TECHNICAL MANUAL
FOR
RECEIVER CONVERTER
MODEL TTRR-( ) D

8650

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

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FIGURE 1-1. RECEIVER CONVERTER, MODEL TTRR- ( ) D

SECTION 1
GENERAL INFORMATION

1-1 FUNCTIONAL DESCRIPTION

The Receiver Converter, model TTRR–( )D, is a transistorized, fixed-tuned, plug-in, RF module that is used with several types of TMC receivers. The TTRR module accepts modulated or unmodulated RF inputs from a 50-ohm unbalanced antenna, amplifies the inputs and converts them to IF signals with a carrier frequency of 1.75 MHz. Six modules (models TTRR–(1A)D, TTRR–(1B)D, TTRR–(2A)D, TTRR –(2B)D, TTRR–(3A)D, and TTRR–(3B)D, cover the frequency range from 2 to 16 MHz.

The TTRR contains an RF amplifier, a mixer, an HF oscillator oven assembly, two buffer amplifiers and an emitter follower. The gain of the RF amplifier is controlled by an AGC voltage supplied by the associated receiver.

The TTRR is normally provided with a type AO1-0001 HFO assembly. It is possible, however, to provide the TTRR with an HFO signal from an external source, in which case the HFO assembly is not required, and will be omitted if so specified at the time of order.

The six TTRR modules covering 2 to 16 MHz are identical except for transformers T1, T2, and T3 on the printed circuit board and the crystal in the HF oscillator assembly (when provided). Thus to change from one frequency band to another it is only necessary to change these components. The part numbers for the coils used in each module are listed in table 1-1.

1-2 PHYSICAL DESCRIPTION

All components of the TTRR are located either on the printed circuit board or in the HF oscillator oven assembly. The plug-in interchangeability feature of the TTRR is provided by an etched connector at the rear of the module.

TABLE 1–1 TTRR–( )D COIL COMPLEMENT

Module	Frequency Range	T1	T2	T3
TTRR–(1A)D	2– 3 MHz	TT10002–11A	TT10002–12A	TT10002–13A
TTRR–(1B)D	3– 4 MHz	TT10002–11B	TT10002–12B	TT10002–13B
TTRR–(2A)D	4– 6 MHz	TT10002–21A	TT10002–22A	TT10002–23A
TTRR–(2B)D	6– 8 MHz	TT10002–21B	TT10002–22B	TT10002–23B
TTRR–(3A)D	8–12 MHz	TT10002–31A	TT10002–32A	TT10002–33A
TTRR–(3B)D	12–16 MHz	TT10002–31B	TT10002–32B	TT10002–33B

1-3 TECHNICAL SPECIFICATIONS

Frequency range	TTRR–(1A)D : 2-3 MHz TTRR–(1B)D : 3-4 MHz TTRR–(2A)D : 4-6 MHz TTRR–(2B)D : 6-8 MHz TTRR–(3A)D : 8-12 MHz TTRR–(3B)D : 12-16 MHz
Tuning	Fixed-tuned
Frequency control	HF oscillator (when provided) is crystal controlled
Oscillator stability (A010001)	1 part per million per day
Input impedance	50 ohms nominal, unbalanced
Output frequency	1.75 MHz
Power requirement	+12 Vdc, from associated receiver
Dimensions	Height: 5 3/8 inches Width: 1 1/2 inches Depth: 8 inches
Weight	Approximately 1 pound.

SECTION 2
INSTALLATION

2-1 INITIAL INSPECTION

Each TTRR 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 occured during transit. Unpack the equipment carefully, and inspect all packing 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 furnishing of replacement parts.

2-2 INSTALLATION PROCEDURE

The TTRR is a plug-in module and is installed in the associated receiver by inserting the unit into the receptacle in the front of the receiver. Installation and initial check-out procedures for the TTRR are, therefore, given in the manual for the receiver.

2-3 CHANGING TRANSFORMERS

To convert from one band to another, it is only necessary to change transformers T1, T2 and T3 and the crystal in the HF oscillator assembly (when provided). The transformers required for each band are listed in table 1-1.

SECTION 3
OPERATING PROCEDURES

3-1 GENERAL

The TTRR does not have any external operating controls.

3-2 WARM-UP PERIOD

When an HF oscillator oven assembly (A010001) is provided in the TTRR, a 20-minute warm-up is required to attain proper frequency and stability.

SECTION 4
PRINCIPLES OF OPERATION

4-1 GENERAL

The operating principles are the same for all of the TTRR modules. Refer to the block diagram, figure 4-1, and schematic diagrams, figures 7-1 and 7-2.

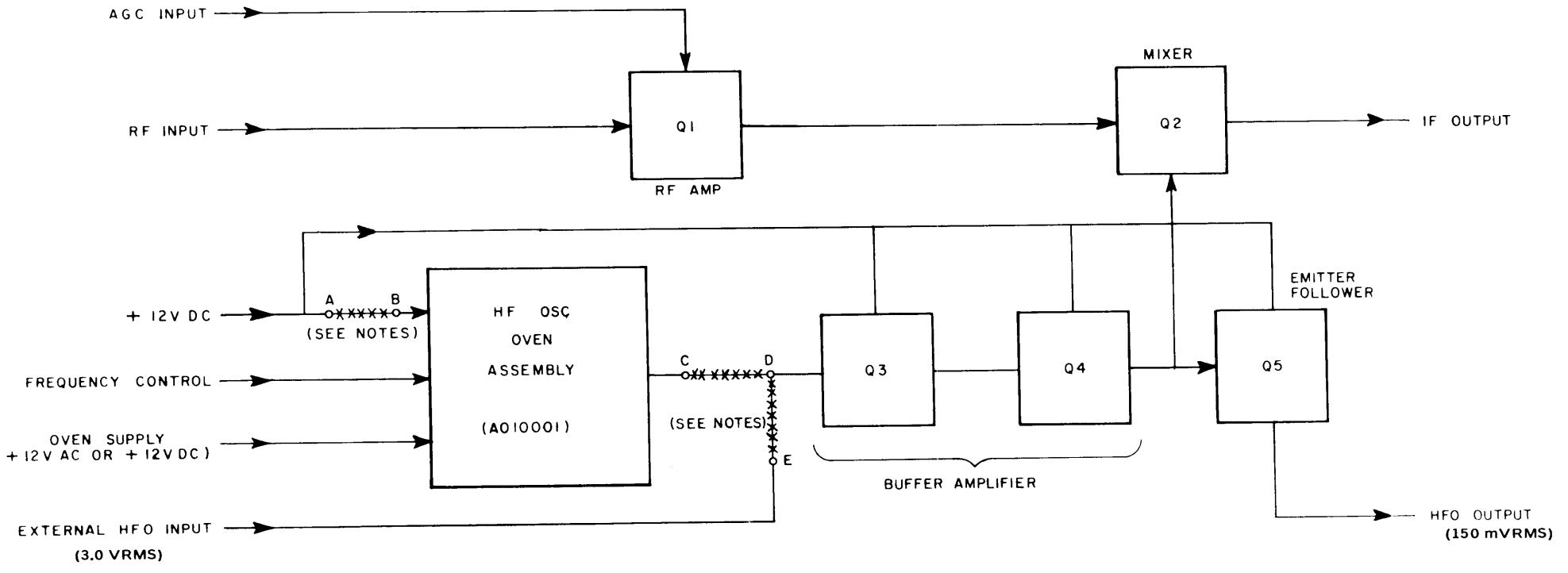
4-2 CIRCUIT ANALYSIS

The RF input is applied to amplifier Q1. The AGC signal from the associated receiver is also applied to Q1 to control the gain of the amplifier. The RF input is amplified by Q1 and provided to mixer Q2. In addition, an HF oscillator signal is provided to Q2, either from the crystal-controlled HF oscillator oven assembly or from an external source. The jumper connections required for operation with external HFO or internal HFO signals are shown in figure 4-1.

The HFO signal is set 1.75 MHz above the carrier frequency of the received signal, thus the spectrum of the received frequencies is inverted, the highest frequency in the sideband(s) producing the lowest difference frequency. The output from mixer Q2 is then an IF signal whose carrier frequency is 1.75 MHz.

The frequency of the internally provided HFO signal may be fine tuned by varying the frequency control input to the TTRR. A clarifier control is normally provided on the associated receiver or on a remote clarifier control unit for this purpose. This control will allow a minimum variation of ± .005% of the operating frequency.

The HFO signal, either externally provided at an amplitude of 3.0 VRMS or internally generated, is applied to mixer Q2 through HF injection level control R6 and buffer amplifier Q3/Q4. The HFO signal is also provided as a monitor output through emitter follower Q5, at an amplitude of 150 mVRMS.



NOTES:

1 CONNECT POINTS 'A' AND 'B', 'C' AND 'D' FOR HF OSC OVEN ASSEMBLY OPERATION.

2 CONNECT POINTS 'D' AND 'E' FOR OPERATION WITH EXTERNAL HFO INPUT.

FIGURE 4-1. BLOCK DIAGRAM, TTRR- ( ) D

SECTION 5
MAINTENANCE

5-1 PREVENTIVE MAINTENANCE

Periodically remove the TTRR module from its associated receiver, inspect for general cleanliness and check the condition of the etched connector at the rear of the unit. 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.

5-2 TROUBLESHOOTING

The following equipment is required for troubleshooting.
a) Frequency Counter, Hewlett Packard Model 524C, or equivalent.
b) RF Signal Generator, Hewlett Packard Model 606A, or equivalent.
c) Oscilloscope, Tektronix Model 545, or equivalent.
d) Volt-Ohm-Milliameter, Simpson Model 260, or equivalent.

When a TTRR is suspected of malfunction, the source of trouble may be located by the following procedure. The TTRR must remain inserted in its associated receiver during troubleshooting. Refer to figure 5-1 for aid in locating components in the TTRR.

a) Using an oscilloscope, measure the level of the HF oscillator signal (either externally or internally provided, as the case may be) at the base of Q5. The level should be at least 2.5 volts, peak-to-peak. Adjust R6 to obtain this level. If the proper level cannot be obtained, check the HFO oven assembly and buffer amplifier Q3/Q4 when the HFO signal is being provided internally. Check the external HFO supply when an external HFO signal is being used.

b) Using a frequency counter, check the frequency of the HF oscillator signal at the base of Q5. The signal should be 1.75 MHz above the operating frequency of the TTRR module. Adjust the external clarifier control if necessary. If the required frequency cannot be obtained check the HFO oven assembly or check the source for the externally provided HFO signal.

c) Check that the HFO signal is present at terminal 8 on the connector at the rear of the TTRR. If it is not, check emitter follower Q5.

d) Check that the voltage level at the source of RF amplifier Q1 is between +1.5 to +2.5 Vdc. If this level is not observed, check diode CR1 and the AGC circuitry of the receiver.

e) Connect an RF signal generator to the antenna jack of the receiver and adjust it to deliver a 1mV modulated signal at the TTRR operating frequency. Using an oscilloscope, check for the presence of a signal at the gate of Q2; if no signal is present, check RF amplifier Q1 and associated circuitry, using extender tray AX10043, available from the factory.

f) With the HFO signal present and a 1mV input to the receiver, check for the presence of a signal to terminals 14 and 15 on the connector at the rear of the TTRR module. If no signal is present, check mixer Q2 and associated circuitry.

5-3 REPAIR

Repair of the TTRR modules consists of replacing electrical components. After a component has been replaced, the TTRR may require alignment (refer to paragraph 5-4). The following precautions should be taken when repairing a TTRR module.

a) Use replacement components identical to the defective components and position the replacement component in the same location on the board.

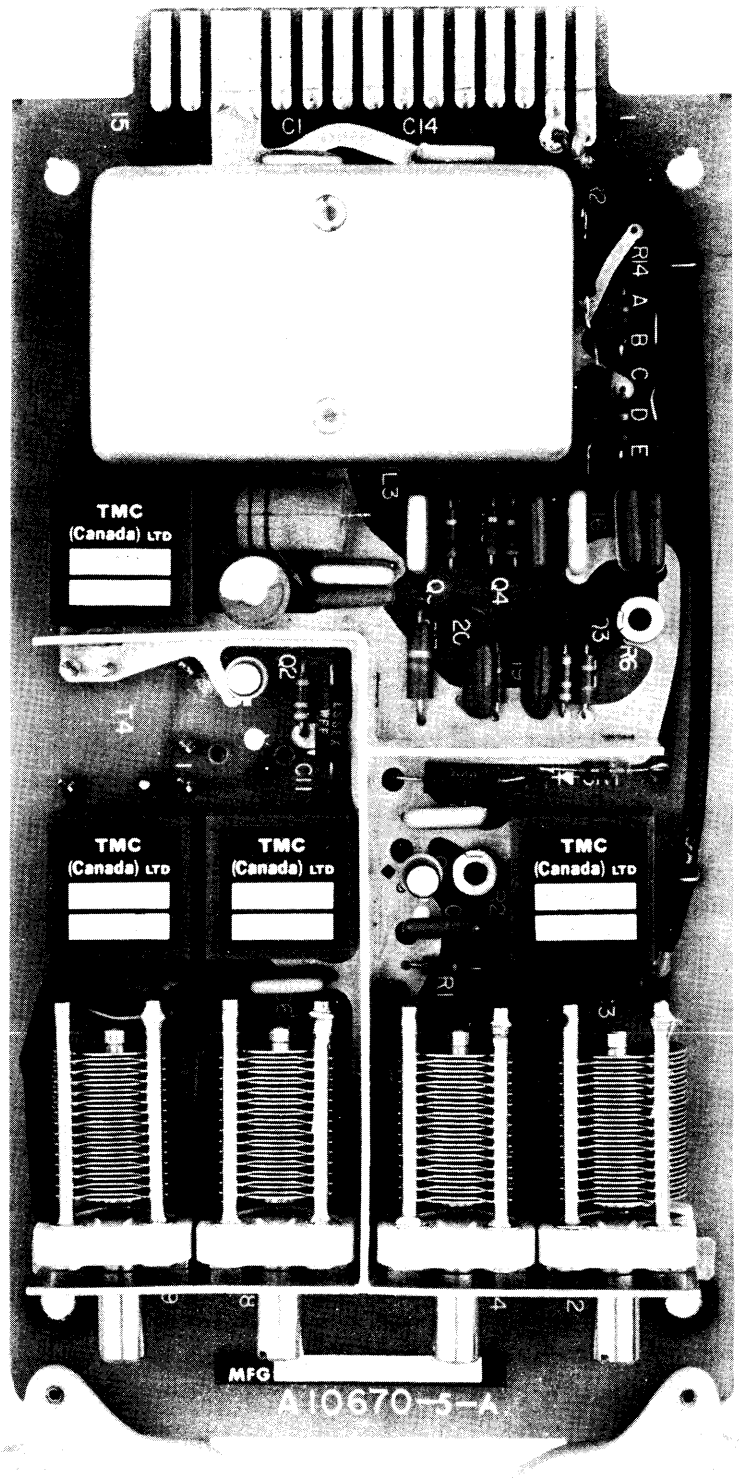


FIGURE 5-1. TOP VIEW, TTRR-( ) D

b) Use long-nose pliers or alligator clips when soldering wire leads 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

After repairing or replacing components in the TTRR, the unit must be checked for alignment. When the operating frequency of a module is changed, the alignment must be repeated as well.

a) With no RF input to the receiver in which the TTRR is inserted, adjust R2 to obtain +2.5 Vdc at the source of Q1. This is best achieved by rotating R2 one quarter turn clockwise from zero position.

b) Adjust R6 to set the HF oscillator signal at the base of Q5 to approximately 3 volts, peak-to-peak. (Approximately 1v RMS)

c) Connect a meter to the audio line output (with 600-ohm load) of the receiver.

d) Connect an RF signal generator to the antenna jack of the receiver and adjust it to deliver a signal at the TTRR operating frequency and of sufficient voltage to produce a signal on the meter.

e) Set C2 to its mid-position. Adjust first C4, then C8, then C9 for maximum signal on the meter. If necessary, reduce the RF input from the signal generator.

f) Adjust C2 for maximum signal on the meter.

g) Repeat the tuning procedure adjusting C9, C8, C4 and C2 in that order for maximum signal on the meter.

h) Connect a volt meter to the AGC output of the receiver. Set the RF signal generator to deliver a signal above, but as close as possible to the sensitivity threshold for the receiver and still obtain a reading on the meter. Repeat step g and then step a obtaining the maximum AGC voltage as indicated on the meter.

i) Readjust R6 to just obtain maximimum audio line level for the receiver.

j) Repeat step h with the RF input set at the sensitivity threshold for the receiver.

5-5 DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY

Each TTRR module requires an HF oscillator crystal. The crystal frequency is selected to obtain the desired frequency of reception in accordance with the following equation.

$$fx = fi + fo$$

Where fx = HF oscillator crystal frequency
fi = frequency of signal to be received
fo = frequency of IF output from the module

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

EXAMPLE: A TTRR module is required to receive a signal whose frequency is 4020 kHz, and the IF is 1750 kHz; hence the required crystal frequency is fx = 4020 + 1750 = 5770 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 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 Y101 is designated XY101. To expedite delivery, when ordering replacement parts, specify the TMC part number and the model number of the equipment.

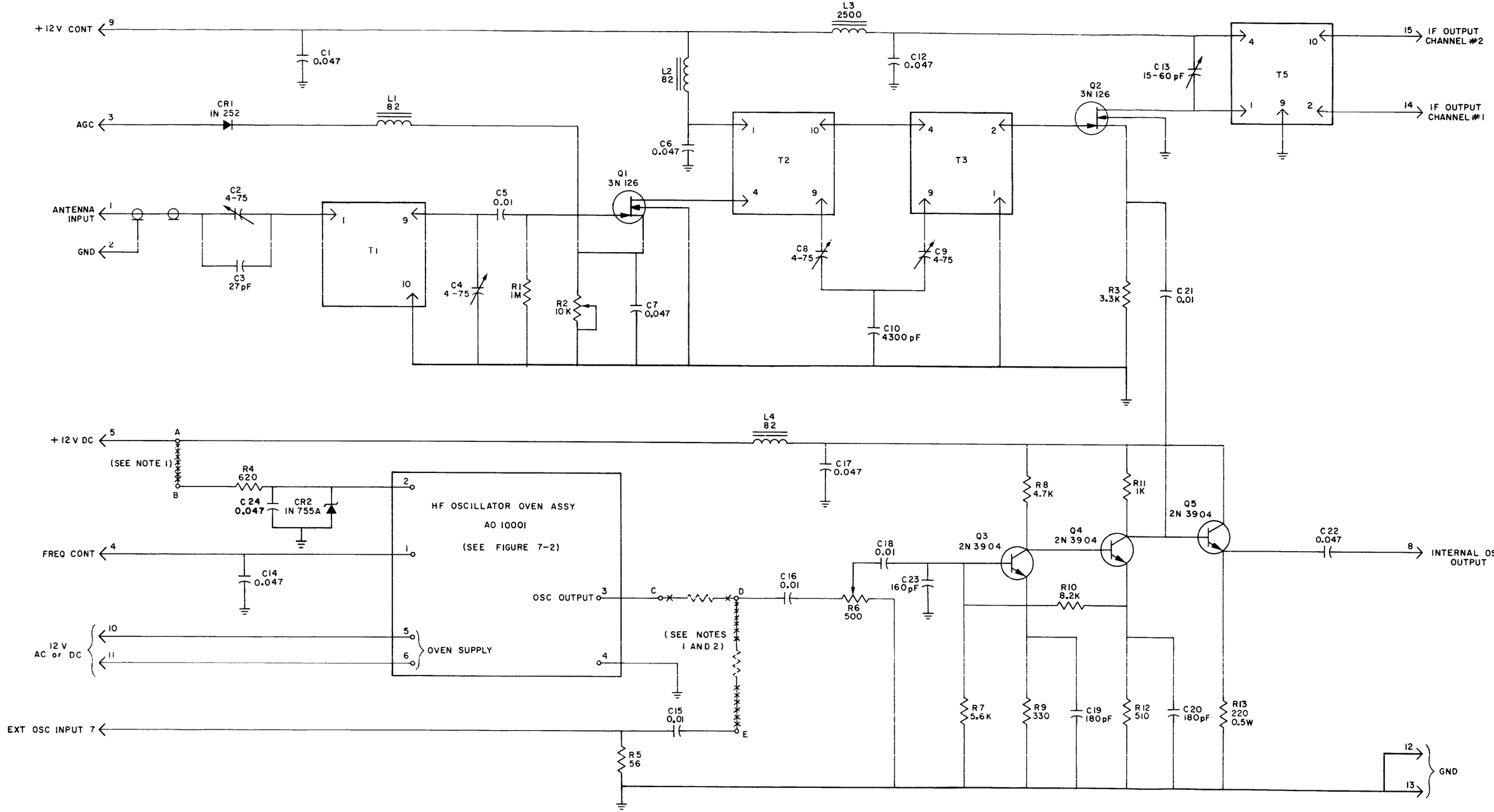
DESIGNATION	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FLAT, FOIL: 0.047 uF; 250 Vdc	CC10011-5
C2	CAPACITOR, VARIABLE, AIR. 4-75 uF	CT103-2
C3	CAPACITOR, FIXED. MICA 27 pF ± 5%; 100 WVdc	CM111E270J1S
C4	Same as C2	
C5	CAPACITOR, FLAT, FOIL: 0.01 uF; 250 Vdc	CC10011-1
C6	Same as C1	
C7	Same as C1	
C8	Same as C2	
C9	Same as C2	
C10	CAPACITOR, FIXED, MICA: 4300 pF ± 5%; 100 WVdc	CM112E432J1S
C11	Not used	
C12	Same as C1	
C13	CAPACITOR, VARIABLE, CERAMIC: 15-60 pF	CV112-5
C14	Same as C1	
C15	Same as C5	
C16	Same as C5	
C17	Same as C1	
C18	Same as C5	
C19	CAPACITOR, FIXED, MICA: 180 pF ± 5%, 100 WVdc	CM111E181J1S
C20	Same as C19	
C21	Same as C5	
C22	Same as C1	
C23	CAPACITOR, FIXED, MICA: 160 pF ± 5% 100 WVdc	CM111E161J1S
C24	Same as C1	
CR1	DIODE	1N252
CR2	DIODE, ZENER	1N755A
L1	COIL, FIXED, RF: 82 uH	CL275-820
L2	Same as L1	

DESIGNATION	DESCRIPTION	TMC PART NUMBER
L3	COIL, FIXED, RF: 2500 uH	CL140-1
L4	Same as L1	
Q1	TRANSISTOR	3N126
Q2	Same as Q1	
Q3	TRANSISTOR	2N3904
Q4	Same as Q3	
Q5	Same as Q3	
R1	RESISTOR, FIXED, COMPOSITION: 1 Mohm ± 5%; 1/4 watt	RC07GF105J
R2	RESISTOR, VARIABLE, COMPOSITION: 10 Kohms ± 30%; 1/2 watt at 70°C	RV10007-10-P
R3	RESISTOR, FIXED, COMPOSITION: 3.3K ohms ± 5%; 1/4 watt	RC07GF332J
R4	RESISTOR, FIXED, COMPOSITION: 620 ohms ± 5%; 1/4 watt	RC07GF621J
R5	RESISTOR, FIXED, COMPOSITION: 56 ohms ± 5%; 1/4 watt	RC07GF560J
R6	RESISTOR, VARIABLE, COMPOSITION: 500 ohms ± 30%; 1/2 watt at 70°C	RV10007–6–p
R7	RESISTOR, FIXED, COMPOSITION: 5.6K ohms ± 5%; 1/4 watt	RC07GF562J
R8	RESISTOR, FIXED, COMPOSITION: 4.7K ohms ± 5%; 1/4 watt	RC07GF472J
R9	RESISTOR, FIXED, COMPOSITION: 330 ohms ± 5%; 1/4 watt	RC07GF331J
R10	RESISTOR, FIXED, COMPOSITION: 8.2 Kohms ± 5%; 1/4 watt	RC07GF822J
R11	RESISTOR, FIXED, COMPOSITION: 1 Kohm ± 5%; 1/4 watt	RC07GF102J

DESIGNATION	DESCRIPTION	TMC PART NUMBER
R12	RESISTOR, FIXED, COMPOSITION: 510 ohms 5%, 1/4 watt	RC07GF511J
R13	RESISTOR, FIXED, COMPOSITION: 220 ohms 5%, 1/2 watt	RC20GF221J
R14	RESISTOR, FIXED, COMPOSITION: 47 ohms 5%; 1/4 watt	RC07GF470J
T1 BAND 1A	TRANSFORMER, RF	TT10002-11A
BAND 1B	TRANSFORMER, RF	TT10002-11B
BAND 2A	TRANSFORMER, RF	TT10002-21A
BAND 2B	TRANSFORMER, RF	TT10002-21B
BAND 3A	TRANSFORMER, RF	TT10002-31A
BAND 3B	TRANSFORMER, RF	TT10002-31B
T2-BAND 1A	TRANSFORMER, RF	TT10002-12A
BAND 1B	TRANSFORMER, RF	TT10002-12B
BAND 2A	TRANSFORMER, RF	TT10002-22A
BAND 2B	TRANSFORMER, RF	TT10002-22B
BAND 3A	TRANSFORMER, RF	TT10002-32A
BAND 3B	TRANSFORMER, RF	TT10002-32B
T3-BAND 1A	TRANSFORMER, RF	TT10002-13A
BAND 1B	TRANSFORMER, RF	TT10002-13B
BAND 2A	TRANSFORMER, RF	TT10002-23A
BAND 2B	TRANSFORMER, RF	TT10002-23B
BAND 3A	TRANSFORMER, RF	TT10002-33A
BAND 3B	TRANSFORMER, RF	TT10002-33B
T4	Not used	
T5	TRANSFORMER, RF	TT10002-1
Z1	HFO OVEN OSCILLATOR (on separate parts list) *Optional	A010001*

DESIGNATION	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA: 560 pF, ± 5%;	CM10002C561J
C2	Same as C1	
C3	CAPACITOR, FIXED, CERAMIC: 1,000 uF, GMV; 500 WVdc	CC100-29
C4	Same as C3	
C5	Same as C3	
C6	Same as C3	
CR1	DIODE	1N5146A
Q1	TRANSISTOR	2N3904
Q2	Same as Q1	
R1	RESISTOR, FIXED, COMPOSITION: 3.3 Mohm ± 5%; 1/4 watt	RC07GF335J
R2	RESISTOR, FIXED, COMPOSITION: 1 Kohm ± 5%; 1/4 watt	RC07GF102J
R3	RESISTOR, FIXED, COMPOSITION: 270 ohms ± 5%; 1/4 watt	RC07GF271J
R4	RESISTOR, FIXED, COMPOSITION: 270K ohms ± 5%; 1/4 watt	RC07GF274J
R5	RESISTOR, FIXED, COMPOSITION: 15K ohms ± 5%; 1/4 watt	RC07GF153J
R6	RESISTOR, FIXED, COMPOSITION: 2.2K ohms ± 5%; 1/4 watt	RC07GF222J
R7	RESISTOR, VARIABLE, COMPOSITION: 1 Kohm ± 30%; 1/2 watt at 70°C	RV10007-7-P
R8	RESISTOR, FIXED, COMPOSITION: 220 ohms ± 5%; 1/4 watt	RC07GF221J
RT1	THERMISTOR: JA35J1	RR10003
Y1	CRYSTAL UNIT, QUARTZ: Frequency determined by customer requirement	CR110-1-X
	*Optional, for internal HFO operation	

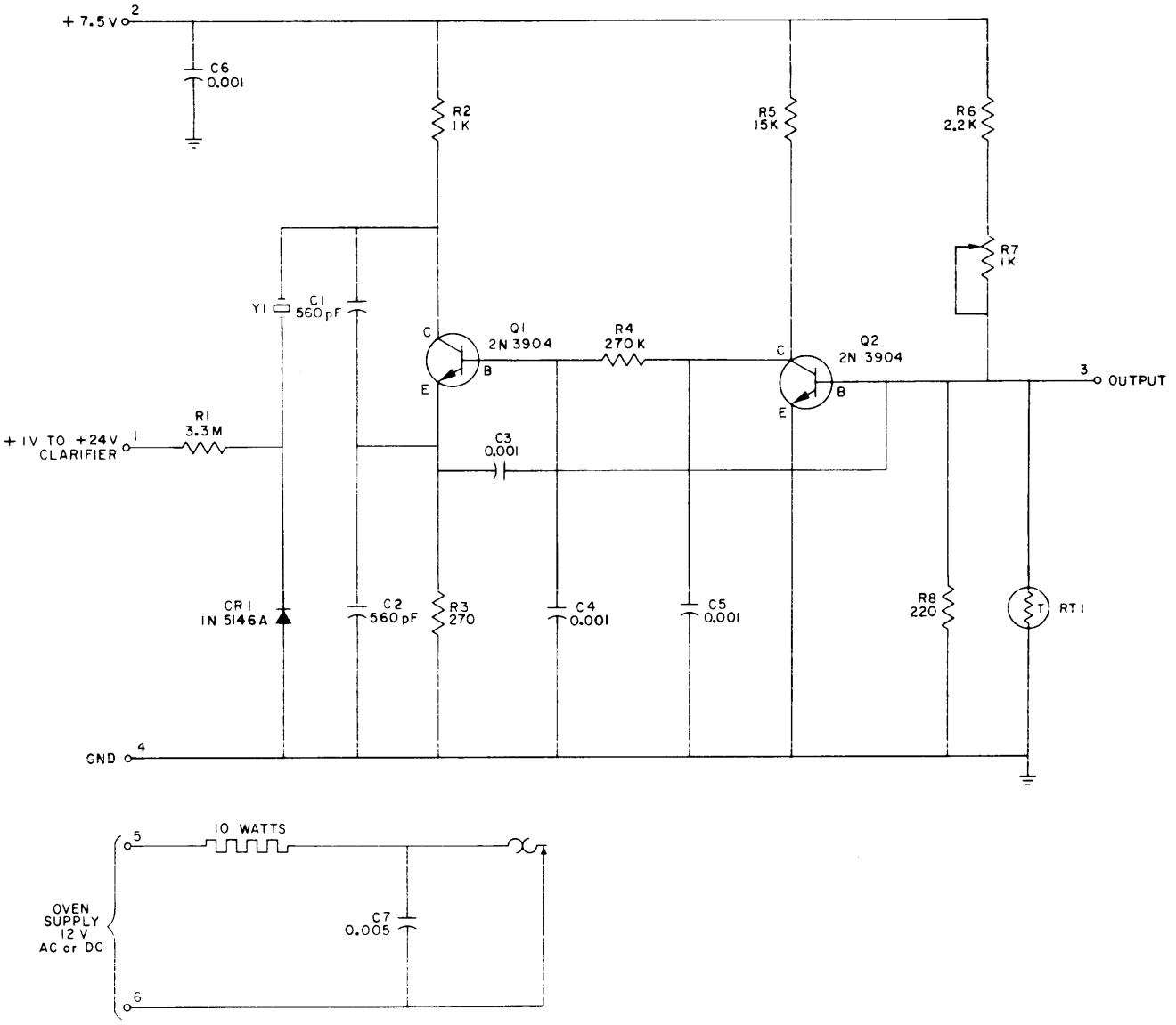
SECTION 7
SCHEMATIC DIAGRAMS



NOTES:

1. CONNECT POINTS 'A' AND 'B' ; 'C' AND 'D' USING R14 (47Ω) FOR HF OVEN OSC OPERATION.
2. CONNECT POINTS 'D' AND 'E' USING R14 (47Ω) FOR EXTERNAL OSC INPUT.
3. UNLESS OTHERWISE STATED
   RESISTANCE IN OHMS, 0.25 WATTS
   CAPACITANCE IN μF.
   INDUCTANCE IN μH.

FIGURE 7-1. SCHEMATIC DIAGRAM, TTRR-( ) D



NOTE

UNLESS OTHERWISE STATED, ALL RESISTANCE IN OHMS, 1/4 WATT
ALL CAPACITANCE IN μF.

FIGURE 7-2 SCHEMATIC DIAGRAM, HF OSCILLATOR OVEN ASSEMBLY, A010001.