



## SECTION I

### GENERAL INFORMATION

#### 1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 608E and 608F Signal Generators (see Figure 1-1) are designed to meet the requirements of precision laboratory work, and yet to be equally useful for general applications in the VHF frequency range. The Model 608E furnishes RF signals from 0.1 microvolt to 1 volt from 10 MHz to 480 MHz, while the Model 608F supplies RF signals from 0.1 microvolt to 0.5 volt in a frequency range from 10 MHz to 455 MHz. The RF carrier can be amplitude modulated by internally generated sine-wave signals, or by externally supplied sine-wave or pulse signals. The Model 608F contains frequency control circuitry which permits the instrument to be used in phase-lock operation with the Model 8708A Synchronizer. This provision provides a stabilized output across most of the range of the instrument, with a drift factor of  $2 \times 10^{-7}$  in 10 minutes. The instruments can be used for troubleshooting, testing, calibrating, measuring standing-wave ratios, and checking antenna and transmission line characteristics. To preserve accuracy, equipment design holds spurious modulation to a low value under all operating conditions. Detailed specifications for both instruments are listed in Table 1-1.

#### 1-3. FREQUENCY.

1-4. The frequency of the output signal is indicated on a direct-reading dial, the calibration of which is accurate to better than  $\pm 0.5\%$  for the 608E and  $\pm 0.1\%$  for the 608F, when the cursor and FINE FREQ adjustments are properly aligned. Calibration accuracy may be improved further by use of a built-in crystal-controlled heterodyne calibrator which furnishes 1 MHz checkpoints from 10 MHz to 270 MHz, or 5 MHz checkpoints over the entire frequency range of the instrument. At any checkpoint the calibration can be set very close to the calibrator accuracy of 0.01%, bringing overall accuracy to at least  $\pm 0.05\%$ . Frequency check point signals are obtained when a headphone set (not furnished) is plugged into the XTAL CAL OUTPUT jack. The control for the output attenuator is calibrated in both decibels and volts. When the instrument is connected to a 50-ohm resistive load and power into the output attenuator is exactly at the ATTENUATOR CALIBRATED mark (+7 dB) on the RF OUTPUT meter, the level of power or voltage applied to the RF OUTPUT connector may be read directly on the ATTENUATOR dial with an accuracy of  $\pm 1$  dB. When connected to a 50-ohm resistive load, the VSWR at the RF OUTPUT connector will not be greater than 1.2 (SWR of 1.6 dB). The signal generators feature automatic output leveling, maintaining the RF output within  $\pm 1$  dB of the adjusted output.

#### 1-5. MODULATION.

1-6. The RF output signal can be amplitude modulated by internally generated 400 or 1000-cycle sine waves,

externally applied sine waves above 1.0 volt rms over the frequency range from 20 Hz to 20 kHz, or externally applied pulses of 10 volts peak-to-peak. When pulse modulated, the signal generators are capable of producing pulses of RF energy as short as 4 microseconds at signal frequencies above 40 MHz, and pulses as short as 2 microsecond above 220 MHz. The degree of sine-wave modulation is continuously variable from 0 to 90% by a front-panel control. All sine-wave modulation of the output signal is continuously monitored and indicated in percentage on a direct reading modulation meter.

#### 1-7. RFI.

1-8. RF leakage is held to a minimum and is such that when the output signal is adjusted for 0.1 microvolt, the conducted signal leakage at any other front panel connector and the radiated leakage two inches from the instrument are each less than 1.0 microvolt.

#### 1-9. AUXILIARY EQUIPMENT.

##### 1-10. MODEL 11509A FUSEHOLDER.

1-11. To protect the output attenuator from damage, for some applications (such as transceiver testing) it is desirable to insert a fuse between the signal generators and external equipment. The 11509A is a special coaxial fuseholder which houses a type 8AG, 1/16 amp fuse which protects the output attenuator from damage in the event that an external voltage is accidentally applied to the RF OUTPUT connector. The fuseholder has an insertion loss of 0.50 dB at 200 MHz, 0.56 dB at 300 MHz, and 0.65 dB at 400 MHz; its SWR is not greater than 1.35 when connected to a 50-ohm resistive load.

##### 1-12. MODEL 11508A TERMINATED OUTPUT CABLE.

1-13. This cable assembly provides a 50-ohm termination and standard binding posts at the end of a 24-inch length of cable. The 11508A allows direct connection of the instruments to a high-impedance circuit.

#### 1-14. INSTRUMENT IDENTIFICATION.

1-15. Hewlett-Packard instruments carry a two-section, eight-digit serial number. The first three digits are a prefix. The contents of this manual apply to those instruments having the serial number prefix shown on the title page. If the serial prefix on your instrument is not mentioned on the title page, in the Appendix to this manual, or in a Manual Change Sheet enclosed with the manual, the correct information may be obtained from any Hewlett-Packard Sales and Service Office (see rear of manual for addresses).

Table 1-1. Specifications

## FREQUENCY CHARACTERISTICS

608E

Range: 10 to 480 MHz in five bands (10-21, 21-43, 43-95, 95-215, and 215-480 MHz).

Accuracy:  $\pm 0.5\%$ .

Drift: Less than 50 parts in  $10^6$  per 10 min. period after 1 hr. warmup.

Tuning Control: Frequency control mechanism provides a main dial calibrated in MHz and a vernier dial for interpolation purposes. Total scale length approximately 45 inches. Calibration: every other MHz from 130 to 270 MHz; every 5 MHz above 270 MHz.

Resettability: Main frequency control resettability better than  $\pm 0.1\%$  after initial warmup. FINE FREQUENCY ADJUST provides approximately  $\pm 25$  kHz settability at 480 MHz (proportionately finer adjustment at lower frequencies).

Crystal Calibrator: Provides frequency check points every 1 MHz up to 270 MHz or every 5 MHz over the range of the instrument. Headphone jack provided for audio frequency output (headphones not included). Crystal frequency accuracy better than  $0.01\%$  at normal room temperatures. Cursor on frequency dial adjustable over small range to aid in interpolation adjustment. Calibrator may be turned off when not in use.

Residual FM: Less than  $\pm 5$  parts in  $10^7$ .

Harmonic Output: At least 35 dB below the carrier for harmonic frequencies below 500 MHz.

Frequency Control Input: (608F only). The 608F FREQ CONTROL INPUT normally used with the 8708A Synchronizer can also be used for external frequency control by varying a dc voltage

608F

Range: 10 to 455 MHz in five bands (10-21, 21-44, 44-95, 95-210, and 210-455 MHz). 10-430 MHz when used with 8708A Synchronizer.

Accuracy:  $\pm 1\%$ .

Drift: Less than 50 parts in  $10^6$  per 10 min. period after 1 hr. warmup. Stability used with 8708A Synchronizer.

$5 \times 10^{-8}$ /min.

$2 \times 10^{-7}$ /min.

( $0^\circ$ - $55^\circ\text{C}$ )

$2 \times 10^{-7}$ /10% line voltage change.

input. A voltage change from -2 volts to -32 volts will change the output frequency more than  $0.2\%$  at the low end of each band and more than  $1\%$  at the high end of each band. Nominal  $4 \text{ K}\Omega$  input impedance, direct coupled. Voltage limits:  $0\text{V} \leq$  applied voltage  $\leq -50\text{V}$ .

## OUTPUT CHARACTERISTICS

608E

Output Level: Continuously adjustable from  $0.1 \mu\text{V}$  to  $1\text{V}$  into a  $50\Omega$  load. Output attenuator calibrated in V and dBm ( $0 \text{ dBm} = 1 \text{ mW}$  in  $50\Omega$ ).

Accuracy: Within  $\pm 1$  dB of attenuator dial reading at any frequency when RF output meter indicates "ATTENUATOR CALIBRATED."

Leveling: Internal feedback circuit retains "ATTENUATOR CALIBRATED" reference on RF output meter over wide frequency ranges (typically octave bands). Adjustment of front panel AMP. TRIMMER control (only) for maximum RF output indication automatically restores initial carrier level for greater frequency changes.

Impedance:  $50\Omega$ ; reflection coefficient  $\leq 0.091$  (1.2 SWR, 20.8 dB return loss) for attenuator setting below -7 dBm.

RFI: Meets all conditions specified in MIL-I-6181D; permits receiver sensitivity measurements down to at least  $0.1 \mu\text{V}$ .

Auxiliary RF Output:

608E

Fixed level CW signal from RF oscillator (minimum amplitude  $180 \text{ mV rms}$  into  $50\Omega$ ) provided at front panel BNC female connector for use with external equipment (e.g., frequency counter).

608F

CW signal from RF Oscillator provided at front panel BNC female connector. Power levels into  $50\Omega$  are as follows:

10 to 215 MHz:  $+1.8$  to  $+7 \text{ dBm}$   
 215 to 400 MHz:  $+2.0$  to  $+6 \text{ dBm}$   
 400 to 430 MHz:  $+1.0$  to  $+5 \text{ dBm}$

Signal for use with HP 8708A Synchronizer or other external equipment (e.g., frequency counter).

Table 1-1. Specifications (Cont.)

**MODULATION CHARACTERISTICS**

(Front-panel AMP. TRIMMER control adjusted for maximum indication of RF Output Meter and RF Output Meter set to Attenuator Calibrated.)

**Internal AM**

Frequency: 400 and 1000 Hz,  $\pm 10\%$ . Modulation signal available at front panel BNC female connector for synchronization of external equipment.

608E

608F

Modulation Level: 0 to 95% modulation at carrier levels 0.5 V and below; continuously adjustable with front-panel MOD LEVEL control.

Modulation Level: 0 to 95% modulation with Output Attenuator at 0.224 V (1 mW) or below; continuously adjustable with front-panel MOD LEVEL control.

Carrier Envelope Distortion: Less than 2% at 30% AM and less than 5% at 70% AM.

**External AM**

Frequency: 20 Hz to 20 kHz.

608E

608F

Modulation Level: 0 to 95% modulation at carrier levels 0.5 V and below; continuously adjustable with front-panel MOD LEVEL control. Input required: 1 to 10 V rms (1 k  $\Omega$  input impedance).

Modulation Level: 0 to 95% modulation with Output Attenuator at 0.224 V (1 mW) or below; continuously adjustable with front-panel MOD LEVEL control. Input required: 1 to 10 V rms (1 k  $\Omega$  input impedance).

Carrier Envelope Distortion: Less than 2% at 30% AM, less than 5% at 70% AM (modulation source distortion less than 0.5%).

External control of carrier level can be achieved through application of dc voltage in EXT AM mode.

**Modulation Meter**

Accuracy:  $\pm 5\%$  of full scale 0 to 80%,  $\pm 10\%$  from 80% to 95% (for INT AM or 20 Hz to 20 kHz EXT AM).

**Incidental Frequency Modulation (at 400 and 1000 Hz modulation)**

Less than 1000 Hz peak at 50% AM for frequencies above 100 MHz. For frequencies below 100 MHz, less than 0.001% at 30% AM.

**External Pulse Modulation**

Rise and Decay Time: From 40 MHz to 220 MHz, combined rise and decay time less than 4  $\mu$ s.

Above 220 MHz, combined rise and decay time less than 2.5  $\mu$ s.

On-Off Ratio: At least 20 dB for pulsed carrier levels of 0.5 V and above.

Input Required: Positive pulse, 10-50 V peak; input impedance 2 k  $\Omega$ .

**GENERAL**

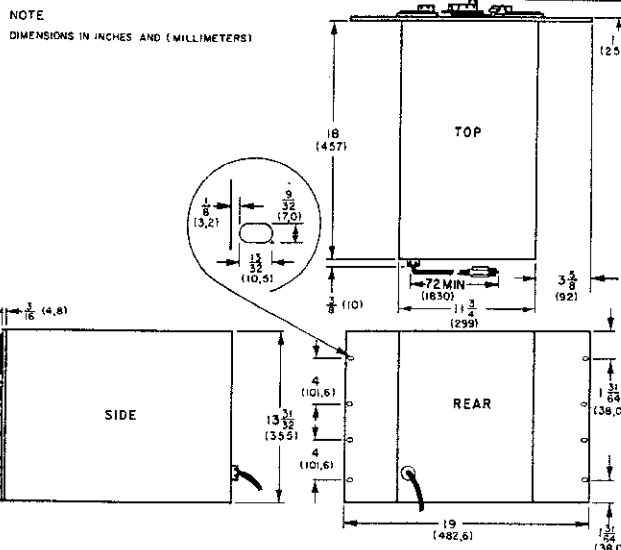
608E and 608F

Power: 115 or 230 V  $\pm 10\%$ , 50 to 400 Hz. Approximately 220 W.

**Dimensions**

Cabinet Mount: 13-1/4 in. (337 mm) wide, 16-3/4 in. (416 mm) high, 21 in. (533 mm) deep.

Rack Mount:



NOTE  
DIMENSIONS IN INCHES AND (MILLIMETERS)

**Weight**

Cabinet Mount: Net, 62 lb (28 kg). Shipping, 74 lb (33, 4 kg).

Rack Mount: Net, 62 lb (28 kg). Shipping, 83 lb (37, 4 kg).

**Accessories Available**

11508A Output Cable provides 50- $\Omega$  termination and standard binding posts at the end of a 24-inch (610 mm) length of cable. Allows direct connection of the signal generator to high impedance circuits.

11509A Fuse Holder provides protection for the output attenuator when the 608 is used for transceiver tests.

10514A Mixer for use as nanosecond pulse modulator or balanced modulator.

10515A Doubler for extending the frequency range.

## SECTION III OPERATION

### 3-1. INTRODUCTION.

3-2. This section provides operating instructions for the Model 608E and 608F Signal Generators. Included are a listing of controls, indicators and connectors, pre-operation procedures, mode operating procedures, and phase-lock operation procedures (Model 608F only). Controls and indicators on both instruments are nearly identical; therefore, an illustration of the Model 608F will be referenced during this discussion, with the difference between instruments identified.

### 3-3. CONTROLS, INDICATORS AND CONNECTORS.

3-4. Except for the 115/230 volt power switch, all controls, indicators, and connectors are located on the front panel. Figure 3-1 locates and provides a functional description of each front-panel mounted control, indicator and connector. The 115-230 volt power switch is located inside the rear panel and is not shown.

### 3-5. PRE-OPERATION PROCEDURES.

3-6. Prior to use, certain procedures must be completed to obtain maximum accuracy during operation of the instrument. Consideration must be given to the possibility of RF loading, and calibration of the instrument is required. During the following discussion, each control used will be identified by an item number that is referenced to Figure 3-1.

### 3-7. RF OUTPUT LOADING.

#### CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inactive while the equipment is connected to the signal generator.

#### NOTE

To protect the Attenuator when there is a possibility of voltage being applied to the RF OUTPUT connector, a Model 11509A Fuseholder is recommended. The fuseholder is connected between the test cable and RF OUTPUT connector.

3-8. A resistive load of 50 ohms is used at the factory during calibration of the Attenuator Control dial. Therefore, for an accurate indication of output power the external load should be 50 ohms resistive. The internal impedance of the generator is close to 50 ohms, with a maximum VSWR of 1.2 existing when the generator is terminated in 50 ohms. This VSWR will have no important effect on the accuracy of the Attenuator Control calibration. However, a severe mismatch between the instrument and load will produce a considerable difference between the output voltage selected on the Attenuator Control dial and the actual voltage impressed across the external load. Particular care should be exercised in the selection of coaxial connectors. A coaxial connector that has been improperly assembled can produce a substantial increase in the standing-wave ratio.

### 3-9. TURN-ON PROCEDURES.

3-10. Turn-on procedures for the signal generator are as follows:

#### CAUTION

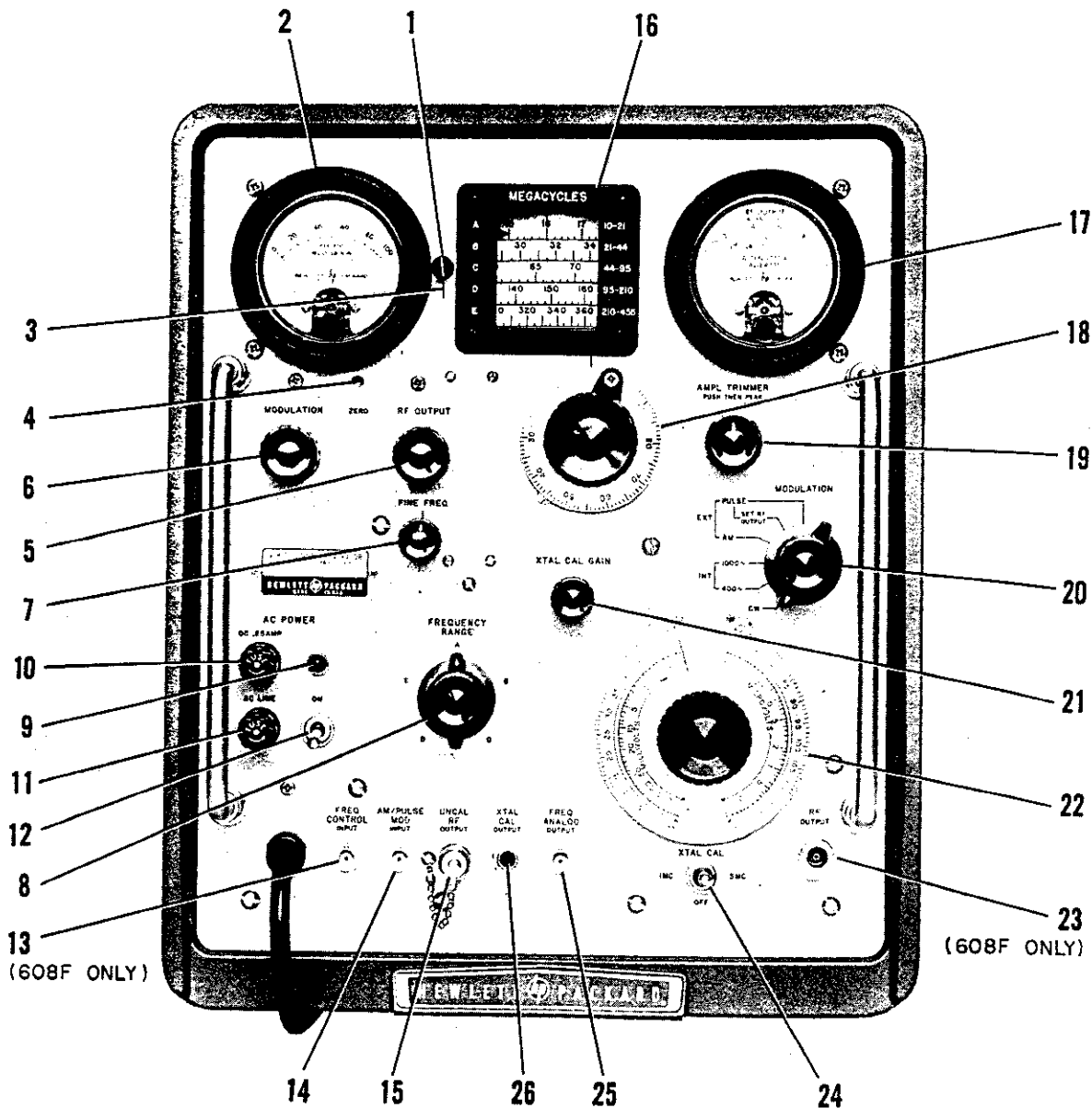
Do not obstruct the ventilating louvers on the side of the instrument cabinet. Safe operating temperature requires free air flow through the louvers.

- a. Set AC POWER switch (item 12) to the OFF position.
- b. Check position of 115-230 volt power switch (refer to paragraph 2-5) on rear of chassis.
- c. Set MODULATION selector switch (item 20) to CW position.
- d. Set RF OUTPUT control (item 5) to near maximum position (clockwise).
- e. Set AC POWER switch to ON position.
- f. Warmup equipment for 10 minutes prior to use. If greater frequency stability is required, extend warmup period to 60 minutes.

### 3-11. CALIBRATION PROCEDURES.

3-12. Prior to operation certain calibration of the instrument may be deemed necessary. The following discussion contains frequency and power output calibration procedures.

3-13. FREQUENCY CALIBRATION. The frequency (MEGACYCLES) dial in the signal generators are calibrated to be accurate within  $\pm 0.5\%$  for the 608E and  $\pm 0.1\%$  for the 608F. To obtain higher accuracy,



1. Cursor knob: Positions cursor on the MEGACYCLES (frequency) dial.
2. PERCENT MODULATION meter: Indicates the percent of modulation of the RF output signal.
3. Panel marker: Scribed mark for cursor alignment.
4. ZERO control: Screwdriver adjustment to electrically zero the PERCENT MODULATION meter.
5. RF OUTPUT control: Controls RF power input to the attenuator. Also controls output power levels between +7 dBm and +13 dBm in the Model 608E.

Figure 3-1. Front Panel Controls, Indicators, and Connectors

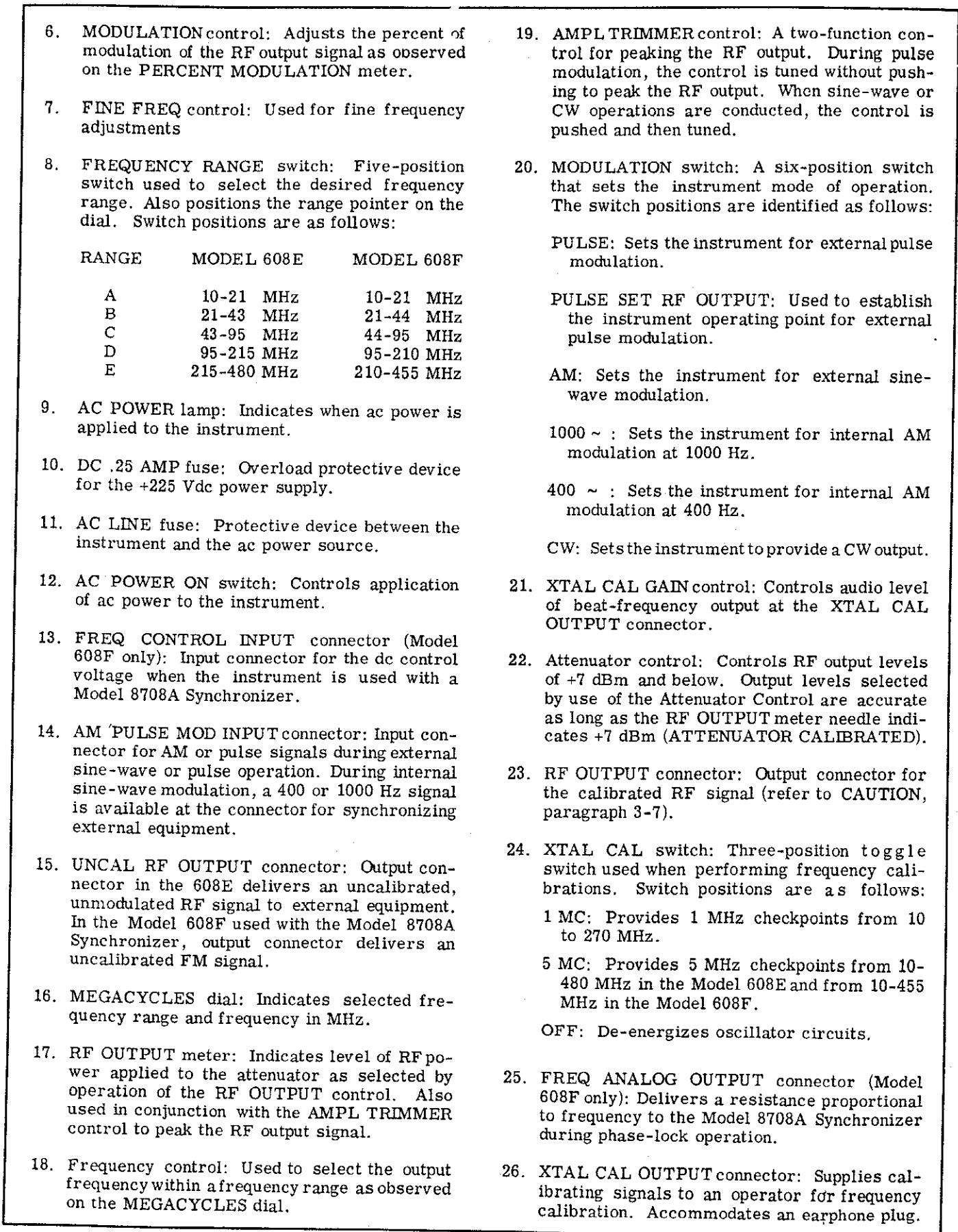


Figure 3-1. Front Panel Controls, Indicators, and Connectors (Cont.)

a crystal-controlled calibrator has been included to provide a means of calibrating the instrument at any multiple of 1 MHz between 10 and 270 MHz, or any multiple of 5 MHz across the frequency range of the instrument. Procedures to crystal-calibrate the instrument are as follows:

- a. Conduct turn-on procedures listed in paragraph 3-9.
- b. Connect headphones (not supplied) to the XTAL CAL OUTPUT connector (item 26).
- c. Set XTAL CAL switch (item 24) to 1 MC or 5 MC as applicable.
- d. Rotate frequency control (item 18) until MEGACYCLES dial (item 16) is set on the 1 MHz or 5 MHz checkpoint nearest the frequency to be used.
- e. Adjust XTAL CAL GAIN control (item 21) for a comfortable audio level in headphones.
- f. Slowly rotate frequency control around the selected checkpoint until a null (zero beat) is reached.
- g. Rotate Cursor Knob (item 3) until cursor is aligned on MEGACYCLES dial with zero-beat point achieved in step f.
- h. Rotate frequency control until selected frequency on MEGACYCLES dial appears directly under cursor.
- i. Set XTAL CAL switch to OFF.

3-14. A FINE FREQ control (item 7) is located on the instrument front panel for making minor frequency adjustments. During normal operation no adjustment of the FINE FREQ control is required, and the knob arrow should be aligned with the front-panel marker. For a precision frequency selection using a frequency counter, the FINE FREQ control is used after the frequency has been selected by use of the frequency control. Tuning the knob arrow counterclockwise from the panel marker lowers the frequency, while a clockwise rotation raises the frequency.

3-15. POWER OUTPUT CALIBRATION. The RF leveling circuit in the instrument maintains a flat RF output over wide frequency ranges with proper initial adjustments. These adjustments are conducted using the RF OUTPUT and AMPL TRIMMER controls in conjunction with the RF OUTPUT meter. The take-off point for the detected RF signal displayed on the RF OUTPUT meter is at the input circuit of the attenuator. Therefore, calibrating the RF output into the attenuator ensures that subsequent operation of the attenuator control will produce an accurate calibrated RF output from the attenuator. RF output calibration procedures are as follows:

- a. Conduct turn-on procedures listed in paragraph 3-9.
- b. Set the MODULATION switch (item 20) to the CW position.

#### NOTE

For maximum accuracy, power output calibrations should be conducted with the instrument set in the CW Mode.

c. Set the FREQUENCY RANGE switch (item 8) to the desired range.

d. Tune the frequency control (item 18) five turns in from the low end of the selected frequency range as indicated on the MEGACYCLES dial (item 16).

e. Adjust the RF OUTPUT control (item 5) for an indication on the RF OUTPUT meter (item 17).

f. Depress the AMPL TRIMMER control (item 19) and tune for a peak RF indication on the RF OUTPUT meter.

g. Readjust the RF OUTPUT control until the RF OUTPUT meter pointer is aligned with the +7 dBm (ATTENUATOR CALIBRATED) mark.

#### NOTE

To calibrate range "E" tune to top of band and repeat steps e through g, before proceeding on to step h.

h. Tune the frequency control across the selected frequency range. The RF OUTPUT meter pointer should remain aligned with the ATTENUATOR CALIBRATED mark.

#### NOTE

If the pointer does not remain aligned with the ATTENUATOR CALIBRATED mark, the leveling circuit is not functioning properly. Stop tuning and readjust the AMPL TRIMMER control to restore leveling. The latter adjustment is made without depressing the control.

i. Proceed with operating adjustments listed in paragraphs 3-18 and 3-20.

### 3-16. MODE OPERATING PROCEDURES.

3-17. The signal generators have four operating modes identified as CW operation, internal sine-wave modulation, external sine-wave modulation, and external pulse modulation. In addition, the RF output level established for CW operation can be remotely controlled by an externally supplied dc control voltage. The following discussion combines locally controlled CW operation and internal sine-wave modulation into operating instructions used with internally generated signals, external sine-wave modulation, external pulse modulation and remote-controlled CW operation. These operating procedures are used with externally supplied signals.

### 3-18. INTERNAL MODULATION.

3-19. The signal generators provide internal facilities to produce a CW output, or selector of either a 400 Hz or 1000 Hz sine-wave modulated signal output. Figure 3-2 illustrates and provides instructions for



proper operation of the controls, indicators, and connectors used with internally generated signals.

### 3-20. EXTERNAL MODULATION.

3-21. The signal generators operate with externally supplied sine-wave or pulse signals, which are used to modulate the internally developed RF carrier. Also, an external dc voltage can be applied to provide remote on-off control of the RF carrier output from the instruments. Figure 3-3 illustrates and describes the operation of controls, indicators, and connectors used in the three operations.

### 3-22. PHASE-LOCK OPERATING PROCEDURES (MODEL 608F ONLY).

3-23. The RF Generator Section in the Model 608F signal generator is designed for phase-lock operation

with the Model 8708A Synchronizer. This method of operation provides a highly stable output from the instrument, and requires only normal control adjustments followed by cable connections between the signal generator and synchronizer. Figure 3-4 illustrates and describes operation of controls, indicators and connectors on the Model 608F when the instrument is used in phase-lock operation.

3-24. Configuration of the RF Generator Section in the Model 608F signal generator also permits the instrument to be used in narrow-band frequency or phase modulation operations. In this application, consideration must be given to the internal bias of -22 volts dc on the FREQ CONTROL INPUT connector, and the input impedance of approximately 5K ohms. (I.E., a blocking capacitor must be added to the input circuit for passing the modulating signal while preventing any change in the reference reverse bias applied to the varicap diodes.)

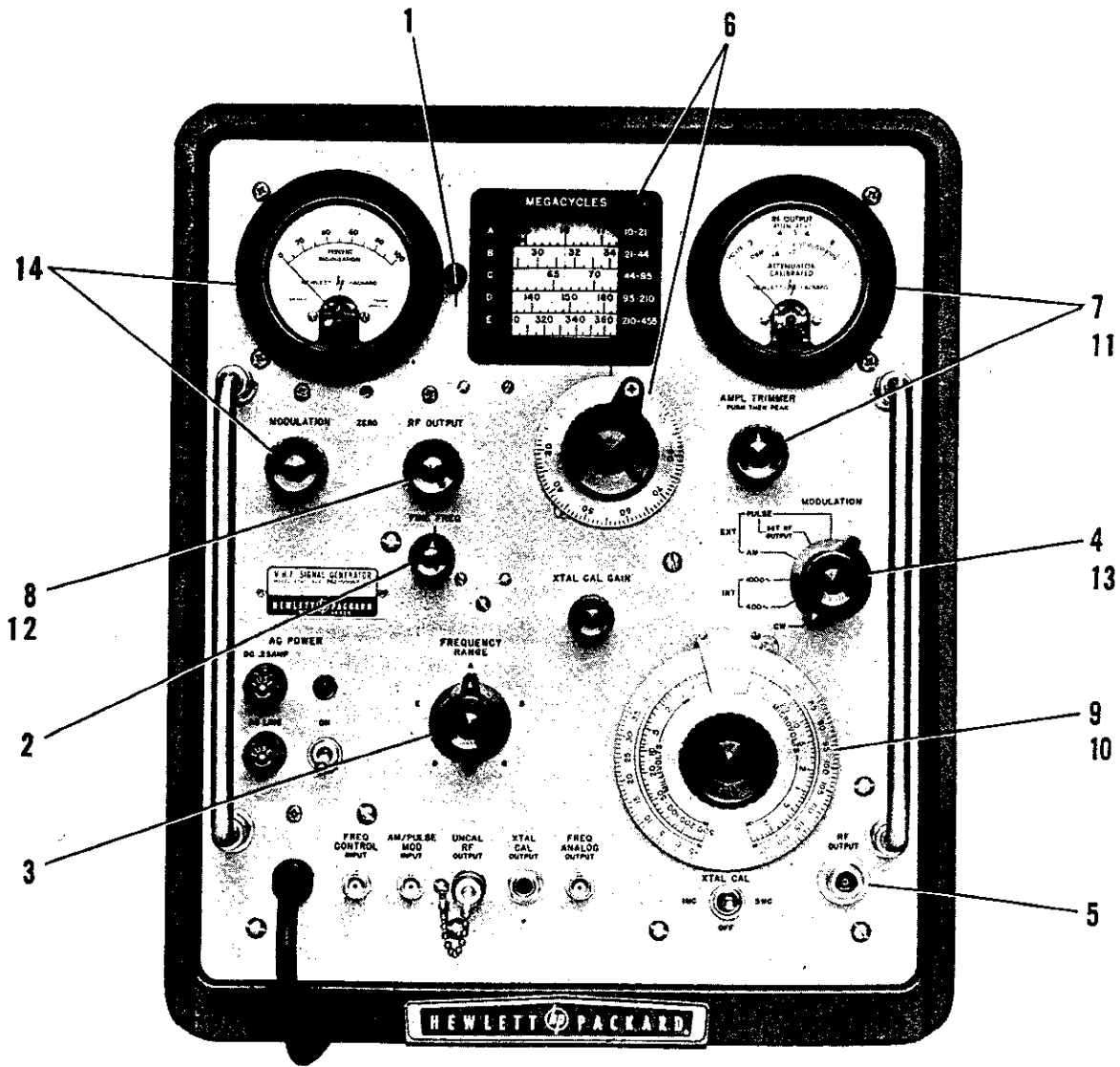


Figure 3-2. Controls, Indicators, and Connectors Used  
 in Operation with Internally Generated Signals

## CW OPERATION

## NOTE

Perform turn-on procedures listed in paragraph 3-9.

1. Align cursor knob with panel marker.
2. Align FINE FREQ control with panel marker.
3. Set FREQUENCY RANGE switch to desired range (frequency limits for each range shown on MEGACYCLES dial housing).
4. Set MODULATION switch to the CW position.

## CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inoperative while the equipment is connected to the signal generator (refer to NOTE in paragraph 3-7).

5. Connect the equipment under test to the RF OUTPUT connector observing that the signal generator is terminated in the proper load (refer to paragraph 3-8).

## NOTE

If deemed necessary, conduct power output calibration procedures for the selected frequency range as listed in procedural steps d. through h. in paragraph 3-15.

6. Tune the Frequency Control until MEGACYCLES dial cursor is aligned with frequency to be used as indicated on dial face.

## NOTE

To crystal calibrate the frequency dial, refer to procedures listed in paragraph 3-13.

7. Depress and tune AMPL TRIMMER control for maximum indication on RF OUTPUT meter.
8. Adjust RF OUTPUT control until RF OUTPUT Meter pointer is aligned with +7 dBm mark (ATTENUATOR CALIBRATED).

## NOTE

Accuracy of the Attenuator Control setting and PERCENT MODULATION meter are within specifications only when the RF OUTPUT meter is indicating ATTENUATOR CALIBRATED.

9. Adjust Attenuator Control for desired output level of +7 dBm or below.

## NOTE

To select RF output levels from +7 dBm to +13 dBm in the Model 608E, perform steps 10 through 12. In this operation, the RF OUTPUT meter pointer is used in lieu of the Attenuator Control to indicate the power output level.

10. Adjust the Attenuator Control to the +7 dBm dial mark.
11. Check that the RF OUTPUT meter pointer indicates ATTENUATOR CALIBRATED.
12. Adjust RF OUTPUT control for desired output level above +7 dBm as indicated by the RF OUTPUT meter pointer.

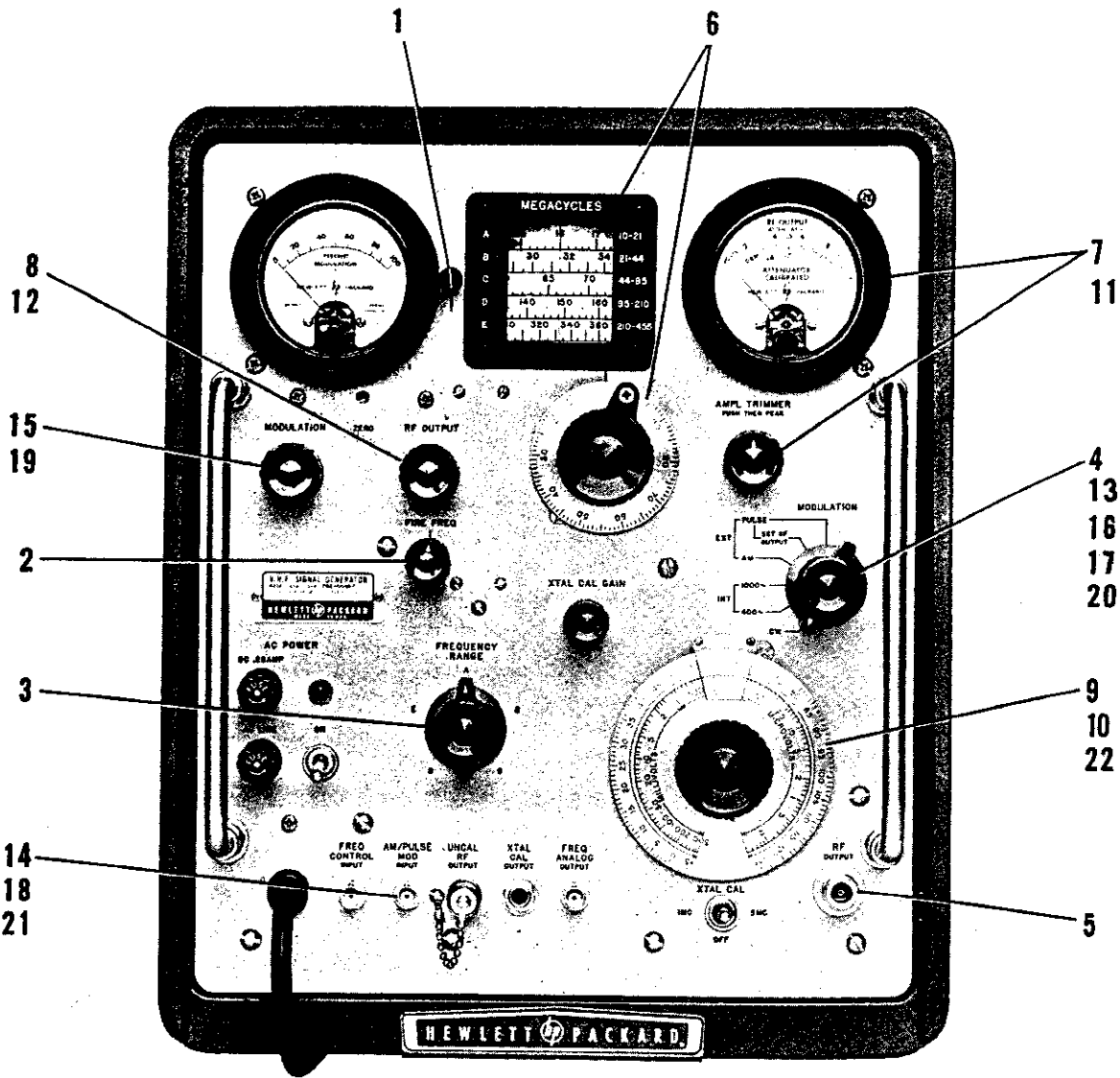
## INTERNAL SINE-WAVE MODULATION

## NOTE

Steps 1 through 12, as applicable, must be completed before setting the instrument for internal sine-wave AM modulation.

13. Set MODULATION switch to 400 ~ or 1000 ~ position as desired.
14. Adjust MODULATION control for desired modulation percentage as indicated on the PERCENT MODULATION meter.

Figure 3-2. Controls, Indicators and Connectors Used in Operation with Internally Generated Signals (Cont.)



EXTERNAL SINE-WAVE MODULATION

NOTE

Perform turn-on procedures listed in paragraph 3-9.

1. Align cursor knob with panel marker.
2. Align FINE FREQ control with panel marker.
3. Set FREQUENCY RANGE switch to desired range (frequency limits for each range shown on MEGACYCLES dial housing).

Figure 3-3. Controls, Indicators, and Connectors Used in Operation with Externally Supplied Signals

4. Set MODULATION switch to CW position.

#### CAUTION

Do not connect any source of RF or dc power to the RF OUTPUT connector on the signal generator. To do so may permanently damage the impedance-matching network in the Attenuator Section. Particular care must be observed when testing transceiver-type equipment to insure that the transmitter remains inoperative while the equipment is connected to the signal generator (refer to NOTE in paragraph 3-7).

5. Connect the equipment under test to the RF OUTPUT connector observing that the signal generator is terminated in the proper load (refer to paragraph 3-8).

#### NOTE

If deemed necessary, conduct power output calibration procedures for the selected frequency range as listed in procedural steps d. through h. in paragraph 3-15.

6. Tune Frequency Control until MEGACYCLES dial cursor is aligned with frequency to be used as indicated on dial face.

#### NOTE

To crystal calibrate the frequency, refer to procedures listed in paragraph 3-13.

7. Depress and tune AMPL TRIMMER control for maximum indication on RF OUTPUT meter.
8. Adjust RF OUTPUT control until RF OUTPUT meter pointer is aligned with +7 dBm mark (ATTENUATOR CALIBRATED).

#### NOTE

Accuracy of the Attenuator Control setting and PERCENT MODULATION meter are within specifications only when the RF OUTPUT meter is indicating ATTENUATOR CALIBRATED.

9. Adjust Attenuator Control for desired output level of +7 dBm or below.

#### NOTE

To select RF output levels from +7 dBm to +13 dBm in the Model 608E, perform steps 10 through 12. In this operation, the RF OUTPUT meter pointer is used to indicate the power output level in lieu of the Attenuator Control.

10. Adjust the Attenuator Control to the +7 dBm dial mark.

11. Check that the RF OUTPUT meter pointer indicates ATTENUATOR CALIBRATED.

12. Adjust the RF OUTPUT control for the desired output level above +7 dBm as indicated by the RF OUTPUT meter pointer.

13. Set the MODULATION switch to the AM position.

14. Connect the external sine-wave generator to the AM/PULSE MOD INPUT connector and set generator for a sine-wave input between 20 Hz and 20 kHz.

15. Set MODULATION control for desired percentage of modulation as observed on the PERCENT MODULATION meter.

#### EXTERNAL PULSE MODULATION

#### NOTE

Perform turn-on procedures if required, and complete steps 1 through 3.

16. Set MODULATION switch to the PULSE/SET RF OUTPUT position.

#### NOTE

Perform steps 5 through 12 as applicable.

17. Set the MODULATION switch to the PULSE position.

18. Connect the external pulse generator to the AM/PULSE MOD INPUT connector and set generator for an input pulse level above 10 volts peak-to-peak.

#### EXTERNAL DC CONTROL

#### NOTE

Perform turn-on procedures if required, and complete steps 1 through 8.

19. Set the MODULATION control to a maximum clockwise position.

20. Set MODULATION switch to the AM position.

21. Connect external power source to AM/PULSE MOD INPUT connector.

#### NOTE

Voltages required for external control of the RF carrier are +15 volts dc for full-on operation and -15 volts dc for full-off operation.

22. Adjust Attenuator Control and dc control voltage input for desired RF output level.

Figure 3-3. Controls, Indicators and Connectors Used in Operation with Externally Supplied Signals (Cont.)

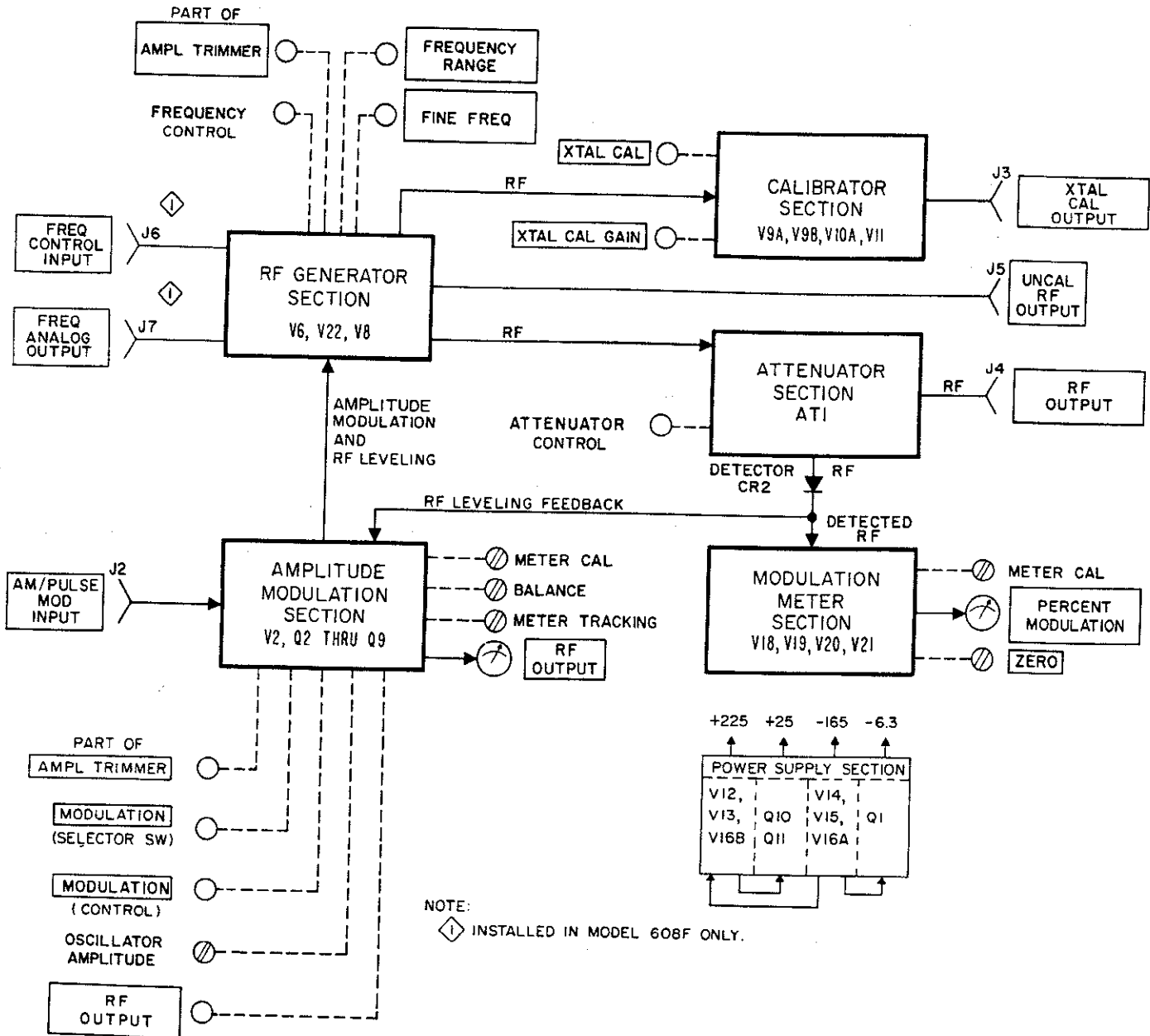


Figure 4-1. Overall Block Diagram, Models 608E and 608F

## SECTION IV

### PRINCIPLES OF OPERATION

#### 4-1. INTRODUCTION.

4-2. This section contains principles of operation for the Model 608E and Model 608F Signal Generators. Included herein is a general description of the instruments to a block diagram level, and a detailed circuit description which references the schematic diagrams. Principal dissimilarities between the Model 608E and 608F occur in the RF Generator Section; therefore, this section of each instrument will be described separately. The remaining sections in both instruments are nearly identical. These sections will be presented in a single description with the minor differences between instruments noted.

#### 4-3. GENERAL DESCRIPTION.

4-4. As illustrated in Figure 4-1, the signal generators contain a RF Generator Section, Amplitude Modulation Section, Attenuator Section, Calibrator Section, Modulation Meter Section, and Power Supply Section. Each section is described in the succeeding paragraphs.

#### 4-5. RF GENERATOR SECTION, MODEL 608E.

4-6. The RF Generator Section in the Model 608E includes RF Oscillator V6, Buffer Amplifier V22, Power Amplifier V8, and associated circuitry. The RF Oscillator generates sine-wave signals from 10 MHz to 480 MHz in five frequency bands, which are identified in Figure 3-1 (item 8). Operation of the FREQUENCY RANGE switch selects tuned circuits in both the RF Oscillator and Power Amplifier stages for the desired operating range, and the Frequency Control adjustment selects frequencies within the range. The latter control tunes the RF Oscillator and Power Amplifier simultaneously. Minor frequency adjustments can be made by use of the FINE FREQ control connected in the output circuit of RF Oscillator V8. An uncalibrated RF output signal is also provided at the output circuit of Oscillator V6. The signal is applied to UNCAL RF OUTPUT connector J5 and is available for use with a frequency counter or other external measuring equipment. Buffer Amplifier V22 isolates RF Oscillator V6 and the output stages. A connection between the output stage of Buffer Amplifier V22 and the input circuit of Power Amplifier V8 serves as the modulation point, with the modulating signal being received from the Amplitude Modulation Section. The modulated RF signal is amplified in V8 and applied to the output circuit of the stage, which has been tuned by the FREQUENCY RANGE and Frequency Control adjustments. The AMPL TRIMMER control connected in the output circuit of Power Amplifier V8 is mechanically linked to a pushbutton switch in the Amplitude Modulation section. The interconnected control permits peaking the

RF output of the instrument, and maintaining a fixed RF output across the frequency range of the instrument. Tuning the control without engaging the pushbutton provides a fine-tune adjustment, which is used in conjunction with the RF OUTPUT control to maintain a fixed, leveled RF output regardless of the selected frequency. Depressing the control and then tuning permits a sharp peak to be obtained on the RF OUTPUT meter for optimizing the RF output of Power Amplifier V8.

#### 4-7. RF GENERATOR SECTION, MODEL 608F.

4-8. The RF Generator Section in the Model 608F Signal Generator is essentially the same as the Model 608E, containing the RF Oscillator, Buffer Amplifier, and Power Amplifier stages discussed in paragraph 4-5. Frequency capability of the instrument is between 10 MHz and 455 MHz in five frequency ranges. Differences between the frequency capabilities of the Model 608F and 608E can be ascertained by reference to Figure 3-1 (item 8). Two circuits and associated input and output connectors have been added to the Model 608F to permit the unit to be used with a Model 8708A Synchronizer. This equipment arrangement provides a highly stable, phase-locked RF signal output from the Model 608F, or permits the instrument to be used in narrow-band frequency or phase modulation applications. During use with a synchronizer a connection is made between UNCAL RF OUTPUT connector J5 on the Model 608F and synchronizer to provide a sample to the uncalibrated RF signal output from RF Oscillator V6. A second connection is made between the synchronizer and FREQ CONTROL INPUT connector J6 on the Model 608F. The latter connection delivers dc control voltage to varactors connected across the tank circuit of RF Oscillator V6 in the Model 608F. This dc control voltage reflects any frequency difference between the uncalibrated RF signal output of V6 and a calibrated reference frequency developed in the synchronizer. Hence, any drift in the output of RF Oscillator V6 is detected and an offsetting control voltage is returned to the Model 608F to maintain a correct frequency output. A third connection between the Model 608F and synchronizer is made at FREQ ANALOG OUTPUT connector J7. This connection provides a resistance to the synchronizer that is inversely proportional to the frequency in use. The resistance is used to maintain constant loop gain across the frequency band during phase-lock operation.

#### 4-9. AMPLITUDE MODULATION SECTION.

4-10. The Amplitude Modulation Section consists of Modulation Oscillator V2, Differential Amplifier Q2 and Q3, Sine-Wave Amplifier Q4, Pulse Amplifier Q5, Amplifiers Q6 and Q7, Modulators Q8 and Q9, the RF OUTPUT meter, and associated circuits. Selection of

the signal generator mode of operation is made by use of the MODULATION selector switch connected in the Amplitude Modulation Section. The four modes of operation are internal sine-wave modulation (400 or 1000 Hz), external sine-wave modulation, external pulse modulation, and cw operation; these four operations are discussed in the following paragraphs.

**4-11. INTERNAL SINE-WAVE MODULATION.** To select internal modulation, the MODULATION selector switch is set to either the 400 ~ or 1000 ~ position. Modulation Oscillator V2 provides a sine-wave output of fixed amplitude established by the Oscillator Amplitude control, a screwdriver adjustment within the instrument. The sine-wave output is then applied to transistor Q3 in the differential amplifier stage, and to AM/PULSE MOD INPUT connector J2. The signal at the connector is made available for synchronizing external equipment during internal modulation operation. The second signal applied to Differential Amplifier Q2-Q3 is a detected RF output signal received from diode CR2. This leveling feedback signal, which is used to counteract variations in the RF output signal, is applied to transistor Q2. The product of Differential Amplifier Q2-Q3 is amplified in Sine-Wave Amplifier Q4, and Amplifiers Q6 and Q7, then passed to Modulators Q8 and Q9. During internal and external modulation and when CW operation is conducted, Pulse Amplifier Q5 is disabled. Signal output from the modulator stage is applied to the input circuit of Power Amplifier V8 in the RF Generator Section where modulation of the RF signal and signal leveling occur. A MODULATION control between Modulator Oscillator V2 and transistor Q3 in the differential amplifier stage provides an adjustment to select the desired percentage of modulation as observed on the PERCENT MODULATION meter discussed in paragraph 4-19. The RF OUTPUT control connected in the differential amplifier stage is used in conjunction with the Attenuator Control to calibrate RF power output from the instrument. Final selection of the desired output level up to +7 dBm is made using the Attenuator Control in both the Model 608E and 608F. In the Model 608E only, an RF output level above +7 dBm is selected by use of the RF OUTPUT control only. The AMPL TRIMMER control in the Amplitude Modulation Section is ganged to a tuning control in the output circuit of Power Amplifier V8 in the RF Generator Section. Operation of these controls is discussed in paragraph 4-5. The Meter Cal, Balance, and Meter Tracking controls are internal adjustments to set the RF OUTPUT meter and differential amplifier stage for proper operation.

**4-12. EXTERNAL SINE-WAVE MODULATION.** During external sine-wave modulation a connection is made between the external modulating equipment and AM/PULSE MODE INPUT connector J2 on the instrument, and the MODULATION selector switch is set to the AM position. The latter adjustment disables Modulation Oscillator V2, and routes the incoming modulation signal through the MODULATION control to transistor Q3 in the differential amplifier stage. Operation of the remaining circuits and controls in the Amplitude Modulation Section is identical to that described in paragraph 4-11.

**4-13. EXTERNAL PULSE MODULATION.** To set the signal generators for external pulse modulation, the desired RF output level and operating characteristics of the Amplitude Modulation Section are established with the MODULATION selector switch in the PULSE/SET RF OUTPUT position. The switch position enables Pulse Amplifier Q5 and disables Modulation Oscillator V2 and Sine-Wave Amplifier Q4. With the MODULATION switch in the PULSE/SET RF OUTPUT position, the operating characteristics of Amplifier Q7 and Modulators Q8-Q9 in the Amplitude Modulation Section are established by use of the RF OUTPUT control, and the desired RF output level from the instruments selected as observed on the RF OUTPUT meter. Fine adjustment of the RF output level can be made at this time using the AMPL TRIMMER and RF OUTPUT controls conjunctively. Upon completion of these preliminary adjustments, the MODULATION selector switch is set to the PULSE position, and the external pulse source connected to the signal generators at AM/PULSE INPUT connector J2. The input signals are amplified by transistors Q5, Q6 and Q7 then passed to Modulators Q8-Q9. The output of the Modulator stage is applied to the input circuit of Power Amplifier V8 where modulation of the RF signal occurs. During pulse modulation, the MODULATION, RF OUTPUT and AMPL TRIMMER controls should not be operated after initial adjustments are made, and the PERCENT MODULATION and RF OUTPUT meters are inoperative. To readjust the RF output level, the external modulating source must be removed at connector J2, and the MODULATION switch returned to the PULSE/SET RF OUTPUT position. Adjustment of the RF OUTPUT and AMPL TRIMMER controls can then be made as previously discussed.

**4-14. CW OPERATION.** When the instrument is set for CW operation with the MODULATION selector switch in the CW position, Modulation Oscillator V2 and transistor Q3 in the differential amplifier stage are disabled. The RF leveling signal received from diode CR2 is passed through the Amplitude Modulation Section in a normal manner, and applied to the input circuit of Power Amplifier V8 in the RF Generator Section for stabilization of the RF power output level. The RF leveling signal is also applied to the RF OUTPUT meter circuit in the Amplitude Modulation Section for RF level calibration. Operation of both the AMPL TRIMMER PUSH TO PEAK and RF OUTPUT controls is identical to that described in paragraph 4-11.

#### 4-15. ATTENUATOR SECTION.

**4-16. Attenuator Section AT1** couples RF energy from Power Amplifier V8 in the RF Generator Section to the load through RF OUTPUT connector J4, and provides control over the RF output level. The previously discussed RF leveling signal developed across diode CR2 is provided by a second RF output from the Attenuator Section. The Attenuator Control is used in conjunction with the RF OUTPUT meter and RF OUTPUT control in the Amplitude Modulation Section to calibrate the RF output level of the instrument, and also to select the desired output level from the equipment after calibration procedures have been completed.



#### 4-17. CALIBRATOR SECTION.

4-18. The Calibrator Section consists of 5-MHz Oscillator V9A, 1-MHz Oscillator V9B, Amplifiers V10A and V11, and the associated circuits. Operation of the oscillators is controlled by the XTAL CAL toggle switch that has three positions; OFF, 1 MC, and 5 MC. With the selector switch in either the 1 MC or 5 MC position, an output from the active oscillator is mixed with a sample RF signal from Power Amplifier V8 in the RF Generator Section to produce audio beat signals. The audio signals are passed through amplifiers V10A and V11 to a matching transformer. The transformer output is then applied to XTAL CAL OUTPUT connector J3 for use by an operator during frequency calibration operations. A XTAL CAL GAIN control connected in the output circuit of Amplifier V11 provides an audio output level adjustment.

#### 4-19. MODULATION METER SECTION.

4-20. The Modulation Meter Section consists of stabilized wideband amplifiers V18 and V19, rectifier V20, and twin-triode V21 connected in a bridge circuit. Prior to operation the PERCENT MODULATION meter, also connected in the bridge circuit, is calibrated by use of the Meter Calibration control, an internal adjustment. Also, the bridge circuit is balanced to electrical zero by the ZERO adjustment located on the front panel of the instrument. The RF signal output of the Attenuator Section is detected across diode CR2 and applied to a filter network that produces the modulating signal. This signal is amplified in V18 and V19, rectified in V20, and applied to the bridge circuit. The bridge circuit is unbalanced in direct proportion to the peak amplitude of the input modulating signal; therefore, the PERCENT MODULATION meter connected across the bridge indicates the degree of unbalance in the bridge, or the percentage of modulation. The percentage of modulation is established by use of the MODULATION control in the Amplitude Modulation Section.

#### 4-21. POWER SUPPLY SECTION.

4-22. The Power Supply Section consists of four series-regulated interrelated power supplies. The +225-volt power supply contains Comparison Amplifier V12 and a Series Regulator comprised of both sections of V13 and V16B. The +25-volt power supply contains Reference Amplifier Q10 and Series Regulator Q11. The -165-volt power supply consists of Reference Tube V15, Comparison Amplifier V14, and Series Regulator V16A. The -6.3 volt supply contains a reference diode and Series Regulator Q1. The -165 volt supply is used to reference both the -6.3 volt and +225 volt supplies. The +225 volt supply is used to reference the +25 volt supply. A further discussion of these power supplies is contained in the detailed circuit description that follows.

#### 4-23. DETAILED DESCRIPTION.

4-24. This discussion describes the circuits in the RF Generator Section (Model 608E), RF Generator

Section (Model 608F), Amplitude Modulation Section, Attenuator Section, Calibrator Section, Modulation Meter Section, and the Power Supply Section. Figures 7-4 and 7-5 will be used as reference during the description, and where transition from one diagram to the second is required appropriate notice will be made.

#### 4-25. RF GENERATOR SECTION, MODEL 608E.

4-26. The RF Generator Section in the Model 608E includes RF Oscillator V6, Buffer Amplifier V22, and Power Amplifier V8. RF Oscillator V6 is a type 4042 triode connected across the +225 and -165 Vdc supplies in a Colpitts circuit. The oscillator tank circuit contains split-stator capacitor C17A and five separate RF transformers mounted on a revolving turret assembly. Capacitor segment C17A is mechanically linked to segment C17B in the output circuit of Power Amplifier V8, and the oscillator turret assembly is linked to an amplifier turret assembly also located in the output circuit of V8. Choice of frequency band is made by operating the FREQUENCY RANGE switch located on the front panel of the instrument. This function rotates the oscillator and power amplifier turret assemblies simultaneously to the selected range (Range A through E), and sets the associated inductor (L1 through L6, and L12 through L16) into the output circuits of RF Oscillator V6 and Power Amplifier V8 respectively. Capacitors C17A and C17B are then tuned by the front-panel mounted Frequency Control to the desired frequency within the range. Minor frequency adjustments can be made by tuning capacitor C68 (FINE FREQ control) in the tank circuit of Oscillator V6.

4-27. The plate circuit of RF Oscillator V6 is series fed through resistors R246 and R247. These resistors in conjunction with resistor R43 in the cathode of the stage serve to limit plate current within safe limits. The cathode of Oscillator V6 is bypassed by capacitor C25, which is part of the tube mounting plate and is not visible when the plate is in position. Bias for the stage is developed by cathode resistor R249 and grid resistor R248, with coupling capacitor C16 returning feedback to the grid to maintain oscillation. Capacitor C59 connected across a portion of the tuned circuit is used to calibrate the high end of the frequency dial after replacing an oscillator tube. Capacitor C18, installed in the Model 608E only, is used to improve tracking characteristics of the tuned circuit at higher frequencies. Adjustment of this internal control is critical, since a compromise must be reached between tracking capabilities and optimum power output. Misadjustment of capacitor C18 can produce improved tracking capability but a loss in RF power output. The control is factory aligned, and no further adjustment should be required.

4-28. All voltages applied to RF Oscillator V6 located in the RF Generator housing assembly are regulated, and brought into the stage through RFI filters. The +225 Vdc plate voltage is received through filter FL5, the -165 Vdc supply is received through filter FL2, and a regulated -6.3 heater voltage is received through filter FL4.

4-29. The secondary windings in the oscillator turret assembly couple RF energy from RF Oscillator V6 through a coaxial cable to Buffer Amplifier V22. Resistors R240, R242, R244, and R245 located in the secondary windings of coils L2 through L5 damp undesirable resonance in the cathode of Buffer Amplifier V22. Resistors R241 and R243 connected across the secondary windings of coils L4 and L5 limit the RF drive at lower frequencies. Resistors R250, R251, and capacitor C218 form a take-off network for an uncalibrated RF output signal that is applied through coaxial cable W1 to UNCAL RF OUTPUT connector J5. Resistor R251 in the take-off network is 301 ohms in the Model 608E and 200 ohms in the Model 608F. This configuration is due to the difference in RF output level between instruments. The RF signal at connector J5 can be used with a frequency counter or other external measuring equipment. When the Model 608F is used with a Model 8708A synchronizer during phase-lock operation, the signal is used by the synchronizer.

4-30. Buffer Amplifier V22 is a type EC-8010 triode connected as a grounded-grid amplifier. The stage isolates RF Oscillator V6 and Power Amplifier V8, and reduces any incidental frequency modulation to a minimum level. Cathode resistors R255 and R252 operate with resistors R254 and R256 in the plate circuit to limit plate current to a safe value. Power to the stage is supplied through RFI filters FL2, FL4, and FL5, with the plate, cathode and filament supplies being decoupled by capacitors C222, C220, and C221 respectively. The plate circuit of Buffer Amplifier V22 is coupled to the cathode circuit of Power Amplifier V8 through a wide-band network consisting of dc blocking capacitor C224 and coil L22. Coil L20 in the plate circuit of V22 serves as an RF choke, while isolation network L11 blocks an RF signal path to the output circuit of the Amplitude Modulation Section.

4-31. Power Amplifier V8 is a grounded-grid, cathode-modulated amplifier that delivers the modulated or CW output signal to the Attenuator Section. The plate circuit of V8 contains the amplifier turret assembly which houses inductors L12 through L16. These inductors are placed into the output circuit of V8 by operation of the FREQUENCY RANGE switch discussed in paragraph 4-26. The second segment of Frequency Control capacitor C17 is also located in the plate circuit of Power Amplifier V8. Linkage between capacitor C17B and C17A in the RF Oscillator Stage permit tuning to a frequency within a range as discussed in paragraph 4-26. A second linkage between capacitor C17B and the AMPL TRIMMER control permit the capacitor to be tuned separately or in conjunction with push-to-operate switch S6 in the Amplitude Modulation Section for peaking the RF output signal. This function is discussed further in paragraph 4-45.

4-32. When the instrument is set to provide an amplitude modulated output, the modulating signal and an RF leveling signal are received at the cathode of Power Amplifier V8 from the Amplitude Modulation Section through isolation network L11. During CW operation, only the RF leveling signal is received from the

Amplitude Modulation Section. Diode CR7 connected in the signal path prevents damage to Power Amplifier V8 by limiting the negative swing of the cathode. Capacitor C32 is connected in the plate circuit of V8 in the Model 608F only, and is adjusted for improved tracking characteristics in the power amplifier stage at higher frequencies. Capacitors C30, C229, C230, and C231 connected across coils L16, L15, L14, and L13 respectively are also installed in the Model 608F only. These capacitors are selected in test to improve tracking between the power amplifier and oscillator stages. Nominal values for the capacitors are illustrated in Figure 7-4. The RF output signal from Power Amplifier V8 is inductively coupled through the amplifier turret assembly coil and applied to the Attenuator Section. This section of the instrument is discussed in paragraph 4-51.

#### 4-33. RF GENERATOR SECTION, MODEL 608F.

4-34. The RF Generator Section in the Model 608F is essentially the same as the generator section in the Model 608E, except for the addition of circuits to permit the unit to be used with a Model 8708A Synchronizer. These circuit differences occur in the tank circuit of RF Oscillator V6 and the output stage of Power Amplifier V8.

4-35. Two varactor diodes, CR31 and CR32, are connected across the oscillator tank circuit in the Model 608F. The varactors are reverse-biased junctions that act as variable capacitors, changing capacitance with a change in the applied reverse bias. In quiescent condition the diodes are biased by a voltage divider network comprised of resistors R271, R267, and R268. A change in bias, and the resultant change in capacitance, is produced by a dc control voltage received at FREQ CONTROL INPUT connector J6. During operation with a Model 8708A Synchronizer, a connection is made between UNCAL RF OUTPUT connector J5 and the synchronizer to provide a sample of the RF output from the Model 608F. A second connection is made between the synchronizer and FREQ CONTROL INPUT connector J6 to receive the dc control voltage from the synchronizer. The frequency sample sent to the synchronizer is compared to a reference frequency developed in the synchronizer. A drift tendency in RF Oscillator V6 is compared with the reference frequency, and translated into a dc control voltage for application to varactors CR31 and CR32 in the Model 608F. The varactors change capacitance in direct proportion to the detected drift holding RF Oscillator V6 on frequency.

4-36. Potentiometer R269 is installed in the Model 608F only, and is mechanically linked to Frequency Control capacitor C17B in the output circuit of Power Amplifier V8. The potentiometer output resistance varies as the Frequency Control adjustment is tuned, presenting 4K ohms at the low-frequency end of the capacitor tuning range and zero ohms at the high-frequency end. The resistance is applied through FREQ ANALOG OUTPUT connector J7 to the dc control voltage circuit in the synchronizer. This loop arrangement controls the voltage level applied to varactors CR31 and CR32, thereby assuring correct

operating conditions for the devices across a frequency range.

#### 4-37. AMPLITUDE MODULATION SECTION.

4-38. The Amplitude Modulation Section consists of Modulation Oscillator V2, a portion of the Modulator and ALC Board, a RF OUTPUT meter and control, two MODULATION controls, and the associated circuitry. The Modulator and ALC Board contains Differential Amplifier Q2-Q3, Sine-Wave Amplifier Q4, Pulse Amplifier Q5, Amplifiers Q6 and Q7, and Modulators Q8 and Q9. Four modes of operation will be discussed during the description of the Amplitude Modulation Section; these are identified as internal sine-wave modulation, external sine-wave modulation, external pulse modulation, and CW operation.

4-39. INTERNAL SINE-WAVE MODULATION. The internal sine-wave modulation mode is selected by placing MODULATION switch S7 to either the 400 ~ or 1000 ~ position (switch setting 2 or 3), which provides a  $400 \pm 40$  Hz or a  $1000 \pm 100$  Hz output from Modulation Oscillator V2. The oscillator consists of resistance-coupled amplifiers V2A and V2B connected in a Wein-Bridge circuit. At the resonant frequency, positive feedback from the plate of Amplifier V2B is applied to the grid of amplifier V2A sustaining oscillation. A change in frequency is obtained by inserting resistors R3-R5 or R4-R6 into the feedback network through two segments of MODULATION switch-wafer 2F. A negative feedback circuit consisting of resistors R7, R8 and lamp DS1 is used to stabilize the oscillator, reduce distortion, and maintain a constant output level. If the amplitude of the signal increases, current through the lamp increases thereby raising the resistance of lamp DS1; consequently, the signal amplitude is held constant. Potentiometer R7 is an internal adjustment for adjusting the amplitude of the output signal. Heater voltage to the stage is applied at all times during instrument operation; however, plate voltage is applied to V2A and V2B only when MODULATION switch-wafer 2R is in position 2 or 3.

4-40. The sine-wave signal from Modulation Oscillator V2 is applied through dc blocking capacitor C205, MODULATION switch-wafer 1F, to MODULATION control R210. A second signal path for the sine-wave is provided through resistor R262 to AM/PULSE MOD INPUT connector J2 where the signal is available for synchronizing external equipment during the internal modulation mode. The signal at the wiper of MODULATION control R210 is passed through, a frequency-compensation network consisting of resistor R261, and capacitors C203 and C204. The signal is then routed through MODULATION switch-wafer 1R to the base of transistor Q3 in the differential amplifier stage. The second input to the differential amplifier is a detected signal developed across diode CR2 and filter network C38 and R119 located in the bolometer portion of the Attenuator Section. This leveling signal, which is representative of the RF power output from the instrument, is passed through RFI filter FL8 to the base of transistor Q2. The leveling signal is also applied through resistor R201. Meter Cal potentiometer R202.

MODULATION switch-wafer 4F, and AMPI TRIM-MER pushbutton switch S6 to RF OUTPUT meter M1. Operating characteristics of switch S6 and the RF OUTPUT meter are contained in paragraph 4-45.

4-41. Balance potentiometer R203 is a board adjustment in the emitter circuit of Differential Amplifier Q2 and Q3 used to set the stage for proper operation. The RF OUTPUT control R212 connected with resistor R213 in a voltage divider network sets the operating characteristics of the differential amplifier stage, and is used in conjunction with the Attenuator Control to calibrate and control the RF output from the instrument. The output of the differential amplifier is the product of the leveling signal on the base of transistor Q2 and the modulating signal on the base of transistor Q3. This product signal is then applied to the base of Sine-Wave Amplifier Q4.

4-42. The base circuit of amplifier Q4 contains a low-frequency compensating network consisting of resistor R214 and capacitor C202. In the Model 608E resistor R214 is 200 ohms, and in the Model 608F the resistor value is 392 ohms. Amplifier Q4 is biased by voltage divider network R217 and R215, with diode CR21 installed as a protective device to maintain a safe relationship between the base and emitter circuits of Q4 during operation. The collector circuit of Q4 also contains two frequency-compensating networks consisting of resistor R219 and capacitor C208, and resistor R218 and capacitor C207. The output of amplifier Q4 is developed across resistor R216 and applied to the base circuit of Amplifier Q6.

4-43. During internal or external sine-wave modulation, Amplifier Q6 receives the leveling and modulating signals from Amplifier Q4. During CW operation, only the leveling signal is received at Amplifiers Q4 and Q6. During external pulse modulation, Amplifier Q4 is inhibited and the input pulse signals are received at Amplifier Q6 from Pulse Amplifier Q5. The external pulse modulation and CW modes of operation are discussed later in this section. The emitter of Amplifier Q6 is biased by a voltage divider network consisting of resistors R223 and R224, and during internal sine-wave operation the modulating and leveling signals are developed across load resistor R222 for application to Amplifier Q7.

4-44. Resistor R229 and capacitor C211 provide emitter bias for Amplifier Q7, while the collector voltage is developed across load resistor R228 and resistor R233. This voltage divider network also establishes the base conditions on Modulators Q8 and Q9. During the pulse modulation mode, the collector voltage on Amplifier Q7 can be controlled by operation of the RF OUTPUT control; this function is discussed in paragraph 4-47. The collector output of Amplifier Q7 is applied to the base of Modulators Q8 and Q9 connected in parallel emitter-follower configuration. The emitter bias for the stage is derived from a voltage divider network consisting of resistor R33, Zener diode CR26, and resistor R258 in the RF Generator Section. Diode CR25 is connected as a protective device between the base and emitter circuits of the stage. The modulator

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output is applied through RFI filter FL6 and isolation network L11 to the cathode of Power Amplifier V8, where modulation and RF leveling occur.

4-45. A feedback path for the output of Modulators Q8 and Q9 is provided through filter network R235 and capacitor C200 which removes the modulating signal. The leveling signal is passed through MODULATION switch-wafer 4F and applied to the normally-open contacts of AMPL TRIMMER pushbutton switch S6 when the MODULATION switch is in positions 1 through 4. As previously mentioned, the AMPL TRIMMER pushbutton is mechanically linked to AMPL TRIMMER capacitor C17B in the output circuit of Power Amplifier V8. During normal operation the detected feedback from diode CR2 in the Attenuator Section is applied through resistor R201, potentiometer R202, and the normally-closed contacts of pushbutton switch S6 to RF OUTPUT meter M1; therefore, the meter normally displays the leveled RF output of the instrument. Rotation of RF OUTPUT control R212 changes the conduction level of Differential Amplifier Q2-Q3 and the signal output level of Modulators Q8-Q9. This change is reflected in the RF output of Power Amplifier V8, and displayed on RF OUTPUT meter M1. Operation of AMPL TRIMMER control C17B without engaging the pushbutton provides a fine-tune adjustment for use with the RF OUTPUT control to maintain a constant, leveled RF output across a frequency range. When AMPL TRIMMER pushbutton S6 is depressed the leveling signal feedback from Modulators Q8-Q9 is displayed on meter M1, and operation of the control permits a sharp peak to be observed on the meter. Hence, the RF output of Power Amplifier V8 can be peaked. During internal and external sine-wave operation, MODULATION control R210 controls the level of the modulation and is used in conjunction with the PERCENT MODULATION meter discussed in paragraph 4-59.

4-46. EXTERNAL SINE-WAVE MODULATION. Operation of the instruments during external sine-wave modulation is similar to the internal mode, and is established by setting MODULATION switch S7 to the AM position (switch position 4). Modulation Oscillator V2 is disabled by removing the stage plate voltage at MODULATION switch-wafer 2R, and a signal path of the external sine-wave signal is established through MODULATION switch-wafer 1F. A cable connection is made between the external source and AM/PULSE MOD INPUT connector J2, with the incoming signal being routed to MODULATION control resistor R210. The signal is then applied through the frequency-compensation network and MODULATION switch-wafer 1R to the base of transistor Q3 in the differential amplifier stage. Operation of the remaining circuits and controls in the Amplitude Modulation Section is the same as described during internal sine-wave modulation.

4-47. EXTERNAL PULSE MODULATION. During this mode of operation MODULATION switch S7 is set first to the PULSE/SET RF OUTPUT position (switch position 5) to establish operating conditions in the cut-off circuit of the Amplitude Modulation Section, and

consequently the RF output level of the instrument. The switch is then set to the PULSE position (switch position 6) to pulse modulate the RF carrier. In both positions Modulation Oscillator V2 is disabled and the input signal path through MODULATION control resistor R210 is interrupted. The position of MODULATION switch-wafer 4F interrupts the leveling signal path through the normally-open contacts of AMPL TRIMMER pushbutton switch S6, and removes the push-to-peak function of the AMPL TRIMMER control during pulse operation. However, the detected signal from diode CR2 in the Attenuator Section is received through resistor R201 and potentiometer R202 for application to RF OUTPUT meter M1. Therefore, in the PULSE/SET RF OUTPUT position, the AMPL TRIMMER and RF OUTPUT controls can be used to set the desired RF output level as indicated on the RF OUTPUT meter. The two controls are operated only in the PULSE/SET RF OUTPUT position.

4-48. Transistor Q3 in the differential amplifier stage has an inhibiting voltage applied to the base through resistor R211 and MODULATION switch-wafer 1R. With transistor Q3 cut off, transistor Q2 conducts heavily and places a disabling voltage on the base of Amplifier Q4. This condition interrupts to leveling signal path through the Amplitude Modulation Section. Resistor R212 is removed from the circuit by the position of MODULATION switch-wafer 1R; however, the RF OUTPUT control is also connected to potentiometer R226 in the collector circuit of Amplifier Q7 for rf output level control. With the MODULATION switch in position 5, a positive voltage is applied to the base of Pulse Amplifier Q5 through resistors R220 and R225 to enable the amplifier. The position of MODULATION switch-wafer 3R forms a voltage divider network consisting of resistors R228, R226, and R270 in the collector circuit of Amplifier Q7 and the base circuits of Modulators Q8 and Q9. Operation of RF OUTPUT potentiometer R226 controls the conduction level of transistors Q7, Q8, and Q9, and the output level of Power Amplifier V8.

4-49. While the MODULATION switch is still in the PULSE/SET RF OUTPUT position, the RF OUTPUT control is adjusted for an indication on RF OUTPUT meter M1. AMPL TRIMMER control C17B in the output stage of Power Amplifier V8 is then peaked for maximum RF output. The RF OUTPUT is readjusted for an indication of +7 dBm (Attenuator Calibrated) on RF OUTPUT meter M1. With the preliminary adjustments completed, the external modulating equipment is connected to AM/PULSE MOD INPUT connector J2, and MODULATION switch S7 is set to the PULSE position (switch position 6). The incoming pulse train is passed through MODULATION switch-wafer 3F to the base of Pulse Amplifier Q5, and then routed through Amplifier Q6 and the remaining circuits of the Amplitude Modulation Section as previously described.

4-50. CW OPERATION. To set the equipment for CW operation, MODULATION switch S7 is placed to the CW position (switch position 1). Modulation Oscillator

V2 is removed from the circuit by the position of switch-wafer 2R, and the sine-wave input circuit is interrupted by the setting of switch-wafer 1F. A detected RF output signal from diode CR2 in the Attenuator Section is applied to the base of transistor Q2 in the differential amplifier stage for the development of a leveling signal as previously described. RF OUTPUT meter M1 also receives the detected signal through AMPL TRIMMER pushbutton switch S6. Transistor Q3 in the differential amplifier stage is terminated in a network consisting of resistor R263 and capacitor C206; however, RF OUTPUT control resistor R212 is connected in the circuit and controls conduction of the differential amplifier stage. Pulse Amplifier Q5 is disabled by the ground applied to the base circuit through MODULATION switch-wafer 3F. Leveling signal output of the differential amplifier stage is passed through Amplifiers Q4, Q6, Q7 and Modulators Q8-Q9 to the input circuit of Power Amplifier V8. RF OUTPUT meter M1 displays a leveled RF output from the instrument as selected by the RF OUTPUT control and Attenuator Control. AMPL TRIMMER pushbutton switch S6 is returned to operation in conjunction with AMPL TRIMMER capacitor C17B for peaking the RF output using the leveling signal feedback from Modulators Q8-Q9.

#### 4-51. ATTENUATOR SECTION.

4-52. To extract power from the RF Generator Section, a piston-type attenuator is used. The attenuator housing projects through the rear of the generator housing, and provides an open-ended termination near the power amplifier plate-circuit inductor. A single-turn pick-up loop at the end of the attenuator probe couples energy to an impedance-matching network consisting of capacitors C69 and C37, and resistors R58 and R59. Capacitor C37 is a movable slug in the probe body that is used to adjust the standing-wave ratio to a minimum value when RF OUTPUT connector J4 is terminated in a 50-ohm load.

4-53. The front-panel mounted Attenuator Control moves the probe in the attenuator housing, and controls the amount of RF energy passed to the output connector. In both the Model 608E and 608F, calibration is accomplished by adjusting the RF OUTPUT and AMPL TRIMMER controls for a steady +7 dBm (ATTENUATOR CALIBRATED) indication on the RF OUTPUT meter across the frequency range in use. An adjustment of the Attenuator Control after calibration procedures are completed provides the RF output level indicated on the control dial as long as the RF OUTPUT meter needle remains in the ATTENUATOR CALIBRATED position. In the Model 608E only, an rf output between +7 dBm and +13 dBm can be selected. The Attenuator Control is set to the +7 dBm position (maximum clockwise), and the RF OUTPUT and AMPL TRIMMER controls are adjusted for the RF OUTPUT meter indication of +7 dBm as previously discussed. The desired output level above +7 dBm is then selected by operation of the RF OUTPUT control only, and the output is read directly from the RF OUTPUT meter.

4-54. Two parallel wires crossing the open end of the attenuator housing are used to provide a sample of RF energy delivered by Power Amplifier V8. The energy is applied to the Bolometer through ferrite-bead RFC1, which provides isolation between the Bolometer and Attenuator. The Bolometer contains frequency-response coil L17, diode CR2 and resistor R60. The RF signal detected across resistor R60 and diode CR2 is passed through an RF filter consisting of capacitor C38 and resistor R119. The detected signal is then applied through RFI filter FL8 to the Modulation Meter Section discussed in paragraph 4-60, and to transistor Q2 in the Amplitude Modulation Section discussed in paragraph 4-40.

#### 4-55. CALIBRATOR SECTION.

4-56. The Calibrator Section consists of 5-MHz Oscillator V9A, 1-MHz Oscillator V9B, Harmonic Generator and Mixer CR1, Amplifiers V10A and V11, and output transformer T3. The oscillator and mixer circuits are illustrated in Figure 7-4, while the amplifiers and transformer are located on Figure 7-5.

4-57. The 5-MHz Oscillator is a crystal-controlled, electron-coupled oscillator utilizing the pentode half of a type 6U8 tube. The plate and screen circuits are tuned to the crystal frequency of 5 MHz by coils L6 and L7. Trimmer capacitor C23 is used for fine-frequency adjustment of the oscillator. The 1 MHz Oscillator consists of the triode portion of the tube, with coil L18 used to adjust the oscillator to a point where the fifth harmonic is synchronized with the 5-MHz output of Oscillator V9A. When XTAL CAL switch S4 is set to the 5-MC position, only Oscillator V9A is active. In the 1-MC position both oscillators are operating, with Oscillator V9A referencing the 1-MHz oscillator.

4-58. The output signal from Oscillators V9A or V9B is passed across dc blocking capacitor C24 to diode CR1 which acts as a harmonic generator and mixer. The anode of diode CR1 is inductively coupled to the output circuit of Power Amplifier V8 by running a lead near the plate of the amplifier. Oscillator harmonics within the diode are mixed with RF output signals to produce audio-beat frequencies across resistor R50 in the grid circuit of Amplifier V10A. The output of amplifier V10A is again amplified in V11 and applied across capacitor C36 to 600-ohm, line-matching transformer T3. The secondary of transformer T3 is connected to XTAL CAL OUTPUT connector J3 where the calibrating signals can be monitored. XTAL CAL GAIN resistor R56 provides front-panel control of the audio level output at connector J3.

#### 4-59. MODULATION METER SECTION.

4-60. The Modulation Meter Section consists of a detector network in the Bolometer portion of the Attenuator Section. Amplifiers V18 and V19, Rectifier

V20, and a balanced-bridge circuit containing PERCENT MODULATION meter M2. The Bolometer is illustrated in Figure 7-4, and the remainder of the section appears in Figure 7-5.

4-61. The output of diode CR2, capacitor C38 and resistor R119 in the Bolometer is a dc signal which is representative of the RF output level, and the modulating signal when internal or external modulation is in process. The output is passed through RFI filter FL8 and applied to blocking capacitor C39, which couples the modulating signal to Amplifier V18. The output of Amplifier V18 is amplified again in V19 and passed to the plates of Rectifier V20. A stabilization feedback circuit connects the plate of Amplifier V19 and cathode of Amplifier V18, with resistor R99 and capacitor C55 installed in the circuit for frequency compensation.

4-62. Rectifier V20 is connected in a balanced-bridge detector circuit consisting of twin-triode V21, PERCENT MODULATION meter M2, and associated circuitry. With no modulating signal applied to the circuit, the steady-state dc potential at the plate of Amplifier V19 is coupled to the grids of V21A and V21B. In this condition, equal current flows on both sides of the bridge, and the PERCENT MODULATION meter reads zero. ZERO potentiometer R106 is a front-panel adjustment to compensate for variations in tube and component values. When a modulation mode of operation is in progress, the peak value of the rectified modulating signal is applied to the grid of V21B. The bridge is unbalanced accordingly, and produces an indication on the PERCENT MODULATION meter that is in direct proportion to the amplitude of the modulating signal. Triode V21A is unaffected during the detection cycle, since the modulating signal is filtered by resistors R100, R101, and capacitor C58.

#### 4-63. POWER SUPPLY SECTION.

4-64. Four series-regulated power supplies are contained in the power supply section. The power supplies provide +225, -6.3, -165, and +25 volts dc to the Model 608 Signal Generators. The four supplies are connected to a common input source through ON switch S3. A slide switch located on the rear panel of the instrument sets the generators for use with either a 115-Vac or 230-Vac power source, with AC LINE fuse F1 connected between the power supplies and source as a protective device. The supplies are illustrated in Figure 7-5 and are described in the following paragraphs.

4-65. THE +225 VOLT SUPPLY. Input ac voltage to the +225-volt supply is received across transformer

T1. The secondary contains bridge rectifier CR8 through CR11 and filter capacitor C40. The supply is series regulated through triodes V13A, V13B, and V16B, with the output connected to the load through front-panel mounted DC 0.25 AMP fuse F3. The -165 Volt Power Supply output is used as reference, being applied through a voltage divider consisting of resistors R70 through R72. Any change in the load is sensed across +225 Volts Adj potentiometer and applied to the control grid of Comparison Amplifier V12. The plate of amplifier V12 controls the conduction level of the series regulators, and holds the output voltage constant. The +225 volt supply is used to reference the +25 volt supply discussed in paragraph 4-69.

4-66. THE -6.3 VOLT SUPPLY. Input ac voltage to the -6.3-volt supply is also received across transformer T1. Rectification and filtering occur across bridge rectifier CR16 through CR19 and capacitors C75. Transistor Q1 operates as a comparison amplifier and series regulator, with the base circuit referenced by -7.5 Vdc developed from the -165 Vdc supply across resistor R260 and Zener diode CR20. The output voltage of 7.2 Vdc is applied to RFI Filter FL4 where 0.9 Vdc is dropped. The -6.3 volts is then used as a filament supply for RF Oscillator V6, Buffer Amplifier V22, and Power Amplifier V8. Filament voltage for the remaining tubes in the instrument is provided by a separate secondary winding of transformer T1. The latter winding also supplies voltage to a light behind the MEGACYCLES dial, and to the AC POWER light located on the front panel. Both lamps are lighted when switch S3 is in the ON position.

4-67. THE -165 VOLT SUPPLY. Input ac voltage to the -165 volt supply is received across transformer T1, and rectified by diodes CR12 through CR15. Triode V16A is the series regulator, with the grid controlled by the plate of Comparison Amplifier V14 whose cathode is referenced by gas tube V15. The voltage level is controlled -165 Volts Adj potentiometer R80, with the output applied to the load and to the +225 and -6.3 volt supplies for reference.

4-68. THE +25 VOLT SUPPLY. Components of the +25 volt supply are located on the Modulator and ALC Board, which also contains a portion of the Amplitude Modulation Section circuits discussed in paragraph 4-37. Ac power to the supply is received across transformer T2, and rectified by diodes CR29 and CR30. Transistor Q11 is the series regulator, with the conduction level being control by Amplifier Q10. The supply is referenced by +225 Vdc received across resistor R239.

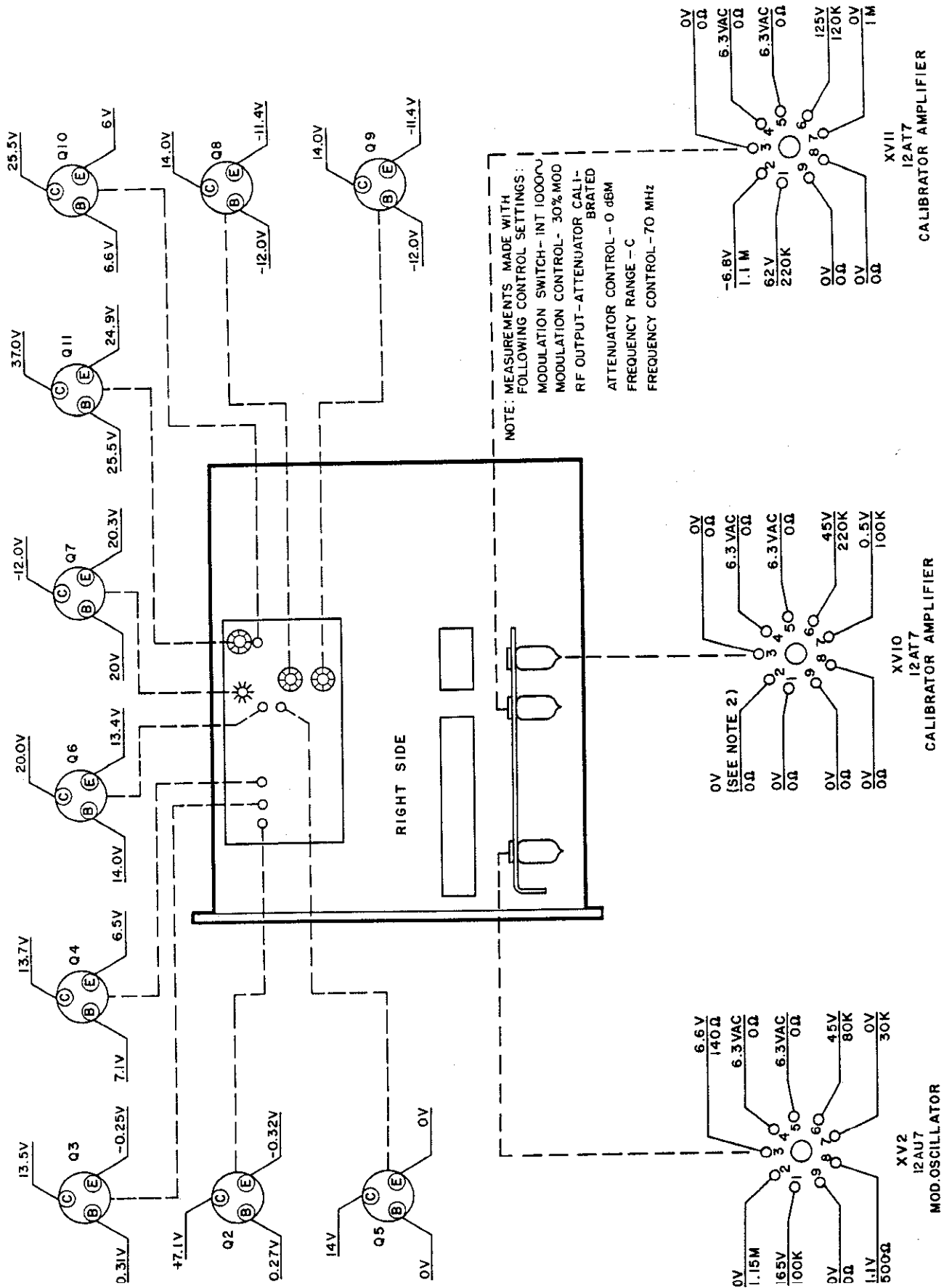


Figure 5-20. Voltage and Resistance Measurements, INT 1000 ~ Operation (Sheet 1 of 3)

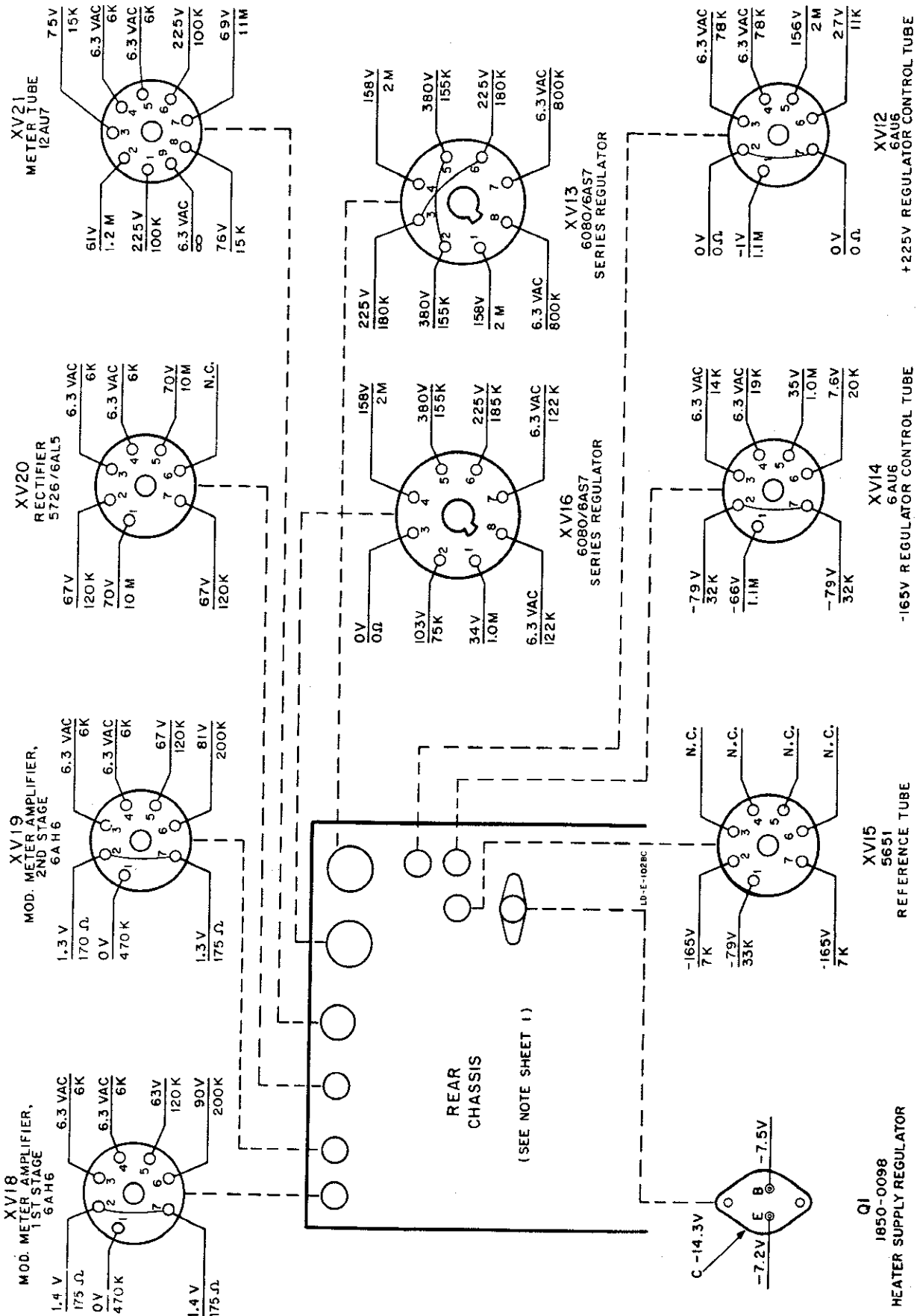


Figure 5-20. Voltage and Resistance Measurements, INT 1000 ~ Operation (Sheet 2 of 3)



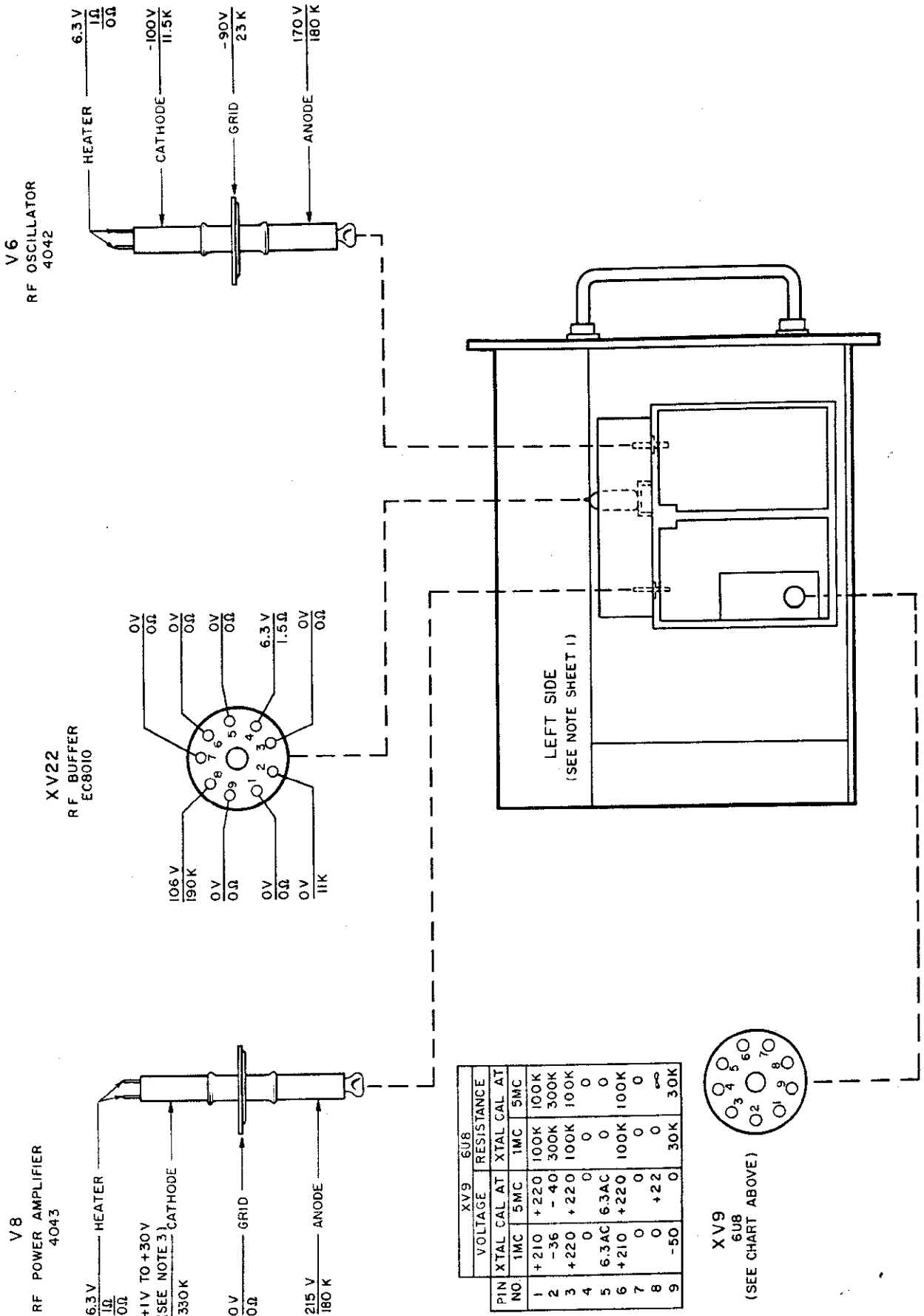
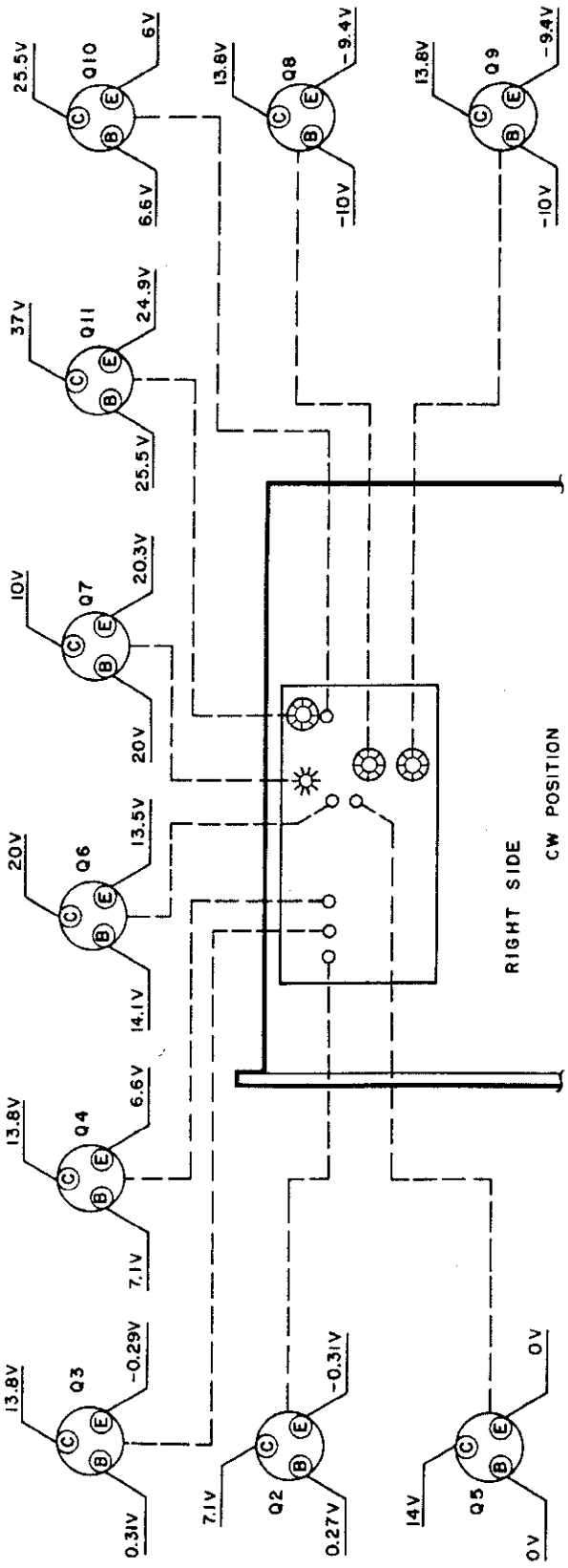


Figure 5-20. Voltage and Resistance Measurements, INT 1000 - Operation (Sheet 3 of 3)



NOTE: DIAL CONTROL FREQUENCY, RF OUTPUT, AND ATTENUATOR CONTROL SETTINGS SAME AS FIGURE 5-20

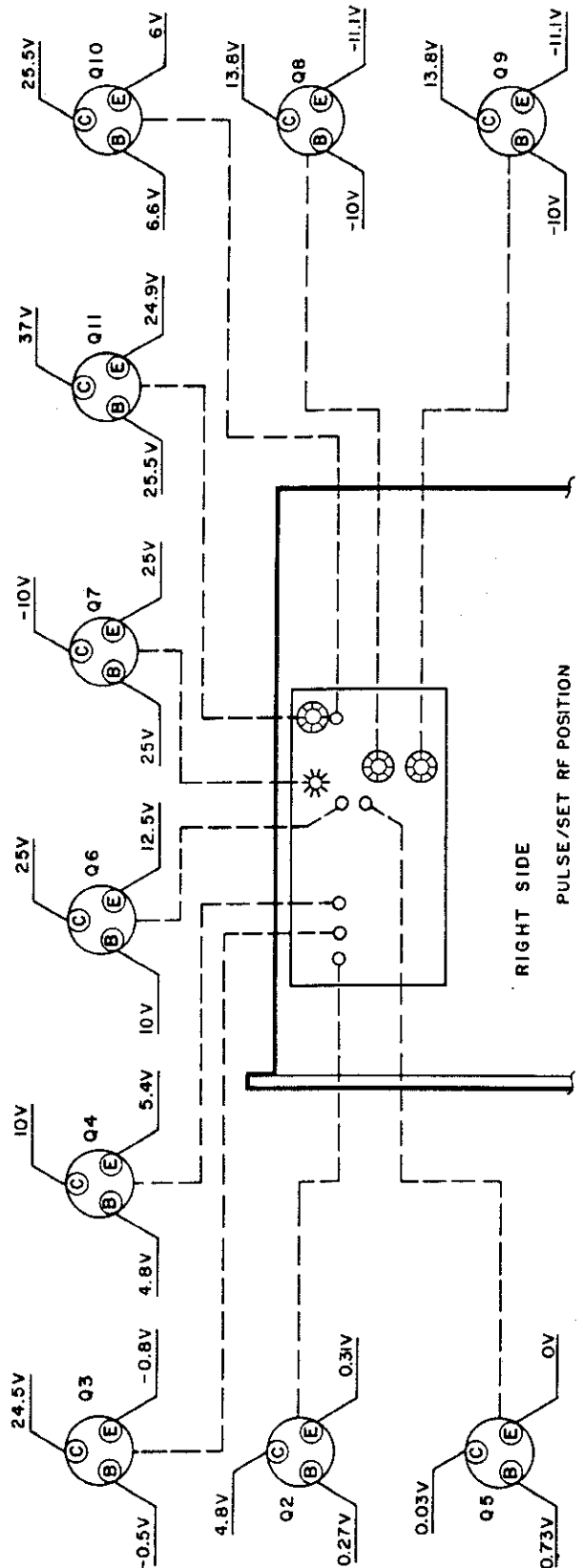


Figure 5-21 ALC Board Voltage and Resistance Measurements, CW and PULSE SET RF OUTPUT Operation







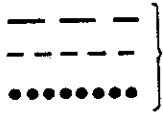
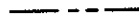
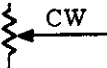





1. Resistance is in ohms, capacitance is in microfarads unless otherwise noted.
2.  Screwdriver adjustment.
3.  Panel control.
4.  Encloses front panel designations.
5.  Signal path.
6.  Denotes feedback paths, used in different circuits.
7.  Circuit assembly borderline.
8.  Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
9.  Test point. Number in circle matches TP number.
10.  Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider strip, and the third number identifies the narrow strip. E G.,  denotes white base, yellow wide stripe, violet narrow stripe.
11.  Voltage regulator (breakdown) diode.
12.  Feed-through capacitor (shunt capacitor, commonly used for bypassing high frequency currents to chassis).

Figure 7-2. Schematic Diagram Notes

Model 608E/F

NOTES:

- 1. INSTALLED IN MODEL 608F ONLY.
- 2. VALUE SELECTED IN TEST-NOMINAL VALUE SHOWN.
- 3. R214 IS 200 OHMS IN MODEL 608E AND 392 OHMS IN MODEL 608F.
- 4. R251 IS 301 OHMS IN MODEL 608E AND 200 OHMS IN MODEL 608F.
- 5. C25 IS NSR: PART OF V6.
- 6. R114 IS NSR: PART OF FL9.
- 7. C37 AND C69 ARE NSR: PART OF AT1.
- 8. L17 IS NSR: PART OF BOLOMETER.
- 9. INDICATED VOLTAGES-IMC PULSE SET RF OUTPUT MODE.

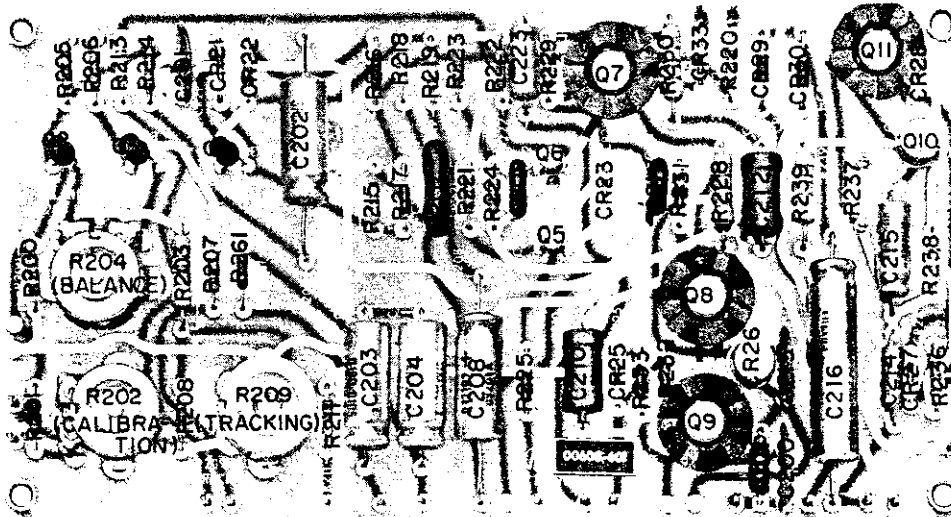
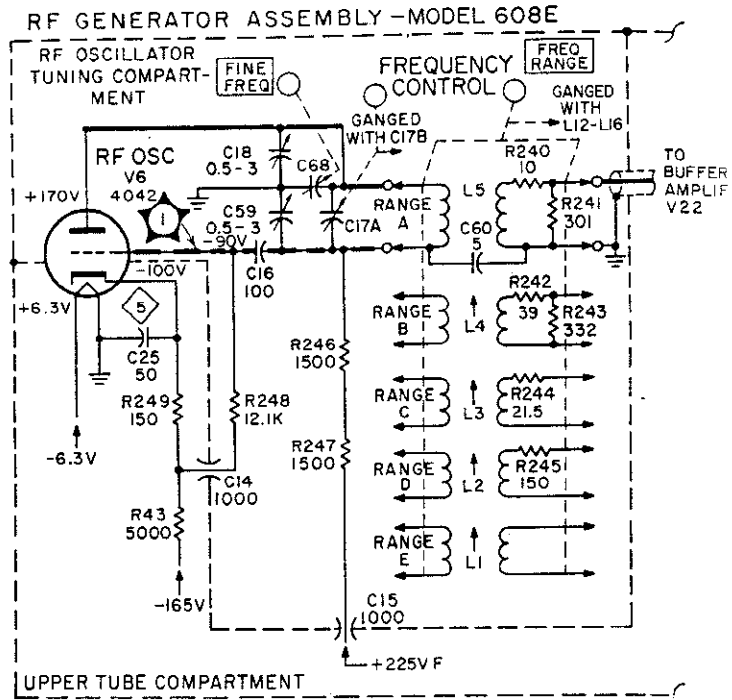


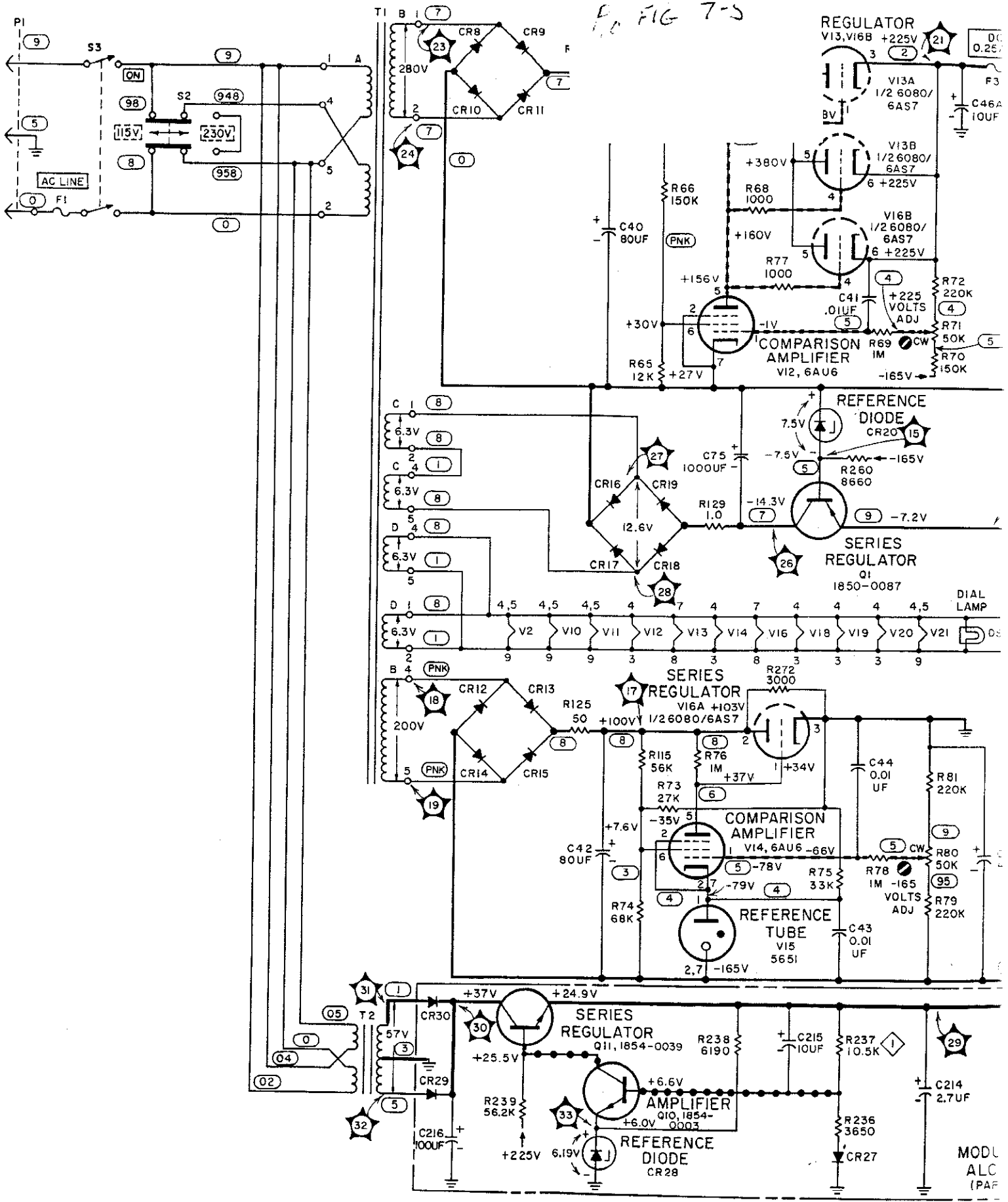
Figure 7-3. Component Identification, Modulation and ALC Board

REFERENCE DESIGNATIONS

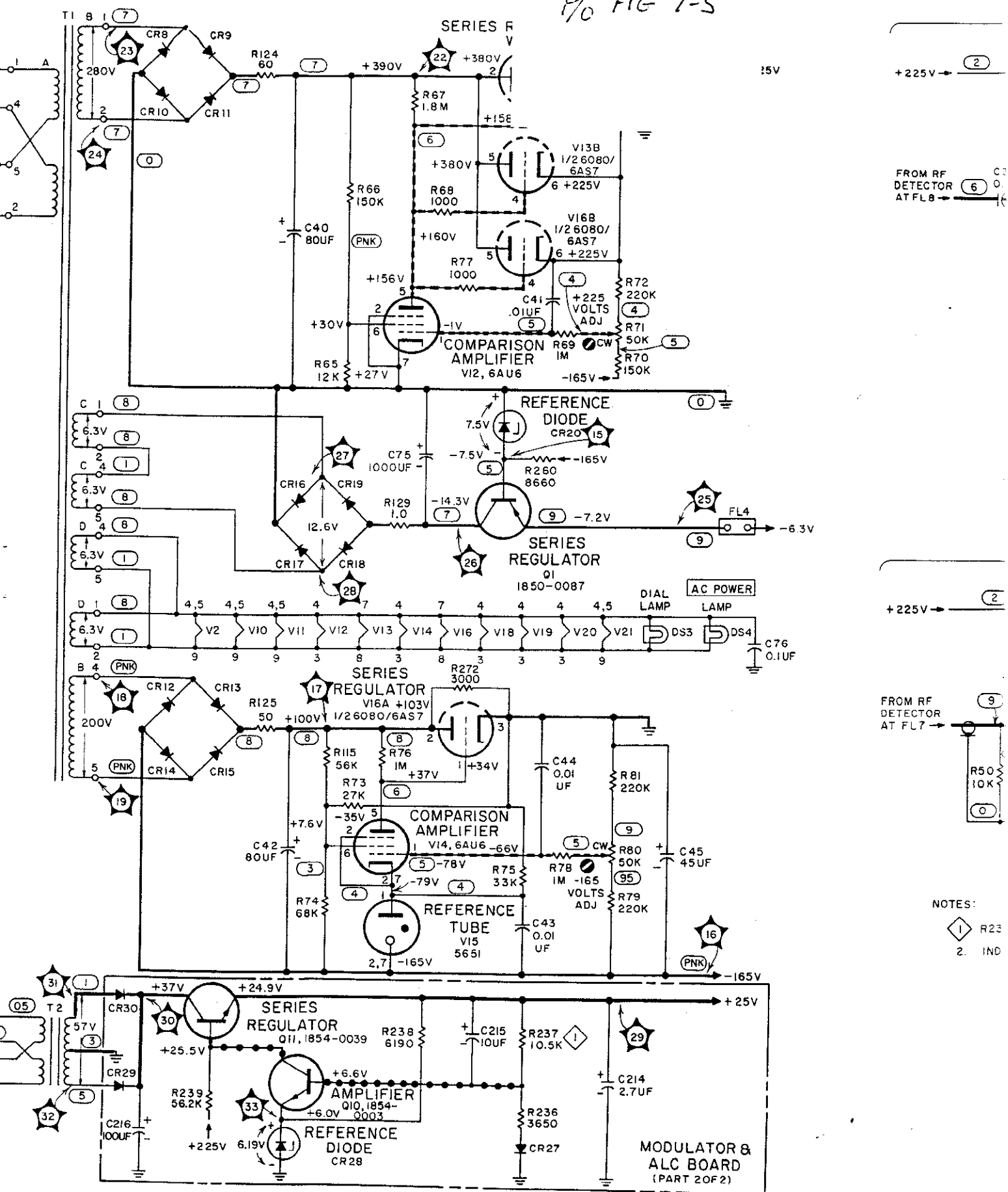
C34-36, 39, 40-46, 49-53, 55-58,  
C62, 75, 76, 214-216  
CR8-20, 27-30  
DS3, 4  
F1, 3  
FL4  
J3  
M2  
PI  
Q1, 10, 11  
R50-56, 65-81, 88-102, 104-107, 115,  
R124, 125, 129, 236-239, 260, 272  
S3  
T1, 2, 3  
V2, 10-14, 16, 18-21

◀ Figure 7-5  
Modulation Meter, Crystal Calibration, and  
Power Supply Schematic Diagrams

FIG 7-5

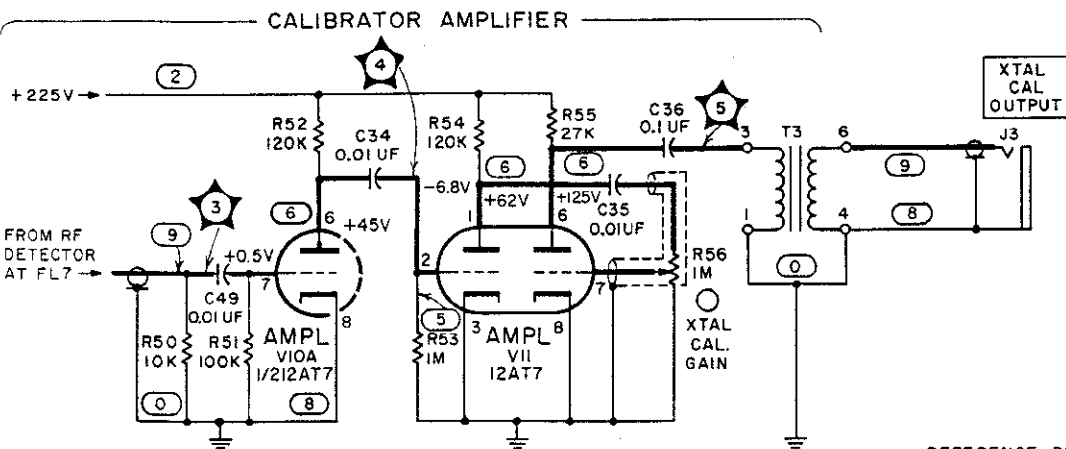
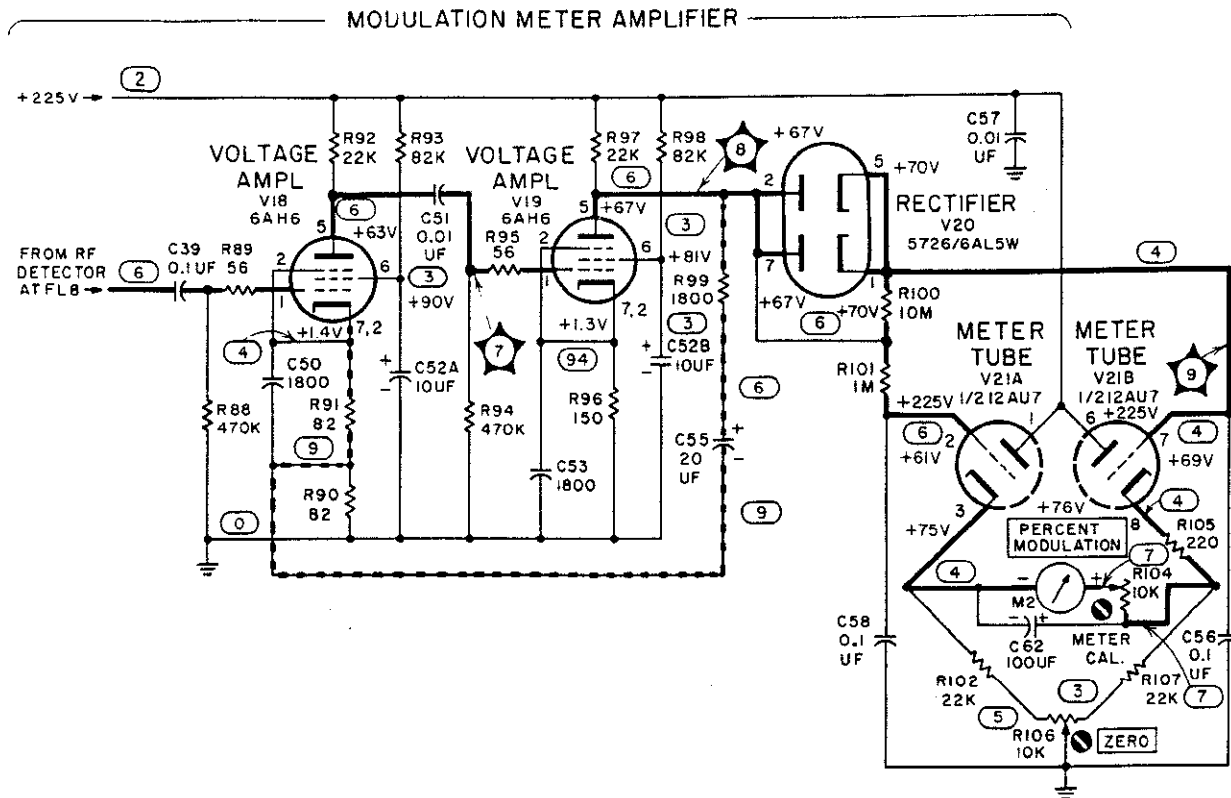


P/O FIG 7-5



NOTES:  
 1. R23  
 2. IND





**NOTES:**

- 1. R237 SELECTED IN TEST - NOMINAL VALUE SHOWN.
- 2. INDICATED VOLTAGES - CW MODE.

**REFERENCE DESIGNATIONS**

- C34-36, 39, 40-46, 49-53, 55-58, C62, 75, 76, 214-216
- CR8-20, 27-30
- DS3, 4
- F1, 3
- FL4
- J3
- M2
- PI
- Q1, 10, 11
- R50-56, 65-81, 88-102, 104-107, 115, R124, 125, 129, 236-239, 260, 272
- S3
- T1, 2, 3
- V2, 10-14, 16, 18-21

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608E-PS-543A-B

Figure 7-5. Modulation Meter, Crystal Calibration and Power Supply Schematic Diagrams

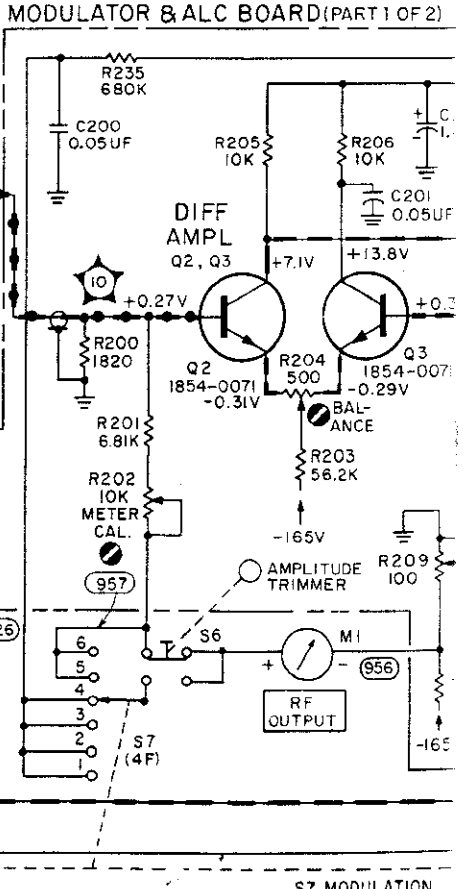
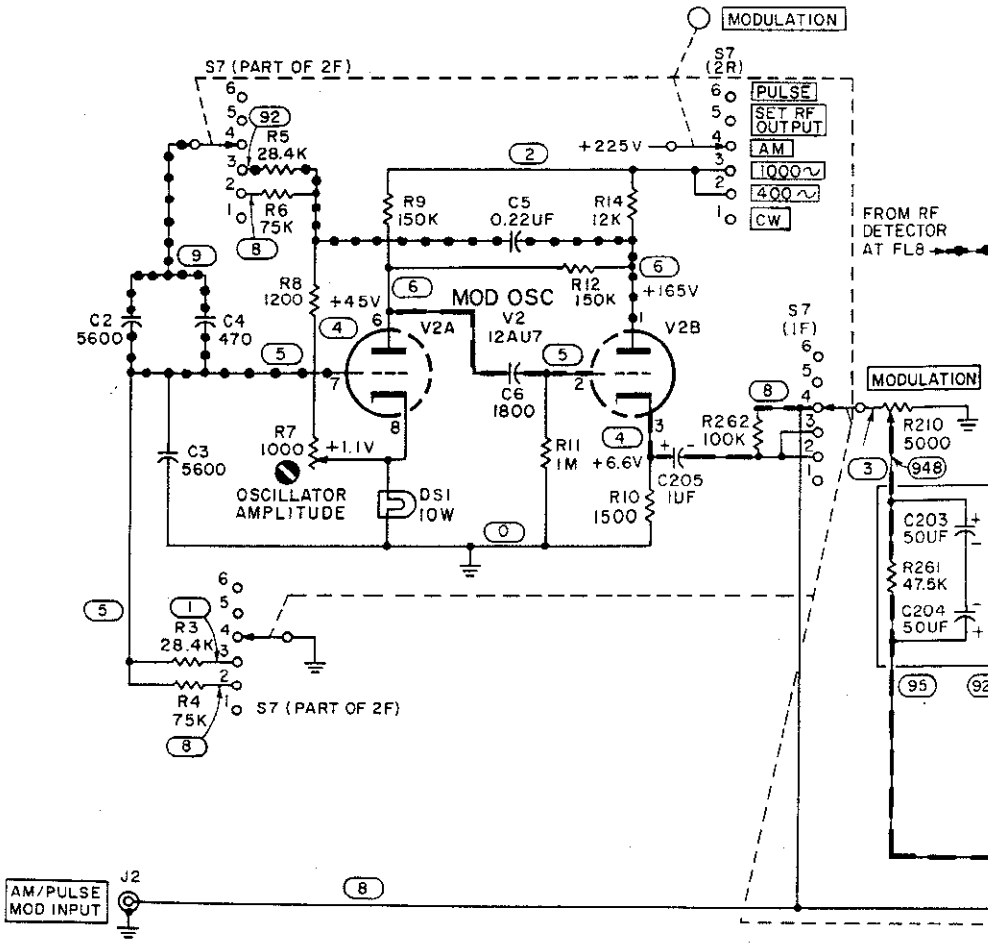
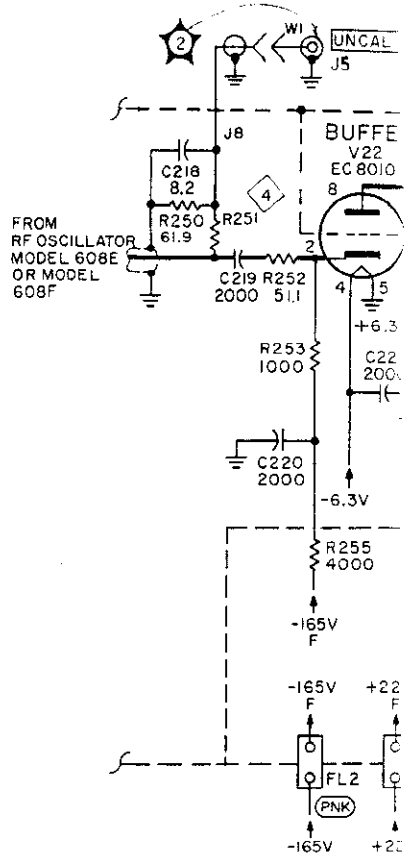
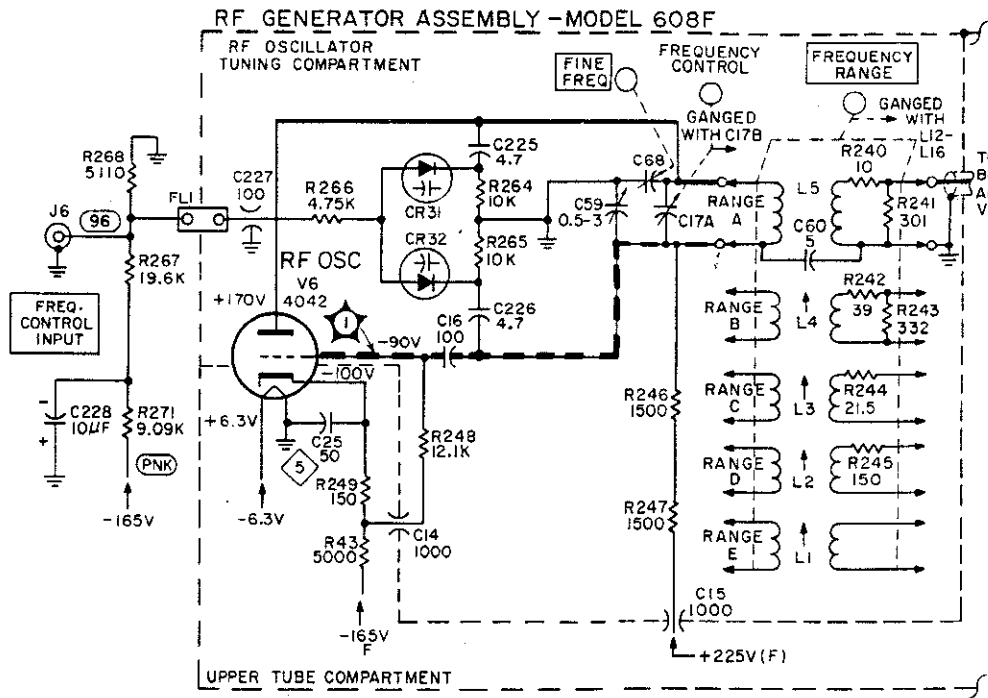
REFERENCE DESIGNATIONS

AT1  
C2-6,14-17,19-26,28,30-33,37,38,59,60  
61,68-74,200-213,218-227  
CPI  
CR1,2,7,21-23,25,26,31-33  
FL2-11  
I1  
J2,4,5,8  
LI-7,11-18,20,22  
M1  
Q2-9  
R3-11,14,33,43,48,49,57-60,114,118,119  
R122,123,200-233,235,240-258,261-270  
S4,6,7  
W1  
Y1

DELETED: CR24, R227, R126

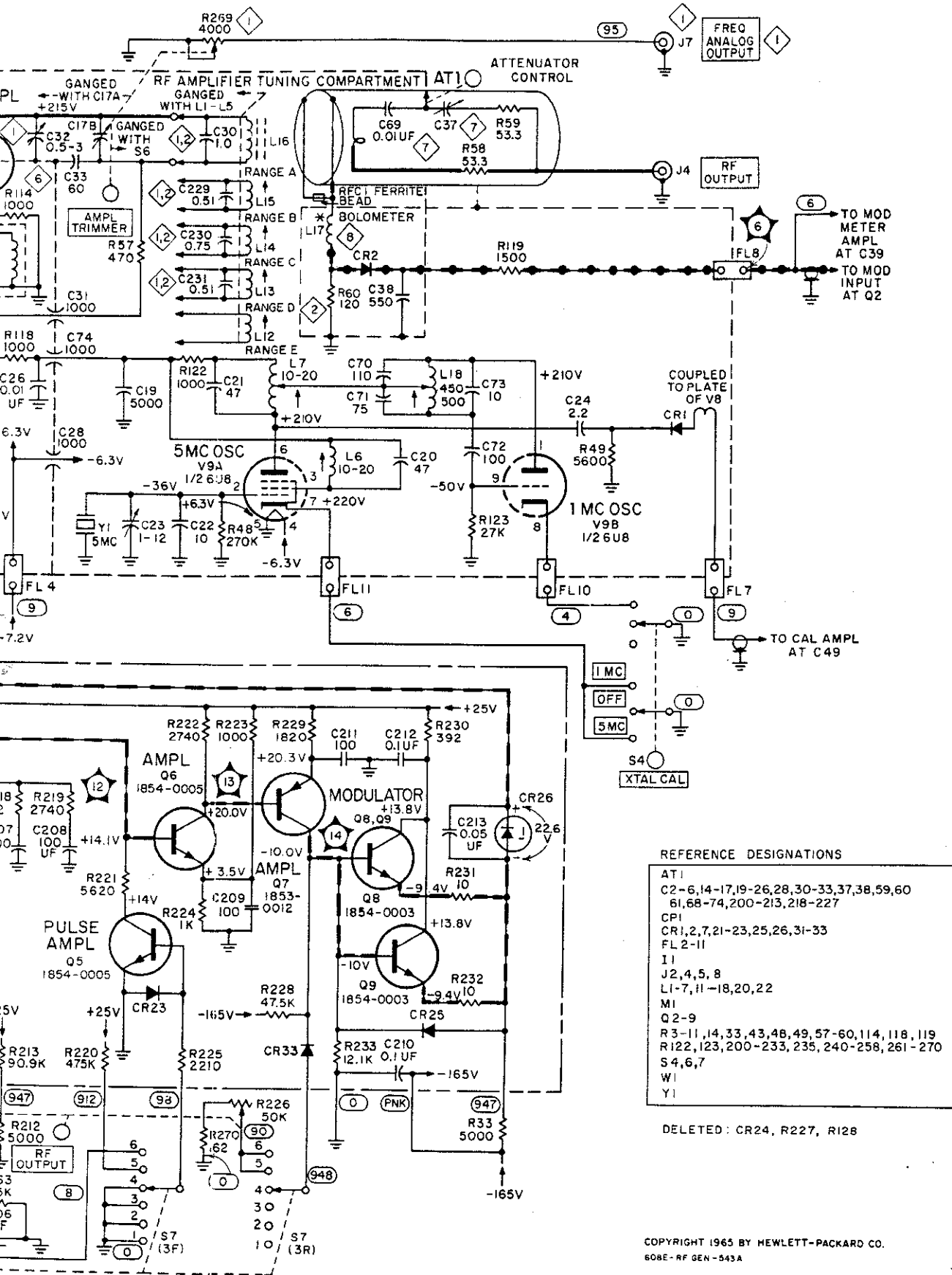
◀ Figure 7-4

**RF Generator and Modulator Schematic  
Diagram**



S7 MODULATION





REFERENCE DESIGNATIONS

AT1
C2-6,14-17,19-26,28,30-33,37,38,59,60 61,68-74,200-213,218-227
CP1
CR1,2,7,21-23,25,26,31-33
FL 2-11
I1
J2,4,5,8
LI-7,11-18,20,22
MI
Q2-9
R3-11,14,33,43,48,49,57-60,114,118,119 R122,123,200-233,235,240-258,261-270
S 4,6,7
W1
Y1

DELETED: CR24, R227, R128

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608E-RF GEN-543A

Figure 7-4. RF Generator and Modulator Schematic Diagram

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