MOBILE RADIO

MAINTENANCE MANUAL
406—512 MHz 20-WATT POWER AMPLIFIER ASSEMBLY 19D423928G1, G3

TABLE OF CONTENTS

DESCRIPTION

The PA Assembly for Custom MVP uses three RF power transistors to provide a power output of 20 Watts. The output power is adjustable over a range of 10 Watts to rated power output, using power adjust control R13. A single transistor is used in the power adjust circuit.

Supply voltage (A+) for the PA is connected from J1 on the back of the radio through FL210-C5 on the side of the radio. C201, C202, and C203 prevent RF from getting on the power leads. Diode CR201 will cause the main fuse assembly to blow if the polarity of the power leads is reversed, providing reverse voltage protection for the radio.

Centralized metering jack J5 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The Test Set meters the Ampl-1 drive (exciter output), power adjust voltage, and PA voltage and current.

CIRCUIT ANALYSIS

RF POWER AMPLIFIERS

The exciter output is coupled through RF cable W201 to PA input jack J1. The 50 ohm RF input is coupled through a matching network comprised of C6, C7, C8 and W2 to the base of amplifier Q1.

Part of the RF input is rectified by CR1 and metered at J5-4 through resistor R1.

Collector voltage for Q1 is applied direct from the DC power input through R4 collector stabilizing network R5 and L2 and collector feed network L3 and C10.

The output of Q1 is coupled to the base of driver Q202 through a matching network consisting of T1, C13, C14, C15 and C16.

Collector voltage to Q202 is controlled by power adjust circuit, Q215, and is applied through a collector stabilizing network L6 and R6 and collector feed network L5 and C18.

The output of Q202 is coupled to the base of power amplifier Q203 through C19 and a matching network consisting of T2, C22, C24, C25, and C52. The collector voltage to Q203 is coupled through collector stabilizing network L9 and R14 and collector feed network L8 and C61.

Collector current for Q203 is metered from tapped manganin resistor R12. The reading is taken in position F with the High Sensitivity button pressed, and read as 0-15 amperes full scale.

Collector voltage for Q203 is metered from tapped manganin resistor R10 to ground. The reading is taken in position G on the 15-Volt scale (4EX3A11) and read as 0-15 Volts full scale. The meter polarity must be reversed.

The output of Power Amplifier Q203 is coupled through an impedance matching network (C29, C30 and T3) that matches the output impedance of Q203 to the input impedance of the low pass filter through a 50 ohm micro strip (W4) and a 50 ohm cable W202. C1 on the low pass filter board provides DC isolation between the transmitter and the antenna.

The PA output is coupled through the low-pass filter to the antenna through antenna relay K1.

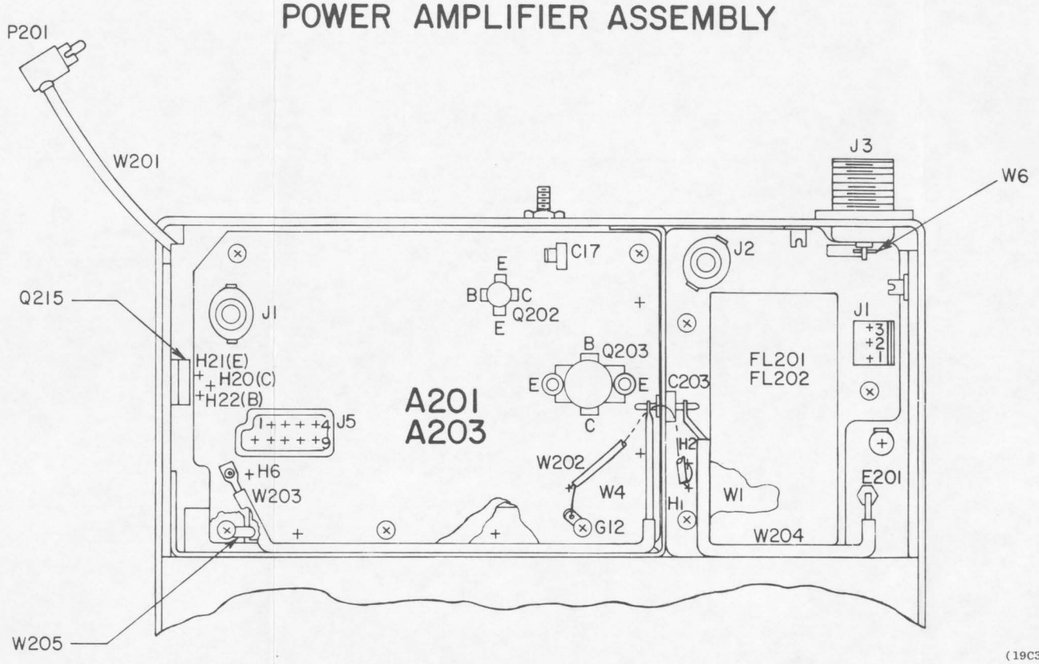
WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

POWER ADJUST CIRCUIT

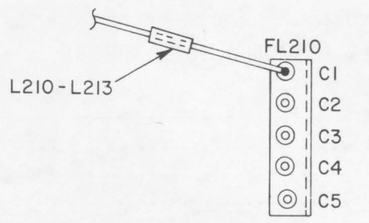
The power adjust circuit consists of R13 and Q215. R13 controls the base voltage, and conduction of Q215. Q215 is connected in series with the collector feed network for Q202 thereby controlling the drive to Power Amplifier Q203 and the output power. R13 is adjusted to provide the desired output power. The collector voltage for Q202 is measured on position C on the 15-Volt scale and read as 0-15 volts full scale.

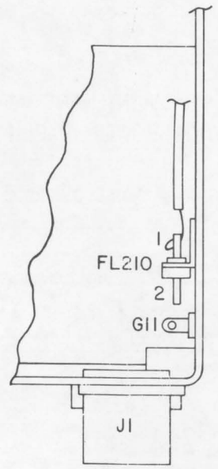
POWER AMPLIFIER ASSEMBLY

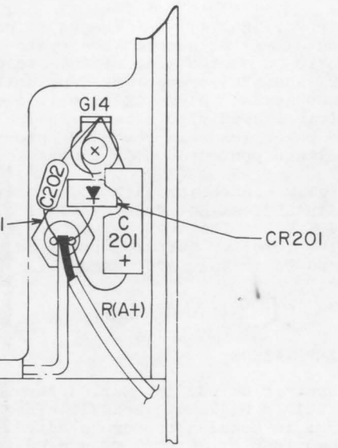


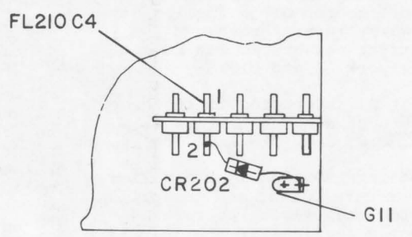
PA BOARD

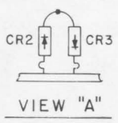
(19C327307, Rev. 1)



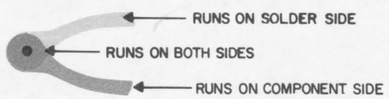


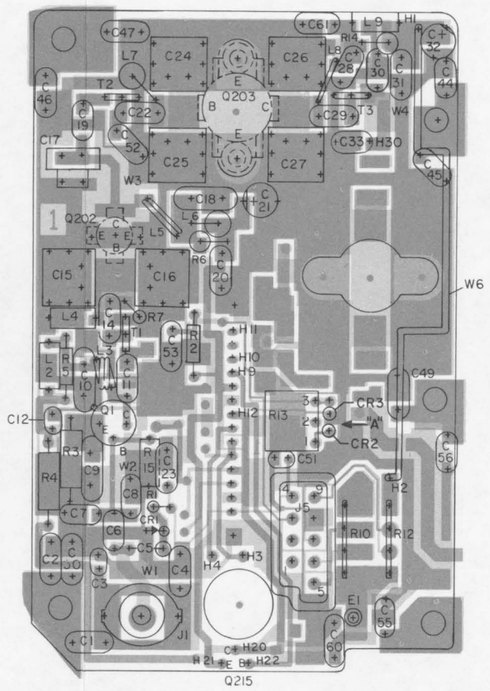






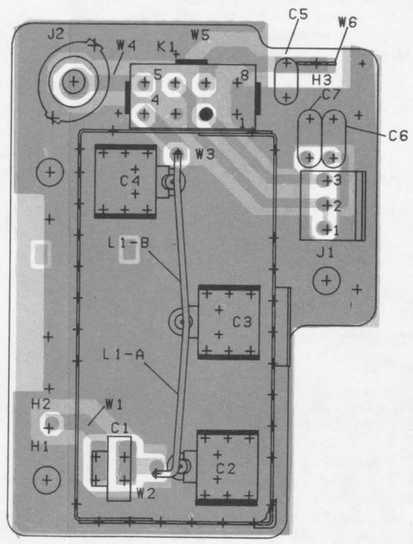
FROM	TO	WIRE	REMARKS
			——
H9	H10	DA	——
H11	H12	DA	SLV





(19C327305, Rev. 4)
(19B226633, Sh. 2, Rev. 1)
(19B226633, Sh. 3, Rev. 1)

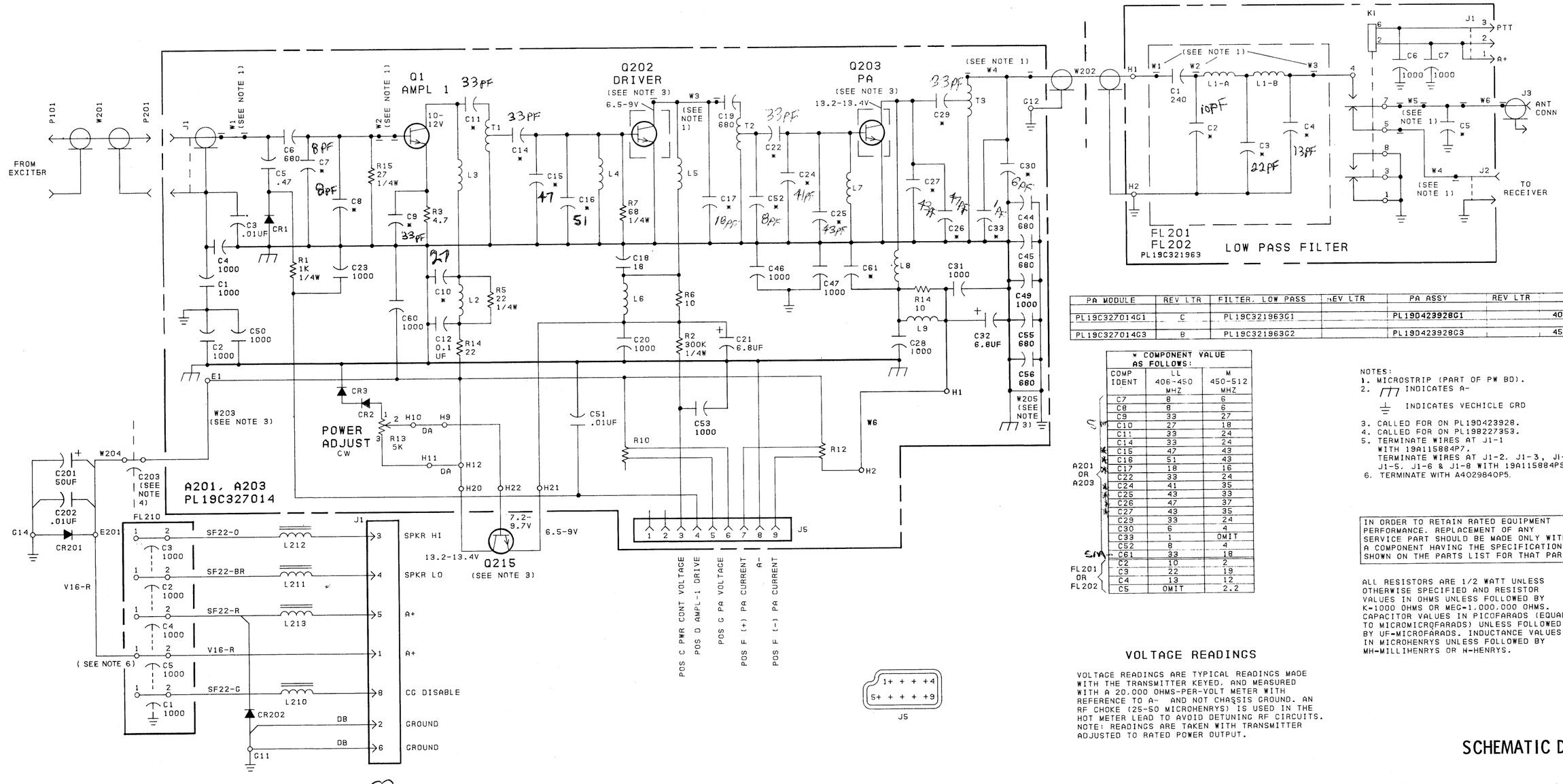
FILTER BOARD



(19C327137, Rev. 2)
(19B227225, Sh. 2, Rev. 0)
(19B227225, Sh. 3, Rev. 0)

OUTLINE DIAGRAM

406—512 MHz Power Amplifier



PA MODULE	REV LTR	FILTER, LOW PASS	REV LTR	PA ASSY	REV LTR	FREQ
PL19C327014G1	C	PL19C321963G1		PL19D423928G1		406-450 MHZ
PL19C327014G3	B	PL19C321963G2		PL19D423928G3		450-512 MHZ

* COMPONENT VALUE AS FOLLOWS:

COMP IDENT	LL 406-450 MHZ	M 450-512 MHZ
C7	8	6
C8	8	6
C9	33	27
C10	27	18
C11	33	24
C14	33	24
C15	47	43
C16	51	43
C17	18	16
C22	33	24
C24	41	35
C25	43	33
C26	47	37
C27	43	35
C29	33	24
C30	6	4
C33	1	OMIT
C52	8	4
C61	33	18
C2	10	2
C3	22	19
C4	13	12
C5	OMIT	2.2

A201 OR A203

FL201 OR FL202

NOTES:
1. MICROSTRIP (PART OF PW BD).
2. ⏚ INDICATES A-
   ⏚ INDICATES VECHICLE GRD
3. CALLED FOR ON PL19D423928.
4. CALLED FOR ON PL19B227353.
5. TERMINATE WIRES AT J1-1 WITH 19A115884P7. TERMINATE WIRES AT J1-2, J1-3, J1-4 J1-5, J1-6 & J1-8 WITH 19A115884P9.
6. TERMINATE WITH A4029840P5.

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.

ALL RESISTORS ARE 1/2 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.

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. NOTE: READINGS ARE TAKEN WITH TRANSMITTER ADJUSTED TO RATED POWER OUTPUT.

Q1 1854237P1

(19R622229, Rev. 11)

SCHEMATIC DIAGRAM

406—512 MHz Power Amplifier

Issue 3

PARTS LIST

LBI-30157B

406-420, 450-512 MHz POWER AMPLIFIER
19D423928G1 406-450 MHz
19D423928G3 450-512 MHz

SYMBOL	GE PART NO.	DESCRIPTION
A201 and A203		POWER AMPLIFIER MODULE A201 19C327014G1 406-450 MHz A203 19C327014G3 450-512 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C3	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C4	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C5*	5491601P113	Phenolic: 0.47 pf ±10%, 500 VDCW.
		Earlier than REV A:
	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C6	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C7LL	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C7M	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C8LL	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C8M	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C9LL	7489162P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C9M	7489162P13	Silver mica: 27 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C10LL	7489162P13	Silver mica: 27 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C10M	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C11LL	19A116656P33J0	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C11M	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C12	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C13*	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM. Deleted by REV C.
C14LL	19A116656P33J0	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C14M	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C15LL	19A116952P47	Metallized teflon: 47 pf ±2%, 250 VDCW.
C15M	19A116952P43	Metallized teflon: 43 pf ±2%, 250 VDCW.
C16LL	19A116952P51	Metallized teflon: 51 pf ±2%, 250 VDCW.
C16M	19A116952P43	Metallized teflon: 43 pf ±2%, 250 VDCW.
C17LL	19A116679P18D	Metallized teflon: 18 pf ±.5 pf, 250 VDCW.
C17M	19A116679P16D	Metallized teflon: 16 pf ±.5 pf, 250 VDCW.
C18	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C19	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C20	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C21	19A134202P15	Tantalum: 6.8 µf ±20%, 35 VDCW.
C22LL	19A116656P33J0	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C22M	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C23	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C24LL	19A116952P41	Metallized teflon: 41 pf ±2%, 250 VDCW.
C24M	19A116952P35	Metallized teflon: 35 pf ±2%, 250 VDCW.
C25LL	19A116952P43	Metallized teflon: 43 pf ±2%, 250 VDCW.
C25M	19A116952P33	Metallized teflon: 33 pf ±2%, 250 VDCW.
C26LL	19A116952P47	Metallized teflon: 47 pf ±2%, 250 VDCW.
C26M	19A116952P37	Metallized teflon: 37 pf ±2%, 250 VDCW.
C27LL	19A116952P43	Metallized teflon: 43 pf ±2%, 250 VDCW.
C27M	19A116952P35	Metallized teflon: 35 pf ±2%, 250 VDCW.
C28	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C29LL	19A116656P33J0	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C29M	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C30LL*	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		In REV B and earlier:
	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C30M	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C31	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C32	19A134202P15	Tantalum: 6.8 µf ±20%, 35 VDCW.
C33LL*	19A134100P19	Ceramic disc: 1 pf ±0.1 pf, 100 VDCW, temp coef 0 ±250 PPM/°C. Added by REV C.
C44 and C45	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C46 and C47	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C49 and C50	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C51	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C52LL*	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		In REV B and earlier:
	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C52M	19A116656P4J0	Ceramic disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C53	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C55 and C56	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C60	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C61*	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Deleted by REV C.
C61LL*	7489162P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Added by REV C.
C61M*	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Added by REV C.
		- - - - - - - - DIODES AND RECEPTACLES - - - - - -
CR1	19A116052P1	Diode, silicon.
CR2* and CR3*	19A115250P1	Silicon. Added by REV B.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1	19A134263P1	Contact, electrical: sim to Selectro X-L-070174-1.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	19A130924G1	Connector, coaxial: jack type; sim to Cinch 14H11613.
J5	19B219374G1	Connector: 9 contacts.
L2	19A129773G1	Coil.
L3	19A129774P1	Coil.
L4	19A129773G1	Coil.
L5	19B219457P6	Coil.
L6	7488079P40	Choke, RF: 5.60 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4422-1K.
L7	7488079P13	Choke, RF: 5.60 µh ±10%, 0.30 ohms DC res max; sim to Jeffers 4421-4K.
L8LL	19B219457P6	Coil.
L8M	19A130650P1	Coil.
L9	19A129773G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A134237P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1LL	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R1M	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R2LL	3R152P304J	Composition: 300K ohms ±5%, 1/4 w.
R2M	3R152P304J	Composition: 300K ohms ±5%, 1/4 w.
R3	7147161P13	Composition: 4.7 ohms ±5%, 1/2 w.
R4	3R77P220J	Composition: 22 ohms ±5%, 1/2 w.
R5	3R152P220J	Composition: 22 ohms ±5%, 1/4 w.
R6	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R7	3R152P680J	Composition: 68 ohms ±5%, 1/4 w.
R10	19C320212P1	Shunt resistor.
R12	19C320212P1	Shunt resistor.
R13	19A116559P102	Variable, cermet: 5K ohms ±20%, .5 w; sim to CTS Series 360.
R14	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R15	3R152P270J	Composition: 27 ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T1 thru T3	19A130446G1	Coil.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1 thru W4		(Part of printed board 19D423005P1).
W6	19B226971G1	Jumper.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C201	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C202	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C203	19B209488P2	Ceramic, feed-thru: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Style FA5D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR201	19A116783P1	Silicon.
CR202	4037822P1	Silicon.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E201	7143206P1	Terminal, standoff.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL201 and FL202		FILTER BOARD FL201 19C321963G1 406-450 MHz (LL) FL202 19C321963G2 450-512 MHz (H)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116679P240J	Silver mica: 240 pf ±5%, 250 VDCW.
C2LL	19A116952P10	Metallized teflon: 10 pf ±0.5 pf, 250 VDCW.
C2H	19A116952P9	Metallized teflon: 9 pf ±0.5 pf, 250 VDCW.
C3LL	19A116952P22	Metallized teflon: 22 pf ±0.5 pf, 250 VDCW.
C3H	19A116952P20	Metallized teflon: 20 pf ±0.5 pf, 250 VDCW.
C4LL	19A116952P13	Metallized teflon: 13 pf ±0.5 pf, 250 VDCW.
C4H	19A116952P12	Metallized teflon: 12 pf ±0.5 pf, 250 VDCW.
C5H	19A134100P20	Ceramic: 2.2 pf ±0.1 pf, 100 VDCW.
C6 and C7	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	19A116659P55	Connector, printed wiring: 3 contacts; sim to Molex 09-65-1031.
J2	19A130924G1	Connector, coaxial: jack type; sim to Cinch 14H11613.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1	19B209558P1	Hermetic sealed: 180 to 330 ohms coil res, 2 form C contacts, 8.0 to 16.3 VDC; sim to GE 3SAV1760A2.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1LL	19B227240P1	Jumper.
L1H	19B227240P2	Jumper.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1 thru W5		(Part of printed board 19C321962P1).
W6	19A136512P1	Antenna strap.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL210		FILTER 19A136680G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 thru C5	5493392P7	Ceramic, feed-thru: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
G11 and G12	7135118P2	Terminal, solderless.
G14	7135118P2	Terminal, solderless.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1		Connector. Includes:
	19A115884P12	Shell.
	19A115884P7	Contacts, male: wire size 14-20; sim to AMP 60528-1.
	19A115884P9	Contacts, male: wire size 22-30; sim to AMP 60910-1.
J3	4029493P1	Connector, receptacle: coaxial; sim to Amphenol 83-798.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L210 thru L213	19A126140P3	Core, toroidal, ferrite: sim to Stackpole 88-31959.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P201		(Part of W201).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q202	19A134164P2	Silicon, NPN; sim to Type 2N5945.
Q203LL	19A134171P4	Silicon, NPN.
Q203M	19A134239P2	Silicon, NPN.
Q215	19A116742P1	Silicon, NPN.
		- - - - - - - - - - CABLES - - - - - - - - - -
W201	5491689P91	Cable, RF: approx 7-1/2 inches long. (Includes P201).
W202	19A136529G1	Cable: approx 4 inches long.
W203	19C327146P1	Jumper.
W204	19C327146P2	Jumper.
W205	7135118P1	Terminal, solder.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19C321982P1	Insulator. (Located under A201 and A203).
	19B227353G1	Shield. (Located around A201, A203).
	19B201074P304	Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4. (Secures shield to frame at C17).
	19B201074P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures shield to frame at J5).
	5492178P2	Washer, spring tension. (Used with Q202).
	N207P15C6	Hex nut: No. 8-32. (Used with Q202).
	19A130465P1	Spacer. (Used with Q202).
	N44P9006C6	Screw, machine: No. 4-40 x 3/8. (Secures Q203).
	19A116023P1	Insulator, plate. Dupont No. 300 Kapton H. (Located under Q215).
	19A134016P1	Insulator, bushing. (Used with Q215).
	7878243P11	Hex nut: No. 8-32. (Secures stud that mates with wing nut securing radio to case).
	4033714P11	Terminal, solderless: sim to Zierick 349. (Solders to FL201 and FL202).
	N84P13003C6	Screw, phillips: No. 6-32 x 3/16. (Secures FL210).
	19B201074P204	Tap screw, Phillips POZIDRIV®: No. 4-40 x 1/4. (Secures J3).
	4036555P1	Insulator, washer: nylon. (Used with Q1).
	19B219554G2	Can. (FL201, FL202).
	19B219555P1	Cover. (FL201, FL202).
	19B209502P1	Terminal, stud. (Used with C2, C3, C4, L1).
	19B227351G1	PA Cover.

*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 - Power Amplifier Module 19C327014G1,3
To increase power output at high end. Changed C5.

REV. B - To increase power output at cold temperatures.
Added CR2 and CR3.

REV. C - Power Amplifier Module 19C327014G1
To increase power output. Changed C30LL and C52LL.
Deleted C13. Added C33LL.