

NOTICE

THE CONTENTS AND INFORMATION CONTAINED IN THIS INSTRUCTION MANUAL IS PROPRIETARY TO THE TECHNICAL MATERIEL CORPORATION TO BE USED AS A GUIDE TO THE OPERATION AND MAINTENANCE OF THE EQUIPMENT FOR WHICH THE MANUAL IS ISSUED AND MAY NOT BE DUPLICATED EITHER IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER WITHOUT THE WRITTEN CONSENT OF THE TECHNICAL MATERIEL CORPORATION

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THE TECHNICAL MATERIEL CORPORATION

COMMUNICATIONS ENGINEERS

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.

Electron tubes furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

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

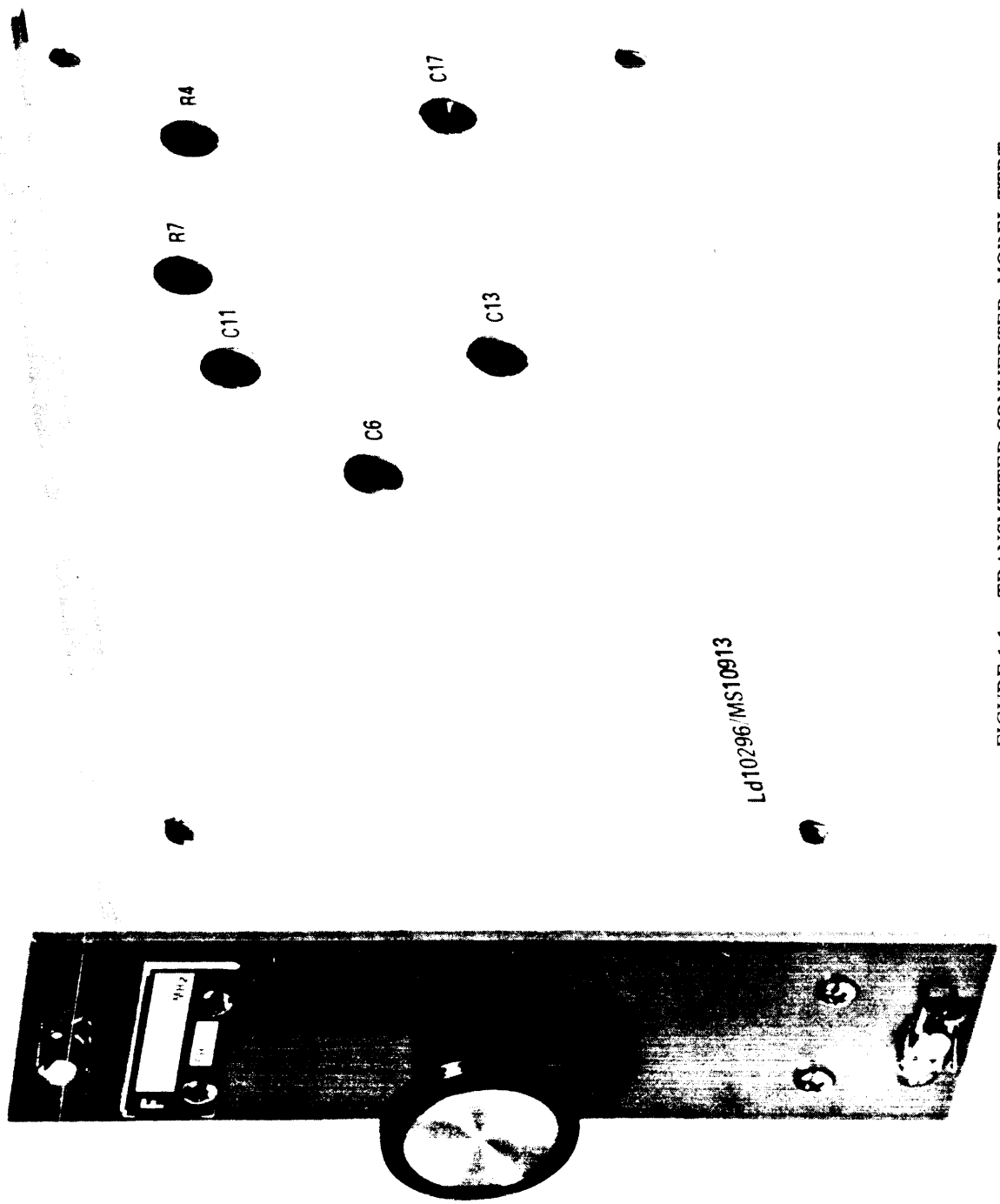


FIGURE I-1. TRANSMITTER CONVERTER, MODEL TTRT- () E

SECTION 1
GENERAL INFORMATION

1-1 FUNCTIONAL DESCRIPTION

(1) The Transmitter Converter, Model TTRT-()E, (see figure 1-1), is a completely transistorized, plug-in RF module that is used with several types of TMC exciters. The TTRT-()E accepts a 1.75 MHz IF signal (modulated or unmodulated) from the exciter, and provides the final stage of frequency translation and RF amplification. These two modules (TTRT-(4A)E and TTRT-(4B)E) cover the frequency range from 16 to 32 MHz in two bands. They are listed in paragraph 1-3.

(2) The TTRT-()E contains a balanced mixer, two emitter followers and two linear RF amplifiers. An oscillator oven assembly which includes a crystal controlled oscillator and a buffer amplifier is provided as well. For purpose of discussion, the AX10034 oscillator oven assembly will be described in this manual. The oscillator design is selected to be compatible with the primary power supplied to the exciter with which the TTRT-()E is being used. The AX10034 requires a 115 vac oven supply, hence this assembly is powered when the primary power to the associated exciter is provided. The balanced mixer and sharp selectivity of the RF amplifiers minimize the local oscillator radiation and undesirable harmonic content.

(3) The two TTRT modules are identical except

from the transformers T1, T2, T3 and T4 which plug into sockets on the printed circuit board. The location of these items can be seen in figure 2-1. Thus to change from one frequency band to the other, it is only necessary to change T1, T2, T3 and T4. The coils used in the two modules are listed in table 1-1.

1-2 PHYSICAL DESCRIPTION

(1) External: The front panel of the TTRT is provided with a knob to facilitate handling of the unit when inserting or removing it from the associated exciter. A plate identifies the transmission frequency associated with that particular transmitter converter.

(2) The plug-in interchangeability feature is the same for this unit as it is for all the TTRT equipment family. It is provided by an etched connector at the rear of the unit. Two slide-latches on the front panel hold the TTRT in position after it has been plugged into the associated exciter. Covers on both sides of the TTRT provide electrostatic shielding and protect the components when the unit is removed from the exciter.

(3) Internal: All the components are located in one of two locations; on a printed circuit board mounted to the chassis or in the oscillator oven assembly.

TABLE 1-1 TTRT COIL COMPLEMENT

Module	T1	T2	T3	T4
TTRT-4AE	TT10007-41A	TT1000742A	TT10007-43A	TT10007-44A
TTRT-4BE	TT10007-41B	TT10007-42B	TT10007-43B	TT10007-44B

1-3 TECHNICAL SPECIFICATIONS

(1) Technical specifications for the TTRT-()E are as follows:

Frequency Ranges:	TTRT-(4A)E 16-24 MHz TTRT-(4B)E 24-32 MHz
Tuning Systems:	Fixed tuned.
Frequency Control:	Crystal controlled oscillator, (crystal type CR110-1)
Transmission:	Type dependent on the exciter with which the TTRT is used.
Input Signal:	1.75 MHz IF, 0 to 400 millivolts peak-to-peak, modulated or unmodulated from associated exciter.
Output Power:	100mw.
Output Impedance:	50 ohms unbalanced.
RF Bandpass:	Approximately 0.5 of the frequency to which the module is tuned.
Frequency Stability:	1 part in 10 ⁶ per day.
Power Requirement:	-12 vdc, +26 vdc provided by the associated exciter.
Dimensions:	Height 5 3/8 inches. Width 1 1/2 inches. Depth 8 inches.
Weight:	3/4 pound.

SECTION 2 INSTALLATION

2-1 INITIAL INSPECTION

(1) Each TTRT unit is tested at the factory and carefully packaged to prevent damage during shipment. Upon receipt of the equipment, inspect the packing case visually. Check the contents for any damage that might have occurred during transit. Unpack the equipment carefully, and inspect all packaging material for parts that may have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, TMC (Canada) Limited will assist in describing methods or repair as well as the furnishing of replacement parts.

2-2 INSTALLATION PROCEDURE

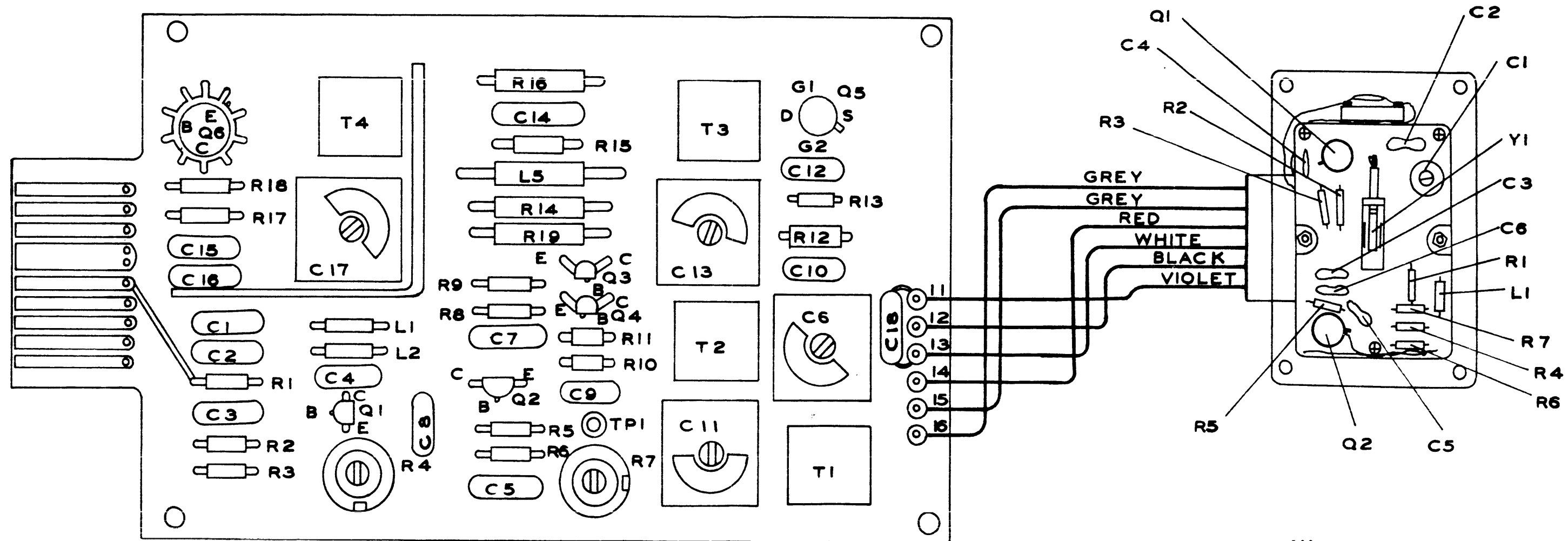
(1) The TTRT is a plug-in module and is installed in an associated exciter by inserting the unit into its

allotted receptacle. Installation and initial check-out procedures for the TTRT are, therefore, given in the associated exciter (or transmitter) manual.

2-3 CHANGING TRANSFORMERS

(1) To convert from one band to the other, it is only necessary to change the set of four transformers which are mounted on the printed circuit board. The transformers required for the two bands are listed in table 1-1.

(2) When changing transformers, ensure that they are installed so that pin 1 on the printed circuit board fits into connector 1 on the bottom of the transformer. The label on the top of the coil should then be aligned with the part labels on the printed circuit board.



TTRT-()E

AX 10034

FIGURE 2-1. COMPONENT LAYOUT, TTRT- () E

**SECTION 3
OPERATING PROCEDURES**

3-1 GENERAL

(1) The TTRT()E does not have any external operating controls.

3-2 WARM-UP PERIOD

(1) As a crystal oven is used in the TTRT module,

a 20 minute warm-up period is required to attain proper frequency and stability.

3-3 OPERATOR'S MAINTENANCE

(1) Operator's maintenance is not required on TTRT modules. Detailed maintenance and alignment procedures are given in section 5 of this manual.

SECTION 4 PRINCIPLES OF OPERATION

4-1 GENERAL

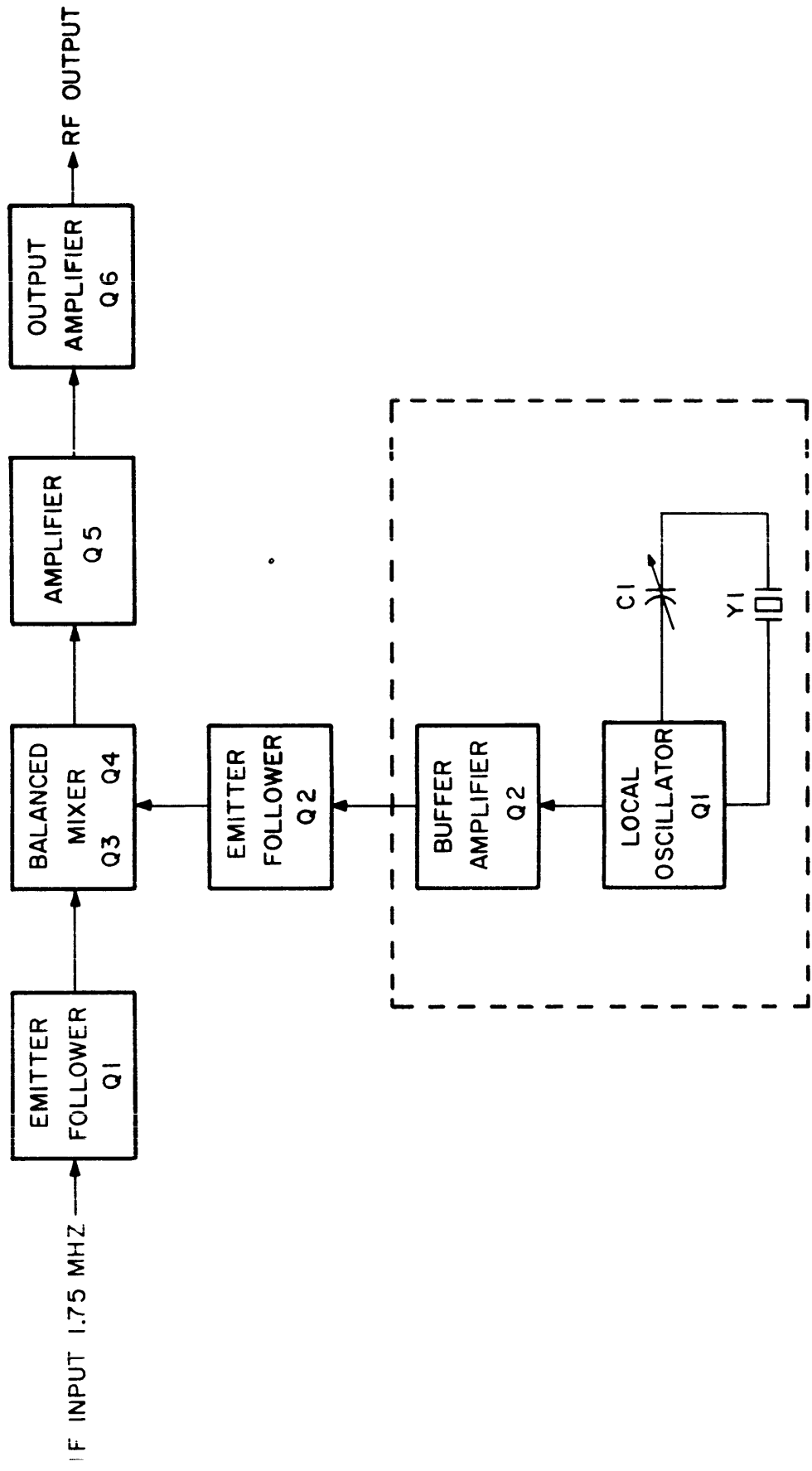
(1) The operating principles are exactly the same for both TTRT modules, and therefore only the TTRT-(4A)E is described in this section. Refer to the block diagram in figure 4-1, and the schematic diagrams, figures 7-1 and 7-2.

4-2 CIRCUIT ANALYSIS

(1) The associated exciter supplies the TTRT with a 1.75 MHz IF signal (modulated or unmodulated). This signal is supplied through an emitter follower Q1 to a balanced mixer formed by Q3 and Q4. The mixer

is also supplied with the output of the local oscillator via another emitter follower Q2. The oscillator is mounted in its own oven assembly. A buffer amplifier also inside the assembly doubles the frequency of the local oscillator. The final output of the oscillator oven assembly is 1.75 MHz above the desired output frequency.

(2) The output of the balanced mixer is amplified by amplifier Q5 and the output amplifier Q6. Each of the two amplifiers is fixed-tuned so that only the desired signal is allowed to pass through. Undesirable noise and heterodyne products are eliminated.



OSCILLATOR OVEN ASSEMBLY AX10034

FIGURE 4-1. BLOCK DIAGRAM TTRT - 4AE AND TTRT - 4BE

SECTION 5
MAINTENANCE

5-1 PREVENTIVE MAINTENANCE

(1) Periodically remove the TTRT module from its associated exciter and inspect for general cleanliness. Check the condition of the double-sided etched connector at the rear of the unit. Remove the one side cover and look for any evidence of discoloured components, damaged wiring and broken or loose solder connections. Clean the components with a soft brush, vacuum cleaner, or dry, filtered, compressed air. Check all hardware for tightness.

(2) Refer to figure 5-1 for aid in locating components of the TTRT ()E which are referred to in the maintenance procedures.

(3) All test equipment required for troubleshooting and alignment is listed in table 5-1.

5-2 TROUBLESHOOTING

(1) Remove TTRT module from its receptacle.

(2) Remove right side cover of TTRT.

(3) Re-connect module to exciter; use service extension module, TMC part no. AX436, (supplied with exciter), to gain access to alignment controls and interior of TTRT.

(4) Disconnect wire from pin 3 of TTRT and

connect a 47 ohm, 1/2 watt resistor to act as a dummy load between pin 3 and ground.

(5) Check the following dc supply voltages at the receptacle:

(a) -12 v at pin 8

(b) 26 v at pin 7

If these voltages are not present, check power supply circuitry of the associated exciter.

(6) Using an oscilloscope, check the output signal of oscillator oven assembly (white lead); level should be approximately 1.5 v peak-to-peak. If this level is not observed, check oscillator oven assembly circuitry.

(7) Adjust the associated equipment to deliver a signal to the TTRT at pin 6. The level should be approximately 400 mv peak-to-peak. If this level is not observed, check AF and IF circuitry of the associated exciter.

(8) Measure the RF signal at output of TTRT module after tuning with oscilloscope across the dummy load resistor. This level should be about 6 v peak-to-peak. If it is not observed, check circuitry of balanced mixer Q3 and Q4 and amplifiers Q5 and Q6.

TABLE 5-1 TEST EQUIPMENT FOR MAINTENANCE

ITEM	FUNCTION
47 ohm, 1/2 watt resistor	Used during troubleshooting and alignment procedures.
Frequency counter (Hewlett Packard Model 524C, or equivalent.)	
Oscilloscope (Tektronix Model 545, or equivalent.)	
Volt, ohm, milliammeter (Simpson Model 260 or equivalent.)	
Two-tone generator (TMC Model TTG1 or equivalent.)	

5-3 REPAIR

(1) Repair of the TTRT module consists primarily of component replacement resoldering connections. The following precautions should be observed:

(a) Use replacement components which are identical to defective components in exactly the same place on the board. After a component has been repaired or replaced, the TTRT may require alignment. Refer to paragraph 5-4.

(b) Use long nose pliers or alligator clips when soldering near semi-conductors devices in order to transfer heat from the junction and thus prevent damage to the component.

(c) Use a soldering iron of 50 watt rating or lower. Use suitable flux remover to clean soldered joints.

CAUTION

Excess heat near the board surface may damage the printed circuit wiring.

5-4 ALIGNMENT

(1) The test equipment required for alignment is listed in table 5-1.

CAUTION

Always remove power from the exciter when removing or inserting TTRT modules.

(2) The alignment procedure is as follows:

(a) Remove TTRT module from the associated exciter.

(b) Remove right side cover of TTRT,

(c) Re-connect module to exciter; use service extension module to gain access to alignment controls and interior of TTRT.

(d) Disconnect wire from pin 3 of TTRT and connect a 47 ohm dummy 1/2 watt load resistor pin 3 and ground. Connect the oscilloscope across the dummy load and connect the counter to the

oscilloscope vertical amplifier output.

(e) Connect the two-tone generator to the 600 ohm line input to the associated exciter.

(f) Adjust the two-tone generator so that a single tone (935 Hz), 100 mv input is provided to pin 6 on the TTRT. Then adjust the capacitor on the oscillator oven assembly until the desired output frequency is obtained as will be indicated on the

(g) Adjust the two-tone generator so that a two-tone, 400 mv input if provided to pin 6 on the TTRT.

(h) Connect the oscilloscope to R13 (either end). With R4 and R7 fully counterclockwise, adjust C4 and C11 to obtain maximum output on the oscilloscope.

(i) Connect the oscilloscope to the junction of C14 and L5. Adjust C13 to obtain maximum output on the oscilloscope.

(j) Connect the oscilloscope across the dummy load at pin 3. Adjust C17 to obtain maximum output.

(k) With the dummy load still connected, adjust R4 until the signal level on the oscilloscope is 6 v peak-to-peak.

5-5 DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY

(1) Each TTRT module requires a local oscillator crystal. The crystal frequency is selected to obtain the desired transmission frequency in accordance with the following equation:

$$2f_x = f_o + f_i$$

where: f_x = local oscillator crystal frequency
 f_o = frequency of signal to be transmitted
 f_i = frequency of IF input to the module

(2) Care must be taken that the desired transmission frequency falls within the RF bandpass of the two amplifier stages.

EXAMPLE: A TTRT module is required to transmit a frequency of 24,000 kHz and the IF is 1750 kHz; hence the desired crystal frequency is:

$$2f_x = 24,000 + 1750$$

$$f_x = \frac{25750}{2}$$

$$f_x = 12,875 \text{ kHz}$$

(3) For CW operation, the IF signal may be displaced slightly from the nominal value and therefore the local oscillator crystal frequency must compensate for this.

EXAMPLE: If the IF is 1749 kHz instead of 1750 kHz, the crystal frequency must then be:

$$2f_x = 24,000 + 1749$$

$$f_x = \frac{25,749}{2}$$

$$f_x = 12,874.5 \text{ kHz.}$$

(4) For FSK or FAX transmission, the IF signal displacement will be equal to the center frequency of the tone telegraph terminal used with the exciter. The local oscillator crystal frequency must be displaced in order to compensate for this.

EXAMPLE: A tone telegraph terminal having an output center frequency of 2550 Hz, is used with the exciter. The crystal frequency must then be:

$$2f_x = 24,000 + (1750 \pm 2.55)$$

$$f_x = \frac{24,000 + 1752.55}{2} \quad \text{or} \quad \frac{24,000 + 1747.45}{2}$$

$$f_x = 12,876.275 \text{ kHz} \quad \text{or} \quad 12,873.725 \text{ kHz}$$

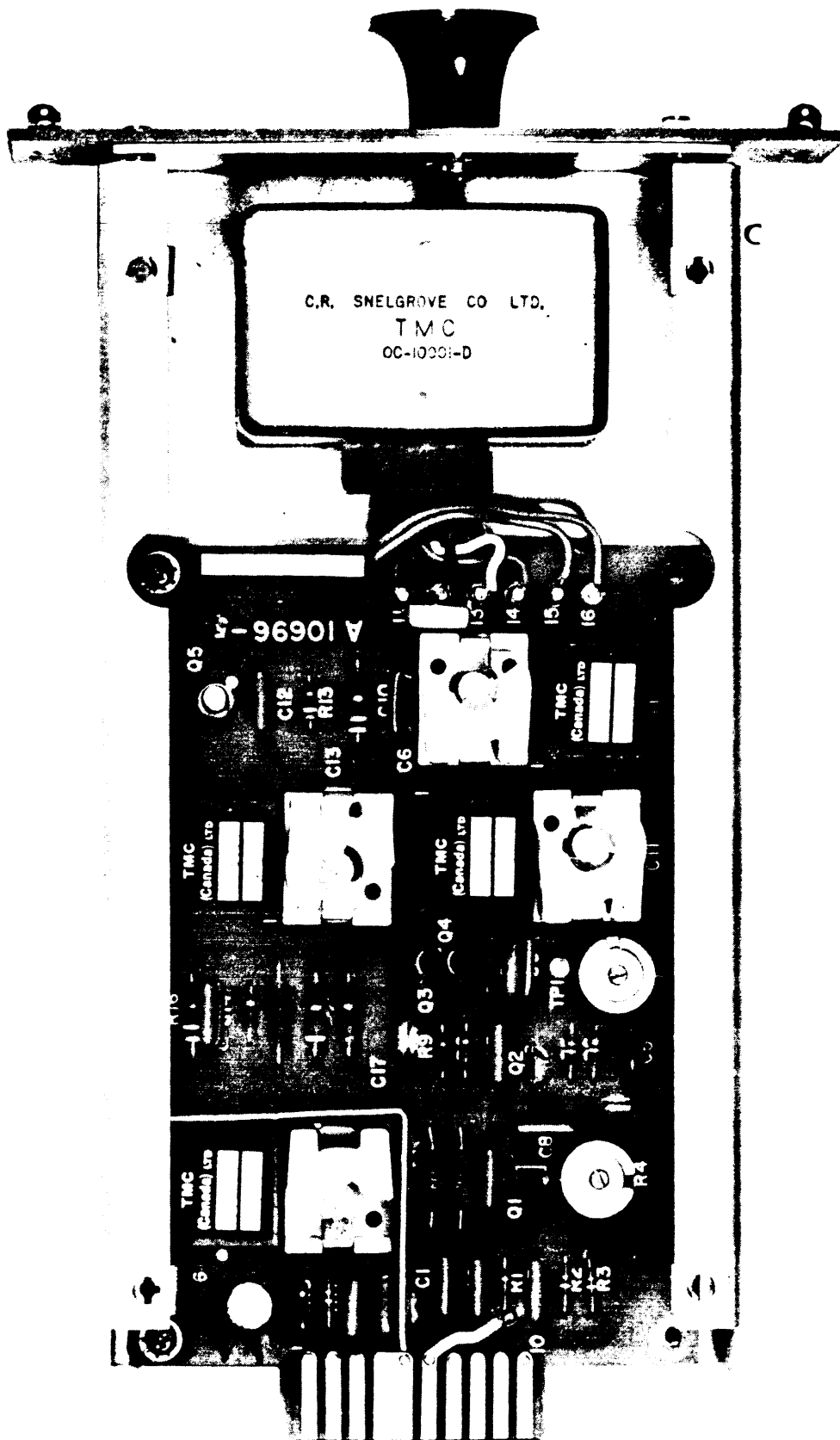


FIGURE 5-1. RIGHT SIDE, COVER REMOVED, TTRT - () E

SECTION 6
PARTS LIST

6-1 INTRODUCTION

(1) Reference designations have been assigned to identify all electrical parts comprised in the equipment. These designations are used for marking the equipment (adjacent to the parts they identify) and are included on drawings, diagrams and the parts lists.

(2) The letters of a reference designation indicate the kind of part (generic group), such as resistor,

capacitor, transistor, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as a transistor or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for crystal Y501 is designated XY501.

(3) To expedite delivery when order replacement parts, specify the TMC part number and the model number of the equipment.

TTRT-4AE and TTRT-4BE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FLAT FOIL; .01 uf, 250 vdc.	CC10011-1
C2	Same as C1	
C3	Same as C1	
C4	Same as C1	
C5	CAPACITOR, FIXED, MICA: 180 pF, 100 vdc.	CM111E181J1S
C6	CAPACITOR, VARIABLE, AIR: 50 pF, 500 vdc.	CB10006-8-5
C7	Same as C1	
C8	Same as C1	
C9	Same as C1	
C10	Same as C1	
C11	Same as C6	
C12	Same as C1	
C13	Same as C6	
C14	Same as C1	
C15	Same as C1	
C16	Same as C1	
C17	Same as C6	
C18	CAPACITOR, FLAT FOIL: .047 uF, 250 vdc.	CC10011-5
L1	INDUCTOR, RF COIL, FIXED: 47 uH, $\pm 10\%$	CL275-470
L2	Same as L1	
L3	Not used	
L4	Not used	
L5	Same as L1	
Q1	TRANSISTOR, PNP, SILICON: low power	2N3906
Q2	Same as Q1	
Q3	TRANSISTOR, NPN, SILICON: low power	2N3904
Q4	Same as Q3	

TTRT-4AE and TTRT-4BE (continued)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q5	SEMICONDUCTOR, SILICON: FIELD EFFECT, "N" CHANNEL	3N126
Q6	TRANSISTOR, NPN, SILICON: HIGH POWER	2N3553
R1	RESISTOR, FIXED, COMPOSITION; 100 ohms $\pm 5\%$ 1/4 watt	RC07GF101J
R2	RESISTOR, FIXED, COMPOSITION: 15 K ohms $\pm 5\%$, 1/4 watt	RC07GF153J
R3	Same as R2	
R4	RESISTOR, VARIABLE, COMPOSITION: 500 ohms $\pm 10\%$, 1/4 watt nominal at 70° C	RV111U501A
R5	Same as R2	
R6	Same as R2	
R7	Same as R4	
R8	RESISTOR, FIXED, COMPOSITION: 560 ohms $\pm 5\%$, 1/4 watt	RC07GF561J
R9	RESISTOR, FIXED, COMPOSITION: 150 ohms $\pm 5\%$, 1/4 watt	RC07GF151J
R10	Same as R8	
R11	Same as R9	
R12	RESISTOR, FIXED, COMPOSITION: 33 ohms $\pm 5\%$, 1/2 watt	RC20GF330J
R13	RESISTOR, FIXED, COMPOSITION: 390 ohms $\pm 5\%$, 1/4 watt	RC07GF391J
R14	RESISTOR, FIXED, COMPOSITION: 47 ohms $\pm 5\%$, 1/2 watt	RC20GF470J
R15	RESISTOR, FIXED, COMPOSITION: 1 k ohm $\pm 5\%$, 1/4 watt	RC07GF102J
R16	RESISTOR, FIXED, COMPOSITION: 39 ohms $\pm 5\%$, 1/2 watt	RC20GF390J
R17	RESISTOR, FIXED, COMPOSITION: 12 k ohms $\pm 5\%$, 1/4 watt	RC07GF123J
R18	Same as R15	
R19	RESISTOR, FIXED, COMPOSITION: 68 ohms $\pm 5\%$, 1/2 watt	RC20GF680J
T1 (TTRT-4AE)	TRANSFORMER, RF TUNED:	TT10007-41A
T1 (TTRT-4BE)	TRANSFORMER, RF TUNED:	TT10007-41B
T2 (TTRT-4AE)	TRANSFORMER, RF TUNED:	TT10007-42A

TTRT-4AE and TTRT-4BE (continued)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T2 (TTRT-4BE)	TRANSFORMER, RF TUNED;	TT10007-42B
T3 (TTRT-4AE)	TRANSFORMER, RF TUNED:	TT10007-43A
T3 (TTRT-4BE)	TRANSFORMER, RF TUNED:	TT10007-43B
T4 (TTRT-4AE)	TRANSFORMER, RF TUNED:	TT10007-44A
T4 (TTRT-4BE)	TRANSFORMER, RF TUNED:	TT10007-44B

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REF SYMBOL	DESCRIPTION	TMC PART NUMBER
	OVEN: crystal	OC10001
C1	CAPACITOR, VARIABLE, CERAMIC: 9-35 pF 100 vdc	CV112-1
C2	CAPACITOR, FIXED, MICA: 22 pF $\pm 5\%$, 500 vdc	CM111C220J1S
C3	CAPACITOR, FIXED, MICA: 560 pF $\pm 5\%$, 100 vdc	CM10001
C4	CAPACITOR, FIXED, CERAMIC: .005 uF, gmV, 500 vdc	CC100-15
C5	CAPACITOR, FIXED, MICA: 47 pF, $\pm 5\%$, 500 vdc	CM111C470J1S
C6	CAPACITOR, FIXED, MICA: 68 pF, $\pm 5\%$, 500 vdc	CM111C680J1S
L1	INDUCTOR, RF CHOKE: 27 uH	CL275-270
Q1	TRANSISTOR, PNP, SILICON: LOW POWER	2N3906
Q2	TRANSISTOR, NPN, SILICON: HIGH POWER	2N2219A
R1	RESISTOR, FIXED, COMPOSITION: 27 K ohms $\pm 5\%$, 1/4 watt	RC07GF273J
R2	RESISTOR, FIXED, COMPOSITION: 5.6 Kohms $\pm 5\%$, 1/4 watt	RC07GF562J
R3	RESISTOR, FIXED, COMPOSITION: 1 K ohm $\pm 5\%$, 1/4 watt	RC07GF102J
R4	RESISTOR, FIXED, COMPOSITION: 13 K ohms $\pm 5\%$, 1/4 watt	RC07GF153J
R5	Same as R4	
R6	Same as R3	
R7	RESISTOR, FIXED, COMPOSITION: 430 ohms $\pm 5\%$, 1/4 watt	RC07GF431J
Y1	CRYSTAL: (Frequency as per customer's requirement)	CR110-1-

SECTION 7
SCHEMATIC DIAGRAMS

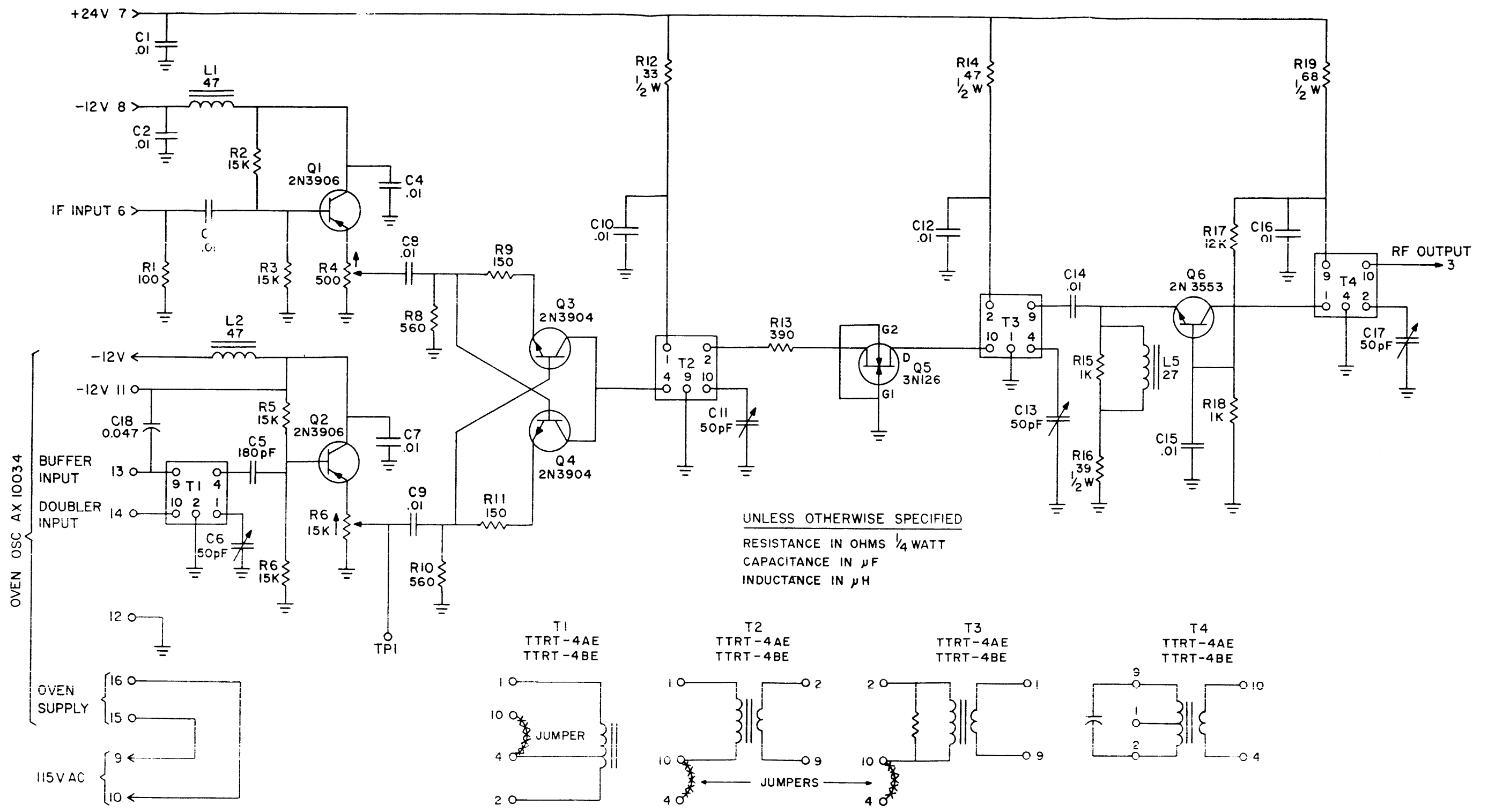


FIGURE 7-1 SCHEMATIC DIAGRAM, TTRT - 4AE AND TTRT - 4BE

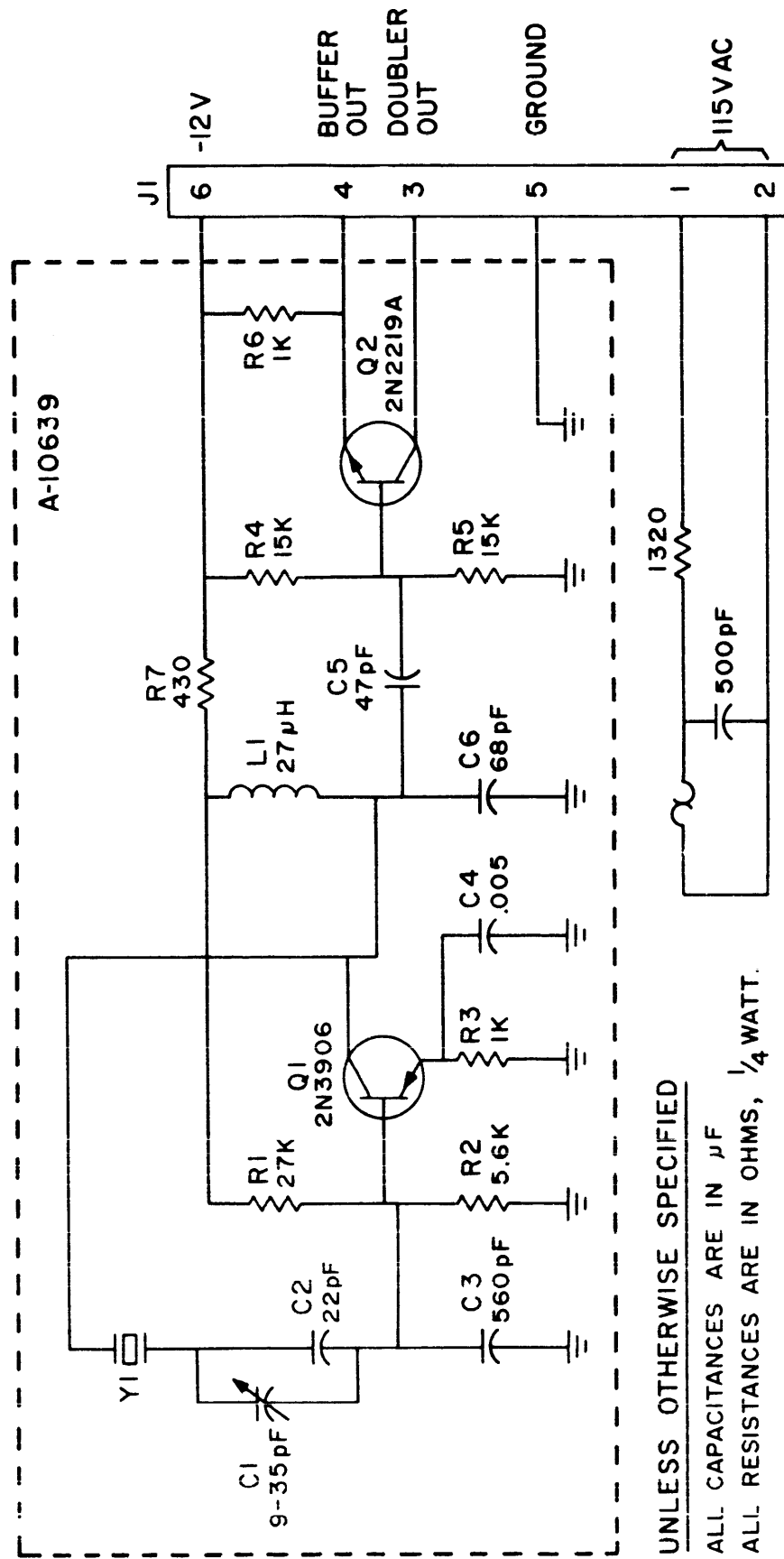


FIGURE 7-2. SCHEMATIC DIAGRAM, OSCILLATOR OVEN ASSEMBLY (AX10034)