MOBILE RADIO

MAINTENANCE MANUAL
138—174 MHz EXCITER BOARD 19D423293G1, G2

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DESCRIPTION

The exciter uses seven transistors, a crystal module and an integrated circuit to provide 250 milliwatt of power to drive the PA assembly. The crystal module determines the (F1) transmitting frequency in single frequency applications.

In multi-frequency transmitters, the crystal modules for frequencies F2-F4 are located on the multi-frequency board.

The crystal frequency ranges from approximately 11.5 to 14.5 megahertz, and is multiplied 12 times.

Audio, supply voltages and control functions are connected from the system audio & squelch 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 multipliers, amplifier and the regulated 10 Volt supply.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

A Colpitts oscillator comprised of Q102, a plug-in crystal module and associated components provides the fundamental operating frequency for the transmitter. The crystal module in the collector base circuit of Q102 is temperature compensated to maintain frequency stability within ±5 PPM over a temperature range of -30°C to +65°C. Compensation voltage is applied from compensator circuit Q101. The output of the oscillator is taken from the collector of Q102, buffered by Q103 and applied to modulator CR101 and CR102.

With the radio turned on and the PTT switch operated, +10 Volts is present on the Tx OSC lead at P902-1 and the emitter of oscillator Q102. R104 and R105 comprise a voltage divider network to establish the bias voltage for Q102, allowing it to oscillate at the crystal frequency.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to compliment the temperature/frequency characteristics of each individual crystal. Should it become necessary to replace either Y1 or C2, the entire crystal module must be replaced.

In single frequency radios, the F1 keying lead is connected directly to A- by a DA jumper connected between H12 and H31 on the system, audio, squelch board (SAS). This assures F1 oscillator operation each time the PTT switch is pressed.

With the radio turned on and the PTT switch operated, +10 Volts is present on the transmitter oscillator lead at P902-1 and the emitter of Q102. R104 and R105 comprise a voltage divider network to establish the base voltage for Q102 allowing it to oscillate at the crystal frequency to allow E1 frequency selection via the frequency selector switch on the control unit.

When frequencies F2 thru F4 are selected the oscillator output frequency from the multi-frequency board is supplied to buffer Q103 through J102-1 on the exciter and cable W2601.

COMPENSATOR CIRCUITS

The crystal modules are temperature compensated at both ends of the temperature range to provide instant frequency compensation. The temperature compensator consists of Q101, VR101, RT101, RT102 and associated components. Zener diode VR101 provides a constant +8.5 V reference voltage for compensator Q101.

The cold end compensation circuit does not operate at temperatures above -10°C (+14°F). When the temperature drops below -10°C, the circuit is activated. As the temperature increases, the resistance of RT101 increases and the compensation voltage increases.

An increase in compensation voltage decreases the capacitance of the varactor in the oscillator, thereby increasing the output frequency of the crystal module.

The hot end compensation circuit does not operate at temperatures below +55°C (131°F). When the temperature rises above +55°C, the circuit is activated. As the temperature increases, the resistance of RT102 decreases and the compensation voltage decreases. The decrease in compensation voltage increases the capacity of the varactor, decreasing the output frequency of the crystal module.

Listed below are typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules. Voltages should be measured using a high impedance meter.

TEMPERATURE RANGE	OUTPUT VOLTAGE	
	MINIMUM	MAXIMUM
-30°	4.9 Volts	6.0 Volts
-10° to 50°C	3.7 Volts	4.3 Volts
+75°C	3.3 Volts	3.8 Volts

AUDIO IC

The transmitter audio circuitry is contained in audio IC U101. A simplified drawing of the audio IC is shown in Figure 1.

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 the 10-Volt regulator through R979 and R980 on the System-Audio-Squelch board to J901A-14 in MASTR®.

EXECUTIVE II RADIOS

In Custom MVP radios, collector voltage for the transistorized microphone preamplifier is supplied from the 20-Volt regulator on the SAS board through R28, R29 and J913 to the microphone.

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 R108 and resistors R109 and R115 to the phase modulators.

SERVICE NOTE: If the DC voltages applied to the audio IC are correct and there is no audio output, replace U101.

For radios equipped with Channel Guard, tone from the encoder is applied to the phase modulators through P902-9, (CG HI) and resistors R112 and R117. Instructions for setting Channel Guard modulation are located in the Transmitter Alignment Procedures.

BUFFER & PHASE MODULATOR

The oscillator output is coupled through buffer-amplifier Q103 to the modulator. The first phase modulator is varactor (voltage-variable capacitor) CR101 is connected in series with tunable coil L101.

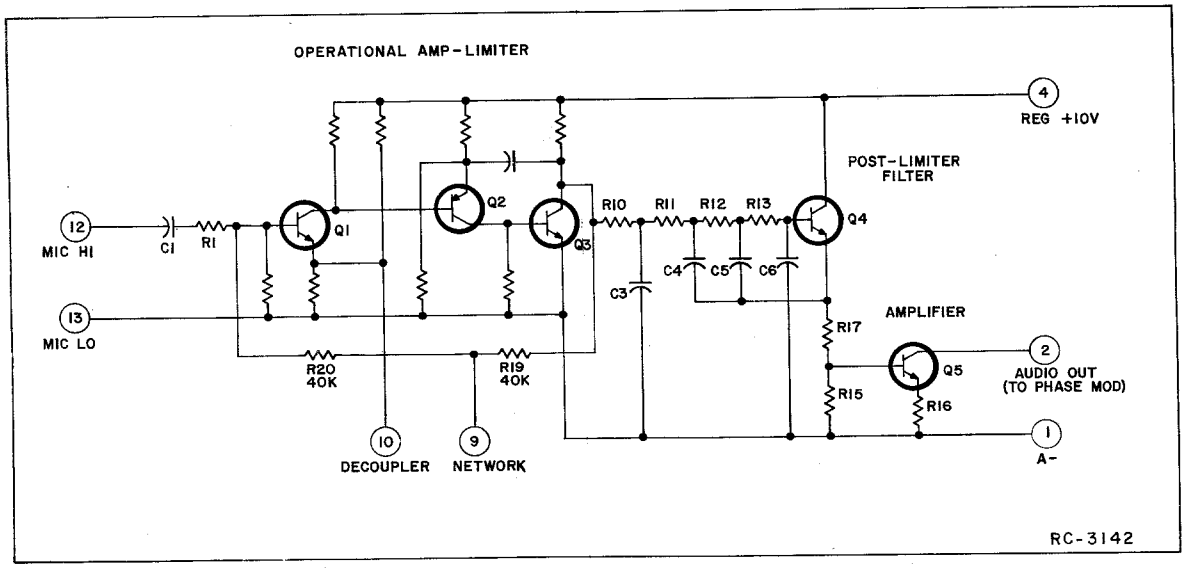


Figure 1 - Simplified Audio IC

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 C114 varies the bias of CR101, resulting in a phase modulated output. A voltage divider network (R109 and R113) provides the proper bias for varactors CR101 and CR102.

The output of the modulator is coupled through blocking capacitor C119 to the base of buffer Q104.

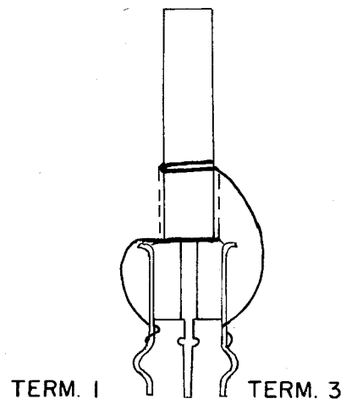
MULTIPLIERS & AMPLIFIER

Buffer Q104 is saturated when no RF signal is present. Applying an RF signal to Q104 provides a sawtooth waveform at its collector to drive class C tripler, Q105. The tripler stage is metered through R122. The output of Q105 is coupled through tuned circuits T101 and T102 to the base of doubler Q106. T101 and T102 are tuned to one-fourth of the operating frequency. The doubler stage is metered through R124.

The output of Q106 is coupled through tuned circuits T103 and T104 to the base of second doubler Q107. T103 and T104 are tuned to one-half the operating frequency. Q107 is metered through R129.

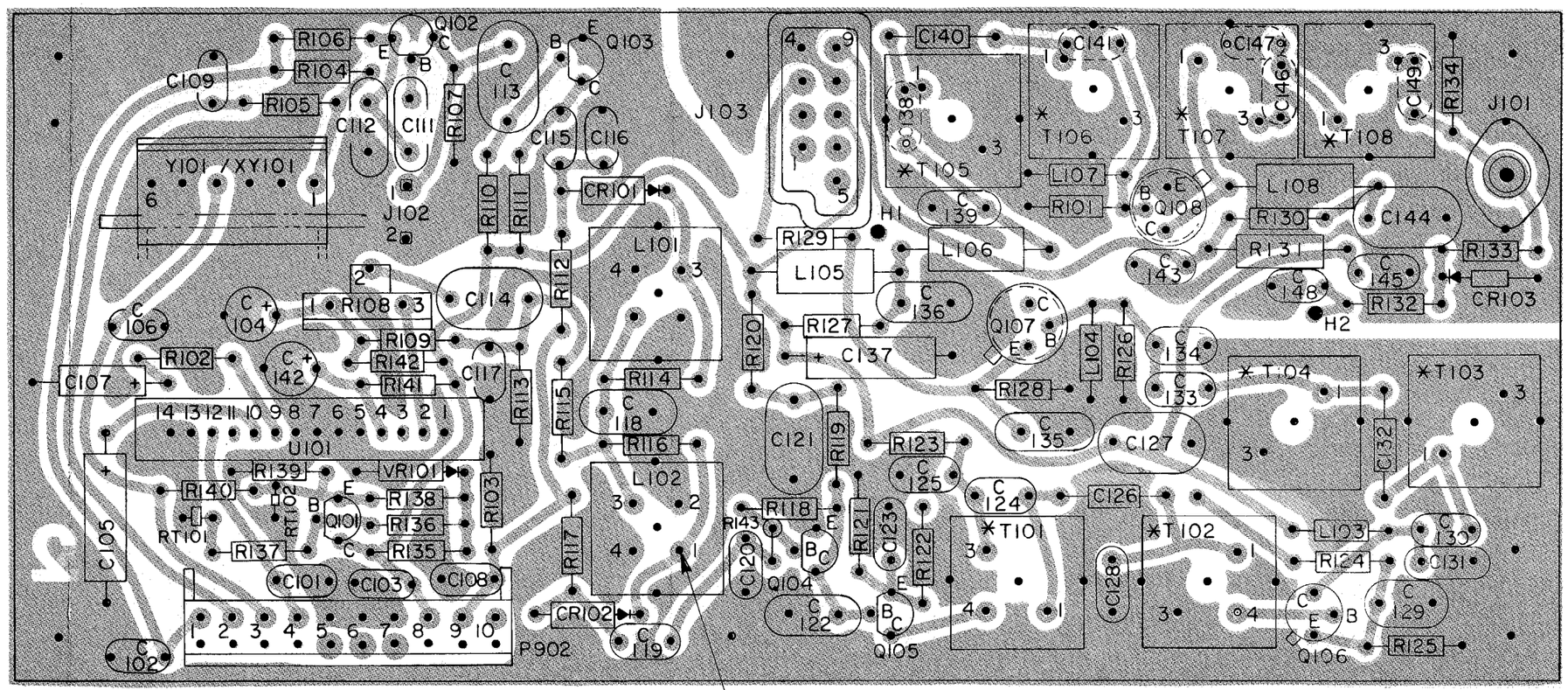
The output of Q107 is coupled through two tuned circuits (T105 and T106) to the base of amplifier Q109. These circuits are tuned to the transmitter operating frequency.

Q108 is a class C amplifier, and is metered through R130. The amplifier collector circuit consists of T107, C146, C147, T108 and C149, and matches the amplifier output to the input of the power amplifier assembly.



DETAIL "C"

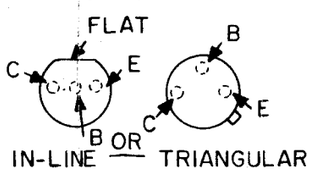
L101 & L102 (ENLARGED)



SEE DETAIL "C"

(19D423895, Rev. 0)
(19D423281, Sh. 2, Rev. 2)
(19D423281, Sh. 3, Rev. 2)

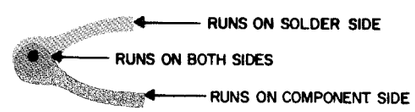
LEAD IDENTIFICATION
FOR Q101 - Q107



TOP VIEW

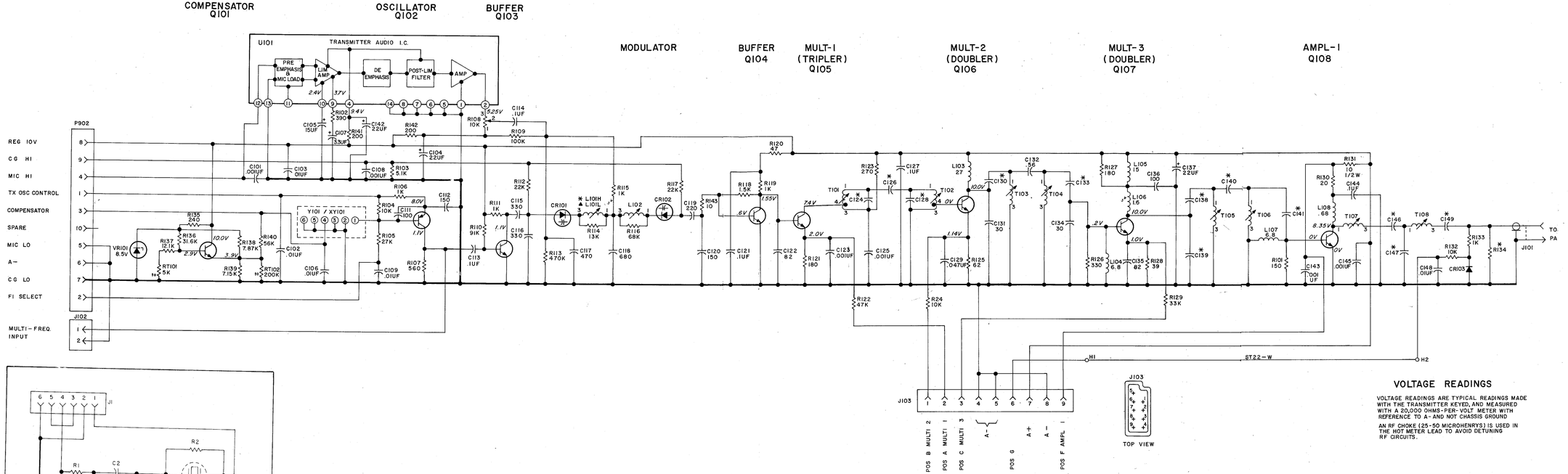
NOTE: LEAD ARRANGEMENT, & NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION TAB INDICATES EMITTER LEAD

✳ RAISED TAB ON COIL FORM INDICATES PIN 1 ON T101 THRU T108



OUTLINE DIAGRAM

138—174 MHz EXCITER BOARD
19D423293G1, 2



TYPICAL CRYSTAL MODULE

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.

(19B623171, Rev. 6)

EXCITER BOARD	REV LETTER	FREQ RANGE
19D423293G1	A	138 - 155 MHz
19D423293G2	B	150.8-174 MHz

* SEE CHART BELOW FOR VALUE

COMPONENT IDENT.	VALUE L 138 - 155	VALUE H 150.8-174
C124	30	24
C126	.82	.75
C128	27	24
C130	24	18
C133	24	18
C138	13	8
C139	27	18
C140	.47	.39
C141	8	6
C146	8	6
C147	13	10
C149	8	6
R134	390	NONE

▲ USE IN GROUP 1
* USE IN GROUP 2

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.

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.

SCHEMATIC DIAGRAM

138—174 MHz EXCITER BOARD
19D423293G1, 2

PARTS LIST

LBI30064B

138-174 MHz EXCITER BOARD
19D423293G1 138-155 MHz
19D423293G2 150.8-174 MHz

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C101	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C102 and C103	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C104	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C105	5496287P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C106	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C107	5496287P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C108	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C109	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C111	19A116656P100J7	Ceramic disc: 100 pf ±5%, 500 VDCW, temp coef -750 PPM.
C112	7489162P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C113 and C114	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C115 and C116	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C117	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C118	5493366P680J	Mica: 680 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C119	5490008P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C120	5490008P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C121	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C122	7489162P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C123	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C124L	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C124H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C125	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C126H	5491601P118	Phenolic: 0.75 pf ±5%, 500 VDCW.
C126L	5491601P119	Phenolic: 0.82 pf ±5%, 500 VDCW.
C127	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C128L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C128H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C129	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C130L	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C130H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C131	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C132	5491601P115	Phenolic: 0.56 pf ±5%, 500 VDCW.
C133L	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C133H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C134	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C135	7489162P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C136	5490008P127	Silver mica: 100 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C137	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C138L	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C138H	5496219P239	Ceramic disc: 8.0 pf ±5%, 500 VDCW, temp coef -80 PPM.
C139L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C139H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C140L	5491601P113	Phenolic: 0.47 pf ±5%, 500 VDCW.
C140H	5491601P111	Phenolic: 0.39 pf ±5%, 500 VDCW.
C141L	5496219P239	Ceramic disc: 8.0 pf ±5%, 500 VDCW, temp coef -80 PPM.
C141H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp -80 PPM.
C142	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C143	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C144	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C145	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C146L	5496219P239	Ceramic disc: 8.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C146H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C147L	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C147H	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C148	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C149L	5496219P239	Ceramic disc: 8.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C149H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR101* and CR102*	5495769P9	Silicon, variable capacitance, 33 pf nominal.
		Earlier than REV A:
	5495769P8	Silicon, variable capacitance, 33 pf nominal.
CR103	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J101	19A130924G1	Connector, receptacle: coaxial, jack type; sim to Cinch 14H1613.
J102	19A116779P1	Contact, electrical: sim to Molex 08-50-0404. (Quantity 2).
J103	19B219374G1	Connector: 9 contacts.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L101*	19C307171P101	Coil, RF. Deleted in G2 by REV B.
L101H*	19C307171P106	Coil, RF. Added to G2 by REV B.
L101L	19C307171P101	Coil, RF.
L102L	19C307171P102	Coil, RF.
L102H*	19C307171P106	Coil, RF.
		In REV A & earlier:
	19C307171P101	Coil, RF.
L103	19B209420P130	Coil, RF: 27.0 µh ±10%, 3.60 ohms DC res max; sim to Jeffers 441316-5K.
L104	19B209420P123	Coil, RF: 6.80 µh ±10%, 1.80 ohms DC res max; sim to Jeffers 4446-2.
L105	7488079P18	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4421-9.
L106	7488079P7	Choke, RF: 1.50 µh ±10%, 0.50 ohms DC res max; sim to Jeffers 4411-10K.
L107	19B209420P123	Coil, RF: 6.80 µh ±10%, 1.80 ohms DC res max; sim to Jeffers 4446-2K.
L108	7488079P5	Choke, RF: 0.68 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4411-5.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P902	19A116659P2	Connector, printed wiring: 10 contacts; sim to Molex 09-52-3102.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q101	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q102	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q103	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q104 and Q105	19A115330P1	Silicon, NPN.
Q106	19A115328P1	Silicon, NPN.
Q107 and Q108	19A115329P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	3R152P151J	Composition: 150 ohms ±5%, 1/4 w.
R102	3R152P391K	Composition: 390 ohms ±10%, 1/4 w.
R103	3R152P512J	Composition: 5.1K ohms ±5%, 1/4 w.
R104	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R105	3R152P273J	Composition: 27K ohms ±5%, 1/4 w.
R106	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R107	3R152P561J	Composition: 560 ohms ±5%, 1/4 w.
R108	19B209358P106	Variable, carbon film: approx 300 to 10,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R109	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
R110	3R152P913J	Composition: 91K ohms ±5%, 1/4 w.
R111	3R152P102K	Composition: 1K ohms ±10%, 1/4 w.
R112	3R152P223K	Composition: 22K ohms ±10%, 1/4 w.
R113	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R114	3R152P133J	Composition: 13K ohms ±5%, 1/4 w.
R115	3R152P102K	Composition: 1K ohms ±10%, 1/4 w.
R116	3R152P683K	Composition: 68K ohms ±10%, 1/4 w.
R117	3R152P223J	Composition: 22K ohms ±5%, 1/4 w.
R118	3R152P152K	Composition: 1.5K ohms ±10%, 1/4 w.
R119	3R152P102K	Composition: 1K ohms ±10%, 1/4 w.
R120	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R121	3R152P181K	Composition: 180 ohms ±10%, 1/4 w.
R122	3R152P473K	Composition: 47K ohms ±10%, 1/4 w.
R123	3R152P271K	Composition: 270 ohms ±10%, 1/4 w.
R124	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R125	3R152P620J	Composition: 62 ohms ±5%, 1/4 w.
R126	3R152P331K	Composition: 330 ohms ±10%, 1/4 w.
R127	3R152P181K	Composition: 180 ohms ±10%, 1/4 w.
R128	3R152P390K	Composition: 39 ohms ±10%, 1/4 w.
R129	3R152P333K	Composition: 33K ohms ±10%, 1/4 w.
R130	3R152P200J	Composition: 20 ohms ±5%, 1/4 w.
R131	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R132	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R133	3R152P102K	Composition: 1K ohms ±10%, 1/4 w.
R134	3R152P391K	Composition: 390 ohms ±10%, 1/4 w.
R135	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R136	19C314256P23162	Metal film: 31.6K ohms ±1%, 1/4 w.
R137	19C314256P21212	Metal film: 12.1K ohms ±1%, 1/4 w.
R138	19C314256P27871	Metal film: 7.87K ohms ±1%, 1/4 w.
R139	19C314256P27151	Metal film: 7.15K ohms ±1%, 1/4 w.
R140	3R152P563J	Composition: 56K ohms ±5%, 1/4 w.
R141 and R142	3R152P201J	Composition: 200 ohms ±5%, 1/4 w.
R143	3R152P100K	Composition: 10 ohms ±10%, 1/4 w.
		- - - - - - - - - - THERMISTORS - - - - - - - - -
RT101	19C300048P7	Disc: 5000 ohms ±10%; sim to NL 1D103.
RT102	19C300048P5	Disc: 200,000 ohms ±10%; sim to NL 4D051.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T101	19C307170P301	Coil, RF.
T102	19C307170P302	Coil, RF.
T103 and T104	19C307170P303	Coil, RF.
T105 and T106	19C307169P201	Coil, RF.
T107 and T108	19C307170P304	Coil, RF.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U101	19D416542G2	Transmitter, Audio.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR101	4036887P9	Zener: 500 mW, 8.5 v. nominal.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY101	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		- - - - - - - - - CRYSTAL MODULE - - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
Y101	19B226962G4	Tx. 5 PPM (138-155 MHz).
	19B226962G5	Tx. 5 PPM (150.8-174 MHz).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A129424G2	Can. (Used with L101, L102, T101-T108).
	4036555P1	Insulator, washer: nylon. (Used with Q107, Q108).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

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 - Exciter Board 19D423293G1 & G2

To improve tuning on high end of frequency band. Changed CR101 and CR102.

REV. B - Exciter Board 19D423293G2

To improve band end tuning. Changed L101 and L102.