Errata

Title & Document Type: **8616A Signal Generator Operating and Service Manual**

Manual Part Number: **08616-90022**

Revision Date: **May 1984**

About this Manual

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

HP References in this Manual

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

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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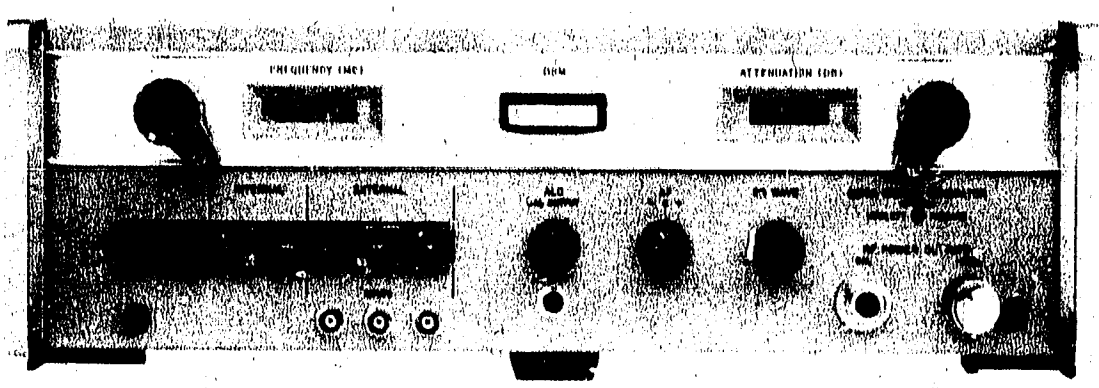
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

HP 8616A
SIGNAL GENERATOR



HEWLETT PACKARD

HP 8616A

CERTIFICATION

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

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment, except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

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

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

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

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

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).

Indicates hazardous voltages.

Indicates earth (ground) terminal.

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

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

OPERATING AND SERVICE MANUAL

HP 8616A
SIGNAL GENERATOR

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2015A.

With the changes described in Appendix I, this manual also applies to instruments with serial numbers prefixed 411, 424, 426, 449, 511, 548, 748, 749, 815, 951, 0951A, 1116A, 1152A, 1313A, 1412A, 1645A, 1739A, 1808A, 1810A, and 1835A.

For information on serial number prefixes above 2015A, refer to the yellow Manual Changes supplement that is supplied with the manual. To keep your manual up to date, you should periodically request the latest Manual Changes supplement from your nearest HP office.

HEWLETT PACKARD

MANUAL PART NUMBER 08616-90022
Microfiche Part No. 08616-90023

Printed: MAY 1984

ILLUSTRATIONS

TABLES

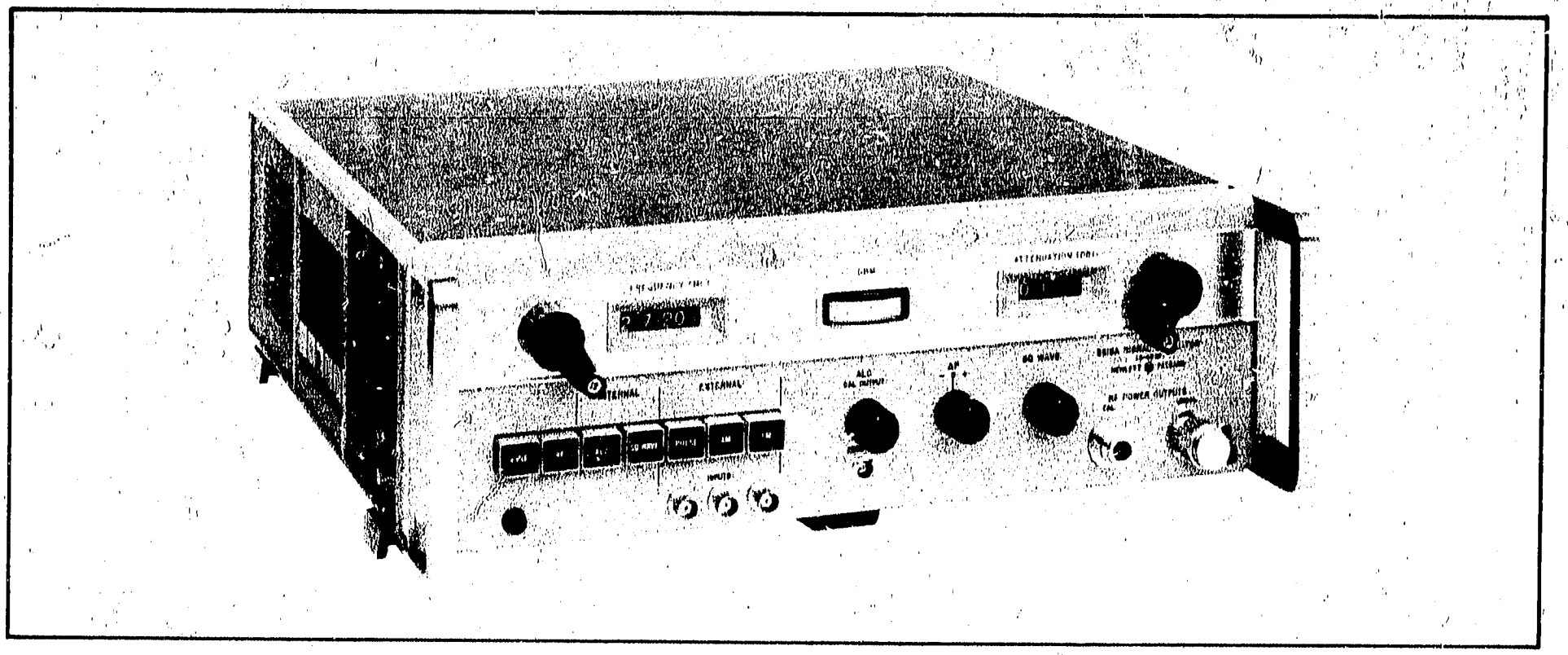


Figure 1-1. Model 8616A Signal Generator

Table 1-1. Specifications

FREQUENCY CHARACTERISTICS

Range: 1800 to 4500 MHz; single, linearly calibrated control; direct reading within 2 MHz.

Vernier: ΔF control has a minimum range of 1.0 MHz for fine tuning.

Frequency Calibration Accuracy (0 dBm and below): ±10 MHz.

Frequency Stability:

Line voltage: < 30 ppm for ±10% change from nominal voltage.

Temperature: approximately 50 ppm/°C change in ambient temperature.

Residual FM: < 2500 Hz peak in a 10 kHz bandwidth.

OUTPUT CHARACTERISTICS

Range:

CAL output: 0 dBm (0.223V) to −127 dBm (0.1 μV), continuously variable. Above 0 dBm output is not calibrated, max level +10 dBm (0.707V) [+3 dBm (0.316V) from 2990—4500 MHz].

UNCAL output: −3 dBm (0.16V) nominal.

Flatness: <±1 dB.

Level Accuracy: ±1 dB + attenuator accuracy (0 to −127 dBm).

Attenuator Accuracy: +0, −1 dB from 0 to −10 dBm; ±0.2 dB ±0.06 dB/10 dB from −10 to −127 dBm; direct reading linear dial, 0.2 dB increments.

Impedance: 50 ohms; SWR < 2.0.

MODULATION CHARACTERISTICS

Internal Square-Wave: 950 to 1050 Hz. Other frequencies available on special order. On/off ratio at least 20 dB.

Square-Wave Sync: Square-wave can be synchronized with a +1 to +10-volt signal applied to the pulse input.

External pulse: 50 Hz to 50 kHz, 2.0 μs rise time, +20 to +100V peak input. On/off ratio at least 20 dB.

External AM: dc to 1 MHz.

External FM: Mode width between 3 dB points varies from about 5.5 MHz to about 4 MHz, 1800—3000 MHz; and from about 8.5 MHz to 5.5 MHz, 3000—4500 MHz. Corresponding klystron repeller sensitivities are approximately 100, 50, 200 and 100 kHz/V respectively.

a. Front-panel connector capacitively coupled to the repeller of the klystron. Input impedance, 220 kΩ shunted by approximately 300 pF.

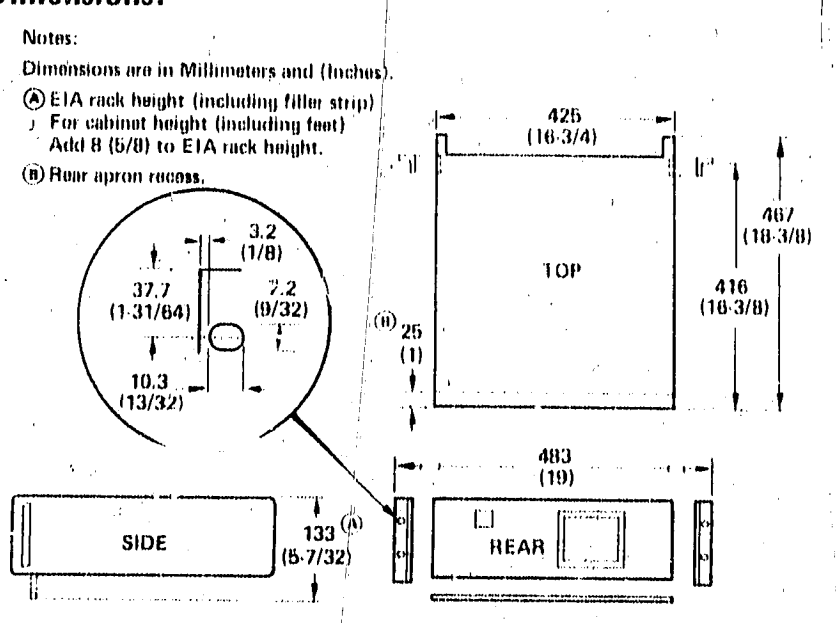
b. Rear-panel connector is dc-coupled to the repeller of the klystron.

GENERAL

RFI: Conducted and radiated leakage limits are below those specified in MIL-I-6181D.

Power Source: 115 or 230 volts ±10%, 50 to 60 Hz, approximately 125 watts.

Dimensions:



Weight: Net, 19.5 kg (43 lb).

Option 001: External modulation input connectors on rear panel in parallel with front-panel connectors: RF connectors on rear panel only.

NOTE: Specifications apply with the ΔF control centered.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The Model 8616A Signal Generator provides RF power in the 1800 to 4500 MHz range. The instrument produces an RF power output of at least 2 mW. Output frequency and attenuation are read directly on digital dials, and fine frequency changes can be made by means of the front-panel ΔF control. Complete specifications are given in Table 1-1. The 8616A is shown in Figure 1-1.

1-3. The instrument has two power output connectors which supply RF power simultaneously. One output provides at least 10 mW (2 mW from 3000 to 4500 MHz) of power and may be leveled. When in the leveled output mode of operation and the output is 0 dBm or less, the RF output is held quite constant across the band without resetting the attenuator or power monitor. The other output connector provides an uncalibrated output of at least 0.5 mW. A waveguide-beyond-cutoff attenuator, which is referenced to the RF output, accurately attenuates the calibrated RF power output from 0 to −127 dBm.

1-4. RF power output can be internally square-wave modulated. In addition, the RF power can be externally AM, FM, or pulse modulated. An external ALC (automatic level control) input which can be used for remote leveling loop control and an external DC-coupled FM input which can be used for external AFC is also provided.

1-5. PIN diode attenuators are used for leveling, square wave, pulse, and amplitude modulation. The PIN attenuator is an absorption device that can be electrically controlled to attenuate RF power. A sampling loop which includes a PIN diode attenuator compensates for changes in RF power output to hold the RF power output nearly constant.

1-6. SUPPLEMENTARY INSTRUMENTS

1-7. The HP 8403A (Option 002), an external pulse and amplitude modulator, extends the Signal Generator's modulation capabilities.

1-8. The Model 2650A (obsolete) Oscillator Synchronizer may be used directly to stabilize all internal cavity reflex klystron signal generators. Short-term stability is one part in 10^8/sec, and long-term stability is one part in 10^6/week over 0 to 50 degrees centigrade.

1-9. INSTRUMENT OPTIONS

1-10. In addition to the standard instrument, the Option 01 is available. The Option 01 instrument has its input connectors located on both the front and rear panel and its output connectors located on the rear panel; in all other respects it is the same as the regular signal generator.

1-11. INSTRUMENT IDENTIFICATION

1-12. Hewlett-Packard uses a ten digit serial number (on instrument rear panel) to identify instruments. The first four numbers and letter are the serial prefix number and the last five digits are unique to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the manual and your instrument which are described in a Manual Change sheet included with the manual. If the change sheet is missing, it may be obtained on request, from your nearest Hewlett-Packard office.

1-13. KLYSTRON WARRANTY CLAIM SHEET

1-14. The klystron supplied and replacement klystrons purchased from Hewlett-Packard are guaranteed as set forth in the CONDITIONS OF WARRANTY FOR KLYSTRON TUBES which is found on the next to last page of this manual.

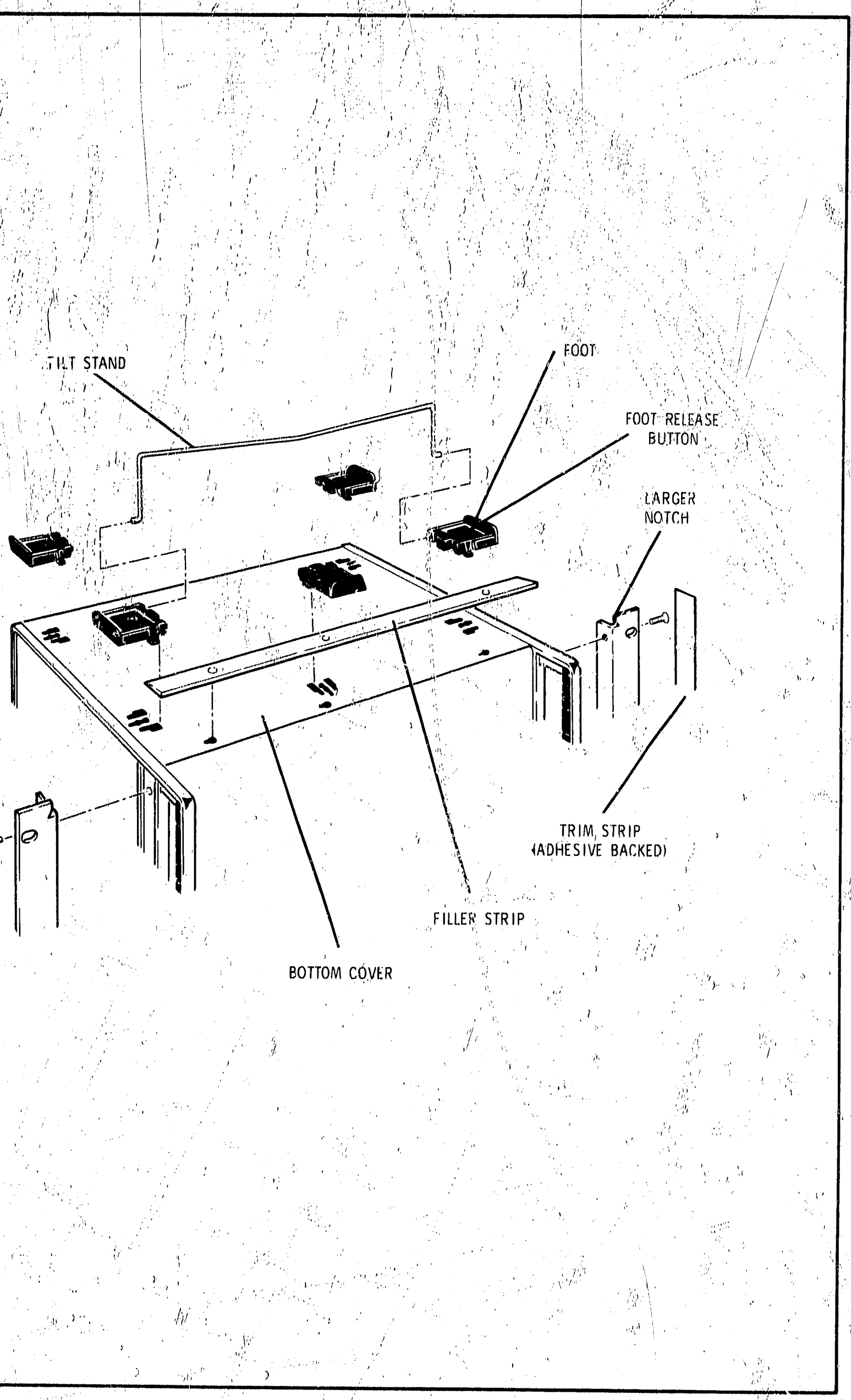


Figure 2-1. Conversion to Rack Mount

SECTION II
INSTALLATION

2-1. INCOMING INSPECTION

2-2. This instrument was inspected both mechanically and electrically before shipment. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument, using the procedure outlined in Paragraph 5-36. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-3. INSTALLATION

2-4. The Model 8616A is delivered as a cabinet mount instrument. A kit is supplied with the instrument for conversion from cabinet to rack mount.

2-5. Whether the instrument is cabinet- or rack-mounted, provision should be made for adequate circulation of air around the instrument. The instrument cooling fan is located at the rear of the instrument and louvers are located on instrument side panels. Proper air circulation is most important at the sides and rear of the instrument.

CAUTION

IF FAN IS NOT OPERATING, THE INSTRUMENT SHOULD NOT BE OPERATED.

2-6. Conversion to Rack Mount

a. Remove trim strip on sides of instrument (refer to Figure 2-1).

b. Remove tilt stand by pressing two sides of stand toward center of instrument and lifting it out.

c. Remove five feet at bottom of instrument. Press button in center of each foot, slide them toward center of instrument, and lift out.

d. Place rack mounting flanges (two) where trim strips were and secure with screws provided.

e. Add filler strip to bottom of instrument.

f. Rack mounting under *severe* vibration conditions must be supplemented with additional support at rear.

2-7. Air Filter Inspection

2-8. The Model 8616A uses forced-air cooling to maintain tolerable temperature within the instrument. Incoming air is filtered through a special filter at the rear of the instrument. The air filter should be checked periodically and if dirty, cleaned. Refer to Paragraph 5-6 for air filter maintenance.

2-9. POWER REQUIREMENT

2-10. The Model 8616A can be operated from a 115 or 230V, 50 to 60 Hz source. A two-position slide switch (LINE VOLTAGE) at the rear of the instrument selects AC operation mode. The line voltage at which the instrument is set to operate appears on the slider of the switch. A 2 ampere standard fuse is used for 115V operation; a 1 ampere standard fuse is used for 230V operation.

2-11. THREE-CONDUCTOR POWER CABLE

2-12. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-13. The protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type is used to couple the ac line voltage to the instrument.

2-14. REPACKAGING FOR SHIPMENT

2-15. The following list is a general guide for repackaging an instrument for shipment. However, if you have any questions, contact your local HP field office.

a. If possible, use the original container designed for the instrument. If a carton and packing materials are desired, they can be ordered from your local HP field office.

b. The instrument is supported by four polyethylene supports fitted to the instrument height: one support located at each corner.

NOTE

If the instrument is to be shipped to the Hewlett-Packard Company for service or repair, attach to the instrument a tag identifying the instrument by owner, model, and full serial number, and indicating the service or repair to be accomplished. In any correspondence, refer to the instrument by model number and complete serial number.

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. The Model 8616A can provide 1.0 mW of leveled power across its frequency range (RF outputs leveled to within ±1.0 dB can be obtained across the band for attenuator setting of 0 dB or less). Output power can be attenuated to −127 dB. When operating unleveled, attenuation reference is the klystron power output; when operating leveled, attenuation reference is output reference setting. Internal square-wave modulation is available from 950 to 1050 Hz. External FM, AM, and pulse modulation voltages also can be used. Two or three modulation modes of operation can be applied to the instrument simultaneously; push-button controls select the mode of operation. External modulation signal inputs are located directly below the modulation to which they apply.

CAUTION

RF power in excess of approximately 125 mW should never be applied to RF power output connectors as internal damage could result.

3-3. CONTROLS AND INDICATORS

3-4. Front and rear panel controls and connectors are shown in Figure 3-1. Each control and connector is identified with a numbered call-out, and an explanation of the function, given in the accompanying text, is keyed to the call-out number.

3-5. OPERATING PROCEDURES

3-6. The operating procedures Figures 3-2 through 3-8) give step-by-step procedures for the various modes of operation. Instructions are given for obtaining the following leveled and unleveled outputs: CW, square-wave modulated (modulating voltage supplied internally, and FM, AM, and pulse-modulated (modulating voltage supplied externally). Steps of each procedure are numbered according to the sequence in which they are to be performed, and any control or connector used is identified with the number of the step in which it is used.

3-7. STABILIZED SOURCE

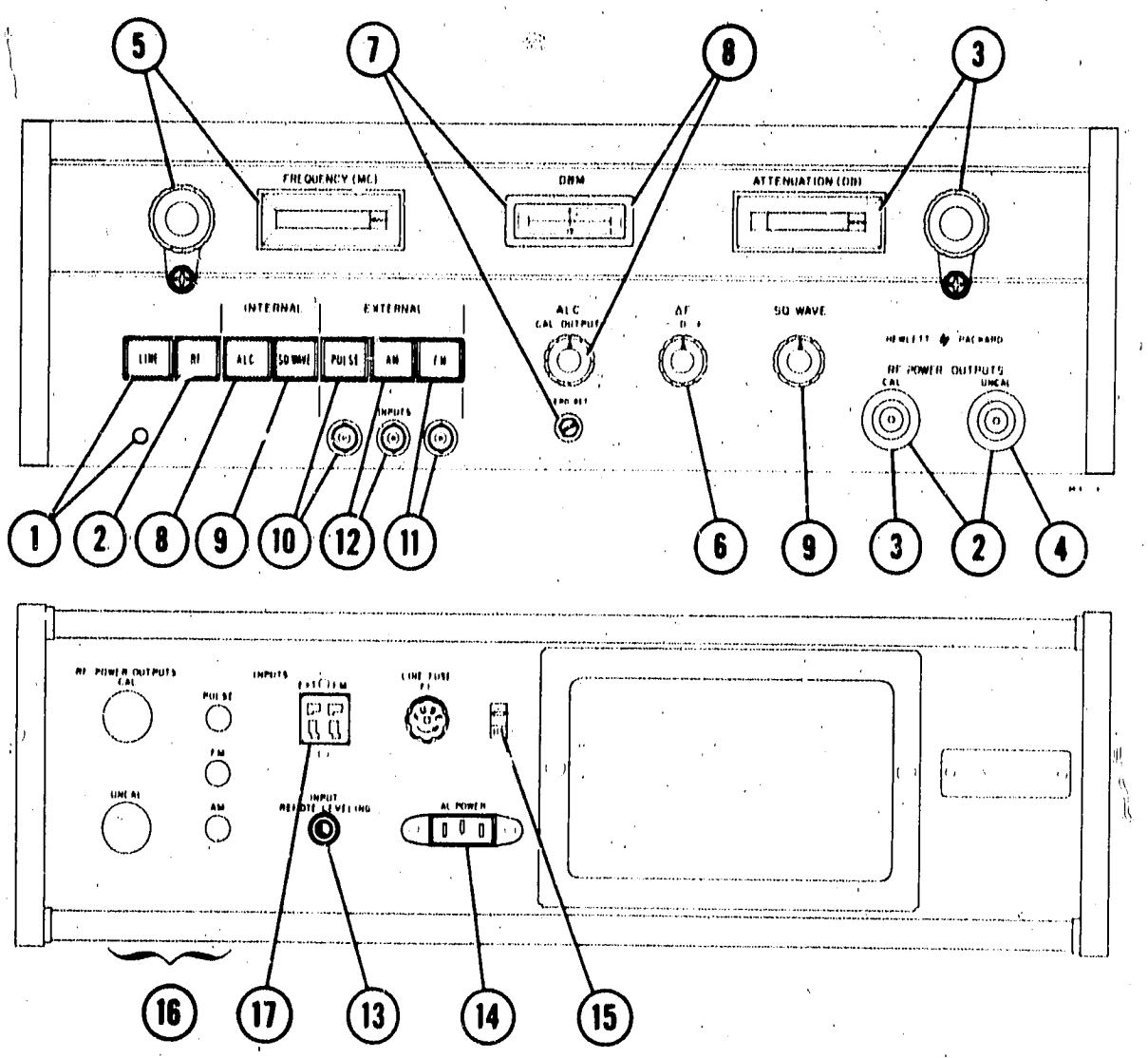
3-8. To use a 2650A (obsolete) Oscillator Synchronizer with the Signal Generator, proceed as follows:

a. The rear panel connector EXT FM (J201) is a Cinch-Jones type S304AB. Connection between this jack and J5 of the 2650A must be made as follows:

Pin 3, J201, to Pin E, J5, 2650A
Pin 4, J201, to Pin F, J5, 2650A
Pin 1, J201, to Pin G, J5, 2650A
Pin 2, J201, no connection

b. Connect RF output from UNCAL OUTPUT connector on Model 8616A to OSCILLATOR INPUT connector on Model 2650A. Depress EXTERNAL FM button on Model 8616A and proceed as explained in the instruction manual for the Model 2650.

FRONT AND REAR PANEL



1. **LINE.** Connects primary power to instrument; lamp glows.

2. **RF.** Applies power to RF POWER OUTPUTS.

3. **ATTENUATION (dB).** Sets RF power level at CAL RF POWER OUTPUT.

4. **UNCAL RF POWER OUTPUT.** Provides approximately 0.5 mW unleveled and unattenuated RF power.

5. **FREQUENCY (MHz).** Sets RF frequency.

6. **ΔF.** Permits small deviations from FREQUENCY setting (±1,5 MHz).

7. **ZERO SET.** Adjust for zero indication on dBM meter (with RF turned off).

8. **ALC.** Levels calibrated RF output; used to set a reference on dBm meter.

9. **INTERNAL SQ WAVE.** Modulates CAL RF OUTPUT. SQ WAVE control adjusts modulation frequency.

10. **EXTERNAL PULSE.** Positive pulses to external pulse input will provide modulation voltages required to pulse modulate CAL RF OUTPUT. Positive pulses turn RF ON.

11. **EXTERNAL FM.** AC voltages applied to external FM input will provide frequency modulation of both CAL and UNCAL outputs.

12. **EXTERNAL AM.** Signals applied to external AM input will provide modulation voltages required to AM modulate CAL RF OUTPUT.

13. **INPUT REMOTE LEVELING.** Input jack for external leveling loop voltage applied to level generator CAL RF POWER OUTPUT.

14. **LINE.** Male receptacle which connects to the power cord.

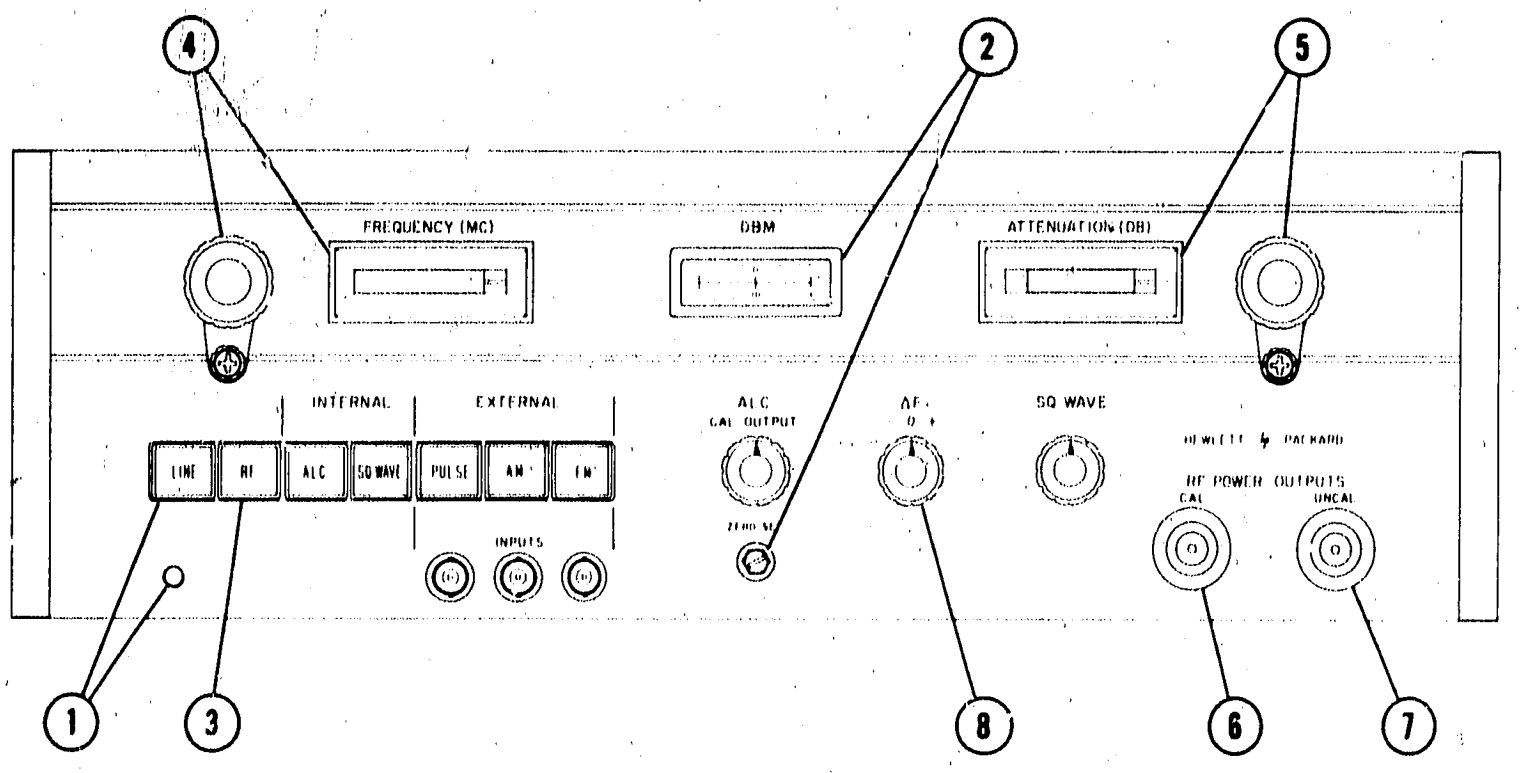
15. **LINE VOLTAGE.** Arranges input power transformer to accept either 115 or 230 volt, 50 to 60 Hz primary power input.

16. **OPTION 01.** Input and output connectors located on rear panel (input connectors also located on front panel).

17. **EXT FM:** Four terminal connector DC-coupled to klystron for stabilization of output frequency.

Figure 3-1. Front and Rear Panel Controls and Indicators

UNLEVELED RF POWER OUTPUT



1. Depress LINE.
2. Note meter pointer on dBm meter.
3. Depress RF; there should be some deflection of dBm meter pointer.

NOTE

When RF button is depressed, meter pointer will fluctuate from approximately +1 dBm at low frequency to +4 dBm or more at high frequency.

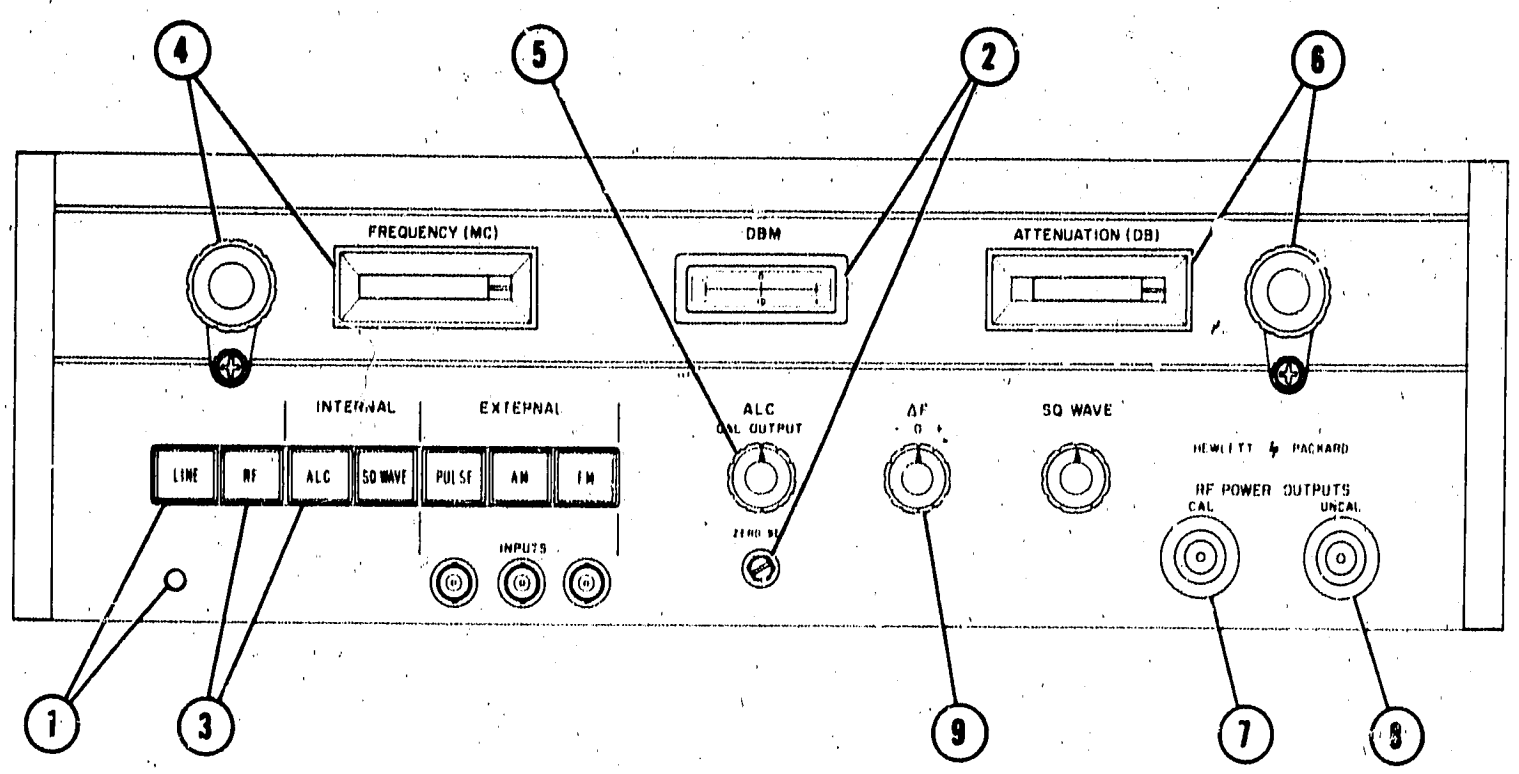
4. Set FREQUENCY (MHz) to desired frequency.
5. The ATTENUATION (dB) knob will attenuate RF power at CAL RF POWER OUTPUT.
6. Take unleveled but attenuable RF power at CAL RF POWER OUTPUT.
7. Take unleveled and unattenuable RF power at UNCAL RF POWER OUTPUT.
8. Use ΔF control when a small deviation from FREQUENCY (MHz) setting is desired.

NOTE

ΔF control should be centered when not in use.

Figure 3-2. Unleveled RF Power Output

INTERNALLY LEVELED RF OUTPUT



1. Depress LINE.
2. Check that meter pointer on dBm meter is on ZERO SET mark; if not, adjust accordingly.
3. Depress RF and INTERNAL ALC; there should be some deflection of dBm meter pointer.
4. Set FREQUENCY (MHz) low frequency.
5. Adjust ALC CAL OUTPUT control for desired dBm reference on dBm meter. The ALC system holds RF output power across the band to within ±1.0 dB for levels of 0 dBm or less. The most common reference used is −10 dBm because the attenuated RF output power can be read directly from attenuator readout. Leveled RF output power can be obtained across the band; however, ATTENUATION (dB) will not accurately calibrate above −10 dBm.

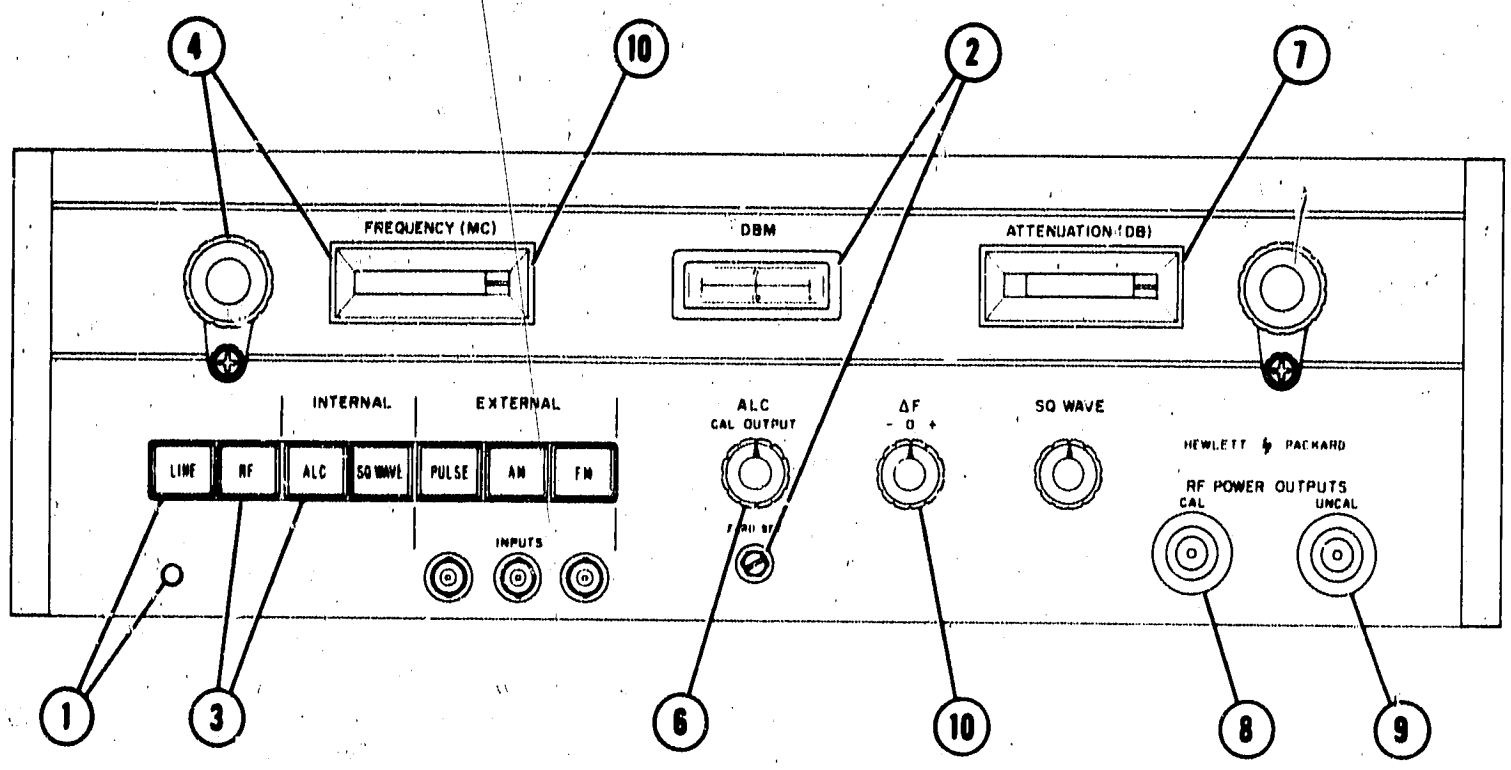
NOTE

Power may be leveled above 0 dBm over that portion of the band where the desired power is available.

6. Set ATTENUATION (dB) to desired attenuation. The RF power level at CAL RF POWER OUTPUT is the algebraic sum of the dBm meter setting and of the ATTENUATION (dB) setting.
7. Take leveled and attenuable RF power available at CAL RF POWER OUTPUT.
8. Take unleveled and unattenuable RF power at UNCAL RF POWER OUTPUT.
9. Use ΔF control when a small deviation from FREQUENCY (MHz) setting is desired.

Figure 3-3. Internally-Leveled RF Output

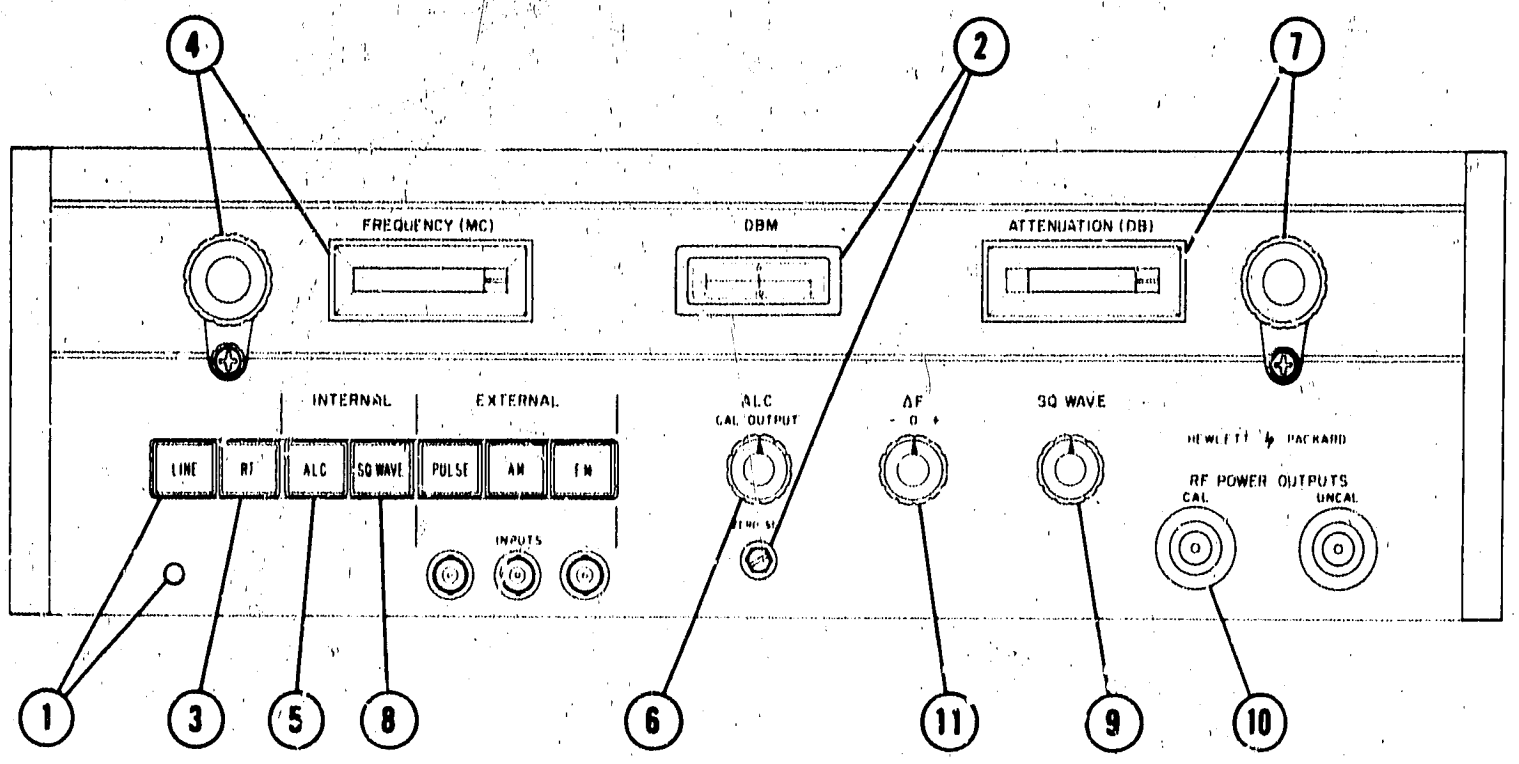
EXTERNALLY LEVELED RF POWER



1. Depress LINE.
2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF and INTERNAL ALC.
4. Set FREQUENCY for 1800 MHz.
5. With a directional coupler connected between CAL output and the load, and as close to the load as possible, sample and detect incident power and apply the detected signal to INPUT REMOTE LEVELING phone jack connection (rear panel). Approximately 40 mV but not more than 240 mV is necessary.
6. Adjust ALC CAL OUTPUT for desired reference on dBm meter. This reference point may vary from that used with internal leveling due to different detector sensitivities.
7. Adjust ATTENUATION (dB) for desired attenuation. The attenuator is not direct reading unless a 0 dBm reference has been set while monitoring with a power meter.
8. Take leveled and attenuable RF power available at CAL RF POWER OUTPUT.
9. Take unleveled and unattenuable RF power at UNCAL RF POWER OUTPUT.
10. Use ΔF control when a small deviation from FREQUENCY (MHz) setting is desired.

Figure 3-4. Externally-Leveled RF Power

INTERNAL SQUARE-WAVE MODULATION



1. Depress LINE.

NOTE

When unleveled power is to be modulated, omit steps 2, 5 and 6.

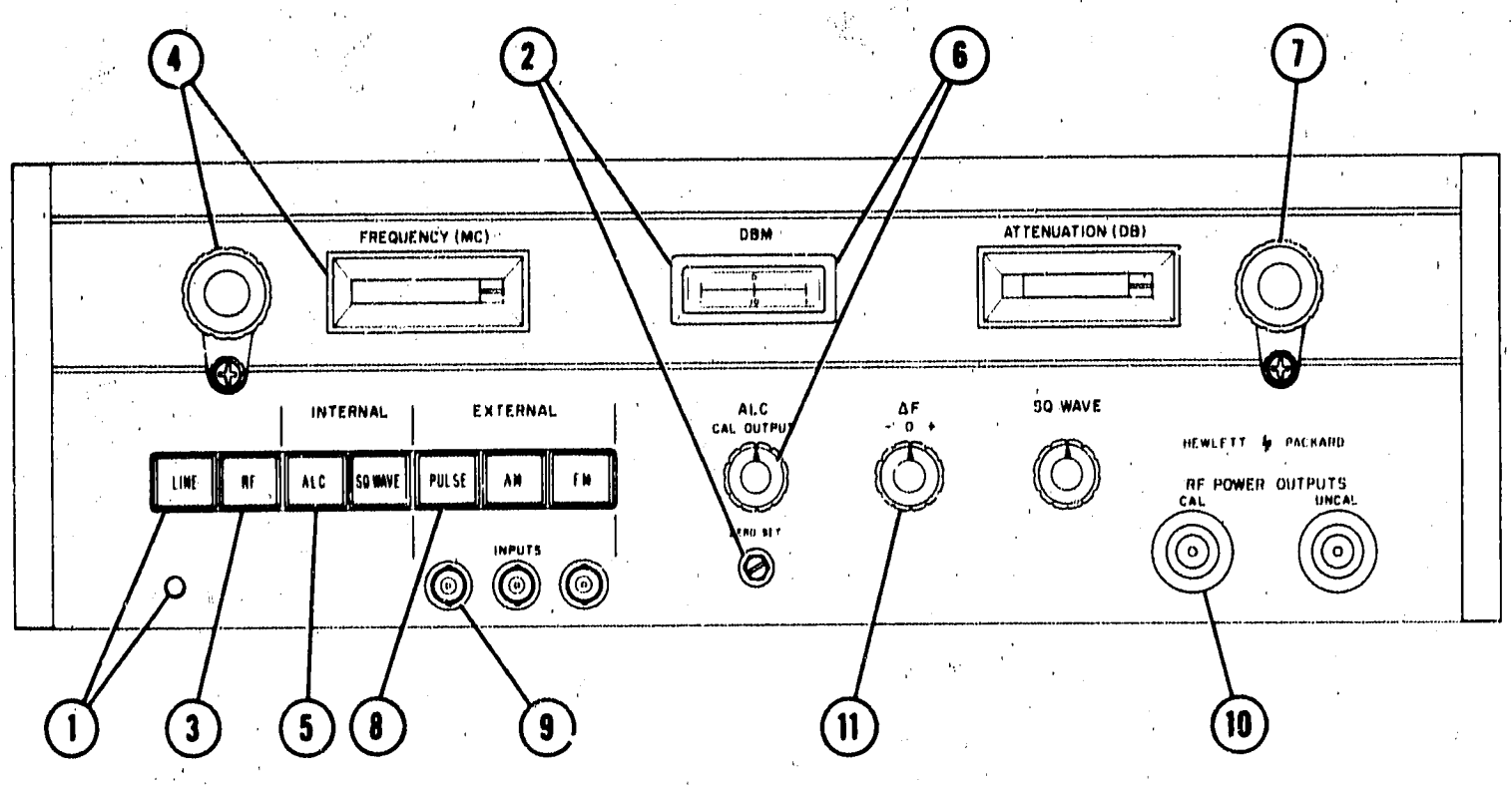
2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF.
4. Set FREQUENCY (MHz).
5. Depress INTERNAL ALC.
6. Adjust ALC CAL OUTPUT for desired dBm reference on dBm meter.
7. Set ATTENUATION dB.
8. Depress SQ. WAVE.
9. Adjust SQ WAVE for desired modulation frequency.
10. Take leveled and attenuable RF power output at CAL RF POWER OUTPUT.
11. Use ΔF control when a small deviation from FREQUENCY MHz setting is desired.

NOTE

ΔF control should be centered when not in use.

Figure 3-5. Internal Square-Wave Modulation

EXTERNAL PULSE MODUATION



1. Depress LINE.

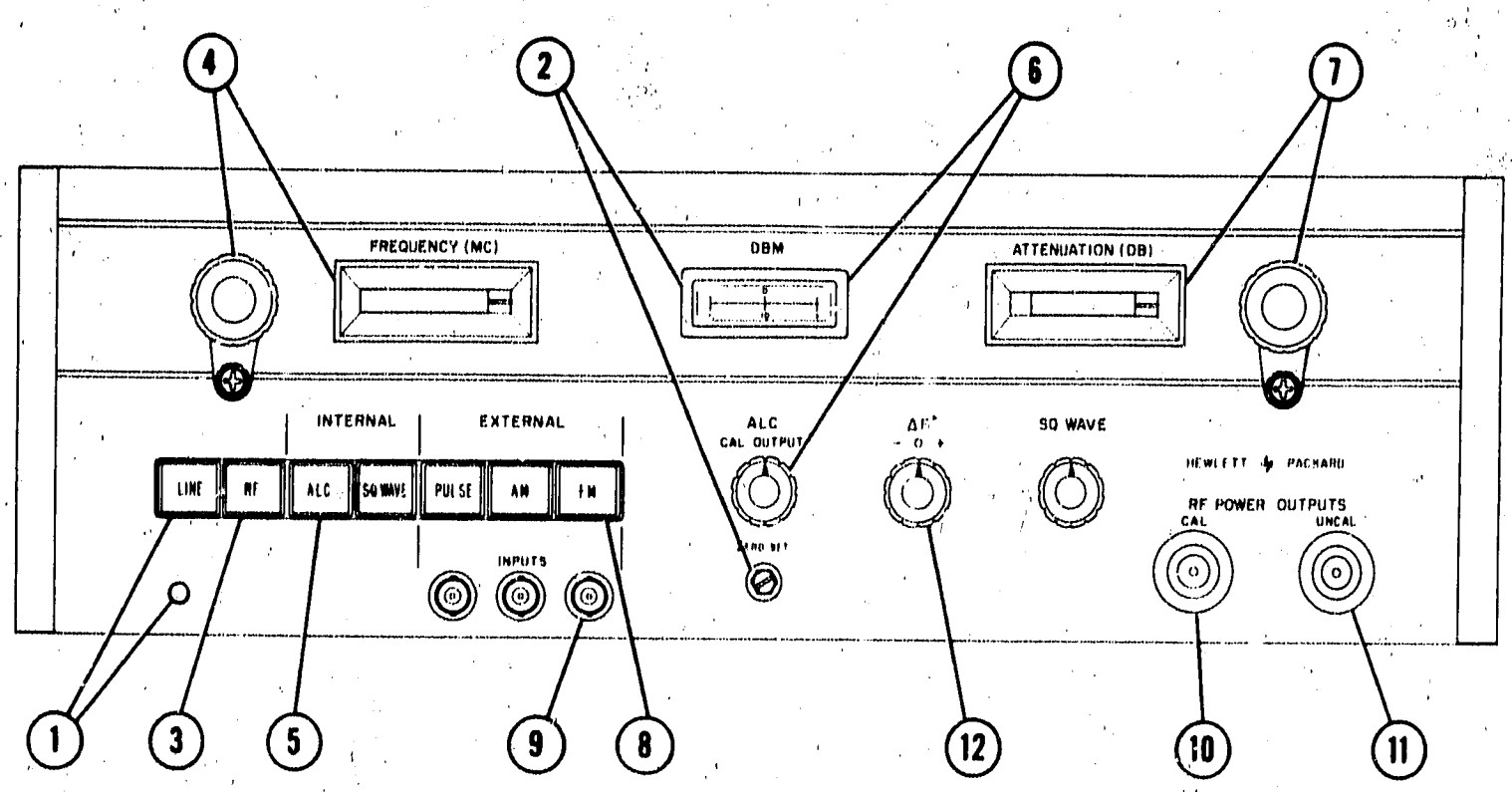
NOTE

If external pulse modulation of unleveled power is desired, omit steps 2, 5 and 6.

2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF.
4. Set FREQUENCY (MHz).
5. Depress INTERNAL ALC.
6. Adjust ALC CAL OUTPUT for desired dBm reference on dBm meter.
7. Set ATTENUATION (dB) as desired.
8. Depress EXTERNAL PULSE.
9. Apply +20 to +100V 50 Hz to 50 kHz positive pulse modulating signal to EXTERNAL PULSE INPUT.
10. Take leveled and attenuable pulse modulated RF power output at CAL RF POWER OUTPUT.
11. Use ΔF control when a small deviation from FREQUENCY (MHz) setting is desired.

Figure 3-6. External Pulse Modulation

EXTERNAL FM MODULATION



1. Depress LINE.

NOTE

If external FM modulation of unleveled power is desired, omit steps 2, 5, and 6.

2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF.
4. Set FREQUENCY (MHz).
5. Depress INTERNAL (ALC).
6. Adjust ALC CAL OUTPUT for desired dBm reference on dBm meter. The ALC system holds the RF output power across the band to within limits at frequencies up to 1 kHz provided the FM voltages are small enough to maintain operation in the center of the mode. The most common reference used is −10 dBm because the attenuator RF output power can be read directly from attenuator readout.

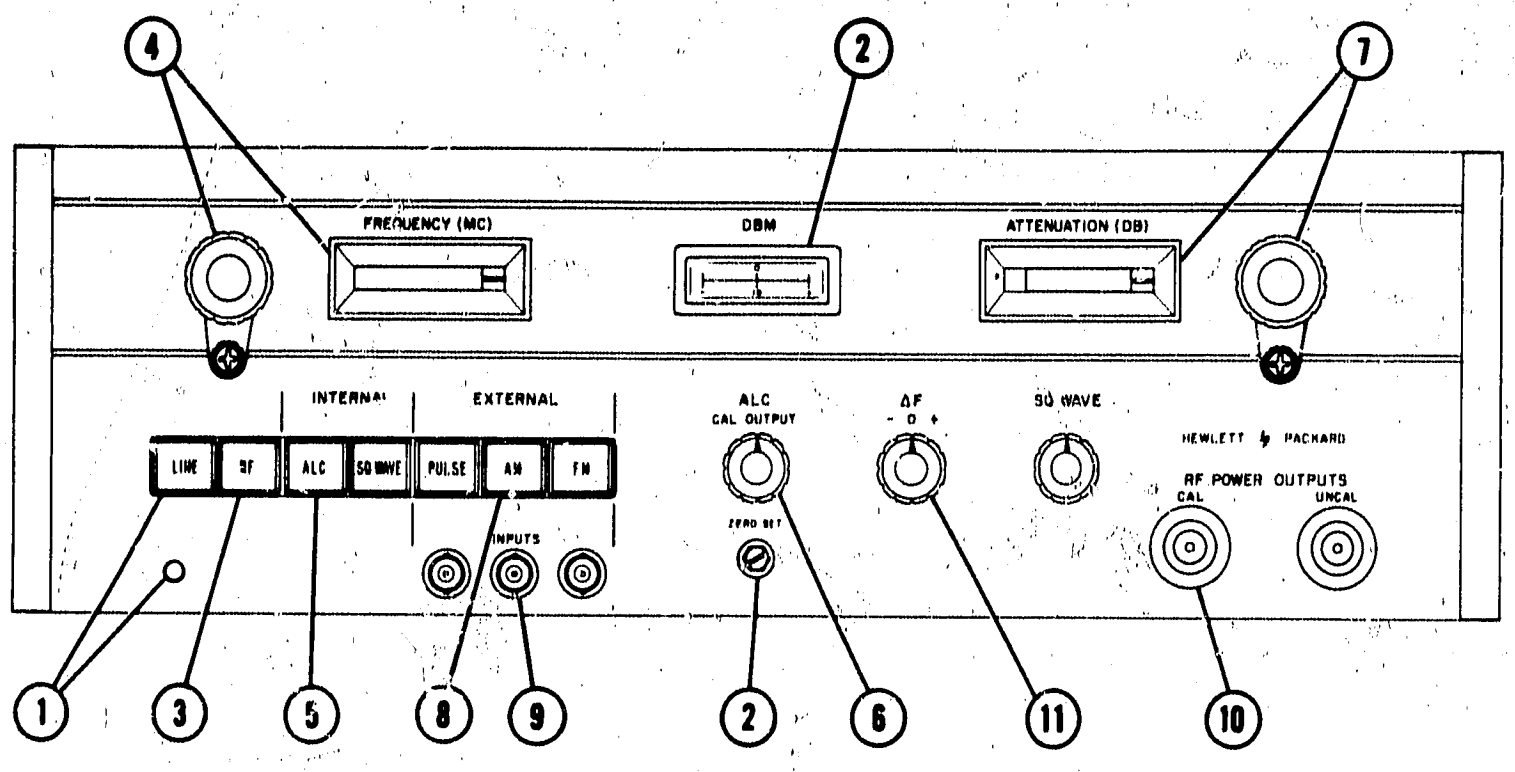
NOTE

Power may be leveled above 0 dBm over that portion of the band where the desired power is available.

7. Set ATTENUATION (dB).
8. Depress EXTERNAL FM.
9. Apply modulating signal to EXTERNAL FM INPUT (front or rear panel).
10. Take leveled and attenuable frequency modulated RF power output at CAL RF POWER OUTPUT.
11. Take unleveled FM-modulated RF power at UNCAL RF POWER OUTPUT.
12. ΔF control should be centered so that the klystron will operate in the center of the mode.

Figure 3-7. External FM Modulation

EXTERNAL AM MODULATION



1. Depress LINE.
2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF.
4. Set FREQUENCY (MHz).

NOTE

If AM modulation of unleveled power is desired, omit steps 5 and 6 and proceed to step 7. Also, unleveled power can be AM-modulated with a dc coupled audio signal.

5. Depress INTERNAL ALC.
6. Adjust ALC CAL OUTPUT control for at least 3 dB of attenuation. Due to leveling at the frequency desired, the ALC system holds the RF output power across the band to within limits except for variations due to an AM signal. The most common reference used is −3 dBm because this allows AM signal to modulate the RF above (3 dB) this level.
7. Set ATTENUATION (dB).
8. Depress EXTERNAL AM.
9. Apply AM modulating signal to EXTERNAL AM INPUT (6 volts peak-to-peak).
10. Take AM-modulated and attenuable RF power output at CAL RF POWER OUTPUT.
11. Use ΔF control when a small deviation from FREQUENCY (MHz) setting is desired.

NOTE

ΔF control should be centered when not in use.

Figure 3-8. External AM Modulation

THEORY

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. Basically the intrument includes a RF Oscillator, PIN Diode Modulator, Automatic Leveling Circuit, Modulation Circuits, and Power Supply as shown in Figure 4-1. The RF Oscillator is a reflex klystron which always operates CW. The PIN diode modulator is a current-controlled device that attenuates RF power up to 20 dB or more. The control circuits provide the modulation currents required by the PIN modulator. The power supply provides the regulated dc voltages required to operate the circuits in the instrument.

4-3. RF OSCILLATOR

4-4. The RF Oscillator, which generates the RF power, consists of a velocity-modulated tube operating in an external resonant cavity. The tube is a reflex klystron operating in the 1-3/4 and 2-3/4 modes.

4-5. The RF power output from the oscillator, which may be CW or CW with FM, is obtained from the resonant cavity by means of pickup probes located in small sections of waveguide which open into the resonant cavity. One of these probes delivers RF power directly to the UNCALIBRATED RF OUTPUT connector, the other two deliver RF power to the PIN modulator.

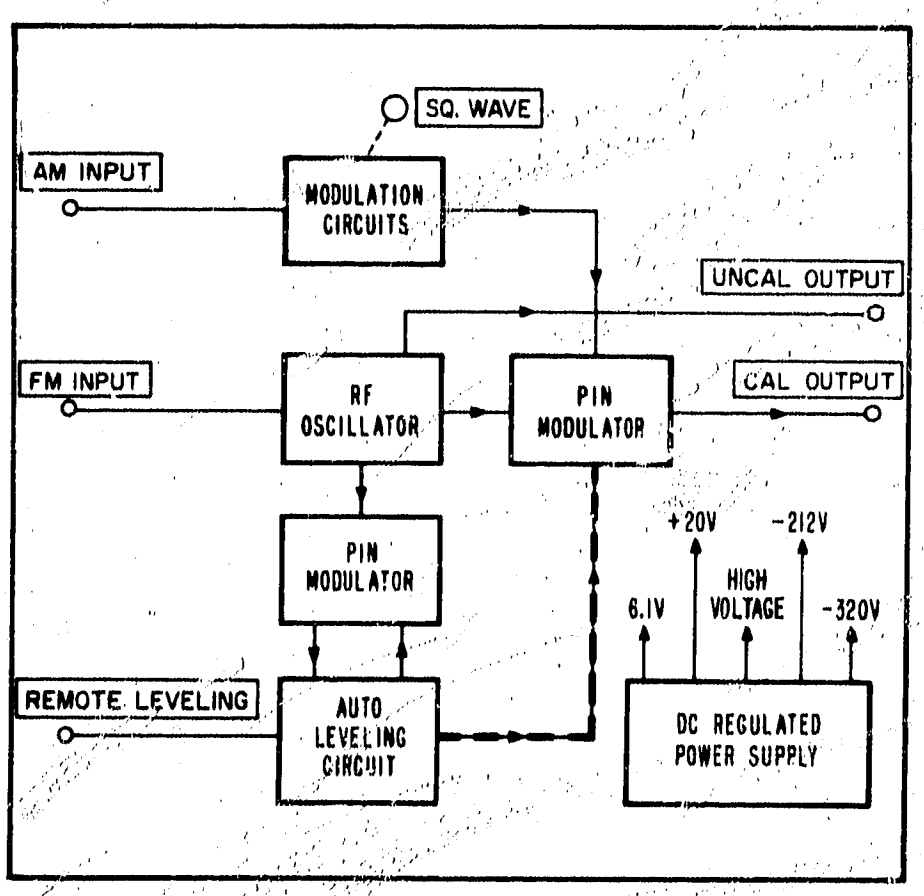


Figure 4-1. Circuit Block Diagram

4-6. PIN DIODE MODULATOR

4-7. The PIN modulator, which is two nearly identical units in one, is a high-speed, current-controlled absorption-type attenuator. One unit, the RF attenuator unit, is shown in Figure 4-3. The second unit, the ALC attenuator unit, is shown in Figure 4-4. It is a comparison unit. A simplified illustration of the modulator is shown in Figure 4-2. Each PIN diode unit includes a transmission line, PIN diodes, low-pass filter, and high-pass filters.

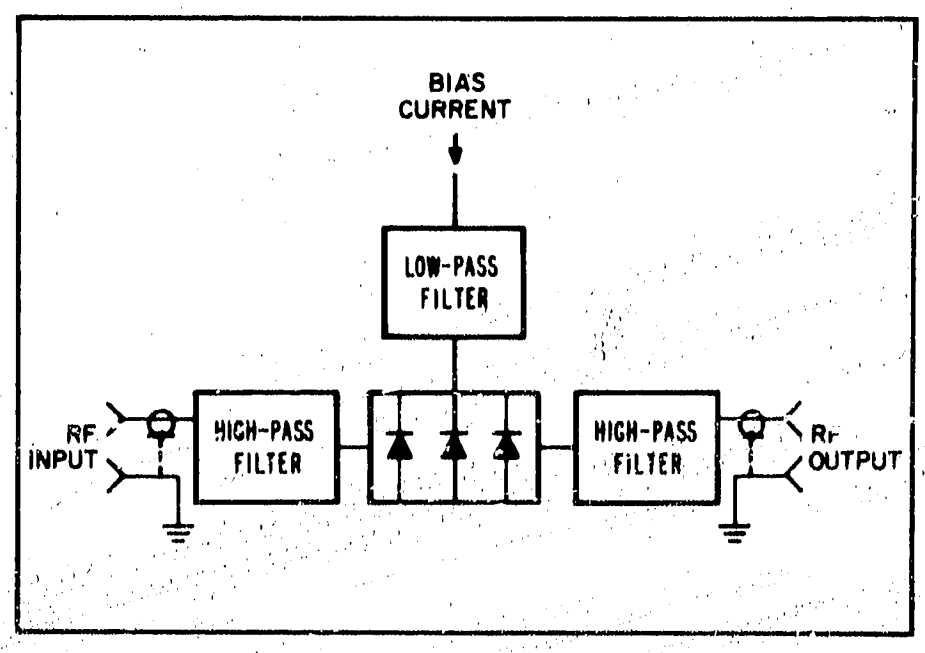


Figure 4-2. Simplified Block Diagram of PIN Modulator

4-8. The PIN diode is a slice of nearly pure silicon wafer in which the P and N traces are nearly equal. P-type impurities are diffused from one side into the wafer, and N-type impurities are diffused from the other side, leaving a layer of intrinsic semiconductor (silicon) through the middle. Thus the name, PIN diode. At frequencies below 100 MHz the PIN diode rectifies the same as any other good junction diode. However, at frequencies above 100 MHz, rectification efficiency drops rapidly because of carrier storage in the intrinsic (I) layer.

4-9. When forward-bias current flows through the PIN diode, holes and electrons are stored in the I layer. The more the bias current, the larger the amount of stored charge-carriers When reverse bias is applied, reverse current flows until the stored carriers are depleted. During this period, the diode impedance remains low. Currents above several hundred magacycles do not flow in the reverse direction for a long enough time to remove those charge carriers. So, microwave currents *do not*

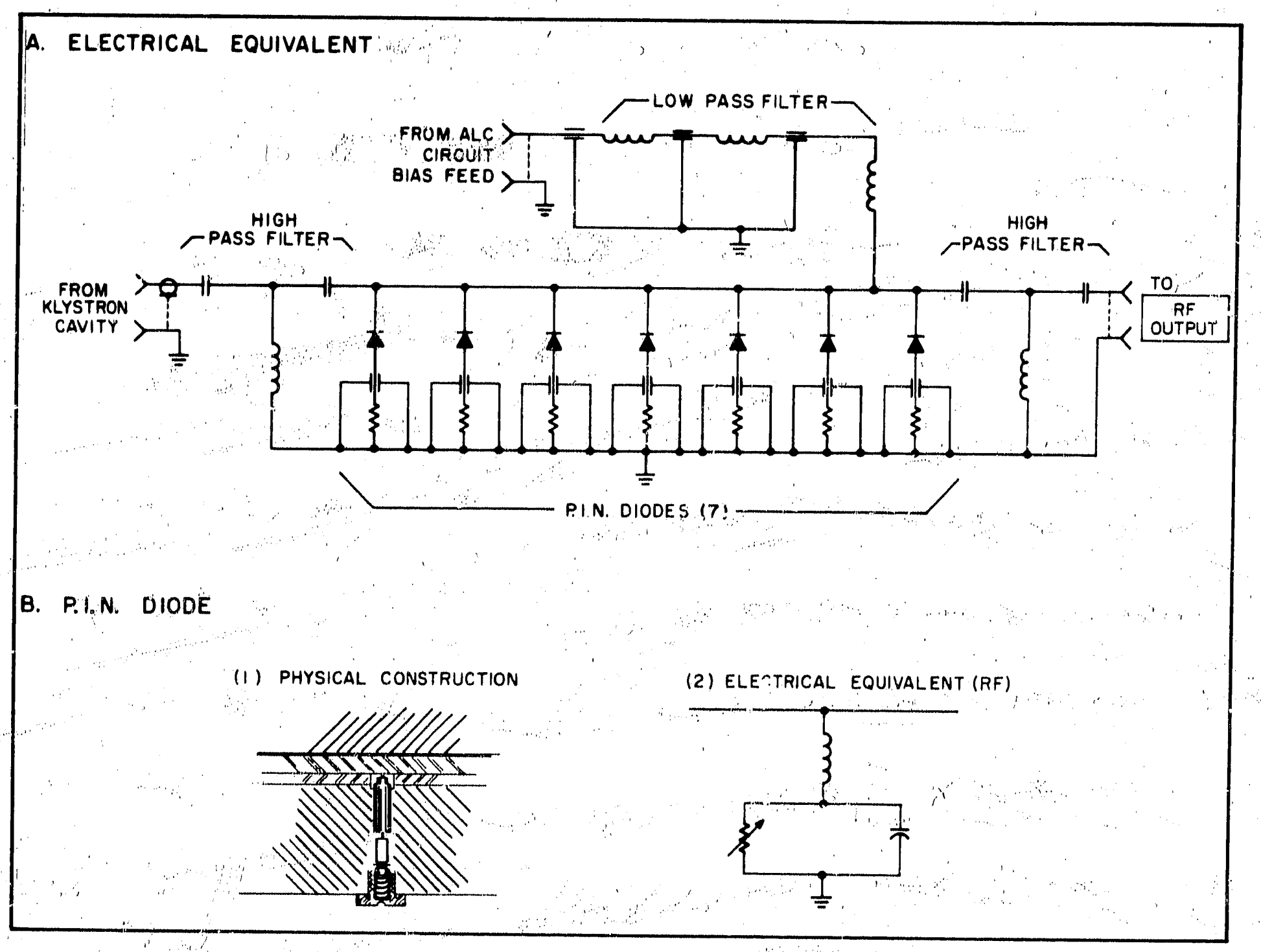


Figure 4-3. RF Attenuator Unit

significantly change the instantaneous amount of charge carriers stored, and there is negligible rectification.

4-10. There is, however, a resistance to microwave current flow. This resistance is inversely proportional to the number of charge carriers stored in the I layer, and the number of charge carriers, in turn, is proportional to the forward bias current. By varying the bias on a diode from back bias (no stored charge) to about 1/2 mA forward bias, the resistance to microwave currents varies from approximately 5000 ohms to 30 ohms.

4-11. Pin Diodes Mounted in a Transmission Line. To understand how a PIN modulator works, consider a PIN diode mounted across a transmission line that has a characteristic impedance of 50 ohms. When the diode is back-biased to about 5000 ohms, the microwave signal on the transmission line is unattenuated because 5000 ohms compared to 50-ohm line impedance has little effect. However, when the diode is forward-biased to about 30 ohms, most of the microwave current will flow through the 30-ohm diode instead of propagating down the 50-ohm transmission line. This current through the 30-ohm diode represents microwave energy dissipated as heat. Consequently the diode actually absorbs microwave energy.

4-12. Figures 4-3A and 4-4A show the schematic of the PIN diode modulator used in the Model 8616A. The PIN modulator contains seven PIN diodes which are placed at approximately 1/4 wavelength along each strip transmission line. The 1/4 wavelength at midband spacing results in the lowest average SWR because reflection from one diode will tend to be absorbed and cancelled by the adjacent diode. The resistance in series with the diodes reduces voltage to the diodes and thereby protects the circuit.

4-13. Modulation input in the form of diode bias is used to change attenuation of the PIN diodes.

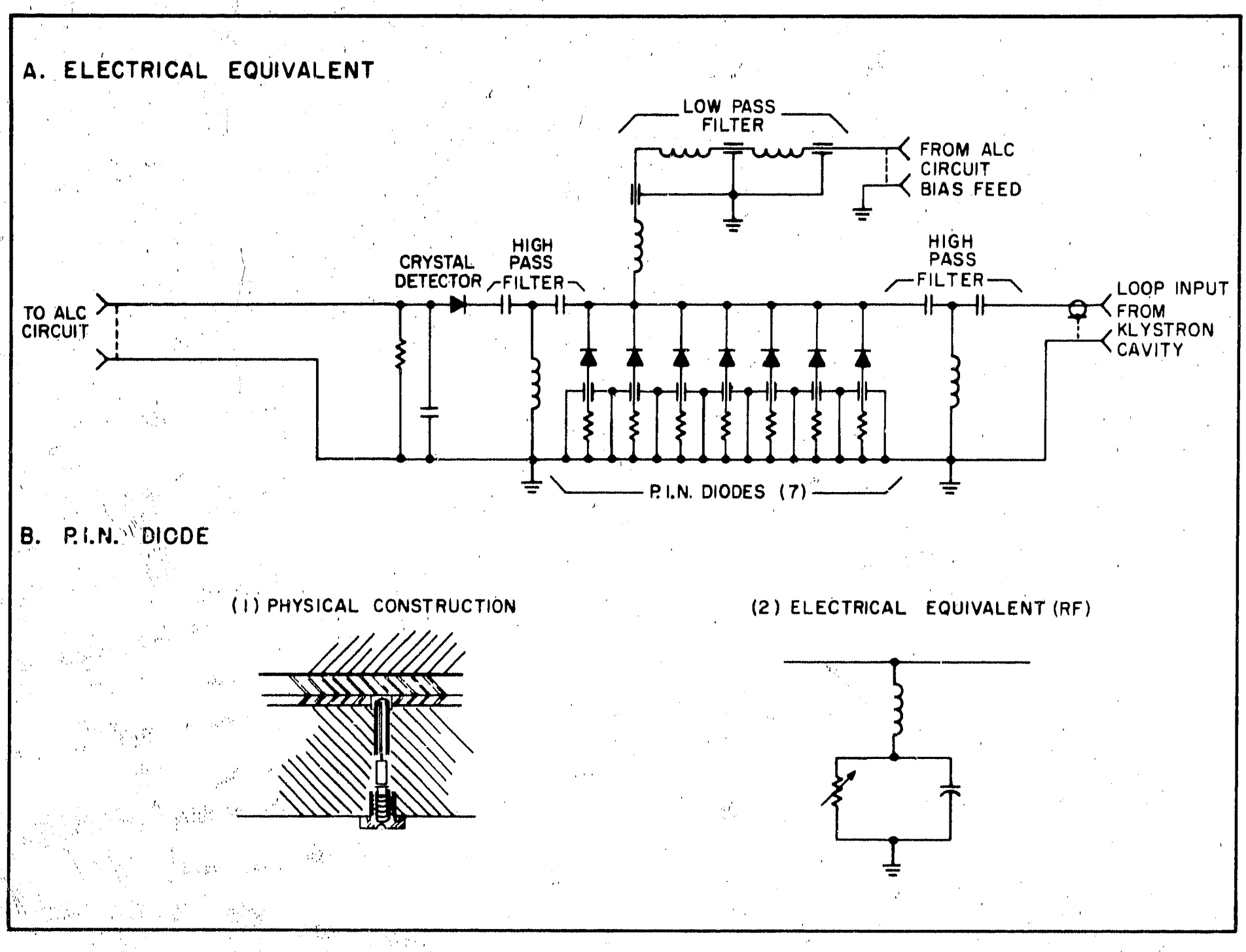


Figure 4-4. ALC Attenuator Unit

Changes in diode bias produce changes in RF output level.

4-14. Modulation circuits external to the PIN modulator are protected by a low-pass filter (Figures 4-3 and 4-4) which prevents RF leakage. Leakage, if present, could cause erratic action in the circuits driving the PIN modulator and also cause RF interference.

4-15. The high-pass filters (Figures 4-3 and 4-4) permit RF energy to enter and leave the diode strip line, while keeping the low frequency modulating signals from entering the RF circuits preceding or following the PIN modulator.

4-16. MODULATION CIRCUITS

4-17. The arrangement of the modulation circuits depends on the mode of operation. Mode of operation switching is accomplished by depressing the appropriate front-panel button.

4-18. External Pulse

4-19. A simplified diagram of the circuits used in the external pulse mode of operation is shown in Figure 4-5. When the pulse button is depressed, V401A is cut off, and V401B is conducting. The conduction of V401B draws current through the PIN diodes in the REF attenuator unit; hence, conduction of V401B forward biases the PIN diodes causing the RF output to decrease by more than 20 dB. A positive pulse applied to the external pulse input turns V401A on, turns V401B off, and allows RF power to pass through the PIN diode attenuator with the RF output level clamped to set level by CR403.

4-20. Internal Square Wave

4-21. A simplified diagram of the circuits used in the internal square wave mode of operation is shown in Figure 4-6. When V401B is conducting, capacitor C402, is discharging toward

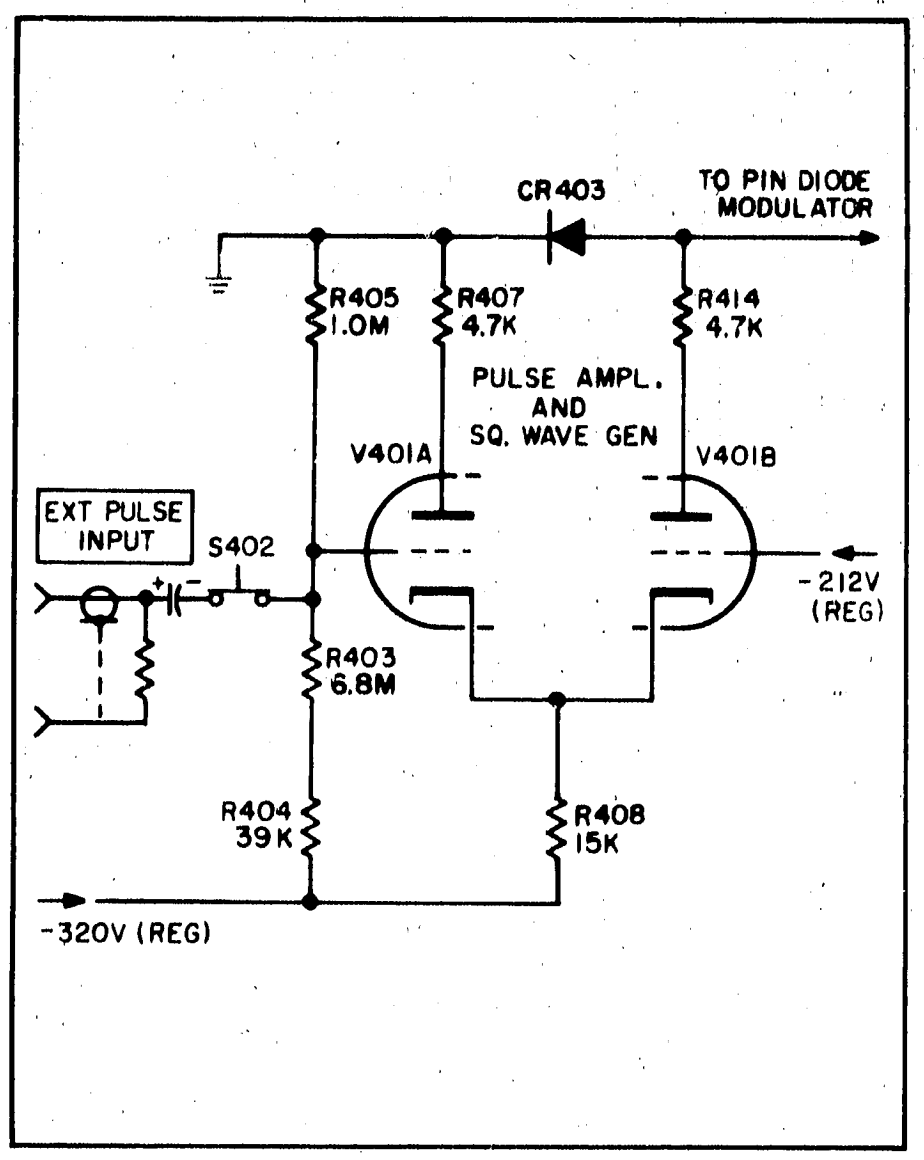


Figure 4-5. Pulse Modulation Circuit

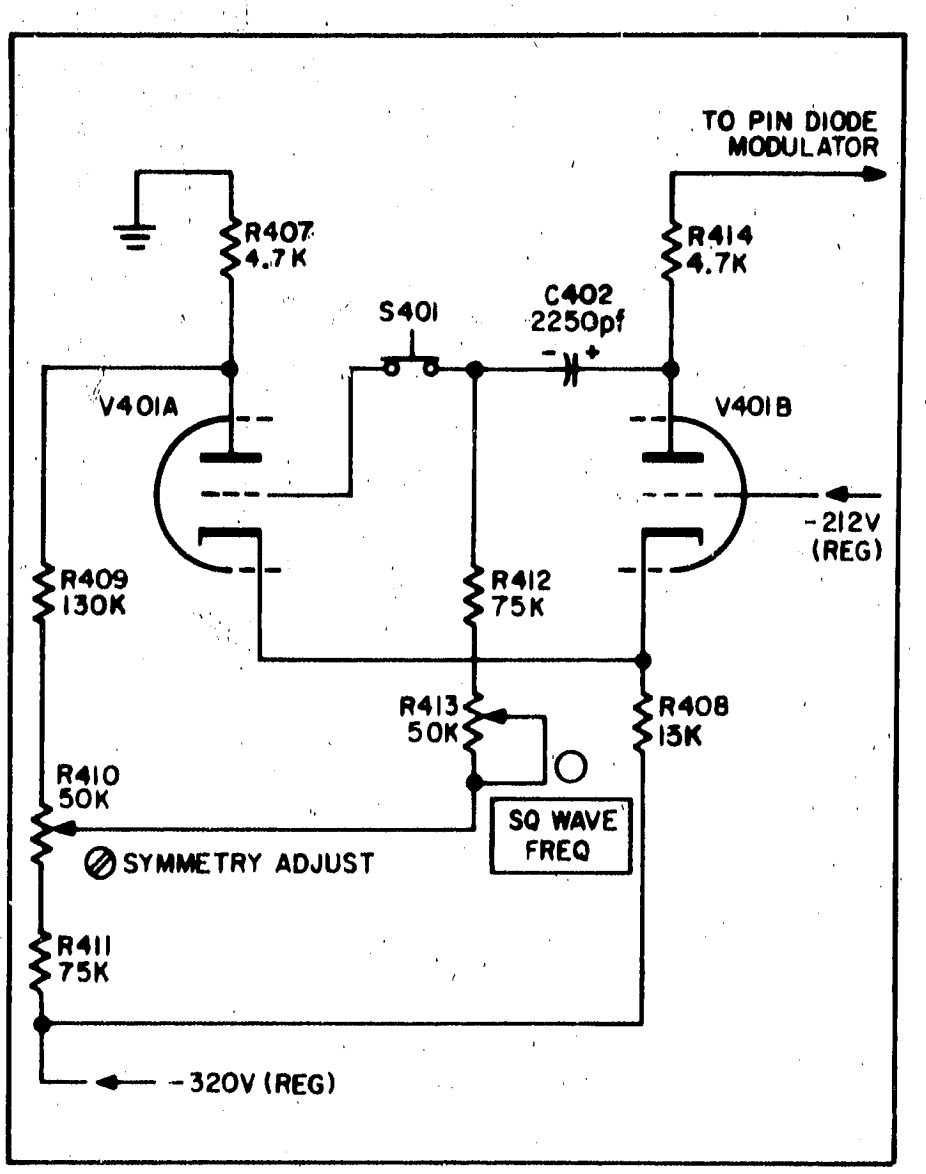


Figure 4-6. Square Wave Modulation Circuit

approximately −200 volts while holding V401A cut off. When C402 discharges sufficiently, V401A begins to conduct and biases V401B off through the common cathode resistor R408. This results in C402 charging toward approximately −225 volts as long as V401A conducts. When C402 charges sufficiently however, the current in V401A becomes limited and V401B again conducts causing V401A to cut off. The RC time constant of C402 is varied by R413, allowing frequency to be changed from 950 to 1050 Hz. When V401B is conducting the RF output is cut off by the PIN diodes. The symmetry of the sqaure wave is adjusted by R410. R410 varies the voltage difference across C402; by varying R410, the time for C402 to charge or discharge to a given potential is controlled.

4-22. External AM

4-23. A simplified diagram of the circuits used in the external AM mode of operation is shown in Figure 4-7. With the square wave and pulse modes of operation off, V401B is cut off, causing conduction of CR403 which isolates the square wave and pulse circuit from the AM input and the PIN diodes. Diode CR403 does this by clamping the voltage at the junction of R414 and CR404 at approximately +0.6 volt. This back biases CR404 providing the isolation.

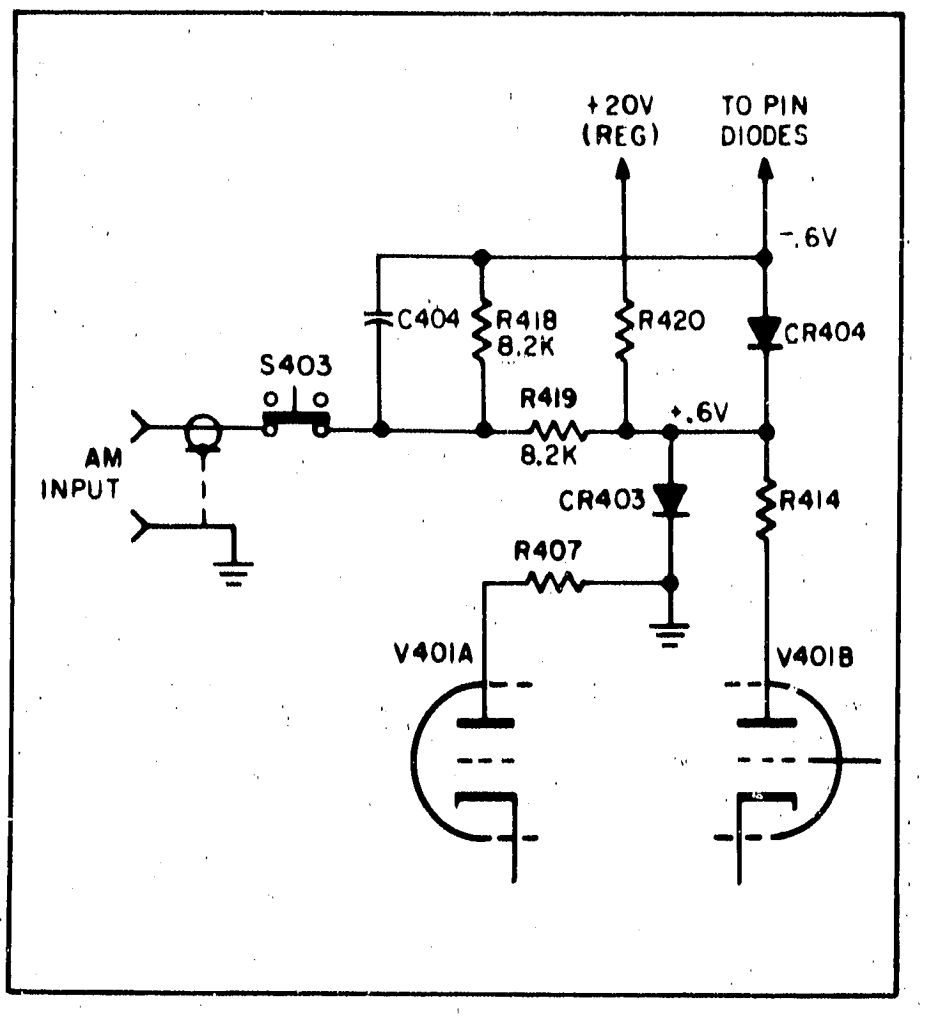


Figure 4-7. External AM Circuit

4-24. Since the PIN diode modulator is of the absorption type, it is necessary to lower the average level of the RF carrier (CW power level) by an amount equal to the peak level of the AM signal so that the peak will not be clipped. The ALC CAL adjust sets the power level of the RF carrier. The external signal then increases or decreases the attenuation to give amplitude modulation. When the external signal goes positive, it increases the RF out of the generator by reducing the current in the PIN diodes. A negative signal causes an increase in current in the PIN diodes, which causes a signal level reduction up to approximately 20 dB on the negative half cycle of the input depending on peak-to-peak amplitude of the AM signal. For most purposes this amount of signal reduction should be sufficient since it very nearly approximates 100% modulation. The amount of distortion, though small, is dependent upon the percentage of modulation: at 30% modulation the amount of distortion is almost unnoticeable; at 100% modulation the distortion may be as great as 5 to 20%.

4-25. Internal Meter and Automatic Level Control (ALC)

4-26. A simplified diagram of the ALC circuit is shown in Figure 4-8. The meter amplifier is a dual function circuit, performing both a leveling and/or a power output monitoring function. RF power is taken from the klystron cavity through the ALC attenuator assembly (part of the PIN diode modulator) and delivered to the ALC circuit. The meter amplifier monitors the power level and in leveled operation with the ALC amplifier, maintains a constant RF output.

4-27. Actual operation is as follows: RF power from the klystron is coupled from a fixed probe in the klystron cavity to the ALC attenuator (part of the PIN diode modulator). The RF power is delivered through a high-pass filter to the ALC diode attenuator, then through another high-pass filter to a crystal detector. The detected signal from CR701 is then delivered to a low-pass filter and to the ALC circuit.

4-28. The crystal detector CR701 is arranged so that the detected signal is negative in polarity. An increase in RF level as the klystron is tuned across the band will cause a more negative output. A decrease in RF power from the klystron causes a less negative output. The detected RF output level from CR701 is then delivered to the base of Q501A.

4-29. Consider the circuit operation when the RF level from the klystron increases. An increase in klystron output level causes a more negative signal on the base of Q501A. The conduction of Q501A decreases causing the collector of Q501A to go in a positive direction. The positive signal goes through

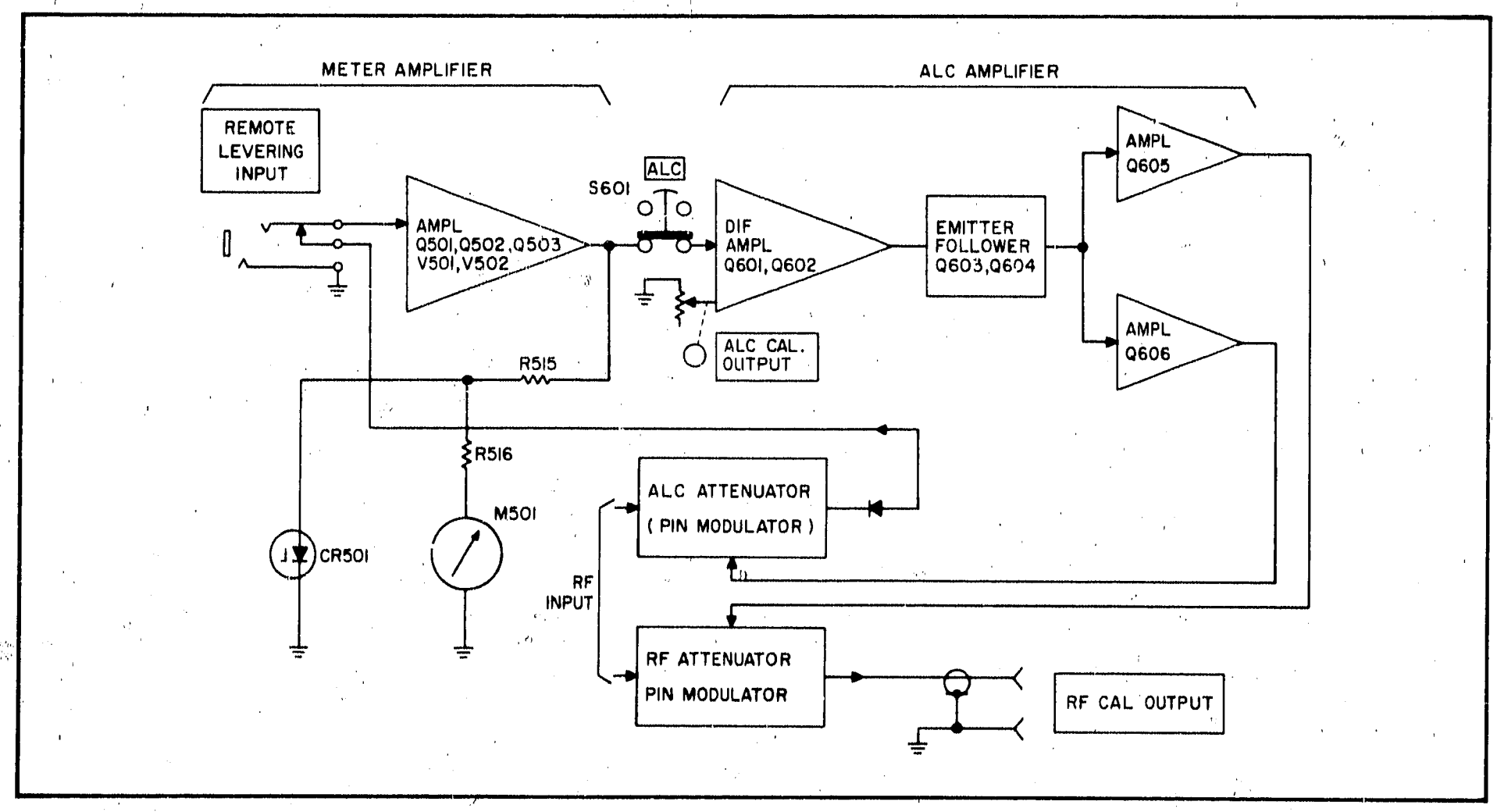


Figure 4-8. ALC and Meter Circuit

the cathode follower, V401, and is applied to the base of Q502, decreasing the conduction of Q502. The collector of Q502 goes more negative.

4-30. A portion of the negative-going signal from the collector of Q502 is applied to the base of Q501B as negative feedback. The feedback factor is determined by the ratio of R513 to R514. The open loop gain of the meter amplifier (Q501A/B, Q502 and Q503) is sufficiently high so that the closed loop gain is essentially a function of the feedback factor and is, therefore, less dependent upon the normal aging effects on the tubes and transistors in the circuit.

4-31. The negative-going signal from Q502 is also applied to the meter M501 for output indication. The meter is protected against overload by the breakdown diode CR501. If the internal ALC switch, S601, is on, the negative-going output is applied to the base of the differential amplifier, Q601, causing a decrease in conduction. The collector of Q601 will go more positive, causing an increase in conduction of the emitter followers, Q603 and Q604. This causes the emitter of Q604 to also become more positive. The positive-going signal is applied to the bases of Q605 and Q606 increasing their conduction and causing both collectors to become more negative.

4-32. The collectors of Q605 and Q606 appear as constant current sources, so the decrease in collector potential causes current to be drawn from the PIN diodes. This increased bias current (increased forward bias) reduces the RF power output to its original level. The negative-going output from Q605 is delivered to the RF PIN diode attenuator allowing less RF to pass through it also. The net result is that an increase in klystron output causes an increase of forward bias on the PIN diodes which decreases the RF output.

4-33. Leveling Accuracy. For accurate leveling, the ALC and RF pin diode attenuators must track together as far as attenuation and frequency are concerned. The adjustment of R614, R620, and R621 provide for matching the attenuator characteristics.

4-34. ALC Cal Output. The RF OUTPUT can be controlled by adjusting the front panel ALC CAL OUTPUT control which varies the bias on the base of the differential amplifier, Q602, which in turn changes the bias on the PIN diode attenuator.

4-35. External Leveling

4-36. A simplified diagram of the ALC circuit is shown in Figure 4-8. Operation of the external leveling is the same as that described for internal leveling with two exceptions. Operation of the ALC circuit is such that the ALC attenuator (part of the PIN diode modulator) will no longer be part of the circuit; therefore, since the ALC attenuator is removed from the overall circuit, the meter, M501, will indicate a RF power level but not an accurate measure of CAL RF OUTPUT power.

4-37. Regulated Power Supply

4-38. There are three regulated power supplies: high voltage, +20 volts, and filament. All three supplies are series-regulated types. The series regulator is connected in series with the main load. The output voltage is monitored and compared to a reference voltage. The voltage differential is applied through a control amplifier to the series regulator. This differential voltage changes the effective resistance of the series regulator which in turn holds the output voltage constant (see Figure 4-9).

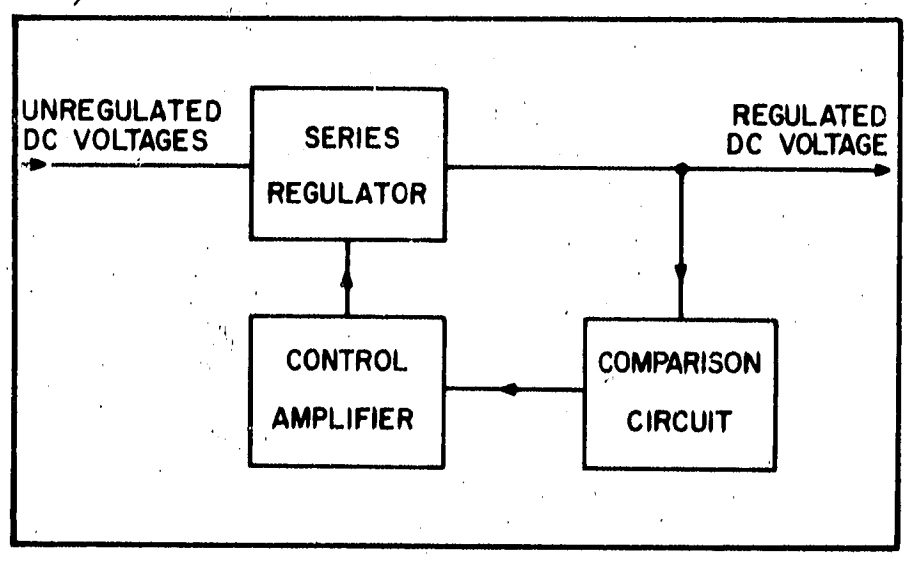


Figure 4-9. Series-Regulated Power Supply

4-39. The high-voltage supply consists of two supplies which have been combined to obtain required voltages. They are a −320 volt supply on which a −350 volt supply has been stacked to provide a total of −670 volts. Both supplies use voltage doublers to drive series regulator circuits. Since this is a combined circuit arrangement, the −320 volt and −400 volt supplies are interdependent. There is also a gas regulator tube, V105, connected to the −320 volt supply to provide a −212 volt regulated source.

4-40. There are two low-voltage supplies. One provides +20 volts DC for the ALC circuit, the

other 6.1 volts DC for filament operation. The +20 volt supply uses a voltage doubler and series regulator, while the filament supply uses a half-wave rectifier and a series regulator.

MAINTENANCE

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides maintenance and service information for the Model 8616A. Included in this section is a performance check which may be used to verify instrument operation (see Appendix II).

5-3. TEST INSTRUMENTS REQUIRED

5-4. Table 5-1 lists test equipment required for the maintenance procedures discussed in this section. Instruments other than those recommended may be used, provided performance meets the basic requirements given in Table 5-1.

5-5. PERIODIC MAINTENANCE

5-6. Cleaning the Air Filter

5-7. Inspect the air filter regularly and clean it before it becomes dirty enough to restrict air flow.

a. Remove filter from instrument rear and wash it in warm water and detergent.

b. Dry filter thoroughly and remount on instrument.

5-8. General Maintenance

5-9. Other than periodic cleaning of the air filters as mentioned above, the Model 8616A requires no special preventive maintenance. We do suggest, however, that every six months or so low pressure air be used to blow any accumulated dust out of the instrument.

5-10. Cover Removal

5-11. The Model 8616A is equipped with removable top and bottom covers. The top cover exposes wiring harnesses and the wired side of the power-supply circuit board. The power-supply board is hinged and may be opened out from the instrument when the top cover is removed. When the power-supply circuit board is opened out from the instrument, all of the adjustments and tests points are accessible. The bottom cover exposes resistor R613 and the wired side of the ALC circuit board.

a. Remove the four flathead screws from cover.

b. Slide cover back and off instrument.

5-12. TROUBLESHOOTING

5-13. The following troubleshooting procedure isolates the trouble to a stage. The procedure should be performed generally in the sequence given below.

CAUTION

When using an ohmmeter to measure transistor forward and reverse resistance, quite a bit of care must be used as almost every ohmmeter has a few ranges that supply enough current or voltage to damage a transistor. Before using any ohmmeter, measure the open-circuit voltage (open-circuit voltage of each range should not exceed 1.5 volts), and measure the short-circuit current (current of each range should not exceed 3 mA). If the open-circuit voltage and or short-circuit current exceeds 1.5 volts or 3 mA, respectively ON THE OHMMENTER RANGE THAT YOU INTEND TO USE then the ohmmeter will probably damage the transistor to be tested. For example: a DC Multimeter cannot be used on the Rx1 and Rx10 range, but all other ranges are perfectly safe.

a. POWER SUPPLIES. The high-voltage supply consists of two supplies which have been combined to obtain the required voltages. They are a −320 volt supply on which a −400 volt supply has been stacked to provide a total high voltage output of −720 volts. Both supplies use voltage doublers to drive the regulator circuits. There is also a gas regulator tube connected to the −320 volt supply to provide a −2.1 volt regulated source. There are two low-voltage supplies. One provides +20 volts DC for the ALC circuit, the other provides 6.1 volts DC for filament operation. The +20 volt supply uses voltage doublers; the 6.1 volt supply uses half-wave rectifier and transistorized series regulator circuits.

Table 5-1. Test Equipment Required

Instrument Type	Use	Critical Specifications	Recommended Instrument
Oscilloscope	Calibration check	Frequency Response: > 1 MHz Range: 50 ms/cm to 0.2 ms/cm Sensitivity: 0.05 V/cm to 1.0 V/cm Accuracy: ±3%	HP Model 1801A/1821A HP Model 180C
Crystal Detector	Calibration check	Frequency Range: 1800 to 4500 MHz Sensitivity: 100 mV/0.35 mW Frequency Response: 0.5 dB	HP Model 423A (Option 002 Load Resistor)
Power Meter	Calibration check	Power Range: 0.1 to 10 mW Frequency Range: 1800 to 4500 MHz Accuracy: ±3%	HP Model 432A Power Meter with HP Model 478A Thermistor Mount
Digital Voltmeter	Troubleshooting Power supply adj Calibration check	Range: 6.0 to 725 volts Accuracy: ±0.2% of reading	HP Model 3435A Digital DC Voltmeter
AC Voltmeter	Power supply adj	Range: 0 to 20 mV Accuracy: ±2% of reading	HP Model 3435A
Clip-On Milliammeter	Calibration check	Range: 0 to 35 mA Accuracy: ±3% ±0.15 mA	HP Model 428B
General Purpose Multimeter	Troubleshooting	Voltage Range: 140 mV to 7.5 Vdc Resistance Range: 1 to 100 MΩ Voltage Accuracy: ±1% of F.S. Resistance Accuracy: ±5% of F.S.	HP Model 3435A
Frequency Counter	Calibration check	Frequency Range: 1800 to 4500 MHz Accuracy: 0.2%	HP Model 5342A
Pulse Generator	Calibration check	Pulse Width: 3 μs Pulse Rep Rate: 50 Hz to 50 kHz Output: 20V peak	HP Model 214B
FM Modulator	Frequency tracking, preliminary	Outputs: 30 volts peak-to-peak 6.3 Vac Input: 115Vac, 60 Hz Phase Adjustable: Approx. 80°	Power Transformer 1 9100-0139 CD9 Capacitor 1 0160-0043 CD1 Potentiometer 1 2100-0134 CD7 1 2100-0047 CD1 Resistor 1 0687-1041 CD7 Fuse 1/4A 1 2100-0004 CD0 Fuseholder, extractor post type 1 1400-0084 CD1 Power Cord 1 8120-0050 CD4
Attenuator Fixed 10 dB			HP Model 8491A
Test Oscillator	Calibration check	Frequency Range: 10 kHz Output: 0.1 to 6V peak-to-peak Output Impedance: 50Ω	HP Model 654A
Modulation Analyzer	Calibration check	Carrier Frequency: 50 MHz Audio Filtering: 15 kHz Low Pass	HP Model 8901A
Mixer	Calibration check	1.8 — 4.5 GHz Double Balanced	RHG DM1-18
Signal Generator	Calibration check	1.8 — 4.5 GHz Residual FM: <2500 Hz peak in a 10 kHz bandwidth	HP 8616A

WARNING

"SOME OF THE MAINTENANCE AND SERVICING OPERATIONS DESCRIBED HEREIN ARE PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT WHILE COVERS ARE REMOVED. BE CAREFUL WHEN PERFORMING THESE OPERATIONS. 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."

(1) Remove four #6 x 32 screws from top cover and remove top cover.

(2) Open out power-supply board by removing two screws that secure board to leveler assembly.

(3) Connect ac power line to an ac power source. Set slide switch at 115 volts ac or 230 volts ac as appropriate.

(4) Connect a digital voltmeter in parallel and make the proper measurements (see Table 5-3).

CAUTION

Use grounded meter for filament and —400 volt measurement.

b. TROUBLESHOOTING LOCATION CHART. Check instrument trouble symptoms against those listed in Table 5-2, Trouble Location.

c. ISOLATING TROUBLE TO A SPECIFIC CIRCUIT. Because each mode of operation uses different circuit combinations (see Figure 5-1), trouble can be isolated to a specific circuit by checking the operation of each mode of operation in logical order.

d. ISOLATING TROUBLE TO THE PIN MODULATOR. This procedure isolates trouble to the PIN diode modulator box or to the instrument circuitry.

(1) LEVEL OUTPUT CHECK

(a) Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
ALC . . . . . not depressed
ATTENUATION 012
FREQUENCY . . . . . 1800 MHz

(b) Using a dc millivolt meter measure voltage on base of Q501A (easiest access is rear panel REMOTE LEVELING INPUT connector). Specification: reading should equal 120 ± 2 mV. If voltage is not within specification refer to paragraph 5-29 and adjust.

(c) With Model 8616A as in step a, depress ALC button and set dBm meter with ALC CAL OUTPUT adjust to 0 dBm. Using dc millivolt meter measure voltage on base of Q501A. Specification: voltage should be approximately 100 mV.

(d) Set up power meter combination for operation on the 3 mW range.

(e) Using power meter measure the CAL RF OUTPUT of the Model 8616A across the entire frequency range. Specification: Level output should be constant within ± 1.0 dB.

(f) If level output is not within specification refer to paragraph 5-28 and check and if necessary adjust klystron repeller voltages across frequency band.

(g) Also, refer to paragraph 5-33 and check and if necessary adjust the ALC Amplifier for proper operation.

(h) Recheck signal generator leveled output. If level output is still not within specification refer to Table 5-2 eliminate cause of

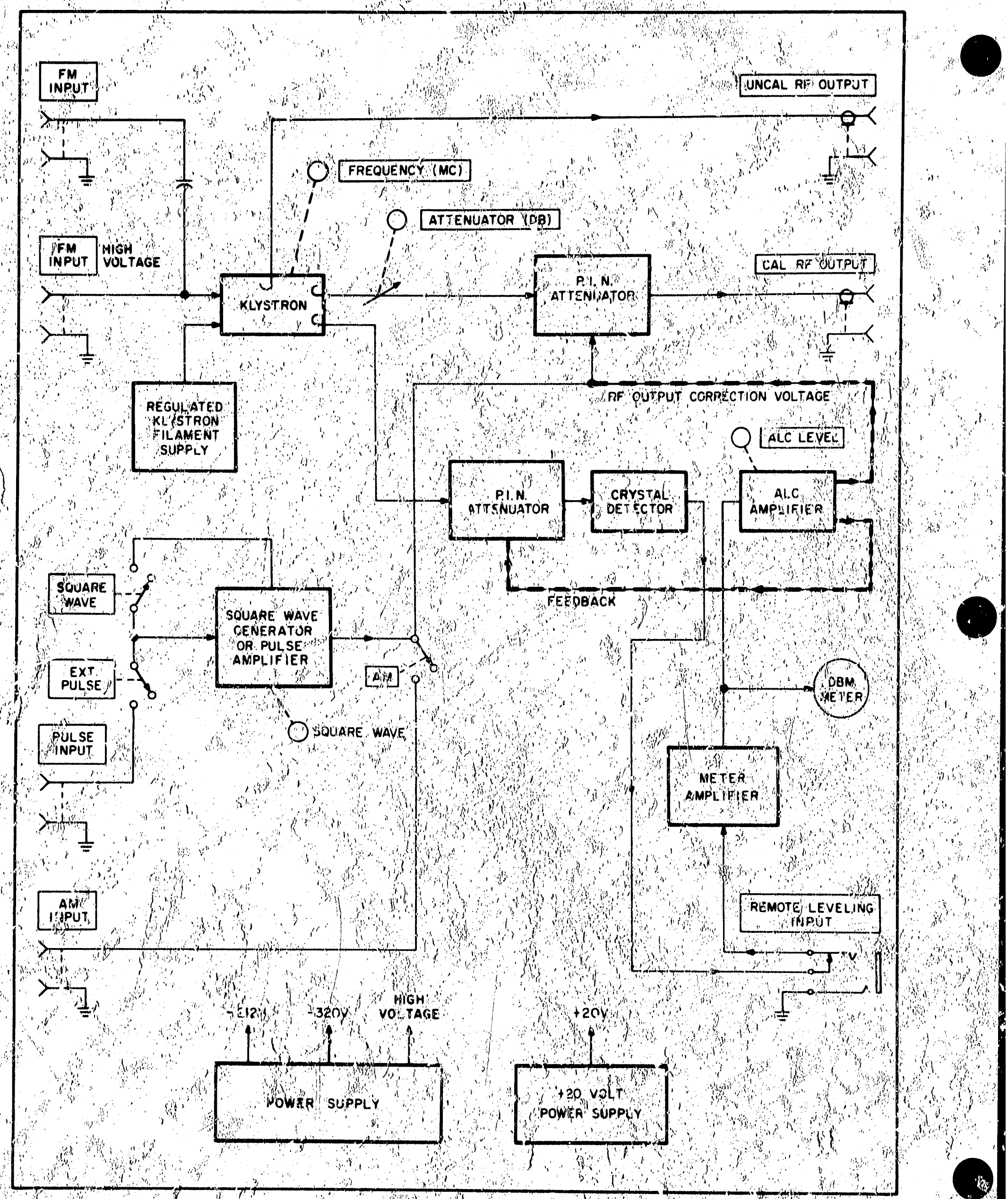


Figure 5-1. Model 8616A Block Diagram

Table 5-2. Trouble Location

Symptom (Outputs)	Trouble Location	Check
No RF	High Voltage Power Supply	V201, V202, V203, V101, V102, V103A/B, V103A/B, V104A/B
	Filament Supply	Q1, Q2, CR4, CR1
	Klystron	V1, RF PIN diodes
No Square Wave	Modulation Circuit	V401A/B
No External Pulse		CR404 open, CR403 short
No ALC	Regulated +20 volt supply	Q50, Q51, Q52, Q53
	ALC Circuit	V501, V502, V501A/B Q502, Q503, Q601, Q602, Q603, Q604, Q605, Q606, CR701 ALC PIN diodes

Table 5-3. Power Supply Adjust

Supply	Measurement Points	Adjust	Measure	Ripple
Filament	Top of R5 (brn and purple traces) to emitter of Q1 (brn traces)	R5	6.1 ± 0.1V	25 mV
−400V	Across C205	R212	−400 ±2V	3.5 mV
−320V	Positive side C205 to ground	—	320 ± 5V	6.5 mV
+20V	Positive side C53 to ground	R53	20 + 0.1V	3.5 mV

trouble to either the PIN diode modulator box or instrument circuitry.

(2) ON-OFF RATIO CHECK. Refer to paragraph 5-42.

5-14. REPAIR

5-15. The etched circuit boards used in the 8616A are of the plated-through type and consist of a base board and conductor. The board does not include funneled eyelets. The conductor material is plated to the wall of the holes and thus the conductor is effectively extended through the hole. This type of board can be soldered from either the conductor or component side of the board with equally good results. The rules given below should be followed when repairing a plated-through type etched circuit board.

a. Avoid applying excessive heat when soldering on the circuit board.

b. To remove a damaged component, clip component leads near the component, then apply heat, and remove the leads with a straight upward motion.

c. Use a special soldering iron tip to remove components having multiple connections, such as potentiometers, transformers, etc. Refer to Table 5-1 for type of soldering tip required.

d. Use a toothpick to free hole of solder before installing a new component.

5-16. KLYSTRON REMOVAL AND REPLACEMENT

5-17. Tube Removal

WARNING

BEFORE ATTEMPTING KLYSTRON REMOVAL OR REPLACEMENT, BE CERTAIN THAT LINE POWER IS COMPLETELY REMOVED FROM INSTRUMENT.

a. Remove panel cover on left (with respect to front panel) side of instrument (see Figure 5-2).

b. Set klystron frequency drive at top end (4500 MHz frequency dial setting).

c. Using truarc pliers which are available in a repair kit, HP Part No. 08614-800, remove the outer truarc ring from the outer cover of the klystron cavity (see Figure 5-2).

d. Remove outer cover. Remove inner truarc ring holding klystron clamp housing in klystron cavity.

e. Pull tube socket from klystron with a straight pull. Grasp klystron tube and remove from cavity.

f. Unscrew clamp nut, lift out clamp spacer, and remove klystron (see Figure 5-2).

g. Remove waffle washer from cavity.

NOTE

Refer to paragraph 1-13 for klystron warranty claim instructions.

5-18. Tube Replacement

a. Reassemble new klystron, housing, spacer, and nut.

b. Set klystron frequency drive at top end (high frequency dial setting) for klystron centering.

c. Place waffle washer in klystron cavity.

d. Insert klystron into klystron cavity.

CAUTION

Klystron should be inserted straight into cavity. Insertion of klystron should require no unnecessary force; the klystron should fit snugly but easily, into cavity.

e. Replace inner truarc ring on clamp housing (if the klystron is properly in place the ring will fit properly). Allow tube to be centered by center conductor.

f. Install tube socket and outer cover.

g. Place edge of truarc ring on outer cover and rotate until ring lies flat on cover and is easily accessible with truarc pliers.

h. Refer to Calibration Checks (paragraph 5-26) and make necessary adjustments.

5-19. RF PROBE REMOVAL AND REPLACEMENT

5-20. Probe Assembly Removal

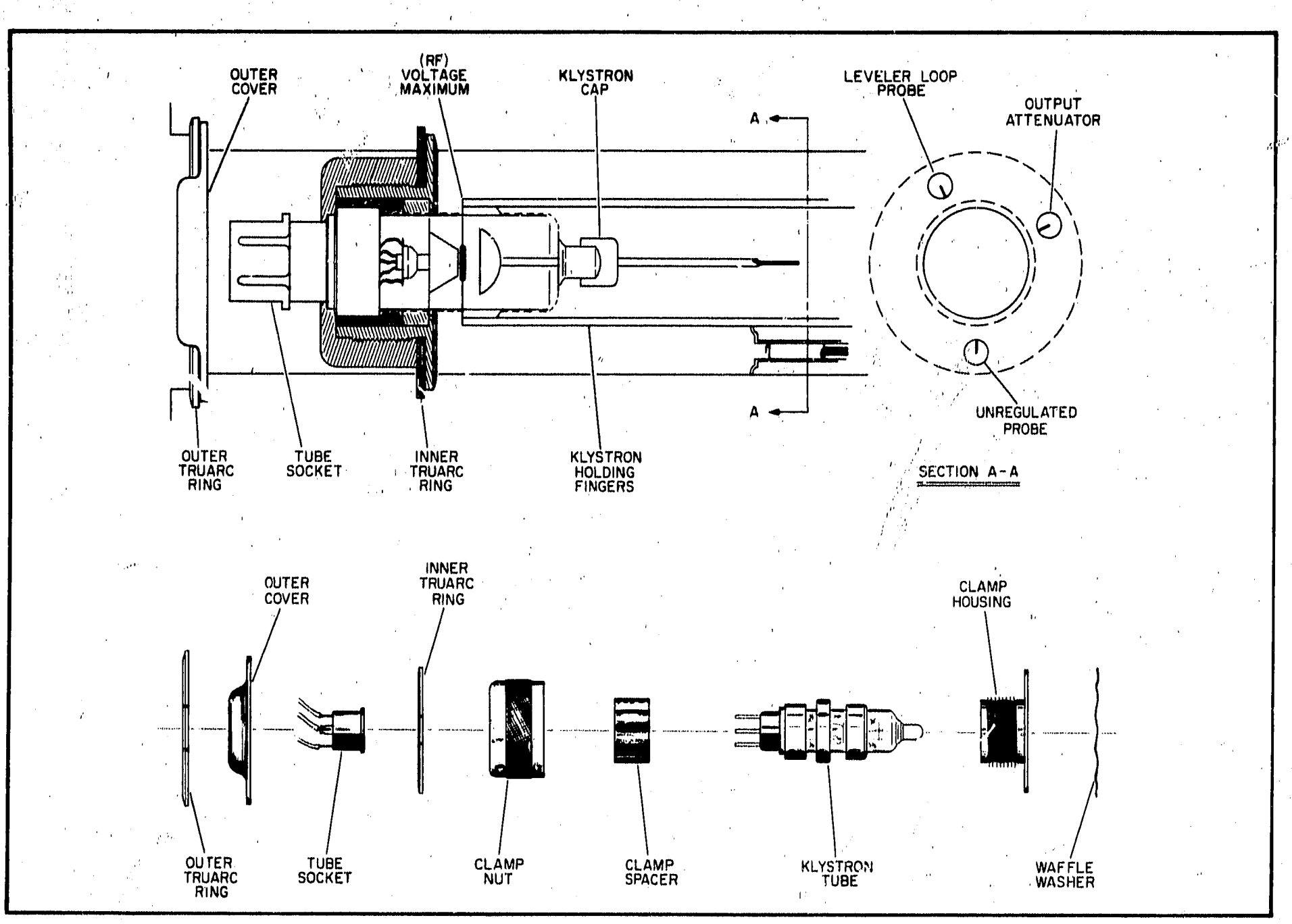


Figure 5-2. Cut-Away View of Klystron Cavity and Klystron Assembly

WARNING

BEFORE ATTEMPTING PROBE ASSEMBLY REMOVAL OR REPLACEMENT, BE CERTAIN THAT LINE POWER IS COMPLETELY REMOVED FROM INSTRUMENT.

a. Remove top cover from instrument.

b. Set FREQUENCY (MHz) drive to the highest frequency setting (4500 MHz).

c. Remove Attenuator access cover from Klystron Cavity Casting and disconnect cable assembly connectors from instrument.

d. Remove the cable assembly connector from the defective RF probe cable. Be careful not to lose any connector parts as they will be required for reassembly.

e. Remove the probe cable from the cable guide.

f. Remove the retaining screw holding the tuning carriage and remove the probe from the casting.

g. The defective probe assembly should be returned to your local Hewlett-Packard Sales and Service Office for repair or replacement (see list at rear of manual).

5-21. Probe Replacement

CAUTION

THE PROBE IS FRAGILE AND SHOULD BE HANDLED WITH CARE. THE PROBLE SHOULD BE PLACED IN A PROTECTIVE SHIELD WHEN HANDLING OR SHIPPING.

a. To install a new probe assembly, carefully insert the new probe into the Klystron Cavity Casting and replace the probe retaining screw.

CAUTION

CARE MUST BE TAKEN NOT TO DAMAGE THE RESISTIVE ELEMENT ON THE PROBE END OR THE SPRING WIPERS THAT MAKE CONTACT WITH THE PROBE GUIDE TUBE.

b. Insert the probe assembly through the cable guide. Install the cable guide.

c. Trim the insulation from the end of the probe assembly cable (for RF UNCAL probe, 5/16 inch; for RF CAL and ALC probes, 1/4 inch).

d. Place cable assembly connector parts on cable, with the exception of the clamping body, and fold the braid upon the connector assembly (see Figure 5-3).

e. Place the clamping body on the RF UNCAL cable and screw the clamp nut and clamping body together.

f. Trim the dielectric flush with the end of the clamping body so that the center conductor is bare.

g. Trim the center conductor protruding from the clamping body, then place the insulator washer on the center conductor.

NOTE

After tinning center conductor the diameter may be too large to fit into the pin, making it necessary to file the center conductor to the proper diameter.

h. In preparing the ALC and CAL RF probes, cut the inner conductor insulation about 1/8" from folded braid.

i. Flatten inner conductor to approximately 1/8" wide and 1/32" thick.

j. Tin flattened conductor with solder and allow it to wick slightly.

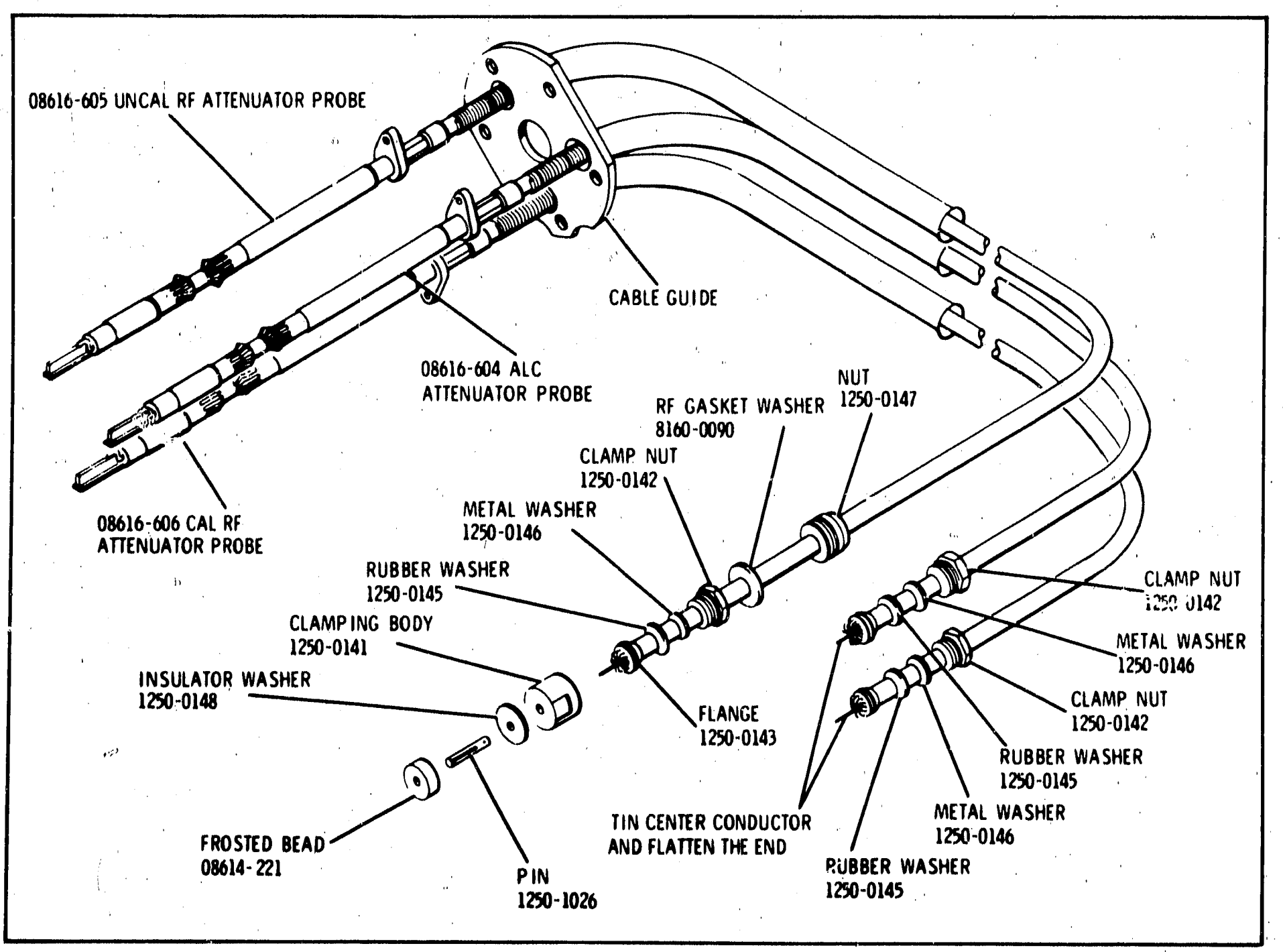


Figure 5-3. RF Probe Assembly

k. Press end of inner conductor with a file to ensure good contact and smooth insertion receptical.

l. Before connecting connector assembly into the instrument, connect an ohmmeter between the probe center conductor and ground and measure the resistance across the range of the attenuator. The resistance should be approximately 50 ohms ±5 ohms. If the probe is open or shorted at any point, the probe is defective and should be replaced.

m. Replace the connector assembly as it was before disassembly. Connect the probe connector to the instrument, making certain the center conductor makes good contact.

n. The probe installation is complete. Reassembly the instrument except for the front, right side panel, which is removed when performing the output power calibration adjustments.

5-22. PIN MODULATOR REMOVAL AND REPLACEMENT

5-23. Modulator Removal

5-24. The PIN modulator CANNOT be repaired in the field. If the PIN modulator is found to be faulty, it should be returned for repair. Remove the four screws holding the PIN modulator only. Removal of screws holding the PIN diodes in place can cause contamination of the PIN diodes, high SWR, etc.

a. Remove power line from instrument.

b. Remove top and bottom covers.

c. Place instrument on its side.

CAUTION

DO NOT HANDLE CRYSTAL DIODE, CR701 NEEDLESSLY. A static charge which builds up on a person, especially on a cold, dry day must NEVER, be allowed to discharge through element. When installing always touch casting first to insure no difference in potential between hand and casting.

d. Refer to Figure 5-14 and unsolder the lead from the capacitor. Disconnect ground lug by removing the screw. DO NOT remove diode assembly.

e. Disconnect probe cable assembly connectors from the modulator (see Figure 5-3). Be careful not to lose any disassembled parts as they will be required for reassembly. Disconnect RF OUTPUT cable J701 (see Figure 5-4) from front panel (not from modulator).

f. Disconnect ALC Bias Feed connections (1 and 2 on A500 board) from ALC circuit board.

g. Remove three screws holding PIN modulator in place.

h. Remove PIN modulator from instrument.

i. Carefully pack PIN modulator in a container and return to your local Hewlett-Packard field office for repair or replacement.

5-25. Modulator Replacement

a. Replace three screws that hold PIN modulator to instrument chassis.

b. Connect RF OUTPUT cable to J701 at front panel.

c. Connect ALC Bias Feed connections to ALC circuit board (A500).

d. Connect probe cable assembly connectors to PIN diode modulator. (See CAUTION, paragraph 5-24).

e. Resolder lead to capacitor and reinstall ground lug.

5-26. CALIBRATION

5-27. Regulated Power-Supply Adjustment

a. Remove instrument top cover and open out top circuit board (see paragraph 5-10).

b. Depress LINE button.

c. Connect ac power line to an ac power source. Set ac voltage at 115 or 230 volts as appropriate.

d. Connect DC voltmeter digital and vacuum tube voltmeter in parallel and make necessary adjustments (see Table 5-3).

CAUTION

Use ungrounded meter for filament and -400V measurement.

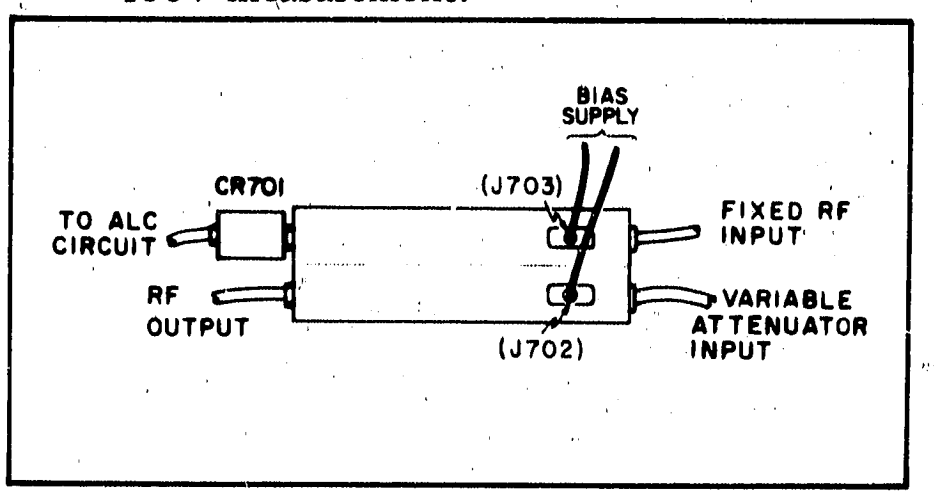


Figure 5-4. PIN Modulator (External View)

5-28. Frequency Tracking, Preliminary

a. Connect dc digital voltmeter between the klystron repeller white/purple/yellow wire coming from center conductor support rod past relay switch between PIN DIODE BOX and Klystron Cavity Casting and ground. Make sure ΔF control on front panel is set at zero (center of pot range), and proceed as indicated in Table 5-4.

Table 5-4. Klystron Repeller Voltages

Frequency Dial 8616A	Adjust	Voltage (between klystron repeller and ground)
1800	R216	-440 ± 5V
Mid-freq.		
below switch	R217	-660 ± 5V
above switch	R218	-460 ± 5V
(4500)	R219	-640 ± 5V
Note: R216 and R217 interact as do R218 and R219; therefore repeat above measurements after any adjustments.		

b. At a dial frequency of 1800 MHz set ATTENUATOR dial for a calibrated output of about 0 dBm.

c. To observe repeller modes of the klystron, a FM Modulator, with adjustable phase and amplitude controls, is necessary. Such a device is shown in Figure 5-5; it consists of a small power transformer connected with the primary and secondary windings interchanged; two potentiometers (1 MΩ and 500 kΩ); a 0.05 μF capacitor; two BNC connectors; a fuse holder, and a power cord. Connected as shown, this modulator provides a power line frequency modulation voltage continuously variable in amplitude from 300 volts peak-to-peak, with phase variable over a range of approximately 80 degrees, plus a 6.3-volt AC output for oscilloscope sweep control.

d. Apply external FM (60 cycles) and view mode patterns on oscilloscope. Adjust PHASE control of FM modulator and adjust tracking pot (R219) for mode pattern shown in Figure 5-5.

e. With Frequency Tracking adjustment completed, measure klystron beam current: Using a clip-on milliammeter, connected to wire on center feedthrough capacitor (C4), current must not exceed 30 mA.

5-29. Power Adjustment

5-30. RF Power Output Adjustment.

a. Front Panel Settings: Have ALC button released (OFF). Set ATTENUATION (dB) to 0.12 dB. Set FREQUENCY to 1800 MHz.

b. CAL RF Adjustment:

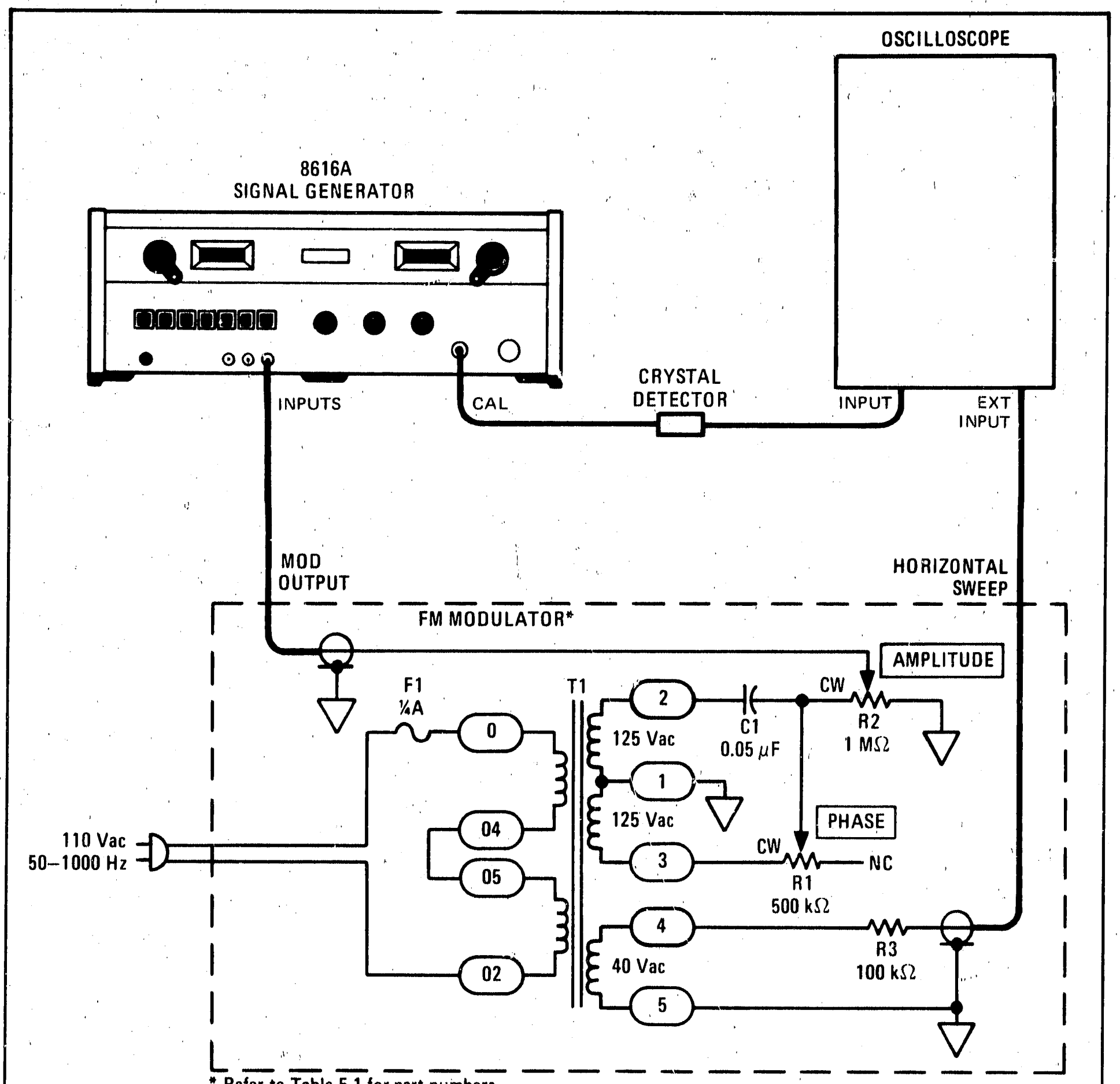
(1) With a power meter, measure the CAL RF output power. It should be −11 dBm ±0.1 dBm.

(2) If it is not, loosen the two set screws in the attenuator drive shaft bevel gear with your fingers until the output power is −11 dBm. Without disturbing the −11 dBm power setting, turn the attenuator knob on the front panel until the attenuator counter reads 012 dB. Tighten the two set screws in the bevel gear.

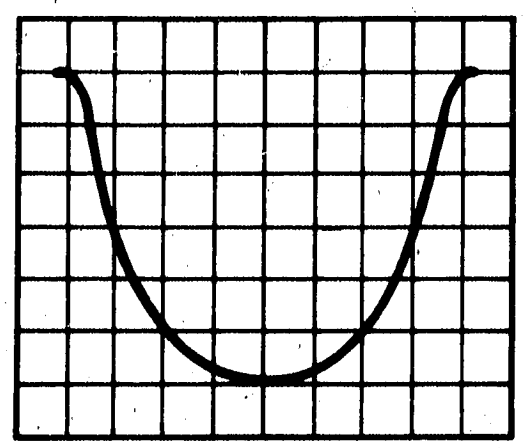
c. UNCAL RF Adjustment:

(1) Measure the UNCAL RF power output. It should be −3 dBm ±0.3 dBm.

(2) If it does not, the RF UNCAL probe requires adjustment. The front, right panel should be removed, exposing the probe assembly cable guide. Remove the screw in the cable guide that is in line with the UNCAL probe retaining screw (see Figure 5-11). Insert a long Allen wrench through the hole left by removing the cable guide screw into the UNCAL probe retaining screw. Turn the retaining screw to adjust the UNCAL probe



* Refer to Table 5-1 for part numbers.



2400 MHz
R219

WARNING

HIGH VOLTAGES ARE PRESENT ON THE FUSE, TRANSFORMER TERMINALS, AND THE POTENTIOMETER OF THE FM MODULATOR. THE ENERGY AVAILABLE AT THESE POINTS AND AT POINTS WITHIN THE SIGNAL GENERATOR MAY RESULT IN PERSONAL INJURY OR DEATH WHEN CONTACTED.

Figure 5-5. Frequency Tracking Setup

penetration for −3 dBm ±0.3 dBm output.

d. ALC Adjustment:

(1) With a dc voltmeter (HP Model 412A) measure the dc voltage at the output of the CR701 crystal diode, or the base of Q501A.

CAUTION

DO NOT USE A DIGITAL VOLTMETER WITH AUTO-RANGING AS IT MIGHT DAMAGE THE CRYSTAL DIODE.

(2) The dc voltage should be 120 mV ±2 mV.

(3) If it is not, the ALC attenuator probe requires adjustment. The front, right side panel should be removed, exposing the probe assembly cable guide. Remove the screw in the cable guide that is in line with the ALC probe retaining screw (see Figure 5-13). Insert a long Allen wrench through the hole left by removing the cable guide screw into the ALC probe retaining screw. Turn the retaining screw to adjust the ALC probe penetration for 120 mV ±2 mV at the ALC crystal output.

5-31. Meter Amplifier

a. Turn off RF power. Zero front panel meter with front panel ZERO SET.

b. Depress RF button and measure meter amplifier output voltage (junction of R515 and C502). This voltage must be −6.4 ±0.3V at 1800 MHz. This corresponds to a gain of 53 ±2.

c. Front panel meter should read ±1.2 ±0.2 dBm.

5-32. Frequency Tracking, Final

a. Use a frequency meter to measure the actual frequency at dial settings of 1800 and 4000 MHz. To eliminate backlash error, always approach frequency settings in the same direction.

b. The difference in frequency meter readings for Model 8616A dial settings should be 2200 MHz.

c. Refer to graph, Figure 5-6. The horizontal axis represents the measured frequency change from step b, the vertical axis indicates the dial corrective setting. For example, if the difference between dial settings (step b) is 2177 MHz, the corrective setting for the dial as found on the graph is 1805 MHz. To make the corrective setting, set the frequency dial to 1800 MHz, loosen the two setscrews that clamp the dial plunger to the rack, shift the dial to 1805 MHz, and then tighten the two setscrews.

d. If any plunger adjustment was necessary (step c), repeat Frequency Tracking, Preliminary Adjustments (paragraph 5-28). Repeat this procedure until rotation from low to high frequency corresponds to a change of 2200 MHz ±6 MHz.

e. Set actual frequency to 1800 MHz. Loosen spur gear on counter shaft and rotate gear until frequency dial reads approximately 1801.5 MHz.

f. Check FREQUENCY (MHz) dial settings at both upper and lower ends of dial travel. The respective dial end points should be less than 1800 MHz and greater than 4500 MHz. If dial travel is not satisfactory then loosen bevel gear on frequency drive shaft and reset dial.

g. Check microswitch action: The microswitch should energize and de-energize at about (2988 to 3012 MHz). If microswitch does not switch at the proper dial settings then the microswitch cam (located on underside of cavity casting) should be repositioned.

Table 5-5. Klystron Probe Adjust

Probe for	Measuring Point	Instrument	Reading
ALC	CR701 or base of Q501A	Multimeter	120 ±2 mV
Cal Pwr	Front panel connector	Power meter	−11 ±0.1 dBm
Uncal Pwr	Front panel connector	Power meter	−3 ±0.3 dBm

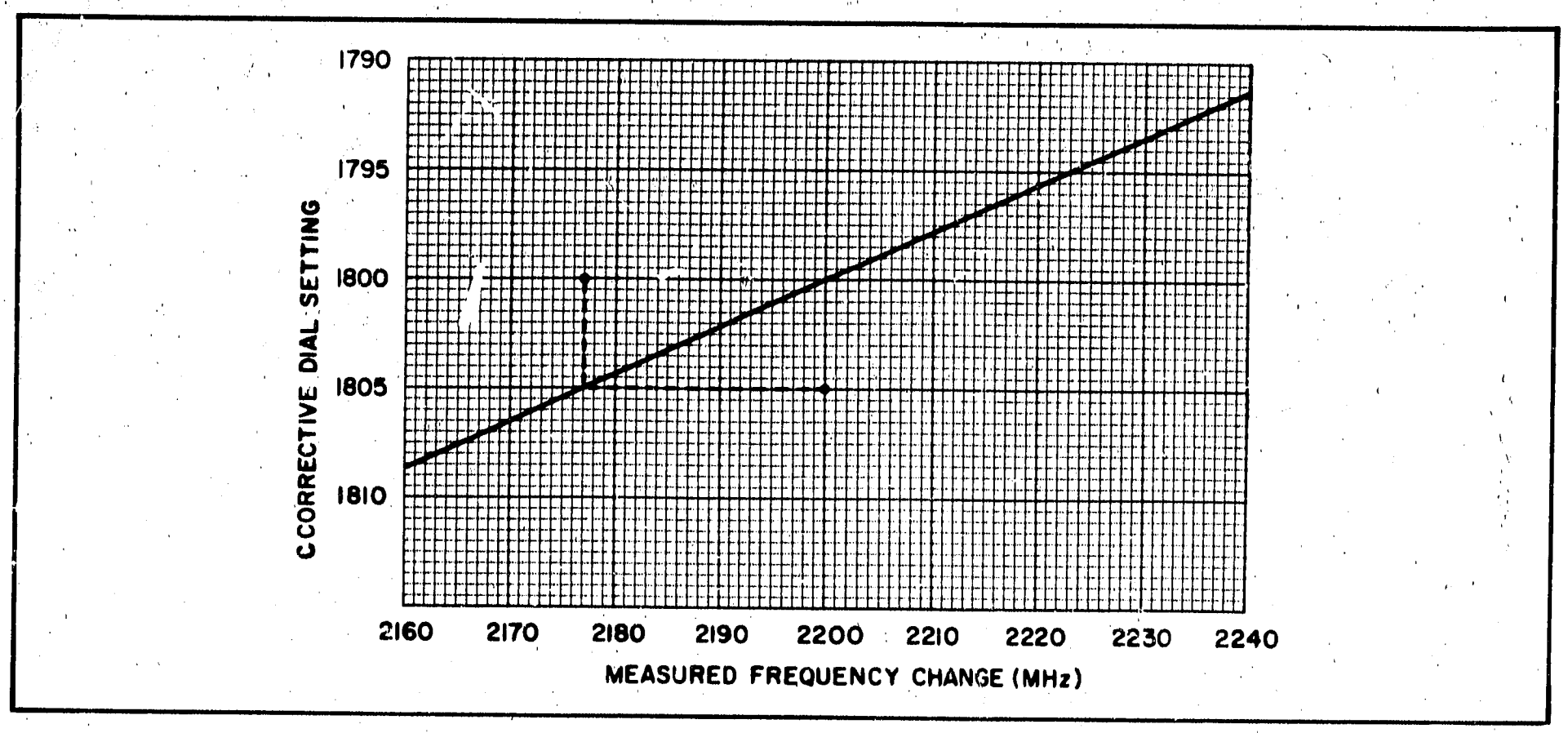


Figure 5-6. Frequency Tracking

h. Being careful to approach all dial settings from the same (either clockwise or counterclockwise) direction, using the procedure given in paragraph 5-38, check the accuracy of the frequency dial by approaching all dial settings from a clockwise direction and then from a counterclockwise direction.

NOTE

The Frequency Meter used must be calibrated to an accuracy of approximately (±0.07%).

i. If frequency dial reading errors are greater than ±10 MHz then shifting the dial may bring all errors within specification. If shifting dial will not sufficiently correct errors then it may be necessary to shift the position of center conductor support rod (see Figure 5-11). The center is held in place by a notched captive screw at the end closest to the right side of the instrument which must be loosen to allow center conductor adjustment "in" or "out" of the klystron cavity. Notch or scratch center conductor rod so that original position may always be known. If overall frequency dial was positive, adjust center conductor toward right side of instrument. When adjusting center conductor position never change by more than about 20 thousandths of an inch at a time.

NOTE

A dial reading of 1800.5 MHz when the actual frequency was 1800 MHz is a positive error.

j. If any adjustment of instrument was necessary repeat entire check and adjustment procedure until no adjustment is required.

5-33. ALC Amplifier

a. Set FREQUENCY (MHz) to 1800 MHz and ATTENUATION (dB) of 012.

b. Depress ALC button and set front panel dBm meter to 0 dBm by means of ALC CAL OUTPUT knob.

c. Track ALC amplifier at CAL RF OUTPUT and adjust as indicated in Table 5-6; use a power meter and a thermistor mount.

Table 5-6. ALC Amplifier Adjust

Frequency	Adjust	Calibration Power Output
Low freq.	R614	−12 ± 0.2 dBm
Mid-freq. below switch	R621	−12 ± 0.2 dBm
Mid-freq. above switch	R615	−12 ± 0.2 dBm
High freq.	R620	−12 ± 0.2 dBm
Note: R614 and R621 interact as do R615 and R620. To simplify the adjustment, overcorrect with pot for frequency indicated, then backoff with interacting pot. For example, the reading at 2900 MHz (below microswitch) is −10 dBm. Adjust R621 for −13 dBm, then adjust R614 for −12 dBm at 2900 MHz.		

5-34. Pulse Modulation Adjust

a. Depress PULSE button and apply an externally-generated 20V, 3 μsec positive pulse to the front panel pulse BNC input.

b. Adjust R404 so that the input pulse is just sufficient to completely pulse modulate the CAL RF output power. This condition is achieved when the ON side of the detected pulse begins to exhibit a flatness.

5-35. Square-Wave Adjust

a. Depress SQ WAVE button and display detected square wave output from CAL RF OUTPUT on an oscilloscope.

b. Adjust R410 for best symmetry at 1000 ±50 Hz.

NOTE

The value of C402 may be 2250 pF, 2676 pF, or 3000 pF depending upon which value will give the instrument square wave frequency range needed.

5-35A. AM Adjust

a. Check AM operation at 50 Hz (see paragraph 5-45).

b. If AM waveform is not satisfactory, change value of C404 by approximately 10 pF and recheck operation.

NOTE

Typically, undistorted AM operation is achieved with either a 30 or a 39-pF capacitor.

5-36. PERFORMANCE CHECKS

5-37. The performance check procedures are used to check the instrument against its specifications. All checks are made from the front panel, thus the instrument panels need not be removed. The procedure is useful in incoming or outgoing quality control check, periodic maintenance, or after-repair check. Performance checks are given in paragraphs 5-38 and 5-46.

5-38. Frequency Range and Accuracy

a. Connect instrument as shown in Figure 5-7.

b. Set up Model 8616A as follows:

LINE ..... depressed
RF ..... depressed
ATTENUATION ..... 0 dBm

c. Set power meter for a mid-scale reading at an 1800 MHz dial indication on the Model 8616A.

d. Set frequency meter to approximately 1800 MHz and note actual signal frequency.

e. Repeat above procedure every 100 MHz to a frequency dial indication of 4500 MHz.

f. Frequency range of Model 8616A should be 1800 to 4500 MHz, accuracy of dial indication should be ±10 MHz.

5-39. ΔF Control Check

a. Connect instrument as shown in Figure 5-7.

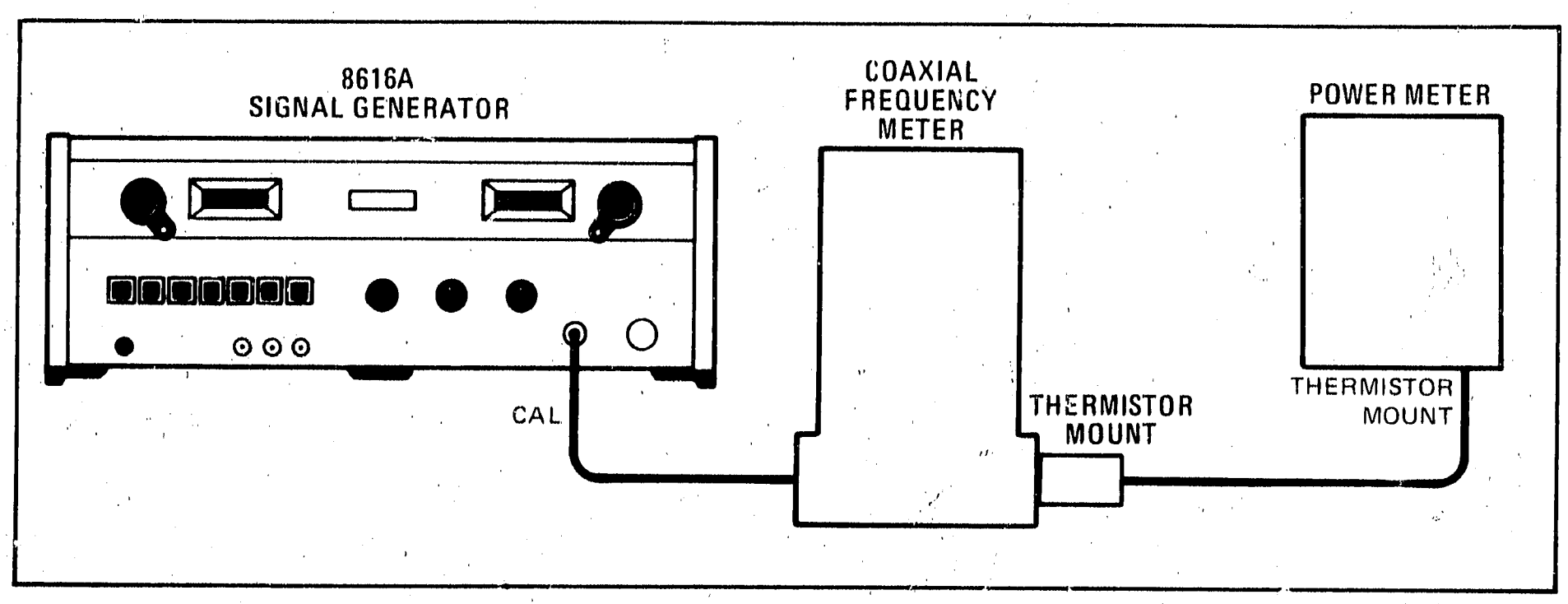


Figure 5-7. Frequency and Power Measurement

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
FREQUENCY . . . frequencies of interest

c. Set power meter for a mid-scale reading.

d. Turn ΔF control fully counterclockwise and measure output frequency with power meter and frequency meter.

e. Turn ΔF control fully clockwise and measure output frequency.

f. The difference between the readings, steps d and e, should be at least 1.0 MHz.

5-40. Power Output Check

a. Connect instruments as shown in Figure 5-7, omitting the frequency meter.

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
FREQUENCY . . . frequencies of interest
ALC . . . . . not depressed

c. Power output at UNCAL RF OUTPUT should be at least 0.5 mW.

d. Maximum power output at CAL RF OUTPUT should be at least 2 mW (2990 to 4500 MHz), or 10 mW (1800 to 2990 MHz).

5-41. Leveled Output Check

a. Connect instruments as shown in Figure 5-7, omitting the frequency meter.

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
FREQUENCY . . . . . 1800 MHz
ALC . . . . . depressed
ALC CAL OUTPUT . . . counterclockwise

NOTE

Before ALC button is depressed, dBm meter should indicate approximately +1 dBm; depressing ALC button should cause dBm meter indication to decrease. ALC CAL OUTPUT: 0 dBm (dBm meter indication); ATTENUATOR (dB): —0 dB or less.

c. Set power meter for convenient mid-scale reading.

d. Noting power meter variation from setting (step c), tune Model 8616A across frequency band. The variation should not exceed ±1.0 dB.

5-42. Pin Diode On-Off Ratio

a. Connect instruments as shown in Figure 5-7, omitting the frequency meter.

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
FREQUENCY . . . . . mid-frequency
EXTERNAL PULSE . . . . not depressed
ATTENUATION . . . . . +9 dB
ALC . . . . . not depressed

c. Set power meter on +10 dBm scale and adjust Model 8616A ATTENUATION control for convenient reference.

d. Depress EXTERNAL PULSE on Model 8616A.

e. Reference on the power meter should change to the —10 dBm scale. Specification: On-off ratio must be at least 20 dB.

f. If the on-off ratio is not 20 dB or greater, the PIN modulator may be defective. Check bias current through R414 and R420: the current through R414 should be approximately 6 mA, and the current through R420 should be 3 mA. If these bias currents are correct, the modulator is defective (refer to paragraph 5-22) or CR403 shorted.

5-43. Internal Square-Wave Check

a. Connect instruments as shown in Figure 5-8.

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
INTERNAL SQ WAVE . . . . . depressed
ATTENUATION . . . . . 0 dB
SQ WAVE . . . . . fully counterclockwise

c. Set oscilloscope sweep time to .1 MHz/cm.

d. Readjust rate control to display one complete square wave on oscilloscope. Square wave symmetry should be better than 45/55%. Range should be 950 to 1050 Hz.

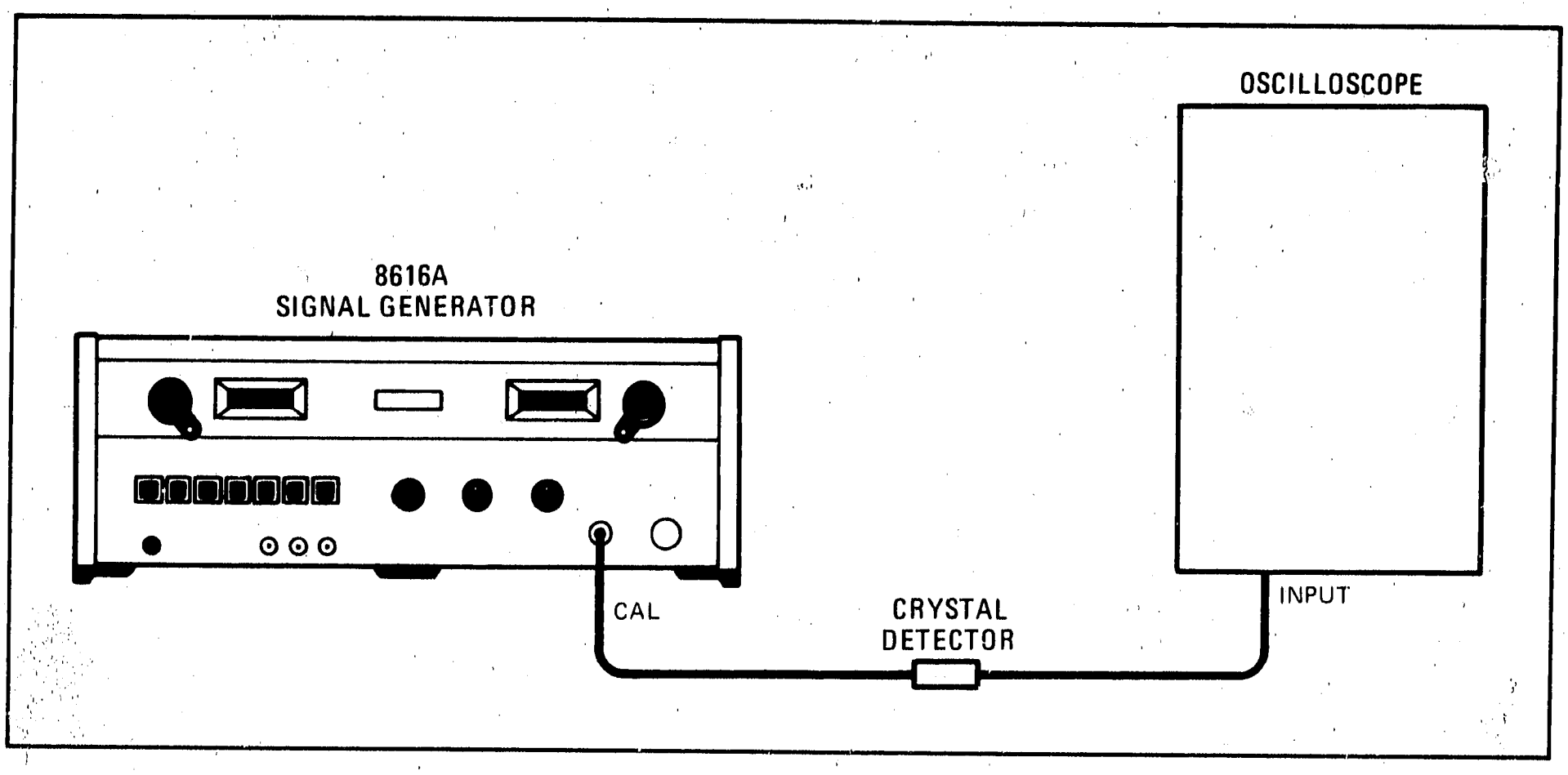


Figure 5-8. Internal Square Wave Check

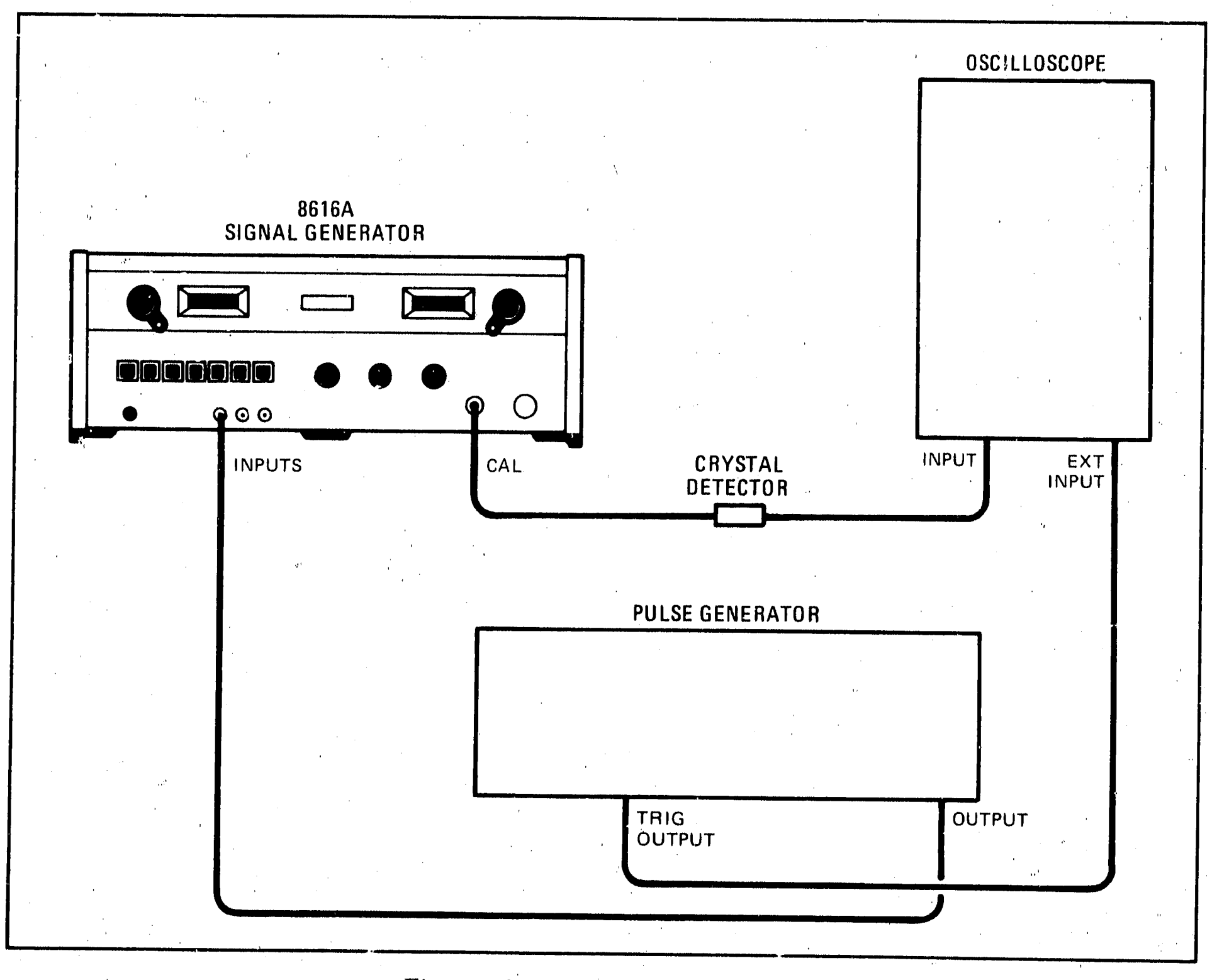


Figure 5-9. External Pulse Check

5-44. External Pulse Check

a. Connect instruments as shown in Figure 5-9.

b. Set up Model 8616A as follows:

LINE ..... depressed
RF ..... depressed
EXTERNAL PULSE ..... depressed

c. Set up pulse generator for a 20-volt 50 prf signal with a pulse width of 3 μsec.

d. A pulse presentation should be seen on the oscilloscope. Specification rise time: 2 μsec.

e. Set up pulse generator for a 20-volt 5000-prf signal with a pulse width of 3 μsec.

f. A pulse presentation should be seen on the oscilloscope. Specification rise time: 2 μsec.

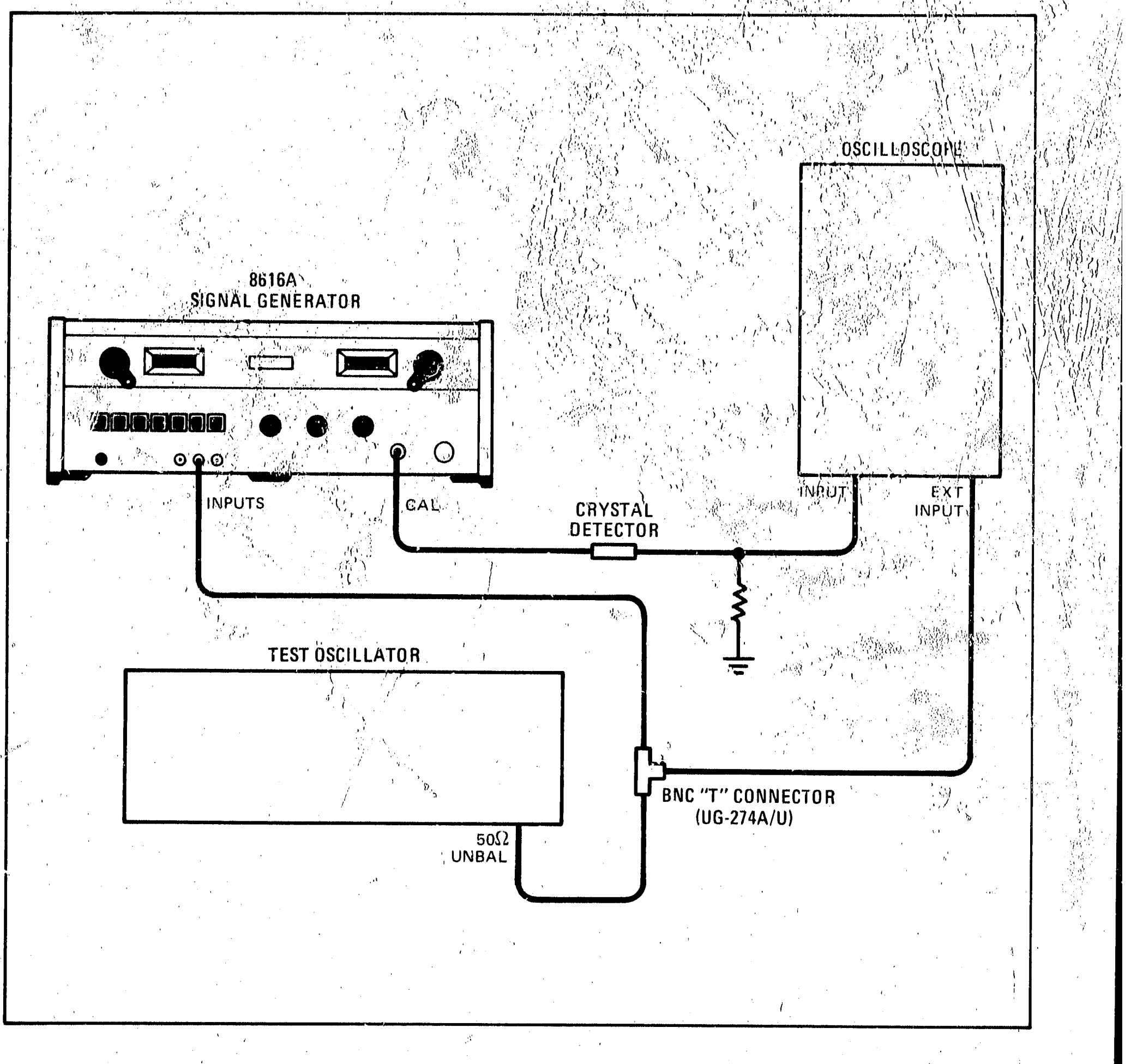


Figure 5-10. External AM Check

5-45. External AM Check

a. Connect instruments as shown in Figure 5-10.

b. Set up Model 8616A as follows:

LINE . . . . . depressed
RF . . . . . depressed
EXTERNAL AM . . . . . depressed
ALC . . . . . depressed
ALC CAL OUTPUT —3 dBm (dBm meter)
FREQUENCY . . . . . 1800 MHz
ATTENUATION . . . . . 0 dB or less

c. Apply a 6 ±0.1 volt peak-to-peak, 1-kHz sine wave to front panel BNC input.

d. Using ALC CAL OUTPUT to vary DC level of detected sinusoid, center wave so there is no peak clippings (vary input amplitude, if necessary).

e. Adjust vertical sensitivity of the oscilloscope to give a 6-cm vertical display of the detected 1 kHz signal and then increase signal frequency to 1 MHz. The vertical display of the 1 MHz signal should be greater than 3.0 cm.

5-46. MEASUREMENT OF RESIDUAL FM

a. Connect equipment as shown in Figure 5-12.

b. Set up 8616A to 2.5 GHz with line and rf pushbuttons pressed. Set rf output power to approximately —10 dBm.

c. Set local oscillator to 2.45 GHz at highest available power.

d. Press AUTOMATIC and FREQ. buttons on 8901A and tune 8616A frequency to obtain roughly 50 MHz on 8901A display.

e. Press FM, 15 kHz LOW PASS, and AVG buttons. Also make sure FM DE-EMPHASIS is off.

f. Read residual FM on display. It should be less than 2500 Hz.

5-47. CAM CABLE REPLACEMENT

5-48. Tools Required

a. Open-end wrench (3/8-inch).

b. Hex-socket wrench and 3/8-inch socket or equivalent tool.

c. Book of matches.

d. Roll of masking tape (1/2-inch or 1-inch, width).

e. Rubber cement.

5-49. Procedure

5-50. If it is necessary to replace the cam cable, order it by HP Stock No. 08614-299 and description of usage. For easier access to the cams, remove the screws holding the High Voltage circuit board and swing the board out of the way. Use Figures 5-11 and 5-13 as a guide and proceed as follows:

a. Remove power cord from instrument.

b. Remove instrument top cover and attenuator access cover.

c. Turn FREQUENCY (MHz) to approximately the middle of the frequency band.

d. Orient Length Cam to Frequency Cam as shown in Figure 5-11.

e. Using a lead pencil, mark the position of each cam and the end of the threaded portion of the center conductor support rod on the klystron cavity casing.

f. Using the hex socket wrench and a 3/8-inch open-end wrench, remove both terminal screws, the four washers, and the two nuts (10-32x0.375 hex nuts).

g. Remove both terminal screws from cable.

h. On replacement cable, place a mark halfway between each end. Using matches apply heat to an area approximately 1/2 to 3/4-inch on either side of the mark to remove wire tension (heat to nearly white hotness.

i. Cut 10 or 11 strips of masking tape, approximately 1-inch in length.

j. Remove 3 retaining screws from Frequency Cam and remove cam from instrument (Note: 3 retaining screws are 4-40x0.625, FH).

k. Slide cable through one terminal screw so that cable is secured to terminal screw as shown in Figure 5-13, for the Frequency Cam, and install terminal screws on Frequency Cam.

CAUTION

Be careful not to catch cable between lockwasher and cam.

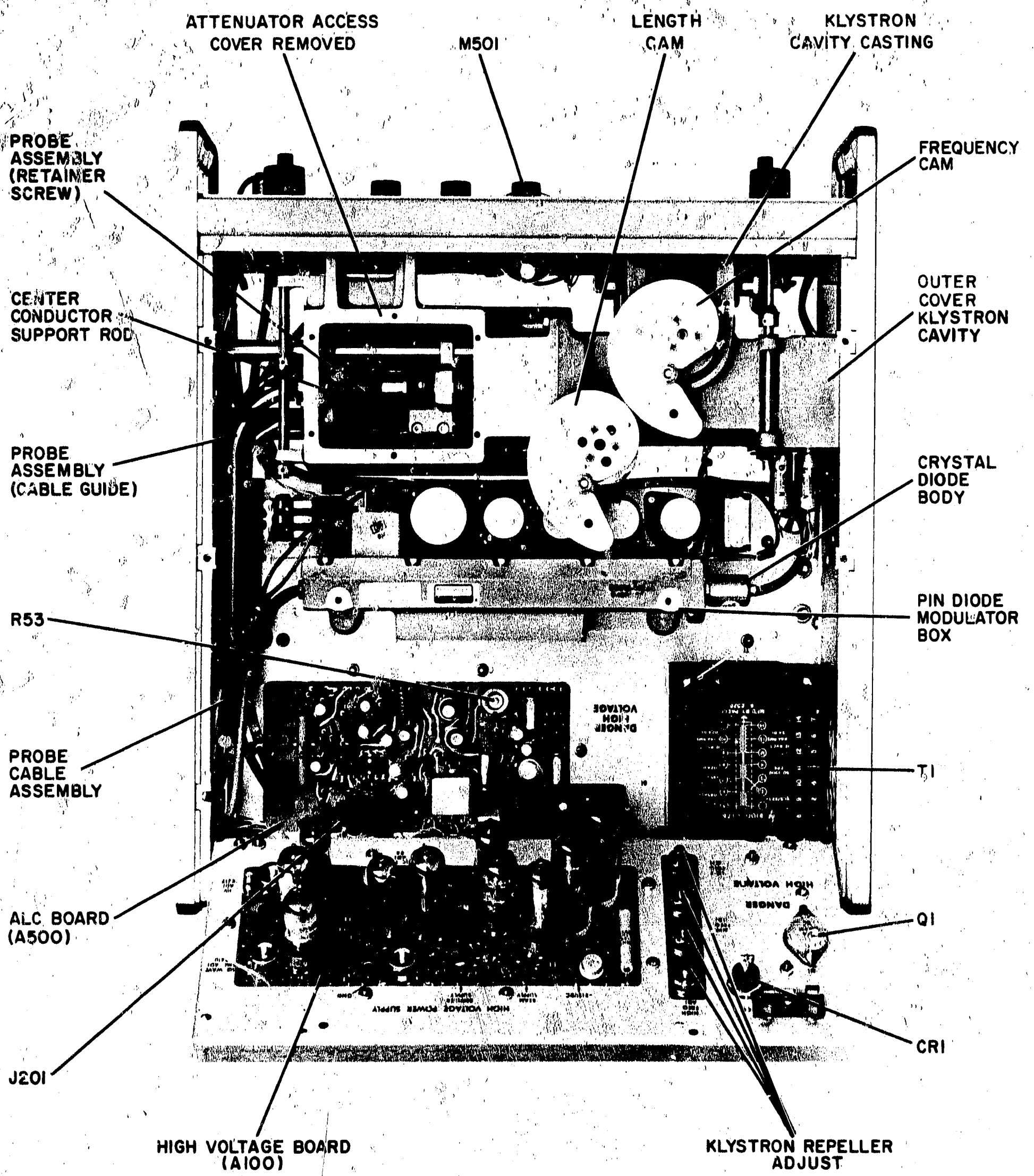


Figure 5-11. Top View, Cover Removed

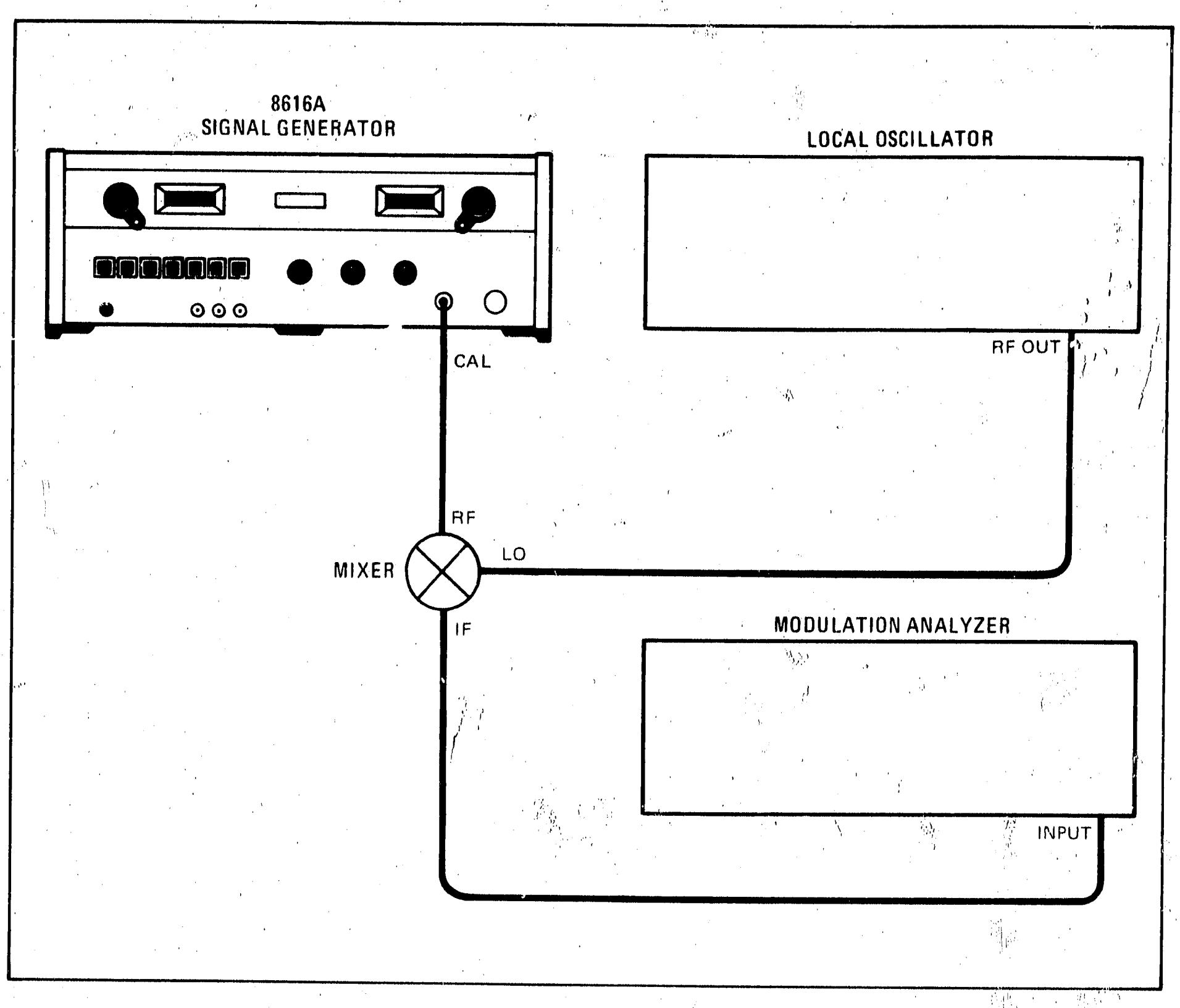


Figure 5-12. Residual and Incidental FM Check

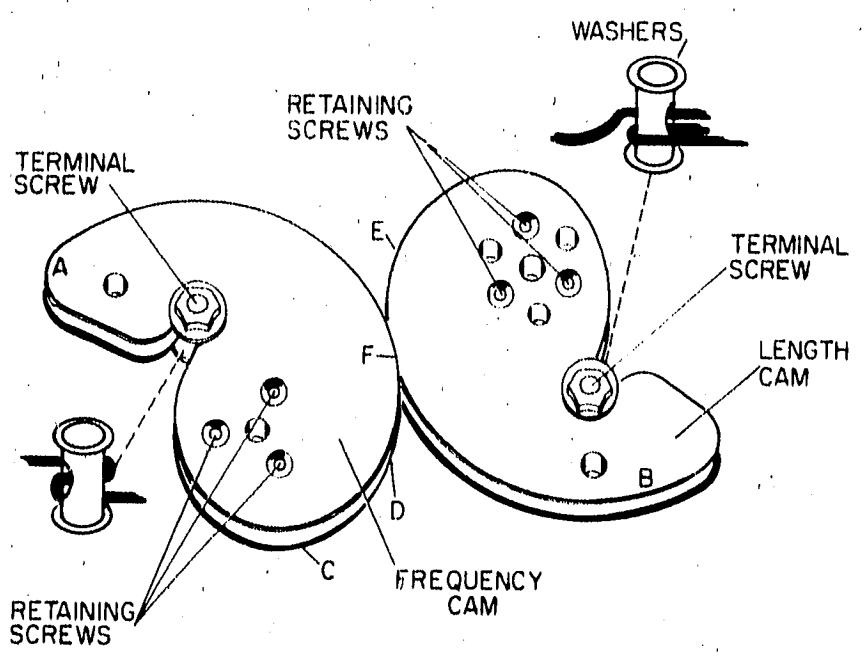


Figure 5-13. Exploded View — Cam Assembly

m. Slide cable onto cam just past point A and B; the other half should pass over points C, D, and E).

NOTE

Each cam as shown in Figure 5-13 has two lips along which the cable should travel, one cable must travel along the upper lip of both cams and one cable must travel along the lower lip of both cams.

n. Slide other half portion of cable onto cam just past point D and tape to cam.

o. Place Frequency Cam in original position in instrument and replace retaining screws.

p. Turn Length Cam so that cams are not touching at point F and place cable between cams: on cable along upper lip of cam and the other along lower lip of lip of cam.

q. Turn Length Cam so that it is apparently touching Frequency Cam at point F and place two pieces of masking tape across the two cams at point F.

r. With the cams held together, slide the cable which passes over points C and D past point E and the cable which passes over point A past point B and tape each portion of cable to the cam.

NOTE

It is important that each cable portion have as little slack between it and the cams as possible: a loose cable causes backlash.

s. Slide cable ends through second terminal screw so that cable is secured to terminal screws as shown in Figure 5-13, for the Length Cam.

t. Install the second terminal screw on the Length Cam and tighten both terminal screws to remove all slack in cable.

u. Remove masking tape from cams and apply rubber cement to ends of cable to ensure that cable will not unravel.

v. Turn FREQUENCY (MHz) knob to match Frequency Cam to pencil mark made in step e, the other marks made should match appropriately.

w. Perform Frequency Tracking adjustments, paragraphs 5-28 and 5-32.

5-51. LOW PASS FILTER REPLACEMENT

5-52. Tools Required

a. Low heat soldering iron and solder (flux)

b. Small pair needle nose pliers.

c. Small pair pliers.

5-53. Procedure

5-54. Figure 5-14 illustrates Low Pass Filter and ALC crystal diode (CR701) parts with stock numbers. The illustration is an assembly drawing. Part removal is the reverse of illustrated assembly instructions. The first step for disassembly is to unsolder the cable to low pass filter and grounding lug connections. The last step of assembly is to solder the cable to Low Pass Filter and grounding lug connections.

CAUTION

Before touching CR701 refer to paragraph 5-24, step c — Caution.

5-55. CAVITY WIPER REPLACEMENT

5-56. The following procedure will enable you to easily replace the wipers in the cavity of the 8616A signal generators. These wipers may need to be replaced when *holes* appear in the FM mode pattern and the klystron is known to be good.

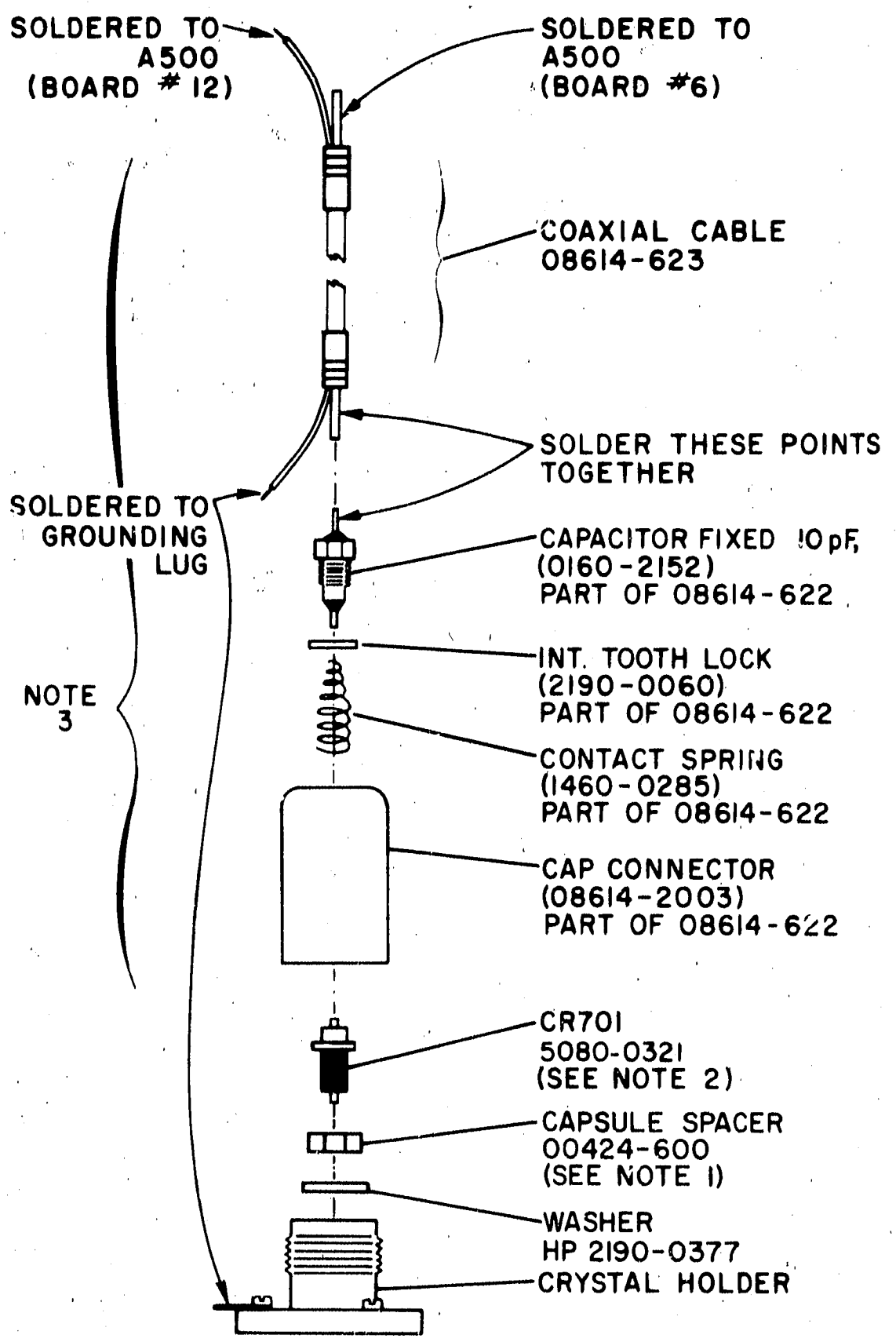
5-57. Parts Required

5-58. The correct parts to order are listed below:

HP Part Number	Description	Quantity
08616-210	Wiper, Cavity	2
08614-282	Conductor, Center	1

5-59. Replacement Procedure

1. Set the attenuator to −20 dBm. This will prevent damage during the wiper replacement.



1. CAPSULE SPACER INCLUDES POLYIRON INSERT WHICH MUST ALWAYS BE INSERTED SO THAT INSERT WILL CONTACT WITH WASHER (POLYIRON DOWN).
2. STOCK NO. 5080-0321 INCLUDES A SPECIAL MATCHING RESISTOR, R519, THAT MUST BE REPLACED WHENEVER CR701 IS REPLACED.
3. COAXIAL CABLE AND ALC FILTER ASSEMBLY PARTS ARE AVAILABLE AS PART OF LOW PASS FILTER KIT *hp* STOCK NO. 08614-625.

Figure 5-14. Low Pass Filter Assembly Drawing

2. Remove all instrument covers, top and bottom, and trim strips.

3. Place instrument on left side frame and unsolder repeller filter lead from bottom of main deck (white, yellow, violet). There are two leads the same color, so be sure to remove lead going to the cavity.

4. Remove two lower cavity retaining screws that hold cavity halves together, and remove the UNCAL RF probe.

5. Place instrument on right side frame; remove klystron cover plate on left side of instrument, then remove klystron.

6. Place instrument on its bottom and remove all screws and covers from right side frame and remove the right side frame.

7. Slide off base casting plate from ends of cavity probe guide and center conductor support rods.

8. Remove attenuator casting cover from top of cavity casting.

9. Use a sharp scribe or awl and mark tuning carriage position on its tuning rod. Also mark position of center conductor rod at right side of casting. Then loosen shaft clamp on center conductor.

10. Tune frequency control to high frequency stop. Use long nose pliers to grip center conductor and slide to left out of the cavity. A new center conductor should also be installed when wipers are changed. Tune to the low frequency stop and remove the frequency tuning and attenuator knobs.

11. On left side of instrument remove the four screws holding cavity casting and three screws into front panel under forward trim strip.

12. Carefully slide front panel *and* cavity assembly to right until left mainframe side is disengaged from front panel. Now slide front panel forward until tuning and attenuation shafts are clear. Tilt panel forward as far as possible without breaking any leads.

13. Loosen two screws in top of tuning carriage that hold carriage to its tuning shaft. Now remove two screws from cavity top that hold cavity halves together.

14. Using your right hand, gently slide the right cavity half and tuning carriage off tuning shafts to the right. Place right cavity half so that wipers are facing upward. Right cavity half and tuning carriage may offer some resistance during removal. A small plastic hammer may be used to free the two cavity halves from each other.

15. Be very careful to prevent damaging probes and remove the three screws from center ring of wipers that hold the wipers to the tuning carriage.

16. Using a thin bladed screwdriver between back of outer wiper and teflon bearing plate, remove outer wiper. Again be careful not to damage probes. Remove teflon bearing plate and three metal spacers. Note the placement of the wipers.

17. Now remove inner wiper from the support rods and clean any excess silver paint from probe guide tubes.

18. Inspect new wipers for bent fingers. Carefully slide a new wiper over probe guide tubes. It may require tapping with plastic hammer around the wiper back plate to make wiper slide into position.

19. Place toothpicks in screw holes of support rods. Slide metal spacers over toothpicks followed by teflon bearing and outer wiper. Again, outer wiper may require gentle tapping to seat fully into position.

NOTE

Holes are not symmetrical in teflon bearing or wipers.

20. Holding the cavity upright remove one toothpick at a time and install the wiper retaining screws. Be careful spacer does not move when a toothpick is removed.

21. Although not necessary, the use of a small amount of silver paint around probe guide tubes and the three wiper retaining screws is recommended. This will help prevent RF leakage.

22. Using paper tissues, remove any excess lubricant from inside of cavity. Use a small amount of Moly coat on another tissue and clean inside of cavity so that cavity walls feel lubricated, but no grease can be seen.

23. Again, holding left cavity half in left hand and right cavity half in right hand, slide the right half over the tuning shafts being careful to line up tuning carriage holes.

CAUTION

Be very careful not to damage wiper fingers during assembly.

24. Slide the two halves together until the tuning carriage can be pushed far enough forward for wipers to enter cavity. Now slowly push tuning carriage to the left until the wipers enter the bevel at the edge of the left cavity half. Now carefully slide wiper into cavity body until both wipers are fully inside cavity.

25. Carefully slide cavity halves together and re-install the two upper allen retaining screws into cavity assembly.

26. Now take new center conductor and scribe mark on shaft in approximately the same location as previously done on the old center conductor.

27. Use silver polish and clean outer surface of center conductor to remove all oxidation. Using same procedure as on cavity walls, lightly wipe on and wipe off Moly coat lubricant.

28. Now roll center conductor along clean bench or table to form the fingers until they are a firm fit over klystron grid ring. (See Figure 5-15.)

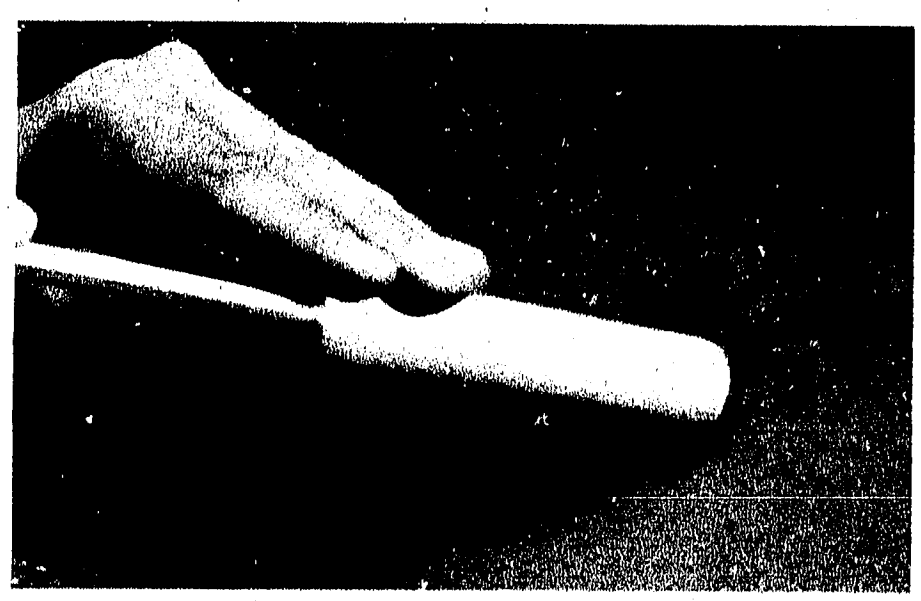


Figure 5-15. Forming the Center Conductor Fingers

29. Remove the repeller filter from the old center conductor and re-install the repeller filter in new center conductor. Now lay center conductor assembly aside temporarily.

NOTE

It will be necessary to use a long, ten inch or longer, allen wrench to remove the repeller filter. Insert alien wrench into the center conductor, alongside repeller filter lead, and use only enough pressure to slowly slide repeller filter out of the center conductor.

30. Slide tuning carriage back to mark previously scribed on tuning shaft during disassembly, and tighten two screws in top of tuning carriage.

31. Now follow steps 12 through 1 disassembly in reverse to re-assemble the instrument.

32. The instrument will need to have both the power output and frequency re-calibrated after this procedure (refer to paragraphs 5-28 through 5-32).

5-60. Frequency Drive Gear Replacement

5-61. The frequency drive gear HP Part Number 08614-245, has been changed to an all brass gear.

The following procedure will speed up replacing the gear:

1. Tune the generator to mid-band. Use a scribe to draw a line across the tops of the two frequency cams marking where they touch.

2. Wrap about four inches of masking tape around the ends of each cam to hold down the stainless steel anti-backlash wires.

3. Remove the three 4-40x.625 inch screws holding each cam. Very carefully lift off the cams as a unit. *Do not allow the cams to fold over.* If cams fold over, the stainless steel wires will have to be restrung and the job will take about three times as long. Place cams under something heavy enough to hold them flat while you finish replacing gear.

4. Mark on casting, position of one of screw holes on gear.

5. Turn signal generator upside-down. Remove bottom cover.

6. Remove the two 6-32x3/8 inch screws holding 2.625 inch repeller pot cover.

7. Mark on edge of casting location of rotor contact.

8. Loosen the two number 6 hex head set screws holding rotor. Remove rotor.

9. Write down location and color code of 4 wires connected to repeller potentiometer. Note location of terminal lugs and connections on inside of repeller potentiometer.

10. Remove the four 4-40x1/2 inch screws holding connection to repeller potentiometer.

11. Mark position of the contact lug on P.C. board mounted under potentiometer resistor.

12. Loosen nylon screw holding contact lug. Lift out wire wound resistor, insulator and P.C. board.

13. Use 1/2 inch drive socket wrench and remove nut holding gear shaft. Remove gear.

14. Install new gear. Reverse disassembly procedure and mount all necessary parts.

NOTE

Refer to paragraph 5-38 to check frequency range and accuracy.

WARNING

"Some of the maintenance and servicing operations described herein are performed with power supplied to the instrument while protective covers are removed. Be careful when performing these operations. 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."

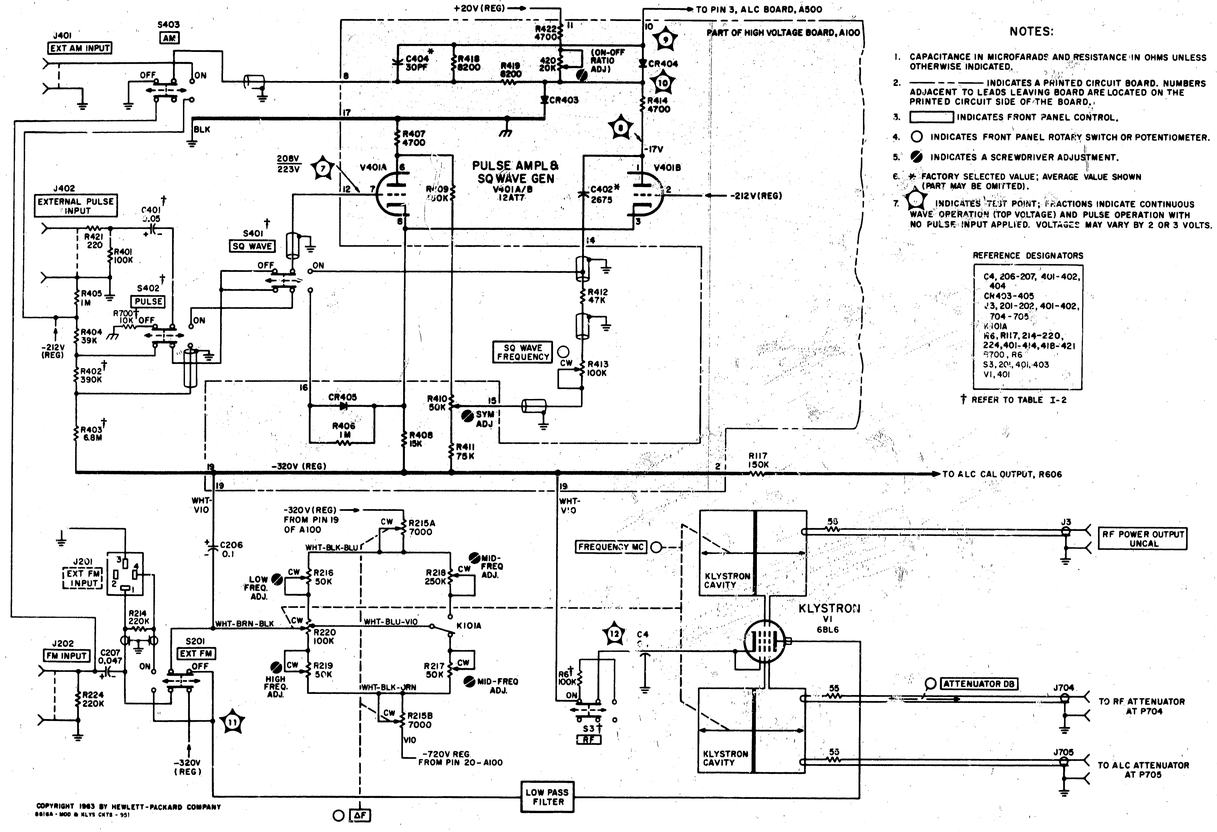
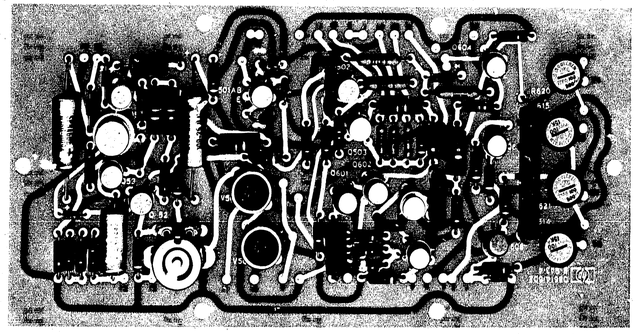


Figure 5-16. Modulation and Klystron Circuits



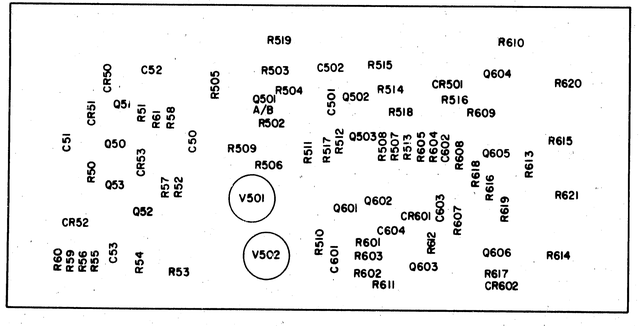


Figure 5-17. ALC Board (A500)

WARNING

"Some of the maintenance and servicing operations described herein are performed with power supplied to the instrument while protective covers are removed. Be careful when performing these operations. 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."

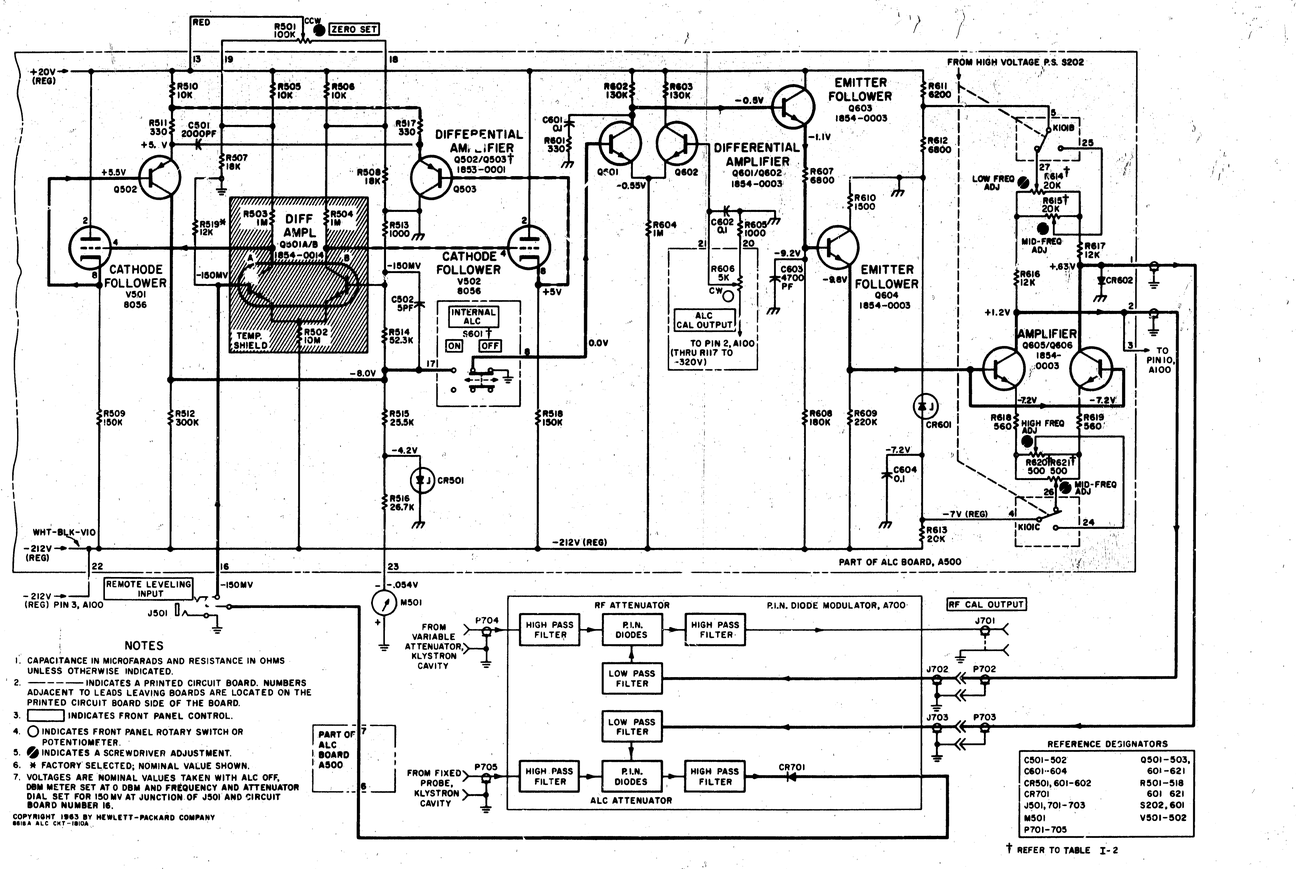


Figure 5-18. ALC Circuit

WARNING

"Some of the maintenance and servicing operations described herein are performed with power supplied to the instrument while protective covers are removed. Be careful when performing these operations. 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."

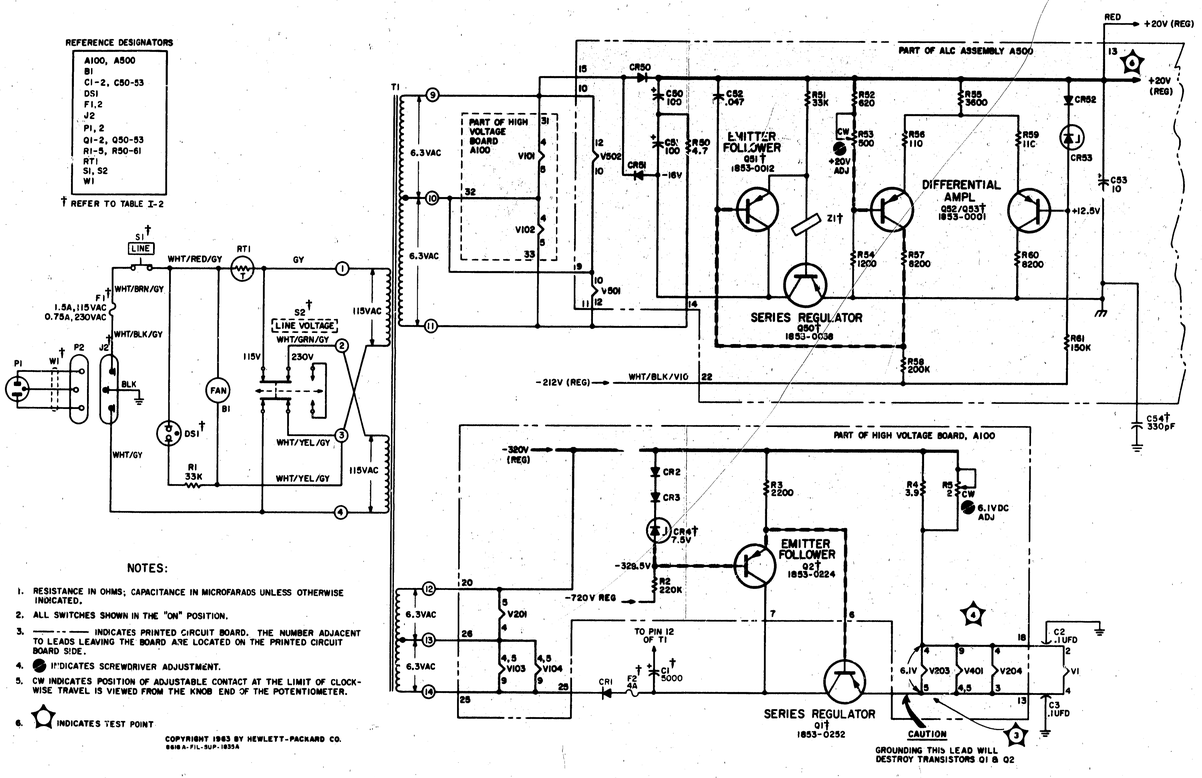
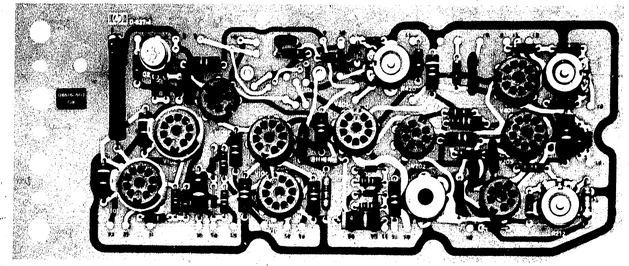


Figure 5-19. Regulated +20 Volt and Filament Supplies



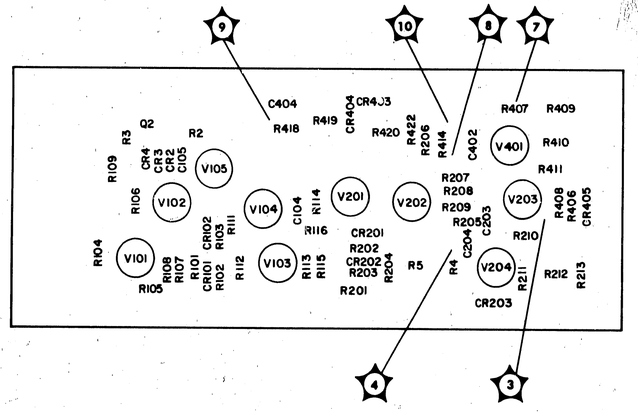


Figure 5-20. High Voltage Board (A100)

WARNING

"Some of the maintenance and servicing operations described herein are performed with power supplied to the instrument while protective covers are removed. Be careful when performing these operations. 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."

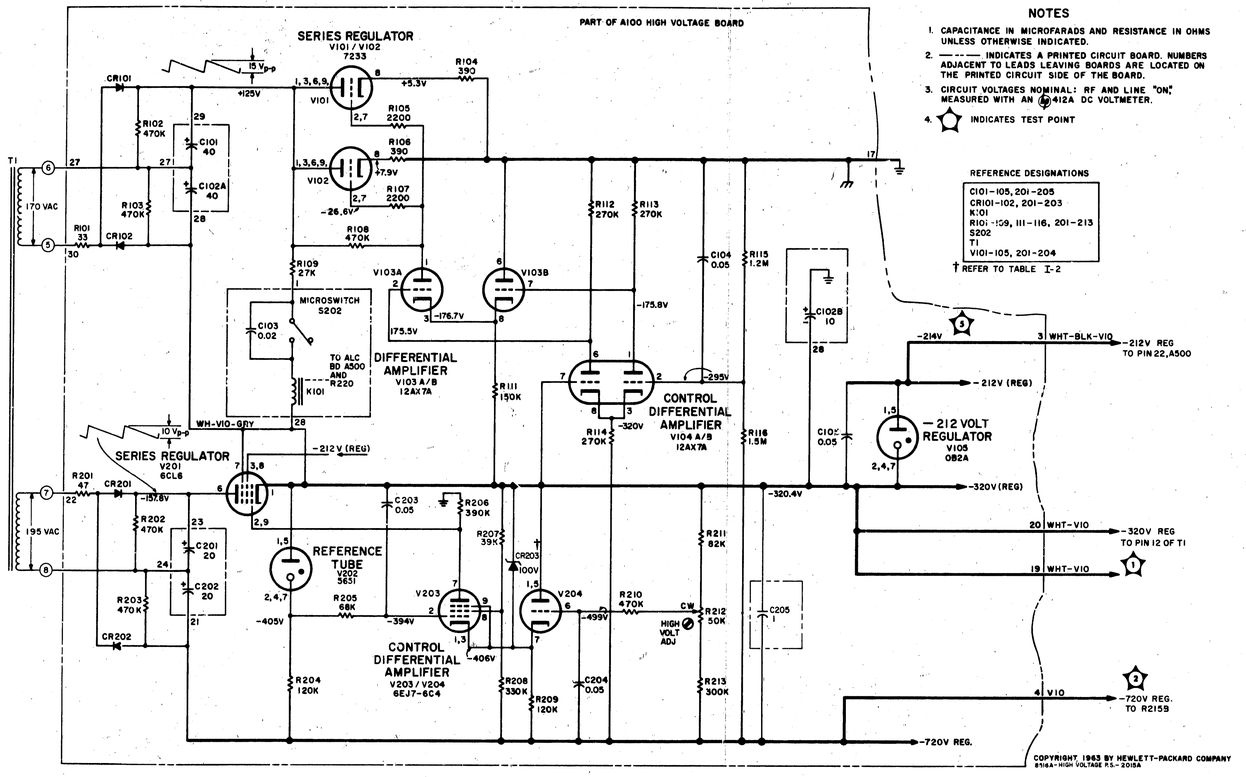


Figure 5-21. High Voltage Power Supply

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

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

6-3. ABBREVIATIONS

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

6-5. REPLACEABLE PARTS LIST

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

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

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

c. Miscellaneous parts.

d. Illustrated parts breakdown.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) in the instrument.

d. The description of the part.

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

f. Manufacturer code number for the part.

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

6-7. ORDERING INSTRUCTIONS

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

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

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

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EME . . 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 . . . . logrithmic 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 . . . . . minature
mm . . . . . millimeter

NOTE

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

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

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

NOTE

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

MULTIPLIERS

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

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A100	08616-603	7	1	BOARD ASSEMBLY, HIGH VOLTAGE	28480	08616-603
A101-A499				NOT ASSIGNED		
A500	08614-602	4	1	BOARD, LOW VOLTAGE & ALC	28480	08614-602
B1	3140-0030	7	1	MOTOR-AC SHADED-P 115V 3000-RPM .001-HP	28480	3140-0030
C1	0180-0213	9	1	CAPACITOR-FXD 5000UF+75-10% 25VDC AL	28480	0180-0213
C2	0160-0152	3	3	CAPACITOR-FXD .1UF +-20% 600VDC PPR	28480	0160-0152
C3	0160-0152	3		CAPACITOR-FXD .1UF +-20% 600VDC PPR	28480	0160-0152
C4	0160-0152	3		CAPACITOR-FXD .1UF +-20% 600VDC PPR	28480	0160-0152
C5-C49				NOT ASSIGNED		
C50	0180-0094	4	2	CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
C51	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
C52	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
C53	0180-0136	5	1	CAPACITOR-FXD 10UF+100-10% 50VDC AL	28480	0180-0136
C54†	0160-3694	4		CAPACITOR-FXD 330PF +-10% 100VDC CER	28480	0160-3694
C55-C100				NOT ASSIGNED		
C101	0180-0024	0	1	CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C102	0180-0135	4	1	CAPACITOR-MLTSECT 40/10UF 450V	28480	0180-0135
C103	0150-0024	7	1	CAPACITOR-FXD .02UF +80-20% 600VDC CER	28480	0150-0024
C104	0150-0052	1	4	CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
C105	0150-0052	1		CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
C106-C200				NOT ASSIGNED		
C201	0180-0011	5	2	CAPACITOR-FXD 20UF+50-10% 450VDC AL	28480	0180-0011
C202	0180-0011	5		CAPACITOR-FXD 20UF+50-10% 450VDC AL	28480	0180-0011
C203	0150-0052	1		CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
C204	0150-0052	1		CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
C205†	0160-0593	6	1	CAPACITOR-FXD 1UF +-10% 600VDC PPR	28480	0160-0593
	1400-0512	0	1	CLAMP-CAP 1.56-WD STL	28480	1400-0512
C206	0170-0022	7	2	CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
C207	0160-0056	6	1	CAPACITOR-FXD .047UF +-10% 1KVDC	56289	160P73910
C208-C400				NOT ASSIGNED		
C401	0170-0022	7		CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
C402*	0140-0158	7	1	CAPACITOR-FXD 2676PF +-1% 500VDC MICA	72136	DM20F2676RF0500WV1CR
C403				NOT ASSIGNED		
C404*	0140-0214	6	1	CAPACITOR-FXD 60PF +-5% 300VDC MICA	72136	DM15E600J0300WV1CR
C405-C500				NOT ASSIGNED		
C501	0140-0180	5	1	CAPACITOR-FXD 2000PF +-2% 300VDC MICA	72136	DM19F202G0300WV1CR
C502	0140-0209	9	1	CAPACITOR-FXD 9PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CR
C503-C600				NOT ASSIGNED		
C601	0170-0019	2	1	CAPACITOR-FXD .1UF +-5% 200VDC POLYE	28480	0170-0019
C602	0150-0121	5	2	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
C603	0140-0162	3	1	CAPACITOR-FXD 4700PF +-10% 300VDC MICA	72136	DM20F472K0300WV1CR
C604	0150-0121	5		CAPACITOR FXD .1UF +80-20% 50VDC CER	28480	0150-0121
CR1	1901-0032	1	1	DIODE-PWR RECT 1N3209 100V 15A DO-5	03508	1N3209
CR2	1901-0025	2	6	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR3	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR4†	1902-3129	5	1	DIODE-ZNR 7.5V 2% DO-35 PD=.4W TC=+.05%	28480	1902-3129
CR5-CR49				NOT ASSIGNED		
CR50	1901-0026	3	2	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR51	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR52	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR53	1902-0045	8	1	DIODE-ZNR 7.32V 2% DO-35 PD=.4W	28480	1902-0045
CR54-CR100				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Appendix I

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CR101	1901-0030	9	4	DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
CR102	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
CR103-CR200				NOT ASSIGNED		
CR201	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
CR202	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
CR203	1902-0075	4	1	DIODE-ZNR 28.7V 5%	28480	1902-0075
CR204-CR402				NOT ASSIGNED		
CR403	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR404	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR405	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR406-CR500				NOT ASSIGNED		
CR501	1902-0057	2	1	DIODE-ZNR 6.49V 5% DO-35 PD=.4W	28480	1902-0057
CR502-CR600				NOT ASSIGNED		
CR601	1902-0216	5	1	DIODE-ZNR 7.15V 5% PD=1.5W TC=+.042%	28480	1902-0216
CR602	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR603-CR700				NOT ASSIGNED		
CR701	5080-0321	3	1	DIODE, SPECIAL (INCLUDES MATCHING RESISTOR R519)	28480	5080-0321
DS1	1450-0566	9	1	LIGHT-IND WHT-TL .4-DIA SLDR-LUG-TERM	91802	2910S21
F1	2110-0002	9	1	FUSE 2A 250V NTD 1.25X.25 UL (FOR 115V OPERATION)	75915	312002
F1	2110-0001	8	1	FUSE 1A 250V NTD 1.25X.25 UL (FOR 230V OPERATION)	75915	312001
F2	2110-0014	3	1	FUSE 4A 250V TD 1.25X.25 UL	75915	313004
	1400-0008	9	1	FUSEHOLDER-BLOCK 15A 250 V 1-FU	28480	1400-0008
J1				NOT ASSIGNED		
J2	1251-2357	8	1	CONNECTOR-AC PWR HP-9 MALE FLG-MTG	28480	1251-2357
J3-J200				NOT ASSIGNED		
J201	1251-0011	7	1	CONNECTOR 4-PIN F JONES TYPE	28480	1251-0011
J202	1250-0083	1	3	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J203-J400				NOT ASSIGNED		
J401	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J402	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J403-J500				NOT ASSIGNED		
J501	1251-0070	8	1	CONNECTOR-TEL JACK 3-CKT .25-SHK-DIA	28480	1251-0070
K101	0490-1198	8	1	RELAY 3C 110VDC-COIL 5A 120VAC	28480	0490-1198
M501	1120-0134	8	1	METER METER,0-200UA 2%,EDGE VIEW	28480	1120-0134
Q1†	1853-0252	4	1	TRANSISTOR PNP SI TO-3 PD=150W FT=4MHZ	28480	1853-0252
Q2†	1853-0224	0	1	TRANSISTOR PNP SI TO-39 PD=1W FT=15MHZ	3L585	2N5415
Q3-Q49				NOT ASSIGNED		
Q50†	1853-0038	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
Q51†	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
Q52†	1853-0001	1	4	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
Q53†	1853-0001	1		TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
Q54-Q500				NOT ASSIGNED		
Q501	1854-0014	8	1	TRANSISTOR-DUAL NPN TO-77 PD=600MW	28480	1854-0014
Q502†	1853-0001	1		TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
Q503†	1853-0001	1		TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
Q504-Q600				NOT ASSIGNED		
Q601	1854-0003	5	6	TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
Q602	1854-0003	5		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
Q603	1854-0003	5		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
Q604	1854-0003	5		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
Q605	1854-0003	5		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003

See introduction to this section for ordering information
***Indicates factory selected value**
†Backdating information in Appendix I

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
Q606	1854-0003	5		TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
R1	0687-3331	2	1	RESISTOR 33K 10% .5W CC TC=0+765	01121	EB3331
R2	0690-2241	8	1	RESISTOR 220K 10% 1W CC TC=0+882	01121	GB2241
R3	0687-2221	7	3	RESISTOR 2.2K 10% .5W CC TC=0+647	01121	EB2221
R4	0813-0030	1	1	RESISTOR 3.9 5% 3W PW TC=0+-50	91637	CW2B1-3W-T2-3R9-J
R5	2100-0317	8	1	RESISTOR-TRMR 2 20% WW TOP-ADJ 1-TRN	11236	115-2W-2RO-M
R6	0757-0367	7	1	RESISTOR 100K 1% .5W F TC=0+-100	28480	0757-0367
R7-R49				NOT ASSIGNED		
R50	698-0001	0	1	RESISTOR 4.7 5% .5W CC TC=0+412	01121	EB47G5
R51	0686-3335	4	1	RESISTOR 33K 5% .5W CC TC=0+765	01121	EB3335
R52	0757-0088	9	1	RESISTOR 620 2% .25W F TC=0+-100	24546	C5-1/4-T0-621-G
R53	2100-0151	8	1	RESISTOR-VAR CONTROL CP 500 20% LIN	28480	2100-0151
R54	0757-0077	6	1	RESISTOR 1.2K 2% .25W F TC=0+-100	28480	0757-0077
R55	0686-3625	5	1	RESISTOR 3.6K 5% .5W CC TC=0+647	01121	EB3625
R56	0686-1115	4	2	RESISTOR 110 5% .5W CC TC=0+529	01121	EB1115
R57	0686-8225	1	2	RESISTOR 8.2K 5% .5W CC TC=0+647	01121	EB8225
R58	0689-2045	7	1	RESISTOR 200K 5% 1W CC TC=0+882	01121	GB2045
R59	0696-1115	4		RESISTOR 110 5% .5W CC TC=0+529	01121	GB1115
R60	0686-8225	1		RESISTOR 8.2K 5% .5W CC TC=0+647	01121	EB8225
R61	0690-1541	9	4	RESISTOR 150K 10% 1W CC TC=0+882	01121	GB1541
R62-R100				NOT ASSIGNED		
R101	0693-3301	9	1	RESISTOR 33 10% 2W CC TC=0+412	01121	HB3301
R102	0687-4741	0	6	RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R103	0687-4741	0		RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R104	0690-3911	1	2	RESISTOR 390 10% 1W CC TC=0+529	01121	GB3911
R105	0687-2221	7		RESISTOR 2.2K 10% .5W CC TC=0+647	01121	EB2221
R106	0690-3911	1		RESISTOR 390 10% 1W CC TC=0+529	01121	GB3911
R107	0687-2221	7		RESISTOR 2.2K 10% .5W CC TC=0+647	01121	EB2221
R108	0687-4741	0		RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R109	0774-0003	4	1	RESISTOR 27K 10% 5W MO TC=0+-250	27167	FP5-5-250-2702-K
R110				NOT ASSIGNED		
R111	0690-1541	9		RESISTOR 150K 10% 1W CC TC=0+882	01121	GB1541
R112	0690-2741	3	3	RESISTOR 270K 10% 1W CC TC=0+882	01121	GB2741
R113	0690-2741	3		RESISTOR 270K 10% 1W CC TC=0+882	01121	GB2741
R114	0690-2741	3		RESISTOR 270K 10% 1W CC TC=0+882	01121	GB2741
R115	0757-0871	8	1	RESISTOR 1.21M 1% .5W F TC=0+-100	28480	0757-0871
R116	0757-0156	2	1	RESISTOR 1.5M 1% .5W F TC=0+-100	28480	0757-0156
R117	0760-0023	9	1	RESISTOR 150K 1% 1W F TC=0+-50	19701	MF6C1-T2-1503-F
R118-R200				NOT ASSIGNED		
R201	0693-4701	5	1	RESISTOR 47 10% 2W CC TC=0+412	01121	HB4701
R202	0687-4741	0		RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R203	0687-4741	0		RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R204	0690-1241	6	2	RESISTOR 120K 10% 1W CC TC=0+882	01121	GB1241
R205	0687-6831	3	1	RESISTOR 68K 10% .5W CC TC=0+765	01121	EB6831
R206	0690-3941	7	1	RESISTOR 390K 10% 1W CC TC=0+882	01121	GB3941
R207	0687-3931	8	2	RESISTOR 39K 10% .5W CC TC=0+765	01121	EB3931
R208	0690-3341	1	1	RESISTOR 330K 10% 1W CC TC=0+882	01121	GB3341
R209	0690-1241	6		RESISTOR 120K 10% 1W CC TC=0+882	01121	GB1241
R210	0687-4741	0		RESISTOR 470K 10% .5W CC TC=0+882	01121	EB4741
R211	0758-0022	3	1	RESISTOR 82K 5% .25W F TC=0+-100	24546	C5-1/4-T0-8202-J
R212	2100-0991	4	2	RESISTOR-VAR CONTROL CP 50K 30% LIN	28480	2100-0991
R213	0761-0017	3	1	RESISTOR 300K 5% 1W MO TC=0+-200	28480	0761-0017
R214	0687-2241	1	3	RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
R215	2100-2141	0	1	RESISTOR-VAR DUAL 7K-10%-CC 7K-10%-CC	28480	2100-2141
R216	2100-0028	8	3	RESISTOR-VAR CONTROL CCP 50K 10% LIN	28480	2100-0028
R217	2100-0028	8		RESISTOR-VAR CONTROL CCP 50K 10% LIN	28480	2100-0028
R218	2100-0029	9	1	RESISTOR-VAR CONTROL CCP 250K 10% LIN	28480	2100-0029
R219	2100-0028	8		RESISTOR-VAR CONTROL CCP 50K 10% LIN	28480	2100-0028
R220	5060-0335	7	1	RESISTOR CARD ELEMENT 100K; WW (REPELLER POT)	28480	5060-0335

See introduction to this section for ordering information.
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†Backdating information in Appendix I

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R221-R223				NOT ASSIGNED		
R224	0687-2241	1		RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
R225-R400				NOT ASSIGNED		
R401	0687-1041	7	1	RESISTOR 100K 10% .5W CC TC=0+882	01121	EB1041
R402	0687-3941	0	1	RESISTOR 390K 10% .5W CC TC=0+882	01121	EB3941
R403	0687-6851	7	1	RESISTOR 6.8M 10% .5W CC TC=0+1000	01121	EB6851
R404	0687-3931	8		RESISTOR 39K 10% .5W CC TC=0+765	01121	EB3931
R405	0687-1051	9	4	RESISTOR 1M 10% .5W CC TC=0+1000	01121	EB1051
R406	0687-1051	9		RESISTOR 1M 10% .5W CC TC=0+1000	01121	EB1051
R407	0686-4725	8	2	RESISTOR 4.7K 5% .5W CC TC=0+647	01121	EB4725
R408	0693-1531	3	1	RESISTOR 15K 10% 2W CC TC=0+765	01121	HB1531
R409	0686-1345	2	3	RESISTOR 130K 5% .5W CC TC=0+882	01121	EB1345
R410	2100-0991	4		RESISTOR-VAR CONTROL CP 50K 30% LIN	28480	2100-0991
R411	0686-7535	4	1	RESISTOR 75K 5% .5W CC TC=0+765	01121	EB7535
R412	0687-4731	8	1	RESISTOR 47K 10% .5W CC TC=0+765	01121	EB4731
R413	2100-3798	5	2	RESISTOR-VAR CONTROL CP 100K 10% LIN	01121	70J4N056S104U
R414	0686-4725	8		RESISTOR 4.7K 5% .5W CC TC=0+647	01121	EB4725
R415-R417				NOT ASSIGNED		
R418	0687-8221	9	2	RESISTOR 8.2K 10% .5W CC TC=0+647	01121	EB8221
R419	0687-8221	9		RESISTOR 8.2K 10% .5W CC TC=0+647	01121	EB8221
R420	2100-0093	7	1	RESISTOR-VAR CONTROL CP 20K 20% LIN	28480	2100-0093
R421	0687-2211	5	1	RESISTOR 220 10% .5W CC TC=0+529	01121	EB2211
R422	0687-4721	6	1	RESISTOR 4.7K 10% .5W CC TC=0+647	01121	EB4721
R423-R500				NOT ASSIGNED		
R501	2100-3798	5		RESISTOR-VAR CONTROL CP 100K 10% LIN	01121	70J4N056S104U
R502	0687-1061	1	1	RESISTOR 10M 10% .5W CC TC=0+1059	01121	EB1061
R503	0757-0344	0	1	RESISTOR 1M 1% .25W F TC=0+-100	24546	C5-1/4-T0-1004-F
R504	0698-4039	2	2	RESISTOR 52.3K 1% .5W F TC=0+-100	28480	0698-4039
R505	0758-0006	3	2	RESISTOR 10K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1002-J
R506	0758-0006	3		RESISTOR 10K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1002-J
R507	0758-0019	8	2	RESISTOR 18K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1802-J
R508	0758-0019	8		RESISTOR 18K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1802-J
R509	0690-1541	9		RESISTOR 150K 10% 1W CC TC=0+882	01121	GB1541
R510	0687-1031	5	1	RESISTOR 10K 10% .5W CC TC=0+765	01121	EB1031
R511	0687-3311	8	3	RESISTOR 330 10% .5W CC TC=0+529	01121	EB3311
R512	0686-3045	3	1	RESISTOR 300K 5% .5W CC TC=0+882	01121	EB3045
R513	0757-0338	2	1	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1001-F
R514	0698-4039	2		RESISTOR 52.3K 1% .5W F TC=0+-100	28480	0698-4039
R515	0698-3542	0	1	RESISTOR 25.5K 1% .5W F TC=0+-100	28480	0698-3542
R516	0757-1080	3	1	RESISTOR 26.7K 1% .5W F TC=0+-100	28480	0757-1080
R517	0687-3311	8		RESISTOR 330 10% .5W CC TC=0+529	01121	EB3311
R518	0690-1541	9		RESISTOR 150K 10% 1W CC TC=0+882	01121	GB1541
R519*	0687-1231	7	1	RESISTOR 12K 10% .5W CC TC=0+765	01121	EB1231
R520-R600				NOT ASSIGNED		
R601	0687-3311	8		RESISTOR 330 10% .5W CC TC=0+529	01121	EB3311
R602	0686-1345	2		RESISTOR 130K 5% .5W CC TC=0+882	01121	EB1345
R603	0686-1345	2		RESISTOR 130K 5% .5W CC TC=0+882	01121	EB1345
R604	0687-1051	9		RESISTOR 1M 10% .5W CC TC=0+1000	01121	EB1051
R605	0758-0003	0	1	RESISTOR 1K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1001-J
R606	2100-0235	9	1	RESISTOR-VAR CONTROL CCP 5K 20% LIN	28480	2100-0235
R607	0687-6821	1	1	RESISTOR 6.8K 10% .5W CC TC=0+647	01121	EB6821
R608	0690-1841	2	1	RESISTOR 180K 10% 1W CC TC=0+882	01121	GB1841
R609	0687-2241	1		RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
R610	0687-1521	8	1	RESISTOR 1.5K 10% .5W CC TC=0+647	01121	EB1521
R611	0758-0046	1	1	RESISTOR 6.2K 5% .25W F TC=0+-100	24546	C5-1/4-T0-6201-J
R612	0758-0009	6	1	RESISTOR 6.8K 5% .25W F TC=0+-100	24546	C5-1/4-T0-6801-J
R613	0773-0007	6	1	RESISTOR 20K 5% 5W MC TC=0+-250	27167	FP5-5-250-2002-J
R614†	2100-1762	9	2	RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
R615†	2100-1762	9		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
R616	0758-0012	1	2	RESISTOR 12K 5% .25W F TC=0+-100	28480	0758-0012
R617	0758-0012	1		RESISTOR 12K 5% .25W F TC=0+-100	28480	0758-0012

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Appendix I

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R618	0758-0002	9	2	RESISTOR 560 5% .25W F TC=0+-100	24546	C5-1/4-T0-561-J
R619	0758-0002	9		RESISTOR 560 5% .25W F TC=0+-100	24546	C5-1/4-T0-561-J
R620†	2100-1757	2	2	RESISTOR-TRMR 500 5% WW SIDE-ADJ 1-TRN	28480	2100-1757
R621†	2100-1757	2		RESISTOR-TRMR 500 5% WW SIDE-ADJ 1-TRN	28480	2100-1757
R622-R699				NOT ASSIGNED		
R700	0687-1051	9		RESISTOR 1M 10% .5W CC TC=0+1000	01121	EB1051
RT1	0839-0020	3	1	THERMISTOR DISC 100-OHM TC=-4.4%/C-DEG	28480	0839-0020
S1	3101-1606	3	1	SWITCH-PE DPST ALTNG 1.5A 230VAC	28480	3101-1606
S2	3101-1234	3	1	SWITCH-SL T STD 1.5A 250VAC SLDR-LUG	28480	3101-1234
S3	3101-1590	4	6	SWITCH-PB DPDT ALTNG	28480	3101-1590
S4-S200				NOT ASSIGNED		
S201	3101-1590	4		SWITCH-PB DPDT ALTNG	28480	3101-1590
S202	3102-0009	0	1	SWITCH-SENS SPDT SUBMIN 5A 250VAC	28480	3102-0009
S203-S400				NOT ASSIGNED		
S401	3101-1590	4		SWITCH-PB DPDT ALTNG	28480	3101-1590
S402	3101-1590	4		SWITCH-PB DPDT ALTNG	28480	3101-1590
S403	3101-1590	4		SWITCH-PB DPDT ALTNG	28480	3101-1590
S404-S600				NOT ASSIGNED		
S601	3101-1590	4		SWITCH-PB DPDT ALTNG	28480	3101-1590
T1	9100-0176	4	1	TRANSFORMER-POWER 115/230V 50-1000HZ	28480	9100-0176
V1	1950-0023	3	1	TUBE-ELECTRON 6BL6 KLYSTRON	28480	1950-0023
V2-V100				NOT ASSIGNED		
V101	1921-0014	1	2	TUBE-ELECTRON 7233 TRIODE	33173	7233
V102	1921-0014	1		TUBE-ELECTRON 7233 TRIODE	33173	7233
V103	1932-0030	4	2	TUBE-ELECTRON 12AX7A TRIODE-DUAL	3L585	12AX7A
V104	1932-0030	4		TUBE-ELECTRON 12AX7A TRIODE-DUAL	3L585	12AX7A
V105	1940-0007	2	1	TUBE-ELECTRON 0B2 DIODE-V RGLTR	94151	0B2
V106-V200				NOT ASSIGNED		
V201	1923-0030	5	1	TUBE-ELECTRON 6CL6 PENTODE	94151	6CL6
V202	1940-0001	6	1	TUBE-ELECTRON 5651A DIODE-V RGLTR	3L585	5651A
V203	1923-0046	3	1	TUBE-ELECTRON 6EJ7 PENTODE	28480	1923-0046
V204	1921-0005	0	1	TUBE-ELECTRON 6C4 TRIODE	3L585	6C4
V205-V400				NOT ASSIGNED		
V401	1932-0042	8	1	TUBE-ELECTRON 12AT7 TRIODE-DUAL	33173	12AT7
V402-V500				NOT ASSIGNED		
V501	1921-0015	2	2	TUBE-ELECTRON 8056 TRIODE	94151	8056
V502	1921-0015	2		TUBE-ELECTRON 8056 TRIODE	94151	8056
W1	8120-1378	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378
XV101	5040-0417	4	2	SOCKET HOLDER;9-PIN	28480	5040-0417
XV102	5040-0417	4		SOCKET HOLDER;9-PIN	28480	5040-0417
XV103	1200-0062	1	5	SOCKET-TUBE 9-CONT DIP-SLDR	28480	1200-0062
XV104	1200-0062	1		SOCKET-TUBE 9-CONT DIP-SLDR	28480	1200-0062
XV105	1200-0053	0	3	SOCKET-TUBE 7-CONT DIP-SLDR	28480	1200-0053
XV106-XV200				NOT ASSIGNED		
XV201	1200-0062	1		SOCKET-TUBE 9-CONT DIP-SLDR	28480	1200-0062
XV202	1200-0053	0		SOCKET-TUBE 7-CONT DIP-SLDR	28480	1200-0053
XV203	1200-0062	1		SOCKET-TUBE 9-CONT DIP-SLDR	28480	1200-0062
XV204	1200-0053	0		SOCKET-TUBE 7-CONT DIP-SLDR	28480	1200-0053
XV205-XV400				NOT ASSIGNED		
XV401	1200-0062	1		SOCKET-TUBE 9-CONT DIP-SLDR	28480	1200-0062
XV402-XV500				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Appendix I

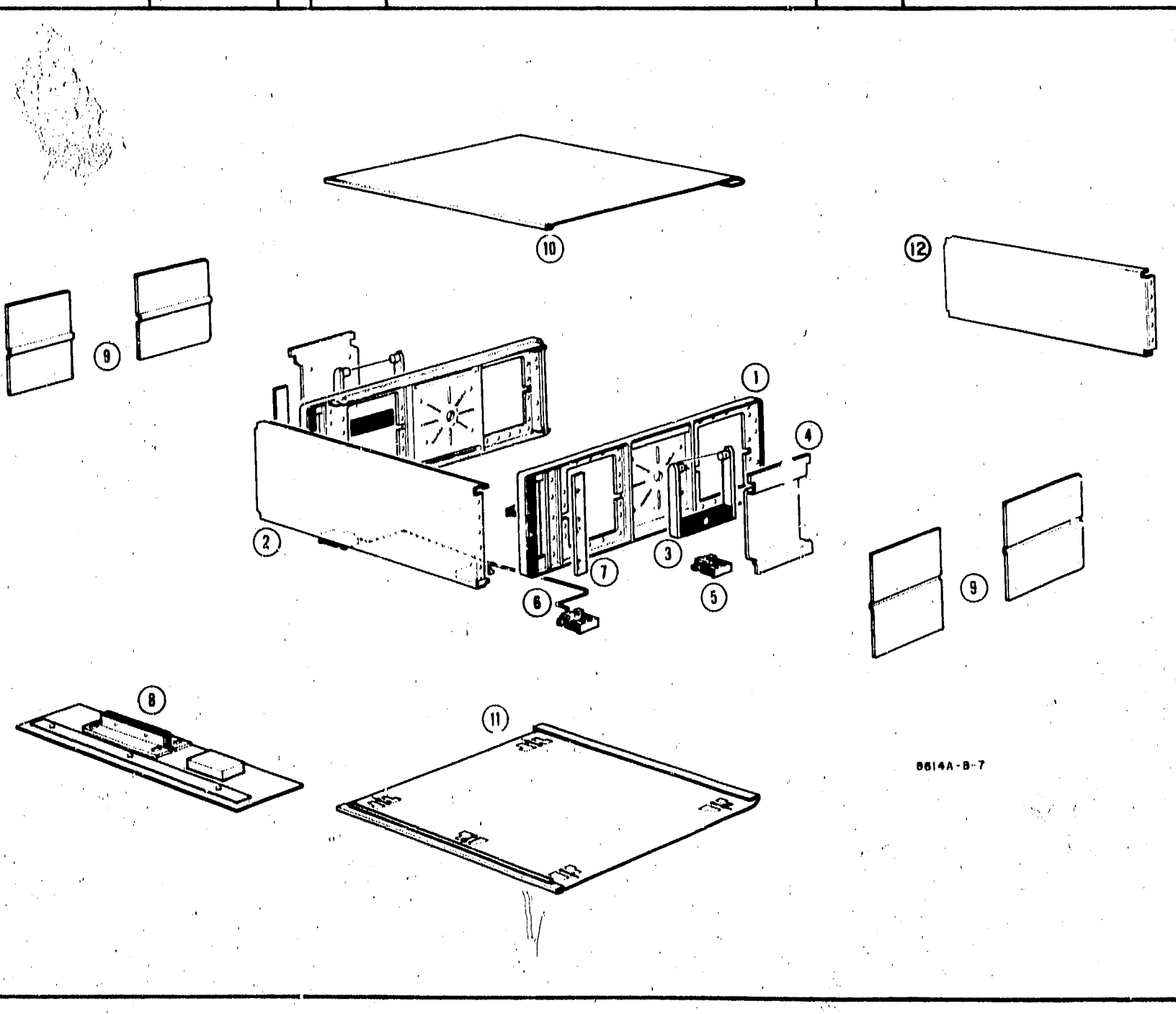
Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
XV501	1200-0086	9	2	SOCKET-TUBE 5-CONT E5-65 DIP-SLDR	28480	1200-0086
XV502	1200-0086	9		SOCKET-TUBE 5-CONT E5-65 DIP-SLDR	28480	1200-0086
Z1†	9170-0029	3	1	CORE SHIELDING BEAD	28480	9170-0029
				MISCELLANEOUS PARTS		
	5040-0369	5	1	BEZEL:COUNTER(ATTEN)MINT GRAY	28480	5040-0369
	5040-0373	1	1	BEZEL:COUNTER(FREQ)MINT GRAY	28480	5040-0373
	1210-0003	1	1	CLAMP-CAP .75-WD STL	28480	1210-0003
	08614-623	9	1	CABLE ASSY,CONNECTS LOW PASS FILTER TO ALC CIRCUIT	28480	08614-623
	08614-299	5	1	CABLE, STAINLESS STEEL	28480	08614-299
	08616-600	4	1	CAVITY ASSEMBLY	28480	08616-600
	08616-210	2	1	CAVITY WIPER FINGER	28480	08616-210
	1250-0144	5	1	BODY-RF CONN SERIES N: BULKHEAD	28480	1250-0144
	08614-612	6	1	FAN ASSEMBLY,INCLUDES BLADE	28480	08614-612
	3160-0030	9	1	FAN BLADE 2.75-OD .125-ID	28480	3160-0030
	0510-0123	1	1	RETAINER-PUSH ON RECT EXT .312-IN-DIA	28480	0510-0123
	0340-0875	9	1	INSULATOR-XSTR THRM-CNDCT	28480	0340-0875
	08614-611	5	1	INTAKE AIR CLEANER ASSEMBLY	28480	08614-611
	7100-0091	0	1	COVER-RND .312-IN-DP-OUT 1.375-IN-WD-OUT	28480	7100-0091
	0370-0025	4	1	KNOB RND:BLK:FOR .250 SHFT:.750D	28480	0370-0025
	0370-0026	5	1	KNOB RND:BLK:FOR .250 SHFT:1 ARO:.750D	28480	0370-0026
	0370-0149	3	1	KNOB-CRANK 1.625 IN OD: .250 IN DIA	28480	0370-0149
	0370-0050	5	1	KNOB RND:BLK:.375D:CRANK SPINNER	28480	0370-0050
	5000-0237	2	1	LABEL:ALC	28480	5000-0237
	5000-0249	6	1	LABEL:AM	28480	5000-0249
	5000-0244	1	1	LABEL:FM	28480	5000-0244
	5000-0248	5	1	LABEL:LINE	28480	5000-0248
	5000-0245	2	1	LABEL:PULSE	28480	5000-0245
	5000-0247	4	1	LABEL:RF	28480	5000-0247
	5000-0246	3	1	LABEL:SQUARE WAVE	28480	5000-0246
	08616-601	5	1	LEVELER ASSEMBLY (INCLUDES CABLE)	28480	08616-601
	08616-602	6	1	LEVELER CABLE ASSEMBLY	28480	08616-602
	08614-800	4	1	MAINTENANCE TOOL KIT 9/64" HEX WRENCH:3/32" HEX WRENCH: #23 TRUARC PLIERS:7/16" OPEN-END WRENCH	28480	08614-800
	08616-604	8	1	PROBE ASSEMBLY, ALC	28480	08616-604
	08616-606	0	1	PROBE ASSEMBLY, ATTENUATOR	28480	08616-606
	08616-605	9	1	PROBE ASSEMBLY, RF	28480	08616-605
	08614-600	2	1	WIRING HARNESS, BRANCHED (AC)	28480	08614-600
	08614-601	3	1	WIRING HARNESS, BRANCHED (DC)	28480	08614-601
	08614-626	2	1	CAP, UNCAL RF POWER OUTPUT	28480	08614-626
	1400-0090	9	1	FUSEHOLDER COMPONENT WASHER RUBBER5/8"OD	28480	1400-0090
	2110-0564	8	1	FUSEHOLDER BODY 12A MAX FOR UL	H9027	031.1657
	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
	2110-0569	3	1	FUSEHOLDER COMPONENT NUT; THREAD M12.7	28480	2110-0569
	0340-0822	6	1	INSULATOR-FLG-BSHG TFE	28480	0340-0822
	3050-0591	4	1	WASHER-FL NM 1/4 IN .265-IN-ID	28480	3050-0591
	7120-4162	6	1	LABEL, WARNING"HAZARDOUS VOLTAGE"(LARGE)	28480	7120-4162
	7120-4163	7	1	LABEL, WARNING"HAZARDOUS VOLTAGE"(SMALL)	28480	7120-4163
	7120-4295	6	1	LABEL, WARNING"HAZARDOUS VOLTAGE ALWAYS PRESENT"	28480	7120-4295
	7120-5087	6		LABEL, WARNING "TO PREVENT ELECTRICAL SHOCK"	28480	7120-5087

See introduction to this section for ordering information
***Indicates factory selected value**
†Backdating information in Appendix I

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CABINET PARTS		
1	5060-0732	8	1	SIDE FRAME ASSEMBLY	28480	5060-0732
	0590-0053	4	1	NUT-SHMET-J-TP 6-32-THD .5-WD STL	28480	0590-0053
2	08616-00007	3	1	FRONT PANEL, MINT GREY	28480	08616-00007
	2530-0011	0	1	SCREW-MACH 8-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
3	5061-0222	1	1	HANDLE ASSY:5H SIDE	28480	5060-0222
4	5060-0766	8	1	HANDLE ASSY:RETAINER(LIGHT GRAY)	28480	5060-0766
4	5060-8736	8	1	HANDLE ASSY:RETAINER(MINT GRAY)	28480	5060-8736
	2550-0013	4	1	SCREW-MACH 8-32 .312-IN-LG PAN-HD-PHL	00000	ORDER BY DESCRIPTION
5	5060-0767	9	1	FOOT ASSY:FM	28480	5060-0767
6	1490-0030	6	1	TILT STAND 3-IN-W 13.75-IN-OA-LG SST	28480	1490-0030
7	5000-0052	9	1	PLATE:FLUTED ALUMINUM	28480	5000-0052
8	5060-0775	9	1	KIT:RACK MOUNT, 5H(LIGHT GRAY)	28480	5060-0775
8	5060-8740	4	1	KIT:RACK MOUNT, 5H(MINT GRAY)	28480	5060-8740
9	5000-8709	9	1	COVER:REAR SIDE	28480	5000-8709
9	5000-8711	3	1	COVER:FRONT SIDE PLATE(MINT GRAY)	28480	5000-8711
	2370-0020	1	1	SCREW-MACH 6-32 .188-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
10	08616-00008	4	1	TOP COVER ASSEMBLY, 16L FM, MINT GREY	28480	08616-00008
	2370-0021	2	2	SCREW-MACH 6-32 .438-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
11	5060-8713	1	1	BOTTOM COVER ASSY:16L FM(MINT GRAY)	28480	5060-8713
	2370-0021	2		SCREW-MACH 6-32 .438-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
12	08614-008	4	1	REAR PANEL	28480	08614-008
	2515-0017	4	1	SCREW-MACH 8-32 .25-IN-LG PAN-HD-PHL	00000	ORDER BY DESCRIPTION



See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Appendix I

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
H9027	SCHURTER A G H	LUZERN	SW	
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
03508	GE CO SEMICONDUCTOR PROD DEPT	AUBURN	NY	13201
11236	CTS OF BERNE INC	BERNE	IN	46711
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
33173	GE CO TUBE DEPT	OWENSBORO	KY	42301
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP	FLORENCE	SC	06226
75915	LITTELFUSE INC	DES PLAINES	IL	60016
91637	DALE ELECTRONICS INC	COLUMBUS	NE	68601
91802	INDUSTRIAL DEVICES INC	EDGEWATER	NJ	07020
94151	GTE SYLVANIA ELEK COMPONENTS GROUP	WALTHAM	MA	02154

BACK DATING MANUAL CHANGES

APPENDIX I
MANUAL CHANGES

I-1. INTRODUCTION

I-2. This section contains information for adapting this manual to instruments for which the content does not apply directly. Refer to Table A-1 Manual Changes by Serial Number. Table A-2 relates individual component changes on assemblies to the MANUAL CHANGES. In addition, information about recommended modifications for improvements to the instruments is provided in Table A-3.

I-3. MANUAL CHANGES

I-4. To adapt this manual to your instrument, refer to Table A-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

I-5. If your instrument serial number is not listed on the title page of this manual or in Table A-1 below, it may be documented in a yellow MANUAL CHANGES supplement.

Table A-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
411-00101 to 00120	A through U	0951A01996 to 02150	L through U
411-00121 to 426-00394	B through U	1116A02151 to 02225	M through U
449—	C through U	1116A02226 to 02450	N through U
511—	D through U	1152A	O through U
548—	E through U	1313A, 1412A	P through U
748—	F through U	1645A	Q through U
749-01256 to 01280	G through U	1739A	R through U
749-01281 to 815-01680	H through U	1808A	S, T, U
815-01681 to 01830	I through U	1810A	T, U
951-01831 to 01930	J through U	1835A	U
951-01931 to 0951A01995	K through U		

Table A-2. Manual Changes by Assembly

Change	A100	A500	Chassis Parts
A		R614, R615 R620, R621	
B			R700
C			C401, R402, R403
D			08614-608 08614-622 08614-609 08614-623 08614-610
E	CR203		F2
F			F2
G			R6
H			C1, R700
I			F1, J2, S2, W1
J			R6
K			DS1
L			S1, S3, S401, S402, S403 and S601
M		R620, R621	
N			5000-8709 5060-8740 5000-8711 08616-00007 5060-8713 08616-60008 5060-8736
O			C205
P			Q1, Q2, CR4
Q		R614, R615 R620, R621	
R			Fuseholder 2110-0470
S		Q502, Q503	Q50, Q51, Q52, Q53, C54
T			Z1
U			Wire color code of C102 to K101 connection

I-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-2:
Change:
R614 and R615 to HP Part No. 2100-0409
R620 and R621 to HP Part No. 2100-0410.

CHANGE B

Figure 5-16 and Table 6-2:
Delete R700
Figure 5-20:
Change the Component Location Diagram to the one shown in Figure 7-1.

CHANGE C

Table 6-2:
Change:
C401 to 0150-0052, C:FXD CER 0.05 μF 20% 400 VDCW, 56289, 33C17A
R402 to 0687-3931, R:FXD COMP 39K ohm 10% 1/2 W, 01121, EB 3931
R403 to 0687-4741, R:FXD COMP 470K ohm 10% 1/2 W, 01121, EB 4741
Figure 5-16.
Change the value of:
C401 to 0.05
R402 to 39K
R403 to 470K.

CHANGE D

Table 6-2:
Add:
08614-608, CABLE ASSY: RF INPUT
08614-609, CABLE ASSY: RF OUTPUT
08614-610, FILTER: LOW PASS.

NOTE

If any of the above components in Change D fail, they must be replaced by the components listed in paragraph 5-51. In addition, a procedure for disassembly and assembly of the component parts is included in paragraph 5-51.

Table 6-2:
Delete:
08614-622
08614-623.
Figure 5-18:
Change the diagram with the partial schematic shown in Figure 7-2.

CHANGE E

Figure 5-19 and Table 6-2:
Delete F2
Figure 5-21 and Table 6-2:
Delete CR203.

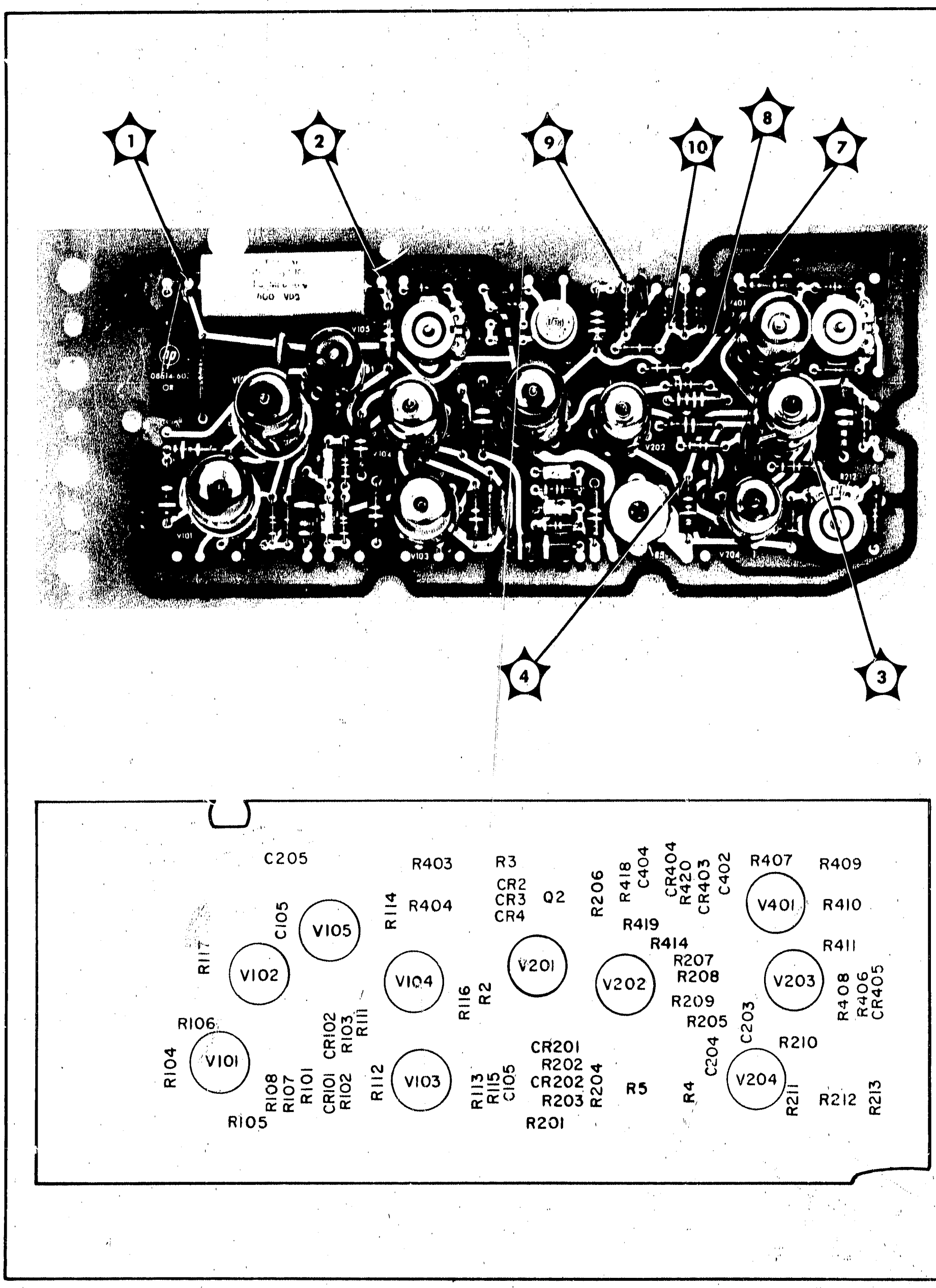


Figure A-1. High Voltage Board (A100)

Table 6-2:
Delete under reference designation F2:
1400-0008, Fuseholder

CHANGE F

Table 6-2:
Change F2 to 2110-0029, FUSE: CARTRIDGE 3 AMP 125V SLOW BLOW, 75915, 313005
Figure 5-19:
Change the value of F2 to 4A

CHANGE G

Figure 5-16 and Table 6-2:
Delete R6

CHANGE H

Figure 5-16:
Change R700 to 0687-1031, R:FXD COMP 10K ohm 10% 1/2 W, 01121, EB 1031
Figure 5-19:
Change C1 to 0180-0128, C:FXD ELEC 2800 μF +50 −10% 30 VDCW, 56289, D35718 DFP
Table 6-2:
Change the value of:
C1 to 2800
R700 to 10K

CHANGE I

Paragraph 2-10:
Change the fourth sentence to:
A 1-1/2 ampere standard fuse is used for 115 volt operation; a 3/4 ampere standard fuse is used for 230 volt operation.
Table 6-2:
Change F1 to:
2110-0043, FUSE: CARTRIDGE 1.5 AMP 250V (115V operation), 75915, 31291.5
2110-0033, FUSE: 0.75 AMP 250V (230V operation), 75915, F02GR750A
Change:
J2 to 1251-0148
S2 to 3101-0033
W1 to 8120-0078
Figure 5-19:
Change F1 description:
2A to 1.5 A
1A to 0.75A

CHANGE J

Table 6-2:
Change:
R6 to 0757-0059, R:FXD MET FLM 1 MEGOHM 1% 1/2 W, 28480, 0757-0059
Figure 5-16:
Change the value of R6 to 1M

CHANGE K

Table 6-2:
Change:
DSI to 1450-0048, INDICATOR: GLOW LAMP
NEON-RED LENS, 08717, 859-R-5

CHANGE L

Table 6-2:
Change the HP Part Number and Manufacturer Part Number of:
S1 to 3101-0042
S3 to 3101-1153
S401, S402, S403 and S601 to 3101-0043
08616-00005 to 08616-001

CHANGE M

Table 6-2:
Change:
R620 and R621 to 2100-0898, R:VAR WW 500 ohm 5% LIN 1 W, 28480, 2100-0898

CHANGE N

Table 6-2:
Delete:
5000-8709
5000-8711
5060-8713
5060-8736
5060-8740
08616-00007
08616-00008

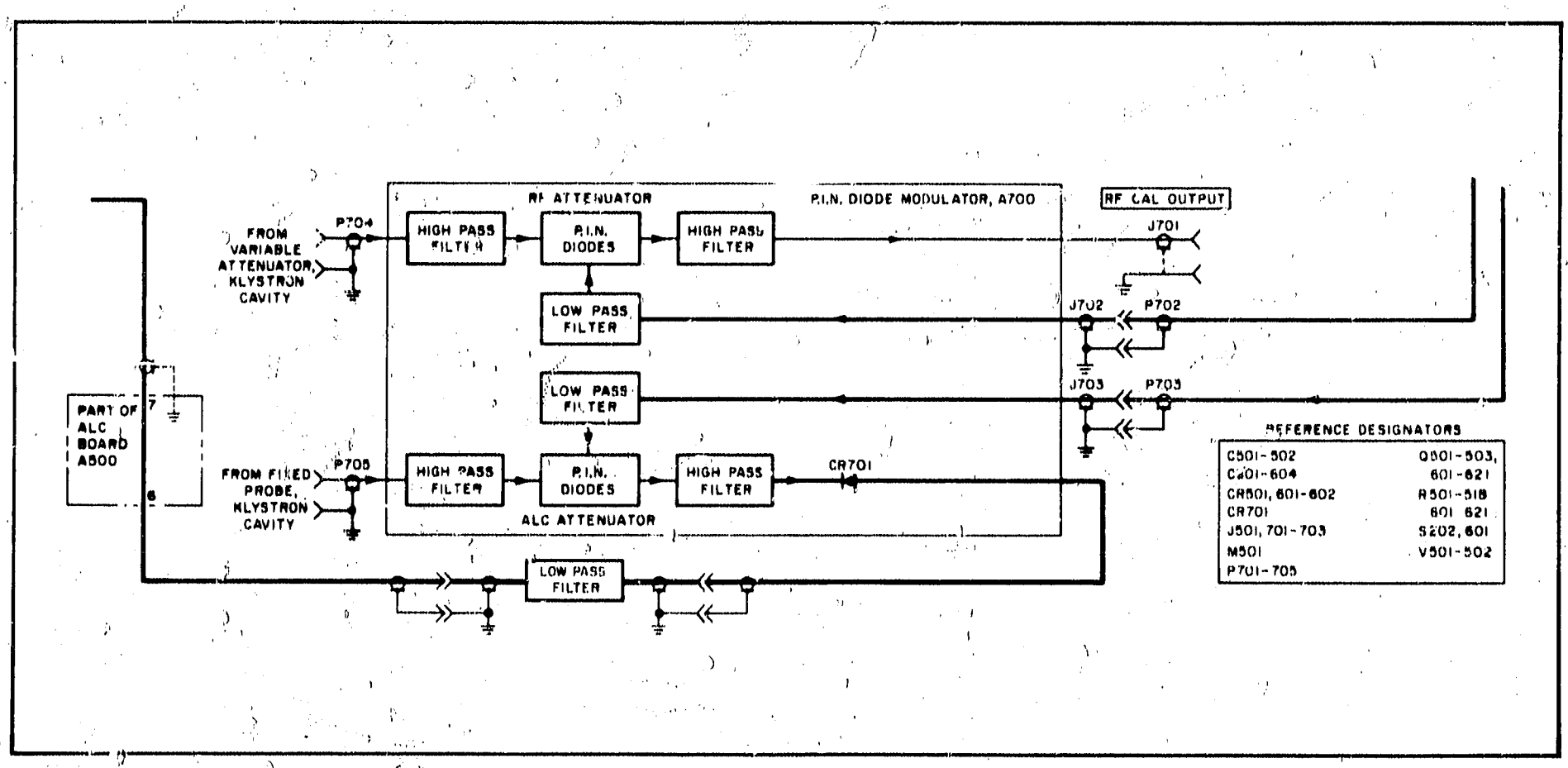


Figure A-2. Partial Schematic of Figure 5-17 ALC Circuit (Part of Change D)

CHANGE O

Table 6-2:
Change C205 to 0160-0079 and mounting bracket to 1210-0003.
Figure B-7, Illustrated Parts Identification:
Change items 46 and 47 in table to 1210-0003 and 0160-0079 respectively.

CHANGE P

Figure 5-19:
Change Q1 to 1850-0098
Change Q2 to 1850-0064
Change voltage at the base of Q2 to -327.5V
Change CR4 to 6.49V
Table 6-2:
Change CR4 to 1902-0057 DIODE—ZNR 6.49V 5% D0-7 PD=.4W TC= ± 0.029%.
Change Q1 to 1853-0098 TRANSISTOR PNP SI PD=310 MW FT=40 MHz.
Change Q2 to 1850-0064 TRANSISTOR PNP 2N1183 GE T0-8 PD=7.5W
Add 1200-0043 INSULATOR-XSTR ALUMINUM
Delete 0340-0875 INSULATOR TRANSISTOR

CHANGE Q

Figure 5-18:
Change R614 and R615 to 15K.
Table 6-2:
Change R614 and R615 to 2100-0896 RESISTOR-TRMR 15K 5% WW TOP-ADJ 1-TRN.
Change R620 and R621 to 2100-0898 RESISTOR-TRMR 500 5% WW TOP-ADJ 1-TRN.

CHANGE R

Table 6-2:
Add 2110-0470 FUSEHOLDER BODY EXTR PST BAYONET TND.
Delete 2110-0564, 2110-0565, 2110-0569, 1490-0090, and associated descriptions.

CHANGE S

Figure 5-18:
Change Q502/Q503 to 1850-0062.
Figure 5-19:
Change Q50 to 2N1183 1850-0064.
Change Q51 to 2N1670 1850-0078.
Change Q52/Q53 to 2N404 1850-0062.
Delete C54.
Table 6-2:
Delete C54.
Change Q50 to 1850-0064 TRANSISTOR PNP 2N1183 GE T0-8 PD=7.5W.
Change Q51 to 1850-0078 TRANSISTOR 2N1670 T0-9 PD=120 MW.
Change Q52, Q53, Q502, and Q503 to 1850-0062 TRANSISTOR PNP GE T0-5 PD=150 MW.

CHANGE T

Figure 5-19:
Delete Z1 from the base of Q50.
Table 6-2:
Delete Z1.

CHANGE U

Figure 5-21:
Change wire color code, connecting C102 to K101, from WH-VIO-GRY to WH-VIO.

Table A-3. 8616A Recommended Changes

Instruments Affected Serial Numbers or Prefixes	Components	Reason	Service Note
411-00101 to 411-00120	R614, R615, R620 R621	More reliable Potentiometer (Change not recommended unless failure occurs.)	8616A-11
411- to 449-	C401, R402, R403	Extends the External Pulse Rate Range to 50 Hz.	8616A-2
411- to 511-	R700	More reliable ALC Low Pass Filter (Change not recommended unless failure occurs.) Parts list and procedure for change is found in paragraph 5-51 of this manual.	8616A-3A
411- to 548-	F2, CR203 (add)	Reduce transients and provide better protection for the power supplies.	8616A-5
411- to 748-	S3, S201	New parts are more reliable (Change recommended only if components fail.)	8616A-4
411- to 748-	F2	Fuse replacement rate is reduced.	—
411- to 749-01280	R6 (add)	Better klystron protection.	8616A-6A
411- to 815-01680	C1	Reduce Residual FM.	8616A-7
411- to 815-01680	R700	Reduce External Pulse Input Transients.	8616A-8
411- to 815-	F1	Fuse replacement rate is reduced.	—
411- to 951-01930	R6	Better klystron protection.	8616A-12

APPENDIX

APPENDIX II
ILLUSTRATED PARTS IDENTIFICATION

SIGNAL GENERATOR
8616A

REF.	STOCK NO.	DESCRIPTION	QTY.
1		See Figure B-2	
2		See Figures B-3 & B-4	
3		See Figure B-5	
4		See Figure B-6	
5		See Figure B-7	
6		See Figure B-8	

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

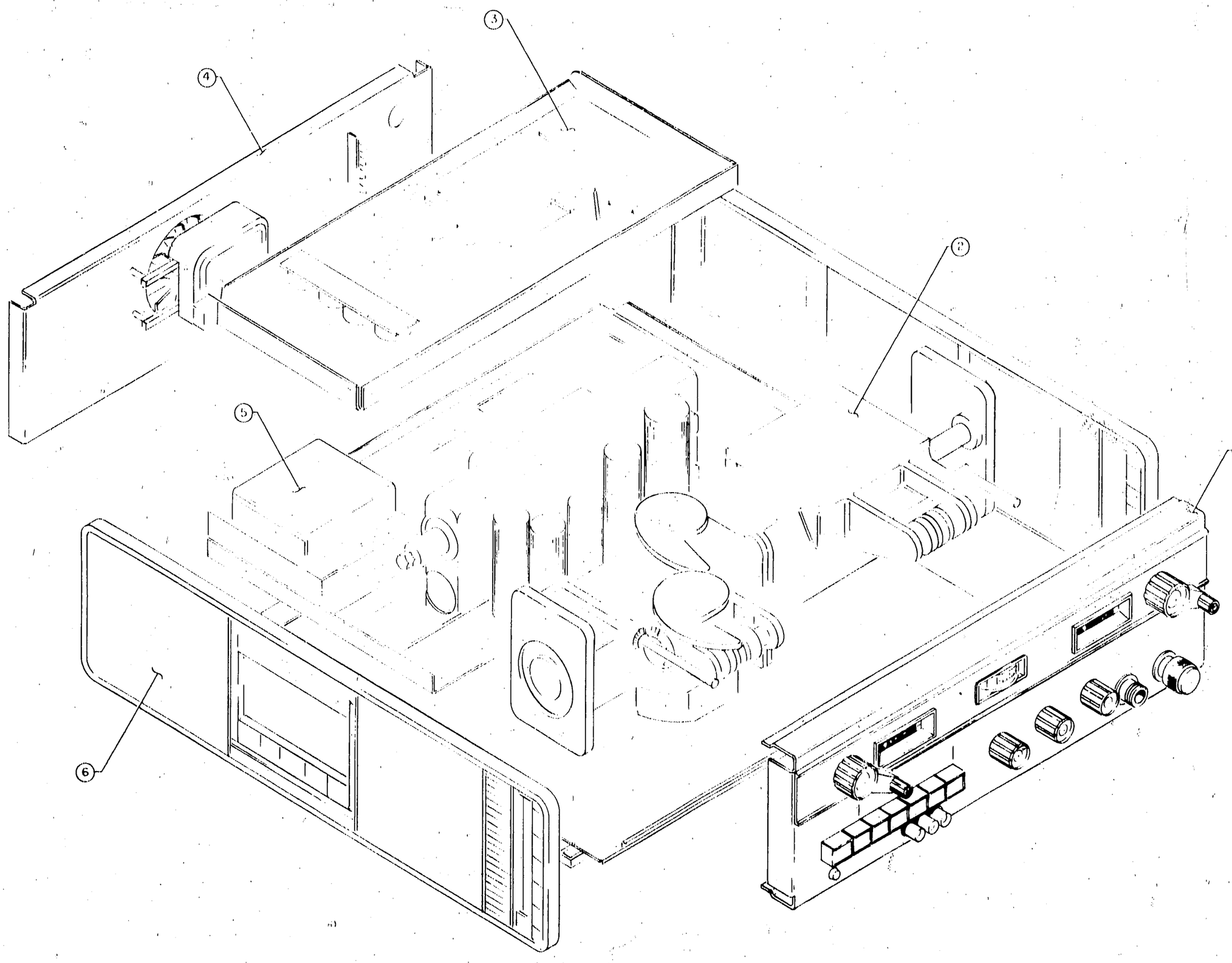


Figure B-1. HP Model 8616A, Signal Generator, General Arrangement

REF.	STOCK NO.	DESCRIPTION	QTY.
1	2550-0008	Screw, mach BH SS 8-32 x .5	1
2	2190-0017	Washer, split lock for No. 8 screw	1
3	0360-0012	Strip, 1 terminal	2
4	1400-0020	Clamp, cable, 5/8 in. dia, nylon	1
5	3101-0042	Switch, pushbutton SPST	1
6	3101-0043	Switch, pushbutton DPDT	6
7	2510-0049	Screw, Pozidrive head, SS 8-32 thd, 1/2 in. lg	3
8	0360-0007	Lug, terminal 7/8 in. lg	1
9	2190-0009	Washer, int lock for No. 8 screw	1
10	2100-0063	Resistor, variable 100K ohms 20%, 1/3W	2
11	08614-005	Plate, Mounting, switch	1
12	1120-0134	Meter, 0-200 MA	1
13	2190-0016	Washer, int lock 1/2 in. od	8
14	2950-0034	Nut, 1/2 in. wide 3/8-32 thd	1
15	2100-2140	Resistor, variable 2 x 5K ohms, 10%	1
16	2190-0022	Washer, int lock 11/16 in. od	8
17	0370-0118	Knob, 11/16 in. wide Gray, pushbutton	6
	0870-1400	Knob, 11/16 in. wide Jade gray, pushbutton	6

REF.	STOCK NO.	DESCRIPTION	QTY.
	0370-0928	Knob, 11/16 in. wide, line switch, light gray, pushbutton	1
	0370-1877	Knob, 11/16 in. wide, line switch, jade gray, pushbutton	1
18	3050-0071	Washer, 7/16 in. od 0.172 in. id, brass	4
19	2950-0030	Nut, 9/16 in. wide 3/8-32 thd, br	2
20	3050-0067	Washer, 5/8 in. od 3/8 in. id, brass	5
21	5000-0247	Label, pushbutton (RF)	1
22	5000-0248	Label, pushbutton (LINE)	1
23	5000-0246	Label, pushbutton (SQ. WAVE)	1
24	5000-0237	Label, pushbutton (ALC)	1
25	5000-0245	Label, pushbutton (PULSE)	1
26	5000-0249	Label, pushbutton (AM)	1
27	5000-0244	Label, pushbutton (FM)	1
28	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	6
29	0360-0024	Lug, terminal 3/8 in. id	2
30	2100-0407	Resistor, variable 5K ohms 10%, 5W	1
31	0370-0111	Knob, 1/4 in. shaft	
32	2950-0042	Nut, 1 in. wide 3/4-20 thd, br	2
33	2190-0051	Washer, int lock 1 in. od	2
34	08616-001	Front panel	1

REF.	STOCK NO.	DESCRIPTION	QTY.
35	2190-0008	Washer, ext lock for No. 6 screw	2
36	0360-0043	Lug, brass	1
37	2390-0007	Screw, bind head, SS 6-32 thd, 5/16 in. lg	14
38	1400-0017	Clamp, cable 5/16 in. dia, nylon	1
39	0510-0123	Retainer, push-on for 5/16 in. stud	1
40	1450-0048	Light, red indicator 3/8 in. dia.	1
41	1250-0083	Connector, recept BNC UG1094/U SPEC	3
42	1250-0144	Body, connector, bulk-head cable jack, Type N	2
43	0370-0026	Knob, 3/4 in. dia, blk, 1/4 in. shaft w/arrow	3
44	08614-626	Cap Assy.	1
45	08614-010	Plate, instruction	1
46	1410-0110	Bushing, .375-32 thd .5 lg, 0.280 id	2
47	0370-0149	Knob, 1-5/8 in. dia. blk, 1/4 in. shaft crank type	2
48	1410-0033	Bushing, knob 0.219 od, 0.140 id	2
49	0370-0050	Knob, 3/8 in. dia, blk, crank handle	2
50	2360-0210	Screw, Posidrive 6-32 thd, 5/8 in. lg	2
51	5040-0202	Bezel, counter; freq	1
52	1410-0052	Bushing, 0.438 in. lg x 0.261 in. id	1
53	5040-0201	Bezel, counter; atten.	1
54	3101-1153	Switch: Push-Button	2

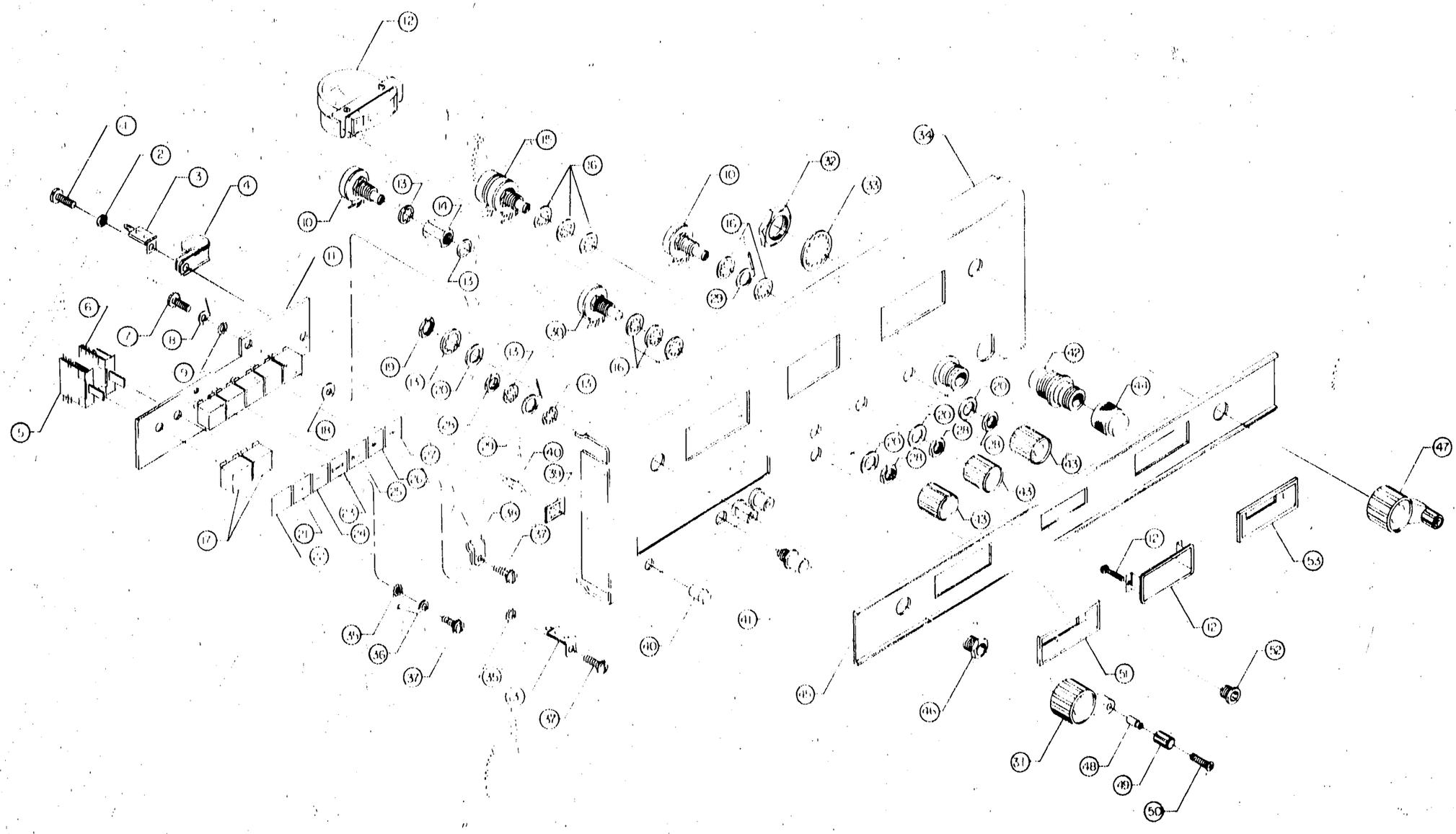


Figure B-2. HP Model 8616A, Signal Generator, Control Panel

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0150-0024	Capacitor, fxd, cer, 0.02 μf, 600 vdcw	1
2	0160-0152	Capacitor, fxd, paper 0.1 μf, 20%, 600 vdcw	3
3	0510-0080	Ring, retain ext .392 D, .042 thk	1
4	0510-0083	Ring, retain ext .025 thk	2
5	0510-0118	Ring, retain int .062 thk	1
6	0510-0152	Ring, retain, 2.490 free dia, .078 thk	1
7	0570-0926	Screw, shoulder, 10-32 x .390 50 MS - 3511	2
8		Not Assigned	
9	1140-0007	Number wheel, 0-9 cc rot., 1 x .5W	1
10	1140-0008	End wheel, 0-9 cc rot. 1 x .281W	1
11	1140-0010	Unit wheel, 00-99 cc rot., 1 od	1
12	1200-0014	Socket, 4 pin tube ring mounting	1
13	1200-0429	Sleeve, nylon 3/16 in. lg	4
14	1410-0012	Bearing, ball 7/8 od, 3/8 id	5
15	1410-0017	Bearing, ball .6882 od, .249 wd	2
16	1410-0203	Bearing, ball, 1-1/16 in.	1
17	1410-0047	Bushing, bronze 1/2 dia, 1/4 lg	2
18	1430-0035	Gear, pinion, 8 T 22 F, .454 od	2
19	1430-0040	Gear, bevel, 30T, 48P .625 PD, .250 bore	1
20	1430-0041	Gear, bevel, 60T, 48P 1.250 PD, .250 bore	1
21		Not Assigned	
22	1460-0116	Washer, spring, .562 id, .812 od, .010 thk	5
23	1460-0117	Spring, Compression	3
24		Not Assigned	
25	1480-0008	Pin, roll, .062D, .25 lg	2
26	1480-0072	Pin, spiral, .062 D, .5 lg	1
27	1600-0023	Disc, alum, 14 ga., 2.625 dia	1
28	1950-0023	Tube, klystron, 6BL6	1
29	5060-0335	Resistor, variable 100K ohms, 5%	1
30	5060-0322	Contact, rotar	1
31	5060-1113	Lug, contact	1
32		Not Assigned	
33	3050-0186	Washer, flat teflon 1 od, .5 id	2
34	3050-0197	Washer, spring, BECU 1.375 id, 1.9375 od	1
35	3050-0199	Washer, flat, SS 0.512 id, 7/16 od, .046 T	1
36	3102-0009	Switch, SPDT	1
37	7100-0091	Cover	1
38	8160-0042	Wire, stainless steel	1
39	3050-0017	Washer, 3/8 in. od 0.26 in. id, bronze	2
40		Not Assigned	
41		Not Assigned	
42	08614-200	Eccentric, adjust	1
43	08616-204	Shield	3
44	08614-20014	Nut, clamp	1
45	08616-20042	Clamp, spacer	1
46	08616-205	Gear, frequency drive	1
47	08614-207	Gear, stop	1
48	08616-206	Gear, freq counter	1
49	08614-210	Shaft	1
50	08614-211	Shaft, freq counter	1
51	08614-214	Shaft, freq pinion	1
52	08614-218	Spacer, shouldered	1
53	08614-220	Spacer, worm gear	1
54	08614-223	Insulator, repeller cap	1
55	08614-224	Nut, plain, hex	2
56	08616-207	Terminal lug	2
57	08614-235	Pin, loading rack	3
58	08614-237	Cam, microswitch	1
59	08616-232	Gear, rack	1

REF.	STOCK NO.	DESCRIPTION	QTY.
60	08614-245	Gear, brass	1
61	08614-247	Gear, rack loading	1
62	08614-248	Gear, stop	1
63	08616-20043	Housing, clamp	1
64	08614-253	Worm, shaft	1
65	08614-254	Insulator, plate	1
66	08616-208	Cam, freq	1
67	08616-209	Cam, length	1
68	08616-211	Spacer, Cam	2
69	08616-218	Carriage, probe	1
70	08614-267	Gear, spur	1
71	08614-270	Board, P.C.	1
72	08614-272	Casting, tuned cavity	1
73	08616-20041	Conductor, center	1
74	2200-0155	Screw, Pozidrive, br 4-40 thd, 1 in. lg	3
75	0360-0036	Terminal, solder lug	2
76	0360-0037	Lug, terminal 1/2 in. lg	4
77	0520-0019	Screw, bd head, nylon 2-56 thd, 3/16 in. lg	1
78	0520-0133	Screw, Pozidrive, SS 2-56 thd, 1/2 in. lg	2
79	2190-0004	Washer, int lock for No. 4 screw	6
80	2190-0014	Washer, int lock 0.185 in. od	2
81	2190-0016	Washer, int lock 1/2 in. od	3
82	2200-0147	Screw, Pozidrive, SS 4-40 thd, 1/2 in. lg	4
83	2260-0002	Nut, 3/16 in. wide 4-40 thd, SS	2
84	2200-0170	Screw, flat head, brass 4-40 x .625 Pozidrive	6
85	2360-0117	Screw, Pozidrive, SS 6-32 thd, 3/8 in. lg	3
86	2740-0002	Nut, 3/8 in. wide 10-32 thd, SS	2
87	2950-0001	Nut, 1/2 in. wide 3/8 -32 thd, br	4
88	3030-0012	Screw, allen, dr set 10-32 thd, 1/4 in. lg	3
89	3030-0017	Screw, allen, dr cap 8-32 thd, 1/2 in. lg	2
90	3030-0022	Screw, allen, dr set 6-32 thd, 1/8 in. lg	10
91	3030-0033	Screw, allen, dr set 6-32 thd, 1/8 in. lg	1
92	3050-0019	Washer, brass .50 D, .2 id, .04 thk	4
93	3050-0010	Washer, brass .3125 od, .147 id	1
94	3050-0100	Washer, 7/16 in. od 0.147 in. id, brass	2
95		Not Assigned	
96	08616-226	Screw Atten	1
97	08614-2002	Bushing, teflon	1
98	08616-220	Plunger Support	3
99	3050-0029	Washer, 7/16 in. od 1/4 in. id, brass	1
100	08616-20047	Bearing, sleeve	1
101	08616-210	Wiper	2
102	08614-6004	Filter Assembly	1
103	08614-258	Nut, Attn.	1

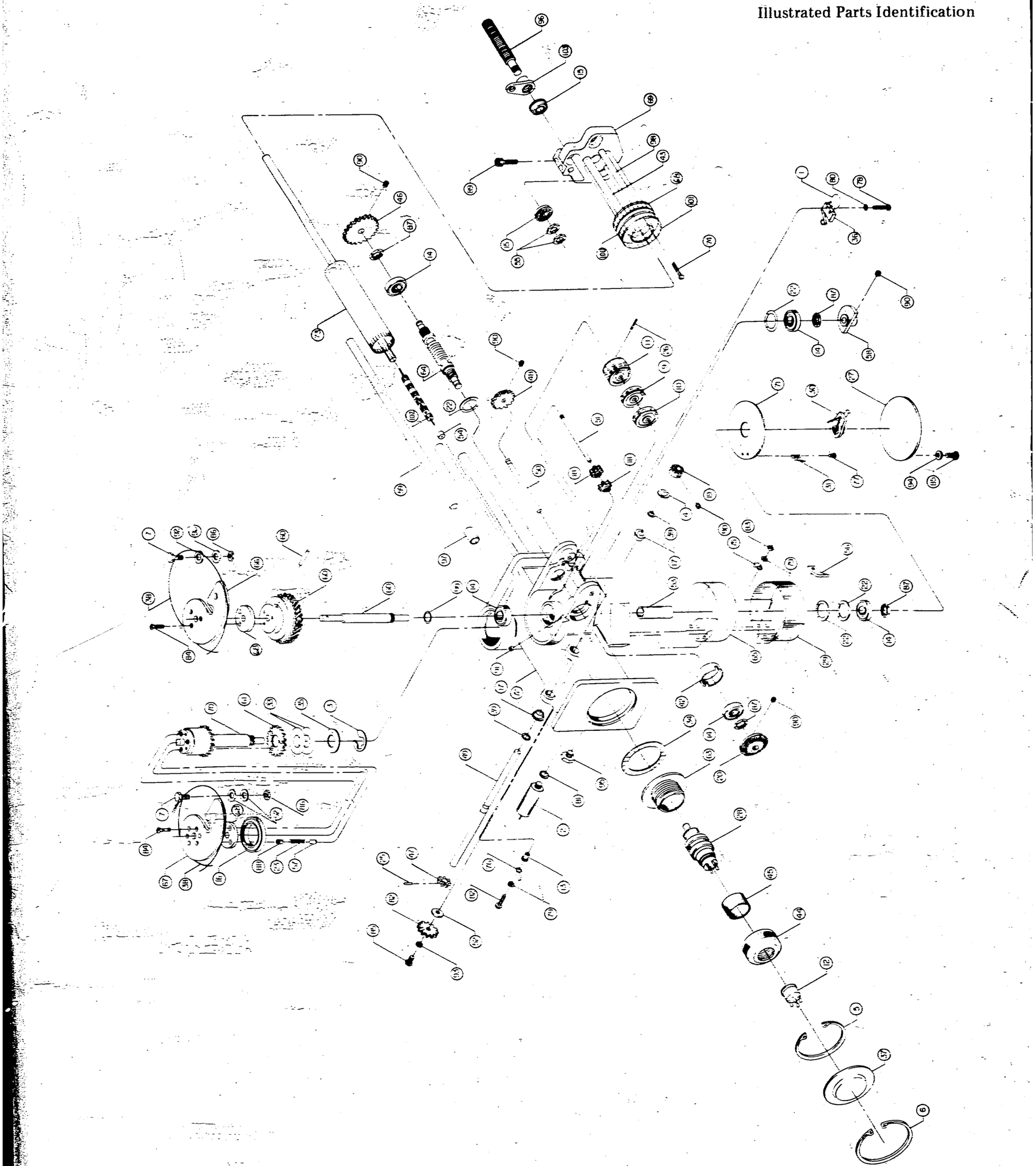


Figure B-3. HP Model 8616A, Signal Generator, Cavity Assembly

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0510-0083	Ring, retain, ext .025 thk	1
2	1140-0007	Number wheel, 0-9 cc rot., 1 x .5 W	1
3	1140-0009	Unit wheel, 0-9 cc w rot., 1 od	1
4	1410-0015	Bearing, ball 5/8 od, 1/4 id	1
5	1410-0047	Bushing, bronze 1/2 dia, 1/4 long	2
6	1430-0023	Gear, bevel 24 teeth, brass	1
7	1430-0035	Gear, pinion, 8T, 22F .454 od	2
8	1430-0038	Gear, bevel, 48P, 32T brass, 50MA3536	1
9	1430-0039	Gear, bevel, 48P, 30T brass, 50MA3537	1
10	1460-0179	Spring, Compression (Probe)	2
11	1480-0227	Pin	1
12	1480-0072	Pin, spirol, .062 D .5 lg	1
13	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	1
14	5040-0217	Gear, brass bevel	1
15	08614-20008	Gear, stop	1
16	08614-207	Gear, stop	1
17	08614-209	Shaft	1
18	08614-212	Shaft, attenuator, pinion	1
19	08614-213	Shaft, attenuator, counter	1
20	08614-218	Spacer, shouldered	1
21	08614-231	Spring, washer	1
22	08614-236	Counter, wheel, modified	1
23	08614-242	Casting, attenuator cover	1
24	08614-252	Shaft, flatted	1
25	08614-273	Housing, attenuator	1
26	08614-279	Nut, clamping	1
27	08614-280	Clamp, shaft	1
28	08616-604	Probe, assembly ALC	1
29	08616-606	Probe assy. attenuator	1
30	08614-262	Guide, coaxial cable	1
31	2360-0119	Screw, Pozidrive 6-32 thd, 7/16 in. lg	1
32	3030-0005	Screw, allen, dr set 8-32 thd, 1/8 in. lg	6
33	3030-0145	Screw, set, stl 6-32 x 1/8 lg, FP	2
34	3030-0017	Screw, allen, dr cap 8-32 thd, 1/2 in. lg	4
35	3030-0007	Screw, allen, dr set 4-40 thd, 1/8 in. lg	2
36	3050-0017	Washer, 3/8 in. od 0.26 in. id, bronze	1
37	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	1
38	2380-0002	Screw, fil h, SS 6-32 x .375	5
39	2360-0121	Screw, Pozidrive, 6-32 thd, 1/2 in. lg	6
40	5000-0206	Washer, spring 9/16 in. dia	1
41	1410-0202	Bushing, bronze	1
42	3030-0151	Screw, cap	2
43	2200-0003	Screw, round head, SS 4-40 thd, 1/4 in. lg	1
44	3050-0124	Washer, brass .218 od, .130 id	1
45	1250-0147	Nut, retaining type BNC connector	3
46	1250-0146	Washer, flat Type BNC connector	3

REF.	STOCK NO.	DESCRIPTION	QTY.
47	1250-0145	Gasket, clamp Type BNC connector	3
48	1250-0143	Washer, clamp Type BNC connector	3
49	1250-0141	Body, clamping Type N connector	3
50	1250-0142	Nut, clamp, Type BNC connector	3
51	8160-0090	Gasket, R. F.	1

REF.	STOCK NO.	DESCRIPTION	QTY.
54	1250-1026	Contact, center, Type N connector, female	1
55	1250-0148	Washer, insulating Type N connector	1
56	08614-00221	Bead, connector 0.45 in. dia	1
57	8120-0114	Cable, RF coax Triple shield, 50 ohm	3

REF.	STOCK NO.	DESCRIPTION	QTY.
58		Same as Items 45, 46, 47, 48, 49, 50, 51, 55, and 57	
59	08614-241	Casting, base	1
60	08616-605	Probe Assembly RF	1
61	1460-1074	Spring: Compression	1
62	08614-217	Label: UNCAL	

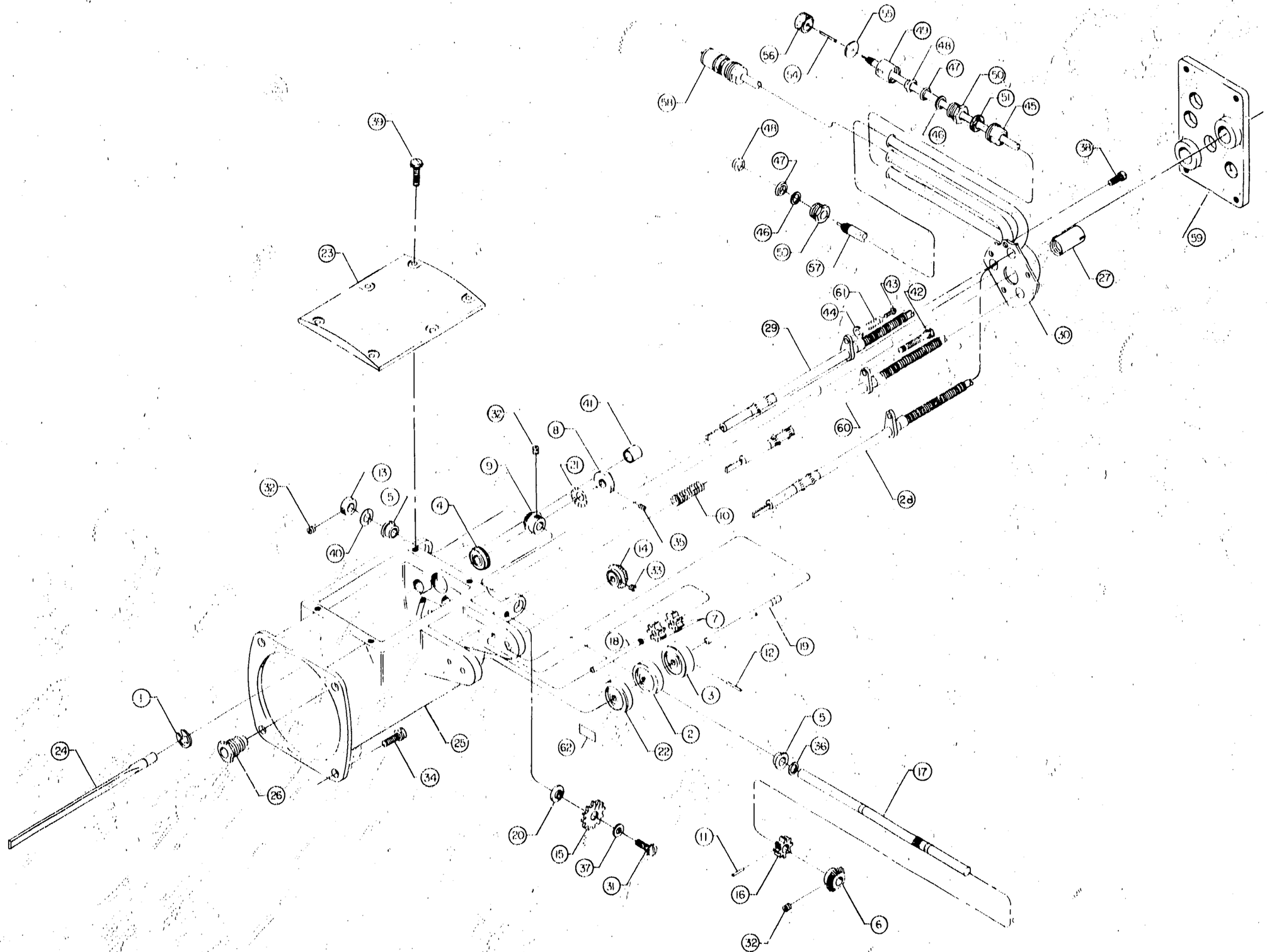


Figure B-4. HP Model 8616A, Signal Generator, Probe Assembly

REF.	STOCK NO.	DESCRIPTION	QTY.
1	08614-215	Plate, insulator	1
2	2100-0028	Resistor, variable 50K ohms 10%, 2.25W	3
3	2100-0029	Resistor, variable 250K ohms 10%, 2.25W	1
4	2510-0107	Screw, Pozidrive, SS 8-32 thd, 1/2 in. lg	11
5	2190-0017	Washer, split lock for No. 8 screw	13
6	3050-0001	Washer, 3/8 in. od 0.172 in. id, brass	13
7	1400-0024	Clamp, cable 1/4 in. dia., nylon	4
8	1400-0017	Clamp, cable 5/16 in. dia., nylon	2
9	08616-603	Board, high voltage	1
10	2190-0016	Washer, int lock 1/2 in. od	4
11	2950-0030	Nut, 9/16 in. wide 3/8-32 thd, br	4
12	2950-0033	Nut, 1/2 in. wide 3/8-32 thd, br	4
13	1400-0071	Clamp, tube 2-3/4 in. high	2
14	2950-0014	Nut, hex, SS .25-28 x .4375	1
15	0360-0040	Terminal, lug, bronze flat type	1
16	3050-0103	Washer, 9/16 in. od 1/4 in. id, SS	1
17	0340-0822 3050-0591	Bushing, Teflon Insulator, Mica	2
18	1400-0023	Clamp, cable 9/16 in. dia, nylon	4
19	2260-0001	Nut, 1/4 in. wide 4-40 thd, SS	2
20	2190-0003	Washer, split lock for No. 4 screw	2
21	1200-0081	Insulator, transistor nylon, .235 in. od	2
22	0360-0016	Lug, terminal 3/4 in. lg	2
23	1200-0043	Insulator, transistor 1.11 x 1.78 in.	1
24	1850-0098	Transistor, Germanium PNP, 2N2084	1
25	2200-0147	Screw, Pozidrive, SS 4-40 thd, 1/2 in. lg	2
26	1901-0032	Diode, Silicon, 1N3209	1
27	08614-219	Spacer Chassis Mtg.	2
28	1400-0008	Fuse Holder	1
29	3050-0001	Flat Washer	1
30	2360-0201	Screw, Pozidrive 6-32 thd, 1/2 in. lg	1
31	2190-0006	Lock Washer	1
32	2420-0003	Nut	1
33	08614-021	Chassis, H.V.	1

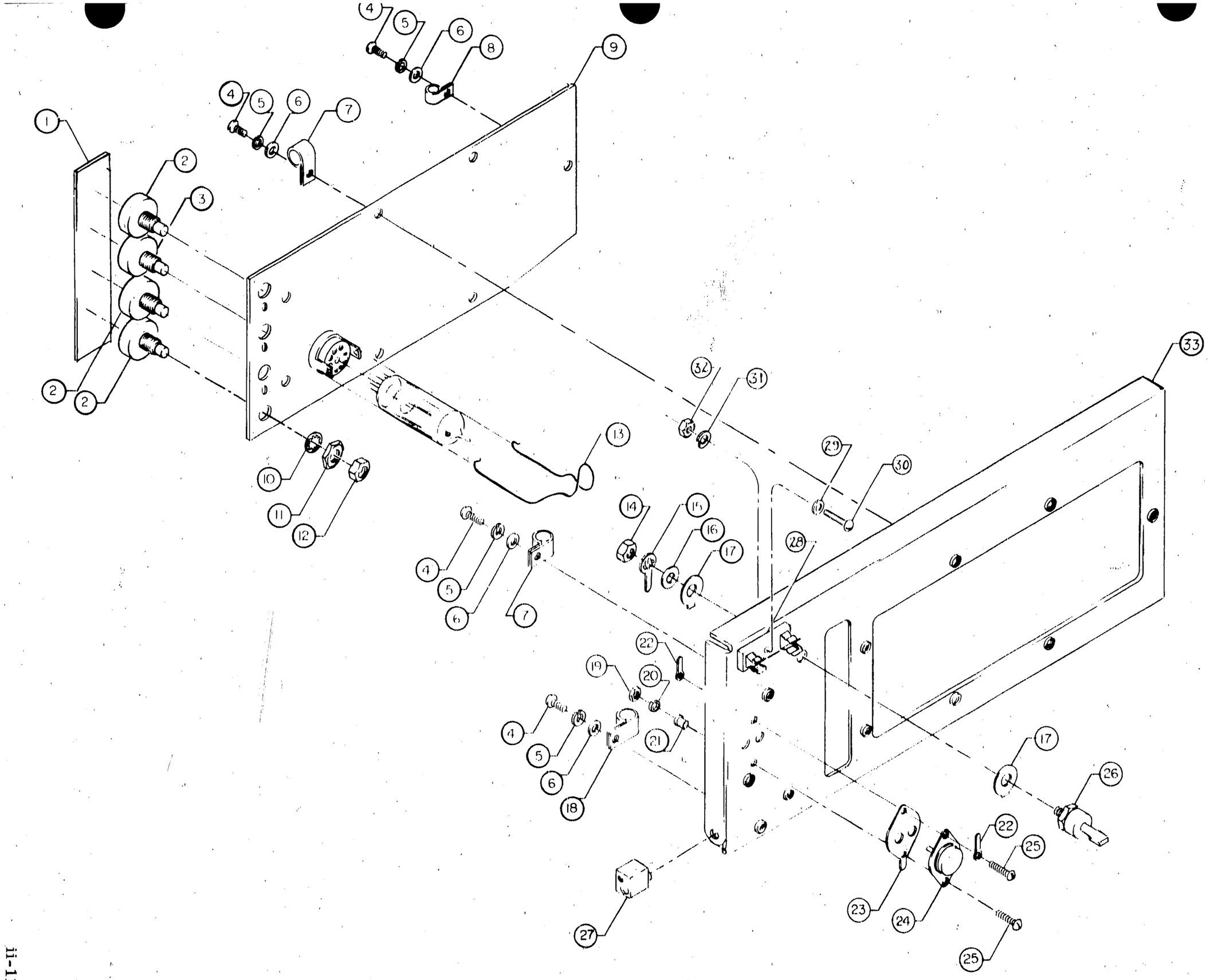


Figure B-5. HP Model 8616A, Signal Generator, High Voltage Power Supply Assembly

REF.	STOCK NO.	DESCRIPTION	QTY.
1	3140-0030	Motor, fan, 2800 RPM 115V, 60 cps	1
2	3160-0030	Fan blade, propeller 2-3/4 in. dia.	1
3	08614-013	Shield	1
4	08614-014	Shield	1
5	08614-015	Shield	1
6	08551-2155	Spacer, bakelite	12
7	08614-281	Support, fan motor	2
8	2190-0004	Washer, int lock for No. 4 screw	8
9	2200-0155	Screw, Pozidrive 4-40 x 1	4
10	2260-0001	Nut, 1/4 in. wide 4-40 thd, SS	4
11	2200-0149	Screw, Pozidrive 4-40 thd, 5/8 in. lg.	4
12	2510-0113	Screw, Pozidrive, 6-32 thd, 7/8 in. lg	4
13	2190-0007	Washer, int lock for No. 6 screw	4
14	3030-0001	Screw, Allen dr. set 8-32 thd, 3/16 in. lg	1
15	2520-0008	Screw, round head SS 8-32 thd, 7/8 in. lg.	2
16	08614-611	Air Filter assembly	1
17	2110-0564	Fuseholder, body	1
	2110-0565	Fuseholder, cap	
18	2110-0002	Fuse, cartridge 2 amp, 250 volt	1
19	0510-0110	Nut, cap, 6-32 thd.	4
20	08614-008	Panel, recessed rear	1
21		Not assigned	
22	0361-0008	Rivet, semi-tubular oh 5/32 long	6
23	3050-0067	Washer, 5/8 in. od 3/8 in. id, brass	1
24	0900-0016	O-Ring, 1/2 in. id x 11/16 in. od	1
25	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	1
26	0361-0004	Rivet, semi-tubular oh 3/16 in. long	1
27	6960-0001	Button, plug for 3/8 in. hole	3
28	6960-0003	Button, plug for 3/4 in. hole	2
29	2190-0021	Washer, int lock 0.78 in. od	1
30	2110-0569	Nut, 11/16 in. wide 1/2-24 thd, steel	1
31	1251-0011	Connector, female, 4 pin	1
32	1251-2357	Connector, male, 3 pin	1
33	0380-0008	Spacer, 1/2 in. lg 1/4 in. od	4
34	0360-0018	Strip, 5 terminal 4 ins, 1 gnd	1
35	2190-0022	Washer, int lock 11/16 in. od	1
36	1251-0070	Connector, phone jack 3 cond	1
37	3101-1234	Switch, slide, DPDT	1

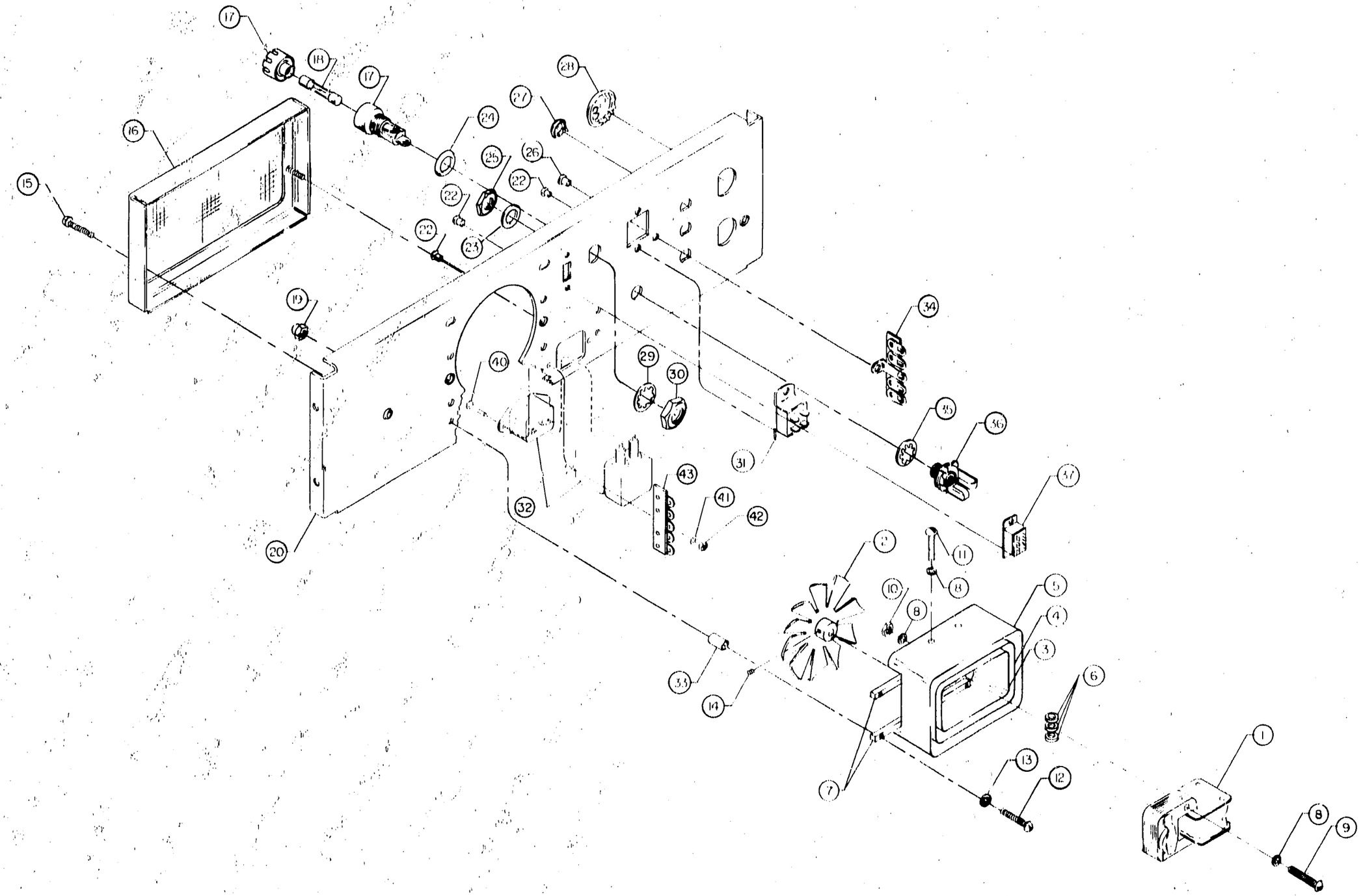


Figure B-6. HP Model 8616A, Signal Generator, Rear Panel

REF.	STOCK NO.	DESCRIPTION	QTY.
1	8120-0114	Cable, RF coax triple shield, 50 ohm	25 "
2	1250-0147	Nut, retaining type BNC connector	2
3	3050-0099	Washer, 1/2 in. od 1/4 in. id, brass	1
4	3050-0182	Washer, SI. rubber .220 id, .510 od	1
5	0905-0064	Gasket - RD BRS Mesh AG PLT 1/4 id, 1/2 od	2
6	1250-0142	Nut, clamp type BNC connector	2
7	1250-0146	Washer, flat type BNC connector	2
8	1250-0145	Gasket, clamp type BNC connector	2
9	1250-0143	Washer, clamp type BNC connector	2
10	1250-0141	Body, clamping type N connector	2
11	1250-0148	Nut, retaining type BNC connector	2
12	1250-0017	Contact, center, type N connector, female	1
13	5040-0214	Bead, connector 0.45 in. dia.	1
14		Not Assigned	
15		Not Assigned	
16		Not Assigned	
17		Not Assigned	
18	8150-0094	Wire, electric, 24 awg	2
19	1250-0041	Connector, nut .136 id, BNC plug	2
20	1250-0042	Washer, flat, type BNC connector	4
21	1250-0043	Gasket, clamp type BNC connector	4
22	3050-0023	Washer, fibre .25 od, .144 id	2
23	08716-207	Capacitor, fixed	2
24	08616-601	Assembly leveler	1
25		Not Assigned	
26		Not Assigned	
27		Not assigned	
28		Not assigned	
29		Not Assigned	
30		Not Assigned	
31		Not assigned	
32		Not Assigned	
33		Not Assigned	
34	2510-0107	Screw, Pozidrive 8-32 thd, .5 lg	13
35	2190-0017	Washer, split lock for No. 8 screw	18
36	3050-0001	Washer, 3/8 in. od 0.172 in. id, brass	13
37	1400-0053	Clamp, cable 3/16 in. dia., nylon	3
38	08614-602	Board assy, circuit	1
39	9100-0176	Transformer, power	1
40	2580-0004	Nut, 11/32 in. wide 8-32 thd, SS	4
41	08614-023	Chassis ALC	1
42	2940-0004	Screw, truss head br 1/4-20, 1/2 in. lg	3
43	2190-0032	Washer, split lock for 1/4 in. screw	4
44	2950-0004	Nut, 7/16 in. wide 1/4-20 thd, SS	4
45	08614-004	Stiffener, chassis	1
46	1400-0512	Bracket, capacitor mounting	1
47	0160-0593	Capacitor, fixed, paper 1 μf, 10%, 600 vdcw	1

REF.	STOCK NO.	DESCRIPTION	QTY.
48	2420-0001	Nut, 5/16 in. wide, SS 6/32 thd, w/lock	3
49	0180-0135	Capacitor, fxd, elect 40/10 μf, 50/450 vdcw	1
50	0180-0011	Capacitor, fxd, elect 20 μf, 450 vdcw	2

REF.	STOCK NO.	DESCRIPTION	QTY.
51	0180-0024	Capacitor, fxd, elect 40 μf, 450 vdcw	1
52	0180-0213	Capacitor, fxd, elect 5000 μf, 30 vdcw	1
53	0490-1198	Relay, open frame 3PDT, 110 vdc coil	1

REF.	STOCK NO.	DESCRIPTION	QTY.
54	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	4
55	0570-0046	Screw, mach, nylon fil hd, 8-32	1
56	1400-0024	Clamp, cable 1/4 in. dia, nylon	5
57	2940-0005	Screw, truss head, SS 1/4-20, 3/4 in. lg	4
58	08614-2003	Cap, Connector	1
59	1460-0285	Spring	1
60	2190-0057	Int. tooth lock	1
61	0160-2152	Capacitor	1
62	08614-623	Coaxial Cable	1
63	08614-622	Assemb y Items 58, 59, 60, 61	

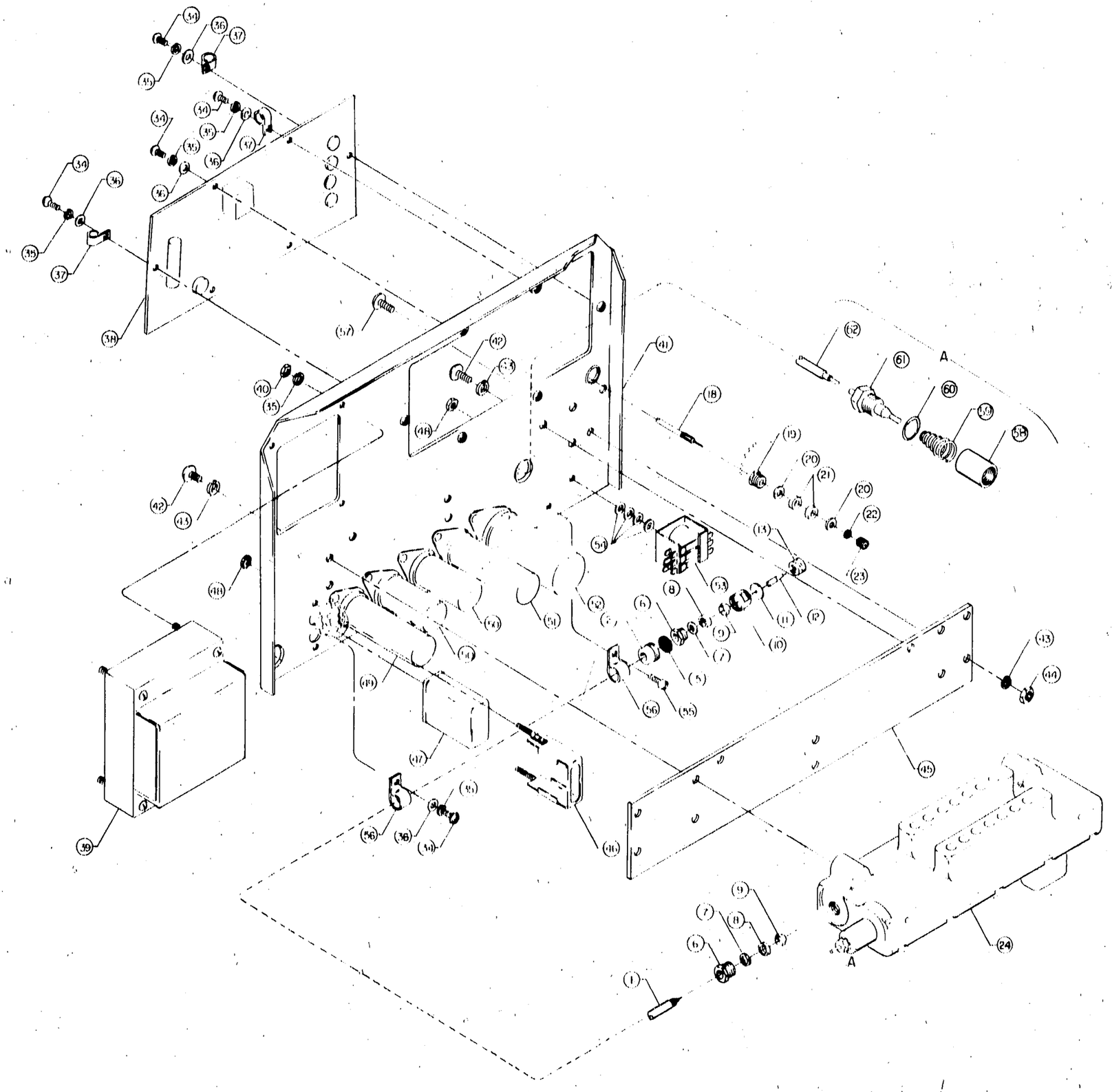


Figure B-7. HP Model 8616A, Signal Generator, Leveler Chassis

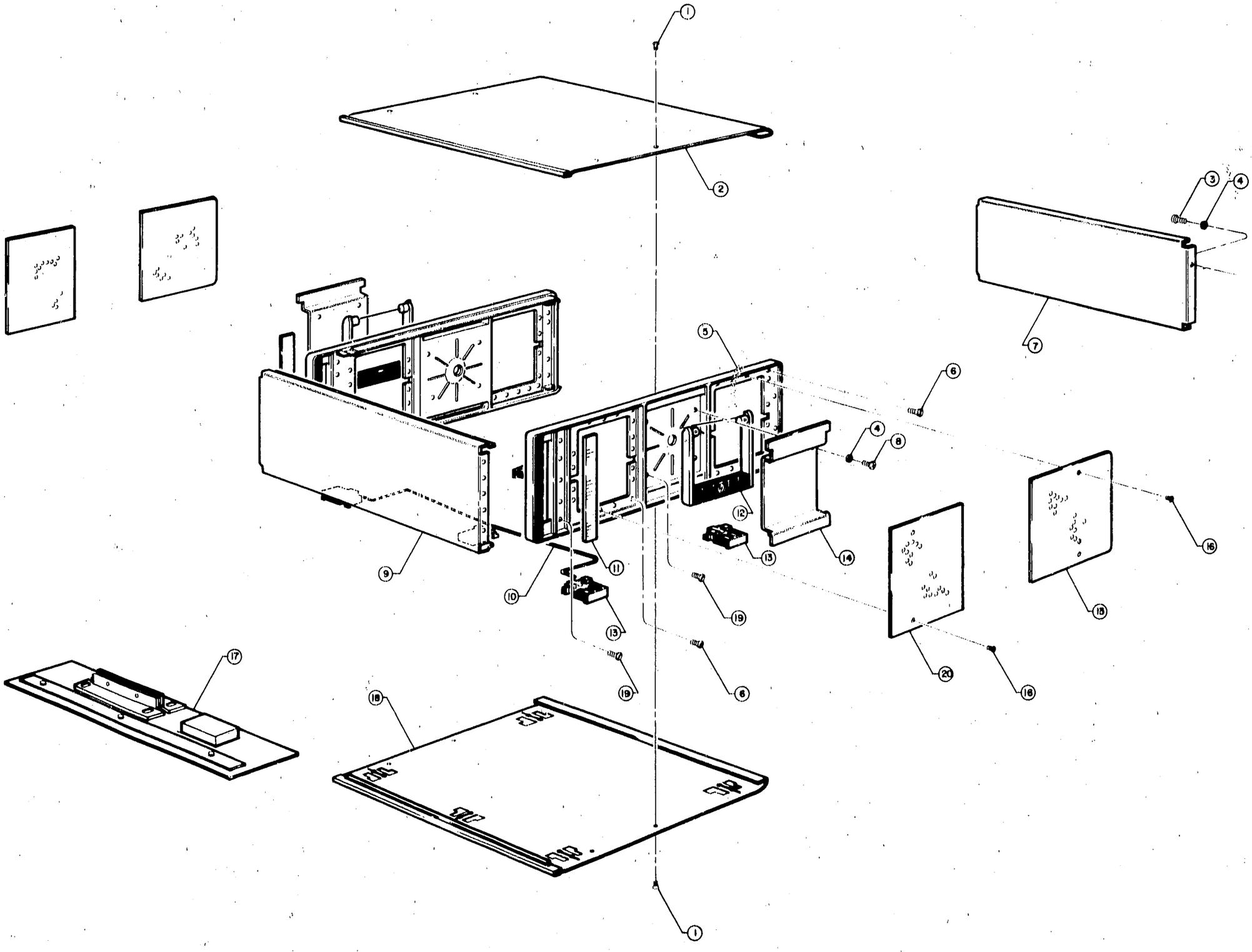


Figure B-8. HP Model 8616A, Signal Generator, Cabinet Assembly