TM 11-6625-2780-14&P

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS FOR

SIGNAL GENERATORS SG-1 112(V)1/U (NSN 6625-00-566-3067) AND SG-1l12(V)2/U (NSN 6625-00-500-6525) (HEWLETT-PACKARD MODEL 8640B, OPTIONS 001 AND 004)

HEADQUARTERS, DEPARTMENT OF THE ARMY

31 DECEMBER 1980

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:
J. C. PENNINGTON
Major General, United States Army
The Adjutant General

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TECHNICAL MANUAL
No. 11-6625-2780-14&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *31 December 1980*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS FOR

SIGNAL GENERATORS SG-1112(V)1/U (NSN 6625-00-566-3067) AND SG-1112(V)2/U (NSN 6625-00-500-6525) (HEWLETT-PACKARD MODEL 8640B, OPTIONS 001 AND 004)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual, direct to: Commander, US Army Communications and Electronics Materiel Readiness Command and Fort Monmouth, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703.

In either case, a reply will be furnished direct to you.

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to rover the data required to opersaate and maintain this equipment. The manual was not prepared in accordance with military specifications; therefore, the format has not been structured to consider categories of maintenance.

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WARNINGS

SAFETY

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

a. If this instrument is to be energized via an autotransformer for voltage reduction, make sure that the common terminal is connected to the earthed pole of the power source.

b. The power cable plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).

c. Before switching on the instrument, the protective earth terminal of the instrument must be connected to a protective conductor of the power cord. This is accomplished by ensuring that the instrument's internal earth terminal is correctly connected to the instrument's chassis and that the power cord is wired correctly (see Service Sheet 22).

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

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.

HIGH VOLTAGE

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

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

FUSES

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.

CAUTIONS

GROUNDING

Any interruption of the protective (grounding) conductor inside or outside the instrument is likely to cause damage to the instrument. To avoid damage, this instrument and all line powered devices connected to it must be connected to the same earth ground (see Section II).

LINE VOLTAGE

Be sure to select the correct fuse rating for the selected line voltage (see LINE VOLTAGE SELECTION in Section II); fuse ratings are listed on the fuse compartment.

To prevent damage to the instrument, make the line voltage selection BEFORE connecting the line power. Also ensure that the line power cord is connected to a line power socket that is provided with a protective earth contact.

SAFETY

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.

COUNTER INPUT

Do not apply a dc voltage or >+15 dBm to COUNTER INPUT.

SEMI-RIGID COAX

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 2 INCH-POUNDS.

SECTION 0
INTRODUCTION

0-1.Scope

This manual describes Signal Generators SG-1112(V)1/-U and SG-1112(v)2/U and provides instructions for operation and maintenance. Throughout this manual, the SG-1112(v)1/U is referred to as Model 8640B Option 004 and the SG-ll12(v)/U is referred to as Model 8640B Optin 001. A Manufacturer's Part Number to National Stock Number Coss Reference Index for the SG-1112(v)1/U and the SG-ll12(V)2/U is given in Section VI of this manual.

0-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam .310- 7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's)pertaining to the equipment.

0-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those described by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward Standard Form 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-1l-2/-NAVSUPINST 4440.127E/AFR 400-54/MCO 4430.3E and DLAR 4140.55.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/-NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C, and DLAR 4500.15.

0-4. Reporting Equipment Improvement Recommendations (EIR)

If your equipment needs improvement, let us know, Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know what you don't like about the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Redness Command and Fort Monmouth, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

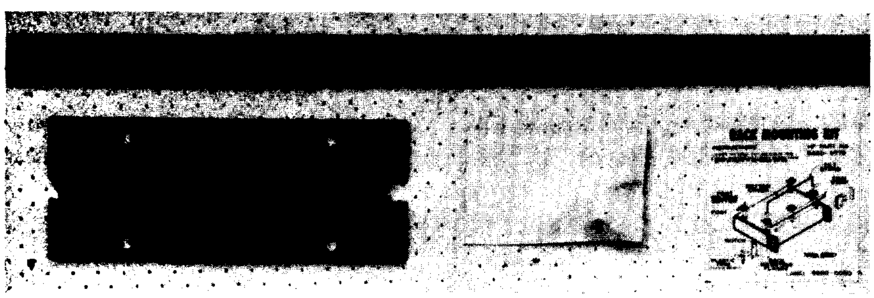
0-5. Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with paragraph 2-22.

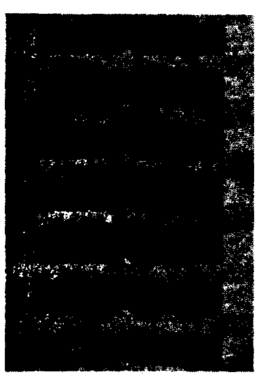
0-6. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

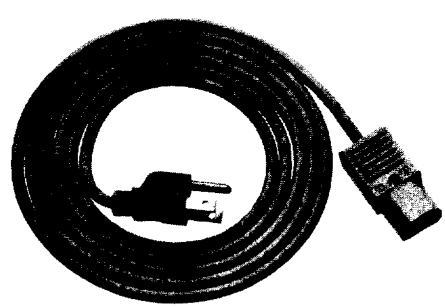
MODEL 8640B OPTION 004



RACK MOUNTING KIT



DEMO CAL LABELS



LINE POWER CABLE

Figure 1-1. HP Model 8640B Option 004 Signal Generator (Option 001) and Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains operating and service information for the Hewlett-Packard Model 8640B Option 004 Signal Generator. The Signal Generator (with variable frequency modulation oscillator Option 001) is shown in Figure 1-1 with all of its externally supplied accessories.

1-3. This section of the manual describes the instruments documented by this manual and covers instrument description, options, accessories, specifications and other basic information. The other sections provide the following:

Section II, Installation: information about initial inspection, preparation for use, and storage and shipment.

Section III, Operation: information about panel features, and provides operating checks, instructions, and maintenance information.

Section IV, Performance Tests: information required to check basic instrument functions and to verify that the instrument is performing as specified in Table 1-1.

Section V, Adjustments: information required to properly adjust and align the instrument.

Section VI, Replaceable Parts: ordering information for all replaceable parts and assemblies.

Section VII, Manual Changes: information to revise this manual to document earlier configurations of the instrument and information suggesting instrument modifications.

Section VIII, Service: information required to repair the instrument.

1-4. Deleted.

1-5. **Deleted.**

1-6. SPECIFICATIONS

1-7. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument can be tested. Paragraph 1-19 lists some supplemental performance characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix which defines the instrument configuration. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the serial prefixes 1435A and 1438A.

1-10. An instrument manufactured after the printing of this manual may have a serial prefix that is different from that indicated above. If 80, refer to Section VII and make the applicable manual changes.

1-11. **Deleted.**

1-12. For information concerning a serial number prefix not covered in this manual, contact your nearest Hewlett-Packard office.

1-13. GENERAL DESCRIPTION

1-14. The Model 8640B Option 004 Signal Generator is an adaptation of the Model 8640B specifically designed for testing ILS, VOR, and UHF communications receivers used in aviation as well as general Purpose HF, VHF and UHF receivers. The Signal Generator covers the frequency range 500 kHz to 512 MHz (450 kHz to 550 MHz with band over-range) and can be extended to 1100 MHz with an external doubler. An optional variable audio oscillator is also available to extend the CW output range of the generator down to 20 Hz.

1-15. This solid-state generator has an output level range of +15 to -142 dBm (1.3V to 0.018 µV) that is calibrated and metered. The output is leveled to within ±0.5 dB from 108 to 336 MHz and within ±0.75 dB across the full frequency range of the instrument.

1-16. The generator also provides AM, FM and pulse modulation for a wide range of receiver test applications. AM and FM can be performed independently or simultaneously in either the internal or external modes. This modulation is calibrated and metered for direct readout under all operating conditions. External pulse modulation is also available.

1-17. For avionics testing (VOR/ILS), an external audio generator[1] is required to provide the composite modulation. When used with a suitable external audio generator the Option 004 has flat AM response and minimum phase shift from 30 Hz to 10 kHz as well as constant group delay between 9 kHz and 11 kHz for accurate VOR and ILS testing. A front panel jack also provides a very accurate demodulated audio signal (AC/DC 0-1 Vrms or AC only 0-5 Vrms) for precise AM settings.

1-18. Other significant features are extremely low noise, built in phase lock and counter, and front panel controls designed for operating convenience and flexibility.

1-19. PERFORMANCE CHARACTERISTICS

1-20. Spectral Purity

1-21. The basic frequency source of the Signal Generator is a mechanically-tuned high-Q cavity oscillator that operates over the frequency range 230-550 MHz. This oscillator has an inherent stability of better than 10 ppm/10 min and exceptionally low noise characteristics. The lower 9 frequency ranges are obtained by dividing the basic oscillator frequency and filtering the unwanted harmonics. Using this technique, sub-harmonic and non harmonic-spurious signals are virtually eliminated. A band overlap of 7% to 10% adds convenience when operating near the nominal band edges.

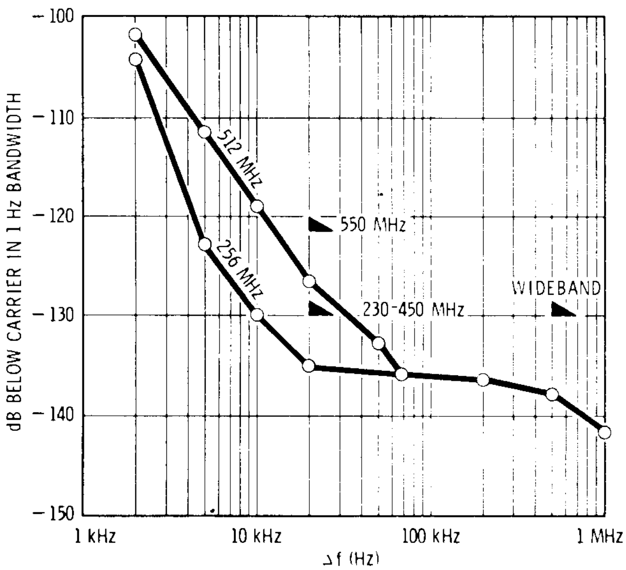


Figure 1-2. Measured Single Sideband Noise vs Offset from Carrier. (Stated in a 1 Hz Bandwidth at 256 and 512 MHz Carrier Frequencies on 256-512 MHz Band.) Markers indicate specified limits.

1-22. Frequency within a band is selected with a FREQUENCY TUNE control of approximately 8 turns (see Figure 3-2) for fast selection of the desired output frequency. A mechanical FINE TUNE control has a tuning range of 1000 ppm for precision frequency setting.

[1] e.g., Bendix RVG 33A — VOR Audio Generator
RIG 32A — ILS Audio Generator
Collins 479S-4A — ILS Audio Signal Generator
Tel-Instrument Corporation T-20A — VOR/ILS Audio Signal Generator

1-23. Restabilization time is short when tuning the frequency across any one band. The total frequency excursion after any frequency change is typically <20 ppm and within 15 minutes the output has restabilized to the specified 10 ppm/10 min. When *not* phase locked, no restabilization time is required when switching frequency binds for a fixed position cm the frequency tune control.

1-24. Noise performance of the generator is excellent. The high-Q cavity oscillator has been optimized with use of a low noise microwave transistor for a spectrally pure output signal. Figure 1-2 shows the typical measured single-sideband noise performance in a 1 Hz bandwidth for various offsets from a (256 and 512 MHz) carrier. The low close-in noise characteristic is ideally suited for the stringent adjacent channel tests that are commonly made on a wide variety of communication receivers.

1-25. Figure 1-3 gives a plot of the specified SSB noise perfomance for a 20 kHz offset from the carrier for the 256-512 MHz band. From 230 to 450 MHz, noise is >130 dB/Hz below the carrier level and rises to 122 dB/Hz at 500 MHz. This signal-to-noise ratio decreases by approximately 6 dB for each division of the output frequency down to the broadband noise floor of better than

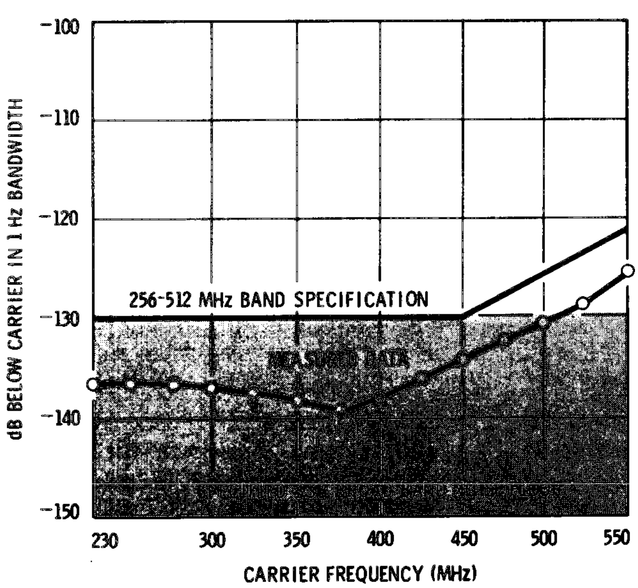


Figure 1-3. Specified Signal-to-Phase Noise Ratio at 20 kHz Offset vsus Carrier Frequency (MHz). (Stated in a 1 Hz Bandwidth.) For lower bands, phase-noise decreases approximately 6 dB per frequency division down to the broadband noise floor.

130 dB/Hz. This exceptional noise performance is also preserved in the phase lock mode and only slightly degraded during FM.

1-26. Frequency Counter

1-27. The Signal Generator has a built-in 550 MHz frequency counter and phase lock synchronizer. The 6-digit light-emitting diode (LED) display gives a normal resolution of 10 kHz at 500 MHz and 10 Hz at 500 kHz. The resolution can be increased using the X10 or X100 EXPAND buttons near the display. In the X100 EXPAND mode, the resolution is 100 Hz at 500 MHz and 0.1 Hz at 500 kHz.

1-28. This resolution, combined with the high stability of the generator, allows precise frequency selection and meaningful measurements on high performance receiver systems. When selecting the external doubler band, the counter displays the doubled output frequency directly.

1-29. When using the expand modes, it is possible for significant digits or the decimal points to be shifted off the display. When this occurs, an OVERFLOW light reminds the operator that the display is not showing the complete output frequency.

1-30. The built-in counter can also be used to count external input signals from 1 Hz to 550 MHz and eliminates the need for a separate frequency counter in many measurement systems. Input sensitivity is <100 mV into 50. Using the EXPAND buttons, it is possible to achieve a resolution of 1 Hz in the 0-10 MHz EXTERNAL count mode or 100 Hz in the 0-550 MHz mode.

1-31. Phase-Lock Mode

1-32. Also included in the Signal Generator is a built-in phase lock synchronizer that locks the RF output frequency to the crystal time base used in the counter. In this locked mode, output stability is better than 5 x 10^{-8}/h while the spectral purity and FM capability of the unlocked mode are preserved. For higher stability, it is possible to lock to an externally applied 5 MHz standard. Two Model 8640B's can also be locked to a common timebase reference for performing various two-tone measurements.

1-33. Phase locking the generator is simple - just push the front panel LOCK button. The generator is then locked to the frequency shown on the **LED** display. If lock is broken (for example by tuning to a new output frequency or during warmup), there is an immediate indication: the LED display flashes. The generator can be relocked by releasing the LOCK button and then relocking.

1-34. The generator can be locked in the normal mode of the counter or in the X10 EXPAND mode if the OVERFLOW light is not on. It is normally not possible nor recommended to lock in the X100 EXPAND mode or when counting external inputs. Maximum resolution in the locked mode is 1 kHz at 500 MHz, increasing to 1 Hz at 500 kHz.

1-35. If an output frequency between adjacent counter indications is required, a TIME BASE VERNIER is provided with a range of ±20 ppm. This fine tunes the internal crystal time base and sets the output frequency between adjacent counts (i.e., the least significant digits of the display). This gives continuous coverage of all output frequencies even in the phase lock mode. An UNCAL annunciator near the vernier will light when this mode has been selected indicating that the counter display is incorrect.

1-36. When phase locked, the narrow bandwidth of the phase lock loop (<5 Hz) preserves full FM capabilities down to rates of 50 Hz and assures no degradation in noise from the unlocked mode (residual FM is not changed by phase locking).

1-37. Amplitude Modulation

1-38. AM is variable from 0 to 100% with the rates, accuracy, and low incidental FM required for the most stringent AM applications. The front panel meter gives a direct readout of percent AM in either the internal or external mode and autoranges the 0-100% scale to 0-30% for improved nettability at low modulation depths.

1-39. For precision measurement of AM, the front panel DEMOD OUTPUT jack provides a demodulated AM signal (either 0 - 1 Vrms or 0 -5 Vrms) which is directly proportional to percent AM. The DEMOD CAL label lists values of this voltage by which percent AM can be set very accurately (within 1%) with an ac voltmeter. The label was prepared when the instrument was calibrated. A new label should be prepared whenever the generator is recalibrated.

1-40. DEMOD OUTPUT can also be connected to the Demod Input of some modulation sources for sensing the phase relationship of the output RF envelope and the input modulating signal.

1-41. AM up to rates of 50 kHz is possible depending on carrier frequency and modulation depths. Distortion is specified at 400 Hz and 1000 Hz to be <1% up to 50% AM, <3% to 90% AM. Figure 1-4 shows measured AM distortion characteristics for other modulation frequencies. Note that for 0-50% AM, distortion is <1% to approximately 90 kHz for an output frequency of 200 MHz.

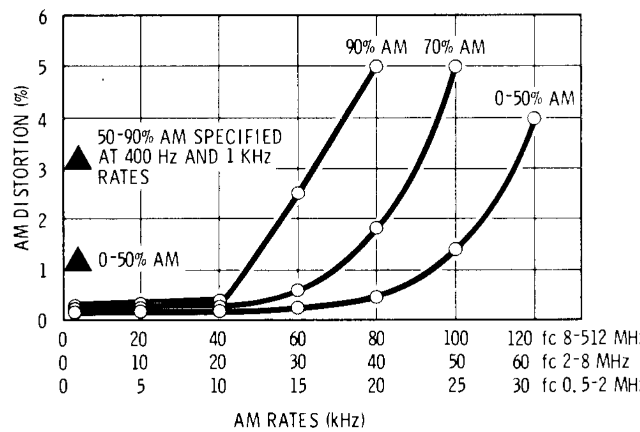


Figure 1-4. AM distortion us AM rate measured at 200 MHz and +10 dBm, but applies to all bands. (Supplemental information only.)

1-42. Pulse Modulation

1-43. Also included on the AM function switch is a position for external PULSE modulation. In this mode, pulse inputs with repetition rates to 500 kHz and widths down to 2 µs can be applied to modulate the RF carrier. Rise and fall times vary with output frequency down to <1 *µs* from 8 to 512 MHz.

1-44. Pulse inputs turn the RF on. Hence with no pulse inputs the RF will read approximately zero on the built-in level meter. For pulse inputs greater than 0.5V, the RF output is on, calibration is preserved and the level meter reads the pulse-on power of the RF output. For repetition rates below that specified, the pulsed RF output is still available but the pulse-on level is no longer calibrated or metered.

1-45. Frequency Modulation

1-46. FM is calibrated, metered and constant with RF frequency and band changes. Peak deviations to at least 0.57. of carrier frequency are available (i.e., 1% of the minimum frequency in each octave band). On the 256-512 MHz band, for example,

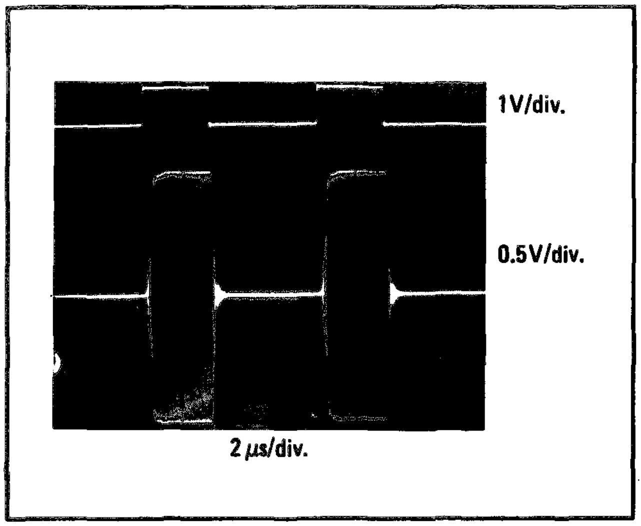


Figure 1-5. Pulsed RF 20 MHz Carrier Frequency at 400 kHz Pulse Rate and 1 μs Pulse Width.

the maximum deviation is 2.56 MHz peak or 5.12 MHz peak-to-peak. With this wide deviation capability, it is possible to sweep the generator, using the dc coupled FM mode and a sawtooth input, to test and align IF filters and discriminators.

1-47. For narrowband FM applications, a minimum full scale deviation of 5 kHz is provided on the meter and the PEAK DEVIATION range switch. When switching from the CWto FM mode, there is negligible shift in carrier frequency and no degradation in spectral purity for these narrow deviations. With the generator in the phase lock mode it is possible to modulate at rates down to 50 Hz while maintaining accurate FM calibration and the carrier drift stability of a crystal oscillator. Using the unlocked mode, it is possible to modulate from dc to 250 kHz with a carrier drift stability of <10 ppm/10 min.

1-48. Standard and Optional Audio Oscillators

1-49. Standard tones for internal modulation are 400 Hz and 1000 Hz. These tones are also available at the front panel and can be varied in output level from 1 V to <10 mV into 600 Ω. Total harmonic distortion is typically <0.25%.

1-50. Optionally available on the Signal Generator is a built-in variable frequency oscillator covering the range 20 Hz to 600 kHz (fixed tones of 400 Hz and 1000 Hz are also provided). This internal oscillator has a wide range of standard modulation frequencies and is useful for testing receiver audio bandwidth. Output from this modulation souce is available separately at the front panel and can be varied in level from 3V to <20 mV into 600 Ω. This audio oscillator, Option 001, extends the usable CW range of the generator down to 20 Hz.

1-51. Multi-Function Meter and Annunciators

1-52. The front panel meter on the Signal Generator monitors the RF output level in dBm and volts, the AM modulation percentage, and the FM peak deviation in kHz or MHz. The accuracy of this meter is usually better then ±3% of reading. Pushbuttons select the meter function, and scale lights indicate the range on which the meter reading should be made. For RF output level and AM%, the scales autorange for better resolution. For FM, the appropriate scale is selected by the PEAK DEVIATION range switch.

1-53. Also provided are three front panel annunciators that indicate when certain settings of RF level and modulation controls exceed specified limits. Besides giving a warning indication, the annunciators instruct the operator about returning the instrument to proper operation.

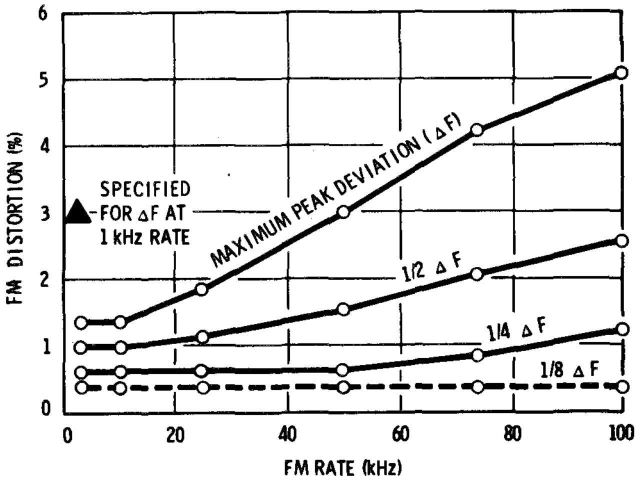


Figure 1-6. FM distortion vs FM rate measured in the 8-16 MHz band, but applies to all bands (supplemental information only).

1-54. The REDUCE PEAK POWER annunciator lights whenever the combined settings of RF output and AM modulation levels exceed allowable knits. The specification allows for up to 100% AM on all RF output ranges except the +16 dBm range. On the +16 dBm range RF levels with up to 50% AM are normally possible before the annunciator will light. When the annunciator lights it is neceasary to reduce either the OUTPUT LEVEL 10 dB switch or the AM MODULATION control.

1-55. The REDUCE PEAK DEVIATION annunciator lights whenever the PEAK DEVIATION RANGE switch has been set to exceed the allowable limits for any output FREQUENCY RANGE. The specification allows for a maximum peak deviation of 1% of the minimum frequency in each band (e.g., 2.56 MHz on the 256-512 MHz band). When the annunciator lights, the FM is automatically turned off and the FM meter reads zero.

1-56. The REDUCE FM VERNIER annunciator lights whenever the FM input and FM vernier setting combine to exceed the 1 volt drive level required to achieve the maximum deviation indicated on the PEAK DEVIATION range switch. When this occurs, either the FM vernier or the amplitude of the incoming modulation signal should be reduced to obtain specified FM performance.

1-57. Output Level

1-58. The wide output range of the generator is achieved with a 20 dB step attenuator, a 1 dB step attenuator and a 2 dB vernier. Output levels can be read directly on the attenuator dials or (for greater accuracy) on the autoranging meter. The meter scales are automatically selected to give the maximum indicator resolution for any output level.

1-59. The maximum output level of +15 dBm permits high level tests on receiver IF's, amplifiers, and mixers without additional power amplification. At the same time, extremely low leakage ensures receiver sensitivity measurements down to levels of 0.03 µV in a shielded system.

1-60. For improved accuracy at low output levels, the meter, in conjunction with the attenuators, is factory-calibrated against a precision standard to remove much of the error that is accumulated from the attenuator's steps. Using a power meter and calibrating the output for one output frequency and vernier setting, it is then possible to make sensitivity measurements to better than ±1 dB accuracy down to output levels of --127 dBm.

1-61. OPTIONS

1-62. Option 001. Option 001 (covered in this manual) provides a modulation oscillator that is continuously settable from 20 Hz to 600 kHz. The oscillator can also be set for 400 Hz or 1 kHz fixed tones.

1-63. Option 002. Option 002 (an internal frequency doubler available in the standard Model 8640B) is not compatible with the Model 8640B Option 004 and thus is not covered in this manual.

1-64. Option 003. Option 003 (either factory built or retrofitted) protects the generator's output circuits from accidental applications of reverse power up to 25 watts. Option 003 is documented in a separate manual supplement.

1-65. ACCESSORIES SUPPLIED

1-66. The Model 8640B Option 004 is supplied with the following accessories (they are shown in Figure 1-1):

Rack Mounting Kit (HP 5060-8740)
Line Power Cable (HP 8120-1378)
2 Amp Fuse (HP 2110-0002)
1.25 Amp Fuse (HP 2110-0094)
Demod Cal Labels (HP 7120-4244)

1-67. The rack mounting kit, the cable, and the fuses are fully described in Section II.

1-68. The following accessories are mounted inside the instrument's chassis and are available for adjustment and repair (for more information, see Sections V and VIII):

Combination Wrench (HP 5001-0135)
Spare fuses for power supply circuit boards
30-pin Extender Board (HP 08640-60036)

1-69. EQUIPMENT AVAILABLE

1-70. Fuseholder. The HP Model 11509A Fuseholder attaches to the RF OUT jack and prevents accidental damage to the generator's output attenuator by externally applied R F. It is primarily used when testing transceivers.

CAUTION

The fuseholder may not protect the output amplifier against a fast pulse of reverse power on the top two ranges, of the OUTPUT LEVEL 10 dB switch.

1-71. Termination. The HP Model 11507A Termination maintains the generator's output level calibration when the output is connected to load impedances other than 50 ohms. It can provide source impedances of 25 and 5 ohms, and it can simulate a broadcast-band dummy antenna. The frequency range is 50 kHz to 65 MHz.

1-72. 75 Ohm Adapter. The HP Model 11687A 50 to 75 Ohm Adapter connects to the generator's output to provide a source impedance of 75 ohms.

1-73. Doubler. The HP Model 11690A Doubler extends the usable frequency range of the generator one octave to 1024 MHz (actually to 1100 MHz with 7% frequency over-range). Conversion low in the doubler is typically <13 dB.

1-74. Mixer. The HP Model 10514A Double Balancedi Mixer can be used at the generator's output as a nanosecond pulse modulator or as a balanced mixer.

1-75. Protective Cover. The HP 5060-8767 Control Panel Cover protects the panel from dust and impact damage.

1-76. SERVICE AND USER AIDS

1-77. 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.

1-78. Application Notes. Informative notes concerning the use of signal generators are also available from the nearest Hewlett-Packard Sales and Service Office.

1-79. Service Notes. Hewlett-Packard makes design improvements to its current line of instrument 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.

1-80. Deleted.

1-81. Deleted.

1-82. TEST EQUIPMENT REQUIRED

1-83. Tables 1-2 and 1-3 list the test equipment and accessories required to check, adjust and repair the Model 8640B Option 004. (Table 4-2 is a separate list of relatively inexpensive, commonly available test equipment for the Basic Functional Check only.) Refer to the Mac in Appendix D for Army test equipment requirements.

NOTE

The safety classification of this instrument is Safety Class I. It has been designed and tested according to IEC Publication 348 SAFETY REQUIREMENTS FOR ELECTRONIC MEASURING APPARATUS and has been supplied in safe condition. The instruction manual contains in formation, warnings, and cautions which must be followed by the user to ensure safe operation and to retain the instrument in safe condition.

Table 1-1. Specifications (1 of 6)

(All specifications apply over the nominal Frequency Bands unless otherwise specified.)

FREQUENCY CHARACTERISTICS

Range: 500 kHz to 512 MHz in 10 Octave Bands (to 1024 MHz with External Frequency Doubler).

Bands and Band Overlap: Bands extend 10% below and 7% above the nominal Frequency Bands shown below.

Frequency Bands (MHz)	Frequency Range (MHz) (with overlap)
0.5 - 1	0.45 - 1.07
1 - 2	0.9 - 2.1
2 - 4	1.8 - 4.2
4 - 8	3.6 - 8.5
8 - 16	7.2 - 17.1
16 - 32	14.4 - 34.3
32 - 64	28.8 - 68.7
64 - 128	57.5 - 137.5
128 - 256	115 - 275
256 - 512	230 - 550
External Doubler Band[1] 512 - 1024	460 - 1100

Internal Counter Resolution:

Frequency Bands (MHz)	Normal Mode	Expand X10	Expand X100
0.5 - 1	10 Hz	1 Hz	0.1 Hz
1 - 16	100 Hz	10 Hz	1 Hz
16 - 128	1 kHz	100 Hz	10 Hz
128 - 1024	10 kHz	1 kHz	100 Hz

Accuracy: 6-digit LED display with X10 and X100 expand; accuracy depends on internal or external reference used.

[Total Count Accuracy] = [Counter Resolution[2] (±1 count)] + [Reference Error (INT or EXT)]

Internal Reference Error <±2 ppm (when calibrated at 25°C every 3 months and operated between 15°C and 35°C)

Fine Tuning:

Unlocked: >1000 ppm total range.

Locked: >±20 ppm by varying internal time base vernier.

Stability:

	Normal	Locked[3]
Time (after 2-hour warmup)	<10 ppm/10 min.	<0.05 ppm/h
Temperature	<50 ppm/°C	<2 ppm total[4] variation (room ambient 15 to 35°C)
Line Voltage[5] (+5% to −10% line voltage change)	<1 ppm	<0.1 ppm
Load (with any passive load change)	<1 ppm	None measureable
Level Change	<1 ppm	
Mode Change (CW to FM)	<1% of selected peak deviation or <200 Hz whichever is greater	

[1]In the External Doubler Band, the 8640B Option 004, counter displays the actual doubled output frequency, and the FM meter indicates the proper peak deviation.

[2]When phase locked, Counter Resolution error is eliminated.

[3]These specifications are given for the 8640B Option 004, internal reference. When using an external reference, drift in the locked mode will depend on the external reference characteristics.

[4]Phase lock may break due to temperature change (i.e., during warmup). Simply relock at desired frequency.

[5]This specification is for short term, transient line changes.

Table 1-1. Specifications (2 of 6)

FREQUENCY CHARACTERISTICS (Cont'd)

Restabilization Time:

	Normal	Locked[1]
After frequency change	<15 min	<1 min after relocking to be within 0.1 ppm of steady-state frequency
After band change	None	
After 1 min in RF OFF Mode[2]	<10 min	

SPECTRAL PURITY

Harmonics: (on IV, +10 dBm, output range and below)

>35 dB below fundamental of 0.5 to 128 MHz.

>30 dB below fundamental of 128 to 512 MHz.

Subharmonic and Nonharmonic Spurious: (excluding frequencies within 15 kHz of carrier whose effects are specified in Residual AM and FM): >100 dB below carrier.

Noise: Averaged rms noise level below carrier stated in a 1 Hz bandwidth.

SSB Phase Noise at 20 kHz offset from carrier. (See Figures 1-2 and 1-3.)
256 MHz to 512 MHz: >130 dB from 230 to 450 MHz increasing linearly to >122 dB down at. 550 MHz.
0.5 MHz to 256 MHz: Decreases approximately 6 dB for each divided frequency range until it reaches SSB Broadband Noise Floor of >140 dB.

SSB Broadband Noise Floor greater than 1 MHz offset from carrier (see Figures 1-2 and 1-3):

>130 dB down.

Residual AM: (Averaged rms)

Post-detection Noise Bandwidth	
300 Hz to 3 kHz	20 Hz to 15 kHz
>85 dB down	>78 dB down

Residual FM: (Averaged rms)

	CW and up to 1/8 maximum allowable peak deviation		Up to maximum allowable peak deviation	
Post-detection Noise Bandwidth	300 Hz to 3 kHz	20 Hz to 15 kHz	300 Hz to 3 kHz	20 Hz to 15 kHz
230 to 550 MHz	<5 Hz	<15 Hz	<15 Hz	<30HZ

Note: *Residual FM decreases by approximately 1/2 for each divided frequency range until limited by broadband noise floor. This limit for 300 Hz to 3 kHz is about 1 Hz, and for 20 Hz to 15 kHz is about 4 Hz. These are measured values in the 230 to 550 MHz* range *and calculated for divided ranges, knowing the noise distribution.*

OUTPUT CHARACTERISTICS

Range: +15 dBm to –142 dBm (1.3V to 0.018 µV).
Attenuators: a 10 dB step attenuator, and a 1 dB step attenuator with vernier allow selection of any output level over the full output level range.
Vernier: >2 dB continuously variable from a CAL detent position.

Level Flatness:
<±0.75 dB from 0.5 to 512 MHz referred to output at 190 MHz.
<±0.5 dB from 108 to 336 MHz referred to output at 190 MHz.
(Flatness applies to +10 to -10 dBm.)

[1]These specifications are given for the 8640B Option 004 internal reference. when using an external reference. drift in the locked mode will depend on the external reference characteristics.

[2]This specification apply only if the RF ON/OFF switch has been wired to turn the RF Oscillator off.

Table 1-1. Specifications (3 of 6)

OUTPUT CHARACTERISTICS (Cont'd)

Impedance: 50 Ω, ac coupled, VSWR. <2.0 on 3V and IV output ranges; <1.3 on all other ranges.

Reverse Power Damage Level: 40 Vdc maximum. 20 dBm maximum on 3V and IV output ranges; 27 dBm maximum on all other ranges.

Reverse Power Protection (Option 003): Protects signal generator from accidental applications of up to 25 watts (+44 dBm) of RF power (between dc and 1100 MHz) into generator output.

Auxiliary Output: Rear panel BNC output is >–5 dBm into 50 Ω, source impedance is approximately 500 Ω.

Leakage: (With all unused outputs terminated properly.) Leakage limits are below those specified in MIL-I-6181D. Furthermore, less than 3 μV is induced in a 2-turn, l-inch diameter loop 1 inch away from any surface and measured into a 50 Ω receiver. This permits receiver sensitivity measurements to at least <0.03 μV in a shielded system.

Level Accuracy:

Output Level (dBm)	+15 to –10	–10 to –50	–50 to –142
Total Accuracy as Indicated on Level Meter	± 1.5 dB	±2.0 dB	±2.5 dB

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.

MODULATION CHARACTERISTICS

General

Types: Internal AM and FM.
External AM, FM, and PULSE.
Simultaneous AM and FM, or PULSE and FM.

Internal Modulation Sources: (independently adjustable output is available at front panel).

Standard:
Frequency: Fixed 400 Hz and 1 kHz, ±2%.
Output Level: Indicated 10 mVrms to 1 Vrms, into 600 Ω

Optional: (Internal Variable Audio Oscillator, Option 001).
Frequency: Variable 20 Hz to 600 kHz,±l0% in 5 decade continuous bands plus fixed 400 Hz and 1 kHz ±3%.

Output Level: 20 mVrms to 3 Vrms into 600 Ω.
Total Harmonic Distortion:
< 0.25% 400 Hz and 1 kHz fixed tones
< 0.5% 20 Hz to 2 kHz
< 1.0% 2 kHz to 600 kHz

Amplitude Modulation
(Not applicable when OUTPUT LEVEL 10 dB switch in +16 dBm position).[1]

Depth: 0 to 100%.

AM Rates: INT and EXT ac; 20 Hz to AM 3 dB bandwidth. EXT dc; dc to AM 3 dB bandwidth.

[1]AM is possible in tbe +16 dBm output range with AM depths typically up to 50%, however DEMOD OUTPUT is not calibrated in this range and degradation of other AM specifications should be expected.

AM 3 dB Bandwidth: (See Figure 1-4.)

Frequency Bands	0 to 50% AM	50 to 90% AM
0.5-2 MHz	15 kHz	12.5 kHz
2-8 MHz	30 kHz	20 kHz
8-512 MHz	50 kHz	35 kHz

Table 1-1. Specifications (4 of 6)

MODULATION CHARACTERISTICS (Cont'd)

Amplitude Modulation (Cont'd)

AM Distortion: (at 400 Hz and 1 kHz rates)

Frequency Bands	0 to 50% AM	50 to 90% AM
0.5 to 512 MHz	<1%	<3%

External AM Sensitivity: (400 Hz and 1 kHz rates)
(0.100 ± 0.005)% AM per mV peak into 600Ω with AM vernier at full cw position.

Indicated AM Accuracy: (400 Hz and 1 kHz rates using internal meter)
±8% of reading on 0 - 10 scale.
±9% of reading on 0 - 3 scale (for greater than 10% of full scale).

Peak Incidental PM (at 30% AM)
Less than 0.15 radians, 0.5 to 128 MHz.
Less than 0.3 radians, 128 to 512 MHz.

Peak Incidental Frequency Deviation: Equals PEAK INCIDENTAL PM x MODULATION RATE.

Demodulated Output:[1] OUTPUT LEVEL vernier in CAL position. (108 to 118 MHz and 329 to 336 MHz carrier and between 20 and 80% AM.) An internal selector switch selects ac only or ac and dc at the demodulated output.

AC Only Output: (AC/DC Switch to AC): Directly proportional to AM depth (90 to 150 Hz modulation rate): % AM equals:[2]
(20 ± 0.6)% per Vrms, 0 to 55°C
(20 ± 0.4)% per Vrms, 20 to 30°C
(20 ± 0.2)% per Vrms, 20 to 30°C (Using the DEMOD CAL label provided by the factory)[3]

AC and DC Output (AC/DC Switch to DC):[4] AC output voltage is directly proportional to AM depth (90 to 150 Hz modulation rate):
% AM equals:[2]
(100 ± 3) % per Vrms, 0 to 55°C
(100 ± 2) % per Vrms, 20 to 30°C
(100 ± 1) % per Vrms 20 to 30°C (Using the DEMOD CAL label provided by the factory)[3]
DC output equals 1.414 ± 0.010 Vdc with vernier in CAL position.

External Input Impedance: nominally 2KΩ.

Frequency Response:
±0.05 dB from 90 Hz to 150 Hz (108 to 118 MHz and 329 to 335 MHz).
±0.05 dB from 9 kHz to 11 kHz (108 to 118 MHz).

Phase Shift from Audio Input to Demodulated Output:
(108 to 118 MHz, AM source selector to DC)
30 Hz: <±0.01°
30 Hz to 10 kHz: <±3°
9 kHz to 11 kHz: <±1° difference (from 9 to 11 kHz).

[1] Performance Tests and Adjustments pertaining to these specifications should be performed at least every three months to ensure instrument accuracy.

[2] When % AM ⩽80% and when measured across a load impedance >1 MΩ.

[3] A factory calibration label is provided with each instrument which contains ac values for particular AM factors to an accuracy of ±1%.

[4] The AC/DC method for calculation of % AM uses the following relationship: $\% AM = 100\sqrt{2} \cdot \frac{Vrms}{Vdc}$, (accuracy ±3%, 0-55°C, and ±2%, 20 to 30°C).

Table 1-1. Specifications (5 of 6)

MODULATION CHARACTERISTICS (Cont'd)

Pulse Modulation

Frequency Bands (MHz)	0.5-1	1-2	2-8	8-32	32-512
Rise and Fall Times	<9 μs	<4 μs	<2 μs	<1 μs	
Pulse Repetition Rate	50 Hz to 50 kHz		50 Hz to 100 kHz	50 Hz to 250 kHz	50 Hz to 500 kHz
Pulse Width Minimum for level accuracy within 1 dB of CW (>0.1% duty cycle)	10 μs		5 μs	2 μs	
Pulse ON/OFF ratio	>40 dB				
Peak Input Required	Nominally > +0.5V (5V max) sinewave or pulse return to zero, into 50 Ω.				

Frequency Modulation

Deviation: Maximum allowable deviation equals 1% of lowest frequency in each band as below.

Frequency Band (MHz)	Maximum Peak Deviation (kHz)
0.5-1	5
1-2	10
2-4	20
4-8	40
8-16	80
16-32	160
32-64	320
64-128	640
128-256	1280
256-512	2560
512-1024	5120

FM 3 dB Bandwidth:[1]
Internal and External ac; 20 Hz to 250 kHz.
External dc; dc to 250 kHz.

FM Distortion: (at 400 Hz and 1 kHz rates) See Figure 1-6.
<1% for deviations up to 1/8 maximum allowable.
<3% for maximum allowable deviation.

External FM Sensitivity: 1 volt peak yields maximum deviation indicated on PEAK DEVIATION switch with FM vernier at full cw position.

External FM Sensitivity Accuracy: ±6% from 15 to 35°C for FM excluding maximum peak deviation position. Maximum peak deviation position, ±9% typically.

Indicated FM Accuracy: (400 Hz and 1 kHz rates using internal meter) ±10% of meter reading (for greater than 10% of full scale).

Incidental AM: (at 400 Hz and 1 kHz rates)
<0.5% AM for FM up to 1/8 maximum allowable deviation.
<1% AM for FM at maximum allowable deviation.

[1]With 8640B Option 004 in LOCKED MODE, external FM is possible only for rates greater than 50 Hz.

Table 1-1. Specifications (6 of 6)

COUNTER CHARACTERISTICS

External RF Input :

Frequency Range: 1 Hz to 550 MHz.
Sensitivity: 100 mVrms, ac only, into 50Ω (−7 dBm).
Maximum Input: 1.3 Vrms (+15 dBm).

External Count Resolution: 6-digit LED DISPLAY

Mode	Normal	Expand X10	Expand X100
0 - 10 MHz	100 Hz	10 Hz	1 Hz
0 - 550MHz	10 kHz	1 kHz	100 Hz

External Reference Input: 5 MHz, nominally >0.5 Vp-p (5V maximum) into 1000Ω.

Internal Reference Characteristics: (after 2-hr. warmup)

Accuracy: (after calibration at 25°C)
Better than ±1 ppm for 15 to 35°C.
Better than ±3 ppm for 0 to 55°C.

Drift Rate:
Time: <0.05 ppm per hr., <2 ppm per year.
Temperature: <2 ppm total variation for room ambient 15 to 35°C.
Line Voltage: <0.1 ppm.

Frequency Tuning:
>±20 ppm using internal time base vernier.

Rear Output: nominally >0.5 Vp-p into 500Ω. This will drive another 8640B.

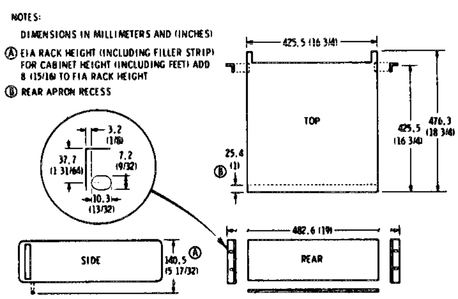
GENERAL CHARACTERISTICS

Operating Temperature Range: 0 to 55°C.

Power Requirements:
100, 120, 220, and 240 volts, +5%, −10%, 48 to 440 Hz; 175 VA maximum. 2.29m (7½ ft.) power cable furnished with mains plug to match destination requirements.

Weight: Net, 21.3 kg (47 lb.)

Dimensions:[1]



[1]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 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
Adjustable Stub	Length: >50 cm Range: to 550 MHz	GR 874-D50L	P
20 dB Amplifier (3 required)	Range: 0.5–520 MHz Gain: 20 to 25 dB Flatness over Range: ±2 dB Impedance: 50Ω Noise Figure: <5 dB	HP 8447A	P, A
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 100 kHz Gain: 20 and 40 dB ±1 dB Input Impedance: >5kΩ Output Impedance: 50Ω Noise: <25 μVrms referred to input Output: >1 Vrms into 50Ω	HP 465A	P, A
40 dB Amplifier	Range: 20 Hz to 100 kHz Gain: 40 ± 1 dB Input Impedance: 50Ω Noise Figure: <3 dB when driven from 50Ω Output Level: >100 mV in 50Ω	HP 08640-60506	P
One-Inch Loop Antenna	To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to very close tolerances.	HP 08640-60501	P
10 dB Step Attenuator	Attenuation: 0–120 dB in 10 dB steps Range: 0.45–550 MHz Accuracy: ±1.5 dB to 90 dB, ± 0.3 dB to 120 dB (below 1 kHz)	HP 355D	P, A
Calibrated Step Attenuator	Attenuation: 0–120 dB in 10 dB steps Accuracy: ± (0.02 + 0.015 dB/10 dB step) at 3 MHz	HP 355D Option H36	P, A
3 dB Attenuator	Accuracy: ±0.5 dB to 550 MHz	HP 8491A Opt 003	P, A
10 dB Attenuator	Accuracy: ±0.5 dB to 550 MHz	HP 8491A Opt 010	P, A
20 dB Attenuator	Accuracy: ±0.5 dB to 550 MHz	HP 8491A Opt 020	P, A
Crystal Detector	Range: 0.45–550 MHz Low Level Sensitivity: >0.35 mV/μW No internal dc return	HP 8471A	P
Crystal Detector	Range: 10–550 MHz Maximum Sensitivity: at 15–17 dBm input With internal dc return	HP 423A	P

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

Table 1-2. Recommended Test Equipment (2 of 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
Digital Voltmeter	DC Accuracy: ±(0.01% of reading +0.02% of range) AC (True RMS) Accuracy: ±0.1% of reading Ohms Range: to 1 kΩ	HP 3480D/3484A (with Options 042, 043)	P,A,T
Digital to Analog Converter	Accuracy: 1% of full scale Input Code: 1248 with 1 (on) state positive (compatible with Frequency Counter) Output: Compatible with Strip Chart Recorder	HP 581A Option 002	P
Directional Coupler	Range: 100—550 MHz Coupling Attenuation: 20 dB Directivity: 36 dB VSWR: <1.1:1	HP 778D, Option 12	P
Distortion Analyzer	Range: 20 Hz to 600 kHz Distortion Range: <0.1% Minimum Input: <300 mVrms	HP 333A	P
FM Discriminator	Ranges: 100 kHz to 10 MHz Linear Analog Output: 1V for full scale	HP 5210A	P, A
Filter Kit	Output Low Pass Filters for HP 5210A FM Discriminator (20 kHz and 1 MHz Butter-worth filters)	HP 10531A	P, A
600 Ohm Feedthrough	Impedance: 600Ω± 1% shunt Connectors: BNC	HP 11095A	P, A
520/1040 MHz Notch Filter	Notch Frequency Accuracy: 500—540 MHz Notch Rejection: >60 dB See Figure 1-7	HP 08640-60502	P
4 MHz Low Pass Filter (2 required)	4 MHz low pass (3 pole) Impedance: 50Ω VSWR: <1.5:1 Ripple: <±0.2 dB	CIR-Q-TEL FLT/21B-4-3/50-3A/3B	P, A
1.5 MHz Low Pass Filter	1.5 MHz low pass (3 pole) Impedance: 50Ω VSWR: <1.5:1 Ripple: <±0.2 dB	CIR-Q-TEL FLT/21B-1500K-3/50-3A/3B	P, A
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
3 kHz Low Pass Filter	3 kHz low pass (5 pole) Impedance: 50Ω Ripple: <±0.2 dB	CIR-Q-TEL FLT/21B-3K-5/50-3A/3B	P
Frequency Counter	Range: to 550 MHz Input Sensitivity: <100 mV Inputs: 50Ω and high impedance (1 MΩ)	HP 5327C	P,A,T

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

Table 1-2. Recommended Test Equipment (3 of 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
Frequency Counter (cont'd)	Standard Reference Accuracy: $<3 \times 10^{-7}$/month aging rate $<5 \times 10^{-9}$/s rms short term stability $<\pm 2.5 \times 10^{-6}$, 0—50°C temperature stability	HP 5327C	P, A, T
	Optional Reference Accuracy: $<3 \times 10^{-9}$/day aging rate $<1 \times 10^{-10}$/s rms short term stability $<1 \times 10^{-8}$, 0—50°C temperature stability	Option H49	P
	Optional Digital Output: 1248 with 1 (on) state positive (compatible with D/A Converter)	Option 003	P
Function Generator	Range: 0.1 Hz to 1 kHz Output Impedance: 600Ω Output Level: >1 V pk	HP 3300A	P, A
FM Linearity Circuit	See Figure 1-8	HP 08640-60503	A
Mixer (3 required)	Double Balanced Range: 0.45—550 MHz	HP 10514A	P, A
Noise Phase Lock Circuit	See Figure 1-9	HP 08640-60504	P
Oscilloscope	50 MHz Real Time Sensitivity: 5 mV/division Internal/External Sweep and Triggering	HP 180A/1801A/ 1820C	P, A, T
Power Meter	Range: 0.45—550 MHz Input Level: —20 to +20 dBm Accuracy: ±1% of reading	HP 435A	P, A, T
With Power Sensor (Thermocouple)	VSWR: <1.2:1	With HP 8482A	
Power Supply	Range: 0 to —5V Noise and Ripple: 200 μVrms Positive ground return	HP 6215A	A
Pulse Generator	Range: 50 Hz to 500 kHz Output: >1V into 50Ω Pulse Width: down to 1 μs Transition Time: <50 ns	HP 8003A	P, T
Quartz Oscillator	Output: 1 MHz (level compatible with Frequency Counter) Stability: $<5 \times 10^{-18}$/24 hours $<5 \times 10^{-12}$/s	HP 105B	P
RMS Voltmeter	Range: 10 Hz to 100 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

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

Table 1-2. Recommended Test Equipment (4 of 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
Signal Generator	Range: 0.45 — 550 MHz Output: >13 dBm into 50Ω Drift: <20 ppm/10 min. SSB Phase Noise: >130 dB down from 230 to 450 MHz increasing linearly to >122 dB down at 550 MHz (stated in a 1 Hz bandwidth at 20 kHz offset from carrier) and decreasing approximately 6 dB/octave for each divided down range — but need not be less than 140 dB down. Residual FM: <15 Hz rms in 20 Hz to 15 kHz post-detection noise bandwidth; <5 Hz rms in 0.3—3 kHz post detection noise bandwidth. Aux RF Out: >—5 dBm. Leakage: <3 μV induced in a 2-turn, 1-inch diameter loop 1 inch away from any surface and measured into a 50Ω receiver. FM: dc coupled; at least 40 kHz deviation for 1V input.	HP 8640A	P, A
Audio Spectrum Analyzer	Range: 20 — 200 kHz Amplitude Calibration: Display Accuracy: ±0.25 dB/dB but not more than 1.5 dB over 70 dB dynamic range. Flatness: ±0.2 dB Vertical Reference Scale: 10 dB/division log, 2 dB/division (or less) log, and linear display calibration Average Noise Level: <—120 dBm (50Ω) with 1 kHz IF bandwidth Spurious Responses: >60 dB down for nominal specified inputs Tracking Generator: Flatness: ±0.25 dB Level: >3 Vrms into 600Ω	HP 141T/ 8552B/8556A	P
Spectrum Analyzer	Range: 0.5—1200 MHz 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 Span Width: 0—1 GHz Compatible with Tracking Generator	HP 141T/ 8552B/8554B	P, A

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

Table 1-2. Recommended Test Equipment (5 of 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
Spectrum Analyzer	Range: 0.45–550 MHz IF Bandwidths: down to 10 Hz All other specifications are the same as the HP 141T/8552B/8554B listed above except Span Width which should be 0–100 MHz (should be compatible with Tracking Generator)	HP 141T/ 8552B/8553B	P, A
Recorder (Strip Chart)	Compatible with Digital to Analog Converter Accuracy: 0.5% of full scale	HP 680	P
Temperature Controlled Chamber	Range: 0–55°C	Statham Model 325	P
Test Oscillator	Range: 10 Hz to 10 MHz Output Impedance: 600Ω and 50Ω Distortion: >40 dB down Output Level: >1 Vrms	HP 652A	P, A, T
Test Oscillator	Range: 30 Hz–50 kHz Level: >1V into 600Ω Distortion: <60 dB, low crossover distortion	HP 204D	P, A
Tracking Generator	Output: to 0 dBm (50Ω) Flatness: ±0.5 dB Compatible with Spectrum Analyzer (HP 141T/8552B/8554B)	HP 8444A	P, A
Tracking Generator	Output: to 0 dBm (50Ω) Flatness: ±0.5 dB Compatible with Spectrum Analyzer (HP 141T/8552B/8554B)	HP 8444A	P, A
Tracking Generator	Output: to 0 dBm (50Ω) Compatible with Spectrum Analyzer (HP 141T/8552B/8553B)	HP 8443B	P, A
Variable Phase Oscillator	Range: 20 Hz to 60 kHz Output Impedance: 600Ω Phase Variability: 0 to 360° Distortion: >64 dB down	HP 203A	P, A
Variable Voltage Transformer	Range: +5% to −10% of nominal line voltage (100, 120, 220 or 240 volts). For 120V, range is 105–130 Vrms. Metered Accuracy: ±1 Vrms	GR W5MT3A	P
Vector Voltmeter	Range: 1–550 MHz Sensitivity: <20 μV Phase Range: ±18° full scale down to ±6° full scale Phase Resolution: 0.1° Phase Accuracy: ±1.5° Voltage Ratio Accuracy: 0.2 dB	HP 8405A	P

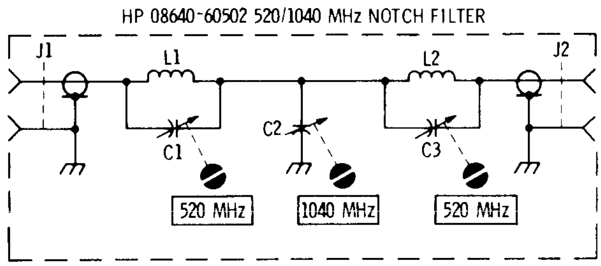
*P = Performance; A = Adjustments; T = Troubleshooting

Table 1-2. Recommended Test Equipment (6 of 6)

Instrument Type	Critical Specifications	Suggested Model	Use*
VSWR Bridge	Range: 0.45—550 MHz Directivity: >40 dB Connectors: Type N	Wiltron Model 60N50	P
*P = Performance; A = Adjustments; T = Troubleshooting			

Table 1-3. Recommended Test Accessories

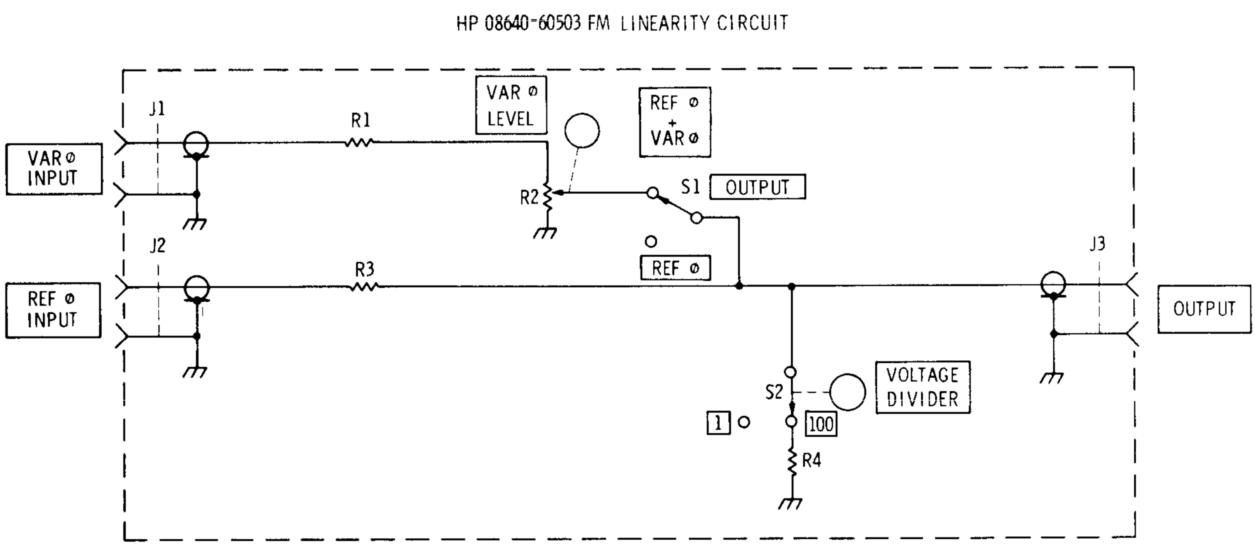
Accessory Type	Suggested Model
Adapter (Type N Male and BNC Female connectors)	HP 1250-0067
Adapter (BNC Male and dual Banana post connectors)	HP 10110A
Adapter (two SMC Male connectors)	HP 1250-0827
Adapter (Type N Male to GR 874)	HP 1250-0847
Double Shielded Cable (BNC Male connectors, coaxial)	HP 08708-6033
Nine-Inch Cable (BNC Male connectors, coaxial)	HP 10502A
Test Cable (48-inch, BNC Male connectors, coaxial)	HP 10503A
Test Cable (SMC Male and BNC Male connectors)	HP 11592-60001
50 Ohm Load (Male, BNC, coaxial)	HP 11593A
Coaxial Short (Male Type N)	HP 11512A
Tee (Coaxial, BNC, one Male and two Female connectors)	HP 1250-0781
Voltage Probe (1:1)	HP 10025A
Extender Board (20 pins)	HP 5060-0256
Bumpers (2) for Extender Board	HP 0403-0115
5 μF Capacitor	HP 0180-2211
100 μF Capacitor	HP 0180-0094
0.001 μF Capacitor	HP 0160-0153
0.033 μF Capacitor	HP 0160-0163
100 kΩ Resistor	HP 0757-0465
10 kΩ Resistor	HP 0757-0442
SPST Switch	HP 3101-0163



C1-3 2-8 pF CERAMIC TRIMMER (HP 0121-0060).
J1 BNC MALE CONNECTOR (HP 1250-0045).
J2 BNC FEMALE CONNECTOR (HP 1250-0083).
L1,2 1.5 INCH NO. 18 ENAMELED WIRE, 2 TURNS.
BOX AND LID.

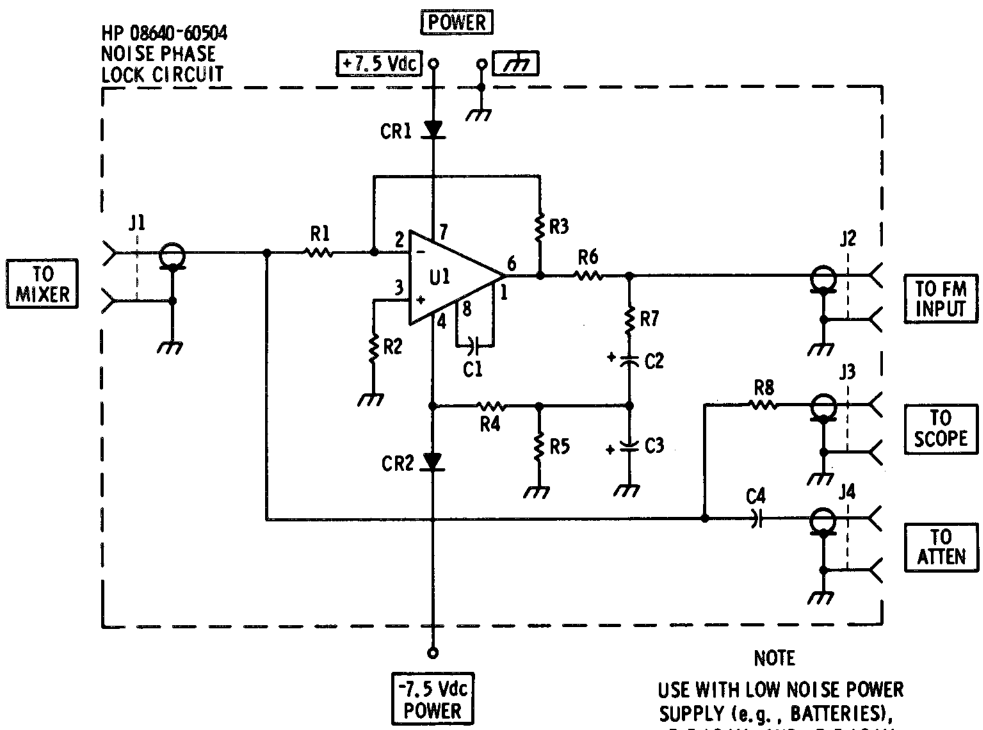
REJECTION: 60 dB AT NOTCH
NOTCH FREQUENCY ACCURACY: 500-540 MHz

Figure 1-7. 520/1040 MHz Notch Filter



R1 178Ω 1/4 WATT (HP 0698-3439)
R2 250Ω VARIABLE (HP 2100-2726)
R3 20kΩ 1/4 WATT (HP 0757-0449)
R4 100Ω 1/4 WATT (HP 0757-0401)
S1,2 SPST SWITCH (HP 3101-1655)
J1-3 BNC FEMALE CONNECTOR (HP 1250-0083)
BOX AND LID

Figure 1-8. FM Linearity Circuit



C1	30 pF (HP 0160-2199)
C2,3	350 μF 15V (HP 0180-2216)
C4	0.27 μF (HP 0160-2406)
CR1,2	DIODE (HP 1901-0033)
	BOX AND LID
J1-4	BNC FEMALE CONN (HP 1250-0083)
R1,2	511Ω (HP 0757-0416)
R3	31.6 kΩ (HP 0698-3160)
R4,5,8	10.0 kΩ (HP 0757-0442)
R6	619Ω (HP 0757-0418)
R7	31.6Ω (HP 0698-3155)
U1	OP AMP (HP 1820-0223)

Figure 1-9. Noise Phase Lock Circuit

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section explains how to prepare the Model 8640B Option 004 Signal Generator for use. It explains how to connect the instrument to accept available line voltage, and it also describes bench operation, rack mounting, storage, and shipment.

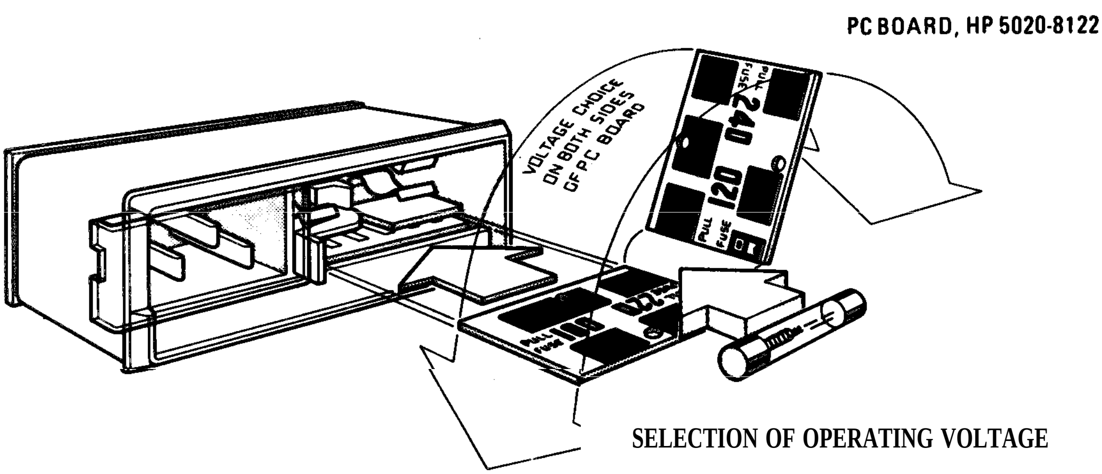
2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaded it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1, and procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, refer to paragraph 0-4. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The Model 8640B Option 004 requires a power source of 100, 120, 220, or 240 Vac +5, –10%, 48 to 440 Hz, single phase. Power consumption is 175 VA maximum.



SELECTION OF OPERATING VOLTAGE

1. Open cover door and rotate fuse-pull to Ieft.
2. Select operating voltaga by orienting PC board to position desired voltage on top-left side. Push board firmly into module slot.
3. Rotate fuse-pull back into normal position and re-insert fuss in holders, using cautions to select correct fuse value.

Operating voltage is shown in module window.

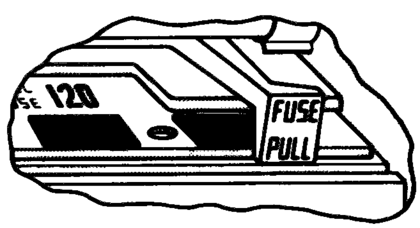


Figure 2-1. Line Selector

2-8. Line Voltage Selection

CAUTION

To prevent damage to the instrument, make the line voltage selection BEFORE connecting the line power. Also ensure the line power cord is connected to a line power socket that is provided with a protective earth contact.

2-9. A rear panel, line power module permits operation from 100, 120, 220, or 240 Vat. The number ‘visible in the window (located on the module) indicates the nominal line voltage to which the instrument must be connected.

2-10. To prepare the instrument for operation, slide the fuse compartment cover to the left (the line power cable must be disconnected). Pull the handle marked FUSE PULL and remove the fuse; rotate the handle to the left. Gently pull the printed circuit voltage selector card from its slot and orient it so that the desired operating voltage appears on the top-left side (see Figure 2-1). Firmly push the voltage selector card back into its slot. Rotate the FUSE PULL handle to the right, install a fuse of the correct rating, and slide the fuse compartment cover to the right. A complete set of fuses is supplied with the instrument — see ACCESSORIES SUPPLIED in Section I.

NOTE

The correct fuse rating for the line voltage selected is listed on the line power module. More information about fuses is given in the table of replaceable parts in Section VI (reference designation is F1).

2-11. Power Cable

2-12. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, 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,

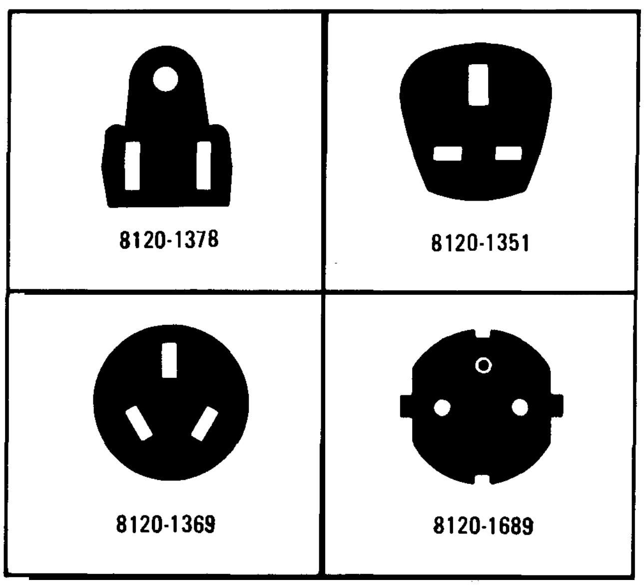


Figure 2-2. Power Cables Available

WARNING

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

a. If this instrument is to be energized via an autotransformer for voltage reduction, make sure that the common terminal is connectad to the earthed pole of the power source.

b. The power cable plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).

c. Before switching on the instrument, the protective earth terminal of the instrument must be connected to a protective conductor of the power cord. This is accomplished by ensuring that the instrument's internal earth terminal is correctly connected to the instrument's chassis and that the power cord is wired correctly (see Service Sheet 22).

2-13. Mating Connectors

2-14. Mating connectors used with the Model 8640B Option 004 should be either 50 ohm-type BNC male or Type N male connectors that are compatible with US MIL-C-39012.

2-15. Operating Environment

2-16. The operating environment should be within the following limitations:

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

2-17. A forced-air cooling system is used to maintain the operating temperature required within the instrument. The air intake and filter are located on the rear panel, and warm air is exhausted through perforations in the right-hand side panel. When operating the instrument, choose a location that provides at least three inches of clearance at the rear and two inches clearance at the right side. The clearances provided by the plastic feet in bench stacking and the filler strips in rack mounting are adequate for the top and bottom cabinet surfaces.

2-18. Bench Operation

2-19. The instrument cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel, and the plastic feet are shaped to make full-width modular instruments self-aligning when stacked.

2-20. Rack Mounting

2-21. This instrument is supplied with a rack mounting kit. This kit contains all the necessary hardware and installation instructions for mounting the instrument on a rack with 19 inch spacing (see Figure 2-3).

2-22. STORAGE AND SHIPMENT

2-23. Environment

2-24. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

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

2-25. Packaging

2-26. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-27. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

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

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

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide 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.

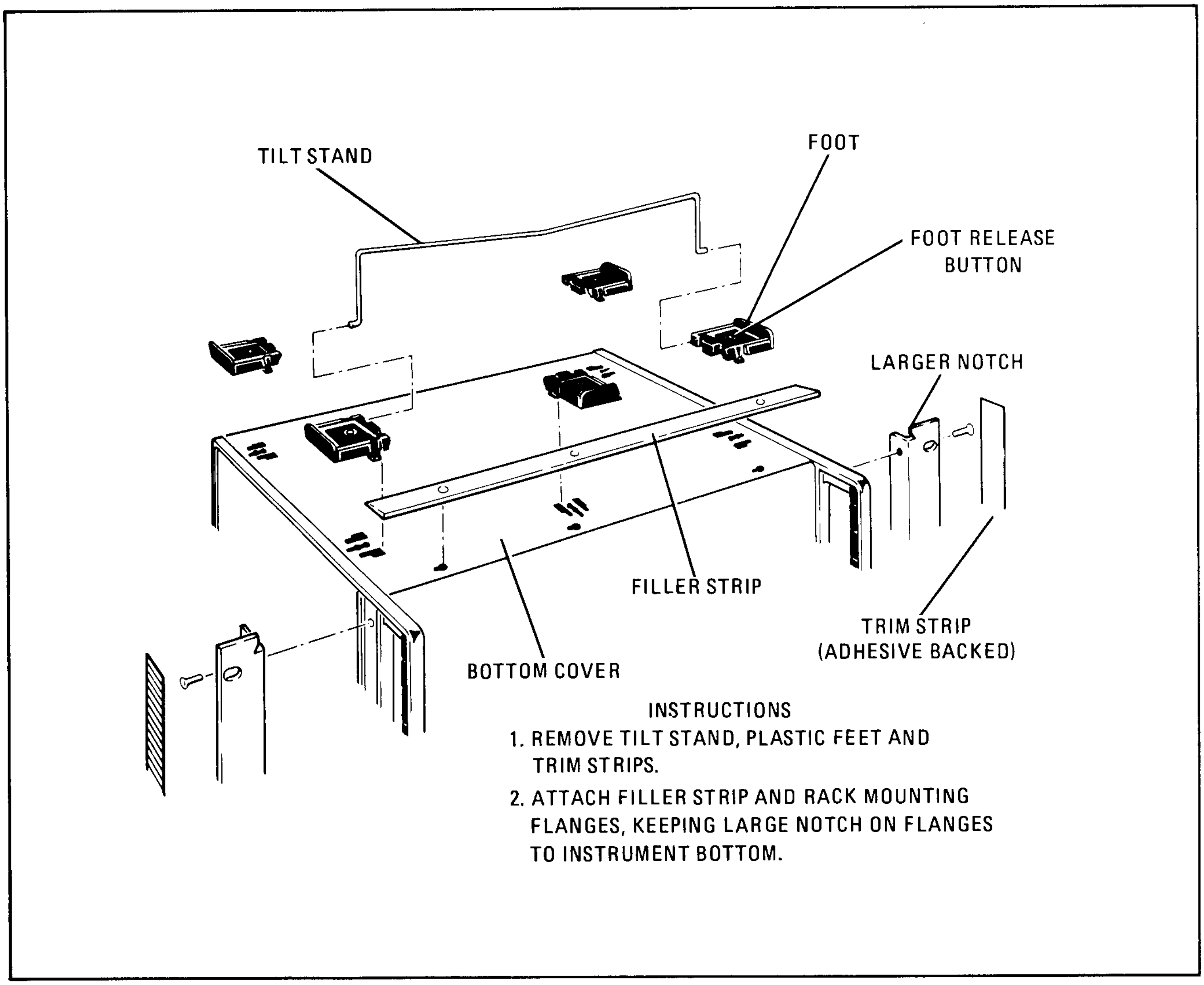


Figure 2-3. Preparation for Rack Mounting

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section describes the functions of the controls and indicators of the Model 8640B Option 004 Signal Generator. It explains how to set the frequency, amplitude, and modulation controls, and covers such operator maintenance as fuse and indicator lamp replacement and fan filter cleaning.

3-3. PANEL FEATURES

3-4. Front panel controls, indicators, and connectors are shown and described in Figure 3-2. The Internal AC/DC Switch is described in Figure 3-3. Rear panel controls and connectors are shown and described in Figure 3-4.

3-5. OPERATOR'S CHECKS

3-6. Use the operator's checks in Figure 3-5 to verify proper operation of the Signal Generator's main functions.

3-7. OPERATING INSTRUCTIONS

3-8. Figures 3-6 and 3-7 explain how to set the frequency, amplitude, and modulation controls. Figure 3-6 also explains how to use the frequency counter and phase lock controls.

3-9. OPERATOR'S MAINTENANCE

3-10. Fuse. The main ac line fuse is located on the rear panel next to the line power cable jack. To remove the fuse, first remove the line power cable from its jack. Slide the fuse compartment cover to the left, then pull the handle marked FUSE PULL and remove the fuse.

CAUTION

Be sure to select the correct fuse rating for the selected line voltage (see LINE VOLTAGE SELECTION in Section II); fuse ratings are listed on the fuse compartment.

3-11. Fan. The cooling fan's filter is located on the rear panel. To service the filter use a No. 2 pozidriv screwdriver (HP 8710-0900) to remove the four screws that hold the falter to the rear panel. Then clean it, using a solution of warm water and soap, or replace it,. using the part number listed in the table of replaceable parts in Section VI.

3-12. The fan motor has factory lubricated, sealed bearings and requires no periodic maintenance.

3-13. Lamp Replacement. Figure 3-1 explains how to replace the lamp located in the line power switch.

3-14. Meter Zeroing. To mechanically zero the front panel meter, set LINE switch to OFF and place instrument in its normal operating position. Turn adjustment screw cw until indicator indicates zero, then turn adjustment slightly ccw to free mechanism from adjusting peg.

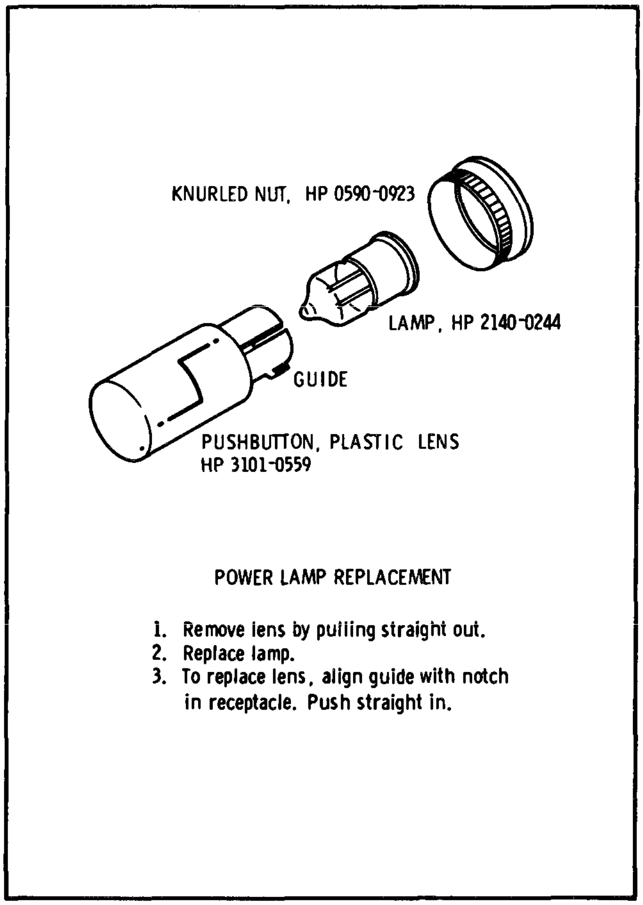
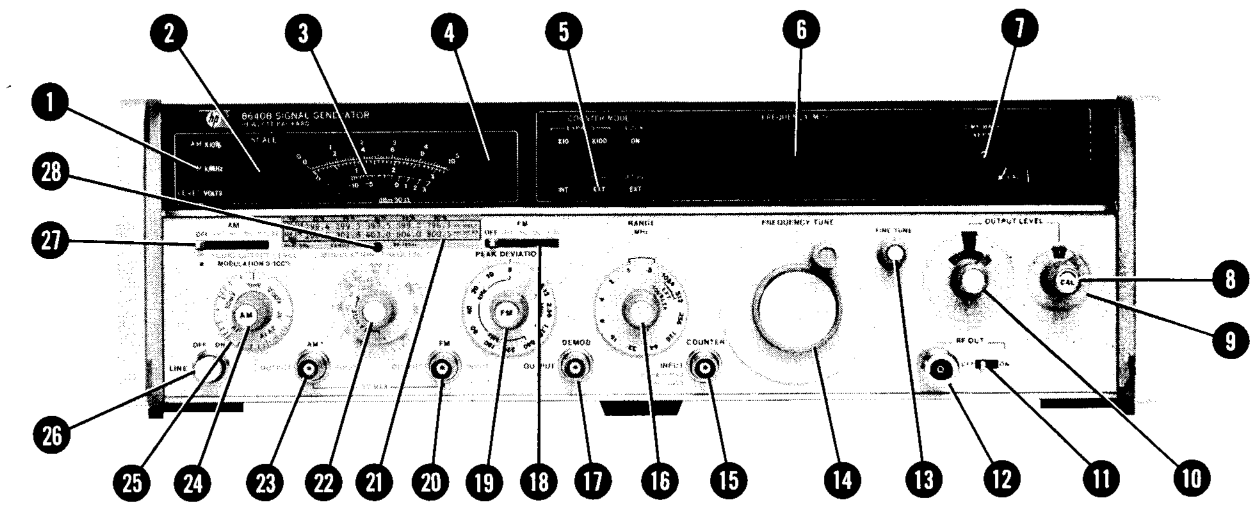


Figure 3-1. Lamp Replacement

FRONT PANEL FEATURES



1 **Meter Function:** interlocked buttons select one of three functions.

AM: meter indicates percent of amplitude modulation.

FM: meter indicates peak frequency deviation.

LEVEL: meter indicates RF output level in Vrms or dBm 50 Ω.

2 **SCALE:** annunciator lamps light to indicate applicable meter scale. Meter scale is automatically selected.

3 Meter: automatically ranges to one of three scales, read according to meter function.

AM X 10%: 0-3 scale is read 0-30%; 0-10 scale is read 0-100%.

FM kHz/MHz: 0-3, 0-5, and 0-10 scales are read in kHz or MHz, depending upon setting of PEAK DEVIATION switch (e.g., with PEAK DEVIATION set to 80 kHz, a meter reading of 7.2 indicates that deviation is 72 kHz).

LEVEL VOLTS: 0-3 and 0-10 scales are read in microvolt, millivolts, or volts depending upon setting of the OUTPUT LEVEL 10 dB switch. The –10 to +3 dB scale is read relative to the dBm scales on the OUTPUT LEVEL dials.

4 **Output Problem Annunciators:** lamps light to indicate that modulation or OUTPUT LEVEL settings are causing generator to be uncalibrated.

REDUCE PEAK POWER: indicates a combination of OUTPUT LEVEL and amplitude modulation that exceeds specified limits (i.e., 100% AM on all RF frequency ranges except 256-512 MHz, and typically greater than 50% AM on this top range).

REDUCE FM VERNIER: indicates that an external FM input level or vernier setting is causing FM deviation to exceed limits.

Figure 3-2. Front Panel Controls, Indicators, and Connectors (1 of 4)

FRONT PANEL FEATURES

REDUCE PEAK DEVIATION: indicates PEAK DEVIATION setting is too high for the selected frequency range.

5 **COUNTER MODE:** Buttons control operation of frequency counter.

EXPAND: X10 expands resolution one digit, moving the decimal point one place to the left; X100 expands resolution two digits, moving the decimal point two places to the left.

NOTE

EXPAND X10 and EXPAND Xl 00 buttons are interlocked so that only one button can be depressed at a time.

LOCK: phase locks Signal Generator to the internal (or to an external) crystal reference. Display indicates lock frequency; loss of lock causes display to flash and indicate actual frequency of Signal Generator

INT: programs counter to count frequency of signal Generator.

EXT 0-10, EXT 0-550: programs counter to count frequency of signal at COUNTER INPUT jack; also selects counter frequency range in MHz.

6 **Frequency MHz:** counter readout indicates RF frequency in MHz. Flashing display indicates loss of phase lock. The OVERFLOW lamp lights to indicate that significant data is not being displayed.

7 **TIME BASE VERNIER:** used as a fine frequency tune when in lock mode to give continuous tuning between lock points (the use of the COUNTER MODE EXPAND X10 control is necessary on some ranges to tune over the full range). When control is not in CAL position, the UNCAL lamp lights to indicate that the counter is uncalibrated.

8 **OUTPUT LEVEL VERNIER:** varies RF amplitude over a 2 dB range from a CAL detent position (also see DEMOD OUTPUT).

9 **OUTPUT LEVEL 1 dB:** 1 dB steps, 0 to-12 dB.

10 **OUTPUT LEVEL 10 dB:** -130dBm to +10 dBm and a 6 dB step to +16 dBm.

11 **RF On/OFF:** enables or disables the RF output.

NOTE

The RF ON/OFF switch may be wired to turn off only the amplitude modulator. This allows the RF oscillator to remain warmed up, the Auxiliary RF Output to remain on, and the counter and phase lock to remain operating. If it is desirable to switch both the modulator and the RF Oscillator off, the RF ON/OFF function may be easily modified (see Service Sheet 5 in Section VIII).

12 **RF OUT:** RF output through Type N female connector. (Connector meets US MIL-C-39012.) 50 ohm ac coupled source impedance.

CAUTION

Any interruption of the protective (grounding) conductor inside or outside the instrument is likely to cause damage to the instrument. To avoid damage, this instrument and all line powered devices connected to it must be connected to the same earth ground (see section II).

13 **FINE TUNE:** fine frequency control.

14 **FREQUENCY TUNE:** coarse frequency control.

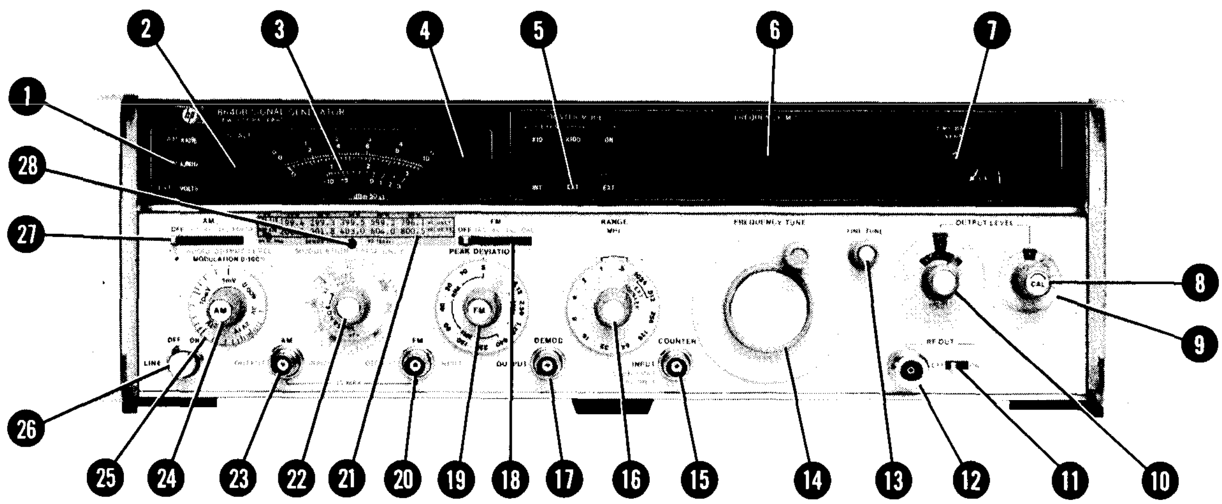
15 **COUNTER INPUT:** external input to frequency counter impedance is 50 ohms.

CAUTION

Do not apply a dc voltage or >+15 dBm to COUNTER INPUT.

Figure 3-2. Front Panel Controls, Indicators, and Connectors (2 of 4)

FRONT PANEL FEATURES



16 **Range:** selects one of ten octave frequency bands. The 512-1024 MHz/Doubler position gives 256-512 MHz at RF OUT, but the FREQUENCY MHz readings and FM meter indications are corrected for use with an RF doubler connected to RF OUT.

17 **DEMOD OUTPUT:** output for a demodulated AM signal for precision measurement of percent AM, and for sensing phase relationship of the output RF envelope and the input modulating signal (600Ω source impedance).

NOTE

DEMOD OUTPUT is calibrated only when the OUTPUT LEVEL Vernier is in the CAL detent and not calibrated when the OUTPUT LEVEL 10 dB switch is set to +16 dBm.

An internal switch controls the level of the DEMOD OUTPUT signal. Refer to Figure 3-3.

18 **FM:** selects frequency modulation and source.

OFF: no FM.

INT: FM by internal oscillator.

AC: FM by external source through FM INPUT jack (>20 Hz, ac + dc <5 Vpk).

DC: FM by external source through FM INPUT jack (ac + dc <5 Vpk).

CAL: used to calibrate external modulation input (do not use when phase locked).

19 **PEAK DEVIATION:** switch and concentric vernier vary FM frequency deviation (as indicated on the meter). Vernier range is from zero to the peak deviation selected by the switch.

20 **FM INPUT/OUTPUT:** 600 ohm input for external FM; nominally 1 Vpk (0.7071 Vrms) required for full peak deviation selected by PEAK

Figure 3-2. Front Panel Controls, Indicators, and Connectors (3 of 4)

FRONT PANEL FEATURES

DEVIATION switch (never more than 5 Vpk). Output for internal oscillator whenever FM selector is set to INT (600 ohm source impedance); level controlled by AUDIO OUTPUT LEVEL.

21 **DEMOD CAL Label:** lists values of rms voltage by which percent AM can be set very accurately (within 1%) with a high impedance voltmeter at DEMOD OUTPUT. Values provided by the factory apply when the internal AC/DC switch is in the DC position. Multiply the given values by 5 to determine values when the switch is in the AC position.

NOTE

DEMOD OUTPUT should be calibrated and a new DEMOD CAL Label filled in at least every three months to ensure accuracy. Perform the following adjustments and tests to determine values of ac voltage for new label.

5-29. RF Detector Offset Adjustment
5-31. Preliminary AM adjustments
5-32. AM Accuracy Adjustment
4-38. Demodulated Output Accuracy Test

22 **MODULATION FREQUENCY:** seitch selects 400 Hz or 1000 Hz. With Option 001 Variable Modulation Oscillator (shown), switch also selects multiplier. Vernier, with multiplier, sets frequency from 20 Hz to 600 kHz.

23 **AM INPUT/OUTPUT:** 2000 ohm input for external AM; 1 Vpk (0.7071 Vrms) required for 100% modulation (never more than 5 Vpk). Input for pulse modulation (50 ohm): >1 Vpk positive pulse required to turn on RF. Output for internal oscillator whenever AM selector is set to INT (600 ohm source impedance); level controlled by AUDIO OUTPUT LEVEL.

NOTE

With the Option 001 Variable Modulation Oscillator, AM OUTPUT and FM OUTPUT are in parallel. Parallel load should be ≥600 ohms.

24 **MODULATION:** vernier varies amplitude modulation from 0 to 100% (as indicated on the meter).

25 **AUDIO OUTPUT LEVEL:** control varies level of signal from AM and/or FM OUTPUT jacks (calibration gives voltage into 600Ω).

26 **LINE:** switch applies or removes AC power. The button lights when ON.

27 **AM:** selects amplitude modulation and source.

OFF: no AM.

INT: AM by internal oscillator.

AC: AM by external source through AM INPUT jack (>20 Hz, ac +dc <5 Vpk).

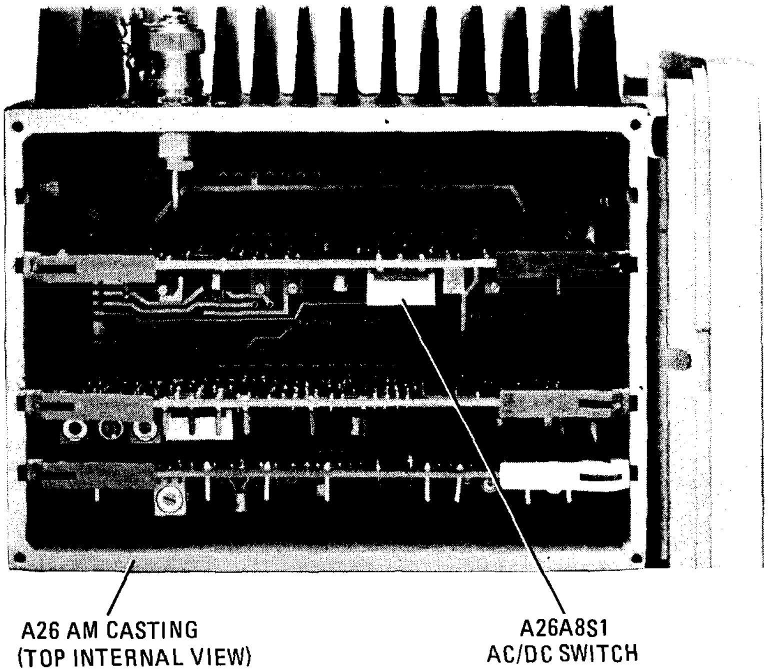
DC: AM by external source through AM INPUT jack (ac +dc <5 Vpk).

PULSE: when selected with no modulation, it disables the RF output; a positive pulse at AM INPUT pulses on the RF.

28 **Mechanical Meter Zero:** sets meter suspension so that meter indicates zero when power is removed from instrument and instrument is in normal operating position.

Figure 3-2. Front Panel Controls, Indicators, and Connectors (4 of 4)

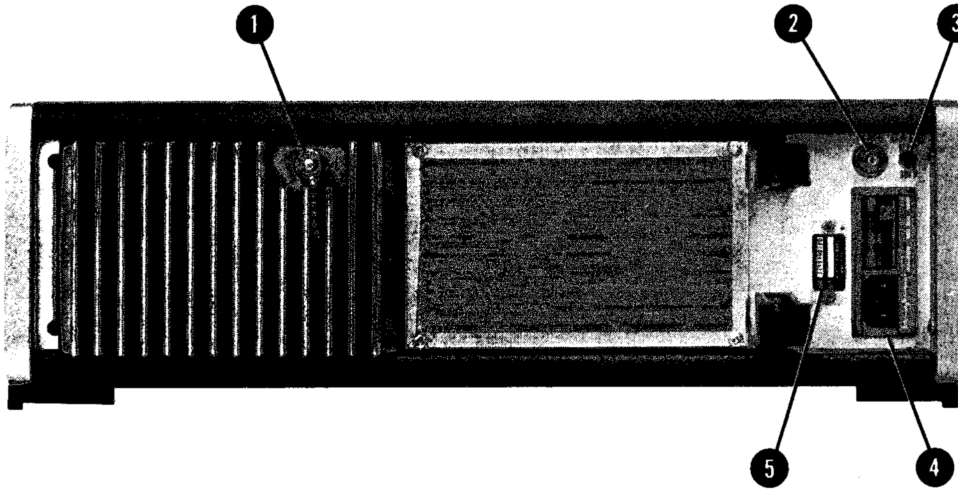
INTERNAL AC/DC SWITCH



AC/DC Switch: An internal selector switch on the Demodulation Amplifier (within the A26 AM casting) selects either ac only at 0-5 Vrms or ac at 0-1 Vrms plus dc at the front panel DEMOD OUTPUT jack. A choice of demodulated outputs ensures compatibility with both solid state and vacuum tube modulation sources.

Figure 3-3. Internal AC/DC Switch

REAR PANEL FEATURES



(1) **AUX RF OUTPUT:** nominal −5 dBm auxiliary RF output; 500 ohm source impedance. Signal does not contain amplitude or pulse modulation (however, it does contain FM). On the 512-1024 MHz/Doubler Band the auxiliary RF output is one-half the frequency of the indicated RF frequency.

(2) **TIME BASE Reference In/Out:** input for external 5 MHz time base reference that is >100 mVrms; load impedance is 1 kΩ. Output for internal 5 MHz time base reference, level is 3 Vrms into an open circuit; source impedance is 500 ohms.

(3) **TIME BASE Reference INT/EXT:** switch selects function of IN/OUT jack. INT position applies internal reference to jack. EXT position feeds external reference from jack to time base.

NOTE

Since the phase lock reference is the 5 MHz time base, the Model 8640B Option 004 can be phase locked to an external reference (such as another Model 8640B) by using the TIME BASE Reference jack and switch.

(4) **Line Power Module:** 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.

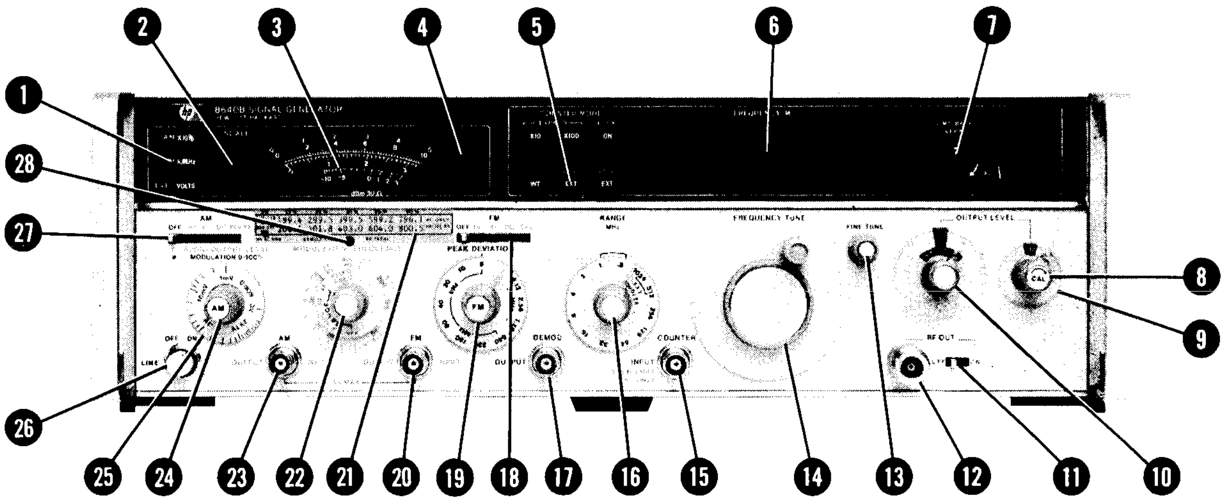
WARNING

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).

(5) **Serial Number Plate:** first four digits of serial number comprise the prefix which defines the instrument configuration; last five digits form sequential suffix that is unique to each instrument. The plate also indicates any options supplied with instruments.

Figure 3-4. Rear Panel Controls and Connectors

OPERATOR'S CHECKS



Initial Control Settings

a. Push LINE switch (22) to ON. Set TIME BASE INT/EXT switch (on rear panel) to INT.

b. Set the controls as follows:

(1)	Meter Function	LEVEL
(5)	COUNTER MODE: EXPAND	Off (Out)
	LOCK	Off (Out)
	Source	INT (In)
(7)	TIME BASE VERNIER	CAL
(27)	AM	OFF
(25)	AUDIO OUTPUT LEVEL	ccw
(24)	MODULATION	ccw
(22)	MODULATION FREQUENCY	400 Hz
(18)	FM	OFF
(19)	PEAK DEVIATION	5 kHz
(19)	PEAK DEVIATION Vernier	ccw
(16)	RANGE	0.5-1 MHz
(14)	FREQUENCY TUNE	Centered (Four turns from stop)
(13)	FINE TUNE	Centered (2.5 turns from stop)
(11)	RF ON/OFF	ON
(10)	OUTPUT LEVEL 10 dB	+10 dBm
(9)	OUTPUT LEVEL 1 dB	−3 dB
(8)	OUTPUT LEVEL Vernier	CAL

Figure 3-5. Operator's Checks (1 of 5)

OPERATOR'S CHECKS

Counter and RF Oscillator

c. Use a type N to BNC adapter and a BNC to BNC cable to connect RF OUT 12 to COUNTER INPUT 15.

d. Adjust FREQUENCY TUNE 14 and FINE TUNE 13 until FREQUENCY 6 reads 0.75000 MHz. Set COUNTER MODE EXPAND 5 to X10; FREQUENCY should read about 0.750000 MHz (the reading should shift one place to the left). Set COUNTER MODE EXPAND to X100; FREQUENCY should read about 500000 MHz (the reading should shift one additional place to the left with the decimal point and the seven no longer displayed; the OVERFLOW annunciator lamp should light).

e. Set COUNTER MODE EXPAND 5 to OFF (buttons out). With RANGE 16 set as follows, FREQUENCY 6 should read approximately as shown:

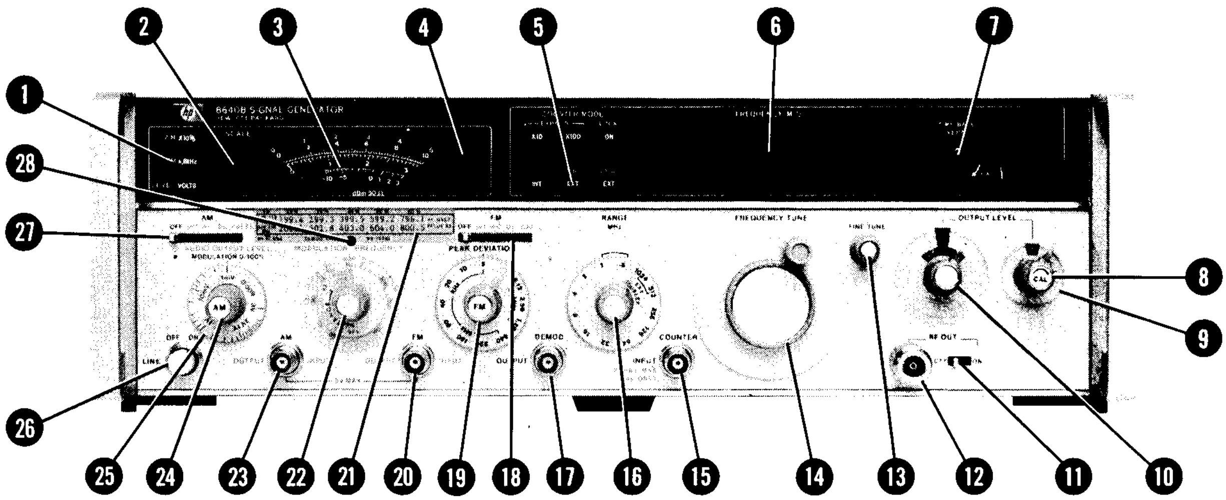
RANGE MHz	FREQUENCY MHz
0.5-1	0.75000
1-2	01.5000
2-4	03.0000
4-8	06.0000
8-16	12.0000
16-32	024.000
32-64	048.000
64-128	096.000
128-256	0192.00
256-512	0384.00
512-1024	0768.00

Phase Lock

f. Set RANGE 16 to 256-512 MHz. Note that the right-hand digit on the FREQUENCY display 6 flickers between two digits. Set COUNTER MODE LOCK 5 to ON; the flickering should stop. Slowly adjust FINE TUNE 13; the FREQUENCY reading should not change. Adjust FREQUENCY TUNE 14; the frequency display should flash at about a 2 Hz rate and the reading should change (the reading should follow FREQUENCY TUNE).

Figure 3-5. Operator's Checks (2 of 5)

OPERATOR'S CHECKS



RF Output

g. Set COUNTER MODE LOCK 5 to OFF and Source 5 to EXT 0-550. Adjust FREQUENCY TUNE 14 until FREQUENCY 6 reads 0384.00 MHz. Step through the ranges as specified in step e, setting the COUNTER MODE EXPAND and Source (EXT) controls 5 to obtain appropriate resolution; FREQUENCY should read approximately as shown in step e.

NOTE

With RANGE set to 512-1024 MHz, FREQUENCY will read approximately 0384.00 MHz (the actual frequency at RF OUT).

Meter

h. Set OUTPUT LEVEL 9, 10 to +7 dBm (+10, −3); the meter 3 should indicate approximately 5 on the 0-10 SCALE (the 0-10 SCALE annunciator 2 should light).

i. Reduce OUTPUT LEVEL 9, 10 to −1 dBm (+10, −11); the meter 3 should auto-range to the 0-3 SCALE when the indicator passes approximately 3 on the 0-10 SCALE.

Figure 3-5. Operator's Checks (3 of 5)

OPERATOR'S CHECKS

j. With OUTPUT LEVEL 9, 10 set to −1 dBm (+10, −11), the meter 3 should indicate approximately 2 on the 0-3 SCALE. Increase OUTPUT LEVEL to +7 dBm; the meter should autorange to the 0-10 SCALE when the indicator passes approximately 3 on the 0-3 SCALE.

Amplitude Modulation

k. Set Meter Function 1 to AM and AM 27 to INT. Slowly turn Modulation 20 clockwise. When the Meter 3 indicates 10 (i.e., 100% modulation) set OUTPUT LEVEL 9, 10 to +16 dBm; the REDUCE PEAK POWER annunciator 4 should light.

Frequency Modulation

l. Set AM 27 to OFF (the annunciator should go out) and FM 18 to INT. Set Meter Function 1 to FM and check that PEAK DEVIATION 19 is set to 5 kHz and the vernier is full counterclockwise; the meter 3 should indicate 0.

m. Turn the PEAK DEVIATION vernier 19 full clockwise; the meter 3 should indicate approximately 5 and the REDUCE FM VERNIER annunciator 4 should light.

n. Reduce FM vernier 19 until meter reads 5 kHz (the annunciator should go out). Check that RANGE 16 is set to 0.5-1 MHz, and set PEAK DEVIATION 19 to 10 kHz; the REDUCE PEAK DEVIATION annunciator 4 should light and the meter should indicate 0.

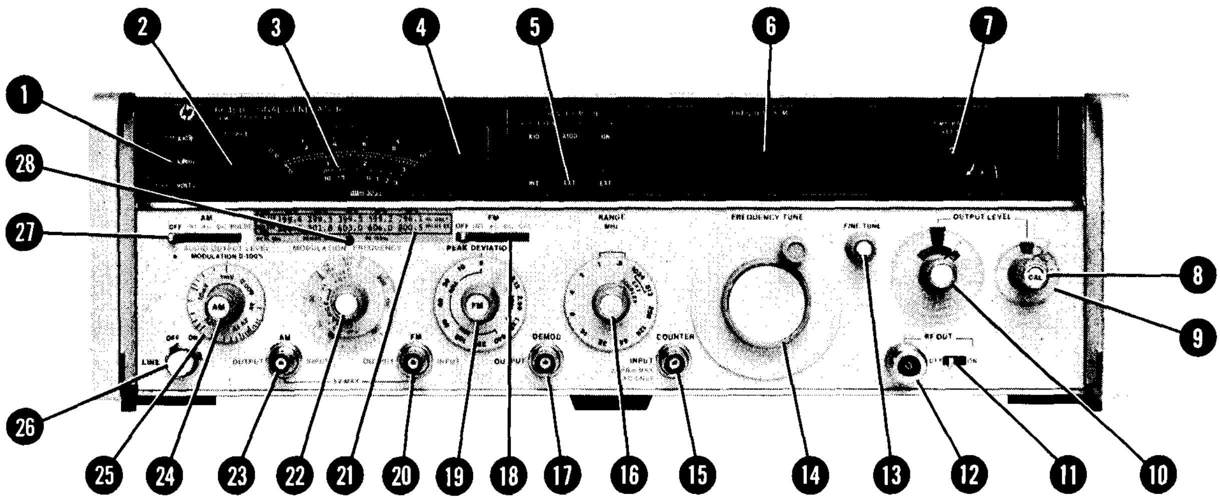
o. Set RANGE 16 to 1-2 MHz (the annunciator should go out) and turn the PEAK DEVIATION vernier 19 full counterclockwise; the meter 3 should indicate 0 on the 0-10 SCALE.

Modulation Oscillator

p. Using the BNC to BNC cable, connect FM OUTPUT 20 to COUNTER INPUT 15. Set COUNTER MODE EXPAND 5 to X100 and Source 5 to EXT 0-10. Set AUDIO OUTPUT LEVEL 25 to 1V and MODULATION FREQUENCY 22, in turn, to 400 Hz and 1 kHz; the FREQUENCY readout 6 should display approximately "0.000400" and "0.001000" MHz.

Figure 3-5. Operator's Checks (4 of 5)

OPERATOR'S CHECKS



Demodulated Output

q. Change the controls as follows:

1	Meter Function	AM
24	MODULATION	Full ccw
27	AM	INT
18	FM	OFF
9	OUTPUT LEVEL 1 db	0 dB
10	OUTPUT LEVEL 10 dB	+10 dBm

Connect a dc voltmeter to DEMOD OUTPUT 17. If the generator's internal AC/DC switch (A26A8S1) is in the DC position the voltmeter should indicate approximately +1.4 Vdc. If the AC/DC switch is in the AC position the voltmeter should indicate approximately 0 Vdc.

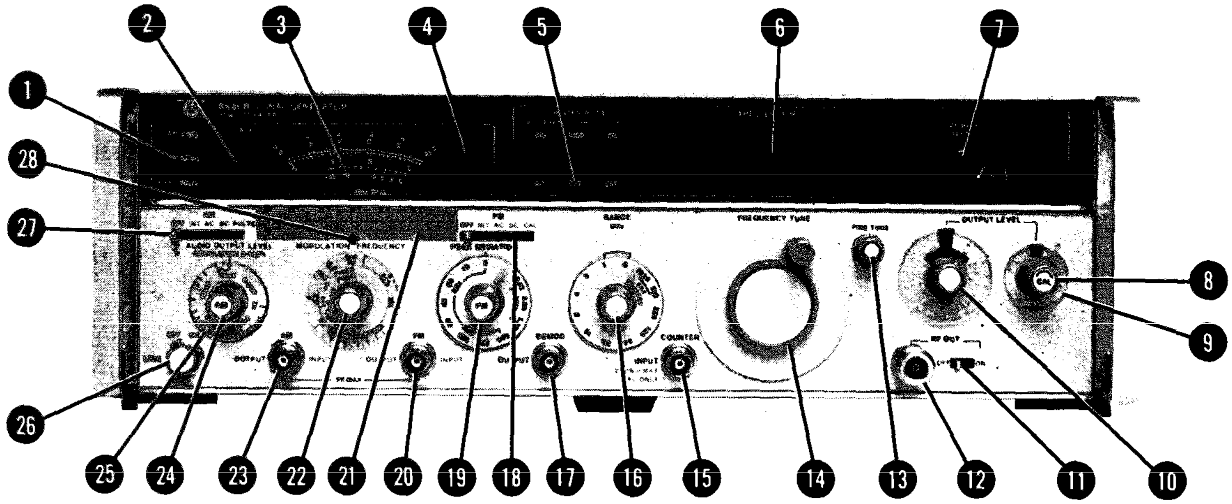
r. Connect an ac voltmeter to DEMOD OUTPUT 17. With the MODULATION 24 control, set percent AM as follows. The voltmeter should indicate approximately as shown for the appropriate AC/DC switch selection.

	Internal AC/DC Switch	
% AM	AC	DC
0	0 Vrms	0 mVrms
20	1.0 Vrms	200 mVrms
30	1.5 Vrms	300 mVrms

	Internal AC/DC Switch	
% AM	AC	DC
40	2.0 Vrms	400 mVrms
60	3.0 Vrms	600 mVrms
80	4.0 Vrms	800 mVrms

Figure 3-5. Operator's Checks (5 of 5)

SETTING FREQUENCY AND AMPLITUDE



Frequency

a. Set COUNTER MODE 5 to INT and TIME BASE VERNIER 7 to CAL.

b. Set RANGE 13 to span the desired frequency.

c. Use FREQUENCY TUNE 12 and FINE TUNE 11 to set the Signal Generator to the desired frequency.

d. The decimal point on the FREQUENCY display 6 is automatically set by the RANGE control 13. For more resolution, set COUNTER MODE EXPAND 5 to X10 or X100.

e. To phase lock the generator's output, set COUNTER MODE LOCK 5 to ON; use TIME BASE VERNIER 7 as the fine frequency tune. On some frequency bands it will be necessary to use the COUNTER MODE EXPAND controls to tune between adjacent counts.

NOTE

If the OVERFLOW annunciator lamp lights, the generator will not enter calibrated phase lock. If the TIME BASE VERN is not in the CAL position, the counter will not be calibrated.

Figure 3-6. Setting the Frequency and Amplitude Controls (1 of 3)

SETTING FREQUENCY AND AMPLITUDE

f. Whenever phase lock is lost, the FREQUENCY display 6 will flash. To re-establish phase lock, set COUNTER MODE LOCK 5 to OFF; re-tune (if necessary) with FREQUENCY TUNE 12 and FINE TUNE 11, and set COUNTER MODE LOCK to ON.

NOTE

To get an accurate indication of frequency when not phase locked, set TIME BASE VERNIER 7 to CAL.

g. To use an external frequency doubler, connect to RF OUT 9 and set RANGE 13 to 512-1024 MHz/DOUBLER. The FREQUENCY display 5 will indicate the frequency out of doubler (i.e., the FREQUENCY display indicates twice the frequency at RF OUT).

Amplitude

a. To enable the RF signal, set the RF ON/OFF switch 11 to ON.

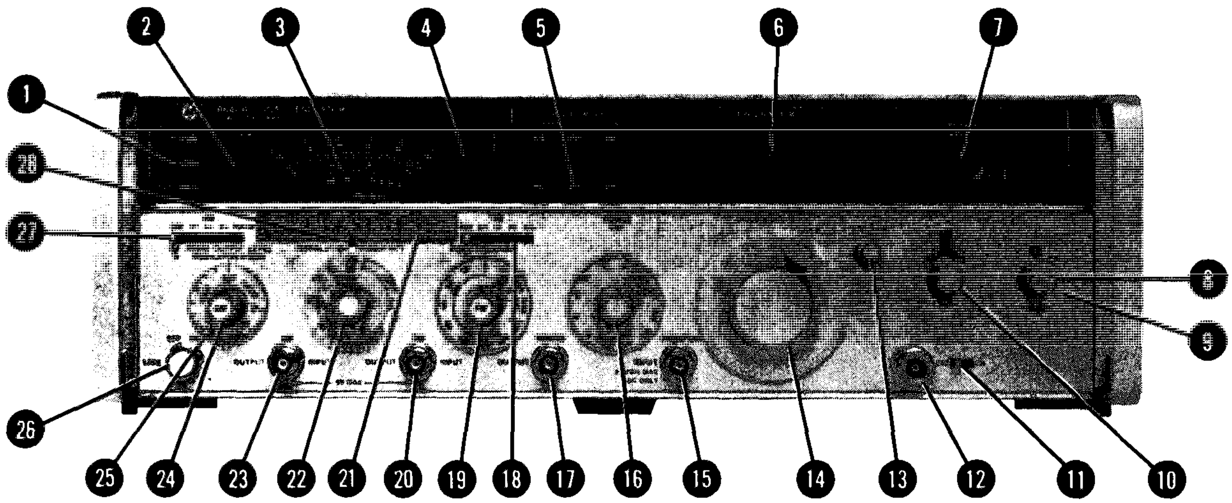
NOTE

The RF ON/OFF switch may be wired to turn off only the amplitude modulator. This allows the RF Oscillator to remain warmed up, the Auxiliary RF Output to remain on, and the counter and phase lock to remain operating. If it is desirable to switch both the modulator and the oscillator off, the RF ON/OFF function may be easily modified (see Service Sheet 5 in Section VIII).

b. The Model 8640B Option 004 indicates RF output amplitude in units of power (dBm 50Ω) or voltage (V, mV, μV). With the vernier in the CAL detent position, RF Output (in dBm) is determined by summing the values indicated on the two OUTPUT LEVEL dials 9, 10. When the vernier is not in CAL detent, an approximate value of output power is derived by the summing method mentioned above. The actual value is then read on the front panel meter 3 (dBm scale). When RF amplitude is read in units of voltage, the OUTPUT LEVEL 10 dB dial 10 indicates meter range (if the small OUTPUT LEVEL 1 dB dial 9 is between 0 and −3 dB, and the vernier 8 is in CAL detent). As output attenuation is increased the meter reading decreases (i.e., the needle moves to the left) and output voltage

Figure 3-6. Setting the Frequency and Amplitude Controls (2 of 3)

SETTING FREQUENCY AND AMPLITUDE

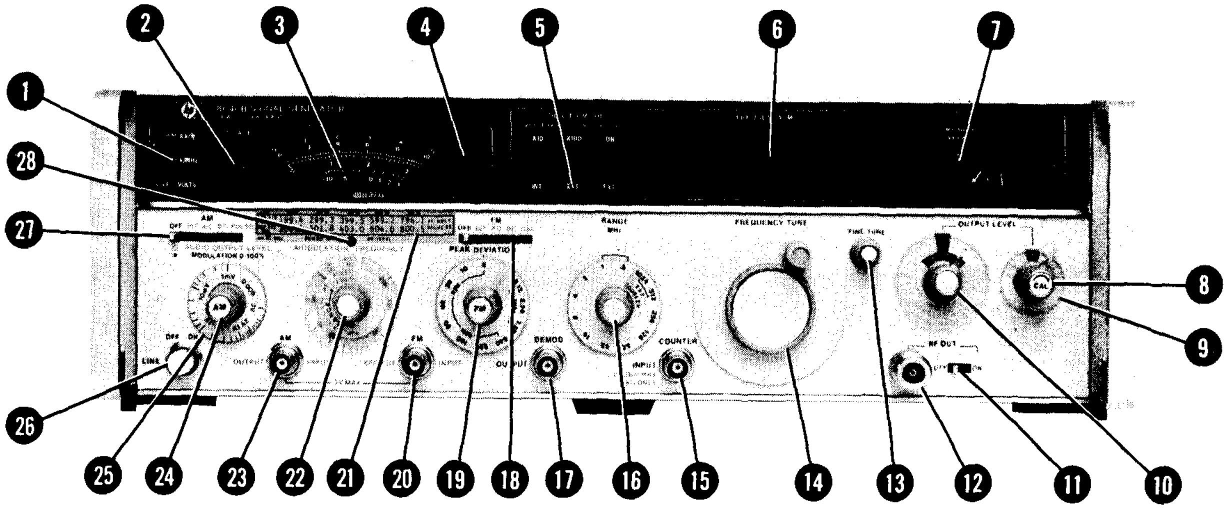


is read on the indicated voltage scale. At approximately 1 on the 0-3 scale, or 3 on the 0-10 scale, the meter autoranges to the next lower range. The vernier provides additional attenuation and also affects meter autoranging.

c. If a 50 ohm to 75 ohm adapter (consisting of a 25 ohm series resistor) is connected to RF OUT 12, the Output Level voltage scale will be correct if the instrument is used with 75 ohm terminations. However, 1.76 dB must be subtracted from the dB scale for correct readings.

Figure 3-6. Setting the Frequency and Amplitude Controls (3 of 3)

SETTING MODULATION



Amplitude Modulation

a. Set Meter Function 1 to AM.

b. To use the internal modulation oscillator, set AM 27 to INT. Set MODULATION FREQUENCY 22 to the desired frequency, and set percent of modulation with the MODULATION vernier 24; modulation is indicated by the meter 3 (e.g., a meter reading of 5.4 indicates that the AM is 54%).

NOTE

The REDUCE PEAK POWER annunciator 4 lights whenever the Signal Generator's output amplifier is being overdriven. When it lights, reduce MODULATION 24 vernier or OUTPUT LEVEL vernier 8.

c. With AM 27 set to INT, the internal modulation oscillator signal is present at the AM OUTPUT jack 23 (600 ohm source impedance). Its level is set by AUDIO OUTPUT LEVEL 25.

Figure 3-7. Setting the Modulation Controls (1 of 5)

SETTING MODULATION

d. To use an external modulation signal, set AM 27 to AC (or DC if modulation signal is less than 20 Hz). Apply the signal to the AM INPUT jack 23 (2000 ohm load impedance). The Signal Generator requires 1 Vpk (0.7071 Vrms) for 100% modulation. Set percent of modulation with the MODULATION vernier 24; percent AM is indicated by the meter 3.

NOTE

The meter reading is accurate when AM is set to DC only if no dc offset is applied to the AM INPUT jack. The meter responds to the positive peak of the ac component of the modulating signal.

e. A path for sensing the phase of the demodulated audio signal is provided at the DEMOD OUTPUT jack 17. DEMOD OUTPUT provides a 0-5 Vrms signal when an internal AC/DC switch (A26A8S1, Demodulation Amplifier Assembly) is in the AC position. With the AC/DC switch in this position the Signal Generator is compatible with most vacuum tube audio oscillators used in VOR receiver testing. When the AC/DC switch is in the DC position, a 0-1 Vrms signal (with 1.414 ± 0.010 Vdc offset) is present which is compatible with solid state VOR audio oscillators.

f. For minimum phase shift of the audio signal between AM INPUT 23 and DEMOD OUTPUT 17 set AM 27 to DC and ensure that the DEMOD OUTPUT is feeding into less than 30 pF at the external VOR/ILS audio oscillator input.

NOTE

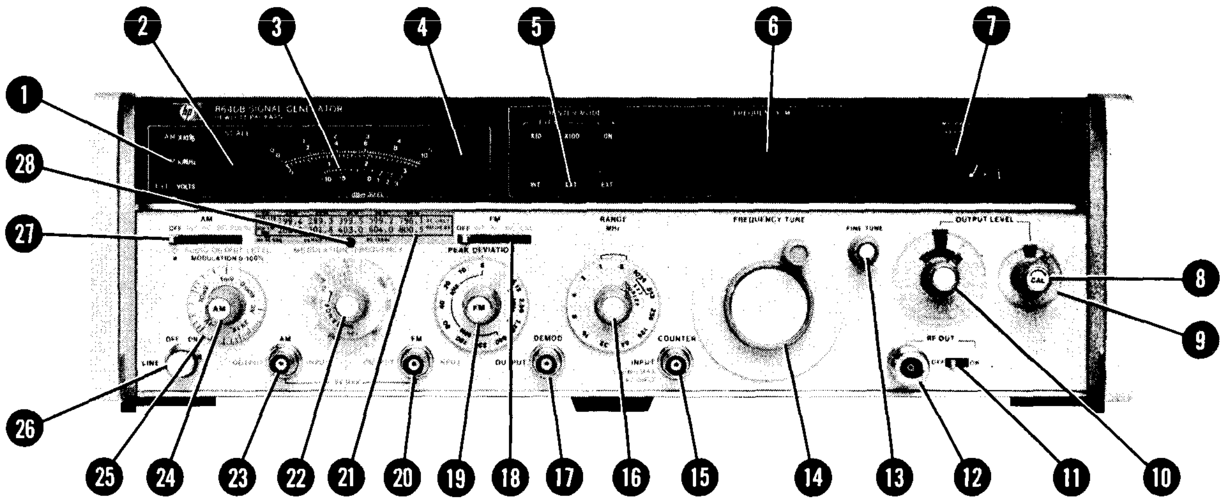
AM accuracy is specified except when the OUTPUT LEVEL 10 dB switch is in the +16 dBm position.

g. Percent AM is indicated on the front panel meter when Meter Function 1 is in the AM position. A more precise method of determining percent AM is provided by the DEMOD OUTPUT feature. With the OUTPUT LEVEL VERNIER 8 in the CAL detent position, percent AM is directly proportional to the ac voltage at the DEMOD OUTPUT 17.

AC/DC switch to AC: % AM = 20% per Vrms
AC/DC switch to DC: % AM = 100% per Vrms (Vdc = 1.414 ± 0.010V)

Figure 3-7. Setting the Modulation Controls (2 of 5)

SETTING MODULATION



h. When the OUTPUT LEVEL vernier 8 is out of the CAL detent and the internal AC/DC switch is in the DC position, percent AM can be derived by applying the following formula:

$$\% \text{ AM} = 100\sqrt{2} \cdot \frac{\text{Vrms}}{\text{Vdc}}$$

Pulse Modulation

a. Set Meter Function 1 to LEVEL.

b. Set AM 27 to PULSE (this disables the RF output). Apply the modulation pulse (>0.5V) to the AM INPUT jack 23 (50 ohm load impedance). The Signal Generator requires a positive level to produce an RF output.

c. Set the desired pulse-on level using the OUTPUT LEVEL controls 9, 10.

Frequency Modulation

a. Set Meter Function 1 to FM.

b. To use the internal modulation oscillator, set FM 18 to INT. Set MODULATION FREQUENCY 22 to the desired frequency, and set the peak deviation with the PEAK DEVIATION switch and vernier 19.

Figure 3-7. Setting the Modulation Controls (3 of 5)

SETTING MODULATION

NOTE

The REDUCE PEAK DEVIATION annunciator 4 lights whenever the PEAK DEVIATION switch setting is too high for the selected frequency range. When it lights, reduce PEAK DEVIATION.

c. Peak frequency deviation is indicated by the meter 3, and the meter is read in conjunction with the PEAK DEVIATION switch 19 (e.g., with PEAK DEVIATION set to 320 kHz, a meter reading of 2.8 indicates that peak frequency deviation is 280 kHz).

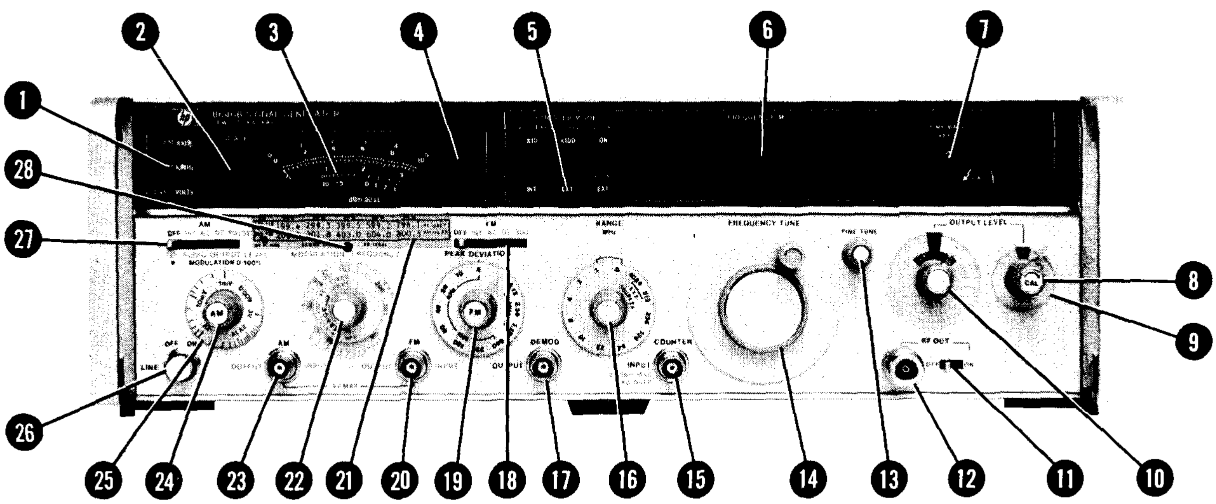
d. With FM 18 set to INT, the internal modulation oscillator signal is present at the FM OUTPUT jack 20 (600 ohm source impedance). Its level is set by AUDIO OUTPUT LEVEL 25.

e. To use an external modulation signal, set FM 18 to AC (or DC if modulation signal is less than 20 Hz). Apply the signal to the FM INPUT jack 20 (600 ohm load impedance). The Signal Generator requires 1 Vpk (0.7071 Vrms) for full peak deviation. The PEAK DEVIATION controls 19 and the meter 3 are used the same as when using the internal modulation oscillator signal.

f. To calibrate the external input, set the FM switch 18 to DC (with no signal applied to FM input) and read the frequency of the RF Output. Set FM to CAL and, using the PEAK DEVIATION switch and vernier 19, offset the frequency at RF OUT an amount equal to the desired peak deviation. Set FM to DC or AC; a 1 Vpk (0.7071 Vrms) signal applied to FM INPUT will now produce the desired peak deviation. (Do not use FM CAL when phase locked.)

Figure 3-7. Setting the Modulation Controls (4 of 5)

SETTING MODULATION



NOTES

1. The REDUCE FM VERNIER annunciator 4 lights whenever an FM input causes peak deviation to exceed its limits. When it lights, reduce either the PEAK DEVIATION vernier or the external signal level.

2. Do not apply FM signals that are less than 50 Hz when using the generator in the phase lock mode. Doing so will cause either the FM deviation to be uncalibrated or the generator to break phase lock (thereby causing the counter display to flash. Also do not use FM CAL after locking.

Simultaneous AM and FM

a. Simultaneous AM and FM, or pulse modulation and FM, can be accomplished using the procedures described above. The internal modulation oscillator can be used for either one or both, AM and FM.

NOTE

On Signal Generators with the Option 001 Variable Modulation Oscillator, don't load both AM OUTPUT 23 and FM OUTPUT 20 when the oscillator is providing both modulating signals. The outputs are in parallel and the parallel load should be greater than 600 ohms.

Figure 3-7. Setting the Modulation Controls (5 of 5)

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the Signal Generator using the specifications of Table 1-1 as the performance standards. The first test (Basic Functional Checks) presents steps for checking the overall basic functions of the generator. The performance tests that follow provide the most comprehensive check of the specifications (see note). A simpler operational test is included in Section III under Operator's Checks.

4-3. The Basic Functional Checks should be useful for incoming inspections, routine maintenance and general post-repair checks, but is not intended to be a complete check of specifications. The test requires a minimum of commonly available equipment and is written so that a wide variety of models with equivalent specifications may be used.

4-4. EQUIPMENT REQUIRED

4-5. Table 4-2 lists the test equipment recommended for the Basic Functional Checks only. Equipment required for the other performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the tables may be substituted for the recommended model(s).

4-6. TEST RECORD

4-7. A separate check-off list is provided as a test record at the end of the Basic Functional Checks. Results of the other 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 and troubleshooting and after repairs or adjustments.

4-8. TEST PROCEDURES

4-9. 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 8640B Option 004, 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.

4-10. It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary. The Test Accessories table in Section I lists the requirements for some of these items.

4-11. Unless otherwise specified, set the following controls as shown:

TIME BASE INT/EXT (on rear panel) . INT
TIME BASE VERNIER . . . . CAL

Use FINE TUNE in conjunction with FREQUENCY TUNE to set whatever frequency is required. Use the COUNTER MODE EXPAND controls whenever necessary to obtain required counter resolution.

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.

NOTE

Table 4-1 contains a list of recommended abridgments to the performance tests. The abridgments suggest rapid and relatively inexpensive ways to test the instrument while retaining those tests which are considered of prime importance in characterizing the generator. Where alteration of a test is recommended, a justification (remark) is also given. Should individual needs make the justification invalid, the test should be performed in its entirety. (For example, the Incidental AM Test, sometimes known as AM on FM, has been omitted as being of secondary importance. Should your application require characterization of this specification, the test should be performed.)

Table 4-1. Recommended Test Abridgements (1 of 3)

Para. No.	Performance Test	Alteration	Remark
4-13.	Frequency Range Test	Check only 0.5 – 1 MHz range	Ranges obtained by binary division of 230–550 MHz RF oscillator. All dividers operate on 0.5 — 1 MHz range.
4-14.	Frequency Accuracy and Fine Tune Test	Omit steps 5 to 8	Fine tune of secondary importance.
4-15.	Frequency Stability vs. Time and Restabilization Time Test	Omit steps 5 to 7	Restabilization time of secondary importance.
4-16.	Frequency Stability vs. Temperature Test	Omit test	Drift is small in a normal lab environment.
4-17.	Frequency Stability vs. Line Voltage Test	Omit test	Frequency shifts are small in a normal lab environment.
4-18.	Frequency Stability vs. Load, Level, and Mode Test	Omit test	RF oscillator well buffered from external loading, FM offset null constant under normal lab environment.
4-19.	Harmonics Test	None	
4-20.	Sub-harmonics and Non-harmonic Spurious Test	Omit test	No mechanism for generation of spurious signals except counter, which is heavily shielded and filtered.
4-21.	Single Sideband Phase Noise Test	None	
4-22.	Single Sideband Broad-band Noise Floor Test	None	
4-23.	Residual AM Test	Omit step 4	Normally within specification for 300 Hz to 3 kHz bandwidth if within specification for 20 Hz to 15 kHz bandwidth.
4-24.	Residual FM Test	Omit steps 6 and 7	Normally within specification for 300 Hz to 3 kHz bandwidth if within specification for 20 Hz to 15 kHz bandwidth.
4-25.	Output Level Accuracy Test (Abbreviated)	None	
4-26.	output Level Accuracy Test (Complete)	Omit test.	Most useful ranges checked by abbreviated test.
4-27.	Output Level Flatness Test	None	

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

Para. No.	Performance Test	Alteration	Remark
4-28. 4-29.	Output Impedance Test (Signal Frequency) Output Impedance Test (Broadband)	Omit one test.	A condition that is out of specification will usually show on both tests.
4-30.	Auxiliary Output Test	Omit test.	Auxiliary output a secondary function.
4-31.	Output Leakage Test	Omit step 5, and use 400 MHz amplifier to check to 512 MHz in step 4.	The 400 MHz amplifier bandwidth is adequate to check leakage over the output range of 0.5 to 512 MHz.
4-32.	Internal Modulation Oscillator Test	Omit test.	Exactness of modulation frequency not critical for most applications.
4-33.	Internal Modulation Oscillator Distortion Test (Option 001)	Omit test	Excessive distortion will usually manifest itself in AM and FM distortion tests.
4-34.	AM 3 dB Bandwidth Test	Omit test.	Accuracy at most often used frequencies checked in AM sensitivity test.
4-35.	AM Distortion Test	**None**	
4-36.	AM Sensitivity and Accuracy Test	Omit step 8, but check meter in steps 1 to 7.	A spot check of meter accuracy is usually adequate,
4-37.	Peak Incidental Phase Modulation Test	Omit test.	Test requires access to inside of instrument. Specification does not normally degrade with time.
4-38.	Demodulated Output Accuracy Test	None	
4-39.	AM Phase Shift Test	Omit test.	A condition that is out of specification will usually show up on the AM Flatness Teat also.
4-40.	AM Flatness Test	None	
4-41.	Pulse Modulation Test	Omit steps 7 to 8.	Performance usually improves at the higher frequencies.
4-42.	Pulse On/Off Ratio Test	omit step 4	Performance usually improves at the lower frequencies.
4-43.	FM 3 dB Bandwidth Test	Omit test.	Accuracy at most often used frequencies checked in FM sensitivity test.
4-44.	FM Distortion Test	None	
4-45.	FM Sensitivity and Accuracy Test	Omit steps 6 to 9, but check meter in steps 1 to 5.	A spot cheek of meter accuracy is usually adequate.

Table 4-1. Recommended Test Abridgements (3 of 3)

Para. No.	Performance Test	Alteration	Remark
4-46.	Incidental AM Test	Omit test.	Incidental AM usually of secondary importance and FM sensitivity test will usually show conditions that are out of specification (i.e., the first order sidebands will be uneven),
4-47.	Counter External Sensitivity Test	Omit steps 3 and 4.	Performance usually improves at lower frequencies.
4-48.	Internal Reference Accuracy Test	None	
4-49.	Internal Reference Drift Rate (Stability) Test	Omit test,	Drift is small in a normal lab environment.
4-50.	Phase Lock Restabilization Time Test	Omit test,	Frequency error during the short lock acquisition time usually not significant.

4-12. BASIC FUNCTIONAL CHECKS

DESCRIPTION:

A minimum of commonly available test equipment is used to check the overall basic functions of the Signal Generator.

EQUIPMENT:

Table 4-2. Recommended Test Equipment (Basic Functional Checks)

Instrument Type	Critical Specifications	Suggested Models
AC Voltmeter	Accuracy: ±1% at 0.7 Vrms	HP 400E, or HP 34740A/34702A
Frequency Counter	Range: 10 MHz Accuracy: <0.1 ppm	HP 5326C Option 010, or HP 5382A Option 001
Power Meter	Frequency Range: 10 MHz to 1 GHz Input Level: >10 dBm Accuracy: ±1%	HP 435A/8482A, or HP 432A/478A
Pulse Generator	output: lV into **50$2** Range: >2 kHz (waveform not critical)	HP 3311A, or HP 8011A
Spectrum Analyzer	Range: >100 MHz Resolution Bandwidth: >10 kHz to <100 Hz Log and linear display	HP 8558B/181T, or HP 8553B/8552A/141T, or HP 8554B/8552A/141T

PROCEDURE:

1. Set the Signal Generator's controls as follows. Return the controls to these initial settings before starting any-section within the check.

Meter Function	FM
COUNTER MODE: EXPAND	off
LOCK	off
Source	INT
TIME BASE VERN	CAL
AM	OFF
AUDIO OUTPUT LEVEL	1v
MODULATION	Fully CCW
MODULATION FREQUENCY	1 kHz
FM	OFF
PEAK DEVIATION	5 kHz
PEAK DEVIATION Vernier	Fully CCW

PERFORMANCE TESTS

4-12. BASIC FUNCTIONAL CHECKS (Cent'd)

RANGE	0.5-1 MHz
FREQUENCY TUNE " :	. Centered
FINE TUNE .,.	. Centered
OUTPUT LEVEL 10 dB	+10 dBm
OUTPUT LEVEL 1 dB	0 dB
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON
L I N E . . . : : :	ON
TIME BASE (rear panel)	INT

2. Preliminary Checks:

(Refer to step 1 for initial control settings.)

a. Set LINE switch to OFF. The panel meter should read exactly O when viewed directly from the front.

b. The air filter on the rear panel should be clean.

c. Set LINE switch to ON. The lamp in the switch pushbutton should light.

d. The fan should be operating.

e. Set PEAK DEVIATION as indicated below. The correct SCALE annunciator should light as shown.

Peak Deviation	Scale
5 kHz	0-5
10 kHz	0-10
20 kHz	0-3

f. Set PEAK DEVIATION to 10 kHz, and FM to INT. The REDUCE PEAK DEVIATION annunciator should light.

g. Set PEAK DEVIATION to 5 kHz and PEAK DEVIATION Vernier fully cw. The REDUCE FM VERNIER annunciator should light. Return FM to OFF.

h. Set OUTPUT LEVEL 10 dB switch fully cw. AM to INT. and MODULATION fully cw. The REDUCE PEAK POWER annunciator should' light. Return OUTPUT LEVEL 10 dB-switch to +10 dBm, AM to OFF, and MODULATION to fully ccw position.

3. Counter and Frequency Checks:

(Refer to step 1 for initial control settings.)

a. Adjust TIME BASE VERN out of CAL position. The UNCAL annunciator should light. Return TIME BASE VERN to CAL.

PERFORMANCE TESTS

4-12. BASIC FUNCTIONAL CHECKS (Cent'd)

b. Measure the frequency of the rear panel TIME BASE output with an accurate counter. The frequency should be between 4,999,995 and 5,000,005 Hz (with a 2-hour **warm-up** and temperature between 15 and 35°C).

c. Set RANGE and counter EXPAND as indicated below. The location of the decimal point should be correct as shown.

Range MHz	Expand	Decimal Point
128-1024	off	XXXXXX
16-128	off	XXXXXX
1-16	off	XXXXXX
0.5-1	off	XXXXXX
0.5-1	X10	XXXXXX
0.5-1	X100	XXXXXX

At the last settings in step c, the OVERFLOW annunciator should be on.

Using RANGE and FREQUENCY TUNE controls, check each display digit for proper lighting of the LED's.

f. Release X1OO EXPAND button. Press LOCK button. The displayed count should be steady and the display should not blink.

g. Rotate FINE TUNE one-half turn CW. The display should remain unchanged.

h. Rotate FINE TUNE one turn CCW. The display should remain unchanged.

i. Rotate FREQUENCY TUNE one-half turn. Phase lock should break and the display should blink.

j. Release LOCK button, set COUNTER MODE to EXT 0-10, RANGE to 0.5-1 MHz, FREQUENCY TUNE to fully ccw position, FINE TUNE centered, and OUTPUT LEVEL to –7 dBm. Connect RF OUT to COUNTER INPUT. Counter should read 0.450 MHz or less (but not all zeros).

k. Rotate FREQUENCY TUNE to fully cw position. Counter should read 1.07 MHz or greater.

1. Set counter reading to 0.625 MHz. Set RANGE as indicated below and note frequency displayed for both EXT 0-10 and INT COUNTER MODE. The frequency should be correct as shown and except for the number of significant digits displayed, should be the same for both counter modes.

4-12. BASIC FUNCTIONAL CHECKS (Cent'd)

Range (MHz)	Counter Reading (MHz)
0.5-1	0.625
1-2	1.25
2-4	2.50
4-8	**5.00**
8-16	**10.0**

m. Continue as in the preceding step except compare the counter reading for EXT 0-550 and INT COUNTER MODE.

Range (MHz)	Counter Reading (MHz)
8-16	**10.0**
16-32	**20.0**
32-64	**40.0**
64-128	**80.0**
128-256	**160**
256-512	**320**
512-1024	**640** (INT)
	320 (EXT 0-550)

n. Set RANGE to 256-512 MHz and tune to 550 MHz. Counter should read 550 MHz on EXT **0-550** COUNTER MODE.

o. Tune frequency to approximately 345 MHz. Slowly rotate FREQUENCY TUNE in a cw direction. A faint but audible click should be heard when tuning through the range 355-357 MHz. This is relay switching of the high band filters.

4. **Meter and Modulation Oscillator Checks:**

(Refer to step 1 for initial control settings.)

a. Set FM to INT, AM to AC, MODULATION fully cw, and Meter Function to AM. Connect FM OUTPUT to AM INPUT through a BNC tee. Connect an ac voltmeter to the tee. Set AUDIO OUTPUT LEVEL to 0.707 Vrms as read on the voltmeter. The generator's front panel meter should read between 9.6 and 10.4. Return AM to OFF.

b. Connect FM OUTPUT to COUNTER INPUT with COUNTER MODE set to EXT 0-10 and EXPAND Xl 00. The counter should read between 980 and 1020 Hz for standard instruments,or 970 and 1030 Hz for Option 001. Record this frequency for future reference.

980 ______________ 1020 Hz

970 ________ 1030 Hz (Option 001)

4-12. BASIC FUNCTIONAL CHECKS (Cent'd)

c. For Option 001 only set MODULATION FREQUENCY to Xl and MODULATION FREQUENCY vernier to 100. Change MODULATION FREQUENCY range as shown below. The counter should read within the frequency limits indicated.

MODULATION FREQUENCY Range	Frequency Limits (Hz)
Xl	90-110
X10	900-1100
Xl00	9,000-11,000
Xlk	90,000-110,000
X3k	270,000-330,000

5. Output Level Checks

(Refer to step 1 for initial control settings.)

a. Set RANGE to 128-256 MHz, FREQUENCY TUNE to 190 MHz, and Meter Function to LEVEL. Connect a power meter to RF OUT and set OUTPUT LEVEL for a front panel meter indication of +9 dBm (+10, -1). The power meter should read between +7.5 and +10.5 dBm.

b. Reduce OUTPUT LEVEL to +3 dBm as read on the panel meter. The power meter should read between +1.5 and +4.5 dBm.

c. Return OUTPUT LEVEL to +9 dBm as ***read on the power meter.*** Tune across all frequency bands for which the power sensor is specified and note maximum and minimum level variations. The level should be between +8.5 and +9.5 dBm for frequencies between 108 and 336 MHz; between +8.25 and +9.75 dBm for other frequencies between 0.5 and 512 MHz.

6. AM and Pulse Checks

(Refer to step 1 for initial control settings.)

a. Set RANGE to 64-128 MHz, FREQUENCY TUNE to 108 MHz, and OUTPUT LEVEL to -40 dBm. Connect RF OUT to the input of a spectrum analyzer.

b. Set analyzer controls to display the 108 MHz signal with 10 kHz or greater resolution bandwidth, linear vertical scale, 5 to 20 kHz of display smoothing, and zero frequency span width. Check that the signal is peaked on the display and adjust the vertical sensitivity for 4 divisions of deflection. (It is also good to ensure that the base lime with no signal is at the bottom line of the display.)

c. Set AM to INT, and Meter Function to AM. Adjust MODULATION for a panel meter reading of 50%. Set the analyzer scan trigger to rodeo. The peak-to-peak amplitude on the display should span 3.6 to 4.4 divisions centered about the fourth graticule line. The waveform should appear undistorted.

PERFORMANCE TESTS

4.12. BASIC FUNCTIONAL CHECKS (Cent'd)

d. Adjust MODULATION for a peak-to-peak amplitude spanning the second and sixth graticule lines. Connect an ac voltmeter to DEMOD OUTPUT. The voltmeter should read between 0.475 and 0.525 Vrms if the internal AC/DC switch is set to DC, or between 2.37 and 2.63 Vrms if the switch is set to AC.

e. Connect a pulse generator to AM INPUT and set it for an output of +lV into 50Ω 1 kHz rate, and 0.5 ms width. Set analyzer resolution bandwidth to 100 kHz or greater and no display smoothing.

f. Set AM to OFF. Check that the signal is peaked and at the fourth graticule line. Set AM to PULSE. The level of the flat part of the pulse should be between 3.5 and 4.5 divisions.

g. Set AM to OFF. Adjust the analyzer to view the 108 MHz signal in the smallest resolution bandwidth and frequency span that is reasonable, and set vertical scale to 10 dB log per division. Step OUTPUT LEVEL down in 10 dB steps and check that the output signal decreases in 10 dB steps to the lowest observable level on the analyzer.

7. FM Check

(Refer to step 1 for initial control settings.)

a. Set FREQUENCY TUNE to 1 MHz, and OUTPUT LEVEL to –37 dBm. Locate the signal on the spectrum analyzer. Adjust the analyzer for full-scale deflection of the signal in 10 dB log per vertical division with 100 Hz resolution bandwidth and 500 Hz to 2 kHz frequency span per division.

b. Set FM to INT and increase PEAK DEVIATION Vernier for a panel meter reading of 2.4 kHz (note that the carrier decreases as peak deviation increases). The carrier signal should be down greater than 18 dB from its original level (which corresponds to a peak deviation accuracy of ± l0%).

NOTE

To obtain a more accurate measurement, adjust PEAK DE VIATION Vernier for a carrier null. The panel meter should read 2.405 times the modulation rate measured in step 4b (± 10%). The above steps may also be repeated for other carrier frequencies.

PERFORMANCE TESTS

Table 4-3. Record of Basic Functional Checks (1 of 2)

Step	Description	√
2.	**Preliminary Checks**	
	a. Meter mechanical zero	
	b. Clean air filter	
	c. LINE ON/OFF lamp	
	d. Fan	
	e. SCALE annunciators:	
	0-5	
	0-10	
	0-3	
	f. REDUCE PEAK DEVIATION annunciator	.
	g. REDUCE FM VERNIER annunciator	
	h. REDUCE PEAK POWER annunciator	
3.	**Counter and Frequency Checks**	
	a. Time base UNCAL annunciator	
	b. Time base accuracy	
	c. Decimal point	
	d. OVERFLOW annunciator	
	e. Frequency display LED's	
	f. Phase lock achieved	
	g. Phase lock range	
	h. Phase lock range	
	i. Phase lock broken	
	j. Low frequency range	
	k. High frequency range	
	l. Band check and counter sensitivity 0.5-16 MHz	
	m. Band check and counter sensitivity 16-1024 MHz	
	n. Counter high frequency sensitivity	
	o. High band/low band switch	
4.	**Meter and Modulation Oscillator Checks**	
	a. Panel meter accuracy	
	b. Modulation oscillator frequency accuracy 1 kHz	

PERFORMANCE TESTS

4-12. BASIC FUNCTIONAL CHECKS (Cont'd)

Table 4-3. Record of Basic Functional Checks (2 of 2)

Step	Description	√
4.	Meter and Modulation Oscillator Checks (Cent'd)	
	c. Modulation oscillator frequency accuracy (Option 001): Xl	
	X10	
	X100	
	X1k	
	X3k	
5.	Output Level Checks	
	a. Output level accuracy	
	b. Output level accuracy	
	c. Output level flatness	
	108 to 336 MHz	
	0.5 to 512 MHz	
6.	AM and Pulse Checks	
	c. AM accuracy and distortion	
	d. DEMOD OUTPUT accuracy	
	f. Pulse level accuracy	
	g. Output attenuator	
7.	FM Check	
	b. FM accuracy	

PERFORMANCE TESTS

4-13. FREQUENCY RANGE TEST

SPECIFICATION:

Range: 500 kHz to 512 MHz in 10 octave bands.
Bands and Band Overlap: Bands extend 10% below and 7% above the nominal limits shown below.

Nominal Frequency Bands (MHz)	0.51	1-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256	256-512	External Doubler Band 512-1024
Frequency (Range (MHz) (with overlap)	0.45 to 1.07	0.9 2.1	1.8 4.2	3.6 8.5	7.2 to 17.1	14.4 to 34.3	28.8 to 68.7	57.5 to 137.5	115 to 275	230 to 550	230 to 550 (without ExternalDoubler)

DESCRIPTION:

The frequency range is verified by using a frequency counter to measure the frequency at the low and high ends of each band. (See Table 4-1. Recommended Test Abridgements.)

EQUIPMENT:

Frequency Counter . . . . HP 5327C

PROCEDURE:

1. Connect generator's AUX RF OUTPUT jack (located on rear panel) to frequency counter's 50 ohm input after setting Signal Generator's controls as follows:

COUNTER MODE: EXPAND . . . . off
LOCK . . . . off
Source . . . . INT
AM . . . . OFF
FM . OFF
RANGE - : : : : : : : : : : : : : : : : : 256-512 MHz
FREQUENCY TUNE . . . . Fully CW
FINE TUNE . . . . Centered
RF ON/OFF . . . . ON

2. Set FREQUENCY TUNE fully ccw. The frequency counter should read 230 MHz or less.

_______________ **230.0** MHz

3. Set FREQUENCY TUNE fully CW. The frequency counter should read 550 MHz or greater.

550.0 MHz _______________

PERFORMANCE TESTS

4-13. FREQUENCY RANGE TEST (Cent'd)

4. Set RANGE as shown below and check frequency at high and low ends of each band.

Range (MHz)	Low End	High End
512-1024	______ <230.0 MHz	>550.0 MHz ______
128-256	______ <115.0 MHz	>275.0 MHz ______
64-128	______ <57.50 MHz	>137.5 MHz ______
32-64	______ <28.80 MHz	>68.70 MHz ______
16-32	______ <14.40 MHz	>34.30 MHz ______
8-16	______ <7.200 MHz	>17.10 MHz ______
4-8	______ <3.600 MHz	>8.500 MHz ______
2-4	______ <1.800 MHz	>4.200 MHz ______
1-2	______ <0.900 MHz	>2.100 MHz ______
0.5-1	______ <0.450 MHz	>1.070 MHz ______

4-14. FREQUENCY ACCURACY AND FINE TUNE TEST

SPECIFICATION:

Accuracy:
$$\begin{bmatrix}\text{Total}\\ \text{Count}\\ \text{Accuracy}\end{bmatrix} = \begin{bmatrix}\text{Counter}\\ \text{Resolution}\\ (\pm 1 \text{ count})\end{bmatrix} + \begin{bmatrix}\text{Reference}\\ \text{Error}\\ (\text{INT or EXT})\end{bmatrix}$$

Internal Reference Error: <t 2 ppm (when calibrated at 25° C every 3 months and operated between 15° C and 35" C).

When phase locked, Counter Resolution error is eliminated.

Fine Tuning: Unlocked, >1000 ppm total range. Locked mode, >± 20 ppm by varying internal time base vernier.

DESCRIPTION:

Frequency accuracy is checked (using the Signal Generator's internal reference) by comparing the generator's counter indication to the frequency reading on an external frequency counter. The fine tune range is also checked with the external counter. (See Table 4-1. Recommended Test Abridgements.)

EQUIPMENT:

Frequency Counter . . . . HP 5327C Option H49

PROCEDURE:

1. Connect generator's AU. RF OUTPUT jack (located on rear panel) to frequency counter's input after setting Signal Generator's controls as follows:

PERFORMANCE TESTS

4-14. FREQUENCY ACCURACY AND FINE TUNE TEST (Cont'd)

COUNTER MODE:	EXPAND	X100
	LOCK	Off
	Source	INT
AM		OFF
FM		OFF
RANGE		32-64 MHz
FREQUENCY TUNE		50 MHz
RF ON/OFF		ON

2. Allow Signal Generator and frequency counter to stabilize for two hours.

3. Set frequency counter time base to give at least one more digit resolution than the generator's counter. The difference in reading between the two counters should be <110 Hz (2 ppm + last digit uncertainty of 10 Hz).

______ 110 Hz

4. Set COUNTER MODE EXPAND to X10 and LOCK to ON. Allow one minute to acquire phase lock. Increase the frequency counter resolution by 10. The difference in counter readings should be <100 Hz (2 ppm).

______ 100 Hz

5. Note frequency counter reading. Turn TIME BASE VERN control ccw until it just leaves the detent position. The frequency counter should now read >1 kHz (> 20 ppm) higher than the reading noted above.

1 kHz ______

6. Turn TIME BASE VERN fully ccw. The frequency counter should now read> 1 kHz (> 20 ppm) lower than the reading first noted in step 5.

1 kHz ______

7. Set TIME BASE VERN to CAL (fully cw). Set COUNTER MODE LOCK to Off.

8. Set FINE TUNE fully cw. Note frequency counter reading, then set FINE TUNE fully ccw. The frequency counter should read >50 kHz (1000 ppm) lower than the reading noted above.

50 kHz ______

PERFORMANCE TESTS

4-15. FREQUENCY STABILITY VS TIME AND RESTABILIZATION TIME TEST

SPECIFICATION:

Stability vs Time (after 2 hour warmup): <10 ppm/10min (normal mode).

Restabilization Time (normal mode):
After frequency change: <15 min.
After band change: none.
After 1 min. in RF OFF mode: <10 min. [1]

NOTE

Stability specifications for phase lock mode are determined by counter time base reference. See the internal reference tests.

DESCRIPTION:

A frequency counter, digital to analog converter, and strip-chart recorder are used to measure the frequency drift after warm-up and restabilization time. (See Table 4-1. Recommended Test Abridgements.)

NOTE

For these tests, ambient room temperature and line voltage must not change.

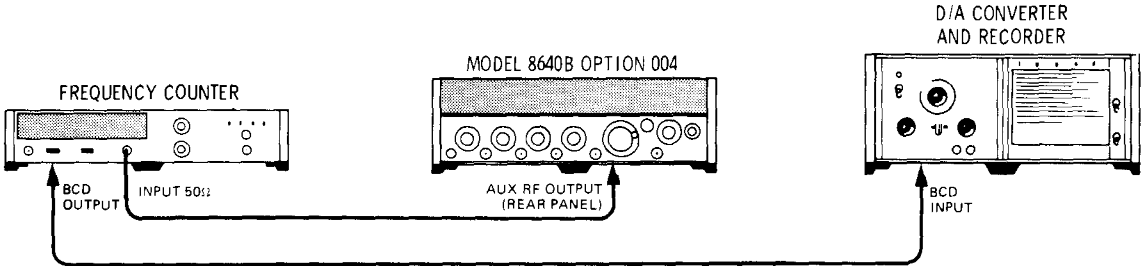


Figure 4-1. Frequency Stability us Time and Restabilization Time Test Setup

EQUIPMENT:

Frequency Counter	HP 5327C Option 003
Digital to Analog Converter	HP 581A Option 002
Recorder (for D/A Converter)	HP 680

PROCEDURE:

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

[1] This specification applies only if the RF ON/0FF switch has been wired to turn the RF Oscillator off.

4-15. FREQUENCY STABILITY VS TIME AND RESTABILIZATION TIME TEST (Cont'd)

COUNTER MODE: EXPAND	Off
LOCK	Off
Source	..INT
AM	OFF
FM	OFF
R A N G E : : : : : : : : : : : : : : : : : :	32-64 MHz
FREQUENCY TUNE	50 MHz
RF ON/OFF	..ON

2. Set frequency counter to read frequency directly (i.e., not divided down). Use a 1s gate time so that the last three digits span from 000 to 999 Hz.

3. Calibrate the recorder for a zero to full-scale reading that corresponds to a 000 to 999 Hz reading of the frequency counter's last three digits (i.e., 1 kHz full scale).

4. Warm up the equipment for two hours. Establish a reference on the recorder and record the generator's output frequency for 10 minutes. The frequency change in 10 minutes should be <500 Hz (half of full scale).

________________ 500 Hz

5. Set the FREQUENCY TUNE control fully ccw and back again to approximately 50 MHz. After 15 minutes record the frequency for 10 minutes. The frequency change in 10 minutes should be <500 Hz.

________________ 500 Hz

6. Set RANGE to 16-32 MHz and record the frequency for 10 minutes. The frequency change in 10 minutes should be <250 Hz.

________________ 250 Hz

7. Set RANGE to 32-64 MHz and set RF ON/OFF to OFF. After one minute set RF ON/OFF to ON. Record the frequency for 10 minutes. The frequency change for 10 minutes should be <500 Hz.

________________ 500 Hz

NOTE

If the instrument has been wired to switch the RF Oscillator off (with RF ON/OFF switch), wait 10 minutes after switching RF mode to ON before continuing with step 7.

PERFORMANCE TESTS

4-16. FREQUENCY STABILITY VS TEMPERATURE TEST

SPECIFICATION:

Stability vs Temperature: <50ppm/°C (normal mode).

NOTE

Stability specifications for phase lock mode are determined by counter time base reference. See the internal reference tests.

DESCRIPTION:

A frequency counter is used to measure drift as temperature is changed. A temperature controlled chamber is used to vary the temperature. (See Table 4-1. Recommended Test Abridgements.)

Figure 4-2. Frequency Stability vs Temperature Test Setup

EQUIPMENT:

Frequency Counter	HP 5327C
Temperature Controlled Chamber	Statham Model 325

PROCEDURE:

1. Connect equipment as shown in Figure 4-2 after setting Signal Generator's controls as follows:

COUNTER MODE: EXPAND	Off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
RANGE	32-64 MHz
FREQUENCY TUNE	50 MHz
RF ON/OFF	ON

2. Set temperature controlled chamger for 15° C. Allow Signal Generator to stabilize for two hours. Then note frequency counter reading.

3. Set chamber for 35° C. Again, allow Signal Generator to stabilize for two hours. Frequency change from reading noted in step 2 should be less than 50 kHz.

____________________ 50 kHz

PERFORMANCE TESTS

4-17. FREQUENCY STABILITY VS LINE VOLTAGE TEST

SPECIFICATION:

Stability vs Line Voltage (+5% to –10% line voltage change): <1 ppm (normal mode).

NOTE

Stability specifications for phase lock mode are determined by counter time base reference. See the internal reference tests.

DESCRIPTION:

A frequency counter is used to measure frequency shift line voltage is changed +5% to -10%o. (See Table **4-1.** Recommended Test Abridgements.)

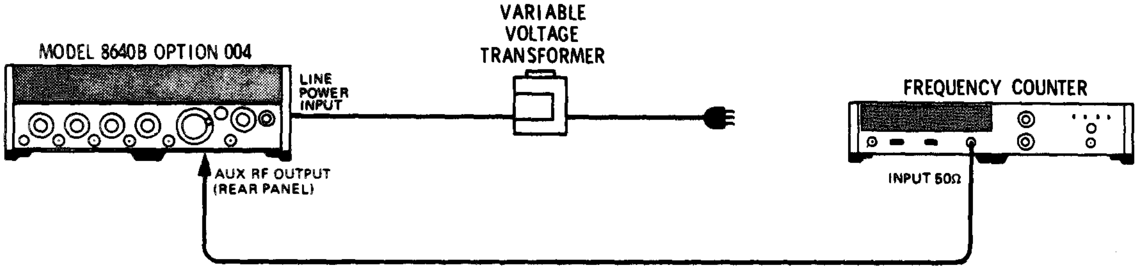


Figure 4-3. Frequency Stability vs Line Voltage Test Setup

EQUIPMENT:

Frequency Counter	HP5327C
Variable Voltage Transformer	GR W5MT3A

PROCEDURE:

1. Connect equipment as shown in Figure 4-3 after setting Signal Generator's controls as follows: follows:

AM.	OFF
FM	OFF
RANGE	32-64 MHz
FREQUENCY TUNE	50 MHz
RF ON/OFF	..ON

2. Set variable voltage transformer 5% above the nominal voltage set on generator's line power module (e.g., if nominal line voltage is 120 Vat, set transformer for 126 Vat). Note frequency counter reading.

3. Set variable voltage transformer 10% below nominal line voltage (e.g., for a nominal 120 Vat, set transformer for 108 Vat), then note counter's reading. The frequency change from the reading noted in step 2 should be <50 Hz (i.e., <1 ppm).

_______________50 Hz

PERFORMANCE TESTS

4-18. FREQUENCY STABILITY VS LOAD, LEVEL, AND MODE TEST

SPECIFICATION:

Stability vs Load (with any passive load change): <1 ppm.
Stability vs Level Change: <1 ppm.
Stability vs Modulation Mode Change (CW to FM): <1’% of selected peak deviation or <200 Hz, whichever is greater.

DESCRIPTION:

A frequency counter is used to measure frequency shift as the output load is changed by means of an adjustable stub, as RF OUTPUT LEVEL is changed 6 dB, and as modulation mode is changed from CW to FM. The frequency is monitored at the rear panel auxiliary RF output jack. (See Table 4-1. Recommended Test Abridgements.)

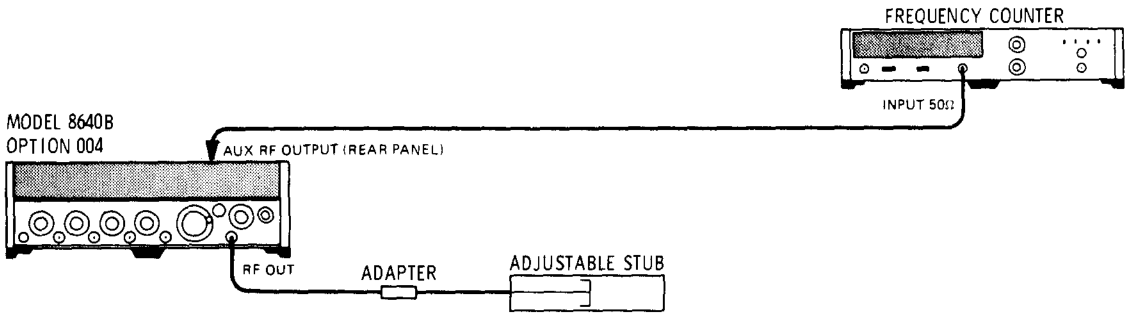


Figure 4-4. Frequency Stability us Load, Level, and Mode Test Setup

EQUIPMENT :

Frequency Counter	HP 5327C
Adapter (Male Type N to GR 874) : : : : : : : : :	HP 1250-0874
Adjustable Stub	General Radio 874-DSOL

PROCEDURE;

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

AM	OFF
FM	OFF
RANGE : : : : : : : : : : : : : : : : : :	256-512 MHz
FREQUENCY TUNE.....	512 MHz
OUTPUT LEVEL Switches	+16 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Slowly slide adjustable stub through its range and note maximum and minimum counter readings. The difference in counter readings should be less than 512 Hz,

________________ 512 Hz

PERFORMANCE TESTS

4-18. FREQUENCY STABILITY VS LOAD, LEVEL, AND MODE TEST (Cont'd)

3. Remove adjustable stub, note frequency counter reading, then set OUTPUT LEVEL 10 dB switch one step ccw. Again, note frequency counter reading. It should have changed less than 512 Hz.

________________ 512 Hz

4. With FM switch set to OFF, note the frequency counter reading. Set PEAK DEVIATION switch to 10 kHz and PEAK DEVIATION vernier fully clockwise. Set FM to AC and again, note frequency counter reading. It should have changed less than 200 Hz.

________________ 200 Hz

5. Repeat step 4 with PEAK DEVIATION set as shown below. The frequency change should be as specified.

peak Deviation	Frequency Change
20 kHz	<200 Hz
40 kHz	<400 Hz
80 kHz	<800 Hz
160 kHz	<1.6 kHz
320 kHz	<3.2 kHz
640 kHz	<6.4 kHz
1.28 MHz	<12.8 kHz
2.56 MHz	<25.6 kHz

4-19. HARMONICS TEST

SPECIFICATIONS:

Harmonics: (on 1V, +10 dBm output range and below)
>35 dB below fundamental of 0.5 to 128 MHz,
>30 dB below fundamental of 128 to 512 MHz.

DESCRIPTION:

A spectrum analyzer is used to measure harmonics as the Signal Generator is tuned from 0.5 to 512 MHz.

EQUIPMENT:

Spectrum Analyzer . . . . HP 141T/8552B/8554B

PERFORMANCE TESTS

4-19. HARMONICS TEST (Cont'd)

PROCEDURE:

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

Meter Function	LEVEL
COUNTER MODE: EXPAND	off
LOCK	off
Source	.INT
AM	OFF
FM .	OFF
RANGE	0.5-1 MHz
FREQUENCY TUNE	.0.5 MHZ
OUTPUT LEVEL Switches	+10 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Set spectrum analyzer to measure harmonics 35 dB below the fundamental from **0.5** to **2** MHz. Set input attenuation to 50 dB, resolution bandwidth to 100 kHz, frequency span per division (scan width) to 1 MHz, scale to log (10 dB/div), and scale reference level to +10 dBm. Adjust analyzer's frequency controls to set O Hz to the left edge of the display.

NOTE

If 50 *dB of analyzer input attenuation is not available, use an external attenuator such as the Model 355D.*

3. Slowly tune Signal Generator to 1 MHz, checking that all harmonics are more than 35 dB below the fundamental.

35 dB ____________________

NOTE

If any harmonic below 512 MHz appears to be out of specification, remove any possible analyzer error and remeasure the harmonic as follows:

a. Tune the generator to the frequency of the harmonic.

b. Using the analyzer's IF attenuator, step the signal down 30 dB on the display and note the –30 dB point on the display.

c. Step the IF attenuator up 30 dB and retune the generator to its original setting.

d. Using the –30 dB point noted on the display as a reference, remeasure the harmonic.

4-19. HARMONICS TEST (Cont'd)

4. **Set** spectrum analyzer and Signal Generator as shown below. On each range, set FREQUENCY TUNE to the low end of the band and use analyzer's frequency controls to set the fundamental to the left edge of the display. Keeping the fundamental near the left edge of the display, tune FREQUENCY TUNE to the high end of the band. All harmonics should be as specified.

NOTE

On *bands 8-16 MHz and above, check for harmonics while tuning down in frequency. For frequencies above 500 MHz, tune analyzer to observe second harmonic.*

Spectrum Analyzer		Signal Generator	
Resolution Bandwidth	**Freq. Span Per Division**	**Range**	**Harmonics Down**
100 kHz	1 MHz	1-2 MHz	>35 dB
100 kHz	2 MHz	2-4 MHz	>35 dB
100 kHz	5 MHz	4-8 MHz	>35 dB
300 kHz	10 MHz	8-16 MHz	>35 dB
300 kHz	20 MHz	16-32 MHz	>35 dB
300 kHz	50 MHz	32-64 MHz	>35 dB
300 kHz	100 MHz	64-128 MHz	>35 dB
300 kHz	100 MHz	128-256 MHz	>30 dB
300 kHz	100 MHz	256-512 MHz	>30 dB

4-20. SUB-HARMONICS AND NON-HARMONIC SPURIOUS TEST

SPECIFICATIONS:

Sub-Harmonics and Non-Harmonic Spurious: (excluding frequencies with 15 kHz of carrier whose effects are specified under Residual AM and FM) >100 dB below carrier.

DESCRIPTION:

A notch filter is used to remove the fundamental. All non-harmonic spurious and sub-harmonics are then amplified and measured with a spectrum analyzer. (See Table 4-1. Recommended Test Abridgements.)

4-20. SUB-HARMONICS AND NON-HARMONIC SPURIOUS TEST (Cont'd)

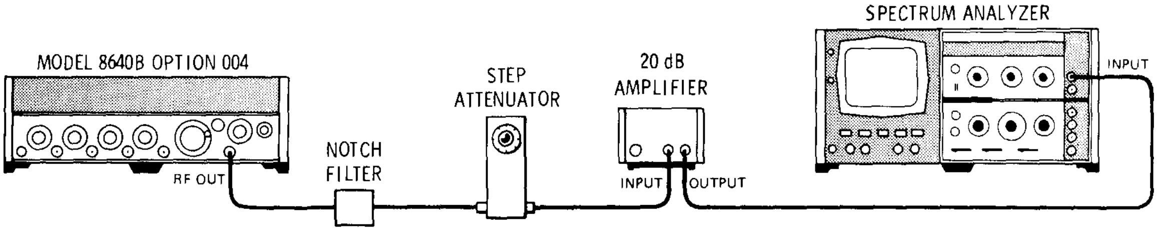


Figure 4-5. Sub-Harmonics and Non-Harmonic Spurious Test Setup

EQUIPMENT:

520/1040 MHz Notch Filter	HP 08640-60502
10dB Step Attenuator	HP 355D
20dB Amplifier	HP 8447A
Spectrum Analyzer	HP 141 T/8552B/8554B

PROCEDURE:

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

Meter Function	LEVEL
COUNTER MODE: ExPAND	off
LOCK	off
Source	.INT
AM,	OFF
FM	OFF
RANGE “ : : :	128-256 MHz
FREQUENCY TUNE.....	260 MHz
OUTPUT LEVEL Switches	+10 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Set step attenuator to 60 dB. Set analyzer's input attenuation to 0 dB, scale switch to log (10 dB/div), and reference level controls to -30 dBm; set resolution bandwidth to 30 kHz, frequency span per division (scan width) to 1 MHz, and tune the frequency controls to set 260 MHz at the center of the display. Adjust reference level vernier to set signal peak to top (reference) graticule line on display.

3. Set generator's RANGE switch to 256-512 MHz. Tune analyzer to display the 520 MHz signal (i.e., the second harmonic of 260 MHz).

4. Tune generator's FREQUENCY TUNE for a minimum signal on analyzer's display. Set the step attenuator to O dB, and again tune FREQUENCY TUNE for a minimum signal.

5. The signal on the display should be below the top (reference level) graticule line. Tune the spectrum analyzer slowly to **500** kHz. All non-harmonic spurious signals, and su-hamonics should be below the –40 dB graticule on the display (> 100 dB down).

40 dB ______________

PERFORMANCE TESTS

4-21. SINGLE SIDEBAND PHASE NOISE TEST

SPECIFICATION:

SSB Phase Noise at **20** kHz Offset from carrier:

(Averaged rms noise level below carrier stated in a 1 Hz bandwidth.)

256 MHz to 512 MHz: >130 dB from 230 to 450 MHz increasing linearly to >122 dB down at 550 MHZ.

0.5 MHz to 256 MHz: Decreases approximately 6 dB for each divided frequency range until it reaches SSB Broadband Noise Floor of >130 dB.

DESCRIPTION:

Phase noise is measured with a spectrum analyzer. A reference signal generator and a mixer are used to down-convert the test Signal Generator's CW signal to O Hz (the two signal generators are phase locked together). Then the spectrum analyzer measures SSB phase noise at a 20 kHz offset from the carrier.

NOTE

This test measures the total SSB phase noise of both generators. Therefore, the reference signal generator must have SSB phase noise that is less than or equal to the specification for the test generator.

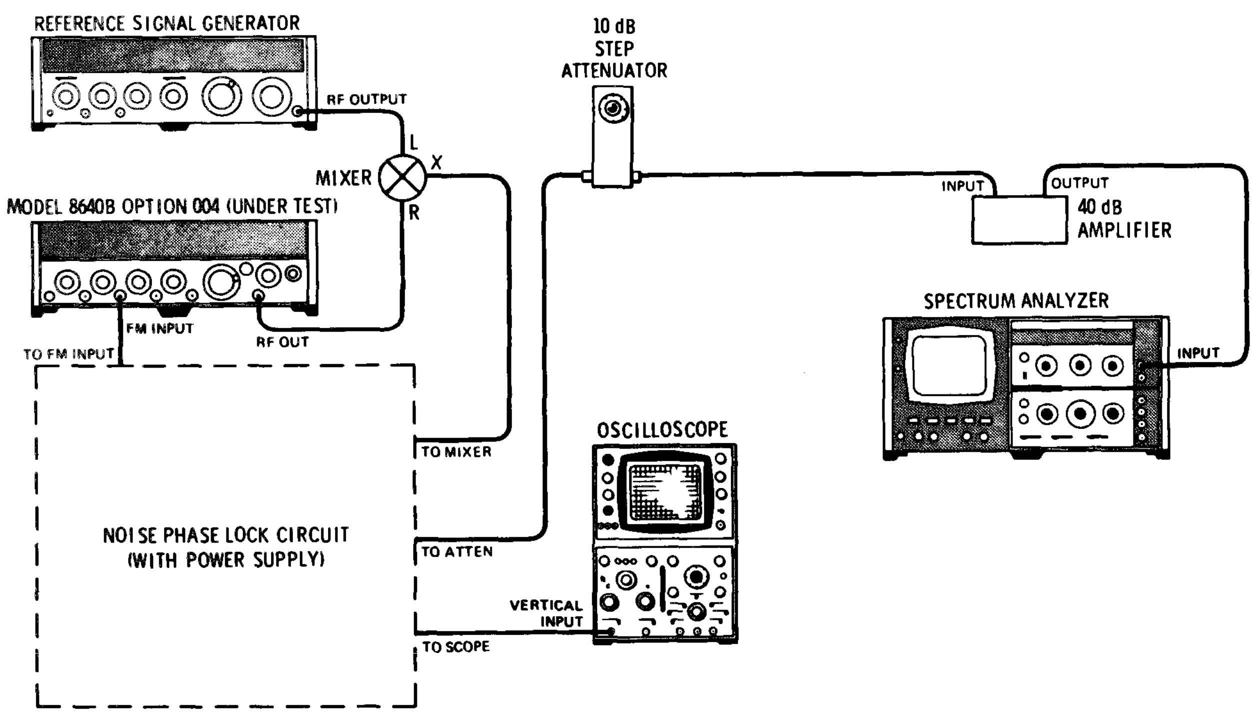


Figure 4-6. Single Sideband Phase Noise Test Setup

4-21. SINGLE SIDEBAND PHASE NOISE TEST (Cont'd)

EQUIPMENT:

Reference Signal Generator	HP 8640A
Mixer	HP 10514A
10dB Step Attenuator	HP 355D
40 dB Amplifier	HP 08640-60506
Oscilloscope	HP 180A/1801A/1820C
Spectrum Analyzer	HP 141T/8552B/8556A
Noise Phase Lock Circuit	HP 08640-60504

PROCEDURE:

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

Meter Function	LEVEL
COUNTER MODE: EXPAND	off
LOCK	off
Source	INT
AM	OFF
FM	OFF
PEAK Deviation	5 kHz
PEAK DEVIATION Vernier	Fully CW
RANGE	256-512 MHz
FREQUENCY TUNE"	550 MHz
OUTPUT LEVEL switches	–7 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set analyzer's input level control to -40 dBm, resolution bandwidth to 1 kHz, dBm/dBV control to dBm 50 ohm, span width per division (scan width) to 5 kHz, and center frequency controls to 20 kHz. Set display reference level to -40 dBm (at 10 dB per division). Using analyzer's 20 kHz markers, measure and note 20 kHz on the display.

3. Set oscilloscope's volts/div control to 0.02 and time/div control to 50 µs; set the input to measure dc. Set 10 dB step attenuator to 80 dB. Set 40 dB amplifier's input impedance switch to 50 ohms.

4. Set reference signal generator for a 549.98 MHz, CW signal at +13 dBm (i.e., 20 kHz below test generator's frequency). Fine adjust its frequency for a 20 kHz signal on analyzer's display. Adjust analyzer's display reference level controls so that the 20 kHz signal is 4.3 dB below the top (reference) graticule line.

NOTE

The correction factors for this measurement are as follows:

a. The DSB to SSB transfer is 6 dB because the mixing process translates two correlated 1 kHz BW portions of the noise into the 1 kHz BW of the analyzer - giving twice the effective noise voltage.

PERFORMANCE TESTS

4-21. SINGLE SIDEBAND PHASE NOISE TEST (Cont'd)

NOTE (Cont'd)

b. +2.5 dB because noise is average detected after logging'.

c. -0.8 dB. Effective noise BW is 1.2 x 3 dB BW which gives -0.8 dB -10 log (actual 3 dB BW/nominal 3 dB BW)'.

Summing the correction factors gives -4.3 dB -1 O log (actual 3 dB B W/nominal 3 dB BW) or approximately -4.3 dB ±1 dB.

5. ***Phase*** lock the generators by setting test generator's FM switch to DC and by tuning reference signal generator to ***550*** MHz (i.e., for a difference frequency of O Hz). Monitor phase lock on oscilloscope, checking that mixer's output is 0 Vdc (if it is not, fine tune reference generator until it is).

6. Set analyzer's display smoothing (video filter) to 10 Hz. Set step attenuator to 0 dB. The top (reference) graticule line on analyzer's display represents 110 dB/Hz below carrier level (the transfer from a 1 kHz BW to a 1 Hz BW is 30 dB). The average noise level on the display should be >12 dB below top graticule line at 20 kHz (i.e., > 122 dB below carrier).

12 dB ________________

NOTE

Set oscilloscope to check for possible line-related signals in test setup. They should be <10 m Vp-p.

7. Set test Signal Generator to 450 MHz and FM switch to OFF. Set reference signal generator to 449.98 MHz (i.e., 20 kHz below the test generator's frequency). Repeat steps 2 through 6. The average noise level on the display should be >20 dB below top graticule line at 20 kHz.

20 dB ________________

NOTE

SSB phase noise can be checked at any other frequency from 230 kHz to 550 MHz by following the procedures given above. Noise decreases approximately 6 dB per each octave band change down to -130 dB below carrier.

4-22. SINGLE SIDEBAND BROADBAND NOISE FLOOR TEST

SPECIFICATION:

SSB Broadband Noise Floor at greater than 1 MHz offset from carrier (averaged rms noise level below carrier stated in a 1 Hz bandwidth): >130 dB down.

[1]**See Hewlett-Padmrd Application Note 160-4, Spectrum Analysis - Noise Measurement.**

4-22. SINGLE SIDEBAND BROADBAND NOISE FLOOR TEST (Cont'd)

DESCRIPTION:

A spectrum analyzer is used to measure the broadband noise floor (a reference signal generator and a mixer are used to down-convert the test Signal Generator's RF output and noise to within the range of the spectrum analyzer). A reference level is set on the analyzer with a 5 kHz signal, the signal is changed to 1 MHz and removed from the analyzer with a filter, and the broadband noise floor is measured.

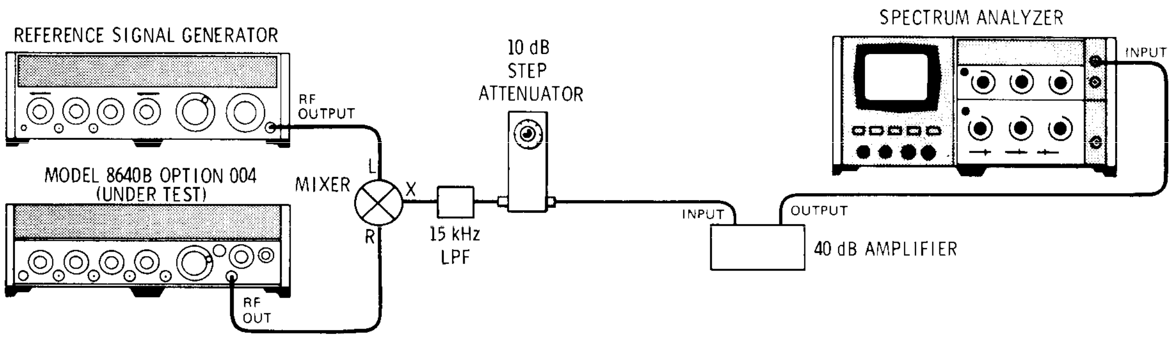


Figure 4-7. Single Sideband Broadband Noise Floor Test Setup

EQUIPMENT:

Reference Signal Generator . . . . HP 8640A
Mixer HP 10514A
15 kHz Low-Pass Filter (LPF) " : : : : : : : : CIR-Q-TEL 7 pole
10dB Step Attenuator . . . . HP 355D
40 dB Amplifier . . . . HP 08640-60506
Spectrum Analyzer . . . . HP 141T/8552B/8556A

PROCEDURE:

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

Meter Function LEVEL
COUNTER MODE: EXPAND : : : : : : : : : : : : : . off
LOCK . . . . Off
Source . . . . .INT
AM . . . . OFF
FM OFF
RANGE : : : : : : : : : : : : 256-512 MHz
FREQUENCY TUNE . . . . 500.000 MHz
OUTPUT LEVEL Switches . . . . -7 dBm
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . .ON

2. Set 10 dB step attenuator to 80 dB. Set reference signal generator for a 500.005 MHz (i.e., 5 kHz above the test generator's frequency), CW signal at +13 dBm (output vernier maximum CW). Set 40 dB amplifier's input impedance switch to 50 ohms.

PERFORMANCE TESTS

4-22. SINGLE SIDEBAND BROADBAND NOISE FLOOR TEST (Cont'd)

3. Set spectrum analyzer's resolution bandwidth to 1 kHz, set input level control to –40 dBm and dBm/dBV to dBm 50 ohm, and adjust frequency controls to set the 5 kHz difference frequency in the center of the display. Set analyzer's display reference level controls for 10 dB per division with the 5 kHz difference signal 1.3 dB from the top (reference) graticule line on the display.

NOTE

The correction factors for this measurement are as follows:

a. The DSB to SSB transfer is –3 dB because the mixing process translates two uncorrelated 1 kHz BW portions of the noise into the 1 kHz BW of the analyzer - giving $\sqrt{2}$ times the effective noise voltage.

b, +2.5 dB because noise is average detected after logging[1].

c. -0.8 dB. Effective noise BW is 1.2 x 3 dB BW which gives -0.8 dB –10 log (actual 3 dB BW/nominal 3 dB B W)'.

Summing the correction factors gives -1.3 dB -10 log (actual 3 dB BW/nominal 3 dB BW) or approximately -1.3 dB ±1 dB.

4. Change reference signal generator's output frequency to 501.00 MHz. Set 10 dB step attenuator to O dB. Set analyzer's display smoothing (video filter) to 10 Hz. The top graticule line on analyzer's display represents —110 dB (the transfer from a 1 kHz BW to a 1 Hz BW is 30 dB). The average noise level on the display should be> 20 dB below the top graticule line (i.e., > 130 dB below carrier).

20 dB ____________

NOTE

If the test generator appears to be out of specification, check for excessive noise in the test setup by disconnecting the test generator. The noise level on the analyzer's display should decrease at least 10 dB.

[1] See Hewlett-Packard Application Note 150-4, Spectrum Analysis - Noise Measurements.

PERFORMANCE TESTS

4-23. RESIDUAL AM TEST

SPECIFICATION:

Residual AM: (Averaged rms)

Post-detection Noise Bandwidth	
300 Hz to 3 kHz	**20 Hz to 15 kHz**
>85 dB down	>78 dB down

DESCRIPTION:

An rms voltmeter is calibrated with a measured amount of amplitude modulation from the Signal Generator. Then the AM is removed and the generator's residual AM is read directly from the voltmeter. (See Table 4-1. Recommended Test Abridgements.)

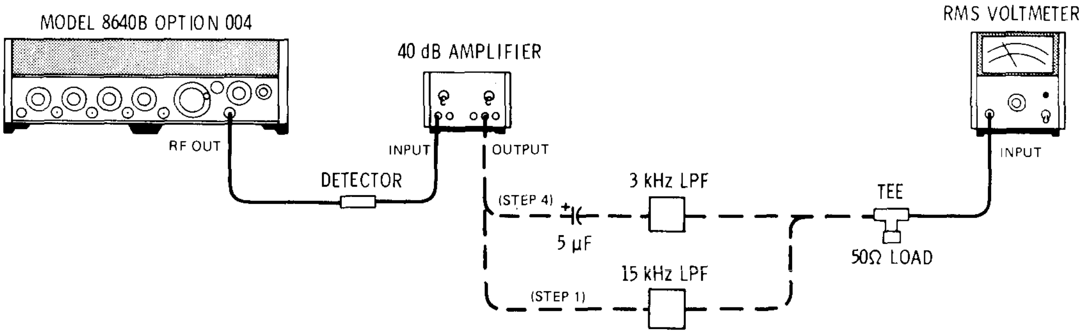


Figure 4-8. Residual AM Test Setup

EQUIPMENT:

RMS Voltmeter . . . . HP 3400A
Detector HP 8471A
3 kHz Low-Pass Filter(LPF) . . . . CIR-Q-TEL 5 Pole
15 kHz Low-Pass Filter (LPF) . . . . CIR-Q-TEL 7 Pole
40 dB Amplifier . . . . HP 465A
Capacitor 5~F . . . . HP 0180-2211
50 Ohm Load . . . . .HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-8 (with the generator connected to the rms voltmeter through the detector, amplifier, 15 kHz LPF, and across the 50 ohm load). Set Signal Generator's controls as follows:

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

Meter Function		LEVEL
COUNTER MODE:	EXPAND	Off
	LOCK	Off
	Source	INT
AM		INT
MODULATION		Fully ccw
MODULATION FREQUENCY		1 kHz
FM		OFF
RANGE		256-512 MHz
FREQUENCY TUNE		500 MHz
OUTPUT LEVEL Switches		+13 dBm
OUTPUT LEVEL Vernier		CAL
RF ON/OFF		ON

2. Set Meter Function to AM and slowly turn Signal Generator's MODULATION control clockwise until its panel meter indicates 10% AM. Note voltmeter reading in dB.

3. Set generator's AM switch to OFF. The residual AM should read >58 dB below the reference noted in step 2 (i.e., >78 dB down). (The 10% AM, after detection, is 20 dB below the carrier level. Residual AM is then 20 dB −78 dB = −58 dB.)

58 dB________________

4. Replace the 15 kHz LPF with the 3 kHz LPF. Add the capacitor between amplifier and filter and repeat steps 1 through 3. The residual AM should read >65 dB below the reference noted in step 2 (i.e., >85 dB down).

65 dB________________

4-24. RESIDUAL FM TEST

SPECIFICATION:

Residual FM: (Averaged rms)

	CW and up to 1/8 maximum allowable peak deviation		Up to maximum allowable Peak deviation	
Post-detection Noise Bandwidth	300 Hz to 3 kHz	20 Hz to 15 kHz	300 Hz to 3 kHz	20 Hz to 15 kHz
230 to 550 MHz	<5 Hz	<15 Hz	<15 Hz	<30 Hz

PERFORMANCE TESTS

4-24. **RESIDUAL FM TEST** (Cent'd)

DESCRIPTION:

An FM discriminator is used to measure FM deviation (a reference signal generator and a mixer are used to down-convert the test Signal Generator's RF output to within the range of the discriminator). The discriminator output is filtered and amplified and then measured with a voltmeter. The voltmeter reading, in mVrms, is proportional to the rms frequency deviation of the residual FM. (See Table 4-1. Recommended Test Abridgements.)

NOTE

This test measures the total residual FM of both generators. Therefore, the reference generator must have residual FM that is less than or equal to the specification for the test generator.

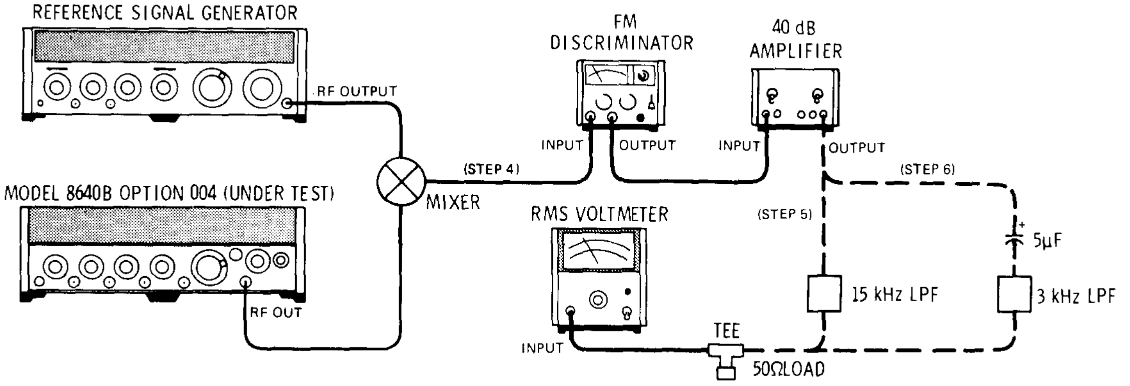


Figure 4-9. Residual FM Test Setup

EQUIPMENT:

FM Discriminator	HP 5210A
Filter Kit	.HP 10531A
RMS Voltmeter	HP 3400A
40dB Amplifier	HP 465A
Capacitor5 µF	HP 0180-2211
Reference Signal Generator	HP 8640A
Mixer	HP 10514A
3 kHz Low-Pass Filter (LPF) " : : : : : : : :	CIR-Q-TEL 5 Pole
15 kHz Low-Pass Filter (LPF)	CIR-Q-TEL 7 Pole
50 0hm Load	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-9 after setting test Signal Generator's controls as follows:

Meter Function		LEVEL
COUNTER MODE:	EXPAND : : : : : : : : : : : : : .	OFF
	LOCK	Off
	Source	.INT
AM		OFF
FM		..AC

PERFORMANCE TESTS

4-24. RESIDUAL FM TEST (Cent'd)

PEAK DEVIATION	.320kHz
PEAK DEVIATION Vernier	Fully cw
RANGE	256-512 MHz
FREQUENCY TUNE" : : : : : : : : : : : : : : .	500 MHz
OUTPUT LEVEL Switches	-7 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Install shorting board in discriminator and calibrate it for 1 Vdc (at the output jack) for a full-scale meter reading. Remove shorting board, prepare a 20 kHz Butterworth low-pass filter (from the filter kit.), and install the filter in the discriminator.

3. Set reference signal generator for a 500.10 MHz, CW signal at +13 dBm.

4. Connect discriminator to mixer. Set discriminator's range to 100 kHz and sensitivity to 0.01 Vrrns. Fine tune either generator for a full-scale meter reading on the discriminator.

5. Connect amplifier to discriminator output. Connect the voltmeter through the 15 kHz LPF to amplifier's output. The signal out of the amplifier is 0.5 mVrms per 1 Hz (rms) of residual FM deviation, and the average voltmeter reading should be less than 7.5 mVrms (i.e., <15 Hz (rms) residual FM).

________________ 7.5 mVrms

NOTE

Test setup calibration can be checked by setting the test generator's FM to INT, PEAK DEVIATION to 5 kHz (vernier fully CW), and MODULATION FREQUENCY to 1000 Hz. The voltmeter should read 1.77 Vrms.

6. connect the capacitor between amplifier and filter. Replace 15 kHz LPF with 3 kHz LPF. The average voltmeter reading should be less than 2.5 mVrms (i.e., <5 Hz (rms) residual FM).

________________ 2.5 mVrms

7. Set test Signal Generator's PEAK DEVIATION switch to 2.56 MHz. The average voltmeter reading should be less than 7.5 mVrms (i.e., <15 Hz (rms) residual FM).

________________ **7.5** mVrrns

8. Remove the capacitor and replace 3 kHz LPF with 15 kHz LPF. The average voltmeter reading should be less than 15 mVrms (i.e., <30 Hz (rms) residual FM).

________________ 15 mVrms

4-25. OUTPUT LEVEL ACCURACY TEST (Abbreviated)

SPECIFICATION:

Range: A 10 dB step attenuator and a 1 dB step attenuator with a vernier allow selection of output levels from +15 dBm to –142 dBm (1.3V to 0.018 μV) into 50Ω.

Level Accuracy:

Output Level (dBm)	+15 to-10	–10to–50	–50 to –142
Total Accuracy as Indicated on Level Meter	±1.5 dB	±2. 0 dB	±2.5 dB

DESCRIPTION:

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

This procedure uses an IF substitution technique in which the spectrum analyzer's 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).

NOTE

This procedure checks output level accuracy from +15 dBm to -130 dBm, all of the attenuator sections in the OUTPUT LEVEL step attenuators, and the OUTPUT LEVEL Vernier. If, in addition, level accuracy must be verified down to -142 dBm, see paragraph 4-26.

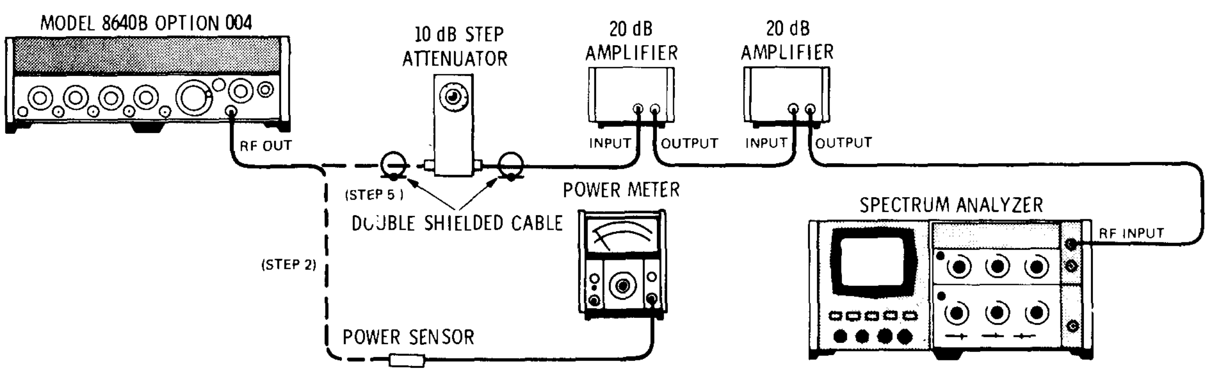


Figure 4-10. Output Level Accuracy Test Setup (Abbreviated)

4-25. OUTPUT LEVEL ACCURACY TEST (Abbreviated) (Cent'd)

EQUIPMENT:

Spectrum Analyzer	HP 141T/8552B/8554B
Power Meter	HP 435A
Power Sensor	HP 8482A
20 dB Amplifier (2 required)	HP 8447A
10 dB Step Attenuator	HP 355D
Double Shielded Cable (2 required)	HP 08708-6033

PROCEDURE:

1. Connect equipment as shown in Figure 4-10 after setting Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND"	off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL Switches	+15 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set power meter's controls so that it can measure +15 dBm. Connect power sensor to Signal Generator's RF OUT.

3. Set Signal Generator's RF OUTPUT LEVEL controls and vernier for levels (set using generator's panel meter) shown in the table below; verify that the level is within the specified tolerance.

PERFORMANCE TESTS

4-25. OUTPUT LEVEL ACCURACY TEST (Abbreviated) (Cent'd)

Signal Generator		Power Meter Reading (dBm)
Output Level 10 dB	RF Level Set (with Panel Meter)	
Fully cw	+15 dBm	+13.5–______+16.5
	+14 dBm	+12.5______+15.5
	+13 dBm	+11.5______+14.5
	+12 dBm	+10.5______+13.5
	+11 dBm	+ 9.5-______+12.5
	+10 dBm	+ 8.5-______+11.5
1 step ccw from fully cw	+10 dBm	+ 8.5-______+11.5
	+ 9 dBm	+ 7.5-______+10.5
	+ 8 dBm	+ 6.5-______+9.5
	+ 7 dBm	+ 5.5______+8.5
	+ 6 dBm	+ 4.5-______+ 7.5
	+ 5 dBm	+ 3.5-______+ 6.5
	+ 4 dBm	+ 2.5-______+ 5.5
	+ 3 dBm	+ 1.5-______+ 4.5
	+ 2 dBm	+ 0.5-______+ 3.5
	+ 1 dBm	- 0.5-______+ 2.5
	0 dBm	- 1.5-______+ 1.5
	- 1 dBm	- 2.5-______+ 0.5
	- 2 dBm	- 3.5-______- 0.5
2 steps ccw from fully cw	0 dBm	- 1.5.______+ 1.5
3 steps ccw	–11 dBm	-12.5.______- 9.5

4. Set step attenuator to 70 dB. Set spectrum analyzer center frequency to 512 MHz, resolution bandwidth to 1 kHz, frequency span per division (scan width) to 0.5-kHz, input attenuation to 0 dB, tuning stabilizer on, display smoothing (video filter) to 100 Hz, 2 dB per division vertical log display with a —20 dBm reference level.

5. Connect attenuator to generator's RF OUT without disturbing generator's controls. Center signal on analyzer's display. Consider the center horizontal graticule line equivalent to —11 dBm (with a panel meter reading of —1 dB), then with the vertical scale reference vernier control set the signal peak to be equal to the last measured level on the power meter.

NOTE

If, for example, the last power meter reading-was -11.4 dBm, the vertical scale resolution is 2 dB/division, therefore, the signal peak should be 0.4 dB or 0.2 division below the center (reference) graticule line.

4-25. OUTPUT LEVEL ACCURACY TEST (Abbreviated) (Cont'd)

6. **Step** Signal Generator's OUTPUT LEVEL 10 dB switch and analyzer's vertical scale log reference level control as shown in the following table. Verify that the amplitude falls within ± 2.0 dB (1 division) of the center (reference) graticule line in each case. If necessary, use generator's OUTPUT LEVEL 1 dB switch and vernier to reset panel meter to -1 dB.

Signal Generator		**Spectrum Anal yzer**	
Output Level 10 dB	**RF Level Set (with Panel Meter)**	**Log Reference Level Control (dBm)**	**Display Amplitude (dB)**
3 steps ccw	–11 dBm	-20	Set Level
4 steps ccw	–21 dBm	-30	-2.0 ______ +2.()
5 steps ccw	–31 dBm	-40	-2.0 ______ +2.()
6 steps ccw	-41 dBm	-50	-2.0 ______ +2.()

7. Set analyzer's vertical scale log reference level to –10 dBm and reset the 10 dB step attenuator to 30 dB. with the vertical scale log reference vernier, set the signal peak to the same level, with respect to the horizontal center (reference) graticule line, as the last measurement recorded on the preceding table.

NOTE

If generator appears to be out of specification, check accuracy of spectrum analyzer's vertical scale calibration.

8. ***Step*** Signal Generator's OUTPUT LEVEL 10 dB switch and analyzer's vertical scale log reference level control as shown in the followimg table. Verify that the amplitude is within the specified tolerance. If necessary, w generator's OUTPUT LEVEL 1 dB switch and-vernier to reset panel_ meter to —1 dB.

Signal Generator		**Spectrum Analyzer**	
Output Level 10 dB	**RF Level Set (with Panel Meter)**	**Log Reference Level Control (dBm)**	**Display Amplitude (dB)**
6 stepsCCW	-41 dBm	–1o	Bet level
7 steps ccw	–51 dBm	–20	–2.5 ______ +2.5
8 steps ccw	-61 dBm	–30	–2.5 ______ +2.5
9 steps ccw	–71 dBm	4 0	–2.5 ______ +2.5
10 steps ccw	**–81** dBm	–50	–2.5 ______ +2.5

9. Set step attenuator to 0 dB; set spectrum analyzer's vertical scale log reference to **–20** dBm. Adjust vertical scale log reference vernier to give the same level, with respect to the center (reference) graticule line, as tie last recorded entry on the previous table.

4-25. OUTPUT LEVEL ACCURACY TEST (Abbreviated) (Cent'd)

10. Set Signal Generator and analyzer controls as shown in the following table. The amplitude levels should be within the specified tolerances. If necessary, use generator's OUTPUT LEVEL 1 dB switch and vernier to reset panel meter to -1 dB.

Signal Generator		Spectrum Anal yzer	
Output Level 10 dB	**RF Level Set (with Panel Meter)**	**Log Reference Level Control (dBm)**	**Display Amplitude (dB)**
10 steps ccw	-81 dBm	-20	Set Level
11 steps ccw	-91 dBm	-30	-2.5 ________ +2.5
12 steps ccw	-101 dBm	-40	-2.5 ________ +2.5
13 steps ccw	-111 dBm	-50	-2.5 ________ +2.5
14 steps ccw	-121 dBm	-60	-2.5 ________ +2.5

11. Set analyzer's display to 10 dB/division log. Adjust log reference level vernier to set signal to –10 dB graticule line (one major division from top of display) plus last recorded entry on previous table.

NOTE

If the following step appears to be out of specification, check the accuracy of the analyzer's display with an external, calibrated attenuator.

12. Set Generator's OUTPUT LEVEL 10 dB switch one step ccw to –131 dBm. The amplitude level indicated on analyzer's display should be within 2.5 dB of the -20 dB graticule line (second major division from top of display).

-22.5 ______________ -17.5 dB

NOTE

The noise level on the analyzer's display should be >10 dB below the signal level. The signal should drop into the noise when the OUTPUT LEVEL 1 dB switch is turned fully CCW.

PERFORMANCE TESTS

4-26. OUTPUT LEVEL ACCURACY TEST (Complete)

SPECIFICATION:

Range: a 10 dB step attenuator and a 1 dB step attenuator with vernier allow selection of output levels from +15 dBm to -142 dBm (1.3V to 0.018 µV) into **50Ω.**

Output Level (dBm)	+15 to -lo	-lo to -50	-50 to -142
Total Accuracy as Indicated on Level Meter	+1.5 dB	±2.O dB	±2.5 dB

DESCRIPTION:

RF output level accuracy above –10 dBm is measured with a power meter; below -10 dBm, cumulative error is measured against a lab calibrated step attenuator using an IF substitution technique. The test Signal Generator's output is down-converted to 3 MHz (the IF) using a mixer and a reference signal generator. The 3 MHz IF is fed through the calibrated step attenuator to a spectrum analyzer. A reference level is established on the analyzer, and the step attenuator and the test generator's OUTPUT LEVEL 10 dB switch are stepped together. Any amplitude variations are measured with a DVM connected to the analyzer's vertical output.

A spectrum analyzer tracking generator is connected, with the two signal generators, in a phase lock loop that prevents relative drift between the units. (See Table 4-1. Recommended Test Abridgements.)

NOTE

This procedure allows the output level accuracy to be verified down to -142 dBm. Care must be taken to ensure that leakage signals do not reduce the dynamic range of the test setup (use double-shielded coaxial cable HP 08708-6033). ***Keep cables in the phase lock path away from cables in the measurement path.***

EQUIPMENT:

Reference Signal Generator . . . . HP 8640A
20 dB Amplifier (3 required) . . . . HP 8447A
10dB Step Attenuator . . . . HP 355D
Calibrated Step Attenuator . . . . HP 355D Option **H36**
Digital Voltmeter . . . . HP 3480D/3484A
Spectrum Analyzer . . . . HP 141T/8552B/8553B
Tracking Generator . . . . HP 8443B
Mixer (3 required) HP10514A
4 MHz Low-Pass Filter (LPF, 2 required) . . . . . CIR-Q-TEL 3 Pole
1.5 MHz Low-Pass Filter (LPF) . . . . CIR-Q-TEL 3 Pole
Oscilloscope . . . . HP 180A/1801A/1820C
20dB Attenuator . . . . ‘. . . HP 8491A Option 20
13 dB Attenuator . . . . . . HP 8491A Option 10 and Option 03
Power Meter . . . . HP 435A

PERFORMANCE TESTS

4-26. OUTPUT LEVEL ACCURACY TEST **(Complete) (Cent'd)**

Power Sensor . . . . HP 8482A
Double Shielded Cable (17 required) . . . . . . HP 08708-6033
Noise Filter
SPST Switch HP3101-0163
100 kΩ Resistor . . . . HP 0757-0465
100µF Capacitor . . . . HP 0180-0094

PERFORMANCE TESTS

4-26. OUTPUT LEVEL ACCURACY TEST (Complete) (Cont'd)

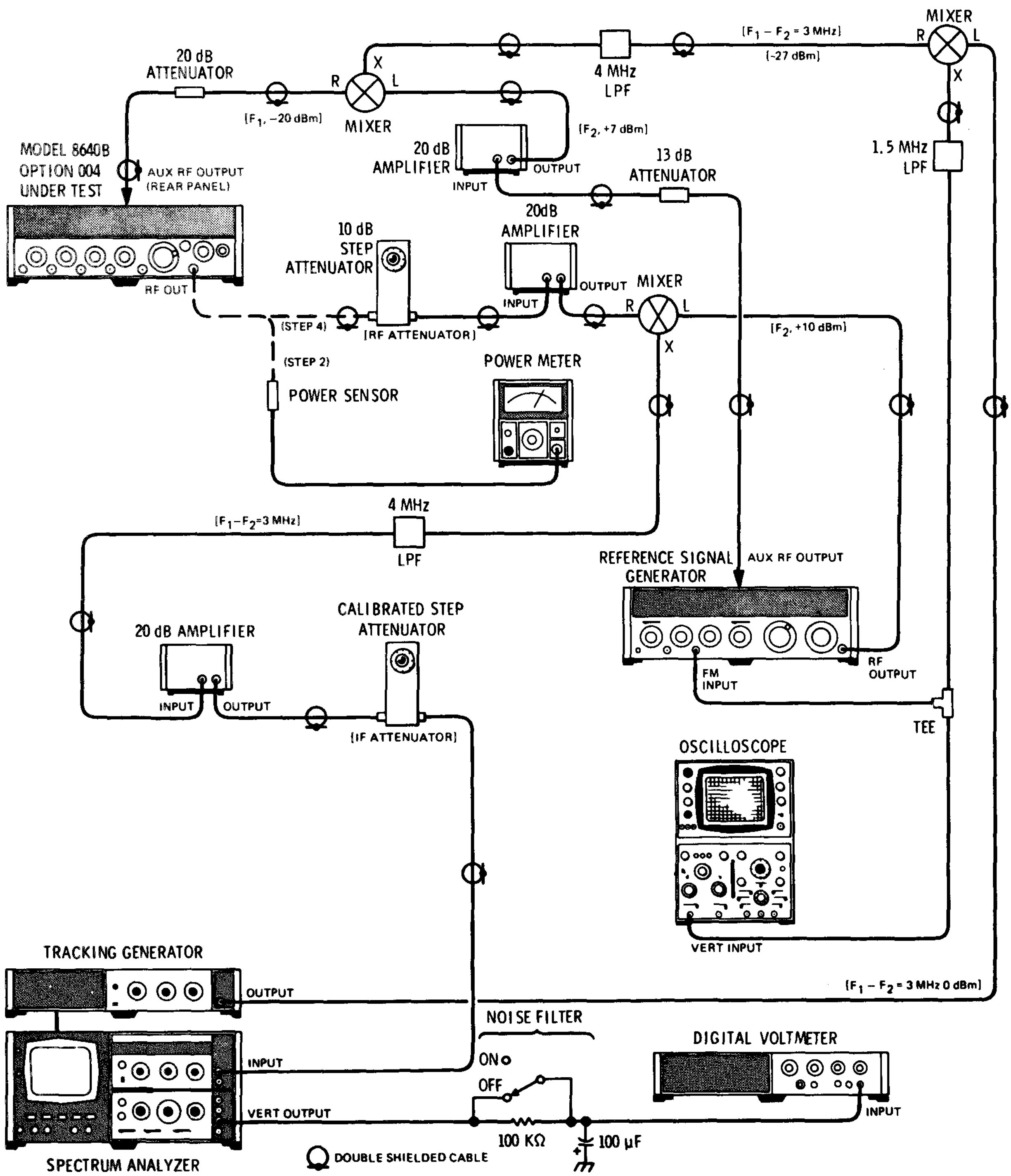


Figure 4-11. Output Level Accuracy Test Setup (Complete)

4-26. OUTPUT LEVEL ACCURACY TEST (Complete) (Cont'd)

PROCEDURE:

1. Connect power meter and power sensor to the test Signal Generator's RF OUT jack. Set test generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND	off
LOCK	off
Source	INT
AM	OFF
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL Switches	+15 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set power meter's controls so that it can measure +15 dBm. Connect power sensor to test Signal Generator's RF OUT.

3. Set test Signal Generator's RF OUTPUT LEVEL controls and vernier for levels (set using generator's panel meter) shown in the table below; verify that the level is within the specified tolerance.

Signal Generator		Power Meter Reading (dBm)
Output Level 10 dB	R F Level Set (with Panel Meter)	
Fully cw	+15 dBm	+13.5 ______ +16.5
	+14 dBm	+12.5 ______ +15.5
	+13 dBm	+11.5 ______ +14.5
	+12 dBm	+10.5 ______ +13.5
	+11 dBm	+ 9.5 ______ +12.5
	+10 dBm	+ 8.5 ______ +11.5
1 step ccw from fully cw	+10 dBm	+ 8.5 ______ +11.5
	+ 9 dBm	+ 7.5 ______ +10.5
	+ 8 dBm	+ 6.5 ______ + 9.5
	+ 7 dBm	+ 5.5 ______ + 8.5
	+ 6 dBm	+ 4.5 ______ + 7.5
	+ 5 dBm	+ 3.5 ______ + 6.5
	+ 4 dBm	+ 2.5 ______ + 5.5
	+ 3 dBm	+ 1.5 ______ + 4.5
	+ 2 dBm	+ 0.5 ______ + 3.5
	+ 1 dBm	- 0.5 ______ + 2.5
	0 dBm	- 1.5 ______ + 1.5
	- 1 dBm	- 2.5 ______ + 0.5
	- 2 dBm	- 3.5 ______ - 0.5
2 steps ccw	0 dBm	- 1.5 ______ + 1.5
3 steps ccw	-11 dBm	-12.5 ______ - 9.5

4-26. OUTPUT LEVEL ACCURACY TEST (Complete) (Cont'd)

4. Disconnect power meter and sensor from generator. Connect test generator's RF OUT to the step attenuator as shown in Figure 4-11. Do not change any of the test generator's control settings (particularly the OUTPUT LEVEL vernier).

5. Set reference signal generator for 515 MHz signal (with no AM) at +10 dBm. Set its modulation controls for external FM (de) and 640 kHz peak deviation (FM vernier at maximum).

6. Set the attenuator to 50 dB and the IF attenuator to 40 dB.

7. Connect spectrum analyzer to tracking generator. Set analyzer's center frequency controls to 3 MHz with the tuning stabilizer on; set resolution bandwidth to 10 Hz, span width per division (scan width) to 5 kHz, and input attenuation to 10 dB. Set the display controls for a linear display with 0.1 mV/div; set display smoothing (video filter) to 100 Hz and set the tracking generator for 0 dBm output.

8. Set oscilloscope for dc input coupling, vertical to 5 mV/div, and horizontal to 0.5 ms/div.

9. Set digital voltmeter's noise filter to maximum filtering, range to 10V, and function to dc.

NOTE

The noise filter between the analyzer and the DVM can be used instead of, or with, the DVM'S noise filter whenever the DVM's reading is obscured by noise. To use this filter, switch it off (if it is on) for approximately two seconds to allow the capacitor to charge, then switch it on; wait approximately 30 seconds - to allow the filter to reach the average value of the signal - then take the reading.

10. Phase lock the system by tuning the reference signal generator's frequency to center the 3 MHz IF signal on the analyzer's display. Set analyzer's span width per division to zero, then tune reference signal generator to indicate phase lock on the oscilloscope (the signal will peak, then become O Vdc when phase lock is reached).

NOTE

Care must be taken to ensure that all measurements are taken during phase lock. Also, the tracking generator's tracking adjustment should be periodically checked to ensure that the trace is peaked on the analyzer.

11. Adjust analyzer's display sensitivity controls for a -500 mVdc reading on the DVM. Measure the accuracy of test Signal Generator's output using IF substitution by switching the OUTPUT LEVEL switch in 10 dB steps while switching the IF attenuator (the calibrated 10 dB step attenuator). The DVM should read -500 mVdc ±0.5 dB.

4-26. OUTPUT LEVEL ACCURACY TEST (Complete) (Cent'd)

IF Attenuator (dB)	Test Generator OUTPUT LEVEL	DVM Readings (mVdc)
40	-11 dBm	-500 (set)
30	-21 dBm	-472.0 ________ -529.6
20	-31 dBm	-472.0 ________ -529.6
10	-41 dBm	-472.0 ________ -529.6
o	-51 dBm	-472.0 ________ -529.6

12. Set the RF attenuator to O dB and the IF attenuator to 50 dB. Use analyzer's display sensitivity controls to set the DVM to the reading noted at the -51 dBm step, then continue. The DVM should read -500 mVdc ±1 dB.

IF Attenuator (dB)	Test Generator OUTPUT LEVEL	DVM Readings (mVdc)
50	–51 dBm	Set Level
40	-61 dBm	-445.6 ________ -561.0

13. Set the IF attenuator to 30 dB, OUTPUT LEVEL to -71 dBm, and then adjust the OUTPUT LEVEL 1 dB switch and vernier so that the test Signal Generator's panel meter reads -71 dBm, then continue. The DVM should read -500 mVdc ± 1 dB.

IF Attenuator (dB)	Test Generator OUTPUT LEVEL	DVM Readings (mVdc)
30	-71 dBm	-445.6 ________ -561.0
20	-81 dBm	-445.6 ________ -561.0
10	-91 dBm	-445.6 ________ -561.0

14. Set the IF attenuator to 0 dB, OUTPUT LEVEL to -101 dBm, and then adjust the OUTPUT LEVEL 1 dB switch and vernier so that the test generator's panel meter reads-101 dBm. The DVM should read -500 mVdc ± 1 dB.

-445.6 ____________ -561.0 mVdc

15. Set the IF attenuator to 30 dB and use analyzer's display sensitivity controls to set the DVM to the reading noted in step 14, then continue. The DVM should read -500 mVdc ± 1 dB.

PERFORMANCE TESTS

4-26. OUTPUT LEVEL ACCURACY TEST (Complete) (Cent'd)

IF Attenuator (dB]	Test Generator OUTPUT LEVEL	DVM Readings (mVdc)
30	-101 dBm	Set Level
20	-111 dBm	-445.6 ______ -561.0
10	-121 dBm	-445.6 ______ -561.0
0	-131 dBm	-445.6 ______ -561.0

16. Set the IF attenuator to 20 dB and use analyzer's display sensitivity controls to set the DVM to the reading noted at the -131 dBm step above, then continue. The DVM should read -500 mVdc ±1 dB.

IF Attenuator (dB)	Test Generator OUTPUT LEVEL	DVM Readings (mVdc)
20	-131 dBm	Set Level
10	-141 dBm	-445.6 ______ -561.0

17. Verify the test accuracy by increasing the RF attenuator by 10 dB. The DVM should drop below -300 mVdc. If it does not, check the test setup for RF leakage paths.

18. Check output level accuracy at other output frequencies by setting the two generators for a 3 MHz difference frequency and repeating steps 1 through 17.

4-27. OUTPUT LEVEL FLATNESS TEST

SPECIFICATION:

Level F!atness: <± 0.75 dB from 0.5 to 512 MHz referred to output at 190 MHz.
<±o.5 dB from 108 to 336 MHz referred to output at 190 MHz.
(Flatness applies to +10 to –10 dBm.)

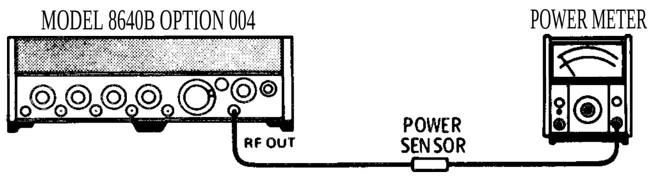


Figure 4-12. Output Level Flatness Test Setup

4-27. OUTPUT LEVEL FLATNESS TEST (Cont'd)

EQUIPMENT:

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

NOTE

The sensor's VSWR should be 1.2:1 max.

PROCEDURE:

1. Connect equipment as shown in Figure 4-12 after setting Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	.INT
AM	OFF
FM	OFF
R A N G E : : : : : : : : : : : : : : : : :	128-256 MHz
FREQUENCY TUNE	190 MHz
OUTPUT LEVEL 10 dB : : : : : : : : : : : : :	+10 dBm
OUTPUT LEVEL ldB	0dB
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Adjust OUTPUT LEVEL Vernier for a power meter reading of +9 dBm at 190 MHz. Using RANGE and FREQUENCY TUNE controls, slowly tune Signal Generator from 0.5 to 512 MHz. Within the ranges listed below note maximum and minimum power readings in dBm.

3. In the 108 to 336 MHz range the maximum and minimum readings should be within 0.5 dB of the reading at 190 MHz.

maximum reading ________________0.5 dB

minimum reading ________________0.5 dB

4. The overall maximum and overall minimum readings (0.5 to 512 MHz) should be within 0.75 dB of the reading at 190 MHz.

maximum reading ________________0.75 dB

minimum reading ________________0.75 dB

PERFORMANCE TESTS

428. OUTPUT IMPEDANCE TEST (Signal-Frequency)

SPECIFICATION:

Impedance: **50Ω** ac. coupled, 40 Vdc maximum, VSWR <2.0 on 3V and 1V output ranges; <1.3 on all other ranges.

DESCRIPTION:

The generator's output signal is reflected back into the RF OUT jack by a coaxial short at the end of an adjustable stub (a variable length of air-line). This reflected signal is re-reflected by any mismatch at the jack. The re-reflected signal combines with the output signal according to the relative phase and magnitude of the two signals. The combined signal is monitored by a directional coupler and then measured by a voltmeter. Maximum and minimum power levels are noted as the electrical length of the stub is varied (i.e., the distance from the RF OUT jack to the coaxial short is varied). VSWR is then calculated from the distance from the RF OUT jack to the coaxial short is varied). VSWR is then calculated from the formula, VSWR = $V_{max} \div V_{min}$. (See Table 4-1. Recommended Test Abridgements.)

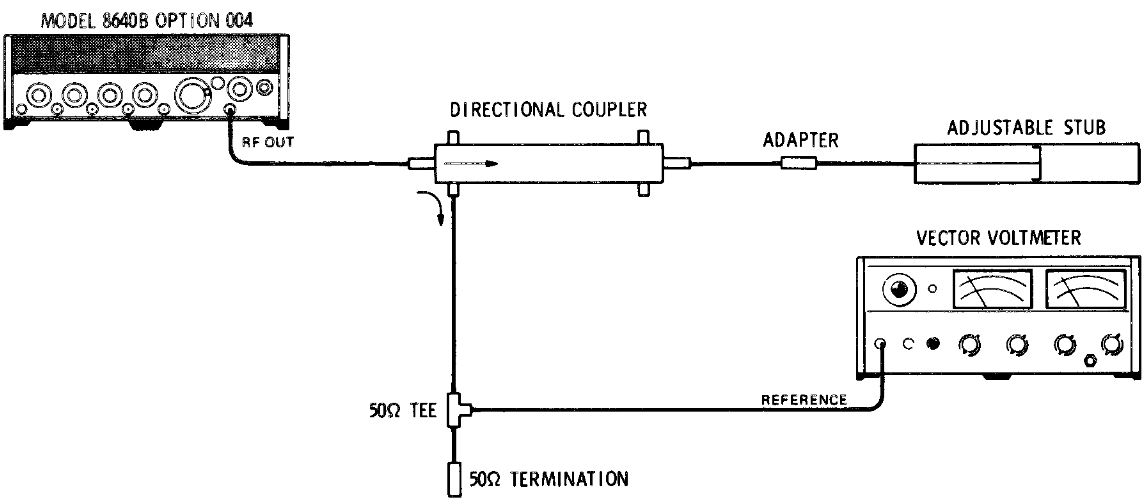


Figure 4-13. Output Impedance Test Setup (Signal Frequency)

EQUIPMENT:

Directional Coupler HP 778D Option 12
Adapter (Type N Male to GR 874). . . . . HP 1250-0847
Adjustable Stub . . . . General Radio 874-D50L
Vector Voltmeter . . . . Hp 8405A
50Ω Tee Hpl1536A
50Q Termination . . . . HP 908A

PROCEDURE:

1. Connect equipment as shown in Figure 4-13 after setting Signal Generator's controls as follows:

4-28. OUTPUT IMPEDANCE TEST (Signal Frequency) (Cont'd)

Meter Function	LEVEL
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL 10 dB	+10 dBm
OUTPUT LEVEL ldB	0dB
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set voltmeter so that it can measure 100 mV. Adjust the stub for a minimum indication on voltmeter. Note the reading on the voltmeter.

________ mV

3. Adjust the stub for a maximum indication on voltmeter. The voltmeter should indicate less than twice the voltage noted in Step 2.

________ mV

4. Set generator's OUTPUT LEVEL 10 dB switch one step ccw to O dBm. Set voltmeter so that it can measure 30 mV. Adjust the stub for a minimum indication on voltmeter, and note this reading.

________ mV

5. Adjust the stub for a maximum indication on voltmeter. The voltmeter should indicate less than 1.3 times the reading noted in step 4.

________ mV

6. Set generator's OUTPUT LEVEL 10 dB switch one step ccw to -10 dBm. Set voltmeter so that it can measure 10 mV. Adjust the stub for a minimum indication on voltmeter, and note this reading.

________ mV

7. Adjust the stub for a maximum indication on voltmeter. The voltmeter should indicate less than 1.3 times the reading noted in step 6.

________ mV

8. If desired, repeat at other frequencies between 256 and 512 MHz

NOTE

The steps given above effectively check VSWR at all settings of the output attenuators (see Service Sheet 13).

PERFORMANCE TESTS

4-29. OUTPUT IMPEDANCE TEST (Broadband)

SPECIFICATION:

Impedance: **50** ac coupled, **40** Vdc maximum, VSWR <2.0 on 3V and IV output ranges; <1.3 on all other ranges.

DESCRIPTION:

A tracking generator is used as an external **50Ω** signal source to feed a VSWR bridge. The output port of the bridge is connected to a spectrum analyzer. The through port of the bridge is connected to a short circuit. to establish a reference, then to the generator output. Return loss versus frequency is displayed on the spectrum analyzer. (See Table 4-1. Recommended Test Abridgements.)

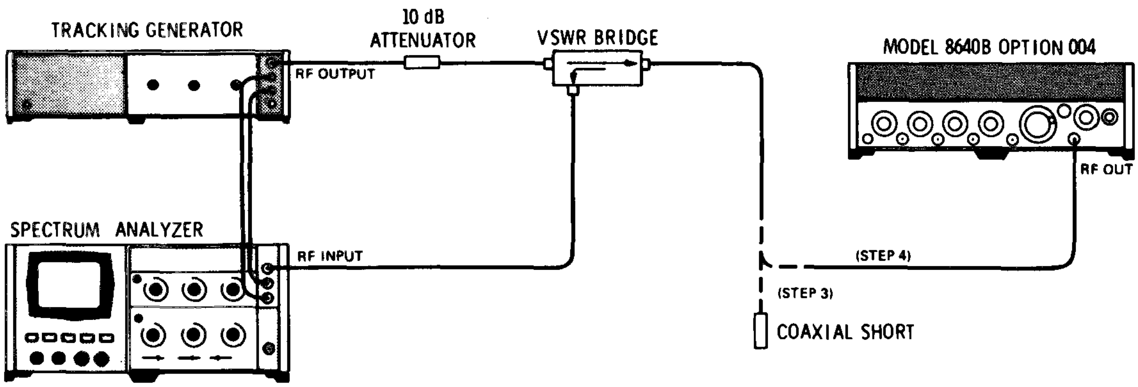


Figure 4-14. Output Impedance Test (Broadband)

EQUIPMENT:

Tracking Generator	HP 8444A
Spectrum Analyzer	HP 8554B/8552B/141T
VSWR Bridge	Wiltron 60N50
Coaxial Short	HP 11512A
10dB Attenuator	HP 8491A Option 10

PROCEDURE:

1. Connect equipment as shown in Figure 4-14 after setting Signal Generator's controls as follows:

AM	OFF
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	Fully CW
OUTPUT LEVEL Switches	**+16** dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	OFF

PERFORMANCE TESTS

4-29. OUTPUT IMPEDANCE TEST (Broadband) (Cont'd)

2. Set spectrum analyzer for a frequency span of 50-550 MHz, 300 kHz resolution bandwidth, and 20 dB input attenuation. Set tracking generator output level to O dBm.

3. To establish a reference level, connect coaxial short to bridge output port. Use the spectrum analyzer's vertical scale, logrithmic level controls to set the reference level trace to the top of the analyzer display.

4. Remove coaxial short and couple bridge output port to Signal Generator's RF OUT connector. The difference, in dB, from the reference level established in step 3 to the level now visible on the display is the return loss of the generator's output port. The return loss should be >9.5 dB from 50 to .512 MHz (VSWR <2.0:1).

9.5 dB ____________

5. Set generator's FREQUENCY TUNE control fully ccw and repeat steps 3 and 4. Return loss should be >9.5 dB from 50 to 512 MHz.

9.5 dB ____________

6. Set generator's OUTPUT LEVEL 10 dB switch two steps ccw to 0 dBm and repeat steps 3 and 4. Return loss should be >17.7 dB from 50 to 512 MHz (VSWR <1.3:1).

17.7 dB ____________

7. Set generator's FREQUENCY TUNE control fully cw and repeat steps 3 and 4. Return loss should be >17.7 dB from 50 to 512 MHz.

17.7 dB ____________

4-30. AUXILIARY OUTPUT TEST

SPECIFICATION:

Auxiliary Output: Rear panel BNC output is >–5 dBm into 50Ω, source impedance is approximately 500!2.

DESCRIPTION:

The power level from the generator's rear panel AUX RF OUTPUT jack is measured with a power meter as the Signal Generator is tuned from 512 MHz to 500 kHz. (See Table 4-1. Recommended Test Abridgements.)

EQUIPMENT:

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

PERFORMANCE TESTS

4-30. AUXILIARY OUTPUT TEST, (Cont'd)

PROCEDURE:

1. Connect power meter's power sensor to generator's rear panel AUX RF OUTPUT jack after setting Signal Generator's controls as follows:

COUNTER MODE :	EXPAND	off
	LOCK	off
	Source	.INT
m..		OFF
FM	. . . .	OFF
R A N G E		256-512 MHz
FREQUENCY TUNE		512 MHz
RF ON/OFF		.ON

2. Use generator's FREQUENCY TUNE and RANGE controls to tune from 512 to 0.5 MHz. The power meter should read > -5 dBm at all frequencies.

-5 dBm ________

4-31. OUTPUT LEAKAGE TEST

SPECIFICATION:

Leakage: (With all unused outputs terminated properly). Leakage limits are below those specified in MIL-I-6181D. Furthermore, less than 3 µV is induced in a 2-turn, l-inch diameter loop 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. (See Table 4-1. Recommended Test Abridgements.)

PERFORMANCE TESTS

4-31. OUTPUT LEAKAGE TEST (Cont'd)

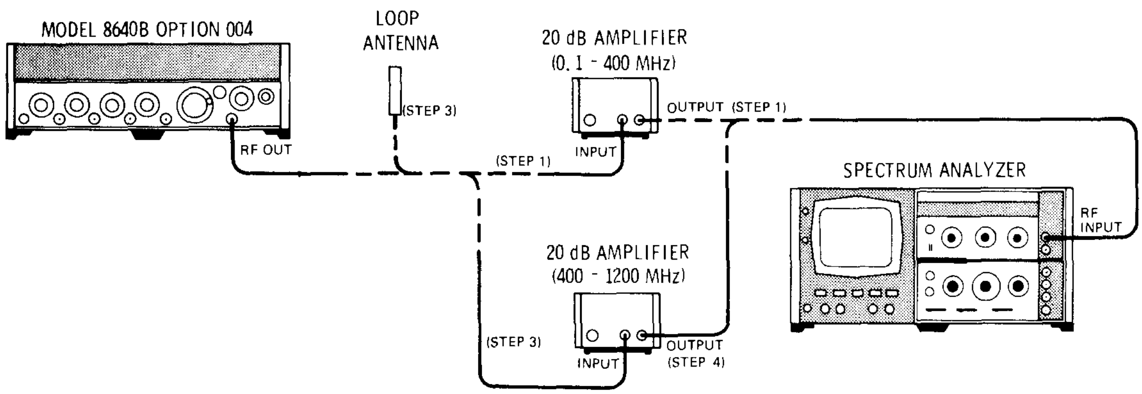


Figure 4-15. Output Leakage Test Setup

NOTE

To avoid disturbing antenna's field and causing measurement error, grasp antenna at the end that has the BNC connector.

EQUIPMENT:

One-Inch Loop Antenna	HP 08640-60501
20 dB Amplifier (0.5-400 MHz)" " : : : : : : : : . .	HP 8447A
20 dB Amplifier (400-1200 MHz)	HP 8447B
Spectrum Analyzer	HP 141T/8552B/8554B
50 Ohm Load (7 required)	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-15 (with Signal Generator connected to spectrum analyzer through 0.5-400 MHz amplifier) after setting Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND : : : : :	Off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
RANGE.	64-128 MHz
FREQUENCY TUNE.....	100 MHz
OUTPUT LEVEL Switches	-107 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	.ON

2. Set spectrum analyzer's resolution bandwidth to 10 kHz, input attenuation to 0 dB, frequency span per division (scan width) to 20 MHz, scale to log (10 dB per division), scale reference level controls to -50 dBm, and scale center frequency controls to 100 MHz. Calibrate the analyzer by using the scale reference level controls to set the -107 dBm signal from the generator to the -37 dB graticule line on the display. Disconnect generator from analyzer and connect 50 ohm terminations to generator's input and output connectors (including the AUX RF OUTPUT on rear panel).

4-31. OUTPUT LEAKAGE TEST (Cent'd)

3. Connect one-inch loop antenna to analyzer through 0.5-400 MHz amplifier. Hold end of loop antenna cylinder in contact with all surfaces of Signal Generator; set analyzer's center frequency controls to 300 MHz and repeat. All signals and noise should be below the -27 dB graticule line on analyzer's display (below --97 dBm) from 0.5 to 400 MHz.

-97 dBm ________

4. Replace 0.5-400 MHz amplifier with 400-1200 MHz amplifier. Set analyzer's center frequency controls to !500 MHz; set generator's RANGE control to 256-512 MHz and FREQUENCY TUNE control to 500 MHz, and connect generator to analyzer and calibrate analyzer as specified in step 2. Then reterminate RF OUT, reconnect loop antenna to analyzer and hold end of loop antenna cylinder in contact with all surfaces of generator. All signals and noise should be below the -27 dB graticule line on analyzer's display (below -97 dBm) from 400 MHz to 600 MHz.

-97 dBm ________

5. Set the analyzer's center frequency controls to 700, 900, and 1100 MHz. Hold the end of the loop antenna cylinder in contact with all surfaces of the generator at each frequency setting. All signals and noise should be below the -27 dB graticule line (below -97 dBm) from 600 MHz to 1200 MHz.

-97 dBm ________

4-32. INTERNAL MODULATION OSCILLATOR TEST

SPECIFICATION:

Standard:

Frequency: fixed 400 Hz and 1 kHz ±2%.
Output Level: indicated 10 mVrms to 1 Vrms into 600 ohms.

Option 001:

Frequency: variable 20 Hz to 600 kHz ± 10% in 5 decade continuous bands plus freed 400 **Hz** and 1 kHz ±3%.
Output Level: 20 mVrms to 3 Vrms into 600 ohms.

DESCRIPTION:

The internal modulation oscillator output is measured with a voltmeter and a frequency counter to verify its frequency range and accuracy and its level. (See Table 4-1. Recommended Test Abridgements.)

4-32. INTERNAL MODULATION OSCILLATOR TEST (Cont'd)

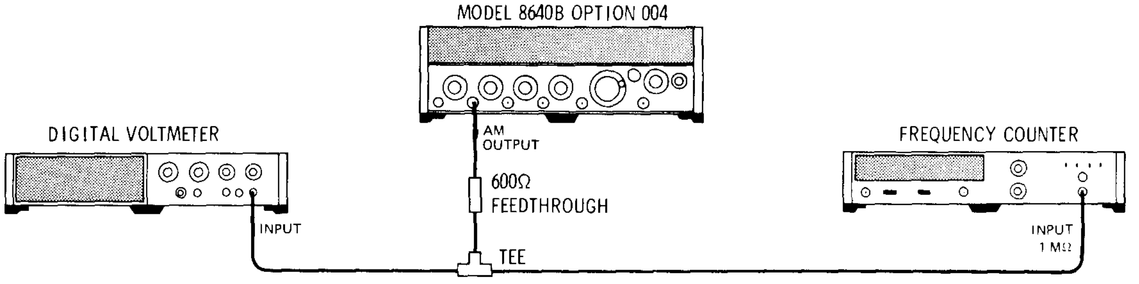


Figure 4-16. Internal Modulation Oscillator Test Setup

EQUIPMENT:

Frequency Counter . . . . HP 5327C
Digital Voltmeter . . . . HP 3480D/3484A Option 043
600 Ohm Feedthrough Termination . . . . HP 11095A

PROCEDURE :

1. Connect equipment as shown in Figure 4-16 after setting Signal Generator's controls as follows:

AM INT
AUDIO OUTPUT LEVEL " : : : : : : : : : : : lV(Standard)
3V (Option 001)
MODULATION Fully CW
MODULATION FREQUENCY" : : : : : : : : 400 Hz (fixed)
FM . . . . OFF

2. The frequency counter should read 400 ± 8 Hz on a standard instrument, 400 ± 12 Hz on an Option 001. The voltmeter should read greater than 1 Vrms on a standard instrument, 3 Vrms on an Option 001.

Standard: 392 ________ 408 Hz
1.0 Vrms ________
Option 001: 388 ________ 412 Hz
3.0 Vrms ________

3. Set MODULATION FREQUENCY to 1 kHz (fixed). The frequency counter should read 1000 ± 20 Hz on a standard instrument, 1000 ± 30 Hz on an Option 001, and the voltmeter should read as specified above.

Standard: 980 ________ 1020 Hz
1.0 Vrms ________
Option 001: 970 ________ 1030 Hz
3.0 Vrms ________

PERFORMANCE TESTS

4-32. INTERNAL MODULATION OSCILLATOR TEST (Cont'd)

4. **If** testing an Option 001, set AUDIO OUTPUT LEVEL to 3V and slowly tune MODULATION FREQUENCY through its variable range from 20 Hz to 600 kHz. The MODULATION FREQUENCY controls should read within ±10% of the frequency counter reading at all frequencies.

_________(√)

4-33. INTERNAL MODULATION OSCILLATOR DISTORTION TEST (Option 001)

SPECIFICATION:

Total Harmonic Distortion:
<0.25%, 400 and 1 kHz fixed tones.
<0.5%, 20 **HZ** to 2 kHz.
<1.0%, 2 kHz to 600 kHz.

DESCRIPTION:

A distortion analyzer is used to measure distortion on the output of the oscillator. (See Table 4-1. Recommended Test Abridgements.)

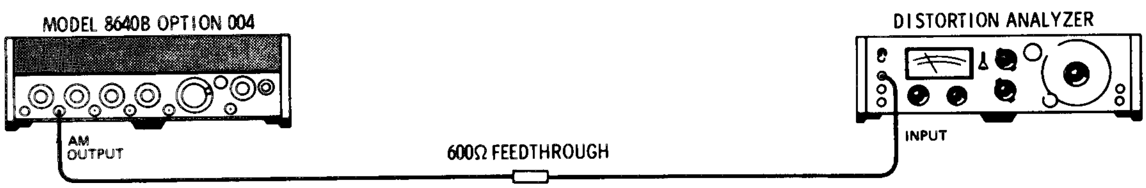


Figure* 4-17. *Internal Modulation Oscillator Distortion Test Setup

EQUIPMENT:

Distortion Analyzer . . . . HP 333A
600 Ohm Feedthrough . . . . Hp 11095A

PROCEDURE :

Connect equipment as shown in Figure 4-17 after setting Signal Generator's controls as follows:

AM . . . . INT
AUDIO OUTPUT LEVEL : : : : : : 3V
MODULATION FREQUENCY . . . . As specified
FM . . . . OFF

2. Set. the MODULATION FREQUENCY controls to various frequencies within the variable ranges shorn below. At each frequency tested, calibrate the distortion analyzer and measure the distortion. It should be as **shown**

4-33. INTERNAL MODULATION OSCILLATOR DISTORTION TEST (Option 001) (Cont'd)

Frequency Range	Distortion
20 Hz to 2 kHz	________≤0.5%
2 kHz to 600 kHz	________≤1.0%

3. Set the MODULATION FREQUENCY controls to the 400 Hz and 1 kHz fixed frequencies. Distortion at both frequencies should be below 0.25%.

400 Hz: ____________*0.25%*

1 kHz : ____________0.25%

4-34. AM 3 dB BANDWIDTH TEST

SPECIFICATION:
AM 3 dB Bandwidth:

Frequency Bands	O to 50% AM	50 to 90% AM
0.5 -,2 MHz	15 kHz	12.5 kHz
2-8 MHz	30 kHz	20 kHz
8-512 MHz	50 kHz	35 kHz

DESCRIPTION :
An audio spectrum analyzer is used to measure the 3 dB (rate). The analyzer is set to sweep over the specified audio frequency range and its tracking generator output is used to amplitude modulate the Signal Generator. The generator's RF output is detected and fed to the analyzer's input. Amplitude variation is measured on the analyzer's display. (See Table 4-1. Recommended Test Abridgements.)

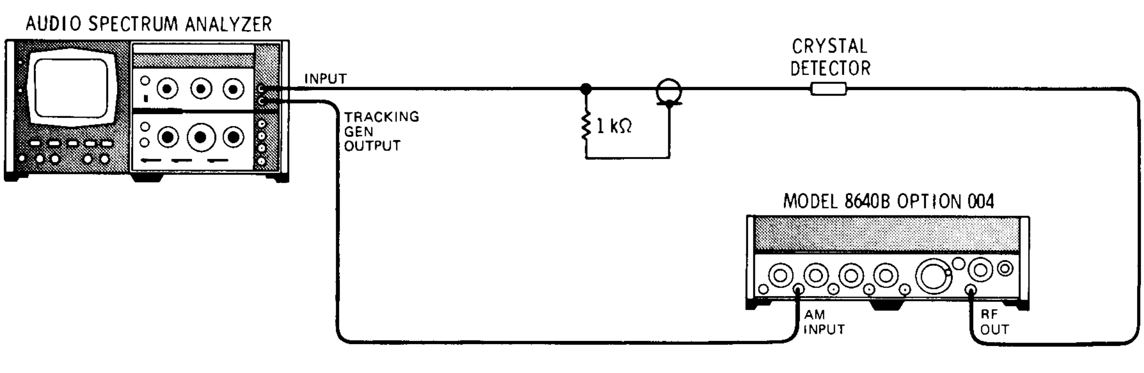


Figure 4-18. AM 3 dB Bandwidth Test Setup

4-34. AM 3 dB BANDWIDTH TEST (Cont'd)

EQUIPMENT:

Audio Spectrum Analyzer . . . . HP 141T/8552B/8556A
Crystal Detector HP8471A
1 KΩ Resistor . . . . HP 0757-0280

PROCEDURE :

1. Connect equipment as shown in Figure 4-18 after setting Signal Generator's controls as follows:

Meter Function		AM
COUNTER MODE :	EXPAND	Off
	LOCK	Off
	Source	INT
AM		DC
MODULATION		Fully cw
FM		OFF
RANGE		8-16 MHz
FREQUENCY TUNE		8 MHz
OUTPUT LEVEL Switches		+3 dBm
OUTPUT LEVEL Vernier		CAL
RF ON/OFF		ON

2. Set analyzer's center frequency controls to 1 kHz, fixed (not scanning) and adjust tracking generator's output level controls for 50% AM as indicated on Signal Generator's panel meter.

3. **Now** set spectrum analyzer's resolution bandwidth to 1 kHz, and set frequency span (scan width) controls for a zero to 100 kHz span. Set display for 2 dB per division.

4. Set analyzer's display reference level controls to display the detected sweep. Slowly tune Signal Generator from 8 to 16 MHz while noting amplitude variations from 0-50 kHz on the display. The variation should be <3 dB referenced to the level at 1 kHz.

________ **3** db

5. Set analyzer and Signal Generator as shown below. At each RANGE switch setting, repeat the procedure outlined in steps 2 through 4, except set analyzer for the frequency and percent AM shown. The amplitude variation should, in each case, be <3 dB.

Signal Generator RANGE	% AM (Tracking Gen. Level)	Frequency span	Amplitude Variation
8-16 MHz	90%	0 to 35 kHz	3 dB
4-8 MHz	50%	0 to 30 kHz	3 dB
4-8 MHz	90%	0 to 20 kHz	3 dB
1-2 MHz	50%	0 to 15 kHz	3 dB
1-2 MHz	90%	0 to 12.5 kHz	3 dB

PERFORMANCE TESTS

4-35. AM DISTORTION TEST

SPECIFICATION:

AM Distortion: (at 400 Hz and 1 kHz rates)

Frequency Bands	O - 50% AM	50- 90% AM
0.5-512 MHz	<1%	**<3%**

DESCRIPTION:

A spectrum analyzer (used to demodulate the AM) is connected to RF OUT, and percent AM is set; a distortion analyzer is connected to the analyzer's vertical output and used to measure AM distortion.

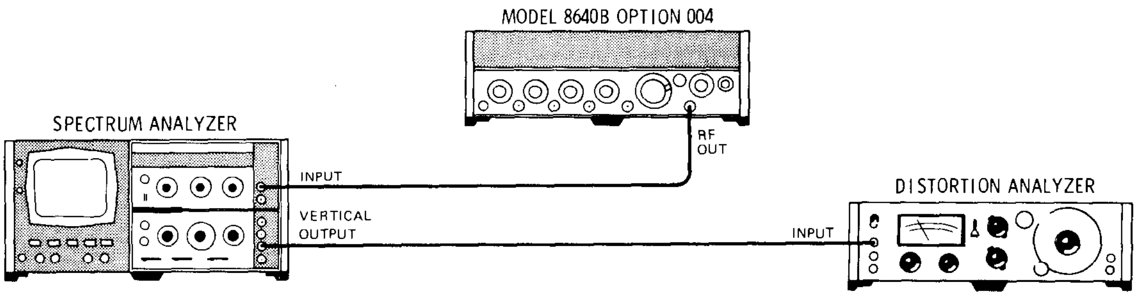


Figure 4-19. AM Distortion Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 141T/8552B/8554B
Distortion Analyzer	HP 333A

PROCEDURE:

1. Connect equipment as shown in Figure 4-19 after setting Signal Generator's controls as follows:

Meter Function . . .	AM
COUNTER MODE: EXPAND : : : : : : : : : . . .	Off
LOCK	Off
Source.	INT
. . .	OFF
Modulation : : : : : : :	Fully ccw
MODULATION FREQUENCY	1 kHz
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL Switches	-17 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

4-35. AM DISTORTION TEST (Cont'd)

2. Set spectrum analyzer's resolution bandwidth to 300 kHz, input attenuation to 20 dB, frequency span per division (scan width) to 10 MHz, scale to linear, and adjust center frequency and scale reference level controls to center the 512 MHz signal on the display. Set frequency span per division to O Hz and display smoothing (video filter) to 10 kHz. Peak trace on display with center frequency controls; set trace to the center of display with referenced level controls.

3. **Set** generator's AM switch to INT and adjust MODULATION control for 50% modulation as read on generator's panel meter.

4. Calibrate the distortion analyzer for 1 kHz. Measure and record distortion; it should be less than 1% with trace peaked on analyzer display.

__________ 1%

5. Use generator's MODULATION control to set percent AM to 90%; calibrate the distortion analyzer and measure distortion. Distortion should be less than 3% with trace peaked on analyzer display.

90% AM: __________ 3%

SPECIFICATION:

External AM Sensitivity: **(400** Hz and 1 kHz rates)
(0.1 ± 0.005)% AM per mV peak into **600Ω** with AM vernier at full cw position.

Indicated AM Accuracy: (400 Hz and 1 kHz rates using internal meter)
±8% of reading on0-10 scale
±9% of reading on 0-3 scale (for greater than 10% of full scale).

DESCRIPTION:

AM sensitivity accuracy and meter accuracy are measured by comparing the actual amount of amplitude modulation to the level of the input modulating signal. A spectrum analyzer is used to demodulate the AM. The analyzer is used with zero frequency span at the carrier frequency. A DVM is used to measure the ac and dc voltages at the analyzer's vertical output, and the dc value of the carrier is set to 282.8 mVdc; the rms value of the modulation is then a very accurate measure of percent AM (percent AM is 1/2 the ac voltage in mVrms). (See Table 4-1. Recommended Test Abridgements.)

4-36. AM SENSITIVITY AND ACCURACY TEST (Cont'd)

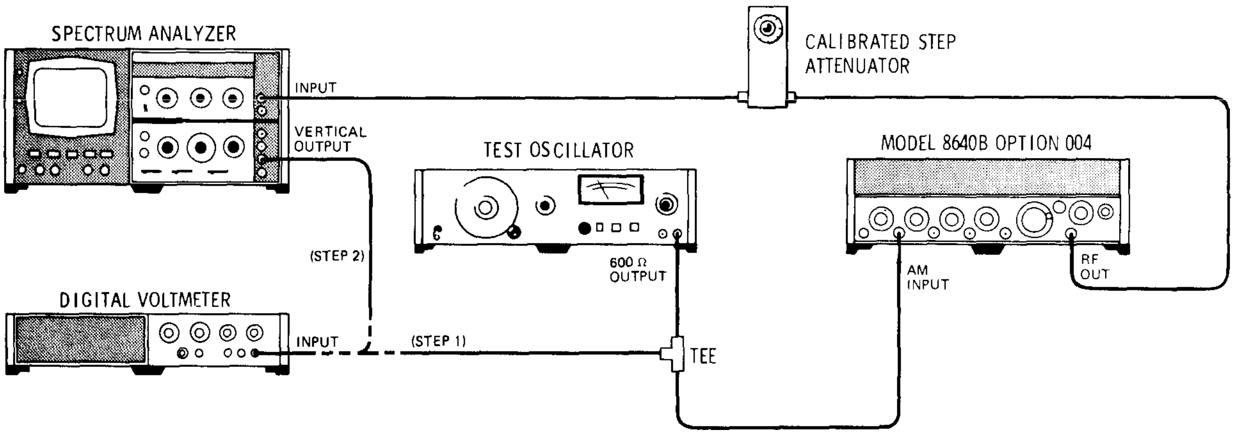


Figure 4-20. AM Sensitivity and Accuracy Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 141T/8552B/8554B
Digital Voltmeter	HP 3480D/3484A Option 043
Test Oscillator	HP 652A
Calibrated Step Attenuator	HP 355D Option H36

PROCEDURE:

1. Connect equipment as shown in Figure 4-20 after setting Signal Generator's controls as follows:

Meter Function		AM
COUNTER MODE:	EXPAND	off
	LOCK	off
	Source.	INT
AM		AC
MODULATION		Fully CW
FM		OFF
RANGE " : : :		256-512 MHz
FREQUENCY TUNE.....		512 MHz
OUTPUT LEVEL Switches		–27 dBm
OUTPUT LEVEL Vernier		CAL
RF ON/OFF		.ON

2. Set test oscillator for a 1 kHz, 636.39 mVrms signal as read on DVM (90% AM). Disconnect DVM from test oscillator (leave oscillator connected to generator). Connect DVM to spectrum analyzer's vertical output. Set calibrated step attenuator to O dB.

3. Set spectrum analyzer's resolution bandwidth to 300 kHz, input attenuation to 20 dB, frequency span per division (scan width) to 20 kHz (tuning stabilizer on), scale to linear, and adjust center frequency and scale reference level controls to center the 512 MHz signal on the display. Set frequency span per division to O Hz and display smoothing (video filter) to 10 kHz. Peak the trace on the display with the center frequency controls; set the trace to the center of the display with the reference controls.

4-36. AM SENSITIVITY AND ACCURACY TEST (Cont'd)

NOTE

Step 4 measure the analyzer's dc offset (Voff) and must be performed to ensure the accuracy of this test. However, if Voff for the analyzer being used has recently been measured and noted, skip step 4 and go to step 5 (and eliminate the calibrated step attenuator from the test setup),

4. Measure analyzer's dc offset (Voff) by performing steps "a" through "f".

a. Set generator's controls as follows:

Meter Function . . . . .LEVEL
AM OFF
RANGE . . . . 2-4 MHz
FREQUENCY TUNE **3MHz**

b. Set analyzer's center frequency controls to 3 MHz.

c. Adjust analyzer's reference level controls for -500 mVdc indicated on DVM (V_{DET} 1).

d. Set step attenuator to 20 dB. Note DVM reading (V_{DET} 2).

e. Calculate V_off where

$$\text{Voff} = \frac{V_{DET}\,2 - a\,V_{DET}\,1}{1 - a}$$

and a = VRF2/VRF1 (i.e., a = attenuation; for 20 dB it is 0.1)

therefore

$$\text{Voff} = \frac{V_{DET}\,2 + 50\text{ mVdc}}{0.9}$$

f. Reset step attenuator O dB, Signal Generator as specified in step 1, and spectrum analyzer as specified in step 3.

5. **To Calibrate the spectrum** analyzer for the percent AM measurement, use the analyzer's reference level controls to set -282.8 mV + V_off at vertical output (as measured on the DVM). For example, if Voff is ***+50.0 mV, then set —282.8*** mV + (+50.0 mV) or -232.8 mV at vertical output. (Check that trace is peaked on analyzer display.)

6. To measure modulation percent, set DVM to measure mVrms (ac only). The DVM should read 180 mVrms ± 5%. (Check that trace is peaked on analyzer display.)

171.0 ________ 189.0 mVrms

4-36. AM SENSITIVITY AND ACCURACY TEST (Cont’d)

7. To check indicated accuracy, set test oscillator’s amplitude controls for a reading of **9 (90%** AM) on the 0-10 scale of generator’s panel meter. The DVM should read 180 mVrms ± 8%. (Check that trace is peaked on analyzer display.)

165.6 ________ **194.4** mVrms

8. Set the test oscillator’s amplitude controls for the panel meter readings shown below. The DVM should read as specified. (After each reading, check that trace is peaked on-analyzer display.)

% AM	Panel Meter		Digital Voltmeter Reading
	Reading (Set)	Scale	
70%	7	0-10	128.8 ________ 151.2 mVrms
50%	5	0-10	92.0 ________ 108.0 mVrms
309%	either 3	0-10	**55.2** ________ **64.8** mVrms
	or 3	0-3	54.6 ________ 65.4 mVrms
20’%	2	0-3	36.4 ________ 43.6 mVrms
10%	1	0-3	18.2 ________ 21.8 mVrms

NOTE

30% *AM may be set on either the 0-10 scale or the 0-3 scale, depending upon whether 30% is approached from above or below.*

4-37. PEAK INCIDENTAL PHASE MODULATION TEST

SPECIFICATION:

Peak Incidental PM (at 30% AM):
Less than 0.15 radians, 0.5 to 128 MHz
Less than 0.3 radians, 128 to 512 MHz.

DESCRIPTION:

A vector voltmeter is used to compare the phase of the signal into the generator’s modulation amplifier with the phase of the same signal (modulated at a 0.1 Hz rate) at the RF OUT port. The signal is supplied by the generator’s own oscillator and divider circuits and has low incidental PM. (See Table 4-1. Recommended Test Abridgements.)

PERFORMANCE TESTS

4-37. PEAK INCIDENTAL PHASE MODULATION TEST

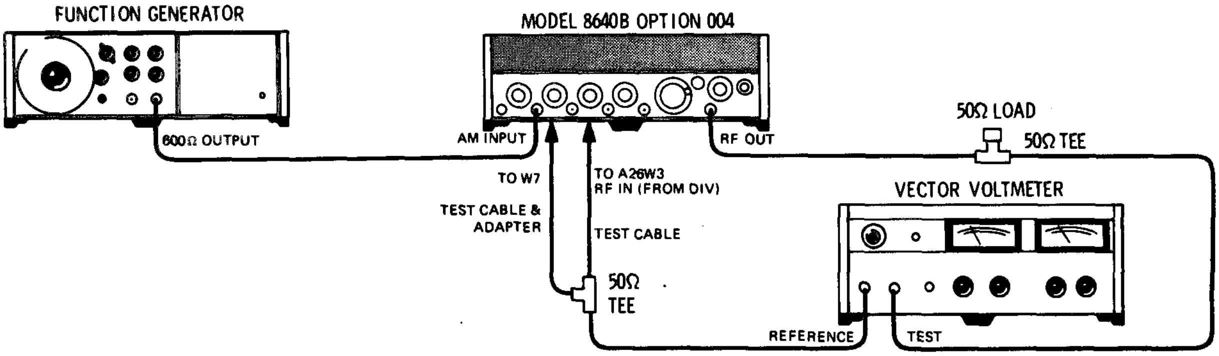


Figure 4-21. Peak Incidental Phase Modulation Test Setup

EQUIPMENT:

Function Generator . . . . HP 3300A
Vector Voltmeter . . . . HP 8405A
50 Ohm Tee(2 required) . . . . HP 11536A
50 Ohm Load HP11593A
Test Cable (2 required) . . . . HP 11592-60001
Adapter . . . . HP 1250-0827

WARNING

This test is performed with power suppliad to the instrument while protective covers are removed. Be careful when performing this test. Line voltage is always present on terminals including the power input connector, fuse holder, power switch, etc. In addition, when the instrument is on, . energy available at many points may result in personal injury or death when contacted.

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

PROCEDURE:

1. Disconnect instrument from the line power source. Remove bottom cover from Signal Generator. Using the wrench provided in the instrument remove semi-rigid coaxial cable W7 from jack A26W3 labeled RF IN (FROM DIV). Connect one test cable from the tee to A26W3; connect other test cable, with adapter, from the tee to W 7. Connect instrument to line power source. Allow one hour warm-up time before continuing with this test.

NOTE

See *Service Sheet H for component identification.*

PERFORMANCE TESTS

4-37. PEAK INCIDENTAL PHASE MODULATION TEST (Cont'd)

2.

Meter Function	AM
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	INT
AM	DC
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL Switches	-7 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

3. Set function generator for 1 kHz at approximately 500 mVrms and adjust Signal Generator's MODULATION control for 30% AM as read on Signal Generator's panel meter. Set function generator for 0.1 Hz. (Percent AM remains the same. The low rate is necessary for the vector voltmeter's metering circuitry.)

4. Set Signal Generator's AM switch to OFF. Set vector voltmeter's frequency range to 300-600 MHz. Zero the voltmeter's phase meter.

5. Set Signal Generator's AM switch to DC. The vector voltmeter's phase meter should indicate less than ±17.2° of deviation (maximum).

__________±17.2"

6. Set Signal Generator's RANGE to 64-128 MHz, FREQUENCY TUNE to 128 MHz and repeat steps 3 through 5 (except set vector voltmeter frequency range to 80-150 MHz). The voltmeter's phase meter should indicate less than ± 8.6° of deviation (maximum).

__________± 8.6°

7. Disconnect instrument from the line power source. Remove test cables, reconnect cable W7 to jack A26W3, and replace bottom cover. Connect instrument to line power source. Allow one hour warm-up time before continuing with this or other test.

8. Check Signal Generator for correct RF output on each frequency range.

WARNING

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

PERFORMANCE TESTS

4-38. DEMODULATED OUTPUT ACCURACY TEST

SPECIFICATION:

Demodulated Output, OUTPUT LEVEL Vernier in CAL position.
(108 to 118 MHz and 329 to 335 MHz carrier and between 20 and 80% AM)

An internal selector switch allows selection of ac only or ac and dc at the demodulated output.

AC only output: Directly proportional to AM depth (90 to 150 Hz modulation rate):
% AM equals:

(20 ± 0.6)% per Vrms, 0 to 55° C
(20 ± 0.4) % per Vrms, 20 to 30°C
(20 ± 0,2) % per Vrms, 20 to 30°C (using DEMOD CAL Label provided by factory).

AC and DC output: AC output voltage is directly proportional to AM depth (90 to 150 Hz modulation rate):
% AM equals:

(100 ± 3) ‘% per Vrms, 0 to 55° C
(100 ± 2)% per Vrms, 20 to 30°C
(100 ± 1)% per Vrms, 20 to 30°C (using DEMOD CAL Label provided by factory).

DC output equals 1.414 ±0.010 Vdc with vernier in CAL position.

DESCRIPTION:

The Signal Generator is amplitude modulated, and the modulation is demodulated by a peak detector in a spectrum analyzer set to a zero-frequency span (scan width). The ac and dc components are measured with a voltmeter at the detector output (vertical output) of the spectrum analyzer. First, the dc component is set to -282.8 mVdc plus a detector offset correction. Then, the ac component is measured and percent AM calculated at 1/2 the ac component read in mVrms. Percent AM is then compared with the ac voltage of the demodulator output.

Because of the required measurement accuracy, the accuracy of the spectrum analyzer’s detector offset must be known to ± 1 mV. The offset voltage is calculated by measuring the change in the detector output for a change in RF input and assuming a linear detector over the range of levels used.

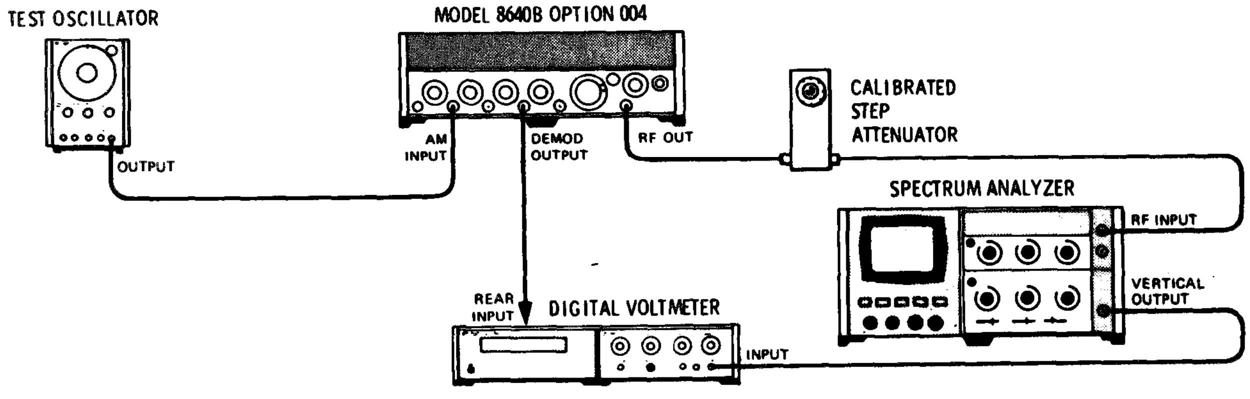


Figure 4-22. Demodulated Output Accuracy Test Setup

4-38. DEMODULATED OUTPUT ACCURACY TEST (Cent'd)

EQUIPMENT:

Digital Voltmeter . . . . HP 3480D/3484A Option 043
Spectrum Analyzer . . . . HP 141T/8554B/8552B
Test Oscillator . . . . HP 204D
10 dB Step Attenuator . . . . HP 355D Option H36

PROCEDURE :

1. Connect the equipment as shown in Figure 4-22, after setting the Signal Generator controls as follows:

Meter Function . . . . AM
COUNTER MODE: EXPAND . : : : . . . . Off
LOCK . . . . Off
Source . . . . , ...INT
AM . . . . OFF
Modulation . . . . , ... Fully cw
FM . . . . OFF
RANGE . . . . 2-4 MHz
FREQUENCY TUNE..... . . . . 3 MHz
OUTPUT LEVEL Switches . . . . -13 dBm
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . .ON

2. Let the equipment warm up for two hours to minimize drift of the spectrum analyzer detector output.

3. Set the calibrated step attenuator to 10 dB.

4. Set the spectrum analyzer center frequency to 3 MHz, frequency span to 200 kHz per division, resolution bandwidth to 300 kHz, input attenuation to 20 dB, and vertical scale to linear. Set the frequency span to zero, and tune the spectrum analyzer to peak the trace.

NOTE

Throughout this test, check that the signal is peaked in the center of the analyzer's passband.

5. Set the digital voltmeter to read mVdc with maximum filtering. Adjust the spectrum analyzer's vertical sensitivity for a digital voltmeter reading of -200.0 mVdc.

6. Set the calibrated step attenuator to 0 dB and note the digital voltmeter reading.

Digital Voltmeter reading —__________________mVdc

7. Set the calibrated step attenuator to 20 dB and note the digital voltmeter reading.

Digital Voltmeter reading –__________________mVdc

4-38. DEMODULATED OUTPUT ACCURACY TEST (Cent'd)

8. Perform steps a, b, and c to obtain a value of offset voltage to be used in step 12.

   a. For steps 6 and 7 derive values of a, expressed as a ratio, from the formula:

   a = 10A

   $$\text{where } A = \frac{\text{Attenuation (dB)}}{20}$$

   and where Attenuation is the attenuation of step 3 minus that of step 6 or step 7. (Attenuation figures should be obtained from the step attenuator's calibration chart which is accurate to ± 0.02 dB at 3 MHz.)

   [e.g., a ≈ **3.16** (+10 dB) for step 6 and a ≈ **0.316** (-10 dB) for step 7.]

   a (Step 6) ______________

   a (step 7) ______________

   b. For steps 6 and 7 derive values of offset voltage (Voff) from the formula:

   $$\text{Voff} = \frac{\text{mVdc} + 200a}{1 - a}$$

   where mVdc is the digital voltmeter reading of step 6 or 7, and where a is the value derived in step 8a.

   Voff (step 6) ______________

   Voff (step 7) ______________

   c. Calculate the average of the two values of offset voltage and use this Voff in step 12 (the difference between the two values of offset voltage should be <2 mVdc).

   Voff

9. Set the Signal Generator RANGE to 64-128 MHz and FREQUENCY TUNE to 113 MHz. Set the calibrated step attenuator to 10 dB.

10. Set the spectrum analyzer to display the 113 MHz signal with zero frequency span and peak the trace.

11. Set AM to DC. Set the test oscillator frequency to 120 Hz and adjust the level to give approximately 20% AM as read on the Signal Generator panel meter.

12. Adjust spectrum analyzer's vertical sensitivity to give digital voltmeter reading of –282.8 mV + Voff (e.g., if Voff from step 8c is +50.0 mV, adjust the spectrum analyzer to give a digital voltmeter reading of —232.8 mVdc.)

PERFORMANCE TESTS

4-38. DEMODULATED OUTPUT ACCURACY TEST (Cont'd)

If AC/DC switch, A26A8S1, is set to AC:

13. Set the digital voltmeter to read mVrms and adjust the test oscillator level to give the readings listed below. For each setting, switch the digital voltmeter to read the ac DEMOD OUTPUT voltage which should read within the specified limits.

NOTE

AM distortion must be <1% for this test to be valid.

Digital Voltmeter mVrms	AM Depth	DEMOD OUTPUT Voltage, mVrms		
		0-55° C	20-30° c	20-30° c Using DEMOD CAL Label
40.00	20%	970 ____ 1030	980 ____ 1020	±l%
60.00	30%	1455 ____ 1545	1470 ____ 1530	of
80.00	40%	1940 ____ 2060	1960 ____ 2040	value
100.0	509%	2425 ____ 2575	2450 ____ 2550	on
120.0	60%	2910 ____ 3090	2940 ____ 3060	DEMOD CAL
140.0	70%	3395 ____ 3605	3430 ____ 3570	Label X 5
160.0	80'%	3880 ____ 4120	3920 ____ 4080	

If AC/DC switch, A26A8S1, is set to DC:

14. Repeat step 13. The DEMOD OUTPUT voltage should "be within the limits specified in the following table.

Digital Voltmeter mVrms	AM Depth	DEMOD OUTPUT Voltage, mVrms		
		0-55°C	20-30° c	20-30° c Using DEMOD CAL Label
40.00	20%	194 ____ 206	196 ____ 204	±l%
60.00	30%	291 ____ 309	294 ____ 306	of
80.00	409%	388 ____ 412	392 ____ 408	value
100.0	50%	485 ____ 515	490 ____ 510	on
120.0	60%	582 ____ 618	588 ____ 612	DEMOD CAL
140.0	70%	679 ____ 721	686 ____ 714	Label
160.0	80%	776 ____ 824	784 ____ 816	

PERFORMANCE TESTS

4-38. DEMODULATED OUTPUT ACCURACY TEST (Cont'd)

15. Set the Signal Generator RANGE to 256-512 MHz, FREQUENCY TUNE TO 333 MHz.

If AC/DC switch A26A8S1, is set to AC, repeat steps 10 to 13 for 333 MHz.
If AC/DC switch A26A8S1, is set to DC, repeat steps 10 to 12, and step 14 for 333 MHz.

4-39. AM PHASE SHIFT TEST

SPECIFICATION:

Phase shift from Audio Input to Demodulated Output: (108 to 118 MHz, AM source selector set to DC).
30 Hz: <±-0.01°
30 **HZ** to 10 kHz: <±3°
9 kHz to 11 kHz: <± 1° (difference from 9 to 11 kHz).

DESCRIPTION:

The X and Y axes of an oscilloscope are driven respectively by the audio input and demodulated output. The phase difference of the two signals is noted from the resulting Lissajous pattern. The measurement for 30 Hz is made indirectly by measuring the phase shift at 10,000 Hz and 1000 Hz. If the phase shift at 1000 Hz is 1/10 the phase shift, at 10,000 Hz, the phase can be assumed to vary linearly with frequency (i.e., a single-pole response) and the phase shift at 30 Hz equals 0.03 the phase shift at 1000 Hz. (See Table 4-1. Recommended Test Abridgements.)

NOTE

For a single-pole frequency response phase $\phi = \tan^{-1} f/fo$ where fo is the cutoff frequency. Since $f << fo$ for our application, $\phi \approx f/fo$.

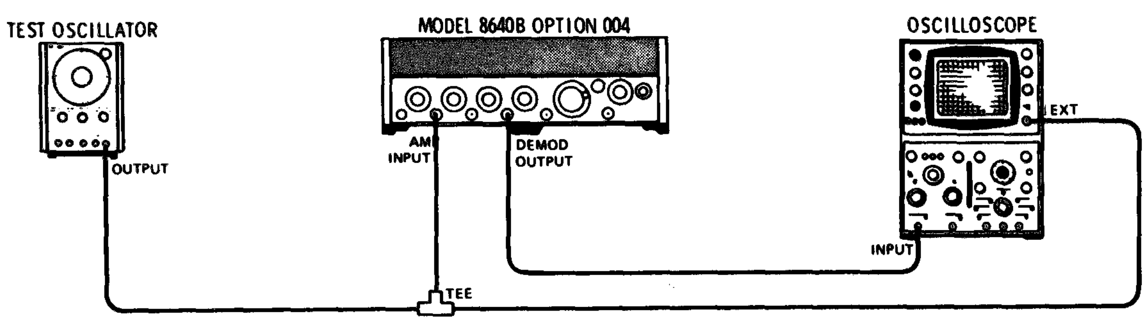


Figure 4-23. AM Phase Shift Test Setup

EQUIPMENT:

Oscilloscope	HP 180A/1801A/1820C
Test Oscillator	HP 204D

4-39. AM PHASE SHIFT TEST (Cont'd)

1. Connect the equipment as shown in Figure 4-23 after setting the Signal Generator's controls as follows:

Meter Function	AM
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	INT
AM	DC
MODULATION	Fully ccw
FM	OFF
RANGE	64-128 MHz
FREQUENCY TUNE	113 MHz
OUTPUT LEVEL Switches	0 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. The internal AC/DC switch should be set to AC (i.e., ˜ 0 Vdc at DEMOD OUTPUT), if not disconnect the instrument from the line power source. Remove generator's top cover and the top cover from the A26 casting. Set the switch to AC. Replace covers and connect instrument to line power source. Allow one hour warm-up time before continuing with this test.

WARNING

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

3. Set the test oscillator output to approximately 2.5 Vrms at 10 kHz and adjust MODULATION for a meter indication of 607. AM.

4. Set the oscilloscope's horizontal axis to sweep from an external input, dc coupled with no magnification. Set the vertical input to dc. Adjust the vertical and horizontal sensitivity y to form a Lissajous pattern which fills the display as shown in Figure 4-24.

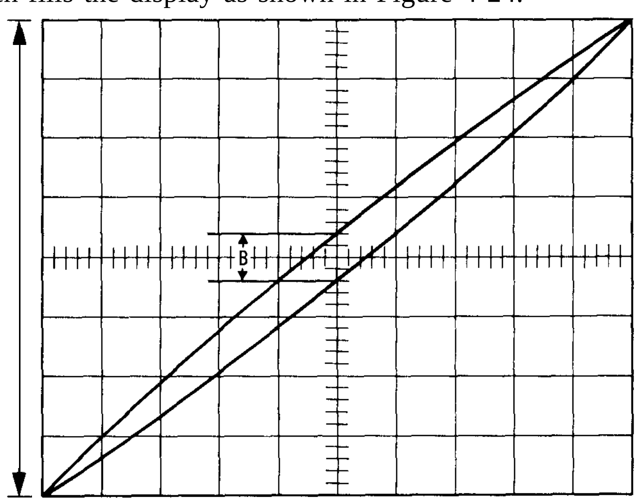


Figure 4-24. Lissajous Display

4-39. AM PHASE SHIFT TEST (Cont'd)

5. To increase the reading sensitivity, set the horizontal magnifier to X10 and increase the vertical sensitivity by a factor of 10.

6. The phase shift is equal to $\sin^{-1}$ B/A= sin-l B/80 (A is 8 divisions multiplied by 10). The Y-axis crossings of the Lissajous pattern should have a separation (B) of less than 4.2 major divisions (less than 3°).

____________________4.2 divisions

7. Set the test oscillator frequency to 1000 Hz. Increase the oscilloscope's vertical sensitivity by a factor of 10. The Y-axis crossings of the Lussajous pattern should have a separation (B) approximately equal to that of step 5 and be less than 4.2 major divisions (less than 0.3°).

____________________4.2 divisions

8. Set the test oscillator frequency to 9 kHz. Decrease the oscilloscope's vertical sensitivity by a factor of 10. Note the separation (B) of the Y-axis crossing of the Lissajous pattern.

9. Set the test oscillator frequency to 11 kHz. The separation (B) of the Y-axis crossings of the Lissajous pattern should be within 2.8 divisions of that in step 7 (less than 2° difference).

____________________2.8 divisions

10. If the Signal Generator is used with an external VOR/ILS audio generator requiring DEMOD OUTPUT, 0-1 Vrms, reverse the procedure in step 2 to return the AC/DC switch to DC.

4-40. AM FLATNESS TEST

SPECIFICATION:

Frequency Response:

±0.05 dB from 90 Hz to 150 Hz (108 to 118 MHz and 329 to 335 MHz)
±0.05 dB from 9 kHz to 11 kHz (108 to 118 MHz)

DESCRIPTION:

The Signal Generator is amplitude modulated and the modulation is demodulated by a peak detector in a spectrum analyzer set to a zero-frequency span (scan width). The demodulated AM is measured with a digital voltmeter as the frequency of modulation is varied from 90 to 150 Hz, and 9 to 11 kHz.

4-40. AM FLATNESS TEST (Cent'd)

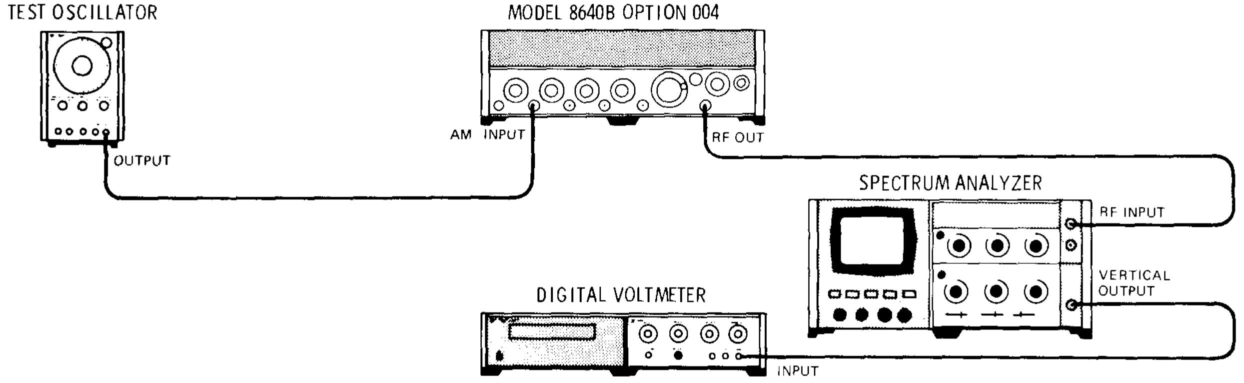


Figure 4-25. AM Flatness Test Setup

EQUIPMENT :

Spectrum Analyzer . . . . HP 141T/8554B/8552B
Test Oscillator . . . . HP 204D
Digital Voltmeter . . . . HP 3480D/3484A Option 043

PROCEDURE:

1. Connect equipment as shown in Figure 4-25 after setting Signal Generator's controls as follows:

Meter Function		AM
COUNTER	MODE: EXPAND : : : : : : : : : : : :	off
	LOCK	Off
	Source	.INT
AM		OFF
MODULATION : : : : : : : : : : : : : : :		Fully ccw
FM		. OFF
RANGE.		64-128 MHz
FREQUENCY TUNE.....		113 MHz
OUTPUT LEVEL Switches		-30 dBm
OUTPUT LEVEL Vernier		CAL
RF ON/OFF . . . . '		..ON

2. Set spectrum analyzer's center frequency to 113 MHz, resolution bandwidth to 300 kHz, input attenuation to 0 dB, and vertical scale to linear. Set frequency span to zero and tune spectrum analyzer to peak the trace on the CRT.

NOTE

Display Smoothing (video filter) must be off.

3. Set test oscillator output level to approximately 0.5 Vrms at 90 Hz. Set Signal Generator's AM control to DC and adjust MODULATION control to give 50% AM as read on the panel meter.

PERFORMANCE TESTS

4-40. AM FLATNESS TEST (Cont'd)

4. Adjust spectrum analyzer vertical sensitivity to give a digital voltmeter reading of 200 mVrms.

5. Slowly increase test oscillator frequency to 150 Hz and note maximum amplitude variation on digital voltmeter. Maximum variation should be less than 1.2 mV (0.05 dB).

198.8 ________ 201.2

6. Set Signal Generator frequency to 332 MHz and repeat steps 2 to 5.

7. Set Signal Generator frequency to 113 MHz and repeat steps 2 to 5 except vary test oscillator frequency from 9 to 11 kHz.

4-41 . PULSE MODULATION TEST

SPECIFICATION:

Pulse Modulation:

Frequency Bands (MHz]	0.5-1	1-2	2-8	8-32	32-512
Rise and Fall Times	<9 µs	<4µs	<2 µs	<1 µs	
Pulse Repetition Rate	50 Hz to 50 kHz		50 Hz to 100 kHz	50 Hz to 250 kHz	50 Hz to 500 kHz
Pulse width Minimum for Level Accuracy within 1 dB of cw (>0.1% duty cycle)	10 µs		5 µs	2 µs	

DESCRIPTION:

A pulse generator is used to pulse modulate the Signal Generator. The RF pulse output is detected and displayed and measured on an oscilloscope. For RF outputs above 32 MHz, a reference signal generator and a mixer are used to down-convert the signal to within the range of the oscilloscope.

NOTE

If a high frequency oscilloscope is available, such as "the HP 183C/1830A/1840A, the above measurement may be made directly to frequencies slightly beyond the oscilloscope's nominal bandwidth. Use the oscilloscope's 50Ω input. (See Table 4-1. Recommended Test Abridgements.)

4-41. PULSE MODULATION TEST (Cont'd)

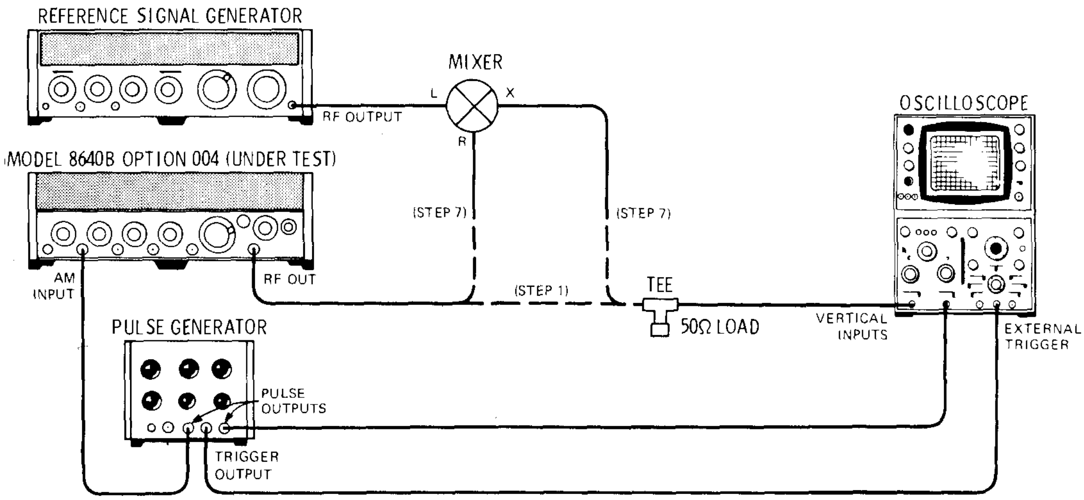


Figure 4-26, Pulse Modulation Test Setup

EQUIPMENT :

Reference Signal Generator	HP 8640A
Mixer . . . . , ...	.HP 10514A
50 Ohm Load	.HP 11593A
Pulse Generator	HP 8003A
Oscilloscope	HP 180A/1801A/1820C

NOTE

The reference signal generator should have a frequency range of 20-500 MHz with an output of +7 dBm.

PROCEDURE:

1. Connect equipment as shown in Figure 4-26, with oscilloscope connected directly to test generator's RF OUT, after setting test Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND : : : : : : : : : : : .	off
LOCK	off
Source	INT
AM	PULSE
FM	OFF
RANGE.	0.5-1 MHz
FREQUENCY TUNE	1 MHz
OUTPUT LEVEL Switches	-17 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

PERFORMANCE TESTS

4-41. PULSE MODULATION TEST (Control)

2. **Set** pulse generator for a repetition rate of 100 Hz, a pulse width of 10, and an amplitude of 1v.

3. Adjust oscilloscope to display the RF pulse envelope. Readjust the pulse width for 10 µs (measured at 50?% amplitude points) and measure the rise and fall times (see Figure 4-27). Both should be less than 9 µs (measured between 10'% and 90% of the full pulse amplitude).

Rise Time: ________ 9 µs

Fall Time: ________ 9 µs

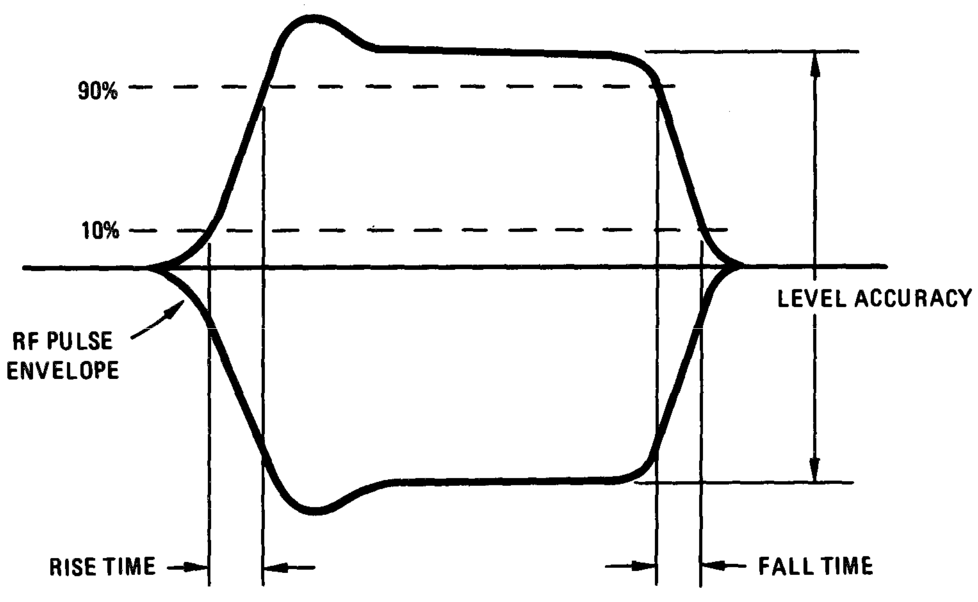


Figure 4-27. Pulse Measurements

4. Set test Signal Generator's AM switch to OFF and adjust oscilloscope's vertical controls for 6 divisions of deflection on the display (peak-to-peak).

5. Set test Signal Generator's AM switch to PULSE. Pulse amplitude (peak-to-peak) on oscilloscope's display should be 5.4 to 6.7 divisions.

Level Accuracy 5.4 ________ 6.7 div

6. Repeat steps 1 through *5* for the frequency ranges shown below. The rise and fall times and level accuracy should be as specified.

4-41. PULSE MODULATION TEST (Cont'd)

Signal Generator Frequency RANGE	Pulse Generator		Rise Time	Fall Time	Level Accuracy
	Pulse Rate	Pulse Width			
1 - 2 MHz	100 Hz	10 μs	______<4 μs	______<4 μs	5.4______6.7 div
2 - 4 MHz	200 Hz	5 μs	______<2 μs	______<2 μs	5.4______6.7 div
4 - 8 MHz	200 Hz	5 μs	______<2 μs	______<2 μs	5.4______6.7 div
8 - 16 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div
16 - 32 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div

7. Connect test generator to mixer and mixer to oscilloscope (across 50 ohm load).

8. Repeat steps 2 through 5 for the frequency ranges shown below. At each frequency range, set the puke generator as specified, and set the reference signal generator for an output frequency 10 MHz below the output frequency of the test generator. The reference generator's output should be at +7 dBm with no modulation.

Signal Generator Frequency RANGE	Pulse Generator		Rise Time	Fall Time	Level Accuracy
	Pulse Rate	Pulse Width			
32 - 64 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div
64 - 128 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div
128 - 256 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div
256 - 512 MHz	500 Hz	2 μs	______<1 μs	______<1 μs	5.4______6.7 div

PERFORMANCE TESTS

4-42. PULSE ON/OF RATIO TEST

SPECIFICATION:

Pulse ON/OFF ratio: >40 dB.

DESCRIPTION:

The on/off ratio of the pulse modulation circuits is measured with a spectrum analyzer. (See Table 4-1. Recommended Test Abridgements.)

EQUIPMENT:

Spectrum Analyzer . . . . HP 141T/8552B/8554B

PROCEDURE:

1. Connect generator's RF OUT to analyzer's input after setting Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND " : : : : : : : : : : : : .	Off
LOCK	Off
Source	..INT
AM	OFF
FM	OFF
RANGE.	256-512 MHz
FREQUENCY TUNE	512 MHz
OUTPUT LEVEL Switches . . . . , ...	—7 dBm
OUTPUT LEVEL Vernier	. CAL
RF ON/OFF.	.ON

2. Set spectrum analyzer's input attenuation to 20 dB. Adjust center frequency controls to center the 512 MHz signal on the display. Adjust scale reference level controls to set the signal to the top (O dB) graticule line with the scale controls set to display 10 dB per division.

3. Set generator's AM switch to PULSE and tune across band. The signal on the analyzer's display should decrease and remain more than 40 dB below the reference.

256-512 MHz: 40 dB

4. Repeat steps 1 through 3 with the RANGE switch set to each of its other positions. At each position, the signal on the analyzer's display should decrease and remain more than 40 dB below the reference.

128-356 MHz: 40 dB ________
64-128 MHz: 40 dB ________
32-64 MHz: 40 dB ________
16-32 MHz: 40 dB ________
8-16 MHz: 40 dB ________
4-8 MHz: 40 dB ________
2-4 MHz: 40 dB ________
1-2 MHz: 40 dB ________
0.5-1 MHz: 40 dB ________

4-43. FM 3 dB BANDWIDTH TEST

SPECIFICATION:

FM 3 dB Bandwidth:
Internal and external ac; 20 Hz to 250 kHz.
External dc; dc to 250 kHz.

DESCRIPTION:

An audio spectrum analyzer is used to measure the 3 dB (rate) bandwidth. The analyzer is set to sweep over the specified audio frequency range and its tracking generator output is used to frequency modulate the Signal Generator. The generator's RF output is demodulated with an FM discriminator. The demodulated signal is fed to the analyzer's input and any amplitude variation is measured on the analyzer's display. Bandwidth is checked at maximum deviation on the 8-16 MHz band. (See Table 4-1. Recommended Test Abridgements.)

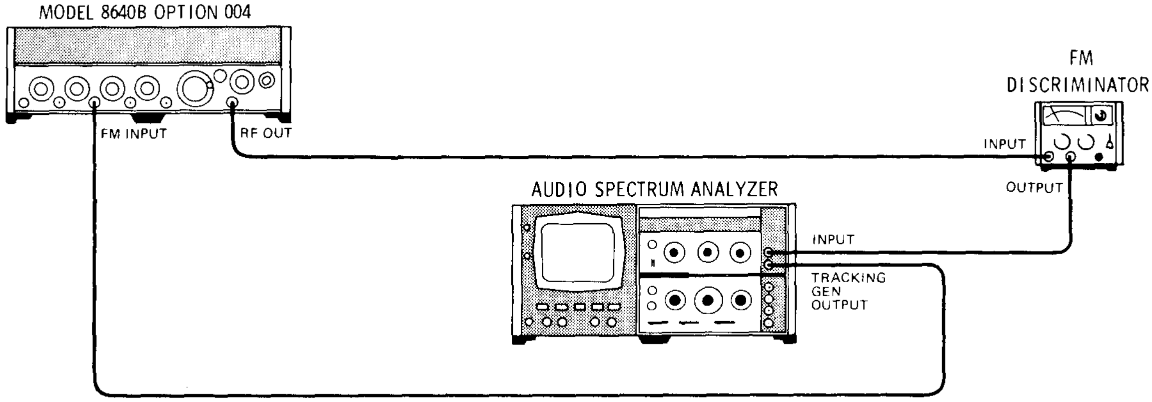


Figure 4-28. FM 3 dB Bandwidth Test Setup

EQUIPMENT:

Audio Spectrum Analyzer . . . . HP 141T/8552B/8556A
FM Discriminator . . . . HP 5210A
Filter Kit (For Discriminator) . . . . HP 10531A

PROCEDURE:

1. Connect equipment as shown in Figure 4-28 after setting Signal Generator's controls as follows:

Meter Function . .	FM
COUNTER MODE: EXPAND : : : : : : : : : : . .	off
LOCK	off
Source	INT
AM	OFF
FM . .	OFF
PEAK DEVIATION.	80 kHz
PEAK DEVIATION Vernier . . . . , ...	Fully **CW**
RANGE	8-16 MHz
FREQUENCY TUNE" : : : : : : : : : : : : : : :	8 MHz
OUTPUT LEVEL Switches	+13 dBm
OUTPUT LEVEL Vernier . .	CAL
RF ON/OFF.....	ON

PERFORMANCE TESTS

4-43. FM 3 dB BANDWIDTH TEST (Cont'd)

2. Prepare a 1 MHz Butterworth low-pass filter and install it in the discriminator. Set discriminator's range to 10 MHz and input sensitivity y to 1 V.

3. Set Signal Generator's FM switch to AC. Set spectrum analyzer's resolution bandwidth to 3 kHz and its center frequency controls to 1 kHz (with no sweep). Set analyzer's tracking generator output level for 80 kHz peak deviation and read on generator's panel meter. Set the analyzer's frequency controls for a O to 250 kHz sweep. Set the analyzer's display for 2 dB per division; adjust the display reference level controls to display the demodulated sweep.

4. Measure the sweep on the analyzer's display. Total amplitude variation from 20 Hz to 250 kHz should be <3 dB.l

__________3 dB

NOTE

If the FM discriminator's incidental AM rejection is insufficient, the generator could appear to be out of specification. To check the discriminator, note analyzer's reading (in dBm), set generator's AM switch to AC and connect analyzer's tracking generator output to AM INPUT. Set MODULATION for 10% as read on panel meter. The analyzer should read >30 dB below the reading noted above. If it does not, adjust discriminator sensitivity and trigger level (or generator's OUTPUT LEVEL controls) until it does. Then repeat steps 2 through 4.

4=44. FM DISTORTION TEST

SPECIFICATION:

FM Distortion: (at 400 Hz and 1 kHz rates)
<1% for deviations up to 1/8 maximum allowable.
<3% for maximum allowable deviation.

DESCRIPTION:

The Signal Generator is modulated with a 1 kHz signal. The generator's RF output is then demodulated with an FM discriminator and the distortion on the discriminator output is measured with a spectrum analyzer.

4-44. **FM DISTORTION TEST (Cont'd)**

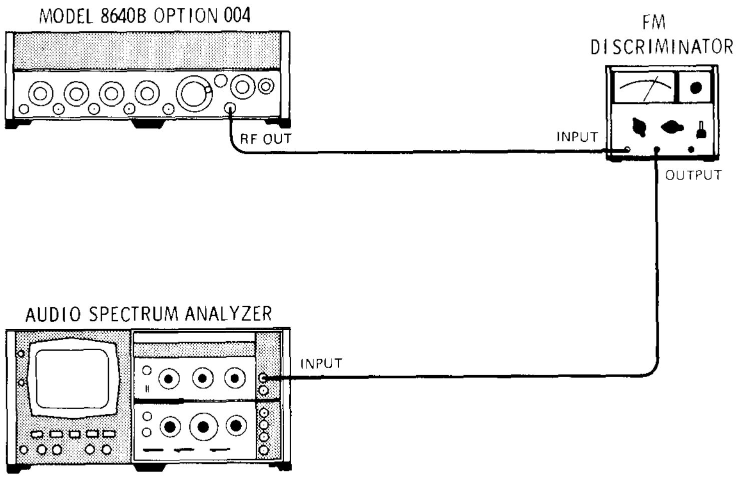


Figure 4-29. FM Distortion Test Setup

EQUIPMENT:

FM Discriminator . . . . , ...	HP 5210A
Filter Kit (For Discriminator)	HP 10531A
Audio Spectrum Analyzer . . . . . . , . . .	HP 141T/8552B/8556A

PROCEDURE:

1. Connect equipment as shown in Figure 4-29 after setting Signal Generator's controls as follows:

Meter Function	FM
COUNTER MODE: EXPAND " : : : : : : : : : : : : :	Off
LOCK	Off
Source	.INT
AM	OFF
MODULATION FREQUENCY " : : : : : : : : :	1 kHz (Fixed)
FM	INT
PEAK DEVIATION	80 kHz
PEAK DEVIATION Vernier	Fully CW
RANGE	8-16 MHz
FREQUENCY TUNE	8 MHz
OUTPUT LEVEL Switches	+13 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Using the filter kit, prepare a 1 MHz Butterworth low-pass filter and install it in the discriminator.

3. Set discriminator's range to 10 MHz and sensitivity to lV.

4. Set spectrum analyzer's resolution bandwidth to 100 Hz and its center frequency controls to a 0 to 5 kHz span. Set the display for 10 dB per division.

4-44. FM DISTORTION TEST (Cont'd)

5. Use generator's PEAK DEVIATION vernier to set 80 kHz of peak deviation (as read on panel meter). Use analyzer's display reference level controls to set the demodulated 1 kHz signal to the top (reference) graticule line on the display.

6. Note the level of the 1 kHz signal's harmonics (2 kHz, **3** kHz, etc.). For less than **3%** distortion, they should be more than 30.5 dB below the reference graticule line.

Maximum Deviation: 30.5 dB________

7. Set generator's PEAK DEVIATION switch to 10 kHz. If necessary, use generator's PEAK DEVIATION vernier to set 10 kHz of peak deviation; use analyzer's display reference level controls to set the demodulated 1 kHz signal to the reference graticule line.

8. For less than 1% distortion, the 1 kHz signal's harmonics should be more than 40 dB below the reference graticule line.

1/8 Maximum Deviation: 40 dB________

4-45. FM SENSITIVITY AND ACCURACY TEST

SPECIFICATION:

Externall FM Sensitivity: 1 volt peak yields maximum deviation indicated on PEAK DEVIATION switch with FM vernier at full cw position.

External FM Sensitivity Accuracy: ±6% from 15 to 35° C for FM excluding maximum peak deviation position. Maximum peak deviation position, ±9% typically.

Indicated FM Accuracy: (400 Hz and 1 kHz rates using internal meter) ± 10% of meter reading (for greater than 10% of full scale).

DESCRIPTION:

The Signal Generator's FM sensitivity is checked using the carrier (Bessel) null technique. An externally applied 1 Vpk signal is used to FM the generator. The modulation signal's frequency is adjusted for the first order null of the carrier and the frequency is measured to find peak deviation, (For the first order null of the carrier, peak deviation equals 2.405 times the modulation rate.) The panel meter accuracy is found by comparing its reading to the given peak deviation. The reference generator and mixer convert the signal into the range of the spectrym analyzer. (See Table 4-1. Recommended Test Abridgements.)

PERFORMANCE TESTS

4-45. FM SENSITIVITY AND ACCURACY TEST (Control)

NOTE

The ambient temperature must be within 15 to 35° C for this test.

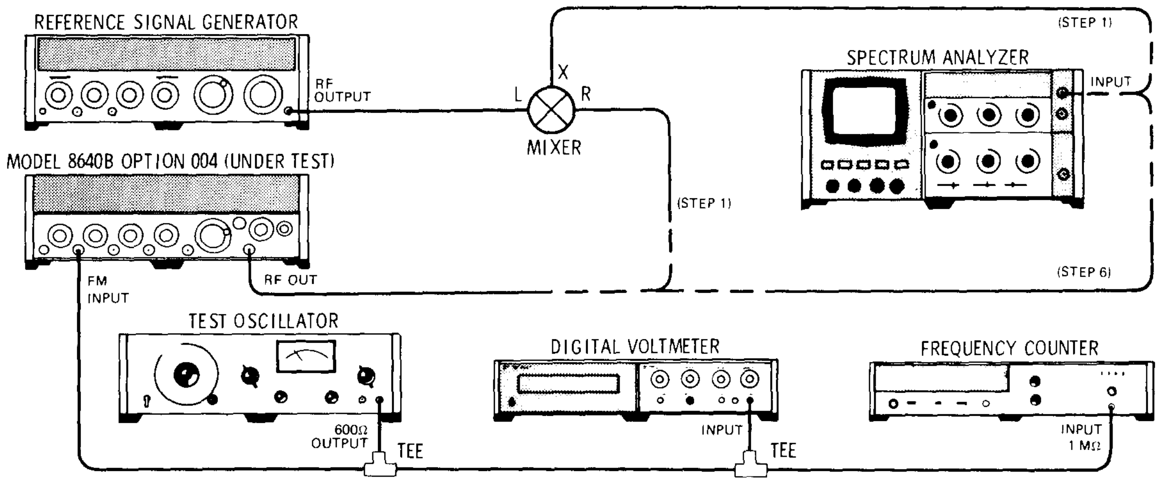


Figure 4-30. FM Sensitivity and Accuracy Test Setup

EQUIPMENT:

Test Oscillator . . . . HP 652A
Digital Voltmeter . . . . HP 3480D/3484A Option 043
Frequency Counter . . . . HP 5327C
Spectrum Analyzer . . . . HP 141T/8552B/8553B
Reference Signal Generator . . . . HP 8640A
Mixer . . . . .HP 10514A

NOTE

The reference signal generator should have frequency drift and residual FM specifications equivalent to the HP Model 8640A.

PROCEDURE:

1. Connect equipment as shown in Figure 4-30 (with test Signal Generator connected to mixer, and mixer connected to analyzer) after setting test generator's controls as follows:

Meter Function . FM
COUNTER MODE : EXPAND.. . . . . off
LOCK . . . . off
Source . . . .INT

4-45. FM SENSITIVITY AND ACCURACY TEST (Cont'd)

AM . . . . OFF
FM . . . . OFF
PEAK DEVIATION . . . . 5 kHz
PEAK DEVIATION Vernier . . . . Fully CW
RANGE . . . . 256-512 MHz
FREQUENCY TUNE . . . . 512 MHz
OUTPUT LEVEL Switches . . . . –7 dBm
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . . ON

2. Set reference signal generator for a 513 MHz, CW signal at +13 dBm.

3. Set spectrum analyzer's center frequency controls to 1 MHz, input attenuation to 20 dB, resolution bandwidth to 0.1 kHz, span width per division (scan width) to 1 kHz, and set display to 10 dB per division. Set reference level controls to put peak of the signal at top (log reference) graticule line on the display.

4. To check external sensitivity, set test oscillator for a 0.7071 Vrrns signal (read on DVM) at approximately 2.079 kHz. Set test generator's FM switch to AC and fine tune test oscillator's frequency for the first carrier null on analyzer's display (at least 50 dB below the top graticule line). With the frequency counter, measure frequency of modulating signal. It should be 2.079 kHz ± 6% (i.e., 5 kHz ±6% peak deviation).

1.954 __________ 2.204 kHz

5. Use the procedures given above to check the remaining bands by setting the test Signal Generator's RANGE switch as shown below. As shown in steps 1 through 4, on each range set FM to OFF and tune the generators for a 1 MHz difference. Set the reference on the analyzer, set FM to AC (with a 0.7071 Vrms modulating signal at approximately 2.079 kHz) and tune the modulating signal's frequency for the first carrier-null. The signal's frequency should be as shown.

RANGE (MHz)	FREQUENCY TUNE	Reference Generator Frequency	Mod. Signal Frequency (kHz)
128-256	**256 MHz**	**257 MHz**	**1.954 __________ 2.204**
64-128	**128 MHz**	**129 MHz**	**1.954 __________ 2.204**
32-64	**64 MHz**	**65 MHz**	**1.954 __________ 2.204**
16-32	**32** MHz	**33** MHz	1.954 __________ 2.204
8-16	16 MHz	17 MHz	1.954 __________ 2.204
4-8	8 MHz	9 MHz	1.954 __________ 2.204
2-4	4 MHz	5 MHz	1.954 __________ 2.204
1-2	2 MHz	3 MHz	1.954 __________ 2.204

4-45. FM SENSITIVITY AND ACCURACY TEST (Cont'd)

6. To check indicated accuracy, set test Signal Generator's RANGE control to 256-512 MHz and FREQUENCY TUNE to 500 MHz. Set reference signal generator for a 501 MHz, CW signal at +13 dBm. Set test generator's FM switch to OFF and tune both generators for a 1 MHz signal at the top graticule line on the analyzer's display.

7. Set test signal generator's FM switch to AC, set test oscillator's frequency for approximately 2.079 kHz, and adjust oscillator's amplitude controls for a reading of 5 (i.e., 5 kHz) on test generator's panel meter (0-5 scale). Tune oscillator's frequency for the first carrier null on the analyzer's display (at least 50 dB below the top graticule line). With frequency counter, measure frequency of modulating signal. It should be 2.079 kHz ± 10%.

1.871 ________ 2.287 kHz

8. Use procedures given in steps 6 and 7 to check indicated accuracy on the remaining bands by setting test generator's RANGE switch as shown below. On each range, set FM to OFF and tune generators for a 1 MHz difference. Set reference on analyzer, set FM to AC (with modulating signal's amplitude set for a test generator panel meter reading of 5 and its frequency set to approximately 2.079 kHz). Then tune modulating signal's frequency for first carrier null. The signal's frequency should be as shown.

RANGE (MHz)	FREQUENCY TUNE	Reference Generator Frequency	Mod. Signal Frequency (kHz)
128-256	256 MHz	257 MHz	1.871 ________ 2.287
64-128	128 MHz	129 MHz	1.871 ________ 2.287
32-64	64 MHz	65 MHz	1.871 ________ 2.287
16-32	32 MHz	33 MHz	1.871 ________ 2.287
8-16	16 MHz	17 MHz	1.871 ________ 2.287
4-8	8 MHz	9 MHz	1.871 ________ 2.287
2-4	4 MHz	5 MHz	1.871 ________ 2.287
1-2	2 MHz	3 MHz	1.871 ________ 2.287

9. Disconnect test Signal Generator and analyzer from mixer and connect test generator directly to analyzer. Set RANGE to 0.5-1 MHz, FREQUENCY TUNE to 1 MHz, FM to OFF, and reset reference on analyzer's display. Set FM to AC (with modulating signal's amplitude set for a test generator panel meter reading of 5 and its frequency set to approximately 2.079 kHz). Then tune the signal's frequency for the first carrier null. The signal's frequency should be 2.079 kHz ± 10%.

1.871 ________ 2.287 kHz

PERFORMANCE TESTS

4-46. INCIDENTAL AM TEST

SPECIFICATION :

Incidental AM: (at 400 Hz and 1 kHz rates)
 <0.5% AM for FM up to 1/8 maximum allowable deviation.
 <1% AM for FM at maximum allowable deviation.

DESCRIPTION:

An audio signal is used to amplitude modulate the Signal Generator. The resulting modulated RF is detected and used to calibrate an oscilloscope. The generator is then frequency modulated and any incidental AM is measured with the oscilloscope. (See Table 4-1. Recommended Test Abridgements.)

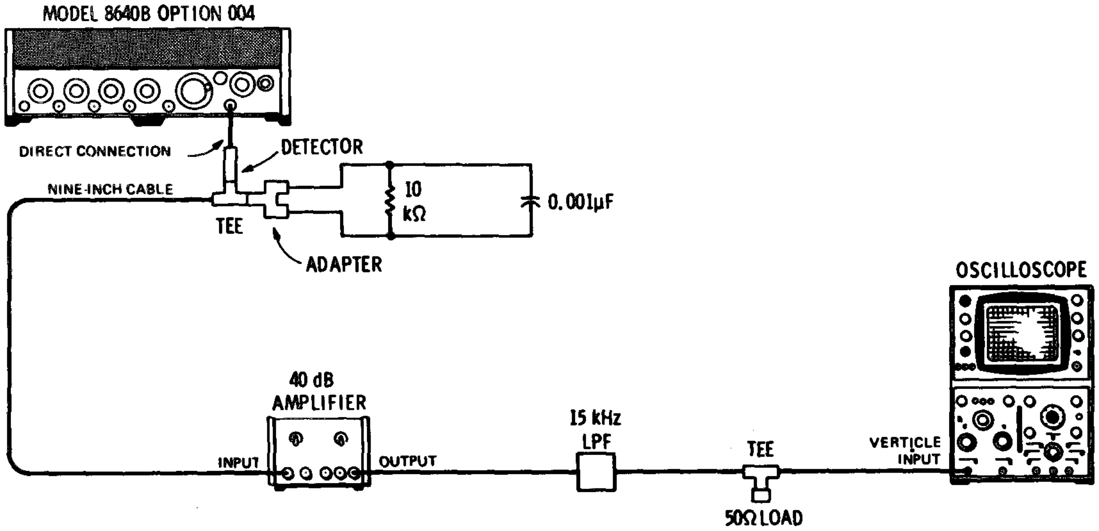


Figure 4-31. Incidental AM Test Setup

EQUIPMENT:

Crystal Detector	HP 423A
15 kHz Low-pass Filter (LPF)	CIR-Q-TEL 7 Pole
40 dB Amplifier	HP 465A
Oscilloscope	HP 180A/1801 A/1820C
50 Ohm Load	HP 11593A
Nine-Inch Cable	HP 10502A
Adapter	HP 1011OA
0.001 µF Capacitor	HP 0160-0153
10 kµ Resistor	HP 0757-0442

PERFORMANCE TESTS

4-46. INCIDENTAL AM TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-31 (with network, adapter, tee, and detector connected as shown) after setting Signal Generator's controls as follows:

Meter Function . . .	AM
COUNTER MODE: EXPAND " : : : : : : : : : : . . .	Off
LOCK	Off
Source	INT
AM . . .	INT
MODULATION	Fully ccw
MODULATION FREQUENCY	1 kHz
FM . . .	OFF
PEAK DEVIATION : : : : : : : : : : : : :	2.56 MHz
PEAK DEVIATION Vernier	Fully cw
RANGE	256-512 MHz
FREQUENCY TUNE" : : : : : : : : : : : : :	256 MHz
OUTPUT LEVEL Switches	+13 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set MODULATION for 10% AM as read on panel meter.

3. Adjust oscilloscope's vertical gain controls so that the 1 kHz signal has 8 divisions of peak to peak deflection (i.e., 1.25% AM per division).

4. Set generator's AM switch to OFF and FM switch to INT. Set Meter Function to FM and set PEAK DEVIATION vernier to 2.56 MHz. Increase oscilloscope sensitivity by 10. Using generator's FREQUENCY TUNE control, tune across the band and record the maximum incidental AM read on the oscilloscope. It should be less than 1% (8 divisions peak to peak on the display).

Maximum Deviation: ______________ 1%

5. Set PEAK DEVIATION switch to 320 kHz. Again, using the generator's FREQUENCY TUNE control, tune **across** the band. Incidental AM should be less than 0.5% (4 divisions peak to peak on the display).

1/8 Maximum Deviation: ______________ 0.5%

NOTE

Incidental AM is usually worse case on the 256-512 MHz band. If desired, it can be checked on any other band using this test except that on the 0.5 to 16 MHz bands the capacitor across the resistor at the detector's output must be changed to 0.033 μF (HP 0160-0163); on the 16 to 512 MHz bands, the 0.001 μF capacitor (shown in the test setup) must be used.

PERFORMANCE TESTS

4-47. COUNTER EXTERNAL SENSITIVITY TEST

SPECIFICATION:

External RF Input:
Frequency Range: 1 Hz to 550 MHz
Sensitivity: 100 mWrms, ac only, into 50$2 (- dBm).

DESCRIPTION:

A test oscillator and the Signal Generator's own RF output are used to verify the counter's range and sensitivity. (See Table 4-1. Recommended Test Abridgements.)

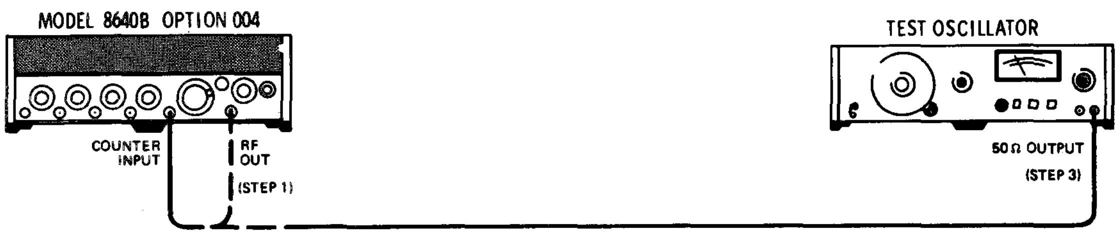


Figure **4-32.** ***Counter External Sensitivity Test Setup***

EQUIPMENT:

Test Oscillator . . . . HP 652A

PROCEDURE:

1. Connect RF OUT to COUNTER INPUT as shown in Figure 4-32 after setting Signal Generator's controls as follows:

Meter Function . .	LEVEL
COUNTER MODE: EXPAND.	off
LOCK	off
Source	INT
TIME BASE VERNIER	CAL
AM	OFF
FM	OFF
RANGE	256-512 MHz
FREQUENCY TUNE	550 MHz
OUTPUT LEVEL	100 mVOLTS
RF ON/OFF	ON

2. Set COUNTER MODE Source to EXT 0-550. Slowly tune Signal Generator to 0.5 MHz using RANGE and FREQUENCY TUNE. The counter should indicate the frequency of the signal at RF OUT at all frequencies.

0.5 to *550* MHz ____________ (√)

4-47. COUNTER EXTERNAL SENSITIVITY TEST (Cont'd)

3. Disconnect RF OUT from COUNTER INPUT. Connect the oscillator to COUNTER INPUT and set it for 500 kHz at 100 mVrms into 50 ohms. Slowly tune oscillator to 20 Hz. The counter should indicate the frequency of the signal from the test oscillator at all frequencies.

20 Hz to 500 kHz ________ (√)

4. Set COUNTER MODE Source to EXT 0-10 and slowly tune oscillator from 10 Hz to 10 MHz. The counter should indicate the frequency of the signal from the test oscillator at all frequencies.

20 Hz to 10 MHz ________ (√)

4-48. INTERNAL REFERENCE ACCURACY TEST

SPECIFICATION:

Accuracy: (after calibration at 25° C and 2-hour warm-up)
Better than ± 1 ppm for 15 to 35° C.
Better than ± 3 ppm for O to 55° C.

DESCRIPTION:

A frequency counter is used to measure the Signal Generator's counter accuracy. A temperature controlled chamber is used to set the temperature.

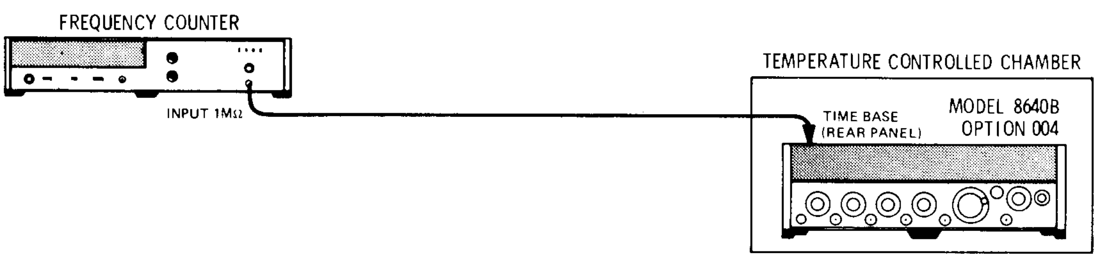


Figure 4-33. Internal Reference Accuracy Test Setup

EQUIPMENT:

Frequency Counter . . . . Hp 5327C Option H49
Temperature Controlled Chaamber . . . . , Statham Model 325

PROCEDURE :

1, Connect equipment as shown in Figure 4-33. Check that TIME BASE REF INT/EXT switch on the rear panel is set to INT.

PERFORMANCE ‘TESTS

4-48. INTERNAL REFERENCE ACCURACY TEST (Cont’d)

2. Set chamber for various temperatures between 15 and 35° C. At each temperature, allow generator to stabilize for two hours, then measure the frequency. It should be 5 MHz ±5 Hz.

4,999,995 ________ 5,000,005 Hz

3. Set the chamber for various temperatures between O and 55° C. Again, allow the generator to stabilize for two hours at each temperature and measure. the frequency. It should be 5 MHz ±15 Hz.

4,999,985 ________ 5,000,015 Hz

4-49. INTERNAL REFERENCE DRIFT RATE (STABILITY) TEST

SPECIFICATION:

Drift Rate: (after 2-hour warm-up)
Time: <0.05 ppm per h, <2 ppm per yr.
Temperature: <2 ppm total variation for room ambient 15 to 35° C.
Line Voltage: <0.1 ppm.

NOTE

Because the phase lock mode references the generator’s RF oscillator to the counter’s frequency reference, the following frequency specifications are also checked in this test.

Frequency Stability (phase lock mode):
Time: <0.05 ppm/hr.
Temperature: <2 ppm total variation (room ambient 15 to 35° C).
Line Voltage (+5% to –10% change): <0.1 ppm.
Load (with any passive load change): None measurable.
Level Change: None measurable.
Mode Change (CW to FM): None measurable.

DESCRIPTION:

After a two-hour warm-up period, the internal reference is measured with a frequency counter, a digital to analog converter, and a strip-chart recorder; frequency variations are noted as the specified changes are made. A quartz oscillator is used as a time standard when measuring drift as a function of time and line voltage change. (See Table 4-1. Recommended Test Abridgements.)

PERFORMANCE TESTS

4-49. INTERNAL REFERENCE DRIFT RATE (STABILITY) TEST (Cont'd)

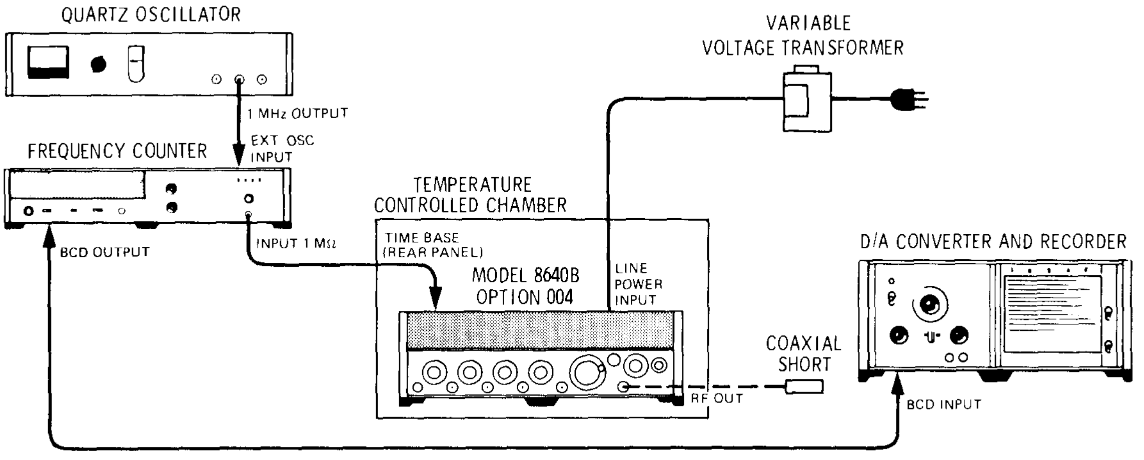


Figure 4-34. Internal Reference Drift Rate (Stability) Test Setup

EQUIPMENT:

Frequency Counter	HP 5327C Option 003
Temperature Controlled Chamber	Statham Model 325
Variable Voltage Transformer	GR W5MT3A
Coaxial Short (Type N Male)	HP 11512A
Quartz Oscillator	HP105B
Digital to Analog Converter	HP 581A Option 002
Recorder (for D/A Converter)	HP 680

PROCEDURE :

1. Connect equipment as shown in Figure 4-34 after setting Signal Generator's controls as follows:

TIME BASE REF INT/EXT (on rear panel	INT
COUNTER MODE: LOCK	Off
AM	OFF
FM	OFF
PEAK DEVITION	5 kHz
PEAK DEVIATION Vernier	Fully **CW**
RANGE	0.5-1 MHz
OUTPUT LEVEL Switches	+16 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set variable voltage transformer to nominal voltage set on generator's line power module (i.e., 100, 120, 220, or 240 Vat). Set temperature controlled chamber for 25° C. Allow equipment to warm up for two hours.

3. Set frequency counter so that it's using its internal reference oscillator. Set counter to read frequency directly (i.e., not divided down). Use a 1s gate time so that last three digits span from 000 to 999 Hz.

PERFORMANCE TESTS

4-49. INTERNAL REFERENCE DRIFT RATE(STABILITY)TEST(Cont'd)

4. Calibrate the recorder for a zero to full-scale reading that corresponds to a 000 to 999 Hz reading of the frequency counter's last three digits.

5. To check drift rate as a function of time and line voltage, now set counter so that it's using the quartz oscillator. Set the counter's time base control for a 10s gate time.

NOTE

The above procedure sets the counter's actual gate time to 100s because the reference being used is 1 MHz instead of the 10 MHz reference the counter normally uses. This means that the counter's reading must be divided by 10 to find the actual frequency of the signal being measured (i.e., the recorder's calibration is 0.00 to 9.99 Hz full scale).

6. Record the generator's internal reference frequency for one hour. The frequency change in one hour should be <0.27 Hz (<0.05 ppm ±1 digit counter ambiguity).

Time: ______________ 0.27 Hz

NOTE

Any change in line voltage or chamber temperature could make the instrument's drift rate us time appear to be out of specification.

7. Set variable voltage transformer 5% above the nominal voltage set on generator's line power module (e.g., if nominal line voltage is 120 Vat, set transformer for 126 Vat). Then note the frequency (the counter's indication must be divided by 10).

8. Set variable voltage transformer 10% below nominal line voltage (e.g., for a nominal 120 Vat, set transformer for 108 Vat), then note the reference frequency. The frequency change from the reading noted in step 7 should be <0.52 Hz (<0.1 ppm ±1 digit counter ambiguity).

Voltage: ______________ 0.52 Hz

NOTE

Any change in chamber temperature could make the instrument's drift rate us voltage appear out of specification.

9. Reset transformer to nominal line voltage. Set temperature controlled chamber to 15° C. Wait two hours to allow generator's internal reference to stabilize, then note its frequency.

10. Set. temperature controlled chamber to 35° C. Wait two hours, then note the reference frequency. The frequency change from the reading noted in step 9 should be <10.2 Hz (i.e., <2 ppm ±1 digit counter ambiguity).

Temperature: ______________ 10.2 Hz

11. Note generator's internal reference frequency, connect coaxial short to RF OUT, then again note reference frequency. Except for the ± 1 digit count ambiguity, it should not have changed.

Load : ______________ (√) No Change

4-49. INTERNAL REFERENCE DRIFT RATE (STABILITY) TEST (Cent'd)

12. Remove coaxial short. Note internal reference frequency, set OUTPUT LEVEL 10 dB switch one step ccw to +10 dBm, then again note reference frequency. Except for the ± 1 digit count ambiguity, it should not have changed.

Level Change: ________ (√) No Change

13. Note internal reference frequency, set FM switch to AC, then again note reference frequency. Except for the ± 1 digit count ambiguity, it should not have changed,

Mode Change: ________ (√) No Change

4-50. PHASE LOCK RESTABILIZATION TIME TEST

SPECIFICATION:

Restabilization Time (phase locked mode) after frequency change; after band change; or after 1 min in RF OFF Mode[1]: <1 min after relocking to be within 0.1 ppm of steady-state frequency.

DESCRIPTION:

A frequency counter, digital to analog converter, and strip-chart recorder are used to measure stability after relocking. (See Table 4-1. Recommended Test Abridgements,)

NOTE

For these tests, ambient room temperature and line voltage should not change,

EQUIPMENT :

Frequency Counter . . . . HP 5327C Option 003
Digital to Analog Converter . . . . HP 581A Option 002
Recorder (for D/A Converter) . . . . HP 680

PROCEDURE:

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

COUNTER MODE:	EXPAND	Off
	LOCK	Off
	Source	..INT
AM		OFF
FM		OFF
RANGE.		32-64MHz
FREQUENCY TUNE		50 MHz
RF ON/OFF		..ON

[1]This specification applies only if the RF ON/OFF switch has he en wired to turn the RF Oscillator off.

PERFORMANCE TESTS

4-50. PHASE LOCK RESTABILIZATION TIME TEST (Cont'd)

2. Warm up equipment for two hours. Then set frequency counter to read frequency directly (i.e., not divided down). Use a 1s gate time so that the last two digits span from 00 to 99 Hz.

3. Calibrate the recorder for a zero to full-scale reading that corresponds to a 00 to 99 Hz reading of the frequency counter's last two digits (i.e., 100 Hz full scale).

4. Set COUNTER MODE LOCK to ON, wait one minute, then record generator's output frequency for five minutes; the frequency should not vary more than 7 Hz (<0.1 ppm ±1 digit counter ambiguity).

   ________7 Hz

5. Set COUNTER MODE LOCK to Off; tune FREQUENCY TUNE control fully ccw and back again to approximately 50 MHz. Repeat step 4; frequency should not vary more than 7 Hz.

   ________7 Hz

6. Set COUNTER MODE LOCK to Off; set RANGE switch to 64-128 MHz and back again to 32-64 MHz. Repeat step 4; frequency should not vary more than 7 Hz.

   ________7 Hz

7. [1] Set COUNTER MODE LOCK to Off; set RF ON/OFF switch to OFF. Wait one minute and set RF ON/OFF switch to ON. Repeat step 4; frequency should not vary more than 7 Hz.

   ________7 Hz

[1] This step is necessary only if the instrument is wired to turn the RF Oscillator off (with RF ON/OFF switch).

Table 4-4. Performance Test Record (1 of 9)

Hewlett-Packard Company
Model 8640B Option 004
Signal Generator
Serial No.________________

Tested By________________

Date________________

Para. No.	Test Description		Results Min	Actual	Max
4-13.	**Frequency Range Test**				
	Low End of Band:	512-1024 MHz		________	230.0 MHz
		256-512 MHz		________	230.0 MHz
		128-256 MHz		________	115.0 MHz
		64-128 MHz		________	57.50 MHz
		32-64 MHz		________	28.80 MHz
		16-32 MHz		________	14.40 MHz
		8-16 MHz		________	7.200 MHz
		4-8 MHz		________	3.600 MHz
		2-4 MHz		________	1.800 MHz
		1-2 MHz		________	0.900 MHz
		0.5-1 MHz		________	0.450 MHz
	High End of Band:	512-1024 MHz	550.0 MHz	________	
		256-512 MHz	550.0 MHz	________	
		128-256 MHz	275.0 MHz	________	
		64-128 MHz	137.5 MHz	________	
		32-64 MHz	68.70 MHz	________	
		16-32 MHz	34.30 MHz	________	
		8-16 MHz	17.10 MHz	________	
		4-8 MHz	8.500 MHz	________	
		2-4 MHz	4.200 MHz	________	
		1-2 MHz	2.100 MHz	________	
		0.5-1 MHz	1.070 MHz	________	
4-14.	**Frequency Accuracy and Fine Tune Test**				
	Counter Readings, Difference:			________	110 Hz
	X10			________	110 Hz
	TIME BASE VERN, not-CAL, cw		1 kHz	________	
	TIME BASE VERN, not-CAL, ccw		1 kHz	________	
	FINE TUNE		50 kHz	________	
4-15.	**Frequency Stability vs Time and Restabilization Time Test**				
	Time			________	500 Hz
	After frequency change			________	500 Hz
	After band change			________	250 Hz
	After RF ON/OFF set to ON			________	500 Hz

Table 4-4. Performance Test Record (2 of 9)

Para. No.	Test Description		Results		
			Min	Actual	Max
4-16.	**Frequency Stability vs. Temperature Test**			______	**50** kHz
4-17.	**Frequency Stability vs Line Voltage Test**				
	+5% ***to*** -10% Line Voltage			______	50 Hz
4-18.	**Frequency Stability Test**				
	(Load)			______	**512 Hz**
	(Level)			______	**512 Hz**
	(Mode):	10 kHz		______	200 Hz
		20 kHz		______	200 Hz
		40 kHz		______	400 Hz
		80 kHz		______	800 Hz
		160 kHz		______	1.6 kHz
		320 kHz		______	3.2 kHz
		640 kHz		______	6.4 kHz
		1.28 MHz		______	12.8 kHz
		2.56 MHz		______	25.6 kHz
4-19.	**Harmonics Test**				
	Frequency Range:				
		0.5-1 MHz	35 dB	______	
		1-2 MHz	35 dB	______	
		2-4 MHz	35 dB	______	
		4-8 MHz	35 dB	______	
		8-16 MHz	35 dB	______	
		16-32 MHz	35 dB	______	
		32-64 MHz	35 dB	______	
		64-128 MHz	35 dB	______	
		128-256 MHz	30 dB	______	
		256-512 MHz	30 dB	______	
4-20.	**Sub-Harmonics and Non-Harmonic Spurious Test**				
	Below carrier		40 dB	______	
4-21.	**Single Sideband Phase Noise Test**				
	At **550** MHz >112 dB down		12 dB	______	
	At 450 MHz >120 dB down		20 dB	______	
4-22.	**Single Sideband Broadband Noise Floor Test**				
	>130 dB down		20 dB	______	

Table 4-4. Performance Test Record (3 of 9)

Para. No.	Test Description	Results		
		Min	Actual	Max
4-23.	**Residual AM Test**			
	>78 dB down	58 dB		
	>85 dB down	65 dB		
4-24.	**Residual FM Test**			
	<7.5 Hz	7.5 mVrms		
	<2.5 Hz	2.5 mVrms		
	<7.5 Hz	7.5 mVrms		
	<15 Hz	15 mVrms		
4-25.	**Output Level Accuracy Test (Abbreviated)**			
	Output Level 10 dB Meter Reading			
	Fully CW +15 dBm	+13.5 dBm		+16.5 dBm
	Fully CW +14 dBm	+12.5 dBm		+15.5 dBm
	Fully CW +13 dBm	+11.5 dBm		+14.5 dBm
	Fully CW +12 dBm	+10.5 dBm		+13.5 dBm
	Fully CW +11 dBm	+ 9.5 dBm		+12.5 dBm
	Fully CW +10 dBm	+ 8.5 dBm		+11.5 dBm
	1 step ccw +10 dBm	+ 8.5 dBm		+11.5 dBm
	1 step ccw + 9 dBm	+ 7.5 dBm		+10.5 dBm
	1 step ccw + 8 dBm	+ 6.5 dBm		+ 9.5 dBm
	1 step ccw + 7 dBm	+ 5.5 dBm		+ 8.5 dBm
	1 step ccw + 6 dBm	+ 4.5 dBm		+ 7.5 dBm
	1 step ccw + 5 dBm	+ 3.5 dBm		+ 6.5 dBm
	1 step ccw + 4 dBm	+ 2.5 dBm		+ 5.5 dBm
	1 step ccw + 3 dBm	+ 1.5 dBm		+ 4.5 dBm
	1 step ccw + 2 dBm	+ 0.5 dBm		+ 3.5 dBm
	1 step ccw + 1 dBm	- 0.5 dBm		+ 2.5 dBm
	1 step ccw 0 dBm	- 1.5 dBm		+ 1.5 dBm
	1 step ccw - 1 dBm	- 2.5 dBm		+ 0.5 dBm
	1 step ccw - 2 dBm	- 3.5 dBm		- 0.5 dBm
	2 steps ccw 0 dBm	- 1.5 dBm		+ 1.5 dBm
	3 steps ccw -11 dBm	-12.5 dBm		- 9.5 dBm
	4 steps ccw -21 dBm	- 2 dB		+ 2 dB
	5 steps ccw -31 dBm	- 2 dB		+ 2 dB
	6 steps ccw -41 dBm	- 2 dB		+ 2 dB
	7 steps ccw -51 dBm	- 2.5 dB		+ 2.5 dB
	8 steps ccw -61 dBm	- 2.5 dB		+ 2.5 dB
	9 steps ccw -71 dBm	- 2.5 dB		+ 2.5 dB
	10 steps ccw -81 dBrn	- 2.5 dB		+ 2.5 dB

Table 4-4. Performance Test Record (4 of 9)

Para. No.	Test Description		Results Min	Actual	Max
4-25.	**Output Level Accuracy Test (Cont'd) {Abbreviated)**				
	Output Level 10 dB	Meter Reading			
	11 steps ccw	- 91 d13m	- 2.5 dB	______	+ 2.5 dB
	12 steps ccw	-101 d13m	- 2.5 dB	______	+ 2.5 dB
	13 steps ccw	-111 dBm	- 2.5 dB	______	+ 2.5 dB
	14 Steps ccw	-121 dBm	- 2.5 dB	______	+ 2.5 dB
		-131 d13m	- 22.5 dB	______	-17.5dB
4-26.	**Output Level Accuracy Test (Complete)**				
	Output Level 10 dB	Meter Reading			
	Fully cw	+ 15 dBm	+13.5 dBm	______	+16.5 dBm
	Fully cw	+ 14 dBm	+12.5 dBm	______	+15.5 dBm
	Fully cw	+ 13 dBm	+11.5 dBm	______	+14.5 dBm
	Fully cw	+ 12 dBm	+10.5 dBm	______	+13.5 dBm
	Fully cw	+ 11 dBm	+ 9.5 dBm	______	+12.5 dBm
	Folly cw	+ 10 dBm	+ 8.5 dBm	______	+11.5 dBm
	1 step ccw	+ 10 dBm	+ 8.5 dBm	______	+11.5 dBm
	1 step ccw	+ 9 dBm	+ 7.5 dBm	______	+10.5 dBm
	1 step ccw	+ 8 dBm	+ 6.5 dBm	______	+ 9.5 dBm
	1 step ccw	+ 7 dBm	+ 5.5 dBm	______	+ 8.5 dBm
	1 step ccw	+ 6 dBm	+ 4.5 dBm	______	+ 7.5 dBm
	1 step ccw	+ 5 dBm	+ 3.5 dBm	______	+ 6.5 dBm
	1 step ccw	+ 4 dBm	+ 2.5 dBm	______	+ 5.5 dBm
	1 step ccw	+ 3 dBm	+ 1.5 dBm	______	+ 4.5 dBm
	1 step ccw	+ 2 dBm	+ 0.5 dBm	______	+ 3.5 dBm
	1 step ccw	+ 1 dBm	- 0.5 dBm	______	+ 2.5 dBm
	1 step ccw	0 dBm	- 1.5 dBm	______	+ 1.5 dBm
	1 step ccw	- 1 dBm	- 2.5 dBm	______	+ 0.5 dBm
	1 step ccw	- 2 dBm	- 3.5 dBm	______	+ 0.5 dBm
	2 steps ccw	0 dBm	- 1.5 dBm	______	+ 1.5 dBm
	3 steps ccw	-11dBm	-12.5 dBm	______	- 9.5 dBm
		- 21 dBm	472.0 mVdc	______	-529.6 mVdc
		- 31 dBm	-472.0 mVdc	______	-529.6 mVdc
		- 41 dBm	472.0 mVdc	______	-529.6 mVdc
		- 51 dBm	-472.0 mVdc	______	-529.6 mVdc
		- 61 dBm	445.6 mVdc	______	-561.0 mVdc
		- 71 dBm	445.6 mVdc	______	-561.0 mVdc
		- 81 dBm	-445.6 mVdc	______	-561.0 mVdc
		- 91 dBm	445.6 mVdc	______	-561.0 mVdc

Table 4-4. Performance Test Record (5 of 9)

Para. No.	Test Description	Results		
		Min	Actual	Max
4-26.	**Output Level Accuracy Test (Complete) (Cent'd)**			
	Output Level 10 dB **Meter Reading**			
	-101 dBm	-445.6 mVdc	________	-561.0 mVdc
	-111 dBm	-445.6 mVdc	________	-561.0 mVdc
	-121 dBm	-445.6 mVdc	________	-561.0 mVdc
	-131 dBm	-445.6 mVdc	________	-561.0 mVdc
	-141 dBm	-445.6 mVdc	________	-561.0 mVdc
4-27.	**Output Level Flatness Test**			
	Maximum reading		________	0.5 dB
	Minimum reading		________	0.5 dB
	Maximum reading		________	0.75 dB
	Minimum reading		________	0.75 dB
4-28.	**Output Impedance Test (Signal Freq.)**			
	Difference voltage: <2.0 x V (step 2)		________	(√)
	<1.3 x V (step 4)		________	(√)
	<1.3 x V (step 6)		________	(√)
4-29.	**Output Impedance Test (Broadband)**			
	Return Loss (VSWR <2.0:1)	9.5 dB	________	
		9.5 dB	________	
	Return Loss (VSWR < 1.3:1)	17.7 dB	________	
		17.7 dB	________	
4-30.	**Auxiliary Output Test**	**–5** dBm	________	
4-31.	**Output Leakage Test**			
	0.5 to 400 MHz		________	-97 dBm
	400 to 600 MHz		________	-97 dBm
	600 to 1200 MHz		________	-97 dBm
4-32.	**Internal Modulation Oscillator Test**			
	400 Hz Fixed: Standard:	392	________	408 Hz
		1.0 Vrms	________	
	Option 001:	388	________	412 Hz
		3.0 Vrms	________	
	1 kHz Fixed: Standard:	980	________	1020 Hz
		1.0 Vrms	________	
	Option 001:	970	________	1030 Hz
		3.0 Vrrns	________	

Table 4-4. Performance Test Record (6 of 9)

Para. No.	Test Description	Results		
		Min	Actual	Max
4-33.	**Internal Modulation Oscillator Distortion Test (Option 001)**			
	Variable: 20 Hz to 2 kHz		________	0.5%
	2 kHz to 600 kHz		________	1.0%
	Fixed: 400 Hz		________	0.25%
	1000 Hz		________	0.25%
4-34.	AM 3 **dB Bandwidth Test**			
	RANGE % AM Bandwidth			
	8-16 MHz 50% 0-50 kHz		________	3 dB
	909% 0-35 kHz		________	3 dB
	4-8 MHz 50% 0-30 kHz		________	3 dB
	9096 0-20 kHz		________	3 dB
	1-2 MHz 50% 0-15 kHz		________	3 dB
	90% 0-12.5 kHz		________	3 dB
4-35.	**AM Distortion Test**			
	50%		________	1%
	90%		________	3%
4-36.	**AM sensitivity and Accuracy Test**			
	External sensitivity Accuracy:	171.0 mVrms	________	189.0 mVrms
	Indicated Accuracy: 90%	165.6 mVrrns	________	194.4 mVrms
	70%	128.8 mVrms	________	151.2 mVrms
	50%	92.0 mVrrns	________	108.0 mVrms
	30% (0-10)	55.2 mVrms	________	64.8 mVrms
	30% (0-3)	54.6 mVrms	________	65.4 mVrms
	20%	36.4 mVrms	________	43.6 mVrms
	10%	18.2 mVrms	________	21.8 mVrms
4-37.	**Peak Incidental Phase Modulation Test**			
	512 MHz		________	**±17.2°**
	128 MHz		________	**±8.60°**
4-38.	**Demodulated Output Accuracy Test**			
	AM Depth (AC/DC to AC): 20%	Refer to Table in text for appropriate tolerances.	________	
	30%		________	
	40%		________	
	509%		________	
	60%		________	
	70%		________	
	80%		________	

Table 4-4. Performance Test Record (7 of 9)

Para. No.	Test Description	Results		
		Min	Actual	Max
4-38.	**Demodulated Output Accuracy Test (cont'd)**			
	AM Depth (AC/DC to DC): 20%	Refer to Table in text for appropriate tolerances.	________	
	30%		________	
	40%		________	
	50%		________	
	60%		________	
	70%		________	
	80%		________	
4-39.	**AM Phase Shift Test**		________	4.2 divisions
			________	4.2 divisions
			________	2.8 divisions
4-40.	**AM Flatness Test**	198.8 mVrms	________	201.2 mVrms
4-41.	**Pulse Modulation Test**			
	0.5—1 MHz Rise Time		________	9 μs
	Fall Time		________	9 μs
	Level Accuracy	5.4 div	________	6.7 div
	1—2 MHz Rise Time		________	4 μs
	Fall Time		________	4 μs
	Level Accuracy	5.4 div	________	6.7 div
	2—4 MHz Rise Time		________	2 μs
	Fall Time		________	2 μs
	Level Accuracy	5.4 div	________	6.7 div
	4—8 MHz Rise Time		________	2 μs
	Fall Time		________	2 μs
	Level Accuracy	5.4 div	________	6.7 div
	8—16 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div
	16—32 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div
	32—64 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div
	64—128 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div
	128—256 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div
	256—512 MHz Rise Time		________	1 μs
	Fall Time		________	1 μs
	Level Accuracy	5.4 div	________	6.7 div

Table 4-4. Performance Test Record (8 of 9)

Para No.	Test Description	Results		
		Min	Actual	Max
4-42.	**Pulse ON/OFF Ratio Test**			
	Frequency Range: 256-512 MHz	40 dB	______	
	128-256 MHz	40 dB	______	
	64-128 MHz	40 dB	______	
	32-64 MHz	40 dB	______	
	16-32 MHz	40 dB	______	
	8-16 MHz	40 dB	______	
	4-8 MHz	40 dB	______	
	2-4 MHz	40 dB	______	
	1-2 MHz	40 dB	______	
	0.5-1 MHz	40 dB	______	
4-43.	**FM 3 dB Bandwidth Test**		______	**3** dB
4-44.	**FM Distortion Test**			
	Maximum Deviation	30.5 dB	______	
	1/8 Maximum Deviation	40. dB	______	
4-45	**FM Sensitivity and Accuracy Test**			
	Sensitivity: Frequency Range			
	256-512 MHz	1.954 kHz	______	2.204 kHz
	128-256 MHz	1.954 kHz	______	2.204 kHz
	64-128 MHz	1.954 kHz	______	2.204 kHz
	32-64 MHz	1.954 kHz	______	2.204 kHz
	16-32 MHz	1.954 kHz	______	2.204 kHz
	8-16 MHz	1.954 kHz	______	2.204 kHz
	4-8 MHz	1.954 kHz	______	2.204 kHz
	2-4 MHz	1.954 kHz	______	2.204 kHz
	1-2 MHz	1,954 kHz	______	2.204 kHz
	0.5-1 MHz	1.954 kHz	______	2.204 kHz
	Accuracy: Frequency Range			
	256-512 MHz	1.871 kHz	______	2.287 kHz
	128-256 MHz	1.871 kHz	______	2.287 kHz
	64-128 MHz	1.871 kHz	______	2.287 kHz
	32-64 MHz	1.871 kHz	______	2.287 **KHz**
	16-32 MHz	1.871 kHz	______	2.287 kHz
	8-16 MHz	1.871 kHz	______	2.287 kHz
	4-8 MHz	1.871 kHz	______	2.287 kHz
	2-4 MHz	1.871 kHz	______	2.287 kHz
	1-2 MHz	1.871 kHz	______	2.287 kHz
	0.5-1 MHz	1.871 kHz	______	2.287 kHz
4-46.	**Incidental AM Test**			
	Maximum Deviation		______	1%
	1/8 Maximum Deviation		______	0.5%

Table 4-4. Performance Test Record (9 of 9)

Para. No.	Test Description	Results Min	Actual	Max
4-47.	**Counter External Sensitivity Test**			
	0.5 to 550 MHz		______	(√)
	20 Hz to 500 kHz		______	(√)
4-48.	**internal Reference Accuracy Test**			
	15°C to 35° C	4,999,995 Hz	______	5,000,005 Hz
	0°C to 55°c	4,999,985 Hz	______	5,000,015 Hz
4-49.	**Internal Reference Drift Rate (Stability) Test**			
	Time		______	0.27 Hz
	Voltage		______	0.52 Hz
	Temperature		______	10.2 Hz
	Load		______	(√) no change
	Level Change		______	(√) no change
	Mode Change		______	(√) no change
5-50.	**Phase Lock Restabilization Time Test**			
	After two-hour warmup		______	7 Hz
	After frequency change		______	7 Hz
	After band change		______	7 Hz
	After 1 min. in RF OFF mode		______	7 Hz

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments required to return the Model 8640B Option 004 Signal Generator to peak operating condition when repairs are required. Included in this section are test setup, and check and adjustment procedures. Removal and replacement procedures are given on the alphabetic service sheets (after the schematics in Section VIII). Adjustment location photographs are given on the last foldouts in Section VIII.

5-3. SAFETY CONSIDERATIONS

5-4. 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 Cautions/Warnings page in the front of the manual). Service and adjustments should be performed only by qualified service personnel,

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 apparatus dangerous. lntentional interruption is prohibited.

5-5. 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. The opening of covers or removal of parts, except those to which access can be gained by hand, may expose live parts, and also accessible terminals may be live.

5-6. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

5-7. 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.

5-8. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

5-9. TEST EQUIPMENT REQUIRED

5-10. Tables 1-2 and 1-3 contain a list of test equipment and test accessories required in the adjustment procedures. In addition, the tables contain the required minimum specifications and a suggested manufacturer's model number.

5-11. Posidriv Screwdrivers

5-12. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Posidriv screwdrivers should be used.

5-13. Blade Tuning Tools

5-14. 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.

5-15. Service Aids

5-16. Miscellaneous Hardware Kit. The HP 08640-60095 Miscellaneous Hardware Kit contains mechanical spare parts for the generator - such things as nuts, bolts, screws and washers.

5-17. Extender Board. An extender board is sup plied with the generator that can be used to extend all circuit plug-in boards (except the A10A2 RF Divider Assembly and the A12 Rectifier Assembly). The RF Divider Assembly is self-extending – just remove the riser board and insert the Divider Assembly into the riser's socket.

5-18. Wrench. A wrench is supplied with the generator. One end fits the SMC connectors used on the generator's RF cables, the other end fits another common size SMC connector which may be used in servicing the instrument.

5-19. FACTORY SELECTED COMPONENTS

5-20. Table 5-1 contains a list of factory selected components by reference designation, basis of selection, and schematic diagram location. Factory selected components are designated by an asterisk (*) on the schematic diagrams in Section VIII.

5-21. The following information supplements Table 5-1.

a. A8A1C8 Selection. Capacitor may or may not be used; its value will always be 2.2 pF. Select as follows:

1. Set COUNTER MODE: Source to EXT 0-550, RANGE to 256-512 MHz, and OUTPUT LEVEL controls to +10 dBm.
2. Connect RF OUT to COUNTER INPUT.
3. Turn FREQUENCY TUNE CW and observe frequency increase towards 550 MHz on the counter.
4. Repeat step 3 for OUTPUT LEVEL settings of 0 dBm and -7 dBm, If count becomes erratic or displays zero count, as frequency approaches 550 MHz, add capacitor between pins 13 and 16 of A8A1U1.

b. A8A1R4 Selection. If A8A1U5 has been replaced and counter external sensitivity is not within specification select A8A1R4 as follows:

1. Set COUNTER MODE to EXT 0-10 or EXT 0-550.
2. Measure dc voltage at A8A1U5 pins 1 and 14.
3. Select a value of resistance that will bring dc voltage at pin 14 to within 10% of voltage at pin 1.

c. A9C8 Selection. If A9 has been changed, perform FM 3 dB BANDWIDTH TEST (4-38) to determine if the FM Amplifier is peaking above specification in the 5 kHz PEAK DEVIATION range. If the FM Amplifier is peaking excessively, increase the value of A9C8 until flatness of the amplifier is within specification.

d. A1OA2R3 Selection. If A10A2U11 or U12 is replaced and RF output irregularities are observed, it may be necessary to change the value of A10A2R3. Select the proper value as follows:

1. Observe the RF OUT signal with a spectrum analyzer.
2. Set RANGE to 64-128 MHz.
3. Adjust FREQUENCY TUNE across the band.
4. If signal irregularities (e.g., erratic frequency, sub-harmonics, or increased level of the noise floor) are observed, increase the value of A10A2R3 within the range of values shown in Table 5-1.

e. A10A2R6-8, R12-14, and R18-20 Selection. If A26U2 (Service Sheet 12) has been replaced, check second harmonic level (at RF OUT jack) on the following bands: 128-256 MHz, 64-128 MHz, and 32-64 MHz. If second harmonic level is out of specification, increase affected band's divider output attenuation until second harmonic level is within specification. The following table indicates correct values of resistance for 3 to 6 dB of attenuation (change attenuation in 1 dB steps).

Band (RANGE)	Resistors (A1OA2)		
128-256 MHz 64-128 32-64	R6 R12 R18	R7 R13 R19	R8 R14 R20
Attenuation	**Resistance**		
3 dB 4 dB 5 dB 6 dB	17.8Ω 23.7Ω 31.6Ω 38.3Ω	287Ω 237Ω 178Ω 147Ω	287Ω 237Ω 178Ω 147Ω

f. To change attenuation, change all three resistors associated with the band that's out of specification. For example, if 64-128 MHz band's second harmonic is too high, then R13, R12, and R14 will have to be changed. Change attenuation in 1 dB steps (e.g., to change their attenuation to 5 dB, change R12 to 31.6Ω, R13 to 178Ω, and R14 to 178Ω.)

NOTE

Attenuation should be no higher than necessary to bring a band's second harmonic within specification. Excessive attenuation may reduce maximum RF output level.

g. A26A3C3, C4, C5 and C6 SeIection. Capacitors may or may not be used; their values are always 0.22 pF. select as follows:

1. Set AM switch to PULSE, FREQIJENCY RANGE to 256-512 MHz, and RF ON/OFF to ON.
2. Connect a spectrum analyzer to RF OUT (TO FLT), A26A3JI.
3. Check from 256 to 512 MHz (tune FREQUENCY TUNE across band). Signals should always be below —58 dBm.
4. Add or remove capacitors across diodes as necessary to keep signals below -58 dBm.

5-22. POST-REPAIR TESTS AND ADJUSTMENTS

5-23. The adjustment in this section should be performed when the troubleshooting information in Section VIII indicates that an adjustable circuit is not operating correctly. Perform the adjustments after repairing or replacing the circuit. The required adjustments are specified in Table 5-2. Allow the instrument to warmup one hour before making any adjustment.

5-24. After making the adjustments, perform the performance tests (found in Section IV) specified in the table. In general, if any 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 that 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

Component	Service Sheet	Range of Values	Basis of Selection
A8AIC8	18	2.2 pF	See paragraph 5-21.
A8A1R4	18	2-5 kΩ	See paragraph 5-21. Select for an indication on counter with 100 mVrms applied to COUNTER INPUT.
A9C8	6	240-310 pF	See paragraph 5-21.
A10A2R3	11	51.1Ω-75.0Ω	See paragraph 5-21.
A10A2R6-8 R12-14, and R18-20	11		See paragraph 5-21.
A11R28 (Option 001)	9A	215 to 316 Ohms	See paragraph 5-27. Select for less than specified distortion with distortion analyzer connected to front panel output jack. (Distortion should not be so low that amplitude stability is poor at 20 Hz.)
A26A3C3, C4, C5, C6	12	0.22 pF	See paragraph 5-21.

Table 5-2. Post-Repair Tests and Adjustments (1 of 4)

Assembly Repaired	Performance Tests	Adjustments
Al 1 dB Output Level Assy	Output Level Accuracy Test (power meter steps) (4-25 or 4-26) Output Level Flatness Test (4-27) Output Leakage Test (4-31)	Check power supply voltages (5-25)
AZ Meter Switch/Detector Assy A4 Meter/Annunciator Drive Assy Panel Meter Ml	Output Level Accuracy Test (+16 and +10 dBm ranges only) (4-25 or 4-26) AM Sensitivity and Accuracy Test (meter only) (4-36) FM Sensitivity and Accuracy Test (meter only) (4-45)	Check power supply voltages (5-25) Meter Adjustments (5-28)
A3 RF Oscillator Assy	Frequency Range Test (256-512 MHz only) (4-13) Frequency Accuracy and Fine Tune Test (fine tune only) (4-14) Frequency Stability Tests (4-15, 4-16,4-17, and 4-18) Harmonics Test (4-19) Single Sideband Phase Noise Test (4-21) Residual FM Test (4-24) Output Level Flatness Test (256-512 MHz only) (4-27) Output Leakage Test (4-31) FM Distortion Test (4-44) FM Sensitivity and Accuracy Test (4-45) Phase Lock Restabilization Time Test (check only that phase lock operates) (4-50)	Check power supply voltages (5-25) V_T Pot Adjustment (5-35) V_T Voltage Adjustment (5-36) RF Oscillator Output Power Adjustment (if necessary) (5-38) Preliminary FM Adjustments (if necessary) (5-40) FM Linearity Adjustment (if necessary) (5-41 or 5-42) FM Sensitivity Adjustment (if necessary) (5-43)
A5 FM Amplifier Ass y A7 FM Shaping Assy	FM 3 d.B Bandwidth Test (4-43) FM Distortion Test (4-44) FM Sensitivity and Accuracy Test (omit meter check) (4-45)	Check power supply voltages (5-25) Preliminary FM Adjustments (5-40) FM Linearity Adjustment (5-41 or 5-42) FM Sensitivity Adjustment (5-43)

Table 5-2. Post-Repair Tests and Adjustments (2 of 4)

Assembly Repaired	Performance Tests	Adjustments
A6 Annunciator Assy	None	None
A8 Counter/Lock Assy	Operator's Checks (Figure 3-5) Frequency Accuracy and Fine Tune Test (accuracy only) (4-14) Frequency Stability Tests (4-15, 4-16,4-17, and .4-18) Sub-Harmonics and Non-Harmonic Spurious Test (4-20) Output Leakage Test (4-31) Counter External Sensitivity Test (4-47) Internal Reference Accuracy Test (4-48) Internal Reference Drift Rate (Stability) Test (4-49) Phase Lock Restabilization Time Test (4-50)	Check power supply voltages (5-25) Internal Reference Frequency Adjustment (if necessary) (5-44)
A9 Peak Deviation and Range Switch Assy	Operator's Checks (Figure 3-5) FM Sensitivity and Accuracy Test (4-45)	Check power supply voltages (5-25) Peak Deviation and Range Switch Adjustment (if necessary) (5-33) Range Switch Adjustment (5-34) preliminary FM Adjustments (if necessary) (5-40) FM Linearity Adjustment (if necessary) (5-41 or 5-42) FM Sensitivity Adjustment (if necessary) (5-43)
Al0 Divider/Filter Assy	Frequency Range Test (4-13) Harmonics Test (4-19) Output Level Flatness Test (4-27) Output Leakage Test (4-31)	Check power supply voltages (5-25) Range Switch Adjustment (if necessary) (5-34) V_T Voltage Adjustment (5-36) RF Filter Adjustment (if necessary) (5-39)

Table 5-2. Post-Repair Test and Adjustments (3 of 4)

Assembly Repaired	Performance Tests	Adjustments
All Fixed-Frequency Modulation Oscillator Assy or Al1 Variable-Frequency Modulation Oscillator Assy (Option 001)	Internal Modulation Oscillator Test (4-32) Internal Modulation Oscillator Distortion Test (Option 001 only) (4-33)	Check power supply voltages (5-25) Fixed Frequency Modulation Oscillator Adjustment (5-26) or Variable-Frequency Modulation Oscillator Adjustment (5-27)
A12 Rectifier Assy A13 Modulation/Metering Mother Board Assy A14 Line Power Module A15 Riser Assy A17 Power Supply Mother Board Assy A20 +5.2V and +44.6V Regulator Assy A22 +20V and –20V Regulator Assy A24 Series Regulator Socket Assy	Frequency Stability vs Time Test (4-15) Frequency Stability vs Line Voltage Test (4-17) Residual FM Test (4-24) Internal Reference Drift Rate (Stability) Test (4-49)	Power Supply Adjustments (5-25)
A16 Fan Motor Assy A18 –5.2V Regulator and Fan Driver Assy	Residual FMTest (4-24)	Power Supply Adjustments (5-25)
A19 10 dB Output Level Assy	Harmonics Test (4-19) Output Level Accuracy Test (4-25 or 4-26) Output Level Flatness Test (4-27) Output Impedance Tests (4-28 or 4-29) Output Leakage Test (4-31)	Output Level Vernier and Meter Adjustment (5-30)
A26 AM/AGC and RF Amplifier Assy	Harmonics Test (4-19) Residual AM Test (4-23) Output Level Accuracy Test (4-25 or 4-26) Output Level Flatness Test (4-27)	Check power supply voltages (5-25) RF Detector Offset Adjust-ment (5-29) Output Level Vernier and Meter Adjustment (5-30) Preliminary AM Adjustments (5-31)

Table 5-2. Post-Repair Test and Adjustments (4 of 4)

Assembly Repaired	Performance Tests	Adjustments
A26 AM/AGC and RF Amplifier Assy (Cont'd)	Output Impedance Test (4-28 or 4-29) Auxiliary Output Test (4-30) Output Leakage Test (4-31) AM 3 dB Bandwidth Test (4-34) AM Distortion Test (4-35) AM Sensitivity and Accuracy Test (4-36) Peak Incidental Phase Modulation Test (4-37) Demod Output Accuracy Test (4-38) AM Phase Shift Test (4-39) Pulse Modulation Test (4-41) Pulse On/Off Ratio Test (4-42) Incidental AM Test (4-46)	AM Accuracy Adjustment (5-32)

5-25. POWER SUPPLY ADJUSTMENTS

REFERENCE:

Service Sheets 22 and 23.

DESCRIPTION:

A digital voltmeter is used to check the power supply voltages. They are then adjusted for the correct voltage. This procedure should be performed before making any other adjustment.

EQUIPMENT :

Digital Voltmeter . . . . HP 3480D/3484A

PROCEDURE :

1. Set LINE switch to ON. The fan should run and five LED's located on power supply boards (A18, A20, and A22) should light.

   Connect DVM to each of the test points listed below. The voltages should be within the tolerances shown; if not, adjust appropriate resistor for a reading within the indicated tolerances.

Test Point		Adjust	Voltage Level	
–5 .2V	A18TP5	A18R2	–5.200V ± 10 mV	*
+5.2v	A2OTP10	A20R16	+5.200V ± 10 mV	
+20V	A22TP4	A22R7	+20. 000V ± 10 mv	**
-20V	A22TP9	A22R19	–20.000V ± 10 mV	***
+44.6V	A20TP4	A20R8	+44.600V ± 100 mV	

*For ambient temperatures other than 25°C, modify the voltage level setting by —4.2 mV/°C.
**Perform FM CAL adjustment (paragraph 5-40, step 5), time base adjustment (paragraph 5-44) and AM accuracy Adjustment (paragraph 5-32).
***Perform VARACTOR BIAS adjustment (paragraph 5-40, step 11), and AM accuracy Adjustment (paragraph 5-32).

5-26, FIXED-FREQUENCY MODULATION OSCILLATOR ADJUSTMENT

REFERENCE:

Service Sheet 9.

DESCRIPTION:

A digital voltmeter is used to monitor the audio oscillator's output while setting its level. The AUDIO OUTPUT LEVEL dial is also adjusted.

EQUIPMENT:

Digital Voltmeter . . . . HP 3480D/3484A Option 043
600 Ohm Feedthrough . . . . HP 11095A

ADJUSTMENTS

5-26. FIXED-FREQUENCY MODULATION OSCILLATOR ADJUSTMENT (Cont'd)

PROCEDURE:

1. Connect DVM, to Al1TP3 AM OUT. Set Signal Generator's controls as follows:

AM	INT
MODULATION FREQUENCY : : : : : : : : : :	**100** Hz
FM	
AUDIO OUTPUT LEVEL : : : : : : : : : : :	Full cw

2. Adjust OSC LEVEL adjustment, Al1R6, for a 840 ± 10 mVrms reading on DVM at A11TP3.

3. Connect DVM through 600 ohm feedthrough to AM OUTPUT. Set AUDIO OUTPUT LEVEL to 100 mVrms as read on DVM. The AUDIO OUTPUT LEVEL dial should read 100 mVrms. If it does not, loosen setscrews on knob and align knob so that it does.

4. Set MODULATION FREQUENCY to 400 Hz. Set AUDIO OUTPUT LEVEL fully CW. The DVM should read 1 Vrms.

____________________Vrms

5-27. VARIABLE-FREQUENCY MODULATION OSCILLATOR ADJUSTMENT (OPTION 001)

REFERENCE:

Service Sheet 9A.

DESCRIPTION:

A digital voltmeter and a frequency counter are used to monitor output voltage and frequency while adjusting the oscillator. The MODULATION FREQUENCY dial and the AUDIO OUTPUT LEVEL dial are adjusted.

EQUIPMENT:

Digital Voltmeter	HP 3480D/3484A Option 043
Frequency Counter	HP 5327C
600 Ohm Feedthrough	HP 11095A

PROCEDURE:

1. Check that modulation oscillator is installed with all of its covers in place.

2. If the knobs have been removed, turn MODULATION FREQUENCY vernier shaft fully CW. Install frequency dial on vernier shaft so that the gears mesh and number 200 on the dial is 10 to 20° to the left (CCW) of the cursor. Turn MODULATION FREQUENCY switch shaft fully ccw and install range knob on switch shaft so that 400 Hz FIXED FREQUENCY position is at the cursor (top). Install vernier knob. (The knobs should not touch each other.)

ADJUSTMENTS

5-27. VARIABLE-FREQUENCY MODULATION OSCILLATOR ADJUSTMENT (OPTION 001) (Cont'd)

3. Turn trim capacitors Al1C2 and C3 fully CW.

NOTE

Turning C2 ccw decreases the output voltage while raising the frequency. Turning C3 ccw increases the output voltage while raising the frequency.

4. Set Signal Generator's controls as follows:

AM . . . ., ...	..INT
MODULATION FREQUENCY Switch	X100
MODULATION FREQUENCY Vernier	Fully **CCW**
FM	OFF
AUDIO OUTPUT LEVEL	Fully **cw**

5. Connect DVM to OSC OUT test point, A11TP4. The DVM should read 1.6 ± 0.3 Vrms.

1.3 ______________ 1.9 Vrms

6. Connect frequency counter to AM OUTPUT jack. The counter should read 1.8 ± 0.2 kHz.

1.6 ______________ 2.0 kHz

7. Set MODULATION FREQUENCY vernier fully cw and adjust trim capacitors, A11C2 and C3, until voltage level at Al1TP4 is within 0.1 Vrms of level read in step 5 and frequency at AM OUTPUT is 21 ± 1 kHz.

8. Set MODULATION FREQUENCY vernier for a frequency counter reading of 2.0 ± 0.01 kHz. Loosen setscrews in gear that meshes with frequency dial gear (vernier). Rotate dial gear so that dial reads 20 (at the cursor) and tighten setscrews in gear. The frequency counter should read 2.0 ± 0.01 kHz when dial reads 20 at the cursor. Record voltage level at Al1TP4.

______________ Vrms

9. Set MODULATION FREQUENCY vernier to 200. Adjust A11C2 and C3 until voltage level at Al1TP4 is within 0.01 Vrms of level recorded in step 8 and frequency is 20.0 ± 0.1 kHz.

10. Set MODULATION FREQUENCY vernier to 20. The counter should read 2.00 ± 0.01 kHz and voltage level at A11TP4 should be within 0.01 Vrms of level recorded in step 8. Repeat steps 8 and 9 until voltage level and frequent y are correct.

11. Monitor voltage at Al 1TP4 while using MODULATION FREQUENCY switch and vernier to tune oscillator from 2 kHz to 20 kHz. The voltage level at 2 kHz (on the X100 range) should be 1.6 ± 0.05 Vrms and level at all other frequencies should be within 0.03 Vrms of level at 2 kHz.

At 2 kHz: 1.55 ______________ 1.65 Vrms

All frequencies: ______________ ±- 0.03 Vrms

ADJUSTMENTS

5-27. VARIABLE-FREQUENCY MODULATION OSCILLATOR ADJUSTMENT (OPTION 001) (Cont'd)

12. If level at A11TP4 is too high, reduce Al1R28 by one standard value (10%); if level is too low, increase A11R28 by one standard value. Then repeat steps 8 through 11.

13. Set MODULATION FREQUENCY range switch to X3 K and vernier to 200 and adjust HIGH FREQ capacitor Al1C9 for a counter reading of 600 ± 3 kHz.

597 ______________ 603 kHz

14. Connect DVM to AM OUT test point, A11TP5. Set MODULATION FREQUENCY range switch to XI00 and the vernier to 20. Adjust AM-FM adjustment, A11R35, for 840* 10 mVrrns at Al1TP5.

830 __________ 850 mVrms

15. Connect DVM to the FM OUT test point, Al1TP3. It should read within 5 mVrms of reading in step 14.

______________ ±5 mVrms

16. Use MODULATION FREQUENCY range switch and vernier to tune oscillator across each range (except 400 and 1000 Hz FIXED FREQ). Monitor voltage level at A11TP3; the DVM should read within 10 mVms of level noted at 20 on vernier dial from 200 Hz to 100 kHz. It should read within 20 mVrms of level noted at 20 on vernier dial from 20 Hz to 600 kHz.

200 Hz tO 100 kHz: ______________ ±10 mVrms

20 Hz to 600 kHz: ______________ ±20 mVrms

17. Set MODULATION FREQUENCY range switch to X3 K and vernier to 20. Connect DVM to AM OUTPUT jack through 600 ohm feedthrough. Adjust AUDIO LEVEL adjustment, A11R40, for 3.00 ± 0.03 Vrms at the jack.

2.97 ______________ 3.03 Vrms

18. Set AM to OFF and FM to INT. Connect DVM to FM OUTPUT jack through the 600 ohm feedthough. The DVM should read 3.0 ± 0.06 Vrms.

19. Check that AUDIO OUTPUT LEVEL control indicates 3V when turned fully CW. If it does not, loosen its setscrews and adjust it so that it does; then tighten setscrews.

ADJUSTMENTS

5-28. METER ADJUSTMENTS

REFERENCE:

Service Sheet 17.

DESCRIPTION:

The panel meter is mechanically zeroed. The meter circuitry is then adjusted at zero and full scale.

EQUIPMENT:

Digital Voltmeter . . . . HP 3480D/3484A

PROCEDURE:

1. With LINE switch set to OFF, place Signal Generator in its normal operating position (e.g., if its normal operating position is tilted up with the tilt stand locked down, place it that way).

2. Adjust mechanical zero adjustment screw on panel meter clockwise for a zero meter reading. Then turn screw slightly counterclockwise to free mechanism from adjusting peg.

3. Set generator's controls as follows:

Meter Function	FM
FM . .	OFF
MODULATION FREQUENCY “ : : : : : : : : : : .	1000 Hz
PEAK DEVIATION	10 kHz
PEAK DEVIATION Vernier	Fully ccw
RANGE	2-4 MHz
LINE	ON

4. Connect DVM to DC OUT test point (A2TP2) on A2 Meter Switch/Detector Assembly. Adjust DET OFFSET pot (A2R5) for O Vdc ± 1 mVdc at A2TP2.

5. Connect DVM to MTR ADJ test point (A4TP1) on A4 Meter Annunciator Drive Assembly. Adjust DRIVER OFFSET pot (A4R10) for 0 Vdc ± 1 mVdc at A4TP1.

6. Set FM to INT. Adjust PEAK DEVIATION vernier clockwise until DVM reads 9.766 Vdc at A4TP1. Then adjust F.S. METER pot (A4R19) for a full scale reading (10 on the 0-10 scale) on the panel meter.

ADJUSTMENTS

5-29. RF DETECTOR OFF SET ADJUSTMENT

REFERENCE:

Service Sheets 13 and 14.

DESCRIPTION:

A dc voltage applied to the AM INPUT is set to vary the AGC reference by, 20 dB. The RF output level is monitored and the detector offset is adjusted so that the RF level varies 20 dB as the AGC reference is varied.

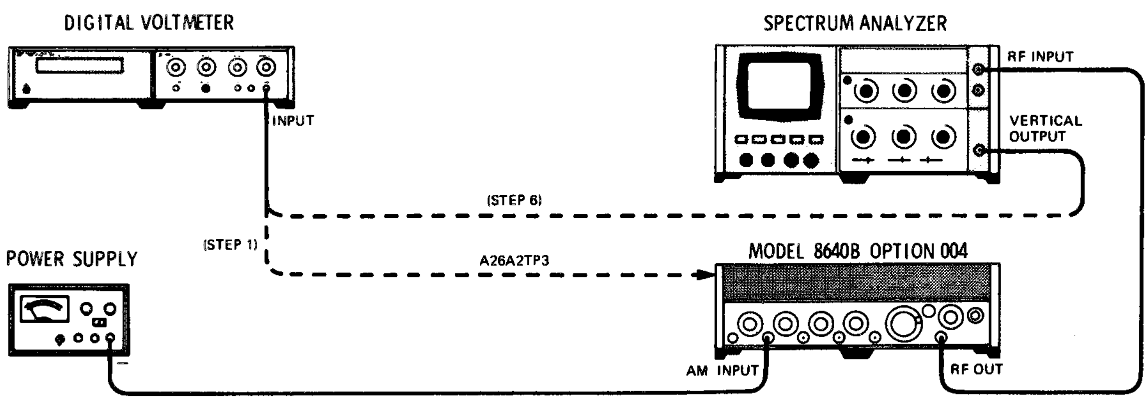


Figure 5-1. RF Detector Offset Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 141T/8554B/8552B
Digital Voltmeter	HP 3480D/3484A
Power Supply	HP 6215A

PROCEDURE:

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

Meter Function		LEVEL
COUNTER MODE :	EXPAND	off
	LOCK	off
	Source	INT
AM		AC
MODULATION		Fully ccw
FM		OFF
RANGE “ : : :		128-256 MHz
FREQUENCY TUNE		190 ± 2 MHz
OUTPUT LEVEL Switches		-10 dBm
OUTPUT LEVEL Vernier		CAL
RF ON/OFF		ON

2. Connect the DVM to AM OUT A26A2TP3 and measure the dc voltage.

dc voltage at A26A2TP3 ______________ Vdc

ADJUSTMENTS

5-29. RF DETECTOR OFFSET ADJUSTMENT (Cont'd)

3. Set the power supply voltage to -1 Vdc.

4. Set AM to DC and adjust MODULATION control to set the level at A26A2TP3 to one-tenth the value in step 2 ± 1 mVdc.

NOTE

Verify the setting by switching AM between AC and DC and observing the variation.

5. Set AM to AC. Set the spectrum analyzer to observe the RF output with input attenuation 20 dB, resolution bandwidth 300 kHz, and linear display. Set the frequency span to zero Hz and peak the trace on the display.

6. Set the DVM filtering to maximum and connect it to the vertical output of the spectrum analyzer. Adjust the vertical sensitivity to give a reading of -500 mVdc.

7. Set AM to DC. Increase the spectrum analyzer's vertical sensitivity by a factor of 10 (e.g., with the Model 141T/8552B/8554B, increase two steps clockwise). Adjust the DET ADJ potentiometer A26A1R19 to give the reading of step 6 ± 1 mVdc.

8. Repeat steps 5 to 7 until the readings of steps 6 and 7 are the same within ± 1 mVdc.

9. Perform Output Level Vernier and Meter Adjustment (5-30) and Preliminary AM Adjustments (5-31).

5-30. OUTPUT LEVEL VERNIER AND METER ADJUSTMENT

REFERENCE:

Service Sheets 12 and 16.

DESCRIPTION:

The RF level accuracy for the upper OUTPUT LEVEL attenuator ranges is measured with a power meter and the generator's output level and panel meter are adjusted at +13 dBm. For the lower ranges, a reference signal is established on a spectrum analyzer display, the Signal Generator's OUTPUT LEVEL switch and the spectrum analyzer's vertical scale log reference level control are stepped together, and any amplitude variations at -67 and -97 dBm are measured on the analyzer's display. An RF attenuator and amplifier at the RF OUTPUT are adjusted for analyzer compatibility and best sensitivity.

This procedure uses an IF substitution technique in which the spectrum analyzer's 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).

ADJUSTMENTS

5-30. OUTPUT LEVEL VERNIER AND METER ADJUSTMENT (Cont'd)

NOTE

1. Check that the RF Detector Offset Adjustment (5-29). and the Meter Adjustrnents (5-28) are correct before performing this adjustment.

2. After making meter adjustment which are accessible only from the bottom of the instrument, check the adjustment with the instrument in its normal operating position.

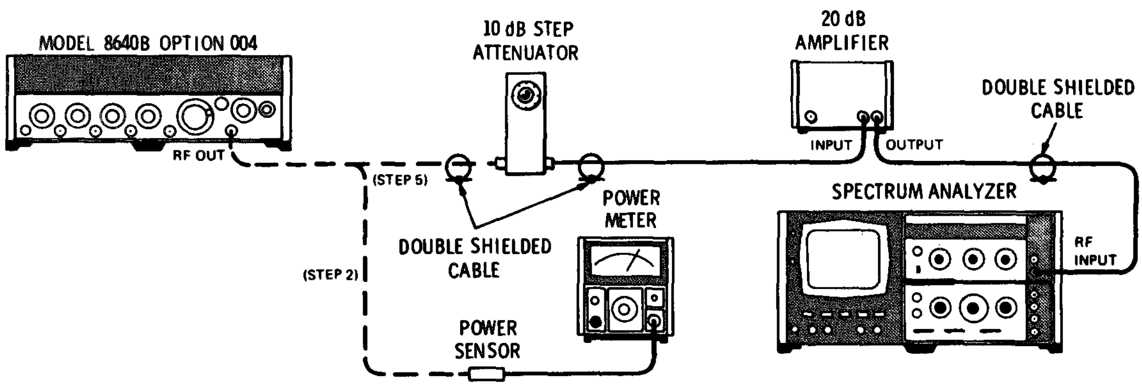


Figure 5-2. Output Level Vernier and Meter Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 141T/8552B/8553B
Power Meter	HP 435A
Power Sensor	HP 8482A
20 dB Amplifier	HP 8447A
Double Shielded Cable (3 required)	HP 08708-6033

PROCEDURE:

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

Meter Function	LEVEL
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	..INT
AM	OFF
FM	OFF
RANGE	32-64 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switches	as specified
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

ADJUSTMENTS

Set OUTPUT LEVEL controls to +13 dBm.

Adjust LVL adjustment, A26A4R1, for a +13 dBm reading on power meter. Adjust MET adjustment, A26A4R12, for a +13 dBm indication on generator's panel meter (+3 dB reading on meter).

4. Set OUTPUT LEVEL switches for a -17 dBm reading on power meter.

5. Disconnect power meter from generator and connect step attenuator, amplifier, and spectrum analyzer to RF OUT.

6. Set step attenuator to 30 dB. Set spectrum analyzer's center frequency controls to 50 MHz (stabilizer on), resolution bandwidth to 10 kHz, frequency span per division (scan width to 5 kHz, input attenuation to 0 dB), display smoothing (video filter) to 100 Hz, and log/linear display switch to 2 dB log. Set the reference level switch for a –10 dBm reference level at the top graticule line on the display; adjust the reference level vernier to place the signal to the display's fifth horizontal graticule line.

7. Set generator's OUTPUT LEVEL to -47 dBm. Set analyzer's reference level switch to -40 dBm and note signal level on display (i.e., the difference between the signal level and the fifth horizontal

8. Set step attenuator to 0 dB; reset analyzer's reference level switch to —10 dBm and adjust analyzer's reference level vernier for the same signal level noted in step 7.

9. Set generator's OUTPUT LEVEL to -67 dBm; set analyzer's reference level switch to –30 dBm and adjust generator's OUTPUT LEVEL Vernier to set signal on analyzer's display to the fifth horizontal graticule line (to the same place it was set in step 6).

10. Adjust the 10 µV adjustment, A19A2R7, for a -67 dBm indication on generator's panel meter (+3 dB reading on meter.)

11. Set generator's OUTPUT LEVEL to -97 dBm. Set analyzer's reference level control to –60 dBm. Adjust OUTPUT LEVEL Vernier to set signal on analyzer's display to the fifth horizontal graticule line (to the same place it was set in step 6). Adjust the 1 µV adjustment, A19A2R8, for a –97 dBm indication on generator's panel meter (+3 dB reading on meter).

12. Perform Preliminary AM Adjustment (5-31), and AM Accuracy Adjustment (5-32), if repairs have been made to the A26 AM/AGC and RF Amplifier Assembly.

ADJUSTMENTS

5-31. PRELIMINARY AM ADJUSTMENTS

REFERENCE:

Service Sheets 13,14, and 15.

DESCRIPTION:

The following adjustments are performed:

1. The dc offset voltages of demodulation amplifiers are adjusted.
2. The ac gain of the AM offset amplifier is adjusted.
3. The ac and dc gains of the demodulation output amplifier are adjusted.

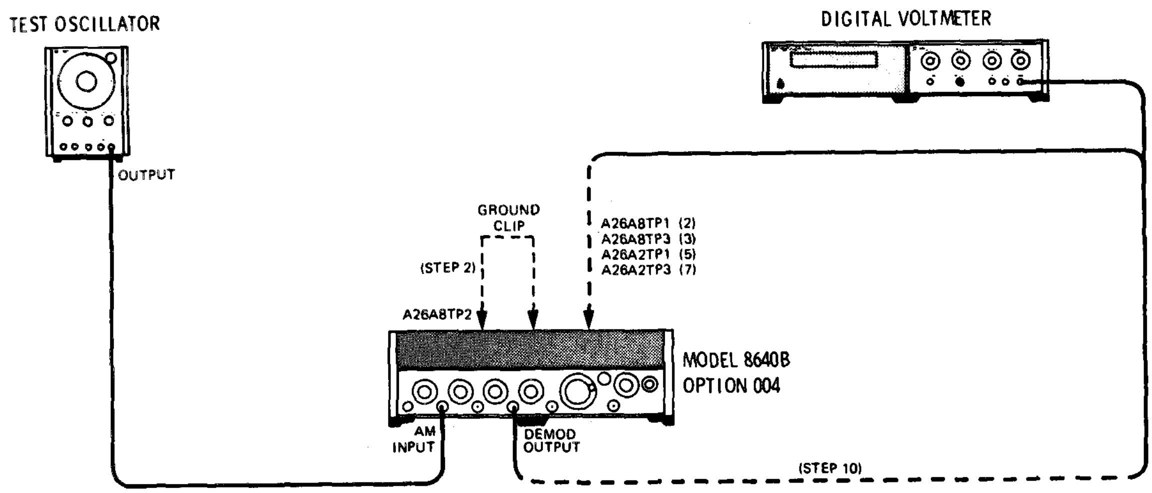


Figure 5-3. Preliminary AM Adjustments

EQUIPMENT:

Digital Voltmeter	HP 3480D/3484A Option 043
Test Oscillator	HP 204D

PROCEDURE:

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

Meter Function	LEVEL
COUNTER MODE : EXPAND	off
LOCK	off
Source	INT
AM	OFF
MODULATION	Centered
FM	OFF
RANGE	128-256 MHz
FREQUENCY	190 ±2 MHz
OUTPUT LEVEL Switches	-20 dBm (-20,0)
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	OFF

ADJUSTMENTS

5-31. PRELIMINARY AM ADJUSTMENTS (Cont'd)

2. With the RF set to OFF, connect a clip lead from DET A26A8TP2 to ground. Connect the DVM to BUFFER DET A26A8TP1 and set to read dc volts. Adjust BUFFER OFFSET A26A8R3 to give a reading of 0± 1 mVdc.

3. Set the AC/DC switch A26A8S1 to DC and adjust the DC OFFSET.A26A8R15 for 0± 1 mVdc at DEMOD,A26A8TP3.

4. Unclip the ground lead to A26A8TP2. Set RF ON/OFF to ON.

5. Set the DVM to read ac volts and connect it to AM IN, A26A2TP1.

6. Set the test oscillator for approximately 0.4 Vrms at 100 Hz. Set AM to DC ad adjust the MODULATION control for a reading of 353.6 ± 0.5 mVrms at A26A2TPI.

7. Set the DVM to read dc volts and connect it to AM OUT A26A2TP3. Record the voltage (should be between 1.9 and 2.1 Vdc).

Vdc at A26A2TP3_______________Vdc

8. Multiply the voltage (from step 7) by 0.3536.

0.3536 x Vdc from step 7_______________Vdc

9. Set the DVM to read ac volts and adjust % AM ADJ A26A2R19 to give a reading equal to the value calculated in step 8 ±1 mVrms.

10. Set the DVM to read dc volts and connect it to DEMOD OUTPUT. Adjust DC GAIN A26A8R10 to give a reading of 1414 ± 1 mVdc.

11. Set the AC/DC switch A26A8S1 to AC. Adjust AC OFFSET A26A8R6 to give a DVM reading of 0±1 mvdc.

12. Set the DVM to read ac volts. Adjust AC GAIN A26A8R8 to give a reading of 2500 ± 1 mVrms.

13. Perform AM Accuracy Adjustment (5-32).

ADJUSTMENTS

5-32. AM ACCURACY ADJUSTMENT

REFERENCE:

Service Sheet 15.

DESCRIPTION:

The Signal Generator is amplitude modulated, and the modulation is demodulated by a peak detector in a spectrum analyzer set to a zero-frequency span. The ac and dc components are measured with a voltmeter at the detector output (vertical output) of the spectrum analyzer. First, the dc component is set to -282.8 mVdc plus a detector offset correction. The, the ac component is measured and the percent AM calculated as 1/2 the ac component read in mVrms. The demodulator amplifiers are then adjusted to give the correct voltage at the demodulator output.

Because of the required measurement accuracy, the accuracy of the spectrum analyzer's detector offset must be known to ± 1 mV. The offset voltage is calculated by measuring the change in the detector output for a chage in RF input and assuming a linear detector over the range of levels used.

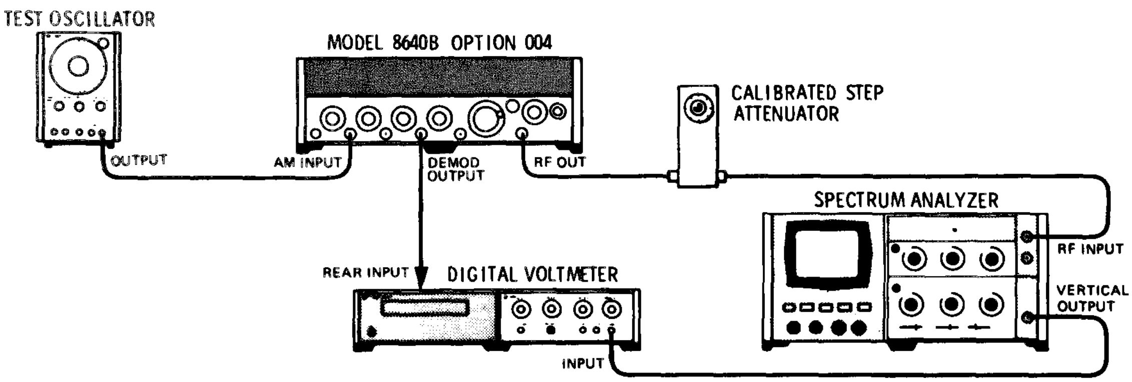


Figure* 5-4. *AM Accuracy Adjustment Test Setup

EQUIPMENT :

Digital Voltmeter . . . . HP 3480D/3484A Option 043
Spectmm Analyzer . . . . HP 141T/8554B/8552B
Test Oscillator . . . . HP 204D
10 dB Step Attenuator . . . . HP 355D Option H36

PROCEDURE:

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

Meter Function . . . . AM
COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . . INT

ADJUSTMENTS

5-32. AM ACCURACY ADJUSTMENT (Cont'd)

AM	OFF
MODULATION : : : : : : : : : : : : : : :	Fully cw
FM	OFF
RANGE	2-4 MHz
FREQUENCY TUNE.	3 MHz
OUTPUT LEVEL Switches	-13 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	..ON

2. Let the equipment warm up for two hours to minimize drift of the spectrum analyzer detector output,

3. Set calibrated step attenuator to 10 dB.

4. Set the spectrum analyzer center frequency to 3 MHz, frequency span to 200 kHz per division, resolution bandwidth to 300 kHz, input attenuation to 20 dB, and vertical scale to linear. Set the frequency span to zero, and tune the spectrum analyzer to peak the trace.

NOTE

Throughout this test, check that the signal is peaked in the center of the analyzer's passband.

5. Set the digital voltmeter to read mVdc with maximum filtering. Adjust the spectrum analyzer's vertical sensitivity for a digital voltmeter reading of -200.0 mVdc.

6. Set calibrated step attenuator to O dB and note the digital voltmeter reading.

Digital Voltmeter reading: ______________mVdc

7. Set calibrated step attenuator to 20 dB and note the digital voltmeter reading.

Digital Voltmeter reading: ______________ mVdc

8. Perform steps a, b, and c to obtain a value of offset voltage to be used in step 12.

   a. For steps 6 and 7 derive values of a, expressed as a ratio, from the formula:

$$a = 10^{A}$$

where $A = \dfrac{\text{Attenuation (dB)}}{20}$

and where Attenuation is the attenuation of step 3 minus that of step 6 or step 7. (Atten - uation figures should be obtained from the step attenuator's calibration chart which is accurate to ± 0.02 dB at 3 MHz.)

[e.g., a = 3.16 (+10 dB) for step 6, and a = 0.31Q(–10 dB) for step 7.]

a (step *6)* ________________

a (step *7)* ________________

ADJUSTMENTS

5-32. AM ACCURACY ADJUSTMENT (Cont'd)

b. For steps 6 and 7 derive values of offset voltage (V. off) from the formula:

$$Voff = \frac{mVdc + 200\ a}{1 - a}$$

where mVdc is the digital voltmeter reading of step 6 or step 7, and where a is the value derived in step 8a.

Voff (step 6)____________

Voff (step 7)____________

c. Calculate the average of the two values of offset voltage and use this Voff in step 12 (the difference between the two values of offset voltage should be <2 mVdc.

Voff ____________

9. Set the Signal Generator RANGE to 128-256 MHz and FREQUENCY TUNE to 190* 2 MHz. Set calibrated step attenuator to 10 dB.

10. Set the spectrum analyzer to display the 190 MHz signal with zero frequency span then peak the trace.

11. Set AM to DC. Set the test oscillator frequency to 120 Hz and adjust the level to give approximately 50% AM as read on the Signal Generator panel meter.

12. Adjust the spectrum analyzer's vertical sensitivity to give a digital voltmeter reading of –282.8 mV + Voff (e.g., if Voff from step 8 is +50.0 mV, adjust the spectrum analyzer to give a digital voltmeter reading of -232.8 mVdc.)

13. Set AC/DC switch A26A8S1 to AC. Set the digital voltmeter to read mVac and adjust the test oscillator level to give a reading of 100 mVrms. Switch the digital voltmeter to read the DEMOD OUTPUT voltage and adjust AC GAIN A26A8R8 to give a reading of 2500 ± 5 mVrms.

NOTE

AM Distortion must be <1$%.

14. Set AC/DC switch A26A8S1 to DC. Repeat step 13 except adjust DC GAIN A26A8R10 to give a reading of 500.00 ±0.05 mVrrns.

15. Set the digital voltmeter to read dc volts and adjust DC OFFSET A26A8R15 to give 1414*1 mVdc.

16. Perform DEMODULATED OUTPUT ACCURACY TEST (4-38).

ADJUSTMENTS

5-33. PEAK DEVIATION AND RANGE SWITCH ADJUSTMENT

REFERENCE:

Service Sheets 6,7, and 8.

DESCRIPTION:

The switches are adjusted so that the FM gain switch (i.e., A9S3, the switch that is controlled by both the peak deviation and the frequency range switch) is correctly positioned, This procedure should be performed whenever the A9 assembly has been disassembled.

PROCEDURE:

1. Set RANGE and PEAK DEVIATION switches fully CW. Loosen setscrews in the knobs and position RANGE switch knob so that 512-1024 MHz is under the cursor on front panel. Position PEAK DEVIATION switch knob so that 5.12 MHz is under the cursor on front panel. Tighten setscrews.

2. Loosen locking screw on gain switch (A9S3) shaft (see exploded view in Section VIII). Rotate shaft until rotor tooth on the front of the front wafer (A9S3AF-3 1/2) is centered under clip with 94 wire (white-yellow). Tighten locking screw.

3. Rotate RANGE and PEAK DEVIATION switches through all of their positions (one at a time). Check that tooth is adequately centered under all of the clips when they are approached from either direction (there is some backlash). If not, readjust the shaft until it is.

4. Perform Range Switch Adjustment, paragraph 5-34.

5-34. RANGE SWITCH ADJUSTMENT

REFERENCE:

Service Sheet 10.

DESCRIPTION:

The frequency at RF OUT is monitored with a frequency counter. The divider/filter cams are positioned so that the frequency at RF OUT agrees with the frequency indicated on the generator's readout. The RANGE switch knob is then set to the correct range. This procedure should be performed whenever the A9 assembly or the Al0 assembly has been removed or replaced.

EQUIPMENT:

Frequency Counter . . , ... HP 5327C

PROCEDURE :

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

COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . .INT

ADJUSTMENTS

RANGE	Fully CCW
FREQUENCY TUNE.	0.5 MHz
OUTPUT LEVEL Switches	+13 dBm
OUTPUT LEVEL Vemier	CAL
RF ON/OFF	..ON

2. Monitor output frequency with frequency counter. Loosen shaft coupling between RANGE switch and divider/filter cams. Rotate cam side of shaft until frequency counter reading agrees with frequency indicated on generator's output frequency display (i.e., to approximately 500 kHz); tighten shaft coupling.

3. Loosen RANGE switch knob, position it so that it indicates that the range is 0.5-1 MHz, and tighten it.

4. Set. RANGE switch to each of its other positions (from both directions). The frequency counter should display readings that agree approximately with generator's readout (the correct frequency counter reading for the EXT DOUBLER 512-1024 MHz position is approximately 256 MHz).

5-35. V_T POT (A3R1) ADJUSTMENT

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The V_T pot is aligned so that it will not hit either end-stop as the FREQUENCY TUNE control is tuned through its full range. This adjustment should be performed whenever the pot has been replaced.

ADJUSTMENTS

5-35. V_T POT (A3R1) ADJUSTMENT (Cont'd)

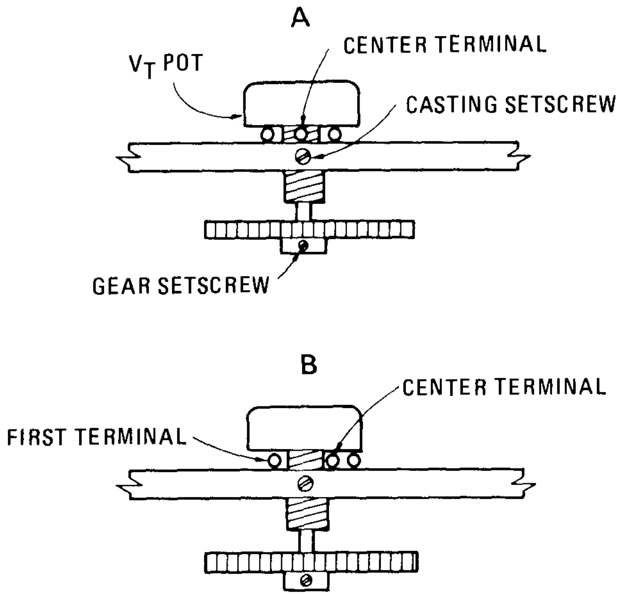


Figure 5-5. V_T Pot Adjustment

1. Set FREQUENCY TUNE fully CW.
2. Tighten the bushing and set V_T pot shaft fully CW.
3. Install pot with gear in casting so that center terminal (934 wire) is in line with casting setscrew (see Figure 5-5,A).
4. Tighten setscrews in gear (not casting setscrew).
5. Rotate the pot cw so that casting setscrew lies between first and center terminals of pot (see Figure 5-5,B).
6. Tighten casting setscrew.
7. Perform the V_T Voltage Adjustment (5-36.)

ADJUSTMENTS

5-36. V_T VOLTAGE ADJUSTMEfVT

REFERENCE:

Service Sheets 5,10, and 11.

DESCRIPTION:

This procedure should be performed whenever either the V_T pot, the A3 assembly, or the A10A2 assembly has been replaced.

PROCEDURE:

1. Set Signal Generator's controls as follows:

Meter Function	LEVEL
COUNTER MODE: EXPAND	Off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
RANGE	**256-512 MHz**
FREQUENCY TUNE	As specified
FINE TUNE	Centered
OUTPUT LEVEL Switches	0 dBm (0,0)
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set FREQUENCY TUNE to 356 MHz approached from low frequency band end (256 MHz); adjust V_T adjustment, A3A4R2 until the relays in the A10 assembly just actuate. When the relays actuate, they make a faint but audible clicking.

3. Tune FREQUENCY TUNE one turn ccw and then cw until relays actuate. The frequency at actuation should be 355-357 MHz.

4. Tune FREQUENCY TUNE from 256 to 512 MHz. The generator's panel meter should read 0 dBm through the entire frequency range.

5-37. RF OSCILLATOR END STOP ADJUSTMENT

REFERENCE:

Service Sheets 5,6, and 7.

DESCRIPTION:

This procedure describes the adjustment of the high and low frequency end stops of the RF Oscillator (A3). Slight adjustment of the end stops may be necessary when the RF Oscillator or Fine Tune assembly has been repaired or replaced. No special tools are required.

ADJUSTMENTS

5-37. RF OSCILLATOR END STOP ADJUSTMENT (Cont'd)

Normally, the adjustment can be made with the RF Oscillator in place. However, if the oscillator has already been removed, the adjustment is easier if the Connector Board Assembly (A3A4) is plugged in and the oscillator set into place with the front resting on the front panel trim strip. Temporarily connect the RF cable (W2) to the counter and install the FREQUENCY TUNE knob.

PROCEDURE :

1. Set Signal Generator's controls as follows:

   RANGE 0.5-1 MHz
   FINE TUNE. . . . . Centered
   LINE . . . . OFF

2. Remove bottom cover.

3. Switch LINE to ON and let instrument warm up for one hour.

4. Check that Varactor Anode bias is -14.70 ± 0.01 Vdc at A7TP2.

5, Tune FREQUENCY TUNE fully CCW. Compare the position of the stop ring teeth with Figure 5-6.

NOTE

Notice how the teeth on the stop rings line up in a staircase at the end stops. The stop pin and the adjustable stop ring determine the lower frequency limit. The stop pin and forward-most stop ring determine the high frequency limit, however, adjustment of this will also effect the low frequency limit.

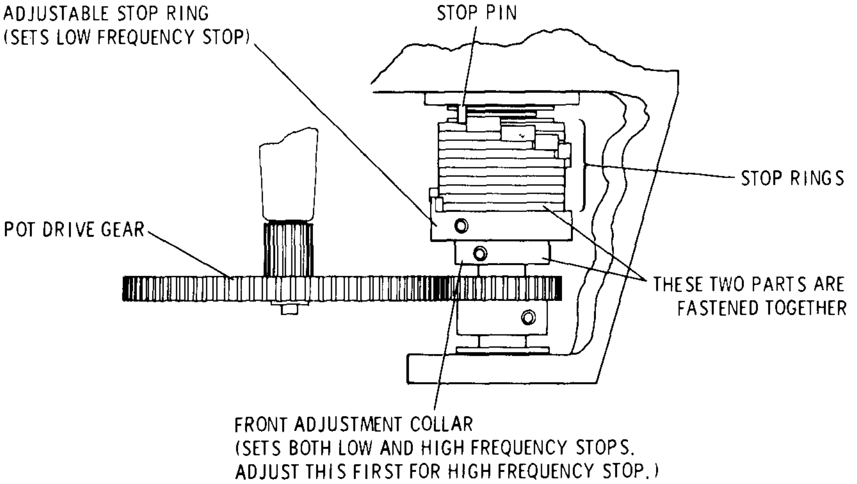


Figure 5-6. Location of RF Oscillator Stop Adjustments. Shown in Maximum ccw Position. Top View with Instrument Upside Down.

6. Adjust FREQUENCY TUNE fully CW. The frequency should read between 1.0752 and 1.0760 MHz. If it does not, note how far off the frequency is.

7. Adjust FREQUENCY TUNE ccw until first setscrew on front adjustment collar appears. Loosen setscrew.

ADJUSTMENTS

5-37. RF OSCILLATOR END STOP ADJUSTMENT (Cent'd)

8. Tune further ccw until second setscrew appears.

9. Loosen setscrew and rotate FREQUENCY TUNE up or down by the amount of correction needed (as noted in step 6), and tighten setscrew. Do not allow front adjustment collar to rotate.

10. Recheck high stop frequency and repeat preceding step as needed until stop frequency is correct. Then secure both setscrews.

NOTE

If the preceding steps have no effect, check that the V_T and FM Gain Compensation pots do not reach their stops first. If so, loosen the gear on the pot shaft and continue.

11. Adjust FREQUENCY TUNE fully ccw. The frequency should read between 0.4475 and 0.4482 MHz. If it does not, note how far off the frequency is.

12. Adjust FREQUENCY TUNE cw until first setscrew cm adjustable stop ring appears. Loosen setscrew.

13. Tune further cw until second setscrew appears.

14. Loosen setscrew and rot-ate FREQUENCY TUNE up or down by the amount of correction needed (as noted in step 11), and tighten setscrew. Do not allow adjustable stop ring to rotate.

15. Recheck low stop frequency and repeat preceding step as needed until stop frequency is correct. Them secure both setscrews.

CAUTION

Do **not overtighten setscrews. This may crack the adjustable end stop.**

NOTE

If the preceding steps have no effect, check that the V_T and FM Gain Compensation pots do not reach their stops first. If-so, loosen the gear on the pot shaft and continue.

16. *Recheck both stop* frequencies.

17. If either the V_T or FM Gain Compensation pots were altered, perform either the V_T Pot (A3R1) Adjustment (5-35), or Preliminary FM Adjustment (5-40).

ADJUSTMENTS

5-38. RF OSCILLATOR OUTPUT POWER ADJUSTMENT

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The RF Oscillator output will require adjusting if the power level varies beyond the limits +0.5 to +4.5 dBm at the Divider/Filter Buffer Amplifier, or —12 to —2 dBm at the Frequency Counter Buffer Amplifier. The power level is adjusted by changing the input loop penetration, of the appropriate buffer amplifier, in the oscillator cavity.

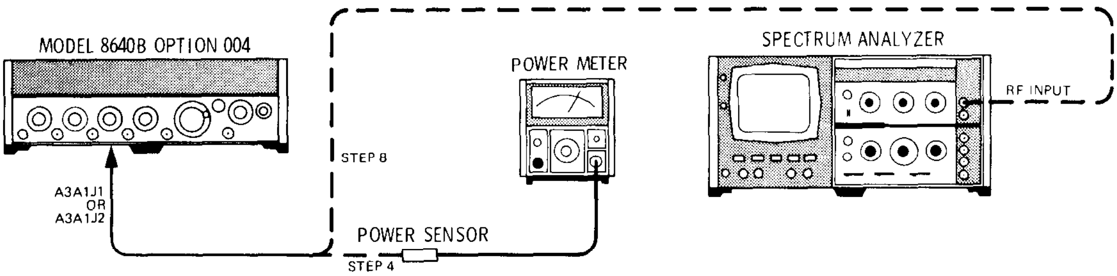


Figure 5-7. RF Oscillator Output Power Adjustment Test Setup

EQUIPMENT :

Power Meter	HP 435A
Power Sensor	HP 8482A
Spectrum Analyzer	HP 141T/8552B/8554B

PROCEDURE:

1. Remove A3 RF Oscillator from chassis. Refer to Service Sheet B for removal procedure.

2. Remove cover from the appropriate buffer amplifier assembly.

3. Re-insert A3A4 Connector Board Assembly into place while keeping oscillator section free of chassis. (It may be necessary to unsnap the clip on the rear of the oscillator housing to free the wiring harness.)

4. Connect power meter sensor to oscillator output connector A3A1J1 (Divider/Filter Buffer Amplifier) or A3A1J2 (Counter Buffer Amplifier).

5. Turn LINE to ON. Tune FREQUENCY TUNE across entire band and note point of minimum power as read on power meter. Tune to frequency of minimum power.

6. Loosen two screws on the buffer amplifier board and slide board forward or backward until power reads +0.5 dBm (Divider/Filter Buffer Amplifier) or **—12** dBm (Counter Buffer Amplifier). (Pushing board forward will increase power.)

7. Tighten screws and check power level across band. Power should remain within the limits of +0.5 to +4.5 dBm (Divider/Filter Buffer Amplifier) or —12 to —2 dBm (Counter Buffer Amplifier).

ADJUSTMENTS

5-38. RF OSCILLATOR OUTPUT POWER ADJUSTMENT (Cont'd)

8. Disconnect power sensor and connect spectrum analyzer to the buffer amplifier output.

9. Set analyzer's input attenuation to 50 dB, resolution bandwidth to 300 kHz, frequency controls to span 200 to 1200 MHz, and vertical sensitivity (reference level) controls to +10 dBm.

10. Tune oscillator across band and observe second and third harmonics, which should be more than 17 dB below fundamental for all frequencies.

11. W-install RF Oscillator.

12. Perform Harmonics Test (4-19), Output Level Flatness Test (4-27), Single Sideband Phase Noise Test (4-21) or Residual FM Test (4-24), and Output Leakage Test (4-31).

5-39. RF FILTER ADJUSTMENT

REFERENCE:

Service Sheet 10.

DESCRIPTION:

A spectrum analyzer and a tracking generator are used to measure the insertion loss and frequency response of each of the RF filters. Those filters that are adjustable are adjusted if necessary. A frequency counter, connected to the tracking generator's auxiliary output, is used to accurately set the analyzer's frequency. This procedure should be performed only when the RF filters have been repaired or are suspect.

The filters must meet specified pass band and stop band characteristics. Figure 5-8 illustrates the terms used in the procedure.

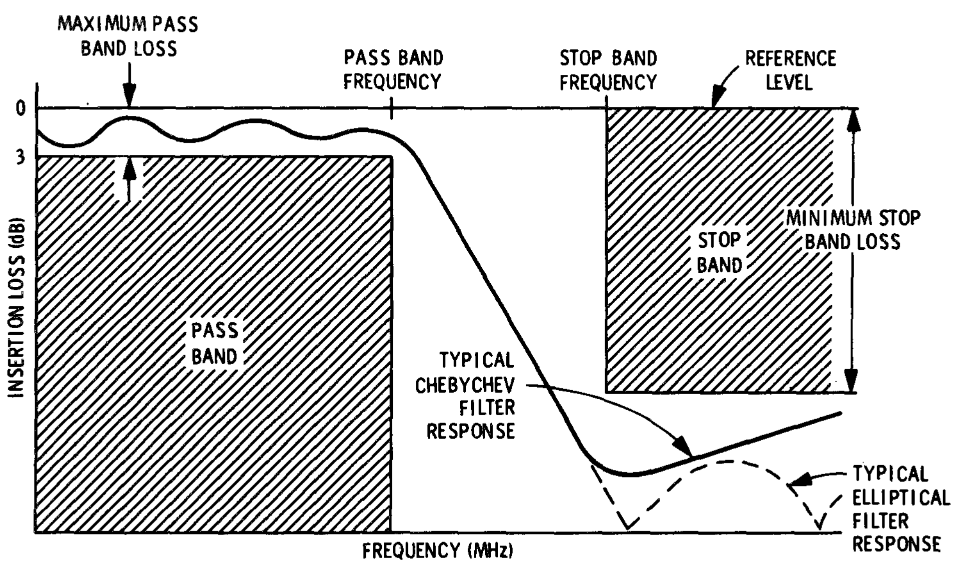


Figure 5-8. Filter Terminology

ADJUSTMENTS

5-39. RF FILTER ADJUSTMENT (Cont'd)

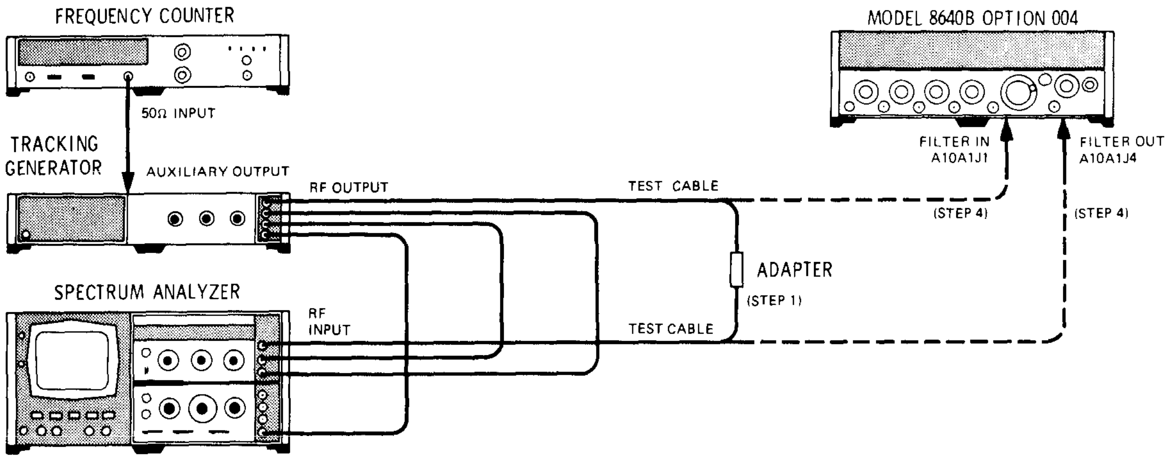


Figure 5-9. RF Filter Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 141T/8552B/8554B
Tracking Generator	HP 8444A
Frequency Counter	HP 5327C
Test Cable (2 required)	HP 11592-60001
Adapter	HP 1250-0827

PROCEDURE:

1. Connect equipment as shown in Figure 5-9 after setting Signal Generator's controls as follows:

RANGE	256-512 MHz
FREQUENCY TUNE	Fully cw
RF ON/OFF	OFF

2. Set spectrum analyzer center frequency to 550 MHz, frequency span (scan width) to 100 MHz per division, resolution bandwidth to 10 kHz, and input attenuation to 20 dB.

3. Set tracking generator's output level to O dBm. Adjust the tracking for maximum response in a 10 kHz resolution bandwidth. (Tracking should be checked periodically during this test.) Set analyzer's resolution bandwidth to 300 kHz.

4. For each of the frequency range bands listed in Table 5-3, perform the following:

   a. Connect spectrum analyzer's RF input to tracking generator's RF output (use test cables and adapter as shown in test setup). Set Signal Generator's RANGE and FREQUENCY TUNE controls as listed in the table. Set spectrum analyzer's frequency span (scan width) controls to zero Hz.

ADJUSTMENTS

5-39. RF FILTER ADJUSTMENT (Cont'd)

NOTE

Geometric mean switching (on the 8 to 512 MHz bands) occurs near the middle of the frequency range. Switching is controlled by the position of the FREQUENCY TUNE control and switches between the high and low band filters for the frequency range. It can be noted either by listening for the faint but audible clicking of the RF relays or by observing a change in the spectrum analyzer's display when connected to the RF filters.

b. Adjust analyzer's center frequency controls for a frequency counter indication of the pass band frequency listed in the table. Adjust analyzer's vertical sensitivity controls to set trace to top (reference) graticule line on display (use 2 dB log per division); this sets the reference level for the filter check.

c. Set analyzer's frequency span controls as listed in the table. Connect test cables to RF filter input and output as shown in the test setup. Check maximum loss at pass band frequency (center vertical graticule line) and below; it should be as specified.

d. Set analyzer's frequency span controls to zero Hz. Adjust analyzer's center frequency controls for a frequency counter indication of the stop band frequency listed in the table. Then reset frequency span controls as listed in the table and set analyzer's display for 10 dB log per division.

NOTE

To measure the stop band frequency on the highest band it is necessary to set a frequency of 492 MHz at the second vertical graticule line to the left of center. This puts 692 MHz at the center (the counter will only read to 550 MHz).

e. Check minimum loss at stop band frequency (center vertical graticule line) and above; it should be as specified.

f. If necessary, on the 64-512 MHz bands, adjust the appropriate filter components to set pass band and stop band insertion loss within the specified limits. Use a non-metallic tuning tool.

NOTE

The 256-512 MHz high band is the most difficult to adjust and usually takes many iterations. Start with the adjustment capacitors oriented as in Figure 5-10. Stop band minimum loss should be >30 dB from 692-1000 MHz.

ADJUSTMENTS

5-39. RF FILTER ADJUSTMENT (Cont'd)

Table 5-3. RF Filter Check

Signal Generator			Spectrum Analyzer	Pass Band		Stop Band		Adjust-ment (A10A1)
RANGE (Band)	FREQUENCY TUNE	Filter	Frequency Span Per Division	Frequency	Maximum Loss	Frequency	Minimum Loss	
256-.512 MHz	Fully cw Fully ccw	High Low	100 MHz 50 MHz	550 MHz 356 MHz	<3 dB <3 dB	692 MHz 460 MHz	>30 dB >30 dB	C81-84 L43-45
128-256 MHz	Fully cw Fully ccw	High Low	50 MHz 20 MHz	275 MHz 128 MHz	<3 dB <3 dB	346 MHz 230 MHz	>30 dB >30 dB	L40-42 L37-39
54-128 MHz	Fully cw Fully ccw	High Low	20 MHz 10 MHz	137 MHz 89 MHz	<3 dB <3 dB	173 MHz 115 MHz	>30 dB >25 dB	L31-33 None
32-64 MHz	Fully cw Fully ccw	High Low	10 MHz 5 MHz	69 MHz 45 MHz	<3 dB <3 dB	86.5 MHz 58 MHz	>25 dB >25 dB	None None
16-32 MHz	Fully cw Fully ccw	High Low	5 MHz 2 MHz	34 MHz 22 MHz	<3 dB <3 dB	43.2 MHz 28.7 MHz	>20 dB >20 dB	None None
8-16 MHz	Fully cw Fully ccw	High Low	2 MHz 2 MHz	17.0 MHz 11.0 MHz	<3 dB <3 dB	21.6 MHz 14.3 MHz	>15 dB >15 dB	None None
4-8 MHz	*	*	1 MHz	8.6 MHz	<3 dB	10.7 MHz	>38 dB	None
2-4 MHZ	*	*	1 MHz	4.3 MHz	<3 dB	5.40 MHz	>40 dB	None
1-2 MHz	*	*	1 MHz	2.2 MHz	<3 dB	2.70 MHz	>30 dB	None
1.5-1 MHz	*	*	1 MHz	1.1 MHz	<3 dB	1.30 MHz	>30 dB	None

* The 0.5 to 8 MHz bands have a single filter for each band. Geometric mean switching does not take place and the FREQUENCY TUNE control can be left at any position.

ADJUSTMENTS

5-39. RF FILTER ADJUSTMENT (Cont'd)

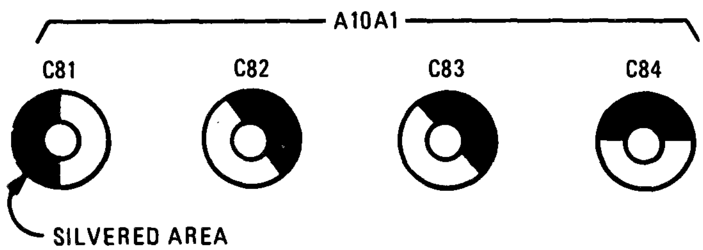


Figure 5-10. 256-512 MHz High Band Capacitor Adjustment Orientation

540. PRELIMINARY FM ADJUSTMENTS

REFERENCE:

Service Sheets 6 and 7.

DESCRIPTION:

A digital voltmeter is used to correctly set the mechanical position of the FM compensation pot on the RF oscillator (this is necessary only if either the oscillator or the pot has been changed). Then the DVM is used to adjust the FM calibration voltage and the offset (balance) voltages in the FM amplifiers.

EQUIPMENT :

Digital Voltmeter . . . . **HP 3480D/3484A** Option 042

PROCEDURE:

1. Set Signal Generator's controls as follows:

Meter Function	**FM**
COUNTER MODE: **EXPAND**	Off
LOCK	Off
Source	INT
AM	OFF
FM	OFF
PEAK DEVIATION	2.56 MHz
PEAK DEVIATION Vernier	Fully cw
RANGE	256-512 MHz
FREQUENCY TUNE	Fully ccw
RF ON/OFF	ON

ADJUSTMENTS

5-40. PRELIMINARY FM ADJUSTMENTS (Cont'd)

2. To set the compensation pot, A3R2, turn generator's LINE switch to OFF. Loosen setscrews in the gear on pot's shaft. Set DVM to measure ohms and connect it between 936 and 938 wires on the pot.

3. Without changing position of FREQUENCY TUNE knob, rotate compensation pot's shaft until DVM indicates between 0 and 9 ohms across the two wires.

4. Remove DVM, tighten setscrews, and set LINE to ON.

5. To adjust calibration voltage, set FM switch to CAL, set DVM to measure dc voltage, and connect DVM to FM BUFFER IN test point, A5TP5. Adjust FM CAL POT, A13R3, for 1.000 ± 0.001 Vdc at A5TP5.

6. To adjust amplifier offset voltages, set FM switch to DC, and set FREQUENCY TUNE to 300 MHz. Connect DVM to BUFFER OUT test point, A5TP6, and adjust BUFFER OFFSET adjustment, A5R23, for 0 ± 0.5 mVdc at A5TP6.

7. Connect DVM to OUTPUT test point, A5TP2, and adjust AMPLIFIER OFFSET adjustment, A5R8, for 0 ± 1.0 mVdc at A5TP2,

8. Connect DVM to VARACTOR CATHODE test point, A7TP3, and set PEAK DEVIATION switch as shown below. The DVM should read as specified.

PEAK DEVIATION	DVM Reading at A7TP3
2.56 MHz	<± 1.5 mVdc
1.28 MHz	<± 1.0 mVdc
640 kHz	<± 0.75 mVdc
320 kHz	<± 0.50 mVdc
160 kHz	<± 0.50 mVdc
80 kHz	<± 0.50 mVdc
40 kHz	<± 0.50 mVdc
20 kHz	<± 0.50 mVdc
10 kHz	<± 0.50 mVdc
5 kHz	<± 0.50 mVdc

9. Reset PEAK DEVIATION switch to 2.56 MHz. Turn PEAK DEVIATION vernier and FREQUENCY TUNE control through their ranges. The voltage at A7TP3 should remain less than 1.5 mVdc.

_____________1.5 mVdc

10. Set FM switch to OFF and note frequency displayed on generator's counter. Set FM to DC; the frequency should change less than 800 Hz.

_____________800 Hz

ADJUSTMENTS

5-40. PRELIMINARY FM ADJUSTMENTS (Cont'd)

11. To set VAR pot (VARACTOR BIAS), A7R19, connect DVM to VARACTOR ANODE test point, A7TP2, and check that voltage is –14.70 ± 0.01 Vdc. If it is not, adjust A7R19 until it is.

12. Perform the FM Linearity Adjustment, (5-39).

5-41. FM LINEARITY ADJUSTMENT

REFERENCE:

Service sheet 7.

DESCRIPTION:

The positive and negative shaping circuits are adjusted to match the characteristics of the varactors in the RF oscillator. The reference output of a variable-phase generator is used to drive the Signal Generator's FM circuits; its variable phase output is used to drive an oscilloscope's horizontal circuits and the FM linearity circuit. A discriminator is used to demodulate the FM and the demodulated signal is subtracted (i.e., summed 180° out of phase) from the modulation signal in the FM linearity circuit and fed to the oscilloscope's vertical circuits. The shaping circuits are then adjusted for the flattest trace possible on the oscilloscope's display. A reference signal generator and a mixer are used to down-convert the test generator's output to within the range of the discriminator.

NOTE

The *Preliminary FM Adjustment (5-40) should be made before performing this adjustment.*

A simpler method for adjusting FM linearity, using less test equipment, is presented in paragraph 5-42. This alternate method however, is not as effective for locating the source of FM distortion when used in trouble-shooting.

ADJUSTMENTS

5-41. FM LINEARITY ADJUSTMENT (Cent'd)

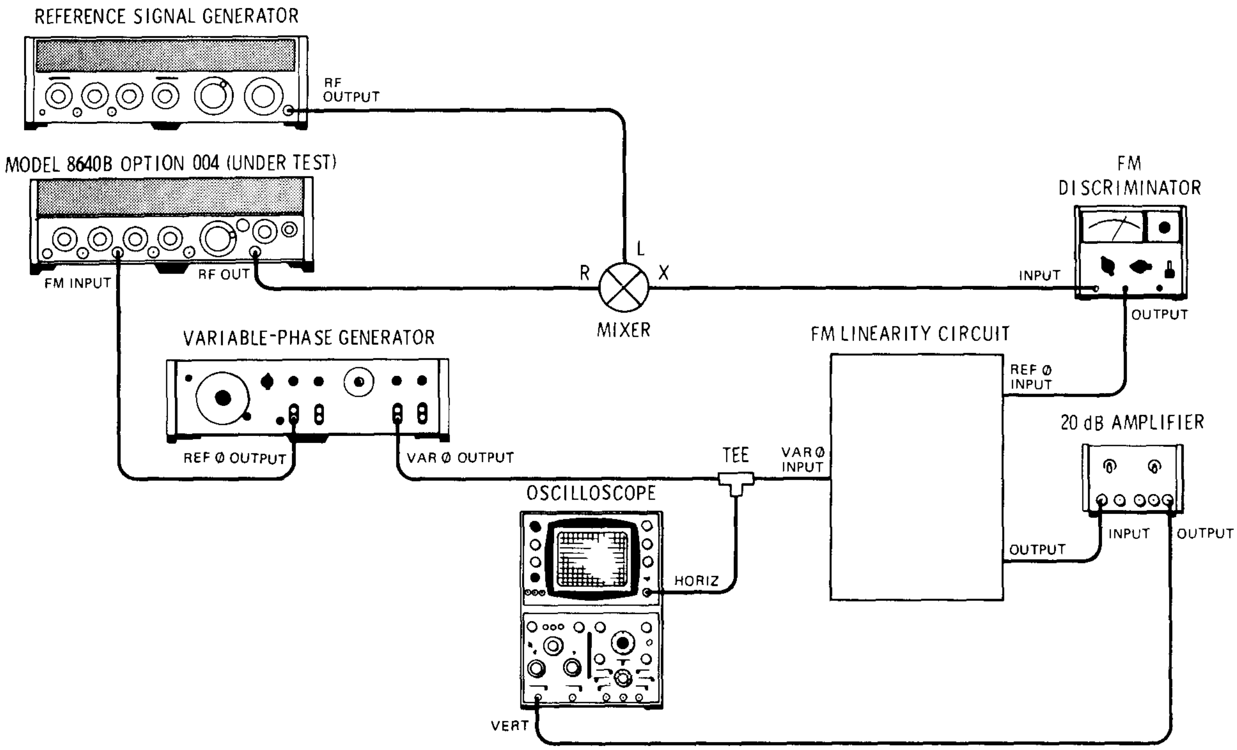


Figure 5-11. FM Linearity Adjustment Test Setup

EQUIPMENT:

Reference Signal Generator	HP 8640A
Mixer	HP 10514A
FM Discriminator	HP 5210A
Filter Kit (for Discriminator)	HP 10531A
Variable-Phase Generator	HP 203A
Oscilloscope	HP 180A/1801A/1820C
FM Linearity Circuit	HP 08640-60503
20 dB Amplifier	HP 465A

NOTE

The reference signal generator should have low RF drift, low residual FM (performance approximately equal to the Model 8640A) and be capable of producing 355 MHz at +7 dBm.

ADJUSTMENTS

5-41. F-M LINEARITY ADJUSTMENT (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 5-11 after setting Signal Generator's controls as follows:

Meter Function	FM
COUNTER MODE : EXPAND	Off
LOCK	Off
Sound	INT
A M	OFF
FM	AC
PEAK DEVIATION	2.56 MHz
PEAK DEVIATION Vernier	Fully cw
RANGE	256-512 MHz
FREQUENCY TUNE	360 MHz
OUTPUT LEVEL Switches	-7 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

NOTE

If it is desired to optimize FM linearity at a frequency other than mid-band, proceed as follows:

a. Set RANGE and FREQUENCY TUNE to the desired frequency.

b. Set RANGE to 256-512 MHz.

c. Set the reference signal generator 5 MHz below the test generator's output frequency.

2. Set reference signal generator for a 355 MHz, CW signal at +7 dBm.

3. Calibrate the discriminator; prepare a 25 kHz filter (from the filter kit) and install it in the discriminator. Set FM linearity circuit's output switch to ref Ø. Adjust variable-phase generator's variable phase output's amplitude and the oscilloscope's horizontal gain for full screen deflection on the display. Adjust reference signal generator for 5 MHz on the discriminator.

4. Set variable-phase generator's reference phase output for a 1 kHz signal at an amplitude that gives a 2.56 MHz peak deviation indication on the Signal Generator's panel meter. Set linearity circuit's voltage divider switch to 100. Adjust generator's variable phase output's phase for a straight line on the display as shown in Figure 5-12. Adjust oscilloscope's vertical gain for ±1 division at edge of display.

ADJUSTMENTS

5-41. FM LINEARITY ADJUSTMENT (Cont'd)

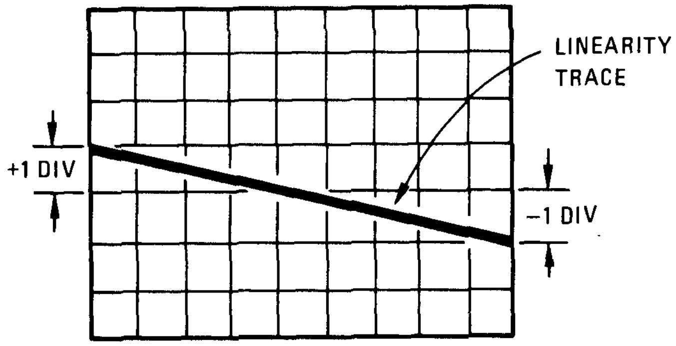


Figure 5-12. FM Linearity Display

5. Set linearity circuit's output switch to ref Ø + var Ø and the voltage divider switch to 1. This calibrates the display for 1% error in linearity per division.

6. Adjust variable-phase generator's variable phase output's phase and linearity circuits var Ø level control for the best possible horizontal straight line over *center* portion of trace.

7. Adjust POS SHAPE and NEG SHAPE adjustments, A7R12 and A7R41, for the best possible horizontal straight line at both ends of the trace (but within ± one major division or ± 1%).

8. Perform the FM Sensitivity Adjustment, (5-43).

5-42. FM LINEARITY ADJUSTMENT (Alternate)

REFERENCE:

Service Sheet 7.

DESCRIPTION :

The Signal Generator is modulated with a 1 kHz signal. The generator's RF output is then demodulated with an FM discriminator and the distortion on the discriminator output is observed with a spectrum analyzer. The shaping circuits are then adjusted for minimum distortion across the 0.5 to 1 MHz frequency range. (See paragraph 5-41 for another FM Linearity Adjustment which should be more useful in troubleshooting FM distortion).

NOTE

The preliminary FM Adjustment (5-40) should be made before performing this adjustment.

ADJUSTMENTS

5-42. FM LINEARITY ADJUSTMENT (Alternate) (cont'd)

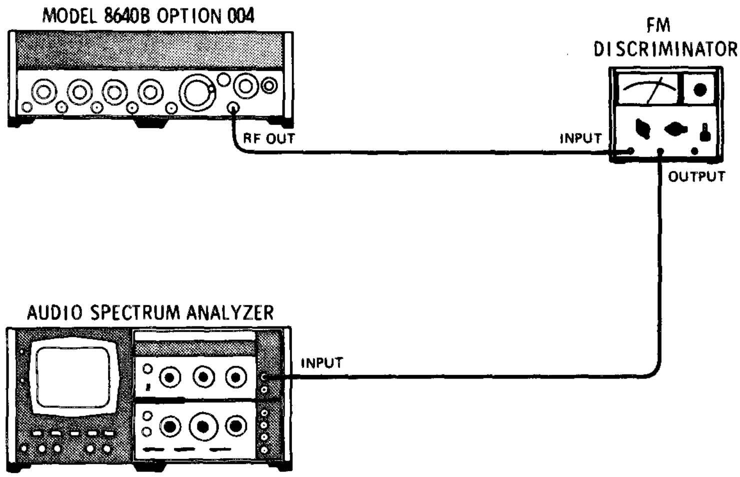


Figure 5-13. FM Linearity Adjustment (Alternate) Test Setup

EQUIPMENT:

FM Discriminator	HP5210A
Filter Kit (For Discriminator)	HP 10531A
Audio Spectrum Analyzer	HP 141T/8552B/8556A

PROCEDURE:

1. Connect equipment as shown in Figure 5-13 after setting Signal Generator's controls as follows:

Meter Function	FM
COUNTER MODE: EXPAND	off
LOCK	off
Source	INT
[illegible]	OFF
MODULATION FREQUENCY	1 kHz (Fixed)
FM	INT
PEAK DEVIATION	5 kHz
PEAK DEVIATION Vernier	Fully CW
RANGE	0.5-1 MHz
FREQUENCY TUNE	0.7 MHz
OUTPUT LEVEL Switches	+13 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

NOTE

If it is desired to optimize FM linearity at a frequency other than mid-band, proceed as follows:

a. Set RANGE and FREQUENCY TUNE to the desired frequency.
b. Set RANGE to 0.5-1 MHz.

ADJUSTMENTS

5-42. FM LINEARITY ADJUSTMENT (Alternate) (Cont'd)

2. Using the filter kit, prepare a 25 kHz Butterworth low-pass filter and install it in the discriminator.

3. Set the discriminator's range to 1 MHz and sensitivity to IV.

4. Set spectrum analyzer's resolution bandwidth to 100 Hz and its center frequency controls for a O to 5 kHz span. Set the display for 10 dB per division.

5. Use generator's PEAK DEVIATION vernier to set 5 kHz of peak deviation (as read on panel meter). Use analyzer's display reference level controls to set the demodulated 1 kHz signal to the top (reference) graticule line on the display.

6. Adjust POS SHAPE and NEG SHAPE adjustments, A7R12 and A7R41, for minimum distortion. Observe both second and third harmonics.

7. Slowly tune from 0.5 to 1 MHz and observe distortion. If harmonics are less than 30 dB down (3% distortion) or if it is desired to minimize distortion across the band, adjust A7R12 and A7 R41 for best compromise. However, harmonics must always be greater than 30 dB down.

8. Perform the FM sensitivity adjustment (5-43).

5-43. FM SENSITIVITY ADJUSTMENT

REFERENCE:

Service Sheets 6 and 7.

DESCRIPTION:

The Signal Generator is frequency modulated with an accurate, 1 Vpk, 16.63 kHz signal. The modulated RF output is monitored on a spectrum analyzer and FM sensitivity is adjusted for the first carrier (Bessel) null. The adjustments are made at mid-band and at both band ends. (Peak deviation = 2.405 x fmod at first carrier null.)

NOTE

The FM Linearity Adjustment (5-41 or 5-42) should be made before performing this adjustment.

ADJUSTMENTS

5-43. FM SENSITIVITY ADJUSTMENT (Cont'd)

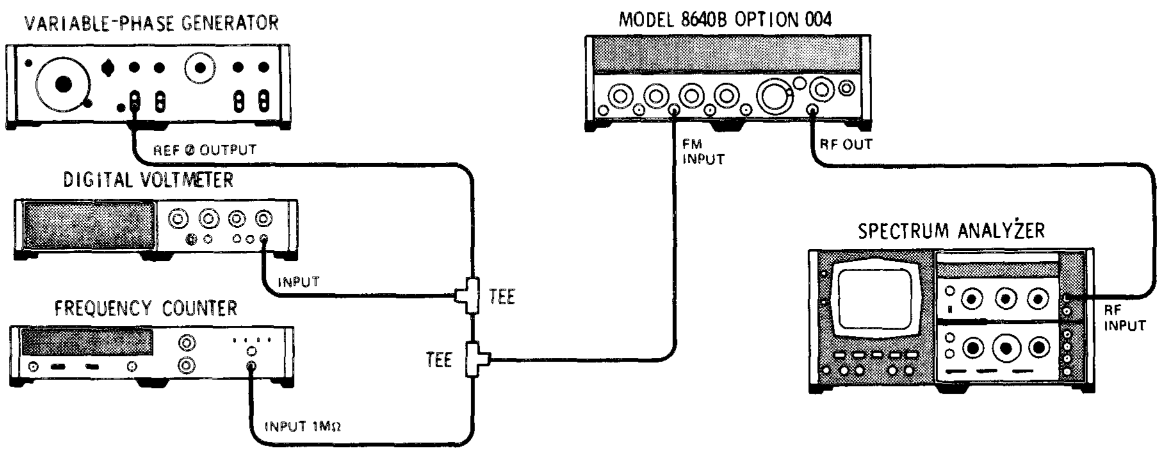


Figure 5-14. FM Sensitivity Adjustment Test Setup

EQUIPMENT:

Variable-Phwe Generator	HP 203A
Digital Voltmeter	HP 3480D/3484A Option 043
Frequency Counter	HP 5327C
Spectrum Analyzer	HP 141T/8552B/8553B

PROCEDURE;

1. Connect equipment as shown in Figure 5-14 after setting Signal Generator's controls as follows:

Meter Function	FM
COUNTER MODE: EXPAND	off
LOCK	off
Source	INT
AM	OFF
FM	OFF
PEAK DEVIATION:	40 kHz
PEAK DEVIATION Vernier	Fully CW
RANGE	16-32 MHz
FREQUENCY TUNE " : : :	24 MHz
OUTPUT LEVEL Switches	-37 dBm
OUTPUT LEVEL Vernier	CAL
RF ON/OFF	ON

2. Set spectrum analyzer's center frequency to 24 MHz, resolution bandwidth to 3 kHz frequency span (scan width) per division to 20 kHz, and input attenuation to 0 dB. Center signal on display and use reference level controls (set for 10 dB/division) to set signal peak to top (0 dB reference) graticule line on display.

3. Set Signal Generator's FM switch to AC. Adjust variable-phase generator for a frequency counter reading of 16.63 kHz at 707 mVrms as read on DVM.

4. Adjust MID FM SENS adjustment, A3A4R3, for at least 50 dB of carrier null.

NOTE

The carrier is the center spectrum line on the display. A 50 dB null is when it drops 50 dB below its CW amplitude (set in step 2).

5. Set Signal Generator's FREQUENCY TUNE to 16 MHz. Adjust analyzer to center the carrier on the display. Adjust LOW FM SENS adjustment, A3A4R2 for at least 50 dB of carrier null.

6. Set Signal Generator's FREQUENCY TUNE to 32 MHz. Adjust analyzer to center the carrier on the display. Adjust HI FM SENS adjustment, A3A4R4, for at least 50 dB of carrier null.

7. Repeat steps 4 through 6 until carrier null is >50 dB at 16, 24, and 32 MHz.

8. Perform the FM Distortion Test (4-44) and FM Sensitivity y and Accuracy Tests (4-45).

5-44. INTERNAL REFERENCE FREQUENCY ADJUSTMENT

REFERENCE:

Service Sheet 19.

DESCRIPTION:

An oscilloscope is used to display a Lissajous figure (2:1) to set the internal reference frequency. The Lissajous figure is derived from the 10 MHz reference of a frequency counter and the Signal Generator's 5 MHz internal reference. This procedure should be performed whenever the internal reference is found to be out of specification.

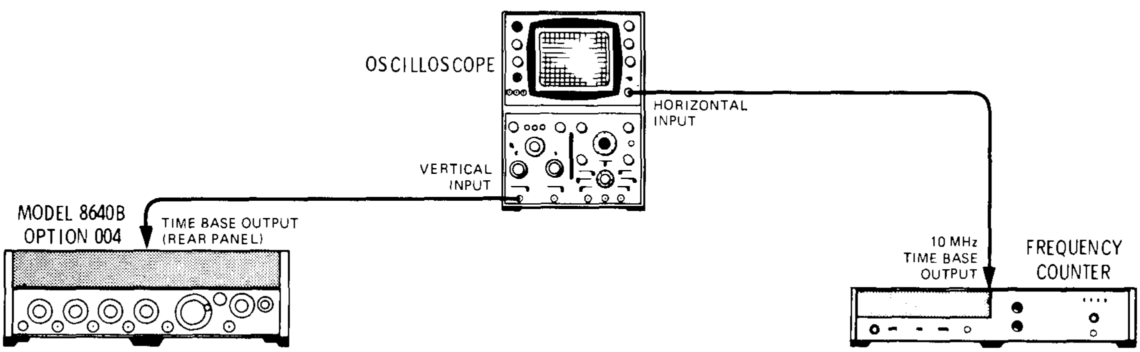


Figure 5-15. Internal Reference Frequency Adjustment Test Setup

EQUIPMENT:

Frequency Counter . . . . HP 5327C Option H49
Oscilloscope . . . . HP 180A/1801A/1820C

ADJUSTMENTS

5-44. INTERNAL REFERENCE FREQUENCY ADJUSTMENT (Cont'd)

PROCEDURE:

1. Remove trim strip that holds front panel window in place. Gently pull window up and out and remove it. Allow generator to warm up for 2 hours.

2. Connect equipment as shorn in Figure 5-15 after setting Signal Generator's controls as follows:

   TIME BASE REF INT/EXT (on rear panel) . . . . INT
   TIME BASE VERNIER . . . . CAL

3. Set oscilloscope's vertical sensitivity to 0.05 V/div (at) and horizontal scale for external ac. Set magnifier for X 10 and adjust oscilloscope's controls for a Lissajous figure.

4. Adjust time base adjustment pot (available through the hole in the front of the counter casting) for a stable 2:1 Lissajous figure (it will look approximately like a figure eight on its side).

5. Replace front panel window and trim strip.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for odering parts. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording 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.

6-5. ABBREVIATIONS

6-6. Table 6-2 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 part of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-3 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.

6-9. The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) 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.

6-10. The total quantity for each part is given only once - at the first appearance of the part number in the list.

NOTE

Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-11. ORDERING INFORMATION

6-12. To order a part listed in the replaceable parts table, note the Hewlett-Packard number and then cross-reference that part number to the National Stock NUmber in table 6-5. Then order through normal ordering channels.

6-13. If the part number does not have a National Stock Number, then order the part through normal ordering channels using the Hewlett-Packard part number.

6-14. SPARE PARTS KIT

6-15. Stocking spare parts for an instrument is often done to insure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data, and parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

6-16. ILLUSTRATED PARTS BREAKDOWNS

6-17. Illustrated Parts Breakdowns for the following assemblies are given on the alphabetic foldout pages in this manual (located after the numbered, schematic foldouts):

- Al Output Level 1 dB Assembly
- A3 RF Oscillator Assembly
- A8 Counter Lock Assembly
- A9 Peak Deviation and Range Switch Assembly
- AlO Divider/Filter Assembly
- A11 Variable-Frequency Modulation Oscillator Assembly (Option 001)
- A19 Output Level 10 dB Assembly
- A26 AM/AGC and RF Amplifier Assembly

6-18. Figures 6-1 and 6-2 are breakdowns of the generator's cabinet parts and the parts that comprise the Type N connector, Jl,

Table 6-1. Part Numbers for Exchange Assemblies

Reference Designation	Description	Part Number	
		Exchange Assy	New Assy
A1	Output Level Assy, 1 dB	08640-60077	08640-60062
A3	RF Oscillator Assy	08640-60098	08640-60099
A8A1	RF Scaler Assy	08640-60097	08640-60168
A8A2	Counter/Lock Board Assy	08640-60087	08640-60027
A19	Output Level Assy, 10 dB	08640-60078	08640-60060

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

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

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

NOTE

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

Table 6-2. 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 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1	08640-60062	1	OUTPUT LEVEL ASSY, 1DB	28480	08640-60062
A1	08640-60077		RESTORED 08640-60062,REQUIRES EXCHANGE	28480	08640-60077
A1MP1	0380-0020	3	SPACER-RND .25-LG .128-ID .1880-OD BRS NI	76854	2295-616
A1MP2	0380-0023	1	SPACER-RND .5-LG .128-ID .19-OC STL CO	76854	3457-432
A1MP3	0380-0029	1	SPACER-RND 1-LG .128.ID .19-OD STL CD-AU	76854	3457-464
A1MP4	2200-0781	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0781
A1MP5	3130-0038	1	COUPLES: SWITCH SST U-SHAPED	76854	12276-6
A1MP6	08640-00068	1	PLATE, PCT MCUNTING	08480	08640-00068
A1MP7	08640-20235	1	SHAFT, VERNIER	28480	08640-20235
A1MP8	08640-20236	1	SHAFT, VERNIER	28480	08640-20236
A1MP9	2190-0003	4	WASHER-LK HLCL NO. 4 .115 IN ID .253 IN	28480	2190-0003
A1MP10	2190-0016	3	WASHER-LK INTL T .377 IN ID .507 IN OD	78189	1920-02
A1MP11	2360-0120	2	SCREW-MACH 6-32 82 DEG FL HD POZI REC	2840	2360-0120
A1MP12	2950-0001	1	NUT-MEX-DBL CHAM 3/8-32-THD .094-THK .5	12697	20/4-13
A1P1	1251-0198	3	CONNECTOR: PC EDGE: 6-CONT: SOLDER EYE	71785	251-06-30-261
A1R1	2100-0638	1	RESISTOR-VAR 250 OHM 20% C	28480	2100-0638
A1R2	0698-4197	1	RESISTOR 1.081K .25% .125W F TUBULAR	03888	PME55-1/8-T0-1081R-C
A1R3	0698-0096	1	RESISTOR 968 OHM 1% .125W F TUBULAR	03888	PME55-I/8-TO-9680-F
A1R4	0698-3495	1	RESISTOR 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A1R5	0698-4462	1	RESISTOR 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A1R6	0757-0419	1	RESISTOR 681 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-681R-F
A1R7	0698-3162	7	RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A1R8	0757-0418	2	RESISTOR 619 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-619R-F
A1R9	0698-7676	1	RESISTOR 546 OHM 1% .125W F TUBULAR	19701	MF4C1/8-T0-546R-F
A1R10	0698-3178	1	RESISTOR 487 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-487R-F
A1R11	0757-0414	1	RESISTOR 432 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-432R-F
A1R12	0698-3446	3	RESISTOR 383 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-383R-F
A1R13	0698-3445	5	RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-348R-F
A1R14	0698-4449	1	RESISTOR 309 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-309R-F
A1R15	0698-6250	1	RESISTOR 2.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2501-F
A1S1A	3130-0485	1	SWITCH:ROTARY, WAFER	28480	3130-0485
A1S1B	3130-0486	1	SWITCH:ROTARY, WAFER	28480	3130-0486
A1S1C	3130-0487	1	SWITCH:ROTARY, WAFER	28480	3130-0487
A1A1	08640-60063	1	ATTENUATOR ASSY	28480	08640-60063
A1A1J1			NSR, P/O A1A1		
A1A1J2			NSR, P/O A1A1		
A2	08640-60055	1	BOARD ASSY, METER SELECT	28480	08640-60055
A2C1	0160-0128		CAPACITOR-FXD 2.2UF +-20% 25WVDC CER	28480	0160-0128
A2C2	0180-1746	4	CAPACITOR-FXD: 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C3	0160-2199	4	CAPACITOR-FXD 30 PF +-5% 300 WCDV MICA	28480	0160-2199
A2C4	0180-1746		CAPACITOR-FXD: 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C5	0180-2207	1	CAPACITOR-FXD: 100UF+-10% 10VDC TA	56289	150D107X9010R2
A2CR1	1901-0040	30	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2MP1	4040-0749	4	EXTRACTOR,PC BOARD, BROWN	28480	4040-0749
	1480-0073	15	PIN:DRIVE 0.250" LG	00000	OBD
A2R1			NOT ASSIGNED		
A2R2	0698-3160		ESSITOR 31.6K 1% 125W F TUBULAR	16299	C4-1/8-T0-3162-F
A2R3	0698-3160		RESISTOR 31.6K 1% .125W F TUBULAR	16299	C4-1/8-T0-3162-F
A2R4	0757-0442	38	RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A2R5	2100-2633	2	REISISTOR: VAR: TRMR: 105OHM 10% C	19701	ET50X102
A2R6	0698-3440	7	RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A2R7	0698-3460	1	RESISTOR 422K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4223-F
A2R8	0757-0279	9	RESISTOR 3.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A2R9	0757-0420	10	RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-751-F
A2R10	0698-3157	3	RESISTOR, 19.6K 1% .125W F TUBULAR	16299	C4-1/8-T0-1962-F
A2R11	0757-0398	3	RESISTOR 75 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-75R0-F
A2S1	3101-1728	1	SWITCH: PH -STA CPDT	28480	3101-1728
A2TP1	0360-1514	88	TERMINAL: SLDR STUD	28480	0360-1514
A2TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A2TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A2TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A2TP5	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A2U1	1820-0158	3	IC LIN LM302 FOLLOWER	27014	LM302H
A2U2	1820-0476	1	IC LIN AMPLIFIER	07263	715HC

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2VR1	1902-3104	1	DIODE-ZNR 5.62V 5% DO-7 PD=.4W	04713	SZ 10939-110
A2VR2	1902-0025	5	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A3	08640-60099	1	RF OSCILLATOR ASSY, NRFR	28480	08640-60099
A3	08640-60098		RESTORED 08640-60099, REQUIRES EXCHANGE	28480	08640-60098
A3C1			NSR, PART OF A3		
A3C2			NSR, PART OF A3		
A3L1			NSR, PART OF A3MP10		
A3MP1	0510-0052	2	RETAINER, RING, .125 DIA, CAD PLT STL	97464	7100-12-CD
A3MP2	0510-0055	2	RETAINER, RING, .438 DIA, CAD PLT STL	97464	3100-43-ST-CD
A3MP3	1430-0537	1	GEAR SPUR	28480	1430-0537
A3MP4	1430-0759	3	GEAR SPUR	28480	1430-0759
A3MP5	08640-00085	1	GASKET, COVER (FINE TUNE)	28480	08640-00085
A3MP6	08640-20106	2	BUSHING, POT	28480	08640-20106
A3MP7	8160-0233	1	RFI PLUG BE CU IAU PL .173-OD .18-L	28480	8160-0233
A3MP8	08640-20106		BUSHING, POT	28480	08640-20106
A3MP9	08640-20224	1	CAP, TRANSISTOR	28480	08640-20224
A3MP10	08640-60206	1	OSCILLATOR FINE TUNE ASSY	28480	08640-60206
A3MP11	2200-0151	3	SCREW-MACH 4-40 PAN HD POZI REFC SST-300	28480	2200-0151
A3MP12	2190-0019	5	WASHER-LK HLCL NO. 4 .115 IN ID .226 IN	28480	2190-0019
A3MP13	8160-0203	1	RFI ROUND STRIP NI ALY .06-OD	07700	20-90044
A3MP14	0510-0055		RETAINER, RING, .438 DIA, CAD PLT STL	97464	3100-43-ST-CD
A3MP15	3030-0007	13	SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
A3MP16	1430-0759		GEAR SPUR	28480	1430-0759
A3MP17	3030-0196	2	SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0196
A3MP18	2190-0016		WASHER-LK INTL T .377 IN ID .507 IN OD	78189	1920-02
A3MP19	3030-0196		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0196
A3MP20	2190-0016		WASHER-LK INTL T .377 IN ID .507 IN OD	78189	1920-02
A3MP21	3030-0007		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
A3MP22	2510-0135	8	SCREW-MACH 8-32 PAN HD POZI REC SST-300	28480	2510-0135
A3MP23	3050-0001		WASHER-FL MTLC NO. 8 .172 IN ID .375 UB	73734	NO. 1445
A3MP24	2190-0017		WASHER-LK HLCL NO. 8 .168 IN ID .31 IN	28480	2190-0017
A3MP25	08640-20193		SHAFT MOD. FINE TUNE	28480	08640-20193
A3MP26	0510-0015	1	RETAINER, RING, .125 DIA, CAD PLT STL	79136	5133-12-S-MD-R
A3Q1	5086-7082	1	TRANSISTOR	28480	5086-7082
A3R1	2100-3265	1	RESISTOR-VAR 10K 20% C	71450	550
A3R2	2100-0541	1	RESISTOR-VAR PREC 1K 3% WW NOTE WHEN REPLACING A3R1 OR R2, ALSO RE- PLACE BUSHING A3MP6 OR MP8, AND LOCK- WASHER A3MP18 OR MP20.	28480	2100-0541
A3T1			MSR, PART OF A3		
A3A1			FILTER/BUFFER AMPLIFIER ASSY, NRFR		
A3A1FL1	0160-0204	13	CAPACITOR=FXD 5500PF +-0% 200WVDC CER	01121	SMF8-A2
A3A1FL2	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A3A1FL3	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A3A1FL4	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A3A1FL5	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A3A1FL6	0160-0204		CAPACITOR=FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A3A1J1	1250-0830	2	CONNECTOR-RF SMC M SGL HOLE FR	2K497	701872
A3A1J2	1250-0830		CONNECTOR-RF SMC N SGL HOLE FR	2K497	701872
A3A1MP1	08640-00011	2	COVER, BUFFER BOARD	28480	08640-00011
A3A1MP2	2200-0105	6	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0105
A3A1MP3	3050-0105	4	WASHER-FL MTLC NO. 4 .125 IN ID .281 IN	28480	3050-0105
A3A1MP4	8160-0229	4	GASKET, RFI	07700	48-90092
A3A1MP5	08640-00011		COVER, BUFFER BOARD	28480	08640-00011
A3A1MP6	8160-0229		GASKET, RFI	07700	48-90092
A3A1MP7	2200-0105		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0105
A3A1MP8	3050-0105		WASHER-FL MTLC NO. 4 .125 IN ID .281 IN	28480	3050-0105
A3A1MP9	2740-0001	2	NUT-HEX-DBL CHAM 10-20-THD .109-THK	28480	2740-0001
A3A1MP10	2190-0011	2	WASHER-LK INTL T NO. 10 .195 IN ID .381	78189	1910-00
A3A1MP11	2740-0001		NUT-HEX-DBL CHAM 10-32-THD .109-THK	28480	2740-0001
A3A1MP12	2190-0011		WASHER INTL T NO. .195 IN ID ID .381	78189	1910-00
A3A1MP13	2200-0121	10	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0121
A3A1MP14	2190-0019		WASHER-LK HLCL NO. 4 .115 IN IC .226 IN	28480	2190-0019
A3A1MP15	2190-0019		WASHER-LK HLCL NO. 4 .115 IN ID .226 IN	28480	2190-0019
A3A1MP16	2200-0143	8	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0143
A3A1A1			VARACTOR HEAD FILTER ASSY, NRFR		

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3A1A2	08640-60024	1	RF DIVISION/FILTER BUFFER AMPLIFIER ASSY	28480	08640-60024
A3A1A2C1	0160-3456	41	CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A2C2	0160-3456		CAPACITOR-FXD 1000PFD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A2C3	0160-3878	4	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3A1A2C4	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A2C5	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A2C6	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3A1A2C7	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A2C8	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A3A1A2C9	0160-3876	4	CAPACITOR-FXD 47PF +-20% 200WVCC CER	28480	0160-3876
A3A1A2L1	9140-0142	4	COIL: FXD: MOLDED PF CHOKE: 2.2UH 10%	24226	10/221
A3A1A2L2	9140-0142		COIL: FXD: MOLDED RF CHOKE: 2.2UH 10%	24226	10/221
A3A1A2MP1	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A3A1A2Q1	1854-0247	8	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A2Q2	1854-0247		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A2R1	0757-0422	5	RESISTOR 909 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A3A1A2R2	0698-7212	3	RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A3A1A2R3	0698-7188	2	RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-10R-G
A3A1A2R4	0698-3445		RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-348R-F
A3A1A2R5	0698-7214	2	RESISTOR 121 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-121R-G
A3A1A2R6	0698-7224	4	RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3A1A2R7	0757-0422		RESSITOR 909 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A3A1A2R8	0698-7193	2	RESISTOR 16.2 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-16R2-G
A3A1A2R9	0698-3445		RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-348R-F
A3A1A2R10	0698-7214		RESISTOR 121 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-121R-G
A3A1A2T1	08640-00007	3	LOOP BUFFER INPUT	28480	08640-00007
A3A1A3	08640-60037	1	COUNTER/BUFFER AMPLIFIER ASSY	28480	08640-60037
A3A1A3C1	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A3C2	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A3C3	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3A1A3C4	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A3C5	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A3C6	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3A1A3C7	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3A1A3L1	9140-0142		COIL: FXD: MOLDED RF CHOKE: 2.2UH 10%	24226	10/221
A3A1A3L2	9140-0142		COIL: FXD: MOLDED RF CHOKE: 2.2UH 10%	24226	10/221
A3A1A3MP1	1200-0173		INSULATION-XSTR TO- 5 .075-THK	28480	1200-0173
A3A1A3Q1	1854-0247		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A3Q2	1854-0247		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A3R1	0757-0422		RESISTOR 909 CHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A3A1A3R2	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-100R-G
A3A1A3R3	0698-7188		RESISTOR 10 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-1OR-G
A3A1A3R4	0698-3445		RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-348R-F
A3A1A3R5	0698-7216	1	RESSITOR 147 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-147R-G
A3A1A3R6	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-316R-G
A3A1A3R7	0757-0422		RESISTOR 909 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A3A1A3R8	0698-7193		RESISTOR 16.2 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-16R2-G
A3A1A3R9	0698-3445		RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-348R-F
A3A1A3R10	0698-7196	2	RESSITOR 21.5 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-21R5-G
A3A1A3R11	0698-7196		RESISTOR 21.5 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-21R5-G
A3A1A3R12	0698-7205	1	RESISTOR 51.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-T00-51R1-G
A3A1A3T1	08640-00007		LOOP BUFFER INPUT	28480	08640-00007
A3A2			VARACTOR HEAD ASSY, NFRF		
A3A2CR1			NSR, PART OF A3A2.		
A3A2CR2			NSR, PART OF A3A2.		
A3A2CR3			NSR, PART OF A3A2.		
A3A2R1			NSR, PART OF A3A2.		
A3A3			OSCILLATOR LOOP ASSY, NRFR		
A3A4	08640-60196	1	CONNECTOR BOARD ASSY	28480	08640-60196
A3A4C1			NOT ASSIGNED		
A3A4C2			NOT ASSIGNED		
A3A4R1	2100-3054	2	RESISTOR-VAR TRMR 50KOHM 10% C SIDE ADJ	32997	3006P-1-503
A3A4R2	2100-3109	4	RESISTOR,VAR TRMR 2KOHM 10% C SIDE ADJ	32997	3006P-1-202
A3A4R3	2100-3123	5	RESISTOR,VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A3A4R4	2100-3154	3	RESISTOR-VAR TRMR 1KOHM 10% C SIDE ADJ	32997	3006P-1-102
A3A4R5			NOT ASSIGNED		

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3A4R6			NOT ASSIGNED		
A3A4R7	0698-3439	3	RESISTOR 178 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-178R-F
A3A4R8	0757-0416	17	RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A3A4R9	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A3A4TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A3A4TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A3A4U1			NOT ASSIGNED		
A4	08640-60056	1	BOARD ASSY, METER DRIVER	28480	08640-60056
A4C1	0160-2199		CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A4C2	0180-0228	4	CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A4C3	0160-2055	40	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A4C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A4C5	0160-2199		CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A4CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A4CR2	1901-0025	21	DIODE-GEN PRP 100V 200MA	28480	1901-0025
A4MP1	4040-0750	2	EXTRACTOR-PC BOARD, RED	28480	4040-0750
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A4Q1	1854-0071	28	TRANSSITOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q2	1854-0019	4	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4Q3	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4R1	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R2	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R3	0757-0199	6	RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2152-F
A4R4	0698-3444	3	RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-316R-F
A4R5	0757-0460	4	RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A4R6	0757-0280	21	RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R7	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R8			NOT ASSIGNED		
A4R9	0698-3193	2	RESISTOR 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A4R10	2100-2514	2	RESISTOR: VAR: TRMR: 20KOHM 10% C	19701	ET50X203
A4R11	0698-3193		RESISTOR 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A4R12	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A4R13	0757-0280		RESISTOR 1K 1% /125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R14	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R15	0757-0346	18	RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A4R16	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A4R17	0698-7340	1	RESSITOR 79.95K .25% .125W F TUBULAR	19701	MF4C1/8-T2-79951-C
A4R18	0698-8307	1	RESISTOR 7.4K .25% .125W F TUBULAR	19701	MF52C1/4-T2-7401-C
A4R19	2100-2521	4	RESISTOR: VAR: TRMR: 2KOHM 10% C	19701	ET50X202
A4R20	0757-0288	2	RESISTOR 9.09K 1% .125W F TUBULAR	19701	MF4C1/8-T0-9091-F
A4R21	0683-1065	1	RESISTOR 10M 5% .25W CC TUBULAR	01121	CB1065
A4R22	0698-5094	1	RESISTOR 5.1M 5% .25W CC TUBULAR	01121	CB5155
A4TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP3	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP4	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP5	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP6	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A4TP7	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A4U1	1820-0223	2	IC LIN LM301AH AMPLIFIER	27014	LM301AH
A4U2	1820-0223		IC LIN LM301AH AMPLIFIER	27014	LM301AH
A4U3	1820-0054	8	IC DGTL SN74 00 N GATE	01295	S17400N
A4U4	1820-0511	5	IC DGTL SM74 08 N GATE	01295	SN7408N
A4VR1	1902-0025		DIODE-ZNR 10V 5% DC-7 PD-.4W TC=+.06%	04713	SZ 10939-182
A4VR2	1902-0025		DIODE-ZNR 10V 5% DC-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A5	08640-60029	1	FM AMPLIFIER ASSY	28480	08640-60029
A5C1	0160-2228	2	CAPACITOR-FXD 2700PF +-5% 300WVDC MICA	28480	0160-2228
A5C2	0160-2228		CAPACITOR-FXD 2700PF +-5% 300WVDC MICA	28480	0160-2228
A5C3	0180-0116	6	CAPACITOR-FXC: 6.8UF+-10% 35VDC TA	56289	150D685X903582
A5C4	0180-1715	3	CAPACITOR-FXD: 150UF+-10% 6VDC TA-SOLID	56289	150D157X9006R2
A5C5	0180-0269	1	CAPACITOR-FXD: 1UF+75-10% 150VDC AL	56289	30D105G1508A2
A5C6	0180-0197	25	CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C7	0180-0116		CAPACITOR-FXD: 6.BUF+-10% 35VDC TA	56289	150D685X903582
A5C8	0180-2211	1	CAPACITOR-FXD: 5UF+5-10% 150VDC AL	56289	30D505F150CC2
A5C9	0160-0939	3	CAPACITOR-FXD 430P +-5% 300WVDC MICA	28480	0160-0939
A5CR1			NOT ASSIGNED		
A5CR2			NOT ASSIGNED		
A5CR3			NOT ASSIGNED		
A5CR4			NOT ASSIGNED		
A5CR5	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5CR6	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A5CR7	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A5CR8	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A5CR9	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A5CR10	1901-0050	14	DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A5CR11	1901-0050		DIODE-SWITCHING 2N2 80V 200MA	28480	1901-0050
A5CR12	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A5CR13	1901-0025		DIODE-GEN PAP 100V 200MA	28480	1901-0025
A5K1	0490-1078	1	RELAY: REED: A1 .5A 200V CONT: 4V COIL	28480	0490-1078
A5MP1	4040-0750		EXTRACTOR-PC BOARD, RED	28480	4040-0750
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A5MP2	4040-0756	1	EXTRACTOR, P.C. BOARD, WHITE	28480	4040-0756
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A5Q1	1854-0221	5	TRANSISTOR NPN DUAL 200%-HFE 10MV-VBE	28480	1854-0221
A5Q2	1854-0221		TRANSISTOR NPN DUAL 200%-HFE 10MV-V8E	28480	1854-0221
A5Q3	1854-0404	8	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q4	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q5	1853-0038	4	TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0038
	1205-0011	3	HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
	1200-0173	26	INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A5Q6	1853-0038		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0038
	1205-0011		HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A5Q7	1853-0038		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0038
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A5Q8	1854-0039	1	TRANSISTOR NPN 2N3053 SI PD=1W	04713	2N3053
	1200-0173		INSULATOR,XSTR TO- 5 .075-THK	28480	1200-0173
	1205-0011		HEAT-DISSIPATOR SGL TO-5 PKG	28480	1205-0011
A5Q9	1854-0022	3	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A5Q10	1854-0237	2	TRANSISTOR NPN SI PD=20W	04713	2N3738
	0510-0002	2	PRESS-IN NUT 6-23 .062-LG .062-HGT	28480	0510-0002
	1205-0085	2	HEAT-DISSIPATOR SGL TO-49 PKG	28480	1205-0085
	2360-0199	2	SCREW-MACH 6-32 PAN HD POZI REC SST-300	28480	2360-0199
	2420-0003	2	NUT-HEX-DBL CHAM 6-32-THD .094-THK .25	28480	2420-0003
	2190-0018	3	WASHER-LK HLCL NO. 6 .141 IN ID .269 IN	28480	2190-0018
	2190-0007	2	WASHER-LK INTL T NO. 6 .141 IN ID .288	78189	1906-00
A5Q11	1853-0012	1	TRANSISTOR PNP 2N2904A SI CHIP	01295	2N2904A
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A5Q12	1854-0237		TRANSISTOR NPN 2N3738 SI PD=20W	04713	2N3738
	0510-0002		PRESS-IN NUT 6-32 .062-LG 062-HGT	28480	0510-0002
	1205-0085		HEAT-DISSIPATOR SGL TO-49 PKG	28480	1205-0085
	2360-0199		SCREW-MACH 6-32 PAN HD PDZI REC SST-300	28480	2360-0199
	2420-0003		NUT-HEX-DBL CHAM 6-32-THD .094-THK .25	28480	2420-0003
	2190-0018		WASHER-LK HLCL NO. 6 .141 IN ID .269 IN	28480	2190-0018
	2190-0007		WASHER-LK INTL T NO. 6 .141 IN ID .288	78189	1906-00
A5R1	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A5R2	0757-0180	2	RESISTOR 31. OHM 1% .125W F TUBULAR	24546	C5-1/4-T0-31R6-F
A5R3	0757-0403	4	RESISTOR 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R4	0757-0290	7	RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-T0-6191-F
A5R5	0757-0317	5	RESISTOR 1.33K 1% .125W F TUBULAR	24546	C4-1/8-T0-1331-F
A5R6	0698-3132	6	RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-2610-F
A5R7	0698-3410	1	RESISTOR 3.16K 1% .5W F TUBULAR	19701	MF7C1/2-T0-3161-F
A5R8	2100-3164	1	RESISTOR-VAR TRMR 10 OHM 20% C SIDE ADJ	32997	3006P-1-100
A5R9	0698-0085	10	RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-T0-2611-F
A5R10	0757-0317		RESISTOR 1.33K 1% .125W F TUBULAR	24546	C4-1/8-T0-1331-F
A5R11	0698-3132		RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-2610-F
A5R12	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-T0-6191-F
A5R13	0757-0180		RESISTOR 31.6 OHM 1% .125W F TUBULAR	24546	C5-1/4-T0-31R6-F
A5R14	0757-0403		RESISTOR 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R15	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A5R16	0757-0401	15	RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A5R17	0698-3446		RESISTOR 383 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-383R-F
A5R18	0698-3132		RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-2610-F
A5R19	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A5R20	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-1080-F
A5R21			NOT ASSIGNED		
A5R22	0698-3430	1	RESISTOR 21.5 OHM .125W F TUBULAR	03888	PME55-1/8-T0-21R5-F
A5R23	2100-3154		RESISTOR-VAR TRMR 1KOHM 10% C SIDE ADJ	32997	3006P-I-I02
A5R24	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A5R25	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A5R26	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A5R27	0757-0441	5	RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-T0-8251-F
A5R28	0757-0440	8	RESISTOR 7.5K 1% .125W F F TUBULAR	24546	C4-1/8-TO-7501-F
A5R29	0698-3158	1	RESISTOR 23.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1102-F
A5R30	0757-0443	5	RESISTOR 11K 1% .125W F TUUBLAR	24546	C4-1/8-T0-1102-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R31	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A5R32	0757-0438	35	RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A5R33	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-T0-2611-F
A5R34	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-T0-2611-F
A5R35	0757-0399	6	RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A5R36	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A5R37	0698-3391	1	RESISTOR 21.5 OHM 1% .5W F TUBULAR	19701	MF7C1/2-T0-21R5-F
A5R38	0757-0198	1	RESISTOR 100 OHM 1% .5W F TUBULAR	19701	MF7C1/2-T0-101-F
A5R39	0698-5839	2	RESISTOR 9.1 OHM 5% .25W CC TUBULAR	01121	CB91G5
A5R40	0698-5839		RESISTOR 9.1 OHM 5% .25W CC TUBULAR	01121	CB91G5
A5R41	0698-3260	2	RESISTOR 464K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4643-F
A5TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A5TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A5TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A5TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A5TP5	0360-1514		TERMINAL: SLDR STD	28480	0360-1514
A5TP6	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A5U1	1820-0158		IC LIN LM302 FOLLOWER	27014	LM302H
A6	08640-60033	1	ANNUNCIATOR ASSY	28480	08640-60033
A6DS1	2140-0427	6	LAMP, INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6DS2	2140-0427		LAMP, INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6DS3	2140-0427		LAMP, INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6DS4	2140-0427		LAMP,INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6DS5	2140-0427		LAMP, INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6DS6	2140-0427		LAMP, INCAND T-1 BULB,5V,0.06A	00501	LA-851
A6P1	1251-3054		CONNECTOR STRIP:9 OPEN POSIITON	74868	221-68
	1251-1249	2	PLZG KEY-PRINTED CIRCUIT CONN	90949	143-953
	1251-1313	2	CONTACT, CONN, U/W MICRO SER, FEM	13511	220-502
A6R1	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A7	08640-60046	1	FM SHAPING BOARD ASSY	28480	08640-60046
A7C1	0180-1735	3	CAPACITOR-FXD: .22UF+-10% 35VDC TA	56289	150D224X9035A2
A7C2	0180-1735		CAPACITOR-FXD: .22UF+-10% 35VDC TA	56289	150D224X9035A2
A7C3	0180-0373	1	CAPACITOR-FXD: .68UF+-10% 35VDC TA	56289	150D684X9035A2
A7C4	0180-2141	1	CAPACITOR-FXD: 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A7C5	0180-0141	2	CAPACITOR-FXD: 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A7C6	0180-1715		CAPACITOR-FXD: 150UF+-10% 6VDC TA-SOLID	56289	150D157X9006R2
A7C7	0160-2453	1	CAPACITOR-FXD .22UF +-10% 80WVDC POLYE	84411	HEW-238T
A7C8	0180-1846	1	CAPACITOR-FXD; 2.2UF+-10% 35VDC TA	56287	150D225X9035B2
A7C9	0160-2204	5	CAPACITOR-FXO 100PF +-5% 300WVDC MICA	28480	0160-2204
A7C10	0180-0141		CAPACITOR-FXD: 50UF+-75-10% 50VDC AL	56289	30D506G050DD2
A7C11	0180-1715		CAPACITOR-FXD: 150UF+-10% LVDC TA-SOLID	56289	150D157X9006R2
A7C12	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A7C13	0180-2206	2	CAPACITOR-FXD: 60UF+-10% 6VDC TA-SOLID	56289	150D606X9006B2
A7CR1	1901-0033	20	DIODE-GEN PRP 180V200MA	28480	1901-0033
A7CR2	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR3	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR4	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR5	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR6	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR7	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR8	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR9	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR10	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A7CR11	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR12	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR13	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR14	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR15	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR16	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR17	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR18	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR19	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR20	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7CR21	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A7J1	1250-0835	1	CONNECTOR-RF SMC M PC	24931	37JR104-2
A7K1	0490-1080	2	RELAY: REED: 1C .25A 150V CONT: 5V COIL	28480	0490-1080

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A7MP1	4040-0751	1	EXTRACTOR-PC BD ORN LEXAN .062 BD THKNS	28480	4040-0751
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A7MP2	4040-0748	3	EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A7Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q3	1854-0022		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173		INSULATION-XSTR TO- 5 .075-THK	28480	1200-0173
A7Q4	1853-0020	11	TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A7Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q6	1853-0038		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0038
	1200-0173		INSULATION-XSTR TO- 5 .075-THK	28480	1200-0173
A7Q7	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A7Q8	1853-0020		TRANSISTOR PNP SI CHIP PD-300MW	28480	1853-0020
A7R1	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16289	C4-1/8-T0-4642-F
A7R2	0698-3450	8	RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A7R3	0698-3153	3	RESISTOR 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A7R4	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2152-F
A7R5	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A7R6	0698-3243	1	RESISTOR 178K 1% .125W F TUBULAR	16299	C4-1/8-T0-1783-F
A7R7	0698-3454	2	RESISTOR 215K 1% .125W F TUBULAR	16299	C4-1/8-T0-2153-F
A7R8	0757-0289	3	RESISTOR 13.3K 1% .125W F TUBULAR	19701	MF4C1/8-T0-1332-F
A7R9	0698-3161	2	RESISTOR 38.3K 1% .125W F TUBULAR	16299	C4-1/8-T0-3832-F
A7R10	0698-3154	6	RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A7R11	0757-0288		RESISTOR 9.09K 1% .125W F TUBULAR	19701	MF4C1/8-T0-9091-F
A7R12	2100-3109		RESISTOR-VAR TRMR 2KOHM 10% C SIDE ADJ	32997	3006P-I-202
A7R13	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A7R14	0698-3260		RESISTOR 464K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4643-F
A7R15	0757-0458	4	RESISTOR 51.1K 1% .125W F TUUBLAR	24546	C4-1/8-T0-5112-F
A7R16	0757-0443		RESISTOR 11K 1% .125W F TUBULAR	24546	C4-1/8-T0-1102-F
A7R17	0698-3155	5	RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-T0-4641-F
A7R18	0757-0123	2	RESISTOR 34.8K 1% .125W F TUBULAR	24546	C5-1/4-T0-3482-F
A7R19	2100-3103	3	RESISTOR-VAR TRMR 10KOHM 10% C SIDE ADJ	32997	3006P-I-103
A7R20	0698-3152	1	RESISTOR 3.485 1% .125W F TUBULAR	16299	C4-1/8-T0-3481-F
A7R21	0757-1094	4	RESISTOR 1.47K 1% .125W F TUBULAR	24546	C4-1/8-T0-1471-F
A7R22	0757-0278	6	RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A7R23	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A7R24	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-T0-6191-F
A7R25	0757-0443		RESISTOR 11K 1% .125W F TUBULAR	24546	C4-1/8-T0-1102-F
A7R26	0698-3157		RESISTOR 19.6K 1% .125W F TUBULAR	16299	C4-1/8-T0-1962-F
A7R27	0698-3160		RESISTOR 31.6K 1% .125W F TUUBLAR	16299	C4-1/8-T0-3162-F
A7R28	0757-0461	1	RESISTOR 68.15 1% .125W F TUBULAR	24546	C4-1/8-T0-6812-F
A7R29	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A7R30	0757-0403		RESISTOR 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A7R31	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A7R32	0757-0395	1	RESSITOR 56.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-56R2-F
A7R33	0698-3435	1	RESISTOR 38.3 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-38R3-F
A7R34	0698-3432	2	RESISTOR 26.1 OHM 1% 1.25W F TUBULAR	03888	PME55-1/8-T0-26R1-F
A7R35	0757-0294	1	RESISTOR 17.8 OHM 1% .125W F TUBULAR	19701	MF4C1/8-T0-17R8-F
A7R36	0698-3427	1	RESISTOR 13.3 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-13R3-F
A7R37	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A7R38	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A7R39	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A7R40	0757-0200	2	RESISTOR 5.62K 1% .125W F TUBULAR	24546	C4-1/8-T0-5621-F
A7R41	2100-3109		RESISTOR-VAR TRMR 2KOHM 10% C SIDE ADJ	32997	3006P-I-202
A7R42	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A7R43	0698-3155		RESISTOR 4.6K 1% .125W F TUBULAR	16299	C4-1/8-T0-4641-F
A7R44	0757-0443		RESISTOR 11K 1% .125W F TUBULAR	24546	C4-1/8-T0-1102-F
A7R45	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A7R46	0757-0123		RESISTOR 34.8K 1% .125W F TUBULAR	24546	C5-1/4-T0-3482-F
A7R47	0698-3449	4	RESISTOR 28.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2872-F
A7R48	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2152-F
A7R49	0698-3136	1	RESISTOR 17.8K 1% .125W F TUBULAR	16299	C4-1/8-T0-1782-F
A7R50	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A7R51	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A7R52	0757-0200		RESISTOR 5.62K 1% .125W F TUBULAR	24546	C4-1/8-T0-5621-F
A7R53	0698-3151	2	RESISTOR 2.87K 1% .125W F TUBULAR	16299	C4-1/8-T0-2871-F
A7R54	0757-1094		RESISTOR 1.47K 1% .125W F TUBULAR	24546	C4-1/8-T0-1471-F
A7R55	0757-0401		RESISTOR 100 OHM 1% .125W F F TUBULAR	24546	C4-1/8-T0-101-F
A7R56	0698-3432		RESISTOR 26.1 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-26R1-F
A7R57	0698-3433	1	RESISTOR 28.7 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-2BR7-F
A7R58	0698-3434	1	RESISTOR 34.8 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-34R8-F
A7R59	0757-0316	3	RESISTOR 42.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-42R2-F
A7R60	0757-0394	8	RESISTOR 51.1 OHM .125W F TUBULAR	24546	C4-1/8-T0-51R1-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A7R61	0757-0276	1	RESISTOR 61.9 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A7R62	0757-0398		RESISTOR 75 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-75R0-F
A7R63	0757-0400	1	RESISTOR 90.9 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-90R9-F
A7R64	0757-0403		RESISTOR 121 OHM 1% .125W F TUBULAR	2446	C4-1/8-T0-121R-F
A7R65	0757-0405	1	RESISTOR 162 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-162R-F
A7R66	0757-0401		RESISTOR 100 OMM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A7R67			NOT ASSIGNED		
A7R68			NOT ASSIGNED		
A7R69			NOT ASSIGNED		
A7R70	0698-3150	6	RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-T0-2371-F
A7R71	0757-0424	2	RESISTOR 1.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1101-F
A7R72	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A7R73	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A7R74	0698-3150		RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-T0-2371-F
A7R75	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-751-F
A7R76	0757-0441		RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-T0-8251-F
A7R77	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A7R78	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A7R79	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	245465	C4-1/8-T0-511R-F
A7TP1	0360-1514		TERMINAL: SLDR SUD	28480	0360-1514
A7TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A7TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A7TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A7U1	1826-0013	2	IC LIN AMPLIFIER	28480	1826-0013
A7U2	1820-0125	1	IC DGTL COMPARATOR (ANALOG)	07263	711HC
A7U3	1820-0175	1	IC DGTL SN74 05 N INVERTER	01295	SN7405N
A7VR1	1902-0049	5	DIODE-ZNR 6.19V 5% DO-7 PD=.4W	28480	1902-0049
A7VR2	1902-3182	2	DIODE-ZNR 12.2V 5% DO-7 PD=.4W	04713	SZ 10939-206
A8	08640-60115	1	COUNTER/LOCK ASSY	28480	08640-60115
ABC1	0160-2049	16	CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
ABC2	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WCDV CER	28480	0160-2049
ABC3	0160-2049		CAPACITOR-FXC 5000PF +80-20% 500WVDC CER	28480	0160-2049
ABC4	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
ABC5	0160-2357	2	CAPACITOR-FXD 1000PF +80-20% 500WVDC CER	28480	0160-2357
ABC6	0160-2357		CAPACITOR-FXD 1000PF +80-20% 500WVDC CER	28480	0160-2357
A8FL1	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A8FL2	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A8FL3	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A8FL4	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A8L1	9100-2232	5	COIL: FXD: MOLDED RF CHOKE: .56UH 10%	24226	15/560
A8L2	9100-2232		COIL: FXD: MOLDED RF CHOCK: .56UH 10%	24226	15/560
A8L3	9100-2232		COIL: FXD: MOLDED RF CHOCK: .56UH 10%	24226	15/560
A8L4	9100-2232		COIL: FXD: MOLDED RF CHOKE: .56UH 10%	24226	15/560
A8L5	9100-2232		COIL: FXD: MOLDED RF CHOKE: .56UH 10%	24226	15/560
A8MP1	1200-0081	1	INSULATOR, BSGH,FLG, .115 ID	26365	974-307
A8MP2	2190-0027	1	WASHER-LK INTL T NO. 1/4 .256 IN ID .478	78189	1914-00
A8MP3	3050-0443	1	WASHER-FL MN NO. 8 .176 IN ID .375 IN OD	86928	5624-16-10
A8MP4	8160-0219	1	RFI STRIP NI ALY 1.06-W 2.64-L	28480	8160-0219
A8MP5	8160-0220	1	RFI STRIP NI ALY 2.48-W 4.215-L	28480	8160-0220
A8MP6	08640-00001	1	SHIELD, LEO TAPE	28480	08640-00001
A8MP7	08640-00009	1	COVER, CENTER FILTER	28480	08640-00009
A8MP8	08640-00051	1	FRAME C SHIELD, LARGE	28480	08640-00051
A8MP9	08640-00052	1	FRAME C SHIELD, SMALL	28480	08640-00052
A8MP10	08640-20280	1	COVER, CONTROL INPUT	28480	08640-20280
A8MP11	08640-20281	1	HEAT SINK	28480	08640-20281
A8MP12	08640-20063	1	WINDOW COUNTER	28480	08640-20063
A8MP13	08640-20089	1	SUPPORT, PC BOARD, CENTER	28480	08640-20089
A8MP14	08640-20092	1	SHIELD, BUTTON	28480	08640-20092
A8MP15	08640-20202	1	CASTING, TOP	28480	08640-20202
A8MP16	08640-20203	1	CASTING, BOTTOM	28480	08640-20203
A8MP17	08640-40003	1	PIPE LIGHT	28480	08640-40003
A8MP18	08640-40041	1	PIPE LIGHT, OFLOW	28480	08640-40041
A8MP19	5040-0391	1	BUTTON ,X10	28480	5040-0391
A8MP20	5040-0392	1	BUTTON, X100	28480	5040-0392
A8MP21	5040-0393	1	BUTTON-ON	28480	5040-0393
A8MP22	5040-0394	1	BUTTON-INT	28480	5040-0394
A8MP23	5040-0395	1	BUTTON-EXT	28480	5040-0395
A8MP24	2190-0368	1	WASHER-FL MTLC NO. 5 .13 IN ID .235 IN	28480	2190-0368
A8MP25	2190-0019		WASHER-LK MLCL NO. 4 .115 IN ID .226 IN	28480	2190-0019
A8MP26	2200-0147	2	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0147
A8MP27	2200-0107	2	SCREW-MACH 4-40 PAH HD POZI REC SST-300	28480	2200-0107
A8MP28	2200-0151		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0151
A8MP29	2190-0005	1	WASHER-LK EXT T NO. 4 .116 IN ID .285 IN	78189	1804-01
A8MP30	2950-0006	1	NUT-HEX-DBL CHAN 1/4-32-THD .094-THK	73734	9000

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A8MP31	2200-0140	1	SCREW-MACH 4-40 100 DEG FL HD POZI REC	28480	2200-0140
A8MP32	08640-00058	2	INSULATOR, COUNTER	28480	08640-00058
A8MP33	2200-0105		SCREW-MACH 4-40 PAN HD POSI REC SST-300	28480	2200-0105
A8MP34	0520-0127	2	SCREW-MACH 2-56 PAN HD POZI REC SST-300	28480	0520-0127
A8MP35	2190-0014	2	WASHER-LLK INTL T NC. 2 .089 IN ID .185	78189	1902-00
A8MP36	0516-0005	1	SCREW-MACH 0-80 PAH HD SLT REC SST-300	28480	0516-0005
A8MP37	2200-0103	1	SCREW-MACH 4-40 PAN HD POSI REC SST-300	28480	2200-0103
A8MP38	2200-0155	2	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0155
A8MP39	0361-0207	1	RIVET: BLIND, BLACK NYLON 0.125" DIA	00000	OBD
A8MP40	2200-0504	1	SCREW-MACH 4-40 PNA	28480	2200-0504
A8MP41			NOT ASSIGNED		
A8MP42	2190-0012	2	WASHER-LK EXT T NO. 10 .195 IN ID .406	78189	1810-00
A8MP43	2190-0057	1	WASHER-LK INTL T NO.12 .218 IN ID .383	78189	1912-03
A8MP44	2680-0128	1	SCREW-MACH 10-32 PAN HD POZI REC SST	28480	2680-0128
A8MP45	08640-20088	2	HEAT SINK NUT	28480	08640-20088
A8U1	1990-0330	6	DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8U2	1990-0330		DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8U3	1990-0330		DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8U4	1990-0330		DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8U5	1990-0330		DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8U6	1990-0330		DISPLAY NUM DOT MAT 1 CHAR .29 IN HIGH	28480	1990-0330
A8A1	08640-60168	1	RF SCALER ASSY	28480	08640-60168
A8A1	08640-60097		SAME AS 08640-60168 WITHOUT U2 AND U5.	28480	08640-60097
A8A1C1	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A1C2	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A1C3	0160-3879	9	CAPACITOR-FXD .01UF +20-% 100WVDC CER	28480	0160-3879
A8A1C4	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A1C5			NOT ASSIGNED		
A8A1C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A1C7	0160-3877	4	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A8A1C8	0160-3872	1	CAPACITOR-FXD 2.2PF +-.25F 200WVDC CER	28480	0160-3872
A8A1CR1	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A8A1CR2	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A8A1CR3	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A8A1CR4	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A8A1CR5	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A8A1J1	1250-1220	6	CONNECTOR-RF SMC M PC	98291	50-051-0109
A8A1J2	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A8A1K1	0490-1073	6	RELAY-REED 1A .25A 120V CONT 4.5V-COIL	28480	0490-1073
A8A1K2	0490-1073		RELAY-REED 1A .25A 120V CONT 4.5V-COIL	28480	0490-1073
A8A1MP1	08640-20088		HEAT SINK NUT	28480	08640-20088
A8A1MP2	0360-0124	2	TERMINAL, STUD .40 "	97300	SIZE A
A8A1MP3	0360-0124		TERMINAL, STUD .040"	97300	SIZE A
A8A1MP4	0361-0036	1	RIVET: SEMITUBULAR 0.89" BODY DIA	00000	OBD
A8A1Q1	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8A1Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A8A1R1	0698-7236	2	RESISTOR 1K 2% .05W F TUBULAR	24546	C3-1/8-TO-1001-G
A8A1R2			NOT ASSIGNED		
A8A1R3			NOT ASSIGNED		
A8A1R4	0698-7248	4	RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-TO-3161-G
A8A1R5	0698-7248		RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-I/8-TO-3161-G
A8A1R6	0698-7212		RESISTOR 100 OHM 2% .05W F TUBULAR	24546	C3-I/8-TO-100R-G
A8A1R7	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A8A1R8	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A1R9	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A1R10	0757-1094		RESISTOR 1.47K 1% .125W F TUBULAR	24546	C4-1/8-TO-1471-F
A8A1R11	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A1R12	0698-7221	2	RESISTOR 237 OHM 2% 0.05 F TC=+100	24546	C3-1/8-TO-237R-G
A8A1R13	0698-7197	1	RESISTOR 23.7 2% 0.05W F TC=+100	24546	C3-1/8-TO-23R7-G
A8A1R14	0698-7221		RESISTOR 237 OHM 2% 0.05W F TC=+100	24546	C3-1/8-TO-237R-G
A8A1U1	1820-0736	2	IC DGTL COUNTER	28480	1820-0736
A8A1U2	1820-1003	1	IC DGTL COUNTER	28480	1820-1003
A8A1U3	1820-0145	6	OC DGTL MC 1010P GATE	04713	MC1010P
A8A1U4	1820-0102	6	IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A8A1U5	5086-7089	1	TRIGGER AMPLIFIER	28480	5086-7089
A8A2	08640-60027	1	COUNTER/LOCK BOARD ASSY	28480	08640-60027
A8A2	08640-60087		RESTORED 08640-60027,REQUIRES EXCHANGE	28480	08640-60087
A8A2C1	0160-3456		CAPACITOR-FXD 1000PF +=10% 1000WVDC CER	28480	0160-3456
A8A2C2	0160-3094	19	CAPACITOR-FXD .1UF +=10% 100WVDC CER	28480	0160-3094
A8A2C3	0160-3094		CAPACITOR-FXD .IUF +-10% 100WVDC CER	28480	0160-3094
A8A2C4	0180-0049	1	CAPACITOR,FXD: 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A8A2C5	0180-1735		CAPACITOR-FXD: .22IF+-10% 35VDC TA	56289	150D224X9035A2
A8A2C6	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A2C7	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A8A2C8	0180-0228		CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A8A2C9	0180-0228		CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A8A2C10	0160-3455	2	CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3455

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A8A2C11	0160-3455		CAPACITOR-FXD 047PF +-10% 1000WVDC CER	28480	0160-3455
A8A2C12	0160-3466	1	CAPACITOR-FXD 100PF +-10% 1000WVDC CER	28480	0160-3466
A8A2C13	0160-2207	1	CAPACITOR-FXD 300PF +-5% 300WVDC MICA	28480	0160-2207
A8A2C14	0160-3877		CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A8A2C15	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A2C16	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A2C17	0160-0174	4	CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A8A2C18	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A2C19	0160-2201	4	CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A8A2C20	0180-0291	11	CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A8A2C21	0180-0197		CAPACITOR-FXD: 2-2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A2C22	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A2C23	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A2C24	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A2C25	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A2C26	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A2C27	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A8A2C28	0160-3876		CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A8A2C29	0160-3876		CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A8A2C30	0160-3876		CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A8A2C31	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A8A2CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A8A2CR2	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A8A2L1	9100-1622	1	COIL: FXD: MOLDED RF CHOKE: 24UH 5%	24226	15/242
A8A2L2	9100-1620	15	COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A8A2Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q2	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q3	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q6	1855-0062	1	TRANSISTOR: J-GET N-CHAN, D-MODE SI	28480	1855-0062
A8A2Q7	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8A2Q10	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q11	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8A2Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8A2Q13	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q14	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q15	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A8A2Q16	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q17	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A8A2Q18	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8A2R1	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A8A2R2	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A8A2R3	0698-7253	6	RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A8A2R4	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A8A2R5	0698-7239	2	RESISTOR 1.33K 2% .05W F TUBULAR	24546	C3-1/8-TO-1331-G
A8A2R6	0698-7239		RESISTOR 1.33K 2% F TUBULAR	24546	C3-1/8-TO-1331-G
A8A2R7	0698-7246	4	RESISTOR 2.61K 2% .05W F TUBULAR	24546	C3-1/8-TO-2611-G
A8A2R8	0698-7246		RESISTOR 2.61K 2% .05W F TUBULAR	24546	C3-1/8-TO-2611-G
A8A2R9	0698-7277	6	RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A2R10	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A2R11	0683-8245	2	RESISTOR 820K 5% .25W CC TUBULAR	01121	CB8245
A8A2R12	0683-8245		RESISTOR 820K 5% .25W CC TUBULAR	01121	CB8245
A8A2R13	0698-7267	2	RESISTOR 19.6K 2% .05W F TUBULAR	24546	C3-1/8-TO-1962-G
A8A2R14	0698-7272	1	RESISTOR 31.6K 2% .05W F TUBULAR	24546	C3-1/8-TO-3162-G
A8A2R15	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A2R16	0698-7267		RESISTOR 19.6K 2% .05W F TUBULAR	24546	C3-1/8-TO-1962-G
A8A2R17	0698-7284	3	RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-TO-1003-G
A8A2R18	0698-7284		RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-TO-1003-G
A8A2R19	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A2R20	0698-7288	1	RESISTOR 147K 2% .05W F TUBULAR	24546	C3-1/8-TO-1473-G
A8A2R21	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A8A2R22	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A8A2R23	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A2R24	0698-7260	7	RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A8A2R25	0698-7284		RESISTOR 100K 2% .05W F TUBULAR	24546	C3-1/8-TO-1003-G
A8A2R26	0698-3453	3	RESISTOR 1965 1% .125W F TUBULAR	16299	C4-1/8-TO-1963-F
A8A2R27	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A8A2R28	0698-7260		RESISTOR 10K 2% 05.W F TUBULAR	24546	C3-1/8-TO-1002-G
A8A2R29	0698-7256	1	RESISTOR 6.81K 2% .05W F TUBULAR	24546	C3-1/8-TO-6811-G
A8A2R30	0698-7258	1	RESISTOR 8.25K 2% .05W F TUBULAR	24546	C3-1/8-TO-8251-G

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A8A2R31	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A8A2R32	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A8A2R33	0698-7264	1	RESISTOR 14.7K 2% .05W F TUBULAR	24546	C3-1/8-TO-1472-G
A8A2R34	0698-7243	1	RESISTOR 1.965 2% .05W F TUBULAR	24546	C3-1/8-TO-1961-G
A8A2R35	0698-7229	6	RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-511R-G
A8A2R36	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A2R37	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A2R38	0698-3442	1	RESISTOR 237 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-237R-F
A8A2R39	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A2R40	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A8A2R41	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A2R42	0698-0083	9	RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A8A2R43	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A8A2R44	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A8A2R45	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A2R46			NOT ASSIGNED		
A8A2R47	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A2R48			NOT ASSIGNED		
A8A2R49	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-511R-G
A8A2R50	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A8A2R51	0698-7248		RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-TO-3161-G
A8A2R52	0698-7248		RESISTOR 3.16K 2% .05W F TUBULAR	24546	C3-1/8-TO-3161-G
A8A2R53	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	04546	C3-1/8-TO-511R-G
A8A2R54	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-511R-G
A8A2R55	0698-7236		RESISTOR 1K 2% .05 W F TUBULAR	24546	C3-1/8-TO-1001-G
A8A2R56	0811-1662	1	RESISTOR .47 OHM 5% PW TUBULAR	75042	BWH2-47/100-J
A8A2R57	0698-7219	3	RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-196R-G
A8A2S1A	3101-1729	1	SWITCH: PB -STA DPDT	28480	3101-1729
A8A2S1B		2	NSR, P/O A8A2S1A		
A8A2S1C			NSR, P/O A8A2S1A		
A8A2TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A2TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A2TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A2TP4	0360-1514		TERMINAL: STDR STUD	28480	0360-1514
A8A2TP5	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A2TP6	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A2U1	1820-0077	4	IC DGTL SN74 74 N FLIP-FLOP	01295	SN7474N
A8A2U2	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A2U3	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A2U4	1820-0174	2	IC DGTL SN74 N INVERTER	01295	SN7404N
A8A2U5	1820-0077		IC DGTL SN74 N FLIP-FLOP	01295	SN7474N
A8A2U6	1820-0328	3	IC DGTL SN74 02 N GATE	01295	SN7402N
A8A2U7	1820-0701	6	IC DGTL LATCH	07263	93L14DC
A8A2U8	1820-0701		IC DGTL LATCH	07263	93L14DC
A8A2U9	1820-0701		IC DGTL LATCH	07263	93L14DC
A8A2U10	1820-0701		IC DGTL LATCH	07263	93L14DC
A8A2U11	1820-0701		IC DGTL LATCH	07263	93L14DC
A8A2U12	1820-0701		IC DGTL LATCH	07263	93L14DC
A8A2U13	1820-0511		IC DGTL SN74 08 N GATE	01295	SN7408N
A8A2U14	1820-0205	2	IV FHYL MC 3003P GATE	04713	MC3003P
A8A2U15	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A2U16	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A2U17	1820-0511		IC DGTL SN74 08 N GATE	0195	SN7408N
A8A2U18	1820-0511		IC DGTL SN74 08 N GATE	01295	SN7408N
A8A2U19	1820-0546	7	OC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U20	1820-0546		IC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U21	1820-0546		IC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U22	1820-0546		IC DGLT SN74 192 N COUNTER	01295	SN74192N
A8A2U23	1820-0546		IC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U24	1820-0546		IC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U25	1820-0328		IC DGTL SN74 02 N GATE	01295	SN7402N
A8A2U26	1820-0077		IC DGTL SN74 74 N FLIP-FLOP	01295	SN7474N
A8A2U27	1820-0205		IC-DGTL MC 3003P GATE	04713	MC3003P
A8A2U28	1820-0546		IC DGTL SN74 192 N COUNTER	01295	SN74192N
A8A2U29	1826-0092	2	IC LIN AMPLIFIER	04713	MC7812CP
A8A2VR1	1902-3070	1	DIODE-ZNR 4.22V 5% DO-7 PD=.4W TC=	04713	SZ 10939-74
A8A2VR2	1902-3182		DIODE-ZNR 12.1V 5% DO-7 PD=.4W	04713	SZ 10939-206
A8A3	08640-60026	1	TIME BASE ASSY	28480	08640-60026
A8A3C1	0160-3094		CAPACITOR-FXD .1UF +-10% 100MVDC CER	28480	0160-3094
A8A3C2	0160-3094		CAPACITOR-FXD .1UF +-10% 100 WVDC CER	28480	0160-3094
A8A3C3	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C4	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C5	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A8A3C6	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C7			NOT ASSIGNED		
A8A3C8	0160-2055		CA[ACOTPR-FXD .01UF +-80-20% 100WVDC CER	28480	0160-2055
A8A3C9	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C10	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C11	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C12	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C13	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C14	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C15	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A3C16	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C17	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC DC CER	28480	0160-3094
A8A3C18	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C19	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A3C20	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A8A3C21	0160-3877		CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A8A3C22	0160-3877		CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A8A3C23	0160-3457	1	CAPACITOR=FXD 2000RF +-10% 250WVDC CER	28480	0160-3457
A8A3C24	0160-3456		CAPACITOR-FXD 1000PF +-10% 100CWVDC CER	28480	0160-3456
A8A3C25	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C26	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C27	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C28	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C29	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C30	0180-0197		CAPACITOR-FXD: 2-2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C31	0180-0197		CAPACITOR-FXD: 2-2UF-10% 20VDC TA	56289	150D225X9020A2
A8A3C32	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A8A3C33	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C34	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C35	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C36	0180-0197		CAPACITOR-FXD: 2-2UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C37	0180-0197		CAPACITOR-FXD: 2.2UF-10% 20VDC TA	56289	150D225X9020A2
A8A3C38	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A8A3C39	0180-0197		CAPACITOR-FXD 2.2.UF+-10% 20VDC TA	56289	150D225X9020A2
A8A3C40	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A8A3CR1	1901-0040		DIODE-SWITCHING 2N2 30V 50MA	28480	1901-0040
A8A3J1	1250-1383	1	CONNECTOR-RF SN SNP M SGL HOLE RR	28480	1250-1383
A8A3L1	9140-0137	10	COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L2	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L3	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L4	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH %5	24226	19/104
A8A3L5	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L6	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L7	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L8	9140-0137		COIL: FXD: MOLDED RF CHOKE: 1MH 5%	24226	19/104
A8A3L9	9140-0137		COIL: FXD: HOLDED RF CHOKE: IMH 5%	24226	19/104
A8A3L10	08640-80001	8	TORDID FILTER	28480	08640-80001
A8A3L11	9140-0137		COIL: FXD: MOLDED RF CHOKE: UMH 5%	24226	19/104
A8A3L12	08640-80001		TOROID FILTER	28480	08640-80001
A8A3L13	08640-80001		TOROID FILTER	28480	08640-80001
A8A3L14	08640-80001		TOROID FILTER	28480	08640-80001
A8A3MP1	2190-0003		WASHER-LK HLCL NO. 4 .115 IN ID .253 IN	28480	2190-0003
A8A3MP2	2200-0155		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0155
A8A3MP3	2260-0001	1	NUT-HEX-DBL CHAM 4-40 THD .094-THK .25	28480	2260-0001
A8A3MP4	08640-20211	2	GUIDE, CONNECTOR	28480	08640-20211
A8A3MP5	08640-40040	1	INSULATOR SWITCH	28480	08640-40040
A8A3Q1	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A8A3Q2	1854-0019		TRANSISTOR NPN SI TO-18 PD-360MW	28480	1854-0019
A8A3R1	0698-3155		RESISTOR 4.6K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A8A3R2	0757-0274	1	RESISTOR 1.21K 1% .125W F TUBULAR	24546	C4-1/8-TO-1213-F
A8A3R3	0757-0442		RESISTOR 10L 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A3R4	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A8A3R5	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-511R-G
A8A3R6	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A3R7	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A3R8	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A8A3R9	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A8A3R10	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A8A3R11	0757-0416		RESISTOR 511 OHM .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A8A3R12	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24564	C4-1/8-TO-511R-F
A8A3R13	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A8A3R14	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A8A3R15	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A8A3R16	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A8A3R17	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A8A3R18	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-82R5-F
A8A3R19	0698-3437	3	RESISTOR 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-133R-F
A8A3R20	0698-3160		RESISTOR 31.6K 1% .125W F TUBULAR	16299	C4-1/8-TO-3162-F
A8A3R21	0698-3444		RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-316R-F
A8A3R22	0757-0280		RESISTOR 1K 1% /125W F TUBULAR	24546	C4-1/8-TO-1001-F
A8A3R23	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A8A3S1A	3101-1730	1	SWITCH: PB -STA CPDT	28480	3101-1730
A8A3S1B			MSR, PART OF A8A3S1A		
A8A3S1C			NSR, PART OF A8A3S1A		
A8A3TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A8A3U1	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A3U2	1820-0077		IC DGTL SN74 74 N FLIP-FLOP	01295	SN7474N
A8A3U3	1820-0368	1	IC DGTL SN74 96 N REGISTER	01295	SN7496N
A8A3U4	1820-0511		IC DGTL SN74 08 N GATE	01295	SN7408N
A8A3U5	1820-0661	2	IC DGTL SN74 32 N GATE	01295	SN7432N
A8A3U6	1820-0661		IC DGTL SN74 32 N GATE	01295	SN7432N
A8A3U7	1820-0174		IC DGTL SN74 04N INVERTER	01295	SN7404N
A8A3U8	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A3U9	1820-0054		IC DGTL SN74 00 N GATE	01295	SN7400N
A8A3U10	1820-0600	4	IC DGTL DM85L 90N COUNTER	27014	DM74L90N
A8A3U11	1820-0600		IC DGTL DM85L 90N COUNTER	27014	DM74L90N
A8A3U12	1820-0055	1	IC DGTL SN74 90 N COUNTER	01295	SN7490N
A8A3U13	1820-0986	3	IC DGTL DM86L 75N COUNTER	27014	DM86L75N
A8A3U14	1820-0986		IC DGTL DM86L 75N COUNTER	27014	DM86L75N
A8A3U15	1820-0986		IC DGTL DM86L 75N COUNTER	27014	DM86L75N
A8A3U16	1820-0600		IC DGTL DM85L 90N COUNTER	27014	DM74L90N
A8A3U17	1820-0600		IC DGTL DM85L 90N COUNTER	27014	DM74L90N
A8A3VR1	1902-3203	2	DIODE-ZNR 14.7V 5% OO-7 PD=.4W	04713	SZ 10939-230
A8A3Y1	1813-0006	1	CRYSTAL OSCILLATOR	28480	1813-0006
A8A3XA8A5	1251-2035		CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-300
A8A4	08640-60025	1	COUNTER/DISPLAY ASSY	28480	08640-60025
A8A4DS1	2140-0356	1	LAMP, INCAND: BULB T1: 5V	71744	CM7-7683
A8A4DS2	2140-0016	1	LAMP, INCAND, BULD T-1, 5V	71744	683
A8A4J1	1200-0471	1	CONTACT:8-PIN, IC	28480	1200-0471
	1200-0472	1	SOCKET:40-PIN, IC	28480	1200-0472
A8A4MP1	03431-01201	3	BRACKET, MOUNTING	28480	03431-01201
A8A4MP2	03431-01201		BRACKET, MOUNTING	28480	03431-01201
A8A4MP3	03431-01201		BRACKET, MOUNTING	28480	03431-01201
A8A4P1A	1260-0363	1	CONNECTOR:11 PIN	28480	1260-0363
A8A4P1B	1260-0364	1	CONNECTOR:25 PIN	28480	1260-0364
A8A4Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8A4R1	2100-0647	1	RESISTOR-VAR 5K 20% SPST SW	01121	GS4G120P502MZ
A8A4R2	2100-3216	1	RESISTOR-VAR TRMR 10KMR 20% C TOP ADJ	32997	3339H-1-103
A8A4R3	0698-7277		RESISTOR 51.1K 2% .05W F TUBULAR	24546	C3-1/8-TO-5112-G
A8A4R4			NOT ASSIGNED		
A8A4R5	0698-7276	1	RESISTOR 46.4K 2% .05W F TUBULAR	24546	C3-1/8-TO-4642-G
A8A4XDS1A	1251-2194	2	CONNECTOR-CONT SKT .021 DIA	00779	3-331272-0
A8A4XDS1B	1251-2194		CONNECTOR:1-CONT SKT .021 DIA	00779	3-331272-0
A8A5	08640-60028	1	RISER ASSY	28480	08640-60028
A8A5XA8A2	1251-2035		CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-300
A9	08640-60117	1	PEAK DEVIATION AND RANGE SWITCH ASSY	28480	08640-60117
A9C1	0140-0191	6	CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A9C2	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A9C3	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A9C4	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A9C5	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A9C6			NOT ASSIGNED		
A9C7			NOT ASSIGNED		
A9C8	0140-0210	1	CAPACITOR-FXD 270PF +-5% 300WVDC MICA	72136	DM15F271J0300WV1CR
A9MP1	0510-0052		RETAINER, RING, .125 DIA, CAD PLT STL	97464	7100-12-CD
A9MP2	1430-0759		GEAR SPUR	28480	1430-0759
A9MP3	1430-0772	1	GEAR:PLANET	28480	1430-0772
A9MP4	1430-0773	1	GEAR:COMBINATION	28480	1430-0773
A9MP5	1430-0774	1	GEAR:COMBINATION	28480	1430-0774

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A9MP6	3050-0099	1	WASHER-FL MTLC .25 IN ID .5 IN OD	28480	3050-0099
A9MP7	5040-0218	1	COUPLER: SWITCH SHAFT	28480	5040-0218
A9MP8	08640-00019	1	SUPPORT, SWITCH	28480	08640-00019
A9MP9	08640-40039	1	SHAFT, ADJUSTABLE	28480	08640-40039
A9MP10	08640-40045	1	SHAFT, SWITCH AF BAND	28480	08640-40045
A9P1	1251-2799	1	CONNECTOR: PC EDGE: 15-CONT: SOLDER EYE	71785	251-15-30-400
A9R1	2100-3262	1	RESISTOR-VAR 2.5K 10% C	71450	550
A9R2			NOT ASSIGNED		
A9R3			NO ASSIGNED		
A9R4	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R5	0757-0278		RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-TO-1781-F
A9R6	0757-0274		RESISTOR 1.21K 1% .125W F TUBULAR	24546	C4-1/8-TO-1213-F
A9R7	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A9R8	0698-0082	1	RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R9	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R10	0698-8211		RESUSTOR 2K .25% .25W F	19701	MF52C1/4-T9-2001-C
A9R11	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R12	0698-8212		RESISTOR L6 .25% .125W F TUBULAR	19701	MF4C1/4-T9-6001-C
A9R13	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R14	0698-8213		RESISTOR 3K .25% .125W F TUBULAR	19701	MF4C1/4-T9-3001-C
A9R15	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R16	0698-8213		RESISTOR 3K .25% .125W F TUBULAR	19701	MF4C1/4-T9-3001-C
A9R17	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R18	0698-8213		RESISTOR 3K .25% .125W F TUBULAR	19701	MF4C1/4-T9-3001-C
A9R19	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R20	0698-8213		RESISTOR 3K .25% .125W F TUBULAR	19701	MF4C1/4-T9-3001-C
A9R21	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R22	0698-5669		RESISTOR 1.5K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1501-C
A9R23	0698-8299		RESISTOR 4.259K .25% .125W F TUBULAR	19701	MF4C1/8-T9-4259R-C
A9R24	0698-8298		RESISTOR 1.071K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1071R-C
A9R25	0698-8297		RESISTOR 1.28K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1284R-C
A9R26	0757-0398		RESISTOR 75 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-75R0-F
A9R27	0698-8296		RESISTOR 1.49K .25% .125W F TUBULAR	19701	MF4C1/8-T9-1493R-C
A9R28	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-82R5-F
A9R29	0698-8295		RESISTOR 1.556K .25% .125W G TUBULAR	19701	MF4C1/8-T9-1556R-C
A9R30	0757-0400		RESISTOR 90.9 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-90R9-F
A9R31	0757-0400		RESISTOR 90.9 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-90R9-F
A9S1			NSR, PART OF A9		
A9S2			NSR, PART OF A9		
A9S3			NSR, PART OF A9		
A9W1	08640-60107		CABLE ASSY, PEAK DEVIATION	28480	08640-60107
A10	08640-60105	1	DIVIDER/FILTER ASSY	28480	08640-60105
A10MP1	0403-0156	2	GUIDE, P.C. BOARD, YELLOW	28480	0403-0156
A10MP2	0403-0157	2	GUIDE, P.C. BOARD, GREEN	28480	0403-0157
A10MP3	0403-0158	2	GUIDE, P.C. BOARD, BLUE	28480	0403-0158
A10MP4	8160-0226	1	RFI ROUND STRIP NI ALY .062-0D	28480	8160-0226
A10MP5	08640-00047	1	SHIELD, SPRING #1	28480	08640-00047
A10MP6	08640-00048	1	SHIELD, SPRING #2	28480	08640-00048
A10MP7	08640-00049	1	SHIELD, SPRING #3	28480	08640-00049
A10MP8	08640-00050	1	SHIELD, SPRING #4	28480	08640-00050
A10MP9	08640-20268	1	CAST COVER, TOP D/F	28480	08640-20268
A10MP10	08640-20269	1	CAST, CENTER D/F	28480	08640-20269
A10MP11	2190-0003		WASHER-LK HLCL NO. 4 .115 IN ID .253 IN	28480	2190-0003
A10MP12	2200-0101	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0101
A10MP13	2200-0121		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0121
A10MP14	2200-0147		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0147
A10MP15	2200-0127	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0127
A10MP16	2190-0124	2	WASHER-LK INTL T NO. 10 .195 IN ID .311	24931	LW101-30
A10MP17	2950-0078	2	NUT-HEX-DBL CHAM 10-32-THD .067-THK .25	24931	HN100-11
A10MP18	2200-0129	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0129
A10MP19	0361-1071	2	RIVET:BLIND, DOME HD 0.125" DIA	11815	AAP-4-3
A10A1	08640-60204	1	RF FILTER ASSY	28480	08640-60204
A10A1C1	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 1001VDC CER	28480	0160-2055
A10A1C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C7	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1C9	0140-0219	2	CAPACITOR-FXD 180PF +-2% 200WVDC MICA	72136	DM15F181G0300WV1CR
A10A1C10	0140-0226	2	CAPACITOR-FXD 320PF +-1% 300WVDC MICA	72136	DM15F321F0300WV1C

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A10A1C11	0140-0226		CAPACITOR-FXD 320PF +-% 300WVDC MICA	72136	DM15F321F0300WV1C
A10A1C12	0140-0220	3	CAPACITOR-FXD 200PF +-1% 300WVDC MICA	72136	DM15F201F0300WV1CR
A10A1C13	0140-0195	2	CAPACITOR-FXD 130PF +-5% 300MVDC MICA	72136	DM15F131J0300WV1CR
A10A1C14	0140-0220		CAPACITOR-FXD 200PF +-1% 300MVDC MICA	72136	DM15F201F0300WV1CR
A10A1C15	0140-0220		CAPACITOR-FXD 200PF +-1% 300WVDC MICA	72136	DM15F201F0300WV1CR
A10A1C16	0140-0195		CAPACITOR-FXD 130PF +-5% 300WVDC MICA	72136	DM15F131J0300WV1CR
A10A1C17	0160-3156	2	CAPACITOR-FXD 750PF +-1% 300WVDC MICA	28480	0160-3156
A10A1C18	0160-3940	1	CAPACITOR-FXD 3200PF +-1% 100WVDC MICA	28480	0160-3940
A10A1C19	0160-2587	1	CAPACITOR-FXD 4000PF +-1% 100WVDC MICA	28480	0160-2587
A10A1C20	0160-4217	1	CAPACITOR-FXD 3900PF +-1% 500WVDC MICA	28480	0160-4217
A10A1C21	0160-2276	1	CAPACITOR-FXD 2780PF +-2% 300WVDC MICA	28480	0160-2276
A10A1C22	0140-0172	1	CAPACITOR-FXD 3000PF +-1% 100WVDC MICA	72136	DM19F302F0100WV1CR
A10A1C23	0160-2585	2	CAPACITOR-FXD 2000PF +-1% 100WVDC MICA	28480	0160-2585
A10A1C24	0160-2537	3	CAPACITOR,FXD 360PF +-1% 300WVDC MICA	28480	0160-2537
A10A1C25	0160-0341	2	CAPACITOR-FXD 640PF +-1% 300WVDC MICA	28480	0160-0341
A10A1C26	0160-0341		CAPACITOR-FXD 640PF +-1% 300WVDC MICA	28480	0160-0341
A10A1C27	0140-0200	1	CAPACITOR-FXD 390PF +-5% 300MVDC MICA	72136	DM15F391J0300WV1CR
A10A1C28	0140-0199	2	CAPACITOR-FXD 240PF +-5% 300WVDC MICA	72136	DM15F241J0300WV1CR
A10A1C29	0160-0939		CAPACITOR-FXD 430PF +-5% 3002WVDC MICA	28480	0160-0939
A10A1C30	0160-0939		CAPACITOR-FXD 430PF +-5% 300WVDC MICA	28480	0160-0939
A10A1C31	0140-0199		CAPACITOR-FXD 240PF +-5% 300WVDC MICA	72136	DM15F241J0300WV1CR
A10A1C32	0160-2537		CAPACITOR-FXD 360PF +-1% 300WVDC MICA	28480	0160-2537
A10A1C33	0160-3092	1	CAPACITOR-FXD 1600PF +-1% 100WVDC MICA	28480	0160-3092
A10A1C34	0160-2585		CAPACITOR-FXD 2000PF +-1% 100WVDC MICA	28480	0160-2585
A10A1C35	0160-3937	1	CAPACITOR-FXD 1916PF +-1% 100WVDC MICA	28480	0160-3937
A10A1C36	0160-3939	1	CAPACITOR-FXD 1400PF +-1% 100WVDC MICA	28480	0160-3939
A10A1C37	0160-3938	1	CAPACITOR-FXD 1470PF +-1% 100WVDC MICA	28480	0160-3938
A10A1C38	0160-2387	2	CAPACITOR-FXD 1000PF +01% 500WVDC MICA	28480	0160-2387
A10A1C39	0160-0335	2	CAPACITOR-FXD 91PF +-1% 300WVDC MICA	28480	0160-0335
A10A1C40	0160-2206	2	CAPACITOR-FXD 160PF +-5% 300WDC MICA	28480	0160-2206
A10A1C41	0160-2206		CAPACITOR-FXD 100PF +-300WVDC MICA	28480	0160-2206
A10A1C42	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A10A1C43	0140-0205	2	CAPACITOR-FXD 62PF +-5% 300WVDC MICA	72136	DM15E620J0300WV1CR
A10A1C44	0160-0839	2	CAPACITOR-FXD 110PF +-1% 300WVDC MICA	28480	0160-0839
A10A1C45	0160-0839		CAPACITOR-FXD 110PF +-1% 300WVDC MICA	28480	0160-0839
A10A1C46	0140-0205		CAPACITOR-FXD 62PF +-5% 300WVDC MICA	72136	DM15E620J0300WV1CR
A10A1C47	0140-0219		CAPACITOR-FXD 180PF +-2% 300WVDC MICA	72136	DM15F181G0300WV1CR
A10A1C48	0160-0342	1	CAPACITOR-FXD 800PF +-1% 300WVDC MICA	28480	0160-0342
A10A1C49	0160-2387		CAPACITOR-FXD 1000PF +-1% 500WVDC MICA	28480	0160-2387
A10A1C50	0160-3835	1	CAPACITOR-FXD 4.7PF +-.5PF 100WVDC CER	28480	0160-3835
A10A1C51	0160-3936	1	CAPACITOR-FXD 700PF +-1% 100WVDC MICA	28480	0160-3936
A10A1C52	0160-3156		CAPACITOR-FXD 750PF +-1% 300WVDC MICA	28480	0160-3156
A10A1C53	0140-0234	2	CAPACITOR-FXD 500PF +-1% 300WVDC MICA	72136	DM15F501F0300WV1C
A10A1C54	0160-2307	1	CAPACITOR-FXD 47PF +-5% 300WVDC MICA	28480	0160-2307
A10A1C55	0160-0974	2	CAPACITOR-FXD 80PF +-2% 300MVDC MICA	28480	0160-0974
A10A1C56	0160-0974		CAPACITOR=FXD 80PF +-2% 300MVDC MICA	28480	0160-0974
A10A1C57	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A10A1C58	0160-2306	1	CAPACITOR-FXD 27PF +-5% 300WVDC MICA	28480	0160-2306
A10A1C59	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A10A1C60	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A10A1C61	0160-2199		CAPACITOR-FXD 30PF +-300WVDC MICA	28480	0160-2199
A10A1C62	0160-0335		CAPACITOR-FXD 91PF +-1% 300WVDC MICA	28480	0160-0335
A10A1C63	0140-0177	1	APACITOR-FXD 400PF +-1% 300WVDC MICA	72136	DM15F401F0300WV1CR
A10A1C64	0140-0234		CAPACITOR-FXD 500PF +-1% 300WVDC MICA	72136	DM15F501F0300WVIC
A10A1C65	0140-0233	1	CAPACITOR-FXD 480PF +-1% 300WVDC MCIA	72136	DM15F481F0300WV1C
A10A1C66	0160-3934	1	CAPACITOR-FXD 340PF +-1% 100WVDC MICA	28480	0160-3934
A10A1C67	0160-2537		CAPACITOR-FXD 360PF +-1% 300WVDC MICA	28480	0160-2537
A10A1C68	0160-3046	1	CAPACITOR-FXD 250PF +-1% 100WVDC MICA	28480	0160-3046
A10A1C69	0160-2265	1	CAPACITOR-FXD 22PF +-5% 500MVDC CER 0+	28480	0160-2265
A10A1C70	0140-0190		CAPACITOR-FXD 39PF +-5% 300WVDC MCIA	72136	DM15E390J0300WV1CR
A10A1C71	0140-0190		CAPACITOR-FXD 39PF +-5% 300WVDC MICA	72136	DM15E390J0300WV1CR
A10A1C72	0160-2266	3	CAPACITOR-FXD 24PF +-5% 500WVDC CER 0+	28480	0160-2266
A10A1C73	0160-2260	1	CAPACITOR-FXD 13PF +-5% 500WVDC CER 0+	28480	0160-2260
A10A1C74	0160-2266		CAPACITOR-FXD 24PF +-5% 500WVDC CER 0+	28480	0160-2266
A10A1C75	0160-2266		CAPACITOR-FXD 24PF +-5% 500WVDC CER 0+	28480	0160-2266
A10A1C76	0160-2262	1	CAPACITOR-FXD 16PF +-5% 500WVDC CER 0+	28480	0160-2262
A10A1C77	0160-2257	2	CAPACITOR-FXD 10PF +-5% 500WVDC CER 0+	28480	0160-2257
A10A1C78	0160-2263	2	CAPACITOR-FXD 18PF +-5% 500WDVC CER 0+	28480	0160-2263
A10A1C79	0160-2263		CAPACITOR-FXD 18PF +-5% 500WVDC CER 0+	28480	0160-2263
A10A1C80	0160-2257		CAPACITOR-FXD +-5% 500WVDC CER 0+	28480	0160-2257
A10A1C81	0121-0060	2	CAPACITOR: VAR: TRMR: CER: 2/8PF	73899	DV11PS8A
A10A1C82	0121-0061	2	CAPACITOR: VAR: TRMR: CER: 5.5/18P F	73899	DV11PS18A
A10A1C83	0121-0061		CAPACITOR: VAR: TRMR: CER: 5.5/18PF	73899	DV11PS18A
A10A1C84	0121-0060		CAPACITOR: VAR: TRMR: CER: 2/8PF	73899	DV11PS8A
A10A1C85	0160-0174		CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A10A1C86	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10A1C87	0160-0174		CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A10A1C88	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X902A02
A10A1C89	0160-0174		CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A10A1C90	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10A1C91	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A1FL1	0160-0204		CAPACITOR-FXD 5500 PF +-0% 200WWDC CER	01121	SMF8-A2
A10A1FL2	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A10A1FL3	0160-0204		CAPACITOR-FXD 5500PF +-0% 200WVDC CER	01121	SMFB-A2
A10A1J1	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A10A1J2	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A10A1J3	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A10A1J4	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A10A1K1	0490-1073		RELAY-REED A1 .25A 120V CONT 4.5V-COIL	28480	0490-1073
A10A1K2	0490-1073		RELAY-REED A1 .25A 120V CONT 4.5V-COIL	28480	0490-1073
A10A1K3	0490-1073		RELAY-REED A1 .25A 120V CONT 4.5V-COIL	28480	0490-1073
A10A1K4	0490-1073		RELAY-REED 1A .25A 120V CONT 4.5V-COIL	28480	0490-1073
A10A1L1	9100-3375	2	COIL: PXD: MOLDED RF CHOKE: .462UH 5%	28480	9100-3375
A10A1L2	9100-3365	2	COIL: FXD: MOLDED RF CHOKE: .5UH 5%	0004A	AE-.500J-P
A10A1L3	9100-3375		COIL: FXD: MOLDED RF CHOKE: .462UH 5%	28480	9100-3375
A10A1L4	9100-3361	2	COIL: FXD: MOLDED RF CHOKE: .3UH 5%	0004A	AD-.300J-P
A10A1L5	9100-3362	1	COIL: FXD: MOLDED RF CHOKE: .32UH 5%	0004A	AD-.323J-P
A10A1L6	9100-3361		COIL: FXD: MOLDED RF CHOKE: .3UH 5%	0004A	AD-.300J-P
A10A1L7	9100-3364	1	COIL: FXD: MOLDED RF CHOKE: 8UH 5%	0004A	AH-8.00J-I
A10A1L8	9100-3374	2	COIL: FXD: MOLDED RF CHOKE: .000004UH	28480	9100-3374
A10A1L9	9100-3363	1	COIL: FXD: MOLDED RF CHOKE: 4.74UH 5%	0004A	AK-4.74J-P
A10A1L10	9100-3369	2	COIL: FXD: MOLDED RF CHOKE: .924UH 5%	28480	9100-3369
A10A1L11	9100-3370	3	COIL: FXD: MOLDED RF CHOKE: .000001UH	28480	9100-3370
A10A1L12	9100-3369		COIL: FXD: MOLDED RF CHOKE: .924UH 5%	28480	9100-3369
A10A1L13	9100-3368	2	COIL: FXD: MOLDED RF CHOKE: .6UH 5%	28480	9100-3368
A10A1L14	9100-3367	1	COIL: FXD: MOLDED RF CHOKE: .646UH 5%	0004A	AE-.646J-P
A10A1L15	9100-3368		COIL: FXD: MOLDED RF CHOKE: .6UH 5%	28480	9100-3368
A10A1L16	9100-3374		COIL: FXD: MOLDED RF CHOKE: .000004UH	28480	9100-3374
A10A1L17	9100-3372	2	COIL: FXD: MOLDED RF CHOKE: .000002UH	28480	9100-3372
A10A1L18	9100-3373	1	COIL: FXD: MOLDED RF CHOKE: 2.37UH 5%	28480	9100-3373
A10A1L19	9100-3359	2	COIL: FXD: MOLDED RF CHOKE: .231UH 5%	0004A	AC-.231J-P
A10A1L20	9100-3360	1	COIL: FXD: MOLDED RF CHOKE: .25UH 5%	0004A	AC-.250J-P
A10A1L21	9100-3359		COIL: FXD: MOLDED RF CHOKE: .231UH 5%	0004A	AC-.231J-P
A10A1L22	9100-3357	2	COIL: FXD: MOLDED RF CHOKE: .15UH 5%	0004A	AC-.150J-P
A10A1L23	9100-3358	1	COIL: FXD: MOLDED RF CHOKE: .162UH %5	0004A	AC-.162J-P
A10A1L24	9100-3357		COIL: FXD: MOLDED: RF CHOKE: .159UH 5%	0004A	AC-.150J-P
A10A1L25	9100-3372		COIL: FXD: MOLDED RF CHOKE: .000002UH	28480	9100-3372
A10A1L26	9100-3370		COIL: FXD: MOLDED RF CHOKE: .000001UH	28480	9100-3370
A10A1L27	9100-3371	1	COIL: FXD: MOLDED RF CHOKE: 1.18UH 5%	28480	9100-3371
A10A1L28	9100-3355	2	COIL: FXD: MOLDED RF CHOKE: .12UH 5%	0004A	AC-.115J-P
A10A1L29	9100-3356	1	COIL: FXD: MOLDED RF CHOKE: .125UH 5%	0004A	AC-.125J-P
A10A1L30	9100-3355		COIL: FXD: MOLDED RF CHOKE: .125UH 5%	0004A	AC-.115J-P
A10A1L31	9100-3513	3	COIL, FXD 75UH 500VAC RMS (3-1/2 T)	24226	8123-2
A10A1L32	9100-3513		COIL, FXD 75UH 500VAC RMS (3-1/2-T)	24226	8123-2
A10A1L33	9100-3513		COIL, FXD 75UH 500VAC RMS (3-1/2-T)	24226	8123-2
A10A1L34	9100-3370		COIL: FXD: MOLDED RF CHOKE: .00001UH	28480	9100-3370
A10A1L35	9100-3365		COIL: FXD: MOLDED RF CHOKE: .5UH 5%	0004A	AE-.500J-P
A10A1L36	9100-3366		COIL: FXD; MOLDED RF CHOKE: .592UH 5%	0004A	AE-.592J-P
A10A1L37	9100-3512	3	COIL, FXD 50UH 500VAC RMS (2-1/2-T)	24226	8123-1
A10A1L38	9100-3512		COIL, FXD 50UH 500VAC RMS (2-1/2 T)	24226	8123-1
A10A1L39	9100-3512		COIL, FXD 50UH 500VAC RMS (2-2/2 T)	24226	8123-1
A10A1L40	9100-3514	6	COIL, FXD 30UH 500VAC RMS (1-1/2 T)	24226	8123-3
A10A1L41	9100-3514		COIL, FXD 30UH 500VAC RMS (1-1/2 T)	24226	8123-3
A10A1L42	9100-3514		COIL, FXD, 30UH 500VAC RMS (1-1/2 T)	24226	8123-3
A10A1L43	9100-3514		COIL, FXD 30UH 500VAC RMS (1-1/2 T)	24226	8123-3
A10A1L44	9100-3514		COIL, FXD 30UH 500VAC RMS (1-1/2 T)	24226	8123-3
A10A1L45	9100-3514		COIL, FXD 30UH 500VAC RMS (1-1/2 T)	84226	8123-3
A10A1L46			PART OF ETCHED CIRCUIT BOARD		
A10A1L47			PART OF ETCHED CIRCUIT BOARD		
A10A1L48			PART OF CIRCUIT BOARD		
A10A1L49	9140-0144	2	COIL: FXD: MOLDED RF CHOKE: 4/7UH 10%	24226	10/471
A10A1L50	9140-0144		COIL: FXD: MOLDED RF CHOKE: 4.7UH 10%	24226	10/471
A10A1L51	08640-80001		TOROID FILTER	28480	08640-80001
A10A1L52	08640-80001		TOROID FILTER	28480	08640-80001
A10A1L53	08640-80001		TOROID FILTER	28480	08640-80001
A10A1L54	08640-80001		TOROID FILTER	28480	08640-80001
A10A1MP1	1480-0352	1	PIN:DETENT 0.055 X 0.750" DIA	00000	1480-0352
A10A1MP2	08443-20003	1	ROLLER, DETENT	28480	08443-20003
A10A1MP3	08640-00029	1	SPRING, DETENT	28480	08640-00029
A10A1MP4	08640-20082	1	SHAFT, CAM	28480	08640-20082
A10A1MP5	08640-20083	1	SHAFT, CAN FOLL	28480	08640-20083

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A10A1MP6	08640-20200	1	CAST COVER, BOTTOM D/F	28480	08640-20200
A10A1MP7	08640-20214		BUSHING, CAM HOUSING	28480	08640-20214
A10A1MP8	08640-20219	1	COVER, CAM	28480	08640-20219
A10A1MP9	08640-40004	1	FOLLOWER, CAM	28480	08640-40004
A10A1MP10	08640-20064	1	CAM, SLIDER	28480	08640-20064
A10A1MP11	2200-0105		SCREW-MACH 4-40 PANHD POZI REC SST-300	28480	2200-0105
A10A1MP12	08640-20133	1	SUPPORT, CLAMP	28480	08640-20133
A10A1MP13	3030-0007		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
A10A1MP14	2200-0145	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0145
A10A1MP15	08640-20206	1	RETAINER, SLIDER	28480	08640-20206
A10A1MP16	0510-0015		RETAINER, RING, .125 DIA, CAD PLT STL	79136	5133-12-S-MD-R
A10A1R1	0757-0346		RESISTOR 10 CHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R2	0757-0346		RESISTOR 10 CHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R3	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R4	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R5	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R6	0757-0346		RESISTOR 10 OHM 1% .125W TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R7	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R8	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1R9	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A10A1S1	08640-60106	6	SWITCH, SLIDE O/F	28480	08640-60106
A10A1S2	08640-60106		SWITCH, SLIDE D/F	28480	08640-60106
A10A1S3	08640-60106		SWITCH, SLIDE D/F	28480	08640-60106
A10A1S4	08640-60106		SWITCH, SLIDE D/F	28480	08640-60106
A10A1S5	08640-60106		SWITCH, SLIDE D/F	28480	08640-60106
A10A1S6	08640-60106		SWITCH, SLIDE D/F	28480	08640-60106
A10A1W1	8120-1830	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1830
A10A1W2	8120-1832	1	CABLE-COAX 50 CHM .086-OD	28480	8120-1832
A10A1W3	8120-1831	1	CABLE-COAX 50 OHM .086-00	28480	8120-1831
A10A1XA10A3A	1251-2035	5	CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-300
A10A1XA10A3B	1251-2026	2	CONNECTOR: PC EDGE: 18-CONT: DIP SOLDER	71785	252-18-30-300
A10A2	08640-60023	1	RF DIVIDER ASSY	28480	08640-60023
A10A2C1	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C2	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C3	0160-3456		CAPACITOR-FXD 1000FF +-10% 1000WVDC CER	28480	0160-3456
A10A2C4	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C5			NOT ASSIGNED		
A10A2C6	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C7	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C8	0160-3456		CAPACITOR-FXD 1000PF +-1000WVDC CER	28480	0160-3456
A10A2C9	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C10	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C11	0160-3456		CAPACITOR-FXD 1000PF +-100% 100WVDC CER	28480	0160-3456
A10A2C12	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C13	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C14	0160-3456		CAPACITOR-FXD 1000PF +-1000WVDC CER	28480	0160-3456
A10A2C15	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C16	0180-0100	3	CAPACITOR-FXD: 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A10A2C17	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C18	0180-0100		CAPACITOR-FXD: 4.7UF+-10% 35VDCM TA	56289	150D475X9035B2
A10A2C19	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10A2C20	0180-0374	2	CAPACITOR-FXD: 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A10A2C21			NOT ASSIGNED		
A10A2C22	0180-1743	11	CAPACITOR-XD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C23	0180-0374		CAPACITOR-FXD: 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A10A2C24	0160-3456		CAPACITOR-FXD 1000FF +-10% 1000WVDC CER	28480	0160-3456
A10A2C25	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVCD CER	28480	0160-3456
A10A2C26	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C27	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C28	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C29	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C30	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C31	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C32	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C33	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C34	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C35	0160-3456		CAPACITOR-FXD +-10% 1000WVDC CER	28480	0160-3456
A10A2C36	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C37	0160-2055		CAPACTIOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C38	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C39	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C40	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A10A2C41	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A10A2C42	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C43	0180-1743		CAPACITOR-FXD .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C44	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C45	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA0SOLID	56289	150D104X9035A2
A10A2C46	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C47	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C48	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C49	0180-1743		CAPACITOR-FXD: .1UF+-10% 35VDC TA0SOLID	56289	150D104X9035A2
A10A2C50	0180-1743		CAPACITOR-FXD: .1UF+-1-% 35VDC TA-SOLID	56289	150D104X9035A2
A10A2C51	0160-3456		CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A10A2C52	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10A2C53	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10A2C54	0160-3456		CAPACITOR-FXC 1000[F +-10% 1000WVDC CER	28480	0160-3456
A10A2CR1	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR2	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR3	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR4	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR5	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR6	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR7	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR8	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2CR9	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A10A2L1			PART OF ETCHED CIRCUIT BOARD		
A10A2L2			NOT ASSIGNED		
A10A2L3	9100-1620		COIL: FXD: MOLDED RF CHOCKE: 15UH 10%	24226	15/152
A10A2L4	9140-0096	1	COIL: FXD: MOLDED RF CHOKE: 1UH 10%	24226	15/101
A10A2L5	9100-1612	1	COIL: FXD: MOLDED RF CHOKE: .33UH 20%	24226	15/330
A10A2L6	9140-0094	1	COIL: FXD: MOLDED RF CHOKE: 68UH 10%	24226	15/680
A10A2L7	9100-1615	1	COIL: FXD: MOLDED RF CHOKE: 1.2UH 10%	24226	15/121
A10A2L8	9140-0098	1	COIL: FXD: MOLDED RF CHOKE: 2.2UH 10%	24226	15/221
A10A2L9	9100-1618	1	COIL: FXD: MOLDED RF CHOKE: 5.6UH 10%	24226	15/561
A10A2L10	9140-0114	1	COIL: FXD: MOLDED RF CHOKE: 10UH 10%	24226	15/102
A10A2L11	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A10A2L12	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A10A2L13	9100-1628	2	COIL: FXD: RF CHOKE: 43UH 5%	24226	15/432
A10A2L14	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A10A2L15	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A10A2L16	9100-1628		COIL: FXD: RF CHOKE: 43UH 5%	24226	15/432
A10A2Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT-200MHZ	28480	1854-0071
A10A2Q2	1853-0034	9	TRANSISTOR PNP SI CHIP TO-18 PD-360MW	28480	1853-0034
A10A2Q3	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A10A2Q4	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A10A2Q5	1854-0345	1	TRANSISTOR NPN 2N5179 SI PD=200MW	04713	2N5179
A10A2R1	0757-0394		RESISTOR 51.1 OHN 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A10A2R2	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A10A2R3	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A10A2R4	0757-0984	9	RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R5	0757-0438		RESISTOR 5.1K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R6	0698-7194	3	RESISTOR 17.8 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-17R8-G
A10A2R7	0698-7223	6	RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R8	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R9	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A10A2R10	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R11	0757-0438		RESISTOR 5.11K 1% .125K F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R12	0698-7194		RESISTOR 17.8 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-17R8-G
A10A2R13	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R14	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R15	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-51R1-F
A10A2R16	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R17	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R18	0698-7194		RESISTOR 17.8 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-17R8-G
A10A2R19	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R20	0698-7223		RESISTOR 287 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-287R-G
A10A2R21	0757-0398		RESISTOR 75 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-75R0-F
A10A2R22	0757-0984		RESSITOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R23	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R24	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-316R-G
A10A2R25	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-196R-G
A10A2R26	0698-7190	2	RESISTOR 12.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-12R1-G
A10A2R27	0698-7227	4	RESISTOR 422 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-422R-G
A10A2R28	0698-7227		RESISTOR 422 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-422R-G
A10A2R29	0698-3437		RESISTOR 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-133R-F
A10A2R30	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-82R5-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A10A2R31	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R32	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R33	0698-7224		RESISTOR 316 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-316R-G
A10A2R34	0698-7219		RESISTOR 196 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-196R-G
A10A2R35	0698-7190		RESISTOR 12.1 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-12R1-G
A10A2R36	0698-7227		RESISTOR 422 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-422R-G
A10A2R37	0698-7227		RESISTOR 422 OHM 2% .05W F TUBULAR	24546	C3-1/8-TO-422R-G
A10A2R38	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-82R5-F
A10A2R39	0698-3437		RESISTOR 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-133R-F
A10A2R40	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R41	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R42	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R43	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A10A2R44	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R45	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A10A2R46	0698-7253		RESISTOR 5.11K 2% .05W F TUBULAR	24546	C3-1/8-TO-5111-G
A10A2R47	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A10A2R48	0698-3444		RESISTOR 316 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-316R-F
A10A2R49	0757-0379	1	RESISTOR 12.1 OHM 1% .125W F TUBULAR	19701	MF4C1/8-TO-12R1-F
A10A2R50	0698-3447	10	RESISTOR 422 OHM 1% .125 F TUBULAR	16299	C4-1/8-TO-422R-F
A10A2R51	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A10A2R52	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A10A2R53	0757-0984		RESISTOR 10 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-10R0-F
A10A2R54	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A10A2R55	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A10A2R56			NOT ASSIGNED		
A10A2R57	0757-1094		RESISTOR 1.47K 1% .125W F TUBULAR	24546	C4-1/8-TO-1471-F
A10A2R58	0698-3454		RESISTOR 215K 1% .125W F TUBULAR	16299	C4-1/8-TO-2153-F
A10A2R59	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A10A2R60	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A10A2R61	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A10A2R62	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A10A2T1	08553-6012	5	TRANSFORMER,RF (CODE = BLUE)	28480	08553-6012
A10A2T2	08553-6012		TRANSFORMER, RF (CODE = BLUE)	28480	08553-6012
A10A2T3	08553-6012		TRANSFORMER, RF (CODE = BLUE)	28480	08553-6012
A10A2T4	08553-6012		TRANSFORMER, RF (CODE = BLUE)	28480	08553-6012
A10A2T5	08553-6012		TRANSFORMER, RF (CODE = BLUE)	28480	08553-6012
A10A2T6	08640-80002	1	TRANSFORMER, RF 12-TURN	28480	08640-80002
A10A2TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A10A2TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A10A2TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A10A2TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A10A2U1	1826-0013		IC LIN AMPLIFIER	28480	1826-0013
A10A2U2	1820-0102		IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A10A2U3	1820-0102		IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A10A2U4	1820-0102		IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A10A2U5	1820-0102		IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A10A2U6	1820-0535	1	IC DGTL SN75 4518P DRIVER	01295	SN75451BP
A10A2U7	1820-0145		IC DGTL MN 1010P GATE	04713	MC1010P
A10A2U8	1820-0145		IC DGTL MC 1010P GATE	04713	MC1010P
A10A2U9	1820-0145		IC DGTL MC 1010P GATE	04713	MC1010P
A10A2U10	1820-0753	3	IC DGTL GATE	28480	1820-0753
A10A2U11	1820-0982	1	IC LIN AMPLIFIER	28480	1820-0982
A10A2U12	1820-0736		IC DGTL COUNTER	28480	1820-0736
A10A2U13	1820-0753		IC DGTL GATE	28480	1820-0753
A10A2U14	1820-1354	1	IC DGTL COUNTER	28480	1820-1354
A10A2U15	1820-0753		IC DGTL GATE	28480	1820-0753
A10A2U16	1820-0557	1	IC DGTL FLIP-FLOP	28480	1820-0557
A10A2U17	1820-0145		IC DGTL MC 1010P GATE	04713	MC1010P
A10A2U18	1820-0143	1	IC DGTL MC 1027P FLIP-FLOP	04713	MC1027P
A10A2U19	1820-0145		IC DGTL MC 1010P GATE	04713	MC1010P
A10A2U20	1820-0102		IC DGTL MC 1013P FLIP-FLOP	04713	MC1013P
A10A2VR1	1902-3002	1	DIODE-2NR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A10A2W1	8120-1823	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1823
A10A2W2	8120-1824	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1824
A10A2W3	8120-1825	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1825
A10A2W4	8120-1826	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1826
A10A2W5	8120-1828		ABLE-COAX 50 OHM .086-OD	28480	8120-1828
A10A2W6	8120-1827	1	CABLE-COAX 50 OHN .086-OD	28480	8120-1827
A10A2W7	8120-1829	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1829
A10A2XA10A2U5	1200-0474	2	SOCKET: ELEC: IC 14-CONT DIP SLDR TERM	28480	1200-0474
A10A2XA10A2U9	1200-0474		SOCKET: ELEC: IC 14-CONT DIP SLDR TERM	28480	1200-0474
A10A3	08640-60022	1	RISER ASSY	28480	08640-60022
A10A3XA10A2A	1251-2035		CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-300
A10A3XA10A2B	1251-2026		CONNECTOR: PC EDGE: 18-CONT: DIP SOLDER	71785	252-18-30-300

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	08640-60020	1	FIXED-FREQUENCY MODULATION OSCILLATOR (STANDARD MODULE)	28480	08640-60020
A11C1	0160-3548	1	CAPACITOR-FXD .01UF +-1% 100WVDC MICA	28480	0160-3548
A11C2	0160-0336	1	CAPACITOR-FXD 100PF +-1% 300WVDC MICA	28480	0160-0336
A11C3	0180-0094	2	CAPACITOR-FXD: 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A11C4	0180-0094		CAPACITOR-FXD: 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A11C5	0180-2206		CAPACITOR-FXD: 60UF+-10% 6VDC TA-SOLID	56289	150D606X900682
A11C6	0180-1746		CAPACITOR-FXD: 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A11C7	0180-1746		CAPACITOR-FXD: 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A11CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR2	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11Q1	1854-0003	5	TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A11Q2	1854-0003		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
	1200-0173		INSULATOR=XSTR TO- 5 .075-THK	28480	1200-0173
A11Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q4	1854-0003		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A11Q5	1854-0003		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A11Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11R1			NOT ASSIGNED		
A11R2	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A11R3	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A11R4	0698-3457	1	RESISTOR 315K 1% .125W F TUBULAR	19701	MF4C1/8-TO-3163-F
A11R5	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A11R6	2100-1758	1	RESISTOR: VAR: TRMR: IKOHM 5% WW	BG027	CT-106-4
A11R7	0698-3151		RESISTOR 2.87K 1% .125W F TUBULAR	16299	C4-1/8-TO-2871-F
A11R8	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A11R9	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-TO-1963-F
A11R10	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A11R11	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A11R12	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A11R13	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A11R14	0698-0085		RESISTOR 2.6K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A11R15	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R16	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R17	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R18	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R19	0698-0024	4	RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-TO-2611-E
A11R20	0698-0024		RESISTOR 2.61K 1% .5M F TUBULAR	03888	PME65-1/2-TO-2611-F
A11R21	0698-0024		RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-TO-2611-F
A11R22	0698-0024		RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-TO-2611-F
A11R23	0757-1100	2	RESISTOR 600 OMM 1% .125W F TUBULAR	24546	C4-1/8-TO-601-F
A11R24	0757-1100		RESISTOR 600 OHN 1% .125W F TUBULAR	24546	C4-1/8-TO-601-F
A11R25	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R26	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11TP1	0340-1514		TERMINAL: SLDR STUD	28480	0360-1514
A11TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A11TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A11TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A11TP5	0340-1514		TERMINAL: SLDR STUD	28480	0360-1514
A11TP6	0360-1514		TERMINAL: STDR STUD	28480	0360-1514
A11U1	1826-0007	1	IC LIN AMPLIFIER	28480	1826-0007
A11VR1	1902-0049		DIODE-ZNR 6.19V 5% DO-7 PD=4W	28480	1902-0049
A11VR2	1902-0049		DIODE-ZNR 6.19V 5% DO-7 PD=.4W	28480	1902-0049
A11A1	08640-60116	1	FREQUENCY SELECT SWITCH ASSY	28480	08640-60116
A11A1MP1	08640-20218	1	HOUSING, GEAR SPROCKET, AUDIO	28480	08640-20218
A11A1R1	0698-8272	2	RESISTOR 157K 1% .125W F TUBULAR	19701	MF4C1/8-TO-1573-F
A11A1R2	0757-0479	2	RESISTOR 392K 1% .125W F TUBULAR	19701	MF4C1/8-TO-3923-F
A11A1R3	0698-8272		RESISTOR 157K 1% .125W F TUBULAR	19701	MF4C1/8-TO-1573-F
A11A1R4	0757-0479		RESISTOR 392K 1% .125W F TUBULAR	19701	MF4C1/8-TO-3923-F
A11A1S1	3100-3091	1	SWITCH:ROTARY	28480	3100-3091

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	08640-60019	1	VARIABLE-FREQUENCY MODULATION OSC. ASSY (OPTION 001)	28480	08640-60019
A11C1	0121-0477	1	CAPACITOR, VAR, 11HORIZ (INCLUDES C2, C3)	80486	2112 MODIFIED
A11C2			NSR PART OF A11C1		
A11C3			NSR PART OF A11C1		
A11C4	0160-2257	1	CAPACTOR-FXD 10PF +-5% 500WVDC CER 0+	28480	0160-2257
A11C5	0160-2261	2	CAPACITOR-FXD 15PF +-5% 500WVDC CER 0+	28480	0160-2261
A11C6	0140-0213	2	CAPACITOR-FXD 2000PF +-1% 300WVDC MICA	72136	DM19F202F0300WV1CR
A11C7	0140-0213		CAPACITOR-FXD 2000PF +-1% 300WVDC MICA	72136	DM19F202F0300WV1CR
A11C8	0160-2055	1	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A11C9	0121-0036	1	CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	DV11PR18A
A11C10	0180-0374	1	CAPACITOR-FXD; 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A11C11	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A11C12	0160-2199	1	CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A11C13	0180-0116	4	CAPACITOR-FXD; 6.8UF +-10% 35VDC TA	56289	150D685X9035B2
A11C14	0180-0116		CAPACITOR-FXD; 6.8UF +-10% 35VDC TA	56289	150D685X9035B2
A11C15	0180-1714	2	CAPACITOR-FXD; 330UF+-10% 6VDC TA-SOLID	56289	150D337X9006S2
A11C16	0180-1714		CAPACITOR-FXD; 330UF+-10% 6VDC TA-SOLID	56289	150D337X9006S2
A11C17	0180-0116		CAPACITOR-FXD; 6.8BUF+-10% 35VDC TA	56289	150D685X9035B2
A11C18	0180-0116		CAPACITOR-FXD; 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C19	0180-0228	1	CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A11C20	0160-2261		CAPACITOR-FXD 15PF +-5% 500WV9C CER 0+	28480	0160-2261
A11C21	0160-2236	1	CAPACITOR-FXD 1PF +-.25PF 500WVDC CER	28480	0160-2236
A11C22	0180-2207	2	CAPACITOR-FXD; 100UF+-10% 10VDC TA	56289	150D107X9010R2
A11C23	0180-2207		CAPACITOR-FXD; 100UF+-10% 10VDC TA	56289	150D107X9010R2
A11CR1	1901-0040	10	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR2	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR6	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR9	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A11CR10	1901-0040		DIODE-SWITCHING 2ND 30V 50MA	28480	1901-0040
A11MP1	0340-0037	2	TERMINAL-STUD DBL TURRET PRESS MTG .221	28480	0340-0037
	0340-0039	2	TERMINAL BUSHING - TEFLON: MOUNTS IN	28480	0340-0039
A11MP2	0340-0037		TERMINAL-STUD DBL TURRET PRESS MTG .221	28480	0340-0037
	0340-0039		TERMINAL BUSHING - TEFLON: MOUNTS IN	28480	0340-0039
A11MP3	1430-0764	1	GEAR SPUR	28480	1430-0764
A11MP4	08640-00006	1	COVER, AUDIO OSCILLATOR	28480	08640-00006
A11MP5	08640-20090	4	SUPPORT, COVER AUDIO OSCILLATOR	28480	08640-20090
A11MP6	08640-00008	1	COVER, BACK A OSCILLATOR	28480	08640-00008
A11MP7	08640-20062	1	SPACER, BUSHING	28480	08640-20062
A11MP8	2200-0103	1	SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0103
A11MP9	0570-0111	1	SCREW-MACH 6-32 RD HD SLT REC NYL-NAT	95987	N-632-3/8
A11MP10	2190-0004	1	WASHER-LK INTL T NO. 4 .115 IN ID .27 IN	78189	SF 1904-00
A11MP11	2260-0009	1	NUT-HEX-W/LKWR 4-40-THD .094-THK .25-A/F	28480	2260-0009
A11MP12	0403-0026	1	GLIDE:NYLON	28480	0403-0026
A11MP13	4040-0749	1	EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
	1480-0073	5	PIN:DRIVE 0.250" LG	00000	OBD
A11MP14	08640-20090		SUPPORT, LOWER, AUDIO OSCILLATOR	28480	08640-20090
A11MP15	08640-20090		SUPPORT, LOWER, AUDIO OSCILLATOR	28480	08640-20090
A11MP16	08640-20090		SUPPORT, LOWER, AUDIO OSCILLATOR	28480	08640-20090
A11MP17	08640-00081	1	INSULATOR, VAR AUDIO OSCILLATOR	28480	08640-00081
A11Q1	1853-0050	1	TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0050
A11Q2	1854-0071	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q3	1853-0276	2	TRANSISTOR PNP SI CHIP TO-52 PD=360MW	28480	1853-0276
A11Q3	1200-0173	2	INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A11Q4	1854-0351	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0351
A11Q5	1854-0003	2	TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
A11Q6	1854-0003		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
A11Q6	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A11Q7	1854-0351		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0351
A11Q8	1853-0276		TRANSISTOR PNP SI CHIP TO-52 PD=360MW	28480	1853-0276
A11Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q10	1853-0020	1	TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A11Q11	1855-0062	1	TRANSISTOR; J-FET N-CHAN, D-MOCE SI	28480	1855-0062
A11Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11R1	0698-8294	2	RESISTOR 21.5M 1% .5W F TUBULAR	28480	0698-8294
A11R2	0698-3453	2	RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-TO-1963-F
A11R3	0698-4508	1	RESISTOR 78.7K 1% .125W F TUBULAR	24546	C4-1/8-TO-7872-F
A11R4	0698-8294		RESISTOR 21.5M 1% .5W F TUBULAR	28480	0698-8294
A11R5	0698-3451	1	RESISTOR 133K 1% .125W F TUBULAR	16299	C4-1/8-TO-I333-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11R6	0757-0472	1	RESISTOR 200K 1% .125W F TUBULAR	24546	C4-1/8-TO-2003-F
A11R7	0757-0401	8	RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R8	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R9	0757-0441	1	RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-TO-8251-F
A11R10	0757-0447	1	RESISTOR 16.2K 1% .125W F TUBULAR	24546	C4-1/8-TO-1622-F
A11R11	0757-0199	5	RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A11R12	0757-0442	6	RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R13	0757-0279	2	RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A11R14	0757-0199		RESISTOR 21.5k 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A11R15	0698-0082	2	RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A11R16	0757-0200	2	RESISTOR 5.62K 1% .125F TUBULAR	24546	C4-1/8-TO-5621-F
A11R17	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R18	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R19	0757-0395	5	RESISTOR 56.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-56R2-F
A11R20	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R21	0757-0395		RESISTOR 56.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-56R2-F
A11R22	0757-0395		RESISTOR 56.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-56R2-F
A11R23	0757-0346	4	RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A11R24	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A11R25	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R26	0698-3156	2	RESISTOR 14.7K 1% .125W F TUBULAR	16299	C4-1/8-TO-1472-F
A11R27	0757-0280	2	RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A11R28	0698-3132	1	RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-2610-F
A11R29			NOT ASSIGNED		
A11R30	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A11R31	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-10R0-F
A11R32	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A11R33	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-TO-1963-F
A11R34	0698-3152	1	RESISTOR 3.48K 1% .125W F TUBULAR	16299	C4-1/8-TO-3481-F
A11R35	2100-2521	2	RESISTOR; VAR; TRMR; 2KOHM 10% C	19701	ET50X202
A11R36	0757-0290	1	RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-TO-6191-F
A11R37	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A11R38	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A11R39	0698-3150	1	RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-TO-2371-F
A11R40	2100-2521		RESISTOR; VAR; TRMR; 2KOHM 10% C	19701	ET50X202
A11R41	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A11R42	0757-0200		RESISTOR 5.62K 1% .125W F TUBULAR	24546	C4-1/8-TO-5621-F
A11R43	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A11R44	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A11R45	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R46	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R47	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A11R48	0698-3156		RESISTOR 14.7K 1% .125W F TUBULAR	16299	C4-1/8-TO-1472-F
A11R49	0698-0024	2	RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-TO-2611-F
A11R50	0698-0024		RESISTOR 2.61K 1% .5W F TUBULAR	03888	PME65-1/2-TO-2611-F
A11R51	0757-0395		RESISTOR 56.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-56R2-F
A11R52	0757-0395		RESISTOR 56.2 OHM 1% 125W F TUBULAR	24546	C4-1/8-TO-56R2-F
A11R53	0757-1100	2	RESISTOR 600 OHM 1% 125W F TUBULAR	24546	C4-1/8-TO-601-F
A11R54	0757-1100		RESISTOR 600 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-601-F
A11R55	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11R56	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A11RT1	5080-1718	1	THERMISTOR	28480	5080-1718
A11TP1	0360-1514	6	TERMINAL; SLDR STUD	28480	0360-1514
A11TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A11TP3	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A11TP4	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A11TP5	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A11TP6	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A11VR1	1902-3059	2	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=	04713	SZ 10939-62
A11VR2	1902-3059		DIODE-ZNR 3.83V 5% D0-7 PD=.4W TC=	04713	SZ 10939-62
A11A1	08640-60149	1	FREQUENCY SELECT SWITCH ASSY	28480	08640-60149
A11A1MP1	08640-20218	1	HOUSING, GEAR SPROCKET, AUDIO	28480	08640-20218
A11A1MP2	08640-20205	1	GEAR SPUR	28480	08640-20205
A11A1MP3	1430-0763	1	GEAR SPUR	28480	1430-0763
A11A1MP4	08640-20084	1	SHAFT, AUDIO OSCILLATOR	28480	08640-20084
A11A1MP5	3030-0196	1	SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0196
A11A1MP6	3030-0007	1	SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
A11A1R1	0698-4471	2	RESISTOR 7.15K 1% .125W F TUBULAR	24546	C4-1/8-TO-7151-F
A11A1R2	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A11A1R3	0698-3454	2	RESISTOR 215K 1% .125W F TUBULAR	16299	C4-1/8-TO-2153-F
A11A1R4	0698-5903	2	RESISTOR 2.4M 1% .5W F TUBULAR	19701	MF7C1/2-TO-2404-F
A11A1R5	0698-4471		RESISTOR 7.15K 1% .125W F TUBULAR	24546	C4-1/8-TO-7151-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11A1R6	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAI	24546	C4-1/8-TO-2152-F
A11A1R7	0698-3454		RESISTOR 215K 1% .125W F TUBULAR	16299	C4-1/8-TO-2153-F
A11A1R8	0698-5903		RESISTOR 2.4N 1% .5W F TUBULAR	19701	MF7C1/2-TO-2404-F
A11A1S1	08640-60108	1	SWITCH ASSY,AUDIO OSCILLATOR	28480	08640-60108
	3100-3081	1	SWITCH:ROTARY	28480	3100-3081

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A12	08640-60190	1	RECTIFIER ASSY	28480	08640-60190
A12C1	0160-0168	5	CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A12C2	0160-0168		CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A12C3	0160-0168		CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A12C4	0160-0168		CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A12C5	0160-0168		CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A12CR1	1901-0418	20	DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR2	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR3	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR4	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR5	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR6	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR7	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR8	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR9	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR10	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR11	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR12	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR13	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR14	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR15	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR16	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR17	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR18	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR19	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12CR20	1901-0418		DIODE-PWR RECT 400V 1.5A	04713	SR1846-12
A12MP1	0403-0026	4	GLIDE:NYLON	28480	0403-0026
A12Q1			NOT ASSIGNED		
A12R1			NOT ASSIGNED		
A12R2			NOT ASSIGNED		
A12R3	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A12R4	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A12R5	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A12R6	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A12R7	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A12VR1			NOT ASSIGNED		
A13	08640-60057	1	BOARD ASSY, MODULATION/METERING MOTHER	28480	08640-60057
A13C1	0180-2208	5	CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A13C2	0180-2208		CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A13C3	0180-2208		CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A13C4	0180-2208		CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A13J1	1250-0257	3	CONNECTOR-RF SMB M PC	28480	1250-0257
A13J2	1251-3055	2	CONNECTOR STRIP:8 MALE CONTACT	74868	221-70
A13J3	1250-0257		CONNECTOR-RF SMB M PC	28480	1250-0257
A13J4	1250-0257		CONNECTOR-RF SMB M PC	28480	1250-0257
A13J5	1251-3055		CONNECTOR STRIP:8 MALE CONTACT	74868	221-70
A13MP1	0403-0026		GLIDE:NYLON	28480	0403-0026
A13MP2	7120-1232	1	BLK LBL NO TEXT	0052B	3659 SCOTCH-CAL
A13MP3	08640-20211		GUIDE, CONNECTOR	28480	08640-20211
A13MP4	08640-40063	1	GUIDE, SLIDE SWITCH	28480	08640-40063
A13R1			NOT ASSIGNED		
A13R2	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A13R3	2100-1986	1	RESISTOR; VAR; TRMR; 1KOHM 10% C	30983	ET50W102
A13R4	0757-0443		RESISTOR 11K 1% .125W F TUBULAR	24546	C4-1/8-TO-1102-F
A13R5	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A13R6	0698-4014	1	RESISTOR 787 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-787R-F
A13S1	08640-60152	1	SWITCH, PC SLIDE 4R	28480	08640-60152
	5020-3440	2	SPRING DETENT		5020-3440
	08640-40063	4	GUIDE, SLIDE SWITCH		08640-40063
A13S2	08640-60153	1	SWITCH, PC SLIDE SR	28480	08640-60153
	5020-3440		SPRING DETENT		5020-3440
	08640-40063		GUIDE,SLIDE SWITCH		08640-40063
A13XA11	1251-2571	9	CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A13XA15	1251-2035		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	71785	252-15-30-300
A13XA2	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A13XA3A4	1251-0472	1	CONNECTOR; PC EDGE; 6-CONT; DIP SOLDER	71785	252-06-30-300
A13XA4	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A13XA5	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A13XA7	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A13XA8A3	5060-0109		CONNECTOR; 15-CONT	28480	5060-0109
A14	5060-9409	1	LINE MODULE WITH FILTER, JADE GRAY	28480	5060-9409
A14J1			NSR, P/O A14		
A14MP1	7120-4264	1	LABE, INFO	28480	7120-4264
A14P1	5020-8122	1	LINE VOLTAGE SELECTION CARD	28480	5020-8122
A15	08640-60018	1	RISER ASSY	28480	08640-60018
A15MP1	0403-0153	2	GUIDE, P.C. BOARD, BROWN	28480	0403-0153
A15MP2	0403-0154	1	GUIDE, P.C. BOARD, RED	28480	0403-0154
A15MP3	0403-0155	1	GUIDE, P.C. BOARD, ORANGE	28480	0403-0155
A15XA17	1251-3308	1	CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	71785	252-12-30-032
A16	08640-60119	1	FAN MOTOR ASSY	28480	08640-60119
A16B1	3140-0490	1	MOTOR, ELEC, BRUSHLES 10VDC 2550 PRM	28480	3140-0490
A16P1	1251-0198		CONNECTOR; PC EDGE; 6-CONT; SOLDER EYE	71785	251-06-30-261
	5040-0327	2	HOOD,CONNECTOR	28480	5040-0327
A17	08640-60001	1	POWER SUPPLY MOTHER BOARD ASSY	28480	08640-60001
A17XA12	1251-2034	3	CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	71785	252-10-30-300
A17XA18	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A17XA20	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A17XA22	1251-2571		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	26742	91-6915-0702-00
A17XA24	1251-2034		CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	71785	252-10-30-300
A17XA26A5	1251-2034		CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	71785	252-10-30-300
A18	08640-60004	1	-5.2V REGULATOR & FAN DRIVER ASSY	28480	08640-60004
A18C1	0180-0229	5	CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A18C2	0160-3534	4	CAPACITOR-FXD 510PF +-5% 100WVDC MICA	28480	0160-3534
A18C3	0180-2214	1	CAPACITOR-FXD; 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A18C4	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A18C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A18CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR2	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A18CR3	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A18CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR6	1901-0159	5	DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A18CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR9	1901-0049	2	DIODE-PWR RECT 50V 750MA	28480	1901-0049
A18CR10	1901-0049		DIODE-PWR RECT 50V 750MA	28480	1901-0049
A18CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A18CR12	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A18DS1	1990-0326	5	PHOTO-DEVICE; SW PNP-S1 3V .05MW PD	28480	1990-0326
A18F1	2110-0425	1	FUSE 2A 125V SLO-BLO	71400	GMW 2A
A18MP1	4040-0752	2	EXTRACTOR-PC BOARD, YELLOW	28480	4040-0752
	1480-0073		PIN; DRIVE 0.250" LG	00000	OBD
A18Q1	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A18Q2	1854-0232	4	TRANSISTOR NPN SI TO-39 PD-1W FT=15MHZ	28480	1854-0232
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A18Q3	1884-0012	5	THYRISTOR, SCR, JEDEC 2N3528	02735	2N3528
A18Q4	1854-0003		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
A18Q5	1853-0027	4	TRANSISTOR PNP SI CHIP TO-39 PD-1W	28480	1853-0027
	1200-0173		INSULATOR-XSTR TO- 5. 075-THK	28480	1200-0173
A18Q6	1853-0050	4	TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0050
A18Q7	1853-0027		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0027
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A18Q8	1853-0050		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0050
A18Q9	1853-0050		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0050
A18Q10	1853-0027		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0027
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A18Q11	1853-0050		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0050
A18Q12	1853-0027		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0027
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A18R1	0757-0317		RESISTOR 1.33K 1% .125W F TUBULAR	24546	C4-1/8-TO-1331-F
A18R2	2100-3123		RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A18R3	0757-0278		RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-TO-1781-F
A18R4	0683-0475	1	RESISTOR 4.7 OHM 5% .25W CC TUBULAR	01121	CB47G5
A18R5	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A18R6	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A18R7	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A18R8	0698-3161		RESISTOR 38.3K 1% .125W F TUBULAR	16299	C4-1/8-TO-3832-F
A18R9	0811-2813	3	RESISTOR 1 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R0-J
A18R10	0757-0316		RESISTOR 42.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-42R2-F
A18R11	0757-0317		RESISTOR 1.33K 1% .125W F TUBULAR	24546	C4-1/8-TO-1331-F
A18R12	0757-0397	5	RESISTOR 68.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-68R1-F
A18R13	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A18R14	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-TO-6191-F
A18R15	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A18R16	0811-1553	1	RESISTOR .68 OHM 5% 2W PW TUBULAR	75042	BWH2-11/16-J
A18R17	0698-3438	4	RESISTOR 147 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-147R-F
A18R18	0698-3438		RESISTOR 147 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-147R-F
A18R19	0698-7246		RESISTOR 2.61K 2% .05W F TUBULAR	24546	C3-1/8-TO-2611-G
A18TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18TP3	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18TP4	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18TP5	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18TP6	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A18U1	1826-0177	5	IC LIN REGULATOR	15818	723BE
A18VR1	1902-3005	2	DIODE-ZNR 2.43V 5% DO-7 PD=.4W TC=	04713	SZ 10939-5
A18VR2	1902-3094	1	DIODE-ZNR 5.11V 2% DO-7 PD=.4W TC=	04713	SZ 10939-99
A18VR3	1902-0049		DIODE-ZNR 6.19V 5% DO-7 PD=.4W	28480	1902-0049
A18XF1A	1251-2313	10	CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A18XF1B	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A19	08640-60060	1	OUTPUT LEVEL ASSY, 10 DB	28480	08640-60060
A19	08640-60078		RESTORED 08640-60060,REQUIRES EXCHANGE	28480	08640-60078
A19MP1	0380-0020		SPACER-RND .25-LG .128-ID .188-OD BRS IN	76854	2295-616
A19MP2	0380-0072	2	SPACER-RND .188-LG .128-ID .188-OD BRS	76854	2295-412
A19MP3	0550-0053	2	SCREW-MACH 5-40 PAN	28480	0550-0053
A19MP4	1500-0382	1	CCUPLER-FLEX .25-ID .562-OD 2.45-L	28480	1500-0382
A19MP5	2190-0020	1	WASHER-LK HLCL NO.5 .128 IN ID .239 IN	28480	2190-0020
A19MP6	2360-0119	2	SCREW-MACH 6-32 PAN HD POZI REC SST-300	28480	2360-0119
A19S1A	3130-0446	1	SWITCH,SGL SECT	28480	3130-0446
A19S1B	3130-0445	1	SWITCH,SGL SECT	28480	3130-0445
A19A1	08640-60061	1	ATTENUATOR ASSY	28480	08640-60061
A19A1C1			NSR, P/O A19A1		
A19A1J1			NSR, P/O A19A1		
A19A1J2			NSR, P/O A19A1		
A19A2	08640-60054	1	BOARD ASSY, RF VERNIER	28480	08640-60054
A19A2R1	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A19A2R2	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-TO-3161-F
A19A2R3	0698-3150		RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-TO-2371-F
A19A2R4	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A19A2R5	0698-3449		RESISTOR 28.7K 1% .125W F TUBULAR	16299	C4-1/8-TO-2872-F
A19A2R6	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A19A2R7	2100-2521		RESISTOR; VAR; TRMR; 2KOHM 10% C	19701	ET50X202
A19A2R8	2100-2521		RESISTOR; VAR; TRMR; 2KOHM 10% C	19701	ET50X202
A19A2R9	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A19A2TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A19A2TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20	08640-60005	1	REGULATOR ASSY, +5.2V & 44.6V	28480	08640-60005

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A20C1	0160-0153	1	CAPACITOR-FXD 1000PF +-10% 200WVDC POLYE	56289	292P10292
A20C2	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A20C3	0180-0234	1	CAPACITOR-FXD; 33UF+-20% 75VDC TA-WET	56289	109D336X0075F2
A20C4	0180-0228		CAPACITOR-FXD; 22UF-+10% 15VDC TA-SOLID	56289	150D226X9015B2
A20C5	0160-0300	1	CAPACITOR-FXD 2700PF +-10% 200WVDC POLYE	56289	292P27292
A20C6	0180-2208		CAPACITOR-FXD; 220UF+-10% 10VDC TA	56289	150D227X9010S2
A20C7	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A20C8	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A20CR1	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A20CR2	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A20CR3	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A20CR4	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A20CR5	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A20DS1	1990-0326		PHOTO-DEVICE; SW PNP-SI 3V .05MW PD	28480	1990-0326
A20DS2	1990-0326		PHOTO-DEVIC; SW PNP-SI 3V .05MW PD	28480	1990-0326
A20F1	2110-0332	1	FUSE 3A 125V	71400	GMW 3
A20F2	2110-0047	1	FUSE 1A 125V	71400	TYPE GMW-1/2
A20MP1	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	1480-0073		PIN:DRIVE 0.250"LG	00000	OBD
A20MP2	4040-0753	2	EXTRACTOR-PC BOARD, GREEN	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250"LG	00000	OBD
A20Q1	1884-0012		THRYISTOR, SCR, JEDEC 2N3528	02735	2N3528
A20Q2	1854-0232		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
	1200-0173		INSULATOR-XSTR TO- 5.075-THK	28480	1200-0173
A20Q3	1854-0022		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A20Q4	1853-0224	1	TRANSISTOR PNP SI CHIP PD=1W FT=15MHZ	02735	2N5415
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A20Q5	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A20Q6	1854-0023	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A20Q7	1884-0012		THYRISTOR, SCR, JEDEC 2N3528	02735	2N3528
A20R1	0698-3160		RESISTOR 31.6K 1% .125W F TUBULAR	16299	C4-1/8-TO-3162-F
A20R2	0698-3438		RESISTOR 147 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-147R-F
A20R3	0757-0462	3	RESISTOR 75K 1% .125W F TUBULAR	24546	C4-1/8-TO-7502-F
A20R4	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A20R5	0698-3407	1	RESISTOR 1.96K 1% .5W F TUBULAR	19701	MF7C1/2-TO-1961-F
A20R6	0698-3155		RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A20R7	0698-3449		RESISTOR 28.7K 1% .125W F TUBULAR	16299	C4-1/8-TO-2872-F
A20R8	2100-3154		RESISTOR-VAR TRMR 1KOHM 10% C SIDE ADJ	32997	3006P-I-102
A20R9	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A20R10	0811-2813		RESISTOR 1 OHM 5% .2W PW TUBULAR	91637	RS1/2-T2-IRO-J
A20R11	0757-0158	1	RESISTOR 619 OHM 1% .5W F TUBULAR	19701	MF7C1/2-TO-619R-F
A20R12	0757-0397		RESISTOR 68.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-68R1-F
A20R13	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A20R14	0811-1666	3	RESISTOR 1 OHM 5% 2W PW TUBULAR	75042	BWH2-1R0-J
A20R15	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A20R16	2100-3123		RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A20R17	0698-3150		RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-TO-2371-F
A20R18	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A20R19	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A20R20	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A20R21	0811-2813		RESISTOR 1 OHM 5% .5W TUBULAR	91637	RS1/2-T2-1R0-J
A20R22	0757-0316		RESISTOR 42.2 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-42R2-F
A20R23	0757-0397		RESISTOR 68.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-68R1-F
A20R24	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A20R25	0811-1666		RESISTOR 1 OHM 5% 2W PW TUBULAR	75042	BWH2-1R0-J
A20R26	0811-1666		RESISTOR 1 OHM 5% 2W PW TUBULAR	75042	BWH2-1R0-J
A20R27	0698-7246		RESISTOR 2.61K 2% .05W F TUBULAR	24546	C3-1/8-TO-2611-G
A20TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP3	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP4	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP5	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP6	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP7	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP8	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP9	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20TP10	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A20U1	1826-0177		IC LIN REGULATOR	15818	723BE
A20U2	1826-0177		IC LIN REGULATOR	15818	723BE
A20VR1	1902-0025		DIODE-ZNR 10V 5% D0-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A20VR2	1902-3234	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W	04713	SZ 10939-266
A20VR3	1902-0244	1	DIODE; ZENER; 30.1V VZ; 1W MAX PD	04713	SZ11213-278
A20VR4	1902-3345	1	DIODE-ZNR 51.1V 5% DO-7 PD=.4W	04713	SZ 10939-386
A20VR5	1902-3005		DIODE-ZNR 2.43V 5% DO-7 PD=.4W TC=	04713	SZ 10939-5

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A20VR6	1902-0049		DIODE-ZNR 6.19V 5% DO-7 PD=.4W	28480	1902-0049
A20XF1A	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A20XF1B	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A20XF2A	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A20XF2B	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A21			NOT ASSIGNED		
A22	08640-60177	1	REGULATOR ASSY, +20V & -20V	28480	08640-60177
A22C1	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A22C2	0160-3534		CAPACITOR-FXD 510PF +-5% 100WVDC MICA	28480	0160-3534
A22C3	0160-0158	2	CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A22C4	0180-0058	2	CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A22C5	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A22C6	0160-3534		CAPACITOR-FXD 510PF +-5% 100WVDC MICA	28480	0160-3534
A22C7	0160-0158		CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A22C8	0180-0058		CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A22CR1	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A22CR2	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A22CR3	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A22CR4	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A22CR5	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A22CR6	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A22DS1	1990-0326		PHOTO-DEVICE; SW PNP-SI 3V .05MW PD	28480	1990-0326
A22DS2	1990-0326		PHOTO-DEVICE; SW PNP-SI 3V .05MW PD	28480	1990-0326
A22F1	2110-0424	2	FUSE .75A 125V SLO-BLO	71400	GMW 3/4A
A22F2	2110-0424		FUSE .75A 125V SLO-BLO	71400	GMW 3/4A
A22MP1	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A22MP2	4040-0754	2	EXTRACTOR-PC BOARD, BLUE	28480	4040-0754
	1480-0073		PIN:DRIVE 0.250"LG	00000	OBD
A22Q1	1884-0012		THRYISTOR, SCR, JEDEC 2N3528	02735	2N3528
A22Q2	1854-0232		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A22Q3	1854-0232		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
	1200-0173		INSULATOR-XSTR TO- 5 .075-THK	28480	1200-0173
A22Q4	1884-0012		THYRISTOR, SCR, JEDEC 2N3528	02735	2N3528
A22R1	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A22R2	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A22R3	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-TO-4221-F
A22R4	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A22R5	0698-0084	2	RESISTOR 2.15K 1% .125W F TUBULAR	16299	C4-1/8-TO-2151-F
A22R6	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A22R7	2100-3123		RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A22R8	0683-0275	2	RESISTOR 2.7 OHM 5% .25W CC TUBULAR	01121	CB27G5
A22R9	0698-3439		RESISTOR 178 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-178R-F
A22R10	0757-0397		RESISTOR 68.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-68R1-F
A22R11	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A22R12	0811-1668	2	RESISTOR 1.5 OHM 5% 2W PW TUBULAR	75042	BWH2-1R5-J
A22R13	0757-0278		RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-TO-1781-F
A22R14	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-TO-2611-F
A22R15	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A22R16	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-TO-4221-F
A22R17	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A22R18	0757-0438		RESISITOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A22R19	2100-3123		RESISTOR-VAR TRMR 500 OHM 10% C SIDE ADJ	32997	3006P-1-501
A22R20	0698-0084		RESISTOR 2.15K 1% .125W F TUBULAR	16299	C4-1/8-TO-2151-F
A22R21	0683-0275		RESISTOR 2.7 OHM 5% .25W CC TUBULAR	01121	CB27G5
A22R22	0698-3439		RESISTOR 178 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-178R-F
A22R23	0757-0397		RESISTOR 68.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-68R1-F
A22R24	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-422R-F
A22R25	0811-1668		RESISTOR 1.5 OHM 5% 2W PW TUBULAR	75042	BWH2-1R5-J
A22R26	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A22R27	0698-7260		RESISTOR 10K 2% .05W F TUBULAR	24546	C3-1/8-TO-1002-G
A22R28	0757-0278		RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-TO-1781-F
A22TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP2	0360-1514		TERMINAL;SLDR STUD	288480	0360-1514
A22TP3	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP4	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP5	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A22TP6	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP7	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP8	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22TP9	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A22U1	1826-0177		IC LIN REGULATOR	15818	723BE
A22U2	1826-0177		IC LIN REGULATOR	15818	723BE
A22VR1	1902-0202	4	DIODE; ZENER; 15V VZ; 1W MAX PD	04713	SZ11213-191
A22VR2	1902-3256	2	DIODE-ZNR-23.7V 5% DO-7 PD=.4W	04713	SZ 10939-290
A22VR3	1902-0761	2	DIODE; ZENER; 6.2V VZ; .25W MAX PD	04713	1N821
A22VR4	1902-0202		DIODE; ZENER 15V VZ; 1W MAX PC	04713	SZ11213-191
A22VR5	1902-3256		DIODE-ZNR 23.7V 5% DO-7 PD=.4W	04713	SZ 10939-290
A22VR6	1902-0761		DIODE; ZENER; 6.2V VZ; .25W MAX PD	04713	1N821
A22XF1A	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A22XF1B	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A22XF2A	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A22XF2B	1251-2313		CONNECTOR;1-CONT SKT .04 DIA	00779	3-332070-5
A23			NOT ASSIGNED		
A24	08640-60007	1	SERIES REGULATOR SOCKET ASSY	28480	08640-60007
A24MP1	0361-0009	1	RIVET, SEMITUBULAR OVAL HD 0.188" LG	00000	OBD
A24MP2	0403-0152	1	GUIDE, P.C. BOARD, BLACK	28480	0403-0152
A24XQ1	1200-0041	5	SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLDR	00014	PTS-1
A24XQ2	1200-0041		SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLDR	00014	PTS-1
A24XQ3	1200-0041		SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLDR	00014	PTS-1
A24XQ4	1200-0041		SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLDR	00014	PTS-1
A25			NOT ASSIGNED		
A26	08640-60058	1	AM CASTING ASSY	28480	08640-60058
A26C1	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C2	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C3	0160-3219	3	CAPACITOR-FXD 100PF +-20% 500WVDC CER	28480	0160-3219
A26C4	0160-3219		CAPACITOR-FXD 100PF +-20% 500WVDC CER	28480	0160-3219
A26C5	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C6	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C7	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C8	0160-2049		CAPACITOR-FXD 5000PF +80-20% 5000WVDC CER	28480	0160-2049
A26C9	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C10	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C11	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C12	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C13	0160-3961	1	CAPACITOR-FXD 56PF +-20% 500WVDC CER	28480	0160-3961
A26C14	0160-3219		CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3219
A26C15	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C16	0160-2049		CAPACITOR-FXD 5000PF +80-20% 500WVDC CER	28480	0160-2049
A26C17	0160-2152	2	CAPACITOR-FXD 10PF +-20% 500WVDC CER	28480	0160-2152
A26C18	0160-2152		CAPACITOR-FXD 10PF +-20% 500WVDC CER	28480	0160-2152
A26J1	1250-0829	1	CONNECTOR-RF SMC M SGL HOLE FR	98291	50-045-4610
A26L1	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26L2	9100-1621	1	COIL; FXD; MOLDED RF CHOKE; 18UH 10%	24226	15/182
A26L3	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26L4	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26L5	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26L6	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26L7	9140-0178	1	COIL; FXD; MOLDED RF CHOKE; 12UH 10%	24226	15/122
A26L8	9100-1620		COIL; RXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26MP1	8160-0218	1	RFI STRIP NI ALY .782-W 4.728-L	28480	8160-0218
A26MP2	8160-0222	1	RFI STRIP NI ALY 2.027-W 3.053-L	28480	8160-0222
A26MP3	8160-0223	1	RFI STRIP NI ALY 1-W 2.196-L	28480	8160-0223
A26MP4	8160-0224	1	GASKET:MOD BOTTOM COVER	28480	8160-0224
A26MP5	08640-00012	1	COVER, ACCESS	28480	08640-00012
A26MP6	08640-00018	1	COVER, FILTER MODULE	28480	08640-00018
A26MP7	08640-20262	1	COVER, TOP MODULE	28480	08640-20
A26MP8	08640-20263	1	CASTING, MODULE	28480	08640-20
A26MP9	08640-20264	1	COVER, BUTTOM MODULE	28480	08640-20
A26MP10	08640-00013	1	COVER, FILTER AMPLIFIER	28480	08640-00013
A26MP11	0403-0153		GUIDE, P.C. BOARD, BROWN	28480	0403-0153
A26MP12	0403-0156		GUIDE, P.C. BOARD, YELLOW	28480	0403-0156
A26MP13	0403-0157		GUIDE, P.C. BOARD, GREEN	28480	0403-0157
A26MP14	2200-0107		SCREW-MACH 4-40 PAN HD POZI REC SST-300	28480	2200-0107
A26MP15	0520-0127		SCREW-PACH 2-56 PAN HD POZI REC SST-300	28480	0520-0127

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26MP16	2360-0201	1	SCREW-MACH 6-32 PAN HD POZI REC SST-300	28480	2360-0201
A26MP17	2950-0078		NUT-HEX-DBL CHAM 10-32 THD. 067-THK .25	24931	HN100-11
A26MP18	2190-0124		WASHER-LK INTL T NC. 10 .195 IN ID .311	24931	LW101-30
A26MP19	2190-0012		WASHER-LK EXT T NO. 10 .195 IN ID .406	78189	1810-00
A26MP20	2190-0014		WASHER-LK INTL T NO. 2 .089 IN ID. 185	78189	1902-00
A26MP21	2190-0018		WASHER-LK HLCL NO. 6 .141 IN ID .269 IN	28480	2190-0018
A26MPC22	3050-0228	1	WASHER-FL MTLC .156 IN ID. 312 IN OD	80120	MS15795-305
A26MP23	2950-0035	1	NUT-HEX-DBL CHAM 15/32-32-THD .078-THK	28480	2950-0035
A26MP24	2190-0068	1	WASHER-LK INTL T .505 IN ID .63 IN OD	78189	1924-02
A26MP25	0361-1071		RIVET:BLIND, DOME HD 0.125" DIA	11815	AAP-4-3
A26MP26	0403-0158		GUIDE, P.C. BOARD, BLUE	28480	0403-0158
A26R1	0757-0159	1	RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-TO-1R0-F
A26U1	08640-67006	1	OUTPUT AMPLIFIER	28480	08640-6700
A26U1C1			NSR, PART OF A26U1		
A26U1C2			NSR, PART OF A26U1		
A26U1C3			NSR, PART OF A26U1		
A26U1CR1			NSR, PART OF A26U1		
A26U1R1			NSR, PART OF A26U1		
A26U1R2			NSR, PART OF A26U1		
A26U1R3			NSR, PART OF A26U1		
A26U2	08640-67003	1	MODULATOR PREAMPLIFIER	28480	08640-67003
A26W1	8120-1889	1	CABLE-COAX .086-OD	28480	8120-1889
A26W2	8120-1887	1	CABLE-COAX 50 OHM .086-OD	28480	8120-1887
A26W3	8120-1905	1	CABLE-COAX .086-OD	28480	8120-1905
A26W4	8120-1892	1	CABLE-COAX .086-OD	28480	8120-1892
A26A1	08640-60074	1	BOARD ASSY, OUTPUT AMPLIFIER	28480	08640-60074
A26A1C1	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A26A1C2	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A26A1C3	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A26A1C4	0140-0198	1	CAPACITOR-FXD 200PF +-5% 300WVDC MICA	72136	DM15F201J0300WV1CR
A26A1C5	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A26A1C6	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A26A1CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A1CR2	1901-0022	8	DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A1CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A1CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A1CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A1CR6	1901-0539	4	DIODE-SCHOTTKY	28480	1901-0539
A26A1L1	9100-1620		COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
A26A1L2	9140-0180	1	COIL; FXD; MOLDED RF CHOKE; 2.7UH 10%	24226	15/271
A26A1Q1	1853-0007	3	TRANSISTOR PNP 2N23251 SI CHIP	04713	2N3251
A26A1Q2	1855-0049	1	TRANSISTOR; JFET;DUAL; N-CHAN D-MODE SI	28480	1855-0049
A26A1Q3	1855-0020	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0020
A26A1Q4	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A26A1Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A1Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A1Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A1Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A1Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A1R1	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	C4-1/8-TO-422R-F	
A26A1R2	0698-3446		RESISTOR 383 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-383R-F
A26A1R3	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A26A1R4	0757-0317		RESISTOR 1.33K 1% .125W F TUBULAR	24546	C4-1/8-TO-1331-F
A26A1R5	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A26A1R6	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A26A1R7	0757-0441		RESISTOR 8.25K 1% 125W F TUBULAR	24546	C4-1/8-TO-8251-F
A26A1R8	0698-3443	1	RESISTOR 287 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-287R-F
A26A1R9	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A26A1R10	0757-0199		RESISTOR 21.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-2152-F
A26A1R11	0757-0458		RESISTOR 51.1K 1% .125W F TUBULAR	24546	C4-1/8-TO-5112-F
A26A1R12	0683-3355	1	RESISTOR 3.3M 5% .25W CC TUBULAR	01121	CB3355
A26A1R13	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-TO-4222-F
A26A1R14	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-TO-4222-F
A26A1R15	0683-1055	2	RESISTOR IM 5% .25W CC TUBULAR	01121	CB1055
A26A1R16	0698-3438		RESISTOR 147 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-147R-F
A26A1R17	0698-3132		RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-2610-F
A26A1R18	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A26A1R19	2100-2061	1	RESISTOR: VAR: TRMR: 200 OHM 10% C	30983	ET50W201
A26A1R20	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26A1R21	0757-0420		RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A26A1R22			NOT ASSIGNED		
A26A1R23	0683-1055		RESISTOR IM 5% .25W CC TUBULAR	01121	CB1055
A26A1TP1	0340-0044	1	TERMINAL-STUD DBL TURRET PRESS MTG .25	83330	92-1500
A26A1TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A1VR1	1902-0184	1	DIODE-ZNR 16.2V 5% 00-7 PD-.4W	28480	1902-0184
A26A1VR2	1902-0048	1	DIODE-ZNR 6.81V 5% DO-7 PD=.4W	28480	1902-0048
A26A1XU1A-E	1251-2613	2	CONNECTOR: 1-CONT SKT .033 DIA	00779	50864-3
A26A2	08640-60014	1	AM OFFSET & PULSE SWITCHING ASSY	28480	08640-60014
A26A2C1	0180-0291		CAPACITOR-FXC: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A2C2	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-S0LID	56289	150D105X9035A2
A26A2C3	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A2C4	0180-0291		CAPACITOR-FXD: 1UF +-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A2C5	0160-3450	2	CAPACITOR-FXD 5000PF +-10% 250WVDC	28480	0160-3450
A26A2C6	0160-0161	2	CAPACITOR-FXD .01UF +- 10% 200WVDC POLYE	56289	292P10392
A26A2C7	0160-3450		CAPACITOR-FXD 5000PF +-10% 250WVDC	28480	0160-3450
A26A2C8	0180-1743		CAPACITOR-FXD .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A26A2C9			NOT ASSIGNED		
A26A2C10	0180-0100		CAPACITOR-FXD: 4.77UF+-10% 35VDC TA	56289	150D475X9035B2
A26A2C11	0180-0116		CAPACITOR-FXD: 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A26A2C12	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A2CR1	1910-0022	5	DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A26A2CR2	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A2CR3	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A2CR4	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A2CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR6			NOT ASSIGNED		
A26A2CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR8			NOT ASSIGNED		
A26A2CR9	1910-0016		DIODE, SWITCHING; GE: 60V VRM 60 MA	28480	1910-0016
A26A2CR10	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR12	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR13	1901-0539		DIODE-SCHOTTKY	28480	1901-0539
A26A2CR14	1910-0022		DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A26A2CR15	1910-0022		DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A26A2CR16	1910-0022		DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A26A2CR17	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A2CR18	1910-0022		DIODE-SWITCHING 3.5NS 5V 60MA	28480	1910-0022
A26A2K1			NOT ASSIGNED		
A26A2L1	9100-1641	4	COIL: FXD: MOLDED RF CHOKE: 24OUH 5%	24226	15/243
A26A2L2	9100-1641		COIL: FXD: MOLDED RF CHOKE: 240UH 5%	24226	15/243
A26A2L3	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A26A2MP1	4040-0749		EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A26A2MP2	4040-0752		EXTRACTOR-PC BOARD, YELLOW	28480	4040-0752
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A26A2Q1	1854-0221		TRANSISTOR NPN DUAL 200%-HFE 10MV-VBE	28480	1854-0221
A26A2Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A26A2Q3	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A26A2Q4	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A26A2Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A26A2Q6	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A26A2Q7	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A26A2Q8	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD-360MW	28480	1853-0034
A26A2Q9	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PC=360MW	28480	1853-0034
A26A2R1	0757-0465	6	RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-TO-1003-F
A26A2R2	0757-0440		RESISTOR 7.5K 1% .125 F TUBULAR	24546	C4-1/8-TO-7501-F
A26A2R3	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A26A2R4	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A26A2R5	0698-3155		RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A26A2R6	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A26A2R7	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-7501-F
A26A2R8	0757-0422		RESISTOR 909 OHM 1% .125W TUBULAR	24546	C4-1/8-TO-909R-F
A26A2R9	0757-0421	4	RESISTOR 825 OHM 1% .125W TUBULAR	24546	C4-1/8-TO-825R-F
A26A2R10	0757-0439	1	RESISTOR 6.81K 1% .125W F TUBULAR	24546	C4-1/8-TO-6811-F
A26A2R11	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A26A2R12	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A26A2R13	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A26A2R14	0757-0421		RESISTOR 825 OHM 1% .125 F TUBULAR	24546	C4-1/8-TO-825R-F
A26A2R15	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26A2R16	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A26A2R17	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A26A2R18	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A26A2R19	2100-2413	1	RESISTOR: VAR: TRMR: 200 OHM 10% C	19701	ET50X201
A26A2R20	0698-3157		RESISTOR 19.6K 1% .125W F TUBULAR	16299	C4-1/8-TO-1962-F
A26A2R21	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-511R-F
A26A2R22	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-51R1-F
A26A2R23	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A26A2R24	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A2R25	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A26A2R26	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A2R27	0698-0085		RESISTOR 2.61K 1% .125W F TUBULAR	16299	C4-1/8-T0-2611-F
A26A2R28	0698-3162		RESISTOR 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A26A2R29	0698-3150		RESISTOR 2.37K 1% .125F TUBULAR	16299	C4-1/8-T0-2371-F
A26A2R30	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A2R31	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A26A2R32	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A2R33	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A26A2R34	0757-0289		RESISTOR 13.3K 1% .125W F TUBULAR	19701	MF4C1/8-T0-1332-F
A26A2R35	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-4640-F
A26A2R36	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	162999	C4-1/8-TO-1961-F
A26A2R37	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A2R38	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A2R39	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A26A2TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP5	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP6	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP7	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2TP8	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A2U1	1826-0114	1	IC DGTL COMPARATOR (ANALOG)	07263	710HM
A26A2U2	1820-0448	1	IC DGTL SN54 00 N GATE	01295	SN5400N
A26A2U3	1820-0579	1	IC DGTL SN74 123 N MULTIVIBRATOR	01295	SN74123N
A26A2VR1	1902-3139	1	DIODE-ZNR 8.25V 5% DO-7 PD=.4W	04713	SZ 10939-158
A26A3	08640-60016	1	MODULATOR ASSY	28480	08640-60016
A26A3C1	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A26A3C2	0160-3094		CAPACITOR-FXD .1UF +-10% 100WVDC CER	28480	0160-3094
A26A3C3	0150-0048	4	CAPACITOR-FXD .22PF +-5% 500MVCC TI DIOX	95121	TYPE QC
A26A3C4	0150-0048		CAPACITOR-FXD .22PF +-5% 500WVDC TI DIOX	95121	TYPE QC
A26A3C5	0150-0048		CAPACITOR-FXD .22PF +-5% 500MVDC TI DIOX	95121	TYPE QC
A26A3C6	0150-0048		CAPACITOR-FXD .22PF +-5% 500MVDC TI DIOX	95121	TYPE QC
A26A3CR1	08640-60163	1	MATCHED DIODE SET (INCL A26A3CR2-8,NSR)	28480	08640-60163
A26A3CR2			NSR, PART OF A26A3RC1.		
A26A3CR3			NSR, PART OF A26A3CR1.		
A26A3CR4			NSR, PART OF A26A3CR1.		
A26A3CR5			NSR, PART OF A26A3CR1.		
A26A3CR6			NSR, PART OF A26A3CR1.		
A26A3CR7			NSR, PAR OF A26A3CR1.		
A26A3CR8			NSR, PART OF A26A3CR1.		
A26A3J1	1250-1425	1	CONNECTOR-RF SMC M SGL HDLE RR	2K497	700177-1
A26A3L1	9100-1620		COIL: FXD: MOLDED RF CHOKE: 15UH 10%	24226	15/152
A26A3L2	9140-0112	1	COIL: FXD: MOLDED RF CHOKE: 4.7UH 10%	24226	15/471
A26A3R1	0698-7229		RESISTOR 511 OHM 2% .05W F TUBULAR	24546	C3-1/8-T0-511R-G
A26A3R2	0698-3132		RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-2610-F
A26A3R3	0698-3132		RESISTOR 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-2610-F
A26A3R4	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A26A3R5	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A26A3T1	08640-80003	2	BALUN ASSY	28480	08640-80003
A26A3T2	08640-80003		BALUM ASSY	28480	08640-80003
A26A3XU2A-E	1251-2613		CONNECTOR:1-CONT SKT .033 DIA	00779	50864-3
A26A4	08640-60165	1	BOARD ASSY, AGC AMPLIFIER	28480	08640-60165
A26A4C1	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A4C2	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLI	56289	150D105X9035A2
A26A4C3	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A4C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A26A4C5			NOT ASSIGNED		

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26A4C6	0160-3458	1	CAPACITOR-FXD 5000FF +-10% 250WVDC CER	28480	0160-3458
A26A4C7	0180-0291		CAPACITOR-FXD: 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A4C8	0180-0197		CAPACITOR-FXD: 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A26A4C9	0160-0157	2	CAPACITOR-FXD 4700PF +-10% 200WVDC POLYE	56289	292P47292
A26A4C10	0160-0302	1	CAPACITOR-FXD .018UF +-10% 200WVDC POLYE	56289	292P18392
A26A4C11	0160-0161		CAPACITOR-FXD .01UF +-10% 200WVDC POLYE	56289	292P10392
A26A4C12	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A26A4C13	0180-0291		CAPACITOR-FXD: 1UF +-10% 35VDC TA-SOLID	56289	150D105X9035A2
A26A4C14	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A26A4C15	0160-0297	1	CAPACITOR-FXD 1200PF +-10% 200WVDC POLYE	56289	292P12292
A26A4C16	0160-3534		CAPACITOR-FXD 510PF +-5% 100WVCC MICA	28480	0160-3534
A26A4C17	0160-3459	1	CAPACITOR-FXD .02U +-20% 100WVDC VER	28480	0160-3459
A26A4C18	0160-0157		CAPACITOR-FXD 4700PF +-10% 200WVDC POLYE	56289	292P47292
A26A4CR1	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A4CR2	1901-0040		DIODE-SWITCHING 2NS 30 50MA	28480	1901-0040
A26A4CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A4CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A4CR5	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A4CR6	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A4CR7	1910-0016	3	DIODE-SWITCHING 1US 60V 60MA	28480	1910-0016
A26A4CR8	1910-0016		DIODE-SWITCHING 1US 60V 60MA	28480	1910-0016
A26A4CR9	1910-0016		DIODE-SWITCHING 1US 60V 60MA	28480	1910-0016
A26A4CR10	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A4CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A4CR12	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A26A4CR13	1901-0539		DIODE-SCHOTTKY	28480	1901-0539
A26A4CR14	1901-0518	1	DIODE-SCHOTTKY	28480	1901-0518
A26A4CR15	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A26A4K1	0490-1080		RELAY; REED; 1C .25A 150V CONT; 5V COIL	28480	0490-1080
A26A4L1	9100-1641		COIL: FXD: MOLDED RF CHOKE: 24OUH 5%	24226	15/243
A26A4L2	9100-1641		COIL: FXD: MOLDED RF CHOKE: 24OUH 5%	24226	15/243
A26A4MP1	4040-0749		EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A26A4MP2	4040-0753		EXTRACTOR-PC BOARD, GREEN	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A26A4Q1	1854-0221		TRANSISTOR NPN DUAL 200%-HFE 10MV VBE	28480	1854-0221
A26A4Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A4Q3	1853-0007		TRANSISTOR PNP 2N3251 SI CHIP	04713	2N3251
A26A4Q4	1854-0221		TRANSISTOR NPN DUAL 200%-HFE 10MV-VBE	28480	1854-0221
A26A4Q5	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A26A4Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A4Q7	1853-0034		TRANISTOR PNP SI CHIP TO-18 PC=360MW	28480	1853-0034
A26A4Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A4Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A26A4R1	2100-2489	1	RESISTOR: VAR: TRMP: 5KOHM 10% C	19701	ET50X502
A26A4R2	2100-2521		RESISTOR: VAR: TRMP: 2KOHM 10% C	19701	ET50X202
A26A4R3	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A26A4R4	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MFC1/8-T0-6191-F
A26A4R5	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-T0-6191-F
A26A4R6	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A26A4R7	0757-0424		RESISTOR 1.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1101-F
A26A4R8	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-7501-F
A26A4R9	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A26A4R10	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R11	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R12	2100-2514		RESISTOR: VAR: TRMR: 20KOHM 10% C	19701	ET50X203
A26A4R13	0698-3156	2	RESISTOR 14.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1472-F
A26A4R14	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R15	0698-3156		RESISTOR 14.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1472-F
A26A4R16	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24566	C4-1/8-T0-5111-F
A26A4R17	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A26A4R18	0698-3153		RESISTOR 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A26A4R19	0757-0464	1	RESISTOR 90.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-9092-F
A26A4R20	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A4R21	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A4R22	0757-0278		RESISTOR 1.78K .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A26A4R23	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	19701	MF4C1/8-T0-6191-F
A26A4R24	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A26A4R25	0757-0458		RESISTOR 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A26A4R26	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A4R27	0757-0458		RESISTOR 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A26A4R28	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A26A4R29	0757-0442		RESISTOR 10K 1% 125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R30	0757-0441		RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-T0-8251-F

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26A4R31	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A26A4R32	0757-0279		RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A26A4R33	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A26A4R34	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A26A4R35	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A26A4R36	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A26A4R37			NOT ASSIGNED		
A26A4R38	0698-3153		RESISTOR 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A26A4R39	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A26A4R40	0757-0346		RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A26A4R41	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A26A4R42	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A26A4R43	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A26A4R44	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A26A4R45	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R46	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A26A4R47	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A26A4R48	0757-0289		RESISTOR 13.3K 1% .125W F TUBULAR	19701	MF4C1/8-T0-1332-F
A26A4R49	0698-3150		RESISTOR 2.37K 1% .125W F TUBULAR	16299	C4-1/8-T0-2371-F
A26A4R50	0698-3451	1	RESISTOR 133K 1% .125W F TUBULAR	16299	C4-1/8-T0-1333-F
A26A4R51			NOT ASSIGNED		
A26A4R52	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A26A4R53	0757-0278		RESISTOR 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A26A4R54	0757-0421		RESISTOR 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A26A4R55	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A26A4R56	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A4R57	0757-0421		RESISTOR 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A26A4TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4TP2	0360-1514		TERMINAL: SLD STUD	28480	0360-1514
A26A4TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4TP4	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4TP5	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4TP6	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4TP7	0360-1514		TERMINAL: SLDR STUD	23480	0360-1514
A26A4TP8	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A4U1	1826-0092		IC LIN AMPLIFIER	04713	MC7812CP
A26A4U2	1826-0026	1	IC DGTL LM311H COMPARATOR (ANALOG)	27014	LM311H
A26A4U3	1820-0328		IC DGTL SN74 02 N GATE	01295	SN7402N
A26A4U4	1820-0471	1	IC DGTL SN74 06 N INVERTER	01295	SN7406N
A26A4VR1	1902-0025		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A26A4VR2	1902-3203		DIODE-ZNR 14.7V 5% DO-7 PD=.4W	04713	SZ 10939-230
A26A5	08640-60068	1	BOARD ASSY, AM RISER	28480	08640-60068
A26A5XA26A6	1251-3231	1	CONNECTOR: PC EDGE: 15-CONT; WIRE WRAP	28480	1251-3231
A26A6	08640-60067	1	BOARD ASSY, AM MOTHER	28480	08640-60067
A26A6XA26A2	1251-1886	2	CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-340
A26A6XA26A4	1251-1886		CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	71785	252-15-30-340
A26A6XA26A8	1251-2571		CONNECTOR: PC EDGE: 15-CONT: DIP SOLDER	26742	91-6915-0702-00
A26A7			NOT ASSIGNED		
A26A8	08640-60069	1	BOARD ASSY, DEMODULATOR AMPLIFIER	28480	08640-60069
A26A8C1	0180-0116		CAPACITOR-FXD: 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A26A8C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A26A8C3	0180-0116		CAPACITOR-FXD: 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A26A8C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A26A8C5	0180-0116		CAPACITOR-FXD: 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A26A8C6	0160-2055		CAPACITOR-FXD .01U +80-20% 100MVDC CER	284480	0160-2055
A26A8MP1	4040-0749		EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
A26A8MP2	4040-0754		EXTRACTOR-PC BOARD, BLUE	28480	4040-0754
A26A8R1	0698-3334	2	RESISTOR 178 OHM 1% .5W F TUBULAR	19701	MFC1/2 T0-178R-F
A26A8R2	0698-3334		RESISTOR 178 OHM 1% .5W F TUBULAR	19701	MF7C1/2 TO 178R-F
A26A8R3	2100-2633		RESISTOR: VAR: TRMR: 1KOHM 10% C	19701	ET50X102
A26A8R4	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A26A8R5	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A26A8R6	2100-3103		RESISTOR-VAR TRMR 10KOHM 10% C SIDE ADJ	32997	3006P-1-103
A26A8R7	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A26A8R8	2100-3103		RESISTOR-VAR TRMR 10KOHM 10% C SIDE ADJ	32997	3006P-1-103
A26A8R9	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A26A8R10	2100-3109		RESISTOR-VAR TRMR 2KOHM 10% C SIDE ADJ	32997	3006P-1-202

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
A26A8R11	0757-0441		RESISTOR 8.25K 1% .125F W TUBULAR	245446	C4-1/8-T0-8251-F
A26A8R12	0757-0462		RESISTOR 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A26A8R13	0757-0418		RESISTOR 619 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-619R-F
A26A8R14	0757-0462		RESISTOR 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A26A8R15	2100-3054		RESISTOR-VAR TRMR 50KOHM 10% C SIDE ADJ	32997	3006P-1-503
A26A8S1	3101-0973	1	SWITCH: SL: DPOT NS; .5A 125VAC/DC	79727	GF126-0018
A26A8TP1	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A8TP2	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A8TP3	0360-1514		TERMINAL: SLDR STUD	28480	0360-1514
A26A8U1	1820-0158		IC LIN LM302 FOLLOWER	27014	LM302H
A26A8U2	1820-0081	1	IC DGTL GATE	07263	911HC
A26A8VR1	1902-0202		DIODE: ZENER: 15V VZ: 1W MAX PD	04713	SZ11213-191
A26A8VR2	1902-0202		DIODE: ZENER: 15V VZ: 1W MAX PD	04713	SZ11213-191

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
			CHASSIS PARTS		
C1	0180-2530	2	CAPACITOR-FXD: 390 OUF+75-10% 50VDC AL	56289	36D392G050AC2B
C2	0180-2530		CAPACITOR-FXD: 390OUF+75-10% 50VDC AL	56289	36D392G050AC2B
C3	0180-2334	1	CAPACITOR-FXD: 390OUF+75-10% 75VOC AL	56289	36D392F075BB2B
C4	0180-2277	2	CAPACITOR-FXD: 820OUF+75-10% 25VDC AL	56289	36D822G025AC2A
C5	0180-2277		CAPACITOR-FXC: 820OUF+75-10% 25VDC	56289	36D822G025AC2A
C6	0160-4048	1	CAPACITOR-FXD .022UF +-20% 250WVAC MET	0057R	PME 271 M 522
DS1	2140-0244	1	LAMP, GLOW, BULB T-2, 105V	87034	A1H
F1	2110-0002	1	FUSE 2A 250V (FOR 100/120V OPERATION)	71400	AGC-2
F1	2110-0094	1	FUSE 1.25A 250V (FOR 220/240V OPERATION)	75915	3121.25
J1			RF OUTPUT, SEE FIGURE 6-2.		
J2			NSR, P/O W4		
J3			NSR, P/O W12		
J4			NOT ASSIGNED		
J5			NSR, P/O W14		
J6			NSR, P/O W15		
J7			NSR, P/O W17		
M1	1120-0539	1	METER	28480	1120-0539
	0360-0053	1	TERMINAL, SLDR LUG, 10 SCR, .204/094	78189	2101-10-00
MP1	0340-0486	1	INSULATOR COVER, T0- 3, .33 THK	28480	0340-0486
MP2	0370-2376	1	KNOB:BAR, SKIRTED 0.250" DIA SHAFT (FREQUENCY RANGE)	28480	0370-2376
MP3	0370-2378	1	KNOB:RIND, CONCENTRIC 0.125" DIA SHAFT (FM)	28480	0370-2378
MP4	0370-2379	1	KNOB:RND, CONCETRAIC 0.125" DIA SHAFT (AM)	28480	0370-2379
MP5	0370-2380	1	KNOB:BAR BASE 0.250" DIA SHAFT (PEAK DEVIATION RANGE)	28480	0370-2380
MP6	0370-2381	1	KNOB:BAR BASE 0.250" DIA SHAFT	28480	0370-2381 (OPTION 001) AUD OUT 3V
MP7	0370-2382	1	KNOB:RND SKIRTED 0.250" DIA SHAFT (STANDARD) MOD. FREQUENCY	28480	0370-2382
MP8	0370-2623	1	KNOB BASE,PTR,.375", JGK, MGP (FINE TUNE)	28480	0370-2623
MP9	0370-2387	1	KNOB: BASE 0.250" DIA SHAFT (STANDARD) AUD CUT IV	28480	0370-2387
MP10	0370-0623	1	KNOB, BASE, RND .5", JGK,MGP DECAL (OUTPUT LEVEL VERNIER)	28480	0370-0623
MP11	0370-2446	1	KNOB, CONC, RND, .5 IN, JGK, MGP DECAL (OPTION 001) MOD. FREQUENCY VERNIER	28480	0370-2446
MP12	0403-0026		GLIDE:NYLON	28480	0403-0026
MP13	0590-1011	1	NUT-KNURLED R 15/32-32-THD .12-THK .61	28480	0590-1011
MP14	1400-0825	1	INSULATOR: MISC: CLIP PANEL: .201 ID	28480	1400-0825
MP15	1540-0034	1	CONTAINER-PLSTC POLYSTY 1.062-LG 1.062	28480	1540-0034
MP16	08640-20163	1	CLAMP, CAP	28480	08640-20163
MP17	3150-0203	1	FILTER-AIR EXP AL 3.6-W 6-L	28480	3150-0203
MP18	5001-0135	1	WRENCH, COMBINATION	28480	5001-0135
MP19	5060-0109	1	CONNECTOR: 15 CONTRACTS	28480	5060-0109
MP20	08640-00066	1	PANEL, FRONT	28480	08640-00066
MP21	08640-00021	1	SHIELD, FM AMPLIFIER	28480	08640-00021
MP22	08640-4044	1	SCREW, METER ZERO	28480	08640-4044
MP23	08640-00022	1	SUPPORT, PC BOARD	28480	08640-00022
MP24	08640-00030	1	SUPPORT, MODULE	28480	08640-00030
MP25	08640-00058		INSULATOR, COUNTER	28480	08640-00058
MP26	08640-00059	1	INSULATOR, CONNECTOR	28480	08640-00059
MP27	08640-20078	1	EXTRUSION, TOP	28480	08640-20078
MP28	08640-20079	1	EXTRUSION, BOTTOM	28480	08640-20079
MP29	08640-20085	1	COUPLER, SHAFT	28480	08640-20085
MP30	08640-20204	1	FRONT CASTING, 5H FM	28480	08640-20204
MP31	08640-40016	1	CLAMP, METER	28480	08640-40016
MP32			NOT ASSIGNED		
MP33	08640-40046	1	LENS, DIFFUSING	28480	08640-40046
MP34	08640-40047	1	KNOB/DIAL ASSY	28480	08640-40047 (OPTION 001) MOD FREQUENCY
MP35	08640-40049	1	WINDOW, FRONT	28480	08640-40049
MP36	08640-40051	1	DIAL AND GEAR ASSY (OPTION 001) MOD FREQ. VERNIER SKIRT	28480	08640-40051

TABLE 6-3. REPLACEABLE PARTS

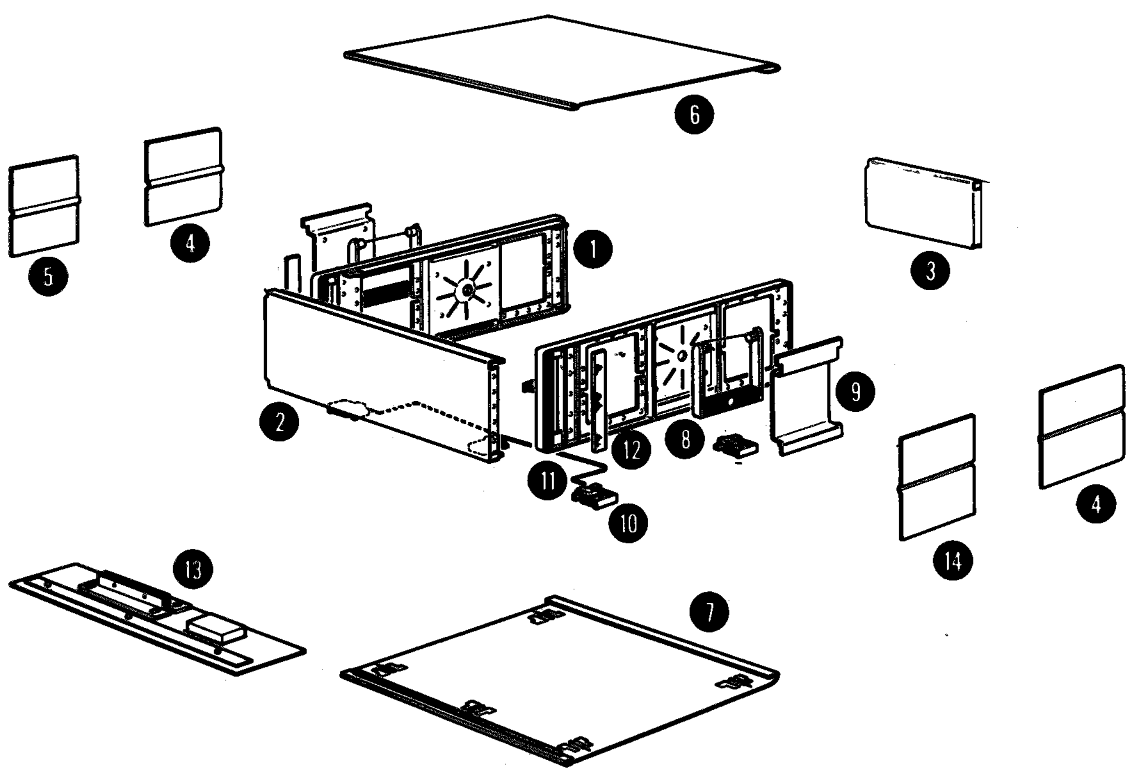
REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
MP37	08640-40055	1	KNOB AND SKIRT, FREQUENCY TUNE	28480	08640-40055
MP38			NOT ASSIGNED		
MP39	08640-60036	1	BOARD ASSY, EXTENDER	28480	08640-60036
MP40	5040-0388	1	BUTTON, X10%	28480	5040-0388
MP41	5040-0389	1	BUTTON, 507'Z	28480	5040-0389
MP42	5040-0390	1	BUTTON, VOLTS	28480	5040-0390
MP43	3030-0007		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY (FRONT PANEL KNOBS)	28480	3030-0007
MP44	0624-0267	1	SCREW-TPG 6-20 PAN	28480	0624-0267
MP45	0626-0002	1	SCREW-TPG 6-20 PAN	28480	0626-0002
MP46	1200-0043	1	INSULATOR; XSTR: TC- 3; .02 THK	28480	1200-0043
MP47	3160-0217	1	FAN BLADE .76-THK 3-OD .079-ID	28480	3160-0217
MP48	5040-0170	1	GUIDE: PLUG-IN PC BOARD	28480	5040-0170
MP49	3030-0007		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
MP50	5040-0447	1	FOOT:REAR(LONG)	28480	5040-0447
MP51			NOT ASSIGNED		
MP52	08620-20016	1	HEAT SINK, TRANSISTOR	28480	08620-20016
MP53	08640-00014	1	CECK, TRANSFORMER	28480	08640-00014
MP54	08640-00015	1	DECK, MAIN	28480	08640-00015
MP55			NOT ASSIGNED		
MP56	0400-0005	1	GROMMET:RUBBER FOR 0.562" DIA HOLE	73734	#1660
MP57	0403-0026		GLIDE:NYLON	28480	0403-0026
MP58	8160-0238	1	RFI RING MNL .75-OD .218-ID .4-L (MAIN TUNE)	28480	8160-0238
MP59	8160-0239	1	RFI RING MNL .63-OD .12-ID .2-L (FINE TUNE)	28480	8160-0239
MP60	08640-20228	1	COLLAR, RETAINING (FINE TUNE SHAFT)	28480	08640-20228
MP61	08640-40052	1	LEVER SLIDE SWITCH	28480	08640-40052
MP62	08640-20057	1	INSULATOR, TRANSISTOR	28480	08640-20057
MP63	08640-00077	1	KNOB ASSY, OUTPUT LEVEL 1 DB	28480	08640-00077
MP64	08640-00078	1	KNOB ASSY, OUTPUT LEVEL 10 DB	28480	08640-00078
MP65	5020-0343	1	SHAFT	28480	5020-0343
MP66	1410-0758	1	BUSHING, PANEL, 3/8-52 THD BRASS	83330	119
MP67			NOT ASSIGNED		
MP68	08640-00072	1	BRACKET, FAN, TOP	28480	08640-00072
MP69	08640-00073	1	BRACKET, FAN, BOTTOM	28480	08640-00073
MP70	08640-00074	1	FOAM STRIP, BOTTOM COVER	28460	08640-00074
MP71	7120-4244	1	LABEL, DEMOD CAL	28480	7120-4244
MP72			NOT ASSIGNED		
MP73	08640-40067	1	KNOB, TIME BASE	28480	08640-40067
MP74	3030-0007		SCREW-SET 4-40 SMALL CUP PT HEX REC ALY	28480	3030-0007
P1	1251-3294	1	CONNECTOR, PC EDGE, 10-CONT, SOLDER EYE	05574	3VH10/1JN12
P2	1251-0198		CONNECTOR: PC EDGE: 6-CONT: SOLDER EYE	71785	251-06-30-261
	5040-0327		HOOD:CONNECTOR	28480	5040-0327
P3	1251-1249		PLZG KEY-PRINTED CIRCUIT CONN	9D949	143-953
	1251-1313		CONTACT, CONN, U/W MICRO SER, FEM	13511	220-502
	1251-3054	2	CONNECTOR STRIP: 9 OPEN POSITION	74868	221-68
Q1	1854-0063	4	TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
Q2	1854-0063		TRANSISTOR NPN 2N3055 SI PO=115W	28480	1854-0063
Q3	1854-0250	1	TRANSISTOR NPN SI T0-3 PD=115W	28480	1854-0250
Q4	1854-0063		TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
Q5	1854-0063		TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
R1	2100-3325	1	RESISTOR-VAR CNCTRC 20K/2K 10% CC	28480	2100-3325
R1			NSR, PART OF R1		
R3	0698-3449		RESISTOR 28.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2872-F
S1	3101-1395	1	SWITCH: PB 1-STA RECT DPOT	87034	53-67280-121/A1H
S2	3101-0070	1	SWITCH: SL: DPOT NS: .5A 125VAC/DC	79727	GF-126-0000
S3	3101-0163	1	SWITCH-TGL SUBMIN SPDT 5A 115VAC SLDR	09353	7101
T1	9100-3350	1	TRANSFORMER: POWER	28480	9100-3350
W1	8120-1378	1	CABLE: UNSHIELD 3-COND 18AWG	28480	8120-1378
W2	8120-0660	1	CABLE ASSY, COAX (9.579)	28480	8120-0660
W3	8120-1890	1	CABLE: COAX ASSY (11.764)	94142	C-8120-1890-1
W4	08640-60127	1	CABLE ASSY, FM INPUT/OUTPUT	28480	08640-60127
W5	8150-0447	2	WIRE 24AWG BK 300V PVC 7X32	28480	8150-0447
	8150-0496	2	WIRE 24AWG W/G/GY 300V PVC 7X32	28480	8150-0496
	8150-0498	2	WIRE 24AWG W/G/GY 300V PVC 7X32	28480	8150-0498
W6	8120-1881	1	CABLE-COAX .086-OD	28480	8120-1881
W7	8120-1882	1	CABLE-COAX .086-OD	28480	8120-1882
W8	8120-0580	1	CABLE-COAX 0.85-OD	28480	8120-0580
W9	8150-0447		WIRE 24AWG BK 300V PC 7X32	28480	8150-0447
	8150-0496		WIRE 24AWG W/G/BL 300V PVC 7X32	28480	8150-0496
	8150-0498		WIRE 24AWG W/G/GY 300V PVC 7X32	28480	8150-0498

TABLE 6-3. REPLACEABLE PARTS

REFERENCE DESIGNATION	HP PART NUMBER	QTY	DESCRIPTION	MFR CODE	MFR PART NUMBER
W10	8120-0661	1	CABLE ASSY, COAX (5.409)	28480	8120-0661
W11	8120-0663	1	CABLE ASSY, COAX (2.864)	28480	8120-0663
W12	08640-60128	1	CABLE ASSY, AM INPUT/OUTPUT	28480	08640-60128
W13	8120-1182	1	CABLE, SHIELD 2-COND 24AWG	83501	OBD
W14	8120-0659	1	CABLE ASSY, COAX (12.104 (COUNTER INPUT)	28480	8120-0659
W15	08640-60124	1	CABLE ASSY, EXTERNAL TIME BASE IN/OUT	28480	08640-60124
W16	8120-1593	1	CABLE SHLD 5-COND 22AWG	28480	8120-1593
W17	08640-60059	1	CABLE ASSY, DEMOD OUTPUT	28480	08640-60059
W18	8120-0662	1	CABLE ASSY, AN ASSY	28480	8120-0662
XQ1			NOT ASSIGNED		
XQ2			NOT ASSIGNED		
XQ3			NOT ASSIGNED		
XQ4			NOT ASSIGNED		
XQ5	1200-0041		SOCKET, ELEC, XSTR 2-CONT T0-3 PKG SLDR	00014	PTS-1

Table 6-3. Replaceable Parts

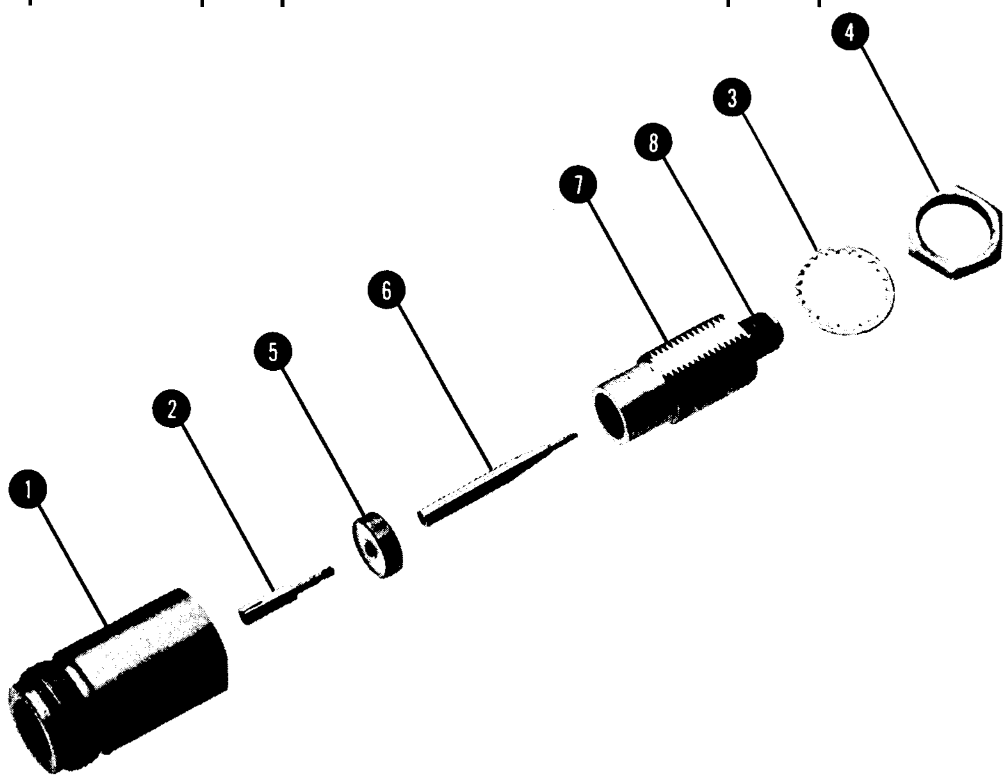
Reference Designation	HP Part Number	Qty	Description	Code	Mfr Part Number
			FIGURE 6-1. CABINET PARTS		
1	08640-20075	2	FRAME ASSY, 5 X 16	28480	08640-20075
2	08640-20231	3	FRONT CASTING, 5H FM	28480	08640-20231
3	08640-00026	1	PANEL, REAR	28480	08640-00026
4	5000-8705	2	COVER, S IDE, PERFORATED	28480	5000-8705
5	5000-8707	2	COVER , FRONT S IDE	28480	5000-8707
6	08640-00003	1	COVE R, TOP	28480	08640-00003
7	08640-00004	1	COVER, BOTTOM	28480	08640-00004
8	5060-0222	2	HANDLE ASSY, 5H SIDE	28480	5060-0222
9	5060-8737	2	HANDLE, RETAINER	28480	5060-8737
10	5060-0767	5	FOOT ASSY, FM	28480	5060-0767
11	1490-0030	1	WIREFORM	28480	1490-0030
12	5000-0051	2	TRIM STRIP	28480	5000-0051
13	5060-8740	1	KIT, RACK MOUNT, 5H (MINT GRAY	28480	5060-8740
14	5000-8711	1	COVER, FRONT SIDE (MINT GRAY)	28480	5000-8711



See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			FIGURE 6-2. TYPE "N" CONNECTOR		
J1MP1	1250-0914	1	CONNECTOR-RF APC-N FEM	90949	131-150
J1MP2	1250-0915	1	CONTACT, RF CONNECTOR, FEMALE CENTER	71785	131-149
J1MP3	2190-C104	1	WASHER-LK INTL T .439 IN ID .547 IN OD	78189	1922-04
J1MP4	2950-0132	1	NUT-HEX-DBL CHAM 7/16-28-THD .094-THK	73734	76500NP
J1MP5	5040-0306	1	INSULATOR		5040-0306
J1MP6	08555-20093	2	CENTER CONDUCTOR	28480	08555-20093
J1MP7	08555-20094	1	BODY, BULKHEAD	28480	08555-20094
J1MP8	08761-2027	1	INSULATOR		08761-2027



See introduction to this section for ordering information

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
GB027	NEOHM	ENGLAND	
00000	ANY SUPPLIER OF U.S. A.		
0004A	ARIZONA COIL INC	NOGALES AZ	85621
0050I	ILLUMINATED PRODUCTS I NC	ANAHEIM CA	92803
0052B	BEE LINE SPECIALTY PRINTERS INC	SAN FRANC ISCO CA	94103
00779	AMP INC	HARRI SBURG PA	17105
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
05574	VIKING INDUSTRIES INC	CHATSWORTH CA	91311
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
07700	TECHNICAL WIRE PRODUCTS INC	CR ANFORD NJ	07016
09353	C AND K COMPONENTS INC	WATERTOWN MA	02172
11815	CHERRY RIVET DIV TOWNSEND CO	SANTA ANA CA	92707
12697	CL AROSTAT MFG CO INC	DOVER NH	03820
15818	TEL EDYNE SEMICONDUCTOR	MOUNTAIN VIEW CA	94040
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
2K497	CABLEWAVE SYSTEMS INC	NORTH HAVEN CT	06473
24226	GOWANCA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
24931	SPEC IALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
26365	GRIES REPRODUCER CORP	NEW ROCHELLE NY	10802
26742	METHODE ELECTRONICS INC	CHICAGO IL	60656
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPR AGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63017
71450	CTS CORP	ELKHART IN	46514
71744	CHICAGO MI NIATURE LAMP WORKS	CHICAGO IL	60640
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE V ILLAGE IL	60007
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC CT	06226
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
73899	J F D ELECTRONICS CORP	BROOKLYN NY	11219
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTLEFUSE INC	DES PLAINES IL	60016
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
79136	WALDES-KOHINOOR INC	LONG ISLAND CITY NY	11101
79727	C-W INDUSTR IES	WARMINSTER PA	18974
80120	SCHN ITZER ALLOY PRODUCTS CO	EL IZABETH NJ	07206
80486	ALL STAR PROD INC	DEFIANCE OH	43512
83330	SM ITH HERMAN H INC	BROOKLYN NY	11207
83501	GAVI TT WIRE & CABLE	BROOKFIELD MA	01506
84411	TRW CAPAC ITOR DIV	OGALLALA NE	69153
86928	SEASTROM MFG CO	GLENDALE CA	91201
90949	AMPHENOL SALES D I V OF BUNKER-RAMO	HA ZELWOOD MO	63042
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
95121	QUALITY COMPONENTS INC	ST MARYS PA	15857
95987	WECKESSER CO I NC	CHICAGO IL	60641
97300	ART WIRE & STAMPING CO	CEDAR KNOLLS NJ	07927
97464	INDUSTRIAL RETAINING RING CO	IRVINGTON NJ	07111
98291	SEAL EC TRO CORP	MAMARONECK NY	10544

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
A1H	87034	6240-00-951-3376	SZ11213-278	4713	5961-00-787-4343
CB1055	01121	5905-00-116-8554	S17843	7263	5961-00-917-0660
CB27G5	01121	5905-00-909-1672	0121-0036	28480	5910-00-463-5960
CB3355	01121	5905-00-402-4264	0121-0060	28480	5910-00-767-4977
CB47G5	01121	5905-00-126-6705	0121-0061	28480	5910-00-983-2623
CB8245	01121	5905-00-244-6934	0140-0177	28480	5910-00-917-9737
CB8245	01121	5905-00-968-6140	0140-0190	28480	5910-00-852-3004
DM15F481F0300WV1C	72136	5910-00-728-4974			
DM74L90N	27014	5962-01-007-2815	0140-0195	28480	5910-00-776-8913
DV11PR18A	73899	5910-00-879-6053	0140-0198	28480	5910-00-914-2605
GF126-0018	79727	5930-00-412-0939	0140-0199	28480	5910-00-914-2604
LM301AH	27014	5962-00-563-1929	0140-0200	28480	5910-00-914-4732
LM302H	27014	5962-00-405-3777	0140-0205	28480	5910-00-782-1853
LM311H	27014	5962-00-935-0162	0140-0219	28480	5910-00-828-0808
MC1010P	04713	5962-00-466-1654	0140-0220	28480	5910-00-772-6726
MC1013P	04713	5962-00-450-8830	0140-0226	28480	5910-00-831-8690
MC1027P	04713	5962-00-117-8726	0140-0233	28480	5910-00-728-4974
MC7812CP	04713	5962-00-443-9486	0140-0234	28480	5910-00-494-5056
SN7400N	01295	5962-00-865-4625	0160-0128	28480	5910-00-057-3934
SN7402N	01295	5962-00-103-0990	0160-0157	28480	5910-00-961-9591
SN7404N	01295	5962-00-404-2559	0160-0158	28480	5910-00-497-7598
SN7405N	01295	5962-00-229-8500	0160-0161	28480	5910-00-911-9271
SN7406N	01295	5962-00-474-3469	0160-0168	28480	5910-00-917-0668
SN7408N	01295	5962-00-156-0983	0160-0174	28480	5910-00-234-9817
SN74123N	01295	5962-00-172-5563	0160-0297	28480	5910-00-936-0577
SN7432N	01295	5962-00-276-9929	0160-0300	28480	5910-00-058-7916
SN7474N	01295	5962-00-106-4287	0160-0335	28480	5910-00-411-3606
SN7490N	01295	5962-00-102-7519	0160-0341	28480	5910-00-776-4174
SN7496N	01295	5962-00-404-6174	0160-0342	28480	5910-00-776-4176
SN75451BP	01295	5962-00-497-1587	0160-0839	28480	5910-00-477-8013
SR1358-4	04713	5961-00-496-7363	0160-0939	28480	5910-00-455-0119
SZ11213-191	04713	5961-00-873-0867	0160-2049	28480	5910-00-247-8593

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
0160-2055	28480	5910-00-211-1611	0160-3939	28480	5910-00-488-3049
0160-2152	28480	5910-00-410-9365	0160-3940	28480	5910-00-488-3054
0160-2199	28480	5910-00-244-7164	0160-3961	28480	5910-00-487-7558
0160-2204	28480	5910-00-463-5949	0180-0049	28480	5910-00-893-5179
0160-2207	28480	5910-00-430-5675	0180-0058	28480	5910-00-027-7069
0160-2228	28480	5910-00-719-9880	0180-0094	28480	5910-00-082-5119
0160-2236	28480	5910-00-444-6724	0180-0100	28480	5910-00-752-4172
0160-2260	28480	5910-00-789-6956	0180-0116	28480	5910-00-809-4701
0160-2261	28480	5910-00-430-5750	0180-0141	28480	5910-00-879-0123
0160-2262	28480	5910-00-887-9754	0180-0197	28480	5910-00-850-5355
0160-2263	28480	5910-00-401-7891	0180-0228	28480	5910-00-719-9907
0160-2265	28480	5910-00-444-6725	0180-0229	28480	5910-00-403-2449
0160-2266	28480	5910-00-430-5754	0180-0234	28480	5910-00-430-5953
0160-2276	28480	5910-00-469-2953	0180-0269	28480	5910-00-043-1396
0160-2306	28480	5910-00-883-6281	0180-0291	28480	5910-00-931-7055
0160-2307	28480	5910-00-406-9675	0180-0374	28480	5910-00-931-7050
0160-2357	28480	5910-00-451-3194	0180-1714	28480	5910-00-172-3138
0160-3046	28480	5910-00-138-5048	0180-1735	28480	5910-00-430-6016
0160-3094	28480	5910-00-847-9842	0180-1743	28480	5910-00-430-6017
0160-3219	28480	5910-00-430-5821	0180-1746	28480	5910-00-430-6036
0160-3456	28480	5910-01-014-2874	0180-2206	28480	5910-00-879-7313
0160-3457	28480	5910-00-832-9122	0180-2208	28480	5910-00-172-3140
0160-3458	28480	5910-01-005-9921	0180-2214	28480	5910-00-009-3200
0160-3459	28480	5910-00-894-6728	0180-2530	28480	5910-00-103-7651
0160-3872	28480	5910-01-027-9482	0340-0037	28480	5940-00-056-5560
0160-3876	28480	5910-00-572-5507	0340-0039	58480	5970-00-072-1625
0160-3878	28480	5910-00-348-2617	0360-0124	28480	5940-00-993-9338
0160-3879	28480	5910-00-477-8011	0360-1514	28480	5940-00-150-4513
0160-3934	28480	5910-00-500-9087	0490-1073	28480	5945-01-006-1410
0160-3936	28480	5910-00-500-9092	0490-1078	28480	5945-01-021-1345
0160-3937	28480	5910-00-500-9114	0490-1080	28480	5945-01-014-8137
0160-3938	28480	5910-00-488-3048	0510-0015	28480	5365-00-804-9672

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
0510-0052	28480	5365-00-422-0240	0698-3438	28480	5905-00-974-6080
0683-0475	28480	5905-00-407-2349	0698-3439	28480	5905-00-407-0059
0683-3355	28480	5905-00-402-4264	0698-3440	28480	5905-00-828-0377
0698-0024	28480	5905-00-891-2808	0698-3442	28480	5905-00-489-6773
0698-0082	28480	5905-00-974-6075	0698-3443	28480	5905-00-194-0341
0698-0083	28480	5905-00-407-0052	0698-3444	28480	5905-00-974-6079
0698-0084	28480	5905-00-974-6073	0698-3445	28480	5905-00-493-4289
0698-0085	28480	5905-00-998-1814	0698-3446	28480	5905-00-974-6083
0698-3132	28480	5905-00-828-0388	0698-3447	28480	5905-00-828-0404
0698-3136	28480	5905-00-891-4247	0698-3449	28480	5905-00-828-0397
0698-3150	28480	5905-00-481-1357	0698-3450	28780	5905-00-826-3262
0698-3151	28480	5905-00-246-8634	0698-3451	28480	5905-00-405-3677
0698-3152	28480	5905-00-420-7130	0698-3453	28780	5905-00-078-1548
0698-3153	28480	5905-00-974-6081	0698-3454	28480	5905-00-974-6077
0698-3154	28480	5905-00-891-4215	0698-3457	28480	5905-00-491-4586
0698-3155	28480	5905-00-976-3418	0698-3460	28480	5905-00-489-2047
0698-3156	28480	5905-00-974-6084	0698-4014	28480	5905-00-138-5053
0698-3157	28480	5905-00-433-6904	0698-4197	28480	5905-00-126-1711
0698-3158	28480	5905-00-858-8927	0698-4471	58480	5905-00-407-0114
0698-3160	28480	5905-00-974-6078	0698-7212	28480	5905-00-138-7305
0698-3161	28480	5905-00-974-6082	0698-7229	28480	5905-01-009-7560
0698-3162	28480	5905-00-840-8162	0698-7277	28480	5905-00-161-9026
0698-3243	28480	5905-00-891-4227	0757-0123	28480	5905-00-954-8684
0698-3260	28480	5905-00-998-1809	0757-0158	28480	5905-00-430-6204
0698-3334	28480	5905-00-407-2350	0757-0159	28480	5905-00-830-6677
0698-3410	28480	5905-00-405-3724	0757-0180	28480	5905-00-972-4907
0698-3427	28480	5905-00-475-8180	0757-0198	8480	5905-00-830-6188
0698-3430	28480	5905-00-420-7136	0757-0199	28480	5905-00-981-7513
0698-3432	28480	5905-00-407-0105	0757-0200	28480	5905-00-891-4224
0698-3433	28480	5905-00-407-0076	0757-0274	28480	5905-00-858-9105
0698-3434	28480	5905-00-997-4071	0757-0278	28480	5905-00-110-0851
0698-3437	28480	5905-00-402-7080	0757-0279	28480	5905-00-221-8310

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
0757-0280	28480	5905-00-853-8190	0757-0447	28480	5905-00-981-7530
0757-0288	28480	5905-00-193-4318	0757-0458	28480	5905-00-494-4628
0757-0289	28480	5905-00-998-1908	0757-0460	28480	5905-00-858-8959
0757-0290	28480	5905-00-858-8826	0757-0461	28480	5905-00-089-7577
0757-0294	28480	5905-00-974-5709	0757-0462	28480	5905-00-493-0783
0757-0316	28480	5905-00-981-7475	0757-0464	28480	5905-00-420-7155
0757-0317	28480	5905-00-244-7189	0757-0465	28480	5905-00-904-4412
0757-0346	28480	5905-00-998-1906	0757-0472	28480	5905-00-257-9210
0757-0379	28480	5905-00-244-7190	0757-0934	28480	5905-00-102-8023
0757-0394	28480	5905-00-412-4036	0757-0984	28480	5905-00-221-8312
0757-0395	28480	5905-00-891-4210	0757-1094	28480	5905-00-917-0580
0757-0397	28480	5905-00-232-3125	0757-1100	28480	5905-00-917-0586
0757-0398	28480	5905-00-788-0291	0811-1553	28480	5905-00-139-9567
0757-0399	28480	5905-00-929-7774	0811-1662	28480	5905-00-475-8185
0757-0400	28480	5905-00-998-1902	0811-1666	28480	5905-00-402-7082
0757-0401	28480	5905-00-981-7529	08553-6012	28480	5950-00-138-1335
0757-0403	28480	5905-00-412-4023	08555-20093	28480	5999-00-008-8444
0757-0405	28480	5905-00-493-0738	08640-60004	28480	6625-00-528-8978
0757-0414	28480	5905-00-764-2021	08640-60005	28480	6625-00-521-2598
0757-0416	28480	5905-00-998-1795	08640-60007	28480	6625-00-521-2600
0757-0418	28480	5905-00-412-4037	08640-60014	28480	6625-00-521-2604
0757-0419	28480	5905-00-891-4213	08640-60016	28480	6625-00-521-2605
0757-0420	28480	5905-00-493-5404	08640-60022	28480	6625-00-521-2606
0757-0421	28480	5905-00-891-4219	08640-60028	28480	6625-00-521-2607
0757-0422	28480	5905-00-728-9980	08640-60163	28480	5961-00-577-0556
0757-0424	28480	5905-00-493-0736	08640-60177	28480	6625-00-521-2599
0757-0438	28480	5905-00-929-2529	08640-60190	28480	5961-01-007-1256
0757-0439	28480	5905-00-990-0303	08640-80002	28480	5950-01-005-9932
0757-0440	28480	5905-00-858-6795	08640-80003	28480	5985-00-524-1310
0757-0441	28480	5905-00-858-6799	1N821	4713	5961-00-866-5454
0757-0442	28480	5905-00-998-1792	10/471	24226	5950-00-961-9600
0757-0443	28480	5905-00-891-4252	109D336X0075F2	56289	5910-00-430-5953

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
1200-0041	28480	5935-00-971-9712	1820-0077	28480	5962-00-138-5250
1200-0043	28480	5970-00-805-7166	1820-0102	28480	5962-00-450-8830
1200-0173	28480	5999-00-008-7037	1820-0125	28480	5962-00-252-4921
1205-0011	28480	5999-00-789-3794	1820-0143	28480	5962-00-117-8726
1205-0085	28480	5999-00-412-0599	1820-0158	28480	5962-00-405-3777
1250-0257	28480	5935-00-497-5630	1820-0174	28480	5962-00-404-2559
1250-0829	28480	5935-00-428-2944	1820-0175	28480	5962-00-229-8500
1250-0830	28480	5935-00-488-9782	1820-0205	28480	5962-00-170-9478
1250-0835	28480	5935-00-068-3546	1820-0223	28480	5962-00-614-5251
1250-0914	28480	5935-00-434-3040	1820-0328	28480	5962-00-009-1356
1251-1886	28480	5935-00-236-7955	1820-0535	28480	5962-00-788-0298
1251-2026	28480	5935-00-446-8768	1820-0557	28480	5962-00-189-0271
1251-2034	28480	5935-00-267-2973	1820-0736	28480	5962-00-513-2691
1251-2313	28480	5935-00-104-1184	1820-0753	28480	5962-01-006-0177
1490-0030	28480	6625-00-760-9521	1820-0982	28480	5962-00-628-8129
150D104X9035A2	56289	5910-00-839-3940	1820-1003	28480	5962-01-006-8383
150D105X9035A2	56289	5910-00-104-0144	1826-0013	28480	5962-00-247-9568
150D106X9020B2	56289	5910-00-936-1522	1853-0007	28480	5961-00-765-6071
150D156X9020B2	59289	5910-00-235-2356	1853-0020	28480	5961-00-904-2540
150D157X9006R2	56289	5910-00-908-0402	1853-0027	28480	5961-00-193-4463
150D224X9035A2	56289	5910-00-840-3042	1853-0034	28480	5961-00-987-4700
150D225X9020A2	56289	5910-00-177-2581	1853-0038	28480	5961-00-111-0455
150D225X9035B2	56289	5910-00-816-9485	1853-0050	28480	5961-00-138-7314
150D226X9015B2	56289	5910-00-807-7253	1853-0224	28480	5961-00-139-9588
150D227X9010S2	56289	5910-00-945-9849	1853-0276	28480	5961-00-162-9698
150D336X9010B2	56289	5910-00-722-4117	1854-0003	28480	5961-00-990-5369
150D337X9006S2	56289	5910-00-878-6691	1854-0022	28480	5961-00-917-0660
150D475X9035B2	56289	5910-00-177-4300	1854-0023	28480	5961-00-998-1923
150D606X9006B2	56289	5910-00-879-7313	1854-0063	28480	5961-00-985-9074
150D685X9035B2	56289	5910-00-104-0145	1854-0071	28480	5961-00-137-4608
1820-0054	28480	5962-00-138-5248	1854-0221	28480	5961-00-836-1887
1820-0055	28480	5962-00-493-5961	1854-0232	28480	5961-00-229-1963

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
1854-0247	28480	5961-00-464-4049	1902-3234	28480	5961-00-491-6606
1854-0250	28480	5961-00-577-0557	1902-3256	28480	5961-00-412-0957
1854-0345	28480	5961-00-401-0507	1902-3345	28480	5961-00-412-0959
1854-0351	28480	5961-00-892-8706	1906-00	78189	5310-00-754-4399
1854-0404	28480	5961-00-408-9807	1910-0016	28480	5961-00-954-9182
1855-0020	28480	5961-00-105-8867	1910-0022	28480	5961-00-690-9341
1855-0049	28480	5961-00-520-5000	1920-02	78189	5310-00-262-0359
1855-0062	28480	5961-00-222-6451	1924-02	78189	5310-00-596-7681
1901-0022	28480	5961-00-071-5271	1990-0326	28480	5961-00-513-2831
1901-0025	28480	5961-00-978-7468	2N3053	4713	5961-00-985-9073
1901-0033	28480	5961-00-821-0710	2N3251	4713	5961-00-760-0960
1901-0040	28480	5961-00-965-5917	2N3528	2735	5961-00-945-3380
1901-0049	28480	5961-00-911-9275	2N3738	4713	5961-00-850-8921
1901-0050	28480	5961-00-914-7496	2N5179	4713	5961-00-401-0507
1901-0159	28480	5961-00-496-7363	2N5415	2735	5961-00-139-9588
1901-0418	28480	5961-00-721-3615	2100-1758	28480	5905-00-228-5989
1901-0518	28480	5961-00-430-6819	2100-1986	28480	5905-00-139-2306
1901-0539	28480	5961-00-577-0558	2100-2061	28480	5905-00-105-1775
1902-00	78189	5310-00-261-7352	2100-2413	28480	5905-00-138-5086
1902-0025	28480	5961-00-914-3087	2100-2489	28480	5905-00-105-1774
1902-0048	28480	5961-00-912-3099	2100-2514	28480	5905-00-828-5431
1902-0049	28480	5961-00-911-9277	2100-2521	28480	5905-00-170-3842
1902-0184	28480	5961-00-835-3237	2100-2633	28480	5905-00-476-5796
1902-0202	28480	5961-00-873-0867	2100-3154	28480	5905-00-615-8111
1902-0244	28080	5961-00-787-4343	2100-3216	28480	5905-01-020-9348
1902-3005	28480	5961-00-577-0559	2100-3265	28480	5905-00-474-8813
1902-3059	28480	5961-00-458-4506	2100-3325	28480	5905-01-037-1599
1902-3070	28480	5961-00-931-6989	2101-10-00	78189	5940-00-155-7685
1902-3094	28480	5961-00-493-5428	2110-0332	28480	5920-00-921-6502
1902-3104	28480	5961-00-494-8988	2140-0016	28480	6240-00-060-2941
1902-3139	28480	5961-00-494-4848	2140-0244	28480	6240-00-951-3376
1902-3182	28480	5961-00-229-1966	2190-0014	28480	5310-00-522-9950

TABLE 6-5

PART NUMBER-NATIONAL STOCK NUMBER

CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
251-06-30-261	71785	5935-00-974-6874	4040-0748	28480	5999-00-230-8834
251-15-30-400	71785	5935-00-565-8380	4040-0749	28480	6625-00-031-4796
252-06-30-300	71785	5935-00-188-0135	4040-0750	28480	5999-00-415-1213
252-10-30-300	71785	5935-00-267-2973	4040-0751	28480	5999-00-230-8835
252-15-30-300	71785	5935-00-405-7720	4040-0752	28480	5999-00-230-8832
252-15-30-340	71785	5935-00-236-7955	4040-0753	28480	5999-00-230-8836
252-18-30-300	71785	5935-00-446-8768	4040-0754	28480	5999-00-230-8837
2950-0001	28480	5310-00-450-3324	50-045-4610	98291	5935-00-428-2944
2950-0035	28480	5310-00-454-1335	50-051-0109	98291	5935-00-858-8794
3-331272-0	00779	5999-00-137-1142	5000-0051	28480	6625-00-412-1204
3-332070-5	00779	5935-00-104-1184	5040-0170	28480	6625-00-911-7214
30D107G025DD2	56489	5910-00-827-1209	5040-0218	28480	6625-00-435-3153
30D506G025CC2	56289	5910-00-027-7069	5040-0306	28480	5970-00-470-7622
30D506G050DD2	56289	5910-00-879-0123	5040-0447	28480	5340-00-494-7440
30D906G016CC2	56289	5910-00-138-7324	5060-0109	28480	5935-00-004-6303
3006P-1-102	32997	5905-00-107-4881	5060-0222	28480	5340-00-435-5340
3006P-1-103	32997	5905-00-243-1778	5060-0767	28480	6625-00-903-0348
3006P-1-202	32997	5905-00-359-5421	50864-3	00779	5999-00-574-4399
3006P-1-501	32997	5905-00-428-5335	550	71450	5905-00-532-2926
3100-3081	28480	5930-01-037-6226	683	71744	6240-00-060-2941
3101-0070	28480	5930-00-919-1755	710HM	07263	5962-00-248-2636
3101-0163	28480	5930-00-490-4829	7101	09353	5930-00-050-1198
3101-0973	28480	5930-00-455-0120	723BE	15818	5962-00-453-7739
3101-1395	28480	5930-00-164-0850	8120-1378	28480	6150-00-008-5075
3101-1728	28480	5930-01-025-9369	8120-1829	28480	6625-00-521-2801
3130-0445	28480	5930-00-574-4432	8120-1830	28480	6625-00-521-2802
3130-0446	28480	5930-00-574-4437	8120-1831	28480	6625-00-521-2803
3140-0490	28480	6105-00-032-0345	8120-1832	28480	6625-00-521-2809
3339H-1-103	32997	5905-01-020-9348	8120-1887	28480	6625-00-525-5256
36D392G050AC2B	56289	5910-00-103-7651	8120-1892	28480	6625-00-525-5263
36D822G025AC2A	56289	5910-00-127-1848	8120-1905	28480	6625-00-525-5311
37JR104-2	24931	5935-00-068-3546	8123-1	24226	5950-00-584-0107

TABLE 6-5
PART NUMBER-NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
9000	73734	5310-00-460-3057			
9100-1612	28480	5950-00-438-4376			
9100-1615	28480	5950-00-431-3195			
9100-1618	28480	5950-00-431-3196			
9100-1620	28480	5950-00-469-3077			
9100-1622	28480	5950-00-431-3197			
9100-1641	28480	5950-00-431-3203			
9100-2232	28480	5950-00-431-3210			
9100-3512	28480	5950-00-584-0107			
9140-0036	28480	5950-00-578-1933			
9140-0098	28480	5950-00-805-5186			
9140-0112	28480	5950-00-455-7744			
9140-0114	28480	5950-00-657-8167			
9140-0137	28480	5950-00-984-3433			
9140-0142	28480	5950-00-971-1645			
9140-0144	28480	5950-00-837-6029			
9140-0178	28480	5950-00-199-7652			
9140-0180	28480	5950-00-101-2507			
974-307	26365	5970-00-869-8798			

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains manual change instructions for backdating this manual for HP Model 8640B Option 004 Signal Generators that have serial number prefixes that are lower than 1435A. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your generators

7-3. MANUAL CHANGES

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

7-5. **Refer** to paragraph 7-38 **for manual changes pertaining to later serial numbered instruments.**

Table 7-1. ***Manual Changes by Serial Number***

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1323A, 1327A	M, L, K. J, I, H, G, F, E, D, C, B, A	1404A, 1405A	M, L, K, J, I, H
1332A, 1333A	M, L, K, J, I, H, G, F E, D, C, B	1406A	M, L, K, J, I
1339A	M, L, K, J, I, H, G, F, E, D, C	1416A	M, L, K, J
1342A	M, L, K, J, I, H, G, F, E, D	1419A	M, L, K
1345A	M, L, K, J, I, H, G, F E	1423A	M, L
1350A	M, L, K, J, I, H, G, F	1429A, 1431A	M
1401A	M, L, K, J, I, H, G		

Table 7-2. Summary of Changes by Component (1 of 2)

Change	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A								A4R2	C8 ☆	A2C53 A2R55,56, A2R58
B								A4R1		A2C54 ☆
C									R2	
D										
E										
F								A2C31 ☆		
G			A4 (entire sub-assy)					A2U14		
H								A1C5, C7 A1CR4, A1CR5		
I										
J										A1C17, A1C52
K			A4R1, R6							
L										
M										A2U14

☆ Instrument modification recommended, see paragraph 7-7.

Table 7-2. Summary of Changes by Component (2 of 2)

Change	A11	A12	A13	A14	A18	A19	A20	A22	A26	No Prefix
A										
B					Q2☆		Q2☆	Q2,☆ Q3☆		
C	Q1☆ R2, 6 (Opt 001)	A12 Assy Part No. Q1☆ R1,2☆ VR1☆	R6						A2CR6 A2K1 A8R11	
D										MP73
E									A2CR9☆ A2CR13☆	
F	MP17☆ (Opt 001)									
G										
H	R2 (Opt 001)						Q4☆			
I					U1☆		U1☆, U2☆	A22 Assy Part No. R6, R28 U1☆, U2☆ VR6		W16☆
J										
K										
L				MP1☆						F1☆
M										

☆ Instrument modification recommended, see paragraph 7-7.

MANUAL CHANGES

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 6-17, Table 6-3:
The recommended replacement for A844R2 is HP 2100-3216.
Delete A9C8.

Page 6-22, Table 6-3:
Delete A10A2C53.

Page 6-23, Table 6-3:
Change A10A2R55 to 0698-3151 RESISTOR; FXD; 2.87K 1% 0.125W F TUBULAR.
Add A10A2R56 0757-0461 RESISTOR; FXD; 68.lK 1% 0.125W F TUBULAR,
Change A10A2R58 to 0757-0458 RESISTOR; FXD; 51.lK 1% 0.125W F TUBULAR.

Service Sheet 6 (schematic):
Delete A9C8.

NOTE

See *paragraph 7-9 for recommended instrument modification.*

Service Sheet 11 (schematic):
Delete A10A2C53.
Change A10A2R55 to 2870.
Add A10A2R56, 68.lK in parallel with R55.
Change A10A2R58 to 51.lK.

CHANGE B

Page 6-17, Table 6-3:
Change A8A4R1 to 2100-3299 RESISTOR; VAR; 5K 20% MC SPST SW.

Page *6-22*, Table 6-3:
Delete A10A2C54.

Page 6-29, Table 6-3:
Change A18Q2 to 1854-0039 TRANSISTOR NPN 2N3053 S1 PD=lW.

Page 6-31, Table 6-3:
Change A20 Q2 to 1854-0039 TRANSISTOR NPN 2N3053 S1 PD=lW.

Page 6-32, Table 6-3:
Change A22Q2 and Q3 to 1854-0039 TRANSISTOR NPN 2N3053 S1 PD=lW.

Service Sheet 11 (schematic):
Delete A20A2C54.

NOTE

See *paragraph* 7-11 *for recommended instrument modification.*

MANUAL CHANGES

NOTE

See *paragraph 7-13 for recommended instrument modification.*

Service Sheet 23 (schematic):
Change A18Q2 to 1854-0039.

NOTE

See *puragraph 7-13 for recommended instrument modification.*

CHANGE C

Page 6-18, Table 6-3:
Add A9R2 0698-4014 RESISTOR; FXD; 787 OHM 1% 0.125W F.

Pages 6-25 and 6-26, Table 6-3:
Change A11Q1 to 1853-0020 TRANSISTOR PNP S1 PD=300 MW FT=150 MHz.
Change A11R2 and R6 to 0698-3452 RESISTOR; FXD; 196K 1% 0.125W F TUBULAR.

Page 6-28, Table 6-3:
Change A12 t.o 08640-60003.
Add A12Q1 1884-0012 THYRISTOR; SCR; JEDEC 2N3528.
Add A12R1 0757-0401 RESISTOR; FXD; 100 OHM 1% 0.125W F TUBULAR.
Add A12R2 0698-3447 RESISTOR; FXD; 422 OHM 1% 0.125W F TUBULAR.
Add A12VR1 1902-3393 DIODE; ZENER; 75 VZ 0.4W MAX PD.
Delete A13R6.

Page 6-35, Table 6-3:
Add A26A2CR6 1901-0040 DIODE; SWITCHING; S1; 30V MAX VRM 50 MA.
Add A26A2K1 0490-1080 RELAY, REED, IC 0.25A 150V CONT, 5V COIL.

Page ***6-39,*** Table 6-3:
Change A26A8R11 to 0757-0288 RESISTOR, FXD 9.09K 1% 0.125W.

Service Sheet ***6*** (schematic):
Add A9R2 787 ohms with one end connected to pin 28 (of P1) and the other end grounded through a wire with a 94 color code.
Delete A13R6.

NOTE

If A9 is replaced, A13R6 should be added. If Al 3 is replaced, A9R2 should be removed.

Service Sheet 9A (schematic):
Change A11Q1 to 1853-0020.
Change A11R2 and R6 to 196K.

MANUAL CHANGES

CHANGE C (Cont'd)

NOTE

See *paragraph 7-15 for recommended instrument modification.*

Service Sheet 13 (schematic):
Replace appropriate portion of schematic with attached partial schematic.

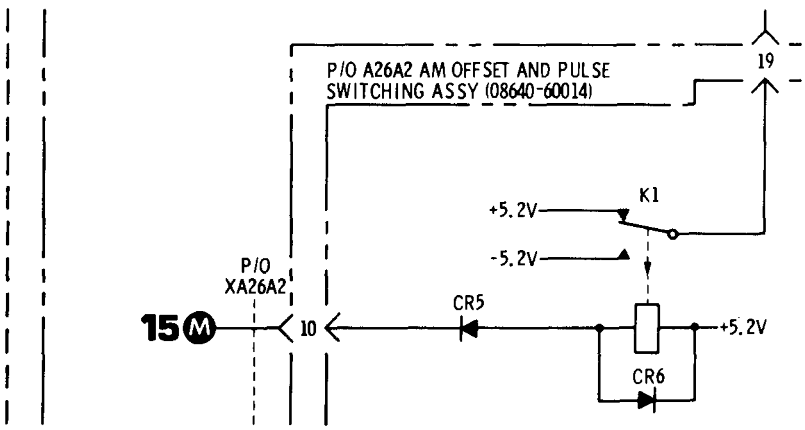


Figure 7-1. *A26A 2 AM Offset and Pulse Switching Assembly Backdating (Change C)*

Service Sheet 15 (schematic):
Change A26A8R11 to 9090 ohms.

NOTE

HP 0757-0441, 8250 ohms, is recommended replacement if A26A8R11 should fail.

Service Sheet 22 (Principles of Operation):
Under Input Voltage (Al 2 and A14) delete the last sentence and add the following paragraph.

The A12 Rectifier Assembly contains five full-wave rectifiers and a crowbar to protect the instrument from excessively high line voltages. The crowbar is across the output of the rectifier bridge to the +44.6V regulator. If the rectified voltage exceeds 75V, breakdown diode VR1 conducts and triggers the gate of SCR A12Q1. Q1 then conducts and blows the primary fuse.

MANUAL CHANGES

CHANGE C (Cont'd)

Service Sheet 22 (component locations):
Replace Figure 8-71 with the attached figure.

A12

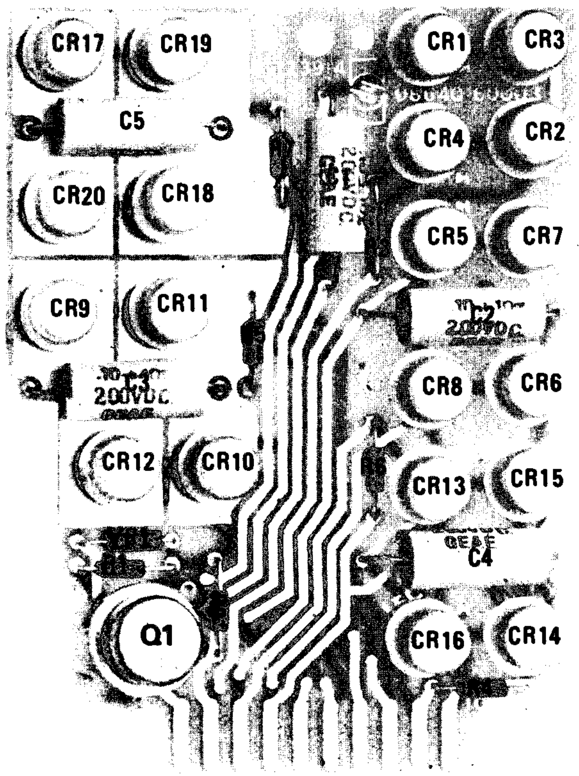


Figure 7-2. A12 Rectifier Assembly Component Locations Backdating (Change C)

Service Sheet 22 (schematic):
Replace appropriate portion of schematic with attached partial schematic.

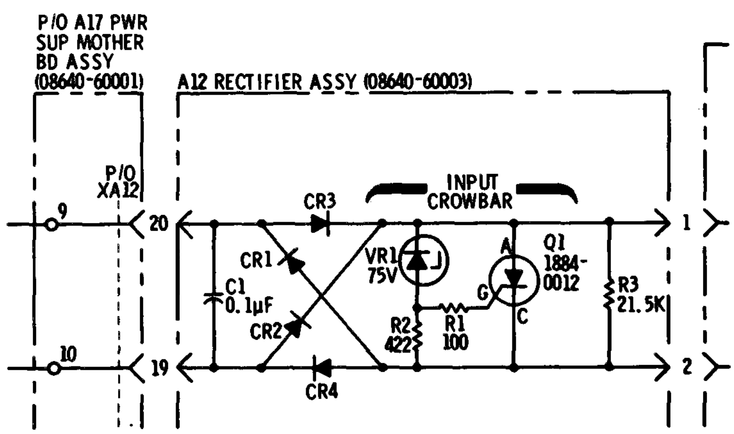


Figure 7-3. A12 Rectifier Assembly Backdating (Change C)

MANUAL CHANGES

CHANGE C (Cont'd)

NOTE

See *paragraph 7-18 for recommended instrument modification,*

Service Sheet *25* (schematic):
Delete A13R6.

CHANGE D

Page *6-41*, Table 6-3:
The recommended replacement for MP73 is 08640-40067.

NOTE

For instruments with serial number prefixes 1333A and below, changing MP73 (Time Base Vernier Knob) will also require changing A8A4R 1 (Time Base Vernier Pot) to HP part number 2100-0647. Since the new knob has a a larger skirt, it may be desirable, though not necessary, to replace the front window (the skirt will slightly cover some of the markings near it). The correct part number for the window is in the parts list.

CHANGE E

Page *6-35*, Table 6-3:
Change A26A2CR9 to 1910-0016 DIODE, SWITCHING 1 µs 60V 60 MA.
Change A26A2CR13 to 1910-0022 DIODE, SWITCHING GE 5V MAX VRM 60 MA.

NOTE

See *paragraph 7-20, for recommended instrument modification.*

CHANGE F

Page 6-14, Table 6-3:
Delete A8A2C31.

Page **6-25,** Table 6-3:
Delete A11MP17.

NOTE

See *paragraph 7-20 for recommended instrument modification.*

Service Sheet 21 (schematic):
Delete A8A2C31.

NOTE

See *paragraph 7-26 for recommended instrument modification.*

MANUAL CHANGES

CHANGE G

Page 5-34, paragraph 5-40:
Add the following after step 6: "Connect DVM to A3A4TP2 and adjust OFFSET adjustment, A3A4R5, for 0 ± 0.5 mVdc at A3A4TP2."

Pages 6-7 and 6-8, Table 6-3:
***Replace entire A3A4* sub-assembly list with the following:**

A3A4	08640-60040	CONNECTOR BOAR.D ASSY
A3A4CI	0160-2055	CAPACITOR, FXD, 0.01 UF +80 –20% 100 WVDC
A3A4C2	0160-2055	CAPACITOR, FXD, 0.01 UF +80 –20% 100 WVDC
A3A4RI	2100-3161	RESISTOR., VAR, TRMR 20K OHM 10% C
A3A4R2	2100-3109	RESISTOR, VAR, TRMR. 2K OHM 10% C
A3A4R3	2100-3109	RESISTOR, VAR, TRMR 2K OHM 10% C
A3A4R4	2100-3154	RESISTOR, VAR, TRMR lK OHM 10% C
A3A4R5	2100-3154	RESISTOR, VAR, TRMR. lK OHM 10% C
A3A4R6	0757-0442	RESISTOR.; FXD; 10K 1% 0.125W F TUBULAR
A3A4R7	0757-0420	RESISTOR; FXJ3; 750 OHM 1% 0.125W F
A3A4R8	0698-0084	RESISTOR; FXD; 2.15K 1% 0.125W F TUBULAR
A3A4R9	0757-0416	RESISTOR; FXD; 511 OHM 1% 0.125W F
A3A4UI	1820-0158	IC; LIN; MISCELLANEOUS (LINEAR)

Page 6-15. Table 6-3:
The recommended replacement for A8A2U14 is 1820-0205.

Service Sheet 5 (schematic):
Change the parti number for A3A4 Connector Board Assembly to 08640-60040.

Service Sheet 6 (schematic):
Replace appropriate portion of schematic with attached partial schematic.

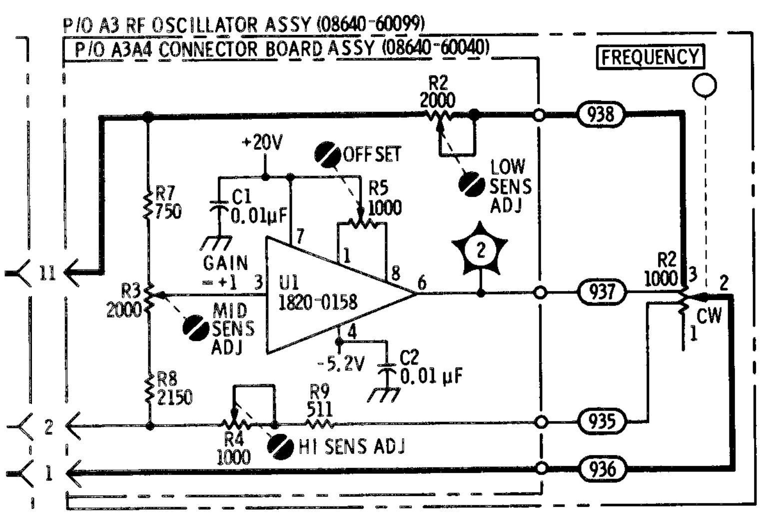


Figure 7-4. A3A4 Connector Board Assembly Backdating (Change G)

MANUAL CHANGES

CHANGE G (Cent'd)

Service Sheets 20 and 21 (schematic):
Change part number for A8A2U14 (at U14B and U14A) to 1820-0661.

NOTE

Part number 1820-0205 is the recommended replacement for A8A2U14.

Service Sheet H (internal view):
Add OFFSET adjustment A3A4R5 on the left side of A3A4TP2.

CHANGE H

Page 6-13, Table 6-3:
Delete A8A1C5.
Change A8A1C7 to 0160-2204 CAPACITOR; FXD; 100 PF ± 5% 300 WVDC.
Delete A8A1CR4 and CR5.

Page 6-25, Table 6-3:
Change A11R2 to 0757-0472 RESISTOR; FXD; 200K 1% 0.125W F TUBULAR,

Page 6-31, Table 6-3:
Change A20Q4 to 1853-0038 TRANSISTOR PNP S1 PD = lW FT = 100 MHz.

Service Sheet 9A (schematic):
Change A11R2 to 200K.

Service Sheet 18 (component locations):
Replace Figure 8-60 with the attached figure.

A8A1

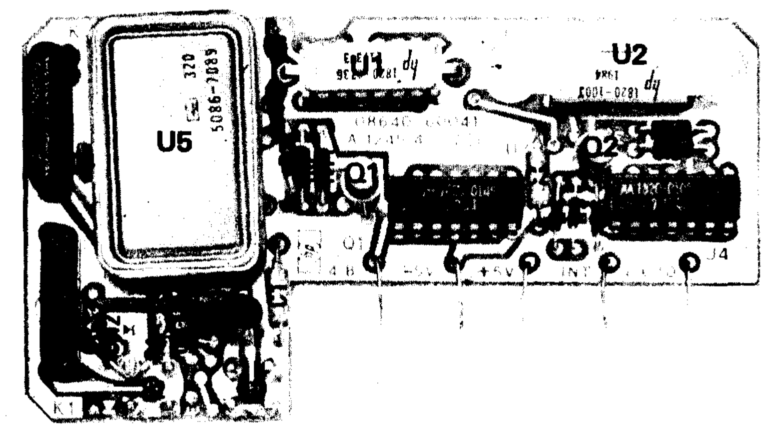


Figure 7-5. A8A1 RF Scaler Assembly Component Locations Backdating (Change H)

MANUAL CHANGES

CHANGE G (Cont'd)

Service Sheet 18 (schematic):
Delete A8A1CR4 and CR5.

Service Sheet 22 (schematic):
Change part number for A20Q4 to 1853-0038.

NOTE

See paragraph 7-28 for recommended instrument modification.

CHANGE 1

Page *6-30*, Table 6-3:
Change A18U1 to 1826-0010.

Page 6-31, Table 6-3:
Change A20U1 and U2 to 1826-0010.

Pages 6-32 and 6-33, Table 6-3:
Change A22 to 08640-60006.
Change A22R6 to 0698-3154 RESISTOR; FXD; 4.22K 1% 0.125W F TUBULAR.
Delete A22R28.
Change A22U1 and U2 to 1826-0010.
Delete A22VR6.

Page 6-42, Table 6-3:
Change W16 to 8120-1525 CABLE; SHLD 6-COND 22 AWG.

Service Sheet 22 (Principles of Operation):
Change the first sentence of **+20V Regulator (A22) as** follows:
. . . R5, R6, and R7, and is compared directly with the zener diode reference at pin 4 of U2."

MANUAL CHANGES

CHANGE I (Cont'd)

Service Sheet 22 (component locations):
Replace Figure 8-73 with the attached figure.

A22

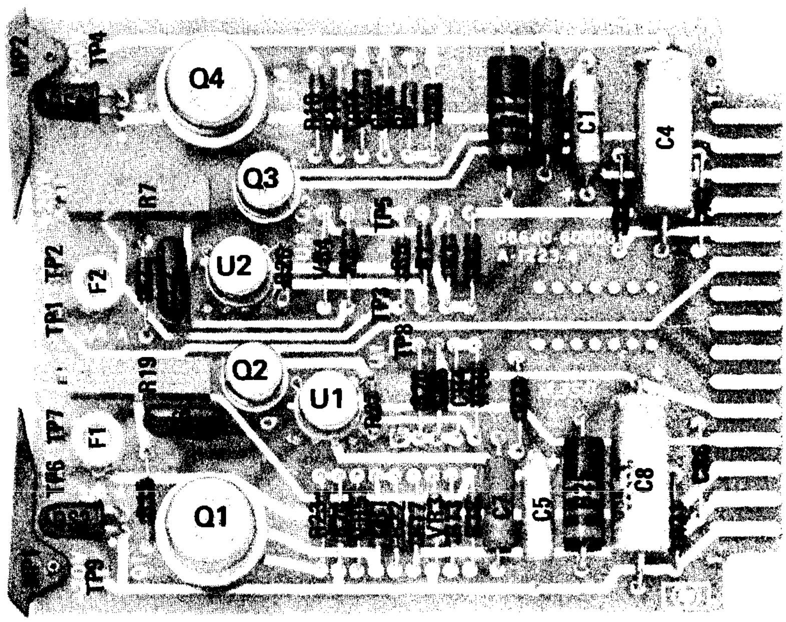


Figure 7-6. A22 +20V and –20V Regulator Assembly Component Locations Backdating (Change I)

Service Sheet 22 (schematic):
Change part number for A22 to 08640-60006 (2 places).
Change part number for voltage regulators A20U1 and U2, and A22U1 and U2 to 1826-0010.
Replace appropriate portions of schematic with attached partial schematics.

NOTE

See *paragraphs 7-30 and 7-32 for recommended instrument modifications.*

MANUAL CHANGES

CHANGE I (Cont'd)

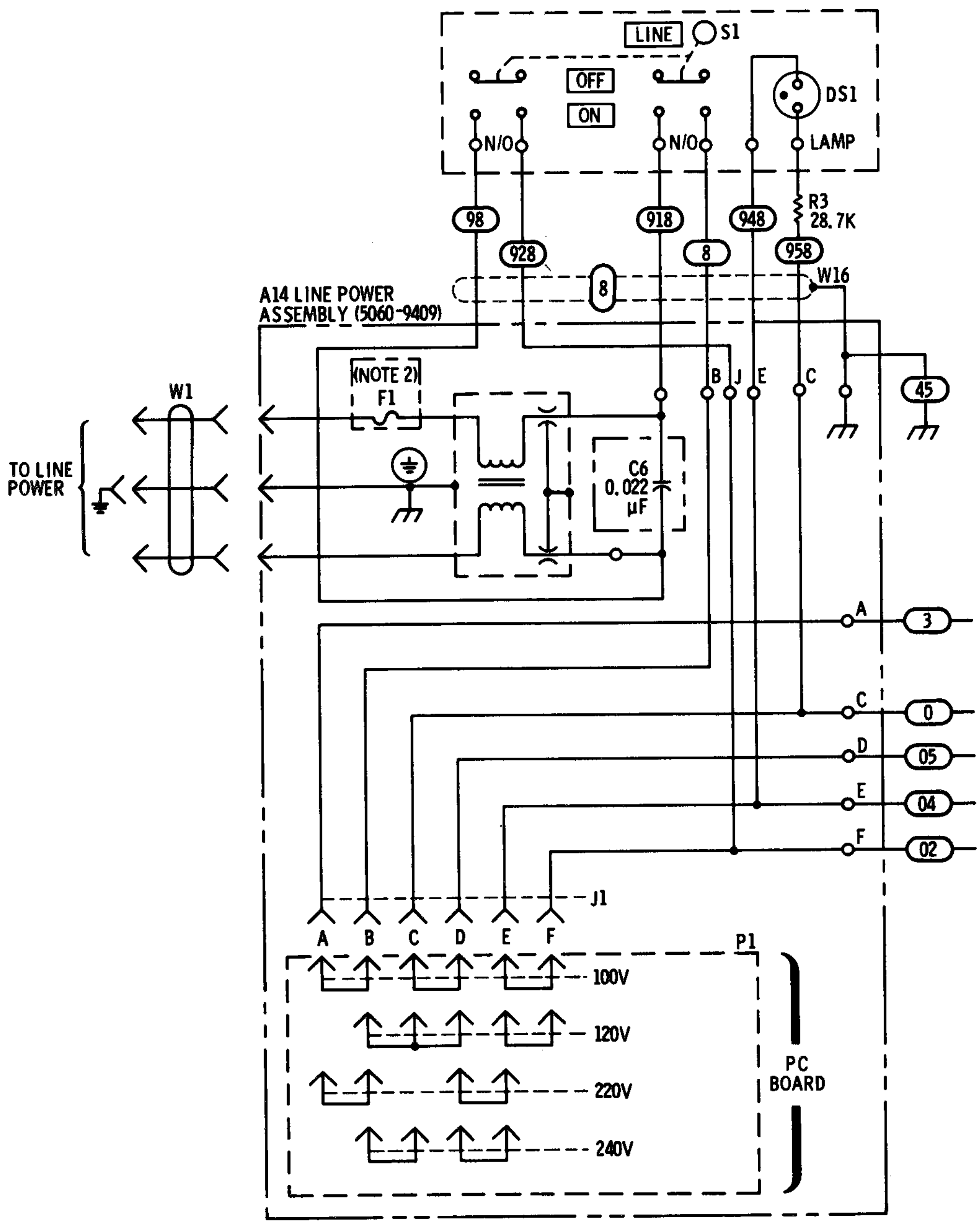


Figure 7-7. Power Supply Circuits Backdating (Change I)

MANUAL CHANGES

CHANGE 1 (Cont'd)

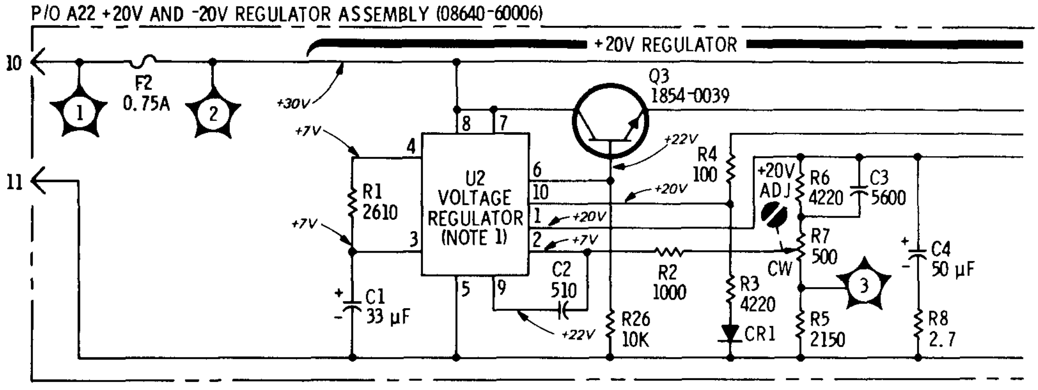


Figure 7-8. A22 +20V and -20V Regulator Assembly Backdating (Change I)

Service Sheet 23 (schematic):
Change part number for A18U1 to 1826-0010.

NOTE

See *paragraph 7-32 for recommended instrument modification.*

CHANGE J

Page 6-19, Table 6-3:
Change A101C17 and C52 to 0140-0150 CAPACITOR; FXD 731.5 PF ± 1% 300 WVDC.

Service Sheet 10 (schematic):
Change A101C17 and C52 to 731.5 pF.

CHANGE K

Pages **6-7** and 6-8, Table 6-3:
Change A3A4R1 to 2100-3161 RESISTOR; VAR; TRMR 20K OHM 10% C SIDE ADJ.
Add A3A4R6 0757-0442 RESISTOR; FXD; 10K 1% 0.125W F TUBULAR.

Service Sheet 5 (schematic):
Change A3A4R1 to 20K.
Add A3A4R6 between PC board connector pin 5 and A3A4R1.

MANUAL CHANGES

CHANGE L

Page 1-6, paragraph 1-65:
Delete “1.25A Fuse (HP 2110-0094).”
Add “1A Fuse (HP 2110 -0001).”

Page 6-29, Table 6-3:
Change A14MP1 to 7124-2310 LABEL; INFO; 200 VA 2A 1A.

Page 6-40, Table 6-3:
Change F1 2110-0094 to F1 2110-0001 FUSE 1A 250V.

Service Sheet 22 (schematic):
Change Note 2 as follows:
“ . . . AND 1 AMP FOR 220/240V.”

NOTE

See *paragraph 7-34 for recommended instrument modification.*

CHANGE M

Page 6-23, Table 6-3:
The recommended replacement for A10A2U14 is 1820-1354.

Service Sheet 11 (schematic):
Change part number for A10A2U14 to 1820-0736.

NOTE

Part number 1820-1354 is the recommended replacement for A 10A2U14.

7-7. INSTRUMENT IMPROVEMENT MODIFICATIONS

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

7-9. Improved FM Bandwidth on 5 kHz Deviation Range (Serial Number Prefixes 1323A and 1327A)

7-10. A slight peaking in FM deviation at approximately 200 kHz rates may be reduced by adding A9C8. See paragraph 5-21 for selection of the proper value.

7-11. AI0A2 RF Divider Assembly Improvement (Serial Number Prefixes 1333A and Below)

7-12. Spurious response and second harmonic level can be reduced by adding a 1000 pF capacitor (HP 0160-3456) between the heat sink (-5.2V line) of A10A2U14 and ground. Some RF Divider boards have holes to accommodate the new capacitor. If the board does not, solder the capacitor (C54) directly to the heat sink lead (-5.2V) and to the ground plane.

7-13. A18, A20, and A22 Power Supply Regulator Improvements (Serial Number Prefixes 1333A and Below)

7-14. Changing the power supply regulator driver transistors will reduce the possibility of oscillation. If any of the power supplies oscillate, change either A18Q2, A20Q2, or A22Q2 and Q3 to a new transistor (HP 1854-0232) with a lower cutoff frequency (15 MHz as opposed to 200 MHz). After completion of the modification perform the Power Supply Adjustments and the appropriate performance tests (see Post-Repair Tests and Adjustments table in SectionV).

7-15. Al 1 Variable Frequency Modulation Oscillator Improvements (Serial Number Prefixes 1339A and Below)

7-16. Distortion in the Variable Frequency Modulation Oscillator (Option 001) at high frequencies can be reduced by changing A1l Q1. (Refer to Service Sheet 9A.) The new transistor has a higher frequency response. Distortion will improve mainly on the x3k band (60 to 600 kHz) and only for the signal at the audio output jacks. The change will not affect the signal into the AM and FM circuits.

7-17. To make the modification, order HP Part Number 1853-0050 and replace A11Q1 on A11 Variable Frequency Modulation Oscillator. Perform the Internal Modulation Oscillator Test (check voltage levels only) and the Internal Modulation Oscillator Distortion Test (Option 001).

7-18. A12 Rectifier Assembly Input Crowbar Failures (Serial Number Prefixes 1339A and Below)

7-19. If the input crowbar SCR A12Q1 should fail, do not replace it. Instead, remove A12Q1 (Refer to Service Sheet 22). The A12 assembly is located directly behind the power transformer. With the input crowbar disabled, care must be taken to ensure that the Line Power Module is set to the correct line voltage. Failure to do so could result in severe damage to major portions of the instrument. Also check that the correct line fuse is in place.

7-20. Reliability Improvements in AM and Pulse Circuits (Serial Number Prefixes 1345A and Below)

7-21. The reliability of some of the switching logic in the AM and pulse circuits (especially at elevated temperatures) can be improved by changing certain germanium diodes to hot carrier diodes. The new diodes will prevent the possibility of the RF detector filter capacitors (A26A1C5, C6 or C7) being switched in when not selected. This can occur if the reverse leakage current through the diodes (which flows from the +20V to the +5.2V supply) is sufficient to turn on transistors A26A2Q8 or Q9 (Refer to Service Sheet 13).

7-22. To make the modification, order HP Part Number 1901-0539. On A26A2 AM/Offset and Pulse Switching Assembly, replace A25A2CR9 and CR13.

7-23. Al 1 Variable Frequency Modulation Oscillator (Option 001) Improvement (Serial Number Prefixes 1350A and Below)

7-24. Possibility of failure of the Variable Frequency Modulation Oscillator (Option 001) can be reduced by adding insulator A11MP17 between spur gear Al lA1MP3 and the variable capacitor AllC1. The insulator prevents the shaft or metal insert in the gear from shorting the capacitor to ground. This modification is recommended at time of oscillator service or repair.

7-25. Install insulator as follows: '

Order HP part number **08640-00087** (insulator).

'b. Remove A11 Variable Frequency Modulation Oscillator (see Service Sheet D).

c. Remove two 4-40 pm-head screws and two hex-nuts which secure the Audio Oscillator cover. Remove cover.

d. Remove adhesive backing from insulator and apply to the tuning capacitor, behind the plastic gear A11A1MP3 and small spur gear Al1AIMP2.

NOTE

If there is insufficient clearance for the insulator between gears and capacitor, perform step e.

e. Remove back cover from the oscillator. Then loosen three nylon screws which secure the tuning capacitor to the PC board. This til allow a small amount of shift in the capacitor's position and afford clearance for the insulator. Tighten nylon screws and reassemble back cover.

f. Replace Audio Oscillator cover and reinstall A11 assembly (see Semite sheet D).

g. Perform Internal Modulation Oscillator Test in Section IV. If out of specification, perform Variable-Frequency Modulation Oscillator Adjustment (Option 001) in Section V.

7-26. Improvement in Lock Acquisition Capability (Serial Number Prefixes 1350A and Below)

7-27. The counter may fail to lock on random occasions. This may be caused by the time base signal present at A8A2TP6 which might instantaneously exceed the phase lock error detector threshold when going into the lock mode. Should this occur, connect a 1000 pF capacitor A8A2C31, HP Part Number 0160-3456, between the line connecting to A8A2TP6 and ground.

7-28. +44,6V Regulator improvement (Serial Number Prefixes 1405A and Below)

7-29. Changing A20Q4 regulator transistor to one with a lower cutoff frequency will reduce the possibility of oscillation. The recommended transister is HP 1853-0224. After modification perform the Power Supply Adjustment for the +44.6V supply (Section V):

7-30. Line Switch Modification (Serial Number Prefixes 1406A and Below)

7-31. If the line fuse blows as the instrument is switched off the line switch and line power assembly wiring (W16) should be modified as explained below. The fuse blows because of a momentary short on the primary input that can occur on a switch terminal used in wiring the pilot lamp. The modification is simple and requires no special tools.

7-32. Modify the switch as follows:

a. Remove the power line cord.

b. Remove instrument bottom cover and side cover nearest line power assembly.

c. Remove nut that secures line switch to front panel and lift line switch free of instrument.

d. Slip insulation tubing off line switch to expose wiring.

e. Remove white-green-gray (958) wire from switch and clip off near cable sleeve. This wire will no longer be used.

f. Unsolder resistor lead from terminal where the white-green-gray (958) wire was previously attached and solder it to the terminal where the white-red-gray (928) wire is attached. Switch wiring should now appear as in Figure 7-9.

g. Slip insulation tubing back over switch and install switch into front panel.

h. Remove white-green-gray (958) wire from terminal C of line power assembly and clip off near cable sleeve.

i. Unsolder white-yellow-gray (948) wire from terminal E and solder it to terminal D (where black-green (05) wire is also attached).

j. Insert power cord and check instrument for proper line switch operation.

k. Reinstall covers.

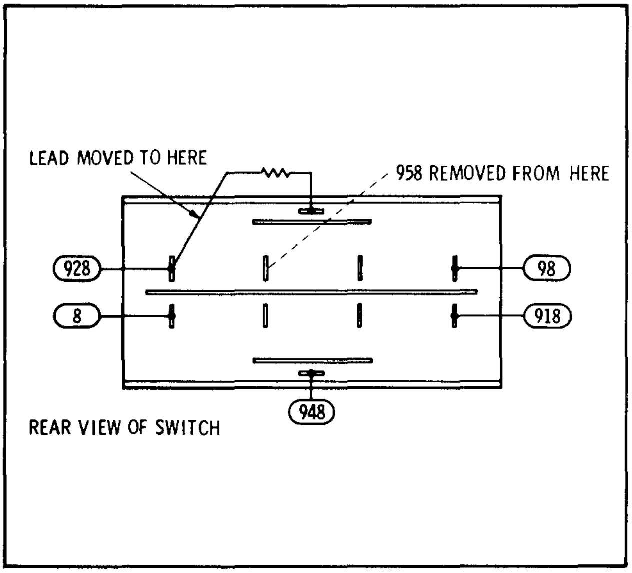


Figure 7-9. Modified Line Switch Wiring

7-33. Reduction in Popcorn Noise on Power Supplies (Serial Number Prefixes 1406A and Below)

7-34. Excessive popcorn noise (i.e., random voltage shifts on the order of 1 mV) can be reduced by changing the IC regulator (A18U1, A20U1 and U2, A22U1 and U2) to HP 1826-0177. The noise can cause random shifts in frequency of the RF oscillator which is particularly sensitive to noise on the ± 20 V supplies. After mofication perform the Power Supply Adjustments (Section V).

7-35. Recommended Fuse Replacement for 220/240V OperatIon

‘refixes 1423A and (Serial Number

7-36. The recommended replacement for the power line fuse F1 to 220 or 240V operation is 1.25A normal blow, HP Part Number 2110-0094. The higher current rating will prevent occasional blowing of the fuse at turn on.

7-37. To show the new fuse rating on the line power module, an adhesive-backed label is available (A14MP1, HP Part Number is 7120-4264).

7-38. The manual changes given below are for correcting errors and for adapting tbe manual to instruments containing improvements made after the printing of the manual. Make all ERRATA corrections first and then make all appropriate serial number related changes indicated in the table.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1440A	Errata	1538A	1-12
1442A	1	1542A,1543A	1–13
1501A	1, 2	1544A	1–14
1506A, 1513A	1—3	1545A	1-15
1515A	1-4	1552A, 1606A	1–16
1519A	1-5	1607A	1–17
1520A	1-6		
1524A, 1526A	1-7		
1530A	1-8		
1532A	1-9		
1534A	1-10		
1535A	1-11		

ERRATA

Page 1.0, Figure 1-1.
Delete: RACK MOUNT KIT

Page 1-6, Paragraph 1.65.
Delete: Rack Mounting Kit (HP 5060-8740)

Page 1-6, Paragraph 1-67.
Delete entire paragraph.

Page 1-6, Paragraph 1-69.
Add: "l-69a. A Rack Mounting Kit is available to install the instrument in a 19-inch rack. Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8740".

ERRATA (Cont'd)

Page 2-3, Paragraph 2-20:
Change the first sentence to read: "Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8740".

Page 3-17, Figure 3-7:
In step d, change the first sentence to read as follows and with the additional note:
"When using an external modulation signal for avionics (VOR/ILS) testing, set AM 27 to DC."

NOTE

When using an external modulation signal for general purpose testing, AM switch 27 may be set to DC or AC (DC if modulation signal is less than 20 Hz or if minimum phase shift is required).

Pages 5-2 and 5-3, paragraph 5-21:
Add the following step.

h. A8A1R7, A8A1R12-14 Selection. If A8AlUl ***or*** U5 is replaced, proceed as follows before reassembling the counter.

1. Inspect the A8A1 RF Scaler Board Assembly. If resistors R12, R13, and R14 are in the circuit remove them and install a jumper in place of R13.

2. If the counter displays erratic readings in the EXT 550 mode, it maybe necessary to change A8A1R7 or add attenuator pad A8A1R12-14.

3. If the malfunction occurs at input levels less than 0 dBm, change A8A1R7 to 68.1 ohms.

Continued . . .

ERRATA (Cont'd)

4. If the malfunction occurs at input levels greater than 0 dBm, add A8A1R12-14 according the the following table.

Input Level (dBm)	R12	R13	R14
0	147Ω	38.3Ω	147Ω
1	178Ω	31.6Ω	178Ω
2	237Ω	23.7Ω	237Ω
3	237Ω	23.7Ω	237Ω
4	287Ω	17.8Ω	287Ω
5 (or greater)	464Ω	11.0Ω	464Ω

NOTE

Newer versions of the RF Scaler Assembly (A8A1) have printed circuit pads provided for resistors R12, R13, and R14. In older versions it may be desirable to replace some components with solder posts and wire the new circuitry to the posts.

Page 5-3, Table 5-1:
We the following additions to the table:

Component	Service Sheet	Range of Values	Basis of Selection
A8A1R7	18	51 or 68.1$2	See paragraph 5-21.
A8AIR12 A8A1R13 A8A1R14	18		See paragraph 5-21.

Page 5-34, Paragraph 5-40:
Change the table in step 8 to read as follows.

PEAK DEVIATION	DVM Raading at A7TP3
2.56 MHz	<± 5.6 mVdc
1.28 MHz	<± 5.6 mVdc
640 kHz	<± 5.6 mVdc
320 kHZ	<* 5.6 mVdc
160 kHZ	<*4.5 mVdc
80 kHz	<± 2.2 mVdc
40 kHz	<± 1.1 mVdc
20 kHz	<± 0.6 mvdc
10 kHz	<±0.6 mVdc
5 kHz	<± 0.6 mvdc

Page 6-2, Table 6-1:
Delete entire entry for A8A1.
Under A8A2, change Exchange Assy part number to 08640-60187.

Page 6-6, Table 6-3:
Change A2VR2 to 1902-3104 DIODE ZNR 5.6V 5% DO-7 PD-0.4W.
A3MP9 and A3MP13. The single recommended replacement for both parts is 08640-20267 (see Change 14).
A3Q1. The recommended replacement for A3Q1 is transistor 5086-4282 (see Change 11).

ERRATA (Cont'd)

Page 6-11, Table 6-3.
A7R28 and A7R45 The recommended replacement for A7R28 is 0757-0465 and for A7R45 is 0698-3159.

NOTE

For instruments not already modified as above, it will be necessary to replace both A7R28 and A7R45 the first time that either resistor is replaced (see Change 16).

Page 6-13, Table 6-3:
Change A8U1-U6 to 1990-0507.
Change A8A2 08640-60087 to 08640-60187 RESISTOR 08640-60027,60189 or 60258, REQUIRES EXCHANGE.

Page 6-15, Table 6-3:
A8A2U20-24 and U28. The recommended replacement for A8A2U20-24 and U28 is 1820.1684 (see Change 16).

Page 6-17, Table 6-3:
A8A3U1O, U11 and U13 thru U17: Recommended replacements for these parts and associated resistors (A8A3R10 and R17) are presented in Change 15.

Page 6-40, Table 6-3:
Add HP Part Number, 08640-60103, for J1.
MP29. The recommended replacement for MP29 is coupler 1500-0433 (see Change 7).

Page 6-41, Table 6-3:
Add MP81 08640-00037 INSULATOR, BOTTOM COVER.
MP82. Added in Change 7.
Add MP83 3030-0343 SCREW-SET, 1/4-28 0.25-in-lg, HALF DOG-PT.

NOTE

Reference designations MP75 thru MP80 are not assigned.

Page 6-42, Table 6-3:
Change W13 to 08640-60125 CABLE ASSEMBLY, PULSE IN.

Service Sheet 5 (component locations):
Add the following figures

A3A1A3

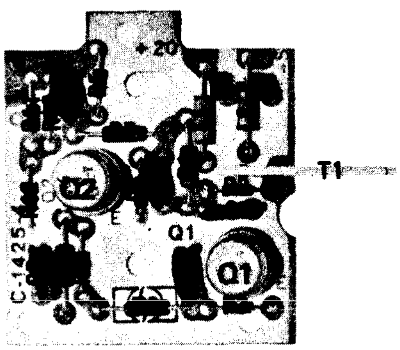


Figure 8-22A. A3A1A3 Counter Buffer Amplifier Board Assembly (Errata)

A3A1A2

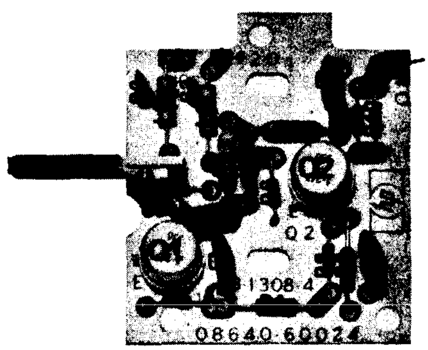


Figure 8-22B. A3A1A2 Divider/Filter Buffer Amplifier Board Assembly (Errata)

Service Sheet 5 (Schematic):
On the A3A1A3 and A3A1A2 assemblies, change the indicated voltage at the junctions of R4 and R9 to –5.2V.
A3Q1, The recommended replacement for A3Q1 is transistor 5086-4282 (see Change 11).

ERRATA (Cont'd)

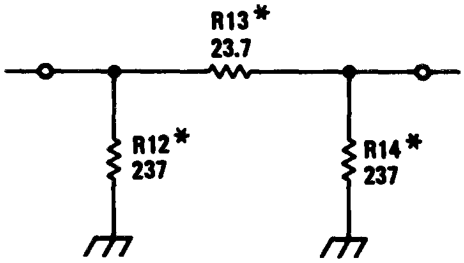
Service Sheet 8 (schematic):
Make the following changes to the A7 assembly.
Change the indicated voltage at U2B pin 7 to +1.05V.
Change the indicated voltage at U2A pin 4 to -1.05V.

Service Sheet 9A (component location):
Delete A11MP6 (2 places), MP7, MP8, and MP9.
Delete A1lA1MP1, A1MP2, A1MP3, A1MP4, and A1MP5 (2 places),

Service Sheet 11 (schematic):
On the A10A2 assembly, add an asterisk (*) after R3.

Service Sheet 13 (schematic):
On the A26 assembly, change the part number for U1 to 08640-67006.

service Sheet 18 (schematic):
On the A8A1 assembly, make the following changes.
Add an asterick (*) after R7.
Add the following circuitry between the junction of CR4 and CR5, and K2.



Service Sheet 19 (Schematic):
A8A3U1 O, U11 and U13 thru U17: Recommended replacements for these parts and associated resistors (A8A3R10 and R17) are presented in Change 15.

Service Sheet 20 (Schematic):
Change the part number for A8LU-U6 to 1990-0507.
A8WU20-U24 and U28. The recommended replacement for A8A7U20-U24 is 1820-1684 (see Change 16).

service Sheet 21 (Schematic):
Change the pin designation diagram for A8A2Q6 to read from left to right G, D, S.

CHANGE 1

Page 6-2, Table 6-1:
Change A8A2 as follows:
Part Number
New Assy: 08640-60189.

Page 6-8, Table 6-3:
Change A4C1 to 0140-0191 CAPACITOR: FXD 56 PF ± 5% 300 WVDC MICA.
Change A4C3 and A4C4 to 0180-0116 CAPACITOR: FXD 6.8 UF ±10% 35 VDC TA.
Delete A4CR1.
Change A4R3 to 0757-0449 RESISTOR 20K 1% 0.125W F TUBULAR.
Change A4R5 to 0698-3243 RESISTOR 178K 1% 0.125W F TUBULAR.
Add A4R23 0757-0418 RESISTOR 619 OHM 1% 0.125W F TUBULAR.
Add A4R24 0757-1094 RESISTOR 1.47K 1% 0.125W F TUBULAR.

Continued. . .

CHANGE 1 (Cont'd)

Page 6-13, Table 6-3:
Change A8A2 08640-60027 to A8A2 08640-60189.

Page 6-23, Table 6-3:
Change A10A2U5 to 1820-0143 IC DGTL MC 1027P J-K FLIP-FLOP.
Delete A10A2XA10A2U5 and A10A2XA10A2U9.

Page 6-28, Table 6-3:
Add A12C6 0180-0197 CAPACITOR: FXD: 2.2 UF ±10% 20 VDC TA.
Add A12CR21 1901-0418 DIODE: PWR RECT: SI: 400V MAX VRM 1.5A.
Add A12Q1 1884-0239 THYRISTOR: SCR.
Add A12R1 and A12R2 0698-3447 RESISTOR 422 OHM 1% 0.125W F TUBULAR.
Add A12VR1 1902-3393 DIODE ZNR 75V 5% DO-7 PD=0.4W TC=+0.077%.

Page 6-38, Table 6-3:
Change A26A4R34 and R35 to 0683-1055 RESISTOR, 1M 5% 0.25W CC TUBULAR.

Service Sheet 11 (schematic):
Change part number for A10A2U5 to 1820-0143.

Service Sheet 12 (schematic):
Change A26A4R34 and R35 to 1MΩ.

Service Sheet 17 (component locations):
Replace Figure 8-57 with the attached figure.

A4

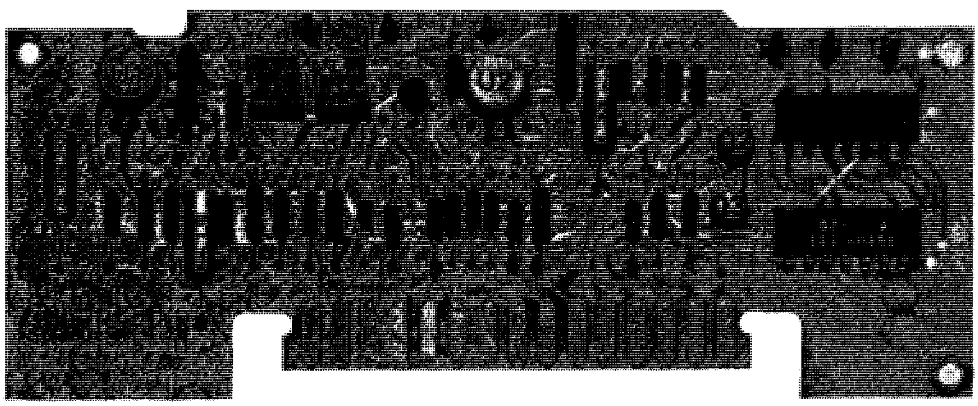


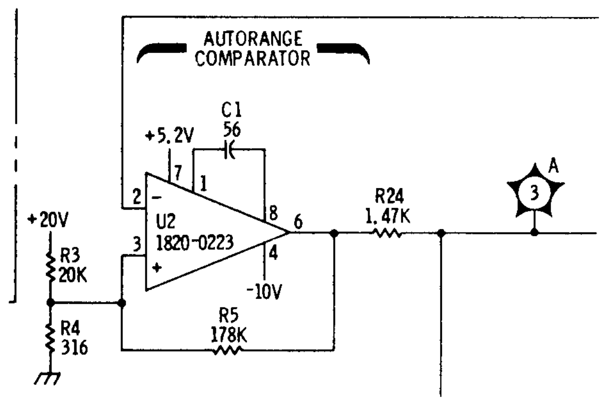
Figure 8-57. A4 Meter/Annunciator Drive Assembly Component Locations (P/O Change 1)

Continued . . .

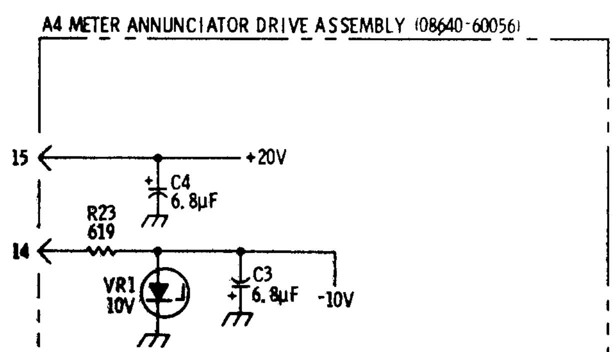
CHANGE1 (Cont'd)

Service Sheet 17 (schematic):

Replace appropriate portions of schematic with the attached partial schematics (P/O Figure 8-59, 1 of 2, and 2 of 2).



P/O Figure 8-59. Meter Circuits Schematic Diagram (P/O Change 1, 1 of 2)



P/O Figure 8-59. Meter Circuits Schematic Diagram (P/O Change 1, 2 of 2)

Continued . . .

CHANGE 1 (Cont'd)

Service Sheet 20 (Component Locations):
Replace Figure 8-66 with attached figure.

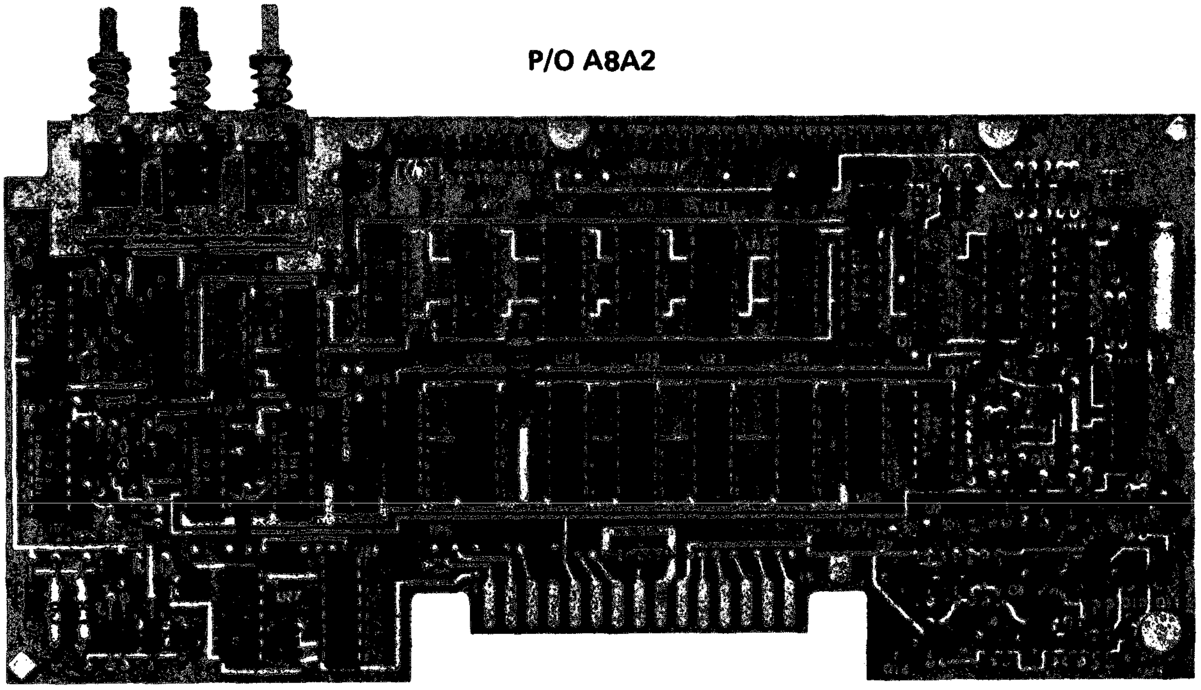


Figure 8-66. ***P/0*** A8A2 ***Counter/Lock Board Assembly Component Locations (P/O Change 1)***

Service Sheet 20 (schematic):
Change part number for A8A2 subassembly to 08640-60189.

Continued. . .

CHANGE 1 (Cont'd)

Service Sheet 21 (component locations):
Replace Figure 8-68 with attached figure.

P/O A8A2

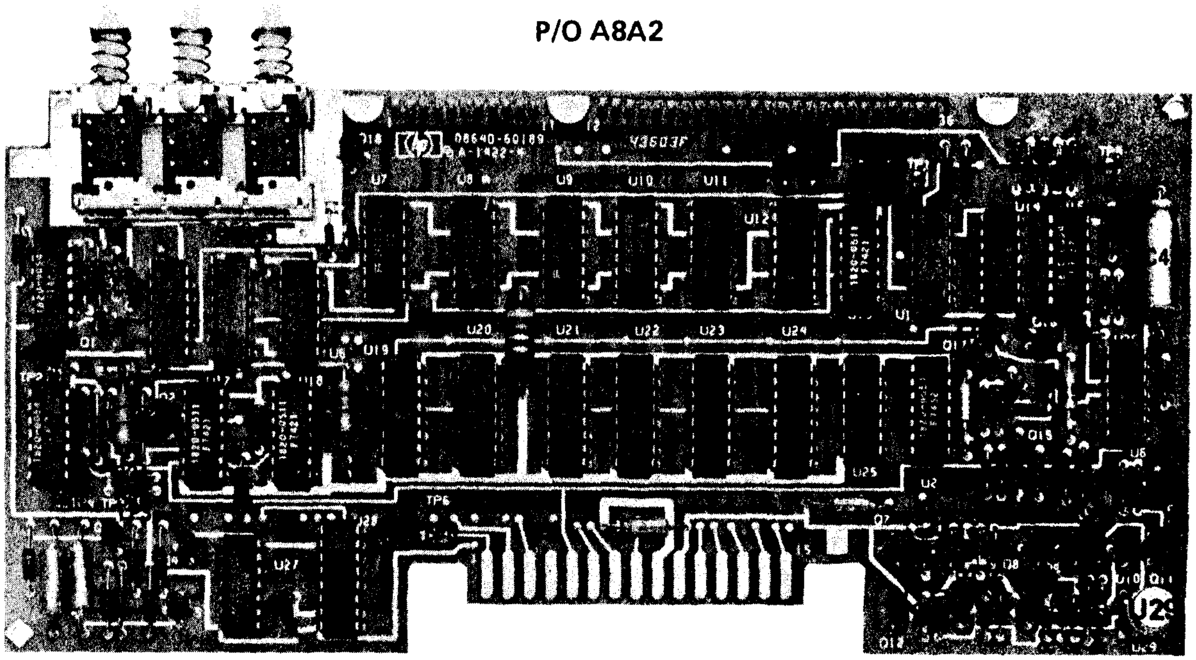


Figure 8-68. P/O A8A2 Counter/Lock Board Assembly Component Locations (P/O Change 1)

Service Sheet 21 (schematic):
Change part number for A8A2 subassembly to 08640-60189.

Service Sheet 22 (Principles of Operation):
Under **Input Voltage (A12 and A14),** delete the last sentence and add the following paragraph.

The A12 Rectifier Assembly contains five ful-wave rectifiers and a crowbar to protect the instrument from excessively high line voltages. The crowbar is across the output of the rectifier bridge to the +44 .6V regulator. If the rectified voltage exceeds 75V, breakdown diode A12VR1 conducts and triggers the gate of SCR A12Q1. Q1 then conducts and blows the primary fuse, Diode A12CR21 prevents filter capacitor C3 from discharging through the crowbar when the crowbar conducts.

Continued . . .

CHANGE 1 (Cont'd)

Service Sheet 22 (component locations):
Replace Figure 8-71 with the attached figure.

A12

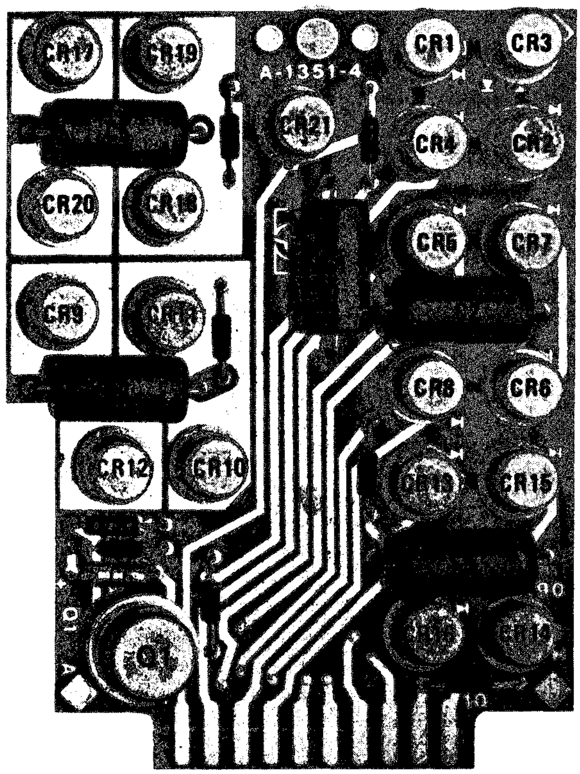
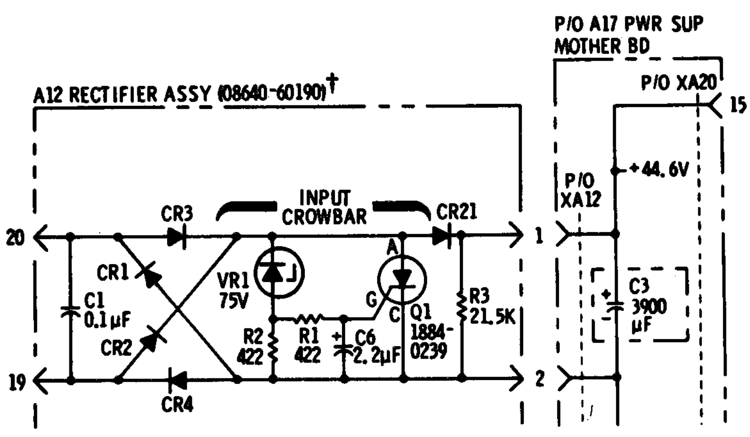


Figure 8-71. A12 ***Rectifier Assembly Component Locations (P/O Change 1)***

Service Sheet 22 (schematic):
Replace appropriate portion of schematic with the attached partial schematic (P/O Figure 8-74).



P/O Figure 8-74. ***Power Supply Circuits Schematic Diagram (P/O Change 1)***

CHANGE 2

Page 6-7, Table 6-3:
Add A3A4C3 and A3A4C4 0180-0116 CAPACITOR, FXD, 6.8 UF ±10%.

Add A3A4L1 and A3A4L2 9100-1664 COIL, FXD, MOLDED RF CHOKE 3 mH, 5%.

Page 6-25, Table 6-3:
Add Al 1C24 0140-0145 CAPACITOR - FXD 22PF ± 5% 500 WVDC MICA.

Page 6-37, Table 6-3:
Change A26A4CR7, CR8, CR9, and CR13 to 1901-0518 DIODE, SCHOTTKY, HOT CARRIER.

Page 6-41, Table 6-3:
Add MP72 7120-4294, LABEL, WARNING.

Service Sheet 5 (component locations):
Replace Figure 8-22 with the attached figure.

P/o A3A4

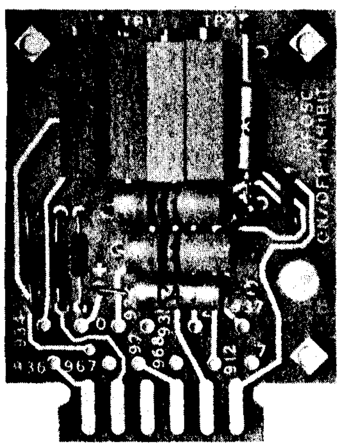


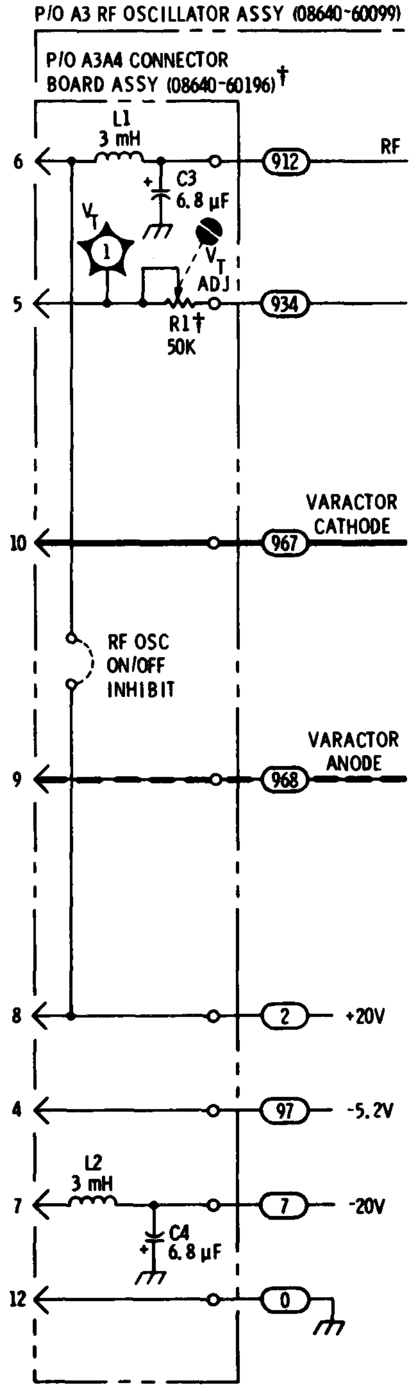
Figure 8-22. P/O A3A4 Connector Board Assembly Component Locations (P/O Change 2)

Continued . . .

CHANGE 2 (Cont'd)

Service Sheet 5 (schematic):

Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8-23).



P/O *Figure* 8-23. *RF Oscillator Simplified Diagram (P/O Change 2)*

Continued . . .

CHANGE 2 (Cont'd)

Service Sheet 6 (component locations):
Replace Figure 8-24 with the attached figure.

P/O A3A4

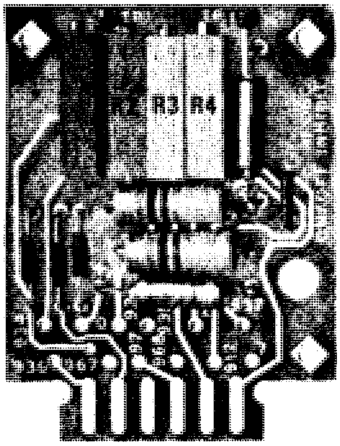


Figure 8-24. P/O A3A4 Connector Board Assembly Component Locations (P/O Change 2)

Service Sheet 9A (schematic):
Add a 22 pF capacitor, A11C24, parallel to A11R36.

CHANGE 3

Page 6-13, Table 6-3:
Add A8MP46 08640-00096 INSULATOR, COUNTER HEAT SINK.

CHANGE 4

Page *6-35*, Table 6-3:
Delete A26A2CR5.

Service Sheet 13 (schematic):
Delete diode A26A2CR5. Connect pin 10 directly to pin 19.

CHANGE 5

Page 6-36, Table 6-3:
Change A26A3R1 to 0698-7227 RESISTOR, FXD, 422 OHM 1% 0.125W F.

Service Sheet 12 (schematic):
Change A26A3R1 to 422CL

CHANGE 6

Page 5-43/5-44:
Add the attached paragraph 5-45.

5-45. PHASE LOCK ERROR VOLTAGE ADJUSTMENT

REFERENCE:

Service Sheet 21.

DESCRIPTION:

When the instrument is operating in the normal count mode, a nominal mid-range (phase lock error) voltage should exist at test point A8A2TP6. A mid-range voltage ensures that the generator will maintain phase lock when the oscillator **shifts** up or down in frequency.

EQUIPMENT:

Digital Voltmeter . . . . HP 3480B/3484A

PROCEDURE:

1. Set Signal Generator's controls as **follows:**

   COUNTER MODE: LOCK . . . . off

2. Connect one lead of the voltmeter to testpoint A8A2TP6 and the other lead to ground. Adjust potentiometer **A8A2R58 for a voltmeter reading of +11.5 ± 1.0Vdc.**

Page 6-2, Table 6-1:
Change A8A2 as follows:
Part Number
New Assy: 08640-60258.

Page 6-13, Table 6-3:
Change A8A2 08640-60189 to 08640-60258.

Page 6-14, Table 6-3:
Delete A8A2C27, C28, C29 and C30.

Change A8A2R28 to 069-7258 RESISTOR; FXD; 8.25K 2% 0.05W F TUBULAR.

Page 6-15, Table 6-3:
Add A8A2R58 2100-2497 RESISTOR, VAR., TRMR, 2K OHM 10% C TOP ADJ.

Service Sheet 20 (component locations):
Replace Figure 8-66 with attached figure.

CHANGE 6 (Cont'd)

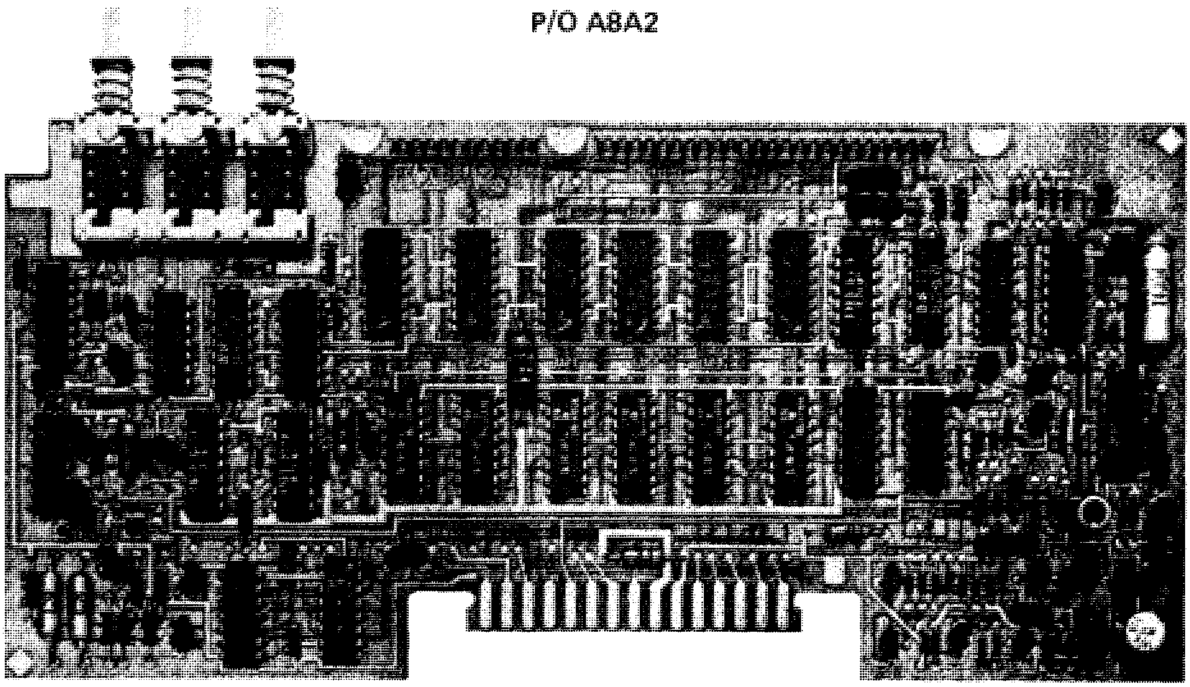
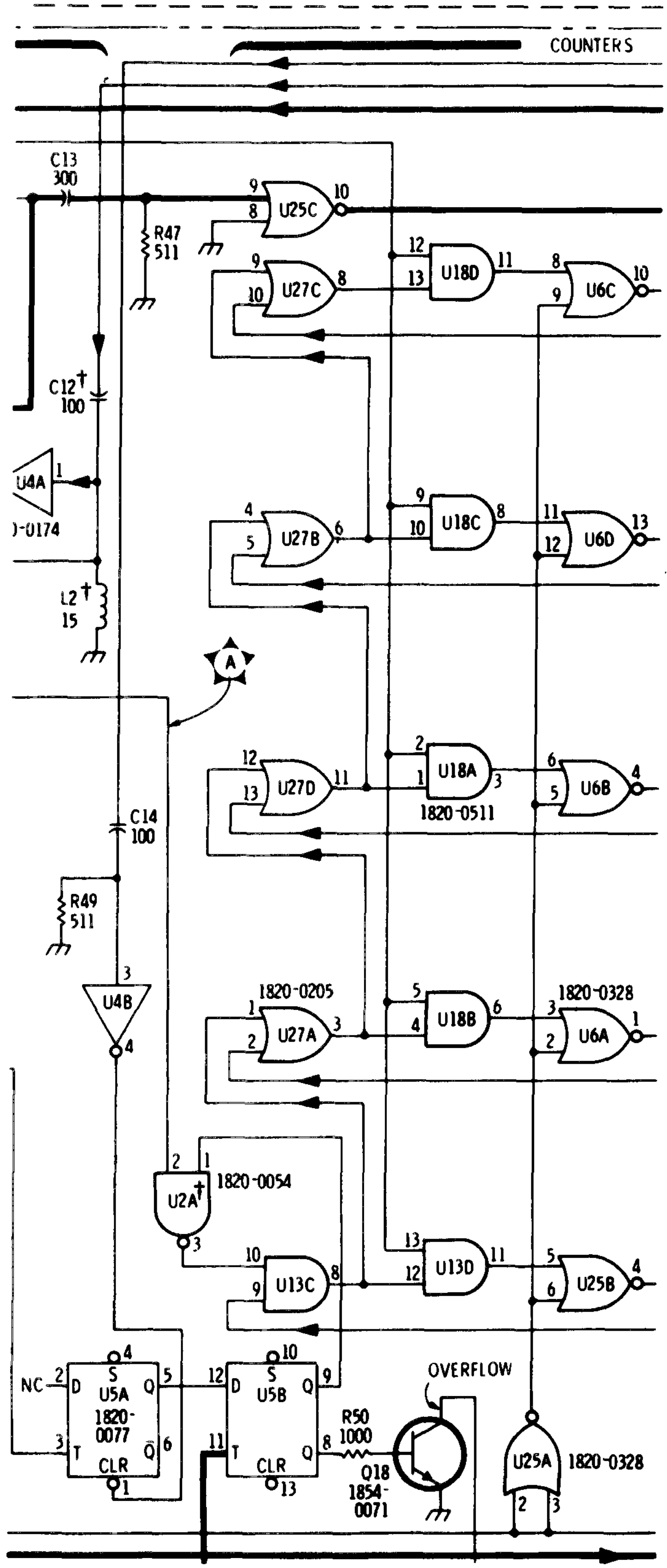


Figure 8-66. P/O A8A2 Counter/Lock Board Assembly Component Locations (P/O Change 6)

Service Sheet *20* (schematic):
Change part number of *A8A2* subassembly to 08640-60258. Replace appropriate portion of schematic with attached partial schematic (P/O Figure *8.67)*.

CHANGE 6 (Cont'd)



P/O Figure 8-67. Up/Down Counter and Display Schematic Diagram (P/O Change 6)

CHANGE 6 (Cont'd)

Service Sheet 21 (component locations):
Replace Figure 8-68 with attached figure.

P/O A8A2

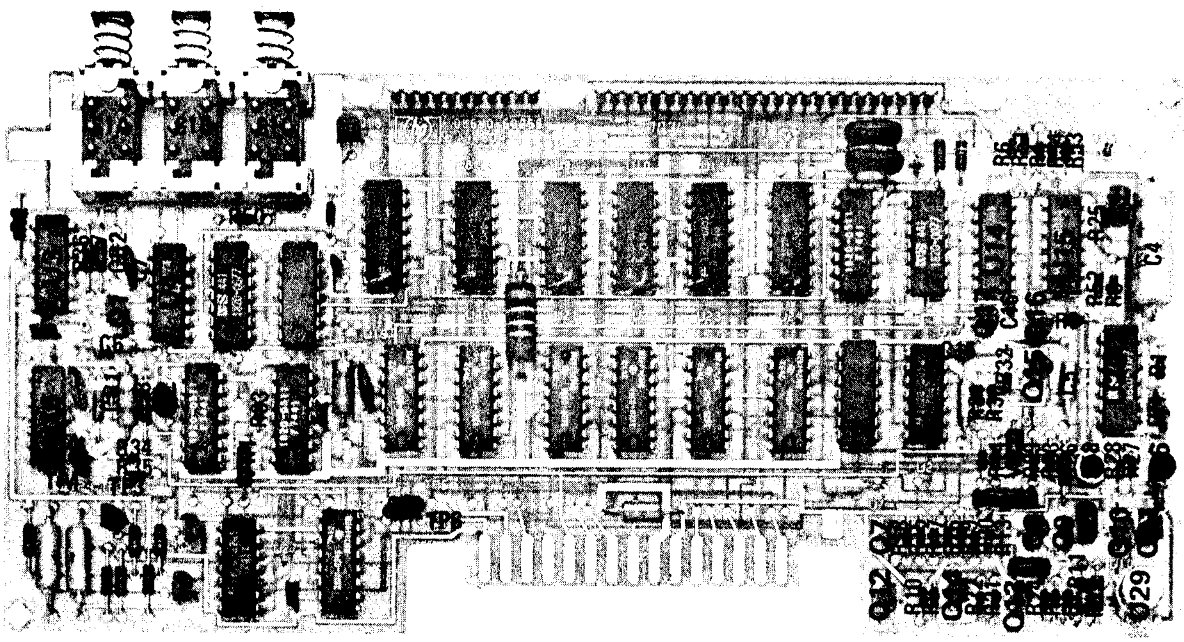
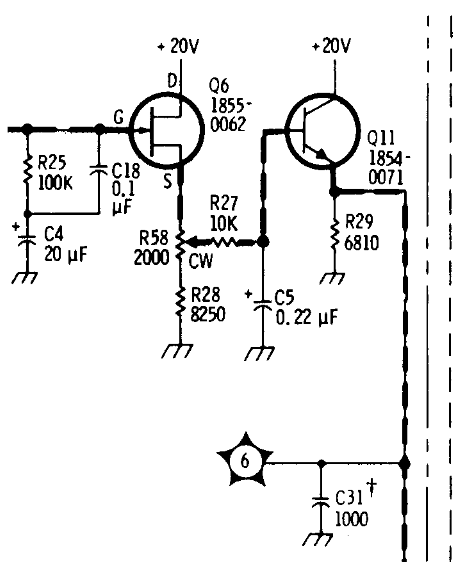


Figure 8-68. P/O A8A2 Counter/Lock Board Assembly Component Locations (P/O Change 6)

Service Sheet *21* (schematic):
Change part number of A8A2 subassembly to 08640-60258.
Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8-69).



P/O Figure 8-69. Counter Phase Lock Schematic Diagram (P/O Change 6)

CHANGE 7

Page 5-2, paragraph 5-21:

Change paragraph c to read as follows:

c. **A9A1A2C6, C7 and C8.** If the A9A1A2 FM Gain Switch Board Assembly has been replaced or repaired, measure the 3 dB bandwidth at A7TP3 with an oscilloscope on the following RF frequency ranges while driving the FM INPUT connector with an external test oscillator. Change the corresponding capacitor, if necessary, for best flatness (less than 3 dB down at 250 kHz rate). Increase capacitance to decrease deviation (250 kHz rate).

FREQUENCY RANGE (MHz)	PEAK DEVIATION Range	Capacitor
512–1024	5 kHz	A9A1A2C8
256 – 512	5 kHz	A9A1A2C7
128-256	5 kHz	A9A1A2C6

NOTE

Changing any capacitor will likely affect flatness on other ranges.

Page 5-3, Table 5-1:

Delete A9C8 (see Change 1).

Add the following

Component	Service Sheet	Range of Values	Basis of Selection
A9A1A2C6	6	0 – 5 6 p F	See paragraph 5-21.
A9A1A2C7	6	500 – 900 pF	
A9A1A2C8	6	750 – 2000 pF	

Page 6-17 and 6-18, Table 6-3:

Raplace the entire A9 assembly parts list with the following list.

A9	——	PEAK DEVIATION AND RANGE SWITCH ASSEMBLY
A9A1	08640-60179	SWITCH ASSEMBLY
A9A1MP1	0380-0013	SPACER, 1.0 LONG
A9A1MP2	03800013	SPACER, 1.0 LONG
A9A1MP3	0510.0005	RING, RETAINER 1/4 DIA
A9A1MP4	05100005	RING, RETAINER 1/4 DIA
A9A1MP5	0510-0005	RING, RETAINER 1/4 DIA
A9AMP6	0510-0015	RING, RETAINER EXT
A9A1MP7	05100052	RING, EXT 0.125 DIA
A9AM4P8	05100052	RING, EXT 0.125 DIA
A9A1MP8	1430-0759	GEAR, SPUR
A9A1M10	1430-0772	GEAR, PLANET
A9AMP11	1430-0772	GEAR, PLANET
A9A1MP12	1430-0773	GEAR, COMBINATION
A9A1WP13	1430-0774	GEAR, COMBINATION
A9A1MP14	14600019	SPRING, COMPRESSION

CHANGE 7 (Cont'd)

A9A1MP15	1460-0019	SPRING, COMPRESSION
A9A1MP16	1460-0019	SPRING, COMPRESSION
A9A1MP17	2190-0390	WASHER, FLAT NON-METALIC
A9A1MP18	3050-0103	WASHER,FLAT
A9A1MP19	3050-0103	WASHER,FLAT
A9A1MP20	3050-0103	WASHER,FLAT
A9A1MP21	3130-0503	SHAFT,INDEXASSY
A9A1MP22	3130-0504	SHAFT,INDEXASSY
A9A1MP23	08640-00091	MOUNTING PLATE, DETENTS
A9A1MP24	08640-00092	MOUNTING PLATE, GEARS
A9A1MP25	08640-00093	MOUNTING PLATE, POT
A9A1MP26	08640-00098	BOARD,SUPPORT
A9A1MP27	08640-20241	BUSHING,PLASTIC
A9A1MP28	08640-20242	SHAFT, FMGAIN SWITCH
A9A1MP29	08640-20248	SWITCH ROTOR, 4CONTACT(P/O A9A1A2S1)
A9A1MP30	08640-20249	SWITCH ROTOR,3 CONTACT(P/OA9AlAlS2)
A9A1MP31	08640-20250	SWITCH ROTOR, 2 CONTACT(P/O A9A1A1S1)
A9A1MP32	2360-0220	SCREW,6-32X2.25
A9A1MP33	2360-0123	SCREW, 6-32X6.25 W/LOCK
A9A1MP34	2260-0009	NUT,4-4ow/LocK
A9A1MP35	0520-0173	SCREW,2-56X0.25 W/LOCK
A9A1MP36	2360-0135	SCREW,6-32X1-50
A9A1MP37	2200-0107	SCREW,4-40X0.312 W/LOCK
A9A1MP38	2360-0129	SCREW, 6-32X1.000 LG
A9AIMP39	2190-0006	WASHER,SPLIT LOCK
A9A1MP40	2950-0006	NUT,l/4–32
A9A1MP41	2190-0027	WASHER,LOCK INT STAR
A9A1R1	2100-3435	RESISTOR,VAR 2.5KOHM
A9A1W1	08640-60197	CABLE ASSEMBLY, COAX
A9A1A1	08640-60253	PEAK DEVIATION BAND SWITCHBOARD ASSEMBLY (DOES NOT INCLUDE ROTORS A9A1MP31 and A9AlMP30, P/OSl AND S2)
A9A1A1R1	0698-8299	RESISTOR, FXD 4.259K OHM
A9A1A1R2	0698-8298	RESISTOR, FXD 1.071K OHM
A9AIAIR3	0698-8297	RESISTOR, FXD 1.284K OHM
A9A1A1R4	0757-0398	RESISTOR, FXD 75 OHM 1%
A9A1A1R5	0698-8296	RESISTOR, FXD 1.493K OHM
A9AIAIR6	0757-0399	RESISTOR, FXD 82.5 OHM 1%
A9A1A1R7	0698-8295	RESISTOR, FXD 1.556K OHM
A9A1A1R8	0757-0400	RESISTOR, FXD 90.9 OHM 1%
A9A1A1R9	0757-0400	RESISTOR, FXD 90.9 OHM 1%
A9A1A1S1	———	NSR, INCLUDES PRINTED CIRCUIT TRACES AND ROTOR A9A1MP31
A9A1A1S2	———	NSR, INCLUDES PRINTED CIRCUIT TRACES AND ROTOR A9A1MP30

CHANGE 7 (Cont'd)

A9A1A2	08640-60254	FM GAIN SWTCH- BOARD ASSEMBLY (DOES NOT INCLUDE ROTOR A9A1MP29, P/O Sl)
A9A1A2C1	0140-0191	CAPACITOR,FXD 56 PF 300V
A9A1A2C2	0140-0191	CAPACITOR,FXD 56 PF 300V
A9A1A2C3	0140-0191	CAPACITOR,FXD 56 PF 300V
A9A1A2C4	0140-0191	CAPACITOR,FXD 56 PF 300V
A9A1A2C5	0140-0191	CAPACITOR,FXD 56 PF 300V
A9A1A2C6	0160-2204	CAPACITOR,FXD 1OO PF 300V(SELECTED COMPONENT)
A9A1A2C7	0160-3537	CAPACITOR,FX13 680 PF 300V(SELECTED COMPONENT)
A9A1A2C8	0160-2222	CAPACITOR,FXD 1500 PF 300V(SELECTED COMPONENT)
A9A1A2C9	0160-2204	CAPACITOR,FXD 1OO PF 300V
A9A1A2R1	0757-0280	RESISTOR,FXD 1K OHM
A9A1A2R2	0757-0278	RESISTOR,FXD 1.78K OHM
A9A1A2R3	0757-0274	RESISTOR,FXD 1.21K OHM
A9A1A2R4	0757-0416	RESISTOR,FXD 511 OHM
A9A1A2R5	0698-0082	RESISTOR,FXD 464 OHM
A9A1A2R6	0757-0280	RESISTOR,FXD lK OHM
A9A1A2R7	06907799	RESISTOR,FXD 2K OHM
A9A1A2R8	0698-5669	RESISTOR,FXD 1.5K OHM
A9A1A2R9	0698-8212	RESISTOR,FXD 6K OHM
A9AlA2R10	0698-5669	RESISTOR,FXD 1.5K OHM
A9A1A2R11	0698-8213	RESISTOR,FXD 3K OHM
A9A1A2R12	06905669	RESISTOR,FXD 1.5K OHM
A9A1A2R13	0698-8213	RESISTOR,FXD 3K OHM
A9A1A2R14	0757-0280	RESISTOR, FXD lK OHM
A9A1A2R15	0698-5669	RESISTOR, FXD 1.5K OHM
A9A1A2R16	0698-8213	RESISTOR, FXD 3K OHM
A9A1A2R17	0698-5669	RESISTOR, FXD 1.5K OHM
A9A1A2R18	0698-8213	RESISTOR, FXD 3K OHM
A9A1A2R19	0698-5669	RESISTOR, FXD 1.5K OHM
A9A1A2R20	0757-0447	RESISTOR, FXD 16.2K OHM
A9A1IA2S1	———	NSR, INCLUDES PRINTED CIRCUIT TRACES AND ROTOR A9A1MP29
A9A2	0864060256	INTERCONNECT ASSEMBLY
A9A2P1	1251-1959	CONNECTOR, PC EDGE
	08640-00101	LABEL
	08640-20256	BOARD, CONNECTOR

CHANGE 7 (Cont'd)

A9A2W1	08640-60198	CABLE, RIBBON 5.45 (INCLUDES THE FOLLOWING ITEMS)
	1251-2615	CONNECTOR, RIBBON CBL, 2 EACH
	81201711	CABLE 16 COND 28 GAUGE
A9A2W2	08640-60199	CABLE, RIBBON, 7.50(INCLUDESTHE FOLLOWING ITEMS)
	1251-2615	CONNECTOR, RIBBON CBL, 2 EACH
	8120-1711	CABLE 16 COND 28 GAUGE
A9A2A1	08640-60255	INTERCONNECT BOARD ASSEMBLY (INCLUDES A9A2Wl and A9A2W2)
A9A2A1J1	1250-0507	SOCKET, DIP16-PIN
A9A2A1J2	1250-0507	SOCKET, DIP16-PIN
A9A2A1P1	1251-1626	CONNECTOR, PC 24 CONT
A9A2A1P2	1251-0472	CONNECTOR, PC 12 CONT

Pages 6-40 and 6-41, Table 6-3:
Change MP29 to 1500-0433 COUPLER, SHAFT.
Add MP82 08640-00037 INSULATOR, BOTTOM COVER.
Change W4 to 08640-60180.

Service Sheet 6 (component locations):
Replace Figure 8-25 (1 of 2, and 2 of 2) with the attached Figures 8-25A and 8-25B.

Service Sheet 6 (schematic):
Replace appropriate portions of schematic with attached partial schematics (P/O Figure 8-27, 1 of 2 and 2 of 2).

Service Sheet 7 (schematic):
Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8.29).

Service Sheet 8 (component locations):
Replace Figure 8-31 (1 of 2, and 2 of 2) with the attached Figures 8-31A and 8-31B,

Service Sheet 8 (schematic):
Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8-33).

Service Sheet 15 (schematic):
Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8.53),

Service Sheet 19 (schematic):
Replace appropriate portion of schematic with attached partial schematic (P/O Figure 8.64).

Service Sheet 25 (schematic):
Change A9P1 to A9A2P1,
Delete all wire color codes leading away from A9A2P1.
Change description at Pin 24 to read "NON-FUNCTIONING LINE".

Service Sheet D (Illustrated Parts Breakdown):
Replace Figure 8-86 and associated text with attached figure and text.

CHANGE 7 (Cont'd)

A9A1A2

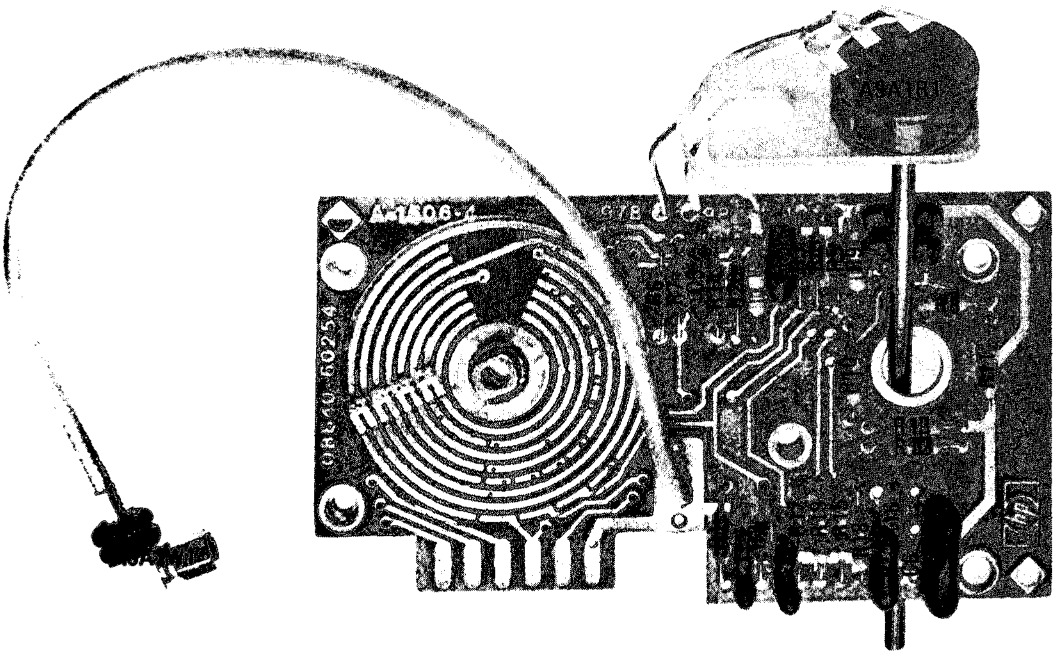


Figure 8-25A. A9A1A2 FM Gain Switch Board Assembly Component Locations (P/O Change 7)

CHANGE 7 (Cont'd)

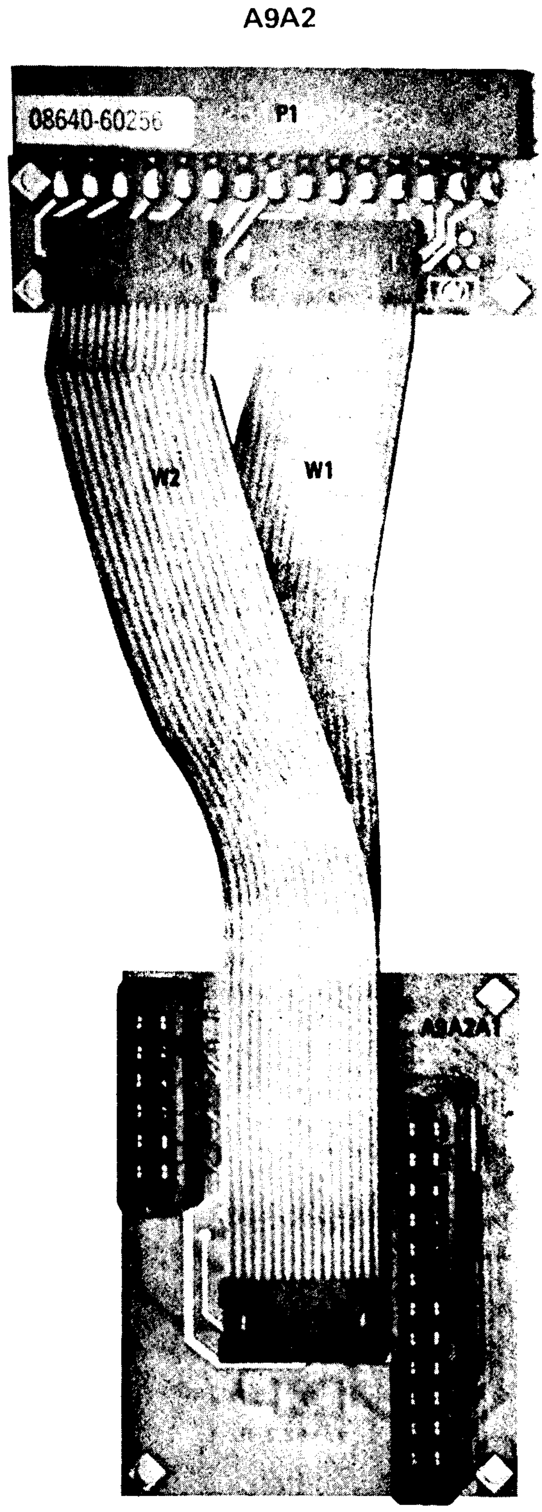
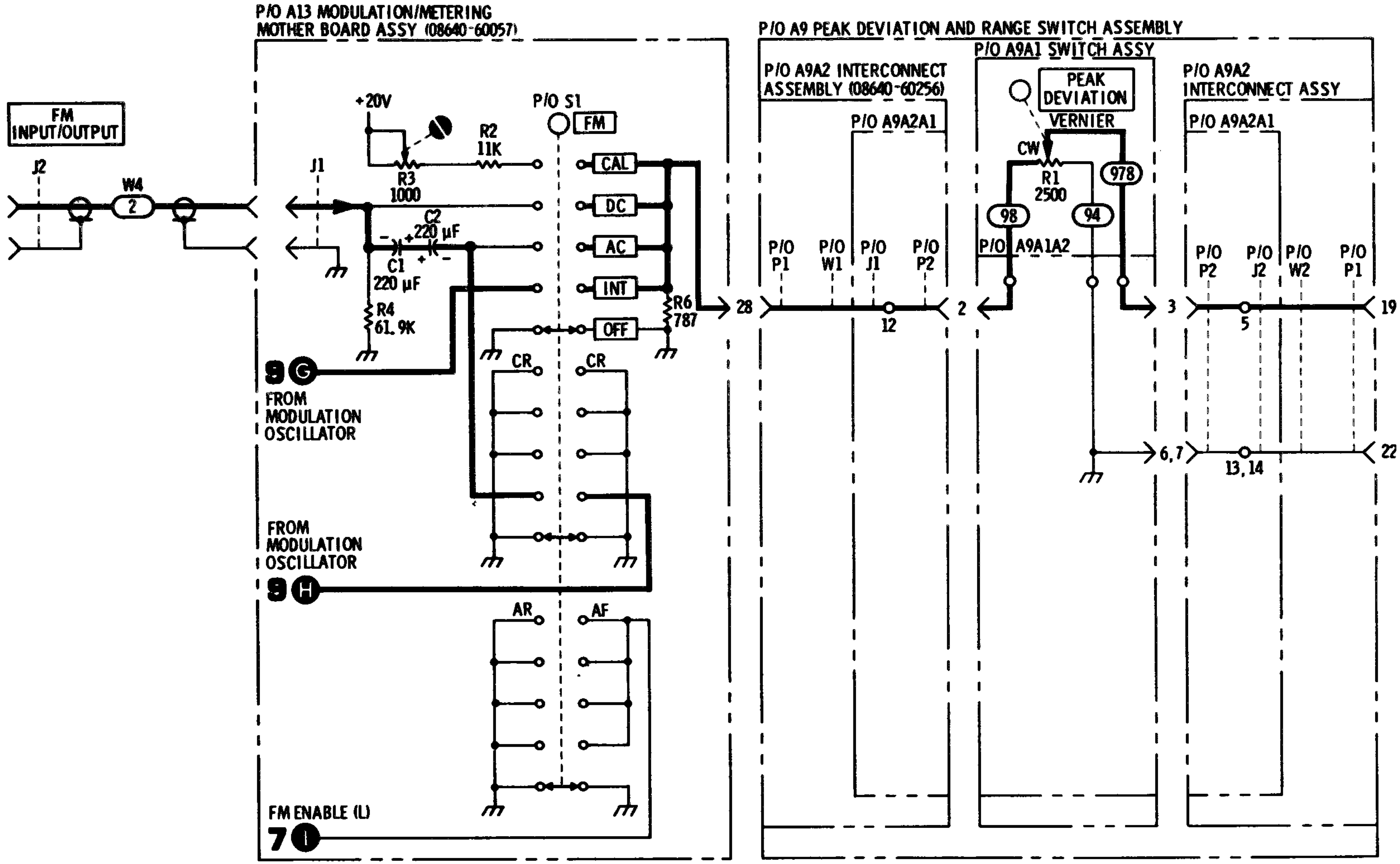
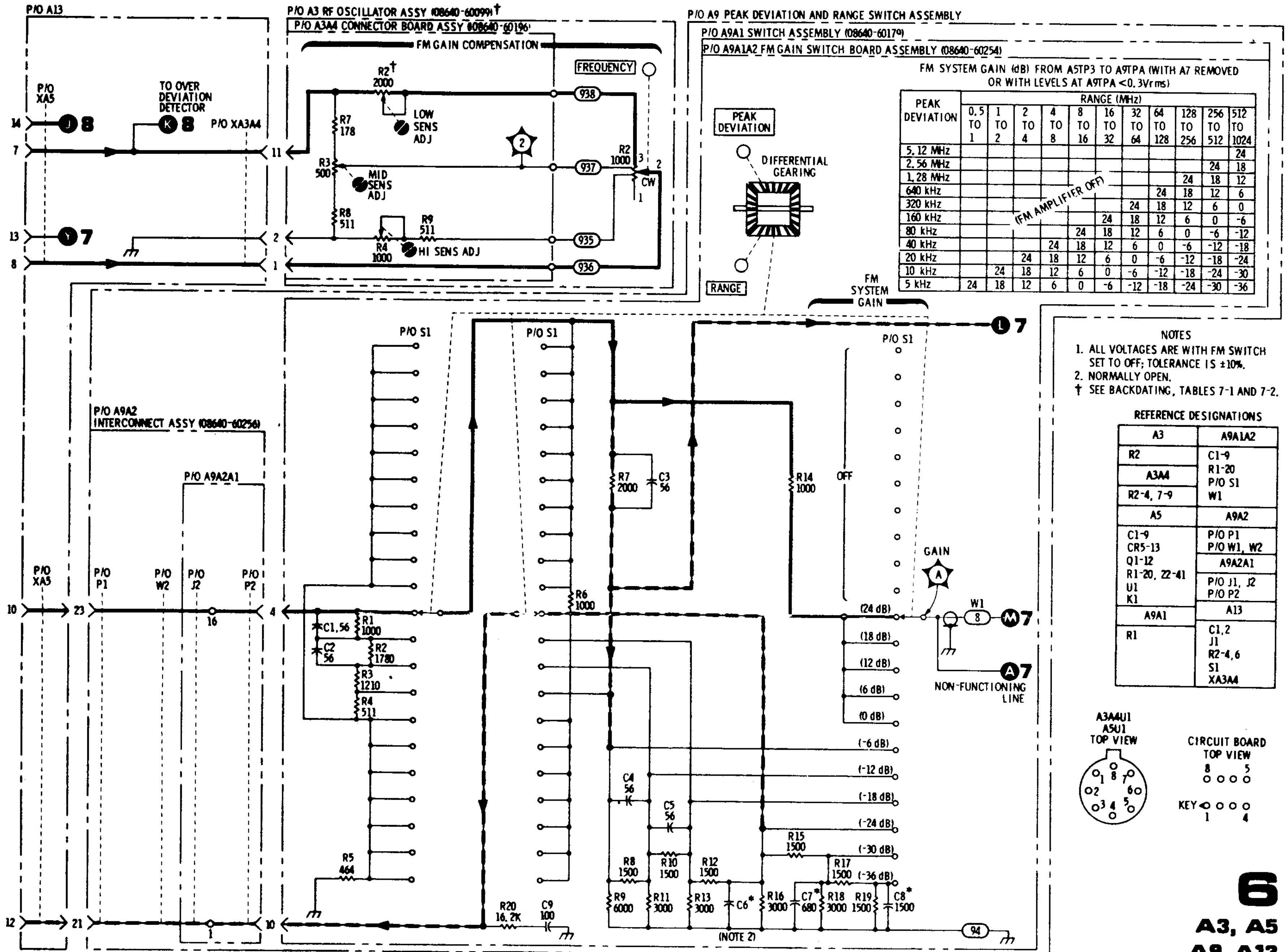


Figure 8-25B. A9A2 ***Interconnect Assembly Component Locations (P/O Change 7)***



P/O Figure 8-27. FM Amplifiers Schematic Diagram (1 of 2, P/O Change 7)



FM SYSTEM GAIN (dB) FROM A5TP3 TO A9TPA (WITH A7 REMOVED OR WITH LEVELS AT A9TPA <0.3Vrms)

PEAK DEVIATION	RANGE (MHz) 0.5 TO 1	1 TO 2	2 TO 4	4 TO 8	8 TO 16	16 TO 32	32 TO 64	64 TO 128	128 TO 256	256 TO 512	512 TO 1024
5.12 MHz											24
2.56 MHz										24	18
1.28 MHz									24	18	12
640 kHz								24	18	12	6
320 kHz							24	18	12	6	0
160 kHz						24	18	12	6	0	-6
80 kHz					24	18	12	6	0	-6	-12
40 kHz				24	18	12	6	0	-6	-12	-18
20 kHz			24	18	12	6	0	-6	-12	-18	-24
10 kHz		24	18	12	6	0	-6	-12	-18	-24	-30
5 kHz	24	18	12	6	0	-6	-12	-18	-24	-30	-36

(FM AMPLIFIER OFF)

NOTES

1. ALL VOLTAGES ARE WITH FM SWITCH SET TO OFF; TOLERANCE IS ±10%.
2. NORMALLY OPEN.

† SEE BACKDATING, TABLES 7-1 AND 7-2.

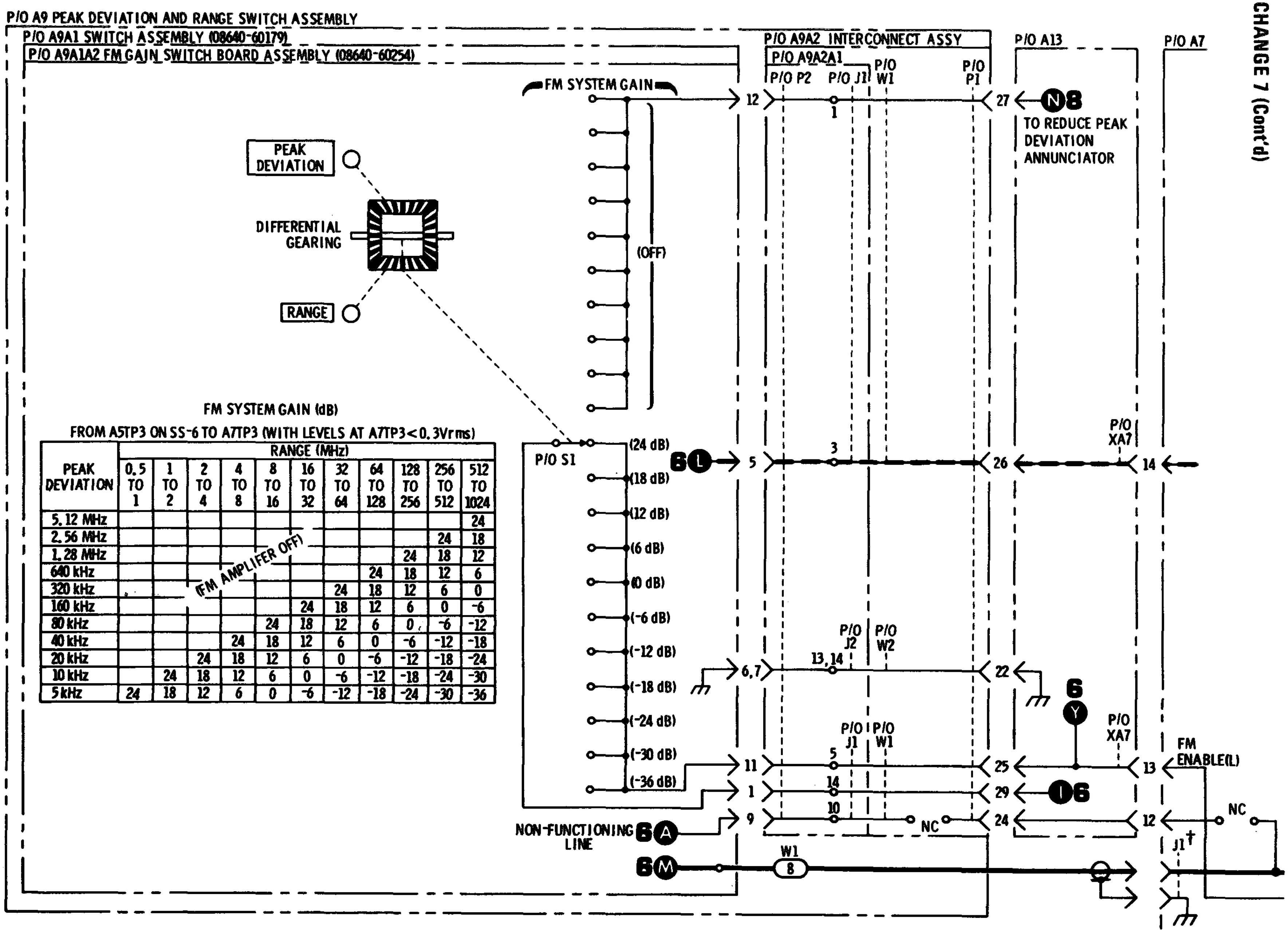
REFERENCE DESIGNATIONS

A3	A9A1A2
R2	C1-9, R1-20, P/O S1, W1
A3A4	
R2-4, 7-9	
A5	A9A2
C1-9, CR5-13, Q1-12, R1-20, 22-41, U1, K1	P/O P1, P/O W1, W2
	A9A2A1
	P/O J1, J2, P/O P2
A9A1	A13
R1	C1,2, J1, R2-4,6, S1, XA3A4

P/O Figure 8-27. FM Amplifiers Schematic Diagram (2 of 2, P/O Change 7)

6
A3, A5
A9, A13

CHANGE 7 (Cont'd)



FM SYSTEM GAIN (dB)

FROM A5TP3 ON SS-6 TO A7TP3 (WITH LEVELS AT A7TP3 < 0.3Vrms)

PEAK DEVIATION	RANGE (MHz) 0.5 TO 1	1 TO 2	2 TO 4	4 TO 8	8 TO 16	16 TO 32	32 TO 64	64 TO 128	128 TO 256	256 TO 512	512 TO 1024
5.12 MHz											24
2.56 MHz										24	18
1.28 MHz									24	18	12
640 kHz								24	18	12	6
320 kHz							24	18	12	6	0
160 kHz						24	18	12	6	0	-6
80 kHz					24	18	12	6	0	-6	-12
40 kHz				24	18	12	6	0	-6	-12	-18
20 kHz			24	18	12	6	0	-6	-12	-18	-24
10 kHz		24	18	12	6	0	-6	-12	-18	-24	-30
5 kHz	24	18	12	6	0	-6	-12	-18	-24	-30	-36

(FM AMPLIFIER OFF)

P/O Figure 8-29. FM Shaping Circuits and Phase Lock Loop Filter Schematic Diagram (P/O Change 7)

CHANGE 7 (Cont'd)

A9A1A1

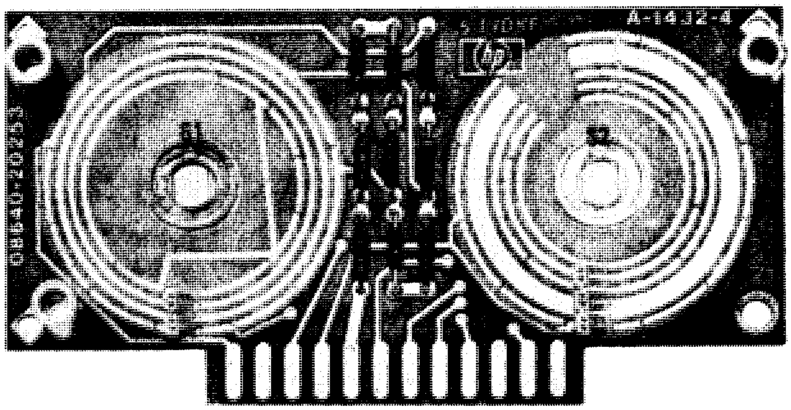


Figure 8-31A. A9A1A1 Peak Deviation Band Switch Board Assembly Component Locations (P/O Change 7)

CHANGE 7 (Cont'd)

A9A2

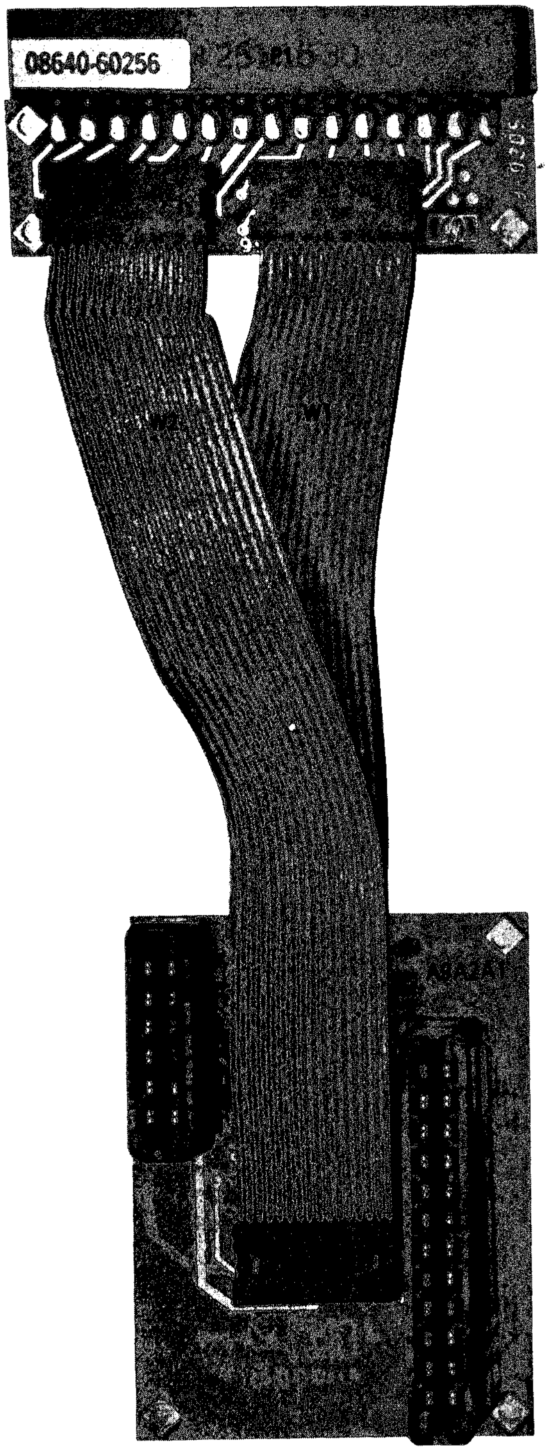
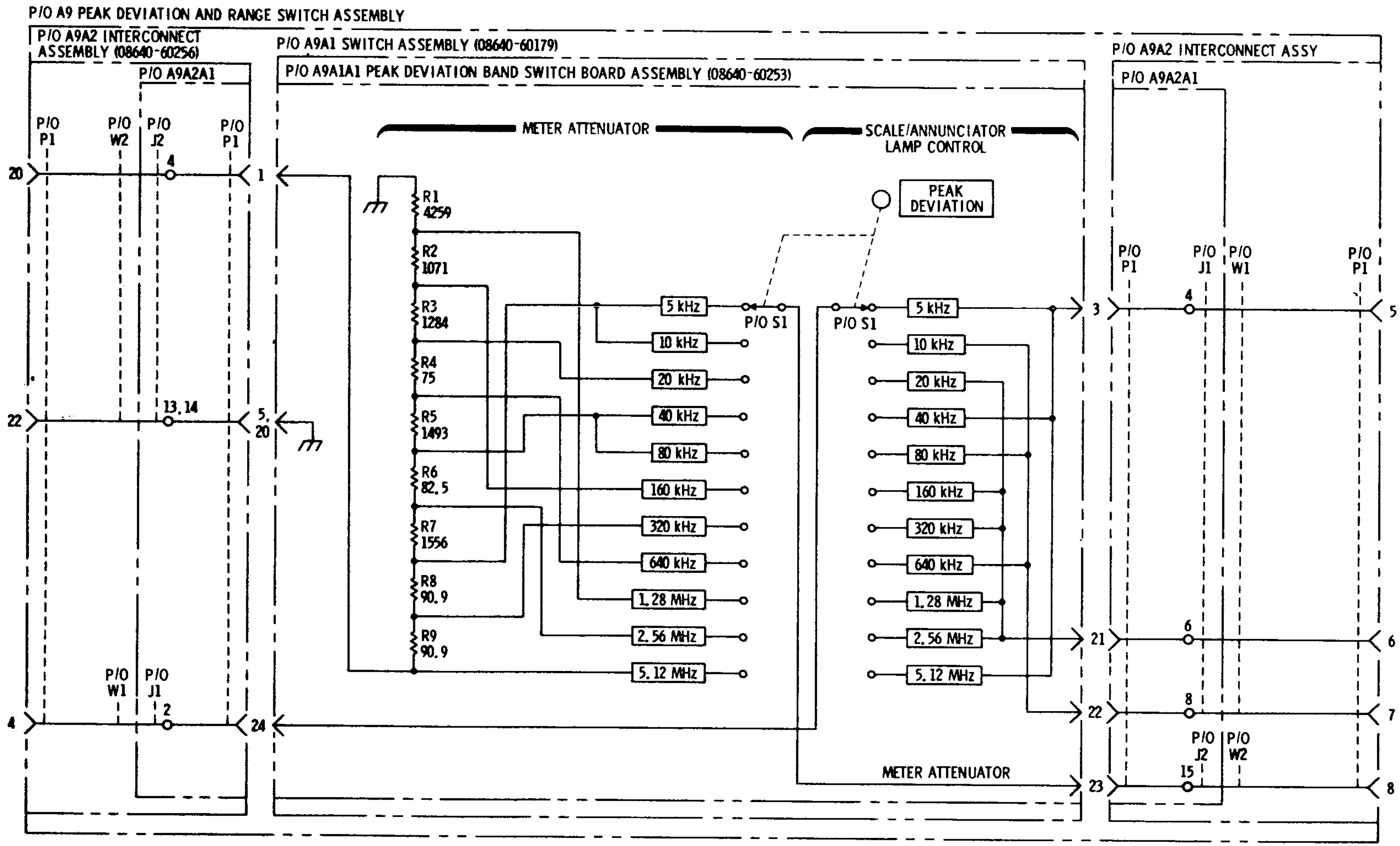
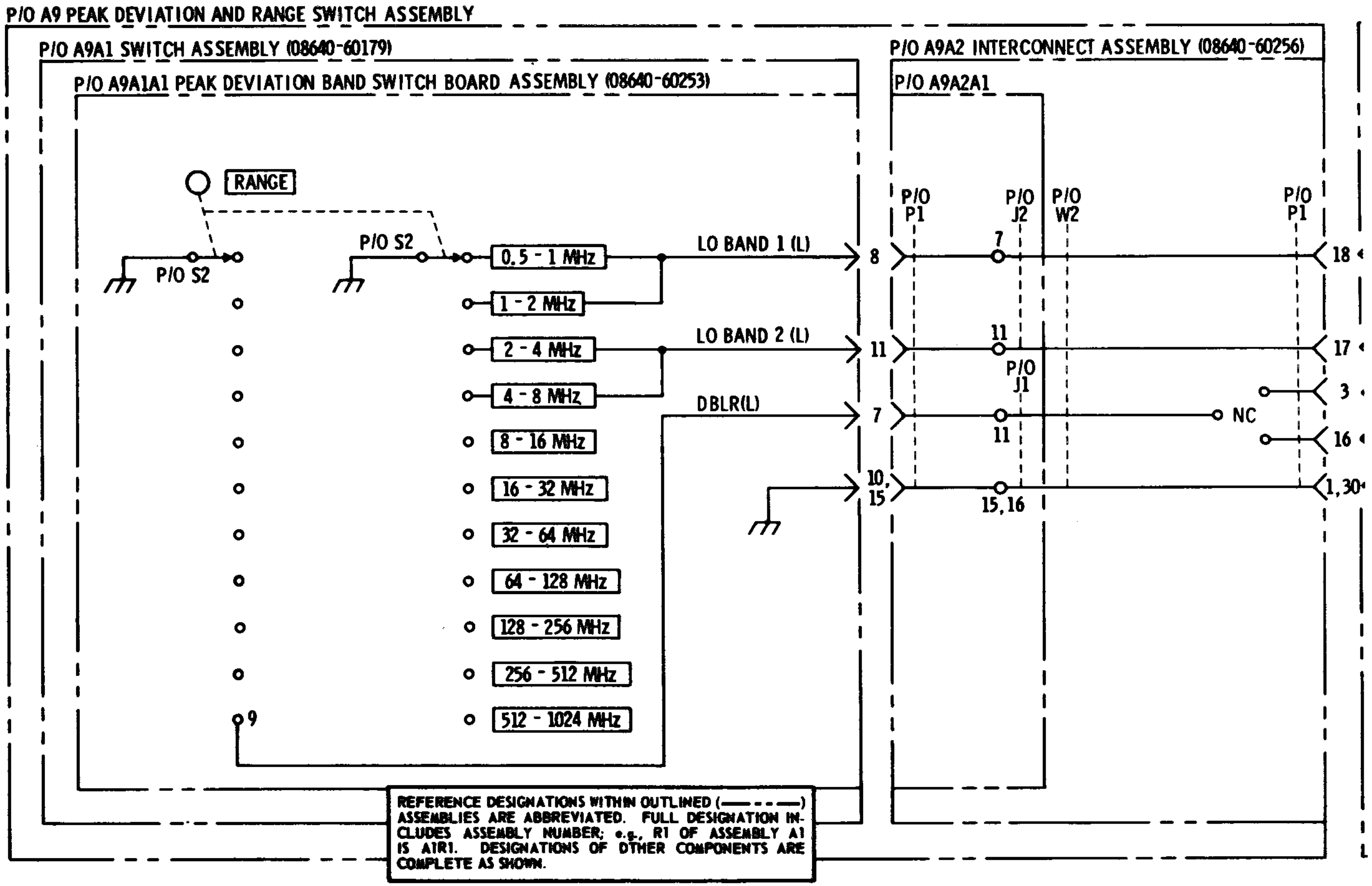


Figure 8-31B. A9A2 Interconnect Assembly Component Locations (P/O Change 7)

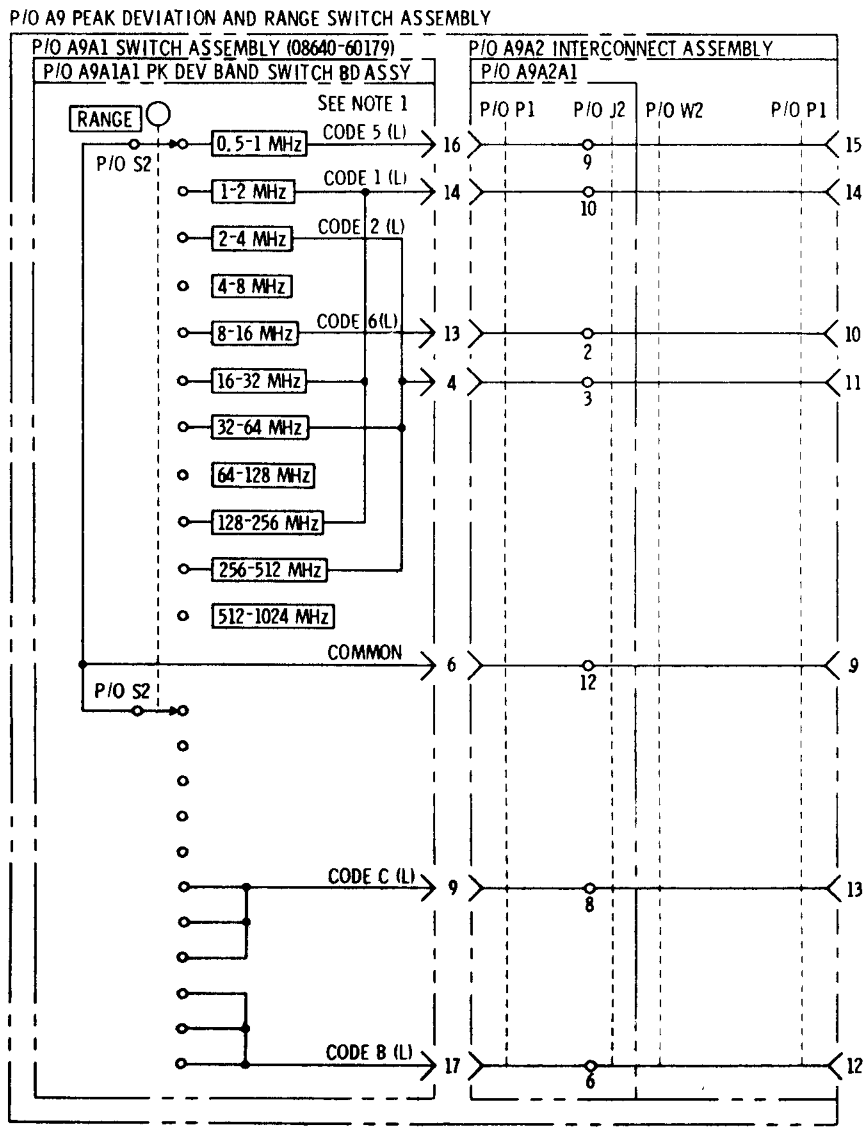


P/O Figure 8-33. Over-Deviation Detector and Meter Control Circuits Schematic Diagram (P/O Change 7)



P/O Figure 8-53. AM Interconnections and RF ON/OFF Switch Schematic Diagram (P/O Change 7)

CHANGE 7 (Cont'd)



P/O *Figure* 8-64. *Counter Time Base Schematic Diagmm (P/O Change 7)*

CHANGE 7 (Cont'd)

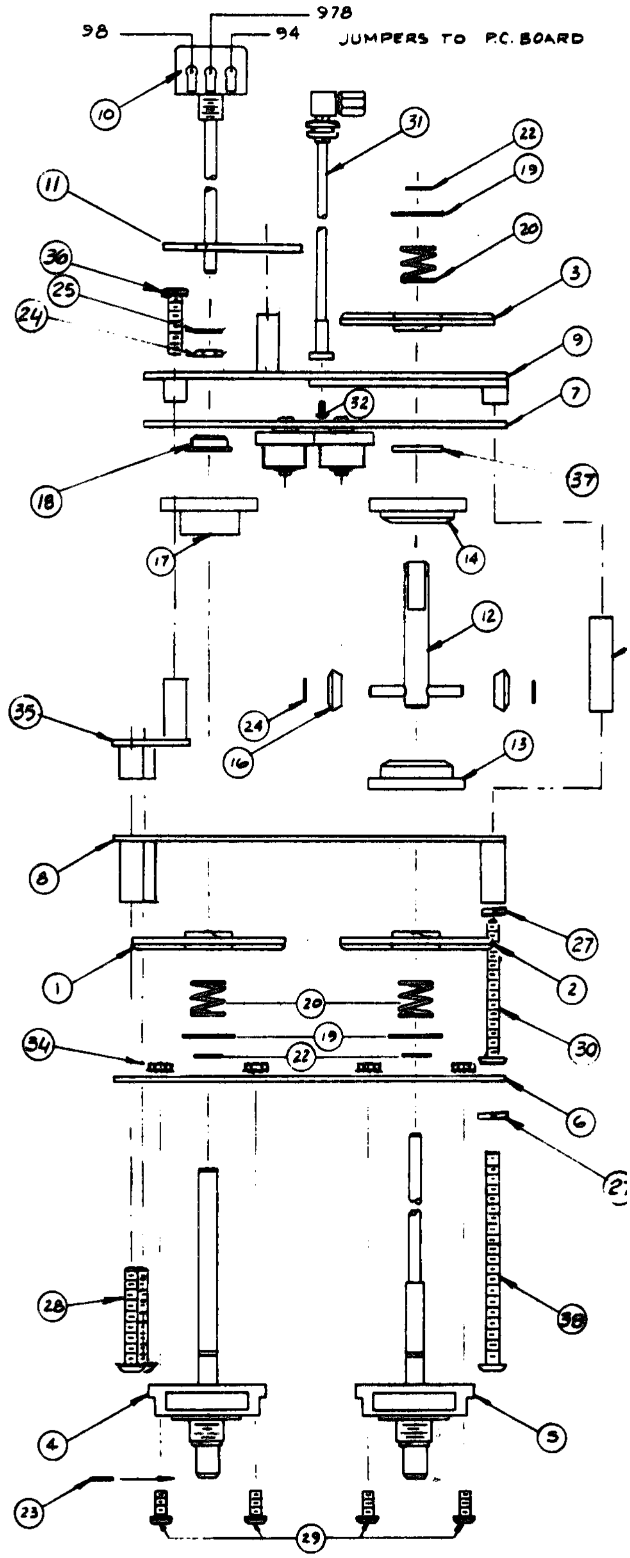


Figure 8-86. A9A1 *Switch Assembly Illustrated Parts Breakdown (P/O Change 7)*

CHANGE 7 (Cont'd)

A9A1 Switch Assembly Legend

Item Number	Reference Designator	Item Number	Reference Designator
1	A9A1MP31	22	A9A1MP3–5
2	A9A1MP30	23	A9A1MP6
3	A9A1MP28	24	A9A1MP7, 8
4	A9A1MP22	25	A9A1MP41
5	A9A1MP21	26	A9A1MP40
6	A9A1MP23	27	A9A1MP39
7	A9A1MP24	28	A9A1MP38
8	A9A1A1	29	A9A1MP37
9	A9A1A2	30	A9A1MP36
10	A9A1R1	31	A9A1W1
11	A9A1MP25	32	A9A1MP35
12	A9A1MP28	33	Not Assigned
13	A9A1MP12	34	A9A1MP34
14	A9A1MP13	35	A9A1MP26
15	Not Assigned	36	A9A1MP33
16	A9A1MP10,11	37	A9A1MP17
17	A9A1MP9	38	A9A1MP32
18	A9A1MP27		
19	A9AlMP18–20		
20	A9A1MP14–16		
21	A9A1MP1, 2		

A9 Assembly Removal Procedure

1. Set PEAK DEVIATION, and RANGE switches four positions ccw from full CW.
2. Place instrument upside down and remove bottom cover (see Service Sheet G).
3. Disconnect gray coaxial cable A9A1W1 from A7 FM Shaper Assembly.
4. Disconnect A9A2 Interconnect Assembly from switch.
5. Loosen two setscrews on coupler at the RANGE switch shaft. Do not disturb coupler at the A10 Divider/Filter Assembly shaft.
6. Remove PEAK DEVIATION, RANGE and FM vernier knobs. The knobs are secured to their shafts with allen setscrews.
7. Remove two nuts and lockwashers that secure the switch assembly to front panel.
8. Lift assembly from instrument.
9. Remove coupler from RANGE switch shaft only.
10. Disconnect 30-pin edge connector A9A2P1 from the mother board.

CHANGE 7 (Cont’d)

A9 Assembly Removal Procedure (cont’d)

11. Reinstall switch assembly besetting both switches four positions ccw from full cw(the Divider/Filter shaft should also be in this position) and by reversing the procedures in steps one through ten.

NOTES

The detents of both A9 and A 10 assembly switches must align and correspond to the same positioAs. Check that the actual RF output frequency agrees with the counter indication on all bands.

Adjust the coupler for minimum binding and tighten the’ setscrews very securely.

CHANGE 8

Page *1-9*, Table 1-1:

Under **SPECTRAL PURITY,** make the folLOWING changes to the **Harmonics** specification,
Delete >35 dB below fundamental of 0.5 to 128 MHz.
Change “128 to 512 MHz” to “0.5 to 512 MHz”.

Page 1-10, Table 1-1:

Under **MODULATION CHARACTERISTICS, General,** make the following changes to the specification for **Optional:** (Internal Variable Audio Oscillator, Option 001).
In the Frequency specification, change ±10% to ±15%.
In the Total Harmonic Distortion specification, change “600 kHz” to “200 kHz”, and add the following:
“<2.0’%, 200 kHz to 600 kHz.”

Pages 4-21, thru 4-23, paragraph 4-19:

Under SPECIFICATIONS, make the following changes:
Delete >35 dB below fundamental of 0.5 to 128 MHz.
Change “128 to 512 MHz” to “0.5 to 512 MHz”.
Change 35 dB to 30 dB in steps 2,3 (two places), and 4 (seven places).

Pages 4-53 and 4-55, paragraph 4-32:

Under SPECIFICATION, make the following change to Option 001, Frequency.
Change ±1O% to ±15%.
In step 4, change ±10% to ±15%.

Pages 4-55 and 4-56, paragraph 4-33:

Under SPECIFICATION, change “600 kHz” to “200 kHz” and add the following:
"<K2.0% 200 kHz to 600 kHz”.
In step 2, change “600 kHz” to “200 kHz” end add the following
“200 kHz to 600 kHz, ____________ <2.0%”.

Page 4-95, Table 4-4:

Under paragraph number 4-19, change 35 dB to 30 dB (eightplaces).

Page 4-99, Table 4-1:

Under paragraph number 4-33, change “600 kHz” to “200 kHz”, and add the following:
“200 kHz to 600 kHz, ______________2.0%”.

Page 6-5, Table 6-3:

Add AlMP13 5040-0327 HOOD, CONNECTOR,

CHANGE 8 (Cont'd)

Page 6-36, Table 6-3:
Change A26A2R35 to 0698-3447 RESISTOR; FXD, 422 OHM 1% 0.125 W F TUBULAR.
Add A26A2R40 0698-3157 RESISTOR; FXD, 19.6K 1% 0.125 W F TUBULAR.

Service Sheet 13 (schematic):
Make the following changes to the A26A2 assembly.
Change +35 to **422Ω**.
Add R40, 19.6K, between the collector of Q9 and ground.

CHANGE 9

Page 6-25, Table 6-3:
Change A11C24 to 0160-2199 CAPACITOR; FXD; 30 pF ±5% 300 WVDC.

Service Sheet 9A (schematic):
Change A11C24 to 30 pF.

CHANGE 10

Page 6-13, Table 6-3:
Add A8MP47 08640-00100 INSULATOR, RF SCALER.
Add A8MP48 08640-00102 INSULATOR, COUNTER TIME BASE,

Page 6-23, Table 6-3:
Change A10A2R58 to 0698-3243 RESISTOR FXD 178K 1% 0.125 W F TUBULAR.

Service Sheet 11 (schematic):
Change resistor A10A2R58 to 178K.

CHANGE 11

Pages 5-14 thru 5-16, paragraph 5-30:
Under REFERENCE, delete service sheet 16.
Under DESCRIPTION, delete all except the first sentence and Note 1.
In Figure 5-2, delete 10 dB step attenuator, 20 dB amplifier and double-shielded cables.
Under EQUIPMENT, delete the spectrum analyzer, 20 dB amplifier and double-shielded cables.
Under PROCEDURE, delete steps 4 thru 11.

Page 6-6, Table 6-3:
Change part number for A3Q1 to 5086-4282 (see note).

Page 6-30, Table 6-3:
Delete A19A2R7 and R8.

Service Sheet 5 (schematic):
Change part number for A3Q1 to 5086-4282.

NOTE

Transistor 5086-4282 is *the recommended replacement for A3Q1 in instruments with serial number prefixes below 1535A also.*

CHANGE 11 (Cont'd)

Service Sheet 16 (Principles of Operation):
Under **Meter Attenuator and Odd Range Code (Al, Al 9A2),** delete the fourth sentence.

Service Sheet 16 (schematic):
Delete resistors A19A2R7 and R8, and associated wiring. On switch A19SlBF/R, connect switch terminals 7 and 9 to terminal 6.

CHANGE 12

Page 6-14, Table 6-3.
Add: A8A2C27, 0140-0205, CAPACITOR-FXD 62PF±5% 300WVDC MICA.

Page 6-15, Table 6-3.
Change A8A2U6 and U25 to 1820-1322, IC-SN74S02N, GATE

Service Sheet 20 (Schematic)
Add: C27, 62 pF between A8A2U13D pin 11 and ground.
Change A8A2U6 and U25 to 1820-1322.

CHANGE 13

Page 6-23, Table 6-3:
Change A1OA2U1 to 1826-0303.

Service Sheet 11 (schematic):
Change part number for A1OA2U1 to 1826-0303.

CHANGE 14

Page 5-3, Table 5-1:
Delete A11R28 (Option 001).

Pages 5-9 and 5-11, paragraph 5-27:
Under EQUIPMENT, add the following instruments.
Distortion Analyzer HP333A
Oscilloscope . . . . HP 180A/1801A/1820C

Change step 12 to read as follows.

12. If level at AllTP4 is too high, adjust A11R28 ccw (reduce resistance); if level is too low, adjust A11R28 cw (increase resistance). Then repeat steps 8 through 11.

Add the following steps after step 16.

16a Set MODULATION FREQUENCY controls to 600 kHz. Connect distortion analyzer to front panel AM OUTPUT connector. Calibrate distortion analyzer and measure distortion. Distortion analyzer should indicate leas than 2%.

16b. Set MODULATION FREQUENCY controls to 20 Hz. Connect oscilloscope to AM OUTPUT connector. Set AM switch alternately between OFF and INT. The envelope of the audio signal displayed on the oscilloscope should stabilize within a few seconds after AM is switched to INT.

16C. If distortion or AM stability is incorrect, adjust A11R28 ccw (reduce resistance) for less distortion or cw (increase resistance) for better stability.

NOTE

Adjustment is correct when distortion and stability areas described in steps 16a and 16b. Measurement results recorded in preceding steps may have changed (perhaps beyond stated limits) after reajusting A11R28.

CHANGE 14 (Cont'd)

Page 6-6, Table 6-3:
Change part number for A3MP9 to 08640-20267.
Delete A3MP13.

NOTE

Transistor cap 08640-20267 is the single recommended replacement for A3MP9 and A3MP13 in instruments with serial number prefixes below 1544A

Page 6-26, Table 6-3:
Change A11R28 to 2100-2574 RESISTOR; VAR; TRMR; 500 OHM 10'% C.

Service Sheet 9A (schematic):
Delete asterisk (*) at Al1R28 and change the symbol to a potentiometer whose wiper is connected to the junction of A11R28 and A1lRT1.

CHANGE 15

Pages 6-16 and 6-17, Table 6-3:

Change A8A3R10 and R17 to 0698-0083 RESISTOR, FXD 1.96K 1% 0.125W F TUBULAR
Change A8A3U1O, Ull, U16 and U17 to 1820-1490.
Change A8A3U13, U14 and U15 to 1820-1429.

NOTE

The parts listed above are the recommended replacements for A8A3R1O, R17, U1O, Ull and U13 thru U17 in instruments with serial number prefixes below 1545A.

Page 6-23, Table 6-3:
Delete A1OA2R38 and R39.

Service Sheet 11 (schematic):
Delete resistors A1OA2R38 and R39.

Service Sheet 19 (schematic):
Make the following changes to the A8A3 assembly.

Change R1O and R17 to 1960 ohms
Change part numbers for U1O, Ull, U16 and U17 to 1820-1490,
Change part numbers for U13, U14 and U15 to 1820-1429.

CHANGE 16

Page 6-11, Table 6-3:
Change A7R28 to 0757-0465, RESISTOR, FXD, lOOK, l%J, 0.125W F TC-O±1OO
Change A7R45 to 0698-3159, RESISTOR, FXD, 26.lK, 19%, 0.125W F TC=O±100

NOTE

For instruments with serial prefixes below 1552A, the recommended replacement for A7R28 is 0757-0465 and for A7R45 is 0698-3159. For instruments not already modified as above, it will be necessary to replace both A7R28 and A7R45 the first time either resistor is replaced,

CHANGE 16 (Cont'd)

Page 5-3, Peragraph 5-21 (cent'd)

c. Compute the value of A5R42 using the following formula: A5R42 - $\frac{36}{40-(2.405)fnull.}$

where: A5R42 is in k ohms and fnull is the frequency in kHz where the null (at least 60 dB) occured.

d. Choose the next lowest standard resistance value and solder it between pins 11 and 12 of the A5 FM Amplifier circuit board.

e. Perform the FM Sensitivity Adjustment.

Page 5-3, Table 5-1:
Make the following addition to the table:

Component	Service Sheet	Range of Values	Basis of Selection
A5R42	6	10 kΩ to infinite	See paragraph 5-21

Page 6-10, Table 6-3:
Add A5R42 RESISTOR NORMALLY NOT LOADED

Page 6-11, Table 6-3:
Change A7R28 to 0757-0465, RESISTOR, FXD, 100K, 1%, 0.125W F TC-O±1OO
Change A7R45 to 0698-3159, RESISTOR, FXD, 26.lK, 1%, 0.125W F TC-0±t100

NOTE

For instruments with serial prefixes below 1552A, the recommended replacement for A7R28 is 0757.0465 and for A7R45 is 0698-3159. For instruments not already" modified as above, it will be necassary to replace both A7R28 and A7R45 the first time either resistor is replaced.

Pages 6-13 through 6-15, Table 6-3:
Change A8A2C4 to 0180-0374, CAPACITOR, FXD, 10UF, ±1O%, 20WVDC
Change A8A2C12 to 0160-2207, CAPACITOR, FXD 900PF ±5%, 900WVDC
Add A8A2C32, 0180-0374, CAPACITOR, FXD 10UF ±1O% 20WVDC
Add A8A2C33 0160-03877 CAPACITOR, FXD, 100PF ±20% 200WVDC CEIL
Change A8A2R17, 0698-7277, RESISTOR, FXD 51.lK 2% 0.05W F TC-O±1OO
Change A8A2R19, 0698-7270, RESISTOR, FXD 26.lK 2% 0.05W F TC-O±1OO
Delete A8A2R68
Add A8A2R59, 0698-7281, RESISTOR, FXD 75K 2% 0.05W F TC-O±1OO
Add A8A2R60, 0698-7188, RESISTOR, FXD 10 2% 0.05W F TC-O±1OO
Add A8A2R61, 0698-7243, RESISTOR, FXD 1.96K 2% 0.06W F TC-O±1OO
Add A8A2R62, 0698-00
Change A8A2U20-24 and U28 and1820-1684.

NOTE

In instruments with serial prefixed below 1552A, the recommended replacement for A8A2U20-24 and U28 is 1820.1684. If not already present, C33 must be added when these parts are installed

Service Sheet 6 (Schematic):
Add a resistor A5R42* from A5TP4 to ground with a nominal value of 19.6k Ohms.

Service Sheet 7 (Schematic):
Change A7R28 to 100K.
Change A7R45 to 26.1K.

CHANGE 16 (Cont'd)

Service Sheet 20 (Schematic).
Change A8A2C12 to 300pF.
Delete the line between A8A2U16B pins 4 and 5.
Add a line from A8A2U16B pin 4 to +5.2V.
Change the part number for A8A2U20-24 and U28 to 1820-1684.

Service Sheet 21 Figure 8-68 with attached figure.

P/O A8A2 ASSEMBLY

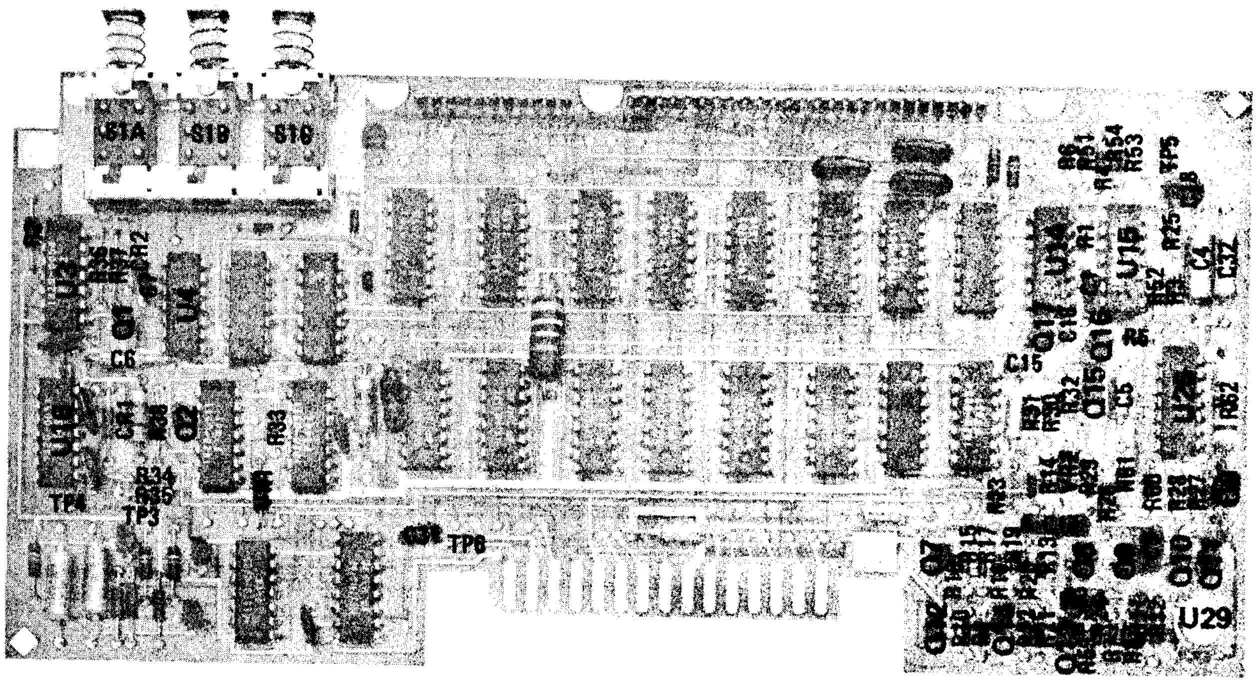
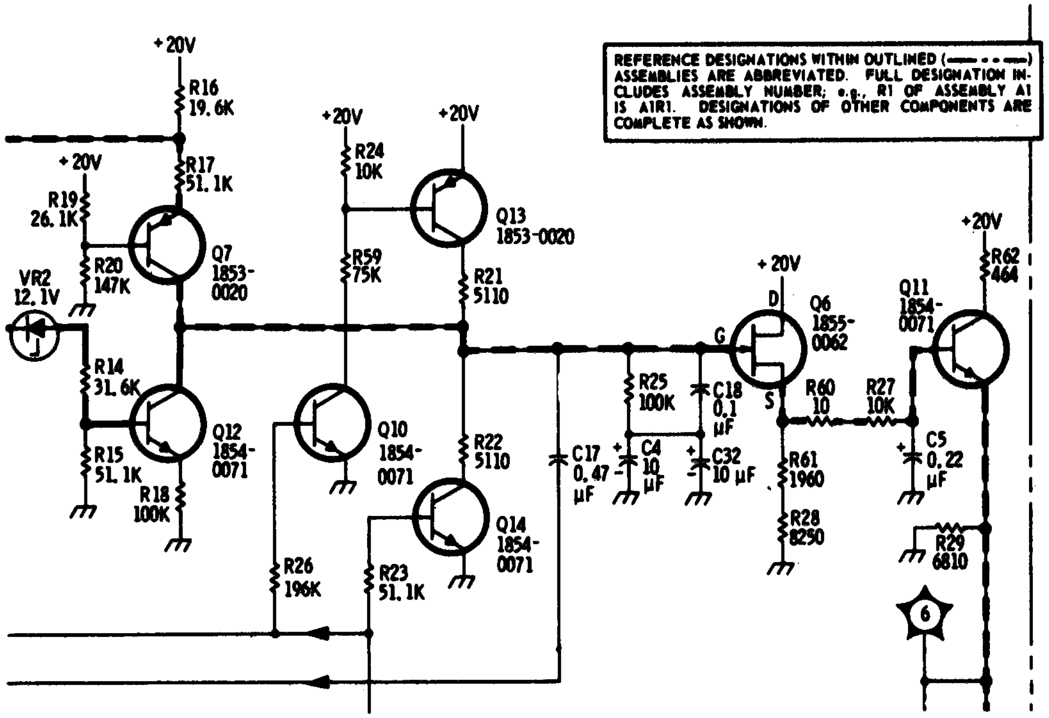


Figure 8-68. P/O A8A2 Counter/Lock Board Assembly, Component Locations {P/O Change 16)

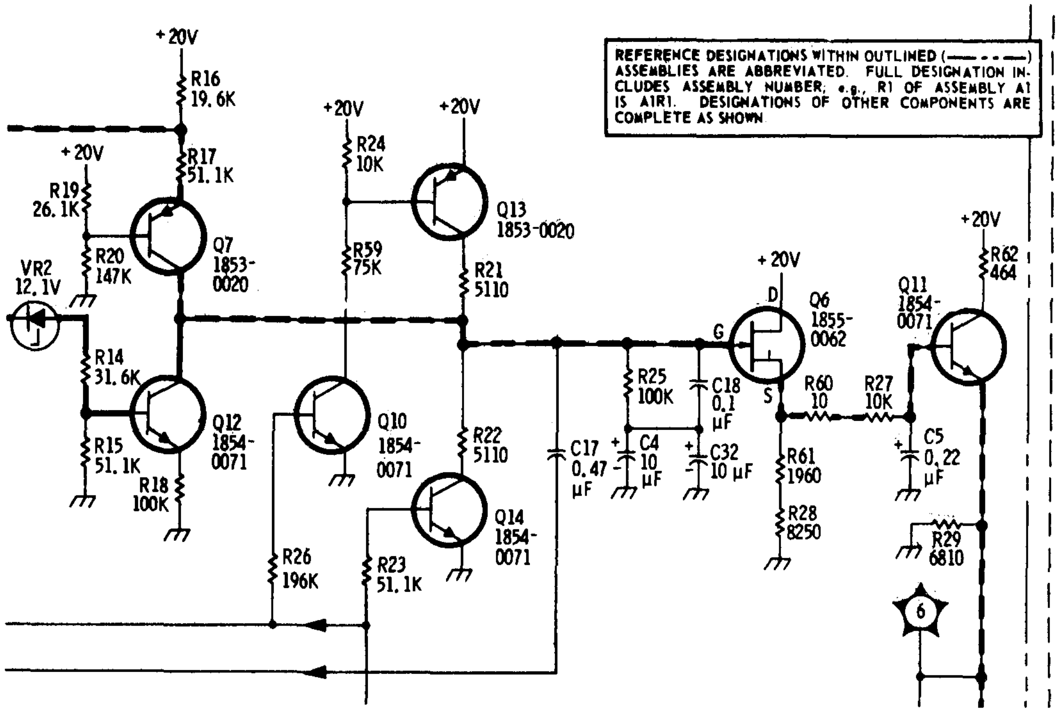
Service Sheet 21 (Schematic).
Replace appropriate portion of schematic with attached partial schematic.

CHANGE 16 (Cont'd)



P/O Figure **8-69.** *Counter Phase Lock Circuits Schematic Diagram (P/O Change 16).*

CHANGE 16 (Cont'd)



P/O Figure 8-69. ***Counter Phase Lock Circuits Schematic Diagram (P/0 Change 16).***

CHANGE 17

Page 6-29, Table 6-3:
Change A14 to 0960-0443 LINE MODULE WITH FILTER, BLACK.

NOTE

For instruments with serial number prefixes below ***1607A,*** the recommended replacement for the A14 LINE MODULE is 0960-0443.

Service Sheet 22 (Schematic):
Change the part number for A14 to 0960-0443.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains instructions for troubleshooting and repairing the Hewlett-Packard Model 8640B Option 004 Signal Generator.

8-3. principles of operation and troubleshooting . information are. located opposite the schematics on the foldout Service Sheets. The last two foldouts in this manual have top and bottom internal views of the instrument' showing the locations of the major assemblies and some of the chassis parts. Also included are top and bottom internal views with the covers removed from the castings; these views show the locations of the sub-assemblies, the adjustments, and most of the instrument's test points. The last foldout also shows a rear panel view of the instrument.

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. PRINCIPLES OF OPERATION

8-6. 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 detailed block diagrams. They provide an assembly-by-assembly description of instrument operation.

8-7. The detailed block diagrams, in turn, are keyed to the schematics on the Service Sheets that follow them. These Service Sheets provide a stage-by-stage description of the circuits on the schematics. The stages are keyed to the descrip tions by the stage names that appear on the schematics.

NOTE

Table 8-3, Schematic Diagram Notes, explains any unusual symbols that appear on the schematics. The table also explains the switch-wafer numbering system.

8-8. TROUBLESHOOTING

8-9. 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.

8-10. Overall Troubleshooting. The second, and primary, troubleshooting method is to use the overall block diagram (found on Service Sheet 1) and the troubleshooting block diagrams that follow it to isolate a problem to a particular assembly or circuit. The troubleshooting information on Service Sheet 1 explains how to use the block diagrams.

8-11. Circuit-Level Troubleshooting. Once a problem has been isolated to a particular assembly or circuit, the text and a table on the service sheet that documents that circuit give detailed troubleshooting information for the circuit.

8-12. RECOMMENDED TEST EQUIPMENT

8-13. Test equipment and test equipment accessories required to maintain the Signal Generator are listed in Tables 1-2 and 1-3. **Refer to the** MAC in Appendix D for Army test **test equipment requirements.**

8-14. SERVICE AIDS

8-15. Posidriv Screwdrivers. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Posidriv screwdrivers should be used.

8-16. 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.)

lSMC Adapter . . . . HP 1250-0827

2 Test Cables SMC to BNC . . HP 11592-60001

1 Extender Board -20 pins . . . HP 5060-0256

2 Bumpers (for Board) . . . . HP 0403-0115

8-17. Hardware Kit. The HP 08640-60095 Hardware Kit contains miscellaneous mechanical spare parts for the generator - such things as nuts, bolts, screws and washers.

8-18. Extender Board. An extender board is supplied with the generator that can be used to extend all circuit boards (except the A1OA2 RF Divider Assembly and the A12 Rectifier Assembly) that are not accessible by removing a casting cover. The RF Divider Assembly is self-extending - just remove the riser board and insert the RF Divider Assembly into the riser's slot. Figure 8-1 shows the extender board in use and the RF Divider Assembly extended.

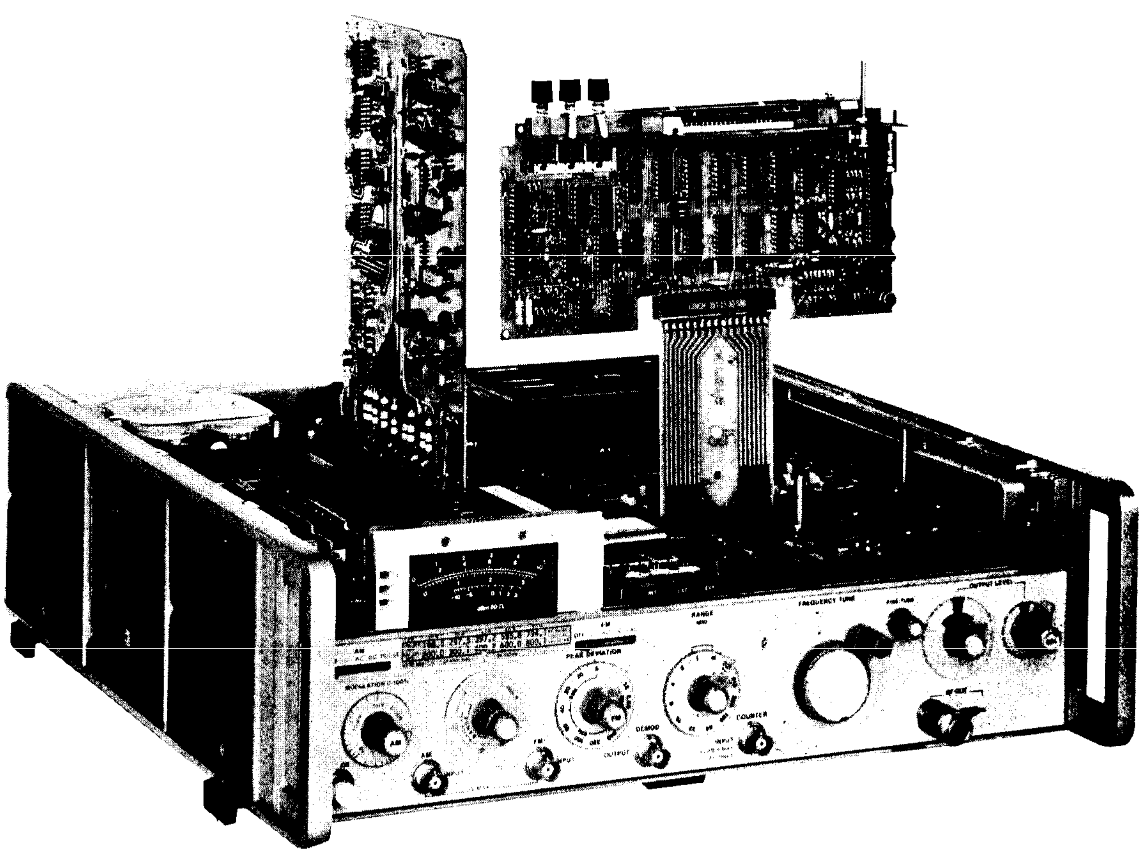


Figure 8-1. Signal Generator with Circuit Boards on Extenders

8-19. Wrench. A wrench is supplied with the. generator with one end that fits the SMC connectors used on the generator's RF cables and the other end that fits another common SMC connector that may be used in servicing.

8-20. Spare Fuses. The plastic box mounted on the chassis filter capacitors contains spare fuses for the power supply voltage regulators.

8-21. Part Location Aids. The locations of some chassis-mounted parts and the major assemblies are shown on the last two foldouts in this manual. 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, A6R9 is R9 on the A6 assembly). For specific component description and ordering information refer to the parts list in Section VI.

8-22. Servicing Aids on Printed Circuit Boards. The servicing aids include test points, transistor and integrated circuit designations, adjustment callouts and assembly stock numbers.

8-23. REPAIR

8-24. Factory Selected Components

8-25. 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 cm individual schematics by an asterisk (*). The recommended procedure for replacing a factory-selected part is as follows:

a. Try the original value, 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.

8-26. Etched Circuits

8-27. 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.

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. (Avoid getting flux remover on the printed circuit board extractors.) See Table 8-1 for recommendation.

8-28. Etched Conductor Repair

8-29. 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.

8-30. Component Replacement

8-31. 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 t component one turn around original leads. Solder wrapped connection and clip off excess lead.

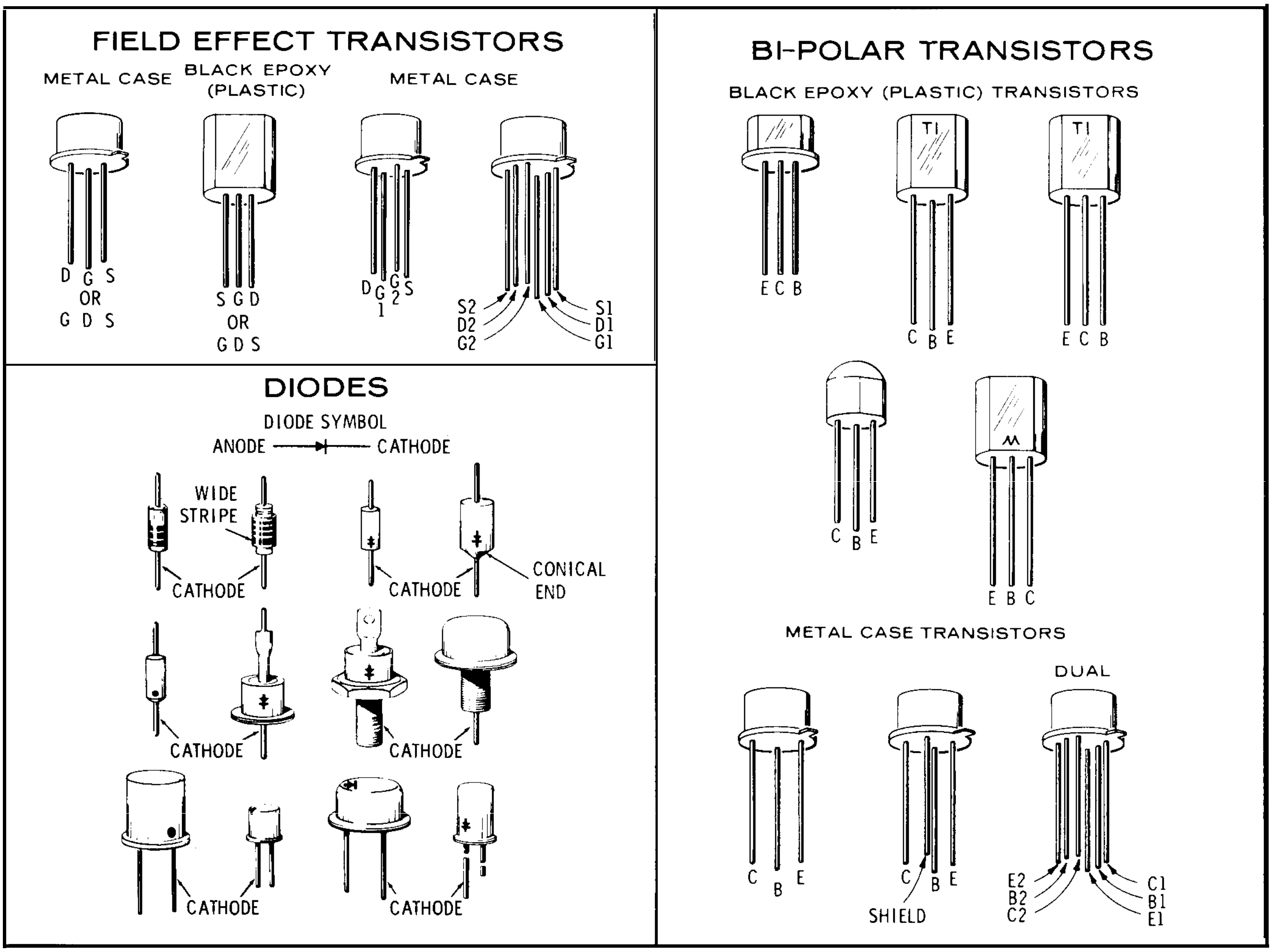


Figure 8-2. Examples of Diode and Transistor Marking Methods

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 (AWG) 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.

8-32. 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.

8-33. 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.

8-34. 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.

8-35. 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 Coming No. 5 silicone compound or equivalent before fastening the transistor to the chassis. Dow Coming No. 5 compound is available in 8 oz. tubes from Hewlett-Packard; order HP Part No. 8500-0059.

8-36. 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 t instructions are the same as those listed for transistor replacement.

8-37. Illustrated Parts Breakdowns

8-38. Illustrated parts breakdowns for the generator's major assemblies are given on Service Sheets A through F. They are keyed to disassembly and removal instructions (given on the alphabetical service sheets) and to the replaceable parts list given in Section VI.

8-39. BASIC CIRCUIT THEORY

8-40. Binary Circuits and Symbols

8-41. Introduction. The binary circuits and symbols used in this manual are as shown in Figure 8-3. This instrument uses three different families of logic circuits: TTL, ECL, and EECL. Most of the logic devices used in this instrument are TTL; there are notes on the Service Sheets that indicate what families the non-TTL devices belong to. Table 8-2 indicates the voltage levels that are associated with each family. The table also shows the effect that an open and a ground has. on each family.

8-42. In general, binary signals that are active-low are indicated with an L in parenthesis (e.g., CLOCK(L) indicates a clock signal that is active-low). Active-high signals are indicated with an H in parenthesis. A circle at an input indicates that it is active-low or triggers on a low-going edge; a circle at an output indicates inversion or that the output is active-low. Active-high inputs, inputs which trigger on a high-going edge, and active-high ouputs are shown without the circle. Complementary outputs are usually designated with a not-bar (e.g., the complement of J/K flip-flop's Q output is its $\overline{Q}$ output). Both Q and may be simultaneously high in some instances (e.g., when both SET and CLEAR are low on some D flip-flops).

NOTE

The term "binary coded decimal" (or BCD) refers to four-bit binary circuits that range from decimal O to 9 in 8421 code.

The term "binary", when applied to four-bit binary circuits, refers to circuits that range from decimal O to 15 in 8421 code.

8-43. Trigger (T) inputs are usually high-going (edge sensitive) unless there is a circle at the input (which would make them low-going). All other inputs are usually level sensitive.

8-44. Open Collector TTL. Some TTL gates have open collector outputs. This feature is indicated by a note on the Service Sheet. In open collector logic the output stage is an NPN transistor with the emitter grounded and the collector connected directly to the output terminal (with no internal pull-up resistor or transistor) as shown in Figure 8-4. The output is low when the output transistor is saturated and is high when the transistor is off. (However, the output can only be high when the collector is connected to the positive supply through an external pull-up resistor). Open collector gates are often used to switch in non-TTL devices such as lamps, relays, and capacitors.

Table 8-2. Logic Levels

Logic Voltage Levels

LOGIC	TTL	ECL	EECL
High (1) Low (0)	$\geqslant$ 2V $\leqslant$ 0.8V	$\geqslant$ −0.5V $\leqslant$ −1.5V	$\geqslant$ −0.1V $\leqslant$ −0.6V
< = more negative than > = more positive than			

Input Conditioning

INPUT	TTL	ECL	EECL
Grounded Open	Low (0) High (1)	High (1) Low (0)	High (1) Low (0)
Ground = OV			

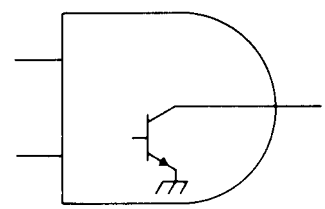
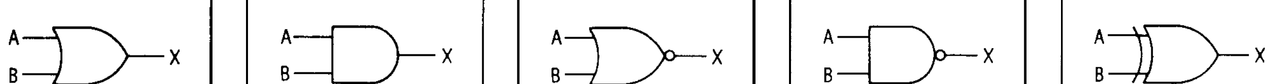


Figure 8-3. Open Collector Output Stage (AND Gate)

BINARY SYMBOLS



OR: X=A+B

A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

AND: X=A•B

A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

NOR: X=$\overline{A+B}$

A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

NAND: X=$\overline{A \bullet B}$

A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

EXCLUSIVE-OR: X=A•$\bar{B}$+$\bar{A}$•B OR X=A⊕B

A	B	X
H	H	L
H	L	H
L	H	H
L	L	L

Figure 8-4. Binary Symbols

8-45. Triggered Flip-Flop. There are two kinds of triggered flip-flops. The bistable triggered flip-flop toggles (changes states) each time the trigger input (T) changes states (shown in Figure 8-5). This effectively divides the input by two, giving one output pulse at the Q output for every two input pulses.

8-46. The nonostable triggered flip-flop's Q output goes high when triggered by the T input. However, after a set amount of time (determined either by the flip-flop's configuration or unless retriggered) the Q output automatically y returns to its original state. The monostable flip-flop (or one shot) is used to stretch or shape pulses.

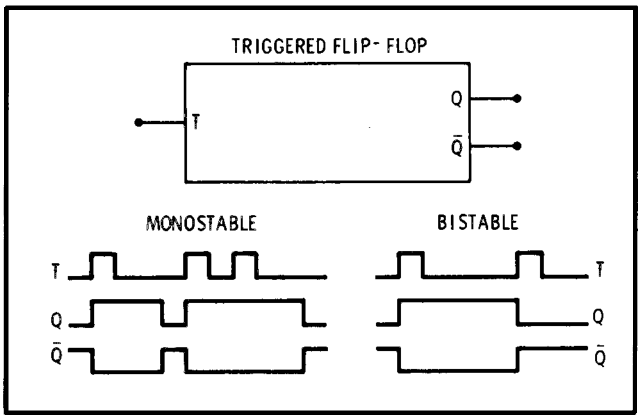


Figure 8-5. *Triggered Flip-Flop*

8-47. D Flip-Flop. The D-type flip-flop, shown in Figure 8-6, is used as a storage latch or buffer. The information at the data input (D) is transferred to the Q output when the trigger input (T) is high-going. Once the T input has passed its threshold, the D input is locked out and the Q outputs do not change until another high-going transition occurs at the T input.

8-48. The set (S) and clear (CLR) inputs override all other input conditions: when set is low, the Q output is forced high; when clear is low, the Q output is forced low. Although normally the $\overline{Q}$ output is the compliment of the Q output, simultaneous low inputs at S and CLR will force both Q and $\overline{Q}$ high on some D flip-flops.

8-49. Schmitt Trigger. A typical Schmitt Trigger is shown in Figure 8-7. Some Schmitt triggers have complementary outputs. The device initially triggers when the input signal passes a voltage reference called the upper trip point. It triggers back into its initial state when the input voltage passes a voltage reference called the lower trip point. One or both trip points may be indicated.

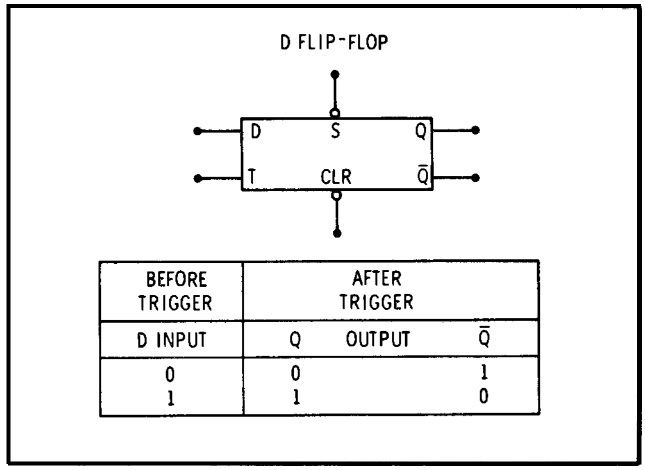


Figure 8-6. D Flip-Flop

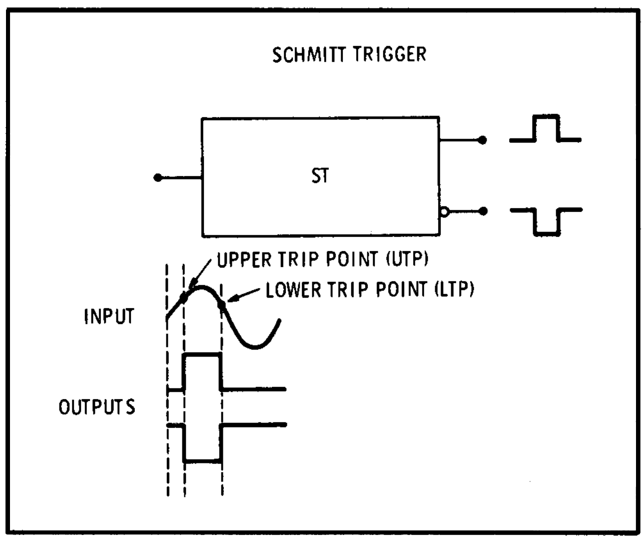


Figure 8-7. Schmitt Trigger

8-50. J/K Flip-Flop. Figure 8-8 shows a typical J/K flip-flop. The trigger-(T) input is activated by a low-going signal as indicated by the circle on the symbol. Flip-flop response is determined by the values of the J and K inputs at the instant that a low-going signal is applied to the trigger input:

a. When J and K are low, the Q outputs will not change state.

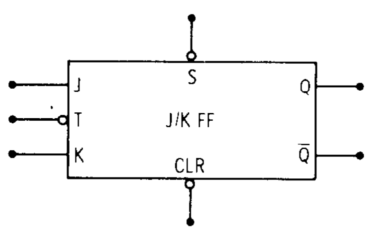
b. When K is high and J is low, Q will go low (unless it is already low).

c. When K is low and J is high, Q will go high (unless it is already high).

d. When K and J are both high, the flip-flop will toggle. That is, if Q is high, the trigger pulse will set Q low, and if Q is low, the trigger pulse will set Q high. If K and J are connected together the J/K flip-flop produces a divide-by-two output.

8-51. The set (S) and clear (CLR) inputs override all other input conditions: when S is low, Q is forced high; when CLR is low, Q is forced low. Although normally the $\overline{Q}$ output is the compliment of the Q output, simultaneous low inputs at S and CLR will force both Q and $\overline{Q}$ high on some J/K flip-flops.

J/K FLIP-FLOP



J	K	OUTPUT AFTER TRIGGER Q	$\overline{Q}$
0	0	NO CHANGE	
0	1	0	1
1	0	1	0
1	1	TOGGLES	

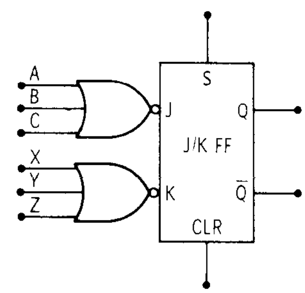
Figure 8-8. J/K Flip-Flop

8-52. Multiple Input J/K Flip-Flop. A multiple input J/K flip-flop is shown in Figure 8-8. It behaves like a J/K flip-flop with NORed inputs: if A, B and C are low, J is high, if A, B or C is high, J is low. A J-related and a K-related input may be tied together to form a trigger input; in this case the trigger would be active-low (if all other inputs are low).

8-53. Binary Registers

8-54. Binary Latch. The four bit binary register shown in Figure 8-10 is used as a storage latch. Information data (Dn)* inputs is transferred to the respective Q_n* outputs when the enable (EN) input is low. When the enable goes high, the outputs are latched and are no longer affected by the data inputs.

MULTIPLE INPUT J/K FLIP-FLOP



A	X	Q	$\overline{Q}$
0	0	TOGGLES	
0	1	1	0
1	0	0	1
1	1	NO CHANGE	
B, C, Y and Z = 0			

Figure 8-9. Multiple Input J/K Flip-Flop

8-55. When enabled, any output may be set (to a high) by a low on the respective set (Sn) input which overrides the data input. When not enabled, the set inputs have no effect on the outputs.

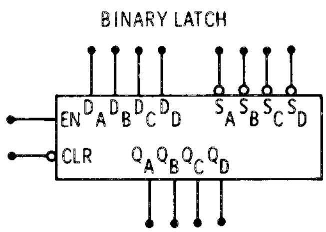
8-56. A low on the master clear (CLR) input overrides all other conditions and forces all outputs low.

8-57. Binary Shift Register. A five bit binary shift register is shown in Figure 8-11. Information of the data (Dn)* inputs is transferred to the respective Qn * outputs when the load (LD) input is high. The load input is independent of the clock (T) input.

8-58. If the load input is low, a high going clock pulse shifts the output to the next adjacent output (e.g., the output at Q_B now appears as the output of Qc). Also, the input state at the serial (SER) input appears at the Q_A output.

*n= A, B. C, or D

8-59. A low at the clear (CLR) input clears all outputs to a low independent of the clock. The clear input overrides the load input.



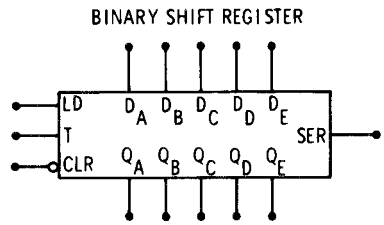
BEFORE CLOCK	AFTER CLOCK
INPUT D_n	OUTPUT Q_n
0	0
1	1

Figure 8-10. Binary Latch

8-60. Decade Counters and Symbols

8-61. Basic Counter. The basic decade counter (or scaler or divider), shown in Figure 8-12, has ten logic states. The active-high outputs (QA, QB, Qc, and QD) increment by one BCD count each time the trigger (TA) or clock input goes from a high to a low. The count sequence is also shown in the file. The counter may be subdivided into a divide-by-two and a divide-by-five counter. The two counters are connected in series (the QA output connected to the TBD input) to obtain a divide-by-ten counter. The counter has two ANDed clear or reset-to-zero (RO) inputs. When both RO inputs are high, the outputs clear to zero. The clear function overrides the clock. Similarly, the two ANDed set or reset-to-nine (R9) inputs set the outputs to the nine count. If all reset-to-zero and reset-to-nine inputs are simultaneously high, the reset-to-nine overrides the reset-to-zero.

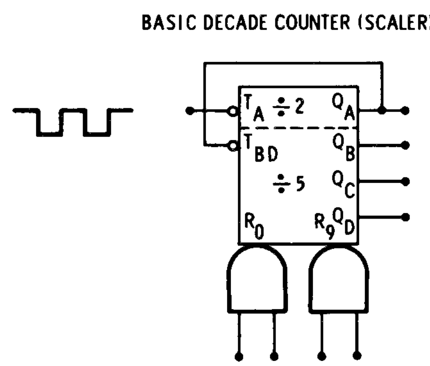
8-62. Programmable Counter. The programmable decade counter, shown in Figure 8-13, operates similarly to the basic decade counter when the load (LD) input is high. The counter shown has only a single clear (CLR) input which is active-low. When the load input is low, the information at the data (or preset) inputs (DA, DB, Dc, and DD) is transferred to the outputs at the next high going clock (T) input. The outputs remain in the preset state until the load input returns to a high and the trigger (T) or clock input again goes high -at which time the count increments by one. The counter may be preset to a count greater than nine, but in such cases the count proceeds as shown in the state diagram.



OUTPUT	OUTPUT STATE BEFORE CLOCK	OUTPUT STATE AFTER CLOCK
Q_A	A	SER *
Q_B	B	A
Q_C	C	B
Q_D	D	C
Q_E	E	D

* The state of the serial (SER) input

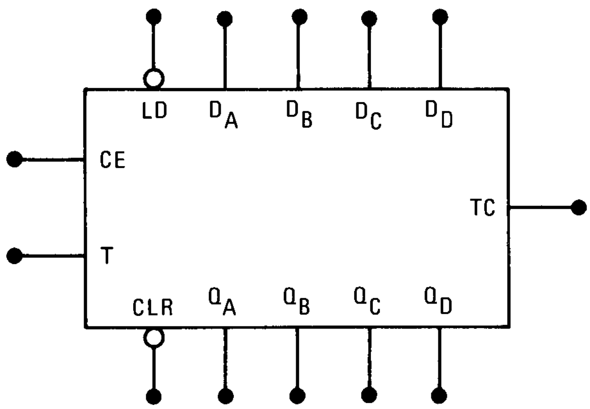
Figure 8-11. Binary Shift Register



COUNT T_A	OUTPUT Q_D	Q_C	Q_B	Q_A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

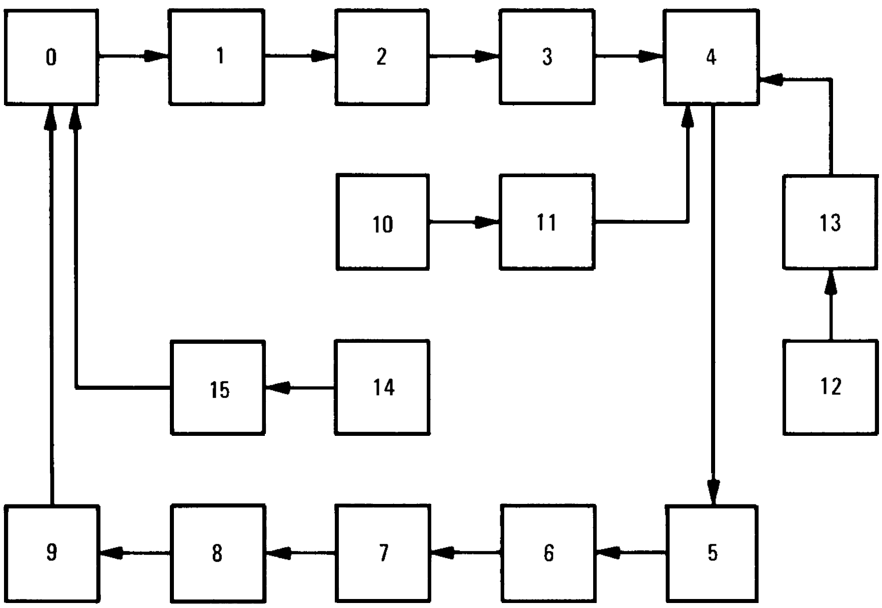
Figure 8-12. Basic Decade Counter (Scaler)

PROGRAMMABLE COUNTER



T = TRIGGER
CE = COUNT ENABLE
LD = LOAD
$D_A \ldots D_D$ = DATA INPUT
CLR = MASTER CLEAR
$Q_A \ldots Q_D$ = DATA OUTPUT
TC = TERMINAL COUNT (9 COUNT AND CE)

BINARY STATE DIAGRAM



COUNT	Q_D	Q_C	Q_B	Q_A	COUNT	Q_D	Q_C	Q_B	Q_A
0	0	0	0	0	5	0	1	0	1
1	0	0	0	1	6	0	1	1	0
2	0	0	1	0	7	0	1	1	1
3	0	0	1	1	8	1	0	0	0
4	0	1	0	0	9	1	0	0	1

Figure 8-13. Programmable Counter

8-63. If the counter has a count enable (CE) input, it must be held high for successive T inputs to cause the counter to increment (or count). When the counter reaches the nine count, a high at CE causes a terminal-count or carry (in this case, a high) to appear at the carry (TC) output.

8-64. A low on the clear (CLR) input clears all outputs to a low independent of any other input conditions.

8-65. Programmable Up/Down Counter. The programmable up/down counter, shown in Figure 8-14, operates similarly to the programmable counter (which could be called a programmable up counter). The up/down counter has two trigger or clock inputs, count up (CU) and count down (CD). A low-to-high transition of either count input (while the other count input is held high) increments the count by one. If both CU and CD are high, the count does not increment.

8-66. The counter's outputs (Q_A, Q_B, Q_C, and Q_D) can be set to any count from zero to fifteen by entering the count at the data inputs (D_A, D_B, D_C, and D_D) while the load input (LD) is held low. Then the count can be incremented up or down by activating either the CU or CD input.

8-67. The borrow (BRW) output is low whenever the Q outputs are at BCD zero (0000). The carry (CRY) output is low whenever the Q outputs are at BCD nine (1001). The master clear input (CLR) overrides all other input conditions and forces the Q outputs to BCD zero.

8-68. Linear Integrated Circuits

8-69. Operational Amplifier. Figure 8-15 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.

8-70. 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.

8-71. 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, +20 V, —12 V).

8-72. Next, check the amplifier's output voltage. It will probably also be close to one of the applied circuit potentials: ground, +20 V, —12 V, 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.

8-73. 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 8-16. When the input signal voltage crosses the reference, the output goes positive; the output remains positive until the signal re-crosses the reference.

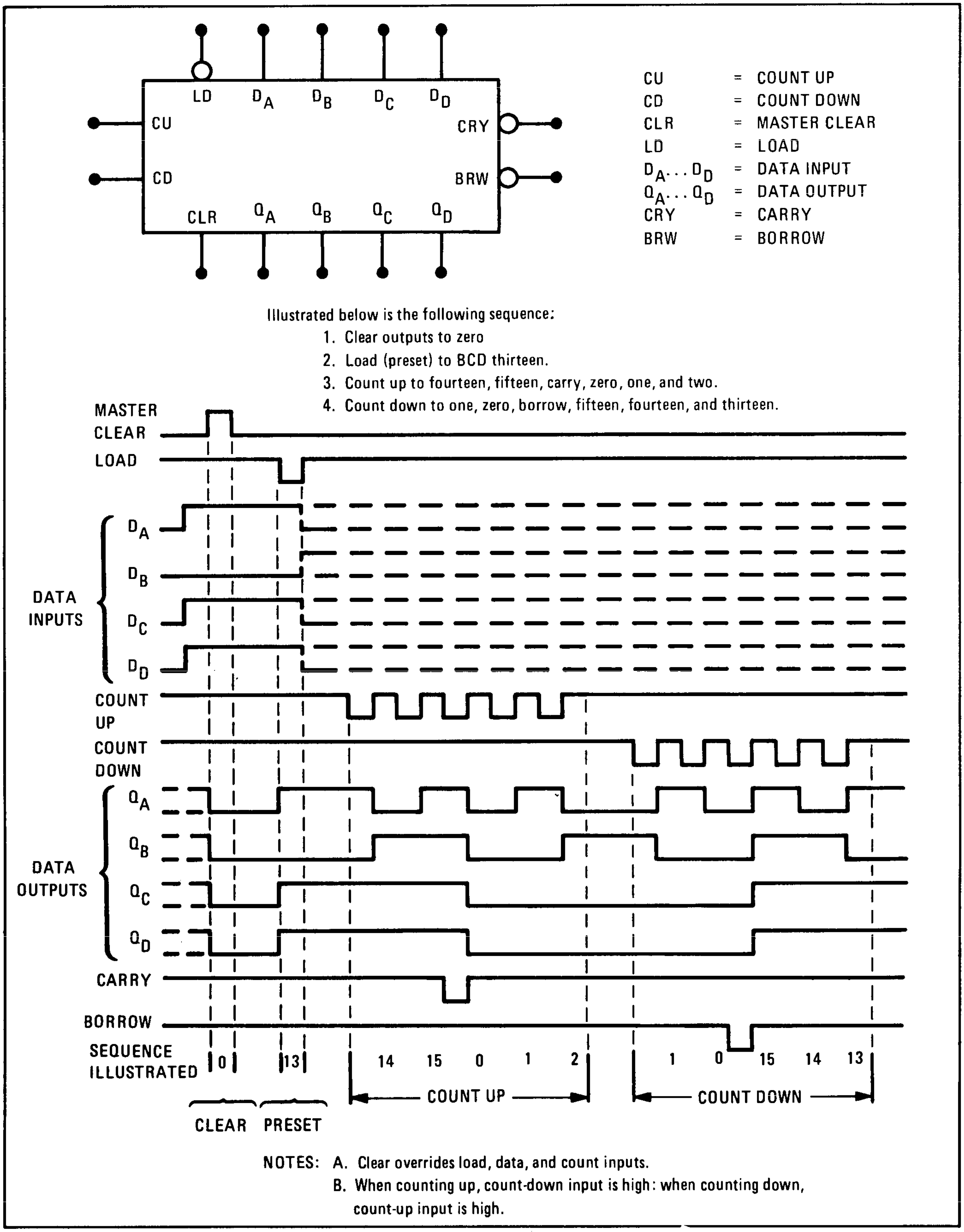
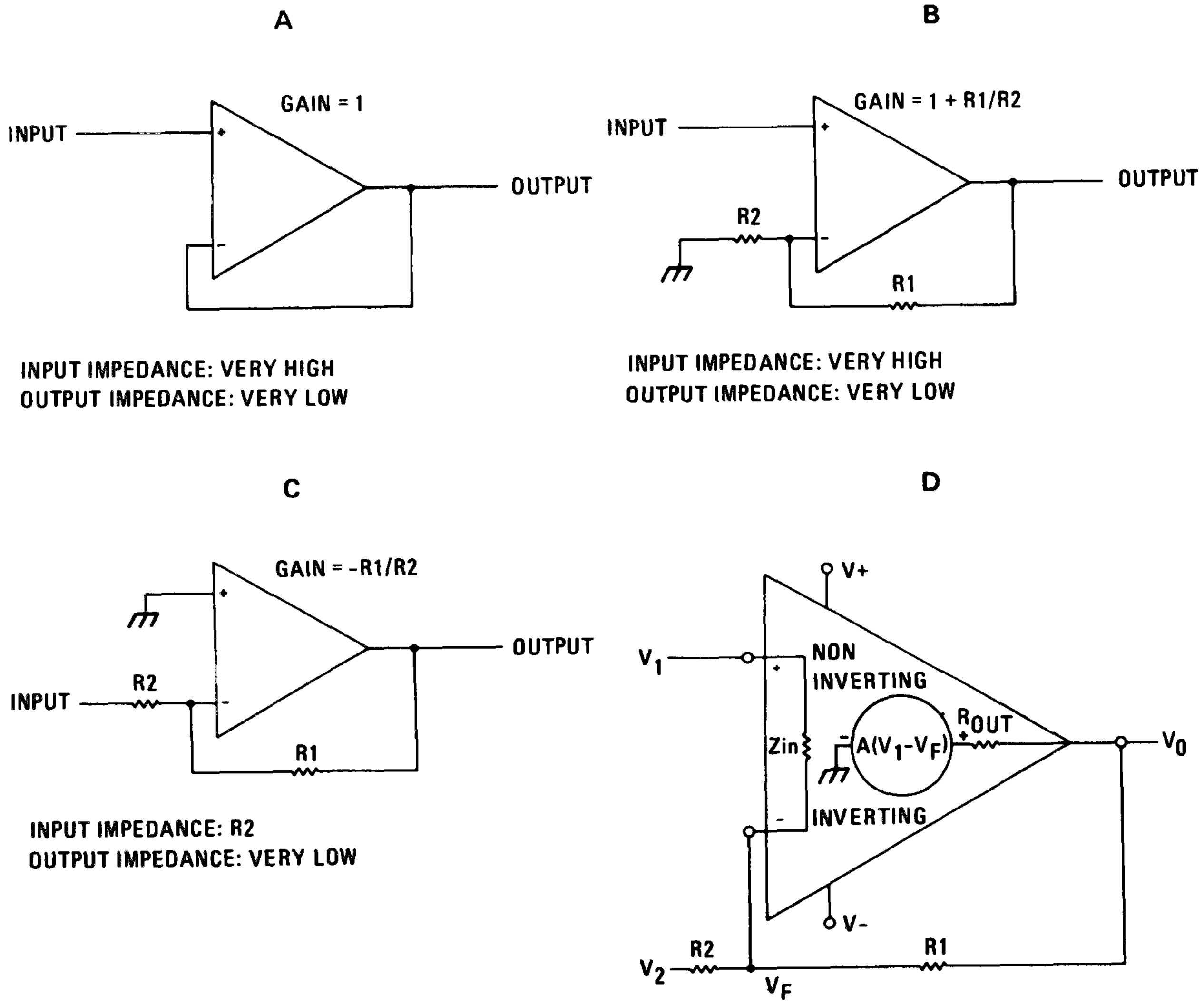


Figure 8-14. Programmable Up/Down Counter

OPERATIONAL AMPLIFIER



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

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

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

(3) IF $V_1 = 0$ (⏚), THEN $\boxed{V_0 = -V_2 \left(\frac{R1}{R2}\right)}$

Figure 8-15. Operational Amplifier

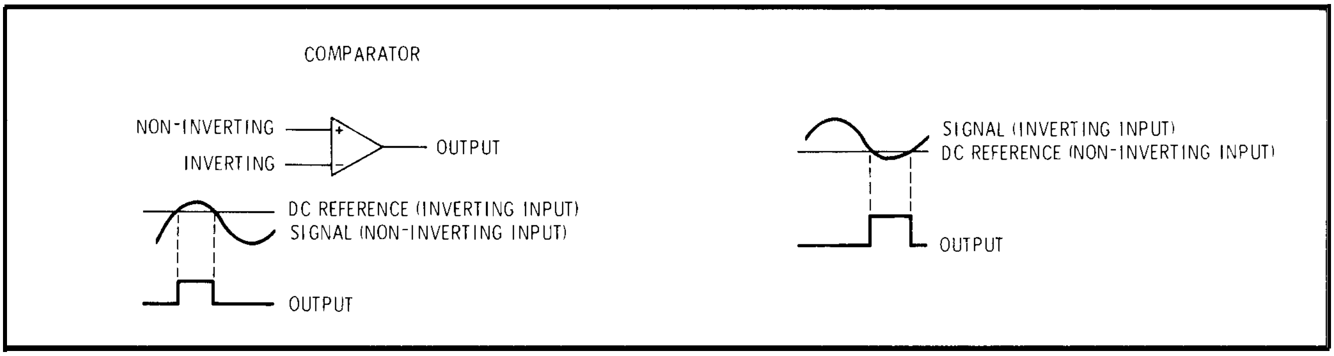


Figure 8-16. Comparator

Table 8-3. Assembly Information Index

Assembly[1]		Schematic[2]
A1	Output Level 1 dB Assy[3]	Service Sheets 13, 16
A2	Meter Switch/Detector Assy	Service Sheet 17
A3	RF Oscillator Assy[4]	Service Sheets 5, 6
A4	Meter Annunciator Drive Assy	Service Sheet 17
A5	FM Amplifier Assy	Service Sheet 6
A6	Annunciator Assy	Service Sheets 8, 17
A7	FM Shaping Assy	Service Sheets 7, 8
A8	Counter/Lock Assy[5]	Service Sheets 18, 19, 20, 21
A9	Peak Deviation and Range Switch Assy[6]	Service Sheets 6,7, 8, 15
A10	Divider/Filter Assy[7]	Service Sheets 10, 11
A11	Fixed-Frequency Modulation Oscillator Assy (Standard)	Service Sheet 9
A11	Variable-Frequency Modulation Oscillator Assy (Option 001)’	Service Sheet 9A
A12	Rectifier Assy	Service Sheet 22
A1 3	Modulation/Metering Mother Board Assy	Service Sheets 6,9, 9A, 14, 25
A14	Line Power Assy	Service Sheet 22
A15	Riser Assy	Service Sheets 14, 15, 16
A16	Fan Motor Assy	Service Sheet 23
A17	Power Supply Mother Board Assy	Service Sheet 24
A18	–5.2V Regulator and Fan Driver Assy	Service Sheet 23
A19	Output Level 10 dB Assy[8]	Service Sheets 13 and 16
A20	+5.2V and +44.6V Regulator Assy	Service Sheet 22
A22	+20V and —20V Regulator Assy	Service Sheet 22
A24	Series Regulator Socket Assy	Service Sheet 22
A26	AM/AGC and RF Amplifier Assy[9]	Service Sheets 12, 13, 14, 15, 16

[1] Odd numbered assemblies and sub-assemblies are accessible from bottom of instrument. Even numbered assemblies and sub-assemblies are accessible from top of instrument. See Service Sheets G and H for top and bottom internal views of instrument.

[2] Assembly principles of operation, troubleshooting, and component location photographs are given on the service sheet with the schematic.

[3] A1 Assembly Illustrated Parts Breakdown is located on Service Sheet A.

[4] A3 Assembly Illustrated Parts Breakdown is located on Service Sheet B.

[5] A8 Assembly Illustrated Parts Breakdown is located on Service Sheet C.

[6] A9 and All Assemblies Illustrated Parts Breakdowns are located on Service Sheet D.

[7] A10 Assembly Illustrated Parts Breakdown is located on Service Sheet E.

[8] A19 Assembly Illustrated Parts Breakdown is located on Service Sheet A.

[9] A26 Assembly (accessible from both top and bottom of instrument) Illustrated Parts Breakdown is located on Service Sheet F.

Table 8-4. *Schematic Diagram Notes (1 of 3)*

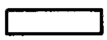
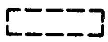
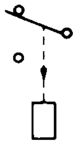
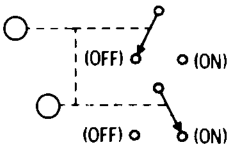
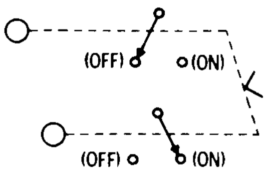
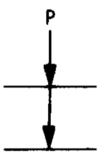
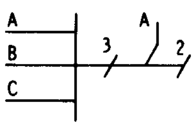
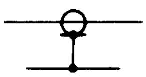
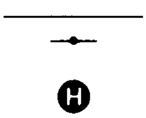
	Resistance in ohms, capacitance in picofarads, inductance in microhenries unless otherwise noted.
*	Asterisk denotes a factory-selected value. Value shown is typical. Part might be omitted. See Table 5-1.
†	See Backdating, Tables 7-1 and 7-2.
	Tool-aided adjustment. O Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
— -- —	Circuit assembly borderline.
— — — — —	Other assembly borderline. Also used to indicate mechancial interconnection (ganging) and RF shielding.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).
	Numbered Test point. Measurement aid (metal post, circuit pad, etc.) provided.
	Lettered Test point. No measurement aid provided.
	Encloses wire color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, third number identifies the narrower stripe. E.g., 947 denotes white base, yellow wide stripe, violet narrow stripe.
	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).
	A conducting connection to a chassis or frame.

Table 8-4. Schematic Diagram Notes (2 of 3)

	Relay contact moves in direction of arrow when energized.
	Indicates interlocked pushbutton switches. Only one switch can be in (ON) at a time.
	Indicates interconnected pushbutton switches. Pushing one switch in (ON) releases the other.
	Indicates twisted wire pair. (T indicates twisted wire triplet.)
	Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.
	Coaxial or shielded cable.
	RF coupling by magnetic (H) field.

SWITCH DESIGNATIONS

EXAMPLE: A3S1AR(2-1/2)

A3S1 = SWITCH S1 WITHIN ASSEMBLY A3

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

R = REAR OF WAFER (F=FRONT)

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

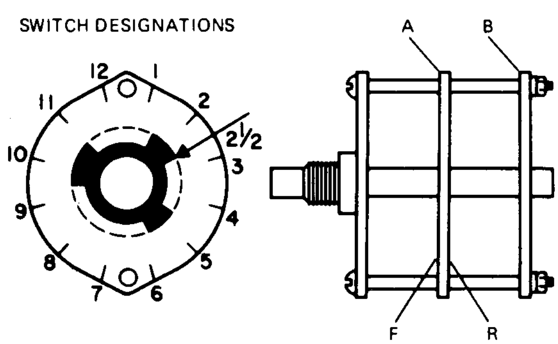
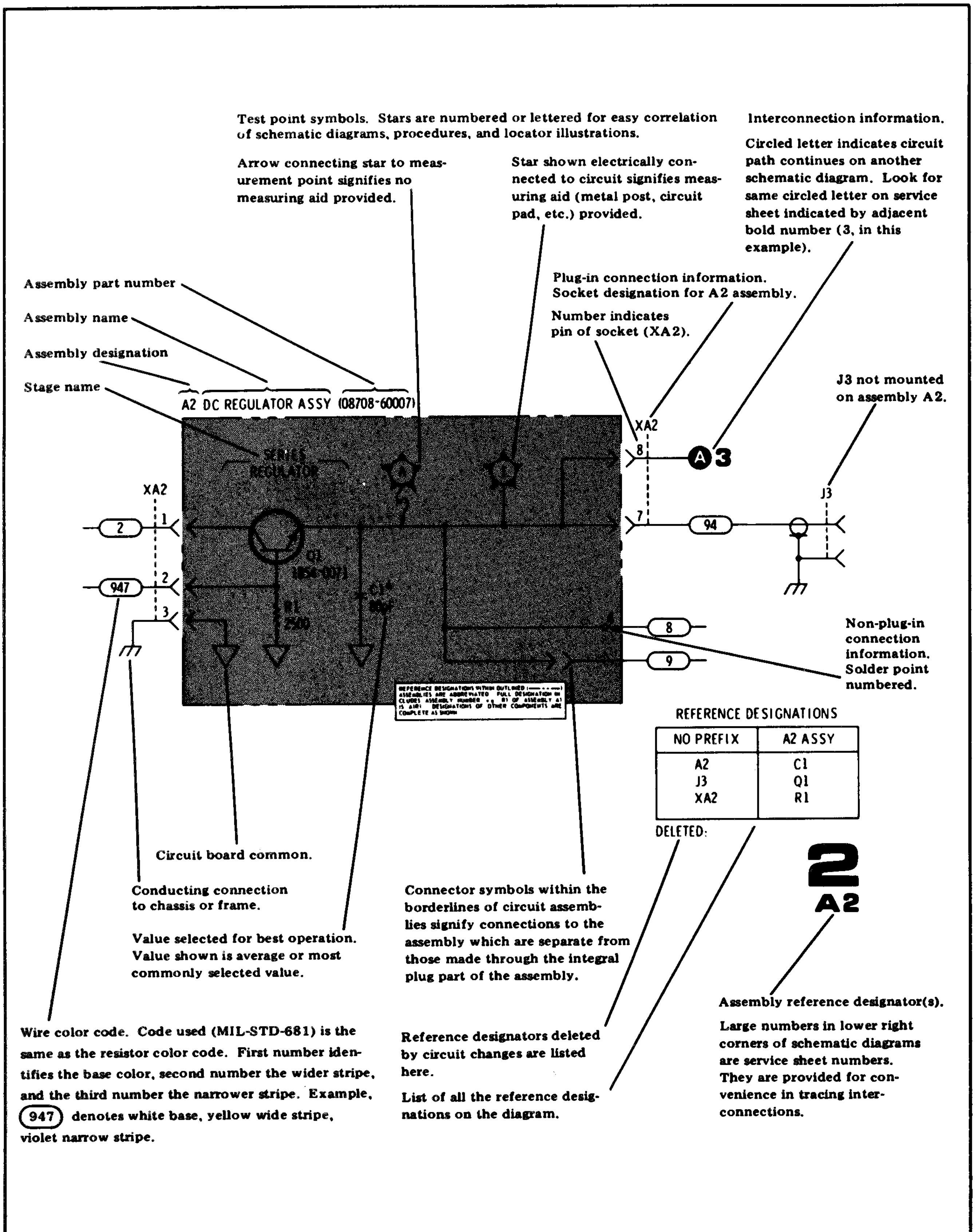


Table 8-4. Schematic Diagram Notes (3 of 3)



SERVICE SHEET 1

PRINCIPLES OF OPERATION

General (Refer to Figure 8-17):

The Model 8640B Option 004 Signal Generator is a mechanically-tuned, solid-state RF signal source producing signals from 0.5 to 512 MHz. The RF Oscillator operates within a basic frequency band of 256 to 512 MHz which can be divided into nine additional octave bands from 0.5 to 256 MHz. The leveled output may be attenuated in 1 db steps from +15 to –142 dBm and continuously varied over a 2 dB range by a vernier (a function of the AM/AGC circuits). Calibrated AM and FM (either internal or external) are provided. External pulse modulation with calibrated output level is provided by the AM/AGC circuits. In addition a very accurate demodulated AM output is provided. The RF output frequency is read on an internal counter which may also be used to count external signals up to 550 MHz and to phase lock the generator to a stable reference oscillator.

FM Circuits and RF Oscillator (Service Sheet 2)

The RF source is a 256 to 512 MHz cavity-tuned oscillator that is mechanically tuned by the FREQUENCY TUNE and FINE TUNE controls. The oscillator can also be electrically tuned over a smaller range by the FM and the counter/lock circuits. The FM circuits amplify and shape the modulation input to provide linear, calibrated frequency modulation. The phase lock circuits tune the oscillator to phase lock it to a reference. FM inputs can be either external (ac or dc coupled), internal from the modulation oscillator, or an accurate 1 Vdc useful for FM calibration.

AM/AGC Circuit and Output Amplifier (Service Sheet 3)

The RF oscillator drives the RF dividers (a chain of binary dividers) which divide the RF for the lower nine frequency ranges. The RF filters remove the harmonics from the RF signal.

The AM/AGC circuits form a feedback system to control the amplitude of the output and to provide AM or pulse modulation. The detector senses the level of the RF signal from the RF output amplifier. A summing amplifier compares the detector output against an input reference and drives the modulator. The modulator acts as a current controlled attenuator to control the RF level.

The reference to the summing amplifier consists of the level reference, which comes from the output level vernier, and the modulation signal, if present. The modulation signal can be either external (ac or dc coupled) or internal (from the modulation oscillator). In the pulse modulation mode, external modulation pulses switch the modulator off and on. Amplitude leveling is maintained in this mode by storing the detector output between pulses.

The detector output is also supplied to a buffer (demodulation) amplifier. A selection switch on the buffer amplifier provides selection of ac only (O-5 Vrms) or ac (0-1 Vrms) plus dc at DEMOD OUTPUT.

The 10 dB and 1 dB RF step attenuators further control the output level. The meter circuits monitor either the detector output (and hence the output level), the positive peak of the AM modulating signal (calibrated to give % AM), or the positive peak of the FM modulating signal (calibrated to give peak deviation).

Counter/Lock Circuits (Service Sheet 4)

In the internal count mode, the counter always counts the 256-512 MHz signal from the RF oscillator. The time base period is adjusted to give the correct frequency reading for the different frequency ranges. In the external count modes, external input signals are counted directly. In the phase lock mode, the counter compares the count of the RF signal against the count just before acquisition of phase lock and adjusts the frequency of the RF oscillator to make the counts coincide. The counter time base reference may be either the internal or an external 5 MHz.

TROUBLESHOOTING

Use the overall block diagram to isolate the trouble to a specific section of the instrument. Then turn to the troubleshooting block diagram that covers that section of the instrument and use the information on the diagram to isolate the trouble to the defective assembly. Next, turn to the Service Sheet that covers that assembly and isolate the trouble to the defective component or replace the assembly.

For example, suppose the AM functions are out of specification. The block diagram on Service Sheet 1 is keyed to the troubleshooting block diagrams

SERVICE SHEET 1 (Cont'd)

that follow it - in this case, Service Sheet 3. Service Sheet 3 gives a list of generator control settings (the list is located in the box on the right-hand side of the sheet) and the voltages and waveforms that should be found at the test points and along the signal paths. To check a voltage at a test point, change the control settings as specified in the box associated with that test point, check the voltage, then reset the controls to the settings specified in the box on the right-hand side.

NOTE

The last two foldouts in the manual have top and bottom internal views of the instrument that show the locations of the test points, assemblies, and cables (all RF cables are accessible from the bottom of the instrument).

The blocks on Service Sheet 3 are keyed, by the numbers located in their lower right-hand corners, to the Service Sheets that have the circuit schematics. In our example, suppose the signals to the A26A3 Assembly are correct and the signals from A26A3 are incorrect. Turn to Service Sheet 12 and isolate the trouble to a component or replace A26A3.

NOTE

After repairs are complete, see Table 5-2 for the appropriate post-repair tests and adjustments.

WARNING

The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, if inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

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.

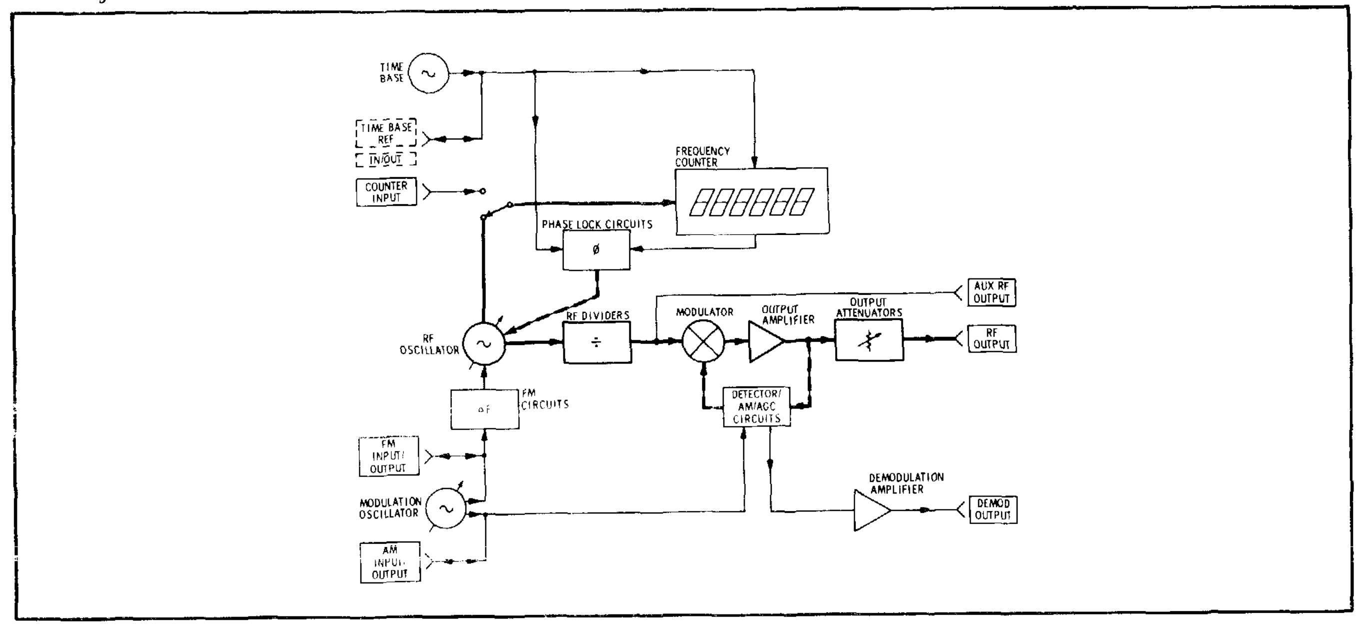


Figure 8-17. Simplified Block Diagram

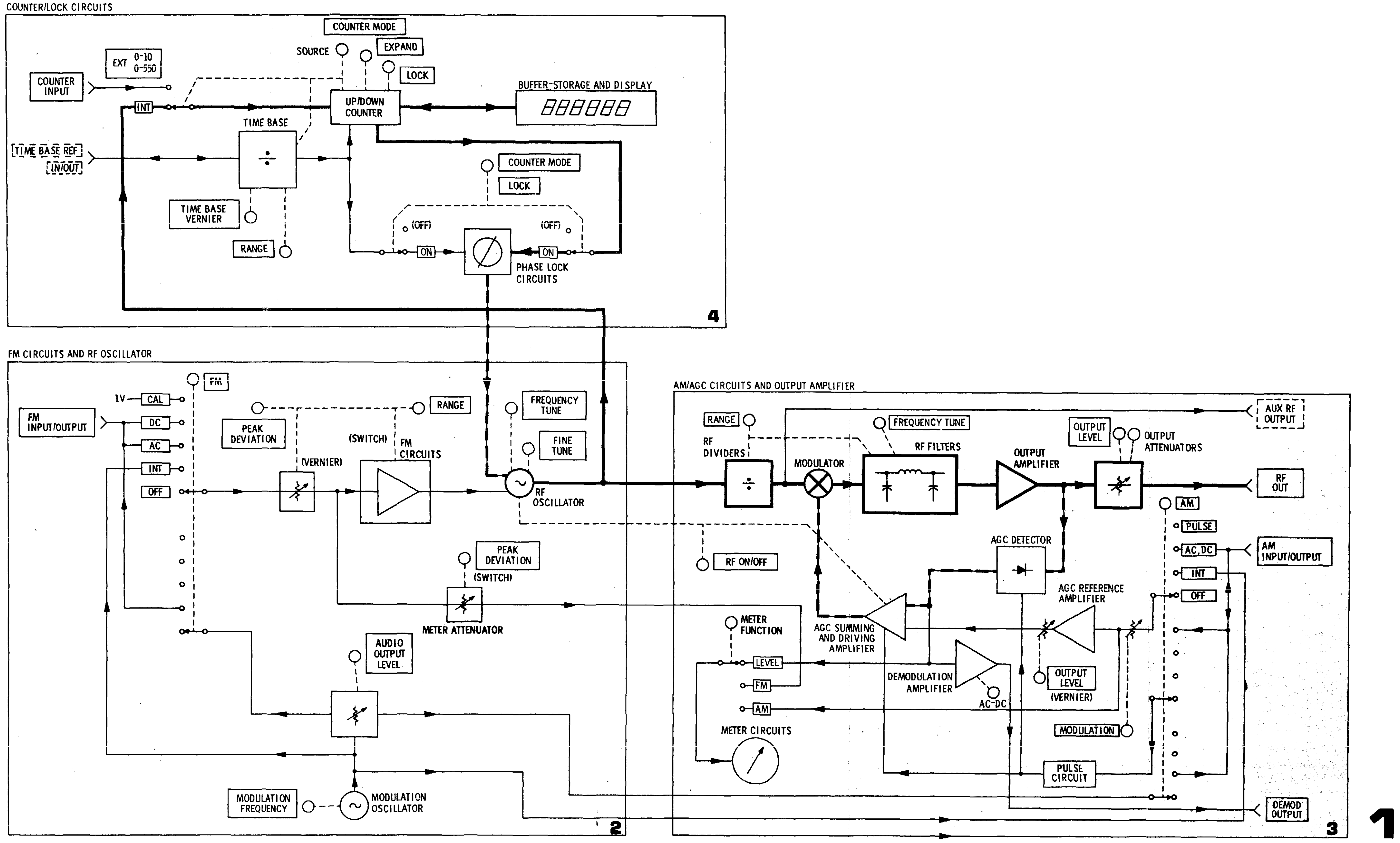


Figure 8-18. Overall Block Diagram

SERVICE SHEET 2

PRINCIPLES OF OPERATION

RF Oscillator (Service Sheet 5)

The full frequency range of the RF Oscillator is 230 to 550 MHz (nominally 256-512 MHz). The oscillator uses a single high-frequency transistor in a foreshortened cavity. Frequency is controlled by varying the capacitive loading of the cavity. The oscillator drives two output amplifiers. The Frequency Counter Buffer Amplifier drives the frequency counter; the Divider/Filter Buffer Amplifier drives the dividers which drive the amplitude modulating and leveling circuits. The oscillator's cavity has two varactor diodes that allow the capacitive loading to be varied by voltages (at the anode and cathode) to provide FM and phase lock.

FM Circuits (Service Sheets 6, 7, and 8)

The RF oscillator's varactor cathode is driven by the FM Amplifier which provides accurate amplification or attenuation of the modulation signal and shapes the signal to compensate for the non-linear characteristics of the varactor diodes. Separate shaping circuits are used for positive and negative voltage excursions. The PEAK DEVIATION switch, which controls basic FM amplifier gain, is mechanically linked to the RANGE switch since, for a given amount of peak deviation, the percent deviation (i.e., the amount of deviation relative to the carrier frequency) changes as the frequency range is changed. Also, as the frequency is tuned, the FM deviation changes. An FM Gain Compensation circuit with a potentiometer, which is geared to the FREQUENCY TUNE control, adjusts for the change in FM sensitivity with tuning.

Inputs to the FM circuits are routed through the FM stitch. In the CAL position, an accurate 1 Vdc is applied to the FM input. External inputs are applied in AC and DC, and an internal modulation signal in INT. The PEAK DEVIATION vernier adjusts the input level into a unity gain Buffer Amplifier. In addition to driving the FM amplifier, the Buffer Amplifier drives the Over-Deviation Detector and the Meter Attenuator. In the event that the input signed exceeds ±1.1V, the Over-Deviation Detector turns on the REDUCE FM VERNIER lamp. The Meter Attenuator scales the input signal to the meter circuits in such a way that a 1 Vpk input corresponds to the deviation selected when read on the meter.

Modulation Oscillator (Service Sheets 9 and 9A)

Internal AM and FM is provided by the Modulation Oscillator. The oscillator drives either the AM modulation circuits and AM OUTPUT port or the FM modulation circuits and FM OUTPUT port or all four. The oscillator is enabled whenever either the AM or FM switch is in INT.

The standard modulation oscillator (shown on Service Sheet 9) has two fixed frequencies -400 Hz and 1 kHz. The oscillator supplied with Option 001 (shown on Service Sheet 9A) has in addition five variable frequency ranges covering from 20 Hz to 600 kHz.

Power Supplies and Fan (Service Sheets 22 and 23)

The instrument has five regulated supply voltages, +44.6V, +20V, —20V, +5.2V, —5.2V. All supplies are protected against overloading, over voltage, and reverse voltage. An LED annunciator on each supply indicates proper operation when on. The cooling fan is driven by a dc brushless motor controlled by the Fan Driver circuits.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the FM circuits and RF oscillator as a result of using the overall block diagram. Troubleshoot by using the test equipment and procedures specified below.

Test Equipment

Digital Voltmeter HP 3480D/3484A Option 043
Oscilloscope . . . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top and bottom covers removed (see Service Sheet G).

Procedure

Set the generator's controls as listed in the box at the right-hand side of the diagram. To check a voltage at a test point, change the control settings as specified in the box associated with that test point, check the voltage, then reset the controls to

Overall Block Diagram
SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

the settings specified in the box at the right-hand side.

The blocks are keyed, by the numbers located in their lower right-hand corners, to the Service Sheets that have the circuit schematics.

NOTE

The last two foldouts in this manual have top and bottom internal views of the instrument that show the locations of the test points, assemblies, and cables (all RF cables are accessible from the bottom of the instrument).

NOTE

After repairs are complete, see Table 5-2 for appropriate post-repair tests and adjustments.

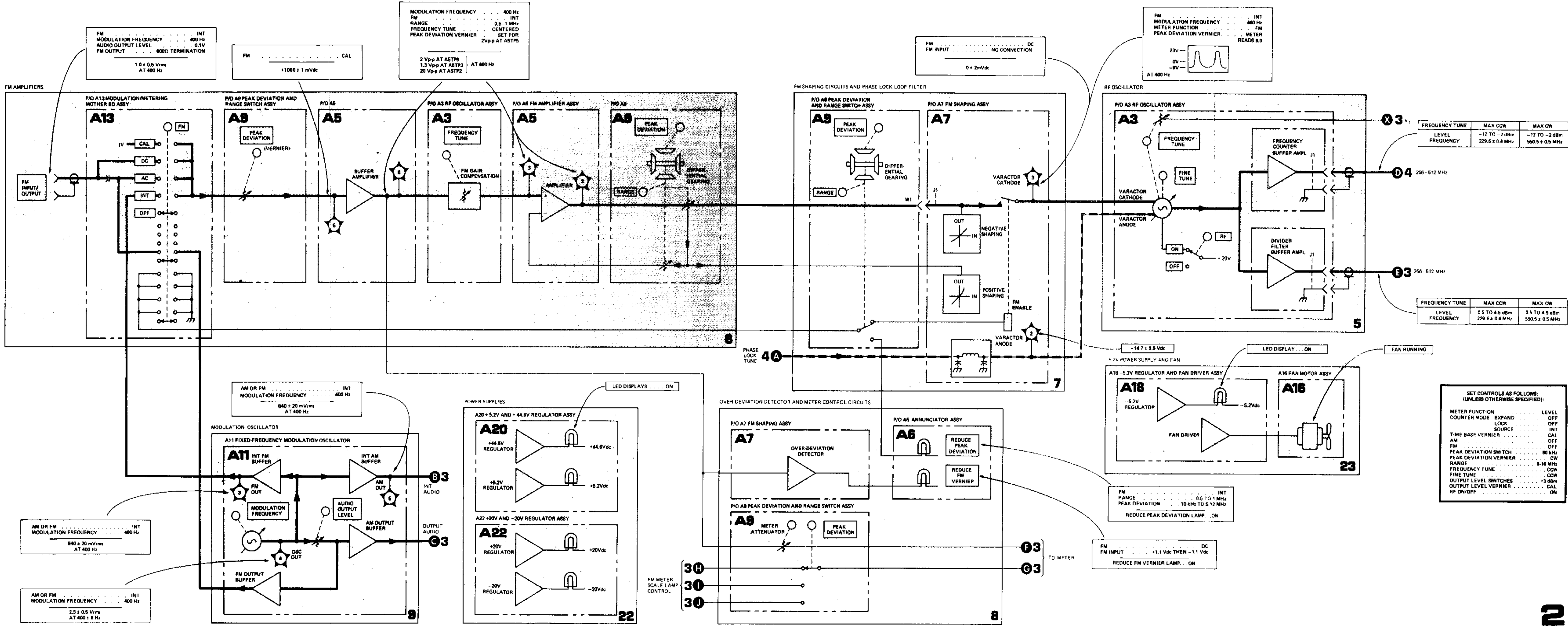


Figure 8-19. FM Circuits and RF Oscillator Block Diagram

SERVICE SHEET 3

PRINCIPLES OF OPERATION

Divider/Filters (Service Sheets 10 and 11)

Except for the 256-512 MHz (and the doubler) frequency range, the RF signal from the Divider/Filter Buffer Amplifier (Service Sheet 2) is routed through a series of binary frequency dividers (i.e., +2) by slide switches on the filter section of the A10 Divider/ Filter Assembly. The RF signal is divided to the selected range. This is also illustrated in simplified logic diagram Figure 8-41.

The divided signal passes through the Modulator Preamplifier, the Modulator, and then to the RF Filters. The filters remove unwanted harmonics from the signal (which is approximately a square wave after being divided). The upper frequency ranges have two filters per range - one for the lower half (Low Band Filters) and one for the upper half (High Band Filters) of the band. This is necessary to effectively remove the second harmonic on the lower half of the band. The midpoint of the band is sensed by a Schmitt Trigger which compares a reference voltage to a voltage proportional to the frequency tuning. On the four lowest frequency ranges the RF signal has little second harmonic content because of good waveform symmetry; therefore, each range has only one filter.

AM/AGC Circuits (Service Sheets 12 and 13)

The output of the RF Filters is amplified by the Output Amplifier.

The amplifier's output is peak-detected and buffered by the Detector Buffer Amplifier. The detected voltage, which is negative, is buffered and amplified by the Demodulation Amplifier which drives DEMOD OUTPUT. The detected voltage is also summed (in the Summing Amplifier) with a positive AGC reference voltage from the OUTPUT LEVEL vernier. The AGC reference may also have the amplitude modulation voltage superimposed on it. The sum of the detector and reference voltages is amplified by the Summing and Modulator Driver Amplifiers. The Modulator Driver Amplifier supplies control current to the Modulator which adjusts the RF output level.

In the pulse modulation mode, the Modulator Driver Amplifier is switched on and off by input pulses from the Schmitt Trigger. To maintain a constant detector voltage into the summing amplifier, the peak detector's output voltage is sampled during the RF-on period and then stored in the Sample And Hold section of the Detector Buffer Amplifier when the RF is off. The Pulse Overload Detector senses any large errors in the leveling circuit which can occur when the OUTPUT LEVEL vernier is reduced. In such a case, the hold function is defeated until equilibrium occurs. The Rate Detector senses pulses of low repetition rate and turns off the meter circuit when the rate is so low that the meter is no longer accurate.

The Modulation Overload Detector senses when the AGC reference, the AM signal, or a combination of the two is beyond the Modulator's capability to deliver power. The REDUCE PEAK POWER lamp is then turned on. The Meter Amplifier produces an output voltage proportional to the detected output voltage (and hence the output level) to drive the meter circuits. The AGC reference voltage originates in the AM Offset Amplifier where it is summed with any AM input signal. The voltage out of the amplifier then passes through the OUTPUT LEVEL vernier to the modulation Summing Amplifier. The Modulator can be disabled (i.e., maximum modulator attenuation) by the RF ON/OFF switch.

Meter Circuits (Service Sheet 17)

The meter can be set to measure either percent AM, peak frequency deviation" (FM), or output level. In measuring AM and FM, the modulation signal is peak-detected by the Positive Peak Detector and amplified. For output level, the output of the Meter Amplifier, which is proportional to the detector output, is amplified by the Meter Drive Amplifier. On both AM and LEVEL, one range of autoranging is provided. The Autorange Comparator senses the autorange condition and switches the gain of the Meter Drive Amplifier. Logic circuits control gain switching of the Meter Drive Amplifier and turn on the proper scale lamps.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the AM/AGC circuits and output amplifier as a result of using the overall block diagram. Troubleshoot by using the test equipment and procedures specified below.

Test Equipment

Digital Voltmeter	HP 3480D/3484A Option 043
Oscilloscope	HP 180A/1801A/1820C
Power Meter and Sensor	HP 435A/8482A
Frequency Counter	HP 5327C

Initial Test Conditions

Top and bottom covers removed (see Service Sheet G).

Procedure

Set the generator's controls as specified in the box at the right-hand side of the diagram. To check a voltage at a test point, change the control setting as specified in the box associated with that test point, check the voltage, then reset the controls to the settings specified in the box at the right-hand side.

The blocks are keyed, by the numbers located in their lower right-hand corners, to the Service Sheets that have the circuit schematics.

NOTE

The last two foldouts in this manual have top and bottom internal views of the instrument that show the locations of the test points, assemblies, and cables (all RF cables are accessible from the bottom of the instrument).

NOTE

After repairs are complete, see Table 5-2 for appropriate post-repair test and adjustments.

Figure 8-20. AM/AGC Circuits and Output Amplifier Block Diagram

SERVICE SHEET 4

PRINCIPLES OF OPERATION

Internal Count Mode

When the internal count mode is selected, the 256-512 MHz signal from the Frequent y Counter Buffer Amplifier (Service Sheet 2) is first divided by 64 and then is counted by the Up/Down Counter (used in the count-up mode). An ECL to TTL Translator shifts the logic levels of the +64 Divider to be compatible with the counter.

The counter's time base is derived from a 5 MHz Reference Oscillator (or an external reference) and is divided by a divide-by-N counter (the Time Base Decoder). The division ratio is programmed by the frequency RANGE and EXPAND X10 and X100 switches. The Up/Down Counter drives the Storage Buffers which store the previous count while the counter is counting. The Counter Display is driven from the Storage Buffers. The Decimal Point Decoder decodes the decimal point information on the RANGE switch and the EXPAND switches and drives the display's decimal points. The Overflow Detector senses when the count overflows the number of digits available on the display and turns on the OVERFLOW annunciator.

External Count Mode

When the external count mode is selected, the external signal enters the counter input in place of the RF oscillator's output. When the 0-10 MHz mode is selected, the :64 Divider is bypassed. The EXT 0-550 MHz and 0-10 MHz switches also program the Time Base Decoder; otherwise, the counter's operation is identical to the internal count mode.

Phase Lock Mode

When the LOCK switch is first depressed, the counter continues to count up until the present count is terminated. The count is then stored in the Storage Buffers, and the counter enters the phase lock mode. The count now proceeds with the count from the Storage Buffers being preset into the Up/Down Counter. The counter counts down to zero and then underflows (i.e., all counters at the state of nine) and the time of occurance of the underflow is compared with the termination of the time base cycle in the Null Phase Detector (at the underflow the counter is once again preset from the buffers and continues counting toward zero). The error from the detector adjusts the tuning of the RF Oscillator (Service Sheet 2) to bring the average error to zero. When the Error Detector senses the tuning voltage nearing its limit, phase lock is broken, the counter reverts to the normal count-up mode, and the Flash Oscillator is enabled which blinks the display.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the counter/lock circuits as a result of using the overall block diagram. Troubleshoot by using the test equipment and procedures specified below.

Test Equipment

Digital Voltmeter . . . HP 3480D/3484A
Oscilloscope . . . HP 180A/1801A/1820C
Frequency Counter . . . . . . HP 5327C

Initial Test Conditions

Top and bottom covers removed (see Service Sheet G).

Procedure

Set the generator's controls as listed in the box at the right-hand side of the diagram. To check a voltage at a test point, change the control settings as specified in the box associated with that test point, check the voltage, then reset the controls to the settings specified in the box at the right-hand side.

The blocks are keyed, by the numbers located in their lower right-hand corners, to the Service Sheets that have the circuit schematics.

NOTE

The last two foldouts in this manual have top and bottom internal views of the instrument that show the locations of the test points, assemblies, and cables (all RF cables are accessible from the bottom of the instrument).

NOTE

After repairs are complete, see Table 5-2 for appropriate post-repair tests and adjustments.

AM/AGC Circuits and Output Amplifier Troubleshooting
SERVICE SHEET 3

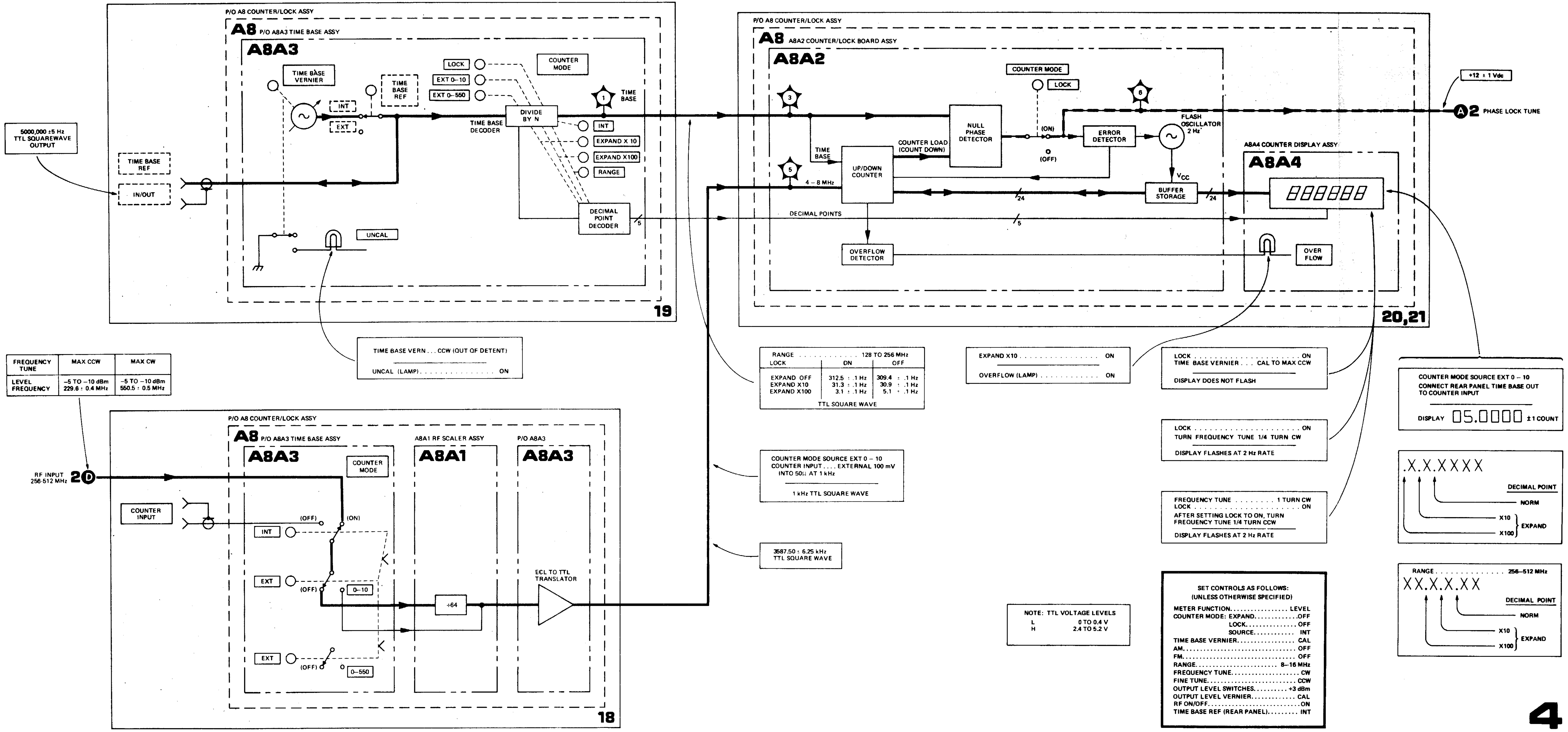


Figure 8-21. Counter/Lock Circuits Block Diagram

SERVICE SHEET 5

PRINCIPLES OF OPERATION

General

The A3 RF Oscillator Assembly contains the main RF oscillator, a varactor assembly, and two buffer amplifiers. The output of the RF oscillator is applied to the RF OUT port through the Al0 Divider/Filter Assembly, the A26 AM/AGC and RF Amplifier Assembly, and the A1A1 and A19A1 Output Attenuators (see block diagrams for schematic locations).

Oscillator Loop

The 230 and 550 MHz RF oscillator is a single transistor, cavity-tuned oscillator. Integral with the oscillator assembly is a Varactor Head Assembly which provides electrical tuning for FM. The high-frequency transistor is in a common-base configuration. The emitter and collector loops couple into the cavity and to each other to provide the positive feedback necessary for oscillation.

Tunable Cavity

The cavity is a foreshortened type which is essentially a length of coaxial transmission line with a short at one end and a capacitive load at the other. The shorted transmission line is less than 1/4 wavelength long at the frequency of oscillation and its impedance is inductive. The cavity resonates at the frequent y at which the inductive reactance of the transmission line equals the capacitive reactance of the load capacitor. The resonant frequency is varied by changing the length of the cavity (a secondary effect) and by changing the load capacitance. The varactor diodes are in parallel with the main load capacitance. The cavity is mechanically fine tuned by protruding a small metal slug into the cavity. Signal is coupled out of the cavity into two buffer amplifiers by loops which protrude into the cavity.

Buffer Amplifiers (A3A1A2, and A3A1A3)

Operation of the Divider/Filter Buffer Amplifier and the Counter Buffer Amplifier is essentially the same. The Divider/Filter Buffer Amplifier drives the Modulator Preamplifier. The Counter Buffer Amplifier drives the counter input. The main function of these amplifiers, however, is to isolate the RF Oscillator from external circuits.

Transistors Q1 and Q2 are two common-emitter amplifier stages. The base of Q1 is de-grounded through the coupling loop T1. Emitter current is established by resistors R3 and R4; capacitor C2 at-bypasses R4. The gain of Q1 is set by R1, R2, R3, and R6 (also C8, Divider/Filter Buffer Amplifier only). The collector of Q1 is

SERVICE SHEET 5 (Cent'd)

at-coupled to the base of Q2 by capacitor C4. Operation of transistor Q2 is similar to Q1. In the Counter Buffer Amplifier only, resistors R10, R11, and R12 form a 10 dB pad to reduce the output level and increase the output-to-input reverse isolation.

The amplifier board is secured through slotted holes by two screws. By loosening the screws and sliding the board, the amount of coupling loop protruding into the cavity can be altered and the amplifier output level varied.

TROUBLESHOOTING

General

The oscillator transistor, buffer amplifiers, and external circuits of the A3 RF Oscillator Assembly may be repaired to the component level. However, if a problem has been isolated to components in the RF Oscillator cavity, the oscillator assembly should be returned to Hewlett-Packard for repair. Do not attempt to disassemble it because proper reassembly depends upon specialized skills and procedures.

Buffer Amplifiers

Refer to Service Sheet B for access to the buffer amplifier assemblies. Check dc bias voltages to reveal a faulty component. See Section V for adjustment.

RF ON/OFF Switch Modification

The RF ON/OFF Switch function may be wired to:

a. switch off both the RF Oscillator and Modulator leaving the RF output completely off but requiring a stabilization period after turn on; or

b. switch off only the Modulator leaving the RF Oscillator on and warmed up, the Auxiliary RF Output on, and the counter and phase lock operating. In this case, however, the RF is not truly "off" but is reduced by an amount equal to the pulse on/off ratio (at least 40 dB down and dependent on OUTPUT LEVEL vernier setting).

Either configuration can be easily altered to the other as follows:

a. Remove bottom cover (see Service Sheet G).

b. Remove two nuts that secure A3A4 Connector Board Assembly, and remove board. The board is located directly behind the Range Switch cam housing.

c. To modify the circuitry to leave the RF Oscillator on at all times, add a jumper wire between the two holes labeled "RF OSC ON/OFF INHIBIT" as shown overleaf. To modify the circuitry so the RF Oscillator is switched off, remove the existing jumper wire.

d. Reinstall board and bottom cover.

e. Check RF ON/OFF operation by observing counter or Auxiliary RF Output signal.

Counter/Lock Circuits Troubleshooting
SERVICE SHEET 4

A3A4

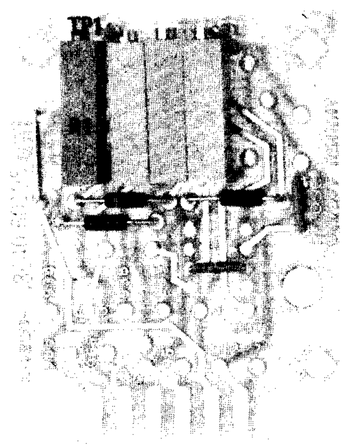


Figure 8-22. P/O A3A4 Connector Board Assembly Component Locations

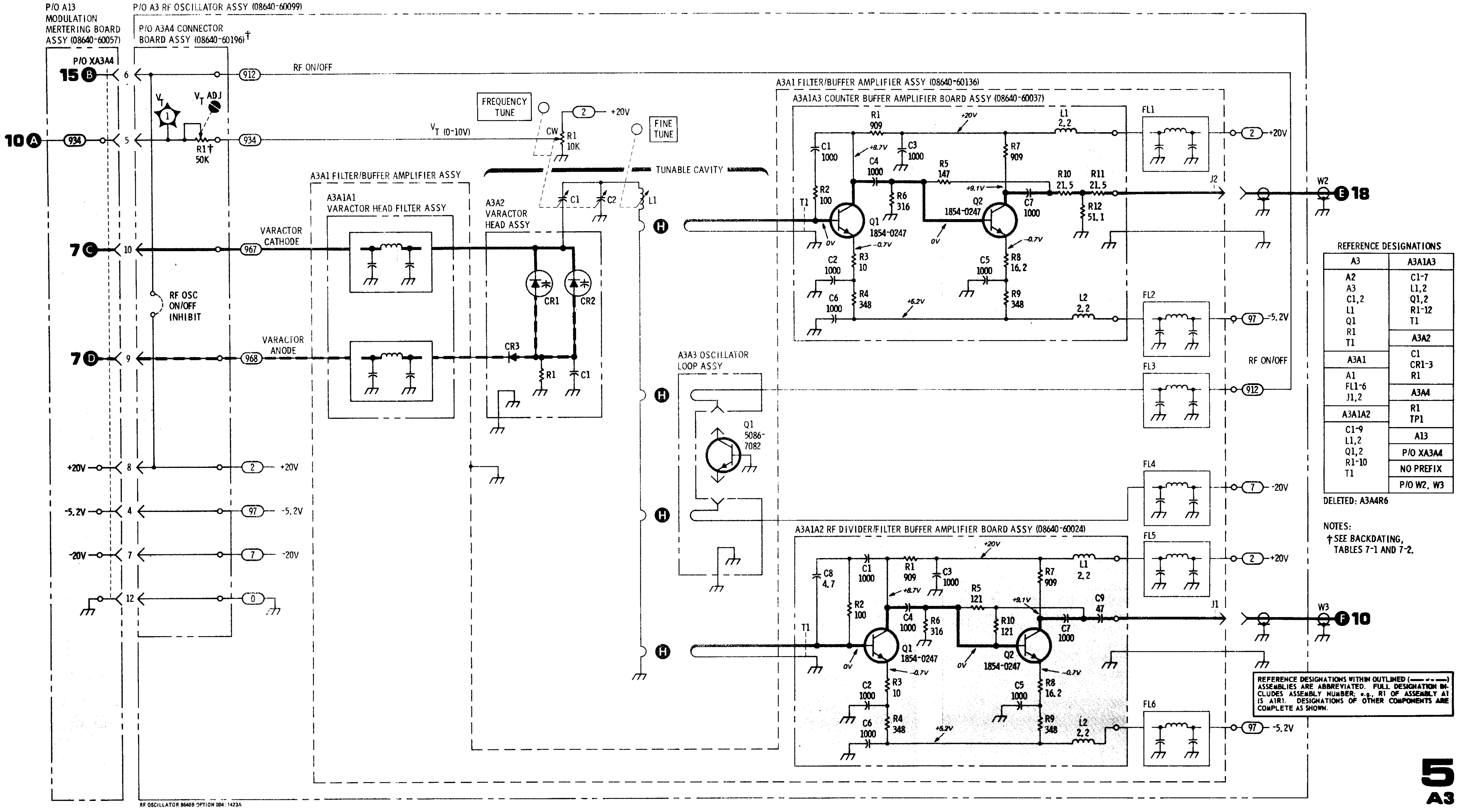


Figure 8-23. RF Oscillator Simplified Diagram

SERVICE SHEET 6

PRINCIPLES OF OPERATION

General

The A5 FM Amplifier Assembly, in conjunction with the A9 Peak Deviation and Range Switch and the A7 Shaping Assembly, conditions the modulation signal to drive the varactor diodes which frequent y modulate the RF oscillator. Modulation signals may be dc or ac coupled.

Input and Buffer Circuits (A5)

The FM modulating signal is applied to the Deviation Vernier which presents a 600 impedance to the modulation source. Buffer Amplifier U1 is internally connected as a voltage follower. The output of U1 drives the meter attenuator (Service Sheet 8), the over deviation detector (Service Sheet 8), and the FM Gain Compensation circuit through relay K1. When the FM switch is OFF, or if the PEAK DEVIATION switch is set to an unallowable position, the relay is de-energized and the signal path to the FM and meter circuits is opened. FM gain compensation potentiometer A3R2 is geared to the FREQUENCY TUNE control and adjusts the gain of the circuit. FM sensitivity is higher for higher RF oscillator frequencies and the FM Gain Compensation circuit reduces the modulation circuit drive at high frequencies. The gain compensation adjustment potentiometers (A3A4R2, R3, and R4) set the FM sensitivity at the frequency mid-point and extremes. The output of the FM Gain Compensation circuit drives the FM Amplifier input.

Amplifier (A5)

The FM Amplifier is a non-linear, feedback amplifier which drives the varactor diodes in the RF oscillator. The amplifier and shaping circuits correct for the non-linear tuning sensitivity of the RF oscillator by the varactor diodes. The correction for the negative excursions of the modulation signal is provided by the negative shaping circuit (Service Sheet 7) which follows the amplifier output. Correction for positive excursions is provided by the positive shaping circuit (Service Sheet 7) which is part of the amplifier feedback path.

Transistors Q1 through Q4 form a two-stage differential input applifier. The dual transistors Q1 and Q2 are connected in a Darlington configuration to provide matched, high impedance inputs. Amplifier offset adjustment, R8 adjusts the dc offset. The gain of the first stage is approximately one-half the ratio R4/R3; gain for the second stage is approximately one-half the ratio R5/R6.

Transistors Q5 through Q8 form an intermediate driver stage. The voltage gain of the stage is approximately twice the ratio of the impedance across R27 to that of R17.

The shaping circuits require more gain for large positive voltage excursions. For low positive voltages, the resistor network R29 to R34 is in parallel with R27. As the voltage increases, diodes CR10, 11, and 12 respectively switch off and increase the impedance across R27 and thereby increase the amplifier's gain.

Transistors Q9 through Q12 form the amplifier output stage. Transistors Q9 and Q10 are in a Darlington configuration and supply current to the load during positive excursions. Transistors Q11 and Q12 are in an inverted Darlington configuration and sink load current during negative excursions.

SERVICE SHEET 6 (Cent'd)

Amplifier Configurations

The FM Amplifier is switched by the A9 Peak Deviation and Range Switch into three different configurations depending on the gain needed. For gains less than 0 dB, the amplifier is in a unity gain configuration followed by the positive shaping network (Service Sheet 7) which has little effect; an attenuator, which determines the overall gain; and the negative shaping network (Service Sheet 7) which has only a small effect. The effect of the shaping networks is small because voltage swings are small and the tuning characteristic of the varactor diodes is fairly linear over the narrow range of operation. For 0 dB gain, the amplifier is in a unity gain configuration, the positive shaping network and attenuator have no effect, and the negative shaping network has a small effect. For gains greater than 0 dB, the attenuator is in the feedback path and the gain is inversely proportional to the feedback attenuation. The positive shaping network is also in the feedback path and for large positive voltage excursions it increases the feedback attenuation and hence increases the amplifier gain. The negative shaping network is in the output path, and for large negative voltage excursions, the output attenuation is increased and the overall amplifier gain decreases.

Attenuator (A9)

Before entering the feedback path, the FM Amplifier output passes through an attenuator formed by resistors R4 through R7 which reduces the open-loop gain of the amplifier when only small closed-loop gain is needed. The gain control attenuator used in the feedback or output of the amplifier is formed by resistors R12 through R22.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the FM amplifier circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C

NOTE

Use a 10 k resistor, in series with the DVM probe tip, to reduce spurious oscillations in the amplifier circuitry while making dc measurements.

Initial Test Conditions

Bottom cover removed (see Service Sheet G for removal procedure). Extend, A5 FM Amplifier Assembly on extender board. Remove A7 FM Shaping Assembly from chassis and disconnect cable A9W1 from A7J1.

SERVICE SHEET 6 (Cent'd)

Initial Control Settings

MODULATION FREQUENCY . . . . *400* Hz
FM . . . . INT
PEAK DEVIATION . . . . 5 kHz
PEAK DEVIATION Vernier . . . . Fully cw
RANGE . . . . *0.5-1* MHz
FREQUENCY TUNE Centered
(Four turns from stop)
RF ON/OFF . . . . ON

FM Amplifier Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
Buffer Amplifier (A5)	Initial conditions and settings. Adjust PEAK DEVIATION vernier for 2 Vp-p at TP5 (BUFFER IN).	2 Vp-p at TP6 (BUFFER OUT)	Check U1 and associated circuitry
FM Amplifier (A5)	Initial conditions and settings. Adjust PEAK DEVIATION vernier for 2 Vp-p at TP5 (BUFFER IN).	Peak-to-peak voltages at TP3 (+ INPUT) and TP4 (–INPUT) are the same	Set FM to OFF and use DVM to check dc voltages shown on schematic
)	Switch RANGE through all ranges and check gain	Gain in accordance with FM system gain table on schematic	Check switching of A9

A3A4

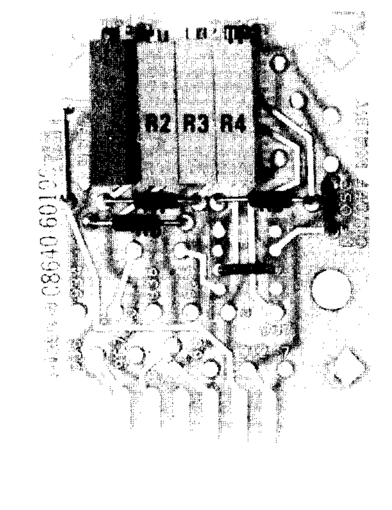


Figure 8-24. P/O A3A4 Connector Board Assembly Component Locations

A13

Component Locations for Al 3 Assembly are on Service Sheet 25.

A9 (TOP VIEW)

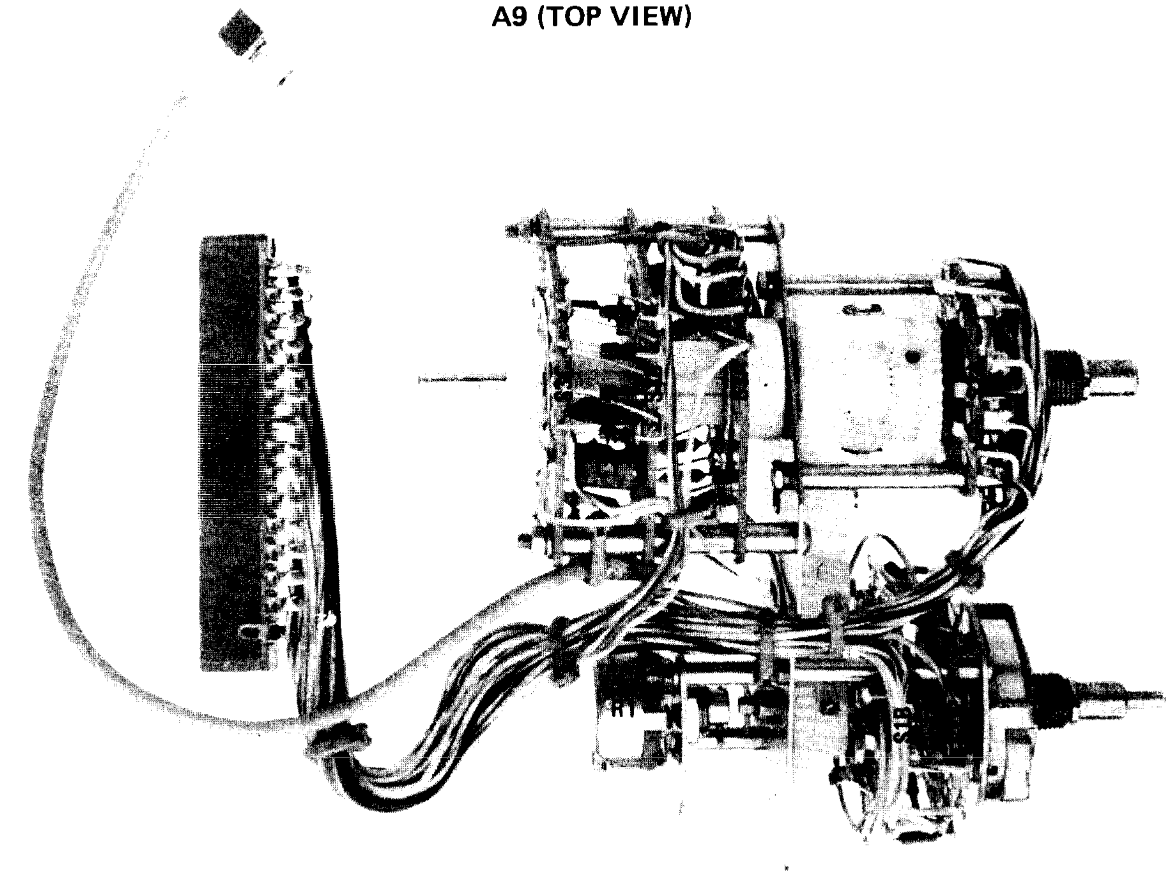


Figure 8-25. P/O A9 Peak Deviation and Range Switch Assembly Component Locations (1 of 2)

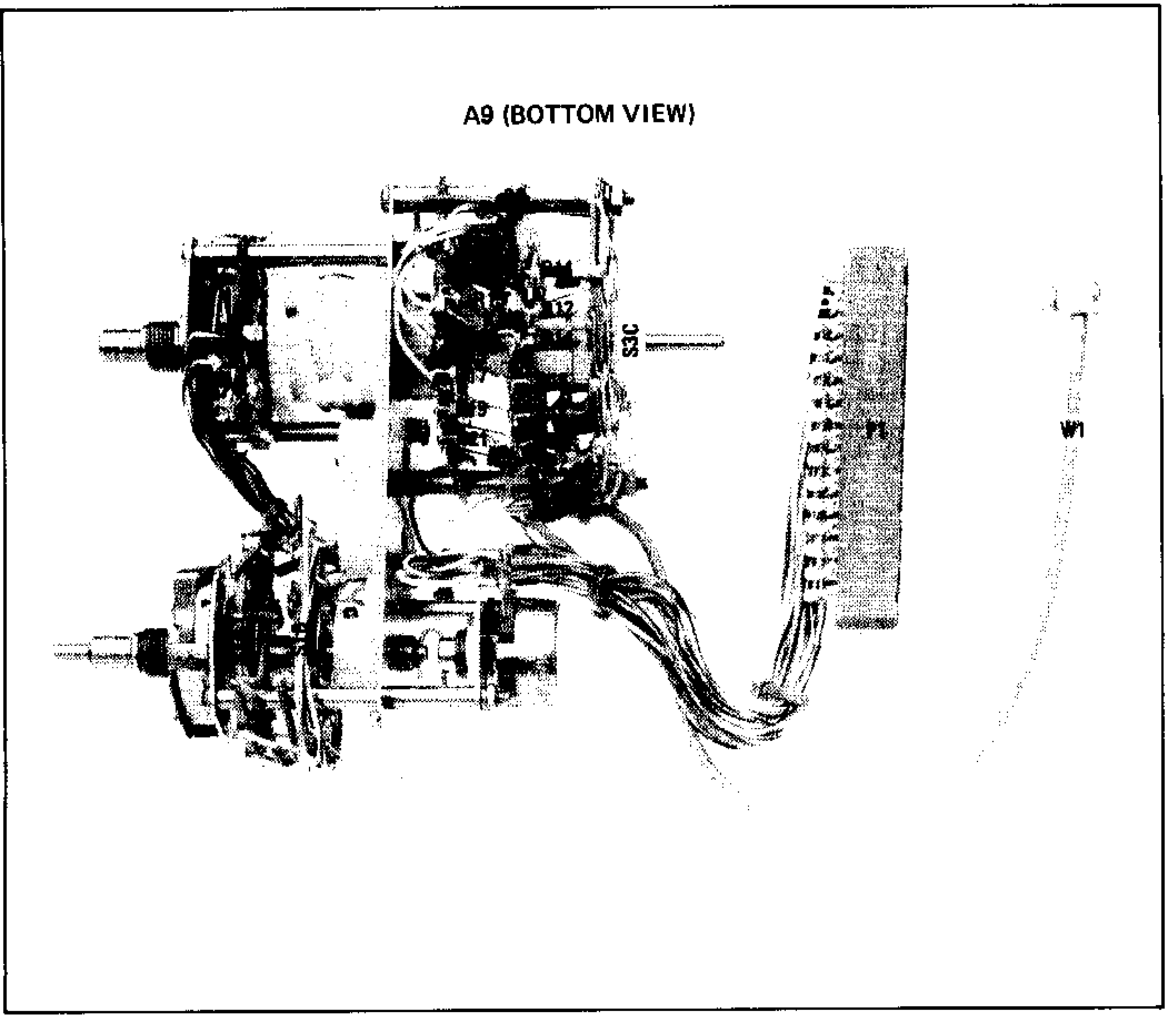


Figure 8-25. P/O A9 Peak Deviation and Range Switch Assembly Component Locations (2 of 2)

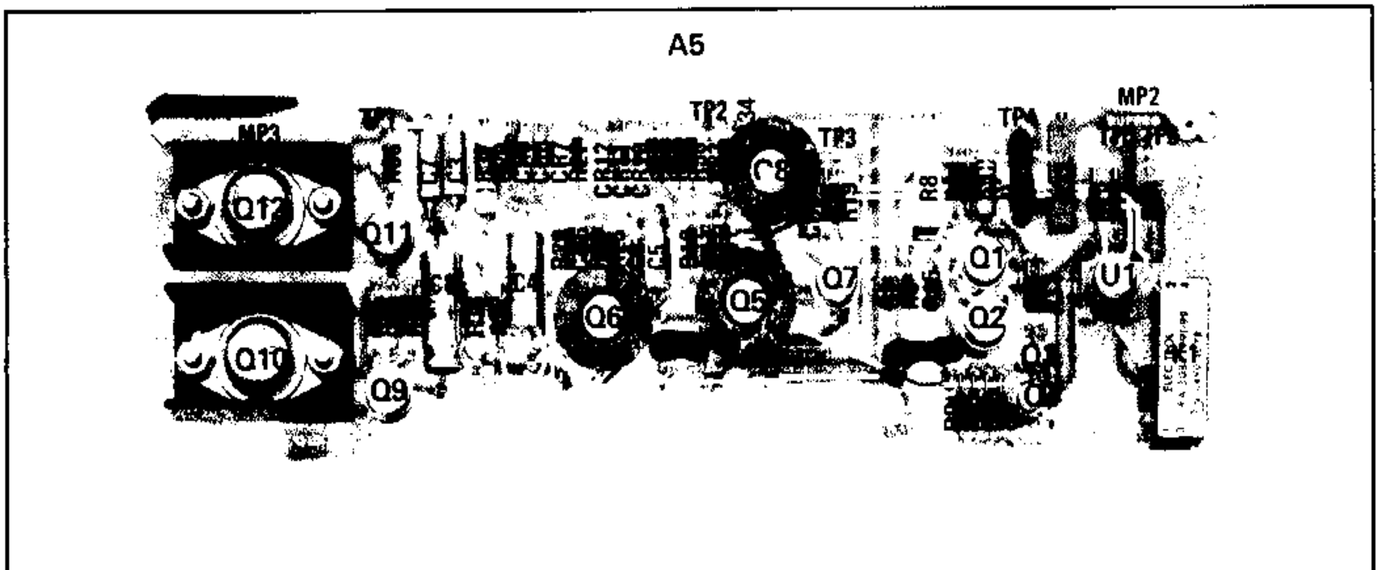
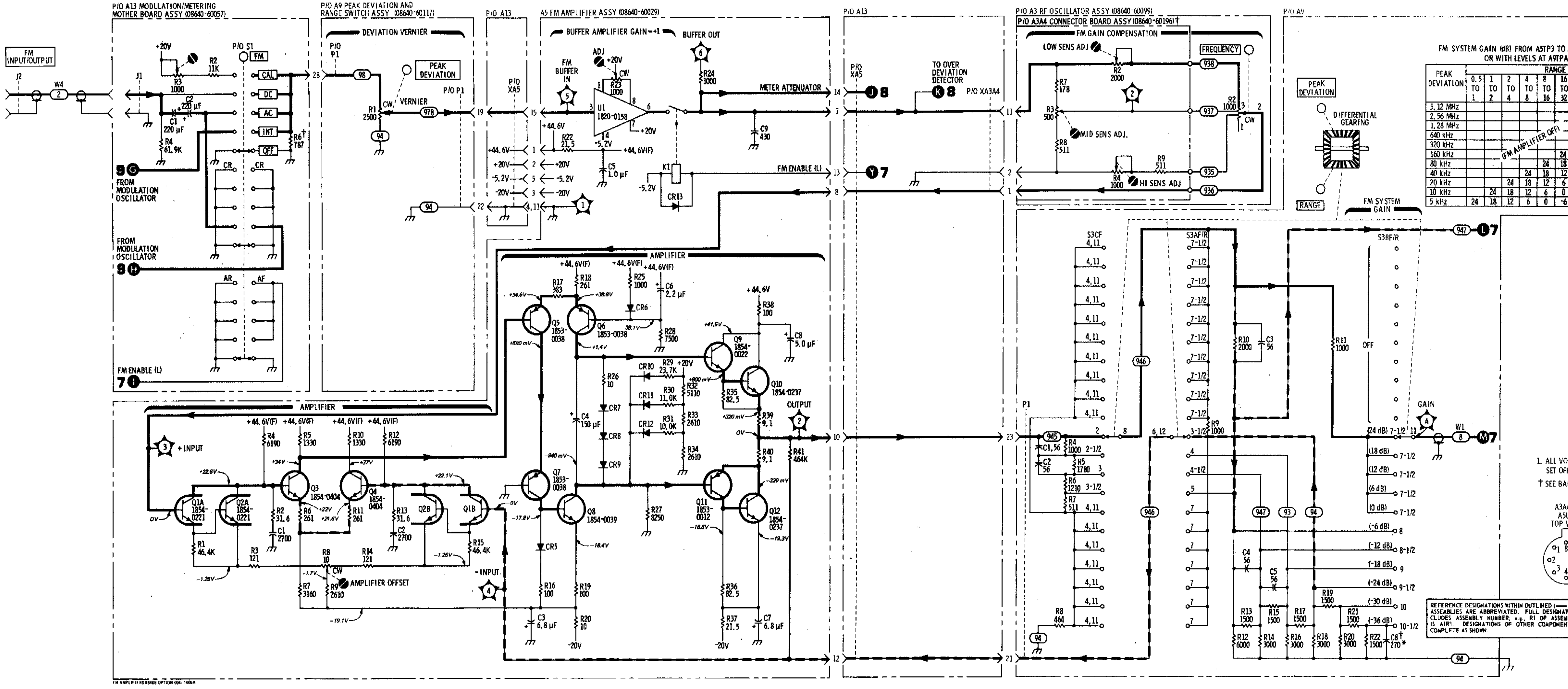


Figure 8-26. A5 FM Amplifier Assembly Component Locations



FM SYSTEM GAIN (dB) FROM A5TP3 TO A9TPA (WITH A7 REMOVED OR WITH LEVELS AT A9TPA <0.3Vrms)

PEAK DEVIATION	RANGE (MHz) 0.5 TO 1	1 TO 2	2 TO 4	4 TO 8	8 TO 16	16 TO 32	32 TO 64	64 TO 128	128 TO 256	256 TO 512	512 TO 1024
5.12 MHz											24
2.56 MHz										24	18
1.28 MHz									24	18	12
640 kHz								24	18	12	6
320 kHz							24	18	12	6	0
160 kHz						24	18	12	6	0	-6
80 kHz					24	18	12	6	0	-6	-12
40 kHz				24	18	12	6	0	-6	-12	-18
20 kHz			24	18	12	6	0	-6	-12	-18	-24
10 kHz		24	18	12	6	0	-6	-12	-18	-24	-30
5 kHz	24	18	12	6	0	-6	-12	-18	-24	-30	-36

(FM AMPLIFIER OFF)

REFERENCE DESIGNATIONS

A3	A9
R2	C1-5, 8 P1 R1, 4-22 P/O S3 P/O W1
A3A4	**A13**
R2-4, 7-9 TP2	C1,2 J1 R2-4, 6 P/O S1 P/O XA3A4 XA5
A5	**NO PREFIX**
C1-9 CR5-13 K1 Q1-12 R1-20, 22-41 TP1-6 U1	J2 W4

DELETED: A3A4R5, A5CR1-4, A5R21, A9C6, A9C7, A9R2, A9R3

NOTES

1. ALL VOLTAGES ARE WITH FM SWITCH SET OFF; TOLERANCE IS ±10%

† SEE BACKDATING, TABLES 7-1 AND 7-2

A3A4U1 A5U1 TOP VIEW

CIRCUIT BOARD TOP VIEW

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

6

A3, A5
A9, A13

Figure 8-27. FM Amplifiers Schematic Diagram

SERVICE SHEET 7

PRINCIPLES OF OPERATION

General

The FM shaping networks, in conjunction with the FM amplifier (Service Sheet 6) and the peak deviation attenuator, condition the modulation signal to drive the RF Oscillator's varactor diodes which electrically tune the oscillator. The tuning sensitivity of the oscillator with respect to the modulation input decreases as the tuning voltage becomes more positive. The shaping networks compensate for the non-linear tuning characteristic. In addition, the varactor diodes can be tuned by the phase lock circuits to synchronize the RF oscillator with an accurate and stable reference oscillator.

FM Enable (A7)

The varactor diode cathodes are switched by FM Enable reed relay K1 either to R39 when the FM is disabled or to the amplifier output when the FM is enabled. The relay is energized only when the FM switch is not OFF and when the PEAK DEVIATION and RANGE switches are set to an allowable combination. The maximum peak FM deviation possible is 170 of the output frequency at the low end of a range (e.g., 2.56 MHz deviation on the 256-512 MHz range). The PEAK DEVIATION and RANGE switches, however, can be set to combinations that exceed this (e.g., 2.56 MHz deviation on the 2-4 MHz range). For such unallowable combinations, the FM amplifier is disabled (by A5K1 on Service Sheet 6), the varactor diode cathodes are grounded (by A7K1), the meter input is opened (by A5K1), and the REDUCE PEAK DEVIATION annunciator lamp A6DS2 is turned on (see Service Sheet 8). The interaction of the PEAK DEVIATION switch and the RANGE switch is accomplished by differential gearing between the two switches.

Positive and Negative Shaping (A7)

The Positive Shaping network presents an increasingly lower impedance to the input as the input voltage increases. Resistors R11, R12, and R13 set the base voltage of transistor Q5, and Q5 sets the voltage supply to the resistor-diode ladder. Transistor Q6 supplies most of the current. Capacitor C5 keeps the base of Q5 at an ac ground potential. Diode CR9 protects Q6 in the event of a shorted +20V supply. The base-emitter junction of Q5 temperature-compensates the diodes of the ladder near it.

Transistor Q7 sets the voltage at the other end of the resistor-diode ladder at one diode junction drop below ground; it also temperature-compensates the diodes of the ladder near it. Transistor Q8 is a current sink. Capacitor C6 frequency-stabilizes Q7 and Q8. The diode cathodes in the ladder between Q7 and Q5 are at increasingly higher potentials. As the voltage at the input to the ladder increases, the diodes turn on consecutively and the

FM Amplifiers (A3, A5, A9, A13)
SERVICE SHEET 6

SERVICE SHEET 7 (Cont'd)

impedance at the input lowers. The Negative Shaping network is analogous to the Positive Shaping network except the polarity of all voltages is reversed, the diodes are reversed, all transistors are complemented, and the shaping characteristic is modified.

Phase Lock Loop Filter (A7)

The Phase Lock Loop Filter is a 17 Hz active elliptic-function low-pass filter which filters the phase detector error voltage and drives the varactor diode anodes (on Service Sheet 5). The phase lock input may vary from +5 to +15V; the voltage at the varactor anodes varies from –13.6 to –16V with a quiescent value adjusted by R 19.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the FM shaping circuits or to the phase lock loop filter as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the intial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A

Initial Test Conditions

Bottom cover removed (see Service Sheet 6 for removal procedure). Extend A7 FM Shaping Assembly on extender board.

Initial Control Settings

COUNTER MODE LOCK . . . . OFF

Positive and Negative Shaping

A trouble in one of the shaping circuits will usually cause FM sensitivity, distortion, and meter accuracy to be out of specification and will also prevent FM linearity from being correct] y adjusted. The quickest way to troubleshoot the shaping circuits is to use the ohms function of the DVM to check the components.

Phase Lock Loop Filter

A trouble in the loop filter will either prevent the generator from becoming phase-locked or prevent frequency modulation at low modulation rates. Trouble might also cause an increase in SSB noise or residual FM while phase-locked. A low voltage at A7TP2 (VARACTOR ANODE) may indicate a faulty Phase Lock Loop Filter or Varactor Assembly (shown on Service Sheet 5).

FM Shaping Circuits and Phase Lock Loop Filter Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
POSITIVE and NEGATIVE SHAPING (A7)	Remove A7 Assembly from chassis. Check component resistances with DVM.	Components check good	Replace faulty component
PHASE LOCK LOOP FILTER (A7)	Initial conditions and settings. Check voltages shown on schematic.	Voltages check good	Check counter phase lock circuits and U1
	Remove A7 Assembly from chassis. Check component resistances with DVM.	Components check good	Replace faulty component

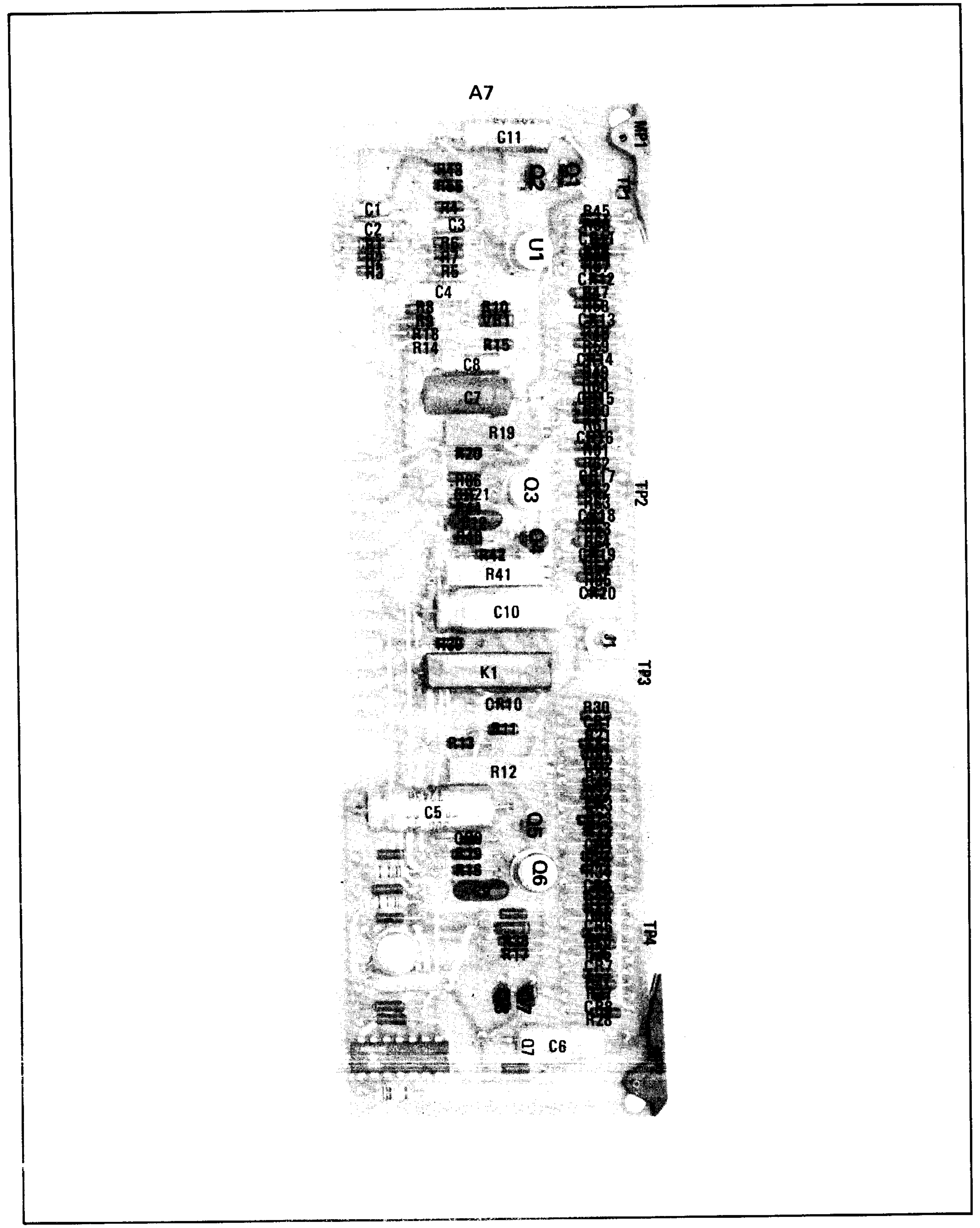
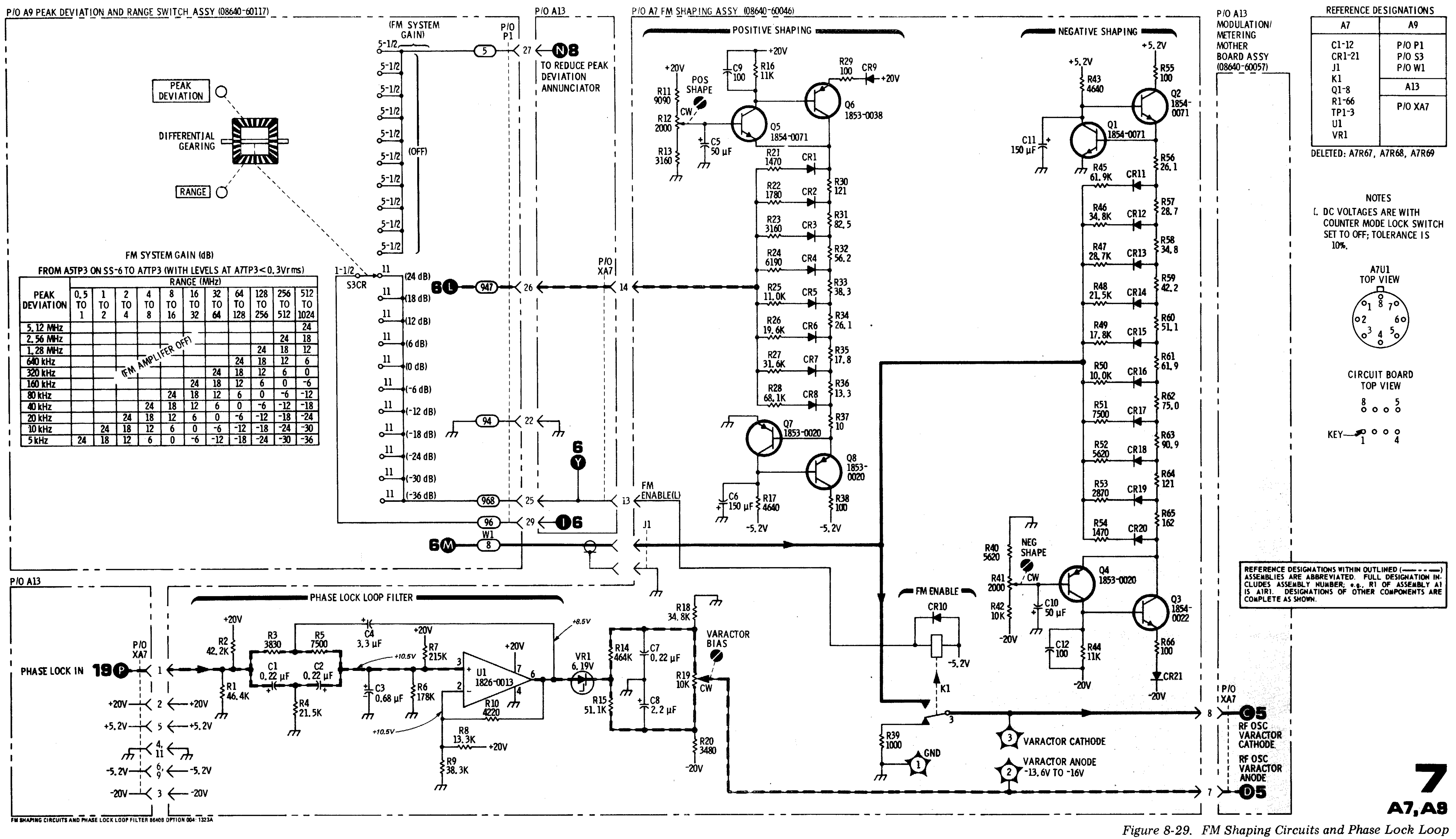


Figure 8-28. P/O A7 FM Shaping Assembly Component Locations



FM SYSTEM GAIN (dB)

FROM A5TP3 ON SS-6 TO A7TP3 (WITH LEVELS AT A7TP3 < 0.3Vrms)

PEAK DEVIATION	RANGE (MHz) 0.5 TO 1	1 TO 2	2 TO 4	4 TO 8	8 TO 16	16 TO 32	32 TO 64	64 TO 128	128 TO 256	256 TO 512	512 TO 1024
5.12 MHz											24
2.56 MHz										24	18
1.28 MHz									24	18	12
640 kHz								24	18	12	6
320 kHz							24	18	12	6	0
160 kHz						24	18	12	6	0	-6
80 kHz					24	18	12	6	0	-6	-12
40 kHz				24	18	12	6	0	-6	-12	-18
20 kHz			24	18	12	6	0	-6	-12	-18	-24
10 kHz		24	18	12	6	0	-6	-12	-18	-24	-30
5 kHz	24	18	12	6	0	-6	-12	-18	-24	-30	-36

(FM AMPLIFER OFF)

REFERENCE DESIGNATIONS

A7	A9
C1-12, CR1-21, J1, K1, Q1-8, R1-66, TP1-3, U1, VR1	P/O P1, P/O S3, P/O W1
	A13
	P/O XA7

DELETED: A7R67, A7R68, A7R69

NOTES

1. DC VOLTAGES ARE WITH COUNTER MODE LOCK SWITCH SET TO OFF; TOLERANCE IS 10%.

Figure 8-29. FM Shaping Circuits and Phase Lock Loop Filter Schematic Diagram

SERVICE SHEET 8

PRINCIPLES OF OPERATION

Over-Deviation Detector (A7)

If the FM input signal is too large for the FM circuits to operate properly, the Over-Deviation Detector lights the REDUCE FM VERNIER annunciator lamp A6DS1. Integrated circuit U2 is a dual comparator amplifier with wired-OR outputs. Pin 7 of U2B is at 1.1 Vdc; pin 4 of U2A is at -1.1 Vdc; these two voltages are the high and low reference voltages. Pins 6 and 3 of U2 are the common inputs. If the input, which comes from the FM buffer amplifier, is not between +1.1 and -1.lV, the outputs go high (> lV). Integrated circuit U3 is a hex inverter with open collector outputs. U3A inverts the comparator output. When U3A goes low, capacitor C13 is discharged; when U3A goes high again, C13 slowly charges through R76. This effectively increases the duration of the comparator output when overloading occurs only for short periods. U3B inverts the output of U3A and drives four parallel inverters U3C to U3F. When the outputs of the four parallel inverters are low, the display lamp turns on, which occurs whenever the input to U3B is low.

Peak Deviation Switch (A9)

The Meter Attenuator scales the FM input signal to give the correct reading on the meter. The Scale/Annunciator Lamp Control section of the switch lights the proper scale annunciator lamp (on A6) for a given peak deviation range when the meter mode selected is FM.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the over-deviation detector, meter attenuator, or scale/annunciator lamp control circuits as a result of using the troubleshooting block diagrams.

Test Equipment

Digital Voltmeter HP3480D/3484A
Oscilloscope . . . . - . . . . Hp 180A/1801A/1820C

Initial Test Conditions

Bottom cover removed (see Service Sheet G for removal procedure). Extend A7 FM Shaping Assembly on extender board. Connect AM OUTPUT to FM INPUT.

Initial Control Settings

AM . . . . INT
AUDIO OUTPUT LEViL . . . . C W
MODULATION . . . .ccw
MODULATION FREQUENCY . . . . 400 **Hz (Fixed)**
FM . . . . AC
PEAK DEVIATION. 5kHz
PEAK DEVIATION Vernier.. . . . .ccw
RANGE 0.5-1MHz

SERVICE SHEET 8 (Cent'd)

Over-Deviation and Meter Control Circuits Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
OVER-DEVIATION DETECTOR (A7)	Initial conditions and settings. Adjust PEAK DEVIATION vernier for 1.8 Vp-p at U2 pins 3 and 6.	REDUCE FM VERNIER lamp unlit and 1. pins 6, 8, 10, 12 high 2. U3Bpin 4 low 3. U3A pin 2 high 4. TP4 (FM OVER-LOAD) low	Replace faulty component
	Adjust PEAK DEVIATION vernier for 2.4 V p-pat U2 pins 3 and 6	REDUCE FM VERNIER lamp lit and 1. pins 6, 8, 10, 12 low 2. U3B pin 4 high 3. U3A pin 2 low 4. TP4 (FM OVER-LOAD) >2 Vp-P	Replace faulty component
SCALE] ANNUNCIATOR LAMP CONTROL (A9)	Initial conditions and settings. Set Meter Function to FM and set PEAK DEVIATION as follows: 5 kHz 10 kHz 20 kHz 40 kHz 80 kHz 160 kHz 320 kHz 640 kHz 1.28 MHz 2.56 MHz 5.12 MHz	SCALE lamps light as follows: 5 10 3 5 10 3 3 10 3 3 5	Check scale lamps (A6) and switches (A9)

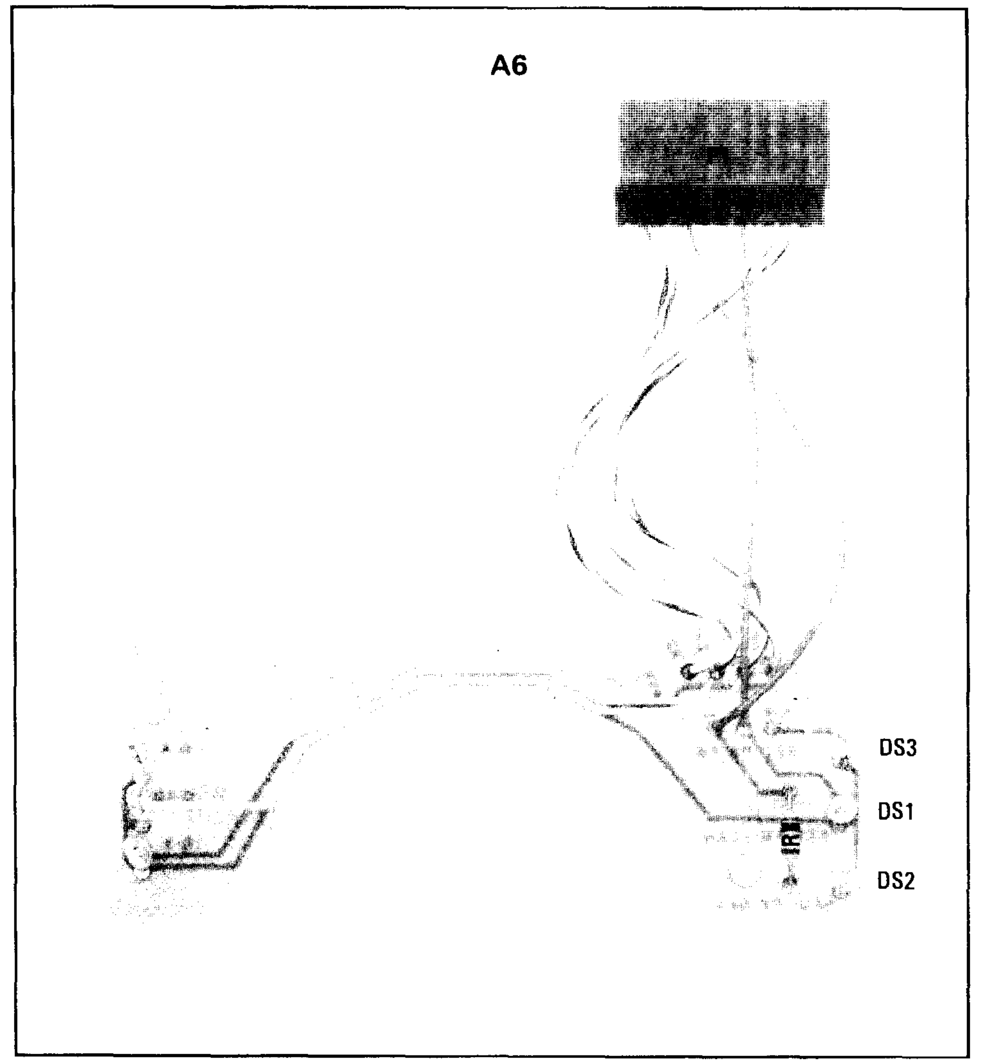


Figure 8-30. P/O A6 Annunciator Assembly Component Locations

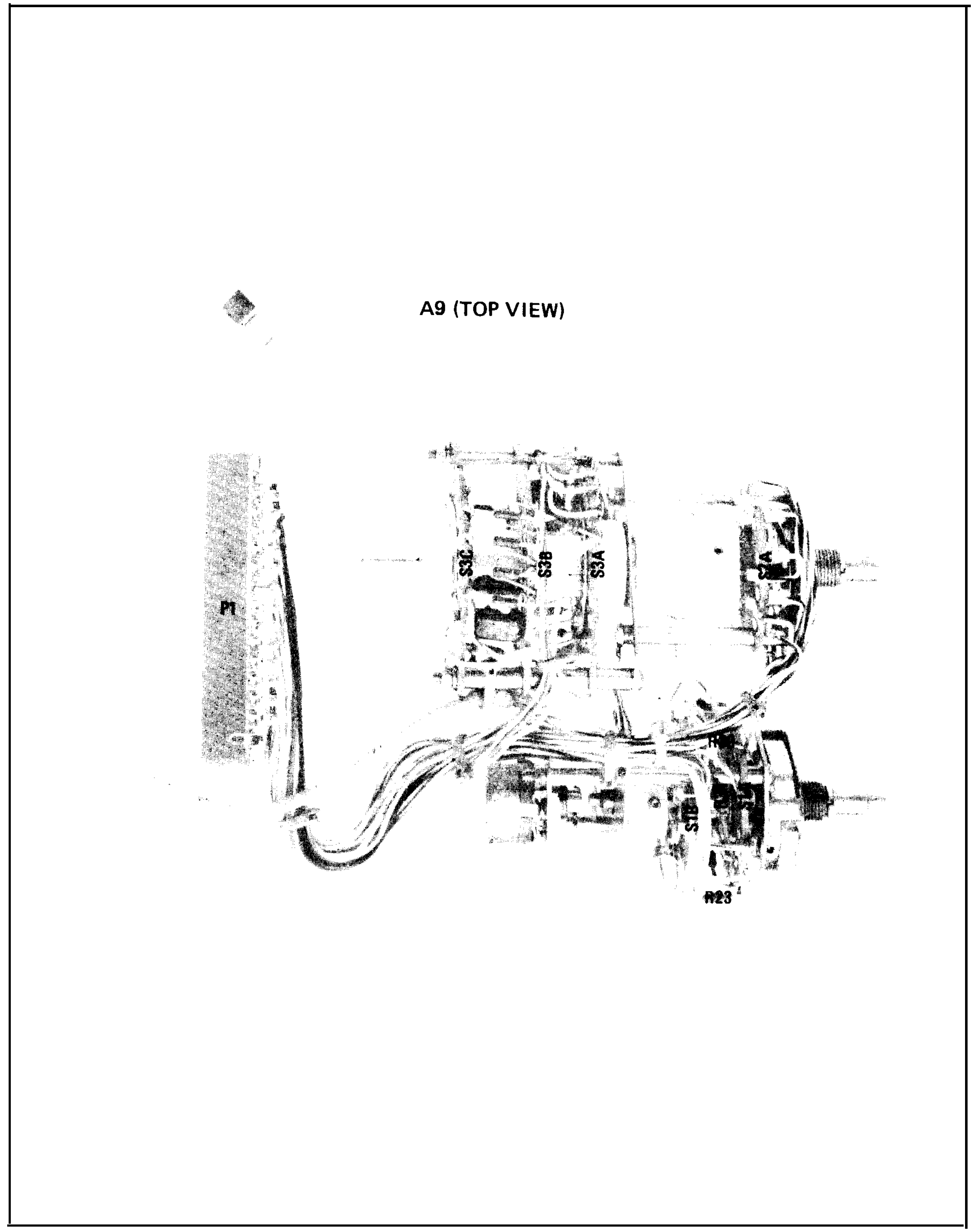


Figure 8-31. P/O A9 Peak Deviation and Range Switch Assembly Component Locations (1 of 2)

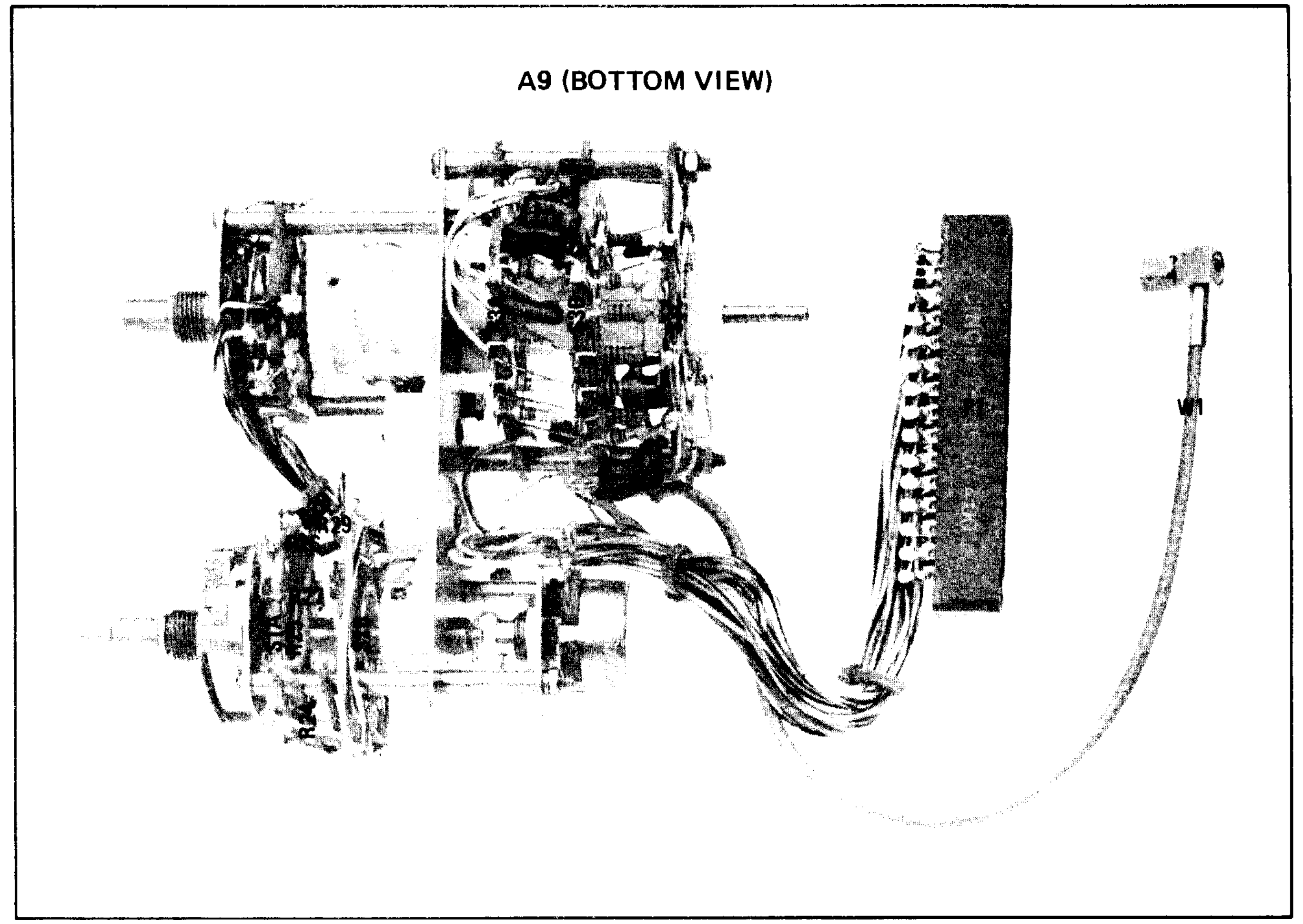


Figure 8-31. P/O A9 Peak Deviation and Range Switch Assembly Component Locations (2 of 2)

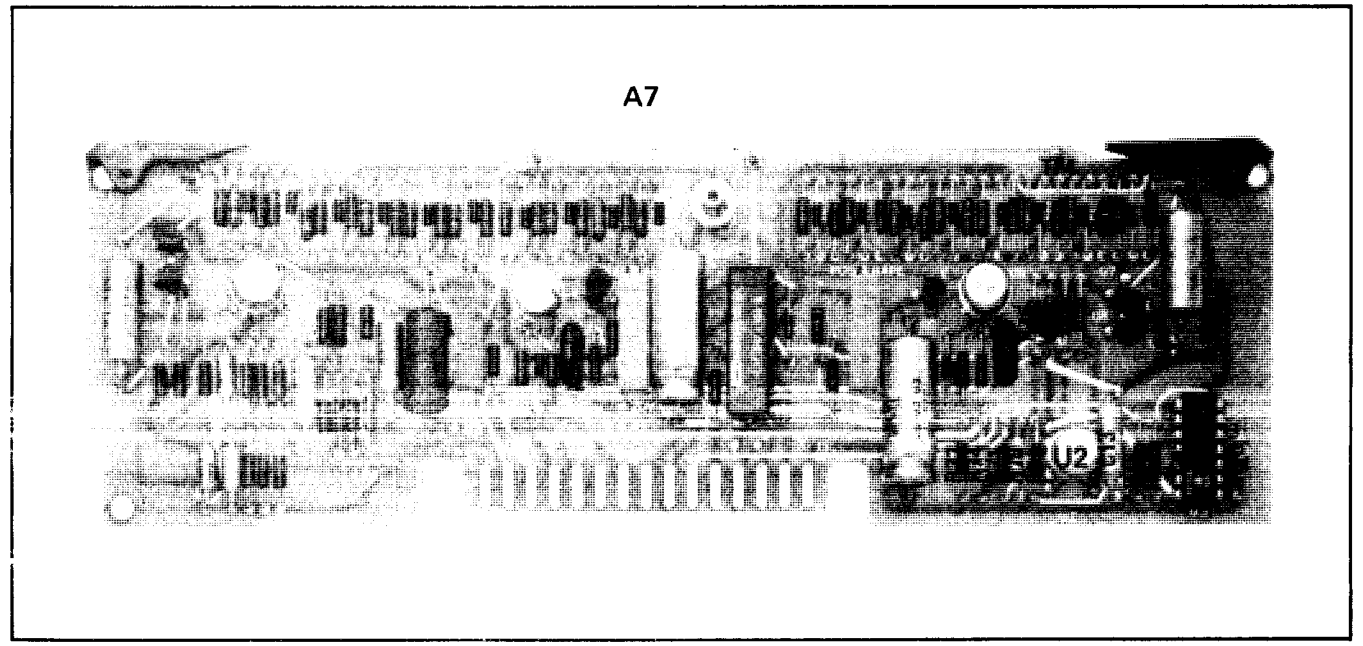
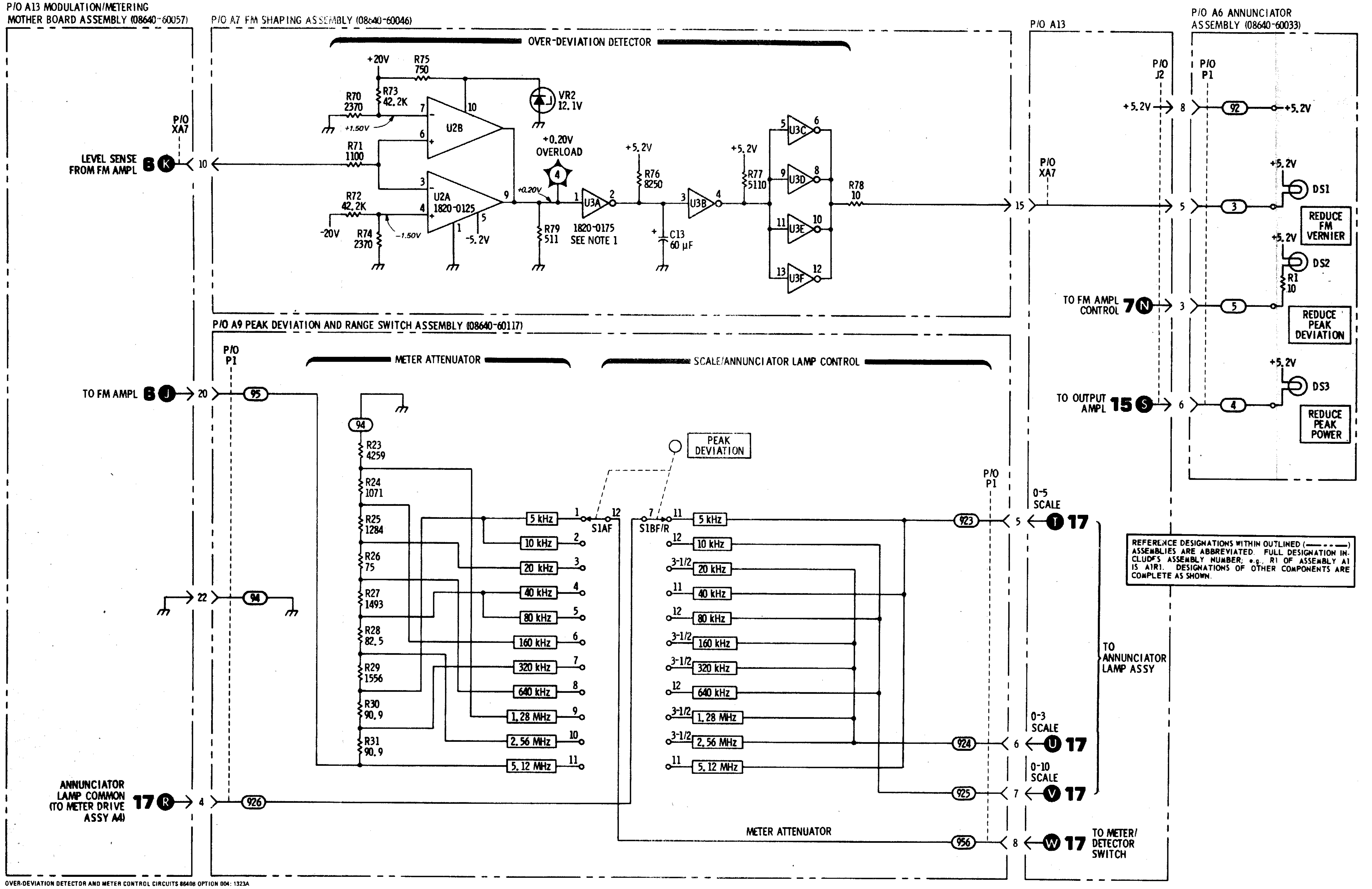


Figure 8-32. P/O A7 FM Shaping Assembly Component Locations

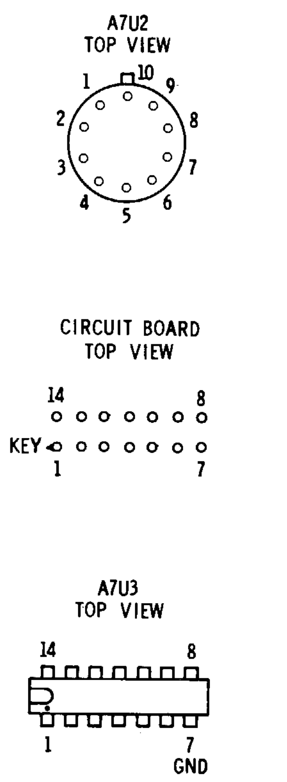


REFERENCE DESIGNATIONS

A6	A9
DS1-3 P/O P1 R1	P/O P1 R23-31 S1
A7	**A13**
C13 R70-79 TP4 U2,3 VR2	J2 P/O XA7

NOTES:

1. OPEN COLLECTOR TTL



8
A6, A7, A9

Figure 8-33. Over-Deviation Detector and Meter Control Circuits Schematic Diagram

SERVICE SHEET 9

PRINCIPLES OF OPERATION

General

When either the AM or FM modulation select switch is set to INT, the Modulation Oscillator is enabled. The oscillator feeds a 1000 or 400 Hz signal (selected by the MODULATION FREQUENCY switch) into the AM or FM modulator circuits and to the AM or FM front panel OUTPUT ports. The fixed-frequency modulation oscillator, shown on this Service Sheet, is the standard oscillator supplied with the generator.

Modulation Oscillator (Al 1)

Amplifier U1 is the gain block. A frequency-selective bridged-tee network forms a negative feedback path for U1. (This network is a notch filter with zero phase shift at the minimum of the notch.) The frequency of oscillation is determined by the network: Cl, C2, and either A1lA1R1 and R2 or R3 and R4. 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 amplitude.) The voltage divider consists of R4, R3, CR1, and CR2. Diodes CR1 and CR2 are in ac parallel and dc series. The ac resistance is determined by the dc voltage across capacitor C5. At the peak of each output cycle VR2 and CR3 conduct and replenish the charge lost from C5. The ac voltage at the output of U1 is about 5.1 Vrms.

Buffer Amplifiers (Al 1)

Resistors R5, R6, and R7 lower the oscillator output voltage to 2.3 Vrms at TP5. Resistors R13 and R14 lower the voltage to about 0.84 Vrms at TP3 and TP4. Transistor Q5 drives the FM PEAK DEVIATION vernier potentiometer; Q4 drives the AM MODULATION potentiometer; Q1 drives the AM OUTPUT port; and Q2 drives the FM OUTPUT port. Signal levels at the two ports are approximately 1 Vrms into 600fl.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the fixed-frequency modulation oscillator as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top and bottom covers removed (see Service Sheet G for removal procedure). Extend All Fixed-Frequency Modulation Oscillator Assembly on extender board (see Service Sheet C for removal procedure).

Initial Control Settings

AM INT
AUDIO OUTPUT LEVEL . : : : : : : : : : . CW
MODULATION FREQUENCY . . . . . **400** Hz

Fine Frequency Adjustment

The oscillator's frequency can be lowered slightly by twisting the orange (3), yellow (4), and green (5) wires together. The wires connect MODULATION FREQUENCY switch A11A1S1 to the All circuit board.

Fixed-Frequency Modulation Oscillator Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
MODULATION OSCILLATOR ASSY (All)	Initial conditions and settings. Then set MODULATION FREQUENCY to 1000 Hz.	Peak-to-peak voltages are as shown on schematic	Check appropriate circuit and replace faulty component
	Set AM to OFF. Use DVM to check dc voltages.	DC voltages check good	Replace faulty component

Over-Deviation Detector and Meter Control Circuits (A6, A7, A9)
SERVICE SHEET 8

A11

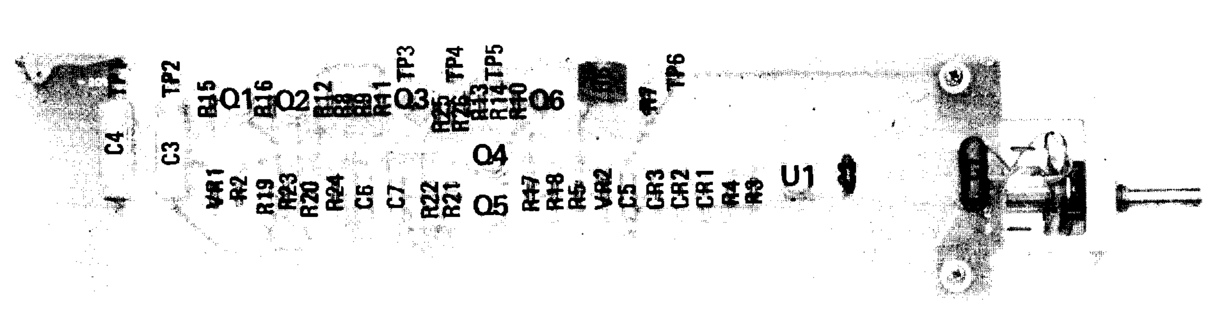
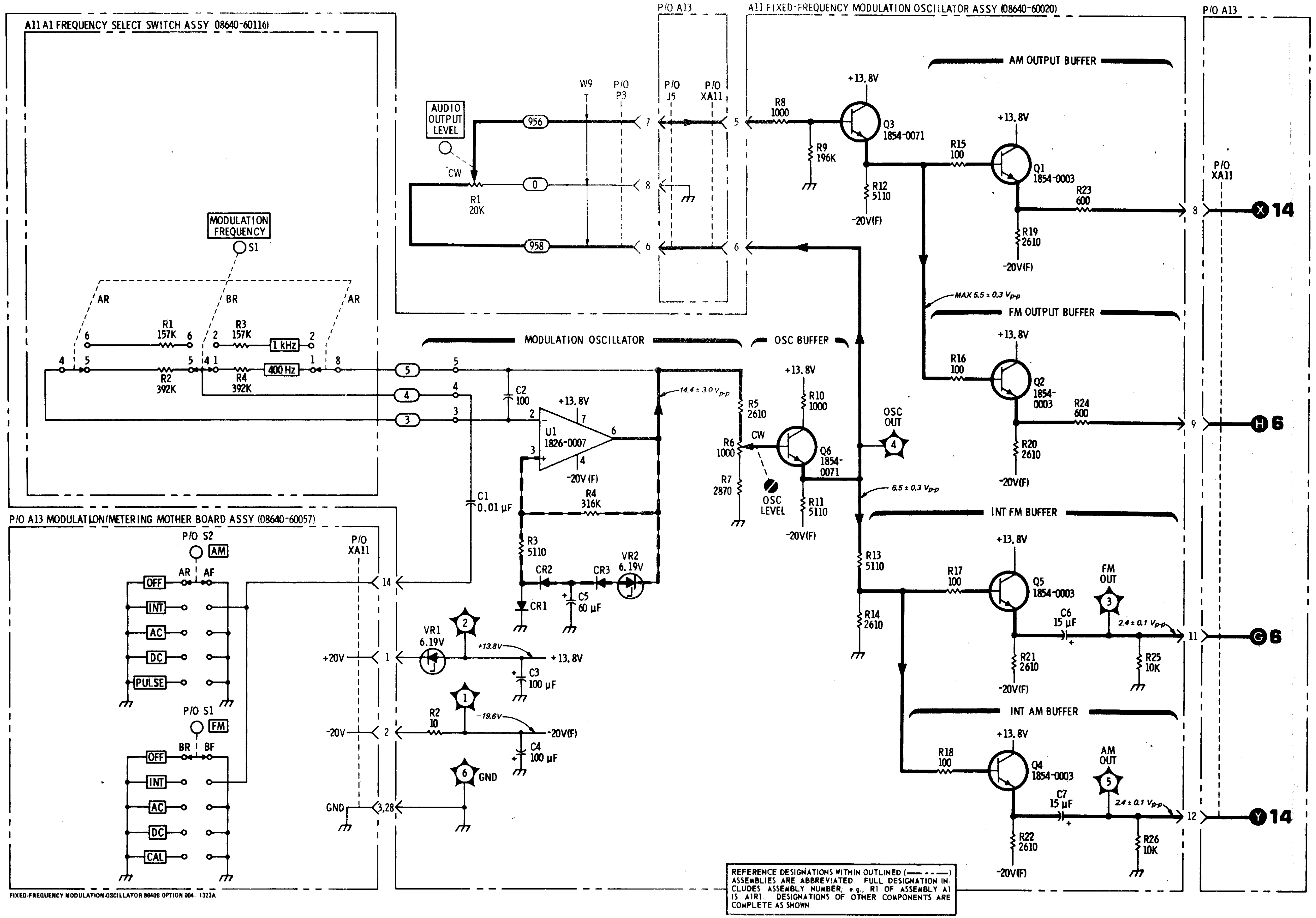


Figure 8-34. A11 Fixed-Frequency Modulation Oscillator Component Locations

A13

Component Locations for A13 Assembly are on Service Sheet 25.



REFERENCE DESIGNATIONS	
A11	A13
C1-7 CR1-3 Q1-6 R2-26 TP1-6 U1 VR1,2	J5 P/O S1, S2 XA11
A11A1	NO PREFIX
R1-4 S1	P/O P3 R1 W9

DELETED: A11R1

9

A11, A13

Figure 8-35. Fixed-Frequency Modulation Oscillator Schematic Diagram

SERVICE SHEET 9A

PRINCIPLES OF OPERATION

General

When either the AM or FM modulation select switch is set to INT, the Modulation Oscillator is enabled. The oscillator feeds a signal with a frequency selected by the MODULATION FREQUENCY switch into the AM or FM modulator circuits and to the AM or FM front panel OUTPUT ports. The variable-frequency modulation oscillator, shown on this Service Sheet, is supplied with Option 001.

Modulation Oscillator (Al 1)

The Modulation Oscillator is a Wein-bridge type. Transistors Q7 to Q12 form a differential amplifier. The gate of FET Qll is a high impedance non-inverting input of the amplifier. Transistor Q12 is an emitter-follower buffer amplifier. Trimmer capacitor C9 compensates for the high frequency phase shift of the amplifier. Transistors Q9 and Q10 provide voltage gain and drive the complementary symmetry output transistors Q7 and Q8. The inverting input to the amplifier is the emitter of Q9. Diodes CR2 to CR4 bias and thermally compensate Q7 and Q8. Components R19, Cll, and C12 frequency compensate the amplifier. Resistor R26 provides negative dc feedback.

A frequency-selective Wein ladder forms a positive feedback path. This network is a band pass filter with zero phase shift at the maximum of the pass band. The frequency of oscillation is determined by the resistors and capacitors of the ladder. In the FIXED FREQ range, C6 and C7 are the ladder capacitors and either R2 and R6 or R3 and R5 in parallel with R6 are the resistors. In the variable frequency ranges, C1A and C1B are the variable ladder capacitors and R1 and R4 (each in parallel with one or none of the resistors on the AllA1 Frequency Select Switch) are the resistors. Capacitors C2, C3, C4, and C5 set the frequency end points and maximize flatness for a given frequency range. The negative feedback path is a voltage divider in which the amount of feedback is determined by the output signal level. The amount of feedback adjusts to maintain oscillation at a constant amplitude. The voltage divider consists of R28 and RT1, a thermistor assembly. Diodes VR1, VR2, CR5, and CR6 add a small amount of odd-harmonic distortion to stabilize the amplitude characteristic of the oscillator.

Buffer Amplifiers (Al 1)

Transistors Q1 to Q4 form the AM/FM Output Buffer Amplifier which is similar in operation to the oscillator output amplifier. Gain of the amplifier is adjusted by R40. The outputs drive the external AM or FM ports. Resistors R34, R35, and R36 attenuate the oscillator output to a level of

Fixed-Frequency Modulation Oscillator (A11, A13) SERVICE SHEET 9

SERVICE SHEET 9A (Cent'd)

0.84 Vrms. Transistor Q5 drives the FM PEAK DEVIATION potentiometer (Service Sheet 6), and Q6 drives the AM MODULATION potentiometer (Service Sheet 14).

TROUBLESHOOTING

It is assumed that a problem has been isolated to the variable-frequency modulation oscillator as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top and bottom covers removed (see Service Sheet G for removal procedure). Extend All Variable-Frequency Modulation Oscillator Assembly on extender board (see Service Sheet D for removal procedure).

Initial Control Settings

AM . . . INT
AUDIO OUTPUT-LEVEL " : : : : : : : : : . CW
MODULATION FREQUENCY . 400 Hz (Fixed)

Amplitude Stability and Distortion

The signal level of the oscillator is adjusted (by selection of R28) for best compromise between harmonic distortion and amplitude stability (squegging at turn-on or range change). See Table 5-1, Factory Selected Components.

Variable-Frequency Modulation Oscillator Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
MODULATION OSCILLATOR ASSY (All)	Initial conditions and settings. Then set MODULATION FRE-QUENCY to 1000 Hz (fixed) and to each of the variable ranges (Xl, X10, etc.) Vary the vernier on each range.	Peak-to-peak voltages are as shown on schematic	Check appropriate circuit and replace faulty component
	Set AM to OFF	DC voltages are as shown on schematic	Replace faulty component

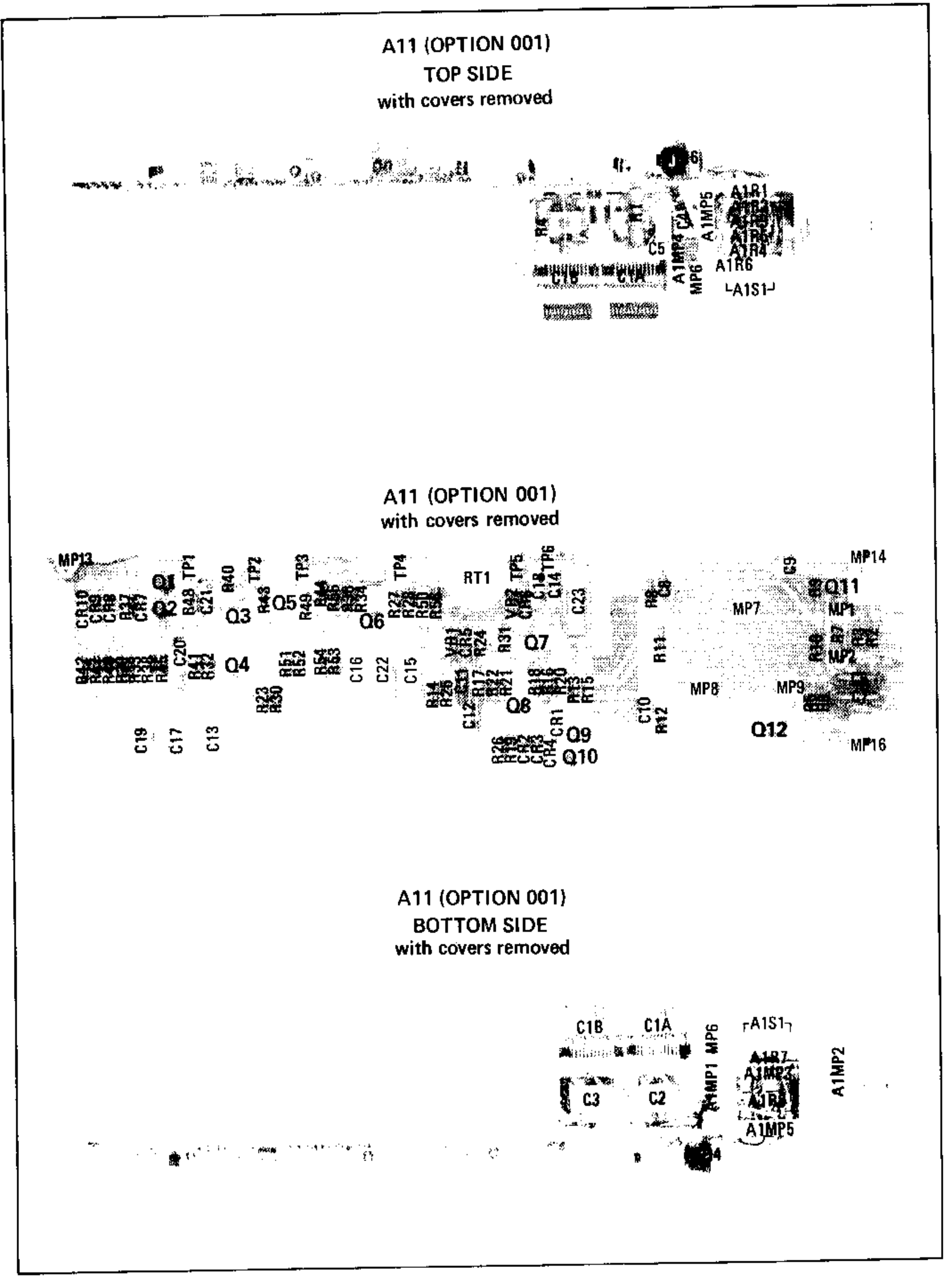
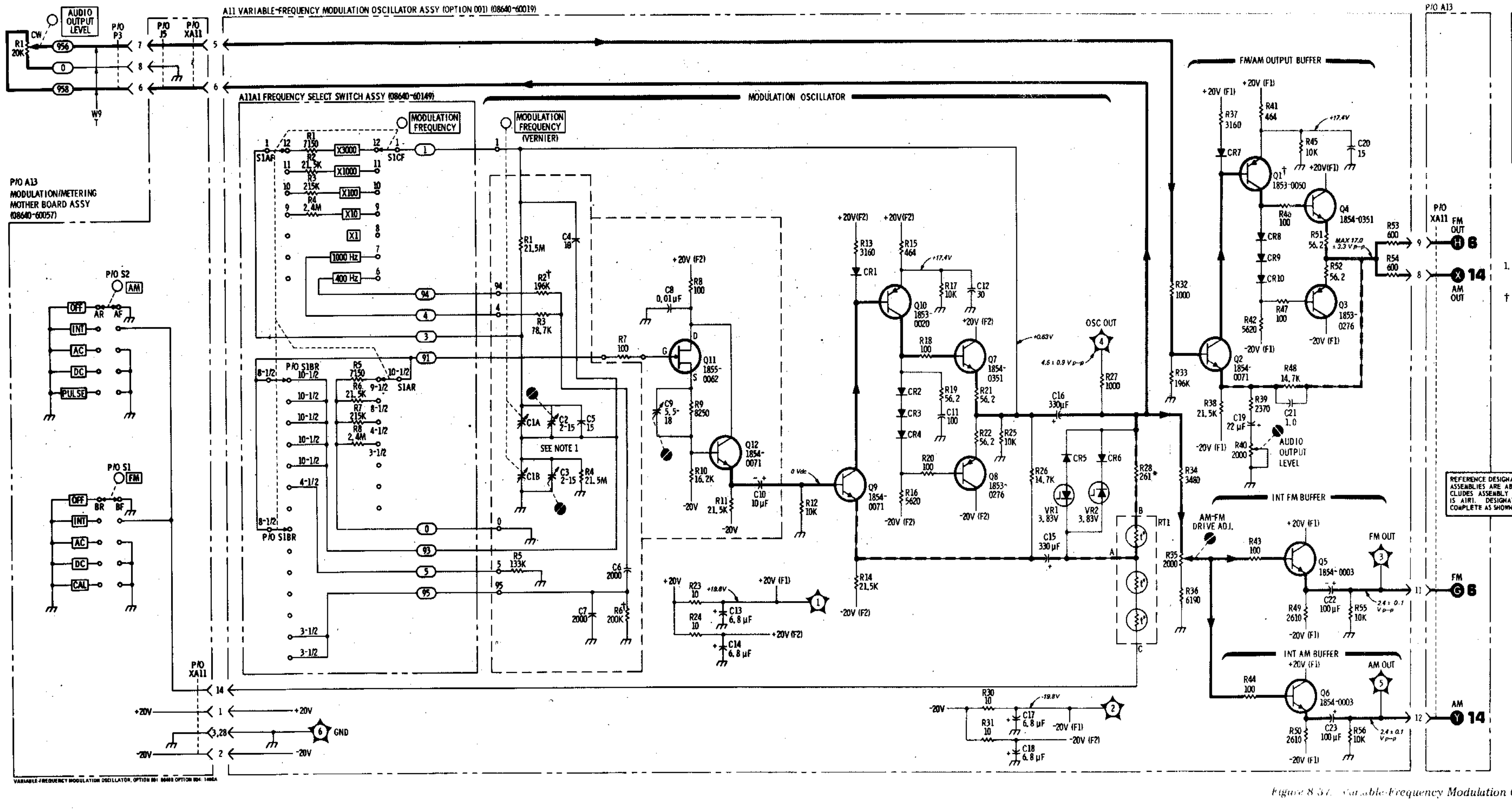


Figure 8-36. A11 Variable-Frequency Modulation Oscillator Assembly (Option 001) Component Locations

A13

Component Locations for A13 Assembly are on Service Sheet 25.



REFERENCE DESIGNATIONS	
A11	A13
C1-23 CR1-10 Q1-12 R1-28,30-56 RT1 TP1-6 VR1,2	J5 P/O S1,S2 XA11
	NO PREFIX
	P/O P3 R1 W9
A11A1	
R1-8 S1	

DELETED: A11R29

NOTES:

1. THE COMBINED CAPACITANCE OF A11C1A AND A11C1B IS APPROXIMATELY 10-365 pF.

† SEE BACKDATING, TABLES 7-1 AND 7-2.

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.

9A
A11, A13

Figure 8-37. Variable-Frequency Modulation Oscillator (Option 001) Schematic Diagram

SERVICE SHEET 10

PRINCIPLES OF OPERATION

Divider/Filter Assembly - General

The A10 Divider/Filter Assembly frequency divides and filters the signal from the RF oscillator. The divider network (see Figure 8-41.) consists of a chain of nine binary dividers (+2). The output is taken either from the RF oscillator buffer or from an OR gate at the output of one of the dividers, depending on the frequency range selected; all other divider output gates are disabled and also the divider immediately following the output divider. The output gates are transformer coupled out and drive a power amplifier which drives the modulator. The modulator controls the signal level and adds AM.

The output from the dividers (and the modulator) is approximately a square wave. The low-pass filters remove the signal's harmonics. On the four lowest frequency bands, the square wave output is quite symmetrical (i.e., second harmonics are well suppressed). In the lower portion of these bands, the filters suppress only the third harmonic and higher.

On higher frequency bands the divider output is more asymmetrical and more second harmonic is present. Each of these bands has two filters. In the lower portion of these bands, the first filter's stop-band frequency is made low enough to suppress the second harmonic. In the higher portion of the band, a filter with a higher stop-band frequency is switched in to suppress the second harmonic. The high-band filter is switched in at approximately the geometric mean of the frequency extremes of the band. A Schmitt Trigger senses a dc voltage, V_T which is proportional to the frequency, and relays switch the filters at the geometric mean. On the four lowest bands, the low band filter for the 16-32 MHz range is also switched in series with the band filters to improve the rejection of high-order harmonics. All range switching is done by cam-operated slide switches on the filter board (A10A1). The filters drive the output amplifier which drives the RF output and AGC circuits. The filters are inside the AGC feedback loop.

RF Filters (A1OA1)

The Al0A1 RF Filter Assembly contains sixteen RF lowpass filters and six slide switches that are controlled by the RANGE switch. The filters for the four lowest bands (0.5 -8 MHz bands) are sharp-cutoff, elliptic-f unction filters. The remaining filters are Chebishev filters. In the six highest bands, relays K1 and K3 switch in the low band filters when the frequency is below the geometric mean frequency of the range and relays K2 and K4 switch in the high band filters when above the geometric mean. The slide switches route the RF signal to the proper filters, activate the frequency dividers, and route the RF signal to and from dividers. Each slider has three detented positions. Mechanical action of the RANGE switch is shown in Figure 8-38.

SERVICE SHEET 10 (Cent'd)

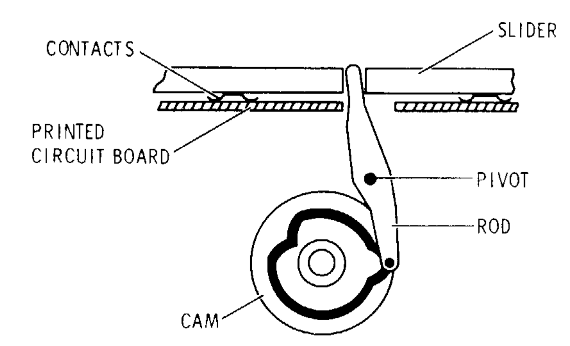


Figure 8-38. Action of RANGE Switch

TROUBLESHOOTING

It is assumed that a problem has been isolated to the RF Filter circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). A10 Divider/Filter Assembly casting cover removed, A10A2 RF Divider Assembly removed and extended for service with access to A10A1 RF Filter Assembly (see Service Sheet E for procedures).

Initial Control Settings

Meter Function . . . . VOLTS
COUNTER MODE: EXPAND . . . . Off
LOCK . . . . off
Source INT
AM.............. . . . . OFF
FM . . OFF
RANGE. . . . . 256-512 MH z
FREQUENCY TUNE . . . .550 MHz
OUTPUT LEVEL . . . .–l0dBm
RF ON/OFF . . . . .ON

SERVICE SHEET 10 (Cont'd)

RF Filter Circuits

The quickest way to isolate a divider/filter problem is to use the front panel controls to set various frequencies and frequency ranges while monitoring the output voltage meter. Usually a problem will appear as shown in the following table.

Symptom	Probable Cause
No output on one band only	Defective output circuit for one of the dividers, a filter, or a slide switch
No output on one band and all bands below that band	Defective divider or 16-32 MHz low band filter or 0.5 to 8 MHz divider output transformer
Low power at highest end of bands (8 to 1024 MHz) only	Defective geometric mean switching (high band filters not being switched in)
Overly high harmonics at lowest end of bands (8 to 1024 MHz) only	Defective geometric mean switching (low band filters not being switched in)
Intermittent power	Poor contact on slide switch
Changing bands does not change output frequency even though the counter may indicate a change	Loose coupler between RANGE switch and Divider/ Filter switch assembly

The dividers and the Schmitt Trigger circuits are shown and discussed on Service Sheet 11 (the relays driven by the Schmitt Trigger circuits are shown on this service sheet).

NOTE

The following procedure checks gross failure. A more comprehensive check can be made by performing the Filter Adjustment in Section V.

Variable-Frequency Modulation Oscillator for Option 001 (A11, A13) SERVICE SHEET 9A

SERVICE SHEET 10 (Cont'd)

RF Filter Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
HIGH/LOW BAND RELAYS (A10A1)	Initial conditions and settings	DC continuity across contacts of K2 and K4	Check K2, K4, and associated circuitry
	Set FREQUENCY TUNE to 256 MHz	DC continuity across contacts of K1 and K3	Check Kl, K3 and associated circuitry
RF FILTERS (A10A1)	Initial conditions and settings then set RANGE to each position and tune FREQUENCY TUNE full CW and full CCW	—1 O dBm on panel meter	Check appropriate switch contacts and appropriate high and low band filters

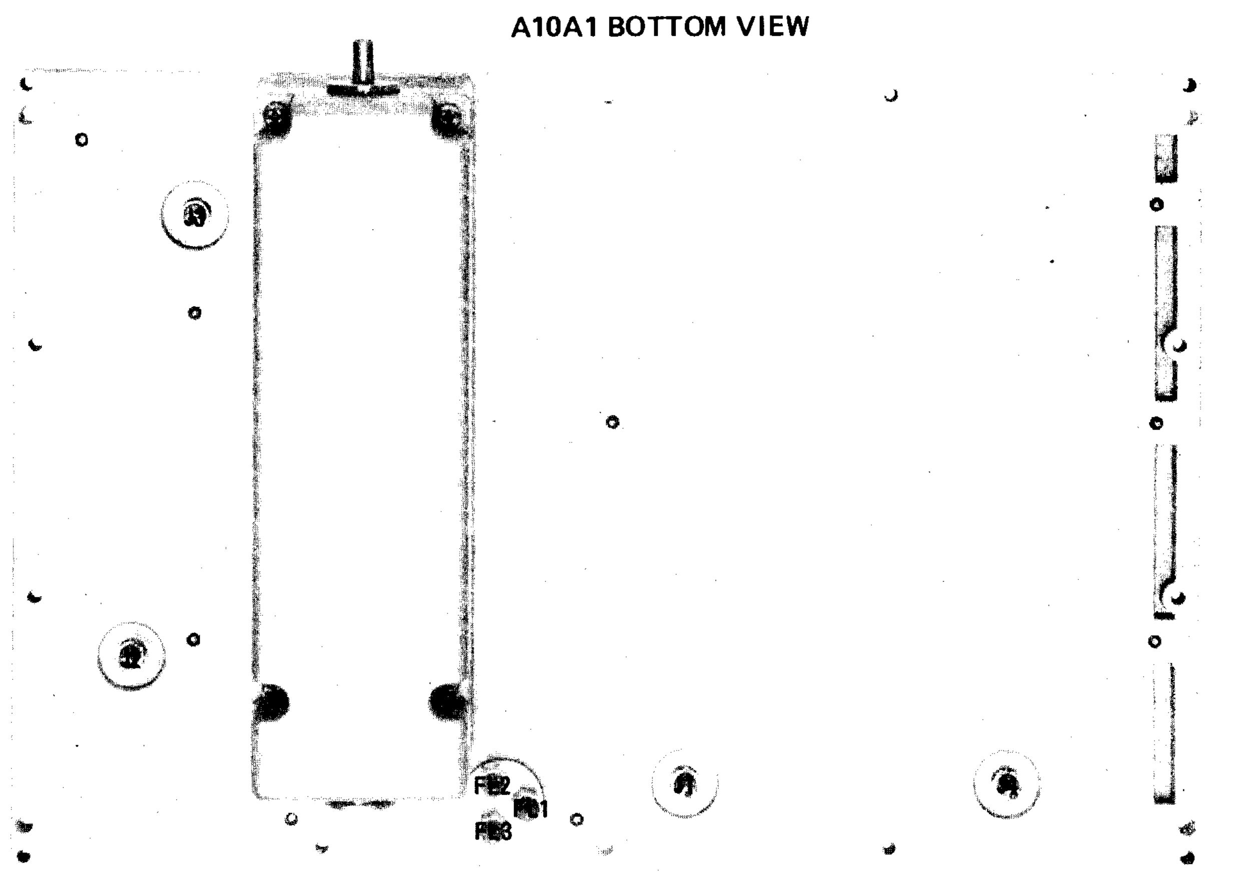


Figure 8-39. A10A1 RF Filter Assembly Component Locations (1 of 2)

A10A1 TOP VIEW

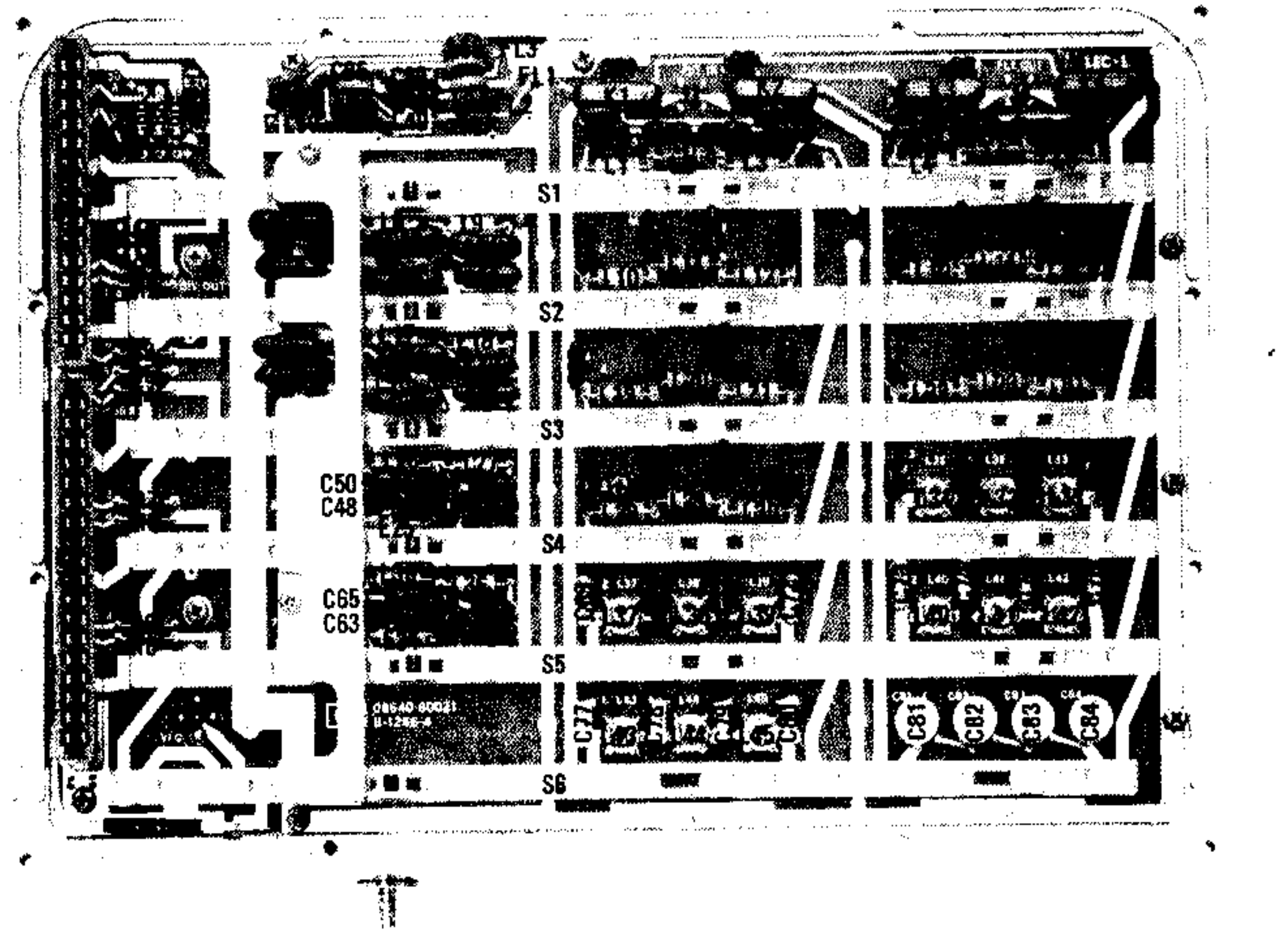
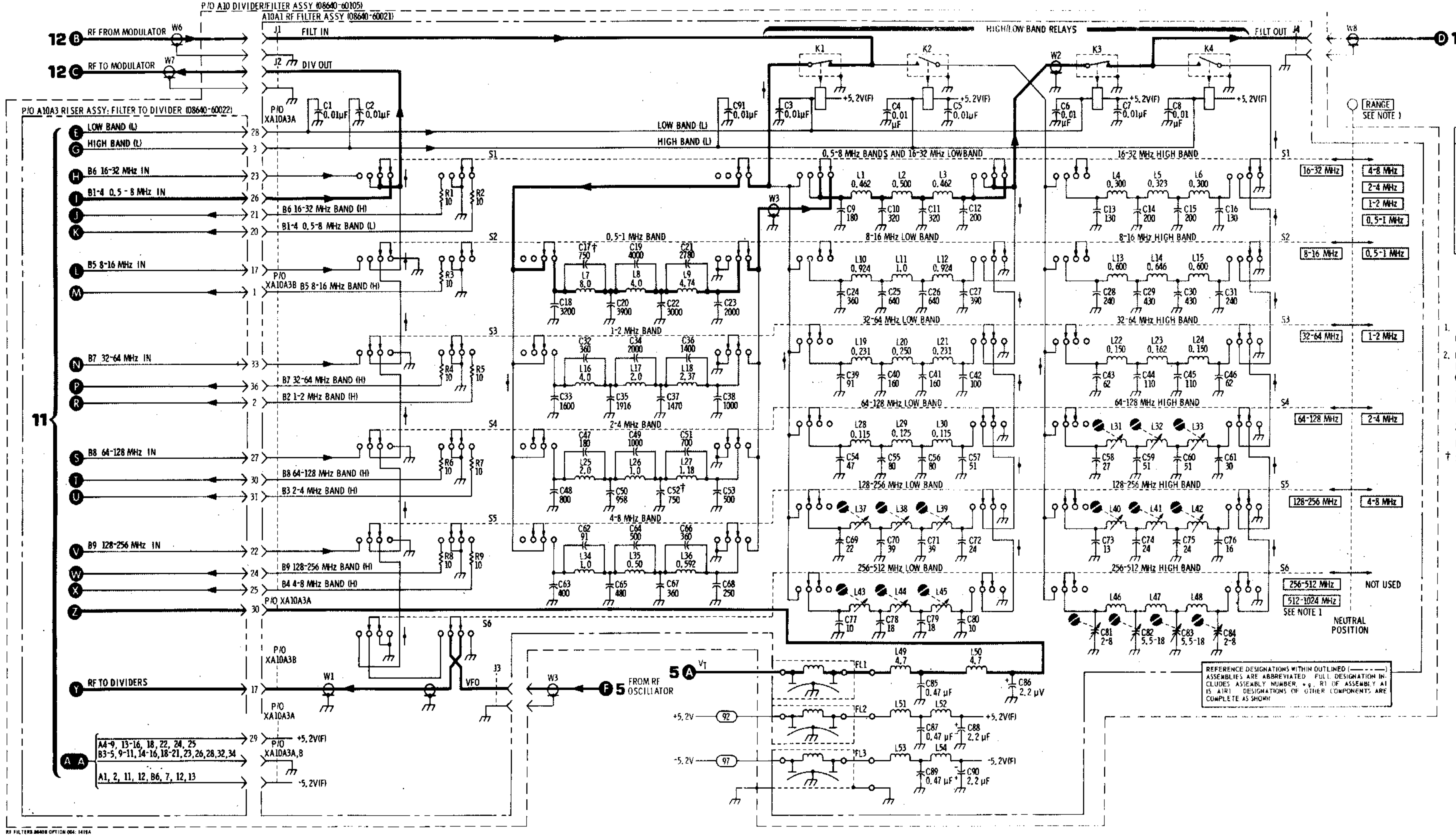


Figure 8-39. A10A1 RF Filter Assembly Component Locations (2 of 2)



REFERENCE DESIGNATIONS

NO PREFIX	A10A1
P/O W3, W6 P/O W7, W8	C1-91 FL1-3 J1-4 K1-4 L1-54 R1-9 S1-6 W1-3 XA10A3A/B

NOTES

1. ALL SWITCHES SHOWN SET FOR 0.5-1 MHz BAND.
2. LOGIC LEVELS ON THIS SCHEMATIC BELONG TO ECL AND EECL FAMILIES. GROUND IS HIGH AND OPEN (NEGATIVE) IS LOW. EXCEPTIONS ARE LINES LABELED "LOW BAND" AT INPUT E, "HIGH BAND" AT INPUT G, AND "B1-4" AT OUTPUT K WHICH ARE TTL FOR WHICH OPEN (POSITIVE) IS HIGH AND GROUND IS LOW.

† SEE BACKDATING, TABLES 7-1 AND 7-2.

10
A10A1

Figure 8-40. RF Filters Schematic Diagram

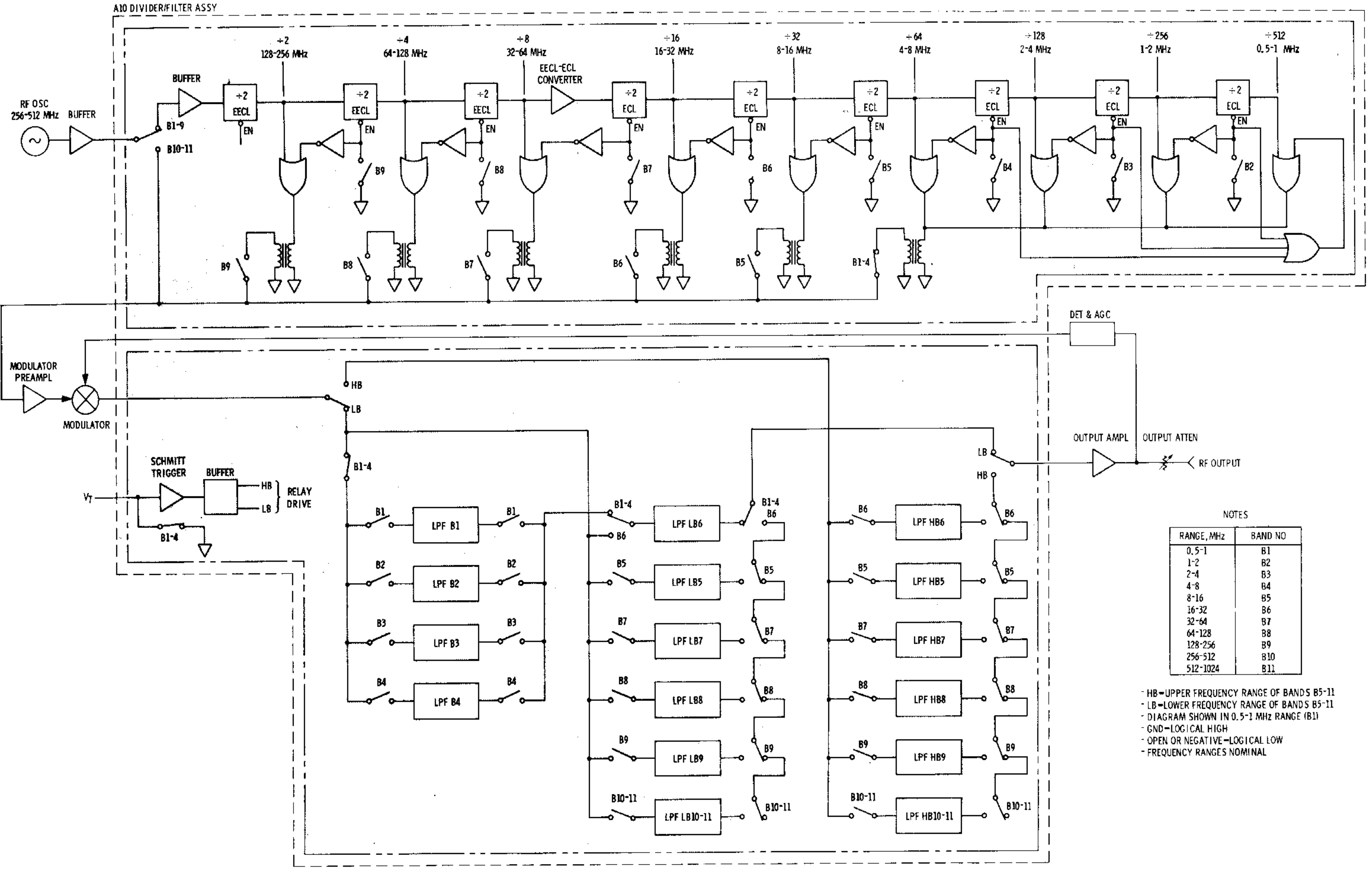


Figure 8-41. Simplified Logic Diagram of the Filter Divider Assembly

SERVICE SHEET 11

PRINCIPLES OF OPERATION

RF Dividers (A10A2)

The A10A2 RF Divider Assembly frequencies - divides the 256-512 MHz signal from the RF oscillator to obtain lower output frequencies. The overall operation of the A10 Divider/Filter Assembly is described on Service Sheet 10. Refer also to Figure 8-41 for a simplied logic diagram of the RF Dividers and Filters. On the two highest frequency bands (256-512 MHz and external doubler), the dividers are bypassed. On the other bands, the signal from the oscillator is amplified and limited by buffer amplifier U11.

The outputs of the first three dividers drive complementary output OR gates (U10A, U13B and U15B) which drive the next divider stage with one output and another complementary output OR gate (U10B, U13A, and U15A) with the other. The latter gates drive output transformers T1, T2, and T3 in push-pull, and are enabled by inverter transistors Q2, Q3, and Q4 respectively.

When an output OR gate is enabled, the next divider stage is disabled. (Note that ground is a logical high and negative or open a logical low for EECL and ECL devices.) The Q and $\overline{Q}$ outputs of the next two stages each drive NOR gates (U17B, U17C, U19B, and U19C) in push-pull which in turn drive transformers T4 and T5 in push-pull. The final four divider stages operate in a manner similar to the previous two stages. The NOR-gate outputs, however, drive a common output transformer T6. The last NOR-gate output pair is enabled through diodes CR1, CR2, and CR3 connected in a logical OR configuration.

All output transformers drive pi-network pads which are switched onto the line leading to the modulator circuits. The attenuation of the first three pads (R6-8, R12-14, and R18-20) is set (from 3 to 6 dB) to prevent excessive signal level from being applied to A26U2 (Service Sheet 12). The attenuation level is set by changing the values of the resistors.

Schmitt Trigger (A10A2)

Amplifier U1 is a Schmitt Trigger which senses when the voltage V_T (proportional to the RF oscillator frequency) reaches the value corresponding to the geometric mean of the frequency band. The reference voltage is determined by resistors R55, and R57; R58 adds a small amount of hysteresis. Transistor Q1 complements the amplifier output. Inverter U6A activates the low band relays A10A1K1 and K3 (Service Sheet 10); and U6B activates the high band relays A10A1K2 and K4 (Service Sheet 10). The inverters are driven in complement except that capacitors C18 and C19 hold both inverters on simultaneously for a few milliseconds during a transition to provide a make-before-break action.

SERVICE SHEET 11 (Cont'd)

TROUBLESHOOTING

It is assumed that a problem has been isolated to the RF divider circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A

NOTE

If problems occur only on the lower bands, an oscilloscope can be used to locate the defective RF circuit. On the higher bands, either a high frequency oscilloscope, a sampling oscilloscope, or a spectrum analyzer (with a high impedance probe) can be used.

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure) and A10 Divider/Filter Assembly casting cover removed (see Service Sheet F for removal procedure).

Initial Control Settings

Meter Function . . . . VOLTS
COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . . INT
AM . . . . OFF
FM . . . . OFF
RANGE . . . . 256 - 512 MHz
FREQUENCY TUNE . . . . 550 MHz
OUTPUT LEVEL Switches . . . . −10 dBm (−10,0)
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . . ON

RF Divider Circuits

The quickest way to isolate a divider/filter problem is to use the front panel controls to set various frequencies and frequency ranges while monitoring the output voltage meter. Usually a problem will appear as shown in the following table.

RF Filters (A10A1)
SERVICE SHEET 10

SERVICE SHEET 11 (Cont'd)

Symptom	Probable Cause
No output on one band only	Defective output circuit for one of the dividers, a filter, or a slide switch
No output on one band and all bands below that band	Defective divider or 16 - 32 MHz low band filter or 0.5 to 8 MHz divider output transformer
Low power at highest end of bands (8 to 1024 MHz) only	Defective geometric mean switching (high band filters not being switched in)
Overly high harmonics at lowest end of bands (8 to 1024 MHz) only	Defective geometric mean switching (low band filters not being switched in)
Intermittent power	Poor contact on slide switch
Changing bands does not change output frequency even though the counter may indicate a change	Loose coupler between RANGE switch and Divider/Filter switch assembly

The filters, slide-switches, and the relays driven by the Schmitt Trigger circuits are shown and discussed on Service Sheet 10.

NOTE

Check that the control inputs to the RF gates are correct before suspecting the gates themselves.

RF Divider Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
SCHMITT TRIGGER (A10A2)	Initial conditions and settings	≈ +10V at TP1 (V_T)	Check slide-switches (Service Sheet 10) and V_T pot (Service Sheet 5)
		≈ −3V at TP2	Check U1 and associated circuitry
		≈ 0V at TP3	Check U6 and associated circuitry
		≈ +5V at TP4	Check U6, Q1 and associated circuitry
	Set FREQUENCY TUNE to 230 MHz	≈ 0V at TP1 (V_T)	Check V_T pot (Service Sheet 5)
		≈ +5V at TP2	Check U1 and associated circuitry
		≈ +5V at TP3	Check U6 and associated circuitry
		≈ 0V at TP4	Check U6, Q1 and associated circuitry
RF DIVIDERS (A10A2)	Initial conditions and settings then set RANGE to each position	−10 dBm on panel meter	Check appropriate divider and associated circuitry. Check that following divider is off

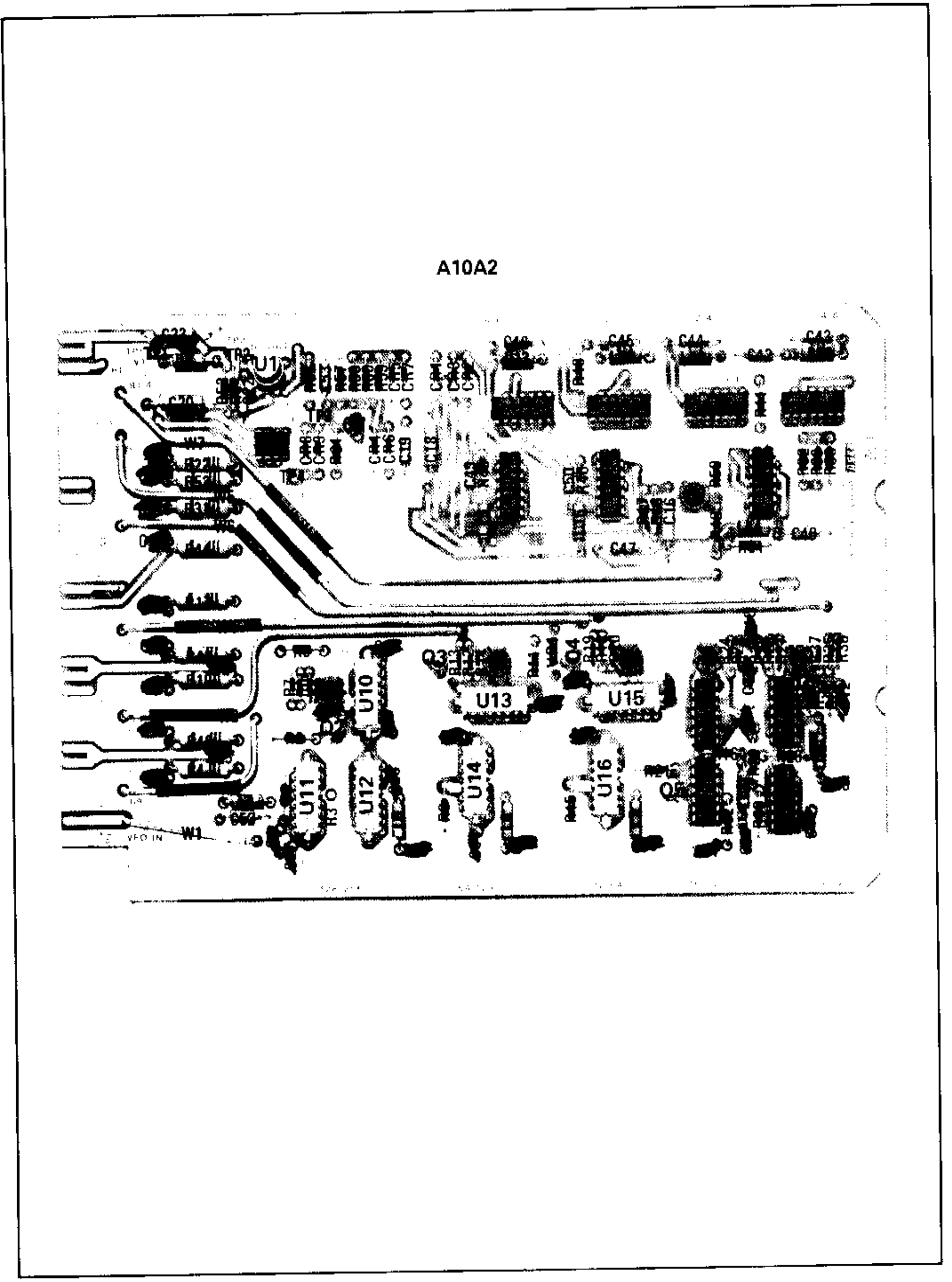


Figure 8-42. A10A2 RF Divider Assembly Component Locations

Figure 8-43. RF Dividers Schematic Diagram

SERVICE SHEET 12

PRINCIPLES OF OPERATION

General

The A26A3 Modulator Assembly contains a current controlled attenuator which varies the RF output level. The A26A4 AGC Amplifier controls the drive to the modulator. Attenuation is determined by the OUTPUT LEVEL vernier and by the AM input signal when the AM switch is on or by the pulse input signals when AM is set to PULSE.

Modulator (A26A3)

The RF signal from the binary dividers is amplified by Modulator Preamplifier A26U2. The amplifier is a sealed microcircuit that plugs into the rear of the modulator board. The amplifier drives the AUX RF OUT port through resistor RI and drives the modulator diodes. Diodes CR1 through CR8 for a balanced resistive network in which the resistance is controlled by the current biasing them. Capacitors C3 through C6 improve the modulator balance at high frequencies. The control current comes from the AGC output amplifier through choke L2 and then splits between R4. CR1 to CR4, and R3 or R5, CR5 to CR8, and R2. The RF signal is coupled into the modulator through T1 and out through T2. The modulator output drives the RF filters (Service Sheet 10).

AGC Amplifier (A26A4)

The AGC Amplifier sums the negative detector output from the A26A1 Detector Buffer Amplifier (Service Sheet 13) with the positive AGC reference voltage from the OUTPUT LEVEL vernier A1R1 (Service Sheet 16). The input to the vernier is a 2 Vdc signal (± 2 Vpk for 100% AM). When AM is set to PULSE, the amplifier's output (and therefore, the modulator) is switched on and off by the input pulses.

Summing Amplifier

Transistors Q1, Q2, and Q3 form a Summing Amplifier. The output of Q3 is the amplified sum of the detector and reference currents and represents the output level error. Resist or R 1 is adjusted to give the correct RF output voltage corresponding to the AGC reference. Switch S1 allows the AGC circuits to be tested in an open-loop condition.

Modulator Driver Amplifier

Transistors Q4, Q 5, and Q6 form the high gain Modulator Driver Amplifier. R56, R57, R32, C18, and C9 frequency-compensate the AGC system. Capacitor C10 is switched in parallel with C9 in the 0.5-1 and 1-2 MHz ranges (called LO BAND 1) to give added compensation. The LO BAND 1 line is grounded in LO

SERVICE SHEET 12 (Cont'd)

BAND 1 ranges and causes inverter U3B to go high and inverter U4F (an open collector output gate) to go low which switches in C10. In a similar manner capacitor C11 is switched in parallel with C9 in the 2 -4 and 4-8 MHz ranges (called LO BAND 2). In a similar manner resistor R55 is switched in parallel with C18 and R57 to attenuate the signal in the pulse modulation mode of operation. Transistor Q5 is a current. source. Transistor Q6 is a constant current sink. The difference between the collector currents of Q5 and Q6 is the modulator drive current.

In the pulse modulation mode of operation, Q5 is switched on and off at the pulse repetition rate by transistor switch Q7 which is driven by the pulse Schmitt Trigger output of A26A2 (Service Sheet 13). When Q7 is on, Q5 and the modulator are off, (i.e., when either the ***MOD*** PULSE line is low or when the RF OFF line is low). Hot carrier diodes CR13 and CR14 prevent saturation of Q7 and Q6 for rapid switching. Capacitor C15 is switched in across the modulator drive line by gates U3C and U4E to lower the rise and fall time of the modulator in LO BAND 1 ranges to reduce RF ringing in the filters following the modulator. Similarly, capacitor C16 is switched in for LO BAND 2 ranges.

Pulse Overload Detector

In the pulse modulation mode, the peak detector in A26U1 (Service Sheet 13) samples the RF output only when an input pulse is present; when no pulse is present, the detector output is stored on a capacitor. If the OUTPUT LEVEL vernier is reduced while in the pulse mode, the error voltage of the summing amplifier becomes very large and the modulator is turned off. The detector storage capacitor then discharges only during each pulse on period until the error is zero. At low repetition rates and short on-periods, the capacitor discharge time is very long. To correct for this, Pulse Overload Detector U1B senses the condition of large error (i.e., when the collector voltage of Q3 exceeds +0.4 Vdc) and switches a discharge resistor on to bring the system to a near zero error condition.

Meter Amplifier

Amplifier U1 A is an inverting amplifier with a gain of about 1/2 (adjusted by R12) which scales the detector output voltage to drive the metering circuits. Capacitor C8 filters any superimposed modulation signal on the detector output.

Modulator Overload Detector

If the OUTPUT LEVEL vernier setting or input modulation signal requires the output to exceed its maximum capability, Modulator Overload Detector U2 senses the condition and lights the REDUCE PEAK POWER annunciator A6DS3 (Service Sheet 16). The reference voltage is set by resistors R29, R30, and R31. When the output from the OUTPUT LEVEL vernier exceeds the

SERVICE SHEET 12 (Cont'd

reference, the output of U2 goes high and Q8 turns on which turns on Q9 and the annunciator. Since the overload condition may be of short duration, capacitor C13 holds the output of U2 high to keep the annunciator lit for a longer period.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the AGC amplifier or the modulator as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 34801D/3484A Option 043
Oscilloscope . . . . HP 180A/1801A/1820C

Initial Test Conditions

To test A26A4 AGC Amplifier Assembly, remove top cover (see Service Sheet G for removal procedure), remove A26 AM/AGC and RF Amplifier Assembly casting top cover, and remove A26A4 and extend for service (see Service Sheet F for procedure).

To test A26A3 Modulator Assembly and A26U2 Modulator Preamplifier, remove bottom cover (see Service Sheet G for removal procedure) and remove A26 casting bottom cover (see Service Sheet F for procedure).

Initial Control Settings

COUNTER MODE: EXPAND . . . . Off
LOCK . . . . .Off
Source . . . .INT
AM . . . . INT
MODULATION. . . . .100'%
Meter Function . . . . LEVEL
MODULATION FREQUENCY . . . . 1 kHz
FM . OFF
RANGE. . . . . .8-16 MHz
FREQUENCY TUNE . . . . 7.20 MHz
OUTPUT LEVEL Switches . . . . +10 dBm (+10,0)
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . .ON

RF Dividers (A10A2)
SERVICE SHEET 11

SERVICE SHEET 12 (Cont'd)

AGC Amplifiers and Amplitude Modulator Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
SUMMING AMPLIFIER (A26A4)	Initial conditions and settings. Set AGC switch, S1, to AGC off position.	% 1.2 Vp-p sine wave (1 kHz) at TP6 (CQ3)	Check Ql, Q2, Q3 and associated circuitry
MODULATOR DRIVER AMPLIFIER (A26A4)	Initial conditions and settings. Set AGC switch, S1, to AGC off position.	= 4.8 Vp-p modified square wave (1 kHz) at TP7 (DRVR) = 16 Vp-p modified square wave (1 kHz) at TP8 (MOD)	Check Q4, U4A, U4C, and associated circuitry Check Q5, Q6, Q7 and associated circuitry
	Set RANGE to 4-8 MHz	= 16 Vp-p modified square wave (1 kHz) at TP8 (MOD)	Check U3A, U3D, U4B, U4D, and associated circuitry
	Set RANGE to 1-2 MHz	= 16 Vp-p modified square wave (1 kHz) at TP8 (MOD)	Check U3B, U3C. U4E. U4F and associated circuitry
MODULATOR PREAMPLIFIER (A26U2)	initial conditions and set. tings (AGC switch, A26U4S1, set to AGC on position)	> –5 dBm (> 125 mVrms into 50S1) at AUX RF OUT jack on rear panel	Check U2 and associated circuitry
METER AMPLIFIER (A26A4)	Initial conditions and settings	Panel meter indicates +10 dBm (707 rnV)	Check U1A and associated circuitry
MODULATION OVERLOAD DETECTOR (A26A4)	Initial conditions and settings except set OUTPUT LEVEL switches to +16 dBm	REDUCE PEAK POWER annunciator unlit	Check U2, Q8, Q9 and associated circuitry
	Set MODULATION full CW	REDUCE PEAK POWER annunciator lit	
PULSE OVERLOAD DETECTOR (A26A4)	Initial conditions and set. tings except set AM to OFF CAUTION **Check that OUTPUT LEVEL switch is set one step ccw from full cw**	~ +9V at TP3 (OVLD)	Check U1B and associate circuitry
	Short TP5 (GND) to TP4 (VERN)	= 0 Vdc at TP3 (OVLD)	

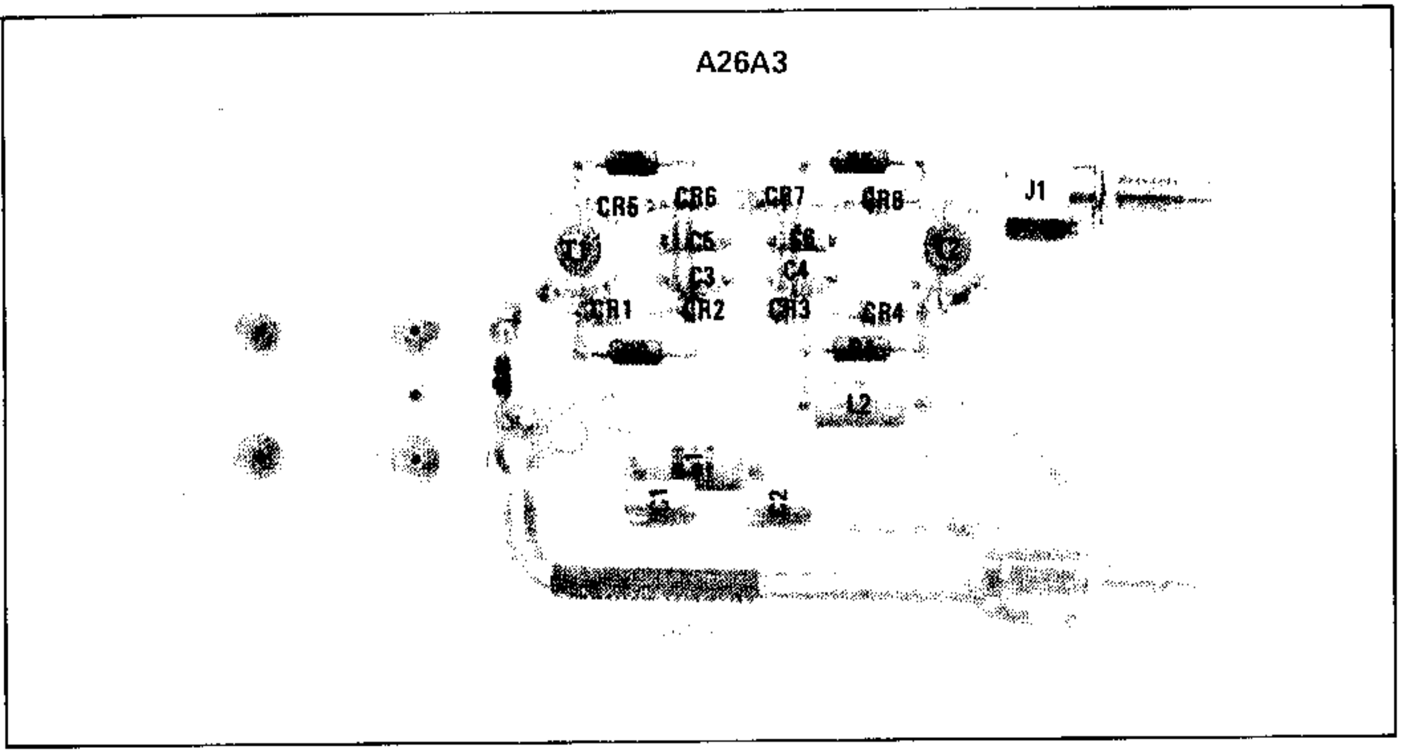


Figure 8-44. A26A3 Modulator Assembly Component Locations

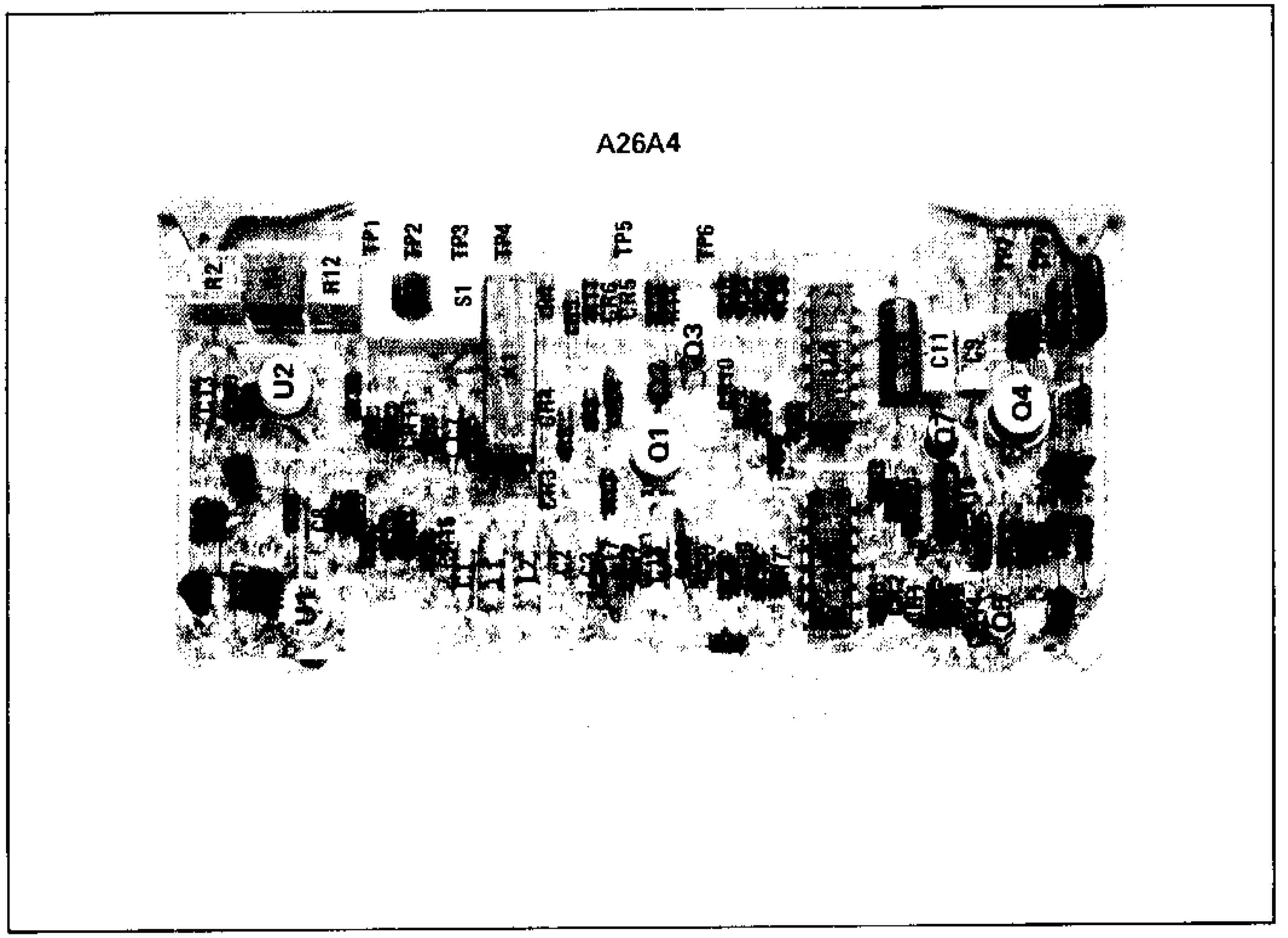


Figure 8-45. A26A4 AGC Amplifier Assembly Component Locations

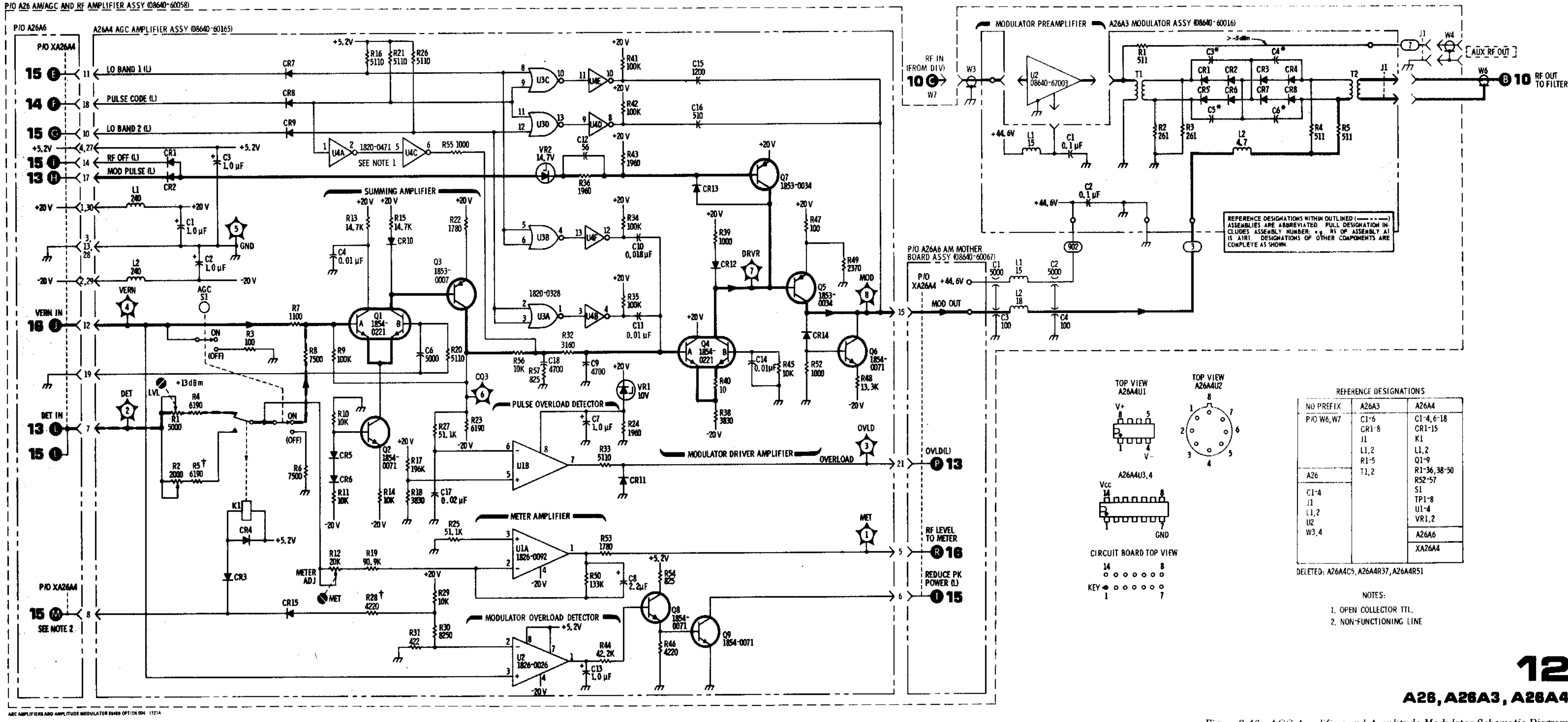


Figure 8-46. AGC Amplifiers and Amplitude Modulator Schematic Diagram

SERVICE SHEET 13

PRINCIPLES OF OPERATION

General

The RF signal from the RF Filters is amplified by RF Output Amplifier A26U1. The amplifier is a sealed microcircuit that plugs into the rear of the AGC detector board. The amplifier drives resistor U1R1 which sets the amplifier output impedance. The output is ac coupled through U1C2 and drives the two Output Attenuators. The step attenuators consist of resistive attenuator sections which are switched in and out by cam driven micro-switches. The attenuators consist of a 6 dB step, 10 dB steps, and 1 dB steps with an impedance of 50(2. Capacitor A19A1C1 ac couples the RF output to the RF OUT jack J1.

AGC Detector (A26U1)

The AGC detector (CR1) detects the negative peaks of the RF signal from the Output Amplifier. The detector output is summed with the positive AGC reference voltage in the Summing Amplifier (Service Sheet 12). Detector diode CR1 conducts when-ever the RF amplifier output is one diode junction voltage drop below the voltage across C3. The capacitor is then negatively charged until the amplifier voltage rises, at which time CR1 shuts off. C3 then slowly discharges through resistor A26A1R23 until another negative peak recharges it. FET A26A1Q3 is normally on except in the pulse modulation mode.

Bandwidth Control (A26A1 and A26A2)

In the 2 - 4 and 4 - 8 MHz (or LO BAND 2) frequency ranges, capacitor A26A1C5 is switched in parallel with A26U1C3 by A26A1Q7. Transistor A26A1Q7 is a switch which operates in the inverted mode (i.e., the emitter functions as a collector and the collector as an emitter). The added capacitance of A26A1C5 reduces the amount of capacitor discharge between RF voltage peaks on the lower frequency bands and limits the AM bandwidth. Capacitor A26A1C4 is also switched in for the 0.5-1 and 1-2 MHz (or LO BAND 1) ranges by A26A1Q6.

In the pulse modulation mode A26A1Q8, Q9, and Q5 are switched on. This switches out A26A1C4 and C5 and switches A26A1C6 in. The Schmitt Trigger A26A2U1 and U2A, and A26U2B, U2C and A26A1Q4 bias A26A1Q3 off between pulses, which prevents A26A1C6 from discharging. (If C6 were to discharge between pulse bursts, the Modulator would be driven to maximum output when the next pulse arrived).

Switching of A26A1Q5-Q9 is multiplexed onto one line by transistors A26A2Q8 and Q9. Q8 is a switchable current source. In LOW BAND 2, Q8 generates just enough current to turn on the collector-base junction of Q7. In LOW BAND 1, the current increases enough to turn on both Q6 and Q7 (because the voltage

SERVICE SHEET 13 (Cont'd)

drop across A26A1R4 is enough to turn on Zener diode A26A1VR2). When the PULSE CODE line is low, A26A2Q9 is on which turns on A26A1Q8, Q9, and Q5.

Detector Buffer Amplifier (A26A1)

Transistor Q1 and FET Q2 form a high impedance, unity gain buffer amplifier. Diode CR6 and resistor R19 add a dc offset which compensates for the junction voltage drop of the detector diode to linearize the detector.

Schmitt Trigger (A26A2)

A Schmitt Trigger formed by U1 and U2A converts the pulse input voltage into O to 5V pulses. Resistors R20 and R21 set the trigger reference at about 0.5 Vdc. When the input to U1 is above the ref-erence, the output of U2A is low. When the input goes below the reference, the output of U2A goes high (+5 V).

Resistor R23 adds a small amount of hysteresis to the reference voltage. In the normal pulse modulation mode, NAND gate U2C inverts the trigger output and switches transistors A26A1Q4 and Q3 on when the input pulse is high, or off when the input pulse is low. Thus the charge on capacitor A 26A1C6 is stored between pulses, but is shunted by A26A1R23 when an input pulse is present. Similarly, NAND gate U2D inverts the trigger output and switches the Modulator Driver Amplifier A26A4 (Service Sheet 12).

Rate Detector (A26A2)

Flip-flops U3A and U3B form a rate detector to turn off the RF level drive to the meter circuits whenever the pulse repetition rate falls below 20 Hz. Below 20 Hz rates, the output leveling system cannot accurately control the output amplitude. The flip-flops are arranged as retriggerable monostable (one-shot) multivibrators with timing elements R25 and C10, and R28 and C11. A low-going output from U2A triggers U3A and the Q output of U3A goes low for 50 ms. If the repetition rate of the incoming pulses is higher than 20 Hz, U3A retriggers and the Q output remains low. In the absence of pulses from the Q output of U3A, the Q output of U3B is low, transistor Q7 is off and the meter operates normally. For pulse repetition rates less than 20 Hz, U3B is periodically triggered by the Q output of U3A. The Q output of U3B goes high for 100 ms (or longer if U3B is retriggered by U3A) and turns on Q7 which disables the meter drive amplifier output, and the meter reads zero. Thus the meter is turned off for low rate pulses. When not in the pulse modulation mode, the output of inverter U2B is low; the output of U2C is high and A26A1Q1 is held on; the output of U2D is high and the modulator is held in its normal on mode; and Q7 is held off.

SERVICE SHEET 13 (Cont'd)

TROUBLESHOOTING

It is assumed that a problem has been isolated to the power amplifier and AGC detector or to the AM offset and pulse switching circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C
Pulse Generator . . . . HP 8003A
Power Meter . . . . HP 435A
Power Sensor . . . . HP 8482A

Initial Test Conditions

To test A26A2 AM Offset and Pulse Switching Assembly, remove top cover (see Service Sheet G for removal procedure), remove A26 AM/AGC and RF Amplifier Assembly casting top cover, and remove A26A2 and extend for service (see Service Sheet F for procedure).

To test A26U1 Output Amplifier and A26A1 AGC Detector Assembly, also remove bottom cover (see Service' Sheet G for removal procedure) and remove A26 casting bottom cover (see Service Sheet F for procedure).

Connect the pulse generator to AM INPUT. Set the pulse generator for a repetition rate of 20 Hz, a pulse width of 25 ms, and an amplitude of IV.

Initial Control Settings

Meter Function . . . . LEVEL
COUNTER MODE: EXPAND . . . . Off
LOCK . . . . .Off
Source . . . . .INT
AM . . . . OFF
MODULATION. . . . . Fully cw
MODULATION FREQUENCY . . . . 1 kHz
FM . . OFF
RANGE. .8-16 MHz
FREQUENCY TUNE . . . . 7.20 MHz
OUTPUT LEVEL . . . .+16dBm
RF ON/OFF . . . .ON

AGC Amplifiers and Amplitude Modulator
(A26, A26A3, A26A4)
SERVICE SHEET 12

SERVICE SHEET 13 (Cont'd)

NOTE

If pulse burst amplitude is too high for low-duty cycle pulses, check all components connected between A26U1CR1 and A26A1Q2 (G1) for dc current leakage.

RF Amplifier Pulse Switching and Step Attenuator Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication Is Abnormal
OUTPUT AMPLIFIER (A26U1)	Initial conditions and set. tings (+16 dBm output). Connect power meter and sensor to RF OUT.	>+15 dBm at RF OUT	Check A26U1,Q3 and asso-ciated circuitry
	Set AGC switch (A26A4S1) to AGC off. Adjust OUT-PUT LEVEL vernier for +10 dBm at RF OUT.	≈−3 Vdc at TP1 (A26A1Q2-G1)	
DETECTOR BUFFER AMPLIFIER (A26A1)	As above	≈−3 Vdc at TP2 (DET)	Check Ql, Q2 and asso-ciated circuitry
SCHMITT TRIGGER (A26A2)	Initial conditions and settings except set AM to PULSE and set AGC switch (A26A4S1) to AGC on	≈ 5V pulse at TP6 (MOD PUL) and ≈4V pulse at TP5 (DET PUL)	Check A26A2U1, U2 and associated circuitry
RATE DETECTOR (A26A2)	Initial conditions and set. tings except set AM to PULSE	Panel meter reads normal (>+15 dBm)	Check A26A2U3, Q7 and associated circuitry
	Set pulse generator pulse repetition rate to 15 Hz	Panel meter reads approx-imately zero	
BW CONTROL (A26A2)	Initial conditions and settings	<+lV at TP8 (BW)	Check A26A2Q8, Q9 and associated circuitry
	Set RANGE to 4-8 MHz	≈ +5V at TP8 (BW)	
	Set RANGE to 1-2 MHz	≈+12V at TP8 (BW)	
	Set AM to PULSE	≈+ 19V at TP8 (BW)	
BW CONTROL (A26A1)	Initial conditions and settings except set AM to INT	Same signal level on both sides of C4 and C5	————
	Set RANGE to 4-8 MHz	Signal level differs across C5 (i.e., no signal at Q7-e)	Check C5, Q7, Q9 and associated circuitry
	Set RANGE to 1-2 MHz	Signal level differs across C4 (i.e., no signal at Q6-e)	Check C4, Q6, VR2 and associated circuitry
	Set AM to PULSE	Signal level differs across C6 (i.e, no signal at Q5-e)	Check Q5, Q7, Q8, VR1, and associated circuitry

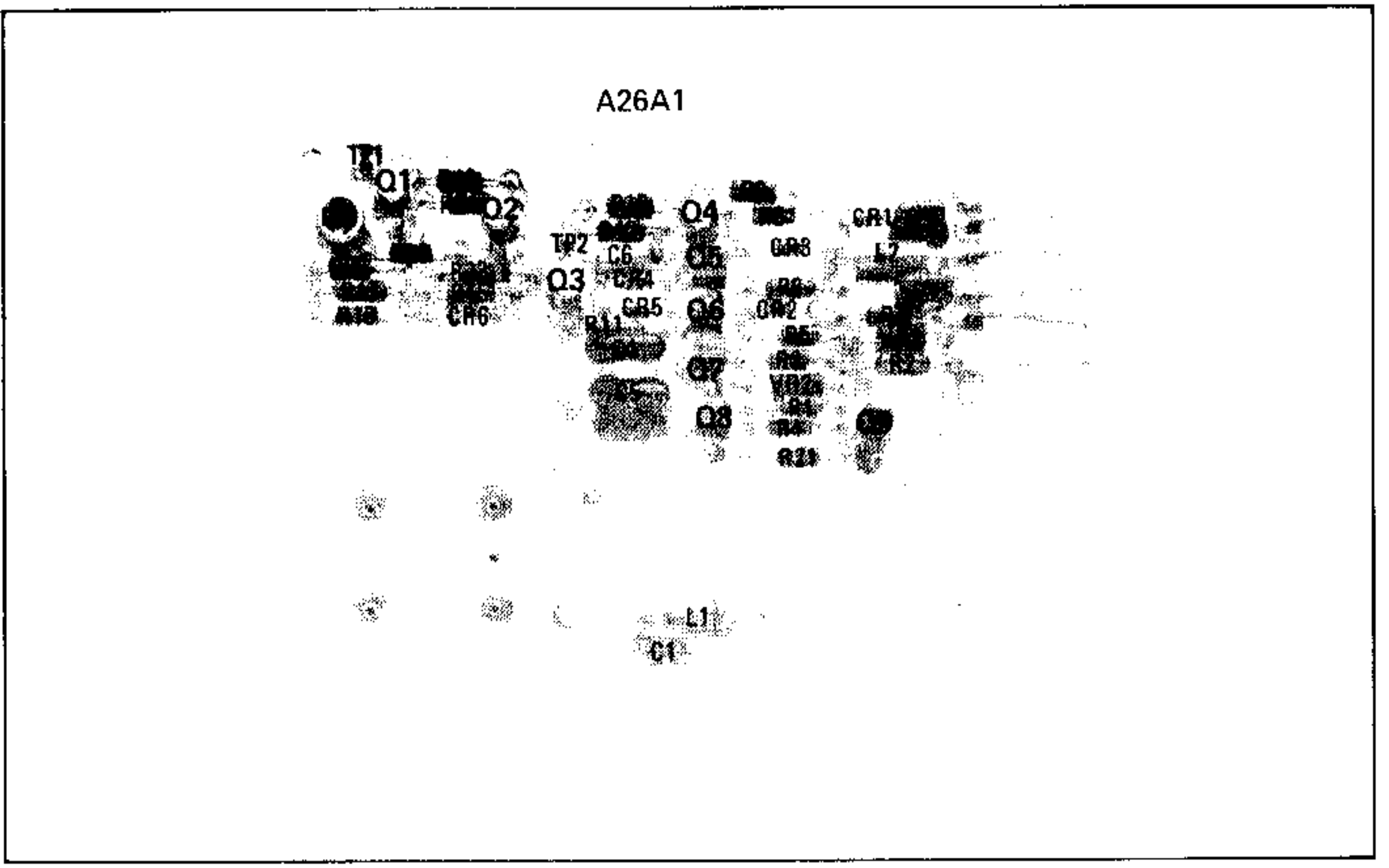


Figure 8-47. A26A1 Power Amplifier and AGC Detector Assembly Component Locations

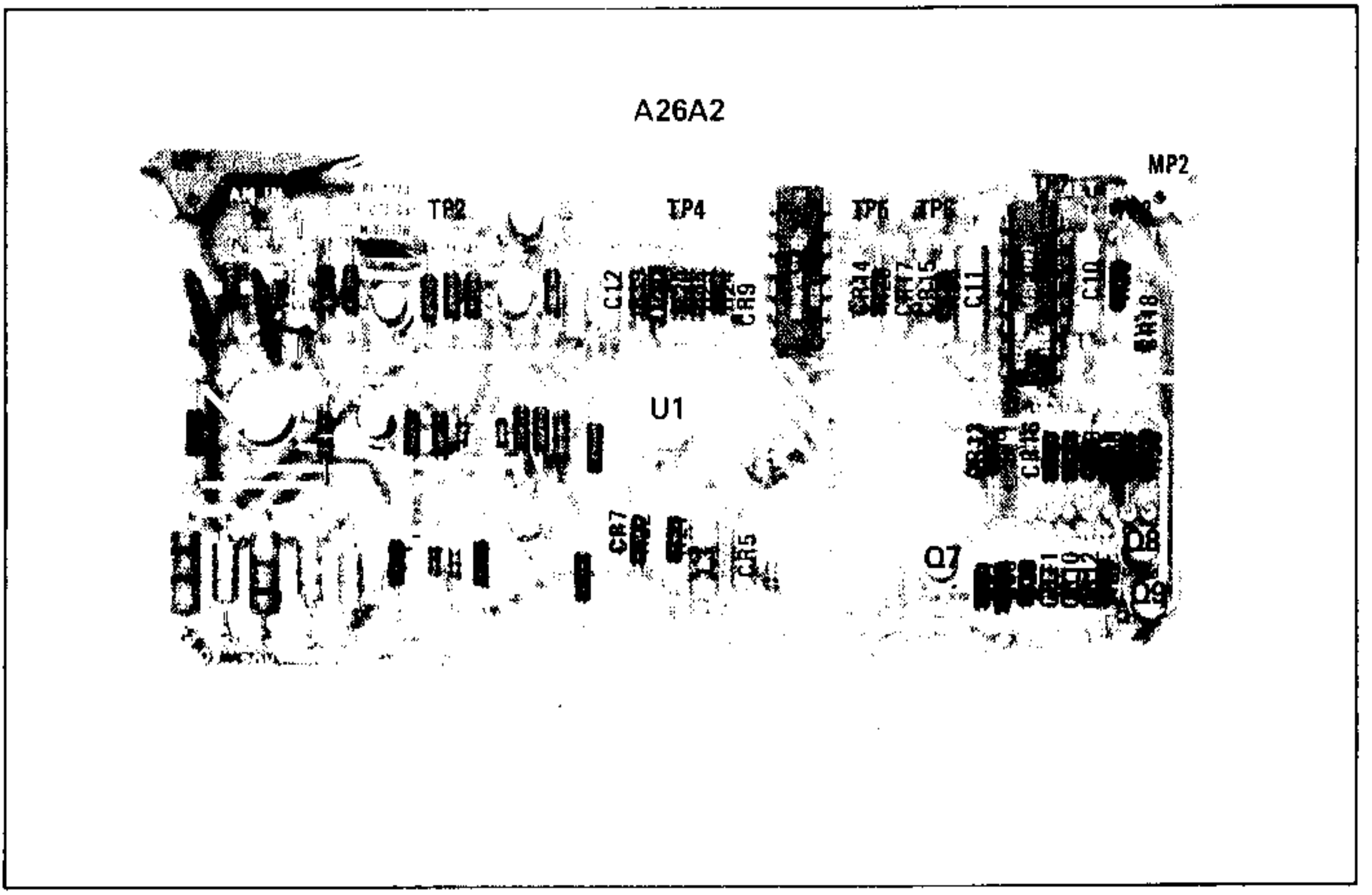


Figure 8-48. P/O A26A2 AM Offset and Pulse Switching Assembly Component Locations

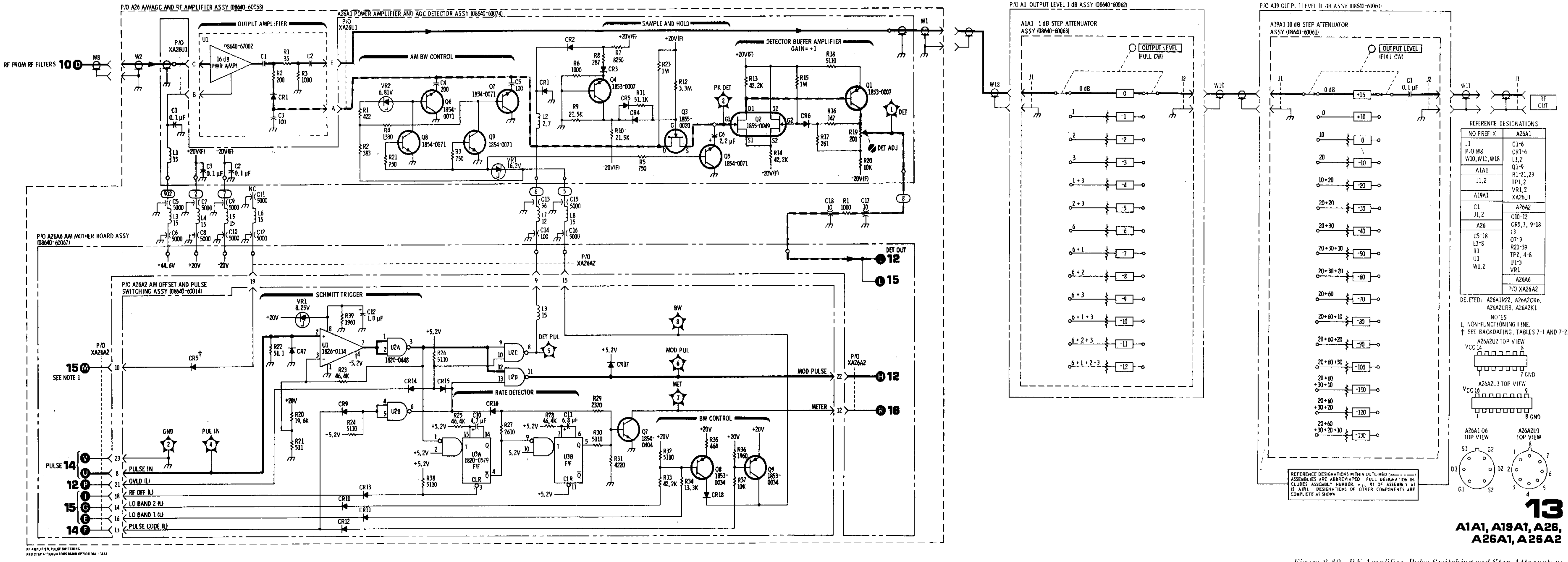


Figure 8-49. RF Amplifier, Pulse Switching and Step Attenuators Schematic Diagram

SERVICE SHEET 14

PRINCIPLES OF OPERATION

AM Offset (A26A2)

The AM Offset Amplifier establishes the AGC reference for the output leveling system and superimposes on it the AM modulation signal. The modulation signal is coupled into the amplifier through slide switch A13S2C and MODULATION potentiometer R2. The amplifier input stage is the differential transistor pair Q1A and Q1B. Transistor Q2 is a constant current source for the emitters of Q1. Transistors Q3 and Q4 form a second differential amplifier stage. Transistor Q5 is a common emitter output stage. Resistors R16, R19, and R8 form a resistive feedback divider. The ac voltage gain (≈+2) is adjusted by R19. Transistor Q6 is a constant current source. The collector current of Q6 causes a 2V drop across R16 which offsets the amplifier output by +2 Vdc and establishes the AGC reference. Capacitors C5, C6, and C7 frequency compensate the amplifier. The amplifier output drives OUTPUT LEVEL vernier A1R1 (Service Sheet 16).

TROUBLESHOOTING

It is assumed that a problem has been isolated to the AM preamplifier as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure), A26 AM/AGC and RF Amplifier Assembly casting top cover removed, and A26A2 AM Offset and Pulse Switching Assembly extended for service (see Service Sheet F for procedures).

Initial Control Settings

Meter Function . . . . AM
AM . . . . INT
MODULATION 100%
MODULATION FREQUENCY . . . . . 1000 Hz

AM Preamplifier Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
AM PREAMPLIFIER (A26A2)	Initial conditions and settings	≈ 2 Vp-p at TP1 (AM IN)	Check input switching
		≈ 4 Vp-p and +2 Vdc at TP3 (AM OUT)	Check Q1-Q6 and associated circuitry

RF Amplifier, Pulse Switching, and Step Attenuators (A1A1, A19A1, A26, A26A1, A26A2)
◆ SERVICE SHEET 13

A26A2

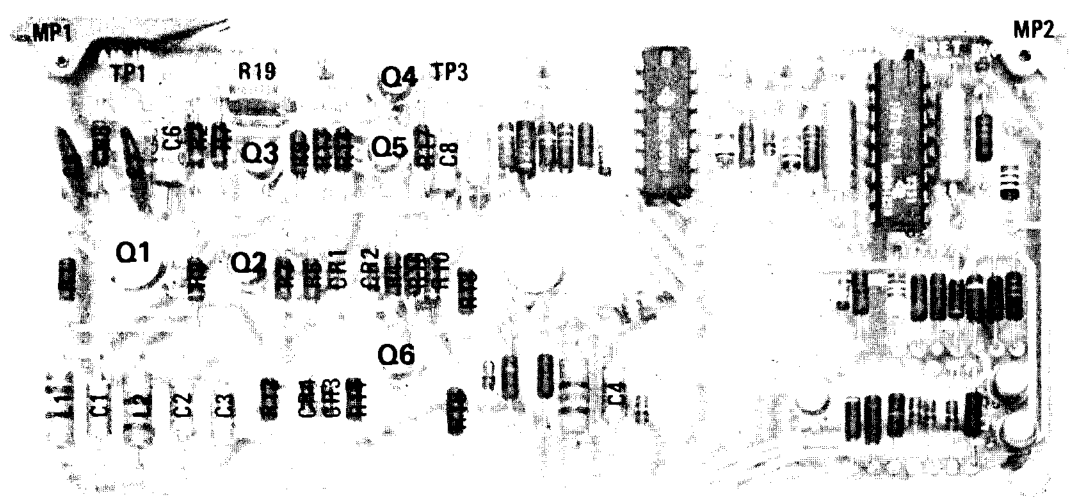
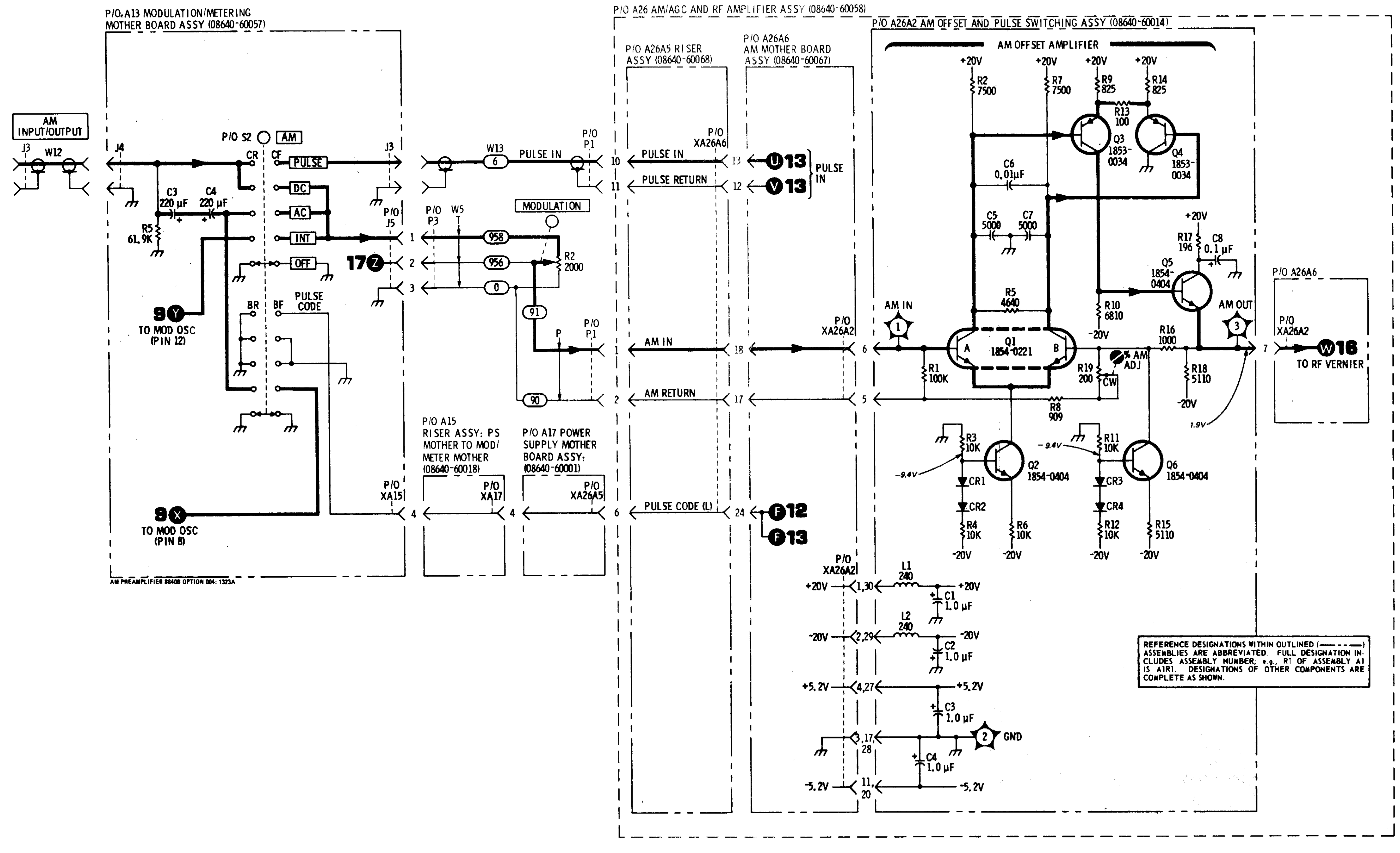


Figure 8-50. P/O A26A2 AM Offset and Pulse Switching Assembly Component Locations

A13

Component Locations for A13 Assembly are on Service Sheet 25.



REFERENCE DESIGNATIONS

NO PREFIX	A26A2
J3 P/O P1, P3 R2 W5, 12, 13	C1-8 CR1-4 L1, 2 Q1-6 R1-19 TP1, 3
A13	
C3, 4 R5 P/O S2	A26A5
	P/O XA26A6
A15	A26A6
P/O XA17	P/O XA26A2
A17	
P/O XA26A5	

DELETED: A26A2C9

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A13, A26A2

Figure 8-51. AM Preamplifier Schematic Diagram

SERVICE SHEET 15

PRINCIPLES OF OPERATION

RF ON/OFF Switch

The RF ON/OFF switch S2 may be wired to turn both RF Oscillator and Modulator off, or to turn only the Modulator off. The RF ON/OFF function may easily be changed to either configuration by following the instructions on Service Sheet 5.

Demodulation Amplifier (A26A8)

Buffer Amplifier U1 is internally connected as a voltage follower. The output of U1 drives the Scaling Amplifier U2, which is connected in an inverting configuration. With S1 in the AC position R8 and R9 form the feedback path and set the gain of the amplifier (such that 100?% AM produces 5 Vrms at DEMOD OUTPUT). R6 provides adjustment to remove the dc component of the Detector output at U2 pin 6. With S1 set to DC, R1O and RI 1 set the gain of the amplifier (such that 100% AM produces 1 Vrms at DEMOD OUTPUT). R15 provides adjustment to set the dc level at the output of U2.

NOTE

If the —20V supply *is replaced or repaired perform the Preliminary AM Adjustments (5-31), AM Accuracy Adjustment (5-32), and Demodulated Output Accuracy performance test (4-38].*

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Demodulation Amplifier as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Oscilloscope . . . . HP 180A/1801A/1820C

SERVICE SHEET 15 (Cont'd)

Initial Test Conditions

To test A26A8 Demodulation Amplifier Assembly, remove top cover (see Service Sheet G for removal procedure), remove A26 AM/AGC and RF Amplifier Assembly casting top cover, and remove A26A8 and extend for service (see Service Sheet F for procedure).

Initial Control Settings

Meter Function . . . . .AM
COUNTER MODE: EXPAND . . . . Off

Initial Control Settings (Cont'd)

LOCK . . . . Off
Source . . . .INT
AM . . . . INT
MODULUATION. 50%
MODULATION FREQUENCY . . . . . . 1 kHz
FM . . . . OFF
RANGE. . . . . 64-128 MHz
FREQUENCY TUNE . . . . 110 MHz
OUTPUT LEVEL Switches . . +10 dBm (+10,0)
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . .ON

Demodulation Amplifier Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
BUFFER AMPLIFIER (A26A8)	Initial conditions and settings	≈ –1.4 Vdc with ≈ 1.5 Vp-p at TP1	Check A26A8U1 and associated circuitry
SCALING AMPLIFIER (A26A8)	Initial conditions and settings. Set AC/DC switch (Al) to DC position.	≈ 1.4 Vdc with ≈ 1.4 Vp-p at TP3	Check A26A8U2 and associated circuitry
	Set AC/DC switch (S1) to AC position	≈ 0 Vdc with ≈ 7.0 Vp-p at TP3	Check A26A8U2 and associated circuitry

AM Preamplifier (A13, A26A2)
SERVICE SHEET 14

A9

Component Locations for A9 Assembly are on Service Sheets 6 and 8.

A26A8

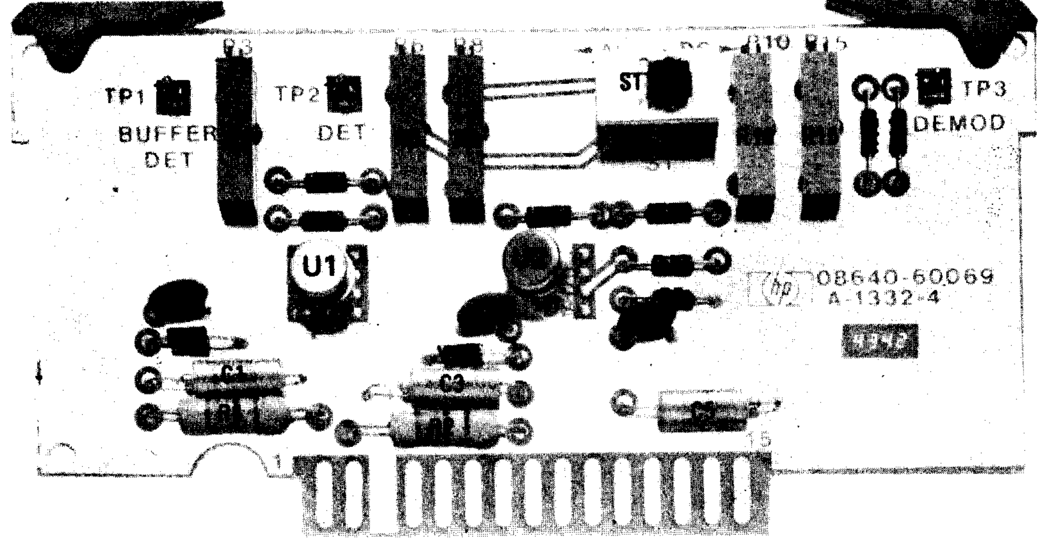
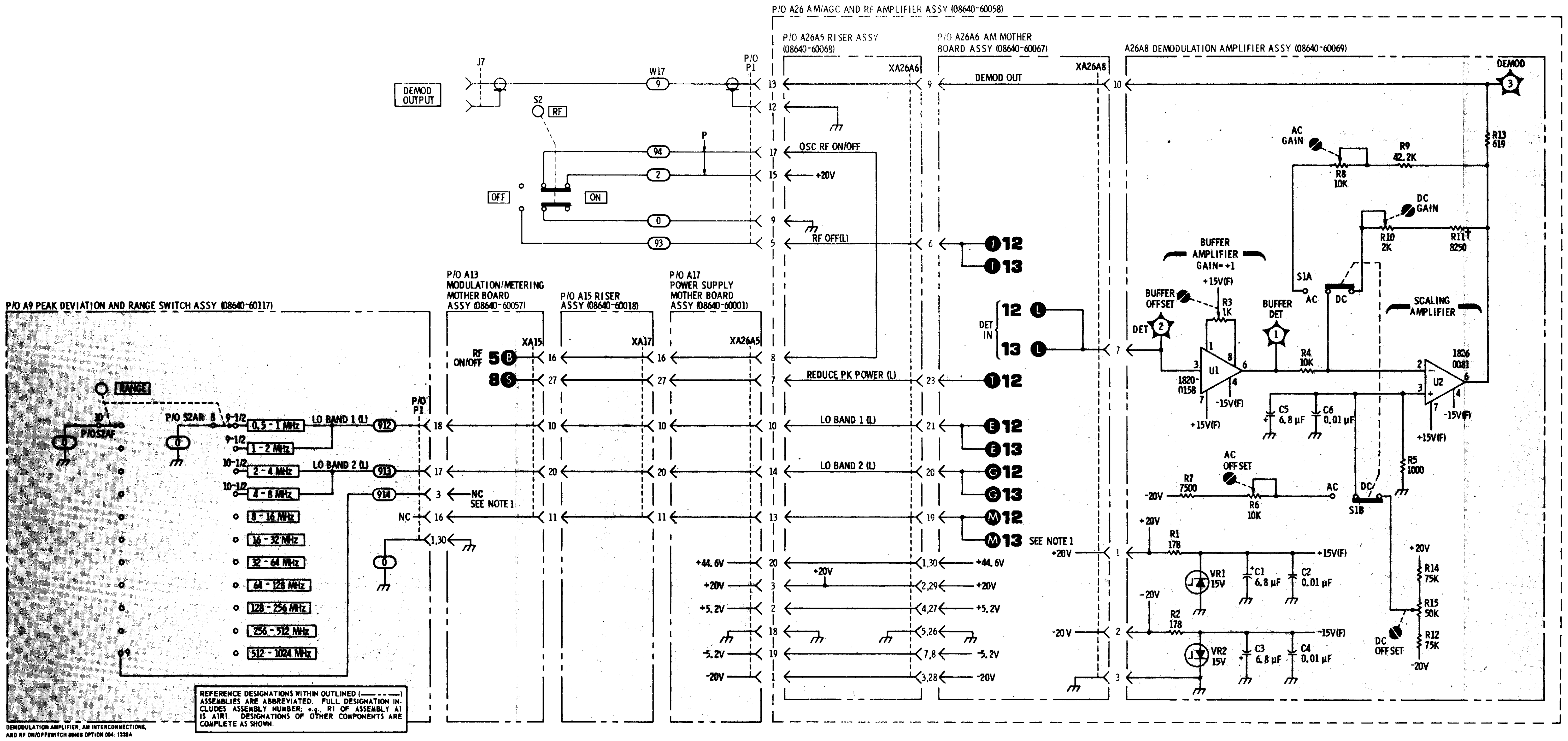


Figure 8-52. A26A8 Demodulation Amplifier Assembly Component Locations



REFERENCE DESIGNATIONS

A9	**A26A6**
P/O P1 P/O S2	XA26A8
A13	**A26A8**
P/O XA15	C1-6 R1-15 S1 TP1-3 U1,2 VR1,2
A15	
P/O XA17	
A17	
P/O A26A5	
A26A5	**NO PREFIX**
P/O XA26A6	J7 P/O P1 S2 W17

NOTES

1. NON-FUNCTIONING LINE.

† SEE BACKDATING, TABLES 7-1 AND 7-2.

15

A9, A26A8

Figure 8-53. AM Interconnections, RF ON/OFF Switch and Demodulation Amplifier Schematic Diagram

SERVICE SHEET 16

PRINCIPLES OF OPERATION

Vernier Attenuator (A1 and A19A2)

OUTPUT LEVEL Vernier A1R1 attenuates the AGC reference voltage and the superimposed AM modulation signal and drives the AGC Amplifier. The potentiometer has a detent for the CAL position where the wiper is fully 'clockwise. Resistor A19A2R1 limits the low resistance end of the potentiometer. Resistor A19A2R4 is switched into the AGC amplifier input line by S1AR in all but the highest OUTPUT LEVEL range. On the highest OUTPUT LEVEL range, A19A2R3 is switched in place of R4, and the AGC reference is increased by 6 dB (a factor of 2), and the RF output is increased by 6 dB.

Meter Attenuator and Odd Range Code (Al, A19A2)

The output of Meter Amplifier A26A4U1A (Service Sheet 12) is the RF LEVEL meter voltage. Resistor A19A2R5 attenuates the amplifier output by 1/3.5 in the highest or 16 dBm OUTPUT LEVEL range. Resistor A19A2R6 attenuates the output by 1/1.1 on ranges 8 to 15. Resistors A19A2R7 and R8 adjust the meter output attenuation to compensate the meter for cumulative errors in the output attenuator on the high attenuation ranges. Switching is done on SIB. Switch S1AF gives a closure to ground on all odd numbered ranges for use by the lamp logic circuits on A4 (Service Sheet 17). Switch A1S1 provides additional 1 dB steps for attenuating the RF LEVEL meter voltage.

OUTPUT LEVEL Vernier Modification

OUTPUT LEVEL Vernier, A1R1, is normally wired to provide additional attenuation (0-2 dB) to the AGC reference voltage and the superimposed AM modulation signal. The potentiometer has a CAL detent where the wiper is fully clockwise and the potentiometer is effectively removed from the circuit. However, for some applications it may be desirable to disable the vernier function so that the OUTPUT LEVEL will always be calibrated.

To modify the OUTPUT LEVEL Vernier function, proceed as follows:

1. Remove the bottom cover (see Service Sheet G).
2. Locate variable resistor A1R1.
3. Unsolder and remove wire 90 (white-black) from the center terminal of R1.
4. Connect and solder wire 90 to wire 4 (yellow) on the top terminal of R1.
5. Reinstall bottom cover.
6. Check OUTPUT LEVEL Vernier operation by observing OUTPUT LEVEL which should remain constant as the vernier knob is adjusted.

TROUBLESHOOTING

Troubleshoot by checking switches, connectors, and resistors for proper contact and resistance.

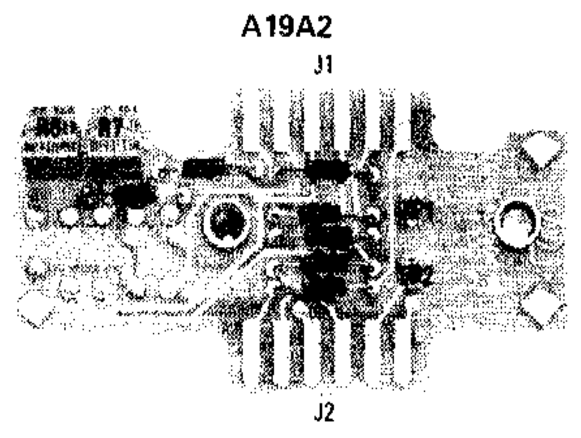


Figure 8-54. A19A2 RF Vernier Assembly Component Locations

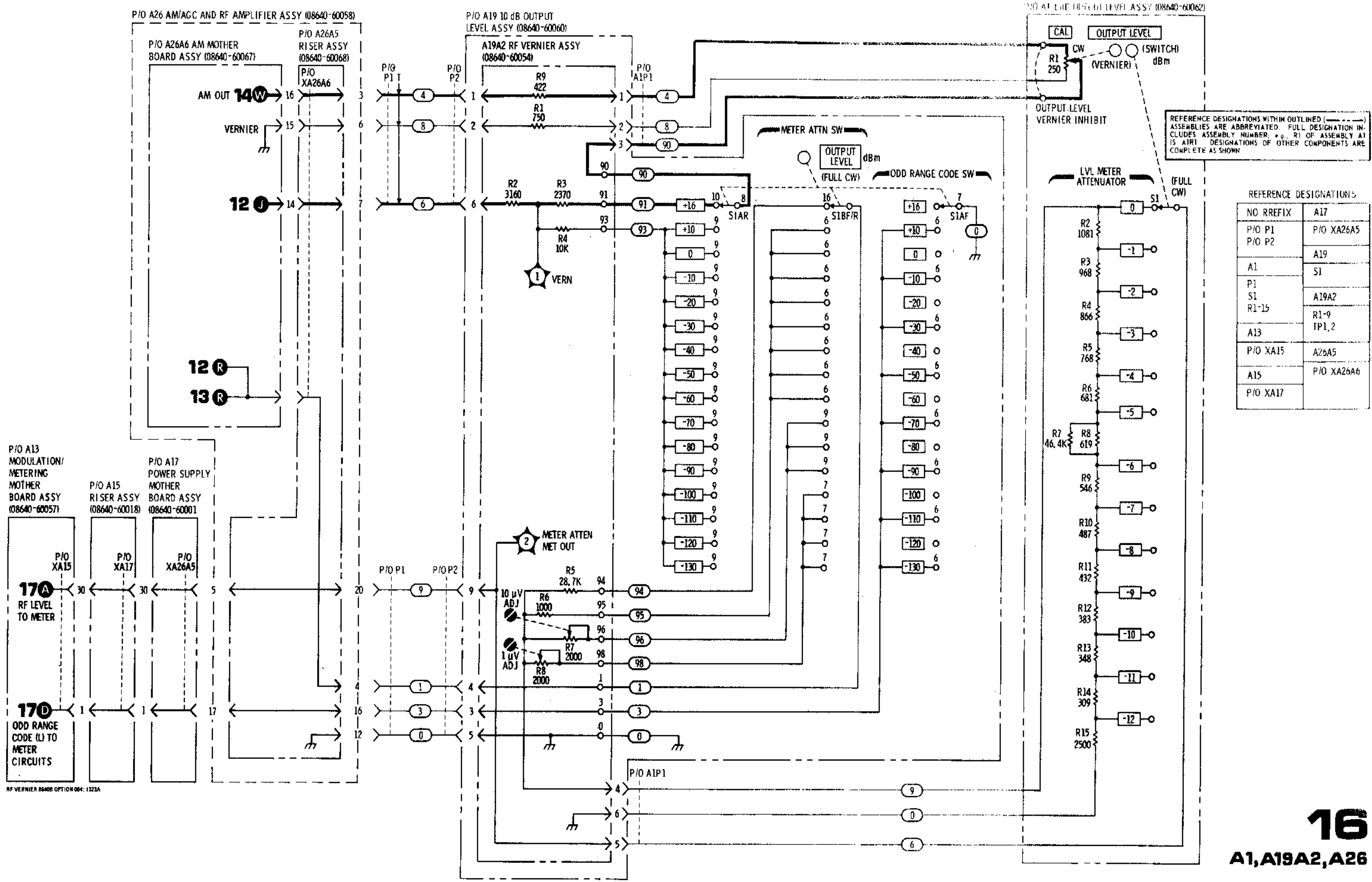


Figure 8-55. RF Vernier Schematic Diagram

SERVICE SHEET 17

PRINCIPLES OF OPERATION

General

Front panel meter M1 indicates one of three quantities selected by Meter Function switch A2S1. For each function, the metering circuitry performs the following:

1) AM percent modulation (X10%): The ac component of the modulation signal from MODULATION potentiometer R2 is peak detected and amplified. One range of autoranging is provided at 30% maximum. Logic circuitry selects the appropriate amplifier gain and meter scale lamp.

2) FM peak deviation (kHz or MHz): The ac component of the modulation signal from the Meter Attenuator section of PEAK DEVIATION switch is peak detected and amplified. No autoranging is provided. The scale lamp is selected by the PEAK DEVIATION switch.

3) LEVEL, the RF output level (VOLTS or dBm): A positive dc voltage proportional to the AGC voltage of the A26A4 AGC Amplifier Assembly is amplified. One range of autoranging is provided at 30% maximum. Logic circuitry selects the appropriate amplifier gain and meter scale lamp.

The meter has three linear scales (0 - 5, 0 - 10, and 0 - 3 or actually 0 - 3.16) with three lamps to indicate the appropriate scale. The lamps are located on the A6 Annunciator Assembly. The meter also has a log scale calibrated in dBm 50Ω for use in the LEVEL meter mode.

Positive Peak Detector (A2)

The Positive Peak Detector samples the ac peak of the incoming signal and stores the voltage on capacitor C5. The AM or FM input signals are ac coupled into Buffer Amplifier U1 by capacitor C1 and resistor R4. U1 is internally connected as a voltage follower. Resistor R3 provides input bias current for U1 and presents a constant load impedance to the inputs.

Amplifier U2 is a voltage comparator. When the input voltage at pin 4 exceeds the voltage at pin 3, the output rapidly switches to a level equal to the voltage across C5 (which is also connected to pin 3) plus the voltage drop across the forward-biased diode CR1. The amplifier charges C5 until the voltage at pin 4 equals the voltage at pin 3, and maintains this condition until the input at pin 4 drops. The amplifier output then swings to a maximum negative value (about −8V), CR1 reverse biases, and C5 slowly discharges until the input at pin 4 again exceeds that at pin 3. Thus the positive peak value of the input voltage is stored on C5. Resistors R7 and R10 discharge C5 whenever the input signal level is reduced slightly between input peaks. Resistor R11 adds a small amount of gain to the detector.

A 1 Vpk ac signal into the Positive Peak Detector will produce 1 Vdc out. However, a 0.977 Vdc input to the Meter Drive Amplifier A4U1 produces full-scale meter deflection. In the LEVEL meter mode, A26A4U1A (Service Sheet 12) provides the proper input level to the peak detector. In the AM mode, a 1 Vpk ac input would be reduced to 0.977 Vpk (by voltage divider R9/R3), and correspond to full-scale meter deflection. In the FM mode, the signal from the Peak Deviation Switch is not further attenuated, so 1 Vpk would produce slightly greater than full-scale meter deflection (e.g., 5.12 MHz on the 5 scale).

Meter Drive Amplifier (A4)

Meter Drive Amplifier U1 scales the dc input voltage and drives meter M1. Transistor Q1 is a switch which operates in the inverted mode (i.e., the emitter functions as a collector and the collector as an emitter). When Q1 is OFF, the amplifier gain is 10, when Q1 is ON, the gain is 3.16. With an amplifier gain of 10 and an input of 977 mVdc, the meter (which has a nominal 1 mA full-scale movement) is adjusted to read full scale (on the 0-10 scale) by means of R19. Breakdown diode VR2 protects the meter from being overdriven or driven negative.

Autorange Comparator (A4)

Amplifier U2 functions as a Schmitt Trigger. A reference voltage is established at pin 3 by voltage divider R3 and R4. Resistor R5 adds a small amount of hysteresis to the comparator. Ripple at the input pin 2 is reduced by R7 and C2.

SERVICE SHEET 17 (Cont'd)

Logic Circuitry (A4)

The logic gates control the meter amplifier gain and scale lamps (except for FM) as outlined in Table 8-5. Whenever OUTPUT LEVEL switch A1S1AF is in an odd range, the ODD RANGE CODE line is grounded. The ranges on the switch are numbered consecutively from 1 to 16. The highest output range is 16 which corresponds to a maximum output level of 3.16V. For range 15 the maximum output level is 1V; for range 14, 0.316V; etc. When the LEVEL mode is selected, the 0 - 10 scale lamp is turned on by Q2 when the range is odd and the input above the autorange reference; or the 0 - 3 scale lamp is turned on by Q3 when the input is below the autorange reference. When the range is even, the lamp sequence is reversed; the reversal is accomplished by Exclusive-OR Invert function formed by gates U3A, U3B, U3C, and U4B.

In the AM meter mode the logic conditions are the same as for the LEVEL mode on an odd range. In both the AM and LEVEL modes the Autorange Comparator and AND gate U4A turn on Q1 when the input to the Meter Drive Amplifier is below the autorange reference and turn off Q1 when above it.

Table 8-5. Meter Drive Amplifier Data

				Input Below Autorange Reference							Input Above Autorange Reference						
Meter Mode	Odd/ Even Range	Test Point 6	Test Point 2	Test Point 3	Nom. Volts In	A4U1 Gain	Scale	Q1	Q2	Q3	Test Point 3	Nom. Volts In	A4U1 Gain	Scale	Q1	Q2	Q3
AM	Either	L	H	H	0 - 0.3	31.6	0 - 3	ON	OFF	ON	L	0.3 - 1	10	0 - 10	OFF	ON	OFF
FM	Either	L	L	H	*	*	**	OFF	OFF	OFF	L	0 - 1	10	**	OFF	OFF	OFF
LEVEL	Odd	L	H	H	0 - 0.3	31.6	0 - 3	ON	OFF	ON	L	0.3 - 1	10	0 - 10	OFF	ON	OFF
	Even	H	H	H	0 - 0.3	31.6	0 - 10	ON	ON	OFF	L	0.3 - 1	10	0 - 3	OFF	OFF	ON

NOTES:

* No autoranging in FM mode

** Scale lamps determined by PEAK DEVIATION switch

L = 0 to 0.8 Vdc

H = 3 to 5.2 Vdc

SERVICE SHEET 17 (Cont'd)

TROUBLESHOOTING

It is assumed that a problem has been isolated to the meter circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top cover, trim strip, and front panel window removed (see Service Sheet G for removal procedure). Use extender board to extend desired circuit board assembly (set instrument LINE power switch to OFF while removing or inserting circuit boards).

Initial Control Settings

Meter Function . . . . AM
AM . . . . INT
MODULATION FREQUENCY . . . . 1 kHz
FM . . . . INT
PEAK DEVIATION . . . . 5 kHz
OUTPUT LEVEL Switches . . . . 0 dBm (0,0)
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . . ON

Meter Circuits Troubleshooting (1 of 2)

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
BUFFER AMPL (A2U1)	Initial conditions and settings. Adjust MODULATION for a 2 Vp-p (1 Vpk) signal at TP3 (AC IN).	2 Vp-p (1 Vpk) at U1 pin 6	Check U1 and associated circuitry
POSITIVE PEAK DETECTOR (A2U2)	Initial conditions and settings. Adjust MODULATION for a 2 Vp-p (1 Vpk) signal at TP3 (AC IN).	1 Vdc at TP2 (DC OUT)	Check U2, CR1, C5 and associated circuitry
AUTORANGE COMPARATOR (A4U2)	Initial conditions and settings. Adjust MODULATION for 250 mVdc at TP4 (DC IN).	≈ 4.5 Vdc at TP3 (A)	Check U2 and associated circuitry
	Adjust MODULATION for 350 mVdc at TP4 (DC IN)	≈ −100 mVdc at TP3 (A)	
AMPL GAIN LOGIC (A4U4A)	Initial conditions and settings. Adjust MODULATION for 250 mVdc at TP4 (DC IN).	≈ 4.0 Vdc at U4A pin 3	Check U4 and associated circuitry
	Adjust MODULATION for 350 mVdc at TP4 (DC IN)	≈ 50 mVdc at U4A pin 3	
	Set Meter Function to FM	≈ 50 mVdc at U4A pin 3	

RF Vernier (A19A1, A26)
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Meter Circuits Troubleshooting (2 of 2)

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
METER DRIVE AMPL (A4U1)	Initial conditions and settings. Adjust MODULATION for 977 mVdc at TP4 (DC IN)	9.77 Vdc at TP1 (F.S. ADJ)	Check U1, Q1, and associated circuitry
	Adjust MODULATION for 300 mVdc at TP4 (DC IN)	9.5 Vdc at TP1 (F.S. ADJ)	
SCALE Annunciator Lamps (A6)	Initial conditions and settings except set Meter Function to FM	0 - 5 SCALE annunciator lit	Check DS4
	Set PEAK DEVIATION to 10 kHz	0 - 10 SCALE annunciator lit	Check DS6
	Set PEAK DEVIATION to 20 kHz	0 - 3 SCALE annunciator lit	Check DS5
EXCLUSIVE-OR INVERT and LAMP DRIVE LOGIC (A4U3, U4)	Initial conditions and settings. Set MODULATION fully ccw.	0 - 3 SCALE annunciator lit	Check U3, U4, and Q3
	Set MODULATION fully cw	0 - 10 SCALE annunciator lit	
	Set Meter Function to LEVEL	0 - 3 SCALE annunciator lit	Check U3, U4, Q2 and Q3
	Set OUTPUT LEVEL 10 dB switch to −10 dBm	0 - 10 SCALE annunciator lit	

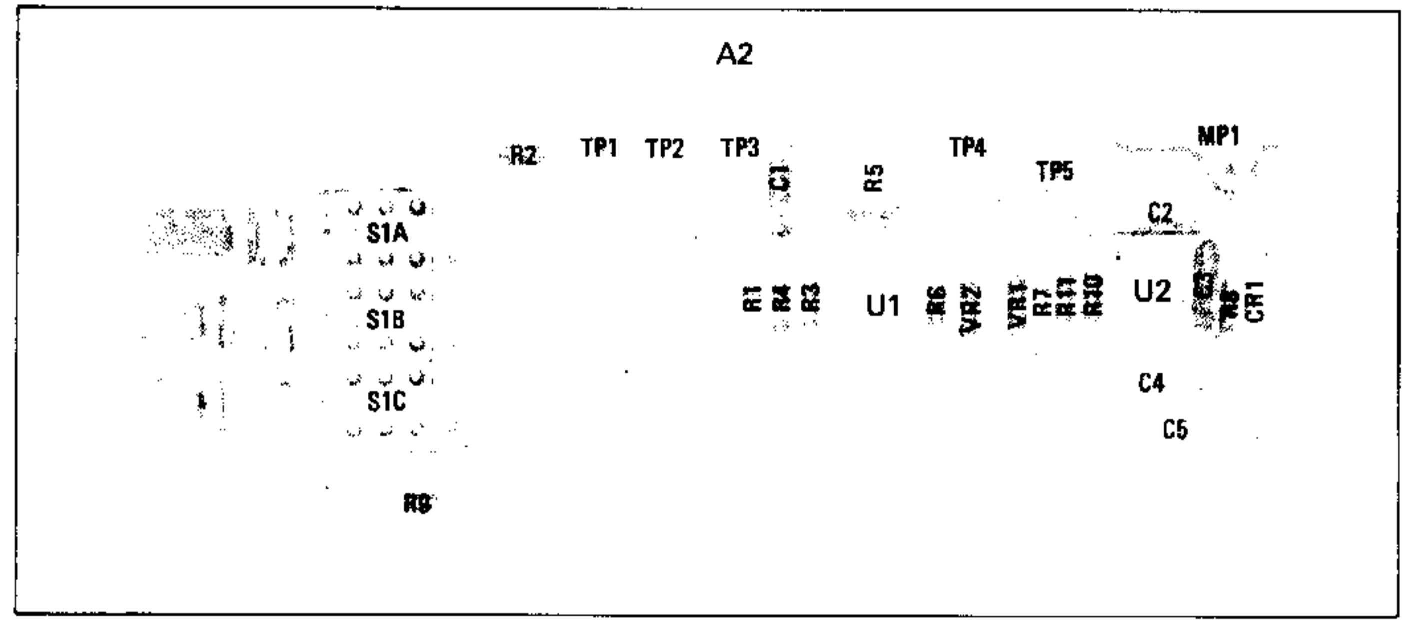

Figure 8-56. A2 Meter Switch/Detector Assembly Component Locations

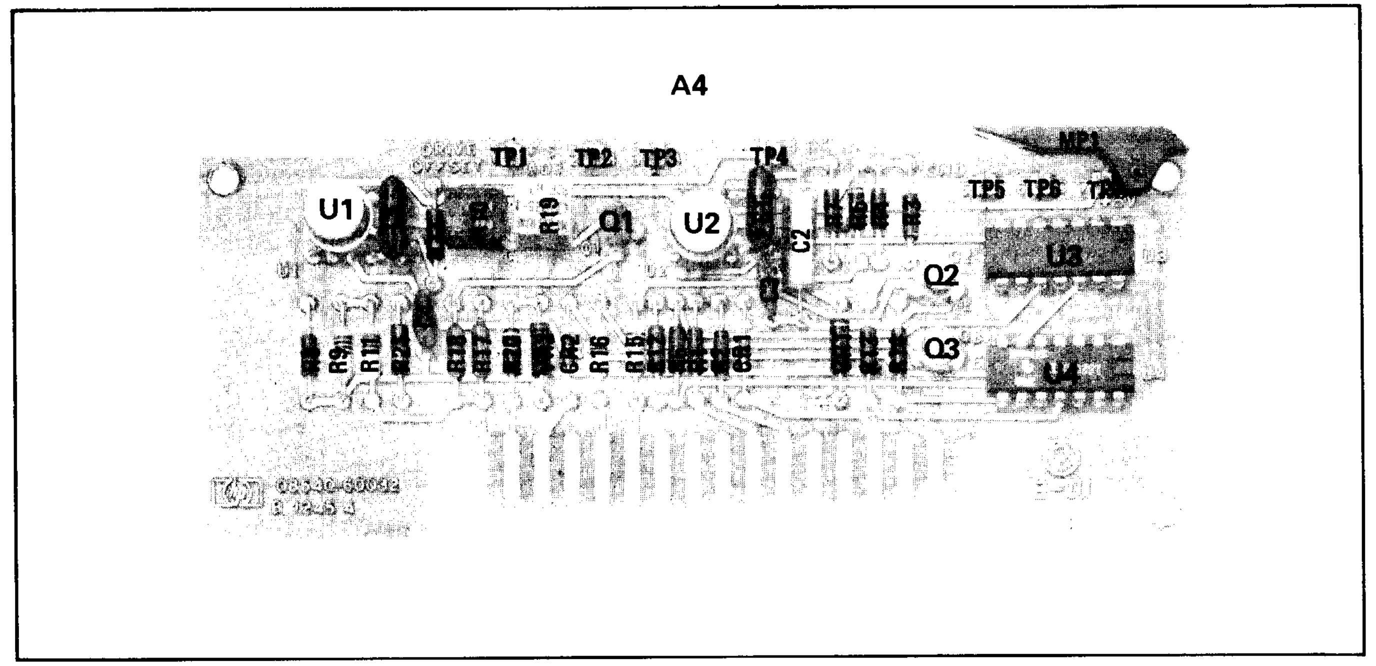

Figure 8-57. A4 Meter/Annunciator Drive Assembly Component Locations

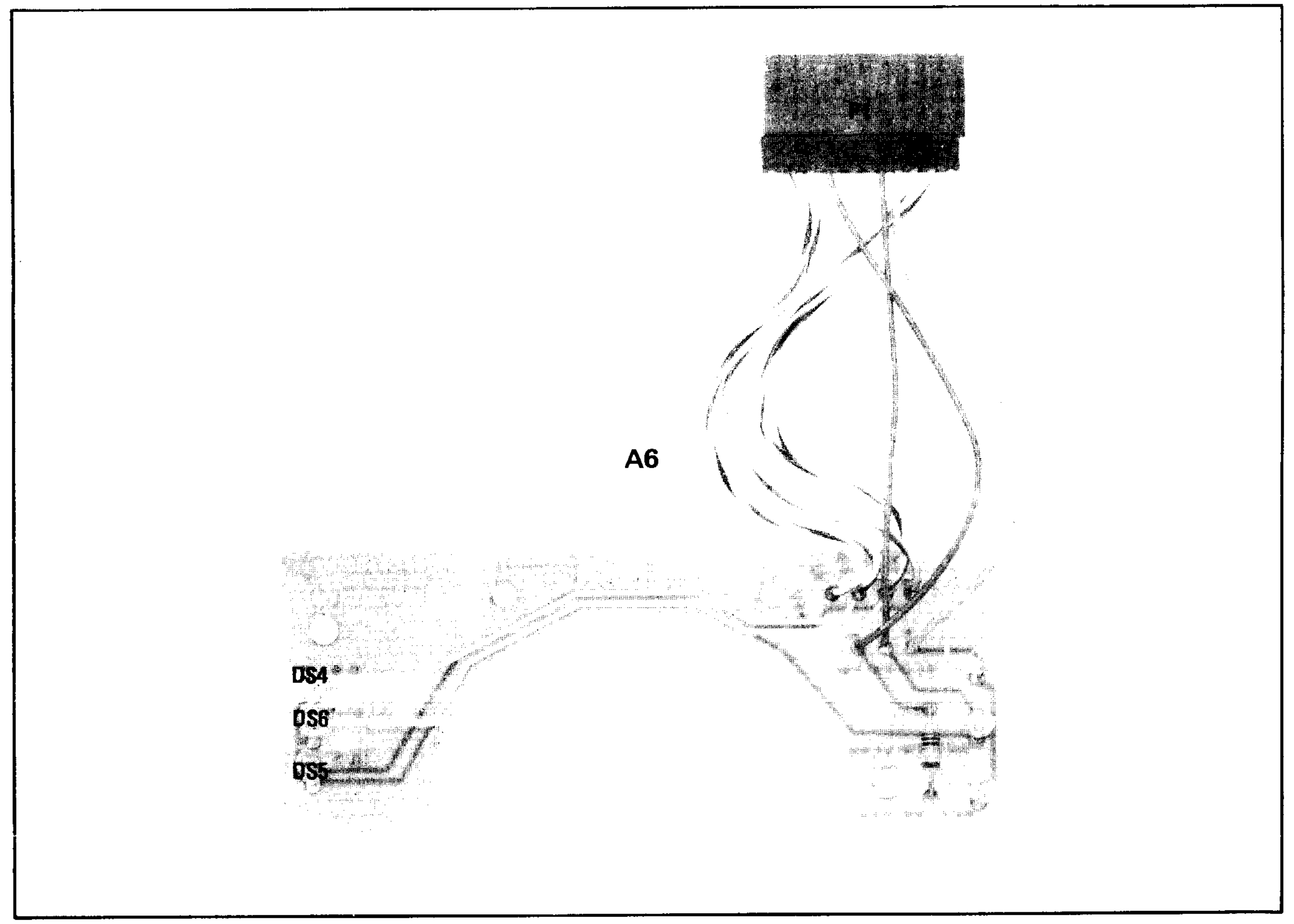

Figure 8-58. P/O A6 Annunciator Assembly Component Locations

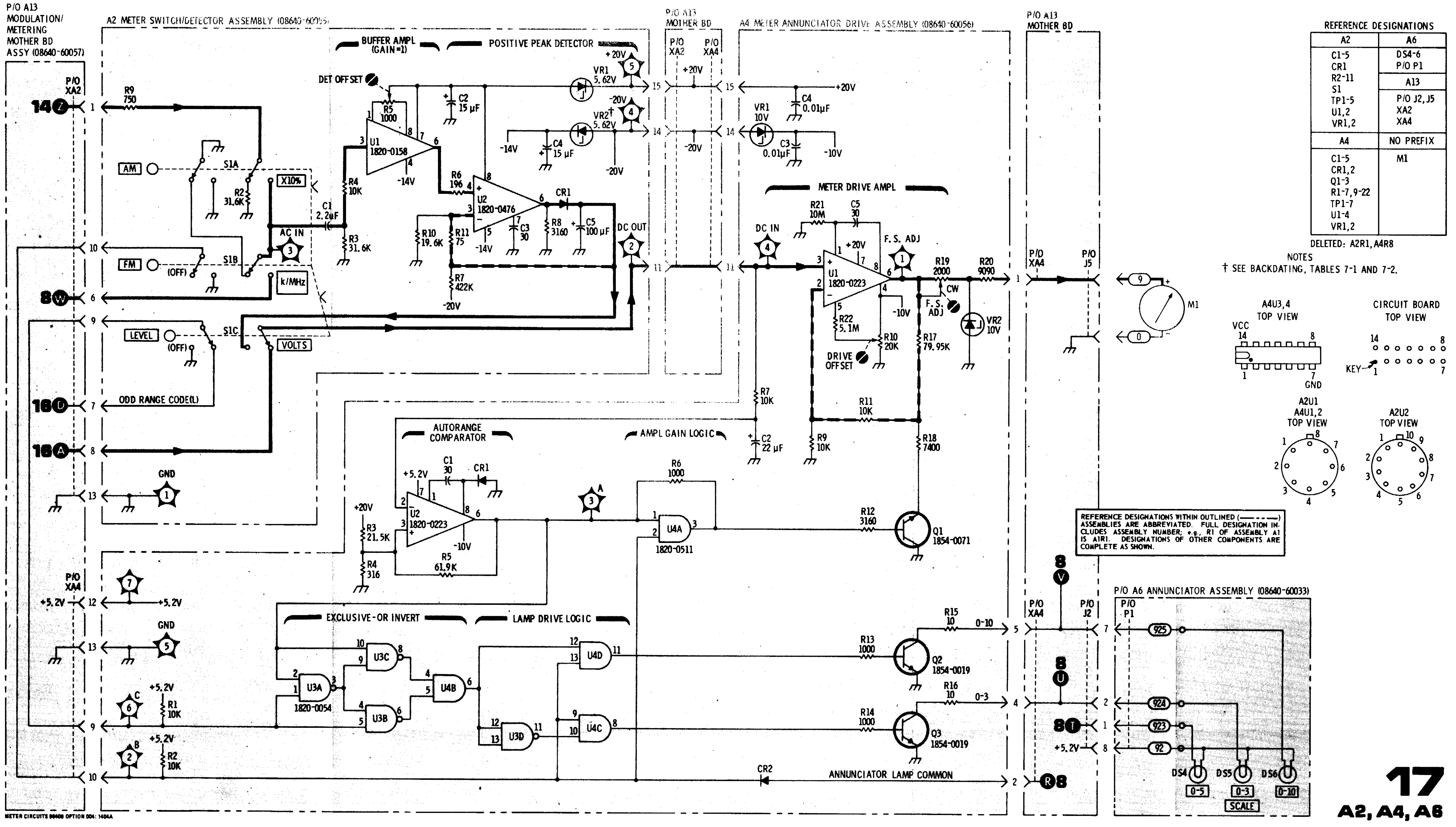

Figure 8-59. Meter Circuits Schematic Diagram

SERVICE SHEET 18

PRINCIPLES OF OPERATION

General

The RF A8A1 Scaler Assembly processes the RF input to the counter. In INT or EXT 0-550 MHz counter modes, the input frequency is divided by 64. In the EXT 0-10 MHz mode, the input frequency is not divided.

Comparator (A8A1)

In the INT counter mode, the RF signal from the RF oscillator Frequency Counter Buffer Amplifier (Service Sheet 5) passes through relay K1 into Comparator U5 which converts the input signal to EECL compatible pulses. In the EXT counter mode, the external input couples into U5 through relay K2 and a diode network (CR2 to CR5) which protects U5 from large voltages.

Dividers (A8A1)

EECL dividers U1 and U2 divide the frequency by 2 and 16 respectively; U4 is an ECL divide-by-two. In the INT or EXT 0-550 MHz counter modes, the divider stages are enabled through the OR input of U1 and set (S) input of U4. The output of U3A is high, U3D is low, U3B inverts the Q output of U4. Note that for ECL and EECL, ground is a logical high and an open and a negative, is a logical low. In the EXT 0 - 10 MHz counter mode the OR input of U1 is disabled (high), and the set (S) input of U4 is high; therefore, the Q output is low. The output of U3A is low, U3D inverts the RF input and U3B inverts the output from U3D with no frequency division. Transistors Q1 and Q2 shift the EECL logic levels to ECL logic levels. The output from the bypass gate U3D is ac coupled into transistor A8A3Q2 which converts the ECL logic levels to TTL logic levels. The output of A8A3Q2 drives the counter circuits.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the counter RF scaler circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the' procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C
Frequency Counter . . . .HP 5327C

SERVICE SHEET 18 (Cont'd)

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). A8 Counter/Lock Assembly casting cover removed with access to A8A1 RF Scaler Assembly and A8A3 Time Base Assembly (see Service Sheet C for procedures). Connect RF OUT to COUNTER INPUT.

Initial Control Settings

COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . . . EXT 0-10
AM . . . . OFF
FM . . OFF
RANGE. . . . . .4-8 MHz
FREQUENCY TUNE . . . . Fully CW
OUTPUT LEVEL . . . . 100 mVOLTS
OUTPUT LEVEL Vernier . . . . CAL
RF ON/OFF . . . .ON

Counter RF Scaler Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
RF SCALER (A8A1)	Initial conditions and settings. Check frequency at COUNTER INPUT jack and at U3B pin 6.	Frequency at COUNTER INPUT the same as U3B pin 6	Check K2, U5, Ql, U3A, U3D, and associated circuitry
	Set RANGE to 32-64 MHz and COUNTER MODE to EXT 0-550. Check frequency at COUNTER INPUT jack and at U3B pin 6.	Frequency at COUNTER INPUT 64 times frequency at U3B pin 6	Check K2, U5, Ul, U2, U3B, U4, Q2, and associated circuitry
COMPARATOR (A8A1)	Initial conditions and settings except set COUNTER MODE to INT, RANGE to 256-512 MHz, and FREQUENCY TUNE to 550 MHz (with counter at RF OUT	Frequency at U3B pin 6 ≈ 8.58 MHz	Check U5, Ul, K1, and associated circuitry
	Set COUNTER MODE to EXT 0-550	Frequency at U3B pin 6 ≈ 8.58 MHz	Check CR2, CR3, K2, and associated circuitry
ECL to TTL TRANSLATOR (A8A3)	Initial conditions and settings except set COUNTER MODE to INT	≈ 0-5V square wave at Q2-C at ≈ 8 MHz	Check Q2 and associated circuitry

Meter Circuits (A2, A4, A6)
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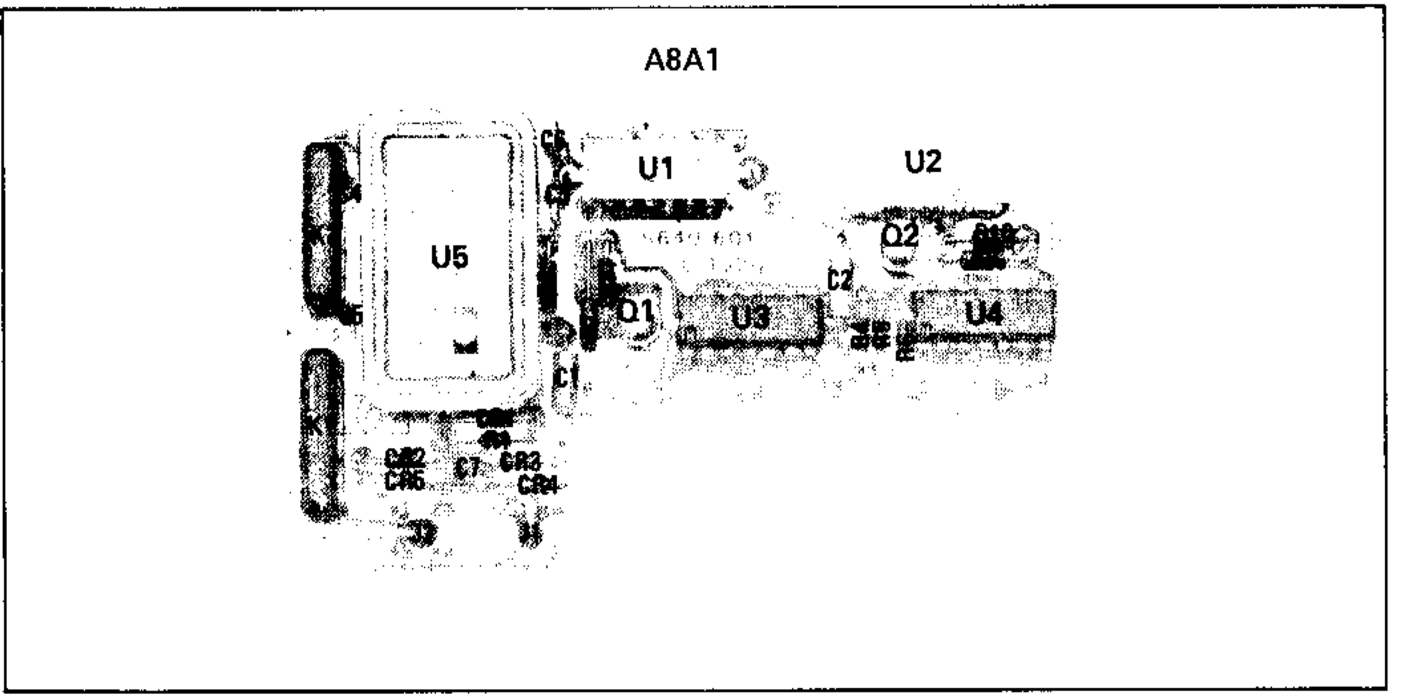


Figure 8-60. A8A1 RF Scaler Assembly Component Locations

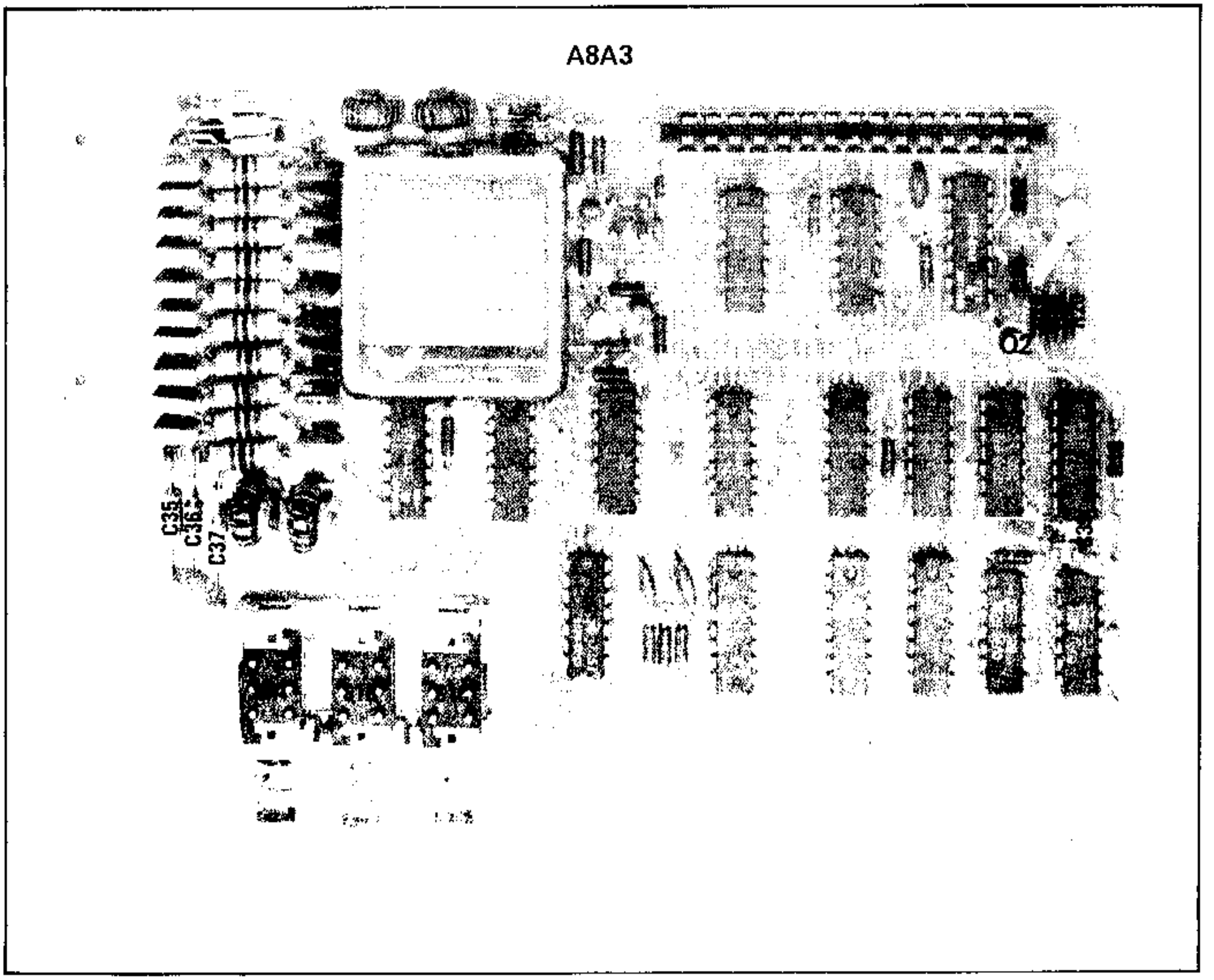


Figure 8-61. P/O A8A3 Time Base Assembly Component Locations

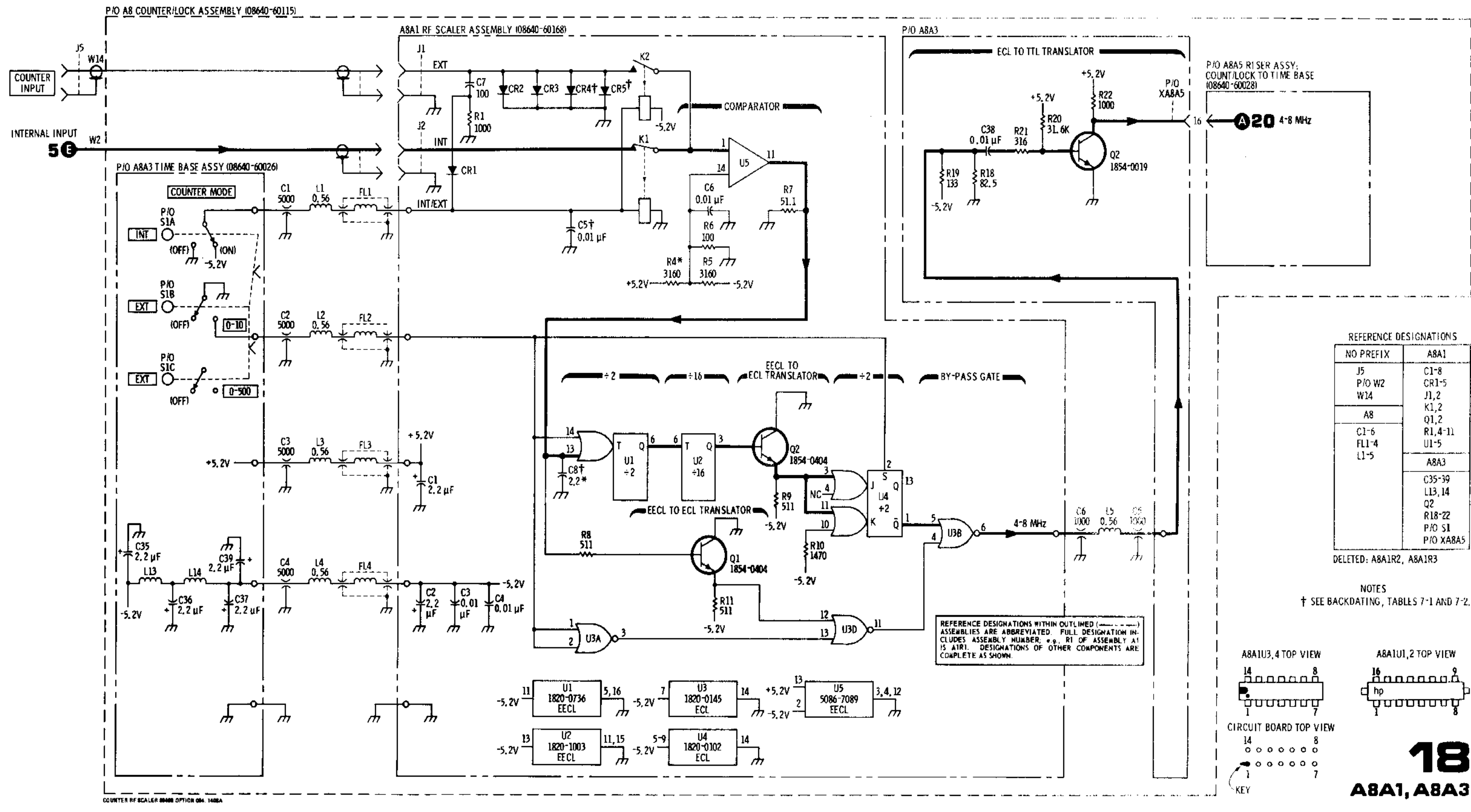


Figure 8-62. Counter RF Scaler Schematic Diagram

SERVICE SHEET 19

PRINCIPLES OF OPERATION

General

The A8A3 Time Base Assembly contains the internal counter time base reference and circuits that frequency divide the time base reference down to the period required to gate the counter for a particular selection of frequency range and counter mode. Additional circuits adjust the duty cycle of the time base for phase lock and non-phase lock modes and decode the decimal point to the counter display. All counter assembly inputs are heavily filtered to prevent RF leakage.

Time Base Reference Crystal Oscillator (A8A3)

The internal Time Base Reference Crystal Oscillator Y1 is a 5 MHz crystal oscillator which can be voltage tuned over a ±100 Hz range. The tuning voltage comes from the TIME BASE VERNIER potentiometer A8A4R1 (Service Sheet 21). The oscillator output is ORed with the INT/EXT time base switch S3. The output of OR gate U6B follows the oscillator frequency when S3 is ground (INT), or is high when S3 is open (EXT). An external time base reference (if present) is ac coupled into the output of U6B. Transistor Q1 is a buffer amplifier and drives the ÷5 counter U12A.

Time Base Reference Decoder (A8A3)

Depending on the COUNTER MODE and RANGE selected, the time base reference frequency is divided by counters U13, U14, and U15 which are programmed by the Preset Decoders. The division ratio is given in Table 8-6. The Q_D output of U12A drives synchronously loading counters U13 and U14 which together form a programmable ÷25, ÷32, or ÷40 counter.

The counters work as follows: At the last count of a 99-count sequence, the load inputs (LD) are enabled (with a low). The next count input presets the counters to the BCD count at the data inputs (D_A, D_B, D_C, D_D). Counter U13 then counts the clock input (T) pulses beginning at the preset count. When the count reaches nine, the counter generates a high carry output (TC) pulse. The carry pulse enables (CE) counter U14 for one clock period which increments the count of U14 by one. Counter U13 then counts from zero to nine and generates another carry pulse. Counter U14 then increments by one more count. This process continues until both counters reach a count of nine. Counter U14 then generates a high carry which enables the load inputs (via inverter U7E). The next clock pulse presets the counter. The count sequence is then repeated. The total count equals (9 - preset count of U14) x 10 + (10 - preset count of U13). The preset count is determined by the range section of the switch A9S2A and the COUNTER MODE switches.

In the INT mode the COMMON switch line is low, gates U1A, U1B, U8B, and U8D decode the band code lines (CODE B and CODE C) and preset the data inputs of U13 and U14. In the EXT mode the COMMON line is high and CODE B and CODE C are high. The data inputs of U13 and U14 for different count conditions are given in Table 8-7. Note that band CODE A is defined as high on both CODE B and CODE C.

SERVICE SHEET 19 (Cont'd)

Table 8-6. Total Count of Time Base Reference Counters U13, U14, and U15

COUNTER MODE	Range MHz	Band Code	Total Count (Division)
INT	0.5 - 1	A5	25 x 5 = 125
	1 - 2	A1	25 x 1 = 25
	2 - 4	A2	25 x 2 = 50
	4 - 8	A4	25 x 4 = 100
	8 - 16	A8	25 x 8 = 200
	16 - 32	C1	40 x 1 = 40
	32 - 64	C2	40 x 2 = 80
	64 - 128	C4	40 x 4 = 160
	128 - 256	B1	32 x 1 = 32
	256 - 512	B2	32 x 2 = 64
	512 - 1024	B4	32 x 4 = 128
EXT	0 - 550	—	32 x 2 = 64
	0 - 10	—	25 x 4 = 100

The Q_D output of U14 drives inverter U7F which drives counter U15 and OR gate U5B. Counter U15 is a programmable ÷1, 2, 4, 5 or 8 counter; its operation is similar to that of U13 and U14. At the last count of a nine-count sequence the load (LD) input is enabled. The next count input presets the counter to the binary count at the data inputs (D_A, D_B, D_C, and D_D). The counter then counts the clock input (T) pulses beginning at the preset count. When the count reaches nine, the counter generates a high carry (TC). The carry pulse enables the load input (via inverter U7C) and on the next clock pulse presets the counter. The count sequence is then repeated. The total count equals 10 - preset count. The preset count is also determined by the RANGE switch and COUNTER MODE switches. The band code lines CODE 1, CODE 2, CODE 5, and CODE 8 and the COUNTER MODE functions are decoded by gates U1C, U4A, U4B, U6D, and U9 which drive the data inputs of U15. The data inputs of U15 for different count conditions are given in Table 8-8. (Note that band CODE 4 is defined as all highs on CODE 1, CODE 2, CODE 5, and CODE 8). When counter U15 is preset for ÷1, the carry output remains high and the output of U7C remains low. OR gate U5B now reproduces the output of inverter U7F directly.

Expand Decoder (A8A3)

The Expand Decoder counters, U16 and U17, are programmed to divide the Time Base Reference Decoder output by one (normally), by ten (in EXPAND X10), or by 100 (in EXPAND X100). The counters are configured as ÷10 counters with output Q_A connected to input T_{BD}. When the reset-to-nine input (R_9 at pin 7) is low, the counter operates as a ÷10 counter. When pin 7 is high, the counter, initially at a count of nine, overflows to zero when input T_A goes low. The other reset-to-nine inputs (R_9 at pin 6) are normally low, being held low by the resistors (R10 and R17) on their inputs. When input T_A goes high, capacitors C21 and C22 ac couple the high into the reset-to-nine inputs which resets the counters to nine. A short time later pin 6 returns low. When input T_A again goes low, the counter again overflows to zero and the sequence repeats. The Q_D output then follows the T_A input in frequency.

In the unexpanded mode, EXP 10 and EXP 100 are both high, the output of NAND gate U1D is low, and the output of inverter U7B is high. Both reset-to-nine inputs are high and counters U16 and U17 function as ÷1 counter.

In EXPAND X10, EXP 10 is low, NAND gate U1D is high, inverter U7B is low, and counter U16 functions as a ÷10 counter. In EXPAND X100, EXP 100 is low, NAND gate U1D is again high, inverter U7B is low, and this time both counters U16 and U17 function as ÷10 counters. The two counters in series divide the input frequency by 100.

Table 8-7. Count Modes of Counters A8A3U13 and U14

COUNTER MODE	Count Condition	U13 and U14 Data Inputs: U13 D_A	D_B	D_C	D_D	Preset Count	U14 D_A	D_B	D_C	D_D	Preset Count	Total* Count (Division)
INT	Band Code A	H	L	H	L	5	H	H	H	L	7	25
	Band Code B	L	L	L	H	8	L	H	H	L	6	32
	Band Code C	L	L	L	L	0	L	H	H	L	6	40
EXT	0-550 MHz	L	L	L	H	8	L	H	H	L	6	32
	0-10 MHz	H	L	H	L	5	H	H	H	L	7	25

*Total Count = (9 Preset Count of U14) x 10 + (10 − Preset Count of U13)

Table 8-8. Count Modes of Counter A8A3U15

COUNTER MODE	Count Condition	U15 Data Inputs: D_A	D_B	D_C	D_D	Preset Count	Total* Count (Division)
INT	Band Code 1	H	L	L	H	9	1
	Band Code 2	L	L	L	H	8	2
	Band Code 4	L	H	H	L	6	4
	Band Code 5	H	L	H	L	5	5
	Band Code 8	L	H	L	L	2	8
EXT	0-550 MHz	L	L	L	H	8	2
	0-10 MHz	L	H	H	L	6	4

*Total Count 10 − Preset Count

SERVICE SHEET 19 (Cont'd)

Lock Decoder (A8A3)

The lock decoder further divides the time base reference frequency and adjusts the time base duty cycle for phase lock and non-phase lock modes. Counters U11 and U10 each function as ÷10 counters. In the unlocked mode, LOCK is low as is the output of AND gate U4C which drives the reset-to-zero inputs (R_0 at pin 2) of U11 and U10. The two counters in series count to 100. At the 100th count the Q_D output of U10 goes low as does the output of buffer gate U5D; the Q_A output of U12B goes high. The output gate U5C is normally low, being held low by resistor R12 on the inputs. When the Q_A output of U12B goes high, capacitor C24 ac couples the high into the reset-to-nine inputs of the counters and resets them to nine. A short time later the output of U5C returns low. The next pulse into the T_A input of U11 clocks counters U11 and U10 to zero and the Q_A output of U12B goes low. The count sequence now repeats. The result of the sequence is that the output of U12B is low for 100 counts of the T_A input of U11, and high for one count, dividing the frequency by 101.

In the locked mode, the LOCK line is high. Counters U11 and U10 count the T_A input pulses of U11. When the count reaches 100, the Q_D output of U10 goes low and the Q_A output of U12B goes high, the high pulse sets counters U11 and U10 to nine through the resistor-capacitor network and U5C. The reset-to-zero inputs (R_0 at pin 2) are also held high through resistor-capacitor network R11 and C23 and AND gate U4C, but the reset-to-nine overrides the reset-to-zero. The time constant of the reset-to-zero resistor -capacitor network is longer than the reset-to-nine resistor-capacitor network so counter U11 and U10 first reset to nine then reset to zero (and both happen between input pulses). The low going Q_D output of U10 sets the output of U12B to zero. The count sequence now repeats. The result of the sequence is that the output of U12B is low for nearly all of 100 counts and high for only a small fraction of one count, dividing the frequency by 100. The output of the lock decoder drives inverter U17A whose output is the counter time base.

Decimal Point Decoder (A8A3)

The decimal point decoder decodes the band code and counter mode inputs and drives the decimal point lines to the display. In the EXPAND X10 mode the decimal point is shifted to the left one place; in the EXPAND X100 mode it is shifted two places. Gates U1A, U1B, U8B, U8C, and U8D decode the decimal point location from the band code and counter mode inputs and drive the data inputs (D_A, D_B, D_C, and D_D) of the decimal point shift register U3. The data inputs for the different counter modes are shown in Table 8-9. Note that only one data input is low for each case.

In the unexpanded counter mode, both EXP 10 and EXP 100 are high, the output of NAND gate U1D is low, and the clear (CLR) input of D flip-flop U2B is low. Flip-flop U2B clears and holds the $\overline{Q}$ output high which holds one input of OR gate U5A high. The output of OR gate U5A remains high regardless of the state of the other input which is the clock output from U5B. The T input of shift register U3 is held high. At the termination of a time base period, the output of U5C goes momentarily high. This output is inverted by U8A and drives the clear (CLR) input of U3. The output of U5C is also delayed by resistor-capacitor network R13 and C25 and drives the load (LD) input of U3. At the termination of each time base period, the shift register outputs (Q_A, Q_B, Q_C, Q_D, and Q_E) are first cleared (i.e., all go low) and then loaded with the data inputs. The outputs drive the decimal point inputs of the LED display.

SERVICE SHEET 19 (Cont'd)

Table 8-9. Data Inputs of Decimal Point Shift Register

COUNTER MODE	RANGE (MHz)	Band Code	Data Inputs: A	B	C	D	E	Decimal Point Position
INT	0.5 - 1	A5	H	H	H	L	H	5
	1 - 2	A1	H	H	L	H	H	4
	2 - 4	A2	H	H	L	H	H	4
	4 - 8	A4	H	H	L	H	H	4
	8 - 16	A8	H	H	L	H	H	4
	16 - 32	C1	H	L	H	H	H	3
	32 - 64	C2	H	L	H	H	H	3
	64 - 128	C4	H	L	H	H	H	3
	128 - 256	B1	L	H	H	H	H	2
	256 - 512	B2	L	H	H	H	H	2
	512 - 1024	B4	L	H	H	H	H	2
EXT	0 - 550	–	L	H	H	H	H	2
	0 - 10	–	H	H	L	H	H	4

In the EXPAND X10 mode, EXP 10 is low; the output of U1D is high; the set (S) input of flip-flop U2A is low and sets the output (i.e., $\overline{Q}$ is low). The D input of U2B is low. Except at the termination of the time base period, the clear (CLR) input of U2A and the set (S) input of U2B are high. The $\overline{Q}$ output of U2B is high and holds the output of OR gate U5A high. At the termination of a time base period, the set input of U2B goes momentarily low; the $\overline{Q}$ output goes low until the clock pulse returns it to a high. The output of OR gate U5A is low for one low clock period then it goes high. The T input of U3 then receives one trigger pulse for each time base period in EXPAND X10. At the termination of a time base period the shift register is cleared, the input data is transferred to the output and then shifted up one bit. A high appears in the output Q_A of U3 when shifting because the serial (SER) input is a high (i.e., open).

Counter RF Scaler (A8A1, A8A3)
SERVICE SHEET 18

SERVICE SHEET 19 (Cont'd)

In the EXPAND X100 mode, EXP 100 is low; the output of U1D is high. Except at the termination of a time base period, the clear and set inputs of U2A and U2B are high. The $\overline{Q}$ output of U2A is low, and the $\overline{Q}$ output of U2B is high, therefore the output of OR gate U5A is high. At the termination of a time base period, the set input of U2B goes momentarily low as does the clear input of U2A which causes the $\overline{Q}$ output of U2A to go high and the $\overline{Q}$ output of U2B to go low. When the clock is low, the output of OR gate U5A is low. When the clock goes high, the $\overline{Q}$ output of U2A goes low, the $\overline{Q}$ output of U2B remains low, and the output of OR gate U5A goes high. When the clock goes low, the output of OR gate U5A again goes low. When the clock goes high, the $\overline{Q}$ output of U2B goes high as does the output of OR gate U5A and remains high until the next time base termination. The T input of U2 received two pulses, which shifted the output register up twice after being cleared and loaded with the preset inputs.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the counter time base as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . . . HP 180A/1801A/1820C
Frequency Counter . . . . HP 5327C

Initial Test Conditions

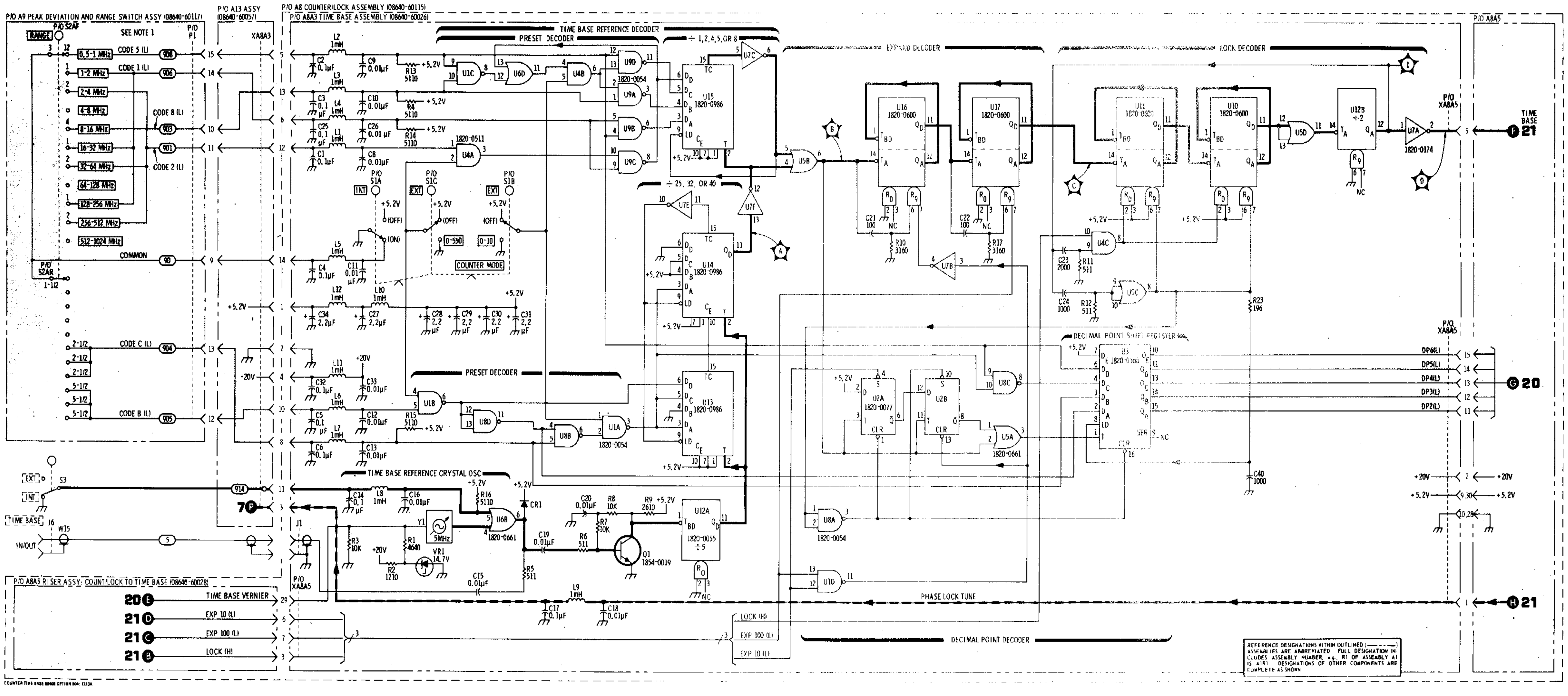
Top cover removed (see Service Sheet G for removal procedure). A8 Counter/Lock Assembly casting cover removed, A8A2 Counter/Lock Board Assembly removed and extended for service with access to A8A3 Time Base Assembly (see Service Sheet C for procedures).

Initial Control Settings

COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . . INT
RANGE . . . . 512 - 1024 MHz
TIME BASE INT/EXT (rear panel) . . . . . INT

Counter Time Base Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
TIME BASE REFERENCE CRYSTAL OSCILLATOR (A8A3)	Initial conditions and settings except set TIME BASE (on rear panel) to INT	Internal Reference Performance Tests (see Section IV) check good	Check U1 and associated circuitry
TIME BASE REFERENCE DECODER (A8A3)	Initial conditions and settings. Connect high impedance input of frequency counter to test point A (U14 pin 11).	1 MHz (from U12A) division is as shown in Table 8-7. (See Table 8-6 for Band Codes.)	Check U13, U14, preset decoder, RANGE switch, and associated circuitry
	Connect counter to test point B (U5 pin 6). Set RANGE and COUNTER MODE switches as shown in Table 8-6.	1 MHz division is as shown in Table 8-6	Check U15, preset decoder, RANGE switch, and associated circuitry
EXPAND DECODER (A8A3)	Initial conditions and settings. Connect high impedance input of frequency counter to test point C (U17 pin 11).	7,812.5 Hz (i.e., division by one)	Check U16, U17 and associated circuitry
	Set COUNTER MODE EXPAND to X10	781.25 Hz (i.e., division by 10)	
	Set COUNTER MODE EXPAND to X100	78.125 Hz (i.e., division by 100)	
LOCK DECODER (A8A3)	Initial conditions and settings. Connect high impedance input of frequency counter to TP1.	77.35 Hz (i.e., division by 101)	Check U10, U11, and associated circuitry
	Set COUNTER MODE LOCK to ON	78.125 Hz (i.e., division by 100)	
DECIMAL POINT DECODER (A8A3)	Initial conditions and settings. Set RANGE and COUNTER MODE switches as shown in Table 8-9.	Decimal Point outputs (high) or decimal points lit as indicated in the table	Check U2, U3, and associated circuitry. Also check A8A4 U1-6 (see Service Sheet 20).



REFERENCE DESIGNATIONS

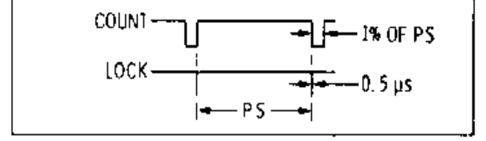
A8A3	A9
C1-6, 8-34, 40 CR1 J1 L1-12 Q1 R1-17, 23 P/O S1 TP1 U1-17 VR1 P/O XA8A5 Y1	P/O P1 P/O S2
	A13
	XA8A3
	NO PREFIX
	J6 S3 W15

DELETED: A8A3C7

NOTES

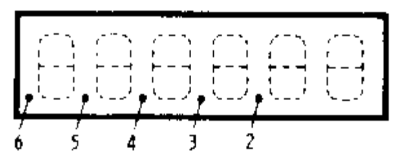
1. CODE A = $\bar{\bar{B}} \cdot \bar{C}$, CODE 4 = $\overline{\bar{1} \cdot \bar{2} \cdot \bar{5} \cdot \bar{8}}$

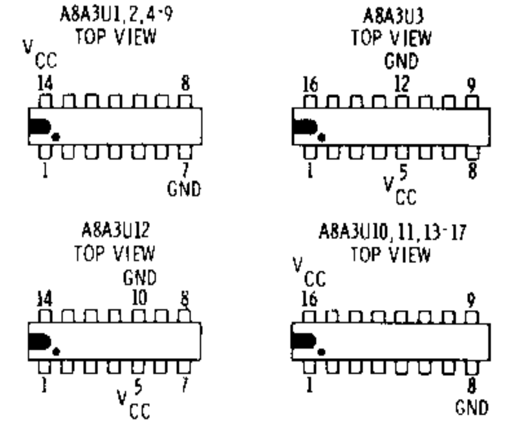
RANGE	CODES (LOW-TRUE)	TIME BASE* PS(ms)	TIME BASE* PRF(Hz)	DECIMAL POINT
0.5-1 MHz	A5	12.5	80	5
1-2 MHz	A1	2.5	400	4
2-4 MHz	A2	5.0	200	4
4-8 MHz	A4	10.0	100	4
8-16 MHz	A8	20.0	50	4
16-32 MHz	C1	4.0	250	3
32-64 MHz	C2	8.0	125	3
64-128 MHz	C4	16.0	62.5	3
128-256 MHz	B1	3.2	312.5	2
256-512 MHz	B2	6.4	156.25	2
512-1024 MHz	B4	12.8	78.125	2
EXT 0-10	-	10.0	100	4
EXT 0-550	-	6.4	156.25	2



*PRF (Hz) AT TP0 SHOWN FOR LOCK MODE. PRF (Hz) FOR COUNT MODE IS 1% LESS THAN THAT SHOWN.

DECIMAL POINTS





19
A8A3, A9

Figure 8-64. Counter Time Base Schematic Diagram

SERVICE SHEET 20

PRINCIPLES OF OPERATION

General

The counter has two modes of operation:

1) COUNT (count up): The counter counts the input frequency.
2) PHASE LOCK (count down): The counter finishes the current count sequence, stores the count, then enters phase lock counting down from the stored count to zero in a free-running mode.

The frequency is displayed on a six-digit LED numeric display.

Counter Operation - Count Mode (A8A2)

When COUNTER MODE LOCK switch S1 is out (Off) the count sequence is as follows: When the TIME BASE line is high, decade counters U24 through U19 count the input pulses. When TIME BASE goes low, the count is inhibited, the counter outputs are transferred to the outputs of storage buffers U7 through U12 which in turn drive the numeric displays A8A4U1 to U6. The storage buffer outputs are latched, and then the counters are cleared. When TIME BASE goes high, the count begins again.

Shaping and Input Gating

Gates U15A, U2B, U2C, U14D, and U13A shape the input waveform into pulses of about 30 nanoseconds duration. The circuit uses gate delays and positive feedback to shape the pulses. NAND gate U2D inhibits the input to the counter when TIME BASE is low. D flip-flop U1A and gates U14B and U15B also shape the input pulses and further assure that the pulse is either of full duration or is absent in the event that TIME BASE goes low while an input pulse is high.

The output of gate U17C is normally low, and the output of gate U16B is normally high (the resistor R45 and inductor L1 hold the inputs low). When the TIME BASE goes low, the output of inverter U4E goes high. The output of U16B goes low until resistor R45 discharges capacitor C10 and the output returns to a high. While U16B is low, the low enable (EN) inputs of the storage buffers allow the data inputs to transfer to the outputs. When the output of U16B goes high, the output of U17C goes high until inductor L1 charges C11 and the output returns to a low. While U17C is high, the counters are cleared. When TIME BASE goes high, the outputs of U16B and U17C remain unchanged.

Overflow Detector

The overflow detector lights OVER FLOW lamp A8A4DS2 whenever a carry is generated by counter U19, in which case the count has exceeded the number of digits available in the display. The output of inverter U4B is normally high. Counter U14 generates a low at the carry (CRY) output on the count of nine, but the output of U4B remains high. At the count of ten, the carry output of U14 returns high, output of U4B goes low until

SERVICE SHEET 20 (Cont'd)

resistor R49 discharges capacitor C14 and the output returns to a high. While U4B is low, D flip-flop U5A clears. Shortly after TIME BASE goes low, the output of U16B goes high and toggles D flip-flop U5B. If a low was present at the D input, the $\overline{Q}$ output goes high, turns on transistor Q16, and lights the OVER FLOW lamp; otherwise $\overline{Q}$ remains low. When the TIME BASE goes high, the Q output of U5A goes (or remains) high, and remains so until an overflow carry is generated.

Counter Operation - Phase Lock (Count Down) (A8A2)

When COUNTER MODE LOCK switch S1 is in (ON) the count just prior to the acquisition of phase lock is transferred to the storage buffers U7 through U12 and then the buffers are latched. The decade counters U19 to U24 then count the input pulses, counting down from the count stored in the buffers.

The count sequence is as follows: The count proceeds down to zero, then to 999,999, generating a borrow output in U19. The borrow causes the Stall Counter - decade counter U28 with D flip-flop U1B - to be cleared from its normal nine count and the main counters to be preset from the Storage Buffers. The input to the main counter is inhibited while the input to the Stall Counter is enabled. The Stall Counter then begins counting up. At the count of four, a high is generated at the output Q_C of the Stall Counter which clocks the count-down input of the second counter U23 which subtracts ten from the count. When the Stall Counter reaches the count of nine, the clock to the main counter is enabled and the clock to the Stall Counter is disabled. The count proceeds down until a zero count is reached and the sequence repeats.

In summary, the counter counts down to zero, then to 999,999, and then is preset to the stored count where it remains for four more clock pulses. A count pulse into the second counter then subtracts ten from the preset count. Finally, when a total of nine pulses has been counted by the Stall Counter, the main counter starts counting down towards zero. The stall of nine counts gives the main counters adequate time to preset. The nine count delay plus the count to one below zero (i.e., to 999,999) is compensated for by subtracting ten from the main counter.

The circuit implementation of the sequence is as follows: When the count reaches 000,000, the borrow (BRW) output of U19 goes low. The count proceeds to 999,999 at which time the borrow output goes high. Normally, the input to inverter U4A is held low by inductor L2. The high at the borrow output of U19 is ac coupled through capacitor C12 to the inverter and also the clear (CLR) input of the Stall Counter U28. The inputs are held high long enough to clear U28 and flip-flop U1B. The $\overline{Q}$ output of U1B goes high and inhibits the input to the main counter by means of OR gate U14C and enables the Stall Counter by means of AND gate U17B. When counter U28 reaches a count of four, output Q_C goes high and the output of NAND gate U2A goes low. The borrow output of counter U24 is high because the count down (CD) input is held high by U14C. The low from the output of

SERVICE SHEET 20 (Cont'd)

U2A causes a low at the output of U13C and also U13D. Since the output of U14C is high, the output of NOR gate U25A is low. The low from U13D causes a high at the output of NOR gate U25B and clocks the count down (CD) input of U23 once. If U23 is at a zero count, its borrow output clocks counter U22. If U22 is at zero, it clocks counter U21, etc. When Stall Counter U28 reaches the count of eight, output Q_D goes high and causes a high on the D input of flip-flop U1B. The next clock causes the $\overline{Q}$ output of U1B to go low which inhibits the clock to the Stall Counter and enables the clock to the main counter.

In the normal count down mode, decade counters U19 to U24 form a synchronous counter. OR gates U27A to U27C and AND gate U13C have high outputs unless all previous counters are at the zero count. When any of the OR gates (or AND gate U13C) are low, the output of the following NOR gate (U5A to U5D or U25B) goes high on the next clock input. Thus each counter changes count only at the occurence of a clock input and only if all previous counters are zero (their borrows having rippled through to enable it).

Counter Operation - Transition from Counter Mode to Phase Lock Mode (A8A2)

When COUNTER MODE LOCK switch S1 is depressed (to ON) the counter sequences as follows: Counters U19 to U24 continue counting up until TIME BASE goes low. Stall Counter U28 has been preset to the count of eight, Storage Buffers U7 through U12 are loaded with the outputs of the counters and then latched; then the counters are cleared and the input to the main counter is inhibited while the input to the Stall Counter is enabled. The lock mode is now entered with LOCK high, and the Q_D output of stall counter U28 high. The D input of U1B is high and the next clock input toggles the $\overline{Q}$ output to a low. The clock to the main counter is then enabled and that to the Stall Counter disabled. The next input pulse sends the main counter to 999,999 since it was previously cleared to zero. The counter now sequences in the normal phase lock mode.

Flash Oscillator (A8A2)

When a phase lock error is detected, a 2 Hz flash oscillator is turned on to blink the display. Transistors Q5 and Q4 form a two-stage astable multivibrator. A high on the ERROR line holds collector resistor R42 at about 3V, and the oscillator is biased on. The frequency of oscillation is determined by the time constants of R39, C9 and R41, C8. The collector of Q4 switches transistor Q3 which switches the Vcc supply to the Storage Buffers U7 through U12. With an open at the Vcc Supply, the Storage Buffer outputs are open which represents a high to each display input. The displays generate a blank when all inputs are high. When no error exists Q3 is held on by Q4 which is also on, and Vcc is at 5V.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the up/down counter and display circuits as a result of using the trouble-

SERVICE SHEET 20 (Cont'd)

shooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings, and following the procedures outlined in the table.

NOTE

The following tests depend upon the counter RF scaler circuits (shown on Service Sheet 18) and the counter time base circuits (shown on Service Sheet 19) working correctly.

Test Equipment

Digital Voltmeter	HP 3480D/3484A
Oscilloscope	HP 180A/1801A/1820C
Frequency Counter	HP 5327C
Test Oscillator	HP 652A

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). A8 Counter/Lock Assembly casting cover removed and A8A2 Counter/Lock Board Assembly removed and extended for service (see Service Sheet C for procedures). Connect the test oscillator 50-ohm output to COUNTER INPUT; set it for 500 mVrms.

Initial Control Settings

COUNTER MODE:	EXPAND	Off
	LOCK	Off
	Source	EXT 0 - 550
RANGE		0.5 - 1 MHz
FREQUENCY TUNE		Full ccw
RF ON/OFF		ON

NOTE

If in LOCK mode the frequency at RF OUT differs by one count in the least significant digit from the frequency indicated on the display (±1 ambiguity of the counter), the problem is probably caused by the total gate delays in the lock circuit. Replace A8A2U14.

If the counter won't phase lock on a certain count in a certain digit, but will lock on all other counts displayed by that digit, replace that digit's up/down counter.

Counter Time Base (A8A3, A9)
SERVICE SHEET 19

SERVICE SHEET 20 (Cont'd)

Up/Down Counter and Display Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
SHAPING (A8A2)	Initial conditions and settings. Set COUNTER MODE to EXT 0 - 10 MHz.	Pulse width at U13A pin 3 >25 ns (high going pulse)	Check U2, U13, U14, U15, and associated circuitry
INPUT GATING (A8A2)	Initial conditions and settings. Set COUNTER MODE to EXT 0 - 10 MHz.	Pulse width at U15B pin 6 >25 ns (low going pulse)	Check U1, U2, U14, U15
COUNTERS, STORAGE BUFFERS (A8A2), AND DISPLAY (A8)	Initial conditions and settings. Ground TP2 to disable Storage Buffers. Vary test oscillator frequency.	Each Display digit capable of being cycled up from 0 - 9	Check Counter and circuitry associated with faulty digit
	Ground TP4 (shown on Service Sheet 21) to disable Flash Oscillator and phase lock error signal. Then set COUNTER MODE LOCK to ON and vary test oscillator frequency.	Each Display digit capable of being cycled down from 9 - 0	
STALL COUNTER (A8A2)	Initial conditions and settings (with test points ungrounded). Set test oscillator frequency to 64 Hz then: Ground TP2; Ground TP4; Set COUNTER MODE LOCK to ON. **NOTE** *Increase test oscillator frequency to set display count to ≈ 000010 then reset frequency to 64 Hz* *You can also use a Logic Pulser (such as HP 10526T) to inject pulses into XA8A5 pin 16 (i.e., the input to U15A)*	Display count counts down to 000000 (decrementing 1 count per input cycle - 1 Hz). When count reaches 000000, the following will happen Input Cycle / TPA (U28-6) / Display Count 0 Low 000000 1 Low 999999 2 Low 999999 3 Low 999999 4 Low 999999 5 High 999989 6 High 999989 7 High 999989 8 High 999989 9 Low 999989 10 Low 999989 11 Low 999988 12 Low 999987	Check U1B, U2, U13, U25, U28, and associated circuitry
	NOTE *0 — The count has reached 000000* *1 — The main counter underflows to 999999 and presets to the displayed count (i.e., 999999)* *2-4 — The main counter holds at 999999 while the stall counter counts 1, 2, 3* *5 — On count 4 of the stall counter, the main counter's second decade counts down by one (i.e., the display is 999989)* *6-10 — The counter holds at 999989 while the stall counter counts 5, 6, 7, 8, 9* *11 on — The main counter counts down normally*		
OVERFLOW DETECTOR (A8A2)	Initial conditions and settings (with test points ungrounded). Set COUNTER MODE to INT and EXP X100.	OVER FLOW lamp lit	Check U5, Q18, A8A4DS2, and associated circuitry
FLASH OSCILLATOR (A8A2)	Initial conditions and settings. Set COUNTER MODE to INT, LOCK to ON, and turn FREQUENCY TUNE cw.	Display flahses at approximately a 2 Hz rate and digits count up as FREQUENCY TUNE is turned cw	Check Q3-5, U3, U16 (SS 21) and associated circuitry

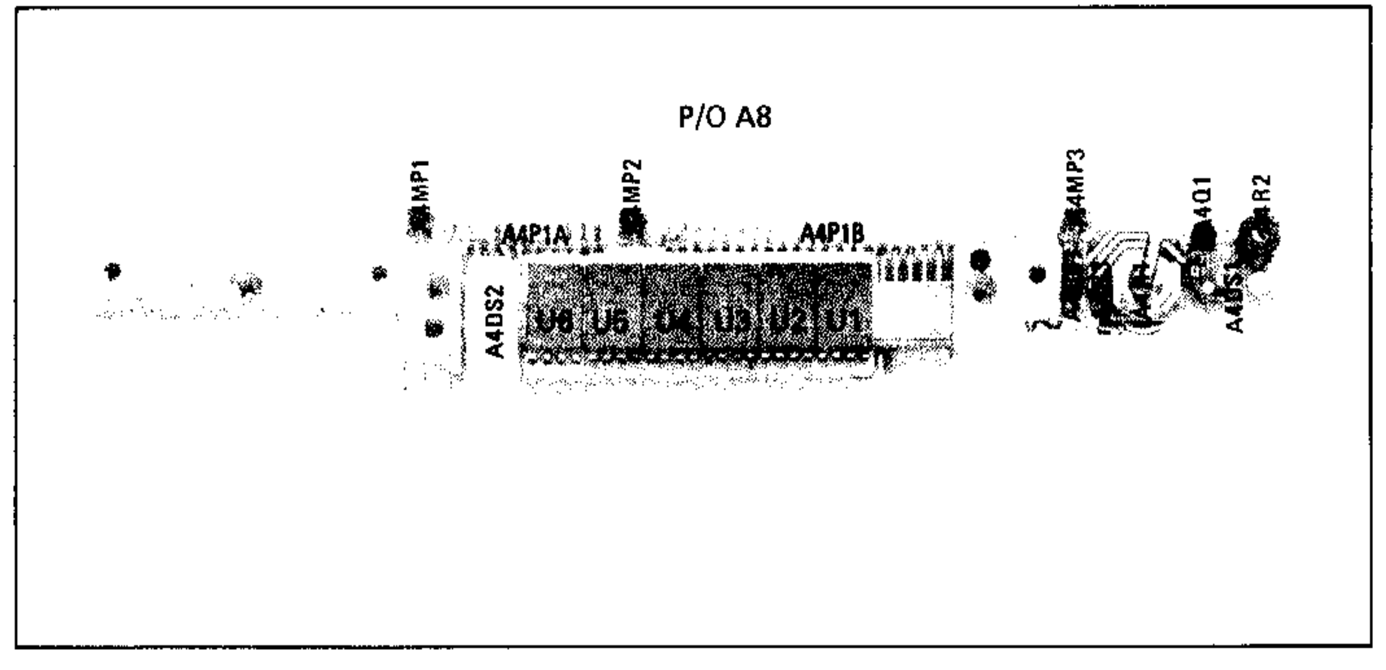


Figure 8-65. A8A4 Counter Display Assembly Component Locations (P/O A8)

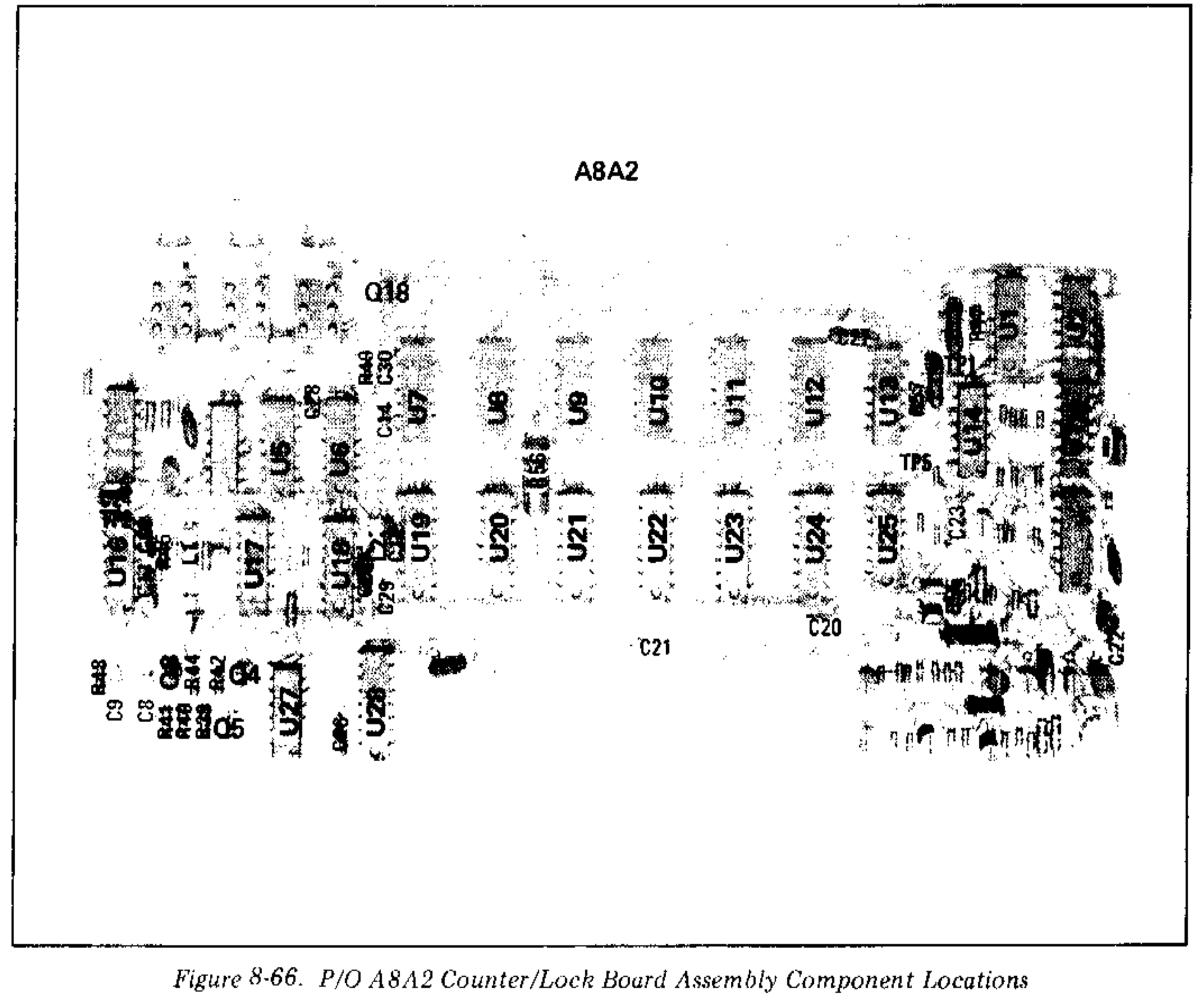


Figure 8-66. P/O A8A2 Counter/Lock Board Assembly Component Locations

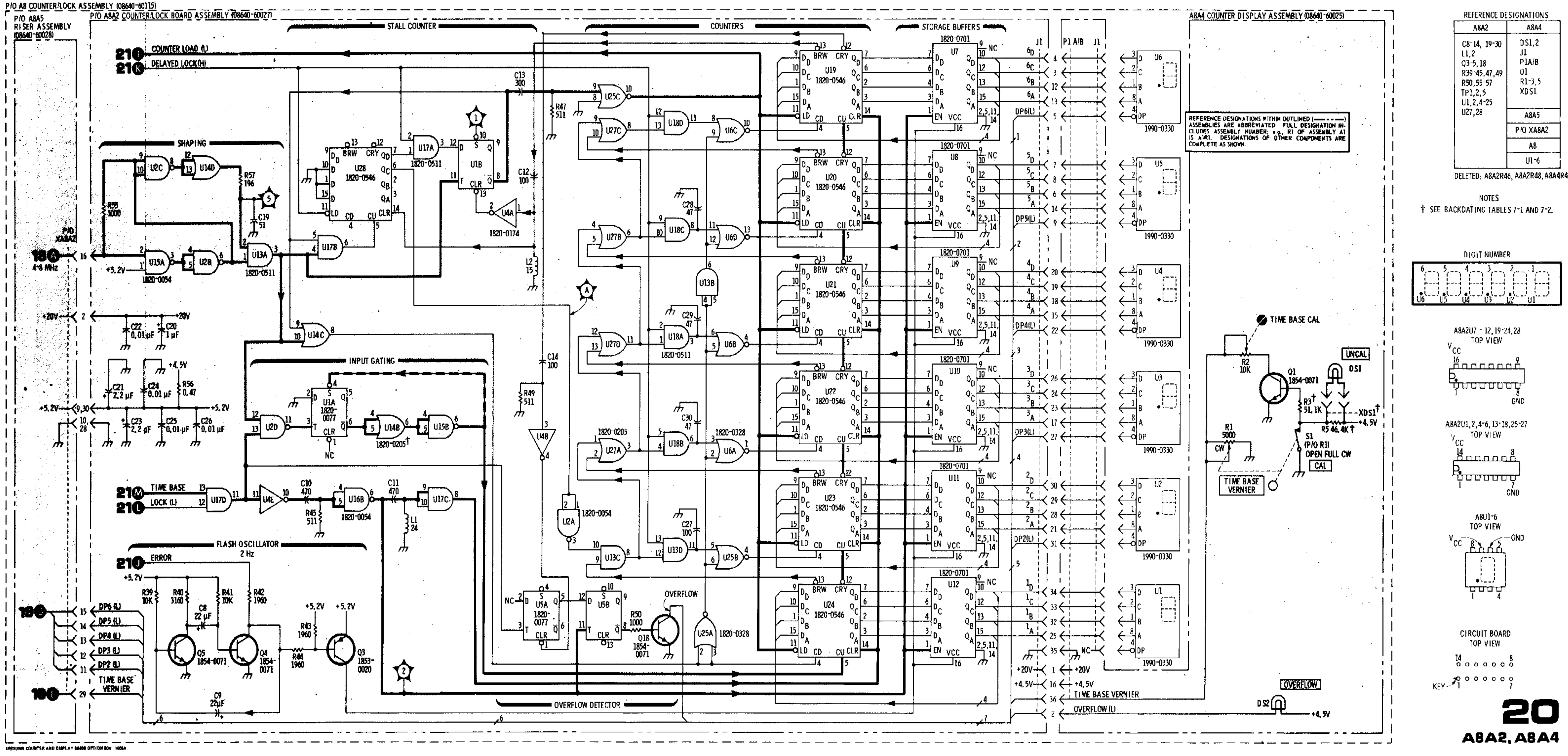


Figure 8-67. Up/Down Counter and Display Schematic Diagram

SERVICE SHEET 21

PRINCIPLES OF OPERATION

General (A8A2)

The lock mode is entered as follows: Cross-coupled NAND gates U3A and U3B form an RS flip-flop. The output of U3A is low in the count mode and goes high after S1 is depressed and TIME BASE goes low. It remains high until S1 is unlocked. Transistor Q1 and diodes CR1 and CR2 form an OR gate, with TIME BASE and S1 as inputs.

When the phase lock error exceeds a predetermined limit, an error condition exists and a low appears at the input to NAND gate U16A and at the input to NAND gate U3D of the cross coupled pair formed by U3C and U3D. The output of U3D goes high and turns on the Flash Oscillator (Service Sheet 20). The output of U3C is normally high, but goes low when an error exists (with U3A high). The output of NAND gate U16C is low when phase lock exists. This is true when the output of U3A is high (i.e., S1 has been depressed and after that TIME BASE has gone low) and the output of U3C is high (i.e., no error exists). The output of U16C is delayed by the resistor-capacitor network of R38 and C7 and inverted by U4D which enables the Stall Counter and the main counter. When an error occurs, the output of U16C goes high and the counter reverts to the count mode until S1 has been released and then depressed. NAND gate U16D prevents the error condition from reaching gate U3D when TP4 is grounded as an aid to troubleshooting.

Phase Lock Circuits (A8A2)

A phase error is sensed in the Null Phase Detector by detecting the difference in time of occurence of the 999,999 count of the counter (see Service Sheet 20) and the TIME BASE signal. D flip-flops U26A and U26B and NAND gate U15C form the phase detector. When phase locked, both set (S) inputs are high. Between the low occurrences of COUNTER LOAD and TIME BASE, the Q outputs of both U26A and U26B are low. If COUNTER LOAD goes high first, the Q output of U26B goes high first. When TIME BASE goes high, the Q output of U26A goes high. Both inputs of NAND gate U15C are now high so the output goes low, and after a slight delay through resistor-capacitor network R1 and C1 and OR gate U14A, both flip-flops are cleared. The $\overline{Q}$ output of U26B remained low longer than the $\overline{Q}$ output of U26A. If a high on TIME BASE had occurred first, the opposite would have been true. If both occur simultaneously, both outputs remain high for an equal duration.

The $\overline{Q}$ output pulses of U26A and U26B are increased in duration by a pulse width multiplier and then drive current sources which charge and discharge a storage capacitor. When the $\overline{Q}$ output of U26B goes low it turns on transistor switch Q8. Capacitor C2 is at 10V when Q8 is off because the inverting input of amplifier U29A is at 10V; the output of U29A is also at 10V since, with Q8 off, no current flows through R7. When Q8 goes on, C2 rapidly discharges through Q8. The output of U29A goes high to about 20V and remains at that voltage until Q8 switches off and C2 charges slowly to about 10V. Current source Q7 is on when the output of U29A goes high. In a similar manner amplifier U29B goes high and turns on current source Q12 when the $\overline{Q}$ output of U26A goes low. Current source Q7 charges capacitor C4 and Q12 discharges it. Any phase difference from the phase detector results in a net charge or discharge (i.e., an increase or decrease in voltage) of C4. FET Q6 is a high impedance buffer amplifier which drives buffer Q11. Q11 drives the Phase Lock Loop Filter in the FM shaping circuits (Service Sheet 2). In the EXPAND X10 mode transistors Q16 and Q17 are switched in. Resistor-capacitor networks R51 and C15, and R52 and C16 now hold Q16 and Q17 on longer which in turn hold transistors Q8 and Q9 on longer to increase the duration of the pulse stretcher. Capacitor C17 is also switched in to reduce ripple on C4. In the normal count mode U26A and U26B are both set and cleared, i.e., both Q and $\overline{Q}$ are high, the current sources Q13 and Q14 are switched on to bias C4 at a nominal mid-range voltage.

Error Detector (A8A2)

If the phase lock tune voltage from Q11 is too high or too low, the limit of the lock range is approached so an error exists. The error is sensed by transistors Q2 and Q15. The emitter of Q2 is held at 14.9V and Q15 normally holds Q2 on. If the base of Q15 is low, the collector current is insufficient to hold resistor R30 and the base of Q2 at the 14.3V needed to keep Q2 on. If the base of Q15 is high, Q15 saturates and the collector voltage rises as the base rises. When the collector voltage of Q15 exceeds 14.3V, Q2 switches off and a low appears at the input of U16A which represents an error. Resistor-capacitor network R31 and C6 filters the voltage to the base of Q2.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the counter phase lock circuits as a result of using the troubleshooting block diagrams. Troubleshoot by using the test equipment listed below, performing the initial test conditions and control settings and following the procedures outlined in the table.

NOTE

If the counter phase lock circuits fail, the usual effect is that the generator won't enter phase lock or that it won't break phase lock. Ensure that the counter circuits shown on Service Sheet 20 operate correctly before checking the phase lock circuits.

When the procedures in the table require that a point be grounded, they often depend upon multiple groundings (ground probe or contact bounce) to work correctly. Clipping or touching a grounding probe to a point will usually supply enough multiple groundings to make the procedure work.

The procedures in the table also depend upon the sequence of switch settings and groundings. If a procedure does not work correctly, try ungrounding the test points, resetting the switches to the Initial Control Settings, and repeating the procedures.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). A8 Counter/Lock Assembly casting cover removed and A8A2 Counter/Lock Board Assembly removed and extended for service (see Service Sheet C for procedure).

Initial Control Settings

COUNTER MODE: EXPAND . . . . Off
LOCK . . . . Off
Source . . . . EXT 0 - 10
TIME BASE INT/EXT (on rear panel) . . . . INT

NOTE

If phase lock is broken when the TIME BASE VERN control is turned (with COUNTER MODE set to INT, LOCK, and EXP X10), check Q16, Q17 and associated circuitry. (This will probably happen when RANGE is set to 8-16 MHz).

Up/Down Counter and Display (A8A2, A8A4)
◄ SERVICE SHEET 20

SERVICE SHEET 21 (Cont'd)

Counter Phase Lock Circuits Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
COUNTER PHASE LOCK CIRCUITS (A8A2)	Initial conditions and settings. Perform the following steps in sequence. 1. Ground TP4 to disable error signal 2. Set COUNTER MODE LOCK to ON 3. Set TIME BASE INT/EXT to EXT (with no input - this sets time base line high) 4. Connect DVM to TP6 (phase lock tune line) and use a grounding probe to momentarily ground the following points a. Ground U14A pin 1 (clears U26) b. Ground U26B pin 11 (T) c. Ground U14A pin 1 (clears U26) d. Ground U26A pin 3 (T) e. Ground U14A pin 1 (clears U26) f. Set EXPAND to X10. Repeat steps a through e	a. TP6 at any voltage from ≈+5 to +17V and stable b. TP6 voltage should rise within a few seconds to ≈+17V and U26B pin 8 ($\overline{Q}$) should be low. U29A pin 1 should be ≈+20V. c. TP6 voltage should remain at ≈+17V d. TP6 voltage should decrease within a few seconds to ≈+5V and U26A pin 6 ($\overline{Q}$) should be low. U29B pin 7 should be ≈+20V. e. TP6 should remain at ≈+5V f. Same results as steps a through e	a. Check Q6, Q7, Q8, Q11, U26B, U29A, and associated circuitry b. Same as above c. Same as above d. Same as above e. Same as above f. Check Q16, Q17, and associated circuitry
ERROR DETECTOR (A8A2)	Initial conditions and settings. Then set COUNTER MODE Source to INT and LOCK to ON. Turn FREQUENCY TUNE control cw.	U3D pin 11 (error signal) is ≈+5V (high)	Check Q2, Q15, U3, U16 and associated circuitry
	Repeat above except turn FREQUENCY TUNE control ccw	Same as above	Same as above
	Set COUNTER MODE LOCK to Off. Turn FREQUENCY TUNE control.	U3D pin 11 (error signal) is ≈0Vdc (low)	Same as above
LOCK EXPAND SWITCHING (A8A2)	Initial conditions and settings. Then set COUNTER MODE Source to INT and exercise EXPAND and LOCK switches.	Gates and switches operate correctly	Check S1, Q1, U3, U4, U16, and associated circuitry

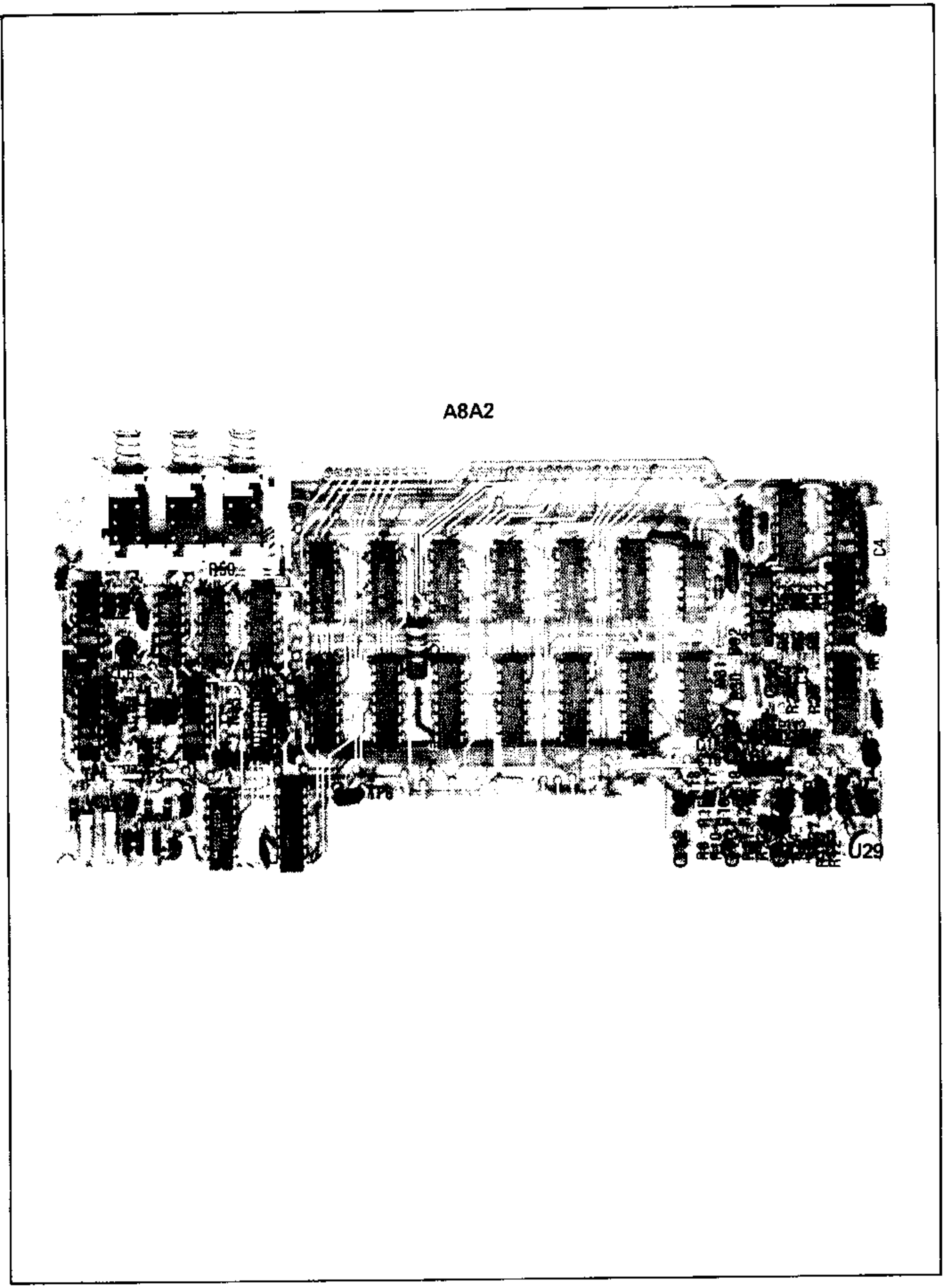


Figure 8-68. P/O A8A2 Counter/Lock Board Assembly Component Locations

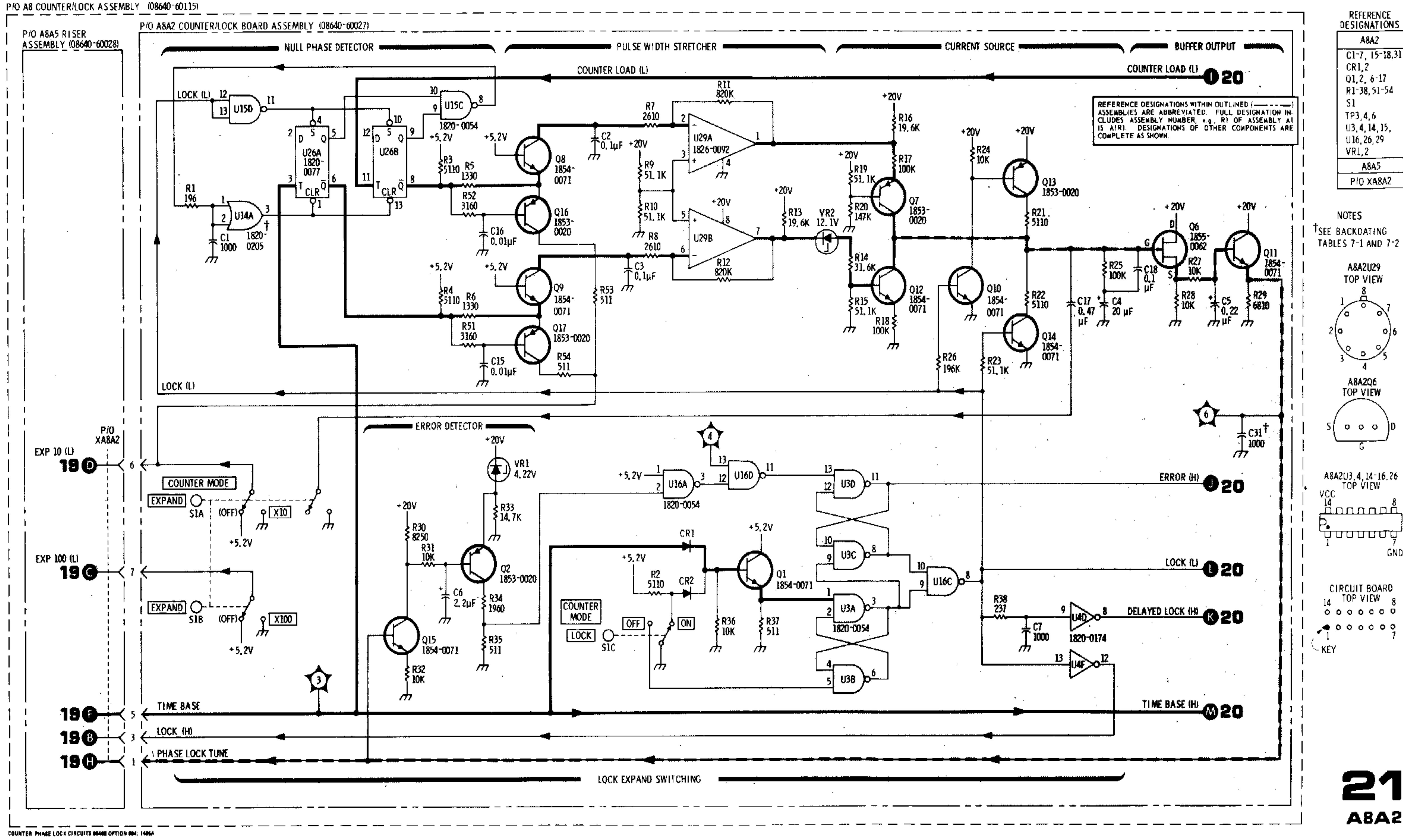


Figure 8-69. Counter Phase Lock Circuits Schematic Diagram

SERVICE SHEET 22

PRINCIPLES OF OPERATION

General

The power supply assemblies provide five regulated dc supply voltages. The characteristics and locations of each regulator are as follows:

Supply Voltage	Voltage Regulation	Limiting Current	Assembly Number	Service Sheet No.
+44.6V	±10 mV	1A	A20	22
+20V	±10 mV	0.7A	A22	22
+5.2V	±10 mV	2.25A	A20	22
−5.2V	±10 mV*	1.75A	A18	23
−20V	±10 mV	0.7A	A22	22

*With a temperature coefficient of −4.2 mV/°C.

Input Voltage (A12 and A14)

Main ac power enters the A14 Line Power Module, which contains the primary line fuse, an RFI filter, and a printed circuit card switch which matches the transformer primary windings to the appropriate line voltage. Power transformer T1 has a separate secondary winding for each regulator. The A12 Rectifier Assembly contains five full-wave rectifiers.

+5.2V Regulator (A20)

The +5.2V Regulator is a linear series type with current foldback for over-current protection and a crowbar for over-voltage protection. The Voltage Regulator amplifier U1 compares the output voltage with the (internal) divided-down reference voltage and drives transistor Q2 which in turn drives the Series Regulator Transistor Q1 (chassis mounted) to regulate the current through it.

Current foldback is activated when the voltage across (and hence the current through) R25 and R26 exceeds the voltage across R19. The base-to-emitter junction between pins 1 and 10 of U1 (see note on schematic) is then forward biased which reduces the drive to the Series Regulator transistor. As shown in Figure 8-70, short-circuit current is quite low.

The output crowbar consisting of Q1, VR6, R23, and R24 protects against over-voltage outputs (due for example to a shorted series pass transistor). An output voltage greater than about 6.2V triggers Q1 which conducts and causes current foldback or blows F1. Light-emitting diode DS2 is on only if the output voltage is high enough to allow CR5 to conduct but not high enough to activate the crowbar. Diode CR3 protects the regulator against reverse polarity load voltages. Diode CR4 protects Q1 against reverse bias.

SERVICE SHEET 22 (Cont'd)

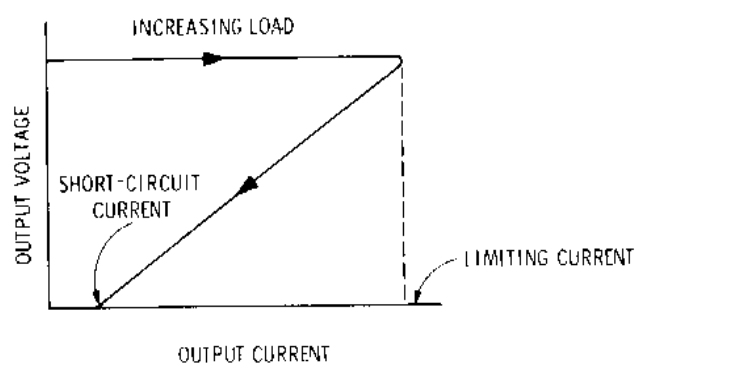


Figure 8-70. Current Foldback

+20V Regulator (A22)

The +20V regulator functions similarly to the +5.2V regulator, except that the output voltage is reduced by the voltage divider formed by R5, R6, and R7 and is referenced to the voltage across VR6. Also, the series pass transistor base-emitter junction is not in the current foldback circuit, resulting in a larger short-circuit output current.

−20V Regulator (A22)

The −20V regulator functions identically to the +20V regulator, except that the −20V output is taken from the point corresponding to the ground point on the +20V regulator, and the −20V ground return is connected to a point that corresponds to the +20V output. Also, the −20V regulator uses VR3 for a reference.

+44.6V Regulator (A20)

The +44.6V regulator functions similarly to the +5.2V regulator, except that the output voltage is reduced by the voltage divider formed by R7, R8, and R9 and is applied to the non-inverting input of the comparison amplifier of U2 (pin 3). The reference voltage is applied to the inverting input (pin 2). The Series Regulator transistor Q3 (chassis mounted) is in the regulator return line and is driven by Q4. The two transistors are in an inverted-Darlington configuration which is common emitter instead of emitter follower as in the +5.2V regulator. Components Q3, Q6, R1, and R2 form a constant current source which sinks the current from pin 6 of U2 and the base of Q4. Q5 provides foldback current limiting.

TROUBLESHOOTING

It is assumed that one of the light-emitting diodes is not lit or that ripple, noise, or voltage from one of the power supplies is suspect. Troubleshoot by using the test equipment listed below, performing the initial test conditions, and following the procedures outlined in the text and the table.

SERVICE SHEET 22 (Cont'd)

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). Use extender board to extend desired assembly (set instrument LINE power switch to OFF while removing or inserting circuit boards).

Initial Control Settings

LINE . . . . ON

Rectifiers and Input Crowbar (A12)

If the Input Crowbar fires, causing the line fuse to blow, check the following:

1. Voltage Selection Card, P1, in A14 Line Power Assembly correctly set for line voltage.
2. All rectifier diodes and filter capacitors.
3. VR1, Q1, and associated components (Input Crowbar).

If one or two rectifier diodes in one of the bridge rectifiers are defective, ripple and noise could increase without affecting the supply's average voltage or output current. Use the oscilloscope to measure ripple and noise; connect the probe from the test points given below to chassis ground.

Supply	Test Point	Typical Ripple and Noise
+44.6V	A20TP1	<0.7 Vp-p
+20V	A22TP1	<0.5 Vp-p
+5.2V	A20TP6	<1 Vp-p
-20V	A22TP6	<0.3 Vp-p
-5.2V	A18TP1	<0.8 Vp-p

If one of the supplies is out of specification, check the rectifier diodes, filter capacitors, and associated components. Also check the Series Regulator transistor.

If noise on a supply appears to be excessive check the reference (either internal or external) and its associated filter capacitor and the regulator amplifier. Noise may either be of the broadband type (i.e., white noise) or it may consist of random jumps in level on the order of 1 mV (i.e., popcorn noise).

SERVICE SHEET 22 (Cont'd)

Regulator Circuits (A20 and A22)

The first step in solving a power supply problem is to ensure that the problem is caused by the power supply. Minimum load resistances are given in the table for each supply. However, depending upon the ohmmeter and resistance range used, measured resistance can vary from a few ohms to several kilohms. So unless the load is actually shorted to ground, measuring load resistance doesn't always isolate the problem.

Another way to isolate a power supply problem is to disconnect the supply from the load and check the supply voltage. The quickest way to do this is to unsolder and lift pins on the extender board. However, under some failure conditions, the regulator integrated circuit can regulate correctly with the load removed from the power supply and yet cannot regulate correctly when the supply has its correct load.

To isolate a power supply problem to a specific circuit, use the data given in the table.

NOTE

The voltmeter input must float (i.e., both connections must be ungrounded) when checking voltages with extender board pins open.

SERVICE SHEET 22 (Cont'd)

WARNING

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

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.

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.

Power Supply Troubleshooting (1 of 2)

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
−20V REGULATOR	Remove A22 assembly. Measure resistance from A17XA22-1 to chassis ground.	>30Ω	Check supply load circuits for short
	Open pins 5 and 26 on extender board. Extend A22 assembly and check voltage from A22 board pin 5 to A20TP9.	−20 ± 0.1V	Check A22U1 and supply load circuits
	Check diodes and transistors for correct operation with voltage applied. Check components for correct resistance.	Correct operation and resistance	Replace faulty component
+20V REGULATOR	Remove A22 assembly. Measure resistance from A17XA22-7 to chassis ground.	>26Ω	Check supply load circuits for short
	Open pins 7 and 24 on extender board. Extend A22 assy and check voltage from A22TP5 to TP4.	+20 ± 0.1V	Check A22U2 and supply load circuits.
	Check diodes and transistors for correct operation with voltage applied. Check components for correct resistance.	Correct operation and resistance	Replace faulty component
+5.2V REGULATOR	Remove A20 assy. Measure resistance from A17XA20-4, 7 to chassis ground.	>3Ω	Check supply load circuits for short

Counter Phase Lock Circuits (A8A2)
◀SERVICE SHEET 21

SERVICE SHEET 22 (Cont'd)

Power Supply Troubleshooting (2 of 2)

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
+5.2V REGULATOR (Cont'd)	Open pins 4, 27, 7, and 24 on extender board. Extend A20 assy and check voltage from A20 board pin 1 to A20TP10.	+5.2 ± 0.15V	Check A20U1 and supply load circuits
	Check diodes and transistors for correct operation with voltage applied. Check components for correct resistance.	Correct operation and resistance	Replace faulty component
+44.6V REGULATOR	Remove A20 assy. Measure resistance from A17XA20-15 to chassis ground.	>45Ω	Check supply load circuits for short
	Open pins 13 and 18 on extender board. Extend A20 assy and check voltage from A20 board pin 13 to A20TP4.	+44.6 ± 0.1V	Check A20U2 and supply load circuits
	Check diodes and transistors for correct operation with voltage applied. Check components for correct resistance.	Correct operation and resistance	Replace faulty component

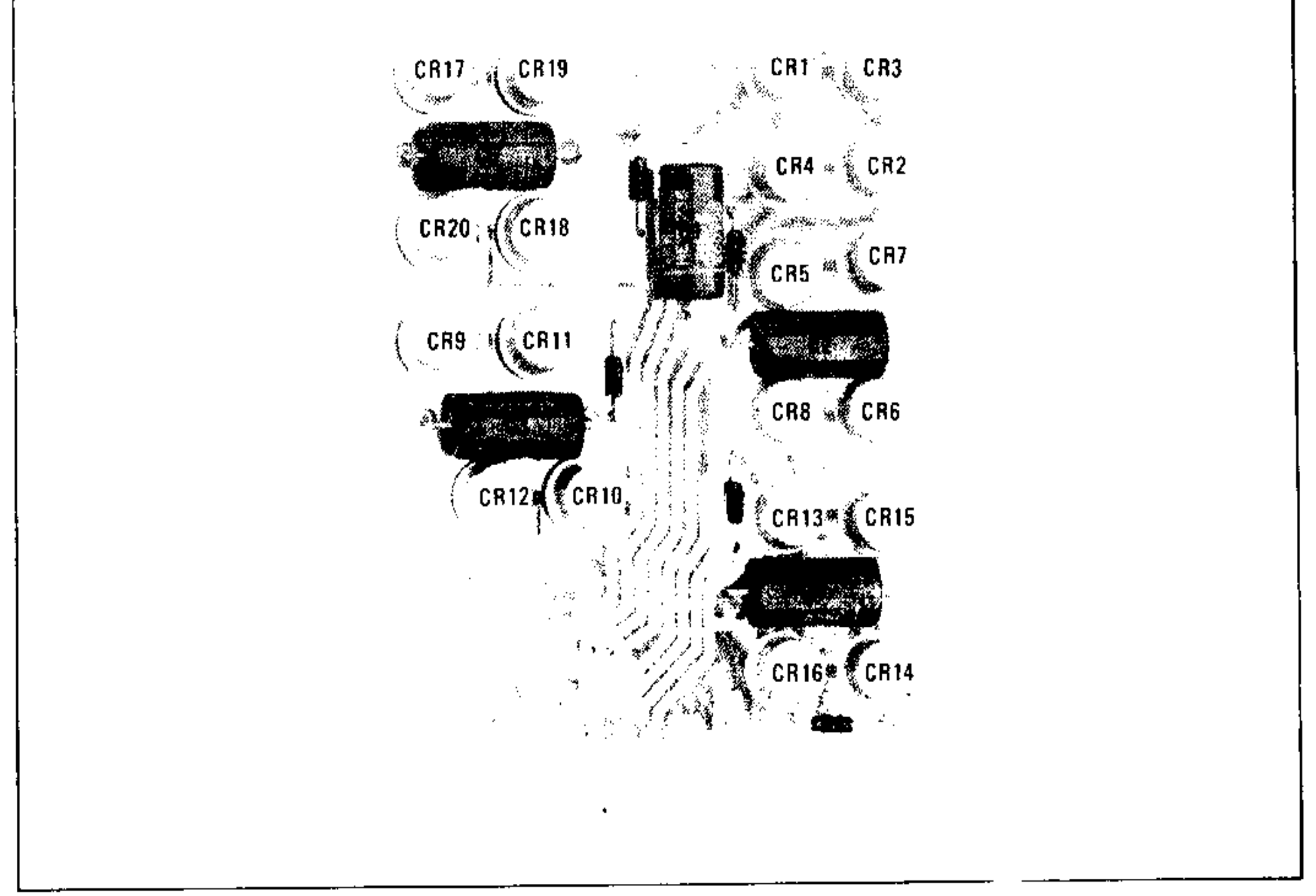


Figure 8-71. A12 Rectifier Assembly Component Locations

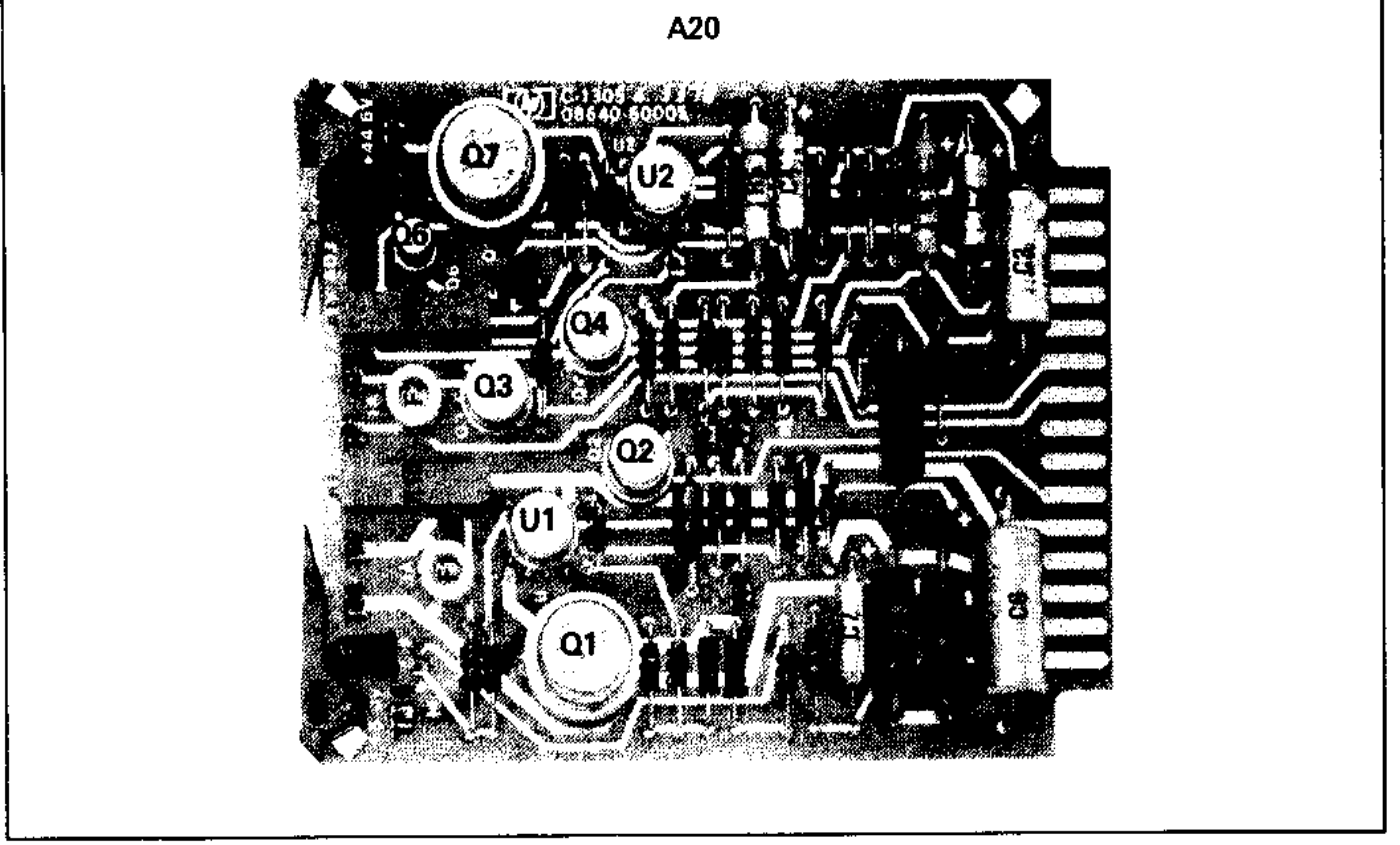


Figure 8-72. A20 +5.2V and +44.6V Regulator Assembly Component Locations

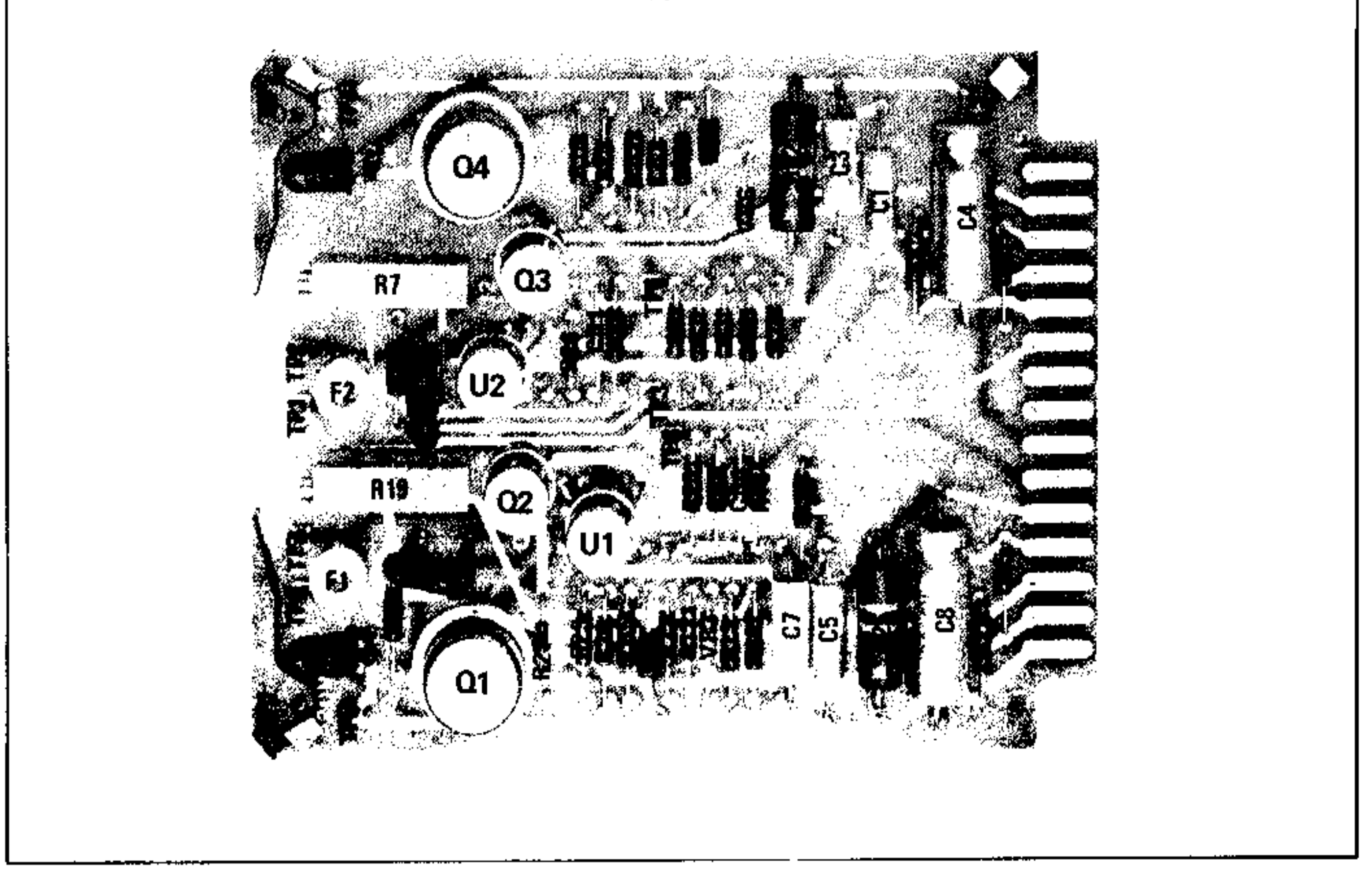
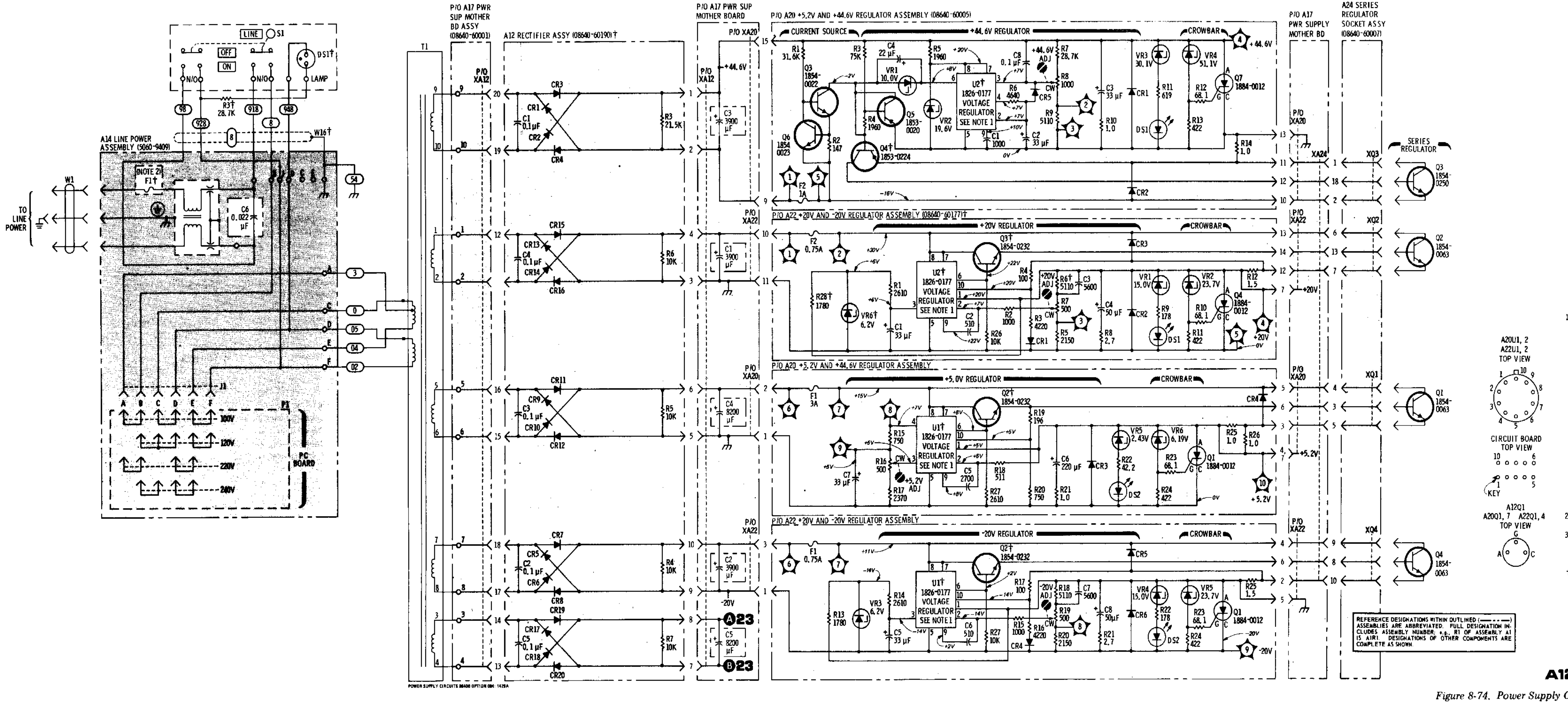


Figure 8-73. A22 +20V and 20V Regulator Assembly Component Locations



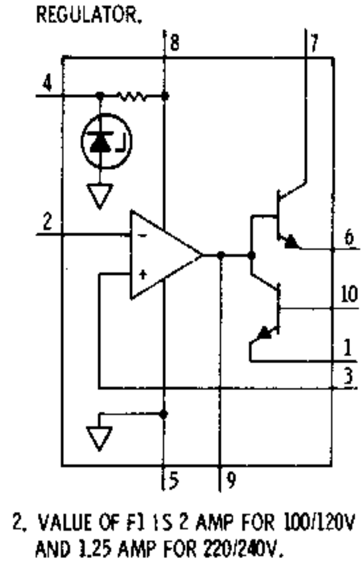
REFERENCE DESIGNATIONS

NO PREFIX	A20
C1-6 DS1 F1 Q1-4 R3 S1 T1 W1,16 XQ1-4	C1-8 CR1-5 DS1,2 F1,2 Q1-7 R1-27 TP1-10 U1,2 VR1-6
A12	**A22**
C1-5 CR1-20 R3-7	C1-8 CR1-6 DS1,2 F1,2 Q1-4 R1-28 TP1-9 U1,2 VR1-6
A14	
J1 P1	
A17	**A24**
XA12,20 XA22,24	XQ1-4

DELETED: A12Q1, A12R1, A12R2, A12VR1.

NOTES

1. SHOWN BELOW IS AN ELECTRICAL APPROXIMATION OF THE VOLTAGE REGULATOR.



2. VALUE OF F1 IS 2 AMP FOR 100/120V AND 1.25 AMP FOR 220/240V.
3. VOLTAGES SHOWN ARE APPROXIMATE AND MAY VARY AS LINE VOLTAGE VARIES; TOLERANCE IS APPROXIMATELY ±10%.

† SEE BACKDATING, TABLES 7-1 AND 7-2.

22

A12, A14, A20, A22

Figure 8-74. Power Supply Circuits Schematic Diagram

SERVICE SHEET 23

PRINCIPLES OF OPERATION

–5.2V Regulator (A18)

The -5.2V regulator functions similarly to the +5.2V regulator described on Service Sheet 22, except that the -5.2V output is taken from the point corresponding to the ground point on the +5.2V regulator, and the -5.2V ground return is connected to a point that corresponds to the +5.2V output. In addition, diodes CR2 and CR3 give the output voltage a small negative temperature coefficient.

Fan Motor and Fan Driver (A18)

Fan Motor A16B1 is a brushless, dc motor comprising a cylindrical, permanent magnet rotor and a four-section stator winding. The motor's stator windings are energized sequentially by the Fan Driver circuit. Two Hall generators are located on the stator, 90° apart. In the presence of a magnetic field, each Hall generator will produce two out-of-phase voltages at its two output terminals. The magnitude of the voltage is proportional to the strength of the field and the amount of bias current. The phase is determined by the polarity of the field. The Hall generators sense the position of the rotor and turn on the appropriate drive transistors.

Fan Speed Regulator (Al 8)

An emf which is proportional to rotor speed is generated in the unenergized stator windings. Diodes CR1, CR4, CR7, and CR1l detect this emf and charge C4 to a negative voltage. Current source Q1 discharges C4 at a constant rate. The voltage across C4 plus the constant voltage drop across RI 5 is the base voltage of Q4. If rotor speed decreases, the voltage across C4 becomes less negative, the base of Q4 becomes more positive and Q4 more heavily biases the Hall generators. The drive transistors turn on harder and rotor speed increases.

TROUBLESHOOTING

It is assumed that the light-emitting diode is unlit or that ripple, noise, or voltage from the —5.2V power supply is suspect, or that the fan is operating erratically or not at all. Troubleshoot by using the test equipment listed below, performing the initial test conditions, and following the procedures outlined in the text and the table.

Test Equipment

Digital Voltmeter . . . . HP 3480D/3484A
Oscilloscope . . . . HP 180A/1801A/1820C

SERVICE SHEET 23 (Cont'd)

Initial Test Conditions

Top cover removed (see Service Sheet G for removal procedure). Use extender board to extend desired assembly (set instrument LINE power switch to OFF while removing or inserting circuit boards).

Initial Control Settings

LINE . . . .ON

Regulator Circuits (A18)

The first step in solving a power supply problem is to ensure that the problem is caused by the power supply. Minimum load resistances are given below for the supply. However, depending upon the ohmmeter and resistance range used, measured resistance can vary from a few ohms to several kilohms. So unless the load is actually shorted to ground, measuring load resistance doesn't isolate the problem.

Another way to isolate a power supply problem is to disconnect the supply from the load and check the supply voltage. The quickest way to do this is to unsolder and lift pins on the extender board. However under some failure conditions, the regulator integrated circuit can regulate correctly with the load removed from the power supply and yet cannot regulate correctly when the supply has its correct load.

To isolate a power supply problem to a specific circuit, use the data given in the table.

NOTE

The voltmeter input must float (i. e., both connectors must be ungrounded) when checking voltages with extender board pins open.

Fan Driver and Speed Regulator (Al 8)

If one or two of the fan's windings are open or are not being supplied with the correct voltage, the fan may not start in all positions. However, once started, it may run correctly. Use the data given in the table to isolate a problem to a specific circuit. Also check that the fan blade does not hit against the rear vent. If it does, loosen the setscrew and slide the blade forward.

Power Supply Circuits (A12, A14, A20, A22)
SERVICE SHEET 22

SERVICE SHEET 23 (Cont'd)

Regulator and Fan Driver Troubleshooting

Component or Circuit	Test Conditions and Control Settings	Normal Indication	If Indication is Abnormal
-5.2V REGULATOR	Remove A18 assy. Measure resistance from A17XA18-6, 14 to chassis ground.	$>3\Omega$	Check supply load circuits for short
	Open pins 15 and 16 on extender board. Extend Al 8 assy and check voltage from A18 board pin 15 to A18TP5.	-5.2 ± 01V	Check A18U1 and supply load circuits
	Check diodes and transistors for correct operation with voltage applied. Check components for correct resistance.	Correct operation and resistance	Replace faulty component
FAN DRIVER	Measure voltage applied to each winding of motor	As shown on schematic (approximately sinusoidal)	Check appropriate components
	Measure period of voltages applied to windings of mot or	As shown on schematic	Check speed regulator circuits

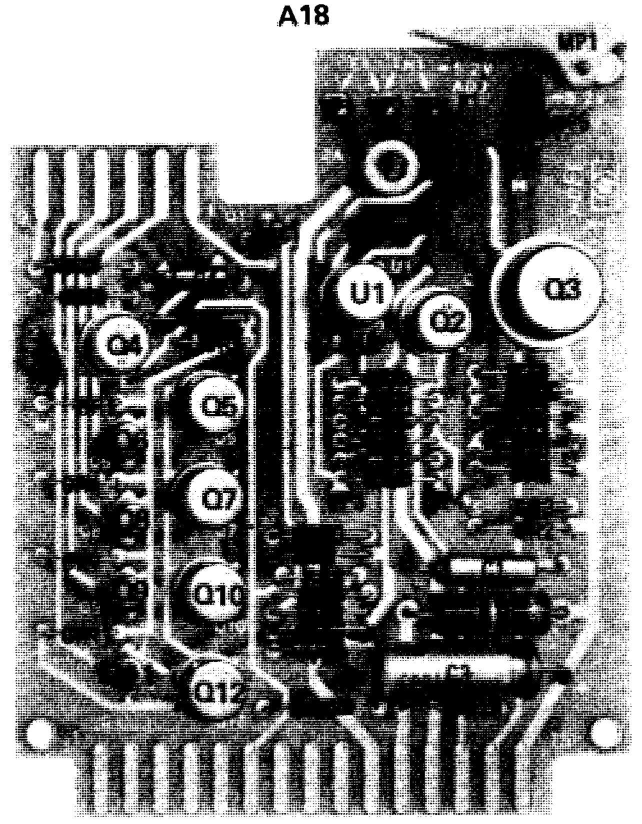
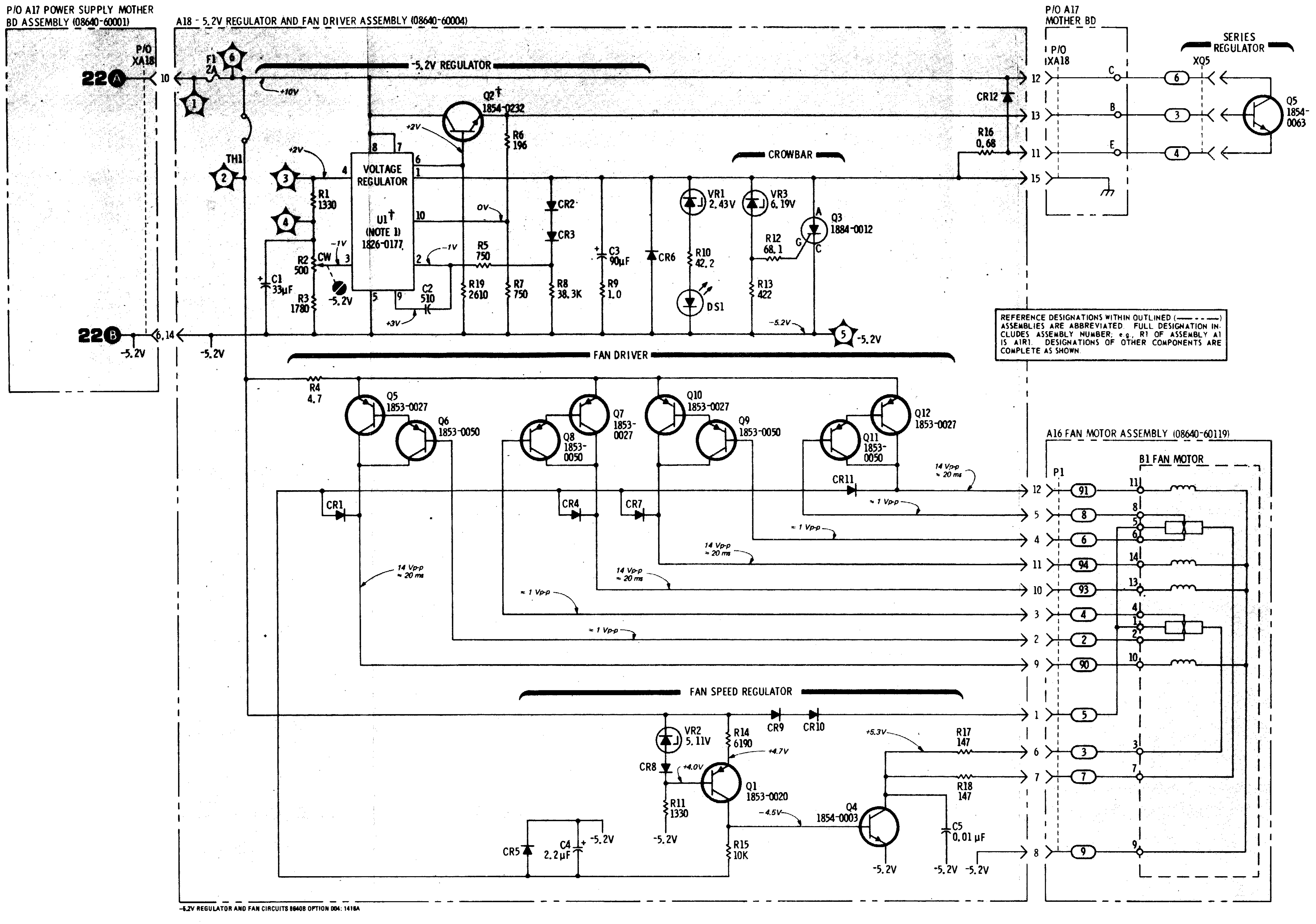


Figure 8-75. A18 —5.2V Regulator and Fan Driver Assembly Component Locations

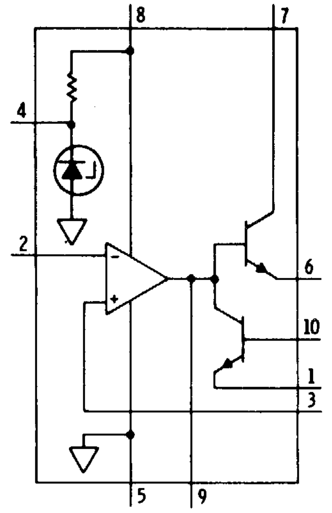


REFERENCE DESIGNATIONS

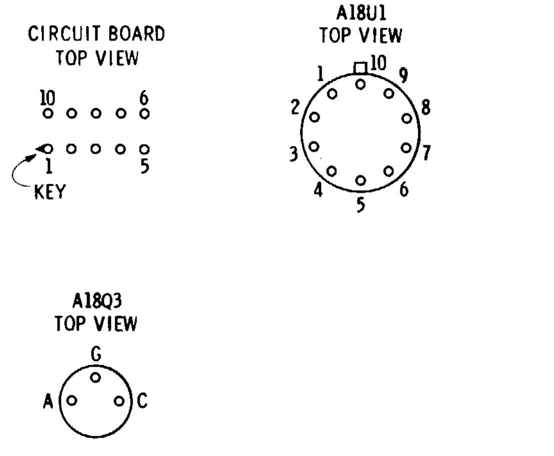
NO PREFIX	A18
Q5 XQ5	C1-5 CR1-12 DS1 F1 Q1-12 R1-19 TP1-6 U1 VR1-3
A16	
B1 P1	
A17	
XA18	

NOTES

1. SHOWN BELOW IS AN ELECTRICAL APPROXIMATION OF THE VOLTAGE REGULATOR.



† SEE BACKDATING, TABLES 7-1 AND 7-2.



23
A16, A18

Figure 8-76. —5.2V Regulator and Fan Circuits Schematic Diagram

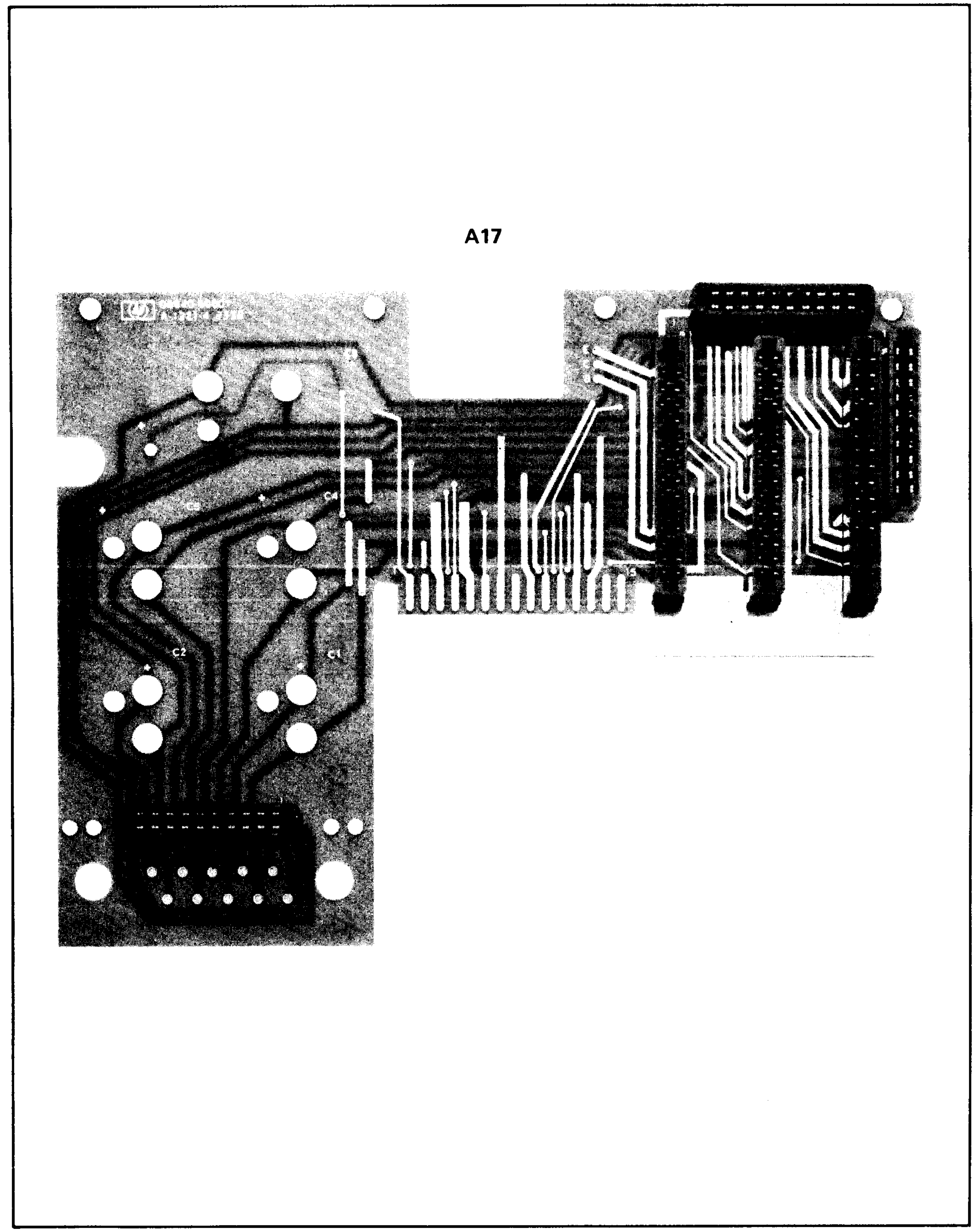
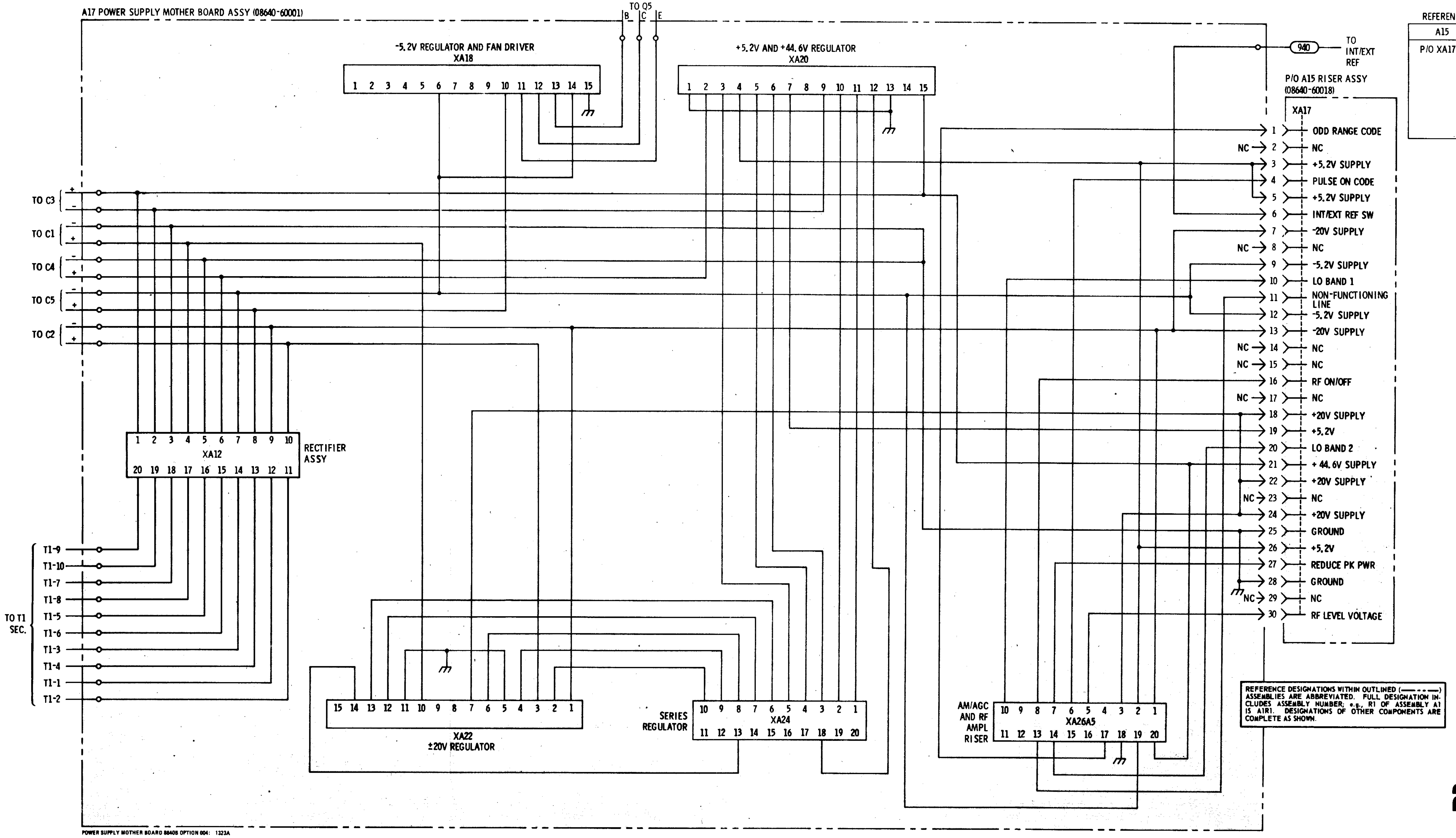


Figure 8-77. A17 Power Supply Mother Board Assembly Component Locations

REFERENCE DESIGNATIONS	
A15	A17
P/O XA17	XA12 XA18 XA20 XA22 XA24 XA26A5



24
A17

Figure 8-78. Power Supply Mother Board Schematic Diagram

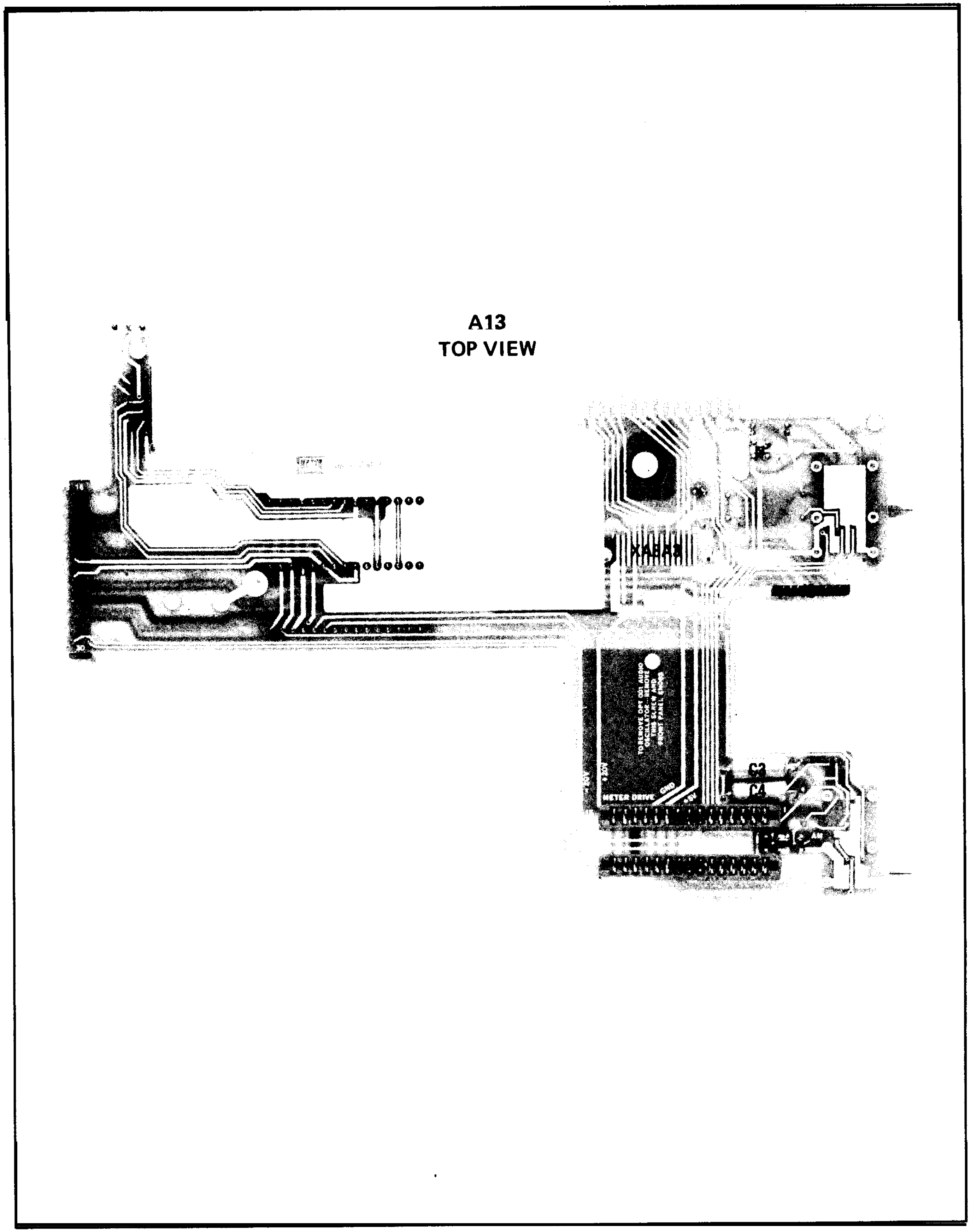


Figure 8-79. A13 Modulation/Metering Mother Board Assembly component Locations (1of 2)

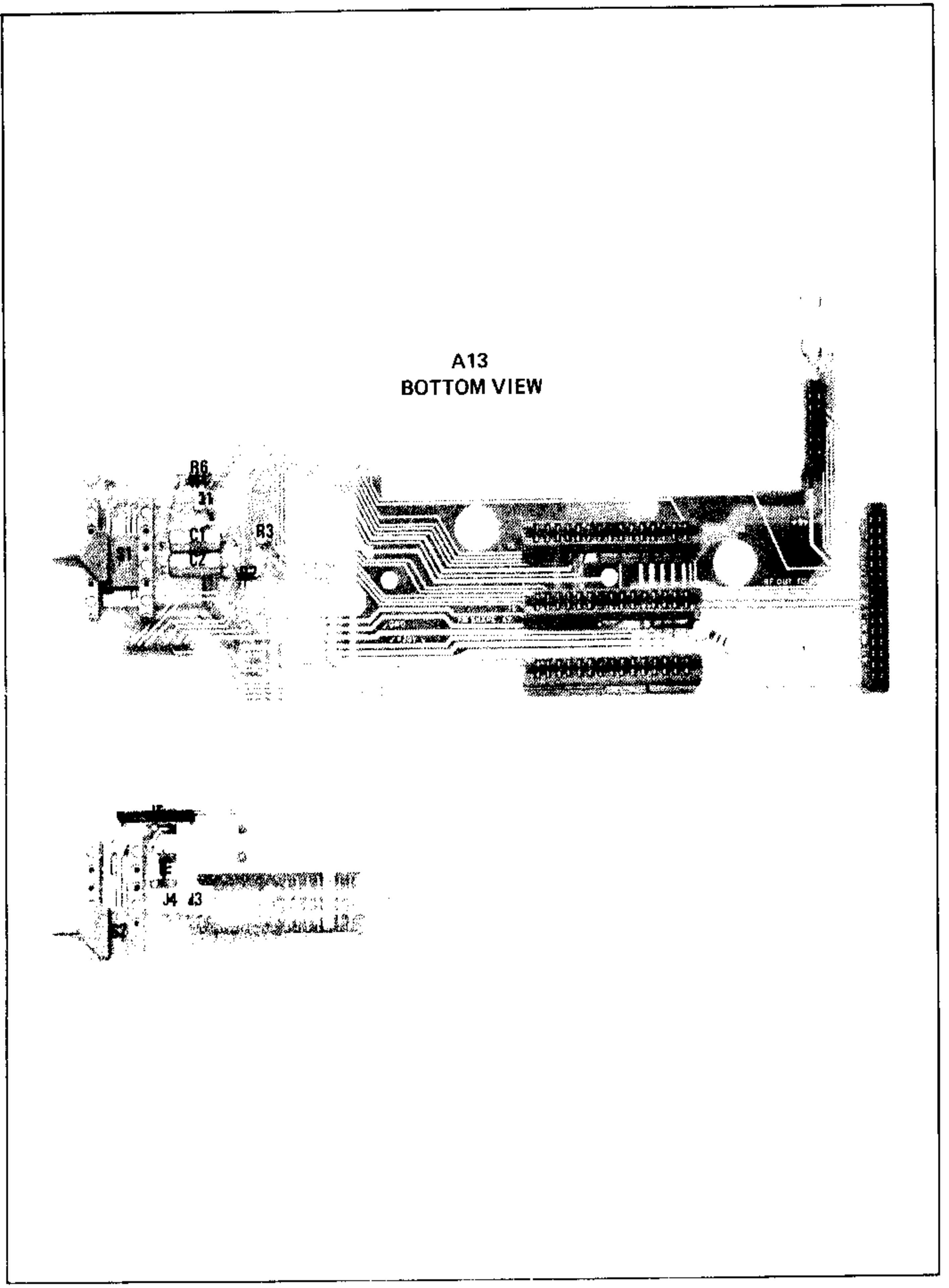


Figure 8-79. A13 Modulation/Metering Mother Board Assembly Component Locations (2 of 2)

Figure 8-80. Modulation/Metering Mother Board Schematic Diagram

SERVICE SHEET A

Al 9 Assembly Removal Procedure

1. Place instrument upside down and remove bottom cover (see Service Sheet G).

CAUTION

While working with and around the semi-rigid coaxial cables in the generator, do not bend the cables more than necessary and do not torque the R F connectors to more than 2 inch-pounds.

2. Remove flexible coupler (25) from the OUTPUT LEVEL 1 dB knob by loosening two setscrews in the coupler.

3. Using the wrench supplied in the instrument, disconnect two semi-rigid coaxial cables, W10 at A19A1J1 (28) and W11 at A19A1J2 (26).

4. Remove three pan-head screws which secure the 10 dB step attenuator to the instrument.

5. While lifting the attenuator from the instrument, disconnect printed circuit board connectors P2 and A1P1.

6. Reinstall assembly by reversing the procedures in steps one through five.

Al Assembly Removal Procedure

1. Remove A19 OUTPUT LEVEL 10 dB Assembly for the instrument.

2. Remove OUTPUT LEVEL 1 dB and Vernier knobs from the front panel. The knobs are secured to concentric shafts by setscrews in the knobs.

3. Disconnect semi-rigid coaxial cables W18 at A1A1J1 (18) and W10 A1A1J2 (17).

4. Remove 2 flat-head screws which secure the front side panel (item 14, Figure 6-1).

5. Remove two flat-head screws which secure the attenuator mounting plate (14).

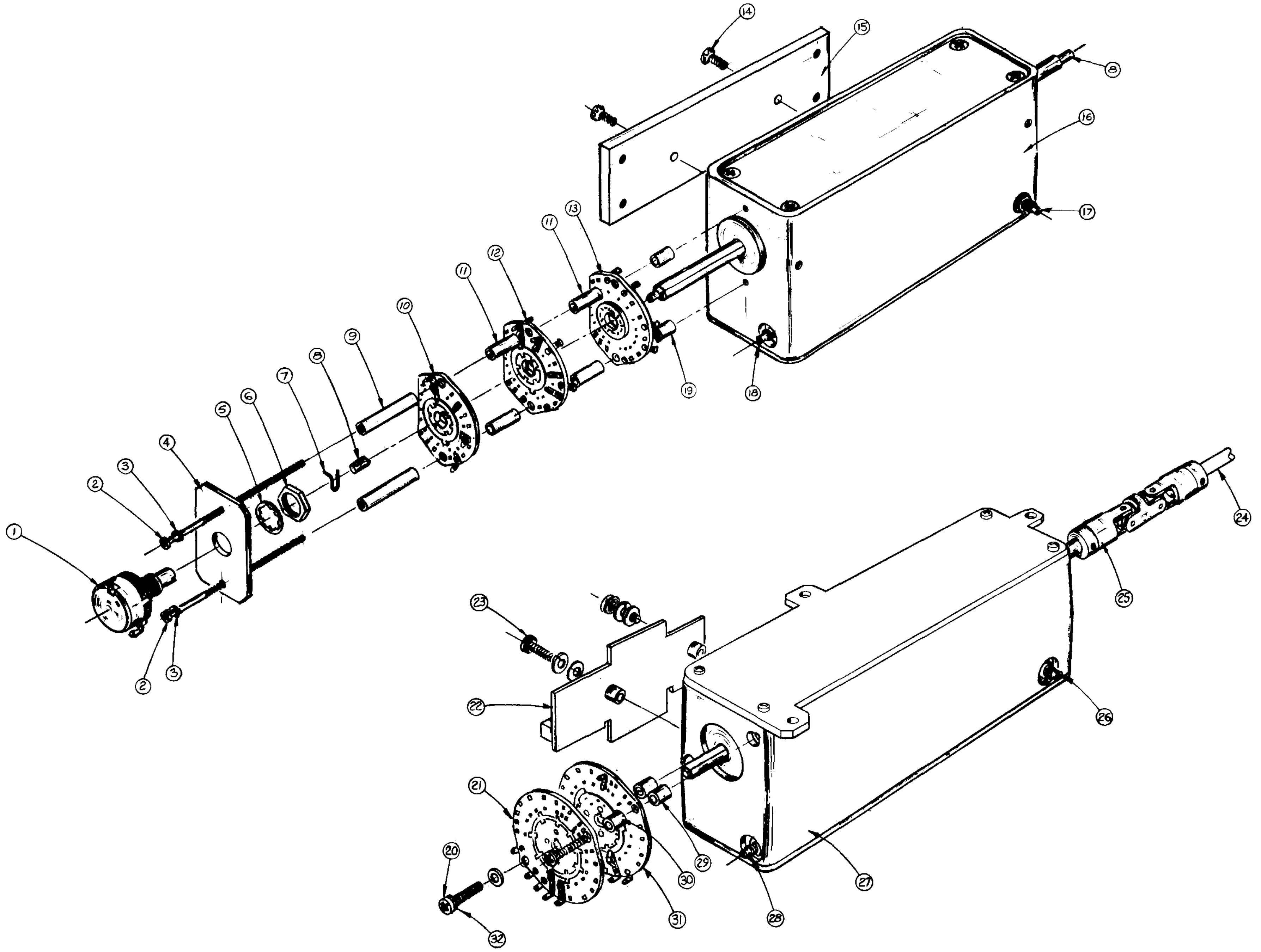
6. Carefully lift the Al OUTPUT LEVEL 10 dB Assembly from the instrument.

7. Reinstall assembly by reversing the procedures in steps one through six.

SERVICE SHEET A (Cont'd)

A1 Output Level Assembly Legend

Item Number	Reference Designator	Description
1	A1R1	Potentiometer, Output Level Vernier
2	A1MP4	Machine Screw (2)
3	A1MP9	Lockwasher (2)
4	A1MP6	Potentiometer Mounting Plate
5	A1MP10	Lockwasher
6	A1MP12	Hexnut
7	A1MP5	Shaft Coupler
8	A1MP8	Vernier Shaft
9	A1MP3	Spacer (2)
10	A1S1A	Switch Wafer
11	A1MP2	Spacer (4)
12	A1S1B	Switch Wafer
13	A1S1C	Switch Wafer
14	A1MP11	Machine Screw (2)
15	A1MP7	Attenuator Mounting Place
16	A1A1	1 dB Step Attenuator
17	A1A1J2	RF Connector
18	A1A1J1	RF Connector
19	A1MP1	Spacer (2)
20	A19MP3	Machine Screw (2)
21	A19S1B	Switch Wafer
22	A19A2	RF Vernier Assembly
23	A19MP6	Machine Screw (2)
24	MP65	Shaft
25	A19MP4	Flexible Coupler
26	A19A1J2	RF Connector
27	A19A1	10 dB Step Attenuator
28	A19A1J1	RF Connector
29	A19MP1	Spacer (2)
30	A19MP2	Spacer (2)
31	A19S1A	Switch Wafer
32	A19MP5	Lockwasher (2)



A

Figure 8-81. A1 and A19 Output Level Assemblies Illustrated Parts Breakdown

SERVICE SHEET B

A3 Removal Procedure

1. Place instrument upside down and remove bottom cover (Service Sheet G).

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 R F connectors to more than 2 inch-pounds.

2. Set frequency to 230 MHz.
3. Remove front panel FREQUENCY TUNE and FINE tune control knobs.
4. On rear of oscillator assembly, disconnect coaxial connectors W 2 at A3A1J2 (36), and W3 at A3A1J1 (39) using wrench supplied.
5. Remove two 8-32 nuts (45) that secure connector board assembly A3A4 to chassis. Lift out connector board assembly from mating connector.
6. Remove four 8-32 screws (20) securing oscillator to center plate of chassis.
7. Exert firm pressure on assembly toward the front panel to compress the RFI gaskets and raise assembly about 1/4 inch to clear mounting studs. Ease the assembly back and upwards to clear the tuning shafts. This completes removal.

CAUTION

Do not twist oscillator assembly while removing or inserting in chassis. Doing so may loosen the front section of the oscillator causing excessive R F Ieakage and poor frequency calibration.

NOTE

When re-installing RF Oscillator Assembly, loosen collar (2) on fine tune shaft. After installation, press collar and RFI gasket (1) firmly against front panel and secure collar setscrew (3).

A3A1A2 Removal Procedure

1. Remove eight 4-40 screws (47) securing cover plate to buffer housing.
2. Unsolder three leads connecting buffer board and two feedthrough filters (53 and 54) and RF connector (40).
3. Remove two *6-32 (50)* securing the buffer board to the housing.

SERVICE SHEET B (Cent'd)

4. Lift out buffer board, ensuring that attached probe does not bind in cavity opening.

NOTE

The buffer board has two adjustment slots for attaching to the housing. Refer to the adjustment procedure in Section V, paragraph 5-38, when reinstalling the buffer board.

A3A1A3 **Removal Procedure**

1. Remove eight 4-40 screws (21) securing cover plate to buffer housing.
2. Unsolder three leads connecting buffer board and two feedthrough filters (35 and 36) and RF connector (37).
3. Remove two 6-32 (24) securing the buffer board to the housing.
4. Lift out buffer board, ensuring that attached probe does not bind in cavity opening.

NOTE

The buffer board has two adjustment slots for attaching to the housing. Refer to the adjustment procedure in Section V, paragraph 5-38, when reinstalling the buffer board.

A3Q1 **Replacement Procedure**

1. Unscrew transistor cap (32).
2. Remove transistor (55).
3. Clip new transistor leads as shown in Figure 8-82.
4. Re-insert transistor as shown in Figure 8-83. Replace transistor cap (31) including the two RF I plugs (33 and 34).
5. Connect power meter sensor (HP 435A/8482A) to the Divider/Filter Buffer Amplifier output, A3A1J1 (41). Measure output power while tuning oscillator across band - it should always be within +0.5 to +4.5 dBm. If not, perform adjustment in paragraph 5-38.
6. Connect power meter sensor to the Counter Buffer Amplifier Output, A3A1J2 (37). Measure output power while tuning oscillator across band - it should always be within -12 to -2 dBm. If not, perform adjustment in paragraph 5-38.

A1 and A9 Assemblies Removal and Disassembly
SERVICE SHEET A

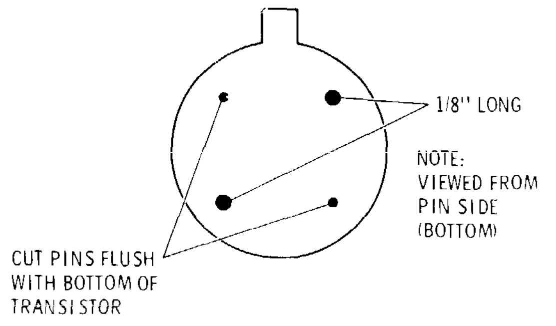


Figure 8-82. RF Oscillator Transistor Preparation

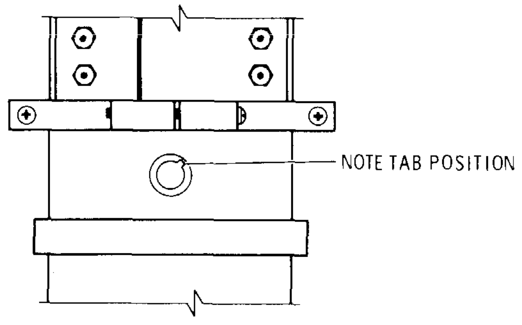


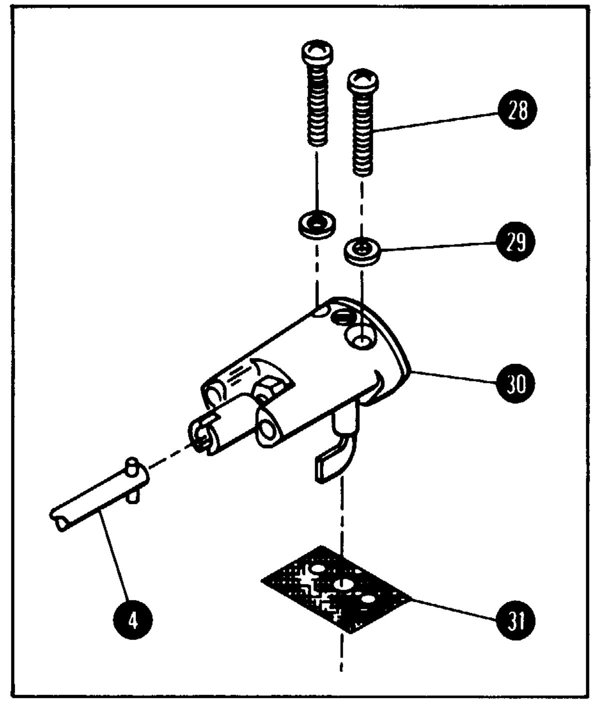
Figure 8-83. RF Oscillator Transistor Orientation

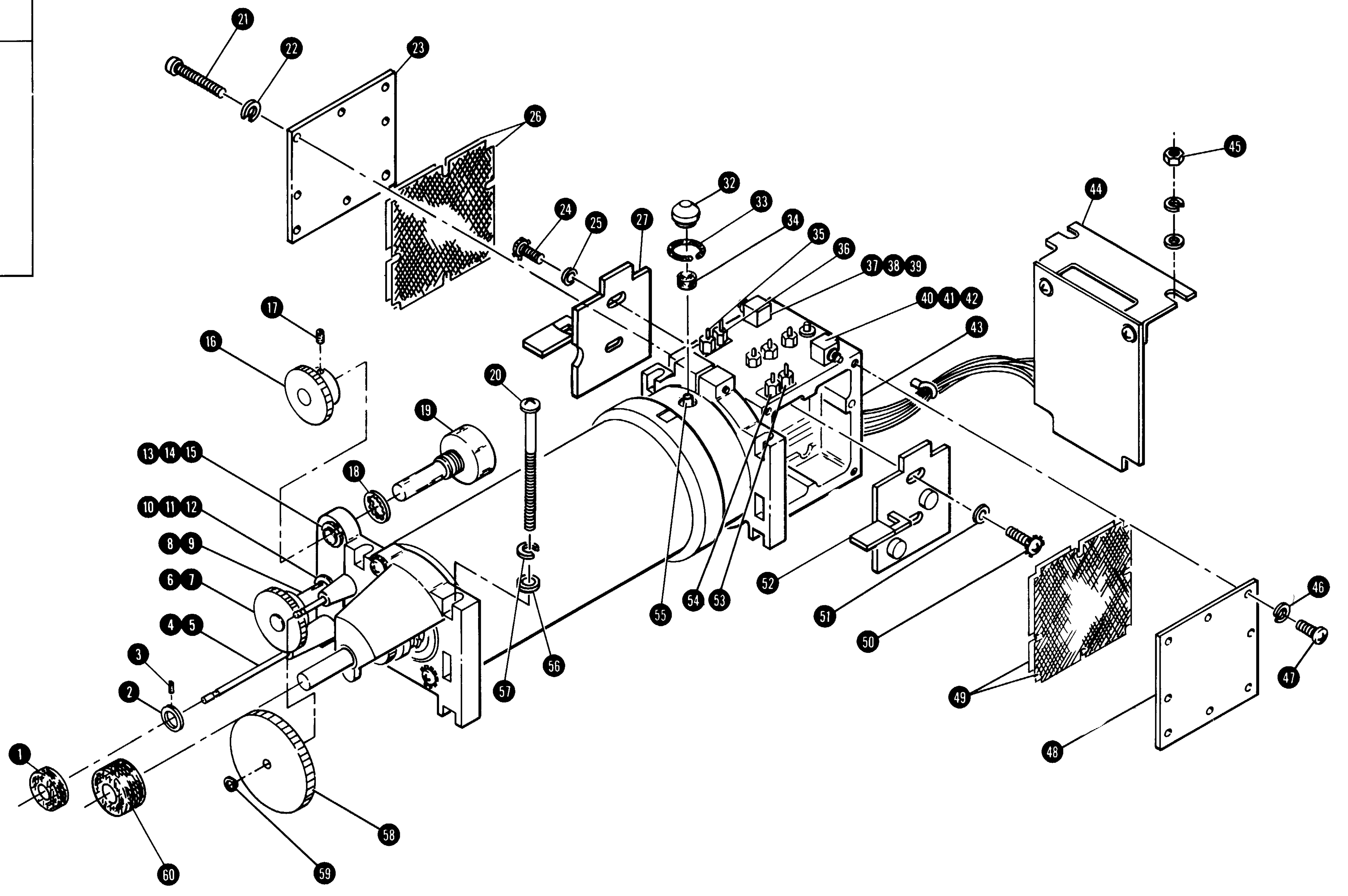
A3 RF Oscillator Assembly Legend

Item Number	Reference Designator	Description
1	MP59	RFI Gasket
2	MP60	Retaining Collar
3	MP74	Setscrew (2)
4	A3MP25	Fine Tune Shaft
5	A3MP26	Retaining Ring
6	A3MP4	Spur Gear
7	A3MP17	Setscrew
8	A3R1	Potentiometer, Frequency Tune
9	A3MP18	Lockwasher
10	A3MP6	Potentiometer Bushing
11	A2MP14	Retainer Ring
12	A3MP15	Setscrew
13	A3MP8	Potentiometer Bushing
14	A3MP2	Retainer Ring
15	A3MP21	Setscrew
16	A3MP16	Spur Gear
17	A3MP19	Setscrew
18	A3MP20	Lockwasher
19	A3R2	Potentiometer, FM Gain Compensation
20	A3MP22	Machine Screws (4)
21	A3A1MP13	Machine Screws (8)
22	A3A1MP14	Lockwasher (8)
23	A3A1MP1	Buffer Board Cover
24	A3A1MP2	Machine Screw
25	A3A1MP3	Lockwasher
26	A3A1MP4	RFI Gasket (2)
27	A3A1A3	Counter Buffer Amplifier Assembly
28	A3MP11	Machine Screws (2)
29	A3MP12	Lockwashers (2)
30	A3MP10	Oscillator Fine Tune Assembly
31	A3MP5	RFI Gasket
32	A3MP9	Transistor Cap
33	A3MP13	RFI Plug
34	A3MP7	RFI Plug
35	A3A1FL2	Filter Capacitor
36	A3A1FL1	Filter Capacitor
37	A3A1J2	RF Connector
38	A3A1MP10	Lockwasher
39	A3A1MP9	Hex Nut
40	A3A1J1	RF Connector
41	A3A1MP12	Lockwasher
42	A3A1MP11	Hex Nut
43	A3A4MP1	Cable Clamp
44	A3A4	Connector Board Assembly
45	A3A4MP2	Machine Screw
46	A3A1MP15	Lockwasher (8)
47	A3A1MP16	Setscrew (8)
48	A3A1MP5	Buffer Board Cover
49	A3A1MP6	RFI Gasket (2)

A3 RF Oscillator Assembly Legend (2 of 2)

Item Number	Reference Designator	Description
50	A3A1MP7	Machine Screws (2)
51	A3A1MP8	Lockwashers (2)
52	A3A1A2	RF Divider/Filter Buffer Amplifier Assembly
53	A3A1FL5	Filter Capacitor
54	A3A1FL6	Filter Capacitor
55	A3Q1	Transistor
56	A3MP23	Flatwashers (4)
57	A3MP24	Lockwashers (4)
58	A3MP3	Spur Gear
59	A3MP1	Retainer Ring
60	MP58	RFI Gasket





B

Figure 8-84. A3 RF Oscillator Illustrated Parts Breakdown

SERVICE SHEET C

A8 Assembly Removal and Disassembly Procedure

A8 Casting Cover Removal

1. Place instrument right side up and remove top cover (see Service Sheet G).

2. Remove trim strip (extrusion) that overlaps front of A8 Assembly casting by removing two flat-head screws. Remove plastic front panel window by lifting it up and out.

3. Remove three pan-head screws on front of casting (note length of screws) and remove the button shield. Remove eight pan-head screws (with lockwashers) that secure casting cover to casting (screws marked with asterisk (*) on cover).

4 Lift cover from two "honey comb" RF shields and casting.

A8A2 and A8A4 Removal

5. Remove two pan-head screws (with lock-washers) that secure the A8A2 Assembly. Remove A8A2 Counter/Lock Board Assembly and A8A5 Riser Assembly by lifting at the riser; the A8A4 Counter Display Assembly is attached to the A8A2 Assembly - do not damage the brass LED/button shield while removing the assemblies.

NOTE

The A8A2 and A8A4 Assemblies can be extended for service by removing the A8A5 Riser Assembly from A8A2 and installing A8A2 on the extender board in the riser socket (A8A3XA8A5). This also gives access to the A8A3 Time Base Assembly.

CAUTION

Do not remove A8A4 from A8A2 unless necessary. If it has been removed, exercise care during reassembly to avoid bending the connector pins and sockets.

A8A1 Access

WARNING

The edges of the RF 1 gasket may be sharp and may cause personal injury if not handled with care.

6. To gain access to the A8A1 RF Scaler Assembly, remove six pan-head screws (with lock-washers) that secure the cover shield. Remove the cover shield and gasket.

A8 *Removal*

NOTE

The entire A8 Assembly must be removed from the chassis to remove the A8A1 and A8A3 Assemblies.

Do not attempt to replace components on the A8A1 and A8A3 Assemblies (except A 8A1U3) without removing boards.

7. Turn instrument upside down and remove bottom cover (see Service Sheet G).

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 R F connectors to more than 2 *inch-pounds.*

8. Disconnect two semi-rigid coaxial cables from bottom of A8 Assembly (cable W2 at A8A1J2 and cable W14 at A8A1J1). Disconnect green flexible coaxial cable from bottom of A8 Assembly (cable W15 at A8A3J1).

9. Turn instrument right side up. Remove A8 Assembly by removing four pan-head screws (with lockwashers) that secure the A8 Assembly to the chassis.

A8A1 Removal

10. Remove two pan-head screws that secure A8A1U3; remove two lockwashers, two washers, and two nylon bushings. Remove A8A1U3 and two mica washers.

11. On bottom of A8 Assembly casting, under A8A1 Assembly, remove hex nut and lock-

A3 Assembly Removal and Disassembly
SERVICE SHEET B

SERVICE SHEET C (Cont'd)

washer. Remove two hex nuts and lockwashers that secure coaxial connectors A8A1J1 and J2.

12. Unsolder five wires from feedthroughs to left of A8A1 Assembly. Remove A8A1.

A8A3 Removal

13. On bottom of A8 Assembly casting, under A8A3 Assembly, remove hex nut and lockwasher that secure A8A3J1.

14. Unsolder five wires from feedthroughs to right of A8A3 Assembly.

15. Remove two board supports and pan-head screw (with lockwashers). Remove A8A3.

Reassembly

16. Reassemble and reinstall A8 Assembly be reversing the procedures in steps one through 15.

NOTES

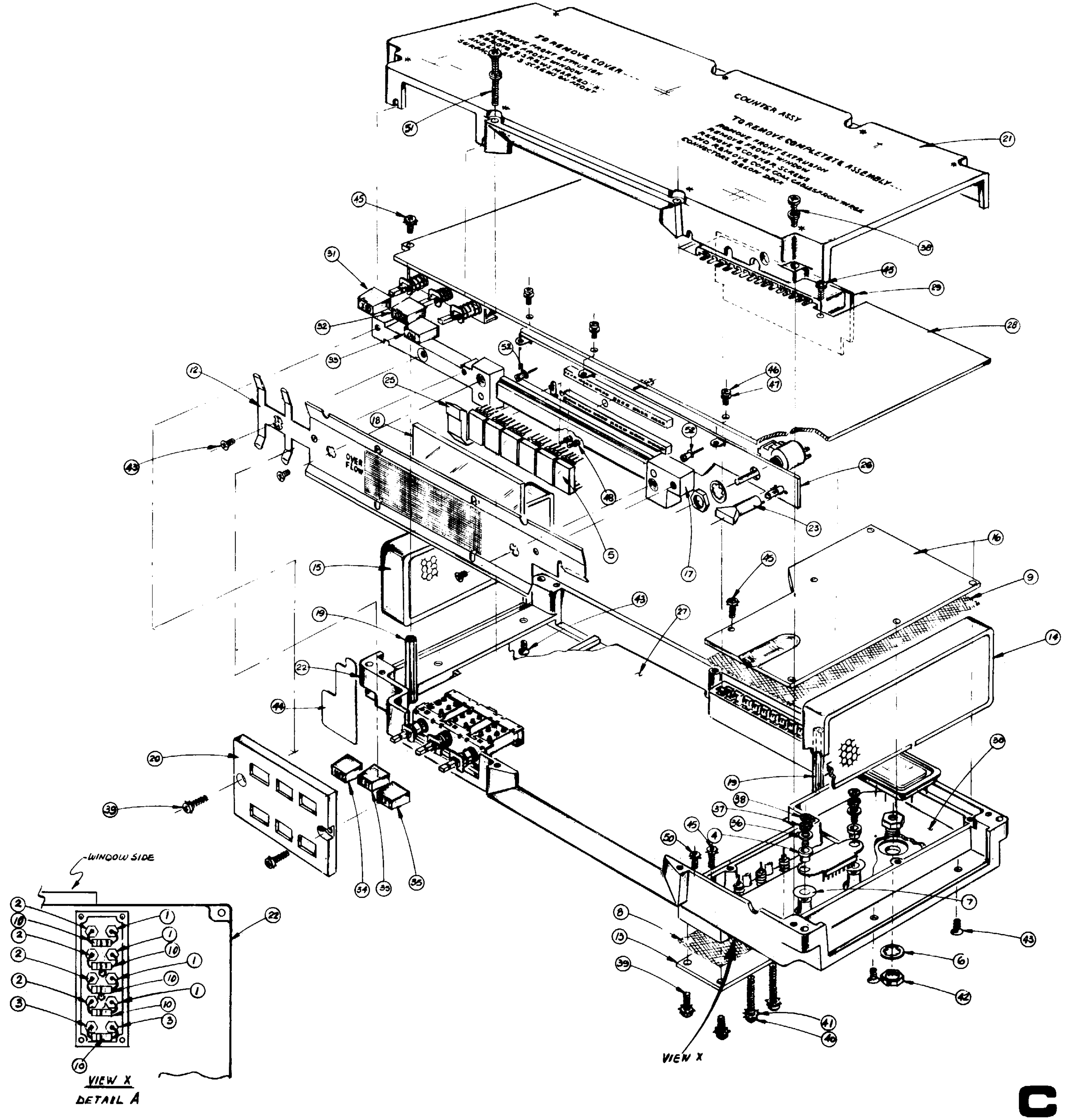
1. When replacing the casting top cover be sure that the prongs on the brass RFI shield are behind the casting wall.

2. The button shield must be carefully aligned to be sure that the buttons do not catch on the edges of the holes. Check the action of all the COUNTER MODE buttons when the window is replaced.

SERVICE SHEET C (Cont'd)

A8 Counter/Lock Assembly Legend

Item Number	Reference Designator	Description
1	A8FL1-4	Feed Thru Filter
2	A8C1-4	Feed Thru Capacitor
3	A8C5,6	Feed Thru Capacitor
4	A8MP1	Bushing Insulator (Nylon)
5	A8U1-6	Numeric Display
6	A8MP2	Lockwasher
7	A8MP3	Mica Washer
8	A8MP4	Center Filter Gasket
9	A8MP5	Center Scaler Gasket
10	A8L1-5	Inductor
12	A8MP6	LED/Button Shield
13	A8MP7	Center Filter Cover
14	A8MP8	Large Frame (RF Shield)
15	A8MP9	Small Frame (RF Shield)
16	A8MP10	Center Input Cover Shield
17	A8 MP11	Heat Sink
18	A8MP12	Counter Window
19	A8MP13	P.C. Board Support
20	A8MP14	Button Shield
21	A8MP15	Top Casting Cover
22	A8MP16	Bottom Casting
23	A8MP17	Light Pipe
25	A8MP18	Light Pipe
26	A8A4	Counter/Display Assembly
27	A8A3	Time Base Assembly
28	A8A2	Counter/Lock Assembly
29	A8A5	Counter Riser Board
30	A8A1	R.F. Scaler Assembly
31	A8MP19	X10 Button
32	A8MP20	X100 Button
33	A8MP21	ON Button
34	A8MP22	INT Button
35	A8MP23	EXT Button
36	A8MP24	Flat Washer
37	A8MP25	Lockwasher
38	A8MP26	Machine Screw
39	A8MP27	Machine Screw
40	A8MP28	Machine Screw
41	A8MP29	Lockwasher
42	A8MP30	Hex Nut
43	A8MP31	Flat Head Screw
44	A8MP32	Counter Insulator
45	A8MP33	Machine Screw
46	A8MP34	Machine Screw
47	A8MP35	Lockwasher
48	A8MP36	Machine Screw
50	A8MP37	Machine Screw
51	A8MP38	Machine Screw
52	A8MP39	Blind Dome Rivet



C

Figure 8-85. A8 Counter/Lock Assembly Illustrated Parts Breakdown

SERVICE SHEET D

A9 Assembly Removal Procedure

1. Set PEAK DEVIATION and RANGE switches fully counterclockwise.

2. Remove PEAK DEVIATION and RANGE switch knobs. The knobs are secured to their shafts with allen screws in the knobs.

3. Place instrument upside down and remove bottom cover (see Service Sheet G).

4. Loosen coupling between RANGE switch shaft and A10 Divider/Filter Assembly.

5. Remove two nuts and lockwashers that secure A9 Assembly to front panel (located at switch bushings).

6. Remove connector A9P1 from jack on A13 Assembly. Lift out A9 Assembly.

7. Reinstall assembly by setting both switch shafts fully counterclockwise and reversing the procedures in steps one through six.

NOTES

1. The detents of both the A9 Assembly and Al O Assembly switches must align and correspond to the same positions Check that the actual RF output frequency agrees with the counter indication on all bands.

2. Adjust the coupler longitudinally for minimum binding and tighten the setscrews very securely.

A11 Assembly Removal Procedure

A11 Removal (Standard)

1. Remove bottom cover from instrument (see Service Sheet G).

2. Set MODULATION FREQUENCY knob to 400 Hz. Remove MODULATION FREQUENCY knob. The knob is secured to its shaft with allen screws.

3. Remove Al 1 Assembly by gently lifting the board extractor at rear of board and sliding assembly to the rear and out of chassis.

4. To connect Al 1 Assembly for service, place assembly on extender board and install in chassis. Reinstall MODULATION FREQUENCY knob with 400 Hz position toward top of instrument.

All Removal (Option 001)

1. Remove top and bottom covers from instrument (see Service Sheet G).

2. Set MODULATION FREQUENCY knob to 400 Hz (fixed). Remove MODULATION FREQUENCY knob, vernier knob, and cursor disc and gear. The knobs are secured to concentric shafts with allen screws in the knobs.

CAUTION

When removing cursor disc and gear, gently slide it off the shaft to avoid damage to the disc.

3. Remove pan-head screw (with washer and lockwasher) that secures All Assembly to A13 Mother Board Assembly. The screw is accessible from top of instrument.

4. Remove All Assembly by gently lifting the board extractor at rear of board and sliding assembly to rear and out of chassis.

5. To connect Al 1 Assembly for service, place assembly on extender board and install in chassis. Reinstall cursor disc and gear, MODULATION FREQUENCY knob, and vernier knob. 400 Hz position of knob should be toward top of instrument.

Al 1 Reinstallation

6. Reinstall All Assembly by reversing the procedures in steps one through four or five.

NOTE

Check variable frequency accuracy to assure that the vernier disc is in the proper position.

A9 Peak Deviation and Range Switch Assembly Legend

Item Number	Reference Designator	Description
1	A9MP1	Retainer Ring
2	A9MP2	Gear
3	P/O A9MP8	Gear
4	A9MP3	Gear
5	A9MP4	Gear
6	A9MP5	Gear
7	A9R1	Potentiometer
8	A9MP6	Flat Washer
9	A9MP7	Coupler
10	A9MP8	Switch Support
11	P/O A9MP8	Gear Support
12	A9MP9	Adjustable Shaft
13	A9MP1O	Switch Shaft

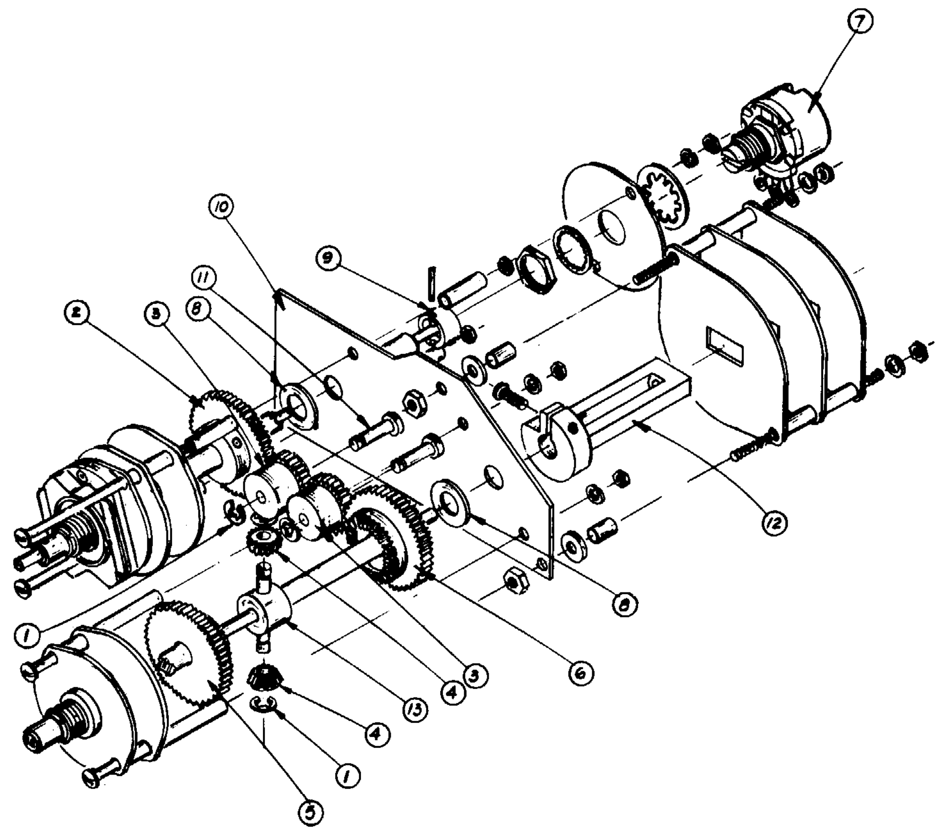
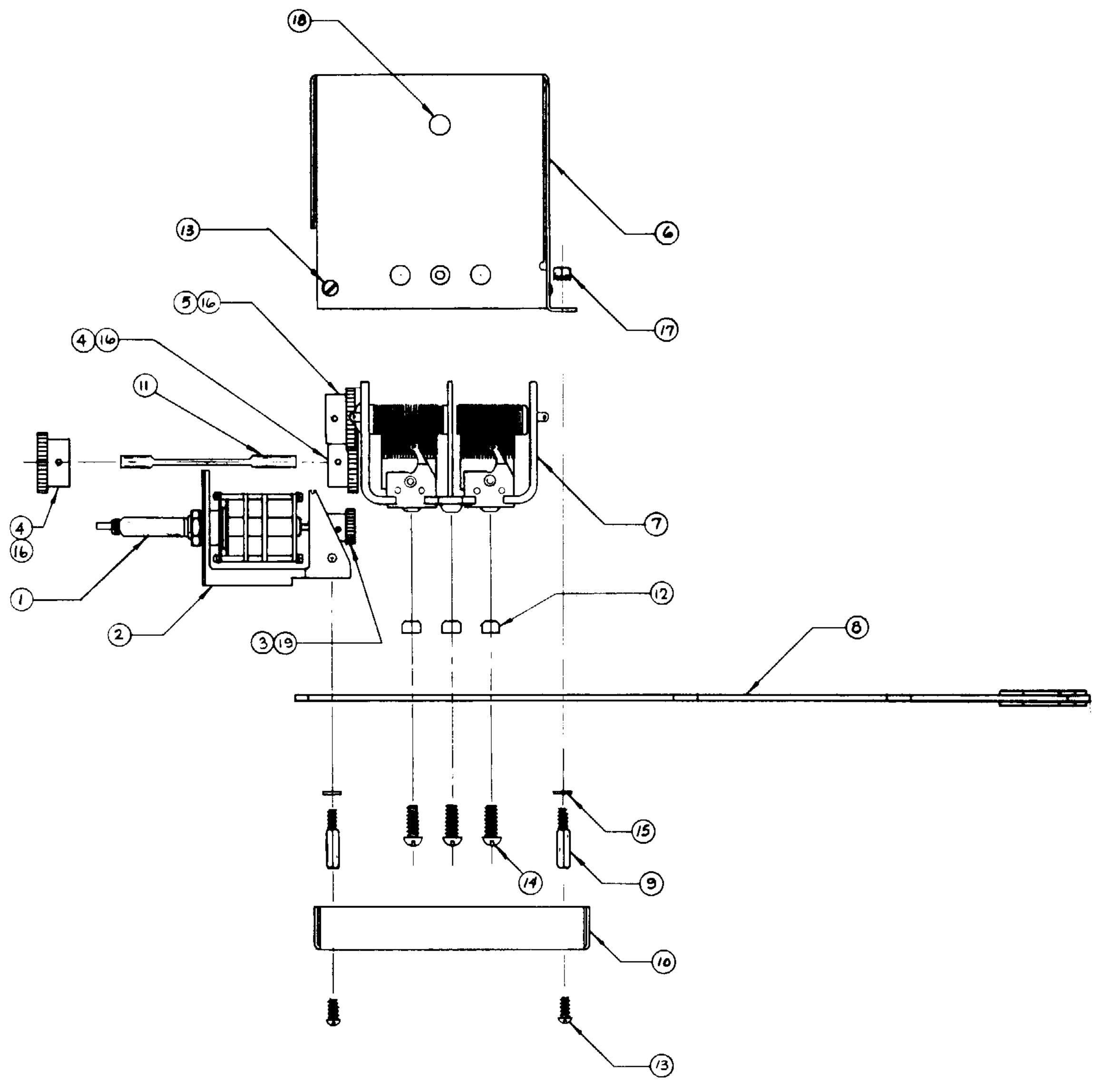


Figure 8-86. A9 Peak Deviation and Range Switch Assembly Illustrated Parts Breakdown

A11 Variable Frequency Modulation Oscillator Assembly (Option 001) Legend

Item Number	Reference Designator	Description
1	A11A1S1	Rotary Switch
2	A11A1MP1	Gear Support Housing
3	A11A1MP2	Spur Gear
4	A11A1MP3	Spur Gear
5	A11MP3	Spur Gear
6	A11MP4	Audio Oscillator Cover (Capacitor)
7	A11C1	Variable Capacitor
8	P/O All	Audio Oscillator Assembly
9	A11MP5	support
10	A11MP6	Audio Oscillator Cover (Circuit)
11	A11A1MP4	Audio Oscillator Shaft
12	A11MP7	Spacer
13	A11MP8	Screw
14	A11MP9	Screw
15	A11MP1O	Washer
16	A11A1MP5	Setscrew
17	A11MP11	Nut
18	A11MP12	Nylon Glide
19	A11A1MP6	Setscrew



D

Figure 8-87. A 11 Variable-Frequency Modulation Oscillator (Option 001) Illustrated Parts Breakdown

SERVICE SHEET E

A1O Assembly Removal and Disassembly Procedure

A10 Casting Cover Removal

1. Place instrument right side up and remove top cover (see Service Sheet G).

2. Remove fourteen pan-head screws (with lockwashers) that secure casting cover to casting (screws marked with asterisk - * - on cover).

NOTE

Note the location of the screws. The long screws vary in length.

3. Lift cover from casting.

A10A2 Removal

4. Remove twelve pan-head screws (with lockwashers) that secure A10A2 Assembly to casting. Remove A10A2 RF Divider Assembly and A10A3 Riser Assembly by lifting at the riser.

NOTES

1. The A10A2 Assembly can be extended for service by removing the A10A3 Riser Assembly from A10A2 and installing A10A2 in the riser socket (AIOAl-XA10A3A and B). Remove the riser evenly to avoid cracking the connector.

2. When replacing transistors on A10A2, assure that the cans will not contact the casting top cover.

A10A1 Access

5. Remove four pan-head screws (with lockwashers) that secure casting center section to casting.

6. Remove three power supply circuit boards (A18, A20, and A22) that are betwee Al0 Assembly and rear panel.

7. Remove casting center section.

NOTE

The A10A1 Assembly can be checked and adjusted by installing the A10A2 Assembly in the riser socket (Al0A1XA10A3A and B) and reinstalling the power supply circuit boards (A18, A20, and A22).

A10A1 Removal

8. Turn instrument upside down and remove bottom cover (see Service Sheet G).

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 2 *inch-pounds.*

9. Remove FM circuit boards (A5 and A7) and the A3A4 Connector Board Assembly (see Service Sheet F).

10. Disconnect four semi-rigid coaxial cables from bottom of A10 Assembly (cable W3 and A10A1J3, cable W7 at A10A1J2, cable W5 at A10A1J1, and cable W8 at A10A1J4). A10A1J2 and J3 are located in area occupied by FM circuit boards. A10A1J1 and J4 are located in front of A26 Assembly.

11. Remove four hex nuts and lockwashers that secure coaxial connectors A10A1J1 through J4.

12. Turn instrument right side up. Unsolder three feedthroughs at rear center of Al 0A1 Assembly (located to right of two toroid inductors and to left of relay).

CAUTION

Be **sure the terminals have been completely resoldered.**

13. Remove the ten pan-head screws (with lockwashers) that secure Al0A1 Assembly to casting. Remove A10A1.

NOTE

If necessary, the bottom casting cover can be removed by removing four allen screws (with lockwashers).

Reassembly

14. Reassemble A10 Assembly by reversing the procedures in steps one through 13.

A9 and Al 1 Assemblies Removal and Disassembly
SERVICE SHEET D

SERVICE SHEET E (Cont'd)

A10 Divider/Filter Assembly Legend

Item Number	Reference Designator	Description
1	**A10A1FL1,2,3**	Feed Thru Filter
2	A10MP1	Yellow P.C. Board Guide
3	A10MP2	Green P.C. Board Guide
4	A10MP3	Blue P.C. Board Guide
5	A10A1MP1	Detent Pin
6	A19MP4	RFI Braid
7	A10A1MP2	Detent Roller
8	A10A1MP3	Detent Spring
9	A10MP5	Spring Shield No. 1
10	A10MP6	Spring Shield No. 2
11	A10MP7	Spring Shield No. 3
12	A10MP8	Spring Shield No. 4
13	A10A1MP4	Cam Shaft
14	A10A1MP5	Cam Shaft Follower
15	A10MP9	D/F Top Cover Casting
16	A10MP10	D/F Center Casting
17	A10A1MP6	D/F Bottom Cover Casting
18	A10A1MP7	Bushing
19	A10A1MP8	Cam Cover
20	A10A1MP9	Cam Follower
21	A10A1MP10	Slider Clamp
22	A10A1	Filter/Switch Assembly
23	A10A3	Riser Board
24	A10A2	RF Divider Assembly
25	A10MP11	Lockwasher
26	A10MP12	Machine Screw
27	A10A1MP11	Machine Screw
28	A10MP13	Machine Screw
29	A10MP14	Machine Screw
30	**A10A1MP12**	Clamp Support
31	A10MP15	Machine Screw
32	A10A1MP13	Setscrew
34	A10MP16	Lockwasher
35	A10MP17	Hex Nut
36	A10A1MP14	Machine Screw
37	A10MP18	Machine Screw
38	A10MP19	Blind Dome Rivet
39	A10A1S1-6	Slider Switch

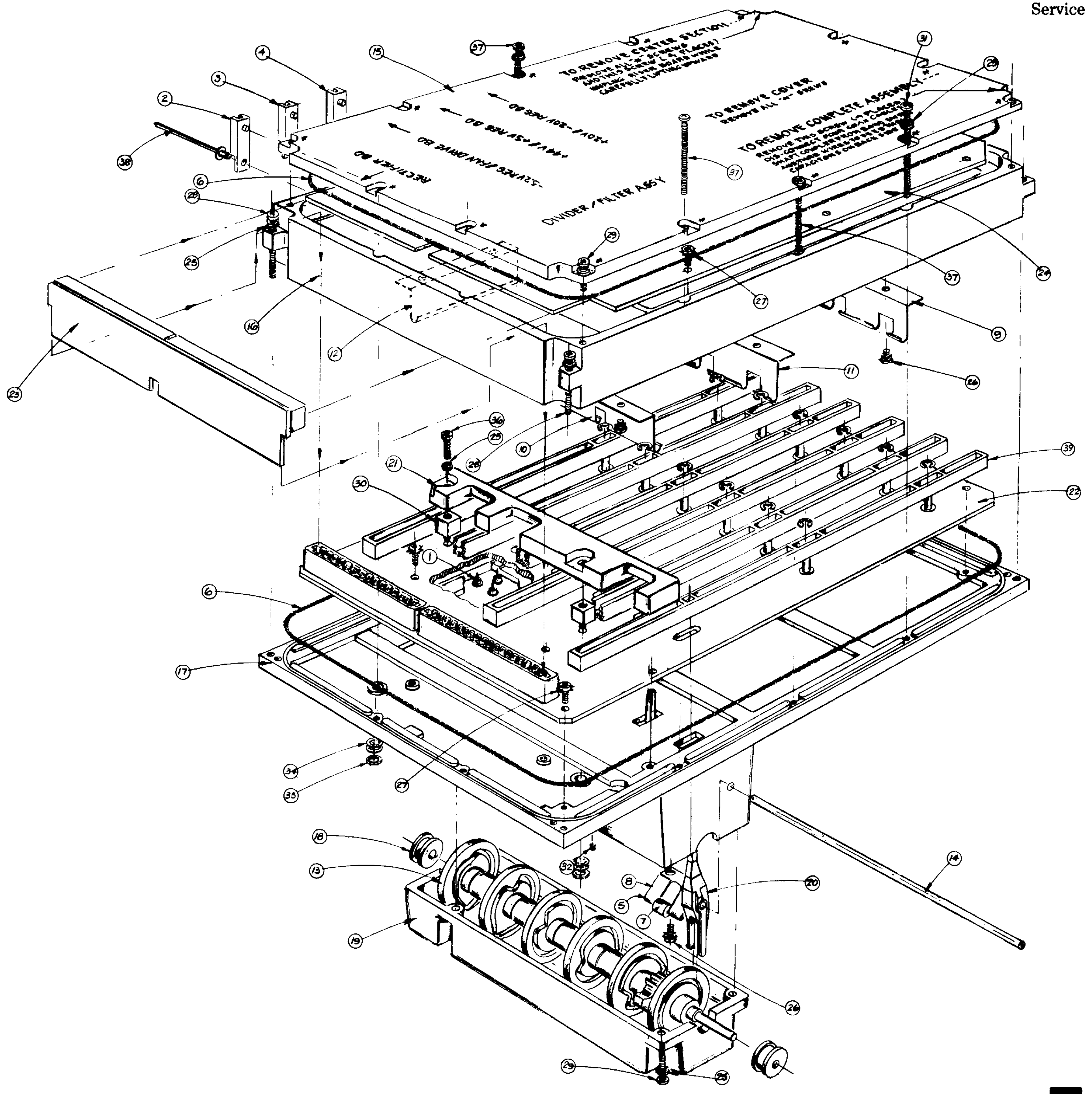


Figure 8-88. A10 Divider/Filter Assembly Illustrated Parts Breakdown

SERVICE SHEET F

A26 Assembly Disassembly Procedure

A26A2, A26A4 *and A26A8 Access*

1. Place instrument right side up and remove top cover (see Service Sheet G).

2. Remove four pan-head screws (with lockwashers) that secure casting top cover to casting.

3. Lift cover from casting.

4. To service either A26A2, A26A4, or A26A8, gently lift board's extractors and reinstall it on extender board.

5. Reassemble by reversing procedures in steps one through four.

A26A1 and A26A3 Access

1. Place instrument upside down and remove bottom cover (see Service Sheet G).

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 2** *inch-pounds.*

2. Remove ten pan-head screws (with lockwashers) that secure casting bottom cover to the casting.

WARNING

The RF I gasket on casting cover may have sharp edges and may cause personal injury if not handled with care.

3. Lift cover from casting, noting the orientation of the RFI gasket under the cover.

NOTE

Do not attempt to replace components on the A26A1 and A26A3 assemblies without removing them.

A26U1 and A26U2 Removal

4. Remove two pan-head screws (with washers) that secure microcircuit amplifier A26U1 or U2 to casting.

5. Remove A26U1 or U2.

6. Remove four pan-head screws (with lockwashers) that secure the heat sink to the casting.

7. Remove pan-head screws (with lockwashers) that secure the circuit board to the casting.

8. Disconnect two coaxial cables from casting connectors.

9. Remove nuts and washers that secure cable connectors to casting.

10. To replace components mounted on the circuit board, tilt the board up while sliding it to the rear.

11. To replace or remove the circuit board, label the wires soldered to the board before unsoldering them.

12. Reassemble by reversing procedures in steps one through twelve.

A10 Assembly Removal and Disassembly
SERVICE SHEET E

SERVICE SHEET F (Cont'd)

A26 AM/AGC and RF Amplifier Assembly Legend

Item Number	Reference Designator	Description
1	A26C1,2,5-12 C15,16	Feed Thru Capacitor
2	A26C17,18	Feed Thru Capacitor
3	A26C3,4,14	Feed Thru Capacitor
4	A26C13	Feed Thru Capacitor
5	A26R1	Resistor
6	A26U1	Amplifier
7	A26U2	Amplifier
8	A26J1	RF Connector
9	A26MP26	Coaxial Cap
10	A26W2	Cable Assembly
11	A26W1	Cable Assembly
12	A26W4	Cable Assembly
13	A26W3	Cable Assembly
14	A26MP1	Gasket
15	A26MP2	Gasket
16	A26MP3	Gasket
17	A26MP4	Gasket
18	A26L1,3-6,L8	Inductor
19	A26L2	Inductor
20	A26L7	Inductor
21	P/OA26U1,2	Heat Sink
22	A26MP5	Cover
23	A26MP6	Cover
24	A26MP7	Cover
25	A26MP8	Casting
26	A26MP9	Cover
27	A26A5	Riser Board
28	A26A6	Mother Board
29	A26A2	AM OFF/PUL Assembly
30	A26A4	AGC Amplifier Assembly
31	A26A3	Modulator Assembly
32	A26A1	Power Amplifier and AGC/ Detector Assembly
33	A26MP10	Cover
34	A26MP11	Guide
35	A26MP12	Guide
36	A26MP13	Guide
37	A26MP14	Machine Screw
38	A26MP15	Machine Screw
39	A26MP16	Machine Screw
40	A26MP17	Hex Nut
41	A26MP18	Lockwasher
42	A26MP19	Lockwasher
43	A26MP20	Lockwasher
44	A26MP21	Lockwasher
45	A26MP22	Washer
46	A26MP23	Hex Nut
47	A26MP24	Lockwasher
48	A26MP25	Blind Dome Rivet
49	A26A8	Demodulator Amplifier Assembly
50	A26MP26	Guide

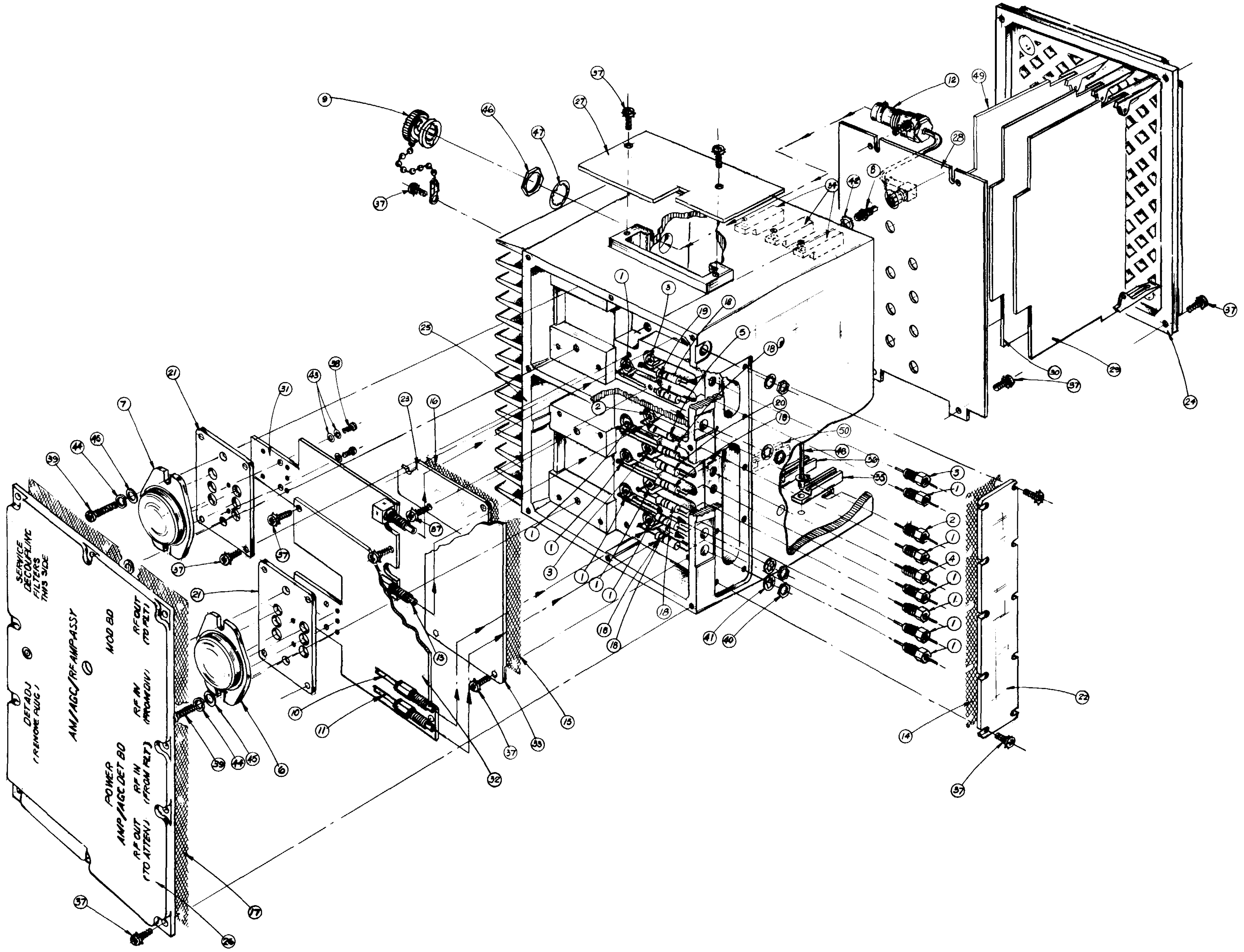


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Figure 8-89. A26 AM/AGC and RF Amplifier Illustrated Parts Breakdown

SERVICE SHEET G

General Removal Procedures

Top and Bottom Cover Removal

CAUTION

Before attempting to disassemble or remove any part of the generator, remove line power from the instrument by disconnecting the instrument's line power cable from the line power outlet.

1. Remove top cover by removing four screws. Slide cover to the rear approximately two inches to disengage it from flanges at the instrument's front and rear. Lift it off.

2. Remove bottom cover by removing four screws. Slide cover to the rear approximately two inches to disengage it from flanges at the instruments front and rear. Lift it off.

Circuit Board Removal

3. Remove any plug-in circuit board by gently lifting the bead's extractors (the extractors are color-keyed to the guides at the board's edges).

M1 Removal

1. Remove top cover.

2. Remove trim strip (extrusion) that overlaps panel meter by removing two flat-head screws. Remove plastic front panel window by lifting it up and out.

3. Remove A4 Meter/Annunciator Drive Assembly.

4. Remove four pan-head screws (with lock-washers) that secure A8 Counter/Lock Assembly to chassis.

5. Remove A6 Annunciator Assembly by first disconnecting plug A6P1 and removing two flat-head screws on front face of meter bezel. Then lift left edge of A8 Assembly and move A6 Assembly to the rear.

6. To remove meter, disconnect two wires at rear of meter (black-wire from negative post, white wire to positive post).

7. Push top edge of meter to the rear and lift meter from chassis.

NOTE

If necessary, loosen A 11 Modulation Oscillator to provide clearance for meter (see Service Sheet D).

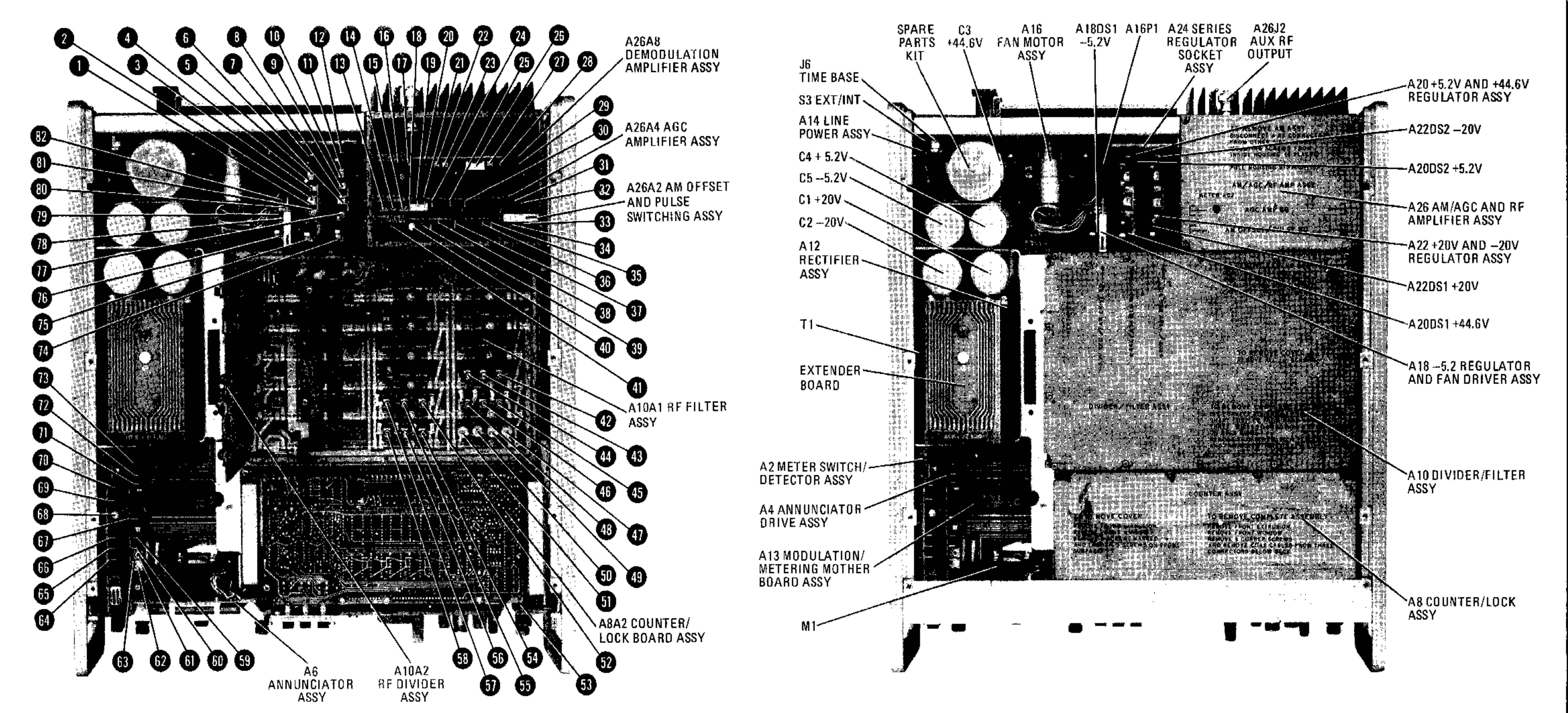
8. To install meter, reverse procedure given in steps one through seven. To install Annunciator Assembly, reverse procedure given in steps one through five

NOTE

Check that the insulator between the right-hand annunciators and the counter is properly in place to prevent shorting of the lamps.

SERVICE SHEET G

A2R5	DET OFFSET 68
A2TP1	GND 64
A2TP2	DC OUT 65
A2TP3	AC IN 66
A2TP4	−20V 69
A2TP5	+20V 70
A4R10	DRIVE OFFSET 62
A4R19	F.S. ADJ 61
A4TP1	F.S. ADJ 63
A4TP2	B 60
A4TP3	A 59
A4TP4	DC IN 67
A4TP5	GND 71
A4TP6	C 72
A4TP7	+5.2V 73
A8A4R2	TIME BASE CAL 53
A10A1C81	51
A10A1C82	50
A10A1C83	49
A10A1C84	47
A10A1L31	44
A10A1L32	43
A10A1L33	42
A10A1L37	57
A10A1L38	55
A10A1L39	52
A10A1L40	48
A10A1L41	46
A10A1L42	45
A10A1L43	58
A10A1L44	56
A10A1L45	54
A18R2	−5.2V ADJ 78
A18TP1	F1 82
A18TP2	TH1 79
A18TP5	−5.2V 76
A18TP6	F1 80
A20R8	+44.6V ADJ 81
A20R16	+5.2V ADJ 3
A20TP1	F2 2
A20TP4	+44.6V 75
A20TP5	F2 1
A20TP6	F1 5
A20TP7	F1 4
A20TP10	+5.2V 7
A22R7	+20V ADJ 77
A22R19	−20V ADJ 9
A22TP1	F2 8
A22TP2	F2 6
A22TP4	+20V 74
A22TP6	F1 11
A22TP7	F1 10
A22TP9	−20V 12
A26A2R19	% AM 40
A26A2TP1	AM IN 41
A26A2TP2	GND 39
A26A2TP3	AM OUT 38
A26A2TP4	PUL IN 37
A26A2TP5	DET PUL 36
A26A2TP6	MOD PUL 35
A26A2TP7	MET 34
A26A2TP8	BW 33
A26A4R1	LVL 14
A26A4R2	DBLR LVL 13
A26A4R12	METER ADJ 15
A26A4TP1	MET 18
A26A4TP2	DET 19
A26A4TP3	OVLD 21
A26A4TP4	VERN 24
A26A4TP5	GND 25
A26A4TP6	CQ1 30
A26A4TP7	DRVR 31
A26A4TP8	MOD 32
A26A8R3	GAIN 17
A26A8R6	AC OFFSET 22
A26A8R8	AC GAIN 23
A26A8R10	DC GAIN 27
A26A8R15	DC OFFSET 28
A26A8S1	AC/DC 26
A26A8TP1	BUFFER DET 16
A26A8TP2	DET 20
A26A8TP3	DEMOD 29



G

Figure 8-90. Top Internal Views (Option 001 Shown)

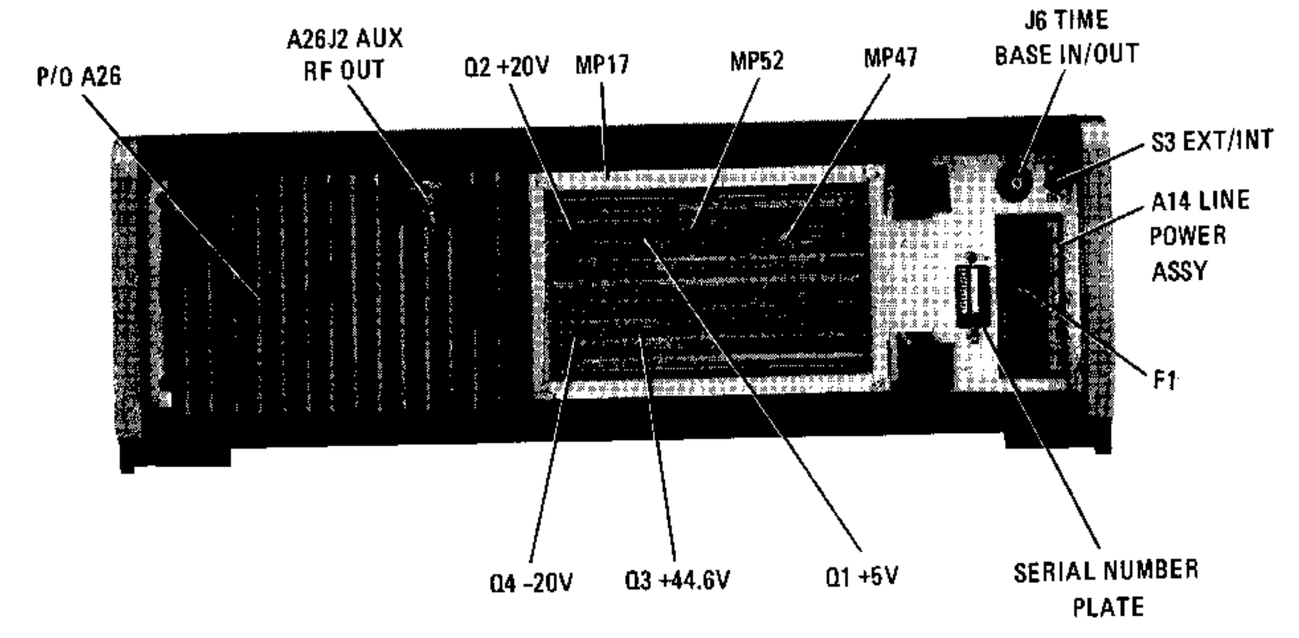


Figure 8-91. Rear Panel View

SERVICE SHEET H

A1R1	OUTPUT LEVEL VERNIER	44
A3R1	FREQUENCY TUNE	43
A3R2	FM GAIN COMPENSATION	42
A3A4R1	V_T ADJ	13
A3A4R2	LOW SENS	11
A3A4R3	MID SENS	10
A3A4R4	HI SENS	9
A3A4TP1	V_T	12
A3A4TP2		8
A5R9	AMPLIFIER OFFSET	33
A5R23	BUFFER ADJ	37
A5TP1	GND	14
A5TP2	OUTPUT	23
A5TP3	+ INPUT	30
A5TP4	− INPUT	36
A5TP5	FM BUFFER IN	38
A5TP6	BUFFER OUT	40
A7R12	POS SHAPE	27
A7R19	VARACTOR BIAS	16
A7R41	NEG SHAPE	22
A7TP1	GND	15
A7TP2	VARACTOR ANODE	17

SERVICE SHEET H (Cont'd)

A7TP3	VARACTOR CATHODE	26
A7TP4	+0.20V OVERLOAD	31
A9R1	PEAK DEVIATION VERNIER	39
A11C2	TRIMMER ADJ	34
A11C3	TRIMMER ADJ	32
A11C9		35
A11R35	AM-FM DRIVE ADJ	24
A11R40	AUDIO OUTPUT LEVEL	19
A11TP1		18
A11TP2		20
A11TP3	FM OUT	21
A11TP4	OSC OUT	25
A11TP5	AM OUT	28
A11TP6	GND	29
A13R3		41
A19A2R7	10 μV ADJ	45
A19A2R8	1 μV ADJ	46
A26U1		1
A26U2		6
A26W1		47
A26W2		48
A26W3		5
A26A1R19	DET ADJ	3
A26A1TP1	DET	4
A26A1TP2	PK DET	2
A26A3J1		7

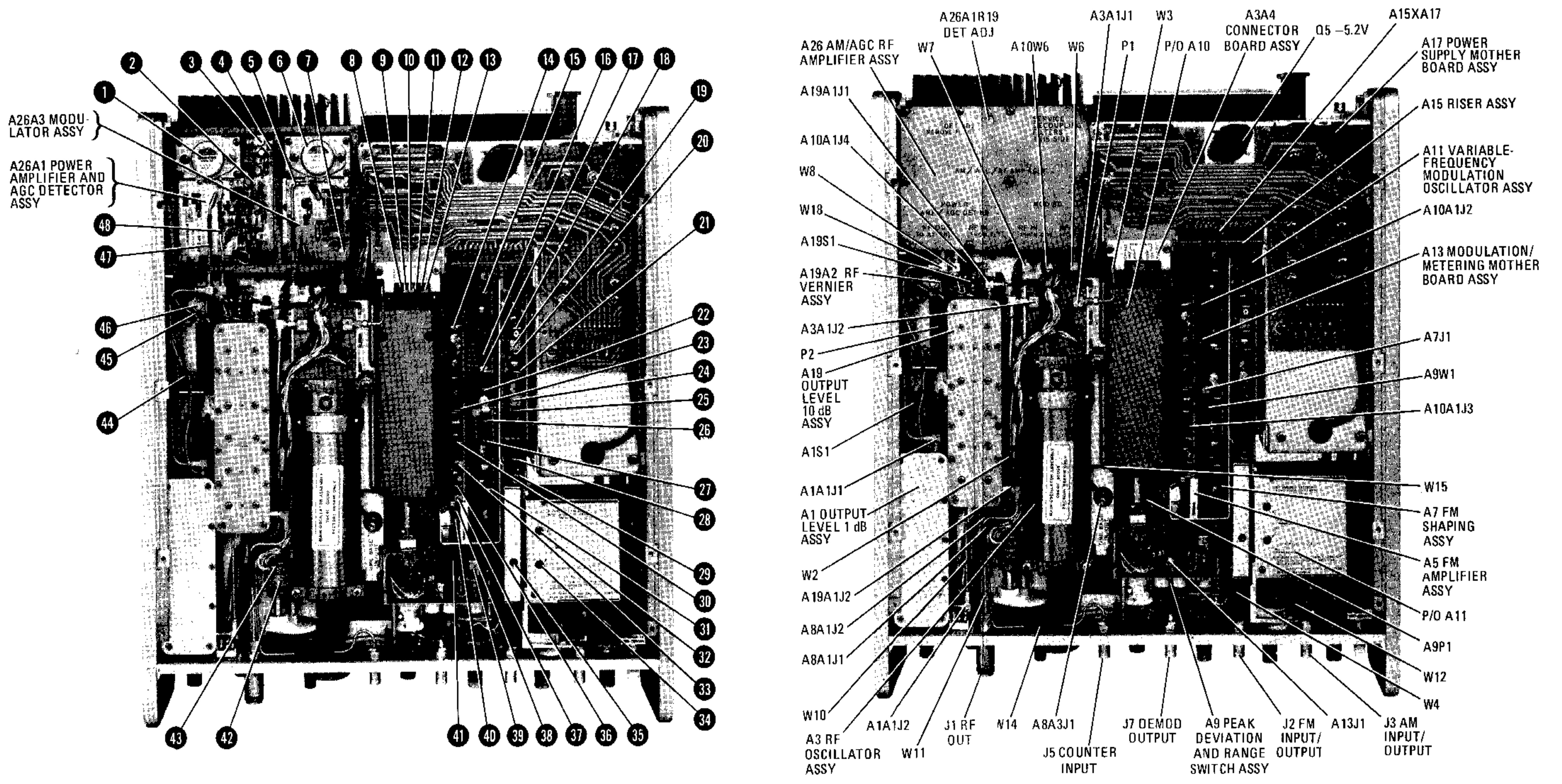


Figure 8-92. Bottom Internal Views (Option 001 Shown)

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
TB 43-0118	Field Instructions for Painting and preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 38-750	The Army Maintenance Management System.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics command) .

APPENDIX B
COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

B-1. Scope

This appendix lists integral components of and basic issue items for the HP-8640B to help you inventory items required for safe and efficient operation.

B-2. General

This Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. Not applicable. These items, when assembled, comprise the HP-8640B and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III. Basic Issue Items. Not applicable. These are the minimum essential items required to place the HP-8640B in operation, to operate it, and to perform emergency repairs. Although shipped separately packed they must accompany the HP-8640B during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify kerns. This manual is your authority to requisition replacement BII, based on TOE/MTOE authorization of the end item.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows

(1) *Figure number. Indicates the figure* number of the illustration on which the item is shown.

(2) *Item number. The* number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. *Description. Indicates the* Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. *Location. The* physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. *Usable on Code.* Not applicable. "USABLE ON" codes are included to help you identify which component items are used on the different models. Identification of the codes usedin these lists are

Code	*Used on*

f. Quantity Required (Qty Regal). This column lists the quantity of each item required for a complete major item.

g. *Quantity. This* Column is left blank for use during an inventory. Under the Rcvd column, list the quantity you actually receive on your major item. The Date columns are for your use when You inventory the major item.

(Next printed page is B-2)

SECTION II INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION (A) FIG NO.	(B) ITEM NO.	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION PART NUMBER	(FSCM)	(4) LOCATION	(5) USABLE ON CODE	(6) QTY REQD	(7) QUANTITY RCVD	DATE
1-1		6625-00-566-3067	SIGNAL GENERATOR SG-1112(V)1/U HEWLETT-PACKARD MODEL 8640B OPTION 004				1		
1-1		6625-00-500-6525	SIGNAL GENERATOR SG-1112(V)2/U HEWLETT-PACKARD MODEL 8640B OPTION 001				1		
1-1			LINE POWER CABLE HEWLETT-PACKARD P/N 6120-1378				1		
			SECTION III BASIC ISSUE ITEMS						
			TECHNICAL MANUAL TM 11-6625-2780-14&P				1		

APPENDIX D
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for the SG-1112(V)(1)/U and SG-1112(V) (2) /U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance **operations.**

D-2. Maintenance Function

Maintenance fumctions will be limited to and defined as follows:

a. Inspect. *To determine the serviceability* of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. ***Ajust.*** To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristic to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. ***Calibrate.*** To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to alIow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, winding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by corroding specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/-operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

D-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identfy components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. ***Column 3, Maintenance Functions.*** Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column ***4*** specifies, by the listing of a “work time” figure in the ap propriate subcolumns(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate “work time” figures will be shown for each category. The number of task-hours specified by the “work time” figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions, This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specitic tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows

C-Operator/Crew
O-Organizational

F—Direct Support
H—General Support
D—Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sec III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or teat equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. *Nomenclature. This* column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specfic tool or test equipment,

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

D-5. Remarks (Sec IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is D-3)

SECTION II MAINTENANCE ALLOCATION CHART
FOR
SIGNAL GENERATOR SG-1112(V)1/U and SG-1112(V)2/U

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	SIGNAL GENERATOR SG-1112(V)1/U and SG-1112(V)2/U	Inspect		0.2					A
		Test		0.3					B
		Test				0.6		1 thru 12	
		Service		0.3				48	
		Adjust				0.6		13	
		Replace		0.3				48	
		Repair		0.2					C
		Repair				0.5		13	
		Overhaul					3.0	1 thru 47	
01	OUTPUT LEVEL ASSEMBLY (A1)	Test				0.4		1 thru 12	
		Repair				0.5		13	
02	METER SW/DETECTOR ASSEMBLY (A2)	Test				0.4		1 thru 12	
		Repair				0.5		13	
03	RF OSCILLOSCOPE ASSEMBLY (A3)	Test				0.4		1 thru 12	
		Repair				0.5		13	
04	METER/ANNUCIATOR DRIVE ASSEMBLY (A4)	Test				0.4		1 thru 12	
		Repair				0.5		13	
05	FM AMPLIFIER ASSEMBLY (A5)	Test				0.4		1 thru 12	
		Repair				0.5		13	
06	ANNUNCIATOR ASSEMBLY (A6)	Test				0.4		1 thru 12	
		Repair				0.5		13	
07	FM SHAPING BOARD ASSEMBLY (A7)	Test				0.4		1 thru 12	
		Repair				0.5		13	
08	COUNTER/LOCK ASSEMBLY (A8)	Test				0.4		1 thru 12	
		Repair						13	
09	PEAK DEVIATION ANO RANGE SWITCH ASSEMBLY (A9)	Test				0.4		1 thru 12	
		Repair				0.5		13	
10	DIVIDER/FILTER ASSEMBLY (A10)	Test				0.4		1 thru 12	
		Repair				0.5		13	
11	FIXEO FREQUENCY MODULATION OSCILLATOR (A11)	Test				0.4		1 thru 12	
		Repair				0.5		13	
12	RECTIFIER ASSEMBLY (A12)	Test				0.4		1 thru 12	
		Repair				0.5		13	
13	MOOULATOR/METERING MOTHER BOARD ASSEMBLY (A13)	Test				0.4		1 thru 12	
		Repair				0.5		13	
14	LINE MOOULE ANO FILTER (A14)	Test				0.4		1 thru 12	
		Repair				0.5		13	
15	RISER ASSEMBLY (A15)	Test				0.4		1 thru 12	
		Repair				0.5		13	
16	FAN MOTOR (A16)	Test				0.4		1 thru 12	
		Repair				0.5		13	
17	POWER SUPPLY MOTHER BOARO ASSEMBLY (A17)	Test				0.4		1 thru 12	
		Repair				0.5		13	
18	REGULATOR AND FAN DRIVER ASSEMBLY (A18)	Test				0.4		1 thru 12	
		Repair				0.5		13	
19	REGULATOR ASSEMBLY 5.2 V ANO 44.6 V (A20)	Test				0.4		1 thru 12	
		Repair				0.5		13	
20	REGULATOR ASSEMBLY +20 V ANO -20 V (A22)	Test				0.4		1 thru 12	
		Repair						13	
21	SERIES REGULATOR SOCKET ASSEMBLY (A24)	Test				0.4		1 thru 12	
		Repair				0.5		13	
22	AM/AGC AND RF AMPLIFIER ASSEMBLY (A26)	Test				0.4		1 thru 12	
		Repair				0.5		13	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
SG-1112(V)(1)/U AND SG-1112(V)(2)/U

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	ANALYZER, SPECTRUM TS-723D/U	6625-00-668-9418	
2	H,D	ANALYZER, SPECTRUM IP-1216/U	6625-00-424-4370	
3	H, D	PLUG-IN PL-1387/U	6625-00-167-5267	
4	H, D	PLUG-IN PL-1388/U	6625-00-431-9339	
5	H, D	PLUG-IN PL-1399/U	6625-00-432-5055	
6	H, D	PLUG-IN PL-1406/U	6625-00-140-0156	
7	H, D	COUNTER, ELECTRONIC AN/USM-207A	6625-00-044-3228	
8	H, D	GENERATOR, SIGNAL SG-1122/U	6625-00-153-5990	
9	H, D	GENERATOR, SIGNAL SG-1125/U	6625-00-185-4802	
10	H, D	OSCILLOSCOPE AN/USM-281C	6625-00-106-9622	
11	H, D	VOLTMETER AN/GSM-64	6625-00-022-7894	
12	H, D	TRASFORMER, VARIABLE, POWER CN-16/U	5950-00-235-2086	
13	H, D	TOOL KIT ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
14	D	ADJUSTABLE STUB GR 874-D50L		
15	D	AMPLIFIER (20DB) HP 8447A		
16	D	AMPLIFIER (20DB) HP 8447B		
17	D	AMPLIFIER (40DB) HP 465A		
18	D	AMPLIFIER (40 DB) HP 08640-60506		
19	D	ANTENNA, LOOP HP 08640-60501		
20	D	ATTENUATOR HP 355D OPT. H36		
21	D	ATTENUATOR HP 8491 OPT. 003		
22	D	ATTENUATOR HP 8491 OPT.010		
23	D	ATTENUATOR HP 8491 OPT. 020		
24	D	CRYSTAL DETECTOR HP 8471A		
25	D	CRYSTAL DETECTOR HP 423A		
26	D	DIGITAL VOLTMETER HP 3408B/3484 OPT. 042.043		
27	D	DIRECTIONAL COUPLER HP 728D OPT.12		
28	D	FM DISCRIMINATOR HP 5210A		
29	D	FEEDTHROUGH (600OHM) HP 11095A		
30	D	FILTER, NOTCH HP 10531A		
31	D	FILTER, NOTCH HP 08640-60502		
32	D	FILTER, LOW-PASS CIR-Q-TEL FLT/21B-4-3/50-3A/3B		
33	D	FILTER, LOW-PASS CIR-Q-TEL FLT/21B-1500K-3/50-3A/3B		
34	D	FILTER, LOW-PASS CIR-Q-TEL FLT/21B-15K-7/50-3A/3B		
35	D	FILTER, LOW-PASS CIR-Q-TEL FLT/21B-3K-5/50-3A/3B		
36	D	FUNCTION GENERATOR HP 3300A		
37	D	FM LINEARITY CIRCUIT HP 08640-60503		
38	D	MIXER, DOUBLE BALANCED HP 10514A		
39	D	NOISE PHASE LOCK CIRCUIT HP 08640-60504		
40	D	PULSE GENERATOR HP 8002A/8013B		
41	D	POWER METER HP 432A/478A OPT. H63		

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
42	D	POWER METER HP 435A/8481A		
43	D	STANDARD, FREQUENCY HP 105A		
44	D	VOLTMETER (RMS) HP 3400A		
45	D	VARIABLE PHASE OSCILLATOR HP 203A		
46	D	VOLTMETTER, VECTOR HP 8405A		
47	D	VSWR BRIDGE WILTRON 60N50		
48	D	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE ORGANIZATIONAL REPAIR PERSON BECAUSE OF HIS/HER ASSIGNED MISSION.		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	VISUAL, EXTERNAL.
B	OPERATIONAL
C	REPLACE KNOBS, FUSES, ETC.

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)
Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE SENT
10 July 1975

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 11-5840-340-20P	23 Jan 78	Radar Set AN/PRC-76

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
33				For item 2, change the NSN to read: 5835-00-134-9186. Reason: Accuracy.
44		19		Identify the cover on the junction box (item no. 5). Reason: It is a separate item and is not called out on figure 19.
45				Add the cover of the junction box as an item in the listing for figure 19. Reason: Same as above

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE
SSG I. M. DeSpirit of 999-1776	I. M. DeSpirit

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P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 11-6625-2780-14&P	31 Dec 80	Signal Generators SG-1112(V)1/U and SG-1112(V)2/U

BE EXACT PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER	SIGN HERE

TEAR ALONG PERFORATED LINE

DA FORM 1 JUL 79 2028-2

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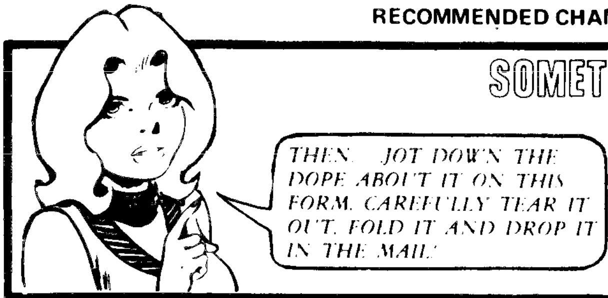

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