TECHNICAL MANUAL
FOR
RECEIVER CONVERTER
MODEL TTRR-( ) E

4766

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

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1N - 3010E 1st MARCH 1969.

TMC (*Canada*) LIMITED

TELECOMMUNICATIONS ENGINEERS

MAILING ADDRESS: R.R. No. 5, Ottawa, Ontario

A Subsidiary of The Technical Materiel Corporation, 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:

TMC (*Canada*) LIMITED
Engineering Services Department
R.R. No.5, Ottawa, Ontario
Telegraphic Address: TEPEI, Ottawa.

PRINTED IN CANADA

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By
001 EMN NO 21949	5/27/82	5/27/82	RU

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

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

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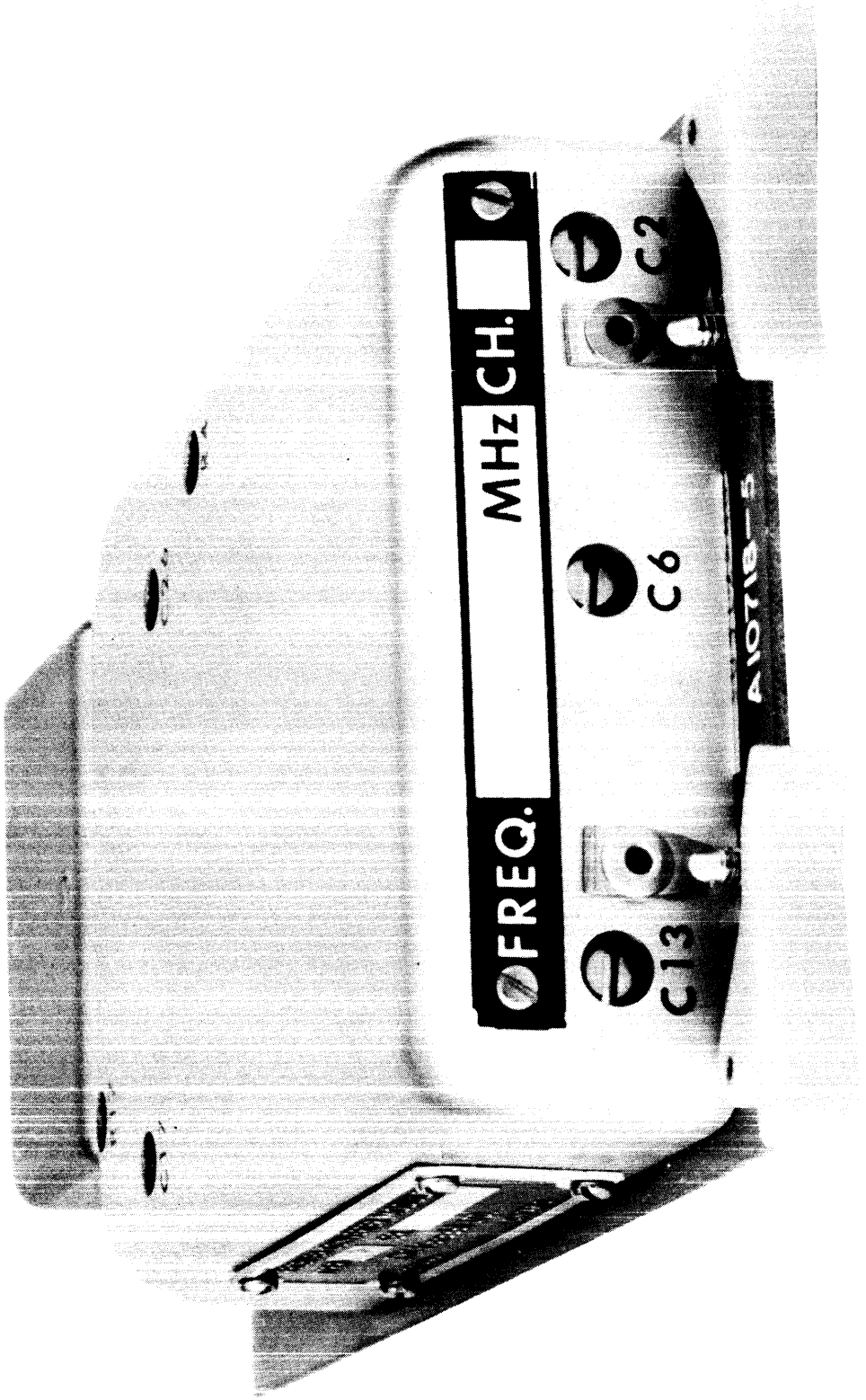


FIGURE 1-1 RECEIVER CONVERTER, MODEL TTRR-( )E

SECTION 1
GENERAL DESCRIPTION

1-1 FUNCTIONAL DESCRIPTION

The Receiver Converter, Model TTRR-( )E, is a solid-state fixed-tuned, plug-in, RF module that is used with several types of TMC receivers. The TTRR module accepts an RF signal from a nominal 50 ohm unbalanced antenna, amplifies it and converts it to an IF frequency of 1.75 MHz. The TTRR-( )E module has two versions, different only in the associated plug-in transformers (T1, T2, T3, and T5) which together with the spot frequency determining local oscillator crystal, determine the frequency. The TTRR-(4A)E and TTRR-(4B)E cover the frequency bands 16 to 24 MHz and 24 to 32 MHz respectively. The part numbers of the appropriate transformers for each band are listed in table 1-1.

The TTRR-( )E module consists of a two-stage RF amplifier, a mixer stage, and HF oscillator oven assembly, a three-stage buffer-doubler amplifier, and an isolation stage to allow frequency monitoring of the local oscillator from the rear-panel. An AGC-voltage supplied by the associated receiver proportionally controls the gain of the two-stage RF Amplifier as well as a shunt attenuation element, thus providing excellent dynamic range.

The TTRR is normally provided with a type AO 10001 High Frequency Oscillator (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.

1-2 PHYSICAL DESCRIPTION

All components of the TTRR are located either on the printed circuit board or in the HFO oven assembly. A cover shields the components on the board excluding the oven assembly. The plug-in interchangability feature of the TTRR is provided by a goldplated etched connector at the rear of the module.

TABLE 1-1 TTRR-( )E TRANSFORMER COMPLEMENT

MODULE	T1	T2	T3	T5
TTRR-(4A)E	TT10005-41A	TT10005-42A	TT10005-43A	TT10006-45A
TTRR-(4B)E	TT10005-41B	TT10005-42B	TT10005-43B	TT10006-45B

1-3 TECHNICAL SPECIFICATIONS

Frequency Range	TTRR-(4A)E 16-24 MHz TTRR-(4B)E 24-32 MHz
Tuning	Fixed tuned
Frequency Control	HF Oscillator (when provided) is crystal controlled
Oscillator stability (A010001)	1 PPM per day
Input Impedance	50-ohm nominal, unbalanced
Output Frequency (IF)	1.75 MHz
Output Impedance	Two 50 ohm unbalanced outputs or one 100 ohm balanced output
Power requirement	+12 VDC & 8 watts AC for oscillator oven if provided 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, T3, and T5 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 for all of the TTRR-( )E modules are the same. Refer to the block diagram, figure 4-1, and schematic diagrams, figures 7-1 and 7-2.

4-2 CIRCUIT ANALYSIS

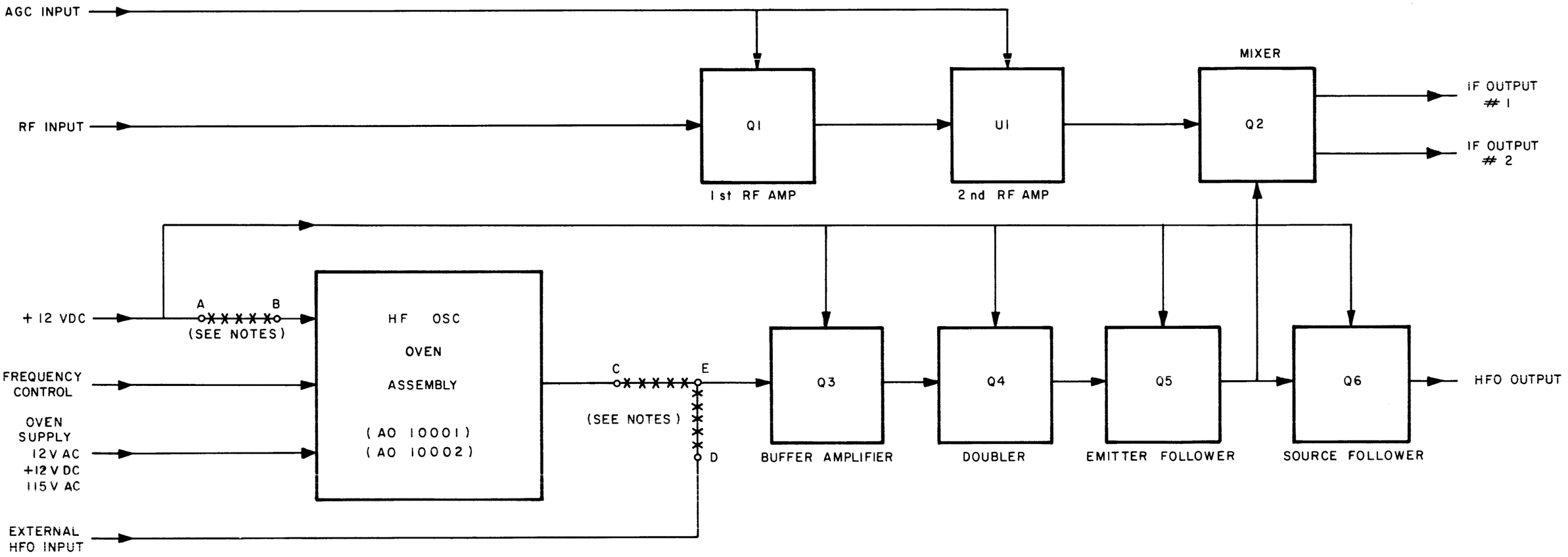
The RF signal is applied to the first RF - stage via tuning and matching transformers T1. The first transister O1 being a low noise, low cross modulation dual-gate junction - FET with AGC capability. The positive going AGC is fed to the source of Q1 as well as to the shunt attenuation element CR1, which is activated at higher input levels. Transformers T2 tunes and matches the output of Q1 to the input of the 2nd RF stage. The excellent AGC characteristics of the intregated circuit amplifier, U1 prevents overloading of the following mixer stage and the cascade configuration of its internal transistors provides stable gain as well as isolation between output and input, this effectively suppressing local oscillator radiation via the receiver antenna. The output of the 2nd RF stage is fed via T3 to the mixer transistor Q2, which is the same as Q1. The mixer stage also provides some gain, thus enhancing the signal-to-noise ratio at low signal levels. The local oscillator signal is capacitively coupled to the source of Q2, and in order to compensate for the scattering in the FET's parameters, the injection level is adjustable via R17 in the emitter of Q5 in the buffer-doubler amplifier. The two outputs of the module are transformer coupled from the IF tank-circuit (T4), and are 50 ohm unbalanced.

The circuit schematic of the HF oscillator is shown in figure 7-2. The oscillator is crystal controlled and the oscillator board is contained in an oven maintaining a temperature of $+70^{o}$c during operation. The output of the oven-oscillator is fed to the first stage (Q3) of the buffer-doubler amplifier. The 2nd stage is the FET-doubler Q4, the output of which is tuned (C26, T5) to second harmonic of the crystal frequency in the oven-oscillator. The following stage, an emitter-follower isolates the buffer-doubler-stage from the mixer Q2 and provides stable drive to same.

Finally Q6, a source-follower, allows the monitoring (at the rear of the associated receiver) of the injected local-oscillator signal. The mixing local-oscillator frequency fx in the oven oscillator equals half the signal frequency fl plus 0.875 MHz, fx= (fl/2+0.875) MHz. This frequency fx is also the frequency an external oscillator has to be set to if used. The level of such external oscillator should be approximately 0.1Vrms.

The use of a higher mixing frequency than the received signal causes an inversion of the received signal-spectrum with respect to the carrier-(centre-) frequency. The upper-sideband of the IF signal is then the original lower-sideband and vice versa. The spectrum inversion being taken care of in the associated receiver.

The inter oven-oscillator has a clarifier-control capability, and the frequency might be varied up to + 30ppm. The control-potentiometer is usually on the front panel of the associated receiver.



NOTES:-

1. CONNECT POINTS 'A' AND 'B', 'C' AND 'D' FOR HF OSC OVEN ASSEMBLY OPERATION.
2. CONNECT POINTS 'E' AND 'D' FOR OPERATION WITH EXTERNAL HFO INPUT.

FIGURE 4-1 BLOCK DIAGRAM, TTRR-( )E

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 hardward for tightness.

5-2 TROUBLESHOOTING

The following equipment is recommended 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 source of Q2. The level should be about 1.0 volt, peak-to-peak. Adjust R17 to obtain this level. If the proper level cannot be obtained, check the HFO oven assembly and buffer doubler Q3/Q4 when the HFO signal is being provided internally. Check the external HFO supply when an external HFO signal is being used.

(b) Check that the voltage level at the source of RF amplifier Q1 is between 1.5 to +2.0Vdc. If higher check the AGC circuitry of the receiver.

(c) 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 the signal at the gate of Q2; if no signal is present, check RF amplifiers Q1, U1, and associated circuitry.

(d) With the HFO signal present and approximately 1mV input to the receiver, check for the presence of the signal at terminals 14 and 15 on the connector at the rear of the TTRR module. If the signal is not 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 section 5). The following precautions should be taken when repairing a TTRR module.

(a) Use replacement components identical to the defective components in the same location on the board.

(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 soldering iron of 50 watt rating or lower. Use suitable flux remover to clean solder joints.

CAUTION

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

ALIGNMENT

5-4 GENERAL

The TTRR4 0L module is always aligned at one specified frequency before delivery. However, in case the frequency has been changed or after repair, the following alignment procedure should be performed.

EQUIPMENT REQUIRED

(1) Signal Generator, 50 ohm, Hewlett Packard 606A or equivalent.
(2) An audio level meter.
(3) A pair of head-phones.

ALIGNMENT CONTROLS

(1) 3 Tuning capacitors, C2, C6, and C13.
(2) RF gain adjustment R4.
(3) IF tank-circuit tuning capacitor C17.
(4) Local oscillator (L.O.) injection adjustment R17, and
(5) L.O. Doubler tuning capacitor C26 (used only if receiving frequency is above 16 MHz).

PROCEDURE

(1) If changing the frequency, determine the new crystal frequency fx as follows:
$fx = \frac{fl + fo}{2}$, where

fl = frequency of signal to be received, and
fo = output of the module, i.e. IF frequency (1.75 MHz)

(2) Switch on and turn R4 to minimum (CCW), and R17 to Maximum (CCW).
(3) With the receiver switched to one channel insert a signal at the appropriate frequency from a 50 ohm source approximately 60db above 1 uV (i.e. appr. 1mV) and peak C2, C6, and C13 respectively reducing the inserted signal level necessary.
(4) If above 15 MHz tune C26 for maximum output.
(5) Tune C17 for maximum output.
(6) Repeat step 2 and again starting with C13, C6, and C2.
(7) Increase local oscillator injection by turning R17 clockwise to point where the audio is reduced by appr. 3db, since too high an injection level would cause distortion.

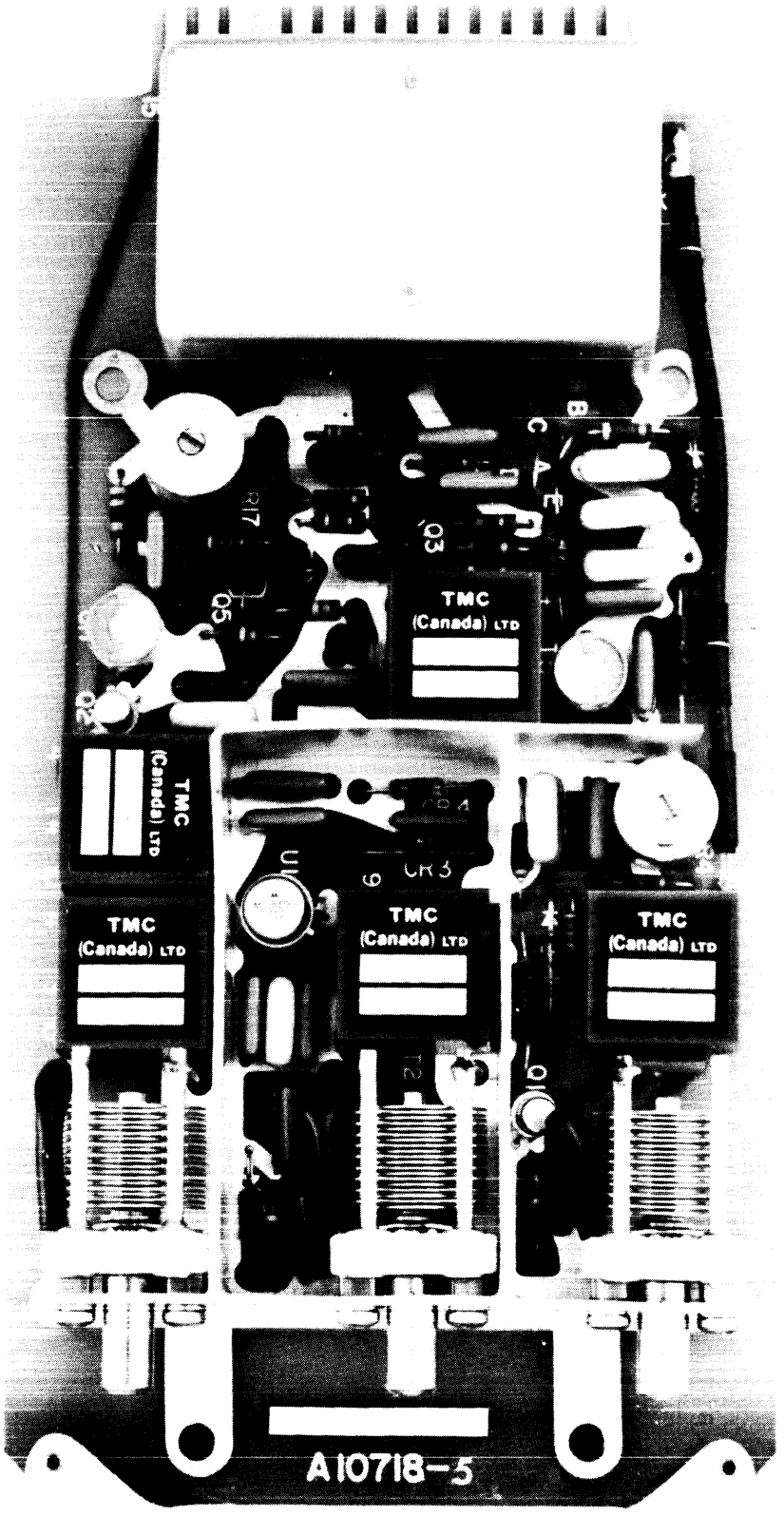


FIGURE 5-1 TOP VIEW, TTRR4 JE

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 differentiated 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.

REF DESIGNATION	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Flat, Foil 0.01 uF; 250 Vdc	CC10011-1
C2	Capacitor, Variable, Air; 3-50 PF	CT103-1
C3	Same As C1	
C4	Capacitor, Flat, Foil: 0.047MF; 250 Vdc	CC10011-5
C5	Same as C1	
C6	Same as C2	
C8	Same as C1	
C9	Same as C1	
C10	Same as C1	
C11	Same as C1	
C12	Same as C1	
C13	Same as C2	
C14	Same as C1	
C15	Same as C1	
C16	Same as C4	
C17	Capacitor, Variable, Ceramic: 15-60PF	CV112-5
C18	Same as C4	
C19	Same as C1	
C20	Same as C4	
C21	Same as C4	
C22	Same as C1	
C23	Same as C1	
C24	Capacitor, Fixed, Mica: 180PF - 5%; 100 WVdc	CM11C181J1S
C25	Same as C24	
C26	Same as C17	
C27	Same as C1	
C28	Same as C24	

REF DESIGNATION	DESCRIPTION	TMC PART NUMBER
C29	Same as C24	
C30	Same as C1	
C31	Same as C4	
CR1	Diode, Silicone	IN252
CR2	Diode, Zener	IN4370A
CR3	Diode, Germanium	IN34A
CR4	Same as CR3	
CR5	Diode, Zener	IN755A
CR6	Diode, Zener	IN753A
L1	Choke, RF: 47 uH	CL275-470
L2	Same as L1	
L3	Same as L1	
Q1	Transistor, Field-effect	2N4220
Q2	Same as Q1	
Q3	Transistor, bipolar	2N3904
Q4	Transistor, Field-effect	MPF105
Q5	Same as Q3	
Q6	Same as Q4	
R1	Resistor, Fixed, Composition: 820/Ohm ± 5%; 1/4 watt	RC07GF821
R2	Resistor, Fixed, Composition: 1 Kohm ± 5%; 1/4 watt	RC07GF102J
R3	Resistor, Fixed, Composition: 1.8 Kohms ± 5%; 1/4 watt	RC07GF182J
R4	Resistor, Variable, Composition: 5 Kohms ±10%; 1/2 watt at 70°c	RV11U502A
R5	Resistor, Fixed, Composition: 470 ohms ± 5%; 1/4 watt	RC07GF471J
R6	Resistor, Fixed, Composition: 120 ohms ± 5%; 1/4 watt	RC07GF121J
R7	Resistor, Fixed, Composition: 3.3 Kohms ± 5%; 1/4 watt	RC07GF332J
R8	Same as R5	
R9	Resistor, Fixed, Composition: 56 ohms ± 5%; 1/4 watt	RC07GF560J

REF DESIGNATION	DESCRIPTION	TMC PART NUMBER
R10	Resistor, Fixed, Composition: 5.6 Kohms ± 5%; 1/4 watt	RC07GF562J
R11	Resistor, Fixed, Composition: 8.2 Kohm ± 5%; 1/4 watt	RC07GF822J
R12	Resistor, Fixed, Composition: 4.7 Kohms 5%; 1/4 watt	RC07GF472J
R13	Resistor, Fixed, Composition: 330 ohms 5%; 1/4 watt	RC07GF331J
R14	Resistor, Fixed, Composition: 100 Kohms 5%; 1/4 watt	RC07GF104J
R15	Same as R12	
R16	Resistor, Fixed, Composition: 27 Kohms 5%; 1/4 watt	RC07GF273J
R17	Resistor, Variable, Composition: 1 Kohm -10%; 1/2 watt at 70°c	RV111U102A
R18	Same as R1	
R19	Resistor, Fixed, Composition: 2.7 Kohm 5%; 1/4 watt	RC07GF272J
R20	Resistor, Fixed, Composition: 130 ohm 5%; 1/4 watt	RC07GF131J
T1-Band	Transformer, RF	TT10005-41A
Band 4B	Transformer, RF	TT10005-41B
T2-Band 4A	Transformer, RF	TT10005-42A
Band 4B	Transformer, RF	TT10005-42B
T3-Band 4A	Transformer, RF	TT10005-43A
Band 41B	Transformer, RF	TT10005-43B
T4- All Bands	Transformer, IF Tank-circuit	TT10003-1
T5-Band 4A	Transformer, Doubler tuning	TT10006-45A
Band 4B	Transformer, Doubler tuning	TT10006-45B
U1	Integrated Circuit	NW-MC1550
Z1	HFO Oven Oscillator (on separate parts list)	A010001*
	* Optional	

REF 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	IN5146A
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

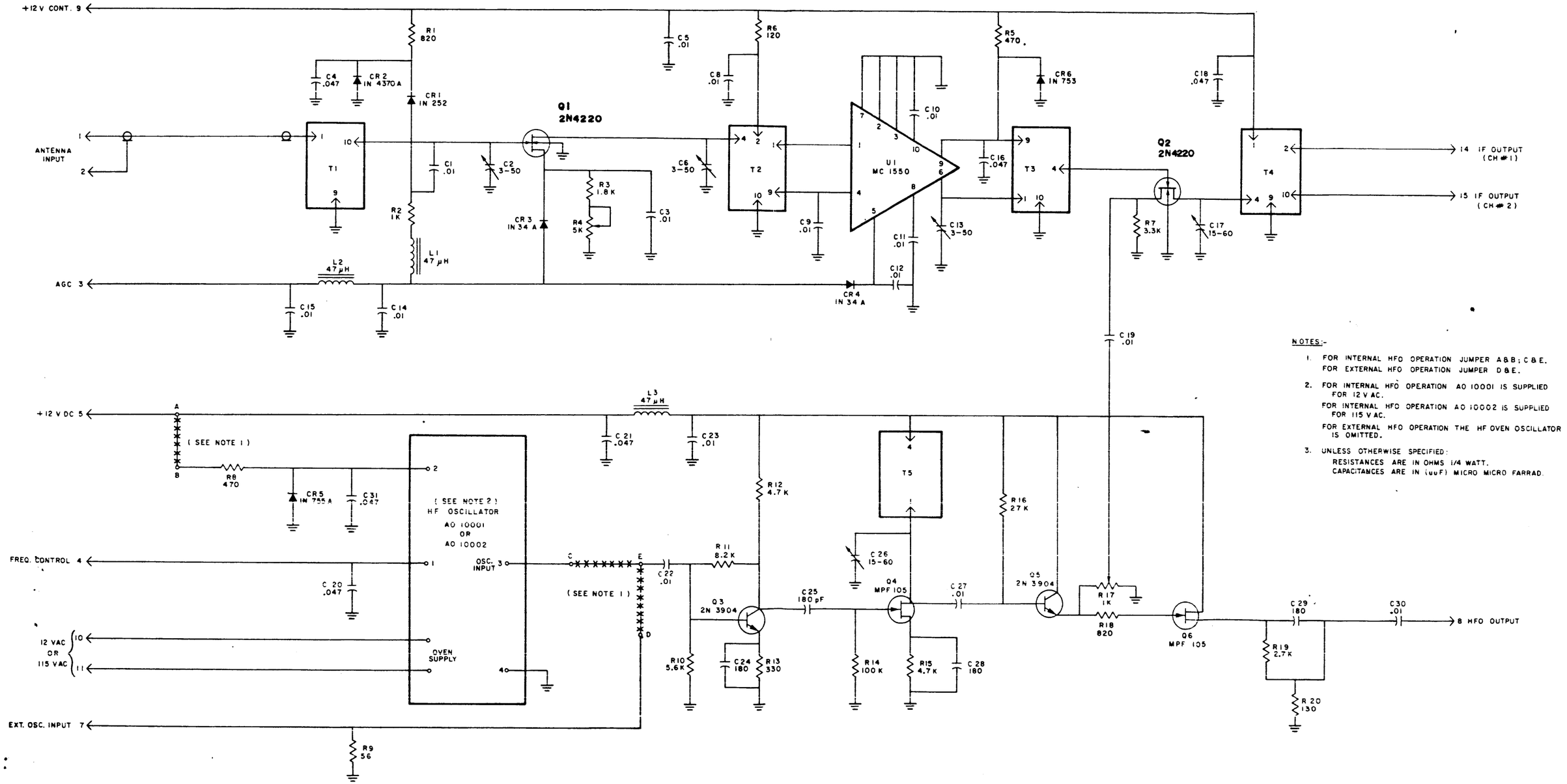
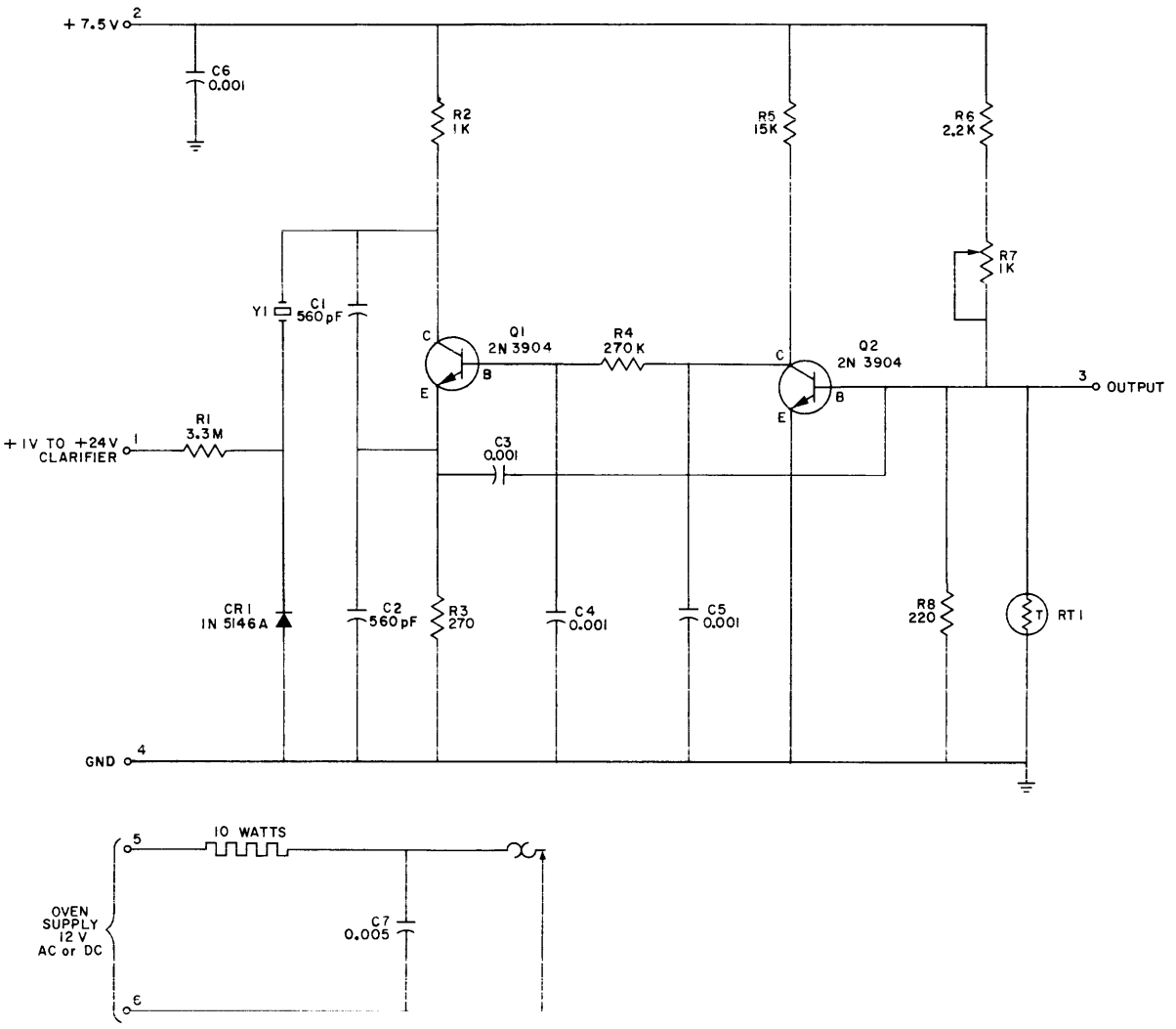


FIGURE 7-1 SCHEMATIC DIAGRAM, TTRR( )E



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