TECHNICAL MANUAL

OPERATOR'S, ORGANZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

FOR

GENERATOR, SIGNAL AN/GRM-50

(FSN 6625-868-8353)

HEADQUARTERS, DEPARTMENT OF THE ARMY

NOVEMBER 1974

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 capacitor. Failure to comply may result in death or serious injury to personnel.

DON’T TAKE CHANCES!

TECHNICAL MANUAL No. 11-6625-573-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *29 November 1974*

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

GENERATOR, SIGNAL AN/ GRM-50

***This publication supersedes TM 11-6625-573-15, 19 February 1964, including all changes.**

LIST OF ILLUSTRATIONS

LIST OF TABLES

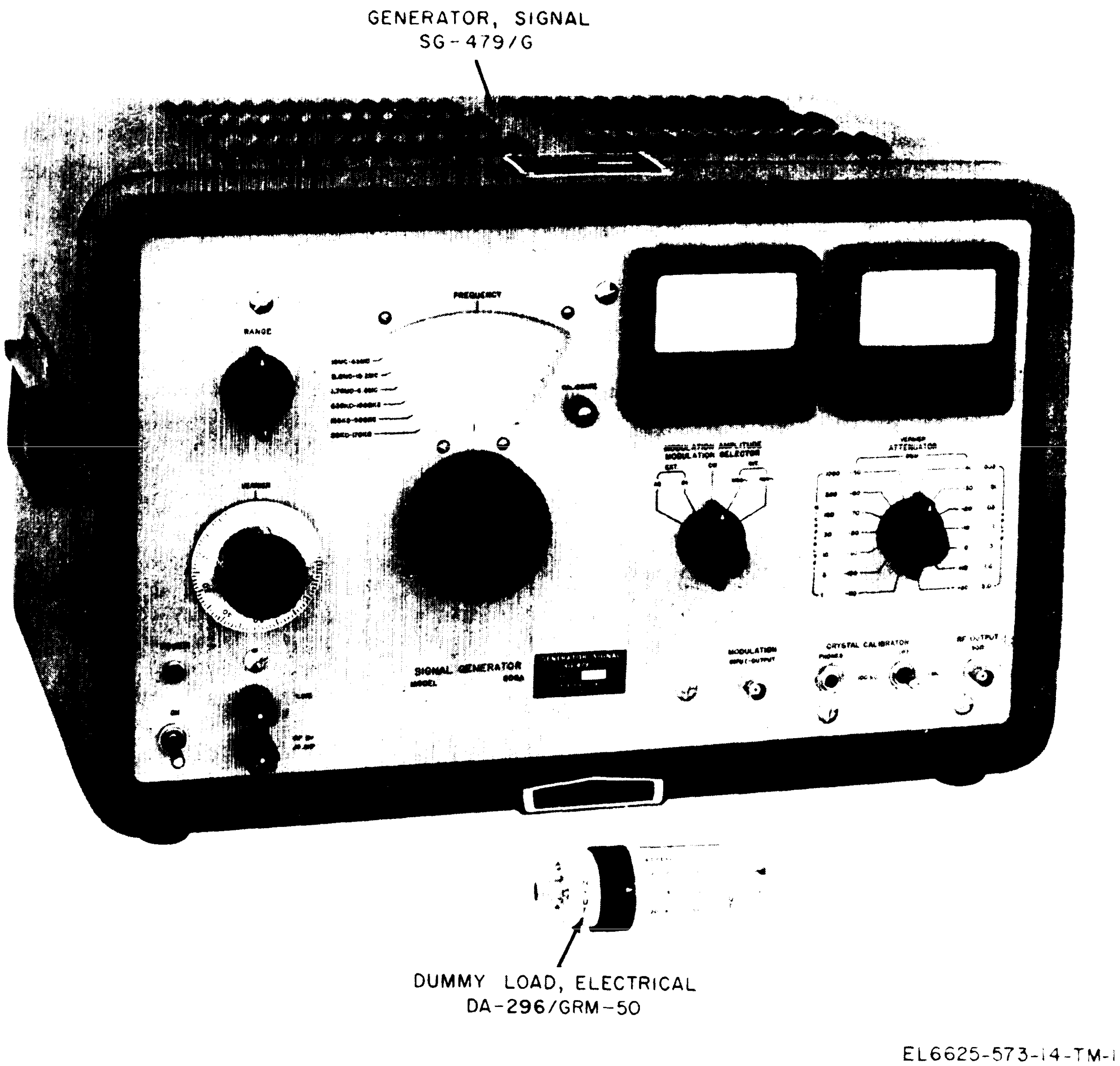


Figure 1-1. Generator, Signal AN/GRM-50 (less running spares).

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual describes Generator, Signal AN/GRM-50 and covers instructions for installation, operation, and operator, organizational, 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 C.

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 to the equipment.

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

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment.
Maintenance forms, records, and reports which are to be used by maintenance personnel at all 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 (Report of packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAVSUP PUB 378/AFR 71-4 MCO P4030.29 (Marine Corps), 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 4610.33/AFM 75-18/MCO P4610.19A, and DSAR 4500.15.

1-4. Reporting of Equipment Publication Improvements

The reporting of errors, omissions, and recommendations for improving this publication is authorized and encouraged. Submit reports on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to *Com*mander, US Army Electronics Command, ATTN: AMSEL-MA-DS, Fort Monmouth, NJ 07703.

1-5. Administrative Storage

The procedures for administrative storage are outlined in TM 740-90-1; however, the exact procedure in repacking for limited storage depends on the materials available and the conditions under which the equipment is to be stored.

1-6. Destruction of Army Materiel to Prevent Enemy Use

Demolition and destruction of this equipment will be under the direction of the commanding officer and in accordance with TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-7. Purpose and Use

The AN/GRM-50 is a general-purpose, high-frequency signal generator set (fig. 1-1), that provides radio frequency (rf) signals used to test, evaluate, and align radio receivers, filters, amplifiers, and similar electronic networks. It provides continuous wave (cw) or amplitude modulated (am.) signals in the frequency range of 50 kHz to 65 MHz at calibrated output levels from 0.1 microvolt to 3.0 volts. A direct reading frequency dial is calibrated to an accuracy of one percent. An internal crystal calibrator provides check points at 100 kHz and 1 MHz intervals with an error of less than 0.01 percent. It can be internally modulated at 400 Hz and externally modulated from dc to 20 kHz or more depending on rf carrier frequency being used. When the DA-296/GRM-50 is connected between the SG-479/G RF OUTPUT 50-ohm connector and the network under test, the SG-479/G operates into a 50-ohm resistive load regardless of the input impedance of the network under test. This maintains a calibrated rf output.

1-8. Description of Generator, Signal SG-479/G

The SG-A79/G is part of the AN/GRM-50 and is the only major unit supplied with the AN /GRM-50 and is housed in a metal cabinet designed for mobile, bench-top operation. The metal cabinet is equipped with handles on two sides for easy handling. All connectors and operating controls are mounted on the front panel.

1-9. Description of Minor Components

The DA-296/GRM-50 (fig. 1-1) is the only minor component supplied with the AN/GRM-50. The DA-296/GRM-50 provides a constant, 50-ohm resistive termination and, in addition, provides a standard Institute of Radio Engineers (IRE) dummy antenna. The unit is completely shielded and has BNC input and output connectors.

1-10. Additional Equipment Required

In addition to equipment supplied, 50-ohm coaxial cables equipped with BNC connectors are required but not supplied. The additional cables and connectors are required to connect the SG-479/G to the DA-296/GRM-50, other test equipment, and to equipment under test.

1-11. Technical Characteristics

a. Generator, Signal SG-479/G.

Frequency range	50 kHz to 65 MHz in 6 bands (50 kHz to 170 kHz, 165 kHz to 560 kHz, 530 kHz to 1,800 kHz, 1.76 MHz to 6.0 MHz, 5.8 MHz to 19.2 MHz to 65 MHz).
Frequency accuracy	±1.0%
Frequency calibration	Crystal oscillator provides check points at 100 kHz (useful to 6 MHz) and 1 MHz intervals accurate within 0.01% from ± 32°F to 122°F (0°C to +50°C).
Rf output level	Continuously adjustable from 0.1 µV to 3.0V into 50 ohm resistive load. Calibration is in volts and dBm (0 dBm is 1 milliwatt into 50 ohms).
Output accuracy.	±dB into 50 ohm resistive load
Frequency response.	±1 dB into 50 ohm resistive load over entire frequency range at any output level setting.
Output impedance	50 ohms, vswr less than 1.2:1 on 0.3V attenuator range and below
Spurious harmonic output	Less than 3.0%.
Leakage	Negligible, permits receiver sensitivity measurements down to least 0.1 µV.
Amplitude modulation	Continuously adjustable from 0 to 10070 as indicated on panel meter. Modulation level is constant within ±0.5 dB regardless of carrier frequency and output level changes.
Internal modulation . . .	0 to 100% sinusoidal modulation at 400 Hz ± 20 . . . . Hz of 1,000 Hz&W Hz.
Modulation bandwidth	DC to 20 kHz sine wave, dc to 3 kHz square wave (depends on frequency f_c and percent modulation). 30% sine wave modulation: f_m= 0.06 f_c up to f_c = 333 kHz 70% sine wave modulation: f m = 0.02 f_c up to f_c = 1.0 MHz square wave: f_m= 0.003 f_c up to f_c = 1.0 MHz.
External modulation	0 to 100% sine wave modulation, dc to 20 kHz (9.0V peak-to-peak produces 100% modulation at modulating frequencies from dc to 20 kHz). Input impedance is approximately 600 ohms .
Envelope distortion	Less than 1.0 % on 1V and lower ranges at 30% modulation using internal 400 Hz or 1,000 Hz source (less than 3.0% from 0 to 70% modulation).
Modulation meter accuracy	5.0% of full scale from 0 to 90% modulation for modulating frequencies to 10 kHz; 10% of full scale from 10 kHz to 20 kHz.
Incidental fm	± 0.0025% of output frequency or ± 100 Hz, whichever is greater, on 1V and lower ranges and with 30% modulation.
Residual fm.	Less than ± 0.0001% or ± 20 Hz, whichever is greater.
Spurious am.	Hum and noise sidebands are 70 dB below carrier level, down to thermal level of 50 ohm output system.
Frequency drift	Less than 50 parts in 10^6 of 5 Hz, whichever is greater, per 10 minute period after 2 hour warmup. Applies to all attenuator ranges except 3.0 volt range. Less than 10 minutes to restabilize after changing frequency.
Power requirements	115 Vac ± 10% or 230 Vac ± 10%, 50 Hz to 400 Hz, 135 watts
Weight:	
Operating	46 pounds
In transit case	82 pounds

b. Dummy LoaD Electrical DA-296/GRM-50.

Frequency range	50 kHz to 65 MHz when used as attenuator, 540 kHz to 23 MHz when used as dummy antenna
Maximum input power	180 milliwatts (3 Vrms across 50 ohms)
Attenuation	1 dB maximum in 0 dB position and 20 dB ±1 dB in 20 dB and 20 dB (DA) positions

Input impedance . . . . 50 ohms all positions
Output impedance . . . . 25 ohms in 0 dB position and 5 ohms in 20 dB position. In 20 dB (DA) position, dummy antenna output impedance is as follows:
2000 ohms ±10% reactive at 400 kHz
1000 ohms ±10 % reactive at 700 kHz
220 ohms ±10% reactive at 2 MHz
400 ohms ±10 % resistive at 20 MHz

Reflection coefficient . . . . . 0.11 maximum in 0 dB and 20 dB positions
Input and output vswr . . . 1.25:1 maximum in 0 dB and 20 dB positions
Weight . . . .4 ounces

1-12. Items Comprising an Operable Generator, Signal AN/GRM-50

items comprising an operable AN/GRM-50 are listed m table 1-1.

Table 1-1. Items Comprising an Operable Generator, Signal AN/GRM-60

Quantity	FSN	Item	Dimensions (in.) Height	Depth	Width	Unit Weight (lb)
1	6625-819-0472	Generator, Signal SG-479/G	12½	14¾	20¾	46
1		Dummy Load, Electrical DA-296/GRM-50	4-3/8	1-7/16 (dia)		0.25
1 set		Running spares*	2	14	18½	1

* For a list of running spares, refer to TM 11-6625-573-25P.

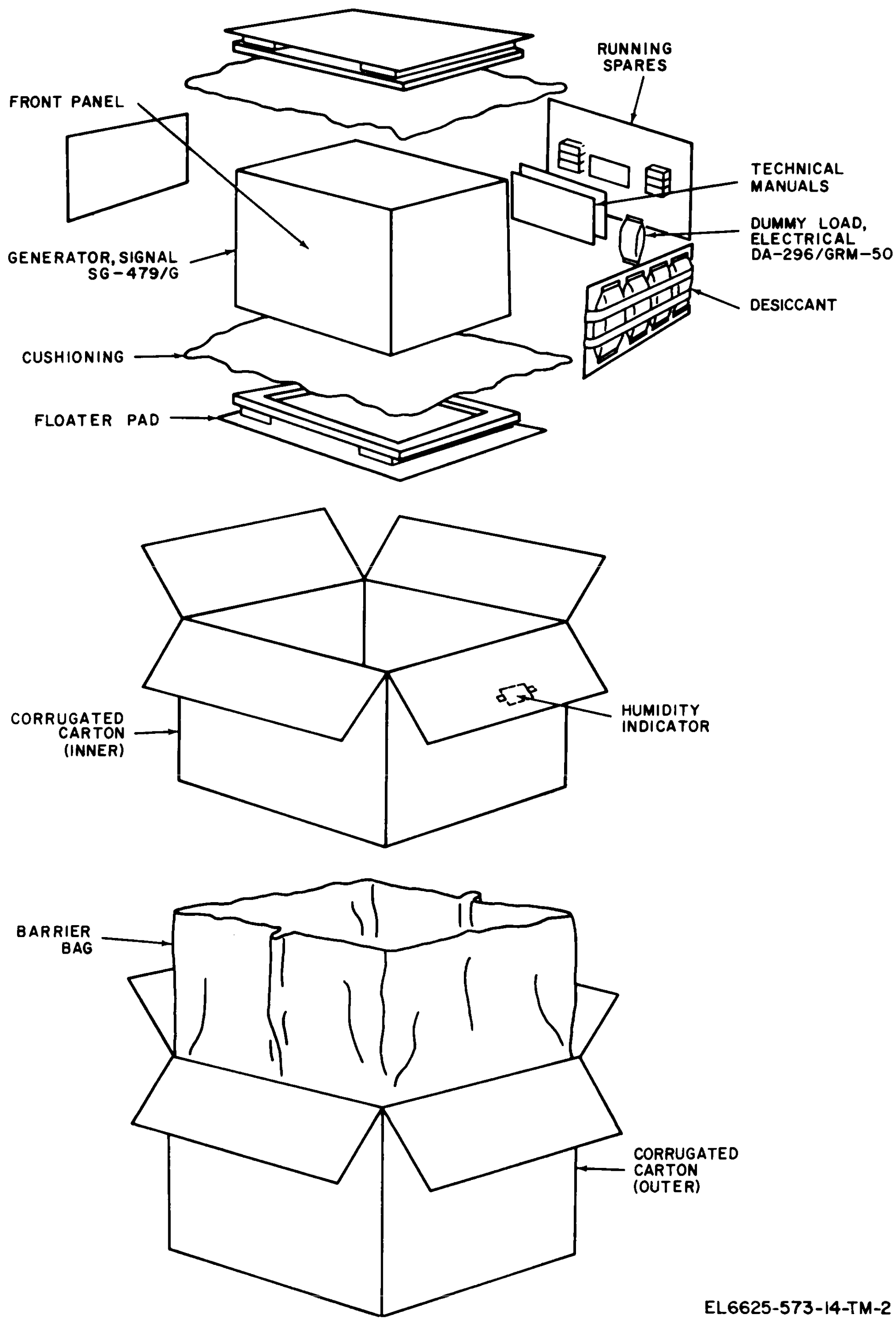
CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

2-1. Unpacking

(fig. 2-1)

a. Packaging Data. When packed for shipment, the SG-479/G, DA-296/GRM-50, running spares, and technical manuals are placed in an inner corrugated carton, enclosed in a moisture-proof and vapor proof barrier, and packed in an outer corrugated carton. The packaging method used is shown in figure 2-1.



b. Removing Contents. Remove contents of packing box as follows:

(1) Open top of outer corrugated carton.

(2) Open moisture proof and vapor proof barrier.

(3) Examine the top circle of humidity indicator card. If it is pink, examine the SG-479/G and DA-296/GRM-50 for rust, corrosion, mildew, or condensed water vapor.

(4) Open inner corrugated carton.

(5) Remove floater pad and cushioning material.

(6) Remove desiccant, the two technical manual packages, running spares, DA-296/GRM-50 package, and remove SG-479/G.

2-2. Checking Unpacked Equipment

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

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 should 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.)

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

The SG-479/G is shipped with all tubes, fuses, and crystals installed. Check that 2.0 ampere, 125-volt line fuse and 0.15 ampere, 125-volt RF B + fuse are installed in the correct front panel fuse holder. Check for breakage and proper seating of tubes and crystals, (fig. 2-3 and 2-4). To check SG-479/G tubes and crystals, remove equipment from chassis and rf shield from main casting in accordance with steps *a* and *b* below.

a. Cabinet Removal (fig. 2-2).

(1) Remove the four screws securing rear cover to rear of equipment chassis and remove rear cover.

(2) Unplug inner power cord from rf filter box mounted on inside of rear cover.

(3) Tip SG-479/G on its back.

(4) Loosen the two set screws on bottom front of cabinet.

(5) Lift cabinet off chassis.

b. Rf Shield Removal.

(1) Remove the 18 screws securing rf shield to main casting.

NOTE

Use special wrench clipped to top of rf shield to remove the four cap screws securing left side of rf shield to main-casting.

(2) Remove the three screws securing upper rf shield brace to crystal calibrator assembly.

(3) Remove the two screws securing left rf shield brace to crystal calibrator assembly.

(4) Loosen the three screws securing upper rf shield brace to rf shield, slide brace away from crystal calibrator assembly as far as possible, and tighten the three screws.

(5) Loosen the two screws securing left rf shield brace to rf shield, slide brace away from crystal calibrator assembly as far as possible, and tighten the two screws.

(6) Remove rf shield by pulling shield straight toward rear of unit.

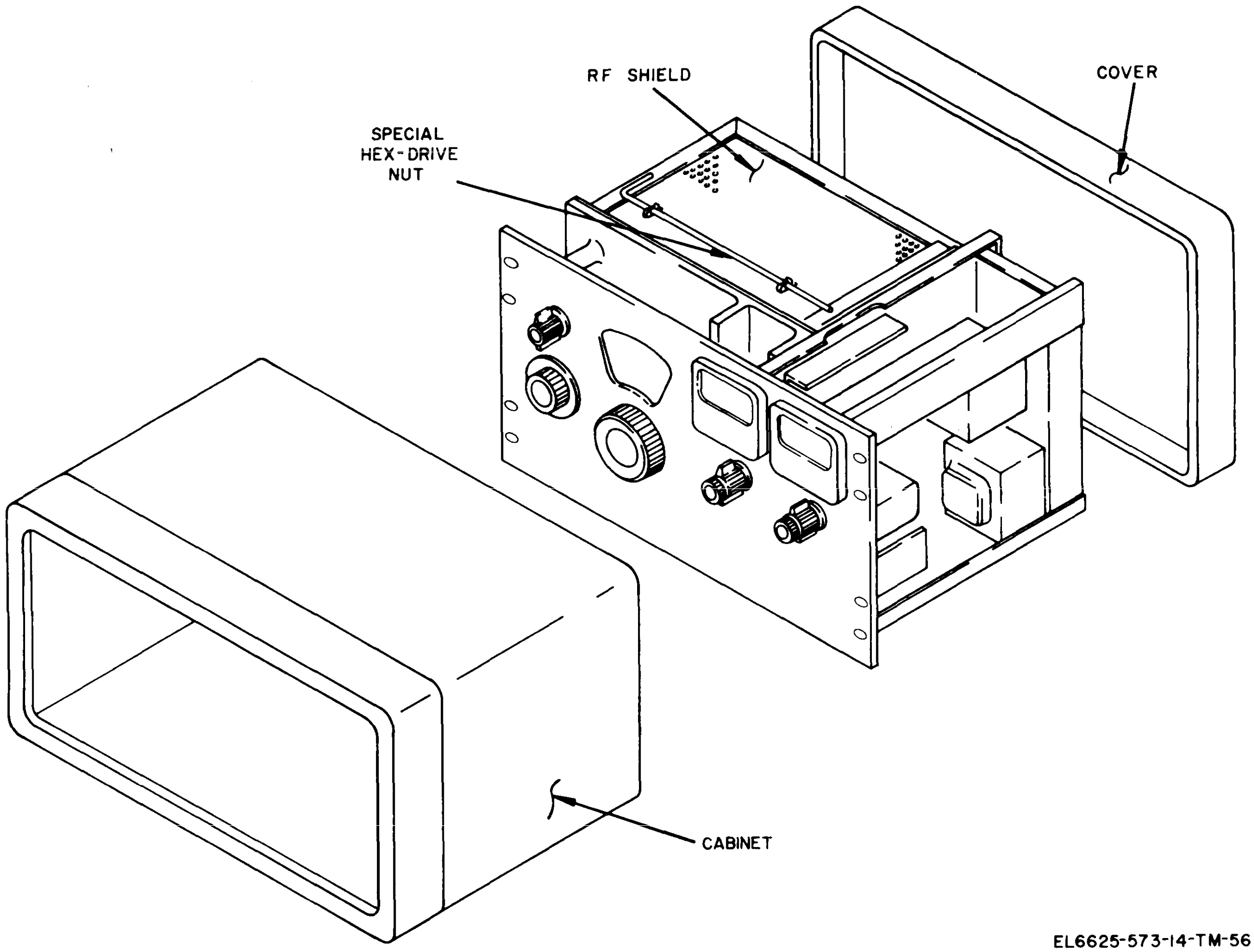
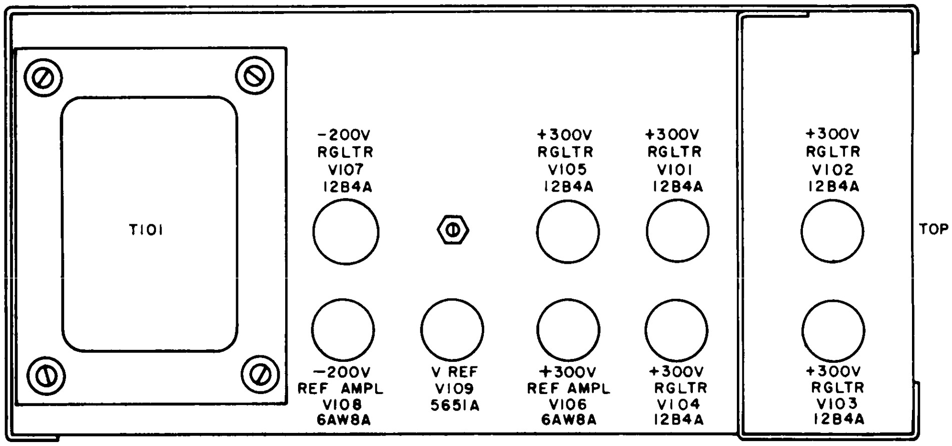
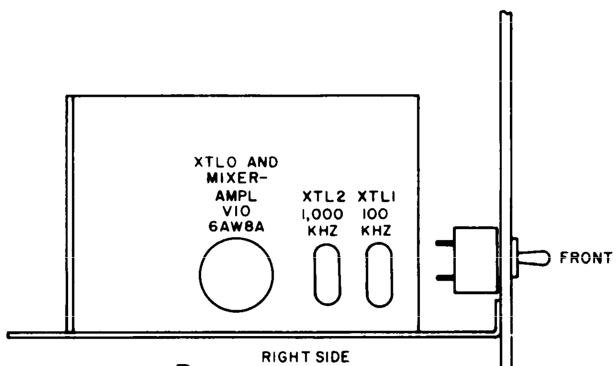


Figure 2-2. SG-479/G equipment chassis.



A. POWER SUPPLY DECK



B. CRYSTAL CALIBRATOR DECK

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Figure 2-3. Power supply and crystal calibrator decks, tube and crystal location diagram.

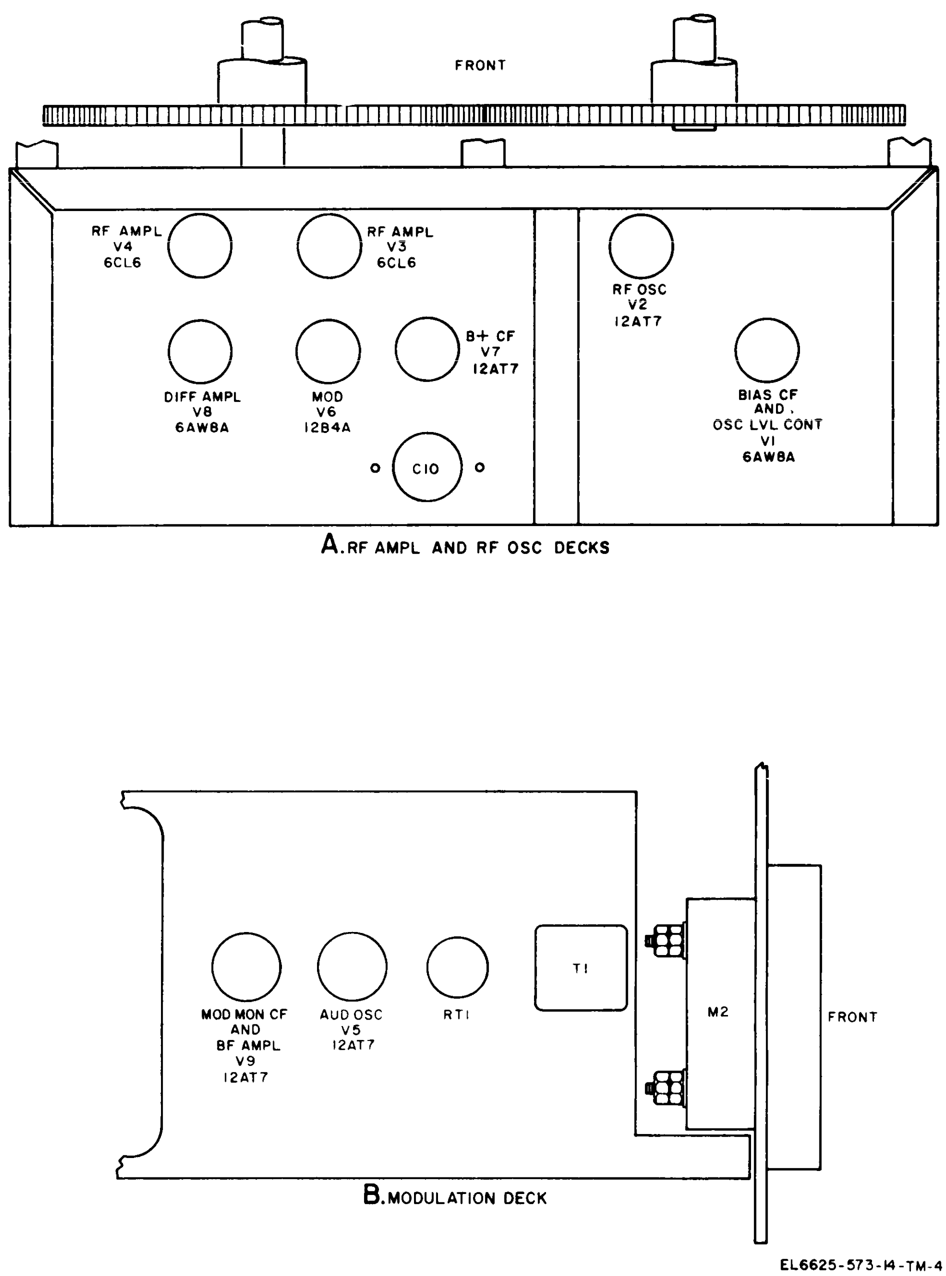


Figure 2-4. Rf oscillator, rf amplifier, and modulation decks, tube location diagram.

c. Crystals. Be sure that the correct crystals are installed in the crystal sockets according to the information listed below.

Operating freq (kHz)	*CRYSTAL CALIBRATOR switch position*	*Crystal freq (kHz)*	*Crystal socket*
100	100 KC	100.000	XTAL2
1000.	1 MC	1000,000	XTAL1

2-4. Equipment Installation and Connections

a. Installation. The SG-479/G is designed for bench top operation. Do not place anything on top of the SG-479/G that will prevent free air movement through the louvers.

b. Connections. The SG-479/G can be operated from either 115 vac or 230 vat, 50 Hz to 400 Hz. For 115 vac operation, set 115/230 switch (fig. 2-5) to 115 and install a 2.0-ampere, 125 volt, 3AG, slow blow fuse in the front panel LINE fuse holder (fig. 3-1). For 230 vac operation, set 115/230 switch S8 to 230 and install a 1.0 ampere, 250 volt, 3AG, slow-blow fuse in the front panel LINE fuse holder. After 115/230 switch S8 has been set to the correct position and the correct LINE fuse has been installed, the only connection required is to connect the SG-479/G power cord to the correct power source receptacle.

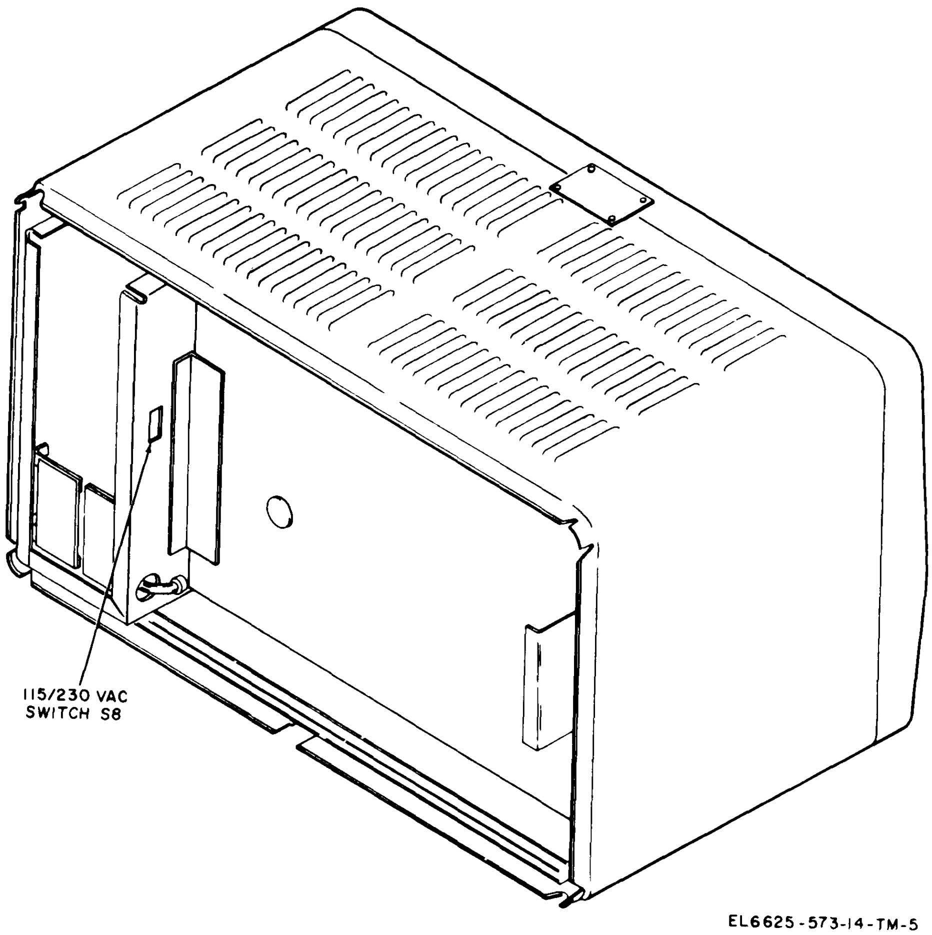


Figure 2-5. 115/230 vac input power selector switch S8 location.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

3-1. General

Before operating the SG-479/G 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.

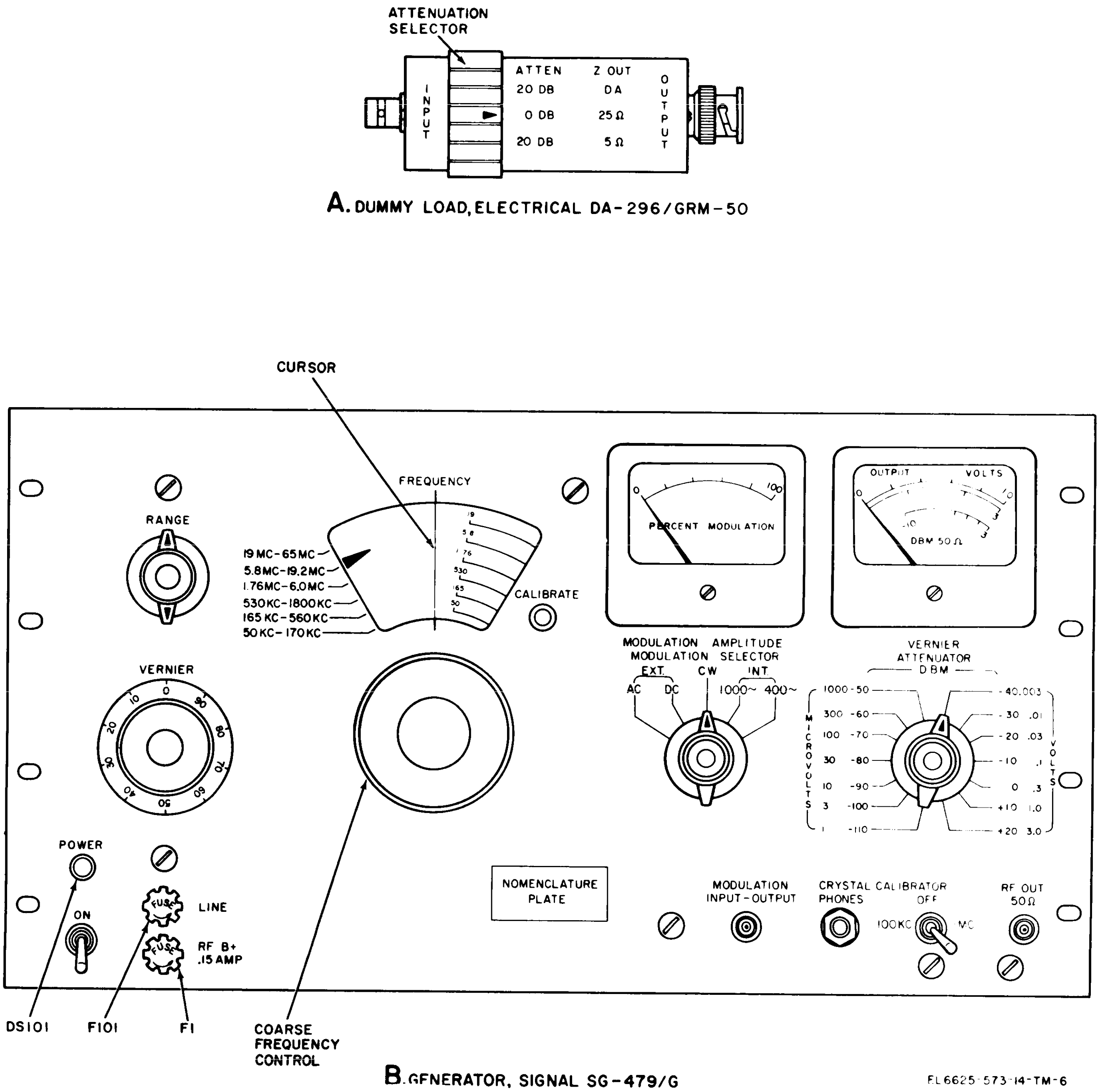


Figure 3-1. Generator, Signal SG-479/G controls, indicators and connectors.

Table 8-1. Operator Controls

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 maintenace categories.

Control indicator, or connector	Function
Power switch	In ON position, connects SG-479/G to ac power source.
POWER indicator lamp	When lighted, indicates that SG-47/G is energized.
LINE fuse (F101)	Power line fuse. Protects the equipment from dam age caused by line surges, application of wrong voltage, or internal short circuit due to part malfunction.
RF B+ .15 AMP fuse (F1)	B+ fuse for rf circuits only. Protects equipment from part malfunction in power supply or rf circuits.
RANGE switch	Selects of six frequency bands (50KC-170KC, 16SKC-560KC, S30KC-1800KC, 1.76MC-6.0MC, 5.8MC-19.2MC, and 19MC-65MC) indicated by red pointer in frequency dial window.
FREQUENCY control	Provides continuous coarse frequency adjustment within selected frequency range.
VERNIER control	Provides continuous fine frequency adjustment within selected frequency range.
MODULATION SELECTOR switch	Selects one of five modulation modes. *Switch position* — *Action* EXT AC — Ac component of external modulating signal amplitude modulates rf output signal. EXT DC — Ac component of external modulating signal amplitude modulates rf output signal. Dc component affects rf carrier level. C W — Removes modulation from rf output signal. INT 1000 ~ — Modulates rf output signal with 1000 Hz sinusoidal signal. INT 400 ~ — Modulates rf output signal with 400 Hz sinusoidal signal.
MODULATION AMPLITUDE control	Sets percent of internal and external amplitude modulation.
PERCENT MODULATION meter	Indicates percent of internal and external amplitude modulation.
MODULATION INPUT-OUTPUT connector	Provides a means of externally amplitude modulating rf output signal. Provides a synchronizing output signal when wing internal modulation.
ATTENUATOR switch	Selects one of fourteen rf output ranges. *Position* — *Range* 1-110 — 0 to 1 microvolt and –120 dBm to – 107 dBm 3-100 — 0 to 3 microvolts and –110 dBm to –97 dBm *Rf Output Range* 10-90 — 0 to 10 microvolt and –100 dBm to 87 dBm 30-80 — 0 to 30 microvolt and – 90 dBm to – 77 dBm 100-70 — 0 to 100 microvolt and – 80 dBm – 67 dBm 300-60 — 0 to 300 microvolts and – 70 dBm to – 57 dBm 1000-50 — 0 to 1000 microvolt and – 60 dBm to – 47 dBm -40 .003 — 0 to .003 volts and – 60 dBm to – 37 dBm -90.01 — 0 to .01 volts and – 40 dBm to – 27 dBm -20.03 — 0 to .03 volts and – 30 dBm to –17 dBm -10.1 — 0 to .1 volts and – 20 dBm to – 7 dBm 0.3 — 0 to .3 volts and – l0 dBm to +3 dBm +10 1.0 — 0 to l volt and 0 dBm to +13 dBm +20 3.0 — 0 to 3 volts and +10 dBm to +23 dBm
VERNIER ATTENUATOR control	Provides continuous adjustment within selected voltage range and from 10 dB below to 3 dB above selected dBm range.
OUTPUT VOLTS/DBM meter	Indicates rf output level in volts and dBm. scale — *Indicates* 0 to 1.0 — Output voltage on 1.0 volt range and all decade sub-multiple 0 to 3 — Output voltage on 3.0 volt range and all decade sub-multiples –10 to 3 — Output power (in dBm) on all dBm ranges
RF OUTPUT 60Ω connector	Provides calibrated rf output when terminated in 50-ohm resistive load.
CRYSTAL CALIBRATOR 100KC/OFF/1MC switch	Selects crystal calibrator frequency interval used to calibrate FREQUENCY dial. *Position* — *Calibration Interval* 100 KC — Every 100 kHz up to maximum of 6.0 MHz OFF — Removes Calibrating signal 1 MC — Every 1 MHz

Table 9-1. Operator Controls-Continued

Control, indicator, or connector	Function
CRYSTAL CALIBRATOR PHONES jack	Provides receptacle for headset used to detect zero beat when calibrating FREQUENCY dial.
CALIBRATE control	Positions FREQUENCY dial tumor.
Dummy Load, Electrical DA-296/GRM-50	
INPUT connector	provides connector for rf input signal.
OUTPUT connector	Provides connector for rf output signal.
Attenuator switch	Selects one of three attenuation factors. *position Attenuation Output Impedance* 20 DB DA 20 DB Standard IRE dummy antenna. Refer to paragraph 1 106 for characteristics. 0 DB 25 Ω 1DB maximum 25 ohms 20 DB 5 Ω 20 DB 5 ohms

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. Preliminary Starting Procedure

a. Check that the power switch is in the OFF position.

b. Set ATTENUATOR switch to 0 DBM.

c. Turn VERNIER ATTENUATOR control fully counterclockwise.

d. Set MODULATION SELECTOR switch to CW.

e. Set CRYSTAL CALIBRATOR 100 KC/ OFF/1MC switch to OFF.

f. Connect the SG-479/G to a power source of 115 vac±10% or 230 vac ± 10 %, 50 Hz to 400 Hz.

g. Set power switch to ON. The POWER indicator lamp should light. Allow equipment to warm up for two hours. This allows the equipment to reach operating temperature and minimize frequency drift.

3-4. CW Operating Procedure

To provide a continuous wave (cw) rf output signal, perform the following steps:

a. Set output frequency as instructed in paragraph 3-7.

CAUTION

When ATTENUATOR switch is set to 3-volt range, certain stages are operated near overload. To insure maximum operating life from components in these stages do not leave ATTENUATOR switch in 3-volt position during warmup or standby operation. Also do not short circuit RF OUTPUT connector. As soon as test is completed, move ATTENUATOR switch out of 3-volt position.

b. Set ATTENUATOR switch to desired output range.

CAUTION

Attenuator resistors may be burned out or overheated to the point where they are no longer in tolerance if voltage is applied to RF OUTPUT connector at any time. If unit under test is a transceiver, disable transmitter section before connecting SG-479/G to the unit. If rf output must be connected to a point where voltage exists, apply the rf through a blocking capacitor that has an adequate voltage rating.

c. If rf output is to be connected to a 50-ohm input impedance, connect a 50-ohm coaxial cable from RF OUTPUT connector to unit under test. If input impedance of unit under test is greater than 60 ohms and it is desired to maintain a calibrated rf output, use DA-296/GRM-50 as instructed in paragraph 3-8.

NOTE

Single-braid shield coaxial cable is usable with rf levels down to minus 80 dBm. For rf levels lower than this, use double-braid shield coaxial cable such as RG-55/U.

d. Adjust VERNIER ATTENUATOR control to obtain desired rf output meter indication on either DBM or OUTPUT VOLTS scale.

NOTE

When output meter is set to 0 on DBM scale, rf output power is equal to selected DBM range.

e. If it is necessary to synchronize a display such as an oscilloscope to the internal modulation signal, connect coaxial cable from MODULATION INPUT-OUTPUT connector to oscilloscope external trigger input. The synchronizing output is approximately 3 volts rms and has a source resistance of 82 kilohms.

f. Adjust VERNIER ATTENUATOR control to obtain desired rf output meter indication on either DBM or OUTPUT VOLTS scale.

3-5. Internal Modulation Operating Procedure

To provide internally amplitude-modulated rf outputs, perform the following steps:

a. Set output frequency as instructed in paragraph 3-7.

b. Set MODULATION SELECTOR switch to either INT 1000 ~ or INT 400 ~ as desired.

CAUTION

When output ATTENUATOR switch is set to 3.0 position, do not exceed 30 percent modulation when frequency is set between 19 MHz and 65 MHz.

c. Adjust MODULATION AMPLITUDE control to obtain desired modulation indicated on PERCENT MODULATION meter.

d. Set ATTENUATOR switch to desired output range.

3-6. External Modulation Operating Procedure

To provide externally amplitude-modulated rf outputs, perform the following steps:

a. Set output frequency as instructed in paragraph 3-7.

b. Set MODULATION SELECTOR switch to either EXT DC or EXT AC as required.

NOTE

When switch is set to EXT DC, dc level of external modulating input will affect rf carrier output level. Use EXT AC position to prevent dc level from affecting rf output.

CAUTION

Do not apply more than 10 volts dc or 10 volts rms to MODULATION INPUT-OUTPUT connector. Exceeding these levels may shorten operating life of MODULATION AMPLITUDE control. When MODULATION SELECTOR switch is set to EXT AC, it does not block dc voltage from MODULATION AMPLITUDE control.

c. Connect a coaxial cable from MODULATION INPUT-OUTPUT connector to external modulation source.

NOTE

The external modulation source must be variable and capable of supplying at least 4.5 volts peak amplitude into 600 ohms in order to obtain 100 percent amplitude modulation.

d. Set external modulating frequency (f_m) as desired. Figure 3-2 shows the relationship between f_m and carrier frequency (f_c) at an envelope distortion of three percent.

e. Adjust MODULATION AMPLITUDE control fully clockwise.

f. Adjust external modulating source output level to obtain 100 percent indication on PERCENT MODULATION meter.

NOTE

When excessive modulating voltage is applied, rf tuned circuits may flash over and cause front panel RF B + fuse to blow. If this occurs, rf output meter needle will be pinned to left of 0. Replace RF B + fuse with a 0.15-ampere, 125 volt, slow blow, 3AG fuse to restore normal operation.

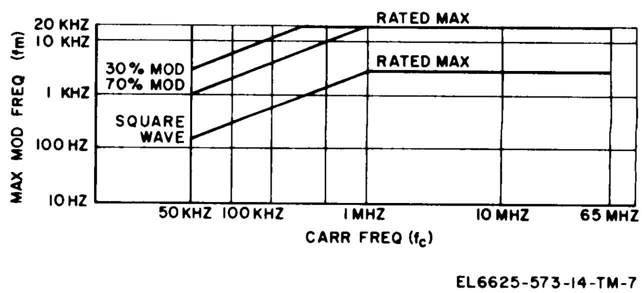


Figure 3-2. External modulating frequency versus carrier frequency graph.

g. Adjust MODULATION AMPLITUDE control to obtain desired percent modulation.

h. Set ATTENUATOR switch to desired output range.

i. Adjust VERNIER ATTENUATOR control to obtain desired rf output indication on either DBM or OUTPUT VOLTS scale.

3-7. Frequency Calibration Procedure

The FREQUENCY dial is accurate to within one percent when the cursor is aligned with the black panel markings above and below the dial window. This can be improved to 0.01 percent when the output frequency is set to an exact multiple of either the 100 kHz or 1 MHz calibrator signals. At all other frequencies, a typical accuracy of 0.2 percent can be obtained by interpolation using the frequency VERNIER control. To obtain maximum frequency accuracy, monitor frequency with an electronic frequency counter.

a. Start equipment as instructed in paragraph 3-3.

b. Set RANGE switch to position red pointer at desired frequency range.

c. Adjust CALIBRATE control to align cursor with black panel markings above and below

FREQUENCY dial window. This calibrates frequency dial to within one percent. If this accuracy is sufficient, set FREQUENCY dial to position desired frequency under cursor. If greater accuracy is desired, proceed to step d below in order to set frequency at an exact multiple of either 100 kHz or 1 MHz. Refer to step *e* for all other frequencies.

d. To set frequency to an exact multiple of either 100 kHz or 1 MHz, perform the following steps:

(1) Plug a high-impedance headset (600 ohms or higher) into CRYSTAL CALIBRATOR PHONES jack.

NOTE

Remove headset from ears when changing CRYSTAL CALIBRATOR 100 KC/OFF/lMC switch position. A very loud transient is generated whenever the switch position is changed.

(2) Set CRYSTAL CALIBRATOR 100KC/OFF/1MC switch to either 100KC or 1MC as desired,

NOTE

The 100KC crystal calibrator frequency can be used to at least 6 MHz.

(3) Adjust coarse FREQUENCY control to set desired frequency on cursor.

(4) Adjust VERNIER ATTENUATOR control clockwise until beat note is heard.

(5) Carefully adjust frequency VERNIER control in vicinity of desired frequency to obtain a zero beat.

NOTE

As zero beat is approached, adjust output attenuator VERNIER control fully clockwise. This improves zero beat detection. ATTENUATOR range switch has no effect on headset audio loudness.

(6) Adjust CALIBRATE control to position cursor directly over dial frequency used to obtain zero beat. This frequency is now accurate to within 0.01 percent.

(7) Set CRYSTAL CALIBRATOR 100 KC/OFF/1MC switch to OFF. If this is not done, calibrator signal will modulate rf output signal.

e. To set freqeuncy to points other than exact multiples of 100 kHz and 1 MHz, perform the following steps:

NOTE

The following procedure is not applicable to 50 KC-170KC frequency range since there is only one zero beat frequency on this range.

(1) Set CRYSTAL CALIBRATOR 100 KC/OFF/1MC switch to 100KC if RANGE switch is set to either 165 KC-560 KC, 530 KC-1800 KC, or 1.76MC-6.0MC range. If either of two highest ranges is selected, set switch to 1MC.

(2) Adjust frequency VERNIER control to obtain zero beats on both sides of desired frequency. Count total frequency VERNIER scale divisions between zero beats.

(3) Calculate ratio of frequency difference between desired frequency and nearest zero beat to total frequency difference between zero beats (either 100 kHz or 1 MHz).

(4) Multiply ratio calculated in step (3) by total frequency VERNIER control divisions counted in step (2).

(5) Starting at zero beat nearest desired frequency, adjust frequency VERNIER control in a direction that moves frequency dial toward desired frequency. Move frequency VERNIER control the exact number of divisions calibrated in step (4). *For example,* it is desired to set frequency to 22.75 MHz using the interpolation method. With CRYSTAL CALIBRATOR 100KC/OFF/1MC switch set to 1MC, zero beats are obtained at 22 MHz and 23 MHz with 80 frequency VERNIER control divisions between zero beats. The ratio of frequency difference between desired frequency (22.75 MHz) and nearest zero beat frequency (23 MHz) to total frequency difference between zero beats (1 MHz) is 0.25 MHz/1 MHz or 0.25. This ratio is multiplied by the 80 frequency VERNIER control divisions to obtain the 20 divisions that frequency VERNIER control must be moved in a counterclockwise direction. The frequency is now set to 22.75 MHz with an accuracy of approximately 0.2 percent.

(6) Set CRYSTAL CALIBRATOR 100KC/OFF/1MC switch to OFF. If this is not done, calibrator signal will modulate rf output signal.

3-8. DA-296/GRM-50 Operating Procedure

When a load impedance other than 50 ohms is connected to the SG-479/G, the rf output meter is no longer calibrated. To retain output meter calibration, the DA-296/GRM-50 is connected between the load and the SG-479/G rf output connector.

a. If the load is 500 ohms or greater, set the ATTEN switch to 0 DB. This reduces the source impedance to 25 ohms and attenuates the rf signal less than 1 dB.

b. If load is between 50 ohms and 500 ohms, set the ATTEN switch to 20 DB 5 Ω. This attenuates the rf signal by 20 DB (10 to 1 voltage division) and reduces the rf source impedance to 5 ohms.

c. To accurately measure the sensitivity of a receiver having a high impedance antenna input connection, set the ATTEN switch to 20 DB DA. This applies the rf signal to the receiver input through a standard dummy antenna. The signal is attenuated by 20 DB (10 to 1 voltage division) and the source impedance varies with the frequency.

3-9. Procedure for Shutdown

a. Set the POWER-ON switch to OFF.

b. Disconnect the equipment under test.

c. Disconnect power cable from power source.

Section Ill. OPERATION UNDER UNUSUAL CONDITIONS

3-10. Operation at Low Temperatures

a. Accuracy of the SG-479/G 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 to two 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.

3-11. Operation under Tropical Conditions

When operated in tropical climates, electronic equipment can be installed in tents, huts, or where necessary, in underground dugouts. When equipment is installed below ground and when it is set up in swamp areas, moisture conditions are more acute than normal in the tropics. Ventilation usually is 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.

3-12. Operation in Desert Climates

The main problem 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. Therefore, cleaning and servicing intervals shall be shorrtened according to local conditions.

CHAPTER 4

OPERATOR/ CREW MAINTENANCE INSTRUCTIONS

Section 1. OPERATOR/ CREW TOOLS AND EQUIPMENT

4-1. Operator/Crew Common Tools and Equipment

Tools and test equipment for the AN/GRM-50 or authorized for use by the operator are listed in appendix C of this manual.

4-2. Special Tools and Equipment

There are no special tools required for operator/crew maintenance. The only test equipment required is ME-26A/U (FSN 6625-360-2493) and a high impedance (600 ohms or greater) headset with a 1¼ inch standard telephone plug.

4-3. Lubrication

No lubrication is required.

Section II. OPERATOR/ CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-4. General

To insure that the AN/GRM-50 is always ready for 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 are listed and prescribed in table 4-1. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation that would damage the equipment. Record all deficiencies together with the corrective action taken as prescribed in TM 38-750.

4-5. Instructions for Performance of Preventive and Services

Preventive maintenance checks and services of the AN/GRM-50 are required on a daily and weekly basis (table 4-1). The daily preventive maintenance checks and services below specify checks and services that must be accomplished daily or under the following special conditions:

a. When signal generator is initially unpacked.

b. When signal generator is returned after higher category maintenance repair.

c. At least once a week if the signal generator is maintained in a standby condition.

Figure 4-1. Operator/Crew Preventive Maintenance Checks and Services.

D—Daily
Time required: 0.2

W—Weekly
Time required: 2.8

Interval and Sequence No. D	Interval and Sequence No. W	Item To Be Inspected Procedure	Work Time (M · H)
1	1	COMPLETENESS Check that the equipment is complete.	0.1
	2	EXTERIOR SURFACE Clean the exterior surfaces, including the panel. Check the indicator glasses for cracks (para 4-6).	0.1
	3	CONNECTORS Check the tightness of all connectors.	0.1
2	4	CONTROLS AND INDICATORS While performing the operating checks (sequence No. 5 through 28), observe that the mechanical action of all controls is smooth and free of internal binding, and that there is no excessive looseness.	0.1

Table 4-1. Operator/Crew Preventive Maintenance Checks and Services — Continued

D–Daily *Time required: 0.2*

W – Weekly *Time required: 2.8*

Interval and Sequence No. D	W	Item To Be Inspected Procedure	Work Time (M H)
		CONTROLS AND INDICATORS-Continued	
	5	Power Switch Set to off (down) position and connect power cord to external power source.	0.1
	6	RF OUTPUT Connector Connect coaxial cable from RF OUTPUT connector to DA-296/GRM-50 INPUT connector.	0.1
	7	DA-296/GRM-50 OUTPUT Connector Connect coaxial cable from DA-296/GRM-50 OUTPUT connector to ME-26A/U input.	0.1
	8	RANGE switch Set to 50KC-170KC	0.1
	9	FREQUENCY Control (Large Knob) Fully clockwise	0.1
	10	MODULATION SELECTOR Switch Set to CW	0.1
	11	MODULATION AMPLITUDE Switch Fully counterclockwise	0.1
	12	ATTENUATOR Switch +10 dBm	0.1
	13	VERNIER ATTENUATOR Fully counterclockwise	0.1
	14	CRYSTAL CALIBRATOR Switch Set to OFF	0.1
	15	Power Switch Set to ON and insure that POWER indicator is lighted and POWER output meter needle rests at 0.	0.1
	16	VERNIER ATTENUATOR Control Adjust clockwise for output meter indication of 0 dB and insure that the ME-26A/U shows an indication.	0.1
	17	FREQUENCY Control Adjust fully counterclockwise and insure that output meter needle does not vary more than ± 1 dB.	0.1
	18	RANGE Switch and FREQUENCY Control *a.* Set RANGE switch to 165KC-560 KC, adjust main FREQUENCY control fully clockwise, and insure that output meter needle does not vary more than ± 1 dB. *b.* Set RANGE switch to 530KC-1800KC, adjust FREQUENCY control fully counterclockwise, and insure that output meter needle does not vary more than ± 1 dB. c. Set RANGE switch to 1.76MC-6.0MC, adjust FREQUENCY control fully clockwise, and insure that output meter needle does not vary more than ± dB. *d.* Set RANGE switch to 5.8MC-19.2MC, adjust FREQUENCY control fully counterclockwise, and insure that output meter needle does not vary more than ± 1 dB. e. Set RANGE switch to 19MC-65MC, adjust FREQUENCY control fully clockwise, and insure that output meter needle does not vary more than ± 1 dB.	0.2
	19	DA-296/GRM-50 ATTEN Switch *a.* Set DA-296/GRM-50 ATTEN switch to 20 DB 5 Ω and insure that ME-26A/U indication decreases. *b.* Set DA-296/GRM-50 ATTEN switch to 20 DB DA and insure that ME-26A/U indication remains the same as in 20 DB 5 Ω position.	0.1
	20	MODULATION SELECTOR Switch Set to INT 1000 ~	
	21	MODULATION' AMPLITUDE Control Adjust MODULATION AMPLITUDE Control fully clockwise and insure that PERCENT MODULATION indicates at least 100.	
	22	MODULATION SELECTOR Switch Set MODULATION SELECTOR switch to INT 400 ~ position and insure that PERCENT MODULATION meter indicates at least 100.	
	23	MODULATION SELECTOR Switch Set to CW	
	24	CRYSTAL CALIBRATOR Switch Set to 1 MC	

Table 4-1. Operator/Crew Preventive Maintenance Checks and Services —Continued

D–Daily *W – weekly*
Time required: 0.2 *Time required 2.8*

Interval and Seqeuence No. D	Interval and Seqeuence No. W	Item To Se Inspected Procedure	Work Time (M/H)
		CONTROLS AND INDICATORS– Continued	
	25	CRYSTAL CALIBRATOR PHONES Connector Plug headset into CRYSTAL CALIBRATOR PHONES connector.	
	26	FREQUENCY Control Adjust FREQUENCY control counterclockwise and insure that zero beats are heard at whole 1 MHz intervals.	
	27	RANGE Switch Set to 5,8MC - 19.2MC	
	28	FREQUENCY Control Adjust FREQUENCY control clockwise and insure that zero beats are heard at whole 100 kHz intervals.	0.1
	29	CABLES Inspect ac power cord for chafed, cracked or frayed insulation. Replace the plug if it is broken, arced, stripped, or worn excessively.	0.2
	30	METAL SURFACES Inspect exposed metal surfaces for rust and corrosion. Touchup paint as required,	0.5

4-6. 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.

CHAPTER 5

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section i. ORGANIZATIONAL TOOLS AND EQUIPMENT

5-1. Common Tools and Equipment

Tools and test equipment required for organizational maintence of the AN/GRM-50 are listed below:

a. Multimeter AN/USM-223 (FSN 6625-999-7465).

b. Tool Kit, Radar Radio Repair TK-101/G (FSN 5180-064-5178).

c. Test Set, Electron Tube TV-7/U (FSN 6625-820-0064).

5-2. Special Tools and Equipment

No special tools or equipment are required for organizational maintenance.

Section II. REPAINTING AND REFINISHING INSTRUCTIONS

5-3. Painting

a. Rustproofing. When the finish on the SG-479/G has become badly scarred or damaged, rust and corrosion can be prevented by touching up the bare surfaces. Use No. 000 sandpaper to clean the surfaces down to the bare metal. Obtain a bright, smooth finish.

b. Painting. Remove rust and corrosion from the metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practIcies specified in TB 746-10.

5-4. Lubrication

No scheduled lubrication is required. All the parts have been previously lubricated by the manufacturer; no further lubrication should be required.

Section III. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

5-5. General

To insure that the AN/GRM-50 is always ready for 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 are listed and prescribed in tables 5-1 and 5-2. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation that would damage the equipment. Record all deficiencies, together with the corrective action taken as prescribed in TM 38-750.

5-6. Instructions for Monthly and Quarterly Performance of Preventive Maintenance Checks and Services

The items listed in tables 5-1 and 5-2 should be inspected or serviced by organizational level personnel on a monthly and quarterly basis.

Table 5-1. Monthly Organizational Preventive Maintenance Checks and Services

M–Monthly
Total man-hours required: 0.7

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.	0.1
2	JACKS Inspect jacks *for* snug fit and good contact.	0.1
3	TRANSFORMER TERMINALS Inspect the terminals on the power transformer. All nuts must be tight. No dirt or corrosion should be evident.	0.1
4	TERMINAL BLOCKS 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 defects.	0.1
6	INTERIOR Clean the interior of the chassis and cabinet.	0.2

Table 6-2. Quarterly Organizational Preventive Maintenance Checks and Services

Q–Quarterly
Total man-hours required: 0.7

Sequence Number	*Item To Be Inspected* *Procedure*	*Work Time (M H)*
1	PUBLICATIONS See that all publications are complete, serviceable, and current (DA Pam 310-4).	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.	O.l
3	SPARE PARTS Check all spare parts (operator and organizational) for general rendition and method of storage. No overstock should be evident and all shortages must be on valid requisitions.	0.5

Section IV. ORGANIZATIONAL TROUBLESHOOTING AND REPAIR

5-7. General

Organizational troubleshooting of the SG-479/G is based on symptoms that appear during normal operation or during performance of any of the maintenance checks and services contained in this manual. To troubleshoot the SG-479/G, select the trouble symptom in table 5-3 which most nearly approximates the trouble being experienced. Perform the checks and corrective measures indicated in table 5-3. If the corrective measures indicated do not result in correction of the trouble, a higher category of maintenance is required .

Table 5-3. Organizational Troubleshooting

Malfunction	Probable Cause	Corrective Action
1 POWER indicator does not light.	Defective LINE fuse F101 or POWER indicator lamp DS101.	Replace fuse F101 or lamp DS101 (para 5-9).
2 Power output meter needle pinned to left of 0.	Defective fuse F1 or defective tube V101 through V109 in power supply.	Replace fuse F1 or replace tube V101 through V109 in power supply (para 5-8).
3 PERCENT MODULATION meter does not indicate at least 100.	Defective tube V9A in modulation monitor on defective tube V5 in audio oscillator.	Replace tube V9 in modulation monitor or tube V5 in audio oscillator (para 5-8 *b*).
4 Beat notes not heard in headset.	Defective tube V10A in crystal oscillator, defective tube V10B m calibrator mixer-amplifier, or defective tube V9B in beat frequency output amplifier.	Replace tube V9 in beat frequency output amplifier or tube V5 in calibrator crystal oscillator and mixer-amplifier (para 5-8 *b*).

5-8. 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 the 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 rear cover and cabinet in accordance with paragraph 2-3 *a.* Location of tubes in the power supply and crystal calibrator are shown on figure 2-2 and those in the audio oscillator and modulation monitor on figure 2-3. Test individual tubes as required.

5-9. Repairs

a. Replacement of POWER Indicator Lamp. Replace indicator lamp DS101 as follows:

(1) Remove equipment rear cover and cabinet in accordance with paragraph 2-3 *a.* It is not necessary to completely remove cabinet.

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

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

b. Replacement of LINE and RF B+ Fuses. Replace either LINE fuse F101 or RF B+ fuse F1 as follows:

(1) Rotate front panel fuse holder cover counterclockwise and remove fuse holder cover and fuse.

(2) Remove fuse from fuse holder cover.

(3) Insert new fuse in fuse holder cover.

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

CHAPTER 6

FUNCTIONING OF EQUIPMENT

6-1. General

This chapter contains an overall functional description of the AN/GRM-50 as a unit and as individual functional circuits.

6-2. Overall Functional Description

a. Signal Generator. Generator, Signal SG-497/G is a high-frequency rf signal generator that uses a master oscillator-power amplifier design. Included is an output termination. The signal generator is used to test, evaluate and align radio receivers, filters, amplifiers, and similar electronic networks. Signal paths and waveforms are shown on the block diagram (fig. 6-1) and are discussed in *b* through *k* below. For complete circuit details, refer to over-all schematic diagram (fig. FO-3).

b. Rf Oscillator and Oscillator Level Control. Rf oscillator V2 generates a 50kHz to 65 MHz signal for application to the rf power amplifier. In addition, a sample of the oscillator output is rectified by detector diode CR1 and applied as a dc control voltage to oscillator level control V1B that controls the output level of oscillator stage V2. When the oscillator output level attempts to change, V1B causes the output of V2 to change in a direction that restores the rf output to its original level. Bias cathode follower V1A supplies bias voltage for V2.

c. Rf Power Amplifier. Rf power amplifier V3-V4 provides all rf gain in the signal generator. Gain of the rf power amplifier is controlled by the modulator that is part of the modulation and output level control functional sections. These sections are discussed in paragraphs *e* and *g* below.

d. Step Attenuator. Attenuator A1 provides 14 output ranges in steps of 10 dB each. Continuous rf output variation between ranges is discussed in e below. The output of A1 is applied to RF OUTPUT 50 Ω connector J2.

e. Rf Feedback. A sample of the rf power amplifier output is applied to detector diodes CR2 and CR3 that form an envelope detector. When amplitude modulation is used, the envelope detector output consists of a dc component proportional to the unmodulated rf carrier level and an ac component that is a duplicate of the modulation envelope. The detector output is applied to differential amplifier V8 and to a low pass filter. The filter output is a dc voltage proportional to the rf carrier level and is displayed on rf output meter M2. The detector output applied to differential amplifier V8 is compared to the rf carrier level and modulation control voltages applied to the second input of V8. Any difference between the control and feedback voltages is detected and amplified by V8 and applied to modulator stage V6. The modulator controls the gain of rf power amplifier V3-V4 in a direction that forces the envelope detector outputs to be equal to the differential amplifier control inputs. In this manner the rf carrier level at the output of rf power amplifier V3-V4 is held constant and modulation envelope distortion is reduced. B + cathode follower V7 supplies B + voltage to V8.

f. Audio Oscillator. Audio oscillator stage V5 provides either 400 Hz or 1000 Hz sinusoidal signals for internal amplitude modulation. When S6 is set to position four or five, the V5 output is applied to modulation monitor follower V9A and to differential amplifier V8. In addition, the internal modulation signal is applied to MODULATION INPUT-OUTPUT connector J3 for use in synchronizing external equipment.

g. Modulation Monitor. Both internal and external modulating signals are applied to modulation monitor cathode follower V9A that drives rectifier diode CR5. The rectified signal is then applied to PERCENT MODULATION meter M1 that is calibrated to indicate percent amplitude modulation for sinusoidal modulation signals.

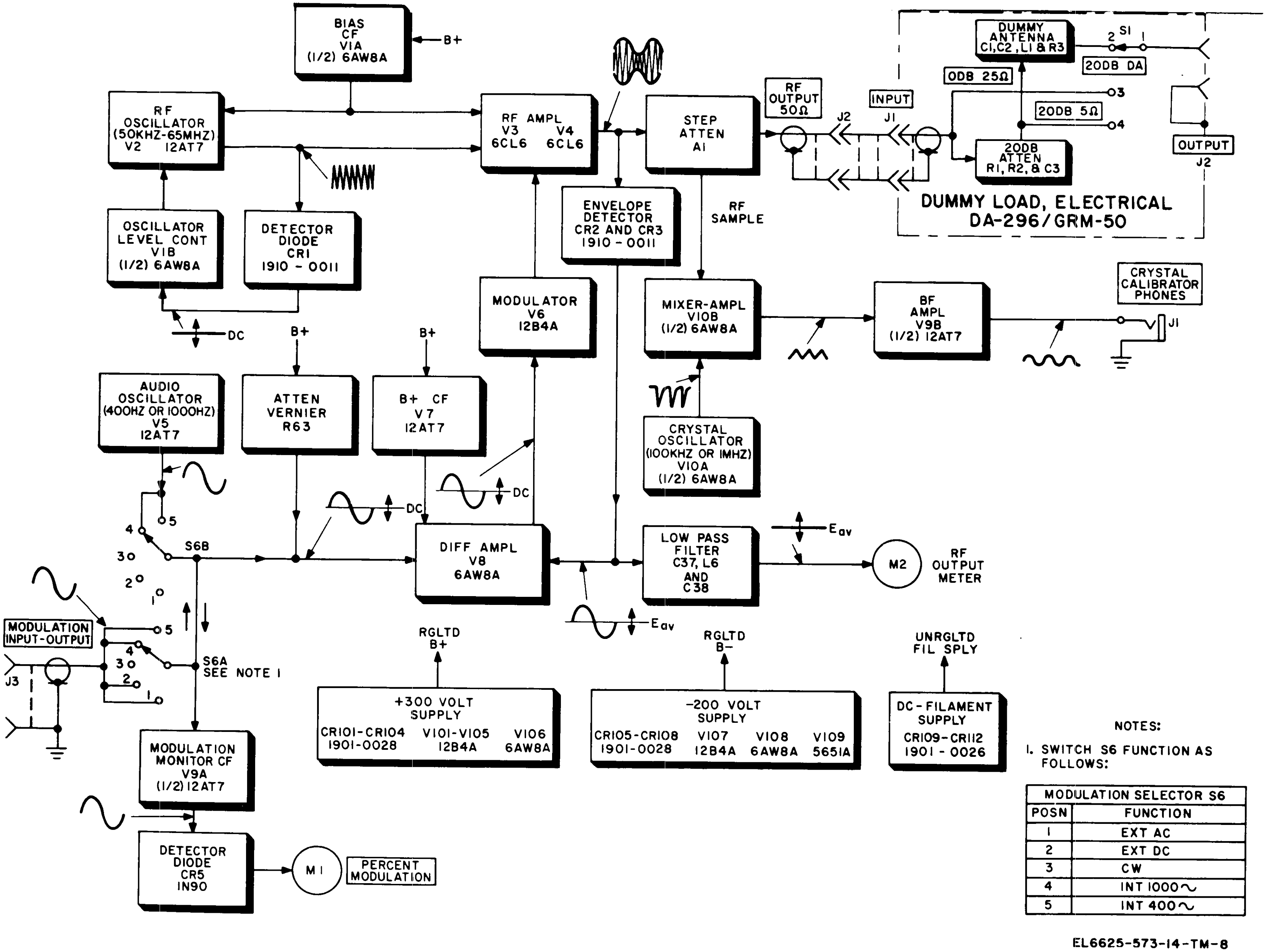
h. Modulation and Carrier Level Control. Amplitude modulation and carrier level control is accomplished by controlling the gain of rf power amplifier V3-V4 with modulator V6 driven by differential amplifier V8. Rf carrier level is set by the dc voltage from VERNIER ATTENUATOR control R63 and amplitude modulation is determined by the waveform selected by MODULATION SELECTOR switch S6, When S6 is set to either position four or five, the sinusoidal modulating signal is supplied by audio oscillator V5. This signal is superimposed on the dc rf carrier voltage and applied to one input of differential amplifier V8. In addition the output of V5 is applied to MODULATION INPUT-

OUTPUT connector J3 for external synchronization use. When S6 is set to positions one and two, the external modulating signal at connector J3 is applied to V8. When S6 is set to position three, all modulating signals are removed and only the rf carrier level control voltage is applied to V8. As previously described in e above the output of differential amplifier V8 drives modulator V6 to control the gain of rf power amplifier V3-V4.

i. Crystal Calibrator. The crystal calibrator is used to set the signal generator output frequency to some harmonic of the calibrator in order to obtain increased accuracy. The calibrator is comprised of crystal oscillator V10A, mixer-amplifier V10B, and beat frequency output amplifier V9B. Crystal oscillator V10A generates either a 100 kHz or 1 MHz semi-square wave containing a great number of fundamental frequency harmonics. This signal is mixed with an rf sample and the difference or beat frequency is amplified by V9B and applied to CRYSTAL CALIBRATOR PHONES connector J1. With a high-impedance headset connected to J1, the rf is adjusted until a zero beat is heard.

j. Power Supplies. The +300 volt B + power supply consists of rectifiers CR101 through CR104 and regulator tubes V101 through V106. The – 200 volt power supply is comprised of rectifiers CR105 through CR108 and regulator tubes V107, V108, and V109. An unregulated +27 volt filament supply is comprised of rectifiers CR109 through CR112.

k. Dummy Load, Electrical DA-296/GRM-60. The dummy load provides a constant 50-ohm load for the signal generator output to retain rf output meter calibration. When S1 is set to position three, the rf signal passes unattenuated. When S1 is set to position four, the signal is attenuated 20 dB. In position two, the signal is attenuated 20 dB and then applied to output connector J2 through a standard dummy antenna.



NOTES:

1. SWITCH S6 FUNCTION AS FOLLOWS:

MODULATION SELECTOR S6	
POSN	FUNCTION
1	EXT AC
2	EXT DC
3	CW
4	INT 1000~
5	INT 400~

Figure 6-1. Generator, Signal AN/GRM-50 block diagram.

6-3. Stage Analysis

The general functioning and purpose of each stage has been explained in paragraph 6-2. Paragraphs 6-4 through 6-19 present a detailed analysis of each stage. To understand completely the function of all circuits in this equipment, constant reference should be made to the system block diagram (fig. 6-1) and to the complete schematic diagram (fig. FO-3).

6-4. Range-Switching Components (fig. 6-2)

a. Rf range switching for the oscillator and power amplifier is accomplished with the rf range-switching components. The range-switching function is initiated by rotating the RANGE knob. This angular motion is transferred through the turret drive shaft to the turret drive spur gear that drives the detent assembly gear.

b. As the RANGE knob is rotated, the detent lift assembly rotates and opposite flat surfaces lift the detent rollers out of the detents. Simultaneously, the drive roll pin extending through a slot in the detent cam extends the helical spring that is held in place by a roll pin secured to the detent cam. When the drive roll pin contacts the end of the detent cam slot, the detent cam rotates 60 degrees and the detent rollers drop into the next set of detents terminating the switching cycle. As the lower detent spring is forced down by the detent lift assembly, the microswitch roller is contacted and S7 is activated until the switching cycle is completed.

c. The rf oscillator turret shaft is directly driven by the detent assembly and causes the oscillator turret to rotate and change tuned circuits. Since the turrets are in the form of gears, the oscillator turret drives the rf power amplifier turret. Wafer switch S3 is connected to the rf power amplifier turret shaft through a mechanical coupling and rotates one position each time the RANGE switch is operated.

d. Also driven by the rf oscillator turret shaft is the pointer cam. This irregular, six-sided cam positions the pointer that has a constant clockwise torque applied to it by the pointer spring. The pointer rotates about the outer end of the pointer shaft secured to the casting.

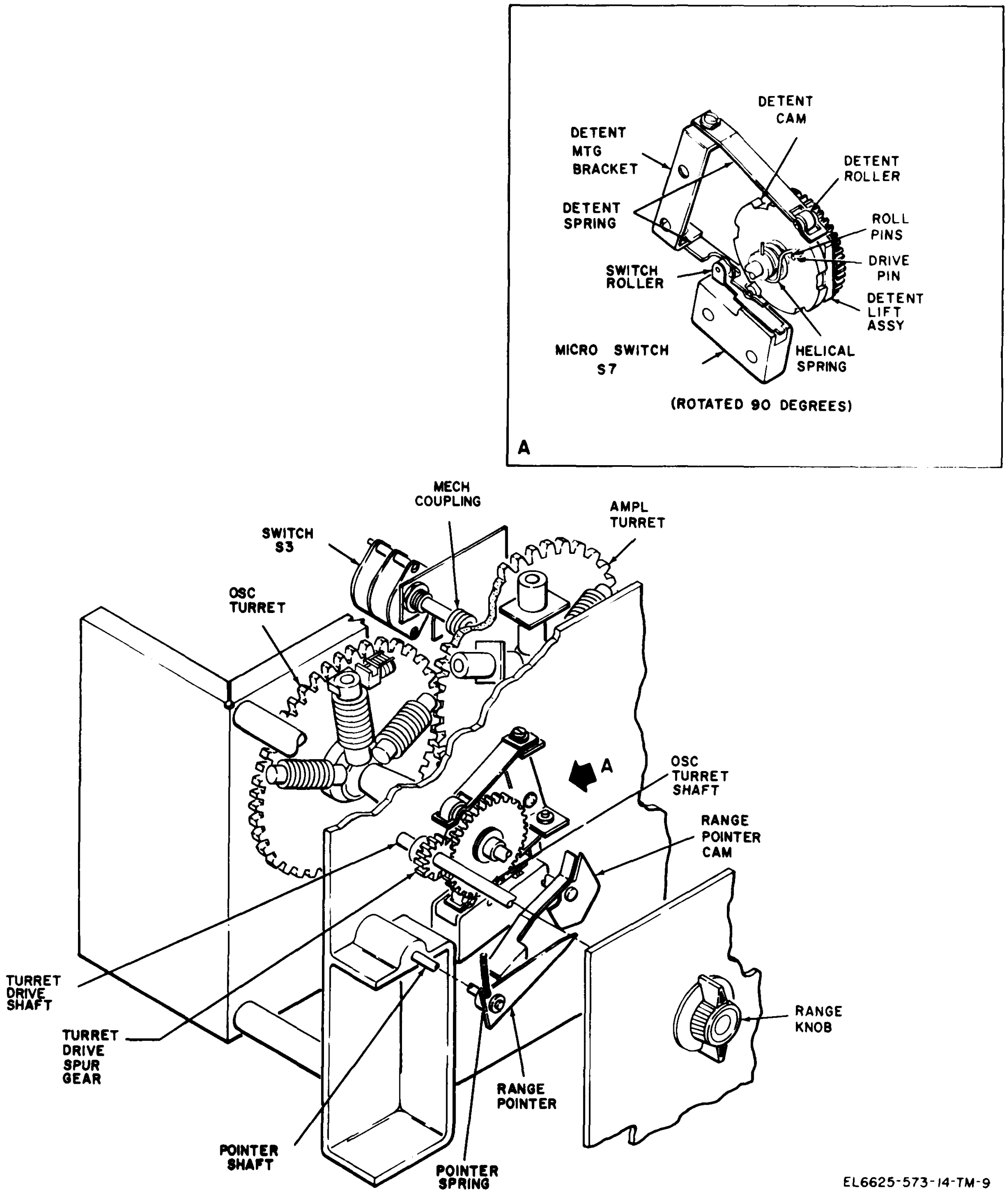


Figure 6-2. Rf range-switching components.

6-5. Rf Variable Frequency Tuning Components (fig. 6-3)

a. Continuous adjustment within a given frequency range is provided by the variable frequency tuning components. Coarse frequency adjustment is obtained by rotating the large main frequency adjustment knob that is connected to the outer dial hub shaft. Sandwiched between the outer dial hub and the dial hub is the calibrated frequency dial that provides a direct reading frequency indication through the dial window.

b. An offset pin inserted in the end of the calibrate knob protrudes through a slot in the dial window that then moves a small distance from side-to-side as the calibrate knob is rotated. This allows the dial window cursor line to be positioned exactly at a calibrated frequency such as that obtained when using the internal crystal calibrator. A frequency vernier knob drives a vernier antibacklash pinion gear to provide a tuning reduction ratio of approximately eighteen-to-one. The split, antibacklash gear is spring loaded to reduce frequency dial resetability error.

c. Connected to the dial hub is the tuner shaft that transmits rotation through the main casting to a cable drive drum attached to the tuner shaft end. One and a half turns of drive cable are placed on the cable drive drum. One free end of the drive cable is wrapped one turn around the cable drum, one and a half turns around the fixed idler collar, and then secured to the fixed idler collar. The other free end is wrapped three times around the floating idler collar and then secured to the floating collar. The drive cable transfers tuning rotation to the rf oscillator and rf power amplifier tuning capacitors through the cable drum and flexible coupling.

d. Attached to the floating idler collar is one end of a torsion spring that is firmly attached at the other end to the spring loading nut. Since this nut is secured to the idler shaft and is prevented from turning, it exerts a constant torque to the floating idler collar which in turn provides a constant tension for the drive cable. Two roll pins, one attached to the dial hub and the other attached to the main casting, prevent 360 degree turner shaft rotation and subsequent complete unwinding of the drive cable from the idler shaft collars.

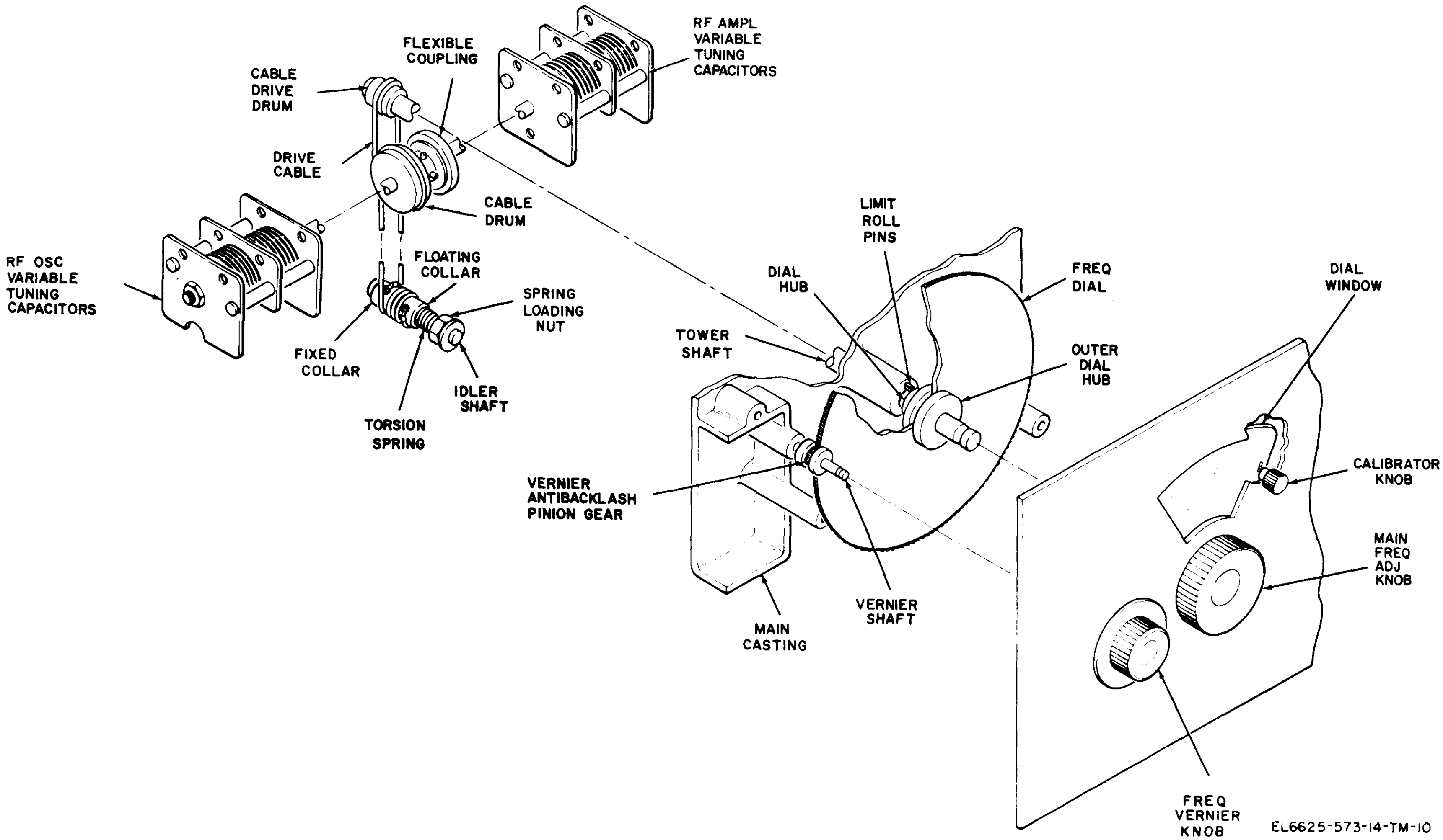


Figure 6-3. Rf variable frequency tuning components.

6-6. Rf Oscillator Level Control Circuits
(fig. 6-4)

a. Rf Oscillator circuits generate the 50 kHz to 65 MHz rf signals and level control circuits maintain a constant rf level at the oscillator output regardless of frequency. Oscillator output signals are applied to the rf power amplifier.

b. The rf oscillator is a tuned-plate, push-pull circuit consisting of vacuum tube V2 and tuned plate circuits on oscillator turret subassembly A2. Typical plate tuned circuits shown are for the 50 kHz to 170kHz frequency range. Transformer T201 primary inductance and the parallel combination of capacitors C201, C9, and variable tuning capacitors C4-C5 determine the oscillator frequency.

c. Trimmer capacitor C201 is used to calibrate the high-frequency end of the range and transformer T201 is adjusted to calibrate the low-frequency end. Dual, ganged tuning capacitors C4 and C5 vary the frequency continuously within each frequency range. Capacitor C9 provides a minimum capacitance that allows trimmer C201 to operate in the approximate center of its range.

d. Positive feedback necessary to sustain oscillations is applied to the control grids of V2A and V2B through the secondary of T201. resistors R7 and R8 prevent parasitic oscillations. Fixed bias for V2 is furnished by cathode follower V1A and applied to the grids through the secondary of T201. This potential of +100 volts is determined by voltage divider resistors R1, R2, and R3. Capacitor C1 provides noise filtering in the grid circuit of V1A.

e. Frames and rotors of C4 and C5 are connected to +295 volts through resistor R72 and feedthrough capacitor C34. This places the frames and rotors at the same potential as the stators that are connected to +295 volts through the primary of T201. In this manner, arcing between any of the tuning capacitor elements is prevented. By applying the +295 volts through 10 megohm resistor R72, virtually all shock hazard is eliminated in the event maintenance personnel come in touch with these elements. This resistor limits current that can be drawn from accidental contact with the rotors and frames to approximately 300 microampere.

f. Stators of the tuning capacitors are relatively inaccessible and, therefore, are maintained at chassis potential. Plate voltage for the two halves of V2 is applied through current limiting resistor R9 and the primary windings of T201. The rf signal across the secondary of T201 is applied in push-pull form to the rf power amplifier stages.

g. Oscillator level control is accomplished by varying the amount of cathode degeneration in the oscillator circuit. Level control tube V1B is made to appear as a variable, unbypassed resistance by varying the dc bias on the control grid in accordance with unwanted variations in the oscillator rf output level. Out of phase oscillator samples are applied through networks R7-C6 and R8-C3 across detector diode CR1.

h. When the polarity of the rf signal at the top of R7 is positive, the top of R8 is negative and capacitors C6 and C7 charge to the peak rf voltage through diode CR1. When the polarity reverses, CR1 is reverse biased and the rf source and capacitors C6 and C3 discharge through R6 in a direction that places the junction of R5 and R6 negative with respect to ground. This voltage is filtered by network R5-C2. A positive reference voltage is set by OSC LEVEL potentiometer R2 and applied to the amplitude, the negative bias voltage applied to the grid of V1B becomes more negative. This results in less current through V1B that then appears as an increased, unbypassed cathode resistor for V2. Increasing the resistance increases rf signal degeneration and reduces the rf output level until the former level is reached. In a similar manner, decreased rf output level reduces negative bias on VIB, reduces degeneration, and increases the rf output level.

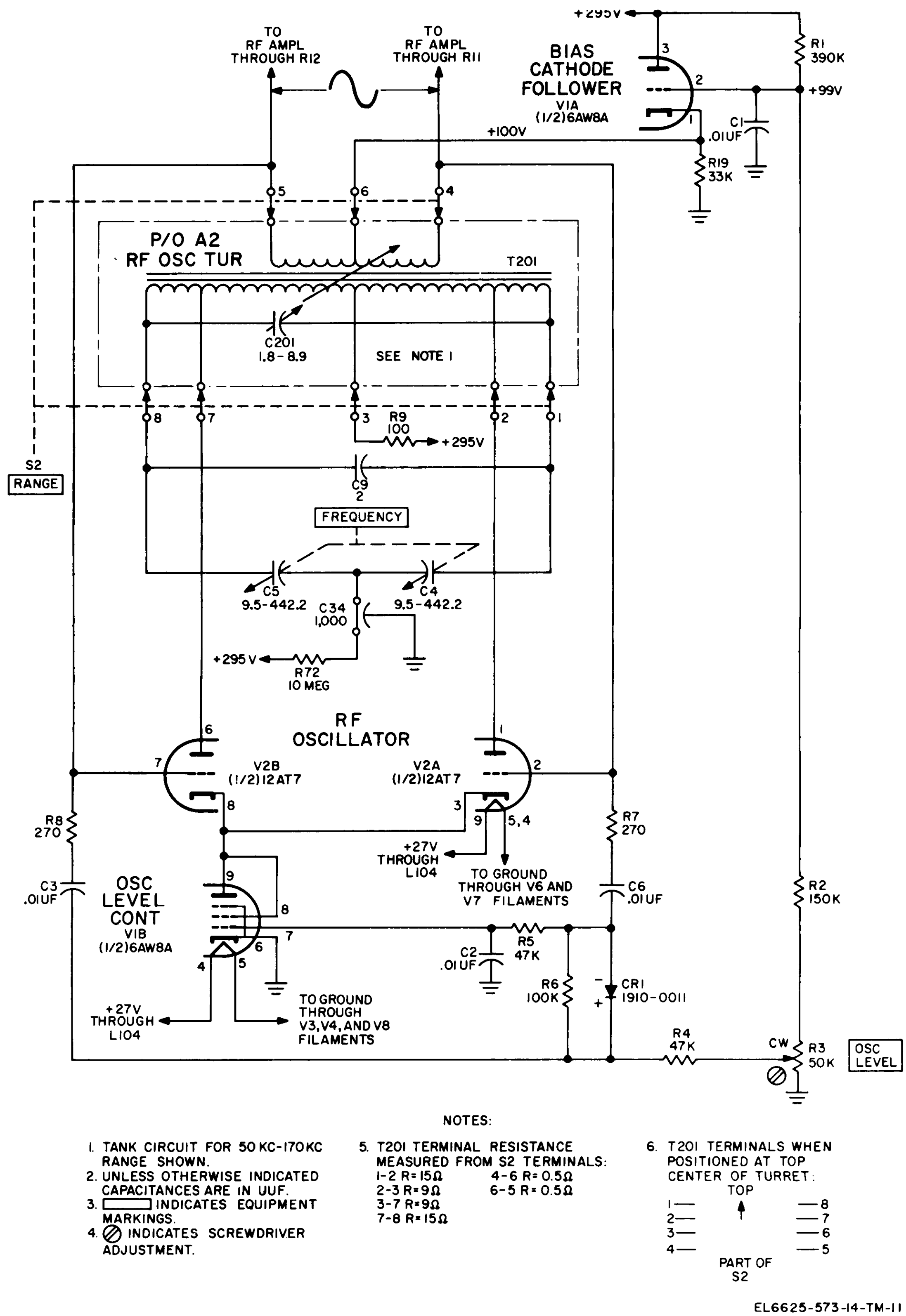


Figure 6-4. Rf oscillator and oscillator level control circuits. schematic diagram.

6-7. Rf Power Amplifier and Modulator Circuits (fig. 6-5)

a. Rf power amplifier stages V3 and V4 raise the low-level of oscillator output to a level suitable for application to the output step attenuator. Modulator V6 controls the carrier level and modulates the carrier in accordance with input voltages supplied by the differential amplifier.

b. The rf power amplifier is a push-pull circuit operating into a tuned plate load. Fixed bias is applied to V3 and V4 control grids through secondary windings of the preceding oscillator stage. Resistors R11 and R12 in the control grid circuits of V3 and V4 prevent parasitic oscillations. Positive 295 volts is connected directly to the screen grids for power operation and through dropping resistors R10 and R38 to the suppressor grids.

c. Plate voltage is applied through current limiting resistor R15 and the primaries of T207. Filterrng for this voltage is supplied by capacitors C10A, C10B, and rf chock L1. In addition, this network prevents rf energy in the primary of T207 from getting into the B+ supply. Push-pull inputs from the secondaries of oscillator transformer T201 are applied to the control grids.

d. Resistors R13 and R14 in the cathode circuits of V3 and V4 help equalize current through the two tubes by swamping variations in cathode source resistance. The high-level output is developed across the secondary of T207. Resistor R203 is selected to obtain a flat frequency response across the entire frequency range. The full secondary output is applied to the envelope detector while a tap on the secondary provides a reduced output level for application to the output step attenuator. Resistor R18 sets the output impedance at 50 ohms and capacitor C17 improves the output VSWR over the entire frequency range of 50 kHz to 65 MHz. Rotors and frames of tuning capacitors C14 and C15 are connected to +295 volts through R73 and C35 and serve the same functions described in paragraph 6-6.

e. Rf carrier modulation is accomplished by controlling the rf power amplifier gain through the use of variable cathode degeneration similar to that used to control the rf oscillator output level discussed in paragraph 6-6. The control input at the junction of resistor R29 and capacitor C19 has both dc and ac components.

f. The dc component is proportional to the rf carrier level and the ac component is proportional to the amplitude modulation level. In the absence of any modulation only the dc component is present. Resistors R29 and R30 form a voltage divider between the control input and the – 200 volt bias supply. Capacitor C 19 and the stray capacitance plus the grid-to-cathode capacitance of modulator V6 form an ac voltage divider that has the same division ratio to ac signals that resistors R29 and R30 have to dc signals. This frequency compensates the voltage divider so that modulation levels do not fall off when high-frequency modulating signals such as square waves are used.

g. When the control input becomes more positive, the negative bias on modulator V6 is reduced, the tube conducts more to decrease the equivalent cathode resistance of V3-V4, degeneration is decreased, and the rf power amplifier output increases. In a similar manner, the rf power amplifier output decreases when the modulator control input becomes more negative.

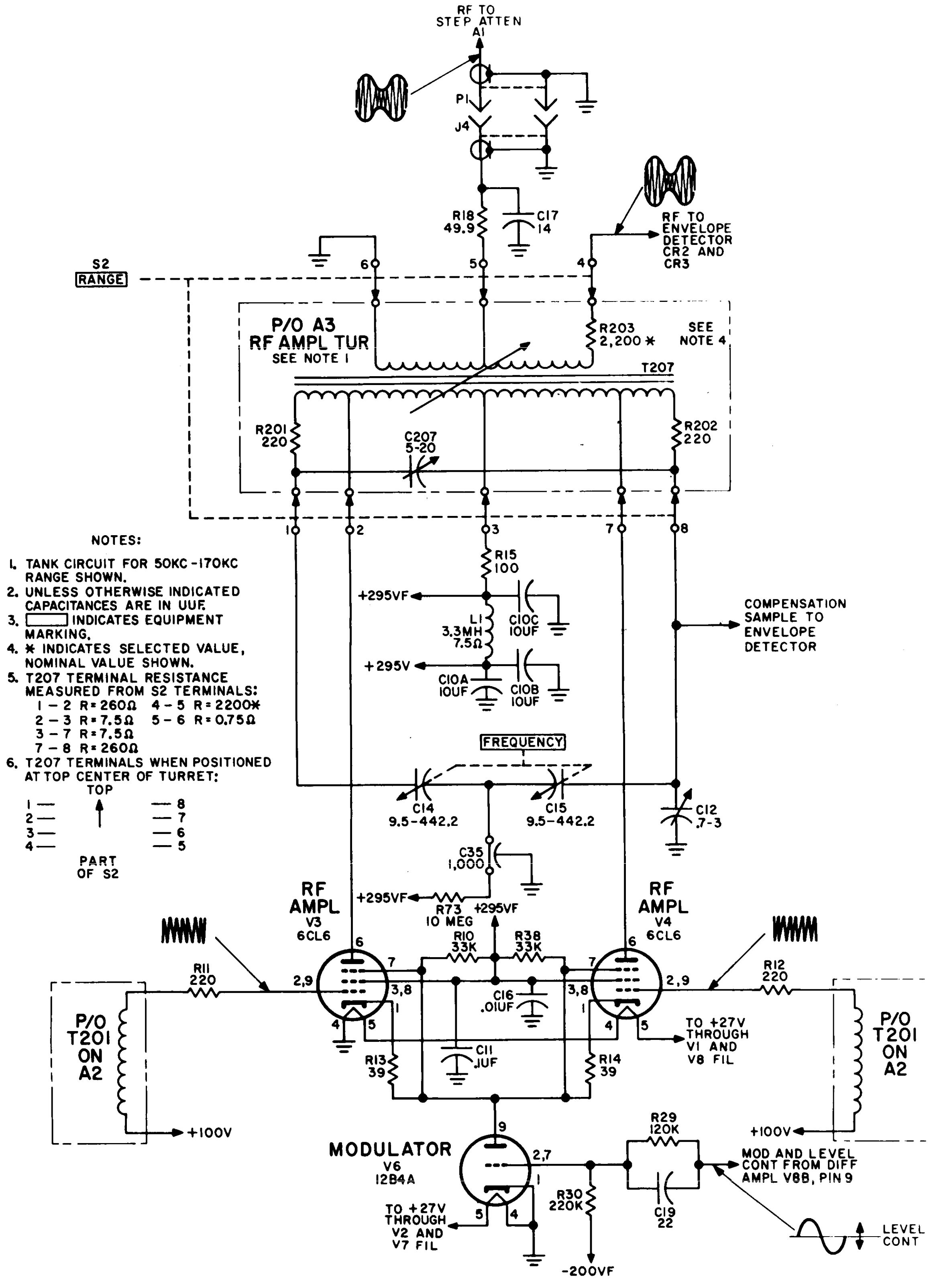


Figure 6-6. Rf power amplifier and modulator circuits.

6-8. Envelope Detector and Rf Output Meter Circuits
(fig. 6-6)

a. The envelope detector circuit is supplied with a sample of the rf power amplifier out, demodulates this sample, and applies the dc and ac component as negative feedback to the differential amplifier. The rf output meter circuit provides a direct rf carrier level meter indication.

b. When S3B and S5 are in the positions shown, the positive half cycles of the rf sample, forward biases detector diodes CR2, CR3 and charge capacitors C24 and C25 to a voltage nearly equal to the peak of the applied rf sample. Amplitude modulation detectors such as the one being described here produce both dc and ac output components that are proportional to the rf carrier level and modulation signal respectively.

c. For any given rf and modulation levels, ac and dc component magnitudes are determined by the respective ac and dc loads presented to the detector. As shown, the dc load consists of R24 in parallel with the series combination of R25, R36, and the dc resistance of the rf output meter circuits. Since the rf output meter circuit resistance is small compared to R36, resistors R25 and R36 form a voltage divider that attenuates the dc component before it is applied to the differential amplifier. For a given rf carrier level, the dc component E_{av} is independent of the modulation level as long as the modulating waveform is symmetrical such as a sinusoid or a square wave. For complex modulating waveforms, the dc component will shift as the wave shape is changed.

d. The ac load is comprised of R24 in parallel with the series combination of R25, R36, and the reactance of the pi filter at the modulating frequency. Due to the reactive component of the ac load, the load on the detector varies with modulating frequency. Because the dc and ac loads' presented to the detector are not equal for all modulating frequencies, a type of distortion known as diagonal clipping causes the negative excursion of the detected modulating signal to flatten out for high modulation levels. To compensate for this distortion, a sample is taken from the rf power amplifier output transformer primary winding and applied to the cathode of diode CR3. This low-level, out-of-phase signal supplies a small amount of forward bias for the detector diodes and reduces the distortion. The compensation is required on the two lowest frequency ranges only.

e. The charging capacitor for the detector output is C25 in parallel with C24 on the 50 kHz to 170 kHz range and C25 in parallel with C23 plus C24 on the 165 kHz to 560 kHz range. On all higher ranges, C25 is the charging capacitor. Assuming that the time constant of the charging capacitors and the resistors that follow is constant, an increase in carrier frequency causes the demodulated signal amplitude to increase. Thus capacitors C23 and C24 are proportioned so that the dc component of the demodulated signal is equal at the high end of the two lowest frequency ranges. On the 530 kHz to 1800 kHz range and all other higher ranges, the demodulator time constant is sufficiently long compared to the period of one carrier frequency cycle so that the change in demodulated signal is insignificant over the range of 530 kHz to 65 MHz.

f. When ATTENUATOR switch S5 is in the +20 DBM position, relay K1 is energized. This removes R24 as part of the detector load and inserts R26 in its place. Resistors R25 and R26 form a voltage divider that increases the feedback level to the differential amplifier and causes the rf carrier output level to increase by 10 dB.

g. Resistors R27, R28, and R46 in conjunction with capacitors C26 and C27 form a low pass filter that keeps rf energy out of the +300 volt distribution system. In addition, R28 and C27 are enclosed in a shield to reduce rf leakage.

h. The demodulated signal is also appled to low pass filter R36, C37, L6, and C38 to remove the ac component of the signal and leave E_{av} that is proportional to the rf carrier level. This voltage is applied across rf output meter M2 and output calibrate potentiometer R37. Inductor L6 and capacitor C38 are enclosed in a shield to reduce rf leakage.

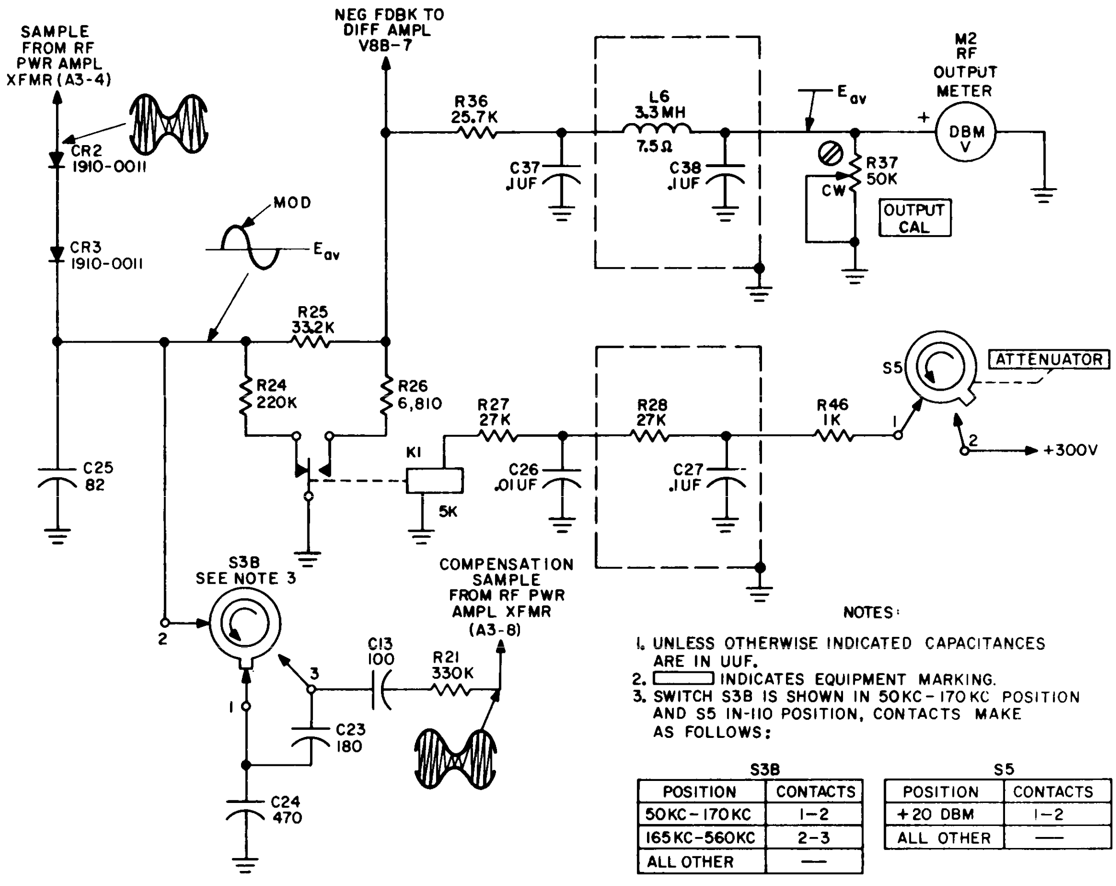


Figure 6-6. Envelope detector and rf output meter circuits.

6-9. Differential Amplifier Circuit
(fig. 6-7)

a. The differential amplifier circuit compares the ac and dc control signals used to set rf carrier and modulation levels to the ac and dc feedback components supplied by the envelope detector. Any change between the two sets on inputs is amplified and applied to the modulator stage.

b. The modulation waveform is applied across MODULATION AMPLITUDE control R54 and then is either ac or dc coupled through S6. Dc coupling is used in all position of S6 except EXT AC that uses coupling capacitor C52 to block any dc voltage supplied by the external modulation source. The modulation signal is applied through R57 and added to the dc rf carrier control voltage supplied by voltage divider resistors R60 through R63.

c. The dc control voltage is adjusted by MAX CARRIER SET potentiometer R60 to obtain full scale rf output when VERNIER ATTENUATOR control R63 is set fully clockwise. Capacitor C54 provides rf decoupling. Each time the RANGE switch position is changed, a cam on the switch shaft opens S7 to remove the +300 volt source and reduce the rf output level to zero. This prevents the rf power amplifier tubes from drawing excessive grid current when the rf amplifier turret assembly is momentarily disconnected from the amplifiers each time the switch position is changed.

d. Resistor R64 provides a load for the +300 volt supply to maintain regulation. MOD ZERO SET potentiometer R69 is used to set rf carrier modulation to zero when no modulation signal is present. Both rf carrier and modulation control voltages are attenuated equally by VERNIER ATTENUATOR control R63 and thus the percent modulation remains unchanged as the rf carrier level is varied. The combined ac and dc control voltages are applied to V8A control grid. Resistor R31 prevents parasitic oscillations in V8A and low pass filter R65 and C55 prevents any rf energy in the grid circuit of V8A from reaching modulation monitor stage V9A and producing an erroneous percent modulation indication.

e. During normal operation, both dc and ac components at V8A and V8B control grids are very nearly equal and are maintained at a small fixed difference. However, when either input at the control grid of V8A is varied or if either feedback component at the control grid of V8B attempts to change, the fixed difference changes. This change is amplified by V8A and V8B and applied to modulator stage V6 to change the rf output level in a manner that restores the fixed difference at the differential amplifier control grids.

f. The dc plate load for V8B is fried and consists of resistors R20, R22, and R23. The ac load for this stage, however, vanes as the rear section of wafer switch S3A is changed. This is accomplished by changing the capacitive load on the stage and causes the high-frequency gain of the entire feedback control loop to roll off at a rate that reduces loop gain to less than unity when the feedback becomes regenerative. In this manner, unwanted high-frequency oscillations cannot occur.

g. Diode CR6 clamps the common cathode junction of V8A and V8B at ground if V8B tries to draw grid current during frequency range switching. A low pass filter consisting of capacitors C30 and C31 and rf choke L3 decouples from the —200 volt supply. In addition, inductor L3 and capacitor C31 are enclosed in a shield to reduce rf leakage.

h. Cathode followers V7A and V7B supply plate and screen grid voltage to V8A and V8B respectively. This voltage is set at approximately +150 volts by voltage divider R33, R34, and R35. CARRIER ZERO SET adjustment R35 is set so that V8B screen current is zero when both V8A and V8B grid inputs are at ground potential. Capacitors C28 and C29 provide low pass noise filtering for the grid circuits of V7A and V7B.

NOTES:

1. UNLESS OTHERWISE INDICATED CAPACITANCES ARE IN UUF.
2. ▭ INDICATES EQUIPMENT MARKING.
3. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
4. S3A REAR SHOWN IN [50KC-170KC] POSITION AND S6 REAR SEG X SHOWN IN [INT 1000~] POSITION. SWITCH CONTACTS MAKE AS FOLLOWS:

S3A POSITION	CONTACTS
50 KC - 170KC	1-2
165KC - 560KC	1-2
530KC - 1800KC	1-6
1.76MC - 6.0MC	4-5
5.8MC - 19.2MC	3-4
19.0MC - 65MC	3-4

S6 POSITION	CONTACTS
EXT AC	—
ALL OTHER	1-2

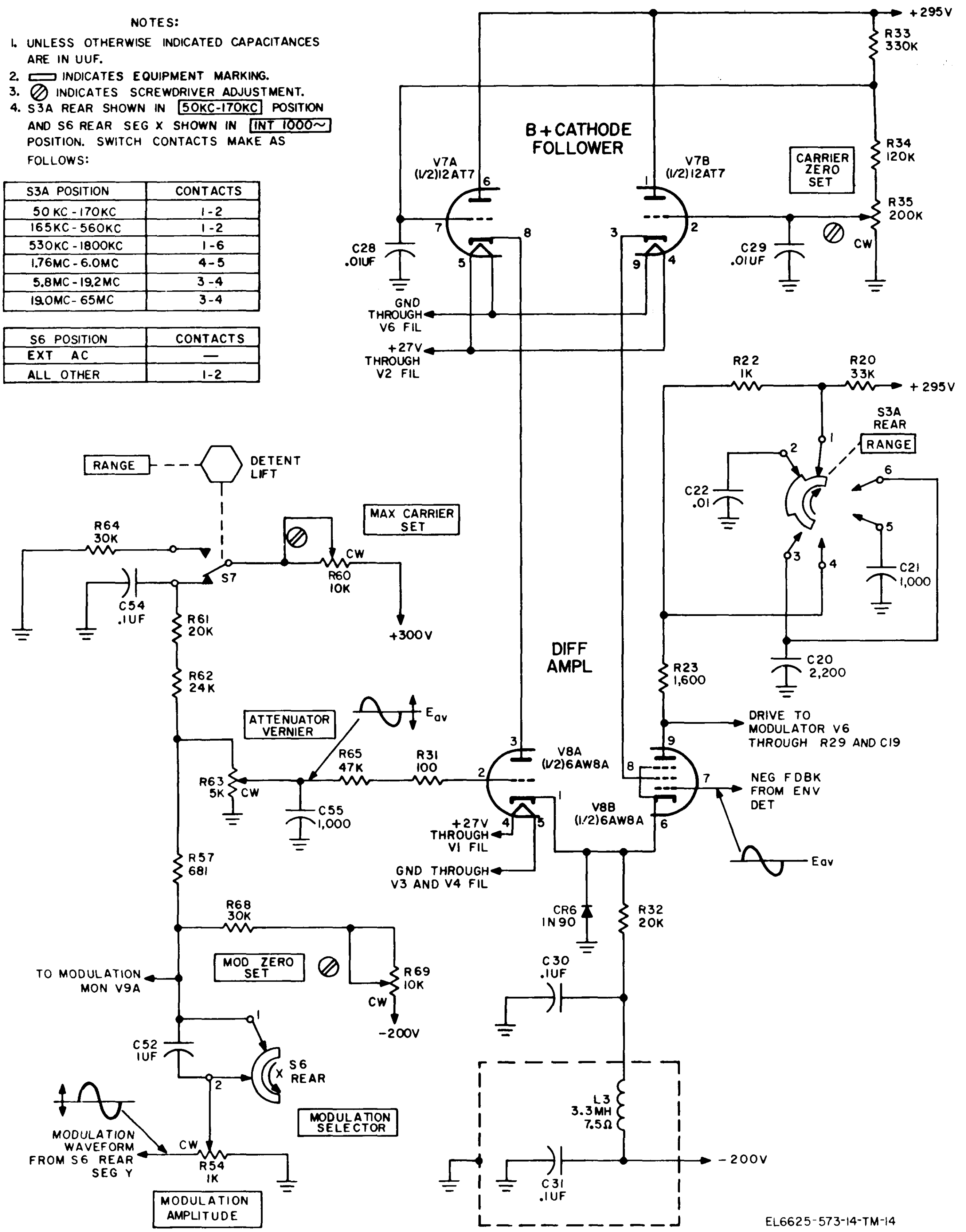


Figure 6-7. Differential amplifier circuit.

6-10. Audio Oscillator Circuit
(fig. 6-8)

a. Audio oscillator stage V5 provides either a 400 Hz or 1000 Hz, low distortion sine wave for use during internal modulation. This signal is applied to differential amplifier stage V8 and modulation monitor stage V9A. In addition, it is supplied as an output for external synchronization use.

b. The oscillator circuit is a modified Wien bridge followed by a two-stage, RC coupled amplifier. Both positive and negative feedback are applied around the amplifier to produce oscillations and stabilize amplitude and waveform purity respectively. With MODULATION SELECTOR switch S6 in the INT 100~ position as shown, resistor R59 is in series with capacitor C51 and resistor R56 in parallel with capacitor C50. Since V5A and V5B provide a combined phase shift of 360 degrees, the two reactive arms of the Wien bridge must provide zero phase shift in order to make the signal at the grid of V5A regenerative and cause oscillation.

c. At the oscillating frequency, R56 and C50 provide a phase lag that is exactly offset by an equal lead provided by C51 and R59. At this frequency only, the signal at the control grid of V5A is in phase with the signal at the plate of V5B and oscillations occur, If the frequency tries to drift, the phase shift balance required for oscillation is upset, and no output is present. For this reason, a Wien bridge oscillator frequency is very stable. The frequency is changed to 400 Hz by switching resistors R55 and R58 into the bridge.

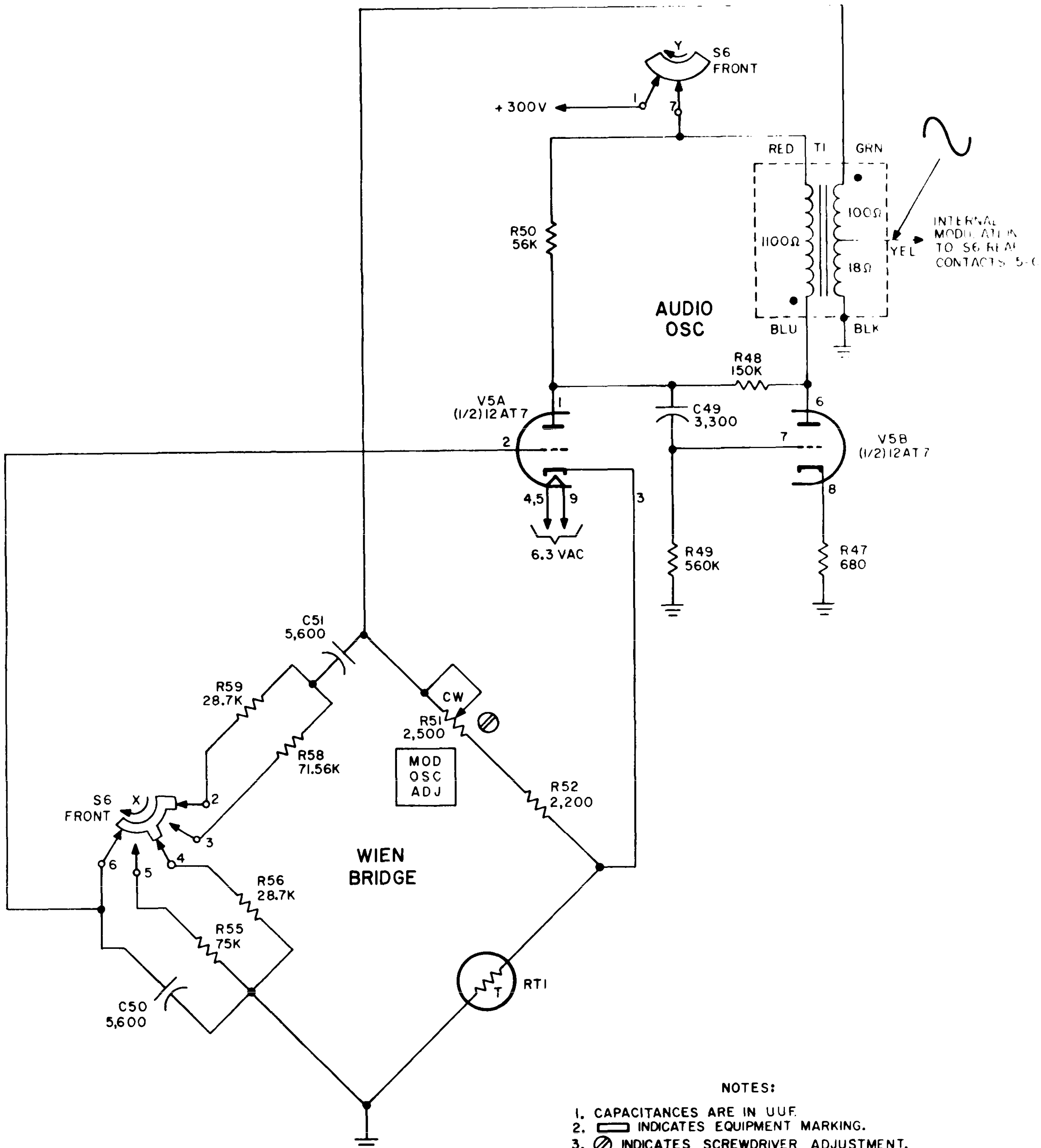
d. Resistive components R51, R52, and RT1 of the bridge provide negative feedback to stabilize output waveform amplitude and reduce distortion. These components provide no phase shift so the signal at the cathode of V5A is in phase with the signal at the plate of V5B.

e. Negative feedback control is improved by using temperature sensitive resistor RT1 in the cathode circuit of V5A. If the oscillator output amplitude tries to increase, *for example, in*creased current through RT1 causes its resistance to increase. The increased cathode degeneration reduces amplifier output to the original level.

f. Thermistor RT1 is a tungsten-filament lamp operated at a current level below incandescence. This places the lamp operating point in a very nonlinear region to improve amplitude control loop sensitivity. MOD OSC ADJ potentiometer R51 varies amplifier negative feedback and is used to set oscillator output amplitude.

g. The amplifier is comprised of RC-coupled stages V5A and V5B using transformer output coupling and additional internal negative feedback to further improve signal distortion. The signal at the plate of V5A is developed across grid return resistor R49 and capacitively coupled to the control grid of V5B. Output transformer T1 is the plate load for V5B. Negative feedback is applied to the grid of V5B through R48. Additional negative feedback is furnished by unbypassed cathode resistor R47. The Y-segment of the front section of S6 applies +300 volts to the two sections of V5 in the INT 1000~ and INT 400~positions of the SELECTOR switch.

h. A T1 secondary tap supplies the oscillator output waveform that is applied to contacts 5 and 6 of the rear section of S6. The signal is then distributed to differential amplifier stage V8, modulation monitor stage V9A, and to the front panel MODULATION INPUT-OUTPUT connector.



NOTES:

1. CAPACITANCES ARE IN UUF.
2. ▭ INDICATES EQUIPMENT MARKING.
3. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
4. WAFER SWITCH S6 SHOWN IN [INT 1000~] POSITION. S6 CONTACTS MAKE AS FOLLOWS:

POSITION	FRONT SECTION
[EXT AC]	5-6
[EXT DC]	-
[CW]	-
[INT 1000~]	1-7,2-4-6
[INT 400~]	1-7,3-5-6

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Figure 6-8. Audio oscillator circuit.

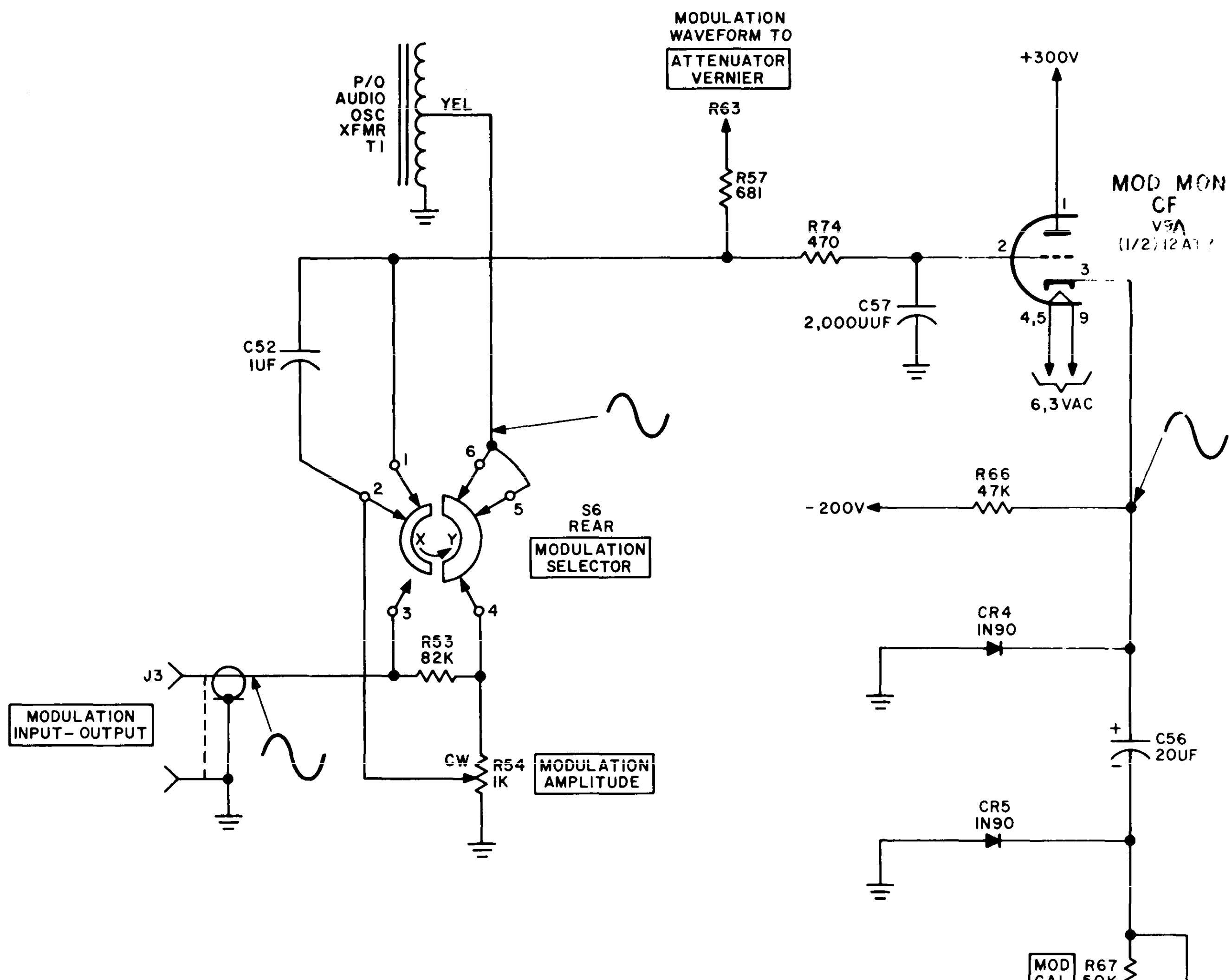
6-11. Modulation Monitor Circuit
(fig. 6-9)

a. Modulation monitor stage V9A monitors internal and external modulation waveforms and provides a percent modulation meter indication calibrated for sinusoidal modulation.

b. With MODULATION SELECTOR switch S6 set to INT 1000~ as shown, internal modulation waveforms from audio output transformer T1 are applied across MODULATION AMPLITUDE control R54. This signal is direct coupled through switch contacts 1 and 2 and applied to VERNIER ATTENUATOR control R63 and to modulation monitor cathode follower V9A.

c. Low pass filter R74 and C57 rolls off the gain of V9A to match the gain roll off of differential amplifier V8A caused by low pass filter R63 and C55 shown in figure 6-7. This allows PERCENT MODULATION meter M1 to track the actual modulation level impressed on the rf carrier. Cathode follower V9A provides isolation between the modulation source and meter M1. The waveform at the cathode of V9A is half wave rectified by diode CR5, filtered by capacitor C56, and applied to PERCENT MODULATION meter M1.

d. Diode CR4 clamps the cathode of V9A at ground if this point tries to go negative due to greatly reduced cathode emission or if the tube is removed while power is applied. This prevents reverse voltage polarity on, and subsequent damage to, electrolytic capacitor C56.



NOTES:

1. [ ] INDICATES EQUIPMENT MARKING.
2. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
3. WAFER SWITCH S6 REAR SHOWN IN [INT. 1000~] POSITION. S6 CONTACTS MAKE AS FOLLOWS:

POSITION	CONTACTS
EXT. AC	3-4
EXT. DC	1-2,3-4
CW	1-2,4-5
INT. 1000~	1-2,4-5-6
INT. 400~	1-2,4-5-6

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Figure 6-9. Modulation monitor circuit, schematic diagram.

6-12. Calibrator Crystal Oscillator Circuit

(fig. 6-10)

a. The calibrator crystal oscillator provides either 100 kHz or 1 MHz signals for frequency calibration purposes. This signal is applied to mixer-amplifier V10B.

b. The circuit is a crystal-controlled, *electron*-coupled, Colpitts oscillator. The screen grid of V10A acts as the oscillator plate and is isolated from the output load by the grounded suppressor grid. Coupling from the oscillator to the plate load occurs within the tube electron stream. This provides maximum isolation between the load and oscillator and results in a very stable oscillator frequency that is determined by the equivalent crystal inductance in parallel with split capacitors C40 and C41. Positive feedback to sustain oscillation is coupled from the screen grid through C43 and applied to the control grid through capacitors C40 and C41 that form a capacitive voltage divider.

c. Trimmer capacitor C41 provides a fine frequency adjustment and is set to provide the best compromise of the two oscillator output frequencies. The stage is operated class C to produce a semi square wave output. The rapid decay time is very rich in harmonic content and allows the calibrator output to be used over the entire frequency range of the signal generator.

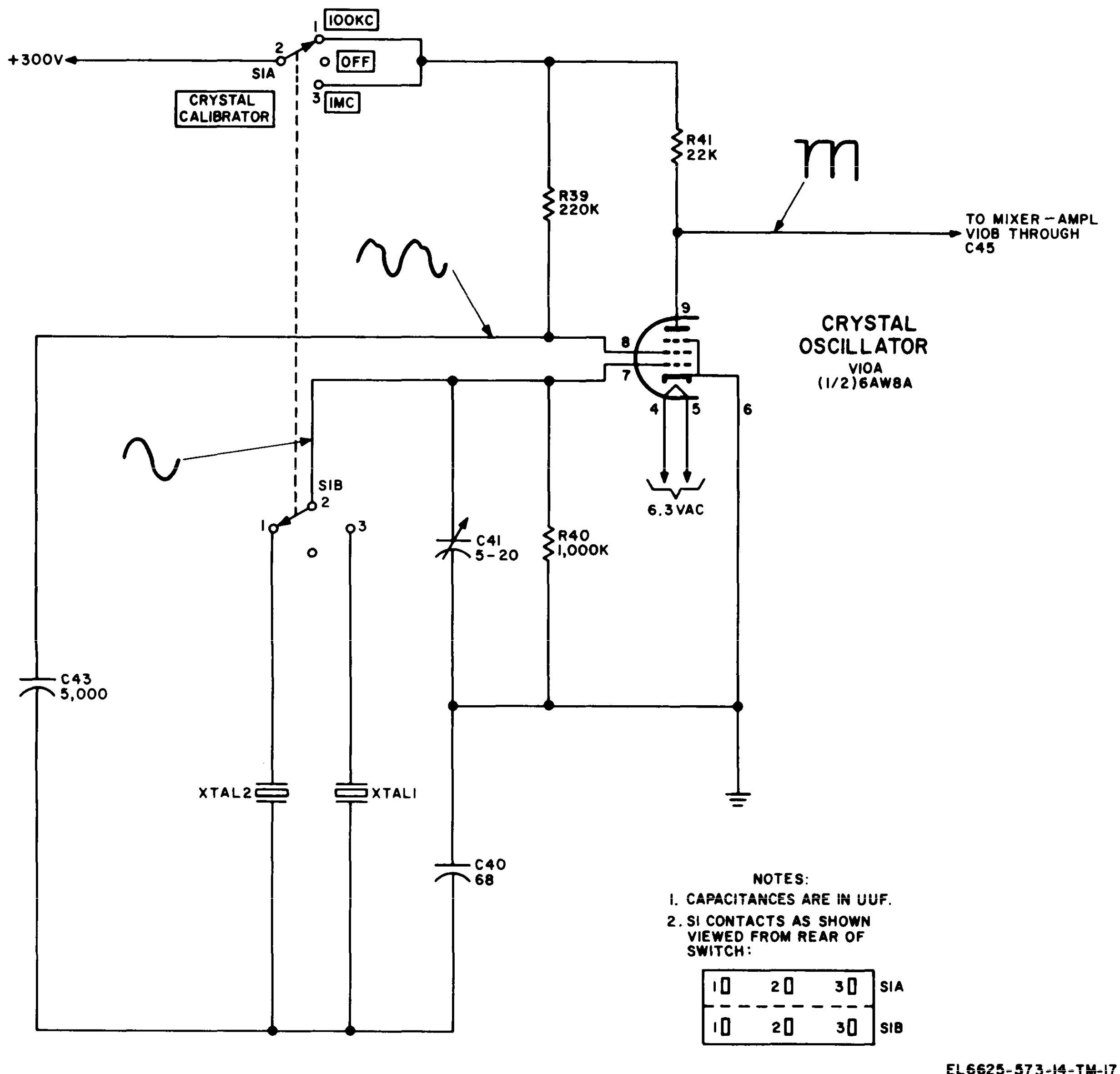


Figure 6-10. Calibration crystal oscillator, schematic diagram.

6-13. Calibrator Mixer-Amplifier Circuit
(fig. 6-11)

a. The calibrator mixer-amplifier combines the crystal oscillator and rf output sample to generate and amplify a beat frequency and applies the result in g waveform to the beat frequency amplifier.

b. When either of the crystal calibrator frequencies is selected, CRYSTAL CALIBRATOR switch S1A applies +300 volts to mixer-amplifier stage V10B. The rf sample is direct coupled to the control grid while the crystal oscillator signal is capacitively coupled by C45. Resistor R43 is the grid return resistor. Mixing occurs in the nonlinear plate circuit of V10B and the frequency products are coupled to output beat frequency amplifier V9B. Plate waveform distortion is caused by the grid current drawn by the stage to develop grid leak bias.

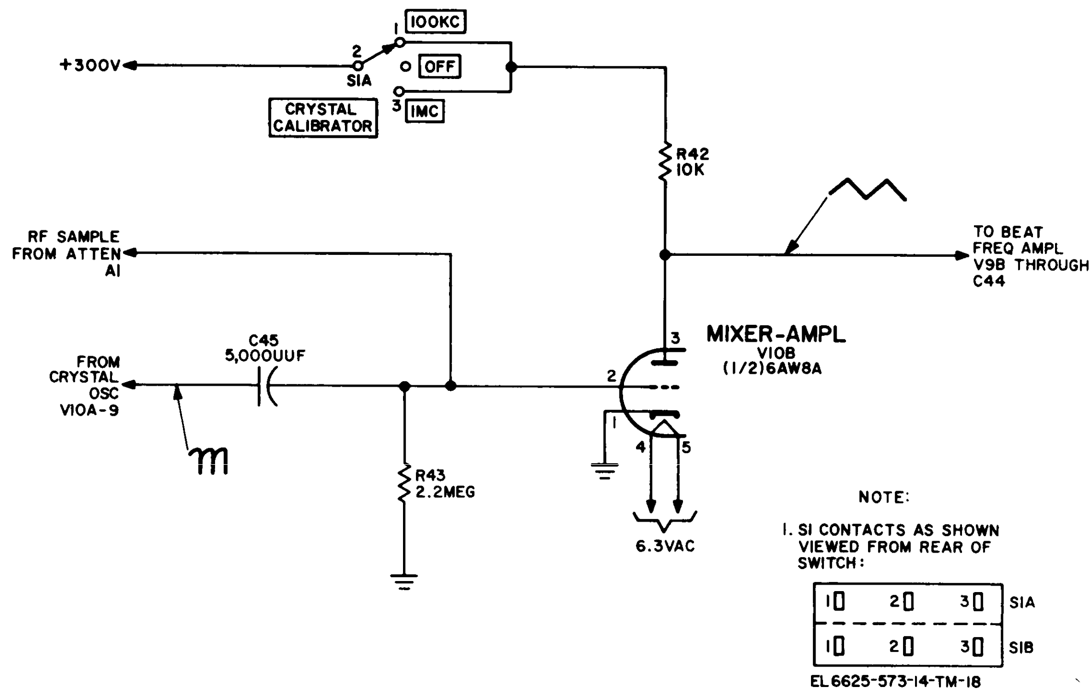


Figure 6-11. Calibrator mixer amplifier, schematic diagram.

6-14. Calibrator Beat Frequency Amplifier Circuit (fig. 6-12)

a. The calibrator beat frequency amplifier amplifies the beat frequency generated in the mixer-amplifier and applies this signal to CRYSTAL CALIBRATOR PHONES connector J1.

b. The beat frequnecy signal is capacitively coupled to V9B control grid through C44 and developed across grid resistor R44. Capacitor C48 filters out some of the higher order mixer products. The plate signal is coupled through C46 and developed across R71. Capacitor C47 provides additional filtering to further decrease the harmonic content of the beat frequency before it is applied to CRYSTAL CALIBRATOR PHONES connector J1.

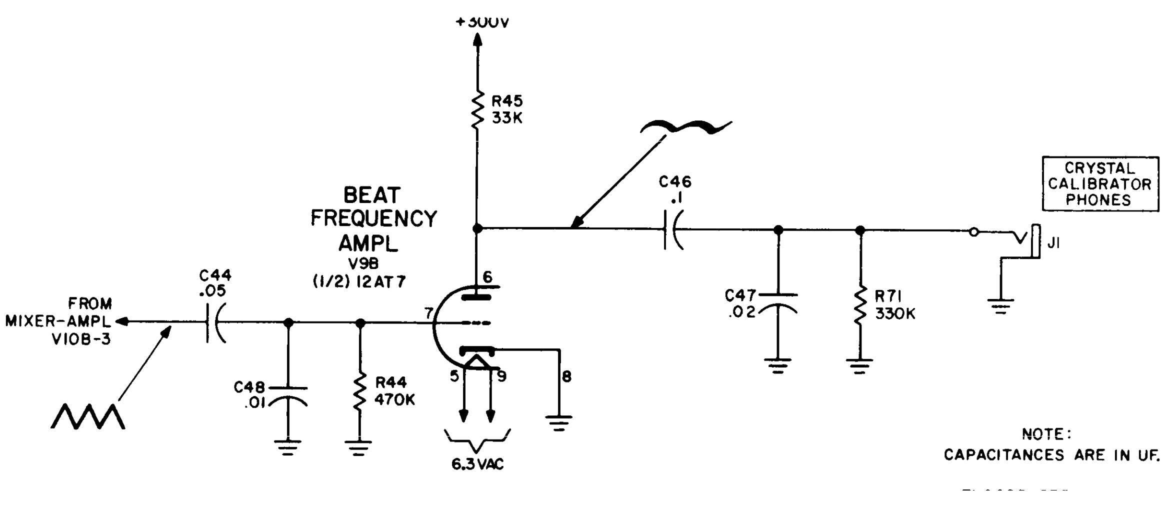


Figure 6-12. Calibrator beat frequency amplifier circuit, schematic diagram.

6-15. Primary Ac Power Input Circuit
(fig. 6-13)

a. Primary ac power input circuits provide rfi filtering, overload protection, and selection of either 115 vac or 230 vac as the primary ac operating voltage.

b. Polarized ac power connector P102 applies the input power to a balanced, low pass rfi filter comprised of capacitors C112 through C115 and rf chokes L102 and L103. In addition, the rf chokes are enclosed in a shield with leads brought in by feed-through capacitors C114 and C115. This reduces rf leakage from the signal generator.

c. Mating polarized connectors J101 and P101 apply the ac power to LINE fuse F101 that must be changed when ac line voltage is changed. When POWER switch S101 is in the ON position, ac power is applied to the primary of power transformer T101 that actually consists of two primary windings. These windings are connected in parallel when S8 is in the 115 V position as shown. When S8 is set to the 230 V position, the windings are connected in series to halve the turns ratio and maintain constant secondary voltages.

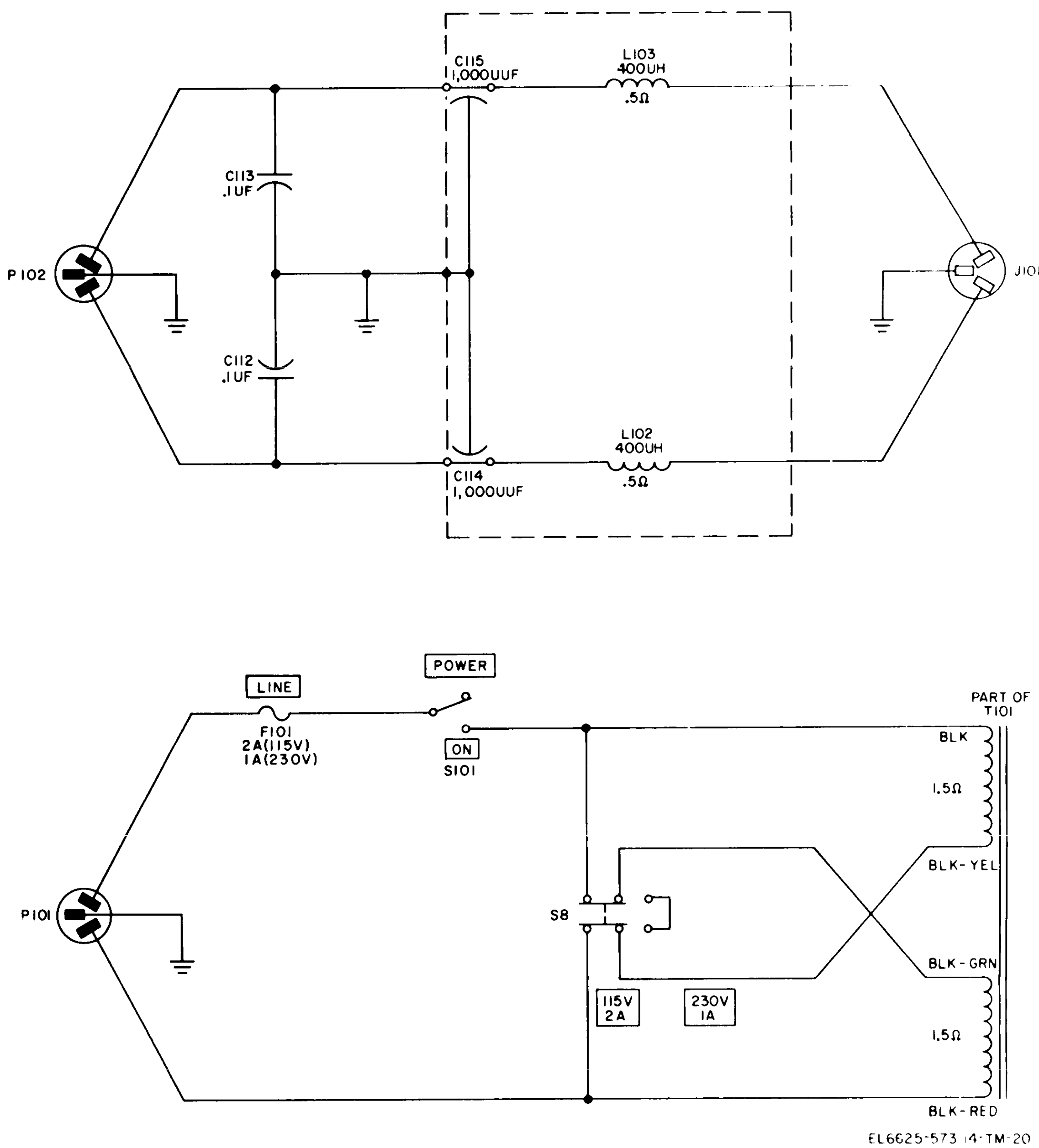


Figure 6-13. Primary ac power input circuit, schematic diagram.

6-16. Filament Supply Circuits
(fig. 6-14)

a. Filament supply circuits furnish heater voltage for all vacuum tubes. One +27 volt and two 6.3 vac supplies are used.

b. Vacuum tubes V1 through V4 and V6 through V8 are all rf stages. For this reason, a well filtered dc filament supply is used to keep power line hum modulation to a minimum. The brown lead secondary provides 24 Vrms that is applied across full wave bridge rectifier CR109 through CR112 to develop approximately +27 volts across filter capacitor C11. A low pass, Pi network filter consisting of capacitors C109 and C110 and rf choke L104 is enclosed in a shield to reduce rf leakage. Rf choke resistance reduces filament voltage to approximately +26 volts.

c. Tubes V1 and V8 filaments have a warmup time of 11 seconds. During this time, filament current for rf power output tubes V3 and V4 is supplied through resistor R132. The yellow lead secondary winding provides 6.3 vac filament voltage for tubes V101 through V105. These filaments are floated on +300 volts to maintain heater-to-cathode voltage within specified limits.

d. The green lead secondary furnishes 6.3 vac filament voltage for tubes V5, V9, V10, and V106 through V108. Resistors R133 and R134 form a voltage divider and supply +35 volts to float the filaments and reduce heater-to-cathode voltage. POWER indicator lamp DS101, connected in series with current limiting resistor R135, is lighted when primary ac power is present.

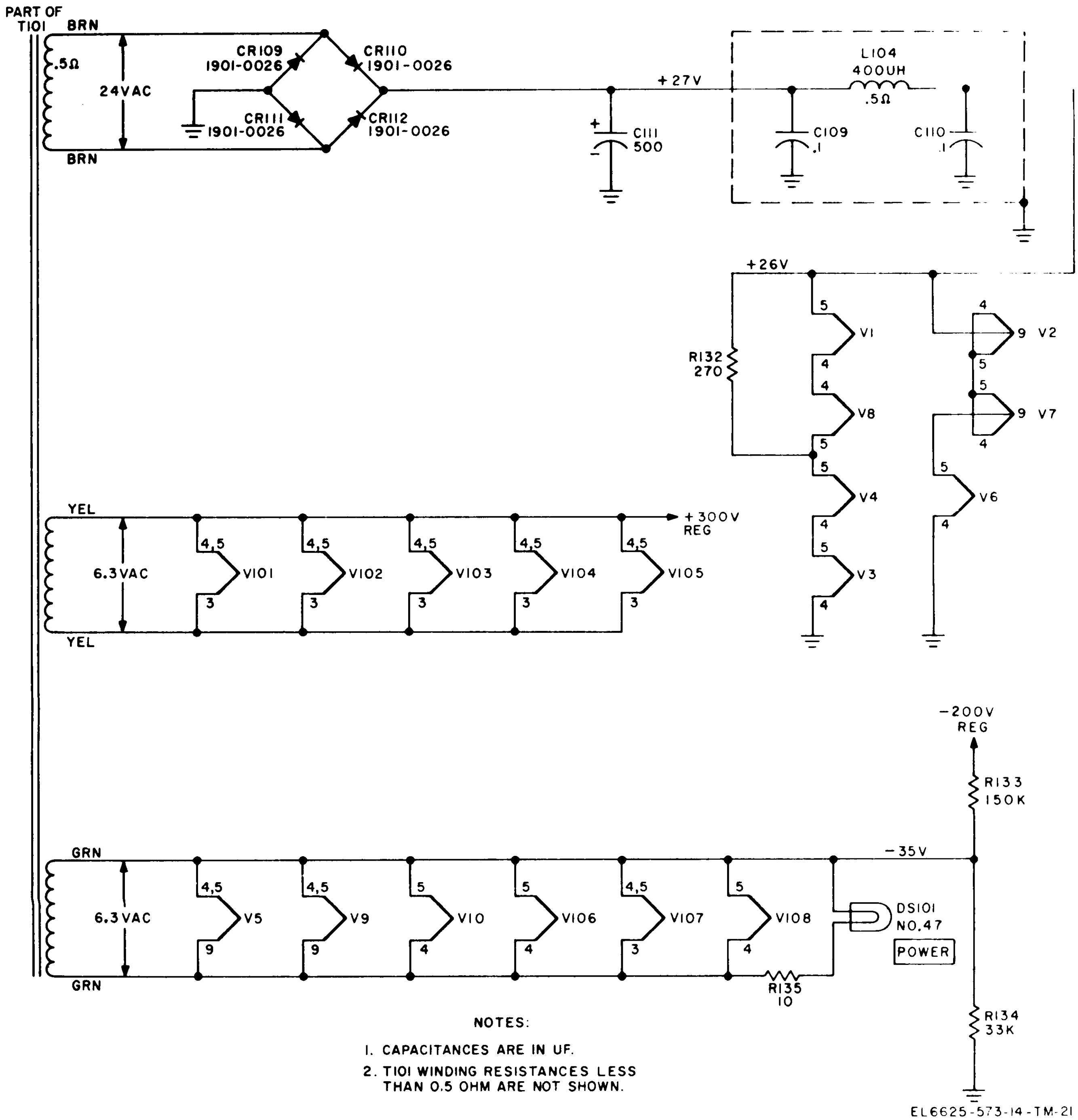


Figure 6-14. Filament supply circuits, schematic diagram.

6-17. —200 Volt Regulated Supply Circuit
(fig. 6-15)

a. The – 200 volt regulated power supply furnishes a regulated output of – 200 volts. The blue lead secondary winding of T101 applies 286 Vrms across full wave bridge rectifier CR105 through CR108 to furnish an unregulated output of approximately 395 volts across filter capacitor C105A. The regulator circuit is a standard type with ground connected to the cathode of series regulator tube V107. Thus the regulated output voltage across capacitor C105B is equal to the unregualted input voltage minus the voltage drop across regulator V107

b. Reference amplifier V108A and V108B is a differential amplifier stage that compares a sample of the regulated output voltage to a reference voltage. Voltage reference tube V109 drops a constant voltage of approximately 80 volts. Resistor R131 drops the excess 120 volts and resistor R130 and capacitor C107 attenuate noise spikes generated by the ionized gas in V109. The –200 volt regulated output is applied across voltage divider R125, R126, and R127 and a sample of approximately — 115 volts is applied to the control grid of V108B. The reference amplifier operates at a fixed difference of approximately 5 volts between the two control grids.

c. Capacitor C106 is a noise filter. Screen grid voltage for V108B is supplied from a combination of regulated output voltage and unregulated input voltage through resistors R122, R123 and R124. Any change in the fixed voltage difference between the control grids of V108A and V108B is amplified and applied to series regulator tube V107 that then either drops more or drops less voltage to restore the regulated output voltage to its correct level.

d. As an example of regulator operation, assume that the regulated output decreases (becomes less negative). Voltage reference tube V109 drops a constant voltage and the full decrease is applied to V108A control grid. On the other hand, only approximately one half of the output decrease is applied to V108B control grid. The net result is that the control grid of V108B becomes more negative than it normally is when the output voltage level is correct. This unbalances the reference amplifier in a direction that decreases current in V108B and the control grid of series regulator tube V107 becomes more positive.

e. The series tube conducts more and appears as a smaller resistor that drops less voltage to restore the output to its correct level. Resistor R121 parallels series tube V107 and provides a minimum load of approximately 3 milliamperes. Output capacitor C105B lowers the regulator output impedance at high frequencies to improve transient regulation.

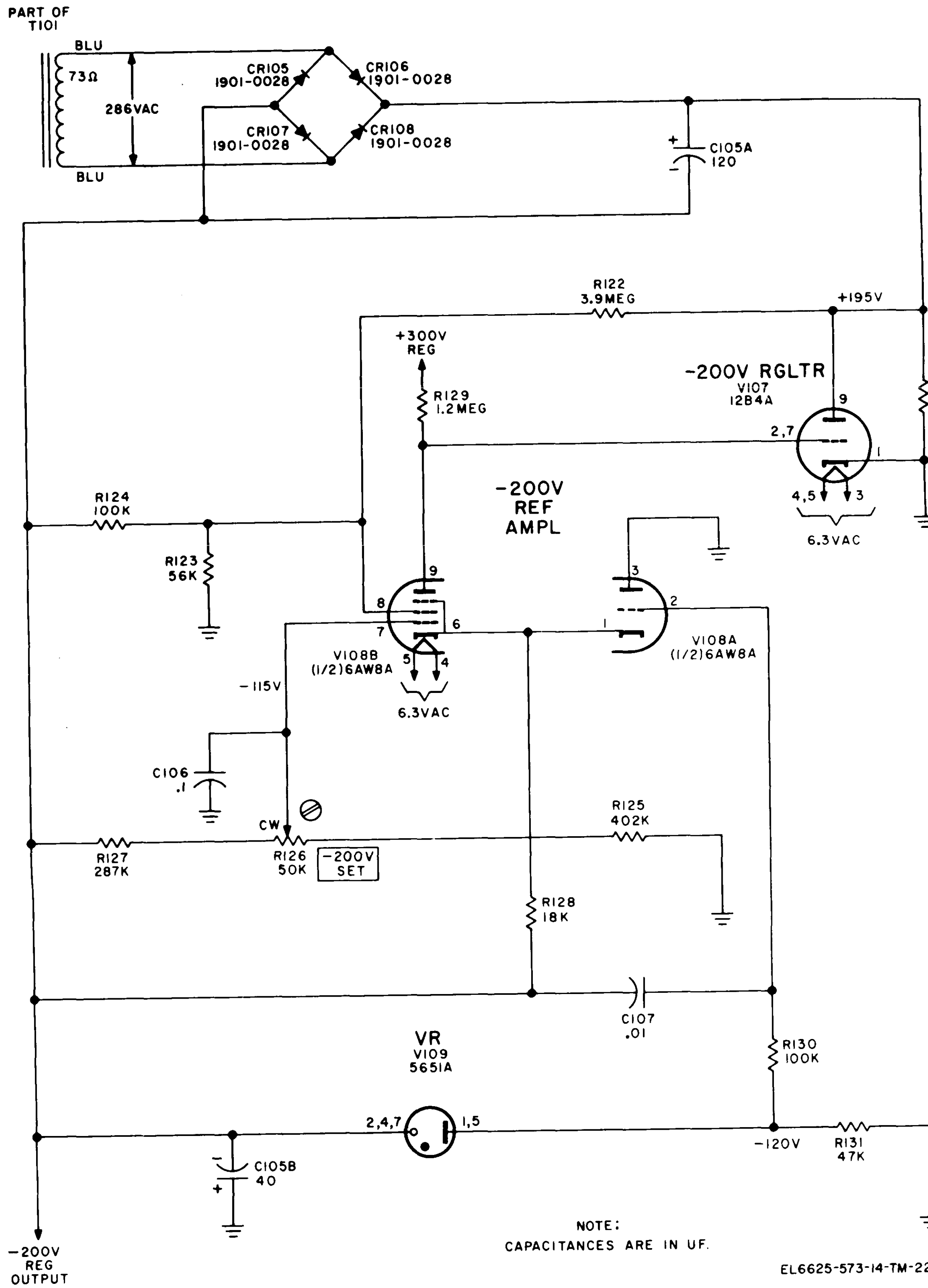


Figure 6-15. –200 volt regulated power supply, schematic diagram.

6-18. +300 Volt Regulated Supply Circuit
(fig. 6-16)

a. The +300 volt regulated power supply is a standard series regulator type that uses five series regulator tubes in parallel to accommodate the heavy load current. The red lead secondary of T101 applies 174 Vrms to a full wave voltage doubler consisting of diodes CR101 through

CR104 and filter capacitors C101A and C102. Resistor R101 limits the surge current into the filter capacitors when ac power is first applied.

b. When diodes CR101 and CR102 conduct, capacitor C101A charges to the peak secondary voltage of approximately 250 volts. When diodes CR103 and CR104 conduct, capacitor C102 charges to the peak secondary voltage of approximately 250 volts. Voltages across C101A and C102 are series aiding and the total voltage across the two capacitors is twice the peak secondary voltage or approximately 500 volts. Stacked rectifier diodes are used to meet the maximum peak inverse voltage requirements.

c. Reference amplifier stage V106A and V106B is a differential amplifier that compares a sample of the regulated output voltage to a reference voltage. The regulated output is applied across voltage divider R110 and R111 and a sample of approximately +2 volts is applied to V106B control grid. Capacitor C103 bypasses R110.

d. Screen grid voltage for V106B is supplied from a combination of regulated and unregulated voltages through resistors R105, R107, and R108. The reference voltage for V106A is ground and the reference amplifier operates at a fixed difference of approximately 2 volts between the two control grids. Any change in the fixed difference is amplified and applied to the control grids of the five series regulator tubes. These tubes change conduction level in a direction that restores the regulated output voltage to its correct level. As an example of regulator operation, assume that the output voltage tries to decrease. Approximately 40 percent of this decrease is applied to the control grid of V106B.

e. The differential amplifier is unbalanced in a direction that decreases the current in V106B and applies a more positive voltage to the control grids of the five series regulator tubes. Resistors R103, R109, R114, R116, and R118 in the control grids of the series regulators are parasitic oscillation suppressors. All of the series regulator tubes increase conduction and appear as decreased resistances that drop less voltage to bring the output voltage up to its correct level. Resistors R106, R112, R115, R117, and R119 in the cathodes of the series regulator tubes equalize the load current in the five tubes. output capacitor C10lB reduces the regulator output impedance at high frequencies.

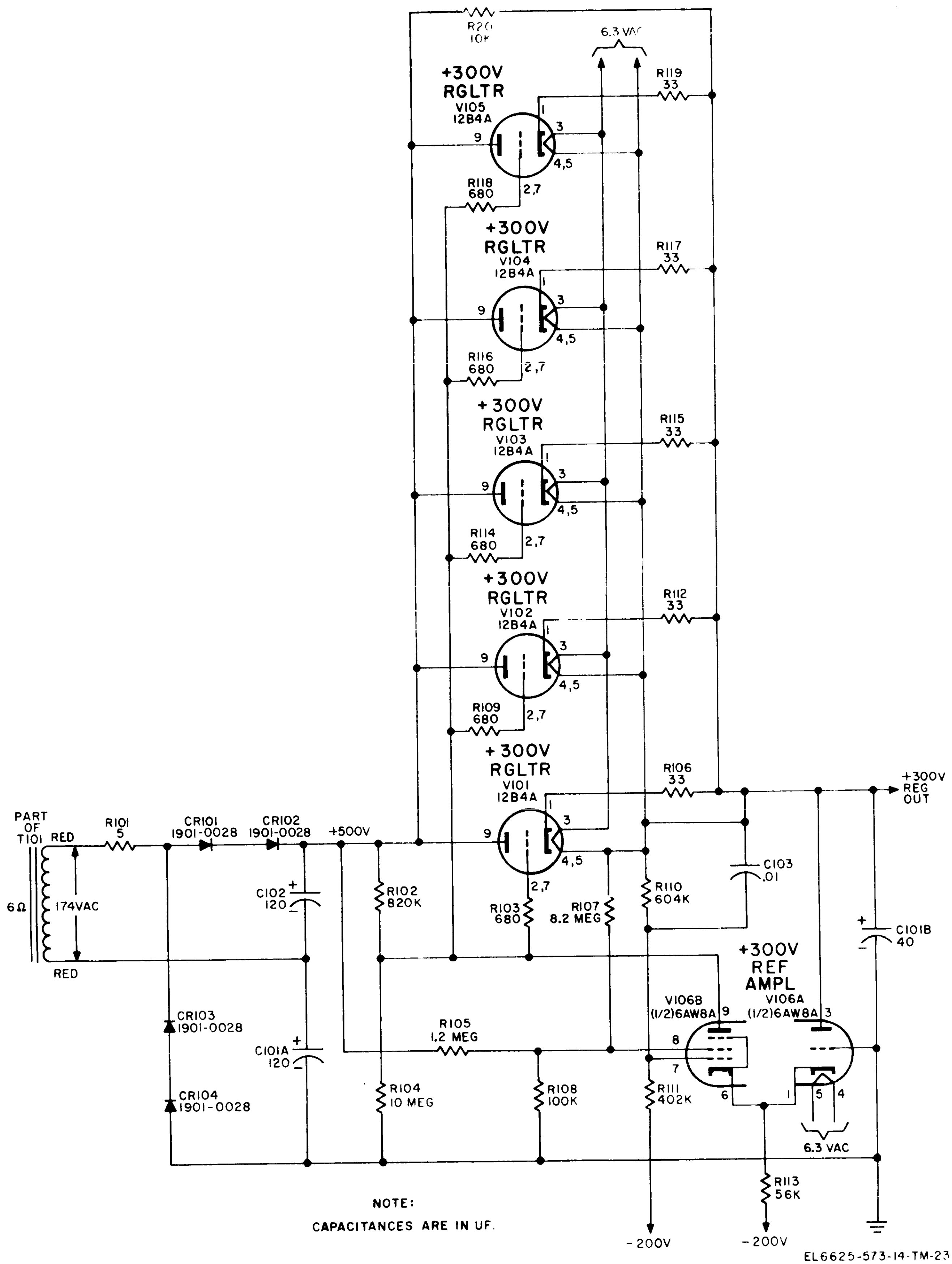


Figure 6-16. +300 volt regulated supply, schematic diagram.

6-19. Dummy Load, Electrical DA-296/GRM-50 Circuit
(fig. 6-17)

a. The dummy load provides a constant 50-ohm load for the signal generator regardless of the load connected to the dummy load output connector. This retains the signal generator rf output meter calibration.

b. Resistors R1 and R2 form the 50-ohm load for the signal generator. When wafer switch S1 is on the ODB 25 Ω position, R1 and R2 parallel the 50-ohm signal generator output impedance and the dummy load output impedance is reduced to 25 ohms. If the total impedance connected to J2 is 500 ohms or greater, attenuation from J1 to J2 is less than 1 dB. When S1 is in the 20DB 5Ω position, R1 and R2 forma 10-to-1 voltage divider that provides a 20 dB power attenuation from J1 to J2. This further reduces the output impedance to 5 ohms for use with load impedances of less than 500 ohms. Capacitor C3 and stray input capacitance form a 10-to-1 ac voltage divider that frequency compensates input voltage divider R1-R2.

c. For accurately measuring receiver sensitivity when the receiver does not have a 50-ohm antenna input impedance, the 20DB DA position of S1 couples the signal to the output connector through a standard dummy antenna, This is comprised of C1, C2, L1, and R3 and simulates a straight-wire antenna 4 meters in length (approximately 13 feet) for frequencies covering the standard broadcast band. Use of the dummy antenna simplifies receiver sensitivity measurement as most standard receiver sensitivity tests specify that the test signal be applied to the receiver input through a standard dummy antenna. The dummy antenna is also fed from the 10-to-1 voltage divider.

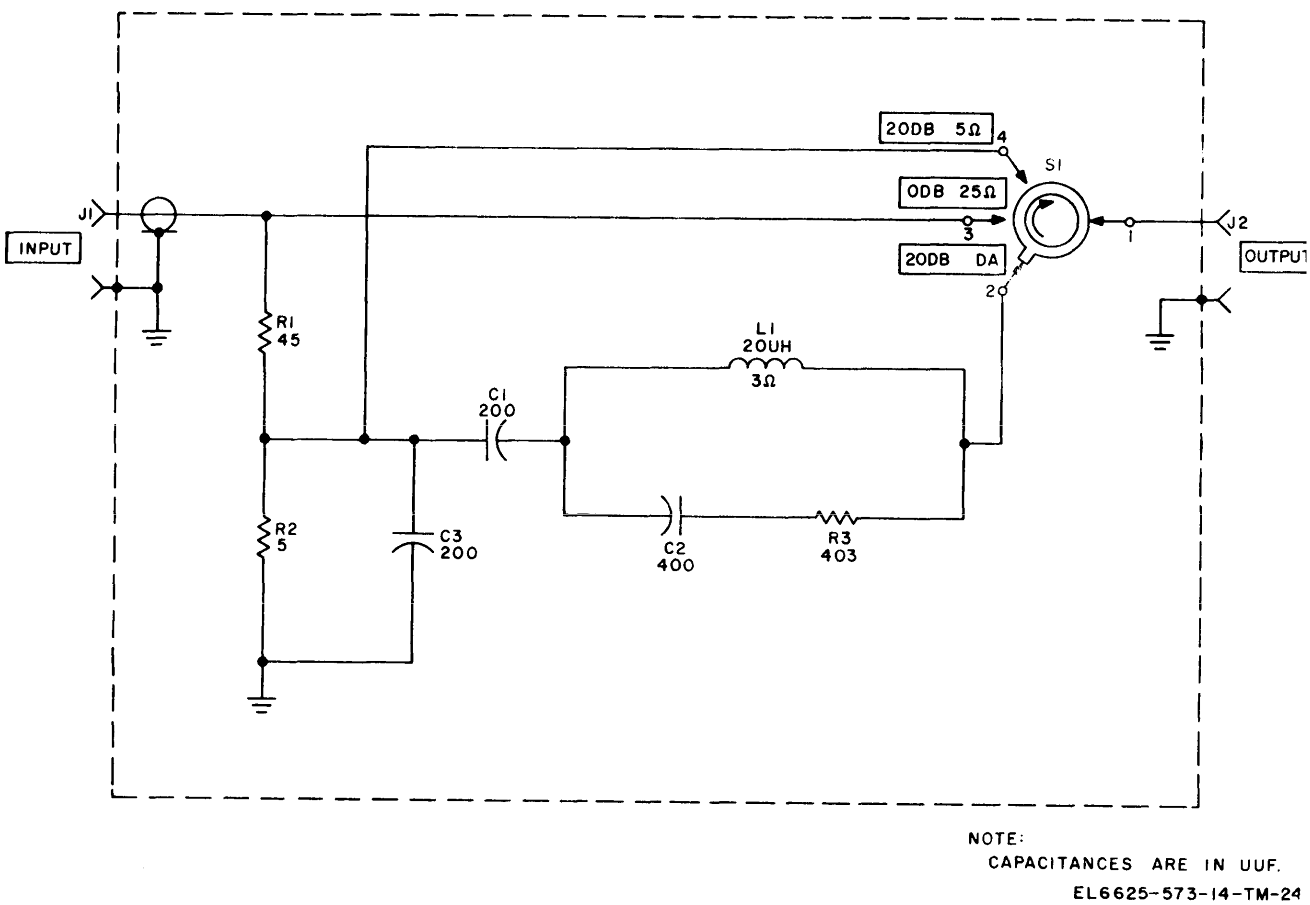


Figure 6-17. Dummy Load, Electrical DA-295/GRM-50, schematic diagram.

CHAPTER 7

DIRECT AND GENERAL SUPPORT MAINTENANCE

Section I. GENERAL

7-1. Scope of Direct and General Support Maintenance

The procedures for troubleshooting and maintenance of the AN/GRM-50 are contained in subsequent sections of this chapter. Where applicable, the procedures include instructions for making voltage and resistance measurements and instructions for replacing components when the procedure is not obvious. When making voltage and resistance measurements, observe the instructions in paragraph 7-2.

7-2. Voltage and Resistance Measurements

WARNING

When servicing the SG-497/G, be extremely careful of exposed high voltages. With the equipment deenergized, potentials as great as 500 volts may be retained on charged capacitors. Prior to touching any part, short the part to chassis ground. Use only one hand when measuring tube socket voltages.

Make all voltage and resistance measurements using Multimeter ME-26/U at the points specified in the troubleshooting chart. To make additional voltage, resistance, or continuity measurements that are not specified in the chart, refer to the wiring diagrams to determine the test point desired.

7-3. Wiring and Schematic Diagrams

The wiring and schematic diagrams are presented in figures FO-2 and FO-3. These illustrations are used as an aid in signal tracing and troubleshooting.

Section II. DIRECT AND GENERAL SUPPORT TOOLS AND EQUIPMENT

7-4. Common Tools and Equipment for Direct and General Support

Tools and test equipment required for maintenance of the AN/GRM-50 are listed in appendix C.

7-5. Special Tools and Equipment for Direct and General Support

No special tools and equipment are required for direct and general support maintenance.

Section III. TROUBLESHOOTING

7-6. General Instructions for Direct and General Support

Troubleshooting at direct and general support maintenance categories includes all techniques outlined for organizational maintenance (chapter 5) and any special or additional techniques required to isolate a defective part. Paragraphs 7-8 and 7-9 describe localizing and isolating techniques to be used within the unit.

7-7. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective AN/GRM-50 is to sectionalize the fault. Sectionalization means tracing the fault to either the SG-479/G or the DA-296/GRM-50. The second step is to localize the fault. Localization means tracing the fault to a defective stage or circuit responsible for the abnormal condition. The third step is isolation. Isolation means the locating of the defective part or parts. Some defective parts, such as burned resistors and arcing shorted transformers can often be located by sight, smell, and hearing. Most defective parts, however, must be isolated by checking voltages and resistance.

b. Sectionalization. Generator, Signal AN/GRM-50 consists of two units: the SG-479/G and the DA-296/GRM-50. The first step in tracing trouble is to locate the unit at fault by the following methods:

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits. All meter readings or other visual signs should be observed and an attempt made to sectionalize the fault to a particular unit.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The daily maintenance, service and inspection table (3- 1) contains a good operational test.

c. Localization. Perform localization procedures applicable to this equipment after the trouble has been sectionalized (*b* above). These procedures are listed in (1) below, and are used to isolate the trouble at its stage.

(1) *Troubleshooting table.* The troubleshooting table lists symptoms of common troubles and gives (or references) corrective measures. Such a table cannot include all trouble symptoms that may occur. This table is used by the repairman as a guide in analyzing symptoms that may not be listed.

(2) *Isolation.* General procedures for isolating troubles are given in paragraph 7-12. Specific procedures for isolating troubles in the power supplies, oscillator, and rf amplifier feedback loop are given in paragraphs 7-13, 7-14- 7-15 and 7-16, respectively.

d. Techniques. In performing the sectionalization, localization, and isolation procedures, one or more of the techniques below can be applied. Apply these techniques only as indicated, and observe all cautions.

(1) *Voltage measurements.* When measuring voltages, use tape or sleeving (spaghetti) to insulate the entire test probe, except for the extreme tip. Use the same or equivalent electronic multimeter specified on the voltage and resistance diagrams (fig. 7-1 through 7-4).

(2) *Resistance measurements.* Make resistance measurements in this equipment only as directed on voltage and resistance diagrams or charts.

(3) *Wave shapes.* Compare the wave shapes obtained at indicated tube sockets with the wave shapes shown in figure 7-5.

7-8. Visual Inspection

a. Failure of the SG-479/G to operate properly is usually caused by one or more of the following faults:

(1) Improperly connected power cable, or no voltage at the outlet into which the power cable is connected;

(2) Burned out fuses;

(3) Wires broken because vibration;

(4) Defective vacuum tubes;

(5) Improperly connected output or input cables;

(6) Worn, broken, or disconnected cords or connectors.

6. When failure is encountered and the cause is not immediately apparent, check as many of the items in *a* above as is practicable before starting a detailed examination of the individual parts of the circuit. If possible, obtain information from the person who normally uses the equipment regarding performance at the time trouble occurred.

7-9. Checking Filament, B + and B— Circuits for Shorts

a. When to Check. Trouble within the SG-479/G is often detected by checking the resistance of the filament and high voltage circuits before applying power to the equipment, thereby preventing damage to the power supply. Perform the check whenever the LINE and RF B + fuses are blown. When the RF B + fuse is blown and the LINE fuse is not, a short circuit is indicated in the rf circuits only. If the LINE fuse is blown and the RF B + fuse is normal, a short circuit is indicated in either of the filament circuits, the power supplies, or the circuits powered by the power supplies.

b. Condition for Tests. To prepare for short circuit tests, perform the following steps:

(1) Disconnect power cord from power source.

(2) Set power switch to off position.

(3) Remove all vacuum tubes and POWER indicator DS101.

c. Measurements. Perform the resistance measurements indicated in table 7-1. If abnormal indications are obtained, perform the additional isolating procedures outlined. When the faulty part is located, repair the trouble before applying power.

CAUTION

The ohms probe of the ME-26A/U is negative with respect to the common clip lead. Because of the electrolytic capacitors used in the power supply circuits, the probe and common lead must be connected with proper polarity. If this is not done, incorrect results will be obtained and the capacitors may be damaged. In table 7-1, correct polarities are indicated.

7-10. Localizing Troubles

a. General. In the troubleshooting table, procedures are outlined for sectionalizing troubles to the SG-479/G or to the DA-296/GRM-50, and for localizing troubles to a stage within the various sections of the SG-479/G. Location of tubes and crystals are shown in figures 2-2 and 2-3. Voltage and resistance measurements are shown in figures 7-1 through 7-4, waveforms in figure 7-5, and parts location in figures 7-6 through 7-18. An overall schematic diagram is contained in figure FO-3. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary. When trouble has been localized in a particular stage, use voltage and resistance measurements to isolate the trouble to a particular component.

Table 7-1. Short-Circuit Tests

Pant d measurement	Normal indication	Isolating procedure
From tube socket V106, pin 3 (+) (fig. 7-1) to chassis (–)	Resistance indication approximately 17K ohms.	If resistance is considerably less than normal, check capacitors C101B, C10A, C10B, and C10C,
From tube socket V101, pin 9 (+) (fig. 7-1) to chassis (–)	Resistance indication of approximately 26K ohms.	If resistance is considerably less than normal, check capacitors C102, C101A and diodes CR101 through CR104.
From tube socket V109, pin 2, 4, or 6 (–) (fig. 7-1) to chassis (+)	Resistance indication of approximately 13K ohms.	If resistince is considerably less than normal, check capacitors C105A and C105B and diodes CR105 through CR108.
From tube socket V1, pin 5 (+) (fig. 7-2) to chassis (–)	Infinite resistance indication.	If resistance is considerably less than normal, check capacitors C109, C110, and C111 and diodes CR109 through CR112.

b. Use of Table. When an abnormal symptom has been observed in the equipment, look for a description of this symptom in the “Malfunction” column of table 7-2, and perform the corrective action shown in the "Corrective action" column. If the symptom is not included in the table, begin with item 5 of the Preventive Maintenance Checks and Services procedures (table 4-1) and proceed until a trouble symptom appears.

CAUTION

If operational symptoms are not known, or if they indicate the possibility of short circuits, make the short-circuit checks described in paragraph 7-9 before applying power.

c. Conditions to Tests. All checks outlined in the table are to be conducted with the SG-479/G connected to a power source of 115 Vac ± 10% or 230 Vac ± 10% 50 Hz to 400 Hz, 135 watts.

NOTE

Perform the operations in the equipment performance check list (table 3-1) before using table 7-2, unless trouble has already been localized.

Table 7-2. Troubleshooting

Malfunction	Probable Causes	Corrective Action
1 Power indicator lamp DS101 dose not light and there is no rf output from SG-479/G when the power switch is set to ON.	No ac power applied to SG-479/G	Check for input voltage.
	Open RF B + fuse F11 in power supply .	Replace fuse. If the replace fuse blows, set RANGE switch between any two ranges and replace fuse. If the fuse does not blow, check tuning capacitors C4, C5, C14, and C15. If the replaced fuse blows, check tubes V1 through V4 and V6 through V8 . If the tubes chink good, check resistances at these tube sockets.
	Open LINE fuse F101.	Replace fuse. If the replaced fuse blows, unsolder the red and blue wires of T101 and replace the fuse.

Table 7-2. Troubleshooting-Continued

Malfunction	Probable Causes	Corrective Action
1 (Continued)		If the replaced fuse does not blow, the trouble is in either the B + or B– power supplies or the circuits they supply. Perform the power supply trouble isolating procedures outlined in paragraph 7-13 and 7-14. If the replaced fuse blows unsolder the brown leads of T101 and replace fuse. If the replaced fuse does not blow, check capacitors C109, C110, and C111; diodes CR109 through CR112, and tubes V1 through V4 and V6 through V8. Also check the brown-wire secondary of T101. If the replaced fuse blows, unsolder the yellow leads of T101 and replace fuse. If the replaced fuse does not blow, check the yellow-wire secondary of T101 and tubes V101 through V105. If the replaced fuse does blow, check resistors R134 and R135, DS101, tubes V5, V9, V10, and V 106 through V 108, and the green-wire secondary of T101.
	P101 not plugged into J101.	Check that internal power plug P101 is inserted into J101 located on rfi filter box (fig. 7-6).
	Open filter inductors in rfi filter box.	Check inductors L102 and L103.
	Open power switch S101, S8, or T101 primary.	Check S101, S8, and T101 primary.
2 Power indicator lamp DS101 does not light and rf output is normal.	Burned-out lamp DS101 or open resistor R135.	Replace lamp. If lamp does not light check R135.
3 Power indicator lamp DS101 lights but rf output is abnormal on all frequency ranges and no fuses are blown.	Dc filament supply not operating properly	Check components in dc filament supply .
	Oscillator or rf amplifier stages not operating properly.	Connect an oscilloscope probe between V3, pin 2 or 9 and V4, pin 2 or 9. The rf voltage should be 9.6 volts peak-to-peak. If the voltage is abnormal, the oscillator stage is not. functioning properly. Refer to paragraph 7-15 for trouble isolating procedures. I f the voltage is normal, disconnect J4 from P1 and connect ME-26A/U ac probe to J4. If rf voltage is present, step attenuator Al is faulty. Replace the attenuator (a nonreparable item). If the rf voltage is not present, the trouble is in rf amplifier feedback loop. Refer to paragraph 7-12 for applicable trouble isolating procedure.
4 Rf output is abnormal on one or more, but not all, frequency ranges.	Faulty tuned-circuit components on corresponding position of oscillator or amplifier turret	Check continuity and value of corresponding tuned-circuit components.
	Poor electrical contact between turret switch contacts and switching blocks.	Ensure that turret switching contact: are centered in switching bloc contacts.
5 Rf output is abnormal on one or more, but not all, ATTENUATOR switch ranges.	Faulty step attenuator A1.	Replace step attenuator. This is a nonreparable item.
6 SG-479/G rf output is normal but DA-296/GRM-50 output is abnormal.	Faulty DA-296/GRM-50.	Check R1 through R3, C1 through C3, and L1. Also check sold joints. Poor solder connections can affect performance considerably by disturbing the VSWR (reflection coefficient).

Table 7-2. Troubleshooting-Continued

Malfunction	Probable Causes	Corrective Action
7 Rf output is normal, but rf output meter reading is abnormal.	Faulty meter circuit; OUTPUT CAL adjustment R37 not correctly set.	Check M2, R37, C37, C38, L6, and R36. Adjust R37 (para 7-39).
8 Rf output is normal, but rf output meter does not momentarily read 0 when changing frequency range	Nonfunctioning microswitch S7.	Replace microswitch S7.
9 Rf output is normal, but rf output meter does not decrease slightly when ATTENUATOR switch is set to 3 volts range.	Relay K1 not operating properly.	Check Kl, S5, R27, R28, R46, C26, and C27.
10 Sharp drop in rf output level as FREQUENCY dial is rotated	Turret shorting contacts not making good electrical contact with next lower frequency tuned circuit.	Replace shorting contact if damaged. Check alignment of turret switching contacts with respect to switching block contacts.
11 Frequency does not vary as FREQUENCY dial is rotated.	Broken drive cable. Drive cable not connected to fixed or floating collars.	Refer to paragraph 7-18.
12 No detent action when RANGE switch is changed	Improper alignment of detent assembly or missing drive roll pin.	Refer to paragraph 7-17.
13 Rf modulation envelope flattened at bottom on two lowest freqency ranges only	No diagonal clipping compensation applied to envelop detector.	Check C13, C23, C24, R21, and S3B.
14 High-frequency parasitic oscillations on 530KC-1800KC, 5.8MC-19.2MC, or 19MC-65MC ranges	High-frequency gain of rf amplifier not correctly rolled off.	Check C20 and S3A.
15 High-frequency parasitic oscillations on 1.76MC-6.0MC range	High-frequency gain of rf amplifier not correctly rolled off.	Check C21 and S3A.
16 High-frequency parasitic oscillations on 50KC-170KC or 165KC-560KC ranges	High-frequency gain of rf amplifier not correctly rolled off.	Check C22 and S3A.
17 Both 400 Hz and 1000 Hz internal modulating functions abnormal	Audio oscillator inoperative.	Check V5 and associated components.
18 Internal modulation normal but PERCENT MODULATION meter abnormal	Modulation monitor stage not functioning; Meter M1 defective; MOD CAL adjustment not correctly set .	Check V9A and associated components. Check and replace Ml. Perform modulation meter calibration adjustment (para 7-38).
19 Both 400 Hz and 1000 Hz internal modulating frequencies abnormal	Frequency determining components defective.	Check C50 and C51.
20 400 Hz internal modulating frequency normal but 1000 Hz frequency abnormal	Frequency determining components for 1000 Hz frequency defective.	Check R59, R56, and S6.
21 1000 Hz internal modulating frequency normal but 400 Hz frequency abnormal	Frequency determining for 400 Hz frequency defective.	Check R55, R58, and S6.
22 Both internal modulating signals distorted or vary in amplitude	Stabilizing thermistor RT1 defective; Tube V5 or associated components defective.	Check and replace RT1. Check V5 and associated components.
23 Rf output normal but no beat note in both positions of CRYSTAL CALIBRATOR switch	Crystal calibrator oscillator inoperative; Mixer-amplifier V10B inoperative; Beat frequency amplifier V9B inoperative; Head set inoperative No rf sample supplied by step attenuator A1.	Check V10A and associated components. Check V10B and associated components. Check V9B and associated components. Replace head set. Check for rf sample at step attenuator. If not present, replace step attenuator. This is a nonrepairable item.
24 Crystal calibrator abnormal in 100KC position only	XTAL 2 defective.	Replace XTAL 2.
26 Crystal calibrator abnormal in 1MC position only	XTAL 1 defective,	Replace XTAL 1.

7-11. Waveform Analysis
(fig. 7-5)

a. Waveforms can be observed at tube socket pins by using Oscilloscope AN/USM-281. The normal waveforms obtained at tube socket pins are shown on tube socket waveform diagram (fig. 7-5). By comparing observed waveforms with normal waveforms, trouble can sometimes be quickly located.

b. Before comparing the observed waveforms with normal waveforms, carefully read the notes on the waveform illustration and exactly duplicate the conditions under which the normal waveforms were obtained. If an observed waveform does not closely resemble the normal waveform, trouble is indicated.

c. A distorted waveform indicates a malfunction between the point at which the waveform is normal and the point at which it is abnormal. For example, if the oscilloscope indicates distortion at the plate of a stage, and shows a normal waveform at the grid, the malfunction will be found in that stage. Before making any further tests, replace the tube. If tube replacement does not correct the trouble, put the original tube back in the socket, and take voltage and resistance measurements at the tube socket pins.

7-12. General Trouble Isolation Within a Stage

When trouble has been localized to a stage, either through operational checks or the use of the troubleshooting table, use the following techniques to isolate the defective part. Specific isolating procedures applicable to the B + and B – power supplies, rf oscillator, and rf amplifier feedback loop are presented in paragraphs 7-13 through 7-16.

a. Substitute a tube known to be good for the suspected tube in preference to using a tube tester. If the substitute tube does not correct the trouble, remove the new tube and return the old one to the socket.

b. Take voltage measurements at the tube sockets (fig. 7-1, 7-2 and 7-3) and at the resistor-capacitor boards (fig. 7-4) that contain components associated with the defective stage.

c. If voltage readings are abnormal, take resistance readings.

d. Use the wiring diagrams (fig. 7-19 and FO-2) to trace circuits and to isolate the faulty part.

7-13. —200 Volt Power Supply Trouble Isolating Procedure

To isolate a trouble in the — 200 volt power supply, proceed as follows:

a. Disable +300 volt power supply by unsoldering either red wire on R101 (fig. 7-7).

b. Solder a 1 megohm, 1 watt resistor between pins 2 and 9 of V107 (fig. 7-l).

NOTE

All the following voltages are measured with respect to chassis.

c. Measure voltage across S105B. The reading should be – 200 vdc ± 5%. If the voltage is abnormal, check C105B. Check adjustment.

d. On C105, unsolder the two violet wires that enter wire harness and then pass through power supply deck. This removes load on -200 volt power supply. Remeasure voltage across C105B. If it is normal, a short circuit is indicated in circuits connected to – 200 volt power supply. Check the resistance of these circuits.

e. Measure ac voltage across blue wires of T101. The reading should be 143 vrms ± 10%. If the reading is abnormal, check the blue-wire secondary of T101.

f. Measure voltage at V107 pin 9. The reading should be +195 volts ±10%. If the voltage is abnormal, check CR105 through CR108 and V107.

g. Measure voltage at V109, pins 1 and 5. Reading should be – 110 vdc ± 20%. If voltage is abnormal, check V109 for orange glow.

h. Measure voltage V108, pins 1 and 6. The reading should be –112vdc ±20%. If voltage is abnormal, check V108 and associated components.

i. Resolder red wire to R101 and C105B. Unsolder and remove resistor connected between pins 2 and 9 of V107.

7-14. +300 Volt Power Supply Trouble Isolating Procedure

To isolate a trouble in the +300 volt power supply, proceed as follows:

NOTE

Unless otherwise indicated, the following voltages are measured with respect to chassis. It is also assumed that the —200 vdc power supply is operating properly.

a. Measure voltage across C101B. The reading should be +300 vdc ± 5%. If voltage is abnormal, check C101B.

b. Unsolder the red wire connected between C101B and the single terminal insulated standoff located between C101 and C102. This removes the load on the +300 volt power supply. Remeasure the voltage across C101B. If voltage is normal, a short circuit is indicated in the circuits connected to the +300 volt power supply. Check the resistances of these circuits.

c. Measure ac voltage across red wire secondary of T101. Reading should be 175 vrms ± 10%. If voltage is abnormal, check the red-wire secondary of T101.

d. Measure the voltage across C101A and C102. The reading should be +250 vdc ± 10% across each. If voltage is abnormal, check C101A and C102, and CR101 through CR104.

e. Measure voltage at V101, pin 9. The reading should be +500 vdc ± 10%. If the voltage is abnormal, check V101 through V105.

f. Measure voltage at V106, pin 9. Reading should be +270 vdc ± 10%. If voltage is abnormal, check V106 and R102 through R104.

g. Measure voltage at V106, pin 8. Reading should be +38 vdc ± 10%. If voltage is abnormal, check CR103, R110, and R111.

h. Measure voltage at V106, pin 6. Reading should be +3.6 vdc ± 10%. If voltage is abnormal, check V106 and R113.

i. Resolder the red wire removed in step *b.*

7-15. Oscillator Trouble Isolating Procedure

To isolate a trouble in the oscillator stage, proceed as follows:

NOTE

The following procedure assumes that the —200 volt and +300 volt power supplies are operating properly.

a. Use a clip lead to short R30 (fig. 7-8). This disables the rf amplifier feedback loop.

b. Measure voltage at V2, pin 9. The reading should be +26 vdc ± 10%. If the voltage is abnormal, check C53, C33, L4, and C32.

c. Measure voltage at V1, pin 3. Reading should be +295 vdc ± 5%. If voltage is abnormal, check C8, C10A, C10B, C10C, C11, C16, and V1.

d. Measure voltage at V1, pin 2. The reading should be +99 vdc ± 5%. If voltage is abnormal, check V1, R1 through R3, and C1.

e. Measure voltage at V1, pin 1. Reading should be +100 vdc ± 5%. If voltage is abnormal, check V1 and R19.

f. Measure voltage at V2, pins 1 and 6. Reading should be +295 vdc ± 5%. If voltage is abnormal, check R9, C4, C5, and C7.

g. Measure voltage at V2, pins 2 and 7. Reading should be +100 vdc ± 5%. If voltage is abnormal, check VI and associated grid components.

h. Measure voltage at V2, pins 3 and 8. Reading should be +110 Vdc ± 5%. If voltage is abnormal, check V1, V2, CR1 and associated diode components.

i. With ME-26A/U and ac probe, measure rf voltage at V2, pins 2 and 7. Reading should be approximately 6 Vrms up to 19 MHz and 3 to 5 Vrms up 65 MHz. If voltage is abnormal, check V2, CR1, C4, C5, R7 and wiring in V2 grid circuits. Check oscillator adjustment (para 7-33).

j. Set power switch to off and measure resistance of R9. Reading should be 100 ohms ± 10%. If reading is abnormal, replace R9. Also check C4, C5, V1, and V2.

k. Remove clip lead installed in *a* above.

7-16. Rf Amplifier Feedback Loop Trouble Isolating Procedure

To isolate a trouble in the rf amplifier feedback loop, proceed as follows:

NOTE

The following procedures assumes that both the – 200 volt and +300 volt power supplies and the oscillator are all operating properly.

a. Set operating controls as follows:

(1) RANGE switch to 530 KC-1800KC.

(2) FREQUENCY control to 1000kHz.

(3) MODULATION SELECTOR switch to CW.

(4) ATTENUATOR switch to 1.0V.

(5) VERNIER ATTENUATOR control to fully ccw.

(6) CRYSTAL CALIBRATOR switch to OFF.

b. Carefully inspect tuning capacitors C4, C5, C14, and C15 for any foreign material between the rotor and stator plates. If necessary, use a low-velocity stream of air to clean the capacitors.

c. Use a clip lead to short R30 (fig. 7-8). This disables the feedback loop.

d. Connect DA-296/GRM-50 INPUT connector to RF OUTPUT connector.

e. Set MODULATION SELECTOR switch to CW. Set RANGE switch to 530KC-1800KC and set FREQUENCY dial to 1000kHz.

f. Solder a 5K, 5-watt, fixed resistor to V6, pin 9. Solder a variable 2K, 2 watt resistor between the other end of the 5K resistor and the chassis. Connect a jumper from the center wiper of the variable resistor to chassis.

g. Set ATTENUATOR switch to 1.0 V.

h. Connect ME-26A/U ac probe to DA-296/GRM-50 OUTPUT connector.

i. Adjust variable 2K resistor to obtain indication of 1 volt on ME-26A/U.

j. Measure voltage at V1, pin 5. Reading should be at least +26 Vdc. If voltage is abnormal, check the dc filament supply and tubes V1 through V4 and V6 through V8.

k. Disconnect wire from V6 pin 1 and insert milliammeter between pin 1 and ground. Reading should be approximately 19 milliamperes. If reading is abnormal, check V6, R38, C10A, C10B, C10C and L1.

l. Connect a milliammeter in series with R10 component lead. Reading should be approximately 5.6 milliamperes. If reading is abnormal, check R10.

m. Connect milliammeter in series with R38 component lead. Reading should be approximately 5.6 milliamperes on the five lowest frequency bands and 0 milliampere on the highest frequency band. If readings are abnormal, check the corresponding tuned circuits on the amplifier turret.

n. Measure ac voltage at V3, pin 6 and V4, pin 6. Reading should be approximately 7.8 Vrms. If voltage is abnormal, check V3, V4, R15, C14, C15, and tuned circuits on amplifier turret.

o. Measure ac voltage at V3, pin 1 and V4, pin 1. Reading should be approximately 2 Vrms. If voltage is abnormal, check R13 and R14.

p. Measure voltage from V3, pin 1 to pin 2 and V4, pin 1 to pin 2. Reading should be approximately —14 Vdc (pin 2 negative). If voltage is abnormal, check R11 and R12.

q. Measure voltage at V3, pin 8 and V4, pin 8. Reading should be +295 Vdc ± 59%. If voltage is abnormal, check C11 and C16.

r. Measure voltage at V3, pin 7 and V4, pin 7. Reading should be +110 Vdc ± 5 %. If voltage is abnormal, check V3 and V4.

s. Measure ac voltage at CR2 anode. Reading should be approximately 5.7 Vrms. If voltage is abnormal, check tuned circuits on amplifier turret and turret switching contacts.

t. Measure voltage at CR3 cathode. Reading should be approximately +7.1 Vdc. If voltage is abnormal, check CR2, CR3, CR4, C23 through C25 and R21.

u. Measure voltage at V8, pin 7. Reading should be approximately +3.1 Vdc. If voltage is abnormal, check R25, R36, C37, L6, C38, R37, and M2.

v. Measure ac voltage at input end of R18. Reading should be approximately 2 Vrms. If voltage is abnormal, check tuned circuits on amplifier turrets and turret switching contacts.

w. Measure ac voltage at output end of R18. Reading should be approximately 1 Vrms. If voltage is abnormal, check R18 and C17.

x. Repeat *k* through *w* above for each of the other five frequency ranges. Readings for s through w above remain the same. Set the FREQUENCY dial to the frequencies listed in table 7-3.

y. Measure voltage at V8, pin 7 and adjust 2K ohm variable resistor to obtain a reading of +3.1 Vdc.

z. Measure voltage at V8, pins 1 and 6. Reading should be approximately +3.9 Vdc. If voltage is abnormal, check V7, V8, R32, CR6, C30, C31 and L3.

au. Measure voltage at V8, pin 2. Reading should be 0 volt. If voltage is abnormal, check R63.

ab. Measure voltage at V8, pin 3. Reading should be approximately +143 Vdc. If voltage is abnormal, check V7, C28, R33, R34, and R35.

ac. Measure voltage at V8, pin 8. Reading should be approximately +54 Vdc. If voltage is abnormal, check V7, R33, R34, R35, and C29.

Table 7-3. Frequency Dial Settings

RANGE	FREQ	V3 or V4 pin 6 (Vrms)	V6, pin 1 cur. (mA)
50 KC-170KC	94kHz	9.3-	19
165 KC-560KC	310kHz	9.8	19
530 KC-1800KC	1000kHz	7.8	19
1.76 MC-6.0MC	3.33 MHZ	19.0	26
5.8 MC-19.2MC	10.9 MHZ	15.5	17
19. 0MC-65MC	36.3 MHz	6.8	26

ad. Measure voltage at V8, pin Y. Reading should be approximately +10 Vdc. If voltage is abnormal, check R20, R22, R23, and S3A.

ae. Measure voltage at V7, pins 1 and 6. Reading should be +295 Vdc +5 70. If voltage is abnormal, check C10A, C10B, C10C, and L1.

af. Measure voltage at V7, pin 2. Reading should be approximately +50 Vdc. If voltage is abnormal, check R33, R34, R35, and C29.

ag. Measure voltage at V7, pin 3. Reading should be approximately +54 Vdc. If voltage is abnormal, check V7 and V8.

ah. Measure voltage at V7, pin 7. Reading should be approximately +135 V. If voltage is abnormal, check R33, R34, and R35.

ai. Measure voltage at V7, pin 8. Reading should be approximately +143 Vdc. If voltage is abnormal, check V7 and V8.

aj. Rotate ATTENUATOR control fully cw.

ak. Measure voltage at V8, pins 1 and 6. Reading should be approximately +4.5 Vdc. If voltage is abnormal, check R32, CR6, C30, C31, and L3.

al. Measure voltage at V8, pin 2. Reading should be approximately +3.3 Vdc. If voltage is abnormal, check R60, S7, C54, R61 through R6, C55, R65, R31, R57, R68, and R69.

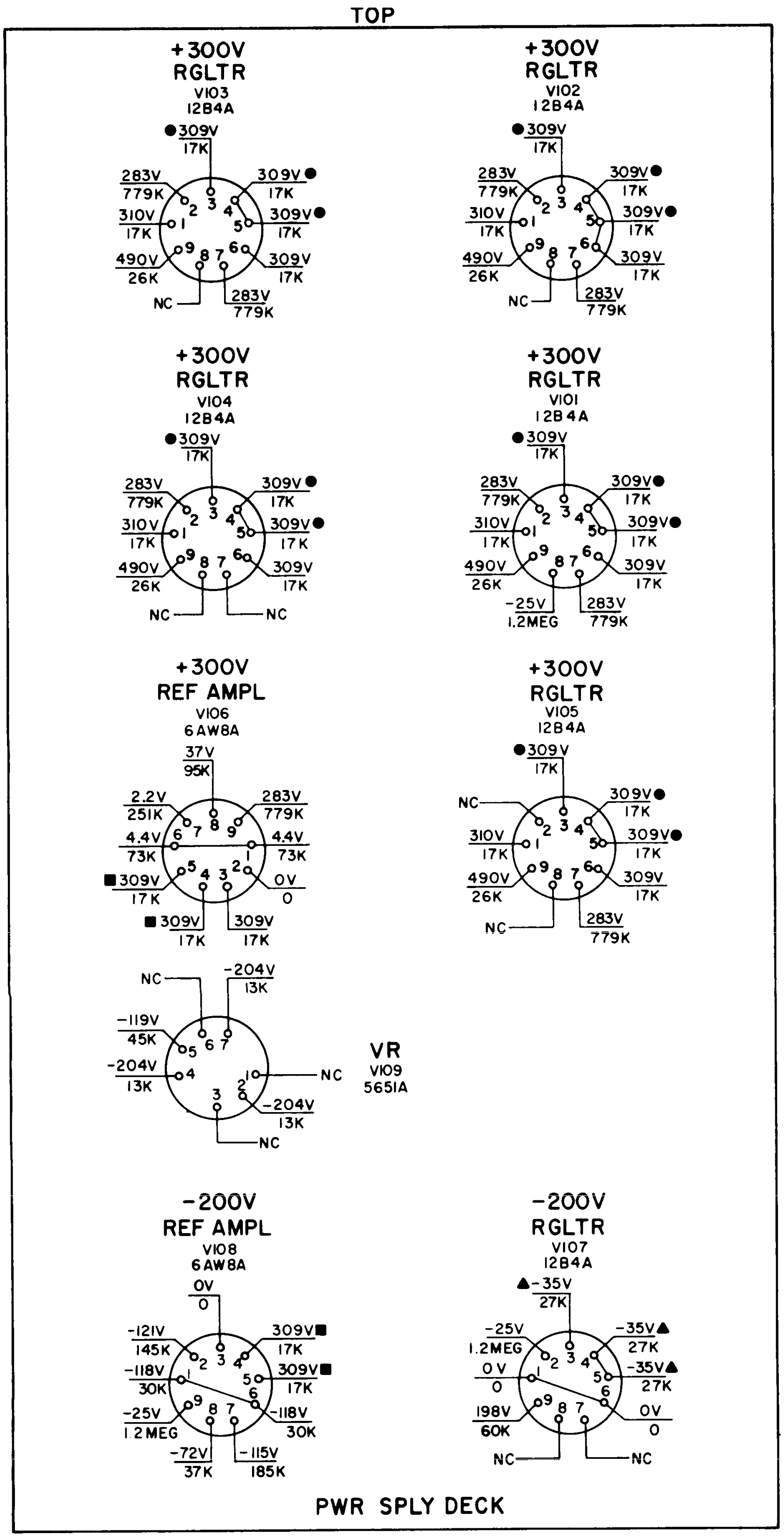
am. Measure voltage at V8, pin 3. Reading should be approximately +138 Vdc. If voltage is abnormal, check V7 and V8.

an. Measure voltage at V8, pin 8. Reading should be approximately +54 Vdc. If voltage is abnormal, check V7 and V8.

ao. Measure voltage at V8, pin 9. Reading should be approximately +42 Vdc. It voltage is abnormal, check V8.

ap. Remove clip lead that shorts R30. Remove 2K and 5K resistors.

aq. Perform amplifier adjustments (para 7-33).



NOTES:

1. LINE VOLTAGE AT 115V, 50 TO 400 HZ.
2. ALL VOLTAGE READINGS ARE DC MEASURED TO CHASSIS GROUND.
3. NC INDICATES NO CONNECTION.
4. ALL VOLTAGES MEASURED WITH 122 MEGOHM INPUT IMPEDANCE VTVM.
5. CONTROL SETTINGS ARE AS FOLLOWS:

   RANGE ----- 530KC-1800KC

   FREQUENCY --- 1000 KC

   MODULATION SELECTOR --- INT 1000~

   ATTENUATOR --- +10, 1.0

   OUTPUT LEVEL --- 1.0 VOLT

   MODULATION AMPLITUDE ---- 30 PERCENT

6. ■ V106 AND V108 FIL 4-5=6.3VAC.
7. ▲ V107 FIL 4,5-9=6.3VAC.
8. ● V101 THROUGH V105 FIL 4,5-3=6.3VAC.

EL6625-573-14-TM-25

Figure 7-1. Power supply deck tube socket voltage and resistance diagram.

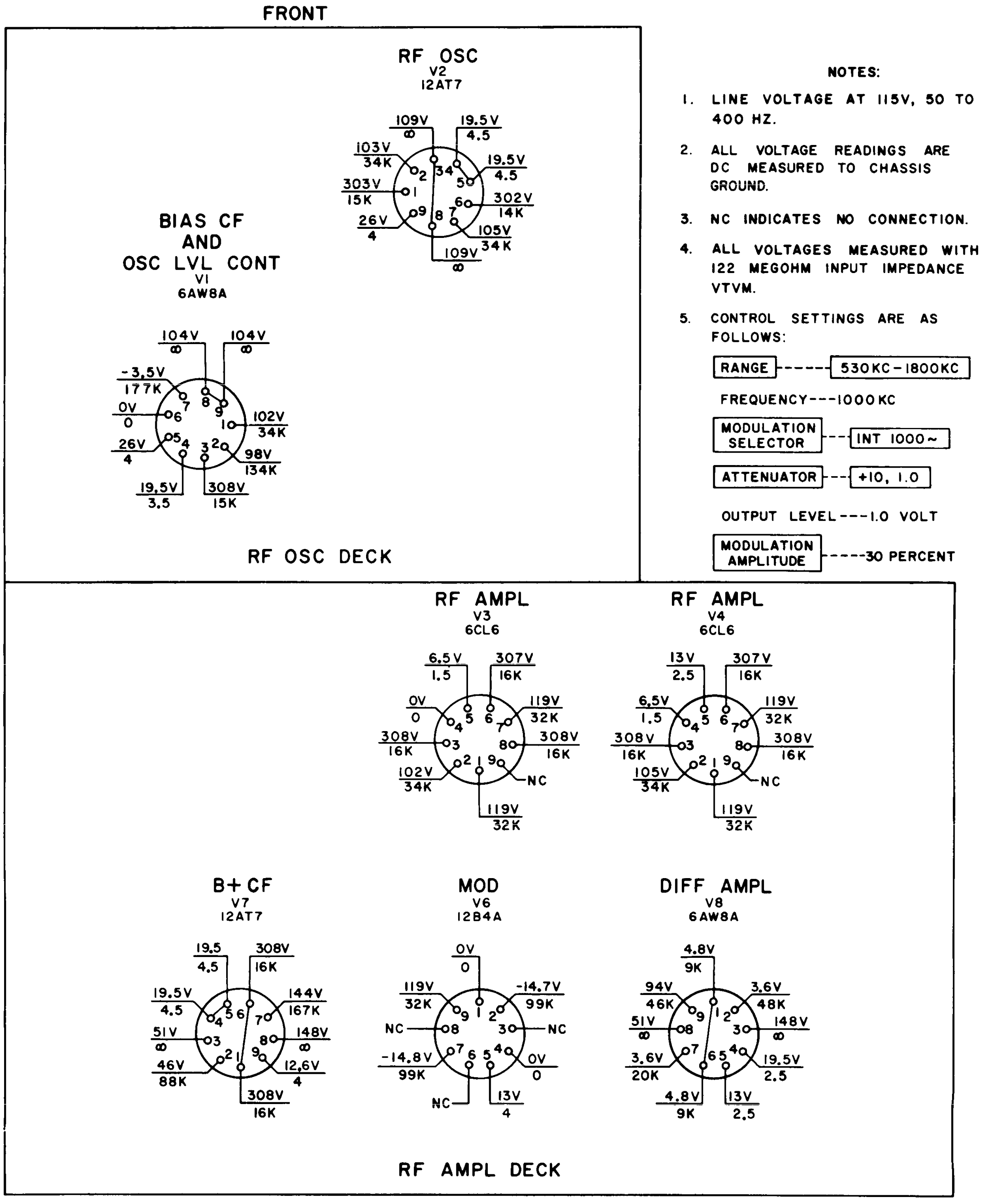


Figure 7-2. Rf oscillator and amplifier decks, tube socket voltage and resistance diagram.

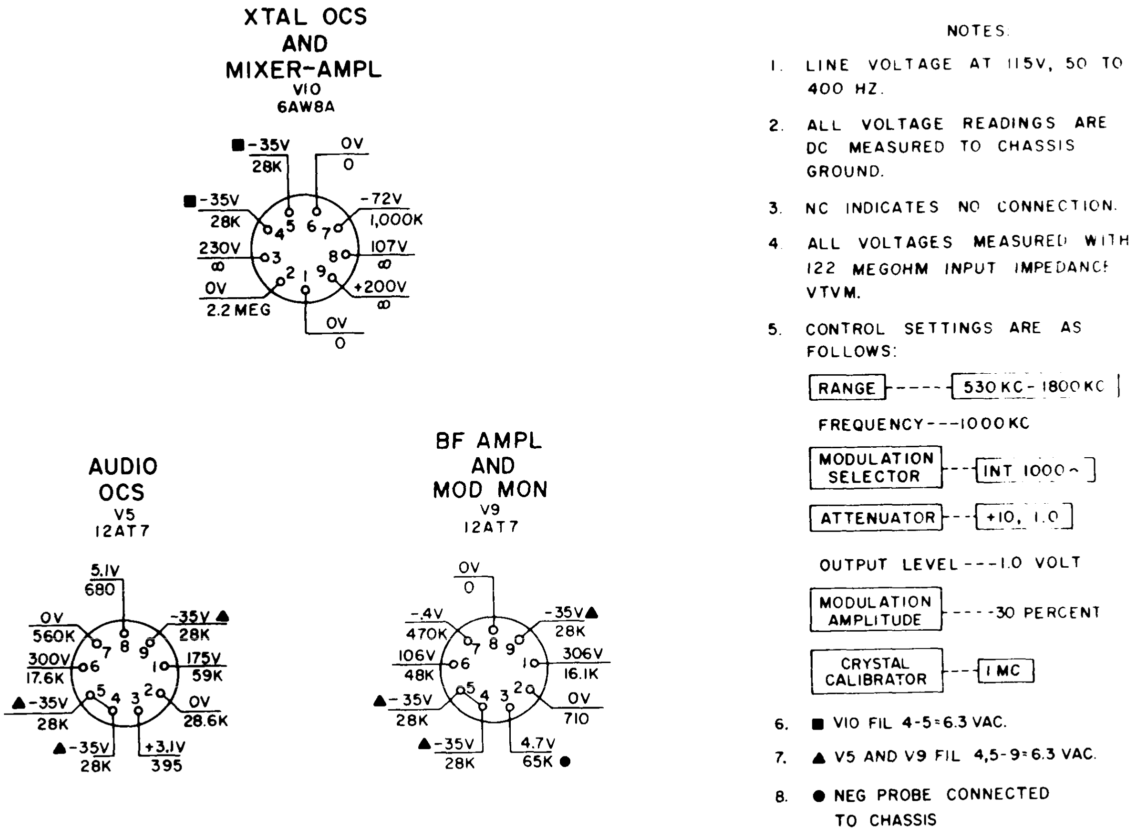


Figure 7-3. Calibrator and audio oscillator, tube socket voltage and resistance diagram.

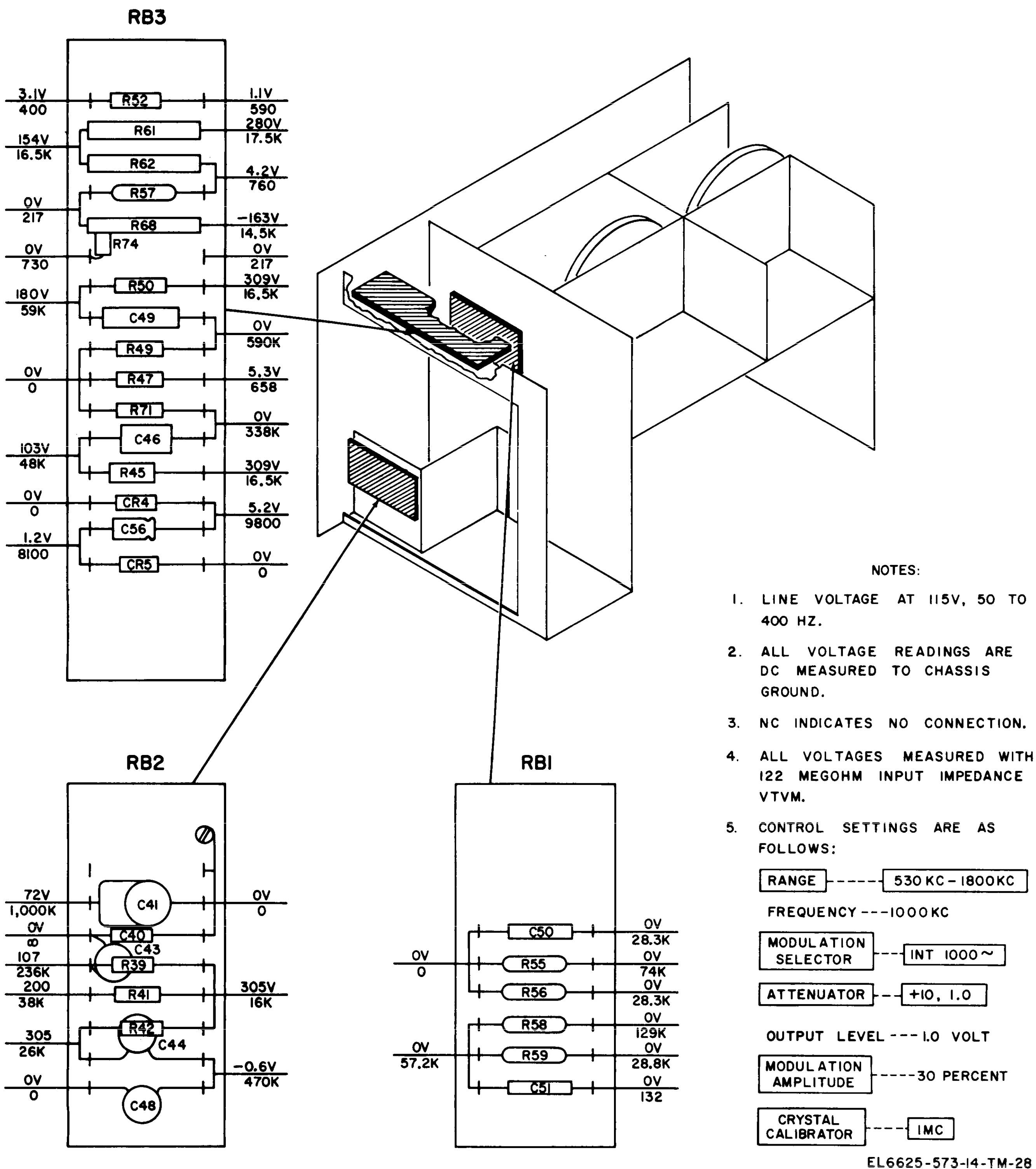


Figure 7-4. Resistor and capacitor mounting boards, voltage and resistance diagram.

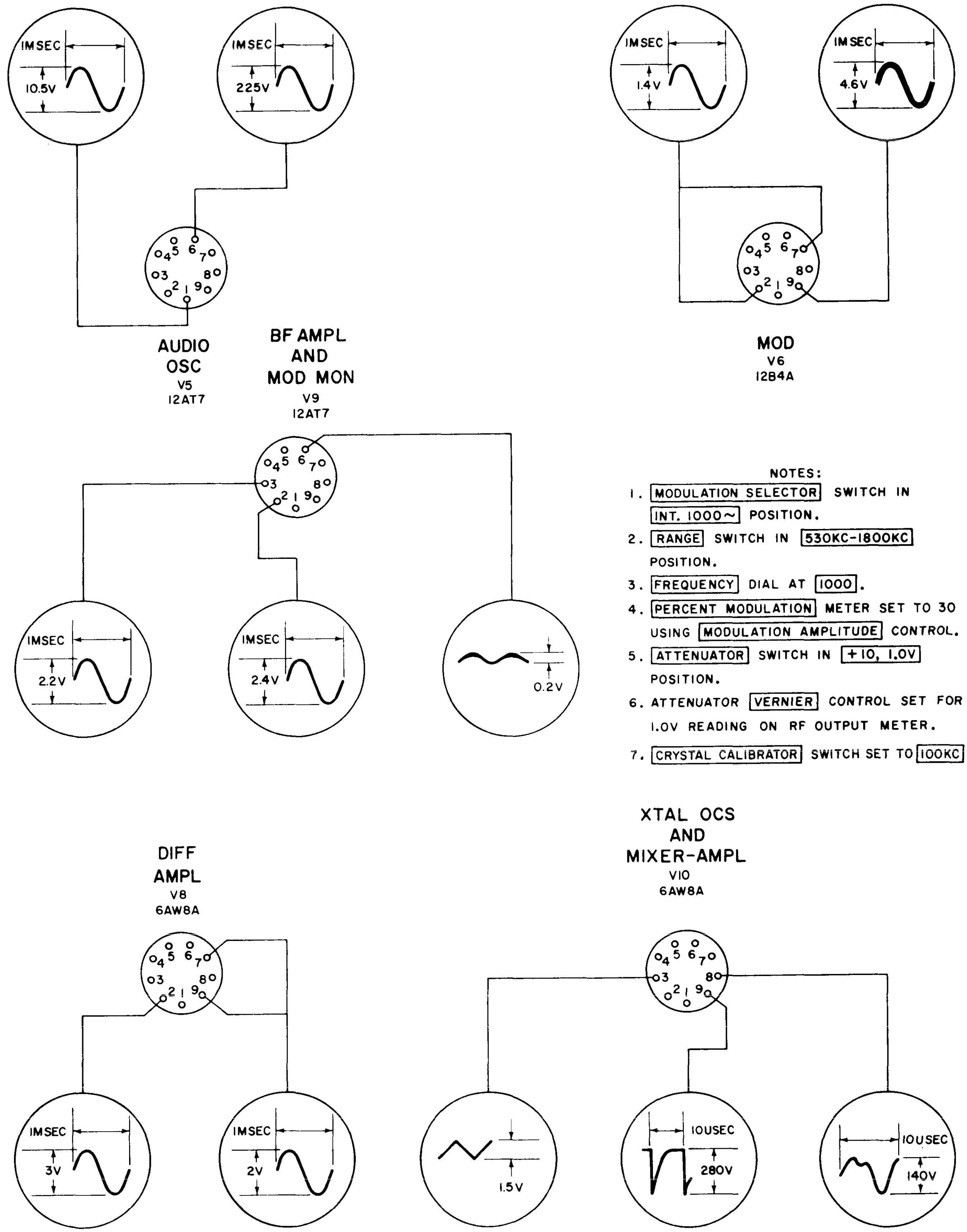


Figure 7-5. Tube socket waveform diagram.

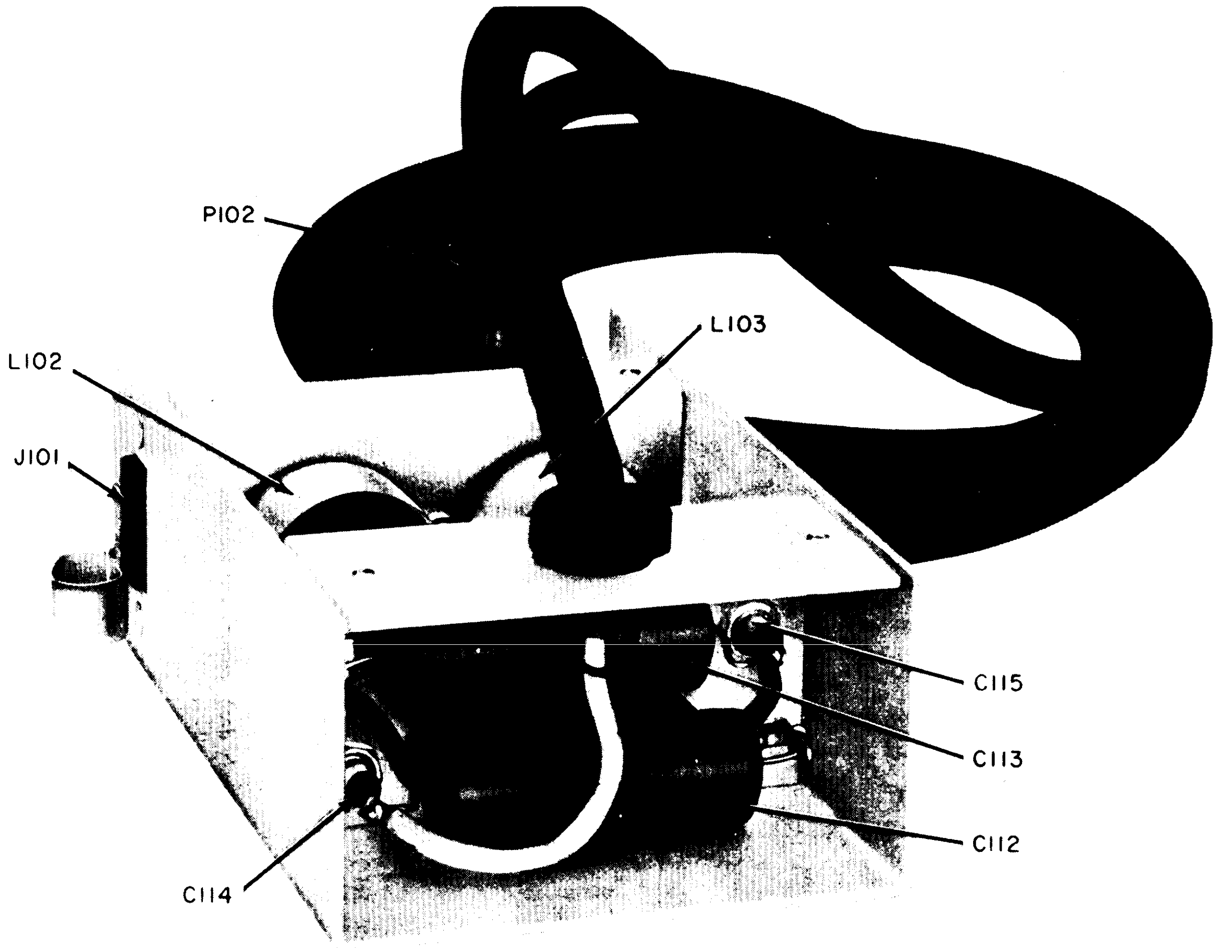


Figure 7-6. Rfi ac line filter, component location.

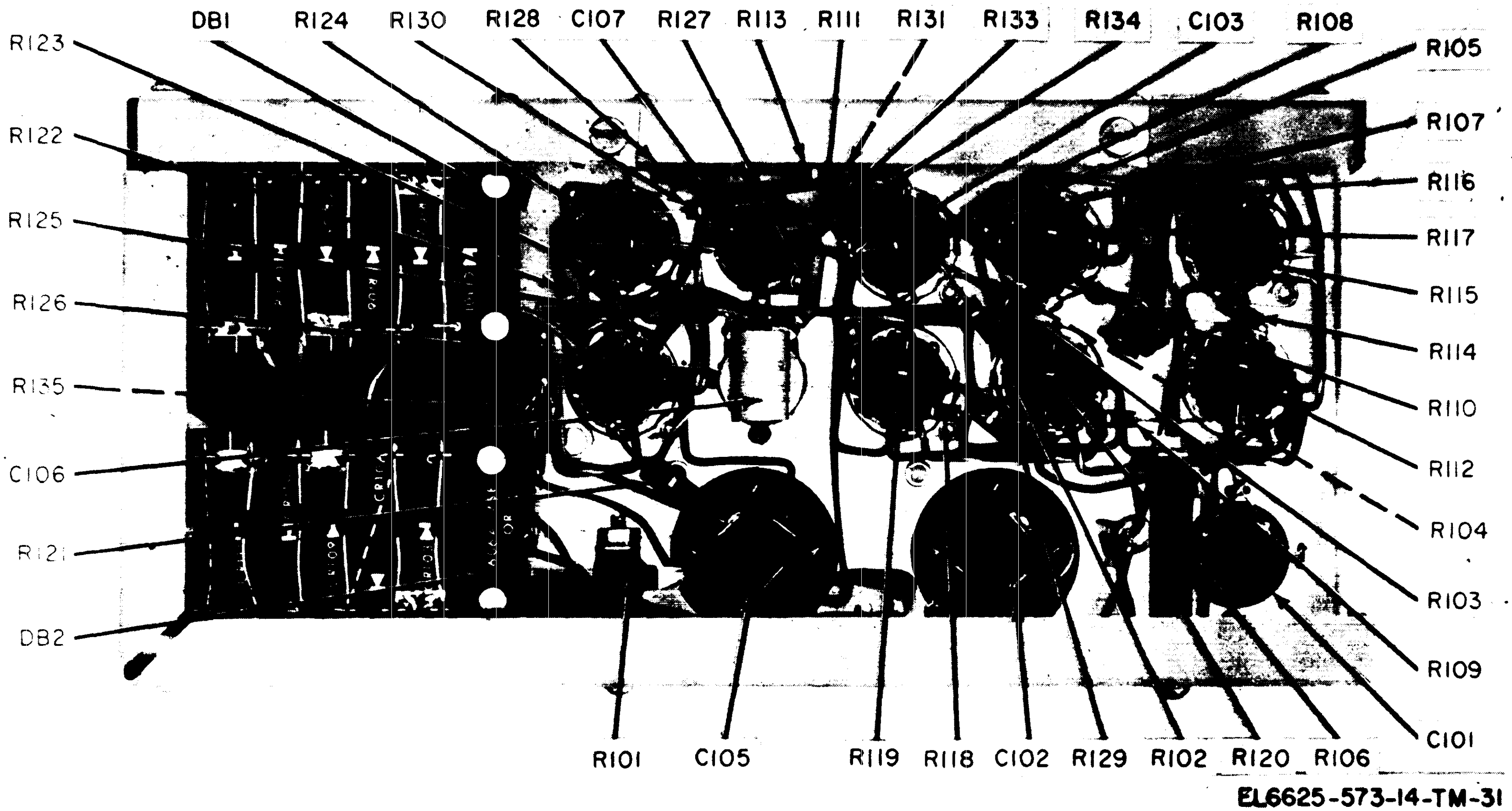


Figure 7-7. Power supply deck, component location.

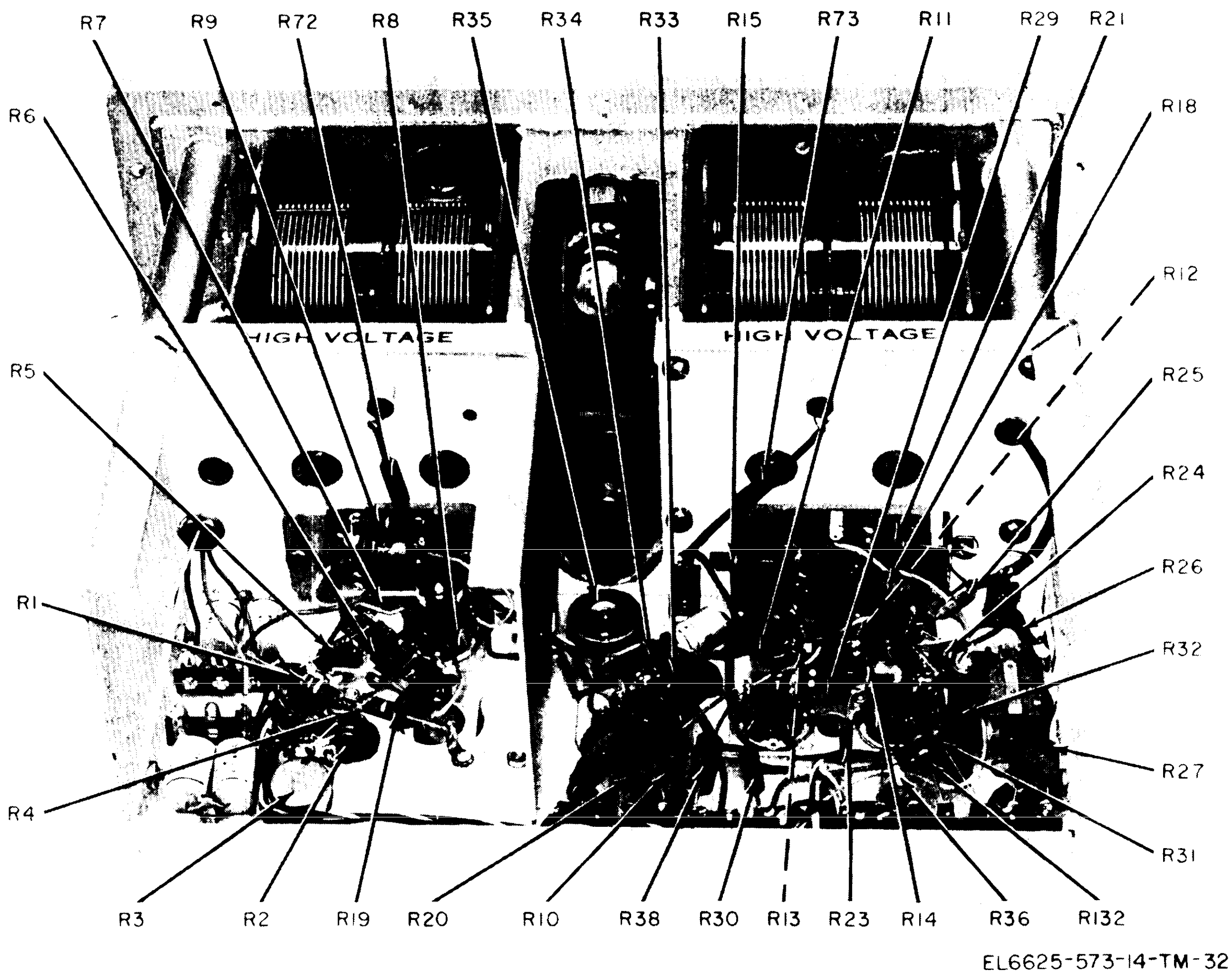


Figure 7-8. Rf oscillator and amplifier decks, resistor location.

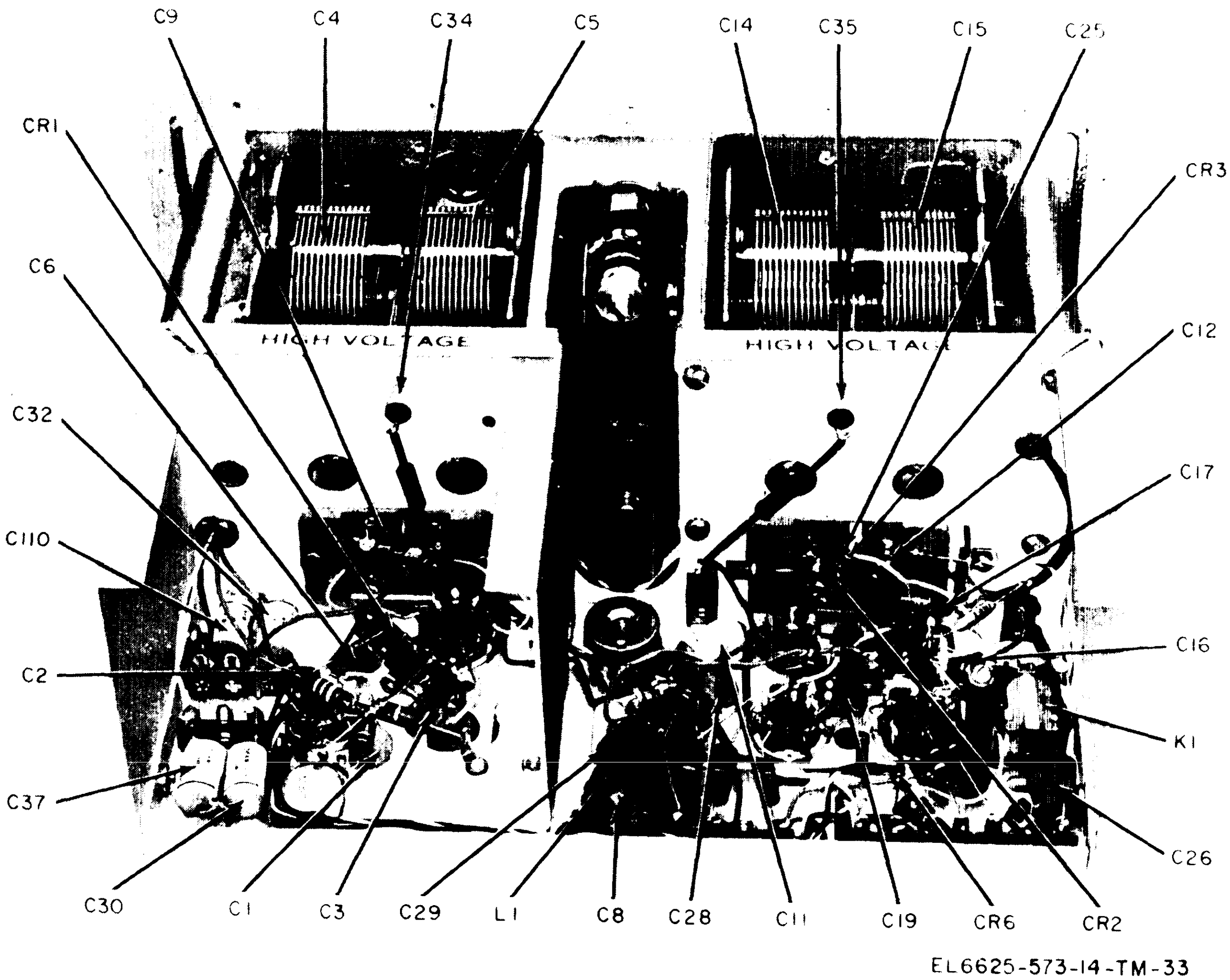


Figure 7-9. Rf oscillator and amplifier decks, capacitor, diode, relay and inductor location.

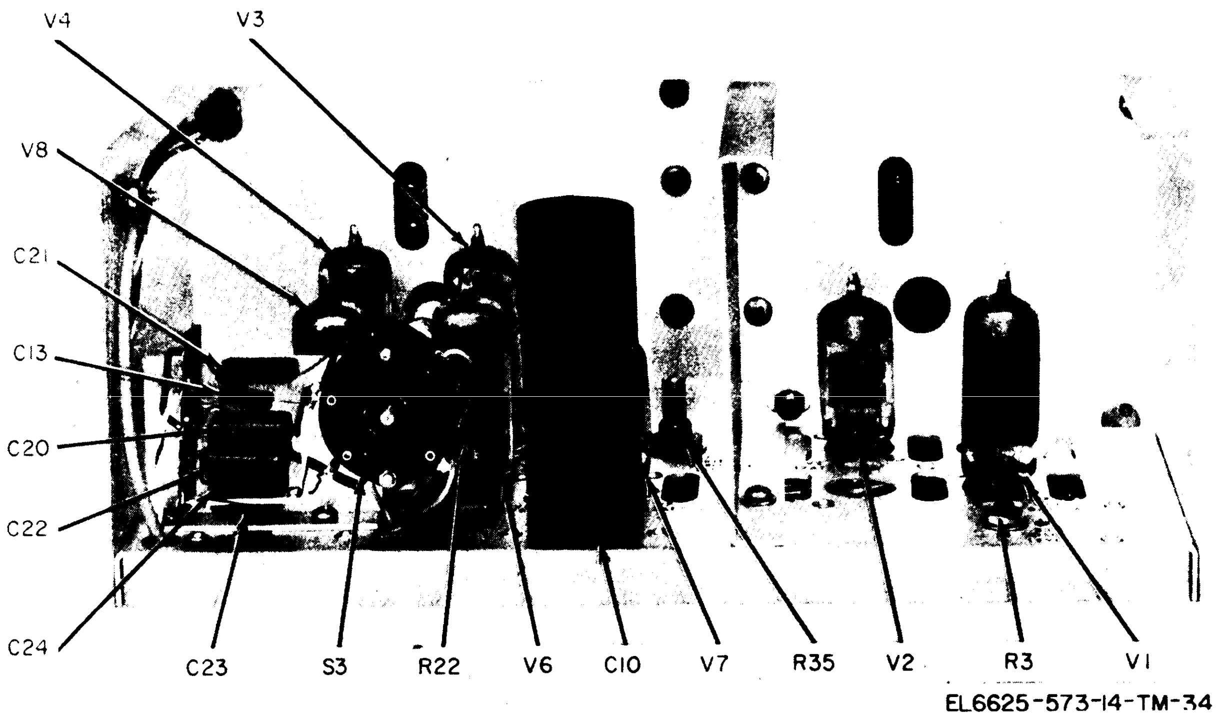


Figure 7-10. Rf oscillator and amplifier decks, top view, component location.

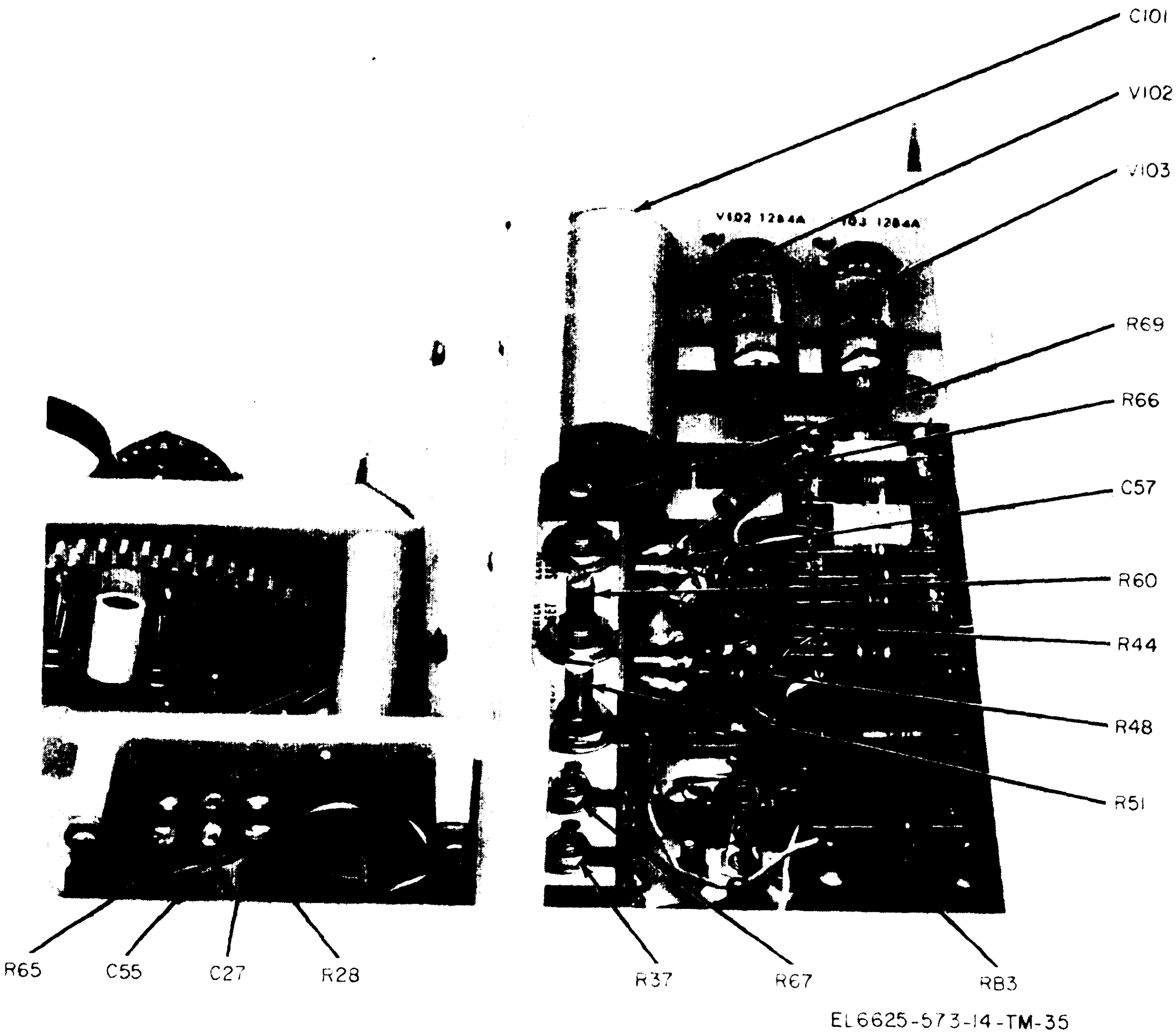


Figure 7-11. Top casting filter and top right side deck, component location.

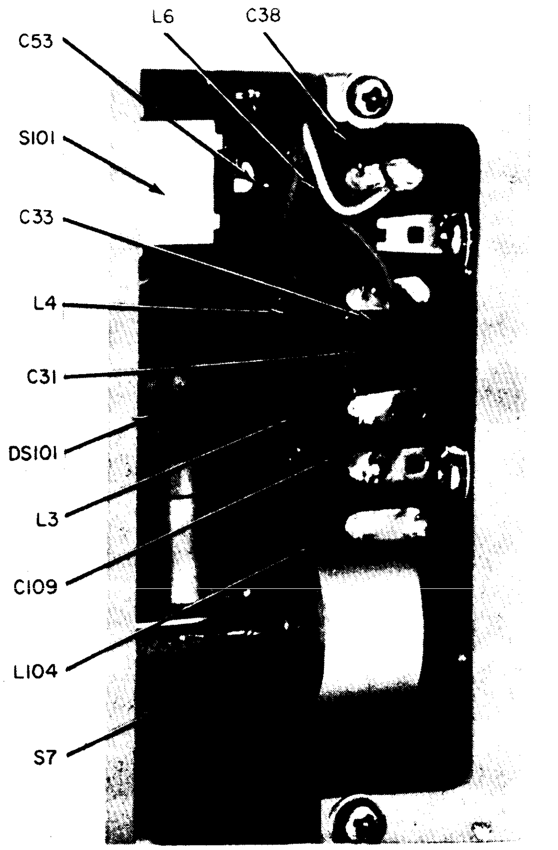


Figure 7-12. Left side casting filter, component Location.

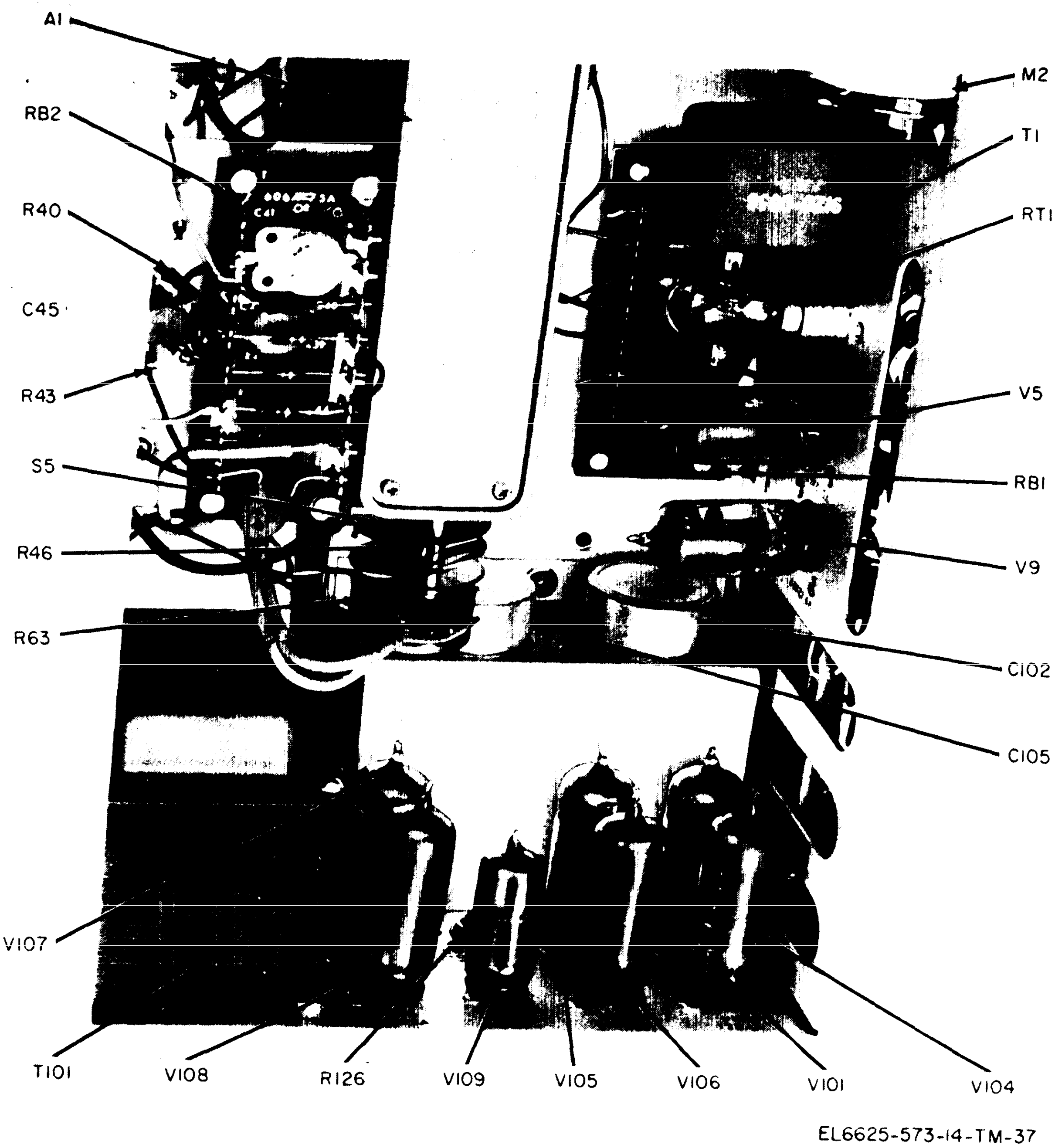


Figure 7-13. Chassis right side, component location.

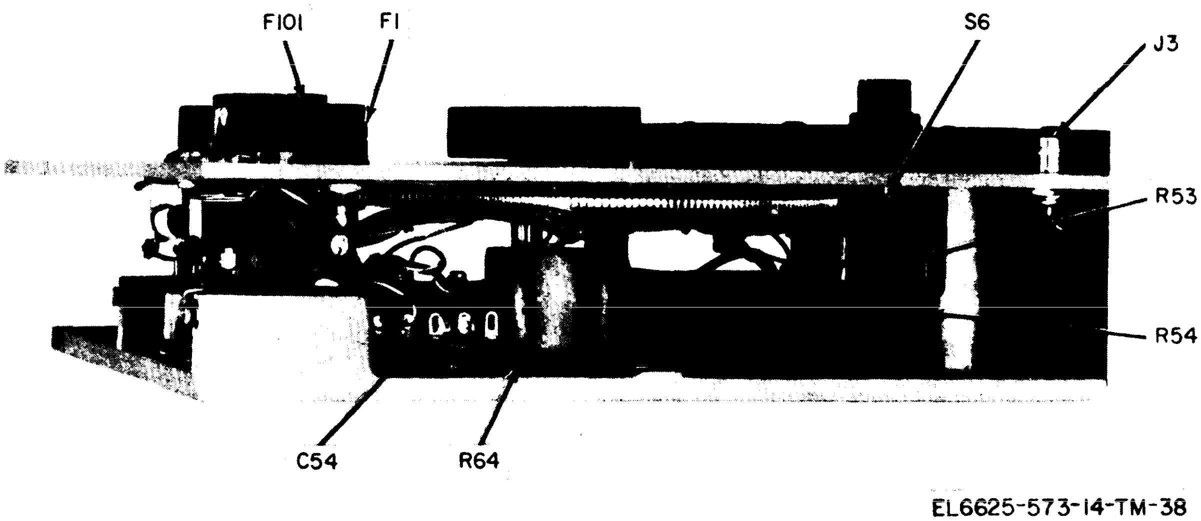


Figure 7-14. Casting and front panel, lower left view, component location.

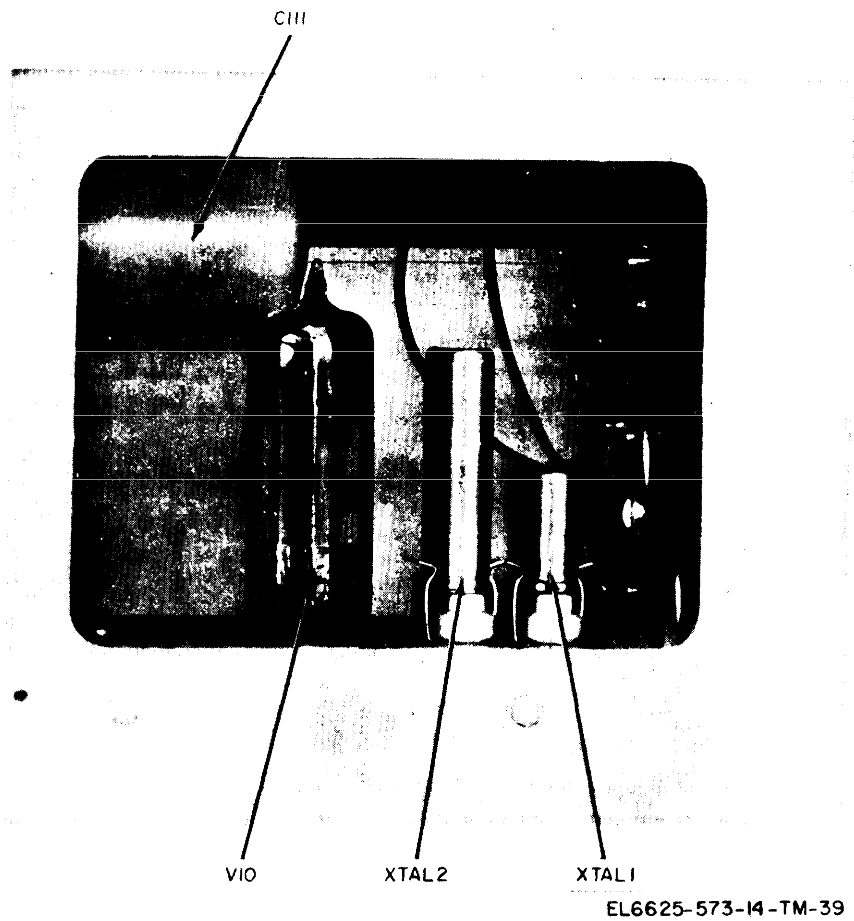


Figure 7-15. Crystal calibrator deck, top view, component location.

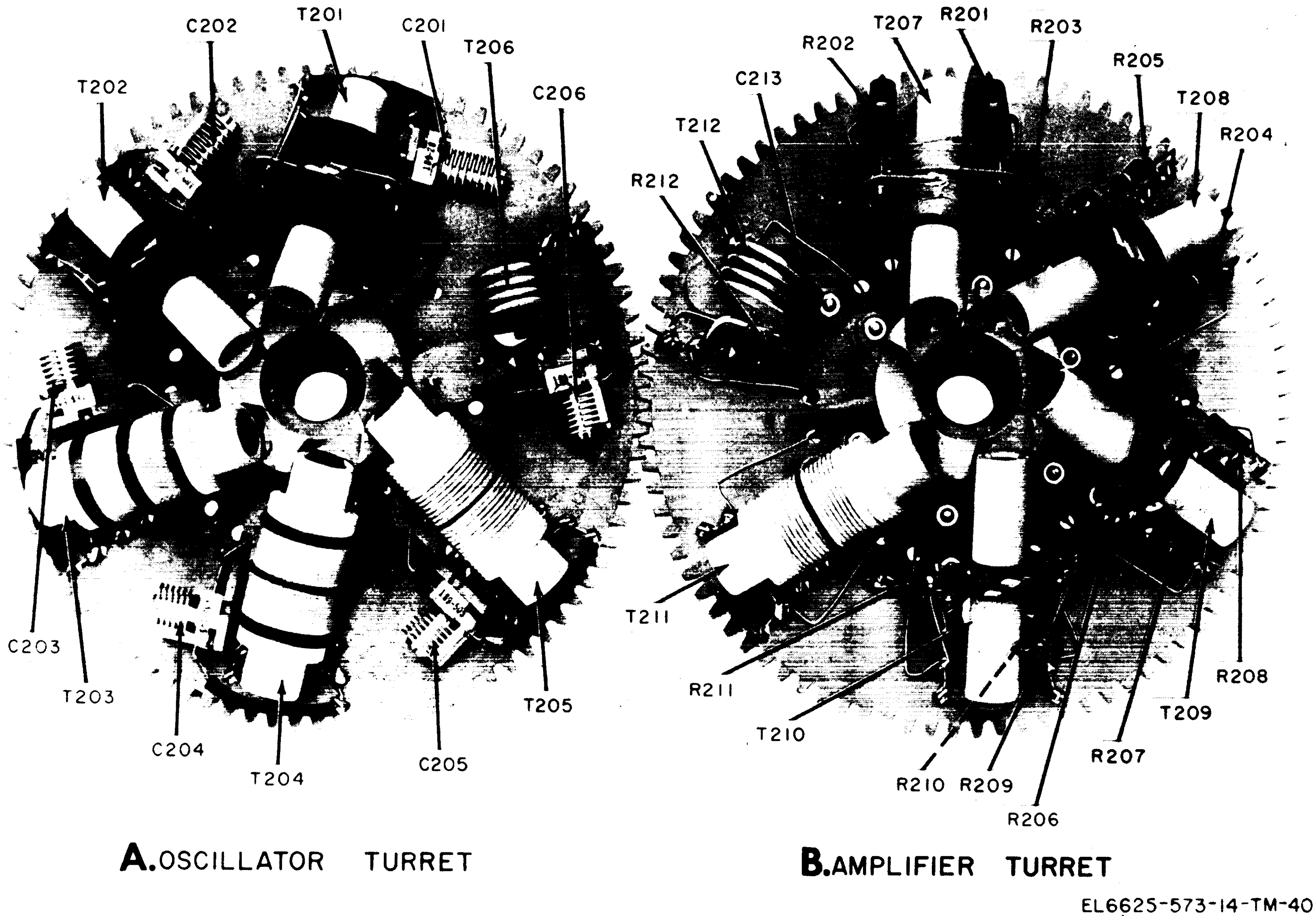


Figure 7-16. Rf oscillator and amplifier turrets, front view, component location.

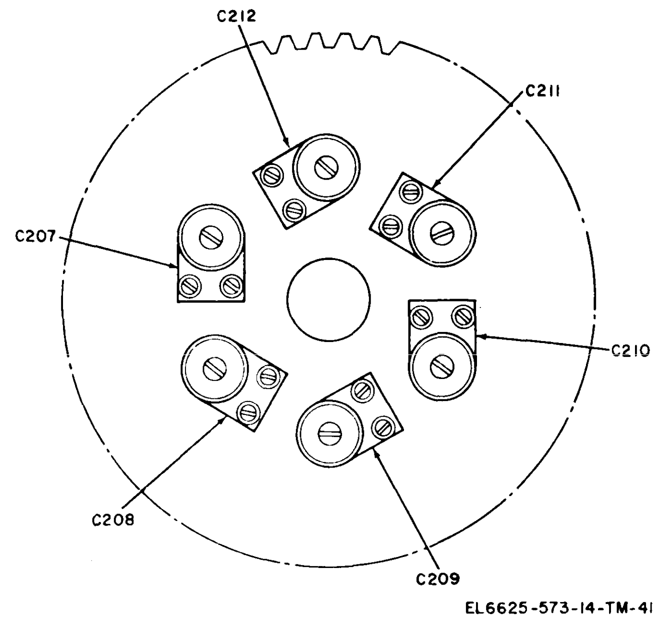


Figure 7-17. Rf amplifier turret, trimmer capacitor location.

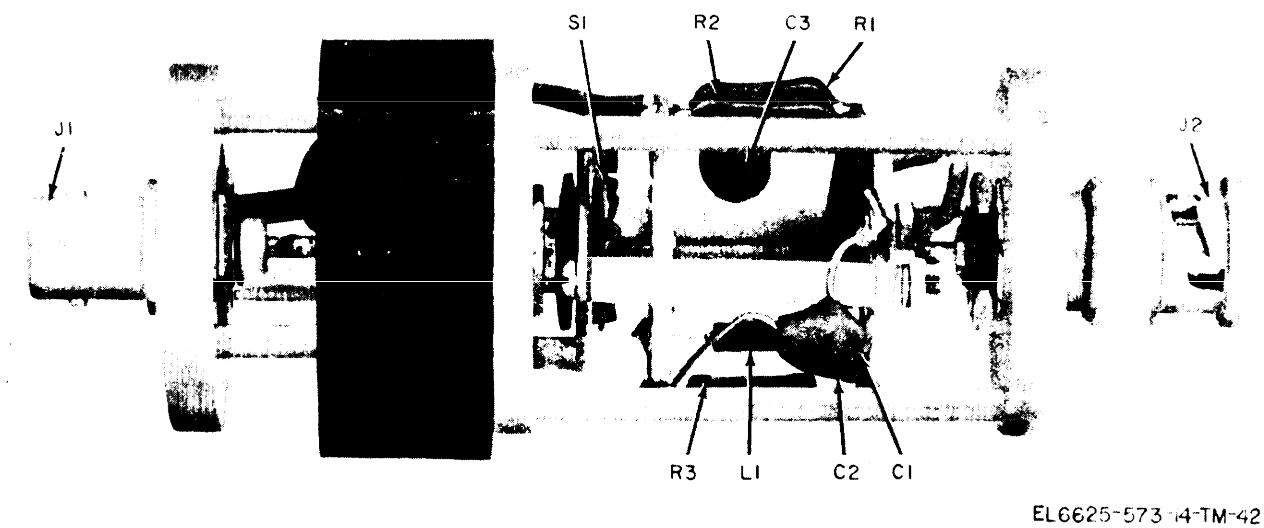


Figure 7-18. Dummy Load, Electrical DA-296/GRM-50, component location.

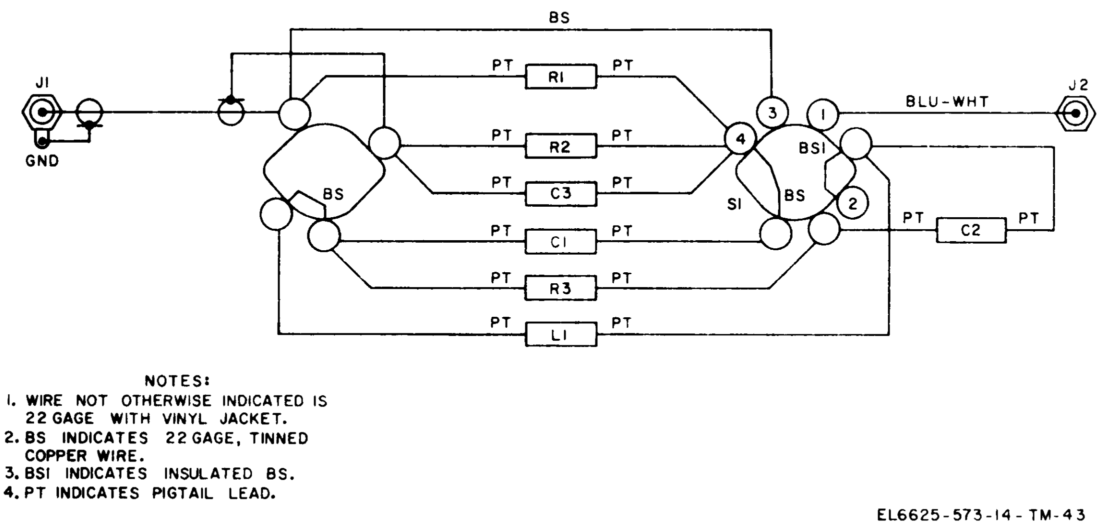


Figure 7-19. Dummy Load, Electrical DA-296/GRM-50, wiring diagram.

7-17. Range Switching Troubles

a. The troubles most likely to occur in the range-switching components are misalignment of the detent springs on the detent lift assembly, broken or missing detent drive roll pin, and frozen oscillator turret shafts. If the RANGE switch rotates continuously with no detent snap action, the drive roll pin (fig. 7-20) has worked loose and fallen out, or has broken off.

b. Refer to paragraph 7-42 for drive roll pin repair and detent spring adjustment procedures. If the RANGE switch control is frozen, or requires excessive pressure for rotation, the detent rollers may be incorrectly seated in the control cam detents (fig. 7-20). A stiff or frozen range switching control may also be due to burrs on one of the steel turret shafts. Burrs can damage the soft metal casting borings. If so, remove the turret shafts (para 7-28). File off the burrs with a fine file, remove chips from inside the casting, and replace turret shafts. However, if scoring is so severe that the turret shaft cannot be supported, replace the casting.

7-18. Variable Tuning Troubles

If the FREQUENCY dial rotates completely and fails to stop just past the numbered portion of the dial, one or both of the roll pins used to stop the dial are missing. Replace missing pin or pins (fig. 7-20). If the rf output frequency does not vary as the FREQUENCY dial is rotated, the drive cable (fig. 7-21) is either broken or loosened from the tuning capacitor drive components. Replace the drive cable (para 7-23).

Section IV. MAINTENANCE OF SIGNAL GENERATOR AN/ GRM-50

7-19. General Parts Removal and Replacement

Before unsoldering any wire leads or components, tag all leads for future identification and note the lead dress of the wires and components to be replaced. When installing new wires or components, use the same lead dress as used on the old wires or components. In addition, keep all wires as close to the chassis as possible. These steps will minimize or eliminate readjustment. When making repairs, do not disturb the setting of any adjustment controls. Heavy negative feedback is used in many of the circuits to reduce effects of supply voltage changes and minor component variations. Even after component replacement, it may be unnecessary to make any adjustments if the adjustment controls are not disturbed during repair.

7-20. Removal and Replacement of Cabinet

a. Removal. The cabinet must be removed to perform any internal repairs. To remove the cabinet, proceed as follows:

(1) Remove the four screws securing rear cover to chassis.

(2) Unplug inner power cord from rf filter box mounted on inside of rear cover.

(3) Tip SG-479/G on its back.

(4) Loosen the two set screws located at front of cabinet bottom.

(5) Lift cabinet off chassis.

b. Replacement. To replace the cabinet, proceed as follows:

(1) Set chassis on its back.

(2) Ensure that set screws located at bottom front of cabinet are turned out approximately ½ inch.

(3) Slip cabinet over chassis and push on top of cabinet to seat top of front panel in cabinet slots.

(4) Tighten set screws.

(5) Plug chassis power cord into rf filter box mounted on rear cover.

(6) Install rear cover and secure with the four sheet metal screws.

7-21. Removal and Replacement of Rf Shield

a. Removal. Rf shield removal is required to make repairs to the rf oscillator and rf amplifier decks, both turrets, and any of the mechanical parts comprising the band switching and variable tuning drive assemblies. To remove the rf shield, proceed as follows:

(1) Remove the 18 screws securing rf shield to main casting.

NOTE

Use special wrench clipped to top of rf shield to remove the four cap screws securing left side of rf shield.

(2) Remove the three screws securing upper rf shield brace to crystal calibrator assembly.

(3) Remove the two screws securing rf shield brace to crystal calibrator assembly.

(4) Loosen the three screws securing upper rf shield brace to rf shield, slide brace away from crystal calibrator assembly as far as it will go, and tighten the three screws.

(5) Loosen the two screws securing left rf shield brace to rf shield, slide brace away from crystal calibrator assembly as far as it will go, and tighten the two screws.

(6) Remove rf shield by pulling straight to rear.

b. Replacement. To replace the rf shield, proceed as follows:

(1) Slide rf shield into position over rf amplifier and rf oscillator decks.

(2) Install the 18 rf shield mounting screws. Use special wrench clipped to top of rf shield to install the four cap screws that secure left side of rf shield.

(3) Slide upper rf shield brace to left and install the three screws, lockwashers, and flat washers to secure brace to crystal calibrator assembly.

(4) Tighten the three screws securing upper rf shield brace to rf shield.

(5) Slide left rf shield brace to left and install the two screws, lockwashers, and flat washers to secure brace to crystal calibrator assembly.

(6) Tighten the two screws securing left rf shield brace to rf shield.

7-22. Removal and Replacement of Front Panel (fig. 7-20)

a. Removal. To repair any electronic components mounted behind the front panel or on front of main casting or to repair either the range-switching or variable tuning mechanical drive components, the front panel must be separated from the main casting. To remove the front panel, refer to figure 7-20 and proceed as follows:

(1) Remove the two set screws (1) securing FREQUENCY knob (3) and remove knob.

(2) Remove the two set screws (1) securing VERNIER knob (2) and remove knob.

(3) Remove the two set screws (4) securing RANGE knob (5) and remove knob.

(4) Remove the four screws (24) securing outer dial hub (25) and frequency dial (26) to dial hub (27). Remove outer dial hub and frequency dial.

(5) Remove the four screws (76) and washers (77) securing front panel (13) to casting (41).

(6) Remove coaxial connector that mates with connector (79) on casting (41).

(7) Swing front panel away from casting.

b. Replacement. To replace front panel, refer to figure 7-20 and proceed as follows:

(1) Remove vernier shaft (17).

(2) Preload vernier load pinion gear (15) two and one half teeth and secure with masking tape.

(3) Apply Mobilux No. 1 grease to vernier shaft and insert shaft in casting.

KEY to fig. 7-20:

1 Set screw, 8-32 x 1/8
2 VERNIER knob
3 FREQUENCY knob
4 Set screw, 6-32 x 1/8
5 RANGE knob
6 Machine screw, 4-40 x ¼
7 Guide boss
8 Dial window
9 Retaining ring, 5/16 x 0.025
10 Flat washer
11 Calibrate knob
12 Flat washer, 7/16 x 0.318 x 0.02
13 Front panel
14 Vernier helical spring
15 Vernier load pinion gear
16 Drive roll pin, 1/16 x ½
17 Vernier shaft
18 Retaining ring, ¼ in.
19 Pointer
20 Pointer spring
21 Flat washer, 3/4 x 0.255
22 Pointer shaft
23 Set screw, 8-32 x 3/16
24 Machine screw, 6-32 x 3/8
25 Outer dial hub
26. Frequency dial
27 Dial hub
28 Roll pin, 1/8 x ½
29 Retaining ring, 0.461 x 0.035
30 Tuner shaft
31 Tuner shaft rf gasket
32 Tuner shaft ball bearing
33 Tuner shaft bushing
34 Roll pin, 5/32 x 1
35 Machine screw, 10-24 x 5/8
36 Lock washer, S10
37 Machine screw, 4-40 x ¼
38. Cable drive drum
39 Retaining ring, 0.5 x 0.035
40 Drive pin, 3/32 x 9.16
41 Casting
42. Pointer cam
43 Retaining ring, 7/8 x 0.042
44 Flat wahser, 7/8 x 1-1/8
45 Detent lift assembly
46 Drive roll pin, 3/32 x 7/8
47 Control cam
48 Detent spring retaining pin, 3/32 x 9/16
49 Detent helical spring, 1-3/8
50 Retaining spring, ½ in.
51 Flat washer, 1¼ x 9/32 x 0.006
52 Oscillator turret shaft
53 Oscillator turret shaft rf gasket
54 Flat washer, 17/32 x 1¼ x 0.006
55 Machine screw, 8-32 x ½
56 Lock washer
57 Washer, 5/8 x 3/16 x 1/8
58 Leaf spring
59 Detent spring
60 Detent mounting bracket
61 Detent roller
62 Machine screw, 8-32 x ½
63 No. 8 lock washer
64 No. 8 flat washer
65 No. 8 star washer
66 Bushing, 3/8-32 x ½
67 Lock washer, ½ x 3/8
68 Turret drive spur gear
69 Turret drive shaft
70 Set screw, 8-32 x 1/8
71 Hollow spacer
72 Machine screw, 8-32 x 3/8
73 No. 8 star washer
74 No. 8 flat washer
75 Side filter cover
76 Machine screw, 10-24 x 3/8
77 No. 10 flat washer
78 To filter cover
79 Female coaxial connector
80 Solid spacer

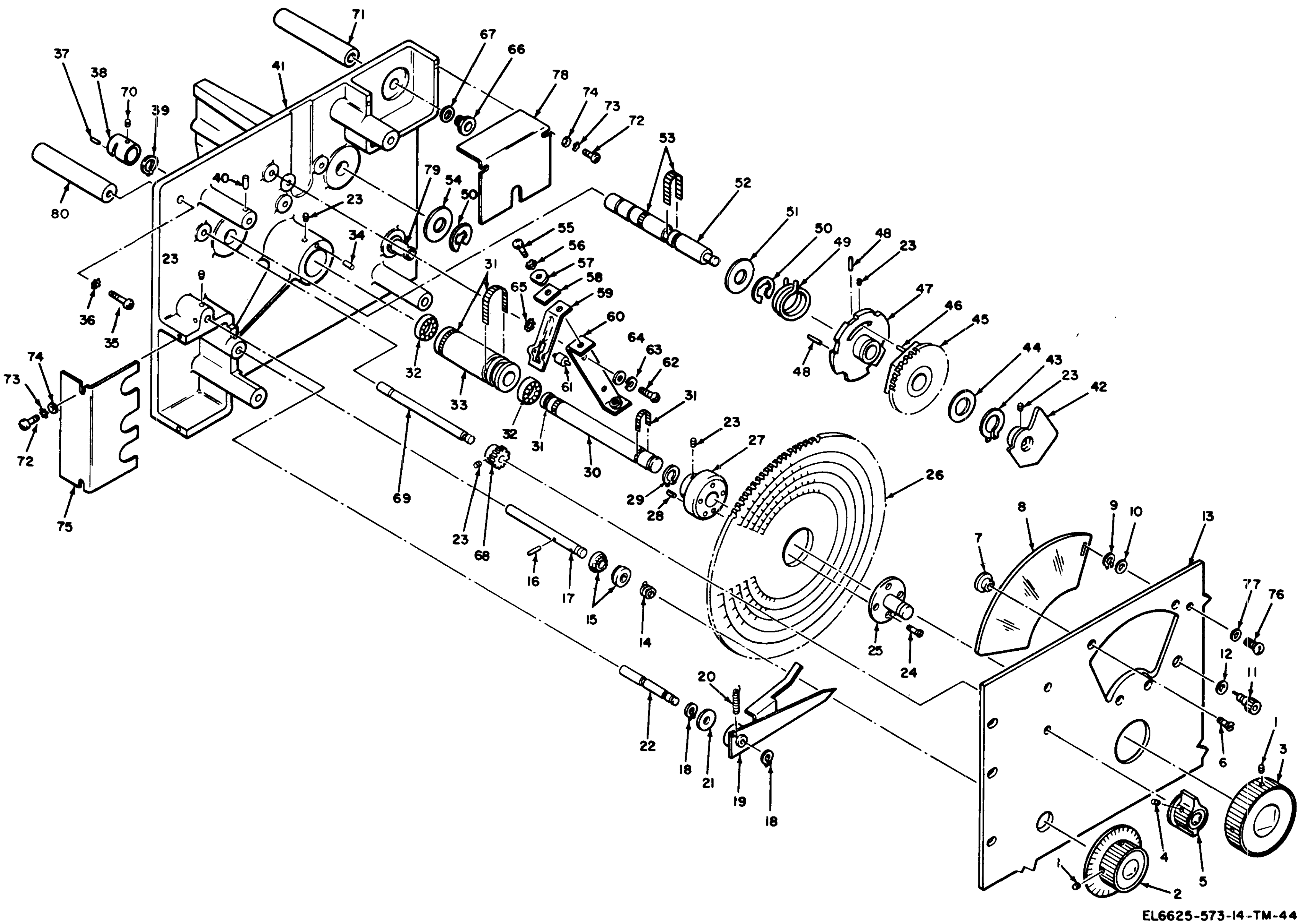


Figure 7-20. Band-switching and variable tuning components (forward exploded view).

CAUTION

Do not pinch wires between front panel and casting.

(4) Swing front panel into place in front of casting.

(5) Install the four screws (76) and flat washers (77) that secure front panel to casting. Secure to finger tightness only.

(6) Center turret drive shaft (69) in front panel hole and tighten the four screws (76).

(7) Rotate dial hub (27) fully clockwise.

(8) Insert frequency dial (26) from bottom and behind front panel, mate gear teeth with vernier load pinion gear (15), and set on dial hub (27).

(9) Install outer dial hub (25) over frequency dial and secure with the four screws (24). Do not fully tighten.

(10) Remove masking tape from vernier load pinion gear.

(11) Rotate frequency dial clockwise until the number 52 can be seen through vernier shaft access hole in front panel.

(12) Tighten screws in outer dial hub.

(13) With pointer marks aligned vertically, install RANGE knob (5) and tighten the two set screws (4).

(14) Install VERNIER knob (2) and tighten the two set screws (4).

(15) Install FREQUENCY knob (3) and tighten the two set screws (1).

7-23. Drive Cable Replacement
(fig. 7-21)

a. Removal. To remove the drive cable, proceed as follows:

(1) Remove cabinet.

(2) Remove rf shield.

(3) Set chassis on its top.

(4) Remove the two pan-head screws and washers and the one Phillips-head screw and washer and remove upper shield plate separating rf oscillator and rf amplifier decks.

(5) Loosen the two set screws in spring loading nut and one set screw in the end of cable drive drum.

(6) Remove round-head screws and lock washers securing drive cable to fixed and floating collars. Remove old drive cable.

b. Replacement. To replace the drive cable, refer to figure 7-21 and proceed as follows:

(1) Fully mesh tuning capacitors.

(2) Push end of drive cable nearest drive collar forward over cable drum and press drive collar into notch in cable drum.

(3) Wrap short end of drive cable one turn around cable drum and 1½ turns around floating collar.

(4) Use 4-40 x ¼ round-head screw and lock washers to secure short end of drive cable to floating collar.

(5) Position spring loading nut so that one set screw is accessible and place a 9/16 inch open-end wrench over spring loading nut to prevent nut from turning.

(6) Wrap drive cable 1½ turns around cable drive drum.

(7) Rotate idler shaft so that 4-40 screw hole in fixed collar is accessible.

(8) Use 4-40 x ¼ inch round-head screw and lockwashers to secure long end of drive cable to fixed collar.

(9) Place screwdriver in idler shaft end slot and rotate shaft counterclockwise until all slack is removed from drive cable.

(10) Tighten one set screw in spring loading nut and remove open-end wrench.

(11) Set frequency dial to midrange.

(12) Press drive cable into slot cut in cable drive drum.

(13) Hold spring loading nut with 9/16 inch open-end wrench and loosen set screw tightened in step 10.

(14) Place screwdriver in idler shaft end slot, rotate shaft ¼ turn counterclockwise, and tighten both set screws in spring loading nut. Remove open-end wrench.

(15) Rotate and hold frequency dial to low-frequency stop.

(16) Slip drive cable on cable drive drum by turning idler shaft with screwdriver. Turn until both tuning capacitors are fully meshed.

(17) Tighten set screw in end of cable drive drum.

(18) Rotate frequency dial throughout entire range and observe drive cable. Cable turns should be close together and have no overlaps.

(19) Replace upper shield plate between rf oscillator and rf amplifier decks and secure with two pan-head screws and one phillips-head screw and washers.

(20) Replace rf shield.

(21) Replace cabinet.

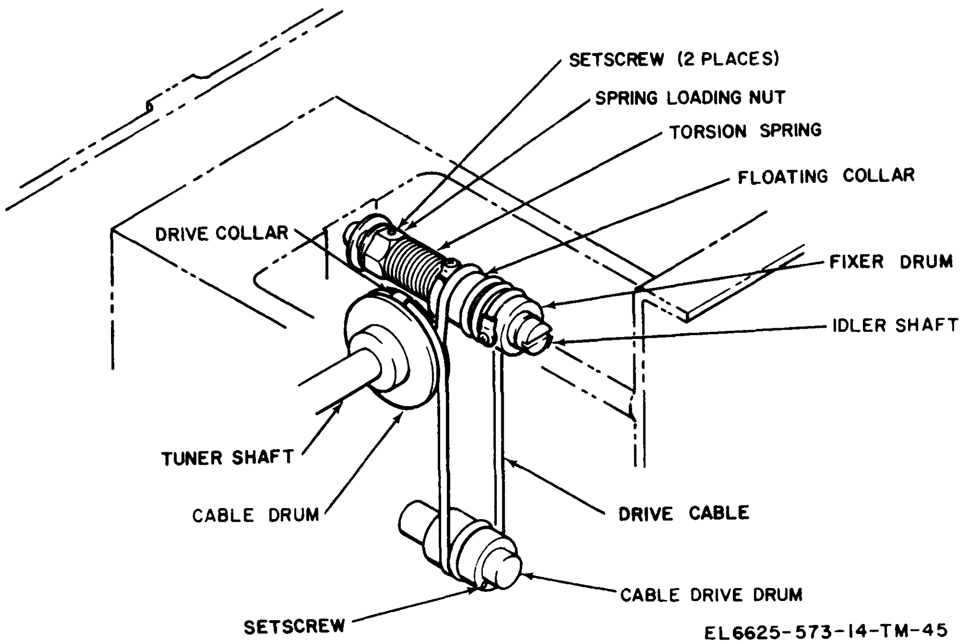


Figure 7-21. Drive cable replacement diagram.

7-24. Turret Transformer Replacement
(fig, 7-16)

Any of the rf oscillator or rf amplifier turret transformers can be replaced without removing the turret assembly.

a. Removal. To remove a turret transformer, proceed as follows:

(1) Remove cabinet.

(2) Remove rf shield.

(3) Set chassis in normal position.

(4) Rotate RANGE switch until defective turret transformer is positioned at top of turret.

NOTE

Before unsoldering any wires on defective transformer, compare leads on replacement transformer with leads on defective transformer so that installation will be correct. Tag leads if necessary.

(5) Unsolder all transformer wires and any resistors or capacitors soldered to transformer.

(6) If defective transformer is either T206 on oscillator turret or T212 on amplifier turret, unsolder the two large transformer wires from turret terminals and remove defective transformer.

(7) For any of the other transformers, place blade of a large screwdriver against inner rim of ceramic transformer form. Strike the handle end of the screwdriver a sharp blow to separate transformer from turret mountings.

b. Replacement. To replace a turret transformer, proceed as follows:

(1) If required, clean the old cement from transformer mounting pads on turret. Use a round file for this purpose.

(2) If the replacement transformer is either T206 on oscillator turret or T212 on amplifier turret, solder replacement transformer leads to correct turret terminals as noted prior to removing defective transformer.

NOTE

Do not allow cement to get between ceramic transformer form and adjustable core.

(3) For any of the other transformers, determine correct orientation for replacement transformer and use Hysol epoxy cement to secure transformer on turret mounting pads. Hold transformer in place until cement has set enough so that transformer does not move. Allow cement to cure at room temperature for 24 hours before proceeding.

(4) Solder transformer leads to correct turret terminals as noted prior to removal of defective transformer.

(5) Resolder any resistors or capacitors to transformer.

(6) Perform the frequency adjustment.

(7) Replace rf shield.

(8) Replace cabinet.

7-25. Turret Transformer Swamping Resistor Replacement
(fig. 7-16)

Resistors R203, R206, R209, and R211, located on the amplifier turret, broaden and flatten the frequency response. All these resistors can be replaced without removing the amplifier turret. Resistor values are selected at the time of manufacture to optimize frequency response, and replacement values should remain the same unless the associated transformers are replaced. In either case, install a resistor that has the same value as the defective one, and perform the selection procedure given in paragraph 7-40.

7-26. Turret Trimmer Capacitor Replacement (fig. 7-22)

Trimmer capacitors on both the oscillator and amplifier turrets can be replaced without removing the turrets.

a. Removal. To remove any turret trimmer capacitor, proceed as follows:

(1) Remove cabinet.

(2) Remove rf shield.

(3) Set chassis in normal position.

(4) Rotate RANGE switch to position defective capacitor at top of turret.

NOTE

Before unsoldering any wires on defective trimmer capacitor, check position of leads and orientation of capacitor so that installation will be correct. Tag leads if necessary.

(5) Unsolder all wires to capacitor.

(6) Use access hole in appropriate shield plate to remove the two screws securing trimmer capacitor. Remove defective trimmer capacitor.

b. Replacement. To replace trimmer capacitor, proceed as follows:

(1) On amplifier trimmer capacitors, solder 3 inches of AWG 22 bare solid copper wire to each capacitor terminal. On oscillator turret trimmer capacitors, the existing wiring can be reused.

CAUTION

Do not overtighten self-tapping screws when installing replacement trimmer capacitor on oscillator turret. If screws are overtightened, the plastic mounting tab on trimmer capacitor will break.

(2) Position replacement trimmer capacitor in correct orientation and install the two self-tapping screws and washers.

(3) Perform frequency adjustment (para 7-33).

(4) Replace rf shield.

(5) Replace cabinet.

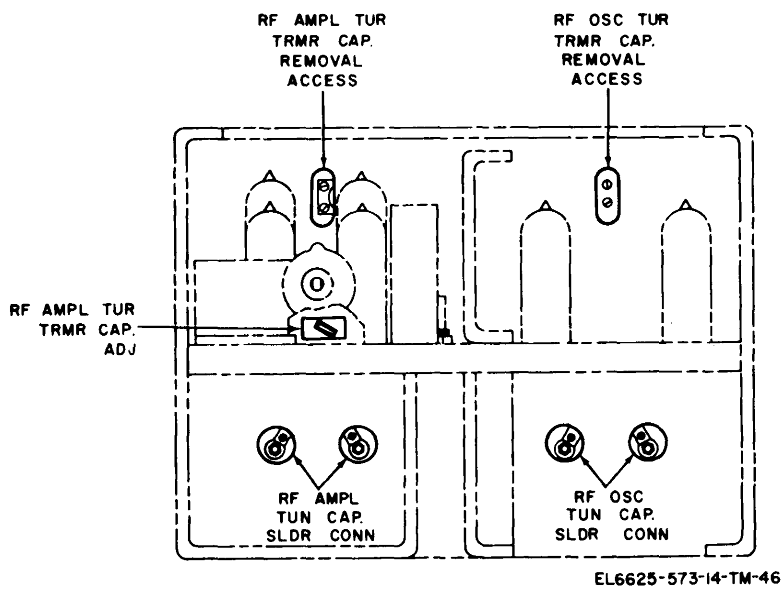


Figure 7-22. Turret trimmer capacities and tuning capacitor replacement access.

7-27. Variable Tuning Capacitor Replacement (fig. 7-23)

a. *Removal.* To remove either variable tuning capacitor, proceed as follows:

(1) Remove cabinet.

(2) Remove rf shield.

(3) Set chassis on its top.

(4) Unsolder feedthrough capacitor from tuning capacitor (5 or 8) center frame plate.

(5) Unsolder the two variable tuning capacitor solder connecting straps (fig. 7-22).

(6) If replacing oscillator tuning capacitor, remove drive cable (para 7-23) loosen the two set screws (15) in cable drum (16) and the two set

screws (13) in flexible coupling (14) adjacent to cable drum. If replacing amplifier tuning capacitor only.

(7) If replacing oscillator tuning capacitor, remove plastic brace from oscillator tuning capacitor outside frame plate.

(8) Remove three screws (2), washers (3), and insulating washers (4, 6, and 7) securing tuning capacitor to casting (1).

(9) Move tuning capacitor toward outside of chassis to free tuning shaft from cable drum or flexible coupling.

(10) Lift tuning capacitor out of chassis.

b. Replacement. To replace either variable tuning capacitor, proceed as follows:

(1) Insert replacement tuning capacitor into chassis opening and secure to casting (1) with the three screws (2), washers (3), and insulating washers (4, 6, and 7).

(2) If replacing rf oscillator tuning capacitor, attach plastic brace to tuning capacitor (8) outside frame plate.

(3) If replacing oscillator tuning capacitor, fully mesh capacitor plates, position cable drum (16) so that drive collar slot is at top, and tighten the two set screws (15) in cable drum. Tighten the two set screws (13) in flexible coupling (14). Replace drive cable (para 7-23).

(4) If replacing amplifier tuning capacitor, fully mesh capacitor plates and tighten the two set screws (13) in flexible coupling (14).

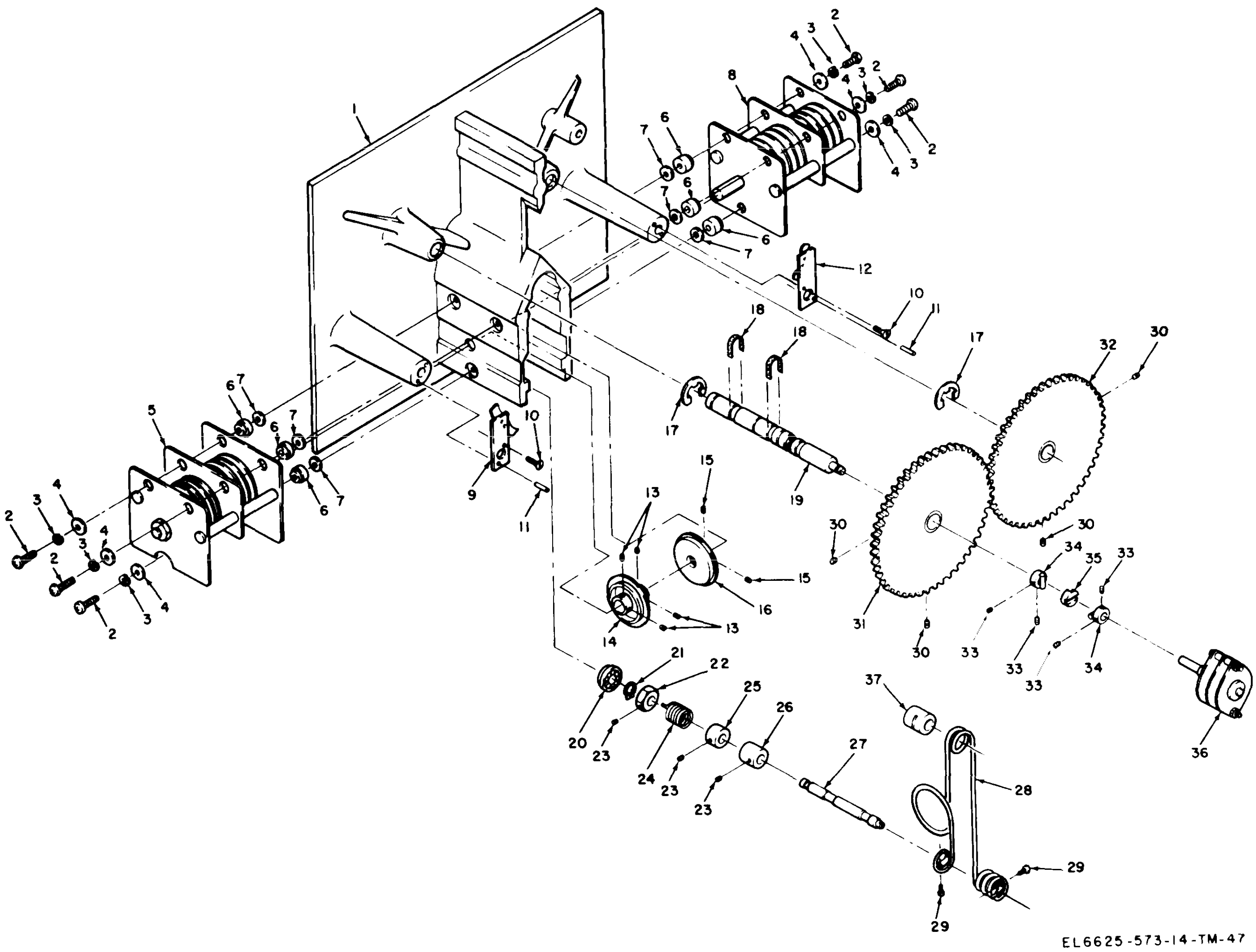
(5) Resolder the two tuning capacitor connection straps.

(6) Resolder feedthrough capacitor to center frame plate on tuning capacitor.

(7) Perform frequency adjustment.

(8) Replace rf shield.

(9) Replace cabinet.



1 Casting
2 Machine screw, 8-32 x 5/8
3 No. 8 lock washer
4 Fiber washer, ½ x 1/16
5 Amplifier tuning capacitor
6 Shoulder washer
7 Flat washer, 7/16 x 0.031
8 Oscillator tuning capacitor
9 Amplifier shorting contact
10 Machine screw, 4-40 x ¼
11 Roll pin, 0.094 x 3/8
12 Oscillator shorting contact
13 Set screw, 8-32 x 3/16
14 Flexible coupling
15 Set screw, 6-32 x 3/16
16 Cable drum
17 Retaining ring, ½ in.
18 Rf gasket
19 Amplifier turret shaft
20 Idler shaft ball bearing
21 Idler shaft retaining
22 Spring loading nut
23 Set screw, 8-32 x 3/8
24 Torsion spring
25 Floating collar
26 Fixed collar
27 Idler shaft
28 Drive cable
29 Set screw, 4-40 x ¼
30 Set screw, 10-32 x 3/16
31 Amplifier turret
32 Oscillator turret
33 Set screw, 6-32 x 1/8
34 Coupling, ¼ x ½ X 3/16
35 Coupling, ½ x 7/32
36 S3 switch assembly
37 Cable drive *drum*

Figure 7-23. Band switching, and variable tuning components (rear) exploded view.

7-28. Turret Replacement

a. Removal. Refer to figure 7-20 and proceed as follows:

(1) Remove cabinet.

(2) Remove rf shield.

(3) Remove front panel.

(4) Loosen the two set screws (23) and remove pointer cam (42).

(5) Remove pointer spring (20).

(6) Loosen the two set screws (23) that secure pointer shaft (22) to casting (41) and remove pointer assembly (18, 19, 21, and 22).

(7) Set turrets to 19MC-65MC position (large-wire, four-turn coils in bottom position).

(8) Refer to figure 7-23. Loosen the two set screws (33) that secure coupler (34) to amplifier turret shaft (19).

(9) Refer to figure 7-20. Loosen the two set screws (23) that secure control cam (47) to oscillator turret shaft (52). Both turrets should be free to rotate now,

(10) Refer to figure 7-23. Loosen the two set screws (30) that secure amplifier turret (31) to turret shaft (19).

(11) On oscillator turret, remove the two self-tapping screws that secure trimmer capacitors blocking access to the two set screws in oscillator turret (32).

(12) Loosen the two set screws (30) that secure oscillator turret (32) to turret shaft.

(13) On inside of amplifier turret compartment, remove retaining ring (17).

(14) On inside of oscillator turret compartment, remove retaining ring (17).

(15) Refer to figure 7-20. Remove retaining spring (50) that secures oscillator turret shaft (52).

(16) Pull amplifier turret shaft forward out through front of main casting. Rock turret back and forth so that shaft does not bind. Be careful not to let the two thin rf gaskets fly off the shaft. The shaft is very tight and a plastic or wooden dowel can, be used to lightly tap out the shaft.

(17) Remove the two nuts and washers (66) and (67) that secure hollow spacer (71).

(18) Remove top filter cover (78) from front of casting.

(19) Tag and unsolder the red/white wire and coaxial cable routed through hollow spacer.

(20) Remove hollow spacer.

(21) Remove amplifier turret.

(22) Remove the two screws (35) and washers (36) that secure solid spacer (80).

(23) Push detent assembly up against casting.

(24) Pull oscillator turret shaft forward out through front of casting. Rock turret back and forth so that shaft does not bind. Be careful not to let the two thin rf gaskets fly off the shaft. The shaft is very tight and a plastic or wooden dowel can be used to lightly tap out the shaft.

b. Replacement. To replace turrets, refer to figures 7-20 and 7-23 and proceed as follows:

(1) carefully inspect oscillator turret shaft for burrs. If any burrs are found, carefully file them down with a fine-toothed file.

(2) Insert oscillator turret into oscillator compartment behind casting. Be careful not to bump turret switch contacts mounted on rear of turret.

(3) If necessary, apply lubriplate grease to oscillator turret shaft.

(4) Slip oscillator turret shaft through hole in plate behind oscillator compartment, through oscillator turret, and into casting.

(5) Use a plastic or leather mallet to lightly tap oscillator shaft into casting until first rf gasket releaf in shaft is about to enter casting.

(6) Apply lubriplate grease to releaf and position rf gasket in releaf with ridged side facing outward. Bend rf gasket completely around shaft and hold the two ends together.

(7) Carefully tap shaft into casting being careful not to let rf gasket get pinched. Continue to tap shaft until second rf gasket releaf is about to enter casting.

(8) Repeat (6) above.

(9) Carefully tap shaft into casting until rear retaining ring slot is about to enter casting.

(10) Position retaining ring with rounded edge toward casting and force ring into slot.

(11) Tap shaft to seat retaining ring against casting.

(12) Position forward retaining ring with rounded edge toward casting and force ring into forward slot in front of casting.

(13) Rotate oscillator turret until large four-turn transformer is in bottom position.

(14) Place amplifier turret in amplifier turret compartment behind casting and rotate turret until large four-turn transformer is in bottom position.

(15) Through hole in plate behind turrets, observe mesh of the turret teeth and mesh the teeth so that the two timing marks are aligned exactly opposite each other.

(16) Insert amplifier turret shaft through front of casting and through amplifier turret.

(17) Use lubriplate grease to lubricate portion of shaft that will be within casting.

(18) Carefully tap shaft into casting until first rf gasket releaf is about to enter casting.

(19) Repeat (6) above.

(20) Continue to tap shaft until second rf gasket releaf is about to enter casting.

(21) Repeat (6) above.

(22) Continue to tap shaft into casting until front retaining ring slot is about to enter casting.

(23) Position retaining ring with rounded edge toward casting and force ring into rear slot behind casting.

(24) Position retaining ring with rounder edge toward casting and force ring into front slot in front of casting.

(25) Recheck turret timing mark alignment.

(26) Rotate oscillator turret until one of the two set screws is accessible.

(27) Push oscillator turret toward casting; then push back until outer turret switch contact just touches shorting contact; then push turret an additional 1/16 inch toward rear.

(28) Tighten set screw on oscillator turret.

(29) Align amplfier turret in fore-aft direction to position teeth flush with oscillator turret teeth.

(30) Tighten set screw in amplifier turret.

(31) Slowly rotate turrets through all six positions and check that outer turret switch contacts mate with shorting contacts in all positions. Also check for signs of scratch marks near turret switch contacts. If scratches are found or if shorting contacts do not mate properly, loosen turret set screws and return to (27) above. Turrets must be aligned in fore-aft direction so that shorting contacts make adequate contact in all six positions but are far enough forward so that turrets do not rub against turret switching block contacts.

(32) Tighten two remaining turret set screws.

(33) Clean ends of two wires unsoldered during removal.

(34) Feed wires through hollow support leg and secure support leg with the two nuts.

(35) Resolder the two wires.

(36) Install solid support leg. Use long screw in front.

(37) Rotate turrets to position large four-turn transformers at bottom and center turret switch contacts in mating contacts on blocks.

(38) Push detent assembly forward until there is 1/8 inch clearance between detent and forward retaining ring on oscillator turret shaft.

(39) Tighten the two detent assembly set screws.

(40) Position pointer cam with hub toward rear and slip cam onto detent shaft. Do not tighten set screws.

(41) Insert pointer shaft (with pointer attached) into casting.

(42) Connect pointer tension spring.

(43) Remove vernier shaft.

(44) Preload vernier drive pinion gear's two teeth and use masking tape to hold the gears in position.

(45) Apply Mobilux grease No. 1 vernier shaft and replace shaft.

CAUTION

Do not pinch wires between front panel and casting.

(46) Swing front panel into place in front of casting.

(47) Install the four round-head screws and flat washers that secure front panel to casting. Secure to finger tightness only.

(48) Center RANGE switch shaft in front panel mounting hole and tighten the four round head screws.

(49) Rotate dial hub fully clockwise.

(50) Insert frequency dial from bottom and behind front panel, mate teeth with vernier load pinion gear, and set dial on dial hub.

(51) Install outer dial hub over frequency dial and secure with the four counter-sunk machine screws. Do not fully tighten.

(52) Remove masking tape from vernier load pinion gear.

(53) Rotate frequency dial clockwise until the number 52 can be seen through vernier shaft access hole in front panel.

(54) Tighten screws in outer dial hub.

(55) Align pointer so that it just clears frequency dial window glass.

(56) Tighten the two set screws that secure dial pointer shaft.

(57) Check that the large four-turn transformers are positioned at bottom of turrets.

(58) Rotate pointer cam so that longest and narrowest lobe rests against pointer lifting arm and align cam in fore-aft direction to center cam lobe on pointer lifting arm.

(59) Tighten the two set screws in pointer cam.

(60) On amplfier deck, loosen the two screws that secure switch S3 to deck.

(61) Insert shaft coupler.

(62) Push S3 forward to mate couplers.

(63) Tighten S3 bracket screws.

(64) Tighten the two set screws on coupler.

(65) Replace RANGE knob (pointers vertical) and tighten set screws.

(66) In all six positions of RANGE switch, check that oscillator turret cannot be rocked about its rotational axis. A small amount of rocking will be present in the amplifier turret because of the slight gear backlash. If oscillator turret rocks, the detent assembly must be adjusted.

(67) Replace vernier knob and tighten set screws.

(68) Replace main frequency knob and tighten set screws.

CAUTION

Do not overtighten self-tapping screws when securing trimmer capacitors. If the screws are overtightened, the plastic mounting tab on the trimmer capacitor will break.

(69) Replace self-tapping screws to secure the two trimmer capacitors on oscillator turret.

(70) Replace rf shield.

(71) Replace cabinet.

7-29. Dummy Load, Electrical DA-296/GRM-50 Switch Replacement

(fig. 7-24)

To replace the switch assembly (including all electrical components), proceed as follows:

a. *Removal.* To remove the switch assembly, proceed as follows:

(1) Remove the three screws (1) and washers (2) on each end and remove shields (3 and 19).

(2) Unsolder blue-white wire from switch assembly (14).

(3) Unsolder coaxial cable center conductor and shield braid from switch assembly. Also unsolder shield braid from output spacer (15).

(4) Remove the three screws (4), washers (2), and input spacers (10).

(5) Remove the three screws (18), washers (2), and output spacers (15).

(6) Loosen the two set screws (11) in knob (12).

(7) Remove the nut (9) and washer (8) securing switch assembly (14) to center disc (13) and remove switch assembly.

b. Replacement. To replace switch assembly, proceed as follows:

(1) Set switch to fully clockwise position.

(2) Insert switch assembly through hole in center disc and align switch tab in small hole in center disc.

(3) Replace nut and washer to secure switch assembly to center disc. Tighten nut.

(4) Replace the three screws, washers, and output spacers to assemble output end disc and center disc. Tighten screws.

(5) Slip knob onto switch shaft and align pointer with resistors R1 and R2. Do not tighten set screws.

(6) Clean ends of wires unsoldered during removal.

(7) Insert coaxial cable through small hole in center disc.

(8) Solder coaxial center conductor to R1 and the shield braid to R2 and the output spacer.

(9) Solder blue-white wire to switch terminal centered over black insulated bus wire.

(10) Install the three screws, washers, and input spacers to assemble input end disc and center disc. Tighten screws.

(11) Hold unit with output connector in left hand and rotate knob fully clockwise.

(12) Tighten one set screw in knob.

(13) Slip output shield over output coaxial connector and align 20 DB 5 Ω position with knob pointer.

(14) Replace the three screws and washers in output shield.

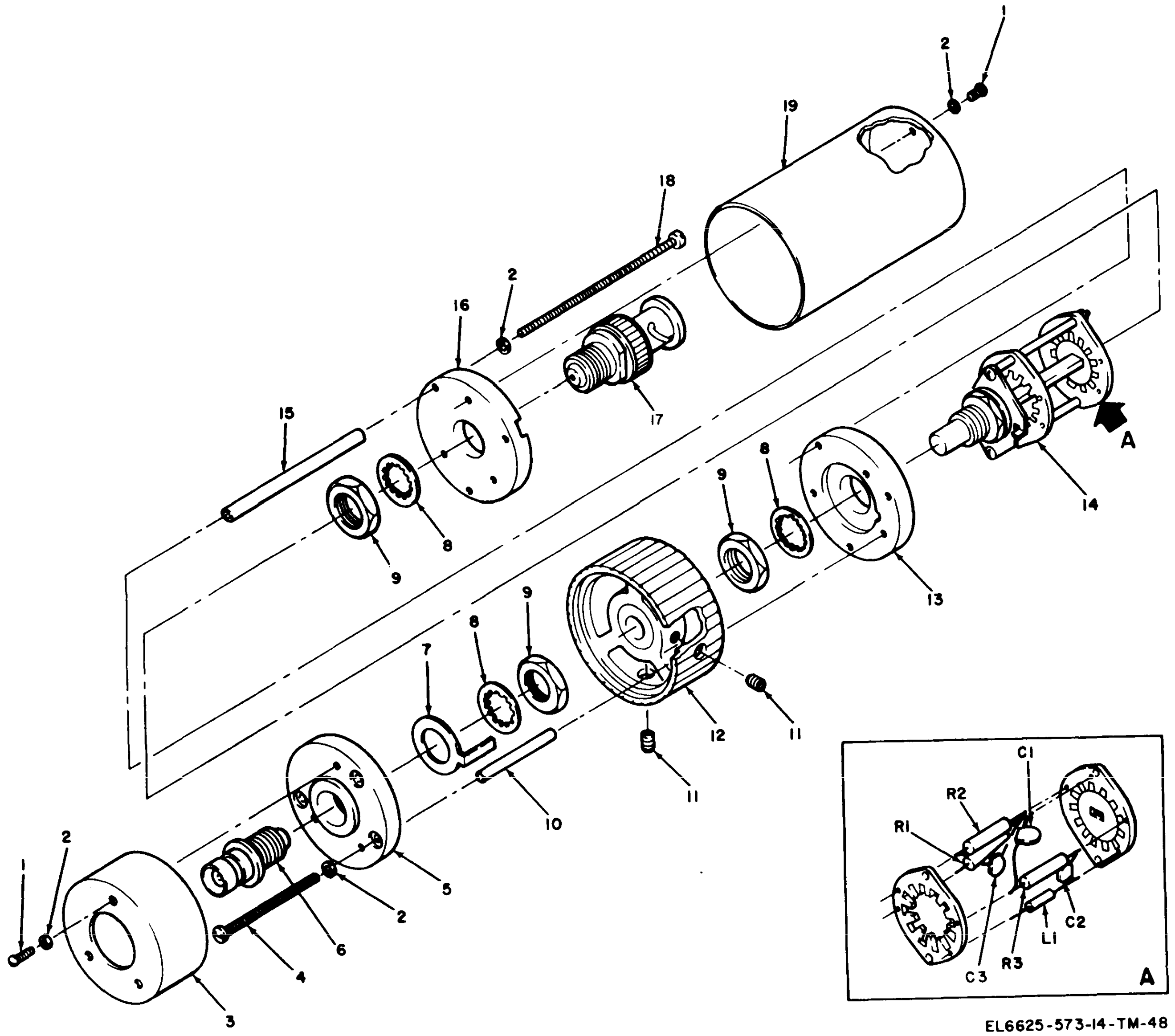
(15) Slip input shield over input connector and align so that INPUT nomenclature is in line with OUTPUT nomenclature.

(16) Replace the three screws and washers to secure input shield.

(17) Set switch to 0 DB 25 Ω position.

(18) Loosen set screw in knob.

(19) Align knob pointer with 0 DB 250 position and tighten the two set screws in knob.



1 Machine screw, 2-56 x 3/16
2 No. 2 lock washer
3 Input shield
4 Machine screw, 2-56 x 1¼
5 Input end disc
6 Female BNC input connector
7 Terminal lug, 3/8
8 Lock washer, 3/8 x 1
9 Nut, 3/8-32 x ½
10 Input spacer
11 Set screw, 8-32 x 3/16
12 Knob
13 Center disc
14 Switch assembly
15 Output spacer
16 Output end disc
17 Male BNC output connector
18 Machine screw, 2-56 x 2-11/32
19 Output shield

Figure 7-24. Dummy Lad Electrical DA-296/GRM-50, exploded view.

Section V. ADJUSTMENTS

7-30. General Adjustment Instructions

In general, the SG-479/G will not require a complete adjustment. This is particulary true when repairs have been made without movig any internal adjustments. Because all circuits are not affected when individual vacuum tubes are replaced, unnecessary adjustments can be avoided by reading the following referenced paragraphs. Paragraphs 7-30 through 7-41 are presented in a sequence to be followed when a complete adjustment is to be performed. However, the adjustment can be performed individually with no performance accurancy loss. Prior to making any adjustments, perform the following steps:

a. Remove cabinet (para 7-20).

b. Remove rf shield (para 7-21).

c. Insert internal power plug into filter receptacle located on inside of rear cover.

WARNING

Dangerous voltages are present within SG-479/G.

d. Insert power plug into ac power receptacle.

e. Set power switch to ON and allow a 2-hour warmup.

7-31. Regulated Power Supply Adjustment (fig. 7-25)

To adjust the — 200 volt regulated power supply, proceed as follows:

a. Connect ME-26A/U VTVM to V109 pin 7 (fig. 7-1).

b. Adjust – 200 V SET potentiometer R126 (fig. 7-25) to obtain an indication of –200.0 vac on VTVM. This adjustment also adjusts the +300 VDC regulated output.

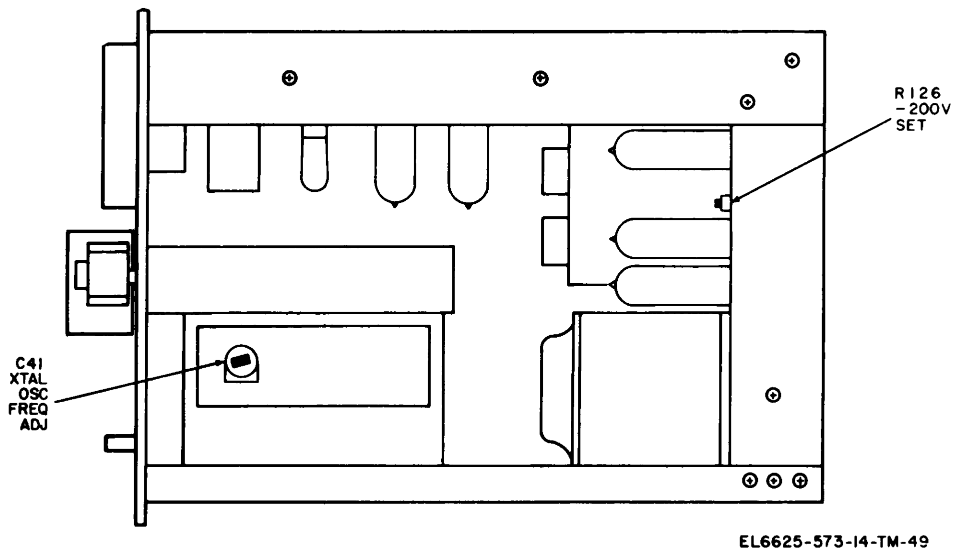


Figure 7-25. Crystal oscillator and –200 volt power supply adjustments.

7-32. Audio Oscillator Output Level Adjustment

To adjust the internal modulating signal level, proceed as follows:

a. Set operating controls to the following posititions.

RANGE switch. 530KC-1800KC
MODULATION SE-
LECTOR switch. . . . . INT. 400~

b. Connect ME-30A/U ac VTVM to transformer T1 yellow lead. Connect ground lead to chassis.

c. Adjust MOD OSC ADJ potentiometer R51 (fig. 7-26) for a VTVM indication of 3.2 Vrms.

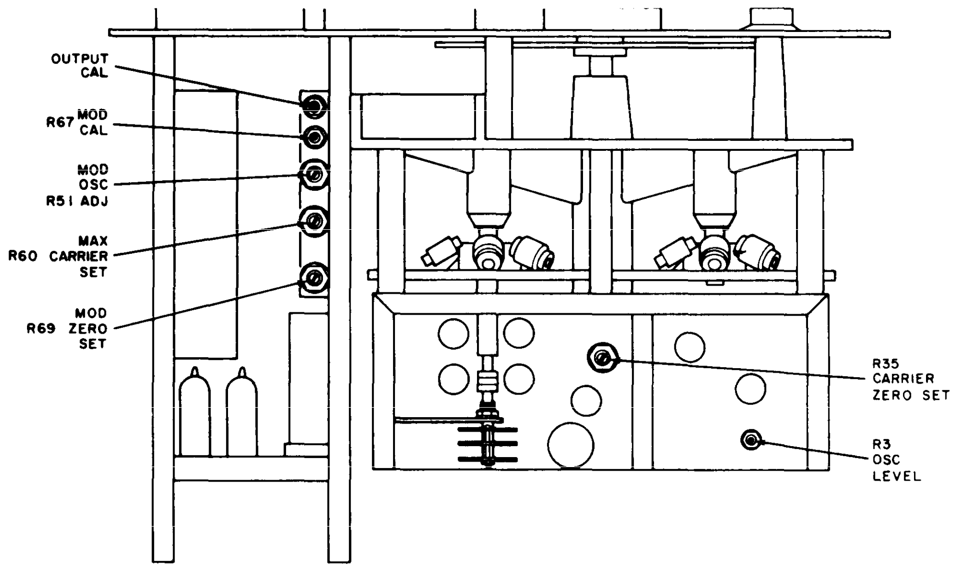


Figure 7-26. Chassis adjustments, top view.

7-33. Crystal Oscillator Frequency Adjustments (fig. 7-25)

a. Set CRYSTAL CALIBRATOR switch to 100KC.

b. Connect AN/USM-207 frequency counter to V10 pin 2. Connect frequency counter return to chassis.

c. Adjust trimmer C41 (fig. 7-25) for a frequency counter indication of exactly 100.00 kHz.

d. Set CRYSTAL CALIBRATOR switch to 1 MC. The frequency counter should indicate between 999.900 kHz and 1000.100 kHz.

e. Set CRYSTAL CALIBRATOR switch to 100 KC. The frequency counter should indicate between 99.990 kHz and 100.010 kHz.

f. Adjust C41 so that preceding frequency counter displays are as close as possible to 1000.00 kHz and 100.00 kHz, respectively.

g. Turn CRYSTAL CALIBRATOR switch to OFF.

7-34. Rf Oscillator and Rf Amplifier Tuned Circuit Adjustments (fig. 7-26)

NOTE

The following procedures should be performed only when the troubleshooting procedures indicate that rf oscillator current is excessive, frequencies are out of tolerance, or rf amplifier currents are incorrect. DO NOT perform any procedures on a routine basis. No adjustment should be made unless the parameter being measured is not within the tolerance given.

a. To adjust the rf tuned circuits proceed as follows:

(1) Connect DA-296/GRM-50 to RF OUT 50 Ω connector.

(2) Set CALIBRATE control to align cursor with panel markings.

(3) Set RANGE switch to 19MC-65MC.

(4) Set MODULATION SELECTOR switch to CW.

(5) Set ATTENUATOR switch to 1.0V.

(6) Set VERNIER ATTENUATOR control fully clockwise.

(7) Set CRYSTAL CALIBRATOR switch to OFF.

b. Insert a milliammeter in series between R9 and transformer T201.

c. Rotate FREQUENCY dial for maximum milliampere reading. If this reading is not 25 milliamperes, adjust OSC LEVEL potentiometer R3 (fig. 7-26) to obtain this reading. If this adjustment is made, perform carrier zero set adjustments (para 7-36), maximum carrier and modulation zero set adjustments (para 7-37), and percent modulation meter calibration adjustments (para 7-38). After the 25 milliampere measurement has been verified, insert the milliammeter in series between R15 and transformer T207 (fig. 7-8), and reset FREQUENCY dial to 19MC. If the milliammeter reading is not between 12 and 15 milliamperes, adjust AMPLIFIER TURRET slug T212 (fig. 7-16) for a plate current dip within this range.

NOTE

If transformer T212 is positioned so that its slug cannot be tuned, rotate RANGE switch until slug is accessible. After tuning slug, return RANGE switch to 19MC-65MC position and observe milliammeter reading. It may be necessary to repeat this procedure until a plate current dip is obtained.

7-35. Adjustments with Frequency Counter, 50KC to 65MC

a. Connect AN/USM-207 frequency counter to DA0296/GRM-50 OUTPUT connector and set attenuator switch to 0 DB 25 ohms. With the signal generator RANGE switch set to 50KC-170KC and its FREQUENCY dial set to 50KC, the frequency counter display should be between 49.500 kHz and 50.500 kHz. With the FREQUENCY dial set to 170KC, the frequency counter should indicate between 168.300 kHz and 171.700 kHz. If the frequency is incorrect, a 170.00 kHz readout should be obtained by adjusting OSCILLATOR TURRET trimmer capacitor C201 (fig. 7-16). It may be necessary to repeat this procedure until no further adjustments are necessary.

b. With the signal generator RANGE switch set to 165KC-560KC, and the FREQUENCY dial at 165 KC, the frequency counter should indicate between 163.350 kHz and 166.650 kHz. If readout is incorrect, adjust OSCILLATOR TURRET (fig. 7-16) slug T202 for a frequency counter reading of 165.000 kHz. When the FREQUENCY dial is set to 560 KC, the frequency counter indication should be between 554.400 kHz and 565.600 kHz. If not, adjust OSCILLATOR TURRET trimmer capacitor C202 for a 560.000 kHz reading. It may be necessary to repeat these adjustments until the correct readout is obtained.

c. With the signal generator RANGE switch set to 530KC-1800KC, and FREQUENCY dial at 530 KC, the frequency counter indication should be between 524.700 kHz and 535.300 kHz. If not, adjust OSCILLATOR TURRET slug T203 for a frequency counter reading of 530.000 kHz. When the FREQUENCY dial is set to 1800KC, the frequency counter reading should be between 1782.000 kHz and 1818.000 kHz. If not, adjust OSCILLATOR TURRET trimmer capacitor C203 for a counter reading of 1800.000 kHz. It may be necessary to repeat these adjustments.

d. With RANGE switch set to 1.76MC-6.0MC and FREQUENCY dial at 1.76 MHz, the frequency counter indication should be between 1.742400 MHz and 1.777600 MHz. If not, adjust OSCILLATOR TURRET (fig. 7-16) slug T204 for a counter display of 1.7600000 MHz. With FREQUENCY dial at 6.0MC, counter reading should be between 5.940000 MHz and 6.060000 MHz. If not, adjust OSCILLATOR TURRET trimmer capacitor C204 for a readout of 6.000000 MHz. It may be necessary to repeat these adjustments.

e. With RANGE switch set to 5.8MC-19.2MC, and FREQUENCY dial at 5 .8 MC, counter reading should be between 5.742000 MHz and 5.858000 MHz. If not, adjust OSCILLATOR TURRET (fig. 7-16) slug T205 for a display of 5.800000 MHz. When FREQUENCY dial is set to 19.2 MC, the counter reading should be between 19.008000 MHz and 19.392000 MHz. If not, adjust OSCILLATOR TURRET trimmer capacitor C205 for a counter reading of 19.200000 MHz. It may be necessary to repeat these adjustments.

f. RANGE switch rotation determines the signal generator's operating range and the oscillator turret gear position. Since the amplifier turret is meshed with the oscillator turret gear, accessibility to turret components is determined by gear positions, figure 7-27. With RANGE switch at 19MC-65MC, and FREQUENCY dial at 19MC, the counter reading should be between 18.810000 MHz and 19.190000 MHz. If not, adjust OSCILLATOR TURRET (fig. 7-16) slug T206 for a frequency counter readout of 19.000000 MHz. When FREQUENCY dial is set at 65MC, the counter reading should be between 64.350000 MHz and 65.650000 MHz. If not, adjust OSCILLATOR TURRET trimmer capacitor C206 for a counter display of 65.000000 MHz. As in previous steps, it may be necessary to repeat these adjustments-until correct readout is obtained.

NOTE

When correct readings have been obtained, remove frequency counter and insert a milliammeter in series between R15 and transformer T207.

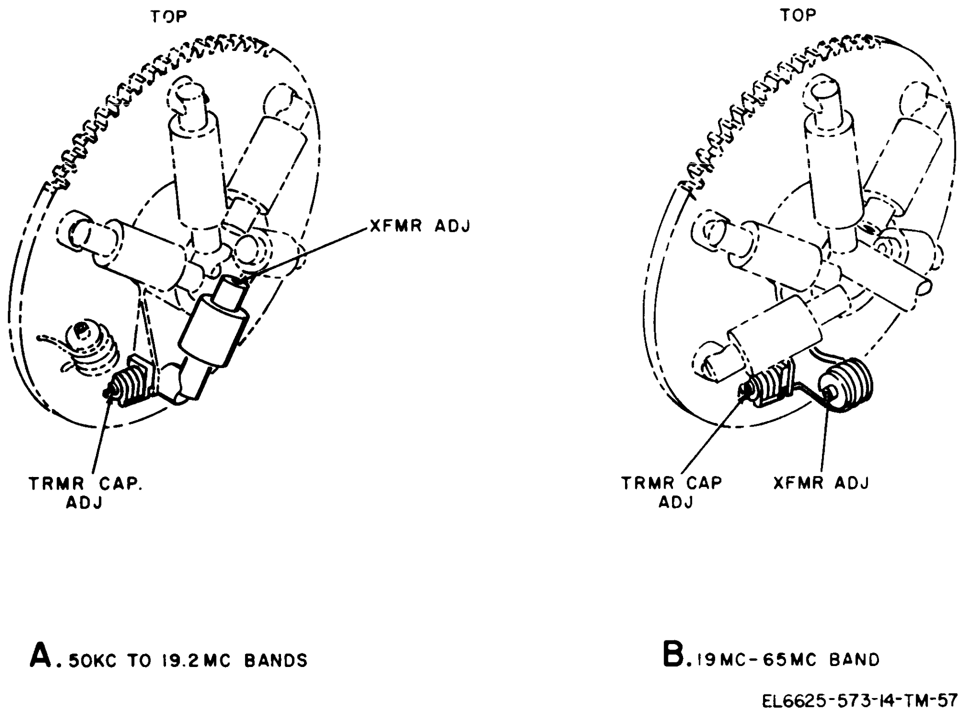


Figure 7-27. Typical oscillator turret gear positions.

7-36. Amplifier Current Adjustments, 50MC to 65MC

a. With signal generator RANGE switch set to 50KC-170KC, and its FREQUENCY dial at 50KC, adjust AMPLIFIER TURRET (fig. 7-16) slug T207 for a current dip reading in the range of 8 to 12 milliamperes. Rotate FREQUENCY dial to 170KC. Using a plastic screwdriver, or one with an insulated shaft, to avoid shorting capacitor, adjust amplifier trimmer capacitor C207 (fig. 7-17) for a current dip reading in the 4- to 6-milliampem range. It may be necessary to repeat these adjustments.

b. With the signal generator RANGE switch set to 165KC-560KC, and FREQUENCY dial at 165KC, adjust AMPLIFIER TURRET (fig. 7-16) slug T208 for a current dip in the 8 to 12 milliampere range. With FREQUENCY dial at 560 kHz, adjust trimmer capacitor (fig. 7-17) C208 for current dip in the 4 to 6 milliampere range. It may be necessary to repeat these procedures until no further adjustments are necessary.

c. With RANGE switch set to 530KC-1800KC and FREQUENCY dial at 530KC, adjust AMPLIFIER TURRET (fig. 7-16) slug T209 for a current dip in the 8 to 12 milliampere range. Set FREQUENCY dial to 1800KC and amplifier trimmer capacitor (fig. 7-17) C209 for a current dip in the 4 to 6 milliampere range. It may be necessary to repeat these procedures until no further adjustments are necessary.

d. With RANGE switch set to 1.76MC-6.0MC, and FREQUENCY dial at 1.76MC, adjust AMPLIFIER TURRET (fig. 7-16) slug T210 for a current dip in the 8 to 12 milliampere range. Set FREQUENCY dial to 6.0MC. Adjust amplifier trimmer capacitor (fig. 7-17) for a current dip in the 4 to 6 milliampere range. It may be necessary to repeat these procedures until no further adjustments are necessary.

e. With RANGE switch set to 5.8MC-19.2MC and FREQUENCY dial at 5.8MC, adjust AMPLIFIER TURRET (fig. 7-16) slug T211 to obtain a current dip in the 5 to 7 milliampere range. With FREQUENCY dial at 19.2MC, adjust amplifier trimmer capacitor (fig. 7-17) C211 for a current dip in the 3 to 4 milliampere range. It may be necessary to repeat these procedures until no further adjustments are necessary.

f. With RANGE switch set to 19MC-65MC, and FREQUENCY dial at 19 MHz, adjust AMPLIFIER TURRET (fig. 7-16) slug T212 for a current dip in the 12 to 15 milliampere range. With FREQUENCY dial at 65MC, adjust amplifier trimmer capacitor (fig. 7-17) C212 for a current dip in the 10 to 18 milliampere range. It may be necessary to repeat these procedures until no further adjustments are necessary.

g. With the signal generator ATTENUATOR switch in the 3.0 volt range, rotate FREQUENCY dial across entire 19MC to 65MC range. Current will normally be less than 60 milliamperes. It will never exceed 75 milliamperes.

h. Set ATTENUATOR switch to 1.0 VOLTS, and remove milliammeter.

7-37. Carrier Zero Set Adjustment

To adjust the rf carrier level to zero when all operating controls are set for a zero output, proceed as follows:

a. Set operating controls as follows:

(1) RANGE switch 50KC-170KC
(2) ATTENUATOR switch . . . . . 1.0 VOLTS
(3) VERNIER ATTENUATOR control . . . . Fully ccw
(4) MODULATION SELECTOR switch . . . . EXT. DC (no input)
(5) MODULATION AMPLITUDE control . . . . Fully ccw

b. Connect AN/USM-281 oscilloscope to DA-296/GRM-50 OUTPUT connector.

c. Set DA-296/GRM-50 attenuator switch to 0 DB 25 Ω

d. Adjust CARRIER ZERO SET potentiometer R35 (fig. 7-26) fully ccw.

e. Check and adjust if required rf output meter mechanical zero adjustment (para 7-41).

f. Set power switch to ON and allow a 5-minute warmup.

g. Set oscilloscope sweep to free run and vertical amplifier to most sensitive range.

h. Slowly adjust CARRIER ZERO SET potentiometer R35 (fig. 7-26) clockwise until some rf signal is seen on the oscilloscope and then counterclockwise until signal just collapses into sweep base line.

i. Sequentially set RANGE switch to the five remaining positions and check rf signal amplitude on oscilloscope. On 165KC-560KC 530KC-1800KC, and 1.76MC-6.0MC ranges, rf signal should be negligible or unobservable. On the two highest ranges it is normally 85 millivolts peak-to-peak.

j. Perform maximum carrier adjustment (para 7-37) and percent modulation meter calibration adjustment (para 7-38).

7-38. Maximum Carrier and Modulation Zero Adjustment

To adjust the maximum carrier and zero modulation levels, proceed as follows:

a. Set operating controls as follows:

(1) RANGE switch 50KC-170KC
(2) ATTENUATOR switch . 1.0 VOLTS
(3) VERNIER ATTENUATOR control . . . . Fully clockwise
(4) MODULATION SELECTOR switch . . . . EXT. AC

b. Solder tip of ME-26A/U VTVM ac probe to center conductor of UG-290/U coaxial connector.

c. Clip ac probe ground lead to UG-290/U flange.

d. Connect UG-290/U DA-296/GRM-50 OUTPUT connector.

e. Connect DA-296/GRM-50 INPUT connector to SG-479/G RF OUTPUT 50 connector.

f. Rotate FREQUENCY dial at moderate speed over entire range and note minimum reading on VTVM .

g. Repeat *f* above on the five remaining frequency ranges. On highest frequency range, rotate FREQUENCY dial slowly.

h. Set RANGE switch and FREQUENCY dial to positions that produced lowest VTVM reading.

i. Set MODULATION SELECTOR switch to CW.

j. Adjust MAX CARRIER SET potentiometer R60 (fig. 7-26) to obtain 1.05 Vrms reading on VTVM.

k. Observe VTVM and set MODULATION SELECTOR switch to EXT. AC. VTVM reading should not change.

l. If reading in *k* above changed, adjust MOD ZERO SET potentiometer R69 (fig. 7-26) until there is no VTVM reading change when MODULATION SELECTOR switch is changed from CW to EXT. AC.

m. Observe VTVM and rotate MODULATION AMPLITUDE control over entire range. VTVM reading should not change.

n. If reading in *m* above changed, readjust MOD ZERO SET potentiometer R69 until there is no VTVM reading change as MODULATION AMPLITUDE control is rotated over entire range.

o. Repeat *i* through *n* above until no further improvement is observed.

7-39. Percent Modulation Meter Calibration Adjustment

To calibrate the PERCENT MODULATION meter, proceed as follows:

a. Perform mechanical zero adjustment (para 7-41) on PERCENT MODULATION meter.

b. Set power switch to ON and allow a 5-minute warmup.

c. Set operating controls as follows:

(1) RANGE switch 530KC-1800KC
(2) FREQUENCY dial 1000kHz
(3) MODULATION SELECTOR switch . . . . INT. 1000-
(4) ATTENUATOR switch 1.0 VOLTS
(5) VERNIER ATTENUATOR control . . . . 1.0 VOLTS on rf output meter
(6) MODULATION AMPLITUDE control . . . . . 50 on PERCENT MODULATION meter

d. Connect DA-296/GRM-50 INPUT connector to SG-479/G RF OUTPUT connector.

e. Set DA-296/GRM-50 attenuator switch to 0 DB 25 Ω.

f. Connect AN/USM-281 oscilloscope to DA-296/GRM-50 OUTPUT connector.

g. Set oscilloscope for internal synchronization and adjust sweep rate so that five or six cycles of modulation are displayed.

h. Set MODULATION SELECTOR switch to CW.

i. Adjust oscilloscope vertical amplifier sensitivity until rf signal display is exactly 4 centimeters in amplitude.

j. Set MODULATION SELECTOR switch to INT. 1000~.

k. Adjust MODULATION AMPLITUDE control to obtain oscilloscope display that is 6 centimeters peak-to-peak at modulation crests and 2 centimeters peak-to-peak at modulation troughs.

l. Adjust MOD CAL potentiometer R67 (fig. 7-26) until PERCENT MODULATION meter reads 50.

m. Adjust VERNIER ATTENUATOR control to obtain .2 V reading on rf output meter.

n. Repeat *h* through *k* above. If PERCENT MODULATION meter does not read between 45 and 55 after *k* is completed, adjust MODULATION AMPLITUDE control until reading just comes within this range. Then readjust CARRIER ZERO SET potentiometer R35 (fig. 7-26) until modulation crests are 6 centimeters peak-to-peak and troughs are 2 centimeters peak-to-peak.

o. If an adjustment is made in *n,* perform maximum carrier and modulation zero adjustment (para 7-37).

7-40. Rf output Meter Calibration Adjustment

To calibrate the rf output meter, proceed as follows :

a. Perform mechanical zero adjustment (para 7-41) on rf output meter.

b. Set. power switch to ON and allow a 5-minute warmup.

c. Set operating controls as follows:

(1) RANGE switch 50 KC-170KC
(2) MODULATION SELECTOR switch . . . . CW
(3) ATTENUATOR switch . . . . 1.0 VOLTS

d. Solder tip of ME-26A/U VTVM ac probe to center conductor of UG-290/U coaxial connector.

e. Clip ac probe ground lead to UG-290/U flange.

f. Connect UG-290/U to DA-296/GRM-50 OUTPUT connector.

g. Connect DA-296/GRM-50 INPUT connector to SG-479/G RF OUTPUT 50 Ω connector.

h. Adjust VERNIER ATTENUATOR control to obtain rf output meter reading of .9 V.

i. Rotate FREQUENCY dial over entire range for all ranges and record highest and lowest VTVM readings. If required, readjust VERNIER ATTENUATOR control to keep rf output meter reading at .9 V.

j. Calculate average of two readings recorded in i above.

k. Set RANGE switch and FREQUENCY dial to any position that produces this average reading on VTVM.

l. Adjust VERNIER ATTENUATOR control to obtain VTVM reading of 0.9 V.

m. Adjust OUTPUT CAL potentiometer R37 (fig. 7-26) to obtain reading of .9 V on rf output meter.

7-41. Rf Amplifier Swamping Resistor Adjustment

To select values for resistors R203, R206, R209, and R211, located on the rf amplifier turret, proceed as follows:

a. Perform rf output meter calibration adjustment (para 7-39).

b. Set operating controls as follows:

(1) RANGE switch 530KC-1800KC
(2) FREQUENCY dial 1000kHz
(3) MODULATION SELECTOR switch . . . . CW
(4) ATTENUATOR switch . . 1.0 VOLTS
(5) CRYSTAL CALIBRATOR switch . . . . OFF

c. Connect DA-296/GRM-50 INPUT connector to SG-479/G OUTPUT 50 Ω connector.

d. Solder ME-26A/U VTVM ac probe tip UG-290/U receptacle center conductor. Clip VTVM ground lead to UG-290/U flange.

e. Connect UG-290 to DA-296/GRM-50 OUTPUT connector.

f. Set DA-296/GRM-50 attenuator to 0 DB 25 Ω.

g. Set VTVM to 3 V range.

h. Adjust SG-479/G VERNIER ATTENUATOR control to obtain VTVM reading of .9 v.

i. Set RANGE switch that corresponds to frequency range of resistor to be selected.

j. Install resistor that has same value of one to be replaced. If value of old resistor is not known, start with the typical value shown on schematic diagram (fig. FO-31.

k. Rotate FREQUENCY dial across entire range and observe VTVM. Reading should be between .801 V and .999 V across entire range.

l. If reading in *k* above is not correct, change resistor value to obtain correct reading. To increase output, increase resistor value.

7-42. Panel Meter Mechanical Zero Adjustment

To adjust the mechanical zero of either front panel meter, proceed as follows:

c. Set power switch to ON and allow the SG-479/G to warm up for at least 20 minutes.

b. Set power switch to off and allow 30 seconds for capacitors to discharge.

c. On front of panel meter, rotate zero adjustment screw clockwise until meter pointer is positioned to left of zero and moving upscale toward zero.

d. Carefully continue to rotate screw clockwise and stop when pointer rests exactly over zero mark.

NOTE

If pointer overshoots zero, repeat *c* and *d* above.

e. Rotate adjustment screw counterclockwise 15 degrees. This frees adjustment screw from meter suspension.

NOTE

If pointer moves during this step, repeat *c, d,* and *e* above.

7-43. Detent Assembly Adjustment
(fig. 7-20)

If the oscillator turret can be rocked about its rotational axis or there is no snap detent action, the detent assembly must be adjusted. To adjust the detent assembly, proceed as follows:

a. Remove cabinet.

b. Remove front panel.

c. If the oscillator turret recks, one or both detent rollers (61) are not correctly seated in control cam detents (47) because of maladjusted detent spring (59). To adjust the detent springs, proceed as follows:

(1) Observe the detent rollers in the control cam detents to determine which roller is incorrectly seated in the detent.

(2) Loosen the binding head screw (55) on appropriate detent spring.

(3) Pull or push along long axis of detent spring in order to seat detent roller in control cam detent.

(4) Move detent roller toward or away from casting so that it rests two thirds on the control cam (47), and one third on the detent lift assembly (45).

(5) Tighten binding head screw.

d. If there is no snap detent action, the drive roll pin (46) has probably loosened and fallen out. To replace a loose drive roll pin, or one that has fallen out, proceed as follows:

(1) On front of detent lift assembly gear, tap the drive roll pin hole for a 4-40 machine screw.

(2) Install a 4-40 x 7/8 round-head stainless steel machine screw in the tapped hole. Turn the screw all the way into the detent lift assembly gear.

e. Replace front panel.

f. Replace cabinet.

CHAPTER 8

GENERAL SUPPORT TESTING PROCEDURES

8-1. General

a. Testing procedures in this chapter 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.

8-2. General Support Tools and Test Equipment

All tools, test equipment, and other equipment required for the testing procedures are listed in tables 8-1 and 8-2. No special tools are required to perform testing procedures contained in this chapter. For performance tests, see tables 8-3 through 8-9.

Table 8-1. Tools and Test Equipment

Nomenclature	*Federal stock No.*	*Technical manual*
Meter, Standing Wave Ratio AN/USM-261	6625-935-1473	TM 11-6626-1534-15
Multimeter ME-26A/U	6625-360-2493	TM 11-6625-200-16
Voltmeter, Electronic ME-30/U	6625-669-0724	TM 11-6826-320-12
Multimeter AN/USM-223	6625-999-7465	TM 11-6826-654-14
Counter, Electronic Digital Readout AN/USM-207	6625-911-6366	TM 11-6625-700-10
Oscilloscope AN/USM-281	6625-053-3112	TM 11-6625-1703-15
Generator, Signal AN/URM-127	6625-783-5965	TM 11-6625-683-15
Test Set, Electron Tube TV-2/U	6625-699-0263	TM 11-6625416-12
RF Generator, Signal AN/URM-25D	6625-649-5793	TM 11-5551D
Tool Kit, Radar and Radio Repair TK-100/G	5180-605-0079	SC-6180-91-CL-S21
Crystal Detector HP-420A	6625-600-9901	Hewlett-Packard
Variable Attenuator CN-796( )/U	5985-831-5991	TM 11-6985-237-14P
Analyzer, Specturm TS-723/U	6625-668-9418	TM 11-5097

Table 8-2. Additional Equipment Required

Equipment	*Federal stock* No.
Variable Transformer (General Radio W10MT3A or equivalent)	6120-054-7794
Coaxial Cable RG-58A/U	6625-230-5505
Adapter UG-274A/U	5935-666-4976
Adapter UG-914/U	5935-280-1454
Receptacle UG-290/U	5935-201-3511

8-3. Physical Tests and Inspections (table 8-3)

a. Test Equipment and Materials. None required.

b. Test Connections and *Conditions.*

(1) No connections are required.

(2) Remove signal generator chassis from its case (para 7-20).

Table 8-3. Physical Tests and Inspections

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
1	N/A	Controls may be in any position.	*a.* Inspect case and chassis for damage, missing parts, and condition of paint. NOTE Touch-up painting is recommended in lieu of refinishing whenever practicable; screw heads, binding posts, receptacles, and other plated parts will not be painted or polished with abrasives. *b.* Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts. *c.* Inspect all connectors and fuse holders for looseness, damage, or missing parts.	*a.* No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible. *b.* Screws, bolts, and nuts will be tight. None missing. *c.* No loose parts or damage. No missing parts.
2	N/A	Controls may be in any position.	*a.* Rotate all panel controls throughout their limits of travel. *b.* Inspect dial stops for damage or bending, and for proper operation. *c.* Operate all switches.	*a.* Controls will rotate freely without binding or excessive looseness. *b.* Stops should operate properly without evidence of damage. *c.* Switches should operate properly.

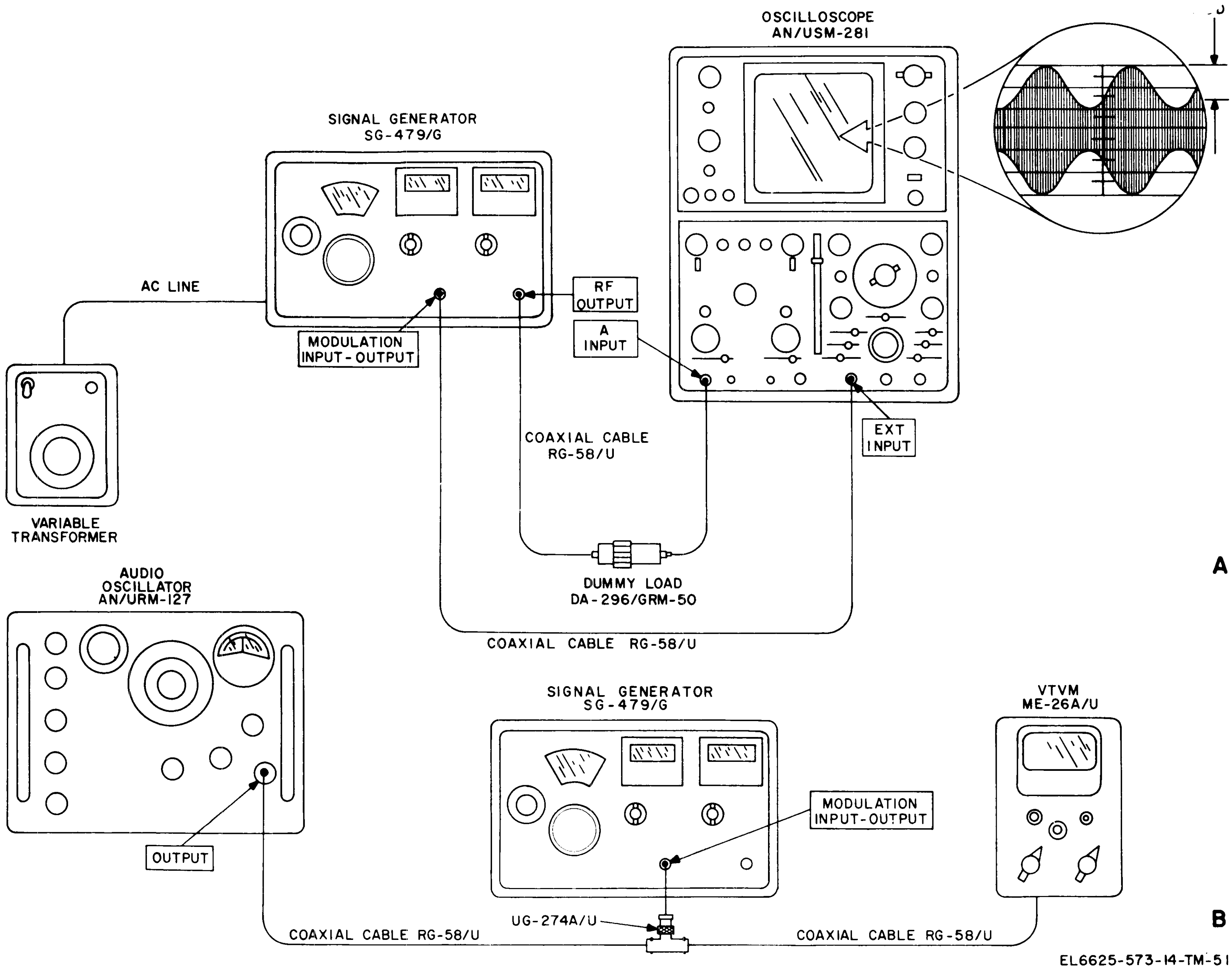


Figure 8-1. Modulation meter calibration test connections.

8-4. Modulation Meter Calibration Tests
(table 8-4)

a. Test Equipment and Material.

(1) Variable Transformer, General Radio W10MT3A or equivalent.

(2) Oscilloscope AN/USM-281.

(3) Generator, Signal AN/URM-127.

(4) Multimeter ME-26A/U.

(5) Dummy Load, Electrical DA-296/GRM-50.

(6) Coaxial Cable RG-58/U (2 es).

b. Test Connections and Conditions. Connect the equipment as shown in A, figure 8-1.

Table 8-4. *Modulation Meter Calibration Tests*

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
1	Variable Transformer *a.* Voltage: 115 Vac *b.* Power: ON	SG-479/G Power: ON	Observe OUTPUT volts on DBM meter.	Meter must not indicate off scale in negative direction.
2	AN/USM-281 *a.* Vertical Display switch to CHANNEL A *b.* POWER: ON DA-296/GRM-50 Attenuator: ODB 25 Ω	*a.* RANGE: 530KC-1800KC *b.* FREQUENCY DIAL: 1000kHz *c.* MODULATION SELECTOR: CW *d.* ATTENUATOR 1.0V	Energize test equipment, and allow 20 minute warmup before proceeding.	None
3	AN/USM-281 *a.* FOCUS Control: As required *b.* INTENSITY *c.* HORIZONTAL POSITION Control: As required *d.* CHANNEL A POSITION Control: As required	Controls remain the same as at end of step 2.	Adjust oscilloscope channel A vernier VOLTS/DIV control until oscilloscope indicates 4.0 cm vertical deflection.	None
4	AN/USM-281 SWEEP TIME: As required	MODULATION SELECTOR: INT. 1000 ~	*a.* Adjust signal generator MODULATION AMPLITUDE control as required until oscilloscope indicates modulation crests (A, fig. 8-1) with 6.0 cm vertical deflection. *b.* Check PERCENT MODULATION meter calibration from 0 to 90 percent.	*a.* PERCENT MODULATION meter should indicate from 45 to 55. *b.* PERCENT MODULATION meter should be accurate within ± 5.0 percent of full scale.
5	Variable Transformer Voltage: 102.5 Vac	MODULATION SELECTOR: CW	Adjust oscilloscope Channel A vernier VOLTS/DIV control as required until oscilloscope indicates 4.0 cm vertical deflection.	None
6	NA	MODULATION SELECTOR: INT. 1000 ~	*a.* Adjust signal generator MODULATION AMPLITUDE control as required until oscilloscope indicates modulation wave form (A, fig. 8-1) with 6.0 cm vertical deflection. *b.* Check PERCENT MODULATION meter calibration from 0 to 90.	*a.* PERCENT MODULATION meter should indicate from 45 to 55. *b.* PERCENT MODULATION meter should be accurate within ± 5.0 percent of full scale.
7	Variable Transformer Voltage: 127.5 Vac	MODULATION SELECTOR: CW	Adjust oscilloscope Channel A vernier VOLTS/DIV as required until oscilloscope indicates 4.0 cm vertical deflection.	None
8	NA	MODULATION SELECTOR: INT. 1000~	a. Adjust signal generator MODULATION AMPLITUDE control as required until oscilloscope indicates modulation waveform (A, fig. 8-1) with 6.0 cm vertical deflection.	*a.* PERCENT MODULATION meter should indicate from 45 to 55.

Table 8-4. Modulation Meter Calibration Tests—Continued

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
8 (Cont)			*b*. Check PERCENT MODULATION meter calibration from 0 to 90.	*b*. PERCENT MODULATION meter should be accurate within ± 5.0 percent of full scale.
9	Variable Transformer Voltage: 115 Vac AN/USM-127 *a*. Power: ON *b*. RANGE: As required ME-26A/U *a*. SELECTOR: AC *b*. RANGE: 10V *c* AC ZERO ADJ: 0 **NOTE** Ac probe clip should be connected to probe tip when adjusting AC ZERO ADJ.	*a*. MODULATION SELECTOR: EXT. AC *b*. MODULATION AMPLITUDE: Fully cw *c*. RANGE: 5.8MC-19.2MC *d*. FREQUENCY dial: 15MHz	*a*. Disconnect RG-58/U coaxial cable from MODULATION INPUT-OUTPUT connector and connect AN/URM-127 as shown in B, figure 8-1. *b*. Adjust audio oscillator AMPLITUDE control to produce a VTVM reading of 3.2V. *c*. Set variable transformer voltage to 102.5 Vac *d*. Set variable transformer voltage to 127.5 Vac	*a*. None *b*. PERCENT MODULATION meter should indicate a minimum of 100. *c*. PERCENT MODULATION meter should indicate a minimum of 100. *d*. PERCENT MODULATION meter should indicate a minimum of 100.

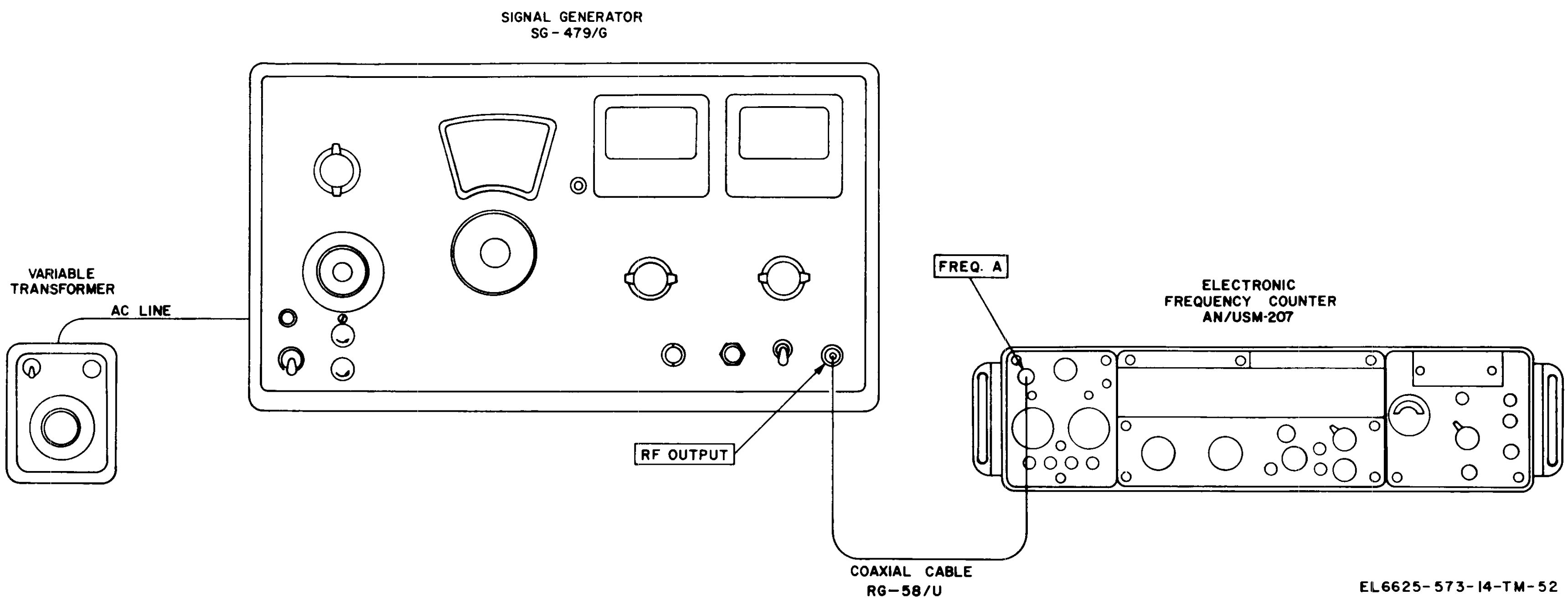


Figure 8-2. Frequency calibration and drift test connections.

8-6. Frequency Calibration and Drift Tests (table 8-5)

a. Test Equipment and Material.

(1) Counter, Electronic Digital Readout AN/USM-207

(2) Variable Transformer General Radio W10MT8A or equivalent

(3) Coaxial Cable RG-58/U (3 ea)

b. Test Connections and Conditions. Connect the equipment as shown in figure 8-2.

Table 8-5. Frequency Calibration and Drift Tests

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
1	Variable Transformer *a.* Voltage: 115 Vac *b.* Power: ON	SG-479/G Power: ON	Observe OUTPUT volts/DBM meter	Meter must not indicate off scale in negative direction.
2	AN/USM-207 *a.* Set FUNCTION switch to FREQUENCY *b.* FREQUENCY UNIT: As required *c.* DISPLAY: To midrange GATE TIME: As required	*a.* RANGE: 50KC-170KC. *b.* FREQUENCY dial: 50kHz *c.* ATTENUATOR 1.0 Volt. *d.* MODULATION SELECTOR: CW *e.* CRYSTAL CALIBRATOR: OFF. *f.* CALIBRATE: Position cursor with black panel marks.	*a.* Energize test equipment and allow 2 hour warmup before proceeding. *b.* Adjust signal generator attenuator VERNIER control as required until OUTPUT VOLTS/DBM meter indicates 1.0V. *c.* Adjust electronic counter SENSITIVITY switch for proper signal level. *d.* Observe electronic counter. *e.* Set signal generator FREQUENCY dial to 100kHz. *f.* Set signal generator FREQUENCY dial to 170kHz.	*a.* None. *b.* None. *c.* None. *d.* Electronic counter should indicate 50kHz ± 1.0 percent. *e.* Electronic counter should indicate 100kHz ± 1.0 percent. *f.* Electronic counter should indicate 170kHz ± 1.0 percent.
3	NA	*a.* RANGE: 165KC-560KC. *b.* FREQUENCY dial: 165kHz	*a.* Observe electronic counter. *b.* Set signal generator FREQUENCY dial to 300kHz. *c.* Set signal generator FREQUENCY dial to 560kHz.	*a.* Electronic counter should indicate 165kHz ± 1.0 percent. *b.* Electronic counter should indicate 300kHz ± 1.0 percent. *c.* Electronic counter should indicate 560kHz ± 1.0 percent.
4	NA	*a.* RANGE: 530KC-1800KC. *b.* FREQUENCY dial: 530kHz.	*a.* Observe electronic counter. *b.* Set signal generator FREQUENCY dial to 1000kHz. *c.* Set signal generator FREQUENCY dial to 1800kHz.	*a.* Electronic counter should indicate 530kHz ± 1.0 percent. *b.* Electronic counter should indicate 1000kHz ± 1.0 percent. *c.* Electronic counter should indicate 1800kHz ± 1.0 percent.
5	NA	*a.* RANGE: 1.76MC-6.0MC. *b.* FREQUENCY dial: 1.76MHz.	*a.* Observe electronic counter. *b.* Set signal generator FREQUENCY dial to 3.0MHz. *c.* Set signal generator FREQUENCY dial to 6.0MHz.	*a.* Electronic counter should indicate 1.76MHz ± 1.0 percent. *b.* Electronic counter should indicate 3.0MHz ± 1.0 percent. *c.* Electronic counter should indicate 6.0MHz ± 1.0 percent.
6	NA	*a.* RANGE: 5.8MC-19.2MC. *b.* FREQUENCY dial: 5.8MHz.	*a.* Observe electronic counter. *b.* Set signal generator FREQUENCY dial to 10MHz. *c.* Set signal generator FREQUENCY dial to 19.2MHz. *d.* Adjust frequency counter SENSITIVITY switch if necessary.	*a.* Electronic counter should indicate 5.8MHz ± 1.0 percent. *b.* Electronic counter should indicate 10MHz ± 1.0 percent. *c.* None *d.* Electronic counter should indicate 19.2MHz ± 1.0 percent.
7	NA	*a.* RANGE: 19MC-65MC.	*a.* Observe electronic counter.	*a.* Electronic counter should indicate 19MHz ± 1.0 percent.

Table 8-5. Frequency Calibration and Drift Tests—Continued

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
7 (Cont)		*b.* FREQUENCY dial: 19MHz.	*b.* Set signal generator FREQUENCY dial to 40MHz. *c.* Set signal generator FREQUENCY dial to 65MHz.	*b.* Electronic counter should indicate 40MHz ± 1.0 percent. *c.* Electronic counter should indicate 65MHz ± 1.0 percent.
8	AN/USM-207	*a.* RANGE: 530KC-1800KC. *b.* FREQUENCY dial: 1000kHz.	*a.* Insure equipment has been operating for a minimum of two hours before proceeding. *b.* Monitor electronic counter for 10 minutes.	*a.* None. *b.* Frequency drift should be less than 50 Hz for the 10 minute period.

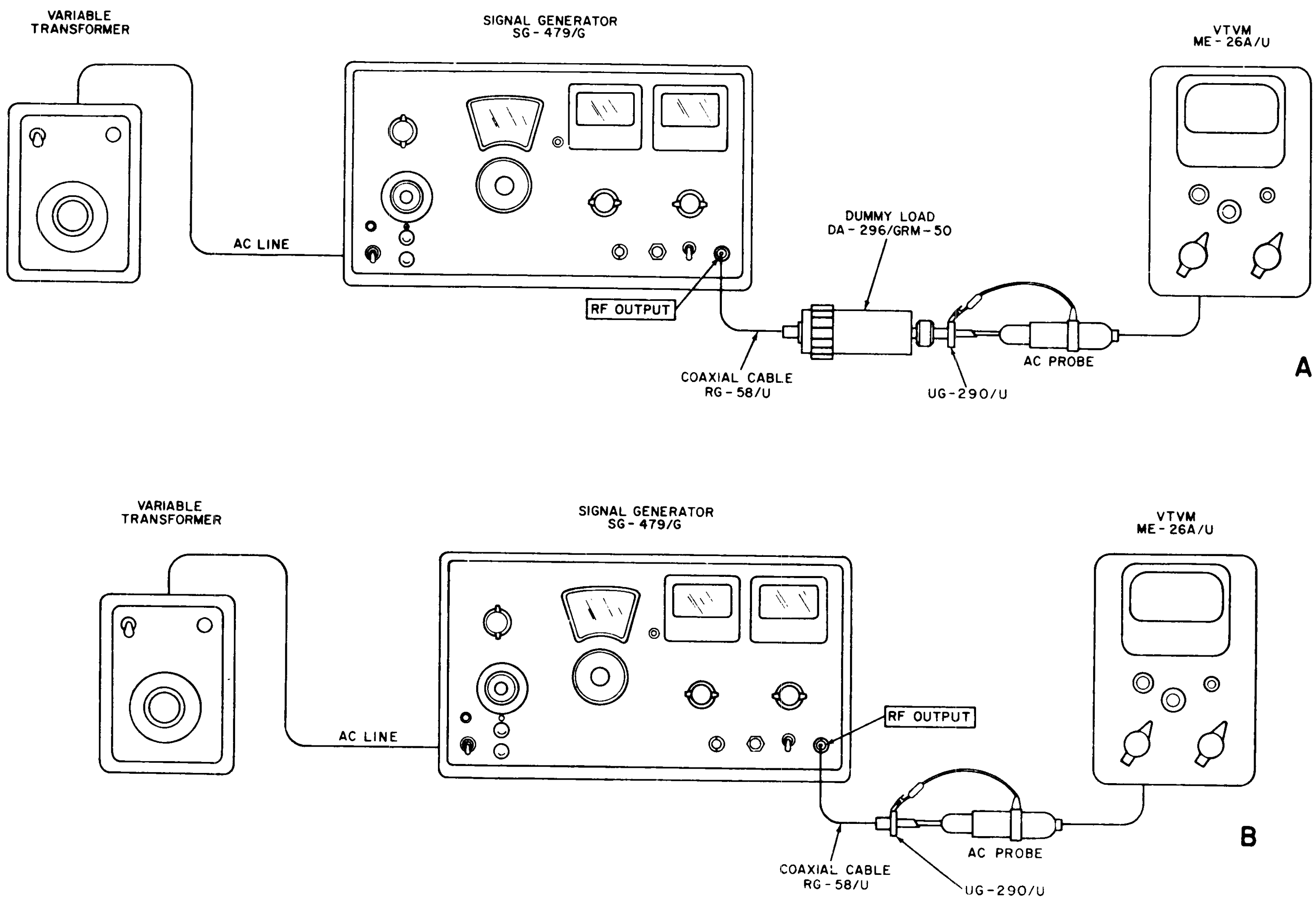


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Figure 8-3. Output level frequency response test connections.

8-6. Output Level Frequency Response Tests (table 8-6)

a. Test Equipment and Material.

(1) Variable Transformer General Radio W10MT3A or equivalent

(2) Multimeter ME 26A/U

(3) Dummy Load, Electrical DA-296/GRM-50

(4) Coaxial Cable RG-58/U

(5) Receptacle UG-290/U

b. Test Connections and Conditions.

(1) Solder ME-26A/U ac probe tip to UG-290/U center conductor and clip probe ground lead to UG-290/U flange.

(2) Connect the equipment as shown in A, figure 8-3.

Table 8-6. Output Level Frequency Response Tests

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
1	Set Variable Transformer *a.* Voltage: 115 Vac. *b.* Power: ON.	Power: ON.	Observe OUTPUT VOLTS/DBM meter.	Meter must not indicate off scale in negative direction.
2	ME-26A/U *a.* SELECTOR: Switch to AC. *b.* RANGE: 1 Vac *c.* AC ZERO ADJ: to 0. NOTE Ac probe clip should be connected to probe tip when adjusting AC AERO ADJ. DA-296/GRM-50 Attenuator: 0 DB 25 Ω .	*a.* RANGE: 530KC-1800KC. *b.* FREQUENCY dial: 1000kHz. *c.* ATTENUATOR: 1.0 V. *d.* MODULATION SELECTOR: CW.	*a.* Energize test equipment and allow a 20 minute warmup period before proceeding. *b.* Adjust signal generator VERNIER ATTENUATOR control as required until VTVM indicates 0.9 Vac. *c.* Set signal generator RANGE switch to 1.76MC-6.0MC and rotate FREQUENCY knob from maximum cw to maximum ccw. *d.* Set signal generator RANGE switch to 5.8MC-19.2MC and rotate FREQUENCY knob from maximum cw to maximum ccw. *e.* Set signal generator RANGE switch to 19MC-65MC and rotate FREQUENCY knob from maximum cw to maximum ccw. *f.* Set signal generator RANGE switch to 50KC-170KC and rotate FREQUENCY knob from maximum cw to maximum ccw. *g.* Set signal generator RANGE switch to 165KC-560KC and rotate FREQUENCY knob from maximum cw to maximum ccw.	*a.* None. *b.* None. *c.* VTVM should indicate 0.9 Vac ± 11 percent. *d.* VTVM should indicate 0.9 Vac ± 11 percent. *e.* VTVM should indicate 0.9 Vac ± 11 percent. *f.* VTVM should indicate 0.9 Vac ± 11 percent. *g.* VTVM should indicate 0.9 Vac ± 11 percent.
3	NA	*a.* RANGE: 530KC-1800KC. *b.* FREQUENCY dial: 1000kHz.	*a.* Rotate signal generator VERNIER ATTENUATOR control from maximum ccw to maximum cw. *b.* Set ATTENUATOR to 3.0 VOLTS and rotate VERNIER ATTENUATOR control from maximum ccw to maximum cw. *c.* Repeat *b* for each ATTENUATOR position.	*a.* VTVM should vary from zero to full scale. *b.* VTVM should vary from zero to full scale. *c.* VTVM should vary from zero to full scale.
4	Set Variable Transformer Voltage: 102.5 Vac.	Repeat steps 2 and 3.		
5	Set Variable Transformer Voltage: 127.5 Vac.	Repeat steps 2 and 3.		
6	Variable Transformer Voltage: 115 Vac.	*a.* RANGE: 19MC-65MC. *b.* FREQUENCY dial: 20MHz. *c.* ATTENUATOR: .3 Vac.	*a.* Adjust signal generator VERNIER ATTENUATOR control as required until VTVM indicates 0.1 Vac. *b.* Disconnect DA-296/GRM-50 and connect UG-290/U as shown in B, figure 8-3.	*a.* None. *b.* VTVM should indicate 0.2 (±0.02) Vac.

Table 8-6. Output Level Frequency Response Tests—Continued

Step No.	Control settings		Test procedures	Performance standard
	Test equipment	Equipment under test		
7	NA.	FREQUENCY dial: 65.	*a.* Connect DA-296/GRM-50 as shown in A, figure 8-3. *b.* Adjust signal generator VERNIER ATTENUATOR control as required until VTVM indicates 0.1 Vac. *c.* Disconnect DA-296/GRM-50 and connect UG-290/U as shown in B, figure 8-3.	*a.* None. *b.* None. *c.* VTVM should indicate 0.2 (±0.02) Vac.

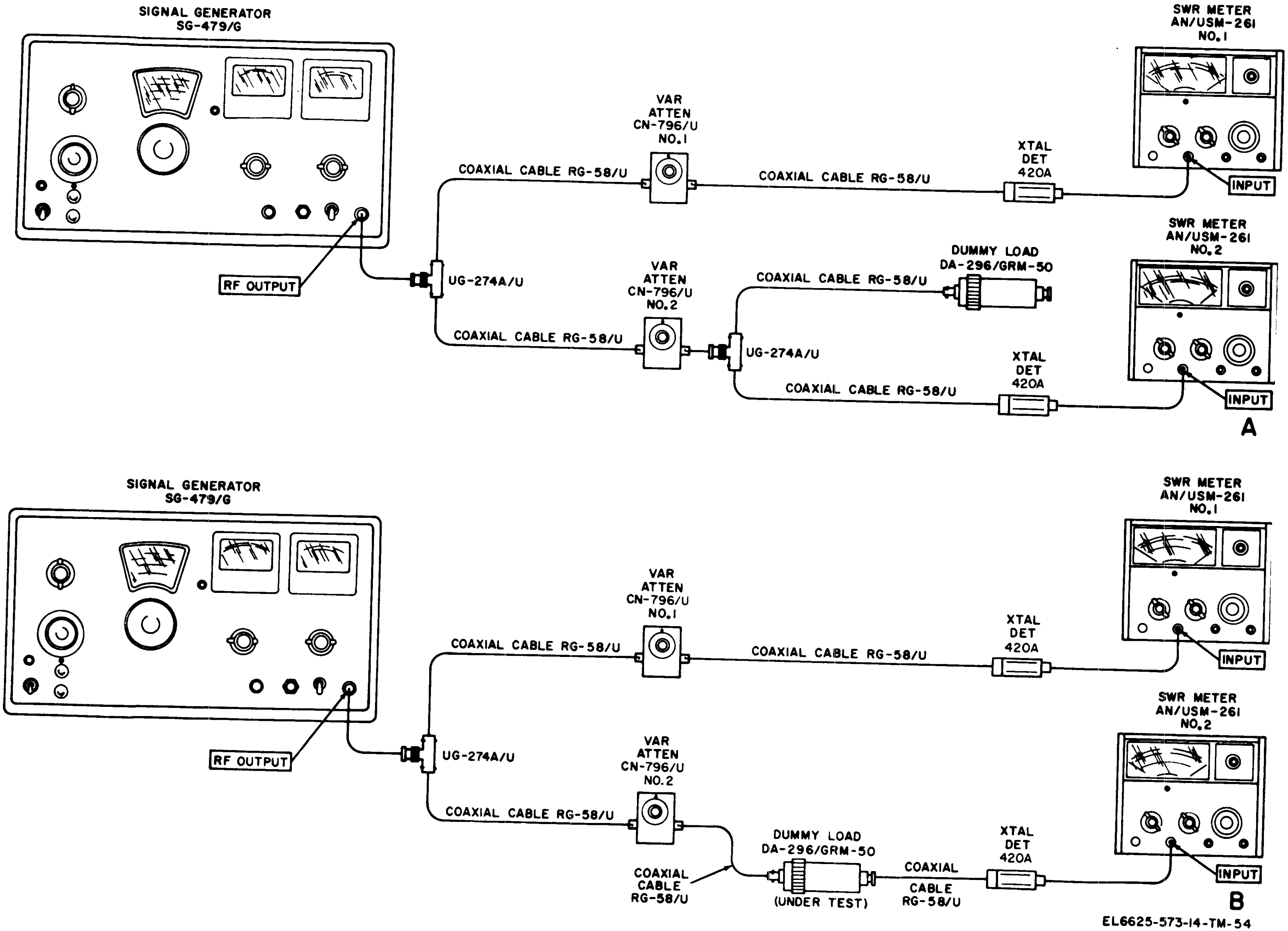


Figure 8-4. Insertion loss measurement test connections.

8-7. Insertion Loss Measurement Tests (table 8-7)

a. Test Equipment and Material.

(1) Signal Generator SG-479/G

(2) Standing Wave Ratio Meter AN/USM. 261 (2 ea)

(3) Variable Attenuator CN-769( )/U (2 ea)

(4) Dummy Load, Electrical DA-296/GRM-50

(5) Crystal Detector 420A (2 ea)

(6) Adapter UG-274A/U (2 ea)

(7) Adapter UG-914/U (5 ea)

(8) Coaxial Cable RG-58/U (5 ea)

b. Test Connections and Conditions.

(1) Connect the equipment as shown in A, figure 8-4.

(2) Energize test equipment and allow a 20 minute warmup period before proceeding.

Table 8-7. *Insertion Loss Measurement Tests.*

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
1	SG-479/G *a.* RANGE: 5.8MC 19.2MC. *b.* FREQUENCY dial: 10MHz. *c.* MODULATION SELECTOR INT. 1000~. *d.* ATTENUATOR: As required. *e.* Power: ON. CN-769( )/U DB: 40 DA-296/GRM-50 Attenuator: 0 DB 25 Ω . AN/USM-261 *a.* POWER: AC. *b.* INPUT SELECTOR: XTAL 200 Ω . *c.* RANGE (SWR-DB). BAND-WIDTH: 50. *d.* RANGE (SWR-DB). EXPAND: NORM. NOTE Both CN-769( )/U's and both AN/URM-261's are set the same.	None None.	Adjust signal generator ATTENUATOR, VERNIER ATTENUATOR and swr meter VERNIER GAIN controls as required until both swr meters indicate −50 dB. NOTE After swr meters are set, do not change swr meter VERNIER GAIN controls, adjust signal generator ATTENUATOR controls.	None.
2	SG-479/G *a.* RANGE: 530KC-1800KC. *b.* FREQUENCY dial: 560kHz.		*a.* Adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls as required until swr meter no. 1 indicates −50 dB. *b.* Record swr meter No. 2 dB indication. *c.* Record the difference between swr meters No. 1 and No. 2. NOTE The difference is system tracking error for 560kHz. *d.* Set signal generator RANGE to 19MC-65MC and FREQUENCY dial to 50MHz. *e.* Repeat *a* through *c*. NOTE This is the tracking error for 50MHz.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None.

Table 8-7. Insertion Loss Measurement Tests—Continued

Step No.	Control settings		Test procedures	Performance standard
	Test equipment	Equipment under test		
2 (Cont)			*f.* Set signal generator FREQUENCY dial to 65MHz. *g.* Repeat *a* through *c*. NOTE This is the tracking error for 65 MHz.	*f.* None. *g.* None.
3	SG-479/G *a.* RANGE: 5.8MC-19.2MC. *b.* FREQUENCY dial: 10MHz.	Attenuator: 0 DB 25 Ω .	*a.* Disconnect DA-296/GRM-50, RG-58/U, UG-274A/U and connect equipment as shown in B, figure 8-4. *b.* Adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls as required until swr meter No. 1 indicates −50 dB. *c.* Repeat *b* for 560kHz, 50MHz, and 65MHz.	*a.* None. *b.* Insertion loss should not exceed 1.0 dB. NOTE Insertion loss is the difference between swr meters No. 1 and No. 2. *c.* Insertion loss should not exceed ±1.0 dB. NOTE Swr meter indication must be corrected with respective tracking error recorded in step 2.
4	SG-479/G *a.* RANGE: 5.8MC-19.2MC. *b.* FREQUENCY dial: 10MHz.	Attenuator: 20 DB 5 Ω	*a.* Set variable attenuator No. 2 to 20. *b.* Adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls as required until swr meter No. 1 indicates −50 dB and observe swr meter No. 2. *c.* Repeat *b* for 560kHz, 50MHz, and 65MHz.	*a.* None. *b.* Insertion loss should not exceed 1.0 dB. *c.* Insertion loss should not exceed 1.0 dB.

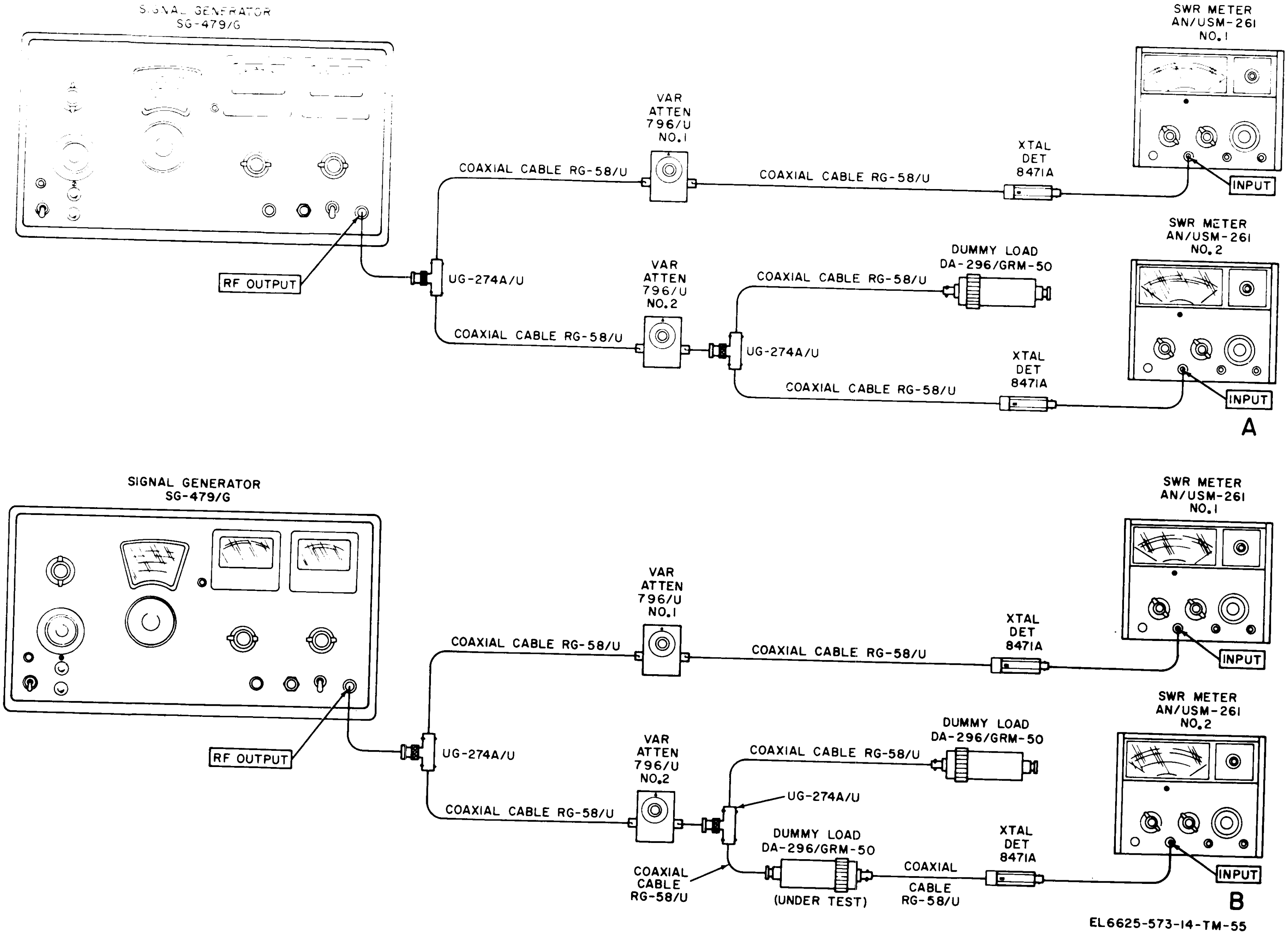


Figure 8-5. Dummy antenna insertion loss measurement test connections.

8-8. Dummy Antenna Insertion Loss Measurement Tests
(table 8-8)

a *Test Equipment and Material.*

(1) Signal Generator SG-479/G

(2) Standing Wave Ratio Meter AN/USM-261

(3) Variable Attenuator CN-769( )/U

(4) Dummy Load, Electrical DA-296/GRM-6O

(5) Adapter UG-274A/U (2 ea)

(6) Adapter UG-914/U (2 ea)

(7) Coaxial Cable RG-58/U (6 ea)

b. Test Connections and Conditions.

(1) Connect the equipment as shown in A, figure 8-4.

(2) Energize test equipment and allow a 20 minute warm-up period before proceeding.

Table 8-8. Dummy Antenna Insertion Loss Measurement Tests

Step No.	Control settings		Test procedures	Performance standard
	Test equipment	Equipment under test		
1	SG-479/G *a.* RANGE: 165KC-560KC. *b.* FREQUENCY dial: 500kHz. *c.* MODULATION SELECTOR: INT. 1000 ~ . *d.* ATTENUATOR: As required. *e.* Power: ON. CN-769( )/U No. 1 DB: 40. No. 2 DB: 50. DA-296/GRM-50 Attenuator: 0 DB 25 Ω . AN/USM-261 *a.* POWER: AC. *b.* INPUT SELECTOR: XTAL 200 Ω . *c.* RANGE (SWR-DB) BAND-WIDTH: 50. *d.* RANGE (SWR-DB) EXPAND NORM.	None.	Adjust signal generator ATTENUATOR, VERNIER ATTENUATOR and swr meter VERNIER GAIN controls as required until swr meter No. 1 indicates −50 dB and swr meter No. 2 indicates −60 dB. **NOTE** After swr meters are set, do not change swr meter VERNIER GAIN controls; adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls.	None
2	NA.	Attenuator: 20 DB DA.	*a.* Connect dummy load to be tested as shown in figure 8-5. **NOTE** Connect dummy load OUTPUT connector to variable attenuator No. 2. *b.* Adjust variable attenuator No. 2 as required until swr meter No. 2 approaches −60 dB. *c.* Record change of variable attenuator No. 2 and add swr meter No. 2 pointer shift from its −60 dB reference. **NOTE** The sum is the dummy antenna insertion loss. *d.* Disconnect dummy load tested and connect equipment as shown in A, figure 8-4.	*a.* None. *b.* None. *c.* Insertion loss should be 49.6 dB (minimum 47.5 dB, maximum 51.5 dB). *d.* None.
3	SG-479/G *a.* RANGE: 1.76MC-6.0MC. *b.* FREQUENCY dial: 2.2MHz.	None.	*a.* Adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls as required until swr meter No. 1 indicates −50 dB and swr meter No. 2 indicates −60 dB.	*a.* None.

Table 8-8. Dummy Antenna Insertion Loss Measurement Tests—Continued

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedures	Performance standard
3 (Cont)	CN-769( )/U No. 2 DB: 50.		*b*. Repeat step 2.	*b*. Insertion loss should be 33.8 dB (minimum 31.5 dB, maximum 36.0 dB).
4	SG-479/G *a*. RANGE: 5.8MC-19.2MC. *b*. FREQUENCY dial: 10MHz. CN-769( )/U No. 2 DB: 50.	None.	a. Adjust signal generator ATTENUATOR and VERNIER ATTENUATOR controls as required until swr meter No. 1 indicates −50 dB and swr meter indicates −60 dB. *b*. Repeat step 2.	*a*. None. *b*. Insertion loss should be 39.1 dB (minimum 36.5 dB, maximum 41.5 dB).

8-9. Test Data Summary

Prepare a checklist from the tests that have been performed. This data may be used as a check against the findings the next time that the tests are performed. Personnel may find it convenient to arrange the checklist in a manner similar to that shown below.

1. MODULATION METER CALIBRATION TEST

a. Meter accuracy ± 590 of full scale

b. External modulation sensitivity 3.2 Vrms maximum for 100% modulation

2. FREQUENCY CALIBRATION AND DRIFT TESTS

a. Dial calibration accuracy ± 1% of setting

b. Frequency drift 50 Hz or less per 10 minutes

3. OUTPUT LEVEL FREQUENCY RESPONSE TESTS

a. Frequency response ±11% (1 dB) over entire frequency range

b. Output level range Zero to full scale on all ranges

c. Output impedance 50 ohms ± 10%

4. INSERTION LOSS MEASUREMENT TESTS

a. DA-296/GRM-50 insertion loss in 0 DB 25 ~ position 1 dB maximum

5. DUMMY ANTENNA INSERTION LOSS MEASUREMENT TESTS

a. 500 kHz insertion loss 47.5 dB to 51.5 dB

b. *2.2* MHz insertion loss 33.8 dB to 36.0 dB

c. 10 MHz insertion loss 39.1 dB to 41.5 dB

APPENDIX A

REFERENCES

The following publications contain information applicable to the operation and maintenance of AN/GRM-50.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U.S. Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies and Equipment Used by the Army.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.
TM 11-5551D	R.F. Signal Generator Set AN/URM-25D.
TM 11-5985-237-14P	Operators, organizational, DS and GS maintenance repair parts and special tool lists (including depot maintenance repair parts and special tools): Attenuator, variable, CN-7961/U FSN 5985-831-5991.
TM 11-6625-200-15	Operators, Organizational, DS, GS, and Depot Maintenance Manual: Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets Electron Tube TV-7/U, TV-7A/U, TV-7L/U, and TV-7D/U.
TM 11-6625-316-12	Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-320-12	Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U, and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-573-25P	Organizational, DS, GS, and Depot Maintenance Repair Parts and Special Tools List: Generator Signal AN/GRM-50.
TM 11-6625-683-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Signal Generator AN/URM-127.
TM 11-6625-700-10	Operator's Manual Digital Readout, Electronic Counter AN /USM-207.
TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tools List: Oscilloscope AN/USM-281A.
SC 5180-91-CL-S21	Tool Kit, Radar and Radio Repair TK-100/G.
TM 38-750	The Army Maintenance Management Systems (TAM MS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Signal Generator AN/GRM-50. 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.

C-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceabiliy of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical 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 clean, 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 of 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, module (component or assembly) in a manner to allow the proper functioning of an equipment/system.

i. Repair. The application of maintenance services (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.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e. g., DMWR) in pertinent technical manuals. 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 material 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.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

C-3. Explanation of Format

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to match components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Functional Group. Column 2 lists the next higher assembly group and the item names of components, assemblies, subassemblies, and modules within the group for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform a function at higher categories. The codes used represent the various maintenance categories as follows :

(1) *Use of symbols.* The following symbols are used to prescribe work function responsibility:

Code	*Maintenance category*
C	Operator/crew
O	Organizational
F	Direct Support
H	GeneralSupport
D	Depot

(2) *Work measurement time.* The active repair time required to perform the maintenance function is included directly below th symbol identifying the category of maintenance. The skill levels used to obtain the measurement times approximate those found in typical TOE units. Active repair time is the average aggregate time required to restore an item (subassembly, assembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, fault isolation/diagnostic time, and QA/QC the in addition to the time required to perform specific maintenance functions identified for the tasks

d. Column 4, Tools and Equipment. Column 4 specifies, by code, those tools and equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table 1.

e. Column 5, Remarks. Self-explanatory.

C-4. Explanation of Format of Table I, Tool and Test Equipment Requirements

The columns in Table I, Tool and Test Equipment Requirements, are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

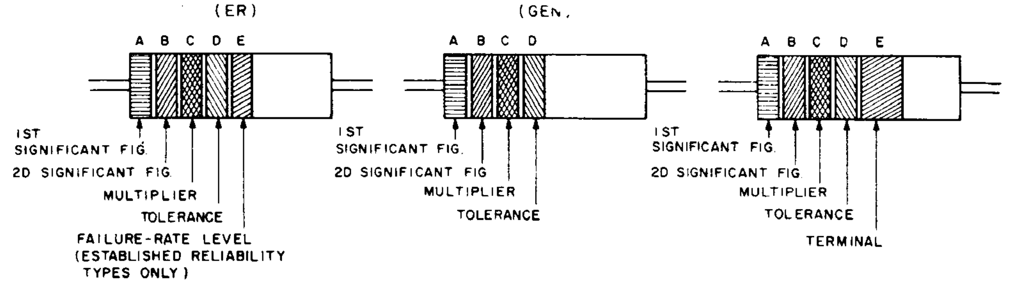
e. Tool Number. Not used.

Section II. MAINTENANCE ALLOCATION CHART FOR SIGNAL GENERATOR AN/ GRM-50

(1) GROUP NO.	(2) Functional group Component Assembly Nomenclature	(3) MAINTENANCE FUNCTION											(4) TOOLS AND EQUIPMENT	(5) REMARKS
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
	GENERATOR, SIGNAL SG-479/G	O	O	O				O	O				10, 11, 13	Simple tests and adjustments
			H		H	H	H	H	H	H	H		1 to 8, 10, 12, 14	
			D		D	D	D	D	D	D	D	D	1 to 10, 12, 14, 15, 16, 17	
	DUMMY LOAD DA-296/ GRM-50	O	O	O				O	O				10	Simple tests
		H	H					H	H				1 to 8, 12, 16, 17	
		D	D					D	D	D	D	D	1 to 9, 12, 15 to 17	

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS SIGNAL GENERATOR AN/GRM-50

Tools and equipment	Maintenance Category	Nomenclature	Federal stock number	Tool Number
1	H D	COUNTER, ELECTRONIC DIGITAL READOUT AN/USM-207	6625-711-6368	
2	H D	OSCILLOSCOPE AN/USM-281	6625-053-3112	
3	F H D	MULTIMETER ME-26A/U	6625-360-2493	
4	F H D	VOLTMETER, ELECTRONIC ME-30/U	6625-669-0472	
5	F H D	ANALYZER, SPECTRUM TS-723/U	6625-668-9418	
6	H D	GENERATOR, SIGNAL AN/URM-250	6625-649-5193	
7	H D	ATTENUATOR, VARIABLE CN-796/U	5985-831-5991	
8	F H D	GENERATOR, SIGNAL AN/URM-127	6625-783-5965	
9	D	CRYSTAL DETECTOR HP420A	6625-600-9901	Hewlett-Packard
10	O F H D	MULTIMETER AN/USM-223	6625-999-7465	
11	O	TOOL KIT, RADAR & RADIO REPAIR TK-101/G	5180-064-5178	
12	H D	TOOL KIT, RADAR & RADIO REPAIR TK-100/G	5180-605-0079	
13	O	TEST SET, ELECTRON TUBE TV-7/U	6625-820-0064	
14	H D	TEST SET, ELECTRON TUBE TB-2/U	6625-699-0263	
15	D	CLIP-ON D.C. MILLIAMMETER HP428B	6625-816-9324	
16	H D	METER, STANDING WAVE, RATIO, AN/USM-261	6625-935-1473	
17	H D	CALIBRATOR SET, FREQUENCY, AN/URM-18	6625-376-9793	



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS.

COLOR-CODE MARKING FOR FILM-TYPE RESISTORS.

TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK	0	BLACK	0	BLACK	.1			BROWN	M=1.0	
BROWN	1	BROWN	1	BROWN	10			RED	P=0.1	
RED	2	RED	2	RED	100			ORANGE	R=0.01	
ORANGE	3	ORANGE	3	ORANGE	1,000			YELLOW	S=0.001	
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	±10 (COMP. TYPE ONLY)	WHITE	....	SOLDERABLE
GREEN	5	GREEN	5	GREEN	100,000	GOLD	±5			
BLUE	6	BLUE	6	BLUE	1,000,000	RED	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY).			
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7							
GRAY	8	GRAY	8	SILVER	0.01					
WHITE	9	WHITE	9	GOLD	0.1					

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 ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS). ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.

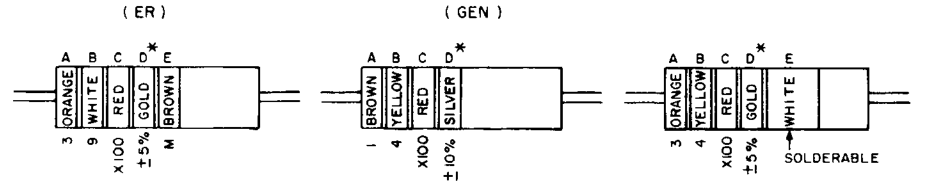
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS
(THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS   10R0 = 10.0 OHMS

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

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 OHMS
RESISTANCE TOLERANCE ±5%
FAILURE RATE LEVEL M

NOMINAL RESISTANCE 1,400 OHMS
RESISTANCE TOLERANCE ±10%

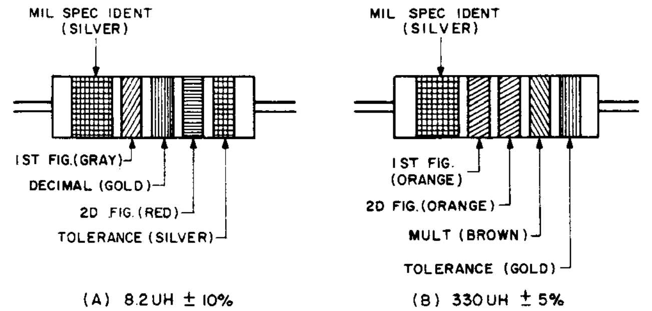
NOMINAL RESISTANCE 3,400 OHMS
RESISTANCE TOLERANCE ±5%
TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS

FILM-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.



(A) 8.2UH ± 10%

(B) 330UH ± 5%

COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF OF THE CODING FOR AN 8.2UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

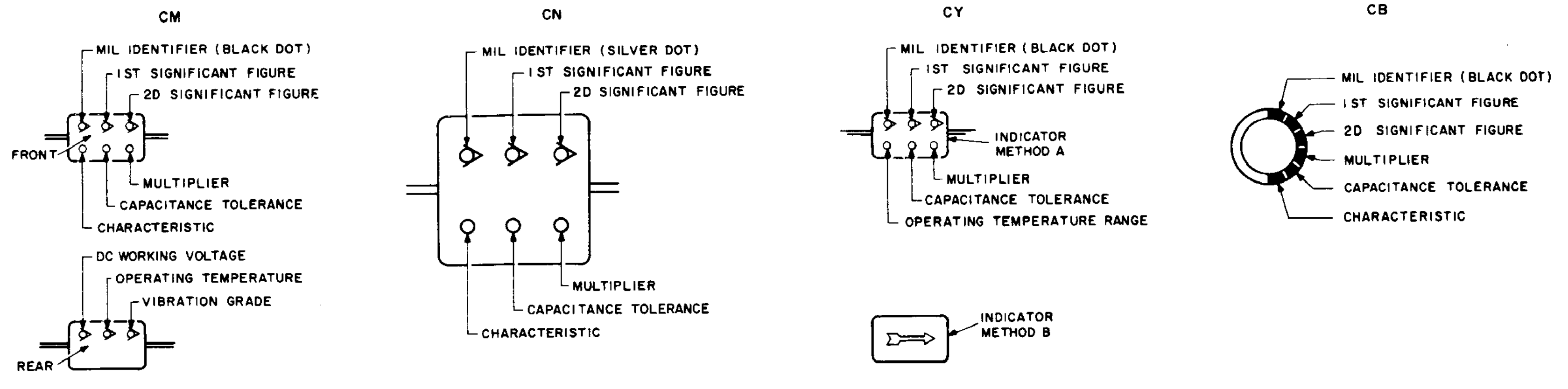
TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

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

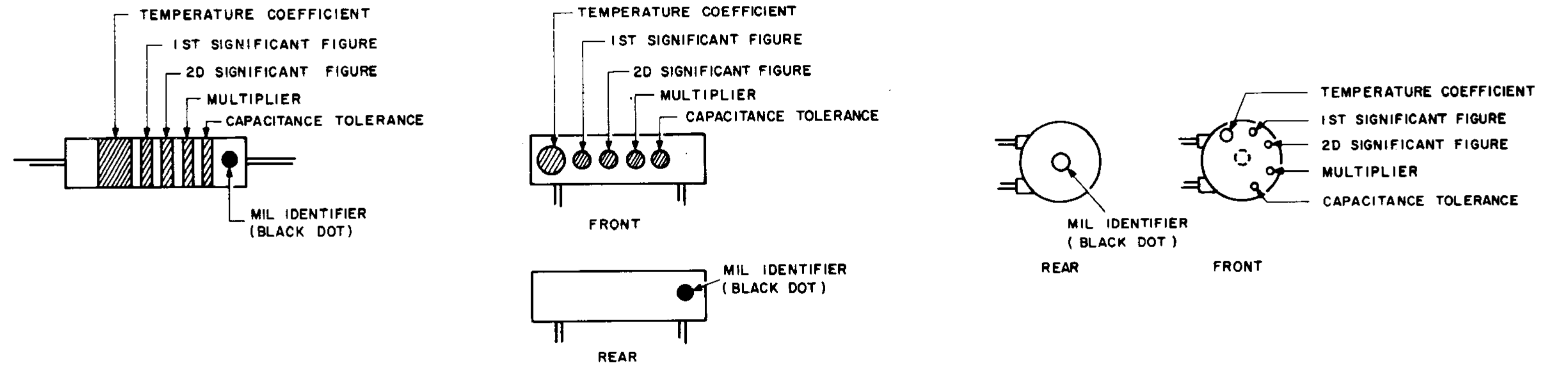


MICA-DIELECTRIC

PAPER-DIELECTRIC

GLASS-DIELECTRIC, GLASS CASE

MICA, BUTTON TYPE



AXIAL LEAD

RADIAL LEAD

DISK-TYPE

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[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]			DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB	CM	CY, CM	CM
BLACK	CM, CY CB	0	0	1			±20%	±20%		A			-55° TO +70°C	10-55 HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55° TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55° TO +125°C	10-2,000Hz
GREEN		5	5		±5%				F			500		
BLUE		6	6										-55° TO +150°C	
PURPLE (VIOLET)		7	7											
GRAY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-25D, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.

* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

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

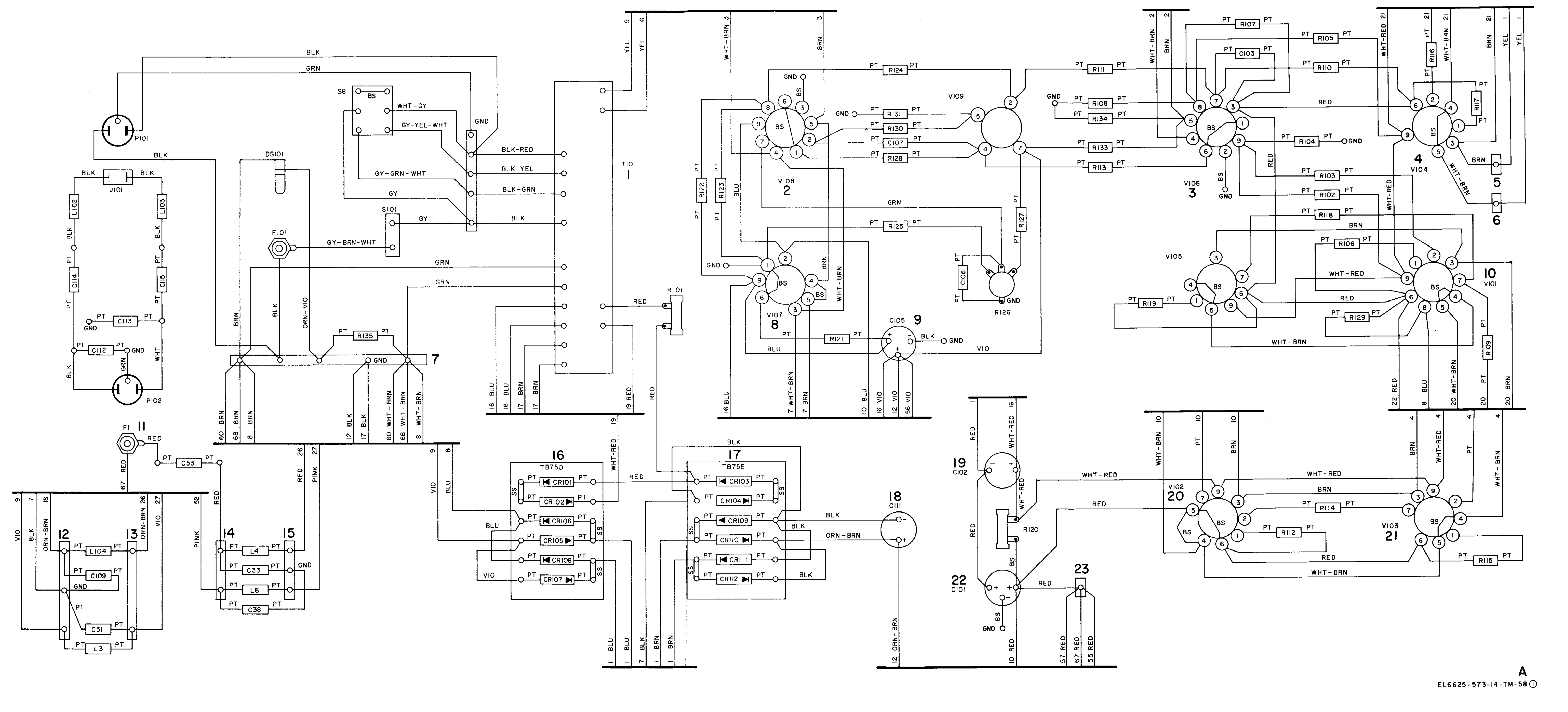

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Figure FO-2.① Generator, Signal SG-479/G, wiring diagram (part 1 of 3).

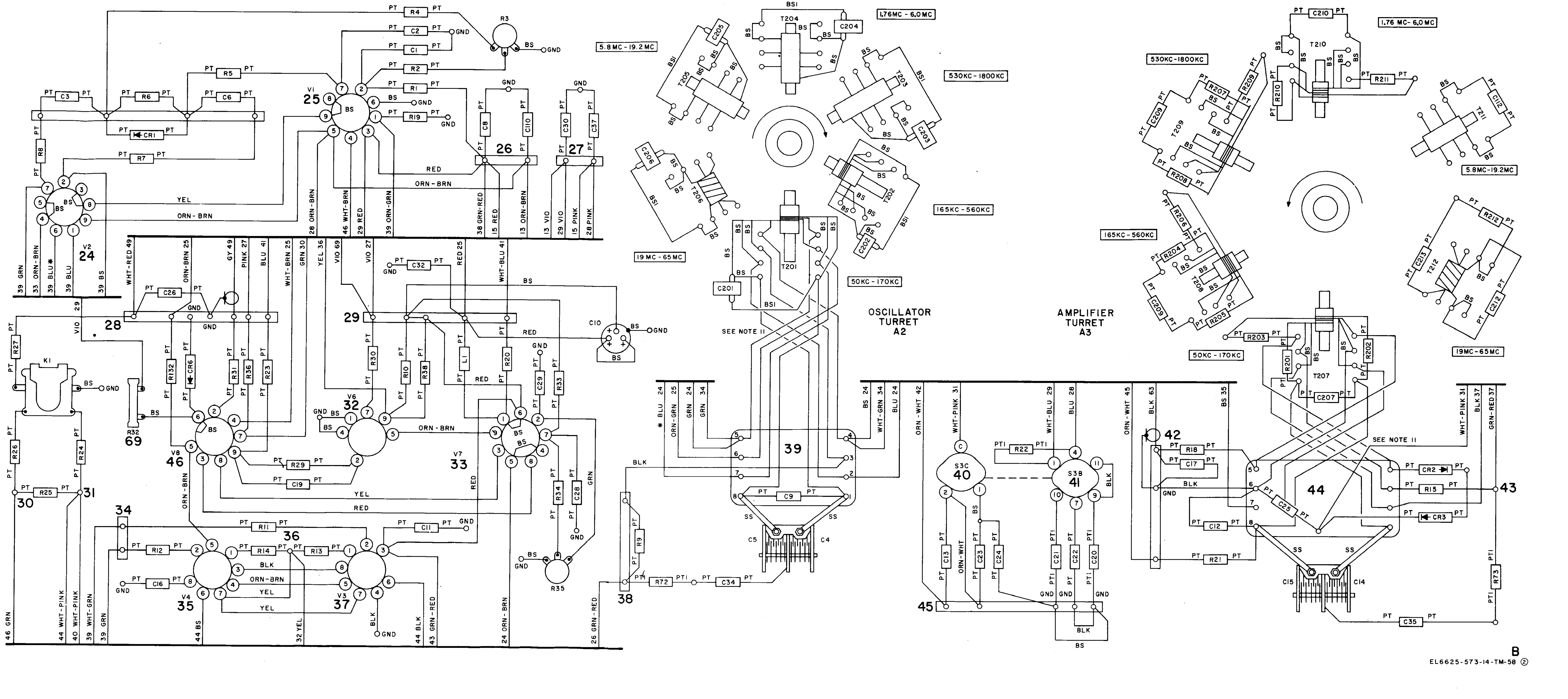
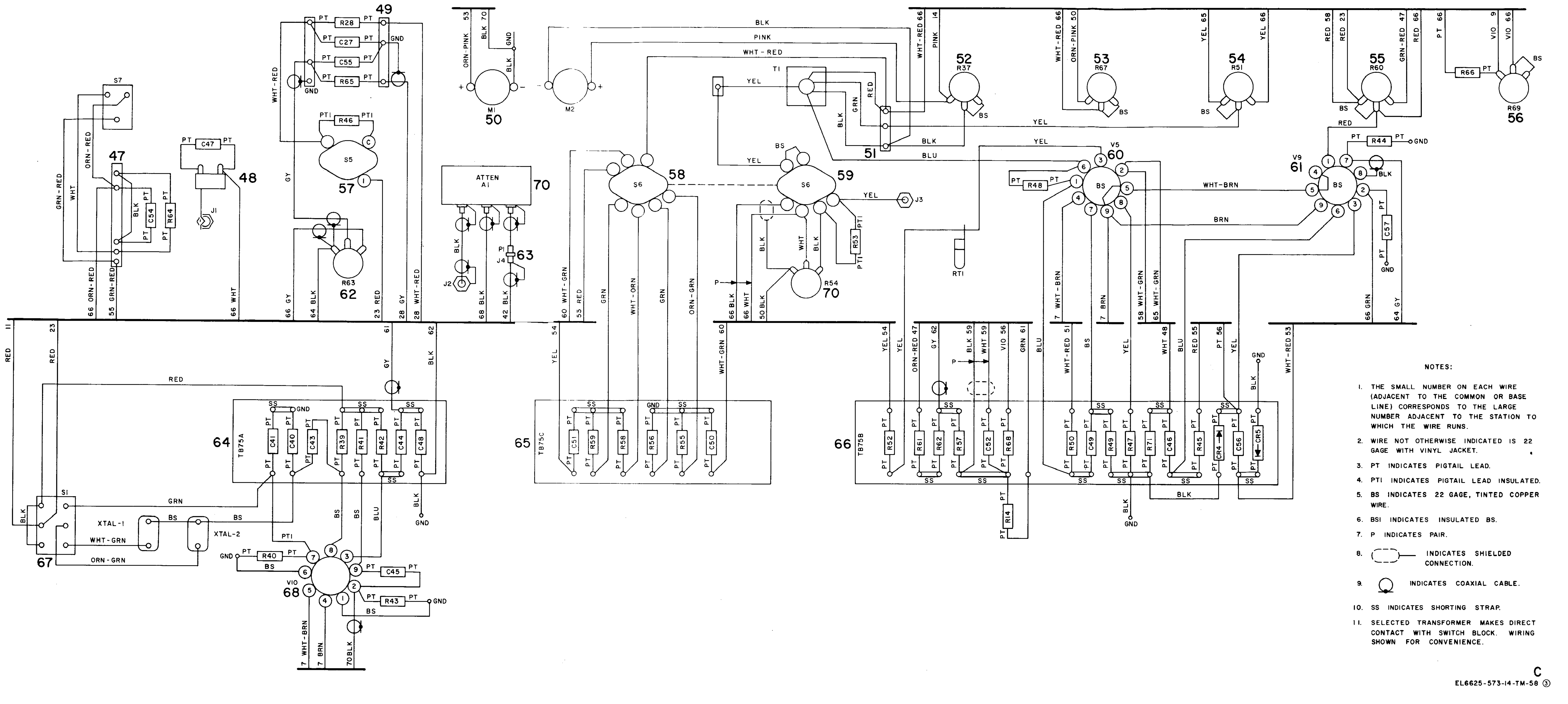


Figure FO-2.(2) Generator, Signal SG-479/G, wiring diagram (part 2 of 3).



NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. WIRE NOT OTHERWISE INDICATED IS 22 GAGE WITH VINYL JACKET.
3. PT INDICATES PIGTAIL LEAD.
4. PTI INDICATES PIGTAIL LEAD INSULATED.
5. BS INDICATES 22 GAGE, TINTED COPPER WIRE.
6. BSI INDICATES INSULATED BS.
7. P INDICATES PAIR.
8. (dashed oval symbol) INDICATES SHIELDED CONNECTION.
9. (circle symbol) INDICATES COAXIAL CABLE.
10. SS INDICATES SHORTING STRAP.
11. SELECTED TRANSFORMER MAKES DIRECT CONTACT WITH SWITCH BLOCK. WIRING SHOWN FOR CONVENIENCE.

C
EL6625-573-14-TM-58 ③

Figure FO-2.③ Generator, Signal SG-479/G, wiring diagram (part 3 of 3).

NOTES:

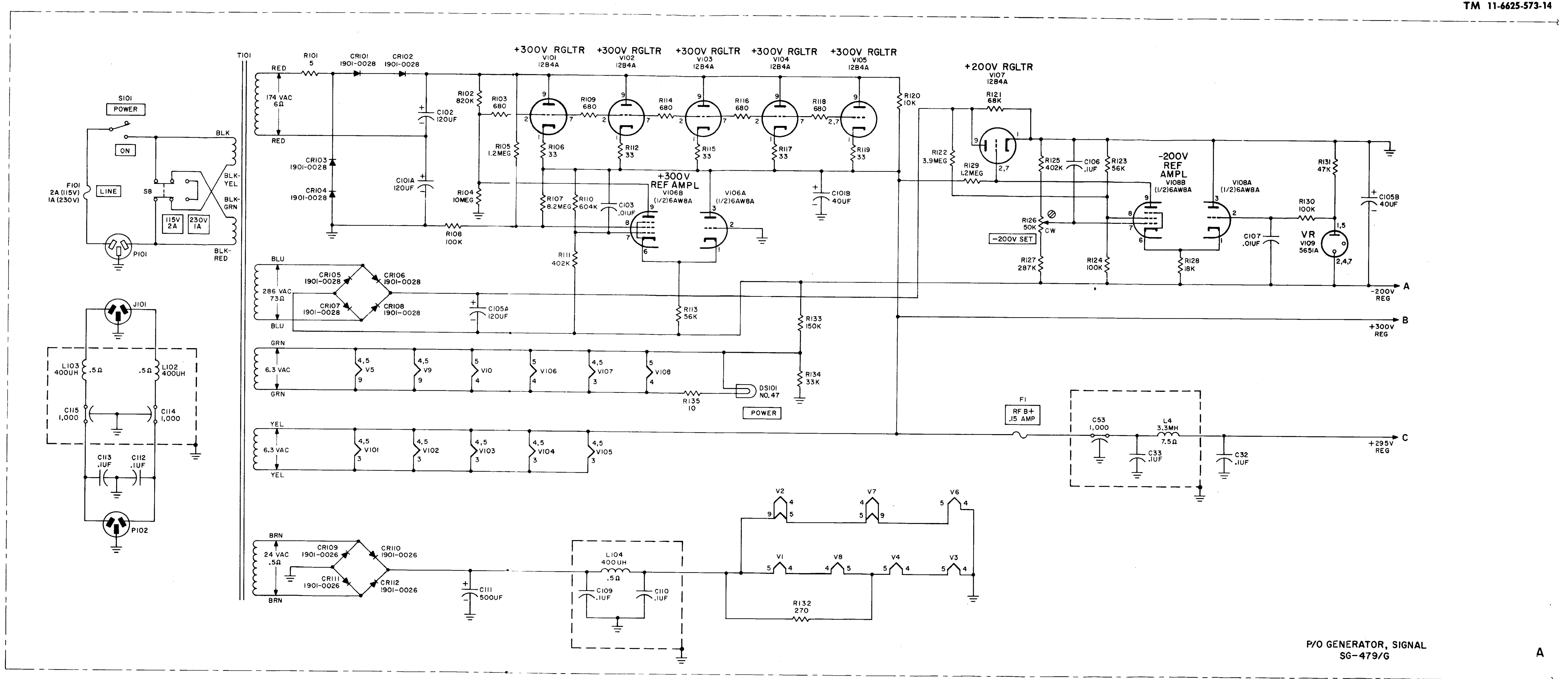
1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS AND CAPACITANCES ARE IN UUF.
2. [ ] INDICATES EQUIPMENT MARKINGS.
3. WAFER SWITCHES SHOWN IN EXTREME COUNTERCLOCKWISE POSITION AND ARE VIEWED FROM SIDE ON WHICH SEGMENTS ARE MOUNTED. FRONT OF WAFER IS SIDE TOWARD CONTROL POINT. WAFER NEAREST CONTROL POINT IS SECTION A. SEGMENTS OF WAFERS ARE IDENTIFIED BY X AND Y.
4. TRANSFORMER WINDING RESISTANCES LESS THAN .5 OHM ARE NOT LISTED.
5. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
6. CW INDICATES CLOCKWISE DIRECTION AS VIEWED FROM CONTROL POINT.
7. SELECTED VALUE, TYPICAL VALUE SHOWN.
8. [MODULATION SELECTOR] SWITCH S6 CONTACTS MAKE AS FOLLOWS:

S6 POSITION	FRONT	REAR
EXT. AC	5–6	3–4
EXT. DC	–	1–2, 3–4
CW	–	1–2, 4–5
INT. 1000~	1–7, 2–4–6	1–2, 4–5–6
INT. 400~	1–7, 3–5–6	1–2, 4–5–6

9. SWITCH S3 CONTACTS MAKE AS FOLLOWS:

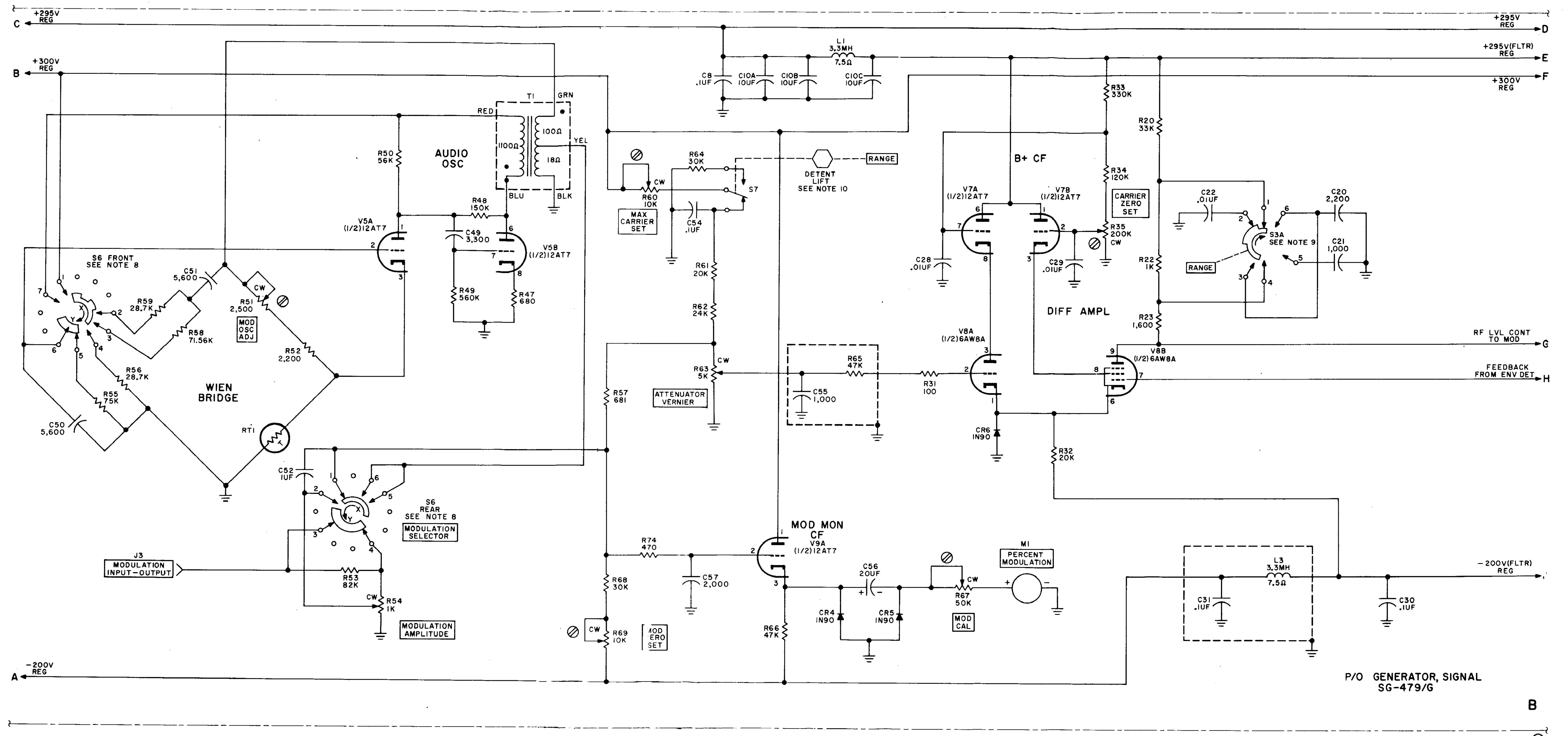
RANGE	A SECT	B SECT
50KC–170KC	1–2	1–2
165KC–560KC	1–2	2–3
530KC–1800KC	1–6	–
1.76MC–6.0MC	4–5	–
5.8MC–19.2MC	3–4	–
19.0MC–65MC	3–4	–

10. S7 CLOSE EACH TIME [RANGE] CHANGED.



EL6625-573-14-TM-59 ①

Figure FO-3.① Generator, Signal AN/GRM-50, overall schematic diagram (part 1 of 4).



EL6625-573-14-TM-59 (2)

Figure FO-3. (4) Generator, Signal AN/GRM-50, overall schematic diagram (part 2 of 4).

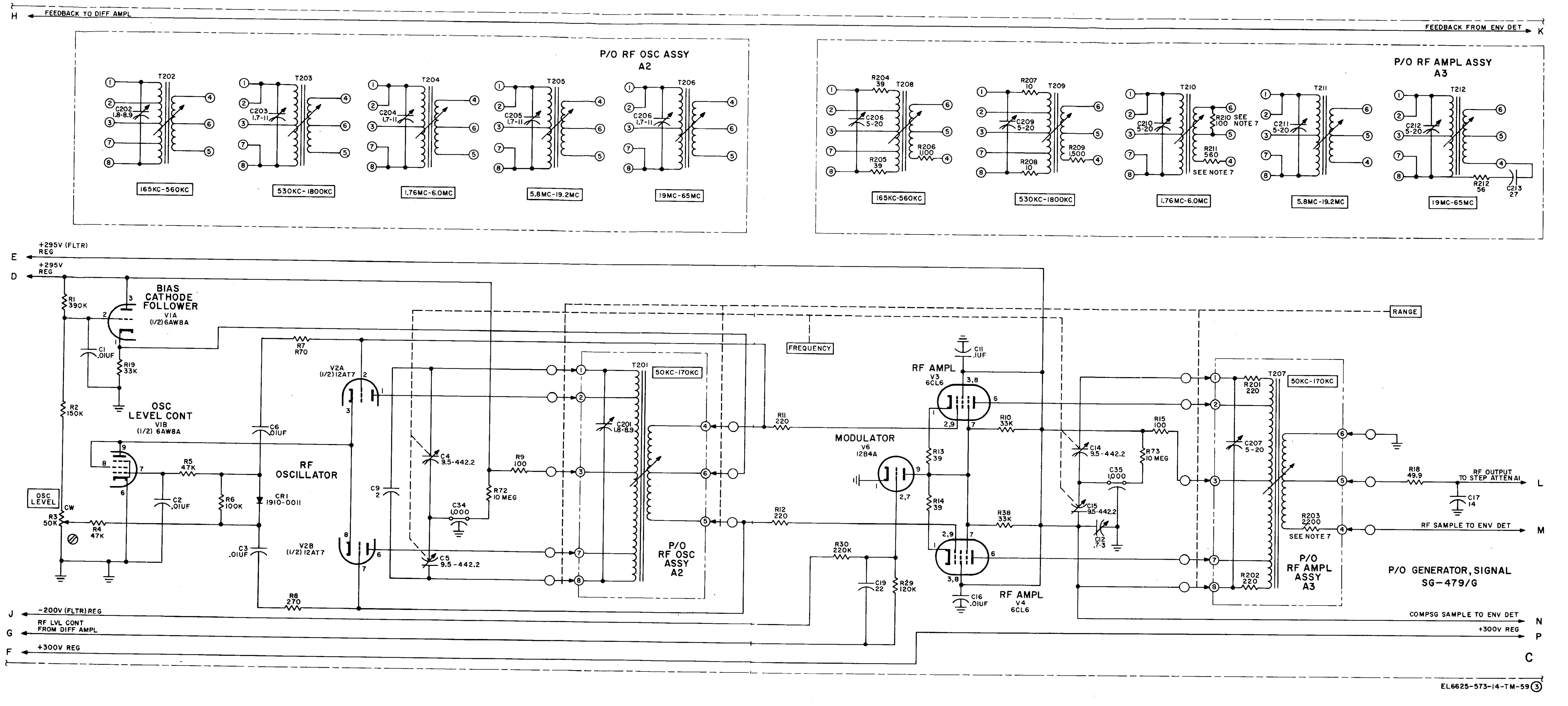


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Figure FO-3. ③ Generator, Signal AN/GRM-50, overall schematic diagram (part 3 of 4).

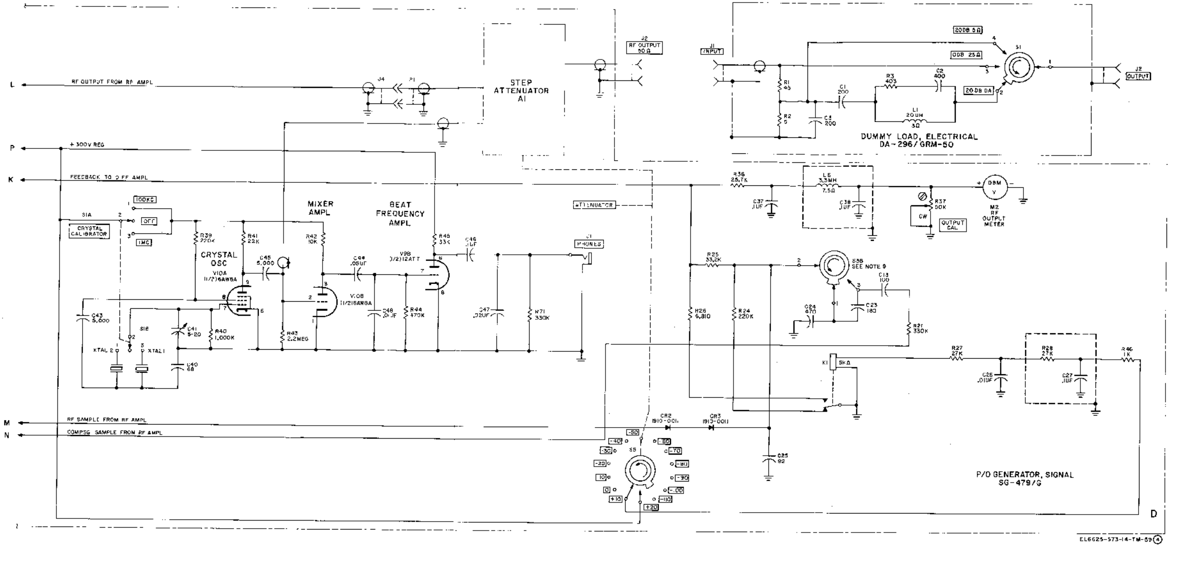

Figure FO-3.④ Generator Signal AN/GRM-50, overall schematic diagram (part 4 of 4).

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By Order of the Secretary of the Army:

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