,2 L1 Q1-11 R1-37 U1,2	

Figure 8-14. Phase Modulation Section Schematic Diagram (Option 002)

SERVICE SHEET 6

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (Systems Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems troubleshooting information in Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for further troubleshooting information.

PRINCIPLES OF OPERATION

Amplifier/Detector Assembly

The A6 1-1300 MHz Amplifier Assembly contains an RF Preamplifier and Amplifier which are separated by an elliptic low pass filter. The combined RF gain is approximately 41 dB.

The RF Detector provides a dc output which is proportional to the peak RF output from the A6 Assembly. The dc level charges the 68 pF capacitor which is coupled to the A3 Detector Amplifier Assembly.

Detector Amplifier Assembly

A small bias current through the RF and Reference Diodes is set by the A4R13 Detector Bias Adjustment for maximum detector sensitivity. Beyond the initial bias current, any further change in current flow is due to temperature variations. Because the two diodes are located in the same thermal environment, an increase in current flow through the RF Detector Diode is matched by an equal increase in current flow through the Reference Diode. The Reference Diode current is coupled to the non-inverting input of the Detector Amplifier (a discrete operational amplifier comprised of A4Q3, A4Q2, A4Q1 and associated components) while the RF Detector Diode output is coupled to the inverting output. Therefore, any change in current flow due to a change in temperature is cancelled in the operational amplifier which leaves the output level dependent only on the peak RF output from the A6 Assembly.

At center frequenices of <10 MHz, the Code 1 input causes A4Q4 to be biased on which connects A4C3 parallel with the 68 pF capacitor found in the Amplifier/Detector Assembly.

SERVICE SHEET 6 (Cont'd)

As the center frequency is decreased, the detector output needs to be retained for a longer period of time so the leveling circuits respond to the average RF level rather than the instantaneous level.

In output ranges of ⩽0 dBm, the Detector Amplifier is coupled directly to the A3 ALC Amplifier Assembly. The output is compared to a dc reference level and an error signal results which is coupled to the A5 Modulator Assembly to complete the ALC loop. When OUTPUT RANGE switch is set to +10 dBm, the 10H logic input goes high (≈+5 Vdc) and turns A4Q5 off. Relay A4K1 opens and the dc voltage is attenuated 10 dB by A4R19, A4R20, A4R21, and resistors on the A3 assembly. The RF output signal increases 10 dB which brings the dc output to the A3 ALC Amplifier input back to the quiescent level present before switching to the +10 dBm range.

Amplifier A4U1 functions as an active low pass filter because of A4R23 and A4C5 which are connected in the feedback loop. The amplifier drives the meter and provides a compensating dc level which varies the AM drive input to keep the amplifier modulation level constant with change in RF output level (VERNIER Control setting).

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 2 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshoot the Amplifier/Detector and Detector Amplifier Assemblies by using the test equipment and procedures given below.

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

Test 1. If the circuit problem is associated with the meter and AM Gain output rather than the RF Output level, proceed to Test 2. Check the Detector Output, Detector Amplifier Output A4TP1, and output to ALC Amplifier to see if they are tracking the RF output level. Set A4S1 to the test position. If the RF Amplifier output remains low, the A6 assembly or an associated cable is probably defective. If the RF output increases, measure the detector and A4TP1 and A4TP2 voltages. If the detector output doesn't respond properly, the A6 assembly or an associated input component on the A4 assembly, is probably defective. If the detector output increases but the A4TP1 voltage doesn't go more negative, the Detector Amplifier or an associated component is probably defective.

If the RF output level *is incorrect* only in the +10 dBm range *or is correct* only in the +10 dBm range, and the 10H input is correct for all ranges, the 10 dB attenuator, the relay (A4K1), or an associated component is probably defective.

Test 2. Monitor the RF output with a Spectrum Analyzer. If the modulation level changes with respect to the RF carrier amplitude (change the VERNIER control to three or four different settings), A4U1 or associated components are probably defective. Otherwise, the meter control is misadjusted or the meter connections or an associated component is probably defective.

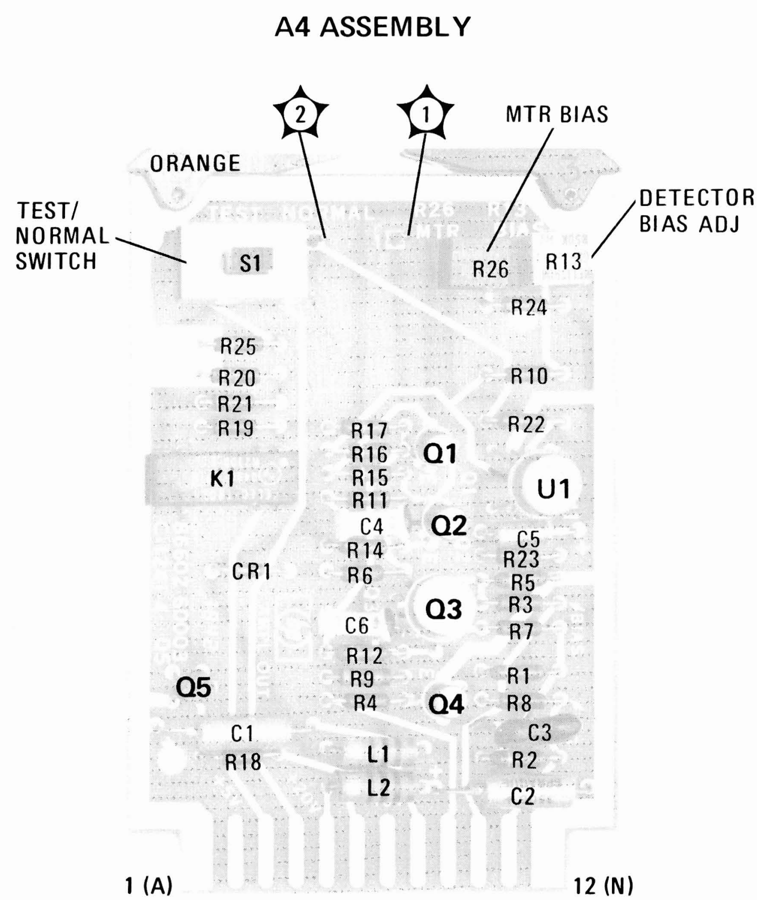
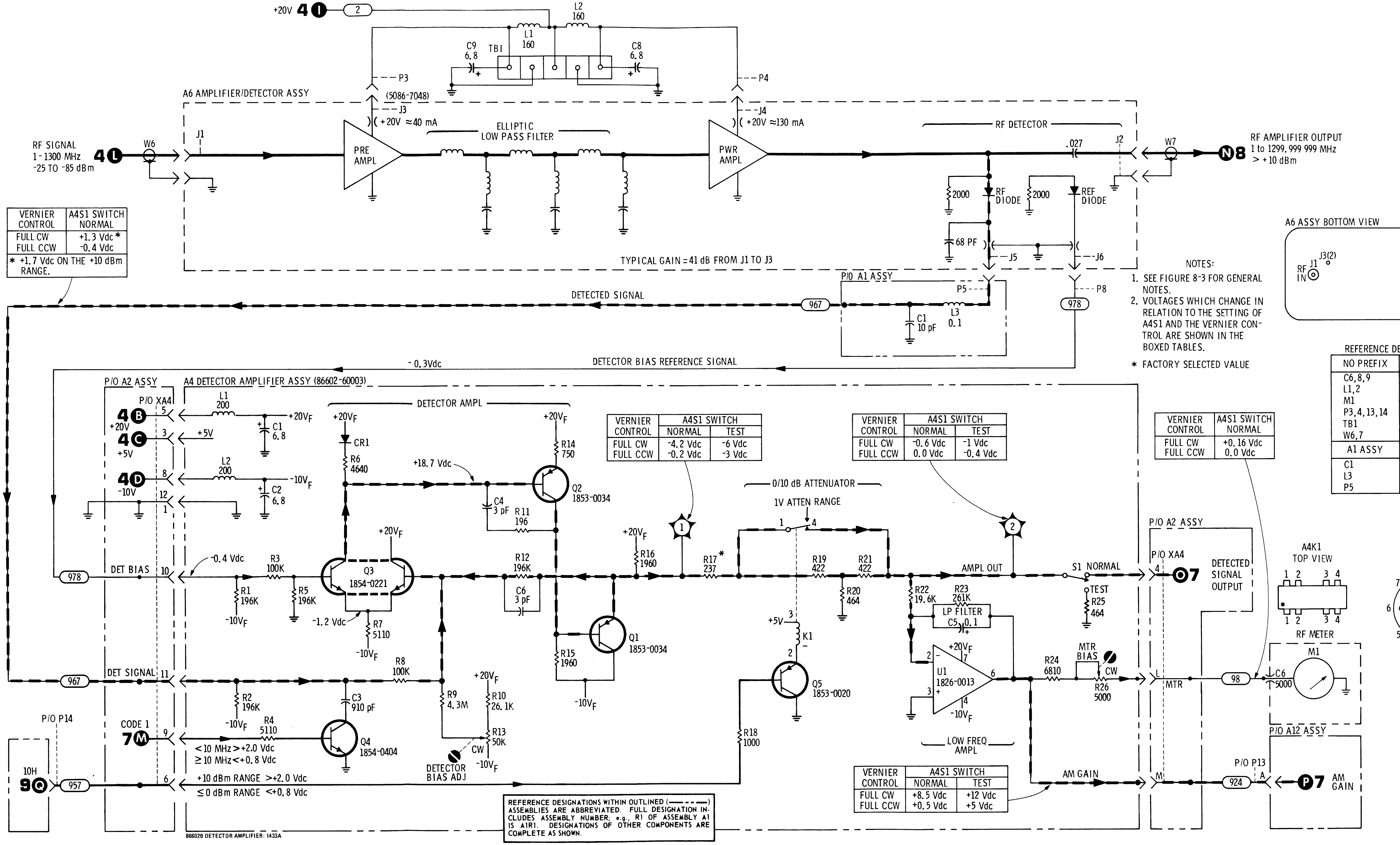


Figure 8-15. A4 Detector Amplifier Assembly Component and Test Point Locations



6 A1, A4, A6

Figure 8-16. Amplifier/Detector Section Schematic Diagram

SERVICE SHEET 7

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (Systems Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for further troubleshooting information.

PRINCIPLES OF OPERATION

General

The detected signal output from the A4 Detector Amplifier Assembly is coupled into the A3 ALC Amplifier Assembly where it is compared to the reference input. Any difference in dc input levels causes an error output signal (i.e., a change from the loop quiescent state) at the difference amplifier output A3TP1. The error signal is coupled through the Gain-Shaping Amplifier to the A5 Modulator Assembly which controls the RF output level. The change in RF output level is reflected in a dc level change at the input to the dc amplifier. The change serves to balance the original error output signal at A3TP1.

A10 Reference Assembly

The Reference Assembly output is coupled to the ALC circuit where it is compared to the Detector Amplifier output. An error signal is generated which causes the RF signal to follow the reference dc level or, in AM mode, a low frequency ac signal which is superimposed on the reference dc output.

A reference dc level is established by A10VR1. This dc level is coupled to the inverting input of A10U1 where (in the +10 dBm range only) a small RF Detector diode linearity compensation current is added from the 10H input through resistor A10R14. The output of A10U1 passes through a remotely controlled attenuator or an adjustable voltage divider which includes R1 VERNIER Control. This provides fine adjustment of the reference output, i.e., the RF Output level over a 10 dB range.

The Amplitude Modulation drive signal is input at the non-inverting input of A10U1. The AM Gain input is a dc compensation signal which effects the level of the AM drive input. As the VERNIER control is rotated cw, the dc level goes more negative which increases the RF Output level. At the same time a negative change of the AM Gain compensation increases the modulation drive signal attenuation of the AM drive signal input to A10U1. The resulting increase in modulation drive signal at the output of A10U1 tends to keep the percentage modulation level constant with change in RF output level.

In the remote mode, the front panel VERNIER control of the RF output level is inhibited and the 1 dB step attenuator assumes "vernier" control over

a 10 dB range. A logic low (<+0.8 Vdc) on the LCL/RMT input lines biases A10Q10 off, which opens the contacts of A10K6 and isolates the VERNIER control. At the same time, A10Q1 is biased on which closes the contacts of A10K5 and enables the 1 dB step attenuator. With no attenuation (RF vernier maximum) the 1A, 2A, 4A, and 8A inputs are all logic lows. Programmed attenuation levels will cause a logic high to appear on the appropriate input. For example, if 1 dB of attenuation is programmed (equivalent to a +2 dB front panel meter reading), a voltage of +5 Vdc will be found on A12XA10 pin J. This voltage biases A10Q9 off. Relay A10K1 opens which causes the reference to be attenuated through A10R21 and A10R22 (which is coupled to ground through A10Q8). When A10Q9 is turned off, bias current is supplied through A10R20 from the negative supply to turn A10Q8 on. Transistor A10Q8 is baised through the base-to-collector junction instead of the normal base-to-emitter junction.

Each step of attenuation is operated in the same manner. The values of the resistors in the voltage divider stick are weighted for greater attenuation of voltage output to the ALC circuits as the programmed attenuation levels are increased.

ALC Amplifier Assembly

The Detector Amplifier output, which is proportional to the RF output level, is compared to the Reference output in the ALC Amplifier Assembly.

The detector signal is coupled to the non-inverting input of the discrete operational amplifier (A3Q10, A3Q9, and associated components) while the reference input is coupled to the inverting input. Under normal operating conditions a change in reference input causes an error output signal at A3TP1. This signal passes through the Gain-Shaping Amplifier where it is coupled to the A5 Modulator Assembly. The change in Modulation Bias Signal causes the RF output to change. The change is reflected in the Detector Amplifier input to the ALC loop. This change serves to balance the error signal at A3TP1 and a new quiescent voltage is established. In a similar fashion, the change in RF output loading or a change in signal level input from the Frequency Extension Module is compensated for in the ALC loop. For example, a decrease in output level due to increased loading causes a positive change in the Detector Amplifier output to the ALC Amplifier. The resultant change in Modulator Bias Signal is negative which decreases the A5 Modulator Assembly Attenuation of the RF Signal and subsequently increases the RF output level.

At <10 MHz, a logic high (>+2.0 Vdc) at the Code 1 input biases A3Q5 off, A3Q2 is biased off, and A3Q3 is turned on. A3C6 is now coupled to ground which effectively reduces the bandwidth of the ALC loop. This occurs so the ALC loop does not respond to individual cyclic variations in the RF Signal but rather to the relatively long term peak output of the RF Detector.

Gain-Shaping Amplifier

The Gain-Shaping Amplifier is a discrete operational amplifier made up of A3Q7, A3Q8, A3Q6, A3Q11, A3Q4, and their associated components. The gain-shaping component is A3CR1. When A3CR1 is reverse biased the gain

of the amplifier is unity (times one). As the instantaneous base voltage of A3Q6 is increased (by either positive dc level or positive excursions of an AM drive signal) A3CR1 is forward biased and the amplifier gain is dependent on the ratio of A3R3 and the effective resistance of A3CR1. This variable gain is used to compensate for the non-linearity of the A5 Modulator Assembly's input voltage to RF attenuation transfer function.

Pulse Modulation

In the Pulse Modulation mode (HP Model 86631B Auxiliary Section is used in place of a Modulation Section), a PULSE ID logic high (≈+5 Vdc) turns A3Q1 off which opens A3K1 and thus opens the ALC loop. At the same time, the PULSE ID input biases A2Q1 on, closes A2K1, and connects the Pulse In through A2R9, A2C2, and A2VR1 to the A5 Modulator Assembly. Withouth a pulse input, the positive bias through A2R8 biases the Modulator for maximum attenuation and reduces the power output to a minimum (>40 dB down). A −10 Vdc input pulse is required to cause the Moduator to exhibit minimum attenuation to the RF Signal.

TROUBLESHOOTING

It is assumed that the Troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshoot the Reference and ALC Amplifier Assemblies and pulse modulation circuits by using the test equipment and procedures given below.

Test Equipment

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

Test 1. Check the power supply inputs to the A3 and A10 assemblies at A2XA3 pin 5 (+20V), pin 3 (+5V), and pin 8 (−10V) and A12XA10 pin D (+20V), pin C (+5V), and pin 5(−10V). If the voltages are correct proceed to Test 2. If incorrect, check the continuity of the inputs from the A12 Assembly.

Test 2. Check the Reference Output at P14 Pin E. If the output level is incorrect for the extreme settings of the vernier control or 1 dB Step Attenuator settings, (see schematic for levels) proceed to Test 3. If the output is correct, set A4S1 and check the levels at A3TP1 with the VERNIER (or 1 dB Step Attenuator) set to one extreme and then the other. If the output levels are normal, the Gain-Shaping Amplifier or the Modulator Bias Signal resistors are probably defective. Also check the Pulse ID input and the relays. Otherwise, the Difference Amplifier is probably defective.

A4 Detector Amplifier Assembly
A6 Amplifier/Detector Assembly
SERVICE SHEET 6

SERVICE SHEET 7 (Cont'd)

Test 3. Check the reference diode A10VR1, and Reference Amplifier A10U1 and their associated components. If the unit responds only to the local control or responds to remote control and not to the VERNIER, check the LCL/RMT input and the relay. If the reference output is incorrect in remote mode only, check the 1 dB Step Attenuator, relays, transistor switches, and other associated components. Small changes in RF Output level may be traceable to defective components coupled to the 10H input. If it was found that the amplitude modulation level varies with RF Output level, check the components associated with the AM Gain input. If the AM drive signal is reaching the RF Section, verify that it is reaching the A10 Assembly circuitry. Determine which component or part is defective, repair or replace it.

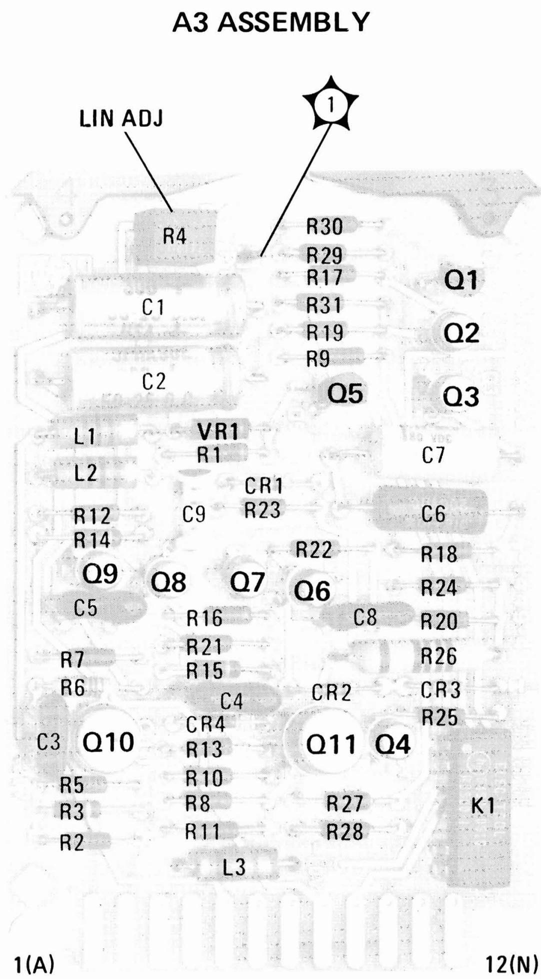


Figure 8-17. A3 ALC Amplifier Assembly Component and Test Point Locations

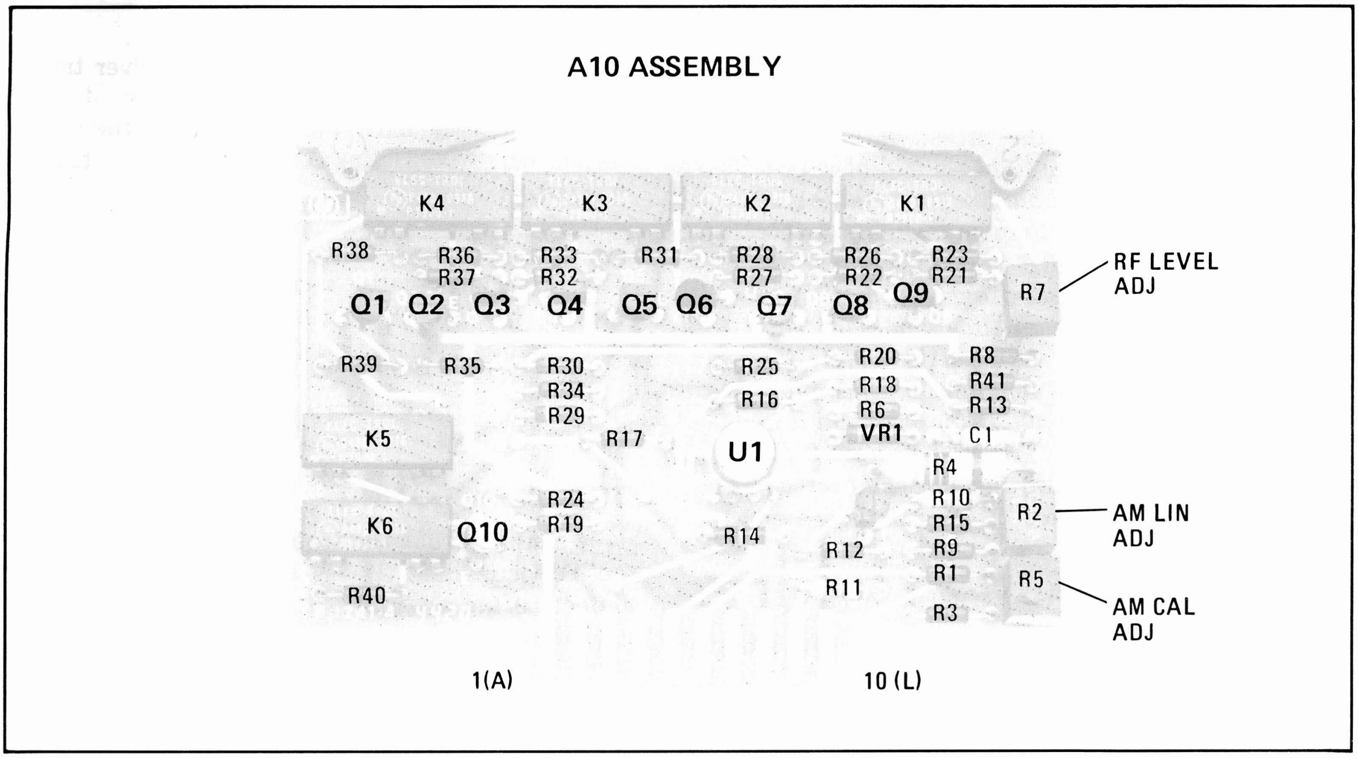


Figure 8-18. A10 Reference Assembly Component Locations

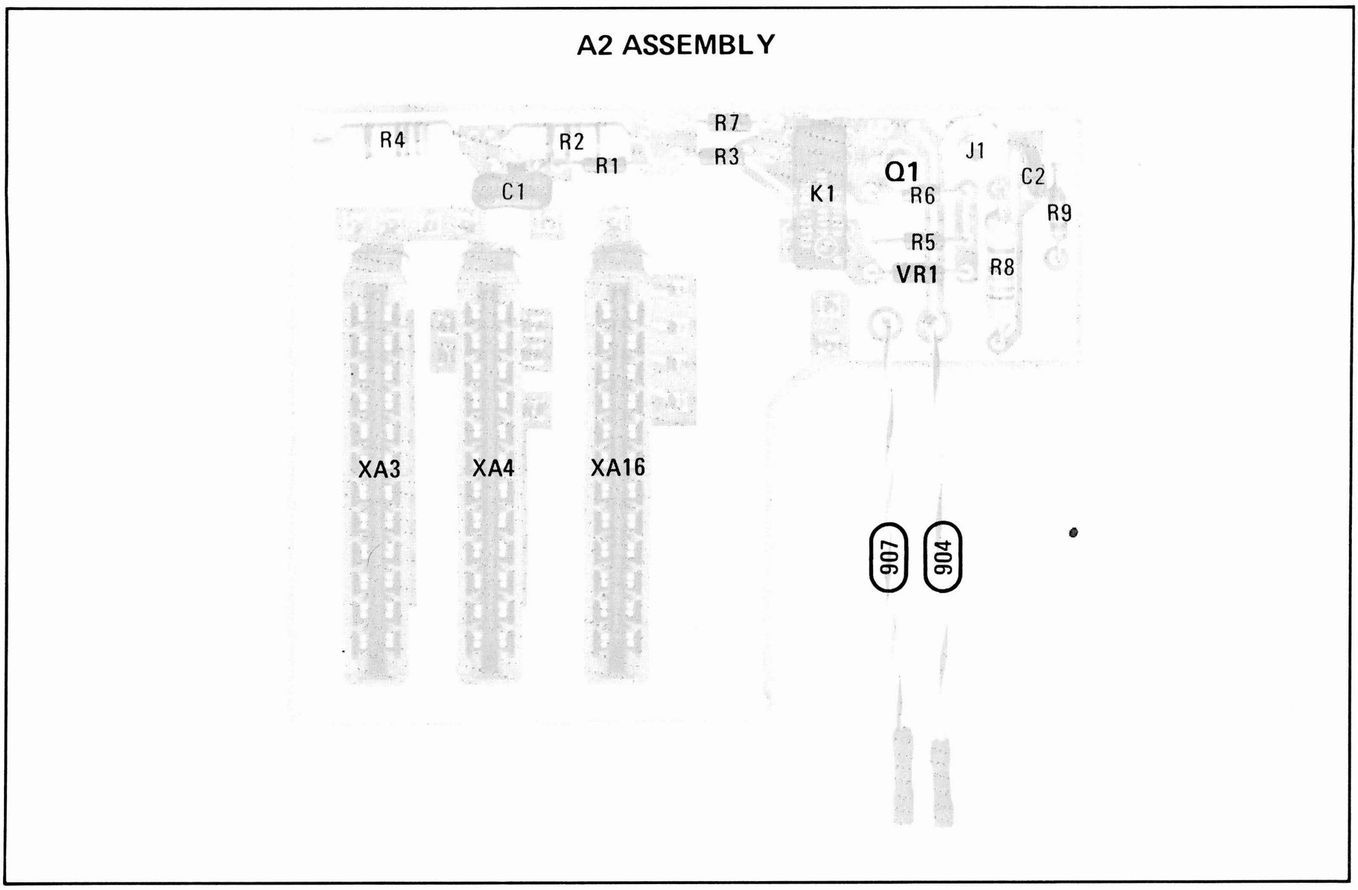


Figure 8-19. A2 ALC Mother Board Assembly Component Locations

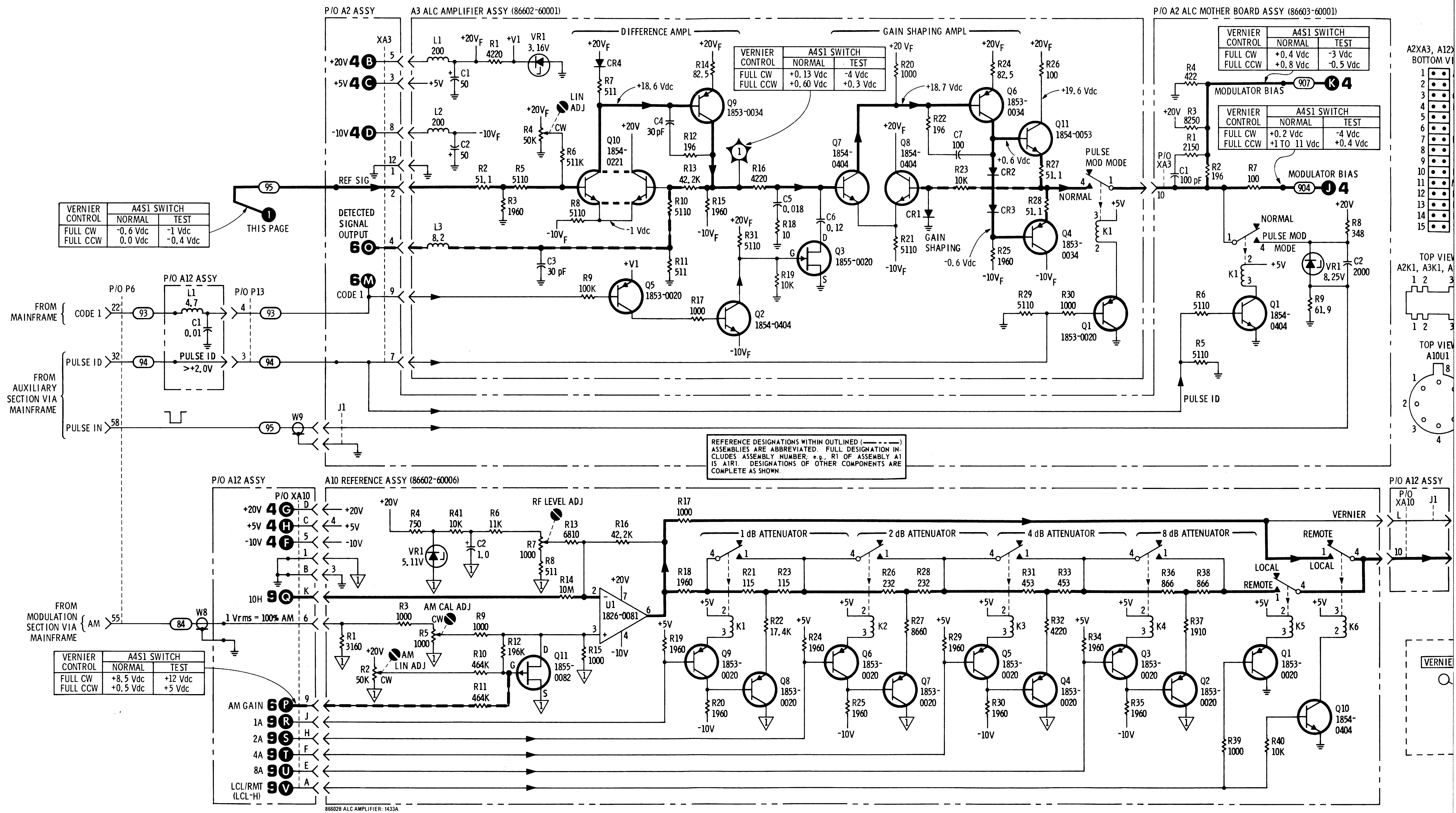
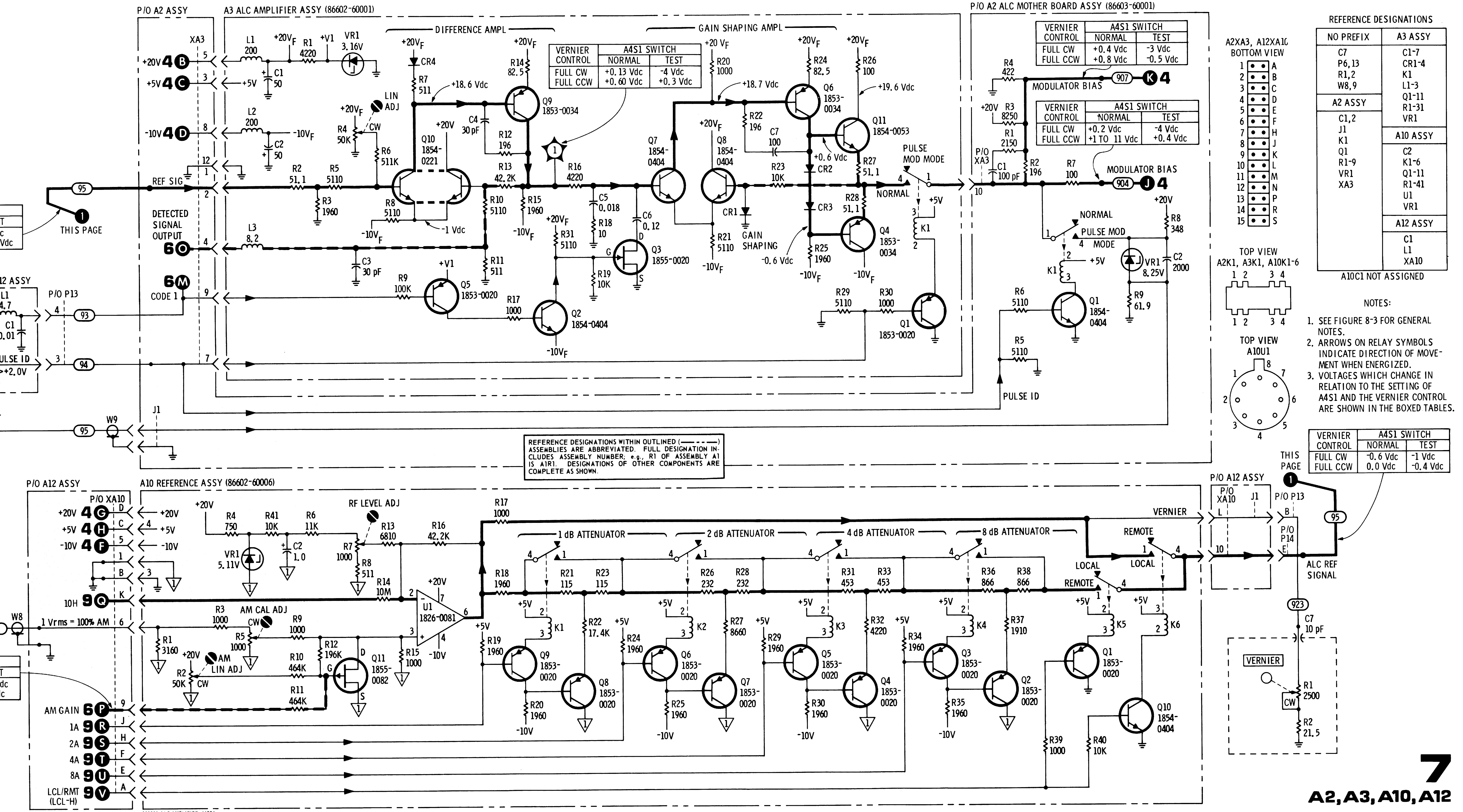

P/O A2 ASSY
A3 ALC AMPLIFIER ASSY (86602-60001)
P/O A2 ALC MOTHER BOARD ASSY (86603-60001)
DIFFERENCE AMPL
GAIN SHAPING AMPL
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +0.13 Vdc | -4 Vdc
FULL CCW | +0.60 Vdc | +0.3 Vdc
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +0.4 Vdc | -3 Vdc
FULL CCW | +0.8 Vdc | -0.5 Vdc
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +0.2 Vdc | -4 Vdc
FULL CCW | +1 TO 11 Vdc | +0.4 Vdc
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | -0.6 Vdc | -1 Vdc
FULL CCW | 0.0 Vdc | -0.4 Vdc
THIS PAGE
REF SIG
DETECTED SIGNAL OUTPUT
CODE 1
FROM MAINFRAME
PULSE ID
PULSE IN
FROM AUXILIARY SECTION VIA MAINFRAME
P/O A12 ASSY
MODULATOR BIAS
PULSE MOD MODE
NORMAL
GAIN SHAPING
LIN ADJ
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.
A10 REFERENCE ASSY (86602-60006)
RF LEVEL ADJ
AM CAL ADJ
AM LIN ADJ
1 dB ATTENUATOR
2 dB ATTENUATOR
4 dB ATTENUATOR
8 dB ATTENUATOR
VERNIER
REMOTE
LOCAL
FROM MODULATION SECTION VIA MAINFRAME
1 Vrms = 100% AM
VERNIER CONTROL | A4S1 SWITCH NORMAL | TEST
FULL CW | +8.5 Vdc | +12 Vdc
FULL CCW | +0.5 Vdc | +5 Vdc
AM GAIN
LCL/RMT (LCL-H)
A2XA3, A12X BOTTOM VI
TOP VIEW
86602B ALC AMPLIFIER: 1433A

Figure 8-20. A



VERNIER CONTROL	A4S1 SWITCH NORMAL	TEST
FULL CW	+0.13 Vdc	-4 Vdc
FULL CCW	+0.60 Vdc	+0.3 Vdc

VERNIER CONTROL	A4S1 SWITCH NORMAL	TEST
FULL CW	+0.4 Vdc	-3 Vdc
FULL CCW	+0.8 Vdc	-0.5 Vdc

VERNIER CONTROL	A4S1 SWITCH NORMAL	TEST
FULL CW	+0.2 Vdc	-4 Vdc
FULL CCW	+1 TO 11 Vdc	+0.4 Vdc

VERNIER CONTROL	A4S1 SWITCH NORMAL	TEST
FULL CW	-0.6 Vdc	-1 Vdc
FULL CCW	0.0 Vdc	-0.4 Vdc

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.

REFERENCE DESIGNATIONS

NO PREFIX	A3 ASSY
C7 P6,13 R1,2 W8,9	C1-7 CR1-4 K1 L1-3 Q1-11 R1-31 VR1
A2 ASSY	**A10 ASSY**
C1,2 J1 K1 Q1 R1-9 VR1 XA3	C2 K1-6 Q1-11 R1-41 U1 VR1
	A12 ASSY
	C1 L1 XA10

A10C1 NOT ASSIGNED

NOTES:

1. SEE FIGURE 8-3 FOR GENERAL NOTES.
2. ARROWS ON RELAY SYMBOLS INDICATE DIRECTION OF MOVEMENT WHEN ENERGIZED.
3. VOLTAGES WHICH CHANGE IN RELATION TO THE SETTING OF A4S1 AND THE VERNIER CONTROL ARE SHOWN IN THE BOXED TABLES.

7

A2, A3, A10, A12

Figure 8-20. ALC Section Schematic Diagram

SERVICE SHEET 8

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (System Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information in Service Sheet 1 of this manual. This information may be used to isolate the defect to the RF Section, another plug-in or the mainframe. If the problem is in this plug-in refer to Service Sheet 2 for further troubleshooting information before returning here.

PRINCIPLES OF OPERATION

Logic high inputs (>+2.0 Vdc) from the A11 Logic Board Assembly will cause the driver transistors to supply current to switch the appropriate attenuator section in the A13 Attenuator Assembly. A logic low (<+0.8 Vdc) switches out the attenuation. For example, if 10 dB of attenuation is desired, the 10L input goes high, A9Q23 is biased on; A9Q19 is also biased on and supplies driving current to switch A13K1. The relay arms all drop down into the lower position. The RF Signal flow is now through attenuator section AT1 (10 dB). The two lower relay arms provide a latching function for the relay. This means that until a drive current of the correct polarity is input to the A9 Attenuator Drive Assembly, the relay is latched in its present state. Also, no current flows after the switching has been completed. A9R4 and A9VR1 provide the proper bias level for the input transistors so they will respond correctly to the inputs.

A9CR1 provides protection for the driver transistor from the inductive switching transient which occurs when the drive current through the relay is turned off. A9Q21 limits the current flow through A9Q19.

The other attenuator sections function the same way as the 10 dB section. However, the 80 dB section actually uses two 40 dB sections in parallel.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 2 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshoot the Attenuator and Attenuator Driver Assemblies using the test equipment and procedures given below.

Test Equipment

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

The malfunction may be isolated to either the A13 or A9 Assemblies by measuring the 10D, 20D, 40D, and 80D control lines and determining if they are correct. If the problem is in the A13 Assembly DO NOT attempt to repair it. It is not a field repairable unit.

DC voltage checks should be sufficient to quickly isolate a defective component in the A9 Assembly. Remember, current flows through the drive transistors only until latching of the relays in A13 is completed.

A9 ASSEMBLY

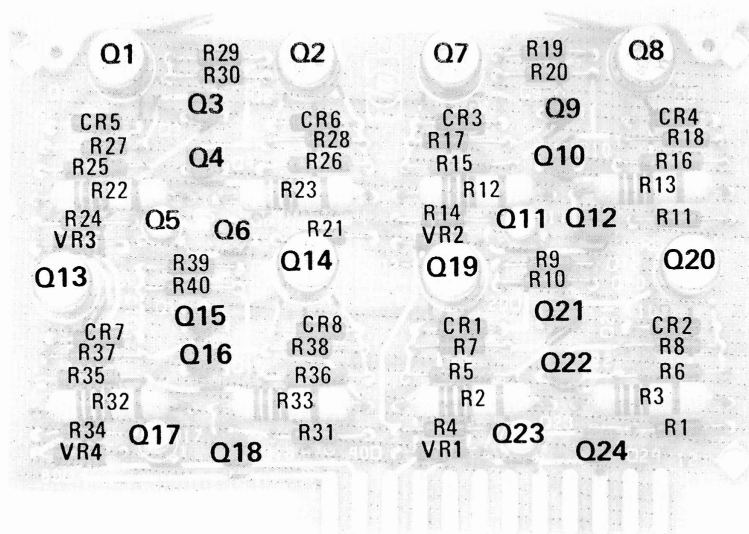


Figure 8-21. A9 Attenuator Driver Assembly Component Locations

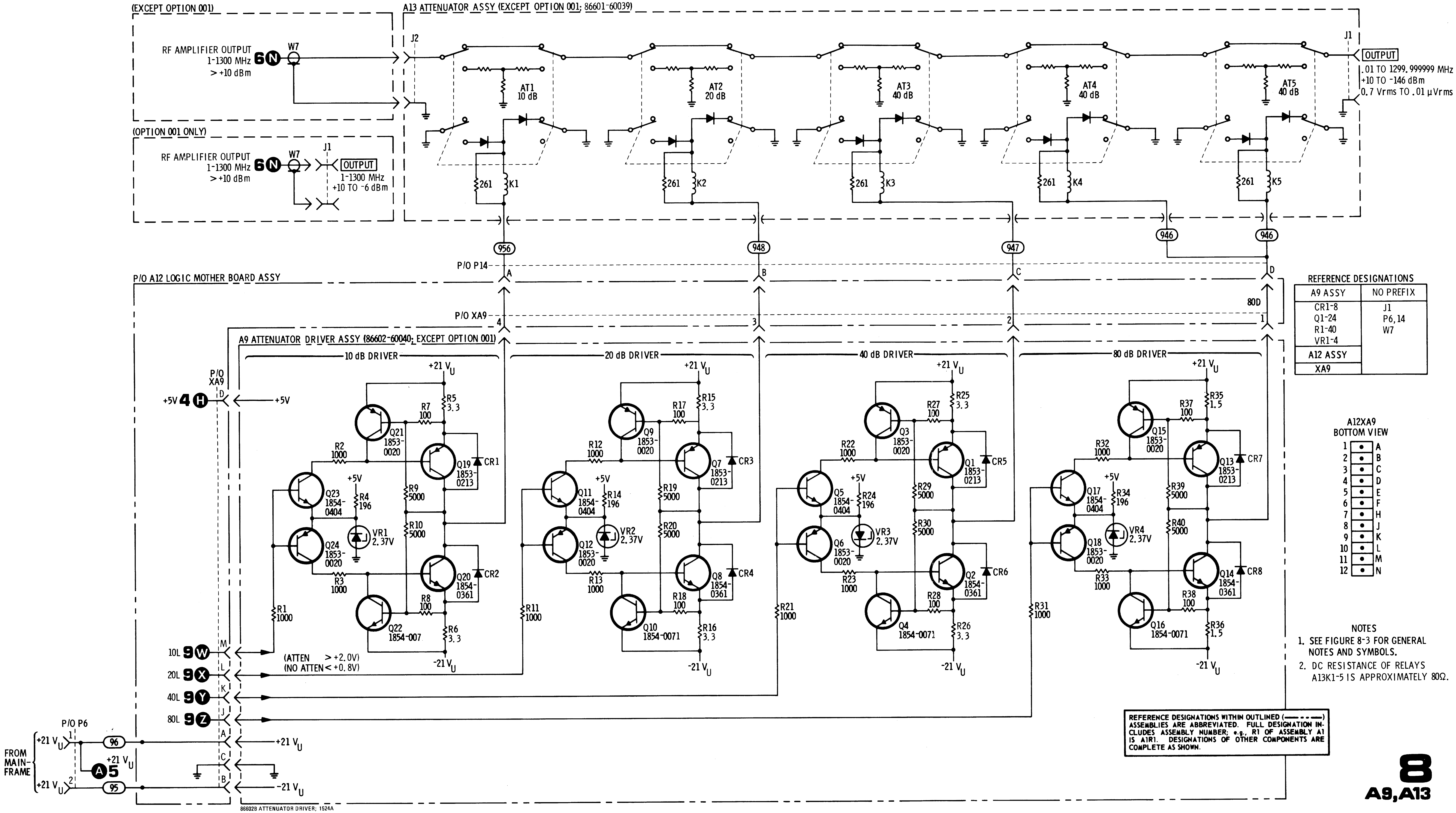


Figure 8-22. Attenuator Section Schematic Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (Systems Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information in Service Sheet 1 of this manual. This information is used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 2 for preliminary troubleshooting information.

PRINCIPLES OF OPERATION

Local (Front panel) Control

The front panel OUTPUT RANGE switch provides a binary coded hexadecimal input (1F, 2F, 4F, 8F) and an over range input (1H) to the A11 Assembly in the local mode. The LCL/RMT input is logic high (>+1.3 Vdc) which causes the switch inputs to be gated directly to the outputs to the attenuator driver circuits and the 10H output. The following table shows the logic states of the inputs from the OUTPUT RANGE switch S1. The input signals are all active highs (attenuation) as are the outputs.

Local Inputs to A11 Logic Assembly

OUTPUT RANGE Switch Setting	Binary Coded Hexadecimal Input*				Over-Range Input*
	8F	4F	2F	1F	1H
+10	L	L	L	L	L
0	L	L	L	L	H
−10	L	L	L	H	H
−20	L	L	H	L	H
−30	L	L	H	H	H
−40	L	H	L	L	H
−50	L	H	L	H	H
−60	L	H	H	L	H
−70	L	H	H	H	H
−80	H	L	L	L	H
−90	H	L	L	H	H
−100	H	L	H	L	H
−110	H	L	H	H	H
−120	H	H	L	L	H
−130	H	H	L	H	H
−140	H	H	H	L	H

*L = <+0.8 Vdc; H = >+1.3 Vdc

Remote Operation

In the remote mode, 3 digits of BCD attenuation information are clocked into the A11 Assembly Shift Registers from the System mainframe. On the ATTN CLK input, a series of 10 pulses are received at pin K. These pulses are coupled to the trigger (T) input to the shift registers. The data input, which is synchronized with the pulses, contain no usable information for the first seven pulses. On the eighth pulse, units information is clocked into the left-handed column of registers with logic highs indicating data ones and lows indicating zeroes. On the ninth pulse, the units information is shifted to the center column of registers while tens information is entered into the left hand registers. On the tenth pulse, the units word is shifted into and stored in the right hand column, the tens information in the center registers, and the hundreds information in the left registers.

The BCD information stored in the units registers is coupled to the 1 dB Step Attenuator on the A10 Reference Assembly. (In local mode these outputs are not used. The VERNIER control is used for fine control of output level.)

The other two digits of BCD information are coupled to the BCD-to-Binary Decoder. The binary tens line actually bypasses the decoder because it expresses odd or even value in either the BCD or binary coded hexadecimal format. The second digit (20, 40 and 80) and third digit (100) in BCD format are output from the BCD-to-Binary Decoder in a 20, 40, and 80 binary format. With the tens level, these outputs are binary coded hexadecimal. In order to obtain the over-range output (10H), the 10, 20, 40 and 80 coded signals are inverted and coupled to a four input nand gate. The nand gate (over-range) output is low only with zero input attenuation (i.e., all the BCD-to-Binary Decoder output lines are low). The over-range level is coupled to A11 U5C and therefore to the 10H output. It is also coupled to the Full Adder along with the 10, 20, 40, and 80 lines. The inputs to the adder are connected so a value of 10 is subtracted from the input with the Over-Range inactive (high); when the over-range line is low the output follows the input directly. The following tables express the assembly inputs and outputs, the BCD-to-Binary converter inputs and outputs, and the Full Adder inputs and outputs. In each case, a level of >+2.0 Vdc is a logic high and <+0.8 Vdc is logic low.

Logic Assembly Inputs Versus Outputs

Programmed Attenuation Input						OUTPUT RANGE	Logic Assembly Output				
Decimal	2-Digit BCD					Decimal					Over-range
(dB)	100	80	40	20	10	(dBm)	80L	40L	20L	10L	10H
0	L	L	L	L	L	+10	L	L	L	L	H
10	L	L	L	L	H	0	L	L	L	L	L
20	L	L	L	H	L	−10	L	L	L	H	L
30	L	L	L	H	H	−20	L	L	H	L	L
40	L	L	H	L	L	−30	L	L	H	H	L
50	L	L	H	L	H	−40	L	H	L	L	L
60	L	L	H	H	L	−50	L	H	L	H	L
70	L	L	H	H	H	−60	L	H	H	L	L
80	L	H	L	L	L	−70	L	H	H	H	L
90	L	H	L	L	H	−80	H	L	L	L	L
100	H	L	L	L	L	−90	H	L	L	H	L
110	H	L	L	L	H	−100	H	L	H	L	L
120	H	L	L	H	L	−110	H	L	H	H	L
130	H	L	L	H	H	−120	H	H	L	L	L
140	H	L	H	L	L	−130	H	H	L	H	L
150	H	L	H	L	H	−140	H	H	H	L	L

BCD-To-Binary Converter

Input				Output		
100	80	40	20	80	40	20
L	L	L	L	L	L	L
L	L	L	H	L	L	H
L	L	H	L	L	H	L
L	L	H	H	L	H	H
L	H	L	L	H	L	L
H	L	L	L	H	L	H
H	L	L	H	H	H	L
H	L	H	L	H	H	H

SERVICE SHEET 9 (Cont'd)

Full Adder

Inputs					Outputs			
A_4	A_3	A_2	A_1	C_0, B_2, B_3, B_4	Σ_4	Σ_3	Σ_2	Σ_1
80	40	20	10	Over-range	80	40	20	10
L	L	L	L	L	L	L	L	L
L	L	L	H	H	L	L	L	L
L	L	H	L	H	L	L	L	H
L	L	H	H	H	L	L	H	L
L	H	L	L	H	L	L	H	H
L	H	L	H	H	L	H	L	L
L	H	H	L	H	L	H	L	H
L	H	H	H	H	L	H	H	L
H	L	L	L	H	L	H	H	H
H	L	L	H	H	H	L	L	L
H	L	H	L	H	H	L	L	H
H	L	H	H	H	H	L	H	L
H	H	L	L	H	H	L	H	H
H	H	L	H	H	H	H	L	L
H	H	H	L	H	H	H	L	H
H	H	H	H	H	H	H	H	L

Local Remote Multiplex

The LCL/RMT input is a logic low in the remote mode. This enables the gates which are connected to the remote attenuation inputs (Full Adder and Over-range) so the remote signals drive the 10 dB Step Attenuator. At the same time logic inputs from the OUTPUT RANGE switch are inhibited.

TROUBLESHOOTING

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

Test Equipment

Digital Voltmeter . . . HP 34740A/34702A

If the problem is evident only in the local mode of operation, check the OUTPUT RANGE switch, continuity of the connections to the A11 assembly, and the Local/Remote Multiplexer. Refer to the table showing the OUTPUT RANGE switch output. If the defect is evident only in the remote mode of operation, check the shift registers, the BCD-to-Binary Decoder, the Full Adder, and the Local/Remote Multiplexer for proper operation. Use the tables showing inputs versus outputs as a tool to isolate the defective component.

If the defect is evident in both the Local and Remote modes, the Local/Remote Multiplexer or an associated component is probably defective.

NOTE

If the inputs and outputs of the A11 Logic Assembly are correct, check the 10 dB step attenuator (Service Sheet 6) in all ranges, the 10 dB attenuator in the A4 Detector Amplifier Assembly, and the 1 dB Step Attenuator in the A10 Reference Assembly (also the 10H inputs and associated components). Also, check the 1 dB and 10 dB Step Attenuator outputs with attenuation inputs of 1, 2, 4, and 8 dB and 10, 20, 40, and 80 dB.

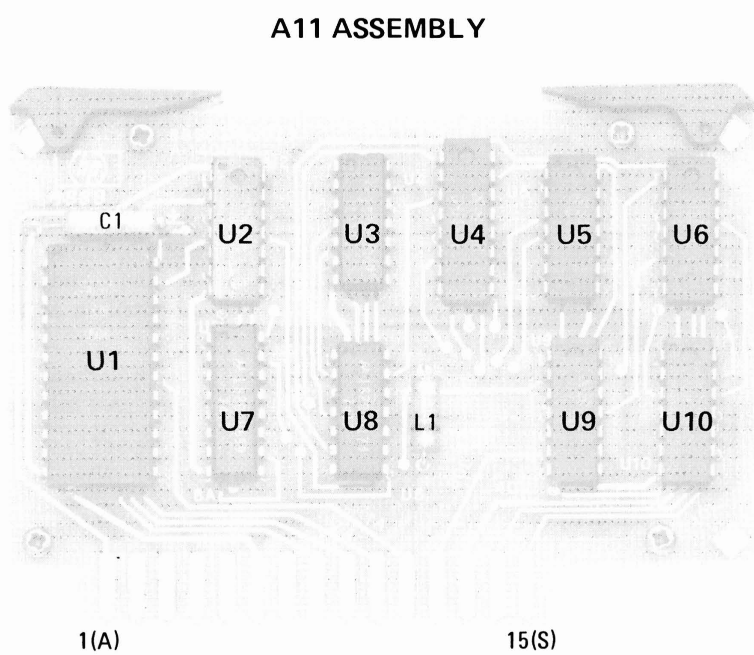
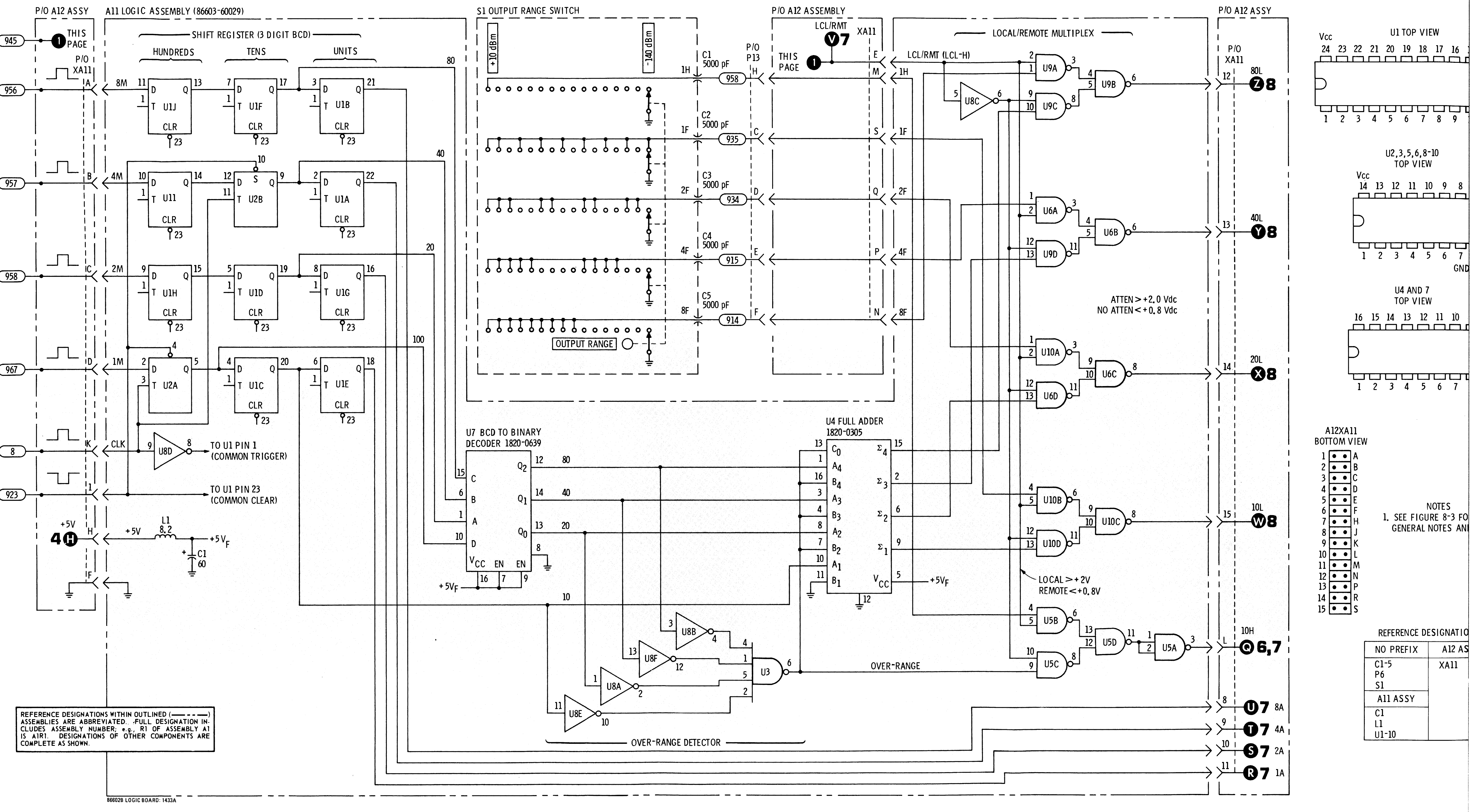


Figure 8-23. A11 Logic Assembly Component Locations



NO PREFIX	A12 AS
C1-5 P6 S1	XA11
A11 ASSY	
C1 L1 U1-10	

Figure 8-24. A11 Logic Assembly Schematic

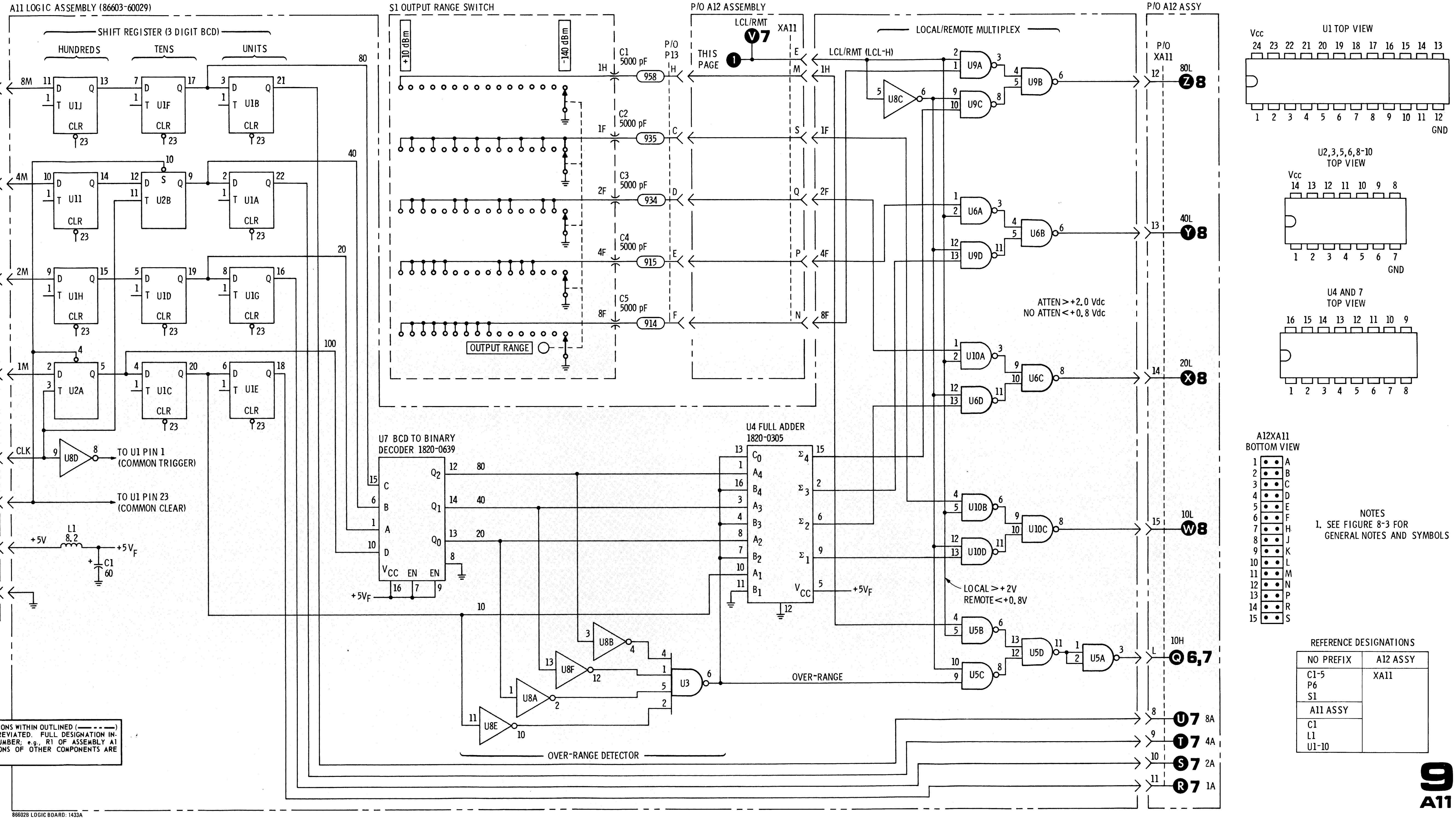


Figure 8-24. A11 Logic Assembly Schematic Diagram

DISASSEMBLY AND INTERCONNECTION PROCEDURES

CAUTION

Before removing the RF Section plug-in from the mainframe, remove the main (Mains) voltage by disconnecting the power cable from the power outlet.

RF Section Plug-in Removal

a. Release the latch below the front panel OUTPUT jack.

b. Pull the latch out while rotating it to the left until it is perpendicular to the front panel. This separates the mating plug and jack (plug-in to mainframe).

c. Grasp the latch and pull the plug-in straight out from mainframe.

Plug-in Cover Removal

a. Remove the 16 Pozidriv screws from both covers.

b. Loosen the 4 screws which hold the teflon/aluminum plug-in guide in place.

c. Remove the covers and set them aside.

d. If necessary, remove the plug-in guides by removing the screws.

Interconnection of RF Section to Mainframe for Troubleshooting Purposes

After the RF Section is removed from the mainframe and its covers have been removed, the RF Section must be reconnected to the mainframe with interconnecting extender cables before troubleshooting can begin.

CAUTION

With the mainframe top cover removed, power is supplied to the system during troubleshooting. Energy available at many points may constitute a shock hazard.

a. Remove the mainframe top cover. First remove the 4 Pozidriv screws; then slide the cover back and off the mainframe siderails.

NOTE

The interconnect cables and adapters are parts 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 for a pictorial cross reference.

DISASSEMBLY AND INTERCONNECTION PROCEDURES (Cont'd)

b. Make connection from J6 (mainframe) to P6 (RF Section rear panel) with the 11672-60001 multi-pin interconnect cable.

CAUTION

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

c. Connect the 1250-1236 adapter to the 11672-60005 gray coaxial cable. Insert the adapter into P2 (on the RF Section rear panel above the multipin connector).

d. Remove the gray-blue cable from the jack on the rear side of the Frequency Extension Module. Connect the gray coaxial cable to the extension module jack.

e. Take the 11672-60004 red coaxial cable and connect it to P1 (RF Section rear panel below the multi-pin connector).

f. Disconnect the gray cable from the other extension module output jack. Connect the red coaxial cable to the jack.

g. Reconnect the mainframe line (Main) power cable to the power outlet and set the mainframe line switch to ON.

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

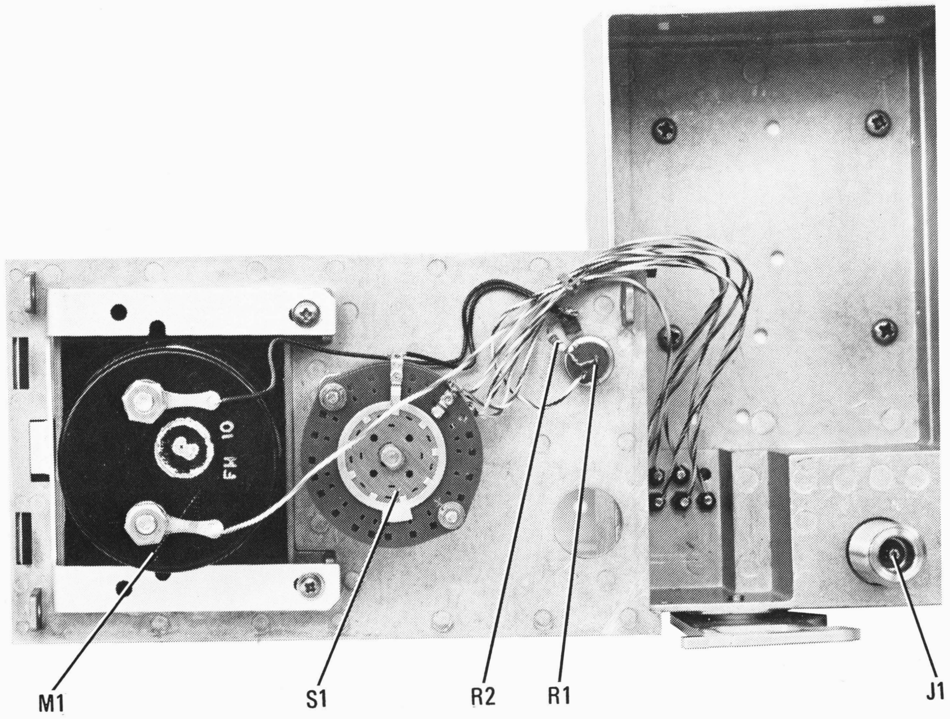
Reference Designator	Service Sheet	Figures	Remarks
A1 Assembly	2, 4	—	Circuit board, mounted on aluminum deck opposite the A5 Assembly.
A2 Assembly	2, 4, 7	8-19, 25	A3, A4, and A16 plug into connectors mounted on A2.
A3 Assembly	2, 7	8-17, 25	
A3R4, ADJ, LIN	7	8-17, 25	8-25, Top View
A4 Assembly	2, 6	8-15, 25	
A4R13 ADJ, DET BIAS	6	8-15, 25	8-15, Top View
A4R26 ADJ, MTR BIAS	6	8-15, 25	8-15, Top View
A4S1 SWITCH, TEST/NORMAL	2, 6	8-15, 25	8-15, Top View
A5 Assembly	2, 4	8-25	
A6 Assembly	2, 6	8-25	
A7 Assembly	2, 4	8-10, 25	Top View
A8 Assembly	2, 4	8-25	
A9 Assembly	3, 8	8-21, 25	8-25, Left Side View
A10 Assembly	2, 7	8-18, 25	8-25, Left Side View
A10R2, ADJ, AM LIN	7	8-18, 25	8-25, Top View
A10R5 ADJ, AM CAL	7	8-18, 25	8-25, Top View
A10R7 ADJ, RF LEVEL	7	8-18, 25	8-25, Top View
A11 Assembly	3, 9	8-23, 25	8-25, Left Side View
A12 Assembly	2, 4	8-25	(A9, A10, and A11 plug into connectors mounted on A12)
A13 Assembly	2, 8	8-25	
A14 Assembly	—	8-25	Wiring Harness
A15 Assembly	2, 4	8-25	Rear Panel Internal View
A16 Assembly	2, 5	8-12, 25	
A16C8 ADJ, FREQ RESP	5	8-12	
A16R1 ADJ, THIRD HARM	5	8-12, 25	8-25, Top View
A16R2, ADJ, GAIN	5	8-12, 25	8-25, Top View
A16R3 ADJ, SECOND HARM	5	8-12, 25	8-25, Top View
A16R4 ADJ, GAIN TRACKING	5	8-12, 25	8-25, Left Side View
A17 Assembly	2, 5	8-13, 25	
A18 Assembly	2, 5	8-25	
A19 Assembly	2, 5	8-25	
A20 Assembly	3, 4	8-25	8-25, Top View
AT1	4	8-25	
AT2	5	—	Not Shown, connected at A8 input
C1-5	3, 9	8-25	8-25, Left Side View Insert
C6	2, 6	8-25	8-25, Left Side View Insert
C7	2, 7	8-25	8-25, Left Side View Insert
C8, 9	6	—	Mounted on TB1 (see 8-25 Top View)
FL1	2, 4	8-25	8-25, Right Side View
J1	8	8-25	
L1, 2	6	—	Mounted on TB1 (see 8-25, Top View)
M1	2, 6	8-25	8-25, Front Panel Internal View

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

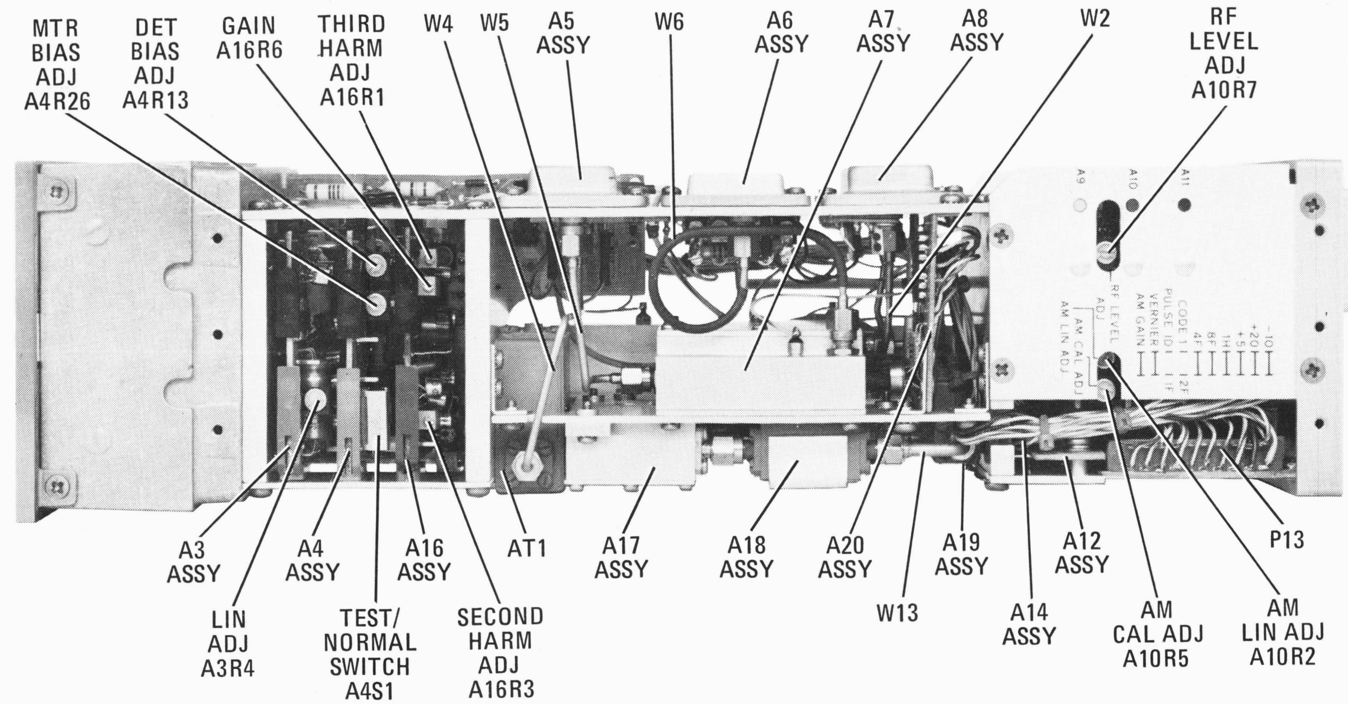
Reference Designator	Service Sheet	Figures	Remarks
P1, 2	2, 4	3-2	3-2, P2 is ① and P1 is ③
P3, 4	6		Not Shown, +20V inputs to A6.
P5	4		Not Shown, +20V input to A8
P6	2, 3, 4, 5, 7, 8, 9	3-2, 8-25	3-2, P6 is ②
P7	4		Not Shown, −10V input to A8
P13	2, 4, 6, 7, 8, 9	8-25	
P14	2, 6, 8	8-25	
R1	2, 7	8-25	8-25, Front Panel Internal View
R2	7	8-25	8-25, Front Panel Internal View
S1	3, 9	8-25	8-25, Front Panel Internal View
TB1	6	8-25	Top View
W1*	2, 5	8-25	Right Side View, FL1 Output
W2*	2, 4	8-25	Top View, A8 Output
W3	2, 4	8-25	AT1 Input, grey/blue
W4*	2, 4	8-25	AT1 Output
W5*	2, 4	8-25	Top View, A5 Output
W6*	2, 4, 6	8-25	Top View, A6 Input
W7*	2, 6, 8	8-25	A13 Input
W8	2, 7	8-25	AM Input to A12, grey/yellow
W9	2, 7	8-4, 25	Pulse Input to A2, white/green
W10*	2, 5	8-25	A18 Output
W11	2, 4	8-25	FL1 Input, grey
W12	2, 5	8-4, 25	ϕM Input to A16, white/violet
W13*	2, 4, 5	8-25	A18 Input
W14	2, 5	8-25	Right Side View, A16 Output, grey
W15	2, 4	8-25	A15 Input from P6, white/blue
W16	2, 4		Not Shown, P6 Interconnect Cable, white/orange
W17	2, 4	8-25	Rear Panel Internal View, P6 Interconnect Cable, white/yellow
W18	2,.4	8-25	Rear Panel Internal View, P6 Interconnect Cable, white/brown
W19	2, 4	8-25	A15 Output to P6, white/red

*Indicates semi-rigid coaxial cable.

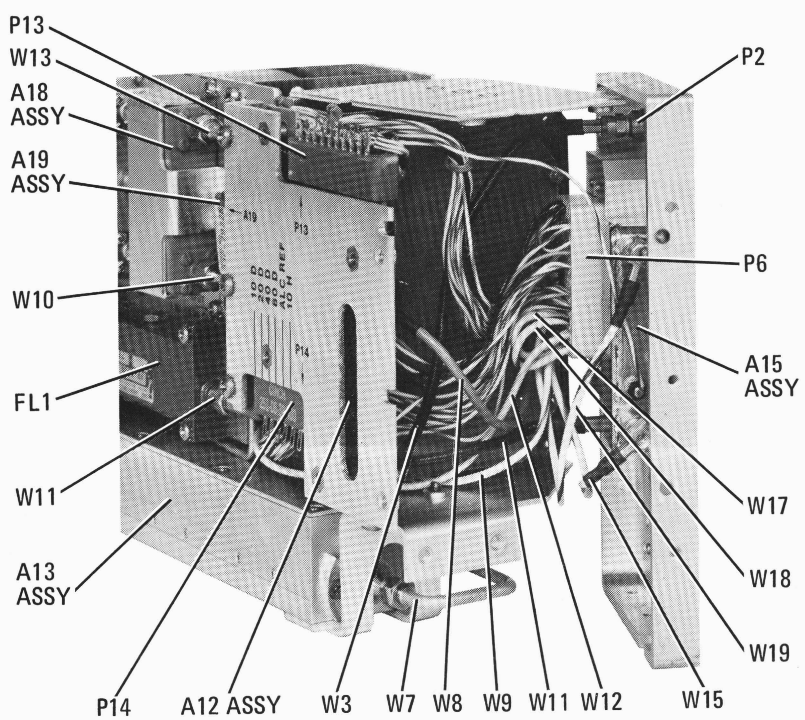
FRONT PANEL INTERNAL VIEW



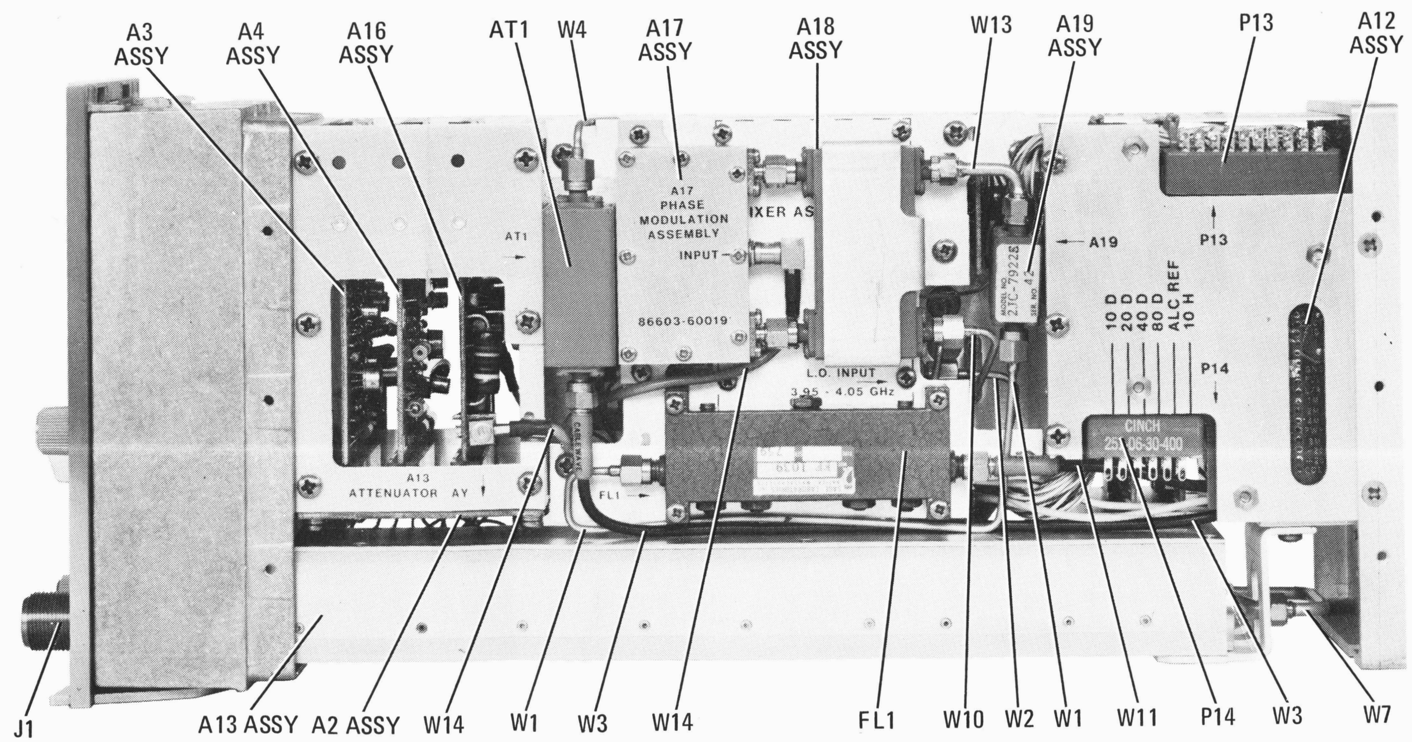
TOP VIEW



REAR PANEL INTERNAL VIEW



RIGHT SIDE VIEW



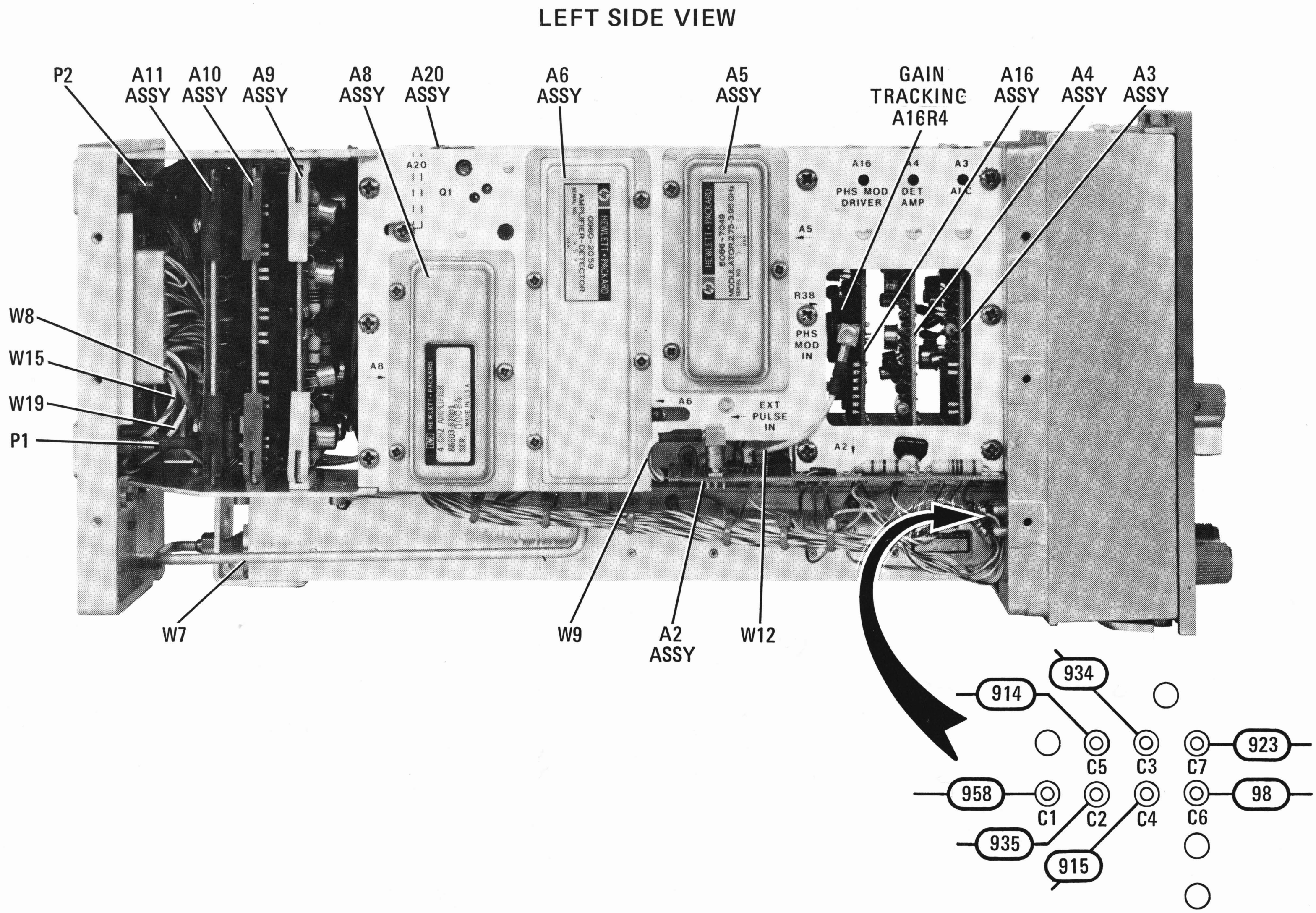


Figure 8-25. Assemblies, Chassis Parts, and Adjustable Component Locations