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UNCLASSIFIED

TECHNICAL MANUAL

*for*

RECEIVER TEST OSCILLATOR

MODEL RTO-1A



THE TECHNICAL MATERIEL CORPORATION  
MAMARONECK, N. Y.

OTTAWA, ONTARIO

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## NOTICE

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## W a r r a n t y

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



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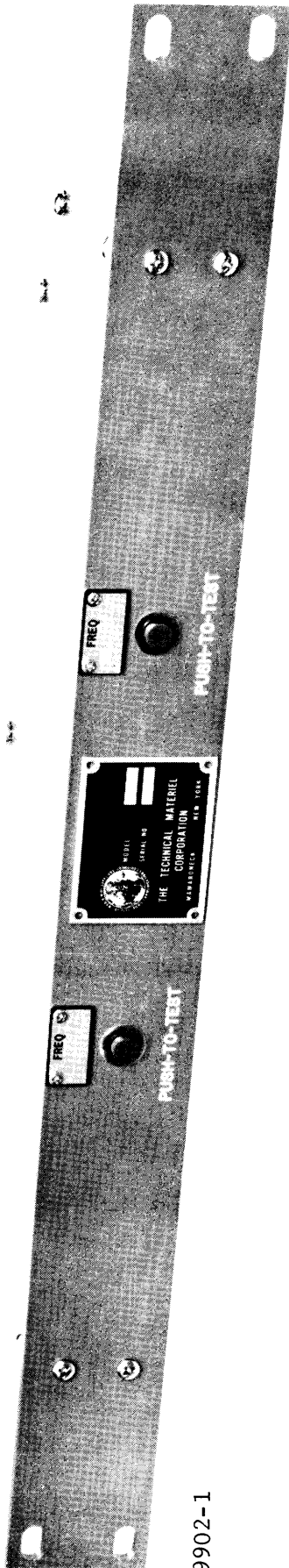


Figure 1-1. Receiver Test Oscillator, Model RTO-1A

## SECTION 1 GENERAL INFORMATION

### 1-1. PURPOSE AND DESCRIPTION.

Receiver Test Oscillator Model RTO-1A is a two-channel signal generator that provides a crystal-controlled modulated signal in the 2- to 4-mc (MHz) frequency range. Each channel is controlled by a front-panel PUSH-TO-TEST switch or by application of a  $\pm 12$  vdc from a remote site. The RTO requires negative 12- vdc supply for circuit operation. The d-c supply voltages may be obtained from an associated receiver or from external batteries.

The RTO is mounted on a standard 19-inch wide panel for rack installation, and requires 1-3/4 inches of panel space. Most of the components are mounted on two printed circuit boards (one for each channel). All external connections are made at the rear of the chassis.

### 1-2. TECHNICAL SPECIFICATIONS.

Technical specifications for the RTO are listed below.

Frequency Range:	2 to 4 megacycles (customer selected crystal).
Output Level:	40 to 50 microvolts.
Input Impedance:	50 ohms, nominal.
Output Impedance:	50 ohms, nominal.
Modulation:	Adjustable from 0 to 100% at 1000 cps.
Power Requirements:	$\pm 12$ vdc current drain of negative d-c supply is approximately 2 ma per channel.

## SECTION 2 INSTALLATION

### 2-1. INITIAL INSPECTION.

The RTO is calibrated and tested at the factory prior to shipment. When it arrives at the operating site, inspect the packing case and contents for possible damage. 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, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of parts.

### 2-2. POWER REQUIREMENTS.

The RTO power requirements are  $\pm 12$  volts d-c. The negative 12 volt d-c supply is used for circuit operation. The positive 12 volt d-c supply is used for remote control operation.

### 2-3. INSTALLATION.

a. MECHANICAL.- The RTO is mounted on a standard 19-inch wide panel for rack installation, and occupies approximately 1-3/4 inches of panel space. Secure the panel to the rack with four mounting screws.

b. ELECTRICAL.- Refer to figure 2-1. The RTO is normally used with two independent receivers. All connections are made at the rear chassis. To connect the RTO to the associated equipment, proceed as follows:

(1) Connect two cables from the antenna (normally connected to the input of each receiver) to the ANT jacks J103 (channel 1) and J104 (channel 2); connect the RCVR jacks J101 (channel 1) and J102 (channel 2) to the input jacks of the two associated receivers.

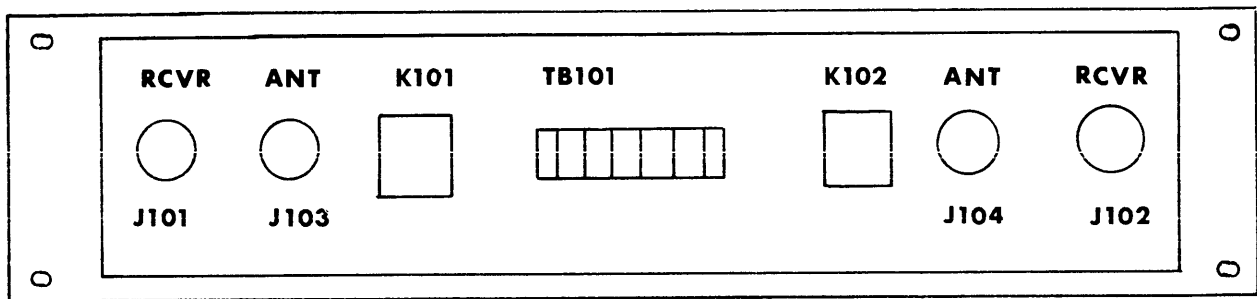
(2) Connect the negative 12 volt d-c supply (positive lead grounded) to terminals 2 (ground) and 3 of TB101.

(3) For remote control operation of the two channels, connect the negative leg of a positive 12 volt d-c supply to terminal 2 (ground). Connect two

wires to the positive leg of the d-c supply; connect the free ends to terminals 4 and 5 of TB101.

### NOTE

Terminal 4 of TB101 is for remote control of channel 1; terminal 5 is for channel 2. The positive leg of the external d-c supply should be connected to the associated terminal via an external switch.



9902-2

Figure 2-1. Rear View, RTO

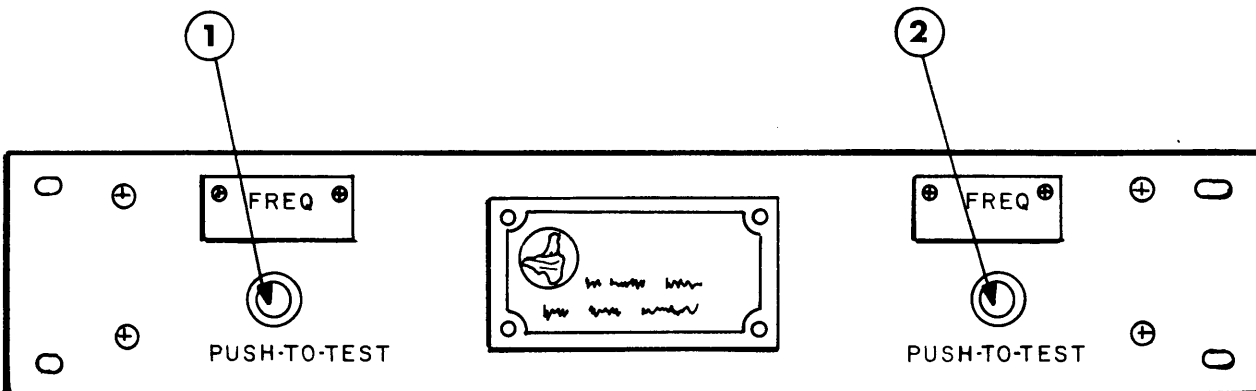
### SECTION 3 OPERATOR'S SECTION

#### 3-1. OPERATING CONTROLS.

The operating controls for the RTO are listed in table 3-1 and are illustrated in figure 3-1.

TABLE 3-1. OPERATING CONTROLS

REFERENCE DESIGNATION (Figure 3-1)	PANEL DESIGNATION	FUNCTION
1	PUSH-TO-TEST pushbutton switch S101 (right-hand pushbutton)	Controls the operation of the associated test oscillator signal. When depressed, the following occurs: (1) Circuits on associated printed circuit board are energized. (2) Connection between the ANT jack J103 and RCVR jack J101 is removed. (3) Connects modulated test signal to RCVR jack J101.
2	PUSH-TO-TEST pushbutton switch S102 (left-hand pushbutton)	Same as 1 except that associated ANT and RCVR jacks are J104 and J102, respectively.



9902-3

Figure 3-1. Front Panel, RTO

## SECTION 4

### PRINCIPLES OF OPERATION

#### 4-1. CIRCUIT ANALYSIS.

Refer to Figures 4-1 and 7-1. The RTO is a two-channel signal generator generally used for receiver testing. Each channel comprises a printed circuit board, ANT and RCVR jacks, a relay, and a PUSH-TO-TEST pushbutton switch. The two channels are identical; therefore, only one channel (Z101) will be fully discussed.

When relay K101 is de-energized input signals applied to ANT jack J103 are coupled to the associated receiver via RCVR jack J101 and the contacts of relay K101. However, when relay K101 is energized, J103 and J101 are disconnected and a modulated test signal from the printed circuit board is applied to the associated receiver via RCVR jack J101. Relay K101 is energized when the PUSH-TO-TEST pushbutton is depressed or when 12 vdc is applied across terminals 2 (ground) and 4 of TB101, applying a -12 vdc (from pin 3 of TB101) to crystal oscillator Q201, modulator Q202, and modulated r-f amplifier Q203. Oscillator Q201 produces a 2- to 4-mc r-f output (output frequency depends upon crystal specified) that is capacitively coupled via C206 to the emitter of amplifier Q203. Modulator Q202 produces a 1-kc output that is capacitively coupled via C217 to the base of amplifier Q203. The combined r-f and audio output (amplitude modulated r-f) at the collector of Q203 is transformer coupled to the output circuit consisting of transformer T201 and capacitors C215 and C214.

Capacitor C214 presents a relatively high impedance to the output signal, and reduces the amplitude from approximately 1 mv (at secondary of T201) to approximately 47uv.

Potentiometer R215 (in the collector circuit of Q202) determines the level of the input signal at the base of Q203 thereby determining the percent modulation (up to 100%) of the output of Q203.

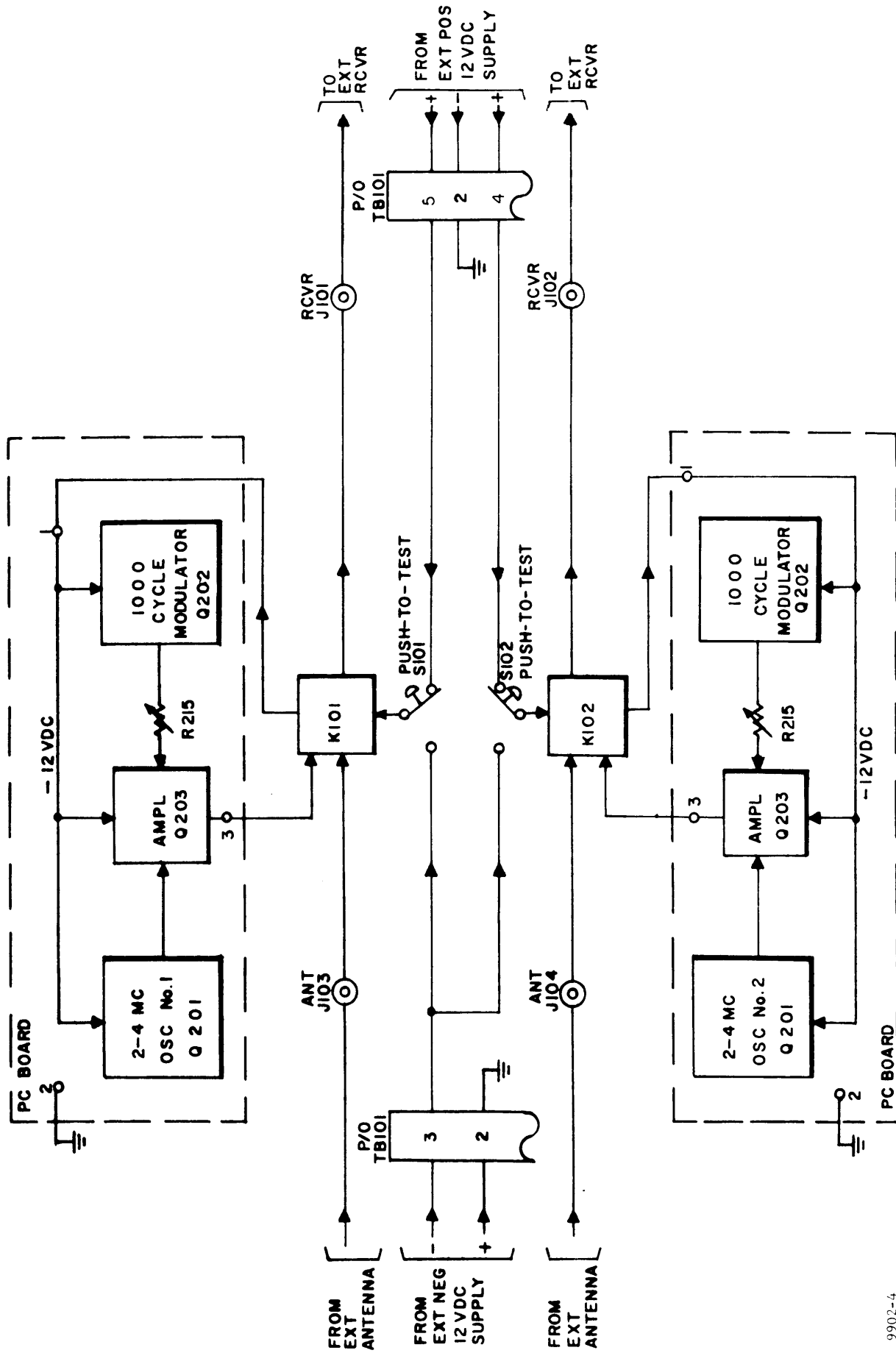


Figure 4-1. Block Diagram, RTO



## **SECTION 5 MAINTENANCE**

### 5-1. PREVENTIVE MAINTENANCE.

a. The RTO has been designed to provide long-term, trouble-free operation under continuous duty conditions. However, in order to prevent failure of the equipment due to corrosion, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methyl chloroform may be used, providing the necessary precautions are observed.

### **NOTE**

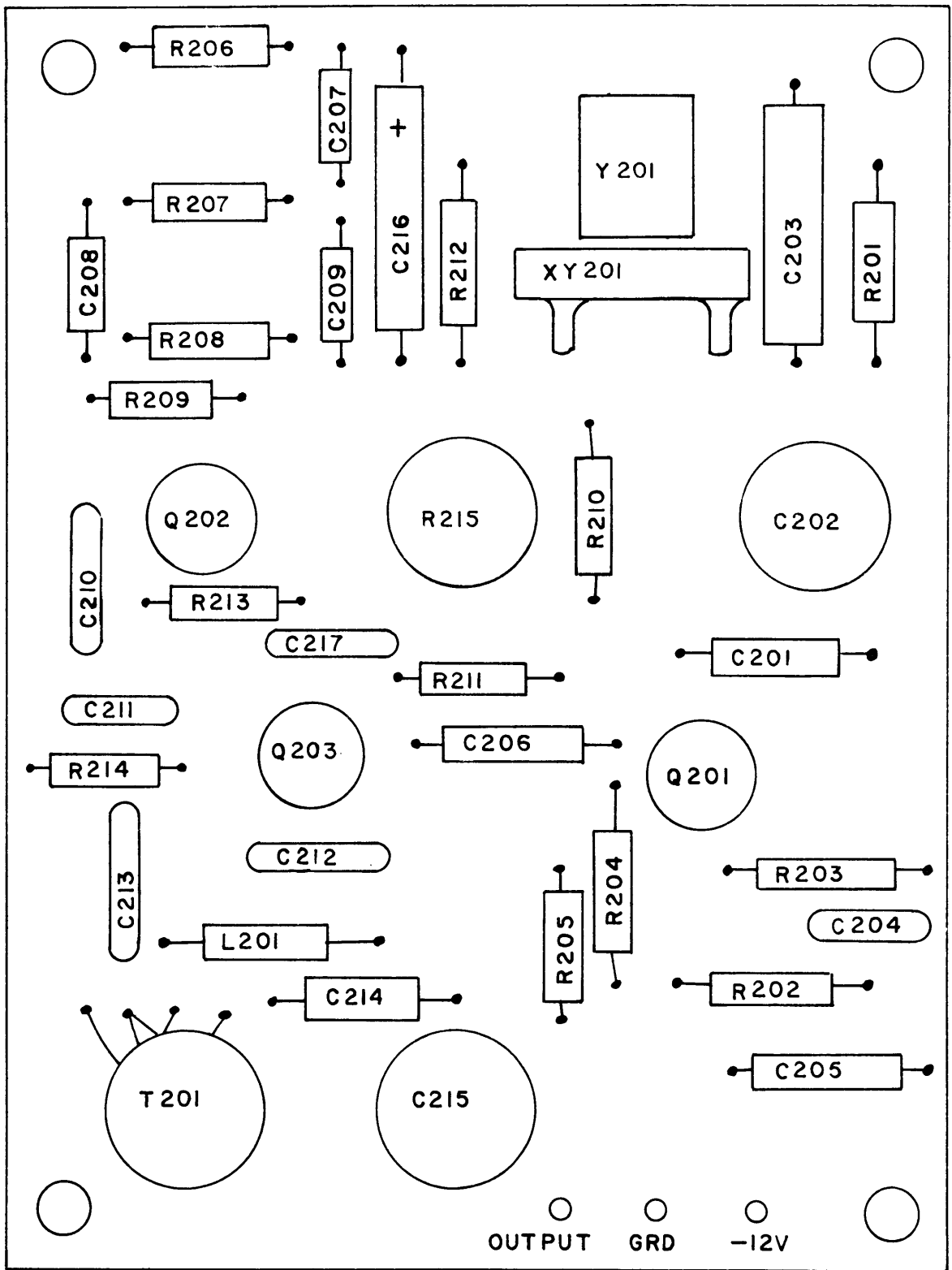
When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with the skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

### **CAUTION**

When using trichlorethylene, avoid contact with painted surfaces due to its paint removing effects.

### 5-2. TROUBLESHOOTING.

Troubleshooting the RTO requires a familiarity of the various unit control functions as used in conjunction with the associated equipment. Therefore, before attempting to troubleshoot the RTO, a knowledge of the unit functions and use of the schematic diagram is a primary requirement. Use figure 5-1 to quickly locate components on the printed circuit board.



9902-5

Figure 5-1. Printed Circuit Board Component Locations

### 5-3. ALIGNMENT PROCEDURE.

a. EQUIPMENT REQUIRED. - The equipment required to align the RTO are listed below.

1. Two (2) 12 volt d-c power supplies (batteries may be used as a substitute).
2. Simpson 260 VOM.
3. Tektronix type 541A oscilloscope with a type "L" plug-in head.
4. Hewlett Packard 5244L frequency counter.
5. Ballantine 314A VTVM.

b. PROCEDURE. - Proceed as follows:

1. Connect the volt-ohmmeter, set to read 12 volts, between Pin 1 and ground of the printed circuit board nearest K101, (negative lead to Pin 1).
2. Connect one 12 volt supply between terminal 3 of TB101 and ground, (negative to Pin 3).
3. When right-hand PUSH-TO-TEST button (S101) is pushed, K101 should energize and the VOM should read -12 vdc.
4. Connect the second 12 volt supply between terminal 5 of TB101 and ground, (negative to ground). K101 should energize and the meter should read -12 vdc.
5. Connect scope to junction of C206 and R205 on the oscillator board nearest K101, connect the counter to the vertical output on the scope. Adjust C202 for the frequency marked on the crystal.
6. Connect the VTVM to the junction of C214 and T201. Peak C215 for maximum on the meter (1 mv minimum).
7. Connect scope to the VTVM amplifier output and set the meter on the 100 mv scale. Adjust R215 for approximately 30% modulation on the scope.

8. Connect the negative lead of the volt-ohmmeter to Pin 1 of the printed circuit board nearest K102, (positive lead to ground).

9. When the left-hand PUSH-TO-TEST button (S102) is pushed, K102 should energize and the meter should read -12 vdc.

10. Connect the positive lead of the 12 volt supply from Pin 4 to Pin 5 on TB101. K102 should energize and the meter should read -12 vdc.

11. Move the scope to the junction of C206 and R205 on the oscillator board nearest K102. Adjust C202 for the frequency marked on the crystal.

12. Move the VTVM to the junction of C214 and T201 on the board nearest K102. Peak C215 for maximum (1 mv minimum).

13. Connect the scope to the amplifier output on the VTVM, and set the meter to the 100 mv scale. Adjust R215 for approximately 30% modulation on the scope.

14. End of test. Remove all external equipment from the RT0.

## SECTION 6 PARTS LIST

### 6-1. INTRODUCTION.

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

- a. Reference symbol.
- b. Description as indicated in parts list.
- c. TMC part number.
- d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation  
Attention: Sales Department  
700 Fenimore Road  
Mamaroneck, New York

<u>Assembly or Subassembly</u>	<u>Page</u>
Receiver Test Oscillator Main Chassis, Model RTO-1A . . . . .	6-2
Printed Circuit Board Assembly, A4364 . . . . .	6-2

## PARTS LIST

for

## RECEIVER TEST OSCILLATOR MAIN CHASSIS, MODEL RTO-1A

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J101	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round female contact, straight type; series BNC to BNC.	UG625*/U
J102 thru J104	Same as J101.	
K101	RELAY, ARMATURE: DPDT; 1,000 ohms, $\pm 10\%$ DC resistance; operating voltage not rated; operating current 8.5 ma; power rating 85 mw at 25°C; 8 contacts rated for 1 amp at 25 VDC; clear high impact styrene dust cover case.	RL156-19
K102	Same as K101.	
S101	SWITCH, PUSHBUTTON: SPST; break before make; rated for 250 ma, non-inductive, AC, 30 watts maximum.	SW296-1
S102	Same as S101.	
TB101	TERMINAL BOARD, BARRIER: six 6-32 thd x 1/4" long binder head machine screws; black bakelite body.	TM100-6
XK101	SOCKET, RELAY: w/retainer; 6 contact; phenolic body.	TS171-1
XK102	Same as XK101.	
Z101	PRINTED CIRCUIT BOARD ASSEMBLY (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4364
Z102	Same as Z101. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	

## PRINTED CIRCUIT BOARD ASSEMBLY, A4364

C201	CAPACITOR, FIXED, MICA DIELECTRIC: 5 uuf, $\pm 5\%$ ; 500 WVDC.	CM15C050J03
C202	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 8 to 50 uuf; 350 WVDC.	CV109-9
C203	CAPACITOR, FIXED, MICA DIELECTRIC: 680 uuf, $\pm 5\%$ ; 500 WVDC; straight wire leads.	CM111F681J5S
C204	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C205	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, $\pm 5\%$ ; 500 WVDC.	CM15F101J03
C206	Same as C205.	

## PARTS LIST (CONT)

## PRINTED CIRCUIT BOARD ASSEMBLY, A4364

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C207	CAPACITOR, FIXED, MICA DIELECTRIC: 10,000 uuf, $\pm 1\%$ ; 100 WVDC; straight wire leads.	CM112F103F1S
C208	Same as C207.	
C209	Same as C207.	
C210	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, $+80\%$ $-20\%$ ; 25 WVDC.	CC100-33
C211	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf, GMV; 500 WVDC.	CC100-9
C212	Same as C210.	
C213	Same as C210.	
C214	CAPACITOR, FIXED, MICA DIELECTRIC: 51 uuf, $\pm 2\%$ ; 500 WVDC.	CM15D510G03
C215	Same as C202.	
C216	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 50 uf, 60 WVDC; polarized; tubular case.	CE107-1
C217	Same as C210.	
L201	COIL, RADIO FREQUENCY: fixed; 680 uh, $\pm 5\%$ ; 12 ohms DC resistance; molded case.	CL275-681
Q201	TRANSISTOR: germanium PNP; collector to base voltage 40 V; emitter to base voltage 1.0 V; current rating 10 ma at 25°C; max. power dissipation 125 mw at 25°C; JEDEC type TO-33 case.	2N2084
Q202	TRANSISTOR: germanium PNP; collector to base voltage 25 V; emitter to base voltage 10 V; collector current 150 ma; power dissipation 150 mw at 25°C; storage temperature range -55°C to +85°C; hermetically sealed glass to metal case.	2N1370
Q203	Same as Q201.	
R201	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF472J
R202	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF683J

## PARTS LIST (CONT)

PRINTED CIRCUIT BOARD ASSEMBLY, A4364

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R203	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF102J
R204	Same as R203.	
R205	Same as R203.	
R206	RESISTOR, FIXED, FILM: 6,800 ohms, $\pm 1\%$ ; 1/4 watt.	RN60D6801F
R207	Same as R206.	
R208	Same as R206.	
R209	RESISTOR, FIXED, COMPOSITION: 10 megohms, $\pm 5\%$ ; 1/2 watt.	RC20GF105J
R210	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF273J
R211	Same as R201.	
R212	RESISTOR, FIXED, COMPOSITION: 1,800 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF182J
R213	RESISTOR, FIXED, COMPOSITION: 180,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF184J
R214	RESISTOR, FIXED, COMPOSITION: 20,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF203J
R215	RESISTOR, VARIABLE, COMPOSITION: 2.5 megohms, $\pm 20\%$ ; linear taper.	RV111U255B
T201	TRANSFORMER, RADIO FREQUENCY: fixed; primary inductance 100 hy, $\pm 15\%$ ; 2 mc.	TZ143
XY201	SOCKET, CRYSTAL: clip type; 2 cadmium plated contacts; 3/64" x 5/32" tail slots.	TS167-1
*Y201	CRYSTAL UNIT, QUARTZ	CR18A/U----

\* Frequency of crystal Y201 is determined by customer request.



**SECTION 7**  
**SCHEMATIC DIAGRAM**

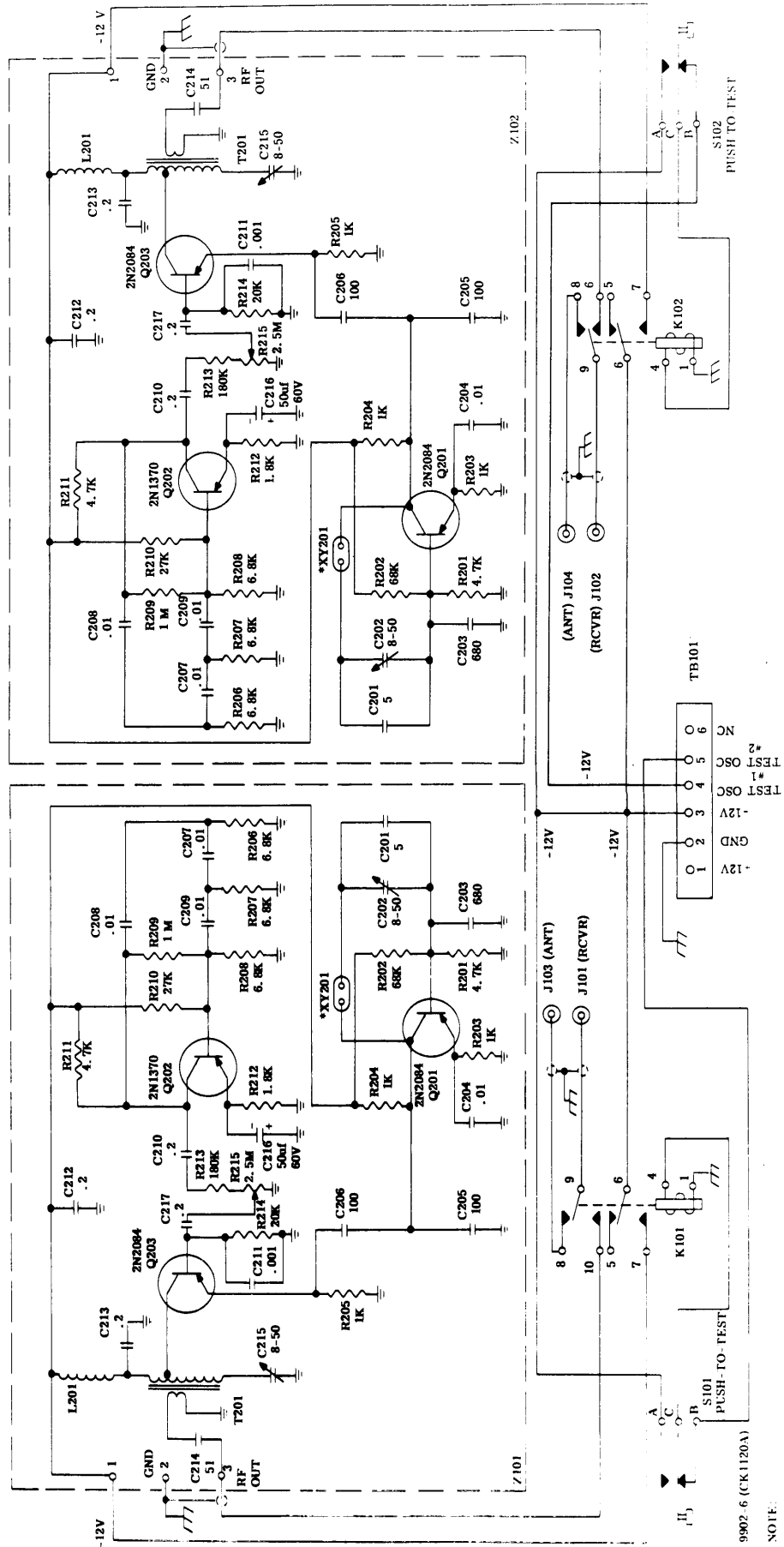


Figure 7-1. Schematic Diagram, RTO