SIGNAL GENERATOR
HEWLETT-PACKARD 8616A

BY COMMAND OF THE DEFENCE COUNCIL

Ministry of Defence

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CONTENTS

SIGNAL GENERATOR
HEWLETT-PACKARD 8616A

GENERAL AND TECHNICAL INFORMATION

Issued Sept 77

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

8616A
SIGNAL GENERATOR

SERIAL NUMBERS

This manual applies directly to instruments with Serial Numbers prefixed 1152A.

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.

For information on serial numbers prefixes above 1152A, 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.

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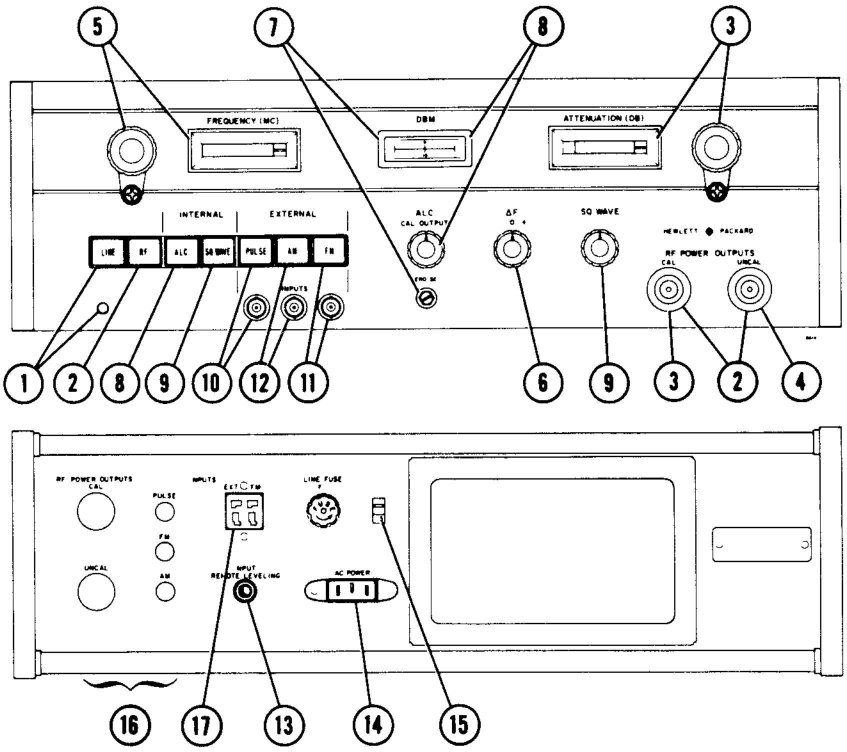
FRONT AND REAR PANEL



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

ILLUSTRATIONS

TABLES

Figure 1-1. Model 8616A Signal Generator

Table 1-1. Specifications

Frequency Range: direct reading within 2 MHz 1800 to 4500 MHz.

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

Frequency Calibration Accuracy: ±10 MHz.

Frequency Stability: Approx. 0.005%/°C change in ambient temperature, less than 2500 Hz peak residual FM, in a 10 kHz bandwidth, negligible incidental FM in pulse and AM operation for attenuator settings below −10 dB. 0.003% change for line voltage variation of ±10%.

RF Output Power: +10 dBm to −127 dBm from 1800 to 3000 MHz into a 50Ω load; +3 dBm to −127 dBm from 3000 to 4500 MHz into a 50Ω load.
A second uncalibrated output (approximately 0.5 mW) is provided on the front panel.

RF Output Power Accuracy (with respect to attenuation dial: ±1.0 dB + attenuator accuracy (0 to −127 dBm).

Attenuator Accuracy: +1, −2 dB from 0 to −10 dBm; ± (0.2 dB + 0.06 dB/10 dB) from −10 to −127 dBm.

Leveled Output: over entire frequency range at any attenuation setting below 0 dB; ±1.0 dB.

Internal Impedance: 50Ω; SWR less than 2.0.

Modulation: On-off ratio at least 20 dB for square wave, pulse.

Internal Square Wave: 950 to 1050 Hz. Other frequencies available on special order.

External Pulse: 50 Hz to 50 kHz; 2 μsec rise time, +20 to +100V peak input.

External AM: DC to 1 MHz.

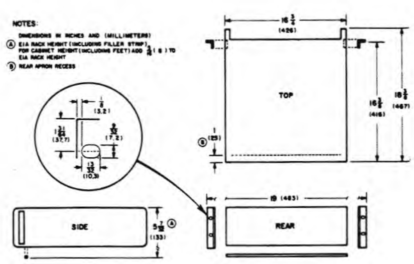
External FM:

a. Front panel connector capacity-coupled to repeller of klystron.
b. Four terminal rear panel connector (Cinch-Jones type S304AB) is DC-coupled to repeller of klystron.

Mode width between 3 dB points varies as follows: from minimum of about 4 MHz to 5.5 MHz between 1800 and 3000 MHz to a maximum of about 8.5 MHz between 3000 and 4500 MHz; klystron sensitivities are about 100, 50, 200 and 100 kHz/V, respectively.

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

Dimensions:



Weight: net 48 lb. (22 kg).

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 wave-guide-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. Two instruments capable of extending the operating parameters of the generator are the 8403A and the Model 2650A. The Model 8403A Modulator produces output pulses with 30 to 40 nanosecond rise and decay time characteristics. Pulse outputs are accurately variable in frequency, width, and delay. Amplitude modulation is available with frequency responses to 10 MHz for sine waves. Square-wave frequency capability is accurately available. The modulator also provides sync and delayed-sync outputs.

1-8. The Model 2650A 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 centrigrade.

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.

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.

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 rear 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.

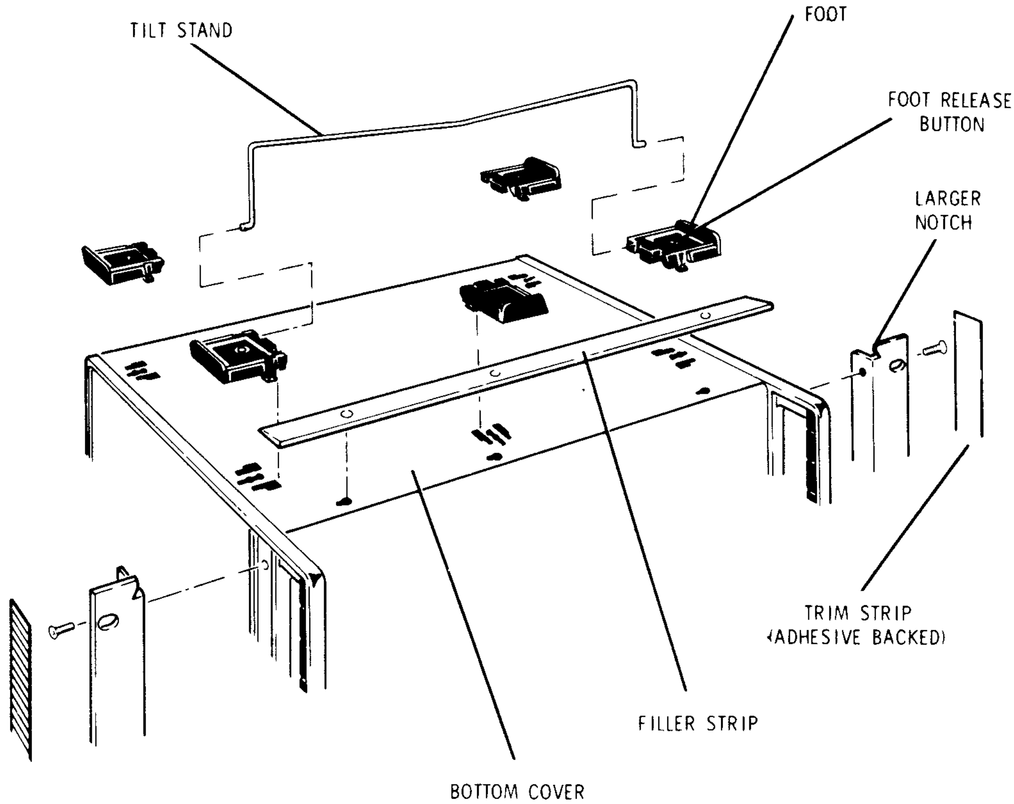


Figure 2-1. Conversion to Rack Mount

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 an 2650A 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.

CONTENTS

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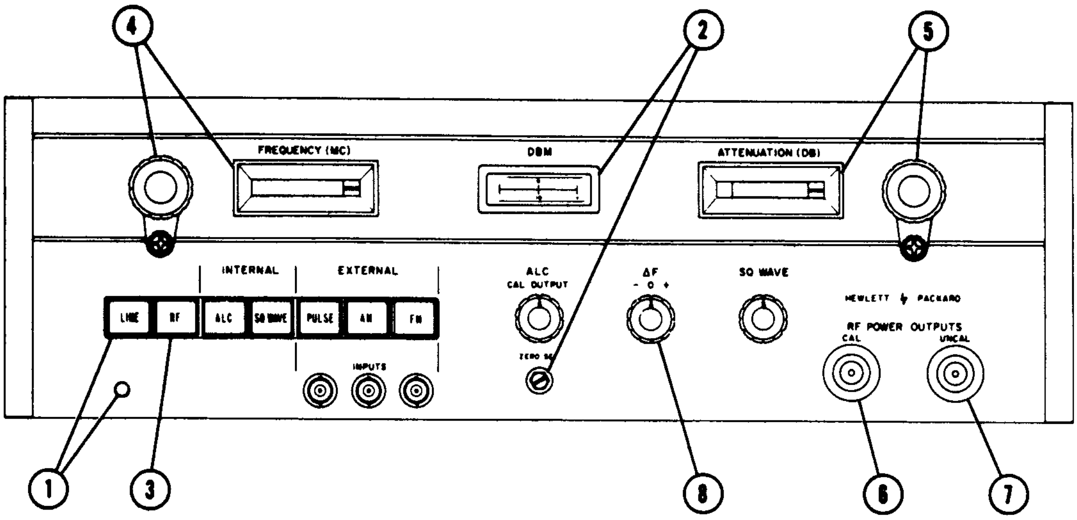
UNLEVELED RF POWER OUTPUT



1. Depress LINE; lamp glows, indicating heater and high voltage are applied.
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.

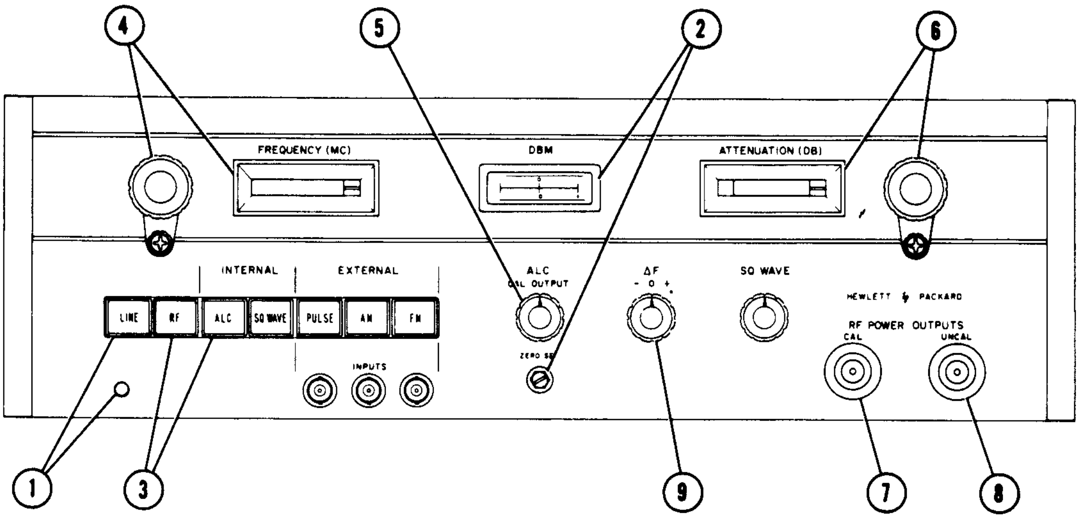
4. Set FREQUENCY (MHz) to desired frequency.
5. The ATTENUATION (dB) knob will attenuate RF power at CAL RF POWER OUTPUT.
6. Take unleveled but attenuable RF power at CAL RF POWER OUTPUT.
7. Take unleveled and unattenuable RF power at UNCAL RF POWER OUTPUT.
8. Use ΔF control when a small deviation from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

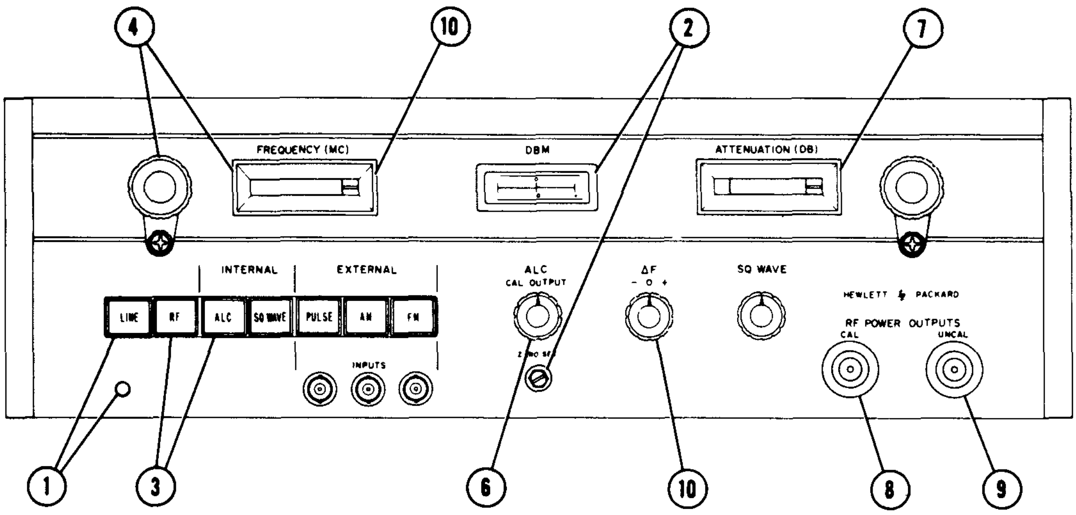
NOTE

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

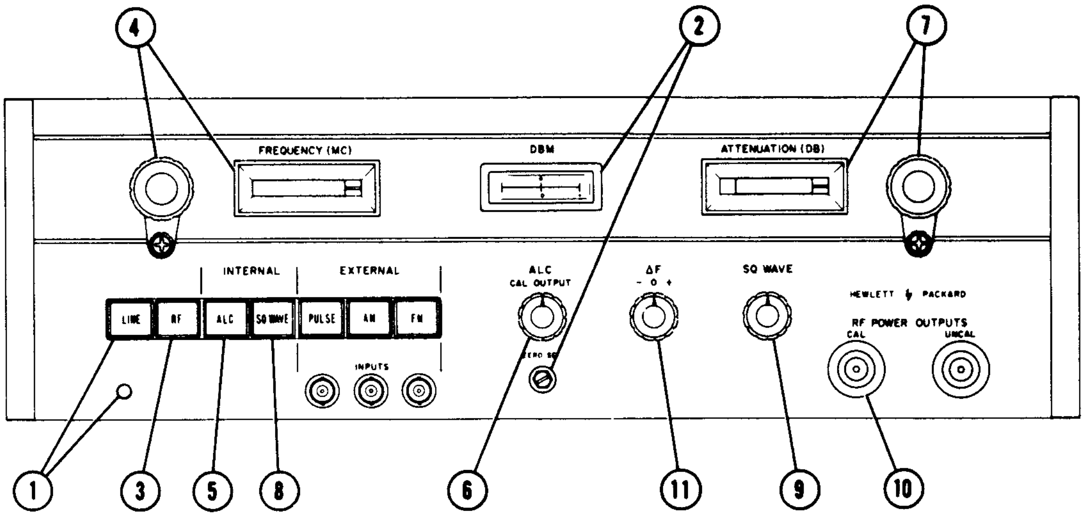
EXTERNALLY LEVELED RF POWER



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.

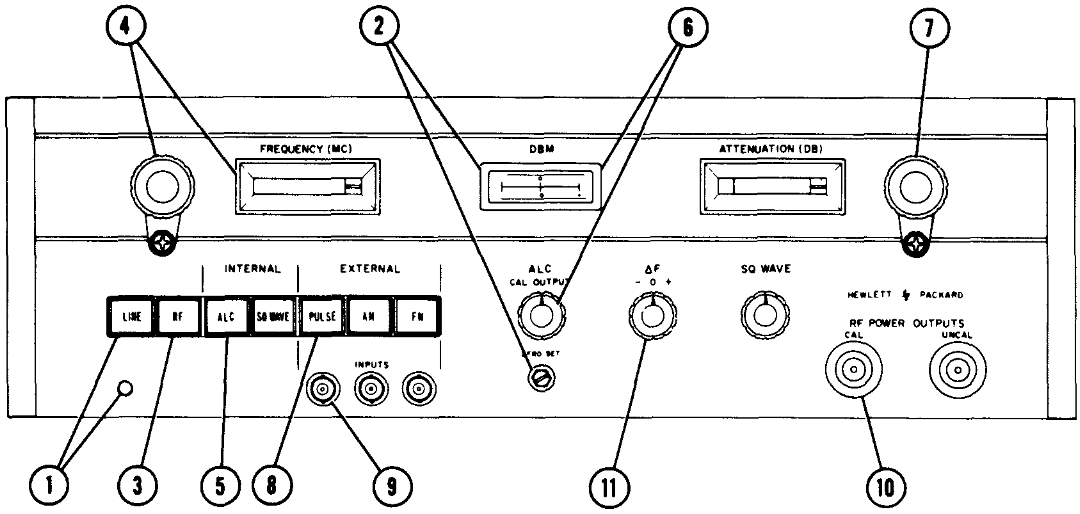
2. Check that meter pointer on dBm meter is on ZERO SET mark.
3. Depress RF.
4. Set FREQUENCY (MHz).
5. Depress INTERNAL ALC.
6. Adjust ALC CAL OUTPUT for desired dBm reference on dBm meter.
7. Set ATTENUATION dB.
8. Depress SQ. WAVE.
9. Adjust SQ WAVE for desired modulation frequency.
10. Take leveled 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.

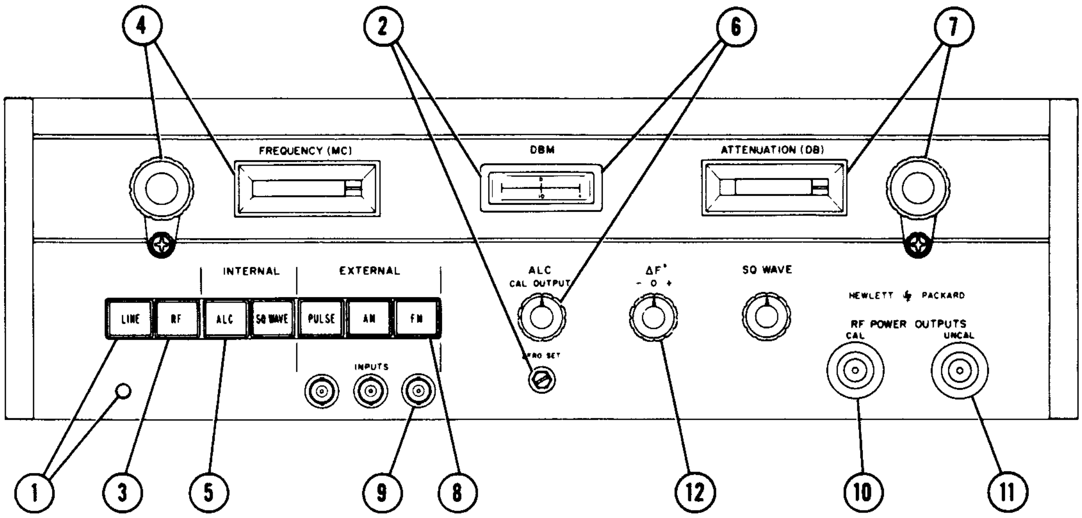
NOTE

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.

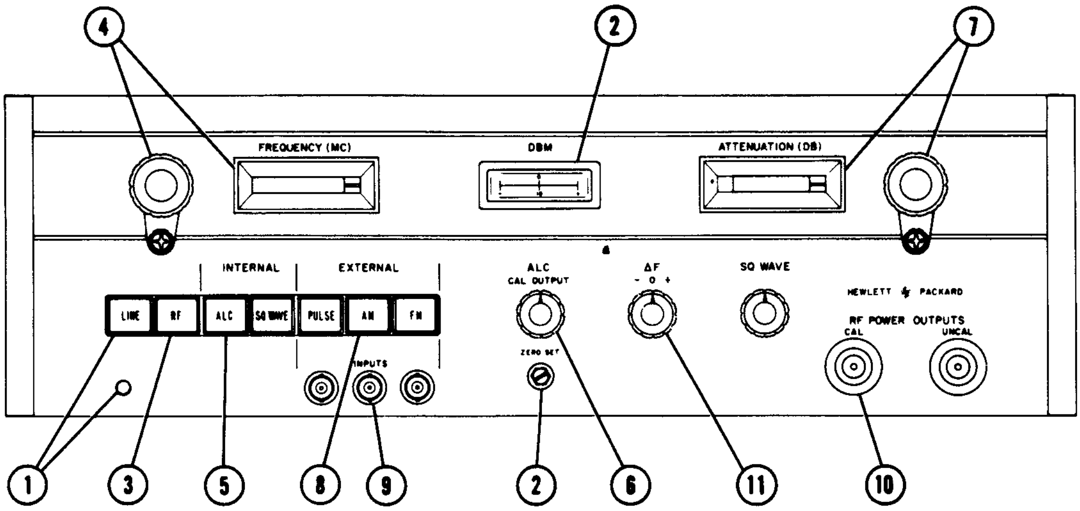
NOTE

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

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.

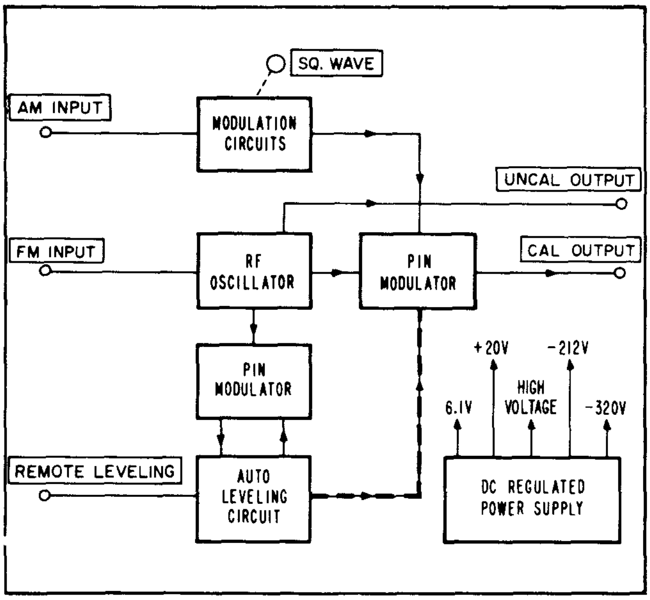


Figure 4-1. Circuit Block Diagram

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.

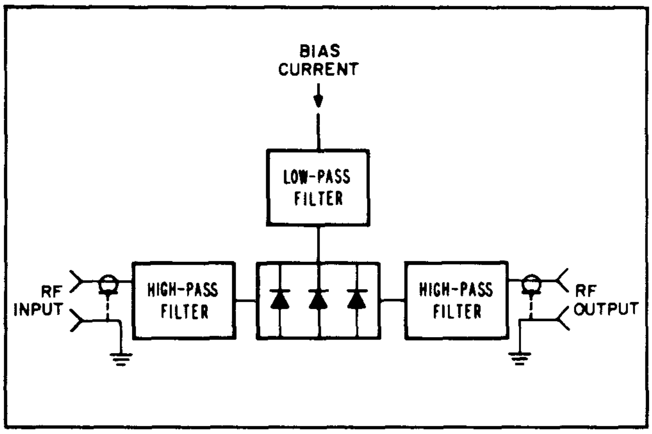


Figure 4-2. Simplified Block Diagram of PIN Modulator

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*

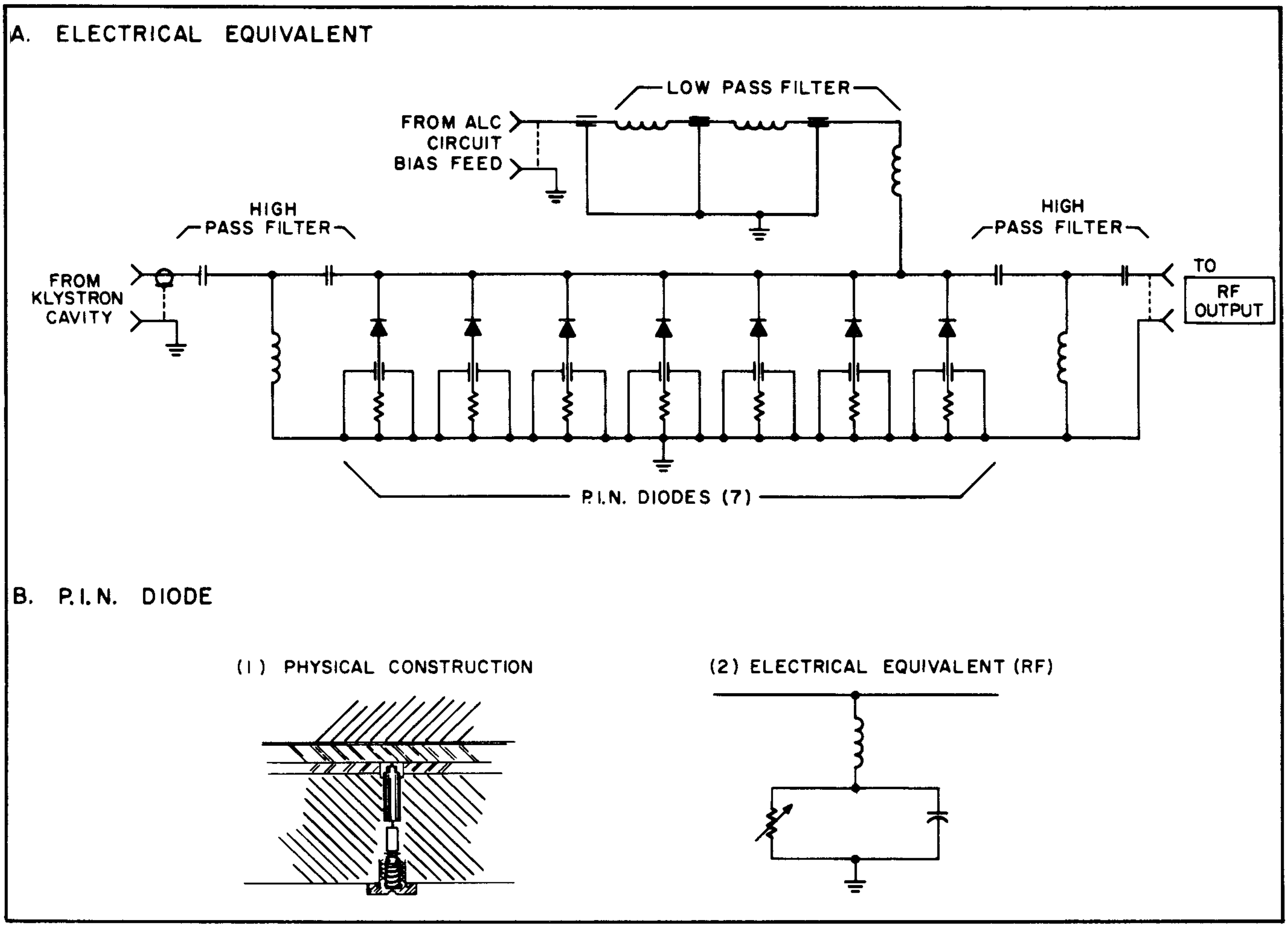


Figure 4-3. RF Attenuator Unit

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.

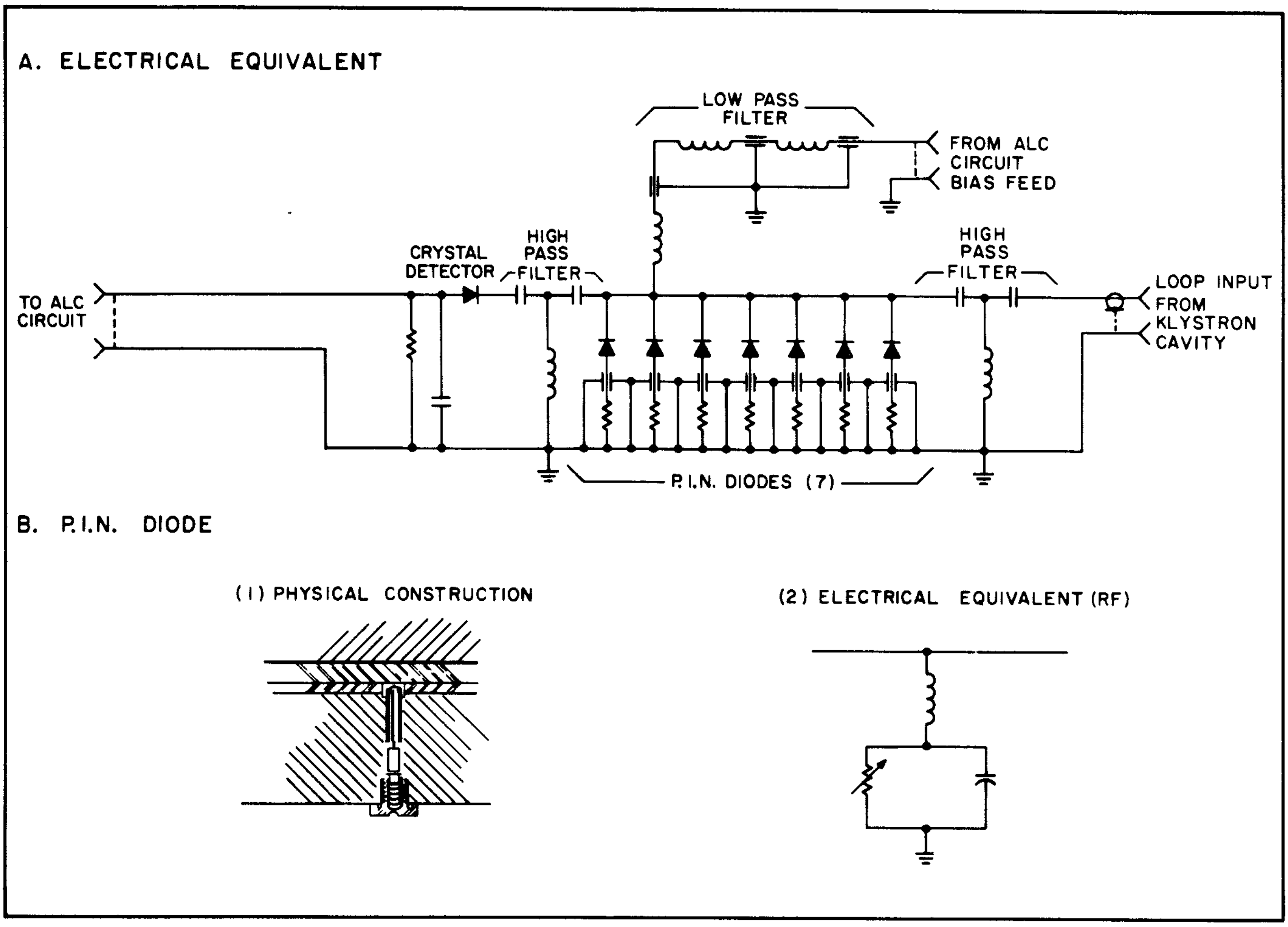


Figure 4-4. ALC Attenuator Unit

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

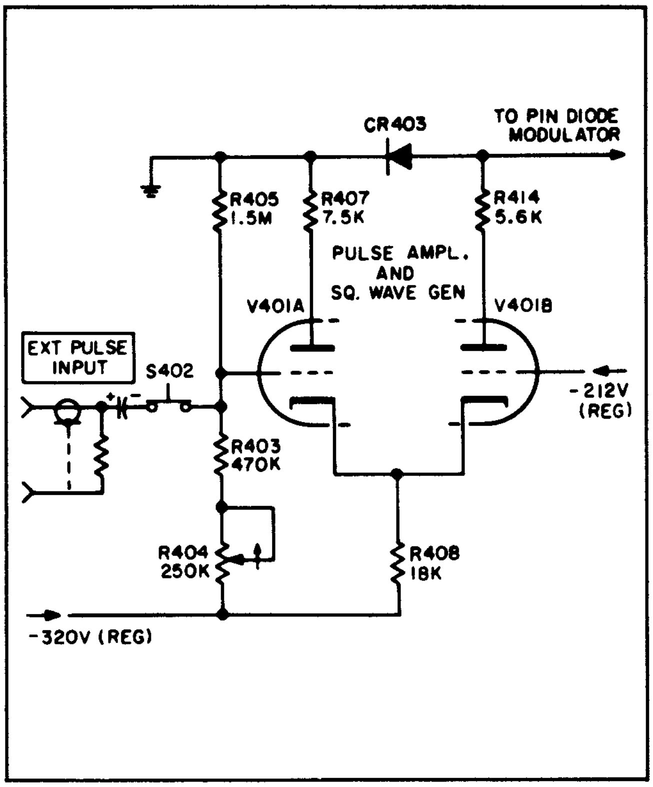


Figure 4-5. Pulse Modulation Circuit

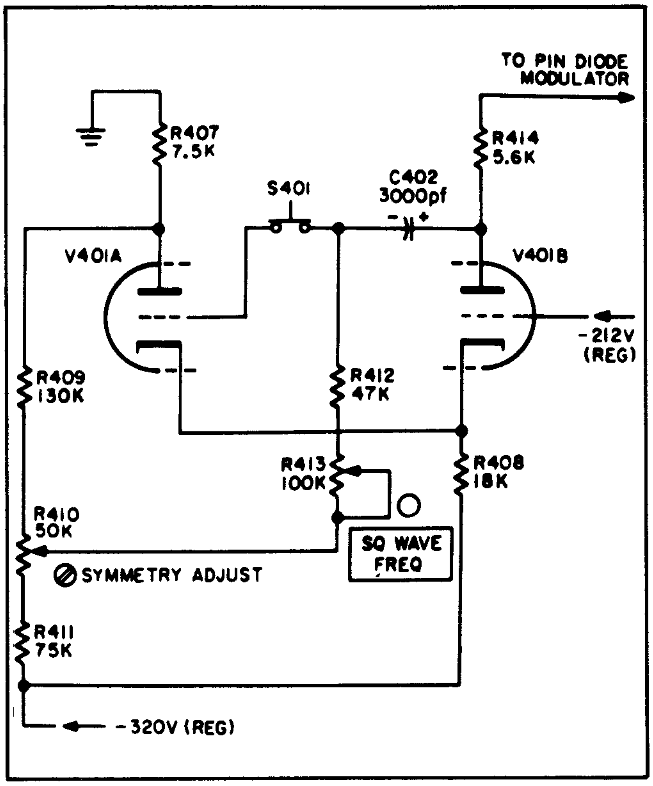


Figure 4-6. Square Wave Modulation Circuit

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.

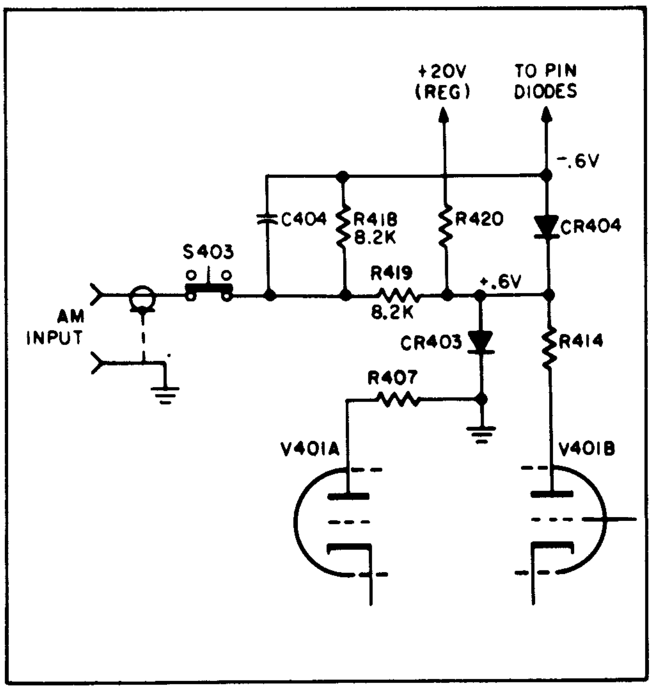


Figure 4-7. External AM Circuit

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

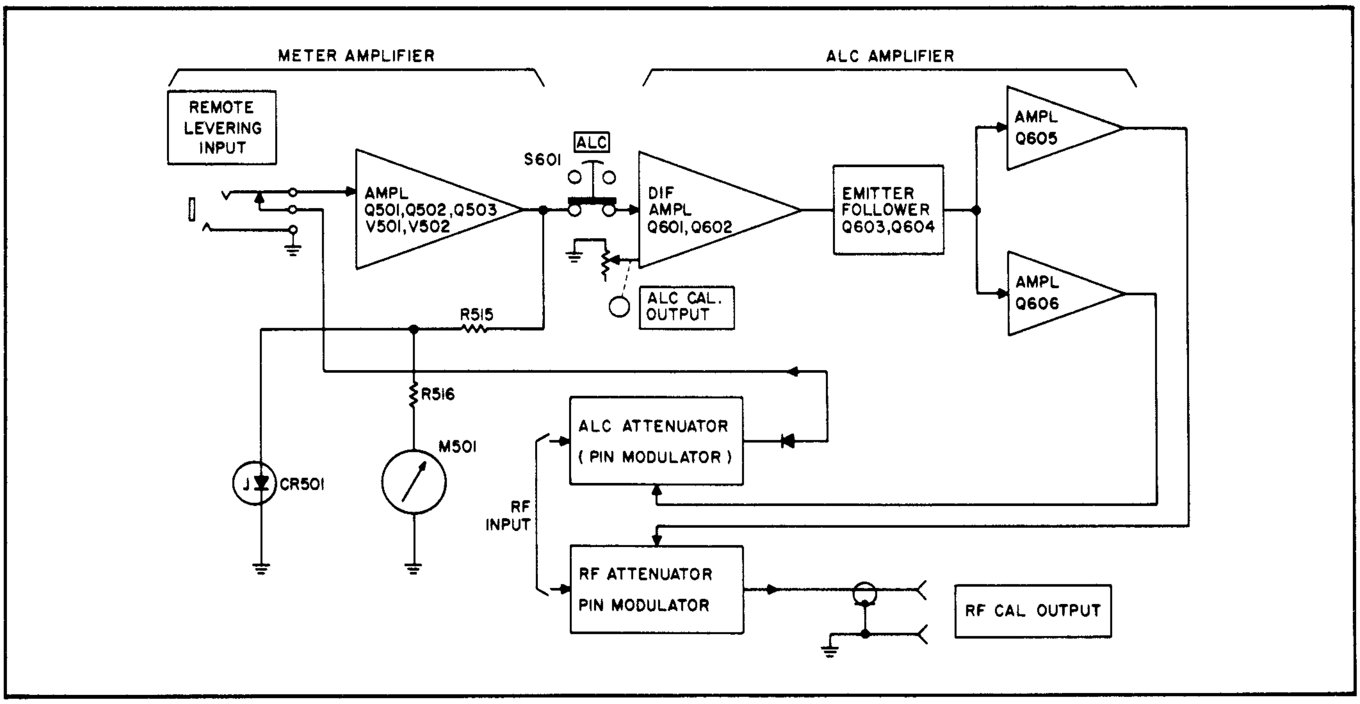


Figure 4-8. ALC and Meter Circuit

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).

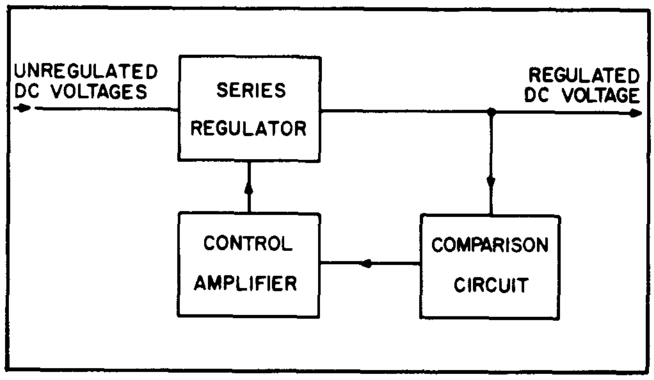


Figure 4-9. Series-Regulated Power Supply

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.

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: 30 ms/cm to 0.2 ms/cm Sensitivity: 0.05 V/cm to 1.0 V/cm Accuracy: ±3%	HP Model 1422A/1402A HP Model 140A
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 431C or 432A Power Meters 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 3440A Digital DC Voltmeter
AC Voltmeter	Power supply adj	Range: 0 to 20 mV Accuracy: ±2% of reading	HP Model 400D/H/L
Clip-On Milliammeter	Calibration check	Range: 0 to 35 mA Accuracy: 3% ±0.1 mA	HP Model 428A
General Purpose Multimeter	Troubleshooting	Voltage Range: 140 mV to 7.5 V DC Resistance Range: 1 to 100 meg Voltage Accuracy: ±1% of full scale Resistance Accuracy: ±5% of F.S.	HP Model 412A
Frequency Meter	Calibration check	Frequency Range: 1800–4500 MHz Accuracy: 0.2%	HP Model 536A (1000 to 4100 MHz) HP Model G532A (with 2-G281A) (4000 to 4500 MHz) HP Model 5240A
Pulse Generator	Calibration check	Pulse Width: 3 μs Pulse Rep Rate: 50 Hz to 50 kHz Output: 20V peak	HP Model 214A
FM Modulator	Frequency tracking, preliminary	Outputs: 300 volts peak-to-peak 6.3 VAC Input: 115 VAC, 60 Hz Phase Adjustable: Approx. 80°	Power Transformer (1) (9100-0045) Capacitors (2) (0140-0003) Potentiometers (2) (2100-0047) Fuseholder (1) extractor post type (1400-0084) Power Cord (1) (8120-0050) Fuse (1) 1 Amp. 115V, Slo Blo, (2100-0007)
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: 50 ohm	HP Model 651B
Electronic Counter	Calibration check	Compatible with Transfer Oscillator	HP Model 5245L
Transfer Oscillator	Calibration check	Frequency Range: 125 MHz Harmonic Range: 200th	HP Model 5257A
Frequency Meter	Calibration check	Frequency Range: 10 kHz Output: 1V	HP Model 5210A

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

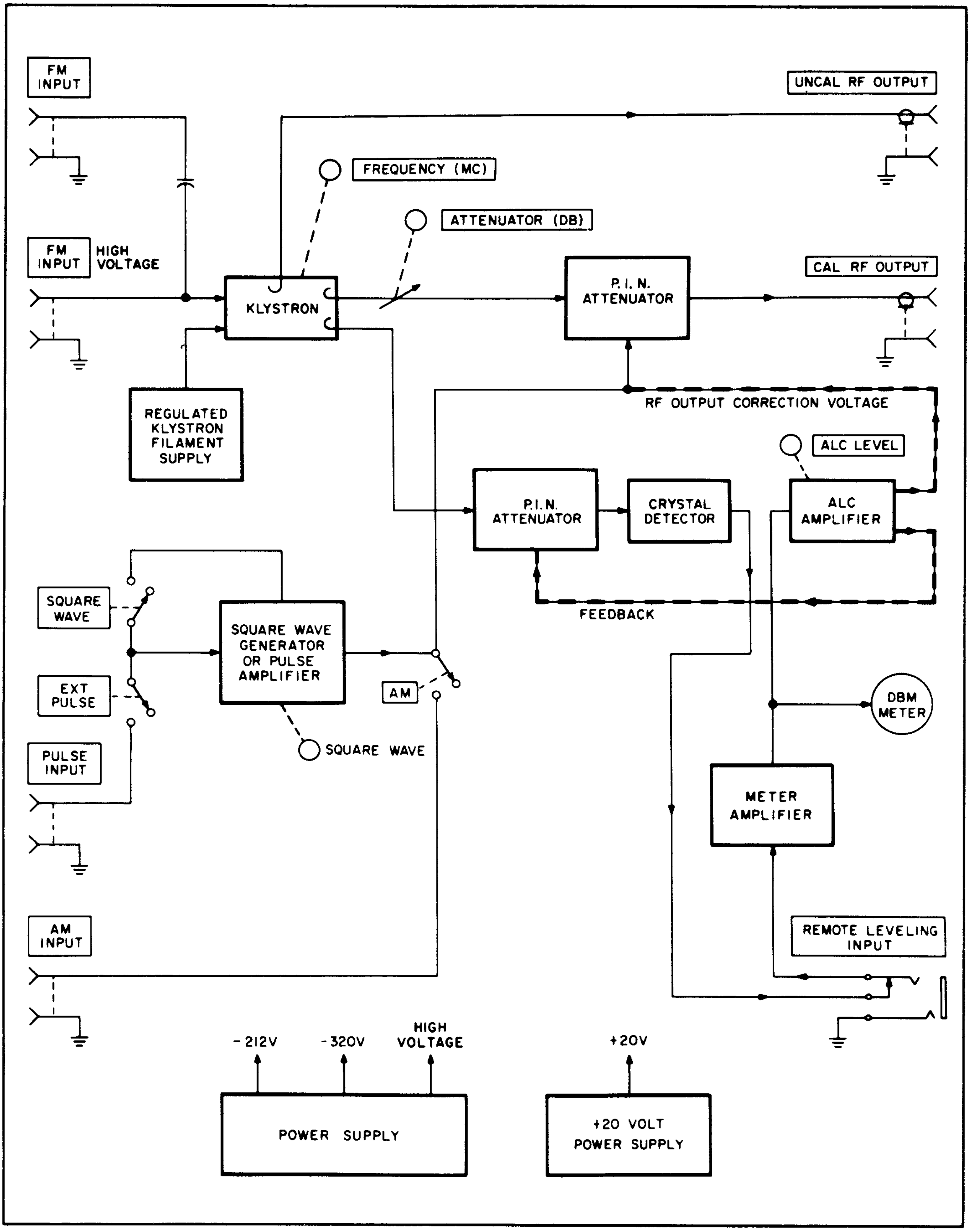


Figure 5-1. Model 8616A Block Diagram

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	R210	—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

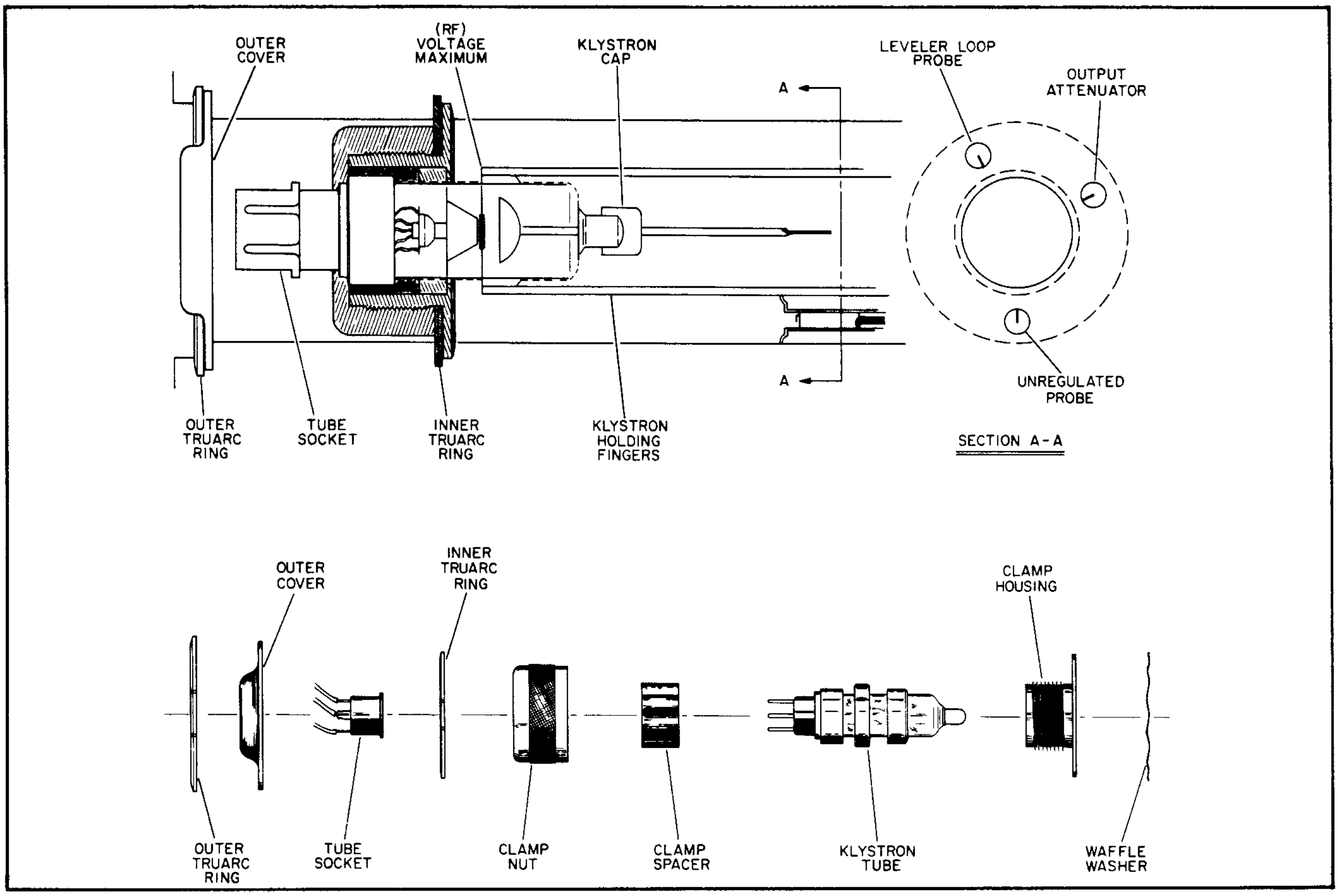


Figure 5-2. Cut-Away View of Klystron Cavity and Klystron Assembly

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.

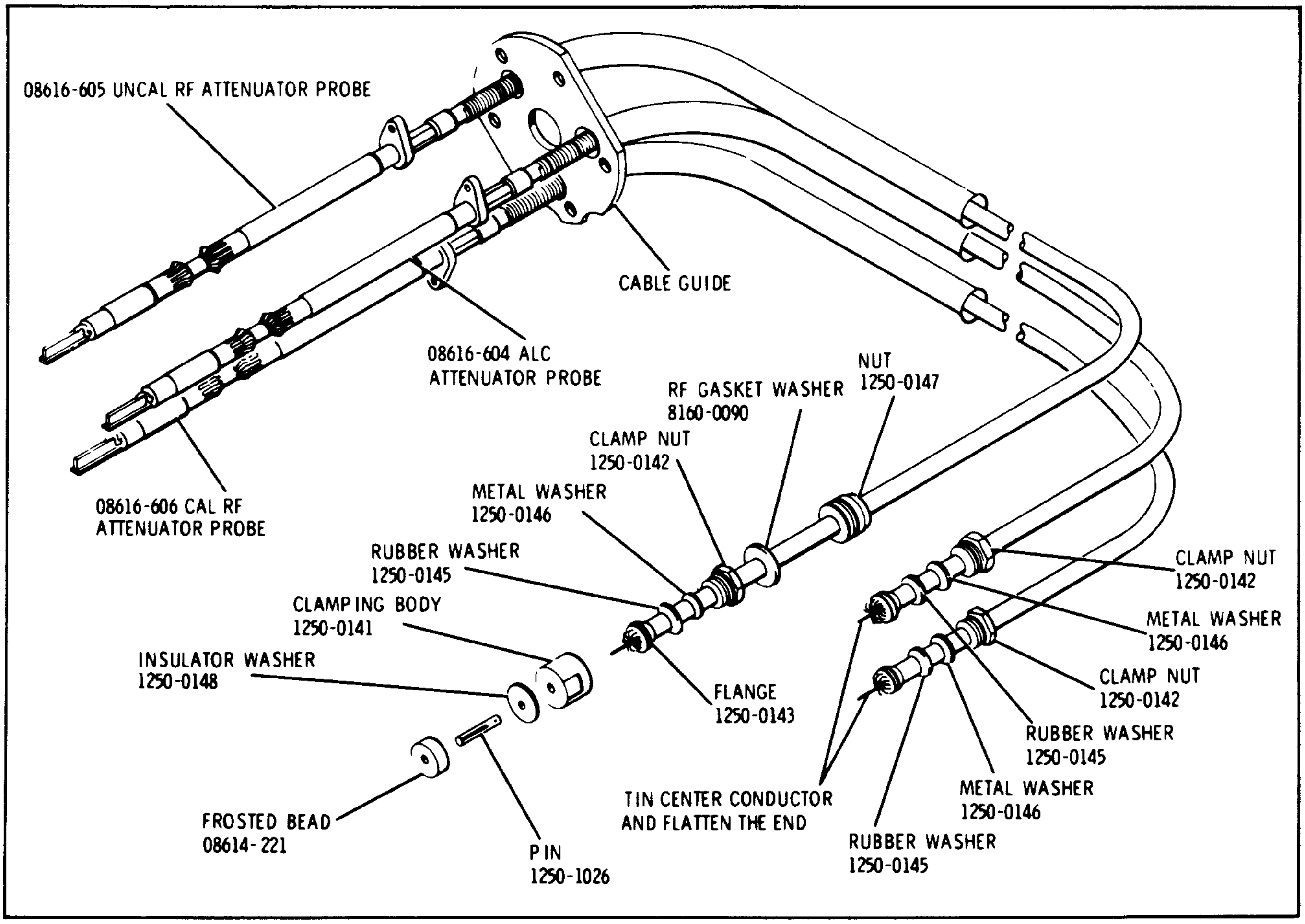


Figure 5-3. RF Probe Assembly

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 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).

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

h. Remove three screws holding PIN modulator in place.

i. Remove PIN modulator from instrument.

j. 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.

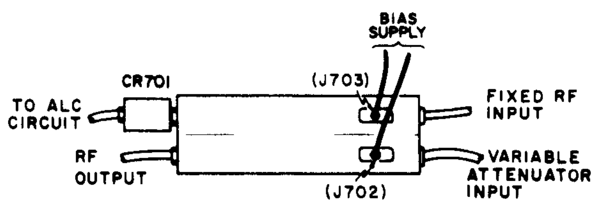


Figure 5-4. PIN Modulator (External View)

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 one-megohm potentiometers; a 0.01 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:

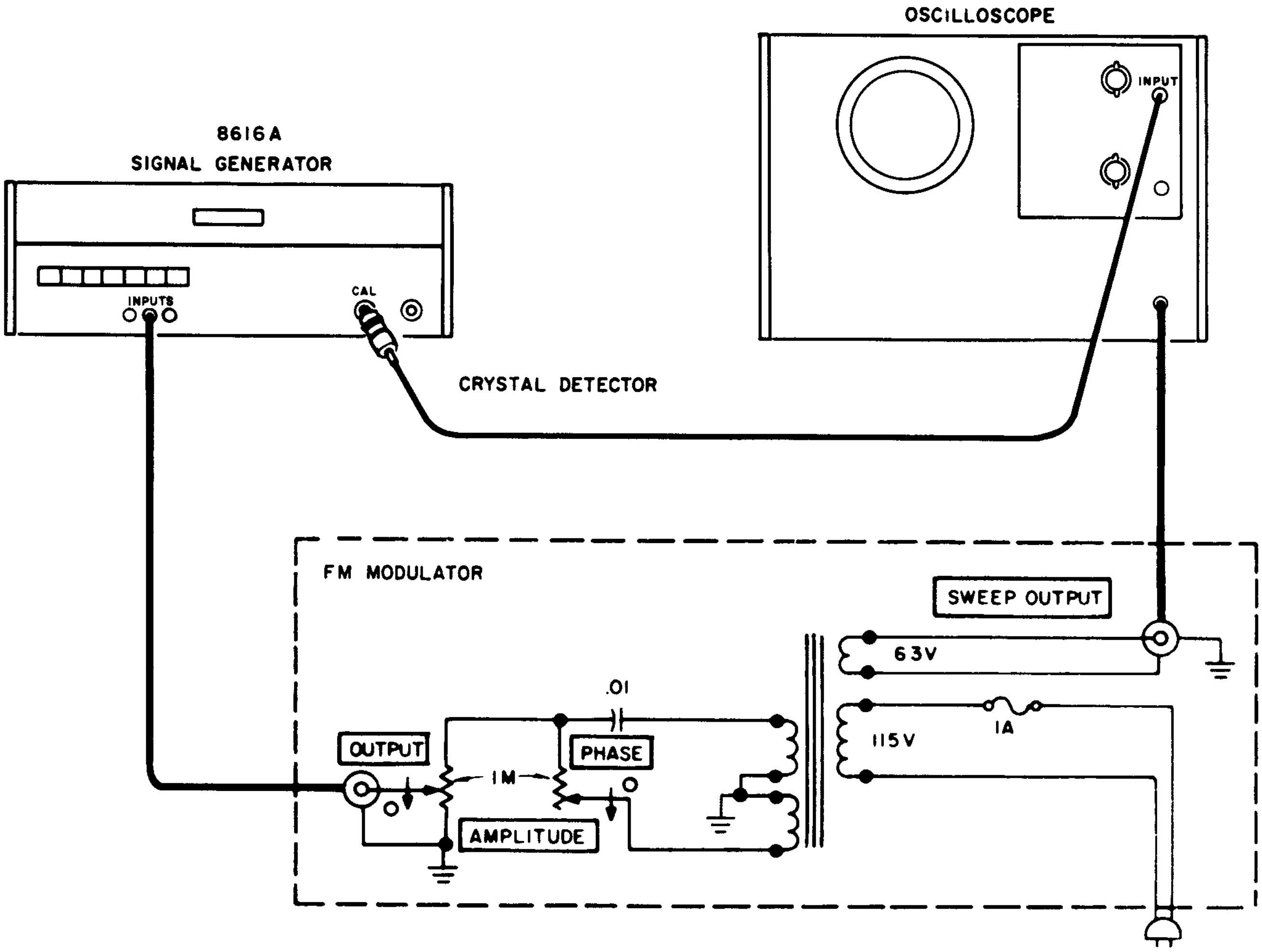
(1) With a power meter, measure the CAL RF output power. It should be −11 dBm ±0.1 dBm.

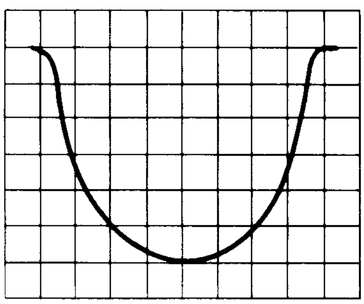
(2) If it is not, loosen the two set screws in the attenuator drive shaft bevel gear with your fingers until the output power is −11 dBm. Without disturbing the −11 dBm power setting, turn the attenuator knob on the front panel until the attenuator counter reads 012 dB. Tighten the two set screws in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





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

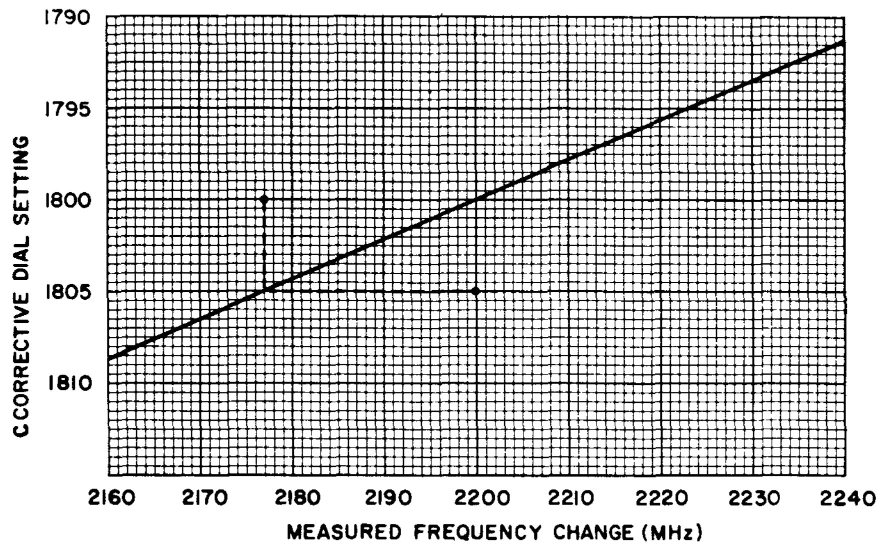


Figure 5-6. Frequency Tracking

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

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.

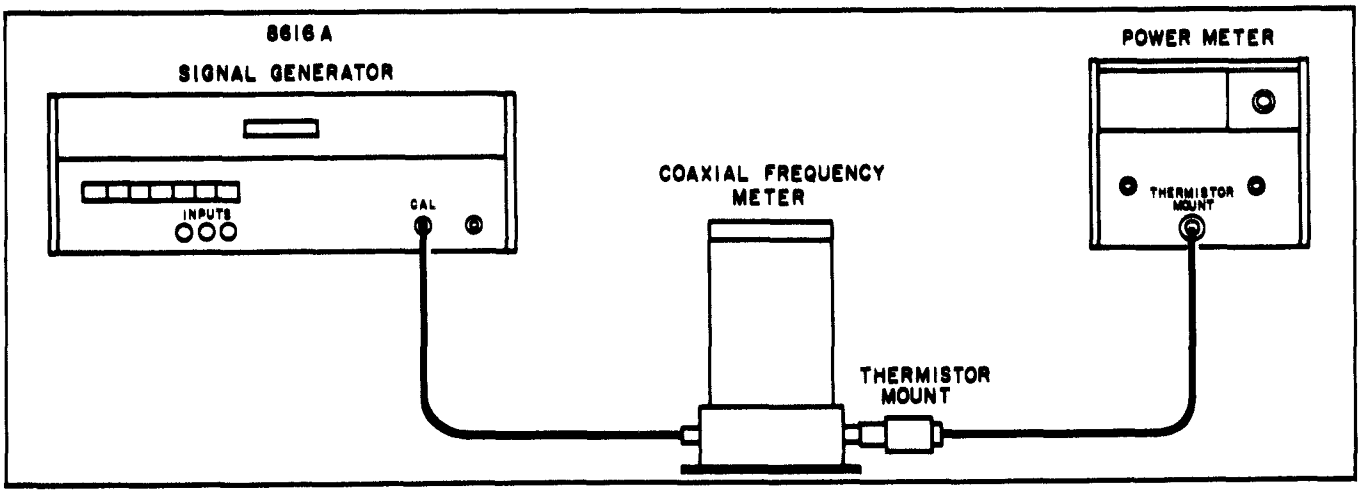


Figure 5-7. Frequency and Power Measurement

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 approximately 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.

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.

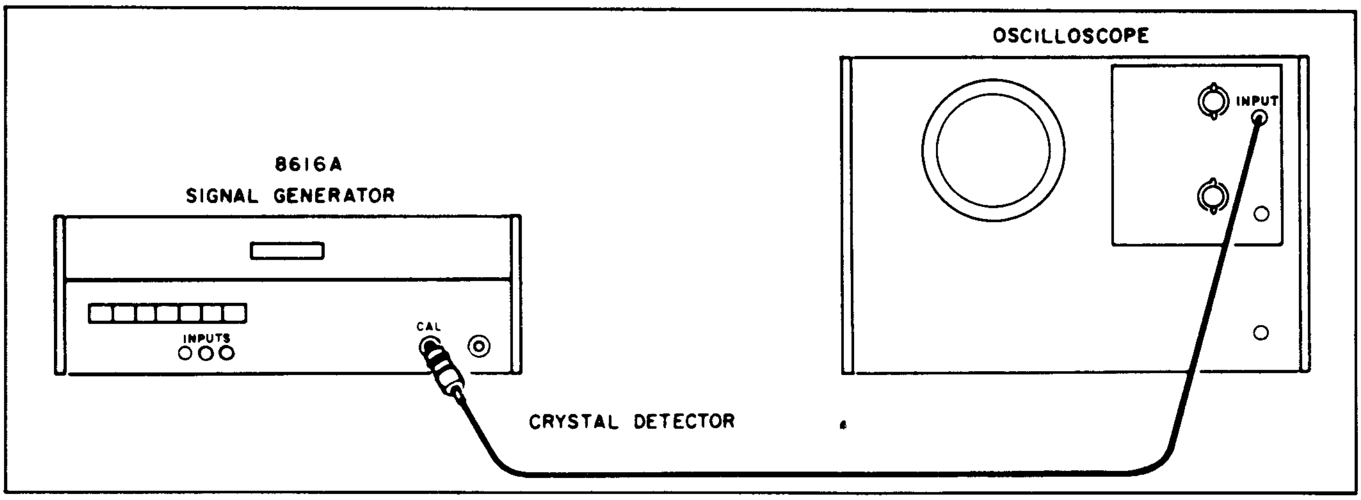


Figure 5-8. Internal Square Wave Check

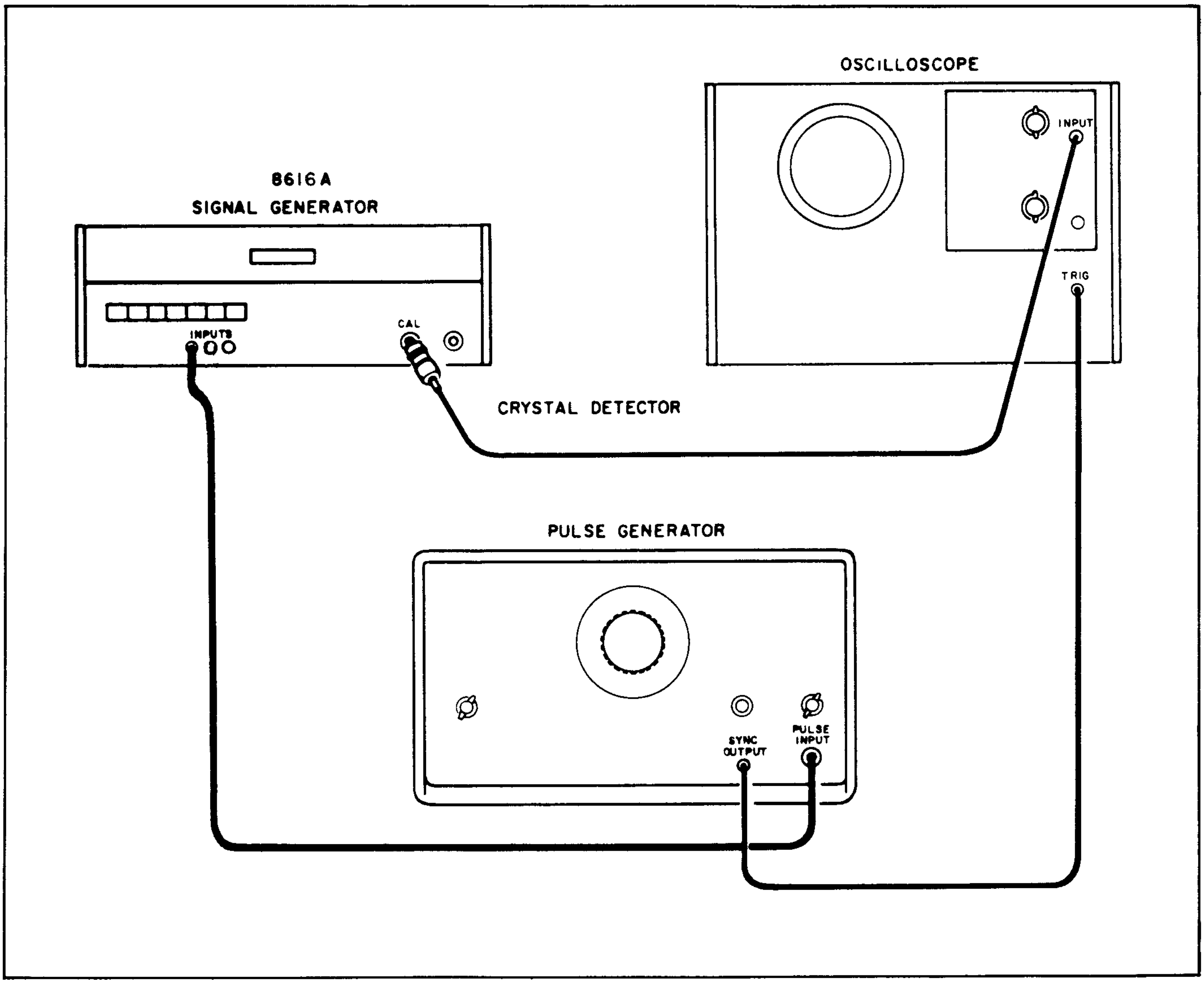


Figure 5-9. External Pulse Check

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.

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).

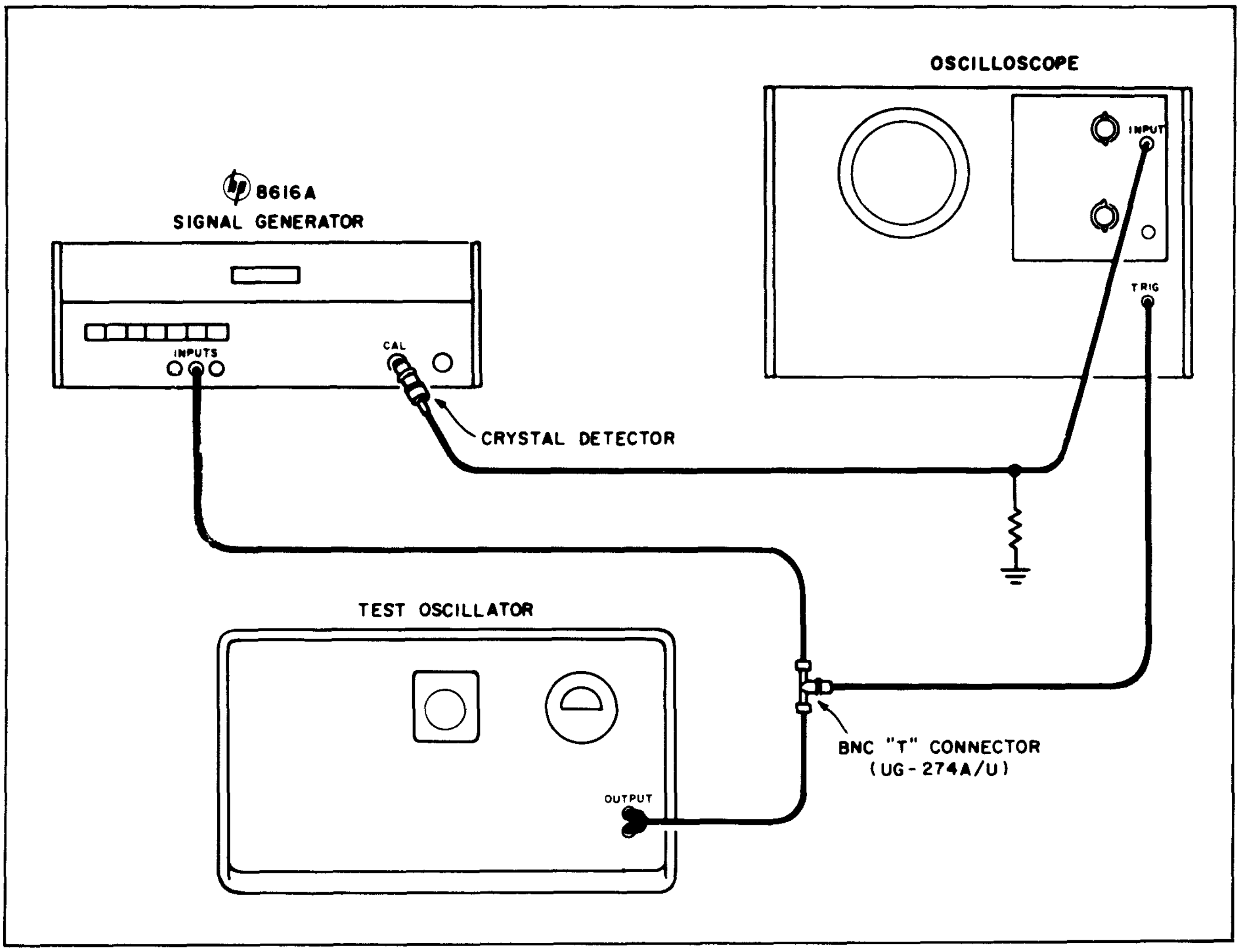


Figure 5-10. External AM Check

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 AND INCIDENTAL FM

a. Connect instruments as shown in Figure 5-12, without the test oscillator in the setup.

b. Set up Model 8616A as follows:

LINE .... depressed
RF .... depressed
FREQUENCY .... 2.5 GHz

c. Adjust frequency meter output for 10 kHz/V. Line sync oscilloscope.

d. Adjust transfer oscillator for 125 MHz and Harmonic of 200.

e. Adjust frequency for 10 kHz difference frequency reading on frequency meter.

f. Residual FM (line related components) reading ("peak to trough") on oscilloscope is less than 250 mV peak (250 mV = 2500 Hz).

g. Set up Model 8616A as follows:

INTERNAL SQ WAVE ...... depressed
ATTENUATION .... −10 dB

h. Incidental FM is negligible.

i. Connect instruments as shown in Figure 5-12, with the test oscillator in the setup.

j. Set up Model 8616A as follows:

EXTERNAL AM .... depressed

k. Adjust test oscillator for a 10 kHz, 5 to 6 volt peak modulating signal.

l. Incidental FM is negligible.

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.

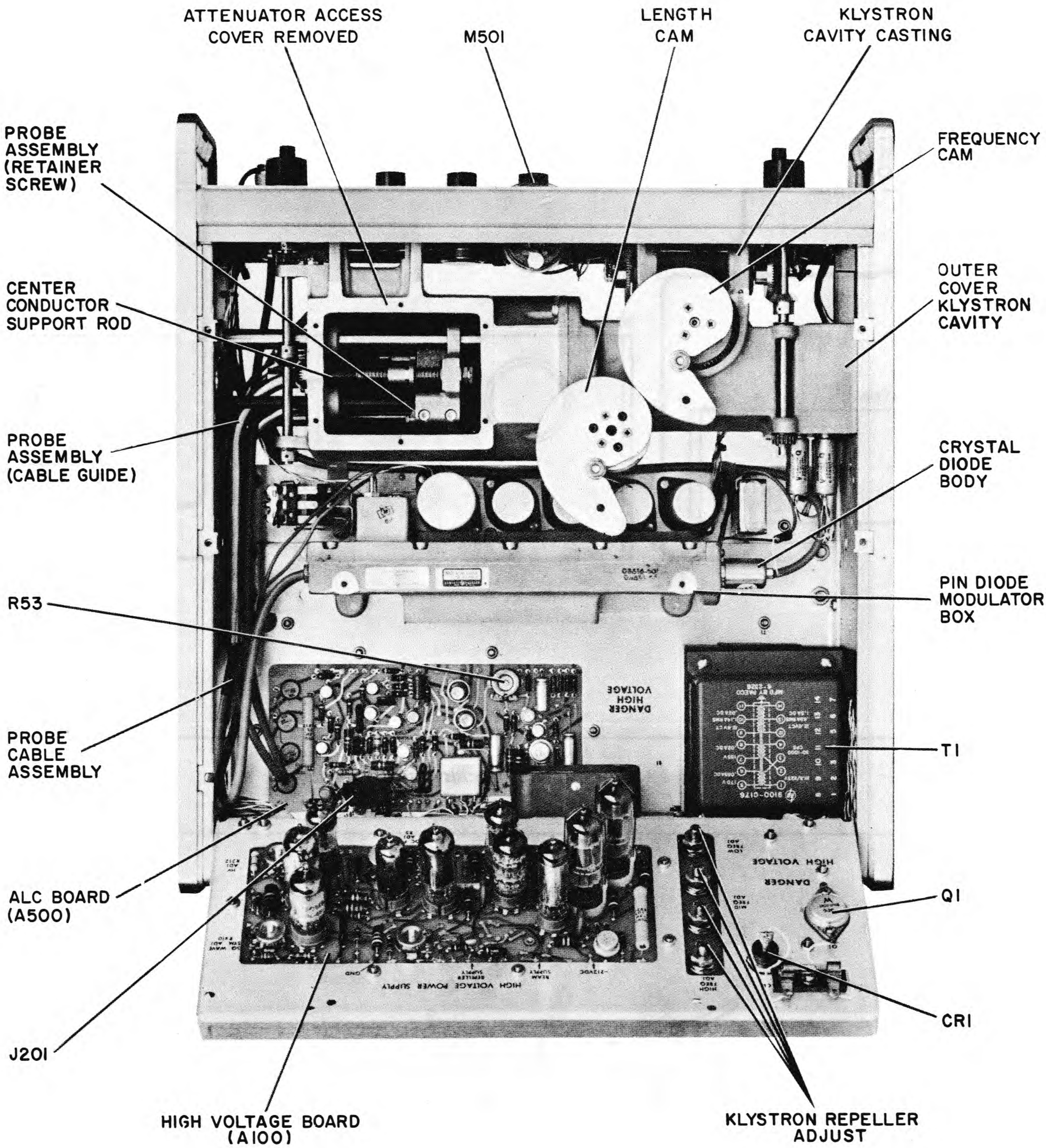


Figure 5-11. Top View, Cover Removed

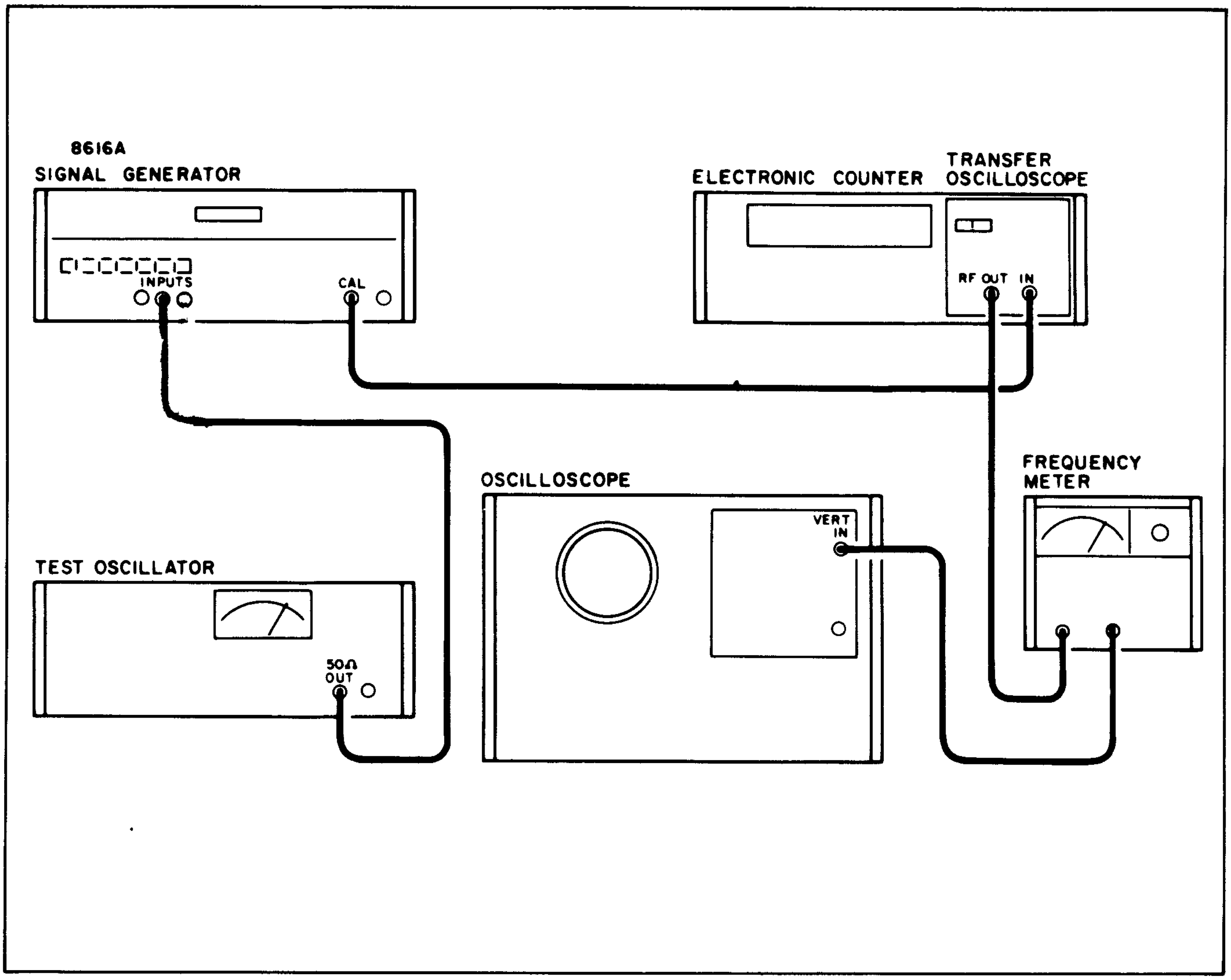


Figure 5-12. Residual and Incidental FM Check

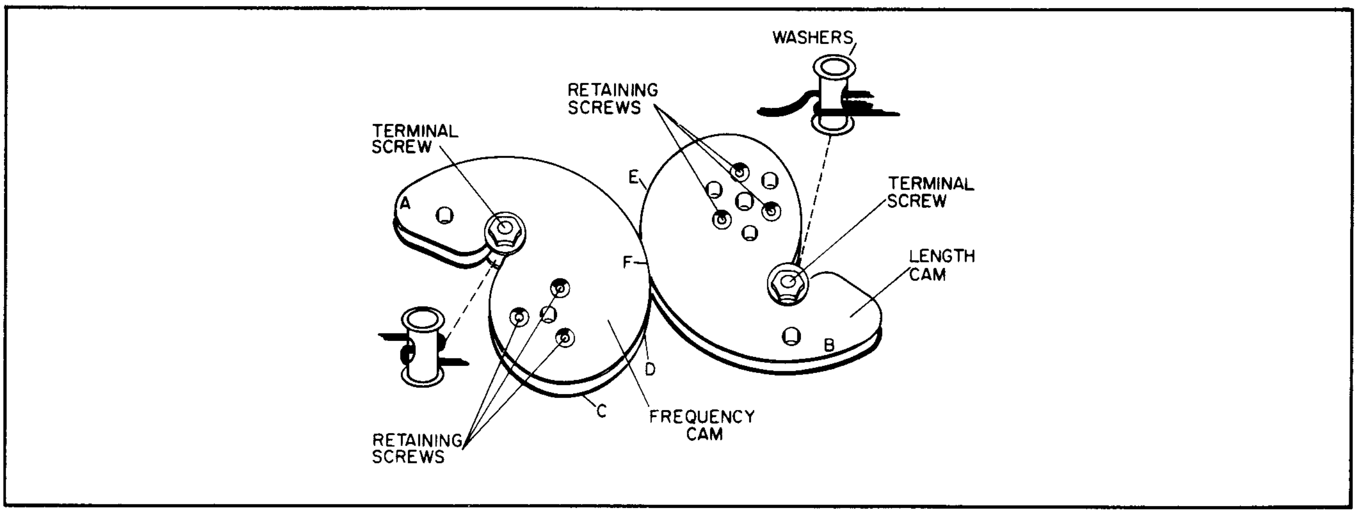


Figure 5-13. Exploded View — Cam Assembly

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 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.

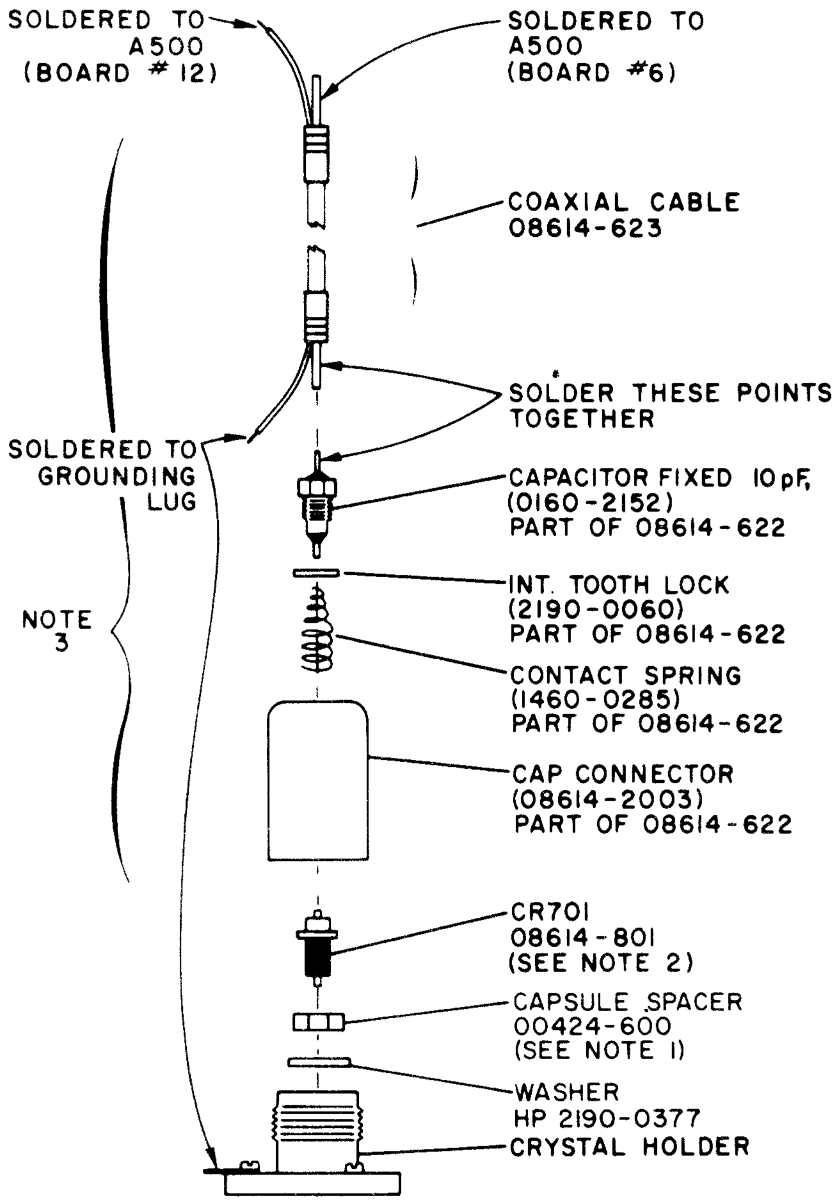
5-57. Parts Required

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. 08614-801 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.)

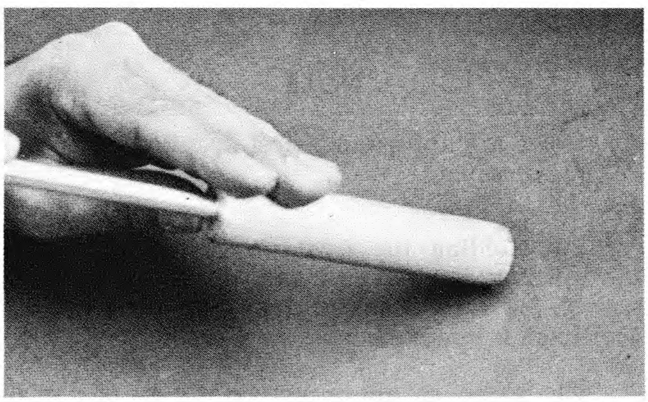


Figure 5-15. Forming the Center Conductor Fingers

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 allen 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.

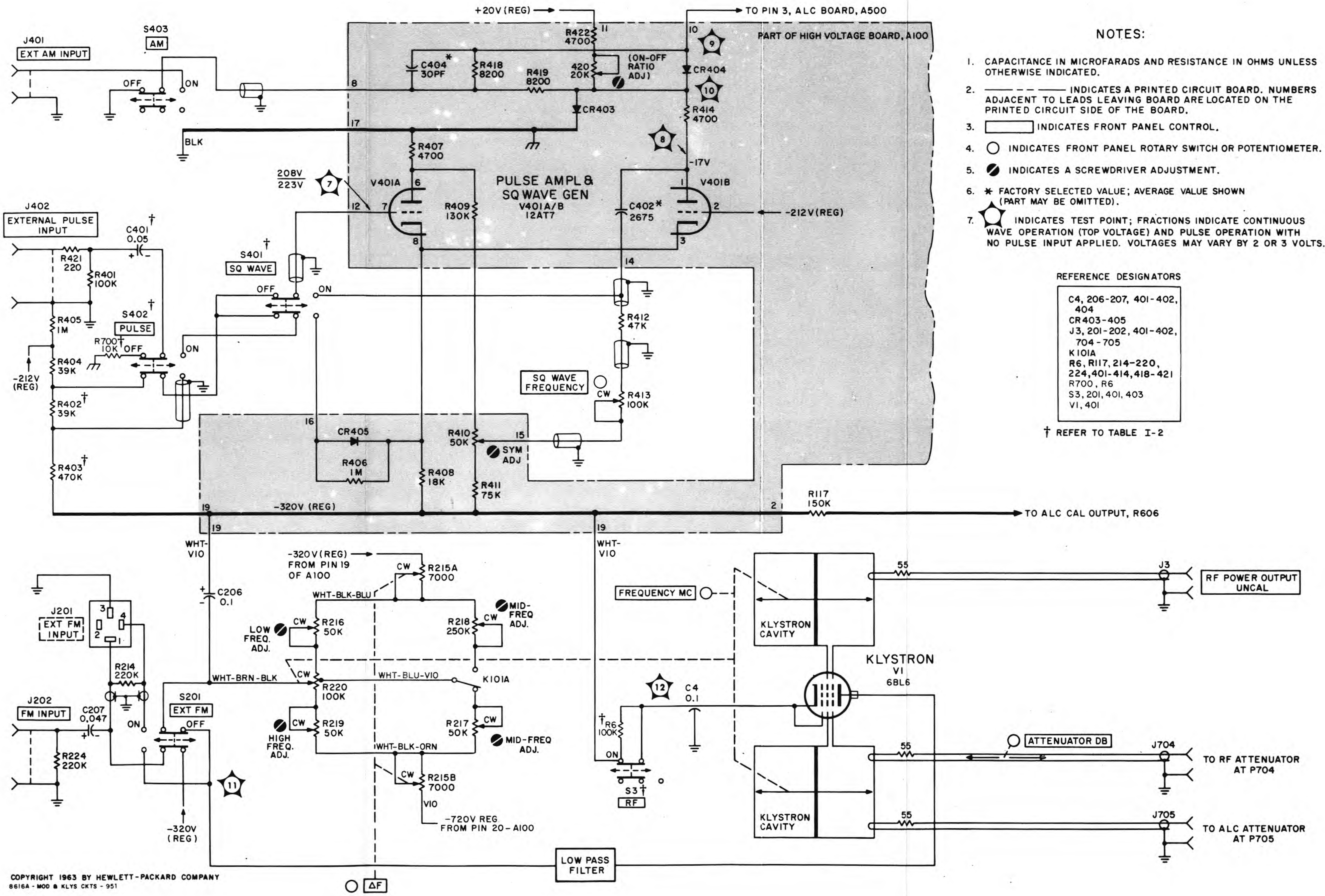
12. Loosen nylon screw holding contact lug. Lift out wire wound resistor, insulator and P.C. board.

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

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

NOTE

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



NOTES:

1. CAPACITANCE IN MICROFARADS AND RESISTANCE IN OHMS UNLESS OTHERWISE INDICATED.
2. ——— — — ——— INDICATES A PRINTED CIRCUIT BOARD. NUMBERS ADJACENT TO LEADS LEAVING BOARD ARE LOCATED ON THE PRINTED CIRCUIT SIDE OF THE BOARD.
3. [box] INDICATES FRONT PANEL CONTROL.
4. ○ INDICATES FRONT PANEL ROTARY SWITCH OR POTENTIOMETER.
5. [screwdriver symbol] INDICATES A SCREWDRIVER ADJUSTMENT.
6. * FACTORY SELECTED VALUE; AVERAGE VALUE SHOWN (PART MAY BE OMITTED).
7. [star symbol] INDICATES TEST POINT; FRACTIONS INDICATE CONTINUOUS WAVE OPERATION (TOP VOLTAGE) AND PULSE OPERATION WITH NO PULSE INPUT APPLIED. VOLTAGES MAY VARY BY 2 OR 3 VOLTS.

REFERENCE DESIGNATORS

C4, 206-207, 401-402, 404
CR403-405
J3, 201-202, 401-402, 704-705
K101A
R6, R117, 214-220, 224, 401-414, 418-421
R700, R6
S3, 201, 401, 403
V1, 401

† REFER TO TABLE I-2

8616A - MOD & KLYS CKTS - 951

Figure 5-16. Modulation and Klystron Circuits

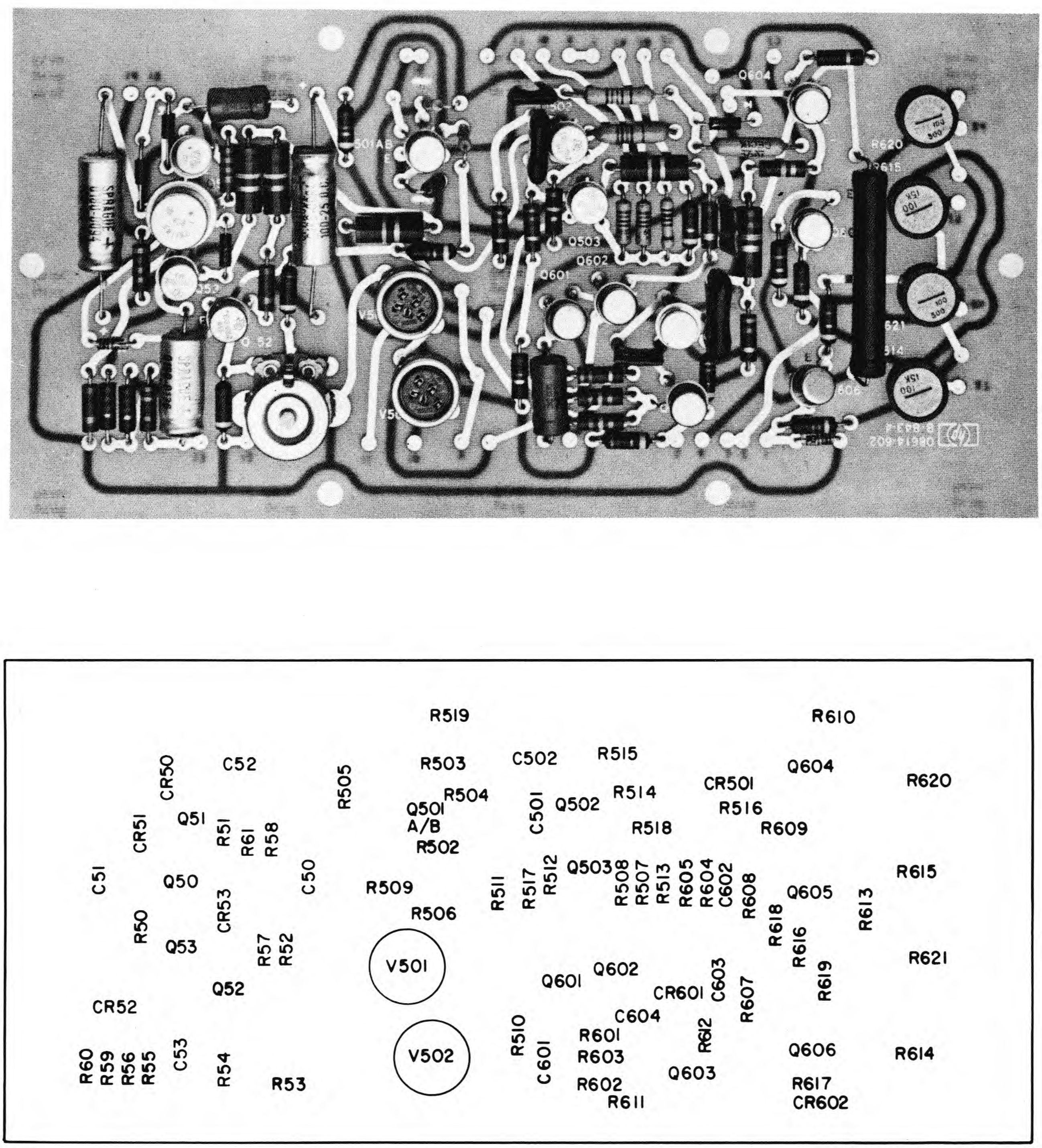
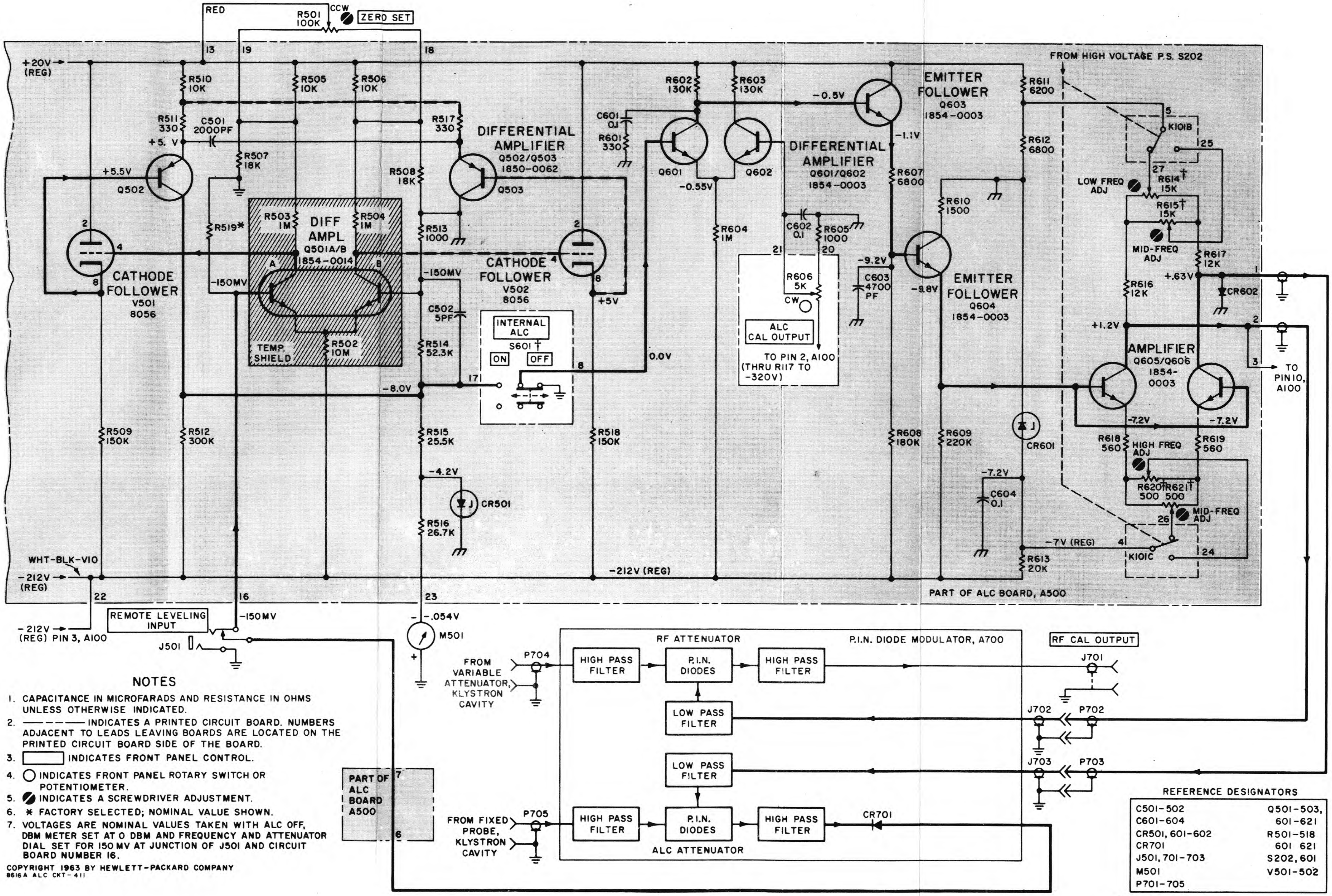


Figure 5-17. ALC Board (A500)



NOTES

1. CAPACITANCE IN MICROFARADS AND RESISTANCE IN OHMS UNLESS OTHERWISE INDICATED.
2. ——————— INDICATES A PRINTED CIRCUIT BOARD. NUMBERS ADJACENT TO LEADS LEAVING BOARDS ARE LOCATED ON THE PRINTED CIRCUIT BOARD SIDE OF THE BOARD.
3. ▭ INDICATES FRONT PANEL CONTROL.
4. ○ INDICATES FRONT PANEL ROTARY SWITCH OR POTENTIOMETER.
5. ⊘ INDICATES A SCREWDRIVER ADJUSTMENT.
6. * FACTORY SELECTED; NOMINAL VALUE SHOWN.
7. VOLTAGES ARE NOMINAL VALUES TAKEN WITH ALC OFF, DBM METER SET AT 0 DBM AND FREQUENCY AND ATTENUATOR DIAL SET FOR 150 MV AT JUNCTION OF J501 AND CIRCUIT BOARD NUMBER 16.

8616A ALC CKT-411

REFERENCE DESIGNATORS

C501-502	Q501-503,
C601-604	601-621
CR501, 601-602	R501-518
CR701	601 621
J501, 701-703	S202, 601
M501	V501-502
P701-705	

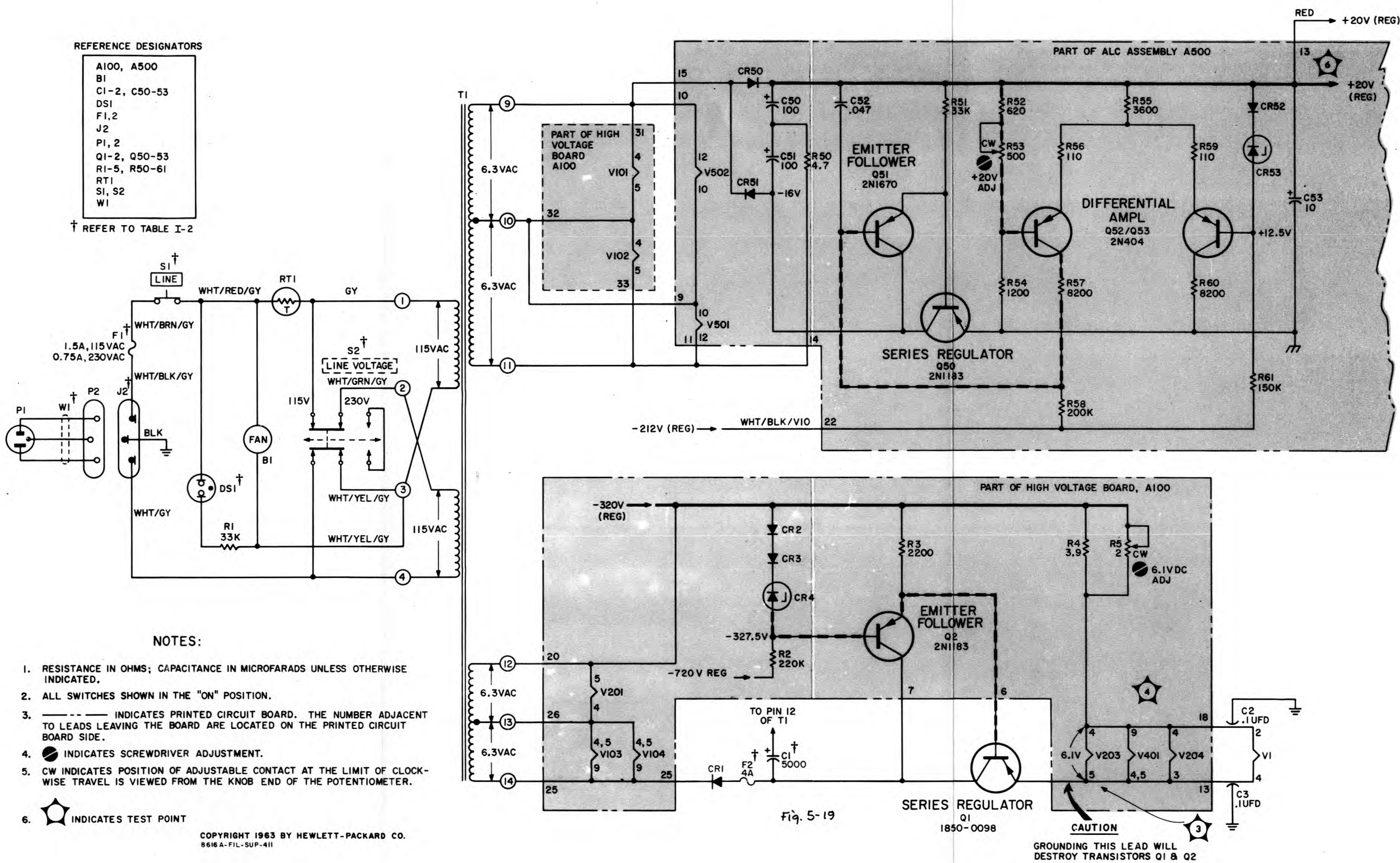
† REFER TO TABLE I-2

Figure 5-18. ALC Circuit

REFERENCE DESIGNATORS

A100, A500
B1
C1-2, C50-53
DS1
F1,2
J2
P1, 2
Q1-2, Q50-53
R1-5, R50-61
RT1
S1, S2
W1

† REFER TO TABLE I-2

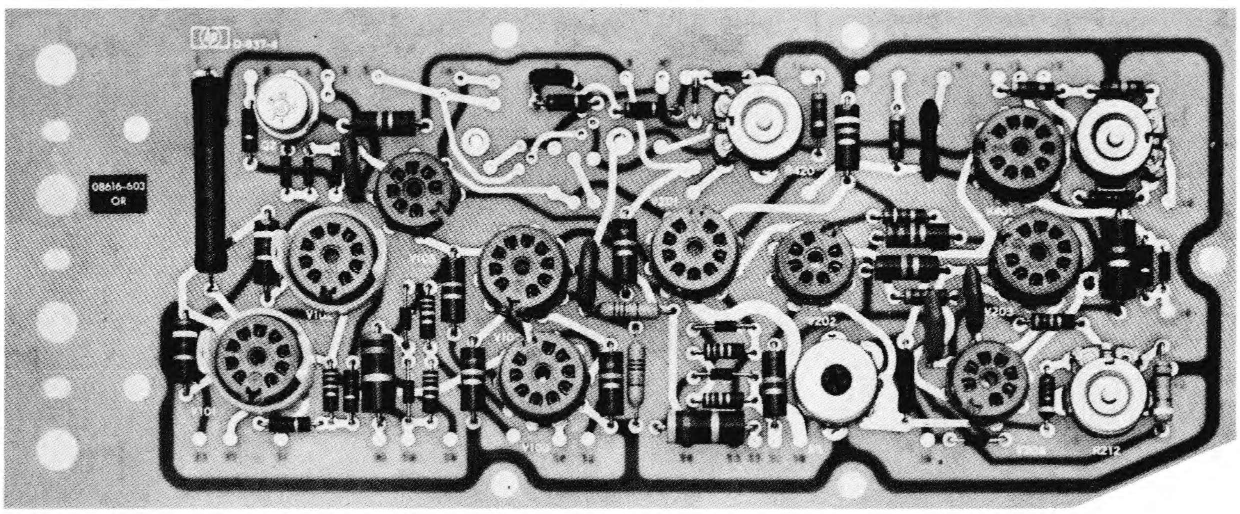


NOTES:

1. RESISTANCE IN OHMS; CAPACITANCE IN MICROFARADS UNLESS OTHERWISE INDICATED.
2. ALL SWITCHES SHOWN IN THE "ON" POSITION.
3. ——-- -—— INDICATES PRINTED CIRCUIT BOARD. THE NUMBER ADJACENT TO LEADS LEAVING THE BOARD ARE LOCATED ON THE PRINTED CIRCUIT BOARD SIDE.
4. ● INDICATES SCREWDRIVER ADJUSTMENT.
5. CW INDICATES POSITION OF ADJUSTABLE CONTACT AT THE LIMIT OF CLOCKWISE TRAVEL IS VIEWED FROM THE KNOB END OF THE POTENTIOMETER.
6. ☆ INDICATES TEST POINT

Fig. 5-19

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



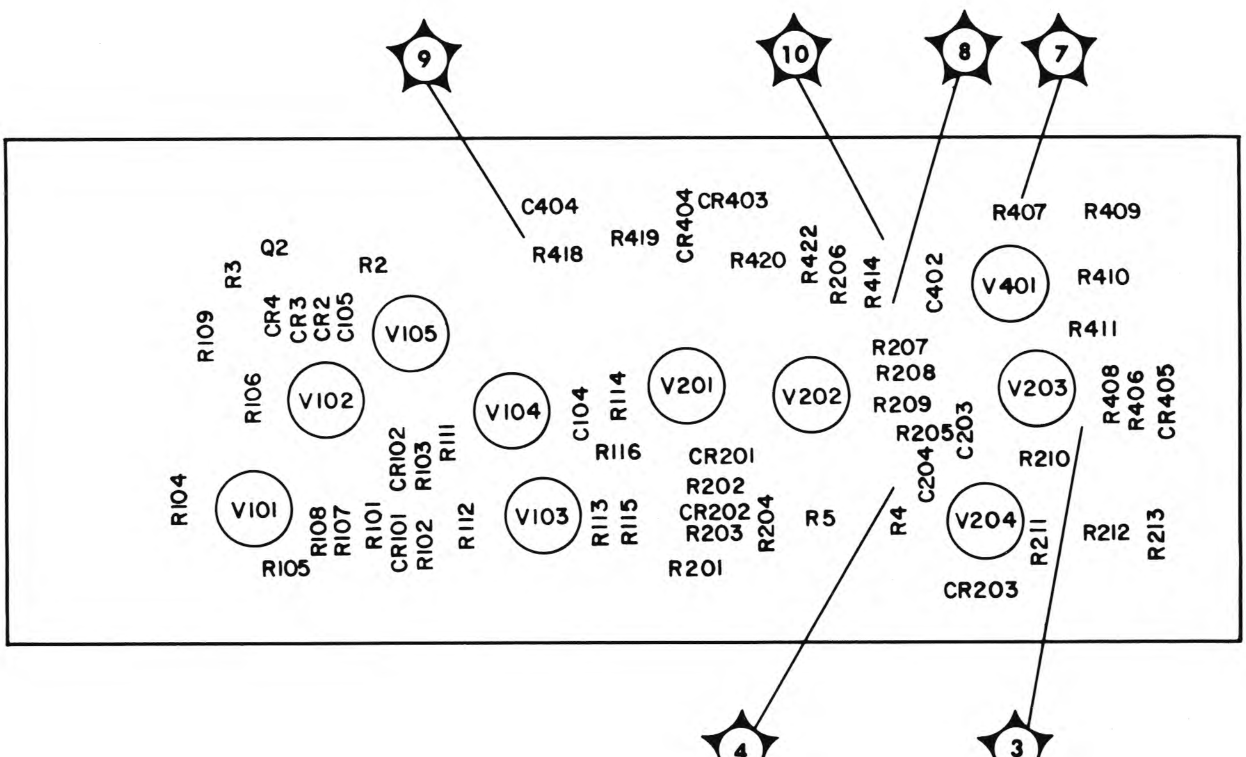


Figure 5-20. High Voltage Board (A100)

NOTES

1. CAPACITANCE IN MICROFARADS AND RESISTANCE IN OHMS UNLESS OTHERWISE INDICATED.
2. ——·——·—— INDICATES A PRINTED CIRCUIT BOARD. NUMBERS ADJACENT TO LEADS LEAVING BOARDS ARE LOCATED ON THE PRINTED CIRCUIT SIDE OF THE BOARD.
3. CIRCUIT VOLTAGES NOMINAL: RF AND LINE "ON", MEASURED WITH AN hp 412A DC VOLTMETER.
4. ☆ INDICATES TEST POINT

REFERENCE DESIGNATIONS

C101-105, 201-205
CR101-102, 201-203
K101
R101-109, 111-116, 201-213
S202
T1
V101-105, 201-204

† REFER TO TABLE I-2

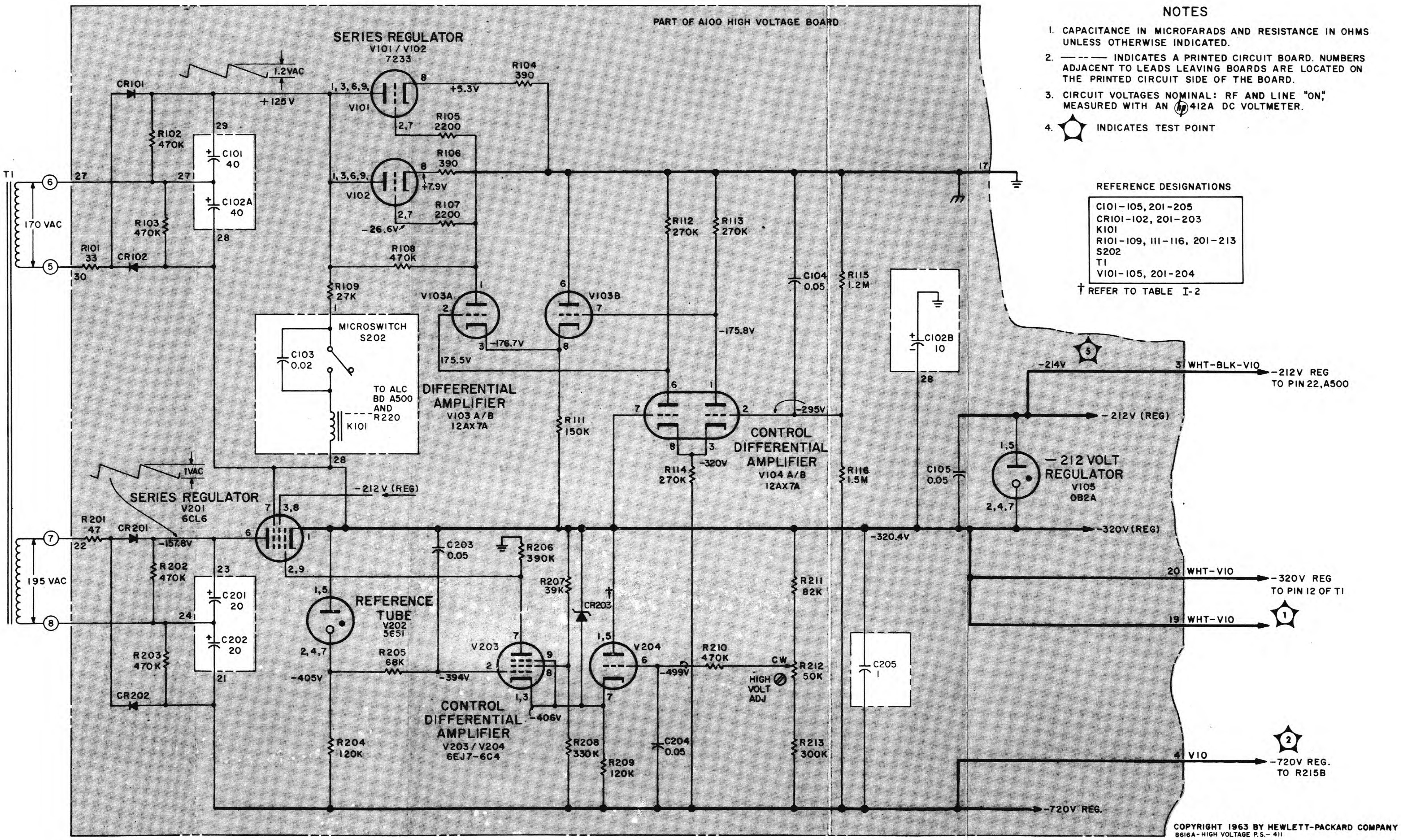


Figure 5-21. High Voltage Power Supply

SIGNAL GENERATOR
HEWLETT-PACKARD 8616A

GENERAL ORDERS AND MODIFICATIONS

Issued Sept 77

AP 117E-0306-3D

SIGNAL GENERATOR
HEWLETT-PACKARD 8616A

SCALE OF SERVICING SPARES

Issued Sept 77

TOPIC 3D

SIGNAL GENERATOR HP 8616A
(10S/6625-00-254-6671)

Introduction

1. This Test Equipment has been spares ranged in accordance with the servicing policy for general purpose Test Equipment, ie RAF Servicing is limited to 2nd line maintenance not affecting the calibration of the equipment (AP 3413, Vol 1, Part 1 refers).

2. Any aspect of the list considered unsatisfactory should be reported in accordance with AP 100B-01 order 0504, to MOD(AFD), ADSM 25(RAF) via Command Headquarters.

Man' Code Nato Stock No	Item Name and Description	Makers Part No/Drg No	No Off	Circuit Ref Remarks
SECTION 110AK				
5355-00-579-2318	KNOB nylon body; through hole type; round; 0.221 in dia un-thd shaft; 3/8 in max od; 0.52 in thk o/a	HEWLETT PACKARD 0370-0050	1	
5355-00-721-8924	KNOB	HEWLETT PACKARD 0370-0025	3	
5355-00-764-2355	KNOB	HEWLETT PACKARD 0370-0026	1	
5355-00-921-8472	KNOB, BLACK CRANK ASSEMBLY	HEWLETT PACKARD 0370-0149	1	
SECTION 110AR				
6625-99-140-1099	INTAKE AIR CLEANER ASSEMBLY	HEWLETT PACKARD 08614-611	1	
6625-00-903-0348	FOOT ASSEMBLY, OSC	HEWLETT PACKARD 5060-0767	4	

Man' Code Nato Stock No.	Item Name and Description	Makers Part No/Drg No.	No Off	Circuit Ref Remarks
SECTION 110H				
5920-00-284-7466	FUSE LINK, CARTRIDGE glass body;4A;125V max; 1/4 in dia	BUSSMAN MDX4	1	F2
5920-00-804-9688	FUSE HOLDER	HEWLETT PACKARD 1400-0008	1	
5935-00-881-7685	SHELL, ELECTRICAL CONNECTOR	HEWLETT PACKARD 1250-0144	1	RF POWER OUTPUT
5920-00-881-4636	FUSE HOLDER, EXTRACTOR incl one hex nut 1/2 in-24 UNS-2; one rubber washer; one lock washer; type CFG; single way; 250V; 15A	HEWLETT PACKARD 1400-0084	1	
5935-00-804-5144	CONNECTOR: PLUG CO-AXIAL TYPE BNC	HEWLETT PACKARD 1250-0083	3	EXTERNAL INPUTS
5935-00-990-7052	CONNECTOR,RECEPTACLE ELECTRICAL ferrous metal shall; fixed; flange mtg; 3 pole; 7A;250V ac	TOWER MFG. CORP.	1	P1
SECTION 110HS				
5950-00-995-9822	CABLE ASSEMBLY, POWER	HEWLETT PACKARD 8120-0078	1	
SECTION 110K				
6105-00-755-6941	MOTOR, FAN	HEWLETT PACKARD 3140-0030	1	B1
SECTION 110Q				
6120-00-926-1319	INDICATOR, GLOW LAMP IN RED PLASTIC	HEWLETT PACKARD 1450-0039	1	DS1, NEON 'MAINS ON' INDICATOR
SECTION 5920				
5920-00-296-0446	FUSE LINK, CARTRIDGE 0.75A; 250V	MIL SPEC F02GR750A	1	F1