

**GENERAL**

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to update your instruction manual.

**INSTRUCTION MANUAL AFFECTED:**

68-80101W58-A      Radius Two-Way Radio Service Manual

**REVISION DETAILS:**

This revision contains servicing information for Radius 2-Watt UHF Low Power Industrial models. The following pages include a model chart, performance specifications, troubleshooting information, schematics, circuit board diagrams, and/or parts lists for the following new UHF Low Power Industrial kits:

HLE9502A      PA Board, 2 Watt, 449-470 MHz  
HLN9501A      PA Hardware Kit (2 Watt, 449-470 MHz)

These items are part of the HLE3192A 2-Watt UHF RF Power Amplifier Kit.

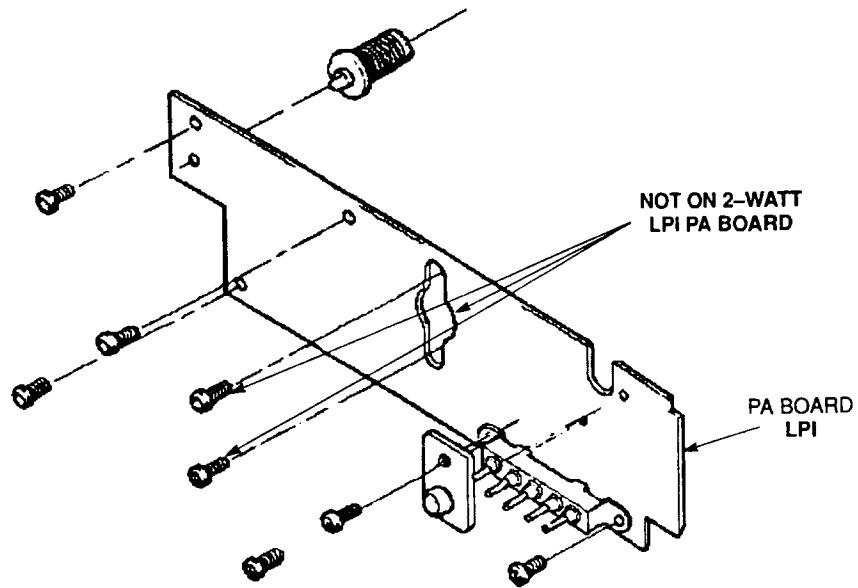
1. The following pages contain additional information covering new kits. No pages in your existing manual should be discarded.
2. Insert the UHF 2-Watt Radius LPI Model Chart after page vi of the Service Manual.
3. Locate page vii; in the Model Series Chart, add the following model information in the appropriate columns:

Model Series	Transmitter Power Output	Type Acceptance Number
D04LRA	2 Watts	ABZ89FT4765

4. Insert the attached UHF 2-Watt Radius LPI Radio Performance Specifications after page viii of the Service Manual.
5. Insert the attached PA Troubleshooting text after page 5 of the Service Manual.
6. Find Table 2 on Page 7 (Troubleshooting Diagram) of the Service Manual. Add two entries for the 2 Watt UHF LPI models in the appropriate columns as follows:

Band	Power	Wire Pair	Resistance
UHF	2W	RED-GREEN	390 OHMS
UHF	2W	RED-BLUE	0.2 OHMS

7. Insert the attached foldout containing the 2-Watt UHF Power Amplifier Circuit Board Diagrams, Schematic, and Parts List after page 22 of your Service Manual.
8. Find the Radio Exploded Views (pages 30 and 31 in the Service Manual). Note in the parts lists that the 2-Watt radios use only 6 of the taptite screws (item 24, page 30; item 27, page 31). Mark the illustrations as shown below.



MODEL		FREQ.	VERSION
D04LRA77A5AK		6	Radius M206 2 Watt
D04LRA77A5AK		16	Radius M214 2 Watt
<b>UHF Radius Mobile Radio 2 Watt RF Power 449-470 MHz</b>			
<b>X = ONE ITEM SUPPLIED.</b>			
ITEM	DESCRIPTION	ITEM	DESCRIPTION
X X	HUE3197B UNIFIED CHASSIS KIT 449-470 MHz	HLE9310B	RF BOARD 449-470 MHz
X X	HLE3192A PA KIT 2 WATT 449-470 MHz (See Note)	HLN5173B	LOGIC BOARD
X	HLN5191A ESCUTCHEON	HLN5174A	DISPLAY BOARD 2 FREQ.
X	HCN3033A FRONT PANEL 6 FREQ.	HLN5175A	DISPLAY BOARD 6/14 FREQ.
X	HCN3034A FRONT PANEL 16 FREQ.	HLN9141A	FRONT PANEL HDWR 2 FREQ.
X X	HLN9180A NAMEPLATE	HLN9142A	FRONT PANEL HDWR 6 FREQ.
X X	HHN4029A HOUSING KIT	HLN9143A	FRONT PANEL HDWR 16 FREQ.
X X	HMN1056C MICROPHONE KIT	HLN5184A	FRONT PANEL SWITCH BOARD
X X	HLN9073A MICROPHONE HANGUP CLIP	HLN5188A	CHASSIS HDWR
X X	HKN4137A POWER CABLE KIT	HLE9502A	2W PA BOARD 449-470 MHz
X X	HLN5189A INSTALLATION HDWR KIT	HLN9501A	2W HEATSINK HDWR
X X	HBN4040A PACKING KIT	HLN1245A	MICROPHONE
X X	HLN9277A ROM KIT	HLN5301A	COILED CORD

NOTE: HLE3192A IS PART OF HUE3197B.

## Performance Specifications for Radius LPI UHF Mobile Radio

### GENERAL

Band:	UHF
Model Series:	D04LRA
Typical RF Output:	2 Watts
Frequency:	449-470 MHz
Dimensions (H x W x L):	2" x 7" x 7-3/4" (50.8 x 178 x 198 mm)
Primary Voltage Input:	13.8 Volts DC
Weight:	61 oz. (1.73 kg)
Typical Current Drain	
Receive (5W):	1.5 Amps
Transmit:	2.5 Amps
Standby:	400 milliAmps
Channel Capability:	6 or 16 channels
Squelch Capability:	<i>Private-Line, Digital Private-Line</i> coded squelch and/or carrier squelch
External Speaker (Optional):	5 Watts

### TRANSMITTER

Spurious & Harmonic Emissions:	-46 dBc
Frequency Stability (-30 to +60 degrees C, 25 degree C reference):	+/-0.0005%
Modulation:	16F1, 16F3, 15F2
Max. Frequency Separation:	21 MHz
Audio Distortion:	5% measured per EIA
Output Impedance:	50 Ohms
Modulation Sensitivity:	80 mV rms for 60% max. deviation @ 1 kHz

### RECEIVER

Channel Spacing:	25 kHz
Sensitivity 12 dB SINAD:	0.30 uV (-117 dBm)
Intermodulation EIA SINAD:	75 dB
Spurious & Image Rejection:	75 dB
Selectivity EIA SINAD:	75 dB
Audio Output:	3W (5W with optional external speaker) at less than 5% distortion
Frequency Stability (-30 to +60 degrees C, 25 degree C reference):	+/-0.0005%
Max. Frequency Separation:	21 MHz
Input Impedance:	50 Ohms

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

## 7. PA Troubleshooting

### 7.1 GENERAL

This section will help you localize failures in the Power Amplifier assembly to a particular circuit by observing symptoms during radio operation. You must understand schematics, fundamental radio frequency operating principles, and be able to fabricate simple DC and RF interconnects. Following are brief comments on circuit operation to aid in isolating problems.

### 7.2 PRE-DRIVER STAGE

Q2610 input is matched to 50 ohms by four reactive components. It is biased by a resistor network referenced to Keyed 9.6V. In the receive mode, this voltage is zero and the stage is off. The collector is reactively matched to the base impedance of the driver. The typical input is 25 mW and the output is approximately 300 mW. The collector of Q2610 has approximately 60 mV RMS signal present.

### 7.3 DRIVER STAGE

Q2620 is biased class C and has collector voltage supplied by the power control circuitry. Variations in collector voltage (P7-2) vary the output power of Q2620, which drives the final stage, and therefore varies the power out of the amplifier. The collector impedance is matched to the base of the final device via reactive components and a transmission line. The impedance matching contribution of the transmission line is significant. This stage is capable of producing 3 watts RF power but typically produces 1/2 watt when the radio is operating at a 2 watt transmit power level.

### 7.4 FINAL STAGE

The collector of the final device (Q2630) is the lowest RF impedance point in the amplifier and must be matched up to 50 ohms at the PIN diode switch interface. For this reason the final collector match is more complicated than other matching

circuitry. Component location, as well as value, is critical in this area. Replacement of any component in this area must be done with precision. The collector de-coupling network has two stages, as compared to one for previous stages. Components in this network are to be considered RF sensitive and treated with care. This stage is capable of generating in excess of 8 watts RF power. If the power amplifier is to be tested with external drive and no power control (see Table 2), be sure that the power measurement equipment will not be damaged by such power. 20 watts at high line can be achieved.

### 7.5 PIN DIODE SWITCH AND HARMONIC FILTER

The PIN diode switch is controlled by Keyed 9.6V. In the transmit mode, current through CR2650 and CR2651 make these components virtual shorts. CR2650 is in series and allows power to pass to the harmonic filter. CR2651 is in shunt with the receive path and denies RF power passage to sensitive receiver circuitry. Additional receiver protection is provided by CR2652, which is also a virtual short. In the receive mode, the Keyed 9.6V line is at zero volts and both diodes are open producing low loss for received signals from the antenna to the RF board. Note that in the receive mode (zero volts on P7-1), the loss can be measured between the antenna connector (J1) and the receiver feed (P4). This is a convenient means of testing the harmonic filter and much of the PIN diode switch circuitry. The loss should be less than 1.5 dB. Checking the remainder of the PIN diode circuit can be done by probing the circuitry in transmit mode, but with no RF drive to the amplifier. If the proper currents are flowing then the circuit is likely to be good. Do not probe this circuit when the transmitter is active.

Using Table 1, Power Amplifier Troubleshooting Chart, you may isolate the stage immediately, based on observations made on an assembled radio. Refer to Table 2, PA Exercise Input Chart, for information on how to exercise the power amplifier when detached from the radio. See the schematic for typical RF and DC voltage values. The information provided should allow any problem in the amplifier assembly to be isolated to a particular stage.

Table 1. Power Amplifier Troubleshooting Chart

RADIO SYMPTOMS			Probable Cause(s)	Recommended Actions
Power Out	Current	Power Variations over Frequency		
LOW	NOM	NOM	Losses Beyond Q2630	Check PIN Switch; Check Harmonic Filter (RX Loss)
LOW	LOW	NOM	Power Set Low	Reset Power
LOW	HIGH	HIGH	Impedance Mismatch Beyond Q2630	Check PIN Switch; Check Harmonic Filter
HIGH	LOW	HIGH	Impedance Mismatch Beyond Q2630	Check PIN Switch; Check Harmonic Filter
ZERO	LOW	—	Low Control Voltage	Check Current Sense
ZERO	LOW	—	Bad A+ Feed	Check From J2 to Collector of Q2630
ZERO	HIGH	—	Open or Short Beyond Q2630	Check Harmonic Filter; Check PIN Switch; Check Final Device
2 W - 2.5 W	1.5 A - 2.0 A	0 W - 0.5 W	Typical Operating Range	

Table 2. PA Exercise Input Chart

Input	Location	TX Value	RX Value
Power in/mW	P5	25	0
Control V/Volts	P7-2	9.5 (Note 1)	0
A+/Volts	J2	13	13
Keyed 9.6/Volts	P7-1	9.5	0
Ground	J2	0 (Note 2)	0 (Note 2)

NOTES:

1. This value may be varied to lower values to simulate Power Control.
2. With two or more supply sources, be sure to have common grounds.

parts list

HLE9502A Radius LPI UHF PA Board MXW-6747-O

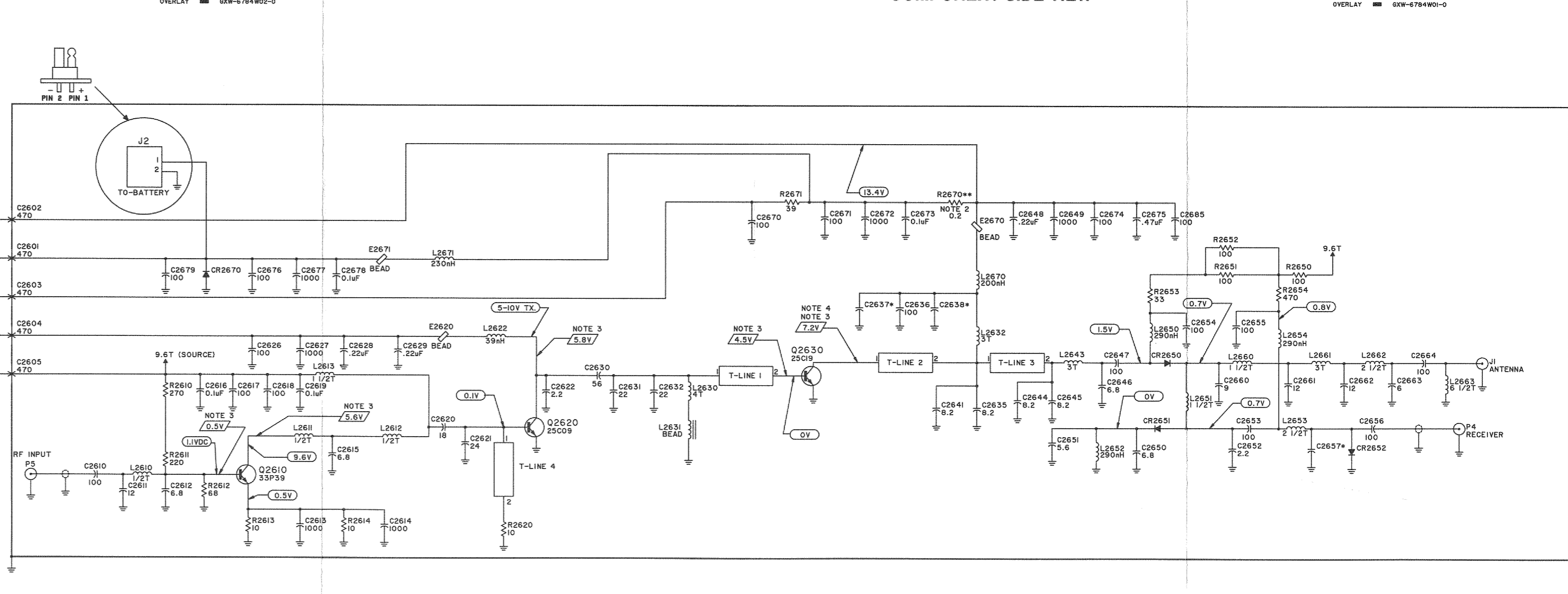
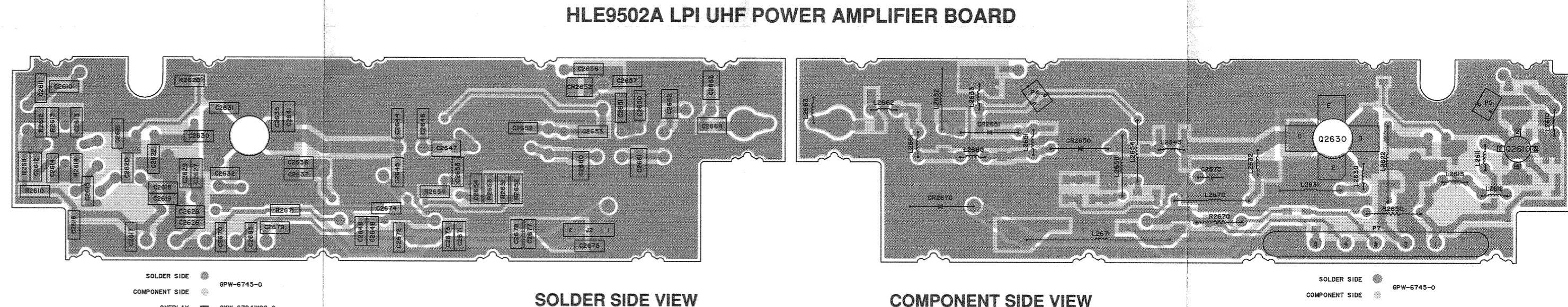
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
<b>capacitor, fixed, pF, ±5%, 50V (unless otherwise stated)</b>		
C2601-2605	21-84874K01	feedthru, 470 pF
C2610	21-13740B49	100
C2611	21-13740B27	12
C2612	21-13740B21	6.8, ±5 pF
C2613,2614	21-13740B73	1000
C2615	21-13740B21	6.8, ±5 pF
C2616	21-13741B69	0.1 uF
C2617,2618	21-13740B49	100
C2619	21-13741B69	0.1 uF
C2620	21-13740B31	18
C2621	21-13740B34	24
C2622	21-13740B09	2.2, ±25 pF
C2625	21-13740B49	100
C2627	21-13740B73	1000
C2628,2629	21-11032B15	0.22 uF, +80-20%
C2630	21-13740B43	56
C2631,2632	21-13740B33	22
C2635	21-13740B23	8.2, ±5 pF
C2636	21-13740B49	100
C2641	21-13740B23	8.2, ±5 pF
C2644,2645	21-13740B23	8.2, ±5 pF
C2646	21-13740B21	6.8, ±5 pF
C2647	21-11078B42	100, 100V
C2648	21-11032B15	0.22 uF, +80-20%
C2649	21-13741N21	1000, ±10%
C2650	21-13740B21	6.8, ±5 pF
C2651	21-13740B19	5.6, ±25 pF
C2652	21-13740B09	2.2, ±25 pF
C2653-2656	21-13740B49	100
C2660	21-80050M17	9.0, ±5 pF, 500V
C2661,2662	21-80060M21	12.0, ±5 pF, 500V
C2663	21-80060M11	6.0, ±5 pF, 500V
C2664	21-11078B42	100, 100V
C2670,2671	21-13740B49	100
C2672	21-13740B73	1000
C2673	21-13741B69	0.1 uF
C2674	21-13740B49	100
C2675	08-11051A17	0.47 uF, 63V
C2676	21-13740B49	100
C2677	21-13740B73	1000
C2678	21-13741B69	0.1 uF
C2679	21-13740B49	100
C2685	21-13740B49	100
<b>diode (see note)</b>		
CR2650,2651	48-80010E01	pin
CR2652	48-80142L01	pin
CR2670	48-80236E07	zener, 28V
<b>ferrite bead</b>		
E2620	76-83960B01	core
E2670,2671	76-83960B01	core
<b>coil, RF</b>		
L2610	24-11030E01	brown
L2611,2612	24-11030E03	orange
L2613	24-11030B01	1.5 turns, brown
L2622	24-82723H44	0.39 uH
L2630	24-11030A03	4 turns
L2631	24-80036A01	choke, 1/2 turn
L2632	24-11030A02	3 turns
L2643	24-11030A02	3 turns
L2650	24-82723H40	0.29 uH
L2651	24-11030B04	1.5 turns, yellow
L2652	24-82723H40	0.29 uH
L2653	24-11030B06	2.5 turns, blue
L2654	24-82723H40	0.29 uH
L2660	24-11030B04	1.5 turns, yellow
L2661	24-11030A02	3 turns
L2662	24-11030B06	2.5 turns, blue
L2663	24-11030B11	6.5 turns, orange
L2670	24-82723H46	0.20 uH
L2671	24-84346A02	choke, 0.23 uH
<b>transistor (see note)</b>		
Q2610	48-82233P39	NPN
Q2620	48-80225C09	NPN
<b>resistor, fixed, ohm, ±5%, 1/8 watt (unless otherwise stated)</b>		
R2610	06-11077A60	270
R2611	06-11077A58	220
R2612	06-11077A46	68
R2613,2614	06-11077A26	10
R2620	06-11077A26	10
R2650	06-11009A25	100, 1/4W
R2651,2652	06-11077A50	100
R2653	06-11077A38	33
R2654	06-11077A66	470
R2670	06-11086D01	0.2, 2W
R2671	06-11077A40	39
<b>non-referenced parts</b>		
04-83755H01	washer, solder	
07-89982T01	bracket, feedthru	
09-80133M01	receptacle, connector	
15-80075M01	housing, connector	
26-80158L01	heatsink	
29-80014A01	clip, coax (2 used)	
42-10217A30	tie strap	

note: Field repair of this kit is not recommended. It should be replaced in its entirety. Parts listed are for reference only.

HLN9501A Radius LPI UHF PA Hardware MXW-6748-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
<b>connector, receptacle</b>		
J1	09-80131M01	coax connector, mini-UHF
J2	09-80255E01	power connector (2 contacts)
<b>connector, plug</b>		
P4	30-80138M07	coax cable assembly
P5	30-80138M08	coax cable assembly
<b>transistor (see note)</b>		
Q2630	48-80225C19	power, NPN
<b>non-referenced parts</b>		
02-00007003	hex nut, 8-32 x 5/16 x 1/8	
03-10943M10	screw, tapping, 3 x 0.5 x 8 (6 used)	
03-10943M11	screw, tapping, 3 x 0.5 x 10 (2 used)	
04-00002636	lockwasher	
04-00131974	washer, flat (2 used)	
04-80943V01	lockwasher	
26-80124L01	heatsink	
26-80223M05	shield, PA	
32-80014N02	gasket, connector access	
42-80047N01	clip, grounding	

note: Field repair of this kit is not recommended. It should be replaced in its entirety. Parts listed are for reference only.



NOTE:  
 1.) ASTERISK IN DESIGNATOR (R2525\*) REFERS TO CONTINGENCY PARTS. SEE PARTS LIST.  
 2.) R2670 HAS UNIQUE LAYOUT. SEE J.SALINOVITGH.  
 3.) ALL R.F. MEASUREMENTS\* ARE DONE USING A BOONTON R.F. MILLIVOLTMETER (MODEL 92BD). FREQUENCY OF MEASUREMENT: 460 MHZ.  
 4.) MUST USE 100:1 DIVIDER PROBE TIP HERE. (MODEL 91-7C BOONTON)  
 5.) 5.8V = R.F. VOLYAGE MEASUREMENTS.  
5.8V = TX.D.C. VOLTAGE MEASUREMENTS.

[MMR028 12/11/89]

Schematic, Circuit Board Diagram, and Parts Lists for 2-Watt UHF Power Amplifier PW-6744-O 7/31/89