MOBILE RADIO

MAINTENANCE MANUAL

406—512 MHz EXCITER BOARD 19D423865G2 & G4

TABLE OF CONTENTS

DESCRIPTION

The exciter uses seven transistors and an integrated circuit to provide 185 milliwatts of RF drive to the PA assembly.

The exciter can be equipped with up to eight Integrated Circuit Oscillator Modules (ICOMs). The ICOM crystal frequency ranges from approximately 11.3 to 14.2 megahertz, and the crystal frequency is multiplied 36 times.

Audio, supply voltages and control functions are connected from the system board to the exciter board through P902.

Centralized metering jack J103 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The test set meters the modulator, multiplier and amplifier stages, and the regulated 10-Volts.

CIRCUIT ANALYSIS

ICOMS

Three different types of ICOMs are available for use in the exciter. Each of the ICOMs contains a crystal-controlled Colpitts oscillator, and two of the ICOMs contain compensator ICs. The different ICOMs are:

- 5C-ICOM - contains an oscillator and a 5 part-per-million (±0.0005%) compensator IC. Provides compensation for EC-ICOMs.
- EC-ICOM - contains an oscillator only. Requires external compensation from a 5C-ICOM.
- 2C-ICOM - contains an oscillator and a 2 PPM (±0.0002%) compensator IC. Will not provide compensation for an EC-ICOM.

The ICOMs are enclosed in an RF shielded can with the type ICOM (5C-ICOM, EC-ICOM or 2C-ICOM) printed on the top of the can. Access to the oscillator trimmer is obtained through a hole on the top of the can.

NOTE

For proper operation, be sure ICOM case makes contact with fingers on the RF shield on the exciter board. Also, the pins on the exciter bottom cover must make contact with the RF shield.

Frequency selection is accomplished by switching the ICOM keying lead (terminal 6) to A- by means of the frequency selector switch on the control unit. In single-frequency radios, a jumper from H9 to H10 in the control unit connects terminal 6 of the ICOM to A-. The oscillator is turned on by applying a keyed +10 Volts to the external oscillator load resistor.

CAUTION

All ICOMs are individually compensated at the factory and cannot be repaired in the field. Any attempt to repair or change an ICOM frequency will void the warranty.

In Standard 5 PPM radios using EC-ICOMs, at least one 5C-ICOM must be used. The 5C-ICOM is normally used in the receiver F1 position, but can be used in any transmit or receive position. One 5C-ICOM can provide compensation for up to 15 EC-ICOMs in the transmit and receiver. Should the 5C-ICOM compensator fail in the open mode, the EC-ICOMs will still maintain 2 PPM frequency stability from 0°C to 55°C (+32°F to 131°F) due to the regulated compensation voltage (5 Volts) from the 10-Volt regulator IC. If desired, up to 16 5C-ICOMs may be used in the radio.

The 2C-ICOMs are self-compensated at 2 PPM and will not provide compensation for EC-ICOMs.

Oscillator Circuit

The quartz crystals used in ICOMs exhibit the traditional "S" curve characteristics of output frequency versus operating temperature.

At both the coldest and hottest temperatures, the frequency increases with increasing temperature. In the middle temperature range (approximately 0°C to 55°C), frequency decreases with increasing temperature.

Since the rate of change is nearly linear over the mid-temperature range, the output frequency change can be compensated by choosing a parallel compensation capacitor with a temperature coefficient approximately equal and opposite that of the crystal.

Figure 1 shows the typical performance of an uncompensated crystal as well as the typical performance of a crystal which has been matched with a properly chosen compensation capacitor.

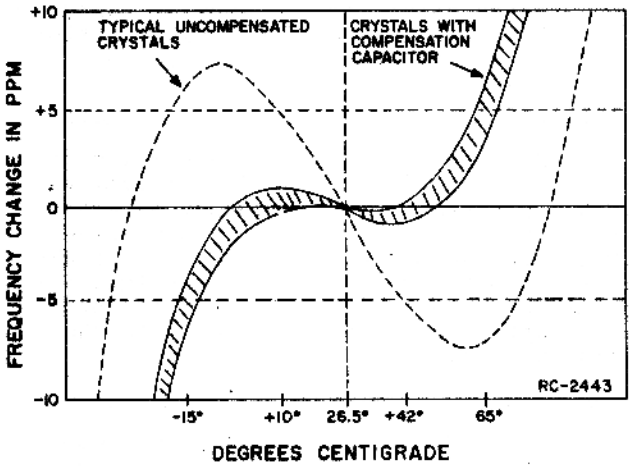

Figure 1 - Typical Crystal Characteristics

At temperatures above and below the mid-range, additional compensation must be introduced. An externally generated compensation voltage is applied to a varactor (voltage-variable capacitor) which is in parallel with the crystal.

A constant bias of 5 Volts (provided from Regulator IC U901 in parallel with the compensator) establishes the varactor capacity at a constant value over the entire mid-temperature range. With no additional compensation, all of the oscillators will provide 2 PPM frequency stability from 0°C to 55 °C (+32°F to 131°F).

Compensator Circuits

Both the 5C-ICOMs and 2C-ICOMs are temperature compensated at both ends of the temperature range to provide instant frequency compensation. An equivalent ICOM circuit is shown in Figure 2.

The cold end compensation circuit does not operate at temperatures above 0°C. When the temperature drops below 0°C, the circuit is activated. As the temperature decreases, the equivalent resistance decreases and the compensation voltage increases.

The increase in compensation voltage decreases the capacity of the varactor in the oscillator, increasing the output frequency of the ICOM.

The hot end compensation circuit does not operate at temperatures below +55°C. When the temperature rises above +55°C, the circuit is activated. As the temperature increases, the equivalent resistance decreases and the compensation voltage decreases. The decrease in compensation voltage increases the capacity of the varactor, decreasing the output frequency of the ICOM.

SERVICE NOTE: Proper ICOM operation is dependent on the closely-controlled input voltages from the 10-Volt regulator. Should all of the ICOMs shift off frequency, check the 10-Volt regulator module.

AUDIO IC

The transmitter audio circuitry is contained in audio IC U101. A simplified drawing of the audio IC is shown in Figure 3.

Audio from the microphone at pin 12 is coupled through pre-emphasis capacitor C1 to the base of Q1 in the operational amplifier-limiter circuit. Collector voltage for the transistorized microphone preamplifier is supplied from pin 11 through microphone collector load resistor R18 to pin 12.

The operational amplifier-limiter circuit consists of Q1, Q2 and Q3. Q3 provides limiting at high signal levels. The gain of the operational amplifier circuit is fixed by negative feedback through R19, R20 and the resistance in the network (Pin 9).

The output of Q3 is coupled through a de-emphasis network (R10 and C3) to an active post-limiter filter consisting of C4, C5, C6, R11, R12, R13, R15, R17 and Q4.

Following the post-limiter filter is class A amplifier Q5. The output of Q5 is coupled through MOD ADJUST potentiometer R104 and resistor R109 to the phase modulator.

SERVICE NOTE: If the DC voltages to the Audio IC are correct and no audio output can be obtained, replace U101.

For radios equipped with Channel Guard, tone from the encoder is applied to the phase modulator through CHANNEL GUARD MOD

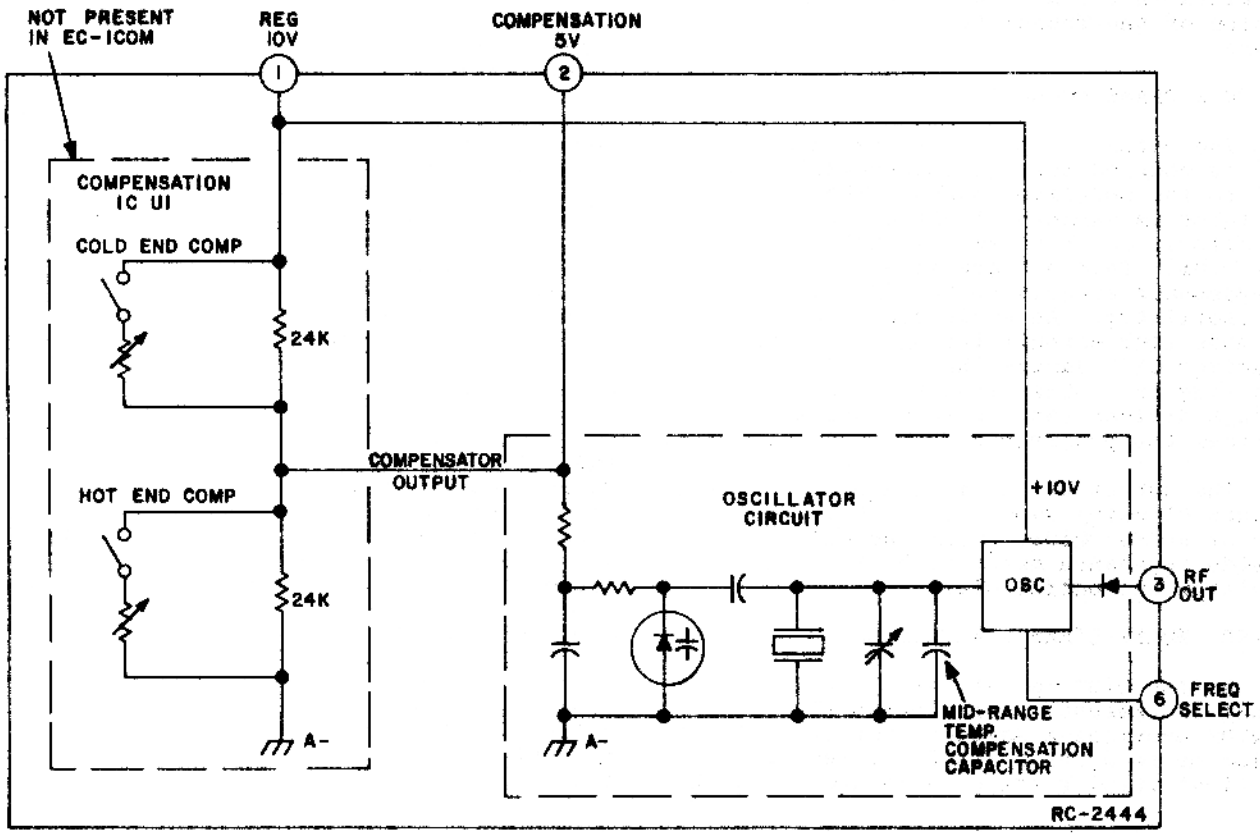

Figure 2 - Equivalent ICOM Circuit

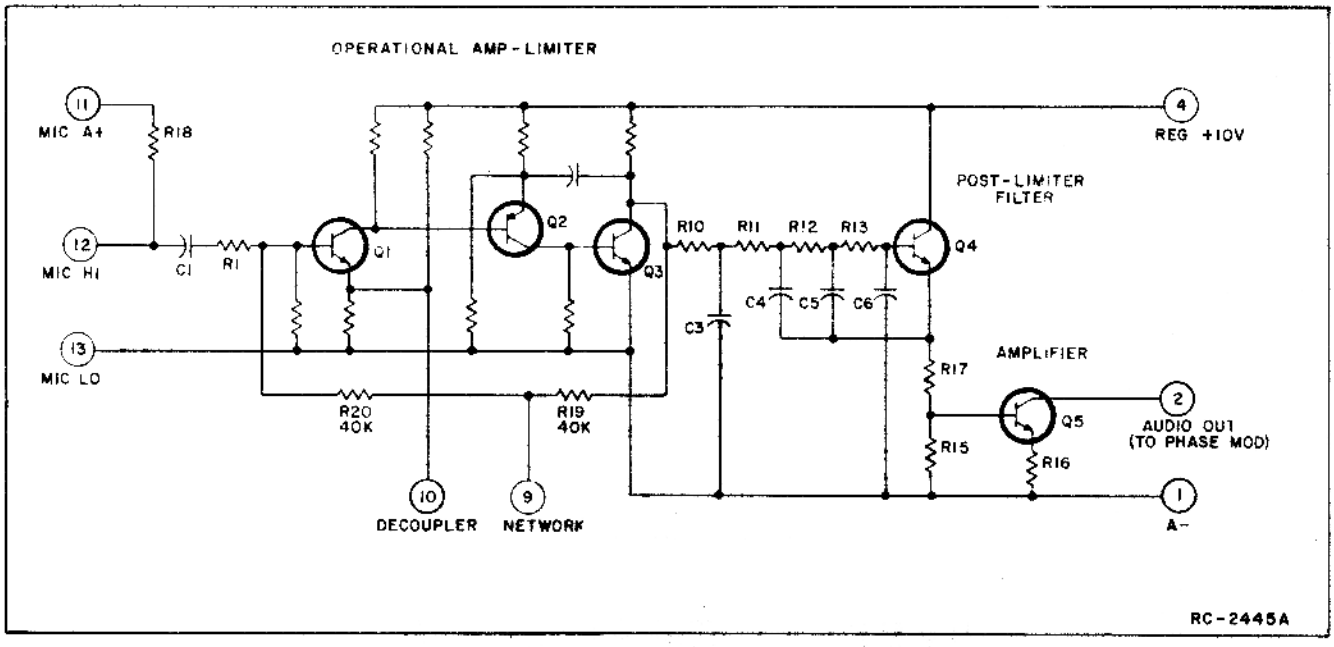

Figure 3 - Simplified Audio IC

ADJUST potentiometer R105, and resistor R113. Instructions for setting R105 are contained in the modulation adjustment section of the Transmitter Alignment Procedure.

BUFFER & PHASE MODULATOR

The output at pin 3 of the selected ICOM is coupled through buffer-amplifier Q101 to the modulator stage. The phase modulator is varactor (voltage-variable capacitor), CV101 in series with tunable coil T101. This network appears as a series-resonant circuit to the RF output of the oscillator. An audio signal applied to the modulator circuit through blocking capacitor C109 varies the bias of CV101, resulting in a phase modulated output. A voltage divider network (R106 and R112) provides the proper bias for varactor CV101.

The output of the modulator is coupled through blocking capacitor C116 to the base of buffer Q102. C116 and C117 also provide impedance matching between the modulator and buffer Q102.

BUFFER, MULTIPLIERS & AMPLIFIER

Buffer Q102 is saturated when no RF signal is present. Applying an RF signal to Q102 provides a sawtooth waveform at its collector to drive class C tripler, Q103. The first tripler stage is metered through R117. The output of Q103 is coupled through tuned circuits T102, T103, and T104 to the base of the second tripler, Q104. T102, T103 and T104 are tuned to three times the crystal frequency. The second tripler stage, Q104 is metered through R122.

The output of Q104 is coupled through tuned circuits T105 and T106 to the base of first doubler Q105. T105 and T106 are tuned to nine times the crystal frequency. Q105 is metered through R126.

The output of Q105 is coupled through two tuned circuits (T107 and T108) to the base of second doubler Q106. These circuits are tuned to 18 times the crystal frequency (one-half the transmitter operating frequency). Q106 is metered through R133.

The output of Q106 is coupled to the base of power amplifier Q107 through impedance matching networks composed of C152, C155, L105, C156, C157, L106, and C161. These networks are all tuned to the operating frequency and present a high shunt impedance at the operating frequency. All other frequencies are shunted to ground. Q107 is metered through R142.

Impedance matching network C166, C167, L108, L113, C171, L109, and C175 matches the output of Q107 to the input of the PA Assembly. C167, C171, and C175 are tuned to the proper operating frequency.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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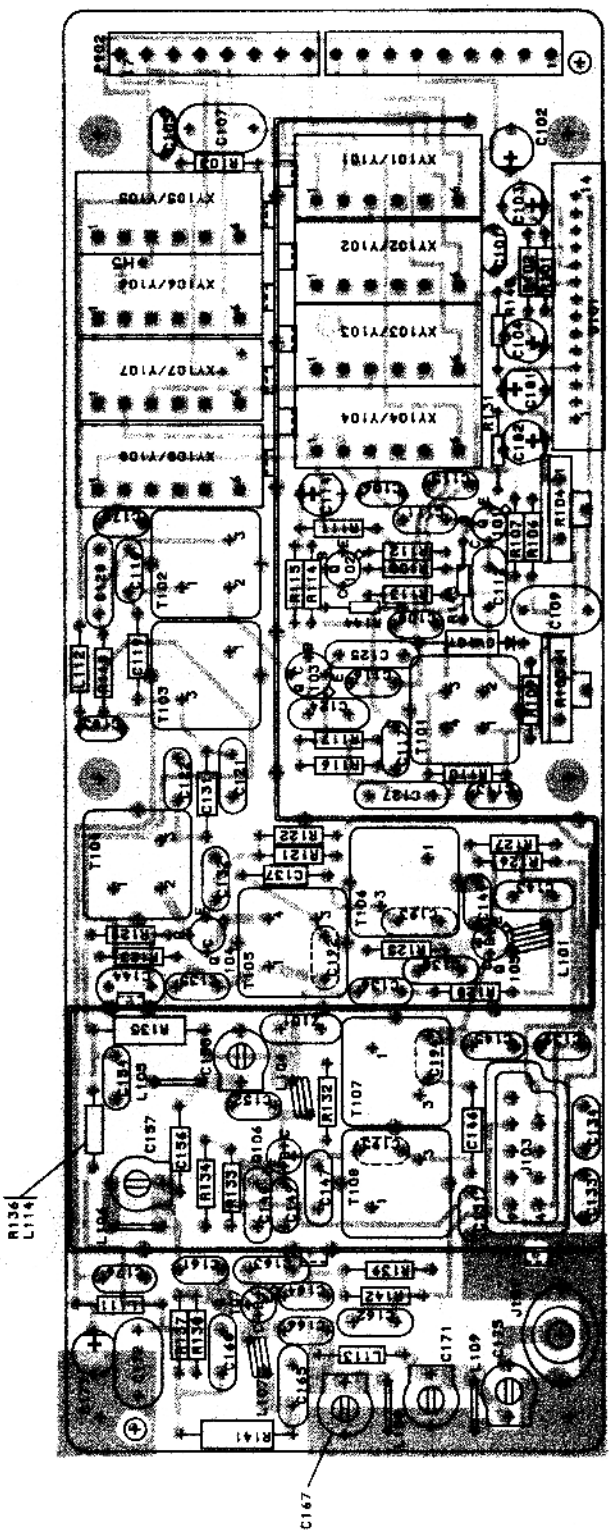
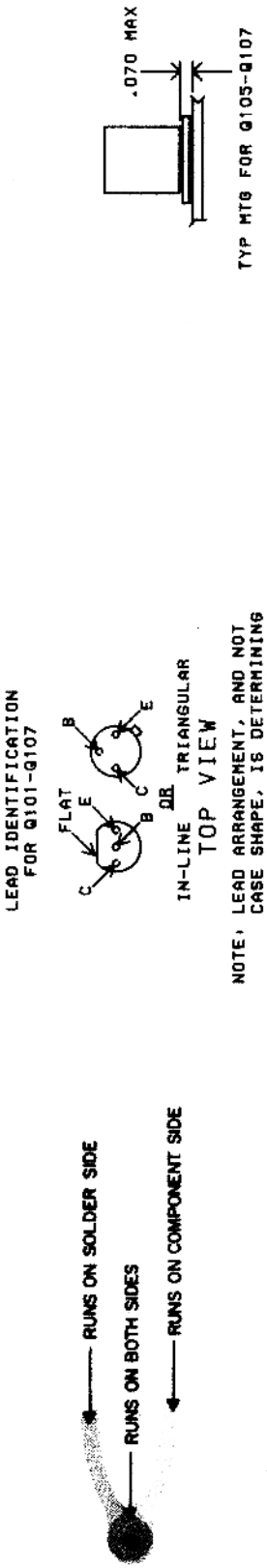
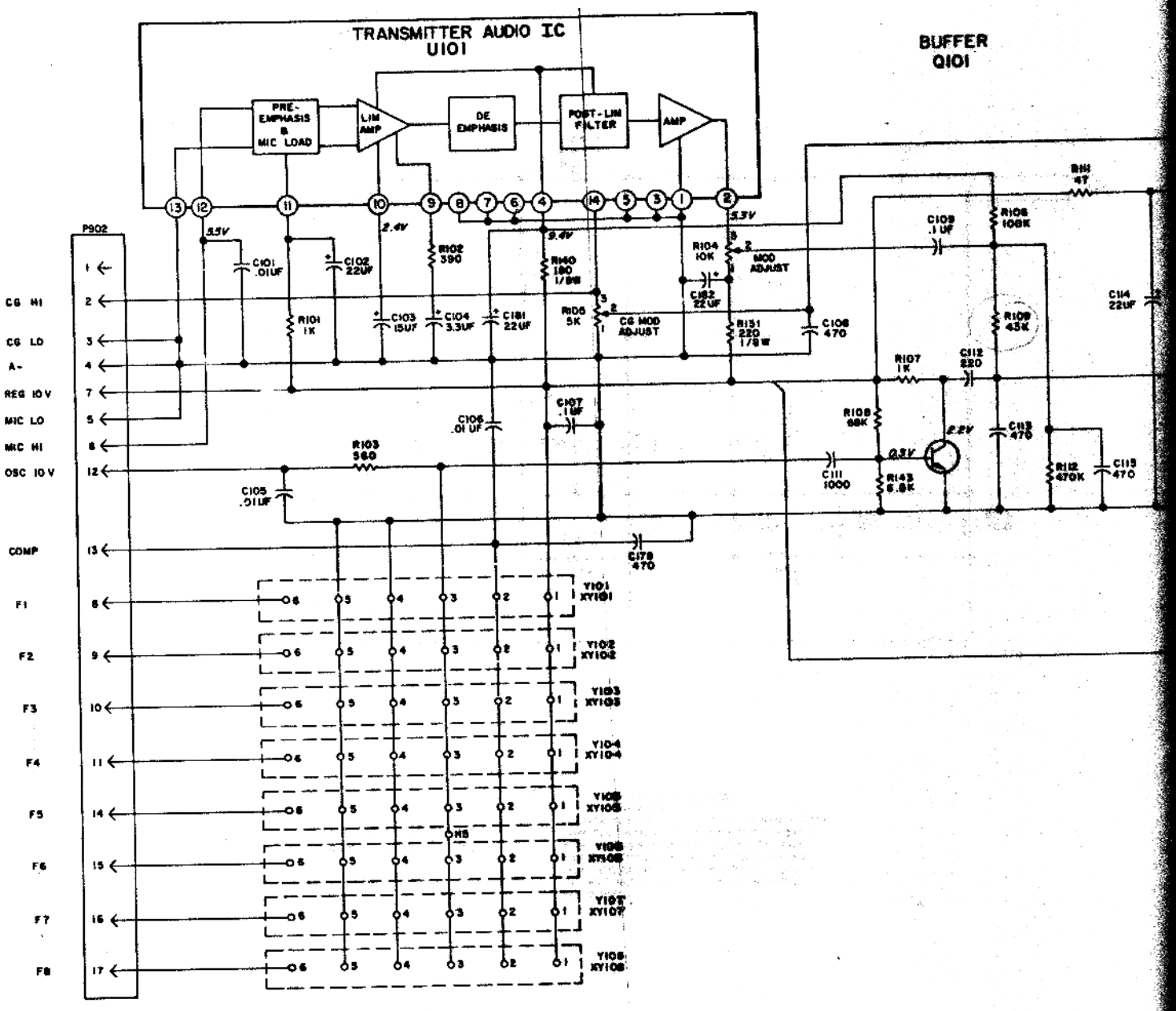




OUTLINE DIAGRAM

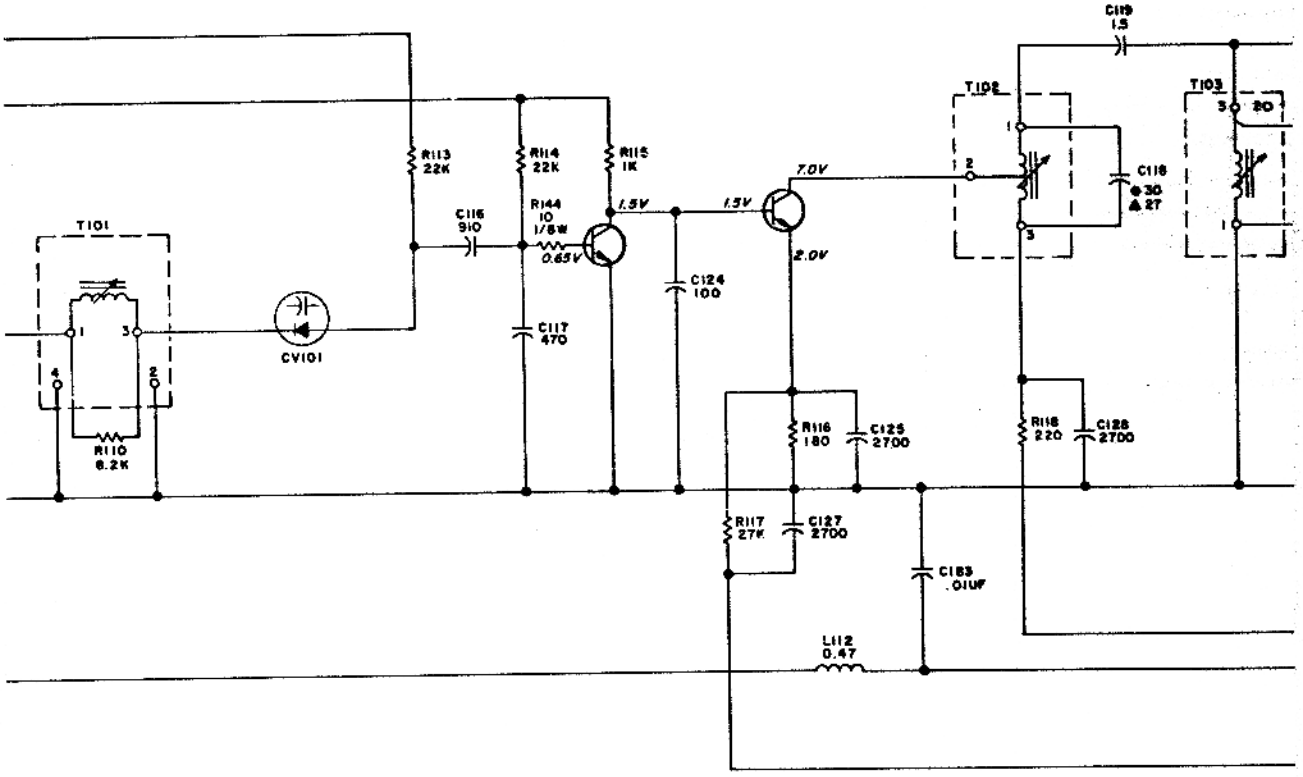
406—512 MHz EXCITER BOARD
19D423865G2 & G4

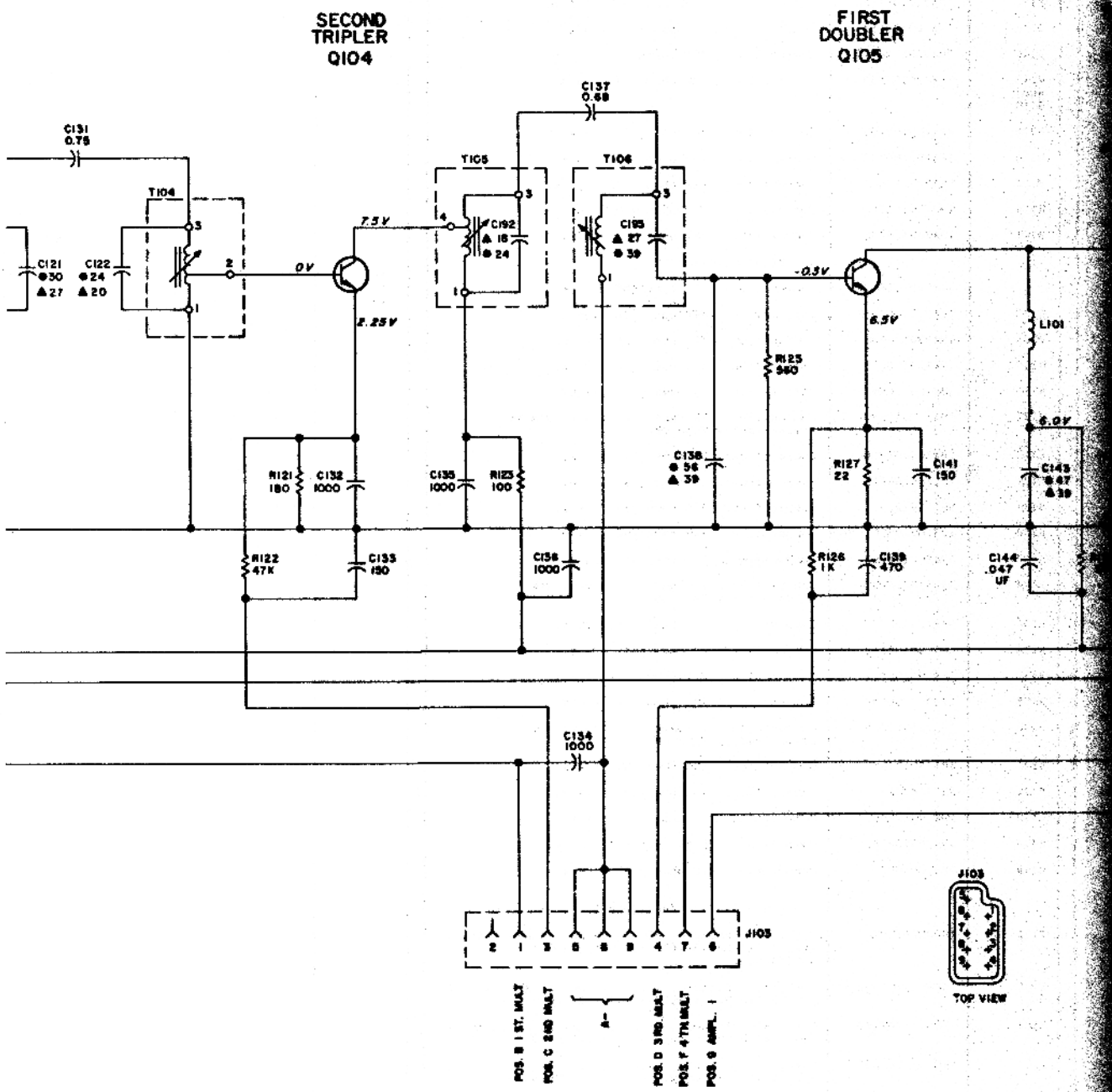

TRANSMITTER AUDIO IC
U101
PRE-EMPHASIS & MIC LOAD
LIM AMP
DE EMPHASIS
POST-LIM FILTER
AMP
BUFFER
Q101
P902
CG HI
CG LO
A-
REG 10V
MIC LO
MIC HI
OSC 10V
COMP
F1
F2
F3
F4
F5
F6
F7
F8
MOD ADJUST
CG MOD ADJUST
5.5V
2.4V
9.4V
5.3V
0.2V
2.2V

MODULATOR

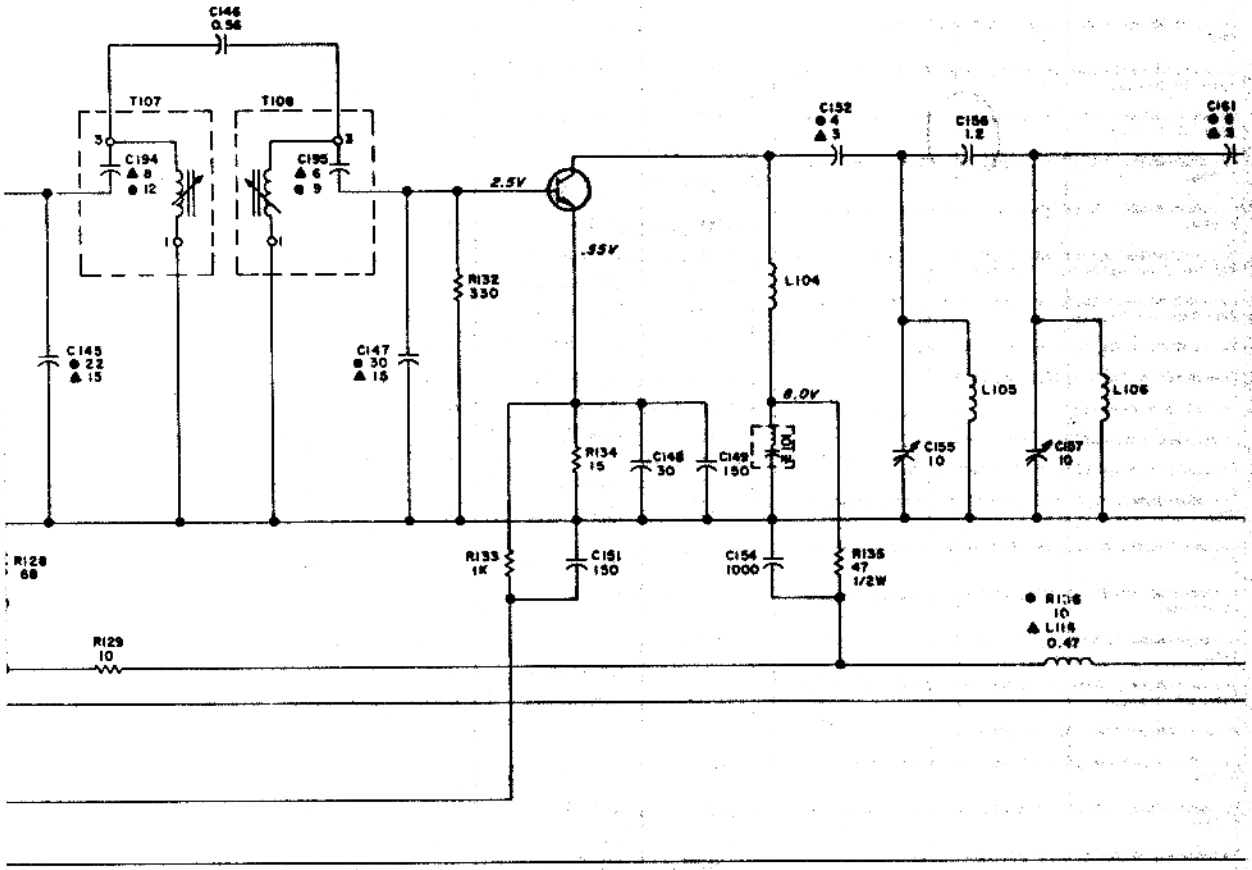
BUFFER
Q102

FIRST
TRIPLER
Q103




SECOND TRIPLER Q104
FIRST DOUBLER Q105
C131 0.75
T104
C121 ●30 ▲27
C122 ●24 ▲20
0V
7.5V
2.25V
T105
T106
C137 0.68
C192 ▲ 16 ● 24
C195 ▲ 27 ● 39
-0.3V
6.5V
L101
R125 560
6.0V
R121 180
C132 1000
C135 1000
R123 100
C138 ● 56 ▲ 39
R127 22
C141 150
C145 ● 47 ▲ 39
R122 47K
C133 150
C136 1000
R126 1K
C139 470
C144 .047 UF
C134 1000
J103
2 1 3 8 5 9 4 7 6
POS. B 1 ST. MULT
POS. C 2ND MULT
POS. D 3RD. MULT
POS. F 47K MULT
POS. 9 AMPL. -
TOP VIEW

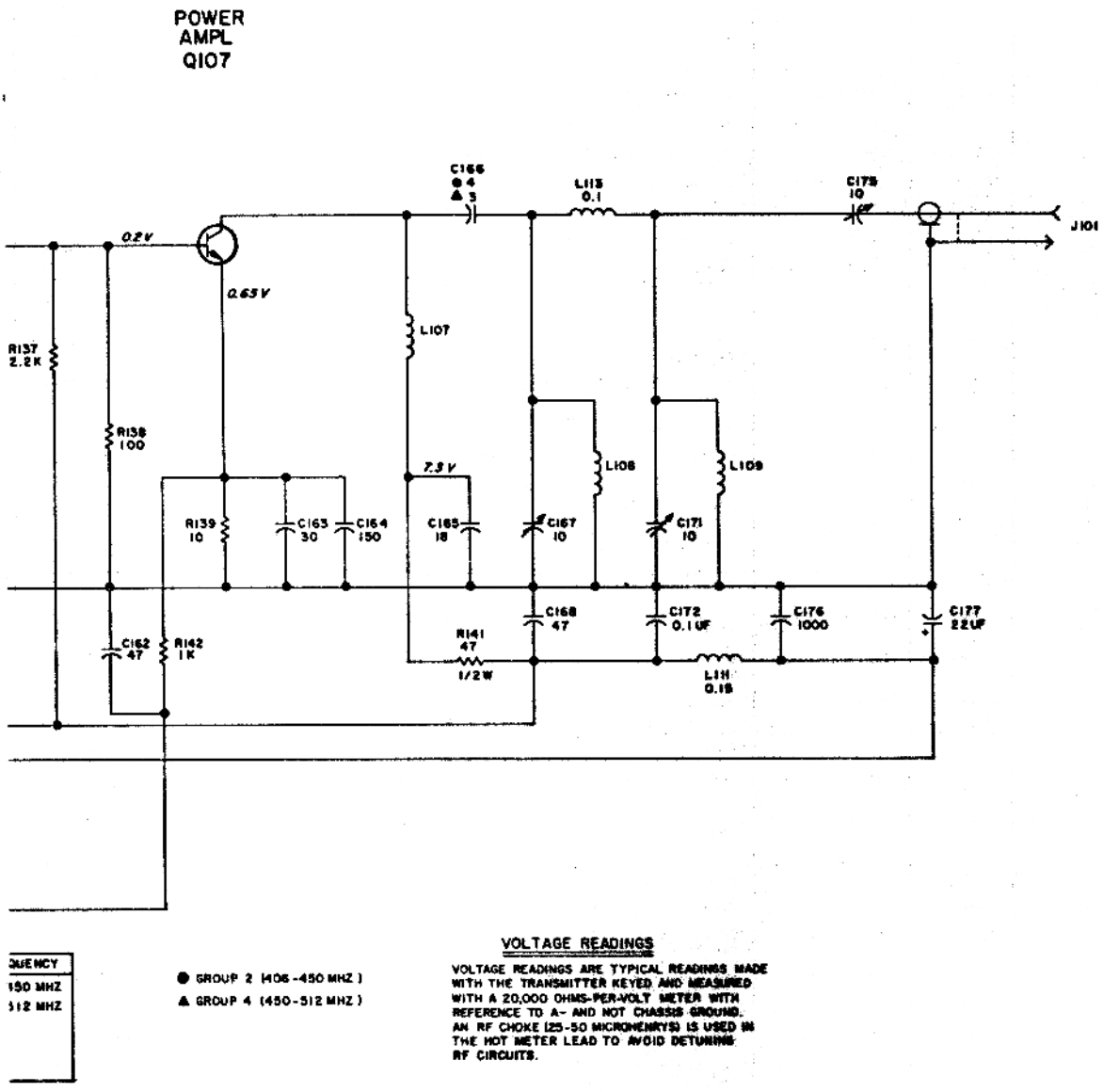
SECOND
DOUBLER
Q106



ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS; CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

MODEL NO.	REV. LETTER	FRE
19042386582	F	406-4
19042386584	F	450-5

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.



VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH THE TRANSMITTER KEYED AND MEASURED WITH A 20,000 OHMS-PER-VOLT METER WITH REFERENCE TO A- AND NOT CHASSIS GROUND. AN RF CHOKE (25-50 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

SCHEMATIC DIAGRAM

406—512 MHz EXCITER BOARD
19D423865G2 & G4

GE PART NO.	DESCRIPTION
19C307169P204	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 100374-DS-8.
	- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
19D416542G2	Audio transmitter.
	- - - - - - - - - - - SOCKETS - - - - - - - - - - -
19A142706P1	Contact, electrical. (Quantity 6 each socket).
	- - - - - - - - - - - NETWORKS - - - - - - - - - - -
19A134666P2	Frequency network: selective, 460-600 MHz resonant freq, 500 VDCW; sim to Dilectron TC501:NPO:270J:SLAC. Added by REV E.
	ASSOCIATED ASSEMBLIES
	- - - - - - - - - - OSCILLATORS - - - - - - - - - -
	NOTE: When reordering specify ICOM Frequency.
	ICOM FREQ = $\frac{\text{Operating Frequency}}{36}$
19A137763G15	Internally compensated, ±2 PPM, 406-512 MHz.
19A137763G18	Externally compensated, ±5 PPM, 406-512 MHz.
19A137763G21	Internally compensated, ±5 PPM, 406-512 MHz.
	- - - - - - - - - MISCELLANEOUS - - - - - - - - -
19C321436G1	Shield.
19A129424G2	Can. (Used with T101-T108).
19A116707P3	Insulator, disc. (Used with Q105-Q107).

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To increase Power Output. Incorporate new transistor Q107.

REV. B - To increase Power Output. Changed R121 and C156.

REV. C - To improve operation. Changed Q104.

REV. D - To improve audio frequency response. Change R109.

REV. E - To incorporate new nomenclature for frequency selective networks. Deleted C153 and added Z101.

REV. F - To permit operation with the 19A137763 ICOM. Changed R143.

SYMBOL	GE PART NO.	DESCRIPTION
C193L	19A116656P39J8	Ceramic disc: 39 pF ±5%, 500 VDCW, temp coef -80 PPM
C193H	19A116656P27J8	Ceramic disc: 27 pF ±5%, 500 VDCW, temp coef -80 PPM.
C194L	19A116656P12J8	Ceramic disc: 12 pF ±5%, 500 VDCW; temp. coef -80 PPM.
C194H	19A116656P8J8	Ceramic disc: 8 pF ±5%, 500 VDCW; temp. coef -80 PPM.
C195L	19A116656P9J8	Ceramic disc: 9 pF ±5%, 500 VDCW; temp. coef -80 PPM.
C195H	19A116656P6J0	Ceramic disc: 6 pF ±0.5 pF, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CV101	5495769P9	Silicon, capacitive.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J101	19A130924G1	Connector, receptacle: coaxial, jack type; sim to Cinch 14H11613.
J103	19B219374G1	Connector: 9 contacts.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L101	19A130255P3	Coil.
L104	19A130255P2	Coil.
L105	19A130443P1	Coil.
L106L	19A130443P4	Coil.
L106H	19A130443P2	Coil.
L107	19A130255P2	Coil.
L108	19A130443P1	Coil.
L109	19A130443P3	Coil.
L111	19B209420P103	Coil, RF: .15 uH ±10%, .10 ohms DC res max; sim to Jeffers 4416-3K.
L112	19A700024P9	Coil, RF: 470 nH ±10%.
L113	19B209420P1	Coil, RF: .10 uH ±5%, .08 ohms DC res max; sim to Jeffers 4416-6J.
L114	19A700024P9	Coil, RF: 470 nH ±10%.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P902		Connector. Includes:
	19B219594P2	Contact, electrical: 8 pins.
	19B219594P3	Contact, electrical: 9 pins.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q102	19A702084P1	Silicon, NPN; sim to MPS 2369.
Q103	19A115328P1	Silicon, NPN.
Q104*	19A116899P1	Silicon, NPN; sim to Type 2N2368.
		In REV B and earlier:
	19A115328P1	Silicon, NPN.
Q105 and Q106	19A116201P3	Silicon, NPN.
Q107*	19A116201P4	Silicon, NPN.
		Earlier than REV A:
	19A116201P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R102	19A700106P53	Composition: 390 ohms ±5%, 1/4 w.
R103	19A700106P57	Composition: 560 ohms ±5%, 1/4 w.
R104	19B209358P106	Variable, carbon film: approx 300 to 10K ohms ±10%, 1/4 w; sim to CTS Type X-201.
R105	19B209358P105	Variable, carbon film: approx 200 to 5K ohms ±10%, 1/4 w; sim to CTS Type X-201.
R106	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R107	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R108	3R152P683K	Composition: 68K ohms ±10%, 1/4 w.
R109*	3R152P433J	Composition: 43K ohms ±5%, 1/4 w.
		In REV C & earlier:
	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R110	19A700106P85	Composition: 8.2K ohms ±5%, 1/4 w.
R111	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R112	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R113 and R114	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R115	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R116	19A700106P45	Composition: 180 ohms ±5%, 1/4 w.
R117	3R152P273K	Composition: 27K ohms ±10%, 1/4 w.
R118	19A700106P47	Composition: 220 ohms ±5%, 1/4 w.
R121*	19A700106P45	Composition: 180 ohms ±5%, 1/4 w.
		In REV A & earlier:
	3R152P151J	Composition: 150 ohms ±5%, 1/4 w.
R122	19A700106P103	Composition: 47K ohms ±5%, 1/4 w.
R123	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
R125	19A700106P57	Composition: 560 ohms ±5%, 1/4 w.
R126	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R127	19A116310P39	Composition: 22 ohms ±5%, 1/4 w; sim to Allen-Bradley Type CB.
R128	19A700106P35	Composition: 68 ohms ±5%, 1/4 w.
R129	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R131	3R151P221J	Composition: 220 ohms ±5%, 1/8 w.
R132	19A700106P61	Composition: 330 ohms ±5%, 1/4 w.
R133	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R134	19A116310P37	Composition: 15 ohms ±5%, 1/4 w; sim to Allen-Bradley Type CB.
R135	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R136	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R137	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R138	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
R139	19A116310P35	Composition: 10 ohms ±5%, 1/4 w; sim to Allen-Bradley Type CB.
R140	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R141	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R142	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R143	19A700106P83	Composition: 6.8K ohms ±5%, 1/4 w.
R144	3R151P100K	Composition: 10 ohms ±10%, 1/8 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T101	19C307171P101	Coil, RF: variable, wire size No. 34 AWG; sim. to Paul Smith Co. Sample No. 080274-OG-1, 092574-DS-1.
T102	19C307170P305	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 092574-DS-2.
T103	19C307170P306	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 092574-DS-3.
T104	19C307170P307	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 092574-DS-4.
T105	19C307169P202	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 092574-DS-5.
T106	19C307169P203	Coil, RF: variable, wire size No. 20 AWG; sim. to Paul Smith Co. Sample No. 092574-DS-6.

PARTS LIST

LBI30202F

406-512 MHz EXCITER BOARD
19D42386SG2 (L) 406-450 MHz
19D42386SG4 (H) 450-512 MHz

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C102	19A134202P6	Tantalum: 22 uF ±20%, 15 VDCW.
C103	19A134202P8	Tantalum: 15 uF ±20%, 20 VDCW.
C104	19A134202P5	Tantalum: 3.3 uF ±20%, 15 VDCW.
C105 and C106	19A116080P1	Polyester: 0.01 uF ±20%, 50 VDCW.
C107	19A116080P7	Polyester: 0.1 uF ±20%, 50 VDCW.
C108	19A116655P13	Ceramic disc: 470 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C109	19A116080P7	Polyester: 0.1 uF ±20%, 50 VDCW.
C111	19A116655P20	Ceramic disc: 1000 pF ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C112	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C113	5496372P365	Ceramic disc: 470 pF ±10%, 500 VDCW, temp coef -4700 PPM.
C114	19A134202P6	Tantalum: 22 uF ±20%, 15 VDCW.
C115	19A116655P13	Ceramic disc: 470 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C116	5496372P379	Ceramic disc: 910 pF ±10%, 500 VDCW, temp coef -4700 PPM.
C117	5496372P365	Ceramic disc: 470 pF ±10%, 500 VDCW, temp coef -4700 PPM.
C118L	19A116656P30J8	Ceramic disc: 30 pF ±5%, 500 VDCW, temp coef -80 PPM.
C118H	19A116656P27J8	Ceramic disc: 27 pF ±5%, 500 VDCW, temp coef -80 PPM.
C119	19A700013P15	Phenolic: 1.50 pF ±5%, 500 VDCW.
C121L	19A116656P30J8	Ceramic disc: 30 pF ±5%, 500 VDCW, temp coef -80 PPM.
C121H	19A116656P27J8	Ceramic disc: 27 pF ±5%, 500 VDCW, temp coef -80 PPM.
C122L	19A116656P24J8	Ceramic disc: 24 pF ±5%, 500 VDCW, temp coef -80 PPM
C122H	19A116656P20J8	Ceramic disc: 20 pF ±5%, 500 VDCW, temp coef -80 PPM
C124	19A700105P34	Mica: 100 pF ±5%, 500 VDCW.
C125	19A116655P21	Ceramic disc: 2700 pF ±20%, 1000 VDCW; sim to RMC Type JR Discap.
C127 and C128	19A116655P21	Ceramic disc: 2700 pF ±20%, 1000 VDCW; sim to RMC Type JR Discap.
C131	5491601P118	Phenolic: 0.75 pF ±5%, 500 VDCW.
C132	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C133	19A116655P7	Ceramic disc: 150 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C134 thru C136	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C137	19A700013P11	Phenolic: 0.68 pF ±5%, 500 VDCW.
C138L	19A116656P56J8	Ceramic disc: 56 pF ±5%, 500 VDCW, temp coef -80 PPM.
C138H	19A116656P39J8	Ceramic disc: 39 pF ±5%, 500 VDCW, temp coef -80 PPM.
C139	19A116655P13	Ceramic disc: 470 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C141	19A116655P7	Ceramic disc: 150 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C143L	19A700105P26	Mica: 47 pF ±5%, 500 VDCW.
C143H	19A700105P23	Mica: 39 pF ±5%, 500 VDCW.
C144	19A116080P5	Polyester: 0.047 uF ±20%, 50 VDCW.
C145L	19A116656P22J8	Ceramic disc: 22 pF ±5%, 500 VDCW, temp coef -8 PPM.
C145H	19A116656P15J8	Ceramic disc: 15 pF ±5%, 500 VDCW, temp coef -8 PPM.
C146	19A700013P10	Phenolic: 0.56 pF ±5%, 500 VDCW.
C147L	19A116656P30J8	Ceramic disc: 30 pF ±5%, 500 VDCW, temp coef -8 PPM.
C147H	19A116656P15J8	Ceramic disc: 15 pF ±5%, 500 VDCW, temp coef -8 PPM.
C148	19A116656P30J8	Ceramic disc: 30 pF ±5%, 500 VDCW, temp coef -8 PPM.
C149	19A116655P7	Ceramic disc: 150 pF ±20%, 1000 VDCW; sim to RM Type JF Discap.
C151	19A116655P7	Ceramic disc: 150 pF ±20%, 1000 VDCW; sim to RM Type JF Discap.
C152L	19A116656P4J0	Ceramic disc: 4 pF ±0.5 pF, 500 VDCW, temp coef 0 PPM.
C152H	19A116656P3J0	Ceramic disc: 3 pF ±0.5 pF, 500 VDCW, temp coef 0 PPM.
C153*	19A134866P2	Silver mica: 22 pF ±5%, 500 VDCW; sim to Electr Motive Type DM154CR. Deleted by REV E.
C154	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C155	19A700008P1	Variable: 2.04 to 9.9 pF, 250V peak.
C156*	19A700013P14	Phenolic: 1.20 pF ±5%, 500 VDCW.
		In REV A & earlier:
	5491601P120	Phenolic: 1.0 pF ±5%, 500 VDCW.
C157	19A700008P1	Variable: 2.04 to 9.9 pF, 250V peak.
C161L	19A116656P6J8	Ceramic disc: 6 pF ±5%, 500 VDCW; temp. coef -80 PPM.
C161H	19A116656P5J8	Ceramic disc: 5 pF ±5%, 500 VDCW; temp. coef -80 PPM.
C162	19A116656P47J1	Ceramic disc: 47 pF ±5%, 500 VDCW; temp. coef -150 PPM.
C163	19A116656P30J8	Ceramic disc: 30 pF ±5%, 500 VDCW, temp coef -8 PPM.
C164	19A116655P7	Ceramic disc: 150 pF ±20%, 1000 VDCW; sim to RM Type JF Discap.
C165	19A700105P14	Mica: 18 pF ±5%, 500 VDCW.
C166L	19A116656P4J0	Ceramic disc: 4 pF ±0.5 pF, 500 VDCW, temp coef 0 PPM.
C166H	19A116656P3J0	Ceramic disc: 3 pF ±0.5 pF, 500 VDCW, temp coef 0 PPM.
C167	19A700008P1	Variable: 2.04 to 9.9 pF, 250V peak.
C168	19A116656P47J1	Ceramic disc: 47 pF ±5%, 500 VDCW; temp. coef -150 PPM.
C171	19A700008P1	Variable: 2.04 to 9.9 pF, 250V peak.
C172	19A116080P7	Polyester: 0.1 uF ±20%, 50 VDCW.
C175	19A700008P1	Variable: 2.04 to 9.9 pF, 250V peak.
C176	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C177	19A134202P6	Tantalum: 22 uF ±20%, 15 VDCW.
C178	19A116655P13	Ceramic disc: 470 pF ±20%, 1000 VDCW; sim to RM Type JF Discap.
C181 and C182	19A134202P6	Tantalum: 22 uF ±20%, 15 VDCW.
C183	19A116080P1	Polyester: 0.01 uF ±20%, 50 VDCW.
C192L	19A116656P24J8	Ceramic disc: 24 pF ±5%, 500 VDCW, temp coef -8 PPM.
C192H	19A116656P18J8	Ceramic disc: 18 pF ±5%, 500 VDCW, temp coef -8 PPM.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES