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TECHNICAL MANUAL
for
RECEIVER CONVERTER
MODEL TTRR–C

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

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Foreword

The Receiver Converter modules, Models TTRR–1C, TTRR–2C, TTRR–3C, and TTRR–4C, are physically and functionally similar. Since the operating principles for each module are the same (varying mainly in frequency range) only Model TTRR–1C is explained in this manual. The differences between the modules are appropriately noted in the text and tables.

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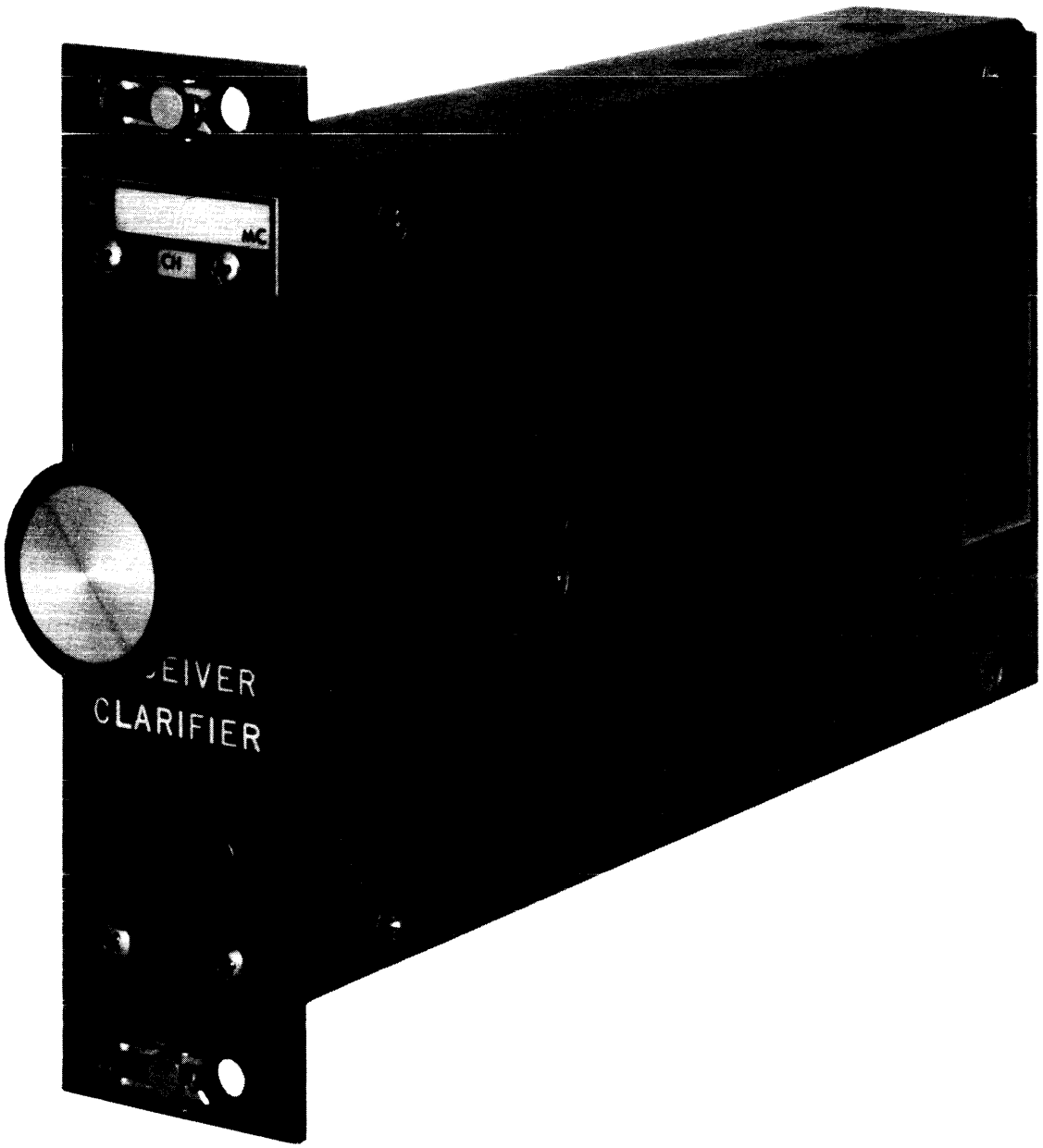


Figure 1–1. Receiver Converter, TTRR–( )C.

Section 1

GENERAL INFORMATION

1–1. FUNCTIONAL DESCRIPTION

The Receiver Converter, Model TTRR–C is a transistorized, fixed-tuned, plug-in rf module that is used with several types of single-sideband receivers. Four modules (Model TTRR–1C, TTRR–2C, TTRR–3C and TTRR–4C) cover the frequency range from 2 to 32 megahertz. Limitations on the mode of operation are dependent upon the receiver in which the TTRR–C is used. The modules may be used for the reception of practically any type of signal, the only limitation being an rf bandpass of approximately 0.5% of the frequency to which the rf amplifiers are tuned.

The TTRR–C contains three high-gain rf amplifiers, a mixer, and a crystal-controlled local oscillator. The gain of the rf amplifier is controlled by an AGC (Automatic gain control) voltage supplied by the associated receiver. A RECEIVER CLARIFIER control (located on the front panel) provides fine-tuning of the oscillator. Frequency stability for the local oscillator is 1 part in 10^6 per day (Oven). The output of the TTRR–C is 1.75 MHz.

1–2. PHYSICAL DESCRIPTION

a. EXTERNAL. – The front panel of the TTRR–C is provided with a knob to facilitate handling the unit when inserting or removing it from the associated receiver. The RECEIVER CLARIFIER control is located on the front panel and a plate identifies the input carrier frequency. The plug-in interchangeability feature of the TTRR–C is provided by an etched connector at the rear of the module; two slide latches on the front panel hold the TTRR–C in place after it has been plugged into the associated receiver. Side covers provide electrostatic shielding and protect the TTRR–C components when the module is removed from the receiver. Each TTRR–C module weighs 1½ pounds, and is 1¼ inches wide, 5⅛ inches high, and 8 inches long.

b. INTERNAL. – Most of the smaller components in the TTRR–C are located on a printed circuit board mounted to the chassis; the remaining components are chassis-mounted. Table 1–1 lists the semiconductor complement of the TTRR–C. (Also refer to the schematic diagrams, figure 7–1 through 7–4.) Each rf section of the TTRR is shielded by removable metal dividers to minimize interaction between stages.

TABLE 1-1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
CR101	1N3019B	Voltage stabilizer
Q101	2N2495	1st rf amplifier
Q102	2N2495	2nd rf amplifier
Q103	2N2495	3rd rf amplifier
Q104	2N2495	Mixer
Q105*	2N2495	Buffer amplifier
Q106	2N2495	Local oscillator
NOTE - Q102 to Q106 may be 2N2084 in the TTRR-1C and TTRR-2C models. * Q105 in the TTRR-4C model functions as a frequency doubler.		

1-3. TECHNICAL SPECIFICATIONS

Technical specifications for the TTRR-C are as follows:-

Frequency range:

TTRR-1C	2-4 MHz
TTRR-2C	4-8 MHz
TTRR-3C	8-16 MHz
TTRR-4C	16-32 MHz
Tuning:	Fixed-tuned
Frequency control:	Crystal-controlled oscillator
Frequency stability:	1 part in 10^6 per day (Oven)
RF bandpass:	Approximately 0.5% of the frequency to which the module is tuned.
Noise figure:	15 dB or better
Input impedance:	50 ohms (nominal) unbalanced
Output:	1.75 MHz if.
Power requirement:	Provided by associated receiver.

Section 2

INSTALLATION

2–1. INITIAL INSPECTION

Each TTRR–C 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 content 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 of 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 TTRR–C is a plug-in module and can be installed in the associated receiver by inserting it into its respective position, no specific installation procedures are given in this manual. Initial installation and test procedures for the TTRR–C are, therefore, given in the associated receiver manual.

Section 3

OPERATOR'S SECTION

3–1. GENERAL

Before attempting to operate the TTRR–C, the operator should familiarize himself with the RECEIVER CLARIFIER control on the front panel. This control is a trimmer capcitor for fine-tuning the local oscillator.

3–2. WARM-UP PERIOD

When a crystal oven is used in the TTRR–C a 30 minute warm-up period is required to attain proper frequency stability.

3–3. OPERATOR'S MAINTENANCE

Operator's maintenance is not required on the TTRR–C modules. Detailed maintenance, trouble-shooting, repair 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 TTRR–C module (TTRR–1C, TTRR–2C, TTRR–3C, and TTRR–4C) are similar, and therefore only the TTRR–1C 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 the TTRR–4C a frequency doubler multiplies the local oscillator output; the difference in operation is noted in the text.

4–2. CIRCUIT ANALYSIS

The rf signal applied to the TTRR–1C is amplified by three common-emitter, tuned-collector, class A amplifiers (Q101, Q102 and Q103). Each of these amplifiers is fixed tuned and will select only one particular signal.

The gain of each rf amplifier is controlled by an externally generated AGC (automatic gain control) signal. The AGC input, a positive voltage, is supplied through the module connector to the emitters of the three amplifiers to forward bias the transistors. The AGC input to each of the three rf amplifiers controls the individual stage gains so that the rf input to mixer Q104 is constant regardless of signal strength.

When the rf signal level is low, the AGC signal is at its maximum value and the transistors are biased to operate on the linear portion of their transfer curves. As the rf signal level and the AGC signal level increases, the operating points of the amplifiers are shifted up the transfer curves into the non-linear region. As the transistors approach saturation, the gain decreases keeping the input to the mixer Q104 relatively constant.

If the AGC input is not connected to the TTRR–C, the gain of the rf amplifiers is fixed by resistor R116 (refer to figures 7–2 through 7–4 for resistor designations for TTRR–2C, TTRR–3C and TTRR–4C).

The output of the third rf amplifier is applied to the mixer Q104; the mixer is also supplied with the output of the local oscillator Q106 through the buffer amplifier Q105, which ensures maximum stability of the local oscillator.

The local oscillator in TTRR–1C, TTRR–2C and TTRR–3C operates 1.75 MHz above the incoming rf signal. The oscillator/doubler in the TTRR–4C operates 1.75 MHz above the incoming rf signal. The oscillator in the TTRR–4C operates between 8.875 and 16.875 MHz; the doubler Q405 multiplies the oscillator output to the range of 17.75 to 33.75 MHz. The RECEIVER CLARIFIER capacitor control is used to fine-tune the local oscillator.

The mixer produces the beat frequency of the rf and local oscillator frequencies; the output circuit of the mixer Q104 is tuned to 1.75 MHz.

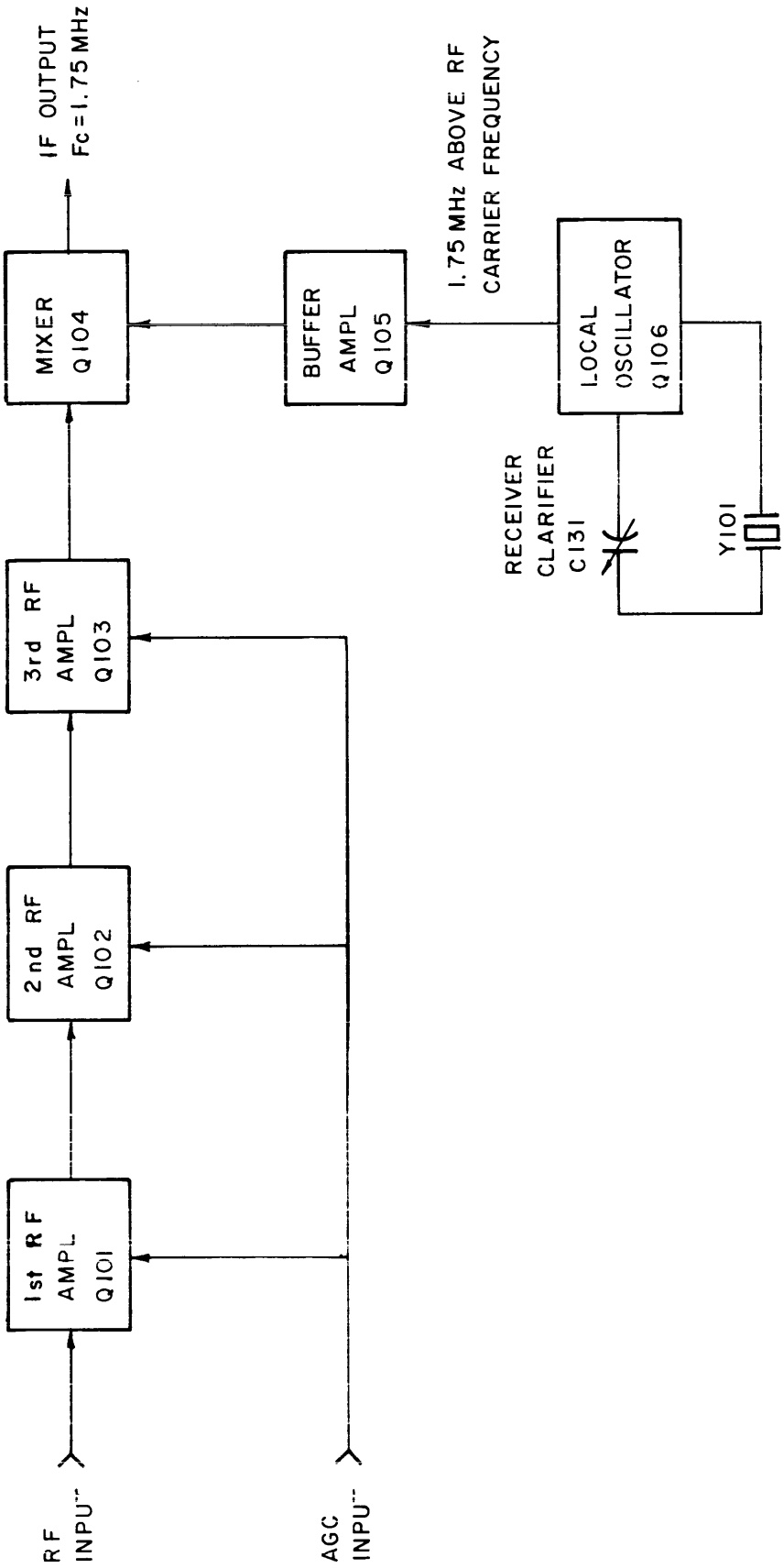


Fig. 4–1. Simplified Block Diagram, TTRR–1C

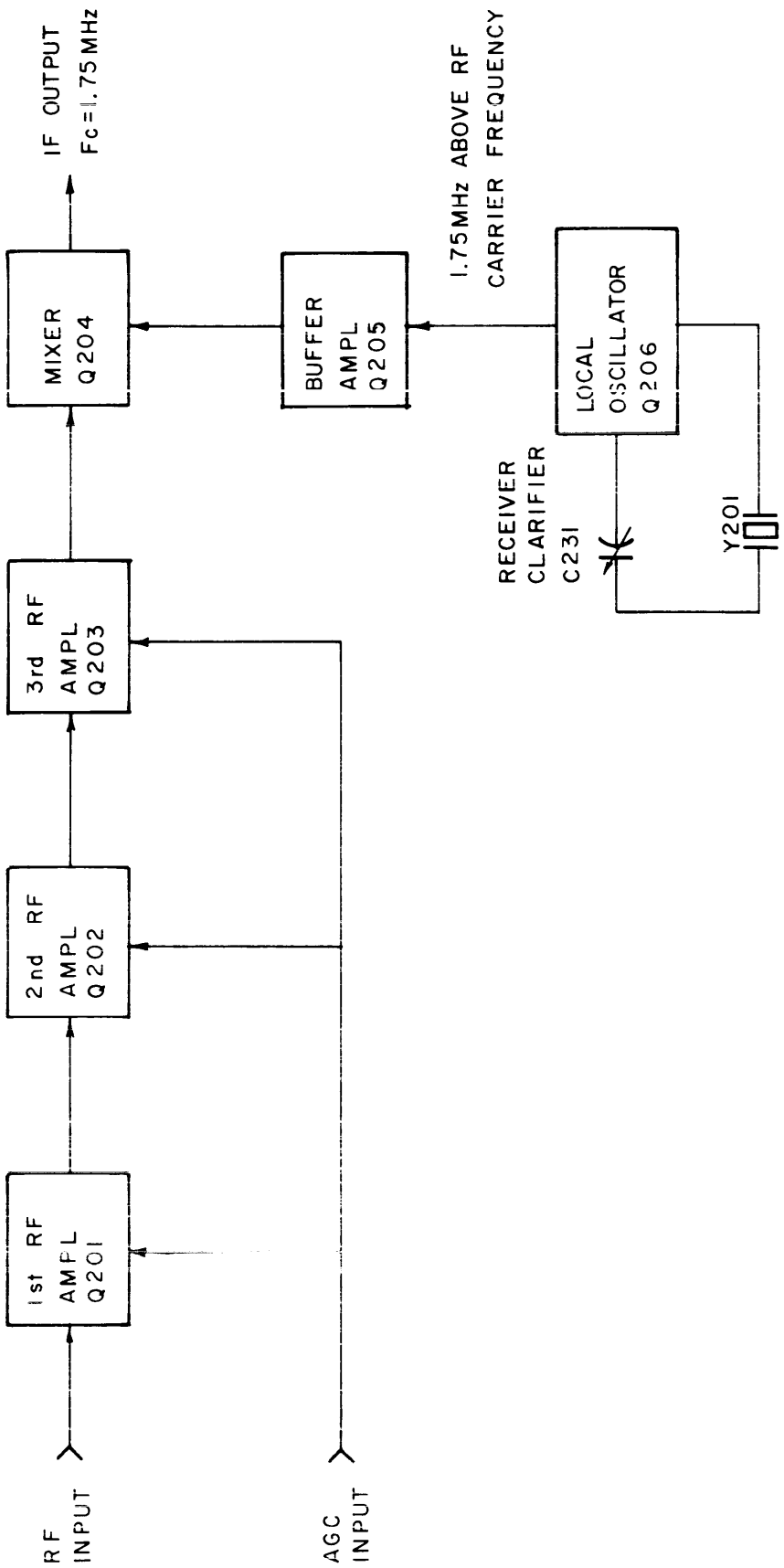


Fig. 4–2. Simplified Block Diagram, TTRR–2C

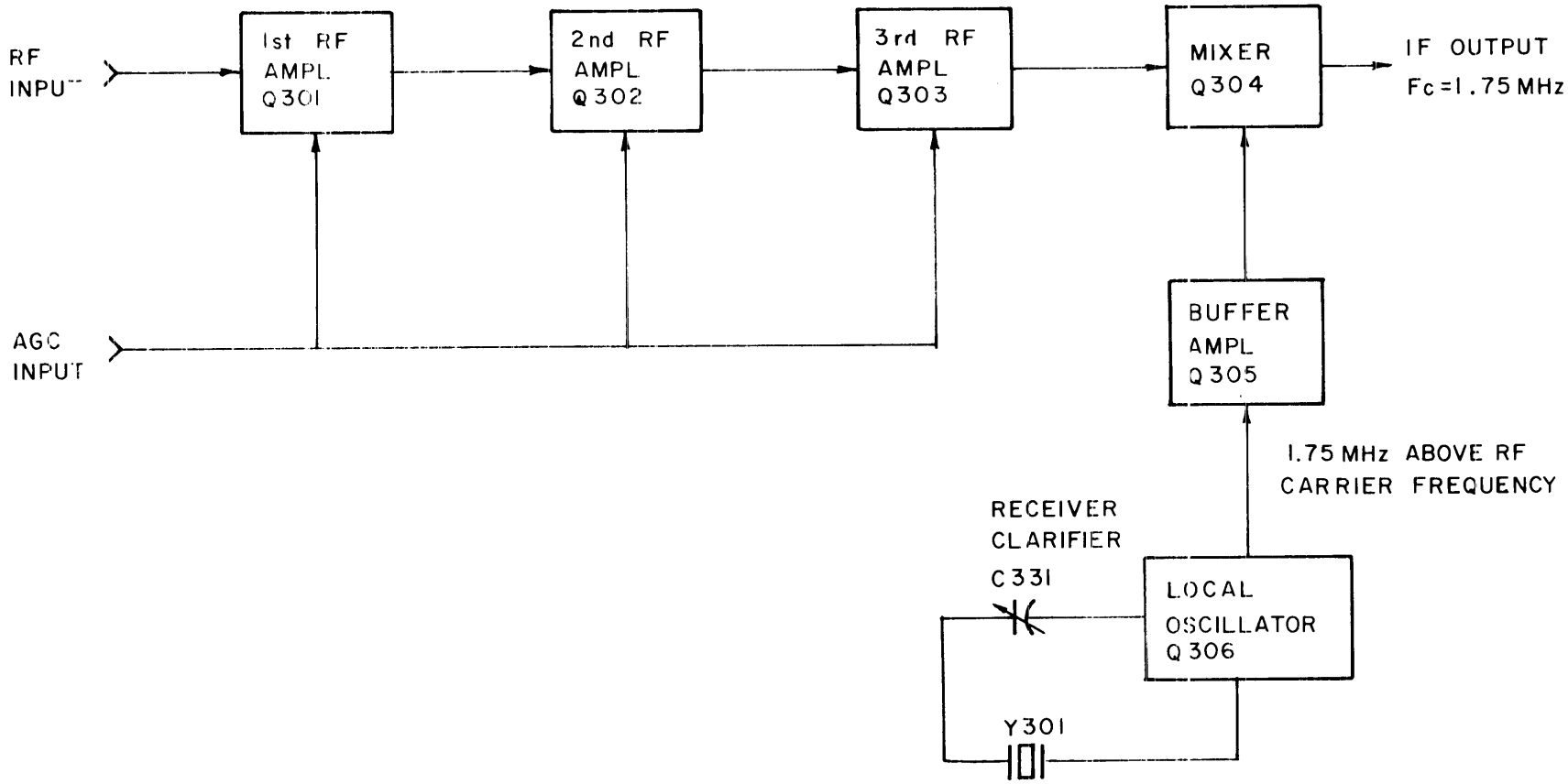


Fig. 4–3. Simplified Block Diagram, TTRR–3C

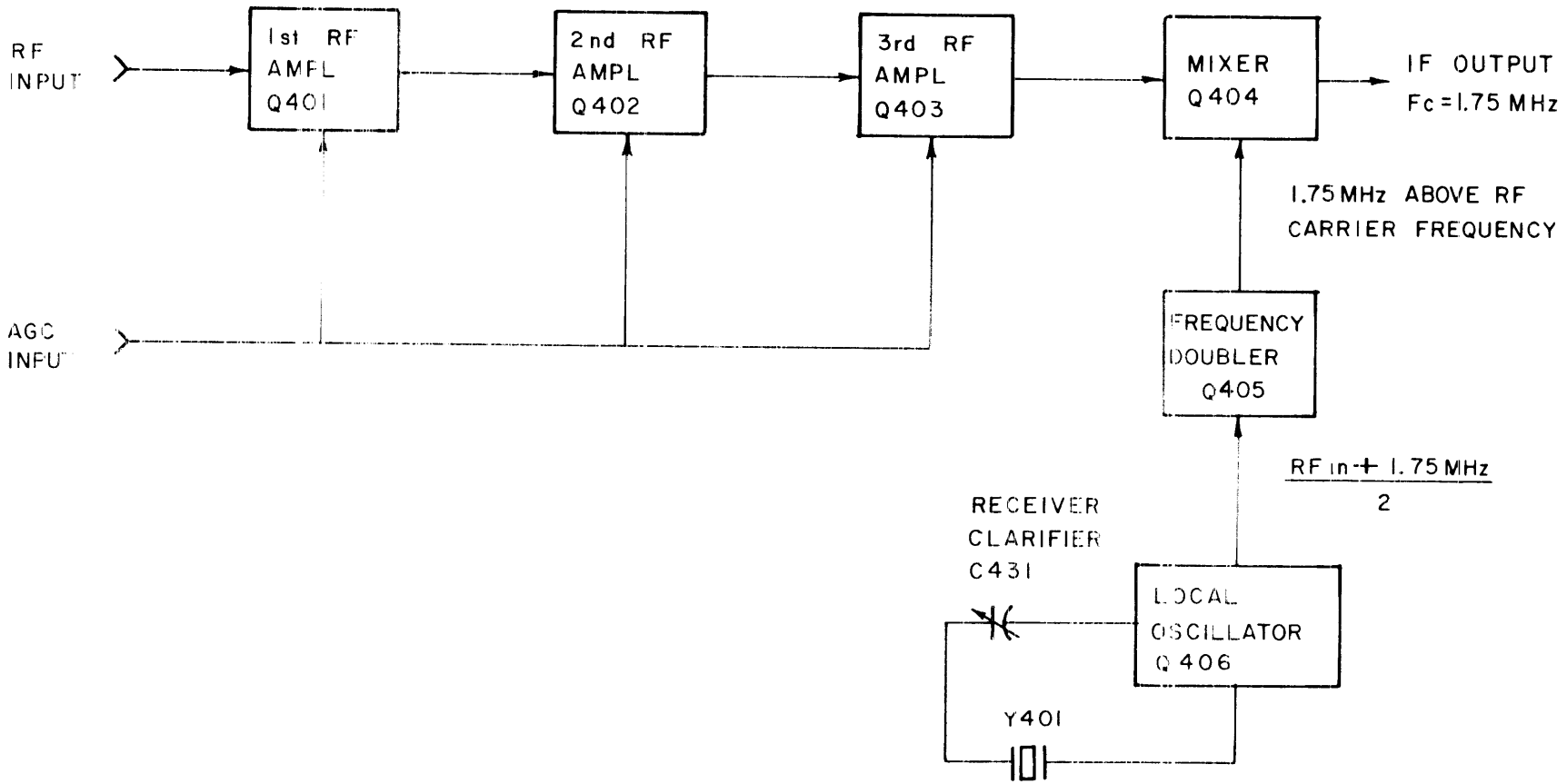


Fig. 4–4. Simplified Block Diagram, TTRR–4C

Section 5

MAINTENANCE

5–1. GENERAL

With the exception of frequency doubling circuitry contained in the TTRR–4C, all TTRR–C modules are physically and functionally similar. Therefore, only the TTRR–1C described in this section; differences between the TTRR–4C and other modules are noted in the text.

> **NOTE**
>
> Reference symbols for the TTRR–C components are assigned according to the particular module. For example, transistors in the TTRR–1C are Q101 through Q106; transistors in the TTRR–2C are Q201 through Q206 etc. (refer to the appropriate schematic diagram.).

5–2. PREVENTIVE MAINTENANCE

Periodically, remove the TTRR–C module from its associated receiver and inspect for general cleanliness and the condition of the etched connector at the rear of the unit. Remove the side cover and check components for discolouration, damaged wiring, broken or loose solder connections, leaking capacitors and warped printed circuit boards. Clean the components with a soft brush, vacuum cleaner, or clean, dry, filtered compressed air. Check all hardware for tightness.

5–3. TROUBLE SHOOTING

When a TTRR–C module is suspected of malfunction, the source of trouble may be located by the following procedures (required test equipment is listed in table 5–1):–

TABLE 5–1. TEST EQUIPMENT

Item	Function
FREQUENCY COUNTER Hewlett Packard, Model 524C or equivalent.	Used during trouble shooting and alignment procedures.
RF SIGNAL GENERATOR Hewlett Packard Model 606A or equivalent.	Same
OSCILLOSCOPE Tektronix, Model 545, or equivalent.	Same
VOLT-OHM-MILLIAMMETER Simpson, Model 260 or equivalent.	Same

a. Remove the side cover of the TTRR–C, and check +12 vdc and –12 vdc inputs at pins 1 and 8 on the connector at the rear of the module. (If necessary, use the module extender supplied with the receiver), if +12 vdc or –vdc are not present, check the power supply circuitry in the associated receiver.

b. Using an oscilloscope, measure the oscillator signal level at TP2; the level should be approximately 0.3 volts peak-to-peak.

c. Using a frequency counter, check the oscillator frequency at TP2; the signal should be approximately 1.75 MHz above the operating frequency of the TTRR–C module; if this signal is not obtained, check the circuitry of the local oscillator and buffer/doubler.

d. Remove the local oscillator oven z101. Connect the rf signal generator to the ANTENNA jack of the receiver; adjust the generator to deliver the TTRR–C operating frequency at 100 uv.

e. Measure the signal level at TP1; the level should be between 100 and 200 mv peak-to-peak; if this signal is not obtained, check the circuitry of the three rf amplifiers.

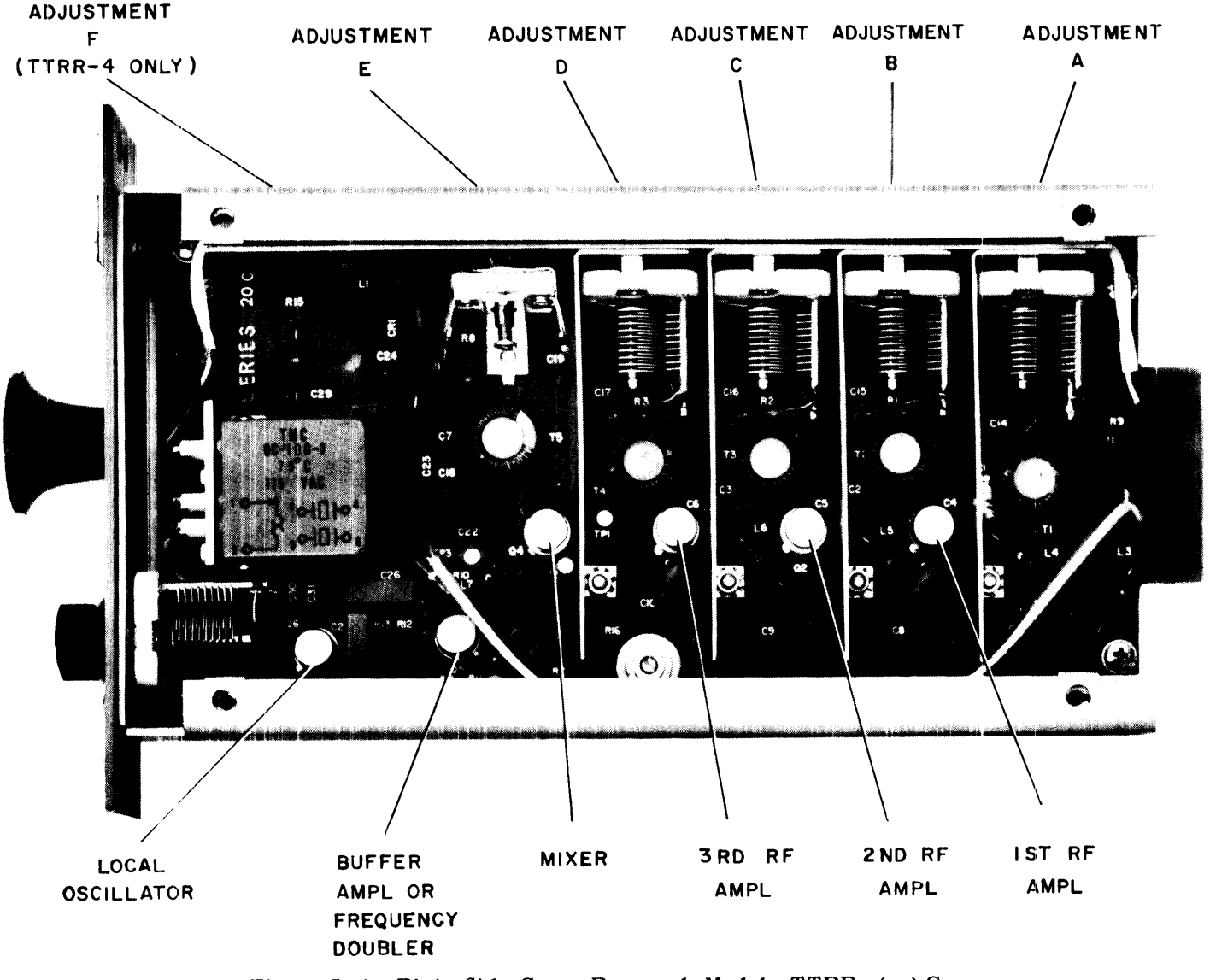


Figure 5–1. Right-Side Cover Removed, Module TTRR–( )C.

f. Replace the local oscillator oven removed in step d. Measure the signal level at TP3; the signal level should be approximately 500 mv peak-to-peak; if this signal level is not obtained, check the circuitry of the mixer stage.

5-4. REPAIR

The repair of the TTRR-C modules consists of component replacement and re-soldering wire connections. The following precautions should be observed:

a. Use replacement components identical to the defective component (same part number), and position the replacement component in the exact place on the board.

> **NOTE**
>
> After a component has been repaired or replaced, the TTRR-C may may require alignment (refer to paragraph 5-5.).

b. Use long-nosed pliers or alligator clips when soldering wire leads to transfer heat from the junction and thus prevent damage to the component.

> **NOTE**
>
> Use a 25 watt soldering iron for soldering all wire leads and con-connections. Use suitable flux remover to clean soldered joints.
>
> **CAUTION**
>
> Excess heat near the board surface may damage the printed-circuit wiring.

5-5. ALIGNMENT

After repairing or replacing components in the TTRR-C, the unit must be checked for alignment, also when the operating frequency of the module is to be changed;

the alignment procedure given is to be followed. (Refer to paragraph 5–6 to determine the local oscillator crystal frequency). To align the rf and if amplifier stages, proceed as follows:

a. Disconnect the antenna from the receiver, and connect the rf signal generator to the antenna input. (If necessary, use the module extended supplied with the receiver).

b. Remove the side cover of the TTRR–C and the local oscillator crystal oven.

> **NOTE**
>
> If only "peaking up" of the amplifiers is required, omit steps c through h.

c. Adjust the signal generator to deliver the desired operating frequency. Connect the oscilloscope to the stator of adjustment B capacitor (refer to table 5–2).

d. Adjust screw A in the TTRR–C for maximum amplitude on the oscilloscope.

e. Connect the oscilloscope to stator of adjustment C capacitor (refer to table 5–2). Adjust screw B for maximum amplitude.

f. Connect the oscilloscope to the stator of adjustment D capacitor (refer to table 5–2). Adjust screw A for maximum amplitude on the oscilloscope; readjust screw B for maximum amplitude, then adjust screw C for maximum amplitude on the oscilloscope.

g. Connect the oscilloscope to TP1. Readjust screws A, B, and C (in that order) for maximum amplitude on the oscilloscope. Adjust screw D for maximum amplitude on the oscilloscope.

h. Connect the oscilloscope to TP1 (mixer input), and set the generator output at 1 microvolt.

i. Readjust screws A through D (in that order) for maximum amplitude on the oscilloscope.

j. Insert the local oscillator crystal oven and allow 30 minutes for the crystal to warm up.

> **NOTE**
>
> On the TTRR-4C unit the alignment is as follows:- Connect the oscilloscope to TP2 and turn adjusting screw F until the pattern at figure 1 is seen. Be careful not to adjust for any of the patterns in figure 2.

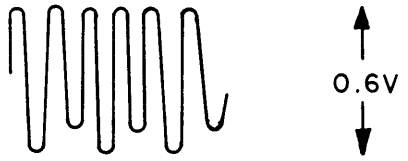
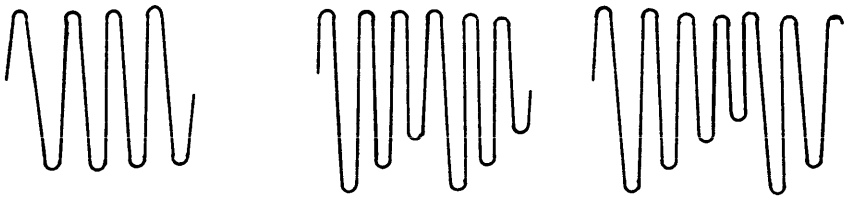


FIGURE 1 - 2nd HARMONIC



A- FUNDAMENTAL B- 3rd HARMONIC C- 4th HARMONIC

FIGURE 2

Check the frequency with the counter; the frequency of the signal should be approximately 1.75 MHz above the module operating frequency.

k. Connect the oscilloscope to TP3, then adjust screw E for maximum amplitude on the oscilloscope.

l. Replace the side cover of the TTRR-C.

m. Connect the oscilloscope to the i–f output (terminal 3 on receiver receptacle) and readjust screws A through E (in that order) for maximum amplitude on the oscilloscope.

n. Disconnect the test equipment, and install the TTRR–C in the receiver.

TABLE 5–2. TUNING CAPACITOR DESIGNATIONS

Adjustment	TTRR–1C	TTRR–2C	TTRR–3C	TTRR–4C
A	C114	C214	C314	C414
B	C115	C215	C315	C415
C	C116	C216	C316	C416
D	C117	C217	C317	C417
E	C119	C219	C319	C419
F				C424

5–6. DETERMINATION OF LOCAL OSCILLATOR CRYSTAL FREQUENCY

Each TTRR–C module is equipped with one local oscillator crystal. Care should be taken that the desired reception frequency falls within the rf bandpass of the amplifier stages.

EXAMPLE: If a TTRR–2C module has been aligned at 4020 KHz, an appropriate crystal may be inserted for the reception of any signal between 4010 and 4030 KHz.

> **NOTE**
>
> The desired sidebands of the signals to be received must also fall within the 0.5% rf bandpass limits.

a. TTRR–1C, TTRR–2C AND TTRR–3C CRYSTAL FREQUENCIES

The local oscillator in the Receiver Converter Models TTRR–1C, TTRR–2C and TTRR–3C operates approximately 1750 KHz above the signal to be received.

fx = fo + KHz where:

fx = local oscillator crystal frequency in kilohertz.

fo = frequency of signal to be received in kilohertz.

b. TTRR-4C CRYSTAL FREQUENCIES

The Receiver Converter Model TTRR-4C has a frequency doubler stage between its local oscillator and mixer; therefore, the formula is modified.

$$fx = \frac{fo + 1750\ KHz}{2}$$

c. CRYSTAL FREQUENCIES FOR CW, FSK AND FAX

The receivers in which the TTRR-C modules are used may not be capable of detecting an i-f signal whose frequency is exactly 1750 KHz. For CW, FSK or FAX reception, the TTRR-C local oscillator frequency must be displaced slightly. For CW reception, the formula becomes:

fx = fo + 1750.5 KHz

or

fx = fo + 1749.5 KHz

For FSK reception, the formula must be modified so as to place the audio output of the receiver in the designed center-frequency of the audio frequency shift converter.

EXAMPLE: If the audio frequency shift converter is designed to accept signals centered at 2550 cps, the formula becomes:

fx = fo + 1752.22 KHz

or

fx = fo + 1747.45 KHz

For FAX reception, the formula becomes:

fx = fo + 1751.9 KHz

or

fx = fo + 1748.1 KHz

Section 6
PARTS LIST

6-1. INTRODUCTION

Reference designations have been assigned to identify all electrical parts of the equipment. These designations are used for marking the equipment (adjacent to the 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 a resistor, capacitor, transistor, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as transistors or fuses 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.

RECEIVER CONVERTER MODULE, 2–4 MHz
SYMBOL SERIES 100

Ref Symbol	Description	TMC Part Number
C101	CAPACITOR, FIXED, CERAMIC: 2.2 pF, ±0.25 pF; 500 WVDC; Char. CK	CC20CK2R2C
C102	CAPACITOR, FIXED, MICA: 47 pF, ±5%, 100 WVDC	CM111C470J1S
C103	Same as C102	
C104	CAPACITOR, FIXED, CERAMIC: 10,000 pF, GMV, 500 WVDC	CC100–16
C105	Same as C104	
C106	Same as C104	
C107	Same as C104	
C108	CAPACITOR, FIXED, CERAMIC: 200,000 pF, +80% –20%; 25 WVDC	CC100–33
C109	Same as C108	
C110	Same as C108	
C111	Same as C108	
C112	Same as C108	
C113	CAPACITOR, FIXED, CERAMIC: 5,000 pF, GMV, 500 WVDC	CC100–15
C114	CAPACITOR, VARIABLE, AIR: 3.9–75 pF; 29 plates	CT103–2
C115	CAPACITOR, VARIABLE, AIR: 3.2–50 pF; 19 plates	CT103–1
C116	Same as C115	
C117	Same as C115	
C118	CAPACITOR, FIXED, MICA: 680 pF, ±5%, 100 WVDC	CM111E681J3S
C119	CAPACITOR, VARIABLE, MICA: 80–480 pF, 175 WVDC	CV113–10
C120	Same as C104	
C121	CAPACITOR, FIXED, CERAMIC: 25,000 pF, +80% –20%; 500 WVDC	CC100–25
C122	CAPACITOR, FIXED, MICA: 2,000 pF	CM112F202J3S
C123	Same as C122	

RECEIVER CONVERTER MODULE, 2–4 MHz
SYMBOL SERIES 100

Ref Symbol	Description	TMC Part Number
C124	Not used	
C125	Same as C121	
C126	CAPACITOR, FIXED, MICA: 270 pF, ± 5%, 500 WVDC	CM15F271J03
C127	CAPACITOR, FIXED, MICA: 680 pF, ± 5%, 500 WVDC	CM20F681J03
C128	Same as C121	
C129	CAPACITOR, FIXED, MICA: 110 pF, ± 5%, 500 WVDC	CM15F111J03
C130	CAPACITOR, FIXED, MICA: 5 pF	CM15C050J03YY
C131	CAPACITOR, VARIABLE, AIR: 3.2 - 50 pF	CT103–1
C132	Same as C104	
C133	Same as C104	
CR101	DIODE, ZENER: 1N3019B	1N3019B
L101	COIL, RF: 470 mH.	CL275–471
L102	Same as L101	
L103	Same as L101	
L104	COIL, RF: 220 mH	CL275–221
L105	Same as L104	
L106	Same as L104	
Q101	TRANSISTOR: 2N2495	2N2495
Q102 thru Q106	Same as Q101	
R101	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ± 5%, ½ watt	RC20GF472J
R102	Same as R101	
R103	Same as R101	
R104	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ± 5%, ½ watt	RC20GF122J
R105	Same as R104	
R106	Same as R104	

RECEIVER CONVERTER MODULE, 2–4 MHz
SYMBOL SERIES 100

Ref Symbol	Description	TMC Part Number
R107	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ± 5%, ½ watt	RC20GF123J
R108	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ± 5%, ½ watt	RC20GF102J
R109	RESISTOR, FIXED, COMPOSITION: 120 ohms, ± 5%, ½ watt	RC20GF121J
R110	RESISTOR, FIXED, COMPOSITION: 68 ohms, ± 5%, ½ watt	RC20GF680J
R111	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ± 5%, ½ watt	RC20GF392J
R112	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ± 5%, ½ watt	RC20GF222J
R113	RESISTOR, FIXED, COMPOSITION: 47 ohms, ± 5%, ½ watt	RC20GF470J
R114	Same as R111	
R115	Same as R108	
R116	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms, ± 10%, ¼ watt	RV111U502A
R117	Same as R108	
T101	TRANSFORMER, RF: primary inductance 108uH, ± 10%	TZ128
T102	TRANSFORMER, RF: primary inductance 117uH, ± 10%	TZ129
T103	Same as T102	
T104	TRANSFORMER, RF: primary inductance 117uH, ± 10%	TZ130
T105	TRANSFORMER, RF: primary inductance 4.5uH, ± 10%	TZ127
W101	CABLE ASSEMBLY, SHIELDED: 2 conductor	CA10476–1
W102	CABLE ASSEMBLY RF:	CA10477–1
Y101	CRYSTAL UNIT, QUARTZ, OVEN (see note 1)	CR110–1–Freq.
Y101	CRYSTAL UNIT, QUARTZ, AMBIENT (see note 2)	CR110–3–Freq.
Z101	OVEN, CRYSTAL, 12VDC	OC100–1
Z101	OVEN, CRYSTAL, 24VDC	OC100–2
Z101	OVEN, CRYSTAL, 115VAC	OC100–3
Z101	OVEN, CRYSTAL, 32VDC	OC100–4

Ref Symbol	Description	TMC Part Number
	NOTES 1. Used when crystal ovens are required by customer. 2. Used when no crystal ovens are required by customer.	

RECEIVER CONVERTER MODULE, 4–8 MHz
SYMBOL SERIES 200

Ref Symbol	Description	TMC Part Number
C201	CAPACITOR, FIXED CERAMIC: 2.2pF, ±0.25pF, 500WVDC	CC20CK2R2C
C202	CAPACITOR, FIXED MICA: 47pF, ±5%, 100 WVDC	CM111C470J1S
C203	Same as C202	
C204	CAPACITOR, FIXED, CERAMIC: 10,000pF, GMV, 500 WVDC	CC100–16
C205	Same as C204	
C206	Same as C204	
C207	Same as C204	
C208	CAPACITOR, FIXED, CERAMIC: 200,000pF, GMV, 500 WVDC	CC100–33
C209	Same as C208	
C210	Same as C208	
C211	Same as C208	
C212	Same as C208	
C213	CAPACITOR, FIXED, CERAMIC: 5,000pF, GMV, 500 WVDC	CC100–15
C214	CAPACITOR, VARIABLE, AIR: 3.2 – 50pF, 19 plates	CT103–1
C215	Same as C214	
C216	Same as C214	
C217	Same as C214	
C218	CAPACITOR, FIXED, MICA: 680pF, 500 WVDC	CM111E681J3S
C219	CAPACITOR, VARIABLE, MICA: 80–480pF, 175 WVDC	CV113–10
C220	Same as C204	
C221	CAPACITOR, FIXED, CERAMIC: 25,000pF, +80% –20%, 25 WVDC	CC100–25
C222	CAPACITOR, FIXED, MICA: 2000pF, ±5%, 500 WVDC	CM112F202J3S
C223	Same as C222	
C224	Not used	
C225	Same as C221	

RECEIVER CONVERTER MODULE, 4–8 MHz
SYMBOL SERIES 200

Ref Symbol	Description	TMC Part Number
C226	CAPACITOR, FIXED, MICA: 180 pF, ±5%, 500 WVDC	CM15F181J03
C227	CAPACITOR, FIXED, MICA: 680 pF, ±2%, 500 WVDC	CM20F681G03
C228	Same as C221	
C229	CAPACITOR, FIXED, MICA: 110 pF, ±5%, 500 WVDC	CM15F111J03
C230	CAPACITOR, FIXED, MICA: 5 pF, ±5%, 500 WVDC	CM15C050J03YY
C231	CAPACITOR, VARIABLE, AIR: 3.2–50 pF, 19 plates	CT103–1
C232	Same as C204	
C233	Same as C204	
CR201	DIODE, ZENER: 1N3019B	1N3019B
L201	COIL, RF: 270 UH	CL275–271
L202	Same as L201	
L203	Same as L201	
L204	SOIL, RF: 100 UH	
L205	Same as L204	
L206	Same as L204	
Q201	TRANSISTOR: 2N2495	2N2495
Q202	Same as Q201	
Q203	Same as Q201	
Q204	Same as Q201	
Q205	Same as Q201	
Q206	Same as Q201	
R201	RESISTOR, FIXED, COMPOSITION: 4700 ohms, ±5%, ½ watt	RC20GF472J
R202	Same as R201	
R203	Same as R201	
R204	RESISTOR, FIXED, COMPOSITION: 1200 ohm, ±5%, ½ watt	RC20GF122J

RECEIVER CONVERTER MODULE, 4–8 MHz
SYMBOL SERIES 200

Ref Symbol	Description	TMC Part Number
R205	Same as R204	
R206	Same as R204	
R207	RESISTOR, FIXED, COMPOSITION: 12K ohms, ±5%, ½ watt	RC20GF123J
R208	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±5%, ½ watt	RC20GF102J
R209	RESISTOR, FIXED, COMPOSITION: 120 ohm, ±5%, ½ watt	RC20GF121J
R210	RESISTOR, FIXED, COMPOSITION: 68 ohms, ±5%, ½ watt	RC20GF680J
R211	RESISTOR, FIXED, COMPOSITION: 3.9K ohms, ±5%, ½ watt	RC20GF392J
R212	RESISTOR, FIXED, COMPOSITION: 2.2K ohms, ±5%, ½ watt	RC20GF222J
R213	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%, ½ watt	RC20GF470J
R214	Same as R211	
R215	Same as R208	
R216	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms, ±10%, ¼ watt	RV111U502A
R217	Same as R208	
T201	TRANSFORMER, RF: primary inductance 31UH, ±10%	TZ131
T202	TRANSFORMER, RF: primary inductance 30UH, ±10%	TZ132
T203	Same as T202	
T204	TRANSFORMER, RF: primary inductance 30UH, ±10%	TZ133
T205	TRANSFORMER, RF: primary inductance 4.5UH, ±10%	TZ127
W201	CABLE, SHIELDED	WI149–1
W202	CABLE, RF	RG188/U
Y201	CRYSTAL, QUARTZ, OVEN (SEE NOTE 1)	CR110–1–Freq.
Y202	CRYSTAL, QUARTZ, AMBIENT (SEE NOTE 2)	CR110–3–Freq.
Z201	OVEN, CRYSTAL, 12 VDC	OC100–1
Z201	OVEN, CRYSTAL, 24 VDC	OC100–2
Z201	OVEN CRYSTAL, 115 VAC	OC100–3

RECEIVER CONVERTER MODULE, 4–8 MHz
SYMBOL SERIES 200

Ref Symbol	Description	TMC Part Number
Z201	OVEN, CRYSTAL, 32 VDC	0C100–4
	NOTES 1. Used when crystal ovens are required by customer. 2. Used when no crystal ovens are required by customer.	

RECEIVER CONVERTER MODULE, 8–16 MHz
SYMBOL SERIES 300

Ref Symbol	Description	TMC Part Number
C301	CAPACITOR, FIXED, CERAMIC: 2.2pF, ±0.25pF, 500 WVDC	CC20CK2R2C
C302	CAPACITOR, FIXED, MICA: 22pF, ±5%, 100 WVDC	CM111C220J1S
C303	Same as C302	
C304	CAPACITOR, FIXED, CERAMIC: 10000pF, GMV, 50 WVDC	CC100–16
C305	Same as C304	
C306	Same as C304	
C307	Same as C304	
C308	CAPACITOR, FIXED, CERAMIC: 200,000pF, +80% -20%, 25 WVDC	CC100–33
C309	Same as C308	
C310	Same as C308	
C311	Same as C308	
C312	Same as C308	
C313	CAPACITOR, FIXED, CERAMIC: 5000pF, GMV, 500 WVDC	CC100–15
C314	CAPACITOR, VARIABLE, AIR: 3.2–50pF, 19 plates	CT103–1
C315	Same as C314	
C316	Same as C314	
C317	Same as C314	
C318	CAPACITOR, FIXED, MICA: 680pF, ±5%, 300 WVDC	CM111E681J3S
C319	CAPACITOR, VARIABLE, MICA: 80–480pF, 6 plates, 175 WVDC	CV113–10
C320	Same as C304	
C321	Same as C304	
C322	CAPACITOR, FIXED, MICA: 2000pF, ±10%, 300 WVDC	CM112F202J3S
C323	Same as C322	
C324	Not used	
C325	Same as C304	

RECEIVER CONVERTER MODULE, 8–16 MHz,
SYMBOL SERIES 300

Ref Symbol	Description	TMC Part Number
C326	CAPACITOR, FIXED, MICA: 100 pF, ±5%, 500 WVDC	CM15F101J03
C327	CAPACITOR, FIXED, MICA: 240 pF, ±5%, 500 WVDC	CM15F241J03
C328	Same as C304	
C329	CAPACITOR, FIXED, MICA: 110 pF, ±5%, 500 WVDC	CM15F111J03
C330	CAPACITOR, FIXED, MICA: 5 pF, ±5%, 500 WVDC	CM15C050J03YY
C331	CAPACITOR, VARIABLE, AIR: 3.2–50 pF, 19 plates	CT103–1
C332	Same as C304	
C333	Same as C304	
CR301	DIODE, ZENER: 1N3019B	1N3019B
L301	COIL, RF: 270UH	CL275–271
L302	Same as L301	
L303	Same as L301	
L304	COIL, RF: 47UH, ±10%, 2.3 ohms dc resistance	CL275–470
L305	Same as L304	
L306	Same as L304	
Q301	TRANSISTOR: 2N2495	2N2495
Q302	Same as Q301	
Q303	Same as Q301	
Q304	Same as Q301	
Q305	Same as Q301	
Q306	Same as Q301	
R301	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%, ½ watt	RC20GF472J
R302	Same as R301	
R303	Same as R301	
R304	RESISTOR, FIXED, COMPOSITION: 1.2K ohms, ±5%, ½ watt	RC20GF122J
R305	Same as R304	

RECEIVER CONVERTER MODULE, 8–16 MHz,
SYMBOL SERIES 300

Ref Symbol	Description	TMC Part Number
R306	Same as R304	
R307	RESISTOR, FIXED, COMPOSITION: 12K ohms, ± 5%, ½ watt	RC20GF123J
R308	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ± 5%, ½ watt	RC20GF102J
R309	RESISTOR, FIXED, COMPOSITION: 120 ohms, ± 5%, ½ watt	RC20GF121J
R310	RESISTOR, FIXED, COMPOSITION: 68 ohms, ± 5%, ½ watt	RC20GF680J
R311	RESISTOR, FIXED, COMPOSITION: 3.9K ohms, ± 5%, ½ watt	RC20GF392J
R312	RESISTOR, FIXED, COMPOSITION: 2.2K ohms, ± 5%, ½ watt	RC20GF222J
R313	RESISTOR, FIXED, COMPOSITION: 47 ohms, ± 5%, ½ watt	RC20GF470J
R314	Same as R311	
R315	Same as R308	
R316	RESISTOR, VARIABLE, COMPOSITION: 5K ohms, ± 10%, ¼ watt	RV111U502A
R317	Same as R308	
T301	TRANSFORMER, RF: primary inductance 8 UH, ± 10%	TZ134
T302	TRANSFORMER, RF: primary inductance 8.7 UH, ± 10%	TZ135
T303	Same as T302	
T304	TRANSFORMER, RF: primary inductance 8.5 UH, ± 10%	TZ136
T305	TRANSFORMER, RF: primary inductance 4.5 UH, ± 10%	TZ127
W301	CABLE, SHIELDED	WI149–1
W302	CABLE, RF	RG188/U
W301	CRYSTAL UNIT, QUARTZ, OVEN (SEE NOTE 1)	CR110–1–Freq.
Y301	CRYSTAL UNIT, QUARTZ, AMBIENT (SEE NOTE 2)	CR110–3–Freq.
Z301	OVEN, CRYSTAL, 12 VDC	OC100–1
Z301	OVEN, CRYSTAL, 24 VDC	OC100–2
Z301	OVEN, CRYSTAL, 115 VAC	OC100–3
Z301	OVEN, CRYSTAL, 32 VDC	OC100–4

RECEIVER CONVERTER, MODULE, 8–16 MHz
SYMBOL SERIES 300

Ref Symbol	Description	TMC Part Number
	NOTES 1. Used when crystal ovens are required by customer. 2. Used when no crystal ovens are required by customer.	

RECEIVER CONVERTER MODULE, 16–32 MHz
SYMBOL SERIES 400

Ref Symbol	Description	TMC Part Number
C401	CAPACITOR, FIXED, CERAMIC: 5pF, ±0.25pF, 500 WVDC	CC20CK050C
C402	CAPACITOR, FIXED, MICA: 10pF, ±5%, 500 WVDC	CM111C100J
C403	Same as C402	
C404	CAPACITOR, FIXED, CERAMIC: 10,000pF, GMV, 500 WVDC	CC100–16
C405	Same as C404	
C406	Same as C404	
C407	Same as C404	
C408	CAPACITOR, FIXED, CERAMIC: 200,000pF, +80% –20%, 25 WVDC	CC100–33
C409	Same as C408	
C410	Same as C408	
C411	Same as C408	
C412	Same as C408	
C413	CAPACITOR, FIXED, CERAMIC: 5,000pF, GMV, 500 WVDC	CC100–15
C414	CAPACITOR, VARIABLE, AIR: 3.2–50pF, 19 plates	CT103–1
C415	Same as C414	
C416	Same as C414	
C417	Same as C414	
C418	CAPACITOR, FIXED, MICA: 680pF, ±5%, 100 WVDC	CM111E681J
C419	CAPACITOR, VARIABLE, MICA: 80–480pF, 175 WVDC	CV113–10
C420	CAPACITOR, FIXED, CERAMIC: 33pF, ±1pF, 500 WVDC	CC107UL330F
C421	Same as C404	
C422	CAPACITOR, FIXED, MICA: 2000pF, ±10%, 300 WVDC	CM112F202J3S
C423	Same as C422	
C424	CAPACITOR, VARIABLE, MICA: 5–80pF, 175 WVDC	CV113–11
C425	CAPACITOR, FIXED, CERAMIC: 25,000pF, +80% –20%, WVDC	CC100–25

RECEIVER CONVERTER, MODULE, 16–32 MHz
SYMBOL SERIES 400

Ref Symbol	Description	TMC Part Number
C426	CAPACITOR, FIXED, MICA: 240 pF, ±5%, 500 WVDC	CM15B241J03
C427	CAPACITOR, FIXED, MICA: 100 pF, ±5%, 500 WVDC	CM15F101J03
C428	Same as C404	
C429	CAPACITOR, FIXED, MICA: 110 pF, ±5%, 500 WVDC	CM15B111J03
C430	CAPACITOR, FIXED, MICA: 5 pF, ±5%, 500 WVDC	CM15C050J03YY
C431	CAPACITOR, VARIABLE, AIR: 3.2–50 pF, 19 plates	CT103–1
C432	Same as C404	
C433	Same as C404	
CR401	DIODE, ZENER: 1N3019B	1N3019B
L401	COIL, RF: 100 UH	CL275–221
L402	COIL, RF: 100 UH	CL275–101
L403	Same as L402	
L404	COIL, RF: 22 UH	CL275–220
L405	Same as L404	
L406	Same as L404	
L407	COIL RF: .68 UH	CL275–OR68
Q401	TRANSISTOR: 2N2495	2N2495
Q402	Same as Q401	
Q403	Same as Q401	
Q404	Same as Q401	
Q405	Same as Q401	
Q406	Same as Q401	
R401	RESISTOR, FIXED, COMPOSITION: 4.7 K ohms, ±5%, ½ watt	RC20GF472J
R402	Same as R401	
R403	Same as R401	

RECEIVER, CONVERTER MODULE, 16–32 MHz
SYMBOL SERIES 400

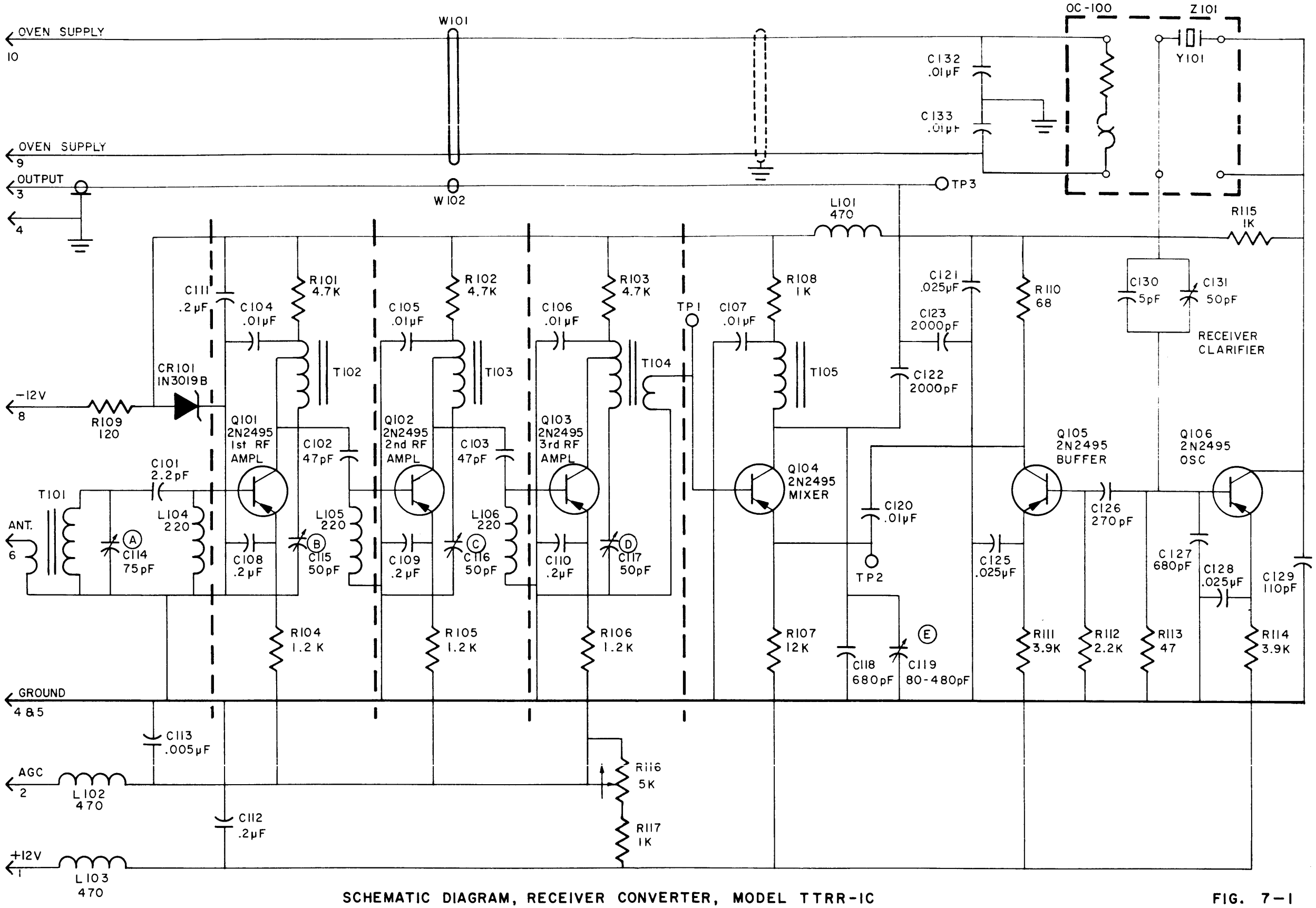
Ref Symbol	Description	TMC Part Number
R404	RESISTOR, FIXED, COMPOSITION: 1200 ohms, ± 5%, ½ watt	RC20GF122J
R405	Same as R404	
R406	Same as R404	
R407	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ± 5%, ½ watt	RC20GF103J
R408	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ± 5%, ½ watt	RC20GF102J
R409	RESISTOR, FIXED, COMPOSITION: 120 ohms, ± 5%, ½ watt	RC20GF121J
R410		
R411	RESISTOR, FIXED, COMPOSITION: 3900 ohms, ± 5%, ½ watt	RC20GF392J
R412	RESISTOR, FIXED, COMPOSITION: 2200 ohms, ± 5%, ½ watt	RC20GF222J
R413	RESISTOR, FIXED, COMPOSITION: 47 ohms, ± 5%, ½ watt	RC20GF470J
R414	Same as R411	
R415	Same as R408	
R416	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms, ± 10%, ¼ watt	RV111U502A
R417	Same as R408	
T401	TRANSFORMER RF: primary inductance 2.7 UH, ± 10%	TZ137
T402	TRANSFORMER RF: primary inductance 2.7 UH, ± 10%	TZ138
T403	Same as T402	
T404	TRANSFORMER RF: primary inductance 2.7 UH, ± 10%	TZ139
T405	TRANSFORMER RF: primary inductance 4.5 UH, ± 10%	TZ127
W401	CABLE, SHIELDED	WI149–1
W402	CABLE, RF	RG188/U
Y401	CRYSTAL QUARTZ, OVEN (SEE NOTE 1)	CR110–1–Freq.
Y401	CRYSTAL QUARTZ, AMBIENT (SEE NOTE 2)	CR110–3–Freq.
Z401	OVEN, CRYSTAL, 12 VDC	OC100–1
Z401	OVEN, CRYSTAL, 24 VDC	OC100–2

RECEIVER CONVERTER, MODULE, 16–32 MHz
SYMBOL SERIES 400

Ref Symbol	Description	TMC Part Number
Z401	OVEN, CRYSTAL, 115 VAC	OC100–3
Z401	OVEN, CRYSTAL, 32 VDC	OC100–4
	NOTES 1. Used when crystal ovens are required by customer. 2. Used when no crystal ovens are required by customer.	

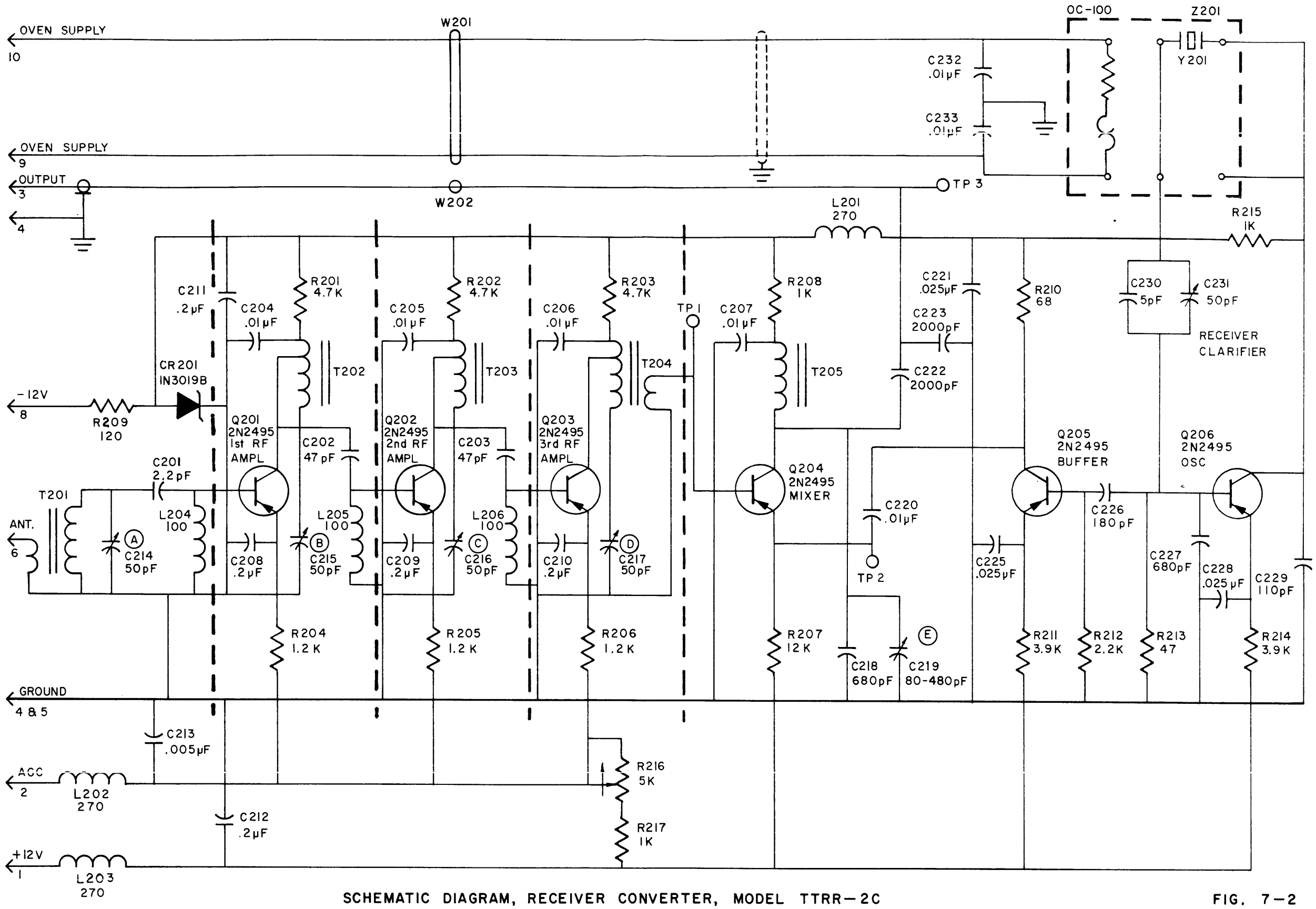
Section 7

SCHEMATIC DIAGRAMS



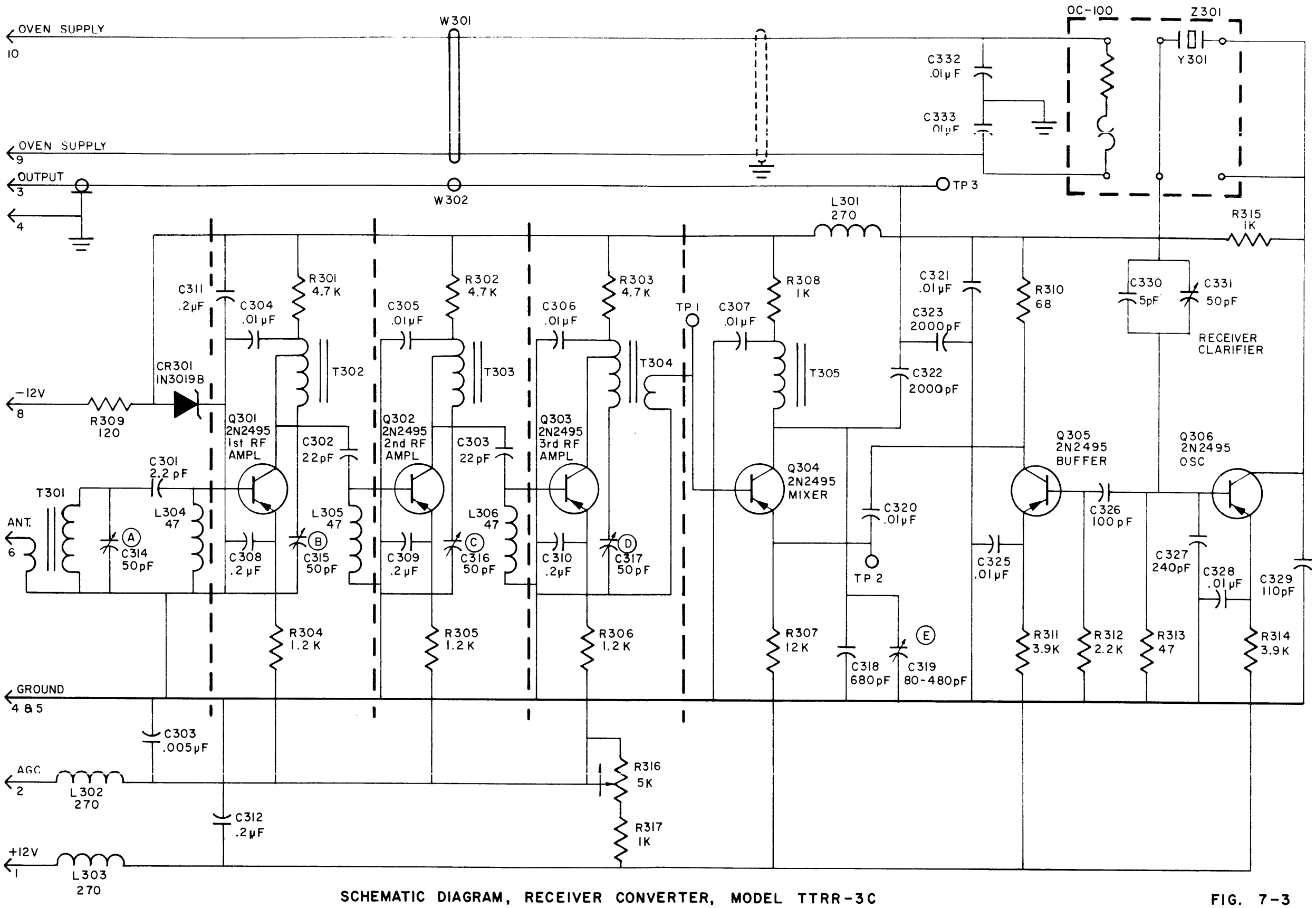
SCHEMATIC DIAGRAM, RECEIVER CONVERTER, MODEL TTRR-IC

FIG. 7-1



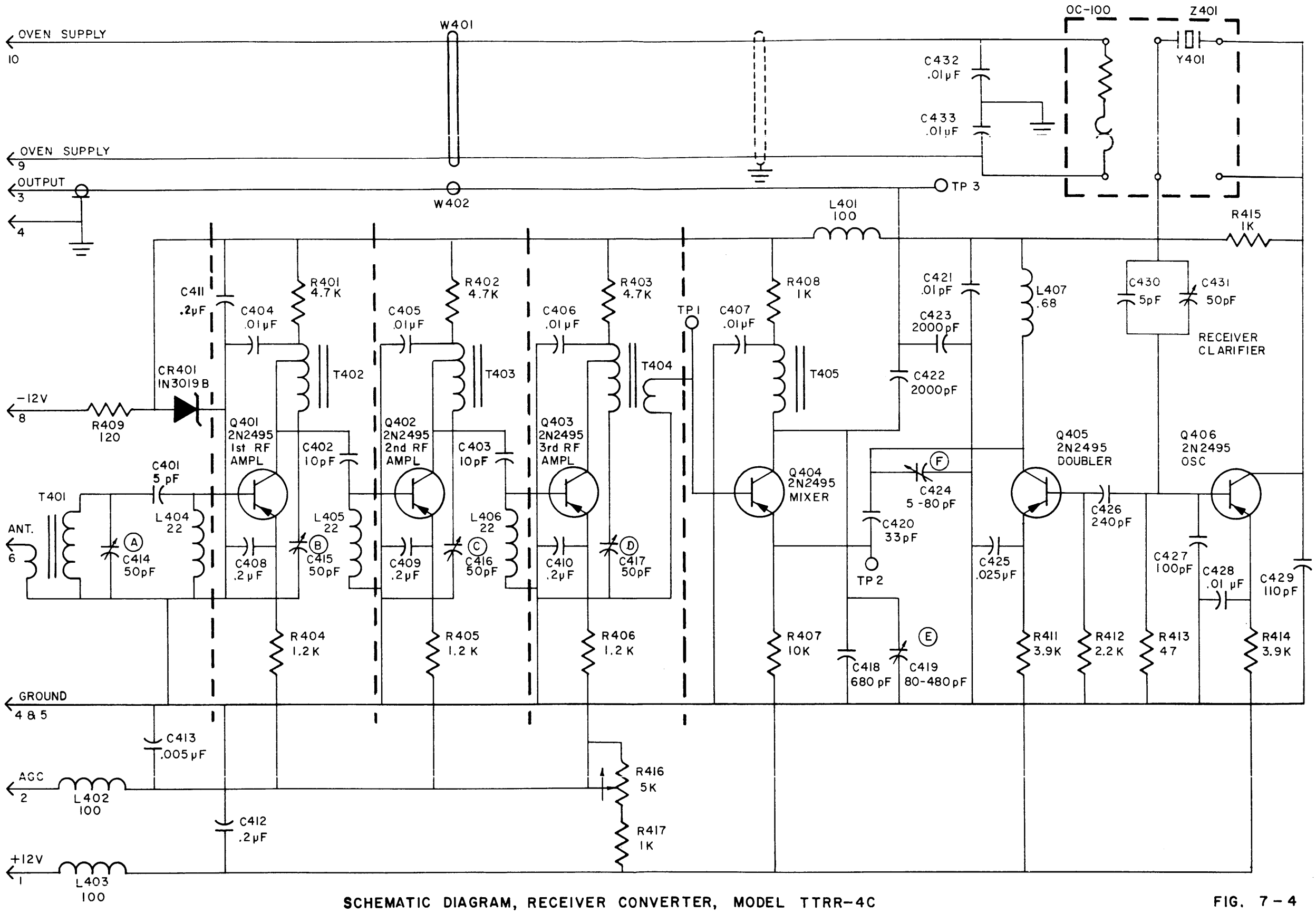
SCHEMATIC DIAGRAM, RECEIVER CONVERTER, MODEL TTRR-2C

FIG. 7-2



SCHEMATIC DIAGRAM, RECEIVER CONVERTER, MODEL TTRR-3C

FIG. 7-3



SCHEMATIC DIAGRAM, RECEIVER CONVERTER, MODEL TTRR-4C

FIG. 7 - 4