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TECHNICAL MANUAL

FOR

TWO TONE GENERATOR

MODEL TTTG-1



TMC (CANADA) LIMITED
Ottawa, Ontario

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22 January 1974

ERRATA

TTTG-1 DATA SHEET (Following Page 5-4)

A250047 Components List

For "T2 XFMR,PWR TF10091 250063", read
"T2 XFMR,OUTPUT TF10091 250063".

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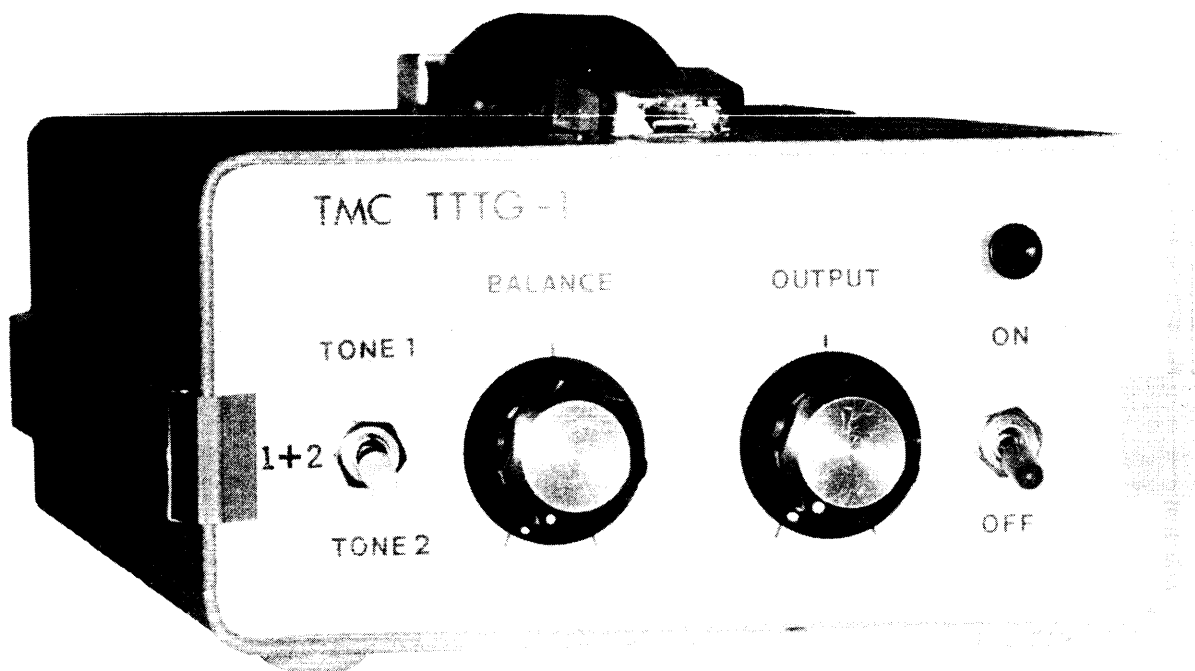


Figure 1-1. Test Generator, Model TTTG-1

SECTION 1

GENERAL INFORMATION

1.1 GENERAL INFORMATION

The TMC TTTG-1 test generator (figure 1-1) is a solid state signal generating device designed to be used with distortion analyzing equipment in the testing of single sideband exciters and transmitters. The TTTG-1 provides two audio tones (935 Hz and 2805 Hz); spacing of the tones is such that the third, fifth and seventh order products may be presented on a spectrum analyzer.

The TTTG-1 is designed with especially low distortion to insure an accurate check of distortion in the standard two-tone test.

1.2 PHYSICAL DESCRIPTION.

Test Generator TTTG-1 is designed for fixed or portable use and is only 3 inches high, 5- $\frac{1}{2}$ inches wide, and 9 inches deep. All controls and indicators necessary for the operation of the TTTG-1 are located on the front panel and are clearly marked according to function. Audio output connections are made to terminal strip TB-1 on the rear chassis apron.

1.3. NOMENCLATURE.

Two Tone Generator, model TTTG-1.

1.4 REFERENCE DATA.

Tables 1-1 and 1-2 provide technical specifications and the semi-conductor complement for the TTTG-1

1.5 LOOSE ITEMS SUPPLIED

Terminal strip, TM-105-3AL, Qty. 1
AC Power Cord, Qty. 1
Connector, 3-pin, Recepticle, JJ10031-1, Qty. 1
Connector, 3-pin, Recepticle, JJ10031-2, Qty. 1

TABLE 1-1
TECHNICAL SPECIFICATIONS, TTTG-1

Output Frequencies:	935 Hz 2805 Hz
	Either or both tones selectable from the front panel
Harmonic Distortion:	Better than 1%
Output Impedance:	600 Ohms unbalanced or balanced.
Output Level:	0 to 0.5 volts RMS continuously variable from panel.
Output Connections:	Terminal strip.
Controls:	Power Switch AF Tone Selector Two-Tone Selector Output Control
Primary Power:	115/230 volts, 50/60 cps, approximately 4 watts or 24Vdc Battery 3 inches high, (7.62cm) 5- $\frac{1}{2}$ inches wide, (13.9cm) 9 inches deep, (22.86cm)
Weight:	Approximately 3 Pounds (1.36kg)
Environmental Conditions	Designed to operate in any ambient temperature of 8-40 °C

TABLE 1-2

SEMI-CONDUCTOR COMPLEMENT

Reference Designation Symbol	Type	Function
Q1	2N5485	Tone 1, Oscillator
Q2, Q3	2N697	Tone 1, Amplifier, E-Follower
A2	CA3036	Tone 1 + Tone 2, Mixer
Q31	2N5485	Tone 2, Oscillator
Q32	2N697	Tone 2, Amplifier, E-Follower
CR1	DD10013	Bridge Rectifier, Power Supply
CR2	1N5242A	Zener Diode, Power Supply
A1	7824	24VDC Regulator

SECTION 2

INSTALLATION

2.1. UNPACKING AND HANDLING

The method used to package the TTTG-1 is dependent upon whether the TTTG-1 is to be shipped by itself or with other equipment. Gross shipping weight of the TTTG-1 when shipped by itself is approximately 5 pounds (2.26kg). Inspect the shipping container for possible damage when it arrives. 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 TTTG-1 with care and inspect all packing material for items that may have been shipped as loose items. A close visual inspection of the unit 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

TTTG-1 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 T-1 as shown on Data Sheet. The TTTG-1 is also a portable unit for field operation by the use of a 24V battery pack.

2.3 INSTALLATION

- a. The TTTG-1 is a desk (or portable) model and does not require mechanical installation.
- b. Electrical Installation.
 1. General. The following paragraphs provide information concerning only the power audio connections made directly to the TTTG-1 chassis. For information regarding the electrical test connections for various applications of the TTTG-1, refer to Section 3 of this manual.
 2. Power Connection. Before connecting the TTTG-1 to power, ensure that the unit is wired correctly for the available power source (refer to para 2.2). With power switch set at OFF, insert plug of power cable into 50/60 power outlet.

2.4. ADJUSTMENT

Before the TTTG-1 is shipped from the factory, it is thoroughly checked against the manufacturer's specifications; no initial adjustments are required before operation. For alignment and adjustment information relative to preventive maintenance, refer to Section 4 of this manual.

SECTION 3

OPERATOR'S SECTION

3.1. OPERATION PROCEDURES.

The TTTG-1 is used in transmission systems to determine the quality of the system. The following paragraphs outline various methods of using the TTTG-1 to check the proper operation of transmitting equipment.

3.2. TWO-TONE TEST FOR DISTORTION PRODUCTS IN TRANSMITTING EQUIPMENT

To test for distortion products in transmitting equipment use the TTTG-1 in conjunction with a spectrum analyzer. Proceed as follows :

- a. Connect TTTG-1 to audio input of exciter. The output (TB-1) of the generator provides matching to an impedance of 600 ohms, balanced or unbalanced.
- b. Terminate power amplifier with dummy load.
- c. Connect signal-input jack of spectrum analyzer to RF output jack of sideband exciter, intermediate amplifier, power amplifiers, or other R-F stages as indicated in figure 3-1.
- d. Set TTTG-1 controls at positions listed below :

<u>CONTROL</u>	<u>POSITION</u>
POWER	ON
TONE	1+2
BALANCE	For equal amplitude of Tones
OUTPUT	Sufficient to properly modulate transmitter to its PEP Rating.

3.3. TWO-TONE MEASUREMENT OF PEAK-ENVELOPE POWER

Use the TTTG-1 in conjunction with an oscilloscope to measure peak-envelope power. Proceed as follows:

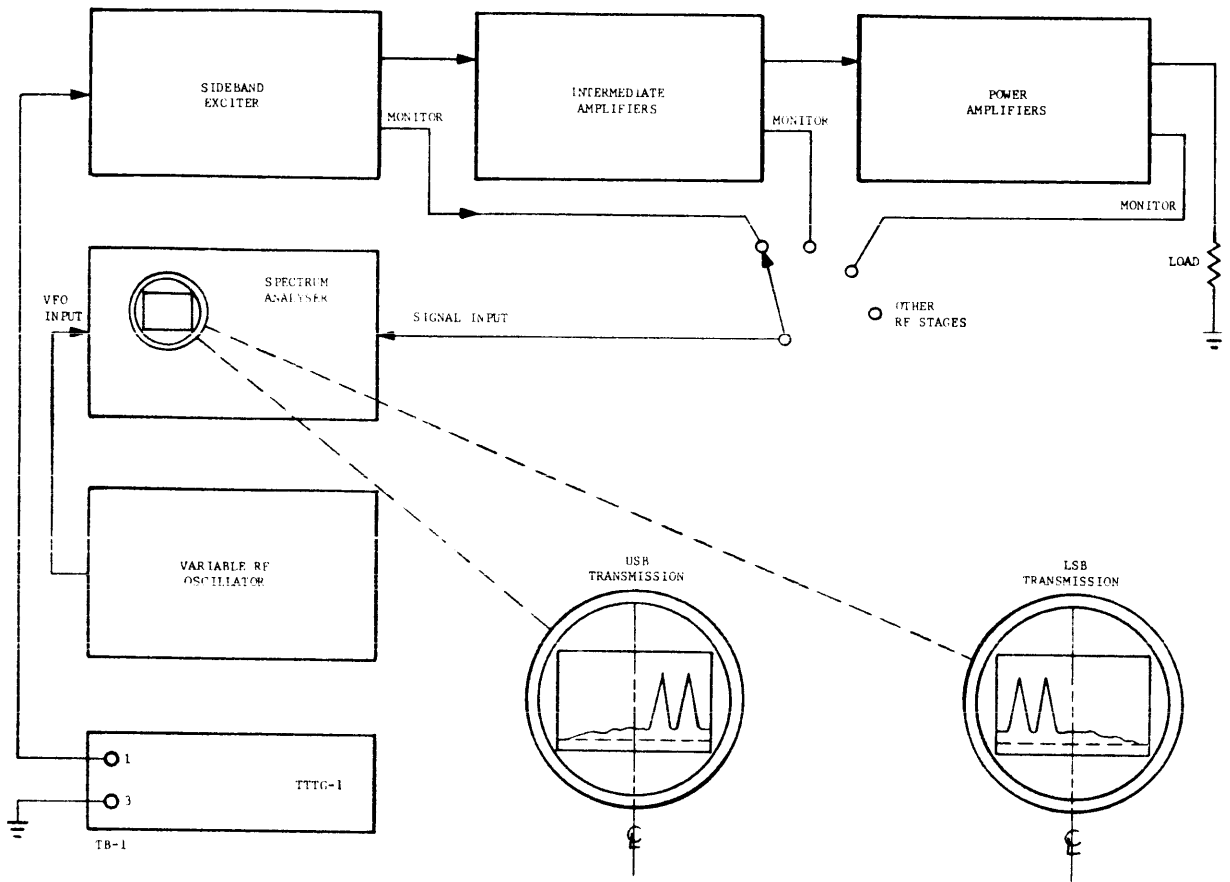


FIGURE 3-1. TWO-TONE TEST FOR DISTORTION

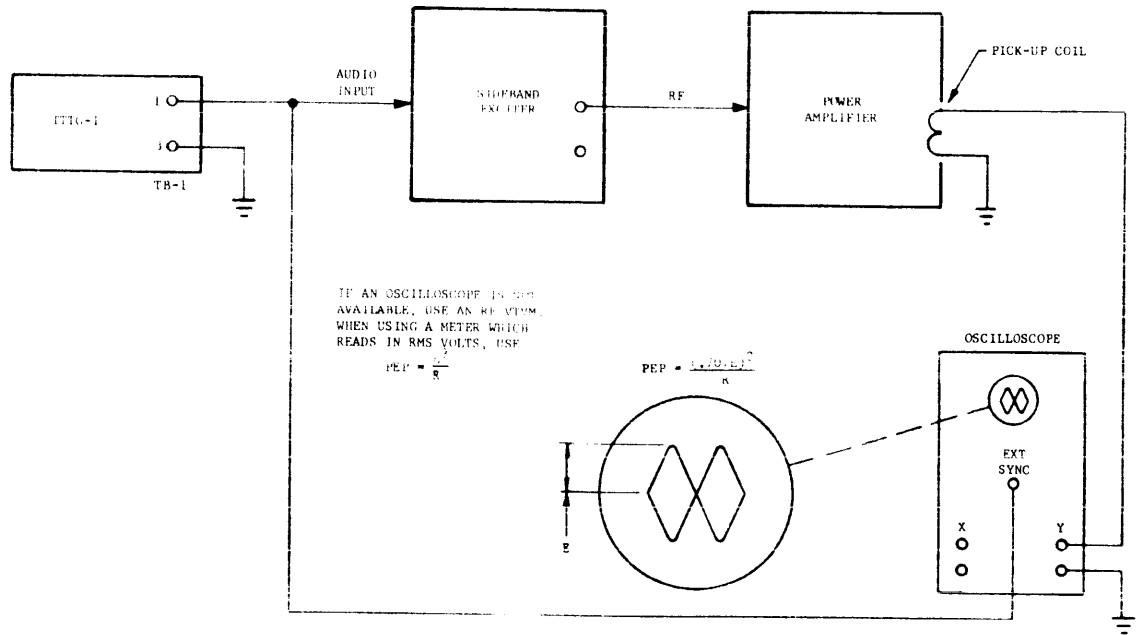


FIGURE 3-2. TWO-TONE MEASUREMENT OF PEAK-ENVELOPE POWER

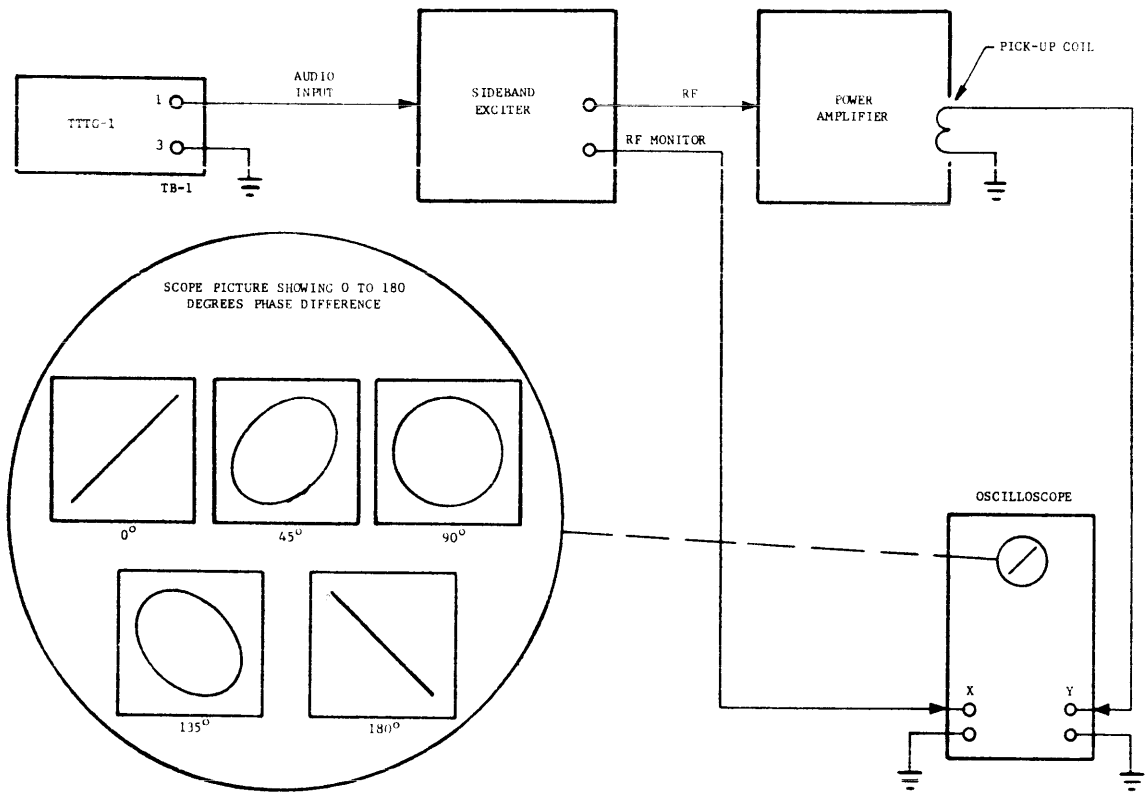


FIGURE 3-3. LINEARITY TEST

- a. Terminate linear power amplifier output with a dummy load.
- b. Connect generator to audio input stage of single-sideband transmitter and to EXT, SYNC input of oscilloscope as indicated in figure 3-2.
- c. Using pick-up coil or RF monitor of linear amplifier, couple to vertical input of oscilloscope as shown in figure 3-2.
- d. Set TTTG-1 controls at positions listed below :

<u>CONTROL</u>	<u>POSITION</u>
POWER	ON
TONE	1+2
BALANCE	For equal amplitude of Tones
OUTPUT	Sufficient to properly modulate transmitter to its PEP rating.

- f. Ensure that oscilloscope is calibrated and adjust oscilloscope controls to obtain scope picture as illustrated in figure 3-2.
- g. Calculate peak-envelope power using the following formula:

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

E = Amplitude of signal (voltage)

R = Resistance of non-inductive load.

3.4. LINEARITY TEST

Use the TTTG-1 in conjunction with an oscilloscope to test linear power amplifier linearity . Proceed as follows:

- a. Connect generator to input sideband exciter as indicated in figure of 3-3.
- b. Connect output of sideband exciter and linear amplifier to horizontal and vertical input

jacks of oscilloscope respectively, as indicated in figure 3-3.

c. Set TTTG-1 controls as follows :

<u>CONTROL</u>	<u>POSITION</u>
POWER	ON
TONE	1 or 2
BALANCE	CENTER
OUTPUT	Sufficient to properly modulate transmitter to its PEP rating.

d. Scope picture should be a straight line as indicated in figure 3-3.

SECTION 4

PRINCIPLES OF OPERATION

4.1. CIRCUIT ANALYSIS

General.

- a. Refer to figure 4-1. Tones are generated by oscillators Q1 and Q31 and amplified by Q2, Q3, Q32, and Q33. The two audio signals can be used separately or together and are available at terminal strip TB1. When both tones are used together, they are mixed in mixer A2. Q4 is an emitter follower. The internal controls (R11/R41) permit adjustment of either tone. Balance control (R30) enables the operator to balance the tones in the output level. Control R29 is for adjusting the output level.

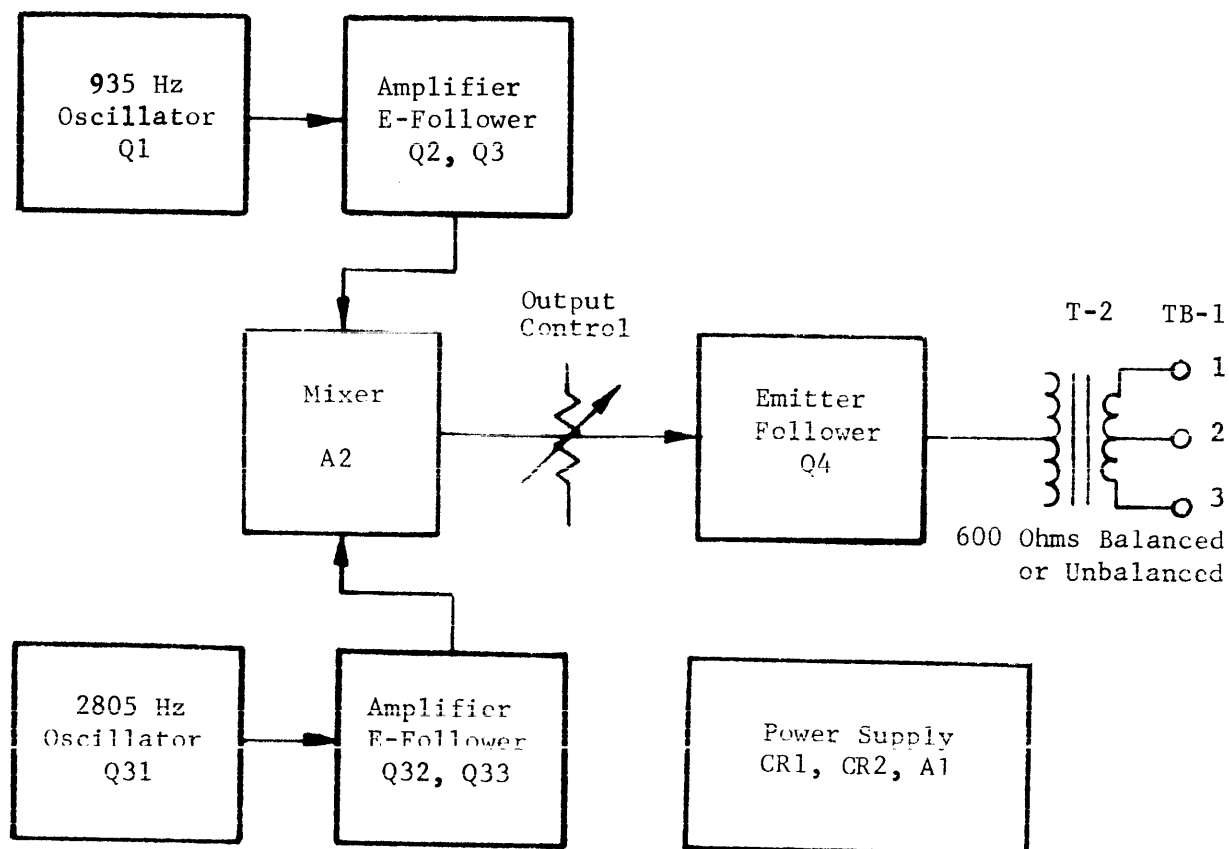


Figure 4-1. Block Diagram, Test Generator, Model TTIC-1

4.1 b. Detailed Circuit Analysis (Refer to Data Sheet)

Detailed circuit analysis for the oscillator, the amplifier and mixer is described in the following paragraphs. The 935 Hz and 2805 Hz oscillator and amplifier stages are identical; therefore only the 935 Hz stage is discussed in paragraphs (i) and (ii) below.

i. Audio Oscillator

The TTTG-1 employs a Wein bridge type oscillator consisting of FET transistor (Q1), frequency-determining capacitors (C9, C10), and a regeneration control (R13). R13 provides adjustment of oscillation for optimum operation. A thermal resistor (TH1) limits current variations to prevent changes in the oscillator output level. The output of the oscillator is coupled to the audio amplifier through capacitor C2.

ii. Audio Amplifier and Mixer

The TTTG-1 employs a class A amplifier consisting of 2N697 transistor (Q2) and an emitter follower consisting of a 2N697 (Q3). Audio voltage is taken from the wiper of R11 and routed through C5 and C11 to the input (4) of mixer A2. If only one tone is desired, switch S1 selects the wanted tone. The switch position TONE 1 + 2 allows both tones to reach both input terminals of the integrated circuit CA3036 A2. The combined tones are fed through C17 to emitter follower Q4. The signals are then applied through C15 to output transformer T2.

SECTION 5

MAINTENANCE

5.1. PREVENTIVE MAINTENANCE

Periodically, remove the top cover of the TTTG-1 cabinet (See 5.2.a) and inspect for general cleanliness, check for discoloured components, damaged wiring, and broken or loose connections. Clean the components with a soft brush, vacuum cleaner, or dry, filtered, compressed air. Check all hardware for tightness.

WARNING

Do not use trichlorethylene or other toxic solvents because of their paint-removing effects. They also can cause deterioration of sensitive components in the TTTG-1.

Refer to Data Sheet for aid in locating components of the TTTG-1. Typical Test equipment required for troubleshooting and alignment is listed below :

EQUIPMENT	MANUFACTURER
Vol-ohm Meter	Simpson, model 260, or equivalent.
VTVM	Hewlett-Packard Model 410B, or equivalent.
Frequency Counter	Hewlett-Packard Model 5244L, or equivalent.
Oscilloscope	Hewlett-Packard Model, 180A, or equivalent.

5.2. TROUBLE SHOOTING AND ALIGNMENT (SEE DATA SHEET)

- a. Remove top and bottom cover of the TTTG-1 cabinet. Remove the plastic items of trim to reveal screw heads on each side.
- b. Plug TTTG-1 into power source for which it is wired.
- c. Check the following DC supply voltage first :
 - (1) +26V at junction of CR1 and C16.
 - (2) +12V at junction of CR2, R27 and R28.
 - (3) +24V at junction of R23, Q4 and R28 .

If these voltages are not present, check power supply circuitry. In most cases, a simple Ohm-meter check with VOM on x1 scale will locate a faulty semi-conductor.

- d. Other DC and AC voltages can be checked as indicated on Data Sheet.
- e. Using an oscilloscope, check the output signals of both audio oscillators. Place TONE selector switch to position TONE 1 + 2. Connect oscilloscope probe first to junction R10 and TH1, then to junction R40 and TH2; level should be approximately 3.4V peak-to-peak. If this level is not observed, check Q1, Q2, Q3 and Q31, Q32, Q33 respectively. Also check regeneration controls R13 and R43. The setting of the regeneration controls is important for achieving minimum distortion. Do not advance the regeneration controls beyond the peak-to-peak level as indicated above.
- f. Set BALANCE control on front panel to its mid-range position. Set TONE selector switch to position TONE 1 + 2. Connect oscilloscope probe to junction R15 and R16. Turn output control located on front panel fully clockwise. Adjust potentiometer R11 for 0.5V peak-to-peak on oscilloscope.

Connect oscilloscope probe to junction R14 and R19. Adjust potentiometer R41 for 0.5V peak-to-peak on oscilloscope. This completes the coarse adjustment of the TTTG-1.

- g. Set TONE selector switch at TONE 1 position. Connect oscilloscope probe to terminal E7. Level should be approximately 1VAC peak-to-peak.

Set TONE selector switch at TONE 2 position. Same level as above should be observed.

- h. Connect an AC VTVM to output terminal strip TB1. Set TONE selector switch to TONE 1. Set BALANCE control at its mid-range position. Turn OUTPUT control fully clockwise. Adjust R11 on printed circuit board for 0.5 volt RMS . Set TONE selector switch to TONE 2. Adjust R43 on printed circuit board for 0.5 volt RMS. This completes the fine adjustment of the audio output signals. Set TONE selector switch on TONE 1 + 2. VTVM should read .65V RMS.

- i. Set TONE selector switch at TONE 1. Turn OUTPUT control fully clockwise. Connect a frequency counter to the unbalanced output terminals TB-1. Alternatively, adjust trimmer capacitors C9 and C10 for a reading of 935 cps. Place TONE select switch to TONE 2. Adjust trimmer capacitors C39 and C40 for a reading of 2805 cps.

NOTE

Adjust the capacitors in a manner that both capacitors have approx. the same capacitance when adjustment is completed.

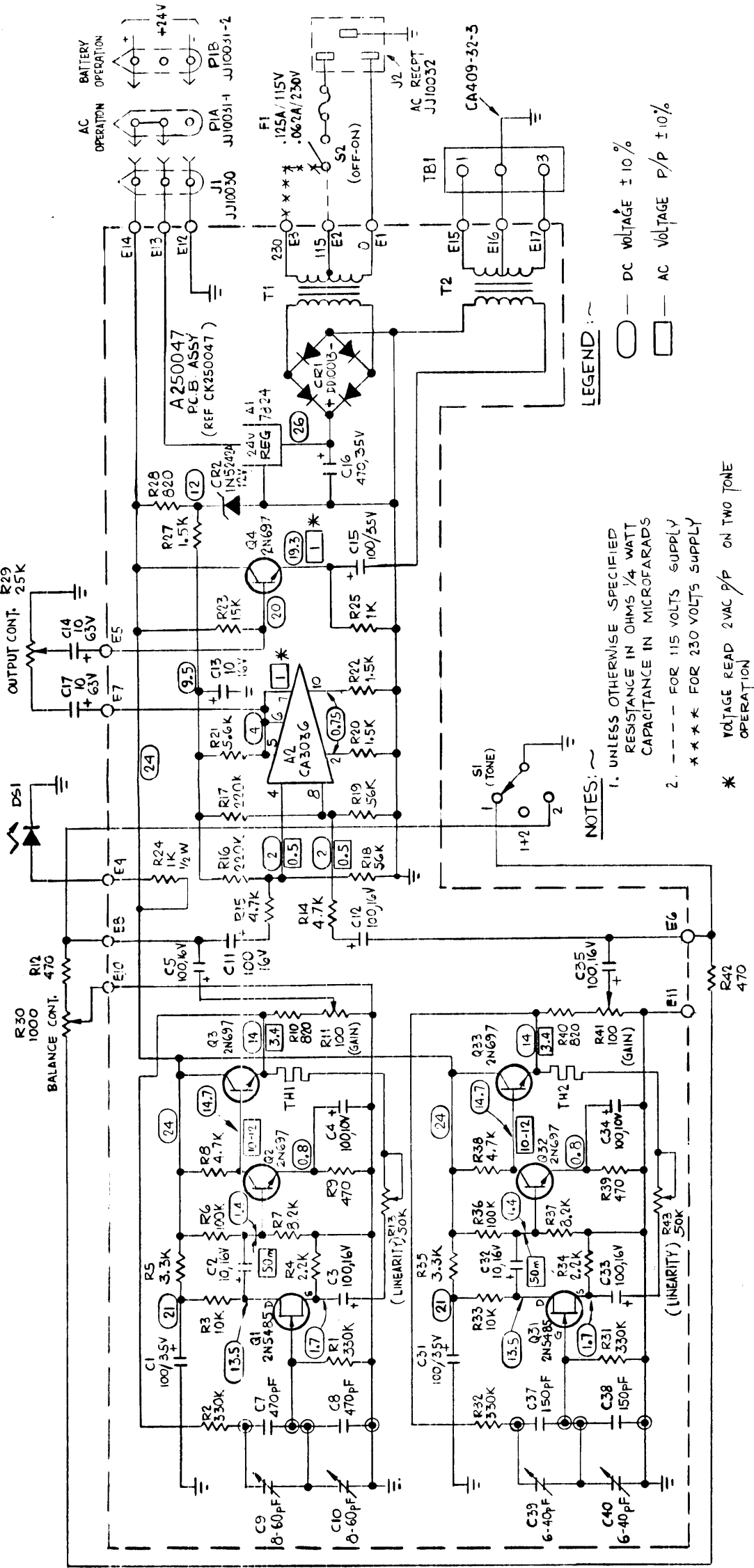
5.3. SOME HINTS ON REPAIR

- a. In most cases, the repair of the TTTG-1 will consist of the replacement of an electrical component. Although no special instruction is required to accomplish this, the following points are provided to ensure that repairs are completed properly.

- b. Always place a new component in the same position as the one it replaces.
- c. Always replace a defective component with its exact duplicate.
- d. Never use a soldering iron with a power rating of more than 45 watts on printed circuit work. Use a pair of long-nose pliers as heat sink to protect components while soldering.
- e. Be extremely careful when replacing components of printed circuit boards. Excessive heat applied to a board might cause the printed wiring to lift off.
- f. Always double-check any solder joints made. Cold or loose solder connections can cause trouble at a later time.

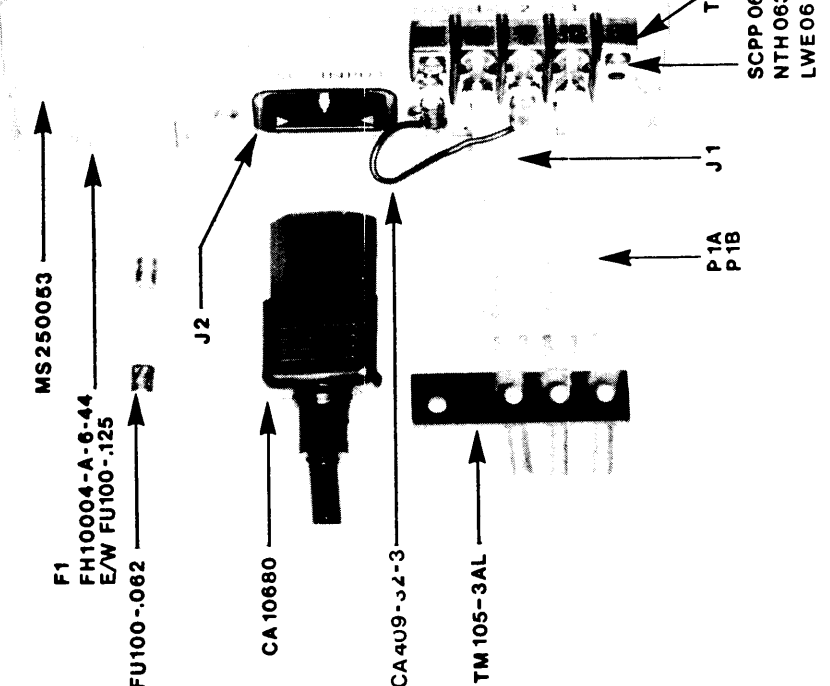
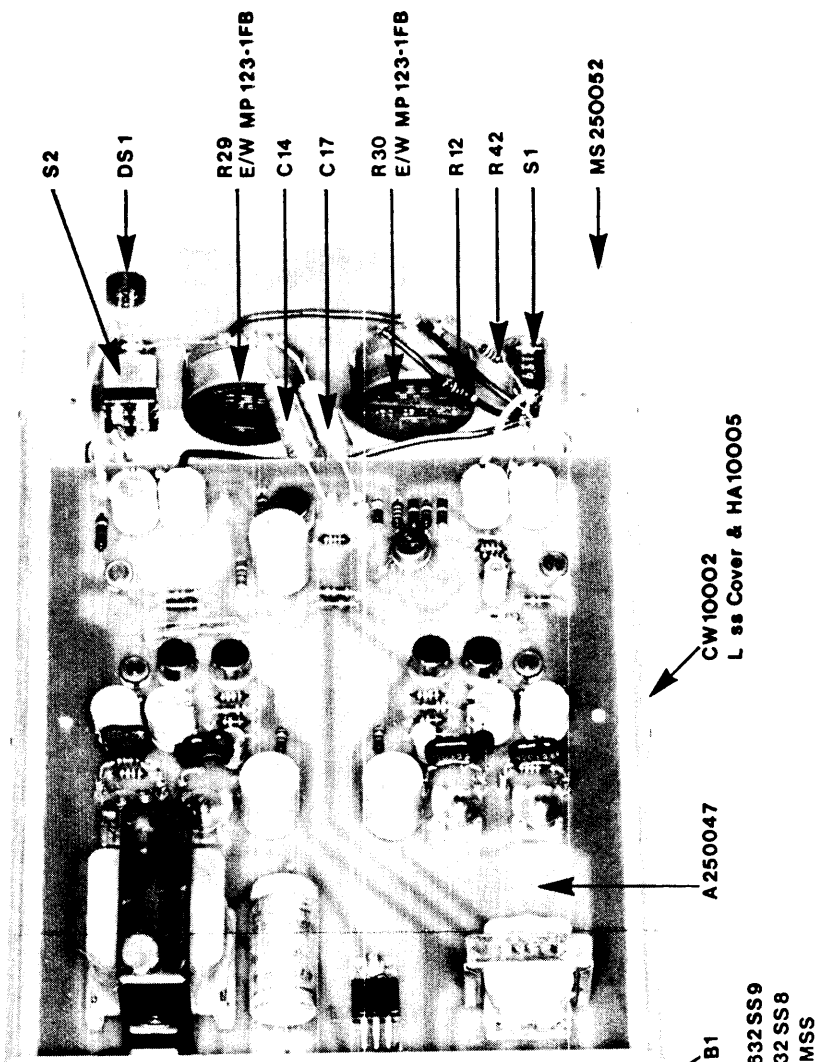
TTTG-1

Data Sheet



LEGEND:
 DC VOLTAGE ±10%
 AC VOLTAGE P/P ±10%

NOTES:
 1. UNLESS OTHERWISE SPECIFIED RESISTANCE IN OHMS 1/4 WATT CAPACITANCE IN MICROFARADS
 2. --- FOR 115 VOLTS SUPPLY ***** FOR 230 VOLTS SUPPLY
 * VOLTAGE READ 2VAC P/P ON TWO TONE OPERATION



COMPONENTS NOT ON A250047

SYMBOL	DESCRIPTION	TMC P/N	STOCK NO.
C14, C17	CAP EXP	CE10017-10-438	250110
DS1	IND. LED	TS10017	250077
J1	CONN, 3P, RECP	J110032	250070
J2	CONN, 3P, RECP	J110032	250070
P1A	CONN, 3P, RECP	J110031-1	250047
P1B	CONN, 3P, RECP	J110031-2	250048
R29	RES, CAR, COMP	RV4NAY5A253A	121740
R30	RES, CAR, COMP	RV4NAY5D102A	122539
R42	RES, SPST	RC07GF471J	121740
S1	SW, DPDT	SW10062	250065
S2	TERM. BLOCK	SW10076	125348
TB1	CONN, 3P, RECP	J110031-2	250048

DESCRIPTION	TMC P/N	STOCK NO.
RES, CAR, COMP	RC07GF472J	250101
	RC07GF24J	250099
	RC07GF563J	121750
	RC07GF152J	250097
	RC07GF42J	250102
	RC07GF152J	250097
	RC07GF153J	250098
	RC200GF102J	121777
	RC07GF102J	121693
	RC07GF332J	121730
	RC07GF821J	121762
	RC07GF334J	250100
	RC07GF103J	121694
	RC07GF222J	121717
	RC07GF332J	121730
	RC07GF104J	250096
	RC07GF822J	250103
	RC07GF472J	250101
	RC07GF821J	121740
CAR, COMP	RV124-1-101	250106
VAR	RC07GF471J	121740
CAR, COMP	RV124-1-503	250107
RES, VAR	2N5485	250080
TS1R, N, CHAN	2N697	127972
TS1R, N, CHAN	2N5485	250080
TS1R, NPN	2N697	127972
XFMR, PWR	TF10090	250062
RES, THERMAL	RF10091	250063
TERM, SOLDER	RI10007	250064
GLUE, ENCAP	TE10019	250078
P.C. BOARD	GL10005	250083
	PC250109	250109

