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TECHNICAL MANUAL

for

TEST GENERATOR

MODEL TTG-2

(0-579A/URT)

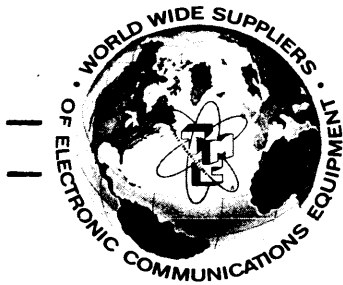


THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N. Y. OTTAWA, CANADA

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NOTICE

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THE TECHNICAL MATERIEL CORPORATION

C O M M U N I C A T I O N S E N G I N E E R S

700 FENIMORE ROAD

MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

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At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

CHANGE NO. 1 TTG-2



INSTRUCTION BOOK CHANGE NOTICE

Date Dec. 1, 1965

Manual affected: Test Generator, Model TTG-2 IN - 6002

COMPONENT CHANGE

1. Page 6-5. Parts List.
Resistors R538 and R539
 - a. Change description to read:
"RESISTOR, fixed: composition, 680 ohms, $\pm 5\%$, 1/2 watt."
 - b. Change TMC Part No. to: "RC20GF681J"
2. Page 7-1/7-2. Figure 7-1.
Change value of resistors R538 and R539 to "680 ohms".

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.

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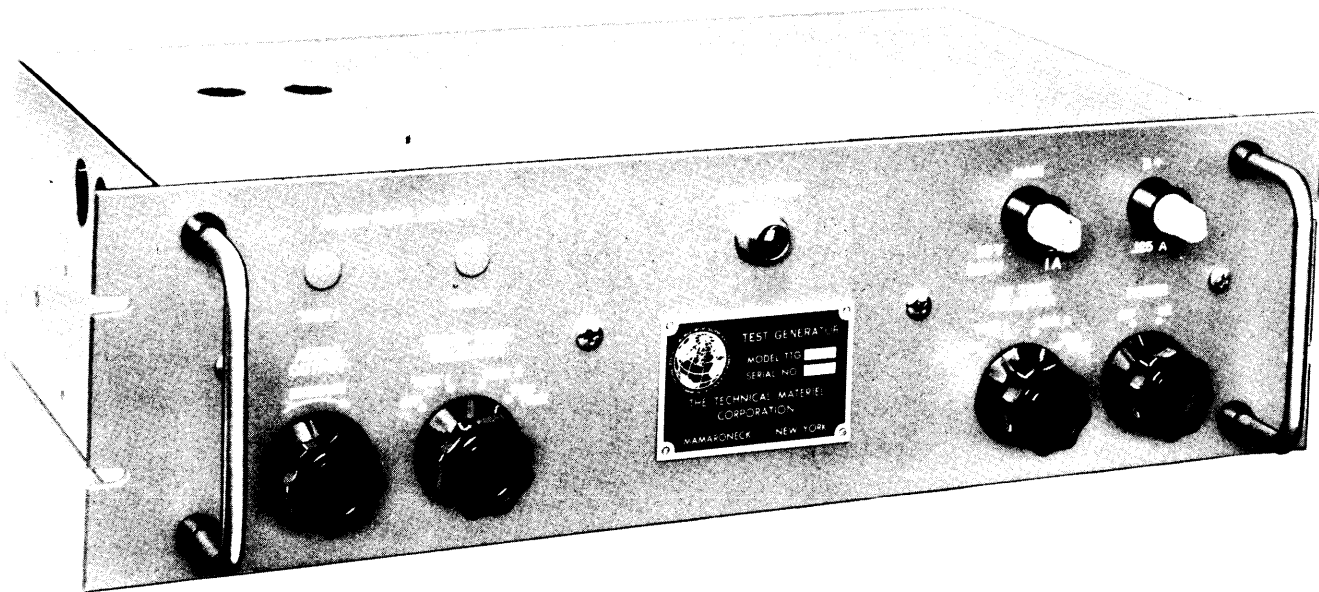


Figure 1-1. Test Generator, Model TTG-2

SECTION 1

GENERAL INFORMATION

1-1. GENERAL DESCRIPTION.

Test Generator, Model TTG-2, (figure 1-1) is a signal generating device designed to be used with distortion analyzing equipment in the testing of single sideband exciters and transmitters. The TTG-2 provides two r-f tones (1999 kc and 2001 kc) and two audio tones (935 cps and 2805 cps); spacing of the audio tones is such that the third, fifth and seventh order products may be presented on a spectrum analyzer.

Clearly labeled front-panel controls permit selection of any combination of the two r-f or audio output frequencies. The audio oscillators employed in the TTG-2 are designed with especially low distortion to insure an accurate check of distortion in the standard two-tone test. Crystal controlled r-f oscillators provide stable and dependable frequency outputs useful for checking the proper operation of spectrum analyzing equipment and the variable oscillators of transmitting equipment.

1-2. PHYSICAL DESCRIPTION.

Test Generator TTG-2 is designed for rack mounting and requires a mounting area 5-1/4 inches high, 19 inches wide, and 13-1/2 inches deep. All controls and indicators necessary for the operation of the TTG-2 are located on the front panel and are clearly marked according to function. Audio and r-f output connections are made to terminal strip

E500 and connector J501 respectively on the rear chassis apron (figure 5-3). Power for the TTG-2 enters connector J500 on the left side of the rear chassis apron. Main power and B+ supply fuses are located on the upper right portion of the front panel.

1-3. NOMENCLATURE.

<u>Commerical</u>	<u>Military</u>
Test Generator, Model TTG-2	Generator, Signal, 0-579A/URT

1-4. REFERENCE DATA.

Tables 1-1 and 1-2 provide technical specifications and tube complement for the TTG-2.

1-5. EQUIPMENT SUPPLIED.

The following items are supplied with Test Generator TTG-2:

<u>Item</u>	<u>Quantity</u>
Terminal Strip, Fanning; TM-105-3AL	1
Connector, Plug UG-625/U	1
Cable Assembly, AC Power; CA-435-1	1

TABLE 1-1. TECHNICAL SPECIFICATIONS, TTG-2

AUDIO FREQUENCY OSCILLATOR:

OUTPUT FREQUENCIES:	935 cps 2805 cps Either or both selectable from the front panel
HARMONIC DISTORTION:	Better than 65 db down
INTERMODULATION DISTORTION:	Better than 55 db down
OUTPUT IMPEDANCE:	600 ohms unbalanced or balanced
OUTPUT LEVEL:	0 to 0.5 volts continuously variable from front panel
OUTPUT CONNECTION:	Barrier Terminal Strip

RADIO-FREQUENCY OSCILLATOR:

OUTPUT FREQUENCIES:	1999 kc crystal controlled 2001 kc crystal controlled Either or both selectable from the front panel
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TABLE 1-1. TECHNICAL SPECIFICATIONS, TTG-2 (CONT)

DISTORTION:	Better than 60 db down
OUTPUT IMPEDANCE:	70 ohms unbalanced
OUTPUT LEVEL:	0.5 volt
OUTPUT CONNECTOR:	BNC
CONTROLS:	Power Switch AF Tone Selector RF Tone Selector Audio Output Control
PRIMARY POWER:	115/230 volts, 50/60 cps, approximately 35 watts
DIMENSIONS:	19 inches wide x 5-1/4 inches high x 13-1/2 inches deep
WEIGHT:	14.5 Pounds
ENVIRONMENTAL CONDITIONS:	Designed to operate in any ambient temperature of 0° to 50°C and any value of humidity up to 95%

TABLE 1-2. ELECTRON TUBE COMPLEMENT

REFERENCE DESIGNATION SYMBOL	TYPE	FUNCTION
V500	12AT7	Tone 1 Audio Oscillator
V501	12AT7	Tone 2 Audio Oscillator
V502	12AU7	Tone 1 Audio Amplifier
V503	12AU7	Tone 2 Audio Amplifier
V504	12AU7	V504A: R-F Oscillator V504B: R-F Amplifier
V505	12AU7	V505A: R-F Oscillator V505B: R-F Amplifier
V506	6X4	Rectifier

SECTION 2 INSTALLATION

2-1. UNPACKING AND HANDLING.

The method used to package the TTG-2 is dependent upon whether the TTG-2 is to be shipped by itself or with other equipment. Gross shipping weight of the TTG-2 when shipped by itself is approximately 50 pounds. Inspect the shipping container for possible damage when it arrives at the operating site; with respect to equipment damage for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

Unpack the TTG-2 with care and inspect all packing material for parts that may have been shipped as loose items. A close visual inspection of all equipment should be made to determine any physical damage due to rough handling during shipment. If damage is found, notify carrier immediately.

2-2. POWER REQUIREMENTS.

Test Generator TTG-2 is designed for 115/230 volt, 50/60 cycle, single phase power; it is factory wired for 115 volts. If 230 volt operation is required, a minor wiring change must be made at the primary winding of transformer T500 as shown in figure 2-1.

NOTE

If changing from 115- to 230-volt operation, replace main-power fuse F500 with a fuse of one half the amperage rating. If changing from 230- to 115-volt operation, replace fuse F500 with a fuse of twice the amperage rating.

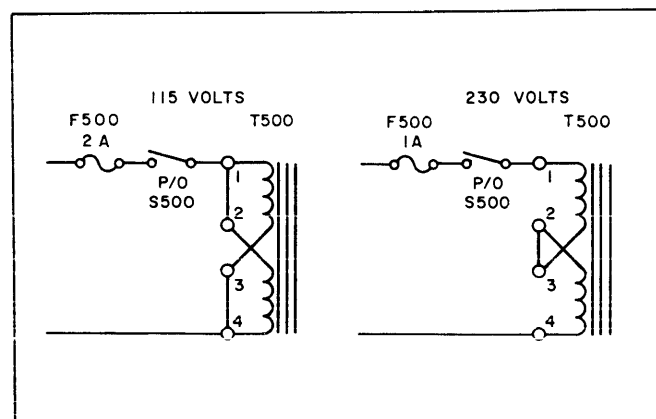


Figure 2-1. Transformer Wiring, 115-Volt and 230-Volt Operation

2-3. INSTALLATION.

a. MECHANICAL INSTALLATION. - Mount the TTG-2 in a standard 19 inch wide equipment rack or other housing as desired; using four machine screws, secure front panel to equipment rack or housing employed. Front panel and chassis mounting dimensions are as follows:

Front Panel: 19 inches wide x 5-1/4 inches high

Chassis: 17 inches wide x 13-1/2 inches deep

b. ELECTRICAL INSTALLATION.

(1) GENERAL. - The following paragraphs provide information concerning only the power connection, and audio and r-f output connections made directly to the TTG-2 chassis. For information regarding the electrical test connections for various applications of the TTG-2, refer to Section 3 of this manual.

(2) POWER CONNECTION. - Before connecting power to the TTG-2, ensure that the unit is wired correctly for the available power source (refer to paragraph 2-2). Proceed as follows:

(a) With POWER switch set at OFF, insert twist lock plug of power cable CA-435-1 in a-c input jack J500 (see figure 5-3); rotate plug clockwise to ensure that it is locked in position.

(b) Plug other end of power cable into 50/60 cycle power outlet.

(3) AUDIO AND R-F OUTPUT CONNECTIONS. - Audio and r-f output connections are made respectively to terminal strip E500 and jack J501 located on the rear chassis apron (see figure 5-3). Connection to jack J501 is made with a BNC connector.

2-4. INSPECTION AND ADJUSTMENT.

Inspection procedures related to installation comprise inspection for physical damage as noted in paragraph 2-1.

Before the TTG-2 is shipped from the factory, it is thoroughly checked against the manufacturer's specifications; no initial adjustments are required before installation and operation. For alignment and adjustment information relative to preventive maintenance, refer to Section 4 of this manual.

SECTION 3 OPERATOR'S SECTION

3-1. PREPARATION FOR USE.

Prior to first usage of Test Generator TTG-2, refer to paragraph 2-2 and ensure that transformer T500 is correctly wired for the available power source. Also ensure that audio and r-f output connections (paragraph 2-3, b) are secure.

3-2. OPERATION OF UNIT.

a. CONTROL FUNCTIONS. - As shown in figure 3-1, Test Generator TTG-2 contains four controls, a MAIN POWER indicator lamp, and two blown-fuse indicators. Table 3-1 lists the controls and indicators and the function of each.

b. OPERATING PROCEDURES. - The TTG-2 is used in transmission systems to determine the quality of the system. Paragraph (1) below outlines one method for using the TTG-2 to check the proper operation of spectrum analyzing equipment. Paragraphs (2), (3), and (4) below outline various methods of using the TTG-2 to check the proper operation of transmitting equipment.

NOTE

In the following procedures, numbers enclosed in parenthesis are callouts referenced to figure 3-1.

TABLE 3-1. CONTROLS AND INDICATORS, TTG-2

PANEL CALLOUTS (Figure 3-1)	PANEL DESIGNATION	FUNCTION
1	MAIN POWER	Lights to indicate that TTG-2 is energized.
2	MAIN/2A	Lights to indicate that main-power fuse F500 is blown.
3	B+/.125A	Lights to indicate that B+ fuse F501 is blown.
4	POWER	ON position applies a-c voltage to TTG-2 power supply. OFF position disconnects a-c voltage from TTG-2 power supply.
5	RF TONE SELECTOR	TONE 1 position applies 1999 kc tone to jack J501. TONE 2 position applies 2001 kc tone to jack J501. TWO TONE position applies 1999 kc and 2001 kc tones to jack J501.
6	AUDIO TONE SELECTOR	TONE 1 position applies 935 cps tone to terminal strip E500. TONE 2 position applies 2805 cps tone to terminal strip E500. TWO TONE position applies 935 cps and 2805 cps tones to terminal strip E500.
7	AUDIO OUTPUT	Varies combined tone output level at terminal strip E500.

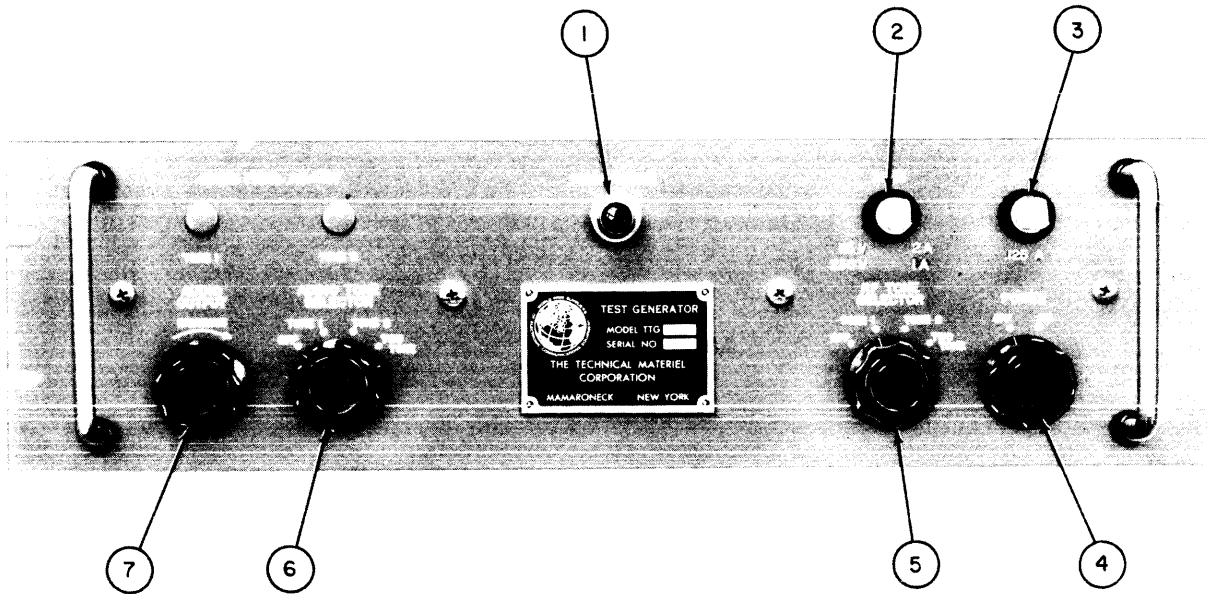


Figure 3-1. Controls and Indicators, TTG-2

(1) SPECTRUM ANALYZER CENTER FREQUENCY CHECK. - Proceed as follows:

(a) Ensure that connector J501 of TTG-2 is connected to signal-input jack of spectrum analyzer as indicated in figure 3-2.

(b) Set TTG-2 controls at positions listed below:

<u>Control</u>	<u>Position</u>
AUDIO OUTPUT * (7)	
AUDIO TONE SELECTOR (6)	OFF
RF TONE SELECTOR (5)	TWO TONE
POWER (4)	ON

*This control not used.

NOTE

When a variable RF oscillator is used in conjunction with the spectrum analyzer, the variable RF oscillator must be tuned to the appropriate frequency to place the 1999 kc and 2001 kc test signals in the passband of the analyzer.

(c) Tune spectrum analyzer so that test signal peaks are equidistant from zero reference line on screen (see figure 3-2). A 2-kc difference between peaks indicates proper calibration of the spectrum analyzer.

(2) TWO-TONE TEST FOR DISTORTION PRODUCTS IN TRANSMITTING EQUIPMENT. - To test for distortion products in transmitting equipment, use the TTG-2 in conjunction with a spectrum analyzer. Proceed as follows:

NOTE

Numbers enclosed in parenthesis are callouts referenced to figure 3-1.

(a) On TTG-2, ensure that terminal 3 of terminal strip E500 is connected to ground; connect terminal 1 of terminal strip E500 to audio input of sideband exciter.

(b) Terminate antenna coil of power-amplifier output tank with dummy load.

(c) Connect signal-input jack of spectrum analyzer to monitor output of sideband exciter, intermediate amplifiers, power amplifiers, or other r-f stages as indicated in figure 3-3.

NOTE

If a variable RF oscillator is used in conjunction with the spectrum analyzer, the variable RF oscillator must be tuned to the appropriate frequency to analyze 935 cps and 2805 cps test signals.

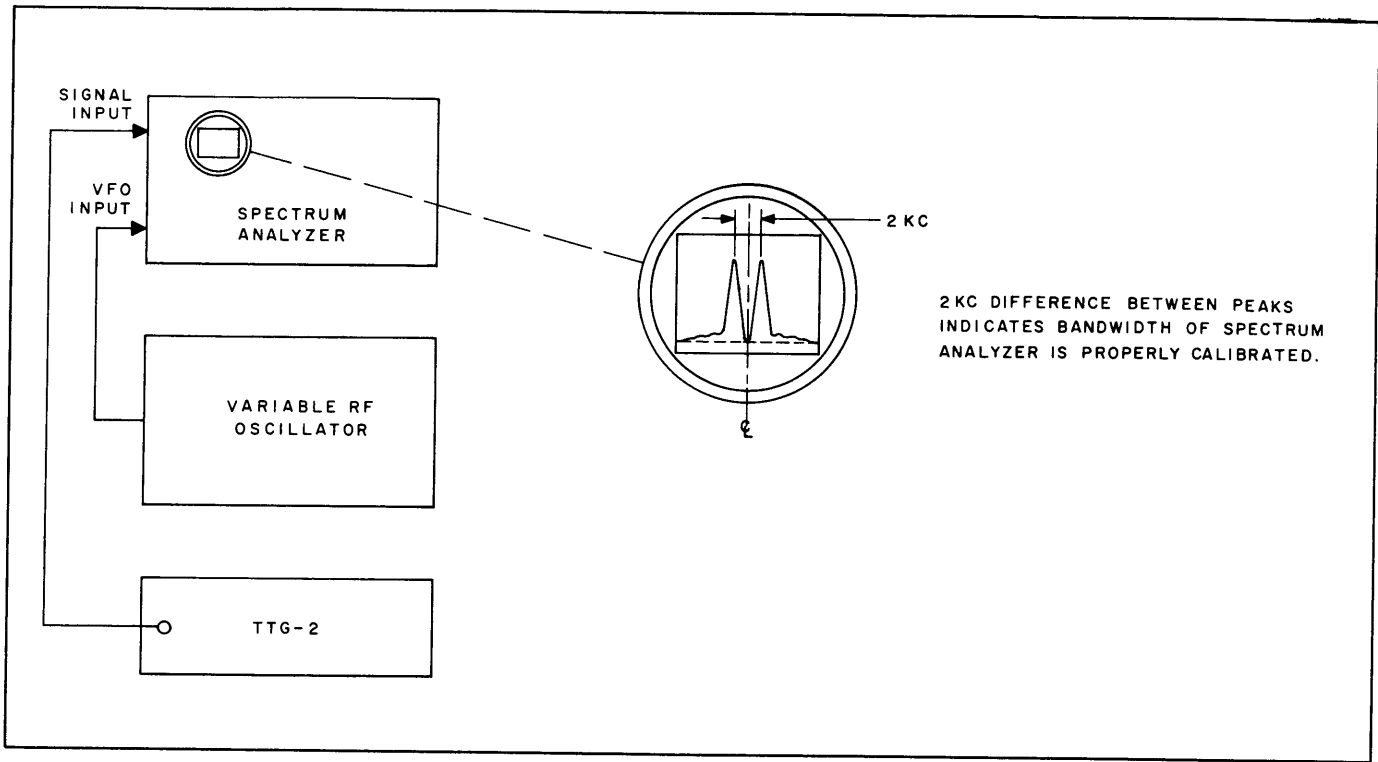


Figure 3-2. Spectrum Analyzer Center Frequency Check

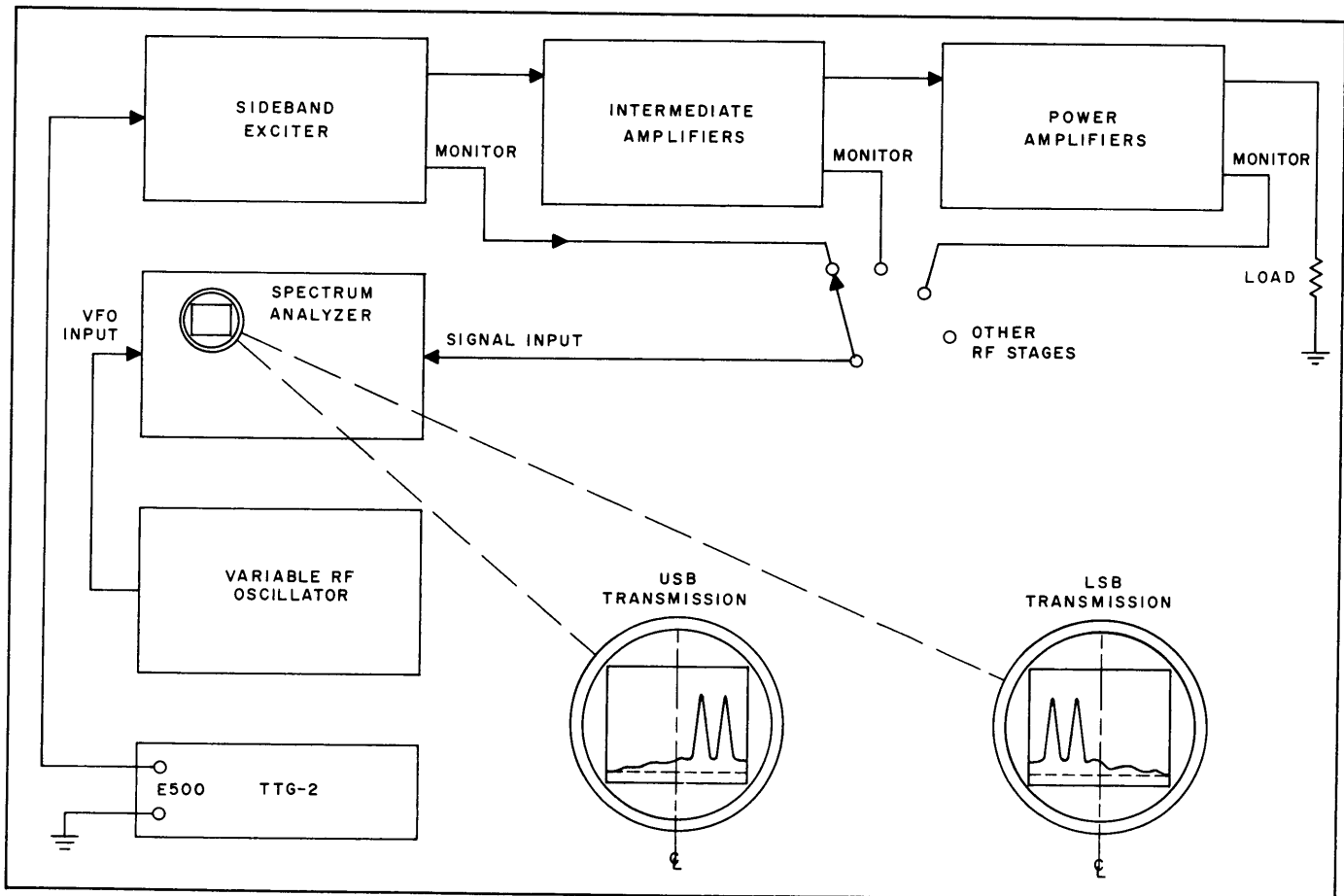


Figure 3-3. Two-Tone Test for Distortion

(d) Set TTG-2 controls at positions listed below:

<u>Control</u>	<u>Position</u>
RF TONE SELECTOR (5)	OFF
AUDIO TONE SELECTOR (6)	TWO TONE
AUDIO OUTPUT (7)	Sufficient to properly modulate transmitter
POWER (4)	ON

(e) On spectrum analyzer, perform two-tone test for distortion.

(3) TWO-TONE MEASUREMENT OF PEAK ENVELOPE POWER. - Use the TTG-2 in conjunction with an oscilloscope to measure peak envelope power. Proceed as follows:

NOTE

Numbers enclosed in parenthesis are callouts referenced to figure 3-1.

(a) On TTG-2, ensure that terminal 3 of terminal strip E500 is connected to ground.

(b) Terminate antenna coil of linear-amplifier output tank with non-inductive dummy load as shown in figure 3-4.

(c) On TTG-2, connect terminal 1 of terminal strip E500 to audio input stage of single-sideband transmitter and to EXT. SYNC input of oscilloscope as indicated in figure 3-4.

(d) Using pick-up coil, couple vertical input of oscilloscope to linear-amplifier output tank as shown in figure 3-4.

(e) Set TTG-2 controls at positions listed below:

<u>Control</u>	<u>Position</u>
AUDIO OUTPUT (7)	Sufficient to properly modulate transmitter
AUDIO TONE SELECTOR (6)	TWO TONE
RF TONE SELECTOR (5)	OFF
POWER (4)	ON

(f) Ensure that oscilloscope is calibrated and then adjust oscilloscope controls as required to obtain scope picture as illustrated in figure 3-4.

(g) Calculate peak envelope power using following formula:

$$PEP = \frac{(.707E)^2}{R}$$

E = Amplitude of signal (voltage)

R = Resistance of non-inductive load

(4) LINEARITY TEST. - Use the TTG-2 in conjunction with an oscilloscope to test transmitter linearity. Proceed as follows:

NOTE

Number enclosed in parenthesis are callouts referenced to figure 3-1.

(a) On terminal strip E500 of TTG-2, ensure that terminal 3 is connected to ground; connect terminal 1 to input of sideband exciter as indicated in figure 3-5.

(b) Connect output of sideband exciter and linear amplifier to horizontal and vertical input jacks respectively of oscilloscope as indicated in figure 3-5.

(c) Set TTG-2 controls as follows:

<u>Control</u>	<u>Position</u>
AUDIO OUTPUT (7)	Sufficient to properly modulate transmitter
AUDIO TONE SELECTOR (6)	TONE 1 or TONE 2
RF TONE SELECTOR (5)	OFF
POWER (4)	ON

(d) Perform phase and frequency measurements on oscilloscope. Scope picture should be a straight line as indicated in figure 3-5.

3-3. OPERATOR'S MAINTENANCE.

The operator should observe whether front-panel controls and indicators are in good condition and functioning properly. Indicator lamps and controls should be replaced as required.

Indicator type fuses should be observed and replaced as required; the front-panel indicators light when the associated fuse is blown.

CAUTION

Do not replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been located and corrected.

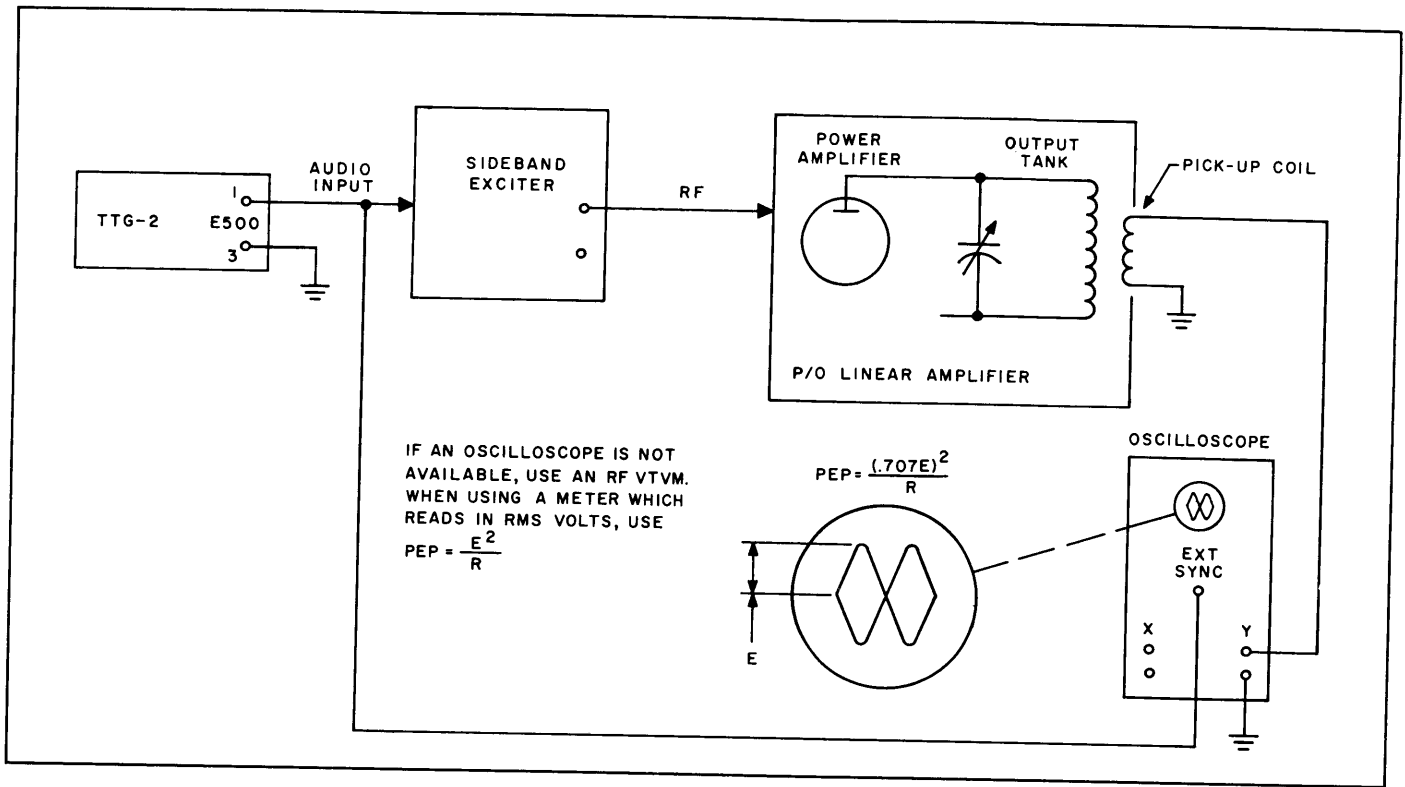


Figure 3-4. Two-Tone Measurement of Peak Envelope Power

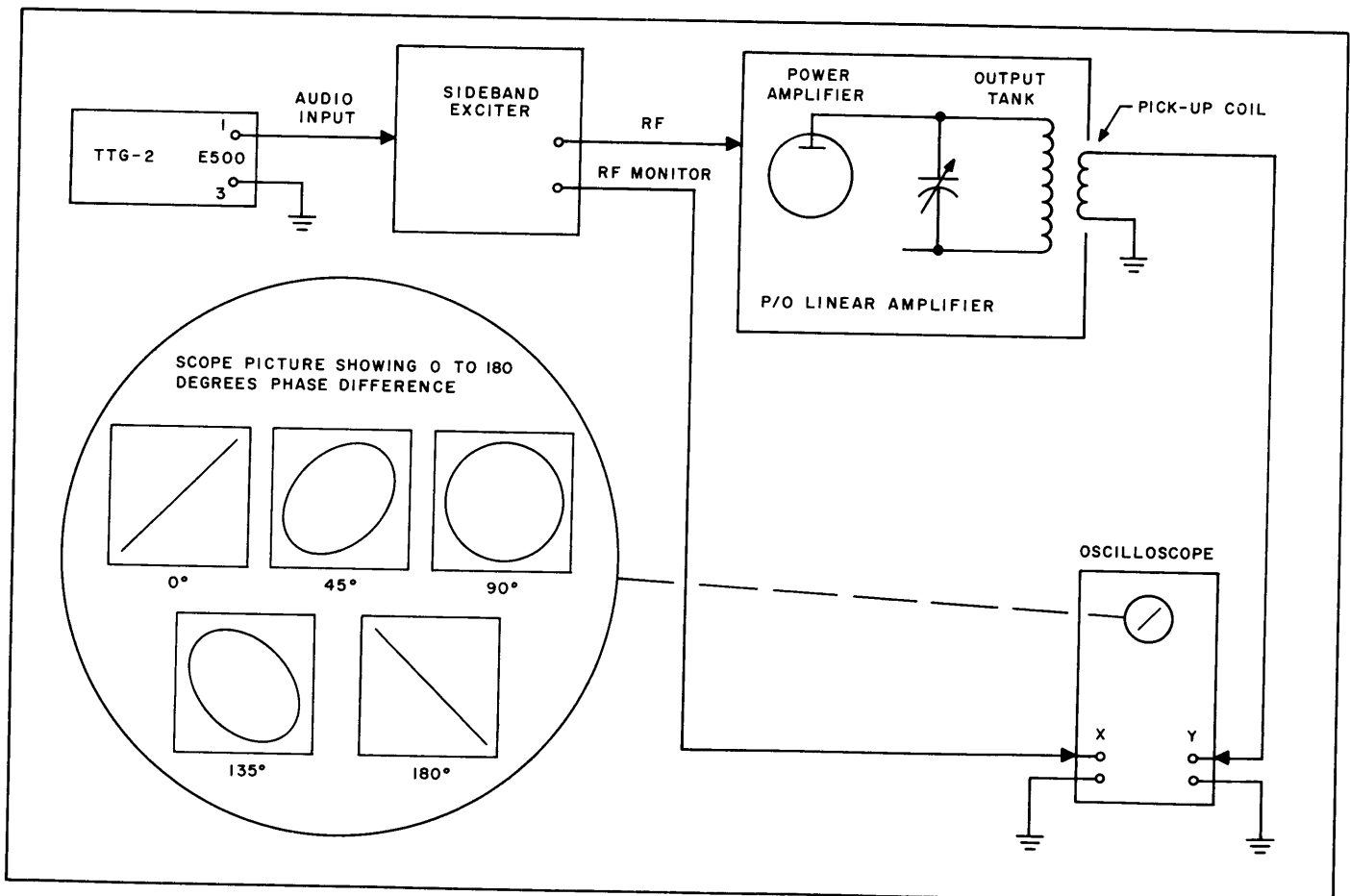


Figure 3-5. Linearity Test

SECTION 4 TROUBLESHOOTING

4-1. INTRODUCTION.

This section contains troubleshooting information and circuit analysis of the TTG-2.

4-2. CIRCUIT ANALYSIS.

a. GENERAL. Refer to figure 4-1. Test Generator TTG-2 contains two audio oscillators (935 cps and 2805 cps) and two r-f oscillators (1999 kc and 2001 kc).

Depending upon the setting of AUDIO TONE SELECTOR S502, signals generated by oscillators V500 and V501 are amplified respectively by stages V502 and V503 and then filtered to assure low distortion. The two audio signals can be used separately or together and are available at terminal strip E500. The AUDIO OUTPUT control (R524) permits adjustment of the combined tone level.

Depending upon the setting of RF TONE SELECTOR S501, signals generated by oscillators V504A

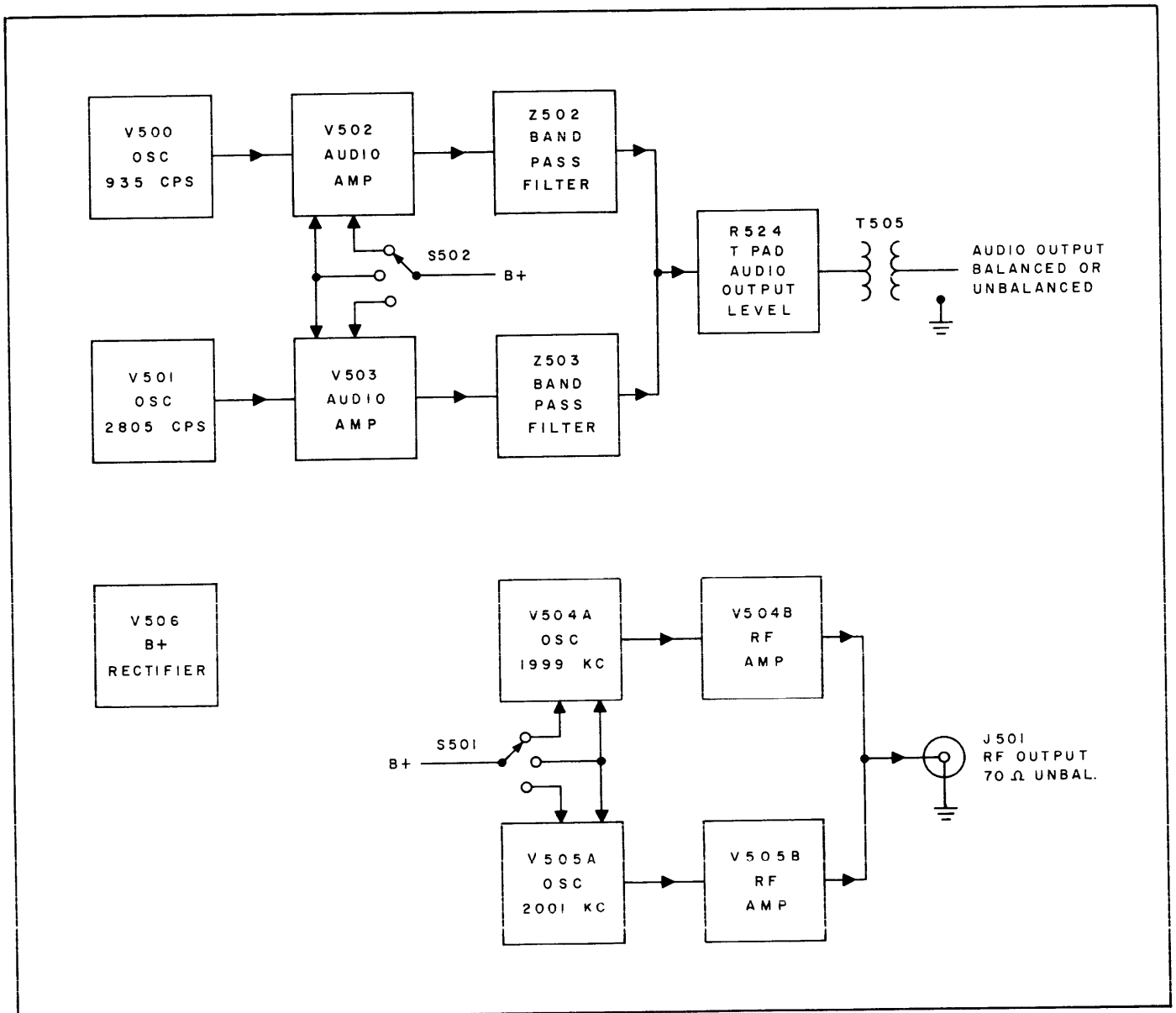


Figure 4-1. Block Diagram, Test Generator, Model TTG-2

and V505A are amplified by stages V504B and V505B respectively. The two r-f signals can be used separately or together and are available at connector J501. Crystal control of oscillators V504A and V505A assures dependable, stable signal.

b. DETAILED CIRCUIT ANALYSIS, AUDIO OSCILLATOR, AMPLIFIER, AND OUTPUT NETWORK. - Detailed circuit analysis for the audio oscillator, audio amplifier, and audio output network used in the TTG-2 are given in the following paragraphs. The 935-cps and 2805-cps oscillator and amplifier stages are identical; therefore only the 935-cps stage is discussed in paragraphs (1) and (2) below.

(1) AUDIO OSCILLATOR. - Refer to figure 4-2. The TTG-2 employs a Wein bridge type oscillator comprising a 12AT7 (V500), a frequency-determining network (Z500), a regeneration control (R501), and the primary of transformer T501. R501 provides adjustment of oscillation for optimum operation. A thermal resistor in the form of lamp I500 limits current variations to prevent changes in oscillator output level. The output of the oscillator is coupled to the audio amplifier through transformer T501.

(2) AUDIO AMPLIFIER. - Refer to figure 4-3. The TTG-2 employs a push-pull class A amplifier comprising a 12AU7 electron tube (V502), the secondary winding of transformer T501, the primary winding of transformer T503, and AUDIO TONE SELECTOR S502. When S502 is set at TONE 1 or

TWO TONE, plate voltage (B+) is applied to V502; audio signals applied to transformer T501 are then amplified and coupled to the audio output network through transformer T503.

(3) AUDIO OUTPUT NETWORK. - Refer to figure 4-4. The audio output network incorporated in the TTG-2 comprises bandpass filters Z502 and Z503, the secondary of transformers T503 and T504, "T" Pad R524, and transformer T505. Output signals from transformers Z502 and Z503 are filtered by Z502 and Z503 to remove any remaining distortion products. The signals are then applied to transformer T505 and coupled to terminal strip E500. The individual signal (935 cps or 2805 cps) level can be varied by R518 or R519 in order to obtain balance of both signals. Combined signal level may be adjusted by R524 (AUDIO OUTPUT control).

c. DETAILED CIRCUIT ANALYSIS, R-F OSCILLATOR AND AMPLIFIER. - Refer to figure 4-5. The 1999 kc and 2001 kc oscillator and amplifier stages used in the TTG-2 are identical; therefore the 1999 kc stage is shown.

The crystal-controlled r-f oscillator circuit employed in the TTG-2 is a modified Pierce oscillator using the first half of a 12AU7 electron tube (V504A). When RF TONE SELECTOR S501 is set at TONE 1 or TWO TONE, plate voltage (B+) is applied to V504A. The output of the oscillator is coupled to the grid of amplifier V504B through variable capacitor C520. V504B, the second half of the 12AU7,

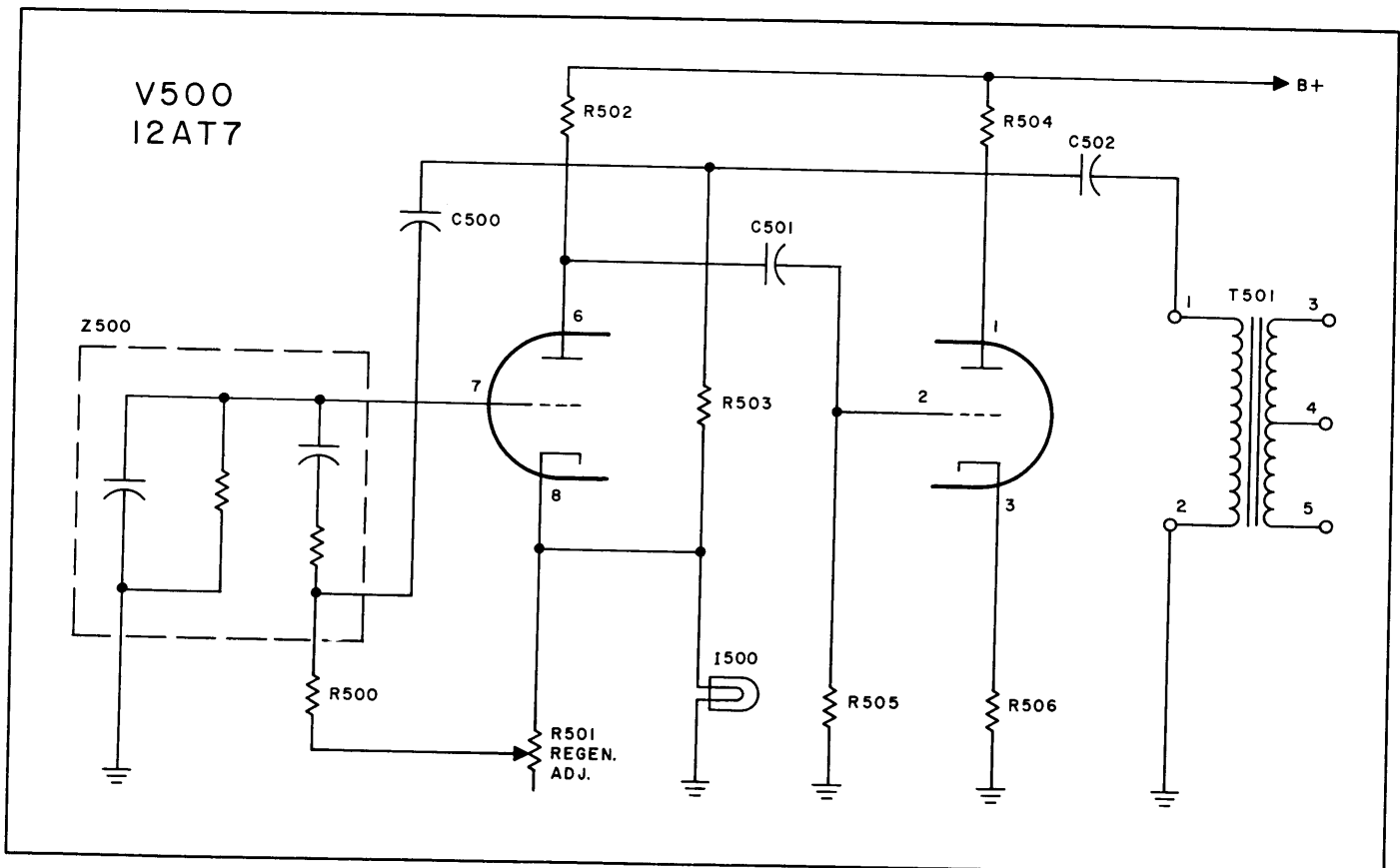


Figure 4-2. Schematic Diagram, Audio Oscillator, TTG-2

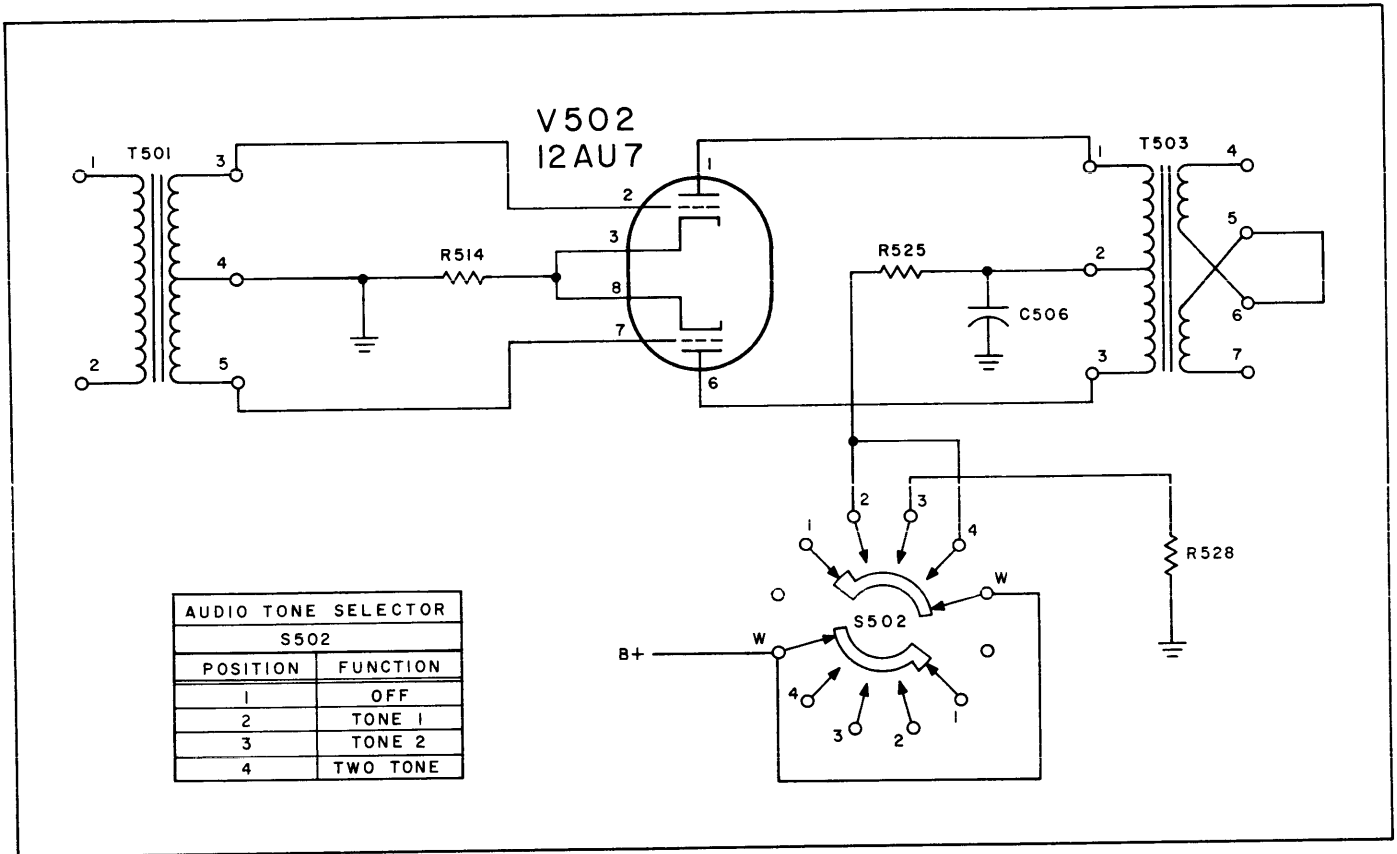


Figure 4-3. Schematic Diagram, Audio Amplifier, TTG-2

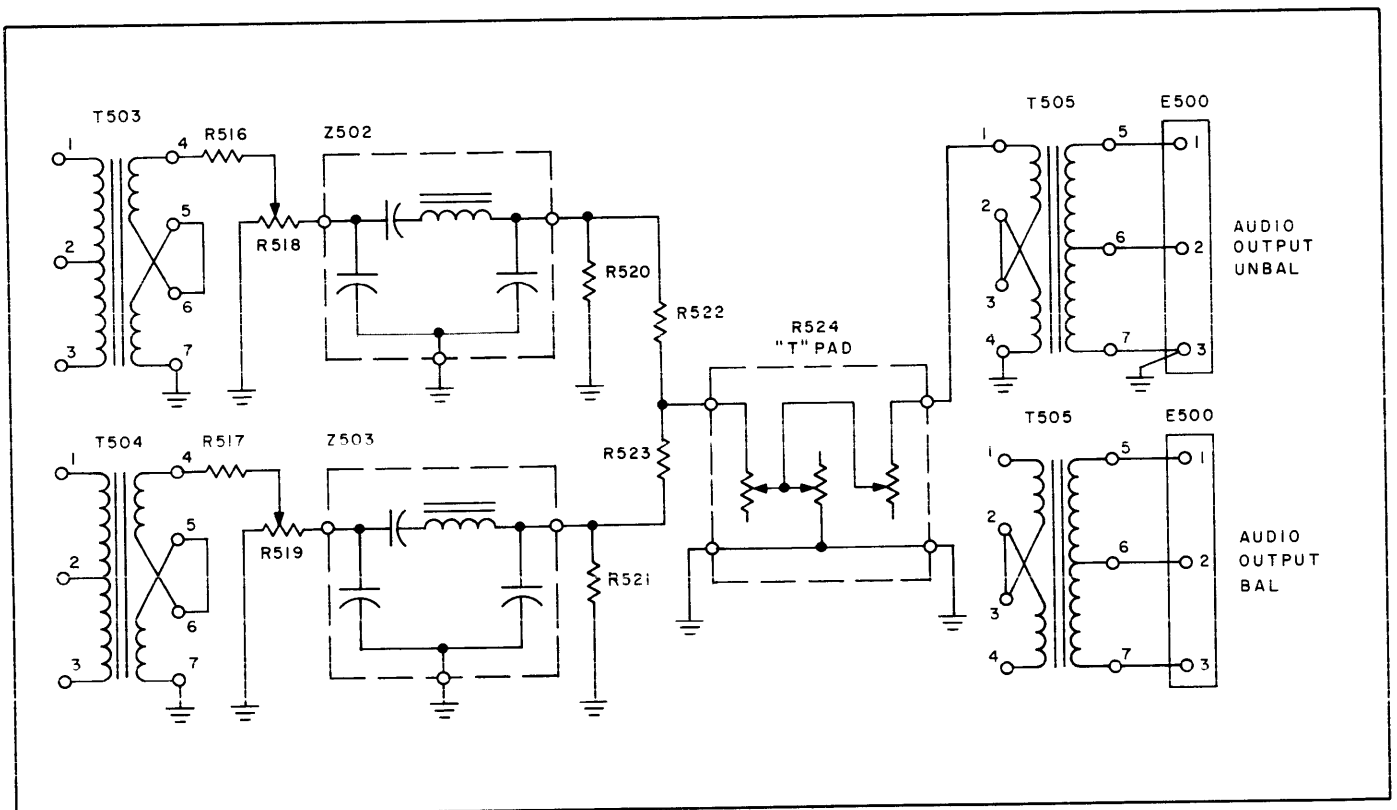


Figure 4-4. Schematic Diagram, Output Network, TTG-2

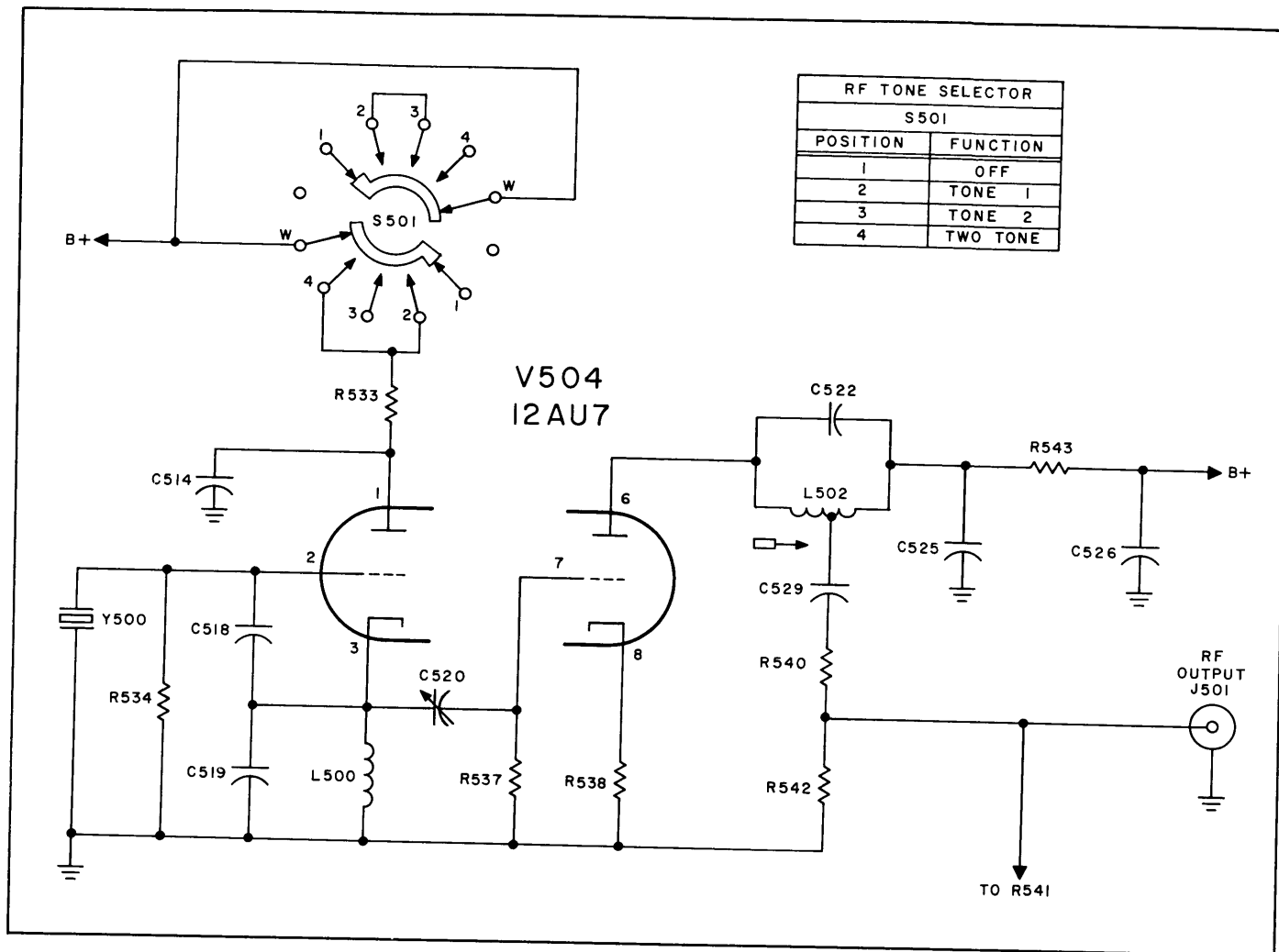


Figure 4-5. Schematic Diagram, R-F Oscillator and Amplifier, TTG-2

is used as a tuned-output amplifier in order to bring the output to the required level. Variable capacitor C520 is adjusted so that the output signals of both oscillators (V504A and V505A) are equal in amplitude after the plate of each amplifier (V504B and V505B) is tuned to resonance.

4-3. TROUBLESHOOTING.

a. GENERAL. - Troubleshooting is the art of locating and diagnosing equipment troubles and maladjustments; the information necessary to remedy the equipment troubles and maladjustments is reserved for Section 5 of this manual under the heading "Maintenance". Refer to the overall schematic diagram given in Section 7 and to the information given in paragraph 4-2 of this Section as additional aids when troubleshooting the TTG-2. Figures 5-1 and 5-2 show the locations of the major components of the TTG-2 and should be used to facilitate the location of components during troubleshooting procedures.

b. TROUBLESHOOTING HINTS. - Ascertain that all tubes are in proper working order, and that the TTG-2 is receiving proper supply voltages. Many times this simple procedure eliminates further investigation.

Examine the TTG-2 section by section, for burned out components, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

It is important to recognize that components may have become defective due to their own weaknesses or to some contributing cause beyond their control.

c. VOLTAGE AND RESISTANCE MEASUREMENTS. - Connect TTG-2 to power source and set POWER switch at ON; note that all tube filaments and MAIN POWER lamp are lit. Proceed as outlined in Plate-Voltage Checkout Procedure Table 4-1; if this procedure does not reveal the trouble, refer to Tables 4-2 and 4-3 and make point-to-point voltage and resistance measurements.

TABLE 4-1. PLATE-VOLTAGE CHECKOUT PROCEDURE

STEP	TEST POINT	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF ABNORMAL INDICATION
A. AUDIO OSCILLATOR AND AMPLIFIER STAGES				
NOTE				
All voltage measurements taken to chassis ground with VTVM.				
1.	(A) Figure 7-1	Measure voltage at pin 6 of V500 and V501	Voltage should be between 150 vdc and 175 vdc	Blown fuse F501 Defective tube V506 or associated power supply circuitry Defective filter C510 or resistor R529
2.	(B) Figure 7-1	Set AUDIO TONE SELECTOR S502 first at TONE 1 and then at TONE 2. Simultaneously measure voltage at pins 1 and 6 of V502 and V503	With S502 set at TONE 1, voltage at pins 1 and 6 of V502 should be approximately 160 vdc. No voltage should be present at pins 1 and 6 of V503 With S502 set at TONE 2, voltage at pins 1 and 6 of V503 should be approximately 160 vdc. No voltage should be present at pins 1 and 6 of V502	Defective switch S502 Defective transformer T503 or associated circuitry Defective switch S502 Defective transformer T504 or associated circuitry
3.	(B) Figure 7-1	Set AUDIO TONE SELECTOR S502 at TWO TONE. Measure voltage at pins 1 and 6 of V502 and V503	Voltage should be approximately 160 vdc	Defective switch S502
B. RF OSCILLATOR AND AMPLIFIER STAGES				
4.	(C) Figure 7-1	Set RF TONE SELECTOR S501 at TWO TONE. Measure voltage at pin 1 of V504 and V505	Voltage should be approximately 110 vdc	Defective switch S501 or resistor R530
5.	(C) Figure 7-1	Set RF TONE SELECTOR S501 first at TONE 1 and then at TONE 2. Simultaneously measure voltage at pin 1 of V504 and V505	With S501 set at TONE 1, voltage at pin 1 of V504 should be approximately 110 vdc. No voltage should be present at pin 1 of V505 With S501 set at TONE 2, voltage at pin 1 of V505 should be approximately 110 vdc. No voltage should be present at pin 1 of V504	Defective switch S501 or resistor R533 Defective switch S501 or resistor R532

TABLE 4-2. VOLTAGE MEASUREMENTS

PIN NO.	1	2	3	4	5	6	7	8	9
V500 12AT7	90	-1.15	0.9	0	0	150	0	3.0	6.3AC
V501 12AT7	120	-1.25	1.5	0	0	150	0	3.3	6.3AC
V502 12AU7	160	0	8	0	0	160	0	11.8	6.3AC
V503 12AU7	160	0	8	0	0	160	0	12.8	6.3AC
V504 12AU7	110	-27	.06	0	0	135	0	6.2	6.3AC
V505 12AU7	110	-35	.06	0	0	130	0	6.0	6.3AC
V506 6X4	270AC	0	0	6.3AC	0	270AC	235	-	-

CONDITIONS

AUDIO OUTPUT-FULLY COUNTER-CLOCKWISE
 AUDIO TONE SELECTOR-TWO TONE
 RF TONE SELECTOR-TWO TONE
 POWER-ON

ALL READINGS TO GROUND WITH HEWLETT-
 PACKARD MODEL 410 VTVM OR EQUIVALENT

VOLTAGES GIVEN ARE TYPICAL AND MAY
 VARY AS MUCH AS 20% FROM UNIT TO
 UNIT.

VOLTAGES ARE DC UNLESS OTHERWISE
 NOTED.

TABLE 4-3. RESISTANCE MEASUREMENTS

PIN NO.	1	2	3	4	5	6	7	8	9
V500 12AT7	26K	460K	490	0	0	90K	160K	500	0
V501 12AT7	26K	460K	490	0	0	95K	18K	500	0
V502 12AU7	30K	1.8K	2.6K	0	0	30K	2.2K	2.6K	0
V503 12AU7	30K	1.8K	2.6K	0	0	30K	2.2K	2.6K	0
V504 12AU7	50K	220K	17	0	0	48K	11K	2.2K	0
V505 12AU7	50K	240K	17	0	0	48K	11K	2.2K	0
V506 6X4	360	INF	0	0	INF	360	26K	-	-

CONDITIONS

AUDIO OUTPUT-FULLY COUNTER-CLOCKWISE
 AUDIO TONE SELECTOR-TWO TONE
 RF TONE SELECTOR-TWO TONE
 POWER-OFF

ALL READINGS TO GROUND

SECTION 5 MAINTENANCE

5-1. GENERAL.

Maintenance is divided into three categories: operator's maintenance, preventive maintenance, and repair. Repair procedures for the TTG-2 include information necessary to remedy equipment troubles. Preventive maintenance includes information necessary to insure optimum performance of the TTG-2; therefore, alignment and adjustment procedures are included under preventive maintenance. Operator's maintenance is described in Section 3.

5-2. SPECIAL TOOLS AND TEST EQUIPMENT.

Table 5-1 lists all special test equipment required for TTG-2 maintenance; no special tools are required.

TABLE 5-1. SPECIAL TEST EQUIPMENT

ITEM	MANUFACTURER
Vacuum Tube Voltmeter	Hewlett-Packard, Model 410B, or equivalent
Sonic Analyzer	Panoramic, Model LP-1a, or equivalent
Spectrum Analyzer	TMC, Model SA-2 (part of Spectrum Analyzer Group, Model FSA-2), or equivalent

5-3. PREVENTIVE MAINTENANCE.

a. GENERAL. - The TTG-2 has been designed to provide long term, trouble-free operation under continuous duty conditions. However, similar to any other piece of electronic equipment, optimum performance and service life of the TTG-2 are dependent upon an adequate preventive maintenance schedule that is strictly adhered to.

b. CLEANING AND INSPECTION. - At periodic intervals (at least every six months), remove the TTG-2 from the equipment rack or housing employed, and inspect the wiring and all components for dirt, corrosion, charring, discoloring, or grease. In particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethylene; remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichlorethylene, make certain that adequate ventilation exists. Avoid prolonged contact with skin.

Trichlorethylene contains paint solvents, do not use it on painted surfaces.

Carefully inspect equipment for loose solder connections or screws, especially those on solder lugs. Tighten and resolder connections as required.

c. REPLACEMENT OF ELECTRON TUBES. - While the TTG-2 is out of the cabinet for periodic inspection, all electron tubes should be checked and replaced as required. Particular attention should be paid to the following:

(1) When withdrawing miniature tubes from their sockets, pull them straight out; do not rock or turn them. If pins of miniature tubes are bent, straighten them with a proper pin straightener before replacing the tube.

(2) Some circuits, for example oscillator circuits, may function better with one tube than with another even though both tubes are new or both tubes measure the same when checked on a tube tester.

(3) Tubes should not be replaced or discarded merely because they have been used for some time. Satisfactory operation in a circuit is the final proof of tube quality; the tube in use may work better than a new tube.

d. ALIGNMENT AND ADJUSTMENT. - If increased distortion should indicate a need for realignment, the TTG-2 may be readjusted according to the procedures outlined in paragraphs (1) and (2) below. Refer to figure 5-1 for location of alignment and adjustment controls.

(1) ADJUSTMENT OF AUDIO SECTION. - Proceed as follows:

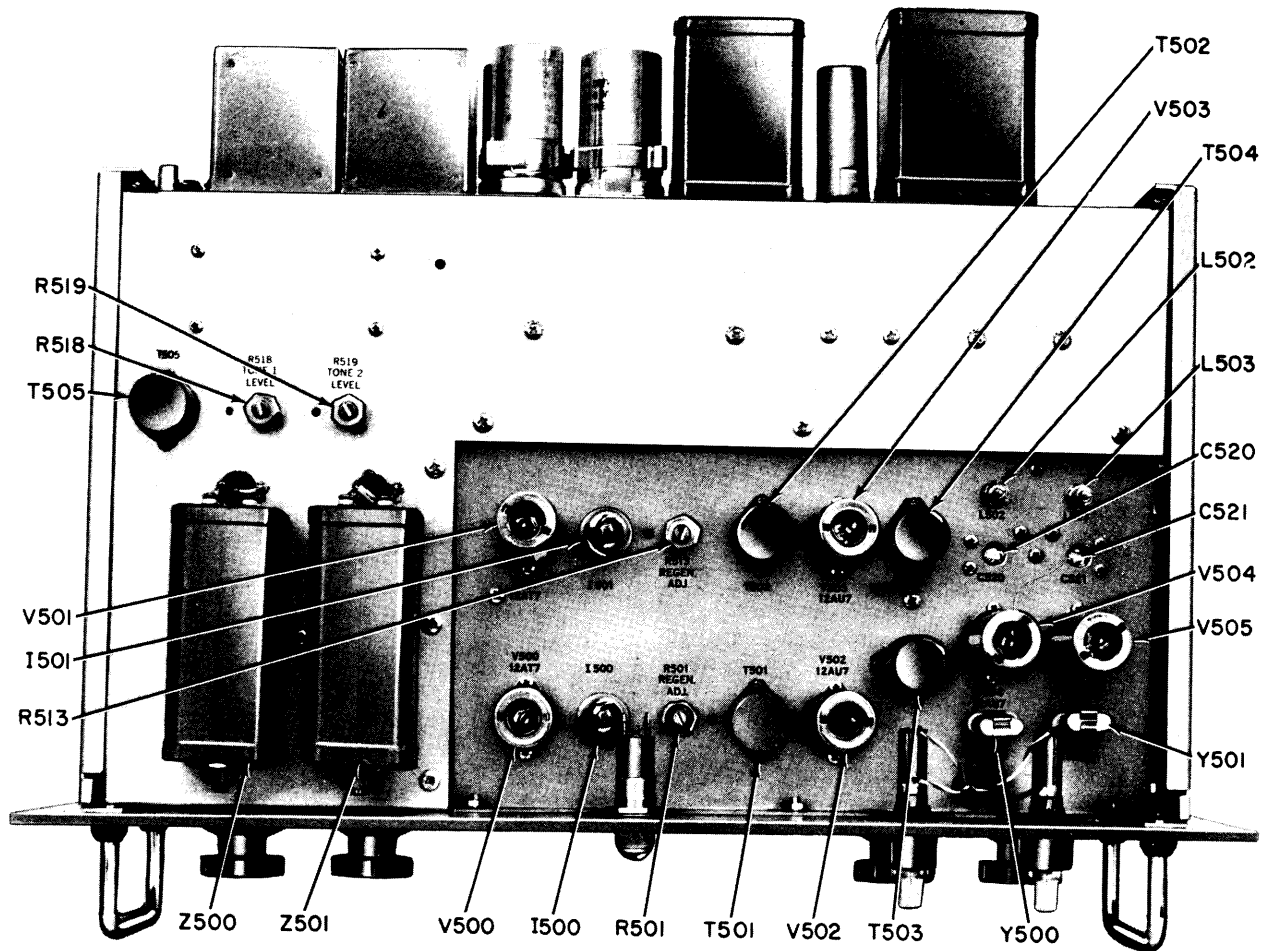


Figure 5-1. Top View, Test Generator TTG-2

NOTE

The setting of the regeneration controls is important to achieve minimum distortion. When a control is not advanced far enough, the oscillator will not "start" immediately when that tone is switched on. When the control is advanced too far, the distortion will increase rapidly. There is a point, however, where the oscillator will start immediately and where distortion is a minimum. This is the correct adjustment.

Performance of oscillators V500 and V501 is affected by lamps I500 and I501 respectively. It is extremely unlikely that I500 or I501 will need replacement. If, however, either one has to be replaced, several lamps may have to be tried to find one which will cause the oscillator to perform properly.

(a) Place ground lug on terminal 3 of terminal strip E500 for unbalanced output connection.

(b) Connect AC VTVM and sonic analyzer (if available) to terminals 1 and 3 of terminal strip E500.

(c) Set R524 and R518 at maximum; set AUDIO TONE SELECTOR S502 at TONE 1.

(d) Adjust regeneration control R501 until an indication is observed on VTVM.

(e) Adjust control on Z500 for peak indication on VTVM.

NOTE

When performing step (f), if a sonic analyzer is not available, the regeneration control (R501) setting likely to produce the least distortion is the minimum rotation of R501 at which oscillator V500 will "start" immediately when AUDIO TONE SELECTOR S502 is set at TONE 1.

(f) Observe analyzer and adjust R501 for minimum second harmonic distortion without affecting oscillator V500 "starting"; distortion, as viewed on analyzer, should be at least -55 db down.

(g) Recheck Z500 for peak on VTVM.

(h) Adjust R518 (Tone 1 level control) for 1.0 volts a-c on VTVM; tighten lock control on R501 and R518.

(i) Set R519 at maximum; set AUDIO TONE SELECTOR S502 at TONE 2.

(j) Adjust regeneration control R513 until an indication is observed on VTVM.

(k) Adjust control on Z501 for peak indication on VTVM.

NOTE

When performing step (1), if a sonic analyzer is not available, the regeneration control (R513) setting likely to produce the least distortion is the minimum rotation of R513 at which oscillator V501 will "start" immediately when AUDIO TONE SELECTOR S502 is set at TONE 2.

(1) Observe analyzer and adjust R513 for minimum second harmonic distortion without affecting oscillator "starting"; distortion, as viewed on analyzer, should be better than -55 db down.

(m) Recheck Z501 for peak on VTVM.

(n) Adjust R519 (Tone 2 level control) for 1.0 volts a-c on VTVM; tighten lock control on R513 and R519.

(o) Set AUDIO TONE SELECTOR S502 at TWO TONE, and recheck distortion on analyzer; distortion should be better than -55 db down.

(2) ADJUSTMENT OF R-F SECTION. - Proceed as follows:

(a) Connect RF VTVM to r-f output jack J501.

(b) Set RF TONE SELECTOR S501 at TONE 2. Set C520 at maximum capacity.

(c) Adjust L502 for maximum reading on RF VTVM; tighten locknut on L502 slug.

(d) Set C520 for .5 volt r-f reading on RF VTVM.

(e) Set RF TONE SELECTOR S501 at TONE 2. Set C521 at maximum capacity.

(f) Adjust L503 for maximum reading on RF VTVM. Tighten locknut on L503 slug.

(g) Set C521 for .5 volt r-f reading on RF VTVM.

(h) Connect spectrum analyzer to jack J501 and examine tones; distortion products should be at least 60 db below tones.

5-4. REPAIR.

Repair and replacement of components contained in the TTG-2 are obvious and do not require special instructions. Refer to figures 5-2 and 5-3 for the location of major components contained in the TTG-2.

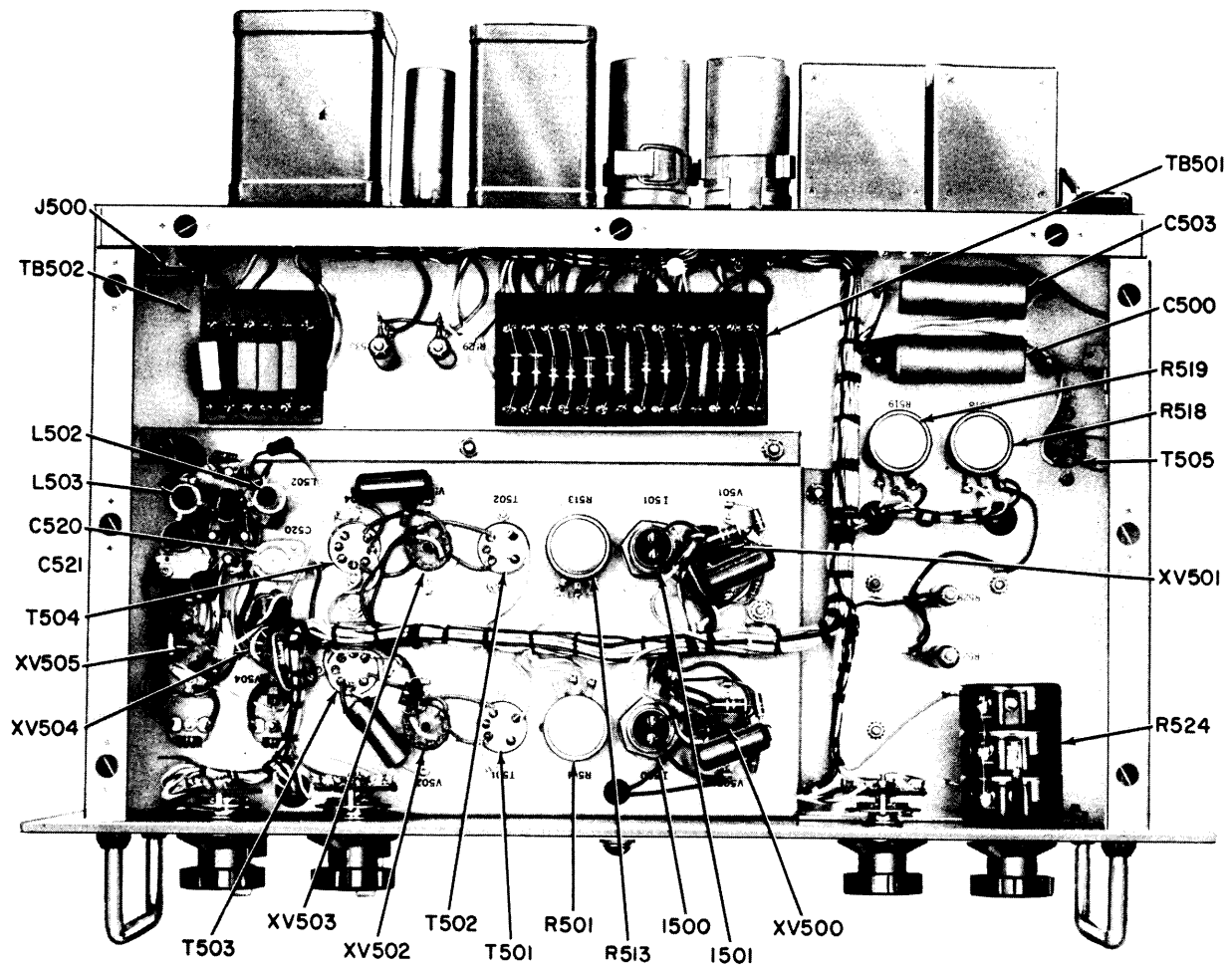


Figure 5-2. Bottom View, Test Generator TTG-2

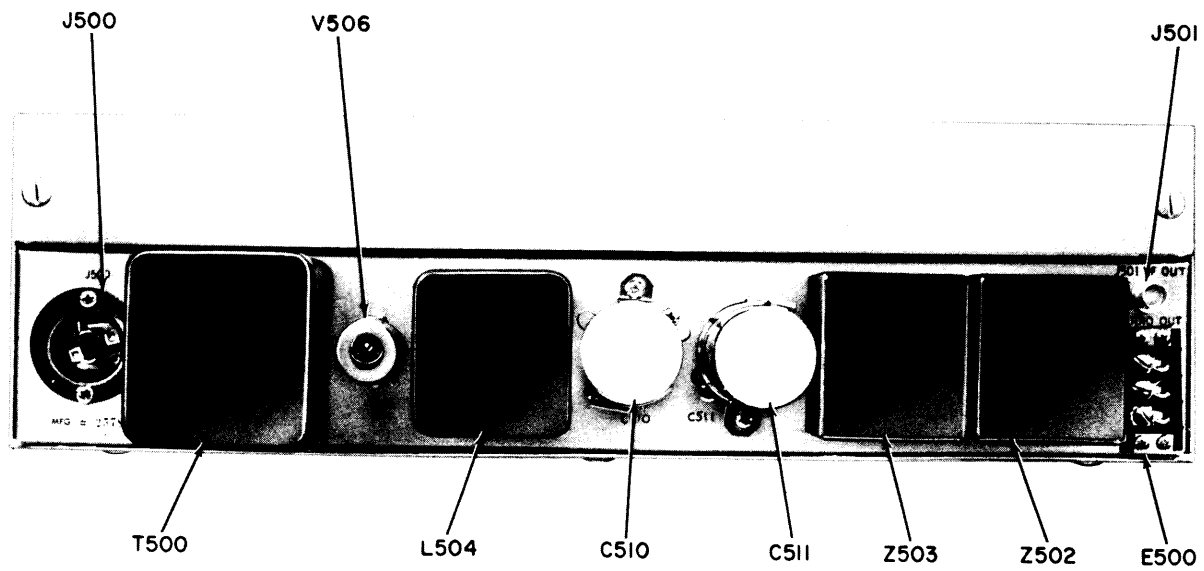


Figure 5-3. Rear View, Test Generator TTG-2

SECTION 6 PARTS LIST

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as electron tube or fuse, are identified by a reference designation that includes the reference designation of the plug-in device. For

example the socket for Fuse F501 is designated XF501. Column 1 lists the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; sub-parts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C500	CAPACITOR, fixed: plastic; 2 ufd, $\pm 5\%$, 200 wvdc.	Feedback	CN108C2004J
C501	CAPACITOR, fixed: paper; .05 ufd, $+40\%$, -20% , 400 wvdc.	Coupling	CN-100-3
C502	CAPACITOR, fixed: paper; .01 ufd, $+40\%$, -20% , 400 wvdc.	Blocking	CN-100-1
C503	Same as C500	Feedback	
C504	Same as C501	Coupling	
C505	Same as C502	Blocking	
C506	Same as C501	Bypass	
C507	Same as C501	Bypass	
C508	CAPACITOR, fixed: mica; .01 ufd, $\pm 10\%$, char. D, 300 wvdc.	RF Filter	CM35B103K
C509	Same as C508	RF Filter	
C510	CAPACITOR, fixed: dry electrolytic: polarized; dual unit; 20 ufd each section, 450 wvdc, char. E.	Filter	CE52E200R
C511	Same as C510	Filter	
C514	CAPACITOR, fixed: ceramic; .01 ufd, $+80\%$, -20% , 500 wvdc.	Bypass	CC-100-16
C515	Same as C514	Bypass	
C516	CAPACITOR, fixed: ceramic; 10 ufd, $\pm 2\%$, 500 wvdc, char. RH.	Excitation Control	CC20RH100G

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C517	CAPACITOR, fixed: mica; 51 uufd, $\pm 5\%$, 500 wvdc, char. C.	Excitation	CM15G510J
C518	Same as C516	Excitation Control	
C519	Same as C517	Excitation	
C520	CAPACITOR, variable: cearmic; 7-45 uufd, 500 wvdc, char. C.	Coupling	CV11C450
C521	CAPACITOR, variable: ceramic; 7-45 uufd, 500 wvdc, char. C.	Coupling	CV11C450
C522	CAPACITOR, fixed: mica; 220 uufd, $\pm 5\%$, 500 wvdc, char. C.	Tank	CM15C221J
C523	Same as C522	Tank	
C524	Same as C514	Bypass	
C525	Same as C514	Bypass	
C526	Same as C514	Bypass	
C527	Same as C508	RF Filter	
C528	Same as C508	RF Filter	
C529	Same as C514	Blocking	
C530	Same as C514	Blocking	
E500	TERMINAL STRIP, barrier type: 3 terminals; 6-32 x 1/4 inch screws; bakelite base.	Audio Output	TM-102-3
F500	FUSE, cartridge: 2 amp.	Main Power Fuse	FU-100-2
F501	FUSE, cartridge: 1/8 amp; 250 v, straight through element.	B+ Fuse	FU-100-.125
I500	LAMP, incandescent: double contact bayonet base; 120 volts, 3 watts; S-6 clear bulb.	Osc. Lamp Stabilization	BI-102-3
I501	LAMP, incandescent: double contact bayonet base; 120 volts, 3 watts; S-6 clear bulb.	Osc. Lamp Stabilization	BI-102-3
I502	LAMP, incandescent: bayonet base; 6-8 volts, 150 ma; T-3-1/4 clear bulb.	Main Power Indicator	BI-101-47

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
J500	CONNECTOR, receptacle: male; two contacts, 10 amps at 250 v, 15 amps at 125 v, twist lock type.	Power Input	JJ-100
J501	CONNECTOR, receptacle: coaxial female.	RF Out	UG-604/U
L500	CHOKE, RF: 750 microhenries, $\pm 20\%$, 100 ma, max. current; DC res. approx. 17 ohms; bakelite body.	Choke, RF	CL-100-5
L501	Same as L500	Choke, RF	
L502	TRANSFORMER, RF: 2-4.3 mc; slug tuned.	RF Transformer	CL-184
L503	Same as L502	RF Transformer	
L504	REACTOR, filter: 50 henries; 30 ma; DC res. approx. 800 ohms; insulated for 1500 v.	Filter	TF-166
L505	COIL, RF: 4 microhenries, 1700 ma max. current, mica body.	Line Filter	CL-105-2
L506	Same as L505	Line Filter	
R500	RESISTOR, fixed: composition; 1500 ohms, $\pm 10\%$, 1/2 watt.	Dropping	RC20GF152K
R501	RESISTOR, variable: composition; 5000 ohms, $\pm 10\%$, 2 watts, linear taper.	Regen. Adj.	RV4ATXA502A
R502	RESISTOR, fixed: composition; 68,000 ohms, $\pm 10\%$, 1 watt.	Plate Load	RC30GF683K
R503	RESISTOR, fixed: composition; 47,000 ohms, $\pm 10\%$, 1 watt.	Dropping	RC30GF473K
R504	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$, 1 watt.	Plate Load	RC30GF223K
R505	RESISTOR, fixed: composition; 470,000 ohms, $\pm 10\%$, 1/2 watt.	Grid Return	RC20GF474K
R506	RESISTOR, fixed: composition; 470 ohms, $\pm 10\%$, 1/2 watt.	Cathode	RC20GF471K
R507	Same as R500	Dropping	
R508	Same as R502	Plate Load	
R509	Same as R503	Dropping	
R510	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$, 1 watt.	Plate Load	RC30GF103K
R511	Same as R505	Grid Return	

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R512	Same as R506	Cathode	
R513	Same as R501	Regen. Adj.	
R514	RESISTOR, fixed: composition; 2700 ohms, $\pm 10\%$, 1/2 watt.	Cathode	RC20GF272K
R515	Same as R514	Cathode	
R516	RESISTOR, fixed: composition; 470 ohms, $\pm 10\%$, 1 watt.	Dropping	RC30GF471K
R517	Same as R516	Dropping	
R518	RESISTOR, variable: composition; 500 ohms, $\pm 10\%$, 2 watts, linear taper.	1 Tone Level	RV4ATXA501A
R519	Same as R518	2 Tone Level	
R520	Same as R500	Imp. Matching	
R521	Same as R500	Imp. Matching	
R522	RESISTOR, fixed: composition; 180 ohms, $\pm 10\%$, 1/2 watt.	Dropping	RC20GF181K
R523	Same as R522	Dropping	
R524	RESISTOR, variable: wirewound; 600 ohms, "T" attenuator, 7/8 in. long flatted 1/4 in. dia. shaft.	Level Adj.	RR-108-9-R-C
R525	RESISTOR, fixed: composition; 4700 ohms, $\pm 10\%$, 1 watt.	Dropping	RC30GF472K
R526	Same as R525	Dropping	
R527	RESISTOR, fixed: wirewound; 30,000 ohms, $\pm 5\%$, 10 watts.	Dropping	RW-109-39
R528	Same as R527	Dropping	
R529	RESISTOR, fixed: wirewound; 3000 ohms, $\pm 5\%$, 10 watts.	Dropping	RW-109-30
R530	Same as R529	Dropping	
R531	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$, 1 watt.	Bleeder	RC30GF104K
R532	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$, 1 watt.	Plate Load	RC30GF223K
R533	Same as R532	Plate Load	
R534	RESISTOR, fixed: composition; 220,000 ohms, $\pm 10\%$, 1/2 watt.	Grid Return	RC20GF224K
R535	Same as R534	Grid Return	

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R536	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$, 1/2 watt.	Grid Return	RC20GF103K
R537	Same as R536	Grid Return	
R538	RESISTOR, fixed: composition; 2200 50 ohms, $\pm 10\%$, 1/2 watt.	Cathode	RC20GF 222K 68J
R539	Same as R538	Cathode	
R540	Same as R506	Dropping	
R541	Same as R506	Dropping	
R542	RESISTOR, fixed: composition; 68 ohms, $\pm 10\%$, 1/2 watt.	Dropping	RC20GF680K
R543	Same as R504	Plate Load	
R544	Same as R504	Plate Load	
S500	SWITCH, rotary: shorting; 1 section, 2 positions, bakelite insulation; silver plated brass contacts.	Main Power	SW-253
S501	SWITCH, rotary: 4 positions; 2 poles, 1 section, non-shorting contacts.	RF Tone Selector	SW-120
S502	Same as S501	Audio Tone Selector	
T500	TRANSFORMER, power: primary - 110/220 v, 50/60 cps, single phase: section 1 -250-0-250 v RMS, 35 ma dc: section 2-6.3 v CT.	Power Transformer	TF-126
T501	TRANSFORMER, audio: primary - impedance 15000 ohms; secondary impedance 9500 ohms split; unbalanced DC in primary 4 ma; hermetically sealed steel case.	Push-Pull Interstage Transformer	TF-206
T502	Same as T501	Push-Pull Interstage Transformer	
T503	TRANSFORMER, audio: primary - 20,000 ohms CT; secondary - 150, 600 ohms, 4 ma dc in primary; ± 2 db; 200 to 10000 cps.	Audio Transformer	TF-138
T504	Same as T503	Audio Transformer	
T505	TRANSFORMER, audio: 50-10,000; primary impedance, 150/160 ohms; secondary impedance 600 ohms CT; response ± 2 db, 50-10,000 cps hermetically sealed case.	Audio Output	TF-170
V500	TUBE, electron: duo-triode, 9 pin miniature.	1 Audio Osc. Tone	12AT7

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
V501	Same as V500	2 Audio Osc. Tone	
V502	TUBE, electron: medium-mu duo-triode, 9 pin miniature.	1 Audio Amp. Tone	12AU7
V503	Same as V502	2 Audio Amp. Tone	
V504	Same as V502	V504A - RF Osc. V504B - RF Ampl.	
V505	Same as V502	V505A - RF Osc. V505B - RF Ampl.	
V506	TUBE, electron: full wave rectifier, 7 pin miniature.	HV Rectifier	6X4
W500	CABLE ASSEMBLY, power: consists of P500 and P501.	AC Power	CA-435-1
XC510	SOCKET, electron tube: octal.		TS101P01
XC511	Same as XC510		
XF500	HOLDER, fuse: bayonet type; 100/250 volts, neon lamp, clear knob; accommodates 1/4 x 1-1/4 in. fuse.	Holder for F500	FH-104-3
XF501	Same as XF500	Holder for F501	
XI500	SOCKET, lamp; double contact, solder lug type; 1 inch x 1-3/16 inch o/a.	Socket for I500	TS-108-2
XI501	Same as XI500	Socket for I501	
XI502	SOCKET, lamp: w/red frosted lens, for miniature bayonet base, T-3-1/4 bulb.	Socket for I502	TS-106-1
XV500	SOCKET, tube: miniature 9 pin.	Socket for V500	TS-103-P01
XV501	Same as XV500	Socket for V501	
XV502	Same as XV500	Socket for V502	
XV503	Same as XV500	Socket for V503	
XV504	Same as XV500	Socket for V504	
XV505	Same as XV500	Socket for V505	
XV506	SOCKET, tube: miniature 7 pin.	Socket for V506	TS-102-P01
XY500	SOCKET, crystal: .486 in. spacing for .050 inch pin dia.	Socket for Y500	TS-104-1

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XY501	Same as XY500	Socket for Y501	
Y500	CRYSTAL UNIT, quartz: 1.999 mc; pin type connectors; $\pm .005\%$ tolerance.	Crystal Osc.	CR-18/U-1.999P
Y501	CRYSTAL UNIT, quartz: 2.001 mc; pin type connectors; $\pm .005\%$ tolerance.	Crystal Osc.	CR-18/U-2.001P
Z500	NETWORK, frequency determining: 935 cps.	p/o Audio Osc.	NF-104-935
Z501	NETWORK, frequency determining: 2805 cps.	p/o Audio Osc.	NF-104-2805
Z502	FILTER, bandpass: 935 cps; 600 ohms input and output impedance; hermetically sealed rectangular steel case.	Bandpass Filter	FX-156
Z503	FILTER, bandpass: 2805 cps; 600 ohms input and output impedance; hermetically sealed rectangular steel case.	Bandpass Filter	FX-157

SECTION 7
SCHEMATIC DIAGRAMS

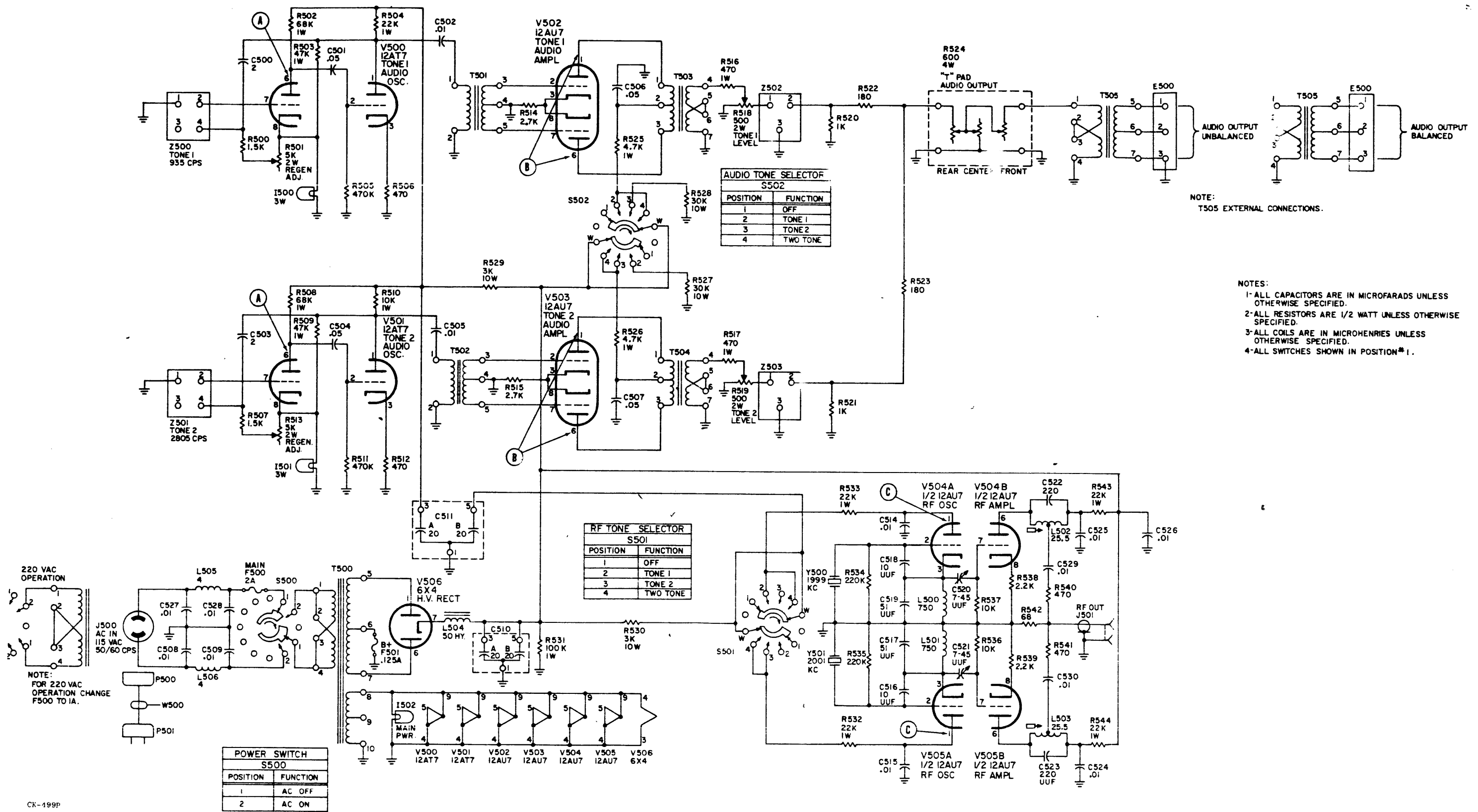


Figure 7-1. Schematic Diagram, TTG-2