MOBILE RADIO

MAINTENANCE MANUAL

406—512 MHz OSCILLATOR-MULTIPLIER BOARD 19C321751G1-G5

TABLE OF CONTENTS

DESCRIPTION

The oscillator-multiplier board (osc-mult) for MASTR® Executive II contains a Colpitts oscillator, three 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 14.5 to 18.5 megahertz and are multiplied 27 times to provide a low side injection frequency to the mixer. Optional crystal modules are available for high side injection.

In station applications requiring a frequency stability of 0.0002%, Integrated Circuit Oscillator Modules (ICOMS) are used. All of the ICOMS (F1 through F4) are located on the multi-frequency board. Optional ICOMS are also available for high side injection.

CIRCUIT ANALYSIS

F1 OSCILLATOR

Transistor Q402, a plug-in crystal module and associated components comprise a Colpitts oscillator operating at the assigned F1 receive frequency. Trimmer capacitor C3 on the crystal module is used to adjust the radio for the exact operating frequency. Refer to the Alignment Procedure for details.

The crystal module, located in the base circuit 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

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 H12-H31 on the SAS board. A voltage divider network consisting of R407 and R408 sets the bias for oscillator transistor Q402.

In multi-frequency radios this jumper (H12-H31) is removed to allow F1 frequency selection by the frequency select switch on the control unit.

With the radio turned on and the PTT switch released, +10 V is present on the Tx 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.

L401 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.

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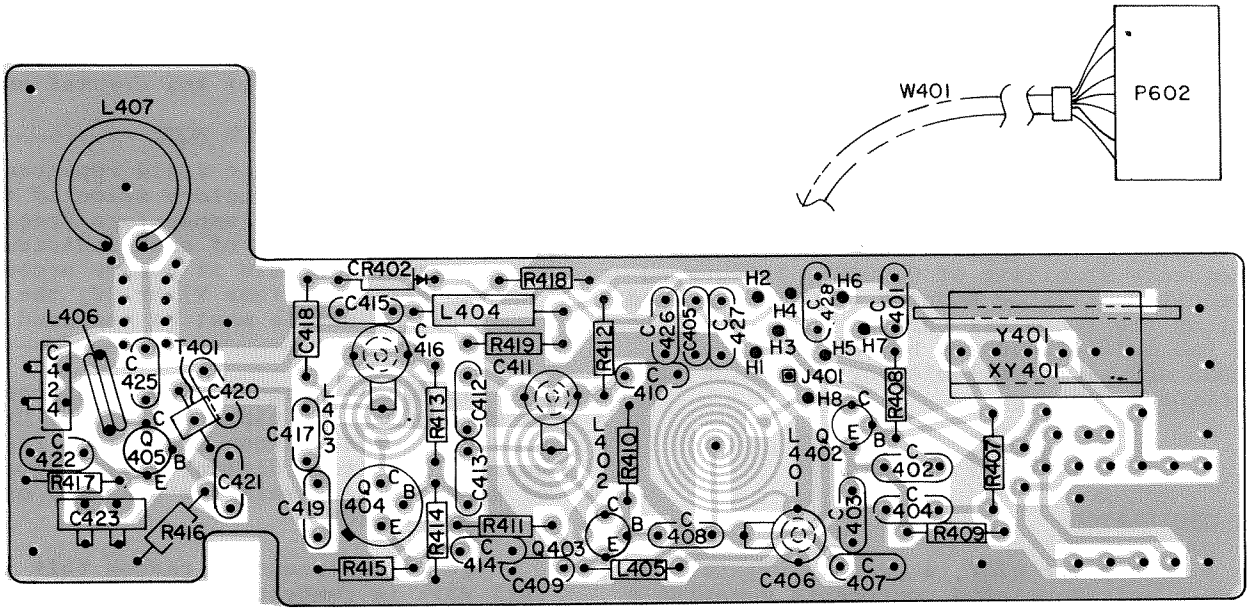
Following the multiplier is a Class A Amplifier stage, Q404. The output of Q404 is metered through a metering network consisting of C418, C426, CR402, and R418 and applied to receiver metering jack J601 through P602-4. The amplified output of Q404 is applied to a tuned circuit (L403 and C416) that is tuned to nine times the crystal frequency. The tuned circuit provides additional selectivity in the oscillator-multiplier chain.

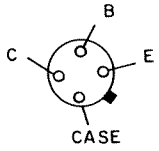
The amplifier output is applied to the base of Class C multiplier Q405 through a matching network (T401 and C421). The output of Q405 is inductively coupled to the first of three helical resonators through L407. The helicals are tuned to 27 times the crystal frequency by C306, C307, and C308.

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.

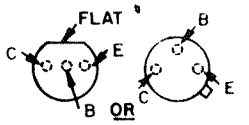


LEAD IDENTIFICATION FOR Q403



VIEW FROM CASE END

LEAD IDENTIFICATION FOR Q402, Q404 & Q405

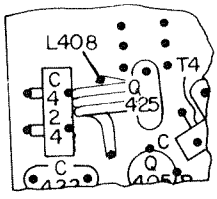


IN-LINE TRIANGULAR

TOP VIEW

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

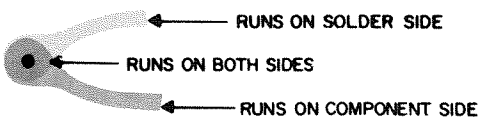
(19C327163, Rev. 4)
(19D423412, Sh. 2, Rev. 1)
(19D423412, Sh. 3, Rev. 1)

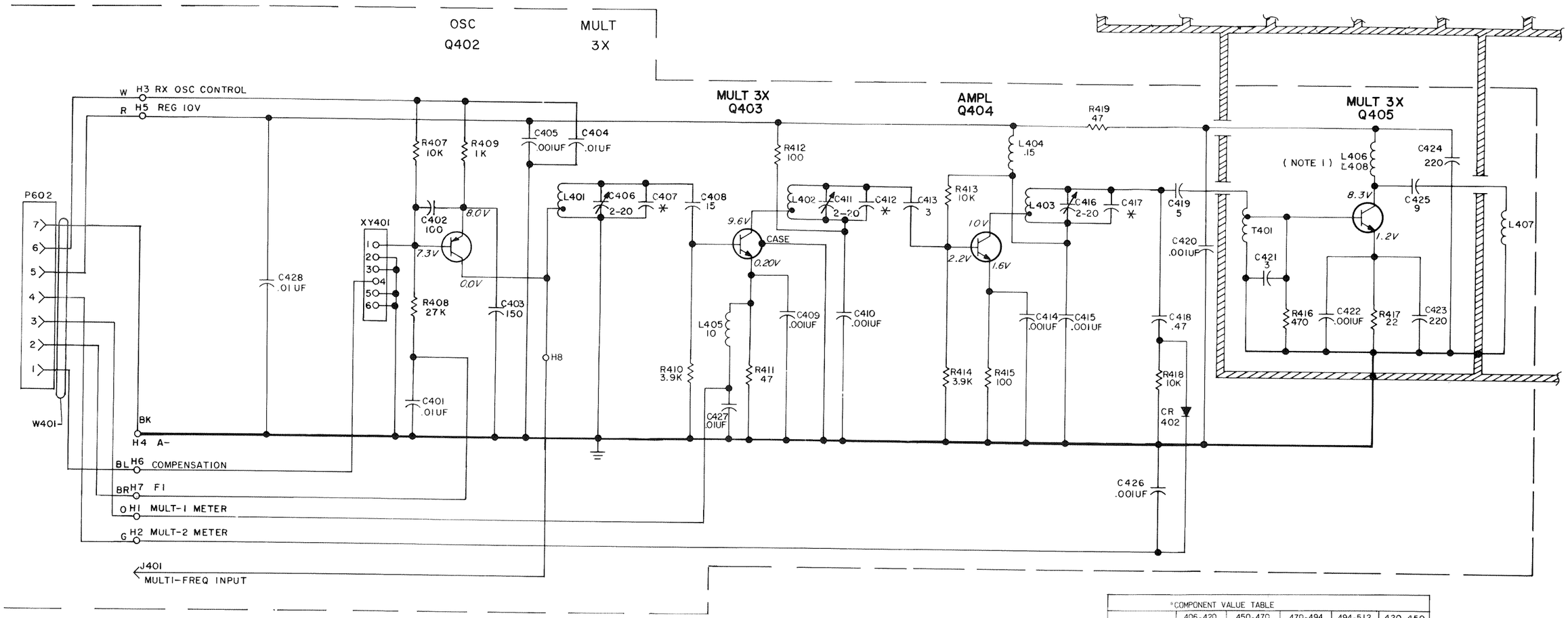


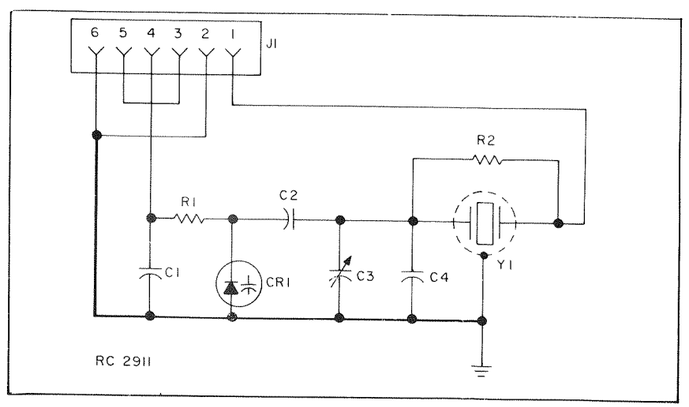
FOR GROUP 1 & GROUP 5 ONLY

OUTLINE DIAGRAM

406—512 MHz
OSCILLATOR-MULTIPLIER BOARD







TYPICAL CRYSTAL MODULE Y401

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-6) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

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.

CPD 310A

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.

*COMPONENT VALUE TABLE

COMPONENT DESIGNATION	406-420 MHz LL	450-470 MHz L	470-494 MHz M	494-512 MHz H	420-450 MHz LM
C407	27	20	18	15	22
C412	12	6	5	4	6
C417	7	3	-	-	3

NOTE: 1. L406 G2, G3, & G4
L408 G1, G5

OSC/MULT BD	REV LETTER	FREQ RANGE	NO OF FREQ
19C321751G1	C	406-420 MHz	1-4
19C321751G2	B	450-470 MHz	1-4
19C321751G3	B	470-494 MHz	1-4
19C321751G4	B	494-512 MHz	1-4
19C321751G5	B	420-450 MHz	1-4

(19D423465, Rev. 6)

SCHEMATIC DIAGRAM

406—512 MHz
OSCILLATOR-MULTIPLIER BOARD

PARTS LIST

LBI30091E

OSCILLATOR-MULTIPLIER BOARD
19C321751G1 406-420 MHz (LL)
19C321751G2 450-470 MHz (L)
19C321751G3 470-494 MHz (M)
19C321751G4 494-512 MHz (H)
19C321751G5 420-450 MHz (LM)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - 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.
C407LM	19A116656P22J0	Ceramic disc: 22 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.
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	19B209351P2	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.
C413	19A116656P3K0	Ceramic disc: 3 pf ±1 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.
C418	5491601P13	Phenolic: 0.47 pf ±10%, 500 VDCW.
C419	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	19A116656P3K0	Ceramic disc: 3 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C422	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C423 and C424	19A116679P220K	Silver mica: 220 pf ±10%, 250 VDCW.
C425	19A116656P9K0	Ceramic disc: 9 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C426	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C427	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C428*	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW. Added by REV A.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR402	19A116052P5	Silicon, hot carrier: Fwd. drop .500 volts max.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J401	19A116779P1	Contact, electrical: sim to Molex 08-50-0404.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L401 thru L403		(Part of printed board 19D423412P1).
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.
L406*	19A129711P1	Coil. Deleted in G5 by REV B.
L407	19A129710P1	Coil.
L408*	19A129352P8	Coil. Added to G5 by REV B.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P602		(Part of W401- Includes shell 19A116659P82, contacts 19A116781P4).
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q402	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q403*	19A134670P1	Silicon, NPN.
		In G1 of REV B & earlier: In G2-G4 of REV A & earlier: In G5 Earlier than REV A:
	19A115440P1	Silicon, NPN.
Q404	19A115329P2	Silicon, NPN.
Q405	19A116201P1	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	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R413	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R414	3R152P392J	Composition: 3.9K ohms ±5%, 1/4 w.
R415	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R416	3R152P471K	Composition: 470 ohms ±10%, 1/4 w.
R417	3R152P220J	Composition: 22 ohms ±5%, 1/4 w.
R418	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R419	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - -
T401	19A129920G1	Coil.
		- - - - - - - - - - CABLES - - - - - - - - - -
W401	19B226965G1	Cable. (Includes P602).
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY401	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		- - - - - - - - CRYSTAL MODULES - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
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.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	4031594P1	Insulator: teflon. (Used with C406, C411, C416).
	4036555P1	Insulator, washer: nylon. (Used with Q404).

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 - 19C321751G1-4
To improve IF Stability. Added C428.

REV. B - 19C321751G1
To increase output in 406-420 MHz range. Replace L406 with L408.

REV. B - 19C321751G2-4
REV. C - 19C321751G1

REV. A - 19C321751G5
Incorporate new transistor. Changed Q403.

REV. B - 19C321751G5
To improve operation in 420-450 MHz band. Deleted L406 and added L408.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES