MOBILE RADIO

MAINTENANCE MANUAL
851-870 MHz, 35 WATT POWER AMPLIFIER ASSEMBLY
19D430488G1, 2

TABLE OF CONTENTS

DESCRIPTION

The power amplifier assembly for MASTR® II uses six RF power transistors to provide a maximum of 35 Watts output power, R24 located on the PA module, is used to adjust the output power to any level from 7 Watts to rated RF power output. The power control circuit consists of R24, Q207, Power Control IC (U1), and a directional coupler.

SUPPLY VOLTAGE AND METERING

Supply voltage is connected through power leads from the system board to feed-through capacitor C219. C219 prevents RF from getting on the power leads.

Centralized metering jack J205 is provided for use with GE Test Model 4EX3A11 or Test Kit 4EX8K12. The test set meters the AMPL-1 DRIVE (exciter output), the POWER CONTROL voltage, and the DRIVER AND PA CURRENT.

CIRCUIT ANALYSIS

PA ASSEMBLY

The exciter output is coupled through a 50 ohm RF cable to the PA input connector P101. The RF input is coupled through a matching network composed of C2, C3, L1, L2 and L3 to the base of power amplifier Q201.

Part of the RF input is rectified by CR1 and metered at J205-4 through resistor R21. The rectified RF is also applied to the power control IC (U1).

Collector voltage to Q201 is applied from the power controller through collector stabilizing network L5 and R4 and collector feed network L4 and C201.

The output of Q201 is coupled to the base of the second power amplifier Q202 through coupling capacitor C5, and a matching network consisting of C6, C7 L6 and L7.

Collector voltage to Q202 is controlled by power control IC (U1), and Q207 and is applied through a collector stabilizing network L11 and R7 and collector feed network C202 and L10.

The output of Q202 is coupled to the base of power amplifier Q203 through C9 and the matching network of C203, C204, C10, L13, L14 and L15.

The collector voltage to Q203 is coupled directly from the supply voltage through collector stabilizing network L17 and R9 and collector feed network L16 and C11.

The output of Q203 is coupled through an impedance matching network (C206, C13, C207, C208, L18, L19, L20 and L21) and a 50 ohm microstrip W4 that matches the output impedance of Q203 to the input impedance of driver Q204.

The collector voltage of Q204 is coupled through R26 from the supply voltage, through collector stabilizing network L23 and R11 through collector feed network L22 and C15.

Collector current for Q204 is metered across tapped manganin resistor R26. The reading, taken in position "F" on the 10 Volt scale of the Test Set with the High Sensitivity button pressed, should be approximately 2.1 Amperes.

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. Be extremely careful to avoid damaging transistors when working with the PA assembly.

The output of Q204 is coupled through an impedance matching network (C209, C210, C36 and L24) and a 50 ohm microstrip, W5, to a power splitter consisting of micro strip transmission line W6-W9 and R12.

RF output power from Q204 (approximately 12 Watts) is split evenly between two identical class C power amplifiers Q205 and Q206 via their respective identical impedance matching networks. The impedance matching networks consist of C19, C211, C213, L27, L25 and C20, C212, C214, L26 and L28.

Collector voltage for Q205 and Q206 is supplied from the A+ line at C219-1 through identical collector stabilizing networks consisting of R13, L31, C23 and L32, R14 and C24 respectively.

Collector current for Q205 and Q206 is metered across tapped manganin resistor R27. The reading taken in position G on the 10 volt scale with the HIGH SENS button on the test set pressed. The meter reading should be 7.9 Amperes.

The output of Q205 and Q206 is coupled through identical impedance matching and RF power combining networks. The RF power combiner consists of micro strip transmission lines W12 and W13 and resistor 15. The combiner adds the outputs of Q205 and Q206 and applies the combined RF output to the low pass filter through 50 ohm micro strip W14. The RF power output is applied to antenna connector J202 through 50 ohm micro strip W1 in the low pass filter, to the antenna relay or to J202.

CAUTION

The placement of monolithic capacitors on the PA board is very critical; therefore, it is not recommended that the PA board be serviced in the field.

POWER CONTROL CIRCUIT

The Power Control Circuit, consists of CR1, U1, Q207 and the directional coupler (C30, C31, CR3, R16 and W15).

When the transmitter is keyed, rectified RF from CR1 is applied to a transistorized switch in the Power Control IC (U1), turning on the switch. The switch operates a voltage regulator. The directional coupler senses the forward power at the output of the power amplifier and feeds voltage back to the Power Control IC, resulting in feedback control of the voltage regulator output. A constant voltage is fed via pin 4 of U1 to Power Adjust potentiometer R24. The setting of R24 determines the voltage fed to the base and collector of Q201 and the collector of Q202. Reducing the supply voltage to these stages reduces the drive to the remaining stages of the power amplifier, thereby reducing the power output of the PA.

Overvoltage sensing of the supply voltage via pin 11 of U1 shuts down the driver when this condition occurs, thus protecting the driver and PA stages. The feedback power control performs the function of power leveling of the amplifier output over a range of varying input conditions such as drive level, DC voltage and load variations.

R29 is provided to limit the maximum power delivered to the antenna to prevent the probability of PA burn up due to misadjustment for excessive power. R29 is set to provide RF output 1 dB greater than rated power.

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

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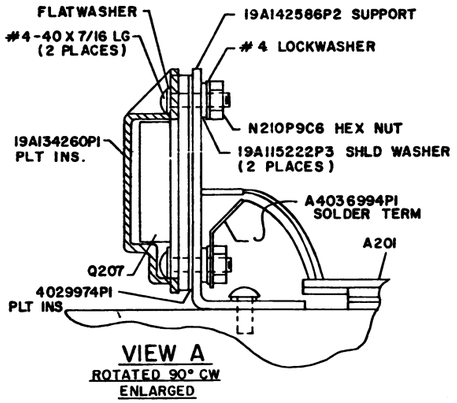
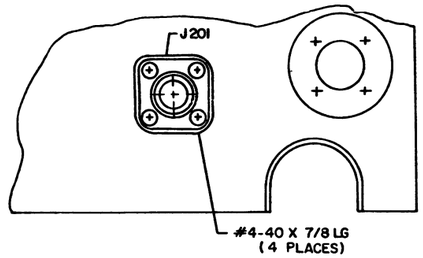
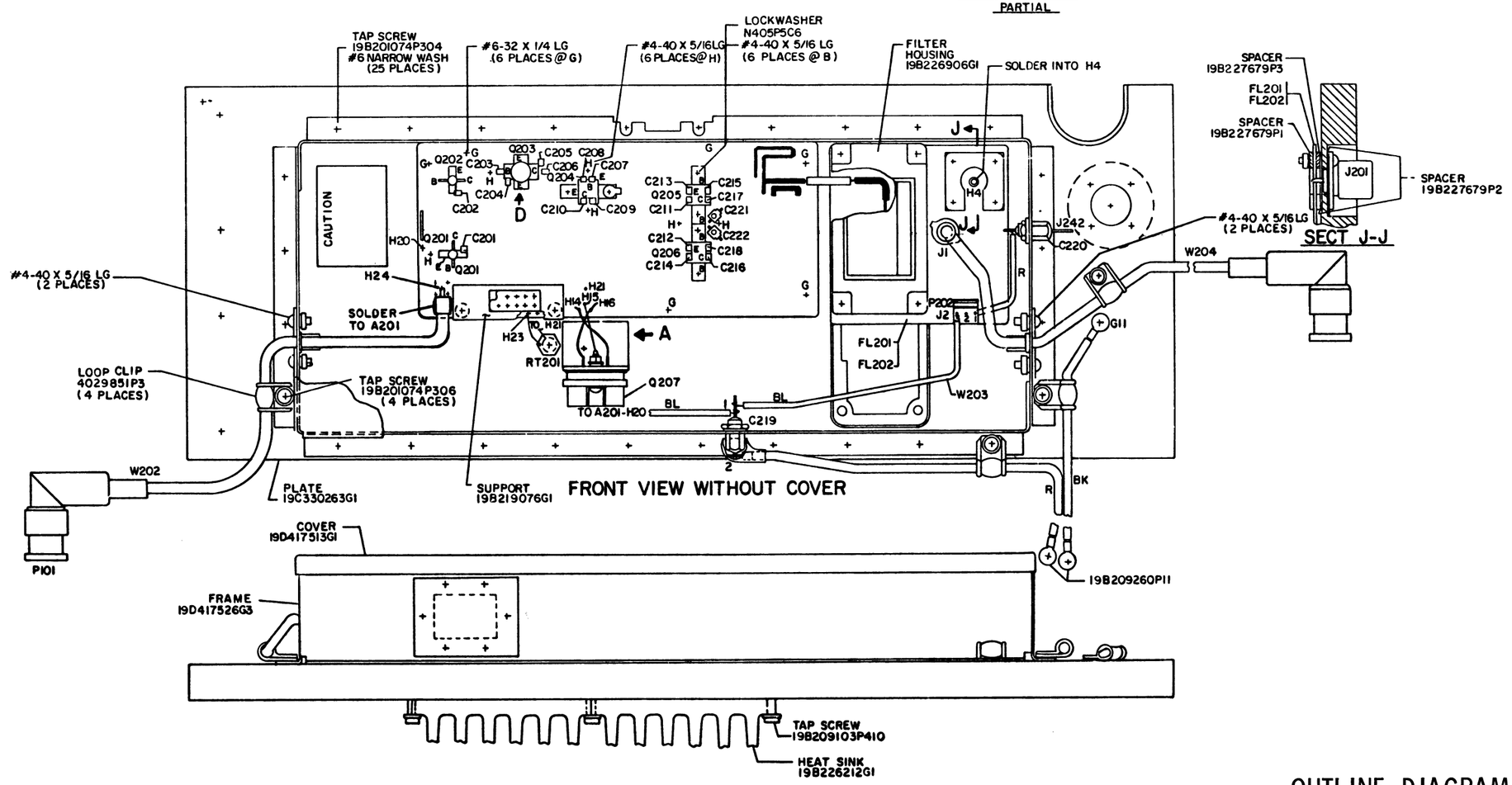


VIEW A
ROTATED 90° CW
ENLARGED

VIEW D
TYP MOUNTING FOR Q201-Q203
ENLARGED



REAR VIEW
PARTIAL

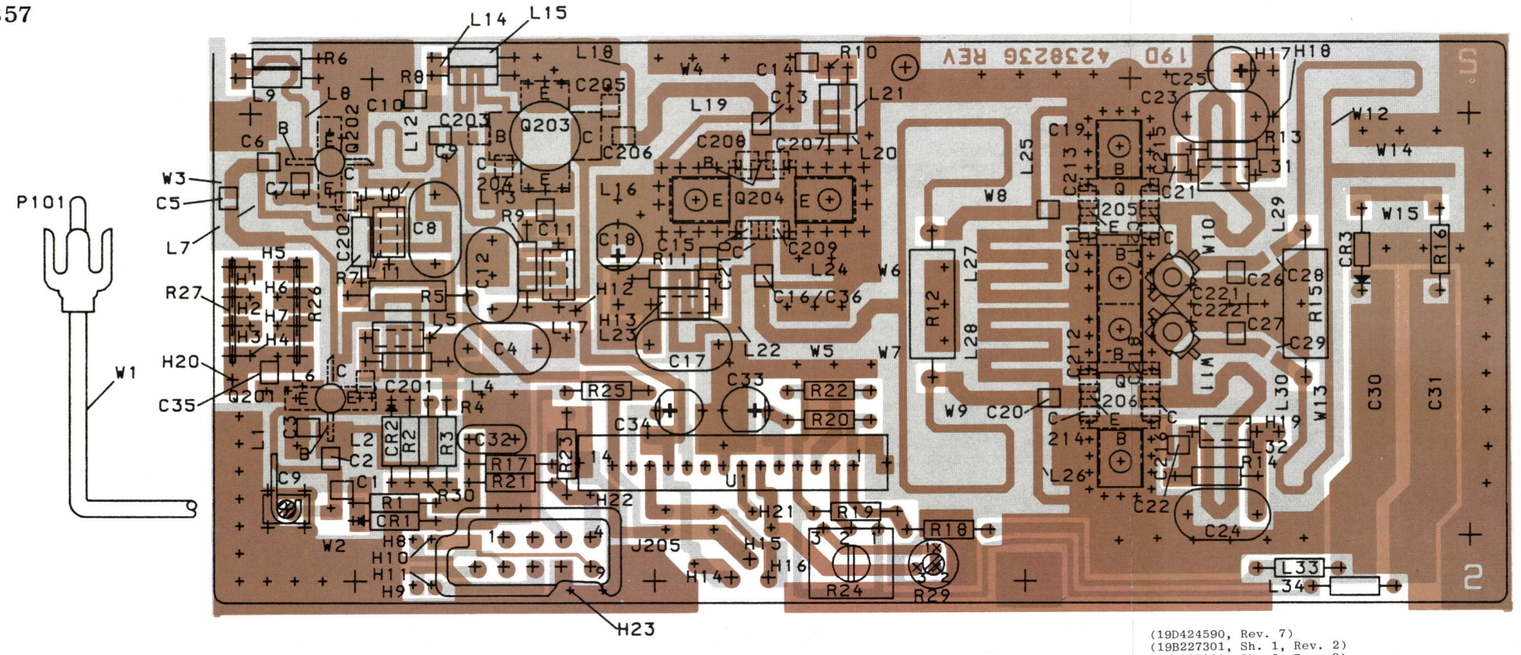


(19D430956, Rev. 4)

OUTLINE DIAGRAM

POWER AMPLIFIER 19D430488G1, G2

Issue 4

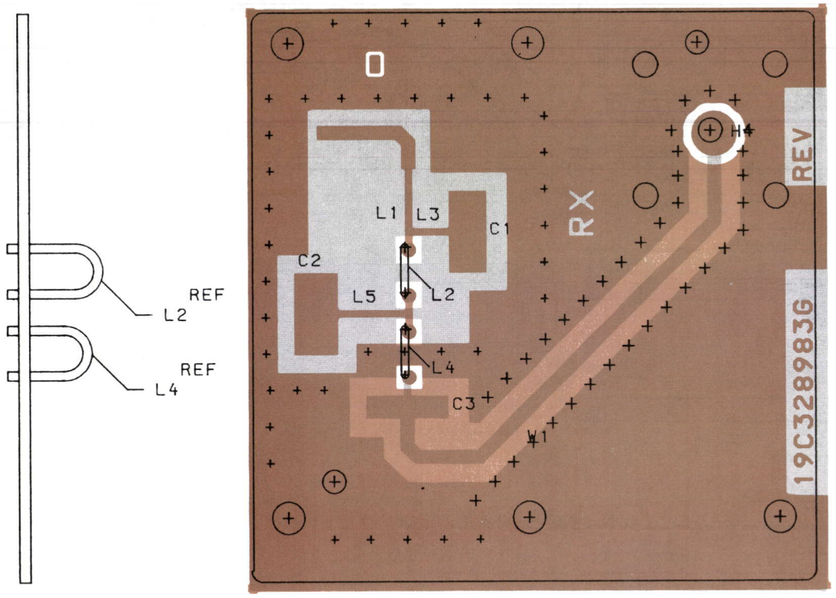


(19D424590, Rev. 7)
(19B227301, Sh. 1, Rev. 2)
(19B227301, Sh. 2, Rev. 2)

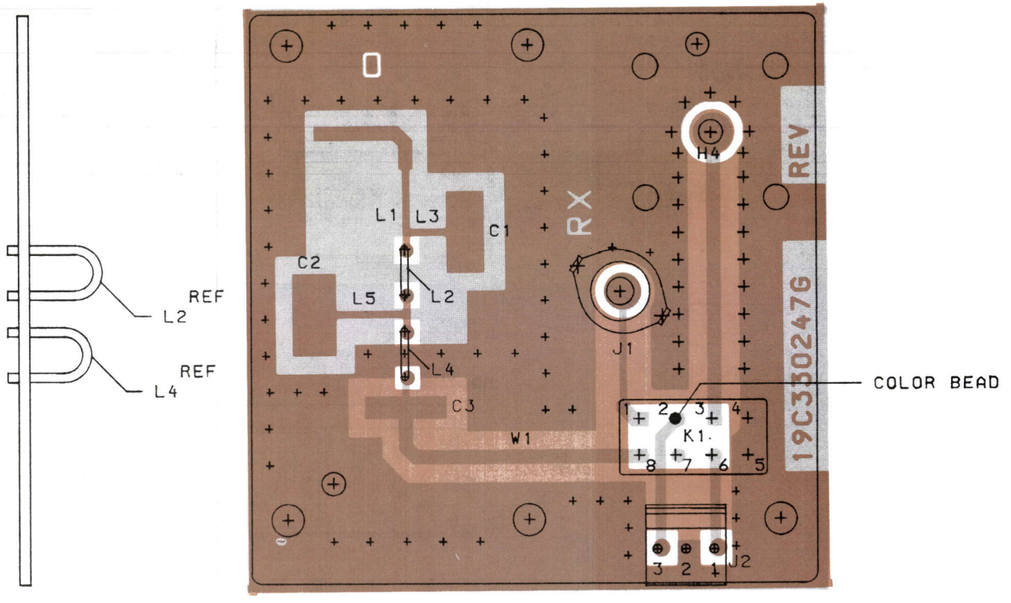
FL202

FL201

CONNECTIONS CHART		
FROM	TO	USING
H1	H17	W18
H2	H9	ST22-BR
H3	H8	ST22-R
H4	H12	W17
H5	H13	W20
H6	H10	ST22-G
H7	H11	ST22-W
H18	H19	W19



(19C328984, Rev. 0)
(19A138346, Sh. 1, Rev. 0)
(19A138346, Sh. 2, Rev. 0)



(19C330249, Rev. 0)
(19A142581, Sh. 1, Rev. 0)
(19A142581, Sh. 2, Rev. 0)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

PA BOARD AND ASSEMBLIES

	POWER AMPLIFIER	REV LTR	COMPONENT BOARD A201	REV LTR	FILTER	REV LTR
W/RELAY	PL19D430488G1	D	PL19D423823G3	B	PL19C330247G1	
W/O RELAY	PL19D430488G2	E	PL19D423823G3	B	PL19C328983G1	

ANY CHANGES TO THIS DIAG. MAY AFFECT 19R622245, 19R622312 OR 19R622262

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.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH TRANSMITTER KEYED, AND MEASURED WITH A 20,000 OHMS-PER-VOLT METER. AN RF COKE (25-50 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.
NOTE: READINGS AT Q201, Q202 COLLECTOR AND IN THE POWER CONTROL CIRCUIT WERE TAKEN WITH THE TRANSMITTER ADJUSTED FOR 35 WATTS OUTPUT. THESE READINGS WILL VARY DEPENDING ON THE SETTING OF POWER ADJUST CONTROL R24.

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.

(19R622411, Rev. 6)

NOTES:
1. 50 OHM MICROSTRIP (PART OF PWB).
2. PARTS INDICATED BY * ARE PART OF PCB.
3. Q205 & Q206 ARE PART OF A PASE-MATCHED PAIR AND MUST BE OF THE SAME GROUP NUMBER. GROUP INDENTIFIES INTERCHANGEABLE PARTS.

SCHEMATIC DIAGRAM

POWER AMPLIFIER 19D430488G1, G2

Issue 6

PARTS LIST

851-870 MHz, 35 WATT
TRANSMITTER POWER AMPLIFIER
19D430488G1 W RELAY
19D430488G2 W/O RELAY
ISSUE 7

SYMBOL	GE PART NO.	DESCRIPTION
A201		POWER AMPLIFIER BOARD 19D423823G3
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A134419P1	Ceramic: 3.3 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -120 PPM.
C2	19A134419P5	Ceramic: 4.7 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -60 PPM.
C3	19A134419P13	Ceramic: 10 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C4	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C5	19A134419P31	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C6	19A134419P5	Ceramic: 4.7 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -60 PPM.
C7	19A134419P11	Ceramic: 8.2 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C8	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C9	19A134419P31	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C10 and C11	19A134419P21	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C12	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C13	19A134419P7	Ceramic: 5.6 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C14 and C15	19A134419P21	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C17	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C18	19A134202P8	Tantalum: 15 uF + or -20%, 20 VDCW.
C19 and C20	19A134419P7	Ceramic: 5.6 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C21 and C22	19A134418P21	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C23 and C24	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C25	19A134202P8	Tantalum: 15 uF + or -20%, 20 VDCW.
C26 and C27	19A134418P7	Ceramic: 5.6 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C28 and C29	19A134418P31	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C30 and C31		(Part of 19D423824G1 printed board).
C32	19A116655P19	Ceramic disc: 1000 pF + or - 20%, 1000 VDCW; sim to RMC Type JF Discap.
C33	19A134202P6	Tantalum: 22 uF + or -20%, 15 VDCW.
C34	19A134202P8	Tantalum: 15 uF + or -20%, 20 VDCW.
C35	19A134419P31	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C36	19A134418P9	Ceramic: 6.8 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
		- - - - - - - - - - - RECTIFIERS - - - - - - - - - -
CR1	19A116052P1	Silicon, hot carrier: Fwd drop .350 volts max.
CR2	19A115775P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR3	19A116052P2	Silicon, fast recovery; sim to Hewlett Packard 5082-2811.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J205	19B219374G1	Connector: 9 contacts.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L1 and L2		(Part of 19D423824P1 printed board).
L4		(Part of 19D423824P1 printed board).
L5	19A701091G1	Coil.
L6 thru L8		(Part of 19D423824P1 printed board).
L9	19B209420P101	Coil, RF: .10 uH + or - 10%, 0.8 ohms DC res max; sim to Jeffers 4416-1K.
L10		(Part of 19D423824P1 printed board).
L11	19A701091G1	Coil.
L12 thru L14		(Part of 19D423824P1 printed board).
L15	19B209420P101	Coil, RF: .10 uH + or - 10%, 0.8 ohms DC res max; sim to Jeffers 4416-1K.
L16		(Part of 19D423824P1 printed board).
L17	19A701091G1	Coil.
L18 thru L20		(Part of 19D423824P1 printed board).
L21	19B209420P101	Coil, RF: .10 uH + or - 10%, 0.8 ohms DC res max; sim to Jeffers 4416-1K.
L22		(Part of 19D423824P1 printed board).
L23	19A701091G1	Coil.
L24 thru L30		(Part of 19D423824P1 printed board).
L31 and L32	19A701091G1	Coil.
L33 and L34	19B209420P101	Coil, RF: .10 uH + or - 10%, 0.8 ohms DC res max; sim to Jeffers 4416-1K.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	19A700106P63	Composition: 1K ohms + or - 5%, 1/4 w.
R2	3R152P301J	Composition: 300 ohms + or -5%, 1/4 w.
R3	3R152P162J	Composition: 1.6K ohms + or -5%, 1/4 w.
R4	19A700106P32	Composition: 51 ohms + or - 5%, 1/4 w.
R5	3R77P240J	Composition: 24 ohms + or - 5%, 1/2 w.
R6	19A700106P15	Composition: 10 ohms + or - 5%, 1/4 w.
R7	19A700106P32	Composition: 51 ohms + or - 5%, 1/4 w.
R8 thru R11	19A700106P15	Composition: 10 ohms + or - 5%, 1/4 w.
R12	19A700112P39	Composition: 100 ohms + or - 5%, 1 w.
R13 and R14	19A700106P15	Composition: 10 ohms + or - 5%, 1/4 w.
R15	19A700112P39	Composition: 100 ohms + or - 5%, 1 w.
R16	3R152P620J	Composition: 62 ohms + or -5%, 1/4 w.
R17	19A700106P63	Composition: 1K ohms + or - 5%, 1/4 w.
R18	3R152P302J	Composition: 3K ohms + or - 5%, 1/4 w.
R19	19A700106P63	Composition: 1K ohms + or - 5%, 1/4 w.
R20	3R152P564J	Composition: 560K ohms + or -5%, 1/4 w.
R21	3R152P203J	Composition: 20K ohms + or - 5%, 1/4 w.
R22	19A700106P63	Composition: 1K ohms + or - 5%, 1/4 w.
R23	3R152P203J	Composition: 20K ohms + or - 5%, 1/4 w.
R24	19A116559P106	Variable cermet: 10K ohms + or - 20%, 1/2 w; sim to CTS Series 360.
R25	3R152P304J	Composition: 300K ohms + or -5%, 1/4 w.
R26 and R27	19C850605P2	Shunt resistor.
R29	19A700016P3	Variable, cermet: 4.7K ohms + or -10%, 1/2 w.
R30	19A700106P15	Composition: 10 ohms + or - 5%, 1/4 w.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	19D429709G4	Power control, low current out.
		- - - - - - - - - - - - CABLES - - - - - - - - - - - -
W2 thru W15		(Part of 19D423824P1 printed board).
W17	19B227659P4	Jumper.
W18	19B227659P2	Jumper.
W19	19B227659P1	Jumper.
W20	19B227659P3	Jumper.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C201 and C202	19A134419P21	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C203	19A134419P5	Ceramic: 4.7 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -60 PPM.
C204 thru C206	19A134419P11	Ceramic: 8.2 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C207 and C208	19A134419P13	Ceramic: 10 pF + or -5%, 50 VDCW, temp coef 0 + or -60 PPM.
C209 and C210	19A134418P19	Ceramic: 18 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C211 thru C214	19A134419P15	Ceramic: 12 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C215 thru C218	19A134418P19	Ceramic: 18 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C219 and C220	19A116708P1	Ceramic: 0.01 uF -0 +100%, 500 VDCW, rated 20 amps; sim to Erie 327050X5W0103P.
C221 and C222	19A703518P2	Variable: 1.44 to 5.20 pF, 125 VDCW; sim to EF Johnson 186-0607-175.
FL201		800 MHz FILTER/RELAY ASSEMBLY 19C330247G1
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J1	19A700049P2	Connector, receptacle; 500 VDCW maximum; sim to NTTF-1058.
J2	19A116659P55	Connector, printed wiring: 3 contacts rated at 5 amps; sim to Molex 09-65-1031.
		- - - - - - - - - - - - RELAYS - - - - - - - - - - -
K1	19A700061P1	Hermetic sealed: 180 to 341 ohms coil res, 8-16.3 VDC; sim to GE 3SAV1760A2, CP Clare HFW-1201558, or Potter-Brumfield HCM6160.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L2	19A136863P1	Coil.
L4	19A136863P1	Coil.
FL202	19C328983G1	Lowpass filter.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J201	7777145P5	Receptacle: sim to Amphenol 82-97.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P101		(Part of W201).
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q201	19A134430P1	Silicon, NPN.
Q202	19A134430P2	Silicon, NPN.
Q203	19A134431P1	Silicon, NPN.
Q204	19A134432P1	Silicon, NPN.
Q205 and Q206		(Part of 19A144342G1 Transistor Kit).
Q207	19A116758P1	Silicon, PNP.
		- - - - - - - - - - - THERMISTOR - - - - - - - - - -
RT201	19A129379G1	Thermistor: 40K ohms + or - 20%, color code white; sim to Carborundum Type M0806J-5.
		- - - - - - - - - - - - CABLES - - - - - - - - - - -
W201	19A136859G1	Cable, RF.
W202	19B227683G3	Cable: approx 3 feet long.
W203	19A142600G1	Cable.
W204	19A142607G1	Cable: approx 2 feet long.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19D417513G1	PA Cover. (Used in Group 1).
	19B233315G1	Filter Web. (W RELAY).
	19B233315G2	Filter Web. (W/O RELAY).
	N80P13016B6	Machine screw: #6(.138)-32 x 1.0. (Secures filter casting).
	19D416275P3	Filter casting.
	19B227679P2	Spacer. (Used with FL201 & FL202).
	19B201074P312	Tap screw, Phillips POZIDRIV: No. 6-32 x 3/4. (Secures support to A201).
	19B219076G1	Support. (Used with A201).
	19B226212G1	Heat sink.
	19B209103P410	Tap screw, hex head: No. 8-32 x 5/8. (Secures Heat Sink).
	19A121006P14	Washer. (Used with Q201 & Q202).
	5492178P2	Washer, spring tension: sim to Wallace Barnes 375-20. (Used with Q201 & Q202).
	19A702782P5	Nut, hex, brass: No. 8-32. (Used with Q201 & Q202).
	7878455P1	Lug terminal; sim to GE89473. (Used with Q204).
	N405P5B6	Lockwasher, spring: #4. (Used with Q204).
	7139898P3	Nut, hex, brass: No. 1/4-28. (Used with C219).
	NP280071	Nameplate. (CAUTION).
	19A701863P13	Cable clip. (Used with W202).
	19B201074P306	Tap screw, Phillips POZIDRIV: No. 6-32 x 3/8. (Used with cable clip).
	19B209268P113	Terminal, solderless: sim to AMP 2-34835-4. (Used with red cable).
	19B209260P11	Solderless terminal. (Used with red & black cable).
	19A700136P7	Sleeving, insulative. (Used with red cable).
	19B227679P1	Spacer. (Used with FL201 & FL202).
	19A134260P1	Insulator cover. (Used with Q207).
	4029974P1	Insulator, plate: aluminum. (Used with Q207).
	4036994P1	Terminal, solderless. (Used with Q207).
	19A115222P3	Washer, shield. (Secures Q207).
	N210P9B6	Nut, hex: #4 (.112) - 40. (Secures Q207).
	19D438235G1	PA Cover, Includes fan. (Used in Group 2).

*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 - 19D430488G1 & G2 800 Mhz Power Amplifier Assembly
To improve reliability. Changed Q207 from 19A116375P1 to 19A116758P1.

REV. A - 19D423823G3 800 MHz Power Amplifier Board
To reduce the probablity of P.A. Burnout due to misadjustment for excessive power. Added R29.

REV. B - 19D423823G3 800 MHz POWER AMPLIFIER BOARD
To improve input VSWR. Replaced L3 with R30.
L3 was: 19B209420P101 - RF Coil: .01 uH ±10%.

REV. C - Not used.

REV. D - 19D430488G1, 2, Power Amplifier
To add tuning adjustment - Added C221 & C222.

REV. E - 19D430488G2 Power Amplifier
To prevent PA from overheating. Changed PA cover to a new one containing a fan.
The old one was: 19D417513G1.