

**TECHNICAL MANUAL**

**OPERATOR'S, ORGANIZATIONAL  
DIRECT SUPPORT, AND GENERAL SUPPORT  
MAINTENANCE MANUAL**

**SIGNAL GENERATOR  
AN/USM-44B  
(NSN 6625-00-176-5708)**

## **WARNING**

Hazardous voltages are used in the operation of this equipment. Use extreme caution not to contact high-voltage, 115-volt, or 230-volt input connections when working on equipment. When working inside the equipment, always disconnect primary power and ground the high-voltage capacitors. Failure to comply may result in death or serious injury to personnel.

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AND GENERAL SUPPORT MAINTENANCE MANUAL**

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You can improve this manual by recommending improvements using DA Form 2028-2 (Test) located in the back of the manual. Simply tear out the self addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail. If there are no blank DA Form 2028-2 (Test) forms in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703.

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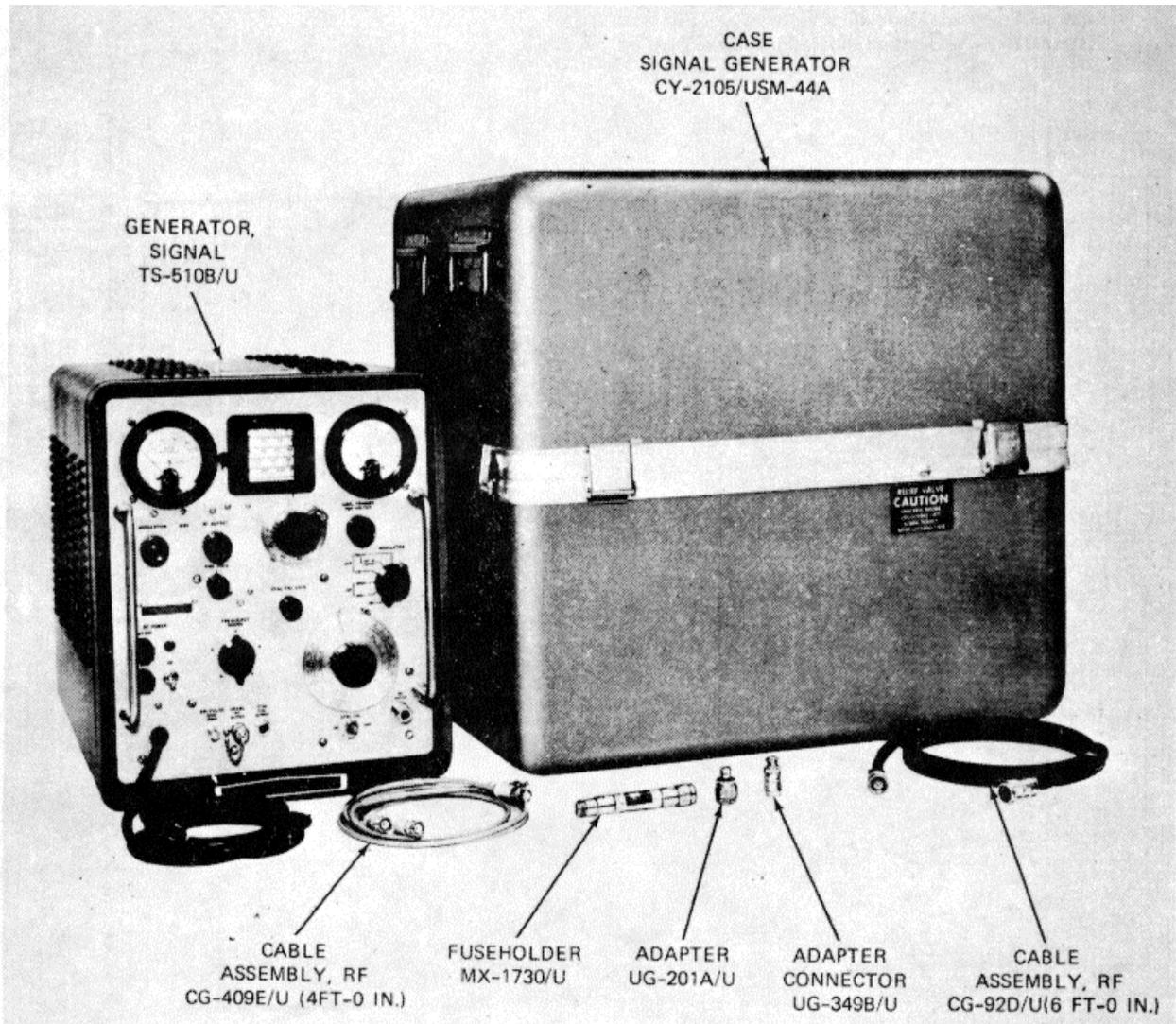


Figure 1-1. Generator, Signal AN/USM-44B (less running spares)

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## CHAPTER 1 INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope.

a. This manual describes Generator, Signal AN/USM-44B (fig. 1-1) and includes instructions for installation, operation, and operator, organization direct support, and general support maintenance.

b. A list of references is contained in appendix A.

c. The maintenance allocation chart (MAC appears in appendix B.

#### 1-2. Indexes of Publications

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

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

#### 1-3. Forms and Records

a. *Reports of Maintenance and Unsatisfactory Equipment*. Maintenance forms, records, and report which are to be used by maintenance personnel at

maintenance levels are listed in and prescribed by TM 38-750.

b. *Report of Packaging and Handling Deficiencies*. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR71-13/MCO P4030.29A, and DSAR 4145.8.

c. *Discrepancy in Shipment Report (DISREP) (SF 361)*. Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR75-18/MCO P4610.19B and DSAR 4500.15.

#### 1-4. Administrative Storage

For procedures, forms and records, and inspections required during administrative storage of this equipment, refer to TM 740-90-1.

#### 1-5. Destruction of Electronic Material

Demolition and destruction of electronic equipment will be under the direction of the commander and in accordance with TM 750-244-2.

### Section II. DESCRIPTION AND DATA

#### 1-6. Purpose and Use

The generator, Signal AN/USM-44B, comprised of Generator, Signal TS-510B/U and various adapters and cable assemblies, is a general-purpose, very high frequency (vhf) signal generator set that provides, radio frequency (rf) signals used to test, evaluate, and align radio receivers, filters, amplifiers, and similar electronic networks. The TS-510B/U provides continuous-wave (cw), amplitude-modulated (am), or pulse-modulated signals in the frequency range of 10 MHz to 480 MHz at calibrated output levels of 0.1 microvolt to 1.0 volt. A direct reading frequency dial is calibrated to an accuracy of 0.5 percent and internal crystal calibrator provides frequency check points at 1 MHz and 5 MHz intervals with an error of less than 0.01 percent. The TS-510B/U can be internally amplitude modulated at 400 Hz or 1000 Hz, externally amplitude modulated from 20 Hz to 20 kHz, and externally pulse modulated.

#### 1-7. Description

Generator, Signal TS-510B/U (fig. 1-1) is the only major unit supplied as part of the AN/USM-44B. It is housed in a metal cabinet designed for mobile, bench-

top operation. The front panel is equipped with handles for easy moving. All connectors and operating controls are mounted on the front panel.

#### 1-8. Description of Minor Components

The minor assemblies of AN/USM-44B are included in figure 1-1. Special functions of the minor assemblies are listed below.

a. *Fuseholder MX-1730/U*. The MX-1730/U fuseholder prevents accidental burnout of TS-510B/U attenuator during transceiver testing. It places a fuse element between the transceiver and the attenuator. Several watts of rf power could otherwise be applied to the output attenuator should the transceiver be accidentally switched to the transmit mode of operation. The MX-1730/U in no way limits the usable output of the TS-510B/U.

b. *Cable Assembly, RF CG-92D/U*. The CG-92D/U (6 ft-0 in.) cable has type N male connectors on both ends, and is used to connect the TS-510B/U rf-output to the equipment under test.

c. *Cable Assembly, RF CG-409E/U*. Two CG-409E/U (4 ft-0 in.) cables are terminated with male BNC connectors each end and are used to connect

the TS-510B/U uncalibrated rf and external modulation connectors to other test equipment.

d. Adapter UG-201A/U and UG-349B/U. UG-201A/U adapter is equipped with a type N female connector and a BNC female connector.

UG-349B/U adapter is equipped with a type N female connector and a male BNC connector.

e. Case, Signal Generator CY-2105/USM-44A. CY-2105/USM-44A case is constructed of fiberglass reinforced resin, is watertight and airtight, and has pressure relief valve. It is designed to carry all components and running spares of the AN/USM-4, Heavy polyurethane foam completely surrounds equipment to provide maximum shock protection with a minimum of case weight.

**1-9. Tabulated Data**

a. Generator, Signal TS-510B/U.

Frequency Range .....	10 MHz to 480 MHz in 5 bands MHz to 21 MHz, 21 MHz to 43 MHz 43 MHz to 95 MHz, 95 MHz to 215MHz; and 215 MHz to 480 MHz)
Frequency dial accuracy ...	+ 0.5%
Frequency drift.....	Less than 50 parts in 106 per 10 minutes after 1 hour warm-up; 1 than 10 minutes to re-stabilize after changing frequency
Frequency dial resettability.	Better than 0.1% after initial warm- up
Crystal calibrator .....	Provides check points every 1 MHz up to 270 MHz and every 5 MHz of entire frequency range; frequency accuracy is better than 0.01% normal room temperature.
Residual FM.....	Less than + 5 parts in 107
Harmonic output .....	At least 35 dB below rf carrier harmonic frequencies below 5 MHz
Output level.....	Continuously adjustable from microvolt to 1.0 volt into a 50-ohm resistive load; output dial calibrated in volts and dBm (0 dBm = 1 milliwatt into 50 ohms).
Attenuator dial accuracy ...	± dB at any frequency when rf output meter indicates ATTENUATOR CALIBRATED
Output impedance .....	50 ohms with a maximum VSWR 1.2:1 for attenuator settings below minus 7 dBm
Rf leakage.....	Permits receiver sensitivity measurement down to at least 0.1 microvolt.
Uncalibrated rf output .....	180 millivolts minimum, fixed-level cw signal

**NOTE**

All modulation specifications are taken with AMPL TRIMMER control adjusted to peak rf output meter, and RF OUTPUT control adjusted to set rf output meter at ATTENUATOR CALIBRATED line.

Internal AM frequency .....	400Hz or 1000Hz, + 10% Internal AM level Continuously adjustable from 0 to 95% at rf carrier levels of 0.5 volt and below
Internal AM rf-carrier envelope distortion .....	Less than 2% at 30% modulation and less than 5% at 70% modulation
External AM frequency .....	20 Hz to 20 kHz
External AM level.....	Continuously adjustable from 0 to 95% at rf carrier levels of 0.5 volt and below; 1 to 10 volts rms into 5000 ohms required
External rf carrier envelope distortion .....	Less than 2% at 30% modulation and less than 5% at 70% modulation when modulation source distortion is less than 0.5%
Modulation meter accuracy	±5% of full scale from 0 to 80%; ± 10% from 80% to 95%; for internal or external (20 Hz to 20 kHz) AM
Incidental FM .....	At modulation frequencies of 400 Hz and 1000 Hz, less than 1000 Hz peak at 50% AM for rf carrier frequencies above 100 MHz; less 0.001% at 30% AM for rf carrier frequencies below 100 MHz
External pulse modulation	Less than 4 microseconds combined rise and decay time for rf carrier frequencies from 40 MHz to 220 MHz; less than 2.5 microseconds combined rise and decay time for rf carrier frequencies above 220 MHz; rf carrier on-off ratio at least 20 dB for pulsed rf carrier levels above 0.5 volt; positive 10-to-50 volts peak into 2000 ohms required
Power requirements .....	115 Vac or 230 Vac, ± 10%, 50 Hz to 400 Hz, 220 watts
Weight:	
Operating .....	70 pounds
In case .....	105 pounds

b. Fuseholder MX-1 730/U.

Overload protection .....	Burnout occurs at approximately 0.4 watt; can be operated continuously at 0.2 watt
Impedance.....	50 ohms; VSWR 1.35:1 when terminated with 50 ohm matched load, 1.6:1 when terminated with TS-510B/U
Insertion loss .....	1 dB
Fuse .....	8AG, 1/16 ampere fast instrument fuse
Connectors .....	Type N, one male and one female
Weight .....	0.5 pound

**1-10. Items Comprising an Operable Equipment**

Items comprising an operable AN/USM-44B are listed in table 1-1.

Table 1-1. Items Comprising an Operable, AN/USM-44B

Quantity No.	National Stock	Item	Dimensions (in.)			Unit weight (lb)
			Height	Depth	Width	
1	6625-00-519-1645	Generator, SignalTS-510B/U	16-3/4	21	13-1/4	70
1	5920-00-636-0679	Fuseholder MX-1730/U	13/16	4-5/8		0.5
2	5995-00-823-2676	Cable Assembly, RF CG-409E/U (4 ft-0 in.)				0.4
1	5995-00-561-9211	Cable Assembly, RF CG-92D/U (6 ft-0 in.)				1
1	5935-00-258-7429	AdapterUG-201A/U	13/16	1-5/16		0.13
1	5935-00-732-1919	AdapterUG-349B/U	5/8	1-1/2		0.06
1	6625-00-542-0991	Case, Signal Generator CY-2105/ 13-30/32 USM-44A	18	11-3/4		25

## CHAPTER 2

## SERVICE UPON RECEIPT AND INSTALLATION

**2-1. Unpacking**

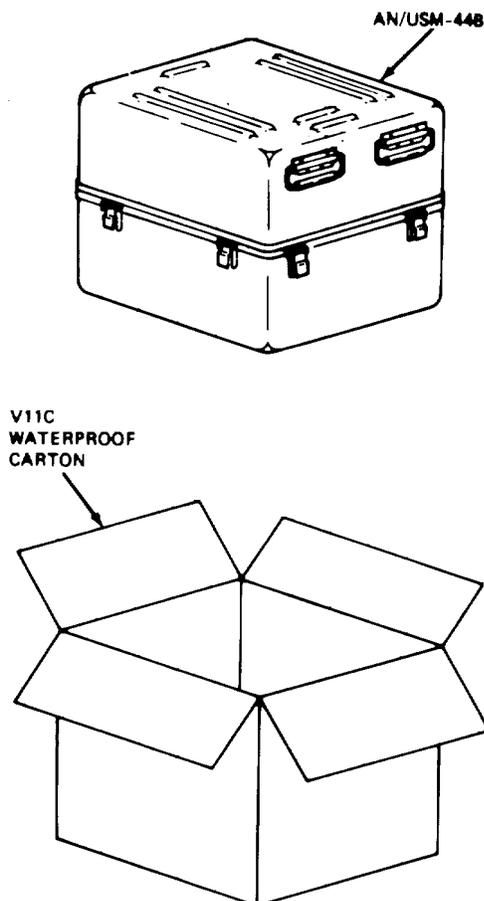
a. *Packaging Data.* When packed for shipment the TS-510B/U, cable assemblies adapters, and fuseholder are stored in the CY-2105/USM-44A case. The running spares and the CY-2105/USM-44A case is then placed in an outer corrugated, waterproof carton. The packing method used is shown in figure 2 -1.

b. *Removing Contents.* Remove contents from packing box as follows:

- (1) Open top of outer corrugated carton.
- (2) Remove AN/USM-44B.

**2-2. Checking Unpacked Equipment**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged report the damage on the DD Form 6(para 1-3b).



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Figure 2-1. Generator Signal AN/USM-44B packing diagram.

b. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the component data given in table 1-1. Report all discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect proper functioning of the equipment shall not prevent use of the equipment.

c. Check to see whether the equipment has been modified. (Equipment which has been modified will have the MWO number on the front panel near the nomenclature plate.) Check to see whether all currently applicable MWO's have been applied. (Current MWO's applicable to the equipment are listed in DA Pam 310-7.)

**NOTE**

A crystal and vacuum tubes are mounted inside the main generator casting. Do not remove casting covers for the sole purpose of checking the seating of these devices. Also, do not disassemble MX-1730/U fuseholder to check for fuse installation.

**2-3. Seating of Tubes, Fuses, and Crystals**

The TS-510B/U is shipped with all tubes, fuses, and crystals installed and the MX-1730/U with a fuse installed. Check that 4.0-ampere, 125-volt line fuse and 0.25-ampere, dc fuse are installed in the correct TS-510B/U front panel fuseholder. Check for breakage and proper seating of tubes (figs. 2-2 and 2-3). To check TS-510B/U tubes, remove equipment cabinet from chassis in accordance with paragraph 2 -4.

**2-4. Cabinet Removal**

- a. Set TS-510B/U on front panel handles.
- b. Remove the four large knurled support/retaining screws on rear panel.
- c. Slide chassis from cabinet.

**2-5. Equipment Installation and Connections**

a. *Installation.* The TS-510B/U is designed primarily for bench top operation. It can, however, be set on the deck by using the rear panel supports. In either operating position do not place anything on top of or against the sides of the TS-510B/U that will prevent free air movement through the louvers.

b. *Connections.* The TS-510B/U can be operated either 115 Vac or 230 Vac, 50 Hz to 400 Hz. For

115 Vac operation, set 115/230 Vac switch S2 (fig. 2-4) to 115 and install a 4.0 ampere, 125 volt 3AG, slow blow fuse in the front panel AC LINE fuseholder (fig. 3-1). For 230 Vac operation set S2 to 230 and in stall a 2.0 ampere, 250 volt, 3AG slow blow fuse in the

front panel AC LINE fuse holder. After S2 has been set to the correct position and the correct AC LINE fuse installed, the only connection required is to connect the TS-510B/U power cord to the correct power source receptacle.

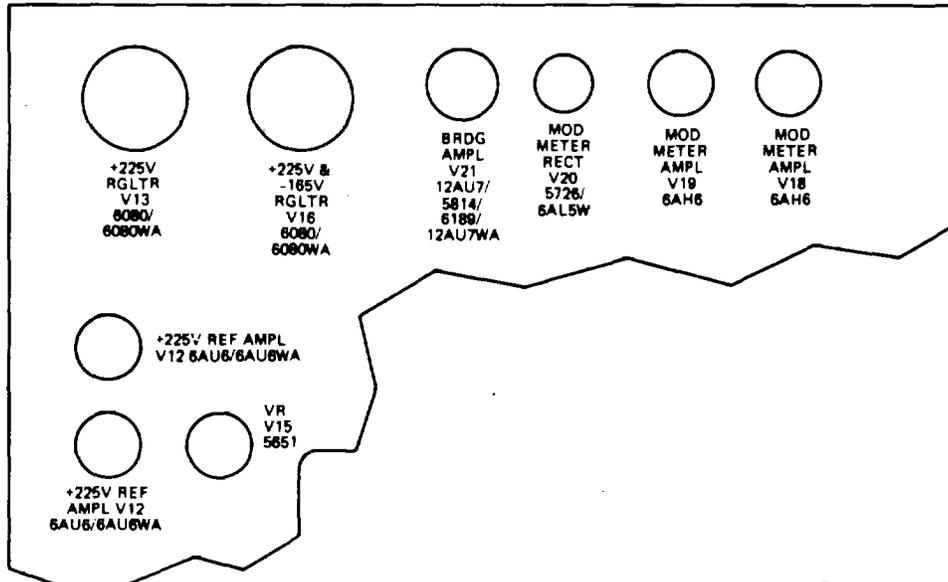
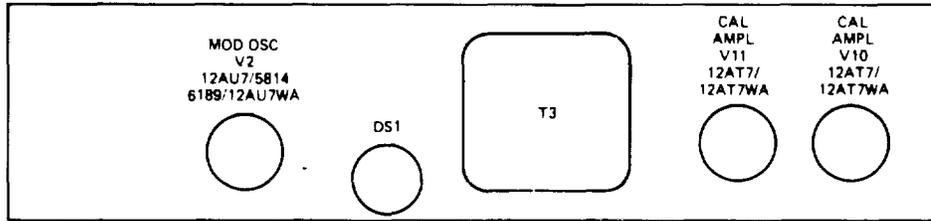
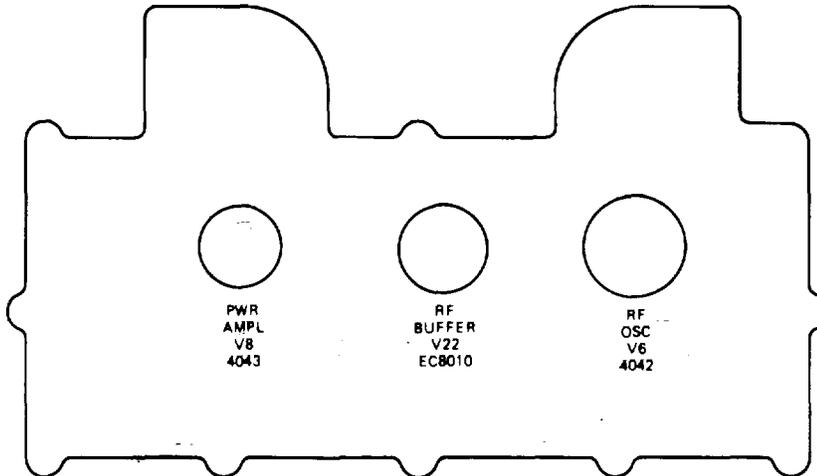


Figure 2-2. Rear desk, tube location diagram.

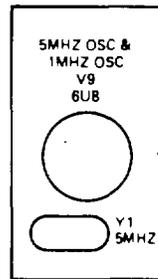
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A. MOD OSC & CAL AMPL DECK



B. TOP CASTING COMPARTMENT



C. SIDE CASTING COMPARTMENT

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C. SIDE CASTING COMPARTMENT

EL6625-508-14-TM-4

Figure 2-3. Modulation oscillator and calibration amplifier deck and casting compartments, tube and crystal location diagram.

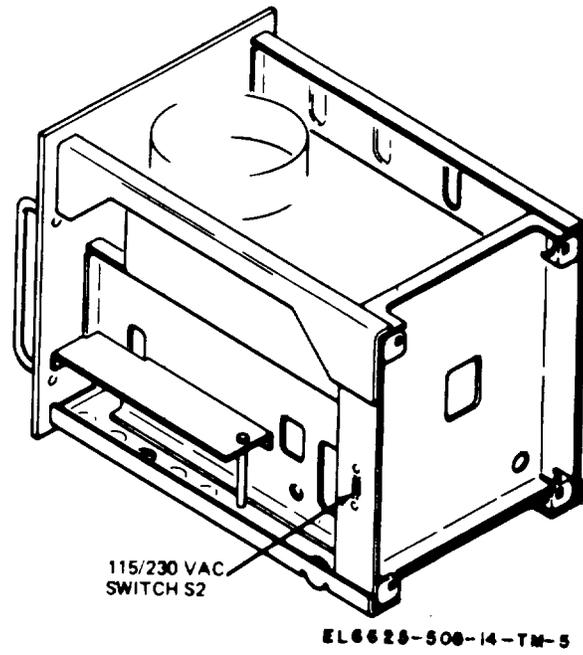


Figure 2-4. 115/230 vac input power selector switch S2 location.

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## CHAPTER 3 OPERATING INSTRUCTIONS

### Section I. CONTROLS AND INSTRUMENTS

#### 3-1. General

Before operating the TS-510B/U the operator must become thoroughly familiar with the controls and indicators. Do not operate the signal generator until the location, function, and use of each control and indicator are understood.

#### 3-2. Operator Controls

Locations of the operator controls and indicators are shown in figure 3-1. Table 3-1 provides information on the function of each of the controls and indicators.

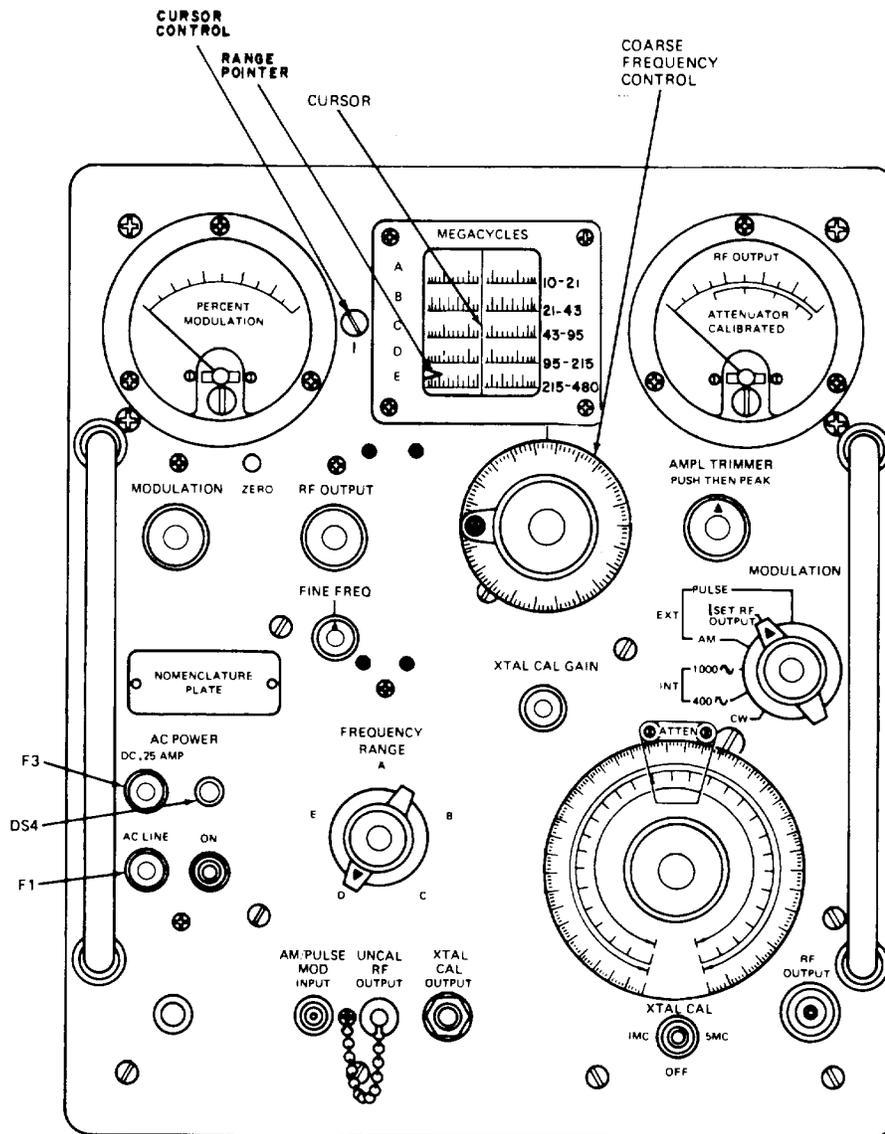


Figure 3-1. Generator, Signal TS-510B/U controls, indicators, and fuses.

Table 3-1. Operator Controls and Indicators

**NOTE**

This table covers only items used by the operator; items used by higher category maintenance personnel are covered in the instructions for the appropriate maintenance categories.

<i>Control Indicator or connector</i>	<i>Function</i>
AC POWER ON switching	ON position, connects TS-510B/U to ac-power source
AC POWER indicator lamp (DS4)	When lighted, indicates TS-510B/U is energize dc
AC LINE fuse (F1)	Power line fuse; protects TS-510B/U from damage caused by line surges application of wrong voltage internal short circuit due to part malfunction.
DC.25 AMP fuse (F3)	B+ fuse; protects + 225V power supply from damage due internal short circuits caused part by malfunction.
FREQUENCY RANGE switch	Selects one of five frequency MHz; B, 21 1 to 43 MHz; C, 43 MHz to 95 MHz D, 95 MHz to 215 MHz; and, 215 MHz to 480 MHz).
Coarse frequency control	Continuously adjusts output, frequency within selected frequency range; vernier dial used to reset frequency.
FINE FREQ control	Provides very limited control of put frequency. For use when precisely setting frequency with aid of frequency counter. Control is calibrated position when white arrow is aligned with black panel mark.
MEGACYCLES dial	Pointer indicates selected frequency range and cursor indicates selected frequency within the range.
Cursor control	Provides limited later positioning MEGACYCLES dial cursor. For use with frequency calibrator function. Cursor is in calibrated position when white control line aligned with black panel mark.
MODULATION switch	Selects one of six modulation mod
	<i>Switch</i>
	<i>potion</i>
	<i>Action</i>
CW	Removes all modulation and provides continuous wave (CW) output.
INT 400	Amplitude modulate signal with internally generated 400 sine wave.
INT 1000	Amplitude modulate signal with internally generated 1000 sine-wave.
EXT AM	Signal applied AM/PULSE MOD PUT connector used to amplitude modulate rf signal

<i>Control, indicator or connector, MODULATION switch</i>	<i>Function</i>
Continued	
SET RF OUTPUT	Selects appropriate internal circuitry for calibrating rf output level with AMPL TRIMMER and RF OUTPUT controls for pulse amplitude modulation.
EXT PULSE	Signal applied to AM/PULSE MOD INPUT connector is used to pulse amplitude modulate rf signal.
MODULATION control	Sets percent of internal and external amplitude modulation.
PERCENT MODULATION meter	Indicates percent of internal and external sine-wave amplitude modulation
AM/PULSE MOD INPUT connector	Provides a means of externally amplitude modulating rf output signal. Provides a synchronizing output signal when using internal modulation.
ZERO screwdriver adjustment	Used to set PERCENT MODULATIONmeter to zero when no modulating signal is applied.
RF OUTPUT meter	Indicates rf power applied to output attenuator.
AMPL TRIMMER control	For CW or sine wave modulation control is pushed in and adjusted to obtain peak indication on RF OUTPUT meter For pulse modulation, control is adjusted to obtain peak indication on RF OUTPUT meter.
RF OUTPUT control	Controls rf power applied to output attenuator. Normally adjusted to obtain +7 DBM ATTENUATOR CALIBRATED indication on RF OUTPUT meter. For rf output levels from + 7 dBm to + 13 dBm, control is adjusted to obtain desired rf output indication on RF OUTPUT meter.
ATTEN control	Controls rf output level. Dial calibrated in dBm and volts. Output levels are calibrated only when RF OUTPUT meter indicates + 7 DBM on ATTENUATOR CALIBRATED portion of RF OUTPUT meter.
RF OUTPUT connector	Provides calibrated rf output level when connector is terminated in a 50-ohm resistive load.
UNCAL RF OUTPUT connector	Provides uncalibrated, cw, rf output in all modes of operation for use with external test equipment.
XTAL CAL switch	Selects crystal calibrator modes.
	<i>Switch</i>
	<i>position</i>
	<i>Action</i>
1MC	Provides checkpoints at 1 MHz intervals from 10 MHz to 270 MHz.
5MC	Provides checkpoints a

Control Indicator or connector	Function	Action
XTAL CAL switch, con't.	5 MHz intervals from 10 MHz to 480 MHz.	
OFF	Disables crystal calibrator.	

Control, Indicator or connector	Function
XTAL CAL OUTPUT con- nector	Provides receptacle for headset when using crystal calibrator.
XTAL CAL GAIN control	Adjust audio level of beat note heard in headset when using crystal calibrator.

**Section II. OPERATION UNDER USUAL CONDITIONS**

**3-3. Types of Operation**

a. *General.* The TS-510BIU can provide cw, internal amplitude modulated, external amplitude modulated, external pulse modulated, and external level controlled rf output. Frequency dial accuracy is proved by using the internal crystal calibrator.

b. *Equipment Required for Operation.* The following is a list of equipment required for operation of TS-510B/U.

- (1) Generator Pulse AN/PPM-1.
- (2) Headset.
- (3) Counter, Electronic, Digital Readout AN/USM-207.

**3-4. Preliminary Starting Procedure**

a. *Preliminary.* Set the front control panel as follows:

- (1) Set AC POWER switch to off.
- (2) Adjust FINE FREQ control to align white arrow with black panel mark.
- (3) Adjust cursor control to align white mark with black panel mark.
- (4) Set MODULATION switch to CW.
- (5) Set RF OUTPUT control fully counter-clockwise.
- (6) Set XTAL CAL switch to OFF.

b. *Starting.* Set AC POWER switch to ON. POWER indicator must be lighted. Allow equipment to warm up for 10 minutes. For maximum frequency stability allow a 1-hour warm-up.

**3-5. Cw Operating Procedure**

**CAUTION**

Do not connect any source of rf or dc power to the RF OUTPUT connector. Permanent damage may be done to the output attenuator.

To provide a cw rf output, perform the following steps:

- a. If it is possible that power may be accidentally applied to RF OUTPUT connector, connect MX-1730/U between RF OUTPUT connector a load.
- b. For frequency ranges A, B, C, or D, set coarse frequency control five turns clockwise from lower edge range. For range E, set coarse frequency control upper edge of range.
- c. Adjust RF OUTPUT control clockwise until up

scale indication is obtained on RF OUTPUT meter.

d. Press and adjust AMPL TRIMMER control to obtain peak indication on RF OUTPUT meter.

e. Adjust RF OUTPUT control to obtain +7 DBM ATTENUATOR CALIBRATED indication on RF OUTPUT meter.

**NOTE**

When changing frequency within a range, observe RF OUTPUT meter. If indication changes, adjust but do not push in AMPL TRIMMER control until RF OUTPUT meter indication returns to +7 DBM ATTENUATOR CALIBRATED.

f. Set output frequency as instructed in paragraph 3-10.

**NOTE**

ATTEN dial is calibrated only when load impedance is 50 ohm.

g. For rf output levels up to + 7 dBm, set ATTEN control dial to required level. For rf output levels greater than + 7 dBm, set ATTEN control dial to + 7 dBm and adjust RF OUTPUT control to obtain required level indication (+ 13 dBm maximum) on RF OUTPUT meter.

h. Connect CG-92D/U rf cable from the load to either the RF OUTPUT connector or the MX- 1730/U.

**3-6. Internal Amplitude Modulation Operating Procedure**

To provide internal amplitude-modulated rf output, perform the following steps:

- a. Set equipment for cw operation as instructed in paragraph 3-5.
- b. Adjust ZERO screwdriver adjustment to obtain zero indication on PERCENT MODULATION meter.
- c. Set MODULATION switch to either INT 400 - or INT 1000 ~ as required.

**NOTE**

Operation is not specified for modulation levels above 95% or for rf carrier levels above + 7 dBm (500 millivolts).

d. Adjust MODULATION control to obtain required indication on PERCENT MODULATION meter.

### 3-7. External Amplitude Modulation Operating Procedure

To provide external sine-wave, amplitude modulated rf outputs, perform the following steps:

- a. Set equipment for cw operation as instructed paragraph 3-6.
- b. Adjust ZERO screwdriver adjustment to obtain zero indication on PERCENT MODULATION meter.
- c. Connect CG-409E/U cable from AM/PULS MOD INPUT connector to external modulation source
- d. Set MODULATION control fully clockwise.
- e. Set MODULATION switch to EXT AM.
- f. Set external modulation source frequency required within limits of 20 Hz to 20 kHz.

#### CAUTION

To prevent damage to MODULATION potentiometer, millivolts source voltage must not exceed 10 vrms.

- g. Adjust external modulation source output voltage to obtain indication of 95 on PERCENT MODULATION meter. Approximately 1 vrms into 5000 ohms is required.

#### NOTE

Operation is not specified for modulation levels above 95% or for rf carrier levels above + 7 dBm (500 millivolts).

- h. Adjust MODULATION control to obtain required indication on PERCENT MODULATION meter.

### 3-8. External Pulse Modulation Operating Procedure

To provide external pulse-modulated rf outputs, perform the following steps:

- a. Set output frequency as instructed in paragraph 3-10.
- b. Set MODULATION switch to EXT PULSE SET RF OUTPUT.

#### NOTE

When MODULATION switch is in EXT PULSE SET RF OUTPUT position, a peak indication can be obtained on RF OUTPUT meter without pushing in on AMPL TRIMMER control. However, a peak indication can also be obtained if the control is pushed in.

- c. Adjust AMPL TRIMMER control to obtain peak indication on RF OUTPUT meter.
- d. Adjust RF OUTPUT control to obtain + 7 DBM ATTENUATOR CALIBRATED indication on 1 OUTPUT meter.
- e. Connect CG-409E/U cable from AM/PULSE MOD INPUT connector to Generator, Pulse AN/PPM-1 (pulse generator).
- f. Set pulse generator output for an amplitude of 10 volts peak-to-peak to 50 volts peak-to-peak. The input impedance is 2000 ohms.

#### NOTE

The minimum usable pulse width is established by the combined rise and decay time of the TS-510B/U. From 40 MHz to 220 MHz the combined rise and decay time is less than 4 microseconds. It is less than 2.5 microseconds above 220 MHz.

- g. Set pulse generator pulse width as required.
- h. Set MODULATION switch to EXT PULSE.
- i. Set ATTEN control dial to required output level.

#### NOTE

During pulse modulation operation, the TS-510B/U rf output is not automatically leveled. After changing frequency, set MODULATION switch to EXT PULSE SET RF OUTPUT and repeat steps b, c, and g to maintain a calibrated rf output. In addition, the load impedance must be 50 ohms to obtain a calibrated rf output.

### 3-9. External RF Control Operating Procedure

To utilize an external dc voltage source to control the rf output level, perform the following steps:

- a. Set equipment for cw operation as instructed in paragraph 3-6.
- b. Set MODULATION control fully clockwise.
- c. Set MODULATION switch to EXT AM.
- d. Connect the CG-409E/U cable from AM/PULSE MOD INPUT connector to external voltage source.

#### NOTE

External voltage required (into 5000 ohms) is + 15 volts for full on rf output (+ 7 dBm) and -15 volts for full off. RF OUTPUT meter indication is proportional to control voltage and indicates the power applied to output attenuator.

- e. Adjust ATTEN control and external voltage to obtain required rf output level.

### 3-10. Frequency Calibration Procedure

The MEGACYCLES dial is accurate to within 0.5 percent when the white marks on the cursor and FINE FREQ controls are aligned with the black panel marks. This can be improved to better than 0.01 percent when the frequency is set to an exact multiple of either 1 MHz or 5 MHz. Maximum frequency accuracy is obtained when using an electronic frequency counter and a headset (see para 3-3b). To calibrate the frequency, perform the following steps

- a. Set FREQUENCY RANGE switch as required.
- b. If 0.5 percent accuracy is adequate, set coarse frequency control to required frequency on MEGACYCLES dial under cursor. If greater accuracy is required, proceed to step c below to set frequency at an exact multiple of either 1 MHz or 5MHz To set the

frequency using an electronic frequency counter, refer to step *d*.

c. To set frequency to an exact multiple of either MHz or 5 MHz, perform the following steps:

- (1) Set MODULATION switch to CW.
- (2) Plug a headset (600 ohms or greater) in to XTAL CAL OUTPUT phone jack.

**NOTE**

The 1 MHz calibrator signal can be used from 10 MHz to 270 MHz and the 5 MHz signal from 10 MHz to 480 MHz.

(3) Set XTAL CAL switch to either 1MC or 5MC as required.

(4) Set coarse frequency control to position MEGACYCLES dial frequency nearest required frequency under cursor.

(5) Adjust XTAL CAL GAIN control to obtain comfortable audio level in headset.

(6) Carefully adjust coarse frequency control near

checkpoint frequency to obtain a zero beat.

(7) Adjust cursor control to position cursor directly over checkpoint frequency. This frequency is now accurate to better than 0.01 percent.

(8) Set XTAL CAL switch to OFF.

*d*. To set frequency using an electronic frequency counter (Counter, Electronic, Digital Readout AN/USM-207), perform the following steps:

(1) Connect the CG-409E/U cable from UNCAL RF OUTPUT connector to electronic frequency counter.

(2) Set MODULATION switch to CW.

(3) Set frequency control to position required frequency on MEGACYCLES dial under cursor.

(4) Adjust FINE FREQ control to obtain exact required indication on electronic frequency counter.

**3-11. Stopping Procedure**

To de-energize the TS-510B/U, set the AC POWER switch to the off (down) position.

**Section III. OPERATION UNDER UNUSUAL CONDITIONS**

**3-12. Operation at Low Temperatures**

*a*. Accuracy of the TS-510B/U is not specified when it is operating in an ambient temperature below + 32 °F(0 °C); do not operate the equipment below this temperature.

*b*. Make certain the equipment is warmed up sufficiently before attempting to use it. This may take up 2 hours depending on the actual ambient temperature

*c*. When equipment that has been exposed to the cold is brought into a warm room, it will sweat until it reaches ambient temperature. When the equipment has reached room temperature, dry it thoroughly.

**3-13. Operation under Tropical Conditions.**

When operated in tropical climates, electronic equipment may be installed in tents, huts, or when necessary, in underground dugouts. When equipment is installed below ground and when it is set up

swamp areas, moisture conditions are more acute than normal in the tropics. Ventilation usually is very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, place lighted light bulbs under the equipment.

**3-14. Operation In Desert Climates**

The main problem that arises with equipment operation in desert areas is the large amount of sand and dust that enters the moving parts of the equipment, such as gear trains, tuning shafts, and switch contacts. If air conditioned spaces are not available, hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the sidewalls of tents with sand to prevent their flapping in the wind. Cleaning and servicing procedures should be performed more often in accordance with the local conditions.

## CHAPTER 4

## OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

## Section I. OPERATOR AND ORGANIZATIONAL TOOLS AND EQUIPMENT

**4-1. Common Tools and Equipment Operator and Organizational Support**

Tools and test equipment used by the operator and organizational repairman for the signal generator are

those tools and test equipment listed in appendix B of this manual.

**4-2. Special Tools and Equipment**

There are no special tools required for operator and organizational maintenance.

## Section II. LUBRICATION INSTRUCTIONS

**4-3. General**

When lubricating the oscillator and rf amplifier rotor worm drive gears, (see figure 4-1), make certain that no grease is applied to the rfi braid that is located under the two outer washers. If grease is applied to the braids, they provide a short circuit for rf energy and the TS-510B/U rfi leakage specification is greatly exceeded. For this same reason all lubrication of TS-510B/U should be done very sparingly. Use the solute minimum quantity of lubricant required to coat the rubbing surfaces.

a. The symbol A stands for one calendar year an applicable regardless of the equipment operating schedule (fig. 4 - 1).

- b. Remove cabinet as instructed in paragraph 2-4.
- c. Apply Mobilux grease No. 1 very sparingly to the oscillator and rf amplifier rotor drive worm gears. Slowly rotate the coarse frequency control to expose the entire worm gear.
- d. Apply tetcyl No. 502-C grease to the stop gear. Rotate coarse frequency control to expose entire gear.
- e. Rotate attenuator control fully clockwise and sparingly apply lubriplate 105-V grease to both sides of the attenuator waveguide slot.
- f. Rotate attenuator control fully clockwise and inject a small amount of molybdenum disulfide powder (MDS) into the attenuator waveguide.

## Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

**4-4. General**

To insure that the AN/USM-44B is always ready operation, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in tables 4 -1, 4 -2, 4-3. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediate if a deficiency is noted which would damage the equipment. Record all deficiencies together with the corrective action take as prescribed in TM 38-750.

**4-5. Scope of Operator's and Organizational Maintenance***a. General*

(1) Operator preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime and to maintain the equipment in serviceable correction. Operator/crew preventive maintenance is performed daily and weekly. Specific procedures are pro-

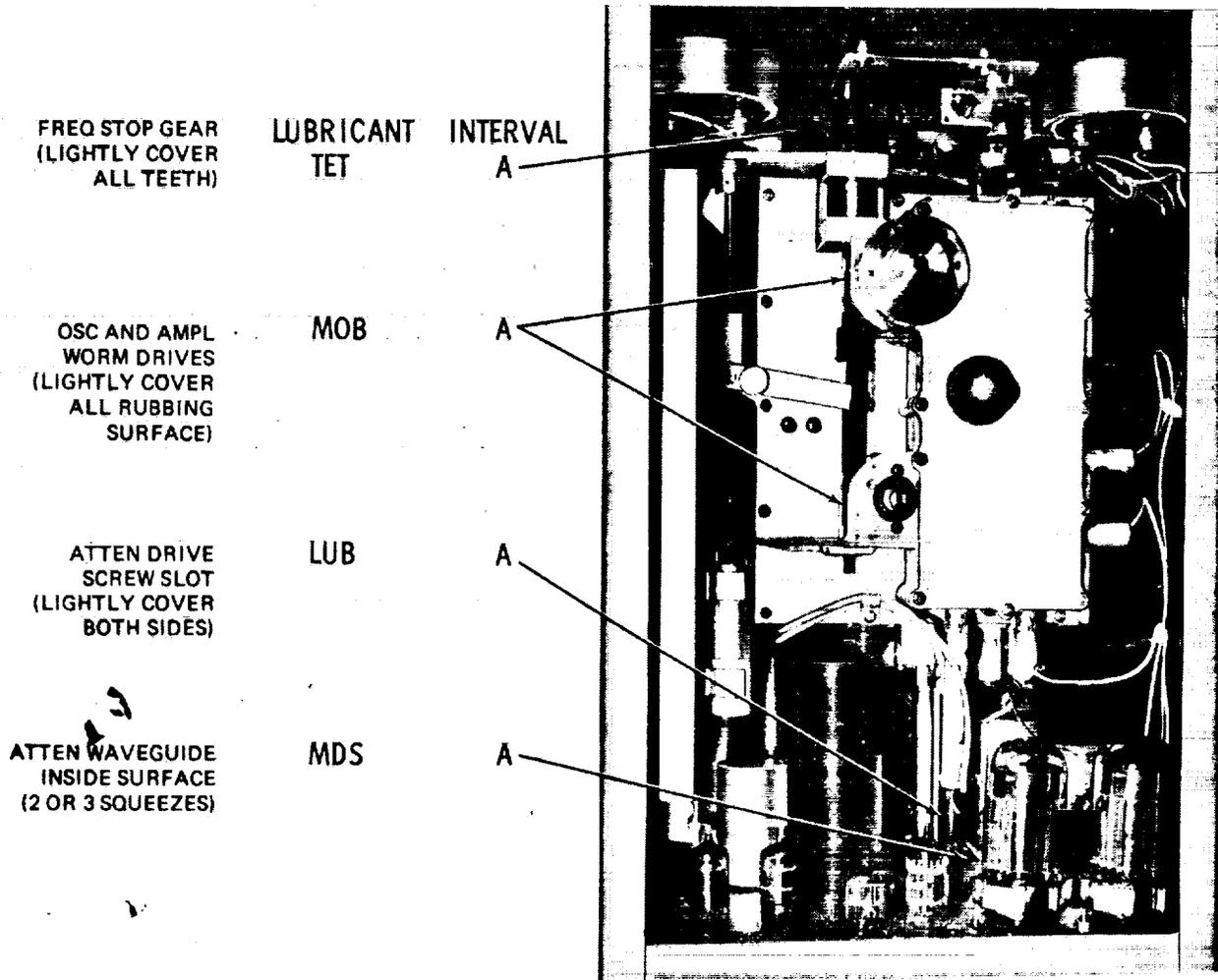
vided in table 4 -1.

(2) Organizational maintenance consists of preventive maintenance (monthly and quarterly) (tables 4-2 and 4-3), troubleshooting (table 4-4) and replacement of authorized repair parts.

(3) The preventive maintenance checks and services described in tables 4-1, 4-2, and 4-3 outline inspections to be made at specific intervals and are designed to help maintain equipment in serviceable condition. They indicate what items should be checked and how they should be checked.

(4) Defects that cannot be corrected must be reported to personnel at a higher maintenance category. Records and reports of repair and preventive maintenance must be made in accordance with procedures given in TM 38 -750.

*b. Preventive Maintenance Checks and Service Periods.* Preventive maintenance checks and services for an operating AN/USM-44B (signal generator) are required on a daily (table 4-1), a monthly (table 4-2), and a quarterly basis (table 4 -3). These checks must be performed during the specified intervals. In addition, the daily checks and services must be performed under



LUBRICANT	INTERVAL
MDS-MOLYBDENUM DISULFIDE POWDER	A--ANNUALLY
LUB--LUBRIPLATE 105V GREASE	
TET--TETCYL NO. 502-C GREASE	
MOB--MOBILUX NO. 1 GREASE	

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Figure 4-1. Lubrication of Generator, Signal TS-510B/U.

the special conditions listed below:

(1) When the signal generator is initially installed.

(2) When the signal generator is returned after higher category maintenance repair.

(3) At least once each week if the signal generator is maintained in a standby condition.

Table 4-1. Operator/Crew Preventive Maintenance Checks a Services

Interval and Sequence No		ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
D	W		
1	1	COMPLETENESS Check that the equipment is complete	0.1
2		EXTERIOR SURFACES.1 Clean the exterior surfaces including the panel. Check the indicator glasses for cracks	
3		CONNECTORS Check the tightness of all connectors	0.1
4		CONTROLS AND INDICATORS During operation (sequence No. 5), observe that the mechanical action of all control is smooth and free of internal binding, and that there is no excessive looseness	0.1
5		OPERATION During operation, be alert for any abnormal indication	0.1
	2	CABLES Inspect ac power cord for chafed, cracked or frayed insulation Replace the plug if it is broken, arced, stripped, or worn excessively	0.1
	3	METAL SURFACES Inspect exposed metal surfaces for rust and corrosion Touch up paint as required (para 4 -6e)	0.1

Table 4-2. Organizational Preventive Maintenance Checks and Services

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
1	PLUCKOUT ITEMS Inspect seating of pluckout items Make certain that crystal clamps grip crystal bases tightly.	0.2
2	JACKS Inspect jacks for snug fit and good contact Inspect the terminals on transformer, T1, .2, and T3. A1 nuts and screws must be tight.	0.3
3	TRANSFORMER TERMINALS No dirt or corrosion should be evident	0.1
4	TERMINALBLOCKS Inspect terminal blocks for loose connections and cracked or broken insulation.	0.1
5	RESISTORS AND CAPACITORS Inspect the resistors and capacitors for cracks, blistering, or other detrimental defect	0.2

Table 4-2. Organizational Preventive Maintenance Checks and Services-Continued

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
6	INTERIOR Clean the interior of the chassis and cabinet	0.4

Table 4-3. Organizational Preventive Maintenance Checks and Services

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	WORK TIME (M/H)
1	PUBLICATIONS See that all publications are complete, serviceable, and current in accordance with DA310-4	0.1
2	MODIFICATIONS Check DA Pam 310-7 to determine if new applicable MWO's have been published ALL URGENT MWO's must be scheduled	0.1
3	SPARE PARTS Check all spare parts (operator and organizational) for general condition and method of storage No overstock should be evident and all shortages must be on valid requisitions	0.5

**44- Cleaning**

Inspect the exterior of the equipment; exterior surfaces shall be free of dust, dirt, grease and fungus.

a. Remove dust and loose dirt with a clean, soft cloth

**WARNING**

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable but exposure of fumes to an open flame converts fumes to highly toxic, dangerous gases.

b. Remove grease, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with trichloroethane.

c. Remove dust and dirt from plugs and jacks with a soft bristled brush.

**CAUTION**

Do not press on the meter faces (glass) when cleaning, the meter can be damaged.

d. Clean the front panel and control knobs; use a soft, clean cloth If dirt is difficult to remove, dampen the cloth with water, use mild soap if necessary.

e. Clean rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB 43 4118.

**Section IV. TROUBLESHOOTING**

**4-7. General**

Troubleshooting this equipment is based on normal observations during operation and is limited in scope. When an abnormal condition or result is observed, locate the corresponding trouble symptom in trouble-

shooting table 4 -4. Perform the checks and corrective actions indicated in the troubleshooting table. If the corrective measures indicated do not result in correction of the trouble, a higher level of maintenance is required

Table 4-4. Troubleshooting

Malfunction	Probable cause	Corrective action
1. AC POWER indicator is not lighted.	Defective AC LINE fuse F1 or AC POWER ER indicator lamp DS4.	Replace fuse F1 or lamp DS4. (para 4-9)
2. MEGACYCLES dial is not lighted.	Defective dial lamp DS3.	Replace lamp DS3. (para 4-9b)
3. RF OUTPUT meter needle is stuck below meter scale.	Defective DC.25 AMP fuse F3 or tubes V12, V13 or V16.	Replace fuse F3 (para 4-9) or tubes V12, V13, or V16 (para 4-8).
4. PERCENT MODULATION meter does not indicate with internal modulation only.	Defective modulation oscillator tube V2.	Replace tube V2. (para4-8b).
5. PERCENT MODULATION meter does not indicate with internal or external modulation.	Defective modulator: meter amplifier tubes V18, or V19, modulation meter Rectifier tube V20, or modulation bridge tube V21.	Replace tubes V18, V19, V20, or V21 (para 4-8b)
6. No calibrator beat notes.	Defective calibrator amplifiers V10 or V11.	Replace tubes V10 or V11. (para 4-8b)
7. RF OUTPUT mete- indicates zero at all times.	Defective -165 volt power supply tubes V14, V15, or V16.	Replace tubes V14, V15, or V16. (para 4-8b)
8. No output through MX-1730/U.	Defective fuse	Replace fuse. (para4-9d)

**Section V. MAINTENANCE OF THE AN/USM-44B**

**4-8. Tube Testing and Replacement**

When a malfunction occurs, check all cables and connections before removing any tubes. Try to isolate the malfunction to an assembly or stage. If tube failure is suspected, use the applicable procedure below to check tubes.

**CAUTION**

Do not rock or rotate a tube when removing it from a socket; pull the tube straight out with a tube puller. Failure to comply may result in damage to the tube or socket.

a. *Use of Tube Tester.* Remove and test one tube at a time. Discard a tube only if its defect is obvious or if the tube tester indicates that it is defective. Do not discard a tube that tests at or near its minimum test limit on the tube tester.

b. *Tube Substitution Method.* Replace a suspected tube with a new tube. If the equipment still does not work, remove the new tube and replace the original tube. Repeat this procedure with each suspected tube until the defective tube is located.

c. *Procedure.* Remove chassis from cabinet in accordance with paragraph 2-4. Location of tubes are shown on figures 2-2 and 2-3. Test individual tubes as required.

**4-9. Repairs**

a. *Replacement of AC POWER Indicator Lamp.* Replace indicator lamp DS4 as follows:

(1) Remove chassis from cabinet in accordance with paragraph 2-4.

(2) Twist defective indicator lamp out of socket located behind AC POWER indicator glass jewel.

(3) Install new indicator lamp in socket and replace cabinet.

b. *Replacement of MEGACYCLES Dial Indicator Lamp.* Replace indicator lamp DS3 as follows

(1) Remove chassis from cabinet in accordance with paragraph 2-4.

(2) Remove the three screws that secure megacycles dial to hub.

(3) Use a straight pull to remove dial.

(4) Twist defective indicator lamp out of socket located beneath MEGACYCLIES dial window.

(5) Install new indicator lamp in socket.

(6) Replace dial on hub and replace screws.

(7) Replace cabinet.

c. *Replacement of TS-510B/U AC LINE and DC.25 AMP Fuses.* Replace either AC LINE fuse F1 or DC .25 AMP fuse F3 as follows:

(1) Rotate front panel fuseholder cover counter-clockwise and remove fuseholder cover and fuse.

(2) Remove fuse from fuseholder cover.

(3) Insert new fuse in fuseholder cover.

(4) Install new fuse and fuseholder cover in fuse holder and secure in place by rotating cover clockwise.

d. *Replacement of MX-1 730/U Fuse.* Replace the fast-blow fuse as follows:

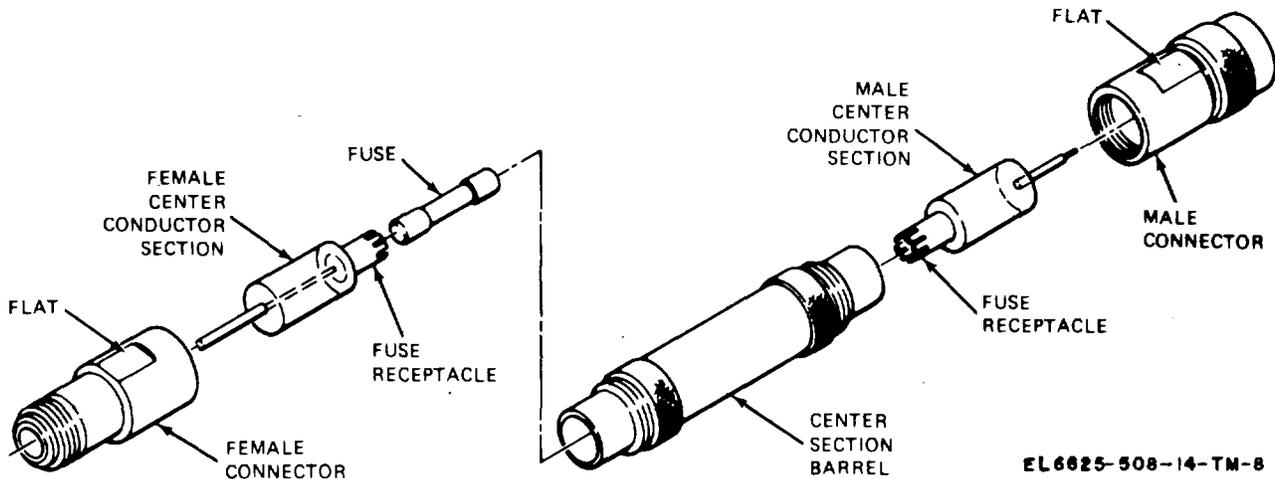


Figure 4-2. Fuseholder MX-1730/U, exploded view

- (1) Wrap center section barrel (fig. 4-2) with heavy cardboard.
- (2) Clamp center section barrel and cardboard in a vise. To prevent denting center section barrel, tighten vise only enough to keep barrel from turning.
- (3) Use two 11/16-inch open end wrenches on the flats to loosen the connectors.
- (4) Unscrew and remove the two connectors.
- (5) Remove the center conductor section from each end of the center section barrel.

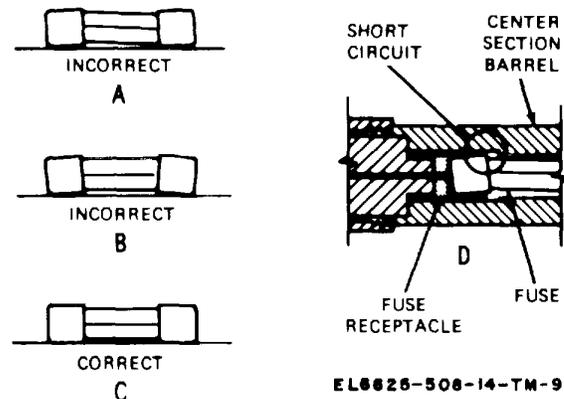
**CAUTION**

Selection and alignment of the replacement fuse is very important to obtain proper operation of the MX-1730/U. A short circuit in the MX-1730/U may cause damage to the TS-510B/U output attenuator.

- (6) Select only a straight fuse for replacement. A method for checking alignment is to roll the fuse on a flat surface and observe the fuse alignment. Select only those fuses that appear as shown in figure 4-3C. A short circuit resulting from a fuse that is not straight is shown in figure 4-3D.

- (7) Insert replacement fuse into fuse receptacle on female center conductor section.
- (8) Insert fuse into either end of center section barrel.
- (9) Insert fuse receptacle end of male center conductor section into other end of center section barrel and press in firmly until completely seated.
- (10) Place female connector over female center conductor and tighten finger tight.
- (11) Place male connector over male center conductor and tighten finger tight.

- (12) Wrap center section barrel with heavy cardboard.
- (13) Clamp center section barrel and cardboard in a vise. To prevent denting center section barrel, tighten vise only enough to keep barrel from turning.
- (14) Use two 11/16-inch open end wrenches on the flats to tighten the connectors.
- (15) Use ME-26A/U to check for shorts between both center conductors and the center section barrel. If a short is found, repeat the complete procedure.
- (16) Use ME-26A/U to measure resistance between the two center conductors. It must be between 5 and 12 ohms. If it is not, repeat the complete procedure.



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Figure 4-3. Fuse alignment in MX-1730/U.

## CHAPTER 5

## FUNCTIONING OF EQUIPMENT

**5-1. General**

This chapter contains an overall function description of Generator, Signal TS-510B/U (part of Generator, Signal AN/USM-44B) as a unit and as individual functional circuits.

**5-2. Overall Function Block Diagram Description**

*a. Signal Generator.* The TS-510B/U is a very-high-frequency rf signal generator employing a master oscillator-power amplifier design. The signal generator is used to test, evaluate and align radio receivers, filters, amplifiers, and other similar electronic networks. Signal paths and waveforms are shown on the block diagram figure 5-1, and are discussed in *b* through *i* below. For complete circuit details refer to over-all schematic diagram, figure FO-2.

*b. Rf Oscillator.* Rf oscillator V6 generates 10 MHz to 480 MHz rf signals that are applied to rf buffer V22. The generated signals are also applied to UNCAL RF OUTPUT jack J5 for external use.

*c. Rf Buffer.* Rf buffer V22 isolates the rf oscillator from the rf power amplifier V8 and modulator stages Q8 and Q9. The isolation prevents loading of the rf oscillator signal by the modulated signal in the rf power amplifier, which would result in a frequency-modulated rf carrier at the output of the rf oscillator.

*d. Rf Power Amplifier.* Rf power amplifier V8 receives two inputs; the rf signals from the rf buffer and the modulating signals from the modulator Q8-Q9. The resultant amplitude-modulated or CW rf output is applied to variable attenuator AT1. Samples of the signal are fed back to envelope detector (bolometer) CR2 and to mixer CR1.

*e. Variable Attenuator.* Variable attenuator AT1 attenuates the output rf signal to provide calibrated outputs from - 127 to + 7dBm at RF OUTPUT jack J4.

*f. Automatic Leveling and Modulation Control.* The automatic leveling and modulation control is a feed-back loop that maintains the rf carrier level constant and provides control for the amplitude modulation. This feedback loop consists of differential amplifier Q2-Q3, sine-wave amplifier Q4, modulation amplifier Q6-Q7, modulator Q8-Q9, and envelope detector CR2. The input to the feedback loop consists of a sample from the output of rf power amplifier V8. The output of the feedback loop is applied to the input of rf power amplifier V8.

(1) *Differential Amplifier.* Two signal inputs are applied to differential amplifier Q2-Q3; the detected rf power amplifier feedback sample from envelope detector (bolometer) CR2, and a reference level. The reference level is supplied by RF OUTPUT control R212 and an ac modulating signal from MODULATION control R210. When the rf power output level exceeds the level established by the reference level, an error voltage is produced, amplified and applied to sine-wave amplifier Q4. The modulating control input is a sine-wave superimposed on the dc level from RF OUTPUT control R212.

(2) *Sine Wave Amplifier.* Sine-wave amplifier Q4 amplifies any resultant output of the differential amplifier and applies it to modulation amplifier Q6-Q7.

(3) *Modulation Amplifier.* Modulation amplifier Q6-Q7 provides two stages of amplification for the dc and sine-wave signals before application to the modulator.

(4) *Modulator.* Modulator Q8-Q9 provide impedance matching and isolation for the input of the rf power amplifier. If the variations, which result from an output of the differential amplifier, are other than zero, a corresponding bias change is applied to rf power amplifier V8. That is, if the rf carrier level at the output of V8 varies, a corrective feedback dc level is applied to the input of rf power amplifier. Similarly, if the amplitude modulation varies from the desired level, a corresponding feedback signal is applied to the input of the rf power amplifier.

(5) *Envelope Detector.* (Bolometer) The sampled output of the rf power amplifier is detected by envelope detector CR2, and then applied to differential amplifier Q2-Q3. The detected signal consists of an ac signal component and a dc signal component. The ac signal component is proportional to the amplitude modulation level and the dc signal component is proportional to the rf carrier level. Also, CR2 provides a sample of the output to RF OUTPUT meter M1 through switch S7-4F.

*g. Modulation Oscillator.* Modulation oscillator V2 provides the basic modulating signal at either 400 or 1000 Hz for the internal source of amplitude modulation. The output of modulation oscillator is applied to differential amplifier Q2-Q3 through switch sections S7-1F, S7-1R and MODULATION control R210. Also, the output is available at AMIPULSE MOD INPUT jack J2 for external use.

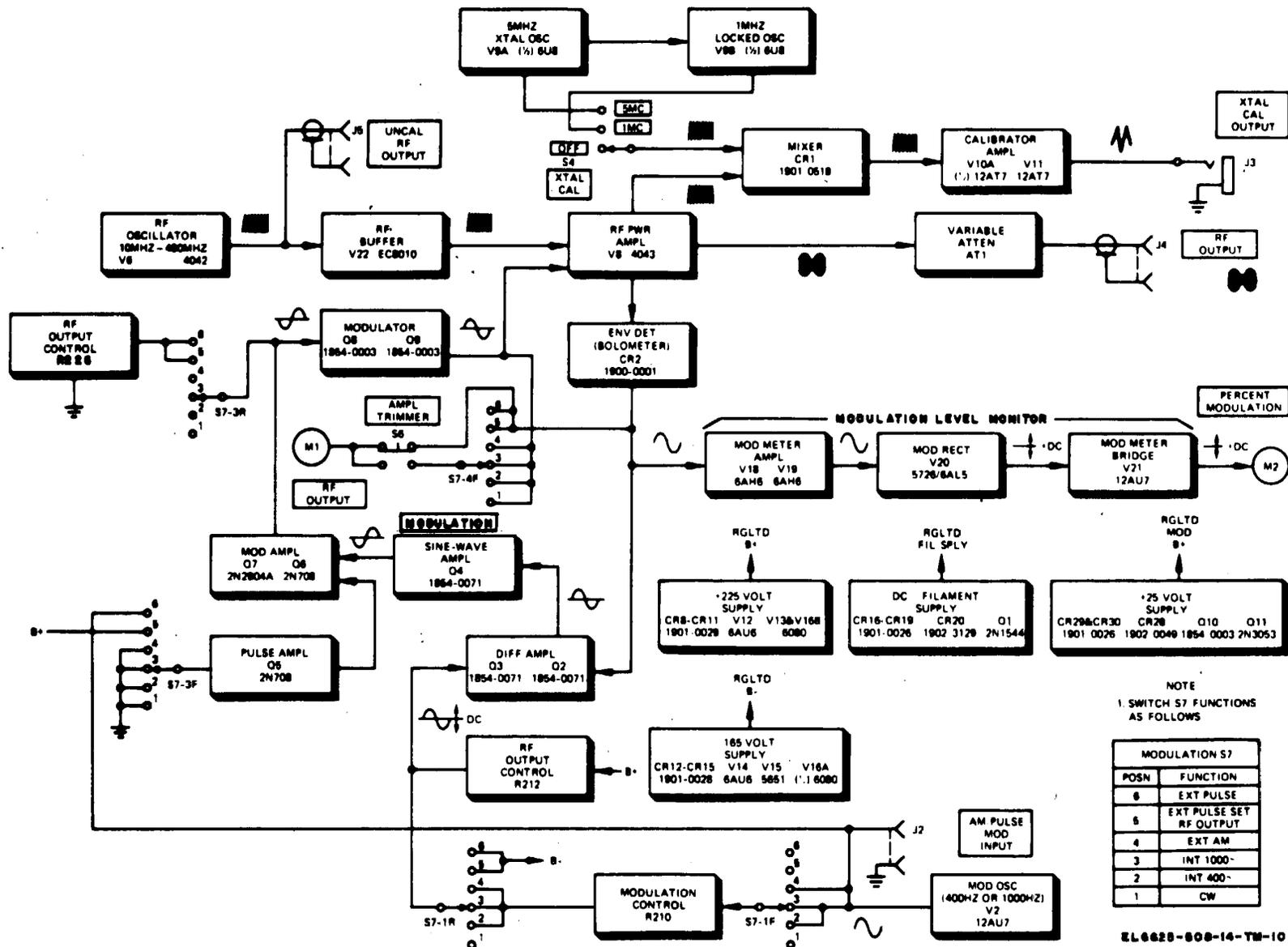


Figure 5-1. Generator, Signal TS-510B/U, block diagram.

When external modulation is applied to the signal generator, modulation oscillator V2 is removed from operation by switch sections S7-1R and S7-1F.

*h. Pulse Amplifier.* During operation in cw or amplitude modulation modes, the input to pulse amplifier Q5 is not connected and therefore inoperative. When an external pulse modulation signal is used for modulating the rf carrier, it is applied to AM/PULSE MOD INPUT jack J2. MODULATION switch S7 when set to (EXT-PULSE) position 6, apply the external pulse modulation signal to the input of pulse amplifier. The pulse modulation signal is then amplified and applied to modulation amplifier Q6-Q7. At the same time differential amplifier Q2-Q3 is inhibited by the negative voltage applied through switch section S7-1R in position 6. The automatic leveling (*f* above) is removed from the feedback loop in this mode of operation. For pulse amplitude modulation operation, the rf carrier level is first established with MODULATION switch S7 set to (SET RF OUTPUT) position 5. A positive voltage is applied to the input of pulse amplifier Q5 through switch section S7-3F. This positive voltage is amplified and applied to modulation amplifiers Q6-Q7 which now become inhibited, thereby allowing modulator Q8-Q9 to be controlled by RF OUTPUT control R226.

*i. RF OUTPUT Meter.* RF OUTPUT meter M1 monitors the dc component of the rf carrier level which is detected by envelope detector CR2. In switch S7 positions 1 through 4, and AMPL TRIMMER switch S6 pressed, meter M1 is connected to the output of modulator Q8-Q9, which allows tuning the rf power amplifier. In the two pulse modulation positions (EXT PULSE and EXT PULSE SET RF OUTPUT) of MODULATION switch S7, meter M1 is connected to the envelope detector output regardless of the position of AMPL TRIM switch S6.

*j. Modulation Level Monitor.* These circuits consist of modulation meter amplifiers V18 and V19, rectifier V20 and meter bridge V21. The detected modulated signal at the output of envelope detector CR2 is amplified by V18 and V19, then rectified by V20. The rectified signal is applied to the bridge circuit, and PERCENT MODULATION meter M2 provides an indication of modulation. The amount of meter deflection is directly proportional to the percentage of modulation.

*k. Frequency Calibration.* The frequency calibrator consists of 5-MHz crystal oscillator V9A, 1-MHz locked oscillator V9B, XTAL CAL switch S4, mixer CR1, and calibrator amplifiers V10A and V11. The nonlinear operation of the mixer generates harmonics of the selected oscillator's fundamental frequencies. These harmonics are mixed with a sample of the rf power amplifier signal to produce beat notes that are amplified by calibrator amplifier V10A and V11. The

amplified beat note is then applied to XTAL CAL OUTPUT jack J3.

*l. Power Supplies.* The regulated power supplies provide 225 volts, -165 volts, 25 volts, and -6.3 volts. The 225 volt supply consists of CR8 through CR11, V12, V13 and V16B. The -165 volt supply consists of CR12 through CR15, V14, V15, and V16A. The regulated -6.3 volt filament supply consists of CR16 through CR20, and Q1. The 25 volt supply consists of CR28 through CR30, Q10, and Q11.

### 5-3. Stage Analysis

Paragraphs 5-4 through 5-21 present a detailed analysis of each stage. To understand the general over-all function of all circuits in this equipment, periodic reference should be made to the system block diagram shown in figure 5-1, and to the complete schematic diagram (fig. FO-2).

### 5-4. Rf Range-Switching Components

*a.* The rf range switching components (fig. 5-2) consist of the FREQUENCY RANGE knob and all connected parts, including rf oscillator and amplifier turrets.

*b.* The FREQUENCY RANGE knob is attached to the turret shaft on which the rf oscillator and amplifier turrets rotate. The shaft rides on, and is held in position by, shaft bearings mounted in the housing wall that separates the rf oscillator from the rf amplifier.

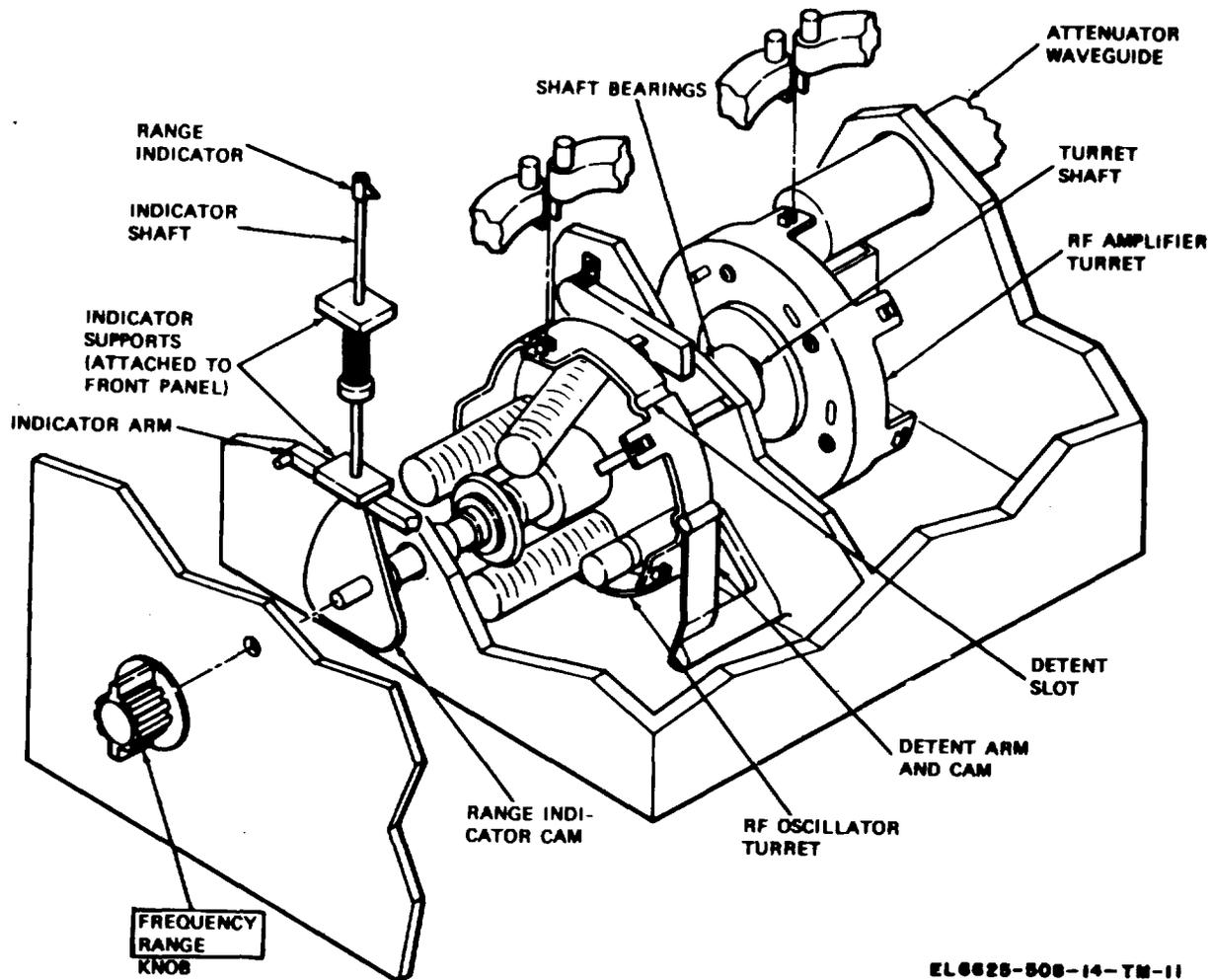
*c.* On the inner side of the rf oscillator housing, a spring-loaded detent arm and cam lock into detent slots to secure the turrets in position. When the FREQUENCY RANGE knob is rotated, either clockwise or counterclockwise, the detent cam is forced out of the detent slot by the rotating action, and the turrets rotate to the next position.

*d.* At the next frequency range position, the detent cam rolls into the appropriate detent slot, enabling the rf oscillator and rf amplifier coils to couple with the rf oscillator and power amplifier tubes.

*e.* The range indicator-cam is located on the turret shaft, just behind the front panel. When the FREQUENCY RANGE knob is rotated to a desired position, the range indicator cam releases the spring-loaded indicator shaft so that the red range indicator points to the correct frequency range on the frequency dial.

### 5-5. Rf Variable Frequency Tuning Components.

*a.* Front panel controls for the rf variable tuning components are the coarse and FINE FREQ control knobs and AMP TRIMMER knob. These enable tuning of the rf and power amplifier capacitors. Although these controls operate independently of each other,



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Figure 5-2. RF range-switching components

they cause interaction when turning.

b. The oscillator and amplifier shafts are so coupled (fig. 5-3), that when the coarse frequency control knob is rotated, their respective worm drive gears are also rotated.

c. The worm drive gears engage and rotate oscillator and amplifier train gears, thereby changing rotor positions with respect to oscillator and amplifier stators. The rotational arrows illustrated in figure 5-3 indicate orientation of frequency tuning components when the coarse frequency control knob is rotated clockwise. In addition:

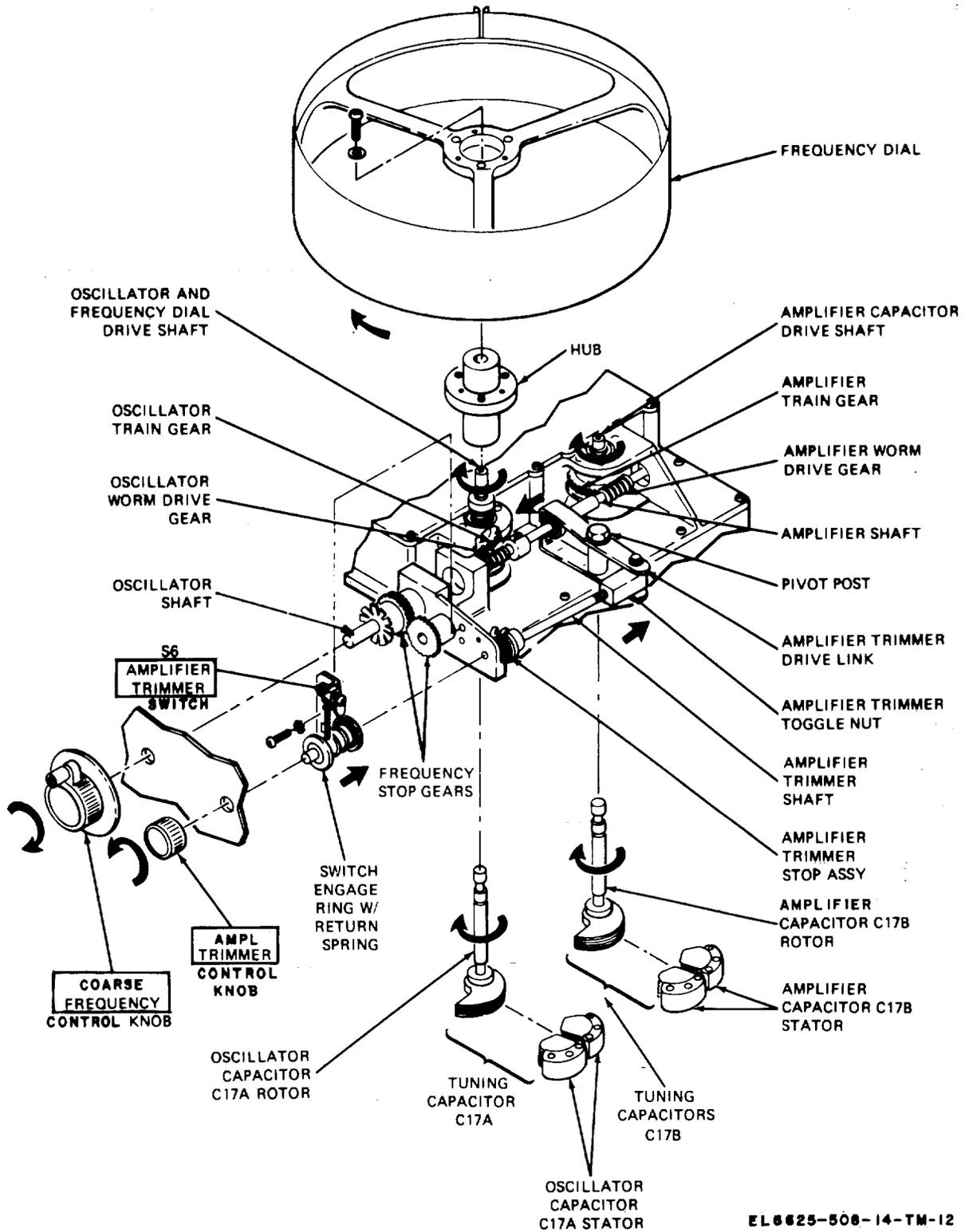
(1) Oscillator shaft, amplifier shaft, and their respective worm drive gears rotate clockwise, causing the engaged train gears to also rotate clockwise.

(2) The oscillator train gear is directly coupled to the frequency dial along with tuning capacitor C17A. The coarse frequency control knob can be rotated 35 full turns, from full counterclockwise to full clockwise, and is controlled, as shown in figure 5-3, by two

meshed frequency stop gears; one, containing 36 teeth, is on the oscillator shaft; the other, containing 37 teeth, is mounted to the casting. A pin is set into the oscillator shaft-mounted gear, and three teeth are bent on the enmeshed gear. Thus, when the coarse frequency control knob is rotated to either extreme, the bent teeth on one gear contact the embedded pin on the other gear, stopping rotation at either end of travel.

d. The AMPL TRIMMER control knob is permitted two full rotations by the amplifier stop assembly, limiting the amount of fine tuning that can be obtained. Figure 5-3 illustrates how the trimmer controls the amplifier tuning capacitor through the amplifier trimmer shaft and attached components.

(1) The amplifier trimmer shaft is attached directly to its knob at the front end and to the trimmer toggle nut at the back end. The amplifier trimmer stop assembly, the switch engage ring, with return spring, are also attached to the shaft.



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Figure 5-3. Rf variable frequency tuning components

(2) When the AMPL TRIMMER knob is depressed, the return spring action closes amplifier trimmer switch, S6. This places RF OUTPUT meter M1, shown in figure 5-7, into the circuit. Interaction of amplifier trimmer components may be understood by following what happens when the trimmer knob is rotated counterclockwise and consulting figure 5-3.

(a) The amplifier trimmer shaft screws out of its toggle nut causing the drive link to pivot around the pivot post.

(b) The amplifier shaft and worm drive gear move to the front of the housing causing the amplifier train gear and capacitor drive shaft to rotate clockwise.

**5-6. Rf Oscillator Circuit**

a. The rf oscillator (fig. 5-4) is a Colpitts circuit composed of vacuum tube V6 and associated resistors

and capacitors.

b. The tank circuit consists of split-stator capacitor C17A, which is controlled by coarse frequency and AMPL TRIMMER controls, and five turret-mounted rf transformers. C17A is ganged to C17B in the output of power amplifier tube V8, shown in figure 5-6. The turret-mounted rf transformers are mechanically linked to rf coils which are mounted on another turret located in the power amplifier section. This linkage insures that frequency range selection and frequency tuning in both the rf oscillator and the power amplifier properly track each other. Fine frequency adjustments are made with FINE FREQ capacitors C68.

c. The plate circuit of V6 (fig. 5-4) is series fed through inductor L5, resistors R246 and R247; these, along with cathode resistor R43 and R249, provide plate current limiting. Capacitor C25 provides cathode bypass. Cathode bias is developed by R248 and R249,

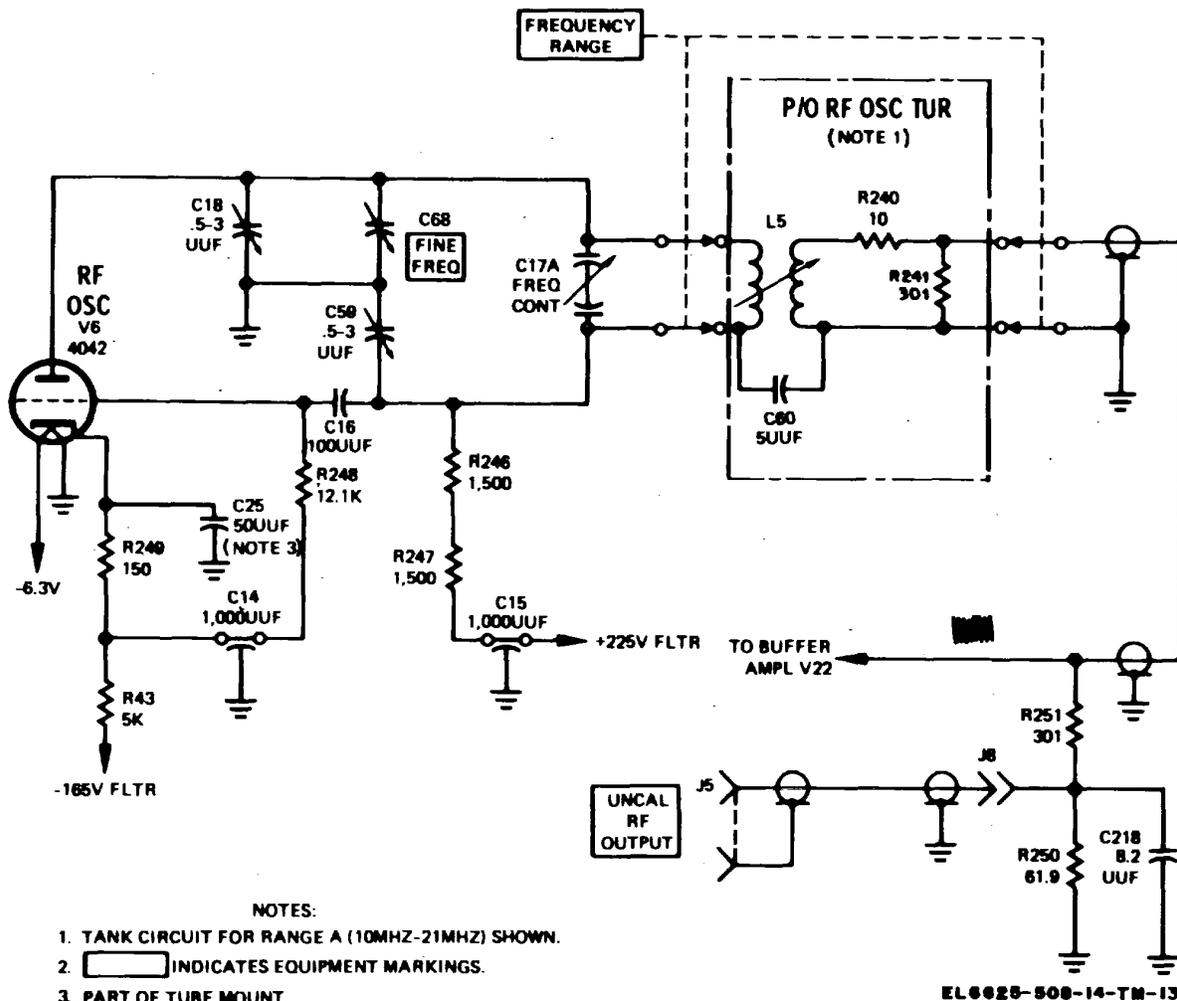


Figure 5-4. Rf oscillator circuit, schematic diagram.

while C16 provides sufficient feedback coupling to sustain oscillation.

d. Additional oscillator tuning is provided by capacitor C59 which tunes the high end of the frequency dial. C18 improves tracking accuracy at higher frequencies.

e. Rf oscillator input voltages are applied through RFI filters. The output signal is coupled to the buffer amplifier V22 through transformer L5 and a coaxial cable. The output signal is also applied to UNCAL RF OUTPUT jack, J5.

f. Series resistor R240 in rf oscillator turret damps unwanted resonances in the cathode of the buffer amplifier, while R241 limits rf drive at lower frequencies.

g. Resistors R250 and R251 constitute an output

voltage divider for the signal applied to UNCAL RF OUTPUT jack, J5.

h. Capacitor C218 provides harmonic filtering for frequencies below approximately 500 MHz.

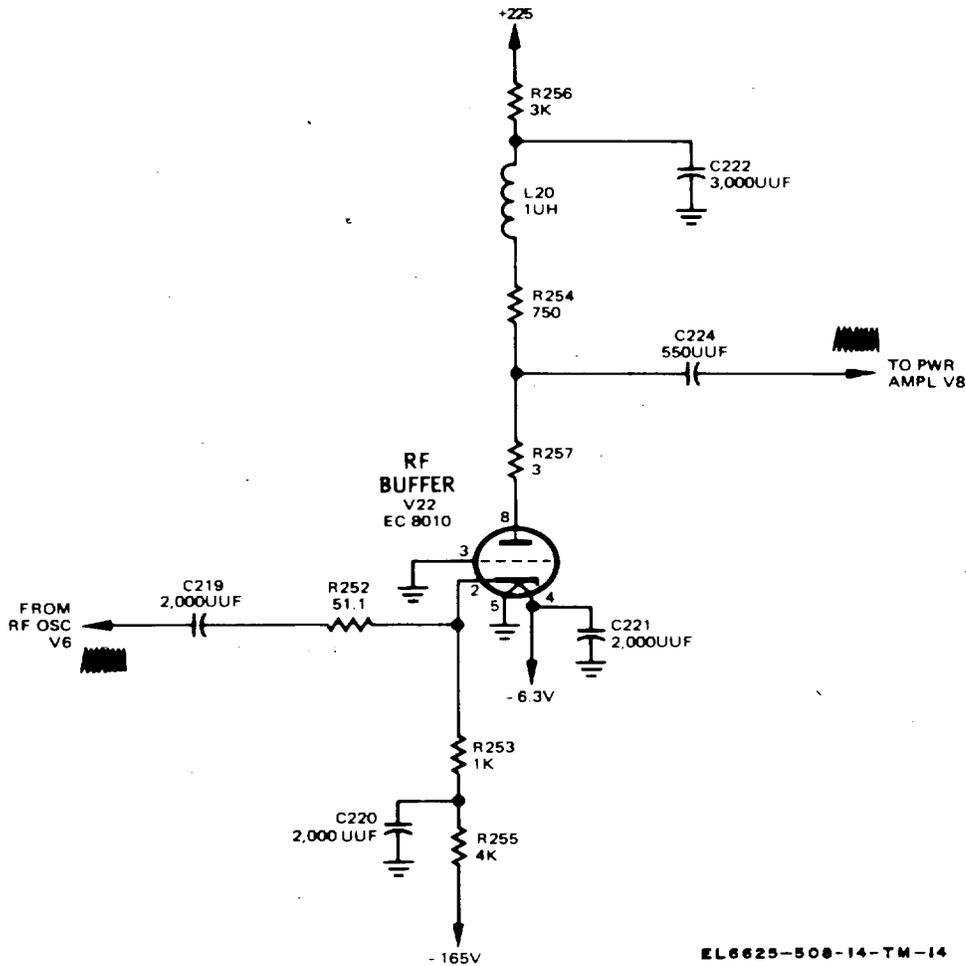
**5-7. Rf Buffer**

a. Rf buffer amplifier, V22 (fig. 5-5) is a grounded grid amplifier that isolates the rf oscillator from the power amplifier.

b. Cathode resistors R253, R255 and plate resistors R254, R256 limit current flow through the tube.

c. Capacitors C220, C221, and C222 bypass cathode, filament, and plate supplies, respectively.

d. The output of the rf buffer is coupled to the rf power amplifier through a wideband network composed of capacitor C224 and coil L22 (not shown): the



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Figure 5-5. Rf buffer amplifier circuit, schematic diagram

latter is actually part of the rf power amplifier circuit.

e. Resistor R252 provides a 50 ohm input impedance for the signal supplied by rf oscillator V6.

**5-8. Rf Power Amplifier**

a. V8 (fig. 5-6) is a grounded-grid rf power amplifier that modulates the rf oscillator signal at coil L16.

b. The plate circuit of V8 includes the rf amplifier turret assembly of which capacitor C30 and inductor L16 are a part. The complete turret assembly, including inductors L12 through L15 and capacitors C229 through C231, is shown in FO-2B. These inductors are

placed into the output of V8 by the FREQUENCY RANGE switch.

c. Capacitor C17B, shown in figure 5-6, is ganged to the rf oscillator tuning capacitor, and tuned by rotation of the front panel coarse frequency control and AMPL TRIMMER control knobs. The AMPL TRIMMER provides fine tuning for the rf power amplifier so that it will correctly track the rf oscillator.

d. The modulating signal is applied to the cathode through isolation network L11, L22. Diode CR7 limits the negative-going portion of the signal to prevent

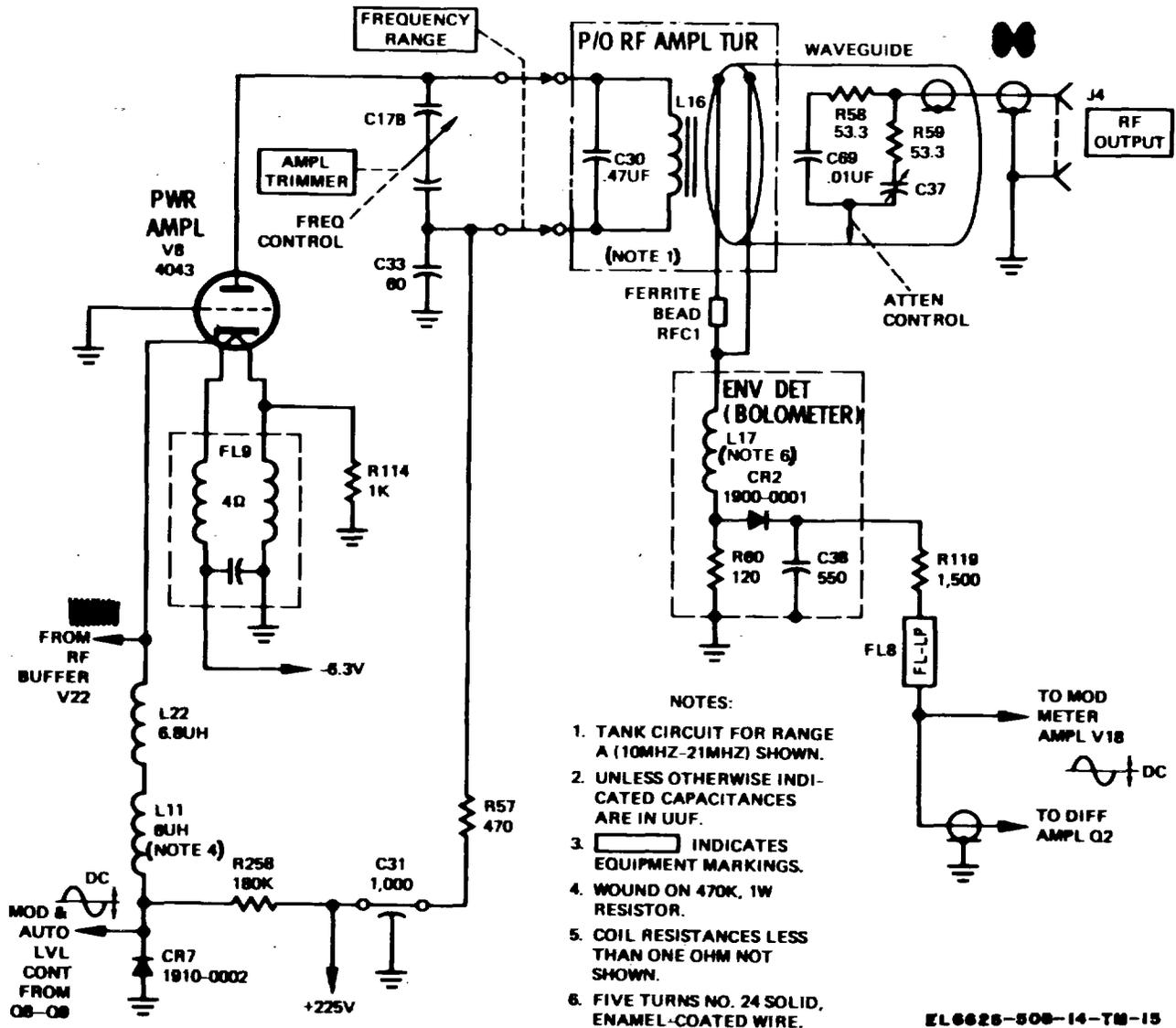


Figure 5-6. Rf power amplifier, output attenuator, and envelope detector, schematic diagram.

vacuum tube damage. Filter FL9 isolates the filament supply from rf, while resistor R114 suppresses unwanted oscillations.

e. Plate voltage is derived from the 225-volt supply. It is applied to plate load resistor R57 through feed through capacitor, C31. Cathode voltage originates from the same source through R258.

f. Rf power amplifier V8 is coupled to RF OUTPUT jack, J4, through a single-loop movable probe and waveguide. A sample of this rf is detected by the envelope detector (bolometer). Since the waveguide has a much higher cutoff frequency than the output frequency at the low end of the frequency dial, the waveguide acts as a linear (dB) attenuator. Hence specific power levels of the output frequency can be selected by the ATTEN control.

g. The detected samples of rf are also applied through low-pass filter FL8, to the modulation meter amplifiers, the RF OUTPUT meter, and differential amplifier, Q2. Detected output is proportional to the average power output of rf power amplifier, V8.

#### 5-9. Rf Output Meter

a. RF OUTPUT meter, M1 (fig. 5-7), indicates detected output from power amplifier V8 through the normally closed contacts of AMPL TRIMMER switch S6, and in either position of S6, when MODULATION switch S7-4F is set to position 5 or 6. The leveling voltage is indicated through the normally open contacts of S6 when the MODULATION switch is set to positions 1, 2, 3, or 4.

b. The signal consists of the modulating signal and the dc leveling signal. However, because of the action of resistor R235 and capacitor C200, the modulating signal is filtered so that only a dc signal is applied to the meter.

c. Meter accuracy is controlled by CALIBRATION potentiometer R202, and TRACKING potentiometer R209.

#### 5-10. Differential and Sine-Wave Amplifiers

a. Differential amplifier Q2-Q3 (fig. 5-8) receives reference signals, selected by MODULATION wafer switch, S7, at the base of Q3. These signals are either dc or, when modulated, dc plus ac. The signal to be compared is the detected output of the envelope detector. The detected output is applied to the base of Q2; the resultant output is applied to the base of sine-wave amplifier, Q4.

b. When the MODULATION switch is set to CW the base of Q3 terminates in the network consisting of R263 and C206; conduction of the differential amplifier is determined by RF OUTPUT potentiometer R212.

c. Two internal sine-wave modulation positions are

available. When the MODULATION switch is set to INT400, the 400 cycle output of the modulation oscillator, shown in figure 5-4, is applied to the differential amplifier through the following components:

(1) Capacitor C205 and MODULATION potentiometer, R210.

(2) Frequency compensation network, R261, C203, and C204.

(3) MODULATION wafer switch section, S7-1R.

d. When the MODULATION switch is set to INT 1000-(position 3), the 1000 cycle position is coupled to the differential amplifier in the same manner as in the 400 cycle position.

e. Either the 400 or 1000 cycle sine wave is coupled through blocking capacitor C205 to MODULATION switch section S7-1F or to AM/PULSE MOD INPUT jack J2 through resistor R262.

f. MODULATION potentiometer R210 sets the modulating signal level, and applies it to the frequency compensation network (R261, C203, C204).

g. In position four (EXT AM) of the MODULATION switch, an external sine wave modulating signal is applied to the differential amplifier in the same manner as an internal sine-wave modulating signal would be applied.

h. Positions five and six of the MODULATION switch are used for external pulse inputs. In these positions, transistor Q3 is biased to cutoff, placing transistor Q2 into heavy conduction. This action cuts off sine-wave amplifier, Q4. As a result, no error signal is present at the output of Q4.

i. Q4 receives sine-wave modulating signals at its base through low frequency compensation network, R214 and C202. Voltage divider resistors R215 and R217 provide bias for Q4, while diode CR21 maintains constant emitter-base voltage during operation.

j. The output from Q4 is applied to amplifier Q6 through diode CR22.

k. Frequency compensation for the output signal is provided by two RC networks:

(1) R218 and C207.

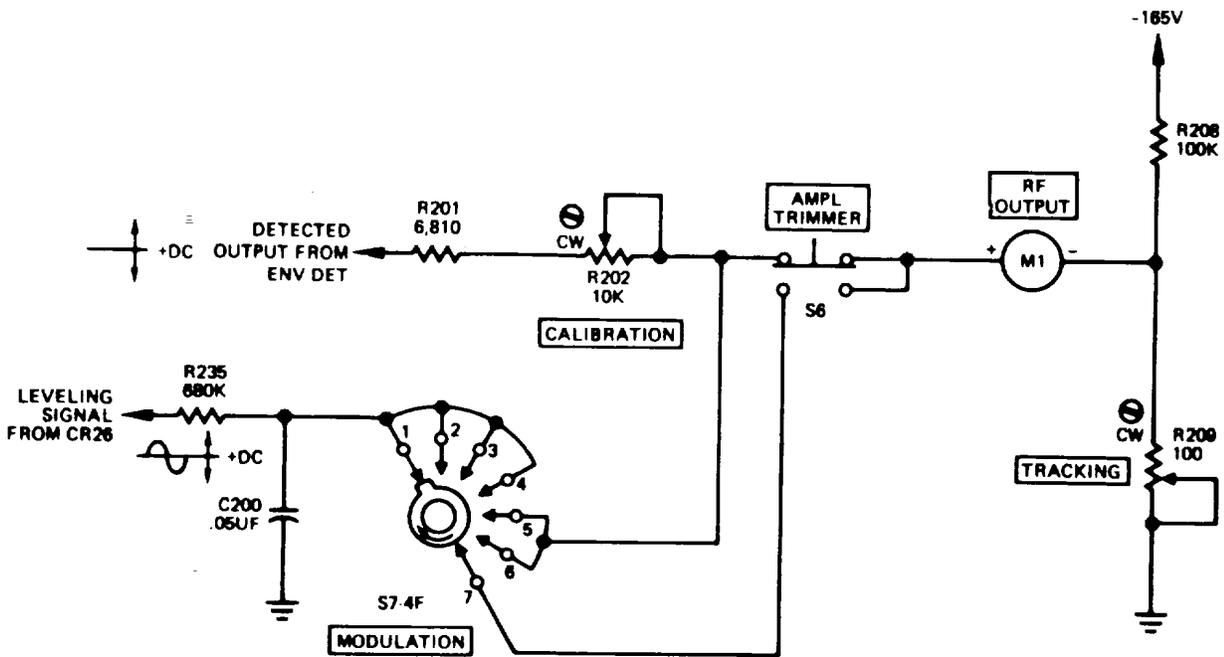
(2) R219 and C208.

#### 5-11. Pulse and Modulator Amplifiers

a. During internal or external sine-wave modulation, leveling and modulating signals from the sine-wave amplifier are received at the base of modulator amplifier Q6 (fig. 5-9).

b. When external pulse modulation is employed, the pulse signal at input AM/PULSE MOD INPUT jack, J2, is applied to the base of pulse amplifier Q5 through pins 6 and 7 of switch S7-3F. The output of Q5 is then applied to modulator amplifier, Q6.

c. During this time, the sine-wave amplifier is cut off, and does not apply an input to modulator ampli-



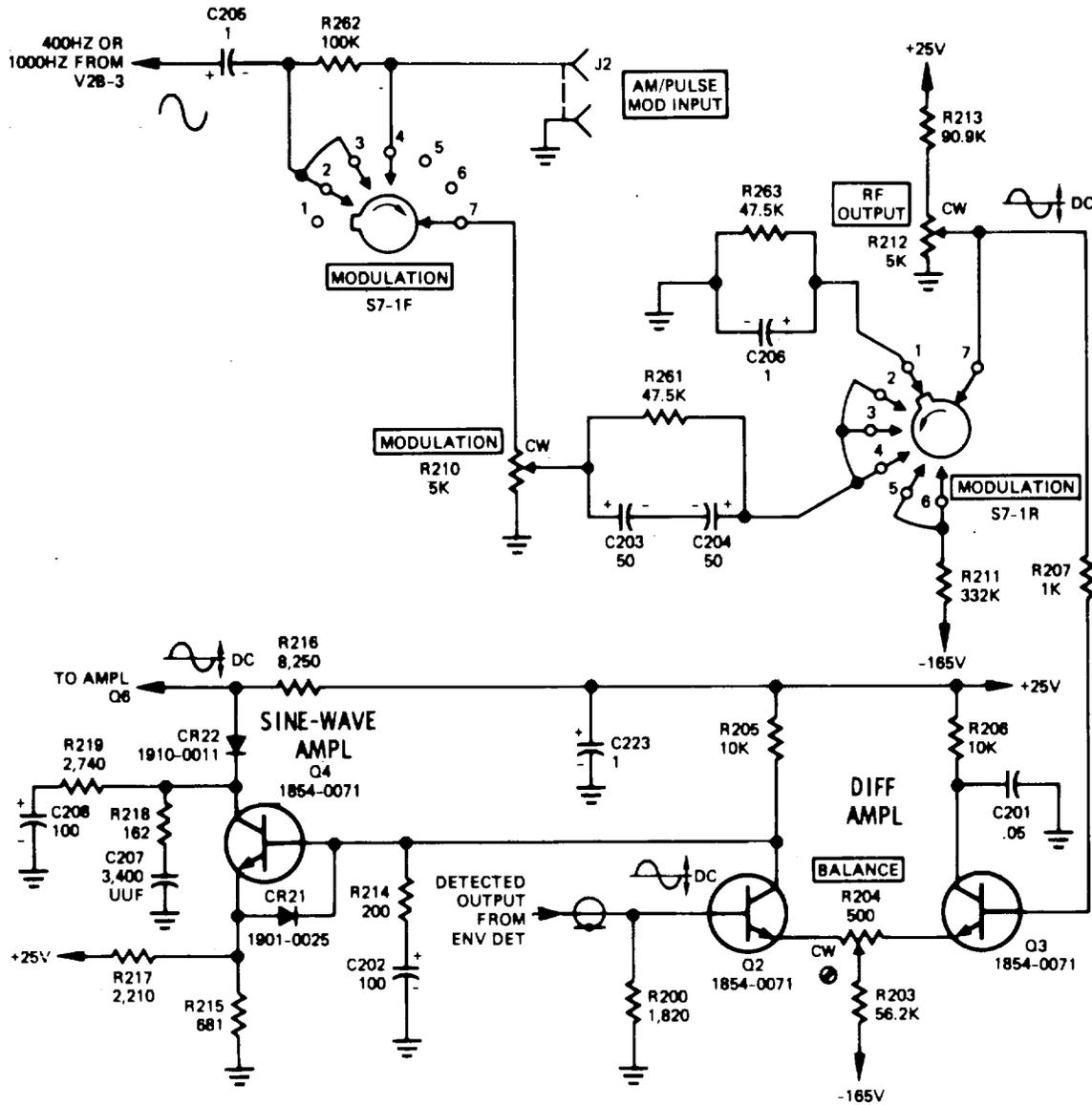
NOTES:

1.   INDICATES EQUIPMENT MARKINGS.
2. INDICATES SCREWDRIVER ADJUSTMENT.
3. WAFER SWITCH S7-4 SHOWN IN CW POSITION. S7-4 CONTACTS MAKE AS FOLLOWS:

POSITION	CONTACTS
<span style="border: 1px solid black; padding: 2px;">CW</span>	1-7
<span style="border: 1px solid black; padding: 2px;">INT 400~</span>	2-7
<span style="border: 1px solid black; padding: 2px;">INT 1000~</span>	3-7
<span style="border: 1px solid black; padding: 2px;">EXT AM</span>	4-7
<span style="border: 1px solid black; padding: 2px;">EXT PULSE SET RF OUTPUT</span>	5-7
<span style="border: 1px solid black; padding: 2px;">EXT PULSE</span>	6-7

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Figure 5-7. Rf output meter, schematic diagram.



NOTES:

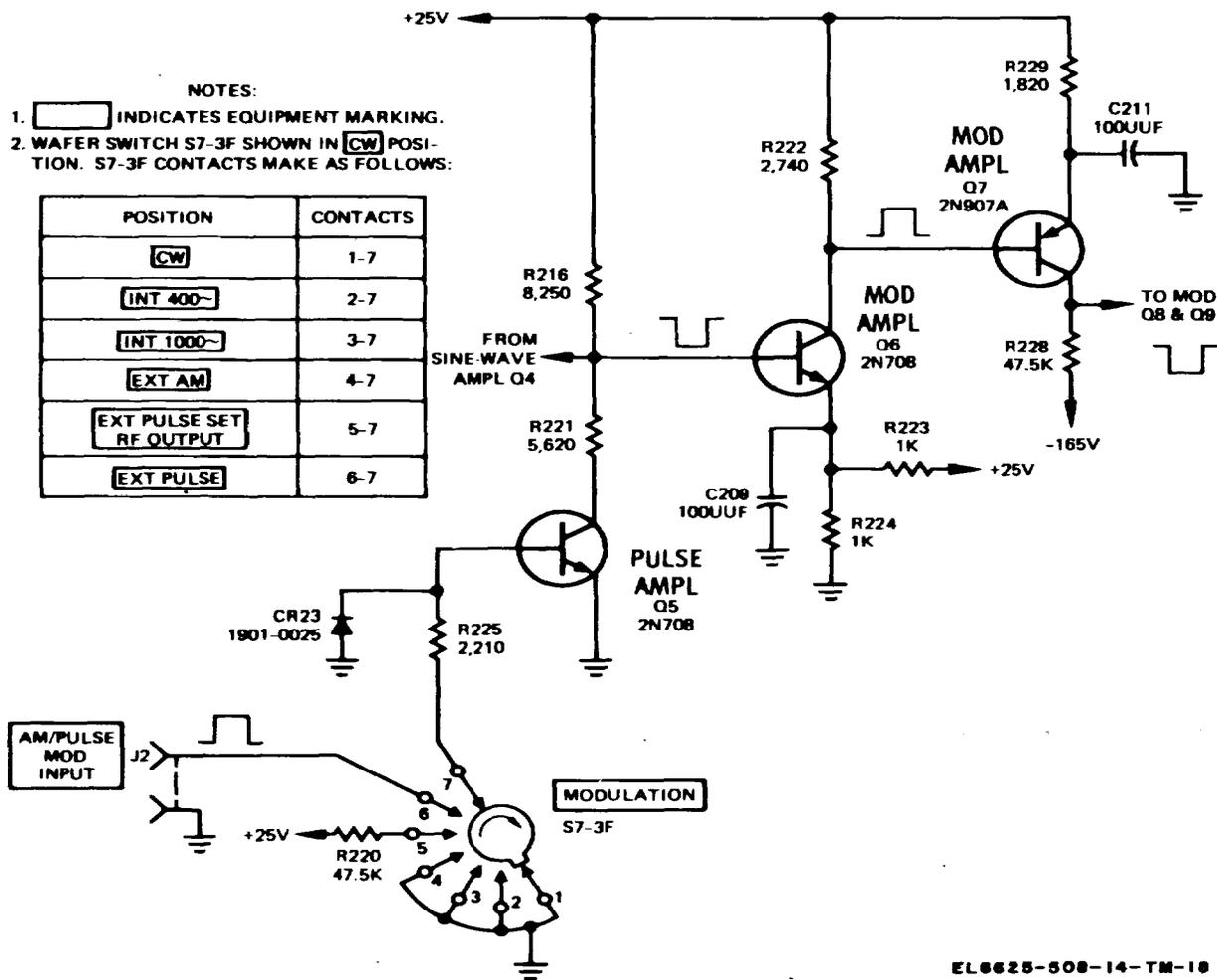
1. UNLESS OTHERWISE INDICATED, CAPACITANCES ARE IN UF.
2. [ ] INDICATES EQUIPMENT MARKING.
3. [⊗] INDICATES SCREWDRIVER ADJUSTMENT.

4. WAFER SWITCH S7-1F AND S7-1R SHOWN IN CW POSITION. S7-1F AND S7-1R CONTACTS MAKE AS FOLLOWS:

POSITION	S7-1F	S7-1R
[CW]	-	1-7
[INT 400~]	2-7	2-7
[INT 1000~]	3-7	3-7
[EXT AM]	4-7	4-7
[EXT PULSE SET RF OUTPUT]	-	5-7
[EXT PULSE]	-	6-7

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Figure 5-8. Differential and sine wave amplifiers, schematic diagram.



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Figure 5-9. Pulse and modulator amplifiers, schematic diagram.

fier, Q6. The latter is biased by the voltage divide composed of R223, R224, and the dc level at the collector of Q5. Additional amplification of the modulation signal is provided by Q7. Q7 emitter bias is provide by R229, and collector voltage is developed across load resistor, R228.

d. The collector voltage is controlled by front pan RF OUTPUT control when the MODULATION switch is set to EXT PULSE SET RF OUTPUT or EF PULSE.

e. The output of Q7 is applied to modulators Q8 al Q9.

### 5-12. Modulators

a. Modulators Q8, Q9 are parallel-connected emitter- followers (fig. 5 -10).

b. Emitter bias for Q8, Q9 is obtained from the voltage divider, composed of R33, zener diode CR26, and R258.

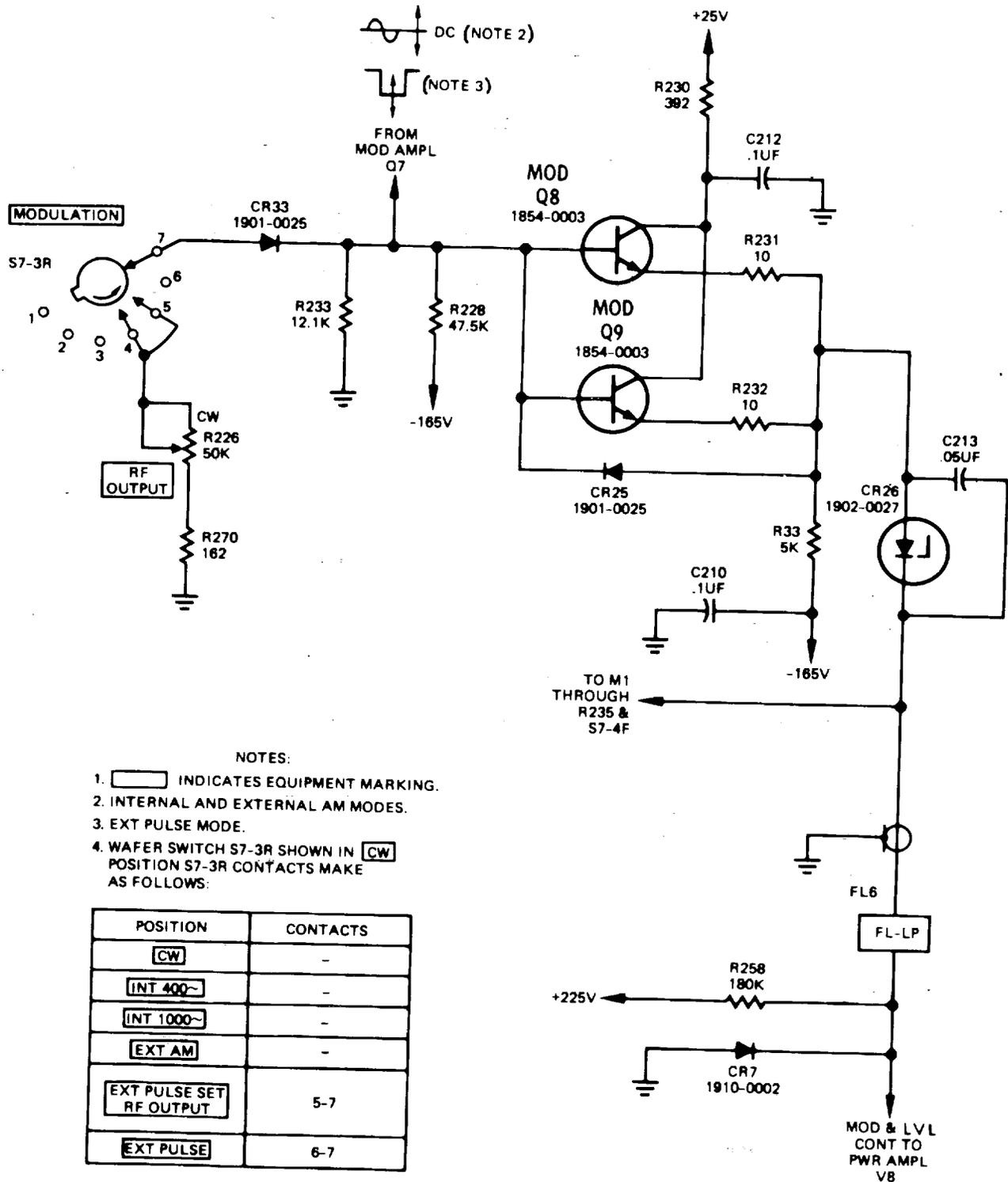
c. Diode CR25 is connected as a protective device between base and emitter of the amplifier.

d. Modulator output is applied to the power amplifier through low-pass filter, FIL and to RF OUTPUT meter, M1, through R235 and S7-4F, shown in figure 5-7.

### 5-13. Modulation Oscillator Circuit

a. The modulation oscillator (figure 5-11) consists of resistance-coupled amplifiers V2A, V2B connected in a Wien-bridge circuit.

b. Positive feedback from the plate of V2B is applied across one side of the bridge and to the grid of



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Figure 5-10. Modulator circuit, schematic diagram

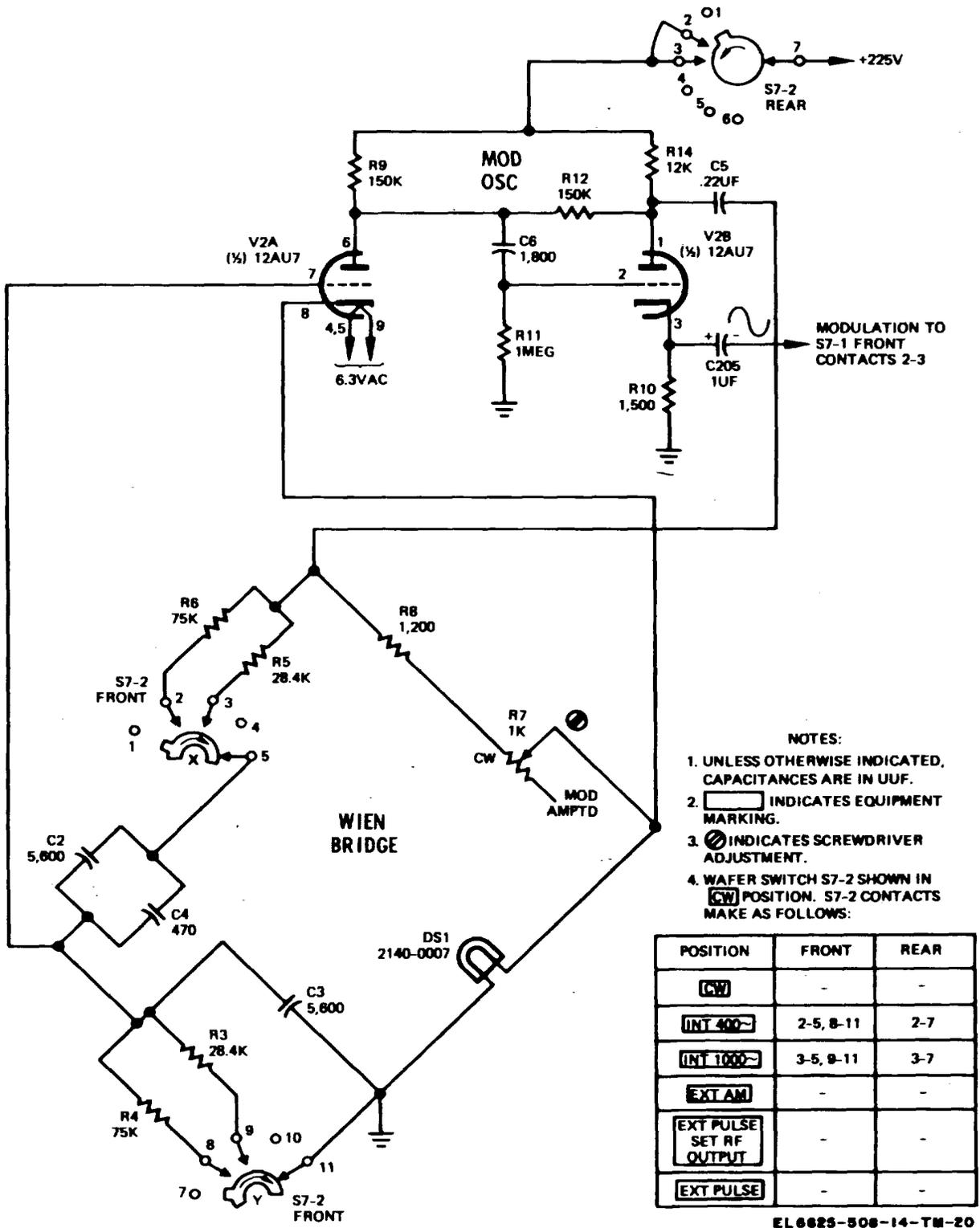


Figure 5-11. Modulation oscillator circuit, schematic diagram.

V2A in order to sustain oscillations.

c. Frequency changes are selected by positions 2 and 3 of MODULATION switch S7-2. In position 2, resistors R4 and R6 are switched into the circuit for 1 400 cycle modulation signal; in position 3, R3 and R5 are switched in for the 1,000 cycle modulation signal.

d. A modulation signal of constant amplitude is applied to the cathode of V2A through the action of lamp DS1, which has a positive temperature coefficient, in the following manner:

(1) An increase of signal amplitude increases current flow through the lamp, resulting in increased filament resistance and increased signal voltage at the cathode of V2A.

(2) Conversely, a decrease in signal amplitude will result in a decreased signal voltage at the cathode of V2A.

e. In addition to the action of DS1, negative feedback from resistor R8 and potentiometer R7 stabilizes the oscillator and reduces distortion.

f. The output side of V2B is connected as a cathode follower to provide isolation for the oscillator circuit.

**5-14. Modulation Meter Amplifiers**

a. Vacuum tubes V18 and V19 (fig. 5-12) constitute the modulation meter amplifiers.

b. The output from the envelope detector, discussed in 5-13, is coupled to the grid of V18 through capacitor C39.

through capacitor C39.

c. The signal, amplified by V18, is coupled to V19 through C51 and R95. It is then rectified by V20, shown in Figure 5-13.

d. A portion of the output from V19 is fed back to the cathode of V18 through R99 and C55, thus providing stabilization for the amplifiers.

**5-15. PERCENT MODULATION Meter, Rectifier, and Bridge Circuit**

a. Modulation meter rectifier (fig. 5-13), V20, is coupled to a balanced bridge detector circuit. This circuit consists of both sections, A and B, of V21, meter M2, and related circuitry.

b. With zero modulation, only the dc level is present at the grids of V21, A and B. Hence, rectifier V20 is inoperative, the bridge is balanced, and PERCENT MODULATION meter, M2, indicates zero.

c. When a modulation signal is present, V20 rectifies the signal and applies its peak value to the grid of V21B; with the bridge thus unbalanced, M2 will show an indication proportionate to the modulation signal's amplitude. However, V21A is unaffected by the modulation signal because of the filtering action of C58 and R100, R101.

d. Adjusting ZERO potentiometer R106 will balance both sides of the bridge to compensate for meter inaccuracy resulting from component replacement and

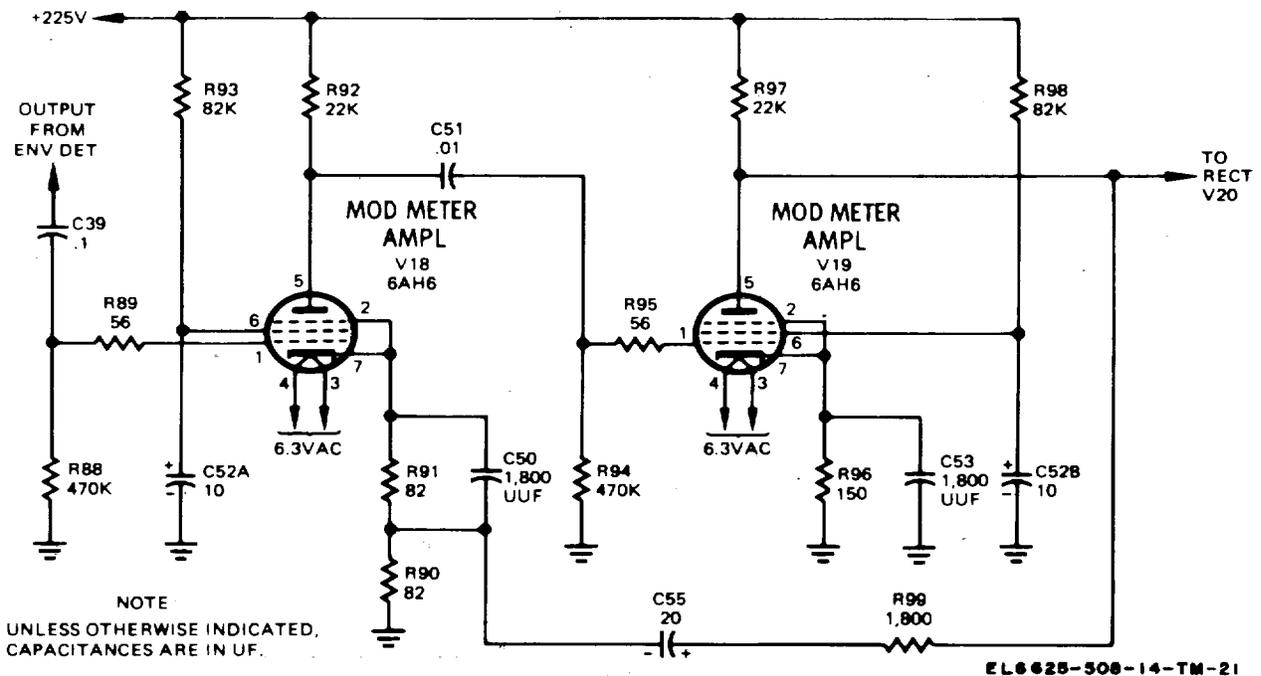


Figure 5-12. Modulation meter amplifiers, schematic diagram.

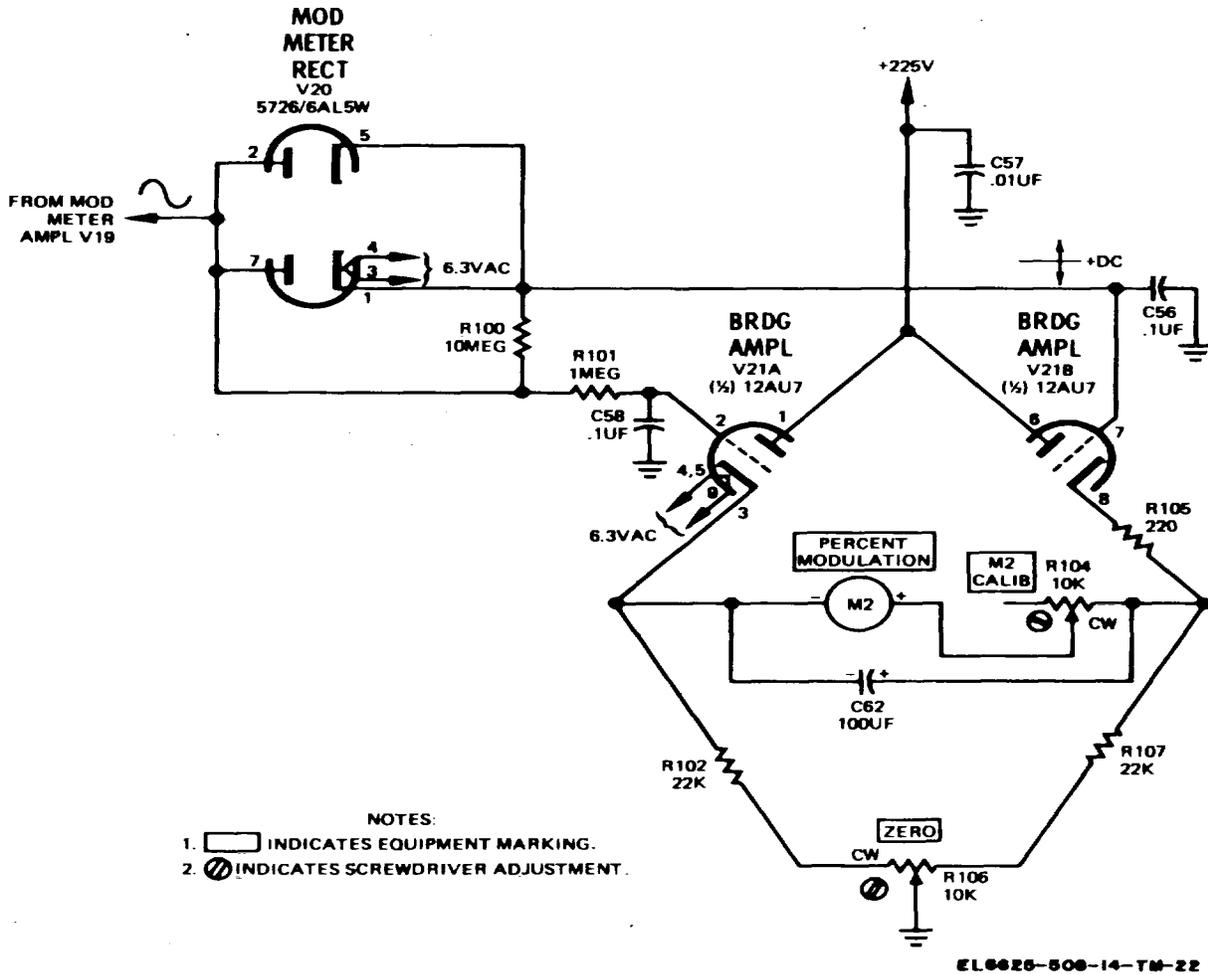


Figure 5-13. Percent modulation meter, rectifier, and bridge circuit, schematic diagram

aging.

e. Meter sensitivity is controlled by adjusting CALIB potentiometer, R104.

**5-16. Calibrator-Oscillator Circuit**

a. The calibrator-oscillator circuit (fig. 5-14) consists of oscillators V9A, V9B, mixer CR1, and associated circuitry.

b. V9A, the 5-MHz oscillator, is crystal-controlled electron-coupled.

(1) The 5-MHz oscillator is inoperative until XTAL CAL switch, S4, is set to either the 5 MC position or the 1 MC position. In either position, the cathode is connected to ground.

(2) Capacitor C23 fine-tunes the frequency to exactly 5-MHz. The screen circuit is also exactly tune

to 5-MHz by adjustable coil L6, in parallel with C20.

(3) Grid bias is developed by resistor, R48.

(4) The plate circuit is tuned by adjustable coil L7, in parallel with C21.

(5) Capacitors C19, C26, and C74 filter rf from the plate supply.

c. V9B and its circuitry constitute a tune-plate, tuned-grid 1 MC oscillator, employing common elements for tuning plate and grid. The oscillator operates only when S4 is set to the 1 MC position. Feed-back for sustaining oscillations is provided by capacitors C72, C73.

(1) The fifth harmonic of the 1 MHz oscillator locks to the stable 5-MHz fundamental of crystal controlled oscillator, V9A.

(2) Hence, the 1-MHz oscillator is stabilized by the

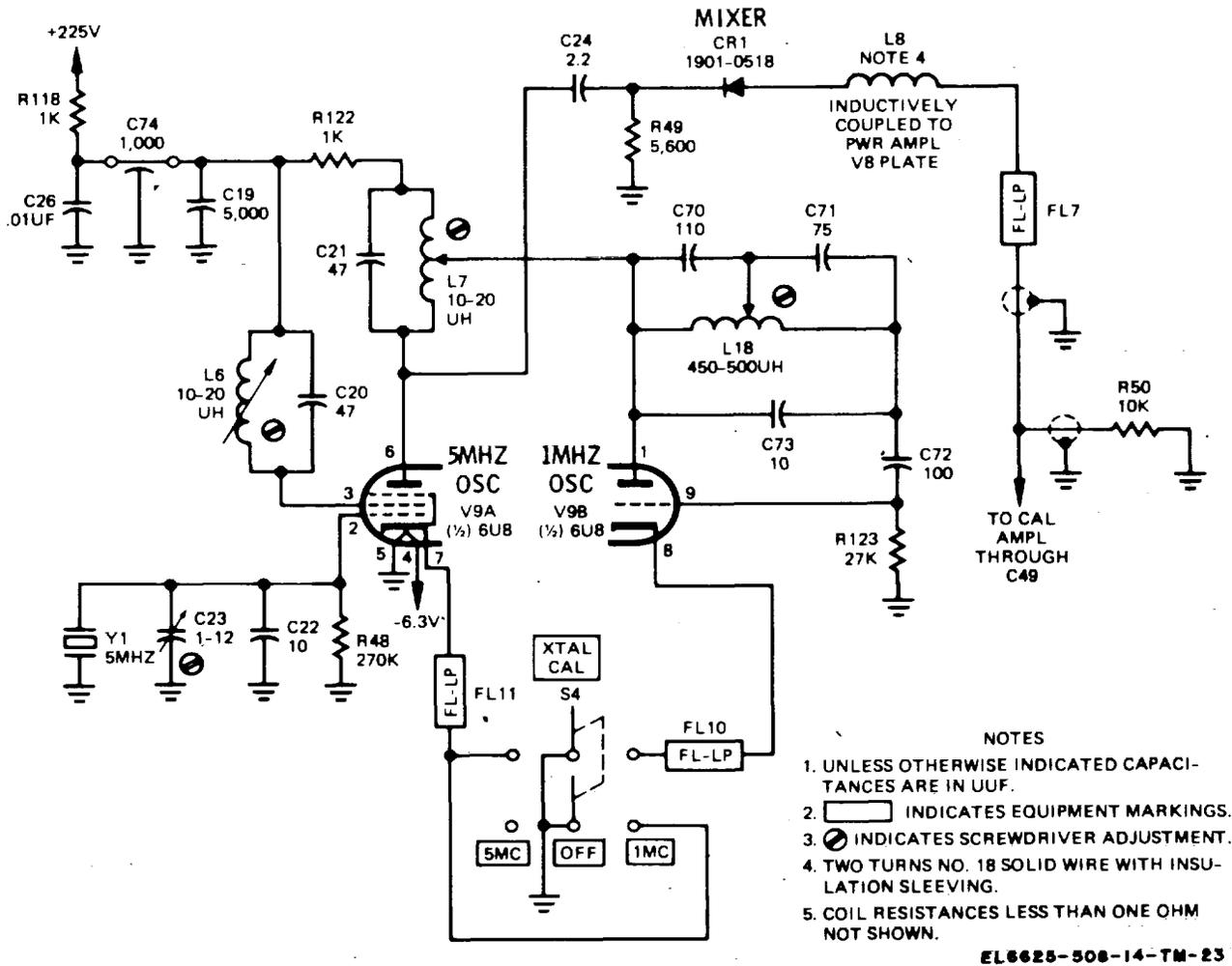


Figure 5-14. Calibrator-oscillator circuit, schematic diagram.

synchronizing effect of the 5-MHz oscillator.

d. The output of both oscillators is coupled, through capacitor C24, to mixer CR1, which acts as an harmonic generator. Since coil L8 is inductively coupled to the rf power amplifier plate, rf frequencies are mixed with multiples of oscillator frequencies. Hence, an audio beat note is applied to the calibrator amplifier through low pass filter, FL7, and capacitor C49.

**5-17. Calibrator Amplifier Circuit**

a. The calibrator amplifier circuit (fig. 5-15) consists of vacuum tubes V10A and both sections of V11. Section B of V10 is not used; therefore, it is not shown in figure 5-15.

b. T3 acts as a line matching transformer before the audio beat note is applied to XTAL CAL OUTPUT jack, J3.

c. The audio level is determined by XTAL CAL GAIN potentiometer, R56.

**5-18. Primary Ac Power Input**

Primary ac power is applied to transformer primaries T1-A and T2 (fig. 5-16) through AC LINE fuse F1, power switch S3, and S2. S2 changes T1-A transformer taps, thereby enabling the equipment to operate from either 115 volts or 230 volts.

**5-19. Filament Power Supply**

a. The filament power supply (fig. 5-17) provides regulated -6.3 volts dc, and unregulated 6.3 volts, ac, to the vacuum tube filaments.

b. Unregulated 6.3 volts ac are provided by transformer secondary T1 -D and applied to the filaments of V2, V10 through V16, V18 through V21, and the fila-

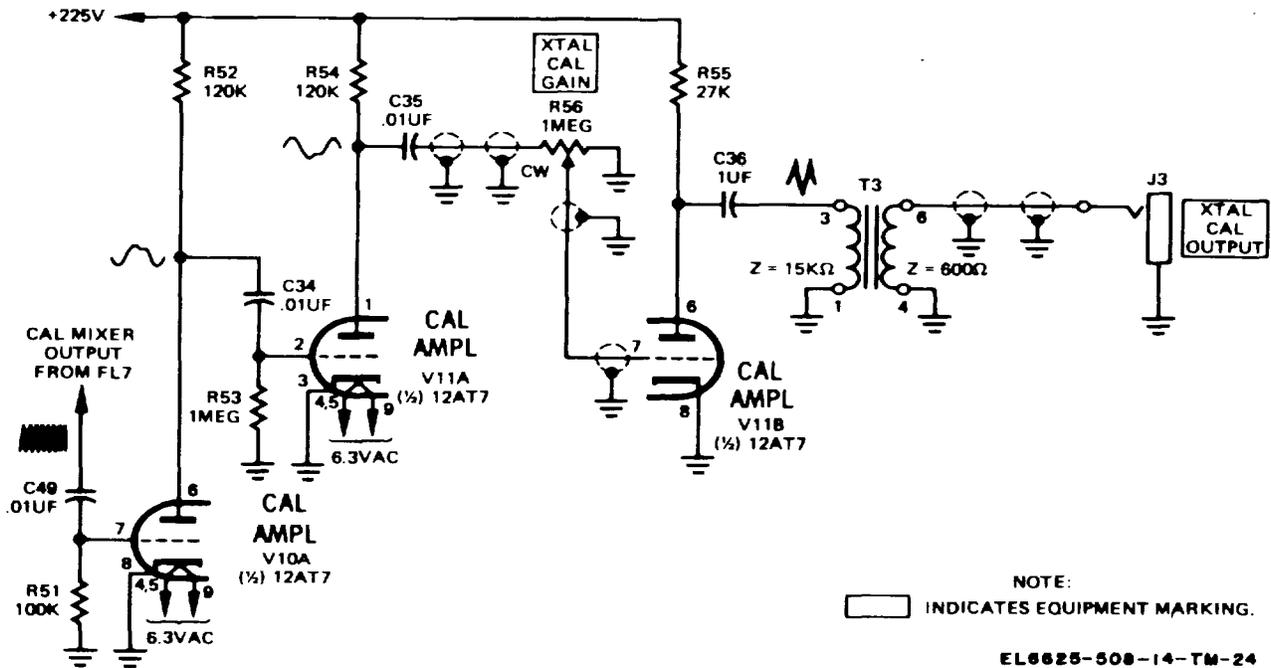


Figure 5-15. Calibrator-amplifier circuit, schematic diagram

ments of indicator lamps DS3, DS4.

c The unregulated 6.3 volts ac are the source of the regulated -6.3 dc volts. The ac voltage is applied transformer secondary T1-C and rectified by diodes CR16 through CR19. Capacitor C75 provides filtering

d. Q1 functions as comparison amplifier and series regulator, its base circuit referenced at - 7.5 dc volts The reference voltage is developed from the - 165 v4 4c supply across resistor R20, and maintained by Zener diode CR20.

e. The emitter output of 7.2 dc volts is applied to Filter FIA where 0.9 of a volt is dropped.

f. The resultant, -6.3 dc regulated volts, constitutes the filament supply for rf oscillator V6, buff amplifier V22, and power amplifier V8.

**5-20. --165 Volt Regulated Power Supply**

a. Input ac voltage across secondary winding T1- (fig. 5-18) is rectified by the bridge composed of odes CR12 through CR15, and filtered by capacity C42.

b. V16A is the series regulator. Its grid is control by the plate of - 165V reference amplifier V14.

c. The reference amplifier's operating level is set the - 165 VOLT ADJ potentiometer, R80; its cathode is maintained at - 79 volts by voltage regulator V15.

d. Voltage changes are sensed by the reference amplifier, while the series regulator compensates t

these changes. The regulated - 165 volt output is supplied to the oscillator circuitry, including the 225 volt and - 6.3 volt power supplies.

**5-21. 225 Volt Regulated Power Supply**

a. The 280 volt ac input across secondary transformer winding T1 -B (fig. 5-19) is rectified by diodes CR8 through CR11, and filtered by capacitor C40.

b. The supply is series regulated through V13 and V16B with the output connected to the load through fuse F3.

c. Reference amplifier V12 is set to operating level by the + 225 VOLT ADJ potentiometer. The reference voltage is derived from the -165 volt regulated supply, discussed in paragraph 5-19, and is applied through voltage divider, R70 through R72.

d. Any changes in the load are applied to the reference amplifier control grid. The plate of V12 controls the conduction level of the series regulators, thereby keeping the output level constant

**5-22. 25 Volt Regulated Power Supply**

a. The ac voltage across transformer secondary winding T2 is rectified by diodes CR29, CR30 (fig. 5-20), and filtered by capacitor C216. As a result, 37.7 volts are applied to the emitter of series + 25V regulator Q11.

b. A reference voltage of 25.5 volts, derived from the 225 volt power supply, is maintained at the base Q11 by voltage regulator CR28 and +25V reference amplifier Q10. Resistor R238 and the voltage regulator form a voltage divider so that 6.19 volts a maintained at the reference amplifier emitter.

Additional filtering is provided by capacitors C214 and C215.

c. Changes in the output voltage are sensed at the base of the reference amplifier across resistor R237. This resistor has been selected to obtain a regulated 25 volt output.

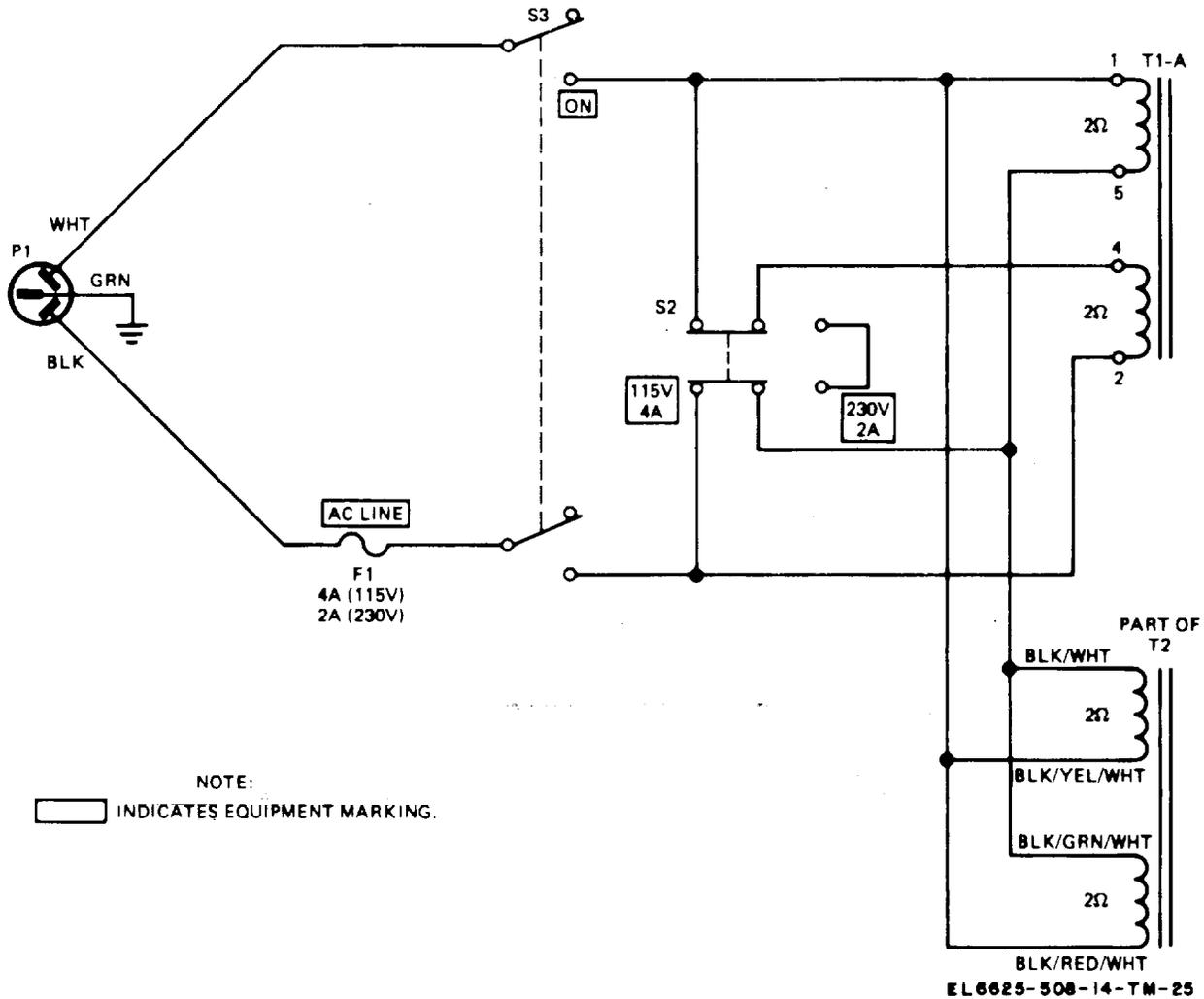
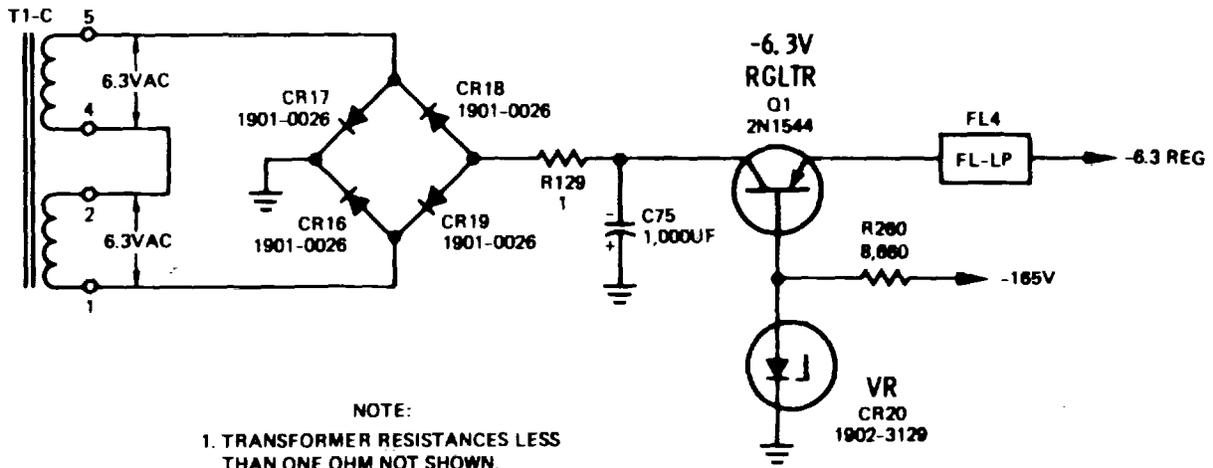


Figure 5-16. Primary ac input circuit, schematic diagram.



NOTE:  
 1. TRANSFORMER RESISTANCES LESS THAN ONE OHM NOT SHOWN.  
 2.  INDICATES EQUIPMENT MARKING.

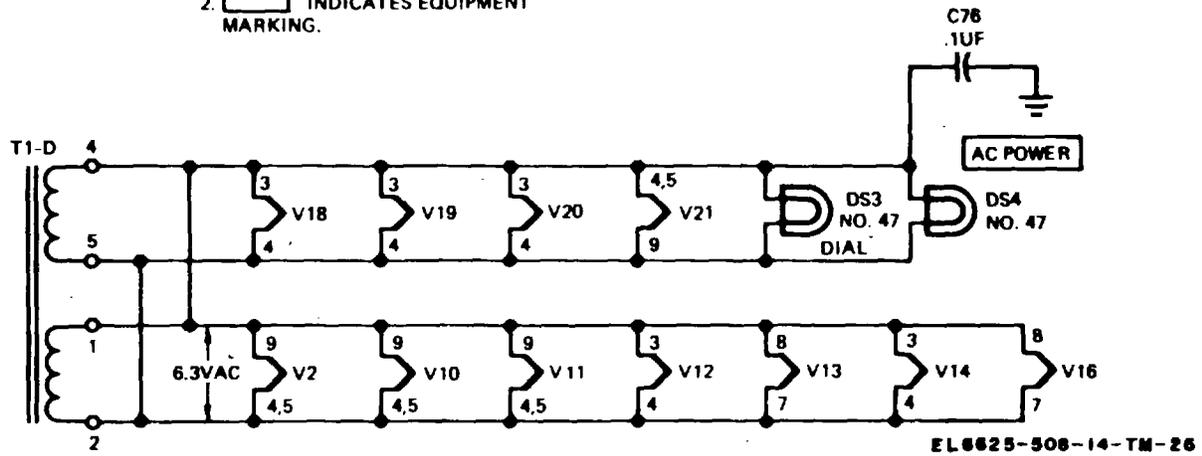
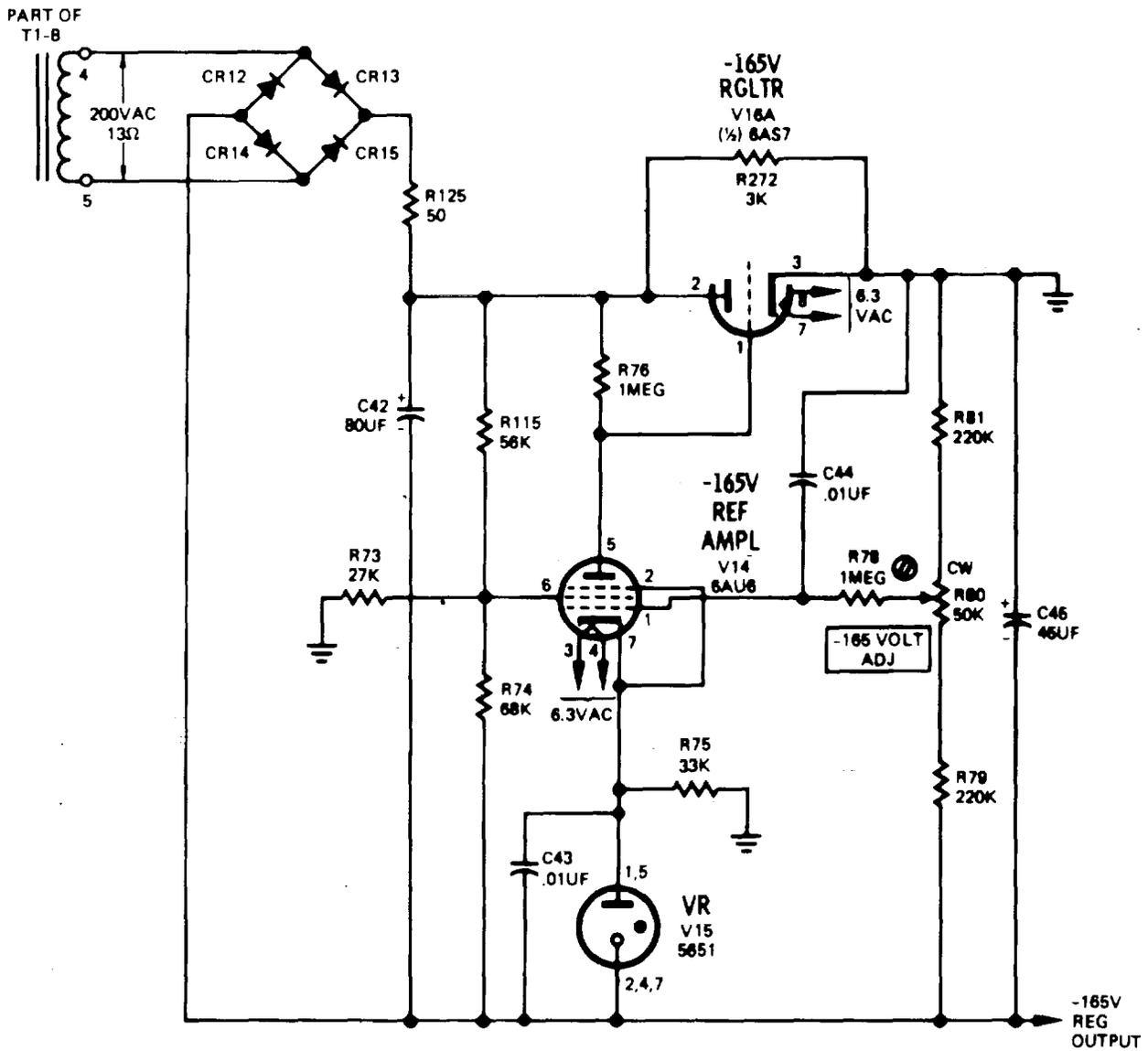


Figure 5-17. Filament power supply circuits, schematic diagram.



- NOTES:
1.  INDICATES EQUIPMENT MARKING.
  2.  INDICATES SCREWDRIVER ADJUSTMENT.
  3. DIODES ARE 1901-0028.

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Figure 5-18. -165 volt regulated power supply, schematic diagram.

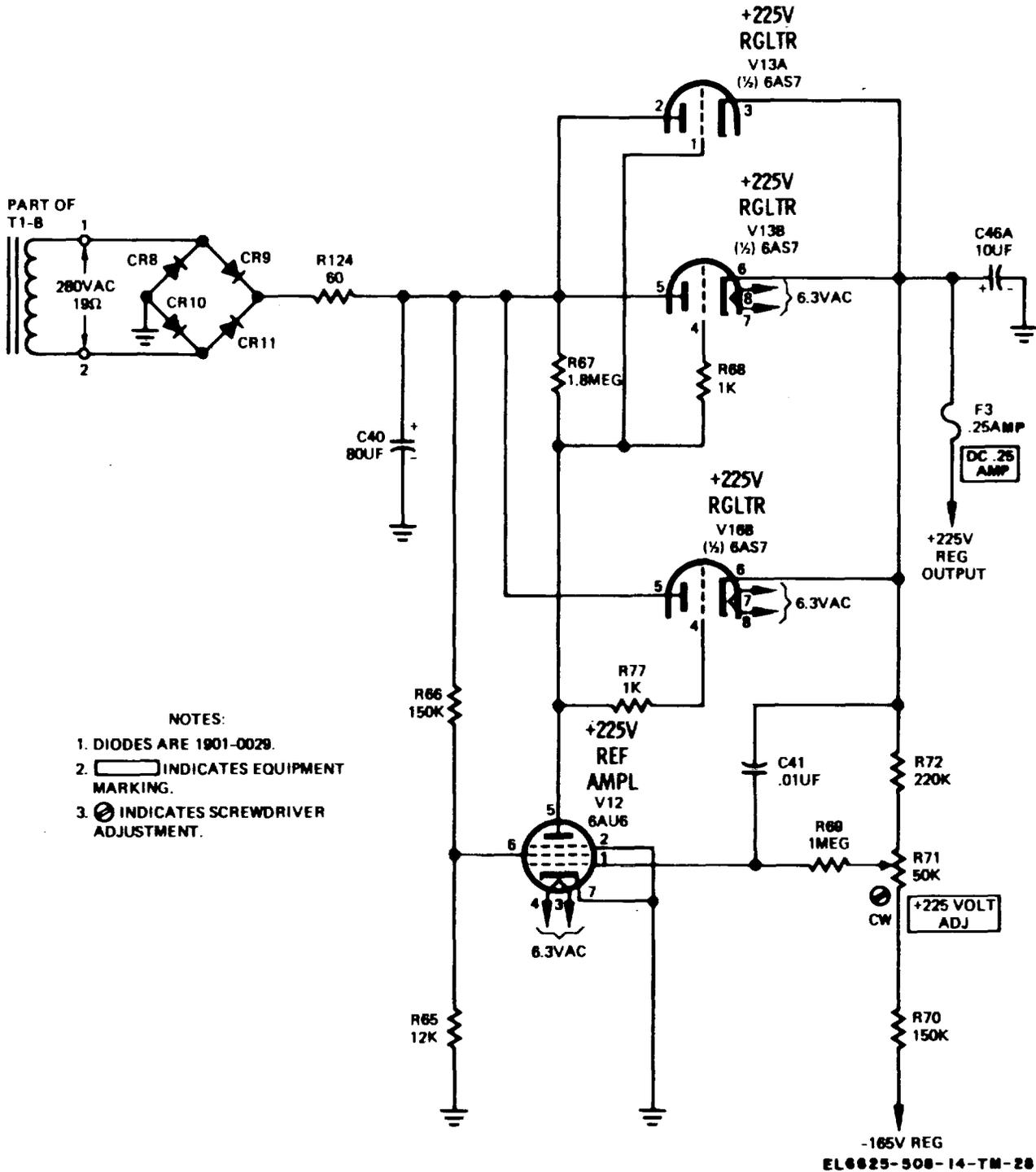


Figure 5-19. 225 volt regulated power supply, schematic diagram.

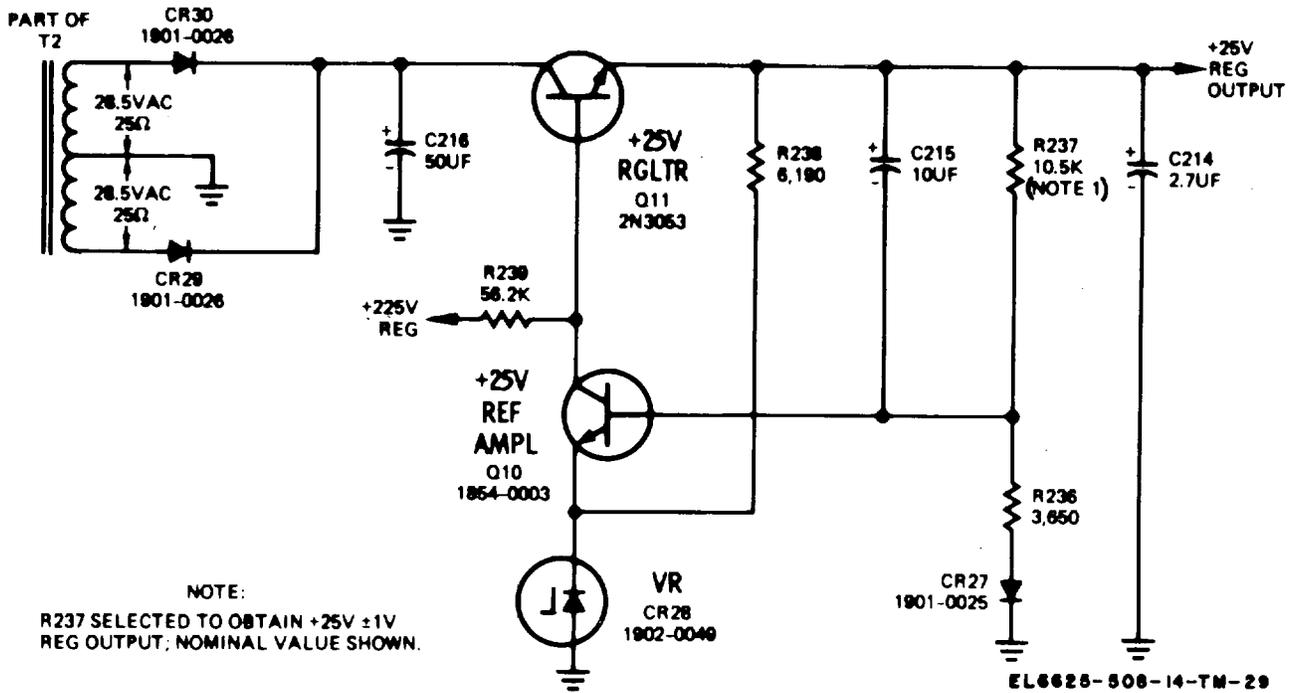


Figure 5-20. 25 volt regulated power supply, schematic diagram

**CHAPTER 6  
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS**

**Section I. GENERAL  
NOTE**

No direct support maintenance is authorized

**6-1. Scope**

Procedures for troubleshooting and maintaining the TS-510BL/U are contained in subsequent sections of this chapter. Unless the methods are obvious, the procedures also include instructions for the replacement of components.

**6-2. Voltage and Resistance Measurements**

**WARNING**

When servicing the TS-510B/U, be extremely careful of exposed high voltages. With the equipment deenergized, potentials as high as 400 volts may be retained on charged capacitors. Before touching any part, short it to chassis ground. Use only one hand when measuring tube socket voltages.

Make all voltage and resistance measurements with Multimeter ME-26/U at the points specified in the troubleshooting chart. When required to make additional voltage, resistance, or continuity measurements that are not specified in the chart, consult applicable illustrations to locate desired test points. For designated voltage and resistance measurements on figs. 6-1 through 6-4 Voltmeter ME-30/U was used.

**6-3. Diagrams**

Partial schematic diagrams are shown in figures 5-4 through 5-20, inclusive. An overall schematic of the signal generator is shown in figure FO-2. Voltage and resistance, parts location, and waveform diagrams are contained in this chapter.

**Section II. GENERAL SUPPORT TOOLS AND EQUIPMENT**

**6-4. Common Tools and Equipment for General Support**

Tools and test equipment authorized-for use by general support maintenance personnel are listed in table 6 -1.

**6-5. Special Tools and Equipment**

No special tools and equipment are required.

*Table 6-1. General Support Tools and Test Equipment*

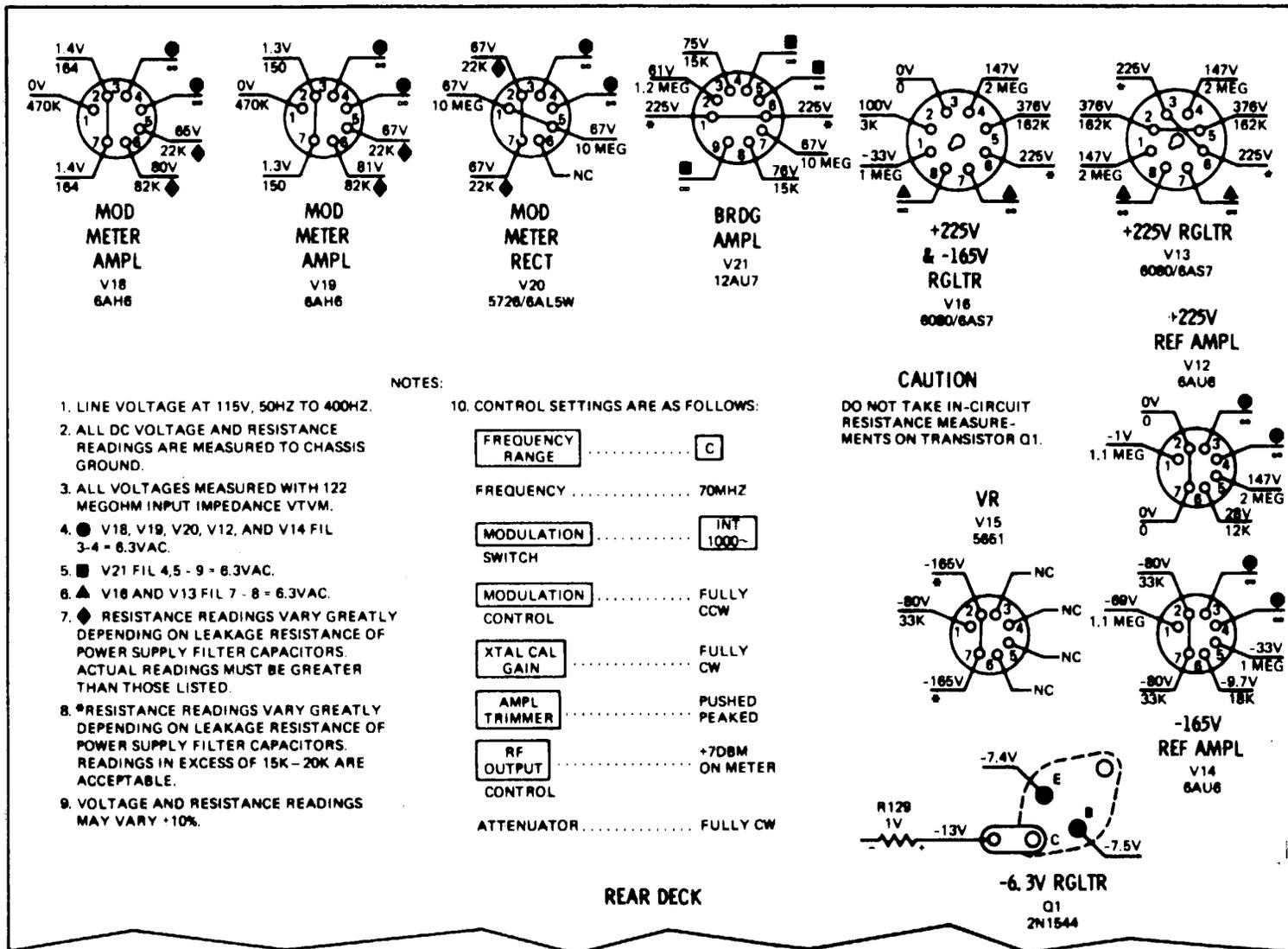
Nomenclature	National stock No.	Technical manual
Counter, Electronic Digital Readout ANIUSM-207	6625-00-911-6368	TM11-6625-700-10
Generator, Pulse ANIPPM-1	6625-00-503-0661	TM11-2678
Generator, Signal ANUTRM-127	6625-00-783-5965	TM11-6625-683-15
Multimeter ME-26/U	6625-00-360-2493	TM11-6625-200-15
Oscilloscope AN/USM-281A	6625-00-228-2201	TM11-6625-1703-15
Voltmeter ME-30/U	6625-00-669-0742	TM11-6625-320-12
Wattmeter AN/URM-98	6625-00-566-4990	TM11-625-433-15
ToolKitTK-100/G	5180-00-605-0079	SC-5180-91-CL-S21

**Section III. TROUBLINGSHOOTING**

**6-6. General.**

Troubleshooting at the general support level include all techniques, including use of a troubleshooting chart, relevant to organizational maintenance, plus any special

or additional techniques required to isolate a defective part, or parts.



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Figure 6-1. Rear deck tube sockets and transistor socket, voltage and resistance diagram

**6-7. Organization of Troubleshooting Procedures**

a. Troubleshooting procedures essentially involve localization and isolation techniques. Localization leads the serviceman to the stage and circuit containing a defective component. Isolation follows localization, and involves actually finding the faulty component, or components.

b. Operational tests are an aid in localization procedures. General support testing procedures, section V contain a complete set of tests.

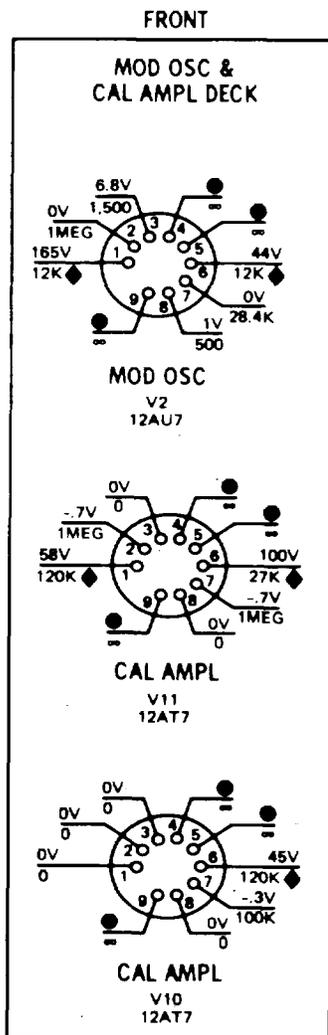
c. When abnormal conditions are observed, either during routine operation or when performing general support testing procedures, operate the signal generator in all modes, and make a complete list of malfunctions; this will expedite localization.

**CAUTION**

The TS-510B/U contains transistors. If any equipment item does not have an isolation transformer in its power supply, connect one in the power input circuit. A suitable transformer is identified by NSN 5950-00-356-1779. Do not make any in-circuit resistance measurements on the modulator and ALC circuit board or the -6.3 volt filament power supply.

**6-8. Techniques**

a. When following localization and isolation procedures, one or more of the following techniques may be employed. Use them only as indicated. Observe cautions. Make test connections with care to avoid shorts, grounding, and other problems. When mea-



**NOTES:**

1. LINE VOLTAGE AT 115V, 50HZ TO 400HZ.
2. ALL DC VOLTAGE AND RESISTANCE READINGS ARE MEASURED TO CHASSIS GROUND.
3. ALL VOLTAGES MEASURED WITH 122 MEGOHM INPUT IMPEDANCE VTVM.
4. ● V2, V10, AND V11 FIL 4.5-9 = 6.3VAC.
5. ◆ RESISTANCE READINGS VARY GREATLY DEPENDING ON LEAKAGE RESISTANCE OF POWER SUPPLY FILTER CAPACITORS. ACTUAL READINGS MUST BE GREATER THAN THOSE LISTED.
6. VOLTAGE AND RESISTANCE READINGS MAY VARY ±10%.
7. CONTROL SETTINGS ARE AS FOLLOWS:

<b>FREQUENCY RANGE</b> .....	<b>C</b>
FREQUENCY .....	70MHZ
<b>MODULATION SWITCH</b> .....	<b>INT</b> 1000~
<b>MODULATION CONTROL</b> .....	FULLY CCW
<b>XTAL CAL GAIN</b> .....	FULLY CW
<b>AMPL TRIMMER</b> .....	PUSHED PEAKED
<b>RF OUTPUT CONTROL</b> .....	+7DBM ON METER
<b>ATTENUATOR</b> .....	FULLY CW

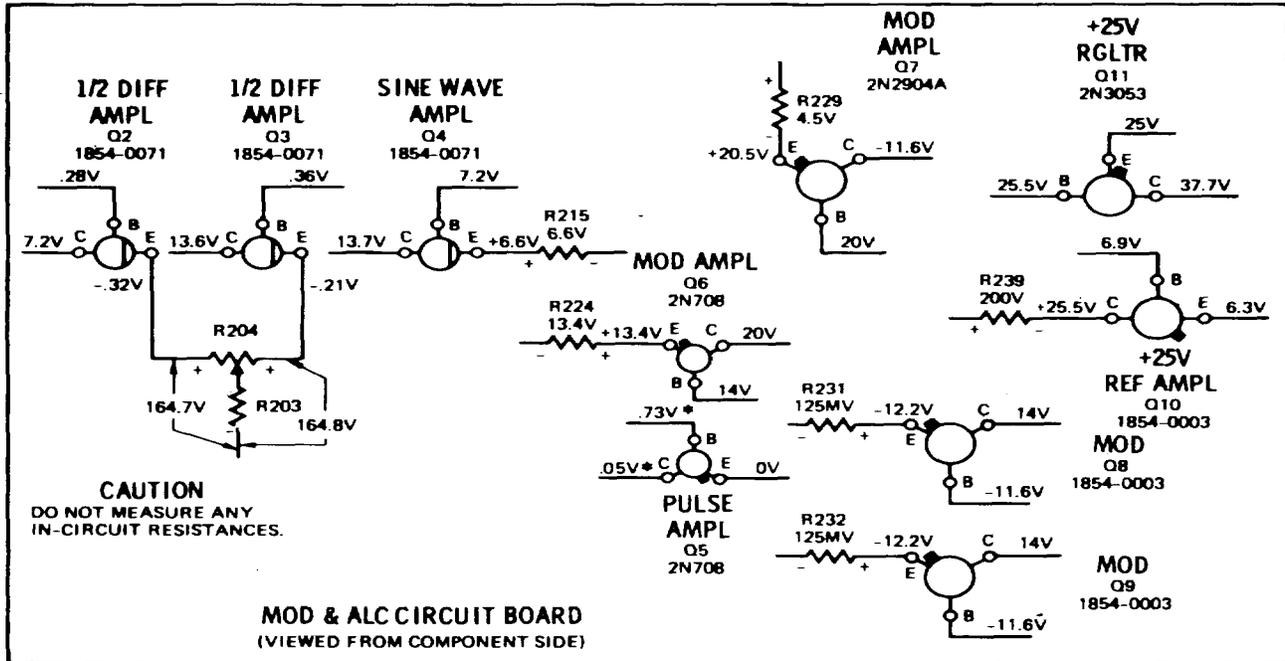
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Figure 6-2. Modulation oscillator and calibration amplifier, tube socket voltage and resistance diagram.

asuring voltages, use tape or sleeving to insulate the entire test probe, except for the extreme tip. Make resistance measurements only as directed on voltage and resistance diagrams or charts

b. Visual inspection is a valid troubleshooting technique. Logically, it should be the first, supplemented by smell and hearing. The eye can sometimes detect arcing transformers and charred resistors. Also look

TOP



1. LINE VOLTAGE AT 115V, 50HZ TO 400HZ.
2. EXCEPT FOR VOLTAGE ACROSS RESISTORS, ALL DC VOLTAGES ARE MEASURED TO CHASSIS GROUND.
3. ALL VOLTAGES MEASURED WITH 122 MEG-OHM INPUT IMPEDANCE VTVM.
4. VOLTAGE READINGS MAY VARY ±10%.

NOTES:

5. CONTROL SETTINGS ARE AS FOLLOWS:

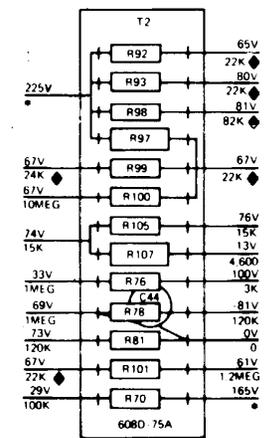
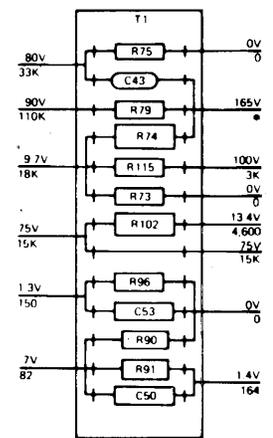
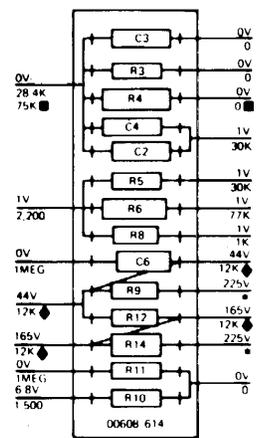
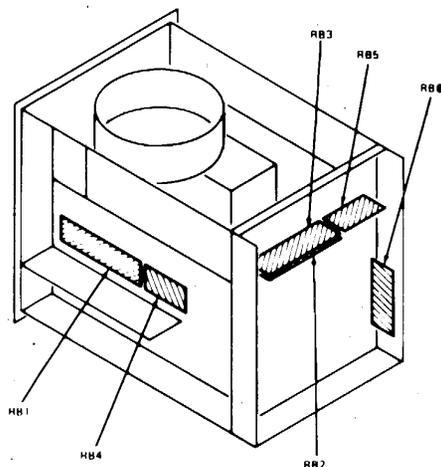
<input type="checkbox"/> FREQUENCY RANGE	.....	<input checked="" type="checkbox"/> C
FREQUENCY	.....	70 MHZ
<input type="checkbox"/> MODULATION SWITCH	.....	<input checked="" type="checkbox"/> CW
<input type="checkbox"/> MODULATION CONTROL	.....	FULLY CCW
<input type="checkbox"/> XTAL CAL GAIN	.....	FULLY CW
<input type="checkbox"/> AMPL TRIMMER	.....	PUSHED PEAKED
<input type="checkbox"/> RF OUTPUT CONTROL	.....	+7DBM ON METER
ATTENUATOR	.....	FULLY CW

- 6.\*Q5 VOLTAGES MEASURED WHEN

MODULATION SWITCH IS SET TO  EXT SET RF OUTPUT

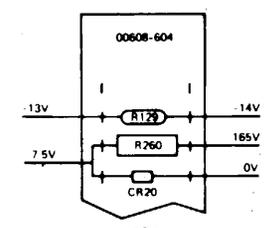
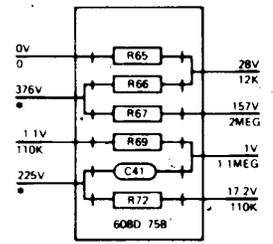
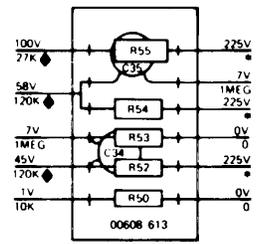
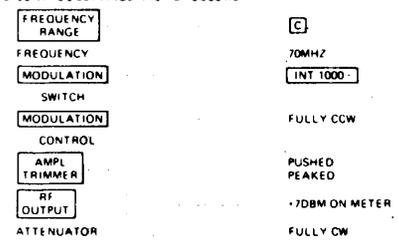
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Figure 6-3. Modulator and ALC circuit board, transistor socket voltage diagram.



NOTES

- 1 LINE VOLTAGE AT 115V. 50HZ TO 400HZ
- 2 ALL DC VOLTAGES AND RESISTANCES ARE MEASURED TO CHASSIS GROUND
- 3 ALL DC VOLTAGES MEASURED WITH 122 MEGOHM INPUT IMPEDANCE VTVM
- 4 VOLTAGE AND RESISTANCE READINGS MAY VARY ±10%
- 5 \* RESISTANCE READINGS VARY GREATLY DEPENDING ON LEAKAGE RESISTANCE OF POWER SUPPLY FILTER CAPACITORS READINGS IN EXCESS OF 15K 20K ARE ACCEPTABLE
- 6 ♦ RESISTANCE READINGS VARY GREATLY DEPENDING ON LEAKAGE RESISTANCE OF POWER SUPPLY FILTER CAPACITORS ACTUAL READINGS MUST BE GREATER THAN THOSE LISTED
- 7 ■ [MODULATION] SWITCH SET TO [INT 400]
- 8 CONTROL SETTINGS ARE AS FOLLOWS



**CAUTION**  
DO NOT MEASURE IN-CIRCUIT RESISTANCES ON RB6  
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Figure 6-4. Resistor and capacitor mounting boards, voltage and resistance diagrams.

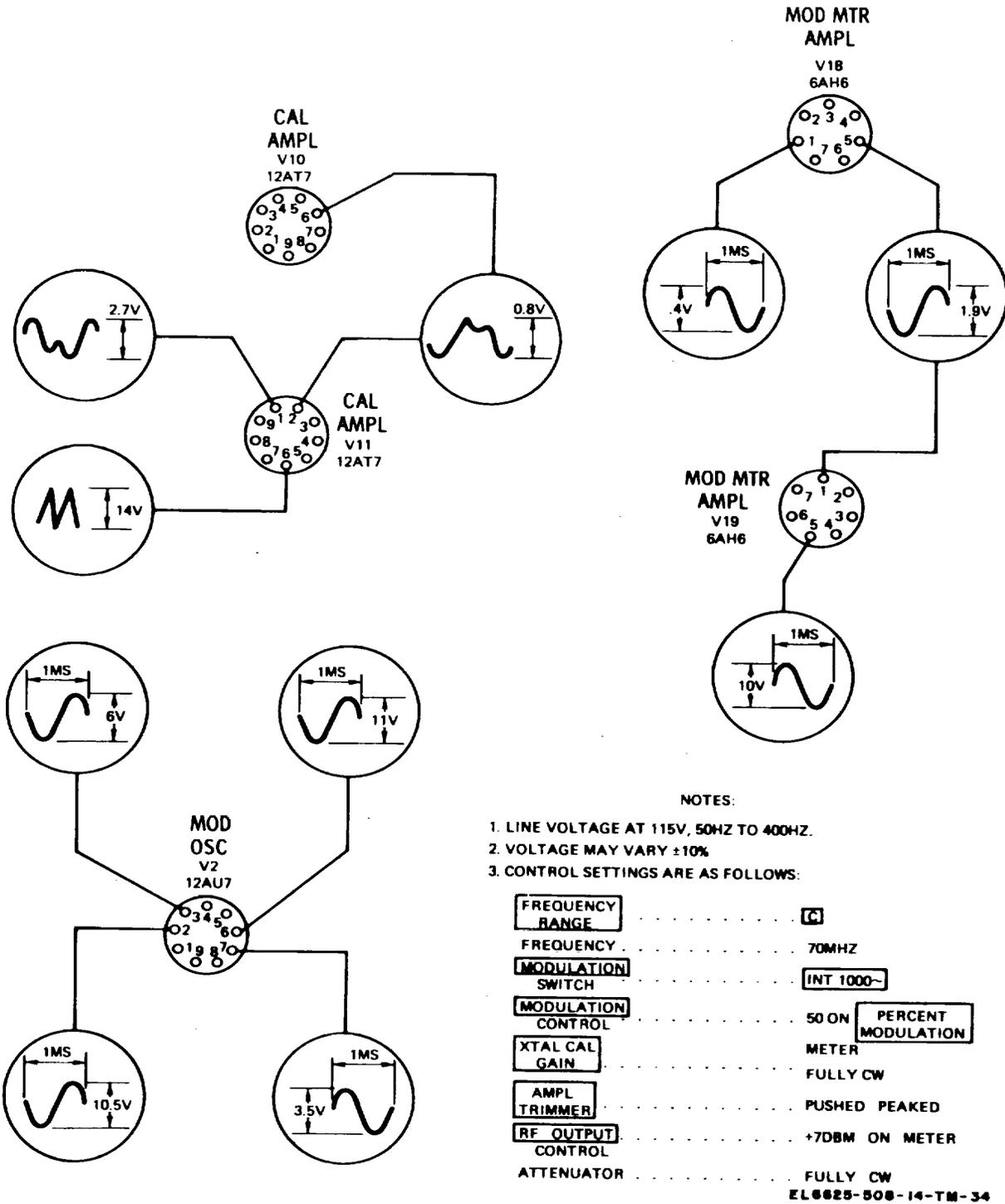
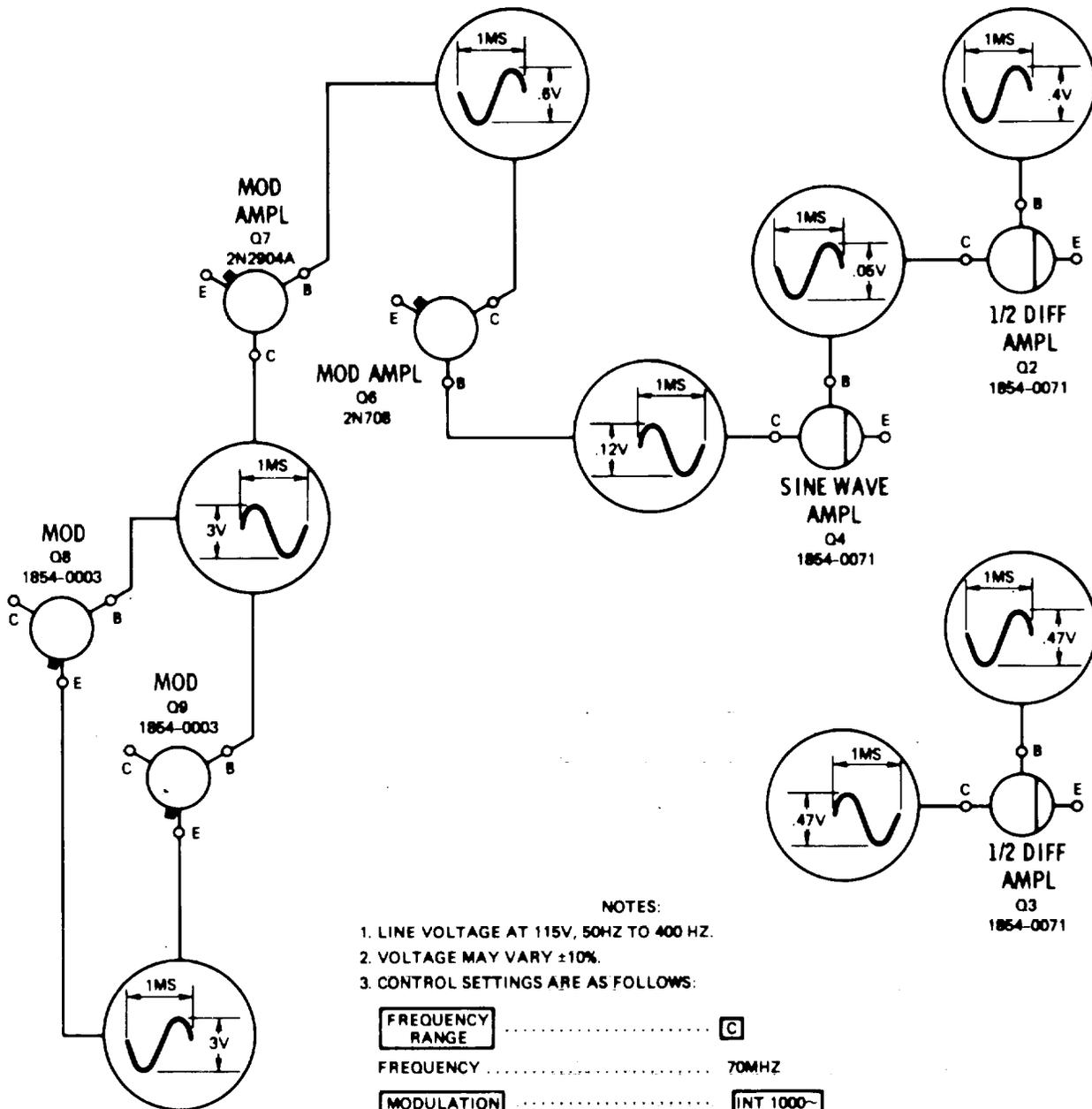


Figure 6-5. Modulation oscillator, modulation meter, and calibrator amplifier tube socket waveform diagram



NOTES:

1. LINE VOLTAGE AT 115V, 50HZ TO 400 HZ.
2. VOLTAGE MAY VARY ±10%.
3. CONTROL SETTINGS ARE AS FOLLOWS:

<b>FREQUENCY RANGE</b> .....	<b>C</b>
FREQUENCY .....	70MHZ
<b>MODULATION SWITCH</b> .....	<b>INT 1000~</b>
<b>MODULATION CONTROL</b> .....	50 ON <b>PERCENT MODULATION</b>
<b>XTAL CAL GAIN</b> .....	METER FULLY CW
<b>AMPL TRIMMER</b> .....	PUSHED PEAKED
<b>RF OUTPUT CONTROL</b> .....	+7DBM ON METER
<b>ATTENUATOR</b> .....	FULLY CW

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Figure 6-6. Modulator and ALC circuit board transistor socket waveform diagram.

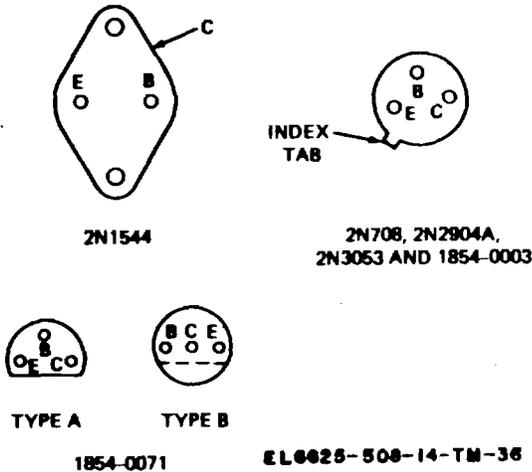


Figure 6-7. Transistor lead configurations

for:

(1) Improperly connected cables and burned out fuses.

(2) Broken wires, cords, and connectors.

(3) Broken vacuum tubes and/or transistors.

c Voltage and resistance readings are another valid technique (figs. 6-1 through 6-4). Use multimeter specified in paragraph 6-2. Resistance readings are taken with the signal generator deenergized

d Waveform analysis is a troubleshooting technique that can be accomplished at appropriate tube and transistor socket pins. The forms can be observed by using Oscilloscope ANI/USM-281A.

(1) Normal waveforms are shown in waveform illustrations (figs 6-5 and 6-6). By comparing observed and normal waveforms, trouble can often be located

(2) Before comparing waveforms, carefully read notes on the appropriate normal waveform illus-

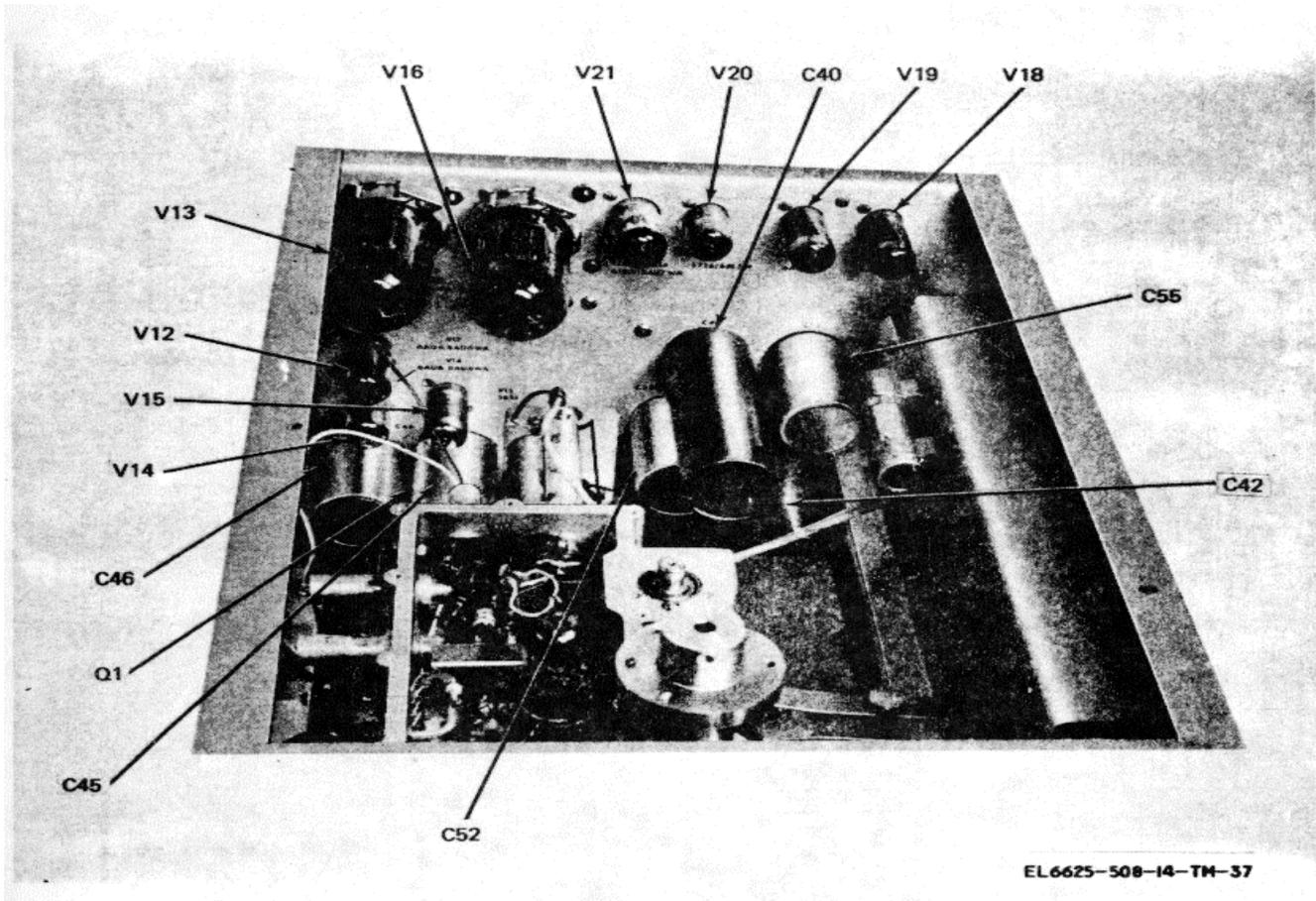


Figure 6-8. Inside rear deck, component locations

tration, and duplicate the exact conditions un which the illustrated waveform was obtained. If, der these conditions, the waveform displayed on oscilloscope does not closely resemble the illustrated waveform, trouble is indicated between the point normalcy and the point of distortion. For example, waveform is observed as normal at the grid of a circuit but abnormal at the plate, the trouble is in that circuit

(3) When trouble is indicated, change the tube fore making further tests. If the problem is not eliminated, reinsert the original tube; take voltage measurements at the tube socket pins and at the resistor capacitor boards, shown in figure 6 -4, containing components associated with the defective circuit.

(4) If voltage readings at tube socket pins are normal, deenergize the signal generator, and take assistance readings at the tube socket pins.

(5) If it is suspected that a transistor is defect

install another (fig. 6-7) and recheck the signal generator's operation. If the problem is not eliminated, re-install the original transistor. Do not take resistance readings at the transistor socket.

**6-9. Power Supply Trouble- Isolating Procedures**

a. References to chapter 5, paragraphs 5-18 through 5-21 and figures 5-17 through 5-20, as well as FO-2, will show how the signal generator's four power supplies are interdependent. Therefore, the following must be considered when troubleshooting these stages;

(1) The 225 and - 6.3 volt supplies depend on the - 165 volt supply.

(2) The 25 volt supply depends on the 225 volt supply.

b. If all power supply outputs are zero or abnormal,

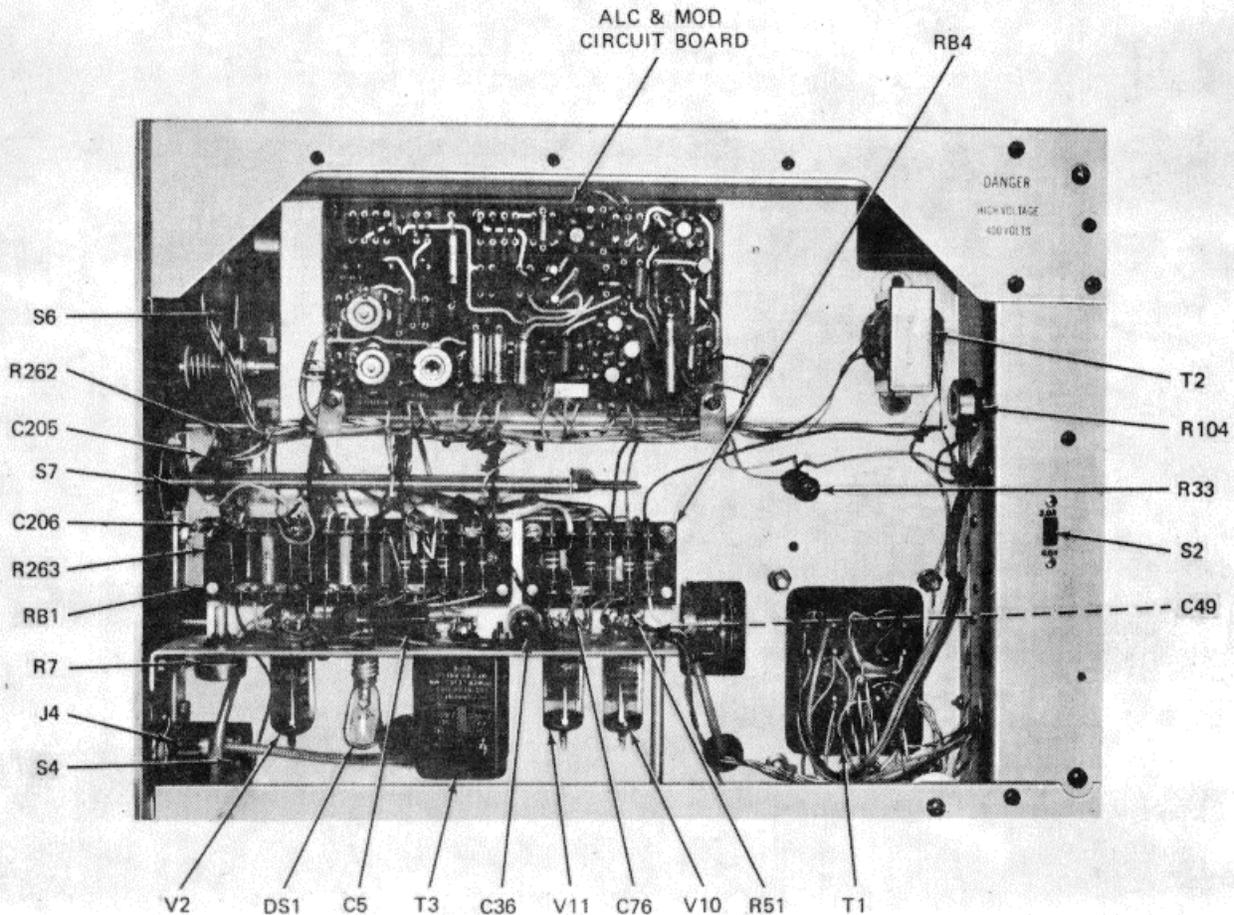


Figure 6-9. Right side view component locations

determine that primary ac input is present. Check line fuse F1, power switch S3, and transformer tap selection switch S2.

c. If the -165 volt supply is abnormal, check the primary of transformer T1, secondary winding T1 B,4 and 5, rectifiers CR12 through CR15, and measurements voltage at the pin of V16A. If the reading is normal check V16A, V14, V15, and associated circuitry.

d. If the 225 volt supply is abnormal, troubleshoot with its relationship to the - 165 volt supply in mind. Check the primary of T1, secondary winding T1B, 1 and 2, diodes CR8 through CR11, V13, V16B, V12, and associated circuitry.

e. A malfunctioning 25 volt supply must be serviced in terms of its dependency upon the 225 volt supply. If this reference voltage is correct, check T2, CR29,

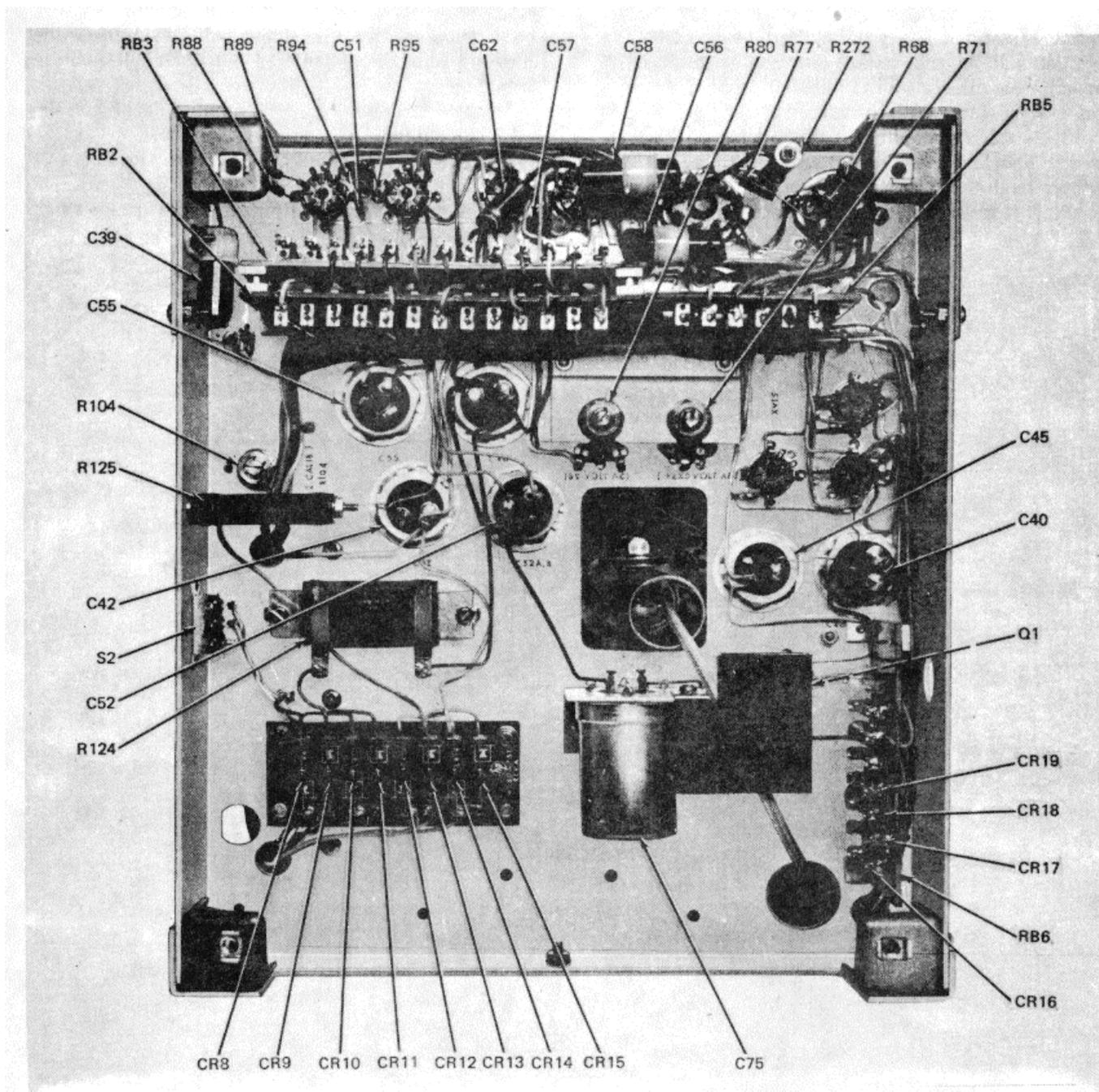


Figure 6-10. Rear deck, component locations

CR30, Q10, Q11, CR28, and associated circuitry. f The - 6.3 volt supply is developed from the - 16 volt supply. Assuming the latter is normal, check the primary of T1 and secondary winding T1C. Also check diodes CR16 through CR19, Q1, CR20, and associate circuitry.

**6-10. Troubleshooting Chart, Table 6-2**

a. The troubleshooting chart which follows list

malfunction, probable cause, and corrective action. Although the chart may include malfunctions or symptoms noted in the compilation suggested in paragraph 6-7, subparagraph c, it obviously cannot include all symptoms that may occur. However, it can still be used as a guide in problem analysis.

b. Illustrations (fig. 6-8 through 6-19) of component locations will supplement the troubleshooting chart and schematic diagrams.

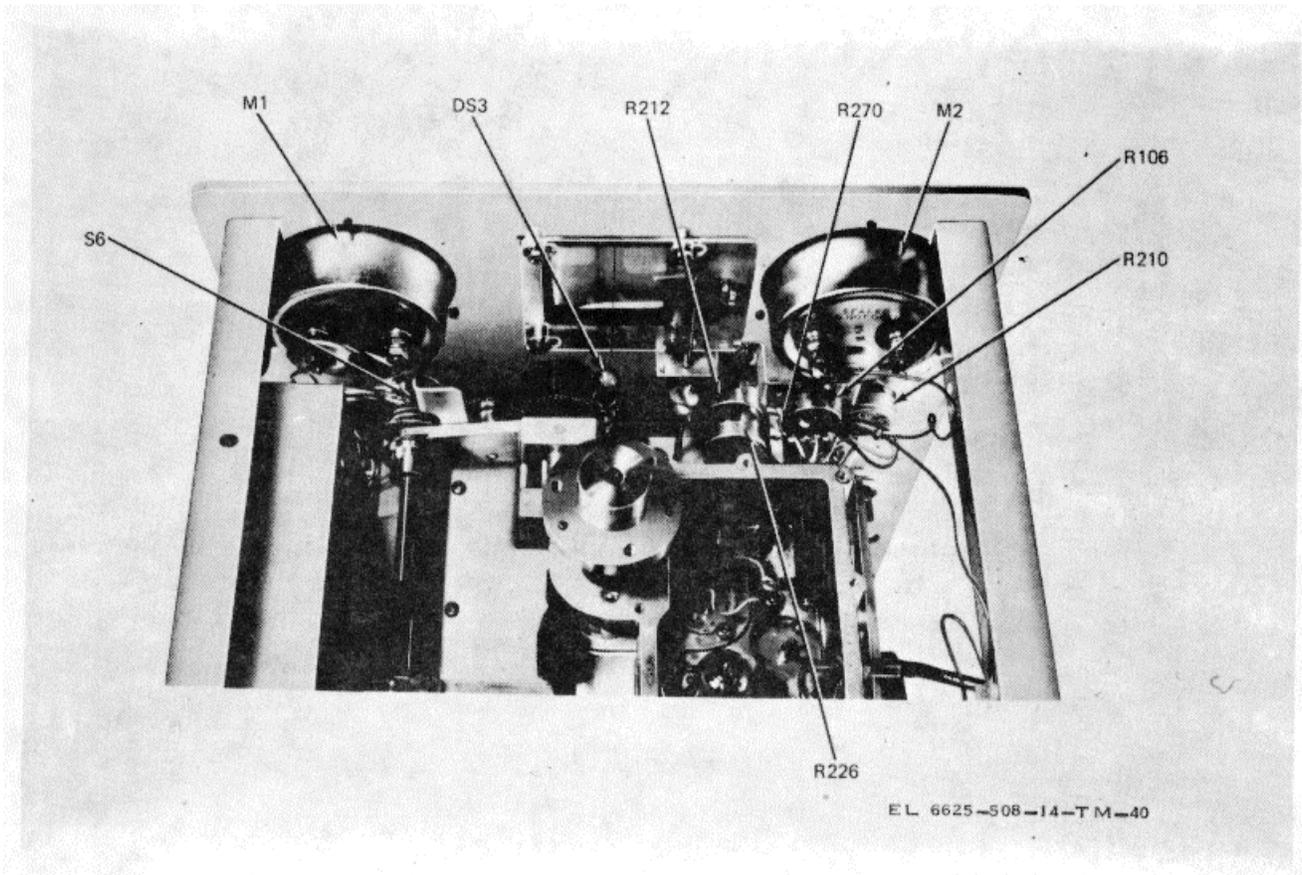


Figure 6-11. Front panel, rear view, component locations

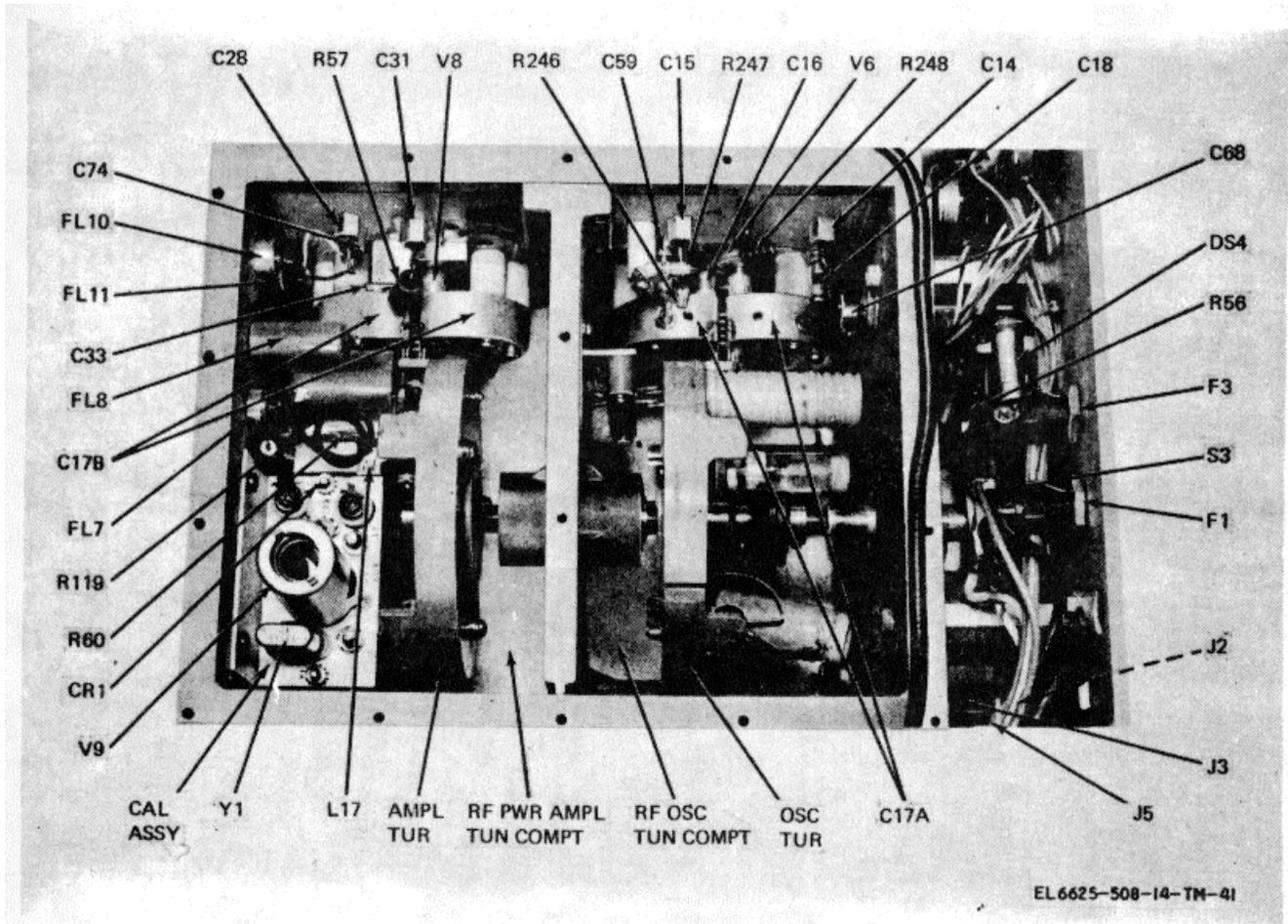


Figure 6-12. Rf oscillator, rf power amplifier tuning compartments, and crystal calibrator, component locations

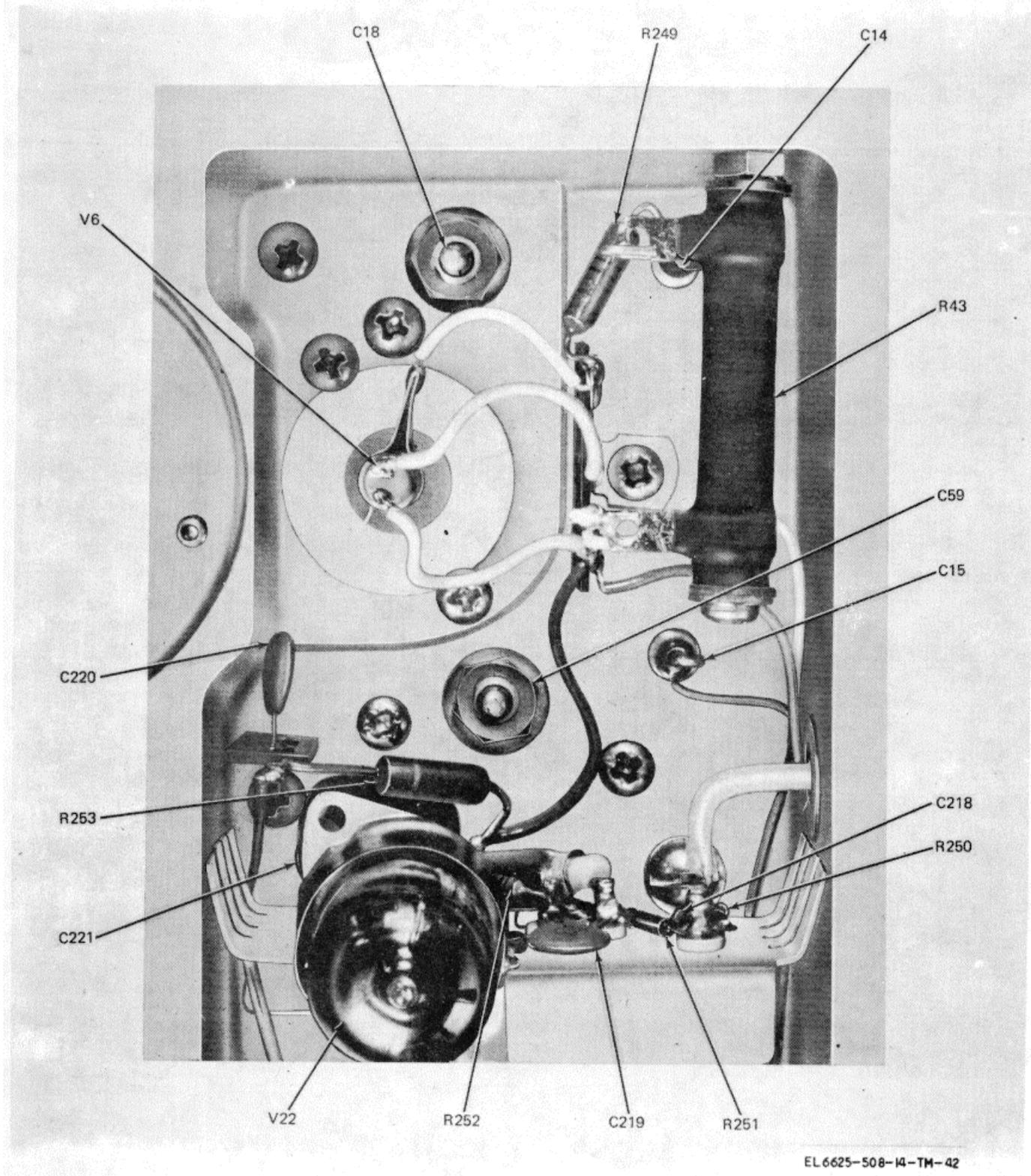


Figure 6-13. Rf oscillator upper tub compartment component, locations.

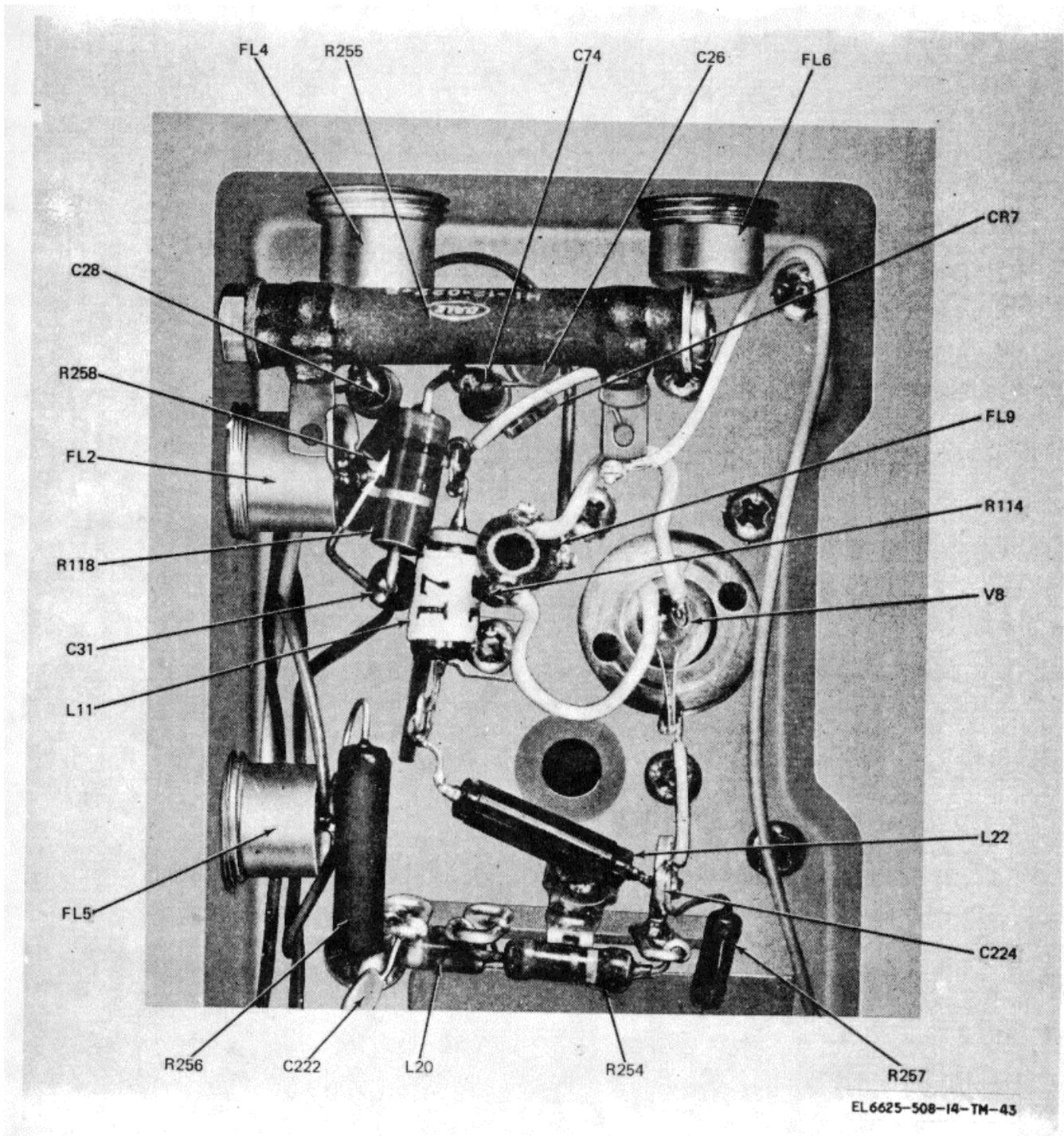


Figure 6-14. Rf power amplifier upper tube compartment, component locations.

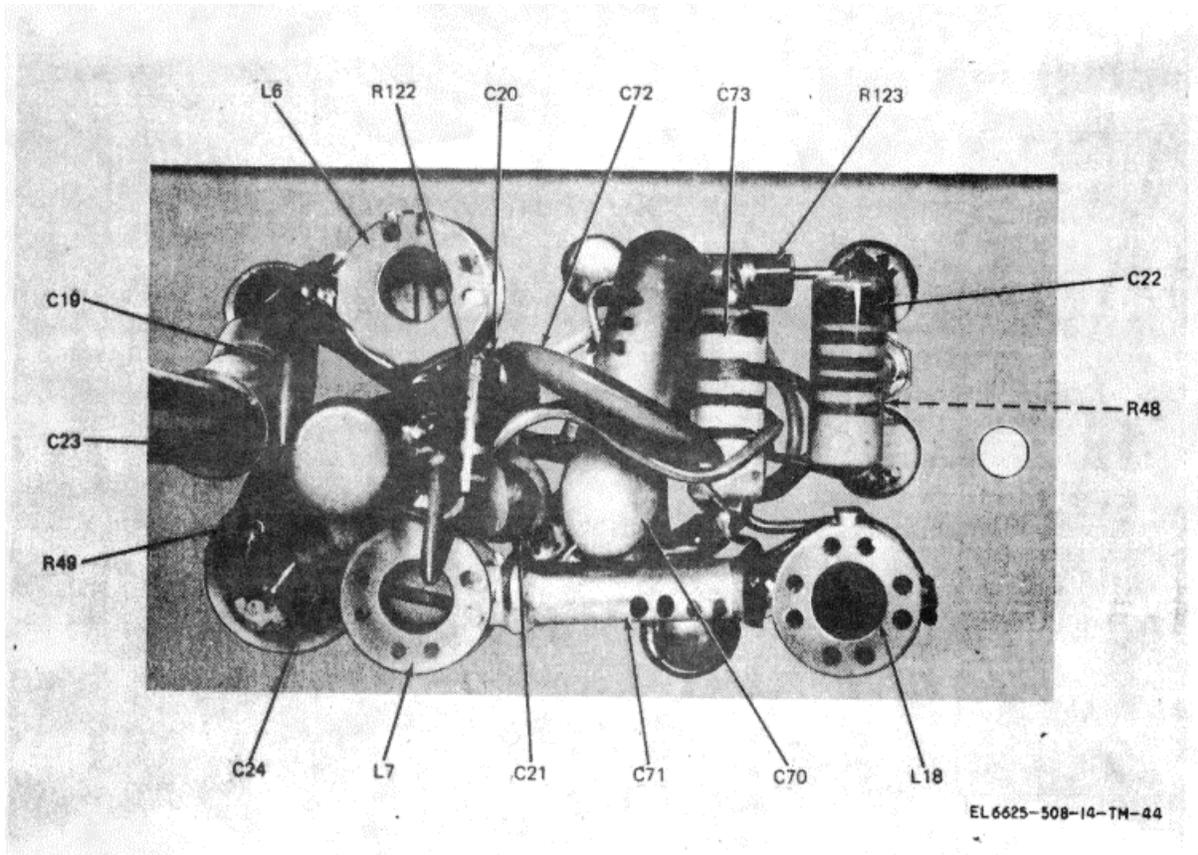


Figure 6-15. Crystal calibrator, bottom view, component locations...

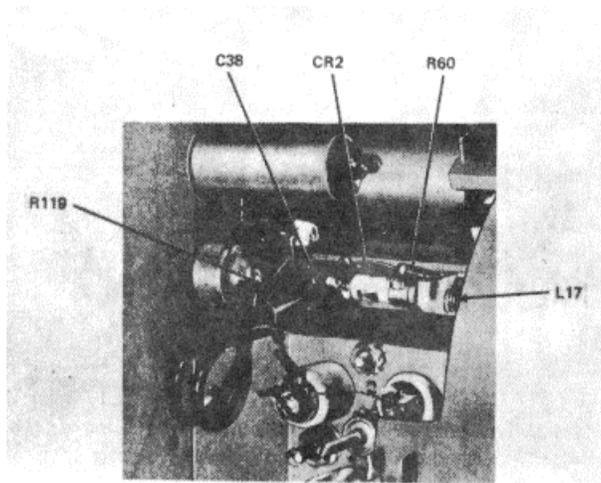


Figure 6-16. Envelope detector, (bolometer), component locations.

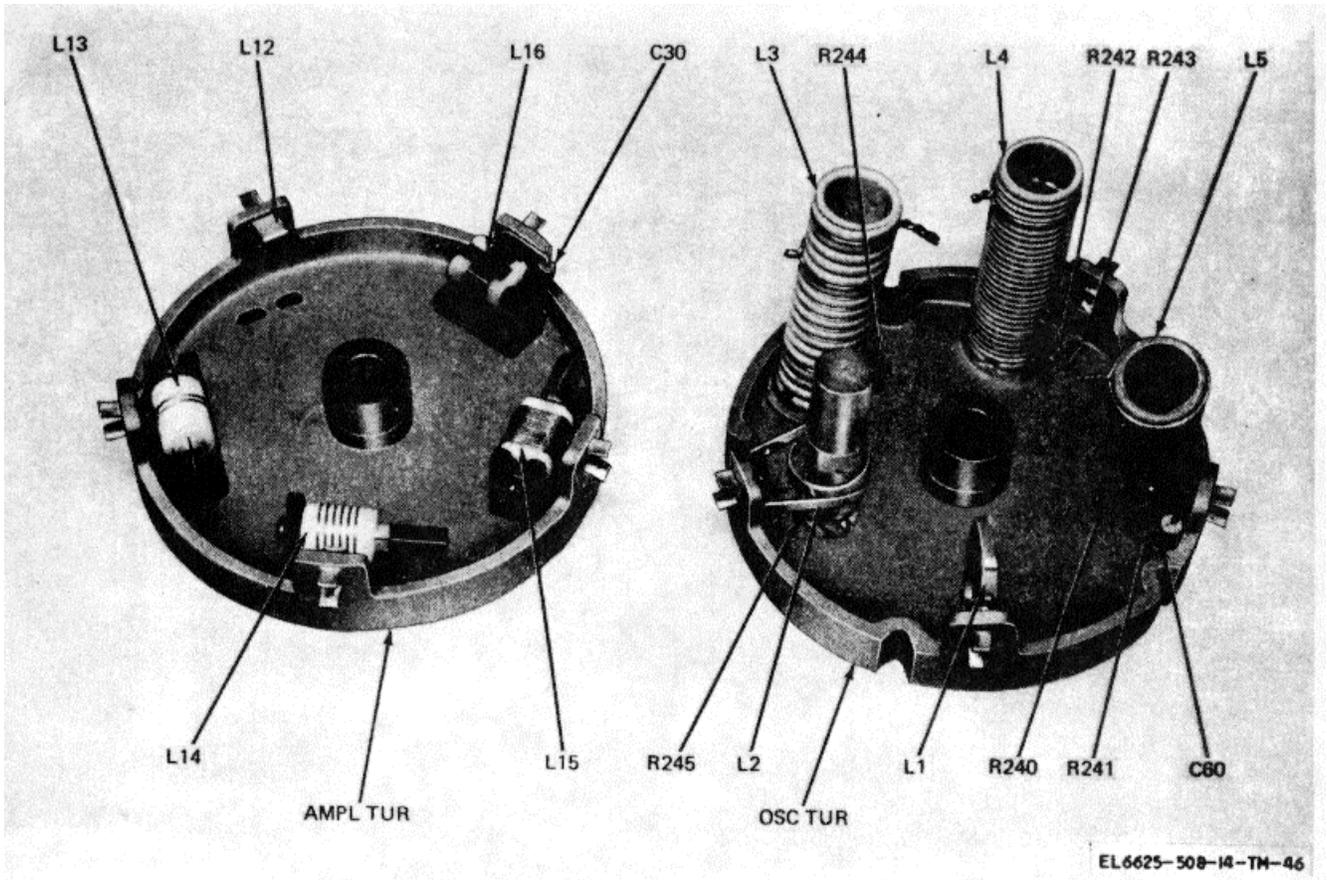


Figure 6-17. Rf oscillator and power amplifier turrets, component locations.

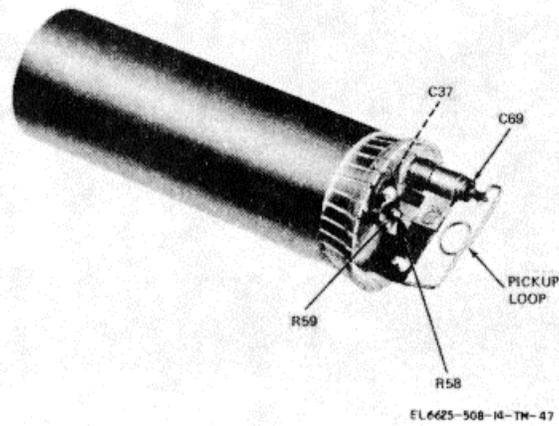
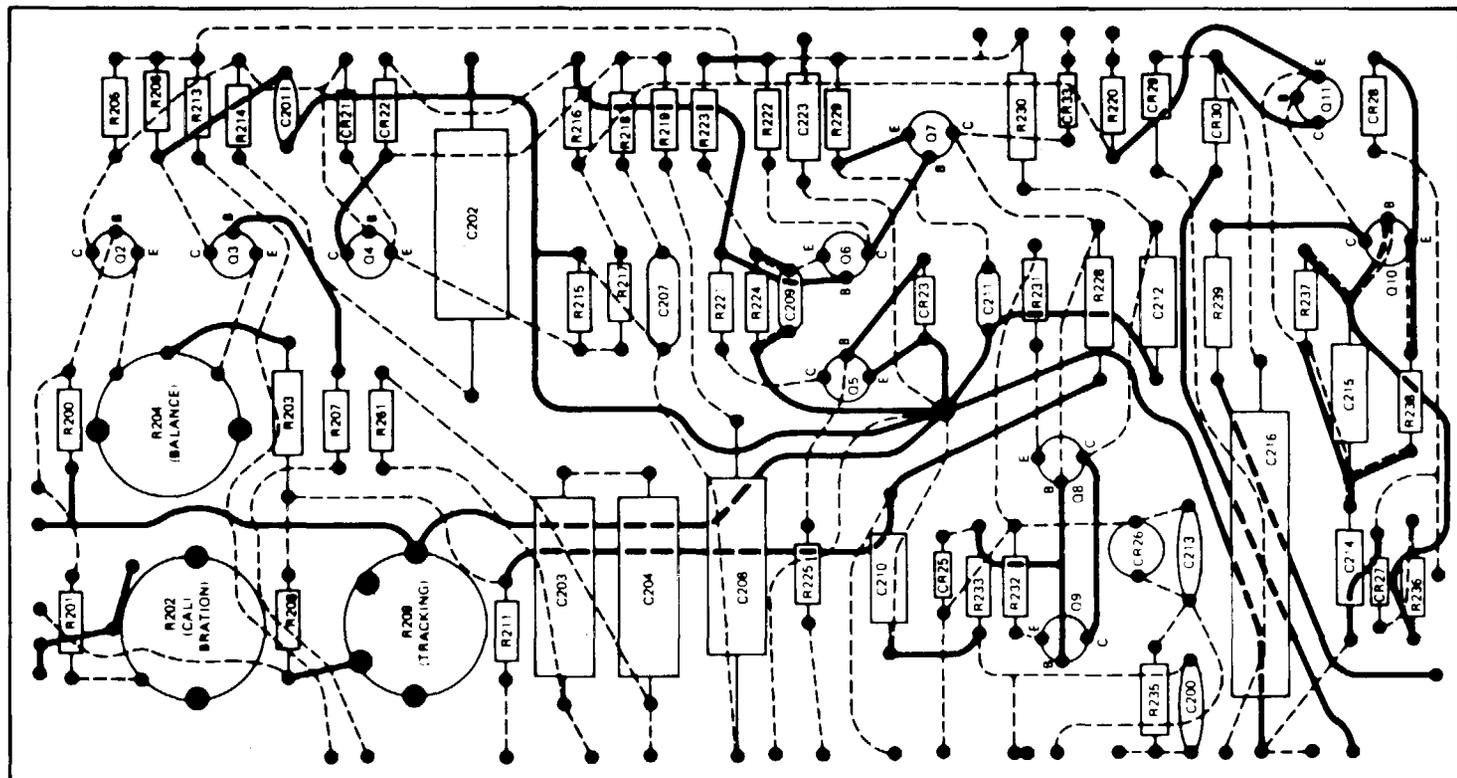


Figure 6-18. Attenuator probe, component locations.



NOTES

1. CIRCUIT VIEWED FROM SIDE ON WHICH PARTS ARE MOUNTED
2. ——— PARTS AND PIGTAILS ON FRONT OF BOARD.
3. - - - - WIRING ON BACK OF BOARD
4. ——— WIRING ON FRONT OF BOARD
5. ●—— WIRING ON FRONT OF BOARD UNDER A PART.

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Figure 6-19. Modulator and automatic leveling control (ALC) circuit board, component locations.

Table 6-2. General Support Troubleshooting Chart

	<i>Malfunction</i>	<i>Probable cause</i>	<i>Corrective action</i>
1	AC POWER lamp DS4 is not lighted; otherwise operation is normal	Defective AC power lamp DS4	Replace DS4.
2	MEGACYCLES dial lamp DS3 is not lighted; otherwise operation is normal	Defective MEGACYCLES dial lamp DS3.	Replace DS3.
3	No rf output in CW mode AC POWER lamp DS4 is not lighted; otherwise operation is normal	<p><b>a</b> Open AC LINE fuse F1</p> <p><b>b</b> Defect in one or more of the power supplies</p>	<p><b>Ca</b> Check F1 if good, check primary ac line cord, and replace if necessary. If line cord good, replace fuse.</p> <p>If F1 opens again, check all power supplies (para 6 -9).</p>
4	No rf output in CW mode; normal output in EXT SET RF OUTPUT mode ; AC POWER lamp is lighted	<p><b>a</b> Defective differential amplifier transistors Q2-Q3, sine wave amplifier Q4, and/or associated circuits</p> <p><b>b</b> Defective modulation amplifier Q6</p>	<p><b>a</b> Measure voltage at Q2 collector, CW mode. If abnormal check Q4 and associated circuits (para 5-10) shown in figure 5-8. Replace components as necessary.</p> <p><b>b</b> Remain in CW mode. Measure voltage at Q6 base. If voltage abnormal check Q6 and associated circuits, shown in figure 5-9. Replace components as required.</p>
5	No rf output in CW and EXT SET RF OUTPUT modes AC POWER lamp is lighted RF OUTPUT meter needle is pinned to left of scale	<p><b>a</b> Open DC.25 AMP fuse F3</p> <p><b>b</b> Defective RF OUTPUT meter M1</p> <p><b>c</b> Defective rf oscillator tube V6, and/or associated circuits</p> <p><b>d</b> Defective rf buffer amplifier tube V22, and/or associated circuits</p> <p><b>e</b> Defective rf power amplifier tube V8, and/or associated circuits</p> <p><b>f</b> Defective microwave envelope detector, diode CR2, and/or associated circuits</p> <p><b>g</b> Defective differential amplifier and/or associated circuits</p> <p><b>h</b> Defective sinewave amplifier Q4, and/or associated circuits</p> <p><b>i</b> Defective pulse amplifier Q5, and/or associated circuits</p> <p><b>j</b> Defective modulator amplifiers Q6, Q7, and/or associated circuits</p> <p><b>k</b> Defective modulator transistors Q8 and Q9, defective zener diode CR26, and/or associated circuits</p>	<p><b>a</b> Replace F3. If it opens, check 225 volt power supply (APRs 6-9), shown in figure 5-19. Replace defective components.</p> <p><b>b</b> Set MODULATION switch at CW. Check output at RF OUTPUT jack J4, shown in figure 5-6. If normal, check M1, figure 5-7, and associated circuits (para 5-9). Replace defective components.</p> <p><b>c</b> Check output at UNCAL RF OUTPUT jack J5, shown in figure 5-4. If abnormal check V6 and associated circuits (para 5-6). Replace defective components.</p> <p><b>d</b> Check V22, shown in figure 5-5, and associated circuits (para 5-7). Replace defective components.</p> <p><b>e</b> Check V8, figure 5-6, and associated circuits (para 5-8). Replace defective components.</p> <p><b>f</b> Check CR2 in bloomer circuit figure 5-6, and associated components. Replace all defective components.</p> <p><b>g</b> Consult figure 5-8. Measure Q2 collector voltage; if abnormal check transistors Q2, Q3, and associated circuits (para 5-10). Replace defective components.</p> <p><b>h</b> Consult figure 5-9. Measure voltage at base of modulation amplifier Q6. If abnormal, check Q4, figure 5-8, and associated circuits (para 5-10). Replace defective components.</p> <p><b>i</b> With MODULATION switch at EXT SET RF OUTPUT, measure Q5 collector voltage. Refer to figure 5-9. If voltage abnormal, check Q5 and associated circuits (para 5-11). Replace defective components.</p> <p><b>j</b> Refer to figure 5-9. Measure Q7 collector voltage. If abnormal check Q6, Q7, and associated circuits (para 5-11). Replace defective components.</p> <p><b>k</b> Consult figure 5-10. Measure Q8 and Q9 emitter voltages. If abnormal check Q8, Q9, diode CR26 and associated cir-</p>

Table6-2. General Support Troubleshooting Chart--Continued

<i>Malfunction</i>	<i>Probable cause</i>	<i>Corrective action</i>
		cuits (para 5 -12). Replace defective components
	i. Defective attenuator AT1	i. Refer to figure 5-6. Check output at RF OUTPUT jack J4. If abnormal, replace AT1. Refer to subparagraphs s and t of paragraph 6-11.
6. Uncontrollable high rf output in CW and EXT SET RF OUTPUT modes.	a. Defective differential amplifiers Q2 -Q3, and/or defective RF OUTPUT control R212, and/or related circuitry.	a. Refer to figures 5-8. Measure Q3 collector voltage. If abnormal, check Q2, Q3, R212, and related circuits. Replace defective components (para 5-10).
	b. Defective sine-wave amplifier Q4, and/or defective modulator amplifiers -Q6-Q7, and/or related circuitry	b. Refer to figures 5-9. Measure Q7 collector voltage. If abnormal, check Q4, Q6, Q7, and related circuits. Replace defective components.
7. Uncontrollable high rf output in CW and EXT SET RF OUTPUT modes	a. Defective pulse amplifier Q5 and/or related circuits.	a. Set MODULATION switch to EXT SET RF OUTPUT position. Refer to figure 5-9. Measure Q5 collector voltage. Check related circuits. Replace defective components (para 5-11).
	b. Defective modulator amplifier Q6-Q7, and/or related circuits.	b. Measure Q7 collector voltage. If abnormal, check Q6, Q7, and related circuits. Replace defective components.
	c. Defective low-pass filter FL6, and/or limiting diode CR7.	c. Refer to figure 5-10. Check FL6 and CR7. Replace if necessary.
	d. Defective modulators Q8, Q9, and/or associated circuits.	d. Refer to figure 5-10. Measure Q8 and Q9 emitter voltages. If abnormal, check Q8, Q9, and related circuits. Replace defective components.
8. Distorted output and 100kHz parasitic oscillations in all modes except EXT PULSE and SET RF OUTPUT positions.	a. Defective transistors Q2 through Q4, Q6 through Q9, and/or related circuits.	a. Refer to figure 6-3. Set MODULATION switch at CW. Measure terminal voltages of Q2 through Q4, and Q6 through Q9. Whenever an abnormal condition is observed, check the appropriate transistor and its related circuitry. Replace defective components.
	b. Defective frequency-compensation circuits.	b. Refer to figure 5-8. Check R214, R218, R219, C202, C207, and C208. Replace defective components.
9. No modulation capability, INT 400-mode	Defective 400 cycle frequency-determining components, and/or MODULATION switch S7.	Refer to figure 5-11. Check R4, R6, and S7. Replace defective components (para 5-13).
10. No modulation capability, INT 1000-mode.	Defective 1000 cycle frequency-determining components, and/or MODULATION switch S7.	Refer to figure 5-11. Check R3, R5, and S7. Replace defective components.
11. No modulation capability in INT 400 and 1000~ modes.	Defective modulation oscillator tube V2, and/or associated circuits	Refer to figure 5-11. Check V2 and related circuits. Replace defective components (para 5-13).
12. No PERCENT MODULATION meter indication, rf output modulation normal	a. Defective modulation meter amplifier tube or tubes V18-V19, and/or their related circuitry.	a. Set MODULATION switch at either of the INT modulation positions. Refer to figure 5-12; check V18, V19, and associated circuits. Replace defective components (para 5-14).
	b. Defective modulation meter rectifier tube V20, and/or associated circuits.	b. Refer again to figure 5-13. Check V20 and related circuits. Replace defective components (para 5-15).
	c. Defective meter bridge amplifier tube V21, and/or PERCENT MODULATION meter M2, and/or circuitry related to these components.	c. Refer again to figure 5-13 and paragraph 5-15. Check V21, M2, and related circuitry. Replace defective components.
13. With XTAL CA1, switch S4 in 1MC position, no crystal calibrator output.	Defective switch S4; defective B section of vacuum tube V9, and/or related circuitry.	Refer to figure 5-14. Check S4 and replace if necessary. Check V9B and related circuits. Replace defective components (para 5-15).

Table 6-2. General Support Troubleshooting Chart-Continued

Malfunction	Probable cause	Corrective action
14 No crystal calibrator output in either 1MC or 5MC position of XTAL CAL switch S4 Rf output normal	<p>a Defective switch S4</p> <p>b Defective crystal oscillator tube V9, and/or defective mixer CR1, and/or related circuits</p> <p>c Defective calibrator amplifier tube or tubes V10A-V11, and/or matching transformer T3, and/or related circuitry</p>	<p>a Refer to figure 5-14 Check S4 Replace if necessary.</p> <p>b Set signal generator's XTAL CAL switch to 1MC Follow appropriate corrective actions recommended for mal function number 13 Then set XTAL CAL switch to 5MC Check V9, section A, CR1, and related circuits Replace defective components</p> <p>c Refer to figure 5-15 Check V10A, V11, '3, and related circuitry Replace defective components (para 5-16).</p>

**Section IV MAINTENANCE OF SIGNAL GENERATOR AN/USM-44B**

**6-11. General Parts Replacement Techniques**

a. *General* Most of the parts in the signal general are readily accessible. If faulty, they can be easily placed without special procedures. In all instances involving multiple connections, however, tag each wire as it is removed so that it can be correctly replaced. not energize equipment unless required.

b. *Etched Circuit Board Repair.* The etched circuit boards in the signal generator are of the plate through type consisting of metallic conductors bone to both sides of the insulating material. The metallic conductors extend through the component mount holes. Soldering can be done from either side of board with equally good results.

c. *Component Substitution.* Avoid unnecessary component substitution; it can result in damage to circuit board and/or adjacent components.

d. *Soldering.* Do not use a high-power soldering in on etched circuit boards. Excessive heat may lift a conductor or damage the board. Refer to TB SIG 222 correct soldering techniques for circuit boards.

e. *Component Replacement.*

(1) Remove defective component from circuit board.

(2) Remove solder from mounting holes using a suction desoldering aid.

(3) Insert component leads into mounting holes and position component as original was positioned. not force leads of replacement component into mounting holes. Sharp lead ends may damage plated-through conductor.

(4) Axial lead components, such as resistors tubular capacitors can be replaced without unsold ing. Clip leads near body of defective component, move component, and straighten leads left in boa Wrap leads of replacement component one turn around original leads. Solder wrapped connection, clip off excess lead.

f. *Cabinet Removal and Replacement.*

(1) Certain procedures will require cabinet removal. To do so, set signal generator on its front panel handles.

(2) Remove the four large knurled support/retaining screws on the rear panel.

(3) Slide cabinet up and over chassis. Be careful that cabinet does not catch on the rf output cable that terminates at the RF OUTPUT jack.

(4) To replace cabinet, reverse steps (1), (2), and (3).

g. *Removal and Replacement of Casting Side Cover.*

**WARNING**

Certain adjustments are made with the signal generator energized and the casting side cover removed. In these circumstances dangerous voltages are present.

(1) Remove 16 screws that secure side cover.

(2) Remove the cover, being careful not to let rfi gasket braid material fall out of mounting grooves.

(3) To replace, set cover in place and install the 16 screws.

h. *Removal and Replacement of FREQUENCY DIAL and Casting Top Cover.*

(1) Certain procedures require removal of the FREQUENCY DIAL and casting top cover.

(2) Refer to figure 5-3. Remove the three screws that secure the FREQUENCY DIAL to the dial hub, and remove dial.

(3) Remove the 12 screws that secure the casting top cover, and remove cover.

(4) To replace, set cover in place; install and tighten 12 screws.

(5) Align small holes in FREQUENCY DIAL with the two roll pins in dial hub, press down firmly on dial, install and tighten the three screws that secure the FREQUENCY DIAL to the hub.

i. *Etched Conductor Repair.* A broken or burned section of a conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap, and remove any varnish from

etched conductor before soldering wire into place.

*j. Transistor and Semiconductor Diode Replacement.*

(1) Do not apply excessive heat. Use a pencil-typing soldering iron of no greater than 25 watt capacity. If the soldering iron is used with ac power, use an isolating transformer between the iron and the source.

(2) Solder quickly. Use a heat sink, such as pliers between the semiconductor body and the hot soldering iron.

(3) When installing a replacement semiconductor insure sufficient lead length, to dissipate soldering heat, by maintaining about the same length of expose lead as was for the original semiconductor.

(4) To remove components on the modulator and ALC circuit board, remove the four screws that security to the chassis. This will allow the board to hand freely. Clip the component leads off as close to the board as possible; heat the joint, and use a toothpick to push the lead out of the mounting hole. Do not use sharp metal object.

*k. Oscillator Tube Replacement.* Replacement of rf oscillator tube V6 may affect calibration of the frequency dial and amplitude of the filament voltage.

Moreover, plate current requirements of 4042 triodes differ with varying applications. Therefore, when V6 is replaced, filament voltage must be checked and, if necessary, adjusted within a range of -6 to -6.6 volts dc.

(1) To remove V6, it is necessary to remove the frequency dial and the small cover at the top of the casting that houses the rf oscillator tube, the rf buffer tube, the power amplifier tube, and associated biasing networks (fig. 6-20). Removal and replacement of frequency dial and casting top cover are described in paragraph 6-11h.

(2) After frequency dial and top cover are removed, remove V6 filament socket by straight pull.

(3) Remove cathode clip by pulling straight up.

(4) Remove two BH screws holding retainer plate; then remove plate and fiber spacer. Do not disassemble the separate parts of the retainer plate.

(5) Lift tube gently from hole by straight pull.

(6) Replace tube in reverse order of above steps.

(7) Paragraph 6-12c describes setting of filament supply voltage.

(8) Replace frequency dial and casting cover.

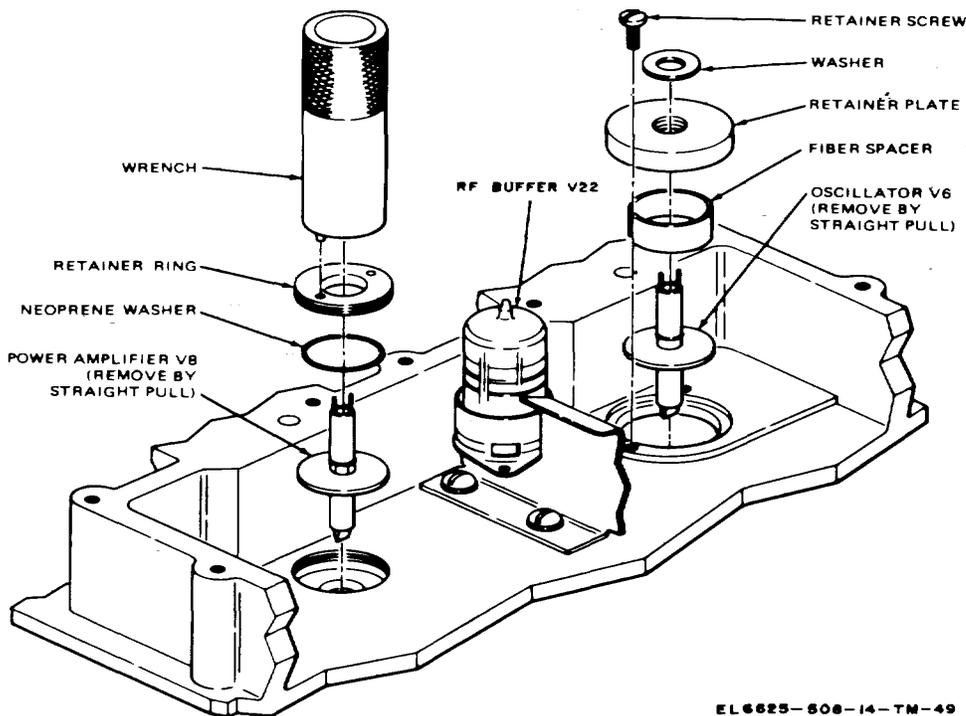


Figure 6-20. Replacement of rf oscillator, rf buffer, and rf amplifier tubes.

*and Rf Buffer Tube.* Replacement of the rf amplifier and buffer tubes can affect the amplitude of the rf filament voltage supply. To remove these tubes, proceed as follows:

- (1) Remove frequency dial and top plate from generator housing. Refer to paragraph 6-11h
- (2) Refer to figure 6-20. Pull rf buffer tube V straight out and replace.
- (3) For amplifier V8, remove filament socket straight pull
- (4) Remove cathode clip from tube by pulling straight up.
- (5) Use special wrench (fig. 6-21) to loosen threaded retainer ring that holds V8 in housing. 1 move retainer ring and neoprene washer.
- (6) Remove tube by straight pull
- (7) To replace V8, install tube straight into socket and press firmly to seat tube.

- (8) Set neoprene washer on grid of tube, and align filament pins parallel with casting sides.
- (9) Keeping neoprene washer centered, install and tighten retainer ring.
- (10) Push clip onto cathode.
- (11) Carefully install filament socket over filament pins, and push down to seat.
- (12) Refer to paragraph 6-12c. Check and, if necessary, adjust filament supply voltage.
- (13) Refer to paragraph 6-12k. Perform power leveling adjustments.
- (14) Replace frequency dial and casting cover.

*m. Removal of Rf Oscillator Coils, D and E.* Do not attempt to remove A, B, and C frequency range coils from the rf oscillator turret. Since the coil forms are cemented to the turret material with a very strong adhesive, it is very likely that the turret material will

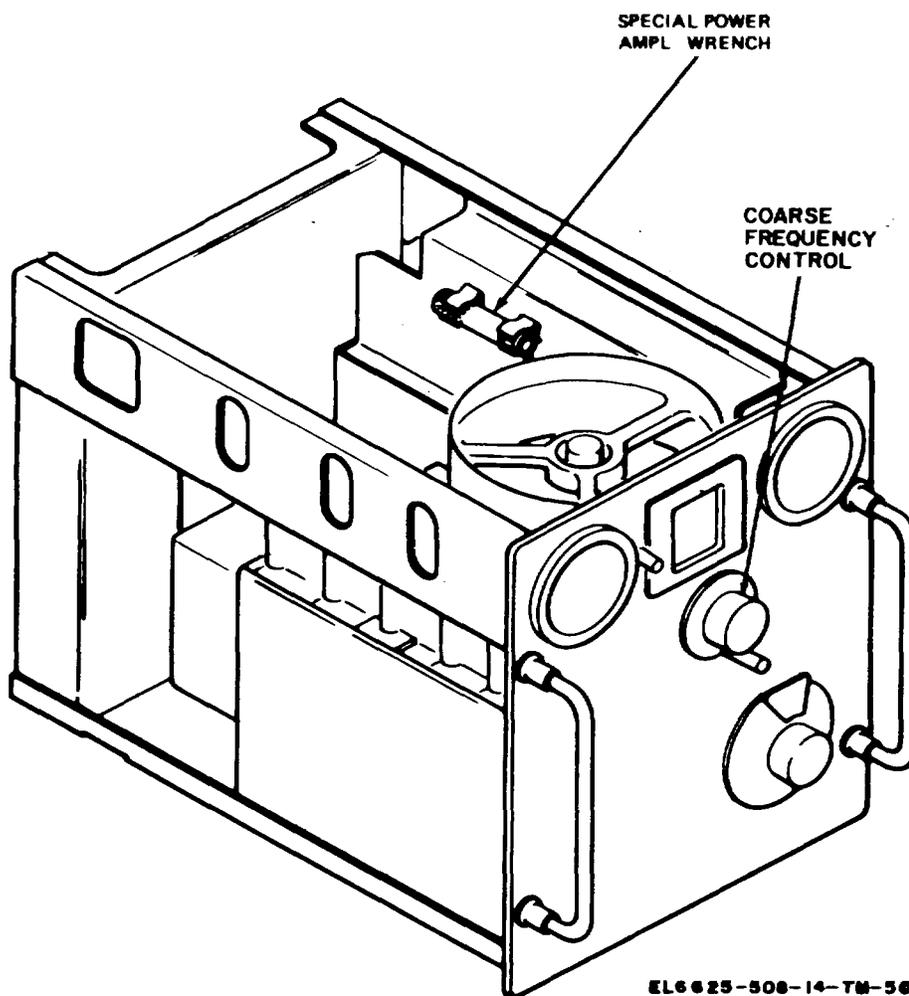


Figure 6-21. Special rf power amplifier wrench, storage location.

coils D and E, proceed as follows:

(1) Determine that ac power is off. Refer to figure 6-17.

(2) Remove casting side cover. Removal and placement are described in paragraph 6-1 g.

(3) To remove range D coil, set FREQUENT RANGE switch at B.

(4) Unsolder large 2-turn wire attached to switch terminals; then unsolder resistor lead and small wire attached to rear switch terminals. Use an offset screwdriver to remove screw that secures clear plastic coil form; remove form.

(5) To remove range E coil, set FREQUENT RANGE switch to C.

(6) Unsolder and remove large loop attached rear switch terminals; then unsolder small U-shape section attached to side switch terminals.

*n. Replacement of Rf Oscillator Coils D and E.*

(1) To replace range D coil, set FREQUENT RANGE switch to B.

(2) Position clear plastic coil form, and in screw from rear of turret. Solder loose end of resistor to inside rear switch terminal, and coil wire to out terminal.

(3) Slide large two-turn loop over coil form solder to side switch terminals.

(4) To replace range E coil, set FREQUENT RANGE switch to C.

(5) Solder small U-shaped section to inside faces of side switch terminals; then solder large loop outside surfaces of rear switch terminals; make that plane of large loop is perpendicular to rear surface of turret. Since the signal generator generates high frequencies, excessive solder and/or bent contacts can cause frequency drift. Therefore, use solder sparingly, and do not solder under stress.

(6) Follow procedures outlined in paragraph 6-11j.

(7) Replace casting side cover.

*o. Removal of Rf Power Amplifier Turret Components, Ranges A through E.*

(1) Determine that ac power is off. Refer to figure 6-17.

(2) Remove casting side cover. Removal and placement are described in paragraph 6-11g.

(3) Carefully note and record coil placement lead dressing before removing any coils.

(4) For ranges A through D, unsolder two lead attached to switch terminals; if there is a capacitor these terminals, unsolder and remove it.

(5) Loosen nut or screw that secures coil to holder and remove coil. If coil holder is damaged, use an offset screwdriver to remove screw that secures holder

(6) For range E, unsolder two contacts f switch terminals, and remove small, Z-shaped coil.

*p. Replacement of Rf Power Amplifier Turret Components, Ranges A through E.*

*ponents, Ranges A through E.*

(1) For ranges A through D, install coil holder; if necessary, secure with screw; then install coil in holder slot.

(2) Position coil so that flat side is toward rear and clears end of attenuator waveguide by about 1/16 inch; tighten screw just enough to hold coil in this position.

(3) Looking at coil from brown slug end, solder nearest lead to rear switch terminal, and farthest lead to forward terminal. Keep leads as short as possible.

(4) For range E, unsolder two contacts from switch terminals and remove small, Z-shaped coil.

(5) Perform power leveling adjustment. Refer to paragraph 6 -12k.

(6) Replace casting side cover.

*q. Removal of Crystal Calibrator.*

(1) Determine that ac power is off.

(2) Remove casting side cover. Removal and placement are described in paragraph 6-1 lg.

(3) All the crystal calibrator components (see figures 6-12 and 6-15) are mounted on a small sub-chassis located inside the rf power amplifier tuning compartment, and secured to the casting by two screws.

(4) Refer to figure 6-12. Inside rf power amplifier tuning compartment, unsolder red, yellow, green and black wires from C74, C28, FL10, and FL11 in sequence. Unsolder end of L8 (not shown in figure 6-12) that is attached to FL7; see figure 5 -14.

(5) Remove oscillator tube V9 and crystal Y1.

(6) Using an offset screwdriver, remove the two screws that secure the subchassis to the casting. When removing, or replacing this unit be careful not to jar the bloomer shield; if this shield is moved, the entire power leveling procedure may have to be performed. Remove nut and washer at each end of sub chassis.

(7) Gently remove subchassis from under cable.

*r. Replacement of Crystal Calibrator.*

(1) Reverse removal procedures outlined in preceding subparagraph.

(2) Perform crystal calibrator adjustment as described in paragraph 6-12h.

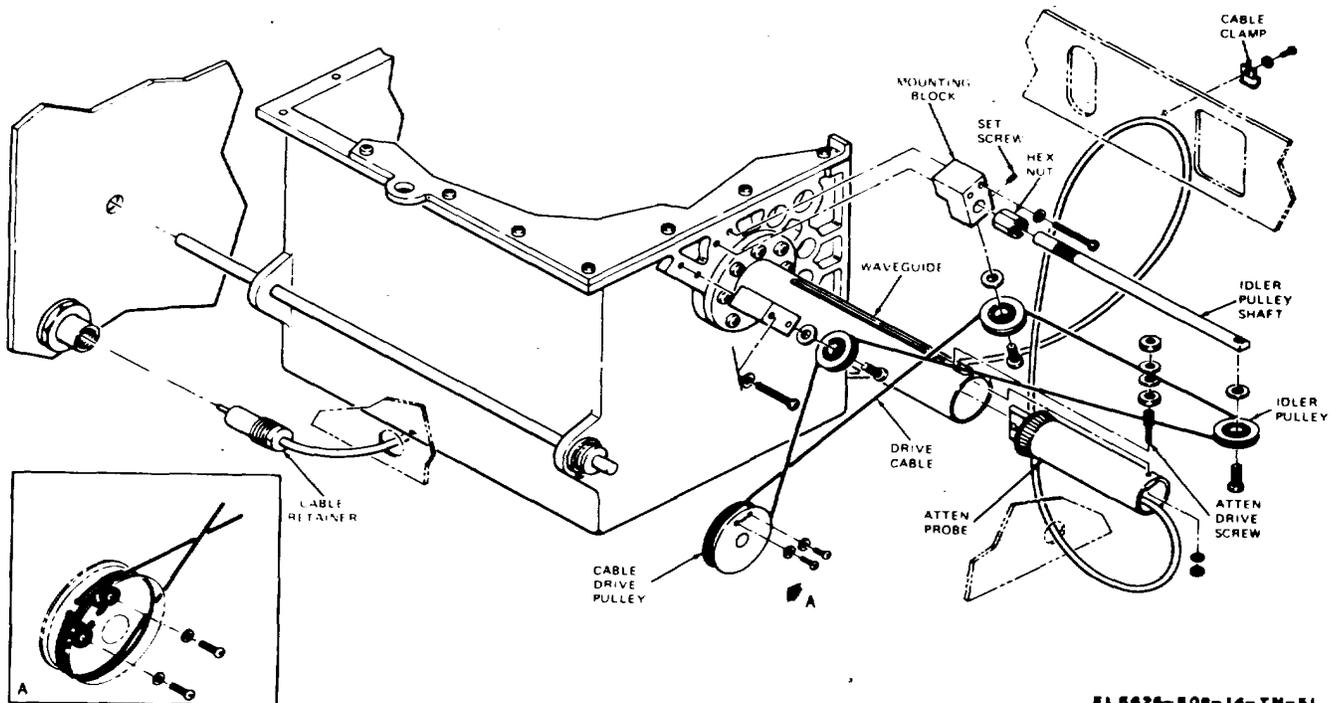
*s. Removing Attenuator Probe and Attaching Rf Output Cable.*

**CAUTION**

When handling the probe, avoid subjecting it to any shock. Do not straighten the one or two probe fingers that are bent toward center. Never force the probe into the wave guide.

(1) Refer to paragraph 6-1 g; remove casting side cover.

(2) When removing attenuator probe and attaching rf output cable (fig. 6-22), first set attenuator (AITEN) control fully counterclock-wise.



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Figure 6-22. Attenuator probe and drive cable details.

(3) Use a 7/16-inch open end wrench to loosen cable retainer behind RF OUTPUT connector and completely unscrew it; this frees the rf output cable from the front panel connector.

(4) Remove screw and clamp that secures rf output cable to upper left chassis frame.

(5) Remove top 3/8-inch nut and two fiber washers from attenuator drive screw, and 1/4-inch nut washer from inside attenuator waveguide.

(6) Unscrew attenuator drive-screw, and carefully slide attenuator probe from rear of waveguide. Do not bump attenuator. Do not bend pickup loop.

*t. Replacing Attenuator Probe and Attaching Rf Output Cable.*

(1) Wrap two turns of solder around, and just behind, end of probe fingers. Refer to figure 6-22. Pull exerting no more tension than necessary, so that probe-fingers will slip easily into end of waveguide.

(2) Position probe so that drive screw mounting block is aligned with waveguide slot, and carefully slide probe into waveguide just far enough so that all probe-fingers are within waveguide.

(3) Carefully release, and pull out, solder.

(4) Slide probe into waveguide until drive screw hole is visible through waveguide slot; then screw the drive-screw completely into mounting block.

(5) Install washer and 1/4-inch nut on bottom

drive screw, and tighten.

(6) Install one fiber washer on drive screw, and set drive cable into drive-screw slot.

(7) Install remaining fiber washer and nut on drive-screw, but do not tighten.

(8) Insert rf output cable through hole in lower right corner of rear deck, from large loop in cable and clamp top of loop to upper left chassis frame.

(9) Route rf output cable under casting, and through hole in chassis frame.

(10) Insert end of rf output cable into rear of RF OUTPUT connector, screw cable retainer into connector, tighten, and set FREQUENCY RANGE switch between any two ranges.

(11) Push forward on attenuator drive-screw until probe pickup loop extends beyond end of waveguide into the rf power amplifier tuning compartment.

(12) Pull on rf cable at rear of attenuator so that loop is flush with end of waveguide.

(13) Exercise care not to move probe, tighten top nut on drive screw. To avoid cutting the drive cable, do not overtighten nut.

(14) Check to see if probe loop is still flush with end of waveguide; if not, repeat steps (11) through (12).

(15) Carefully position plane of probe pickup loop parallel with, and centered midway between, the two

wires in waveguide end.

(16) Refer to subparagraph *k* of paragraph 6-12 and perform power leveling adjustment.

(17) Replace casting side cover.

**6-12. Adjustments**

*a. General.* Because certain repairs can be made without changing any internal settings, and because all circuits are not affected when individual vacuum tubes are replaced, the signal generator seldom requires a complete adjustment. However, if complete adjustment is necessary, follow the sequence outlined below; otherwise, the adjustments can be made individually without compromising the signal generator's performance accuracy. Also, because of the interdependence of the regulated power supplies, an adjustment of any one of these regulators requires output voltage check of each other regulator to be sure it is still within specified tolerances.

*b. Mechanical Zero Adjustments of Either Front Panel Meter.*

(1) Determine that ac power is off, and remove cabinet; removal and replacement are described paragraph 6-1 lf.

(2) Set MODULATION switch at CW.

(3) Set MODULATION and RF output controls fully counterclockwise.

(4) Connect jumper wire across meter terminals

(5) Rotate meter's mechanical zero-adjust screw clockwise until meter pointer is at left of meter zero moving up scale; stop adjustment when pointer is exactly at zero. If pointer overshoots, repeat adjustment

(6) Carefully adjust mechanical zero-adjust screw a few degrees to free it from meter suspension. pointer moves off zero, repeat step (5).

(7) Remove jumper from meter terminals.

(8) Replace cabinet.

*c. Regulated Power Supply Adjustments.*

**WARNING**

Dangerous voltages exist within the signal generator.

(1) For this adjustment, and all adjustments that follow, the cabinet will be removed as described in paragraph 6-1lf, the signal generator will be energized, and a one hour warmup period will be allowed Set controls as follows.

(a) MODULATION, RF OUTPUT, XTAL CAL GAIN controls fully counterclockwise.

(b) AMPL TRIMMER and ATTEN fully clock wise.

(c) FREQUENCY RANGE at C.

(d) Frequency control at high end stop; FINE FREQ centered.

(e) MODULATION at CW.

(t) XTAL CAL at OFF.

(2) Refer to figures 6-8 and 5-18. Connect mul

timer, ME-26A/U to pin 7 of V15.

(3) Adjust -165V ADJ (fig. 6-3), R80, to obtain an indication of - 165 volts dc.

(4) Refer to figures 6-8 and 5-19. Connect ME-26A/U to pin 6 of V13. Adjust + 225V ADJ, R71, shown in figure 6-23 to obtain an indication of + 225 volts dc.

(5) Refer to figures 6-19 and 5-20. Connect ME-26A/U to junction of C214 and C215. Select a resistance value for R237 to obtain an indication between 24 and 26 volts dc. To increase voltage, increase the value of R237. To decrease voltage, decrease the value of R237.

(6) Refer to figures 6-14, 5-17, and 6-4. Connect ME-26A/1J to the end of FLA inside casting. Select a zener diode for CR20 that will result in an indication between - 6 and - 6.6 volts dc.

*d. Modulation Oscillator Amplitude Adjustment.*

(1) Modulation oscillator amplitude adjustment is used to compensate for unit-to-unit differences in DS1 replacement lamps.

(2) Refer to figures 6-9 and 5-11. Connect multimeter ME-26A/U to pin 3 of V2.

(3) Adjust R7 (fig. 6-24) to obtain an indication of 2 volts rms. If this indication cannot be achieved within the range of R7, replace DS1 until correct level is obtained.

*e. Modulation Meter Electrical Zero Adjustment.*

(1) Determine that meter mechanical zero adjustment has been made as described in *b* above.

(2) Insure that MODULATION switch is at CW; then adjust front panel ZERO potentiometer to obtain a zero indication on the PERCENT MODULATION meter.

*f. Modulation Meter Calibration Adjustment.*

(1) Determine that meter mechanical zero adjustment has been made as described in *b* above. Ensure that electrical zero adjustment has been made; see *e* (2) above.

(2) Using cable CG-92D/U with adapter UG-349B/U, connect the RF OUTPUT of the signal generator to the A INPUT of the AN/USM-28/(\*) oscilloscope.

(3) Set signal generator's FREQUENCY RANGE at A; MEGACYCLES dial at 10 MHz; MODULATION switch at INT 1000; AMPL TRIMMER control pushed and adjusted for maximum indication of RF OUTPUT meter; RF OUTPUT control for ATTENUATOR CALIBRATED indication of + 7 DBM; MODULATION control fully counterclockwise.

**NOTE**

The actual MEGACYCLES dial markings for the signal generator show a range of 10-22 for range A; 19-44 for range B; 40-95 for range C; 90-216 for range D, and 210 to 480 for range E.

(4) Set A VOLTS/DIV control at .2; TIME/DIV .2 millisecond, and trigger source at INT.

(5) Adjust oscilloscope's vertical position control so that signal is at center of screen.

(6) Adjust signal generator's attenuator control until a 4 cm peak-to-peak indication is displayed on oscilloscope; then adjust MODULATION control until a sine wave is displayed. Adjust oscilloscope's trigger

(7) Obtain a 6 cm peak to peak display on oscilloscope by adjusting signal generator's MODULATION control.

(8) Refer to figure 6-23. Adjust R104, PCT MOD MTR ADJ, until an indication of 50 is displayed on signal generator's PERCENT MODULATION meter.

(9) Adjust signal generator's MODULATION control to obtain a 7.2 cm Peak to Peak display on oscilloscope. The signal generator's PERCENT MODULA-

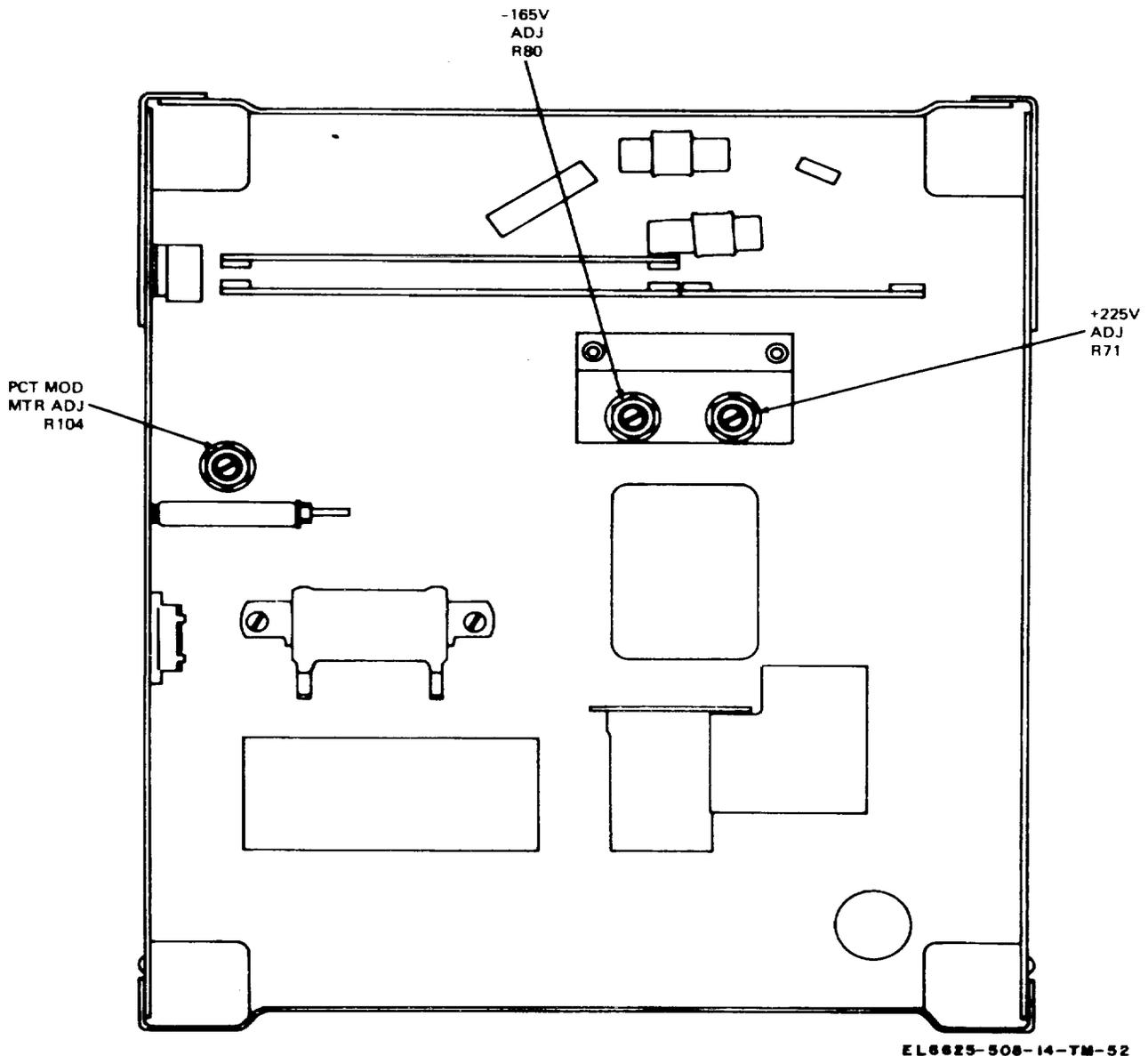


Figure 6-23. Percent modulation meter and power supply, adjustment location

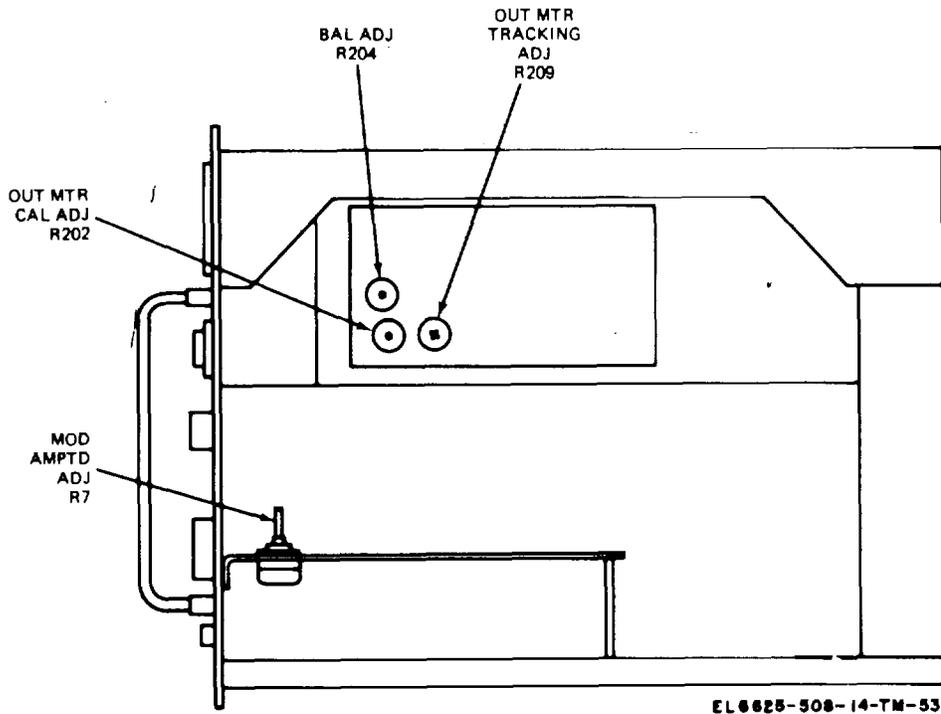


Figure 6-24. ALC circuit board and modulation oscillator adjustment location.

TION meter must indicate between 75 and 85 percent; now adjust MODULATION control for a 5.2 cm peak to peak display. PERCENT MODULATION meter must indicate between 25 and 35 percent.

(10) If the required indications of preceding step (9) are not obtained, repeat steps (7) through (9). The PERCENT MODULATION meter should indicate between 45 and 55 percent, 75 and 85 percent, and 25 and 35 percent, respectively.

#### *g. Automatic Leveling Control (ALC) Balance Adjustment.*

(1) To adjust the balance of the differential amplifier on the modulator and ALC circuit board, set the signal generator's MODULATION switch at CW and the RF OUTPUT control fully counterclockwise.

(2) Refer to figures 2-19, 5-7, and 5-10. Connect multimeter ME-26/U to junction of CR26 and resistor R235.

(3) Refer to figure 6-24. Adjust potentiometer R204, BAL ADJ, to the point where the voltage indication of ME-26/U just stops increasing. The voltage should be equal to or greater than 30 volts.

#### *h. Crystal Calibrator Adjustment.*

(1) Remove casting side cover. Removal and replacement are described in paragraph 6-11g.

(2) Plug high impedance headset (600 ohms or more) into ITAL CAL OUTPUT jack.

(3) Set signal generator's MODULATION switch

at CW, XTAL, CAL switch at 1MC, and XTAL CAL GAIN control at midrange.

(4) Adjust L18 (fig. 6-25) in clockwise direction. Two separate beat frequencies should be heard in headset within one full turn of L18; adjust L18 to audible null in first beat note obtained.

(5) Set XTAL CAL switch at 5 MC.

(6) Refer to figures 6-12 and 5-14. Connect the cathode end of mixer diode CR1 to the input of Electronic Counter AN/USM-207.

(7) Refer to figure 6-25. Adjust 5 MHz ADJ C23 to obtain a display of 5 MHz on AN/USM-207.

(8) Adjust coarse frequency control, figure 6-21, to obtain a beat note.

(9) Set signal generator's FREQUENCY RANGE at E and MEGACYCLES dial at 360 MHz.

(10) Refer to figure 6-25. Adjust AMPTD ADJ L6 to obtain loudest beat note; then slightly decrease loudness; adjust L7 in exactly the same manner.

#### *i. Partial RF Oscillator Frequency Adjustment, and Limited Dial Frequency Calibration.*

(1) Partial rf oscillator frequency adjustment is to be made if, after replacing rf oscillator tube V6, the MEGACYCLES frequency dial is not within listed accuracy parameters. The adjustment provides limited frequency dial calibration. Complete adjustment procedures are described in j below. In some instances it will be necessary to return the signal generator to the

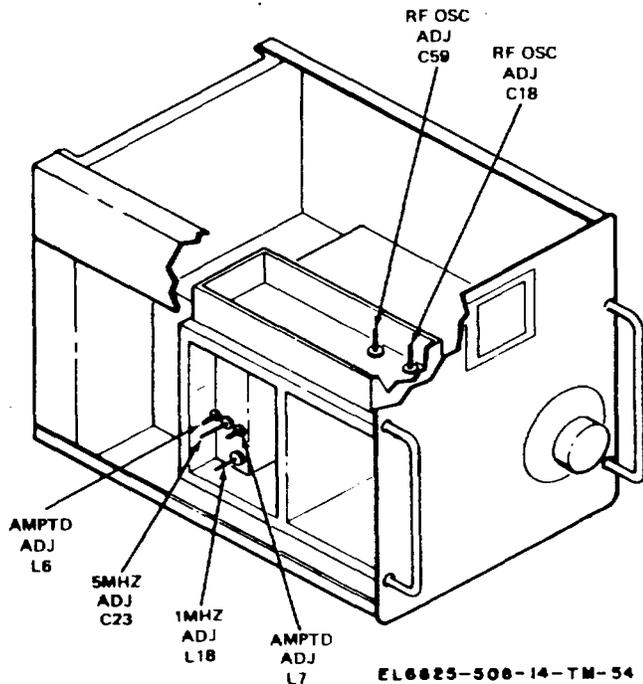


Figure 6-25. Crystal calibrator and rf oscillator, adjustment location.

depot.

(2) To achieve valid results, it is important to replace casting side cover. See paragraph 6-1 g.

(3) Set signal generator's FREQUENCY RANGE switch at E; center FINE FREQ and cursor controls; set XTAL CAL to OFF.

(4) Connect AN/USM-207 electronic frequency counter INPUT to UNCAL RF OUTPUT connector.

(5) Adjust signal generator's MEGACYCLES dial to obtain a 480 MHz display on frequency counter, and compare this display with the signal generator's actual dial setting. Note if the dial setting is above or below 480 MHz.

(6) Set signal generator's FREQUENCY RANGE switch at D, and adjust MEGACYCLES dial to obtain 216 MHz display on frequency counter, compare this display with the signal generator's actual dial setting, note if the dial setting is above or below 216 MHz.

(7) Repeat these observations for 95 MHz range C, 44 MHz range B, and 22 MHz range A

(8) If the signal generator's MEGACYCLES dial indications are either all too high or all too low when compared to the frequency counter display, proceed to step (9) below. However, if the dial indications are sometimes too high and sometimes too low when compared to the counter display, follow the procedures outlined in paragraph 6-1 lj.

(9) Refer to subparagraph h of paragraph 6-11 Remove the signal generator's MEGACYCLES dial so that the casting top cover can be removed. After the

cover is removed, secure the MEGACYCLES dial in place. Set the signal generator's FREQUENCY RANGE switch at E and the MEGACYCLES dial at exactly 480 MHz under the cursor.

(10) Refer to figure 6-25. Adjust C59, RF OSC ADJ, for a 480 MHz display on the frequency counter. If this indication cannot be obtained, even with C59 maximum capacitance (slug turned all the way in), back C59 out one turn, and adjust C18 to obtain the 480 MHz display. Now check the signal generator's MEGACYCLES dial accuracy at 216 MHz, range D; 95 MHz, range C; 44 MHz, range B; and 22 MHz, range A. If, at these settings, dial accuracy is within specifications, proceed to step (11). If not, perform the more complete rf oscillator adjustment procedure given in paragraph 6-1 lj.

(11) Check the signal generator's MEGACYCLES dial against the frequency counter at 10 MHz, band A; 20 MHz, band B; 40 MHz, band C; 90 MHz, band D; and 210 MHz, band E. Refer to NOTE, in f above. If dial is inaccurate, repeat step (10). If the dial still does not meet specifications, the signal generator must be returned to the depot.

*j. Complete RF Oscillator Frequency Adjustment.*

(1) These procedures are to be followed if those outlined in preceding subparagraph i step (11), are not sufficient to calibrate the FREQUENCY DIAL; they must be followed if the D and/or E oscillator coils have been replaced. Refer to figure 6-25. If C59, RF OSC ADJ, is adjusted to calibrate the high frequency end of range E, it is likely that the remaining four coils will have to be adjusted.

**CAUTION**

If coil E and at least one other coil must be adjusted, the E coil must be adjusted first.

(2) The coils for ranges A through D can be adjusted independently without interaction.

**CAUTION**

After adjustments are made to oscillator coils, the frequency will drift. Therefore, wait at least 10 minutes before checking the frequency. Always replace the casting side cover before checking frequencies. One screw in the center of the cover is adequate. Carefully note step (5)

(3) Before adjusting range E oscillator coil, refer to warning regarding dangerous voltages, paragraph 6-11g, this subparagraph also describes removal and replacement of casting side cover, remove this cover.

(4) Connect AN/USM-207 frequency counter INPUT to the signal generator's UNCAL RF OUTPUT connector, and set signal generator's MEGACYCLES dial at exactly 210 MHz.

(5) Now operate signal generator's FREQUENCY RANGE switch to a point between ranges E and D. This action removes high voltage from the turrets, but

not from the variable tuning capacitors. With the switch thus disengaged, experimentally move the small, range E, U-shaped loop up or down the switch contacts. After loop is positioned do not touch it.

(6) Set FREQUENCY RANGE switch at E, and observe frequency counter display. If the indication is not 210 MHz, set the switch between E and D, and move loop again. Continue these procedures until the frequency counter displays 210 MHz.

(7) Set signal generator's MEGACYCLES dial at exactly 480 MHz. If oscilloscope does not display 480 MHz, refer to figure 6-25, and adjust C59 until it does.

(8) Carefully observing previous cautions, repeat steps (5), (6), and (7) to obtain the best compromise between the low and high end frequencies.

(9) Refer to Section V, table 6-4, and perform the frequency dial calibration and Rf Oscillator Drift Tests. If any portion of range E is out of specifications, the signal generator must be returned to the depot for manufacture of a new MEGACYCLES dial.

(10) Refer again to Section V, table 6-4, and perform the frequency dial calibration and rf oscillator drift tests for ranges A through D. If test results so indicate, adjust range D oscillator coil. Refer to paragraph 6-1lg; remove casting side cover, and connect AN/USM-207 electronic frequency counter INPUT to signal generator's UNCAL RF OUTPUT connector.

(11) With signal generator's FREQUENCY RANGE switch at D, set MEGACYCLES dial at exactly 216 MHz. Then, in order to remove high voltage from turret, set FREQUENCY RANGE switch between the D and C ranges.

(12) Loosen ring, on range D plastic coil form with coil dope thinner, and reposition ring. Set FREQUENCY RANGE switch at D, and observe frequency counter display. Continue to reposition ring, on a trial and error basis, until the frequency counter displays; 216 MHz. Do not reposition ring unless the FREQUENCY RANGE switch is between ranges.

(13) With FREQUENCY RANGE switch still at D, set MEGACYCLES dial at 90 MHz. At this setting the frequency counter should indicate 90 MHz, plus or minus 5%. If not, repeat 216 MHz adjustment for the best compromise, within specifications, between the high and low end frequencies. However, if specifications cannot be met, the signal generator must be returned to the depot.

(14) Cover ring with coil dope.

(15) When making complete rf oscillator frequency adjustments (fig. 2-26) for the ranges C, B and A, observe all precautions specified for adjusting bands D and E.

(16) For range C, set signal generator's FREQUENCY RANGE switch at C, and MEGACYCLES dial to 95 Hz.

(a) On oscillator coil, use dope thinner to free

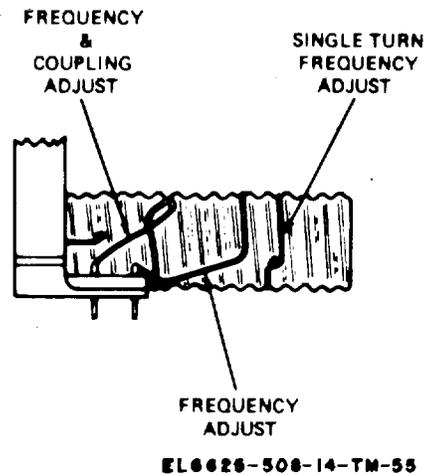


Figure 6-26. Typical rf oscillator coil, frequency adjustments for ranges A,B,C.

single-turn loop and coil lead that is attached to forward switch contact. Adjust loop by rotating it around the coil form, and/or adjusting the two leads attached to the switch contacts in order to obtain a display of 95 MHz on the frequency counter.

(b) If the 95 MHz display cannot be obtained, adjust lead attached to the rear switch contact until the display is obtained. Whenever this lead is adjusted, check the uncalibrated rf level for range C; refer to Section V, table 6-8. If the uncalibrated rf level is less than specified, once again adjust the single-turn loop and/or the two switch contact leads for the best compromise between frequency accuracy and the uncalibrated rf output level. If both specifications cannot be met, the signal generator must be returned to the factory.

(17) Set signal generator FREQUENCY RANGE switch at B, and MEGACYCLES dial at 44 MHz. Refer to figure 6-26.

(a) Use dope thinner on range B oscillator coil to free single turn loop and coil lead that is attached to forward switch contact. Adjust loop by rotating it around the coil form, and/or adjusting the two leads attached to the switch contacts in order to obtain a 44 MHz display on the frequency counter.

(b) If the 44 MHz display cannot be obtained, adjust the rear switch contact lead until it is obtained; whenever this lead is adjusted refer to Section V, table 6-8 and check the uncalibrated rf output level for range B. If this level is less than specified, once again adjust the single-turn loop and/or the two switch contact leads for the best compromise between frequency accuracy and the uncalibrated rf output level. If both specifications cannot be met, the signal generator must be returned to the factory.

(18) Set signal generator's FREQUENCY RANGE switch at A, and MEGACYCLES dial at 22 MHz. Refer to figure 6-26.

(a) Use dope thinner on range A oscillator coil to free single turn loop and coil lead that is attached to forward switch contact. Adjust loop by rotating it around the coil form, and/or adjusting the two leads attached to the switch contacts in order to obtain a 2 MHz display on the frequency counter.

(b) If the 22 MHz display cannot be obtained adjust the rear switch contact lead until it is obtained whenever this lead is adjusted, refer to Section V table 6-8, and check the uncalibrated rf output level for range A. If this level is less than specified, once again adjust the single-turn loop and/or the two switch contact leads for the best compromise between frequency accuracy and the uncalibrated rf output level. If both specifications cannot be met, the signal generator must be returned to the factory.

(19) Check the signal generator's MEGACYCLE; dial accuracy at 10 MHz, range A; 20 MHz, range B; and 40 MHz, range C with the frequency counter. If specifications are not met, repeat for each range and appropriate frequency, the procedures described in (b) of subparagraph (16) for the best compromise between the low and high end frequencies. If the calibration is not within specifications, the signal generator must be returned to the factory.

(20) Cover each oscillator coil's loop and leads with coil dope.

*k. Power Leveling Adjustments.*

(1) Before performing power leveling adjustments, refer to paragraph 6-11g, and remove casting side cover. For these adjustments, the equipment configuration will be identical to that employed in figure 6-30 for the Attenuator Accuracy Tests.

(2) Set the signal generator's FREQUENCY RANGE switch at A, the attenuator (ATTEN) at 0 DBM, the RF OUTPUT control fully clockwise, and the MEGACYCLES dial four turns down from the high end mechanical stop.

(3) Adjust rf amplifier range A turret coil sleeve to obtain a peak indication on wattmeter AN/ URM-98.

(4) Set the signal generator's FREQUENCY RANGE at B, and adjust rf amplifier range B turret coil sleeve to obtain a peak indication on the watt meter. Then set FREQUENCY RANGE switch at C.

(5) Adjust rf amplifier range C turret coil sleeve to obtain a peak indication on the wattmeter.

(6) Set the signal generator's FREQUENCY RANGE switch at D. On the rf amplifier's range D turret coil, spread the coil turns at the rear of the coil form (nearest turret) to obtain a peak indication on the wattmeter.

(7) Set the signal generator's FREQUENCY

RANGE at C, the MEGACYCLES dial at 72 MHz, and the attenuator (ATTEN) dial at -1 DBM. Then adjust the RF OUTPUT control for a + 5 DBM indication on the wattmeter.

(8) Center rf amplifier C turret coil laterally across the attenuator pickup probe loop; then position the coil about 1/16-inch from the end of the attenuator waveguide.

(9) Refer to figure 6-24, and adjust R202 (OUT MTR CAL ADJ) until the signal generator's RF OUTPUT meter indicates + 13 DBM; then adjust the RF OUTPUT control until the wattmeter indicates -4 DBM. Refer again to figure 6-24, and adjust R209 (OUT MTR TRACKING ADJ) until the signal generator's RF OUTPUT meter indicates +4 DBM. Now repeat steps (3) and (4) until there is no interaction between R202 and R209.

**CAUTION**

For the remainder of the procedure, do not adjust the signal generator's RF OUTPUT control. Observe the RF OUTPUT meter, if it does not indicate +7 DBM ATTENUATOR CALIBRATED, adjust the AMPL TRIMMER control.

(10) Set Signal generator's FREQUENCY RANGE switch at E and the MEGACYCLES dial to 480 MHz. If the wattmeter does not indicate between -2 DBM and 0 DBM, refer to figure 6-16; adjust

inductor L17 by spreading or compressing its turns. It may also be necessary to change the effective pigtail length of resistor R60 by either placing a mass of solder between the pigtail and the frame of the envelope detector (bloomer), or by shortening the pigtail. Changes to either L17 or R60 must be made on a trial and error basis; if such adjustments are made, it will be necessary to repeat steps (8) and (9).

(11) With the signal generator's FREQUENCY RANGE still at E, set MEGACYCLES dial at 210 MHz, and observe wattmeter. If indication is not between -2 DBM and 0 DBM, repeat steps (10) and (11) to obtain the best compromise at the high and low frequency ends of range E.

(12) Set FREQUENCY RANGE at D and MEGACYCLES dial at 216 MHz. If wattmeter does not indicate between -2 DBM and 0 DBM, adjust the rf amplifier range D turret coil closer to, or further from, or laterally across, the attenuator probe loop until the wattmeter indicates - 0.8 DBM.

(13) With FREQUENCY RANGE still at D, set MEGACYCLES dial at 90 MHz and observe watt-meter. If indication is not between -2 DBM and 0 DBM, once more adjust the rf amplifier range D turret coil as in step (12) to obtain the best compromise between the high and low frequency ends of the MEGA-CYCLES dial. An indication of approximately -1 DBM is acceptable.

(14) Set FREQUENCY RANGE at C, MEGACYCLES dial at 95 MHz and observe wattmeter indication is not between - 2 DBM and 0 DBM, adjust rf amplifier range C turret coil closer to, or further from, or laterally across the attenuator probe loop to obtain an indication of -0.8 DBM. Set MEGACYCLES at 40 MHz. If wattmeter indication is not between -2 DBM and 0 DBM, again adjust range C rf amplifier turret coil for the best compromise between the high and low frequency ends of the MEGACYCLES dial. An indication of approximately - 1 DBM is acceptable.

(15) Set FREQUENCY RANGE at B, MEGACYCLES dial at 44 MHz and observe wattmeter: indication is not between - 2 DBM and 0 DBM, adjust range B rf amplifier turret coil closer to, further from or laterally across the attenuator loop probe to obtain an indication of -0.8 DBM. Set MEGACYCLES at 19 MHz. If indication is not between - 2 DBM and 0 DBM, again adjust turret coil for the best compromise between the high and low frequency ends of the MEGACYCLES dial. An indication of approximately - 1 DBM is acceptable.

(16) Set FREQUENCY RANGE at A, MEGACYCLES dial at 22 MHz and observe wattmeter. If indication is not between - 2 DBM and 0 DBM, adjust rf amplifier range A turret coil closer to, or further from, or laterally across the attenuator probe loop for an indication of -0.8 DBM. Set MEGACYCLES dial at 10 MHz. If wattmeter does not indicate between -2 and 0 DBM, again adjust range A rf amplifier turret coil for the best compromise between the high and low frequency ends of the MEGACYCLES dial. An indication of approximately - 1 DBM is acceptable.

(17) Set signal generator's attenuator (ATTEN) at +7, FREQUENCY RANGE switch at E, and MEGACYCLES dial at 480 MHz. At these settings, the wattmeter should indicate between + 6 DBM and + 8 DBM. Record the actual indication. Do not adjust the ATTEN dial; record wattmeter indications at 216 MHz, range D; 95 MHz, range C; 44 MHz, range B; and 22 MHz, range A. For all of these settings, the wattmeter should indicate between + 6 DBM and + 8 DBM.

(18) Set FREQUENCY RANGE at E, and MEGACYCLES dial at 210 MHz. If the wattmeter does not indicate between + 6 DBM and + 8 DBM, and if it did not indicate between +6 DBM and +8 DBM at the 480 MEGACYCLES dial setting, adjust the rf amplifier range E turret coil to obtain the best compromise between the high and low frequency ends of the MEGACYCLES dial. With the attenuator (ATTEN) set at -1 DBM, the wattmeter should indicate -1 DBM plus or minus 1 DBM; with the attenuator set at +1 DBM, the wattmeter should indicate + 7 DBM, plus or minus 1 DBM.

(19) Set FREQUENCY RANGE at D, and MEGACYCLES dial at 90 MHz. If wattmeter does not indi-

cate between + 6 DBM and + 8 DBM, and if it did not indicate between +6 DBM and +8 DBM at the 216 MHz setting, adjust the rf amplifier range D turret coil to obtain the best compromise between the high and low frequency ends of the MEGACYCLES dial. With the attenuator (ATTEN) set at -1 DBM, the wattmeter should indicate - 1 DBM, plus or minus 1 DBM; with the attenuator set at +7 DBM, the wattmeter should indicate + 7 DBM, plus or minus 1 DBM.

(20) Set FREQUENCY RANGE at C, and MEGACYCLES dial at 40 MHz. If wattmeter does not indicate between + 6 DBM and + 8 DBM, and if it did not indicate between +6 DBM and +8 DBM at the 95 MHz setting, adjust the rf amplifier range C turret coil to obtain the best compromise between the high and low frequency ends of the MEGACYCLES dial with the attenuator (ATTEN) set at -1 DBM, the wattmeter should indicate - 1 DBM, plus or minus 1 DBM; with the attenuator set at +7 DBM, the wattmeter should indicate + 7 DBM, plus or minus 1 DBM.

(21) Set FREQUENCY RANGE at B, and MEGACYCLES dial at 19 MHz. If wattmeter does not indicate between + 6 DBM and + 8 DBM, and if it did not indicate between +6 DBM and +8 DBM at the 44 MHz setting, adjust the rf amplifier range B turret coil to obtain the best compromise between the high and low frequency ends of the MEGACYCLES dial. With the attenuator (ATTEN) set at -1 DBM, the wattmeter should indicate - 1 DBM, plus or minus 1 DBM; with the attenuator set at +7 DBM, the wattmeter should indicate + 7 DBM, plus or minus 1 DBM.

(22) Set FREQUENCY RANGE at A, and MEGACYCLES dial at 10 MHz. If wattmeter does not indicate between + 6 DBM and + 8 DBM, and if it did not indicate between +6 DBM and +8 DBM at the 22 MHz setting, adjust the rf amplifier range A turret coil to obtain the best compromise between the high and low frequency ends of the MEGACYCLES dial. With the attenuator (ATTEN) set at -1 DBM, the wattmeter should indicate - 1 DBM, plus or minus 1 DBM; with the attenuator set at +7 DBM, the wattmeter should indicate + 7 DBM, plus or minus 1 DBM.

(23) Set signal generator's FREQUENCY RANGE switch at D, and the MEGACYCLES dial at 216 MHz. Set the AMPL TRIMMER control at the middle of its range, and adjust the RF OUTPUT control to obtain an indication of +7 DBM ATTENUATOR CALIBRATED on the RF OUTPUT meter. Now operate the MEGACYCLES dial across its entire range, and set the AMPL TRIMMER control for optimum tracking. However, this control should not be set closer than one quarter turn from either of its mechanical stops. Once the AMPL TRIMMER is set, a constant output of +7 DBM, plus or minus 1 DBM, should be maintained across the D range. If this output cannot be maintained, install a capacitor (the smallest

value possible between 0.47 uuf and 1.5 uuf) across the range D rf amplifier coil. If the capacitor is installed once more set the AMPL TRIMMER at the middle of its range.

(a) Adjust the RF OUTPUT control to obtain a +7 DBM ATTENUATOR CALIBRATED indication on the RF OUTPUT meter.

(b) Operate the MEGACYCLES dial across its entire range, and set the AMPL TRIMMER control for optimum tracking. Again do not set this control closer than one quarter turn from either of its mechanical stops. The RF OUTPUT meter should indicate a constant output of + 7 DBM, plus or minus 1 DBM, across the entire D range without further adjustment of the AMPL TRIMMER.

(24) Set FREQUENCY RANGE at C, and MEGA CYCLES dial at 95 MHz. Perform the same procedure for the C range as were performed above for the D range.

(25) Set FREQUENCY RANGE at B, and MEGA-CYCLES dial at 44 MHz. Perform the same procedures for the B range as were performed for the D range.

(26) Set FREQUENCY RANGE at A, and MEGA-CYCLES dial at 22 MHz. Perform the same procedures for the A range as were performed for the D range. Refer to table 6-6, Section V, and perform the Maximum Rf Output Power Tests.

(27) Through trial and error, find a setting of the AMPL TRIMMER control that results in a levelled out-put of +7 DBM, plus or minus 1 DBM, across the entire MEGACYCLES dial at FREQUENCY RANGE settings of A through D. In most cases, once this setting is found, no further readjustments are necessary.

(28) Do not adjust AMPL TRIMMER control; loosen knob set screws, and position knob so that its arrow points straight up. Then tighten set screws.

(29) Refer to paragraph 6-1lg, and replace casting side cover.

**Section V. GENERAL SUPPORT TESTING PROCEDURES**

**6-13. General**

a. Testing procedures in this section are prepared for use by general support category maintenance. The purpose of these procedures is to insure that repaired equipment will meet mandatory specifications before it is returned to the using organization. These procedures can also be employed as guides for testing equipment that has been repaired by direct category maintenance when appropriate tools and test instruments are available.

b. Before consulting a table, comply with all instructions preceding it. At each step, follow the procedures indicated in the *Test equipment and Equipment under test* columns. Perform each test procedure and verify the result against the information contained in the *Performance standard* column.

**6-14. Tools and Test Equipment**

a. All tools and test equipment required for the testing procedures are listed in tables 6-1. No special tools are required to perform testing procedures contained in this section. For performance tests, see tables 6-3

through 6 -11.

b. The following additional equipment is required for performing tests:

- (1) Adapter UG-349B/U
- (2) Coaxial Cable CG-92D
- (3) Headset(PL-55 plug)
- (4) Coaxial Cable RG-214/U
- (5) Coaxial Cable RG-58/U
- (6) Variable Attenuator CN-762/U
- (7) T-ConnectorUG-274A/U

**6-15. Performance Tests**

a. The general support testing tables, which follow, outline procedures to be performed in logical sequence. Do not vary the sequence.

b. For each step, perform all actions required in the "Control settings" column, for both the "Test equipment" and the "Equipment under test." Then perform each specific test procedure. These procedures provide the means whereby physical and performance stand-

*Table 6-3. Physical Test and Inspection*

Step	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
No.	Test equipment	test	Test procedure	Performance standard
1 None	Controls can be in any positions	generator from case Inspect case and chassis for damage, missing parts, and condition of paint	a Remove signal damage or missing parts External surfaces to be painted shall not show bare metal Panel lettering shall be legible.	a No evidence of

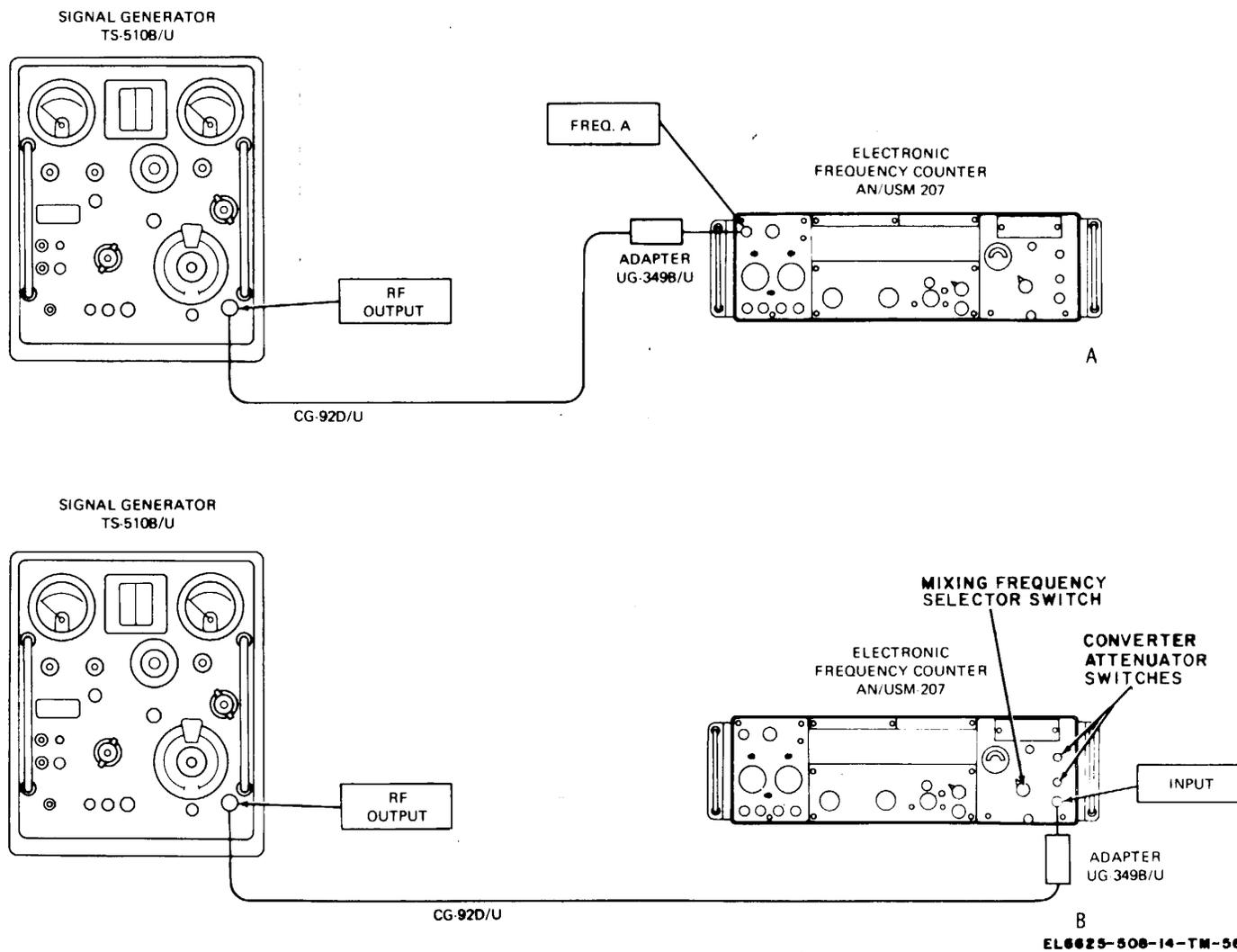


Figure 6-27. Frequency dial calibration and rf oscillator drift test connections.

Table 6-3. Physical Tests and Inspection-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
2	None.	Controls can be in any position.	<p>Touch-up painting is recommended instead of refinishing whenever practicable; screw-heads, binding posts, receptacles, and other plated parts shall not be painted or polished with abrasives.</p> <p>b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts.</p> <p>c. Inspect all connectors and fuse holders for looseness, or missing parts</p> <p>a Rotate all panel Controls throughout their limits of travel</p> <p>b Inspect dial stops for damage; bending, and proper operation</p> <p>c. Operate all switches</p>	<p>b. Screws, bolts, and nuts shall be tight none missing.</p> <p>c. No loose parts or damages No missing parts.</p> <p>a. Controls shall rotate freely without bending or excessive looseness</p> <p>b Stops shall operate properly without evidence of damage.</p> <p>c. Switches shall operate properly.</p>

**6-16. Frequency Dial Calibration and Rf Oscillator Drift Tests**

(table 6-4)

*a Test Equipment and Material*

- (1) Electronic Frequency Counter AN/USM-207

(2) CoaxialCableCG-92DIU

(3) AdapterUG-349/BU

*b. Test Connections and Conditions.* Connect the equipment as shown in A, figure 6-27.

Table 6-4. Frequency Dial Calibration and Rf Oscillator Drift Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	Set ANIUSM-207 POWER switch to STBY	Turn AC POWER to ON Set XTAL CAL, to OFF	Allow equipment to warm up for at least one and FREQ UENCY to step2	None.
2	a Set SENSITIVITY at .1V, POWER at TRACK, and FUNCTION at FREQ	RANGE at A a. Set signal generator's MODULATION switch at CW; ATIENUATOR fully clockwise; XTAL CAL GAIN and MODULATION controls fully counterclockwise	a. Observe AN/USM-207 frequency counter display	hour before proceeding  a. Frequency counter should display 09950.000 to 10050.000 kHz.

Table 6-4. Frequency Dial Calibration and Rf Oscillator Drift Tests-Continued

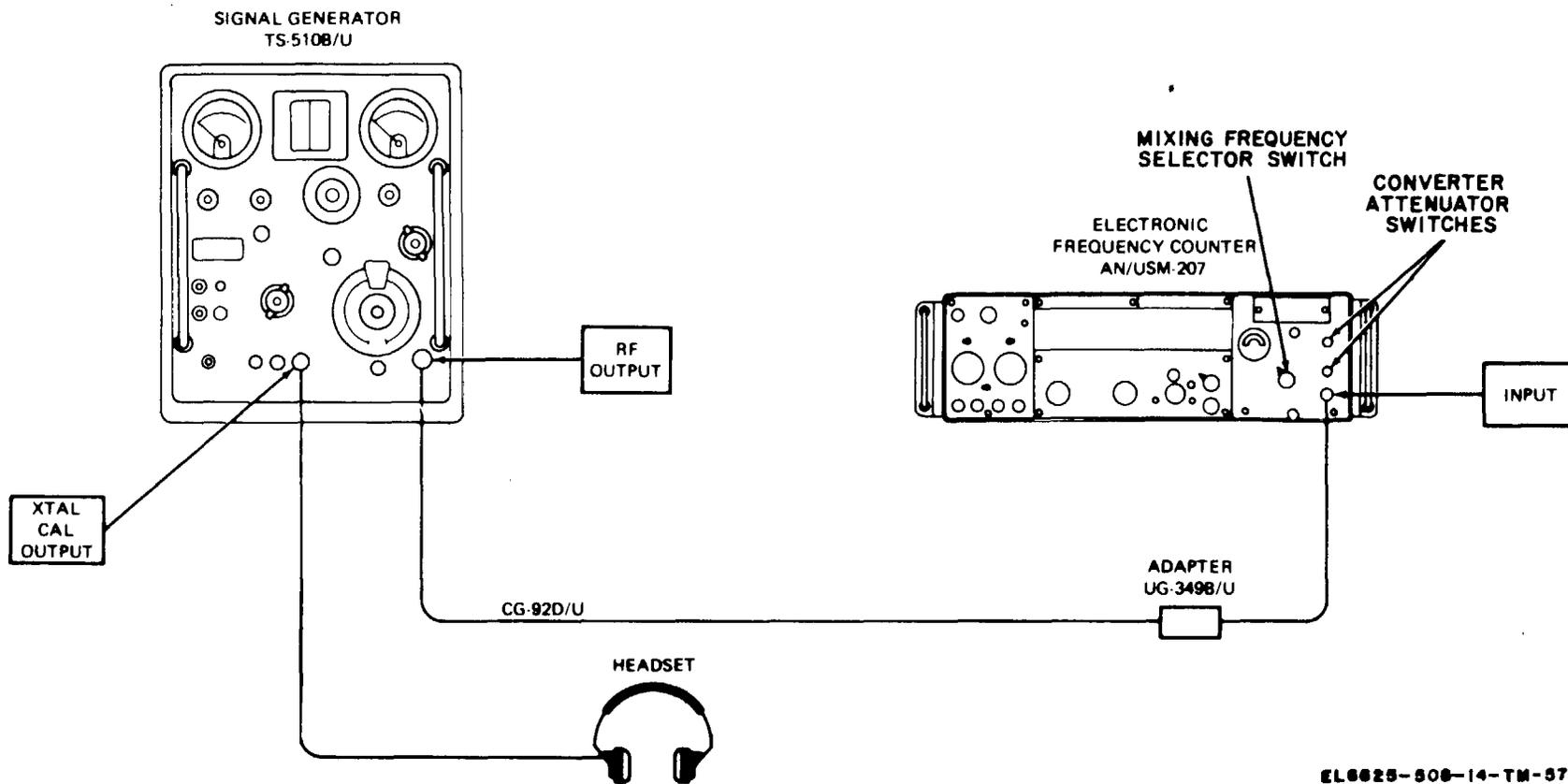
Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
	b. Set GATE TIME (Sec. - 1) at 1 and DISPLAY at mid-range.	b. Set MEGACYCLES dial at 10 MHz; align FINE FREQ control With black panel mark and cursor knob's white line with black panel  c. Set AMPL TRIMMER fully clockwise, then 11/4 turns counter-clockwise.  d. Set RF OUTPUT control fully counter-clockwise, then advance until there is an indication on the RF OUTPUT meter, then push and adjust AMPL TRIMMER to obtain a peak indication  e. Adjust RF OUTPUT control to obtain a + 7 DBM indication	b. None  c. None.  d. None.  e. None	b. None.  c. None.  d. None.  e. None.
3	Do not adjust frequency counter controls.	Set MEGACYCLES dial at 15 MHz.	Observe frequency counterdisplay	Frequency counter should display 14925.000 kHz
4	Do not adjust frequency counter controls.	Set MEGACYCLES dial at 22 MHz.	Observe frequency counter display	Frequency counter should display 21890.000 kHz
5	Do not adjust frequency counter's controls.	Do not adjust signal generator's controls.	Wait' ten minutes for equipment to stabilize; then record frequency counter's display frequency.	None.
6	Do not adjust frequency counter's controls.	Do not adjust signal generator's controls.	Wait an additional ten minutes. Again record the frequency counter's display frequency.	None.
7	Do not adjust frequency counter controls.	Do not adjust controls	Calculate the frequency difference between the step 5 display and the step 6 display.	The difference should be no greater than 1.1 kHz.
8	Do not adjust frequency counter controls.	a. Set FREQUENCY RANGE at B and MEGACYCLES dial at 20 MHz.  b. Push and adjust AMPL TRIMMER control to obtain a peak indication on RF OUTPUT meter.	a. None.  b. Observe frequency counter's display.	a. None.,  b. Frequency counter Should display 19900.000 kHz to 20100.000 kHz.
9	Do not adjust frequency counter's controls.	Set signal generator's MEGACYCLES dial at 30 MHz.	Observe frequency counter's display.	Frequency counter should display 29850.000 kHz to 30150.000 kHz.
10	Do not adjust frequency counter's controls	With signal generator's FREQUENCY RANGE	Observe frequency counter's display	Frequency counter should display 43780.000kHz 44220.000 kHz.

Table 6-4. Frequency Dial Calibration and Rf Oscillator Drift Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
11	Do not adjust frequency counter's controls	still at B, set MEGACYCLES dial at 44 MHz. Do not adjust signal generator's controls	Wait at least 10 minutes for equipment to stabilize; then record frequency counter's display.	None.
12	Do not adjust frequency counter's controls	Do not adjust signal generator's controls	Wait at least 10 minutes; again record the frequency counter's display.	None.
13	Do not adjust frequency counter's controls	Do not adjust signal generator's controls	Calculate the frequency difference between step 11 and step 12	The difference should be no greater than 2.2 kHz.
14	Do not adjust frequency counter controls	a Set FREQUENCY RANGE at C, and MEGACYCLES dial  b Push and adjust AMPL TRIMMER control for a peak indication on the RF output meter.	a None  b Observe frequency counter display	a None.  b Frequency counter should display 39800.000 kHz to 40200.000 kHz.
15	Do not adjust frequency counter's controls	Set signal generator's MEGACYCLES dial at 70 MHz	Observe frequency counter's display	Frequency counter should display 69650.000 kHz to 70350.000 kHz
16	Do not adjust frequency counter's controls	Set MEGACYCLES dial at 95 MHz	Observe frequency counter's display,	Frequency counter should display 94525.000 kHz to 95475.000 kHz
17	Do not adjust frequency counter's controls	Do not adjust signal generator's controls	Wait at least 10 minutes for equipment to stabilize; then record frequency counter's display frequency.	None.
18	Do not adjust frequency counter controls	Do not adjust controls	Wait at least 10 minutes, and record frequency.	None.
19	Do not adjust frequency counter controls	Do not adjust controls	Calculate the frequency difference between step 17 and step 18	The difference should be no greater than 4.75 kHz
20	Do not adjust frequency counter controls	a Set FREQUENCY RANGE at D, and MEGACYCLES dial at 90 MHz  b Push and adjust AMPL TRIMMER control to obtain a peak indication on RF OUTPUT meter.	a None  b Observe frequency counter display	a None.  b Frequency counter should display 89550.000 kHz to 90450.000 kHz
21	a Set frequency counter SENSITIVITY switch at PLUG-IN  b Operate frequency counter's top converter attenuator switch to the left, and the bottom converter	With FREQUENCY RANGE still at D, set MEGACYCLES, dial at 160 MHz  b None	a Connect - signal generator RF OUTPUT to the frequency counter converter INPUT as shown in B of figure 6-28.  b None	a None.

Table 6-4. Frequency Dial Calibration and Rf Oscillator Drift Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
22	c Set DIRECT-HETERODYNE switch at HETERODYNE, and converter mixing frequency at 150.	With signal generator FREQUENCY RANGE still at D, set MEGACYCLES dial at 216	c Observe frequency counter display	c Frequency counter should display 09200.000 kHz to 10800.000 kHz.
	Set frequency counter converter mixing frequency at 200		Observe frequency counter display	Frequency counter should display 14920.000 kHz to 17080.000 kHz.
23	Do not adjust frequency counter controls	Do not adjust signal generator controls	Wait at least 10 minutes for equipment to stabilize, and record the display frequency.	None.
24	Do not adjust frequency counter controls	Do not adjust signal generator controls	Wait at least 10 minutes; again record the display	None.
25	Do not adjust frequency counter controls	Do not adjust signal generator controls	Calculate the frequency difference between step 23 and step 24	The difference should be no greater than 10.8 kHz.
26	a Do not adjust frequency counter controls	a Set signal generator FREQUENCY RANGE at E, and MEGACYCLES dial	a None	a None.
	b. None	b Push and adjust AMPL TRIMMER control to obtain a peak indication on the RF OUTPUT meter	b Observe frequency counter display	b Frequency counter should display 08950.000 kHz to 11050.000 kHz
27	a Set frequency counter mixing frequency selector at	a Set signal generator MEGACYCLES dial at 340	a None	a None.
	b. None	b Check RF OUTPUT meter If indication is less than + 7 dBm, adjust AMPL TRIMMER control until the indication is +7 DBM	b Observe frequency counter display 38300.000 41700000 kHz.	b. Frequency counter should display kHz to
28	a Set frequency counter mixing frequency selector 450 MHz	a Set signal generator at CYCLES dial at 480	a None MEGA-	a None
	b None	b Check RF OUTPUT less than + 7 dBm, adjust AMPL TRIMMER control until the indication is + 7 DBM.	b Observe frequency 27600.000	b Frequency counter kHz to 32400 000 kHz
29	Set frequency counter mixing frequency selector at 200	Set FREQUENCY RANGE at D, and MEGACYCLES dial at 216 MHz	Wait at least 10 minutes for equipment to stabilize; then record frequency counter display frequency.	None



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Figure 6-28. Crystal calibration accuracy test connections.

Table 6-4. Frequency Dial Calibration and Rf Oscillator Drift Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
30	Do not adjust frequency counter controls	Do not adjust signal generator controls	Wait at least 10 minutes, again record the display	None
31	Do not adjust frequency counter controls	Do not adjust signal generator controls	Calculate the difference between the display in step 29c and the display in step 30	The difference should be no greater than 24.0 kHz

**6-17. Crystal Calibrator Accuracy Tests**

(table 6-5)

*a. Test Equipment and Material*

(1) Electronic Frequency Counter AN/USM-207

(2) Coaxial Cable CG-92D/U

(3) Adapter UG-349BIU

(4) Headset (PL-55 plug)

*b. Test Connections and Conditions.* Connect the equipment as shown in figure 6-28.

Table 6-5. Crystal Calibrator Accuracy Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	a. Set frequency counter's POWER switch at STBY and SENSITIVITY switch at PLUG-IN.	a. Set signal generator's AC POWER at ON; MODULATION switch at CW; attenuator (ATTEN) fully clockwise; FREQUENCY RANGE at E; MEGACYCLES dial at 480; and XTAL CAL switch at 5 MC.	a. Allow all equipment to warm up for at least 1 hour before proceeding to step 2,	a. None
	b. Set frequency counter's POWER at TRACK; FUNCTION at FREQ; GATE TIME (Sec-1) at 1, and display at mid-range	b. Set XTAL CAL GAIN control at mid-range, and MODULATION control fully counterclockwise	b. None	b. None
2	a. Set frequency counter's top converter attenuator switch to the left, the bottom attenuator switch to the right, and the DIRECT-HETERODYNE switch at HETERODYNE.	a. Set signal generator's control so that arrow is aligned with black panel mark; also align cursor knob's white line with black panel knob.	a. None. FINE	a. None. FREQ
	b. Set mixing frequency selector switch at 450	b. Set AMPL TRIMMER fully clockwise; then 1-1/4 turns counterclockwise.	b. None.	b. None.
		c. Operate RF OUTPUT control fully counterclockwise then clockwise until RF OUT-	c. None.	c. None

Table 6-5. Crystal Calibrator Accuracy Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
3	Set frequency counter mixing frequency selector switch at 250.	moves upscale.		
		d. Adjust signal generator's AMPL TRIMMER control to obtain peak indication on RF OUTPUT meter	d. None.	d. None
		e. Adjust RF OUTPUT control to obtain +7 DBM on RF OUTPUT meter	e. Adjust signal generator's XTAL GAIN control for comfort-	e. None.
			f. Carefully adjust signal generator MEGACYCLES dial until a zero beat is Heard in headset; then observe frequency counter display	f. None. able audio. Frequency counter should display 29952.000 kHz to 30048.000 kHz.
		a. With FREQUENCY RANGE switch still at E, set MEGACYCLES dial at 270 MHz	a. None.	a. None
		b. Set signal generator's XTAL CAL switch at 1 MC.	b. None.	b. None.
	c. Observe signal generator's RF OUTPUT meter If the indication has decreased adjust AMPL, TRIMMER control until meter indicates +7 DBM	c. Carefully adjust signal generator's MEGACYCLES dial until a zero beat is heard in the headset, then observe frequency counter's display.	c. Frequency counter should display 19973.000 kHz to 20027.000 kHz.	

**6-18. Maximum Rf Output Power Tests**

(table 6-6)

*a. Test Equipment and Material*

- (1) Wattmeter ANIURM-98 with bloomer
- (2) Variable Attenuator CN-762/U
- (3) Coaxial Cable RG-58/U
- (4) AdapterUG-349B/U
- (5) Coaxial Cable CG -92D/U

*b. Test Connections and Conditions.* Connect equipment as shown in figure 6 -29.

**CAUTION**

The wattmeter's BIAS CURRENT range

switch must always be in the OFF position before connecting the bloomer. Do not have the bloomer connected to the equipment under test when zero setting the wattmeter.

*c. COEF POS and Res.* The tests employing wattmeter AN/URM-98 require that the meter be set at NEG temperature coefficient, and the resistance at 200 ohms.

*d. description of Wattmeter AN/URM-98.* Details of the wattmeter's operating parameters can be found in TM 11-6625-433-15.

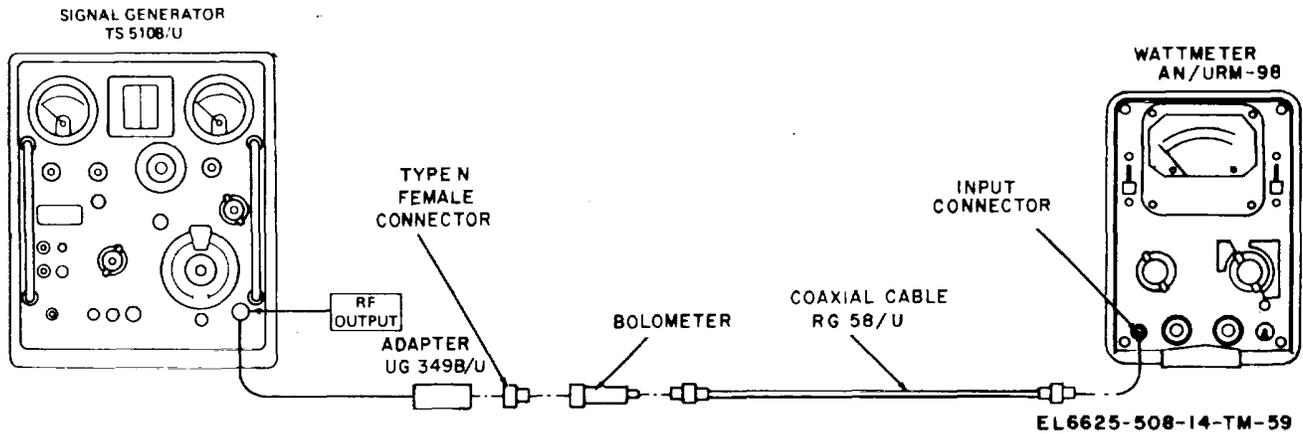


Figure 6-29. Maximum rf output power test connections.

Table 6-6. Maximum Rf Output Power Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	Energize wattmeter ANIURM-98, and set variable attenuator, CN-762Ri for +10 dB attenuator	Energize the signal generator. Set MODULATION switch at CW, FREQUENCY RANGE at A, and XTALCAL at OFF	Allow equipment to warm up for at least 15 minutes before proceeding to step 2	None.
2	Set wattmeter at +5 DBM, and zero set.	Set attenuator (ATTEN) control and RF OUTPUT control fully clockwise.	None	None
3	Do not adjust attenuator, CN-762DU, or wattmeter.	Set signal generator's FREQUENCY RANGE at A	While slowly operating signal generator's MEGACYCLES dial from 10 MHz to 22 MHz, observe the wattmeter's minimum DBM indication. If this indication starts to decrease, peak it by adjusting the AMPL TRIMMAER control.	The minimum wattmeter indication for the A FREQUENCY RANGE should be +3 DBM, which corresponds to a signal generator output of +13 DBM
4	Do not adjust CN-762U, or wattmeter.	Set signal generator's FREQUENCY RANGE at B.	While slowly operating signal generator's MEGACYCLES dial from 44 MHz to 20 MHz, observe the wattmeter's minimum DBM indication. If this indication starts to	The minimum wattmeter indication for the B FREQUENCY RANGE should be +3 DBM, which corresponds to a signal generator output of +13 DBM

Table 6-6. Maximum Rf Output Power Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
-5	Do not adjust attenuator CN-762/U or wattmeter.	Set signal generator's FREQUENCY RANGE at C	While slowly operating signal generator's MEGACYCLES dial from 40 MHz to 95 MHz, observe the wattmeter's minimum DBM indication. If this indication starts to decrease, peak it by adjusting the AMPL TRIMMER control.	The minimum wattmeter indication for the C FREQUENCY RANGE should be +3 DBM, which corresponds to a signal generator output of +13DBM.
6	Do not adjust attenuator CN-762/UT, or wattmeter.	Set signal generator's FREQUENCY RANGE at D.	While slowly operating signal generator's MEGACYCLES dial from 216 MHz to 90 MHz, observe the wattmeter's minimum DBM indication. If this indication starts to decrease, peak it by adjusting the AMPL TRIMMER control.	The minimum wattmeter indication for the D FREQUENCY RANGE should be +3 DBM, which corresponds to a signal generator output of + 13 DBM.
7	Do not adjust attenuator CN-762fU, or wattmeter.	Set signal generator's FREQUENCY RANGE at E	While slowly operating signal generator's MEGACYCLES dial from 210 MHz to 480 MHz, observe the wattmeter's minimum DBM indication. If this indication starts to decrease, peak it by adjusting the AMPL TRIMMER control.	The minimum wattmeter indication for the E FREQUENCY RANGE should be +3 DBM, which corresponds to a signal generator output of + 13 DBM.

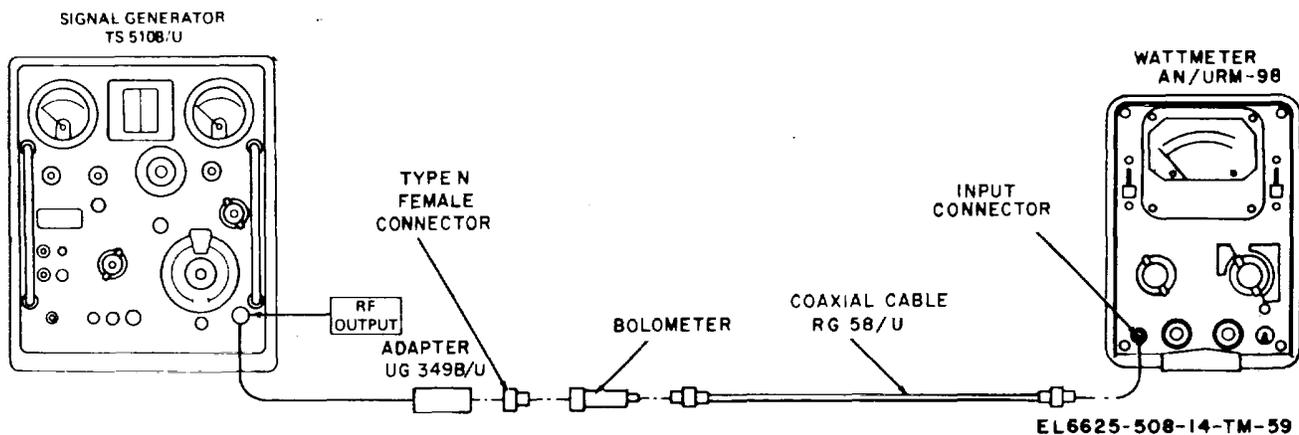


Figure 6-30. Attenuator accuracy test connections.

**6-19. Attenuator Accuracy Tests**

(table 6-7)

*-a. Test Equipment and Material.*

- (1) Wattmeter AN/URM-98 with bloomer
- (2) Adapter UG-349B/U

(3) Coaxial Cable RG-58/U

(4) Coaxial Cable CG-92D/U

*b. Test Connections and Conditions.* Connect the equipment as shown in figure 6-30. Observe cautions specified in subparagraph b of paragraph 6-18.

*Table 6-7. Attenuator Accuracy Tests*

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	a. Energize wattmeter ANIURM-98.	a. Energize signal generator, set MODULATION switch at CW, and attenuator (ATTEN) at -1 DBM. Set XTAL CAL at OFF.	a. Allow equipment to warm up at least 15 minutes before making any further adjustments.	a. None.
	b. Set wattmeter at zero range, and zero set.	b. Operate signal generator's AMPL TRIMMER control fully clockwise, then 1-1/4 turns counterclockwise.	b. None.	b. None.
2	a. Do not adjust the wattmeter.	a. Set FREQUENCY RANGE at A, and MEGACYCLES dial 10 MHz.	a. None.	a. None.
	b. Do not adjust the wattmeter.	b. Operate RF OUTPUT control fully counterclockwise, then clockwise until RF OUTPUT meter pointer moves up-scale. Then push and adjust AMPL TRIMMER control until a peak indication is observed.	b. None.	b. None.
	c. Do not adjust the wattmeter.	c. Adjust RF OUTPUT control until + 7 DBM is indicated on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
3	a. Do not adjust wattmeter.	a. With FREQUENCY RANGE still at A, set MEGACYCLES dial at 22 MHz.	a. None.	a. None.
	b. Do not adjust wattmeter.	b. Push and adjust AMPL TRIMMER control to obtain peak indication on RF	b. None.	b. None.
	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control until + DBM is indicated on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
4	a. Do not adjust wattmeter.	a. Set FREQUENCY RANGE switch at B and MEGACYCLES	a. None.	a. None.

Table 6- 7. Attenuator Accuracy Tests-Continued

Step	Control settings		Test procedure	Performance standard
	No.	Test equipment		
5	b.	dialat44 MHz. Do not adjust wattmeter.	b. None.	b. None.
	c.	Do not adjust wattmeter	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a.	Do not adjust wattmeter.	a. None.	a. None.
	b.	Do not adjust wattmeter.	b. None.	b. None.
6	c.	Do not adjust wattmeter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a.	Do not adjust wattmeter.	a. None.	a. None.
	b.	Do not adjust wattmeter	b. None.	b. None
	c.	Do not adjust wattmeter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
7	a.	Do not adjust wattmeter.	a. None.	a. None.
	b.	Do not adjust wattmeter.	b. None.	b. None.
	c.	Do not adjust wattmeter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a.	Do not adjust wattmeter.	a. None.	a. None.
8	b.	Do not adjust wattmeter.	b. None.	b. None
	a.	Do not adjust wattmeter.	a. None.	a. None.

Table 6-7. Attenuator Accuracy Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
9	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control until +7 DBM is indicated on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a. Do not adjust wattmeter.	a. With FREQUENCY RANGE still at D, set MEGACYCLES DIAL AT(90) MHz.	a. None.	a. None.
	b. Do not adjust wattmeter.	b. Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b. None.	b. None.
10	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control until +7 DBM is indicated on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a. Do not adjust wattmeter.	a. Set FREQUENCY RANGE at E, and MEGACYCLES dial at 210 MHz.	a. None.	a. None.
	b. Do not adjust wattmeter.	b. Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b. None.	b. None.
11	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control until +7 DBM is indicated on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	a. Do not adjust wattmeter.	a. With FREQUENCY RANGE still at E, set MEGACYCLES dial	a. None.	a. None.
	b. Do not adjust wattmeter.	b. Push and adjust AMPL TRIMMER control to obtain peak indication on RF	b. None.	b. None.
12	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control to obtain +7 DBM on RF OUTPUT meter.	c. Observe wattmeter.	c. Wattmeter should indicate -2 DBM to 0 DBM.
	Set wattmeter at its +10 DBM range, and zero set.	Set signal generator's attenuator (ATTEN) at +7 DBM.	None.	None.
13	a. Do not adjust wattmeter.	a. Set FREQUENCY RANGE at E, and MEGACYCLES dial at 480 MHz.	a. None.	a. None.
	b. Do not adjust wattmeter.	b. Push and adjust AMPL TRIMMER control to obtain peak indication on RF OUTPUT meter.	b. None.	b. None.
	c. Do not adjust wattmeter.	c. Adjust RF OUTPUT control until +7	c. Observe wattmeter.	c. Wattmeter should indicate +6 DBM to +8

Table 6-7. Attenuator Accuracy Tests-Continued

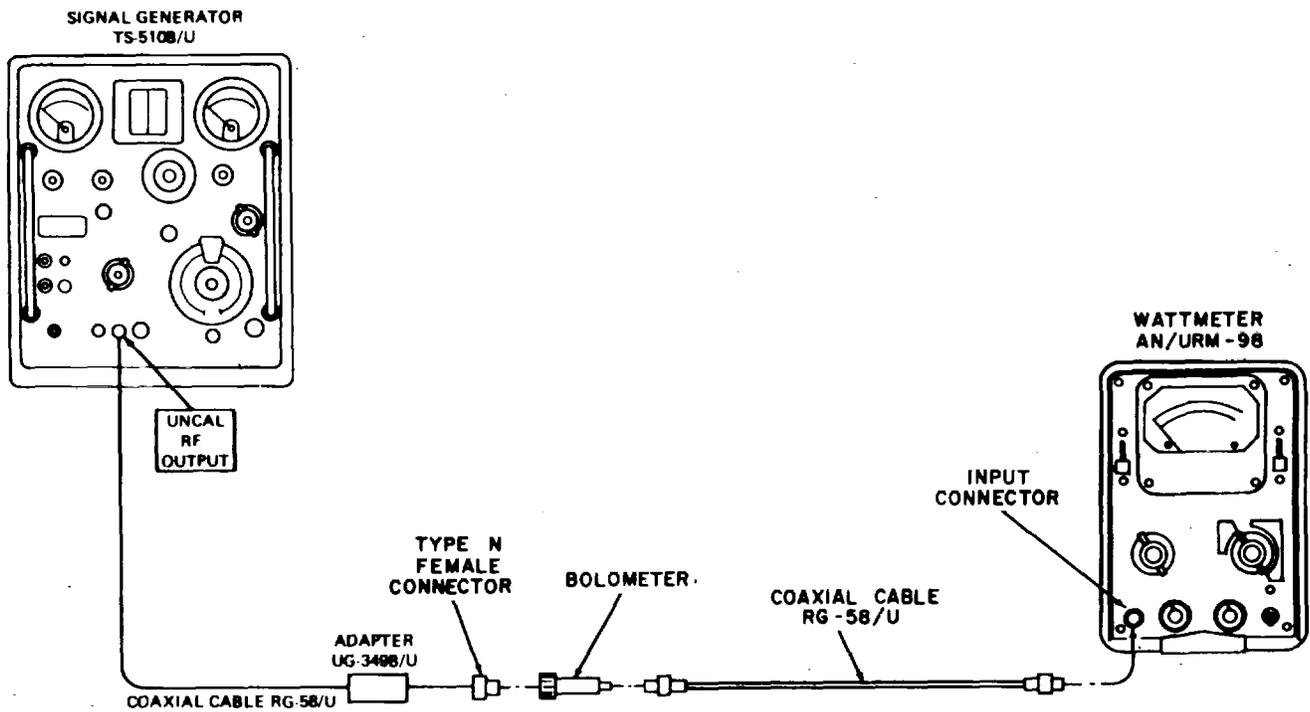
Step	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
14	a Do not adjust wattmeter	a DBM is indicated on RF OUTPUT meter. a With signal generator's FREQUENCY RANGE still at E, set MEGACYCLES dial at 210 MHz.	a None	a None
	b Do not adjust wattmeter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust wattmeter	c Adjust RF OUTPUT control until RF OUTPUT meter indicates + 7 DBM.	c Observe wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
15	a Do not adjust wattmeter	a Set FREQUENCY RANGE at D, and MEGACYCLES dial at 90 MHz.	a None	a None.
	b Do not adjust wattmeter	b Push and adjust AMPL TRIMMER to obtain peak indication on Rf OUT-	b None	b None.
	c Do not adjust wattmeter	c Adjust RF OUTPUT until + 7 DBM is indicated on RF OUTPUT meter.	c Observe wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
16	a Do not adjust wattmeter	a With FREQUENCY RANGE still at D, set MEGACYCLES dial at 216 MHz	a None	a None.
	b Do not adjust wattmeter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust wattmeter	c Adjust RF OUTPUT until + 7 DBM is Indicated on RF OUTPUT meter	c Observe wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
17	a Do not adjust wattmeter	a Set FREQUENCY RANGE at C, and MEGACYCLES dial at 95 MHz.	a None	a None
	b Do not adjust wattmeter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust wattmeter	c Adjust RF OUTPUT until +7 DBM is indicated on RF OUTPUT meter.	c Observe wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
18	a Do not adjust wattmeter	a With FREQUENCY RANGE still at C, set	a None	a None.

Table 6-7. Attenuator Accuracy Tests--Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
19	b Do not adjust watt meter	MEGACYCLES dial at 40 MHz. b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust watt meter	c Adjust -RF OUTPUT meter. indicated OUTPUT meter.	c Observe Wattmeter PUT until + 7 DBM is on RF	c Wattmeter should indicate - +6 DBM to +8 DBM.
	a Do not adjust watt meter	a Set FREQUENCY RANGE MEGACYCLES dial	a None at B, and	a None.
20	at 20 MHz. b Do not adjust watt meter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust watt meter	c Adjust RF OUTPUT until + 7 DBM is indicated on RF DBM. OUTPUT meter.	c Observe Wattmeter cate +6 DBM to +8	c Wattmeter should indi-
	a Do not adjust watt meter	a With FREQUENCY RANGE still at B, set MEGACYCLES dial at 44 MHz.	a None	a None.
21	b Do not adjust watt meter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not, adjust watt meter	c Adjust RF OUTPUT until + 7 DBM is indicated on RF OUTPUT meter.	c Observe Wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
	a Do not adjust watt meter	a Set FREQUENCY RANGE at A., and MEGACYCLES dial at 22 MHz.	a None	a None.
22	b Do not adjust watt meter	b Push and adjust AMPL TRIMMER to obtain peak indication on RF OUT-	b None	b None.
	c Do not adjust watt meter	c Adjust RF OUTPUT until +7 DBM is indicated on RF OUTPUT meter.	c Observe Wattmeter	c Wattmeter should indicate +6 DBM to +8 DBM.
	a Do not adjust watt meter	a With FREQUENCY RANGE still at A, set MEGACYCLES dial at 10 MHz.	a None	a None.
	b Do not adjust watt meter	b Push and adjust AMPL TRIMMER to obtain peak indi-	b None	b None.

Table 6-7. Attenuator Accuracy Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
	c. Do not adjust wattmeter.	caution on RF OUTPUT meter. c Adjust RF OUTPUT until + 7DBM is indicated on RF OUTPUT meter.	c. Observe Wattmeter.	c Wattmeter should indicate +6 DBM to +8 DBM.



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Figure 6-31. Uncalibrated rf output power level test connections

**6-20. Uncalibrated Rf Output Power Level Tests (table 6-8)**

a. Test Equipment and Material

(1) Wattmeter ANIURM-98 with bolometer

(2) AdapterUG-349B/U

(3) Coaxial Cable RG58/U

b. Test Connections and Conditions Connect the equipment as shown in figure 6-31. Observe cautions specified in subparagraph b of paragraph 6-18.

Table 6-8. Uncalibrated Rf Output Power Level Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	Energize Wattmeter ANIU/RM-98	Energize signal generator XTAL CAL switch should be OFF	r Allow equipment to warm up for at least 15 minutes before proceeding to step 2.	None.
2	Set Wattmeter at +5 DBM range, and zero set	Set FREQUENCY RANGE at A, and MEGACYCLES dial at 10 MHz	Slowly operate signal generator's MEGACYCLES dial from 10 MHz to 22 MHz, and observe wattmeter.	Wattmeter should indicate a minimum of -1.8 DBM for entire A range.
3	Do not adjust Wattmeter	Set FREQUENCY RANGE at B	Slowly operate MEGACYCLES dial from 44 MHz to 20 MHz, and observe wattmeter.	Wattmeter should indicate a minimum of -1.8 DBM for entire B range
4	Do not adjust Wattmeter	Set FREQUENCY RANGE at C	Slowly operate MEGACYCLES dial from 40 MHz to 95 MHz, and observe	Wattmeter should indicate a minimum of -1.8 DBM for entire C range.
5	Do not adjust Wattmeter	Set FREQUENCY RANGE at D	Slowly CYCLES dial from 216 MHz to 90 MHz and observe	Wattmeter. operate MEGA-Wattmeter should indicate a minimum of -1.8 DBM for entire D range. serve wattmeter.
6	Do not adjust Wattmeter	Set FREQUENCY RANGE at E	Slowly operate MEGACYCLES dial from 210 MHz to 480 MHz, and observe Wattmeter.	Wattmeter should indicate a minimum of -1.8 DBM for entire E range.

**6-21. Modulation Meter Accuracy and External AM Tests**

(table 6

a. Test Equipment and Material

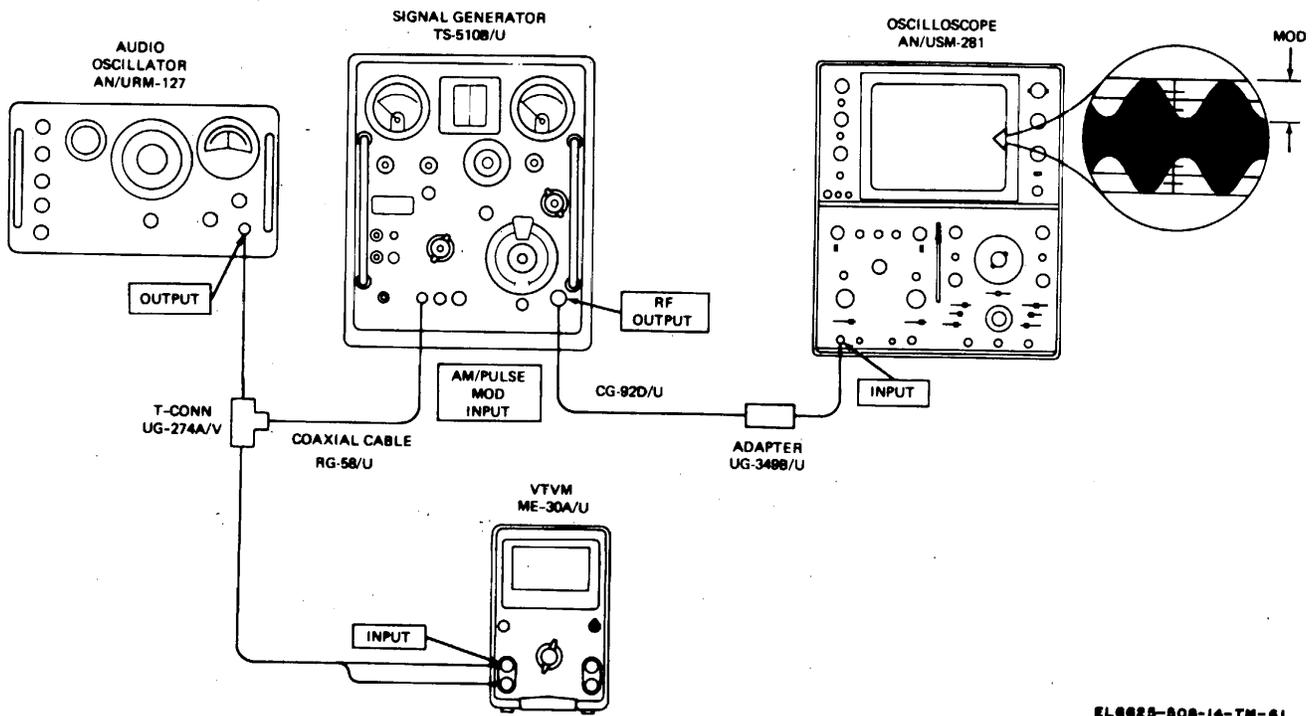
- (1). Signal Generator AN/LRM
- (2) Voltmeter, Electronic ME

- (3) Oscilloscope AN/USM-281C
- (4) Adapter UG-349B/U
- (5) Coaxial Cable CG-92D/U
- (6) Coaxial Cable RG-58/U

b. Test Connections and Conditions. Connect the 30A/U equipment as shown in figure 6 32

Table 6-9. Modulation Meter Accuracy and External AM Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	Energize oscilloscope (ANIUSM-281A), volt meter ME-30AIU, and signal generator (test oscillator) ANIURM-127	Energize signal - generator - TS-510BIU XTAL CAL should be OFF -FREQUENCY RANGE switch at B, and MEGACYCLES dial at 30 MHz Set MODULATION control fully counter clockwise, and attenuator (ATTEN) at 0 DBM	Allow equipment to warm up at least 15 minutes before proceeding - to step2	
2	a Set voltmeter's range selector at 3 volts	a Set the signal generator's - MODULA: TION switch at EXT AM Adjust RF OUTPUT control fu	a None	a None



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Figure 6-32. Modulation meter accuracy and external Am test connections.

Table 6-9. Modulation Meter Accuracy and External AM Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
4	b Set test oscillator's - tuning dial at 200, RANGE switch at X10, ATTENUATOR switch at XI, and adjust OUTPUT LEVEL control to obtain (at 2 kHz) an indication of one volt rms on the voltmeter. c Set oscilloscope's Channel A VOLTS/DIV switch at 1, main TIME/DIV at .2 milliseconds, horizontal DISPLAY at INT, vertical DISPLAY at A, and SWEEP d Adjust oscilloscope's Channel A control until VOLTS/DIV vernier to obtain a 4 cm peak to peak display  3 Do not adjust test equipments' controls  Do not adjust test equipments' controls	ly counterclockwise, then clockwise until RF OUTPUT meter indicator moves up scale.  b Push and adjust AMPL TRIMMER control to obtain peak indication on RF OUTPUT meter.	b None	b None.
		c Adjust RF OUTPUT control until RF OUTPUT meter indicates + 7 DBM.	c None	c None.
		d Adjust MODULATION PERCENT MODULATION meter indicates at least 95 percent; however, do not exceed 100 percent. Adjust MODULATION control to obtain an 80 percent indication on the PERCENT MODULATION meter	d None	Observe oscilloscope Measure peak to peak amplitude of modulation envelope
2.2		Adjust MODULATION PERCENT MODULATION meter	Observe oscilloscope Measure percent indication on the envelope -	cm This corresponds to a PERCENT MODULATION meter indication of 50 percent, plus or minus 5 percent of full scale.
5	Do not adjust test equipments' controls	Adjust MODULATION control to obtain a 10 percent indication on PERCENT MODULATION meter	Observe oscilloscope Measure amplitude of modulation envelope	Oscilloscope should display a peak to peak amplitude of 0.2 cm to 0.6 cm This corresponds to a PERCENT MODULATION meter indication of 10 percent, plus or minus 5 percent of full scale.

Table 6-9. Modulation Meter Accuracy and External AM Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
6	With test oscillator's RANGE switch at X1, and tuning dial at 20, adjust the OUTPUT LEVEL control until the voltmeter indicates 1 volt rms, at a frequency of 20 Hz	Adjust signal generator's MODULATION control to obtain a 50 percent indication on the PERCENT MODULATION meter	Observe oscilloscope Measure peak to peak amplitude of modulation envelope  percent, plus or minus 5 percent of full scale.	Oscilloscope should display a peak to peak amplitude of 1.8 cm to 2.2 cm This corresponds to a PERCENT MODULATION meter indication of 50
7	With test oscillator's RANGE switch at X100 and tuning dial at 200, adjust the OUTPUT LEVEL control until the voltmeter indicates 1 volt rms, at a frequency of 20 kHz	Adjust MODULATION control to obtain a 50 percent indication on the PERCENT MODULATION meter  percent, plus or minus 5	Observe oscilloscope Measure peak to peak amplitude of modulation envelope	Oscilloscope should display a peak to peak amplitude of 1.8 cm to 2.2 cm This corresponds to a PERCENT MODULATION meter indication of 50  percent of full scale.

**6-22. Internal Amplitude Modulation Tests**

(table 6 -10)

- a. Test Equipment and Material None required.
- b. Test Connections and Conditions. Not applicable.

Table 6-10. Internal Amplitude Modulation Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1		Energize signal generator -	Allow signal generator to warm up at least 15 minutes before proceeding to step 2.	None.
2		a Set FREQUENCY RANGE at B, MEGACYCLES dial at 30 MHz, MODULATION control fully counter clockwise. XTAL CAL should be OFF, and attenuator (ATTEN) at 0 DBM. b Operate RF OUTPUT control fully counterclockwise, then clockwise until RF OUTPUT meter pointer moves up- c Push and adjust AMPL TRIMMER control to obtain a	a None  b None  c None	a None.  b None.  c None.

Table 6-10. Internal Amplitude Modulation Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
3		peak indication on RF OUTPUT meter. d Adjust RF OUTPUT control until +7 DBM is indicated on RF OUTPUT meter	d Observe CENT MODULATION meter, and adjust MODULATION control to obtain an indication of at least 95 percent Do not exceed 100 percent. Observe PERCENT MODULATION meter	PER-d None.
4		Set MODULATION switch at INT 400, and adjust MODULATION control fully counterclockwise. a Set MODULATION switch at INT 1000- TION control should still be fully counterclockwise percent Do not exceed - 100 percent. b Operate MODULATION control fully counterclockwise	a Observing PERCENT MODULATION meter, adjust MODULATION control to obtain an indication - of at least 95  b Observe PERCENT MODULATION meter indicate 0 percent.	PERCENT MODULATION meter should indicate 0 percent.  a None.  b. PERCENT MODULATION meter should

**6-23. External Pulse Modulation and Residual Level Tests**

(table 6-11)

a. Test Equipment and Material

- (a) Pulse Generator AN/PPM-1
- (2) Oscilloscope AN/USM-281A
- (3) Crystal Detector 423A
- (4) BNCT Connector UG -274A/U (2 each)

- (5) AdapterUG-349BIU
- (6) Coaxial Cable CG-92D'U
- (7) Coaxial Cable CG-409E[U
- (8) Coaxial CableRG-2141U
- (9) Coaxial Cable RG -581U

b. Test Connections and Conditions. Equipment will - be connected as shown in A or B of figure 6-33, depending on test requirements.

Table 6-11. External Pulse Modulation and Residual Level Tests

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	Set up equipment as shown in figure 6-33, A. Energize - GENERATOR PULSE, ANIPPM-1 and Oscilloscope AN/ USM-281A.	Energize signal generator - TS-510BIU.	Allow equipment to Warm up at least 15 minutes before proceeding tostep2.	None.
2	a. Set pulse generator's - SYNC SELECTOR at X10, PULSE RATE at 300, PULSE	a. XTAL CAL switch should be OFF. Set F R E Q U E N C Y RANGE at C, MEGA	a None.	a None.

Table 6-11. External Pulse Modulation and Residual Level Test-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
	<p>POSITION at 0, and PULSE LENGTH at 10 MSEC.</p> <p>b. Set pulse generator's ATTENUATION switch at 10, POLARITY and SYNC SELECTOR switches at +.</p> <p>c. Set oscilloscope's channel A VOLTS/DIV switch at .1, and main TIME/DIV switch at .2 milli-</p> <p>d. Set oscilloscope's horizontal DISPLAY at EXT SENS, SWEEP MODE at AUTO, and vertical</p> <p>e. Operate pulse generator's - AMPLITUDE control until oscilloscope displays a 5 cm peak to peak</p> <p>f. Set oscilloscope vertical DISPLAY switch at A.</p>	<p>CYCLES dial at 44 MHz, and MODULATION switch at EXT PULSE SET RF OUTPUT.</p> <p>b. Set attenuator (ATTEN) at + 7 DBM, and adjust RF OUTPUT control fully counterclockwise, then clockwise until RF OUTPUT indicator moves upscale.</p> <p>c. Push and adjust AMPL TRIMMER control to obtain a peak indication on RF OUTPUT meter.</p> <p>d. Adjust RF OUTPUT control until RF OUTPUT meter indicates + 7 DBM.</p> <p>f Set MODULATION switch at EXT PULSE.</p> <p>maximum.</p>	<p>b None.</p> <p>c None</p> <p>d None.</p> <p>e None.</p> <p>f. Observe oscilloscope.</p>	<p>b. None.</p> <p>c None</p> <p>d None</p> <p>e None.</p> <p>f. Oscilloscope should display a combined pulse rise and decay time of 4 microseconds,</p>
3	Do not adjust test equipment	Do not adjust signal generator	Observe oscilloscope.	Oscilloscope should display, at 50 percent amplitude pulse width 8.5 to 11.5 microseconds.
4	<p>a Do not adjust test equipment.</p> <p>b. Do not adjust test</p> <p>c. Do not adjust test equipment.</p>	<p>a. Set MODULATION switch at EXT PULSE SET RF OUTPUT, FREQUENCY RANGE at E, and megacycles dial at 220 MHz.</p> <p>b. Adjust AMPL TRIMMER equipment. Obtain a peak indication on RF OUTPUT meter.</p> <p>c. Adjust RF OUTPUT control until RF OUTPUT meter indication</p>	<p>a None</p> <p>b. None. MER control to ob-</p> <p>c None.</p>	<p>a None</p> <p>b None.</p> <p>c None.</p>

Table 6-11. External Pulse Modulation and Residual Level Tests-Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
5	d Do not adjust test equipment	d Set MODULATION switch at EXT PULSE	d Observe oscilloscope	d Oscilloscope should display a combined pulse rise and decay time of maximum. Oscilloscope should display - , at 50 percent amplitude, a pulse width of 8.5 to 11.5 micro-seconds. None.
	Do not adjust test equipment	Do not adjust signal generator	Observe oscilloscope	
6	Connect the equipment as shown in figure 6-33, B	With controls and switches in the same positions as in step 5, connect - signal generator to wattmeter.	None	None.
7	Energize Wattmeter AN/URM-98	Energize signal generator -	Allow equipment to warm up for at least 15 minutes before proceeding to step 8. Observe wattmeter	None.
8	With wattmeter's RANGE switch at ' -10 DBM, zero-set the meter	Set RANGE switch at E, and MEGACYCLES dial at 480 MHZ	<b>6-55</b>	Wattmeter should indicate - -13 DBM, mini- mum.

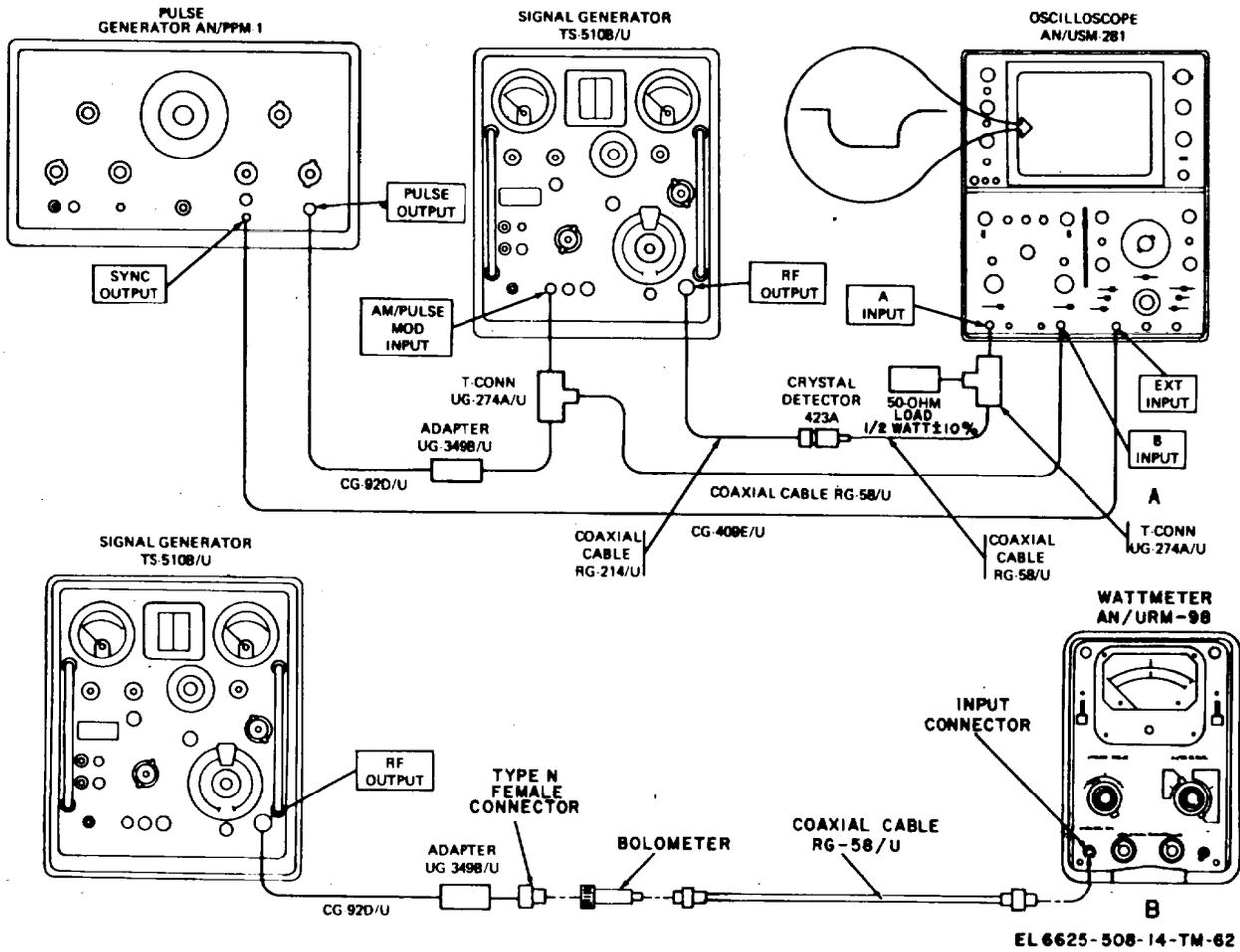


Figure 6-33. External pulse modulation and residual level test connection.

## APPENDIX A REFERENCES

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The following publications contain information applicable to the operation and maintenance of AN/USM-44B.

DA PAM310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA PAM 310 -7	US Army Equipment Index of Modification Work Orders.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.
SC 5180 -91 -CL S21	Tool Kit, Electronic Equipment, TK -100G.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment, Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-2678	Operator, Organizational, Field and Depot Maintenance Manual: Pulse Generator
AN/PPM-1.	
TM 11-6625 -200-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter, ME-26A/U, ME-26B/U, ME-26C/U, and ME-26DIU.
TM 11-6625-320-12	Operator and Organizational Maintenance Manual: Voltmeter, Electronic ME-30AIU, ME-30B/U, ME-30C/U, and ME-30E/U'
TM 11-6625-433-15	Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Wattmeter, AN/URM-98 and AN/URM-98A
TM 11-6625-683-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual: Generator, Signal - AN/URM-127.
TM 11-6625-700-10	Operator's Manual: Counter, Electronic Digital Readout, AN/USM-207
TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Oscilloscope, AN/USM-281A.
TM 38 -750	The Army Maintenance Management System (TAMMS).
TM 740 -90 -1	Administration Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Material to Prevent Enemy Use (Electronics - Command).

## APPENDIX B MAINTENANCE ALLOCATION

### Section I. INTRODUCTION

#### B-1. General

This appendix provides a summary of the maintenance operations for AN/USM-44B. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

#### B-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

- a. **Inspect.** To determine the serviceability of item by comparing its physical, mechanical, and/or electrical characteristics with established standard through examination.
- b. **Test.** To verify serviceability and to detect incident failure by measuring the mechanical or electric characteristics of an item and comparing those characteristics with prescribed standards.
- c. **Service.** Operations required periodically to keep an item in proper operating condition, i.e., to clear, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.
- d. **Adjust.** Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.
- e. **Align.** To adjust specified variable elements of an item to about optimum or desired performance.
- f. **Calibrate.** To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard (known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared).
- g. **Install.** The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.
- h. **Replace.** The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.
- i. **Repair.** The application of maintenance service (inspect, test, service, adjust, align, calibrate, replace or other maintenance actions (welding, grinding, riveting,

straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

- j. **Overhaul.** That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.
- k. **Rebuild.** Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc. considered in classifying Army equipment/components).

#### B-3. Column Entries

- a. **Column 1, Group Number.** Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.
- b. **Column 2, Component/Assembly.** Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.
- c. **Column 3, Maintenance Functions.** Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for the purpose of having the group numbers in the MAC and RPSTL coincide.
- d. **Column 4, Maintenance Category.** Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate

pirate 'worktime" figure will be shown for each category. The number of man-hours specified by the 'worktime" figure represents the average time I required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating condition This time includes preparation time, troubleshoot time and quality assurance/quality control time addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart, If an intermediate facility (L) is not available, this category maintenance will be accomplished at depot. If an intermediate facility (L) has been designated, the maintenance information required to perform this cattalo of maintenance will be provided in the DMWR. Subcolumns of column 4 are as follows:

- C-Operator/Crew
- O-Organizational
- F-Direct Support
- H-General Support
- D-Depot

e. Columns 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual

tools) and special tools, test, and support equipment required to perform the designated function

**B-4. Tool and Test Equipment Requirements (Table 1).**

- a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.
- b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.
- c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.
- d National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment
- e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

**Section II. MAINTENANCE ALLOCATION CHART  
FOR  
Generator, Signal AN/USM-44B**

(1) Group number	(2) Component/assembly	(3) Maintenance. function	(4) Maint. category					(5) Tool/ equipment	(6) Remarks
			C	O	F	H	D		
01	GENERATOR, SIGNAL	Inspect		0.2					23
		Service		0.5					23
		Repair		0.2					1 thru 8
		Test				0.8			10 thru 21
02	CABLE ASSEMBLY	Adjusts						0.3	1 thru 8
		Repair				0.6			10 thru 22
		Overhaul					2.0		13
		Inspect		0.1					10 thru 22
03	FUSEHOLDER	Test		0.3					1 thru 9
		Replace		0.2					
		Repair					0.4		
		<b>B-3</b>							

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS  
FOR  
GENERATOR,SIGNAL AN/USM-44-B

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	H,D	ANALYER,SPETRUM TS-723/U	6625-00-668-9418	
2	H,D	COUNTER,FREQUENCY ELECTRONIC AN/USM-207	6625-00-911-6368	
3	H,D	GENWEATOR,PULSE AN/PPM-1	6625-00-504-9603	
4	H,D	GENERATOR,SIGNAL AN/URM-127	6625-00-783-5965	
5	H,D	MULTIMETER ME-26/U	6625-00-360-2493	
6	H,D	MULTIMETER TS-352/U	6625-00-553-0142	
7	H,D	OSCILLOSCOPE AN/USM-281	6625-00053-3112	
8	H,D	SEMICONDUCTOR DEVICE,	5961-00-755-9099	
9	D	TEST SET,ELECTRON TUBE TV-2/U	6625-00-669-0263	
10	H,D	TEST SET ELECTRON TV-7/U	6625-00-820-0064	
11	H,D	VOLTIMETER,ELECTRONIC ME-30/U	6625-00-643-1670	
12	H,D	WATTMETER AN/URM-98	6625-00-566-4990	
13	H,D	CRYSTAL DETECTOR H-P MOD 423A(RF-235U)		
14	H,D	VARIABLE ATTENUATOR CN-762/U		
15	H,D	HEADSET (PL-55 PLUG)	5935-00-192-4760	
16	H,D	COAXIAL CABLE CG92D/U	6625-00-295-8144	
17	H,D	COAXIAL CABLE CG-409E/U,	6625-00-752-2016	
18	H,D	- COAXIAL CABLE RG-58C/U,	6145-00-542-6092	
19	H,D	- COAXIAL CABLE RG-214/U	6145-00-660-8054	
20	H,D	i /A	5934-00-201-2411	
21	H,D	ADAPTPI Uc-349B/U	5935-00-732-1919	
22	H,D	TOOL KIT TK-I100D/u	5180-00-732-0079	
23	0	TOOLS AND T OT AVAITABIZ TO THE ORGANIZATORIAL REPAIR MAN BECAUSE OF HAS ASSIGNED MISSION		
<b>B-4</b>				

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MAAG(1)

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USAERDAA (1)

USAERDAW(1)

Sig FLDMS(1)

Units org under fol TOE: - 1 ea.

11-16

11-98

11-117

11-500(AA-AC)

ARNG: State AG (3); Units- Same as Active Army except allowance is one copy per unit

USAR: None.

For explanation of abbreviations used, see A R 310-50

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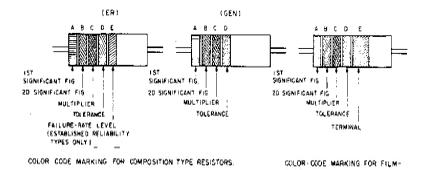


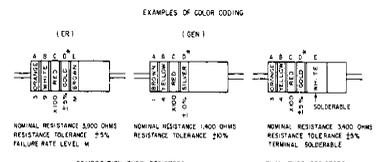
TABLE 1  
COLOR CODE FOR COMPOSITION TYPE RESISTORS

BAND A	BAND B	BAND C	BAND D	BAND E
COLOR	FIRST SIGNIFICANT FIGURE	SECOND SIGNIFICANT FIGURE	MULTIPLIER	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BROWN	1	BROWN
BROWN	1	RED	2	RED
RED	2	ORANGE	3	ORANGE
ORANGE	3	YELLOW	4	YELLOW
YELLOW	4	GREEN	5	GREEN
GREEN	5	BLUE	6	BLUE
BLUE	6	VIOLET	7	VIOLET
VIOLET	7	GRAY	8	GRAY
GRAY	8	WHITE	9	WHITE
WHITE	9			

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH)  
 BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE  
 BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE)  
 BAND D — THE RESISTANCE TOLERANCE  
 BAND E — WHEN USED IN COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE RATE LEVEL. PRESENT FAILURE RATE (100 HOURS) ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1/10 TIMES THE WIDTH OF OTHER BANDS AND INDICATES TYPE OF TERMINAL RESISTANCES (IDENTIFIED BY NUMERICAL LABEL LETTERS (THESE ARE NOT COLOR CODED))

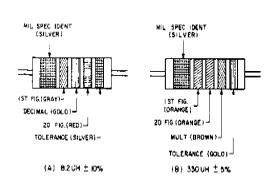
SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATIONS. THE LETTER W IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:  
 2W 2 2 7 OHMS 1000 ± 10 OHMS

FOR WIRE-WOUND TYPE RESISTORS COLOR CODING IS NOT USED. IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.



COMPOSITION-TYPE RESISTORS  
 \* IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



COLOR CODING FOR TUBULAR ENCAPSULATED RF CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN RF CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

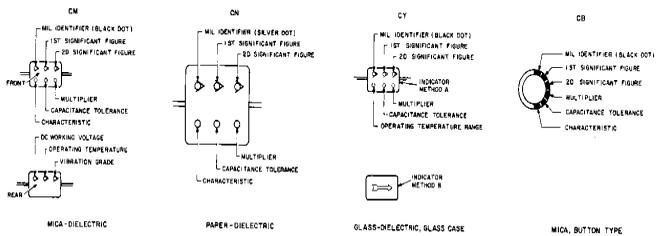
TABLE 2  
COLOR CODING FOR TUBULAR ENCAPSULATED RF CHOKES

COLOR	FIRST SIGNIFICANT FIGURE	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	
BROWN	1	10
RED	2	100
ORANGE	3	1,000
YELLOW	4	
GREEN	5	
BLUE	6	
VIOLET	7	
GRAY	8	
WHITE	9	
NONE		20
SILVER		10
GOLD		5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB



COLOR CODING FOR CAPACITORS. AT A, AN EXAMPLE OF THE CODING FOR A 100PF CAPACITOR IS GIVEN. AT B, THE COLOR BANDS FOR A 100PF CAPACITOR ARE ILLUSTRATED.

TABLE 3  
COLOR CODING FOR CAPACITORS

COLOR	FIRST SIGNIFICANT FIGURE	SECOND SIGNIFICANT FIGURE	MULTIPLIER	CAPACITANCE TOLERANCE (PERCENT)
BLACK	0			
BROWN	1		10	10
RED	2		100	20
ORANGE	3		1,000	30
YELLOW	4			
GREEN	5			
BLUE	6			
VIOLET	7			
GRAY	8			
WHITE	9			
NONE				20
SILVER				10
GOLD				5

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB

COLOR	MIL ID	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE				CHARACTERISTIC	OPERATING TEMPERATURE RANGE	TEMPERATURE RANGE
					CM	CN	CY	CB			
BLACK	CM	0	0		50%	20%					
BROWN	CM	1	1	10					A	B	-55°C to 125°C
RED	CM	2	2	100	15%	10%	25%	C			-55°C to 125°C
ORANGE	CM	3	3	1,000	10%	5%			D		0 to 300
YELLOW	CM	4	4	10,000					E		-55°C to 125°C
GREEN	CM	5	5		15%				F		0 to 2,000 Hz
BLUE	CM	6	6								
PURPLE	CM	7	7								-55°C to 125°C
VIOLET	CM	8	8								
GRAY	CM	9	9								
WHITE	CM										
GOLD	CM			0.1	15%	15%					
SILVER	CM			0.01	10%	10%	10%	10%			

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC

COLOR	TEMPERATURE COEFFICIENT	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE		MIL SPEC
					IN OHMS	IN OHMS	
BLACK	0	0	0				2.0 uF
BROWN	-80	1	1	10	±1%		2.0 uF
RED	-80	2	2	100	±2%		2.0 uF
ORANGE	-100	3	3	1,000			
YELLOW	-120	4	4				2.0 uF
GREEN	-150	5	5		±5%		2.0 uF
BLUE	-170	6	6				
PURPLE (VIOLET)	-180	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1			2.0 uF
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (1ST) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN uF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-280, MIL-C-11272B, AND MIL-C-10900C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-10900C.
4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
5. OPTIONAL CODING WHERE METALLIC ELEMENTS ARE UNDESIRABLE.

Figure FO-1. Color code markings for MIL-STD resistors, capacitors, and inductors.





RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



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