Errata

Title & Document Type: **8654A Signal Generator Operating and Service Manual**

Manual Part Number: **08654-90008**

Revision Date: **March 1977**

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We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

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

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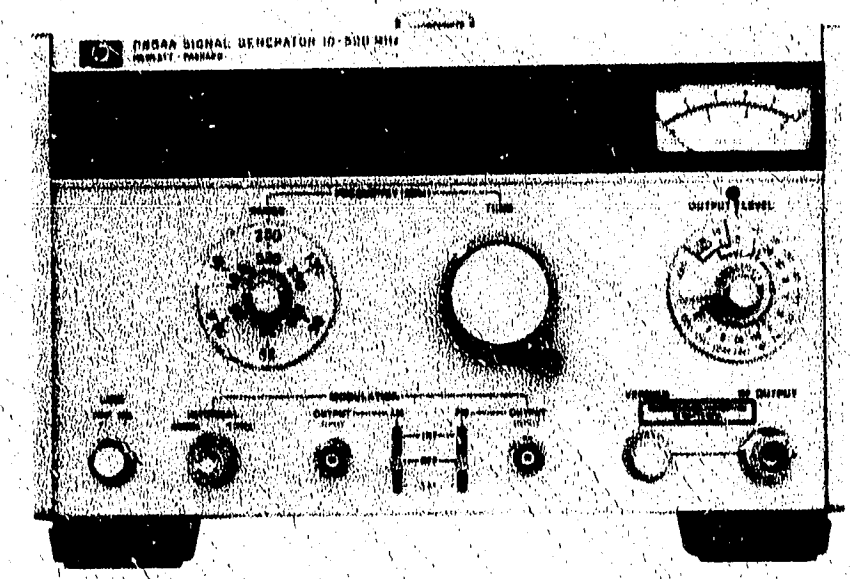
HP 8654A

OPERATING AND SERVICE MANUAL

8654A
SIGNAL GENERATOR



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HP 8654A

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in the manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

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OPERATING AND SERVICE MANUAL

8654A
SIGNAL GENERATOR

(Including Option 003)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1633A.

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

With Changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1540A, 1551A, 1603A, and 1612A.

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1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

MANUAL PART NO. 08654-90028
Microfiche Part No. 08654-90029
Operating Information Supplement Part No. 08654-90030

Printed March 1977

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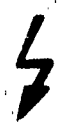
SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Section II of this manual.



Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer make sure the common terminal is connected to the neutral (grounded side of mains supply).

SERVICING

WARNINGS

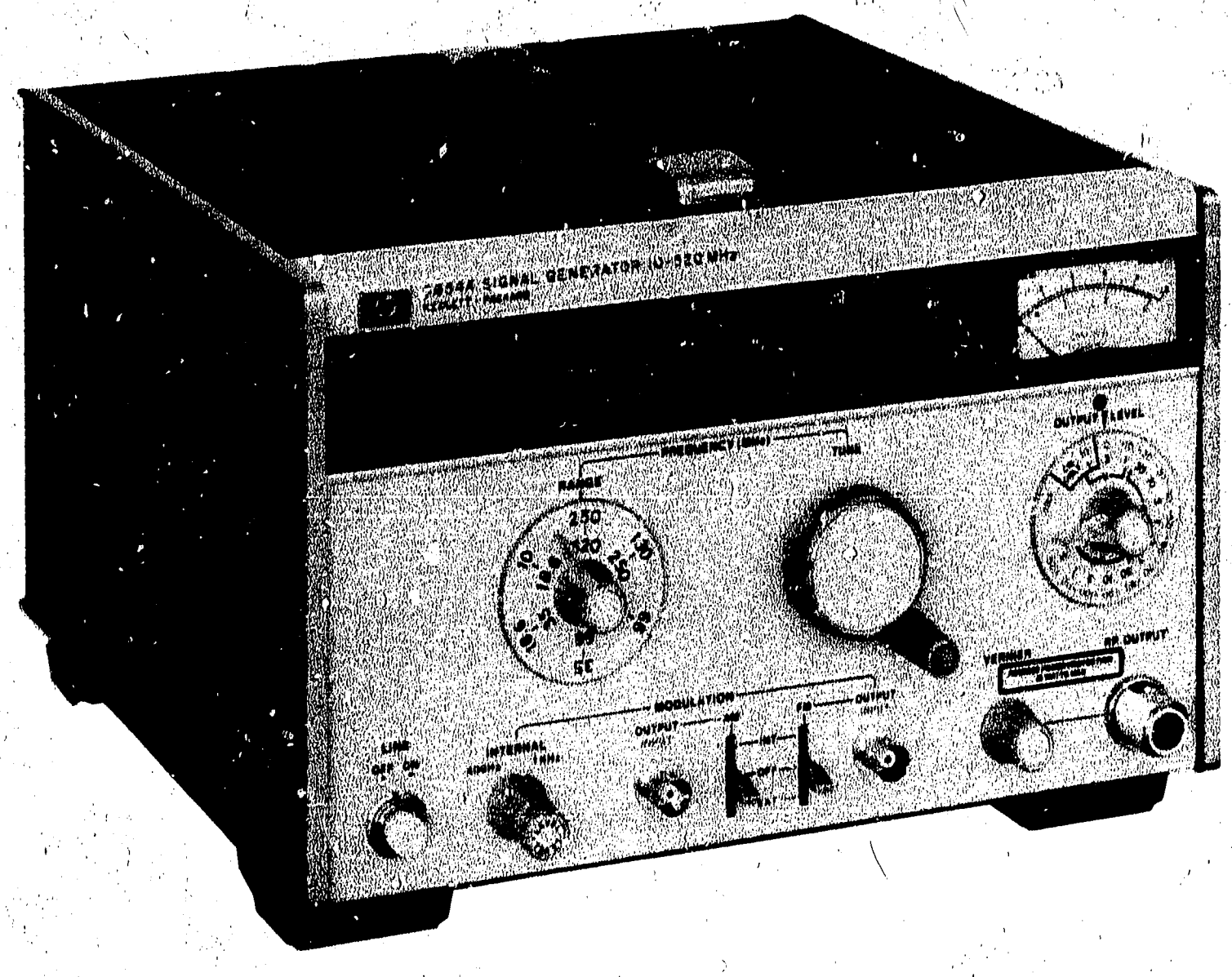
Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

MODEL 8654A



POWER CABLE

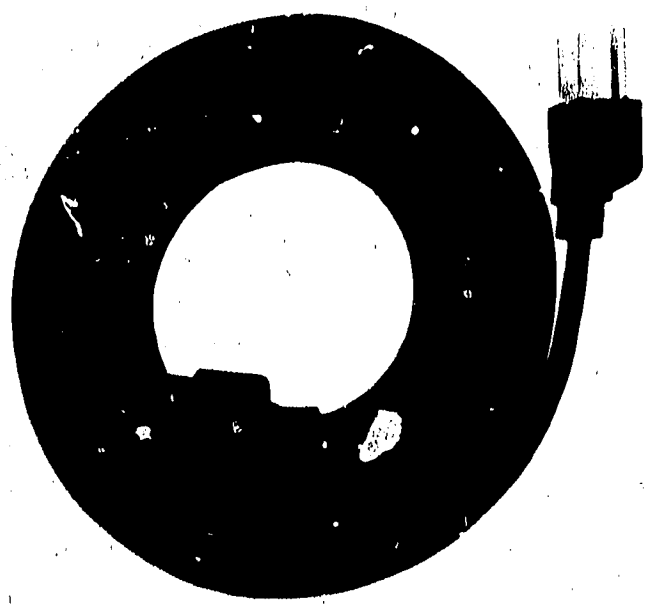


Figure 1-1. HP Model 8654A Signal Generator with Option 003 and Power Cable

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains information pertaining to installation, operation, testing, adjustment, and maintenance of the Model 8654A Signal Generator. Figure 1-1 shows the Hewlett-Packard Model 8654A Signal Generator with Reverse Power Protection, Option 003, and the power cable.

1-3. The information in this manual is divided into sections as shown below:

Section I, GENERAL INFORMATION, describes the instruments documented by this manual and covers instrument identification, description, accessories, specifications and other basic information.

Section II, INSTALLATION, provides information about incoming inspection, power requirements, mounting, storage, and shipping of the instrument.

Section III, OPERATION, provides information about panel features, and gives operating checks, instructions, and maintenance information.

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

Section V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs are made.

Section VI, REPLACEABLE PARTS, provides ordering information for replaceable parts and assemblies.

Section VII, MANUAL CHANGES, provides manual change information necessary to document all prefixes listed on the title page. In addition, this section also contains recommended modifications for the earlier instrument configurations.

Section VIII, SERVICE, includes information required to troubleshoot and repair the instrument.

1-4. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. 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.

1-5. Also listed on the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 10 x 15 cm (4x6-inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplements as well as all pertinent Service Notes.

1-6. SPECIFICATIONS

1-7. Instrument specifications are listed in Table 1-1. These specifications are performance standards or limits against which the instrument may be tested.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number. The first four digits and the letter constitute the serial number prefix, which denotes the instrument's configuration. The last five digits form the suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix as listed under SERIAL NUMBERS on the title page.

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

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

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

1-13. DESCRIPTION

1-14. The HP 8654A is a solid-state portable signal source providing a sinusoidal RF output signal from 10 to 520 MHz at power levels of +10 to —130 dBm (+8 to —130 dBm with Option 003) into a 50 ohm load. Amplitude and/or frequency modulated outputs are obtainable; the modulating signal may be selected from an internal or external source.

1-15. OPTIONS

1-16. Option 003 adds internal reverse power protection for the Signal Generator's output circuitry (guaranteed to protect against reverse power up to 25 watts). The protection circuit uses a limiter and relay to prevent damage to the output circuitry and to automatically restore generator operation when reverse power is removed. Option 003 also protects the instrument when the LINE switch is off.

1-17. EQUIPMENT AVAILABLE

1-18. Information may be obtained on the accessories and equipment, or they may be ordered by contacting your nearest Hewlett-Packard office. Refer to the HP model number.

1-19. Complementary Equipment

1-20. Modulation Oscillator. The HP Model 651B Test Oscillator is fully compatible for external modulation of the Signal Generator.

1-21. Output Amplifier. The HP Model 8447C Power Amplifier is suitable for increasing the output level of the Signal Generator to >+17 dBm. Typical gain is 30 dB. Typical 3-dB bandwidth is 10—400 MHz.

1-22. Output Amplifier. The HP Model 8447E Power Amplifier is suitable for increasing the output level of the Signal Generator to >+15 dBm. Typical gain is 22 dB. Typical 3-dB bandwidth is 0.05 to 1400 MHz.

1-23. Synchronizer/Counter. The HP Model 8655A Synchronizer/Counter is designed to monitor and phase lock the output frequency of the Signal Generator. Maximum counter resolution over the generator's frequency range is 100 Hz. Maximum counter resolution when phase locked to the 8654A is 500 Hz.

1-24. Accessories

1-25. Termination. The HP model 11507A Output Termination may be used to match the Signal Generator's 50-ohm output to low impedance circuits (5 ohms minimum) or to allow the generator to drive high impedance circuits at frequencies to 65 MHz. The termination may also be used as a dummy antenna for receiver measurements.

1-26. 75-Ohm Adapter. The HP Model 11687A 50 to 75-ohm Adapter may be used to match the Signal Generator output to a 75-ohm load. The OUTPUT LEVEL dial and meter scale remain calibrated in volts, but a correction factor is necessary to read output calibrated in dBm.

1-27. Frequency Doubler. The HP Model 11690A Frequency Doubler extends the usable range of signal sources to 1 GHz. Conversion loss is <13 dB.

1-28. Mixer. The HP Model 10514A Double Balanced Mixer may be used as a current controlled attenuator, an amplitude, pulse, or square-wave modulator, or a phase detector.

1-29. Transit Case. A transit case is available to protect the Signal Generator while transporting it from location to location. The case meets the requirements of MIL-C-4150 and may be ordered by specifying HP part number 9211-1895.

1-30. SERVICE AND USER AIDS

1-31. Video Tapes. Video tapes covering instrument use, application, and service are available. Contact the nearest Hewlett-Packard Sales and Service office for a list of presently available tapes.

1-32. Application Notes. Informative notes concerning the use of signal generators are also available from the nearest Hewlett-Packard Sales and Service office.

1-33. Service Notes. Hewlett-Packard makes design improvements to its current line of instruments on a continuing basis. Many of these improvements can be incorporated in earlier produced instruments. Modification and general service information is passed on in the form of Service Notes. To obtain the Service Notes contact the nearest Hewlett-Packard Sales and Service office.

1-34. WARRANTY

1-35. The Signal Generator is warranted and certified as indicated on the inner front cover of this manual. For further information, contact the nearest Hewlett-Packard Sales and Service office, addresses are provided at the back of the manual.

1-36. RECOMMENDED TEST EQUIPMENT

1-37. The equipment recommended for performance testing, adjustments and troubleshooting is listed in Table 1-2. Only equipment that meets or exceeds the critical specifications should be used in place of that shown in the table.

NOTE

The Signal Generator is a safety class I instrument. It has been manufactured and tested in accordance with HP standards. This instrument and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand (installation, operation, performance testing, adjustments, or service) is found throughout this manual.

Table 1-1. Specifications (1 of 2)

SPECIFICATIONS

Specifications apply from 10 to 520 MHz for output power ≤+10 dBm and over the top 10 dB of output level vernier range unless otherwise specified.

FREQUENCY CHARACTERISTICS

Range: 10 to 520 MHz in 6 ranges:
10 to 18.6 MHz
18.6 to 35 MHz
35 to 66 MHz
66 to 130 MHz
130 to 250 MHz
250 to 520 MHz

Accuracy: ±3% after 2-hour warm-up.

Settability: Settable to within 5 ppm of the desired frequency with an external indicator after 1-hour warm-up.

Stability (after 2-hour warm-up and 15 min after frequency change): <(1 kHz plus 20 ppm)/5 min.

SPECTRAL PURITY

Harmonic Distortion (output power ≤ +3 dBm):
>20 dB below carrier (dBc).
Option 003: >15 dBc.

Subharmonics and Non-harmonic Spurious (excluding line related): >100 dBc.

Residual AM (average rms): >55 dBc in a 50 Hz to 15 kHz post-detection noise bandwidth.

Residual FM on CW (averaged rms deviation):
<0.3 ppm in a 0.3 to 3 kHz post-detection noise bandwidth. <0.5 ppm in a 50 Hz to 15 kHz post-detection noise bandwidth.

OUTPUT CHARACTERISTICS

Range: 10 dB steps and a 13 dB vernier provide power settings from +10 dBm to −130 dBm (0.7V to 0.07 μV) into 50Ω. For Option 003, maximum output level is +8 dBm (0.56V).

Impedance: 50Ω ac coupled. SWR <1.3 on 0.1V range or lower. With Option 003, SWR <1.5 on 0.1V range or lower.

Level Accuracy:

	Using Top 10 dB of Vernier Range				Using Full Vernier Range
Output Level (dBm)	+10*to −7	−7 to −57	−57 to −97	−97 to −127	+10* to −130
Total Accuracy as Indicated on Level Meter (dB)	±1.5	±2.0	±2.5	±3.0	Add ± 0.5

Note: Level Accuracy error consists of allowances for meter accuracy, detector linearity, temperature, flatness, attenuator accuracy, and twice the measurement error. All but the attenuator accuracy and the measurement error can be calibrated out with a power meter at a fixed frequency and a fixed vernier setting.

*For Option 003 maximum output level is +8 dBm (0.56V).

Level Flatness: ±1 dB referenced to the output at 250 MHz for output levels > −7 dBm.

Table 1-1. Specifications (2 of 2)

SPECIFICATIONS

OUTPUT CHARACTERISTICS (Cont'd)

Auxiliary RF Output: > -7 dBm (100 mV) into 50Ω.

Leakage (with all RF outputs terminated properly): Leakage limits are below those specified in MIL-I-6181D. Furthermore, with an output level <0.01V, less than 0.5 μV is induced in a 2-turn, 25 mm (1-inch) diameter loop 25 mm (1 inch) away from any surface and measured into a 50Ω receiver.

Reverse Power Damage Level: 75 Vdc maximum. Output Range 1V and 0.3V: 250 mW (+24 dBm). All other output ranges: 500 mW (+27 dBm).

Reverse Power Protection (Option 003): Protects signal generator from accidental applications of up to 25W (+44 dBm) of RF power (between 10 and 520 MHz) into generator output.

MODULATION CHARACTERISTICS

Amplitude Modulation: Specifications apply for output power <+3 dBm.[1]

Depth: 0 to 90%.

Modulation Rate:

Internal: 400 and 1000 Hz ±10%.

External 3 dB bandwidth: dc-coupled to >20 kHz.

External AM Sensitivity:[2] (0.1 ±0.01)% AM/mVpk into 600Ω.

Indicated AM Accuracy:[2] ±(5% of reading +5% of full scale).

Peak Incidental Frequency Deviation (30% AM):[2] less than 200 Hz.

Envelope Distortion:[2] <3%, 0 to 70% modulation; <5%, 70 to 90% modulation.

Frequency Modulation: Uncalibrated.

Deviation: > 0.1% of carrier frequency, maximum.

Modulation Rate:

Internal: 400 and 1000 Hz ±10%.

External: 3 dB bandwidth, dc coupled to >25 kHz driven from 600Ω or less.

External FM Sensitivity:[2] 10 Vpk into 600Ω yields > 0.1% deviation (±15 volts max).

GENERAL CHARACTERISTICS

Power: 100, 120, 220, or 240 volts +5%, −10%, 48 to 440 Hz; 25 VA maximum, 2.29 m (7½ ft) power cable furnished with mains plugs to match destination requirements.

Weight: Net, 7.9 kg (17 lb, 6 oz).

Dimensions:[3] 266 mm wide x 178 mm high x 305 mm deep (10½" x 7" x 12").

[1] AM is possible above +3 dBm as long as the combination of the AM depth plus carrier output level does not exceed +9 dBm.

[2] 400 and 1000 Hz modulation rates.

[3] Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP office.

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

Instrument Type	Critical Specifications	Suggested Model	Use*
20 dB Amplifier	Range: 10–520 MHz Gain: 20 to 25 dB Flatness over Range: ±2 dB Impedance: 50Ω Noise Figure: <5 dB	HP 8447A	P
20 dB Amplifier	Range: 400–1200 MHz Gain: >20 dB Flatness: ±2 dB Impedance: 50Ω Noise Figure: < 5 dB to 1 GHz	HP 8447B	P
40 dB Amplifier	Range: 5 Hz to 50 kHz Gain: 20 and 40 dB ±1 dB Input Impedance: >5 kΩ Output Impedance: 50Ω Noise: < 25μVrms referred to input Output: > 1 Vrms into 50Ω	HP 465A	P
One–Inch Loop Antenna	2-turn, 25 mm (1 inch) dia. 25 mm (1 inch) from end. To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 08640–60501	P
10 dB Step Attenuator	Attenuation: 0–50 dB in 10 dB steps Range: dc to 520 MHz Accuracy: ±1.5 dB to 50 dB below 520 MHz, ±0.3 dB to 50 dB at 1000 Hz	HP 355D	P, A
10 dB Attenuator (Required for 003 only)	Accuracy: ± 0.5 dB to 520 MHz	HP 8491A Opt 010	A
Digital Multimeter	Voltage Range: 1V or less Display: 4–1/2 digits or more DC Accuracy: ±(0.03% of reading +0.02% of range) DC Accuracy: ±(0.25% of reading +0.05% of range) Ohms Range: to 1 MΩ	HP 34702A/ 34740A	P, A, T
Distortion Analyzer	Range: 20 Hz to 10 kHz Distortion Range: <0.1% Minimum Input: <300 mVrms	HP 331A	P
Frequency Meter Filter Kit	Ranges: 100 kHz to 10 MHz Linear Analog Output: 1V for full scale Output Low–pass Filters for HP 5210A FM Discriminator (10 kHz and 100 kHz Butterworth filters)	HP 5210A HP 10531A	P
4 MHz Low-pass Filter	4 MHz low–pass (3 pole) Impedance: 50Ω	CIR-Q-TEL** FLT/ 21B-4-3/50-3A/3B	P

*P = Performance; A = Adjustments; T = Troubleshooting
**CIR-Q-TEL INC./10504 Wheatley/Kensington, MD 20795/Phone 301-946-1800

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

Instrument Type	Critical Specifications	Suggested Model	Use*
15 kHz Low-pass Filter	15 kHz low-pass (7 pole) Impedance: 50Ω Ripple: < ±0.2 dB	CIR-Q-TEL** FLT/21B-15K- 7/50-3A/3B	P
Frequency Counter	Range: 520 MHz Input Sensitivity: < 100 mV Inputs: 50Ω and high impedance (1 MΩ) Accuracy: ±0.1%	HP 5383A	P, A, T
Mixer	Double Balanced Range: 10-520 MHz	HP 10514A	P
Oscilloscope	50 MHz Real Time Sensitivity: 5 mV/division	HP 1820C/1801A/ 182C	P
Power Meter Power Sensor	Input Level: -20 to +20 dBm Accuracy: ±1% of reading Range: 10-520 MHz SWR: < 1.2:1	HP 435A HP 8481A	P, A, T
RMS Voltmeter	Range: 10 Hz to 50 kHz Reading: True rms (ac only) Voltage Range: 1 mV to 10V full scale Accuracy: 1% of full scale 50 Hz to 50 kHz Scale: Voltage and dB	HP 3400A	P
Signal Generator	Range: 10-520 MHz Output: >+7 dBm into 50Ω Drift: <20 ppm/10 min. Residual FM: <50 Hz rms in 20 Hz to 15 kHz post-detection noise bandwidth; <30 Hz rms in 0.3-3 kHz post detection noise bandwidth at 250-520 MHz.	HP 8640A	P
Spectrum Analyzer (continued on next page)	Range: 10-1200 MHz Input Impedance: 50Ω Amplitude Calibration: Display Accuracy: ±0.25 dB/dB but not more than 1.5 dB over 70 dB dynamic range Flatness: ±1 dB IF Gain Step Accuracy: ±0.2 dB Vertical Reference Scale: 10 dB/division log, 2 dB/division (or less) log, and linear display calibration Average Noise Level: <- 102 dBm with 10 kHz IF bandwidth Spurious Responses: > 60 dB down for inputs of -40 dBm or less	HP 8558B/182C Opt. 807	P, A

*P = Performance; A = Adjustments; T = Troubleshooting
**CIR-Q-TEL INC./10504 Wheatley/Kensington, MD 20795/Phone 301-946-1800

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

Instrument Type	Critical Specifications	Suggested Model	Use*
Spectrum Analyzer (cont)	Maximum Bandwidth: ≥300 kHz Span Width: 0–1 GHz Compatible with Tracking Generator		
Test Oscillator	Range: 10 Hz to 50 kHz Output Impedance: 600Ω and 50Ω Distortion: > 40 dB down Output Level: > 1 Vrms	HP 651B	P, A
Test Oscillator	Range: 10 Hz to 50 kHz Level: 10 Vrms into 600Ω	HP 200CD	P
Tracking Generator (req. for Opt. 003 only)	Output: to 0 dBm (50Ω) Flatness: ±0.5 dB Compatible with Spectrum Analyzer HP 8558B/182C	HP 8444A Opt. 058	A
SWR Bridge (req. for Opt. 003 only)	Range: 10–520 MHz Directivity: > 40 dB Connectors: Type N	Wiltron Model** 60N50	A
50Ω Load (2 req.)		HP 11593A	P
50Ω Load (req. for Opt. 003 only)	SWR < 1.05 (dc–520 MHz)	HP 908A	A
Coaxial Short (Male Type N)		HP 11512A	A
Double Shielded Cable (BNC, Male, coaxial, 2 required)		HP 08608-6033	P

*P = Performance; A = Adjustments; T = Troubleshooting

**Wiltron Company /930 E. Meadow Dr./ Palo Alto, CA 94303/TWX 9103731156/Phone 415-494-6666

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information about incoming inspection, selecting the input line voltage, operating environment, and information applicable to bench and rack mounting.

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 are shown in Figure 1-1, and the procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defects, 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 the carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlements.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The 8654A Signal Generator requires a power source of 100, 120, 220, or 240 Vac +5% −10%, 48 to 440 Hz single phase. Power consumption is less than 25 VA.

2-8. Line Voltage Selection

2-9. Figure 2-1 provides instructions for line voltage and fuse selection. The line voltage for which the instrument is set is visible in the module window.

CAUTION

To prevent damage to the instrument make the line voltage and fuse selection before connecting the power cable.

NOTE

The correct fuse rating for the line voltage is shown on the rear panel. Fuse part numbers are given in the replaceable Parts Table in Section VI. (The reference designator is F1.)

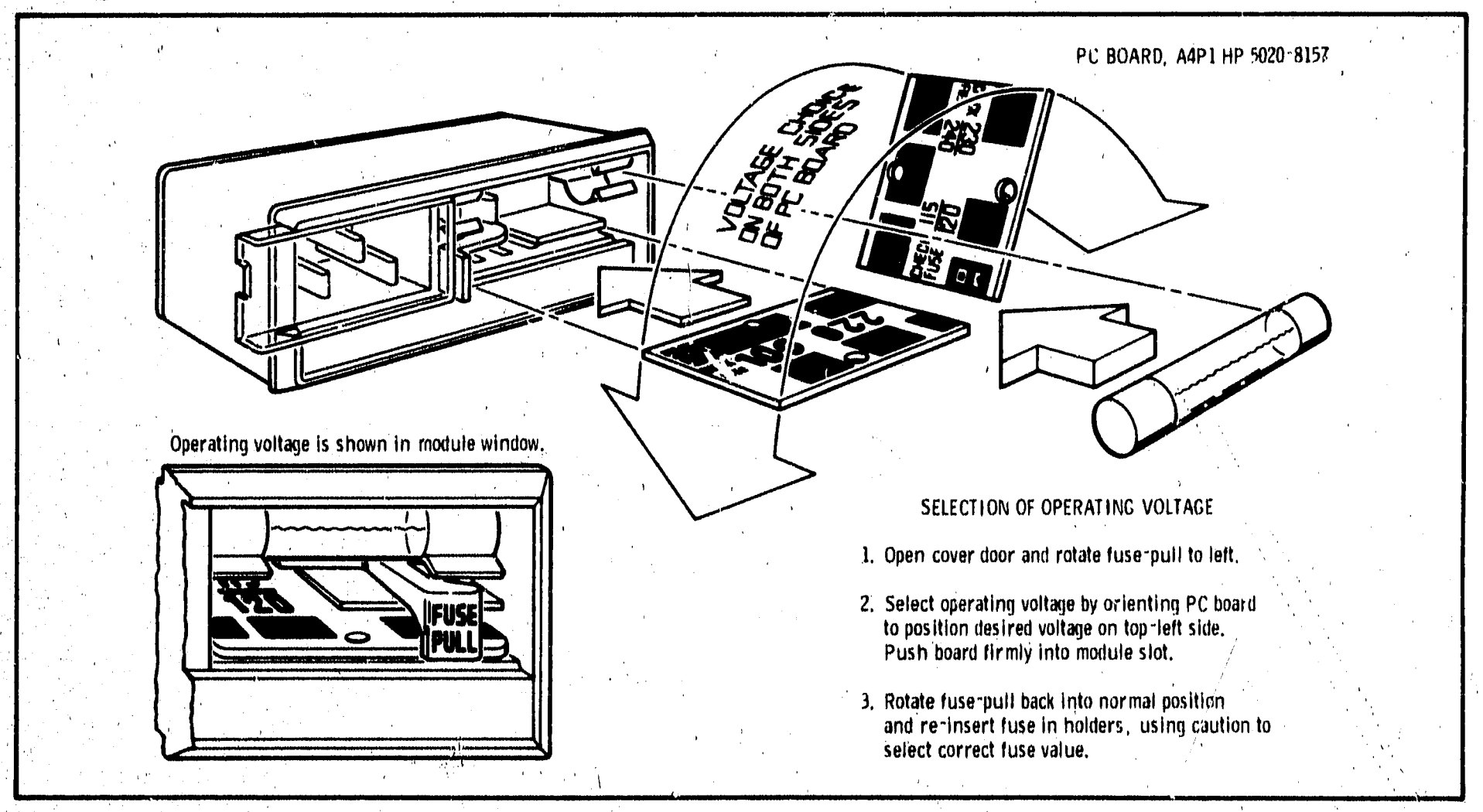


Figure 2-1. Line Voltage Selection

2-10. Power Cable

2-11. In accordance with international safety standards, this instrument is equipped with a three-wire power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cable plugs available.

WARNING

The protection provided by grounding the instrument may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

2-12. Operating Environment

2-13. The operating environment should be within the following limitations:

Temperature . . . . . 0 to +55°C
Humidity. . . . . <95% relative
Altitude. . . . . .<4600 metres (15 000 feet)

2-14. Bench Operation

2-15. The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. The plastic feet are shaped to ensure self-aligning of the instruments when stacked. The tilt stands raise the front of the instrument for easier viewing of the control panel.

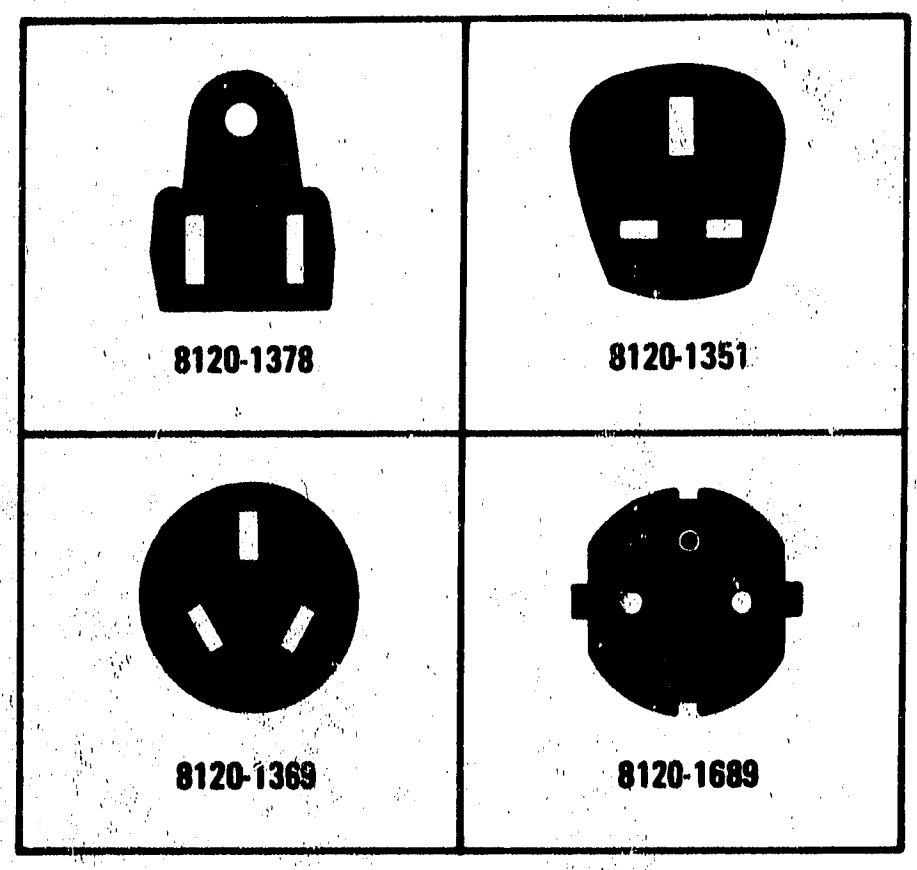


Figure 2-2. Power Cables Available

2-16. Rack Mounting

2-17. Rack Adapter Frames. Hewlett-Packard adapter frames are an economical means of rack mounting instruments that are narrower than full rack width. A set of spacer clamps, supplied with each adapter frame, permits instruments of different dimensions to be combined and rack mounted as a unit. Accessory blanks are available for filling unused spaces.

2-18. Combining Cases. Model 1051A and 1052A Combining Cases are metal enclosures that allow combinations of third- or half-rack width instruments to be assembled for use on a workbench or for mounting in a rack of 482.5 mm (standard 19-inch) spacing. Each case includes a set of partitions for positioning and retaining instruments, and a rack mounting kit. No tools are required for installing the partitions. For bench use the cases have the same convenience features as full rack width instruments (i.e., foldaway tilt stands and specially-designed feet for easier instrument stacking). Accessories available for the combining cases include fan kits, blank filler panels, and snap-on full width control panel covers.

2-19. STORAGE AND SHIPMENT

2-20. Environment

2-21. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

Temperature . . . . . -40 to +75° C
Humidity . . . . . <95% relative
Altitude . . . . . <7600 metres (25 000 feet)

2-22. Packaging

2-23. Original Packaging. Container 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.

2-24. 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

Packaging (Cont'd)

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 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75-100 mm layer) around all sides of the instrument to provide a 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.

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides complete operating instructions for the HP 8654A Signal Generator. The instructions consist of panel features, operator's checks, operating instructions, and operator's maintenance.

WARNINGS

Before switching on the instrument, the protective earth terminals of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

CAUTION

Before switching on this instrument: make sure the instrument is set to the proper line voltage. See Figure 2-1.

3-3. PANEL FEATURES

3-4. Front and rear panel features of the 8654A Signal Generator are described in Figures 3-2 and 3-3. These figures contain a detailed description of the Signal Generator controls, indicators, and connectors.

3-5. OPERATOR'S CHECKS

3-6. Upon receipt of the instrument, or to check the Signal Generator for an indication of normal operation, perform the operational procedures listed in Figure 3-4. These procedures are designed to familiarize the operator with the Signal Generator and permit a determination of operating capabilities.

3-7. OPERATING INSTRUCTIONS

3-8. General operating instructions are contained in Figure 3-5. The instructions will familiarize the operator with basic operating functions of the Signal Generator.

3-9. Calculating External FM Drive Voltage

3-10. The external FM drive voltage needed to obtain a desired peak frequency deviation of the carrier may be calculated from the relationship between the peak frequency deviation and FM sensitivity. Figure 3-6 illustrates how the calculation is made and the curve shown in Figure 3-7 relates FM sensitivity to carrier frequency for each frequency range.

3-11. Auxiliary RF Output

3-12. The isolation of the AUX RF OUT from the front panel RF OUTPUT is typically 30 dB. Any signal that is coupled into the AUX RF OUT may be transmitted to the generator's output. An example of this is an electronic counter used to monitor the RF output frequency. Subharmonic signals at the counter input are coupled into the AUX RF OUT and from there to the front panel output where they are transmitted to the load.

3-13. OPERATOR'S MAINTENANCE

3-14. The maintenance responsibilities of the operator are replacing the primary fuse and LINE switch lamp.

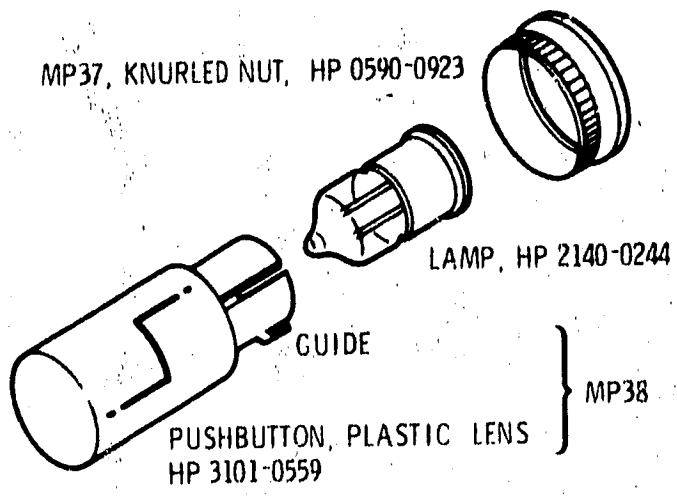
3-15. Fuses. The fuse is located on the rear panel within the power module assembly (see Figure 3-3). Figure 2-1 steps 1 and 3 explain how to remove and install the fuse. Proper fuse ratings for selected line

voltages are given on the rear panel. Fuse part numbers may be found in the Replaceable Parts Table in Section VI. Reference designator is F1.

WARNING

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse-holders must be avoided.

3-16. Line Switch Lamp Replacement. The lamp is contained in the white plastic lens which doubles for the pushbutton on the LINE switch. When the instrument is ON the lamp should be illuminated. Figure 3-1 shows the method of removing and installing the lamp.



POWER LAMP REPLACEMENT

1. Remove lens by pulling straight out.
2. Replace lamp.
3. To replace lens, align guide with notch in receptacle. Push straight in.

Figure 3-1. Lamp Replacement

3-17. Meter Zeroing. With the power off the meter's pointer should be positioned directly over zero. If the pointer is not at zero, insert a screwdriver into the adjustment screw, (beneath meter), and align the pointer with zero on the meter scale. This adjustment should only be made when necessary. If a large adjustment is required, the meter calibration should be checked.

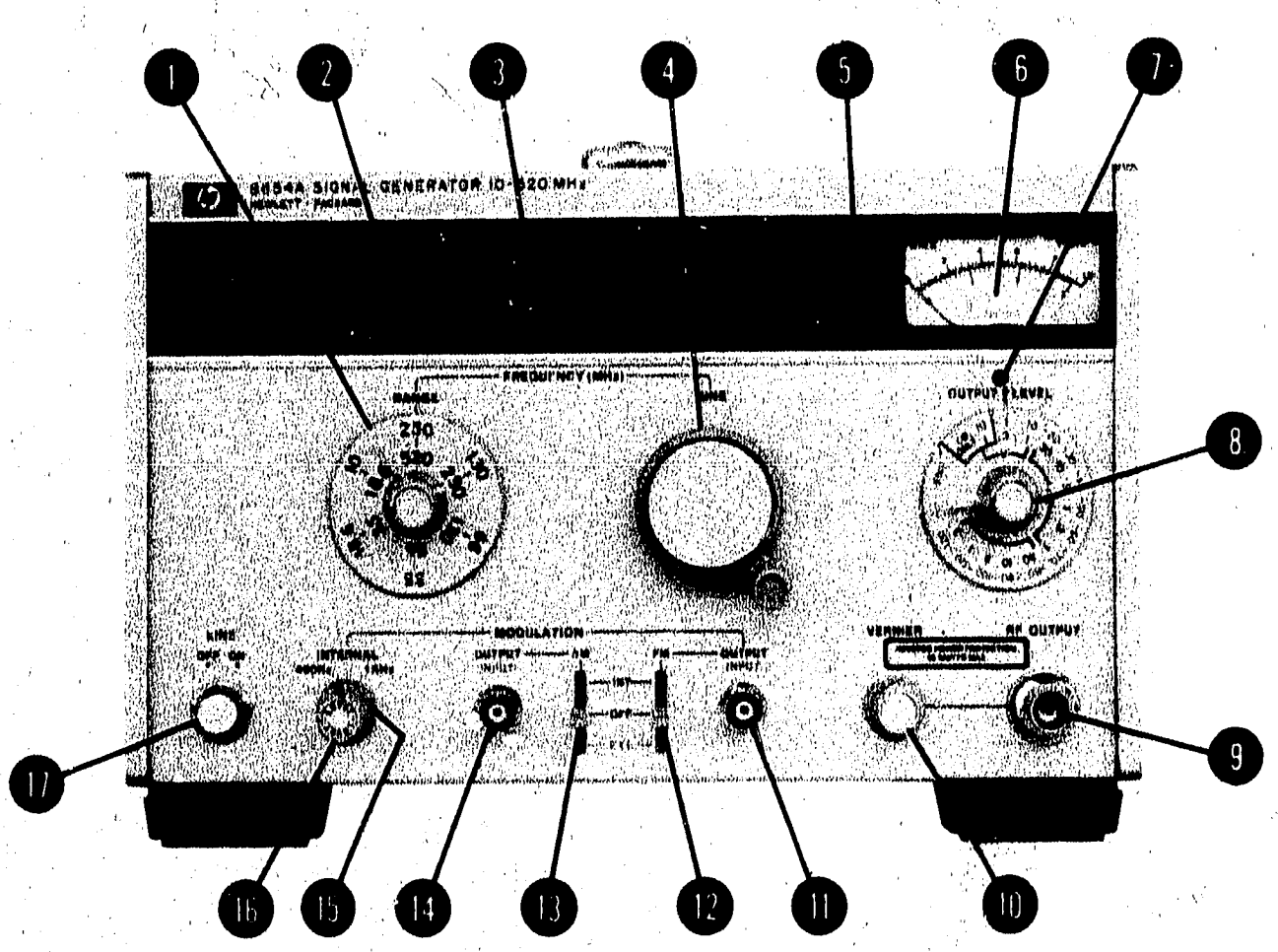


Figure 3-2. Front Panel Controls, Connectors, and Indicators (1 of 2)

FRONT PANEL FEATURES

1. **FREQUENCY RANGE (MHz).** Selects the frequency range as indicated on the control skirt.

2. **Frequency Scale.** Shows the range of frequencies selected by the FREQUENCY RANGE (MHz) control.

3. **Cursor.** Indicates the output frequency; controlled by FREQUENCY TUNE controls.

4. **FREQUENCY TUNE Control.** Tunes to the desired output frequency within the selected range.

5. **AM MTR 0-100%.** When pressed, switches the meter to indicate amplitude modulation depth in percent (read top scale X10).

6. **Meter.** In conjunction with the OUTPUT LEVEL control scale, the meter indicates the RF Output level in dBm (add the levels together) and Vrms (the OUTPUT LEVEL control shows the full-scale voltage and the meter indicates the output voltage). When AM MTR 0—100% is depressed, meter indicates amplitude modulation depth in percent (read top scale X10).

7. **Mechanical Zeroing Adjustment.** Screwdriver adjustment used to align the meter indicator on zero when no power is applied to the instrument.

8. **OUTPUT LEVEL Switch.** Selects output level range as shown on control skirt, +10 to —120 dBm (1V to 0.3 μV).

9. **RF OUTPUT Connector.** Delivers RF output through a 50Ω type N female connector. Output level: +10 to —130 dBm (0.7 Vrms to 0.07 μVrms) into a 50Ω load. (For Option 003, maximum output level is +8 dBm.)

10. **Output Level VERNIER.** RF output continuously variable within a 13 dB range as indicated by meter.

11. **FM OUTPUT/INPUT Jack.** Provides output for internal modulation signal or input for external modulation signal (input impedance is approximately 600 ohms). Open circuit output during internal modulation is ≈5 Vrms (output impedance is approximately 10k ohms).

CAUTION

Voltage levels more positive than +15V or more negative than —20V may damage 8654A internal circuitry if coupled to the FM INPUT jack.

12. **FM Modulation Switch.** Selects internal (INT) or external (EXT) frequency modulation, or OFF.

13. **AM Modulation Switch.** Selects internal (INT) or external (EXT) amplitude modulation, or OFF.

NOTE

A mechanical interlock prevents simultaneous internal amplitude and frequency modulation.

14. **AM OUTPUT/INPUT Jack.** Provides output for internal modulation signal or input for external modulation signal (input impedance is approximately 600 ohms). Open circuit output during internal modulation is ≈5 Vrms (output impedance is approximately 10k ohms).

CAUTION

Voltage levels more positive then +8V or more negative than —8V may damage internal circuitry of the 8654A when coupled to the AM INPUT jack.

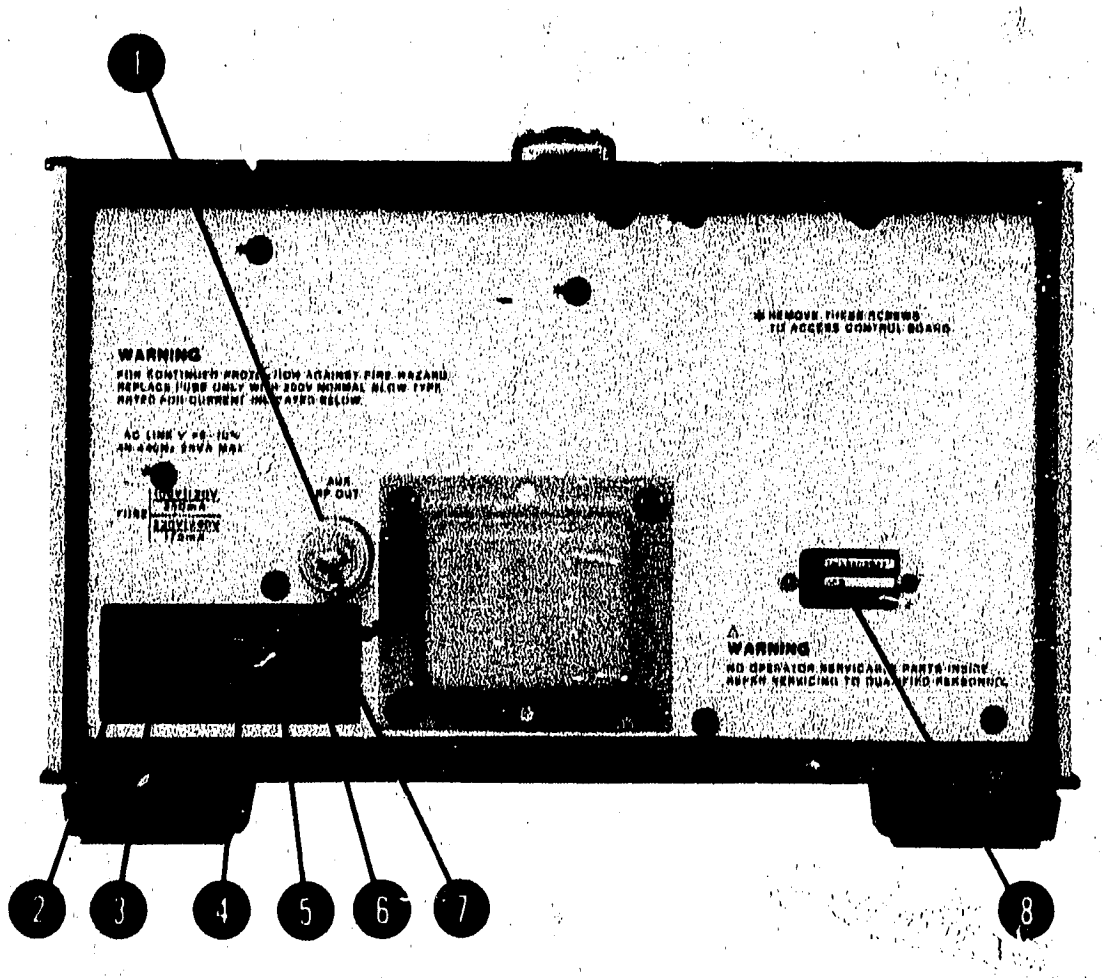
15. **INTERNAL MODULATION Frequency Switch.** Selects 400 or 1000 Hz internal modulation signal rate.

16. **LEVEL Control.** Sets AM depth or FM deviation in the internal modulation mode.

17. **LINE Switch.** Controls primary power. Illuminated when the instrument is on.

Figure 3-2. Front Panel Controls, Connectors, and Indicators (2 of 2)

REAR PANEL FEATURES



1 AUX RF OUT Connector. Provides RF signal, 10–520 MHz at > –7 dBm (fixed level) into a 50Ω load. Signal is unleveled and does not contain amplitude modulation but does contain frequency modulation.

NOTE

The isolation of the AUX RF OUT from the front panel RF OUTPUT is typically 30 dB. Any signal that is coupled into the AUX RF OUT may be transmitted to the generator's output. An example of this is an electronic counter used to monitor the RF output frequency. Subharmonic signals at the counter input are coupled into the AUX RF OUT and from there to the front panel output where they are transmitted to the load.

2 Line Module Assembly. Permits operation from 100, 120, 220 or 240 Vac. The number visible in window indicates nominal line voltage to which instrument must be connected (see Figure 2-1). Center conductor is safety earth ground.

WARNING

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited. (See Section II.)

3 Receptacle. To couple Line Power Cable to instrument.

4 Line Voltage Selection Card. Matches transformer primary to available line voltage.

5 Fuse. 250 mA for 100/120 Vac; 175 mA for 220/240 Vac.

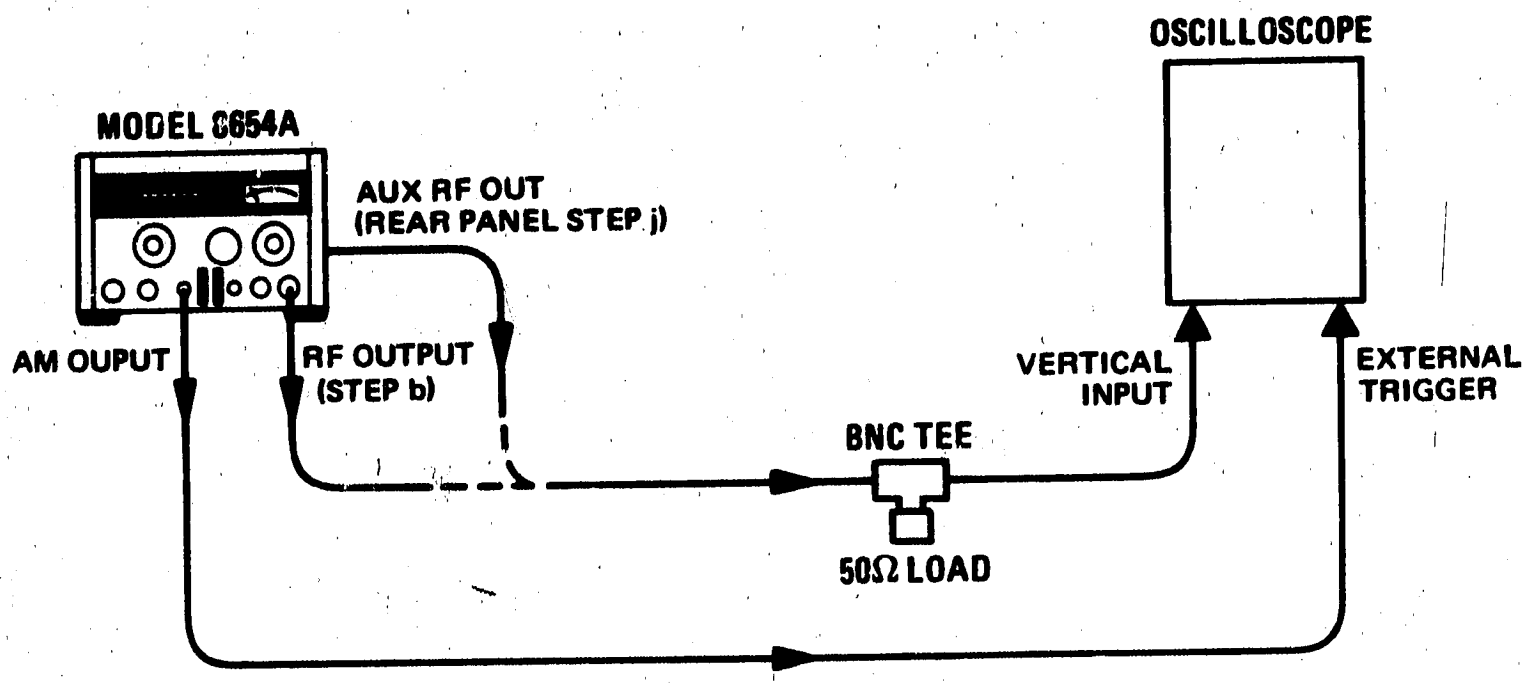
6 FUSE PULL Handle. Mechanical interlock to guarantee fuse has been removed before Line Voltage Selection Card can be removed.

7 Window. Safety interlock ensures fuse cannot be removed while power cable is coupled to the 8654A.

8 Serial Number Plate. First four numbers and letter constitute the prefix that denotes the instrument configuration. The last five digits form the suffix that is unique to each instrument. The Serial Number plate also indicates any options supplied with instrument.

Figure 3-3. Rear Panel Controls, Connectors and Indicators

OPERATOR'S CHECKS



INITIAL SETTINGS

a. Verify that the power transformer primary is matched to the line voltage and that the correct fuse is installed within the rear panel Line Module Assembly. See Line Voltage Selection in Section II.

b. Insert the power cable to the power outlet and Line Module receptacles. When the LINE switch is set to ON, the lamp within the switch lens should be illuminated.

c. Set the generator's controls as follows:

FREQUENCY RANGE	10—18.6 MHz
FREQUENCY TUNE	10.0 MHz
OUTPUT LEVEL Switch	0.1 Vrms
Output Level VERNIER	Full scale meter reading (0.1 Vrms)
AM	OFF
FM	OFF
INTERNAL MODULATION	1 kHz

RF OUTPUT

d. Connect the equipment as shown above and verify that the 10.0 MHz signal has an output level of ~ 0.3 Vp-p.

NOTES

The oscilloscope must have a bandwidth of ⩾10 MHz to perform these checks.

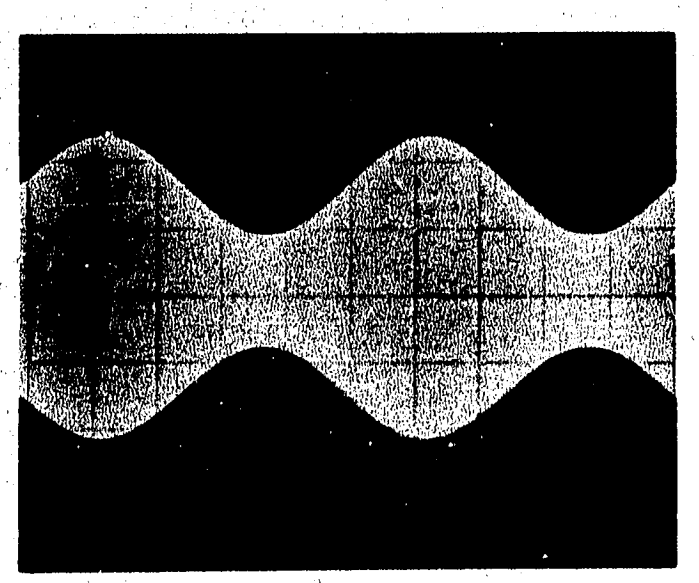
If the oscilloscope has a 50Ω input impedance, the BNC tee and 50Ω load should be omitted.

AMPLITUDE MODULATION

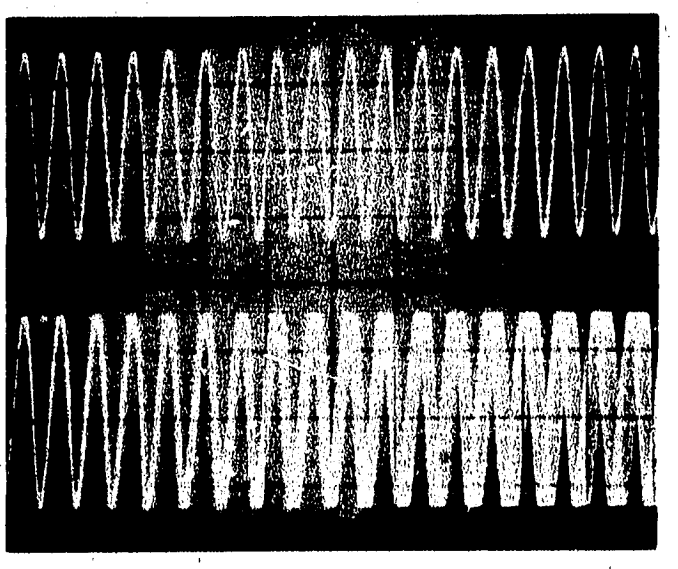
e. Set the generator's AM switch to INT and set the oscilloscope time base trigger to external.

Figure 3-4. Operator's Checks (1 of 2)

OPERATOR'S CHECKS



Typical AM Envelope



Typical FM Display with CW Display for Comparison

AMPLITUDE MODULATION (Cont'd)

f. Press the AM MTR switch and rotate the LEVEL control cw until the meter indicates 50% AM (5 on the 0—10 scale). Verify that the AM envelope display shows a peak-to-valley voltage difference of about 0.15V with a period of 1.0 ms.

g. Set the INTERNAL MODULATION switch to 400 Hz; verify the AM envelope period is 2.5 ms.

FREQUENCY MODULATION

h. Set the AM Modulation switch to OFF and set the FM Modulation switch to INT. Set the oscilloscope time base trigger to internal.

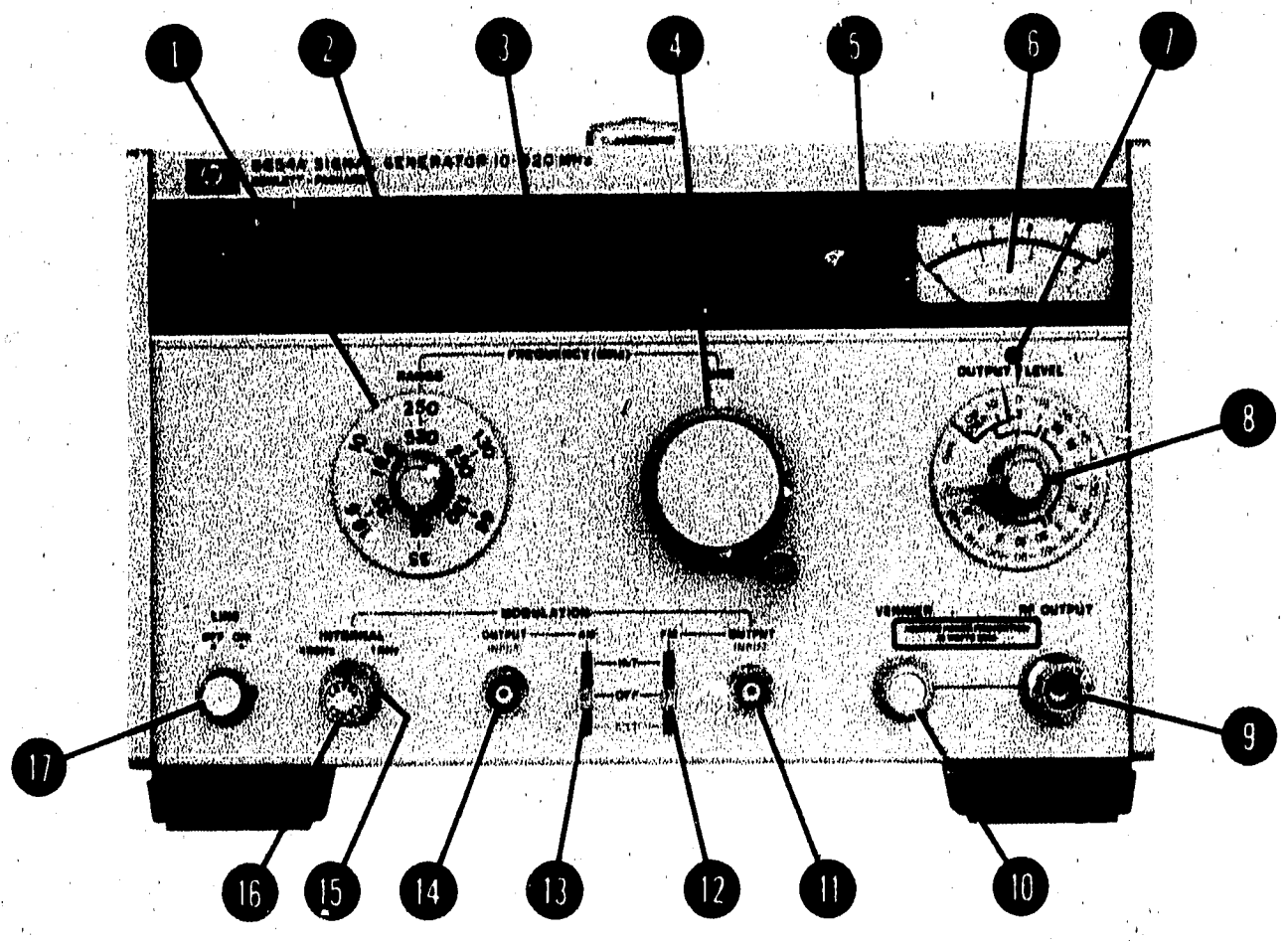
i. Rotate the LEVEL control cw. Verify that the oscilloscope shows the typical FM display. (Increasing the RF output frequency will increase the FM deviation shown by the oscilloscope.)

AUX RF OUT

j. Connect the 8654A AUX RF OUT to the oscilloscope vertical input and verify that a 10.0 MHz signal of $\geq$ 0.3 Vp-p is displayed.

Figure 3-4. Operator's Checks (2 of 2)

OPERATING INSTRUCTIONS



TURN ON

a. Verify that the power transformer primary is matched to the line voltage. See Line Voltage Selection in Section II.

b. Check the fuse, which is contained in the Line Module Assembly, for the correct rating. The voltage and amperage are given in a table on the rear panel. If necessary, change the fuse.

c. Insert the power cable into the power outlet and Line Module receptacles. Press the LINE switch (14) and release. The switch should remain in, the lamp within the plastic lens should be illuminated, and the cursor on the curved portion of the switch should indicate ON.

NOTE

To ensure the 8654A will perform to the standards set forth in the published specifications, let the instrument warm up for two hours before using.

FREQUENCY SELECTION

d. Set the FREQUENCY RANGE control (1) to the range which includes the desired carrier frequency.

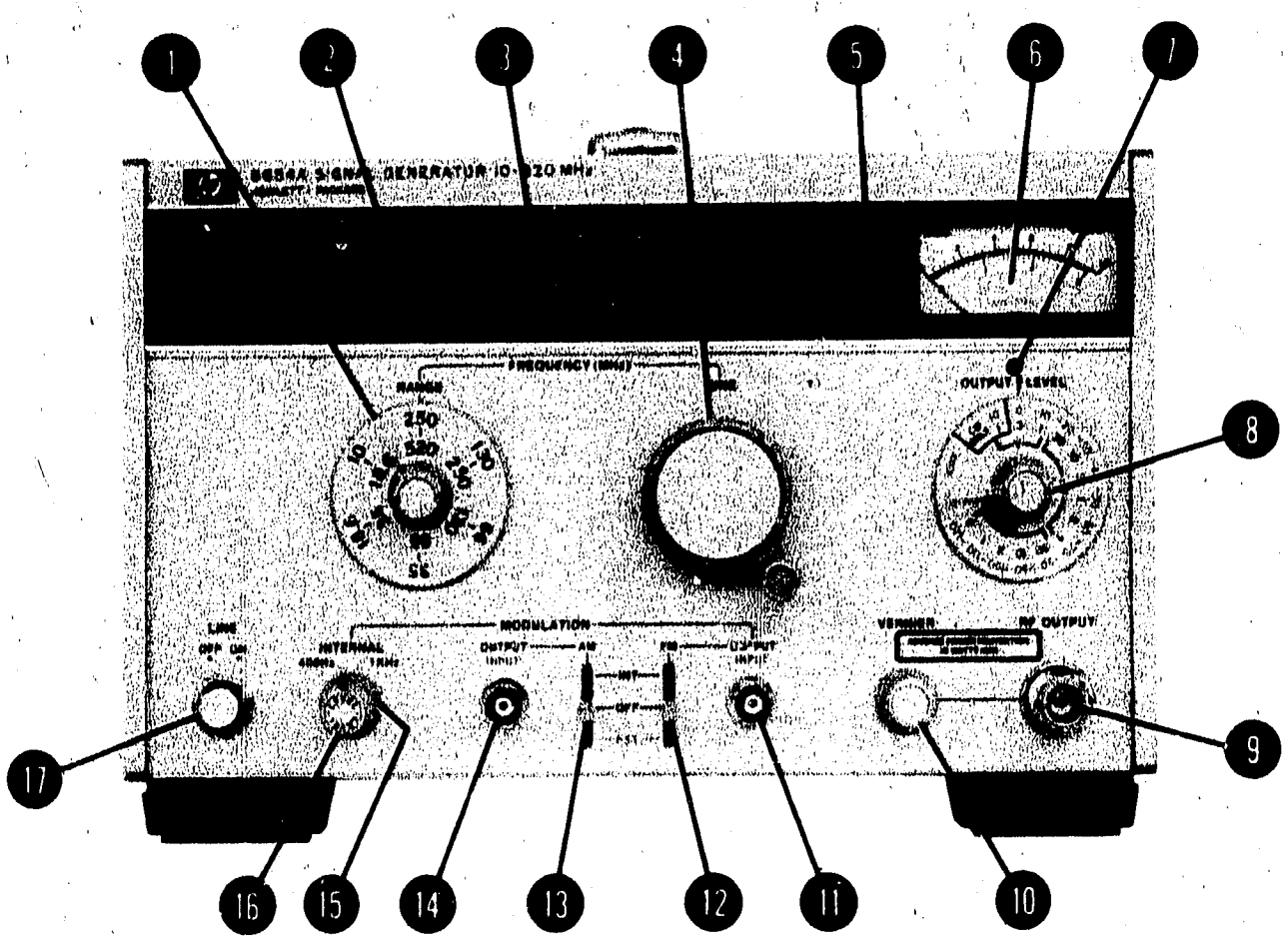
e. Tune to the carrier frequency with the FREQUENCY TUNE control (3) . The Cursor (2) indicates the carrier frequency.

OUTPUT LEVEL SELECTION

f. Set the OUTPUT LEVEL range control (6) and VERNIER (7) to the desired output level. For optimum AM performance and level meter accuracy, the VERNIER control should be set for a meter indication of −7 to +3 dBm (> 1/3 full scale). Amplitude modulation is restricted above +3 dBm.

Figure 3-5. Operating Instructions (1 of 4)

OPERATING INSTRUCTIONS



OUTPUT LEVEL SELECTION (Cont'd)

g. Vary the output level VERNIER control (7) until the level shown on the OUTPUT LEVEL range control (6) added to the meter indication (5) equals the desired level. (For voltage keep in mind that meter full-scale is equivalent to the voltage shown on the OUTPUT LEVEL range control skirt (6).)

AM MODULATION – INTERNAL

h. Set AM Modulation Switch (10) to INT.

i. Select 400 or 1000 Hz modulation rate with the INTERNAL MODULATION frequency switch (13).

j. Press the AM MTR switch (4) and vary the LEVEL control (12) until the meter (5) indicates the desired modulation depth. Use top scale (10 = 100%).

AM MODULATION – EXTERNAL

k. Set the AM Modulation switch (10) to EXT.

l. Set the external generator output to a minimum, and connect the output to the AM INPUT jack (11).

CAUTION

Voltage levels more positive than +8V or more negative than −8V may damage internal circuitry of the 8654A when coupled to the AM INPUT jack.

NOTE

The AM INPUT impedance is ≈ 600 ohms.

m. Set the external signal modulating rate as desired (20 kHz maximum).

Figure 3-5. Operating Instructions (2 of 4)

OPERATING INSTRUCTIONS

AM MODULATION – EXTERNAL (Cont'd)

n. Press the AM MTR switch (4) and increase the external generator output until the meter (5) indicates the desired modulation depth.

NOTES

For more precise setting of % AM using an external source, set AM LEVEL (12) fully cw. Monitor the voltage at AM INPUT with an external voltmeter. With AM LEVEL set fully cw, 1 Vpk (0.707 Vrms) produces 100% AM (AM is specified to 90%).

Amplitude modulation is not recommended for output levels > +3 dBm. If AM is necessry, monitor the RF output with an oscilloscope to verify that the distortion is minimal. Frequency modulation is permissible at all output levels.

The modulation meter responds to the positive peak of the modulation signal. If the modulation signal waveform is asymmetrical or if it has a dc component, the meter reading will be in error.

FM MODULATION – INTERNAL

o. Set the FM Modulation switch (9) to INT.

p. Select 400 or 1000 Hz internal modulating rate with the INTERNAL MODULATION frequency switch (13).

q. The FM Peak deviation is set by the LEVEL control (12).

FM MODULATION – EXTERNAL

r. Set the FM Modulation switch (9) to EXT.

s. Set the external modulation generator output level to a minimum. Connect the generator to the FM INPUT jack (8), and set the external modulating rate as desired (25 kHz maximum).

t. Use Figures 3-6 and 3-7 to find the input from the test generator that will produce the desired peak deviation of the carrier frequency. The FM drive voltage is measured at the FM INPUT jack.

SIMULTANEOUS AM AND FM MODULATION

u. If the desired AM rate is 400 or 1000 Hz, follow the instructions given for AM MODULATION-INTERNAL and FM MODULATION-EXTERNAL. Otherwise follow the procedures for AM MODULATION-EXTERNAL and FM MODULATION-EXTERNAL.

PULSE MODULATION

v. Set the 8654A FREQUENCY RANGE and TUNE controls to the desired frequency with the AM and FM Modulation controls to OFF.

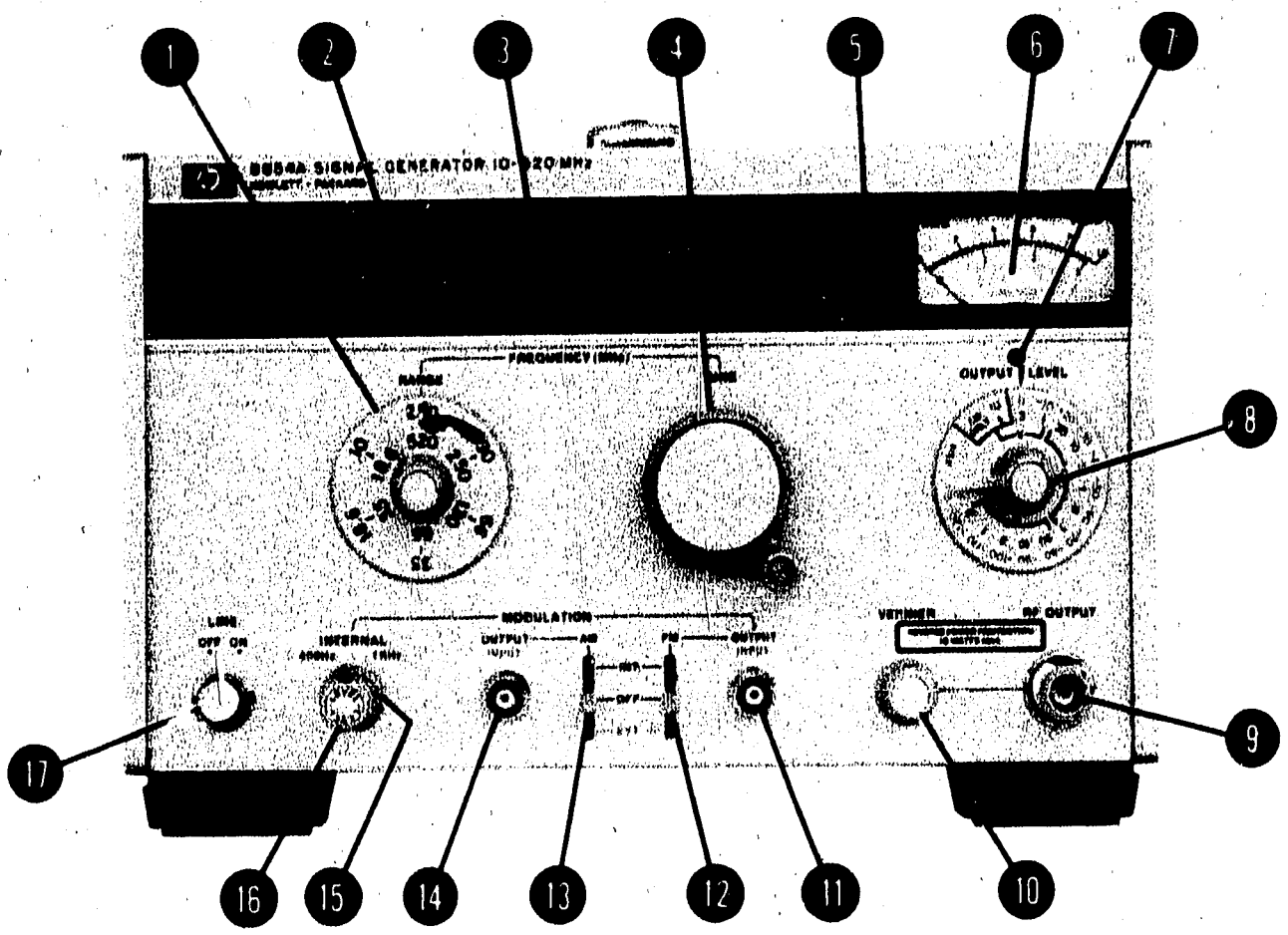
w. Set the 8654A OUTPUT LEVEL switch and VERNIER controls to the desired output level. (This will be the output level during pulse on-time.)

x. Connect the Pulse Generator to the AM INPUT jack.

y. Set the Pulse Generator controls to produce a pulse on-time voltage of 0.0 Vdc and an off-time voltage of −1.5 Vdc (refer to waveform below). Set the other pertinent Pulse Generator controls.

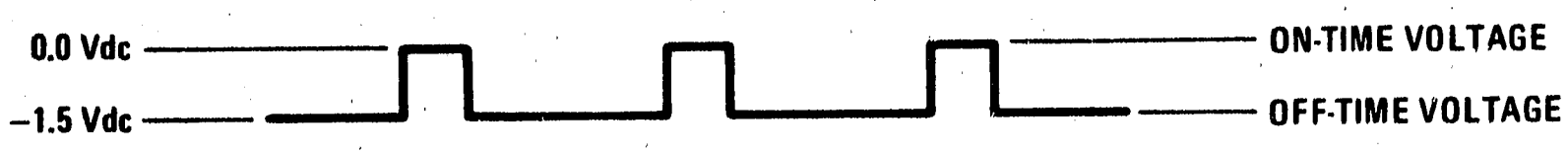
Figure 3-5. Operating Instructions (3 of 4)

OPERATING INSTRUCTIONS



CAUTION

Voltages applied to the AM INPUT jack which are more positive than +8 Vdc or more negative than −8 Vdc may damage internal circuitry of the 8654A.



NOTES

The pulse on-time voltage must be 0.0 Vdc or the output level during the on-time will not be equal to the preset level.

The Pulse On-Off ratio is typically > 40 dB.

z. **Set the 8654A AM Modulation control to EXT.**

NOTE

Rise time for pulse modulated output is typically 50 µs.

Figure 3-5. Operating Instructions (4 of 4)

CALCULATING FM DRIVE VOLTAGE

The following procedure explains the method for calculating FM drive voltage, V_d.

$$V_d = \frac{\text{Desired Peak Deviation (kHz-pk)}}{\text{FM Sensitivity (peak deviation, kHz-pk/Vpk)}}$$

a. Use Figure 3-7 to find the FM sensitivity for the carrier frequency desired. Enter the value in the formula.

b. Enter the desired peak frequency deviation.

c. Calculate the FM drive voltage, V_d.
Example:

Desired carrier frequency	102.1 MHz
Desired peak frequency deviation	100 kHz-pk (200 kHz bandwidth)

From Figure 3-7, the FM sensitivity for 102.1 MHz is 60 kHz-pk/Vpk.

$$V_d = \frac{100}{60} \text{ Vpk}$$

$$V_d = 1.67 \text{ Vpk}$$

CAUTION

Input voltages more positive than +15V or more negative than −20V may damage 8654A internal circuitry.

NOTES

The FM sensitivity accuracy is typically ±25%. Therefore, for the above example, the 1.67 Vpk drive signal will normally produce a peak carrier deviation between 75−125 kHz.

The detected FM signal distortion is dependent on FM drive voltage and may be determined by the following equation:

$$\textit{FM Distortion} = (2\ V_d)\ \%\ \textit{for}\ V_d < 10\ \text{Vpk}$$

Figure 3-6. Calculating FM Drive Voltage

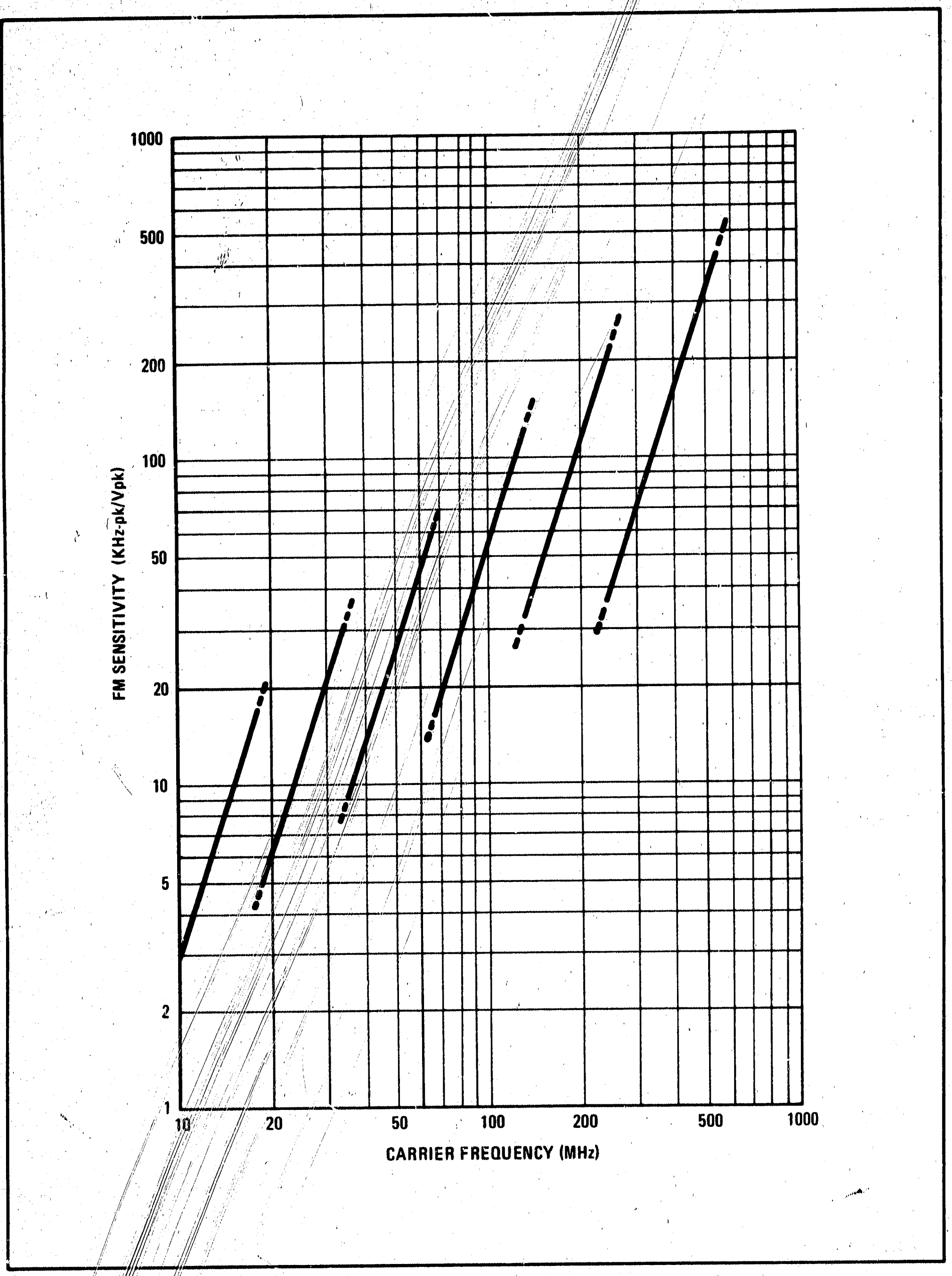


Figure 3-7. FM Sensitivity

PERFORMANCE CHECK

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the HP Model 8654A 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.

CAUTION

To avoid the possibility of damage to test equipment, read completely through each test before starting it. Make any preliminary control settings necessary for correct test equipment operation.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in Table 1-2, Recommended Test Equipment 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 the 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, troubleshooting, and after repairs or adjustments.

4-7. PERFORMANCE TESTS

4-8. The performance tests given in this section are suitable for incoming inspection, troubleshooting, or preventative maintenance. During any performance test, all shields and connecting hardware must be in place. The tests are designed to verify published instrument specifications. Perform the tests in the order given and record the data on the test card and/or in the data spaces provided throughout each procedure.

NOTES

Unless otherwise specified, no warm-up period is required for these tests.

Line voltage must be within +5%, −10% of nominal if the performance tests are to be considered valid.

4-9. The specifications are written as they appear in Table 1-1, Specifications. A description of the test and any special instructions or problem areas are included. Most tests that require test equipment have a setup drawing, and all have a list of the required equipment. The initial steps of each procedure give control settings required for that particular test.

4-10. TEST PROCEDURES

4-11. It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Model 8654A are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division setting would not be specified and the operator would set that control so that the analyzer operates correctly.

4-12. It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary. Table 1-2, Recommended Test Equipment, Section I, lists the requirments for some of these items.

CAUTION

To avoid the possibility of damage to test equipment, read completely through each test before starting it. Make any preliminary control settings necessary for correct test equipment operation.

PERFORMANCE TESTS

4-13. FREQUENCY ACCURACY TEST

SPECIFICATION: **Accuracy**: ±3% after 2-hour warm-up.

DESCRIPTION: The frequency at several points on each range is measured with a counter.

EQUIPMENT: Frequency Counter . . . . . HP 5383A

PROCEDURE:

1. Connect Signal Generator RF OUTPUT to counter's high frequency input setting controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	500 MHz
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

2. After a 2-hour warm-up, precisely set Signal Generator frequency to each point listed in the following table. Counter should read within ±3% of dial indication.

Generator Frequency		Counter Reading (MHz)
RANGE (MHz)	Dial Indication (MHz)	
250—520	500	485.0 _____ 515.0
	450	437.5 _____ 464.5
	400	388.0 _____ 412.0
	350	339.5 _____ 360.5
	300	291.0 _____ 309.0
	250	242.5 _____ 257.5
130—250	130	126.1 _____ 133.9
	150	145.5 _____ 154.5
	170	164.9 _____ 175.1
	190	184.3 _____ 195.7
	210	203.7 _____ 216.3
	230	223.1 _____ 236.9
	250	242.5 _____ 257.5
66—130	130	126.1 _____ 133.9
	120	116.4 _____ 123.6
	110	106.7 _____ 113.3
	100	97.0 _____ 103.0
	90	87.3 _____ 92.7
	80	77.6 _____ 82.4
	70	67.9 _____ 72.1

PERFORMANCE TESTS

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

Generator Frequency		Counter Reading (MHz)
RANGE (MHz)	Dial Indication (MHz)	
35—66	35	34.0 _____ 36.1
	40	38.8 _____ 41.2
	45	43.7 _____ 46.4
	50	48.5 _____ 51.5
	55	53.4 _____ 56.7
	60	58.2 _____ 61.8
	65	63.1 _____ 67.0
18.6—35	35	33.95 _____ 36.05
	30	29.10 _____ 30.90
	25	24.25 _____ 25.75
	20	19.40 _____ 20.60
10—18.6	10	9.70 _____ 10.30
	12	11.64 _____ 12.36
	14	13.58 _____ 14.42
	16	15.52 _____ 16.48
	18	17.46 _____ 18.54

4-14. HARMONIC DISTORTION TEST

SPECIFICATION: **Harmonic Distortion** (output power ≤ +3 dBm): >20 dB below carrier (dBc).
Option 003: >15 dBc.

DESCRIPTION: Harmonics are measured with a spectrum analyzer at a +3 dBm output from the Signal Generator as the frequency is tuned from 10 to 520 MHz.

EQUIPMENT: Spectrum Analyzer . . . . . HP 8558B/182C

PROCEDURE:

1. Connect Signal Generator RF OUTPUT to spectrum analyzer input after setting generator controls as follows:

   FREQUENCY RANGE (MHz) . . . 250—520 MHz
   FREQUENCY TUNE . . . . . 520 MHz
   OUTPUT LEVEL Switch . . . . . 0 dBm
   Output Level VERNIER . . . . . Meter reads +3 dB
   AM . . . . . OFF
   FM . . . . . OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, and optimum input level to 0 dBm (40 dB attenuation). Set analyzer frequency span and center frequency controls, and set Signal Generator FREQUENCY RANGE control as listed in following table. For each FREQUENCY RANGE, tune generator across the range. Record minimum difference of harmonic levels with respect to

PERFORMANCE TESTS

4-14. HARMONIC DISTORTION TEST (Cont'd)

fundamental. Harmonics should be more than 20 dB down from fundamental (more than 15 dB down for Option 003).

Spectrum Analyzer		Signal Generator	Harmonics (dB down from carrier)	
Frequency Span Per Division (MHz)	Center Frequency (MHz)	FREQUENCY RANGE (MHz)	Standard	Option 003
100	700	250–520	20 _____	15 _____
100	600	130–250	20 _____	15 _____
100	500	66–130	20 _____	15 _____
50	250	35–66	20 _____	15 _____
20	100	18.6–35	20 _____	15 _____
10	50	10–18.6	20 _____	15 _____

4-15. RESIDUAL AM TEST

SPECIFICATION: **Residual AM (average rms):** >55 dBc in a 50 Hz to 15 kHz post-detection noise bandwidth.

DESCRIPTION: To calibrate the system, the Signal Generator is internally amplitude modulated at a 10% depth. The AM is demodulated with a spectrum analyzer in a zero-frequency span mode. The demodulated AM is amplified and measured with a true rms voltmeter which becomes a reference of 20 dB down from the carrier. The AM is shut off and the amount of residual AM is measured relative to the 20 dB reference. A filter at the voltmeter input defines the measurement bandwidth.

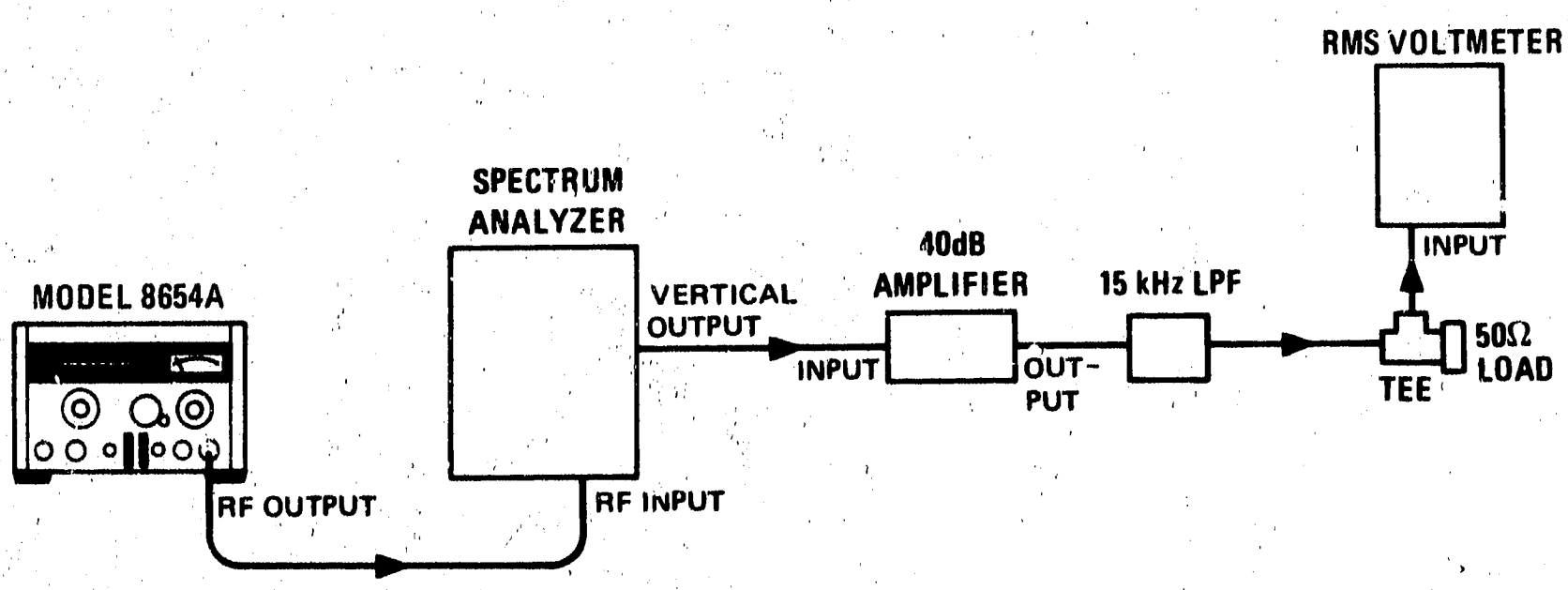


Figure 4-1. Residual AM Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C Opt 807
40 dB Amplifier	HP 465A
RMS Voltmeter	HP 3400A
15 kHz Low-pass Filter . .	CIR-Q-TEL 7 Pole
50Ω Load	HP 11593A

PERFORMANCE TESTS

4-15. RESIDUAL AM TEST (Cont'd)

PROCEDURE: 1. Connect equipment as shown in Figure 4-1 after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—500 MHz
FREQUENCY TUNE	500 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads 0 dB
AM	INT
LEVEL	Fully ccw
FM	OFF
INTERNAL MODULATION	1 kHz

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to minimum (off) and adjust frequency controls to center 500 MHz signal on display. Set frequency span to 0, fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to approximately the fifth graticule line from the bottom.

3. Press AM MTR switch and adjust LEVEL for a panel meter reading of 10%.

4. Readjust analyzer vertical scale control to a convenient reference on voltmeter's dB scale. This reference is 20 dB down from the carrier.

NOTE

If amplifier clipping is suspected, check the voltmeter input with an oscilloscope. If it is clipping, set the amplifier gain to 20 dB.

5. Set AM to OFF. Voltmeter average reading should drop more than 35 dB (i.e., more than 55 dB down from carrier).

35 dB _____

4-16. RESIDUAL FM TEST

SPECIFICATION: **Residual FM on CW** (averaged rms deviation): <0.3 ppm in a 0.3 to 3 kHz post-detection noise bandwidth. <0.5 ppm in a 50 Hz to 15 kHz post-detection noise bandwidth.

DESCRIPTION: The residual FM present on the Signal Generator output is demodulated by a frequency meter whose discriminator output is amplified and measured with a true rms voltmeter. A filter at the voltmeter input defines the measurement bandwidth. A reference generator and mixer convert the RF output of the test Signal Generator to within the range of the frequency meter.

NOTE

The residual FM of the reference generator should be less than 1/3 of that specified for the 8654A since the test measures the residual FM of both enerators simultaneously. Also, both generators should be free from mechanical vibrations and loud noises for this

PERFORMANCE TESTS

4-16. RESIDUAL FM TEST (Cont')

NOTE (Cont'd)

test. Residual FM is measured for a 50 Hz to 15 kHz post-detection bandwidth only since any out of tolerance condition for it will also be out of tolerance for a 0.3 to 3 kHz bandwidth.

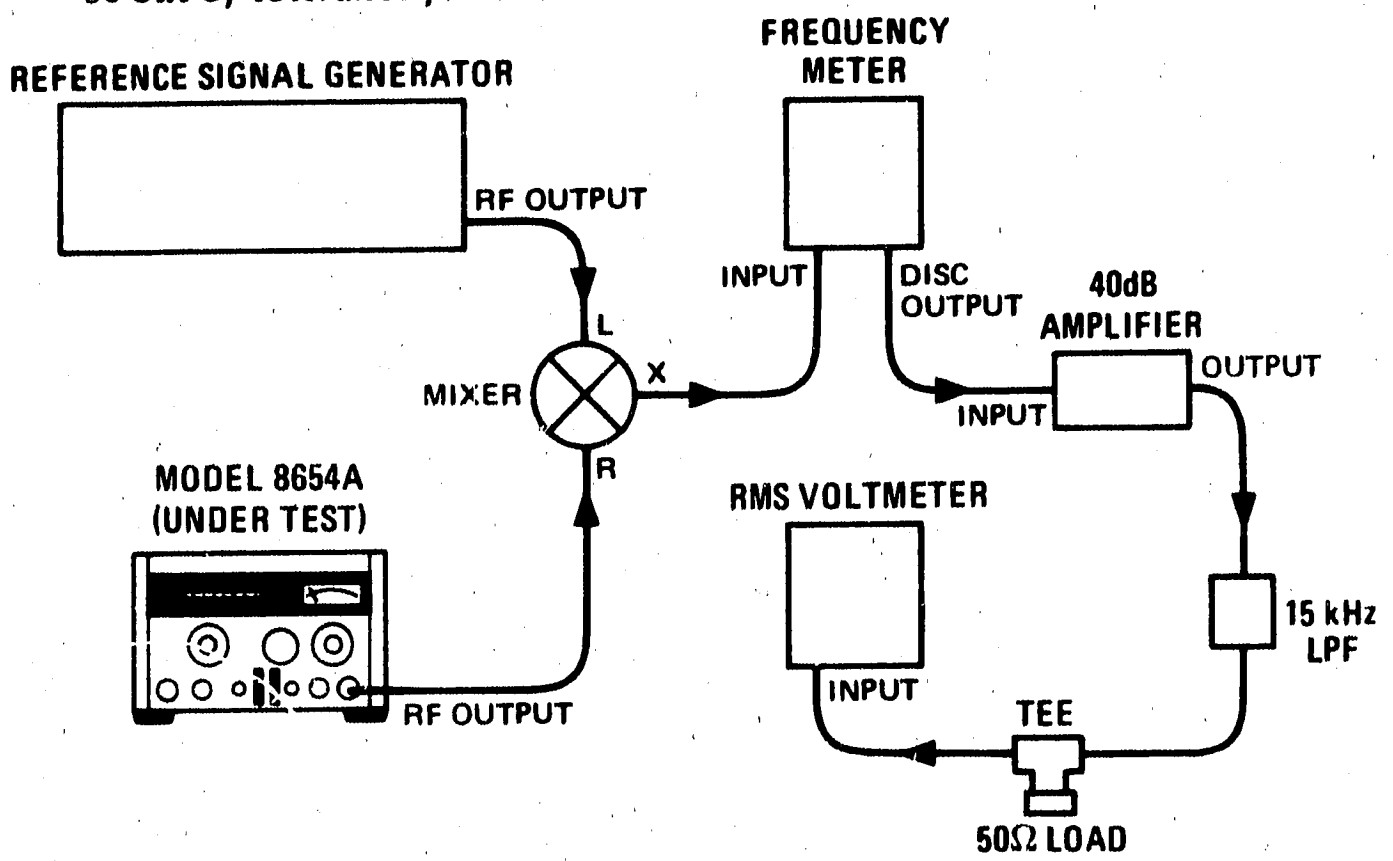


Figure 4-2. Residual FM Test Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
RMS Voltmeter	HP 3400A
40 dB Amplifier	HP 465A
Reference Signal Generator	HP 8640A
Mixer	HP 10514A
15 kHz Low-pass Filter	CIR-Q-TEL 7 Pole
50 Ohm Load	HP 11593A

PROCEDURE:

1. Set test Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	500 MHz
OUTPUT LEVEL Switch	—10 dBm
Output Level VERNIER	Meter reads 0 dB
AM	OFF
FM	OFF

2. Install shorting board in frequency meter and calibrate for 1 Vdc (at output jack) for a full-scale meter reading.

3. Install 100 kHz Butterworth low-pass filter in frequency meter.

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

5. Set reference signal generator to +7 dBm at 501 MHz. Set frequency meter range to 1 MHz.

PERFORMANCE TESTS

4-16. RESIDUAL FM TEST (Cont'd)

6. Tune reference signal generator for a near full-scale reading on frequency meter.

7. Average voltmeter reading should be less than 12.5 mVrms (250 Hz—rms, or 0.5 ppm).

_____12.5 mVrms

NOTE

Sensitivity of the frequency meter is 1V/MHz before amplification. After amplification by a gain of 50 (the amplifier's gain is 50 when terminated by 50Ω), sensitivity is 50 mV/kHz.

4-17. OUTPUT LEVEL ACCURACY TEST

SPECIFICATION: **Range:** 10 dB steps and a 13 dB vernier provide power settings from +10 dBm to −130 dBm (0.7V to 0.07 μV) into 50Ω. For Option 003, maximum output level is +8 dBm (0.56V).

Level Accuracy:

	Using Top 10 dB of Vernier Range				Using Full Vernier Range
Output Level (dBm)	**+10* to −7**	**−7 to −57**	**−57 to −97**	**−97 to −127**	**+10* to −130**
Total Accuracy as Indicated on Level Meter (dB)	±1.5	±2.0	±2.5	±3.0	Add ±0.5

*For Option 003, maximum output level is +8 dBm (0.56V).

DESCRIPTION: The RF level accuracy for the +10 and 0 dBm ranges is measured with a power meter. For the lower ranges, a reference signal is established on a spectrum analyzer display, the Signal Generator OUTPUT LEVEL switch and the spectrum analyzer vertical scale log reference level control are stepped together and any amplitude variations appear on the analyzer display. An RF attenuator and amplifier at the RF OUTPUT are adjusted for analyzer compatibility and best sensitivity.

NOTE

This measurement uses an IF substitution technique in which the spectrum analyzer IF is the standard. The IF step accuracy should be within ±0.2 dB overall. The IF step accuracy can be checked using the above technique by comparing a lab calibrated attenuator (such as HP Model 355D Option H36) with the IF step control at the frequency of attenuator calibration (e.g., 3 MHz for the HP 355D Option H36).

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

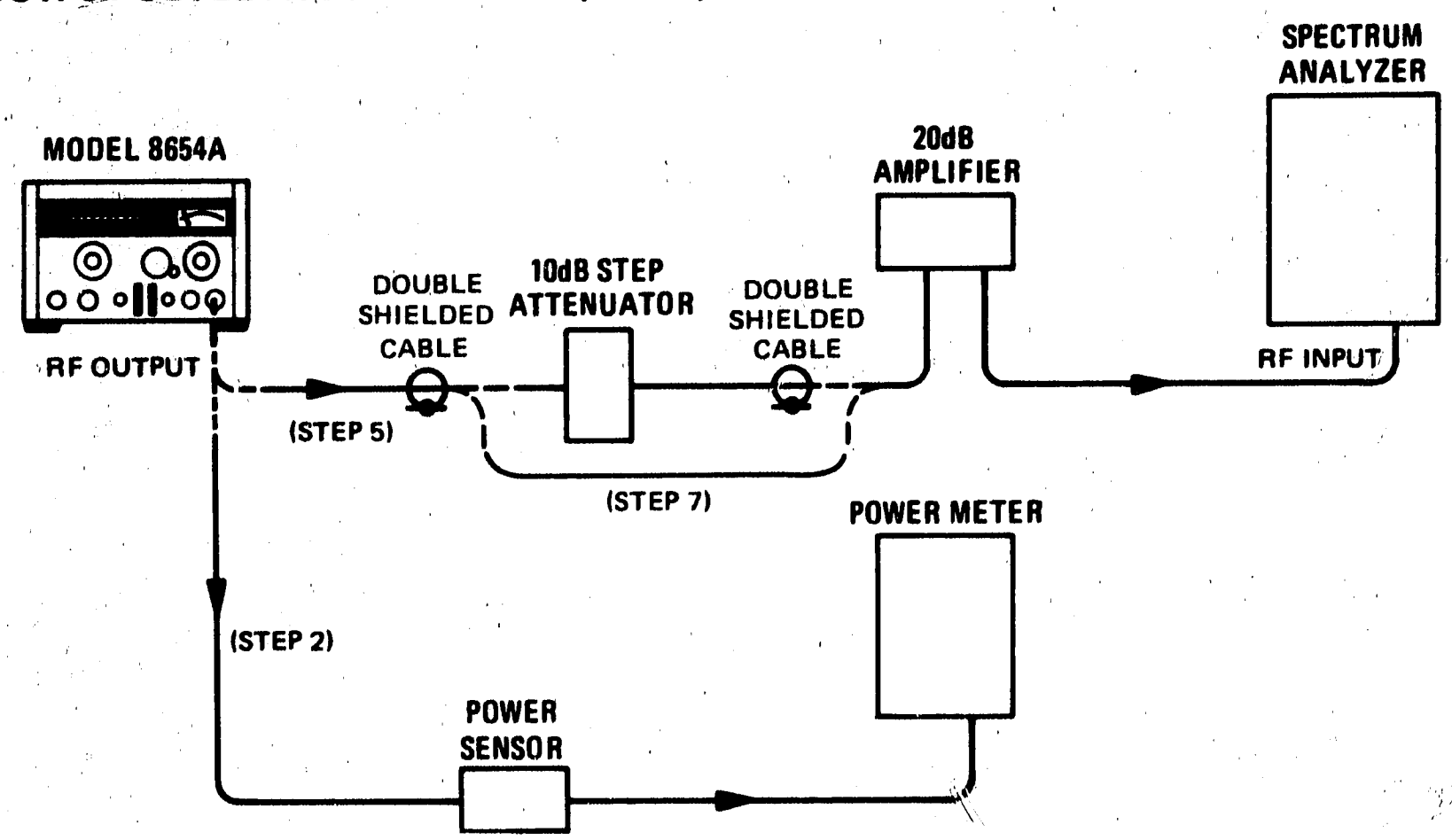


Figure 4-3. Output Level Accuracy Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Power Meter/Sensor	HP 435A/8481A
20 dB Amplifier	HP 8447A
10 dB Step Attenuator	HP 355D
Double Shielded Cables (2 required)	HP 08708-6033

PROCEDURE:

1. Set Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads 0 dB (except Option 003) Meter reads −2 dB (Option 003 only)
AM	OFF
FM	OFF

2. Set power meter controls to +15 dBm range (+10 dBm range for Option 003) Connect power sensor to Signal Generator RF OUTPUT.

3. Set Signal Generator RF OUTPUT level as shown in table below; verify that level is within the specified tolerance.

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

Signal Generator		Power Meter Reading (dBm)
OUTPUT LEVEL Switch (dBm)	Panel Meter Reading (dB)	
+10	0 (except Option 003)	+8.5 _____ +11.5
	−2 (Option 003 only)	+6.5 _____ +9.5
+10	−3	+5.5 _____ +8.5
+10	−7	+1.5 _____ +4.5
+10	−10	−2.0 _____ +2.0
0	−10	−12.0 _____ −8.0
0	−7	−8.5 _____ −5.5
0	−3	−4.5 _____ −1.5
0	0	−1.5 _____ +1.5
0	+3	+1.5 _____ +4.5

4. Set step attenuator to 50 dB. Set spectrum analyzer center frequency to 520 MHz, resolution bandwidth to 10 kHz, frequency span to 5 kHz per division, optimum input level to −40 dBm, display smoothing to approximately 100 Hz, 1 dB per division vertical log display with −20 dBm reference level.

5. Connect attenuator, amplifier, and spectrum analyzer together as shown in Figure 4-3, without disturbing generator controls. Center signal on display. Consider center horizontal scale equivalent to +3 dBm. With vertical reference level vernier; set signal peak to be equal to last measured level on power meter.

NOTE

If, for example, the last power meter reading was +2.6 dBm, the vertical scale resolution is 1 dB/division, therefore, the signal peak should be 0.4 dB or 0.4 division below the center scale reference.

6. Set Signal Generator OUTPUT LEVEL control and analyzer vertical scale log control as shown in the following table. Verify that amplitude falls within ±2.0 dB (2 divisions) of center scale reference in each case.

Signal Generator Output Level (dB)	Spectrum Analyzer	
	Log Reference (dBm)	Display Amplitude (dB)
0	−20	Set Level
−10	−30	−2.0 _____ +2.0
−20	−40	−2.0 _____ +2.0
−30	−50	−2.0 _____ +2.0
−40	−60	−2.0 _____ +2.0
−50	−70	−2.0 _____ +2.0

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

7. Set analyzer's vertical reference level to −20 dBm. Remove 10 dB step attenuator and connect Signal Generator's RF OUTPUT directly to amplifier input. With vertical reference level vernier set signal peak to same level, with respect to horizontal center scale reference, as last measurement recorded on preceding table.

8. Set Signal Generator OUTPUT LEVEL control and analyzer vertical reference level as shown in following table. Verify that amplitude is within tolerance specified.

Signal Generator Output Level (dBm)	Spectrum Analyzer	
	Log Reference (dBm)	Display Amplitude (dB)
−50	−20	Set Level
−60	−30	−2.5 _____ +2.5
−70	−40	−2.5 _____ +2.5
−80	−50	−2.5 _____ +2.5
−90	−60	−2.5 _____ +2.5
−100	−70	−3.0 _____ +3.0
−110	−80	−3.0 _____ +3.0
−120	−90	−3.0 _____ +3.0

NOTE

For the last step, set analyzer vertical scale to 10 dB/division and verify that noise level is at least 10 dB below signal.

4-18. OUTPUT LEVEL FLATNESS TEST

SPECIFICATION: **Level Flatness**: ±1 dB referenced to the output at 250 MHz for output levels >−7 dBm.

DESCRIPTION: An output level reference is established at 250 MHz and the maximum and minimum output levels are measured as the Signal Generator is tuned across each range. The test is performed at both maximum and minimum specified ALC reference levels.

EQUIPMENT: Power Meter and Sensor . . . . . HP 435A/8481A

PROCEDURE: 1. Set Signal Generator controls as follows:

FREQUENCY RANGE (MHz). . . 130—250 MHz
FREQUENCY TUNE . . . . . 250 MHz
OUTPUT LEVEL Switch . . . . . +10 dBm
Output Level VERNIER . . . . . Fully ccw
AM . . . . . OFF
FM . . . . . OFF

PERFORMANCE TESTS

4-18. OUTPUT LEVEL FLATNESS TEST (Cont'd)

2. Set power meter range to +10 dBm. Connect power sensor to Signal Generator RF OUTPUT.

3. Adjust Signal Generator output level VERNIER control for power meter reading of +9 dBm at 250 MHz (+7 dBm for Option 003).

4. Slowly tune Generator across each range and note maximum and minimum power readings for each range. The maximum should not exceed +10 dBm and the minimum should not be less than +8 dBm. (For Option 003, the maximum power reading should not exceed +8 dBm and the minimum should not be less than +6 dBm.

Frequency Range (MHz)	Power Meter Reading			
	Standard		Option 003	
	Minimum (dBm)	Maximum (dBm)	Minimum (dBm)	Maximum (dBm)
250—520	+8 _____	_____ +10	+6 _____	_____ +8
130—270	+8 _____	_____ +10	+6 _____	_____ +8
66—130	+8 _____	_____ +10	+6 _____	_____ +8
35—66	+8 _____	_____ +10	+6 _____	_____ +8
18.6—35	+8 _____	_____ +10	+6 _____	_____ +8
10—18.6	+8 _____	_____ +10	+6 _____	_____ +8

5. Set Signal Generator frequency to 250 MHz; set OUTPUT LEVEL to 0 dBm and adjust VERNIER for panel meter reading of —7 dB.

6. Set power meter range to —5 dBm and adjust Signal Generator VERNIER for power meter reading of —7 dBm.

7. Slowly tune generator across each range and note maximum and minimum power meter readings for each range. The maximum should not exceed —6 dBm and the minimum should not be less than —8 dBm.

Frequency Range (MHz)	Power Meter Reading	
	Minimum (dBm)	Maximum (dBm)
250—520	—8 _____	_____ —6
130—250	—8 _____	_____ —6
66—130	—8 _____	_____ —6
35—66	—8 _____	_____ —6
18.6—35	—8 _____	_____ —6
10—18.6	—8 _____	_____ —6

PERFORMANCE TESTS

4-19. OUTPUT LEAKAGE TEST

SPECIFICATION: **Leakage** (with all RF outputs terminated properly): Leakage limits are below those specified in MIL-1-6181D. Furthermore, with an output level <0.01V, less than 0.5 μV is induced in a 2-turn, 25 mm (1-inch) diameter loop 25 mm (1 inch) away from any surface and measured into a 50Ω receiver.

DESCRIPTION: A loop antenna is held one inch from all surfaces of the Signal Generator and any leakage monitored with a spectrum analyzer. The loop antenna is suspended in a molding so that when the molding is in contact with a surface, the loop antenna is one inch from the surface.

NOTE

The use of a screen room may be necessary to reduce interface from other sources.

Do not grasp the antenna near the ioop end while performing test.

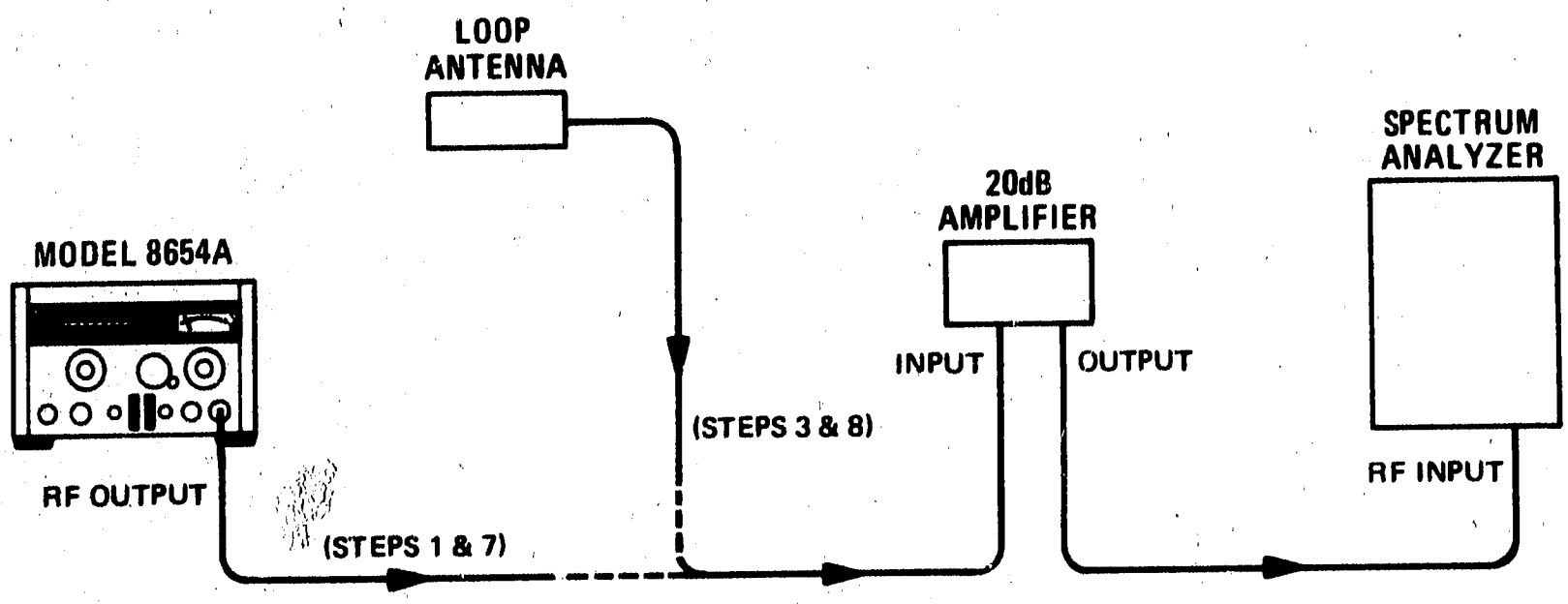


Figure 4-4. Output Leakage Test Setup

EQUIPMENT:

Loop Antenna	HP 08640-60501
20 dB Amplifier (0.1—400 MHz)	HP 8447A
20 dB Amplifier (400—1200 MHz)	HP 8447B
Spectrum Analyzer	HP 8558B/182C
50 Ohm Load (2 required)	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-4 (with Signal Generator connected to spectrum analyzer through 0.1 to 400 MHz amplifier). Set generator controls as follows:

FREQUENCY RANGE (MHz)	66—130 MHz
FREQUENCY TUNE	100 MHz
OUTPUT LEVEL Switch	—110 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	OFF

PERFORMANCE TESTS

4-19. OUTPUT LEAKAGE TEST (Cont'd)

2. Set spectrum analyzer resolution bandwidth to 30 kHz, optimum input level to −40 dBm (0 dB attenuation), frequency span to 50 kHz per division, vertical scale to 10 dB per division log, display smoothing to approximately 100 Hz, and center frequency controls to locate 100 MHz signal. Use vertical reference level controls to set −113 dBm signal to −40 dB graticule line on display.

3. Disconnect generator from analyzer and connect 50 ohm loads to generator RF OUTPUT and rear panel AUX RF OUT connectors. Set analyzer frequency span to 20 MHz per division.

4. Connect loop antenna to analyzer through 0.1−400 MHz 20 dB amplifier. Hold the one-inch side of loop antenna cylinder in contact with various surfaces of Signal Generator and observe display for the duration of a sweep. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 10 to 200 MHz.

_____ −40 dB

5. Set analyzer center frequency control to 300 MHz and repeat step 4. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 200−400 MHz.

_____ −40 dB

6. Replace amplifier with 400−1200 MHz 20 dB amplifier. Set analyzer center frequency controls to 500 MHz. Set generator FREQUENCY RANGE (MHz) to 250−520 MHz and FREQUENCY TUNE to 500 MHz.

7. Connect generator to analyzer and calibrate analyzer at 500 MHz as in step 2.

8. Re-terminate Signal Generator RF OUTPUT and connect loop antenna to amplifier. Set analyzer frequency span to 20 MHz per division.

9. Hold antenna in contact with various surfaces of Signal Generator and observe display. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 400−600 MHz.

10. Set analyzer frequency to 700, 900, and 1100 MHz, and repeat step 9 at each setting. All signals and nosise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV).

600−800 MHz: _____ −40 dB
800−1000 MHz: _____ −40 dB
1000−1200 MHz: _____ −40 dB

PERFORMANCE TESTS

4-20. INTERNAL MODULATION RATE ACCURACY TEST

SPECIFICATION: **Modulation Rate:** Internal, 400 and 1000 Hz ±10%.

DESCRIPTION: The modulation oscillator frequency is measured at the AM and FM output jacks with a frequency counter.

EQUIPMENT: Frequency Counter . . . . . HP 5383A

PROCEDURE:

1. Connect counter high impedance input to AM OUTPUT jack. Set AM to INT and set INTERNAL MODULATION switch to 400 Hz. Counter should read 400 ±40 Hz.

   360 _____ 440 Hz

2. Set INTERNAL MODULATION switch to 1 kHz. Counter should read 1000 ±100 Hz.

   900 _____ 1100 Hz

3. Connect counter to FM OUTPUT jack. Set FM to INT. Counter should read 1000 ±100 Hz.

   900 _____ 1100 Hz

4. Set INTERNAL MODULATION switch to 400 Hz. Counter should read 400 ±40 Hz.

   360 _____ 440 Hz

4-21. AM BANDWIDTH TEST

SPECIFICATION: External 3 dB bandwidth, dc coupled to >20 kHz.

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM is observed directly on the display and any change in AM depth is observed as the modulation rate is increased.

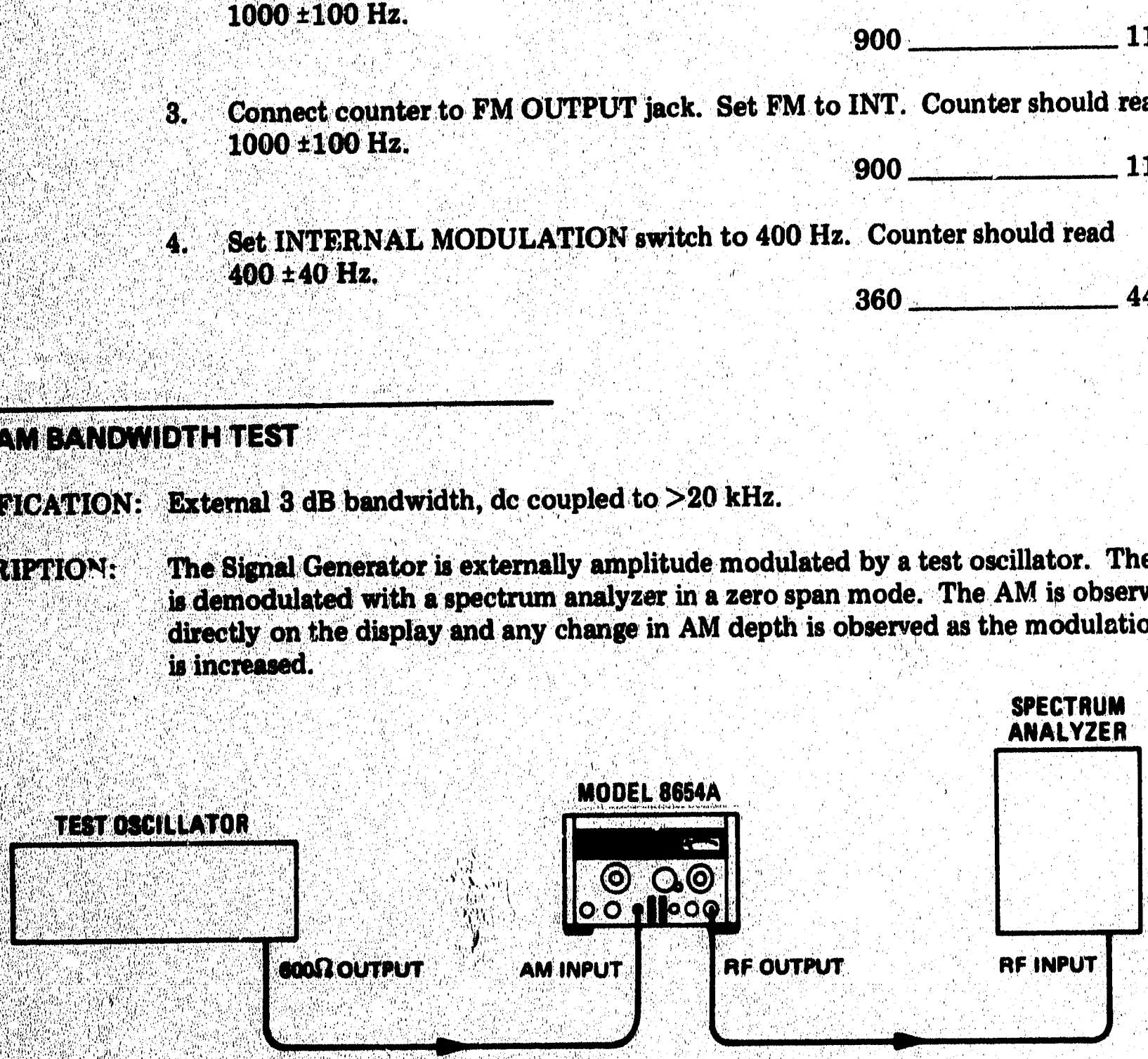


Figure 4-5. AM Bandwidth Test Set.

EQUIPMENT:
Spectrum Analyzer . . . . . HP 8558B/182C
Test Oscillator . . . . . HP 651B

PERFORMANCE TESTS

4-21. AM BANDWIDTH TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-5 after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads +3 dB
AM	INT
LEVEL	Fully ccw
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to minimum (off), and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0; fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to fourth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and approximately 1 Vrms into 600Ω.

4. Increase LEVEL until 4 divisions peak-to-peak of vertical deflection are obtained on display. (Internally trigger spectrum analyzer.)

5. Increase frequency of test oscillator to 20 kHz without changing its level. Peak-to-peak deflection on display should remain greater than 2.8 divisions for frequencies up to 20 kHz (i.e., >3 dB).

2.8 divisions _____

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST

SPECIFICATION: **External AM Sensitivity** (400 and 1000 Hz modulation rates): (0.10 ±0.01) %AM/mVpk into 600Ω.
Indicated AM Accuracy (400 and 1000 Hz modulation rates): ±(5% of reading +5% of full scale).

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator with a level set to give 50% AM. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM depth is measured directly on the display and is compared with the panel meter reading.

PERFORMANCE TESTS

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST (Cont'd)

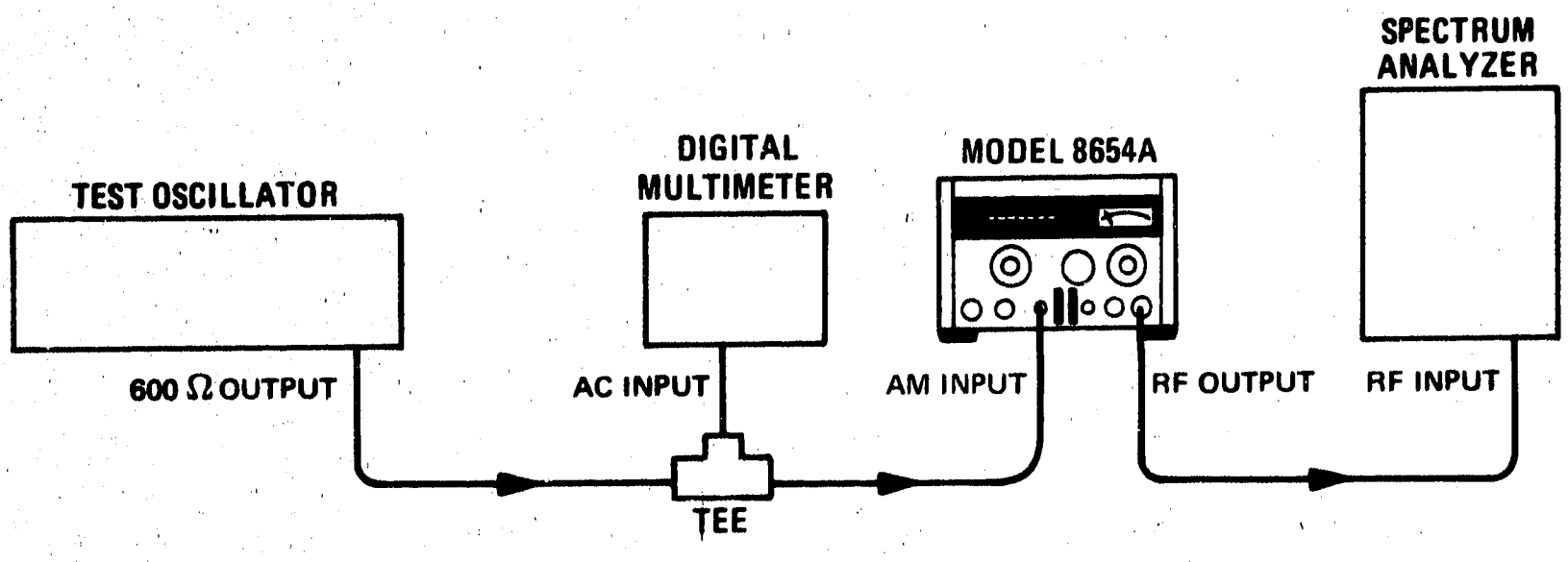


Figure 4-6. AM Sensitivity and Indicated Accuracy Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Test Oscillator	HP 651B
Digital Multimeter	HP 34740A/34702A

PROCEDURE:

1. Connect equipment as shown in Figure 4-6 after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads +3 dB
AM	EXT
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0; fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to fourth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and 0.353 Vrms (0.5 Vpk) as read on ac voltmeter.

4. Peak-to-peak deflection on display should be between 3.6 and 4.4 divisions (corresponding to 50 ±5% AM).

3.6 _____ 4.4 divisions

NOTE

Check spectrum analyzer base line position by removing RF input. Base line should be exactly on bottom graticule line.

5. Adjust both test oscillator level and spectrum analyzer vertical level as needed for signal to span the second and sixth graticule lines from the bottom of display.

PERFORMANCE TESTS

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST (Cont'd)

6. Press AM MTR switch. Meter should read between 42.5% and 57.5% (i.e., 50.0 ±7.5% AM).

42.5% _____ 57.5%

4-23. AM DISTORTION TEST

SPECIFICATION: **Envelope Distortion** (400 and 1000 Hz modulation rates): <3%, 0 to 70% modulation; <5%, 90% modulation.

DESCRIPTION: The Signal Generator is internally amplitude modulated. The AM is demodulated with a spectrum analyzer in a zero-frequency span mode. The distortion of the demodulated signal (present at the vertical output of the spectrum analyzer) is measured with a distortion analyzer. The measurement is made at a low ALC reference level where AM distortion is typically greatest.

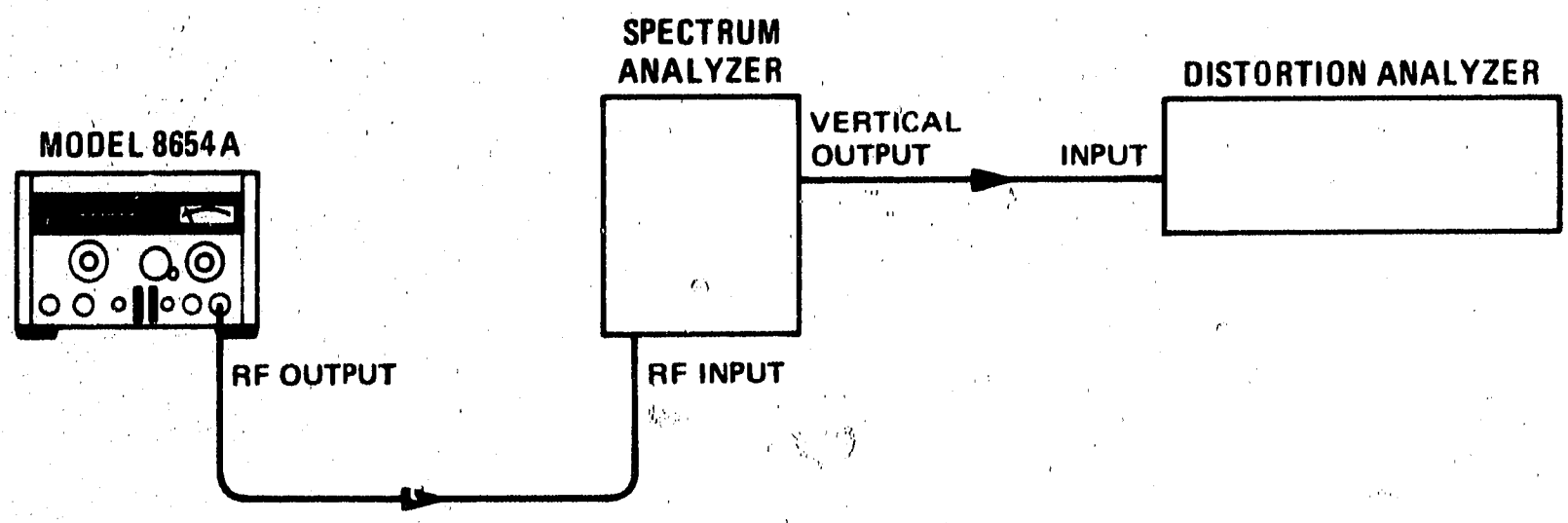


Figure 4-7. AM Distortion Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C Opt 807
Distortion Analyzer	HP 331A

PROCEDURE:

1. Connect equipment as shown in Figure 4-7 after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—30 dBm
Output Level VERNIER	Meter reads —7 dB
AM	INT
LEVEL	Fully ccw
FM	OFF
INTERNAL MODULATION	1 kHz

PERFORMANCE TESTS

4-23. AM DISTORTION TEST (Cont'd)

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to −40 dBm (0 dB attenuation), vertical scale to linear, and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0; fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to center signal on display. Set display smoothing to between 10 and 50 kHz.

3. Adjust LEVEL for front panel meter reading of 70% AM when AM MTR switch is depressed.

4. Calibrate distortion analyzer to measure distortion which should be less than 3%.

_____ 3%

5. Increase LEVEL to 90% as read on panel meter.

6. Recalibrate distortion analyzer. Distortion should be less than 5%.

_____ 5%

4-24. FM BANDWIDTH TEST

SPECIFICATION: External 3 dB bandwidth: dc coupled to >25 kHz driven from 600Ω or less.

DESCRIPTION: The Signal Generator is frequency modulated by an external signal. The FM signal is demodulated by a frequency meter whose discriminator output is measured with a voltmeter. A reference level is set at a 1 kHz rate. The rate is then increased to 25 kHz and the level rechecked. A reference generator and mixer convert the RF output of the test Signal Generator to within the range of the frequency meter. A low-pass filter at the mixer output prevents the frequency meter from mistriggering on the upper sideband generated by the mixer when the RF signal frequency is low.

NOTE

Input impedance of the Signal Generator's FM INPUT is a frequency-dependent reactive load. To ensure adequate driving level at high FM rates, a test oscillator with an output impedance of 600Ω or less is required.

PERFORMANCE TESTS

4-24. FM BANDWIDTH TEST (Cont'd)

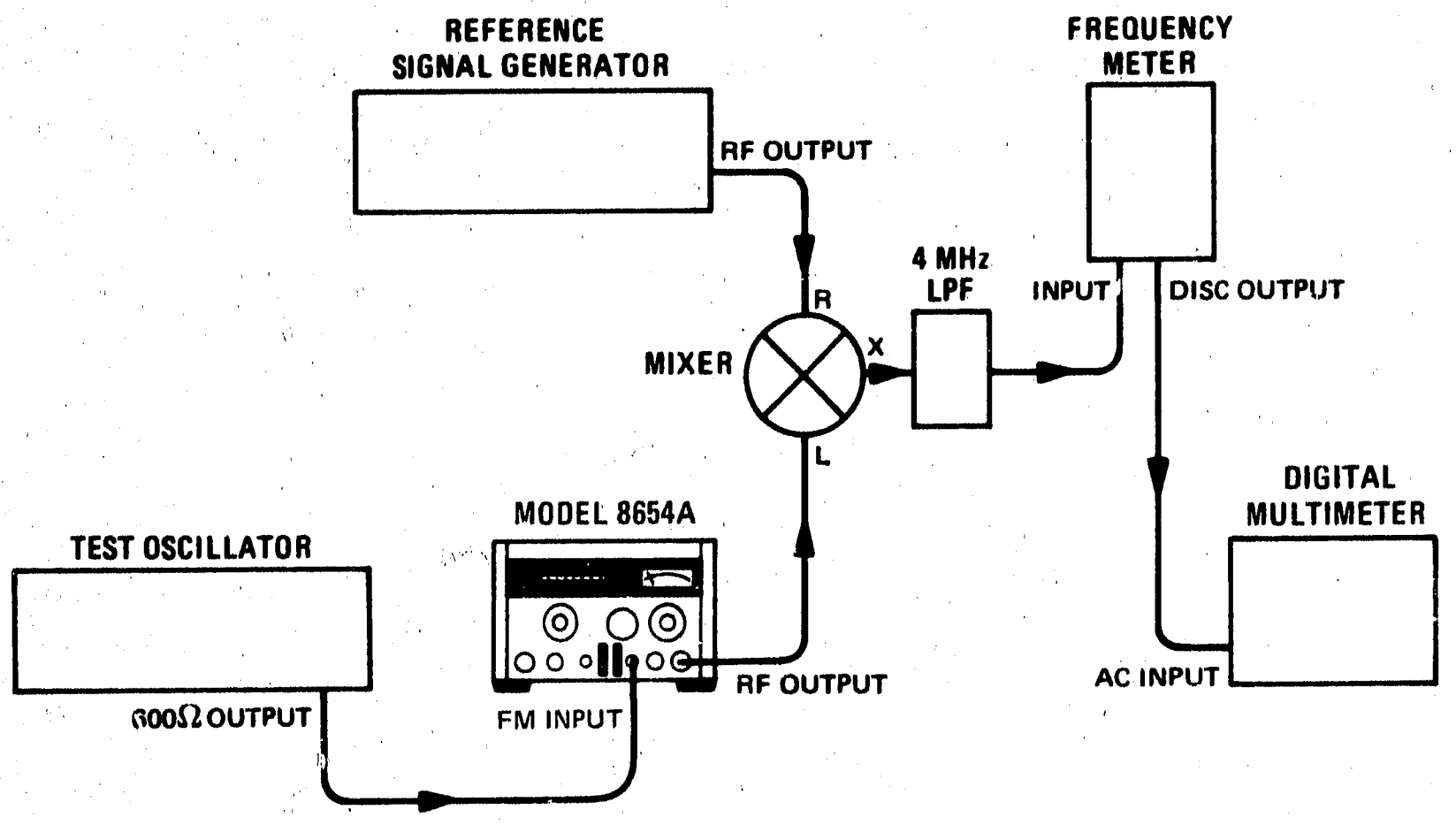


Figure 4-8. FM Bandwidth Test Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Digital Multimeter	HP 34702A/34740A
Signal Generator (reference)	HP 8640A
Test Oscillator	HP 651B
Mixer	HP 10514A
4 MHz Low-pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Install a 100 kHz Butterworth low-pass filter in frequency meter.

2. Connect equipment as shown in Figure 4-8 after setting test Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	10—18.6 MHz
FREQUENCY TUNE	10 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	EXT

3. Set reference signal generator for a —7 dBm signal at 11 MHz.

4. Set frequency meter to trigger on input signal; set frequency range to 1 MHz. Fine tune reference signal generator for an on-scale frequency meter reading of approximately 0.8 MHz.

PERFORMANCE TESTS

4-24. FM BANDWIDTH TEST (Cont'd)

NOTE

If any readings appear to be highly erroneous, check the triggering on the frequency meter. The discriminator output should also be monitored on an oscilloscope and should appear as a pure sinewave.

5. Set test oscillator for a 1 kHz rate and adjust level for voltmeter reading of 20 mVrms.

6. Set test oscillator to 25 kHz. Voltmeter should read greater than 14.1 mVrms (less than 3 dB down from reference).

   14.1 mVrms _____

7. Set test Signal Generator frequency to 80 MHz. Set reference signal generator frequency to 81 MHz; fine tune for a frequency meter reading of approximately 0.8 MHz.

8. Set test oscillator for a 1 kHz rate and adjust level for a voltmeter reading of 70.7 mVrms.

9. Set test oscillator to 25 kHz. Voltmeter should read greater than 50 mVrms (less than 3 dB down from reference).

   50 mVrms _____

4-25. FM SENSITIVITY TEST

SPECIFICATION: **External FM Sensitivity** (400 and 1000 Hz rates): 10 Vpk into 600Ω yields >0.1% deviation (±15 volts maximum).

DESCRIPTION: The test Signal Generator is frequency modulated at a 1 kHz rate. The RF signal is down converted into the range of the frequency meter by a reference signal generator and mixer. The FM signal is demodulated and the frequency meter's discriminator output is displayed on an oscilloscope. The amplitude of the modulation signal is adjusted to give 0.2% peak-to-peak deviation (i.e., 0.1% peak deviation). The amplitude of the modulation signal is then read with a voltmeter. The measurement is made at the low end of the frequency range where FM sensitivity is a minimum.

PERFORMANCE TESTS

4-25. FM SENSITIVITY TEST (Cont'd)

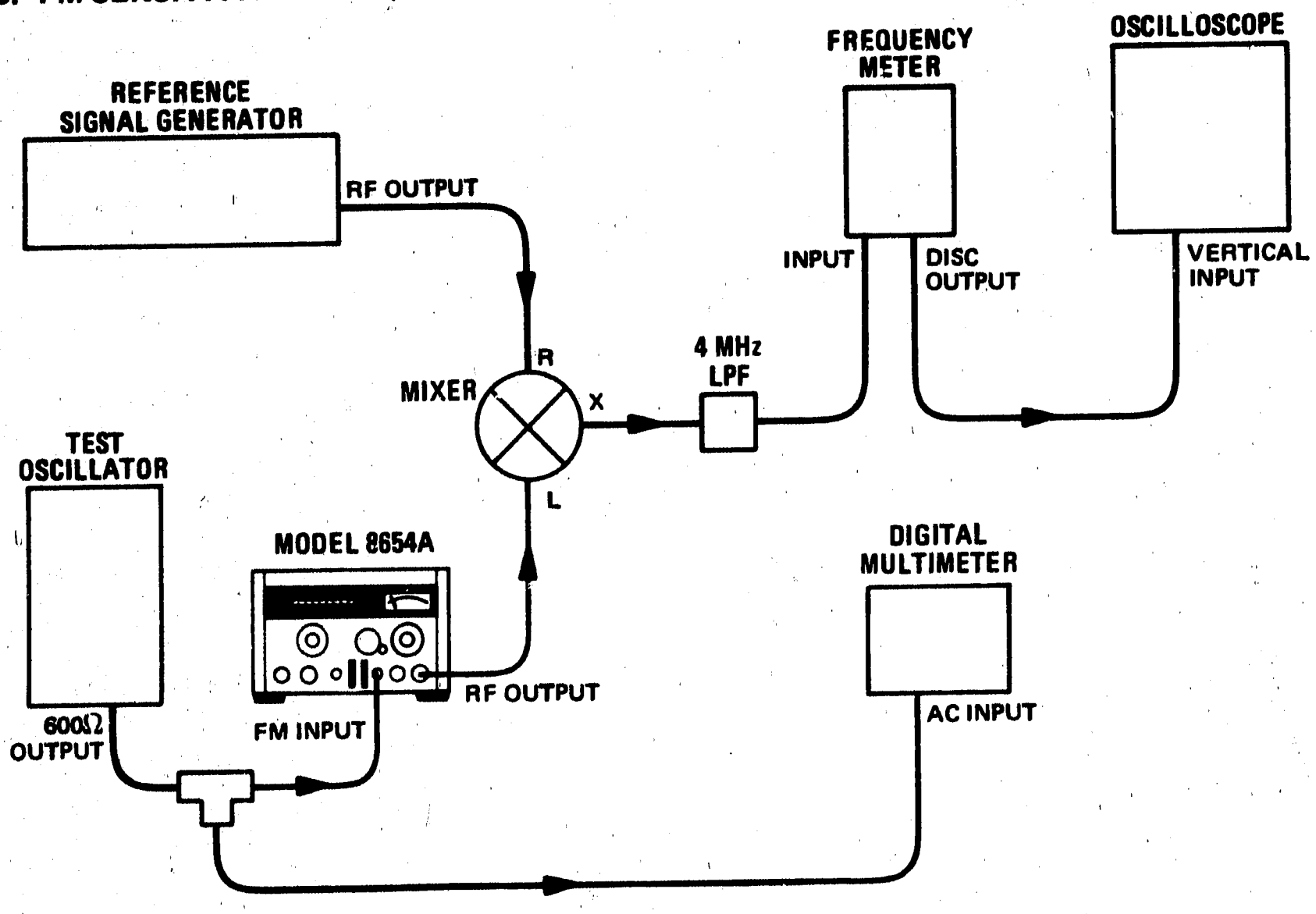


Figure 4-9. FM Sensitivity Test Setup

EQUIPMENT:

Test Oscillator	HP 200CD
Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Oscilloscope	HP 182C/1801A/1820C
Reference Signal Generator	HP 8640A
Mixer	HP 10514A
Digital Multimeter	HP 34702A/34740A
4 MHz Low-pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Set the test Signal Generator's controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	250 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads —2 dB
AM	OFF
FM	OFF

2. Calibrate the frequency meter and install a 100 kHz Butterworth low-pass filter in it; set the frequency meter's range to 10 MHz.

3. Set the reference signal generator for a +7 dBm signal at 255 MHz.

PERFORMANCE TESTS

4-25. FM SENSITIVITY TEST (Cont'd)

4. Connect the equipment together as shown in Figure 4-9. Fine adjust the reference signal generator for a mid-scale reading on the frequency meter.

5. Set the test Signal Generator's FM switch to EXT. Set the oscilloscope's vertical calibration to 10 mV per division. Set the audio oscillator frequency to 1 kHz and adjust the amplitude for an oscilloscope display of 50 mVp-p (corresponding to 500 kHz or 0.2% peak-to-peak deviation). The voltmeter should read 7.07 Vrms or less.

_____7.07 Vrms

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

Hewlett-Packard
Model 8654A
Signal Generator
Serial No.:_____

Tested By _____

Date _____

Para. No.	Test Description		Results		
			Min.	Actual	Max.
4-13.	**Frequency Accuracy Test**				
	Frequency Range	**Dial Indication**			
	250—520 MHz	500	485.0 MHz	_____	515.0 MHz
		450	437.5 MHz	_____	465.5 MHz
		400	388.0 MHz	_____	412.0 MHz
		350	339.5 MHz	_____	360.5 MHz
		300	291.0 MHz	_____	309.0 MHz
		250	242.5 MHz	_____	257.5 MHz
	130—250 MHz	130	126.1 MHz	_____	133.9 MHz
		150	145.5 MHz	_____	154.5 MHz
		170	164.9 MHz	_____	175.1 MHz
		190	184.3 MHz	_____	195.7 MHz
		210	203.7 MHz	_____	216.3 MHz
		230	223.1 MHz	_____	236.9 MHz
		250	242.5 MHz	_____	257.5 MHz
	66—130 MHz	130	126.1 MHz	_____	133.9 MHz
		120	116.4 MHz	_____	123.6 MHz
		110	106.7 MHz	_____	113.3 MHz
		100	97.0 MHz	_____	103.0 MHz
		90	87.3 MHz	_____	92.7 MHz
		80	77.6 MHz	_____	82.4 MHz
		70	67.9 MHz	_____	72.1 MHz
	35—66 MHz	35	34.0 MHz	_____	36.1 MHz
		40	38.8 MHz	_____	41.2 MHz
		45	43.7 MHz	_____	46.4 MHz
		50	48.5 MHz	_____	51.5 MHz
		55	53.4 MHz	_____	56.7 MHz
		60	58.2 MHz	_____	61.8 MHz
		65	63.1 MHz	_____	67.0 MHz
	18.6—35 MHz	35	33.95 MHz	_____	36.05 MHz
		30	29.10 MHz	_____	30.90 MHz
		25	24.25 MHz	_____	25.75 MHz
		20	19.40 MHz	_____	20.60 MHz

Table 4-1. Performance Test Record (2 of 4)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-13.	**Frequency Accuracy Test (cont'd)**			
	Frequency Range **Dial Indication**			
	10—18.6 MHz 10	9.70 MHz	_____	10.30 MHz
	12	11.64 MHz	_____	12.36 MHz
	14	13.58 MHz	_____	14.42 MHz
	16	15.52 MHz	_____	16.48 MHz
	18	17.46 MHz	_____	18.54 MHz
4-14.	**Harmonic Distortion Test**			
	Standard			
	Frequency Range			
	250—520 MHz	20 dB	_____	
	130—250 MHz	20 dB	_____	
	66—130 MHz	20 dB	_____	
	35—66 MHz	20 dB	_____	
	18.6—35 MHz	20 dB	_____	
	10—18.6 MHz	20 dB	_____	
	Option 003			
	Frequency Range			
	250—520 MHz	15 dB	_____	
	130—250 MHz	15 dB	_____	
	66—130 MHz	15 dB	_____	
	35—66 MHz	15 dB	_____	
	18.6—35 MHz	15 dB	_____	
	10—18.6 MHz	15 dB	_____	
4-15.	**Residual AM Test**	35 dB	_____	
4-16.	**Residual FM Test**			
	50 Hz—15 kHz Noise BW		_____	12.5 mVrms
4-17.	**Output Level Accuracy Test**			
	Output Level Switch **Meter**			
	+10 dBm 0 dB (except Opt. 003)	+8.5 dBm	_____	+11.5 dBm
	+10 dBm —2 dB (Option 003 only)	+6.5 dBm	_____	+9.5 dBm
	+10 dBm —3 dB	+5.5 dBm	_____	+8.5 dBm
	+10 dBm —7 dB	+1.5 dBm	_____	+4.5 dBm
	+10 dBm —10 dB	—2.0 dBm	_____	+2.0 dBm

Table 4-1. Performance Test Record (3 of 4)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-17.	**Output Level Accuracy Test (cont'd)**			
	Output Level Switch / **Meter**			
	0 dBm / −10 dB	−12.0 dBm	_____	−8.0 dBm
	0 dBm / −7 dB	−8.5 dBm	_____	−5.5 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	−2.0 dB	_____	+2.0 dB
	−20 dBm	−2.0 dB	_____	+2.0 dB
	−30 dBm	−2.0 dB	_____	+2.0 dB
	−40 dBm	−2.0 dB	_____	+2.0 dB
	−50 dBm	−2.0 dB	_____	+2.0 dB
	−60 dBm	−2.5 dB	_____	+2.5 dB
	−70 dBm	−2.5 dB	_____	+2.5 dB
	−80 dBm	−2.5 dB	_____	+2.5 dB
	−90 dBm	−2.5 dB	_____	+2.5 dB
	−100 dBm	−3.0 dB	_____	+3.0 dB
	−110 dBm	−3.0 dB	_____	+3.0 dB
	−120 dBm	−3.0 dB	_____	+3.0 dB
4-18.	**Output Level Flatness Test**			
	Output Level / **Frequency Range**			
	+9 dBm (except Opt. 003) 250—520 MHz	+8 dBm	_____ _____	+10 dBm
	130—250 MHz	+8 dBm	_____ _____	+10 dBm
	66—130 MHz	+8 dBm	_____ _____	+10 dBm
	35—66 MHz	+8 dBm	_____ _____	+10 dBm
	18.6—35 MHz	+8 dBm	_____ _____	+10 dBm
	10—18.5 MHz	+8 dBm	_____ _____	+10 dBm
	+7 dBm (Opt. 003 only) 250—520 MHz	+6 dBm	_____ _____	+8 dBm
	130—250 MHz	+6 dBm	_____ _____	+8 dBm
	66—130 MHz	+6 dBm	_____ _____	+8 dBm
	35—66 MHz	+6 dBm	_____ _____	+8 dBm
	18.6—35 MHz	+6 dBm	_____ _____	+8 dBm
	10—18.6 MHz	+6 dBm	_____ _____	+8 dBm
	−7 dBm 250—520 MHz	−8 dBm	_____ _____	−6 dBm
	130—250 MHz	−8 dBm	_____ _____	−6 dBm
	66—130 MHz	−8 dBm	_____ _____	−6 dBm
	35—66 MHz	−8 dBm	_____ _____	−6 dBm
	18.6—35 MHz	−8 dBm	_____ _____	−6 dBm
	10—18.6 MHz	−8 dBm	_____ _____	−6 dBm

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

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-19.	**Output Leakage Test**			
	10–200 MHz		_____	–40 dB
	200–400 MHz		_____	–40 dB
	400–600 MHz		_____	–40 dB
	600–800 MHz		_____	–40 dB
	800–1000 MHz		_____	–40 dB
	1000–1200 MHz		_____	–40 dB
4-20.	**Internal Modulation Rate Accuracy Test**			
	AM 400 Hz	360 Hz	_____	440 Hz
	AM 1 kHz	900 Hz	_____	1100 Hz
	FM 1 kHz	900 Hz	_____	1100 Hz
	FM 400 Hz	360 Hz	_____	440 Hz
4-21.	**AM Bandwidth Test**	2.8 div.	_____	
4-22.	**AM Sensitivity and Indicated Accuracy Test**			
	Sensitivity	3.6 div.	_____	4.4 div.
	Meter Accuracy	42.5%	_____	57.5%
4-23.	**AM Distortion Test**			
	0–70% AM		_____	3%
	90% AM		_____	5%
4-24.	**FM Bandwidth Test**			
		14.1 mVrms	_____	
		50 mVrms	_____	
4-25.	**FM Sensitivity Test**		_____	7.07 Vrms

ADJUSTMENTS

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments which will return the HP Model 8654A to peak operating condition. The adjustments are to be performed whenever the performance test results are out of tolerance. This may occur over a period of time because of aging of components within the instrument or because of repair or replacement of certain components, parts, or assemblies. Table 5-2 contains information pertaining to assemblies or parts repaired or replaced, the performance tests which verify the Signal Generator is performing to its maximum capability, and the adjustments to be made if its performance is out of specification. Information is also provided in this section about the equipment required to perform the tests, instructions for locating the adjustable components, and factory-selected components.

5-3. All adjustment procedures include references to service sheets where the adjustable components are shown, a description of the test including any problem areas or special instructions, a test equipment setup diagram where necessary, the test equipment recommended for the adjustment, and a step-by-step procedure for performing the adjustments. Removal and replacement procedures are given on the alphabetic service sheets (after the schematics in Section VIII). If an adjustable component is mounted on a printed circuit board, it will be shown on the component location diagram which accompanies each schematic. Adjustment location photographs are also given on the last foldout in Section VIII.

5-4. SAFETY CONSIDERATIONS

5-5. Although this instrument has been designed in accordance with international safety standards, this manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition (see Safety Considerations page in the front of the manual). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

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.

Removal of the protective cover on the A4 Line Module exposes hazardous voltage (line voltage) at the module's terminals.

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

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

5-6. EQUIPMENT REQUIRED

5-7. The test equipment required for the adjustment procedures is listed in Table 1-2, Recommended Test Equipment. The critical specifications of substitute test instruments must meet or exceed the standards listed in the table if the performance of the generator is to meet the standards set forth in Table 1-1, Specifications.

5-8. Pozidriv Screwdrivers

5-9. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used.

5-10. Blade Tuning Tools

5-11. For adjustments requiring a non-metallic metal-blade tuning tool, use the J.F.D. Model No. 5284 (HP 8710-1010). In situations not requiring non-metallic tuning tools, an ordinary small screwdriver or other suitable tool is sufficient. No matter what tool is used, never try to force any adjustment control in the generator. This is especially critical when tuning variable slug-tuned inductors, and variable capacitors.

5-12. Extender Board. An extender board (HP 08640-60036) is available which can be used to extend the A3 Control/Power Supply Board Assembly for service.

5-13. FACTORY-SELECTED COMPONENTS

5-14. Factory-selected components are identified on the schematics and parts list by an asterisk (*) which follows the reference designator. The nominal value of the components is normally shown. The manual change sheets will provide updated information pertaining to the selected components. Table 5-1 lists the reference designator, the criteria used for selecting a particular value, the normal value range, and the service sheet where the component part is shown.

5-15. POST REPAIR TESTS AND ADJUSTMENTS

5-16. The adjustments in this section should be performed when troubleshooting or performance tests indicate that an adjustable circuit is not operating correctly. Perform the adjustments *after* repairing or replacing the circuit. After making the adjustments, repeat the performance tests (found in Section IV) specified in Table 5-2. In general, if the RF Section casting was opened (or any RF connectors removed) during a repair, the Output Leakage Test should be performed. Performance tests should also be made for any assembly that had a component changed, even if the changed component was not defective. The power supplies should be checked whenever an assembly has been repaired.

NOTE

Table 5-2 can also be used for troubleshooting. If the generator failed one or more performance tests, cross-referencing to the associated assembly or circuitry will often indicate the source of the failure.

Table 5-1. Factory Selected Components

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
R6	Selected for a meter reading of <—10 dB with the output level VERNIER set fully ccw. The Meter Adjustments (paragraph 5-20) should be performed before resistor selection.	909—1000Ω	4
A1A1C4	(See A1A3C6 selection.) If removing A1A3C6 does not solve the RF output flatness/harmonic problem, remove A1A1C4. Perform Harmonic Distortion Test (pagagraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0 or 6.8 pF	3
A1A1R1	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 for Option 003).	133—147Ω	3
A1A1R15	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 for Option 003).	61.9—133Ω	3
A1A1R28	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 for Option 003).	147—215Ω	3
A1A1R31	Selected for output level flatness within specification on the 250—520 MHz range. If frequency response peaks out of specification on the high end of range, decrease value of the resistor.	90.9—121Ω	3
A1A3C6	Selected for output level flatness and carrier harmonics within specifications (on the 250—520 MHz range). Normally, when the capacitor is removed, flatness is improved but harmonic content is increased. (See also A1A1C4 selection.) Perform Harmonic Distortion Test (paragraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0 or 4.3 pF	2
A1A3C12	Selected to provide A1A3C2 adequate adjustment range to lower maximum output frequency on 250—520 MHz range.	0—1.0 pF	2
A3R53	Selected to provide correct meter reading in the +10 dBm OUTPUT LEVEL range. Perform Meter Adjustments (paragraph 5-20).	1330—1470Ω	4
A3C23	Selected for flattest response to external AM input frequencies on the top 10 dB of the output level VERNIER and for all settings of the MODULATION LEVEL control. Perform AM Bandwidth Test (paragraph 4-21).	10—200 pF	4

Table 5-2. Post Repair Tests and Adjustments

Assembly, Circuit, or Part Repaired	Performance Test (After Repair Completed)	Adjustment Procedure (If Necessary)
All electrical repairs	———	Power Supply Adjustment (para.5-17)
A1 RF Section Assembly	Output Leakage Test (para. 4-19)	———
A1A1 RF Amplifier/ALC Board Assembly	Harmonic Distortion Test (para. 4-14) Output Level Accuracy Test (para. 4-17) Output Level Flatness Test (para. 4-18) AM Sensitivity and Indicated Accuracy Test (para. 4-22) AM Distortion Test (para. 4-23)	Factory Selected Components (Table 5-1) Detector Bias and AM Distortion Adjustment (para. 5-18) AM Sensitivity Adjustment (para. 5-19) Meter Adjustments (para. 5-20)
A1A2 FM Modulator Board Assembly	Frequency Accuracy Test (para. 4-13) FM Sensitivity Test (para. 4-25)	Tuning Capacitor and Pulley Adjustment (para. 5-21) Frequency Adjustments (para. 5-22 or 5-23)
A1A3 RF Oscillator Board Assembly	Harmonic Distortion Test (para. 4-14) Frequency Accuracy Test (para. 4-13) FM Sensitivity Test (para. 4-25)	Factory Selected Components (Table 5-1) Frequency Adjustments (para. 5-22 or 5-23)
A1A4 Turret Assembly	Frequency Accuracy Test (para. 4-13) FM Sensitivity Test (para. 4-25)	Frequency Adjustements (para. 5-22 or 5-23)
A1C3 Tuning Capacitor	Frequency Accuracy Test (para. 4-13) FM Sensitivity Test (para. 4-25)	Tuning Capacitor and Pulley Adjustment (para. 5-21) Frequency Adjustments (para. 5-22 or 5-23)
Dial Stringing	Frequency Accuracy Test (para. 4-13)	Tuning Capacitor and Pulley Adjustment (para. 5-21) Frequency Adjustments (para. 5-22 or 5-23)
A3 Assembly (Shaping Amplifier only)	Output Level Accuracy Test (para. 4-17) AM Sensitivity and Indicated Accuracy Test (para. 4-22) AM Distortion Test (para. 4-23)	Detector Bias and AM Distortion Adjustment (para. 5-18) Meter Adjustments (para. 5-20)
A3 Assembly (Audio Detector and Meter Driver only)	AM Sensitivity and Indicated Accuracy Test (para. 4-22)	Meter Adjustments (para. 5-20)
A6A1 Reverse Power Protection Board Assembly (Option 003 only)	———	Output Impedance Adjustment (Option 003 only, para. 5-24) Reverse Power Level Sense Adjustment (Option 003 only, para. 5-25)
M1 Meter	AM Sensitivity and Indicated Accuracy (Para. 4-22)	Meter Adjustments (para. 5-20)

ADJUSTMENTS

5-17. POWER SUPPLY ADJUSTMENT

REFERENCE: Service Sheet 5.

DESCRIPTION: A dc voltmeter is used to monitor the +20V supply voltage as it is adjusted.

EQUIPMENT: Digital Multimeter . . . . . HP 34702A/34740A

PROCEDURE:

1. Set Signal Generator LINE switch to ON. Connect voltmeter to A3TP7. Adjust +20V Adjust control A3R5 for voltmeter reading of +20.0 ±0.2 Vdc.

2. Connect DVM to A3TP6. The voltage should read −10.0 ±0.5 Vdc.

5-18. DETECTOR BIAS AND AM DISTORTION ADJUSTMENT

REFERENCE: Service Sheets 3 and 4.

DESCRIPTION: The RF Detector Bias is adjusted so the RF output voltage tracks the ALC dc reference voltage which is set by the VERNIER control. The Distortion Null is adjusted so the RF envelope accurately represents the audio AM drive signal at low ALC reference levels. Since the two adjustments interact, the adjustments may need to be repeated. A spectrum analyzer is used to measure the RF output level and detect the AM signal. The ALC reference is monitored with a dc voltmeter.

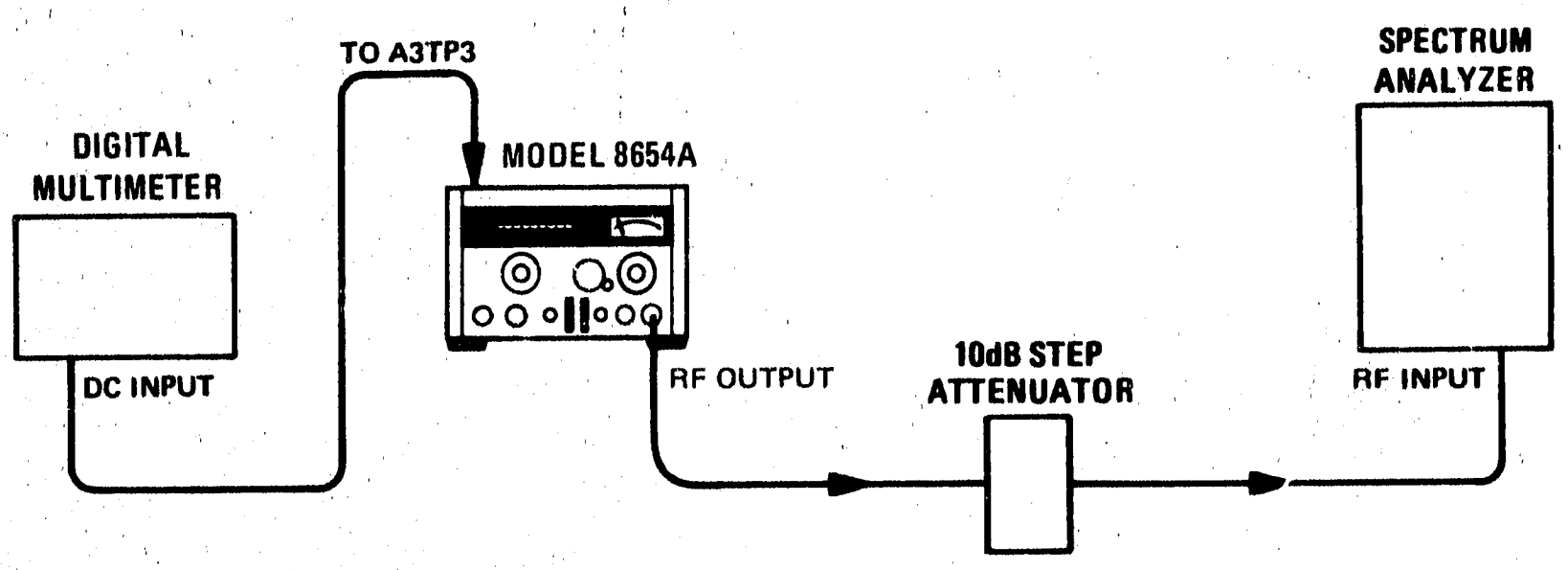


Figure 5-1. Detector Bias and AM Distortion Adjustment Setup

EQUIPMENT:
Spectrum Analyzer . . . . . HP 8558B/182C
Digital Multimeter . . . . . HP 34702A/34740A
10 dB Step Attenuator . . . . HP 355D

PROCEDURE:

1. If A1 RF Section Assembly cover has not been removed, remove detector bias access plug on bottom side of assembly.

2. Center Detector Bias potentiometer A1A1R39 (Service Sheet 3) and Distortion Adjust potentiometer A3R52 (Service Sheet 4).

ADJUSTMENTS

5-18. DETECTOR BIAS AND AM DISTORTION ADJUSTMENT (Cont'd)

3. Connect equipment as shown in Figure 5-1 after settting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	35—66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	+10 dBm
AM	INT
LEVEL	Fully ccw
FM	OFF
INTERNAL MODULATION	400 Hz

4. Set step attenuator to 20 dB.

5. Set Signal Generator output level VERNIER for voltmeter reading of —2.00 Vdc at A3TP3.

6. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to 0 dBm (40 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust frequency controls to center 50 MHz signal on display. Set frequency span to 0 and fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal to fifth graticule line from bottom of display.

NOTE

Check spectrum analyzer base line position by removing RF input. Base line should be exactly on bottom graticule line.

7. Set Signal Generator OUTPUT LEVEL switch to 0 dBm, and adjust VERNIER for voltmeter reading of —0.20 Vdc.

8. Set step attenuator to 0 dB. Use non-metallic tool to adjust Detector Bias control A1A1R39 to bring signal to same reference level (fifth line from bottom).

9. Repeat steps 4 to 8 until RF signal level viewed on the spectrum analyzer is same for both —2.00 Vdc and —0.20 Vdc ALC reference levels.

10. Set —0.20 Vdc at A3TP3 and adjust LEVEL control so that upper peak of sine wave is at eighth graticule line from bottom of display (set analyzer to trigger internally).

11. Adjust Distortion Adjust control A3R52 so that lower peak of sine wave is at second graticule line.

12. Set LEVEL fully ccw. If level has shifted more than 0.2 division from fifth graticule line, set OUTPUT LEVEL to +10 dBm and repeat steps 4 to 12.

13. Perform AM Sensitivity Adjustment (paragraph 5-19), AM Distortion Test (paragraph 4-23) and AM Sensitivity and Indicated Accuracy Test (paragraph 4-22).

ADJUSTMENTS

5-19. AM SENSITIVITY ADJUSTMENT

REFERENCE: Service Sheet 4

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator with a level set to give 60% AM. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM depth is measured directly on the display and is compared with the panel meter reading.

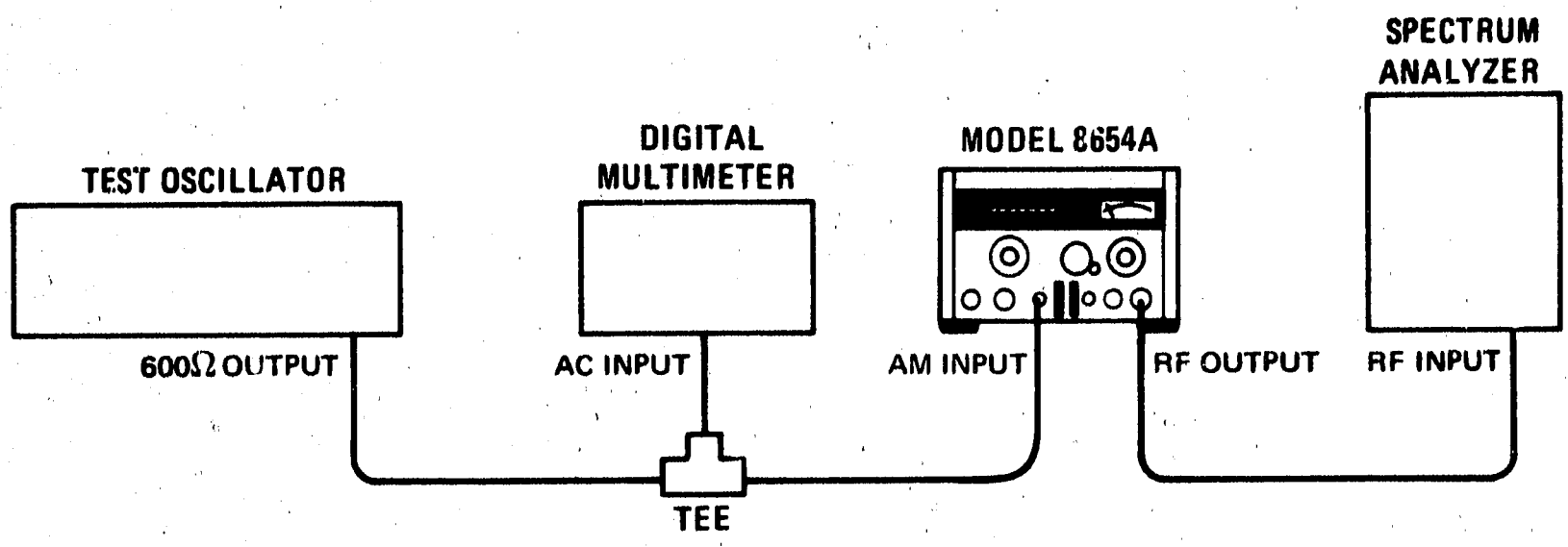


Figure 5-2. AM Sensitivity Adjustment Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Test Oscillator	HP 651B
Digital Multimeter	HP 34702A/34740A

PROCEDURE:

1. Connect equipment as shown in Figure 5-2, after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	35—66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	meter reads +3 dB
AM	EXT
LEVEL	Fully cw
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust center frequency controls to center 50 MHz signal on display. Adjust vertical reference level controls to bring signal level to fifth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and adjust level for 0.424 Vrms (0.6 Vpk) as read on ac voltmeter.

4. Adjust AM Gain potentiometer A3R34 for peak-to-peak deflection of 6 divisions on display (corresponding to 60% AM).

NOTE

Check spectrum analyzer base line position by removing RF input. Base line should be exactly on bottom graticule line.

ADJUSTMENTS

5-20. METER ADJUSTMENTS

REFERENCE: Service Sheet 4.

DESCRIPTION: The meter is set mechanically to zero. Then the meter amplifier gain and zero controls are adjusted so the meter tracks the actual RF output as monitored with a power meter. Finally, the audio detector gain is adjusted.

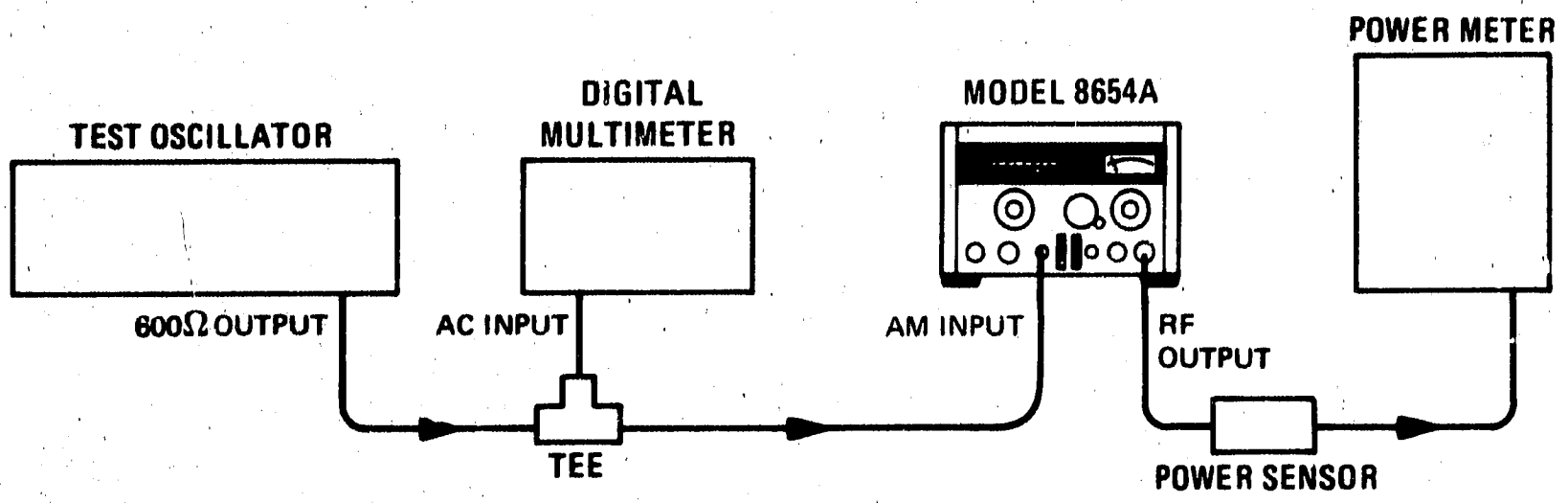


Figure 5-3. Meter Adjustments Setup

EQUIPMENT:

Power Meter and Sensor	HP 435A/8481A
Digital Multimeter	HP 34702A/34740A
Test Oscillator	HP 651B

PROCEDURE:

1. Set Signal Generator LINE switch to OFF. Allow time for meter to fall to rest. Adjust mechanical zero adjustment screw on panel meter cw for a zero meter reading. Then turn screw slightly ccw to free mechanism from adjusting peg.

2. Set LINE switch to ON. Connect equipment as shown in Figure 5-3 after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz) . .	35—66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

3. Allow at least a 5-minute warmup. Set power meter range to measure +10 dBm.

4. Adjust output level VERNIER for power meter reading of +10 dBm (+8 dBm for Option 003). Adjust Meter Gain control A3R57 for 0 dB (—2 dB for Option 003) as read on Signal Generator panel meter.

5. Set OUTPUT LEVEL switch to 0 dBm and adjust VERNIER for power meter reading of —7 dBm. Adjust Meter Zero control A3R54 for —7 dB as read on panel meter.

ADJUSTMENTS

5-20. METER ADJUSTMENTS (Cont'd)

6. Adjust output level VERNIER for power meter reading 0 dBm. If panel meter does not read within ±0.2 dB of 0 dBm, slightly readjust Meter Gain A3R57 for proper reading.

7. Repeat steps 4 to 6, adjusting Meter Gain A3R57 and Meter Zero A3R54 as needed until panel meter reads within ±0.2 dB of power meter reading for levels of +10 (+8 for Option 003), 0, and −7 dBm.

NOTE

If it is not possible to attain meter readings within ±0.2 dB of power meter reading for levels of +10 (+8 for Option 003) and 0 dBm, select a different value of resistance for A3R53 (1330—1470Ω). Decreasing resistance increases the meter indication at 0 dBm but does not directly affect the +10 dBm range.

8. Set OUTPUT LEVEL to approximately 0 dBm, AM to EXT (with LEVEL fully cw).

9. Set test oscillator for 1 kHz and adjust level for 0.707 Vrms as read on ac voltmeter.

10. Adjust Detector Gain control A3R45 for panel meter reading of 10 when AM MTR switch is depressed.

NOTE

Check that Meter jumper (connected to A3C27) is in N (normal) position.

5-21. TUNING CAPACITOR PULLEY ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: The position of the capacitor pulley on the capacitor shaft is set for the full tuning range of the capacitor as the frequency is tuned from stop to stop. The pulley is correctly adjusted when the frequency can be tuned through minimum at the low frequency end of the dial and through maximum at the high end (refer to Figure 5-4).

EQUIPMENT: Frequency Counter . . . . . HP 5383A

PROCEDURE:

1. Remove the RF Section Assembly cover as described in Section VIII.

ADJUSTMENTS

5-21. TUNING CAPACITOR PULLEY ADJUSTMENT (Cont'd)

2. Connect the counter's high frequency low impedance input to RF Amplifier output connector A1A1J3. Set Signal Generator controls as follows:

FREQUENCY RANGE (MHz) . . .	10—18.6 MHz
FREQUENCY TUNE	Fully ccw to stop
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

3. Check that the FREQUENCY TUNE control is against the counterclockwise (low frequency) stop.

4. Loosen the two setscrews on the capacitor pulley.

5. Insert a non-metalic tuning tool into the slotted end of the tuning capacitor shaft (C3) and adjust the low frequency foldback as read on the counter, from 5 to 10 kHz beyond the frequency minimum. The frequency will be approximately 9.5 MHz and the capacitor blades will be almost fully meshed (refer to Figure 5-4).

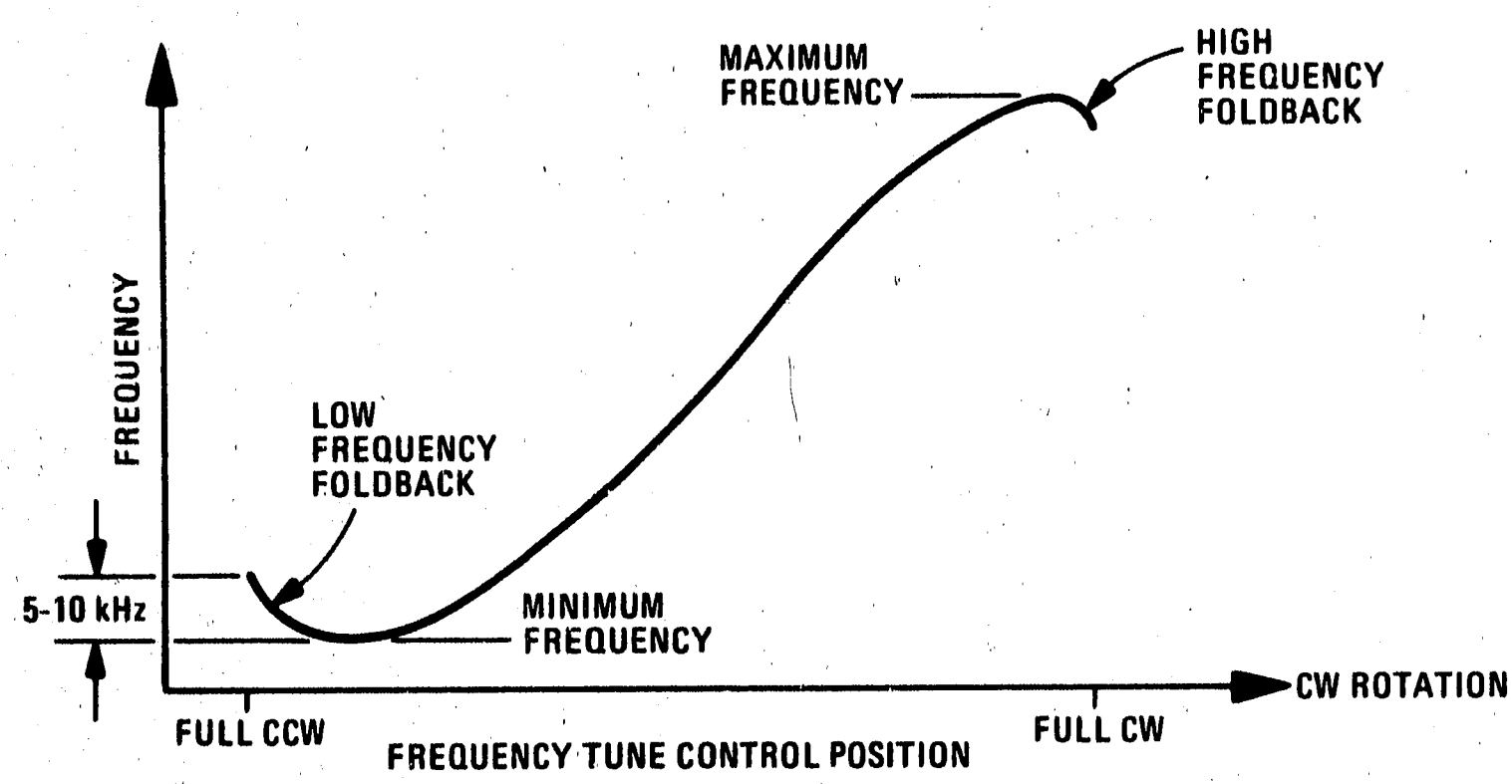


Figure 5-4. Proper Capacitor Tuning Characteristics

6. Tighten the pulley setscrews.

CAUTION

Verify that the pulley does not rub against the oscillator cables or chassis parts, and that the dial cord does not rub against the casting as it passes through the holes.

ADJUSTMENTS

5-21. TUNING CAPACITOR PULLEY ADJUSTMENT (Cont'd)

7. Tune the frequency up a few turns and then back to the counterclockwise stop. Check that the frequency tunes from 5 to 10 kHz beyond the minimum.

NOTE

Some frequency foldback is also normal at the high end of the frequency range.

8. Perform the Frequency and Range Adjustment (paragraph 5-22 or 5-23).

5-22. MINOR FREQUENCY AND RANGE ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: Minor frequency adjustments can be made to the range inductors through a hole in the RF Assembly without disassembling it. If major frequency adjustments are to be made, perform the Major Frequency and Range Adjustment (paragraph 5-23) instead.

EQUIPMENT: Frequency Counter . . . . . HP 5300A/5303B

PROCEDURE:

1. Remove instrument left side cover. Remove 3/4-inch threaded plug in left side of RF Assembly.

2. Set Signal Generator controls as follows:

FREQUENCY RANGE (MHz) . . .	10—19 MHz
FREQUENCY TUNE	14 MHz
AM	OFF
FM	OFF

3. Connect counter's high frequency input to rear panel AUX RF OUT.

4. Set FREQUENCY RANGE (MHz) and FREQUENCY TUNE as indicated in the following table. The counter should read within the limits indicated and in addition the readings at other cardinal (or numbered) frequencies on each nominal range should read within ±2% of that indicated on the dial.

Frequency Range (MHz)	Dial Indication (MHz)	Counter Reading Limits (MHz)	Adjustment Inductor
10—18.6	14	13.72 _____ 14.28	A1A4L1
18.6—35	25	24.50 _____ 25.50	A1A4L2
35—66	50	49.0 _____ 51.0	A1A4L3
66—130	100	98.0 _____ 102.0	A1A4L4
130—250	210	205.8 _____ 214.2	A1A4L5
250—520	350	343.0 _____ 357.0	A1A4L6

ADJUSTMENTS

5-22. MINOR FREQUENCY AND RANGE ADJUSTMENT (Cont'd)

5. If any frequencies are out of limits, adjust appropriate inductor, listed in table above, by rotating FREQUENCY RANGE (MHz) 3 positions and adjusting inductor through hole in RF Assembly. Rotate FREQUENCY RANGE (MHz) 3 positions and recheck frequency accuracy. Repeat until all frequencies are within ±2% of that indicated by the dial.

CAUTION

To prevent damage to the +14 Vdc power supply, set LINE to OFF before making these adjustments.

NOTES

To adjust A1A4L5, use a small pair of needle nose pliers to pinch both loops in by equal amounts. This will raise the frequency.

To adjust A1A4L6, use a small 50W soldering iron to add equal amounts of solder to two slots in inductor strip. This will raise the frequency.

6. If it is not possible to bring the frequency within specified limits, perform **Major Frequency and Range Adjustment (paragraph 5-23).**

7. Install threaded plug and instrument side cover.

8. Perform FM Sensitivity Test (paragraph 4-25).

5-23. MAJOR FREQUENCY AND RANGE ADJUSTMENT

REFERENCE: Service Sheets 2 and 3.

DESCRIPTION: The cover of the RF Section Assembly is removed and both the range inductors and the tuning range capacitor are adjusted.

EQUIPMENT:

Frequency Counter	HP 5383A
Power Meter	HP 435A/8481A

PROCEDURE:

1. Remove the RF Section Assembly and RF Section Assembly cover as described in Section VIII.

2. Connect the counter's high frequency, low impedance input to RF Amplifier output connector A1A1J3 (Service Sheet 3). Set Signal Generator's controls as follows:

FREQUENCY RANGE (MHz)	250—520 MHz
FREQUENCY TUNE	270 MHz
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

ADJUSTMENTS

5-23. MAJOR FREQUENCY AND RANGE ADJUSTMENT (Cont'd)

3. Adjust the 250—520 MHz turret inductor A1A4L6 (Service Sheet 2) for a counter reading of 270 ±2.7 MHz.

CAUTION

To prevent damage to the +14 Vdc power supply, set LINE to OFF before making these adjustments.

NOTE

To increase frequency, add equal amounts of solder to two slots in the inductor strip. To lower frequency bend the inductor tab. (See Figure 5-5.)

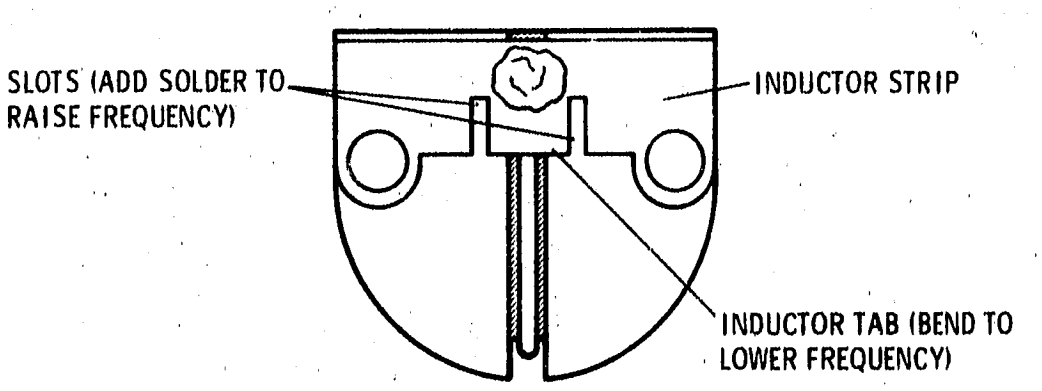


Figure 5-5. A1A4L6 Turret Inductor Adjustment (250–520 MHz Range)

4. Set FREQUENCY TUNE to 520 MHz and adjust Tuning Range capacitor A1A3C2 for a reading of 520 ±5.2 MHz.

NOTE

If 520 MHz is not attainable, see the selection procedure for capacitor A1A3C12 in Table 5-1.

5. Check at least four FREQUENCY TUNE settings on the range to ensure ±2% accuracy for each setting.

6. Set FREQUENCY TUNE to any convenient location on each of the other five ranges. Adjust the turret inductors for counter readings within 2% of dial indication.

CAUTION

To prevent damage to the +14 Vdc power supply, set LINE to OFF before making these adjustments.

NOTE

On the 130—250 MHz range, the inductor is adjusted by spreading or pinching the inductor loops. On the 10—130 MHz ranges adjustment is accomplished with a tuning slug in the inductor.

ADJUSTMENTS

5-23. MAJOR FREQUENCY AND RANGE ADJUSTMENT (Cont'd)

7. Check at least four FREQUENCY TUNE settings on each range to ensure ±2% accuracy for each setting. Readjust the turret inductors as necessary to attain this overall accuracy.

8. Connect the power meter's sensor to RF Oscillator output connector A1A3J1 (Service Sheet 2). Output power should be greater than +3 dBm at all FREQUENCY RANGE (MHz) and FREQUENCY TUNE settings.

9. Replace RF Section Assembly cover and install the RF Section Assembly in the instrument.

5-24. OUTPUT IMPEDANCE ADJUSTMENT (Option 003 only)

REFERENCE: Service Sheet 3A.

DESCRIPTION: A tracking generator is used as an external 50Ω signal source to feed an SWR bridge. The output connector of the bridge is connected to a spectrum analyzer. The through connector of the bridge is connected to a short circuit to establish a reference, then to the output of A6 Reverse Power Protection Assembly. Return loss versus frequency is displayed on the spectrum analyzer.

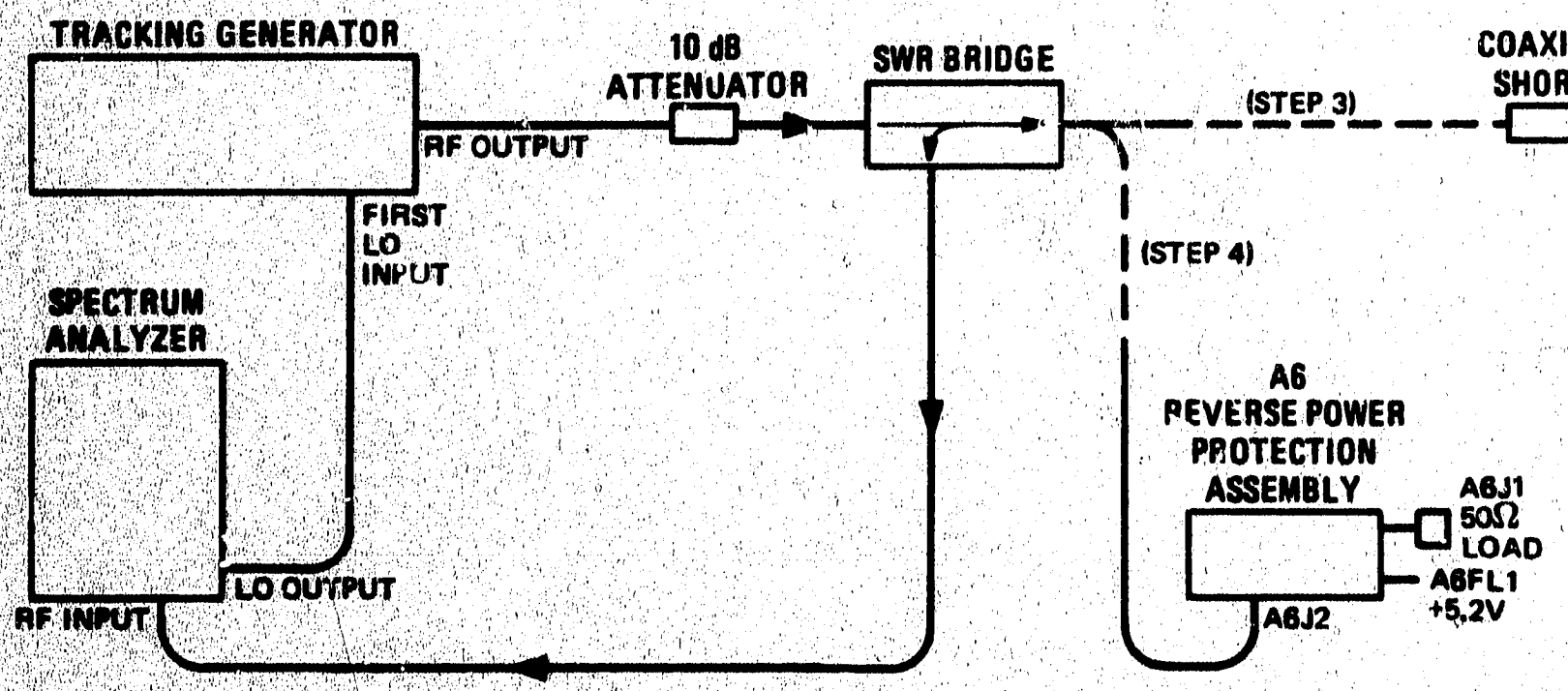


Figure 5-6. Output Impedance Adjustment Setup (Option 003)

ADJUSTMENTS

5-24. OUTPUT IMPEDANCE ADJUSTMENT (Option 003 only) (Cont'd)

EQUIPMENT:

Tracking Generator	HP 8444A Opt 058
Spectrum Analyzer	HP 8558B/182C
SWR Bridge	Wiltron 60N50
Coaxial Short	HP 11512A
10 dB Attenuator	HP 8491A Opt 10
50Ω Load	HP 908A

PROCEDURE:

1. Remove bottom RF Section Assembly support bar by removing 4 flathead screws securing it from the sides (instrument side covers must be removed). The bar is identified on Service Sheet B.

2. Remove cables and screws securing A6 Reverse Power Protection Assembly. Orient assembly so that circuit components are accessible and the +5.2V supply and ground (if needed) are connected.

3. Connect equipment as shown in Figure 5-6.

4. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to −20 dBm (20 dB attenuation), and frequency controls for a frequency span of 0 to 500 MHz. Set tracking generator output for 0 dBm.

5. To establish a reference level, set LINE to OFF and connect coaxial short to bridge output jack. Use the spectrum analyzer's vertical reference level controls to set swept signal display to top graticule line of display with 10 dB per division log vertical scale.

6. Remove coaxial short and connect bridge output jack A6J2.

7. Set Signal Generator LINE to ON.

8. The level now shown on the spectrum analyzer should be greater than 18 dB down from the reference level set in step 5. If not, adjust FLATNESS ADJ, A6A1C9, or A6A1L1 and L2 for minimum level (i.e., maximum return loss). A6A1L1 and L2 can be adjusted by bending them, or raising and lowering them after they are desoldered.

NOTE

If adjustment seems necessary, check the return loss of the 50Ω load alone by connecting it to the bridge output. Return loss should be greater than 30 dB.

ADJUSTMENTS

5-25. REVERSE POWER LEVEL SENSE ADJUSTMENT (Option 003 only)

REFERENCE: Service Sheet 3A.

DESCRIPTION: The output jack, A6J2 of Reverse Power Protection Assembly (A6) is driven by a 1 MHz source. Input jack A6J1 is monitored by a high impedance ac voltmeter. The LEVEL SENSE ADJ is set to trip the Level Sensor at a signal level of 1.8 Vrms.

NOTE

This procedure is also useful for verifying the operation of the reverse power protection without endangering the generator output circuitry.

EQUIPMENT:

Test Oscillator	HP 651B
Digital Voltmeter	HP 34702A/34740A

PROCEDURE:

1. Remove bottom RF Section Assembly support bar by removing 4 flathead screws securing it from the sides (instrument side covers must be removed). The bar (MP57) is identified on Service Sheet B.

2. Remove cables and screws securing A6 Reverse Power Protection Assembly. Orient assembly so that circuit components are accessible and the +5.2V supply and ground (if needed) are connected.

3. Connect voltmeter to input jack A6J1.

4. Connect 50Ω output of test oscillator to output jack A6J1. Set test oscillator frequency to 1 MHz at approximately 3 Vrms into an open circuit.

5. Set Signal Generator LINE to ON.

6. Slowly increase test oscillator level until the reading on the voltmeter switches to zero. Note the signal level at which this occurs. The signal level should be between 1.7 and 1.9 Vrms. If the signal level is incorrect, adjust A6A1R2, LEVEL SENSE ADJ, until switching occurs within the correct limits.

NOTE

Always approach switching point from a lower level. The Level Sensor has a small amount of hysteresis causing the switching point to be lower for a decreasing signal level than for an increasing level.

CAUTION

Avoid setting the switching point below the stated limits. The Signal Generator's own output can trip the Level Sensor (particularly during low frequency, open-circuit operation). This condition can cause relay contuct chatter and reduce contact life.

PARTS LIST

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. Certain assemblies within the instrument 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. Listings for exchange assemblies (if available) may be found directly following the corresponding new assembly listing in Table 6-2.

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 once at the first appearance of the part number in the list. Total quantities for optional assemblies are totaled by assembly and not integrated into the standard 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, description and function of the part, and number of parts required. Address the order to the nearest Hewlett-Packard office.

6-12. PARTS PROVISIONING

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 provides parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

6-14. ILLUSTRATED PARTS BREAKDOWNS

6-15. An illustrated parts breakdown of the A1 RF Section Assembly is given on Service Sheet A located after the numerical foldouts in Section VIII. In addition cabinet and front panel mechanical parts breakdowns appear in this section.

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
dBc . . decibels below carrier
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	08654-60019	1	RF SECTION ASSEMBLY(EXCEPT OPTION 003)	28480	08654-60019
A1	08654-60048		RF SECTION ASSEMBLY(OPTION 003 ONLY)	28480	08654-60048
A1C1	0160-2049	1	CAPACITOR-FDTHRU 5000PF +80 -20% 500V	28480	0160-2049
A1C2	0180-0049	3	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A1C3	0121-0016	1	CAPACITOR-V AIR DIEL 3.5/31.5PF 990V	94033	404-2
A1E1	9170-0029	1	CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1FL1	9135-0002	2	FILTER-LP SOLDER-TERMS	28480	9135-0002
A1FL2	9135-0002		FILTER-LP SOLDER-TERMS	28480	9135-0002
A1FL3	1810-0119	4	CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL4	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL5	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL6	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1L1	9140-0114	3	COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1L2	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1MP1	0360-0001	2	TERMINAL-LUG-SLDR 6 SCR .141/.086 ID	78452	920
A1MP2	0360-0001		TERMINAL-LUG-SLDR 6 SCR .141/.086 ID	78452	920
A1MP3			NOT ASSIGNED		
A1MP4	0510-0042	4	RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP5	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP6	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP7	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP8	0510-0235	1	RETAINER-RING .375-DIA CD PL STL	97464	1000-37-ST-CD
A1MP9	0510-0294	1	PIN:SPRING SST 1/16 X 11/16" LG	00000	OBD
A1MP10	0890-0573	3	TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP11	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP12	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP13	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP14	1200-0087	1	INSULATOR-BSHG-FLG NYLON	28480	1200-0087
A1MP15	2260-0009	5	NUT-HEX-W/LKWR 4-40-THD .094-THK .25-A/F	28480	2260-0011
A1MP16			NOT ASSIGNED		
A1MP17	1460-0195	1	SPRING-EXT .125-OD .5-LG MUW	28480	1460-0195
A1MP18	1500-0432	1	BALL DRIVE 1.807-LG BRS/BRZ	28480	1500-0432
A1MP19	1530-1766	1	DAMP PAD, BACK(SPECIAL)	28480	1530-1766
A1MP20	1530-1767	1	DAMP PAD, COVER(SPECIAL)	28480	1530-1767
A1MP21	2190-0019	5	WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP22	2190-0019		WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP23	2190-0019		WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP24	2190-0124	3	WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP25	2190-0124		WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP26	2190-0124		WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP27	2190-0888	2	WASHER-FL NM NO.-4 .156-IN-ID .25-IN-OD	28480	2190-0888
A1MP28	2190-0888		WASHER-FL NM NO.-4 .156-IN-ID .25-IN-OD	28480	2190-0888
A1MP29	2950-0078	3	NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP30	2950-0078		NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP31	2950-0078		NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP32	3030-0564	4	SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP33	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP34	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP35	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP36	3050-0105	2	WASHER-FL MTLC NO.-4 .125-IN-ID	28480	3050-0105
A1MP37	3050-0105		WASHER-FL MTLC NO.-4 .125-IN-ID	28480	3050-0105
A1MP38	3050-0188	2	WASHER-SPR CRVD NO.-3/8 .385-IN-ID	78189	3502-20-19
A1MP39	3050-0274	3	WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP40	3050-0274		WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP41	3050-0274		WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP42	3050-0316	1	WASHER-SPR CRVD NO.-3/8 .386-IN-ID	28480	3050-0316
A1MP43	3050-0188		WASHER-SPR CRVD NO.-3/8 .385-IN-ID	28480	3050-0188
A1MP44	3130-0013	2	WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP45	3130-0013		WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP46			NOT ASSIGNED		
A1MP47			NOT ASSIGNED		
A1MP48	4320-0281	4	DAMPING PAD, ROUND	28480	4320-0281
A1MP49	4320-0281		DAMPING PAD, ROUND	28480	4320-0281
A1MP50	4320-0281		DAMPING PAD, ROUND	28480	4320-0281
A1MP51	4320-0281		DAMPING PAD, ROUND	28480	4320-0281
A1MP52	4320-0283	2	DAMPING PAD, U-CHANNEL	28480	4320-0283
A1MP53	4320-0283		DAMPING PAD, U-CHANNEL	28480	4320-0283
A1MP54	8160-0008		RFI ROUND STRIP AL .25-IN-OD	07700	20-21103
A1MP55	8160-0021		RFI ROUND STRIP BRS AG-PL .125-IN-OD	12881	10-118

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
A1MP56	8300-0006		BRAID, NYLON	28480	8300-0017
A1MP57	606A-102	1	ROLLER DETENT	28480	606A-102
A1MP58	606A-918	1	SPRING LEAF	28480	606A-918
A1MP59	608D-59C	1	DETENT SPRING	28480	608D-59C
A1MP60	03200-00011	1	CURSOR	28480	03200-00011
A1MP61	03200-00019	1	CONTACT	28480	03200-00019
A1MP62	03200-60018	3	PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP63	03200-60018		PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP64	03200-60018		PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP65	03200-60019	1	PULLEY & BRACKET ASSEMBLY	28480	03200-60019
A1MP66	08654-00003	1	CHASSIS-OSCILLATOR	28480	08654-00003
A1MP67	08654-00014	2	GASKET FEED THRU SHIELD	28480	08654-00014
A1MP68	08654-00014		GASKET FEED THRU SHIELD	28480	08654-00014
A1MP69	08654-00023	1	CLAMP BRAID	28480	08654-00023
A1MP70			NOT ASSIGNED		
A1MP71	08654-00034	1	COVER, RF AMPLIFIER	28480	08654-00034
A1MP72	08654-00042	2	CONTACT, CAPACITOR	28480	08654-00042
A1MP73	08654-00042		CONTACT, CAPACITOR	28480	08654-00042
A1MP74	08654-20048	1	PULLEY, CAPACITOR DRIVE	28480	08654-20048
A1MP75			NOT ASSIGNED		
A1MP76	08654-20053	1	BUSHING	28480	08654-20053
A1MP77	08654-20055	1	SHAFT, FREQUENCY	28480	08654-20055
A1MP78	08654-20086	1	PLATE, FREQUENCY	28480	08654-20086
A1MP79	08654-20058	1	END PLATE, RF AMPLIFIER	28480	08654-20058
A1MP80	08654-20059	1	SHIELD, RF AMPLIFIER	28480	08654-20059
A1MP81	08654-20021	1	DIVIDER, RF AMPLIFIER	28480	08654-20021
A1MP82	08654-20061	1	SHIELD, FEED THRU	28480	08654-20061
A1MP83	08654-20022	1	BASE PLATE, MACH	28480	08654-20022
A1MP84	08654-20063	2	GUIDE, ROD CURSOR	28480	08654-20063
A1MP85	08654-20063		GUIDE, ROD CURSOR	28480	08654-20063
A1MP86	08654-20064	1	GEAR, CENTER SHAFT M	28480	08654-20064
A1MP87	08654-20070	2	PLUG, THREADED	28480	08654-20070
A1MP88	08654-20070		PLUG, THREADED	28480	08654-20070
A1MP89	08654-20074	1	SHAFT ASSEMBLY, DIAL DRIVE	28480	08654-20074
A1MP90	08654-20076	1	COVER, RF SECTION	28480	08654-20076
A1MP91	08654-20077	1	SHAFT ASSEMBLY, COUNTER	28480	08654-20077
A1MP92	08654-20078	1	SHAFT ASSEMBLY, TURRET	28480	08654-20078
A1MP93	08654-20042	1	DRUM ASSEMBLY, DIAL	28480	08654-20042
A1MP94	3030-0001	1	SCREW-SET 8-32 .188-IN-LG SMALL CUP-PT	28480	3030-0001
A1MP95	2680-0105	4	SCREW-MACH 10-32 .625-IN-LG PAN-HD-POZI	28480	2680-0105
A1MP96	2190-0034	4	WASHER-LK HLCL NO.-10 .194-IN-ID	28480	2190-0034
A1MP97	2510-0109	3	SCREW-MACH 8-32 .625-IN-LG PAN-HD-POZI	28480	2510-0109
A1MP98	2190-0087	3	WASHER-LK HLCL NO.-8 .168-IN-ID	28480	2190-0087
A1MP99	2200-0145	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
A1MP100	2360-0117	6	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117
A1MP101	2360-0115	13	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0115
A1MP102	3050-0010	7	WASHER-FL MTLC NO.-6 .147-IN-ID	76210	65
A1MP103	3050-0066	4	WASHER-FL MTLC NO.-6 .147-IN-ID	28480	3050-0066
A1MP104	2420-0001	2	NUT-HEX-W/LKWR 6-32-THD .109-THK	28480	2420-0002
A1MP105	2360-0121	6	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	28480	2360-0121
A1MP106	1400-0015	1	CLAMP-CA .25-DIA .375-WD STL	73734	1550
A1MP107	2190-0019		WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP108	0510-0060	1	RETAINER-RING .375-DIA STL CD-PL	79136	5555-37-8-MD
A1MP109	2360-0192	9	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0192
A1MP110	2200-0153	3	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	28480	2200-0153
A1MP111	2200-0172	2	SCREW-MACH 4-40 .875-IN-LG 82 DEG	28480	2200-0172
A1MP112	3050-0001	2	WASHER-FL MTLC NO.-8 .172-IN-ID	28480	3050-0001
A1MP113	2510-0109		SCREW-MACH 8-32 .625-IN-LG PAN-HD-POZI	28480	2510-0109
A1MP114	2360-0121		SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	28480	2360-0121
A1MP115	2260-0009		NUT-HEX-W/LKWR 4-40-THD .094-THK .25-A/F	28480	2260-0011
A1MP116	2200-0107	9	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	28480	2200-0107
A1MP117			NOT ASSIGNED		
A1MP118			NOT ASSIGNED		
A1MP119			NOT ASSIGNED		
A1MP120			NOT ASSIGNED		
A1MP121			NOT ASSIGNED		
A1MP122			NOT ASSIGNED		
A1MP123			NOT ASSIGNED		
A1MP124			NOT ASSIGNED		
A1MP125			NOT ASSIGNED		
A1MP126	0610-0002	1	NUT-HEX-DBL-CHAM 2-56-THD .062-THK	28480	0610-0002
A1MP127	3030-0032	2	SCREW-SKT FL HD CAP 10-32 1.25-IN-LG 82	28480	3030-0032
A1MP128	08654-00039	1	BRACKET, CAPACITOR MOUNT	28480	08654-00039
A1MP129	3030-0022	2	SCREW-SET 6-32 .125-IN-LG SMALL CUP-PT	28480	3030-0022
A1W1	08654-60018	1	CABLE ASSEMBLY, RF OSC OUT	28480	08654-60018

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
A1A1	08654-60002	1	RF AMPLIFIER/ALC ASSEMBLY(EXCEPT OPT 003)	28480	08654-60002
A1A1	08654-60022		RESTORED 08654-60002 OR 60102, REQUIRES EXCHANGE(EXCEPT OPTION 003)	28480	08654-60022
A1A1	08654-60050	1	BOARD ASSEMBLY, RF AMPLIFIER/ALC (OPTION 003 ONLY)	28480	08654-60050
A1A1	08654-60051	1	RESTORED 08654-60050,REQUIRES EXCHANGE (OPTION 003 ONLY)	28480	08654-60051
A1A1C1	0160-3879	16	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C2	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C3	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C4*	0160-3565	1	CAPACITOR-FXD 6.8PF +-.5PF 100WVDC CER *FACTORY SELECTED PART	28480	0160-3565
A1A1C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C8	0160-3878	6	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C9†	0160-2306	1	CAPACITOR-FXD 27PF +-5% 300WVDC MICA	28480	0160-2306
A1A1C10	0160-0162	1	CAPACITOR-FXD .022UF +-10% 200WVDC POLYE	56289	292P22392
A1A1C11	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C12	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C13	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C14	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C15	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C16	0160-3877	1	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A1A1C17	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C18	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C19	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A1A1C20	0160-3875	2	CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C21	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C22	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C23	0160-3876	1	CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A1A1C24	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C25	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1CR1	1901-0040	17	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A1CR2	1901-0747	2	DIODE-PIN	28480	1901-0747
A1A1CR3	1901-0747		DIODE-PIN	28480	1901-0747
A1A1CR4	1901-0535	4	DIODE-SCHOTTKY	28480	1901-0535
A1A1CR5	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A1J1	1250-1220	3	CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J2	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J3	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1L1	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1A1L2	9100-2252	1	COIL-FXD MOLDED RF CHOKE .27UH 10%	24226	10/270
A1A1L3	08654-80001	1	INDUCTOR, RF 15 NH	28480	08654-80001
A1A1L4	08654-80003	1	INDUCTOR, RF 45 NH	28480	08654-80003
A1A1L5	9100-1623	1	COIL-MLD 27UH 5% Q=60 .155DX.375LG	24226	15/272
A1A1L6	08654-80002	1	INDUCTOR, RF 35 NH	28480	08654-80002
A1A1L7	9100-2247	1	COIL-FXD MOLDED RF CHOKE .1UH 10%	24226	10/100
A1A1MP1	0340-0008	1	TERMINAL-STUD DBL-TUR PRESS-MTG	98291	ST-1000-L2
A1A1MP2	08654-00019	1	SHIELD, BUFFER AMPLIFIER	28480	08654-00019
A1A1MP3	08654-00020	1	SHIELD, MODULATOR	28480	08654-00020
A1A1MP4	08654-00021	1	GROUND STRAP	28480	08654-00021
A1A1MP5	08654-00055	1	LABEL,ID IDENTIFICATION (OPT 003 ONLY)	28480	08654-00055
A1A1Q1	1854-0696	5	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q2	1855-0020	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A1Q3	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q4	5086-4218	4	HP-21 TO 72 PKG	28480	5086-4218
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q5	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q6	5086-4218		HP-21 TO-72 PKG (OPT 003 ONLY)	28480	5086-4218
A1A1Q6	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW (EXCEPT OPTION 003)	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q7	5086-4218		HP-21 TO-72 PKG (OPT 003 ONLY)	28480	5086-4218
A1A1Q7	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW (EXCEPT OPTION 003)	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q8	1853-0020	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A1Q9	1854-0071	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1R1*	0698-7216	4	RESISTOR 147 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-147R-G
A1A1R2	0698-7208	2	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A1A1R3	0698-7232	1	RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-T0-681R-G
A1A1R4	0698-7284	3	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1R5	0698-7227	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A1A1R6	0698-7205	2	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R7	0698-7196	1	RESISTOR 21.5 2% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A1A1R8	0698-7253	3	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R9	0698-7229	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A1A1R10	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R11	0698-7222	1	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A1A1R12	0698-7224	1	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A1A1R13	0698-7214	2	RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G
A1A1R14	0698-7188	5	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R15*	0698-7207	1	RESISTOR 61.9 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T00-61R9-G
A1A1R16	0698-7205		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R17	0698-7284		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R18	0757-0814	1	RESISTOR 511 1% .5W F TC=0+-100	19701	MF7C1/2-T0-511R-F
A1A1R19	0698-7239	1	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A1A1R20	0698-7247	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-G
A1A1R21	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G
A1A1R22	0698-3444	3	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1A1R23	0698-7198	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R24	0698-7217	1	RESISTOR 162 1% .05W F TC=0+-100	24546	C3-1/8-T0-162R-G
A1A1R25	0698-7198		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R26	0698-7284		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R27	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R28*	0698-7220	1	RESISTOR 215 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-215R-G
A1A1R29	0698-7256	1	RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-G
A1A1R30	0698-7195	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A1A1R31*	0698-7212	1	RESISTOR 100 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-100R-G
A1A1R32	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R33	0698-7279	1	RESISTOR 61.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6192-G
A1A1R34	0698-7286	1	RESISTOR 121K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1213-G
A1A1R35	0698-7201	1	RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A1A1R36	0698-7248	5	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A1R37	0698-7269	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-G
A1A1R38	0698-7245	1	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-G
A1A1R39	2100-2497	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	62-207-1
A1A1TP1	0360-0124	5	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP5	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1U1	1826-0013	4	IC 741 OP AMP	28480	1826-0013
A1A2	08654-60004	1	FM MODULATOR ASSEMBLY	28480	08654-60004
A1A2C1			NSR, P/O CIRCUIT BOARD		
A1A2C2			NSR, P/O CIRCUIT BOARD		
A1A2CR1	0122-0245	2	DIODE-VVC 1N5139 6.8PF 10%	04713	1N5139
A1A2CR2	0122-0245		DIODE-VVC 1N5139 6.8PF 10%	04713	1N5139
A1A2R1	0698-7260	5	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A2R2	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3	08654-60003	1	BOARD ASSEMBLY, RF OSCILLATOR	28480	08654-60003
A1A3C1	0180-0116	3	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903SB2
A1A3C2	0121-0447	1	CAPACITOR-V TRMR-CER 1.5/2.5PF 63V	00868	58-TRIKO-04 1.5-2.5 PF-P100
A1A3C3	0160-0682	2	CAPACITOR-FXD 3.3PF +-.5PF 200WVDC CER	28480	0160-0682
A1A3C4	0160-0682		CAPACITOR-FXD 3.3PF +-.5PF 200WVDC CER	28480	0160-0682
A1A3C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A3C6*	0160-2248	1	CAPACITOR-FXD 4.3PF +-.25PF 500WVDC CER *FACTORY SELECTED PART	28480	0160-2248
A1A3C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A3C8	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A3C9	0160-0174	1	CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A1A3C10	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A3C11	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A3C12*	0160-2236	1	CAPACITOR-FXD 1PF +-.25PF 500WVDC CER *FACTORY SELECTED PART	28480	0160-2236
A1A3CR1	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A3CR2	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A3J1	1250-0835	1	CONNECTOR-RF SMC M PC 50-OHM	98291	50-051-0000

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
A1A3Q1	1854-0345	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A3Q2	1854-0345		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A3Q3	5086-4218		HP-21 TO TO-72 PKG	28480	5086-4218
	1205-0037	7	HEAT SINK TO-36-PKG	28480	1205-0037
A1A3Q4	1854-0404	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3Q6	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3R1	0698-7214		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R2	0698-7236	2	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A1A3R3	0698-7236		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A1A3R4	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R5	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R6	0698-7216		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R7	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R8	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R9	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R10	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R11	0698-7228	1	RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
A1A3R12	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R13	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R14	0698-7208		RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A1A3R15	0698-7216		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R16	0698-7230	1	RESISTOR 562 1% .05W F TC=0+-100	24546	C3-1/8-T0-562R-G
A1A3R17	0698-3260	2	RESISTOR 464K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A1A3R18	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R19	0698-7204	1	RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-T00-46R4-G
A1A3R20	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R21	0698-7229		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A1A4	08654-60021	1	TURRET ASSEMBLY	28480	08654-60021
A1A4E1	9170-0847	3	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4E2	9170-0847		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4E3	9170-0847		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4L1			INDUCTOR, NSR, P/O A1A4		
A1A4L2			INDUCTOR, NSR, P/O A1A4		
A1A4L3			INDUCTOR, NSR, P/O A1A4		
A1A4L4			INDUCTOR, NSR, P/O A1A4		
A1A4L5			INDUCTOR, NSR, P/O A1A4		
A1A4L6			INDUCTOR, NSR, P/O A1A4		
A1A4MP1	3030-0002	2	SCREW-SET 8-32 .375-IN-LG SMALL CUP-PT	28480	3030-0002
A1A4R1	0686-1015	5	RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R2	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R3	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R4	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R5	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A2	08654-60024	1	ATTENUATOR ASSEMBLY(INCL A2J1 AND A2J2) NOT RECOMMENDED FOR FIELD REPAIR	28480	08654-60024
A2	08654-60023		RESTORED 08654-60024, REQUIRES EXCHANGE	28480	08654-60023
A2J1			NSR, P/O A2		
A2J2			NSR, P/O A2		
A3	08654-60101	1	BOARD ASSEMBLY, CONTROL/POWER SUPPLY	28480	08654-60101
A3C1	0160-2055	8	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C7	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C9	0180-2181	2	CAPACITOR-FXD 1300UF+75-10% 50VDC AL	56289	36D1326050AA2A
A3C10	0180-2181		CAPACITOR-FXD 1300UF+75-10% 50VDC AL	56289	36D1326050AA2A
A3C11	0180-0049		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C12	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
A3C13	0160-0161	1	CAPACITOR-FXD .01UF +-10% 200WVDC POLYE	56289	292P10392
A3C14	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
A3C15	0160-3460	1	CAPACITOR-FXD .05UF +80-20% 100WVDC CER	28480	0160-3460
A3C16	0160-2194	1	CAPACITOR-FXD .18UF +-5% 200WVDC POLYE	28480	0160-2194
A3C17	0160-3456	1	CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3C18	0180-2206	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X900682
A3C19	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A3C20	0160-0300	1	CAPACITOR-FXD 2700PF +-10% 200WVDC POLYE	56289	292P27292

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3C21	0180-0291	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C22	0160-3534	1	CAPACITOR-FXD 510PF +-5% 100WVDC MICA	28480	0160-3534
A3C23* †	0140-0195	1	CAPACITOR-FXD 130PF +-5% 300WVDC MICA *FACTORY SELECTED PART	72136	DM15F131J0300WV1CR
A3C24	0160-2257	1	CAPACITOR-FXD 10PF +-5% 500WVDC CER	28480	0160-2257
A3C25	0180-0228	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C26	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C27	0160-2201	1	CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A3C28	0180-0049		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C29	0180-0089	1	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A3CR1	1901-0364	2	DIODE-FW BRDG 200V 1A	04713	SDA 10185-4
A3CR2	1901-0364		DIODE-FW BRDG 200V 1A	04713	SDA 10185-4
A3CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR9	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR10	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR14	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR15	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR16	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR17	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR18	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3MP1	0360-1514	28	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3MP2	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3MP3	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3Q1	1854-0072	2	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	02735	2N3054
	08654-20031	1	HEAT SINK, TO-66	28480	08654-20031
A3Q2	1853-0012	1	TRANSISTOR PNP 2N2904A SI TO-5 PD=600MW	01295	2N2904A
A3Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q5	1854-0072		TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	02735	2N3054
A3Q6	1854-0022	1	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3R1	0757-0278	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3R2	0757-0442	8	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R3	0757-0438	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R4	0757-0290	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R5	2100-1758	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 1-TURN	00027	C7-106-4
A3R6	0698-3156	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R7 †	0683-0275	2	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3R8	0698-3633	1	RESISTOR 390 5% 2W MO TC=0+-200	11502	RG42
A3R9	0683-0475	1	RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A3R10	0757-0394	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R11	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R12	0757-0280	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R13	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R14	0757-0465	4	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R15	0683-0275		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3R16	0811-2816	1	RESISTOR 1.8 5% .75W PW TC=0+-50	91637	RS-1/2
A3R17	0698-3628	1	RESISTOR 220 5% 2W MO TC=0+-200	11502	RG42
A3R18	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R19	0698-3440	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3R20	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R21	0757-0464	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A3R22	0757-0463	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A3R23	0698-3457	1	RESISTOR 316K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R24	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R25	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R26	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R27	0757-0458	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3R28	0698-3161	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A3R29	0698-3150	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A3R30	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R31	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R32	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R33	0698-3154	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3R34	2100-2489	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	19701	ET50X502
A3R35	0757-0447	2	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R36	0698-3458	1	RESISTOR 348K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R37	0698-3162	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3R38	0757-0279	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R39	0757-0416	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R40	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R41	0757-0461	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R42	0698-3459	1	RESISTOR 383K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R43	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R44	0757-0462	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A3R45	2100-2517	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	30983	ET50X503
A3R46	0698-3260		RESISTOR 464K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R47	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R48	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R49	0698-3454	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-
A3R50	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R51	0757-0180	1	RESISTOR 31.6 1% .125W F TC=0+-100	24546	C4, T-0
A3R52	2100-2516	2	RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	73138	62-231-1
A3R53*	0698-4424	1	RESISTOR 1.4K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1401-F
A3R54	2100-2516		RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	73138	62-231-1
A3R55	0683-2265	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3R56	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R57	2100-2514	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A3R58	0698-3450	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3R59	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R60†	0698-3155	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R61	0757-0447		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3R62	0757-0288	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3R63	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3S1	3101-0973	1	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC PC	79727	GF126-0018
A3TP1-13	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3U1	1820-0223	1	IC LM 301A OP AMP	27014	LM301AH
A3U2	1826-0013		IC 741 OP AMP	28480	1826-0013
A3U3	1826-0288	1	IC CA 1458 OP AMP	28480	1826-0288
A3U4	1826-0092	1	IC MC 1458 OP AMP	28480	1826-0092
A3U5	1826-0013		IC 741 OP AMP	28480	1826-0013
A3U6	1826-0013		IC 741 OP AMP	28480	1826-0013
A3VR1	1902-0680	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	03877	1N827
A3VR2	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.049%	15818	CD 35822
A3VR3	1902-0049	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A4	0960-0444	1	LINE MODULE(INCLUDES A4J1, A4P1).	28480	0960-0444
A4J1			CONNECTOR, NBR, P/O A4		
A4P1	5020-8157	1	CARD, VOLTAGE SELECT (SEE SECTION II)	28480	5020-8157

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6	08654-60037	1	REVERSE POWER ASSEMBLY (OPTION 003 ONLY)	28480	08654-60037
A6FL1	9135-0002	2	FILTER-LP SOLDER-TERMS	28480	9135-0002
A6FL2	9135-0002		FILTER-LP SOLDER-TERMS	28480	9135-0002
A6J1	1250-0829	1	CONNECTOR-RF SMC M SGL-HOLE-FR 50-OHM	98291	50-845-4610
A6J2	1250-0830	1	CONNECTOR-RF SMC M SGL HOLE FR	2K497	701873
A6MP1	08640-20191	1	HOUSING, REVERSE POWER	28480	08640-20191
A6A1	08640-60049	1	BOARD ASSEMBLY,REVERSE POWER PROTECTION	28480	08640-60049
A6A1C1	0160-0576	3	CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C2	0160-0576		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C3	0160-3879	2	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6A1C4	0180-0197	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6A1C5	0160-3877	1	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A6A1C6	0160-0576		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C7	0160-3875	1	CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A6A1C8	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A6A1C9	0121-0448	1	CAPACITOR-V TRMR-CER 2.5/5PF 63V PC-MTG	00866	59-TRIKO-04 2.5-5 PF-N033
A6A1C10	0160-0699	1	CAPACITOR-FXD 1PF +-.1PF 100WVDC CER	72982	8101-A112-COK-109B
A6A1C11	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6A1CR1	1901-0050	2	DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
A6A1CR2	1901-0518	2	DIODE-SCHOTTKY	28480	1901-0518
A6A1CR3	1901-0050		DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
A6A1CR4	1901-0518		DIODE-SCHOTTKY	28480	1901-0518
A6A1K1	0490-1073	1	RELAY-REED 1A 250MA 120VAC 4.5VDC-COIL	28480	0490-1073
A6A1L1	1460-1395	2	WIREFORM CU ALY	28480	1460-1395
A6A1L2	1460-1395		WIREFORM CU ALY	28480	1460-1395
A6A1MP1	0363-0105	2	CONTACT	28480	0363-0105
A6A1MP2	0363-0105		CONTACT	28480	0363-0105
A6A1MP3	08654-00053	1	LABEL	28480	08654-00053
A6A1Q1	1854-0210	3	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1Q2	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1Q3	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1R1	0698-7241	1	RESISTOR 1.62K 1% .05W F TC=0+-100	24546	C-3, T-0
A6A1R2	2100-1986	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	62-206-1
A6A1R3	0683-1055	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A6A1R4	0698-7277	2	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A6A1R5	0698-7212	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A6A1R6	0683-0275	1	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB2705
A6A1R7	0698-7277		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A6A1R8	0698-7236	1	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6A1R9	0698-7229	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6A1R10	0698-7229		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6A1R11	0757-0346	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A6A1U1	1826-0026	1	IC LM 311 COMPARATOR	27014	LM311H
A6A1VR1	1902-3048	2	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	BZ 10939-30
A6A1VR2	1902-0244	1	DIODE-ZNR 30.1V 5% DO-15 PD=1W TC=+.075%	28480	1902-0244
A6A1VR3	1902-0554		DIODE-ZNR 10V 5% DO-15 PD=1W TC=.06%	28480	1902-0554

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
			MECHANICAL PARTS (FOR CHASSIS PARTS, SEE PAGE 6-14)		
MP1	5000-8876	2	COVER SIDE 6 X 11 SM	28480	5000-8876
MP2	1440-0077	2	HANDLE-CMPNT	12136	346
MP3	1440-0077		HANDLE-CMPNT	12136	346
MP4	1440-0076	1	HANDLE-SPCL 7.75-L	12136	1775-394 COLOR Y31061
MP5	08654-00037	1	COVER, TOP	28480	08654-00037
MP6			NOT ASSIGNED		
MP7	08654-00002	1	PANEL, REAR	28480	08654-00002
MP8	5000-8876		COVER SIDE 6 X 11 SM	28480	5000-8876
MP9	5060-0703	2	FRAME ASSEMBLY, 6 X 11 SM	28480	5060-0703
MP10	5060-0703		FRAME ASSEMBLY, 6 X 11 SM	28480	5060-0703
MP11	08654-00024	1	COVER, BOTTOM	28480	08654-00024
MP12	5040-7201	4	FEET	28480	5040-7201
MP13	5040-7201		FEET	28480	5040-7201
MP14	1460-1345	2	TILT STAND	28480	1460-1345
MP15	1460-1345		TILT STAND	28480	1460-1345
MP16	5040-7201		FEET	28480	5040-7201
MP17	5040-7201		FEET	28480	5040-7201
MP18	08654-00007	1	SUB-PANEL, FRONT	28480	08654-00007
MP19	08654-00001	1	PANEL, FRONT	28480	08654-00001
MP20	7200-1263	1	EXTRUSION:ALUM.(AA6063-T5 ALLOY)	28480	7200-1263
MP21	08654-20026	1	WINDOW	28480	08654-20026
MP22	08654-20017	1	TRIM TOP	28480	08654-20017
MP23	7120-1254	1	NAMEPLATE .312-IN-WD .54-IN-LG AL	28480	7120-1254
MP24	5020-8529	1	KNOB (AM MTR)	28480	5020-8529
MP25			NOT ASSIGNED		
MP26	0370-0585	1	KNOB (OUTPUT LEVEL)	28480	0370-0585
MP27	7120-4787	1	LABEL REVERSE POWER (OPT 003 ONLY)	28480	7120-4787
MP28	0590-0505	1	NUT, KNURLED 5/8-24 UNEF-2B THREAD	73743	TD-801
MP29	0370-0584	1	KNOB(OUTPUT LEVEL VERNIER)	28480	0370-0584
MP30	0370-0583	1	KNOB(MODULATION LEVEL)	28480	0370-0583
MP31	0370-2245	1	KNOB (FREQUENCY TUNE)	28480	0370-2245
MP32	0370-0929	2	KNOB, LEVER (AM)	28480	0370-0929
MP33	0370-2986	1	KNOB (INTERNAL MODULATION)	28480	0370-2986
MP34	0370-0929		KNOB, LEVER (FM)	28480	0370-0929
MP35			NOT ASSIGNED		
MP36			NOT ASSIGNED		
MP37	0590-0923	1	NUT-KNRLD-R 1/2-32-THD .125-THK .635-A/F (SEE FIGURE 3-1)	28480	0590-0923
MP38	3101-0559	1	CAP-PB TRL WHITE; ZIG-ZAG 90 DEG TO (SEE FIGURE 3-1)	28480	3101-0559
MP39	0370-0609	1	KNOB (FREQUENCY RANGE)	28480	0370-0609
MP40	1250-0522	1	CAP-COAX TO FIT F-N NON-SHTG 1.75 IN	24931	28PC100-1
MP41			NOT ASSIGNED		
MP42	08654-00010	1	BRACKET, ATTENUATOR SUPPORT	28480	08654-00010
MP43			NOT ASSIGNED		
MP44	08654-00049	1	BRACKET, RF CONNECTOR SUPPORT	28480	08654-00049
MP45			NOT ASSIGNED		
MP46	08654-20080	2	STANDOFF,TOP COVER	28480	08654-20080
MP47			NOT ASSIGNED		
MP48	08654-00051	1	BRACKET, METER SUPPORT	28480	08654-00051
MP49			NOT ASSIGNED		
MP50			NOT ASSIGNED		
MP51	08654-20069	1	TOP SUPPORT BAR, RF SECTION	28480	08654-20069
MP52	5001-0135	1	WRENCH COMBINATION	28480	5001-0135
MP53	7120-4628	1	LABEL INFORMATION "CAUTION"	28480	7120-4628
MP54	08654-20080		STANDOFF, TOP COVER	28480	08654-20080
MP55			NOT ASSIGNED		
MP56	08654-00008	1	BRACKET, CONNECTOR	28480	08654-00008
MP57	08654-20071	1	BOTTOM SUPPORT BAR, RF SECTION	28480	08654-20071
MP58	5040-0218	1	COUPLER	28480	5040-0218
MP59	8160-0245	1	GASKET (OPT 003 ONLY)	28480	8160-0245
MP60	1401-0101	1	COVER, POWER MODULE	28480	1401-0101
MP61	08654-00022	1	PLATE, LOCKOUT	28480	08654-00022
MP62			NOT ASSIGNED		
MP63	08654-00045	1	BRACKET, ATTENUATOR	28480	08654-00045
MP64	3130-0321	1	SHIELD, ROTARY SWITCH	28480	3130-0321
MP65	08654-00009	1	BRACKET	28480	08654-00009
MP66 †	1460-0036	1	SPRING-CPRSN .197-OD .281-LG MUN (FOR MODULATION LEVEL POT SHAFT)	28480	1460-0036

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

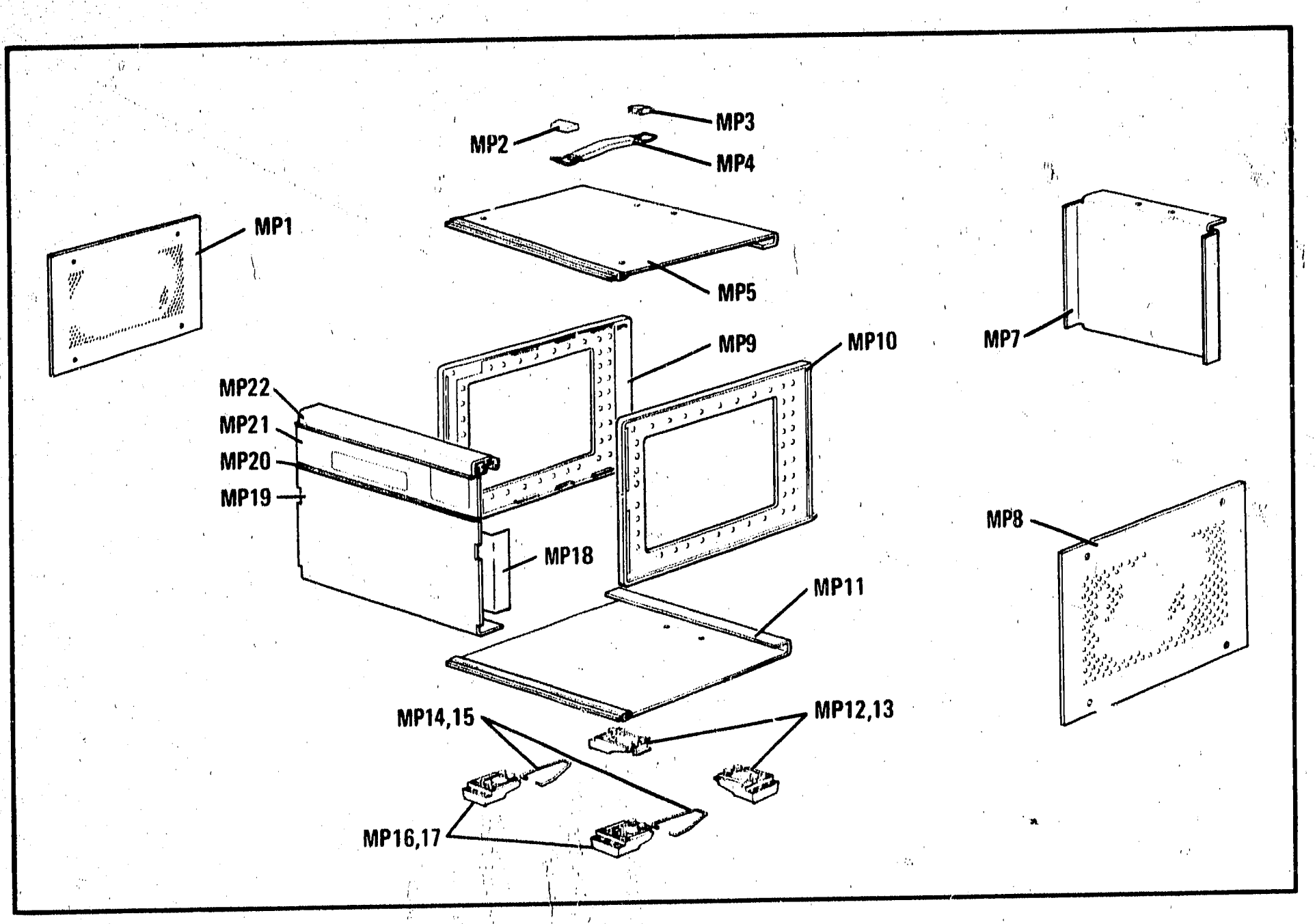


Figure 6-1. Cabinet Parts Exploded View

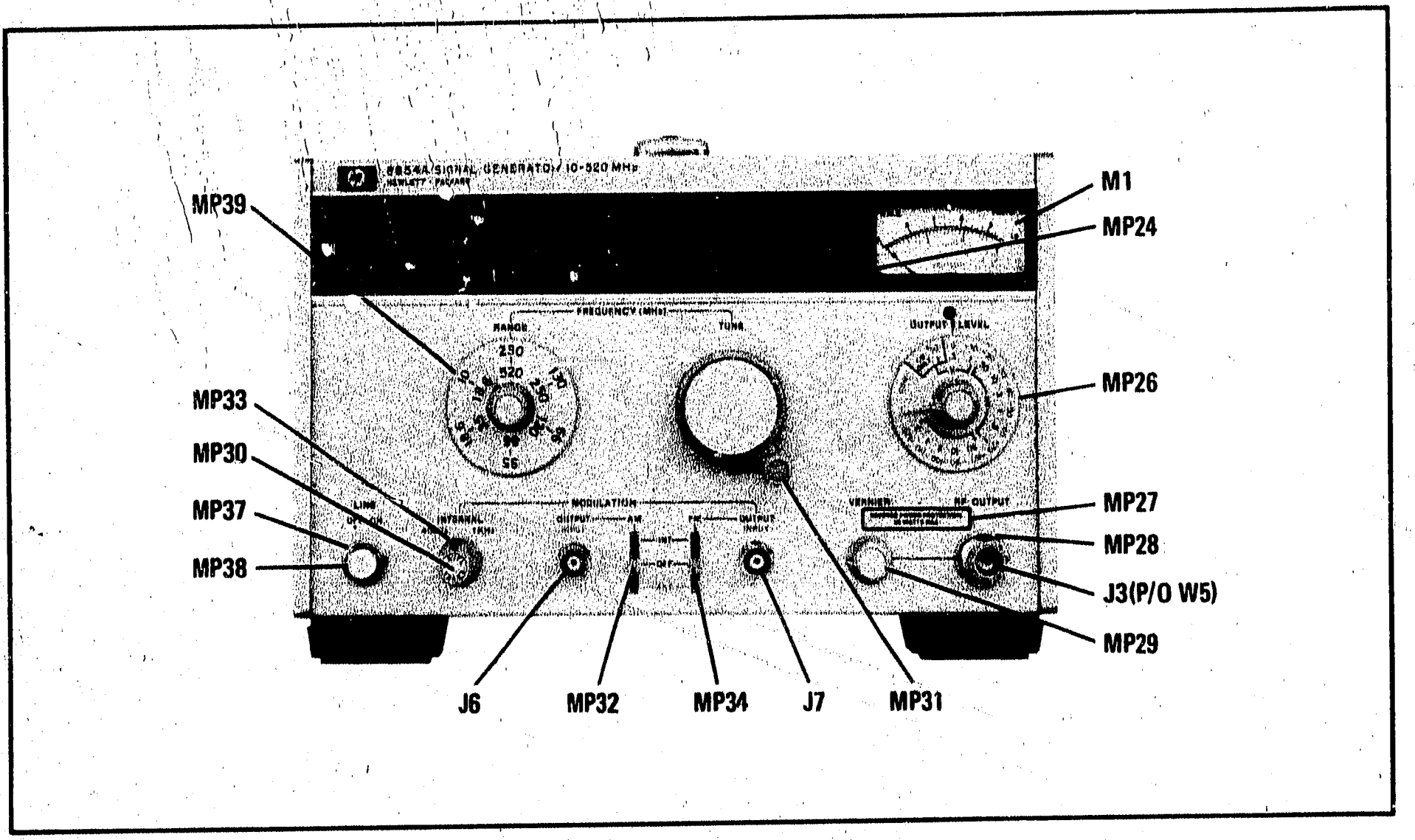


Figure 6-2. Front Panel Mechanical Parts

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
C1	0183-0180	1	CAPACITOR-FXD .033UF +-5% 200WVDC POLYE	56289	292P33392
DS1	2140-0244	1	LAMP-GLOW A1M 65/105VDC 1MA T-2-BULB	28480	2140-0245
F1	2110-0004	1	FUSE .35A 250V FAST-BLO 1.25X.25 UL IEC (FOR 100/120V OPERATION)(SEE SECTION III)	75915	312.250
F1	2110-0479	1	FUSE .175A 250V FAST-BLO 1.25X.25 UL (FOR 220/240V OPERATION)(SEE SECTION III)	75915	312.175
J1	1251-0198	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	71785	251-06-30-261
J2			CONNECTOR(AUX OUTPUT)NSR, P/O W3		
J3			CONNECTOR(RF OUTPUT) NSR, P/O W5		
J4			NOT ASSIGNED		
J5			CONNECTOR, NSR, P/O W2		
J6	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (AM IN/OUT)	24931	28JR128-1
J7	1250-0118		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (FM IN/OUT)	24931	28JR128-1
M1	1120-1951	1	METER:0-1 MA, 2-1/4" METER CASE SIZE	28480	1120-1951
MP			FOR MECHANICAL PARTS, SEE PAGE 6-12.		
P1	08654-20005	1	BOARD, TERMINAL	28480	08654-20005
R1	2100-3380	1	RESISTOR-VAR CONTROL CC 20K 10% DB	01121	70A400B4B03D
R2	0757-0138	2	RESISTOR 619 1% .5W F TC=0+-100	19701	MF7C1/2-T0-619R-F
R3			NOT ASSIGNED		
R4	0757-0138		RESISTOR 619 1% .5W F TC=0+-100	19701	MF7C1/2-T0-619R-F
R5	2100-3097	1	RESISTOR-VAR CONTROL C 5K 10% LIN	11236	530
R6*	0757-0280	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
			*FACTORY SELECTED PART		
R7	0698-3441	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
R8	0698-3160	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
S1	3100-3230	1	SWITCH,ROTARY(INTERNAL MODULATION)	28480	3100-3230
S2	3100-3052	2	SWITCH,LEVER 4 POSITION,1 SECTION (AM)	28480	3100-3052
S3	3100-3052		SWITCH,LEVER 4 POSITION,1 SECTION (FM)	28480	3100-3052
S4	3130-0390	1	WAFER:SECTION 1.718" DIA	76854	TYPE LK
S5	3101-1698	1	SWITCH,PB DPDT MOM (AM MTR)	28480	3101-1698
S6	3101-1395	1	SWITCH-PB DPDT-DB ALTNG 10.5A 250VAC LINE (INCLUDES DS1, MP1 AND MP2)	00501	55-67280-121/A1M
S7	3100-3324	1	SWITCH,ROTARY DP4T-NS (FM RANGE)	28480	3100-3324
T1	9100-3568	1	TRANSFORMER, POWER	28480	9100-3568
W1	8120-1378	1	CABLE ASSY 18AWG 3-CNDCT JSK-JKT .25-OD AC POWER (REFER TO FIGURE 2-2)	28480	8120-1378
W2	8120-0668	1	CABLE-COAX .086-OD (BUFFER AMPL OUT) INCLUDES J5.	28480	8120-0668
W3	8120-2175	1	CABLE ASSEMBLY, AUX OUTPUT (INCL J2)	28480	8120-2175
W4	8120-0667	1	CABLE,COAX .086-OD (RF AMPL, OUT)	28480	8120-0667
W5	8120-0670	1	CABLE-COAX .086-OD RF OUTPUT,INCL J3(EXCEPT OPTION 003)	28480	8120-0670
W6	8120-2110	1	CABLE ASSY-COAX 50-OHM 5.416-LG RF OUTPUT, INCLUDES J3(OPT 003 ONLY)	28480	8120-2110
W7	8120-1593	1	CABLE,SMLD 22AWG 5-CNDCT (LINE SWITCH)	28480	8120-1593
W8			NOT ASSIGNED		
W9			NOT ASSIGNED		
W10	8120-2109	1	CABLE ASSY-COAX ATTENUATOR OUTPUT (OPT 003 ONLY)	28480	8120-2109
XA1			NOT ASSIGNED		
XA2			NOT ASSIGNED		
XA3	1251-0159	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	251-15-30-261

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00027	NEOHM	ENGLAND	
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.	
0016A	AR TECH PACKAGING CORP	LOWELL MA	01854
00469	STETTNER-TRUSH INC	CAZENOVIA NY	13035
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02114	FERROXCUBE CORP	SAUGERTIES NY	12477
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03877	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01880
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
07700	TECHNICAL WIRE PRODUCTS INC	CRANFORD NJ	07016
11502	TRW INC BOONE DIV	BOONE NC	28607
12881	METEX CORP	EDISON NJ	08817
13019	TELEDYNE SEMICONDUCTOR	MOUNTAIN VIEW CA	94040
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
2K497	CABLEWAVE SYSTEMS INC	NORTH HAVEN CT	06473
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
26546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
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
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
72962	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
74163	PHELPS DODGE CORP	NEW YORK NY	10022
76210	MARNEDEL C W	SAN FRANCISCO CA	94103
76385	MINOR RUBBER CO INC	BLOOMFIELD NJ	07003
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60120
78452	EVERLOCK CHICAGO INC	CHICAGO IL	60622
79136	WALDES-KOHINOOR INC	LONG ISLAND CITY NY	11101
79727	C-W INDUSTRIES	WARMINSTER PA	18974
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
94033	LA POINTE INDUSTRIES INC	ROCKVILLE CT	06066
97464	INDUSTRIAL RETAINING RING CO	IRVINGTON NJ	07111
98291	SEALECTRO CORP	MAMARONECK NY	10544
99800	AMER PRCN IND INC DELEVAN DIV	AURORA NY	14052

BACK DATING

MANUAL CHANGES

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains manual change instructions for backdating this manual for HP Model 8654A Signal Generators that have serial number prefixes that are different than the first prefix listed on the title page. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your generator.

7-3. MANUAL CHANGES

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

7-5. If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a 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
1540A	C, B, A
1551A, 1603A	C, B
1612A	C

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 6-10, Table 6-2:
Change A3R60 to 0757-0438 RESISTOR 5.11K 1% 0.125W F TC=0 ±100.

Service Sheet 4 (schematic):
Change A3R60 to 5.11K.

CHANGE B

NOTE

See paragraph 7-9 for recommended instrument modification.

Page 6-9, Table 6-2:
Change A3R7 to 0683-0475 RESISTOR 4.7 OHM 5% 0.25W FC TC= −400/+500 (see note).

Service Sheet 5 (schematic):
Change A3R7 to 4.7 ohms.

CHANGE C

NOTE

See paragraph 7-11 for recommended instrument modification.

Page 6-6, Table 6-2:
Change A1A1C9 to 0140-0131 CAPACITOR-FXD 56 PF ±5% 300 WVDC MICA.

Page 6-8, Table 6-2:
Change A3C23 to 0160-2257 CAPACITOR-FXD 10 PF ±5% 500 WVDC CER.

Page 6-14, Table 6-2:
Delete MP66 1460-0036 SPRING, COMPRESSION .197-OD .281-LG MUW (for MODULATION LEVEL potentiometer shaft).

Service Sheet 3 (schematic):
Change A1A1C9 to 56 PF.

Service Sheet 4 (schematic):
Change the value of A3C23 to 10 PF.

7-7. INSTRUMENT IMPROVEMENT MODIFICATIONS

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

7-9. —10V Regulator Stability Improvement (Serial Prefixes 1551A and 1603A)

7-10. On instruments with serial prefixes 1551A or 1603A unwanted sidebands (at approximately 200 kHz) may appear on the RF signal at output levels near +10 dBm. These may be a result of oscillation of the —10V supply. The performance of the —10V power supply exhibiting the above symptoms may be improved by changing A3R7 to 2.7 ohms, 1/4W (HP 0683-0275).

7-11. Internal Modulation Level Vernier Improvement (Serial Prefixes 1540A, 1551A, 1603A and 1612A)

7-12. On instruments with serial number prefixes 1540A, 1551A, 1603A, and 1612A, if the internal modulation level vernier pot is changed, proper smoothness of operation may be difficult to obtain. The addition of a compression spring (HP 1460-0036) on the concentric shaft ahead of the shaft coupler will improve the smoothness of operation of the vernier.

SERVICE INFO

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains instructions for troubleshooting and repairing the Signal Generator.

8-3. Principles of operation and troubleshooting information are located opposite the schematics on the numerical Service Sheets. Service Sheet A contains an illustrated parts breakdown of the A1 RF Section Assembly. Service Sheet B has top and bottom internal views of the instrument showing the locations of the test points, adjustments, major assemblies, and some of the chassis parts.

8-4. The rest of this section has general service information that should help you to quickly service and repair the Signal Generator.

8-5. SAFETY CONSIDERATIONS

8-6. Although this instrument has been designed in accordance with international safety standards, this manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition (see Safety Considerations page in the front of the manual). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

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.

Removal of the protective cover on the A4 Line Module exposes hazardous voltage (line voltage) at the module's terminals.

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

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

8-7. PRINCIPLES OF OPERATION

8-8. Principles of operation appear on the foldout pages opposite the block diagrams and the schematics on the Service Sheets. Service Sheet 1 is an overall block diagram that briefly describes overall instrument operation. It is keyed, by the numbers in the lower right-hand corners of the blocks, to the schematic diagrams on the Service Sheets that follow. It provides an assembly-by-assembly description of instrument operation.

NOTE

Table 8-2, Schematic Diagram Notes, explains any unusual symbols that appear on the schematics. The table also explains the switch-wafer numbering system.

8-9. TROUBLESHOOTING

8-10. This manual provides two methods to isolate a problem to a particular assembly. The first method is to use the results of the performance tests (given in Section IV) and the table of Post-Repair Performance Tests and Adjustments, found in Section V. More information about this method is given in Section V.

8-11. Overall Troubleshooting. The second, and primary, troubleshooting method is to use the troubleshooting block diagram (found in Service Sheet 1) to isolate a problem to a particular assembly or circuit.

8-12. Circuit-Level Troubleshooting. Once a problem has been isolated to a particular assembly or circuit, the text opposite the service sheet that documents the circuit gives detailed troubleshooting information for the circuit.

8-13. RECOMMENDED TEST EQUIPMENT

8-14. Test equipment and test equipment accessories required to maintain the Signal Generator are listed in Table 1-2. Equipment other than that listed may be used if it meets the listed critical specifications.

8-15. SERVICE AIDS

8-16. Pozidriv Screwdrivers. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slot, Pozidriv screwdrivers should be used.

8-17. Service Kit. The following parts can be ordered for use in a service kit for the generator. (Before ordering, check to ensure that they are not on hand; most of them are common to service kits for other Hewlett-Packard instruments.)

1	SMC Adapter.	HP 1250-0827
2	Test Cables SMC to BNC. . .	HP 11592-60001
1	Extender Board 30 pins. . . .	HP 08640-60036

8-18. Extender Board. An extender board is available that can be used to extend the A3 Control/Power Supply Board as shown in Figure 8-1. The part number is HP 08640-60036.

8-19. Wrench. A wrench is supplied with the generator. One end fits 7/32-inch connectors while the other end fits 1/4-inch connectors.

8-20. Part Location Aids. The locations of some chassis-mounted parts and the major assemblies are shown on the last foldout in this manual. In addition, illustrated parts breakdowns located in Section VI and the alphabetical Service Sheets in Section VIII facilitate the identification of mechanical parts. The locations of individual components mounted on printed circuit boards or other assemblies are shown on the appropriate schematic diagram page or on the page opposite it. The part reference designator is the assembly designator plus the part designator (for example, A3R9 is R9 on the A3 assembly). For specific components description and ordering information refer to the parts list in Section VI.

8-21. Servicing Aids on Printed Circuit Boards. The servicing aids include test points, transistor and integrated circuit designations, adjustment callouts and assembly stock numbers.

8-22. REPAIR

8- Factory-Selected Components

8-24. Some component values are selected at the time of final checkout at the factory (see Table 5-1). Usually these values are not extremely critical; they are selected to provide optimum compatibility with associated components. These components are identified on individual schematics by an asterisk (*). The recommended procedure for replacing a factory-selected part is as follows:

a. Try the same value as the component just removed, then perform the calibration test specified for the circuit in the performance and adjustment sections of this manual.

b. If calibration cannot be accomplished, try the typical value shown in the parts list and repeat the test.

c. If the test results are still not satisfactory, substitute various values within the tolerances specified in Table 5-1, until the desired result is obtained.

8-25. Etched Circuits

8-26. The etched circuit boards in the Signal Generator are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 8-1 lists recommendations and precautions pertinent to etched circuit repair work.

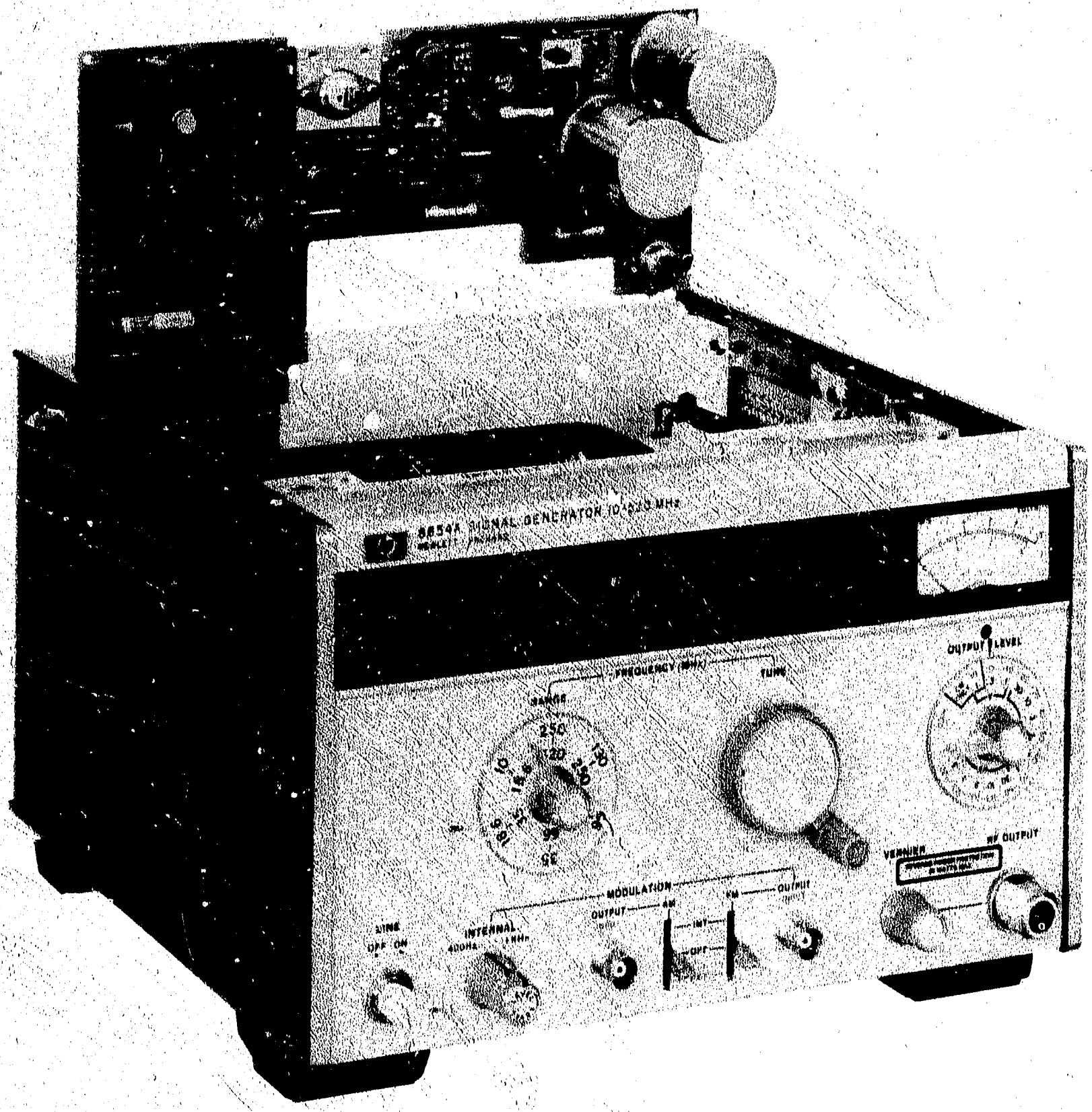


Figure 8-1. Signal Generator With Circuit Board on Extender

Etched Circuits (Cont'd)

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

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

c. Use a suction device (Table 8-1) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion. See Table 8-1 for recommendations.

8-27. Etched Conductor Repair

8-28. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlay and remove any varnish from etched conductor before soldering wire into place.

8-29. Component Replacement

8-30. Remove defective component from board.

NOTE

Although not recommended on boards with high-frequency signals or where both sides of a board are accessible, axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

8-31. If component was unsoldered, remove solder from mounting holes, and position component as original was positioned. DO NOT FORCE LEADS INTO MOUNTING HOLES; sharp lead ends may damage plated-through conductor.

8-32. Transistor Replacement. Transistors are packaged in many physical forms. This sometimes results in confusion as to which lead is the collector, which is the emitter, and which is the base. Figure 8-2 shows typical epoxy and metal case transistors and the means of identifying the leads.

8-33. To replace a transistor, proceed as follows:

a. Do not apply excessive heat; see Table 8-1 for recommended soldering tools.

b. If possible, use long-nose pliers between transistor and hot soldering tools.

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

d. Integrated circuit replacement instructions are the same as those for transistors.

8-34. Some transistors are mounted on heat sinks for good heat dissipation. This requires good thermal contact with mounting surfaces. To assure good thermal contact for a replacement transistor, coat both sides of the insulator with Dow Corning No. 5 silicone compound or equivalent before fastening the transistor to the chassis. Dow Corning No. 5 compound is available in 8 oz. tubes from Hewlett-Packard; order HP 8500-0059.

8-35. Diode Replacement. Solid state diodes have many different physical forms. This sometimes results in confusion as to which lead is the anode (positive), since not all diodes are marked with the standard symbols. Figure 8-2 shows examples of some diode marking methods. If doubt exists as to polarity, an ohmmeter may be used to determine the proper connection. It is necessary to know the polarity of the ohms lead with respect to the common lead for the ohmmeter used. (For the HP Model 410B Vacuum Tube Voltmeter, the ohms lead is negative with respect to the common; for the HP Model 412A DC Vacuum Tube Voltmeter, the ohms lead is positive with respect to the common). When the ohmmeter indicates the least diode resistance, the cathode of the diode is connected to the ohmmeter lead which is negative with respect to the other lead.

NOTE

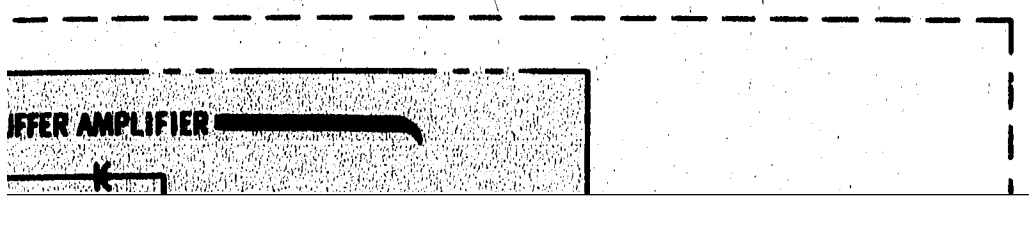
Replacement instructions are the same as those listed for transistor replacement.

8-36. Illustrated Parts Breakdowns

8-37. An illustrated parts breakdown for the A1 RF Section Assembly is given on Service Sheet A. It is keyed to disassembly and removal instructions (given on the alphabetical service sheets) and to the replaceable parts list given in Section VI. In addition, Section VI contains illustrated parts breakdowns for the cabinet parts and front panel mechanical parts.

8-38. BASIC CIRCUIT THEORY

8-39. Operational Amplifier. Figure 8-3 shows a typical operational amplifier. Circuit A is a non-inverting buffer amplifier with a gain of 1. Circuit B is a non-inverting amplifier with gain determined by the impedance of R1 and R2. Circuit C is an inverting amplifier with gain determined by R2 and R1. Circuit D shows typical circuit connections and parameters. It is assumed that the amplifier has high gain, low output impedance, and high input impedance.



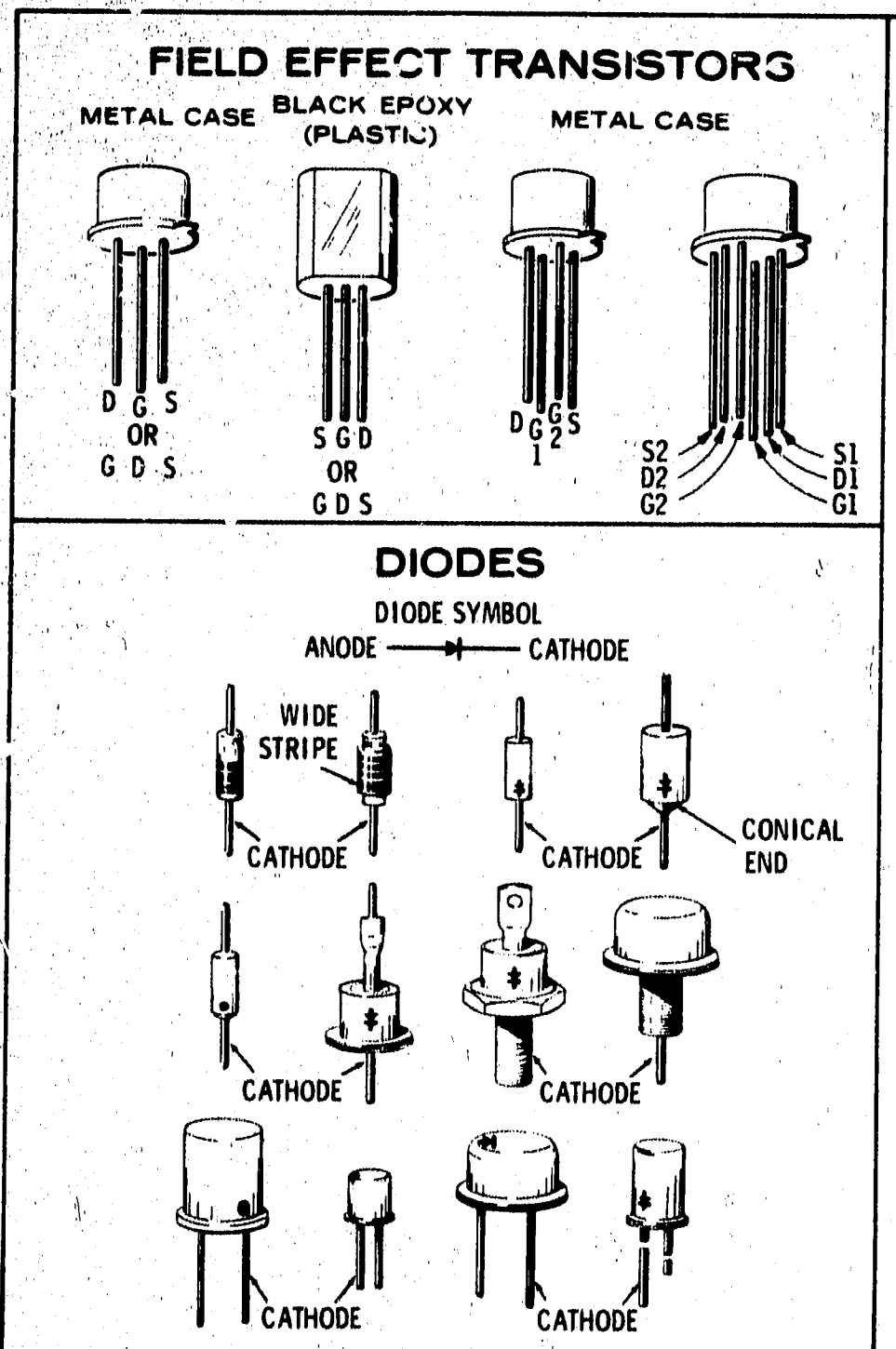


Figure 8-2. Examples of Diode and Transistor Marking Methods

Table 8-1. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering tool	Soldering, unsoldering	Wattage range: 37-50; Tip Temp: 750-800°	Ungar #766 handle w/*Ungar #1237 heating unit
Soldering Tip	Soldering, unsoldering	*Shape: pointed	*Ungar #PL111
De-soldering Aid	To remove molten solder from connection	Suction device	Soldapullt by Edsyn Co., Arleta, California
Resin (flux) Solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board	Freon; Acetone; Lacquer Thinner
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	— —
Protective	Contamination, corrosion protection	Good electrical insulation; corrosion-prevention properties	Silicone Resin such as GE DRI-FILM**88

* For working on circuit boards: for general purpose work, use Ungar No. 4037 Heating Unit (47½-56½W) tip temperature of 850-900 degrees) and Ungar No. PL113 1/8" chisel tip.

** General Electric Co., Silicone Products Dept., Waterford, New York, U.S.A.

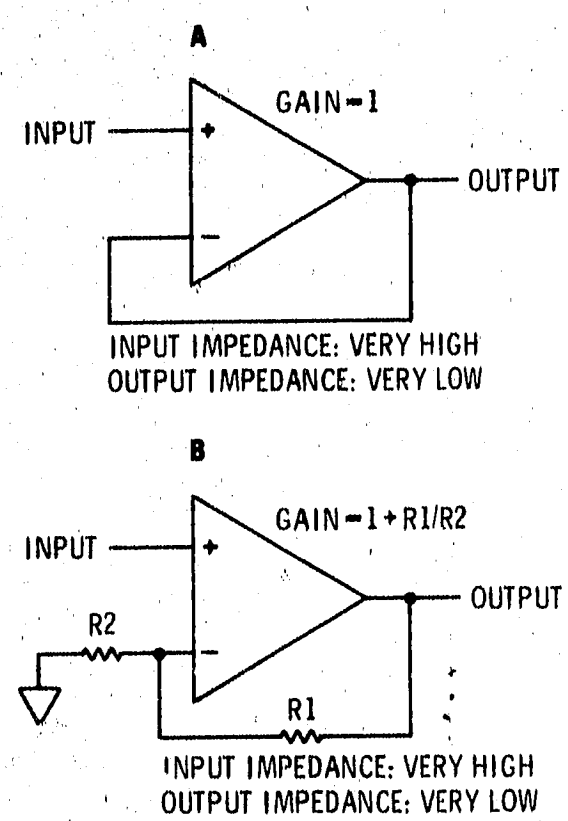
8-40. An operational amplifier can be characterized as an ideal voltage amplifier having low output impedance, high input impedance, and very high gain. Also the output voltage is proportional to the difference in the voltages applied to the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a negative feedback path.

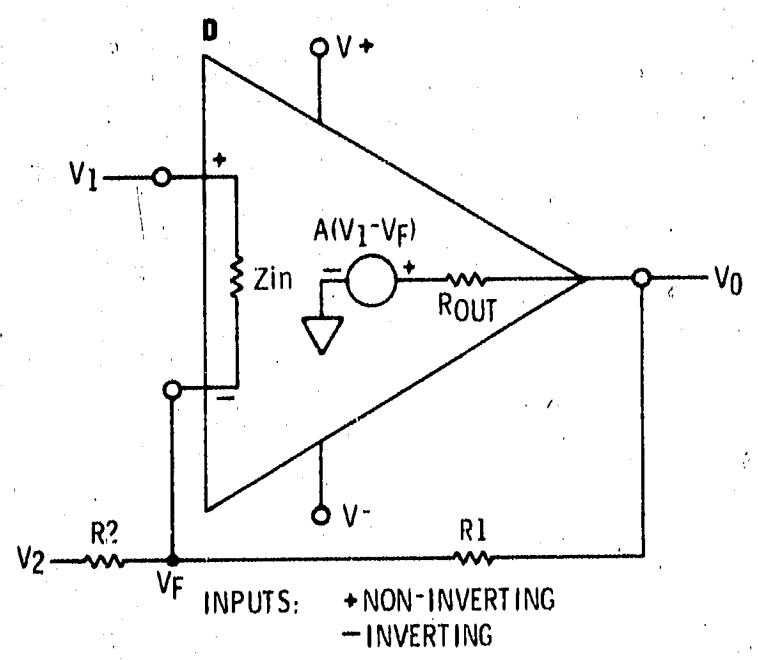
8-41. When troubleshooting an operational amplifier, measure the voltages at the two inputs with no signal applied; the difference between these voltages should be less than 10 mV. A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually this difference will be several volts and one of the inputs will be very close to an applied circuit operating voltage (for example, +20V, —12V).

8-42. Next, check the amplifier's output voltage. It will probably also be close to one of the applied circuit potentials: ground, +20V, —12V, etc. Check to see that the output conforms to the inputs. For example, if the inverting input is positive, the output should be negative; if the non-inverting input is positive, the output should be positive. If the output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

4-43. Comparator. Comparators are used as sense amplifiers, pulse height discriminators, and voltage comparators. A voltage reference is connected to one of the amplifier's inputs as shown in Figure 8-4. When the input signal voltage crosses the reference, the output goes positive; the output remains positive until the signal re-crosses the reference.

OPERATIONAL AMPLIFIER





IF "A" IS LARGE, $V_F = V_1$

(1) $V_0 = V_1 (1 + \frac{R1}{R2}) - V_2 (\frac{R1}{R2})$

(2) IF $V_2 = 0$ (∇), THEN $V_0 = V_1 (1 + \frac{R1}{R2})$

(3) IF $V_1 = 0$ (∇), THEN $V_0 = -V_2 (\frac{R1}{R2})$

Figure 8-3. Operational Amplifier

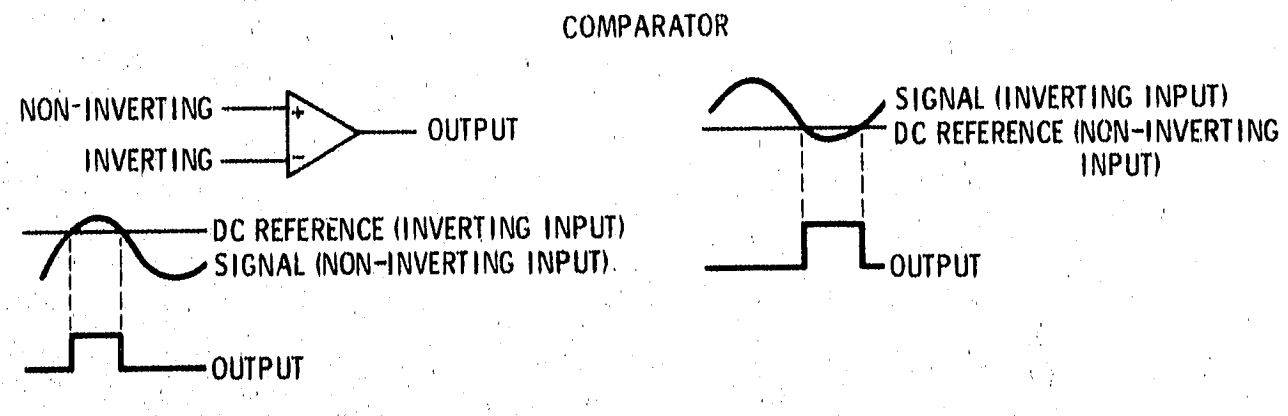


Figure 8-4. Comparator

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

SCHEMATIC DIAGRAM NOTES

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

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

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 arros indicates path and direction of main feedback.

Coaxial or shielded cable.

Relay Contact moves in direction of arrow when energized.

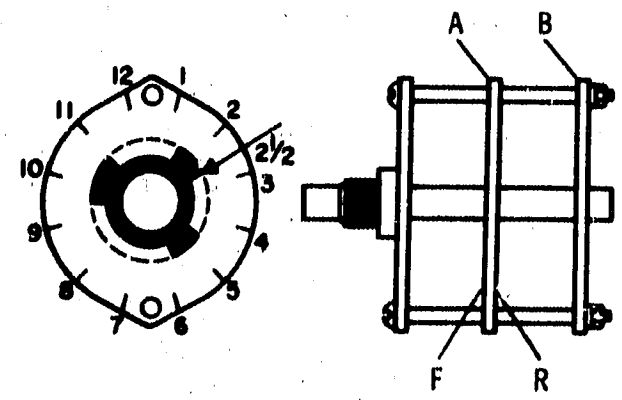
EXAMPLE: A3S1AR(2-1/2)

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)

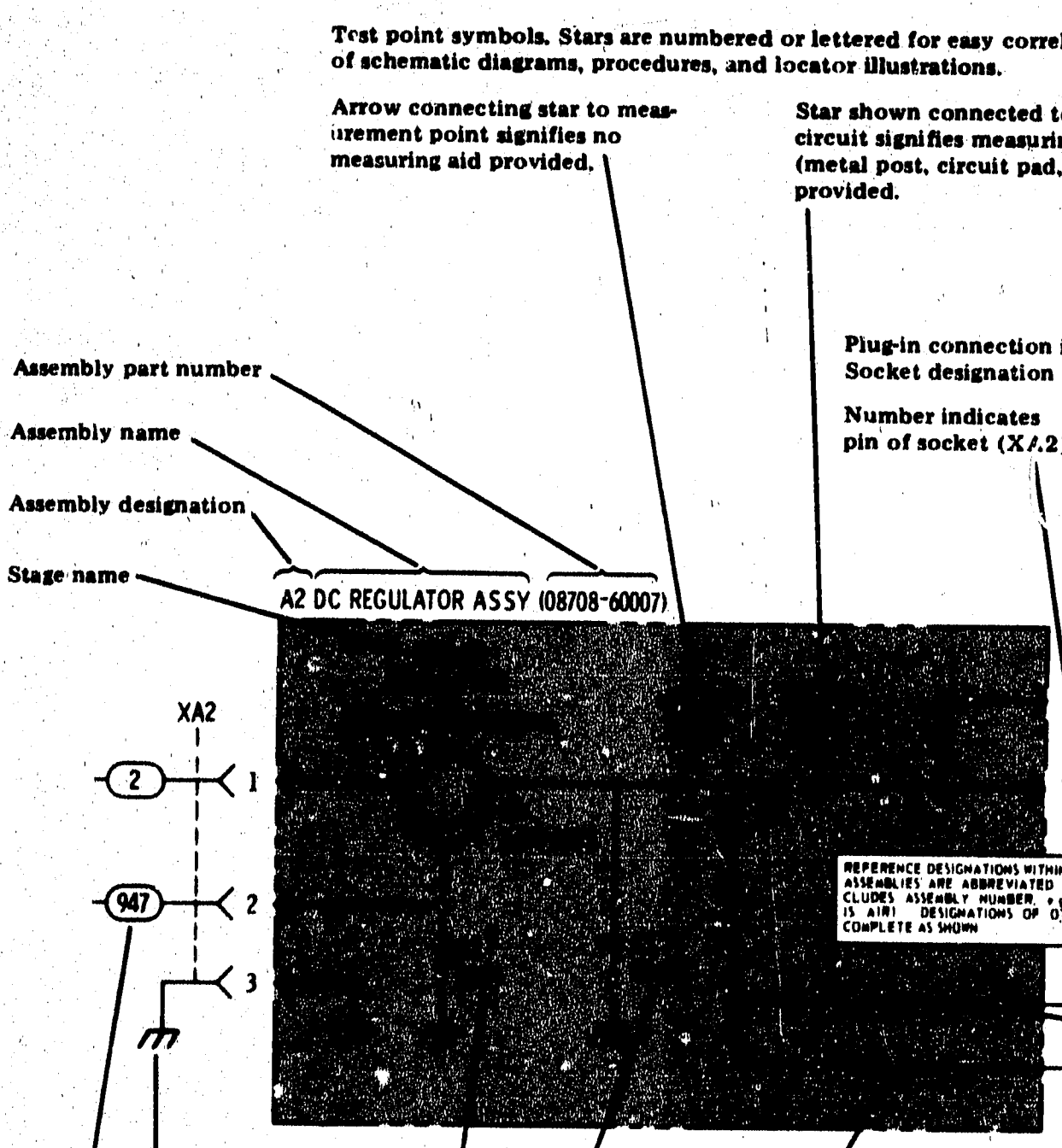


CW Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).

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.

Common connections. All like-designated points are connected.

Table 8-2. Schematic Diagram Notes (2 of 2)



Test point symbols. Stars are numbered or lettered for easy correlation of schematic diagrams, procedures, and locator illustrations.

Arrow connecting star to measurement point signifies no measuring aid provided.

Star shown connected to circuit signifies measuring aid (metal post, circuit pad, etc.) provided.

Interconnection information.

Circled letter indicates circuit path continues on another schematic diagram. Look for same circled letter on service sheet indicated by adjacent bold number (3, in this example).

Assembly part number

Assembly name

Assembly designation

Stage name

Plug-in connection information. Socket designation for A2 assembly.

Number indicates pin of socket (XA2).

J3 not mounted on assembly A2 (or chassis).

Non-plug-in connection information. Solder point named.

Dagger indicates correct change. See Section VII.

Conducting connection to chassis or frame.

Connector symbols within the borderlines of circuit assemblies signify connections to the assembly which are separate from those made through the integral plug part of the assembly.

Value selected for best operation. Value shown is average or most commonly selected value. Asterisk indicates factory selected component.

Wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example, (947) denotes white base, yellow wide stripe, violet narrow stripe.

Reference designators deleted by circuit changes are listed here.

List of all the reference designations on the diagram.

Assembly reference designator(s).

Large numbers in lower right corners of schematic diagrams are service sheet numbers. They are provided for convenience in tracing interconnections.

SERVICE SHEET 1

PRINCIPLES OF OPERATION

General

The Hewlett-Packard Model 8654A is a mechanically tuned solid-state signal generator producing RF signals covering 10 to 520 MHz in 6 ranges. The output is leveled and continuously variable over a 13 dB range. Attenuation of the RF output signal is controlled in 10 dB steps from +10 to −130 dBm. In addition, amplitude and frequency modulation are possible including the option of selecting the drive signal from the internal or an external audio source.

RF Oscillator/FM Modulator Circuits

The RF source of the Signal Generator is an LC oscillator. Six frequency ranges are selected by switching tank circuit inductors (FREQUENCY RANGE switch). A variable capacitor (FREQUENCY TUNE control) provides tuning across individual ranges. Varactor diodes, parallel to the tuning capacitor, provide frequency modulation.

RF Amplifier/ALC Circuits

A Buffer Amplifier isolates the oscillator from the Modulator (a rear panel auxiliary output is taken from the Buffer Amplifier output). The Modulator is a current-controlled RF attenuator which sets the RF level and applies amplitude modulation to the RF signal. A Power Amplifier increases the level of the RF signal from the Modulator. The output is coupled to the RF Detector and Attenuator Assembly (OUTPUT LEVEL switch). The RF Detector produces a dc output which is proportional to the RF signal level. The AM/ALC Amplifier compares the RF detector output with an ALC reference voltage (controlled by output level VERNIER). An error voltage sets the Modulator's drive current which causes the RF signal level to track the dc reference voltage. When the ALC reference voltage has a superimposed audio signal, the RF signal is amplitude modulated.

Reverse Power Protection (Option 003)

The Reverse Power Protection circuit (Option 003 only) has a relay to open the RF signal path if excessive power is applied to the RF OUTPUT connector. In this manner, the generator's output circuitry is protected. The relay automatically closes to restore generator operation when reverse power has been removed. (The relay is also open when the LINE switch is set to OFF.)

Control Circuits

An Audio Oscillator is enabled when either AM or FM switches is set to INT. The INTERNAL MODULATION switch selects the modulation rate. The audio signal is either switched to the AM or FM OUTPUT/INPUT connectors, or passed through the audio LEVEL control and Audio Amplifier to the internal AM or FM circuits (a mechanical interlock prevents simultaneous internal AM and FM).

A Level Reference Amplifier sums the audio (if any) with a constant dc level and produces a negative ALC reference voltage.

The output level VERNIER adjusts the reference voltage (with or without AM) to vary the RF signal within a 13 dB range. On all output level ranges but +10 dBm, the negative reference voltage is decreased by adding a parallel resistance to the Vernier, to produce the first 10 dB of output attenuation. A Shaping Amplifier adds a small amount of distortion to low level ALC signals to compensate for low level non-linearity in the RF Detector. The Shaping Amplifier drives the AM/ALC Amplifier.

The AM MTR switch selects the input signal to a Meter Driver from either the RF or Audio Detectors. The meter provides indications of RF output level, or percent AM.

TROUBLESHOOTING

Use the troubleshooting block diagram (Service Sheet 1) to isolate the trouble to a specific section of the instrument. Then turn to the service sheet (indicated by bold number in lower right corner of block) and isolate the trouble to the defective component.

When using the troubleshooting block diagram, initally set the generator's controls as indicated in the box at the right of the diagram. Then change the control settings as instructed by the boxes throughout the diagram to make specific measurements. Always return controls to their initial settings after completing a measurement.

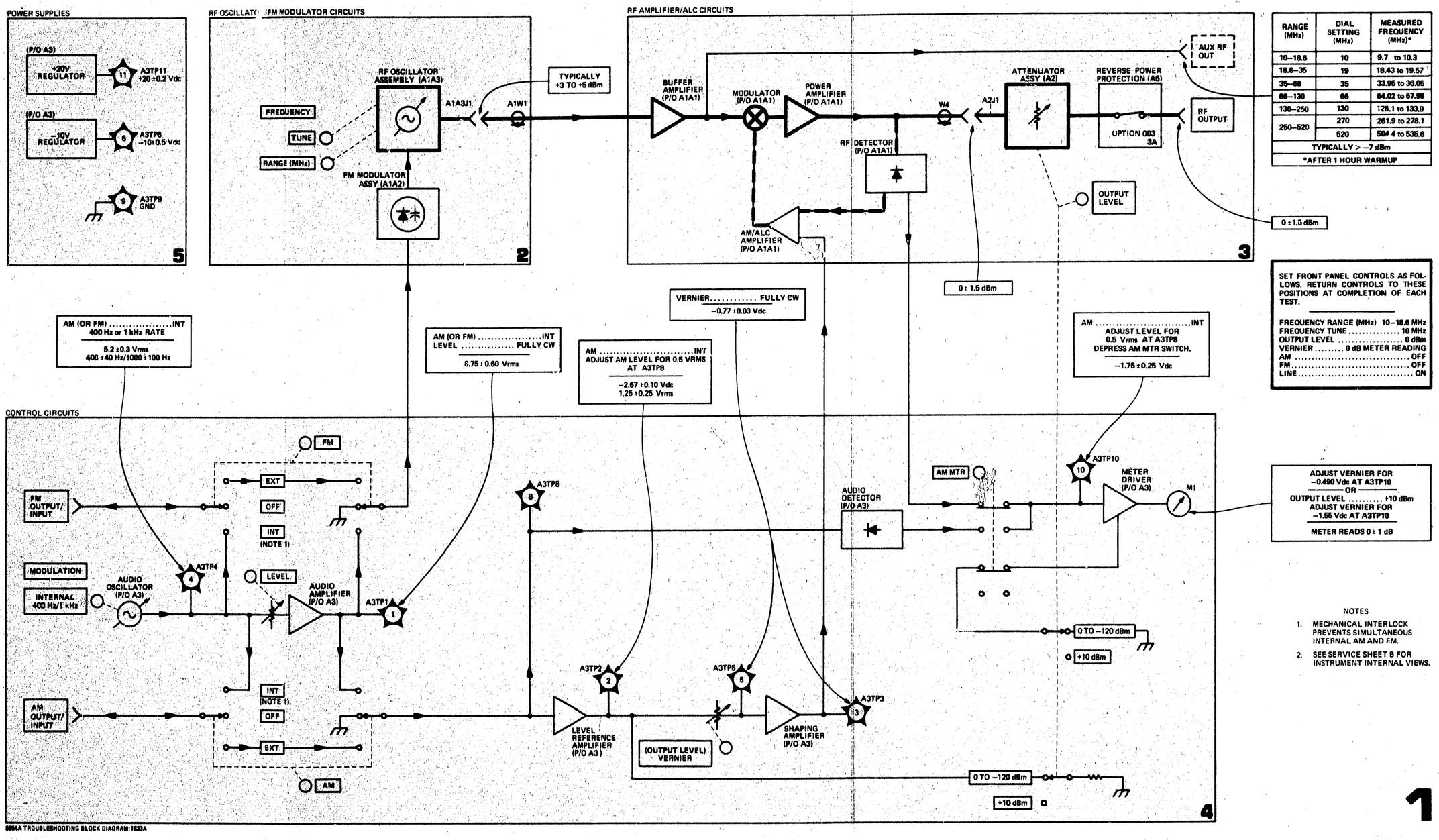


Figure 8-5. Troubleshooting Block Diagram

SERVICE SHEET 2

PRINCIPLES OF OPERATION

General

The A1A3 RF Oscillator Board Assembly contains the active portion of the RF oscillator, a buffer amplifier, an ALC circuit, and two power supplies. The tuning capacitor and turret inductors constitute the oscillator tank circuit. Two varactor diodes on the A1A2 FM Modulator Assembly electrically tune the oscillator over a narrow range for a frequency modulation output.

RF Oscillator and Tank Circuit (A1A3)

The RF Oscillator is a two-transistor, push-pull LC oscillator with a built-in ALC loop. The output power is relatively constant a +4 dBm over the six frequency ranges, 10 to 520 MHz. Cross-coupled transistors Q1 and Q2 form a positive-feedback amplifier. C3 and C4 couple the output from the collector of one transistor to the base of the second. R7 and R13 prevent parasitic oscillation modes caused by Q1 and Q2. The parallel resonant tank circuit is coupled across the collectors of Q1 and Q2. The frequency of oscillation is set by the tank circuit because the frequency of resonance is also the point at which the circuit impedance is maximum (loop gain is maximum) and phase shift is zero (maximum positive feedback). Tuning capacitor A1C3 provides about one octave of frequency tuning on each range. Tuning Range capacitor C2 and parallel capacitor C12 adjust the high-frequency-to-low-frequency ratio for each range. Switching the turret inductors (A1A4L1 to L6), changes the fequency range.

On the five lowest ranges, collector bias current for Q1 and Q2 is supplied from the emitter of transistor Q6 through a resistor (A1A4R1 to R5), and through the center tap of the turret inductor. On the 250—520 MHz range, the resistor is replaced by a short to increase the oscillator output power. Inductive beads A1A4E1, E2, and E3 reduce RF leakage into the power supply. Base voltage for Q1 and Q2 is established by the voltage divider R8 and R9. Current to the emitters of Q1 and Q2 is supplied from current source Q4 through limiting resistor R11. The emitter current is determined by the output of the ALC detector.

The output from the oscillator is taken from the Q1 side of the tank circuit. The output of Buffer Amplifier Q3 is coupled to the output jack and the ALC detector through voltage divider R15 and R16 and coupling capacitor C8. Capacitor C6 filters the oscillator harmonics at high frequencies.

Troubleshooting Block Diagram
SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

The peak-to-peak ALC Detector samples the RF output voltage and regulates the emitter current of Q1 and Q2 to provide a leveled output. The peak-to-peak RF voltage swing is maintained at +0.3 to +1.3 Vdc (+0.8 Vdc average) at the node common to CR1 and CR2. The voltage into the detector is ac coupled through C11. Voltage divider R20 and R21 establishes a +1.0 Vdc reference voltage at the cathode of hot carrier diode CR2. CR2 clamps the positive peak of the output signal at +1.3 Vdc (+1.0 Vdc plus the junction drop of CR2). As the voltage swings negative and begins to approach +0.3 Vdc, CR1 begins to conduct. It diverts some of the charging current flowing to C5 and C9 (from R17) and reduces their charge. The voltage across C5 is the base-to-emitter voltage of Q4, therefore, the emitter current supplied to oscillator transistors Q1 and Q2, and the RF output level, is regulated by this voltage. The RF voltage will seek a level at the node common to CR1 and CR2, such that the positive peak is clamped to +1.3 Vdc and the negative peak causes enough current flow through CR1 so the voltage across C5 is maintained at a constant level. The latter situation occurs when the negative peak approaches +0.3 Vdc.

Transistors Q6 and Q5 isolate the RF oscillator circuit supplies from the power supply. Resistor R1 provides an RF path to chassis ground. The output cable shield provides a dc and signal ground path.

FM Modulator Assembly (A1A2)

Varactor diodes CR1 and CR2 are in parallel with the main tuning capacitor A1C3. The diodes are reverse biased at +19 Vdc through resistors R1 and R2 and are coupled into the tank circuit through capacitors C1 and C2. An audio modulation signal is applied at the node common to CR1 and CR2 during frequency modulation.

TROUBLESHOOTING

If microphonics are more pronounced than normal, check the deflection of the tuning capacitor contacts. Refer to Turret Assembly installation procedure, step 5, (Service Sheet A). In addition, Service Sheets A and B contain assembly procedures for reducing microphonics.

The output of the A3 RF Oscillator Assembly should be +4 ±2 dBm. If the output is incorrect, short the collector (metal case) of A1A3Q4 to ground to open the ALC feedback path. If the oscillator and buffer amplifier are operating properly, the RF output will rise to about +14 dBm at 10 MHz and will drop to about +11 dBm at 520 MHz.

If oscillator distortion is evident, use an oscilloscope to check the A1A3 RF Oscillator Assembly output (at 10 MHz) with a 50Ω termination and with an open circuit. If the distortion is much greater with the 50Ω termination, A1A3Q3 is probably defective. Otherwise, A1A3Q1 or Q2 may be causing the distortion. If distortion is evident at higher frequencies only, repeat the distortion check using a spectrum analyzer and a high impedance (>500Ω) probe. Distortion from the A2 FM Modulator Assembly may be isolated by unsoldering and lifting one lead each of A1A2CR1 and CR2 from the circuit board and rechecking the distortion.

The RF Oscillator may continue to operate with one defective transistor. Symptoms are: the RF output is lower than normal and distortion is evident. The defective transistor may be isolated by "turning-off" the good transistor. Connect the base of one transistor to the collector (metal case) of A1A3Q4. If oscillation ceases, the other oscillator transistor is probably defective. If oscillation continues, check the other oscillator transistor by the same method.

NOTES

To prevent leakage, verify that cables and connectors are secure.

The A1A3 RF Oscillator is normally grounded through the RF Cables and mounting bracket. If it is lifted out for troubleshooting purposes, provide a ground connection to the chassis with a jumper wire.

A1A3 ASSEMBLY

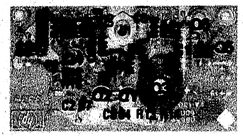


Figure 8-6. A1A3 RF Oscillator Board Assembly Component Locations

A1A4 ASSEMBLY

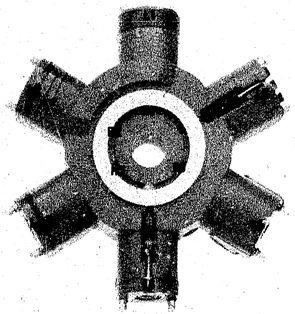


Figure 8-7. A1A4 Turret Assembly Component Locations

A1A2 ASSEMBLY

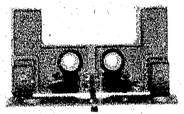
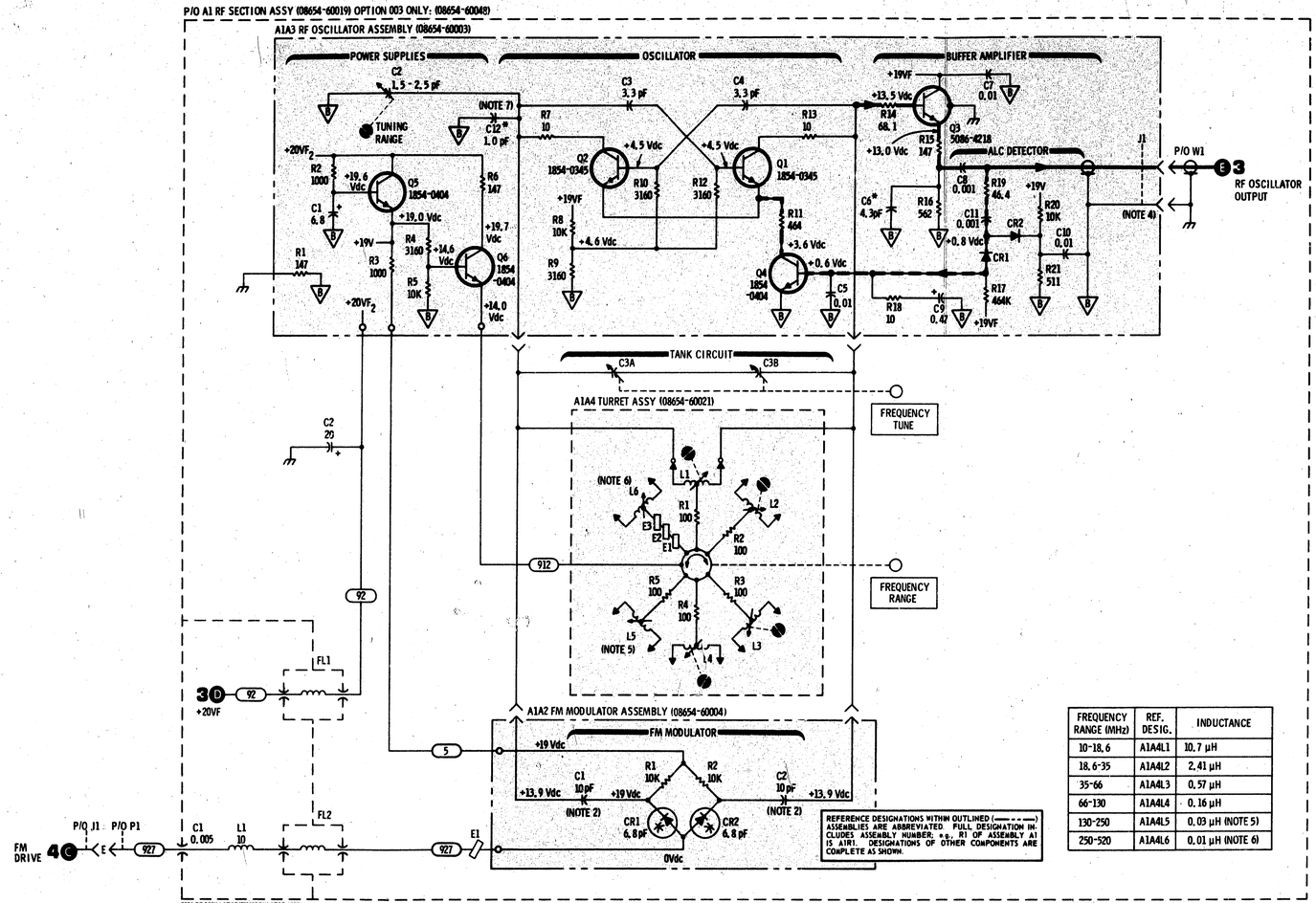


Figure 8-8. A1A2 FM Modulator Board Assembly Component Locations



J1
BOTTOM VIEW

REFERENCE DESIGNATIONS

NO PREFIX	A1A3 ASSY
J1 P1	C1-12 CR1, 2 J1 Q1-6 R1-21
A1 ASSY	
C1-3 E1 FL1, 2 L1 P/O W1	A1A4 ASSY
A1A2 ASSY	E1-3 L1-6 R1-5
C1, 2 CR1, 2 R1, 2	

NOTES

1. SEE TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
2. A1A2C1 AND A1A2C2 ARE PART OF THE PRINTED CIRCUIT BOARD.
3. ⏚ INDICATES SIGNAL GROUND.
4. AT RADIO FREQUENCIES THERE IS A POTENTIAL DIFFERENCE FROM CHASSIS GROUND TO SIGNAL GROUND ⏚ .
5. A1A4L5 INDUCTOR IS ADJUSTED (DECREASE IN VALUE) BY PINCHING THE LOOPS EQUALLY CLOSED (WITH INSTRUMENT TURNED OFF).
6. A1A4L6 INDUCTOR IS ADJUSTED (DECREASE IN VALUE) BY FILLING THE SLOTS EQUALLY WITH SOLDER. (WITH INSTRUMENT TURNED OFF).
7. PADDING CAPACITOR, C12, MAY BE OMITTED.

FREQUENCY RANGE (MHz)	REF. DESIG.	INDUCTANCE
10-18.6	A1A4L1	10.7 µH
18.6-35	A1A4L2	2.41 µH
35-66	A1A4L3	0.57 µH
66-130	A1A4L4	0.16 µH
130-250	A1A4L5	0.03 µH (NOTE 5)
250-520	A1A4L6	0.01 µH (NOTE 6)

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

Figure 8-9. RF Oscillator, FM Modulator Schematic Diagram

SERVICE SHEET 3

PRINCIPLES OF OPERATION

RF Amplifier/ALC Assembly

The RF Amplifier/ALC Assembly contains an RF buffer amplifier, a power amplifier, and the power leveling and amplitude modulation circuits.

Buffer Amplifier (A1A1)

The main function of the Buffer Amplifier is to isolate the RF oscillator from the modulator. The gain of the amplifier is approximately 0 dB. Transistors Q1 through Q4 form the four stages of the amplifier. Transistor Q3 is a common-base amplifier with a 50Ω input. The base of Q3 is biased by voltage divider R3 and R5. Q3 drives the common-gate FET stage Q2, which drives the common-base stage Q1 through R7. The base of Q1 is biased by the voltage divider R8 and R10. Q1 drives the emitter follower Q4. The RL network, R13, and L4, increases the gain at high frequencies. Q4 drives the modulator diodes and also couples the RF signal to the AUX RF OUT port through R21 and C18.

Power Amplifier (A1A1)

The signal from the modulator is amplified by the Power Amplifier. The amplifier has a nominal low-frequency gain of 9 dB with a 1 to 2 dB increase in gain up to 550 MHz and then a rapid roll-off beyond 600 MHz. Transistor Q5 is the input stage and Q6 and Q7 are a push-pull output stage. Q6 is driven from the collector of Q5, and Q7 is driven from the emitter of Q5. The base voltage of Q5 is set by the voltage divider R19 and R20. Emitter current for Q5 is set by resistors R23 and R24. Emitter current for Q7 (and Q6) is set by resistor R28. Networks R22 and L7; R23, R24, and C17; R27 and C19; R30 and C22 shape the frequency response. The power amplifier output is coupled to the attenuator (through C21 and R35) and the RF detector (through C23 and R31).

RF Detector, ALC Amplifier, and Modulator (A1A1)

The RF output level is held constant by the ALC negative feedback loop which is composed of the RF Detector, the ALC Amplifier, and the Modulator. The RF Detector samples the RF output voltage, and

RF Oscillator, FM Modulator (A1A2, A1A3, A1A4) SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

the output is compared to the ALC reference voltage by the ALC Amplifier. The error output of the ALC Amplifier drives the Modulator which, in turn regulates the RF output to keep the level constant.

C23 couples the RF signal into the detector circuit. Q8 is a current source which supplies bias current to both CR5 and CR4. Q9 sinks one half the current of Q8 causing the current through CR4 to equal that of CR5. R39 (DET BIAS) allows these offset currents to be exactly adjusted. This biasing causes any thermal variations in CR5 to be offset by similar variations in CR4. With no RF signal present, CR5 is slightly turned on. When RF enters through C23, CR5 diverts to ground positive excursions greater than +0.4V (one diode junction drop). This causes C24 to charge to a negative dc level. The result is a re-referenced RF waveform at CR5 whose peak positive excursion is clamped to one diode junction drop above ground. The RF signal is filtered out by RC networks R32 and C24, and R29 and C20 leaving the dc component at CR4. The voltage drop across CR4 directly offsets that across CR5. The result is a negative dc potential at the cathode of CR4 whose magnitude is directly proportional to the peak RF voltage entering the circuit.

The detector output drives the meter circuits and the ALC Amplifier U1. U1 compares the ALC reference with the detector output. The resultant error output voltage controls the bias current of CR2 and CR3. CR2 and CR3 are PIN diodes whose RF impedance is inversely related to the dc bias current. Inductor L5 is an RF choke which provides a path to ground for the modulator bias current. Resistors R12 and R16 and inductor L6 provide optimum impedance matching for the modulator. Components CR1 and C10 speed up the modulator response time for AM inputs; C9 provides frequency compensation for the ALC loop.

Attenuator Assembly (A2)

The output of the power amplifier is coupled to the Attenuator Assembly. The step attenuator consists of resistive attenuator sections which are switched in and out by cam-driven microswitches. The top two ranges are 0 dB and each succeeding step is 10 dB (120 dB maximum) at an impedance of 50Ω. The capacitor couples the output to the RF OUTPUT connector J3 (chassis mounted).

TROUBLESHOOTING

In general, troubleshooting the A1A1 assembly is most easily done with the frequency set to 10 MHz, and with an oscilloscope and high impedance probe.

If the AUX RF OUT is lower than normal (<−7 dBm) and the A1 RF Section Assembly output is +4 ±2 dBm, check amplifier stages A1A1Q1 through A1A1Q4 for proper operation.

If the AUX RF OUT level is correct but the signal input applied to A1A1Q5 is abnormal, check the modulator (A1A1CR2 and CR3) and the modulator drive from A1A1U1.

If the input to A1A1Q5 is normal but the RF OUTPUT level is incorrect, check A1A1Q5—Q7 for proper bias. One transistor failure in the Power Amplifier will often cause another to fail.

NOTES

Verify that cables and connectors are secure.

The A1A1 RF Amplifier/ALC Assemblies are normally grounded through the RF Cables and the casting. If either assembly is lifted out for troubleshooting purposes, provide a ground connection to the chassis with a jumper wire.

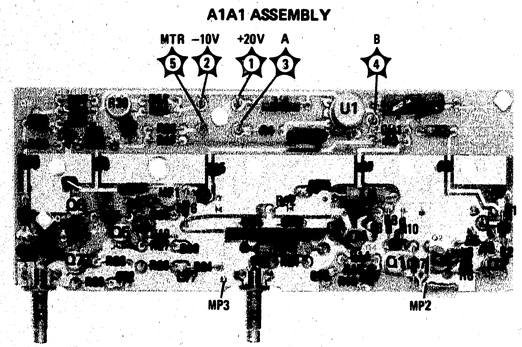
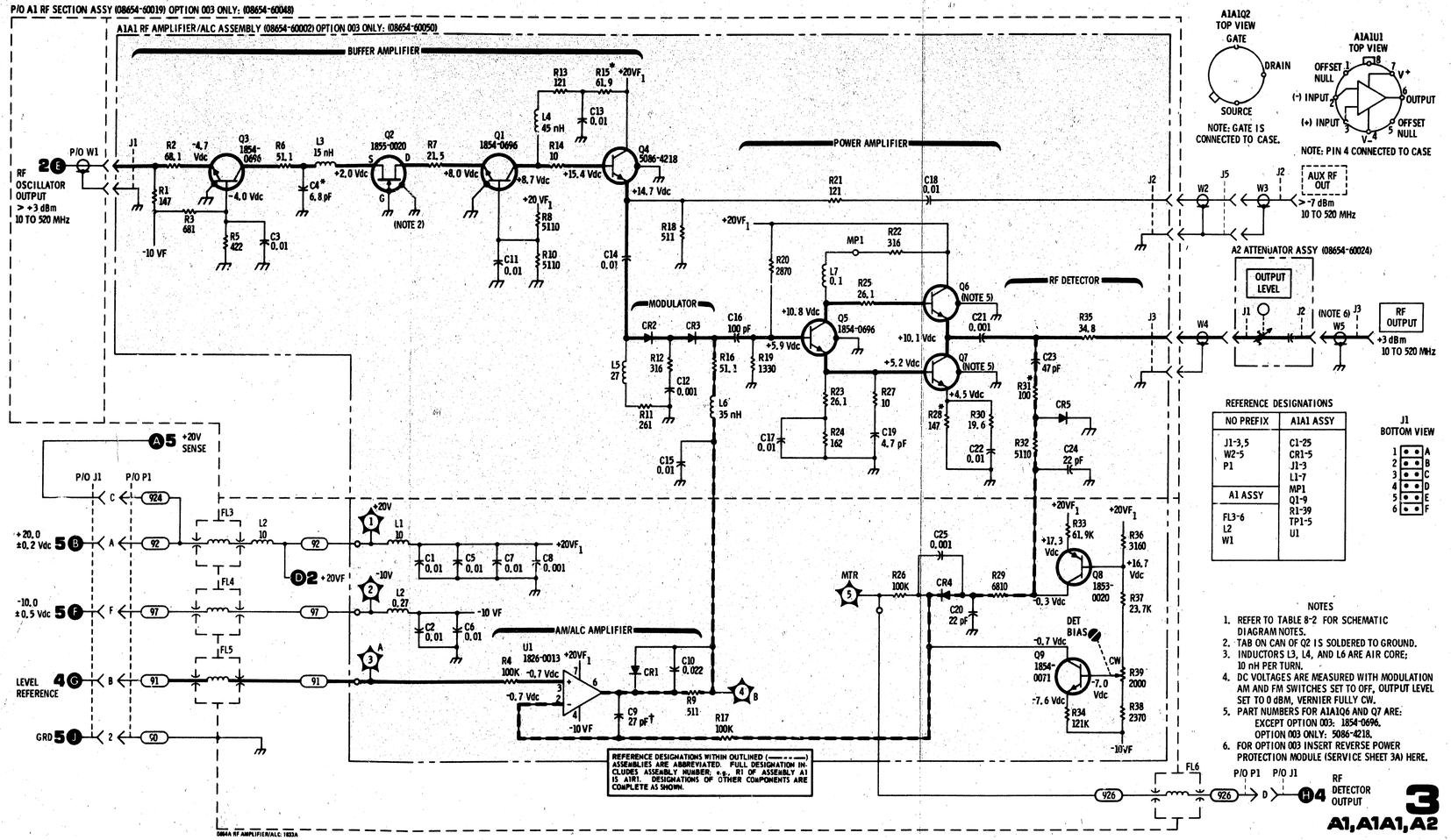


Figure 8-10. A1A1 RF Amplifier/ALC Assembly Component Locations



NOTES

1. REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
2. TAB ON CAN OF Q2 IS SOLDERED TO GROUND.
3. INDUCTORS L3, L4, AND L6 ARE AIR CORE; 10 nH PER TURN.
4. DC VOLTAGES ARE MEASURED WITH MODULATION AM AND FM SWITCHES SET TO OFF, OUTPUT LEVEL SET TO 0 dBM, VERNIER FULLY CW.
5. PART NUMBERS FOR A1A1Q6 AND Q7 ARE: EXCEPT OPTION 003: 1854-0696. OPTION 003 ONLY: 5086-4218.
6. FOR OPTION 003 INSERT REVERSE POWER PROTECTION MODULE (SERVICE SHEET 3A) HERE.

Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram

3
A1, A1A1, A2

SERVICE SHEET 3A (Option 003)

PRINCIPLES OF OPERATION

General

This Service Sheet documents instruments with reverse power protection (Option 003). The Reverse Power Protection circuit opens a relay contact in the RF signal path to prevent damage to the generator's output circuits if excessive power is applied to the output jack A6J2. During the time required to open the relay (≈50 μs), the Limiter maintains a safe signal level at the output circuits of the generator. (With LINE switch set to OFF, the relay contacts are open.)

Detector (A6A1)

The Detector is a peak-to-peak detector which senses the RF level. The signal is first reduced by a capacitive voltage divider to protect the detector against large RF levels. It is formed by C10 and the parallel capacitances of C8, CR4, and CR2 with VR2. During negative excursions of the RF signal, current flows through CR4 and charges C10 to approximately Vpk/8. During positive excursions, the stored charge adds to the signal passed by C10 and passes through detector diode CR2. The detected output is stored in the parasitic capacitance of VR2. VR2 also protects the comparator by limiting the maximum signal applied to the comparator.

Level Sensor and Relay Driver (A6A1)

Normally, the RF output signal passes through relay K1 to the output jack A6J2. K1 is held closed by the action of the Detector, Level Sensor, and Relay Driver. Resistors R1 and R2 set a reference level at the non-inverting input of comparator U1. This reference level is more positive than the normal Detector voltage, so the comparator output is pulled high through resistor R7 (U1 is an open-collector output device requiring and external pull-up resistor). The high level on the base of transistor Q1 biases Q1 and Q2 on, thus energizing relay K1 (closed).

An increased signal level at A6J2 will cause an increased Detector output level. If the level from the Detector exceeds the reference level, the comparator output will switch low. (Resistor R4 provides hysteresis to the comparator input to prevent oscillations and ensure positive switching.) A low level on the base of Q1 will bias Q1 and Q2 off. Relay K1 will de-energize (open) when the collector current of Q2 stops flowing. Collector voltage of Q2 will approach source potential to drive transistor Q3 into conduction which can supply approximately +4V at 50 mA to FL2. When the relay opens, capacitor C11 provides a discharge path for the current induced in the relay coil.

When reverse power is removed, the Detector voltage drops below the reference level. The comparator output starts rising toward its high state to close the relay. Capacitor C4 slows the rate of change to decrease relay contact chatter if the reverse power signal is pulsed.

RF Amplifier/ALC Assembly
(A1A1, A2)
SERVICE SHEET 3

SERVICE SHEET 3A (Cont'd)

Limiter (A6A1)

The limiter clips any RF voltage imposed on it (from any direction) at approximately 21.2V peak-to-peak as described below.

Assume a reverse power signal entering from RF Output. During the first incoming RF cycle, CR3 clips off any negative signal voltage lower than one diode junction drop. During the following half cycle, capacitors C2 and C6 store a charge that positively offsets the cathode of CR3. This has the effect of re-referencing the subsequent RF signal at CR3 so that its peak negative voltage occurs just one diode junction drop below ground. For example, a 5V p-p signal at J2 has excursions of ±2.5Vp. The re-referenced signal at CR3 will have a positive excursion of +4.4V and a negative excursion of −0.6V. During the second RF cycle, the anode of CR1 acquires a similar but negative offset. A re-referenced 5 Vp-p signal at CR1 will have a positive excursion of +0.6V and a negative excursion of −4.4V. Once these offsets are established, the sum of the re-referenced in-phase RF signals across VR1 and VR3 is a dc voltage equal to the peak-to-peak RF voltage minus the two diode junction drops of CR1 and CR3. For the 5 Vp-p signal, this voltage from CR1 anode to CR3 cathode, would be approximately +3.8 Vdc, insufficient to cause the zeners to conduct. When this dc voltage exceeds the sum of the breakdown voltages of VR1 and VR2, the limiter symmetrically clips the RF waveform. This occurs at RF inputs greater than 21.2 Vp-p. Note that the limiter acts on RF from either direction, the generator or reverse power.

Capacitors C8, C9, and C10, inductors L1 and L2, and the parasitic capacitances of CR1 and CR3 form a low-pass filter to maintain level flatness of the output signal over the range of the generator. Capacitors C3, C5, and C7, and resistors R5, R8, and R9 prevent RF from entering the Relay Driver.

TROUBLESHOOTING

Troubleshooting the A6 assembly by using the test equipment and following the procedure listed below.

Test Equipment

Digital Voltmeter	HP 34702A/34740A
Oscilloscope	HP 182C/1801A/1820C
Test Oscillator	HP 651B
50-Ohm Load	HP 11593A

Limiter

1. With LINE set to OFF, connect test oscillator output to RF IN (FROM ATTEN), A6J1, through a coaxial tee. Connect other port of the tee to an oscilloscope.
2. Set test oscillator to 1 MHz with amplitude turned down. Set oscilloscope to display a 1 MHz signal with 10V per vertical division.
3. Increase test oscillator output level until clipping off the signal appears on oscilloscope. Amplitude of the clipped waveform should be 19.0 to 23.0 Vp-p.

Detector

1. With LINE set to OFF, disconnect output cable W11 and connect 50 ohm load to RF OUT (TO FRONT PANEL), A6J2.
2. Orient the Reverse Power Protection Assembly so that comparator A6U1 is accessible.
3. Set OUTPUT LEVEL to +10 dBm range and LINE to ON.
4. Observe dc voltage at pin 3 of A6U1 while adjusting OUTPUT LEVEL over full vernier ranges. The voltage should vary from approximately 50 to 500 mVdc.

Level Sensor, Relay Driver, and Indicator Driver

1. Short pin 2 of comparator A6U1 to ground. The Level Sensor, Relay Driver, and Indicator Driver circuits should switch to "relay-open" conditions (see appropriate dc voltages on schematic).

A6A1 ASSEMBLY

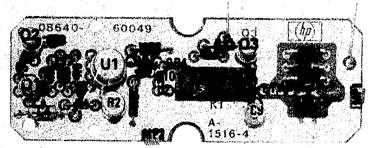
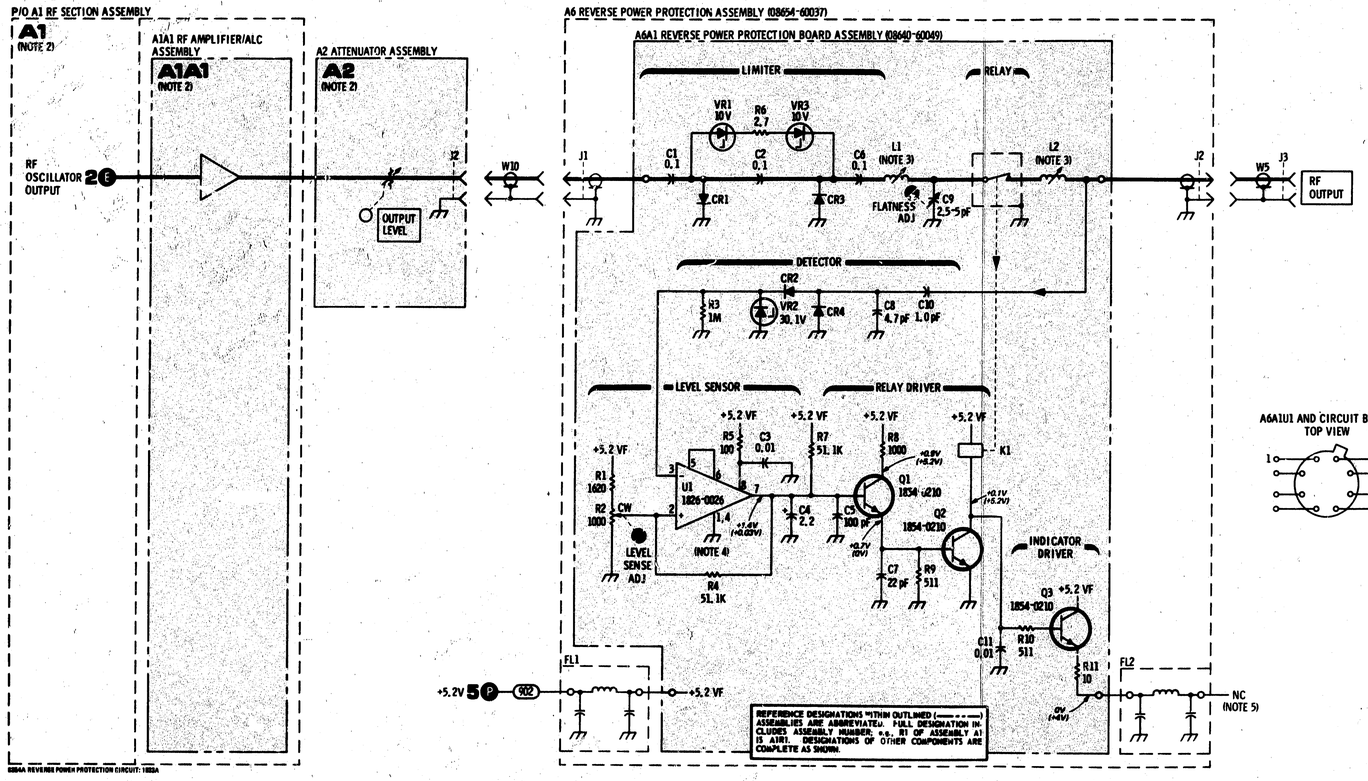


Figure 8-12. A6A1 Reverse Power Protection Board Assembly Component Locations



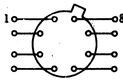
NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. SEE SERVICE SHEET 3 FOR DETAILED SCHEMATIC DIAGRAMS OF THESE ASSEMBLIES.
3. REFER TO OUTPUT IMPEDANCE ADJUSTMENT (OPTION 003).
4. OPEN COLLECTOR OUTPUT.
5. APPROXIMATELY +4V AT 50mA AVAILABLE TO DRIVE A PROTECTION INDICATOR CIRCUIT.
6. DC VOLTAGES ARE SHOWN FIRST FOR RELAY CLOSED. VOLTAGES FOR RELAY OPENED ARE SHOWN IN PARENTHESES.

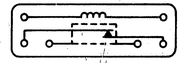
REFERENCE DESIGNATIONS

NO PREFIX	A6A1 ASSY
J3	C1-11
W5, 10	CR1-4
A2 ASSY	K1
J2	L1,2
A6 ASSY	Q1-3
FL1,2	R1-11
J1,2	U1
	VR1-3

A6A1U1 AND CIRCUIT BOARD TOP VIEW



A6A1K1 AND CIRCUIT BOARD BOTTOM VIEW



3A OPTION 003

Figure 8-13. Reverse Power Protection Assembly Schematic Diagram

SERVICE SHEET 4

PRINCIPLES OF OPERATION

General

The A3 Control/Power Supply Assembly contains the +20 and −10 volt power supplies, the audio modulation oscillator, the ALC level reference amplifier, and the meter circuits. Refer to Service Sheet 5 for information and schematics pertaining to the power supplies.

Audio Oscillator (A3)

When either the AM or FM MODULATION switches are set to INT, the Audio Oscillator is enabled. The oscillator couples a signal of either 400 Hz or 1 kHz (selected by the INTERNAL MODULATION switch) into the AM or FM modulator circuits and to the AM or FM front panel output jacks.

The oscillator consists of U4B and associated components. A frequency-selective modified bridged-tee network forms a negative feedback path. This network, composed of chassis-mounted C1 and A3C16, C19, C20, R20, R21, R22, and R25, is a notch filter with zero phase shift (minimum negative feedback) at the minimum of the notch. The positive-feedback path is a voltage divider in which the amount of feedback is determined by the output of a peak detector. The amount of feedback automatically adjusts to maintain oscillation at a constant output amplitude. The voltage divider consists of R23, CR6, and CR7. Diodes CR6 and CR7 are in ac parallel and dc series. The ac resistance is determined by the dc voltage across capacitor C18. At the peak of each output cycle, VR3 and CR8 conduct and replenish the charge lost from C18. The ac voltage at the output of U4B is approximately 5.2 Vrms. The output is coupled to the AM or FM output jacks, and to the Audio Amplifier U4A through chassis-mounted LEVEL control R1.

Audio Amplifier (A3)

The Audio Amplifier U4A increases the level of the internal modulation signal to drive the AM or FM modulator circuits. The signal gain of the amplifier is about 1.7. The output drives the FM modulator directly, or the level reference amplifier through resistor R33.

Level Reference Amplifier (A3)

The Level Reference Amplifier U1 sums the ALC reference current (supplied by the +20 volt supply through R36) and the AM signal current (either external or from the audio amplifier). The sum of the two currents flows through R37 and generates the negative level reference voltage. The amplifier output drives the AM detector and is coupled to the VERNIER control R5 (chassis mounted). On the +10 dBm OUTPUT LEVEL range, R7 (chassis mounted) is switched

Reverse Power Protection Assembly (A6)
SERVICE SHEET 3A

out. The ALC reference to the modulator is increased by 10 dB. The output power increases by 10 dB, but AM depth is limited by the maximum output power available. Diodes CR9 and CR10 protect the Level Reference Amplifier input.

Shaping Amplifier (A3)

The Shaping Amplifier U5 pre-distorts low level inputs to compensate for non-linearities in the RF detector at low RF levels. The amplifier gain is near unity. The signal level at the non-inverting (+) input of U5 is normally negative enough to turn off diode CR15 and thus CR15 has no effect. For small negative signal levels CR15 is turned on slightly, the input impedance is lowered, and the overall gain reduced. The point at which CR15 turns on is set by the current established by R52 and R49. Diode CR16 thermally compensates CR15. The DIST ADJ control R52 is set for minimum AM distortion at a low ALC reference level. The shaping amplifier drives the AM/ALC amplifier (Service Sheet 3).

Audio Detector (A3)

The Audio Detector is a negative peak detector which samples the negative ac peak of the incoming AM modulation signal and stores the voltage on a capacitor. The detector output is proportional to the AM depth. Amplifier U3A is used as a voltage comparator. When the voltage at pin 3 is more negative than the voltage at pin 2, the output rapidly switches to a level equal to the voltage across capacitor C28 (which is connected to pin 2 through R49 and R45) minus the voltage drop across the forward-biased diode CR14. The amplifier discharges C28 until the voltage at pin 2 equals the voltage at pin 3, and maintains this condition until the voltage at pin 3 rises. The amplifier then switches positive and slowly charges C28 through resistor R44 and R45 until the voltage at pin 3 becomes more negative than pin 2. Thus, the negative peak value of the input voltage is stored on C28. Resistor R41 adds a small amount of gain to the detector because R41, R44, and R45 form a voltage divider. The detector drives the meter driver amplifier when the AM MTR switch is pressed.

Meter Driver (A3)

The Meter Driver U3 provides an output current to panel meter M1 proportional to the input voltage. The input is either the RF detector output (proportional to RF output voltage) or the Audio Detector output. The voltage at pin 5 is equal to that at pin 6. The voltage at pin 6 establishes the current through resistors R57, R58, and R59 (and R53 when grounded). The current flowing through these resistors also flows through the meter to the amplifier output. R57 varies the amplifier gain, and R54 varies the amplifier offset. R53 reduces the amplifier gain by 10 dB when the OUTPUT LEVEL is set to +10 dBm to compensate for the 10 dB increase in the amplifier input. Resistor R60 limits the maximum meter current.

TROUBLESHOOTING

Measuring inputs and outputs and comparing them with the normal reading as shown on the schematic is the most efficient way of isolating a malfunctioning stage.

P/O A3 ASSEMBLY

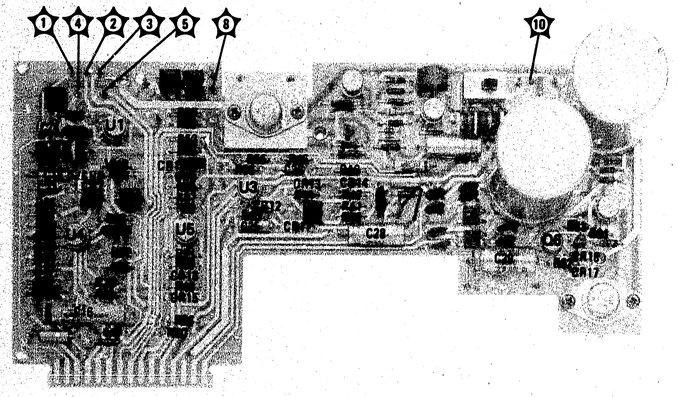


Figure 8-14. P/O A3 Control/Power Supply Board Assembly Component Locations

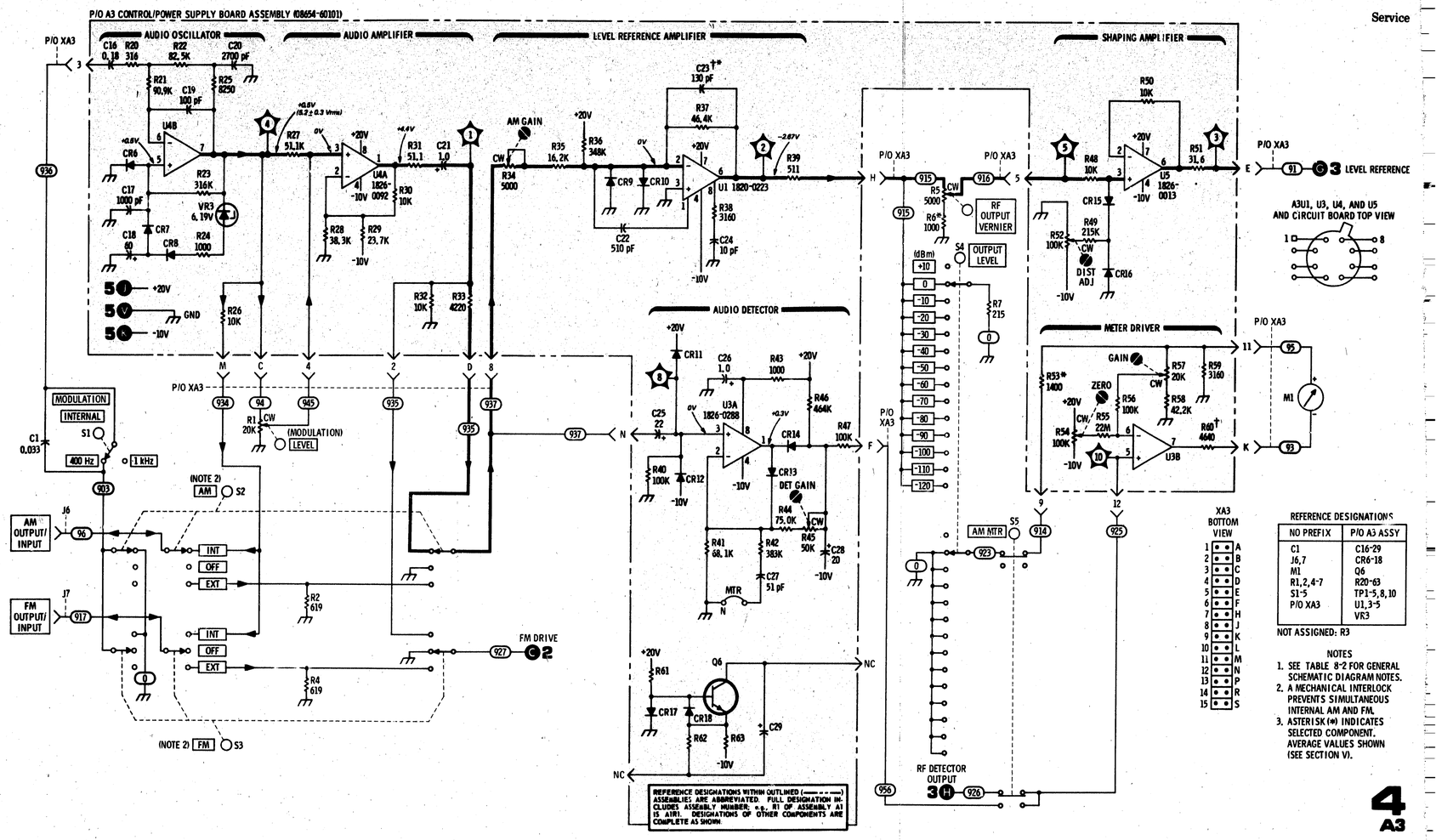


Figure 8-15. P/O A3 Assembly (Control) Schematic Diagram

SERVICE SHEET 5

PRINCIPLES OF OPERATION

+20 Volt Regulator (A3)

The +20 Volt Regulator is a linear series type with current limiting for over-current protection. The series regulator transistor Q1 is collector (case) grounded and regulates on the ground return side of the supply. Amplifier U2 compares the output voltage with the reference extablished by VR1; the output drives transistor Q2. Q2 is a common-base amplifier which drives Q1. RC networks R10 and C18, R19 and C15, and R15 and C14 provide frequency compensation. Transistor Q3 senses excessive supply current flowing through R16 and shuts down the supply by taking drive current away from the base of Q1. Resistor R14 biases the base of Q2 during turn on and diodes CR4 and CR5 clamp the base near ground potential when the supply is on.

The Power Supply Isolation Switch S1 aids in fault isolation of the +20V supply. By switching S1 to TEST, the +20V supply is connected to a test load R8, also the sense line (going to VR1 and R4) is connected directly on the Power Supply Assembly (rather than in A1). If a short had existed on A3 or elsewhere in the instrument, the supply would now operate normally and thus verify that the supply was not at fault.

−10 Volt Regulator (A3)

The −10 Volt Regulator is a linear series type with current limiting. Amplifier U6 compares ground with the output of voltage divider R2 and R3, which is connected between the +20 Vdc and −10 Vdc outputs. U6 drives the series regulator transistor Q5. The −10 Vdc supply is dependent on the +20 Vdc supply for its operation. RC network R7 and C12 provides frequency compensation. Transistor Q4 limits supply current.

TROUBLESHOOTING

Before attempting to troubleshoot the power supplies, check the lamp in the LINE switch to see if it is illuminated. If not, check the fuse. Also verify that the transformer primary is matched to the available line voltage (refer to Figure 2-1).

The −10 volt supply is dependent on the +20 volt supply. Check the +20 volt supply before attempting to troubleshoot the −10 volt supply. Check the +20 volt supply by setting S1 to TEST. If the +20 volt supply checks good with the Power Supply Isolation switch set to TEST, the load on the supply should be suspected.

Q3 and Q4 are current limiting transistors. If the voltage measured across R16 or R9 is ≈ 0.6 Vdc, the supply which exhibits this condition will have a voltage lower than normal due to excess current flow.

Total current flow through a power supply may be calculated by measuring the voltage across R16 or R9. The total current flow to the A1 RF Assembly may be measured at XA3 pin 6 (+20 volt supply) and XA3 pin 10 (−10 volt supply). Malfunctioning components which cause high current flow may be isolated to the RF assembly or chassis by measuring the total and RF section current flow. One may also measure resistance at the power supply outputs with the instrument turned off. Reference the negative ohmmeter probe to ground.

Measurement	Supply	
	+20V	−10V
Total Current	0.25A	0.07A
RF Assy. Current	0.14A	0.05A
Resistance	950Ω*	800Ω**

* S1 switch set to TEST

** S1 switch set to NORMAL

If noise is evident in the power supplies in the form of ripple, a filter capacitor may be defective. The ripple frequency is normally 120 Hz; if it is 60 Hz, a rectifier diode quad is probably defective. White noise may be caused by a defective operational amplifier (U2 or U6) or the regulator diode VR1. RF noise would be evident if the high-frequency rolloff networks (R15 and C14, R10 and C13, C15 and R9; R7 and C12) are defective.

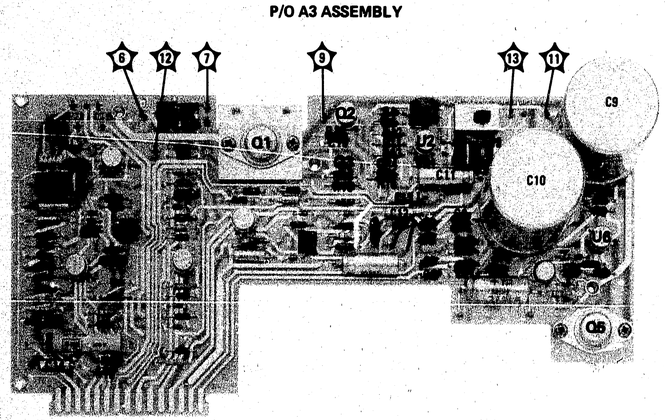
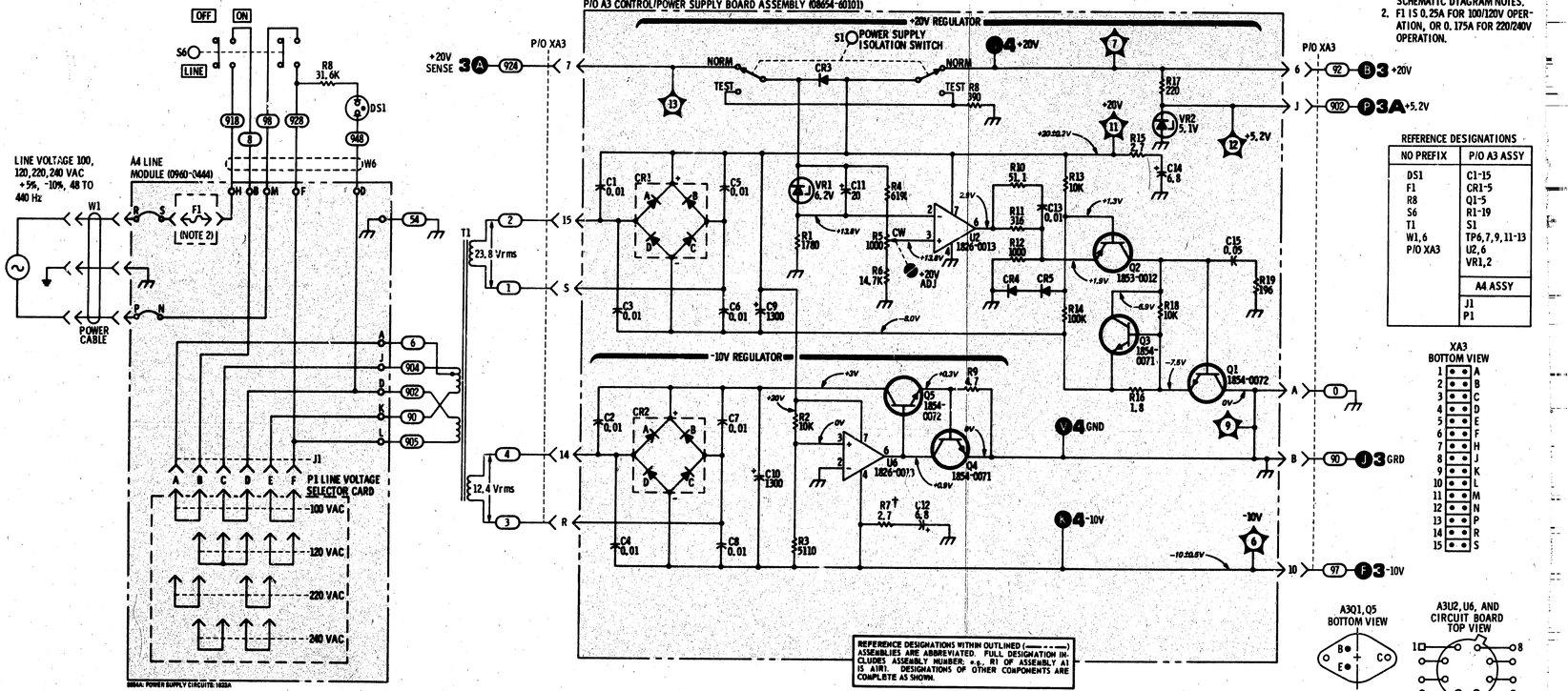


Figure 8-18. P/O A3 Control/Power Supply Board Assembly Component Locations



NOTES:

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. F1 IS 0.25A FOR 100/120V OPERATION, OR 0.175A FOR 220/240V OPERATION.

REFERENCE DESIGNATIONS

NO PREFIX	P/O A3 ASSY
DS1	C1-15
F1	CR1-5
R8	Q1-5
S6	R1-19
T1	S1
W1, 6	TP6, 7, 9, 11-13
P/O XA3	U2, 6
	VR1, 2
	A4 ASSY
	J1
	P1

XA3 BOTTOM VIEW

1	A
2	B
3	C
4	D
5	E
6	F
7	H
8	J
9	K
10	L
11	M
12	N
13	P
14	R
15	S

A3Q1, Q5 BOTTOM VIEW

A3U2, U6, AND CIRCUIT BOARD TOP VIEW

Figure 8-17. P/O A3 Assembly (Power Supplies) Schematic Diagram

SERVICE SHEET A

A1 RF Section Disassembly and Reassembly

NOTE

Numbers in parentheses refer to Figure 8-19.

RF Section Cover (1) Removal

1. Remove RF Section Assembly (Service Sheet B).
2. Remove four pan-head screws with lockwashers (134, 136) and remove cover.

RF Section Cover (1) Installation

MICROPHONICS

In order to minimize the possibility of microphonics and RFI in the generator, perform steps 1 through 4 before replacing the RF section cover.

1. Glue any loose wires on turret inductors with coil varnish.[1]
2. Check the Frequency Tune capacitor shaft for looseness by applying lateral pressure to the large pulley (23). If the shaft is loose, it can be tightened using the screw and locknut on the end of the capacitor opposite the pulley.
3. Check that all nuts, screws, and connectors are tight.
4. Check that the RFI braid (133) is in place and properly meshed to the RF Section cover (1).
5. Carefully lift cover into place and securely replace four pan-head screws with lockwashers (134, 136). Avoid damaging electrical or mechanical parts with cover while installing.

RF Amplifier/ALC Board Assembly Removal (A1A1)

1. Remove RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).

WARNING

The edges of the RFI gasket on the amplifier cover (103) are sharp and can cause personal injury if not handled with care.

2. Remove four pan-head screws with starwashers (107) and three pan-head screws with lockwashers (104, 105) from RF Amplifier cover (103) and lift off cover.

[1] E.g., 1202 Glyptal Clear Air Drying and Baking Varnish, General Electric Supply Co., Insulating Material Products Dept., No. 1 Campbell Rd., Schenectady, N.Y., 12306 (HP 6010-0024).

SERVICE SHEET A (Cont'd)

3. Remove W1, W2, and W4 from A1A1J1 through J3 (100, 101, 110).
4. Remove three hex nuts and lockwashers (71, 73, 76, 77, 114, 116) that secure A1A1J1 through J3 (100, 101, 110).
5. Remove 9/16-inch output amplifier bushing (113).
6. Remove two flat-head screws (102) that secure RF Amplifier divider and remove divider (108).
7. Carefully lift A1A1 RF Amplifier up and back to free board from RF Amplifier Shield. Wires attached to the board are long enough to allow board removal without desoldering.

NOTES

The shield and ground clip near Q2 may easily be broken off. If so they must be resoldered before assembly installation to ensure proper operation of the RF Amplifier/ALC circuits.

If the assembly is to be checked for malfucntions with the board assembly removed from the casting, a ground wire must be attached from circuit board ground to chassis ground.

RF Amplifier/ALC Board Installation (A1A1)

1. Replace RF Amplifier/ALC Board while feeding the four wires through the hole for them in the RF Amplifier Shield. (Do not pinch wires beneath board.)
2. Loosely replace center divider (108) with two flat-head screws (102).
3. Replace 9/16-inch output amplifier bushing (113) and secure tightly.
4. Replace and tighten lockwashers (73, 77) and hex nuts (71, 76) that secure A1A1J2 (100) and A1A1J3 (101).
5. Replace and tighten hex nut and lockwasher (114, 116) that secures A1A1J1 (110).
6. Tighten two flat-head screws (102) that secure RF Amplifier center divider (108).
7. Replace RF Amplifier cover (103) by loosely inserting three pan-head screws with lockwashers (104, 105) and four pan-head screws with star washers (107).

NOTE

RFI gasket should mesh neatly against the base plate (84).

SERVICE SHEET A (Cont'd)

8. While pressing down and forward on cover, first tighten three center screws, then four corner screws.
9. Reconnect W1 (117) to A1A1J1 (110).

RF Oscillator Board Assembly Removal (A1A3)

1. Remove RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).
2. Remove W1 (117) from A1A3J1 (7).
3. Remove two hex nuts (4) with lockwashers (6).
4. Desolder two wires.

CAUTION

Be careful not to damage the capacitors close to the hex nuts. It may be necessary to grind down the sides of the hex-nut driver to gain necessary clearance from the capacitors.

RF Oscillator Board Assembly Installation (A1A3)

1. Install the RF Oscillator Board Assembly (9) by reversing the removal procedure, while observing the following considerations.

CAUTION

Do not overtighten the hex nuts. The mounting studs are easily stripped.

NOTE

When resoldering the two wires, it is important that they be twisted.

Turret Assembly Removal (A1A4)

1. Remove the RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).
2. Remove heat sink on transistor A1A3Q3.
3. Disconnect W1 from A1A3J1 (7).
4. Loosen two setscrews (124) that secure turret to Turret Assembly Shaft (70).
5. Turn turret halfway between ranges and gently slide it off of the shaft.

SERVICE SHEET A (Cont'd)

CAUTION

Do not lift or pull the Turret Assembly by the inductor coils. Be careful not to snag the coils on the RF Oscillator Board.

Turret Assembly Installation (A1A4)

1. If the Frequency Tune capacitor or FM Modulator Board Assembly (14) has been removed, it must be installed before installation of the Turret Assembly.
2. If the RF Oscillator is in place remove the heatsink on A1A3Q3 and remove W1 from A1A3J1 (7).
3. With the Turret Assembly (121) held in a mid-range position carefully press it onto the Turret Assembly Shaft (70). The turret's metal ring should mate with the contact (126).

CAUTION

Do not lift or pull the Turret Assembly by the inductor coils. Be careful not to snag the coils on the RF Oscillator Board.

4. Turn frequency dial to 250—520 MHz range. Turn turret so that the inductor pins for 250—520 MHz range are touching the capacitor contacts (inductor is metal plate, no wire). Center inductor pins (in two planes) on capacitor contacts and tighten two allen setscrews to shaft.
5. Check all ranges for proper contact of the inductor pins with the capacitor contacts. The minimum deflection of the contacts on any range should be greater than or equal to 0.8 mm (1/32 inch). If adjustment is required, loosen two pan-head screws (26) on capacitor bracket and two pan-head screws (12) on FM Modulator Board bracket. Make adjustment by moving entire capacitor assembly just enough so that the contact deflection is as described above for all ranges.
6. Replace heatsink on A1A3Q3 and reconnect W1 to A1A3J1.

FM Modulator Board Assembly Removal (A1A2)

1. Remove RF Section Assembly (Service Sheet B) the RF Section cover, and the Turret Assembly (procedures given above).
2. Remove two pan-head screws (12) with star washers and four flat washers (13, 15).
3. Remove two hex nuts (8) and lockwashers (10).
4. Desolder two wires and remove board.

FM Modulator Board Assembly Installation (A1A2)

1. If the Frequency Tune capacitor (19) has been removed, it must be installed before installation of the FM Modulator Board Assembly (14).
2. Install the FM Modulator Board Assembly by reversing the procedures for removal.

CAUTION

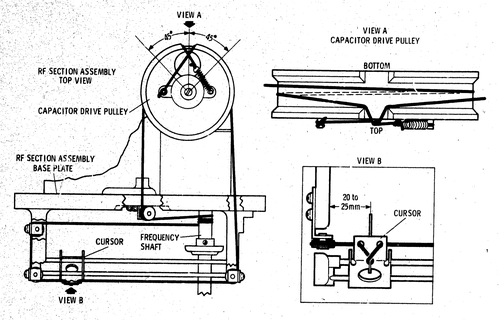
Do not overtighten the hex nuts (8). The mounting studs are easily stripped.

Frequency Tune Capacitor Removal (A1C3)

1. Remove RF Section Assembly (Service Sheet B), and the RF Section cover, the RF Oscillator Board Assembly, the Turret Assembly, and the FM Modulator Board Assembly. The procedures are given above.
2. In order to prevent the need to restring the dial, securely tape the dial cord to the tuning capacitor pulley (23).
3. Loosen two allen setscrews (18) that secure the pulley to the tuning capacitor shaft and lift pulley off. (Position pulley to maintain cord tension.)
4. Remove two pan-head screws (20) and lock nuts (24) at the capacitor mounting bracket (25) and remove capacitor.

Frequency Tune Capacitor Installation (A1C3)

1. Install the Frequency Tune Capacitor by reversing the procedures for removal.



1. Remove RF Section Assembly (Service Sheet B) and the RF Section cover (Service Sheet A).

2. Removing the dial drum facilitates dial stringing. The dial drum is removed by removing the retainer ring, flat washer, and spring washer at the right end of the dial drum shaft assembly. Loosen the dial drum setscrew and remove the shaft and drum.

3. Cut 1.3 m (4 ft.) of 0.7 mm (0.027 in.) diameter, nylon covered, glass core dial cord (A1MP56).

4. Thread approximately 840 mm (33 in.) of cord through the left side of the cursor. Loop the cord twice clockwise around the bottom pin on the cursor and thread the remainder through the right hole in the cursor.

5. Feed the right side of the cord around the right pulley (54), through the base plate, around the tuning capacitor pulley (23) to the start pin (indicated in the figure above).

6. At this point, the notch in the frequency tune pulley should face away from the base plate (±45°), and the pointer of the cursor should be approximately 20 to 25 mm (7/8 to 1-inch) from the left protrusion of the base plate. (This approximates a 10 MHz frequency tune position.) Secure the dial cord to the pin with a figure-eight knot.

7. Feed the left end of the dial cord around the left front pulley (91) and the rear, angle pulley (45). Loop the cord 2½ turns counterclockwise around the frequency shaft (64), and feed it around the base plate pulley and through the base plate. Loop one turn clockwise around the frequency tune pulley and secure the end to the spring (22). Proper tension is achieved when the cord end of the spring extends to or slightly beyond the large hole in the pulley.

8. Rotate the frequency tune control to the extremes of the dial to assure proper operation.

9. Replace dial drum and shaft. Perform Frequency and Range Adjustment (paragraph 5-22).

Figure 8-18. Model 8654A Dial Stringing Procedure

Item No.	Reference Designator	Description
1	A1MP90	RF Section Cover
2	A1MP19	Back Damp Pad
3	A1MP20	Cover Damp Pad
4	A1MP115	Hex Nut
5	A1W1	Pickup Cable Assembly
6	A1MP21	Lock Washer
7	A1A3J1	RF Jack
8	A1MP115	Hex Nut
9	A1A3	RF Oscillator Board Assembly
10	A1MP22	Lock Washer
11	A1MP44	Flat Washer
12	A1MP101	Machine Screw
13	A1MP102	Flat Washer
14	A1A2	FM Board Assembly
15	A1MP102	Flat Washer
16	A1MP72,73	Capacitor Contact
17	A1MP52,53	Capacitor Damp Pad
18	A1MP129	Setscrew
19	A1C3	Variable Capacitor
20	A1MP100	Machine Screw
21	A1MP56	Nylon Cord
22	A1MP17	Extension Spring
23	A1MP74	Capacitor Drive Pulley
24	A1MP104	Hex Nut with Lock Washer
25	A1MP128	Capacitor Mount Bracket
26	A1MP105	Machine Screw
27	A1MP103	Flat Washer
28	A1MP103	Flat Washer
29	A1MP101	Machine Screw
30	A1MP106	Metal Cable Clamp
31	A1MP1	Solder Lug
32	A1MP82	Feedthru Shield
33	A1FL2	Feedthru Filter
34	A1C2	Capacitor
35	A1FL1	Feedthru Filter
36	A1MP109	Flathead Screw
37	A1MP68	Feedthru Shield Gasket
38	A1MP69	Braid Clamp
39	A1MP114	Machine Screw
40	A1MP109	Flathead Screw
41	A1MP54	RFI Braid
42	A1L2	Inductor
43	A1L1	Inductor
44	A1FL4	Feedthru Filter
45	A1MP62	Pulley Bracket
46	A1MP116	Machine Screw
47	A1FL6	Feedthru Filter
48	A1FL5	Feedthru Filter
49	A1FL3	Feedthru Filter
50	A1C1	Feedthru Capacitor

Item No.	Reference Designator	Description
51	A1MP43	Spring Washer
52	A1MP39	Flat Washer
53	A1MP8	Retainer Ring
54	A1MP63	Pulley Bracket
55	A1MP116	Machine Screw
56	P1	Terminal Board
57	A1MP84	Cursor Guide Rod
58	A1MP85	Cursor Guide Rod
59	A1MP4	Push On Retainer
60	A1MP5	Push On Retainer
61	A1MP60	Cursor
62	A1MP94	Setscrew
63	A1MP93	Dial Drum
64	A1MP77	Frequency Shaft
65	A1MP18	Ball Drive
66	A1MP127	Setscrew
67	A1MP78	Frequency Plate
68	A1MP98	Lock Washer
69	A1MP97	Machine Screw
70	A1MP92	Turret Shaft Assembly
71	A1MP29	Hex Nut
72	A1MP100	Machine Screw
73	A1MP24	Lock Washer
74	A1MP2	Solder Lug
75	A1MP10	Flex Tubing
76	A1MP30	Hex Nut
77	A1MP25	Lock Washer
78	A1MP98	Lock Washer
79	A1MP97	Machine Screw
80	A1MP112	Flat Washer
81	A1MP58	Leaf Spring
82	A1MP57	Detent Roller
83	A1MP59	Detent Spring
84	A1MP83	Base Plate
85	A1MP86	Counter Shaft Gear
86	A1MP9	Spring Pin
87	A1MP40	Flat Washer
88	A1MP42	Spring Washer
89	A1MP6	Push On Retainer
90	A1MP7	Push On Retainer
91	A1MP65	Pulley Bracket
92	A1MP116	Machine Screw
93	A1MP64	Pulley Bracket
94	A1MP91	Counter Shaft Assembly
95	A1MP116	Machine Screw
96	A1MP38	Spring Washer
97	A1MP41	Flat Washer
98	A1MP108	Grip Ring
99	A1MP89	Dial Drive Shaft Assembly
100	A1A1J3	RF Jack

Item No.	Reference Designator	Description
101	A1A1J2	RF Jack
102	A1MP111	Flathead Screw
103	A1MP71	RF Amplifier Cover
104	A1MP110	Machine Screw
105	A1MP23	Lock Washer
106	A1MP109	Flathead Screw
107	A1MP101	Machine Screw
108	A1MP81	RF Amplifier Divider
109	A1MP79	RF Amplifier End Plate
110	A1A1J1	RF Jack
111	A1A1	RF Amplifier Board Assembly
112	A1MP80	RF Amplifier Shield
113	A1MP76	Output Amplifier Bushing
114	A1MP26	Lock Washer
115	A1MP101	Machine Screw
116	A1MP31	Hex Nut
117	A1W1	Pickup Cable Assembly
118	A1MP67	Feedthru Shield Gasket
119	A1MP66	Oscillator Chassis
120	A1MP15	Hex Nut with Lock Washer
121	A1A4	Turret Assembly
122	A1MP109	Flathead Screw
123	A1MP100	Machine Screw
124	A1A4MP1	Setscrew
125	A1MP27	Non Metallic Washer
126	A1MP61	Contact
127	A1MP87	Threaded Plug
128	A1MP11	Flex Tubing
129	A1MP32	Setscrew
130	A1MP48	Silicon Rubber Damp Pad
131	A1MP14	Bushing
132	A1MP36	Flat Washer
133	A1MP55	Braid
134	A1MP96	Lock Washer
135	A1MP99	Machine Screw
136	A1MP95	Machine Screw
137	A1MP88	Threaded Plug

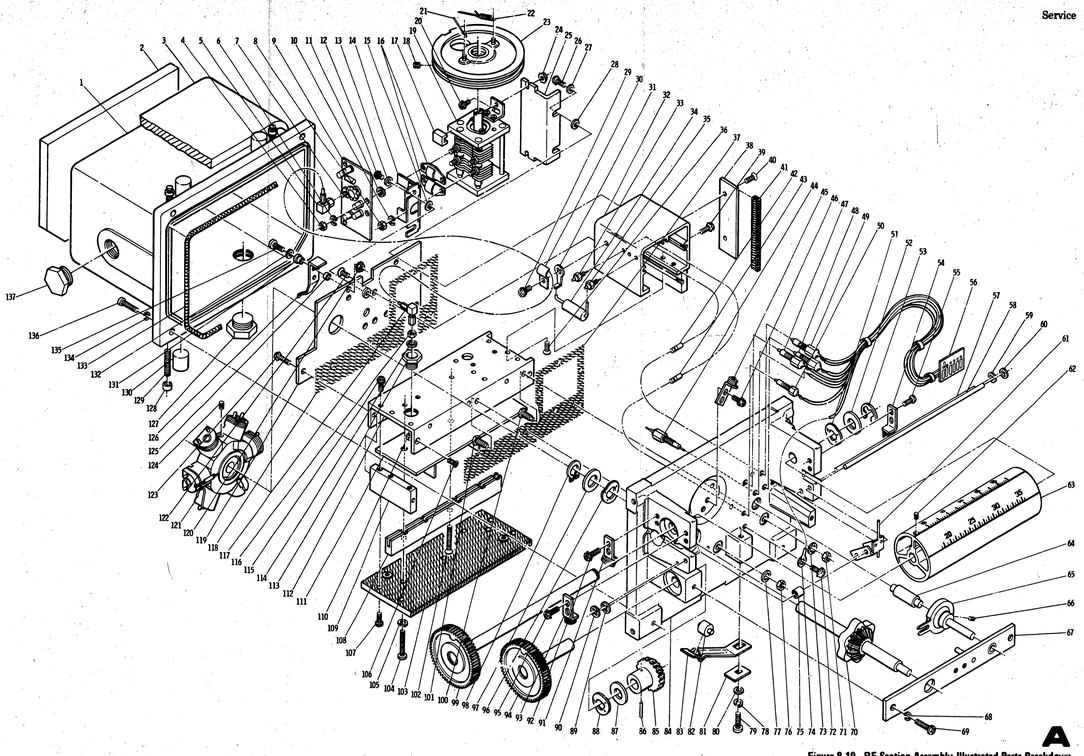


Figure 8-19. RF Section Assembly Illustrated Parts Breakdown

SERVICE SHEET B

A1 RF Section Removal and Installation Procedures

1. Remove all four instrument covers by removing 14 flat-head screws. The covers are shown in Figure 6-1 (MP's 1, 5, 8, and 11).

2. Loosen two machine screws that secure the meter bracket. Remove one flat-head screw from the top of the trim strip and one machine screw from each end of the strip. Carefully lift strip with meter off of the instrument. Be sure the meter index is free of its hole in the right side frame assembly. Slide meter off of trim strip and return it to the instrument.

CAUTION

Since the meter is not secured, care must be taken that it does not fall out when the instrument is tilted.

3. Remove the FREQUENCY RANGE and TUNE knobs from the front panel by loosening two allen screws each.

4. Disconnect semi-rigid cables W2 at J5 and W4 at A2J1 using the combination wrench supplied with the instrument.

5. Remove two flat-head screws from each end of the top RF Section Assembly support bar, and remove bar.

CAUTION

Bars on top and bottom of instrument support the full weight of the RF Section Assembly. To avoid damaging stress to semi-rigid coaxial cables W2 and W4, disconnect cables at J5 and A2J1 before removing support bars.

6. Disconnect 12-pin printed circuit card from J1.

7. Remove two flat-head screws from each end of the bottom RF Section Assembly support bar and remove bar.

8. Carefully lift out RF Section Assembly.

NOTE

Whenever RF Assembly is out of the instrument, take care not to bend dial cursor. It is also recommended that semi-rigid coaxial cables W2 and W4 be disconnected from the RF Assembly (at A1A1J2 and A1A1J3).

RF Section Assembly Installation

CAUTION

While working with and around the semi-rigid coaxial cables in the generator, do not bend the cables more than necessary. Do not torque the RF connectors to more than 0.5 Nm (5 inch-pounds).

MICROPHONICS

To minimize the possibility of microphonics in the generator, perform steps 1 and 2 before installing the RF Section Assembly.

1. Check that semi-rigid coaxial cables W2 and W4 are firmly connected to A1A1J2 and A1A1J3.

2. Check that the four large pan-head screws that secure the RF Section Assembly cover are tight.

3. Install RF Section Assembly in the generator by performing steps 2 through 8 of the removal procedure in reverse order.

MICROPHONICS

To minimize the possibility of microphonics in the generator, perform steps 4 through 7 before replacing the instrument covers.

4. Check that four rubber damper pads are in place in the top and bottom support bars.

5. Check that semi-rigid coaxial cables W2 and W4 are firmly connected at J5 and A2J1. The cables should not be touching the RF assembly casting, or the Attenuator assembly casting. The cables should be wrapped together at approximately 50 mm (2-inch) intervals.

6. Check that the FREQUENCY RANGE and TUNE knobs do not touch the front panel as they turn through their range.

7. Replace the four instrument covers ensuring that all screws are tight.

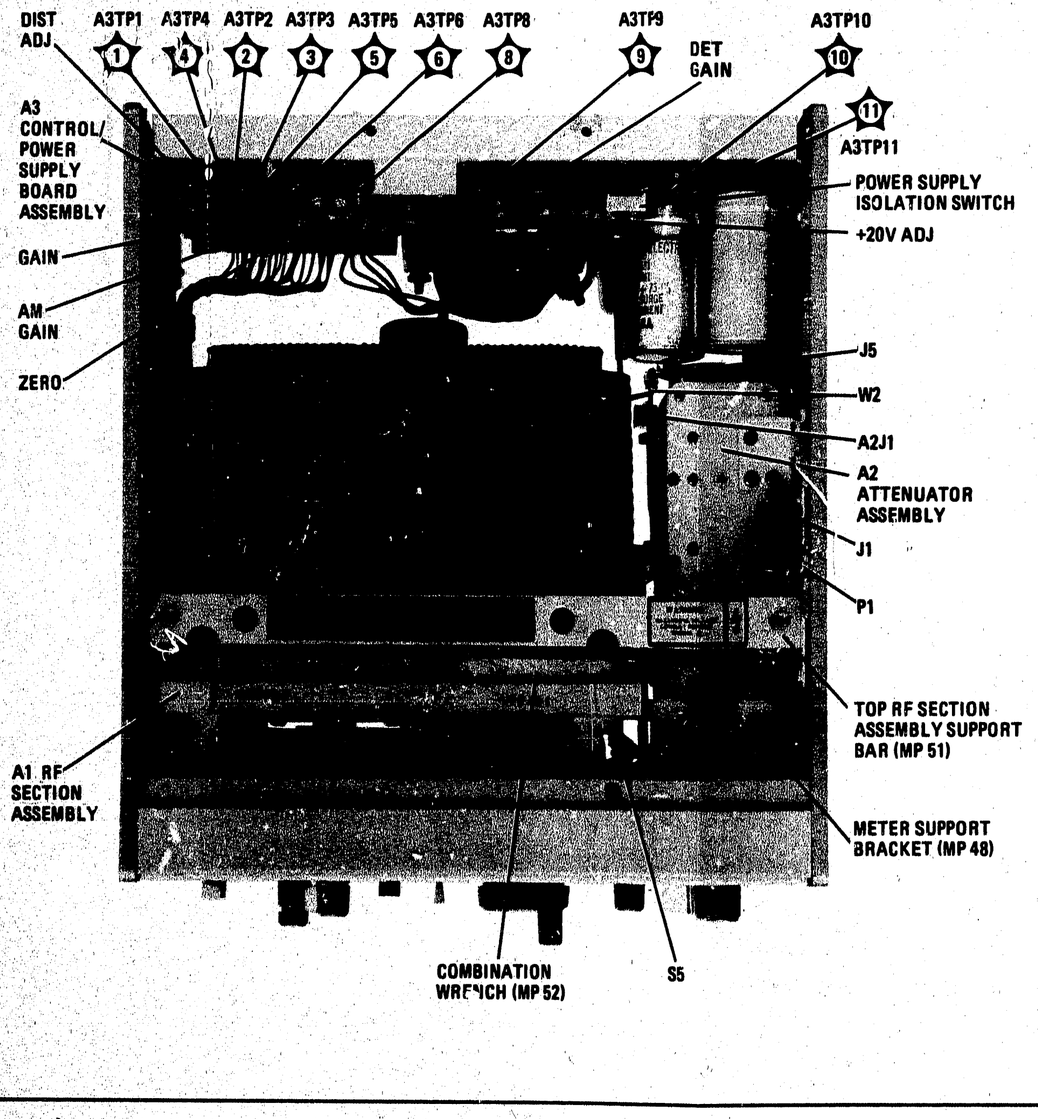


Figure 8-20. Top Internal View.

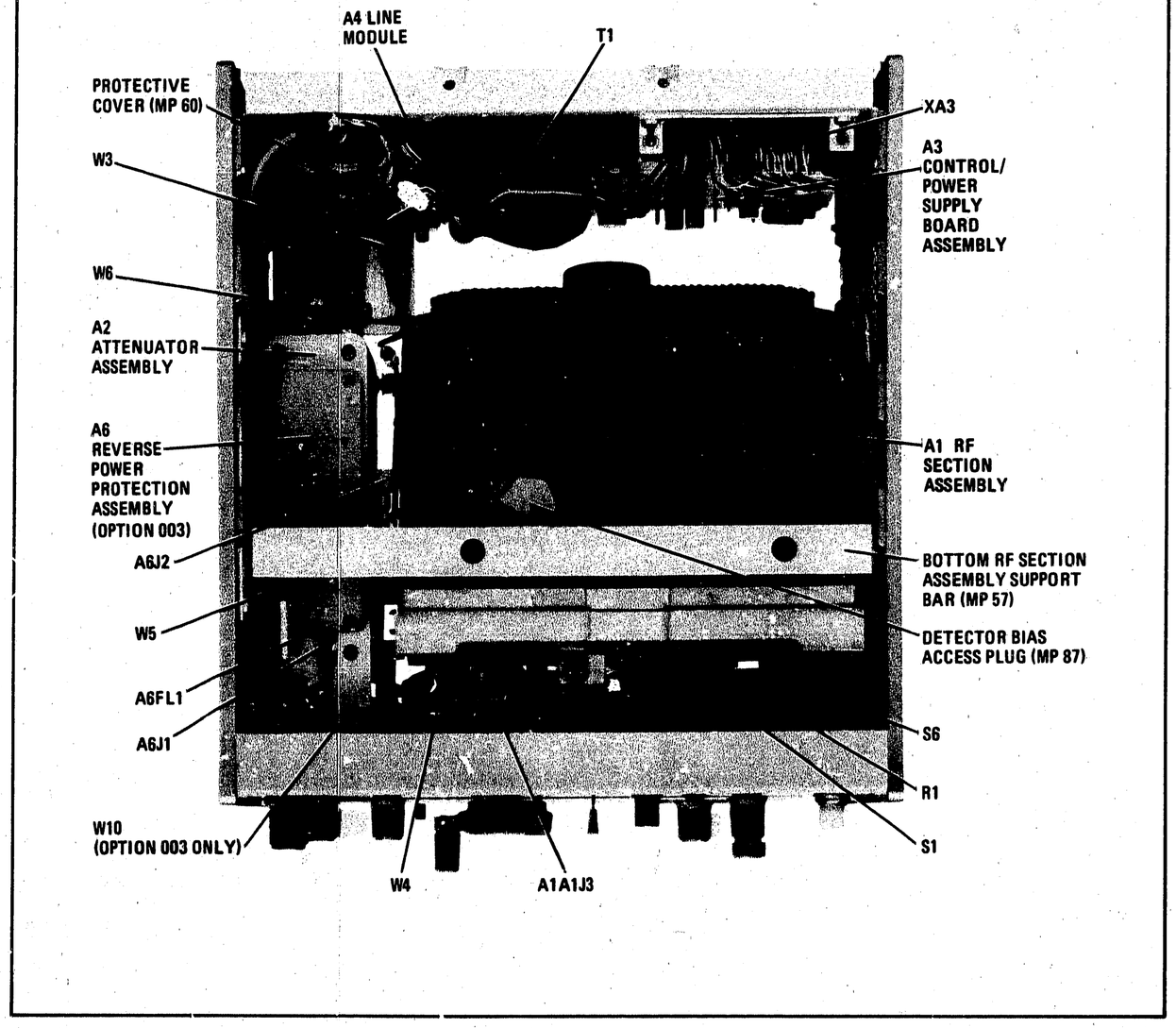


Figure 8-21. Bottom Internal View.

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8654A
Date Printed: March 1977
Part Number: 08654-90028

SIGNAL GENERATOR

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after printing the manual.

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
1811A	1
1846A	1-2
1847A	1-3
1905A	1-5
2125A	1-6
2132A	1-7
2238A	1-8
2250A	1-9
2318A	1-10
>> 2338A	1-11

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

>> NEW ITEM

NOTE:
Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement or the model number and print date from the title page of the manual.

Printed in U.S.A.

01 October 1983
7 Pages Text
4 Pages Illustrations

HEWLETT PACKARD

ERRATA

Page i, Title Page:
Under SERIAL NUMBERS, change the first sentence to read as follows: This manual applies directly to instruments with serial numbers prefixed 1633A and 1733A.

Page 1-4, Table 1-1:
Under GENERAL CHARACTERISTICS, change Power specifications to read: Power: 100 or 120 volts (+5%, -10%) from 48 to 440 Hz; or 220 or 240 volts (+5%, -10%) from 48 to 66 Hz. Power consumption is 25 VA maximum. 2.29m (7 1/2 ft) power cable furnished with mains plug to match destination requirements.

Page 2-1, paragraph 2-7:
Change the first sentence to read:
"The 8654A Signal Generator requires a power source of 100 or 120 volts (+5%, -10%) from 48 to 66 Hz, single phase."
In Figure 2-1, add the following after the third sentence:

| WARNING |

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

Page 6-5, Table 6-2:
Change the part number for A1MP83 to 08654-60062.

Page 6-6, Table 6-2:
Delete the A1A1 08654-60022 and 08654-60051 listings. (Restored 08654-60022 and 08654-60051 Board Assemblies no longer available).
A1A1: For recommended replacement, see CHANGE 4.

NOTE

When replacing A1A1, part number 08654-60002 or 08654-60050, replace RF Amplifier Cover, A1MP71 and order associated hardware A1MP130, A1MP131 and A1MP132. See CHANGE 4 for part numbers.

A1A1C1-3,5,6,11,13-15,17,18,22: For recommended replacement, see CHANGE 10.

>> A1A1Q6: For recommended replacement, see CHANGE 11.

Page 6-10, Table 6-2:
A3U3: Change Part Number to 1826-0092 and under the Description add: (recommended replacement).
A3U4: For recommended replacement, see CHANGE 10.

ERRATA (cont'd)

Page 6-12, Table 6-2:
Add MP67 08654-00057 COVER, TRANSFORMER.
Add MP68 7120-7032 LABEL, SAFETY (CD5)
MP26: Change Part Number to 0370-3051.
MP39: For recommended replacement see CHANGE 9.

Page 8-19, Figure 8-15, Service Sheet 4 (schematic):
In the center portion change U3A part number to 1826-0092.

CHANGE 1

Page 6-9, Table 6-2:
Make the following changes to the A3 listings:
Add A3C30 0180-2214 CAPACITOR-FXD 90 UF +75 -10% 16 VDC AL.
Delete CR1 and CR2.
Add CR19-CR26 1901-0327 DIODE-PWR RECT 200V 1A 6US.
Page 8-21, Service Sheet 5 (component locations):
Replace Figure 8-16 with the attached Figure 8-16. P/O A3 Control/Power Supply Board Assembly Component Locations (P/O CHANGE 1).
Page 8-21, Service Sheet 5 (schematic):
Make the following changes to the A3 Assembly.
Add C30, 90 uF, across VR2 with the positive polarity connected to the +5.2V line.
Delete the dashed line around CR1 and CR2.
Change the reference designators of CR1A-D and CR2A-D to the following:
Change CR1A to CR19.
Change CR1B to CR20.
Change CR1C to CR21.
Change CR1D to CR22.
Change CR2A to CR23.
Change CR2B to CR24.
Change CR2C to CR25.
Change CR2D to CR26.

CHANGE 2

Page 6-8, Table 6-2:
Change A3C12 to 0180-1746 CAPACITOR-FXD 15 UF ± 10% 20 VDC TA (CD5).
Page 6-12, Table 6-2:
Change MP60 to 4040-1083 COVER, POWER MODULE (CD8).
Page 8-21, Service Sheet 5 (schematic):
Change A3C12 to 15 uF.

CHANGE 3

Page 6-14, Table 6-2:
Change R8 to 0698-3162 46.4K 1% .125W F TC=0=100 (CD0).
Page 8-21, Service Sheet 5 (schematic):
Change R8 to 46.4k.

CHANGE 4

Page 5-3, Table 5-1:

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
A1A1C4 and A1A1L3	(See A1A3C6 selection) If the A1A1 RF Amplifier Assembly has been repaired, selection of A1A1C4 and L3 may be necessary in order to achieve the proper RF output level. Check the output level at the rear panel AUX RF OUT connector. If the output level at the high end of the 270-520 MHz range is lower than the published specification, adjust A1A1L3 by increasing the spacing between its turns, which increases the power output. Adjust A1A1L3 until the AUX RF OUT level is just within specified limits. Excessive power may cause the second harmonic to be out of specification. If after adjusting the inductor, the level is still out of specification, increase A1A1C4 one standard value and repeat adjustment of A1A1L3. Perform Harmonic Distortion Test (paragraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0-6.8 pF	3

Page 6-5, 6-6 and 6-7, Table 6-2:

Change A1MP71 to 08654-00060 (CD4).
Add A1MP130 0520-0130 SCREW-MACH 2-56 .375-IN-LG PAN-HD-POZI (CD1).
Add A1MP131 2190-0890 WASHER-LK HLCL NO.2 .088-IN-ID (CD1).
Add A1MP132 3050-0098 WASHER-FL MTCL NO.2 .094-IN-ID (CD6).
Change A1A1 (08654-60002) to 08654-60092.
Change A1A1 (08654-60050) to 08654-60093.
Change A1A1C4 to 0160-3872 CAPACITOR-FXD 2.2 PF ± .25 PF 200 VDC CER (CD0).
Add A1A1CR6 and CR7 1901-0050 DIODE SWITCHING 80V 200 MA 2NS DO-35 (CD3).
Change A1A1L3 to 08654-80002 INDUCTOR RF 35 NH (CD2) and add an asterisk (indicating a factory selected value).
Under A1A1Q4, Q5, Q6, and Q7, change 1205-0037 to 1205-0358 THERMAL LINK SGL TO-18-PKG (CD8).
Add A1A1VR1 and VR2 1902-0579 DIODE-ZNR 5.11V 5% DO-15 PD=1W TC=.009% (CD3).

CHANGE 4 (cont'd)

Page 8-15, Service Sheet 3 (component locations):
Replace Figure 8-10 with the attached Figure 8-10. A1A1 RF Amplifier/ALC Board Assembly Component Location (P/O CHANGE 4).
Page 8-15, Service Sheet 3 (schematic):
Change A1A1C4 to 2.2 pF.
Change A1A1L3 to 3.5 nH and add an asterisk (indicating factory selected value).
Replace appropriate portion of the schematic diagram with the attached partial schematic. P/O Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram (P/O CHANGE 4).
Page 8-22, Service Sheet A (A1 RF Section Disassembly and Reassembly Procedures):
Under RF Amplifier/ALC Board Assembly Removal (A1A1), add the following as the first sentence in step 2:
"Remove four machine screws (98A) with washers (98B, 98C) that secure the thermal links to the RF Amplifier cover.
Under RF Amplifier/ALC Board Installation (A1A1), add the following as the second sentence in step 8:
"Replace and tighten the four machine screws (98A) with washers (98B, 98C) that secure the thermal links to the RF Amplifier cover."
Page 8-23, Service Sheet A (legend):
Add the following to the A1 RF Section Assembly legend:
Item Number 98A A1MP130 Machine Screw.
Item Number 98B A1MP131 Lock Washer.
Item Number 98C A1MP132 Flat Washer.
Page 8-23, Service Sheet A, Figure 8-19:
Replace appropriate portion of Figure 8-19 with the attached partial figure P/O Figure 8-19. RF Section Assembly Illustrated Parts Breakdown (P/O CHANGE 4).

CHANGE 5

Page 6-10, Table 6-3:
Change A3U4 to 1826-0547 IC OP AMP DUAL 8-DIP-8 (CD3).
Page 8-19, Service Sheet 4 (schematic):
Change A3U4 to 1826-0547.

CHANGE 6

Page 1-4, Table 1-1:
Change Peak Incidental Frequency Deviation to read as follows:
Peak Incidental Phase Modulation (30% AM):[2] Less than 0.4 Radians.

CHANGE 7

Page 6-6, Table 6-2:
Add A1A1E1 9170-0847 FERRITE BEAD (CD3).
Page 6-10, Table 6-2:
Change A3R44 to 0698-3159 RESISTOR 26.1K .125W F TC=0+100 (CD5).
Change A3R45 to 2100-3355 RESISTOR TRMR 100K 10% C SIDE ADJ 1-TRN (CD0).

CHANGE 7 (cont'd)

Page 8-15, Service Sheet 3 (schematic):
Add A1A1E1 ferrite bead on the Q4 end of R14.
Page 8-19, Service Sheet 4 (schematic):
Change A3R44 to 26.1k.
Change A3R45 to 100k.

CHANGE 8

Page 6-11, Table 6-2 (Replaceable Parts):
Delete A6A1R6, part number 0683-0275.
Add A6A1L3 9100-2249 INDUCTOR RF-CH-MLD 150 NH 10% .105DX.26LG (CD1).
Page 8-17, Service Sheet 3A (schemtic):
In "LIMITER" portion of A6A1 REVERSE POWER PROTECTON BOARD ASSEMBLY Schematic, replace 2.7 ohm resistor R6 with 150 nH inductor L3.
Replace R6 in A6A1 Component Locator (Figure 8-12) with L3.

CHANGE 9

Page 6-12, Table 6-2:
Change MP39 to 0370-3058 KNOB (FREQUENCY RANGE).

CHANGE 10 - Serial Prefix 2318

Page 6-6, Table 6-2:
Change A1A1C1-3,5,6,11,13-15,17,18,22 to HP Part Number 0160-5759 (CD6) CAPACITOR-FXD .01UF +- 20% 100VDC CER.
Change A1A1C7 to HP Part Number 0160-4077 (CD9) CAPACITOR-FXD .01UF +-20% 50VDC CER.
Page 6-10, Table 6-2:
Change A3U4 to HP Part Number 1826-0785 (CD1) IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C.
Page 8-19, Service Sheet 4 (schematic):
Change A3U4 to 1826-0785.

>> **CHANGE 11**

Page 6-6, Table 6-2:
Change the first A1A1Q6 entry to "5086-4218 HP-21 TO-72 PKG." Delete the phrase, "(OPTION 003 ONLY)."
Delete the second A1A1Q6 entry. Do not delete the A1A1Q6 heat sink entry.
Page 8-15, Service Sheet 3 (schematic):
Under NOTES, change NOTE 5 to read as follows:

5. PART NUMBERS FOR A1A1Q6 AND Q7 ARE:

A1A1Q6
ALL INSTRUMENTS: 5086-4218

A1A1Q7
EXCEPT OPTION 003: 1854-0696
OPTION 003 ONLY: 5086-4218

P/C A3 ASSEMBLY

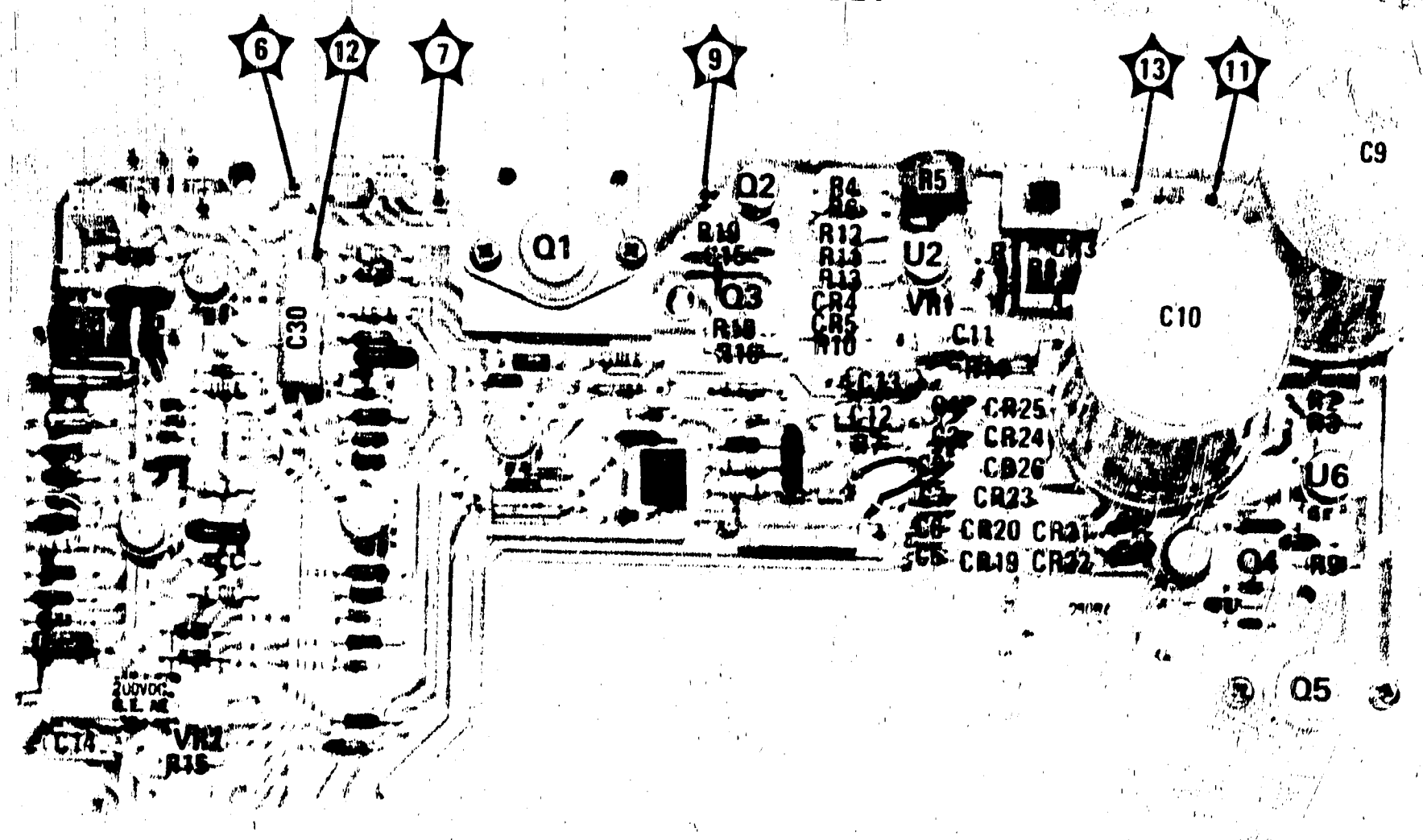


Figure 8-16. P/O A3 Control/Power Supply Board Assembly Component Locations (P/O Change 1)

A1A1 ASSEMBLY

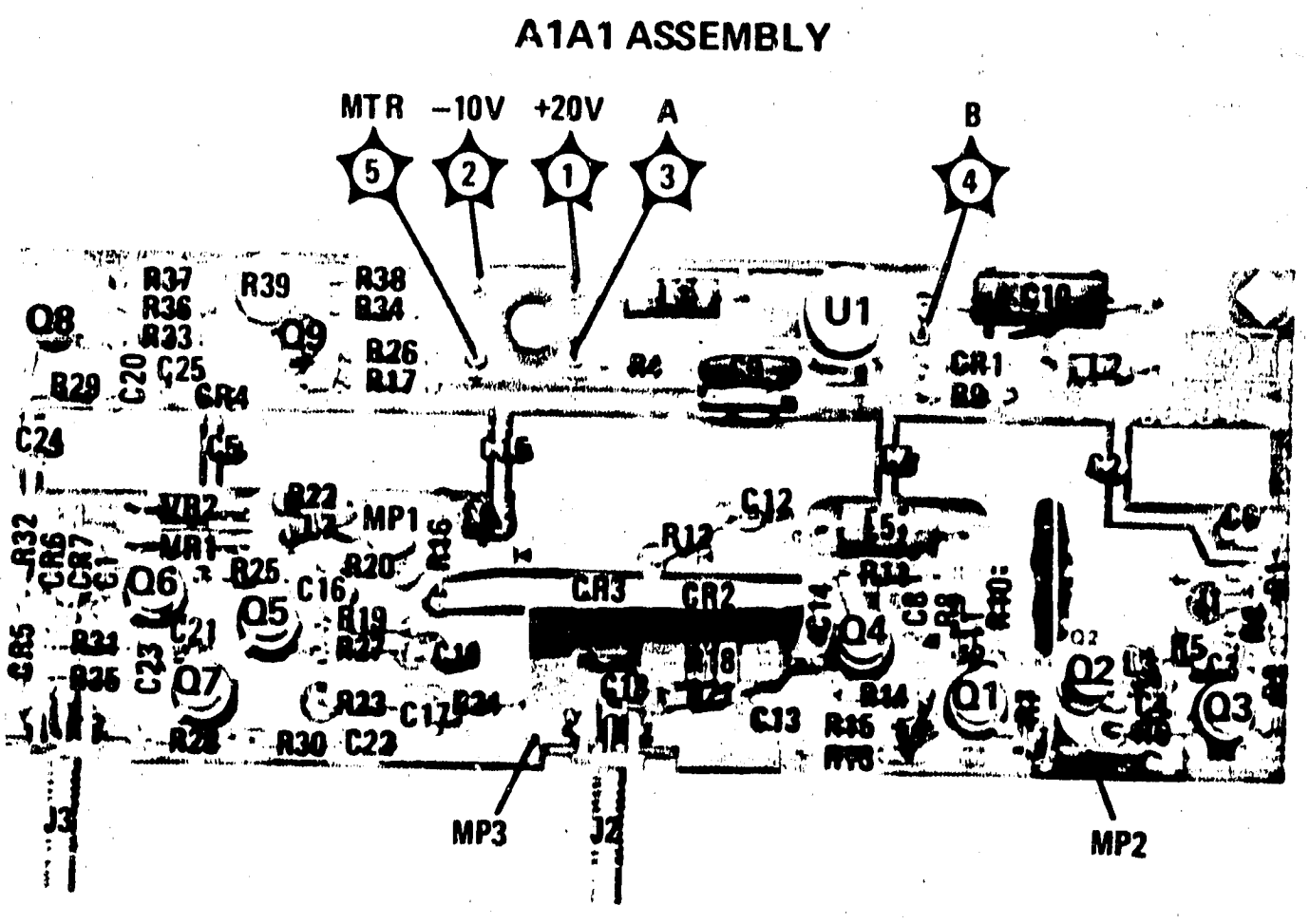
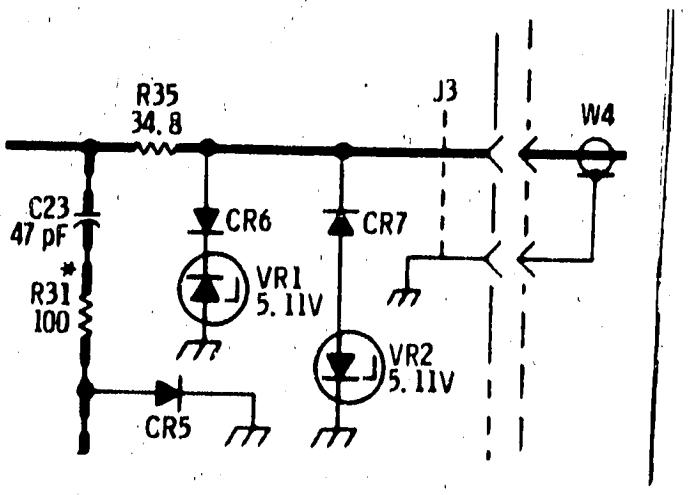
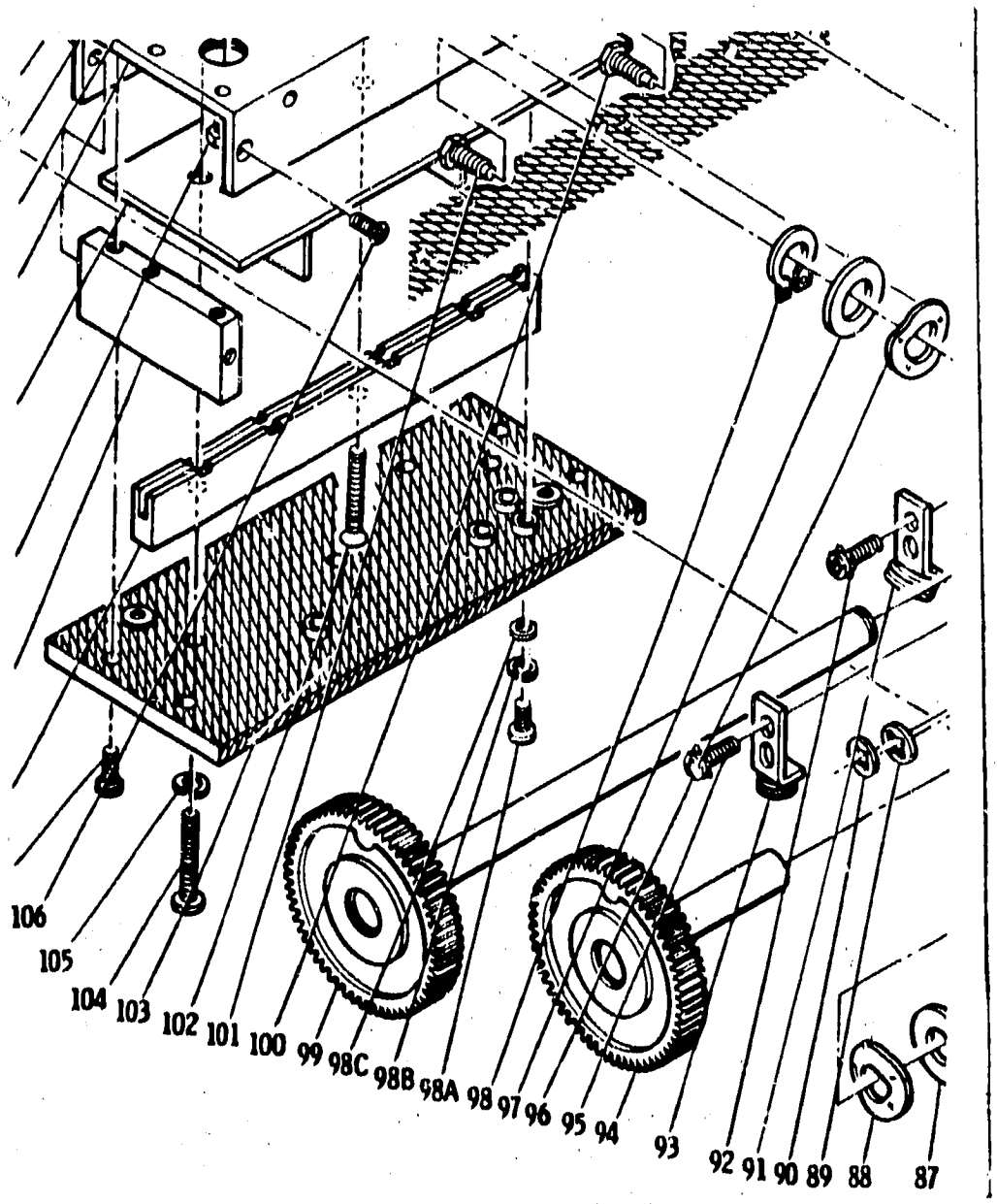


Figure 8-10. A1A1 RF Amplifier/ALC Board Assembly Component Locations (P/O Change 4)



P/O Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram (P/O Change 4)



P/O Figure 8-19. RF Section Assembly Illustrated Parts Breakdown (P/O Change 4)