LBI30147D
(DF1106)

138—174, 406—512 MHz OSCILLATOR-MULTIPLIER BOARD 19C321981G1-6
138—174 MHz ADAPTER BOARD 19B227258G1
406—512 MHz MULTIPLIER BOARD 19C321998G1, 2

TABLE OF CONTENTS

DESCRIPTION

The Oscillator-Multiplier board for the General Electric CUSTOM MVP radio is used in the 138-174 MHz and 406-512 MHz frequency bands. In addition to the oscillator-multiplier board, an adapter board is required on 138-174 MHz applications or a multiplier board in 406-512 MHz applications to complete the oscillator-multiplier chain to the mixer or IF filter boards.

The oscillator-multiplier board (Osc-Mult) contains a Colpitts oscillator, two multiplier stages and an amplifier. The operating frequency of the Colpitts oscillator is maintained within ±5 PPM by an externally compensated crystal module. The crystal frequencies range from approximately 14 to 18 megahertz and are multiplied nine times in the 138-174 MHz frequency band and 27 times in the 406-512 MHz frequency band to provide a low side injection frequency to the mixer.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

Transistor Q402, a plug-in crystal module, trimmer capacitor, varicap and associated components comprise a Colpitts oscillator operating at the assigned F1 receive frequency.

The crystal module, located in the base circuit of Q402, is temperature compensated to maintain frequency stability over a temperature range of -30°C to +60°C. Compensation voltage from the exciter is applied through P602-1 to pin four of the crystal modules.

The compensation voltage varies non-linearly with temperature to complement the temperature-frequency characteristics of the crystal. Listed below are typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules, as measured with a high impedance meter.

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

Trimmer capacitor C3 is used to adjust the radio for the exact operating frequency. Refer to the Alignment Procedure for details.

Refer to the System Maintenance Manual for circuit details of the crystal modules.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to complement 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 applications, the F1 keying lead is wired to A- by a DA jumper wire connected between H8 and H9.

In multi-frequency radios this jumper is removed to allow F1 frequency selection via the frequency selector switch on the control panel.

With the radio turned on and the PTT switch released, +10 V is present on the Rx OSC control lead at P602-6 and the oscillator operates at the crystal frequency. Capacitor C402 provides the necessary in-phase feedback to sustain oscillations. A voltage divider network consisting of R407 and R408 sets the bias for oscillator transistor Q402.

C406 is tuned to three times the crystal frequency. The output of the tuned circuit is applied to the base of Class C multiplier Q403. The collector tank circuit of the multiplier (L402, C411, and C412) is tuned to nine times the crystal frequency. The output of the multiplier stage is metered across R411 and applied to receiver metering jack J601 through P602-3.

Following the multiplier is a Class A Amplifier stage, Q404. The output of Q404 is metered through a metering network consisting of C418, C420, CR401, R417 and R418 and applied to receiver metering jack J601 through P602-4. The amplifier output of Q404 is applied to a tuned circuit (L403 and C416) that is tuned to nine times the crystal frequency. The tuned circuit provides additional selectivity in the oscillator-multiplier chain.

In 138-174 MHz applications, the output of the oscillator-multiplier is coupled through C419 to the adapter board. The output of the adapter board is inductively coupled through L460 and two helical resonators on the RF assembly to the input of the mixer stage.

In 406-512 MHz applications, the output of the oscillator-multiplier is coupled through C419 to the base of Class C multiplier Q450 through a matching network (T450 and C451). The output of Q450 is inductively coupled to the first of three helical resonators through L451. The helicals are tuned to 27 times the crystal frequency by C306, C307, and C308. Most of the selectivity for the oscillator-multiplier chain is provided by the three high-Q helicals. The output of the helicals is applied to the source of mixer FET Q1 on the mixer board. The multiplier output is metered at J601-7 through a metering network on the IF-Filter board. The metering network consists of L505, L506, C512, C513, C514, CR501, and R506.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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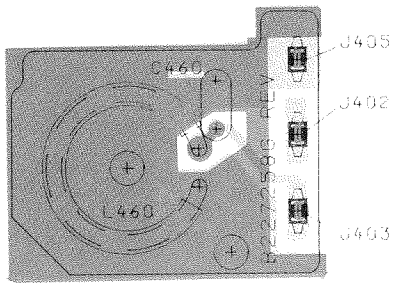
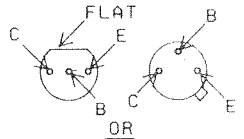
Intentionally Blank

138—174 MHz ADAPTER BOARD



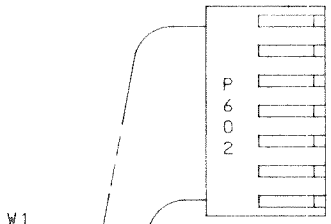
(19B227344, Rev. 1)
(19B227259, Sh. 1, Rev. 1)
(19B227259, Sh. 2, Rev. 1)

LEAD IDENTIFICATION
FOR Q2, Q3, AND Q4



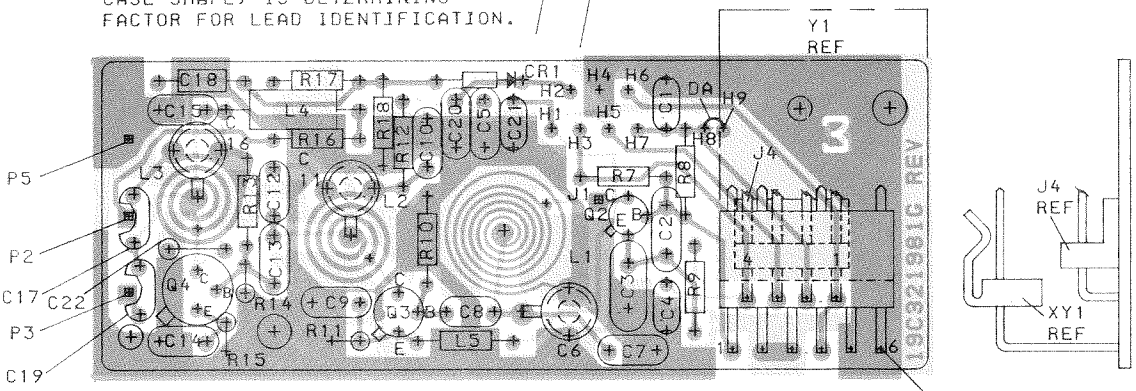
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



CONNECTION CHART	
WIRE	TO
W1-O	H1
W1-G	H2
W1-W	H3
W1-BK	H4
W1-R	H5
W1-BL	H6
W1-BR	H7

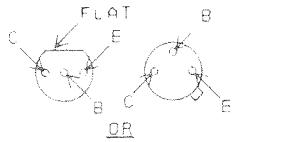
PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH 400 SERIES. EXAMPLE: J1 - J401, C1 - C401, R1 - R401, ETC.



(19C327105, Rev. 4)
(19B227247, Sh. 1, Rev. 3)
(19B227247, Sh. 2, Rev. 2)

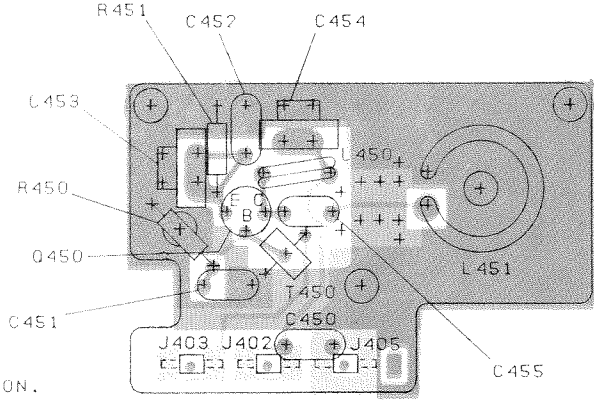
406—512 MHz MULTIPLIER BOARD

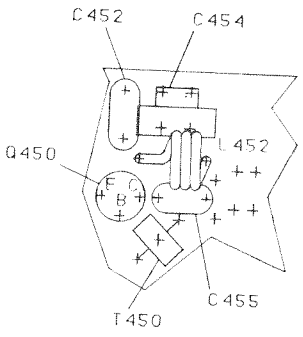
LEAD IDENTIFICATION
FOR Q450



TOP VIEW

NOTE:
LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



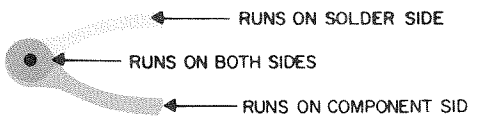


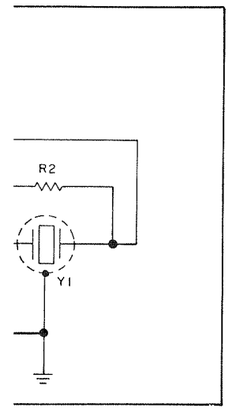
PARTIAL VIEW FOR GROUP 2

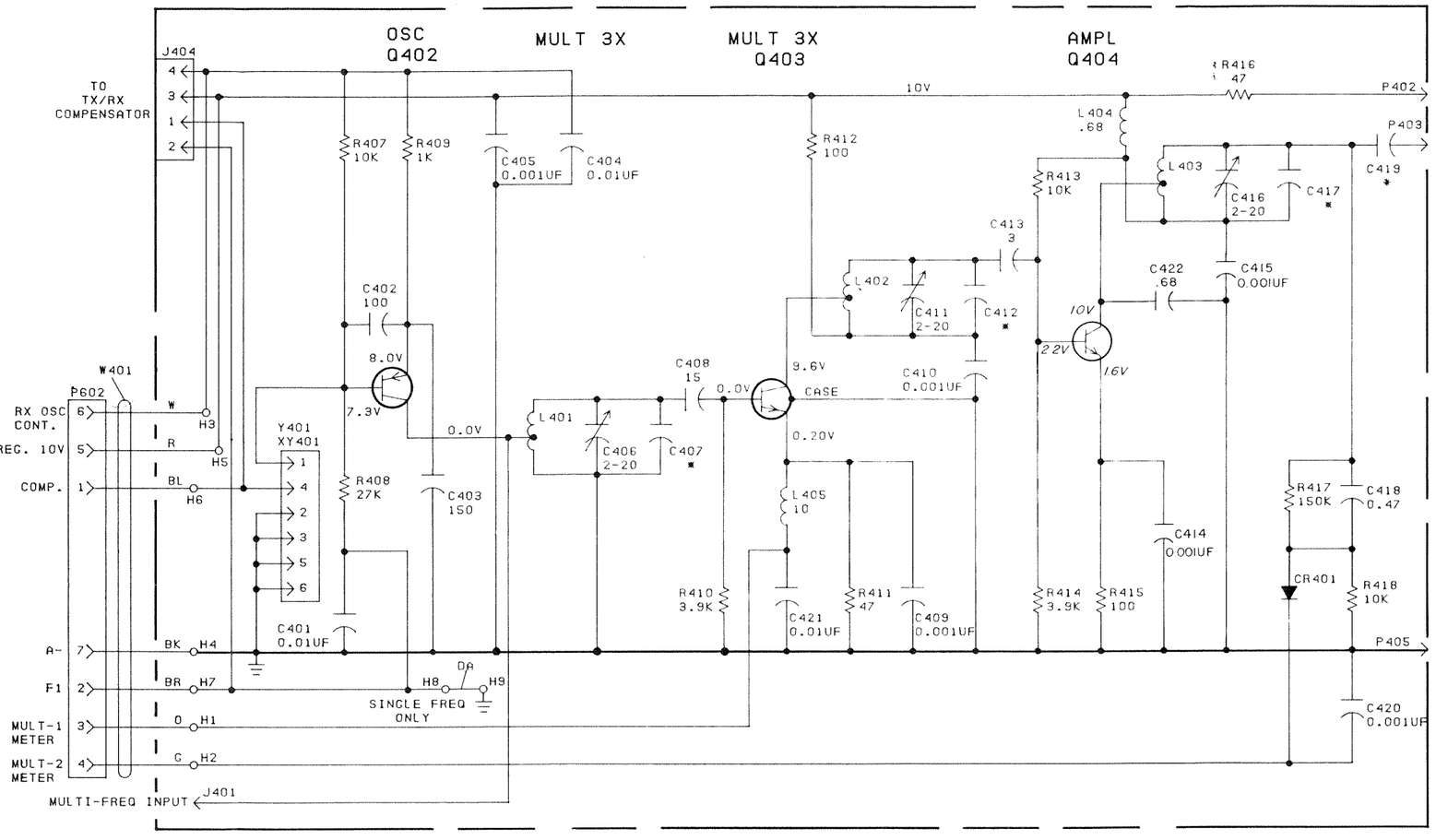
(19C327112, Rev. 2)
(19B227254, Sh. 1, Rev. 0)
(19B227254, Sh. 2, Rev. 0)

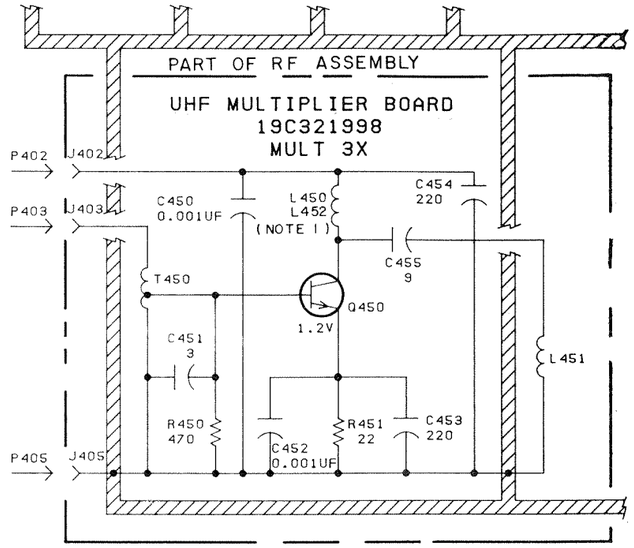
OUTLINE DIAGRAM

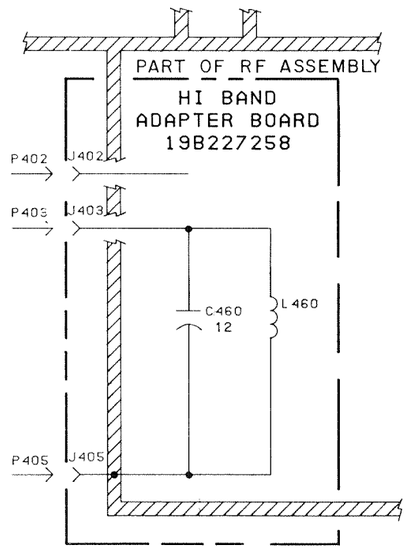
138—174 & 406—512 MHz OSCILLATOR-MULTIPLIER











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.

NOTE: 1. L450 G1
L452 G2

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.

	REV LETTER	FREQ RANGE (MHZ)
OSC/MULT BD		
19C321981G1	C	406-420
19C321981G2	C	420-470
19C321981G3	C	470-490
19C321981G4	C	494-512
19C321981G5	C	138-155
19C321981G6	C	150.8-174
MULT BD		
19C321998G1		450-512
19C321998G2		406-450
ADAPATER BD		
19B227258G1		138-174

*COMPONENT VALUE TABLE FOR OSCILLATOR/MULTIPLIER

COMPONENT DESIGNATION	406-420 MHZ LL	420-470 MHZ L & LM	470-494 MHZ M	494-512 MHZ H	138-155 MHZ LA	150-174 MHZ HA
C407	27	20	18	15	24	18
C412	12	6	5	4	8	5
C417	7	3	-	-	3	-
C419	5	5	5	5	5	3

VOLTAGE READINGS

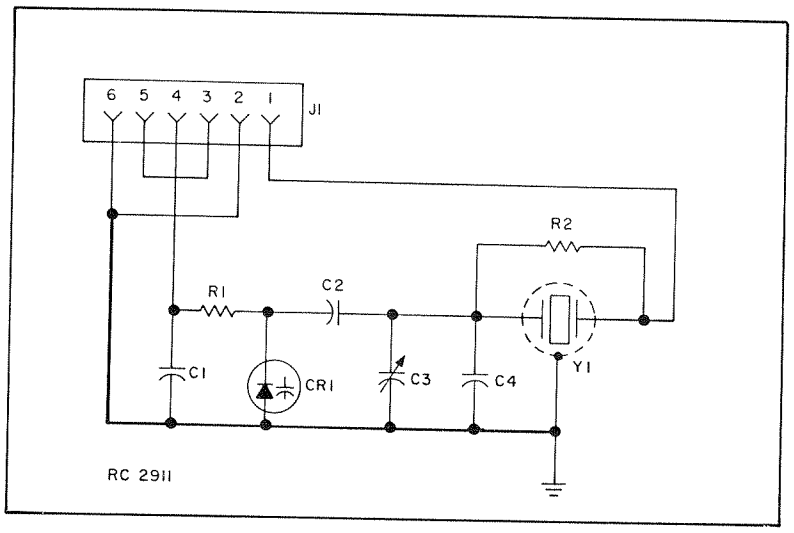
VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P03-6) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

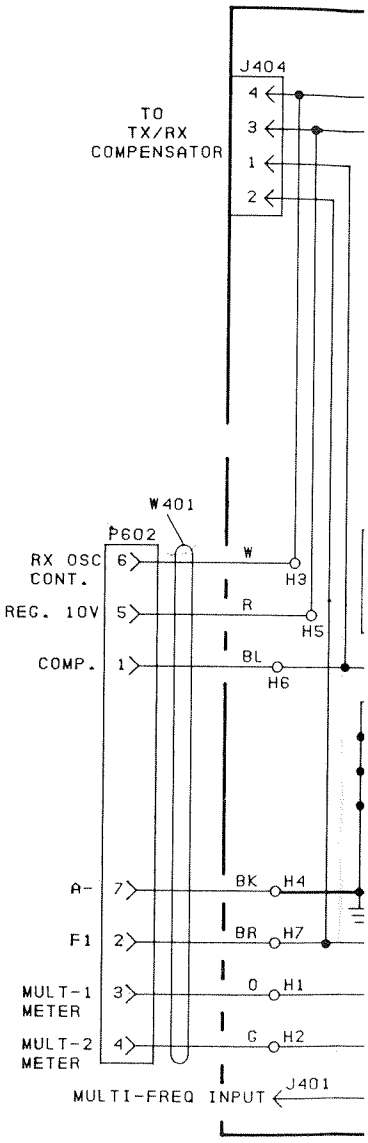
(19D423743, Rev. 7)

SCHEMATIC DIAGRAM

138—174 & 406—512 MHz
OSCILLATOR-MULTIPLIER

TYPICAL CRYSTAL MODULE





PARTS LIST

LBI30153D

138-174, 406-512 MHz
OSCILLATOR - MULTIPLIER
19C321981G1-G6

SYMBOL	GE PART NO.	DESCRIPTION
		19C321981G1 406-420 MHz (LL) 19C321981G2 420-470 MHz (L) 19C321981G3 470-494 MHz (M) 19C321981G4 494-512 MHz (H) 19C321981G5 138-155 MHz (LA) 19C321981G6 150.8-174 MHz (HA)
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C401	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C402	5496218P763	Ceramic disc: 100 pf ±5%, 500 VDCW, temp coef -750 PPM.
C403	7489162P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C404	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C405	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C406	19B209351P2	Variable, ceramic: 2.5 to 20 pf, 200 VDCW, temp coef -250 +700 PPM°C; sim to Matshushita ECV-1ZW20P32.
C407LL	19A116656P27J0	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407L	19A116656P20J0	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407M	19A116656P18J0	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407H	19A116656P15J0	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407LA	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407HA	19A116656P18J0	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C408	19A116656P15J0	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef 0 PPM.
C409 and C410	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C411	19B20951P2	Variable, ceramic: 2.5 to 20 pf, 200 VDCW, temp coef -250 +700 PPM°C; sim to Matshushita ECV-1ZW20P32.
C412LL	19A116656P12J0	Ceramic disc: 12 pf ±5%, 500 VDCW, temp coef 0 PPM.
C412L	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412M	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412H	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412LA	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412HA	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C413	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C414 and C415	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C416	19B209351P2	Variable, ceramic: 2.5 to 20 pf, 200 VDCW, temp coef -250 +700 PPM/°C; sim to Matshushita ECV-1ZW20P32.
C417LL	19A116656P7J0	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C417L	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C417LA	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C418	5491601P13	Phenolic: 0.47 pf ±10%, 500 VDCW.
C419LL	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419L	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419M	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419H	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419LA	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419HA*	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		In REV A & earlier:
	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C420	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C421	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C422*	5491601P117	Phenolic: 0.68 pf ±5%, 500 VDCW. Added by REV A.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR401	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J401	19A116779P1	Contact, electrical: sim to Molex 08-50-0404.
J404	19A116659P118	Connector, printed wiring: 4 contacts; sim to Molex 09-88-2041.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L401 thru L403		(Part of printed board 19C321984P1).
L404	7488079P5	Choke, RF: 0.68 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4411-5K.
L405	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4K.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P402 and P403	19A116779P3	Contact, electrical: sim to Molex 08-50-0416.
P405	19A116779P3	Contact, electrical: sim to Molex 08-50-0416.
P602		(Part of W401).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q402	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q403*	19A134670P1	Silicon, NPN; sim to SRF 2503.
		In REV B & earlier:
	19A115440P1	Silicon, NPN.
Q404	19A115329P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R407	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R408	3R152P273J	Composition: 27K ohms ±5%, 1/4 w.
R409	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R410	3R152P392J	Composition: 3.9K ohms ±5%, 1/4 w.
R411	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R412	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R413	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R414	3R152P392J	Composition: 3.9K ohms ±5%, 1/4 w.
R415	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R416	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R417	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R418	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CABLES - - - - - - - - - -
W401	19B226965G2	Cable, includes (P602) 19A116659P82.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY401	19A136694G1	Connector: 6 terminals.
		- - - - - - - - - CRYSTAL MODULES - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
		For Standard Low Side Injection Frequency.
Y401	19B226962G13	Rx. 5 PPM. (138-155 MHz).
	19B226962G14	Rx. 5 PPM. (150.8-174 MHz).
		NOTE: For High Side Injection Frequency Using High Side Modification Kit 19A130045G1.
	19B226962G19	Rx. 5 PPM. (138-155 MHz).
	19B226962G20	Rx. 5 PPM. (150.8-174 MHz).
		HIGH SIDE INJECTION MODIFICATION KIT 19A130045G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C2311	19A116656P12K0	Ceramic disc: 12 pf ±10%, 500 VDCW, temp coef 0 PPM.
C2312	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C2313	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C2314	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C2318	19A116656P10J8	Ceramic disc: 10 pf ±0.5 pf, 500 VDCW, temp coef -80 PPM.
		- - - - - - - - - CRYSTAL MODULES - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
		For Standard Low Side Injection Frequency.
Y401	19B226962G15	Crystal module: 5 PPM, 406-420 MHz.
	19B226962G29	Crystal module: 5 PPM, 420-450 MHz
	19B226962G16	Crystal module: 5 PPM, 450-470 MHz.
	19B226962G17	Crystal module: 5 PPM, 470-494 MHz.
	19B226962G18	Crystal module: 5 PPM, 494-512 MHz.
		For High Side Injection Frequency:
Y401	19B226962G21	Crystal module: 5 PPM, 406-420 MHz.
	19B226962G36	Crystal module: 5 PPM, 420-450 MHz
	19B226962G22	Crystal module: 5 PPM, 450-470 MHz.
	19B226962G23	Crystal module: 5 PPM, 470-494 MHz.
	19B226962G24	Crystal module: 5 PPM, 494-512 MHz.
		138-174 MHz ADAPTER BOARD 19B227258G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C460*	19A116656P12K0	Ceramic disc: 12 pf ±10%, 500 VDCW, temp coef 0 PPM.
		Earlier than REV A:
	19A116656P18K0	Ceramic disc: 18 pf ±10%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J402 and J403	19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).
J405	19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L460	19A129280P1	Coil.
		406-512 MHz MULTIPLIER BOARD 19C321998G1 420-512 MHz 19C321998G2 406-420 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C450	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C451	19A116656P3K0	Ceramic disc: 3 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C452	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C453 and C454	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
C455	19A116656P9K0	Ceramic disc: 9 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J402 and J403	19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).
J405	19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L450	19A129711P1	Coil.
L451	19A129710P1	Coil.
L452	19A129352P8	Coil.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q450	19A116201P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R450	3R152P471J	Composition: 470 ohms ±5%, 1/4 w.
R451	3R152P220J	Composition: 22 ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T450	19A129920G1	Coil.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4031594P1	Insulator: teflon. (Used with C6, C11, C16).
	4036555P1	Insulator, washer: nylon. (Used with Q4).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

GE PART NO.	DESCRIPTION
	- - - - - - - - - - INDUCTORS - - - - - - - - - -
19A129280P1	Coil. 406-512 MHz MULTIPLIER BOARD 19C321998G1 420-512 MHz 19C321998G2 406-420 MHz
	- - - - - - - - - - CAPACITORS - - - - - - - - - -
19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
19A116656P3K0	Ceramic disc: 3 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
19A116656P9K0	Ceramic disc: 9 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
	- - - - - - - JACKS AND RECEPTACLES - - - - - -
19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).
19A116428P4	Contact, electrical: sim to AMP 86031-1 (Strip Form).
	- - - - - - - - - - INDUCTORS - - - - - - - - - -
19A129711P1	Coil.
19A129710P1	Coil.
19A129352P8	Coil.
	- - - - - - - - - TRANSISTORS - - - - - - - - -
19A116201P1	Silicon, NPN.
	- - - - - - - - - - RESISTORS - - - - - - - - - -
3R152P471J	Composition: 470 ohms ±5%, 1/4 w.
3R152P220J	Composition: 22 ohms ±5%, 1/4 w.
	- - - - - - - - - - TRANSFORMERS - - - - - - - -
19A129920G1	Coil.
	- - - - - - - - - MISCELLANEOUS - - - - - - - - -
4031594P1	Insulator: teflon. (Used with C6, C11, C16).
4036555P1	Insulator, washer: nylon. (Used with Q4).

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 - Oscillator Multiplier Board 19C321981G1-6

Stop spurious oscillation in Amplifier Q404.
Added C422.

REV. B - Oscillator Multiplier Board 19C321981G1-6

REV. A - High Band Adapter Board 19B227258G1

To improve tuning at 174 MHz.
Changed C419 and C460

REV. C - Oscillator Multiplier Board 19C321981G1-6

To improve reliability. Changed Q403.