TECHNICAL MANUAL

for

TRANSMITTER CONVERTER
MODEL TTRT-1D, TTRT-2D, TTRT-3D

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

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IN2030B 15th October, 1967

NOTICE

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

CHANGE NO. 1 TTRT-1D, -2D, -3D

TECHNICAL MANUAL CHANGE NOTICE

DATE: Jan. 31/68

MANUAL AFFECTED: Transmitter Converter Model TTRT-1D, TTRT-2D, TTRT-3D IN2030B

Make the following changes to figure 7-1:

a) Change Q4 from type 2N2219A to type 2N3553.

b) Delete the wiring detail shown for TTRT-3D for both T2 and T3.

c) Add TTRT-3D to TTRT-1D and TTRT-2D for both T2 and T3.

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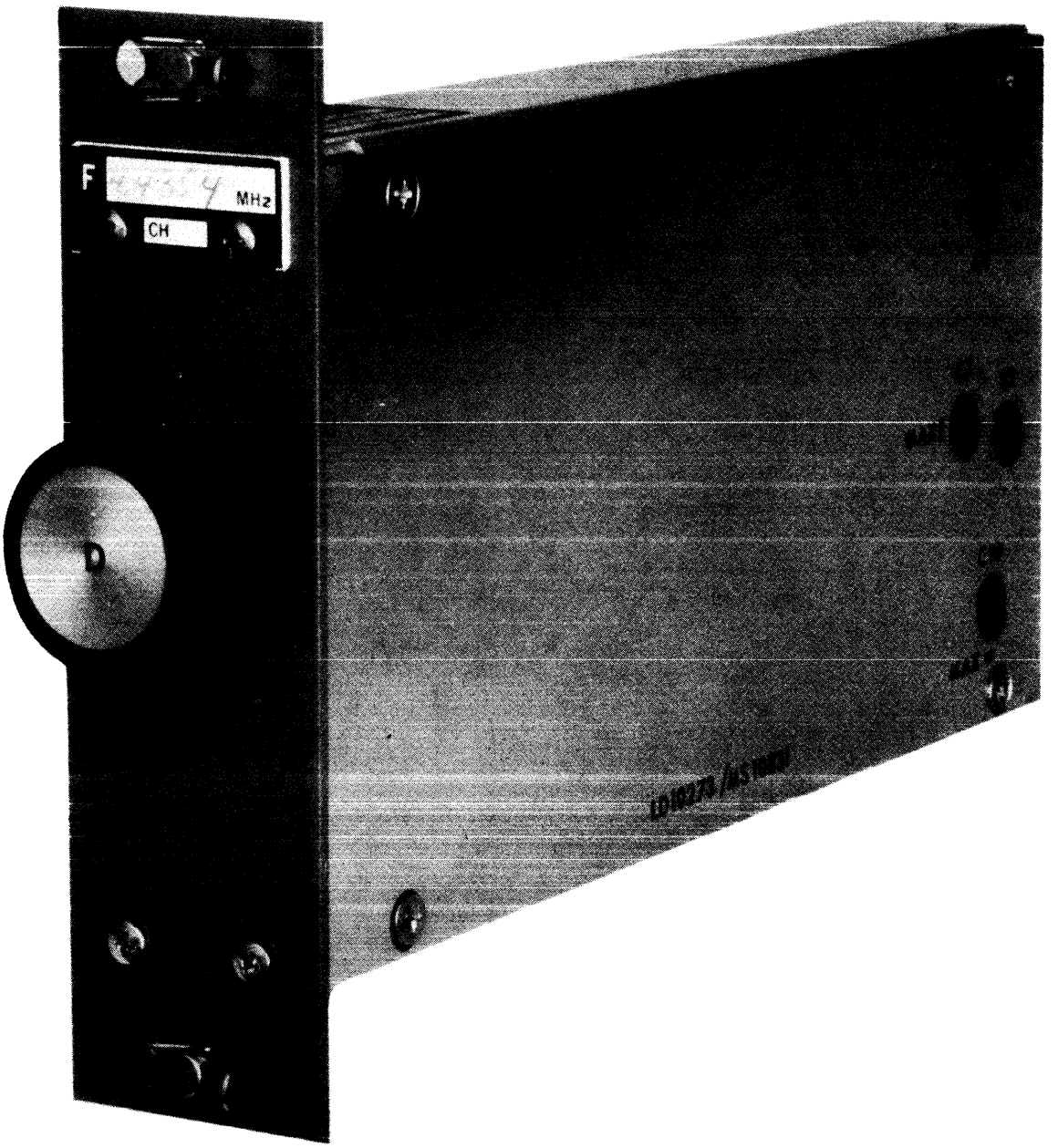


FIGURE 1-1. TRANSMITTER CONVERTER, MODEL TTRT-1D, TTRT-2D, TTRT-3D.

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

Transmitter Converter, model TTRT-( )D, (see figure 1-1), is a completely transistorized, plug-in, RF module that is used with several types of TMC exciters. The TTRT-( )D accepts a 1.75 MHz IF signal (modulated or unmodulated) from the exciter, and provides the final stage of frequency translation and RF amplification. Three modules (TTRT-1D, TTRT-2D and TTRT-3D) cover the frequency range from 2 to 16 MHz in three bands (refer to paragraph 1-3).

The TTRT-( )D contains a balanced mixer and two linear RF amplifiers. An oscillator oven assembly which includes a crystal controlled oscillator and buffer amplifier is provided as well. For purpose of discussion, the AX10010 oscillator oven assembly will be described in this manual. The oscillator assembly is selected to be compatible with the primary power supplied to the exciter in which the TTRT-( ) D is used. The AX10010 requires a 115 Vac oven supply, hence this assembly is provided when the primary power to the associated exciter is 115 Vac. The balanced mixer and sharp selectivity of the RF amplifiers minimize local oscillator radiation and undesirable heterodyne product output.

The three TTRT modules are identical except for the transformers T1, T2, and T3 on the printed circuit board and the crystal Y2 in the oscillator oven assembly (refer to figure 2-1). Thus to change from one frequency band to another, it is only necessary to change T1, T2, T3, and Y1. The coils used in each module are listed in table 1-1.

TABLE 1-1. TTRT COIL COMPLEMENT

Module	T1	T2	T3
TTRT 1D	TT10001-11	TT10001-12	TT10001-13
TTRT-2D	TT10001-21	TT10001-22	TT10001-23
TTRT-3D	TT10001-31	TT10001-32	TT10001-33

1-2. PHYSICAL DESCRIPTION.

a. 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 the TTRT.

The plug-in interchangeability feature of the TTRT is provided by an etched connector at the rear of the unit; two slide-latches on the front panel hold the TTRT in place 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. Each TTRT is 1-1/2 inches wide, 5-3/8 inches high, 8 inches deep, and weighs 3/4 pound.

b. INTERNAL.–The components in the TTRT are located on the printed circuit board mounted to the chassis or the oscillator oven assembly.

1-3. TECHNICAL SPECIFICATIONS.

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

Frequency Range:	
TTRT-1D	2-4 MHz
TTRT-2D	4-8 MHz
TTRT-3D	8-16 MHz
Tuning Systems:	Fixed tuned.
Frequency Control:	Crystal controlled oscillator (crystal type CR110–1).
Types of Transmission:	Dependent on exciter with which TTRT is used.
Input:	1.75 MHz IF, 0 to 400 mV, peak-to-peak, modulated or unmodulated, from associated exciter.
Output Power:	100 mW.
Output Impedance:	50 ohms, unbalanced.
RF Bandpass:	Approximately 0.5% of frequency to which module is tuned.
Frequency Stability:	1 part in 10^6 per day.
Power Requirement:	-12 Vdc, +26 Vdc provided by 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.

Each TTRT is tested at the factory and is carefully packaged to prevent damage during shipment. Upon receipt of the equipment, inspect the packing case and its contents for 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 of repair and the furnishing of replacement parts.

2-2. INSTALLATION PROCEDURE.

The TTRT is a plug-in module and is installed in the associated exciter by inserting the unit into its receptacle. Installation and initial check-out procedures for the TTRT are, therefore, given in the associated exciter (or transmitter) manual.

2-3. CHANGING TRANSFORMERS.

To convert from one band to another, it is only necessary to change the set of transformers and the crystal in the module (refer to paragraph 1-1). The transformers required for each band are listed in table 1-1.

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 top of the transformer should then be aligned with the part labels on the printed circuit board.

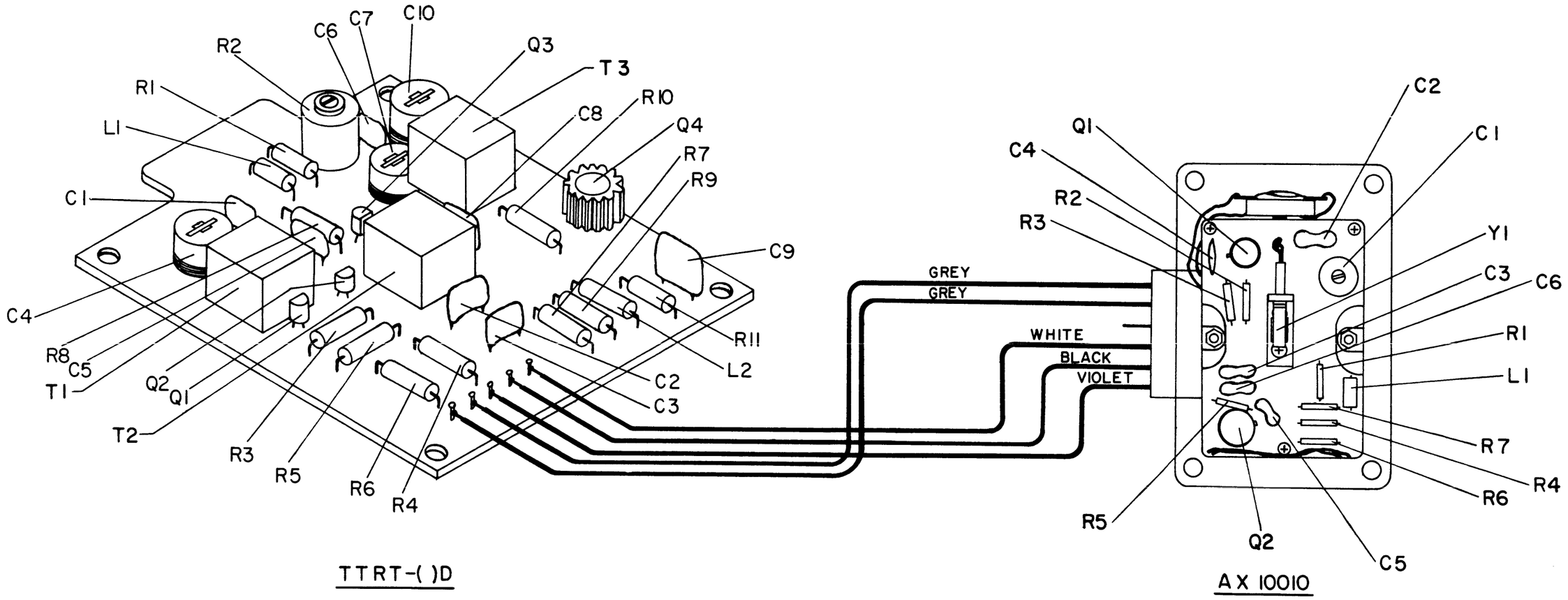


FIGURE 2-1. TTRT-( ) D LAYOUT

FIGURE 2-1

SECTION 3

OPERATING PROCEDURES

3-1. GENERAL.

The TTRT-( )D does not have any external operating controls.

3-2. WARM-UP PERIOD.

As a crystal oven is used in the TTRT module, a 20-minute warm-up is required to attain proper frequency and stability.

3-3. OPERATOR'S MAINTENANCE.

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.

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

4-2. CIRCUIT ANALYSIS.

The associated exciter supplies the TTRT with a 1.75 MHz IF signal (modulated or unmodulated). This signal is supplied to balanced mixer Q1/Q2. The mixer is also supplied with the output of the local oscillator in the oscillator oven assembly through a buffer amplifier in the assembly. The buffer amplifier ensures maximum stability of the local oscillator. The local oscillator operates 1.75 MHz above the desired output frequency.

The output of the balanced mixer is amplified by amplifier Q3 and output amplifier Q4. Each of the amplifiers is fixed-tuned so that only the desired signal is passed; undesirable noise and heterodyne products are eliminated.

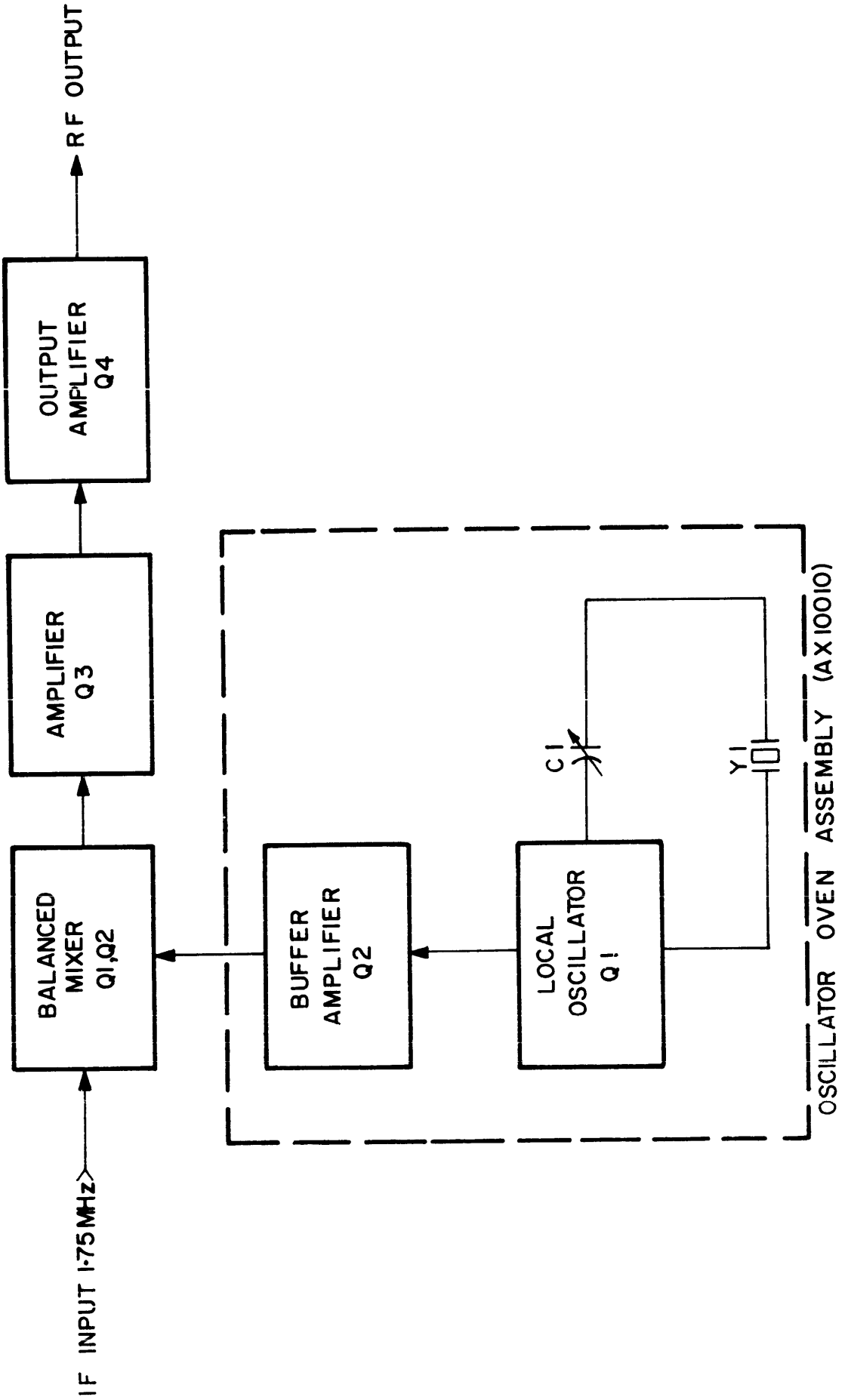


FIGURE 4-1. TTRT-1D, -2D, -3D BLOCK DIAGRAM

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

Periodically, remove the TTRT module from its associated exciter and inspect for general cleanliness and condition of etched connector at the rear of the unit. Remove side covers and check for 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.

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

Test equipment required for troubleshooting and alignment is listed in table 5-1.

5-2. TROUBLESHOOTING.

a. Remove TTRT module from its receptacle.

b. Remove right-side cover of TTRT.

c. 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.

d. Disconnect wire from pin 3 of TTRT and connect a 47 ohm, 1/2 watt dummy load between pin 3 and ground.

e. Check the following dc supply voltages at the receptacle:
(1) -12 V at pin 8.
(2) +26 V at pin 7.
If these voltages are not present, check power supply circuitry of associated exciter.

f. Using an oscilloscope, check the output signal of oscillator oven assembly (white lead); level should be approximately 2.8 V peak-to-peak. If this level is not observed, check oscillator oven assembly circuitry.

g. Adjust the associated equipment to deliver signal to the TTRT. Turn R2 fully counterclockwise and check the signal level at pin 6 with oscilloscope; level should be approximately 400 mV peak-to-peak. If this level is not observed, check AF and IF circuitry of associated exciter.

h. Measure RF signal at output of TTRT module after tuning with oscilloscope (across dummy load resistor). Level should be approximately 6 V peak-to-peak. If this level is not observed, check circuitry of balanced mixer Q1/Q2 and amplifiers Q3 and Q4.

5-3. REPAIR.

Repair of the TTRT module consists of component replacement and resoldering connections. The following precautions should be observed:

a. Use replacement components identical to defective components in exact 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-conductor devices in order to transfer heat from the junction and thus prevent damage to the component.

TABLE 5-1. TEST EQUIPMENT FOR MAINTENANCE

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

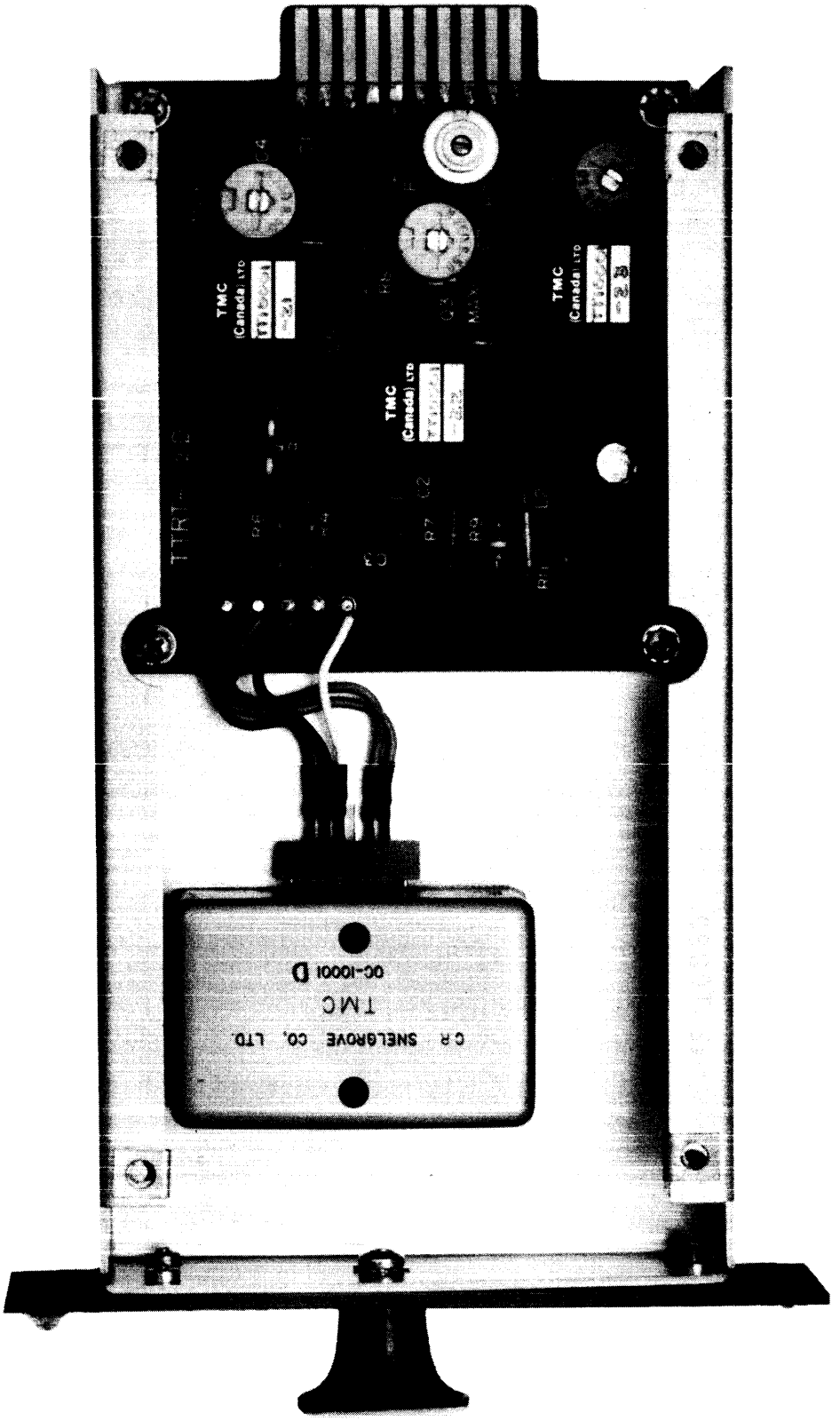


FIGURE 5-1. RIGHT SIDE, COVER REMOVED, TTRT-( )D

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.

Test equipment required for alignment is listed in table 5-1.

CAUTION

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

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, 1/2 watt dummy load between 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 indicated on the counter.

g. Adjust the two-tone generator so that a two-tone, 400 mV input is provided to pin 6 on the TTRT.

h. Connect the oscilloscope to R8 (either end). With R2 fully counter-clockwise, adjust C4 to obtain maximum output on the oscilloscope.

i. Connect the oscilloscope to the junction of C8 and L2. Adjust C7 to obtain maximum output on the oscilloscope.

j. Connect the oscilloscope across the dummy load at pin 3. Adjust C10 to obtain maximum output.

k. Adjust R2 until the signal level on the oscilloscope is 6 V, peak-to-peak.

5-5. DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY.

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:

$$fx = fo + fi$$

where fx = local oscillator crystal frequency

fo = frequency of signal to be transmitted

fi = frequency of IF input to the module

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

EXAMPLE: A TTRT module is required to transmit a frequency of 4020 kHz and the IF is 1750 kHz; hence the required crystal frequency is

$$fx = 4020 + 1750 = 5770 \text{ kHz.}$$

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

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

$$fx = 4020 + 1749 = 5769 \text{ kHz.}$$

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 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:

$$fx = 4020 + (1750 \pm 2.55)$$

$$= 4020 + 1752.55 \text{ OR } 4020 + 1747.45$$

$$= 5772.55 \text{ OR } 5767.45 \text{ kHz.}$$

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

Reference designations have been assigned to identify all electrical parts of 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 list. 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 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. To expedite delivery when ordering replacement parts, specify the TMC part number and the model number of the equipment.

TTRT - 1D, 2D, 3D

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FLAT, FOIL; O.luF, 250 Vdc	CC10011-8
C2	Same as C1	
C3	Same as C1	
C4	CAPACITOR, VARIABLE, CERAMIC: 8 -50pF, 350 WVdc	CV109-9
C5	Same as C1	
C6	Same as C1	
C7	Same as C4	
C8	Same as C1	
C9	Same as C1	
C10	Same as C4	
L1	COIL, RF, FIXED: 1,000uH ±10%	CL275-102
L2	COIL, RF, FIXED: 220uH ±10%	CL275-221
Q1	TRANSISTOR	2N3904
Q2	Same as Q1	
Q3	TRANSISTOR	MPF105
Q4	TRANSISTOR	2N3553
R1	RESISTOR, FIXED, COMPOSITION: 100 ohms ±5%, ½ watt	RC20GF101J
R2	RESISTOR, VARIABLE, COMPOSITION: 1,000 ohms ±10%, 0.25 watt nominal at 70°C	RV111U102A
R3	RESISTOR, FIXED, COMPOSITION: 390 ohms ±5%, ½ watt	RC20GF391J
R4	RESISTOR, FIXED, COMPOSITION: 1,200 ohms ±5%, ½ watt	RC20GF122J
R5	Same as R3	
R6	Same as R4	
R7	Same as R1	

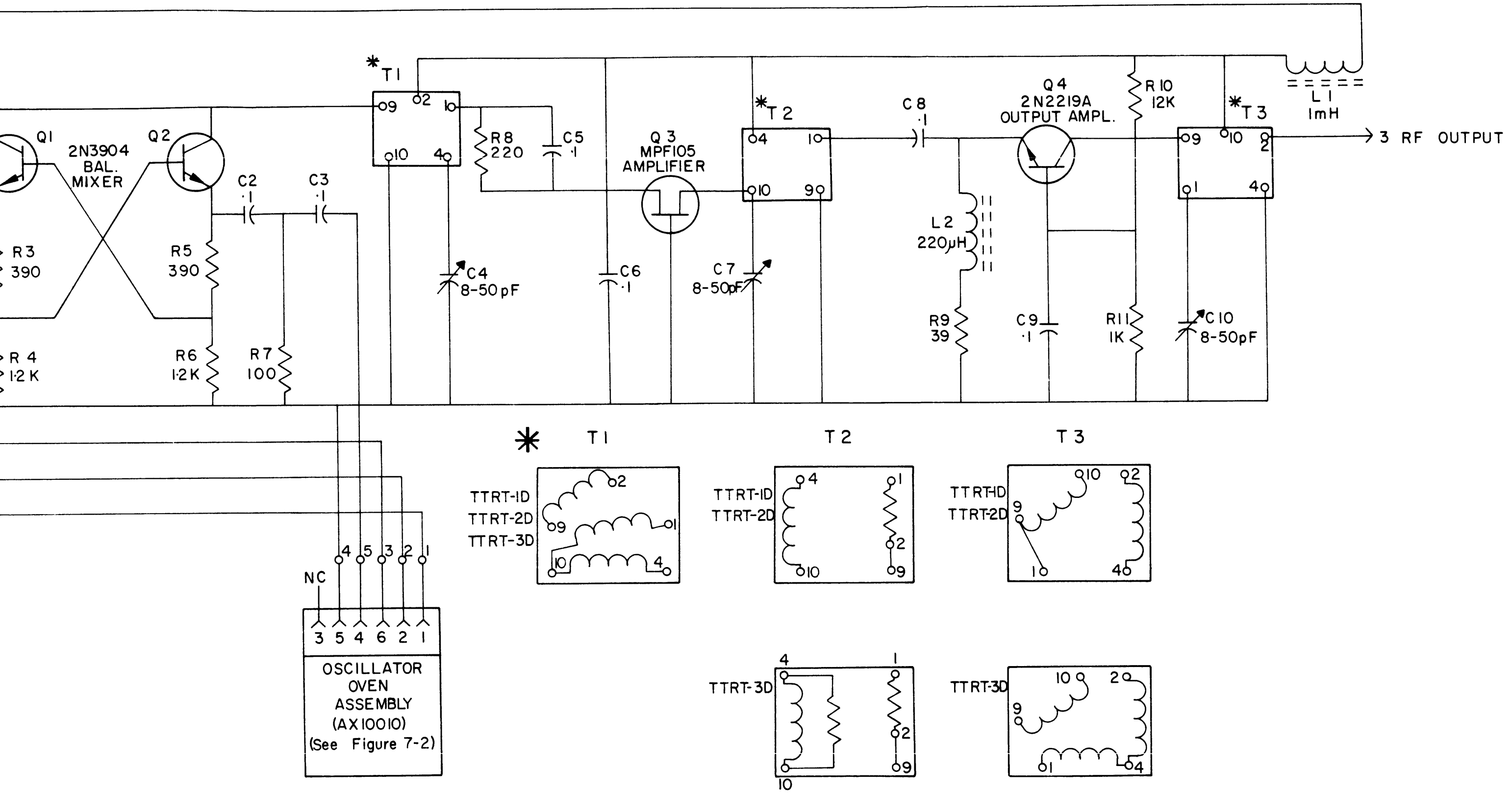
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R8	RESISTOR, FIXED, COMPOSITION: 220 ohms ±5%, ½ watt	RC20GF221J
R9	RESISTOR, FIXED, COMPOSITION: 39 ohms ±5%, ½ watt	RC20GF390J
R10	RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±5%, ½ watt	RC20GF123J
R11	RESISTOR, FIXED, COMPOSITION: 1,000 ohms ±5%, ½ watt	RC20GF102J
T1 (TTRT-1D)	TRANSFORMER, RF TUNED	TT10001-11
T1 (TTRT-2D)	TRANSFORMER, RF TUNED	TT10001-21
T1 (TTRT-3D)	TRANSFORMER, RF TUNED	TT10001-31
T2 (TTRT-1D)	TRANSFORMER, RF TUNED	TT10001-12
T2 (TTRT-2D)	TRANSFORMER, RF TUNED	TT10001-22
T2 (TTRT-3D)	TRANSFORMER, RF TUNED	TT10001-32
T3 (TTRT-1D)	TRANSFORMER, RF TUNED	TT10001-13
T3 (TTRT-2D)	TRANSFORMER, RF TUNED	TT10001-23
T3 (TTRT-3D)	TRANSFORMER, RF TUNED	TT10001-33

OSCILLATOR OVEN MODEL AX10010

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
	OVEN: crystal	OC10001
C1	CAPACITOR: VARIABLE,: 15-60 pF, 100 WVDC	CV112-5
C2	CAPACITOR, FIXED, MICA: 22pF, ±5%, 500 WVDC	CM111C220J1S
C3	CAPACITOR, FIXED, MICA: 560 pF, ±5%, 100 WVDC	CM10001
C4	CAPACITOR, FIXED, CERAMIC: 5000 pF, GMV, 500 WVDC	CC100-15
C5	CAPACITOR, FIXED, MICA: 47 pF, ±5%, 500 WVDC	CM111C470J1S
C6	CAPACITOR, FIXED, MICA: 68 pF, ±5%, 500 WVDC	CM111C680J1S
L1	CHOKE, RF. 220 uH	CL275-221
Q1	TRANSISTOR	2N3906
Q2	TRANSISTOR	2N2219A
R1	RESISTOR, FIXED, COMPOSITION: 27K ohms, ±5%, ¼ watt	RC07GF273J
R2	RESISTOR, FIXED, COMPOSITION: 5.6 K ohms, ±5%, ¼ watt	RC07GF562J
R3	RESISTOR, FIXED, COMPOSITION: 1 K ohm, ±5%, ¼ watt	RC07GF102J
R4	RESISTOR, FIXED, COMPOSITION: 68K ohms, ±5%, ¼ watt	RC07GF683J
R5	RESISTOR, FIXED, COMPOSITION: 15K ohms, ±5%, ¼ watt	RC07GF153J
R6	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±5%, ¼ watt	RC07GF221J
R7	RESISTOR, FIXED, COMPOSITION: 430 ohms, ±5%, ¼ watt	RC07GF431J
Y1	CRYSTAL: (to customer's requirement)	CR110-1-

SECTION 7

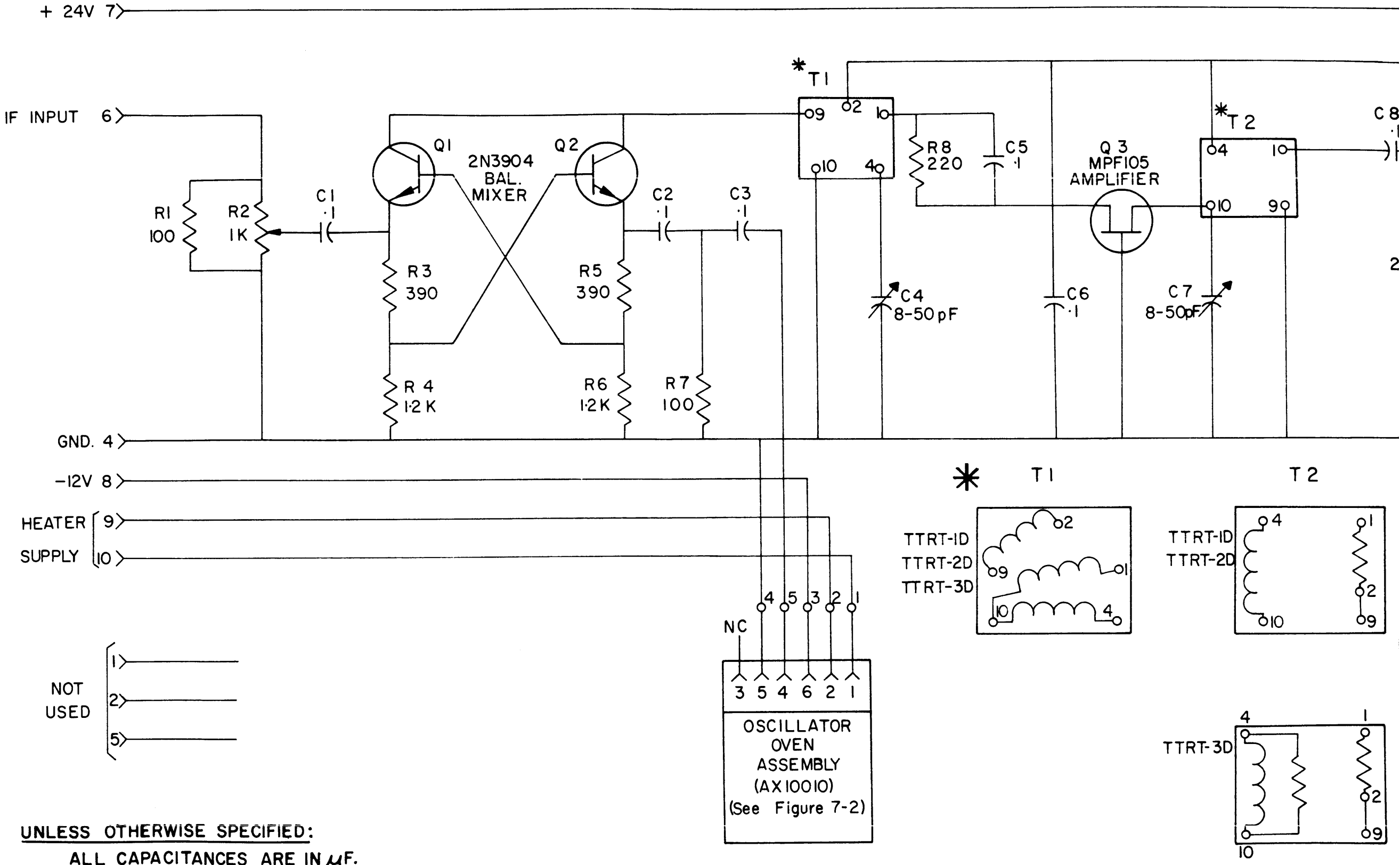
SCHEMATIC DIAGRAMS



2 WATT.

FIGURE 7-1. TTRT-1D, -2D, -3D SCHEMATIC

FIGURE 7-1



UNLESS OTHERWISE SPECIFIED:

ALL CAPACITANCES ARE IN μF.

ALL RESISTANCES ARE IN OHMS, 1/2 WATT.

FIGURE 7-1. TTRT-1D, -2D, -3D SCHEMATIC

UNLESS OTHERWISE SPECIFIED:

ALL CAPACITANCES ARE IN μF.
ALL RESISTANCES ARE IN OHMS, 1/4 WATT.

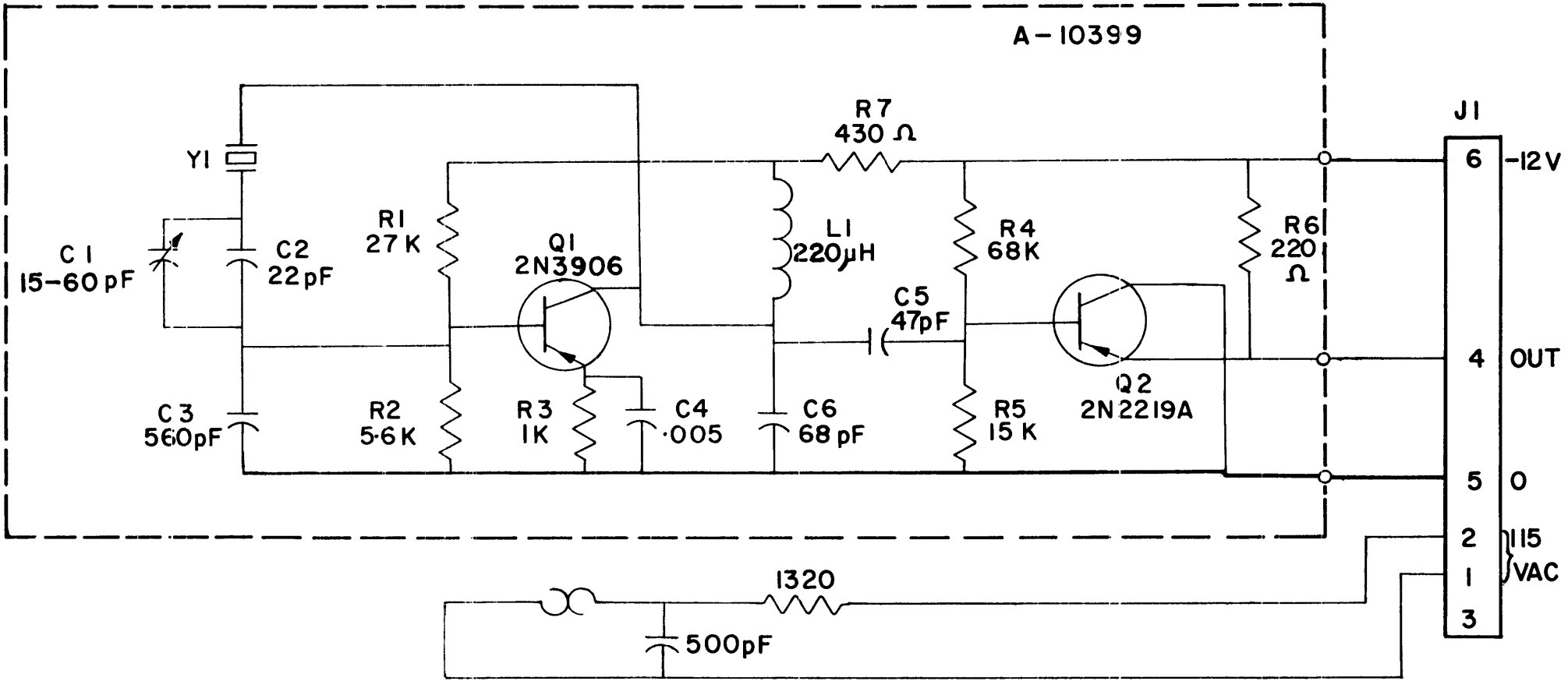


FIGURE 7-2. OSCILLATOR OVEN ASSEMBLY (AX10010) SCHEMATIC