440-470 MHz 40 WATT POWER AMPLIFIER 19D901790G3
470-512 MHz 35 WATT POWER AMPLIFIER 19D901790G4
403-440 MHz 50 WATT POWER AMPLIFIER 19D901790G5

TABLE OF CONTENTS

DESCRIPTION

The power amplifier assembly uses three RF power transistors to provide up to 50 watts of output power. The output power is adjustable over a range of 17.5 watts to 35 watts in the 35 watt PA, 20 to 40 watts in the 40 watt PA, and 25 to 50 watts in the 50 watt PA. Seven transistors are used in the power control circuit.

Supply voltage for the PA is connected from power leads on the Transmit-Receive-System (TRS) board through feedthrough capacitors A2-C1 and C2 to hole 1 (A+) and hole 2 (A-) on the PA board. Capacitor C69 provides RF decoupling for the power leads, and C41 provides low frequency decoupling. Diode D3 will cause the main fuse in the fuse assembly to blow if the polarity of the power leads is reversed.

The PA assembly is insulated from vehicle ground by C32 through C40 to permit operation in positive or negative ground vehicles.

NOTE

In positive ground vehicles, A- is "hot" with respect to vehicle ground. Shorting the transmitter PA printed wiring board ground pattern to the radio case may cause one of the in-line fuses to blow.

PA metering Jack J1 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12 with a cable adaptor. The Test Set meters the RF drive (exciter output), control voltage, driver current, PA current and PA voltage.

CIRCUIT ANALYSIS

RF AMPLIFIERS

The exciter output is coupled through P101 on the TRS board to PA input jack J3. The RF is coupled through 50 ohm microstrip Z9, Z10 and Z11, and then to the base of 1st RF Driver Q1. Z8 is the DC return and decoupling network for Q1. C7 couples RF drive from the exciter which is rectified by D1 and applied to RF Switch A1-Q11 to activate the power control circuitry. Part of the DC voltage is applied to metering jack J1 through R7 for metering the exciter output.

The RF amplifiers consist of three Class C, common-emitter amplifiers. Q3 is the PA stage. Z1, Z2 and Z3 are collector feed and decoupling networks. The output of Q3 is coupled through 50 ohm coaxial cable W8 and coupled through Z24, W7, and Z26 to the low pass filter. The filter output is coupled through 50 ohm stripline Z27 to the antenna relay (K1).

Driver current is metered at J1 (Driver Current). The reading is taken on the Test 1 position with the High Sensitivity button pressed and the polarity switch in the minus (-) position. The current is read as 15 amperes full scale. Jumpers W5 and W6 act as shunt resistors for the metering circuit.

WARNING

The RF Power Transistors used in the transmitter contain Beryilium 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 CONTROL CIRCUIT

The power control circuit provides power leveling as well as thermal protection for the PA.

When the transmitter is keyed, RF is rectified by D1. The resulting DC voltage turns on RF switch A1-Q11. This turns on 9 volt regulator A1-Q12. Current through R14 turns on A1-Q14 which turns on A1-Q16 and pass transistor Q4. Turning on Q4 applies collector voltage to 1st RF driver Q1.

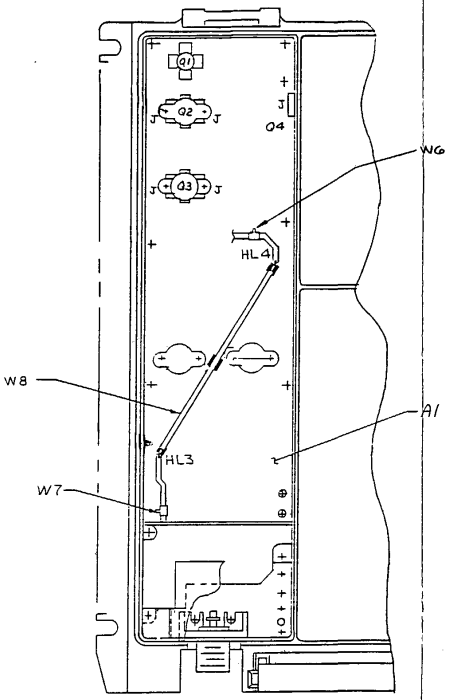
If the power output should start to increase above the level set by R10, A1-Q13 will start conducting harder. This causes A1-Q14, and pass transistor Q4 to conduct less. This reduces the collector voltage to the 1st RF driver, reducing the transmitter power output.

Thermal protection is provided by temperature compensating resistor (thermistor) R20. As the heat sink temperature rises above 85°C, the resistance of R20 decreases, causing A1-Q15 to conduct. This causes A1-Q14 and Q4 to conduct less, reducing the power output.

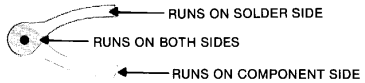
CAUTION

Do not operate the transmitter at levels higher than rated output. Operating at higher than rated output will shorten the life of the RF power transistor.

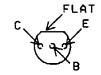
MEDIUM/HIGH POWER



(19D901790, Sh. 1, Rev. 0)

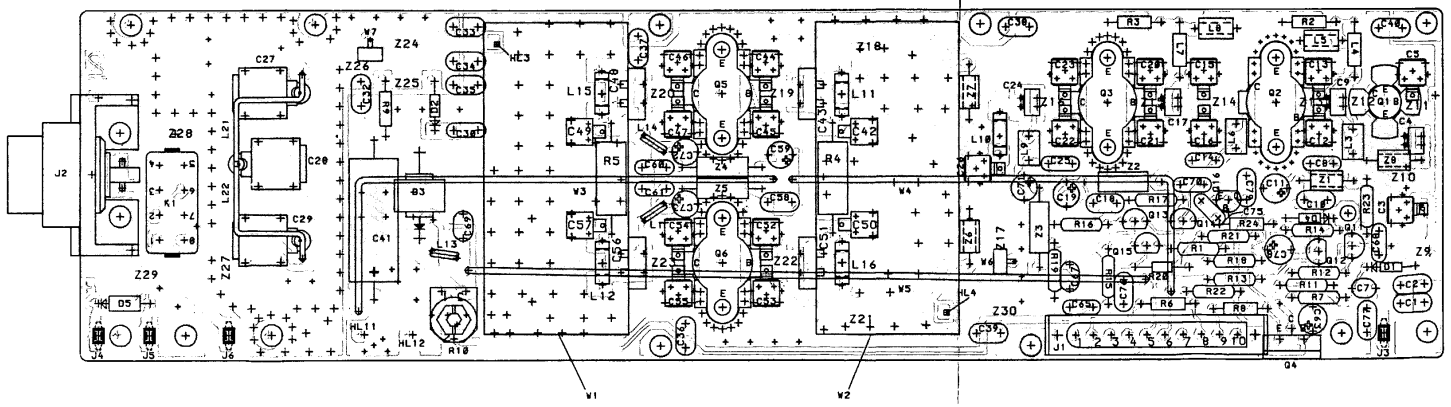


LEAD IDENTIFICATION
FOR ALL TRANSISTORS
NOT OTHERWISE IDENTIFIED



IN-LINE
TOP VIEW

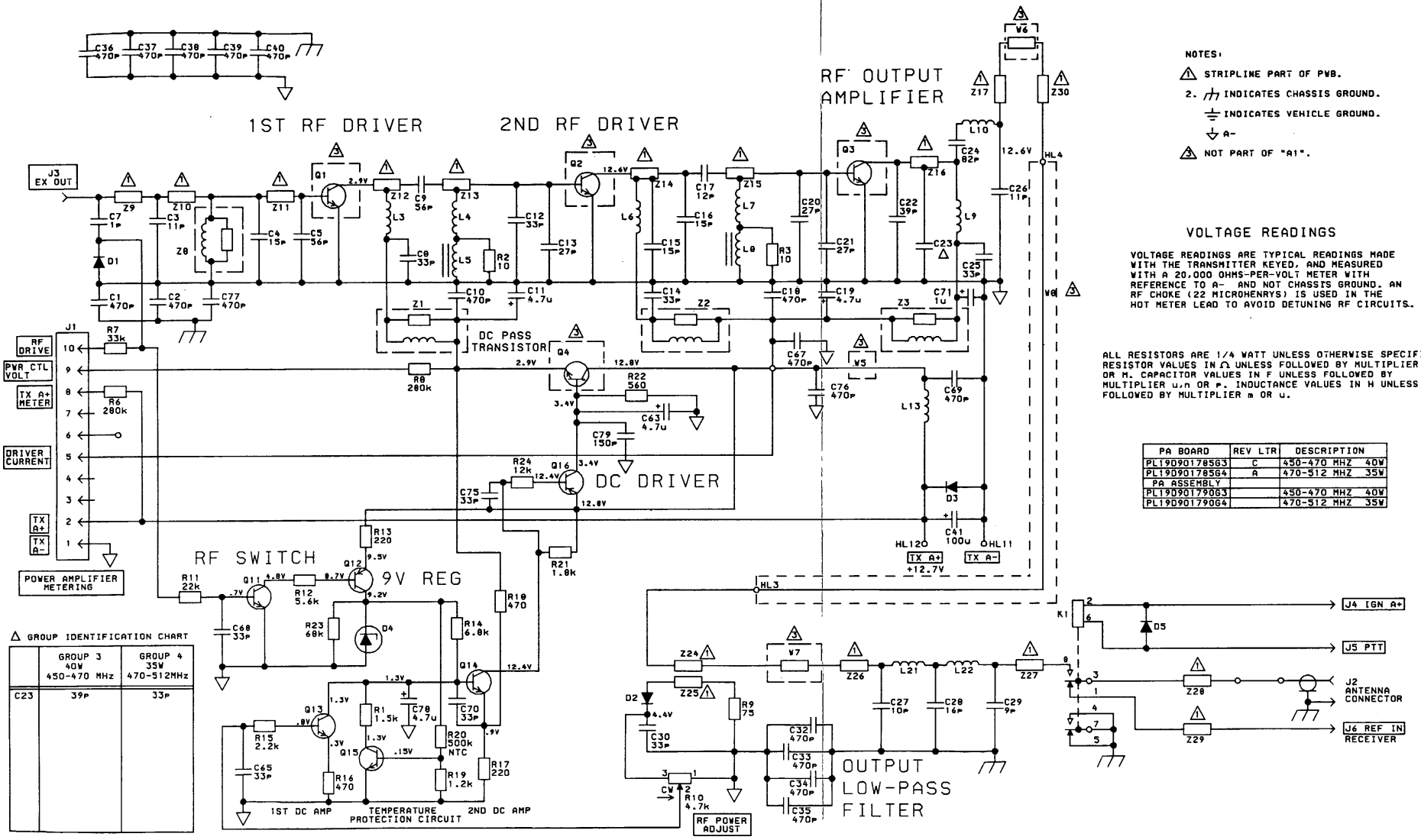
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



(19D901786, Sh. 1, Rev. 2)
(19A704997, Sh. 1 & 2, Rev. 2)
(19A704997, Sh. 3, Rev. 2)
(19A704997, Sh. 4, Rev. 3)

OUTLINE DIAGRAM

Issue 1



NOTES:

1. STRIPLINE PART OF PWB.
2. INDICATES CHASSIS GROUND. INDICATES VEHICLE GROUND. A-
3. NOT PART OF "A1".

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 (22 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u,n OR p. INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR u.

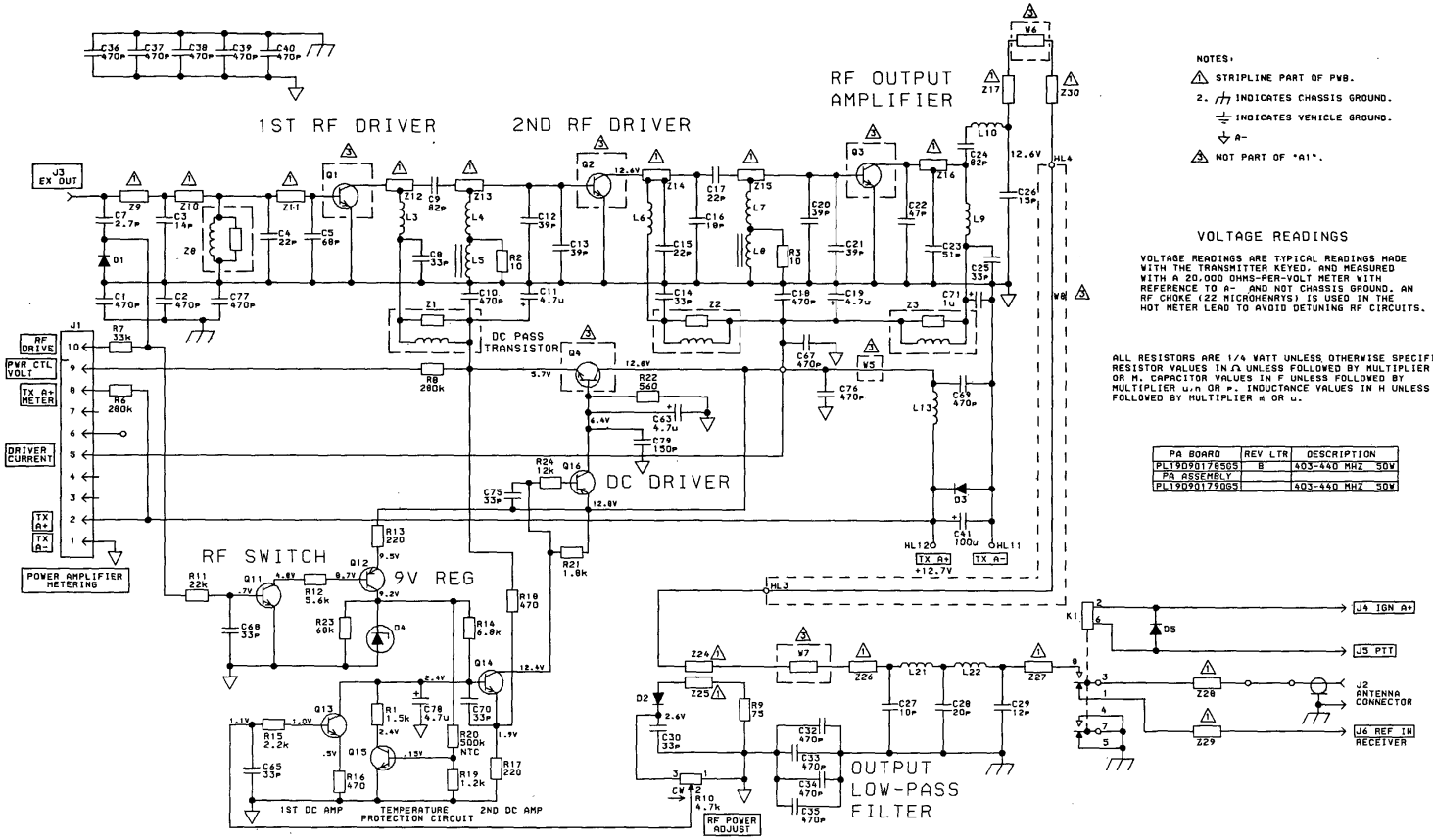
PA BOARD	REV LTR	DESCRIPTION
PL19D90178G3	C	450-470 MHZ 40W
PL19D90178G4	A	470-512 MHZ 35W
PA ASSEMBLY		
PL19D90179G3		450-470 MHZ 40W
PL19D90179G4		470-512 MHZ 35W

△ GROUP IDENTIFICATION CHART

	GROUP 3 40W 450-470 MHz	GROUP 4 35W 470-512MHz
C23	39P	33P

(19D901782, Sh. 1, Rev. 3)

SCHEMATIC DIAGRAM



(19D901783, Sh. 1, Rev. 3)

NOTES:

1. ⚠ STRIPLINE PART OF PWB.
2. ⏚ INDICATES CHASSIS GROUND.
   ⏚ INDICATES VEHICLE GROUND.
   ⏚ A-
3. ⚠ NOT PART OF "A1".

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 (22 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u,n OR p. INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR u.

PA BOARD	REV LTR	DESCRIPTION
PL19D901785G5	B	403-440 MHZ 50W
PA ASSEMBLY		
PL19D901790G5		403-440 MHZ 50W

PARTS LIST

POWER AMPLIFIER ASSEMBLY
19D901790G3 450-470 MHz, 40 WATT
19D901790G4 470-512 MHz, 35 WATT
19D901790G5 403-440 MHz, 50 WATT
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A1		POWER AMPLIFIER BOARD 19D901785G3 450-470 MHz 19D901785G4 470-512 MHz 19D901785G5 403-440 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A701602P13	Ceramic: 470 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C3	19A700006P7	Mica: 11 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C3	19A700006P10	Mica: 14 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C4	19A701413P11	Mica: 15 pF + or - 5%, 100 VDCW. (Used in G3 & G4).
C4	19A701413P17	Mica: 22 pF + or - 5%, 100 VDCW. (Used in G5).
C5	19A700006P28	Mica: 56 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C5	19A700006P30	Mica: 68 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C7	19A700235P1	Ceramic: 1 pF + or - 0.25 pF, 50 VDCW, temp coef 0 PPM. (Used in G3 & G4).
C7	19A700235P6	Ceramic: 2.7 pF + or - 0.25 pF, 50 VDCW, temp coef N150 PPM. (Used in G5).
C8	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C9	19A701413P28	Mica: 56 pF + or - 5%, 100 VDCW. (Used in G3 & G4).
C9	19A701413P32	Mica: 82 pF + or - 5%, 100 VDCW. (Used in G5).
C10	19A701602P13	Ceramic: 470 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C11	19A701534P6	Tantalum: 4.7 uF + or -20%, 35 VDCW.
C12	19A700006P21	Mica: 33 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C12	19A700006P23	Mica: 39 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C13	19A700006P19	Mica: 27 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C13	19A700006P23	Mica: 39 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C14	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C15	19A700006P11	Mica: 15 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C15	19A700006P17	Mica: 22 pF + or -5%, 250 VDCW; sim to Underwood 3HS0020. (Used in G5).
C16	19A700006P11	Mica: 15 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C16	19A700006P14	Mica: 18 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C17	19A701413P8	Mica: 12 pF + or -5%, 100 VDCW; sim to Underwood 3HS0029. (Used in G3 & G4).
C17	19A701413P17	Mica: 27 pF + or -5%, 100 VDCW; (Used in G5).
C18	19A701602P13	Ceramic: 470 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C19	19A703314P9	Electrolytic: 4.7 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C20	19A700006P19	Mica: 27 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C20	19A700006P23	Mica: 39 pF + or -5%, 100 VDCW; sim to Underwood 3Hs0020. (Used in G5).
C21	19A700006P19	Mica: 27 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C21	19A700006P23	Mica: 39 pF + or -5%, 100 VDCW; sim to Underwood 3Hs0020. (Used in G5).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SCHEMATIC DIAGRAM

SYMBOL	GE PART NO.	DESCRIPTION
C22	19A700006P23	Mica: 39 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C22	19A700006P26	Mica: 47 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C23	19A700006P23	Mica: 39 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3).
C23	19A700006P21	Mica: 33 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G4).
C23	19A700006P27	Mica: 51 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C24	19A701413P32	Mica: 82 pF + or -5%, 100 VDCW.
C25	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C26	19A700006P7	Mica: 11 pF + or - 5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G3 & G4).
C26	19A700006P11	Mica: 15 pF + or -5%, 100 VDCW; sim to Underwood 3HS0020. (Used in G5).
C27	19A700131P10	Teflon: 10 pF + or - 0.5 pF, 250 VDCW.
C28	19A700131P16	Teflon: 16 pF + or - 0.5 pF, 250 VDCW. (Used in G3 & G4).
C28	19A700131P20	Metallized teflon: 20 pF + or -0.5 pF, 100 VDCW. (Used in G5).
C29	19A700131P9	Metallized teflon: 9 pF + or -0.5 pF, 250 VDCW. (Used in G3 & G4).
C29	19A700131P12	Metallized teflon: 12 pF + or -0.5 pF, 250 VDCW. (Used in G5).
C30	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C32 thru C40	19A701602P13	Ceramic: 470 pF + or - 20%, 1000 VDCW; sim to Type JF Disc ap.
C41	19A700064P4	Electrolytic: 100 uF, -10+150%, 250 VDCW.
C63	19A701534P6	Tantalum: 4.7 uF + or -20%, 35 VDCW.
C65	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C67	19A700233P5	Ceramic: 470 pF + or - 20%, 50 VDCW.
C68	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C69	19A700233P5	Ceramic: 470 pF + or - 20%, 50 VDCW.
C70	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C71	19A703314P6	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C75	19A700235P19	Ceramic: 33 pF + or - 5%, temp coef -150 PPM.
C76 and C77	19A701602P13	Ceramic: 470 pF + or - 20%, 1000 VDCW; sim to Type JF Disc ap.
C78	19A701534P6	Tantalum: 4.7 uF + or -20%, 35 VDCW.
C79	19A701602P7	Ceramic: 150 pF + or -20%, 1000 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D1	19A115250P2	Silicon, fast recovery; sim to 1N4148.
D2	19A700047P3	Silicon: 100 mW; sim to 1N6263.
D3	19A700082P1	Rectifier, silicon; sim to MR751.
D4	19A700025P16	Silicon, zener: 400 mA max; sim to BZX55-C9V1.
D5	T324AD21041	Rectifier, silicon, general purpose.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J1	19B800555G3	Connector: metering, block. Includes: (10) 19A700237P1 contacts.
J2	19A701854G1	Coax; sim to Amphenol 83-87601002.
J3 thru J6	19A701883P4	Contact, electrical; sim to AMP 86444-1.
		- - - - - - - - - - - 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.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L3	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L4	19A700024P1	Coil, RF: 100 nH + or -10%, 0.08 ohms DC res max, 100 v.
L5	19A701091G1	Coil.
L6	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L7	19A700024P1	Coil, RF: 100 nH + or -10%, 0.08 ohms DC res max, 100 v.
L8	19A701091G1	Coil.
L9	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L10	19A701006P4	Strap.
L13	19A701237P1	Coil.
L21	19B800554P1	Coil. (Used in G3 & G4).
L21	19B800554P2	Coil. (Used in G5).
L22		Part of L21.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q11	19A700023P2	Silicon, NPN: sim to 2N3904.
Q12	19A700022P2	Silicon, PNP: sim to 2N3906.
Q13 thru Q15	19A700023P2	Silicon, NPN: sim to 2N3904.
Q16	19A700020P1	Silicon: PNP, 500 mW; sim to BC558A.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	H212CRP215C	Deposited carbon: 1.5K ohms + or -5%, 1/4 w.
R2 and R3	19A700106P15	Composition: 10 ohms + or - 5%, 1/4 w.
R6	19A701250P444	Metal film: 280K ohms + or - 1%, 1/4 w.
R7	H212CRP333C	Deposited carbon: 33K ohms + or -5%, 1/4 w.
R8	19A701250P444	Metal film: 280K ohms + or - 1%, 1/4 w.
R9	19A700106P36	Composition: 75 ohms + or - 5%, 1/4 w.
R10	19B800784P106	Variable: 5K ohms + or -20%, 1/2 w.
R11	H212CRP322C	Deposited carbon: 22K ohms + or -5%, 1/4 w.
R12	H212CRP256C	Deposited carbon: 5.6K ohms + or -5%, 1/4 w.
R13	H212CRP122C	Deposited carbon: 220 ohms + or -5%, 1/4 w.
R14	H212CRP268C	Deposited carbon: 6.8K ohms + or -5%, 1/4 w.
R15	H212CRP222C	Deposited carbon: 2.2K ohms + or -5%, 1/4 w.
R16	H212CRP147C	Deposited carbon: 470 ohms + or -5%, 1/4 w.
R17	H212CRP122C	Deposited carbon: 220 ohms + or -5%, 1/4 w.
R18	H212CRP147C	Deposited carbon: 470 ohms + or -5%, 1/4 w.
R19	H212CRP212C	Deposited carbon: 1.2K ohms + or -5%, 1/4 w.
R20	19A701864P3	Thermistor: 500K ohms + or - 10%; sim to Midwest Components 4B-504.
R21	H212CRP218C	Deposited carbon: 1.8K ohms + or -5%, 1/4 w.
R22	H212CRP156C	Deposited carbon: 560 ohms + or -5%, 1/4 w.
R23	H212CRP368C	Deposited carbon: 68K ohms + or -5%, 1/4 w.
R24	19A700106P89	Composition: 12K ohms + or - 5%, 1/4 w.
		- - - - - - - - - - FILTERS - - - - - - - - - -
Z1	19A701771G3	Filter Assembly.
Z2 and Z3	19A701092G1	Filter Assembly.
Z8	19A701771G2	Filter Assembly.
Z9 thru Z17		(Part of printed board - 19D901784P1).

SYMBOL	GE PART NO.	DESCRIPTION
A2		FEED THRU CAPACITOR ASSEMBLY 19A703218G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A701895P1	Ceramic, feed thru: 100 pF -0+100%, 500 VDCW.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A703177P1	Silicon: NPN.
Q2	19A700081P3	Silicon, NPN: 18 watt UHF amplifier, 12.5 v.
Q3	19A700056P3	Silicon, NPN. (Used in G3 & G4).
Q3	19A702183P1	Silicon, NPN: UHF amplifier, 62 w. (Used in G5).
Q4	19A700054P1	Silicon, NPN, 60 w; sim to BD-201.
		- - - - - - - - - - CABLES - - - - - - - - - -
W5	19A702034P1	Jumper.
W6 and W7	19A701093P1	Strap.
W8	19A702075G2	Semi rigid cable: coax.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19D900282P1	Low pass filter housing.
	19D900358P1	PA Cover.
		HANDLE LOCK ASSEMBLY 19D900349G3
	19B800004P5	Lock.
	19C850699P1	Lock support.
	19C850627P1	Handle.
	19A700132P818	Dowel pin. (Secures handle).
	19A701347P1	Lock pin. (Locks handle).
	19A700140P2	Compression spring. (Used with lock pin).
	19C850941P1	Retainer ring. (Secures compression spring).
	19A702362P408	Machine screw: M3.5-0.6 x 8. (Quantity 2).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19D900282P1	Low pass filter housing.
	19C850949G1	PA cover.
	19A701368P1	Gasket. (Used with J2 on A1).
	19A700068P1	Insulator, bushing. (Used with Q4).
	19A700115P3	Insulator, plate. (Used with Q4).
	19A704572P1	Metallic eyelet. (Used with C1 & C2 on A2).
	19C850825P1	Cover. (J2).
	19A701400P2	Insulated spacer. (Quantity 4 - Located near A2 board).
	19A702182P1	Spacer. (Used with Q1 on assembly).
	5492178P2	Washer, spring tension: sim to Wallace Barnes 375-20. (Used with Q1 on assembly).
	19A702782P5	Nut, hex, brass: No. 8-32. (Secures Q1 on assembly).
	19A702381P525	Screw, thd forming: No. M3.5-0.6 x 25. (Secures Low pass filter housing).
	19A702381P510	Screw, thread forming: TORX DRIVE No. M3.5 - 0.6 x 10. (Secures J2).
	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8. (Secures A2 board).
	19A700114P1	Stud terminal. (Used with L21 & L22).
	19A702364P208	Machine screw: TORX Drive, M2.5 - 0.45 x 8. (Secures Q2-Q6).
	19A701308P1	RF Terminal. (Connects J2 to Z28).

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 ASSEMBLY 19D901785G3

To improve operation. Changed Z8.

Z8 was: 19A701771G2 filter assembly.

REV. A - POWER AMPLIFIER ASSEMBLY 19D901785G4,5
REV. B - POWER AMPLIFIER ASSEMBLY 19D901785G3

To reduce alternator whine. Added filter circuitry to power control circuit. Deleted C64 and C74. Added R24, C78 and C79. New components and deleted components are shown in the existing parts list.

C64 and C74 were: Tantalum; 4.7uF ± 20%, 35VDCW.

REV. C - POWER AMPLIFIER ASSEMBLY 19D901785G3
REV. B - POWER AMPLIFIER ASSEMBLY 19D901785G5

To improve power margin. Changed C15, C17, C23, and Z8.

C15 is: 19A700006P17 mica 22pF ±5%, 100VDCW.
C17 is: 19A701413P17 mica 22pF ±5%, 100VDCW.
C23 is: 19A700006P27 mica 51pF ±5%, 100VDCW.
Z8 is: 19A701771G2 filter assembly. (Changed back to original.)