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.

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

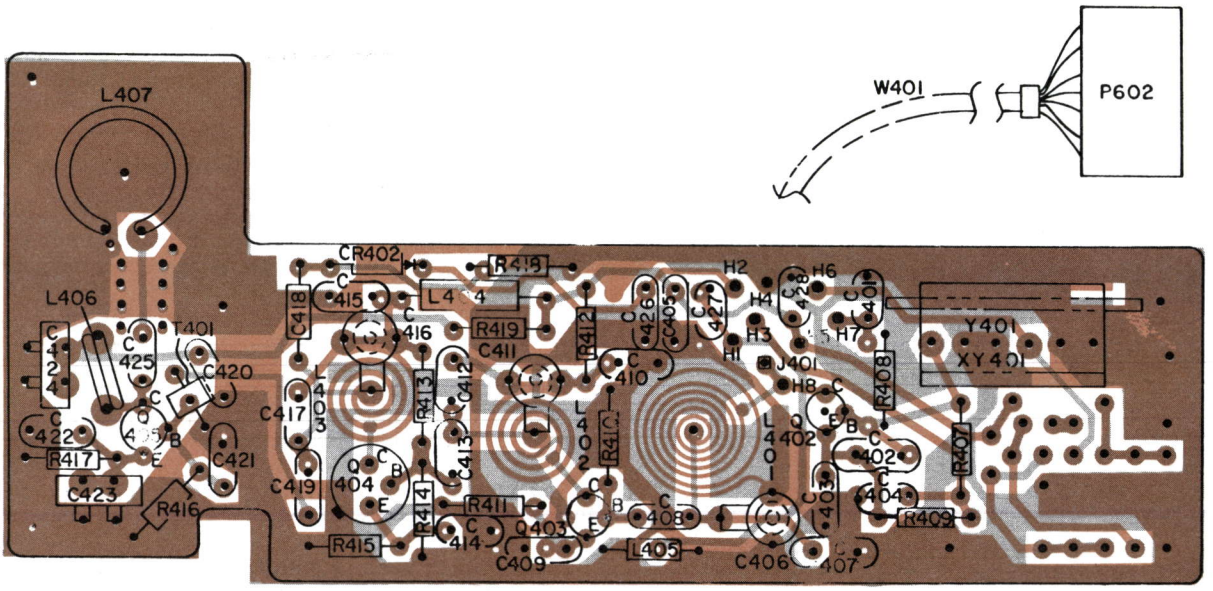
GENERAL ELECTRIC*
U.S.A.

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.

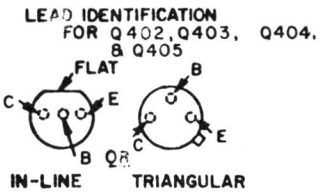
The amplifier output is applied to the base of Class C multiplier Q405 through a matching network (T401 and C421). The output of Q405 is inductively coupled to the first of three helical resonators through L407. The helicals are tuned to 27 times the crystal frequency by C306, C307, and C308.

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.

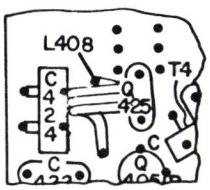
The multiplier output is metered at J601-7 through a metering network on the IF-Filter board. The metering network consists of L505, L506, C512, C513, C514, CR501, and R506.



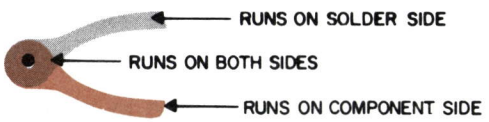
(19C327163, Rev. 5)
(19D423412, Sh. 2, Rev. 1)
(19D423412, Sh. 3, Rev. 1)



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

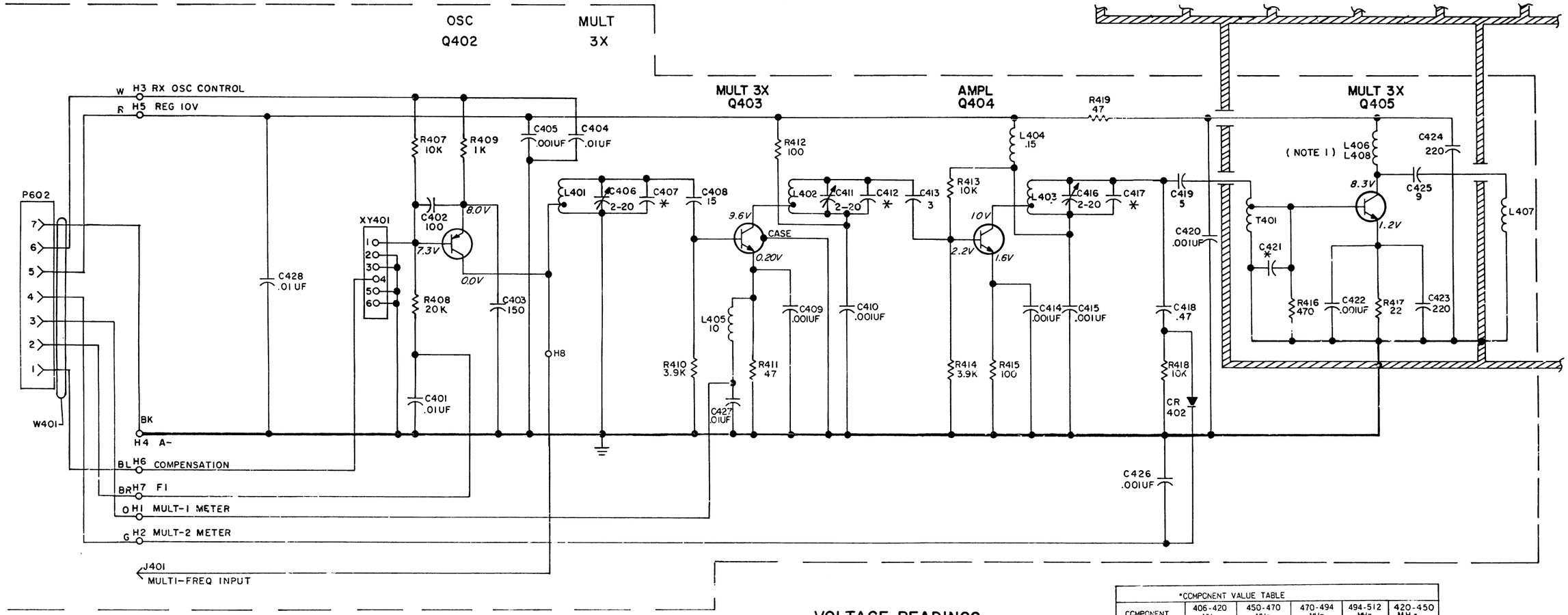


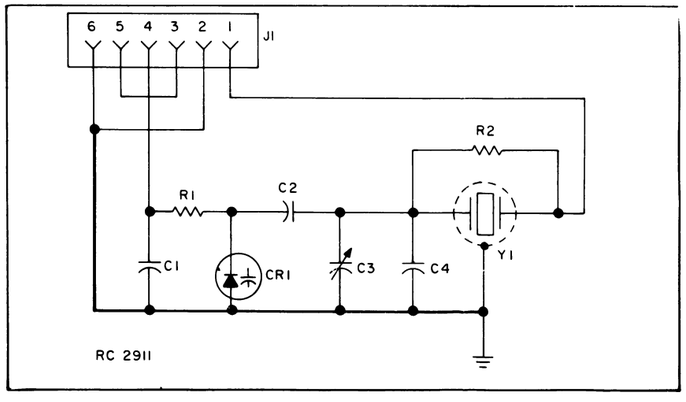
FOR GROUP 1 & GROUP 5 ONLY



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.

*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	15	12	22
C412	12	3	3	3	6
C417	7	-	-	-	3
C421	12	8	6	6	10

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.

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

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

(19D423465, Rev. 8)

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

406—512 MHz
OSCILLATOR-MULTIPLIER BOARD

PARTS LIST

LBI30091F
OSCILLATOR-MULTIPLEXER 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	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C402	19A143491P100J7	Ceramic: 100 pF ±5%, temp coef -750 PPM.
C403	19A700105P38	Mica: 150 pF ±5%, 500 VDCW.
C404	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C405	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C406	19A700012P2	Variable, ceramic: 2.5 to 20 pF, 200 VDCW, temp coef -250+700 PPM; sim to Panasonic ECX1ZW20X32.
C407LL	19A143491P27J0	Ceramic: 27 pF ±5%, temp coef 0 PPM.
C407L	19A143491P20J0	Ceramic: 20 pF ±5%, temp coef 0 PPM.
C407LM	19A143491P22J0	Ceramic: 22 pF ±5%, temp coef 0 PPM.
C407M	19A143491P15J0	Ceramic: 15 pF ±5%, temp coef 0 PPM.
C407H	19A143491P12J0	Ceramic: 12 pF ±5%, temp coef 0 PPM.
C408	19A143491P15J0	Ceramic: 15 pF ±5%, temp coef 0 PPM.
C409C and C410	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C411	19A700012P2	Variable, ceramic: 2.5 to 20 pF, 200 VDCW, temp coef -250+700 PPM; sim to Panasonic ECX1ZW20X32.
C412LL	19A143491P12J0	Ceramic: 12 pF ±5%, temp coef 0 PPM.
C412L	19A143491P3J0	Ceramic: 3 pF ±5%, temp coef 0 PPM.
C412LM	19A143491P6J0	Ceramic: 6 pF ±5%, temp coef 0 PPM.
C412M	19A143149P3J0	Ceramic: 3 pF ±5%, temp coef 0 PPM.
C412H	19A143491P3J0	Ceramic: 3 pF ±5%, temp coef 0 PPM.
C413	19A143491P3K0	Ceramic: 3 pF ±10%, temp coef 0 PPM.
C414 and C415	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C416	19A700012P2	Variable, ceramic: 2.5 to 20 pF, 200 VDCW, temp coef -250+700 PPM; sim to Panasonic ECX1ZW20X32.
C417LL	19A143491P7J0	Ceramic: 7 pF ±5%, temp coef 0 PPM.
C417L	19A143491P3J0	Ceramic: 3 pF ±5%, temp coef 0 PPM.
C418	5491601P13	Phenolic: 0.47 pF ±10%, 500 VDCW.
C419	19A143491P5J0	Ceramic: 5 pF ±5%, temp coef 0 PPM.
C420	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C421LL	19A143491P12J0	Ceramic: 12 pF ±5%, temp coef 0 PPM.
C421L	19A143194P8J0	Ceramic: 8 pF ±5%, temp coef 0 PPM.
C421LM	19A143491P10J0	Ceramic: 10 pF ±5%, temp coef 0 PPM.
C421M	19A143491P6J0	Ceramic: 6 pF ±5%, temp coef 0 PPM.
C421H	19A143491P6J0	Ceramic: 6 pF ±5%, temp coef 0 PPM.
C422	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C423 and C424	19A116679P220K	Silver Mica: 220 pF ±10%, 250 VDCW.
C425	19A143491P9K0	Ceramic: 9 pF ±10%, temp coef 0 PPM.
C426	19A143481P19	Ceramic: 1000 pF ±20%, 1000 VDCW.
C427	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C428*	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW. Added by REV A.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR402	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J401	19A701785P1	Contact, electrical; sim to Molex 08-50-0404.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L401 thru L403		(Part of Printed Board 19D433130P1).
L404	19A700000P10	Choke, RF: 0.68 uF ±10%, sim to Jeffers 4411-5K.
L405	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L406*	19A129711P1	Coil. Deleted in G5 by REV B.
L407	19A129710P1	Coil.
L408*	19A129352P8	Coil. Added by 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	19A116899P1	Silicon, NPN.
Q405	19A116201P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R407	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R408	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
R409	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R410	19A700106P77	Composition: 3.9K ohms ±5%, 1/4 w.
R411	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R412	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
R413	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R414	19A700106P77	Composition: 3.9K ohms ±5%, 1/4 w.
R415	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
R416	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R417	19A700106P23	Composition: 22 ohms ±5%, 1/4 w.
R418	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R419	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T401	19A127108G3	Coil.
		- - - - - - - - - - CABLES - - - - - - - - - -
W401	19B226965G1	Cable. (Includes P602).
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY401	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		ASSOCIATED PARTS
		- - - - - - - - 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).

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-G4
To improve IF Stability. Added C428.

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

REV. B - 19C321751G2-G4
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.

REV. D - 19C321751G1
REV. C - 19C321751G2-G5
To incorporate new transistor. Changed Q404.
Q404 was 19A115329P2, Silicon; NPN.

REV. D - 19C321751G1
REV. D - 19C321751G2-G5
To increase injection into RF casting. Changed C407M, C407H, C412L, C412M, C412H, C417L, CR402, R408, T401 and C421.
C407M was 19A116656P18J0 - Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C407H was 19A116656P15J0 - Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef 0 PPM.
C412L was 19A116656P6J0 - Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412M was 19A116656P5J0 - Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412H was 19A116656P4J0 - Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C417L was 19A116656P3J0 - Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C421 was 19A116656P3K0 - Ceramic disc: 3 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
CR402 was 19A116052P5 - Silicon, hot carrier: Fwd. drop .500 V Max.
R408 was 3R152P273J - Composition: 27K ohms ±5%, 1/4 W.
T401 was 19A129920G1 - Coil.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES