# Notice

## Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product name/number was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP 8648 is now model number Agilent 8648.

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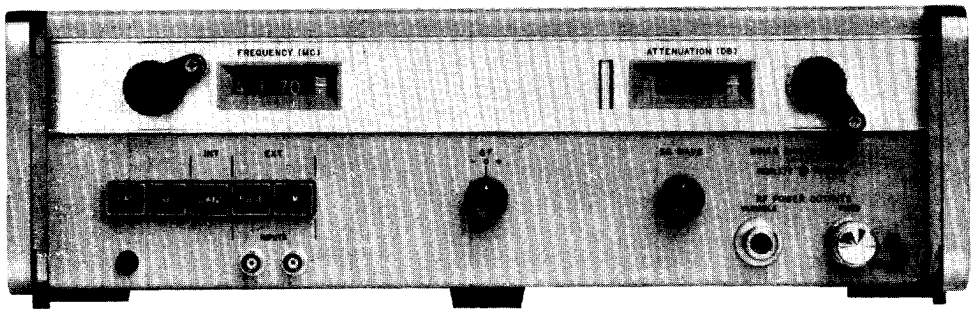
**Printed in USA July 2004**

OPERATING AND SERVICE MANUAL

# SIGNAL SOURCES

## 8614B AND 8616B

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## CERTIFICATION

*The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

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# SIGNAL SOURCES

# 8614B/8616B

### SERIALS PREFIXED: 910-

This Operating and Service Manual applies to HP 8614B and 8616B instruments with serial number prefix 910-.

### SERIAL PREFIXES NOT LISTED

For instruments with serial number prefixes below 910-, a "Backdating" Appendix is supplied in the back of this manual.



**08614-90002 Printed: FEB 1969**

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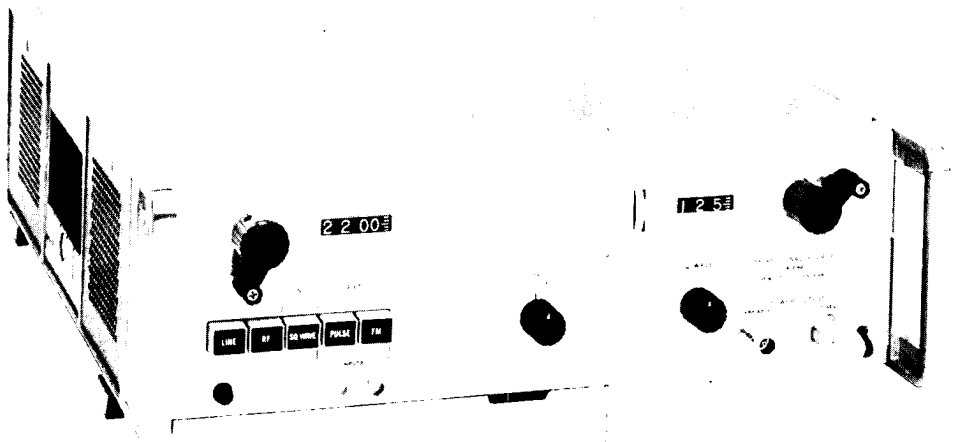


Figure 1-1. Model 8614B Signal Source

Table 1-1. Specifications

FREQUENCY RANGE:
8614B: 800 to 2400 MHz; single, linearly calibrated control, direct reading within 2 MHz.
8616B: 1800 to 4500 MHz; single, linearly calibrated control, direct reading within 2 MHz.

VERNIER:
ΔF control has a minimum range of at least 1.0 MHz for fine tuning.

FREQUENCY CALIBRATION ACCURACY:
8614B: ±5 MHz or ±1/2% whichever is greater
8616B: ±10 MHz or ±0.5%, whichever is greater

FREQUENCY STABILITY:
Approximately 0.005%/°C change in ambient temperature, less than 0.0003% (6 kHz-8616B) peak residual FM, less than 0.003% change for line voltage variation of ±10%.

RF OUTPUT POWER:
8614B: At least 15 mW controlled by attenuator
8616B: At least 15 mW (up to 3 GHz controlled by attenuator; at least 3 mW (3 GHz to 4.5 GHz controlled by attenuator.
8614B/8616B: A second RF output provides about 0.5 mW.

ATTENUATOR ACCURACY:
±0.2 dB ±0.06 dB/10 dB (below -10 dBm), direct reading linear dial, 0.2 dB increments.
RANGE: At least 130 dB for 8616B only.

INTERNAL SQUARE-WAVE MODULATION:
950 to 1050 Hz. Can be synchronized with +2V pulse input.

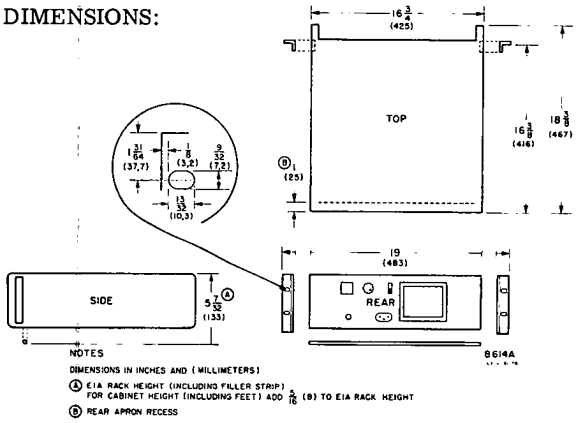
INTERNAL IMPEDANCE:
50 ohms; SWR less than 1.7

EXTERNAL PULSE (8614B and 8616B below 4000 MHz):
50 Hz to 500 kHz; +25 to +50V peak input; minimum RF pulse width, 300 nsec; RF rise time typically 200 nsec.

EXTERNAL FM MODULATION:
(a) Front-panel connector capacitively-coupled to klystron repeller. Input impedance, 220K shunted by about 300 pF.
(b) Rear-panel connector is dc-coupled to klystron repeller.
Mode width between 3-dB points varies as follows:
Model 8614B: From about 4 MHz at 800 MHz to about 15 MHz at 2000 MHz; klystron sensitivity is about 100 kHz/V from 800 to 1600 MHz and 200 kHz/V from about 1600 to 2400 MHz.
Model 8616B: From about 5.5 to 4 MHz from 1800 to 3000 MHz and from about 8.5 to 5.5 MHz from 3000 to 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 100 W.

DIMENSIONS:




WEIGHT: Net 37 lb (16, 7 kg); shipping 42 lb (18, 9 kg)

SUPPLIED: 7-1/2 foot (2290 mm) power cable with NEMA plug; rack-mounting kit.

OPTION 01: Input connectors on front and rear panels; RF connectors on rear panel only.

# SECTION I
# GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. The Model 8614B and 8616B Signal Sources provide RF power in the 800- to 2400- MHz and 1800- to 4500- MHz range, respectively. Each instrument has two power output connectors which supply RF power simultaneously. One output provides at least 15 milliwatts (3 mW for 8616B from 3.0 to 4.5 GHz) over a range of at least 130 dB with a precision attenuator. The other output connector provides an uncalibrated output of about 0.5 milliwatts which can be used for phase locking the source when extreme stability is desired, or it can be monitored with a frequency counter for extreme frequency resolution. Fine frequency changes can be made by means of the front-panel ΔF control and the attenuator dial can be set to any convenient reference while output power is held constant. Complete specifications are given in Table 1-1. The Model 8614B is shown in Figure 1-1.

1-3. Since both the Models 8614B and 8616B Signal Sources are the same in most respects, this manual will discuss the instruments in terms of the Model 8614B. The Model 8616B will be mentioned only where it differs from the Model 8614B Signal Source.

1-4. The internally square-wave modulated output can be externally synchronized to a 1-volt positive pulse signal. In addition, the RF power can be externally FM or pulse modulated. An external dc-coupled FM input which can be used for external AFC is also provided.

## 1-5. SUPPLEMENTARY INFORMATION.

1-6. Two instruments capable of extending the operation parameters of the source are the 8403A and the 2654A. The 8403A Modulator produces output pulses with 20-nanosecond rise and decay time characteristics and have an 80-dB on-off ratio. Pulse outputs are accurately variable in frequency, width, and delay. Amplitude modulation is available with frequency response to 10 MHz for sine. waves. Square-wave frequency capability is accurately available. The modulators also provide sync and delayed-sync outputs.

1-7. The Model 2654A Frequency Standard Synchronizer may be used directly to stabilize all internal cavity reflex klystron signal sources. The Model 2654A virtually eliminates any short-term drift in RF output signal and provides degeneration for any incidental FM in the output signal.

## 1-8. INSTRUMENT OPTIONS.

1-9. In addition to the standard Model 8614B, 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 Model 8614B.

## 1-10. INSTRUMENT IDENTIFICATION.

1-11. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). The first three digits, or the serial prefix, are for the purpose of matching published material to the instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the instrument described and your instrument. These differences are listed in a change sheet included with the manual. If the change sheet is missing, the information can be supplied by your nearest Hewlett-Packard field office.

## 1-12. KLYSTRON WARRANTY CLAIM SHEET.

1-13. The klystron supplied with the Model 8614B and replacement klystrons purchased from the Hewlett-Packard Company are guaranteed by the manufacturer against electrical failure for a specified period of time (time from date of purchase or hours of operation); warranty conditions vary with the type of tube used. Thus, for the actual warranty period of the klystron in your instrument, contact your local HP field office. A sheet for your use is included in the appendix of this manual; follow the instructions on the sheet explicitly.

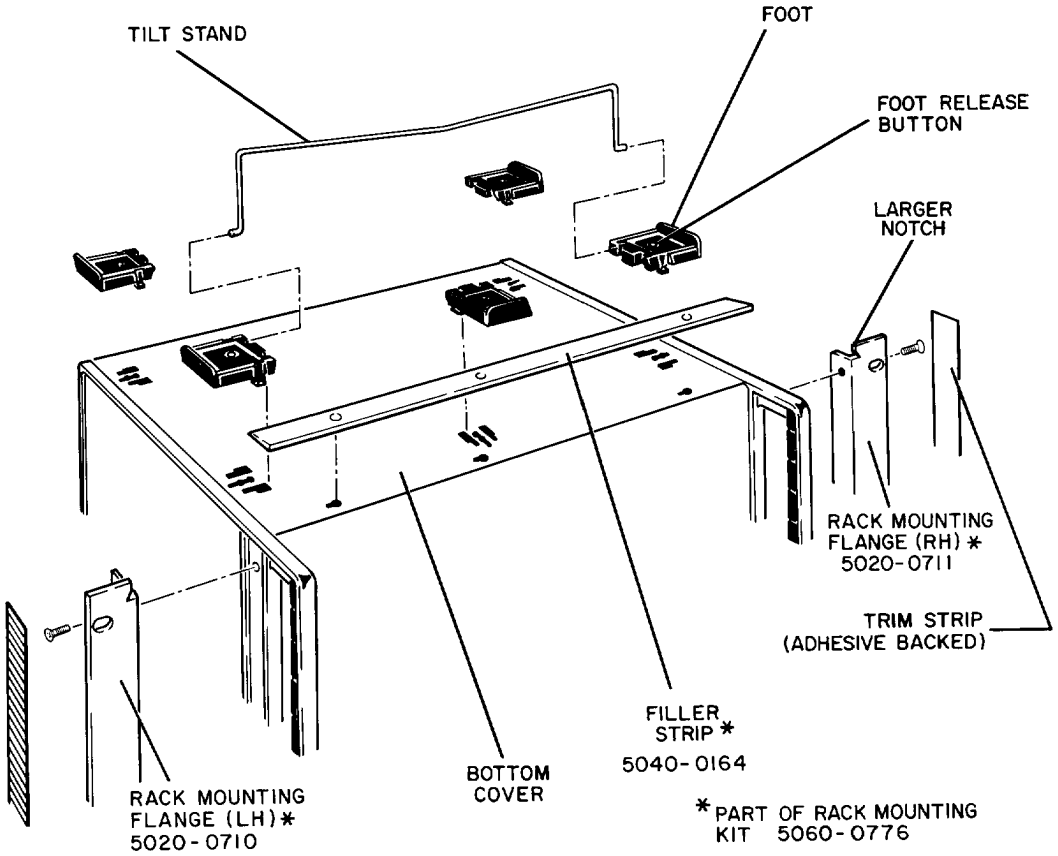



Figure 2-1. Conversion to Rack Mount

# SECTION II
# INSTALLATION

## 2-1. INCOMING INSPECTION.

2-2. This instrument was inspected both mechanically and electrically before shipment. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument, using the procedure outlined in paragraph 5-44. If there is damage or deficiency, see the warranty on the inside rear cover of this manual.

## 2-3. INSTALLATION.

2-4. The Model 8614B is delivered as a cabinet mount instrument. A kit is supplied with the instrument for conversion from cabinet to rack mount.

Note

The instrument is electrostatically shielded but, not magnetically shielded. Hence, a magnetic field near the instrument cover can cause excessive, incidental FM in the output signal. To eliminate this problem a metal shield with high permeability, such as a sheet of silicon steel, must be placed between the 8614B and any instrument radiating a magnetic field.

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 8614B 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 5-3 for air filter maintenance.

## 2-9. POWER REQUIREMENT.

2-10. The 8614B can be operated from a 115- or 230-volt, 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 1-1/2-ampere standard fuse is used for 115-volt operation; a 3/4-ampere standard fuse is used for 230-volt 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. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

## 2-14. REPACKAGING FOR SHIPMENT.

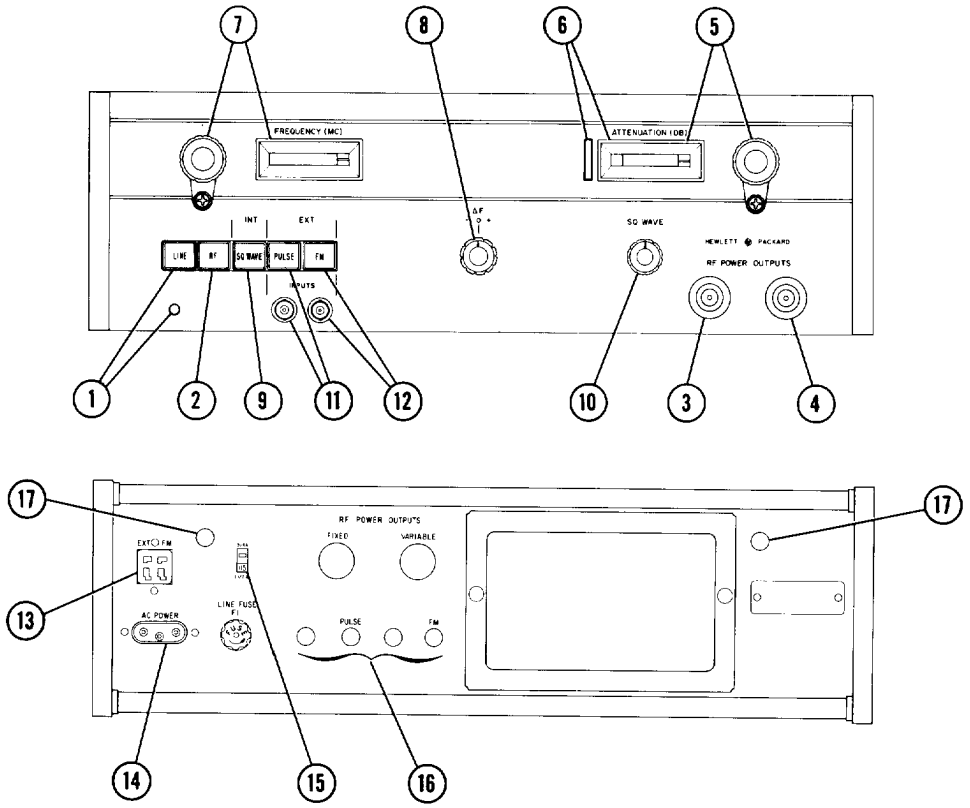
2-15. The following list is a general guide for repackaging an instrument for shipment. However, if you have any questions, contact your local HP field office.

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

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

Note

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




1. LINE. Connects primary power to instrument; lamp glows.
2. RF. Applies power to RF POWER OUTPUTS.
3. VARIABLE RF POWER OUTPUT.
4. FIXED RF POWER OUTPUT. Provides at least 0.5 mW and unattenuated RF power.
5. ATTENUATION (DB). Sets relative RF power level at VARIABLE RF POWER OUTPUT.
6. Thumb wheel. Sets attenuation (DB) dial to any convenient reference without changing VARIABLE power output.
7. FREQUENCY (MC). Sets RF frequency.
8. ΔF. Permits small deviations from FREQUENCY (MC) setting (±1MHz maximum).
9. INT SQ WAVE. Modulates RF POWER OUTPUTS.
10. SQ WAVE (FREQ.) control adjusts modulation frequency.
11. EXT PULSE. Positive pulses to external pulse input will provide modulation voltages required to pulse modulate RF POWER OUTPUTS. Positive pulses turn RF "ON".
12. EXTERNAL FM. AC voltages applied to external FM input will provide frequency modulation of both FIXED and VARIABLE outputs.
13. EXT FM. DC coupled input to klystron for frequency stabilization.
14. POWER. 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. Optional extension of attenuator or frequency shaft for rear panel servo drive arrangement: available upon special request.

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

# SECTION III
# OPERATION

## 3-1. INTRODUCTION.

3-2. The Model 8614B Signal Source can provide RF power up to at least 15 milliwatts at frequencies from 800- to 2400-MHz(1800- to 3000-MHz for the Model 8616B Signal Source). It provides internal square-wave modulation that is variable in rate from 950 to 1050 Hz (other frequencies are available upon request). In addition, external FM and pulse modulation voltages can be applied. Two or three modulation modes of operation can be applied to the instrument simultaneously; pushbutton controls select the mode of operation. External modulation inputs are located directly below the modulation button 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. FRONT AND REAR PANEL CONTROLS AND INDICATORS.

3-4. Functions of all front and rear panel controls and indicators are given in Figure 3-1. The function of each control and indicator is keyed to the illustration of the instrument front and rear panels which appears in Figure 3-1.

Note

Depressing the EXTERNAL PULSE button without the application of an external signal cuts-off the RF output power.

## 3-5. OPERATING PROCEDURES.

3-6. The operating procedures (Figures 3-2 through 3-5) give set up procedures for the various modes of operation. Instructions are given for obtaining the following outputs: CW (unmodulated), square-wave modulated (modulating voltage supplied internally, and FM, and pulse-modulated (modulating voltage supplied externally).

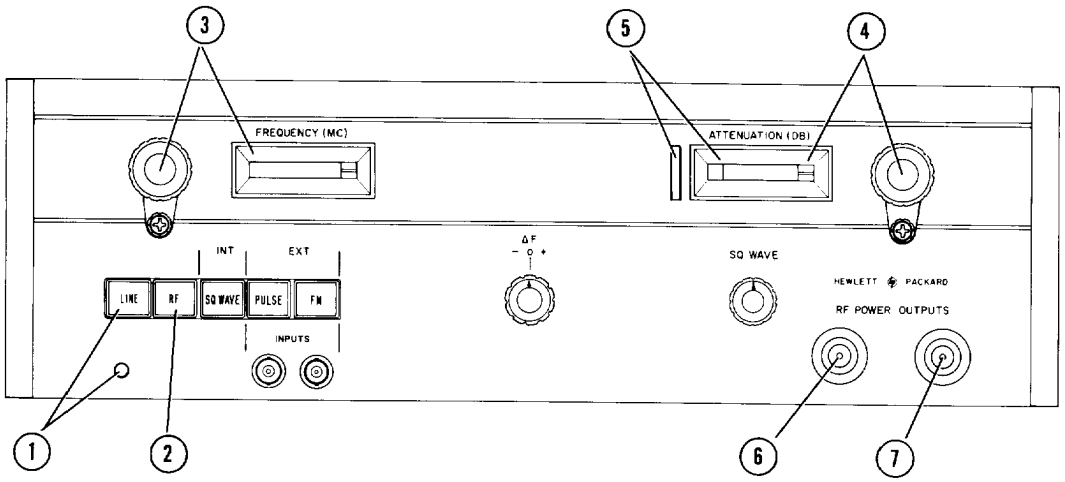
## 3-7. STABILIZED SOURCE.

3-8. To use the 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 8614/8616 to OSCILLATOR INPUT connector on Model 2650A. Depress EXTERNAL FM button on Model 8614/8616 and proceed as explained in the instruction manual for the Model 2650.

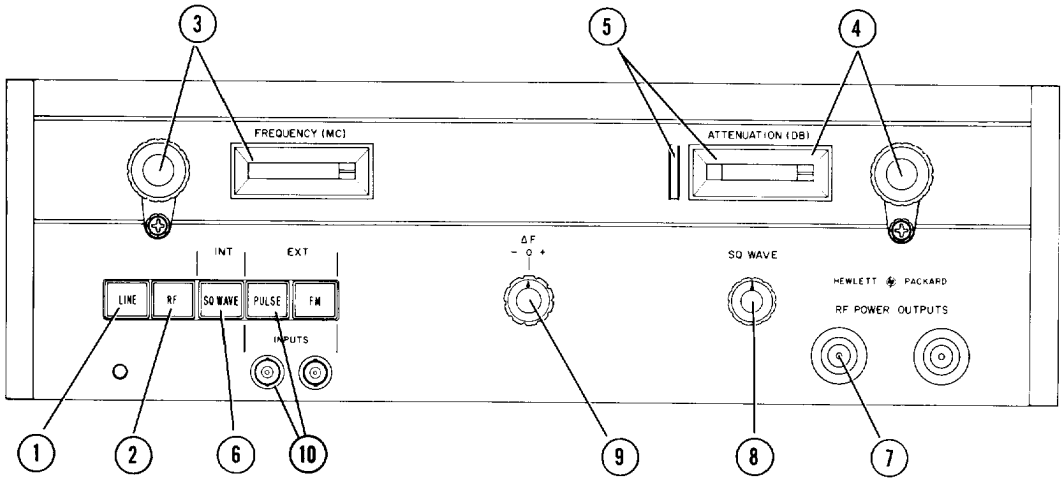



1. Depress LINE; lamp glows, indicating heater and high voltage are applied.
2. Depress RF.
3. Set FREQUENCY (MC) to desired frequency.
4. The ATTENUATION (DB) knob will attenuate RF power at variable RF POWER OUTPUT.
5. The thumb screw adjustment will set ATTENUATION (DB) dial to any convenient reference without affecting output power level.
6. Take attenuable RF power at variable RF POWER OUTPUT.
7. Take unattenuable RF power at FIXED RF POWER OUTPUT.
8. Use ΔF control when a small deviation from FREQUENCY (MC) setting is desired.

Note

ΔF control should be centered when not in use.

Figure 3-2. Unmodulated RF Power Output

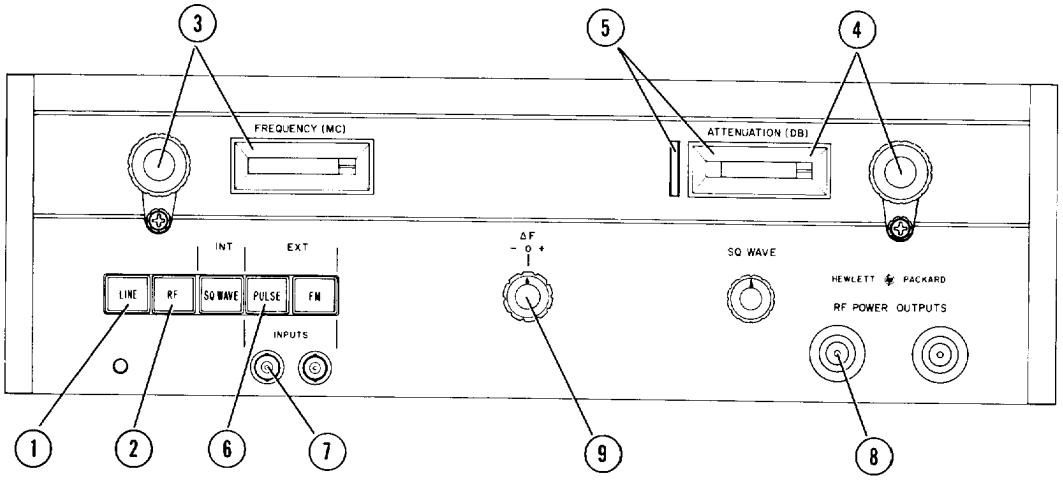



1. Depress LINE.
2. Depress RF.
3. Set FREQUENCY (MC).
4. Set output level with ATTENUATION (DB) knob.
5. Set ATTENUATION (DB) dial to any convenient reference with thumbscrew adjustment.
6. Depress SQ WAVE.
7. Take modulated and attenuable RF power output at variable RF POWER OUTPUT.
8. Adjust SQ WAVE for desired modulation frequency.
9. Use ΔF control when a small deviation from FREQUENCY (MC) setting is desired.

   Note: ΔF control should be centered when not in use.

10. EXTERNAL SYNCHRONIZATION.
    a. Depress PULSE and apply +1 volt pulse;
    b. Pulse repetition rate must be between 955 and 1100 Hz, which will be synchronizing frequency;
    c. Decrease SQ WAVE FREQ to a rate slightly slower than the pulse repetition rate.

Figure 3-3. Internal Square-Wave Modulation and External Sync

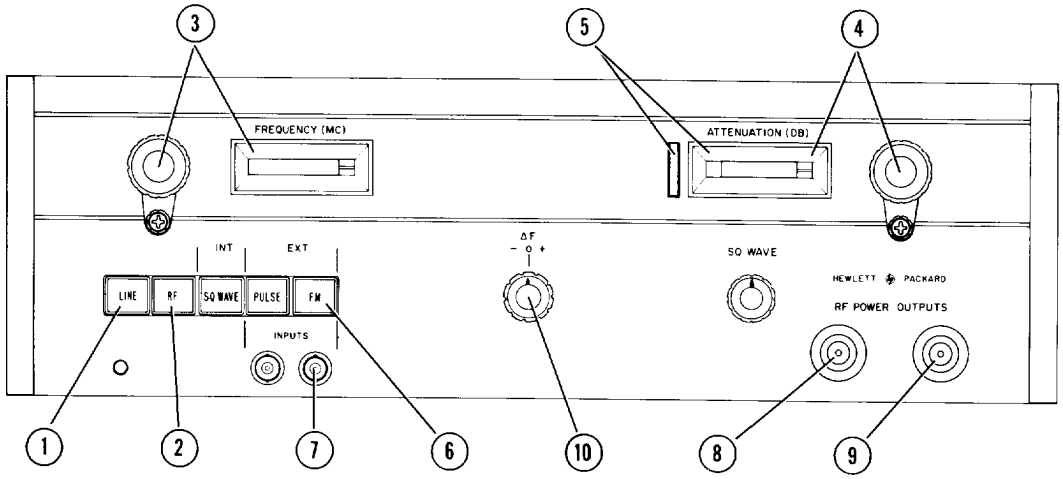



1. Depress LINE.
2. Depress RF.
3. Set FREQUENCY (MC)(to any frequency up to 4000 MHz for 8616B).
4. Set output level with ATTENUATION (DB) knob.
5. Set ATTENUATION (DB) dial to any convenient reference with thumb screw adjust.
6. Depress EXTERNAL PULSE.
7. Apply +25 - to +50-volt 50-Hz to 1/2-MHz positive pulse modulating signal to EXT PULSE INPUT.
8. Take pulse modulated and attenuable RF power output at VARIABLE RF POWER OUTPUT.
9. Use ΔF control when a small deviation from FREQUENCY (MC) setting is desired.

Note

ΔF control should be centered when not in use.

Figure 3-4. External Pulse Modulation




1. Depress LINE.
2. Depress RF.
3. Set FREQUENCY (MC).
4. Set output level with ATTENUATION (DB) knob.
5. Set any convenient reference on ATTENUATION (DB) dial with thumb screw.
6. Depress EXTERNAL FM.
7. Apply modulating signal to EXT FM INPUT (front panel).
8. Take attenuable frequency modulated RF power output at VARIABLE RF POWER OUTPUT.
9. Take unattenuable frequency modulated RF power at FIXED RF POWER OUTPUT.
10. ΔF control should be centered so that the klystron will operate in the center of the mode.

Figure 3-5. External FM

# SECTION IV
# PRINCIPLES OF OPERATION

## 4-1. INTRODUCTION.

4-2. Basically the instrument includes a Modulator, RF Oscillator, and a Power Supply, as shown in Figure 4-1. The RF Oscillator is a reflex klystron which supplies RF power. The Modulator provides the video pulses required to pulse and square wave modulate the klystron output. The power supply provides the regulated dc voltages required to operate the instrument.

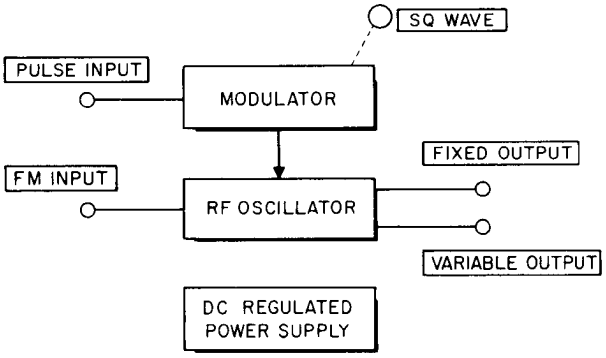



Figure 4-1. Circuit Block Diagram

## 4-3. MODULATOR CIRCUITS.

4-4. The basic function of the modulator circuits is to provide a positive video pulse to the control grid of the klystron, V1. This drives the control grid positive which allows the klystron to oscillate during the time of the pulse. The arrangement of the modulator circuit depends upon the mode of operation. Mode of operation selection is accomplished by depressing the appropriate front-panel button.

4-5. EXTERNAL PULSE.

4-6. A simplified diagram of the circuits used in the external pulse mode of operation is shown in Figure 4-2. When the pulse button is depressed, V401A is cut-off, and V401B starts conducting. Conduction causes the plate voltage of V401B to drop to approximately -50 volts which impresses a voltage of less than -320 volts on the emitter of transistor Q401. Emitter Followers Q401 and Q402 begin to conduct heavily and a voltage of less than -320 volts is impressed on the control grid of the klystron. This voltage which is more negative than the cathode of the klystron causes klystron oscillation to cease. When a positive pulse, of at least +25 volts, is applied to the external pulse input the emitter potential of transistor Q401 is raised to a voltage positive with respect to the cathode of klystron V1. This voltage is applied to the control grid of the klystron causing the klystron to oscillate for the time of the positive pulse.

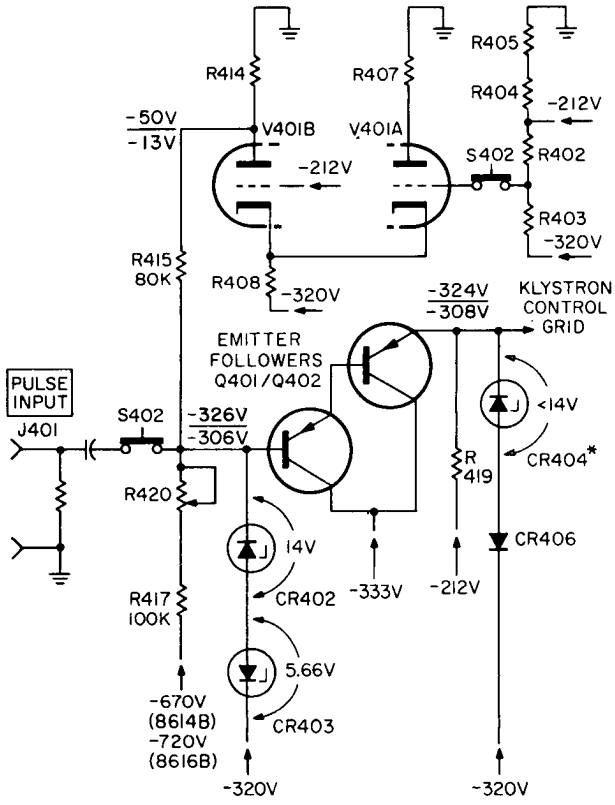



Figure 4-2. Pulse Modulation Circuit

4-7. INTERNAL SQUARE WAVE.

4-8. A simplified diagram of the circuit arrangement for internal square wave operation is shown in Figure 4-3. With the square wave button depressed, when V401A is cut-off and V401B is conducting the voltage on the plate of V401B is approximately -50 volts. A voltage of -50 volts on the plate of V401B causes a voltage on the emitter followers which is negative with respect to the cathode of the klystron. This voltage applied to the control grid of the klystron causes klystron oscillation to cease. With V401B conducting, capacitor C402 is discharging towards approximately -200 volts (the voltage at potentiometer R410). When C402 discharges enough to bring V401A into conduction, V401B is biased off through the common cathode resistor R408. When V401B is cut-off, the tubes plate voltage rises to about -13 volts which results in a voltage on the emitter followers which is more positive than the -320 volt klystron cathode voltage. This voltage applied to the control grid of the klystron causes the klystron to oscillate. With V401A conducting the voltage at R410 drops to about -225 volts and C402 begins to charge toward about -225 volts. When C402 charges to a voltage more negative than the cathode of

V401A, current in V401A becomes limited and V401B again conducts causing the klystron to cease oscillation. The RC time constant of C402 is varied by R413, allowing modulation frequency to be changed from at least 950 to 1050 Hz. When V401B is conducting the RF output of the klystron is cut-off. The symmetry of the square wave is adjusted by R410. The potential to which C402 charges or discharges is controlled by varying R410.

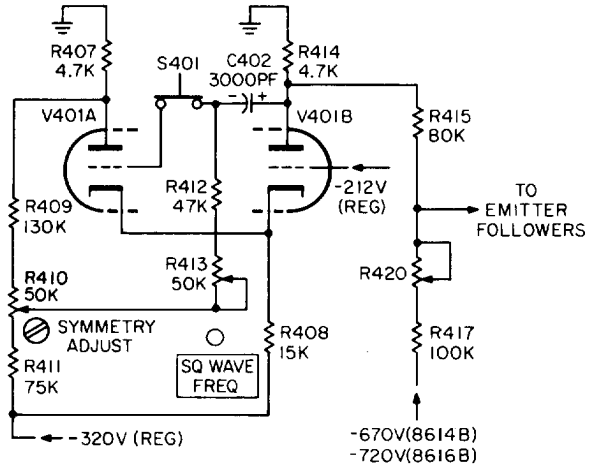



Figure 4-3. Square Wave Modulation Circuit

4-9. SYNCHRONIZED SQUARE WAVE.

4-10. With the SQ WAVE and PULSE depressed and no signal applied to the pulse input, operation is as described in paragraph 4-8. A positive pulse signal, of at least 1 volt, applied through CR405 causes the cathode of V401A to go positive which limits tube current; V401B begins to conduct causing the klystron to cease oscillation. Any input signal applied while V401B is conducting will not affect normal square wave circuit operation. Square wave modulation frequency may be synchronized to any pulse repetition rate between about 955 to 1050 Hz providing internal modulation frequency is set to a slightly slower rate.

## 4-11. RF OSCILLATOR.

4-12. The RF Oscillator is a reflex klystron tube mounted in a plunger tuned cavity for generation of the RF energy. The energy from the cavity is coupled by means of pickup probes located in small sections of waveguide which open into the cavity. The energy from these two probes is coupled directly to the RF OUTPUT connectors. One of the probes is adjustable in depth into and out of the cavity allowing the energy level coupled to the VARIABLE RF OUTPUT connector to be variable.

4-13. REFLEX KLYSTRON OPERATION.

4-14. The resonant circuit of the RF Oscillator klystron includes resonator-grid capacitance, and the primarily inductive impedance of the external cavity. The cavity is a shorted coaxial transmission line, one cylinder within another. The cavity is fitted with a movable plunger (wiper contacts which short-circuit the line at the opposite end of the cavity from the tube) which change cavity dimensions. Changing cavity dimensions changes the resonant frequency of the oscillator circuit. Thus changing the frequency of oscillation.

4-15. Figure 4-4 shows the equivalent circuit of a reflex klystron oscillator. In the following discussion of how oscillations are sustained in a reflex klystron oscillator, the presence of a low amplitude RF voltage across the resonator grids is assumed. As in any oscillator, this initial voltage is supplied by the thermal agitation noise.

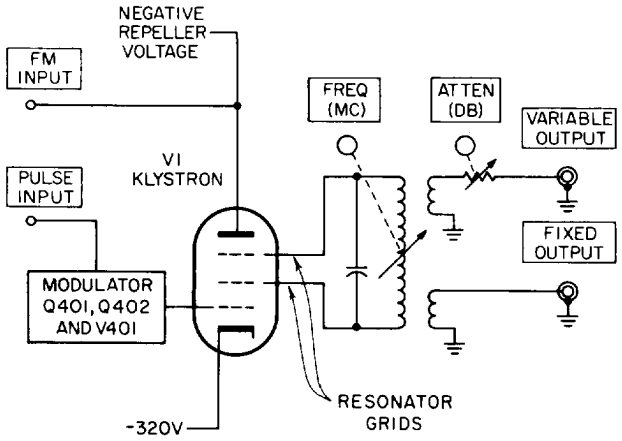



Figure 4-4. Equivalent Oscillator Circuit

4-16. Electrons emitted from the cathode toward the resonator grids are velocity modulated, i.e., the electrons are accelerated or decelerated according to the phase of the RF voltage existing across the resonator grids. After leaving the resonator grids, the electrons encounter a retarding electric field set up by the negative repeller voltage and are repelled back toward the grids. Since the electrons have been velocity modulated they tend to form in bunches when they arrive at the grids.

4-17. This bunching of electrons is illustrated in Figure 4-5, which shows the transit time relationship of electrons while in the drift space between the resonator grids and the repeller. Consider an electron (a) leaving the grids at time $t_1$. The voltage of the RF signal on the grids is such that the electron receives energy and is accelerated into the drift space. It arrives back at the grids at time $t_n$. An electron (b) leaving at time $t_2$ receives no acceleration because the RF signal is now at zero volts. Thus electron (b) does not travel as far into the drift space and arrives back at the grids at the same time as electron (a). Electron (c) leaving at time $t_3$ is decelerated since the RF signal has reversed voltage polarity since time $t_1$.

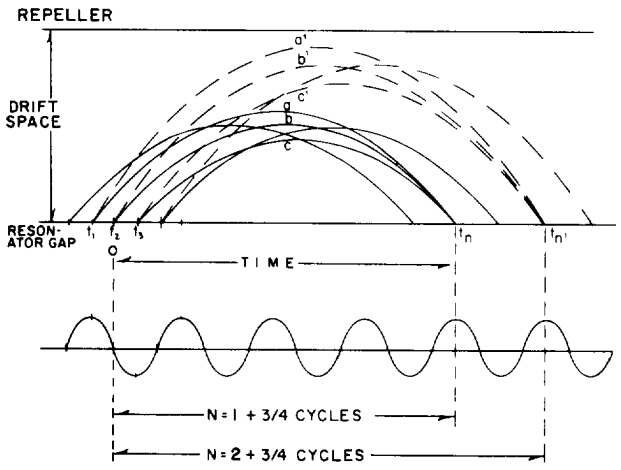



Figure 4-5. Bunching of Electrons

Electron (c) travels a shorter distance into the drift space and arrives back at the grids at the same time as electrons (a) and (b).

4-18. When bunched electrons arrive back at the grids at a time when the RF signal tends to retard their return, they deliver energy to the grids and sustain oscillations in the resonant cavity.

4-19. The time that the electrons spend in the drift space is adjusted by changing the repeller voltage. As repeller voltage is increased in the negative direction, electrons a, b, and c spend less time in the drift space. As repeller voltage is decreased electrons $a^1$, $b^1$, and $c^1$ (Figure 4-5) travel farther into the drift space and take a longer time ($t_n1$) to return to the grids. At the low end of the instrument frequency band (up to about mid-frequency), the repeller voltage is adjusted so that the number of oscillations (N) that occur at the grid while the electrons are in the drift space is equal to 1-3/4 Hz. At the high end of the frequency band (above about mid-frequency), the repeller voltage is adjusted so that the number of oscillations equals 2-3/4 cycles. When the oscillator is operating with 1-3/4 cycles drift time it is known as operating in the 1-3/4 repeller mode.

4-20. RF OSCILLATOR TUBE.

4-21. The RF oscillator tube is a reflex klystron operating in a tunable cavity resonator. The klystron and cavity assembly is shown in Figure 5-5. The klystron cavity system operates on the 3/4 wavelength cavity mode, and oscillation on both the 1-3/4 and 2-3/4 repeller modes are employed to cover the frequency range of the instrument. The 1-3/4 mode is used from low frequency up to about mid-frequency. At about mid-frequency the tuning mechanism actuates mode switch S202 to decrease the voltage applied to the repeller by about 160 volts (200 volts for the 8616B). This action places the system on the 2-3/4 mode for the remainder of the band from approximately 1.6 GHz to 2.4 GHz (3.0 GHz to 4.5 GHz for the 8616B).

4-23. Voltage is applied to the klystron repeller from variable resistor R220. The movable arm of R220 is ganged to the frequency drive in such a manner that voltage on the repeller is automatically tracked with frequency in the desired repeller mode.

## 4-23. REGULATED POWER SUPPLY.

4-24. The regulated power supply includes two power supplies: the high-voltage supply, and the filament supply. The supplies are conventional 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 between the monitored and reference voltage is applied through a control amplifier to the series resulator. This differential voltage changes the effective resistance of the series regulator which in turn holds the output voltage constant (see Figure 4-6).

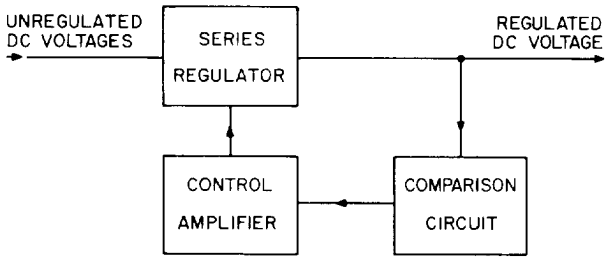



Figure 4-6. Series-Regulated Power Supply

4-25. 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 (-720 volts for 8616B). Both supplies use voltage doublers to drive series regulator circuits. Since this is a combined circuit arrangement, both supplies are interdependent. There is also a gas regulator tube, V105, connected to the -320 volt supply to provide a -212 volt regulated source.

4-26. The low-voltage supply provides 6.1 volts dc for filament operation. The filament supply uses a half-wave rectifier and a series regulator.

Table 5-1. Test Equipment Required

| Instrument Type | Check | Critical Specifications | Recommended HP Model |
|---|---|---|---|
| Oscilloscope | Calibration<br>Troubleshooting<br>Performance | Range: 30 to 0.5 μs/cm<br>Sensitivity: 0.005 to 1.0 V/cm<br>Accuracy: ±3% | HP Model 1422A/1402A |
| Crystal Detector | Calibration<br>Troubleshooting<br>Performance | Frequency Range: 800 to 4500 MHz<br>Sensitivity: 100 mV/0.35 mW<br>Frequency Response: ±0.5 dB | HP Model 423A |
| Power Meter | Calibration<br>Performance | Power Range: 0.1 to 10 mW<br>Frequency Range: 800 to 4500 MHz<br>Accuracy: ±3% | HP Model 431C Power Meter with<br>HP Model 478A<br>Thermistor Mount |
| DC Voltmeter | Calibration<br>Troubleshooting | Range: 1 to 725 V<br>Accuracy: ±0.2% of reading<br>Floating Input: May operate within ±470 Vdc of chassis ground | HP Model 3440A Digital DC Voltmeter |
| AC Voltmeter | Calibration<br>Troubleshooting | Range: 0 to 20 mV<br>Accuracy: ±2% of reading<br>Floating Input: May operate within ±470 Vdc of chassis ground | HP Model 403B |
| Clip-On Milliammeter | Calibration | Range: 0 to 35 mA<br>Accuracy: 3% ±0.1 mA | HP Model 428A |
| Ohmmeter | Troubleshooting | Range: 1 to 100 megohms<br>Accuracy: ±5% of full scale | HP Model 412A |
| Calibrated Frequency Meter | Calibration<br>Performance | Range: 8614B-800 to 2400 MHz<br>8616B-1800 to 4500 MHz<br>Accuracy: 0.06%-8616B<br>0.03%-8614B | HP Model 536A (1000 to 4100 MHz)<br>PRD 587A (800 to 1000 MHz)<br>HP Model G532A with G281A (2) (4000 to 4500 MHz) |
| Pulse Generator | Calibration<br>Performance | Pulse Rep Rate: 50 to 50 kHz<br>Output: 27 V peak | HP Model 212A |
| FM Modulator | Frequency tracking, preliminary | Outputs: 300 V peak-to-peak and 6.3 Vac<br>Input: 115 Vac, 60 Hz<br>Phase Adjustable: Approx 80° | Power Transformer (1) (9100-0045)<br>Capacitors (2) (0140-0003)<br>Potentiometers (2) (2100-0047)<br>Fuseholder, extractor post type(1) (1400-0084)<br>Power Cord (1) (8120-0050)<br>Fuse lamp, 115V (1), Slo-Blo (2110-0007) |
| DC Power Supply | Troubleshooting<br>Power Supply | Output: 315 to 353 Vdc<br>Ripple: Less than 3 mV | HP Model 711A |
| Test Oscillator | Calibration Check | Frequency Range: 10 kHz<br>Output: 5 to 6 V peak<br>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, 180 MHz<br>Harmonic: 20 | HP Model 5257A |
| Frequency Meter | Calibration Check | Frequency Range: 10 kHz<br>Output: 1 V | HP Model 5210A |

# SECTION V
# MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Signal Source. The section includes recommended test equipment, replacement procedures, repair and adjustment procedures, and troubleshooting charts. Also included are performance checks which verify proper instrument operation.

## 5-3. CLEANING THE AIR FILTER.

5-4. Inspect the air filter regularly and clean it before it becomes dirty enough to restrict air flow. To remove and clean the air filter, proceed as follows:

a. Remove filter from instrument rear panel by removing the four machine screws at the corners.

b. Wash filter in warm water and detergent.

c. Dry filter thoroughly and remount on instrument.

## 5-5. TEST EQUIPMENT.

5-6. Table 5-1 lists test equipment required for use in maintaining and checking instrument performance. Equipment having similar characteristics can be substituted for the equipment listed.

## 5-7. TROUBLESHOOTING.

5-8. LOCATING TROUBLE.

5-9. Always start locating trouble with a thorough visual inspection for burned-out or loose components, loose connections, or any condition which suggests a source of trouble. Check tubes for open filaments by touching tubes and replace all that are cold (except V105 and V202 which are cold cathode tubes). Replacing a cold tube, in most cases, will restore the generator to normal operation. Check the fuse to see that it is not open.

5-10. If trouble cannot be isolated to a bad component by a visual inspection or a cold tube, the trouble should then be isolated to a circuit section. Isolation to a circuit section can best be accomplished by using the block diagram, Figure 5-1.

5-11. TROUBLESHOOTING CHARTS.

5-12. Troubleshooting charts, Tables 5-2 and 5-3, list checks and symptoms, possible causes, and remedies of various troubles. The power supply be checked first; refer to paragraph 5-14.

5-13. For simplification, only major components are referenced in the troubleshooting charts, but it should be remembered that associated components are also failure possibilities. When testing the signal source it is recommended that line voltage be applied through a variable transformer, and that the transformer be adjusted to deliver a voltage at the low end of the rated

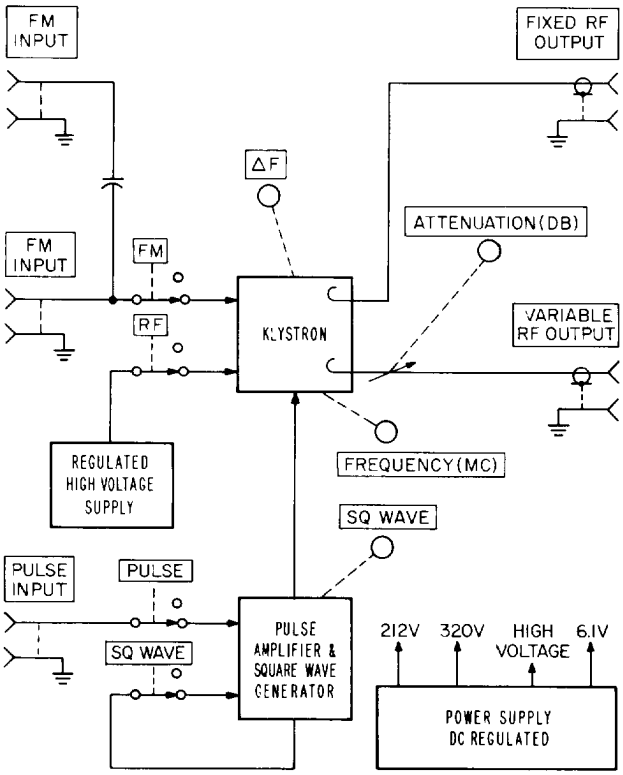



Figure 5-1. Block Diagram

103- to 127-volt range. An instrument in good condition should operate satisfactorily from any line voltage within the rated range, but where there is marginal operation (from weak tubes, etc), weaknesses become easier to trace at low line voltages.

## 5-14. POWER SUPPLY.

5-15. Correct operation of the power supply is vital to proper operation of the signal source. Noise or variation in the regulated voltages causes other circuits to operate in a random or erratic manner. It is advisable to make a voltage check of the power supply whenever the instrument is suspected of marginal operation. This eliminates factors such as low voltages or poor regulation which cause unsatisfactory performance in other sections of the instrument.

5-16. The power supply consists of two interdependent series-regulated voltage supplies, furnishing -320 and -670 volts (-720 volts for 8616B) as measured from chassis ground and a regulated filament supply furnishing -6.15 volts.

a. The -320 volt regulated supply furnishes voltage to the klystron cathode and modulation circuit. It also

Table 5-2. Power Supply Troubleshooting

| Symptom | Conclusion | Remedy |
|---|---|---|
| -350 VOLT SUPPLY (-400 for 8616B) | | |
| Connect Voltmeter common to test point 3 and positive lead to test point 4 (see Figure 5-3). | | |
| -350 ±2 VDC; 4 mV AC (-400 ±2 VDC - 8616B) | Supply OK | |
| Small deviation | Out of adjustment | Adjust R212 (see Figure 5-2) |
| Large or erratic deviation | -350 volt (-400 or -320 volt supply bad<br>Note<br>See Figure 5-4 for component location | Remove V101 and V102 and connect a -320 volt dc power supply between test points 5 and 3. Recheck supply. If deviation still exists check V201, V202, V203, V204, C201, C202, CR201, or CR202. |
| -320 VOLT SUPPLY | | |
| Connect Voltmeter common to test point 3 and positive lead to test point 5 (see Figure 5-3). | | |
| +320 ±5 VDC; 7 mV AC | Supply OK | |
| Small deviation | -350 volt (-400) supply out of adjustment | Check and adjust -350 volt supply |
| Large or erratic deviation | -320 volt or -350 volt (-400) supply bad<br>Note<br>See Figure 5-4 for component location | Remove V201 and connect a -350 volt dc power supply between test points 3 and 4. Recheck supply. If deviation still exists check V101, V102, V103, V104, C101, C102, CR101, or CR102. |
| -212 VOLT SUPPLY | | |
| Connect Voltmeter common to test point 3 and positive lead to test point 6 (see Figure 5-3). | | |
| +108 ±5 VDC | Supply OK | |
| Voltage unstable | Defective V105<br>Defective -320 volt regulation | Check V105<br>Check -320 volt supply |
| FILAMENT SUPPLY | | |
| Connect Voltmeter between test points 1 and 2 (see Figure 5-4). | | |
| -6.15 ±0.1 VDC; 25 mV AC | Supply OK | |
| Small deviation | Out of adjustment | Adjust R5 (see Figure 5-2) |
| Large or erratic deviation | -320 volt reference or or filament regulation defective | Check -320 volt supply<br>Check Q1, Q2, CR1, or CR4 |

furnishes a regulated -212 volts for the modulation circuit. This voltage is taken from an additional voltage regulator tube (V105), included between the -320 volt supply and chassis ground.

b. The -350 volt regulated supply (-400 volt for 8616B), stacked with the -320 volt supply furnishes -670 volts (-720 volts for 8616B) to the klystron repeller and modulation circuit.

5-17. The two high-voltage regulated supplies are stacked, and each supply references the other. To troubleshoot either supply, always remove series regulator and replace the other supply with an external dc power supply.

5-18. To measure and adjust power supply voltages, the following procedures should be followed. This permits the voltmeter common for all high-voltage measurements to be attached to a common point while the dc probe is moved from point to point.

**WARNING**

When using a metal case VTVM with common connected to chassis ground, the metal case will be at common lead potential.

a. Remove four #6-32 screws from top cover and remove top cover (also remove bottom cover).

b. Open out hinged power-supply board by removing two screws that secure board.

Table 5-3. General Trouble Location

| Symptom (outputs) | Trouble Location | Check |
|---|---|---|
| No RF | High Voltage Power Supply | Measure supply voltages (see Table 5-2) |
| | Filament Supply | Measure supply voltage (see Table 5-2) |
| | RF Probes | Turn instrument off and measure resistance at each RF Output connector; should be about 52 to 58 ohms (paragraph 5-43) |
| | Modulation Circuit<br>(a) PULSE. . . not depressed<br>(b) SQ WAVE . not depressed | Measure dc voltage at test point 11 on circuit board; should be about -306 to -310 Vdc (paragraph 4-6) (see Figure 5-4) |
| | Klystron | V1 |
| Continuous wave but no pulse or Sq Wave | Modulation Circuit | Depress PULSE with no pulse input and measure test point voltages (see Figure 5-4) |
| | (a) Test Point 7: about -220V<br>(b) Test Point 8: about -46V<br>(c) Test Point 9: about -325V<br>(d) Test Point 10: about -333V<br>(e) Test Point 11: about -327V | V401A OK<br>V401B OK<br>CR402 OK<br>CR401 OK<br>CR404, CR406, Q401, Q402 OK |
| Continuous wave and sq wave OK but not pulse | Broken ground connection | Check chassis ground connections at board numbers 17 and 9 (see Figure 5-4) |
| | Modulation Circuit | Test points and power supply voltages |

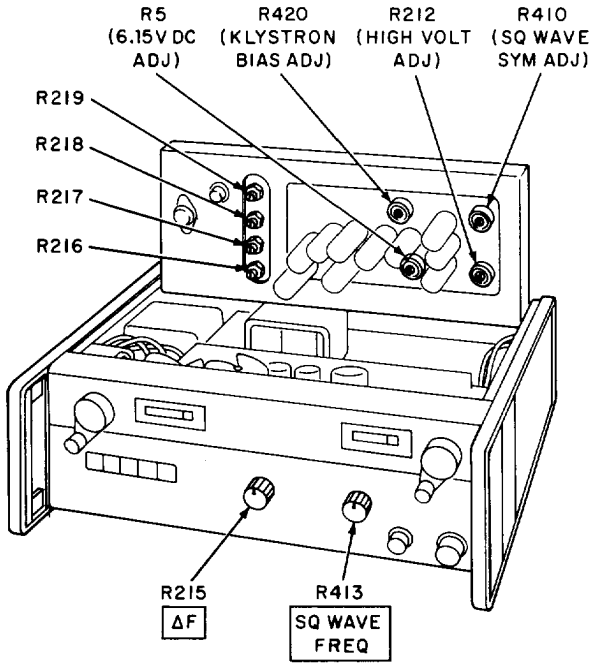



Figure 5-2. Electrical Adjustment Location

c. Set ac voltage at 115 or 230 volts ac as appropriate and depress LINE button.

d. Connect voltmeter and VTVM in parallel (see Table 5-2).

**CAUTION**

Voltmeter leads should not touch chassis ground unless specified.

e. Regulated voltages may vary ±1 volt (high voltages) and ±0.2 volt (filament supply) due to 10% variation in line voltage.

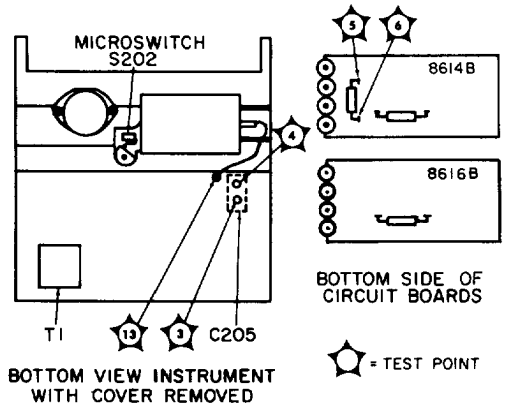



Figure 5-3. High Voltage Test Point Location

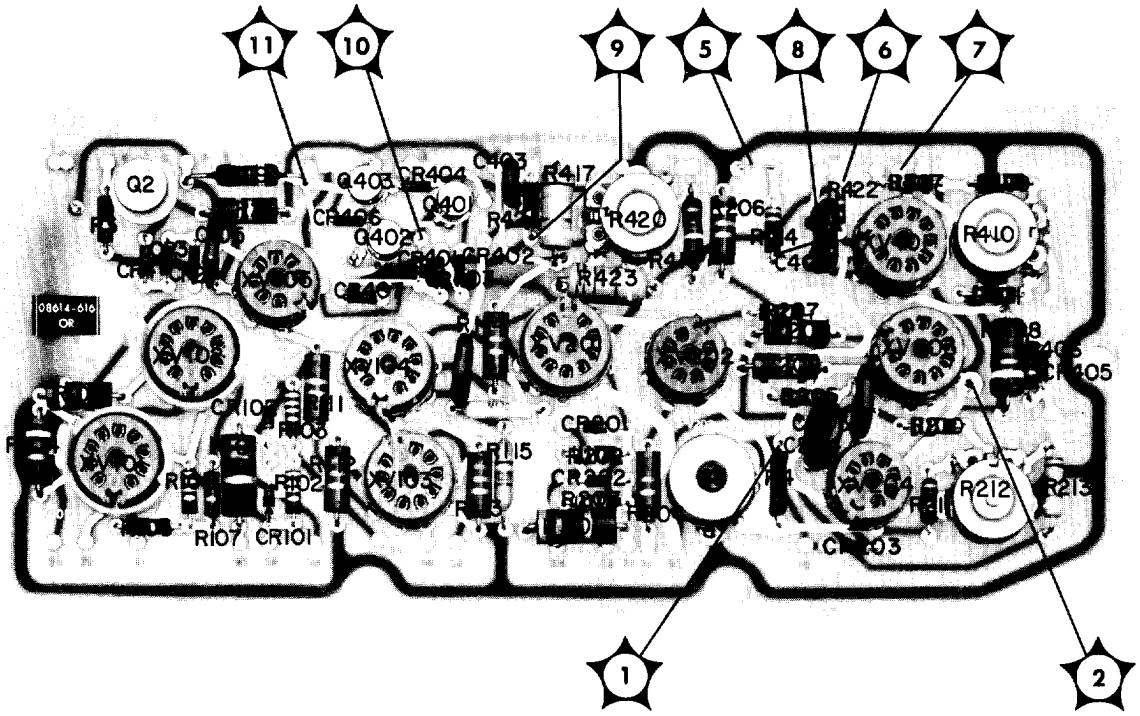



Figure 5-4. High Voltage Board (A100)

## 5-19. REPAIR.

5-20. COVER REMOVAL.

5-21. To remove top or bottom cover proceed as follows:

a. Remove four #6-32 flathead screws from cover.

b. Slide cover back and off instrument.

5-22. SERVICING ETCHED CIRCUIT BOARD.

5-23. The etched circuit board is a plated-through type consisting of a base board and conductor but, not funneled eyelets. The conductor material is plated to the wall of the holes thus the holes are effectively extended through the board. This type of board can be soldered from either side of the board as detailed below.

a. Do not apply excessive heat.

b. Remove a damaged component by clipping leads near component.

c. Apply heat to component lead and remove lead with a straight upward pull. 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.

## 5-24. KLYSTRON REMOVAL & REPLACEMENT.

5-25. TUBE REMOVAL.

**WARNING**

Be certain that line power is removed from instrument.

a. Remove panel cover on left (with respect to front panel) side of instrument.

b. Set klystron frequency drive at top end (2400 MHz for 8614B or 4500 MHz for 8616B).

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

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

e. Remove tube socket from klystron with a straight pull. Remove klystron tube from cavity. Unscrew clamp nut, lift out clamp spacer, and remove klystron (see Figure 5-5).

f. Remove waffle washer from cavity. Note: see paragraph 1-12 for warranty claim instructions.

5-26. 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 straight into cavity. The klystron should fit snugly but easily, into cavity.

e. Replace inner truarc ring on clamp housing (if klystron is properly in place, 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 Adjustments (paragraph 5-34) and make necessary adjustments.

## 5-27. RF PROBE REMOVAL & REPLACEMENT.

5-28. PROBE ASSEMBLY REMOVAL.

**WARNING**

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

a. Set klystron drive at top end (high frequency dial setting).

b. Remove top cover and attenuator access cover (see Figure 5-8).

c. Remove frame assembly cover on right (with respect to front panel) side of instrument.

d. Remove cable guide from klystron cavity casting and detach cable assembly connector from instrument (see Figures 5-6 and 5-8).

e. Remove retaining screw from defective probe in klystron cavity casting and remove from casting (see Figure 5-8).

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

g. The defective probe assembly should be returned to your local Hewlett-Packard field office for repair or replacement.

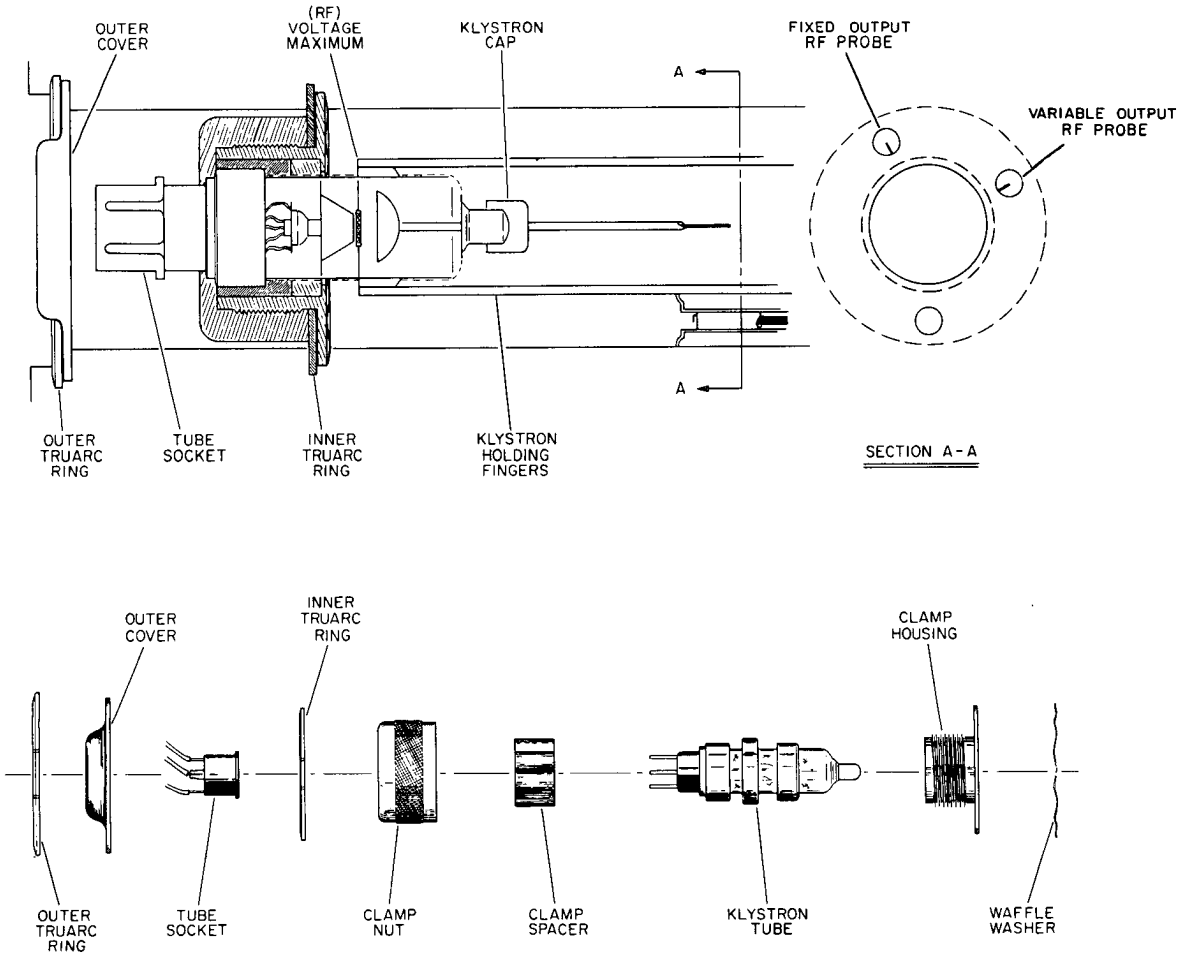



Figure 5-5. Klystron Assembly in Cavity

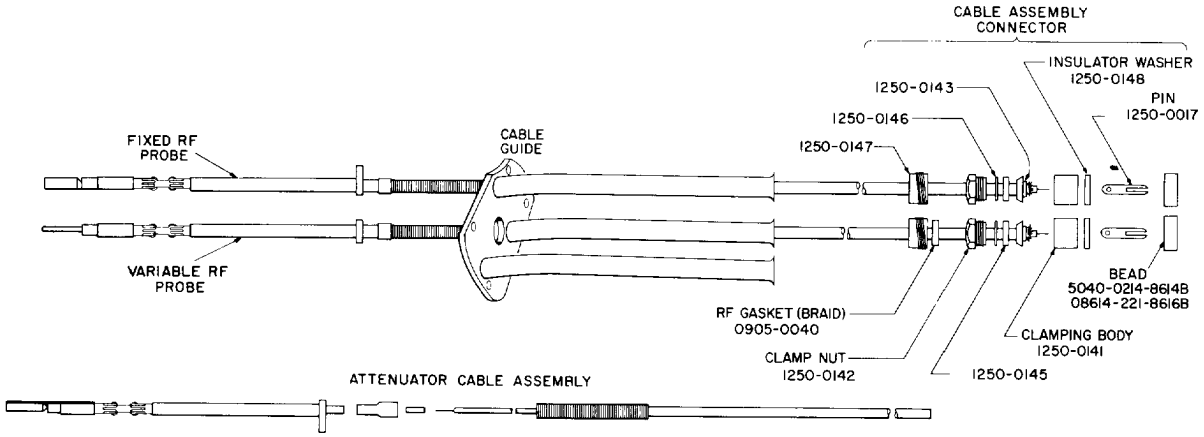



Figure 5-6. RF Probe Assembly

**CAUTION**

THE PROBE IS FRAGILE AND SHOULD BE HANDLED WITH CARE. FOR SHIPPING AND HANDLING PURPOSES THE PROBE SHOULD BE PLACED IN A PROTECTIVE SLEEVE.

5-29. PROBE ASSEMBLY REPLACEMENT.

a. The probe assembly cable must be inserted through the cable guide (see Figure 5-6).

b. Trim insulation from end of probe assembly cable (about 5/16 inch).

c. Place cable assembly connector parts on cable with the exception of clamping body, and fold braid back upon connector assembly.

d. Place clamping body on cable and screw clamp nut and clamping body together.

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

f. Tin center conductor protruding from clamping body, then place insulator washer on center conductor. Note: After tinning center conductor, diameter may be too large making it necessary to file center conductor to proper diameter.

g. Replace connector assembly as it was before disassembly. Refer to Power Adjustment (paragraph 5-43) and make necessary check and adjustment.

## 5-30. CAM CABLE REPLACEMENT.

5-31. 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.

5-32. PROCEDURE.

5-33. If it is necessary to replace 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 5-7 and 5-8 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 (MC) to approximately the middle of the frequency band.

d. Orient Length Cam to Frequency Cam as shown in Figure 5-8.

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

f. Using hex socket wrench and a 3/8-inch open-end wrench, remove both terminal screws, the four washers, and the two nuts (10-32 x 0.375 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

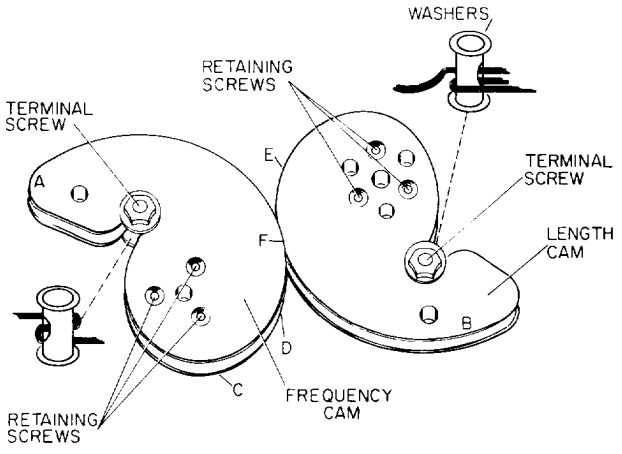



Figure 5-7. Cam Assembly

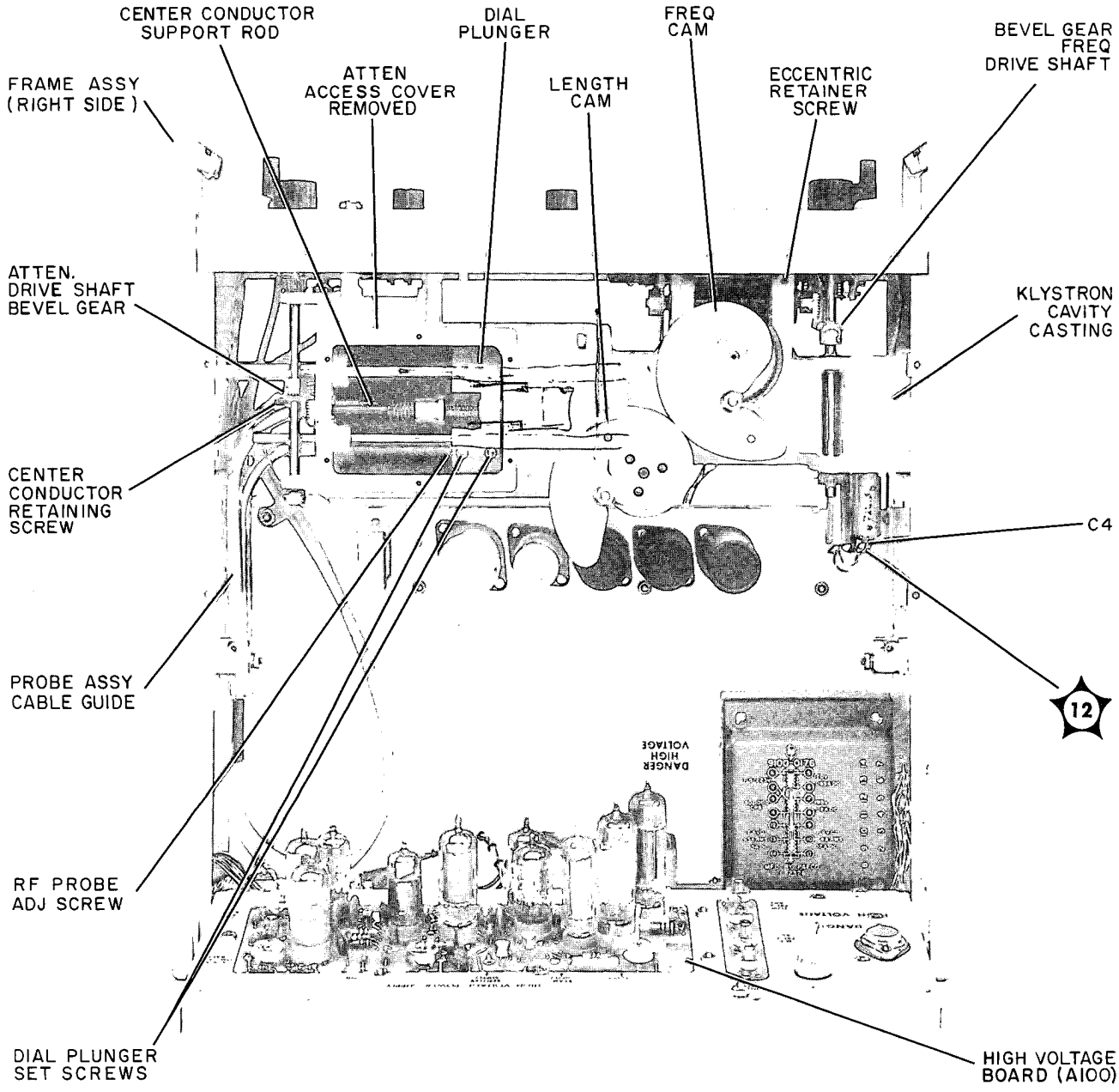



Figure 5-8. Model 8614B Top View, Cover Removed

approximately 1/2 to 3/4 inch on either side of mark to remove wire tension (heat to nearly white hotness).

i. Cut 10 or 11 strips of masking tape approximately one inch in length.

j. Remove three retaining screws from Frequency Cam and remove cam from instrument (Note: three retaining screws are 4-40 x 0.625 FH).

k. Slide cable through one terminal screw so that cable is oriented to terminal screw as shown in Figure 5-7 for the Frequency Cam, and install terminal screws on Frequency Cam.

**CAUTION**

Be careful not to catch cable between lockwasher and cam.

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

Note

Each cam as shown in Figure 5-7 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.

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

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

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

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

t. Slide cable ends through second terminal screw so that cable is oriented to terminal screw as shown in Figure 5-7 for the Length Cam.

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

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

w. Turn FREQUENCY (MC) knob to match Frequency Cam to pencil mark made in step e; the other marks made should match appropriately.

x. Perform Frequency Range Spread Adjustment, paragraph 5-40.

## 5-34. ADJUSTMENTS.

5-35. ADJUSTMENTS FOLLOWING KLYSTRON REPLACEMENT.

5-36. Following replacement of a new klystron, certain adjustments must be made before the instrument will operate in a satisfactory manner. The general steps in the overall procedure are as follows:

a. Establish initial repeller tracking voltages.

b. Establish proper beam current and klystron bias.

c. Establish proper repeller mode operation.

d. Adjust frequency range spread.

e. Adjust pulse modulation.

f. Adjust square-wave modulation.

g. Adjust power output.

5-37. INITIAL REPELLER-VOLTAGE ADJUST.

a. Remove top and bottom covers (refer to paragraph 5-20) and remove two screws that secure circuit board.

b. Check all power supply voltages as indicated in Table 5-2.

c. Connect dc digital voltmeter between klystron repeller (test point 13 and chassis ground, see Figure 5-3). Make sure ΔF control on front panel is set at zero (center position), and set voltages as indicated in Table 5-4 (see Figure 5-2).

**WARNING**

Be careful not to ground test point 13 as power supply will be destroyed.

Table 5-4. Klystron Repeller Voltages

| Frequency Dial (8614B/8616B) | Adjust | Voltage (between klystron repeller and ground) | |
|---|---|---|---|
| | | 8614B | 8616B |
| 800 (1800) | R216 | -370 ±5V | -440 ±5V |
| Mid-frequency | | | |
| below switch | R217 | -600 ±5V | -660 ±5V |
| above switch | R218 | -425 ±5V | -460 ±5V |
| 2400 (4500) | R219 | -580 ±5V | -640 ±5V |

Note: R216 and R217 interact as do R218 and R219; therefore, repeat above measurements after any adjustments.

5-38. BEAM CURRENT AND KLYSTRON BIAS ADJUST.

a. Connect a clip-on milliammeter to wire on center feed-through capacitor, C4 (wht/blu/vio wire, see Figure 5-8).

b. Connect crystal detector/oscilloscope combination to VARIABLE RF OUTPUT and set FREQUENCY (MC) to 1650 MHz (3050 MHz for 8616B).

c. Depress RF button and adjust klystron bias adjust, R420 increasing beam current (as measured on clip-on milliammeter) and VARIABLE RF OUTPUT (as measured on detector/oscilloscope combination) until clamping occurs: clamping occurs when increased rotation of R420 no longer causes a current or RF output increase. Note: beam current should not exceed 28 mA (see Figure 5-2).

d. If beam current exceeds 28 mA or VARIABLE RF OUTPUT begins to decrease, adjust R420 until beam current is equal to or less than 28 mA and VARIABLE RF OUTPUT is slightly less than maximum.

e. Adjust Mid-Freq adjustment, R218, for a maximum VARIABLE RF OUTPUT and repeat steps c and d above.

f. If clamping action referred to in step c occurs before VARIABLE RF OUTPUT begins to decrease and before beam current exceeds 28 mA, go to next procedure. If clamping action does not occur before VARIABLE RF OUTPUT begins to decrease or before beam current exceeds 28 mA, readjust R420 as in step d above. Using a dc voltmeter with a floating input, measure voltage difference between klystron cathode and control grid (see Figure 5-8). Replace CR404 with a zener diode whose breakdown voltage is as close to, but slightly less than, the measured voltage minus 0.6 volts (see Figure 5-4).

g. If CR404 was replaced, repeat adjustment procedure from paragraph 5-37.

5-39. REPELLER MODE ADJUST.

a. At a dial frequency of 950 MHz (1800 MHz-8616B) set attenuator dial for a calibrated output of about 0 dBm.

b. 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 5-9; it consists of a small power transformer connected with the primary and secondary windings interchanged; two one-megohm potentiometers; a 0.01 $\mu$f capacitor; two BNC connectors; a fuseholder, 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 (see Table 5-1).

c. Apply external FM (60 Hz) and view mode patterns on oscilloscope. Adjust PHASE control of FM modulator and appropriate tracking pot for mode patterns shown (all 8616B patterns should appear as 2400 MHz/s pattern for 8614B).

Note

DC repeller voltages (8614B) at 950 MHz and 1600 MHz (above switch) are relatively small and will not appear correctly if FM signal is excessive.

(1) Adjustments should allow about 2-MHz variation with $\Delta$F control.

(2) The tracking pots interact making it necessary to repeat the adjustments a time or two in order to insure proper tracking.

d. Measure klystron beam current: using a clip-on milliammeter connected to wire on center feed-through capacitor C4, current must not exceed 28 mA. Note: If current exceeds 28 mA, refer to paragraph 5-38.

5-40. FREQUENCY RANGE SPREAD ADJUST.

a. Using a calibrated frequency meter, measure actual frequency at dial settings of 1000 and 2400MHz (1800 and 4000 MHz for 8616B). To eliminate backlash error, always approach frequency dial settings from the same direction.

b. The difference in the frequency measurements of step a should be 1400 MHz for the 8614B and 2200 MHz for the 8616B. If frequency difference is other than specified, correction must be made (see step c).

c. Refer to graph, Figure 5-10. 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 1354 MHz, the corrective setting for the dial as found on the graph is 990 MHz. To make correction, set frequency dial to 1000 MHz, loosen the two setscrews that clamp dial plunger to rack, hold dial plunger stationary, and set dial to 990 MHz. Tighten two setscrews (see Figure 5-8).

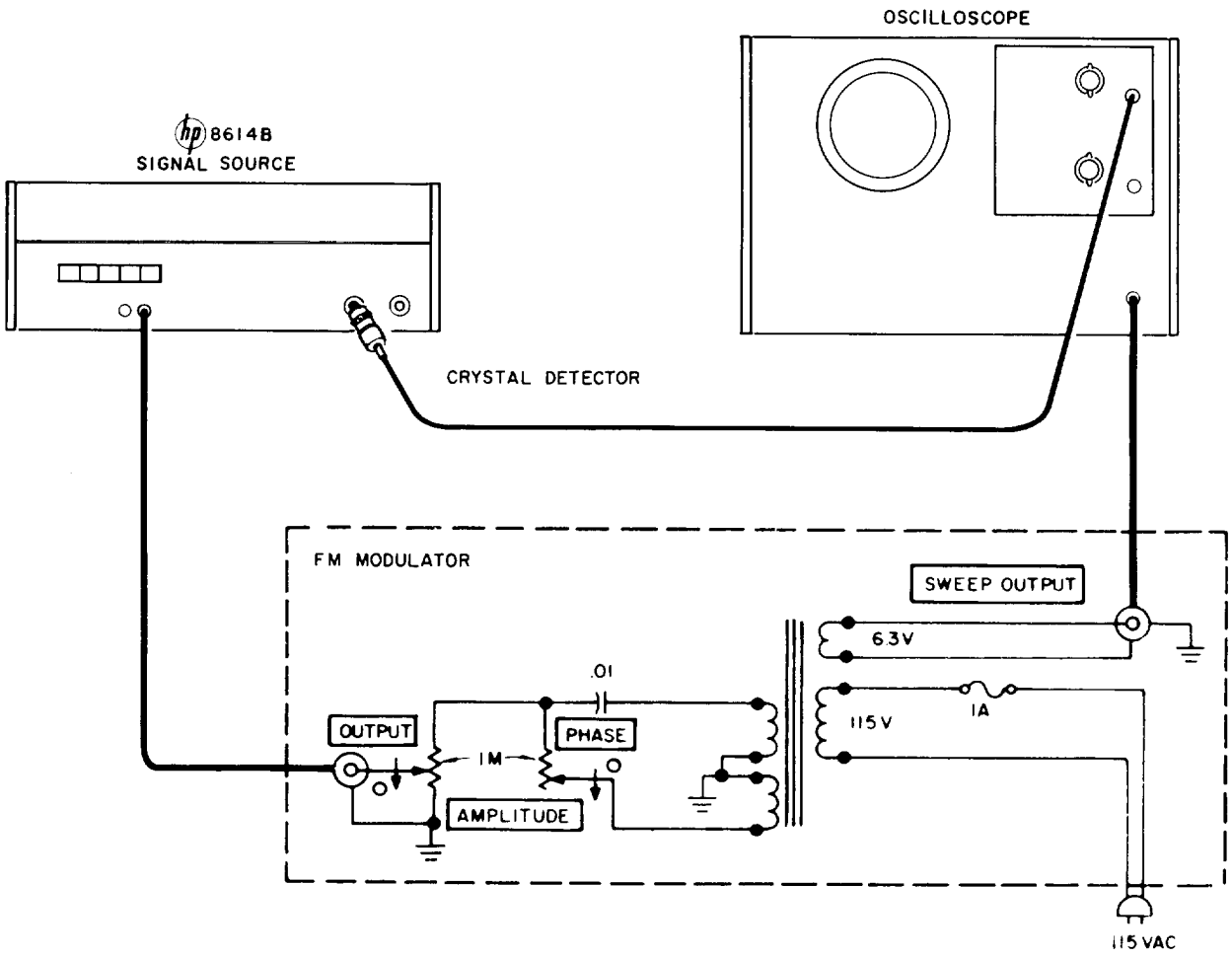
d. If any adjustment was necessary, repeat steps a, b, and c. Repeat this procedure until measured frequency difference corresponds to a change of 1400 MHz $\pm$3 MHz for the 8614B and 2200 MHz $\pm$6 MHz for the 8616B.

e. Set actual frequency to 1000 MHz (1800 MHz for 8616B). Loosen spur gear on worm shaft and rotate gear until frequency dial reads 1000 MHz (1800 MHz).

f. Check FREQUENCY (MC) dial settings at both upper and lower ends of dial travel. The respective dial end points should be less than 800 MHz (1800 MHz for 8616B) and greater than 2400 MHz (4500MHz for 8616B). If dial travel is not satisfactory, loosen bevel gear on frequency drive shaft and reset dial.

g. Check microswitch action: microswitch should energize and de-energize at about 1590 to 1610 MHz (2988 to 3012 MHz for 8616B). If microswitch does not switch at proper dial settings, microswitch cam (located on underside of cavity casting) should be repositioned (see Figure 5-3).

h. Being careful to approach all dial settings from the same (either clockwise or counterclockwise) direction, using the procedure given in paragraph 5-46, check accuracy of frequency dial by approaching all dial settings from a clockwise direction and then from a counterclockwise direction.



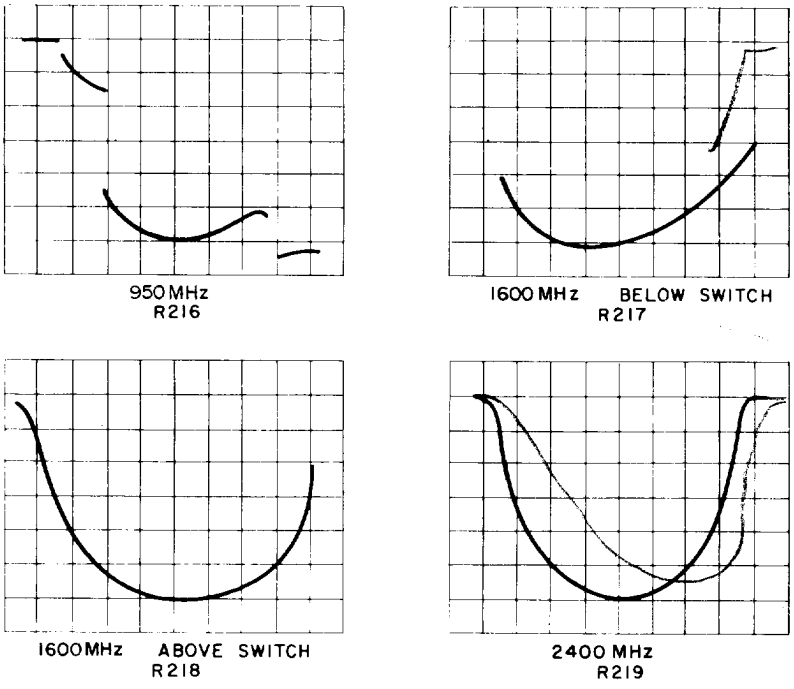




Figure 5-9. Repeller Mode Adjust

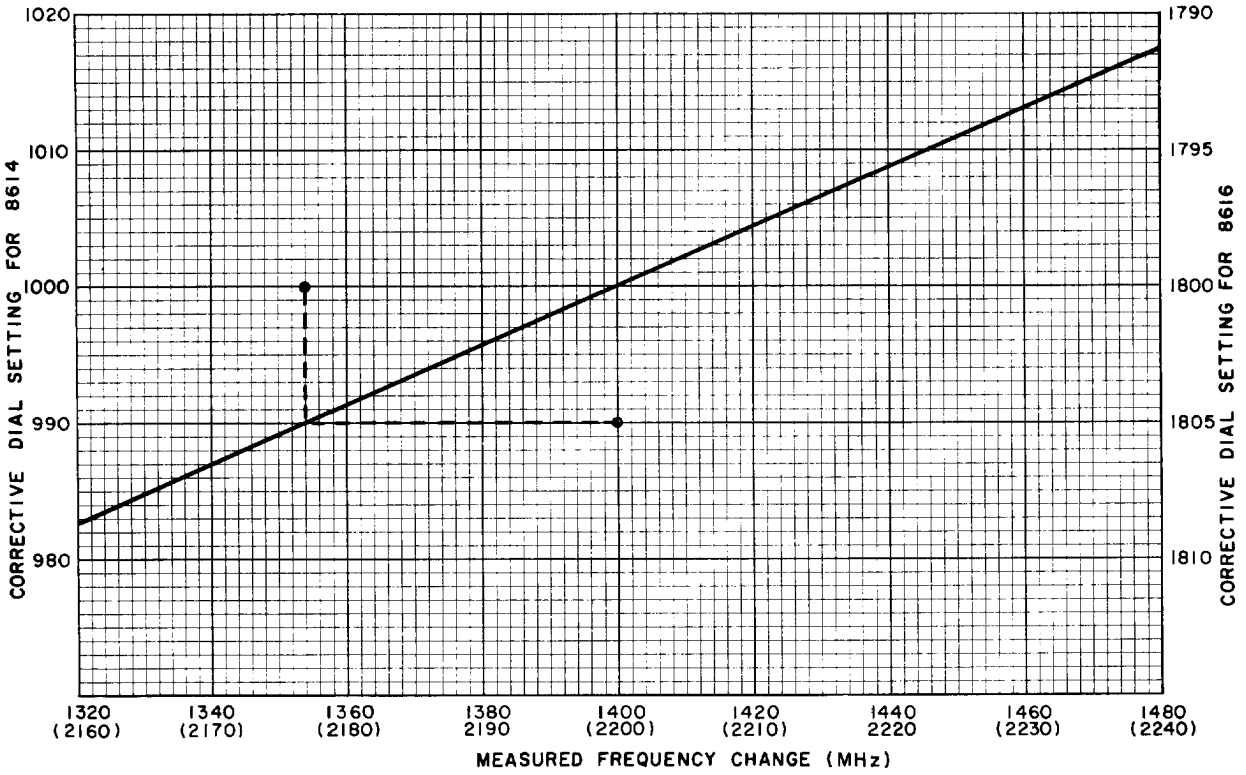



Figure 5-10. Frequency Range Spread Correction

Note

The Frequency Meter used must be calibrated to an accuracy of approximately ±0.03% (±0.07% for 8616B).

i. If frequency dial reading errors are greater than ±5 MHz (±10 MHz for 8616B), shifting the dial may bring all errors within specification. If shifting dial will not sufficiently correct errors, it may be necessary to shift position of center conductor support rod (see Figure 5-8). The center conductor is notched at end closest to right side of instrument and may be loosened and then adjusted "in" or "out" of klystron cavity. Notch or scratch center conductor rod so that original position may always be known. If overall frequency error was positive, adjust center conductor toward right side of instrument. If overall error was negative, adjust center conductor toward left side of instrument. When adjusting center conductor position, never change by more than about 20 thousandths of an inch at a time.

Note

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

5-41. PULSE MODULATION ADJUST.

a. Connect instruments as shown in Figure 5-11.

b. Set up as follows:

| | |
|---|---|
| LINE | depressed |
| RF | depressed |
| EXTERNAL PULSE | not depressed |

c. Set up pulse generator for a +25 volt ±1 volt, 5000-prf signal with a pulse width of 2.0 ±0.5 μsec.

d. Set up Oscilloscope for a 0.005 volt/cm, vertical sensitivity, EXT AC synchronization, and a 0.5 μsec/cm sweep rate.

Note: Oscilloscope vertical input should be shunted with between 50 and 300 ohms for best pulse presentation.

e. Depress PULSE button to be sure that +25 volt input will pulse klystron. Be sure ΔF control is centered.

f. Check pulse operation across the band (at RF frequencies up to 4000 MHz for 8616B) and adjust klystron repeller voltages (using R216 through R219) as necessary. Specification: Rise time ≤ 0.3 μsec; decay time ≤ 0.5 μsec; overshoot ≤ 5%; jitter ≤ 0.4 μsec.

g. If any adjustment of potentiometers R216 through R219 was necessary, repeat procedures detailed in paragraphs 5-39, 5-40, and 5-41.

5-42. SQUARE-WAVE MODULATION ADJUST.

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

b. Set up Signal Source as follows:

| | |
|---|---|
| LINE | depressed |
| RF | depressed |
| INT SQ WAVE | depressed |
| ATTENUATION (DB) | 0 DB |
| SQ WAVE FREQ | full counterclockwise |

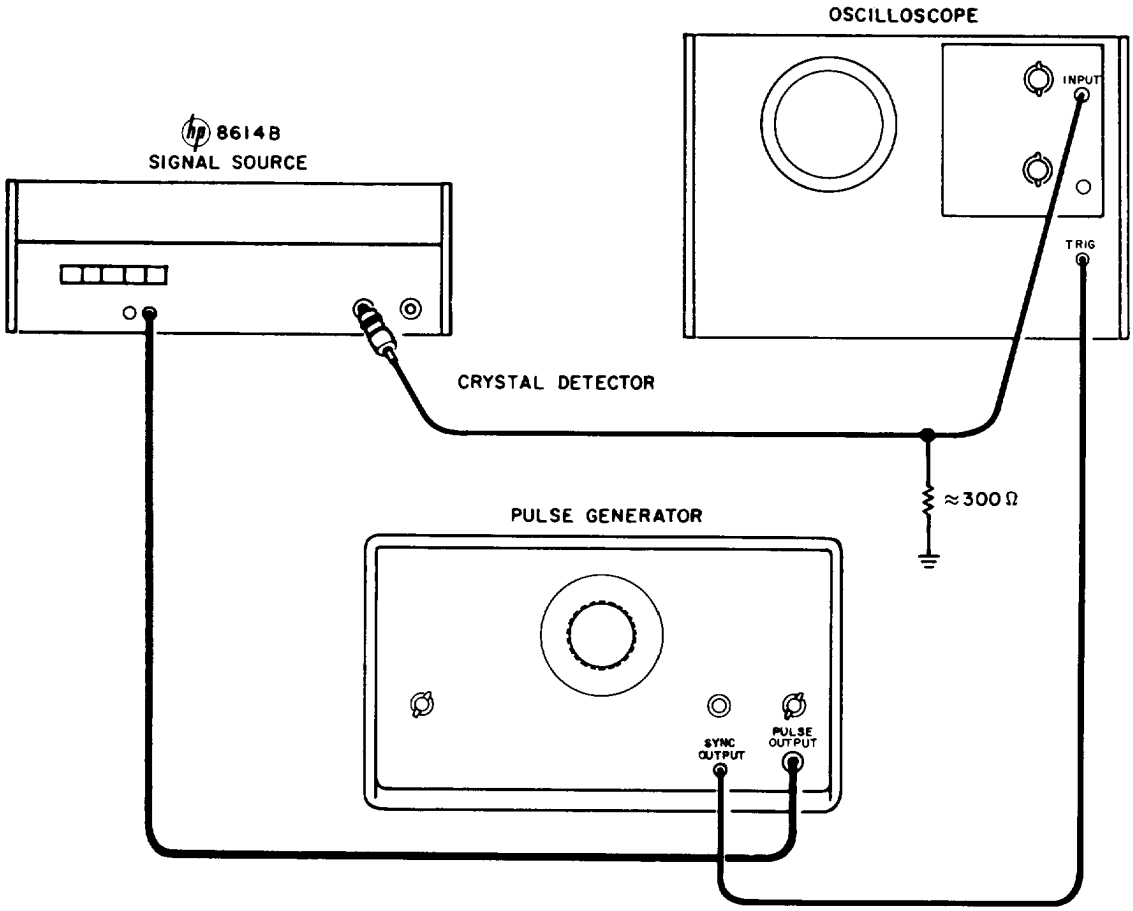



Figure 5-11. Pulse Modulation Adjust

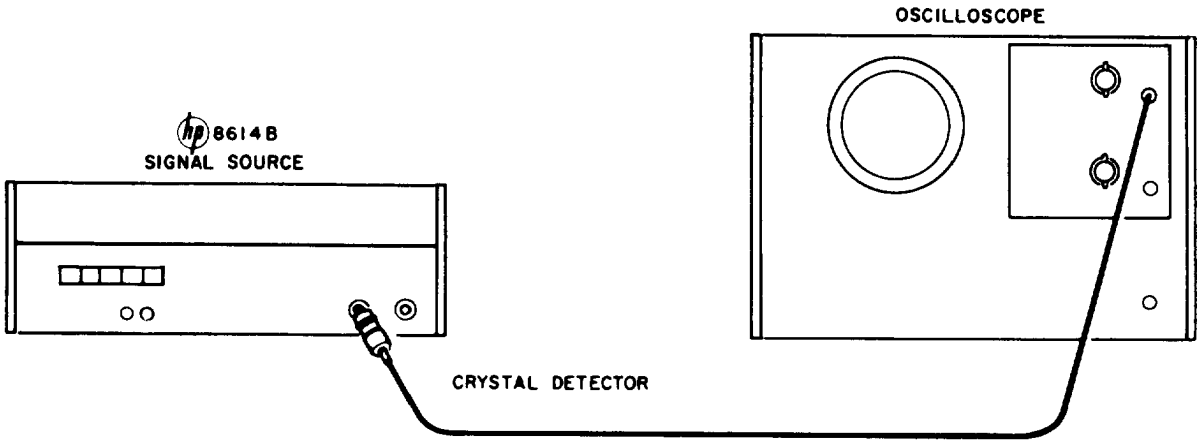



Figure 5-12. Square-Wave Modulation Adjust

c. Set oscilloscope sweep time to .1 MS/CM. Note: oscilloscope vertical input should be shunted with about 200 ohms for best square-wave presentation.

d. Symmetry should be 45/55% or better. Symmetry may be adjusted with Symmetry Adjust R410 (see Figure 5-2). Square modulation range should be at least 940 to 1060 Hz (period range of about 0.94 to 1.07 msec. Note: Capacitor C402 may be 2250pF, 2676pF, or 3000pF depending upon which value will provide the best square wave frequency range.

5-43. POWER ADJUSTMENT.

a. With Signal Source turned off, measure resistance between each RF OUTPUT connector center conductor and chassis ground. Specification: Resistance should be about 55 ohms for all settings of the ATTENUATOR (DB) dial. If probe is open or shorted at any point, the probe is defective and should be replaced (refer to paragraph 5-27).

b. Set up Signal Source as follows:
LINE . . . . . depressed
RF . . . . . depressed
ATTENUATION (DB) . . . . . full clockwise
FREQUENCY (MC) . .800 (8614B); 1800 (8616B)

c. Using a power meter/thermistor mount, connect a calibrated 10-dB fixed attenuator between the signal source and the power meter/thermistor mount combination and measure maximum RF power output. Specification: VARIABLE RF OUTPUT, the attenuation of fixed attenuator plus meter reading must be +11.8 dBm (+3.0 dBm for 8616B between 3.0 and 4.5 GHz); FIXED RF OUTPUT, attenuation of fixed attenuator plus meter reading must be -3.0 dBm.

d. If measurements are satisfactory, no adjustment is necessary. If either is unsatisfactory, adjust FIXED RF probe adjust screw or attenuator drive shaft bevel gear as appropriate (see Figure 5-8). The Probe Adjust is for the FIXED RF OUTPUT.

5-44. BACKLASH ELIMINATION ADJUSTMENT.

a. Refer to Figures 5-7 and 5-8 throughout procedure.

b. Remove instrument top cover.

c. Note FREQUENCY and LENGTH CAMS and FREQUENCY DIAL and slowly turn frequency knob. The two cams should move with the dial: any lag between either cam and dial causes backlash.

d. If the Length Cam does not move with the Freq. Cam-

(1) Refer to paragraph 5-33, there should be no slack in cam cable at all.
(2) Be sure cam retaining screws are tight.
(3) Note that the Length Cam has six holes in a circle: three contain retaining screws and three contain hex head screws. Adjustment of hex head screws in depth will increase or decrease backlash. Do not adjust hex head screws to maximum depth.
(4) If backlash still exists and Length Cam still tends to move after Freq. Cam the cause of trouble is probably the rack gear in the Klystron Cavity Assembly.

e. If the Freq. Cam lags the freq. dial instead of moving with it then adjustment of eccentric should solve the problem.

(1) Loosen Eccentric Retainer screw.
(2) Rotate ECCENTRIC 1/8 turn and tighten retainer screw.
(3) Check backlash.
(4) Repeat steps 1, 2 and 3 until backlash error is least.

f. Refer to paragraph 5-40 and check frequency range spread.

## 5-45. PERFORMANCE CHECKS

5-46. 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 as an incoming or outgoing quality control check, periodic maintenance, or after-repair check.

5-47. FREQUENCY AND POWER CHECK.

a. Connect equipment as shown in Figure 5-13.

b. Set up Signal Source as follows:
LINE . . . . . depressed
RF . . . . . depressed
ΔF . . . . . centered
FREQUENCY (MC) . .800 (8614B); 1800 (8616B)

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

d. Using calibrated frequency meter, measure acutal signal frequency. Specification: For 8614B, accuracy must be ±5 MHz or ±1/2%, whichever is greater; for 8616B, accuracy must be ±10 MHz. Note: frequency meter must be calibrated to an accuracy of approximately ±0.03% for the 8614B and ±0.06% for the 8616B.

e. Repeat above procedure every 100 MHz and at all points of particular interest to a frequency dial indication of 2400 MHz for the 8614B and 4500 MHz for the 8616B.

f. If dial accuracy is not within specification, refer to paragraph 5-40 for adjustment procedure.

g. To chec, ΔF control: Turn ΔF full counterclockwise and measure output frequency; then turn control full clockwide and measure output frequency. Specification: The difference between reading should be approximately 1 MHz. If ΔF control operation is not satisfactory, refer to Modulation and Klystron Circuits schematic diagram, Figure 5-15 and check potentiometer resistance and power supply voltages.

h. To check power output: Remove frequency meter from test setup and measure maximum power output at both FIXED and VARIABLE RF OUTPUT connectors. Specification: The sum of attenuation of 10-dB attenuator plus power meter reading must be at least +11.8 dBm (+3 dBm for 8616B between 3.0 and 4.5 GHz) at VARIABLE RF OUTPUT. The attenuator attenuation and meter reading must equal at least -3.0 dBm at FIXED RF OUTPUT. If either output is not satisfactory, refer to paragraphs 5-15 and 5-43.

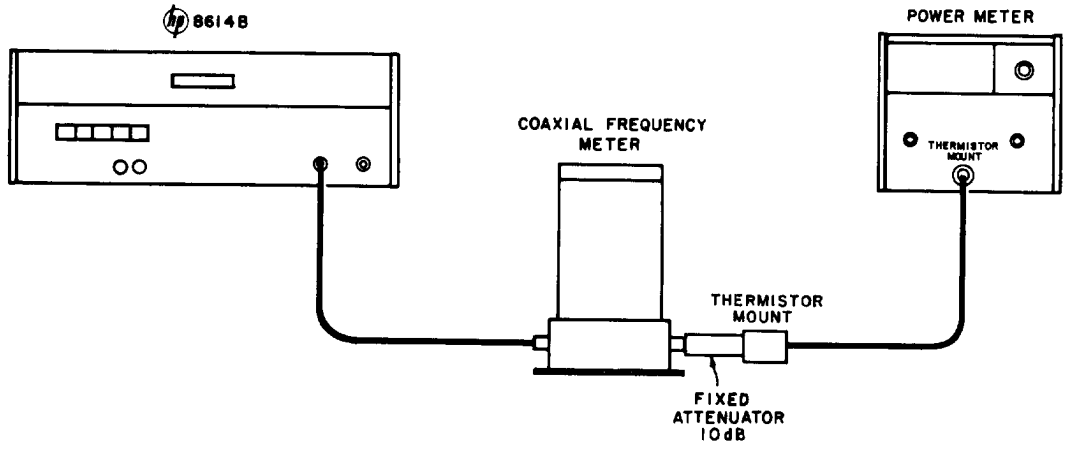



Figure 5-13. Frequency and Power Measurement

5-48. PULSE MODULATION CHECK.

a. Connect instruments as shown in Figure 5-11.

b. Set up Signal Source as follows:
LINE . . . . . depressed
RF . . . . . depressed
EXT PULSE . . . . . depressed

c. Set up pulse generator for a +25-volt 50-prf signal with a pulse width of 2 μsec.

d. A pulse presentation should be seen on the oscilloscope. Specification: Rise Time, 0.3 μsec; Decay Time, 0.5 ±sec.

e. Set up pulse generator for a +25-volt 5000-prf signal with a pulse width of 2 μsec.

f. A pulse presentation should be seen on the oscilloscope. Specification: Rise Time, 0.3 μsec; Decay Time, 0.5 μsec.

g. If pulse operation is not satisfactory, refer to paragraph 5-41.

5-49. SQUARE-WAVE MODULATION AND SYNC CHECK.

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

b. Set up Signal Source as follows:
LINE . . . . . depressed
RF . . . . . depressed
INT SQ WAVE . . . . . depressed
ATTENUATION (DB) . . . . . 0 DB
SQ WAVE FREQ . . . . . full counterclockwise

c. Set oscilloscope sweep time to .1 MHz/CM. Note: oscilloscope vertical input should be shunted with about 200 ohms for best presentation.

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. If square wave operation is not satisfactory, refer to paragraph 5-42.

e. To check external synchronization, connect equipment as shown in Figure 5-11.

f. With signal source set up as detailed in step b above, set pulse generator as follows:

AMPLITUDE . . . . . 2.0
LENGTH (μSEC) . . . . . 1
SYNC SELECTOR . . . . . X10
PULSE RATE . . . . . 100
POLARITY . . . . . (+)

g. Set oscilloscope to INT TRIGGER SOURCE and adjust SQ WAVE FREQ for a period of 1 ±0.02 ms.

h. Set oscilloscope to EXT AC TRIGGER INPUT and depress PULSE button. Slowly increase PULSE RATE of pulse generator until square wave presentation on oscilloscope becomes stationary. If synchronization operation is not satisfactory, refer to paragraph 4-9 and schematic diagram Figure 5-15 and check circuit operation.

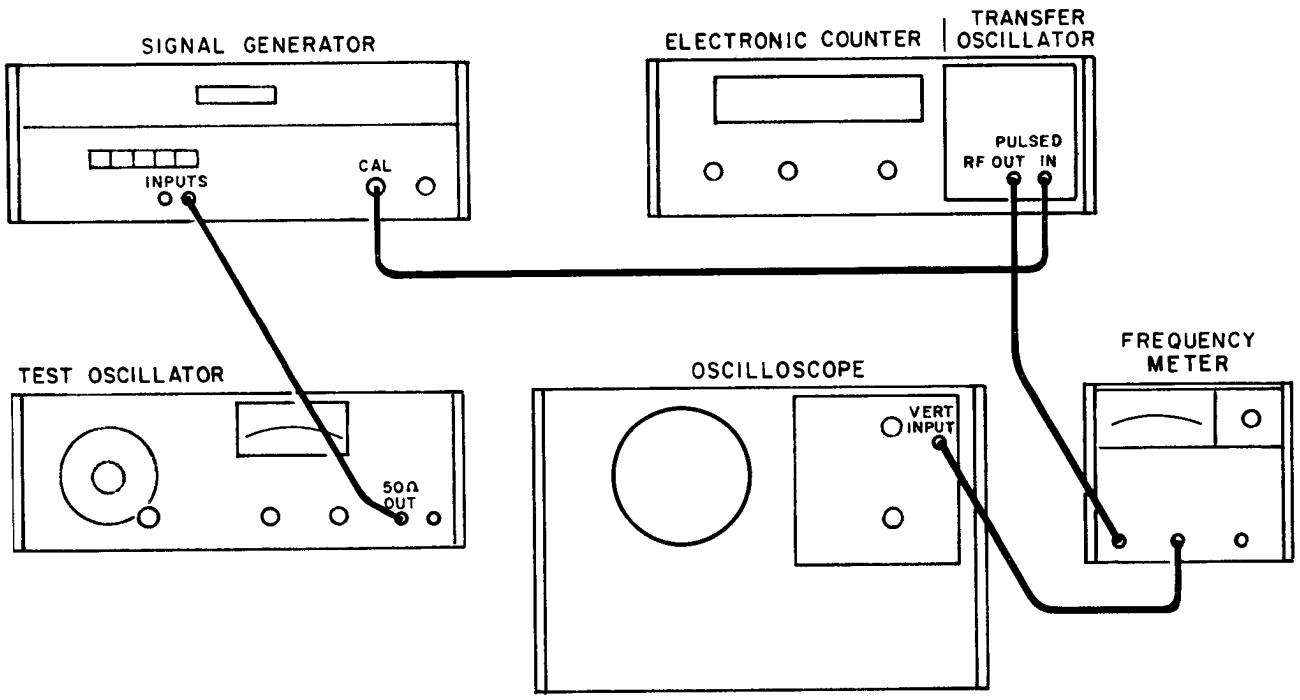



Figure 5-14. Residual and Incidental FM Check

5-50. MEASUREMENT OF RESIDUAL FM.

a. Connect instruments as shown in Figure 5-14, without the test oscillator in the setup.

b. Set up Model 8614B (8616B) as follows:
LINE . . . . . depressed
RF . . . . . depressed
FREQUENCY . . . 1.8 GHz (2.5 GHz for 8616B)

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

d. Adjust transfer oscillator for 90 MHz (125 MHz for 8616B) and a harmonic of 20 (20 for 8616B).

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 180 V peak (180 mV = 1800 Hz) and less than 250 mV peak (250 V = 2500 Hz for 8616B).

5-51. MEASUREMENT OF INCIDENTAL FM.

a. Set up Model 8614B (8616B) as follows:

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

b. Incidental FM is negligible.

c. Connect instruments as shown in Figure 5-14, with the test oscillator in the setup.

d. Set up Model 8616A as follows:

EXTERNAL FM. . . . . .depressed

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

f. Incidental FM negligible.

NOTES

1. RESISTANCE IN OHMS; CAPACITANCE IN MICROFARDS UNLESS OTHERWISE INDICATED
2. ALL SWITCHES SHOW 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. Δ= 86168 VALUE, UNMARKED VALUE FOR 86148
7. ⬠ INDICATES A TEST POINT

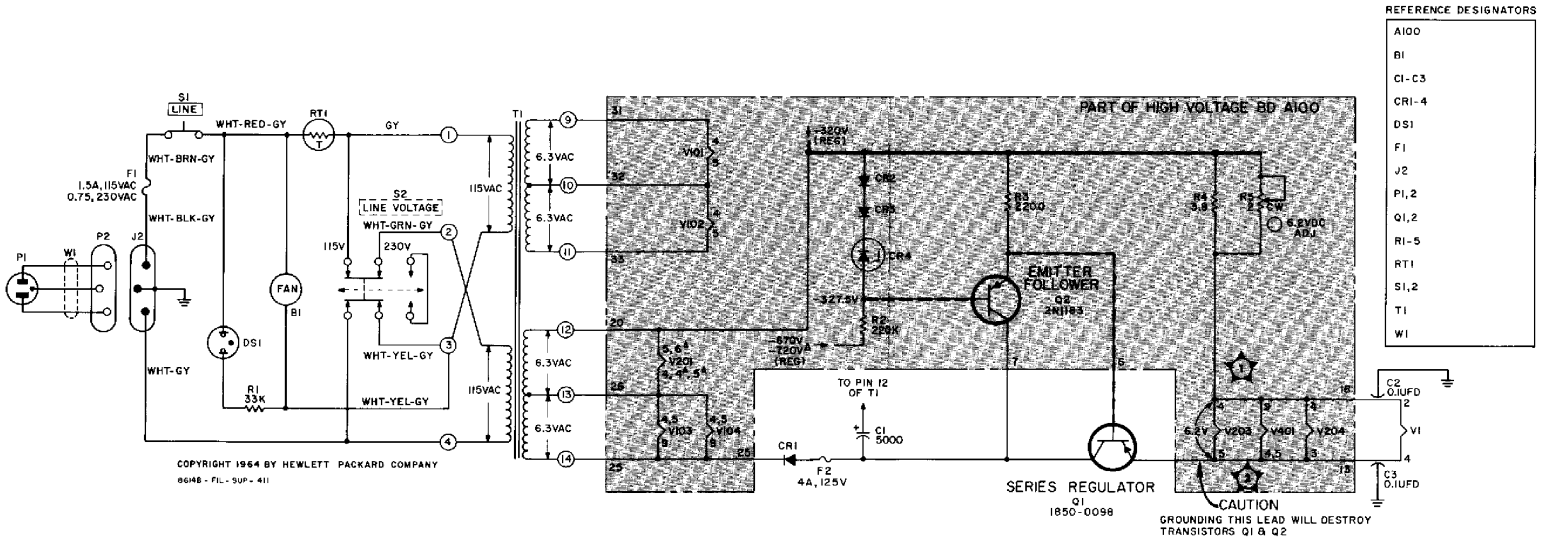



Figure 5-15. Regulated Filament Supply

REFERENCE DESIGNATORS

| |
|---|
| A100 |
| B1 |
| C1-C3 |
| CR1-4 |
| DS1 |
| F1 |
| J2 |
| P1,2 |
| Q1,2 |
| R1-5 |
| RT1 |
| S1,2 |
| T1 |
| W1 |

Figure 5-15

**REGULATED FILAMENT SUPPLY SCHEMATIC DIAGRAM**

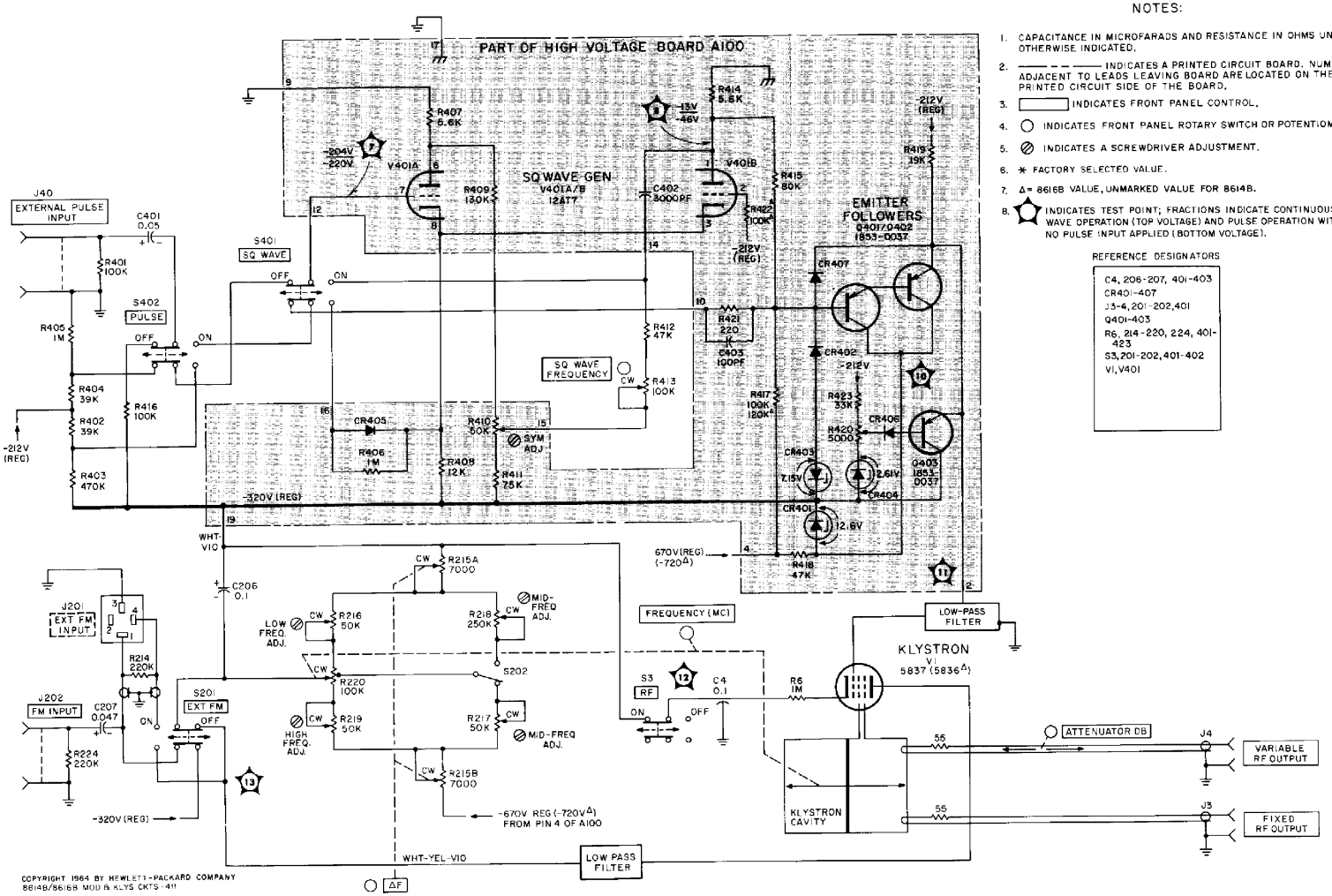



Figure 5-16. Modulation and Klystron Circuits

REFERENCE DESIGNATORS

C4, 206-207, 401-403
CR401-407
J3-4, 201-202, 401
Q401-403
R6, 214-220, 224, 401-423
S3, 201-202, 401-402
V1, V401

Figure 5-16

**MODULATION AND KLYSTRON CIRCUITS SCHEMATIC DIAGRAM**

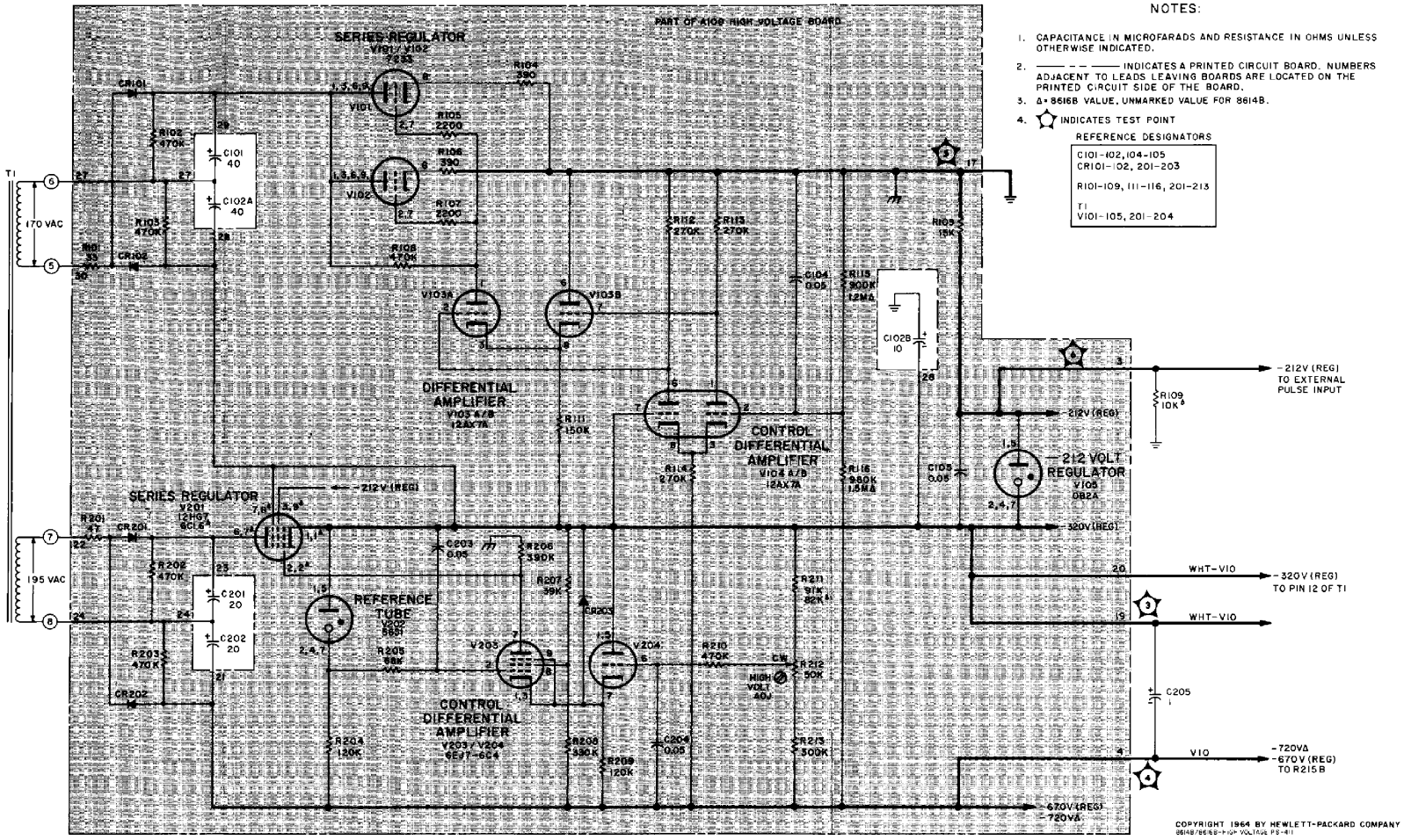



Figure 5-17. High-Voltage Power Supply

REFERENCE DESIGNATORS

| |
|---|
| C101-102, 104-105<br>CR101-102, 201-203 |
| R101-109, 111-116, 201-213 |
| T1<br>V101-105, 201-204 |

Figure 5-17

**HIGH-VOLTAGE POWER SUPPLY SCHEMATIC DIAGRAM**

# SECTION VI
# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designations and indicates the description and HP stock number of each part, together with any applicable notes. Table 6-2 lists parts in numerical order of their HP stock numbers and provides the following information for each part:

a. Description of part (see list of abbreviations below).

b. Typical manufacturer of part in a five-digit code; see list of manufacturers in appendix.

c. Manufacturer's stock number.

d. Total quantity used in instrument (TQ column).

6-3. Miscellaneous and cabinet parts not indexed by reference designations are listed at the end of Table 6-1.

## 6-4. ORDERING INFORMATION.

6-5. To order a replacement part, address order or inquiry to your nearest Hewlett - Packard field office (see maps at rear of manual).

6-6. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard stock number.

c. Circuit reference designation

d. Description.

6-7. To order a part not listed in Tables 6-1 and 6-2, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | = | assembly | F | = | fuse | MP | = | mechanical part | V | = | vacuum, tube, neon bulb, photocell, etc. |
| B | = | motor | FL | = | filter | P | = | plug | VR | = | voltage regulator |
| BT | = | battery | IC | = | integrated circuit | Q | = | transistor | W | = | cable |
| C | = | capacitor | J | = | jack | R | = | resistor | X | = | socket |
| CP | = | coupler | K | = | relay | RT | = | thermistor | Y | = | crystal |
| CR | = | diode | L | = | inductor | S | = | switch | Z | = | tuned cavity, network |
| DL | = | delay line | LS | = | loud speaker | T | = | transformer | | | |
| DS | = | device signaling (lamp) | M | = | meter | TB | = | terminal board | | | |
| E | = | misc electronic part | MK | = | microphone | TP | = | test point | | | |

ABBREVIATIONS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | = | amperes | H | = | henries | N/O | = | normally open | RMO | = | rack mount only |
| AFC | = | automatic frequency control | HDW | = | hardware | NPO | = | negative positive zero (zero temperature coefficient) | RMS | = | root-mean square |
| AMPL | = | amplifier | HEX | = | hexagonal | | | | RWV | = | reverse working voltage |
| | | | HG | = | mercury | | | | | | |
| BFO | = | beat frequency oscillator | HR | = | hour(s) | NPN | = | negative-positive-negative | S-B | = | slow-blow |
| BE CU | = | beryllium copper | HZ | = | hertz | | | | SCR | = | screw |
| BH | = | binder head | | | | NRFR | = | not recommended for field replacement | SE | = | selenium |
| BP | = | bandpass | IF | = | intermediate freq | | | | SECT | = | section(s) |
| BRS | = | brass | IMPG | = | impregnated | NSR | = | not separately replaceable | SEMICON | = | semiconductor |
| BWO | = | backward wave oscillator | INCD | = | incandescent | | | | SI | = | silicon |
| | | | INCL | = | include(s) | | | | SIL | = | silver |
| CCW | = | counter-clockwise | INS | = | insulation(ed) | OBD | = | order by description | SL | = | slide |
| CER | = | ceramic | INT | = | internal | OH | = | oval head | SPG | = | spring |
| CMO | = | cabinet mount only | | | | OX | = | oxide | SPL | = | special |
| COEF | = | coefficient | K | = | kilo = 1000 | | | | SST | = | stainless steel |
| COM | = | common | | | | P | = | peak | SR | = | split ring |
| COMP | = | composition | LH | = | left hand | PC | = | printed circuit | STL | = | steel |
| COMPL | = | complete | LIN | = | linear taper | PF | = | picofarads = $10^{-12}$ farads | TA | = | tantalum |
| CONN | = | connector | LK WASH | = | lock washer | PH BRZ | = | phosphor bronze | TD | = | time delay |
| CP | = | cadmium plate | LOG | = | logarithmic taper | PHL | = | Phillips | TGL | = | toggle |
| CRT | = | cathode-ray tube | LPF | = | low pass filter | PIV | = | peak inverse voltage | THD | = | thread |
| CW | = | clockwise | | | | PNP | = | positive-negative-positive | TI | = | titanium |
| | | | M | = | milli = $10^{-3}$ | | | | TOL | = | tolerance |
| DEPC | = | deposited carbon | MEG | = | meg = $10^{6}$ | P/O | = | part of | TRIM | = | trimmer |
| DR | = | drive | MET FLM | = | metal film | POLY | = | polystyrene | TWT | = | traveling wave tube |
| ELECT | = | electrolytic | MET OX | = | metallic oxide | PORC | = | porcelain | U | = | micro = $10^{-6}$ |
| ENCAP | = | encapsulated | MFR | = | manufacturer | POS | = | position(s) | | | |
| EXT | = | external | MHZ | = | mega hertz | POT | = | potentiometer | VAR | = | variable |
| | | | MINAT | = | miniature | PP | = | peak-to-peak | VDCW | = | dc working volts |
| F | = | farads | MOM | = | momentary | PT | = | point | W/ | = | with |
| FH | = | flat head | MTG | = | mounting | PWV | = | peak working voltage | W | = | watts |
| FIL H | = | fillister head | MY | = | "mylar" | | | | WIV | = | working inverse voltage |
| FXD | = | fixed | | | | RECT | = | rectifier | | | |
| | | | N | = | nano ($10^{-9}$) | RF | = | radio frequency | WW | = | wirewound |
| G | = | giga ($10^{9}$) | N/C | = | normally closed | RH | = | round head or right hand | W/O | = | without |
| GE | = | germanium | NE | = | neon | | | | | | |
| GL | = | glass | NI PL | = | nickel plate | | | | | | |
| GRD | = | ground(ed) | | | | | | | | | |

01194-13

Table 6-1. Reference Designation Index

| Reference Designation | ℗ Part No. | Description # | Note |
|---|---|---|---|
| A100 | 08614-616 | HIGH VOLTAGE BOARD(8614B ONLY)<br>FOR 8614B ONLY | |
| A100 | 08616-607 | HIGH VOLTAGE BOARD(8616B ONLY)<br>FOR 8616B ONLY | |
| A100 | 08614-291 | BOARD:BLANK PC | |
| C1 | 0180-0213 | C:FXD ELECT 5000 UF +75-10% 25VDCW | |
| C2 | 0160-0152 | C:FXD PAPER 0.1UF 20% 600VDCW | |
| C3 | 0160-0152 | C:FXD PAPER 0.1UF 20% 600VDCW | |
| C4 | 0160-0152 | C:FXD PAPER 0.1UF 20% 600VDCW | |
| C5 | | | |
| C100 | | NOT ASSIGNED | |
| C101 | 0180-0024 | C:FXD ELECT 40UF 450VDCW | |
| C102 | 0180-0135 | C:FXD ELECT 40/10 UF +50-10% 450VDCW | |
| C103 | | NOT ASSIGNED | |
| C104 | 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | |
| C105 | 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | |
| C106-<br>C200 | | NOT ASSIGNED | |
| C201 | 0180-0011 | C:FXD ELECT 20 UF 450VDCW | |
| C202 | 0180-0011 | C:FXD ELECT 20 UF 450VDCW | |
| C203 | 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | |
| C204 | 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | |
| C205 | 0160-0079 | C:FXD PAPER 1.0 UF 10% 600VDCW | |
| C205 | 1210-0003 | BRACKET:CAPACITOR | |
| C206 | 0170-0022 | C:FXD MY 0.1UF 20% 600VDCW | |
| C207 | 0160-0056 | C:FXD MY 0.047 UF 10% 1000VDCW | |
| C208-<br>C400 | | NOT ASSIGNED | |
| C401 | 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | |
| C402 | 0140-0159 | C:FXD MICA 3000 PF 2% | |
| C403 | 0160-2204 | C:FXD MICA 100 PF 5% | |
| CR1 | 1901-0032 | DIODE:SILICON 1N3209 | |
| CR2 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| CR3 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| CR4 | 1902-0057 | DIODE BREAKDOWN:6.49V | |
| CR5-<br>CR100 | | NOT ASSIGNED | |
| CR101 | 1901-0030 | DIODE:SILICON 800 PIV | |
| CR102 | 1901-0030 | DIODE:SILICON 800 PIV | |
| CR103-<br>CR200 | | NOT ASSIGNED | |
| CR201 | 1901-0030 | DIODE:SILICON 800 PIV | |
| CR202 | 1901-0030 | DIODE:SILICON 800 PIV | |
| CR203 | 1902-0175 | DIODE BREAKDOWN:100V | |
| CR204-<br>CR400 | | NOT ASSIGNED | |
| CR401 | 1902-0031 | DIODE BREAKDOWN:12.7V 5% | |
| CR402 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| CR403 | 1902-0074 | DIODE BREAKDOWN:7.15V 5% | |
| CR404 | 1902-0126 | DIODE BREAKDOWN:2.61V 5% | |
| CR405 | 1901-0025 | DIODE:SILICON 100WV 100MA | |

**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)

| Reference Designation | Part No. | Description # | Note |
|---|---|---|---|
| CR406 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| CR407 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| DS1 | 1450-0039 | INDICATOR:GLOW-LAMP NEON IN RED PLASTIC | |
| F1 | 2110-0033 | FUSE:0.75A 250V (230V OPERATION) | |
| F1 | 2110-0043 | FUSE:CARTRIDGE 1.5 AMP 250V (115V OPERATION) | |
| F2 | 2110-0014 | FUSE:CARTRIDGE 4 AMP 125V SLOW BLOW | |
| F2 | 1400-0008 | FUSEHOLDER:BRONZE CLIP | |
| J1 | | NOT ASSIGNED | |
| J2 | 1251-0148 | CONNECTOR:POWER 3 PIN MALE | |
| J3 | | PART OF PROBE CONNECTOR ASSY | |
| J4 | | PART OF PROBE CONNECTOR ASSY | |
| J5-J200 | | NOT ASSIGNED | |
| J201 | 1251-0011 | CONNECTOR:FEMALE 4-CONTACT | |
| J202 | 1250-0083 | CONNECTOR:BNC | |
| J203-J400 | | NOT ASSIGNED | |
| J401 | 1250-0083 | CONNECTOR:BNC | |
| Q1 | 1850-0098 | TRANSISTOR:GERMANIUM PNP SELECTED | |
| Q2 | 1850-0064 | TRANSISTOR:GERMANIUM PNP 2N1183 | |
| Q3-Q400 | | NOT ASSIGNED | |
| Q401 | 1853-0037 | TRANSISTOR:SILICON PNP | |
| Q402 | 1853-0037 | TRANSISTOR:SILICON PNP | |
| Q403 | 1853-0037 | TRANSISTOR:SILICON PNP | |
| R1 | 0687-3331 | R:FXD COMP 33K OHM 10% 1/2W | |
| R2 | 0690-2241 | R:FXD COMP 220K OHM 10% 1W | |
| R3 | 0687-2221 | R:FXD COMP 2200 OHM 10% 1/2W | |
| R4 | 0813-0030 | R:FXD WW 3.9 OHM 10% 2W | |
| R5 | 2100-0317 | R:VAR WW 2 OHM 20% LIN 3W | |
| R6 | 0757-0059 | R:FXD MET FLM 1 MEGOHM 1% 1/2W | |
| R7-R100 | | NOT ASSIGNED | |
| R101 | 0693-3301 | R:FXD COMP 33 OHM 10% 2W | |
| R102 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R103 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R104 | 0690-3911 | R:FXD COMP 390 OHM 10% 1W | |
| R105 | 0687-2221 | R:FXD COMP 2200 OHM 10% 1/2W | |
| R106 | 0690-3911 | R:FXD COMP 390 OHM 10% 1W | |
| R107 | 0687-2221 | R:FXD COMP 2200 OHM 10% 1/2W | |
| R108 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R109 | 0816-0008 | R:FXD WW 10K OHM 10% 10W | |
| R110 | | NOT ASSIGNED | |
| R111 | 0690-1541 | R:FXD COMP 150K OHM 10% 1W | |
| R112 | 0690-2741 | R:FXD COMP 270K OHM 10% 1W | |
| R113 | 0690-2741 | R:FXD COMP 270K OHM 10% 1W | |
| R114 | 0690-2741 | R:FXD COMP 270K OHM 10% 1W | |

**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)

| Reference Designation | ℗ Part No. | Description # | Note |
|---|---|---|---|
| R115 | 0727-0259 | R:FXD DEPC 900K OHM 1% 1/2W FOR 8614B ONLY | |
| R115 | 0727-0280 | R:FXD DEPC 1.2 MEGOHM 1% 1/2W FOR 8616B ONLY | |
| R116 | 0727-0267 | R:FXD DEPC 980K OHM 1% 1/2W FOR 8614B ONLY | |
| R116 | 0727-0282 | R:FXD DEPC 1.5 MEGOHM 1% 1/2W FOR 8616B ONLY | |
| R117-R200 | | NOT ASSIGNED | |
| R201 | 0693-4701 | R:FXD COMP 47 OHM 10% 2W | |
| R202 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R203 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R204 | 0690-1241 | R:FXD COMP 120K OHM 10% 1W | |
| R205 | 0687-6831 | R:FXD COMP 68K OHM 10% 1/2W | |
| R206 | 0690-3941 | R:FXD COMP 390K OHM 10% 1W | |
| R207 | 0687-3931 | R:FXD COMP 39K OHM 10% 1/2W | |
| R208 | 0690-3341 | R:FXD COMP 330K OHM 10% 1W | |
| R209 | 0690-1241 | R:FXD COMP 120K OHM 10% 1W | |
| R210 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R211 | 0758-0052 | R:FXD MET OX 91K OHM 5% 1/2W FOR 8614B ONLY | |
| R211 | 0758-0022 | R:FXD FLM 82K OHM 5% 1/4W FOR 8616B ONLY | |
| R212 | 2100-0991 | R:VAR COMP 50K OHM 30% LIN 0.15W | |
| R213 | 0761-0017 | R:FXD MET FLM 300K OHM 5% 1W | |
| R214 | 0687-2241 | R:FXD COMP 220K OHM 10% 1/2W (PREFERRED REPLACEMENT PART) | |
| R215 | 2100-0411 | R:VAR COMP 2-SECT 7K OHM 10% 1/2W EACH | |
| R216 | 2100-0028 | R:VAR COMP 50K OHM 10% LIN 2W | |
| R217 | 2100-0028 | R:VAR COMP 50K OHM 10% LIN 2W | |
| R218 | 2100-0029 | R:VAR COMP 250K OHM 10% LIN 2W | |
| R219 | 2100-0028 | R:VAR COMP 50K OHM 10% LIN 2W | |
| R220 | 2100-0399 | R:VAR WW 100K OHM | |
| R221-R223 | | NOT ASSIGNED | |
| R224 | 0687-2241 | R:FXD COMP 220K OHM 10% 1/2W | |
| R225-R400 | | NOT ASSIGNED | |
| R401 | 0687-1041 | R:FXD COMP 100K OHM 10% 1/2W | |
| R402 | 0687-3931 | R:FXD COMP 39K OHM 10% 1/2W | |
| R403 | 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | |
| R404 | 0687-3931 | R:FXD COMP 39K OHM 10% 1/2W | |
| R405 | 0687-1051 | R:FXD COMP 1 MEGOHM 10% 1/2W | |
| R406 | 0687-1051 | R:FXD COMP 1 MEGOHM 10% 1/2W | |
| R407 | 0686-5625 | R:FXD COMP 5600 OHM 5% 1/2W | |
| R408 | 0698-3646 | R:FXD MET OX 12K OHM 5% 2W | |
| R409 | 0686-1345 | R:FXD COMP 130K OHM 5% 1/2W | |
| R410 | 2100-0991 | R:VAR COMP 50K OHM 30% LIN 0.15W | |
| R411 | 0686-7535 | R:FXD COMP 75K OHM 5% 1/2W | |
| R412 | 0687-4731 | R:FXD COMP 47K OHM 10% 1/2W | |
| R413 | 2100-0063 | R:VAR COMP 100K OHM 20% LIN 1/3W | |
| R414 | 0683-5625 | R:FXD COMP 5600 OHM 5% 1/4W | |

**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)

| Reference Designation | Part No. | Description # | Note |
|---|---|---|---|
| R415 | 0730-0062 | R:FXD DEPC 80K OHM 1% 1W | |
| R416 | 0687-1041 | R:FXD COMP 100K OHM 10% 1/2W | |
| R417 | 0764-0028 | R:FXD MET OX 100K OHM 5% 2W FOR 8614B ONLY | |
| R417 | 0761-0088 | R:FXD MET OX 120K OHM 5% 1W FOR 8616B ONLY | |
| R418 | 0770-0009 | R:FXD MET OX 47K OHM 5% 4W FOR 8614B ONLY | |
| R418 | 0770-0013 | R:FXD MET OX 56K OHM 5% 4W FOR 8616B ONLY | |
| R419 | 0730-0037 | R:FXD FLM 19K OHM 1% 1W | |
| R420 | 2100-0091 | R:VAR COMP 5000 OHM 30% LIN 1/3W | |
| R421 | 0687-2211 | R:FXD COMP 220 OHM 10% 1/2W | |
| R422 | 0684-1041 | R:FXD COMP 100K OHM 10% 1/4W | |
| R423 | 0764-0046 | R:FXD MET OX 33K OHM 5% 2W | |
| RT1 | 0839-0020 | THERMISTOR:DISC 100 OHM 10% | |
| S1 | 3101-0042 | SWITCH:PUSHBUTTON SPST | |
| S2 | 3101-0033 | SWITCH:SLIDE DPDT (115/230V) | |
| S3 | 3101-1153 | SWITCH:PUSHBUTTON | |
| S4-S200 | | NOT ASSIGNED | |
| S201 | 3101-0043 | SWITCH:PUSHBUTTON DPDT | |
| S202 | 3102-0009 | SWITCH,SENS SPDT 5A | |
| S203-S400 | | NOT ASSIGNED | |
| S401 | 3101-0043 | SWITCH:PUSHBUTTON DPDT | |
| S402 | 3101-0043 | SWITCH:PUSHBUTTON DPDT | |
| T1 | 9100-0176 | TRANSFORMER:POWER | |
| V1 | 1950-0003 | ELECTRON TUBE: 5837 KLYSTRON FOR 8614B ONLY | |
| V1 | 1950-0018 | ELECTRON TUBE: 5836 KLYSTRON FOR 8616B ONLY | |
| V2-V100 | | NOT ASSIGNED | |
| V101 | 1921-0014 | ELECTRON TUBE: 7233 TRIODE LOW-MU | |
| V102 | 1921-0014 | ELECTRON TUBE: 7233 TRIODE LOW-MU | |
| V103 | 1932-0030 | ELECTRON TUBE:12AX7 | |
| V104 | 1932-0030 | ELECTRON TUBE:12AX7 | |
| V105 | 1940-0007 | ELECTRON TUBE:OB2 | |
| V106-V200 | | NOT ASSIGNED | |
| V201 | 1923-0071 | ELECTRON TUBE:12HG7 | |
| V202 | 1940-0001 | ELECTRON TUBE:5651 | |
| V203 | 1923-0046 | ELECTRON TUBE: 6EJ7 (EF 184) PENTODE | |
| V204 | 1921-0005 | ELECTRON TUBE: 6C4 TRIODE | |
| V205-V400 | | NOT ASSIGNED | |
| V401 | 1932-0042 | ELECTRON TUBE:12AT7 | |
| W1 | 8120-0078 | CABLE ASSY:POWER CORD | |

**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)

| Reference Designation | Part No. | Description # | Note |
|---|---|---|---|
| XV101 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV102 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV103 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV104 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV105 | 1200-0053 | SOCKET:TUBE 7 PIN MINAT | |
| XV106-XV200 | | NOT ASSIGNED | |
| XV201 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV202 | 1200-0053 | SOCKET:TUBE 7 PIN MINAT | |
| XV203 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| XV204 | 1200-0053 | SOCKET:TUBE 7 PIN MINAT | |
| XV205-XV400 | | NOT ASSIGNED | |
| XV401 | 1200-0062 | SOCKET:TUBE 9 PIN MIN. | |
| | | PROBE CONNECTOR ASSY INCLUDES: | |
| | 1250-0145 | GASKET:RF CONNECTOR V-GROOVE | |
| | 1250-0146 | WASHER:RF CONNECTOR | |
| | 1250-0147 | NUT:RF CONNECTOR,SPEC RETAINING | |
| | 1250-0148 | WASHER:RF CONNECTOR | |
| | 1250-0017 | CONTACT:RF CONNECTOR,CENTER PIN FEMALE | |
| | 1250-0141 | BODY:RF CONNECTOR,SPEC CLAMPING | |
| | 1250-0142 | NUT:RF CONNECTOR CLAMP | |
| | 1250-0143 | CLAMP:RF CONNECTOR | |
| | | MISCELLANEOUS | |
| | 08614-611 | INTAKE AIR CLEANER ASSY | |
| | 08614-612 | FAN ASSY:INCLUDES BLADE | |
| | 08614-264 | ASSY:WIPER | |
| | 5040-0201 | BEZEL:COUNTER(ATTEN) | |
| | 5040-0202 | BEZEL:COUNTER(FREQ) | |
| | 08614-260 | CAM:FREQUENCY | |
| | 08614-261 | CAM:LENGTH | |
| | 08614-615 | CAVITY ASSY(8614B ONLY) | |
| | 08616-606 | CAVITY ASSY(8616B ONLY) | |
| | 08614-017 | CHASSIS:MAIN | |
| | 5020-0306 | NUT:CONNECTOR | |
| | 5040-0417 | SOCKET HOLDER:9-PIN<br>FOR XV101,XV102 | |
| | 1400-0071 | CLAMP:TUBE | |
| | 08614-282 | CONDUCTOR:CENTER | |
| | 1250-0144 | CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE<br>PART OF PROBE CONNECTOR ASSY | |
| | 1251-0053 | CONNECTOR:FEMALE FOR PC BOARD | |
| | 1200-0088 | INSULATOR:DIODE<br>FOR CR1 | |
| | 1200-0043 | INSULATOR:TRANSISTOR MOUNTING<br>FOR Q1 | |

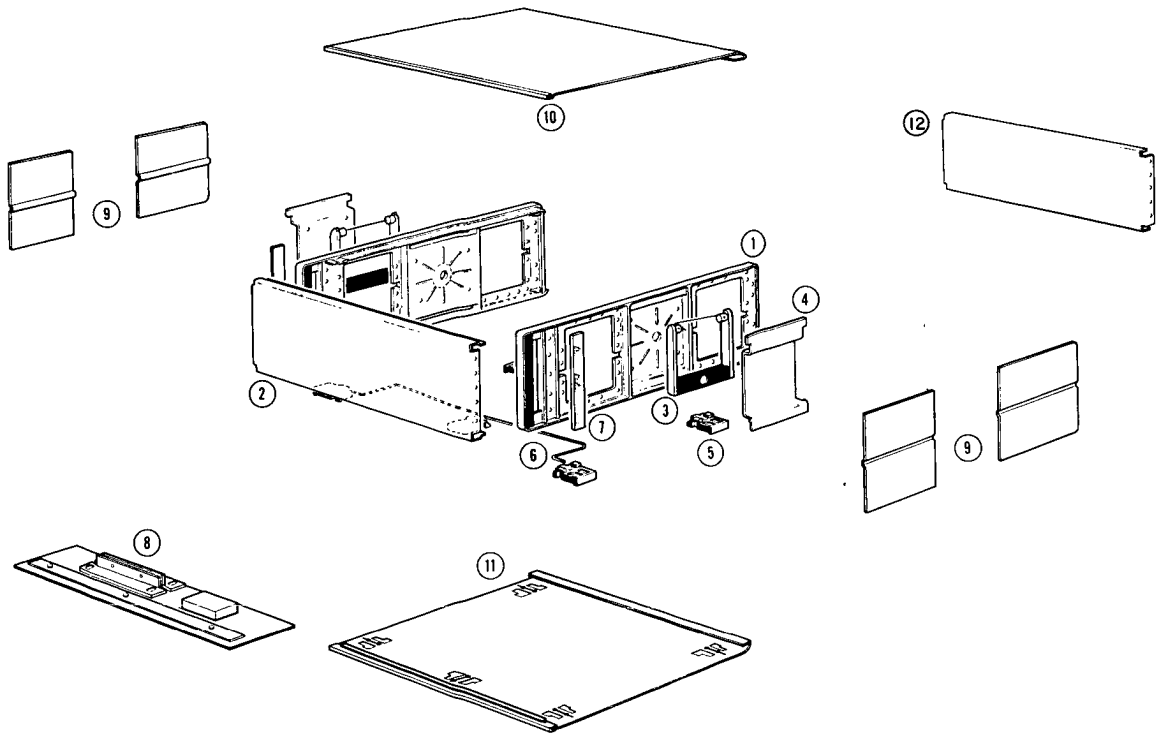
**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)

| Reference Designation | Part No. | Description # | Note |
|---|---|---|---|
| | 0370-0050 | HANDLE:CRANK ONLY 3/8" OD | |
| | 0370-0149 | KNOB:BLACK,CRANK ASSY | |
| | 0370-0026 | KNOB:BLK W/ARROW 3/4" OD 1/8" SHAFT | |
| | 5000-0244 | LABEL:FM | |
| | 5000-0245 | LABEL:PULSE | |
| | 5000-0246 | LABEL:SQUARE WAVE | |
| | 5000-0247 | LABEL:RF | |
| | 5000-0248 | LABEL:LINE | |
| | 1520-0001 | PLATE:MOUNTING ELECTROLYTIC CAPACITOR FOR C1 | |
| | 1520-0002 | PLATE:MOUNTING FOR C2,C3,C4,C205. | |
| | 5000-0051 | TRIM STRIP | |
| | 08614-614 | PROBE ASSY:UNCALIBRATED OUTPUT FOR 8614B ONLY | |
| | 08616-605 | PROBE ASSY(8616B ONLY) | |
| | 08614-227 | PLUG:TYPE N CONNECTOR | |
| | 0370-0118 | KNOB:GRAY PUSHBUTTON 11/16 IN DIA | |
| | 0510-0123 | FASTENER:PUSH-ON TYPE | |
| | 2100-0401 | CONTACT:ELECTRICAL,ROTARY WIPER TYPE | |
| | 2100-0402 | CONTACT:POTENTIOMETER CONTACT LUG | |
| | 08614-617 | WIRING HARNESS:BRANCHED AC | |
| | 08614-618 | WIRING HARNESS:BRANCHED DC | |

**# See introduction to this section for ordering information**

Table 6-1. Reference Designation Index (Contd)




| Reference Designation | Part No. | Description # | Note |
|---|---|---|---|
| 1 | 5060-0732 | SIDE FRAME ASSY | |
| | 0590-0053 | NUT:CAPTIVE 6-32 GOLD CHROMATE | |
| 2 | 08614-018 | PANEL:FRONT | |
| | 2530-0011 | SCREW:SST FLAT HD 8-32 X 3/8 | |
| | 08616-003 | PANEL:FRONT | |
| 3 | 5060-0222 | HANDLE ASSY:5H SIDE | |
| 4 | 5060-0766 | HANDLE ASSY:RETAINER | |
| | 2550-0013 | SCREW:SST BH 8-32 X 5/16 | |
| 5 | 5060-0767 | FOOT ASSY:FM | |
| 6 | 1490-0030 | STAND:TILT | |
| 7 | 5000-0052 | PLATE:FLUTED ALUMINUM | |
| 8 | 5060-0775 | KIT:5H RACK MOUNT | |
| 9 | | COVER:SIDE | |
| | 5000-0738 | COVER:REAR SIDE PLATE | |
| | 5000-0739 | COVER:FRONT SIDE PLATE | |
| | 2370-0020 | SCREW:SST FH PHIL DR 6-32 X 3/16 | |
| 10 | 5060-0740 | TOP COVER ASSY:16L FM | |
| | 2370-0021 | SCREW:SST FH PHIL DR 6-32 X 7/16 | |
| 11 | 5060-0752 | BOTTOM COVER ASSY:16L FM | |
| | 2370-0021 | SCREW:SST FH PHIL DR 6-32 X 7/16 | |
| 12 | 08614-024 | PANEL:REAR | |
| | 2515-0017 | SCREW:PAN HD PHIL DR 8-32 X 1/4 | |

**# See introduction to this section for ordering information**

Table 6-2. Replaceable Parts

| ℗ Part No. | Description # | Mfr. | Mfr. Part No. | TQ | |
|---|---|---|---|---|---|
| 0140-0159 | C:FXD MICA 3000 PF 2% | 28480 | 0140-0159 | 1 | 1 |
| 0150-0052 | C:FXD CER 0.05 UF 20% 400VDCW | 56289 | 33C17A | 5 | 5 |
| 0160-0056 | C:FXD MY 0.047 UF 10% 1000VDCW | 56289 | 160P73910 PMD | 1 | 1 |
| 0160-0079 | C:FXD PAPER 1.0 UF 10% 600VDCW | 82047 | 23F467 | 1 | 1 |
| 0160-0152 | C:FXD PAPER 0.1UF 20% 600VDCW | 56289 | 102P125 | 3 | 3 |
| 0160-2204 | C:FXD MICA 100 PF 5% | 28480 | 0160-2204 | 1 | 1 |
| 0170-0022 | C:FXD MY 0.1UF 20% 600VDCW | 09134 | TYPE 24 | 1 | 1 |
| 0180-0011 | C:FXD ELECT 20 UF 450VDCW | 56289 | D32550 DFP | 2 | 2 |
| 0180-0024 | C:FXD ELECT 40UF 450VDCW | 56289 | D32441 | 1 | 1 |
| 0180-0135 | C:FXD ELECT 40/10 UF +50-10% 450VDCW | 56289 | D40025DFP | 1 | 1 |
| 0180-0213 | C:FXD ELECT 5000 UF +75-10% 25VDCW | 56289 | D39556 | 1 | 1 |
| 0370-0026 | KNOB:BLK W/ARROW 3/4" OD 1/8" SHAFT | 28480 | 0370-0026 | 1 | 1 |
| 0370-0050 | HANDLE:CRANK ONLY 3/8" OD | 28480 | 0370-0050 | 1 | 1 |
| 0370-0118 | KNOB:GRAY PUSHBUTTON 11/16 IN DIA | 28480 | 0370-0118 | 1 | 1 |
| 0370-0149 | KNOB:BLACK,CRANK ASSY | 28480 | 0370-0149 | 1 | 1 |
| 0510-0123 | FASTENER:PUSH-ON TYPE | 78553 | C12008-014-4 | 1 | 1 |
| 0590-0053 | NUT:CAPTIVE 6-32 GOLD CHROMATE | 00000 | OBD | 1 | 1 |
| 0683-5625 | R:FXD COMP 5600 OHM 5% 1/4W | 01121 | CB 5625 | 1 | 1 |
| 0684-1041 | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 | 1 | 1 |
| 0686-1345 | R:FXD COMP 130K OHM 5% 1/2W | 01121 | EB 1345 | 1 | 1 |
| 0686-5625 | R:FXD COMP 5600 OHM 5% 1/2W | 01121 | EB 5625 | 1 | 1 |
| 0686-7535 | R:FXD COMP 75K OHM 5% 1/2W | 01121 | EB 7535 | 1 | 1 |
| 0687-1041 | R:FXD COMP 100K OHM 10% 1/2W | 01121 | EB 1041 | 2 | 2 |
| 0687-1051 | R:FXD COMP 1 MEGOHM 10% 1/2W | 01121 | EB 1051 | 2 | 2 |
| 0687-2211 | R:FXD COMP 220 OHM 10% 1/2W | 01121 | EB 2211 | 1 | 1 |
| 0687-2221 | R:FXD COMP 2200 OHM 10% 1/2W | 01121 | EB 2221 | 3 | 3 |
| 0687-2241 | R:FXD COMP 220K OHM 10% 1/2W | 01121 | EB 2241 | 2 | 1 |
| 0687-3331 | R:FXD COMP 33K OHM 10% 1/2W | 01121 | EB 3331 | 1 | 1 |
| 0687-3931 | R:FXD COMP 39K OHM 10% 1/2W | 01121 | EB 3931 | 3 | 3 |
| 0687-4731 | R:FXD COMP 47K OHM 10% 1/2W | 01121 | EB 4731 | 1 | 1 |
| 0687-4741 | R:FXD COMP 470K OHM 10% 1/2W | 01121 | EB 4741 | 7 | 7 |
| 0687-6831 | R:FXD COMP 68K OHM 10% 1/2W | 01121 | EB 6831 | 1 | 1 |
| 0690-1241 | R:FXD COMP 120K OHM 10% 1W | 01121 | GB 1241 | 2 | 2 |
| 0690-1541 | R:FXD COMP 150K OHM 10% 1W | 01121 | GB 1541 | 1 | 1 |
| 0690-2241 | R:FXD COMP 220K OHM 10% 1W | 01121 | GB 2241 | 1 | 1 |
| 0690-2741 | R:FXD COMP 270K OHM 10% 1W | 01121 | GB 2741 | 3 | 3 |
| 0690-3341 | R:FXD COMP 330K OHM 10% 1W | 01121 | GB 3341 | 1 | 1 |
| 0690-3911 | R:FXD COMP 390 OHM 10% 1W | 01121 | GB 3911 | 2 | 2 |
| 0690-3941 | R:FXD COMP 390K OHM 10% 1W | 01121 | GB 3941 | 1 | 1 |
| 0693-3301 | R:FXD COMP 33 OHM 10% 2W | 01121 | HB 3301 | 1 | 1 |
| 0693-4701 | R:FXD COMP 47 OHM 10% 2W | 01121 | HB 4701 | 1 | 1 |
| 0698-3646 | R:FXD MET OX 12K OHM 5% 2W | 28480 | 0698-3646 | 1 | 1 |
| 0727-0259 | R:FXD DEPC 900K OHM 1% 1/2W | 28480 | 0727-0259 | 1 | |
| 0727-0267 | R:FXD DEPC 960K OHM 1% 1/2W | 28480 | 0727-0267 | 1 | |
| 0727-0280 | R:FXD DEPC 1.2 MEGOHM 1% 1/2W | 28480 | 0727-0280 | | 1 |
| 0727-0282 | R:FXD DEPC 1.5 MEGOHM 1% 1/2W | 28480 | 0727-0282 | | 1 |
| 0730-0037 | R:FXD FLM 19K OHM 1% 1W | 28480 | 0730-0037 | 1 | 1 |
| 0730-0062 | R:FXD DEPC 80K OHM 1% 1W | 28480 | 0730-0062 | 1 | 1 |
| 0757-0059 | R:FXD MET FLM 1 MEGOHM 1% 1/2W | 28480 | 0757-0059 | 1 | 1 |
| 0758-0022 | R:FXD FLM 82K OHM 5% 1/4W | 28480 | 0758-0022 | | 1 |
| 0758-0052 | R:FXD MET OX 91K OHM 5% 1/2W | 28480 | 0758-0052 | 1 | |
| 0761-0017 | R:FXD MET FLM 300K OHM 5% 1W | 28480 | 0761-0017 | 1 | 1 |
| 0761-0088 | R:FXD MET OX 120K OHM 5% 1W | 28480 | 0761-0088 | | 1 |
| 0764-0028 | R:FXD MET OX 100K OHM 5% 2W | 28480 | 0764-0028 | 1 | |
| 0764-0046 | R:FXD MET OX 33K OHM 5% 2W | 28480 | 0764-0046 | 1 | 1 |

**# See introduction to this section for ordering information**

Table 6-2. Replaceable Parts (Contd)

| Part No. | Description # | Mfr. | Mfr. Part No. | TQ | |
|---|---|---|---|---|---|
| 0770-0009 | R:FXD MET OX 47K OHM 5% 4W | 28480 | 0770-0009 | 1 | |
| 0770-0013 | R:FXD MET OX 56K OHM 5% 4W | 28480 | 0770-0013 | | 1 |
| 0813-0030 | R:FXD WW 3.9 OHM 10% 2W | 28480 | 0813-0030 | 1 | 1 |
| 0816-0008 | R:FXD WW 10K OHM 10% 10W | 28480 | 0816-0008 | 1 | 1 |
| 0839-0020 | THERMISTOR:DISC 100 OHM 10% | 24446 | 1D753 | 1 | 1 |
| 1200-0043 | INSULATOR:TRANSISTOR MOUNTING | 71785 | 293011 | 1 | 1 |
| 1200-0053 | SOCKET:TUBE 7 PIN MINAT | 71785 | 111-51-11-069 | 3 | 3 |
| 1200-0062 | SOCKET:TUBE 9 PIN MIN. | 71785 | 121-51-11-060 | 7 | 7 |
| 1200-0088 | INSULATOR:DIODE | 71785 | 293201 | 1 | 1 |
| 1210-0003 | BRACKET:CAPACITOR | 82047 | C-103 FOR 23F467 | 1 | 1 |
| 1250-0017 | CONTACT:RF CONNECTOR,CENTER PIN FEMALE | 91737 | 5090-20AU | 1 | 1 |
| 1250-0083 | CONNECTOR:BNC | 28480 | 1250-0083 | 2 | 2 |
| 1250-0141 | BODY:RF CONNECTOR,SPEC CLAMPING | 91737 | 8124-4 | 1 | 1 |
| 1250-0142 | NUT:RF CONNECTOR CLAMP | 28480 | 1250-0142 | 1 | 1 |
| 1250-0143 | CLAMP:RF CONNECTOR | 28480 | 1250-0143 | 1 | 1 |
| 1250-0144 | CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE | 28480 | 1250-0144 | 1 | 1 |
| 1250-0145 | GASKET:RF CONNECTOR V-GROOVE | 28480 | 1250-0145 | 1 | 1 |
| 1250-0146 | WASHER:RF CONNECTOR | 28480 | 1250-0146 | 1 | 1 |
| 1250-0147 | NUT:RF CONNECTOR,SPEC RETAINING | 91737 | 8124-14 | 1 | 1 |
| 1250-0148 | WASHER:RF CONNECTOR | 02660 | 82-2911 | 1 | 1 |
| 1251-0011 | CONNECTOR:FEMALE 4-CONTACT | 75173 | S304AB | 1 | 1 |
| 1251-0053 | CONNECTOR:FEMALE FOR PC BOARD | 91886 | 13A009-2 | 1 | 1 |
| 1251-0148 | CONNECTOR:POWER 3 PIN MALE | 87930 | 1065-1 | 1 | 1 |
| 1400-0008 | FUSEHOLDER:BRONZE CLIP | 95915 | 3510-11 | 1 | 1 |
| 1400-0071 | CLAMP:TUBE | 28480 | 1400-0071 | 1 | 1 |
| 1450-0039 | INDICATOR:GLOW-LAMP NEON IN RED PLASTIC | 08717 | 859-R-5 NYLON RING | 1 | 1 |
| 1490-0030 | STAND:TILT | 28480 | 1490-0030 | 1 | 1 |
| 1520-0001 | PLATE:MOUNTING ELECTROLYTIC CAPACITOR | 28480 | 1520-0001 | 1 | 1 |
| 1520-0002 | PLATE:MOUNTING | 28480 | 1520-0002 | 1 | 1 |
| 1850-0064 | TRANSISTOR:GERMANIUM PNP 2N1183 | 86684 | 2N1183 | 1 | 1 |
| 1850-0098 | TRANSISTOR:GERMANIUM PNP SELECTED | 28480 | 1850-0098 | 1 | 1 |
| 1853-0037 | TRANSISTOR:SILICON PNP | 28480 | 1853-0037 | 3 | 3 |
| 1901-0025 | DIODE:SILICON 100WV 100MA | 28480 | 1901-0025 | 6 | 6 |
| 1901-0030 | DIODE:SILICON 800 PIV | 28480 | 1901-0030 | 4 | 4 |
| 1901-0032 | DIODE:SILICON 1N3209 | 04713 | 1N3209 | 1 | 1 |
| 1902-0031 | DIODE BREAKDOWN:12.7V 5% | 28480 | 1902-0031 | 1 | 1 |
| 1902-0057 | DIODE BREAKDOWN:6.49V | 28480 | 1902-0057 | 1 | 1 |
| 1902-0074 | DIODE BREAKDOWN:7.15V 5% | 28480 | 1902-0074 | 1 | 1 |
| 1902-0126 | DIODE BREAKDOWN:2.61V 5% | 28480 | 1902-0126 | 1 | 1 |
| 1902-0175 | DIODE BREAKDOWN:100V | 28480 | 1902-0175 | 1 | 1 |
| 1921-0005 | ELECTRON TUBE: 6C4 TRIODE | 33173 | 6C4 | 1 | 1 |
| 1921-0014 | ELECTRON TUBE: 7233 TRIODE LOW-MU | 33173 | 7233 | 2 | 2 |
| 1923-0046 | ELECTRON TUBE: 6EJ7 (EF 184) PENTODE | 73445 | 6EJ7(EF184) | 1 | 1 |
| 1923-0071 | ELECTRON TUBE:12HG7 | 02735 | 12HG7 | 1 | 1 |
| 1932-0030 | ELECTRON TUBE:12AX7 | 02735 | 12AX7 | 2 | 2 |
| 1932-0042 | ELECTRON TUBE:12AT7 | 03508 | 12AT7 | 1 | 1 |
| 1940-0001 | ELECTRON TUBE:5651 | 86684 | 5651A | 1 | 1 |
| 1940-0007 | ELECTRON TUBE:OB2 | 02735 | OB2 | 1 | 1 |
| 1950-0003 | ELECTRON TUBE: 5837 KLYSTRON | 28480 | 1950-0003 | 1 | |
| 1950-0018 | ELECTRON TUBE: 5836 KLYSTRON | 81453 | 5836 | | 1 |
| 2100-0028 | R:VAR COMP 50K OHM 10% LIN 2W | 28480 | 2100-0028 | 3 | 3 |
| 2100-0029 | R:VAR COMP 250K OHM 10% LIN 2W | 28480 | 2100-0029 | 1 | 1 |
| 2100-0063 | R:VAR COMP 100K OHM 20% LIN 1/3W | 28480 | 2100-0063 | 1 | 1 |
| 2100-0091 | R:VAR COMP 5000 OHM 30% LIN 1/3W | 28480 | 2100-0091 | 1 | 1 |

**# See introduction to this section for ordering information**

Table 6-2. Replaceable Parts(Contd)

| Part No. | Description # | Mfr. | Mfr. Part No. | TQ | |
|---|---|---|---|---|---|
| 2100-0317 | R:VAR WW 2 OHM 20% LIN 3W | 28480 | 2100-0317 | 1 | 1 |
| 2100-0399 | R:VAR WW 100K OHM | 28480 | 2100-0399 | 1 | 1 |
| 2100-0401 | CONTACT:ELECTRICAL,ROTARY WIPER TYPE | 28480 | 2100-0401 | 1 | 1 |
| 2100-0402 | CONTACT:POTENTIOMETER CONTACT LUG | 28480 | 2100-0402 | 1 | 1 |
| 2100-0411 | R:VAR COMP 2-SECT 7K OHM 10% 1/2W EACH | 28480 | 2100-0411 | 1 | 1 |
| 2100-0991 | R:VAR COMP 50K OHM 30% LIN 0.15W | 28480 | 2100-0991 | 2 | 2 |
| 2110-0014 | FUSE:CARTRIDGE 4 AMP 125V SLOW BLOW | 71400 | MDX-4 | 1 | 1 |
| 2110-0033 | FUSE:0.75A 250V | 75915 | F02GR750A | 1 | 1 |
| 2110-0043 | FUSE:CARTRIDGE 1.5 AMP 250V | 75915 | 31201.5 | 1 | 1 |
| 2370-0020 | SCREW:SST FH PHIL DR 6-32 X 3/16 | 00000 | OBD | 1 | 1 |
| 2370-0021 | SCREW:SST FH PHIL DR 6-32 X 7/16 | 00000 | OBD | 2 | 2 |
| 2515-0017 | SCREW:PAN HD PHIL DR 8-32 X 1/4 | 00000 | OBD | 1 | 1 |
| 2530-0011 | SCREW:SST FLAT HD 8-32 X 3/8 | 78189 | OBD# | 1 | |
| 2550-0013 | SCREW:SST BH 8-32 X 5/16 | 28480 | 2550-0013 | 1 | 1 |
| 3101-0033 | SWITCH:SLIDE DPDT | 79727 | 6510 C | 1 | 1 |
| 3101-0042 | SWITCH:PUSHBUTTON SPST | 28480 | 3101-0042 | 1 | 1 |
| 3101-0043 | SWITCH:PUSHBUTTON DPDT | 28480 | 3101-0043 | 4 | 4 |
| 3101-1153 | SWITCH:PUSHBUTTON | 28480 | 3101-1153 | 1 | 1 |
| 3102-0009 | SWITCH,SENS SPDT 5A | 80207 | USMW | 1 | 1 |
| 5000-0051 | TRIM STRIP | 28480 | 5000-0051 | 1 | 1 |
| 5000-0052 | PLATE:FLUTED ALUMINUM | 28480 | 5000-0052 | 1 | 1 |
| 5000-0244 | LABEL:FM | 28480 | 5000-0244 | 1 | 1 |
| 5000-0245 | LABEL:PULSE | 28480 | 5000-0245 | 1 | 1 |
| 5000-0246 | LABEL:SQUARE WAVE | 28480 | 5000-0246 | 1 | 1 |
| 5000-0247 | LABEL:RF | 28480 | 5000-0247 | 1 | 1 |
| 5000-0248 | LABEL:LINE | 28480 | 5000-0248 | 1 | 1 |
| 5000-0738 | COVER:REAR SIDE PLATE | 28480 | 5000-0738 | 1 | 1 |
| 5000-0739 | COVER:FRONT SIDEPLATE | 28480 | 5000-0739 | 1 | 1 |
| 5020-0306 | NUT:CONNECTOR | 28480 | 5020-0306 | 1 | 1 |
| 5040-0201 | BEZEL:COUNTER(ATTEN) | 28480 | 5040-0201 | 1 | 1 |
| 5040-0202 | BEZEL:COUNTER(FREQ) | 28480 | 5040-0202 | 1 | 1 |
| 5040-0417 | SOCKET HOLDER:9-PIN | 28480 | 5040-0417 | 1 | 1 |
| 5060-0222 | HANDLE ASSY:5H SIDE | 28480 | 5060-0222 | 1 | 1 |
| 5060-0732 | SIDE FRAME ASSY | 28480 | 5060-0732 | 1 | 1 |
| 5060-0740 | TOP COVER ASSY:16L FM | 28480 | 5060-0740 | 1 | 1 |
| 5060-0752 | BOTTOM COVER ASSY:16L FM | 28480 | 5060-0752 | 1 | 1 |
| 5060-0766 | HANDLE ASSY:RETAINER | 28480 | 5060-0766 | 1 | 1 |
| 5060-0767 | FOOT ASSY:FM | 28480 | 5060-0767 | 1 | 1 |
| 5060-0775 | KIT:5 H RACK MOUNT | 28480 | 5060-0775 | 1 | 1 |
| 8120-0078 | CABLE ASSY:POWER CORD | 28480 | 8120-0078 | 1 | 1 |
| 9100-0176 | TRANSFORMER:POWER | 28480 | 9100-0176 | 1 | 1 |
| 08614-017 | CHASSIS:MAIN | 28480 | 08614-017 | 1 | 1 |
| 08614-018 | PANEL:FRONT | 28480 | 08614-018 | 1 | |
| 08614-024 | PANEL:REAR | 28480 | 08614-024 | 1 | 1 |
| 08614-227 | PLUG:TYPE N CONNECTOR | 28480 | 08614-227 | 1 | 1 |
| 08614-260 | CAM:FREQUENCY | 28480 | 08614-260 | 1 | 1 |
| 08614-261 | CAM:LENGTH | 28480 | 08614-261 | 1 | 1 |
| 08614-264 | ASSY:WIPER | 28480 | 08614-264 | 1 | 1 |
| 08614-282 | CONDUCTOR:CENTER | 28480 | 08614-282 | 1 | 1 |
| 08614-291 | BOARD:BLANK PC | 28480 | 08614-291 | 1 | 1 |
| 08614-611 | INTAKE AIR CLEANER ASSY | 28480 | 08614-611 | 1 | 1 |
| 08614-612 | FAN ASSY:INCLUDES BLADE | 28480 | 08614-612 | 1 | 1 |
| 08614-614 | PROBE ASSY:UNCALIBRATED OUTPUT | 28480 | 08614-614 | 1 | |
| 08614-615 | CAVITY ASSY(8614B ONLY) | 28480 | 08614-615 | 1 | |

**# See introduction to this section for ordering information**

Table 6-2. Replaceable Parts (Contd)

| Part No. | Description # | Mfr. | Mfr. Part No. | TQ | |
|---|---|---|---|---|---|
| 08614-616 | HIGH VOLTAGE BOARD(8614B ONLY) | 28480 | 08614-616 | 1 | 1 |
| 08614-617 | WIRING HARNESS:BRANCHED AC | 28480 | 08614-617 | 1 | 1 |
| 08614-618 | WIRING HARNESS:BRANCHED DC | 28480 | 08614-618 | 1 | 1 |
| 08616-003 | PANEL:FRONT | 28480 | 08616-003 | | 1 |
| 08616-605 | PROBE ASSY(8616B ONLY) | 28480 | 08616-605 | | 1 |
| 08616-606 | CAVITY ASSY(8616B ONLY) | 28480 | 08616-606 | | 1 |
| 08616-607 | HIGH VOLTAGE BOARD(8616B ONLY) | 28480 | 08616-607 | | 1 |

**# See introduction to this section for ordering information**

# TABLE 6-3.
# CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

| Code No. | Manufacturer | Address |
|---|---|---|
| 00000 | U.S.A. Common | Any supplier of U.S. |
| 00136 | McCoy Electronics | Mount Holly Springs, Pa. |
| 00213 | Sage Electronics Corp. | Rochester, N.Y. |
| 00287 | Cemco Inc. | Danielson, Conn. |
| 00334 | Humidial | Colton, Calif. |
| 00348 | Microtron Co., Inc. | Valley Stream, N.Y. |
| 00373 | Garlock Inc. | Cherry Hill, N.J. |
| 00656 | Aerovox Corp. | New Bedford, Mass. |
| 00779 | Amp. Inc. | Harrisburg, Pa. |
| 00781 | Aircraft Radio Corp. | Boonton, N.J. |
| 00815 | Northern Engineering Laboratories, Inc. | Burlington, Wis. |
| 00853 | Sangamo Electric Co., Pickens Div. | Pickens, S.C. |
| 00866 | Goe Engineering Co. | City of Industry, Cal. |
| 00891 | Carl E. Holmes Corp. | Los Angeles, Calif. |
| 00929 | Microlab Inc. | Livingston, N.J. |
| 01002 | General Electric Co., Capacitor Dept. | Hudson Falls, N.Y. |
| 01009 | Alden Products Co. | Brockton, Mass. |
| 01121 | Allen Bradley Co. | Milwaukee, Wis. |
| 01255 | Litton Industries, Inc. | Beverly Hills, Calif. |
| 01281 | TRW Semiconductors, Inc. | Lawndale, Calif. |
| 01295 | Texas Instruments, Inc., Transistor Products Div. | Dallas, Texas |
| 01349 | The Alliance Mfg. Co. | Alliance, Ohio |
| 01589 | Pacific Relays, Inc. | Van Nuys, Calif. |
| 01670 | Gudebrod Bros. Silk Co. | New York, N.Y. |
| 01930 | Amerock Corp. | Rockford, Ill. |
| 01961 | Pulse Engineering Co. | Santa Clara, Calif. |
| 02114 | Ferroxcube Corp. of America | Saugerties, N.Y. |
| 02116 | Wheelock Signals, Inc. | Long Branch, N.J. |
| 02286 | Cole Rubber and Plastics Inc. | Sunnyvale, Calif. |
| 02660 | Amphenol-Borg Electronics Corp. | Broadview, Ill. |
| 02735 | Radio Corp. of America, Semiconductor and Materials Div. | Somerville, N.J. |
| 02771 | Vocaline Co. of America, Inc. | Old Saybrook, Conn. |
| 02777 | Hopkins Engineering Co. | San Fernando, Calif. |
| 02875 | Hudson Tool & Die | Newark, N.J. |
| 03508 | G.E. Semiconductor Prod. Dept. | Syracuse, N.Y. |
| 03705 | Apex Machine & Tool Co. | Dayton, Ohio |
| 03797 | Eldema Corp. | Compton, Calif. |
| 03818 | Parker Seal Co. | Los Angeles, Calif. |
| 03877 | Transitron Electric Corp. | Wakefield, Mass. |
| 03888 | Pyrofilm Resistor Co., Inc. | Cedar Knolls, N.J. |
| 03954 | Singer Co., Diehl Div. Finderne Plant | Sumerville, N.J. |
| 04009 | Arrow, Hart and Hegeman Elect. Co. | Hartford, Conn. |
| 04013 | Taurus Corp. | Lambertville, N.J. |
| 04062 | Arco Electronic Inc. | Great Neck, N.Y. |
| 04222 | Hi-Q Division of Aerovox | Myrtle Beach, S.C. |
| 04354 | Precision Paper Tube Co. | Wheeling, Ill. |
| 04404 | Dymec Division of Hewlett-Packard Co. | Palo Alto, Calif. |
| 04651 | Sylvania Electric Products, Microwave Device Div. | Mountain View, Calif. |
| 04673 | Dakota Engr. Inc. | Culver City, Calif. |
| 04713 | Motorola, Inc., Semiconductor Prod. Div. | Phoenix, Arizona |
| 04732 | Filtron Co., Inc. Western Div. | Culver City, Calif. |
| 04773 | Automatic Electric Co. | Northlake, Ill. |
| 04796 | Sequoia Wire Co. | Redwood City, Calif. |
| 04811 | Precision Coil Spring Co. | El Monte, Calif. |
| 04870 | P.M. Motor Company | Westchester, Ill. |
| 04919 | Component Mfg. Service Co. | W. Bridgewater, Mass. |
| 05006 | Twentieth Century Plastics, Inc. | Los Angeles, Calif. |
| 05277 | Westinghouse Electric Corp. Semi-Conductor Dept. | Youngwood, Pa. |
| 05347 | Ultronix, Inc. | San Mateo, Calif. |
| 05397 | Union Carbide Corp., Elect. Div. | New York, N.Y. |
| 05574 | Viking Ind. Inc. | Canoga Park, Calif. |
| 05593 | Icore Electro-Plastics Inc. | Sunnyvale, Calif. |
| 05616 | Cosmo Plastic (c/o Electrical Spec. Co.) | Cleveland, Ohio |
| 05624 | Barber Colman Co. | Rockford, Ill. |
| 05728 | Tiffen Optical Co. | Roslyn Heights, Long Island, N.Y. |
| 05729 | Metro-Tel Corp. | Westbury, N.Y. |
| 05783 | Stewart Engineering Co. | Santa Cruz, Calif. |
| 05820 | Wakefield Engineering Inc. | Wakefield, Mass. |
| 06004 | Bassick Co., Div. of Stewart Warner Corp. | Bridgeport, Conn. |
| 06090 | Raychem Corp. | Redwood City, Calif. |
| 06175 | Bausch and Lomb Optical Co. | Rochester, N.Y. |
| 06402 | E.T.A. Products Co. of America | Chicago, Ill. |
| 06540 | Amatom Electronic Hardware Co., Inc. | New Rochelle, N.Y. |
| 06555 | Beede Electrical Instrument Co., Inc. | Penacook, N.H. |
| 06666 | General Devices Co., Inc. | Indianapolis, Ind. |
| 06751 | Components Inc., Ariz. Div. | Phoenix, Ariz. |
| 06812 | Torrington Mfg. Co., West Div. | Van Nuys, Calif. |
| 06980 | Varian Assoc. Eimac Div. | San Carlos, Calif. |
| 07088 | Kelvin Electric Co. | Van Nuys, Calif. |
| 07126 | Digitran Co. | Pasadena, Calif. |
| 07137 | Transistor Electronics Corp. | Minneapolis, Minn. |
| 07138 | Westinghouse Electric Corp. Electronic Tube Div. | Elmira, N.Y. |
| 07149 | Filmohm Corp. | New York, N.Y. |
| 07233 | Cinch-Graphik Co. | City of Industry, Calif. |
| 07256 | Silicon Transistor Corp. | Carle Place, N.Y. |
| 07261 | Avnet Corp. | Culver City, Calif. |
| 07263 | Fairchild Camera & Inst. Corp. Semiconductor Div. | Mountain View, Calif. |
| 07322 | Minnesota Rubber Co. | Minneapolis, Minn. |
| 07387 | Birtcher Corp., The | Monterey Park, Calif. |
| 07397 | Sylvania Elect. Prod. Inc., Mt. View Operations | Mountain View, Calif. |
| 07700 | Technical Wire Products Inc. | Cranford, N.J. |
| 07829 | Bodine Elect. Co. | Chicago, Ill. |
| 07910 | Continental Device Corp. | Hawthorne, Calif. |
| 07933 | Raytheon Mfg. Co., Semiconductor Div. | Mountain View, Calif. |
| 07980 | Hewlett-Packard Co., Boonton Radio Div. | Rockaway, N.J. |
| 08145 | U.S. Engineering Co. | Los Angeles, Calif. |
| 08289 | Blinn, Delbert Co. | Pomona, Calif. |
| 08358 | Burgess Battery Co. | Niagara Falls, Ontario, Canada |
| 08524 | Deutsch Fastener Corp. | Los Angeles, Calif. |
| 08664 | Bristol Co., The | Waterbury, Conn. |
| 08717 | Sloan Company | Sun Valley, Calif. |
| 08718 | ITT Cannon Electric Inc., Phoenix Div. | Phoenix, Arizona |
| 08727 | National Radio Lab. Inc. | Paramus, N.J. |
| 08792 | CBS Electronics Semiconductor Operations, Div of C.B.S. Inc. | Lowell, Mass. |
| 08806 | General Electric Co. Miniat. Lamp Dept. | Cleveland, Ohio |
| 08984 | Mel-Rain | Indianapolis, Ind. |
| 09026 | Babcock Relays Div. | Costa Mesa, Calif. |
| 09134 | Texas Capacitor Co. | Houston, Texas |
| 09145 | Tech. Ind. Inc. Atohm Elect. | Burbank, Calif. |
| 09250 | Electro Assemblies, Inc. | Chicago, Ill. |
| 09353 | C & K Components Inc. | Newton, Mass. |
| 09569 | Mallory Battery Co. of Canada, Ltd. | Toronto, Ontario, Canada |
| 09922 | Burndy Corp. | Norwalk, Conn. |
| 10214 | General Transistor Western Corp. | Los Angeles, Calif. |
| 10411 | Ti-Tal, Inc. | Berkeley, Calif. |
| 10646 | Carborundum Co. | Niagara Falls, N.Y. |
| 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 11237 | Chicago Telephone of California, Inc. | So. Pasadena, Calif. |
| 11242 | Bay State Electronics Corp. | Waltham, Mass. |
| 11312 | Teledyne Inc., Microwave Div. | Palo Alto, Calif. |
| 11314 | National Seal | Downey, Calif. |
| 11453 | Precision Connector Corp. | Jamaica, N.Y. |
| 11534 | Duncan Electronics Inc. | Costa Mesa, Calif. |
| 11711 | General Instrument Corp., Semiconductor Div., Products Group | Newark, N.J. |
| 11717 | Imperial Electronic, Inc. | Buena Park, Calif. |
| 11870 | Melabs, Inc. | Palo Alto, Calif. |
| 12136 | Philadelphia Handle Co. | Camden, N.J. |
| 12361 | Grove Mfg. Co., Inc. | Shady Grove, Pa. |
| 12574 | Gulton Ind. Inc. Data System Div. | Albuquerque, N.M. |
| 12697 | Clarostat Mfg. Co. | Dover, N.H. |
| 12728 | Elmar Filter Corp. | W. Haven, Conn. |
| 12859 | Nippon Electric Co., Ltd. | Tokyo, Japan |
| 12881 | Metex Electronics Corp. | Clark, N.J. |
| 12930 | Delta Semiconductor Inc. | Newport Beach, Calif. |
| 12954 | Dickson Electronics Corp. | Scottsdale, Arizona |
| 13103 | Thermolloy | Dallas, Texas |
| 13396 | Telefunken (GmbH) | Hanover, Germany |
| 13835 | Midland-Wright Div. of Pacific Industries, Inc. | Kansas City, Kansas |
| 14099 | Sem-Tech | Newbury Park, Calif. |
| 14193 | Calif. Resistor Corp. | Santa Monica, Calif. |
| 14298 | American Components, Inc. | Conshohocken, Pa. |
| 14433 | ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp. | West Palm Beach, Fla. |
| 14493 | Hewlett-Packard Company | Loveland, Colo. |
| 14655 | Cornell Dublier Electric Corp. | Newark, N.J. |
| 14674 | Corning Glass Works | Corning, N.Y. |
| 14752 | Electro Cube Inc. | San Gabriel, Calif. |
| 14960 | Williams Mfg. Co. | San Jose, Calif. |
| 15203 | Webster Electronics Co. | New York, N.Y. |
| 15287 | Scionics Corp. | Northridge, Calif. |
| 15291 | Adjustable Bushing Co. | N. Hollywood, Calif. |
| 15558 | Micron Electronics | Garden City, Long Island, N.Y. |
| 15566 | Amprobe Inst. Corp. | Lynbrook, N.Y. |
| 15631 | Cabletronics | Costa Mesa, Calif. |
| 15772 | Twentieth Century Coil Spring Co. | Santa Clara, Calif. |
| 15801 | Fenwal Elect. Inc. | Framingham, Mass. |
| 15818 | Amelco Inc. | Mt. View, Calif. |
| 16037 | Spruce Pine Mica Co. | Spruce Pine, N.C. |
| 16179 | Omni-Spectra Inc. | Detroit, Ill. |
| 16352 | Computer Diode Corp. | Lodi, N.J. |
| 16585 | Boots Aircraft Nut Corp. | Pasadena, Calif. |
| 16688 | Ideal Prec. Meter Co., Inc. De Jur Meter Div. | Brooklyn, N.Y. |
| 16758 | Delco Radio Div. of G.M. Corp. | Kokoma, Ind. |
| 17109 | Thermonetics Inc. | Canoga Park, Calif. |
| 17474 | Tranex Company | Mountain View, Calif. |
| 17675 | Hamlin Metal Products Corp. | Akron, Ohio |
| 17745 | Angstrohm Prec. Inc. | No. Hollywood, Calif. |
| 17870 | McGraw-Edison Co. | Manchester, N.H. |
| 18042 | Power Design Pacific Inc. | Palo Alto, Calif. |
| 18083 | Clevite Corp., Semiconductor Div. | Palo Alto, Calif. |

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## TABLE 6-3.
## CODE LIST OF MANUFACTURERS (Cont'd)

| Code No. | Manufacturer | Address |
|---|---|---|
| 18324 | Signetics Corp. | Sunnyvale, Calif. |
| 18476 | Ty-Car Mfg. Co., Inc. | Holliston, Mass. |
| 18486 | TRW Elect. Comp. Div. | Des Plaines, Ill. |
| 18583 | Curtis Instrument, Inc. | Mt. Kisco, N.Y. |
| 18612 | Vishay Instruments Inc. | Malvern, Pa. |
| 18873 | E.I. DuPont and Co., Inc. | Wilmington, Del. |
| 18911 | Durant Mfg. Co. | Milwaukee, Wis. |
| 19315 | The Bendix Corp., Navigation & Control Div. | Teterboro, N.J. |
| 19500 | Thomas A. Edison Industries, Div. of McGraw-Edison Co. | West Orange, N.J. |
| 19589 | Concoa | Baldwin Park, Calif. |
| 19644 | LRC Electronics | Horseheads, N.Y. |
| 19701 | Electra Mfg. Co. | Independence, Kansas |
| 20183 | General Atronics Corp. | Philadelphia, Pa. |
| 21226 | Executone, Inc. | Long Island City, N.Y. |
| 21335 | Fafnir Bearing Co., The | New Britain, Conn. |
| 21520 | Fansteel Metallurgical Corp. | N. Chicago, Ill. |
| 23042 | Texscan Corp. | Indianapolis, Ind. |
| 23783 | British Radio Electronics Ltd. | Washington, D.C. |
| 24455 | G.E. Lamp Division | Nela Park, Cleveland, Ohio |
| 24655 | General Radio Co. | West Concord, Mass. |
| 24681 | Memcor Inc., Comp. Div. | Huntington, Ind. |
| 26365 | Gries Reproducer Corp. | New Rochelle, N.Y. |
| 26462 | Grobet File Co. of America, Inc. | Carlstadt, N.J. |
| 26851 | Compac/Hollister Co. | Hollister, Calif. |
| 26992 | Hamilton Watch Co. | Lancaster, Pa. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Calif. |
| 28520 | Heyman Mfg. Co. | Kenilworth, N.J. |
| 30817 | Instrument Specialties Co., Inc. | Little Falls, N.J. |
| 33173 | G.E. Receiving Tube Dept. | Owensboro, Ky. |
| 35434 | Lectrohm Inc. | Chicago, Ill. |
| 36196 | Stanwyck Coil Products Ltd. | Hawkesbury, Ontario, Canada |
| 36287 | Cunningham, W.H. & Hill, Ltd. | Toronto Ontario, Canada |
| 37942 | P.R. Mallory & Co. Inc. | Indianapolis, Ind. |
| 39543 | Mechanical Industries Prod. Co. | Akron, Ohio |
| 40920 | Miniature Precision Bearings, Inc. | Keene, N.H. |
| 42190 | Muter Co. | Chicago, Ill. |
| 43990 | C.A. Norgren Co. | Englewood, Colo. |
| 44655 | Ohmite Mfg. Co. | Skokie, Ill. |
| 46384 | Penn Eng. & Mfg. Corp. | Doylestown, Pa. |
| 47904 | Polaroid Corp. | Cambridge, Mass. |
| 48620 | Precision Thermometer & Inst. Co. | Southampton, Pa. |
| 49956 | Microwave & Power Tube Div. | Waltham, Mass. |
| 52090 | Rowan Controller Co. | Westminster, Md. |
| 52983 | Sanborn Company | Waltham, Mass. |
| 54294 | Shallcross Mfg. Co. | Selma, N.C. |
| 55026 | Simpson Electric Co. | Chicago, Ill. |
| 55933 | Sonotone Corp. | Elmsford, N.Y. |
| 55938 | Raytheon Co. Commercial Apparatus & Systems Div. | So. Norwalk, Conn. |
| 56137 | Spaulding Fibre Co., Inc. | Tonawanda, N.Y. |
| 56289 | Sprague Electric Co. | North Adams, Mass. |
| 59446 | Telex Corp. | Tulsa, Okla. |
| 59730 | Thomas & Betts Co. | Elizabeth, N.J. |
| 60741 | Triplett Electrical Inst. Co. | Bluffton, Ohio |
| 61775 | Union Switch and Signal, Div. of Westinghouse Air Brake Co. | Pittsburgh, Pa. |
| 62119 | Universal Electric Co. | Owosso, Mich. |
| 63743 | Ward-Leonard Electric Co. | Mt. Vernon, N.Y. |
| 64959 | Western Electric Co., Inc. | New York, N.Y. |
| 65092 | Weston Inst. Inc. Weston-Newark | Newark, N.J. |
| 66295 | Wittek Mfg. Co. | Chicago, Ill. |
| 66346 | Minnesota Mining & Mfg. Co. Revere Mincom Div. | St. Paul, Minn. |
| 70276 | Allen Mfg. Co. | Hartford, Conn. |
| 70309 | Allied Control | New York, N.Y. |
| 70318 | Allmetal Screw Product Co., Inc. | Garden City, N.Y. |
| 70417 | Amplex, Div. of Chrysler Corp. | Detroit, Mich. |
| 70485 | Atlantic India Rubber Works, Inc. | Chicago, Ill. |
| 70563 | Amperite Co., Inc. | Union City, N.J. |
| 70674 | ADC Products Inc. | Minneapolis, Minn. |
| 70903 | Belden Mfg. Co. | Chicago, Ill. |
| 70998 | Bird Electronic Corp. | Cleveland, Ohio |
| 71002 | Birnbach Radio Co. | New York, N.Y. |
| 71034 | Birley Electric Co., Inc. | Erie, Pa. |
| 71041 | Boston Gear Works Div. of Murray Co. of Texas | Quincy, Mass. |
| 71218 | Bud Radio, Inc. | Willoughby, Ohio |
| 71279 | Cambridge Thermionics Corp. | Cambridge, Mass. |
| 71286 | Camloc Fastener Corp. | Paramus, N.J. |
| 71313 | Cardwell Condenser Corp. | Lindenhurst L.I., N.Y. |
| 71400 | Bussmann Mfg. Div. of McGraw-Edison Co. | St. Louis, Mo. |
| 71436 | Chicago Condenser Corp. | Chicago, Ill. |
| 71447 | Calif. Spring Co., Inc. | Pico-Rivera, Calif. |
| 71450 | CTS Corp. | Elkhart, Ind. |
| 71468 | ITT Cannon Electric Inc. | Los Angeles, Calif. |
| 71471 | Cinema, Div. Aerovox Corp. | Burbank, Calif. |
| 71482 | C.P. Clare & Co. | Chicago, Ill. |
| 71590 | Centralab Div. of Globe Union Inc. | Milwaukee, Wis. |
| 71616 | Commercial Plastics Co. | Chicago, Ill. |
| 71700 | Cornish Wire Co., The | New York, N.Y. |
| 71707 | Coto Coil Co., Inc. | Providence, R.I. |
| 71744 | Chicago Miniature Lamp Works | Chicago, Ill. |
| 71785 | Cinch Mfg. Co., Howard B. Jones Div. | Chicago, Ill. |
| 71984 | Dow Corning Corp. | Midland, Mich. |
| 72136 | Electro Motive Mfg. Co., Inc. | Willimantic, Conn. |
| 72619 | Dialight Corp. | Brooklyn, N.Y. |
| 72656 | Indiana General Corp., Electronics Div. | Keasby, N.J. |
| 72699 | General Instrument Corp., Cap. Div. Newark, N.J. | |
| 72765 | Drake Mfg. Co. | Harwood Heights, Ill. |
| 72825 | Hugh H. Eby Inc. | Philadelphia, Pa. |
| 72928 | Gudeman Co. | Chicago, Ill. |
| 72962 | Elastic Stop Nut Corp. | Union, N.J. |
| 72964 | Robert M. Hadley Co. | Los Angeles, Calif. |
| 72982 | Erie Technological Products, Inc. | Erie, Pa. |
| 73061 | Hansen Mfg. Co., Inc. | Princeton, Ind. |
| 73076 | H.M. Harper Co. | Chicago, Ill. |
| 73138 | Helipot Div. of Beckman Inst., Inc. | Fullerton, Calif. |
| 73293 | Hughes Products Division of Hughes Aircraft Co. | Newport Beach, Calif. |
| 73445 | Amperex Elect Co. | Hicksville, L.I., N.Y. |
| 73506 | Bradley Semiconductor Corp. | New Haven, Conn. |
| 73559 | Carling Electric, Inc. | Hartford, Conn. |
| 73586 | Circle F Mfg. Co. | Trenton, N.J. |
| 73682 | George K. Garrett Co., Div. MSL Industries Inc. | Philadelphia, Pa. |
| 73734 | Federal Screw Products Inc. | Chicago, Ill. |
| 73743 | Fischer Special Mfg. Co. | Cincinnati, Ohio |
| 73793 | General Industries Co., The | Elyria, Ohio |
| 73846 | Goshen Stamping & Tool Co. | Goshen, Ind. |
| 73899 | JFD Electronics Corp. | Brooklyn, N.Y. |
| 73905 | Jennings Radio Mfg. Corp. | San Jose, Calif. |
| 73957 | Groov-Pin Corp. | Ridgefield, N.J. |
| 74276 | Signalite Inc. | Neptune, N.J. |
| 74455 | J.H. Winns, and Sons | Winchester, Mass. |
| 74861 | Industrial Condenser Corp. | Chicago, Ill. |
| 74868 | R.F. Products Division of Amphenol-Borg Electronics Corp. | Danbury, Conn. |
| 74970 | E.F. Johnson Co. | Waseca, Minn. |
| 75042 | International Resistance Co. | Philadelphia, Pa. |
| 75263 | Keystone Carbon Co., Inc. | St. Marys, Pa. |
| 75378 | CTS Knights Inc. | Sandwich, Ill. |
| 75382 | Kulka Electric Corporation | Mt. Vernon, N.Y. |
| 75818 | Lenz Electric Mfg. Co. | Chicago, Ill. |
| 75915 | Littlefuse, Inc. | Des Plaines, Ill. |
| 76005 | Lord Mfg. Co. | Erie, Pa. |
| 76210 | C.W. Marwedel | San Francisco, Calif. |
| 76433 | General Instrument Corp., Micamold Division | Newark, N.J. |
| 76487 | James Millen Mfg. Co., Inc. | Malden, Mass. |
| 76493 | J.W. Miller Co. | Los Angeles, Calif. |
| 76530 | Cinch-Monadnock, Div. of United Carr Fastener Corp. | San Leandro, Calif. |
| 76545 | Mueller Electric Co. | Cleveland, Ohio |
| 76703 | National Union | Newark, N.J. |
| 76854 | Oak Manufacturing Co. | Crystal Lake, Ill. |
| 77068 | The Bendix Corp., Electrodynamics Div. | N. Hollywood, Calif. |
| 77075 | Pacific Metals Co. | San Francisco, Calif. |
| 77221 | Phanostran Instrument and Electronic Co. | South Pasadena, Calif. |
| 77252 | Philadelphia Steel and Wire Corp. | Philadelphia, Pa. |
| 77342 | American Machine & Foundry Co. Potter & Brumfield Div. | Princeton, Ind. |
| 77630 | TRW Electronic Components Div. | Camden, N.J. |
| 77638 | General Instrument Corp., Rectifier Div. | Brooklyn, N.Y. |
| 77764 | Resistance Products Co. | Harrisburg, Pa. |
| 77969 | Rubbercraft Corp. of Calif. | Torrance, Calif. |
| 78189 | Shakeproof Division of Illinois Tool Works | Elgin, Ill. |
| 78277 | Sigma | So. Braintree, Mass. |
| 78283 | Signal Indicator Corp. | New York, N.Y. |
| 78290 | Struthers-Dunn Inc. | Pitman, N.J. |
| 78452 | Thompson-Bremer & Co. | Chicago, Ill. |
| 78471 | Tilley Mfg. Co. | San Francisco, Calif. |
| 78488 | Stackpole Carbon Co. | St. Marys, Pa. |
| 78493 | Standard Thomson Corp. | Waltham, Mass. |
| 78553 | Tinnerman Products, Inc. | Cleveland, Ohio |
| 78790 | Transformer Engineers | San Gabriel, Calif. |
| 78947 | Ucinite Co. | Newtonville, Mass. |
| 79136 | Waldes Kohinoor Inc. | Long Island City, N.Y. |
| 79142 | Veeder Root, Inc. | Hartford, Conn. |
| 79251 | Wenco Mfg. Co. | Chicago, Ill. |
| 79727 | Continental-Wirt Electronics Corp. | Philadelphia, Pa. |
| 79963 | Zierick Mfg. Corp. | New Rochelle, N.Y. |
| 80031 | Mepco Division of Sessions Clock Co. | Morristown, N.J. |
| 80120 | Schnitzer Alloy Products Co. | Elizabeth, N.J. |
| 80131 | Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC | |
| 80207 | Unimax Switch, Div. Maxon Electronics Corp. | Wallingford, Conn. |
| 80223 | United Transformer Corp. | New York, N.Y. |
| 80248 | Oxford Electric Corp. | Chicago, Ill. |
| 80294 | Bourns Inc. | Riverside, Calif. |
| 80411 | Acro Div. of Robertshaw Controls Co. | Columbus, Ohio |
| 80486 | All Star Products Inc. | Defiance, Ohio |
| 80509 | Avery Label Co. | Monrovia, Calif. |
| 80583 | Hammarlund Co., Inc. | Mars Hill, N.C. |
| 80640 | Stevens, Arnold, Co., Inc. | Boston, Mass. |
| 80813 | Dimco Gray Co. | Dayton, Ohio |
| 81030 | International Instruments Inc. | Orange, Conn. |
| 81073 | Grayhill Co. | LaGrange, Ill. |
| 81095 | Triad Transformer Corp. | Venice, Calif. |

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## TABLE 6-3.
## CODE LIST OF MANUFACTURERS (Cont'd)

| Code No. | Manufacturer | Address |
|---|---|---|
| 81312 | Winchester Elec. Div. Litton Ind., Inc. | Oakville, Conn. |
| 81349 | Military Specification | |
| 81483 | International Rectifier Corp. | El Segundo, Calif. |
| 81541 | Airpax Electronics, Inc. | Cambridge, Maryland |
| 81860 | Barry Controls, Div. Barry Wright Corp. | Watertown, Mass. |
| 82042 | Carter Precision Electric Co. | Skokie, Ill. |
| 82047 | Sperti Faraday Inc., Copper Hewitt Electric Div. | Hoboken, N.J. |
| 82116 | Electric Regulator Corp. | Norwalk, Conn. |
| 82142 | Jeffers Electronics Division of Speer Carbon Co. | Du Bois, Pa. |
| 82170 | Fairchild Camera & Inst. Corp. Space & Defense System Div. | Paramus, N.J. |
| 82209 | Maguire Industries, Inc. | Greenwich, Conn. |
| 82219 | Sylvania Electric Prod. Inc. Electronic Tube Division | Emporium, Pa. |
| 82376 | Astron Corp. | East Newark, Harrison, N.J. |
| 82389 | Switchcraft, Inc. | Chicago, Ill. |
| 82647 | Metals & Controls Inc. Spencer Products | Attleboro, Mass. |
| 82768 | Phillips-Advance Control Co. | Joliet, Ill. |
| 82866 | Research Products Corp. | Madison, Wis. |
| 82877 | Rotron Mfg. Co., Inc. | Woodstock, N.Y. |
| 82893 | Vector Electronic Co. | Glendale, Calif. |
| 83058 | Carr Fastener Co. | Cambridge, Mass. |
| 83086 | New Hampshire Ball Bearing, Inc. | Peterborough, N.H. |
| 83125 | General Instrument Corp., Capacitor Div. | Darlington, S.C. |
| 83148 | ITT Wire and Cable Div. | Los Angeles, Calif. |
| 83186 | Victory Eng. Corp. | Springfield, N.J. |
| 83298 | Bendix Corp., Red Bank Div. | Red Bank, N.J. |
| 83315 | Hubbell Corp. | Mundelein, Ill. |
| 83324 | Rosan Inc. | Newport Beach, Calif. |
| 83330 | Smith, Herman H., Inc. | Brooklyn, N.Y. |
| 83332 | Tech Labs | Palisade's Park, N.J. |
| 83385 | Central Screw Co. | Chicago, Ill. |
| 83501 | Gavitt Wire and Cable Co. Div. of Amerace Corp. | Brookfield, Mass. |
| 83594 | Burroughs Corp. Electronic Tube Div. | Plainfield, N.J. |
| 83740 | Union Carbide Corp. Consumer Prod. Div. | New York, N.Y. |
| 83777 | Model Eng. and Mfg., Inc. | Huntington, Ind. |
| 83821 | Loyd Scruggs Co. | Festus, Mo. |
| 83942 | Aeronautical Inst. & Radio Co. | Lodi, N.J. |
| 84171 | Arco Electronics Inc. | Great Neck, N.Y. |
| 84396 | A.J. Glesener Co., Inc. | San Francisco, Calif. |
| 84411 | TRW Capacitor Div. | Ogallala, Neb. |
| 84970 | Sarkes Tarzian, Inc. | Bloomington, Ind. |
| 85454 | Boonton Molding Company | Boonton, N.J. |
| 85471 | A.B. Boyd Co. | San Francisco, Calif. |
| 85474 | R.M. Bracamonte & Co. | San Francisco, Calif. |
| 85660 | Koiled Kords, Inc. | Hamden, Conn. |
| 85911 | Seamless Rubber Co. | Chicago, Ill. |
| 86174 | Fafnir Bearing Co. | Los Angeles, Calif. |
| 86197 | Clifton Precision Products Co., Inc. | Clifton Heights, Pa. |
| 86579 | Precision Rubber Products Corp. | Dayton, Ohio |
| 86684 | Radio Corp. of America, Electronic Comp. & Devices Div. | Harrison, N.J. |
| 86928 | Seastrom Mfg. Co. | Glendale, Calif. |
| 87034 | Marco Industries | Anaheim, Calif. |
| 87216 | Philco Corporation (Lansdale Division) | Lansdale, Pa. |
| 87473 | Western Fibrous Glass Products Co. | San Francisco, Calif. |
| 87664 | Van Waters & Rogers Inc. | San Francisco, Calif. |
| 87930 | Tower Mfg. Corp. | Providence, R.I. |
| 88140 | Cutler-Hammer, Inc. | Lincoln, Ill. |
| 88220 | Gould-National Batteries, Inc. | St. Paul, Minn. |
| 88698 | General Mills, Inc. | Buffalo, N.Y. |
| 89231 | Graybar Electric Co. | Oakland, Calif. |
| 89473 | G.E. Distributing Corp. | Schenectady, N.Y. |
| 89665 | United Transformer Co. | Chicago, Ill. |
| 90030 | United Shoe Machinery Corp. | Beverly, Mass. |
| 90179 | US Rubber Co., Consumer Ind. & Plastics Prod. Div. | Passaic, N.J. |
| 90970 | Bearing Engineering Co. | San Francisco, Calif. |
| 91146 | ITT Cannon Elect, Inc., Salem Div. | Salem, Mass. |
| 91260 | Connor Spring Mfg. Co. | San Francisco, Calif. |
| 91345 | Miller Dial & Nameplate Co. | El Monte, Calif. |
| 91418 | Radio Materials Co. | Chicago, Ill. |
| 91506 | Augat Inc. | Attleboro, Mass. |
| 91637 | Dale Electronics, Inc. | Columbus, Nebr. |
| 91662 | Elco Corp. | Willow Grove, Pa. |
| 91737 | Gremar Mfg. Co., Inc. | Wakefield, Mass. |
| 91827 | K F Development Co. | Redwood City, Calif. |
| 91886 | Malco Mfg. Co., Inc. | Chicago, Ill. |
| 91929 | Honeywell Inc., Micro Switch Div. | Freeport, Ill. |
| 91961 | Nahm-Bros. Spring Co. | Oakland, Calif. |
| 92180 | Tru-Connector Corp. | Peabody, Mass. |
| 92367 | Elgeet Optical Co. Inc. | Rochester, N.Y. |
| 92607 | Tensolite Insulated Wire Co., Inc. | Tarrytown, N.Y. |
| 92702 | IMC Magnetics Corp. | Wesbury Long Island, N.Y. |
| 92966 | Hudson Lamp Co. | Kearney, N.J. |
| 93332 | Sylvania Electric Prod. Inc. Semiconductor Div. | Woburn, Mass. |
| 93369 | Robbins & Myers Inc. | Palisades Park, N.J. |
| 93410 | Stemco Controls, Div. of Essex Wire Corp. | Mansfield, Ohio |
| 93632 | Waters Mfg. Co. | Culver City, Calif. |
| 93929 | G.V. Controls | Livingston, N.J. |
| 94137 | General Cable Corp. | Bayonne, N.J. |
| 94144 | Raytheon Co., Comp. Div., Ind. Comp. Operations | Quincy, Mass. |
| 94148 | Scientific Electronics Products, Inc. | Loveland, Colo. |
| 94154 | Wagner Elect. Corp., Tung-Sol Div. | Newark, N.J. |
| 94197 | Curtiss-Wright Corp. Electronics Div. | East Paterson, N.J. |
| 94222 | South Chester Corp. | Chester, Pa. |
| 94330 | Wire Cloth Products, Inc. | Bellwood, Ill. |
| 94375 | Automatic Metal Products Co. | Brooklyn, N.Y. |
| 94682 | Worcester Pressed Aluminum Corp. | Worcester, Mass. |
| 94696 | Magnecraft Electric Co. | Chicago, Ill. |
| 95023 | George A. Philbrick Researchers, Inc. | Boston, Mass. |
| 95236 | Allies Products Corp., | Dania, Fla. |
| 95238 | Continental Connector Corp. | Woodside, N.Y. |
| 95263 | Leecraft Mfg. Co., Inc. | Long Island, N.Y. |
| 95265 | National Coil Co. | Sheridan, Wyo. |
| 95275 | Vitramon, Inc. | Bridgeport, Conn. |
| 95348 | Gordos Corp. | Bloomfield, N.J. |
| 95354 | Methode Mfg. Co. | Rolling Meadows, Ill. |
| 95566 | Arnold Engineering Co. | Marengo, Ill. |
| 95712 | Dage Electric Co., Inc. | Franklin, Ind. |
| 95984 | Siemon Mfg. Co. | Wayne, Ill. |
| 95987 | Weckesser Co. | Chicago, Ill. |
| 96067 | Microwave Assoc., West Inc. | Sunnyvale, Calif. |
| 96095 | Hi-Q Div. of Aerovox Corp. | Olean, N.Y. |
| 96256 | Thordarson-Meissner Inc. | Mt. Carmel, Ill. |
| 96296 | Solar Manufacturing Co. | Los Angeles, Calif. |
| 96306 | Microswitch, Div. of Minn.-Honeywell | Freeport, Ill. |
| 96330 | Carlton Screw Co. | Chicago, Ill. |
| 96341 | Microwave Associates, Inc. | Burlington, Mass. |
| 96501 | Excel Transformer Co. | Oakland, Calif. |
| 96733 | San Fernando Elect. Mfg. Co. | San Fernando, Calif. |
| 96881 | Thomson Ind. Inc. | Long Is., N.Y. |
| 97464 | Industrial Retaining Ring Co. | Irvington, N.J. |
| 97539 | Automatic & Precision Mfg. | Englewood, N.J. |
| 97979 | Reon Resistor Corp. | Yonkers, N.Y. |
| 97983 | Litton System Inc., Adler-Westrex Commun. Div. | New Rochelle, N.Y. |
| 98141 | R-Troncis, Inc. | Jamaica, N.Y. |
| 98159 | Rubber Teck, Inc. | Gardena, Calif. |
| 98220 | Hewlett-Packard Co., Moseley Div. | Pasadena, Calif. |
| 98278 | Microdot, Inc. | So. Pasadena, Calif. |
| 98291 | Sealectro Corp. | Mamaroneck, N.Y. |
| 98376 | Zero Mfg. Co. | Burbank, Calif. |
| 98410 | Etc Inc. | Cleveland, Ohio |
| 98731 | General Mills Inc., Electronics Div. | Minneapolis, Minn. |
| 98734 | Paeco Div. of Hewlett-Packard Co. | Palo Alto, Calif. |
| 98821 | North Hills Electronics, Inc. | Glen Cove, N.Y. |
| 98978 | International Electronic Research Corp. | Burbank, Calif. |
| 99109 | Columbia Technical Corp. | New York, N.Y. |
| 99313 | Varian Associates | Palo Alto, Calif. |
| 99378 | Atlee Corp. | Winchester, Mass. |
| 99515 | Marshall Ind., Capacitor Div. | Monrovia, Calif. |
| 99707 | Control Switch Division, Controls Co. of America | El Segundo, Calif. |
| 99800 | Delevan Electronics Corp. | East Aurora, N.Y. |
| 99848 | Wilco Corporation | Indianapolis, Ind. |
| 99928 | Branson Corp. | Whippany, N.J. |
| 99934 | Renbrandt, Inc. | Boston, Mass. |
| 99942 | Hoffman Electronics Corp. Semiconductor Div. | El Monte, Calif. |
| 99957 | Technology Instrument Corp. of Calif. | Newbury Park, Calif. |

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

| | | |
|---|---|---|
| 0000F | Malco Tool and Die | Los Angeles, Calif. |
| 0000Z | Willow Leather Products Corp. | Newark, N.J. |
| 000AB | ETA | England |
| 000BB | Precision Instrument Components Co. | Van Nuys, Calif. |
| 000CS | Hewlett-Packard Co., Colorado Springs | Colorado Springs, Colorado |
| 000MM | Rubber Eng. & Development | Hayward, Calif. |
| 000NN | A "N" D Mfg. Co. | San Jose, Calif. |
| 000QQ | Cooltron | Oakland, Calif. |
| 000WW | California Eastern Lab. | Burlington, Calif. |
| 000YY | S.K. Smith Co. | Los Angeles, Calif. |

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H4-1 Dated AUGUST 1966

00015-46
Revised: August, 1968

## APPENDIX

BACKDATING

# MANUAL CHANGES

Models 8614B and 8616B

SIGNAL SOURCES

Make all backdating corrections in this manual according to changes below.

Model 8614B

| SERIAL PREFIX OR NUMBER | MAKE MANUAL CHANGES |
|---|---|
| 411-<br>748- | A,B,D,E,G,H,I<br>D,E,G,H,I |
| 748- below 00300<br>748- below 00308 | G,H,I<br>H,I |
| 748-00301, 00303, 00306 | H,I |
| 748- below 00340 | I |

Model 8616B

| SERIAL PREFIX OR NUMBER | MAKE MANUAL CHANGES |
|---|---|
| 411- | A, C, D, F, G, H, I |
| 748- | D, F, G, H, I |
| 748- below 00275 | G, H, I |
| 748- below 00285<br>748- below 00315 | H, I<br>I |

CHANGE A: Figure 5-4:
Replace with illustration Figures 1 and 2 (8616B) of this Backdating Appendix.

Figure 5-15, and Parts List (A100 Assy):
Delete Fuse, F2, 3A, 125V Slo Blow, HP Stock No. 2110-0029.
Delete under F2 listing: Fuseholder, HP Stock No. 1400-0008.
Change S3 from HP Stock No. 3101-1153 to HP Stock No. 3101-0043.

Figure 5-16, and Parts Lists (A100 Assy):
Change the below listed components as indicated:
CR402 from diode, Si, HP Stock No. 1901-0025 to 14V zener diode, HP Stock No. 1902-0040.
CR403 from 7.15V zener, HP Stock No. 1902-0074 to 5.8V zener, HP Stock No. 1902-0034.
CR404 from 2.61V zener, HP Stock No. 1902-0126 to factory selected part.
R408 from 12K, HP Stock No. 0698-3646 to 15K, HP Stock No. 0693-1531.
R414 from 5.6K, HP Stock No. 0683-5625 to 4.7K, HP Stock No. 0686-4725.
R420 from 5K, HP Stock No. 2100-0091 to 10K, HP Stock No. 2100-0092.
Delete the following components:
C403, Cap. fxd. 100 pF, HP Stock No. 0160-2204.
CR407, Diode, Si., HP Stock No. 1901-0025.
Q403, Transistor, HP Stock No. 1853-0001.
R423, Res., fxd., 33K, HP Stock No. 0764-0046.
Change Figure 5-16 as indicated in Figure 3 of this Backdating Appendix.

CHANGE B: Figure 5-17, and Parts Lists (A100 Assy):
Change tube V201 from 12HG7, HP Stock No. 1923-0071 to 6CL6, HP Stock No. 1923-0030.
Delete breakdown diode, CR203, 100V, 1W, HP Stock No. 1902-0175.

CHANGE C: Figure 5-16, and Parts Lists (A100 Assy):
Change Resistor R417 from 120K, HP Stock No. 0761-0088 to 100K, HP Stock No. 0764-0028.

CHANGE D: Figure 5-16, and Parts List:
Change R407 from 5.6K, HP Stock No. 0687-5625 to 4.7K, HP Stock No. 0687-4725.

CHANGE E: Figure 5-15, and Parts List:
(Refer to CHANGE (1). For instrument serials 748- below 00300 change F2 from 4A, 125V Slo Blow, HP Stock No. 2110-0014 to 3A, 125V, HP Stock No. 2110-0029.

CHANGE F: Figure 5-15, and Parts List:
(Refer to CHANGE A). For instrument serials 748- below 00275 change F2 from 4A, 125V Slo Blow, HP Stock No. 2110-0014 to 3A, 125V, HP Stock No. 2110-0029.

CHANGE G: Figure 5-16, and Parts List:
Delete Resistor R6, 0757-0059, 1 meg, ±1%, 1/2W.



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CHANGE H: Figure 5-15, and Parts List:
Change Capacitor C1 from 5000 μfd, HP Stock No. 0180-0213 to 2800 μfd, HP Stock No. 0180-0128.

CHANGE I: Figure 5-16, and Parts Lists:
Change transistor Q401, Q402, and Q403 from HP Stock No. 1853-0037 to HP Stock No. 1853-0001.

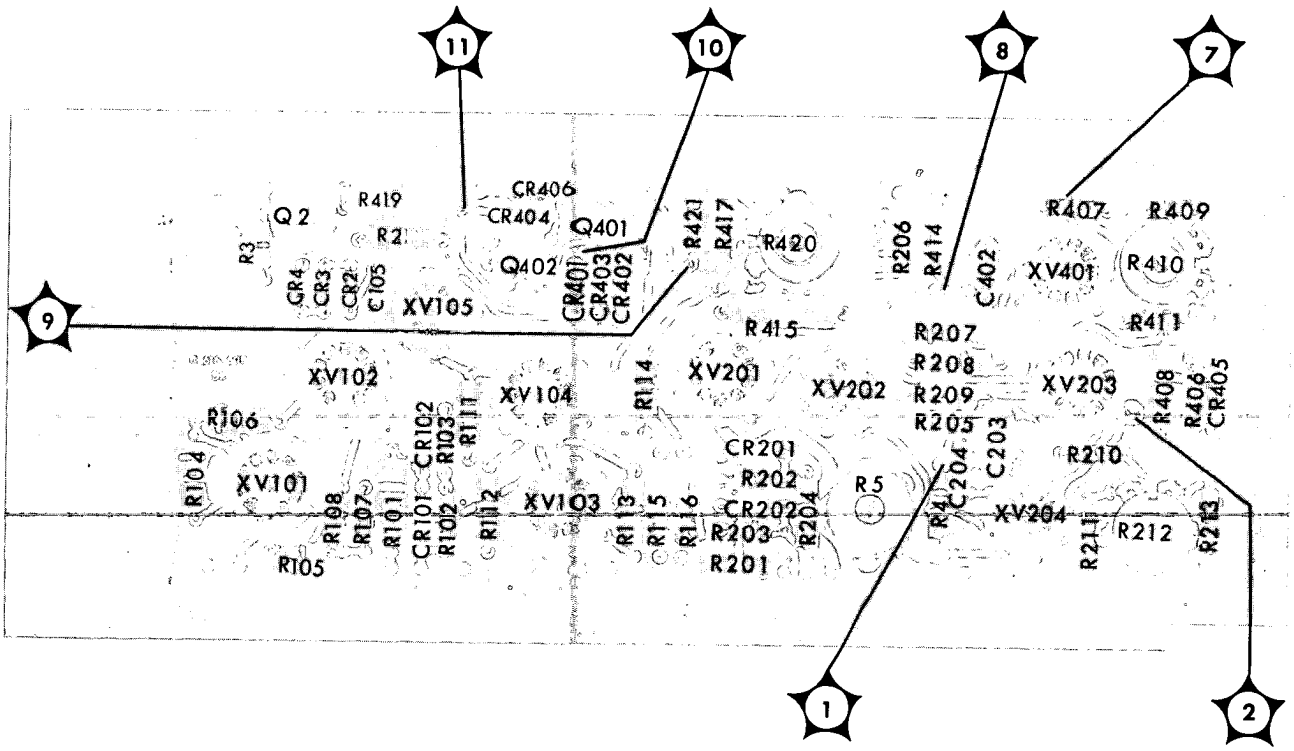


Figure 1. High-Voltage Board (A100) 8614B

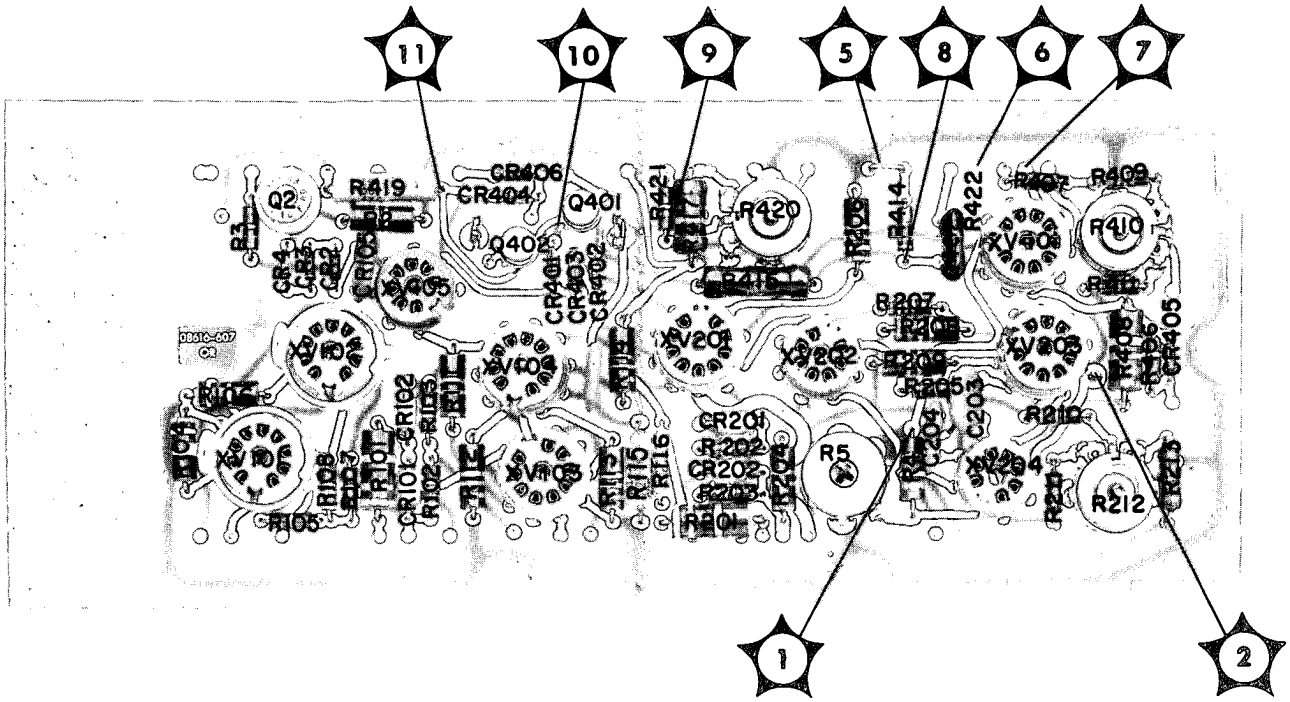


Figure 2. High-Voltage Board (A100) 8616B

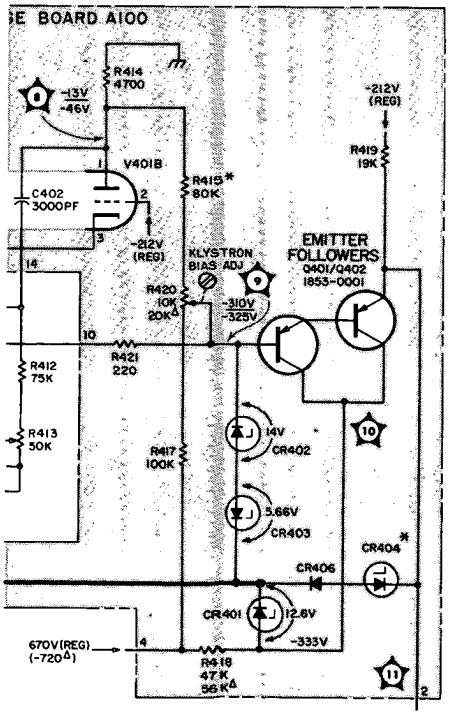


Figure 3. Partial Schematic

# WARRANTY CLAIM AND ADJUSTMENT PROCEDURE

for microwave tubes supplied by the
HEWLETT-PACKARD COMPANY
for use in Hewlett-Packard instruments

The procedure described below is for use within the United States. For warranty claims arising outside the U.S.A., before returning the tube, fill out the form on the reverse side and send it with a request for shipping instructions to your nearest Hewlett-Packard Sales and Service Office or to:

(in Western Europe)

Hewlett-Packard S.A.
54 Route des Acacias
Geneva, Switzerland
Telephone: (022) 42.81.50
Telex: 2.24.86
Cable: HEWPACKSA

(Rest of World)

Hewlett-Packard Co.
International Marketing Dept.
1501 Page Mill Road
Palo Alto, California, 94304, U.S.A.
Telephone: (415) 326-7000
Telex: 033811
Cable: HEWPACK

Microwave tubes supplied by the Hewlett-Packard Company, either as original or replacement, for use in Hewlett-Packard instruments are actually warranted by the tube manufacturer and not by Hewlett-Packard. However, all warranty claims on tubes obtained from us either as original or replacement will be processed by Hewlett-Packard.

In the event of failure you should purchase a new tube and return your old tube immediately to Hewlett-Packard. Credit allowances will be passed on to you upon receipt of the defective tube.

For your convenience, warranty claims for all microwave tubes supplied by the Hewlett-Packard Company may be made on this single form; merely fill out the information on the reverse side and return this form, along with the defective tube, to your Hewlett-Packard Sales and Service Office or to Hewlett-Packard. Please be sure each space on the form is filled in--lack of complete information may delay processing of your claim.

Each tube manufacturer has his own warranty policy. Copies of individual Conditions of Warranty are available from your Hewlett-Packard Sales and Service Office or from the Hewlett-Packard Company.

## SHIPPING INSTRUCTIONS

The following instructions are included to aid you in preventing damage in transit. Package your tube carefully--no allowance can be made on broken tubes.

1. Carefully wrap tube in 1/4-inch thick cellulosic cushioning, cotton batting, or other soft padding material. Cable assemblies and other accessories not rigidly mounted to the tube should be padded and wrapped separately to prevent damage to the tube during shipment.
2. Wrap the above in heavy kraft paper.
3. Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 2 inches of shock absorbing material. Be certain that the packing is tight all around the tube.
5. Tubes returned from outside the continental United States should be packed in a wooden box.
6. Mark container FRAGILE and ship prepaid via Air freight or Railway Express. Do not ship via Parcel Post or Air Parcel Post since experience has shown that fragile items are more apt to be damaged when shipped by these means.

Note

Tubes with permanent magnets can interfere with magnetic compasses.
For air shipment plainly mark container: "MAGNETIZED MATERIAL"

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, or to:

Hewlett-Packard Company
Customer Service Center
333 Logue Avenue
Mountain View, California 94040
USA

MICROWAVE TUBE WARRANTY CLAIM
INFORMATION FORM

IMPORTANT: Please answer all questions fully -- insufficient information may delay processing of your claim.

DATE: _____

FROM: (Tube Owner)

Company _____

Address _____

_____

_____

Tube type _____

Tube serial No. _____

Tube mfr. _____

Use in HP Model _____

Instrument serial No. _____

Tube is Original ( ) or Replacement ( )

Date tube received _____

Date of failure _____

Total hours filament operation _____

SYMPTOMS: (Please describe conditions prior to and at time of failure, along with description of tube's defect, if known) _____

_____

_____

_____

IMPORTANT:
Replacement (new) tube serial No. _____

Signature _____

Title _____

For HP use only
Repair order # _____

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