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**TECHNICAL MANUAL**

for

**TRANSMITTER CONVERTER**  
**MODEL TTRT-1F, TTRT-2F, TTRT-3F**



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



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Your comments on this Technical Manual and Equipment are important in maintaining high standards of quality at TMC. We would appreciate your views and suggestions towards improving the Manuals and the Equipment.

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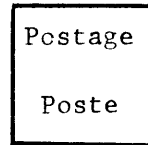
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# TABLE OF CONTENTS

Paragraph		Page
<b>SECTION 1 – GENERAL INFORMATION</b>		
1-1	Functional Description .....	1-3
1-2	Physical Description .....	1-3
1-3	Technical Specifications .....	1-4
<b>SECTION 2 – INSTALLATION</b>		
2-1	Initial Inspection .....	2-1
2-2	Installation Procedure .....	2-1
2-3	Changing Transformers .....	2-1
<b>SECTION 3 – OPERATING PROCEDURES</b>		
3-1	General .....	3-0
3-2	Warm-Up Period .....	3-0
3-3	Operator's Maintenance .....	3-0
<b>SECTION 4 – PRINCIPLES OF OPERATION</b>		
4-1	General .....	3-0
4-2	Circuit Analysis .....	3-0
<b>SECTION 5 – MAINTENANCE</b>		
5-1	Preventive Maintenance .....	5-1
5-2	Troubleshooting .....	5-1
5-3	Repair .....	5-2
5-4	Alignment .....	5-3
5-5	Determination of Local Oscillator Crystal Frequency .....	5-4
<b>SECTION 6 – PARTS LIST</b>		
6-1	Introduction .....	6-1
<b>SECTION 7 – SCHEMATIC DIAGRAMS</b>		



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

# SECTION 1

## GENERAL INFORMATION

### 1-1 FUNCTIONAL DESCRIPTION

Transmitter Converter, Model TTRT-()F, (see figure 1-1), is a completely transistorized, plug-in, RF module that is used with several types of TMC exciters. The TTRT-()F 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-1F, TTRT-2F and TTRT-3F) cover the frequency range from 2 to 16 MHz in three bands (refer to paragraph 1-3).

The TTRT()F contains a balanced mixer, two linear RF amplifiers and a crystal oscillator oven assembly. The TTRT-()F incorporates a Proportional Oven Assembly (AO10007) which includes two circuits; a solid-state proportional oven heater and a solid-state crystal oscillator, the output frequency of which is "fine" adjusted by a potentiometer (R1) mounted outside the oven. Thus, the TTRT-()F can be fine-tuned quickly and conveniently. The balanced mixer and sharp selectivity of the RF amplifiers minimize local oscillator radiation and undesirable heterodyne product output.

The three TTRT-()F modules are identical except for the transformers T1, T2 and T3 on the printed circuit board and the crystal Y1 in the oscillator oven assembly (refer to figure 5-1). Thus, to change from one frequency band to another, it is necessary to change only T1, T2, T3 and Y1. The coils used in each module are listed in table 1-1.

TABLE 1-1. TTRT COIL COMPLEMENT

<u>MODULE</u>	<u>T1</u>	<u>T2</u>	<u>T3</u>
<u>TTRT-1F</u>	TT10001-11	TT10001-12	TT10001-13
<u>TTRT-2F</u>	TT10001-21	TT10001-22	TT10001-23
<u>TTRT-3F</u>	TT10001-31	TT10001-32	TT10001-33

### 1-2 PHYSICAL DESCRIPTION

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. A cover on the side of the TTRT provides electrostatic shielding and protects 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 weights 1-1/2 pounds (680 grams).

### 1-3 TECHNICAL SPECIFICATIONS

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

#### Frequency Range:

TTRT-1F	2-4 MHz
TTRT-2F	4-8 MHz
TTRT-3F	8-16 MHz

Tuning Systems: Fixed tuned.

Frequency Control: Crystal controlled oscillator.

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 Requirements: +12 Vdc, +27 Vdc, 115 Vac, provided by associated exciter.

Dimensions: Height 5-3/8 inches (13.7 cm)  
Width 1-1/2 inches (3.8 cm)  
Depth 8 inches (20.3 cm)

Weight: 1-1/2 pounds (680 grams)

## 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.

TMC Exciters Model STE-5, bearing Manufacturing Numbers lower than 30669-53, require a simple modification to operate with TTRT-( )F modules. To make the modification, add an insulated wire between: (a) the positive terminal of C1524 and (b) pin 2 of J1503. This modification provides the positive 12V required for the TTRT-( )F but it does not affect the normal operation of TTRT-( )D and E modules.

### 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.

## SECTION 3

### OPERATING PROCEDURES

#### 3-1 GENERAL

The TTRT-()F 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-()F modules. Refer to the block diagram (figure 4-1) and the schematic diagram (figure 7-1).

#### 4-2 CIRCUIT ANALYSIS

The associated exciter supplies the TTRT with a 1.75 MHz IF signal (modulated or unmodulated). The 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. 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.

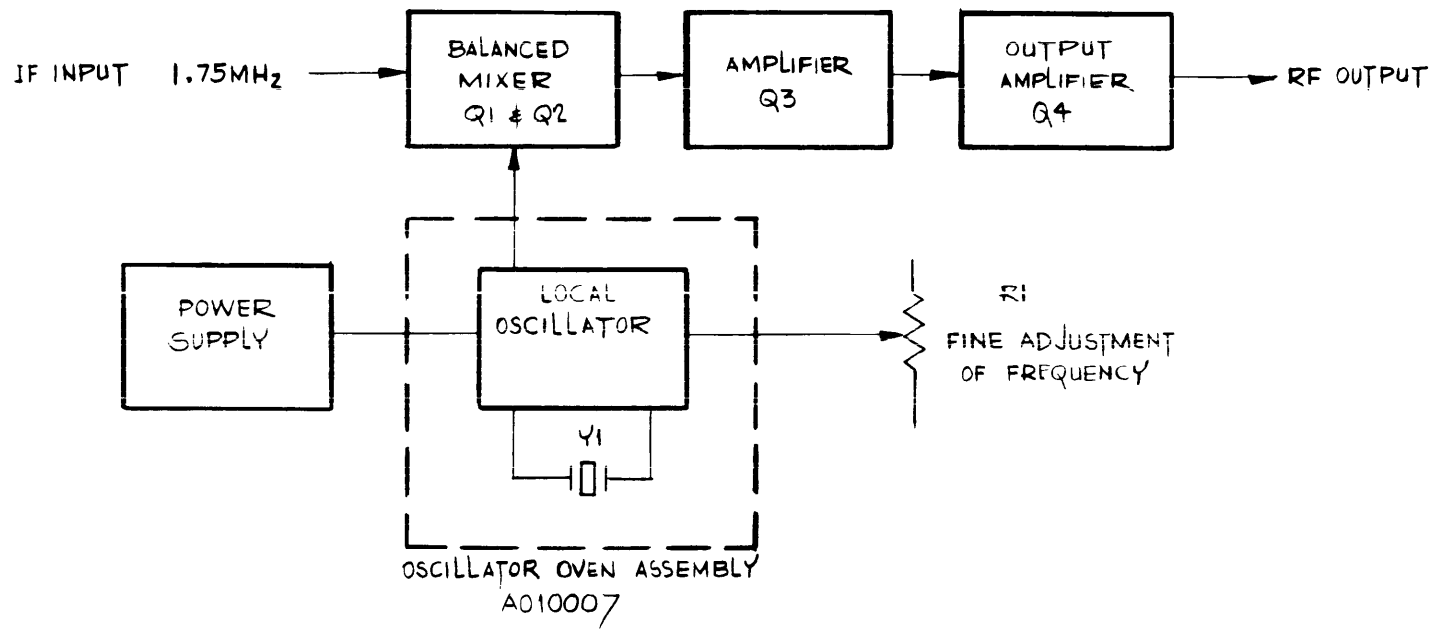


FIGURE 4-1. TTRT-1F, -2F, -3F BLOCK DIAGRAM

## 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 figures 5-1 and 5-2 for aid in locating components of the TTRT-( )F referred to in the maintenance procedures.

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

TABLE 5-1 TEST EQUIPMENT FOR MAINTENANCE

<u>ITEM</u>	<u>FUNCTION</u>
47 ohm, 1/2 watt resistor	Used during troubleshooting and alignment procedures.
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.)	

### 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 Number AX436 (available as an "option" to gain access to alignment controls and interior of TTRT.)

- d. In the exciter, disconnect wire from pin 3 of the TTRT connector 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. Check the following dc supply voltages at the receptacle:
  - (1)+12V at pin 2.
  - (2)+26V at pin 7.If these voltages are not present, check power supply circuitry of associated exciter.
- f. Using an oscilloscope, check the output of the oscillator (terminal 5 on PCB); the 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 clockwise and check the signal level at pin 6 with oscilloscope; level should be approximately 400mV 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.
- 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 cover of TTRT.
- c. Re-connect module to exciter; use service extension module to gain access to alignment controls and interior of TTRT. Ensure that no "load" or remote controls are connected to the exciter.
- d. In the exciter, connect a 47 ohm, 1/2 watt, dummy load between pin 3 of the TTRT connector and ground. (In the case of the TMC STE-5 exciter, this may be accomplished conveniently by connecting the load at the "output" of the exciter.) Connect the oscilloscope across the dummy load and connect the counter to the oscilloscope's vertical amplifier output.
- e. Connect the two-tone generator to the 600 ohm line input to the associated exciter. Switch the exciter to the SSB mode and advance the "AF Gain" fully clockwise.
- f. Adjust the generator for two equal amplitude tones to provide 400 mv at pin 6 of the TTRT.
- g. Connect the oscilloscope to R8 (either end). With R2 fully clockwise, adjust C4 to obtain maximum output on the oscilloscope.
- h. Connect the oscilloscope to the junction of C8 and L2. Adjust C7 to obtain maximum output on the oscilloscope.
- i. Connect the oscilloscope across the dummy load at pin 3. Adjust C10 to obtain maximum output.
- j. Adjust R2 until the signal level on the oscilloscope is 6V, peak-to-peak.

- k. Remove all audio input from the exciter and adjust the exciter for full carrier output (unmodulated AM or AME). Adjust R1 on the chassis until the desired frequency is obtained, as indicated on the frequency counter. Repeat steps f, g, h, i and j.

## 5-5 DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY

Each TTRT module requires an oscillator crystal. The crystal frequency is calculated in accordance with the following equation:

$$f_x = f_c + f_i$$

where  $f_x$  = TTRT oscillator crystal frequency

$f_c$  = frequency of (suppressed) carrier\* signal to be produced.

$f_i$  = frequency of (suppressed) carrier of IF input to the module.

Care must be taken to ensure that the signal to be produced will fall within the RF bandpass of the amplifier stages.

\*In SSB operations the term "carrier" frequency refers to that position in the spectrum reserved for the carrier and acts as a reference for the intelligence signal in the frequency spectrum, whether the carrier is present or not. Certain authorities define "assigned frequency" as the frequency corresponding to the centre frequency of the sideband being utilized.



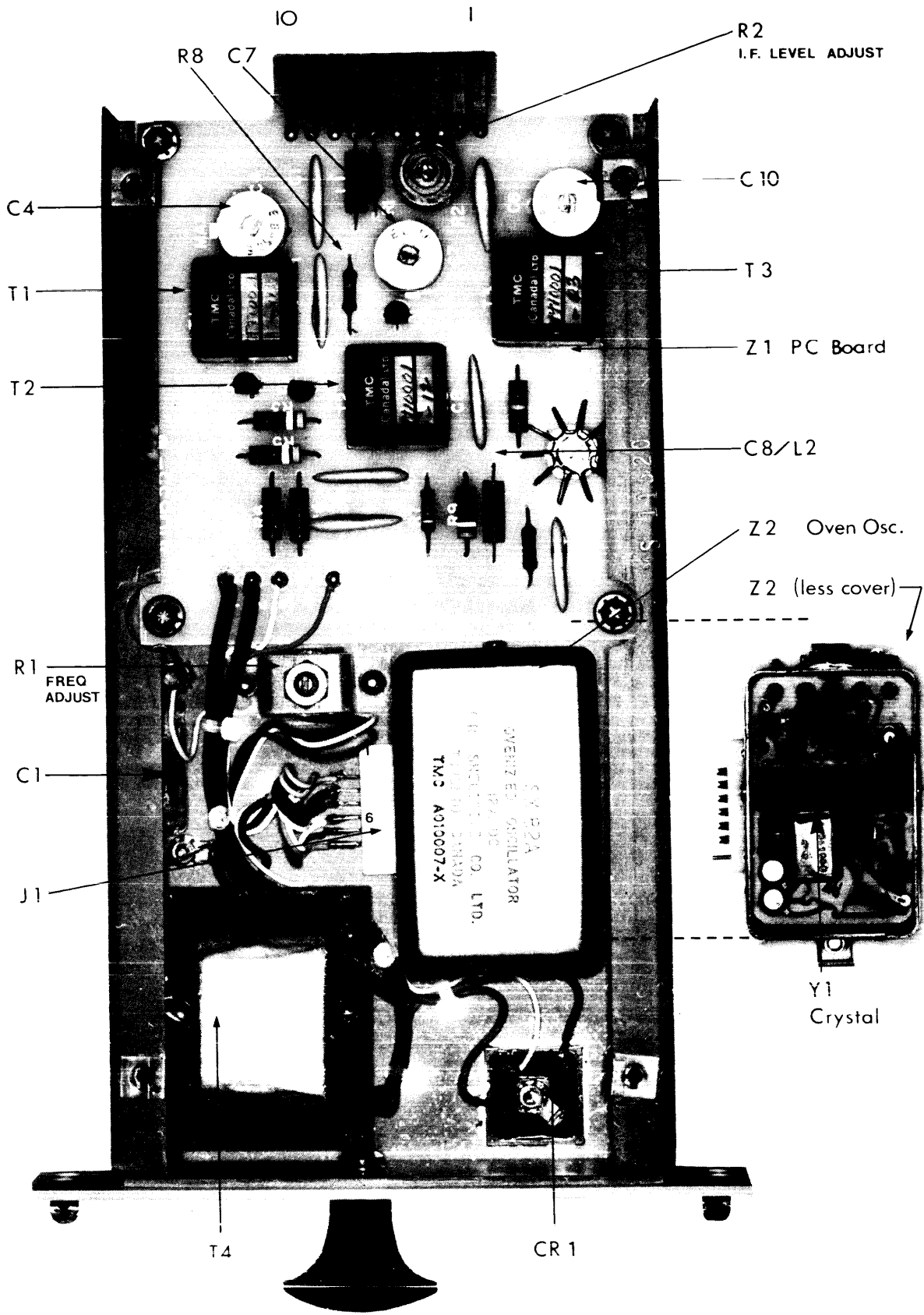
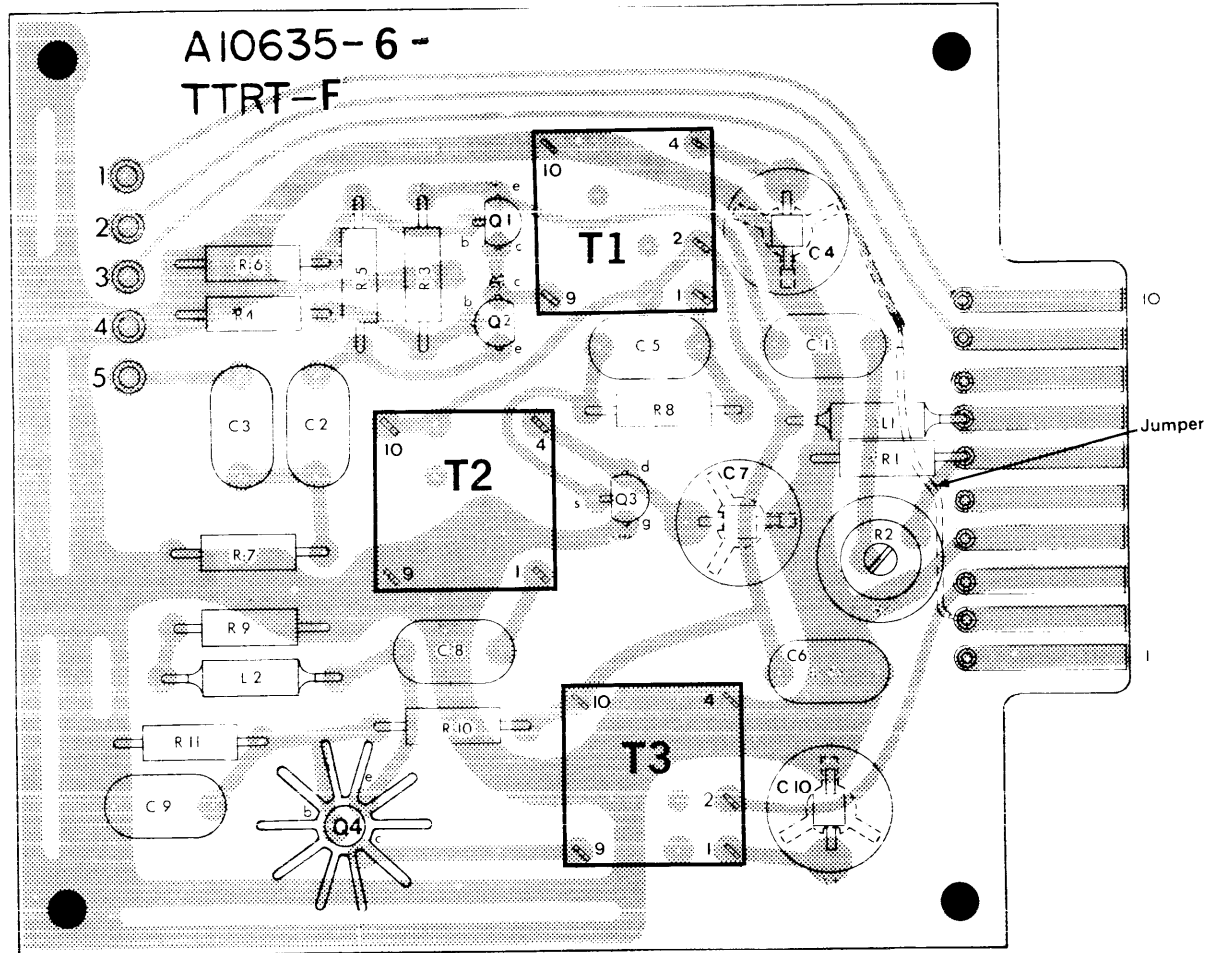


FIGURE 5-1. TTRT-( )F - Cover Removed



This Figure shows component locations as seen from the "component-side" of the board. Also shown are the connections on the "reverse-side" of the board as seen from the component-side.

FIGURE 5-2. BOARD A10635-6 - LAYOUT

## 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.

Included in this Section are forms that may be used for ordering Spare Parts from The Technical Materiel Corporation. Instructions are included on the front of the forms.

#### TTRT-(C)F TRANSMITTER CONVERTER MODULE ASSEMBLY

<u>REF DESIGNATION</u>	<u>DESCRIPTION</u>	<u>TMC PART NUMBER</u>
C1	Capacitor Electrolytic, 220 uf, 40 WVDC	CE105-220-40
CR1	Bridge Rectifier, 220 PIV per leg, 6 amp	DD10010-2
R1	Resistor, variable, com- position, 50K ohms, 1/2 watt, <u>±</u> 10%	RV106UX8B503A
T4	Transformer	TF10088
Y1	Crystal, Quartz, 3.7 to 24 MHz. *Insert crystal frequency in Hz.	CR10009*
Z1	Transmit P.C. Board Assembly	A10635-6
Z2	Oscillator, Oven Assembly	AO10007

## Z1 P.C. BOARD ASSEMBLY A10635-6

<u>REF SYMBOL</u>	<u>DESCRIPTION</u>	<u>TMC PART NUMBER</u>
C1	Capacitor, flat, foil, 0.1uF, 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 <u>+10%</u>	CL275-102
L2	Coil, RF, fixed: 220uH <u>+10%</u>	CL275-221
Q1	Transistor	2N3904
Q2	Same as Q1	
Q3	Transistor	MPF105
Q4	Transistor	2N3553
R1	Resistor, fixed, composition: 100 ohms <u>+5%</u> , 1/2 watt	RC20GF101J
R2	Resistor, variable, composition: 1,000 ohms <u>+10%</u> , 0.25 watts nominal at <u>70°C</u>	RV111U102A
R3	Resistor, fixed, composition: 390 ohms <u>+5%</u> , 1/2 watt	RC20GF391J
R4	Resistor, fixed, composition: 1,200 ohms <u>+5%</u> , 1/2 watt	RC20GF122J
R5	Same as R3	
R6	Same as R4	
R7	Resistor, fixed, composition: 680 ohms, <u>+5%</u> , 1/4 watt	RC07GF681J

<u>REF</u> <u>SYMBOL</u>	<u>DESCRIPTION</u>	<u>TMC</u> <u>PART NUMBER</u>
R8	Resistor, fixed, composition: 220 ohms <u>+5%</u> , 1/2 watt	RC20GF221J
R9	Resistor, fixed; composition: 39 ohms <u>+5%</u> , 1/2 watt	RC20GF390J
R10	Resistor, fixed, composition: 12,000 ohms <u>+5%</u> , 1/2 watt	RC20GF123J
R11	Resistor, fixed, composition: 1,000 ohms <u>+5%</u> , 1/2 watt	RC20GF102J
T1 (TTRT-1F)	Transformer, RF tuned	TT10001-11
T1 (TTRT-2F)	Transformer, RF tuned	TT10001-21
T1 (TTRT-3F)	Transformer, RF tuned	TT10001-31
T2 (TTRT-1F)	Transformer, RF tuned	TT10001-12
T2 (TTRT-2F)	Transformer, RF tuned	TT10001-22
T2 (TTRT-3F)	Transformer, RF tuned	TT10001-32
T3 (TTRT-1F)	Transformer, RF tuned	TT10001-13
T3 (TTRT-2F)	Transformer, RF tuned	TT10001-23
T3 (TTRT-3F)	Transformer, RF tuned	TT10001-33

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**Instructions:**

Use the TMC Technical Manual to identify the spare parts required. List these parts with quantities in the spaces provided below. TMC will return the list to you within 30 days of receipt with both prices and delivery quoted. If you do not have a technical manual and need a current spare parts list, use this form to request one.

TMC EQUIPMENT MODEL \_\_\_\_\_ Serial/Mfgr No \_\_\_\_\_

Quantity	TMC Part Number	Description	Unit Price	Ext Price	Delivery

Shaded Area for TMC Use

Requested Delivery \_\_\_\_\_(Days)

Shipping Charges	
<b>TOTAL QUOTATION</b>	



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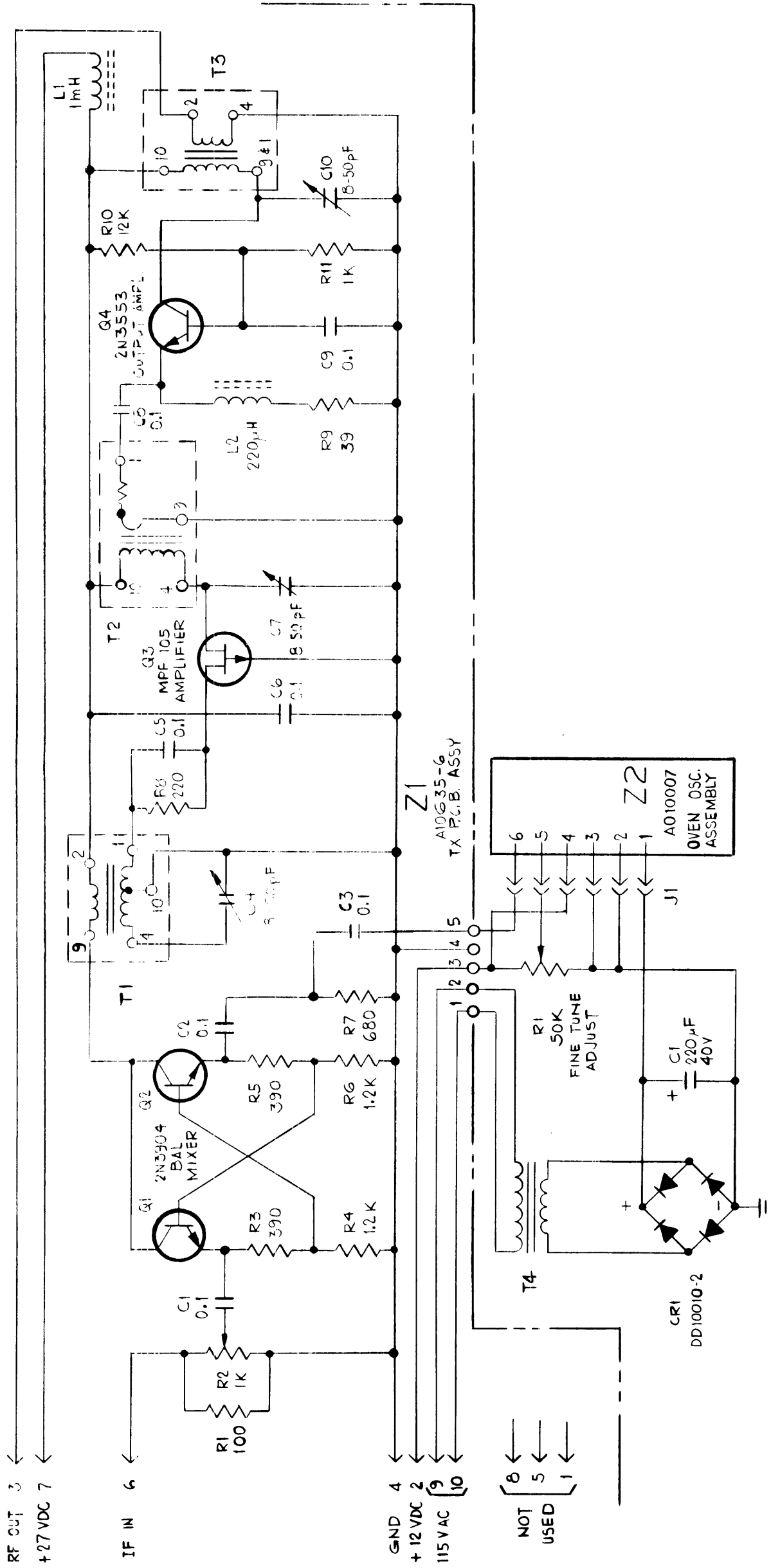
Requested Delivery \_\_\_\_\_ (Days)

Shipping Charges	
TOTAL QUOTATION	





**SECTION 7**  
**SCHEMATIC DIAGRAMS**



UNLESS OTHERWISE SPECIFIED:  
 ALL CAPACITANCES ARE IN μF.  
 ALL RESISTANCES ARE IN OHMS, 1/2 WATT.

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