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UNCLASSIFIED

TECHNICAL MANUAL

*for*

TRANSMITTER CONVERTER

MODEL TTRT ( )B



THE TECHNICAL MATERIEL CORPORATION  
MAMARONECK, N.Y.

OTTAWA, ONTARIO

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## SECTION 1

### GENERAL INFORMATION

#### 1-1. FUNCTIONAL DESCRIPTION.

Transmitter Converter, Model TTRT-( )B, is a completely transistorized, plug-in, r-f module that is used with several types of TMC exciters. The TTRT-( )B accepts a 1.75 mc i-f signal (modulated or unmodulated) from the exciter, and provides the final stage of frequency translation and r-f amplification. Four Modules (Model TTRT-1B, TTRT-2B, TTRT-3B, and TTRT-4B) cover the frequency range from 2- to 32- megacycles (refer to paragraph 1-3).

The TTRT-( )B contains a balanced mixer, a crystal-controlled oscillator, and three linear r-f amplifiers. A crystal is provided for the local oscillator. The balanced mixer, and sharp selectivity of the r-f amplifiers minimize local oscillator radiation and undesirable heterodyne product output. Frequency stability for the local oscillator is 1 part in  $10^5$  per day; crystal ovens are available on special order to provide even greater stability (refer to paragraph 1-4).

#### 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 1-1/2 pounds.

b. INTERNAL. -Most of the smaller components in the TTRT are located on two printed circuit boards mounted to the chassis; the remaining components are chassis mounted. Table 1-1 lists the semi-conductor complement of the TTRT. Removable metal shields are provided to minimize interaction between stages.

TABLE 1-1. SEMICONDUCTOR COMPLEMENT

REFERENCE DESIGNATION				TYPE	FUNCTION
TTRT-1	TTRT-2	TTRT-3	TTRT-4		
Q1	Q1	Q1	Q1	2N727	Oscillator
Q2	Q2	Q2	----	2N2219A	Buffer
----	----	----	Q2	2N2084	Doubler
Q503	Q603	Q703	Q803	2N2084	Balanced Mixer
Q504	Q604	Q704	Q804	2N2084	
Q505	Q605	Q705	----	2N2084	Amplifier
----	----	----	Q805	2N2495	Amplifier
Q506	Q606	Q706	----	2N2084	Driver
----	----	----	Q806	2N2495	Driver
Q507	Q607	Q707	Q807	2N2219A	Power Amplifier

### 1-3. TECHNICAL SPECIFICATIONS.

Technical specifications for the TTRT-( )B are as follows;

#### Frequency Range:

TTRT-(1)B	2-4 mc
TTRT-(2)B	4-8 mc
TTRT-(3)B	8-16 mc
TTRT-(4)B	16-32 mc

#### Tuning Systems:

Fixed Tuned.

#### Frequency Control:

Crystal controlled oscillator.

#### Types of Transmission:

Dependent on exciter with which TTRT is used.

#### Input:

1.75 mc i-f, modulated or unmodulated, from associated exciter.

#### Output Power:

100 mw.

#### Output Impedance:

50 ohms, unbalanced.

#### R-F Bandpass:

Approximately 0.5% of frequency to which module is tuned.

#### Frequency Stability:

1 part in  $10^6$  per day with crystal oven.

#### Power Requirement:

+12 vdc, -12 vdc, -36 vdc provided by associated exciter.

#### Dimensions:

Height 5-3/8 inches.  
Width 1-1/2 inches.  
Depth 3 inches.

#### Weight:

1-1/2 pounds.

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 packaging 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, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-2. INSTALLATION PROCEDURE.

Since the TTRT is a plug-in module and can be installed in the associated exciter by inserting the unit into its receptacle, no specific installation procedures are given in this manual. Installation and initial check-out procedures for the TTRT are, therefore, given in the associated exciter (or transmitter) manual.

## SECTION 3

### OPERATING PROCEDURES

#### 3-1. GENERAL.

The TTRT-( )B does not contain any operating controls.

#### 3-2. WARM-UP PERIOD.

As a crystal oven is used in the TTRT module, a 30-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.

With one exception (refer to the NOTE below), the operating principles for each TTRT module (TTRT-1, TTRT-2, TTRT-3, and TTRT-4) are similar, and therefore only TTRT-1 is explained in this section. Refer to the block diagrams, figures 4-1 through 4-4, and the schematic diagrams, figures 7-1 through 7-4.

#### NOTE

In TTRT-4 a frequency doubler multiplies the local oscillator output; the difference in operation is noted in the text.

#### 4-2. CIRCUIT ANALYSIS.

#### NOTE

The following discussion, written for TTRT-1 will apply equally as well to TTRT-2 through TTRT-4 (refer to figure 4-1 through figure 4-4).

The associated exciter supplies the TTRT with a 1.75 mc i-f signal (modulated or unmodulated). This signal is supplied to balanced mixer Q503/Q504. The mixer is also supplied with the output of local oscillator Q1 through buffer amplifier Q2. Buffer amplifier Q2 ensures maximum stability of the local oscillator.

In the TTRT-1, -2, and -3, the local oscillator operates 1.75 mc above the desired output frequency. In the TTRT-4, the local oscillator operates between 8.875 and 16.875 mc. Frequency doubler Q602 multiplies the local oscillator to the required mixer injection frequency (17.75- to 33.75-mc).

The output of the balanced mixer is amplified by two common emitter, tuned collector, class A, r-f amplifiers (Q505 and Q506), and an emitter follower (power amplifier Q507). Each of the amplifiers is fixed-tuned so that only the desired signal is passed; undesirable noise and heterodyne products are eliminated.



Resistors R517 and R524 (unbypassed emitter resistors) provide negative feedback for amplifiers Q505 and Q506, respectively. Capacitor C523 provides negative feedback for power amplifier Q507.

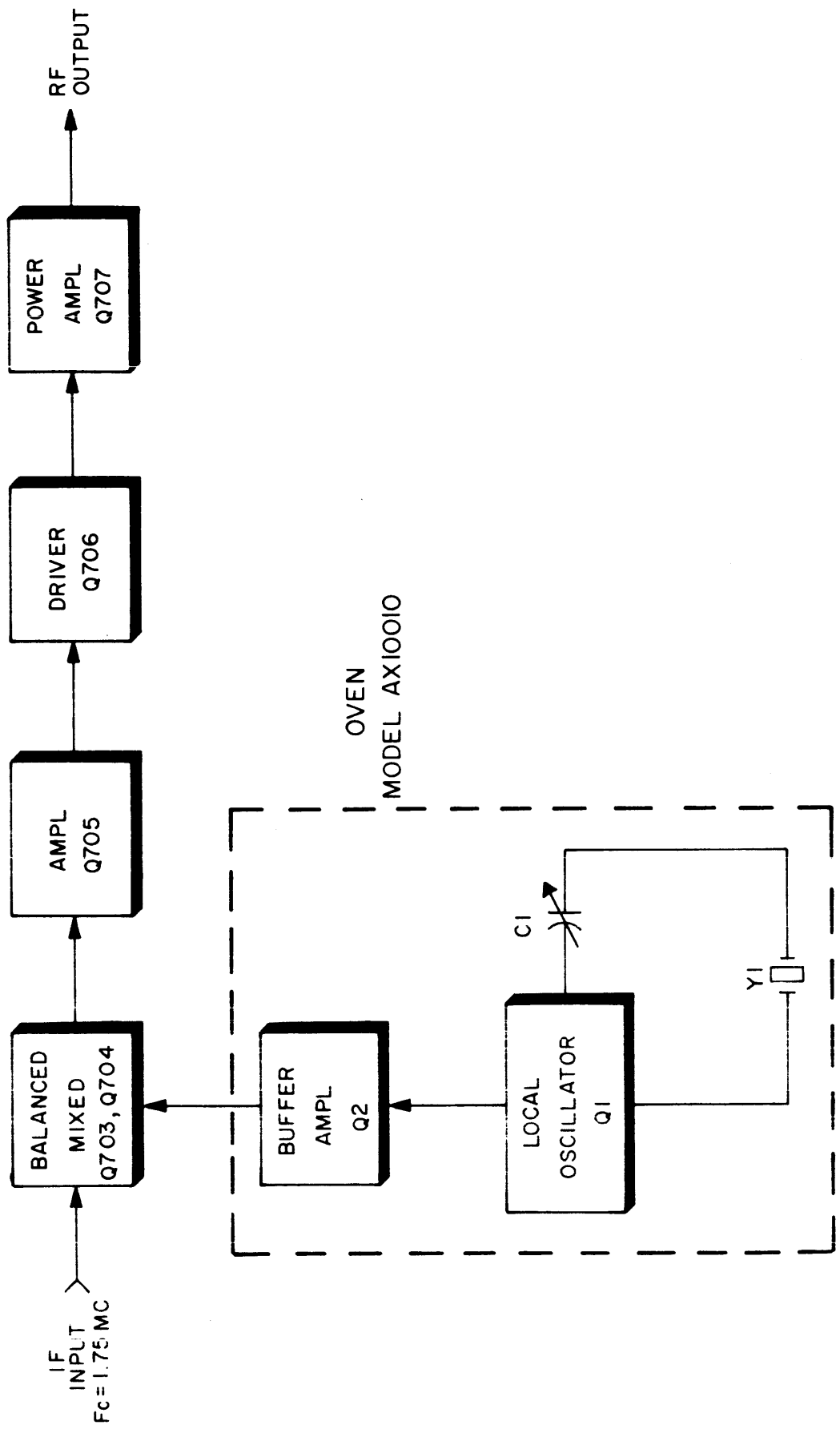


FIGURE 4-3. SIMPLIFIED BLOCK DIAGRAM, TTRT-3B

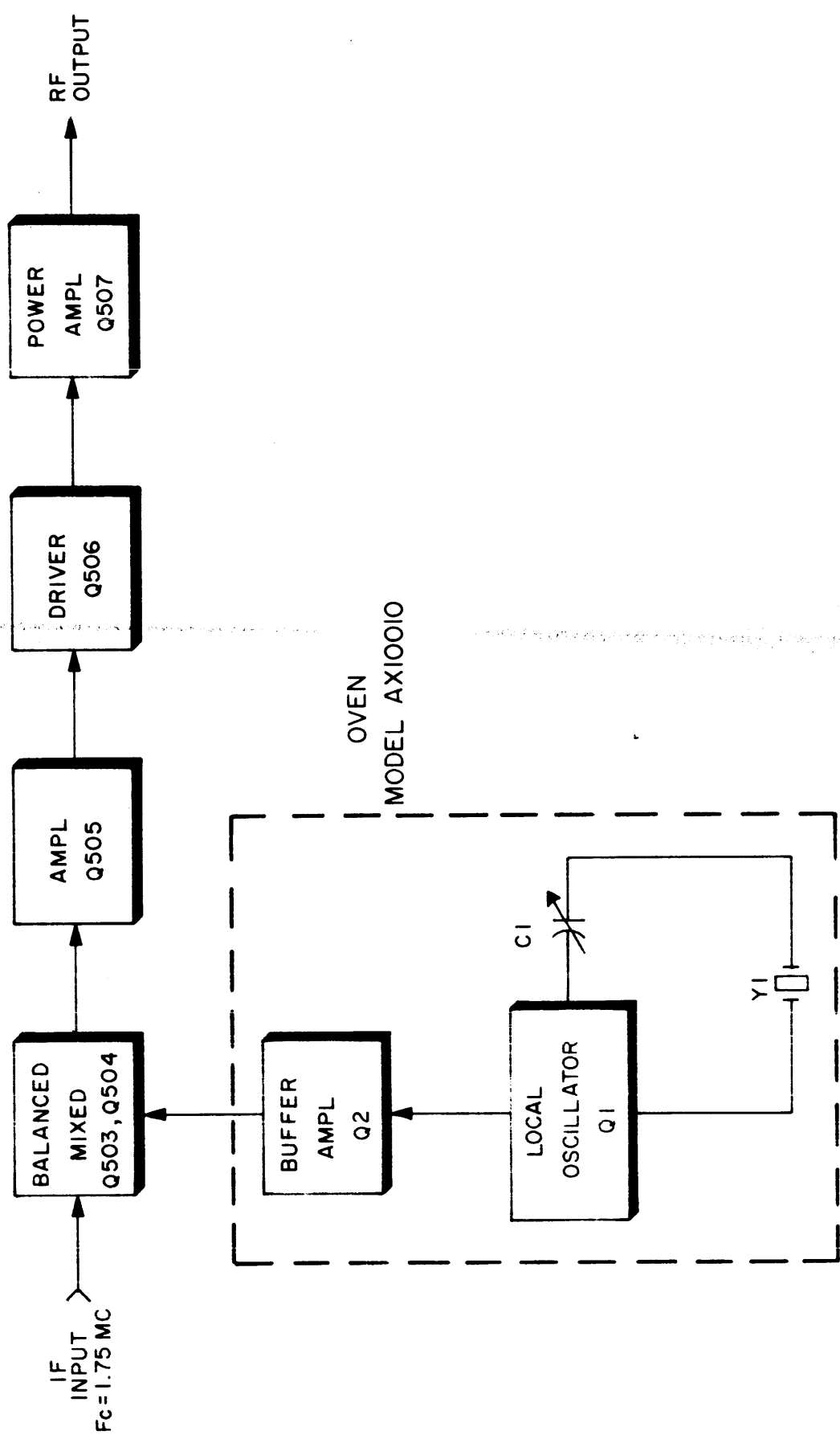


FIGURE 4-1. SIMPLIFIED BLOCK DIAGRAM, TTRT-1B

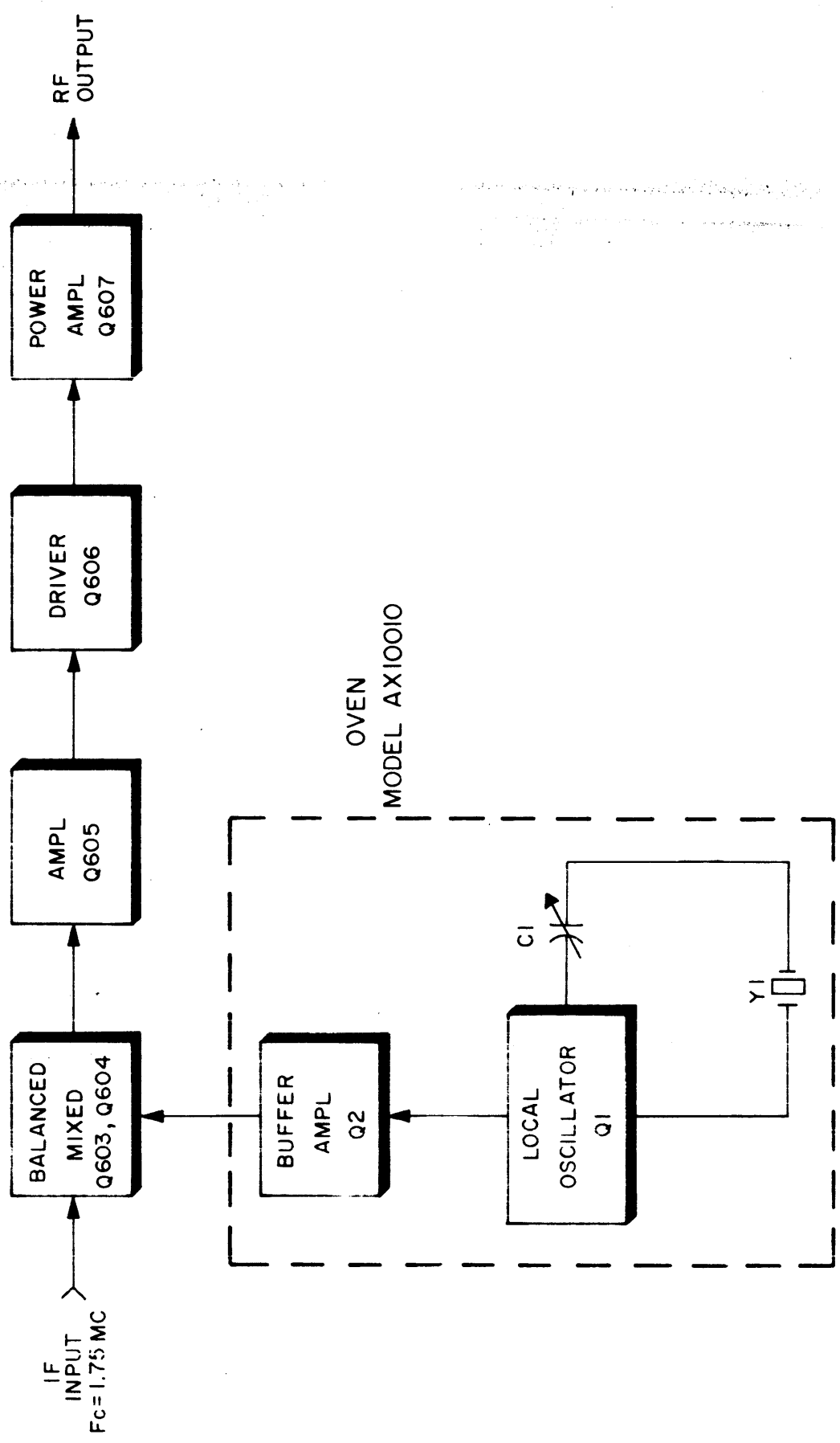


FIGURE 4-2. SIMPLIFIED BLOCK DIAGRAM, TTRT-2B

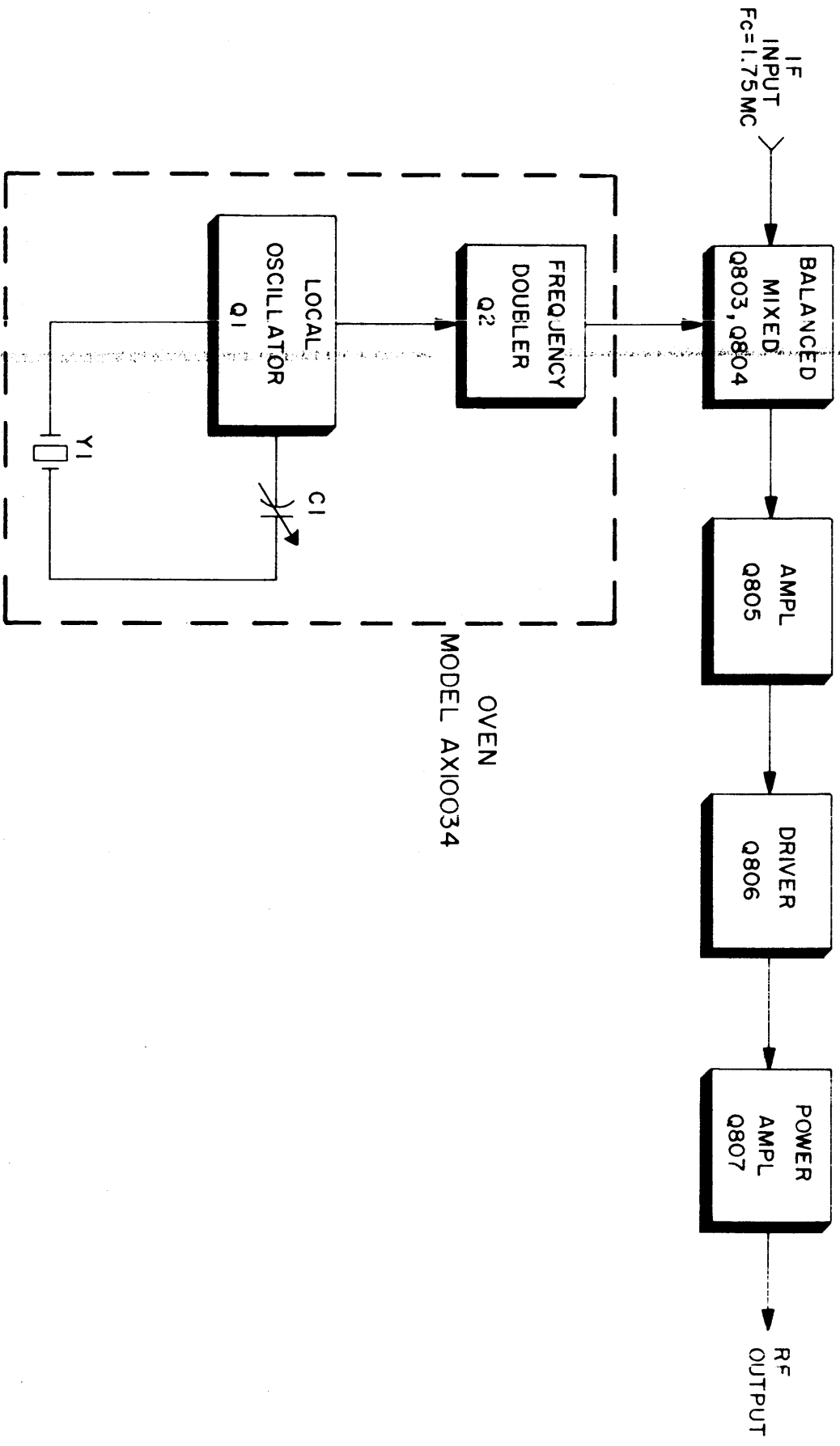


FIGURE 4-4. SIMPLIFIED BLOCK DIAGRAM, TTRT-4B

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 discolored components, damaged wiring, broken or loose solder connections, leaking capacitors, and warped printed circuit board. Clean the components with a soft brush, vacuum cleaner, or dry, filtered, compressed air. Check all hardware for tightness.

5-2. TROUBLESHOOTING.

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

TABLE 5--1. TEST EQUIPMENT

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

- a. Remove TTRT module from the associated exciter.
- b. Remove right-side cover of TTRT.
- c. Re-connect module to exciter; if necessary use service extension module (supplied with exciter) to gain access to alignment controls and interior of TTRT.
- d. Connect a 47 ohm 1/2 watt dummy load to exciter output. If the exciter output is not accessible, disconnect wire from pin 3 of module receptacle, and connect a 47 ohm 1/2 watt resistor between pin 3 and ground.

e. Check the following d-c supply voltages at the receptacle:

(1) +12 v at pin 1

(2) -12 v at pin 8

(3) -36 v at pin 7

If these voltages are not present, check power supply circuitry of associated exciter.

f. Check rf signal of oven output (white lead) or center tap of transformer T601 with an oscilloscope, level should be approximately 2 V peak-to-peak. If this level is not observed, check local oscillator Q1 and buffer Q2.

g. Adjust exciter to deliver a locked key MCW signal to the TTRT. Check signal level at pin 6 of module receptacle with oscilloscope; level should be approximately 45 mv peak-to-peak. If this level is not observed, check a-f and i-f circuitry of associated exciter.

h. Measure r-f signal at output of TTRT module after tuning with oscilloscope (across dummy load resistor). Level should be approximately 8 v peak-to-peak. If this level is not observed, check circuitry of mixer stage and r-f amplifiers.

### 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.

#### N O T E

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 semiconductor 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.

#### C A U T I O N

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.

After repairing or replacing a component in the TTRT, the unit must be checked for alignment.

Proceed as follows:

#### C A U T I O N

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

- a. Remove TTRT module from the associated exciter.
- b. Remove right-side cover of TTRT.
- c. Re-connect module to exciter; if necessary, use service extension module (supplied with exciter) to gain access to alignment controls and interior of TTRT.

#### N O T E

For TTRT-4 alignment only: connect oscilloscope to center tap of transformer T601 (test point 2). Adjust screw F to obtain maximum deflection on scope. Connect frequency counter to vertical amplifier output of oscilloscope. Check that frequency multiplier output is approximately 1.75 MHz above TTRT operating frequency.

- d. Set R513 (R613, R713, or R813) maximum counterclockwise or maximum clockwise. Connect oscilloscope to stator of adjustment E capacitor; adjust screw E for maximum deflection on oscilloscope. Adjust R513 for minimum deflection on oscilloscope.



e. Adjust associated exciter to deliver a locked key MCW signal.

### C A U T I O N

When performing steps f, g, and h, below, keep r-f drive as low as possible (screw D) consistent with usable oscilloscope deflection. Excess r-f drive may damage the power amplifier transistor.

f. Adjust screw E to obtain maximum deflection on oscilloscope.

g. Connect oscilloscope to stator of screw C capacitor; Adjust screw D to obtain a slight deflection on oscilloscope; adjust screws C and E ( in that order) to obtain maximum deflection on oscilloscope.

h. Connect oscilloscope to stator of screw B capacitor; adjust screw B, E, and C to obtain maximum deflection on oscilloscope. Disconnect oscilloscope and replace right-side cover of TTRT.

i. Connect oscilloscope across dummy load at output of exciter (or across resistor at output of module). Adjust screws A, F, E, C, and B to obtain maximum deflection on oscilloscope. Adjust screw D until signal level across dummy load resistor is approximately 8 v peak-to-peak. If output signal is excessively distorted (refer to figure 5-2), readjust screws A and D.

### N O T E

A 30-minute warm-up is required before performing step j.

j. Adjust exciter to deliver an unmodulated carrier signal. Connect counter to oscilloscope vertical amplifier output; adjust local oscillator trimmer capacitor until exact desired output frequency is obtained.

#### 5-5. DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY.

Each TTRT module may be equipped with two local oscillator crystals. Care should be taken that the desired transmission frequencies fall within the r-f bandpass of the amplifier stages.

N O T E

The desired sideband of the signal to be transmitted must also fall within the 0.5% r-f bandpass.

EXAMPLE:

If a TTRT module has been aligned at 4020 kc, appropriate crystals may be installed for transmission on any two frequencies between 4010 and 4030 kc.

a. TTRT-1, TTRT-2, TTRT-3.

The local oscillator operates approximately 1750 kilocycles above the signal to be transmitted.

$$f_x = f_o + 1750 \text{ kc}$$

Where:

$f_x$  = local oscillator crystal frequency (in kilocycles).

$f_o$  = frequency of signal to be transmitted (in kilocycles).

b. TTRT-4.

Transmitter Converter, Model TTRT-4 has a frequency doubler stage between its local oscillator and mixer; therefore, the formula is modified.

$$f_x = \frac{f_o + 1750 \text{ kc}}{2}$$

c. CW, FSK, and FAX.

For CW, FSK, or FAX transmissions, the exciters in which the TTRT module is used may provide an i-f signal slightly displaced from 1750 kc. For CW operation, the i-f output of the exciter would be 1749 or 1751; therefore, the formula becomes:

$$f_x = f_o + 1751 \text{ kc}$$

or

$$f_x = f_o + 1749 \text{ kc}$$

For FSK or FAX transmission, the i-f signal displacement will be equal to the center frequency of the tone telegraph terminal used with the exciter. The local oscillator in the TTRT must be displaced to compensate for this.

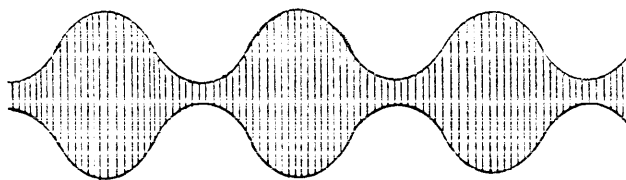
EXAMPLE:

If a tone telegraph terminal that has an output center frequency of 2550 cps is used with the exciter, the crystal frequency formula would become:

$$f_x = f_o + 1752.55$$

or

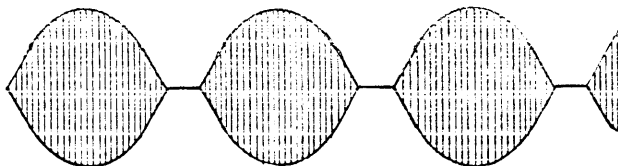
$$f_x = f_o + 1747.45$$



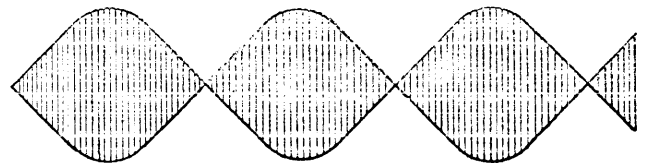
a) INCORRECT SIDEBAND/CARRIER POWER RATIO



c) EXCESSIVE DISTORTION (POSITIVE CLIPPING)



b) EXCESSIVE DISTORTION (NEGATIVE CLIPPING)



d) CORRECT MODULATION ENVELOPE

FIG. 5-2 MODULATION ENVELOPES

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 part 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.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C502	CAPACITOR, VARIABLE, AIR DIELECTRIC: capacitance range 3.2 to 50 uuf; 19 plates.	CT103-1
C503 thru C505	Same as C502.	
C512	CAPACITOR, FIXED, MICA DIELECTRIC: 180 uuf, $\pm 10\%$ ; 500 WVDC; char. B.	CM15B161K
C513	CAPACITOR, FIXED, MICA DIELECTRIC: 33 uuf, $\pm 5\%$ ; 500 WVDC; char. B.	CM15B330J
C514	Same as C513.	
C515	CAPACITOR FIXED, CERAMIC, DISC: 25000 pf, $+80\%$ $-20\%$ , 500 WVDC.	CC100-25
C516	Same as C515.	
C517	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2.0 uuf, $\pm 0.25$ uuf; 500 WVDC; char. RH.	CC20RH020C
C518	Same as C515.	
C519	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, $+30\%$ $-20\%$ ; 25 WVDC.	CC100-33
C520	Same as C515.	
C521	Same as C519.	
C522	Same as C519.	
C523	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, 6WV; 500 WVDC.	CC100-16
C524	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, $+50\%$ $-15\%$ 60 WVDC.	CE107-1
C525 thru C527	Same as C523.	
C528	Same as C523.	
C529	Same as C523.	
C531	Same as C519.	

## TRANSMITTER CONVERTER MODULE, TRPT-1B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R517	RESISTOR, FIXED, COMPOSITION: 68 ohms, $\pm 10\%$ ; 1/2 watt	RC20GF680K
R518	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF222K
R519	Same as R514.	
R520	Same as R518.	
R521	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, $\pm 10\%$ , 1/2 watt.	RC20CF123K
R522	Same as R511.	
R524	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 10\%$ ; 1/2 watt	RC20GF470K
R525	Same as R514.	
T501	TRANSFORMER, RADIO FREQUENCY: primary inductance not rated.	TZ141
T502	TRANSFORMER, RADIO FREQUENCY: primary inductance 100 uh, $\pm 15\%$ .	TZ142
T503	TRANSFORMER, RADIO FREQUENCY: primary inductance 100 uh, $\pm 15\%$ .	TZ143
T504	TRANSFORMER, RADIO FREQUENCY: primary inductance 100 uh, $\pm 15\%$ .	TZ144
T505	TRANSFORMER, RADIO FREQUENCY: primary inductance 100 uh, $\pm 15\%$ .	TZ145
W501	CABLE ASSEMBLY, SHIELDED: 2 conductor wire.	CA308-1
W502	CABLE ASSEMBLY, RF: RG168/U type coaxial cable; no ferrules.	CA418-9

TRANSMITTER CONVERTER MODULE, TRF-2B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C602	CAPACITOR, VARIABLE, AIR DIELECTRIC: capacitance range 3.2 to 50 uuf; 19 plates.	CT103-1
C603 thru C605	Same as C602.	
C612	CAPACITOR, FIXED, MICA DIELECTRIC: 82 uuf, $\pm 5\%$ ; 500 WVDC; char. B.	CM15B320J
C613	CAPACITOR, FIXED, MICA DIELECTRIC: 33 uuf, $\pm 5\%$ ; 500 WVDC; char. B.	CM15B330J
C614	Same as C613.	
C615	CAPACITOR, FIXED, CERAMIC: 10,000 pf, 50V, 500 WVDC	CC100-16
C616	Same as C615.	
C617	CAPACITOR, FIXED, MICA DIELECTRIC: 2.0 uuf, $\pm 0.25$ uuf; 500 WVDC; char. BH.	CC20RH020C
C618	Same as C615.	
C619	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, $+30\%$ $-20\%$ ; 25 WVDC.	CC100-33
C620	Same as C615.	
C621	Same as C619.	
C622	Same as C619.	
C623	Same as C615.	
C624	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, $+50\%$ $-15\%$ ; 50 WVDC.	CA107-1
C625 thru C627	Same as C615.	
C628	Same as C615.	
C629	Same as C615.	
C631	Same as C619.	
C632	Same as C615.	

TRANSISTOR CONVERTER MODULE, TTRT-2E

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R633	Same as R619.	
R634	Same as R619.	
R602	COIL, RADIO FREQUENCY: fixed; 0.270 mh, 5.8 ohms dc res.	CL275-271
R603 thru R605	COIL, RADIO FREQUENCY: fixed; 0.27 mh, $\pm 10\%$ , 200 ma.	CL140
Q603 thru Q606	TRANSISTOR: germanium; PNP; JEDEC type 2N2034 transistor with a controlled life limit of 100-150; JEDEC type TC33 case.	TX109/2N2034
Q607	TRANSISTOR: silicon, NPN; JEDEC type 2N2219A transistor with beta linearity charastics.	TX100/2N2219A
R600	RESISTOR, FIXED, COMPOSITION: 39 ohms, $\pm 5\%$ ; 1/2 watt	RC20GF390J
R601	RESISTOR, VARIABLE, COMPOSITION: 500 ohms, $\pm 10\%$ , 0.5 watt at 70 C, 350 v RMS, linear taper.	RV106UX8B501A
R609	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, $\pm 5\%$ , 1/2 watt	RC20GF123J
R610	Same as R609.	
R611	RESISTOR, FIXED, COMPOSITION: 560 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF561K
R612	Same as R611.	
R613	RESISTOR, VARIABLE, COMPOSITION: 500 ohms, $\pm 10\%$ ; nom. power rating 0.25 watts at 70 c; linear taper.	RV111U501A
R614	RESISTOR, FIXED, COMPOSITION: 330 ohms, $\pm 10\%$ , 1/2 watt.	RC20GF331K
R615	Same as R614.	
R616	Same as R601.	
R617	RESISTOR, FIXED, COMPOSITION: 68 ohms, $\pm 10\%$ ; 1/2 watt	RC20GF680K
R618	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF222K
R619	Same as R614.	



TRANSMITTER CONVERTER MODULE, TWT-2B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R620	Same as R618.	
R621	RESISTOR, FILMED, COMPOSITION: 12,000 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF123K
R622	Same as R611.	
R623	RESISTOR, FILMED, COMPOSITION: 47 ohms, $\pm 10\%$ ; 1/2 watt	RC20GF470K
R625	Same as R611.	
T601	TRANSFORMER, RADIO FREQUENCY: primary inductance not noted.	TZ141
T602	TRANSFORMER, RADIO FREQUENCY: primary inductance 29 $\mu$ , $\pm 15\%$ .	TZ146
T603	TRANSFORMER, RADIO FREQUENCY: primary inductance 29 $\mu$ , $\pm 15\%$ .	TZ147
T604	TRANSFORMER, RADIO FREQUENCY: primary inductance 29 $\mu$ , $\pm 15\%$ .	TZ148
T605	TRANSFORMER, RADIO FREQUENCY: primary inductance 30 $\mu$ , $\pm 15\%$ .	TZ149
W601	CABLE ASSEMBLY, SHIELDED: 2 conductor wire.	CA308-1
W602	CABLE ASSEMBLY, RF: RG138/U coaxial cable; no ferrites.	CA418-9

TRANSMITTER CONVERTER MODULE, TTMT-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
0702	CAPACITOR, VARIABLE, AIR DIELECTRIC: capacitance range 3.2 to 50 uuf; 19 plates.	CT103-1
0703 Chm 0705	Same as 0702.	
0709	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; char. P.	CML5B101J
0712	Same as 0709.	
0713	CAPACITOR, FIXED, MICA DIELECTRIC: 33 uuf, ±5%; 500 WVDC; char. B.	CML5B330J
0714	Same as 0713.	
0715	CAPACITOR, FIXED, CERAMIC: 10,000 pf, 63V, 500 WVDC.	CC100-16
0716	Same as 0715.	
0717	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2.0 uuf, ±0.25 uuf; 500 WVDC; char. M.	CC20RH020C
0718	Same as 0715.	
0719	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, ±30% -20%; 25 WVDC.	CC100-33
0720	Same as 0715.	
0721	Same as 0719.	
0722	Same as 0715.	
0723	Same as 0715.	
0724	CAPACITOR, FIXED, NIKOTRONIC: 50 uuf, +50% -15%; 50 WVDC.	CE107-1
0725 Chm 0727	Same as 0715.	
0728	Same as 0715.	
0729	Same as 0715.	
0730	Same as 0719.	

TRANSMITTER CONVERTER MODULE, TTRT-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
0732	Same as 0715.	
0733	Same as 0719.	
0734	Same as 0719.	
1702	COIL, RADIO FREQUENCY: fixed; 220 oh, .	CL275-221
1703	COIL, RADIO FREQUENCY: fixed; 220 oh, $\pm 10\%$ ; copper wire; rating 200 ma; welded case.	CL140-6
1704	Same as 1703.	
1705		
1706	TRANSISTOR: germanium, PNP; JEDMC type 2N2084; transistor with a controlled life limit of 100-150; JEDMC type 7033 case.	TK109/2N2084
1707	TRANSISTOR: silicon, NPN; JEDMC type 2N2219A; transistor with beta linearity characteristics.	TK100/2N2219A
1708	RESISTOR, FILM, COMPOSITION: 39 ohms, $\pm 5\%$ ; 1/2 watt	RC20GF390J
1709	RESISTOR, VARIANTE, COMPOSITION: 500 ohms, $\pm 10\%$ ; 1/2 watt.	RW106UM3B501A
1710	RESISTOR, FILM, COMPOSITION: 18,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF183J
1711	Same as 1709.	
1712	RESISTOR, FILM, COMPOSITION: 560 ohms, $\pm 10\%$ ; 1/2	RC20GF561K
1713	Same as 1712.	
1714	RESISTOR, VARIANTE, COMPOSITION: 500 ohms, $\pm 10\%$ ; pot. power rating 0.25 watt at 70 C; linear taper.	RW111U501A
1715	RESISTOR, FILM, COMPOSITION: 330 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF331K
1716	Same as 1715.	
1717	Same as 1701.	
1718	RESISTOR, FILM, COMPOSITION: 40 ohms, $\pm 10\%$ ; 1/2 watt	RC20GF400J
1719	RESISTOR, FILM, COMPOSITION: 2,200 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF222K

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R719	Same as R714.	
R720	Same as R718.	
R721	RESISTOR, FILLED, COMPOSITION: 12,000 ohms, $\pm 10\%$ ; 1/2 watt.	R020CF123K
R722	Same as R721.	
R724	RESISTOR, FILLED, COMPOSITION: 47 ohms, $\pm 10\%$ ; 1/2 watt.	R020GF470K
R725	RESISTOR, FILLED, COMPOSITION: 150 ohms, $\pm 10\%$ ; 1/2 watt.	R020CF151K
T701	TRANSFORMER, RADIO FREQUENCY: primary inductance not rated.	TZ141
T702	TRANSFORMER, RADIO FREQUENCY: primary inductance 9.0 uh, $\pm 10\%$ .	TZ150
T703	TRANSFORMER, RADIO FREQUENCY: primary inductance 7.9 uh, $\pm 10\%$ .	TZ151
T704	TRANSFORMER, RADIO FREQUENCY: primary inductance 9.0 uh, $\pm 10\%$ .	TZ152
T705	TRANSFORMER, RADIO FREQUENCY: primary inductance 7.9 uh, $\pm 10\%$ .	TZ153
C701	CABLE ASSEMBLY, SHIELDED: 2 conductor wire.	CA300-1
C702	CABLE ASSEMBLY, RF: KH105/0 type coaxial cable; no terminals.	CA418-9

TRANSFORMER CONVERTER MODULE, TRST-1B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C401	CAPACITOR, FILLED CERAMIC: 10,000 pf, GRV, 500 WVDC	C0100-16
C407	CAPACITOR, FILLED, MICA DIELECTRIC: 15 uuf, $\pm 5\%$ ; 500 WVDC; char. B.	C0150150
C408	CAPACITOR, VARIABLE: 9-35 pf, 100 WVDC.	CV112-2
C409	CAPACITOR, FILLED, MICA DIELECTRIC: 33 pf, $\pm 5\%$ ; 500 WVDC.	C0153330J
C410	Same as C401.	
C411	Same as C401.	
C412	CAPACITOR, VARIABLE, AIR DIELECTRIC: capacitance range 3.2 to 50 uuf; 18 plates.	CT103-1
C413	CAPACITOR, FILLED, CERAMIC DIELECTRIC: 2.0 uuf, $\pm 0.25$ uuf; 500 WVDC; char. KH.	C020PH2R2C
C414	Same as C412.	
C415	Same as C401.	
C416	Same as C401.	
C417	Same as C412.	
C418	CAPACITOR, FILLED, ELECTROLYTIC: 50 uf, $+50\%$ $-15\%$ ; 40 WVDC.	C0107-1
C419	Same as C412.	
C420	Same as C401.	
C421, C422, C423, C424, C425	Same as C401.	
C427	CAPACITOR, FILLED, CERAMIC DIELECTRIC: 200,000 uuf, $\pm 20\%$ $-20\%$ ; 35 WVDC.	C0100-33
C429	Same as C401.	
C430	Same as C427.	
C431	Same as C401.	
C432	Same as C407.	
C433	CAPACITOR, VARIABLE, MICA DIELECTRIC: capacitance range 3 to 75 uuf.	CT103-2

TRANSMITTER CONVERTER MODULE, TTRT-4B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q334	Same as Q301.	
Q335	Same as Q327.	
L301	COIL, RADIO FREQUENCY: fixed; 1 uh.	CL10006-3
L302	COIL, RADIO FREQUENCY: fixed; 100 mh, $\pm 10\%$ ; 2.3 ohms DC resistance; molded case.	CL240-100
L303	Same as L302.	
L304		
L305		
Q306 Q306 Q306	TRANSISTOR: 2N2495	2N2495
Q307	TRANSISTOR: silicon, NPN; JFETC type 2N2219A transistor with beta linearity characteristics.	2N2219A
R300	RESISTOR, FIXED, COMPOSITION: 39 ohms, $\pm 5\%$ ; 1/2 watt	RC20CF390J
R307	RESISTOR, FIXED, COMPOSITION: 18,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20CF183J
R308	Same as R307.	
R309	RESISTOR, FIXED, COMPOSITION: 540 ohms, $\pm 10\%$ ; 1/2 watt.	RC20CF561K
R310	Same as R309.	
R311	RESISTOR, FIXED, COMPOSITION: 540 ohms, $\pm 10\%$ ; non-linear power rating 0.25 watt at 70 C; linear taper.	RV111U501A
R312	RESISTOR, FIXED, COMPOSITION: 330 ohms, $\pm 10\%$ ; 1/2 watt.	RC20CF331K
R313		
R314	RESISTOR, VARIABLE, COMPOSITION: 540 ohms, $\pm 10\%$ ; continuous power rating 0.5 watt at 70 C; 550 V RMS; linear taper.	CV106UM33501A
R315	RESISTOR, FIXED, COMPOSITION: 60 ohms, $\pm 10\%$ ; 1/2 watt	RC20CF680K
R316	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$ ; 1/2 watt.	RC20CF222K
R317	Same as R312.	

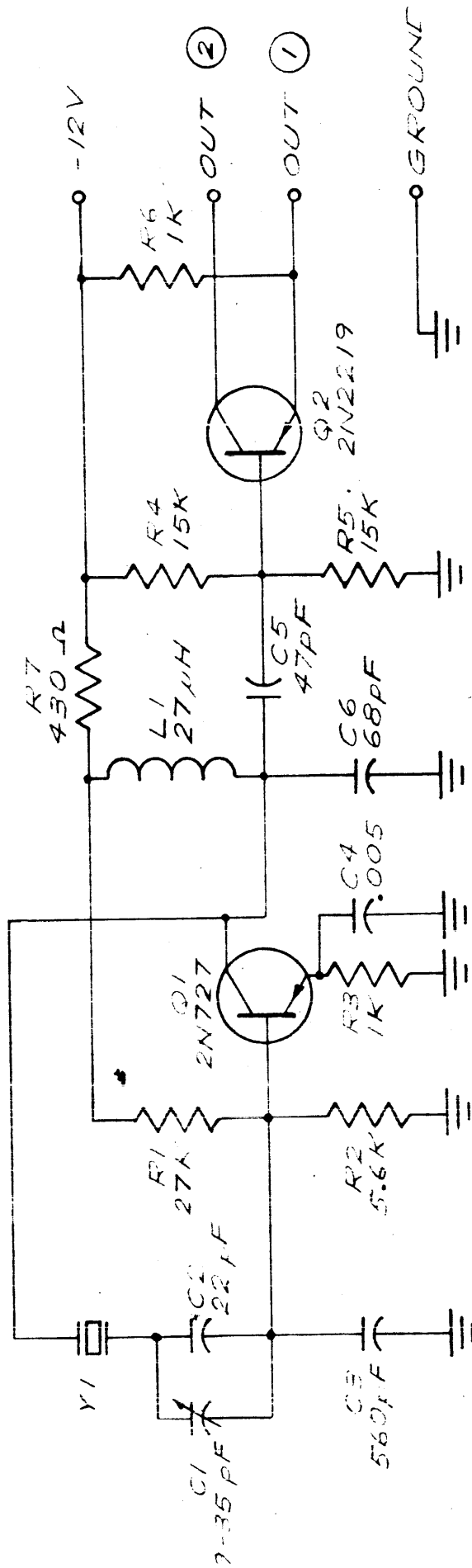
TRANSFORMER COUPLER MODIF, TWT-1B

REF SYMBOL	DESCRIPTION	TYC PART NUMBER
R214	RESISTOR, FILM, COMPOSITION: 47 ohms, $\pm 10\%$ ; 1/2 watt	RC20CF470X
R215	Same as R214.	
R220	RESISTOR, FILM, COMPOSITION: 12,000 ohms, $\pm 10\%$ ; 1/2 watt.	RC20GF123X
R221	Same as R220.	
R227	RESISTOR, FILM, COMPOSITION: 5' ohms, $\pm 10\%$ ; 1/2 watt.	RC20TF560X
R228	TRANSFORMER, RADIO FREQUENCY: primary inductance not stated.	TZ113
R229	TRANSFORMER, RADIO FREQUENCY: primary inductance 1.0 $\mu$ H, $\pm 10\%$ .	TZ154
R230	TRANSFORMER, RADIO FREQUENCY: primary inductance 0.96 $\mu$ H, $\pm 10\%$ .	TZ155
R231	TRANSFORMER, RADIO FREQUENCY: primary inductance 0.96 $\mu$ H, $\pm 10\%$ .	TZ156
R232	TRANSFORMER, RADIO FREQUENCY: primary inductance 0.94 $\mu$ H, $\pm 10\%$ .	TZ157
R201	CABLE ASSEMBLY, SHIELDED: 2 conductor wire.	CA306-1
R202	CABLE ASSEMBLY, WF; 20188/U type coaxial cable; no bounces.	CA428-9

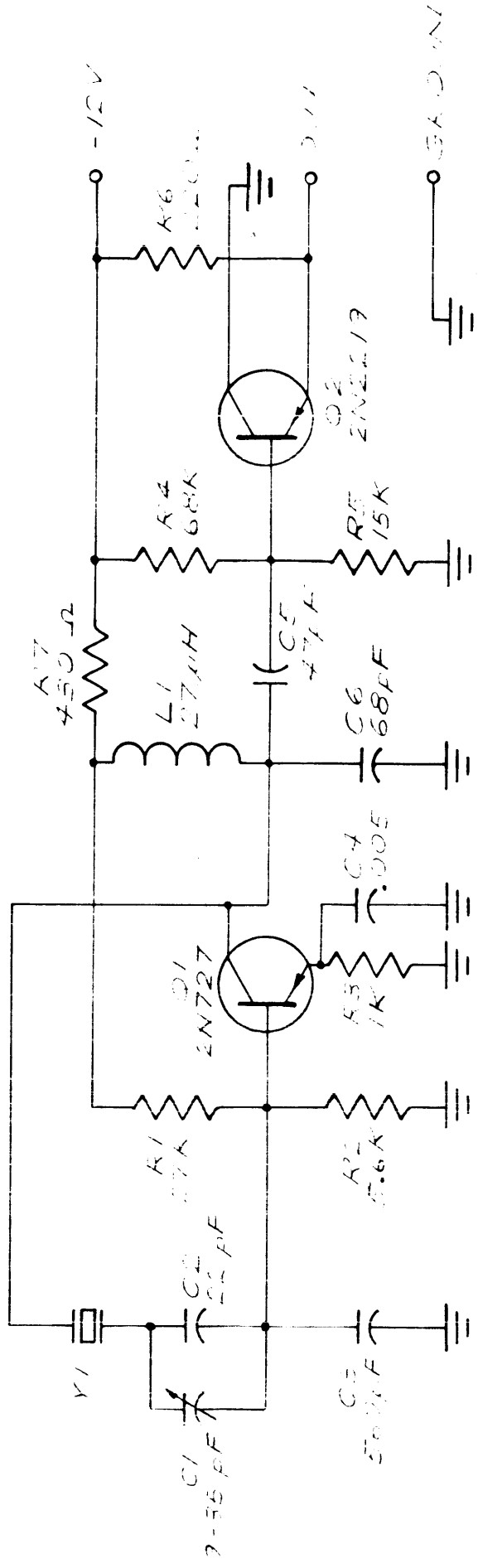
TRANSMITTER, CRYSTAL, OVER MODELS AN10010 & AN10034.

REF SYMBOL	DESCRIPTION	TYC PART NUMBER
	Crystal.	CC10001
07	CAPACITOR, VARIABLE: 9-35 pf, 100 WVDC.	CV12-2
08	CAPACITOR, FIXED, MICA: 22 pf, $\pm 5\%$ , 500 WVDC.	CH11C220J1S
09	CAPACITOR, FIXED, MICA: 560 pf, $\pm 5\%$ , 100 WVDC.	CH10001
04	CAPACITOR, FIXED, CERAMIC: 5000 pf, 50V, 500 WVDC.	CC100-15
15	CAPACITOR, FIXED, MICA: 47 pf, $\pm 5\%$ , 500 WVDC.	CH11C470J1S
01	CAPACITOR, FIXED, MICA: 68 pf, $\pm 5\%$ , 500 WVDC.	CH11C680J1S
12	CRISTAL, RF: 27 mc.	CI 275-270
Q1	TRANSISTOR: 2N727	2N727
Q2	TRANSISTOR: 2N2219A	2N2219A
R1	RESISTOR, FIXED, COMPOSITION: 27K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF273J
R2	RESISTOR, FIXED, COMPOSITION: 5.6K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF562J
R3	RESISTOR, FIXED, COMPOSITION: 1 K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF102J
R4	RESISTOR, FIXED, COMPOSITION: 68K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF683J
R5	RESISTOR, FIXED, COMPOSITION: 15K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF153J
R6	RESISTOR, FIXED, COMPOSITION: 220 ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7CF221J
R7	RESISTOR, FIXED, COMPOSITION: 430 ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF431J
R8	CRYSTAL: (to customer's requirement)	CR110-1-
R9	(15K ohms, $\pm 10\%$ ) RESISTOR, FIXED, COMPOSITION: 15K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF153J
R4	(1K ohms, $\pm 10\%$ ) RESISTOR, FIXED, COMPOSITION: 1 K ohms, $\pm 10\%$ , $\frac{1}{4}$ watt	RCC7GF102J



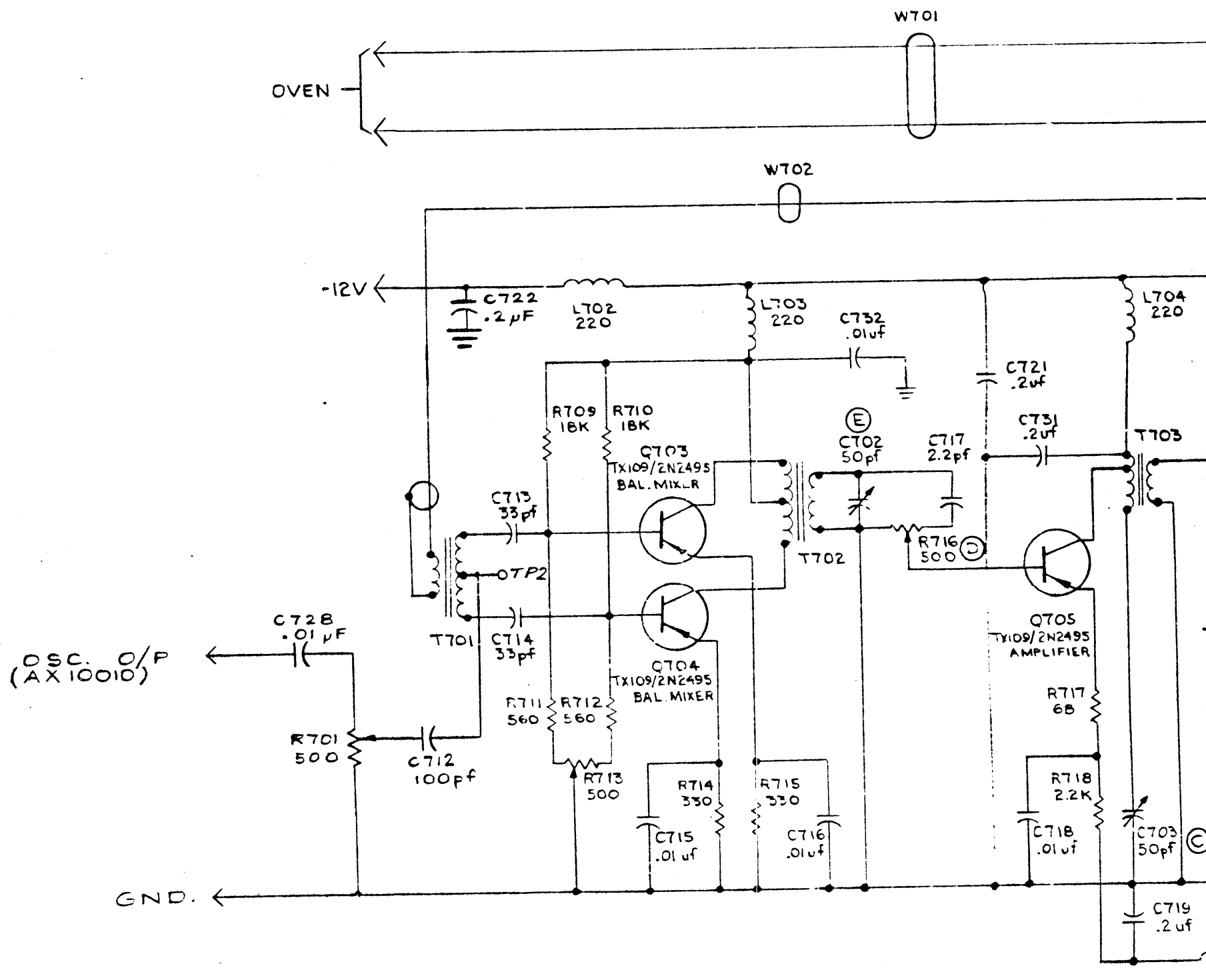


SCHEMATIC TRANSMITTER OSCILLATOR (AX10034)



SCHEMATIC TRANSMITTER OSCILLATOR (MAX 10010)

UNLESS OTHERWISE SPECIFIED						
ISSUE	ITEM	CHANGED FROM	DATE	EN. NO.	DRAWN	CHECKED
2		REL TO PROD	5/6/50		FD	
4		REV FOR CEMN	12/26/50	152	FD	

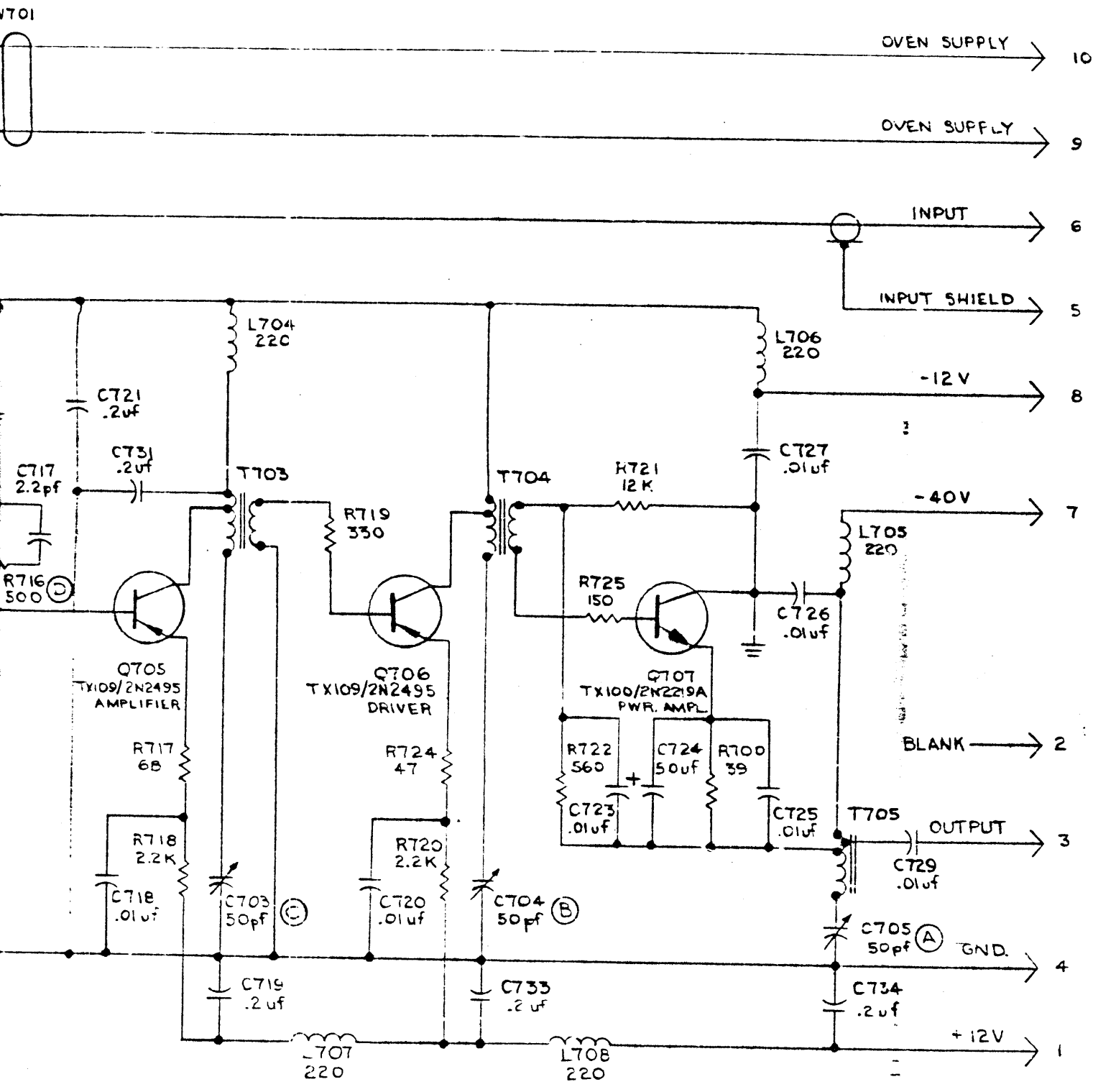


LAST SYMBOLS	MISSING SYMBOLS
C724 L705 Q707 R725 T705	R706

- UNLESS OTHERWISE SPECIFIED
- 1 ALL RESISTORS 1/2 WATT.
  - 2 ALL RESISTANCE VALUES IN OHMS (K=1000)
  - 3 ALL INDUCTANCE VALUES IN  $\mu$ h

TOLERANCES		SCALE
ALL OTHERS	DEC DIM ± FRACTIONAL DIM ± ANGULAR DIM ±	UNLESS OTHERWISE SPECIFIED SIZE AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED

TTRT-38  
MODEL

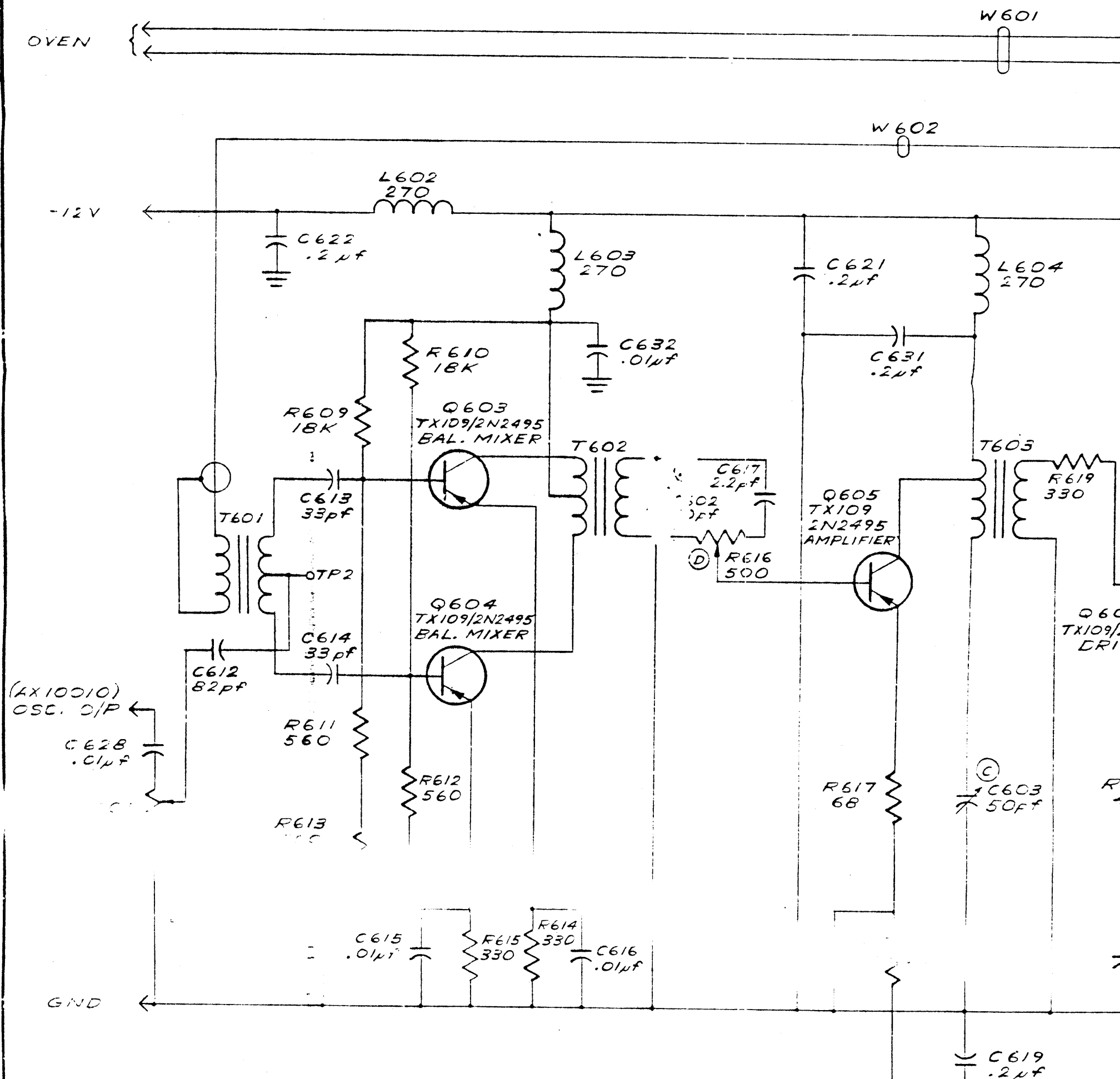


CK10482 A

TTRT-3B	005/66	A10436	3-3-66
MODEL	PROJECT NO	APPY. NO	DATE
USED ON			

STOCK SIZE		TMC (Canada) LIMITED OTTAWA ONTARIO	
MATERIAL		SCHEMATIC	
WEIGHT PER PC		A10436	
TYPE & TEMPER		GAM	
HEAT TREAT SPEC		CRAW	ELEC'DES APP
FINISH & SPEC NO		PLUMMER	MECH DES APP
		CHECKED	FINAL APPROVAL
		CK10482 A	

MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION REMOVE ALL BURRS AND SHARP EDGES						DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED	
ISSUE	ITEM	CHANGED FROM	DATE	CH. NO.	DRAFTS	CHECKED	ENG. APP.
5		REV TO FCC	1-55		1		
4		REV AS PER CEMN	7-55	079	RPL		
3		REV PER CEMN	13176	155	RD		



LAST SYMBOLS
C634
L605
C607
R625
T605
W602

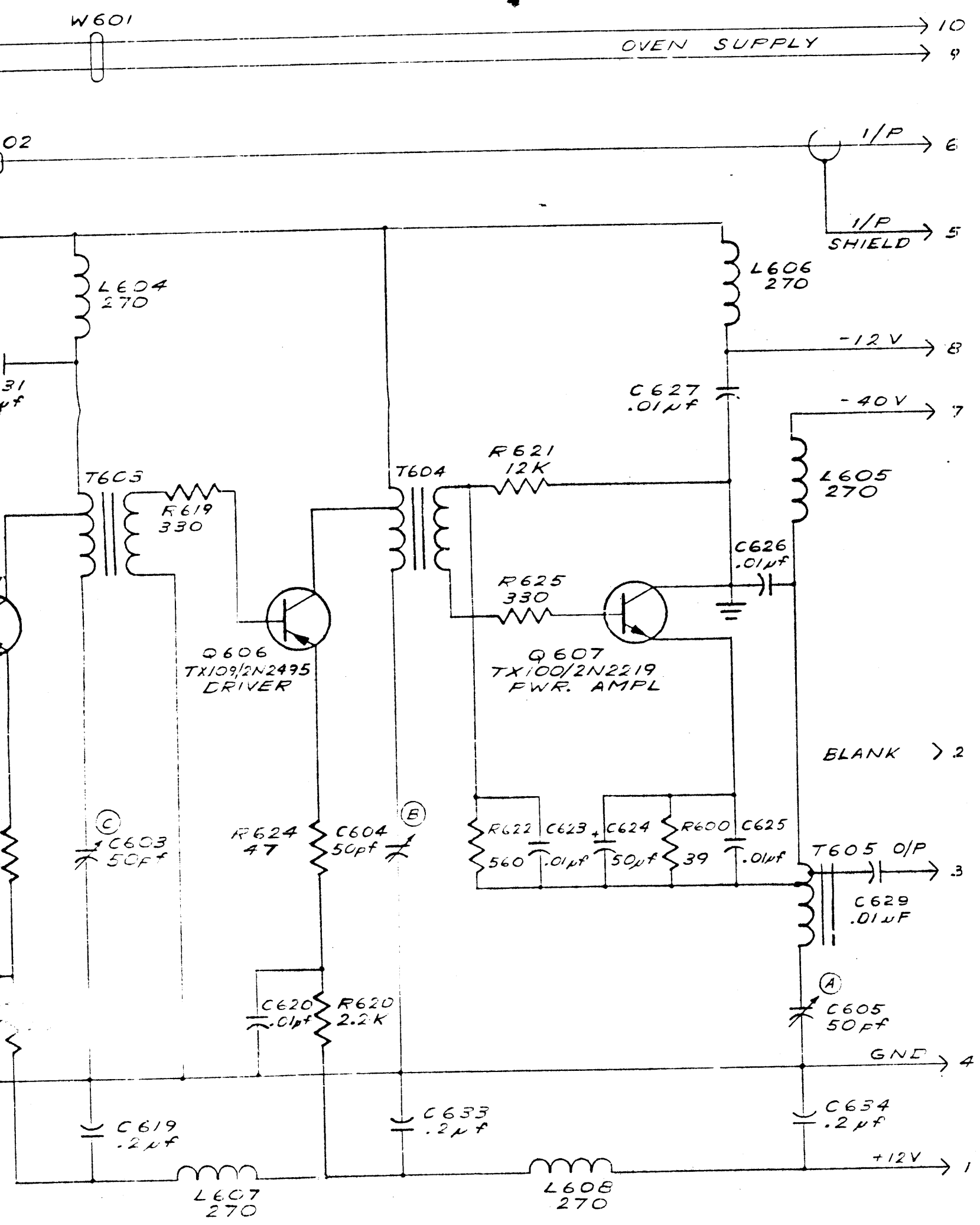
MISSING SYMBOLS
C601
C606
C607
C608
C609
C610
C611
C622
C630
L601
Q601
C602
R602
R603
R604
R605
R606
R607
R608
R625

UNLESS OTHERWISE SPECIFIED  
ALL RESISTANCE IN OHMS, 1/2 W  
ALL INDUCTANCE IN μh

TOLERANCES		SCALE
ALL OTHERS	DIA. DIM ± FOCAL DIM ± ANGULAR DIM ±	DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED

TTRT-2B	OC
MODEL	

REV	ITEM	PART NO	DESCRIPTION	SYMBOL
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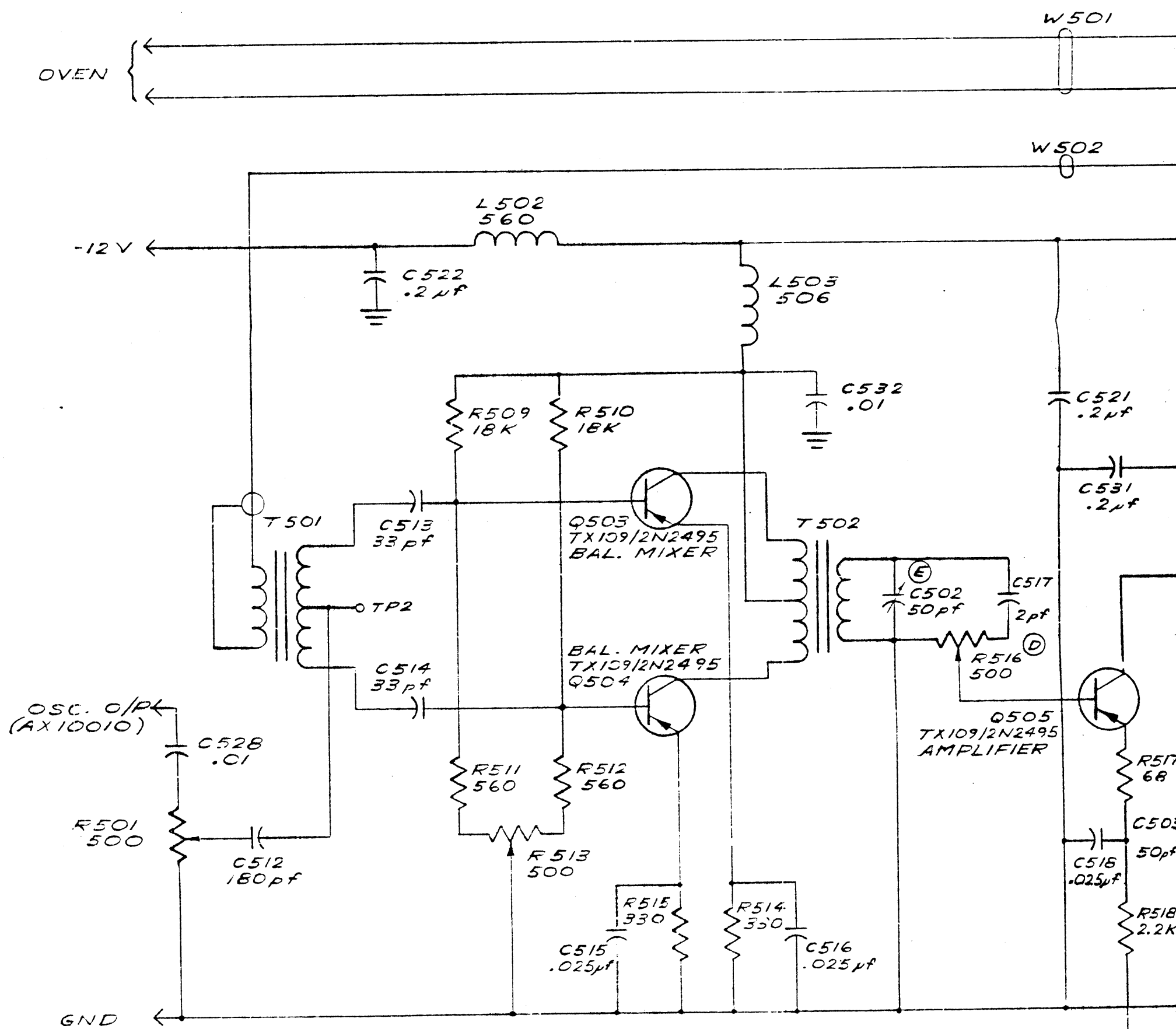
CK10493 C

UNLESS OTHERWISE SPECIFIED  
RESISTORS IN OHMS, 1/2 WATT.  
CAPACITORS IN  $\mu$ F

TTRT-2B	005/66	A10435	3 MAY 66
MODEL	PROJECT NO	ASSY NO	DATE

TMC (Canada) LIMITED OTTAWA ONTARIO			
SCHEMATIC, A10435			
STOCK SIZE			
MATERIAL	WEIGHT PER PC		
TYPE & TEMPER	R/D	ELEC DES APP	MECH DES APP
HEAT TREAT SPEC	CHECKED	FINAL APPROVAL	
FINISH & SPEC NO	FLUMMER	CK10493	C

IF IT IS FOUND DESIRABLE TO CHANGE ANY TOLERANCE OR OTHER DETAIL OF THIS DRAWING NOTIFY THE PURCHASER PROMPTLY						DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED	
MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION REMOVE ALL BURRS AND SHARP EDGES							
ISSUE	ITEM	CHANGED FROM	DATE	EN NO	DRAFTS	CHECKER	ENG APP
5		REV. TO F111	10/2/66		RT		
A		REV. AS PER CEMN	7/66	079	RPL		
B		REV. AS PER CEMN NO.	11/66	082	RPL		
C		REV. PER CEMN	12/66	051	RB		



LAST SYMBOLS
C534
L508
Q507
R525
T505
W502

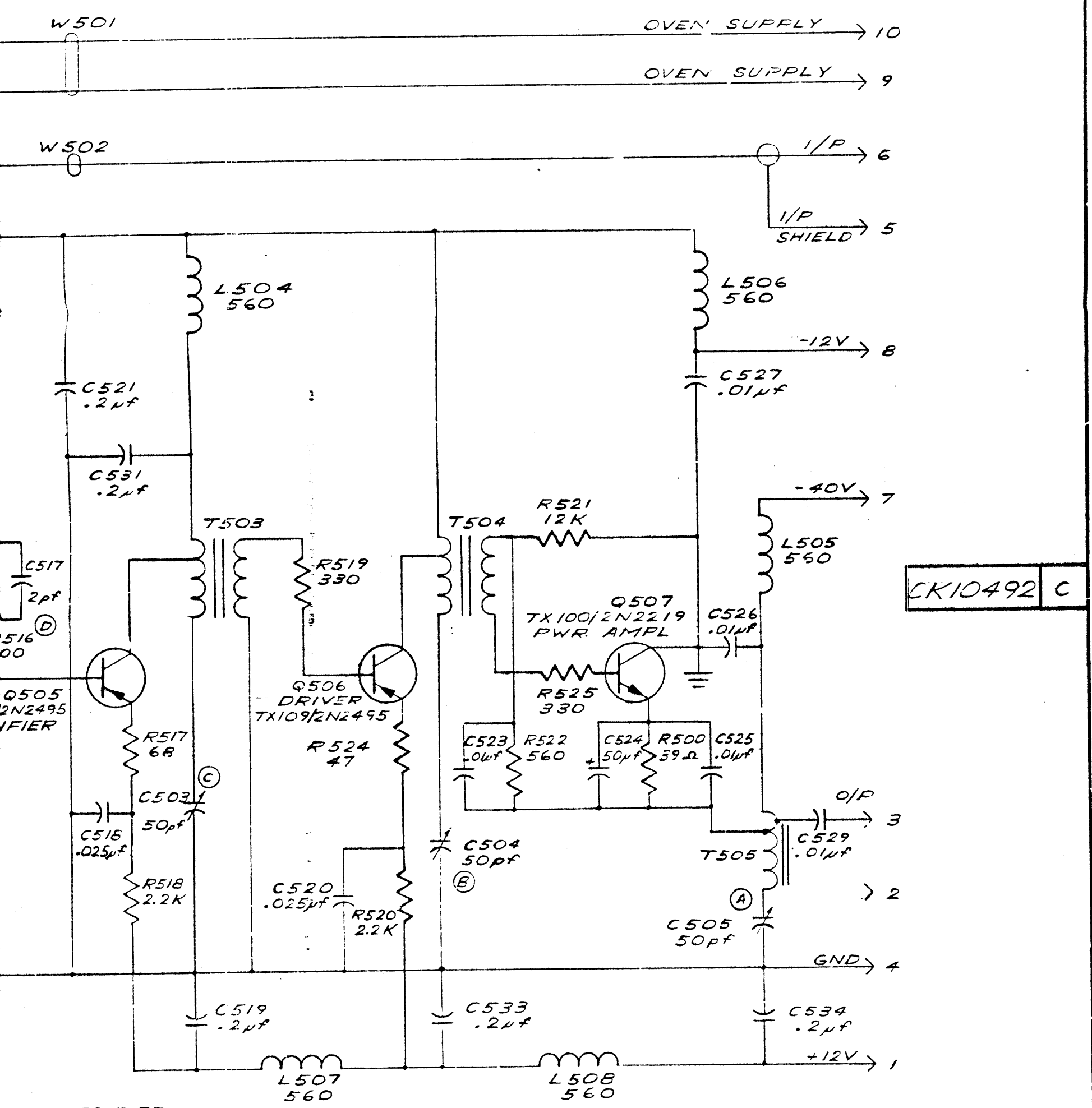
MISSING SYMBOLS
C501
C506
C507
C508
C509
C510
C511
C522
C530
L501
Q501
Q502
R502
R503
R504
R505
R506
R507
R508
R523

UNLESS OTHERWISE SPECIFIED  
ALL RESISTORS IN OHMS, 1/2 WATT  
ALL INDUCTANCE IN  $\mu$ H

TOLERANCES		SCALE
ALL	DEC DIM : FRACTIONAL DIM : ANGULAR DIM :	DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED

TTRT-1B	005
MODEL	PH

REL	ITEM	PART NO.	DESCRIPTION	SYMBOL
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CK10492 C

RESISTORS UNLESS SPECIFIED  
 IN OHMS, 1/2 WATT  
 CAPACITORS IN  $\mu$ F

STOCK SIZE		TMC (Canada) LIMITED	
		OTTAWA ONTARIO	
MATERIAL		SCHEMATIC,	
WEIGHT PER PC		A10434	
TYPE & TEMPER		RD	
NEAT TREAT SPEC		DRAWN	ELEI. DES APP
		PLUMMER	CK10492 C
FINISH & SPEC NO		FINAL APPROVAL	

MODEL	PROJECT NO	ASSY NO	DATE
TTT-1B	005/66	A10434	2 MAY 66

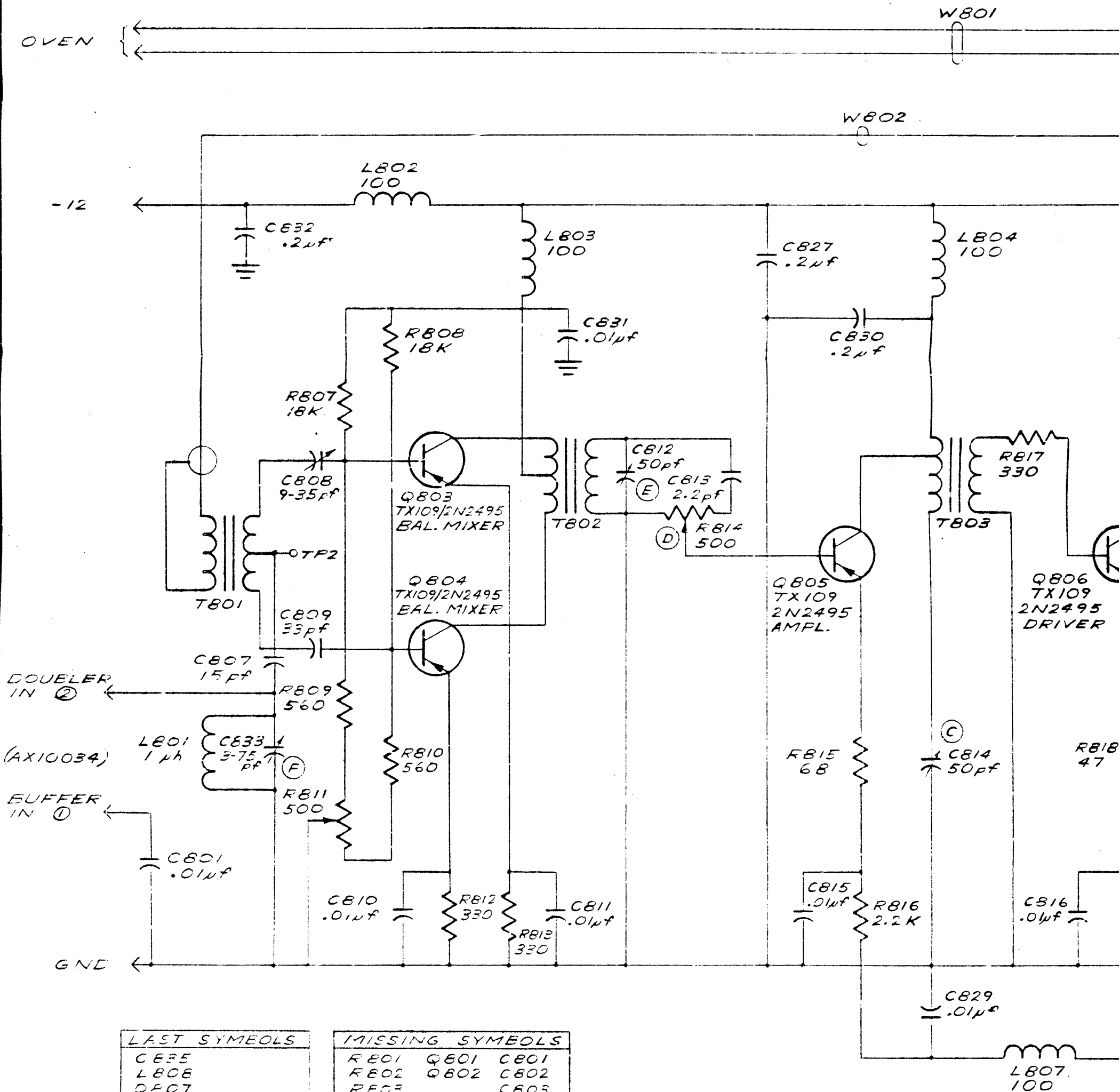


ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED ON THIS DRAWING NOTIFY THE PURCHASER PROMPTLY

DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION REMOVE ALL BURRS AND SHARP EDGES

REV	ITEM	CHANGED FROM	DATE	EN NO	DRAFTS	CHECKER	ENG APP
F		KFL TO PROJ	10-8-66		RD		
A		REV PER CERN	13-12-66	154	RD		



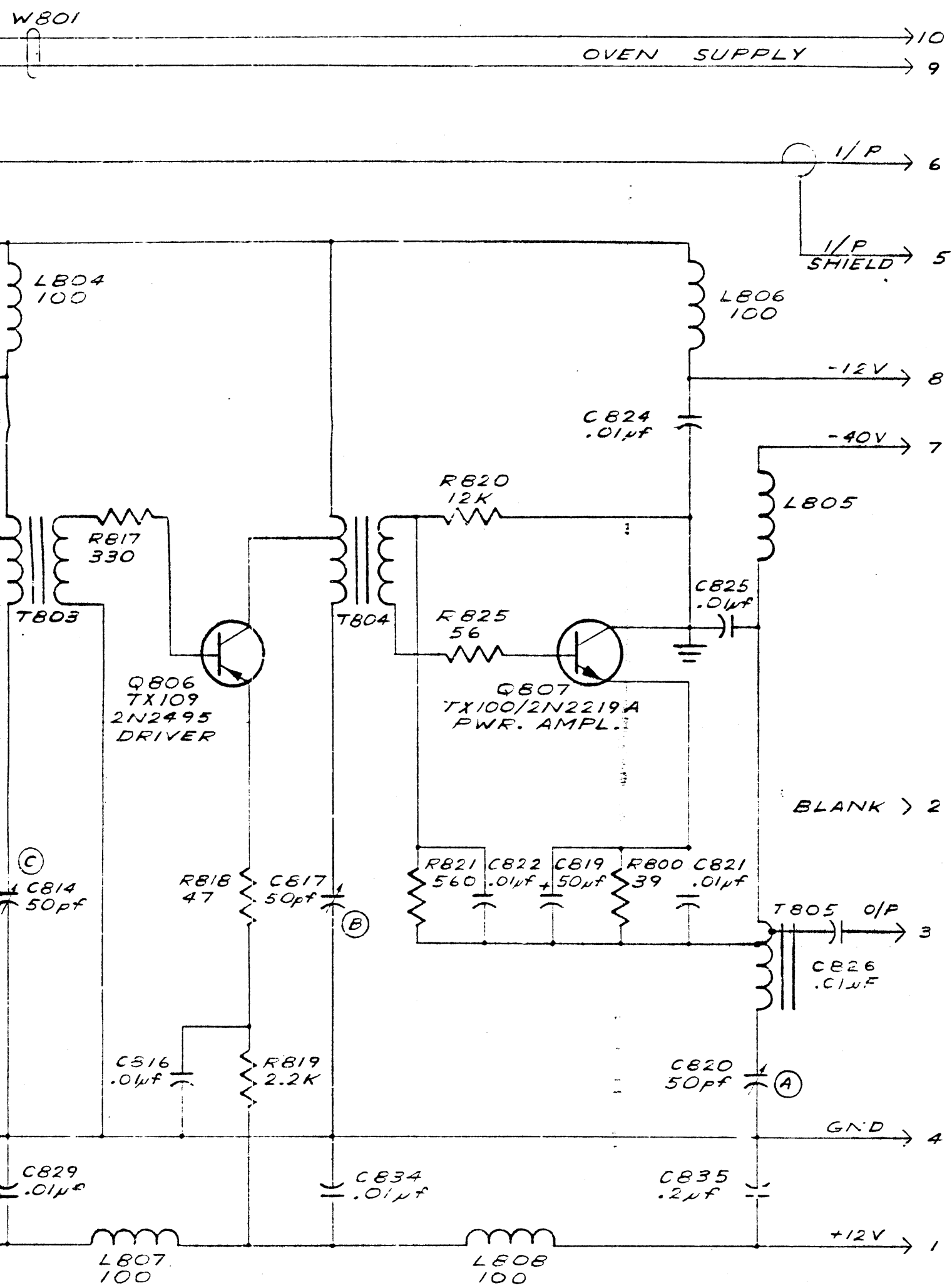
LAST SYMBOOLS
CB35
LB08
Q807
RS25
T805
W802

MISSING SYMBOOLS
RE01
RE02
RE03
RE04
RE05
RE06
RS22
RS23
RS24
Q801
Q802
CB01
CB02
CB03
CB04
CB05
CB06
CB18
CB28
CB32

UNLESS OTHERWISE SPECIFIED  
ALL RESISTORS IN OHMS, 1/2 WATT  
ALL INDUCTORS IN μh

TOLERANCES		SCALE
ALL OTHERS	DEC DIM ± FRAC DIM ± ANGULAR DIM ±	DRILL PUNCH COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED

TTRT-4B	005/6
MODEL	PROJECT



CK10494 A

SPECIFIED  
OHMS, 1/2 WATT  
ph

TRT-4B	005/66	A10437	4-5-66
PROJECT NO	DATE	ASSY NO	DATE
USED ON			

TMC (Canada) LIMITED OTTAWA ONTARIO			
SCHEMATIC - A10437			
RD		ELEC DES APP	
DRAWN		MECH DES APP	
CHECKED		FINAL APPROVAL	
FLUMMER		CK10494 A	