



service manual revision

GENERAL:

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

INSTRUCTION MANUAL AFFECTED:

6880904Z96-A

M1225 Mobile Radio Service Manual

REVISION DETAILS:

1. This supplement contains the new VHF, 10-25 W, 150-170 MHz radio models with new model charts, and revised specifications and theory of operation pages. In addition, the circuit board details, schematic diagrams and parts list have also been supplied. Please refer to the attached pages.

ATTACHMENTS

20-Channel VHF 150-170 MHz, 10-25 W Model Chart
4-Channel VHF 150-170 MHz 10-25 W Model Chart
Specifications
Circuit Board Details for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (parts of HUD3231A & HUD3253A Radios)7
Schematic Diagram for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (parts of HUD3231A & HUD3253A Radios) (Sheet 1 of 2)9
Schematic Diagram for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (parts of HUD3231A & HUD3253A Radios) (Sheet 2 of 2)
Parts List for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (parts of HUD3231A & HUD3253A Radios)
Theory of Operation



Model Charts

FREQ. DESCRIPTION	20 12.5/25 kHz, 10-25 W	M1225 20-Channel VHF Mobile Radio 150 - 170 MHz			Display Board (20-Freq.)	Hardware Kit	Main Board, 12.5/25 kHz, 10-25 W
MODEL	M33DGC90J2AA		Watts RF Power	ITEM	HLN9644_ C	HLN9268_	(See Note)
		Item	Description				
	Х	HUD3231_	Radio, 12.5/ 25 kHz, 10-25 W		Χ	X	Х
	Х	HMN3008_	Microphone				
	X	HLN9154_ Non-Locking Bracket					
	Х	HKN4137_ Power Cable					
	Х	HLN9155	M1225 20-Channel Manual Kit				

FREQ. DESCRIPTION	A 4 12.5/25 kHz, 10-25 W	M1225 4-Channel VHF Mobile Radio 150 - 170 MHz			Display Board (4-Freq.)	Hardware Kit	Main Board, 12.5/25 kHz, 10-25 W
MODEL	M33DGC90E2AA	10-25	Watts RF Power	ITEM	HLN9887_	HLN9268_	(See Note)
		ltem	Description				
	Χ	HUD3253_	Radio, 12.5/25 kHz, 10-25 W		Х	Х	Х
	Х	HMN3008	Microphone				
	X	HLN9154	Non-Locking Bracket				
	Х	HKN4137_	Power Cable				
	Х	HLN9893	M1225 4-Channel Manual Kit				

Specifications

GENERAL

	V	HF	UI	-IF		
Model Series:	M33DGC	M43DGC	M44DGC,	M34DGC		
Frequency Range:	150-170 MHz	150-174 MHz	450-474	4 MHz		
RF Output:	10-25 W	25-40 W	10-25 &:	25-40 W		
Channel Spacing:	12.5 kHz & 2	0/25/30 kHz	12.5 kHz	20/25 kHz		
Dimensions:	H 1.73"	X W 6.61" X D 4.25" (H	44mm X W 168mm X D	108mm)		
Weight:		36 oz. (1.02kg)				
Channel Capacity:		20 or 4 Channels				
Freq. Separation:		24 MHz				
Input Voltage:		13.6 ±10%				
Current Drain: Standby Receive @Rated Audio		300 mA 1.5 A				
Transmit	7 A @ 25 W, 1	7 A @ 25 W, 12.5 A @ 40 W 12.5 A @ 40 W				
Squelch Capabilities:	Te	Tone Coded, Digital Coded and/or Carrier Squelch				

TRANSMITTER

	VHF	UHF			
Freq. Stability (-30C to +60C):	±0.00	±0.00025%			
Spurs/Harmonics:	-23 dBn	n (5 μW)			
Audio Response:*	+1/-3 dB, relative to 6 dB/octave pre-em	phasis, 300-3000 Hz (2550 Hz @ 12.5 kHz)			
FCC Designation:	ABZ99FT3038, ABZ99FT3037	ABZ99FT4044, ABZ99FT3038			
FCC Modulation: 20/25/30 kHz 12.5 kHz	16K0F3E 11K0F3E	16K0F3E 11K0F3E			
Output Impedance:	50 ohms				
Modulation Sensitivity:	80 mV rms for 60% deviation @ 1000 Hz				
FM Noise: 20/25/30 kHz 12.5 kHz	45 dB 40 dB	40 dB 35 dB			
Audio Distortion:	<3% EIA (@1000 Hz, 60% of Rated Max. Deviation)				

RECEIVER

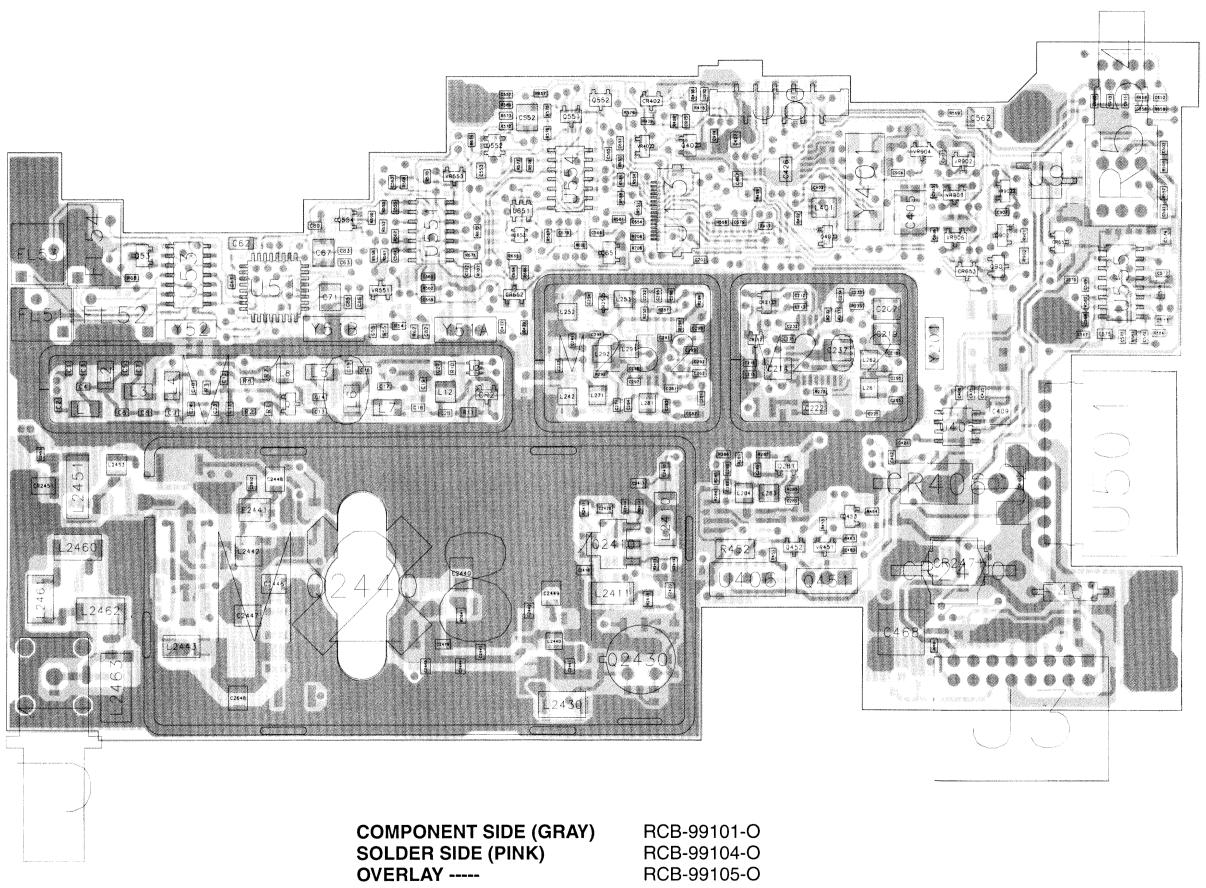
	VI	łF	UI	I F		
	12.5 kHz	25 kHz	12.5 kHz	25 kHz		
Freq. Stability (-30C to +60C):	±0.00025%					
Sensitivity TIA @ 12 dB SINAD:	0.35 μV	0.30 μV	0.35 μV	0.30 μV		
Squelch (internally pre-set):		10 dB	SINAD			
Selectivity TIA:	65 dB	75 dB	60 dB	70 dB		
Intermodulation TIA*:	65 dB	75 dB	60 dB	70 dB		
Spurious Rejection:	75 dB		70 dB			
Image / Half IF Rejection:	70 dB		70 dB			
Audio Output: 8 ohms (external) 16 ohms (internal) 7.5 W @ 5% distortion 4.0 W Nominal						
Input impedance:		50 c	ohms			
TIA Usable Bandwidth:	1.2 kHz	2 kHz	1.2 kHz	2 kHz		

^{*} Local mode adds 10 dB protection against wideband interference.

MILITARY STANDARDS 810 C, D & E FOR MOUNTING ACCESSORIES

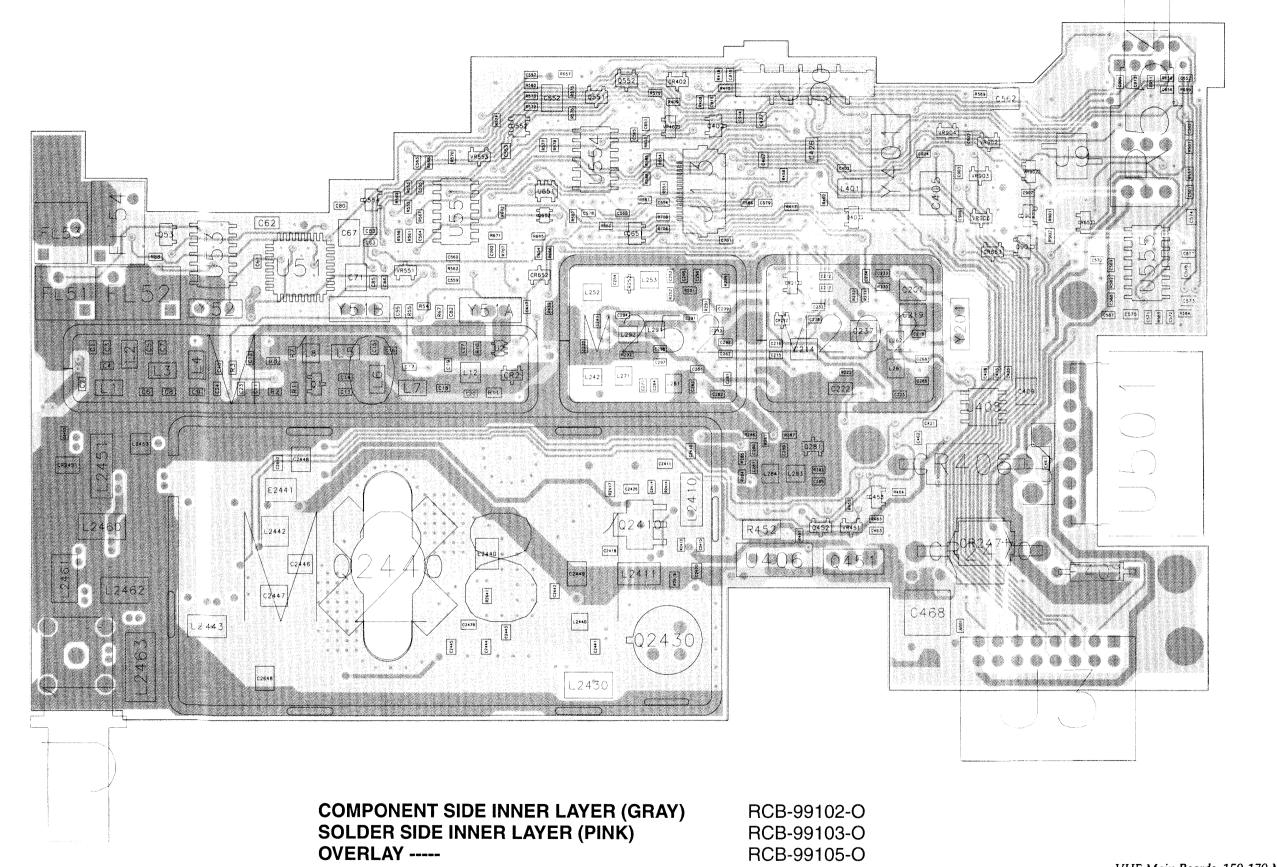
		810C		810D		810E	
Applicable MIL-STD	Required Mounting Accessory	Method	Procedures	Method	Procedures	Method	Procedures
Vibration:	Standard Non-Locking Bracket	514.2	8	514.3	1	514.4	1
Shock:	Standard Non-Locking Bracket	516.2	1,3	516.3	1	516.4	1
Crash Hazard	Any M1225 Mounting Accessory	516.2	3	516.3	5	516.4	5

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



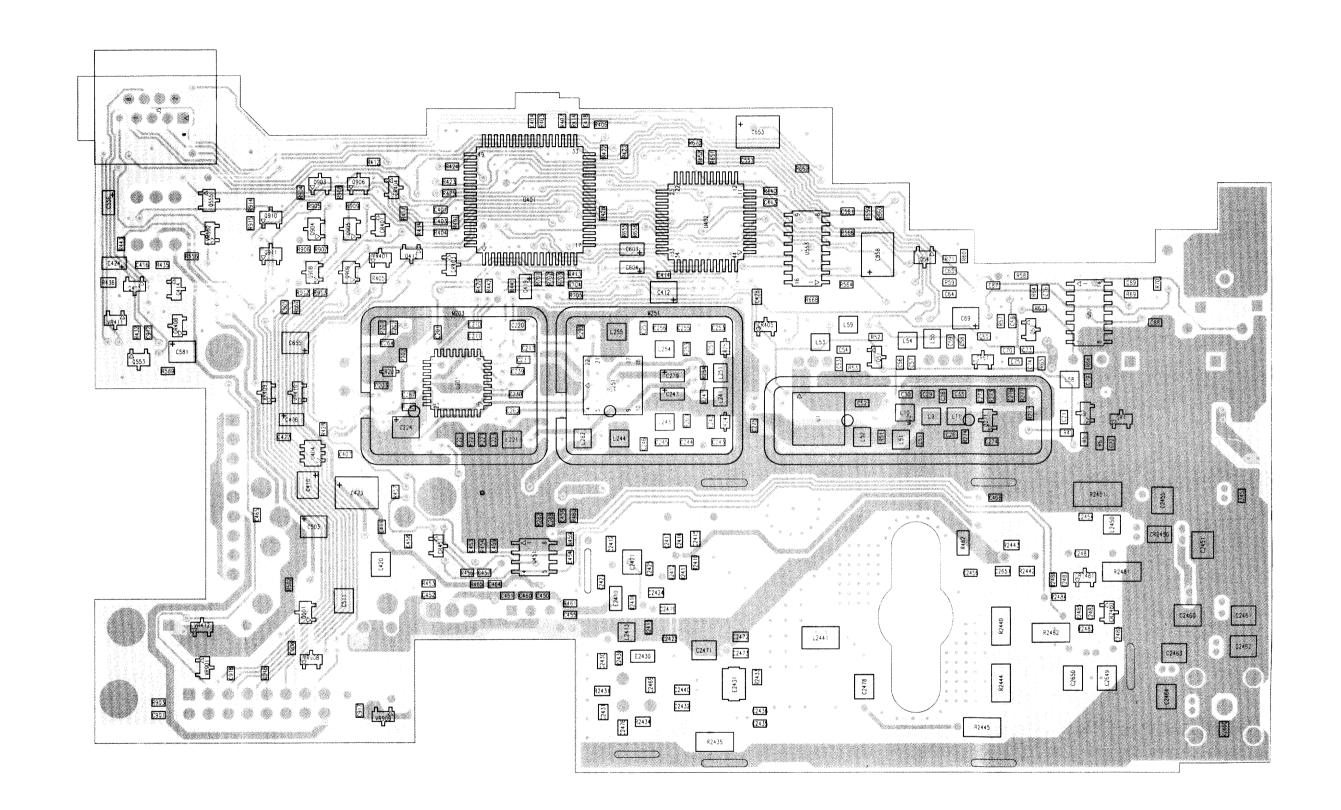
RCB-99105-O

COMPONENT SIDE VIEW



COMPONENT SIDE VIEW

Circuit Board Details for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUD3231A & HUD3253A Radios)



COMPONENT SIDE INNER LAYER (GRAY) SOLDER SIDE INNER LAYER (PINK) OVERLAY -----

RCB-99102-O (REV) RCB-99103-O (REV) RCB-99106-O

Circuit Board Details for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUD3231A & HUD3253A Radios) SOLDER SIDE VIEW OVERLAY -----

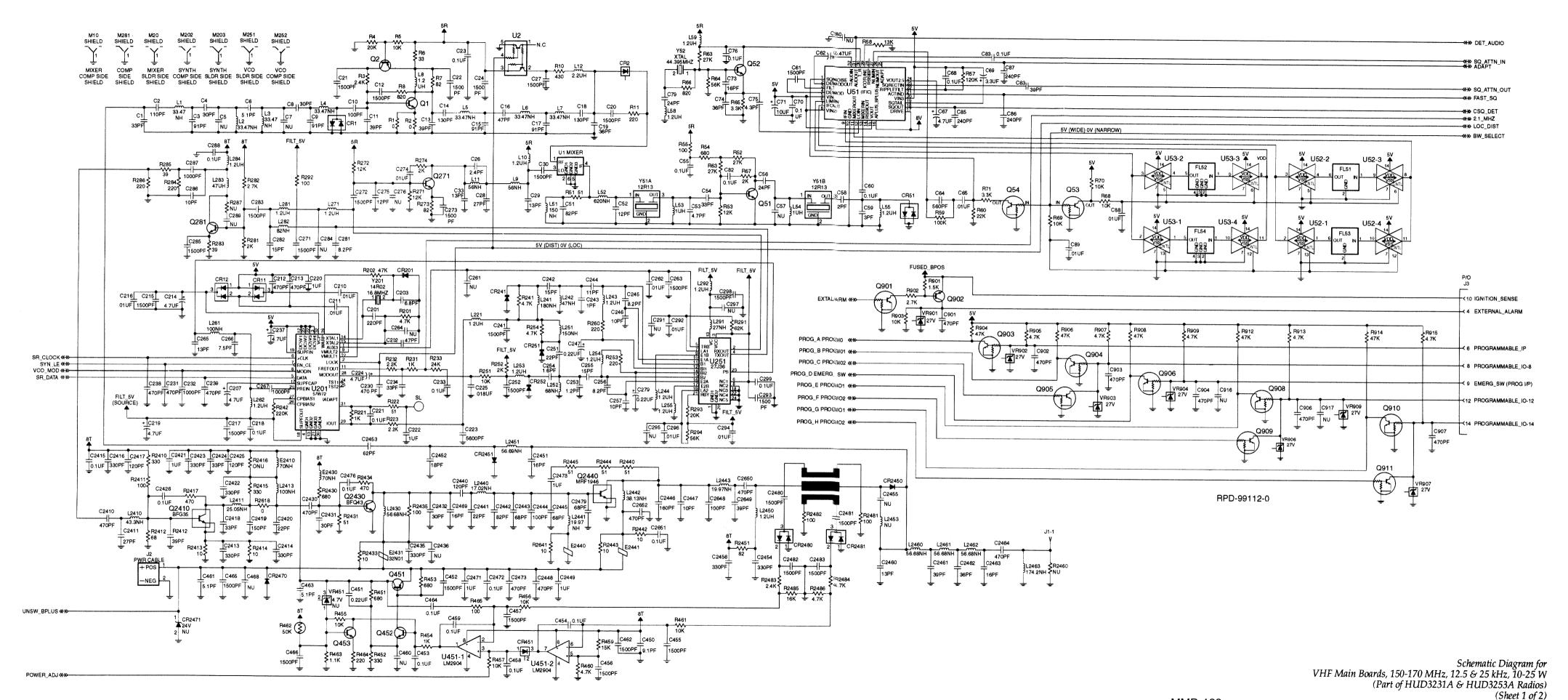
. . .

> COMPONENT SIDE (GRAY) SOLDER SIDE (PINK)

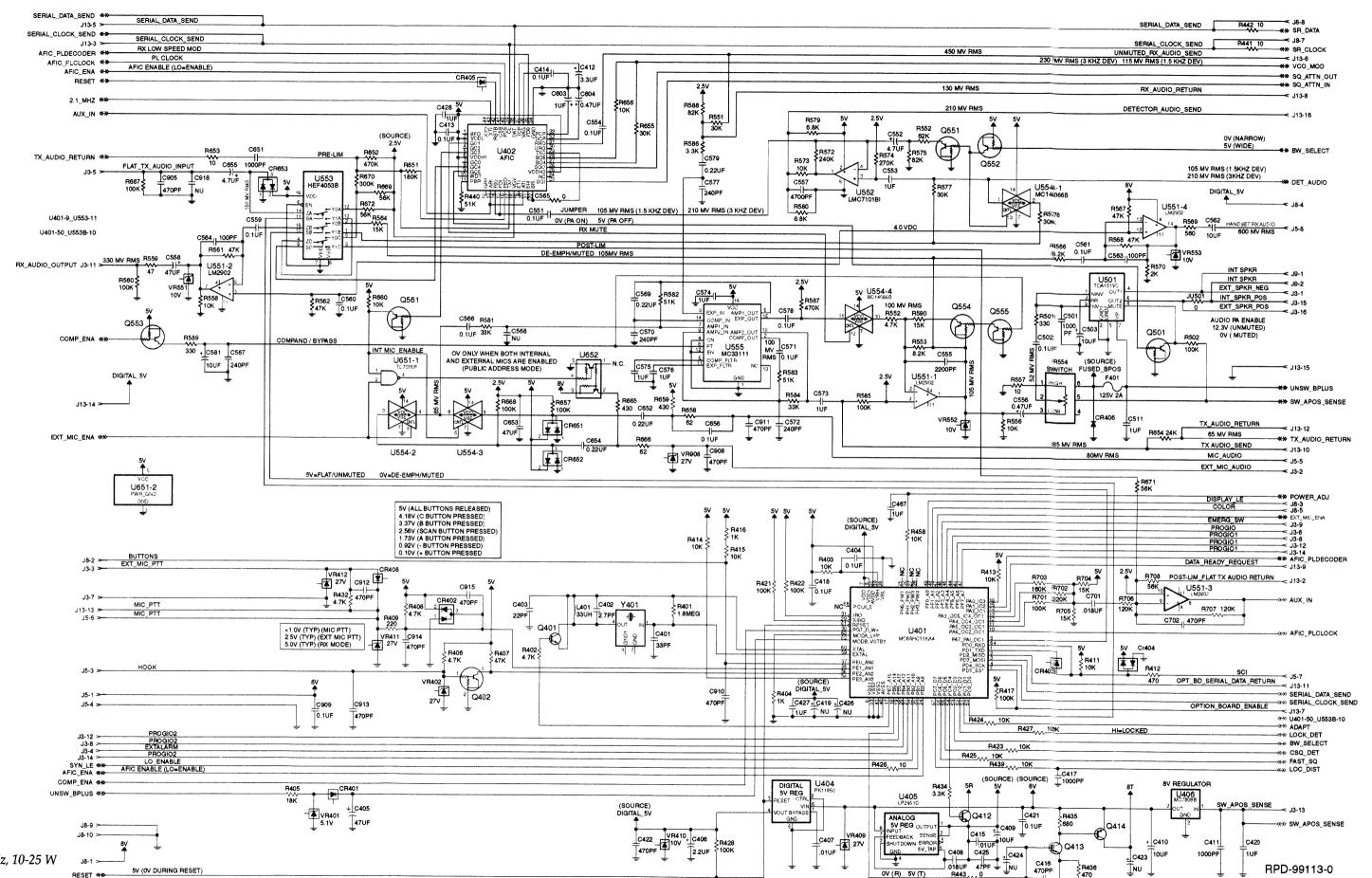
RCB-99101-O (REV) RCB-99104-O (REV) RCB-99106-O

SOLDER SIDE VIEW

MMR-128



MMR-128



Schematic Diagram for VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUD3231A & HUD3253A Radios) (Sheet 2 of 2)

Parts List

21-13740F39 33 pF

23-11049J11 tantalum 4.7 uF, ±10%; 16 V

HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz. HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz, PL-991007-O PL-991007-O PL-991007-O 150-170 MHz, 10-25 W 150-170 MHz. 10-25 W 150-170 MHz. 10-25 W PL-991007-C PI -991007-0 PL-991007-O 150-170 MHz. 10-25 W 150-170 MHz 10-25 W 150-170 MHz. 10-25 W 150-170 MHz, 10-25 W MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA DESCRIPTION PART NO DESCRIPTION PART NO. DESCRIPTION PART NO DESCRIPTION SYMBOL PART NO SYMBOL PART NO DESCRIPTION DESCRIPTION SYMBOL SYMBOL DESCRIPTION SYMBOL PART NO SYMBOL PART NO. 24-62587X69 chip 1.2 uH; 5% C2472 21-13743A19 0.1 uF, ±10%; 16 V 06-62057A82 06-62057A84 30k C501 21-13741F25 1000 pF capacitor, fixed: uF +/-5%; 50 V: 21-13741F17 470 pF C502 C503 C511 C551 21-13743E20 0.1 uF. ±10%; 16 V 21-13740A71 470 pF L281 24-62587X69 chip 1.2 uH: 5% 06-62057A65 06-62057A69 6.8I C2473 C239 21-13741F17 470 pF unless otherwise stated L282 24-62587X52 chip 82 nH: 5% 06-62057B06 C2474 06-62057A85 33k 23-11049A57 tantalum 10 uF. ±10%: 16 \ Not Used 21-13740F39 33 pF 21-13741F29 1500 pF L283 24-62587X49 chip 47 nH; 5% C2476 21-13743A19 0.1 uF. ±10%; 16 V 06-62057A73 R582, 583 06-62057A90 51k 21-13740F52 C242 21-13740L22 15 pF, 2% 21-13741W01 1 nF +10%: 25 V 110 pF L284 24-62587X69 chip 1.2 uH; 5% C2478 R252 06-62057A55 1.8k 06-62057A85 33k 21-13743E20 0.1 uF. ±10%; 16 V 21-13741W01 1 uE +10%: 25 V C243 21-13740F03 1 ±0.25 pf 21-13740F50 91 pF L291 24-62587X46 chip 27 nH; 5% C552 23-11049.111 tantalum 4.7 uF. ±10%: 16 \ C2479 21-13740A51 68 pF 06-62057A33 06-62057A97 100 C244 21-13740L19 11 pF. 2% 21-13740F38 30 pF L292 24-62587X69 chip 1.2 uH; 5% R254 R586 C553 06-62057A65 4.7k 06-62057A61 3.3k 21-13928F01 1 uE. ±10%: 10 V C2480 thru 2483 21-13741F29 1500 pF C245 21-13740L16 8.2, ±0.1 pf L401 C554 C555 24-60578C43 chip 33 uH R587 21-13743F20 0.1 uF. ±10%: 16 V C2648 21-11078B42 100 pF; 100 \ 06-62057A33 220 06-62057B14 470k 21-13740F20 5.1 ±0.25 pF C246 21-13740L18 10 pF 2% L2410 24-60591G77 9 turns R588 06-62057A75 12k 21-13741F33 2200 pF 21-11078B32 39 pF; 100 V R271 272 06-62057A95 82k 23-11049A03 tantalum 0.22 uF, ±10%; 35 V C247 L2411 24-69591E69 7 turns C556 23-11049A05 tantalum 0.47 uF, ±10%; 25 V 21-11078B59 470 pF: 100 V 06-62057A23 R589 06-62057A37 330 21-13740F38 30 pF C251 21-13740L26 22 pF. 2% L2413 24-62587X53 chip 0.1 uH 06-62057A56 R590 06-62057477 156 21-13741F41 4700 pF 21-13743A19 0.1 uF. ±10%; 16 \ 21-13740F50 91 pF C252 21-13741F29 1500 pF L2430 23-11049J43 tantalum 47 uF, ±10%; 10 V 24-60591R29 8 turns C558 C2652 21-13740A71 470 uF R281 06-62057A56 R651 06-62057B04 180 C253 21-13740F04 1 1 +0 25 pF 21-13740F51 L2440 C559 thru 561 21-13743E20 0.1 uF, ±10%; 16 V 24-60591C40 5 turns R282 06-62057A59 R652 06-62057R14 470i C254 21-13740F10 2 ±0.25 pf 21-13740F41 39 pF L2441 24-60591D69 6 turns R283 06-62057A15 R653 06-62057A01 1 23-11049A57 tantalum 10 uF, ±10%; 16 V diode: (see note) C562 21-13740L22 15 pF, 2% 21-13741F29 48-80154K03 dual Schottky SOT L2442 24-60591M77 4 turns 06-62057A33 R654 06-62057A82 24 C563, 546 21-13740F51 100 pF 21-13740F41 39 pF C256 21-13740L16 8.2 ±0.1 pF C565 C566 C567 C568 C569 L2443 24-60591D69 6 turns R285 06-62057A15 R655 06-62057A84 30k 48-80142L01 silicon PIN SOT MMBV3401 21-13740L18 10 pF, 2% 06-62057B47 iumper 21-13740F54 L2450 24-62587X69 chip 1.2 uH 06-62057A33 220 06-62057A73 10 21-13743F20 0.1 uE ±10%: 16 V 48-80154K03 dual Schottky SOT 21-13740F50 91 pF CR201 L2451 24-60591J77 56.69 nH R287 48-02245J22 silicon varactor SOT 1T363 06-62057A97 100 Not Used 21-13741F49 .01 uF 21-13740F60 240 pF 21-13740F43 47 pf 06-62057A92 06-62057A20 62 CR211 48-13833C07 dual silicon SOT MMBD7000 Not Used 21-13741F29 1500 pF 21-13740F50 91 pF L2460 thru 2462 24-60591R29 8 turns CR212 R292 06-62057A25 100 R659 06-62057A40 430 21-13743K16 0.22 uF, +80/-20%; 16 V 48-05218N57 dual silicon SOT C264 21-13740F54 130 p L2463 24-60591V77 12 turns 06-62057A80 20k 06-62057A73 10k 48-62824C03 silicon varactor SOT 1SV232 R293 C265 21-13740F30 13 pF C570 21-13740F60 240 pF CR241 21-13740F40 36 pF R665 R294 06-62057A91 56k 06-62057A40 430 21-13743E20 0.1 uF. ±10%: 16 V CR251, 252 48-62824C03 silicon varactor SOT 1SV232 21-13740F24 7.5 +0.25 pF 21-13741F29 1500 p transistor: (see note 21-13740F60 240 pF CR401 48-05129M76 silicon SOT R401 06-62057B28 1.8 med R666 06-62057A20 62 C267 21-13741F25 1000 pF 21-13741F29 1500 pF 48-13827A07 NPN; type MMBR941 C573 thru 576 21-13928E01 1 uF, ±10%; 10 V 48-13833C07 dual silicon SOT MMBD7000 06-62057465 4.7k R667, 66 06-62057497 1001 21-13743E20 0.1 uF, ±10%; 16 V C271 thru 273 21-13741F29 1500 pF 48-13824A17 PNP; type MMBT3906 21-13740F60 240 pF CR403 48-80939T01 Schottky SOT R403 06-62057A73 10k 06-62057A91 56k 21-13741F29 1500 pF C274 21-13741F49 01 HF 48-13827A07 NPN: type MMBR941 21-13743E20 0.1 uF, ±10%; 16 V Q51, 52 R404 06-62057A49 1 R670 06-62057809 3001 48-13833C07 dual silicon SOT MMBD7000 21-13740F12 2.4 ±0.25 pF C275 21-13740F29 12 pF Q53, 54 48-80947V01 digital NPN: type DTC144V C579 21-13743K16 0.22 uF, +80/-20%; 16 V 48-05129M76 silicon SOT R405 06-62057C81 1.8k; 1/10 watt R671, 672 06-62057A91 56k 21-13741F29 C276 Q271 48-13827A07 NPN: type MMRR941 06-62057A65 06-62057A97 100 23-11049A57 tantalum 10 uF, ±10%; 16 V C279 23-11049A03 tantalum 0.22 uF, ±10%; 35 V 21-13740F37 C603 Q281 48-13827A07 NPN: type MMBR941 06-62057A89 R702 06-62057B06 220k 23-11049A07 tantalum 1 uF. ±10%: 16 V CR408 48-05129M76 silicon SOT 21-13740F25 8.2 ±0.25 pF 21-13740F30 Q401 48-80214G02 NPN; type MMBT3904 06-62057A65 4.7k 06-62057B03 160k C604 C651 23-11049A05 tantalum 0.47 uF, ±10%; 25 ' CR451 48-05129M76 silicon SOT C282 21-13740F31 15 pF 21-13741F29 1500 p Q402 Q412 48-80947V01 digital NPN; type DTC144W R704, 70 21-13741F25 1000 pF CR651 thru 653 48-13833C07 dual silicon SOT MMBD7000 06-62057A33 220 06-62057A77 15k 21-13741F29 1500 pF 21-13740F30 48-13824A17 PNP; type MMBT3906 C652 C653 06-62057A73 06-62057A99 120k CR2450, 2451 48-02482J02 silicon PIN MA4P1250 C284 21-13740F49 82 pl Q413 48-80214G02 NPN; type MMBT3904 R708 06-62057A91 56k 06-62057A41 470 21-13741F29 1500 pF 23-11049.I43 tantalum 47 uE +10%: 10 V 48-80236F07 transient suppressor C285 21-13740F29 12 pF 48-80141L03 PNP: type BCW68G 06-62057A73 10k 06-62057A53 1.5k C654 R413 thru 415 R901 21-13743K16 0.22 uE +80/-20%: 16 V CR2480, 2481 48-82290T02 dual Schottky SOT HSMS-2802 21-13740F19 4.7 ±0.25 pF C286 21-13740F27 10 pF 48-02245J25 PNP: type 2SB1142S R902 06-62057C85 2.7k: 1/10 watt C655 C287 21-13741F25 1000 pF 23-11049.l11 tantalum 4.7 uF. ±10%: 16 V R416 06-62057A49 1k 21-13740F39 33 pF Q452, 453 48-80214G02 NPN; type MMBT3904 21-13743E20 0.1 uF, ±10%; 16V C288 C656 21-13743F20 0.1 uF. ±10%: 16 V ferrite beads 06-62057497 R903 06-62057A73 10k 21-13743E20 0.1 uF. ±10%: 16 V Q501 24-80067M01 ferrite bead 48-80947V01 digital NPN: type DTC144W R904 21-13743E05 .018 uF, ±10%; 16 V R421 422 06-62057497 06-62057A89 47k 21-13740F36 24 pF C289 48-80947V01 digital NPN: type DTC144W 21-13741F17 470 pF E2430 24-80067M01 ferrite bead B423 thru 425 06-62057A73 R905 06-62057465 4.7k C291 Q552 thru 554 48-80494U01 digital PNP: type DTA144W R906 21-13741F17 470 pF 06-62057A01 06-62057A89 47k 24-80132N01 ferrite bead 21-13740F10 2 ±0.25 pF 21-13743F20 0.1 µF +10%: 16 V C292 21-13743E20 0.1 uF, ±10%; 16 V Q555 48-80947V01 digital NPN: type DTC144W 06-62057A73 R907 06-62057A65 4.7k F2440, 2441 24-84657R01 ferrite bead 21-13740F14 3 ±0.25 pF C293 21-13741F29 1500 pF 48-80947V01 digital NPN: type DTC144W 06-62057A97 R908 06-62057A89 47k C910 thru 915 21-13741F17 470 pF 21-13743E20 0.1 uF, ±10%; 16 V C294 21-13741F49 .01 uF 48-80947V01 digital NPN: type DTC144W 06-62057A65 4.7k C916 thru 918 Q901 R432 06-62057A65 4.7k R909 21-13741F29 1500 pF 21-13740A71 470 pF 65-05214E01 2 amp axial lead 48-80141L03 PNP: type BCW68G R912 06-62057A89 47k C2410 F401 06-62057A61 3.3k 23-11049A05 tantalum 0.47 uF, ±10%; 25 V 21-13743E20 0.1 uF, ±10%; 16 V C2411 21-13740A39 27 pF Q903 thru 906 48-80947V01 digital NPN; type DTC144W 06-62057A45 R913 06-62057A65 4.7k 21-13740F41 39 pF 48-80947V01 digital NPN; type DTC144W 06-62057C67 470; 1/10 watt 06-62057A89 47k C2412 21-13740A43 39 pF 21-13741F29 1500 pF 21-13740F69 560 pF C298 R915 48-02245J24 NPN; type BFG35 R439 06-62057A73 10k 06-62057A65 4.7I FI 51 91-80098D14 455 kHz 4F C2413 2414 21-13741F13 330 nF 21-13743E20 0.1 uF, ±10%; 16 V 21-13741F49 .01 uF C299 48-02245J28 NPN; type BFQ43S R2410 06-62057A37 330 06-62057A90 51k C401 21-13740F39 33 pF C2415 21-13743A19 0.1 uF. ±10%: 16 V 91-80097D14 455 kHz 6F 23-11049J11 tantalum 4.7 uF. ±10%: ±16 \ Q2440 48-80225C22 NPN: type M25C22 R2411 06-62057A25 100 21-13740F13 2.7 ±0.25 pF C2416 21-13741F13 330 pF 91-80098D16 455 kHz 4D R441, 442 06-62057A01 10 21-13743E20 0.1 uF. ±10%: 16 V 06-62057A21 68 C2417 21-13740F53 120 pF 91-80097D16 455 kHz 6D R443 06-62057R47 R2412 C403 23-11049J07 tantalum 3.3 uF, ±10%: 20 \ 21-13740F35 22 pF R2413 resistor, fixed: +/-5%: 1/16 W: 06-62057A01 10 21-13743E20 0.1 uF. ±10%: 16 V C2418 21-13740A41 33 pF 06-62057A45 680 C404 21-13743E20 0.1 uF, ±10%; 16 V 06-62057A01 10 C2419 21-13740A59 150 pF unless otherwise stated 06-80195M37 330: 1/2 wa R2414 23-11049.I43 tantalum 47 uF. ±10%: 10 V 23-11049A57 tantalum 10 uF. ±10%: 16 V C405 R1, 2 06-62057B47 06-62057A37 330: 1/10 watt R2415 21-13740A37 22 pF 09-80476U01 mini UHF coax 06-62057445 680 C2420 21-13740F32 16 pF C406 23-11049A40 tantalum 2.2 uF. ±10%: 10 V 06-62057A58 2.4k 06-62057449 R2416 Not Used C2421 21-13741W01 1 uF, ±10%; 16 V 30-04510J01 power cable assembly (includes J2) 21-13740F40 36 pF 21-13741F49 01 uF 06-62057C67 470: 1/10 watt 06-62057A80 20k R455 thru 458 06-62057A73 10k R2417 21-13743E05 .018 uF. ±10%: 16 V C2422, 2423 21-13741F13 330 pF 28-04503J01 16-pin, accessories 21-13740F18 4.3 ±0.25 pF 21-13740A41 33 pF 06-62057A73 10k 06-62057A77 15k R2430 06-62057445 680 09-04426J01 telephone type, 8 contact, microphone C409, 410 23-11049A57 tantalum 10 uF. ±10%: 16 V 21-13743E20 0.1 uF, ±10%; 16 V 21-13740F53 120 pF 06-62057A13 33 06-62057A65 4.7k R2431 06-62057C44 51: 1/10 wat C2425 21-13740F36 24 pF 21-13741F25 1000 pF 09-04422J01 10 pln. display board C2426 21-13743A19 0.1 uF, ±10%; 16 V 06-62057A23 06-62057A73 10k R2433 06-62057C27 10; 1/10 watt 23-11049J07 tantalum 3.3 uF, ±10%; 20 V 28-04423.l01 2-pin internal speake 06-62057A47 06-62057C67 470; 1/10 watt 06-05621T02 thermistor 50k @ 25 degrees C 21-13740A71 470 pF C2430 21-13743E20 0.1 uF, ±10%; 16 V 21-13743E20 0.1 uF, ±10%; 16 V 09-80472U01 16-pin, option board 06-62057A40 430 06-62057A50 1 1k R2435 06-80195M25 100: 1/2 watt C2431, 2432 21-13740A40 30 nF 21-13741F49 .01 uF 21-13740F60 240 pF C85 thru 87 06-62057C59 220; 1/10 watt 06-62057A33 220 06-80195M18 51: 1/2 watt 21-13741F17 470 pF C2435 C2436 21-13741F13 330 pF 21-13741F49 01 uF R51 .11.1501 06-62057B47 06-62057A18 06-62057A25 100 R2441 thru 2443 06-62057C27 10; 1/10 watt 21-13741F25 1000 pF 21-13740F59 220 pF 21-13740A57 120 pF C2440 C2441 06-62057A83 27k 06-62057A37 330 R2444, 2445 06-80195M18 51: 1/2 watt C418 21-13743E20 0.1 uF, ±10%; 16 V 21-13740L34 47 nF 2% R53 06-62057A75 12k R502 06-62057A97 100k R2451 06-80194M23 82: 1 watt 21-13740A37 22 nF 21-13740L14 6.8 ±0.1 pF C419 24-60591G24 9 turns 06-62057A84 30k R2481 2482 06-80195M25 100: 1/2 watt 21-13741W01 1 uF. ±10%: 25 V C2442 21-13740A53 82 pF L1 thru 7 06-62057A45 68 R551 23-11049J11 tantalum 4.7 uF, ±10%; 16 V C420 21-13740A51 68 pF 24-62587X69 chip 1.2 uH; 5% 06-62057A25 100 R552 06-62057A65 4.7k R2483 06-62057A58 2.4k 21-13743F20 0.1 uE +10%: 16 V C210, 211 21-13741F49 .01 uF C421 24-62587X50 chip 56 nH; 5% 21-13740A55 100 pF 06-62057A99 120I R553 06-62057A71 8.2k R2484 06-62057A65 4.7k 21-13741F17 470 pF 21-13741F17 470 pF 21-13740A51 68 pF 24-62587X69 chip 1.2 uH; 5% 06-62057A76 13k 18-04405J02 variable 2k with switch R2485 06-62057A78 16k 23-11049J11 tantalum 4.7 uF, ±10%; 16 V C423, 424 Not Used 21-11078B48 160 pF; 100 V 24-62587X50 chip 56 nH; 5% R59 06-62057497 R556 06-62057A73 R2486 06-62057A65 4.7k 21-13740F43 47 pF 21-13741F29 1500 pF 24-62587N72 chip 2.2 uH; 5% 06-62057A81 22 06-62057A01 06-62057C01 0 ohm: 1/10 wat 21-80060M19 10 pF: 500 \ 21-13741F49 .01 uF C426 Not Used C2448 R63 06-62057A83 R558 06-62057A73 R2641 06-62057C27 10: 1/10 watt 21-11078B59 470 pF 24-62587X55 chip 0.15 uH; 5% 21-13928E01 1 uF. ±10%: 10 V 21-13741F29 1500 pF C427, 428 C2449 06-62057A17 21-13741W01 1 uF, ±10%; 25 V 24-62587X63 chip 0.62 uH: 5% 06-62057A91 21-13743E20 0.1 uF, ±10%; 16 V 21-13740F26 9.1 ±0.25 pF C2451 06-62057A97 L53, 54 06-62057A61 3.3k 21-80060M24 16 pF: 500 V 24-62587X68 chip 1 uH: 5% 21-13743K16 0.22 uF, +80/-20%; 16 V 23-11049J11 tantalum 4.7 uF, ±10%; 16 V 51-80505D05 double-balanced mixer C2452 C2453 C2454 06-62057A47 06-62057A89 47k 21-13741F29 1500 pF 21-13740F33 18 pF 24-62587X69 chip 1,2 uH; 5% 21-13928E01 1 uF, ±10%; 10 V 48-09939C04 dual transistor switch UMC3TL 06-62057A56 2k 21-13743E20 0.1 uF, ±10%; 16 V 21-13740F46 62 pF 1.58, 59 24-62587X69 chip 1.2 uH; 5% 06-62057A77 C453, 454 21-13743E20 0.1 uF. 10%: 16 V 51-80605E02 receiver system R68 thru 7 06-62057A73 06-62057A71 8.2 C455 thru 457 21-13741F29 1500 pF 21-13741F13 330 pF 1 221 24-62587X69 chip 1.2 uH: 5% 23-11049A07 tantalum 1 uF ±10%: 16 ' C222 06-62057A61 3.3k R567, 568 U52, 53 51-05663U35 quad analog switch 4066B 06-62057A89 47k 21-13743E20 0.1 uF, ±10%; 16 V C2455 24-62587V37 chip 0.18 uH: 5% 21-13741F43 5600 pF C458, 459 C223 21-13741F13 330 pF 06-62057A57 C2456 06-62057A43 560 L242 24-62587X49 chip 47 nH; 5% R569 23-11049.111 tantalum 4.7 uF +10%: 16 V C460 C224 U251 R202 51-05414S84 VCO/buffer 06-62057A89 47k R570 C2460 21-80060M22 13 pF; 500 V 24-62587X69 chip 1.2 uH; 5% 06-62057A56 2k 21-13740F20 5.1 ±0.25 pF C225 21-13743E05 .018 uF. ±10%: 16 V microcomputer MC68HC11KA U401* C2461 21-11078B32 39 pF; 100 V L251 24-62587V36 chip 0.15 uH: 5% R221 06-62057A49 R572 06-62057B07 2401 21-13741F29 1500 pF C230 231 21-13741F17 470 pF 51-80604E01 audio filter R222 U402 21-80060M32 36 pF: 500 \ 24-62587X51 chip 68 nH; 5% 06-62057A18 5 R573 06-62057A73 10k 21-13740F20 5 1 +0 25 pF 21-13741F25 1000 pF C463, 464 C232 51-80633C01 5 V regulator TK11950 R223 06-62057A57 2.2k R574 06-62057B08 270k U404 21-11078B19 16 pF; 100 V L253 thru 255 24-62587X69 chip 1.2 uH: 5% 21-13743E20 0.1 uE 1±0%: 16 V C465, 466 21-13741F29 1500 pF

24-62587X53 chip 0.1 uH: 5%

24-62587X69 chip 1.2 uH; 5%

21-11078B59 470 pF; 100 V

21-13741W01 1 uF, ±10%; 25 V

21-13928E01 1 uF, ±10%; 10 V

Not Used

06-62057A49

06-62057A57 2.2

06-62057A95 82k

06-62057A92 62k

U405

51-05469E65 5 V regulator LP2951C

51-13816D03 8 V regulator MC7808BT

HUD3253A & HUD3231A VHF Radio, 12.5/25 kHz,

PL-991007-O

50-170 MHz, 10-2	5 W	PL-991007
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U451	51-80932W01	dual op-amp LM2904 SOIC
J501	51-80147R01	audio power amp TDA1519C
1551	51-02198J28	quad op-amp LM2902D SOIC
J552	51-62852A09	single opamp LMC7101
1553	51-84704M60	triple 2-channel switch 4053B
1554	51-05663U35	quad analog switch 4066B
1555	51-13811A35	compander MC33111
651	51-05461G61	NAND gate TC7S00F
J 6 52	48-09939C04	dual transistor switch UMC3TL
		voltage regulator: (see note)
/R401	48-80140L06	zener diode 5.1 V SOT
'R402	48-80948V01	zener diode 27 V SOT
/R409	48-80948V01	zener diode 27 V SOT
R410	48-80140L15	zener diode 10 V SOT
R411 412	48-80948V01	zener diode 27 V SOT
R451		Not Used
R551 thru 553	48-80140L15	zener diode 10 V SOT
R901 thru 904	48-80948V01	zener diode 27 V SOT
R906 thru 909	48-80948V01	zener diode 27 V SOT
		crystal: (see note)
/51	91-80112R13	filter 44.85 MHz
		(includes Y51A and Y51B)
′52	48-80606B07	44.395 MHz
′201*		16.8 MHz
/ 401	48-80113R01	7.9488 MHz
		enced items
	14-05160A02	crystal insulator (for Y201)
	26-04398J01	VCO/synthesizer shield (4 used)
	26-04399J01	receiver mixer bottom shield
	26-04400J01	receiver front end top shield
	26-04419J01	PA shield frame
	26-04420J01	PA shield cover
	26-80481U01	Tx buffer top shield
	42-80281L01	ground clip (2 used for Q2640)

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

Designators marked with an () denote parts which are not field serviceable Recalibration of the radio using specialized factory equipment is mandatory when these components are replaced in order to guarantee the specified frequency stability of the radio at temperature extremes.

> VHF Main Boards, 150-170 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUD3231A & HUD3253A Radios)

Section 2 Theory of Operation

Overview

This section provides detailed theory of operation for the components of the M1225 mobile radio.

Receiver Circuitry

VHF Receiver Front End

The received signal applied to the radio's antenna input connector is routed through the harmonic filter and PIN diode antenna switch. In the receive mode, PIN diodes CR2450 and CR2451 are both off, allowing the signal to pass unattenuated to the receiver front end filter. The insertion loss of the harmonic filter/antenna switch is less than 1 dB. The harmonic filter provides 19 dB attenuation for image protection at 240 MHz, with increased attenuation at higher frequencies.

The signal is routed to a fixed-tuned 4 pole capacitive-coupled resonator filter having a 3 dB bandwidth of 50 MHz and a 1 dB bandwidth of 45 MHz centered at 162 MHz. Insertion loss is 1.7 dB. Attenuation for image protection is 42 dB at 240 MHz, with increasing attenuation at higher frequencies.

The output of the filter is matched to the base of RF amplifier Q1, which provides 19 dB of gain and has a noise figure of 3 dB. Current source Q2 is used to maintain the collector current of Q1 constant at 30 mA. Transistors Q1 and Q2 are supplied from the 5R source. This source is switched by transistor Q412 which is controlled by U401-54. 5R is only present in the receive mode. This reduces dissipation in Q1 during transmit. Diode CR1 clamps excessive input signals, protecting Q1.

The output of Q1 is applied to a fixed-tuned 3-pole series- coupled resonator filter having a 3 dB bandwidth of 60 MHz and a 1 dB bandwidth of 45 MHz centered at 162 MHz. Insertion loss is 1.3 dB. Attenuation for image protection is 35 dB at 240 MHz, with increasing attenuation at higher frequencies.

A pin diode attenuator is located between the 3-pole filter and the first mixer. The bias current through this diode is switched by dual-composite transistor switch U2. In the Distance mode, U2 is turned on by a logic high at U2-4 from U401-57. CR2 is forward-biased which bypasses R11, and no loss is introduced. In the Local mode, U2 and CR2 are off (U401-57 is low),

inserting 10 dB of attenuation due to R11. Because the attenuator is located after the RF amplifier, receiver sensitivity is reduced only by 5 dB, while the overall third order input intercept is raised by 15 dB. Thus, the Local mode significantly reduces the susceptibility to IM-related interference.

The first mixer, U1, is a passive, double-balanced type. This mixer provides all of the necessary rejection of the half-IF spurious response, since the improvement due to filter selectivity is negligible at 150 MHz. High-side injection at +6 dBm is delivered to the first mixer from the injection buffer, Q271, in the VCO/buffer circuit.

The mixer output is connected to a diplexer network which matches its output to the first two pole crystal filter, Y51A, at the IF frequency of 44.85 MHz, and terminates it in a 51 ohm resistor, R51, at all other frequencies.

UHF Receiver Front End

The received signal applied to the radio's antenna input connector is routed through the harmonic filter and PIN diode antenna switch. In the receive mode, PIN diodes CR2650 and CR2651 are both off, allowing the signal to pass unattenuated to the receiver front end filter. The insertion loss of the harmonic filter/antenna switch is less than 1 dB.

The signal is routed to a fixed-tuned 3 pole shunt resonator filter having a 3 dB bandwidth of 65 MHz and a 1 dB bandwidth of 40 MHz centered at 462 MHz. Insertion loss is 2.0 dB. Attenuation for image protection is 33 dB at 385 MHz, with increasing attenuation at lower frequencies.

The output of the filter is matched to the base of RF amplifier Q1, which provides 17 dB of gain and has a noise figure of 3 dB. Current source Q2 is used to maintain the collector current of Q1 constant at 30 mA. Transistors Q1 and Q2 are supplied from the 5R source. This source is switched by transistor Q412 which is controlled by U401-54. 5R is only present in the receive mode. This reduces dissipation in Q1 during transmit. Diode CR1 clamps excessive input signals, protecting Q1.

The output of Q1 is applied to a fixed-tuned 4 pole shunt resonator filter having a 3 dB bandwidth of 58 MHz and a 1 dB bandwidth of 40 MHz centered at 462 MHz. Insertion loss is 2.8 dB. Attenuation for

Frequency Generation System

image protection is 43 dB at 385 MHz, with increasing attenuation at lower frequencies.

A pin diode attenuator is located between the 4 pole filter and the first mixer. The bias current through this diode is switched by dual-composite transistor switch U2. In the Distance mode, U2 is turned on by a logic high at U2-4 from U401-57. CR2 is forward-biased which bypasses R11, and no loss is introduced. In the Local mode, U2 and CR2 are off (U401-57 is low), inserting 10 dB of attenuation due to R11. Because the attenuator is located after the RF amplifier, receiver sensitivity is reduced only by 5 dB, while the overall third order input intercept is raised by 15 dB. Thus, the Local mode significantly reduces the susceptibility to IM-related interference.

The first mixer, U1, is a passive, double-balanced type. This mixer provides all of the necessary rejection of the half-IF spurious response, since the improvement due to filter selectivity is negligible at 474 MHz. Low-side injection at +6 dBm is delivered to the first mixer from the injection buffer, Q271, in the VCO/buffer circuit.

The mixer output is connected to a diplexer network which matches its output to the first two pole crystal filter, Y51A, at the IF frequency of 44.85 MHz, and terminates it in a 51 ohm resistor, R51, at all other frequencies.

Receiver Back End

Q51 amplifies the IF signal from Y51A by approximately 20 dB. The output of Q51 is matched to a second two pole crystal filter, Y51B. The overall 3 dB bandwidth of the crystal filters is 17 kHz. The signal from Y51B is applied to the input of the receiver system IC U51-13. Diode CR51 prevents overload of the second mixer in the receiver system IC.

Q52 is controlled by crystal Y52 which provides the low side injection second local oscillator signal applied to U51-12. The filtered and amplified 44.85 MHz first IF signal mixes with the second local oscillator signal at 44.395 MHz to produce a second IF signal at 455 kHz. The second IF signal is then filtered by switchable ceramic filter FL51 or FL53, amplified, then filtered by switchable ceramic filter FL52 or FL54 and applied to the audio detector. U401-53 controls the bandwidth select switch, Q53, to switch the narrower bandwidth ceramic filters FL51 and FL52 for 12.5 kHz channel spacing or the wider ceramic filters FL53 and FL54 for 20/25/30 kHz channel spacing.

The audio detector is a phase-locked loop type. The free-running oscillator frequency is determined by capacitor C61. Detected audio from U51-31 is routed via noise-peak limiting stage U552 to Rx IN and PL In ports on the audio filter IC (AFIC) U401 (pins 14 and 15 respectively), and also via CMOS switch U553B to opamp U551B, where output is routed to the accessory connector J3-11 (see "Low-Level Rx Audio").

U51 also-contains the carrier-squelch circuitry. When an on-channel signal is present, the amount of high-frequency audio noise, at the detector, is reduced. This change in noise level is sensed to indicate the presence of an on-channel signal. The bandwidth of the sampled noise is determined by C64, C65, R59, R60, and R71 switched by Q54. U401-53 controls Q54 for 12.5 kHz or 20/25/30 kHz channel spacing operation. Squelch sensitivity is adjusted electronically by an attenuator in U402. Squelch noise is routed from U51-26 to U402-23, and the adjusted noise level is returned from U402-26 back to U51-23. This noise level is detected in U51 and compared to a preset threshold. Noise levels greater than a preset threshold, indicating weak or no signal present, cause U51-18 to go low. This is routed to microcomputer port PC5 (U401-55). When the noise level decreases below the threshold, due to on-channel quieting, U51-18 and therefore U401-55 go high. This indicates an on-channel signal is present, and the microcomputer unmutes the audio path.

Components R57, C68 and C69 determine squelch time constants as a function of the charging currents supplied by U51. These charging currents vary from weak to strong signal conditions, providing a variable squelch closing time-constant. For weak signals the time constant is long to minimize "chattering" or rapid muting and unmuting of the audio. For strong signals, where the carrier-absent to carrier-present conditions are substantial, the closing time-constant is shortened to minimize the length of the "squelch-tail".

Frequency Generation System

The frequency generation system utilizes two IC's, the Fractional-N Synthesizer (U201) and the VCO/Buffer (U251). Designed to maximize compatibility, the two IC's provide many functions which would normally require additional circuitry.

The frequency generation circuitry is supplied from the analog 5 V supply regulated by U405. The synthesizer IC further filters this voltage (SUPFOUT, U201-18, 4.65 Vdc) and supplies it to the VCO/Buffer IC.

The synthesizer also interfaces with the logic and AFIC circuitry. Synthesizer programming is accomplished through the SR DATA (U201-5), SR CLOCK (U201-6), and SYN LE (U201-7) lines by microcomputer U401. A serial stream of 98 bits is sent whenever the synthesizer is programmed. Synthesizer lock is indicated by a logic high at LOCK DET pin U201-2, and a logic low indicates out- of-lock.

In the transmit mode, modulation from the attenuators in the AFIC (U402-27 and 28) is resistively summed and applied to U201-8. The audio is digitized within U201 and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for balancing of the high and

Transmit and Receive Audio Circuitry

low port modulation, before being applied to the VCO from U201-28.

The AFIC employs switched-capacitor filters which require an external 2.1 MHz clock signal. This clock is generated in U201 by dividing the 16.8 MHz reference oscillator. The signal, at U201- 11, is filtered, attenuated, and applied to U402-43 at a level of approximately 2 Vp-p.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-3, R201-2, and CR201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor CR201 is determined by a temperature compensation algorithm within U201, and is specific to each crystal Y201 based on a unique code assigned to the crystal.

The divided frequencies of the reference oscillator and the VCO signal (as applied to U201-20) are compared to generate the necessary correction voltage, or steering line voltage, which maintains the proper VCO frequency. The steering line voltage from U201-29 is filtered and applied to varactors CR241 and CR251 to control the frequencies of the receive and transmit VCOs respectively. To achieve fast lock time, an internal adaptive charge pump provides higher momentary current capability at U201- 31 than in the normal steady-state mode. The normal and adapt charge pumps receive their dc supply from a voltage-multiplier circuit which includes CR211, CR212 and associated capacitors C210-C216. By combining two 5 V square waves which are 180 degrees out-of-phase and adding this to the regulated 5 V supply, a source of approximately 12.6 Vdc is available at U201-32. The current for the normal mode charge pumps is set by R242. The pre-scaler for the loop is internal to U201 with the value determined by the frequency band of operation.

VCO

The VCO (U251) used in conjunction with the Fractional-N synthesizer (U201) generates an RF signal for both receive and transmit modes. The TRB line (U251-5) determines which oscillator and buffer is enabled, as described below. A sample of the RF signal from the enabled oscillator is routed from U251-23 to the prescaler input U201-20 via a matching network. After frequency comparison with the reference in the synthesizer, a resultant control voltage is applied to the varactors CR241 and CR251. This voltage, when locked, is between 3 and 10 V depending on VCO frequency.

In the receive mode, U251-5 is low, enabling the receive VCO and buffer in U251. The RF output signal at U251-2 is further amplified by Q271, low-pass fil-

tered, and matched to the 50 ohm injection port of first mixer U1 at a level of +6 dBm.

During transmit, U251-5 is high, activating the transmit VCO and buffer. The RF output signal at U251-4 is low-pass filtered and matched into Q281 for further amplification before being applied to the RF power amplifier. A resistive attenuator (R284 through R286) isolates the VCO and buffer from impedance variations presented by the power amplifier for improved stability. The power output presented to the first stage (Q2610) of the RF power amplifier is +13 dBm.

Transmit and Receive Audio Circuitry

The majority of Rx and Tx audio processing is performed by U402, the Audio Filter IC (AFIC), which provides the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter in Rx audio path
- Tx pre-emphasis amplifier
- Tx audio limiter
- Post-limiter (splatter) filter
- Tx deviation adjust digitally-controlled attenuators
- Programmable microphone gain attenuator
- Carrier squelch digitally-controlled attenuator
- Microcomputer output port expansion
- 2.5 Vdc reference source

The parameters of U402 which are programmable are selected by the microcomputer via the SR CLOCK (U402-39), SR DATA (U402-38) and chip enable (U402-41) lines.

Rx Audio Path

Low-Level Rx Audio

Detected audio from the IFIC U51-31 is routed via C553 to the switchable-gain limiter stage U552. The gain of limiter stage U552 is changed for 12.5 kHz or 25 kHz channels so that its output limits at slightly greater than full system deviation in either case. This limits the loudness of noise relative to voice during fading, weak signal conditions and squelch tails. Output is taken from this stage at two places. Pin 4, which is the (-) input, serves as an output which feeds AFIC ports Rx IN (pin 14) and PL IN (pin 15) via C551. The feedback around the op amp stage maintains the signal at U552-4 exactly equal to the signal applied to the (+) input, but the signal at U554-4 benefits from the selectable noise limiting threshold. Gain adjustments in the receive audio path for 12.5 or 25 kHz channels are then made in the AFIC. A second output from the limiter stage is taken at pin 1 and is affected by the gain change of U552 so that the level is a constant 840 mV rms at 60% deviation for either 12.5 or 25 kHz channels. This

Transmit and Receive Audio Circuitry

level is attenuated 12 dB by R573, R579 and R580 and routed to the Detector Audio Send pin of the AdvantagePort™ connector (J13-16).

Detected audio from the IFIC U51-31 is also routed via a switchable-gain path (R577, R578 and U554A) to analog switch U553B (see "Accessory Connector Rx Audio Path").

The audio applied to the AFIC at U402-14 (Rx IN) is sharply high- pass filtered to remove all PL and DPL tones below 300 Hz. Audio is then routed through a digitally controlled attenuator which is set to approximately 6 dB attenuation. This attenuation is non-adjustable and maintains the output at U402-31 (Rx OUT) at a fixed and defined level of 450 mV rms for 60% deviation, since this level is applied to the AdvantagePort connector (J13-6). Receive volume adjustment is accomplished at a later point using the volume control R554. The internal de-emphasis characteristic within U402 is enabled, with the result that audio at U402-31 is de-emphasized but unmuted.

This audio signal is processed by the option board if present, or passed through resistor R551 if no option board is installed, and then fed to the expander portion of compander IC U555. The operation of the compander is described below. The output from the compander IC is routed through mute gate U554D, amplified by U551A and fed to the volume control, and also to handset audio buffer U551D (see "Handset Audio Path") and analog switch U553B (see "Accessory Connector Rx Audio Path").

Audio Power Amplifier

Audio from the wiper of the volume control is amplified by the audio power amplifier IC U501. This is a bridge amplifier delivering 7.8 V rms between pins 4 and 6 without distortion. This is sufficient to develop 7.5 watts of audio power into an external 8 ohm load, or approximately 4 watts of audio power into an internal 16 ohm speaker (under this condition, undistorted audio output voltage swing exceeds 8 V rms). The audio power amplifier is muted whenever speaker audio is not required, to reduce current drain and eliminate noise in the speaker. The audio amp is muted when U501-8 is low. This occurs if Q501 is saturated (U402-9 high) or when the radio is turned off. The current drain into supply pin U501-7 is negligible when U501-8 is low.

Because the power amplifier is a bridge-type, neither speaker terminal is grounded. Care should be taken that any test equipment used to measure the speaker audio voltage does not ground either speaker output terminal, otherwise damage to the audio power amplifier IC may result. If the test equipment input is not isolated from ground, voltage measurements may be made from one of the speaker output terminals (J3-1 or J3-16) to ground, in which case the voltage indicated

will be one half of the voltage applied to the speaker or load resistor. When an 8-ohm load resistor is used, it should be connected across pins 1 and 16 of J13, never to ground.

Handset Audio Path

Rx audio from U551A-1 is amplified by op amp U551D and applied to the microphone connector J5-8 for use with a telephone-type handset. This audio is de-emphasized, and muted by U554D. It is also affected by any receive audio processing circuits on the option board, if installed, and by the compander, if enabled. When the radio has been programmed for handset operation, the audio power amplifier is muted whenever the handset is off- hook by a logic high from U402-9. This silences the speaker when the handset is in use.

Accessory Connector Rx Audio Path

Rx audio is amplified by stage U551B and is available at the accessory connector pin 11. This audio may be one of two types, depending on the RSS programming of analog switch U553B.

If U553B-10 is programmed high, the audio fed to U551B comes from the receiver's detector audio via a switchable-gain path using R577, R578 and U554A. In this case, audio at the accessory connector (J3-11) is "flat" (non-de-emphasized) and unmuted.

If U553B-10 is programmed low, the audio fed to U551B comes from U551A. Audio at J3-11 is de-emphasized and muted. This path will also be affected by any receive audio processing circuits on the option board, if installed, and by the compander, if enabled.

PL Decoder

Detected Rx Audio which has been limited by stage U552 is applied to the AFIC PL IN port (U402-15), where it first passes through the Tone PL filter or Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then coupled to the PL detector circuit, with detected output at U402-35. The detected PL signal is coupled from U402-35 to microcomputer port PA1 (U401- 15) where algorithms perform the final PL decoding. Data for the tone PL frequency or Digital PL code for each mode is programmed through the Radio Service Software.

AdvantagePort™ Internal Option Board Rx Audio Path

De-emphasized, unmuted audio is available at J13-6 for use by an internally installed option board. If this audio is to be processed and returned to the radio's receive audio path, the processed audio will be returned from a low-impedance source on the option board to J13-8. The unprocessed audio through R551 is shunted due to the low source impedance of the option board at J13-8.

Transmit and Receive Audio Circuitry

Since the gain of the AFIC is different for 12.5 or 25 kHz channels, the RX audio level at J13-6 is always 450 mV at 1 kHz and 60% deviation, regardless of the channel spacing. Similarly, audio returned to J13-8 from the option board should be supplied at a level of 130 mV rms at 60% deviation, regardless of the channel spacing.

Non-de-emphasized, unmuted audio is available at J13-16. Options requiring non-de-emphasized audio may use this, or may re-pre- emphasize the audio at J13-6, depending on the design of the option board. Because the gain of stage U552 is different for 12.5 or 25 kHz channels, the RX audio level at J13-16 is always 210 mV at 60% deviation, regardless of the channel spacing.

Noise Squelch Attenuator

The AFIC contains a 16 step programmable digital squelch attenuator whose input is U402-23 and output is U402-26. Noise squelch sensitivity is set using RSS, with open squelch at step 0 and maximum (tight) squelch at step 15.

Tx Audio Path

Voice Path via Front Panel

Microphone audio from the front panel mic jack J5-5 is attenuated from 80 mV rms (for 60% deviation at 1 kHz) to 65 mV by R658 and R659. When mic PTT is sensed from J5-6, CMOS gate U554C is enabled by a logic low at U402-5, which is inverted by Q651 to provide a logic high at U554C-6.

This audio is fed to the compander IC where it is amplified from 65 mV to 100 mV by an op amp gain stage (pins 7 and 6) and then applied to the compressor portion of the compander (pin 3). The output (pin 2) is attenuated back to the original 65 mV rms level by another op amp stage (pins 9 and 10) and applied as a low-impedance source to the Tx Audio Send pin of the AdvantagePort connector (J13-10).

Voice Path via Accessory Connector

Microphone audio from an accessory such as a desk set applied to External Mic Audio input J3-2 is attenuated from 80 mV rms (for 60% deviation at 1 kHz) to 65 mV by R666 and R665. When External Mic PTT is sensed at J3-3 (or from any programmable input to which Ext Mic PTT has been assigned), CMOS gate U554B is enabled by a logic high at U401-47.

This audio is fed to the compander IC and processed as described above for the Voice Path via Front Panel.

AdvantagePort™ Internal Option Board Tx Audio Path

Non-pre-emphasized microphone audio is available at J13-10 for use by an internally installed option board. If this audio is to be processed and returned to the radio's transmit audio path, the processed audio will be returned from a low-impedance source on the option board to J13-12 (Tx Audio Return). The unprocessed audio through R654 is shunted due to the low source impedance of the option board at J13-12. Since deviation is adjusted appropriately by the AFIC for 12.5 or 25 kHz channels, the TX audio level at J13-10 and J13-12 is always 65 mV for 60% deviation at 1 kHz, regardless of the channel spacing.

Some option boards must be able to modulate the transmitter with very low frequency data. The Post-Limiter Flat Tx Audio Return pin (J13-2) is used for this application. Audio from this pin is routed to the AUX Tx IN pin on the AFIC (U402-20) via summing op amp stage U551C. A level of 150 mV rms will produce 60% deviation regardless of channel spacing. This path bypasses the limiter stage in the AFIC, therefore the option board must provide the necessary amplitude limiting of this signal to prevent overdeviation. The AUX Tx IN path of the AFIC must be enabled via software control for this path to be active.

Pre-emphasis of Microphone Audio Signals

Pre-emphasis of the front panel or accessory microphone audio signal occurs after the AdvantagePort option board processing has occurred. Series capacitor C651 provides the pre-emphasis characteristic of audio applied to the Tx IN pin of the AFIC (U402-17). This pin is the summing junction of an inverting op- amp gain stage within U402. Audio processing, including limiting, splatter filtering, and level adjustment are performed within U402. The outputs of the two programmable deviation-adjustment attenuators (U402-27 and 28) are resistively summed and applied to the VCO modulation input of the frequency generation system.

Flat (Non-Pre-Emphasized) Tx Audio Path via Accessory Connector

Audio applied at J3-5 may be routed to the transmitter either before the limiter (PRE-LIM) or after (POST-LIM). This is programmed using RSS. The path is controlled by CMOS gate U553C, as controlled by U402-8 (low for PRE-LIM, high for POST-LIM). When the POST-LIM path is chosen, audio is routed via R671 and op amp U551C to the AUX TX INPUT (U402-20), therefore this input of the AFIC must be enabled via software control whenever an accessory connector PTT is sensed at J3-3 (or from any programmable input to which Accessory PTT has been assigned).

Transmitter Circuitry

If the PRE-LIM path is chosen, audio is coupled by C655 and R670 to the summing input of an op amp within U402 (pin 17). Because R670 is significantly larger than R671, R669 provides a charging path for C655 when the PRE-LIM route is selected which is equivalent to the charging path via R671 in the POST-LIM path.

Audio present at J3-5 is muted during transmitter keyup until the frequency synthesizer has settled and locked on-frequency. This prevents unintentional frequency offset due to the presence of modulation while PTT is keyed. Muting occurs when U401-9 provides a low to U553A-11. While muted, R672 maintains the same dc bias on C655 to prevent switching transients.

Tx Data Encoder (D/A Converter)

Data such as MDC or DTMF signalling can be encoded into the TX audio path by generating the waveform at ports PA3, PA4 and PA5 of U401 (pins 13, 12 and 11 respectively). These outputs are resistively summed and weighted to allow either square waves or pseudosinewaves to be encoded. Op amp U551C provides active summing and outputs the signal to the AUX Tx IN port of the AFIC (U402-20). Connection is also made to the AUX Rx IN port (U402- 13) to allow true sidetones to be heard, for example when DTMF tones are encoded. The AUX Tx IN path of the AFIC must be enabled via software control when the data encoder is operating.

The data encoder circuit may not be utilized in all models.

Compander Operation

The compander circuit of U555 is used to improve the signal-to- noise ratio of the voice communications path. This is accomplished by compressing the microphone signal during transmit by a ratio of 2:1 so that a 60 dB range of level changes at the microphone are reduced to only a 30 dB change before being transmitted. A complimentary expander circuit in the receiver audio path restores the 30 dB range of the received signal to its original 60 dB range before being applied to the speaker. Any noise occurring in the over-the-air transmission which is more than 30 dB below full deviation is reduced to greater than 60 dB below the peak voice level at the speaker, making such noise essentially inaudible.

The effectiveness of the compander system requires that both the transmitter and receiver utilize companding. It is possible to program the compander off on a per-channel basis using RSS, for use in systems with other radios that do not have the compander feature. The compander is active when U555-8 is low, and is bypassed when U555-8 is high. When in the bypass mode, the gain of the compressor (pin 3 in, pin 2 out) and expander (pin 14 in, pin 15 out) circuits is unity.

Q553 and C581 keep the compander turned off for approximately one second when the radio is turned on, to allow the compander circuits sufficient time to stabilize. At turn-on, U401-30 pulses low, which turns on Q553 and quickly charges C581 to 5 V, bypassing the compander. If the compander should be on, U401-30 stays high, and C581 discharges due to the internal resistance of U555-8. After one second, the voltage at U555-8 is low enough to enable the compander. If the compander should be off, U401-30 remains low, keeping Q553 on and U555-8 high.

Q554 and Q555 are used to increase the receive audio path gain by approximately 4 dB whenever the compander is turned on. This maintains the same subjective audio level for both compander and noncompander channels.

Public Address Operation

When the public address switch box and amplified speaker(s) accessories are used, and the radio has been programmed by RSS for public address, operation is as follows:

Turning on either the INT PA or EXT PA switches on the public address switch box provides a low at pin 14 of accessory connector J3. This enables public address operation of the radio. In this condition, radio receiver operation is unaffected, but keying of the transmitter is inhibited. If a MIC PTT is sensed from microphone jack J5-6, both the INT MIC ENABLE and EXT MIC ENABLE lines go high (U402-5 is low and U401-47 is high). This turns on both mic audio gates U554C and U554B, and allows audio from the microphone jack J5-5 to be routed directly to accessory connector J3-2. Mic audio from J3-2 is then routed to the selected public address amplified speakers by the public address switch box.

To prevent loading of the mic audio signal and loss of low frequency response, U651 senses that both INT MIC and EXT MIC enable lines are high and provides a low at its output, turning off U652 and removing the loading of R665 from the audio path. At all other times, U652 is on to provide microphone bias voltage to the external mic input via R665.

Transmitter Circuitry

VHF 10-25 Watt Transmitter RF Power Amplifier

The 10-25 watt VHF power amplifier is designed to cover the range of 150-170 MHz. It consists of three stages. The first stage, Q2410, operates in Class A with base bias supplied by the 8T source. The collector voltage is supplied from controlled B+. The output level of this stage (i.e. the gain of this device) is varied by changes in the controlled B+ voltage. The magnitude of

Transmitter Circuitry

the control voltage depends on the PA output power, temperature and also antenna load mismatch.

The second stage of the PA, Q2430, is the driver which amplifies the output of low level amplifier to a level sufficient to drive the final stage device. This device operated in Class C delivers up to 3 watts output power. Collector voltage is supplied by UNSWB+.

The third stage, Q2440, is the final RF power amplifier, which operates in Class C directly from UNSWB+. It provides up to 30 watts output power.

A directional coupler, located between the final power amplifier and the harmonic filter, monitors the forward and reflected power. The sampled RF is rectified by diodes CR2480 (forward power) and CR2481 (reflected power) and the resulting dc voltage is routed to the power control circuit.

The antenna switch consists of two pin diodes, CR2450 and CR2451. L2452 and C2450, combined with the "on" inductance of CR2451, form a series resonant circuit to lower the shunt impedance presented by CR2451 when it is turned on. In the receive mode, both diodes are off. Signals applied at the antenna jack J1 are routed, via the harmonic filter, through L2451 and C2453 to the receiver input. In the transmit mode, 8T is present and both diodes are forward-biased into conduction. The transmitter RF from Q2440 via the directional coupler is routed through CR2450, and via the harmonic filter to the antenna jack. CR2451 conducts, shunting RF power and preventing it from reaching the receiver. L2451 is selected to appear as a 1/4 wave at VHF, so that the low impedance of CR2451 appears as a high impedance at the junction of CR2450 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

During transmit mode, 8T is present and both diodes are forward biased into conduction. The transmitter RF from Q2640 via the directional coupler is routed through CR2650, and via the harmonic filter to the antenna jack J1. The PIN diode CR2651 in the shunt-leg conducts, shunting RF power and preventing it from reaching the sensitive receiver front-end. The impedance inverter network contributes approximately 30 dB to transmit/receive isolation. Whereas, during receive mode, both the PIN diodes are non-conducting. Thus, the signal applied at the antenna jack J1 are routed via the harmonic filter, through C2658, L2652 and C2659 to the receiver input.

The harmonic filter is a seven pole 0.1 dB ripple Chebychev low pass filter with a 3 dB frequency of approximately 200 MHz and less than 1 dB insertion loss in the passband.

VHF 40 Watt Transmitter RF Power Amplifier

The 40 watt VHF power amplifier is designed to cover the range of 150-174 MHz and has four stages. The first stage, Q2410, operates in Class A from the 8T source. It provides 13 dB of gain and an output of 400 mW.

The second stage, Q2420, has a nominal gain of 9.4 dB and power output of up to 3.5 watts. The output of this stage is adjusted by the controlled B+ voltage which supplies its collector. (VB+ \max = 6.55 V).

The third stage, Q2430, operates in Class C with 8.1 dB gain and output power up to 22 watts. Collector voltage is directly from UNSW B+.

The fourth stage, Q2440, is the final RF power amplifier, which operates in Class C, is directly from UNSW B+. It provides up to 65 watts output.

A directional coupler, located between the final power amplifier and the harmonic filter, monitors the forward and reflected power. The sampled RF is rectified by diodes CR2480 (forward power) and CR2481 (reflected power) and the resulting dc voltage is routed to the power control circuit.

The antenna switch consists of two pin diodes, CR2450 and CR2451. L2452 and C2450, combined with the "on" inductance of CR2451, form a series resonant circuit to lower the shunt impedance presented by CR2451 when it is turned on. In the receive mode, both diodes are off. Signals applied at the antenna jack J1 are routed, via the harmonic filter, through L2451 and C2453 to the receiver input. In the transmit mode, 8T is present and both diodes are forward-biased into conduction. The transmitter RF from Q2440 via the directional coupler is routed through CR2450, and via the harmonic filter to the antenna jack. CR2451 conducts, shunting RF power and preventing it from reaching the receiver. L2451 is selected to appear as a 1/4 wave at VHF, so that the low impedance of CR2451 appears as a high impedance at the junction of CR2450 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

The harmonic filter is a seven pole 0.1 dB ripple Chebychev low pass filter with a 3 dB frequency of approximately 200 MHz and less than 1 dB insertion loss in the passband.

UHF 10-40 Watt Transmitter RF Power Amplifier

The 40 watt UHF power amplifier is designed to cover the range of 450-474 MHz and has four stages. The first stage, Q2610, operates in Class A from the 8T source. It provides 11.8 dB of gain and an output of 300 mW.

PTT Circuits

The second stage, Q2620, has a nominal gain of 8.2 dB and power output of up to 2 watts. The output of this stage is adjusted by the controlled B+ voltage which supplies its collector.

The third stage, Q2630, operates in Class C with 8.1 dB gain and a power output of up to 13 watts. Collector voltage is directly from UNSW B+.

The fourth stage, Q2640, is the final RF power amplifier, which operates Class C directly from UNSW B+. It provides up to 30 watts output for low power and 50 watts output for high power.

A directional coupler, located between the final power amplifier and the harmonic filter, monitors the forward and reflected power. The sampled RF is rectified by diodes CR2680 (forward power) and CR2681 (reflected power) and the resulting dc voltage is routed to the power control circuit.

The antenna switch consists of two pin diodes, CR2650 and CR2651. L2652 and C2650, combined with the "on" inductance of CR2651, form a series resonant circuit to lower the shunt impedance presented by CR2651 when it is turned on. In the receive mode, both diodes are off. Signals applied at the antenna jack J1 are routed, via the harmonic filter, through L2651, C2653, and L2664 to the receiver input. In the transmit mode, 8T is present and both diodes are forward-biased into conduction. The transmitter RF from Q2640 via the directional coupler is routed through CR2650, and via the harmonic filter to the antenna jack. CR2651 conducts, shunting RF power and preventing it from reaching the receiver. L2651 is selected to appear as a 1/4 wave at UHF, so that the low impedance of CR2651 appears as a high impedance at the junction of CR2650 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

The harmonic filter is a seven pole 0.1 dB ripple Chebychev low pass filter with a 3 dB frequency of approximately 600 MHz and less than 1 dB insertion loss in the passband.

Power Control Circuit

The power control circuit is a dc-coupled amplifier whose output is the controlled voltage applied to the second stage of the RF power amplifier (Q2420 in 40 W VHF, Q2410 in 25 W VHF, or Q2620 in UHF).

The input voltage to U451A-2 is a dc voltage from the directional coupler forward power detector, and is proportional to RF power output. This is compared to a dc voltage applied to U451A-3 which is proportional to the desired output power setting. This voltage is obtained by integrating a series of square wave pulses from port PH1 of the microprocessor (U401-26). The duty cycle of these pulses is varied in proportion to the

desired output power setting. Components R458, C467, R457 and C458 integrate the PWM pulses into a smooth dc voltage.

The power control loop varies the output of stage Q2420 or Q2620 as necessary to keep equal voltages at U451A pins 2 and 3, and thus maintains forward power at the adjusted setting.

Under conditions of poor antenna match resulting in high reflected power, the dc voltage at U451A-3 is reduced due to a lowering of the voltage at U451B-7. This is interpreted by the power control circuit as a lowering of the desired output power.

The temperature-sensing circuit protects the PA devices from excessively high temperatures. As the PA temperature increases, the resistance of thermistor R462 decreases. This causes Q453 to conduct, reducing the voltage at the base of Q452. This reduces the conduction of series pass device Q451, lowering the control voltage and therefore the output power.

Over-voltage protection prevents the control voltage from rising so high that the subsequent transmitter stages may be overdriven. Zener diode VR451 conducts when the control voltage exceeds 5.3 V in 40 W VHF models or 10.6 V in UHF models. This causes Q453 to conduct, lowering the control voltage as described earlier.

PTT Circuits

The logic system uses a single microcomputer A/D input port PE1 (U401-36) to distinguish between two different types of PTT information. This is done by assigning different voltage levels to the different PTT functions as follows:

0 to 2.1 Vdc (0.6 Vdc typ): Microphone PTT 2.2–3.6 Vdc (2.6 Vdc typ): Accessory PTT 4.75 to 5.0 Vdc (5.0 Vdc typ): Receive Mode

A microphone connected via the front panel jack J5 must present a low of less than approximately 2.0 V dc to be correctly interpreted as MIC PTT and cause the appropriate audio paths to be enabled. Similarly, an accessory whose PTT output is connected to J3-3 must present a low of less than approximately 2.0 V dc to be interpreted as an accessory PTT. This voltage is shifted to the range between 2.2 and 3.6 V by series resistor R432.

Some accessories connected to J3 need to sense microphone PTT by looking for a low at J3-3. Diode CR408 causes J3-3 to be pulled low whenever microphone connector J5-6 is low.

DC Regulation and Distribution

Programmable I/O's

Pins 4, 6, 8, 9, 12, and 14 are programmable I/O's. They are used to control external accessories by the radio, or for control of radio functions by accessories.

Pin 4 is an output only. When U401-21 is high, Q901 and Q902 are on, and pin 4 is pulled high to the battery voltage. This is normally used to turn on a relay for activating the vehicle's horn or lights.

Pin 6 is an input only. Normally, R905 pulls pin 6 high, turning on Q903 and pulling U401-45 low. If pin 6 is pulled low, U401-45 goes high.

Pin 8 is an I/O (input and output). To function as an input, Q905 is turned off by keeping U401-20 low. Then, R907 pulls pin 8 high, turning on Q904 and pulling U401-44 low. If pin 8 is pulled low, U401-44 goes high. To function as an output, Q905 pulls pin 8 low whenever U401-20 is high.

Pin 9 is an input only. Normally, R909 pulls pin 9 high, turning on Q906 and pulling U401-46 low. If pin 9 is pulled low, U401-46 goes high. The emergency switch accessory, if used, is connected here.

Pin 12 is another I/O. To function as an input, Q909 is turned off by keeping U401-19 low. Then, R913 pulls pin 12 high, turning on Q908 and pulling U401-43 low. If pin 12 is pulled low, U401-43 goes high. To function as an output, Q909 pulls pin 12 low whenever U401-19 is high.

Pin 14 is also an I/O. To function as an input, Q911 is turned off by keeping U401-22 low. Then, R915 pulls pin 14 high, turning on Q910 and pulling U401-42 low. If pin 14 is pulled low, U401-42 goes high. To function as an output, Q910 pulls pin 14 low whenever U401-22 is high.

Zener diodes and bypass capacitors on each programmable I/O line prevent damage or abnormal operation due to ESD transients or RF fields.

The extent to which programmable I/O functions are supported may vary with different radio models. RSS allows the functions which are supported to be programmed.

DC Regulation and Distribution

Unswitched B+ supplies operating voltage directly to the RF power amplifier third and fourth stages, the power control series pass device Q451-E, the RAM keep-alive constant voltage supply to U401-62, the audio power amplifier supply pin U501-7 and, via fuse F401, to the on-off switch and external alarm switch transistor Q902-E. All of these circuits draw negligible current when the radio is turned off (less than 15 mA total).

When the on-off switch is "on," battery voltage is applied to 8 volt regulator U406, and via R502 to pin 8 of the audio power amplifier U501 which turns it on unless muted by Q501. The regulated output of U406 is routed to the display board for backlighting, to 8T transistor switch Q414, to U51 pins 16 and 17, to op amp U551 supply pin 4, and to the inputs of the 5 volt regulators U404 (digital) and U405 (analog). Separate analog and digital regulators are used to minimize microcomputer noise from being introduced into sensitive VCO and receiver circuits. The digital 5 V regulator includes a reset timer which hold the reset line U404-3 low for a predetermined time after the radio is turned on. Zener diodes on the 8 V and digital 5 V lines minimize susceptibility to ESD damage.

Ignition control of the radio is accomplished by removing fuse F401. The radio will only be able to turn on if battery voltage from the vehicles ignition switch is applied to accessory connector J3 pin 10. This voltage is routed to the on-off switch.

20-Channel LCD Front Panel Display Board

The 8-character display board contains back lighting LED's, and an LCD that is driven by the LCD driver IC, U1101. When the LCD driver, U1101, is enabled via the CE (Chip Enable) input, the desired display information is then loaded serially via the SR Data line into U1101 from the microprocessor. U1101 also has a clock input that is connected to the main board SR Clock.

The back lighting for the 8-character display board can be toggled between two colors, amber and green per the users choice. This color choice for the LED's is controlled by the microprocessor, which in turn gets its input from either the RSS setup, or one of the pushbuttons if so enabled. Each color of back lighting is produced by 12 pairs of LED's, which are turned on by applying a ground to the cathodes of the 12 pairs of LED's.

To enable the amber LED's, a DC level of 5 V from the microprocessor is applied to the base of Q1108. This 5 V saturates Q1108 which connects a ground to the amber LED cathodes and also the base of Q1107. With the base of Q1107 grounded, the transistor operates in the cutoff mode which leads to the collector having a potential of ~8 V, which is also applied to the cathode of the green LED's.

To enable the green LED's, a DC level of 0 V (ground) to the base of Q1108 keeps Q1108 in cut-off mode which leads to the collector of Q1108 having a potential of 8 V. This 8 V potential on the collector of Q1108 is also applied to the base of Q1107 via R1125, thus saturating Q1107 and connecting the green LED's to ground.

The six pushbuttons apply voltage to the bases of six digital transistors, Q1101 through Q1106. The appro-

September, 1999 6880904Z96-A MMR-128 **2-9**

4-Channel LED Front Panel Display Board

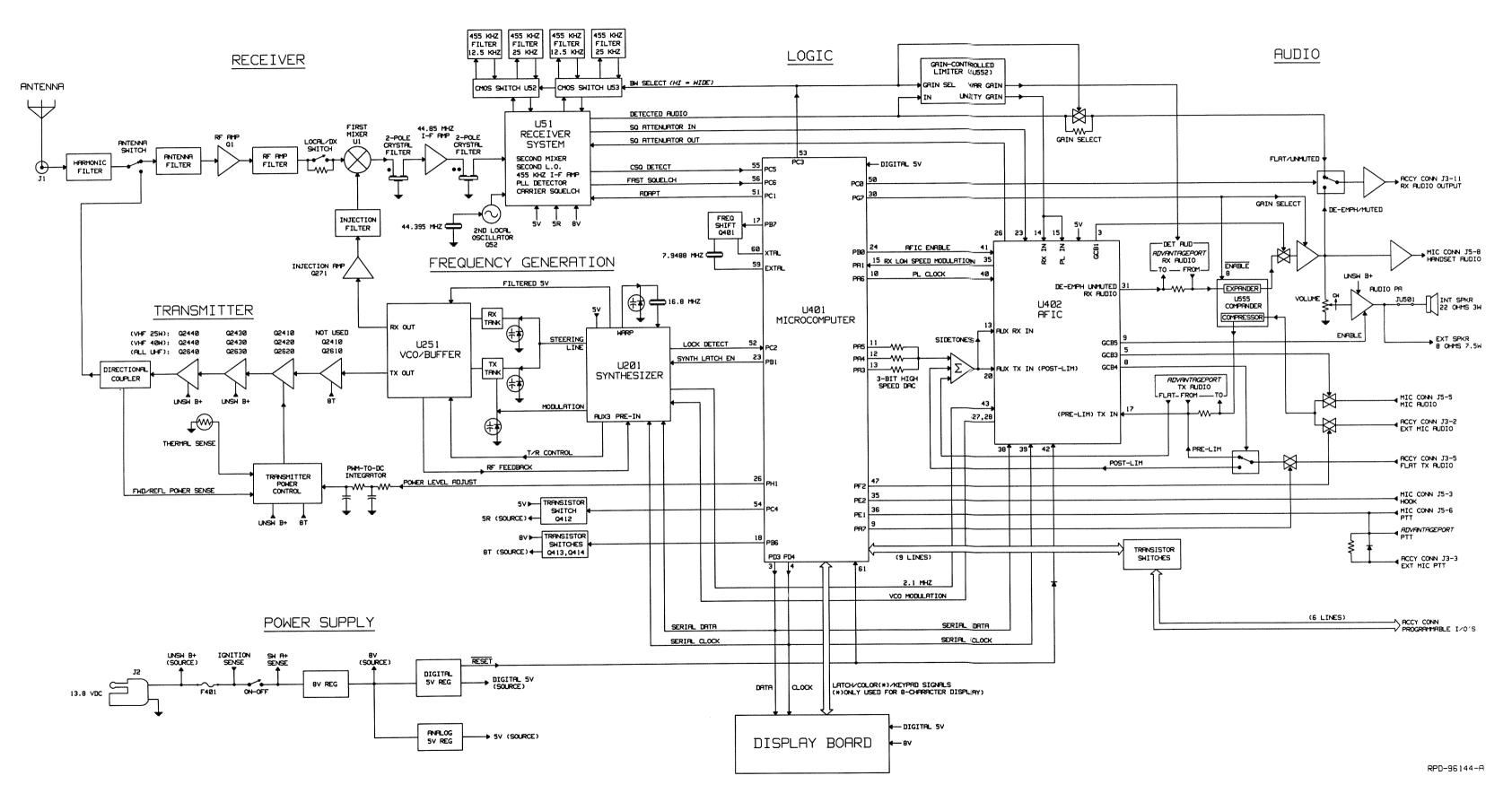
priate transistor, in turn, grounds a tap on the series resistor ladders R1117 through R1122, producing a different DC level depending on which button is pressed. These DC levels are interpreted by an A/D input of the microprocessor (U401-37) and the corresponding function is enabled. The transistors ensure that the DC ladder voltage is consistent, although the series resistance of the keypad may vary.

4-Channel LED Front Panel Display Board

The LED display board contains back lighting LEDs for the keypad, channel indicator LEDs; and status indicators for transmit, monitor, and options. The channel and status display information is loaded serially into the shift register, U101. This information is then latched and turns on the LEDs, DS101 - DS105 and DS1012 - DS1014 via the driver transistors, Q1001 - Q1008.

The six pushbuttons apply voltage to the bases of six digital transistors, Q1009 through Q1014. The appropriate transistor, in turn, grounds a tap on the series resistor ladders R1017 through R1022, producing a different DC level depending on which button is pressed. These DC levels are interpreted by an A/D input of the microprocessor (U401-37) and the corresponding function is enabled. The transistors ensure that the DC ladder voltage is consistent, although the series resistance of the keypad may vary.

2-10 6880904Z96-A MMR-128 September, 1999



M1225 Mobile Functional Block Diagram





Note: This page is the beginning of the original manual. All prior pages are MMR-128 pages.

Foreword	
roleword	
Scope of Manual	iv
Tiow to use This Maitual	
Other Documentation	
rectifical support	
Betvice I oney	_
1120 del Citalio.	
11000001100	
Specifications	•
Service Alus	
Test Equipment	.XII
	.711
Section 1	
Radio Disassembly/Assembly	
Overview	
Overview	1-1
Disassemble Radio	1-1
Remove Front Panel Display Roard	1-1
Remove Front Panel Display Board	1-1
Remove Main Board Reassemble Radio Replace Main Board	1-2
Replace Main Board	1-2
Replace Main Board	1-2
Replace Mechanical Components to Main Board.	1-2
Replace Front Panel Display Board	1-3
Install an Advantage TM Roard into the Advantage Part TM	1-3
Disassemble Radio	1-4
Replace Housing Cover Install an Advantage TM Board into the AdvantagePort TM Disassemble Radio Insert Advantage Board	1-4
Insert Advantage Board	1-4
Section 2	
Theory of Operation	
Overview	2.1
- 11 Procedure Trong Line 11 to 1	
received back Entrans.	
requercy defleration system	
= j = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1	
YCO::::::::::::::::::::::::::::::::::::	
Transmit and receive radio Citables	
Down Dever lox Audio	
	_
- 1 The manager of the filler of the control of the	
Noise Squelch Attenuator	,~ ' ±
	٠.

	Tx Audio Path	2-5
	Voice Path via Front Panel	2-5
	Voice Path via Accessory Connector	2-5
	AdvantagePort™ Internal Option Board Tx Audio Path	2-5
	Pre-emphasis of Microphone Audio Signals	2-5
	Flat (Non-Pre-Emphasized) Tx Audio Path via Accessory Connector	2-5
	Tx Data Encoder (D/A Converter)	2-6
	Compander Operation	2-6
	Public Address Operation	2-6
	Transmitter Circuitry	. 2-6
	VHF 40 Watt Transmitter RF Power Amplifier	2-6
	UHF 10-40 Watt Transmitter RF Power Amplifier	2-7
	Power Control Circuit	2-7
	PTT Circuits	2-8
	Programmable I/O's	2-8
	DC Regulation and Distribution	2-8
	20-Channel LCD Front Panel Display Board	2-9
	4-Channel LED Front Panel Display Board.	2-9
	M1225 Mobile Functional Block Diagram	2-11
		. 2-11
Sei	ction 3	
110	oubleshooting	
	Overview	
	Troubleshooting Flow Chart for Receiver (All Models)	3-2
	Troubleshooting Flow Chart for Transmitter (All Models)	3-3
	Troubleshooting Flow Chart for Synthesizer (All Models)	
	Total Control of Synthesizer (All Woodels)	3-4
	Troubleshooting Flow Chart for VCO (All Models)	3-5
	Troubleshooting Flow Chart for Microprocessor (All Models)	3-6
	ction 4 panded Accessory Connector General	4- 1
	Programmable Pins	4-2
Ciı	rcuit Board Details, Schematic Diagrams, and Parts Lists Circuit Board Details for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios)	1
	Schematic Diagram for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) (Sheet 1 of 2)	
	Schematic Diagram for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios)	
	(Sheet 2 of 2)	
	Parts List for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W	
	Parts List for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W	5
	Parts List for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W (Part of HUE3873C, HUE3579A, HUE3580A & HUE3871A Radios)	5
	Parts List for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W (Part of HUE3873C, HUE3579A, HUE3580A & HUE3871A Radios) Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUE3873C & HUE3579A Radios)	5 7
	Parts List for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W (Part of HUE3873C, HUE3579A, HUE3580A & HUE3871A Radios) Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W	5 7

Parts List for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUE3873C & HUE3579A Radios)	11
Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios) (Sheet 1 of 2)	
Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios) (Sheet 2 of 2)	
Parts List for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios)	
Circuit Board Details for HLN9644A 8-Character Display Board, 20-Frequency	17
Schematic Diagram, and Parts List for HLN9644A 8-Character Display Board, 20-Frequency	19
Circuit Board Details for HLN9887A Display Board, 4-Frequency	20
Schematic Diagram, and Parts List for HLN9887A Display Board, 4-Frequency	21
Circuit Board Details, Schematic Diagram, and Parts List for HMN3001/3008A Compact Microphone	22
Exploded Mechanical View and Parts List for HMN3001/3008A Compact Microphone	23
M1225 Radio Exploded Mechanical View and Parts List	24

Scope of Manual

Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by service manual revisions. These revisions are added to the manuals as the engineering changes are incorporated into the equipment.

How to Use This Manual

This manual contains introductory material such as model charts, accessories, and specifications, as well as four sections that deal with specific service aspects of the M1225 Mobile Radio. Refer to the Table of Contents for a general overview of the manual, or to the "Overview" paragraph in each section for a specific overview of the information in that section.

Other Documentation

Table 1 lists other documentation for the M1225 Mobile Radio.

Table 1. Other Documentations

Information	Location
Basic Use of Radio	M1225 20-Channel Operator Guide (6880904Z85)
Basic Use of Radio	M1225 4-Channel Operator Guide (6880906Z68)
Accessories	M1225 Accessory/Feature Sheet (6880904Z98)
Installation and Licensing	M1225 Installation/Licensing Guide (6880905Z15)
Programming	1225 Series RSS Getting Started (6880904Z93)

Technical Support

To obtain technical support, you may call Motorola's Radius Product Services. When you call, we ask that you have ready the model and serial numbers of the respective radio or its parts.

Service Policy

If malfunctions occur within 30 days that cannot be resolved over the phone with Radius Product Services, a defective major component should be returned. You must obtain authorization from Radius Product Services before returning the component.

Ordering Replacement Parts

You can order additional components and some piece parts directly through your Radius price pages. When ordering replacement parts, include the complete identification number for all chassis, kits, and components. If you do not know a part number, include with your order the number of the chassis or kit which contains the part, and a detailed description of the desired component. If a Motorola part number is identified on a parts list, you should be able to order the part through Motorola Parts. If only a generic part is listed, the part is not normally available through Motorola. If no parts list is shown, generally, no user serviceable parts are available for the kit.

Radius 30-Day Warranty Technical Support Radius Product Services 1000 W. Washington St. Mt. Pleasant, IA 52641 USA

Motorola Radio Support Center Attention: Warranty Return 3760 South Central Avenue Rockford, IL 61102 USA 1-800-227-6772 (U.S. & Canada)

Radius Major Component Repair Motorola Radio Support Center 3760 South Central Avenue Rockford, IL 61102 USA

Motorola Accessory & Aftermarket Division Attention: Order Processing 1313 E. Algonquin Road Schaumburg, IL 60196

Motorola Accessory & Aftermarket Division Attention: International Order Processing 1313 E. Algonquin Road Schaumburg, IL 60196

Customer Service 1-800-422-4210 1-847-538-8198 (FAX)

Parts Identification 1-847-538-0021 1-847-538-8194 (FAX)

Model Charts

Model Charts



FREQ. DESCRIPTION	20 12.5/25 kHz, 25-40 W	VHF 15	Mobile Radio 50 - 174 MHz	DESCRIPTION	Display Board (20-Freq.)	Hardware Kit	Main Board, 12.5/25 kHz, 25-40 W
MODEL	M43DGC90J2AA	25-40	Watts RF Power	ITEM	HLN9644_	HLN9268_	(See Note)
		Item	Description		ellerer Oriental		
	X	HUD3233_	Radio, 12.5/25 kHz, 25-40 W		Х	Χ	Х
	Х	HMN3008_	Microphone				
	Х	HLN9154_	Non-Locking Bracket				
	Х	HKN4137_	Power Cable				
	X	HLN9155	M1225 20-Channel Manual Kit				

_ '	L	·							
DESCRIPTION	12.5/25 kHz, 25-40 W	12.5/25 kHz, 10-25 W		M1225 20-Channel Mobile Radio	DESCRIPTION	Display Board (20-Freq.)	it	Main Board, 12.5/25 kHz, 25-40 W	Main Board, 12.5/25 kHz, 10-25 W
FREQ.	20	20	45	50 - 474 MHz Watts RF Power		Display Boa	Hardware Kit	Main Board,	Main Board,
MODEL	M44DGC90J2AA	M34DGC90J2AA	25-40	& Watts RF Power	ITEM	HLN9644_	HLN9268_	(See Note)	(See Note)
			Item	Description					
	Х	X	HUE3873_ HUE3817_	Radio, 12.5/25 kHz, 25-40 W		X	X	Х	
1000000	X	Ŷ	HMN3008_	Radio, 12.5/25 kHz, 10-25 W Microphone		Х	Х		Х
	X	X	HLN9154_	Non-Locking Bracket					\dashv
1 1 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Х	Х	HKN4137_	Power Cable	_		-	-	\dashv
	X	Х	HLN9155	M1225 20-Channel Manual Kit					\dashv

Model Charts

FREQ. DESCRIPTION	4 12.5/25 kHz, 25-40 W	VHF	M1225 4-Channel Mobile Radio 50 - 174 MHz	DESCRIPTION	Display Board (4-Freq.)	Hardware Kit	Main Board, 12.5/25 kHz, 25-40 W
MODEL	M43DGC90E2AA	25-40	Watts RF Power	ITEM	HLN9887_	HLN9268_	(See Note)
		Item	Description				
	Х	HUD3251_	Radio, 12.5/25 kHz, 25-40 W		Х	Х	Х
	X	HMN3008_	Microphone		<u> </u>		Ш
					ļ		
	H				\vdash	L	\vdash
	X X X	HLN9154_ HKN4137_ HLN9893	Non-Locking Bracket Power Cable M1225 4-Channel Manual Kit				

Model Charts

L FREQ. DESCRIPTION	E2AA 4 12.5/25 KHz, 25-40 W	E2AA 4 12.5/25 kHz, 10-25 W	UHF 45 25-40	M1225 4-Channel Mobile Radio 0 - 474 MHz Watts RF Power & Watts RF Power	DESCRIPTION	Display Board (4-Freq.)	Hardware Kit	Main Board, 12.5/25 kHz, 25-40 W	Main Board, 12.5/25 kHz, 10-25 W
MODEL	M44DGC90E2AA	M34DGC90E2AA	10-25	walls he Power	ITEM	HLN9887_	HLN9268_	(See Note)	(See Note)
			Item	Description	l			77 W.C.	g XG K
	Х		HUE3579_	Radio, 12.5/25 kHz, 25-40 W		Х	Х	Х	
14		×	HUE3580_	Radio, 12.5/25 kHz, 10-25 W		X	Х		Х
	Х	Х	HMN3008_	Microphone					
	Х	X	HLN9154_	Non-Locking Bracket					
3.45.00	X	X	HKN4137_	Power Cable					
	Х	X	HLN9893	M1225 4-Channel Manual Kit					

Accessories

Accessories

Radius offers several accessories to increase communications efficiency. Many of the accessories available are listed below, but for a complete list, consult your Radius dealer.

Antennas:

HAD4006_R	VHF 136-144 MHz, 1/4 Wave Roof Mount
HAD4007_R	VHF 146-150 MHz, 1/4 Wave Roof Mount
HAD4008_R	VHF 150-162 MHz, 1/4 Wave Roof Mount
HAD4009_R	VHF 162-174 MHz, 1/4 Wave Roof Mount
HAD4014_R	VHF 140-174 MHz, 3 dB Gain Roof Mount
RAD4000_MB	VHF 140-174 MHz, 3 dB Gain Magnetic Mount
HAE4003_R	UHF 450-470 MHz, 1/4 Wave Roof Mount
HAE4004_R	UHF 470-512 MHz, 1/4 Wave Roof Mount
HAE4011_R	UHF 450-470 MHz, 3.5 dB Gain Roof Mount
HAE4012 R	I HE 470-404 MHz, 2.5 dB Cain Roof Mount
RAE4004 RB	UHF 470-494 MHz, 3.5 dB Gain Roof Mount
RAE4004_MB	UHF 450-470 MHz, 5 dB Gain Roof Mount
HKN9557_R	UHF 440-470 MHz, 5 dB Gain Magnetic Mount
HLN5282_R	PL259/Mini-U Antenna Adapter with 8 in. Cable
11L1N3Z0Z_K	Mini-U Connector

HLN8027_ Mini - UHF to BNC Adapter

Microphones:

	HMN1035_R	Heavy Duty Palm Microphone with 10.5 ft. Cord
4	HMN3008_	Compact Microphone with Tx LED, 7 ft. Cord & Hang-up Clip
	HMN3001_	Compact Microphone with Tx LED, 10 ft. Cord & Hang-up Clip
	HMN3175_	Compact Touch-Code™ Microphone, 7 ft. Cord & hang-up Clip
	HMN3174_	Compact Micophone with Tx LED, 7ft. Cord & Hang-up Clip
	HMN3141_R	Handset with Hang-up Cup
	HLN9073_R	Microphone Hang-up Clip
	HLN9414_	Universal Hang-Up Clip
	HLN9560_R	10.5 ft. Extended Coil Cord
	HLN9559_R	7 ft. Coil Cord

Installation Accessories: HI N9162

11L145102_	5 in. Goose Neck Mounting Bracket
HLN9227_	8 in. Goose Neck Mounting Bracket
HLN9408_	Goose Neck Decor Sleeve
HLN9534_	Right Angle Mini-UHF Connector
HLN9228_	Clam Shell Swivel Mounting Bracket
HLN9617_	Key Lock Mounting Bracket
HLN9154_	Non-Locking Mounting Bracket
HLN9179_	Quick Release Mounting Bracket
HLN9573_R	Shorting Plug
- HKN4137_	Low Power Cable to Battery

Control Station Accessories:

HLN9226_	Mobile Holder
HLN9886_	Grounding Kit
HMN3000_	Black Desk Microphone
HKN9018_	Control Station Cable
HKN9019_	16-pin Conductor Cable
HPN8393_	Power Supply
HPN9012_	Power Supply (25 W only)
HKN9088_	Mini_U Antenna Adapter
	.

Accessories / Kits Interfacing with the 16-Pin Connector:

T TICK TOO 40	0
HKN9242_	16-pin Accessory Kit with Expanded Connector
HSN9008	The state of the s
110149000_	16-pin External Speaker for Received Audio, 7.5 W
LII NIO14E D	D 11: 11: 11: 11: 11: 11: 11: 11: 11: 11

HLN3145_R Public Address Kit

HSN1000_R Amplified External Speaker, 6 W

Accessories

16-pin Ignition Switch Cable HKN9327_R

External Alarm Relay and Cable for Horn & Lights HLN9328_R

15 ft. Public Address Speaker Cable HKN9324_

Cigarette Lighter Adapter w/LED Indicator (25 W only) HKN9407_

Manuals/Kits:

DC Remote Adapter Manual L1547A Tone Remote Adapter Manual L1475A

6880904Z04

DTMF Microphone Operator's Instructions DTMF Microphone Service Manual M1225 20-Channel Manual Kit 6880904Z05 HLN9155 M1225 4-Channel Manual Kit HLN9893 M1225 Radio Service Software Kit HVN9054

Specifications

Specifications

GENERAL

	VHF UHF			HF	
Model Series:	M4	M43DGC		, M34DGC	
Frequency Range:	150-1	74 MHz	450-47	74 MHz	
RF Output:	25	25-40W		25-40 WW	
Channel Spacing:	12.5 kHz	20/25/30 kHz	12.5 kHz	20/25 kHz	
Dimensions:	H 1.73′	" X W 6.61" X D 4.25" (H	44mm X W 168mm X D	108mm)	
Weight:	36 oz. (1.02kg)				
Channel Capacity:		20 or 4 C	hannels		
Freq. Separation:		24 MHz			
Input Voltage:	13.6 ±10%				
Current Drain: Standby Receive @Rated Audio	300 mA 1.5 A				
Transmit	12.5 A @ 40 W 12.5 A @ 40 W				
Squelch Capabilities:		Tone Coded, Digital Code	d and/or Carrier Squel	lch	

TRANSMITTER

	VHF	UHF		
Freq. Stability (-30C to +60C):	±0.00025%			
Spurs/Harmonics:	-23 dBm (5 μW)			
Audio Response:*	+1/-3 dB, relative to 6 dB/octave pre-emphasis, 300-3000 Hz (2550 Hz @ 12.5 kHz			
FCC Designation:	ABZ99FT3037	ABZ99FT4044, ABZ99FT3038		
FCC Modulation: 20/25/30 kHz 12.5 kHz	16K0F3E 11K0F3E	16K0F3E 11K0F3E		
Output Impedance:		50 ohms		
Modulation Sensitivity:	80 mV rms for 6	80 mV rms for 60% deviation @ 1000 Hz		
FM Noise: 20/25/30 kHz 12.5 kHz	45 dB 40 dB	40 dB 35 dB		
Audio Distortion:	<3% EIA (@1000 Hz, 60% of Rated Max. Deviation)			

RECEIVER

	VI	IF	UI	HF .
	12.5 kHz	25 kHz	12.5 kHz	25 kHz
Freq. Stability (-30C to +60C):		±0.0	0025%	
Sensitivity TIA @ 12 dB SINAD:	0.35 μV	0.30 μV	0.35 μV	0.30 μV
Squelch (internally pre-set):		10 dB	SINAD	
Selectivity TIA:	65 dB	75 dB	60 dB	70 dB
Intermodulation TIA*:	65 dB	75 dB	60 dB	70 dB
Spurious Rejection:	75 dB		70 dB	
Image / Half IF Rejection:	70	dB	70	dB
Audio Output: 8 ohms (external) 16 ohms (internal)			% distortion Nominal	
Input impedance:		50 6	ohms	
TIA Usable Bandwidth:	1.2 kHz	2 kHz	1.2 kHz	2 kHz

Local mode adds 10 dB protection against wideband interference.

MILITARY STANDARDS 810 C, D & E FOR MOUNTING ACCESSORIES

		810C		810D		810E	
Applicable MIL-STD	Required Mounting Accessory	Method	Procedures	Method	Procedures	Method	Procedures
Vibration:	Standard Non-Locking Bracket	514.2	8	514.3	1	514.4	1
Shock:	Standard Non-Locking Bracket	516.2	1,3	516.3	1	516.4	1
Crash Hazard	Any M1225 Mounting Accessory	516.2	3	516.3	5	516.4	5

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Service Aids

Service Aids

The following table lists service aids recommended for working on the M1225 Mobile Radio.

Motorola Part No.	Description	Application		
HLN9214	Radio Interface Box	Enables communication between the radio and the computer's serial communications adapter.		
HSN9412	RIB Power supply	Used to supply power to the RIB.		
HKN9216 HKN9215	Computer Interface cable	Connects the computer's serial communications adapter to the RIB.		
HLN9390	AT to XT Computer adapter	Allows HKN9216 to plug into a XT style communications port.		
HKN9217	Program Test Cable	RIB to Radio Cable		
HKN9402	Power Supply Cable	Connects the power supply to the radio.		
HVN9054	Radio Service Software	Software on 3-1/2 in. diskettes.		

Test Equipment

The following table lists test equipment required to service the M1225 Mobile Radio and other two-way radios.

Motorola Model No.	Description	Characteristics	Application	
R2200, R2400, or R2001 with trunking option	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment	
*R1049	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements	
*S1100	Audio Oscillator	67 to 200 Hz tones	Used with service monitor for injection of PL tones	
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements	
R1053	Dual-trace Oscilloscope	20 MHz bandwidth, 5mV/cm - 20V/cm	Waveform measurements	
*S1350, *ST1215 (VHF) *ST1223 (UHF) *T1013	Wattmeter, Plug-in El- ements (VHF & UHF), RF Dummy Load	50-ohm, + 5% accuracy 10 Watts, maximum 0-1000 Mhz, 300W	Transmitter power output measurements	
S1339	RF Millivolt Meter	100uV to 3V RF, 10 kHz to 1.2 GHz	RF level measurements	
*R1013	SINAD Meter		Receiver sensitivity	
S1347 or S1348 (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 12.5Vdc	

Section 1 Radio Disassembly/Assembly

Overview

This section explains, step-by-step, how to disassemble and reassemble the M1225 radio.

Disassemble Radio

IMPORTANT

Before disassembling and reassembling the radio, wear a conducting wrist strap to prevent damage to any component on the main board from electrostatic discharge.

Remove Housing Cover

- Pull the volume control knob straight off.
- 2. Remove the housing cover by sliding a flat bladed screwdriver under the cover latch (located bottom of radio) and gently pry upward until the latch disengages. (Figure 1-1.)
- Slide the housing cover off of the heatsink rails.

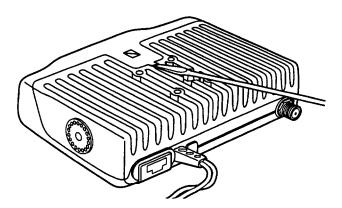


Figure 1-1. Remove Housing

Remove Front Panel Display Board

- Disconnect the flex connector cable from the black header on the main board by gently lifting upwards.
- 2. Remove the display board by tilting forward slightly and gently lifting upwards.

Remove Mechanical Components from Main Board

Refer to Figure 1-2 for steps 1 through 8 for the removal of the mechanical components from the main board. Refer to the exploded mechanical view diagram for more details.

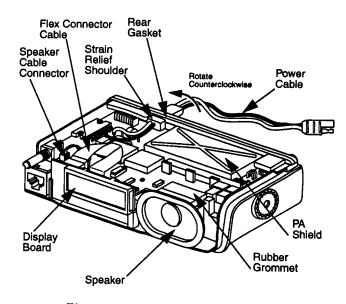


Figure 1-2. Mechanical Components

1. Pull the 2-pin speaker cable connector upwards to disconnect from the main board.

CAUTION

In order to avoid damage to the speaker, **Do Not** grasp the speaker cone when removing the rubber gasket/speaker from the heatsink.

- 2. Grasp the speaker at both edges and slide the rubber grommet/speaker upwards to remove from the heatsink.
- 3. On the rear gasket, pry the plug out of the square pocket.
- 4. Lift up the accessory connector flap located on rear of heatsink.
- 5. Lift and peel off the rear gasket from the heat-sink.

Reassemble Radio

- Disengage the power cable, from the double-D slot of the heatsink, by grasping and rotating the strain relief shoulder away from the PA shield (counterclockwise) and sliding upwards.
- Remove the shroud by unsnapping the catchtabs, located on the heatsink's inside wall, using a flat bladed screwdriver and firmly pulling the shroud away from the heatsink.
- 8. Gently pry off the PA shield cover using a flat bladed screwdriver.

Remove Main Board

- 1. Remove the Hex nut from the bottom of the heatsink using a 5/16" nut driver.
- Remove all 14 mounting screws from the main board using a T10 Torx® driver, being careful not to lose the display board support.
- Loosen the antenna connection using a 1/2" nut driver.
- 4. To remove the main board grasp the edge of the main board, the antenna connector, the microphone connector, and the 16-pin accessory connector using both hands and lift upwards and away from heatsink.

CAUTION

Make sure to avoid damaging the PA stud on the underside of the main board when lifting it upwards and away from the heatsink.

Reassemble Radio

Replace Main Board

1. Carefully place the main board into the heatsink, making sure that the PA stud clears the hole on the bottom of the main board.

NOTE

Make sure that the internal tooth washer and nut of the mini-U connector are on the outside of the heatsink wall.

2. Replace the 14 mounting screws and the display board support (refer to Figure 1-3) into the main board using a T10 Torx driver. Torque the 2 screws on the audio PA and the 2 screws on the transistor and regulator at 6-8 in-lbs. Torque the remaining 10 screws at 8-10 in-lbs.

3. Press down on the antenna connection and tighten using a 1/2" nut driver and torque at 20-24 in-lbs..

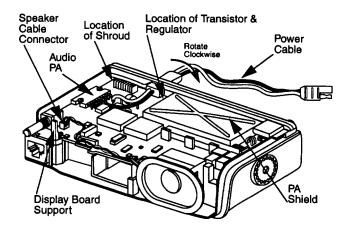


Figure 1-3. Position of Speaker Cable

Replace Mechanical Components to Main Board

- Rotate the strain relief shoulder away from the PA shield and insert into the double-D slot in heatsink
- Press the strain relief shoulder downward and rotate (clockwise) toward the PA shield until it is fully seated.

CAUTION

The power cable should be routed around the components properly and gently pressed into position (Figure 1-3).

- 3. Insert the shroud into the heatsink and press the catch-tabs onto the snaps.
- 4. Place the rear gasket onto the heatsink, making sure it fits between the wall of the heatsink and the PA frame while firmly pressing the five ribs into the five teardrop indentations on the heatsink.
- 5. Press the plug of the rear gasket into the square pocket at the rear of the heatsink.
- 6. Attach the Hex nut to the bottom of the heatsink using a 5/16" nut driver and torque to 5 in-lbs.
- Snap the PA shield cover into place on the PA shield frame, making sure not to pinch the rear gasket.

Reassemble Radio

8. Slide the rubber grommet/speaker downwards onto the posts on the heatsink with the word TOP facing up.

CAUTION

The speaker cable should be routed in front of the 10-position black header on the main board to prevent the housing's rear hook from dislodging and damaging the speaker connector when replacing the housing (Figure 1-3).

9. Connect the speaker connector into the 2-pin jack on the main board.

Replace Front Panel Display Board

1. Insert the display board into the slide rails by gently tilting the board slightly forward and gently pushing down until fully seated.

NOTE

Check that the tab on the main board is locked into the slot on the display board.

2. Connect the flex connector cable to the black header on the main board.

Replace Housing Cover

1. Insert the keypad into the housing and press as shown in Figure 1-4. Check to see that all five buttons on the keypad are secured and protruding properly through the housing.

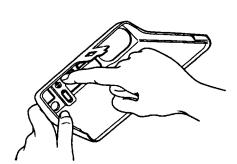


Figure 1-4. Insert Keypad

- 2. With the radio on a flat surface, place the housing approximately halfway on the heat-sink guide rails (Figure 1-5).
- Using both hands, press down on either side of the housing to assure that the heatsink and housing rails are aligned (Figure 1-5).

NOTE

Do not press on the keypad while sliding the housing onto the heatsink.

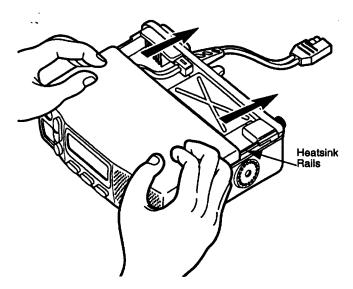


Figure 1-5. Align Housing Cover to Heatsink Rails

- 4. Slide the housing forward onto the heatsink rails, using both hands, Make sure that the power cord and the rear gasket clear the housingwhen the housing is flush with the rear of the heatsink.
- 5. Firmly press the housing cover and the heatsink together until the cover latch snaps into place (refer to Figure 1-6).

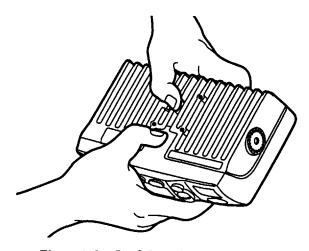


Figure 1-6. Lock Housing Cover into Place

NOTE

Verify that the outside corners of the gasket are properly inserted and aligned with the corners of the housing.

Insert the volume control knob by twisting the "D" shaft of the knob onto the volume control shaft while pushing inward. Install an Advantage™ Board into the AdvantagePort™

Install an Advantage™ Board into the AdvantagePort™

The M1225 radio has been designed with an AdvantagePort interface that allows compatible Advantage Boards to be field installed.

IMPORTANT

Before disassembling and reassembling the radio, wear a conducting wrist strap to prevent damage to any component on the main board from electrostatic discharge.

Disassemble Radio

- Refer to the "Remove Cover Housing" segment of this chapter to remove the cover housing.
- 2. Remove the three mounting screws from main board using a T10 Torx driver (Figure 1-7).

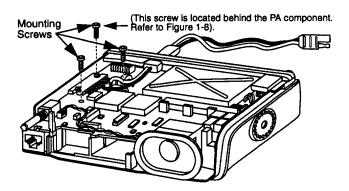


Figure 1-7. Location of Mounting Screws

Insert Advantage Board

1. Insert the three standoff screws into the main board using a 5mm nut driver and torque at 4.5-5.5 in.-lbs.

CAUTION

Avoid excessive force when opening or closing the cover flaps of the 16-pin connectors on both the option and main boards. Damage to the connector's could result!

- 2. Locate the 16-pin connector on the Advantage Board and gently lift the cover flap.
- 3. Locate the 16-pin connector on the main board and gently lift the cover flap.

- 4. With the component side of the option board facing up, insert and properly align the folded end (blue side up) of the flex connector cable into the 16-pin connector on the Advantage Board.
- 5. While holding the flex connector cable in place, gently close the cover flap.
- 6. Insert and properly align the other end (blue side up) of the flex connector cable into the 16-pin connector on the main board
- 7. While holding the flex connector cable in place, gently close the cover flap.
- 8. Align the power cables over the main board so they lay flat.
- 9. With the component side of the option board facing down, position the holes of the Advantage Board over the standoff screws on the main board (Figure 1-8).

NOTE

Make sure that the flex connector cable of the front panel display board is underneath the Advantage Board.

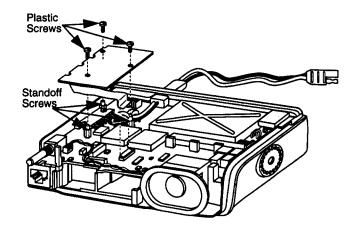


Figure 1-8. Position of Advantage Board

- 10. Insert the three plastic screws into the Advantage Board using a straight edge screw-driver and torque at 0.7-0.9 in.-lbs.
- 11. Refer to the "Replace Housing Cover" segment of this chapter to reassemble the housing cover.

Section 2 Theory of Operation

Overview

This section provides detailed theory of operation for the components of the M1225 mobile radio.

Receiver Circuitry

VHF Receiver Front End

The received signal applied to the radio's antenna input connector is routed through the harmonic filter and PIN diode antenna switch. In the receive mode, PIN diodes CR2450 and CR2451 are both off, allowing the signal to pass unattenuated to the receiver front end filter. The insertion loss of the harmonic filter/antenna switch is less than 1 dB. The harmonic filter provides 19 dB attenuation for image protection at 240 MHz, with increased attenuation at higher frequencies.

The signal is routed to a fixed-tuned 4 pole capacitive-coupled resonator filter having a 3 dB bandwidth of 50 MHz and a 1 dB bandwidth of 45 MHz centered at 162 MHz. Insertion loss is 1.7 dB. Attenuation for image protection is 42 dB at 240 MHz, with increasing attenuation at higher frequencies.

The output of the filter is matched to the base of RF amplifier Q1, which provides 19 dB of gain and has a noise figure of 3 dB. Current source Q2 is used to maintain the collector current of Q1 constant at 30 mA. Transistors Q1 and Q2 are supplied from the 5R source. This source is switched by transistor Q412 which is controlled by U401-54. 5R is only present in the receive mode. This reduces dissipation in Q1 during transmit. Diode CR1 clamps excessive input signals, protecting O1.

The output of Q1 is applied to a fixed-tuned 3-pole series- coupled resonator filter having a 3 dB bandwidth of 60 MHz and a 1 dB bandwidth of 45 MHz centered at 162 MHz. Insertion loss is 1.3 dB. Attenuation for image protection is 35 dB at 240 MHz, with increasing attenuation at higher frequencies.

A pin diode attenuator is located between the 3-pole filter and the first mixer. The bias current through this diode is switched by dual-composite transistor switch U2. In the Distance mode, U2 is turned on by a logic high at U2-4 from U401-57. CR2 is forward-biased which bypasses R11, and no loss is introduced. In the Local mode, U2 and CR2 are off (U401-57 is low),

inserting 10 dB of attenuation due to R11. Because the attenuator is located after the RF amplifier, receiver sensitivity is reduced only by 5 dB, while the overall third order input intercept is raised by 15 dB. Thus, the Local mode significantly reduces the susceptibility to IM-related interference.

The first mixer, U1, is a passive, double-balanced type. This mixer provides all of the necessary rejection of the half-IF spurious response, since the improvement due to filter selectivity is negligible at 150 MHz. High-side injection at +6 dBm is delivered to the first mixer from the injection buffer, Q271, in the VCO/buffer circuit.

The mixer output is connected to a diplexer network which matches its output to the first two pole crystal filter, Y51A, at the IF frequency of 44.85 MHz, and terminates it in a 51 ohm resistor, R51, at all other frequencies.

UHF Receiver Front End

The received signal applied to the radio's antenna input connector is routed through the harmonic filter and PIN diode antenna switch. In the receive mode, PIN diodes CR2650 and CR2651 are both off, allowing the signal to pass unattenuated to the receiver front end filter. The insertion loss of the harmonic filter/ antenna switch is less than 1 dB.

The signal is routed to a fixed-tuned 3 pole shunt resonator filter having a 3 dB bandwidth of 65 MHz and a 1 dB bandwidth of 40 MHz centered at 462 MHz. Insertion loss is 2.0 dB. Attenuation for image protection is 33 dB at 385 MHz, with increasing attenuation at lower frequencies.

The output of the filter is matched to the base of RF amplifier Q1, which provides 17 dB of gain and has a noise figure of 3 dB. Current source Q2 is used to maintain the collector current of Q1 constant at 30 mA. Transistors Q1 and Q2 are supplied from the 5R source. This source is switched by transistor Q412 which is controlled by U401-54. 5R is only present in the receive mode. This reduces dissipation in Q1 during transmit. Diode CR1 clamps excessive input signals, protecting O1.

The output of Q1 is applied to a fixed-tuned 4 pole shunt resonator filter having a 3 dB bandwidth of 58 MHz and a 1 dB bandwidth of 40 MHz centered at 462 MHz. Insertion loss is 2.8 dB. Attenuation for

Frequency Generation System

image protection is 43 dB at 385 MHz, with increasing attenuation at lower frequencies.

A pin diode attenuator is located between the 4 pole filter and the first mixer. The bias current through this diode is switched by dual-composite transistor switch U2. In the Distance mode, U2 is turned on by a logic high at U2-4 from U401-57. CR2 is forward-biased which bypasses R11, and no loss is introduced. In the Local mode, U2 and CR2 are off (U401-57 is low), inserting 10 dB of attenuation due to R11. Because the attenuator is located after the RF amplifier, receiver sensitivity is reduced only by 5 dB, while the overall third order input intercept is raised by 15 dB. Thus, the Local mode significantly reduces the susceptibility to IM-related interference.

The first mixer, U1, is a passive, double-balanced type. This mixer provides all of the necessary rejection of the half-IF spurious response, since the improvement due to filter selectivity is negligible at 474 MHz. Low-side injection at +6 dBm is delivered to the first mixer from the injection buffer, Q271, in the VCO/buffer circuit.

The mixer output is connected to a diplexer network which matches its output to the first two pole crystal filter, Y51A, at the IF frequency of 44.85 MHz, and terminates it in a 51 ohm resistor, R51, at all other frequencies.

Receiver Back End

Q51 amplifies the IF signal from Y51A by approximately 20 dB. The output of Q51 is matched to a second two pole crystal filter, Y51B. The overall 3 dB bandwidth of the crystal filters is 17 kHz. The signal from Y51B is applied to the input of the receiver system IC U51-13. Diode CR51 prevents overload of the second mixer in the receiver system IC.

Q52 is controlled by crystal Y52 which provides the low side injection second local oscillator signal applied to U51-12. The filtered and amplified 44.85 MHz first IF signal mixes with the second local oscillator signal at 44.395 MHz to produce a second IF signal at 455 kHz. The second IF signal is then filtered by switchable ceramic filter FL51 or FL53, amplified, then filtered by switchable ceramic filter FL52 or FL54 and applied to the audio detector. U401-53 controls the bandwidth select switch, Q53, to switch the narrower bandwidth ceramic filters FL51 and FL52 for 12.5 kHz channel spacing or the wider ceramic filters FL53 and FL54 for 20/25/30 kHz channel spacing.

The audio detector is a phase-locked loop type. The free-running oscillator frequency is determined by capacitor C61. Detected audio from U51-31 is routed via noise-peak limiting stage U552 to Rx IN and PL In ports on the audio filter IC (AFIC) U401 (pins 14 and 15 respectively), and also via CMOS switch U553B to opamp U551B, where output is routed to the accessory connector J3-11 (see "Low-Level Rx Audio").

U51 also contains the carrier-squelch circuitry. When an on-channel signal is present, the amount of high-frequency audio noise, at the detector, is reduced. This change in noise level is sensed to indicate the presence of an on-channel signal. The bandwidth of the sampled noise is determined by C64, C65, R59, R60, and R71 switched by Q54. U401-53 controls Q54 for 12.5 kHz or 20/25/30 kHz channel spacing operation. Squelch sensitivity is adjusted electronically by an attenuator in U402. Squelch noise is routed from U51-26 to U402-23, and the adjusted noise level is returned from U402-26 back to U51-23. This noise level is detected in U51 and compared to a preset threshold. Noise levels greater than a preset threshold, indicating weak or no signal present, cause U51-18 to go low. This is routed to microcomputer port PC5 (U401-55). When the noise level decreases below the threshold, due to on-channel quieting, U51-18 and therefore U401-55 go high. This indicates an on-channel signal is present, and the microcomputer unmutes the audio path.

Components R57, C68 and C69 determine squelch time constants as a function of the charging currents supplied by U51. These charging currents vary from weak to strong signal conditions, providing a variable squelch closing time-constant. For weak signals the time constant is long to minimize "chattering" or rapid muting and unmuting of the audio. For strong signals, where the carrier-absent to carrier-present conditions are substantial, the closing time-constant is shortened to minimize the length of the "squelch-tail".

Frequency Generation System

The frequency generation system utilizes two IC's, the Fractional-N Synthesizer (U201) and the VCO/Buffer (U251). Designed to maximize compatibility, the two IC's provide many functions which would normally require additional circuitry.

The frequency generation circuitry is supplied from the analog 5 V supply regulated by U405. The synthesizer IC further filters this voltage (SUPFOUT, U201-18, 4.65 Vdc) and supplies it to the VCO/Buffer IC.

The synthesizer also interfaces with the logic and AFIC circuitry. Synthesizer programming is accomplished through the SR DATA (U201-5), SR CLOCK (U201-6), and SYN LE (U201-7) lines by microcomputer U401. A serial stream of 98 bits is sent whenever the synthesizer is programmed. Synthesizer lock is indicated by a logic high at LOCK DET pin U201-2, and a logic low indicates out- of-lock.

In the transmit mode, modulation from the attenuators in the AFIC (U402-27 and 28) is resistively summed and applied to U201-8. The audio is digitized within U201 and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for balancing of the high and

Transmit and Receive Audio Circuitry

low port modulation, before being applied to the VCO from U201-28.

The AFIC employs switched-capacitor filters which require an external 2.1 MHz clock signal. This clock is generated in U201 by dividing the 16.8 MHz reference oscillator. The signal, at U201- 11, is filtered, attenuated, and applied to U402-43 at a level of approximately 2 Vp-p.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-3, R201-2, and CR201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor CR201 is determined by a temperature compensation algorithm within U201, and is specific to each crystal Y201 based on a unique code assigned to the crystal.

The divided frequencies of the reference oscillator and the VCO signal (as applied to U201-20) are compared to generate the necessary correction voltage, or steering line voltage, which maintains the proper VCO frequency. The steering line voltage from U201-29 is filtered and applied to varactors CR241 and CR251 to control the frequencies of the receive and transmit VCOs respectively. To achieve fast lock time, an internal adaptive charge pump provides higher momentary current capability at U201- 31 than in the normal steady-state mode. The normal and adapt charge pumps receive their dc supply from a voltage-multiplier circuit which includes CR211, CR212 and associated capacitors C210-C216. By combining two 5 V square waves which are 180 degrees out-of-phase and adding this to the regulated 5 V supply, a source of approximately 12.6 Vdc is available at U201-32. The current for the normal mode charge pumps is set by R242. The pre-scaler for the loop is internal to U201 with the value determined by the frequency band of operation.

VCO

The VCO (U251) used in conjunction with the Fractional-N synthesizer (U201) generates an RF signal for both receive and transmit modes. The TRB line (U251-5) determines which oscillator and buffer is enabled, as described below. A sample of the RF signal from the enabled oscillator is routed from U251-23 to the prescaler input U201-20 via a matching network. After frequency comparison with the reference in the synthesizer, a resultant control voltage is applied to the varactors CR241 and CR251. This voltage, when locked, is between 3 and 10 V depending on VCO frequency.

In the receive mode, U251-5 is low, enabling the receive VCO and buffer in U251. The RF output signal at U251-2 is further amplified by Q271, low-pass filtered, and

matched to the 50 ohm injection port of first mixer U1 at a level of +6 dBm.

During transmit, U251-5 is high, activating the transmit VCO and buffer. The RF output signal at U251-4 is low-pass filtered and matched into Q281 for further amplification before being applied to the RF power amplifier. A resistive attenuator (R284 through R286) isolates the VCO and buffer from impedance variations presented by the power amplifier for improved stability. The power output presented to the first stage (Q2610) of the RF power amplifier is +13 dBm.

Transmit and Receive Audio Circuitry

The majority of Rx and Tx audio processing is performed by U402, the Audio Filter IC (AFIC), which provides the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter in Rx audio path
- Tx pre-emphasis amplifier
- Tx audio limiter
- Post-limiter (splatter) filter
- Tx deviation adjust digitally-controlled attenuators
- Programmable microphone gain attenuator
- Carrier squelch digitally-controlled attenuator
- Microcomputer output port expansion
- 2.5 Vdc reference source

The parameters of U402 which are programmable are selected by the microcomputer via the SR CLOCK (U402-39), SR DATA (U402-38) and chip enable (U402-41) lines.

Rx Audio Path

Low-Level Rx Audio

Detected audio from the IFIC U51-31 is routed via C553 to the switchable-gain limiter stage U552. The gain of limiter stage U552 is changed for 12.5 kHz or 25 kHz channels so that its output limits at slightly greater than full system deviation in either case. This limits the loudness of noise relative to voice during fading, weak signal conditions and squelch tails. Output is taken from this stage at two places. Pin 4, which is the (-) input, serves as an output which feeds AFIC ports Rx IN (pin 14) and PL IN (pin 15) via C551. The feedback around the op amp stage maintains the signal at U552-4 exactly equal to the signal applied to the (+) input, but the signal at U554-4 benefits from the selectable noise limiting threshold. Gain adjustments in the receive audio path for 12.5 or 25 kHz channels are then made in the AFIC. A second output from the limiter stage is taken at pin 1 and is affected by the gain change of U552 so that the level is a constant 840 mV rms at 60% deviation for either 12.5 or 25 kHz channels. This

2-3

Transmit and Receive Audio Circuitry

level is attenuated 12 dB by R573, R579 and R580 and routed to the Detector Audio Send pin of the AdvantagePort™ connector (J13-16).

Detected audio from the IFIC U51-31 is also routed via a switchable-gain path (R577, R578 and U554A) to analog switch U553B (see "Accessory Connector Rx Audio Path").

The audio applied to the AFIC at U402-14 (Rx IN) is sharply high- pass filtered to remove all PL and DPL tones below 300 Hz. Audio is then routed through a digitally controlled attenuator which is set to approximately 6 dB attenuation. This attenuation is non-adjustable and maintains the output at U402-31 (Rx OUT) at a fixed and defined level of 450 mV rms for 60% deviation, since this level is applied to the AdvantagePort connector (J13-6). Receive volume adjustment is accomplished at a later point using the volume control R554. The internal de-emphasis characteristic within U402 is enabled, with the result that audio at U402-31 is de-emphasized but unmuted.

This audio signal is processed by the option board if present, or passed through resistor R551 if no option board is installed, and then fed to the expander portion of compander IC U555. The operation of the compander is described below. The output from the compander IC is routed through mute gate U554D, amplified by U551A and fed to the volume control, and also to handset audio buffer U551D (see "Handset Audio Path") and analog switch U553B (see "Accessory Connector Rx Audio Path").

Audio Power Amplifier

Audio from the wiper of the volume control is amplified by the audio power amplifier IC U501. This is a bridge amplifier delivering 7.8 V rms between pins 4 and 6 without distortion. This is sufficient to develop 7.5 watts of audio power into an external 8 ohm load, or approximately 4 watts of audio power into an internal 16 ohm speaker (under this condition, undistorted audio output voltage swing exceeds 8 volts rms). The audio power amplifier is muted whenever speaker audio is not required, to reduce current drain and eliminate noise in the speaker. The audio amp is muted when U501-8 is low. This occurs if Q501 is saturated (U402-9 high) or when the radio is turned off. The current drain into supply pin U501-7 is negligible when U501-8 is low.

Because the power amplifier is a bridge-type, neither speaker terminal is grounded. Care should be taken that any test equipment used to measure the speaker audio voltage does not ground either speaker output terminal, otherwise damage to the audio power amplifier IC may result. If the test equipment input is not isolated from ground, voltage measurements may be made from one of the speaker output terminals (J3-1 or J3-16) to ground, in which case the voltage indicated

will be one half of the voltage applied to the speaker or load resistor. When an 8-ohm load resistor is used, it should be connected across pins 1 and 16 of J13, never to ground.

Handset Audio Path

Rx audio from U551A-1 is amplified by op amp U551D and applied to the microphone connector J5-8 for use with a telephone-type handset. This audio is deemphasized, and muted by U554D. It is also affected by any receive audio processing circuits on the option board, if installed, and by the compander, if enabled. When the radio has been programmed for handset operation, the audio power amplifier is muted whenever the handset is off-hook by a logic high from U402-9. This silences the speaker when the handset is in use.

Accessory Connector Rx Audio Path

Rx audio is amplified by stage U551B and is available at the accessory connector pin 11. This audio may be one of two types, depending on the RSS programming of analog switch U553B.

If U553B-10 is programmed high, the audio fed to U551B comes from the receiver's detector audio via a switchable-gain path using R577, R578 and U554A. In this case, audio at the accessory connector (J3-11) is "flat" (non-de-emphasized) and unmuted.

If U553B-10 is programmed low, the audio fed to U551B comes from U551A. Audio at J3-11 is de-emphasized and muted. This path will also be affected by any receive audio processing circuits on the option board, if installed, and by the compander, if enabled.

PL Decoder

Detected Rx Audio which has been limited by stage U552 is applied to the AFIC PL IN port (U402-15), where it first passes through the Tone PL filter or Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then coupled to the PL detector circuit, with detected output at U402-35. The detected PL signal is coupled from U402-35 to microcomputer port PA1 (U401-15) where algorithms perform the final PL decoding. Data for the tone PL frequency or Digital PL code for each mode is programmed through the Radio Service Software.

AdvantagePort™ Internal Option Board Rx Audio Path

De-emphasized, unmuted audio is available at J13-6 for use by an internally installed option board. If this audio is to be processed and returned to the radio's receive audio path, the processed audio will be returned from a low-impedance source on the option board to J13-8. The unprocessed audio through R551 is shunted due to the low source impedance of the option

Transmit and Receive Audio Circuitry

board at J13-8. Since the gain of the AFIC is different for 12.5 or 25 kHz channels, the RX audio level at J13-6 is always 450 mV at 1 kHz and 60% deviation, regardless of the channel spacing. Similarly, audio returned to J13-8 from the option board should be supplied at a level of 130 mV rms at 60% deviation, regardless of the channel spacing.

Non-de-emphasized, unmuted audio is available at J13-16. Options requiring non-de-emphasized audio may use this, or may re-pre- emphasize the audio at J13-6, depending on the design of the option board. Because the gain of stage U552 is different for 12.5 or 25 kHz channels, the RX audio level at J13-16 is always 210 mV at 60% deviation, regardless of the channel spacing.

Noise Squelch Attenuator

The AFIC contains a 16 step programmable digital squelch attenuator whose input is U402-23 and output is U402-26. Noise squelch sensitivity is set using RSS, with open squelch at step 0 and maximum (tight) squelch at step 15.

Tx Audio Path

Voice Path via Front Panel

Microphone audio from the front panel mic jack J5-5 is attenuated from 80 mV rms (for 60% deviation at 1 kHz) to 65 mV by R658 and R659. When mic PTT is sensed from J5-6, CMOS gate U554C is enabled by a logic low at U402-5, which is inverted by Q651 to provide a logic high at U554C-6.

This audio is fed to the compander IC where it is amplified from 65 mV to 100 mV by an op amp gain stage (pins 7 and 6) and then applied to the compressor portion of the compander (pin 3). The output (pin 2) is attenuated back to the original 65 mV rms level by another op amp stage (pins 9 and 10) and applied as a low-impedance source to the Tx Audio Send pin of the AdvantagePort connector (J13-10).

Voice Path via Accessory Connector

Microphone audio from an accessory such as a desk set applied to External Mic Audio input J3-2 is attenuated from 80 mV rms (for 60% deviation at 1 kHz) to 65 mV by R666 and R665. When External Mic PTT is sensed at J3-3 (or from any programmable input to which Ext Mic PTT has been assigned), CMOS gate U554B is enabled by a logic high at U401-47.

This audio is fed to the compander IC and processed as described above for the Voice Path via Front Panel.

AdvantagePort™ Internal Option Board Tx Audio Path

Non-pre-emphasized microphone audio is available at J13-10 for use by an internally installed option board. If this audio is to be processed and returned to the radio's transmit audio path, the processed audio will be returned from a low-impedance source on the option board to J13-12 (Tx Audio Return). The unprocessed audio through R654 is shunted due to the low source impedance of the option board at J13-12. Since deviation is adjusted appropriately by the AFIC for 12.5 or 25 kHz channels, the TX audio level at J13-10 and J13-12 is always 65 mV for 60% deviation at 1 kHz, regardless of the channel spacing.

Some option boards must be able to modulate the transmitter with very low frequency data. The Post-Limiter Flat Tx Audio Return pin (J13-2) is used for this application. Audio from this pin is routed to the AUX Tx IN pin on the AFIC (U402-20) via summing op amp stage U551C. A level of 150 mV rms will produce 60% deviation regardless of channel spacing. This path bypasses the limiter stage in the AFIC, therefore the option board must provide the necessary amplitude limiting of this signal to prevent overdeviation. The AUX Tx IN path of the AFIC must be enabled via software control for this path to be active.

Pre-emphasis of Microphone Audio Signals

Pre-emphasis of the front panel or accessory microphone audio signal occurs after the AdvantagePort option board processing has occurred. Series capacitor C651 provides the pre-emphasis characteristic of audio applied to the Tx IN pin of the AFIC (U402-17). This pin is the summing junction of an inverting op-amp gain stage within U402. Audio processing, including limiting, splatter filtering, and level adjustment are performed within U402. The outputs of the two programmable deviation-adjustment attenuators (U402-27 and 28) are resistively summed and applied to the VCO modulation input of the frequency generation system.

Flat (Non-Pre-Emphasized) Tx Audio Path via Accessory Connector

Audio applied at J3-5 may be routed to the transmitter either before the limiter (PRE-LIM) or after (POST-LIM). This is programmed using RSS. The path is controlled by CMOS gate U553C, as controlled by U402-8 (low for PRE-LIM, high for POST-LIM). When the POST-LIM path is chosen, audio is routed via R671 and op amp U551C to the AUX TX INPUT (U402-20), therefore this input of the AFIC must be enabled via software control whenever an accessory connector PTT is sensed at J3-3 (or from any programmable input to which Accessory PTT has been assigned).

Transmitter Circuitry

If the PRE-LIM path is chosen, audio is coupled by C655 and R670 to the summing input of an op amp within U402 (pin 17). Because R670 is significantly larger than R671, R669 provides a charging path for C655 when the PRE-LIM route is selected which is equivalent to the charging path via R671 in the POST-LIM path.

Audio present at J3-5 is muted during transmitter keyup until the frequency synthesizer has settled and locked on-frequency. This prevents unintentional frequency offset due to the presence of modulation while PTT is keyed. Muting occurs when U401-9 provides a low to U553A-11. While muted, R672 maintains the same dc bias on C655 to prevent switching transients.

Tx Data Encoder (D/A Converter)

Data such as MDC or DTMF signalling can be encoded into the TX audio path by generating the waveform at ports PA3, PA4 and PA5 of U401 (pins 13, 12 and 11 respectively). These outputs are resistively summed and weighted to allow either square waves or pseudosinewaves to be encoded. Op amp U551C provides active summing and outputs the signal to the AUX Tx IN port of the AFIC (U402-20). Connection is also made to the AUX Rx IN port (U402- 13) to allow true sidetones to be heard, for example when DTMF tones are encoded. The AUX Tx IN path of the AFIC must be enabled via software control when the data encoder is operating.

The data encoder circuit may not be utilized in all models.

Compander Operation

The compander circuit of U555 is used to improve the signal-to- noise ratio of the voice communications path. This is accomplished by compressing the microphone signal during transmit by a ratio of 2:1 so that a 60 dB range of level changes at the microphone are reduced to only a 30 dB change before being transmitted. A complimentary expander circuit in the receiver audio path restores the 30 dB range of the received signal to its original 60 dB range before being applied to the speaker. Any noise occurring in the over-the-air transmission which is more than 30 dB below full deviation is reduced to greater than 60 dB below the peak voice level at the speaker, making such noise essentially inaudible.

The effectiveness of the compander system requires that both the transmitter and receiver utilize companding. It is possible to program the compander off on a per-channel basis using RSS, for use in systems with other radios that do not have the compander feature. The compander is active when U555-8 is low, and is bypassed when U555-8 is high. When in the bypass mode, the gain of the compressor (pin 3 in, pin 2 out) and expander (pin 14 in, pin 15 out) circuits is unity.

Q553 and C581 keep the compander turned off for approximately one second when the radio is turned on, to allow the compander circuits sufficient time to stabilize. At turn-on, U401-30 pulses low, which turns on Q553 and quickly charges C581 to 5 V, bypassing the compander. If the compander should be on, U401-30 stays high, and C581 discharges due to the internal resistance of U555-8. After one second, the voltage at U555-8 is low enough to enable the compander. If the compander should be off, U401-30 remains low, keeping Q553 on and U555-8 high.

Q554 and Q555 are used to increase the receive audio path gain by approximately 4 dB whenever the compander is turned on. This maintains the same subjective audio level for both compander and noncompander channels.

Public Address Operation

When the public address switch box and amplified speaker(s) accessories are used, and the radio has been programmed by RSS for public address, operation is as follows:

Turning on either the INT PA or EXT PA switches on the public address switch box provides a low at pin 14 of accessory connector J3. This enables public address operation of the radio. In this condition, radio receiver operation is unaffected, but keying of the transmitter is inhibited. If a MIC PTT is sensed from microphone jack J5-6, both the INT MIC ENABLE and EXT MIC ENABLE lines go high (U402-5 is low and U401-47 is high). This turns on both mic audio gates U554C and U554B, and allows audio from the microphone jack J5-5 to be routed directly to accessory connector J3-2. Mic audio from J3-2 is then routed to the selected public address amplified speakers by the public address switch box.

To prevent loading of the mic audio signal and loss of low frequency response, U651 senses that both INT MIC and EXT MIC enable lines are high and provides a low at its output, turning off U652 and removing the loading of R665 from the audio path. At all other times, U652 is on to provide microphone bias voltage to the external mic input via R665.

Transmitter Circuitry

VHF 40 Watt Transmitter RF Power Amplifier

The 40 watt VHF power amplifier is designed to cover the range of 150-174 MHz and has four stages. The first stage, Q2410, operates in Class A from the 8T source. It provides 13 dB of gain and an output of 400 mW.

The second stage, Q2420, has a nominal gain of 9.4 dB and power output of up to 3.5 watts. The output of this

Transmitter Circuitry

stage is adjusted by the controlled B+ voltage which supplies its collector. (VB+ max = 6.55 V).

The third stage, Q2430, operates in Class C with 8.1 dB gain and output power up to 22 watts. Collector voltage is directly from UNSW B+.

The fourth stage, Q2440, is the final RF power amplifier, which operates in Class C, is directly from UNSW B+. It provides up to 65 watts output.

A directional coupler, located between the final power amplifier and the harmonic filter, monitors the forward and reflected power. The sampled RF is rectified by diodes CR2480 (forward power) and CR2481 (reflected power) and the resulting dc voltage is routed to the power control circuit.

The antenna switch consists of two pin diodes, CR2450 and CR2451. L2452 and C2450, combined with the "on" inductance of CR2451, form a series resonant circuit to lower the shunt impedance presented by CR2451 when it is turned on. In the receive mode, both diodes are off. Signals applied at the antenna jack J1 are routed, via the harmonic filter, through L2451 and C2453 to the receiver input. In the transmit mode, 8T is present and both diodes are forward-biased into conduction. The transmitter RF from Q2440 via the directional coupler is routed through CR2450, and via the harmonic filter to the antenna jack. CR2451 conducts, shunting RF power and preventing it from reaching the receiver. L2451 is selected to appear as a 1/4 wave at VHF, so that the low impedance of CR2451 appears as a high impedance at the junction of CR2450 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

The harmonic filter is a seven pole 0.1 dB ripple Chebychev low pass filter with a 3 dB frequency of approximately 200 MHz and less than 1 dB insertion loss in the passband.

UHF 10-40 Watt Transmitter RF Power Amplifier

The 40 watt UHF power amplifier is designed to cover the range of 450-474 MHz and has four stages. The first stage, Q2610, operates in Class A from the 8T source. It provides 11.8 dB of gain and an output of 300 mW.

The second stage, Q2620, has a nominal gain of 8.2 dB and power output of up to 2 watts. The output of this stage is adjusted by the controlled B+ voltage which supplies its collector.

The third stage, Q2630, operates in Class C with 8.1 dB gain and a power output of up to 13 watts. Collector voltage is directly from UNSW B+.

The fourth stage, Q2640, is the final RF power amplifier, which operates Class C directly from UNSW B+. It

provides up to 30 watts output for low power and 50 watts output for high power.

A directional coupler, located between the final power amplifier and the harmonic filter, monitors the forward and reflected power. The sampled RF is rectified by diodes CR2680 (forward power) and CR2681 (reflected power) and the resulting dc voltage is routed to the power control circuit.

The antenna switch consists of two pin diodes, CR2650 and CR2651. L2652 and C2650, combined with the "on" inductance of CR2651, form a series resonant circuit to lower the shunt impedance presented by CR2651 when it is turned on. In the receive mode, both diodes are off. Signals applied at the antenna jack J1 are routed, via the harmonic filter, through L2651, C2653, and L2664 to the receiver input. In the transmit mode, 8T is present and both diodes are forward-biased into conduction. The transmitter RF from Q2640 via the directional coupler is routed through CR2650, and via the harmonic filter to the antenna jack. CR2651 conducts, shunting RF power and preventing it from reaching the receiver. L2651 is selected to appear as a 1/4 wave at UHF, so that the low impedance of CR2651 appears as a high impedance at the junction of CR2650 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

The harmonic filter is a seven pole 0.1 dB ripple Chebychev low pass filter with a 3 dB frequency of approximately 600 MHz and less than 1 dB insertion loss in the passband.

Power Control Circuit

The power control circuit is a dc-coupled amplifier whose output is the controlled voltage applied to the second stage of the RF power amplifier (Q2420 in VHF or Q2620 in UHF).

The input voltage to U451A-2 is a dc voltage from the directional coupler forward power detector, and is proportional to RF power output. This is compared to a dc voltage applied to U451A-3 which is proportional to the desired output power setting. This voltage is obtained by integrating a series of square wave pulses from port PH1 of the microprocessor (U401-26). The duty cycle of these pulses is varied in proportion to the desired output power setting. Components R458, C467, R457 and C458 integrate the PWM pulses into a smooth dc voltage.

The power control loop varies the output of stage Q2420 or Q2620 as necessary to keep equal voltages at U451A pins 2 and 3, and thus maintains forward power at the adjusted setting.

Under conditions of poor antenna match resulting in high reflected power, the dc voltage at U451A-3 is

PTT Circuits

reduced due to a lowering of the voltage at U451B-7. This is interpreted by the power control circuit as a lowering of the desired output power.

The temperature-sensing circuit protects the PA devices from excessively high temperatures. As the PA temperature increases, the resistance of thermistor R462 decreases. This causes Q453 to conduct, reducing the voltage at the base of Q452. This reduces the conduction of series pass device Q451, lowering the control voltage and therefore the output power.

Over-voltage protection prevents the control voltage from rising so high that the subsequent transmitter stages may be overdriven. Zener diode VR451 conducts when the control voltage exceeds 5.3 V in VHF models or 10.6 V in UHF models. This causes Q453 to conduct, lowering the control voltage as described earlier.

PTT Circuits

The logic system uses a single microcomputer A/D input port PE1 (U401-36) to distinguish between two different types of PTT information. This is done by assigning different voltage levels to the different PTT functions as follows:

0 to 2.1 Vdc (0.6 Vdc typ): Microphone PTT 2.2–3.6 Vdc (2.6 Vdc typ): Accessory PTT 4.75 to 5.0 Vdc (5.0 Vdc typ): Receive Mode

A microphone connected via the front panel jack J5 must present a low of less than approximately 2.0 V dc to be correctly interpreted as MIC PTT and cause the appropriate audio paths to be enabled. Similarly, an accessory whose PTT output is connected to J3-3 must present a low of less than approximately 2.0 V dc to be interpreted as an accessory PTT. This voltage is shifted to the range between 2.2 and 3.6 V by series resistor R432.

Some accessories connected to J3 need to sense microphone PTT by looking for a low at J3-3. Diode CR408 causes J3-3 to be pulled low whenever microphone connector J5-6 is low.

Programmable I/O's

Pins 4, 6, 8, 9, 12, and 14 are programmable I/O's. They are used to control external accessories by the radio, or for control of radio functions by accessories.

Pin 4 is an output only. When U401-21 is high, Q901 and Q902 are on, and pin 4 is pulled high to the battery voltage. This is normally used to turn on a relay for activating the vehicle's horn or lights.

Pin 6 is an input only. Normally, R905 pulls pin 6 high, turning on Q903 and pulling U401-45 low. If pin 6 is pulled low, U401-45 goes high.

Pin 8 is an I/O (input and output). To function as an input, Q905 is turned off by keeping U401-20 low. Then, R907 pulls pin 8 high, turning on Q904 and pulling U401-44 low. If pin 8 is pulled low, U401-44 goes high. To function as an output, Q905 pulls pin 8 low whenever U401-20 is high.

Pin 9 is an input only. Normally, R909 pulls pin 9 high, turning on Q906 and pulling U401-46 low. If pin 9 is pulled low, U401-46 goes high. The emergency switch accessory, if used, is connected here.

Pin 12 is another I/O. To function as an input, Q909 is turned off by keeping U401-19 low. Then, R913 pulls pin 12 high, turning on Q908 and pulling U401-43 low. If pin 12 is pulled low, U401-43 goes high. To function as an output, Q909 pulls pin 12 low whenever U401-19 is high.

Pin 14 is also an I/O. To function as an input, Q911 is turned off by keeping U401-22 low. Then, R915 pulls pin 14 high, turning on Q910 and pulling U401-42 low. If pin 14 is pulled low, U401-42 goes high. To function as an output, Q910 pulls pin 14 low whenever U401-22 is high.

Zener diodes and bypass capacitors on each programmable I/O line prevent damage or abnormal operation due to ESD transients or RF fields.

The extent to which programmable I/O functions are supported may vary with different radio models. RSS allows the functions which are supported to be programmed.

DC Regulation and Distribution

Unswitched B+ supplies operating voltage directly to the RF power amplifier third and fourth stages, the power control series pass device Q451-E, the RAM keep-alive constant voltage supply to U401-62, the audio power amplifier supply pin U501-7 and, via fuse F401, to the on-off switch and external alarm switch transistor Q902-E. All of these circuits draw negligible current when the radio is turned off (less than 15 mA total).

When the on-off switch is "on," battery voltage is applied to 8 volt regulator U406, and via R502 to pin 8 of the audio power amplifier U501 which turns it on unless muted by Q501. The regulated output of U406 is routed to the display board for backlighting, to 8T transistor switch Q414, to U51 pins 16 and 17, to op amp U551 supply pin 4, and to the inputs of the 5 volt regulators U404 (digital) and U405 (analog). Separate analog and digital regulators are used to minimize microcomputer noise from being introduced into sensitive VCO and receiver circuits. The digital 5V regulator includes a reset timer which hold the reset line U404-3 low for a predetermined time after the radio is turned on. Zener diodes on the 8V and digital 5V lines minimize susceptibility to ESD damage.

20-Channel LCD Front Panel Display Board

Ignition control of the radio is accomplished by removing fuse F401. The radio will only be able to turn on if battery voltage from the vehicles ignition switch is applied to accessory connector J3 pin 10. This voltage is routed to the on-off switch.

20-Channel LCD Front Panel Display Board

The 8-character display board contains back lighting LED's, and an LCD that is driven by the LCD driver IC, U1101. When the LCD driver, U1101, is enabled via the CE (Chip Enable) input, the desired display information is then loaded serially via the SR Data line into U1101 from the microprocessor. U1101 also has a clock input that is connected to the main board SR Clock.

The back lighting for the 8-character display board can be toggled between two colors, amber and green per the users choice. This color choice for the LED's is controlled by the microprocessor, which in turn gets its input from either the RSS setup, or one of the pushbuttons if so enabled. Each color of back lighting is produced by 12 pairs of LED's, which are turned on by applying a ground to the cathodes of the 12 pairs of LED's.

To enable the amber LED's, a DC level of 5 V from the microprocessor is applied to the base of Q1108. This 5 V saturates Q1108 which connects a ground to the amber LED cathodes and also the base of Q1107. With the base of Q1107 grounded, the transistor operates in the cutoff mode which leads to the collector having a potential of ~8 V, which is also applied to the cathode of the green LED's.

To enable the green LED's, a DC level of 0 V (ground) to the base of Q1108 keeps Q1108 in cut-off mode which leads to the collector of Q1108 having a potential of 8 V. This 8 V potential on the collector of Q1108 is also

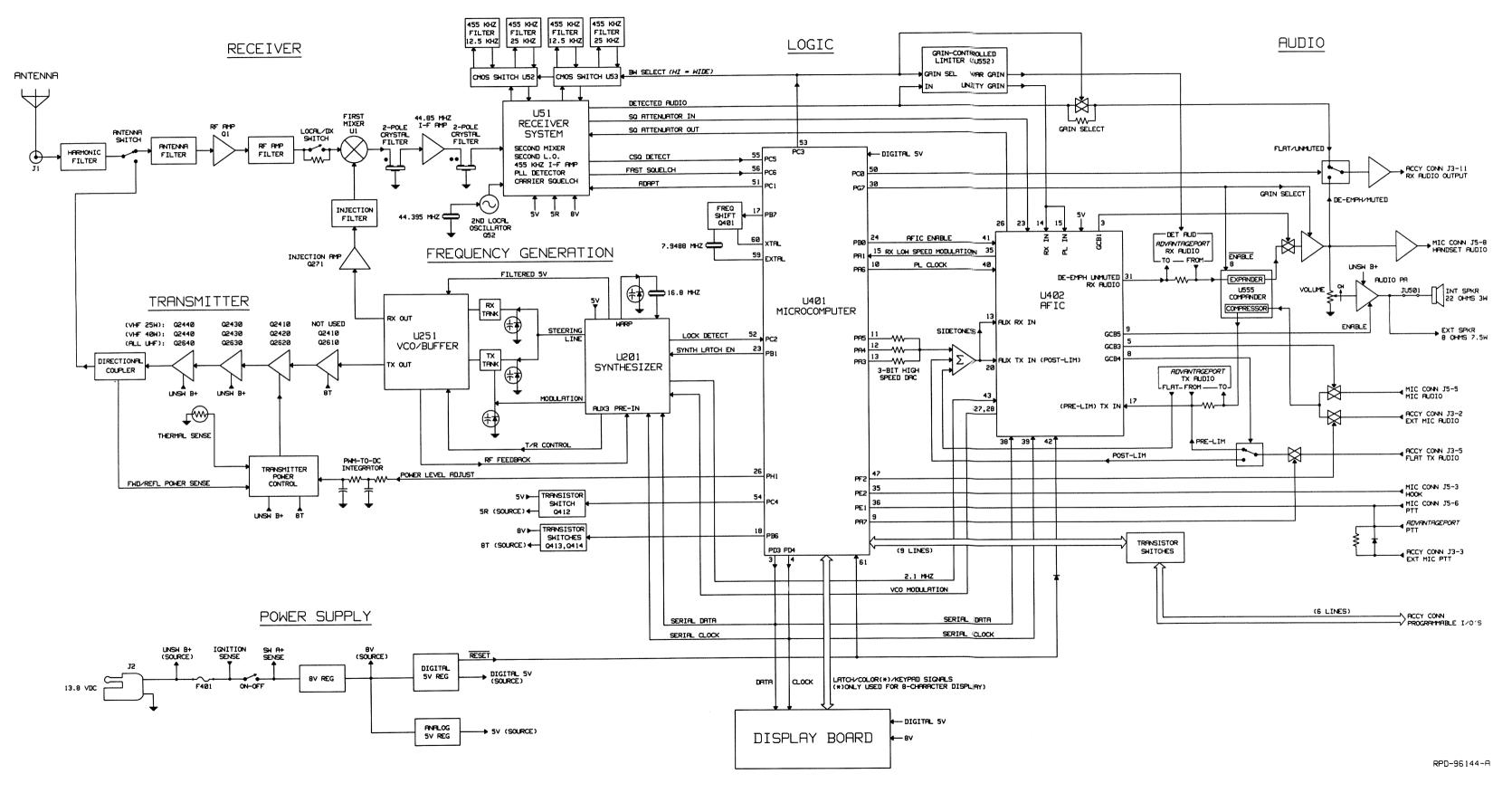
applied to the base of Q1107 via R1125, thus saturating Q1107 and connecting the green LED's to ground.

The six pushbuttons apply voltage to the bases of six digital transistors, Q1101 through Q1106. The appropriate transistor, in turn, grounds a tap on the series resistor ladders R1117 through R1122, producing a different DC level depending on which button is pressed. These DC levels are interpreted by an A/D input of the microprocessor (U401-37) and the corresponding function is enabled. The transistors ensure that the DC ladder voltage is consistent, although the series resistance of the keypad may vary.

4-Channel LED Front Panel Display Board

The LED display board contains back lighting LEDs for the keypad, channel indicator LEDs; and status indicators for transmit, monitor, and options. The channel and status display information is loaded serially into the shift register, U101. This information is then latched and turns on the LEDs, DS101 - DS105 and DS1012 - DS1014 via the driver transistors, Q1001 - Q1008.

The six pushbuttons apply voltage to the bases of six digital transistors, Q1009 through Q1014. The appropriate transistor, in turn, grounds a tap on the series resistor ladders R1017 through R1022, producing a different DC level depending on which button is pressed. These DC levels are interpreted by an A/D input of the microprocessor (U401-37) and the corresponding function is enabled. The transistors ensure that the DC ladder voltage is consistent, although the series resistance of the keypad may vary.

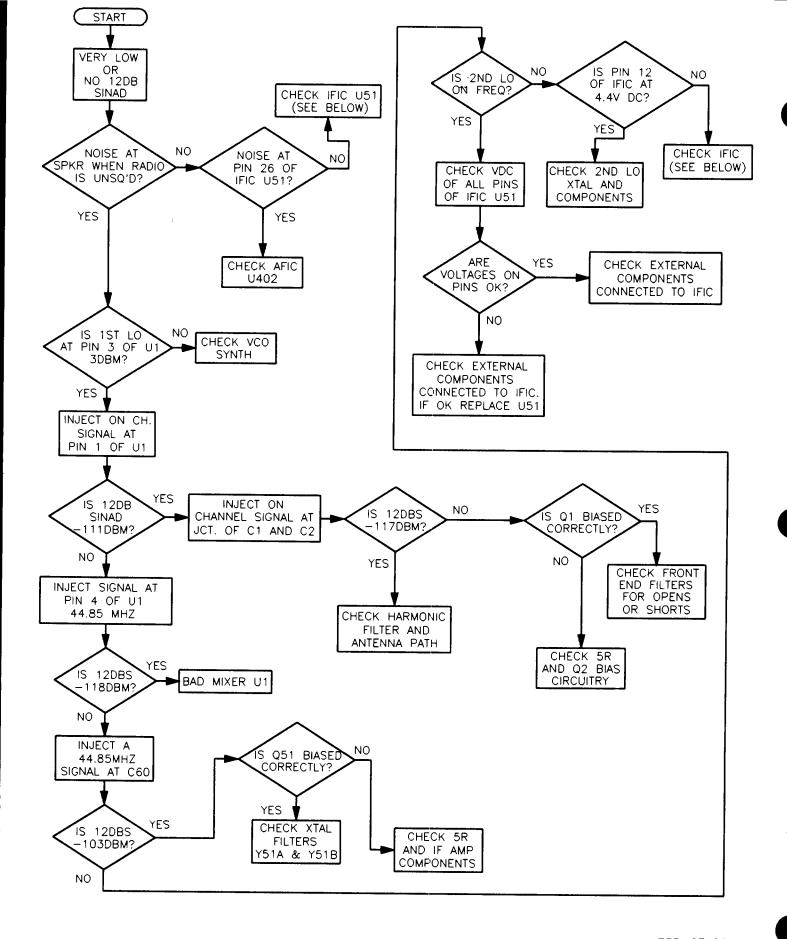


M1225 Mobile Functional Block Diagram

Overview

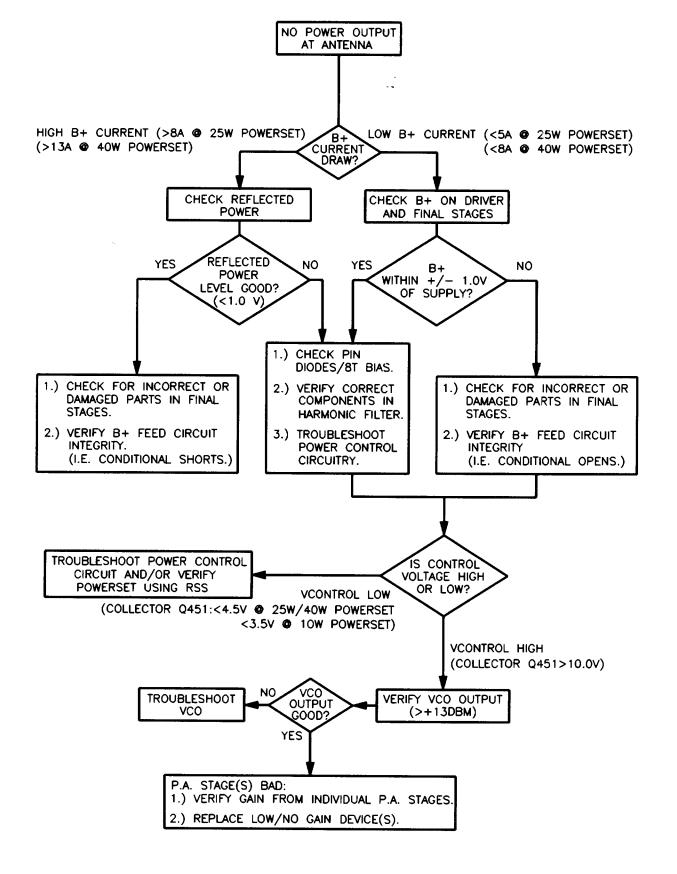
This section contains 5 troubleshooting tables for the following M1225 components:

- Receiver (all models)
- Transmitter (all models)
- Synthesizer (all models)
- Voltage Controlled Oscillator (VCO) (all models)
- Microprocessor (all models)

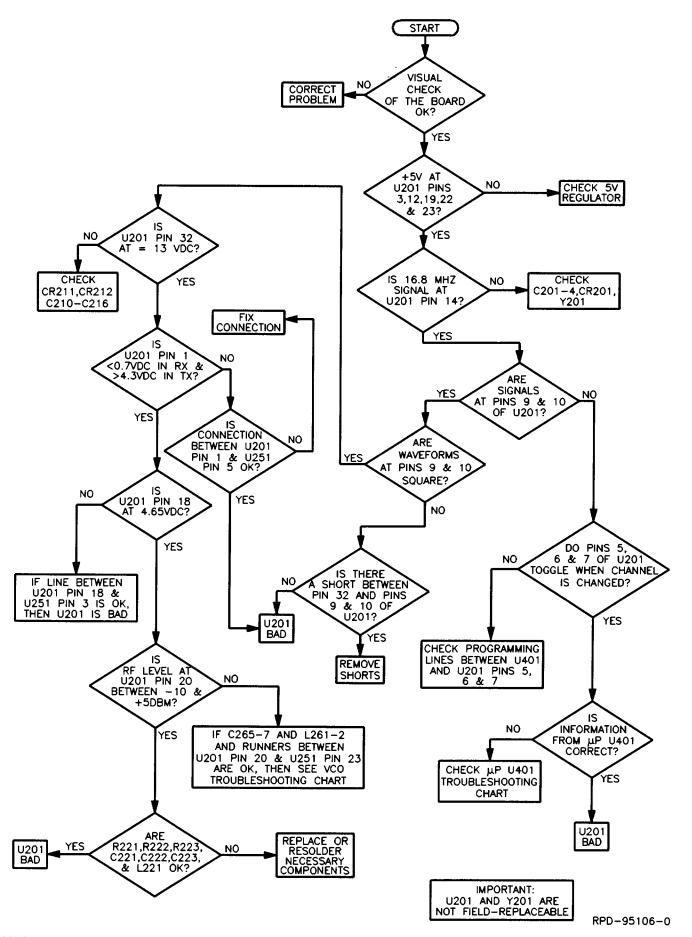


Troubleshooting Flow Chart for Receiver (All Models)

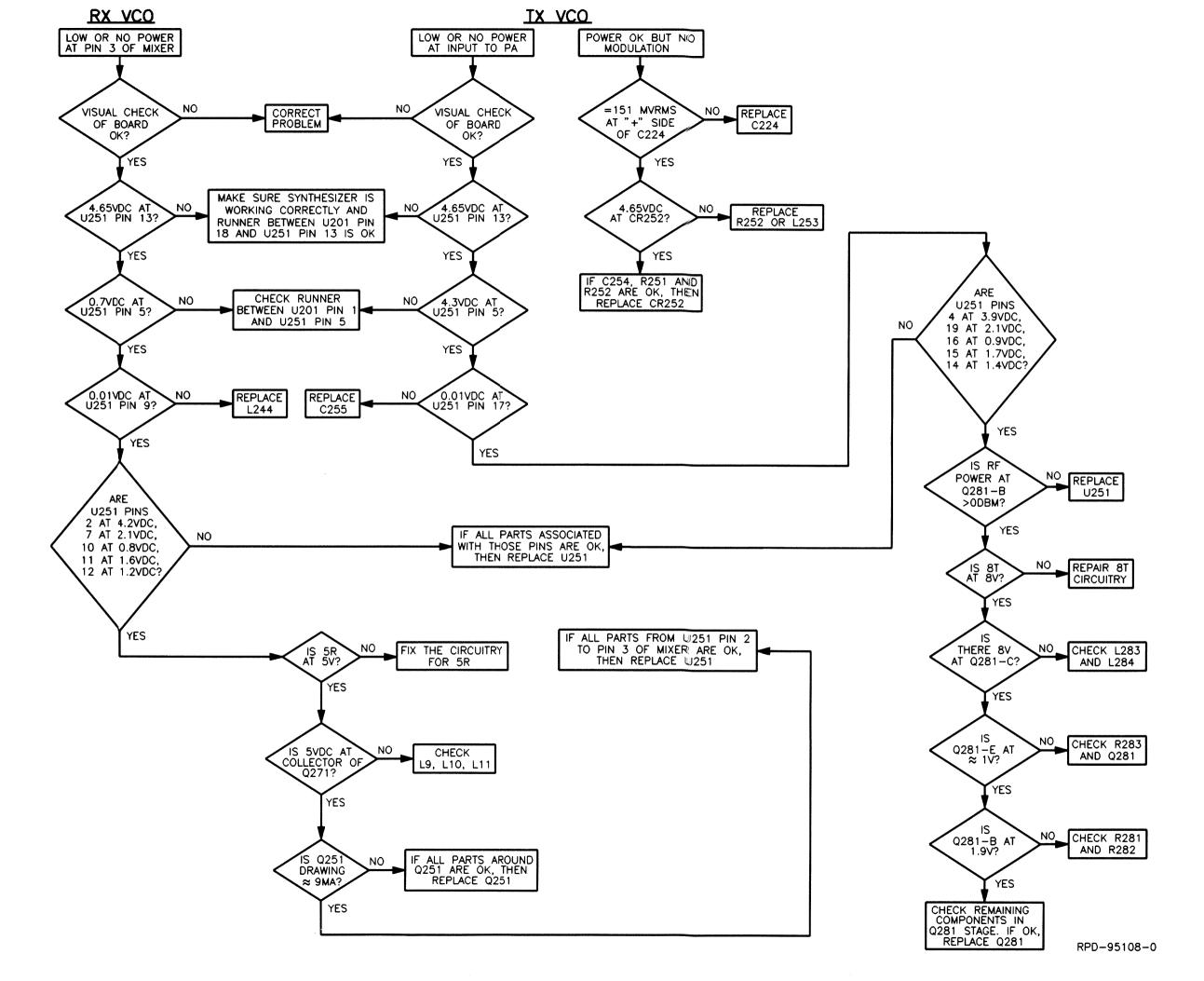
RPD-97108-0



Troubleshooting Flow Chart for Transmitter (All Models)



Troubleshooting Flow Chart for Synthesizer (All Models)

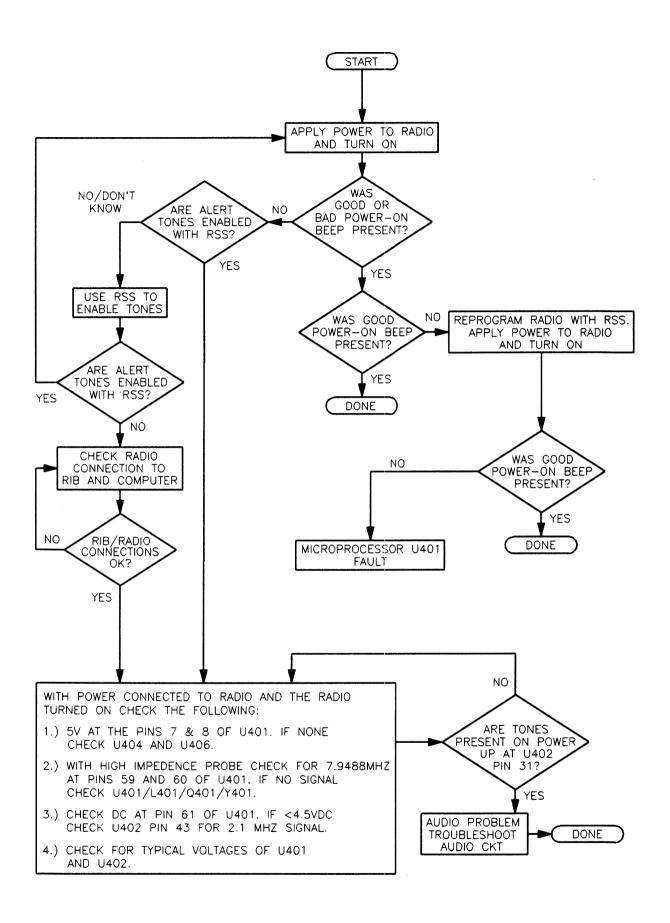


Troubleshooting Flow Chart for VCO (All Models)

April, 1999

6880904Z96-A

3-5



Troubleshooting Flow Chart for Microprocessor (All Models)

Section 4 Expanded Accessory Connector

General

The following is a description of the pin functions on the Expanded Accessory Connector for the M1225 mobile radio. Refer to Figure 1 for pin locations in the connector housing.

Pin	Description	Application
1	External Speaker (-)	Connect external 8-ohm speaker to pins 1 and 16. CAUTION: Bridge-type output. Neither pin 1 nor 16 is ground.
2	External Mic Audio	Input impedance: 500 ohms. 80 mV rms at 1 kHz for 60% deviation. This path is enabled when external mic PTT is keyed.
3	External Mic PTT	Pull this pin low (less than 1.8 V dc) to key transmitter and enable external mic audio path. This pin is pulled low via a diode when front panel mic PTT is pulled low to allow sensing of mic PTT by accessory. This pin is pulled high to 5 V dc via 9.6 k ohms.
4	Programmable Output	Defaults to External Alarm. Provides an active high to 13.8 V dc battery supply. Maximum current: 0.25 amps. Refer to "Programmable Pins" below.
5	Flat Tx Audio Input	Input impedance: 35k ohms. 150 mV rms for 60% deviation. May be programmed to bypass limiter using RSS.
6	Programmable Input	Refer to "Programmable Pin."
7	Ground	
8	Programmable Input/Output	Defaults to COR carrier detect. Refer to "Programmable Pins."
9	Programmable Input	Defaults to Emergency Switch. Refer to "Programmable Pins."
10	Ignition Sense	Remove fuse F401 and connect this pin to vehicle ignition-controlled voltage source for ignition-controlled radio on-off. CAUTION: Accidentally shorting this pin to ground will blow internal fuse F401.
11	Rx Audio Output	330 mV rms (at 1 kHz if de-emphasized) at 60% deviation. Minimum load resistance: 5k ohms. Default is de-emphasized, muted. May be programmed for non-de-emphasized, unmuted using RSS.
12	Programmable Input/Output	Refer to "Programmable Pins."
13	Switched A+ Sense	13.8 V dc source for accessories when radio is turned on. Maximum current: 0.5 amps. CAUTION: Accidentally shorting this pin to ground with radio turned on will blow internal fuse F401.
14	Programmable Input/Output	Refer to "Programmable Pins."
15	Internal Speaker (+)	If jumper JU501 is removed, connect to pin 16 to enable internal speaker. NOTE: If the HLN3145 Public Address and Speaker A/B Switch kit is used, jumper JU501 must be removed if it is desired to mute the internal speaker when the switch is in position B.
16	External Speaker (+)	Connect external 8-ohm speaker to pins 1 and 16. CAUTION: Bridge-type output. Neither pin 1 nor 16 is ground.

Programmable Pins

Programmable Pins

Pins 4, 6, 8, 9, 12, and 14 are programmable I/O's. The functions of the pins can be assigned using RSS. Information on the available functions and how to program them is contained in the RSS help files in the Appendices section.

Pin 4 is an output only. It provides an active high to the 13.8 V dc battery supply (0.25 amps maximum), otherwise it is pulled low via 10k ohms.

Pin 6 and 9 are inputs only. They are normally pulled high to 5 V dc via 4.7k ohms. To activate the input, it should be pulled low to within 0.7 V dc of ground.

Pin 8, 12, and 14 may each be programmed as either an input or output. If programmed as an input, the pin is pulled high to 5 V dc via 4.7k ohms. To activate the input, it should be pulled low to within 0.7 V dc of ground. If programmed as an output, the pin is normally pulled high to 5 V dc via 4.7k ohms. When enabled, the output goes active low. Maximum sinking current is 50 mA.

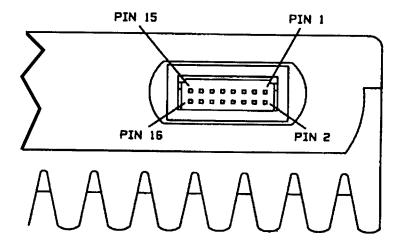
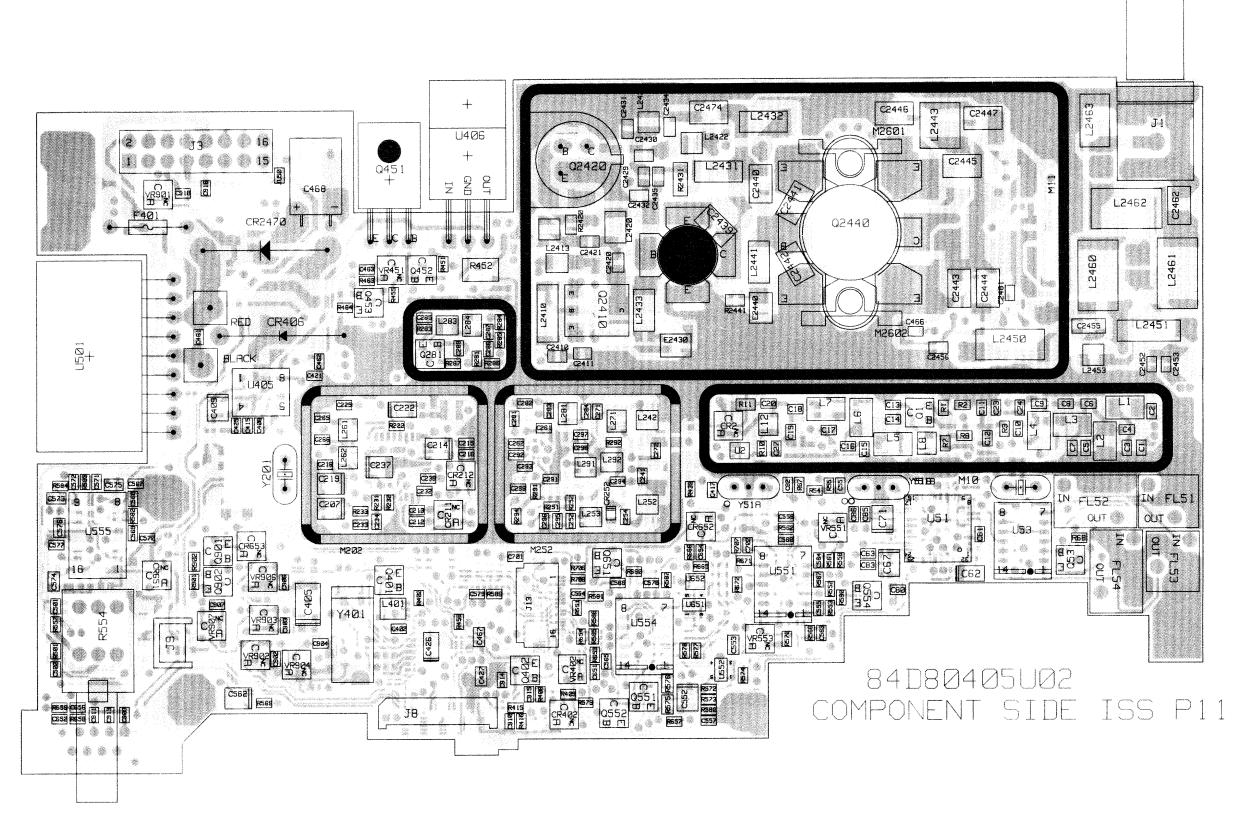


Figure 4-1. Expanded Accessory Connector Pin Locations (viewed from rear of radio)



COMPONENT SIDE (GRAY) SOLDER SIDE (PINK) OVERLAY ----

COMPONENT SIDE VIEW

RCB-97101-O RCB-97104-O RCB-97105-O

COMPONENT SIDE INNER LAYER (GRAY) SOLDER SIDE INNER LAYER (PINK) OVERLAY ----

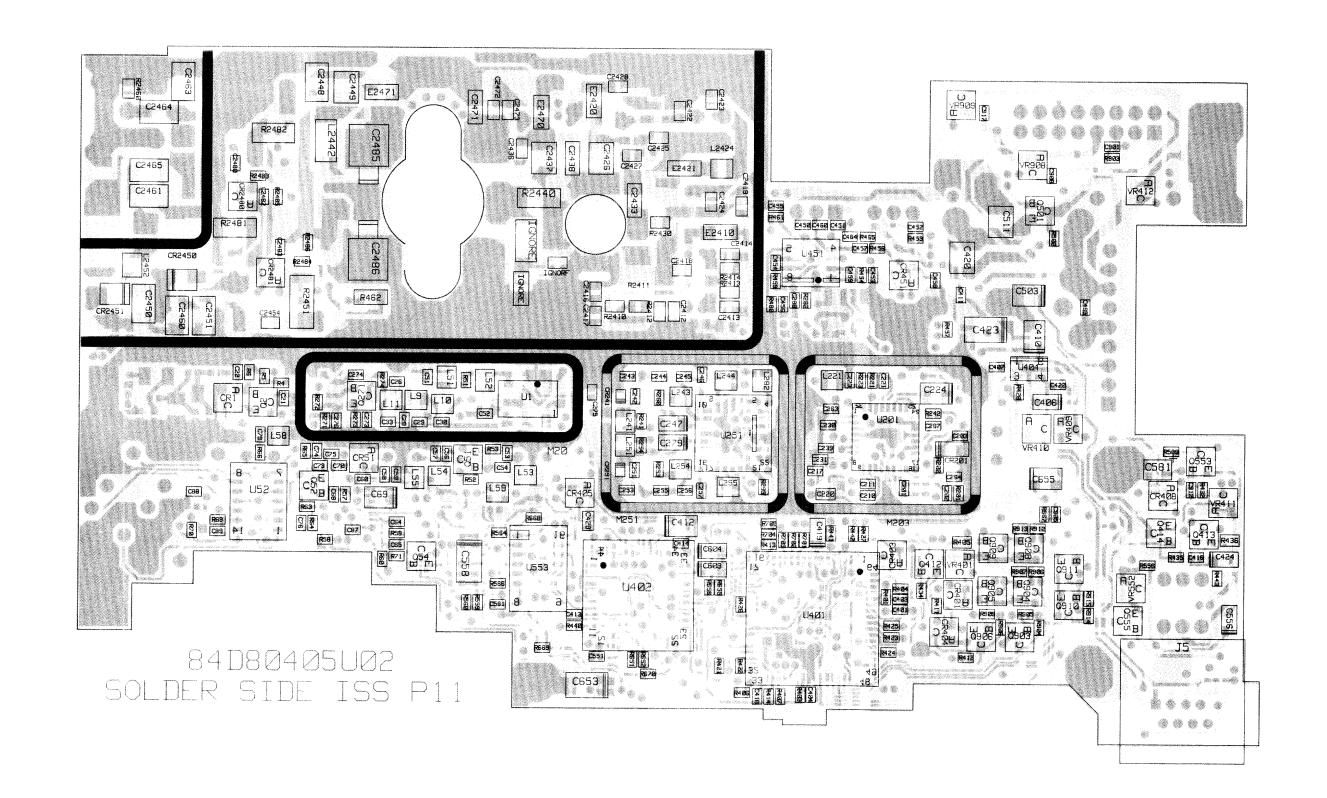
RCB-97102-O RCB-97103-O RCB-97105-O

84D8Ø4Ø5UØ2

COMPONENT SIDE ISS P11

Circuit Board Details for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios)

COMPONENT SIDE VIEW



SOLDER SIDE VIEW

COMPONENT SIDE (GRAY)RCB-97101-O (REV)SOLDER SIDE (PINK)RCB-97104-O (REV)OVERLAY -----RCB-97106-O

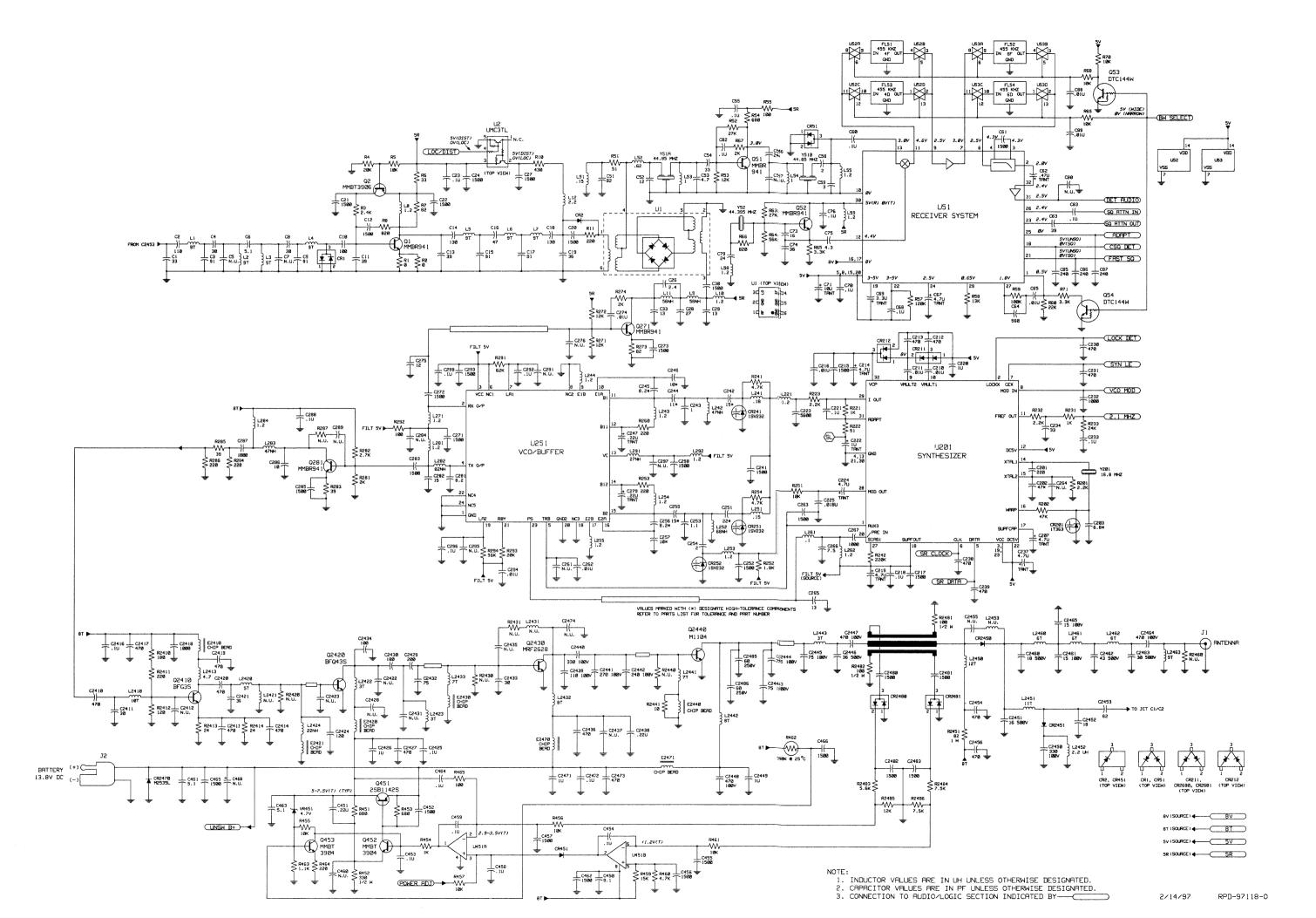
84D80405U02 Solder Side ISS P11

COMPONENT SIDE INNER LAYER (GRAY)
SOLDER SIDE INNER LAYER (PINK)
OVERLAY -----

RCB-97102-O (REV) RCB-97103-O (REV) RCB-97106-O

SOLDER SIDE VIEW

Circuit Board Details for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios)

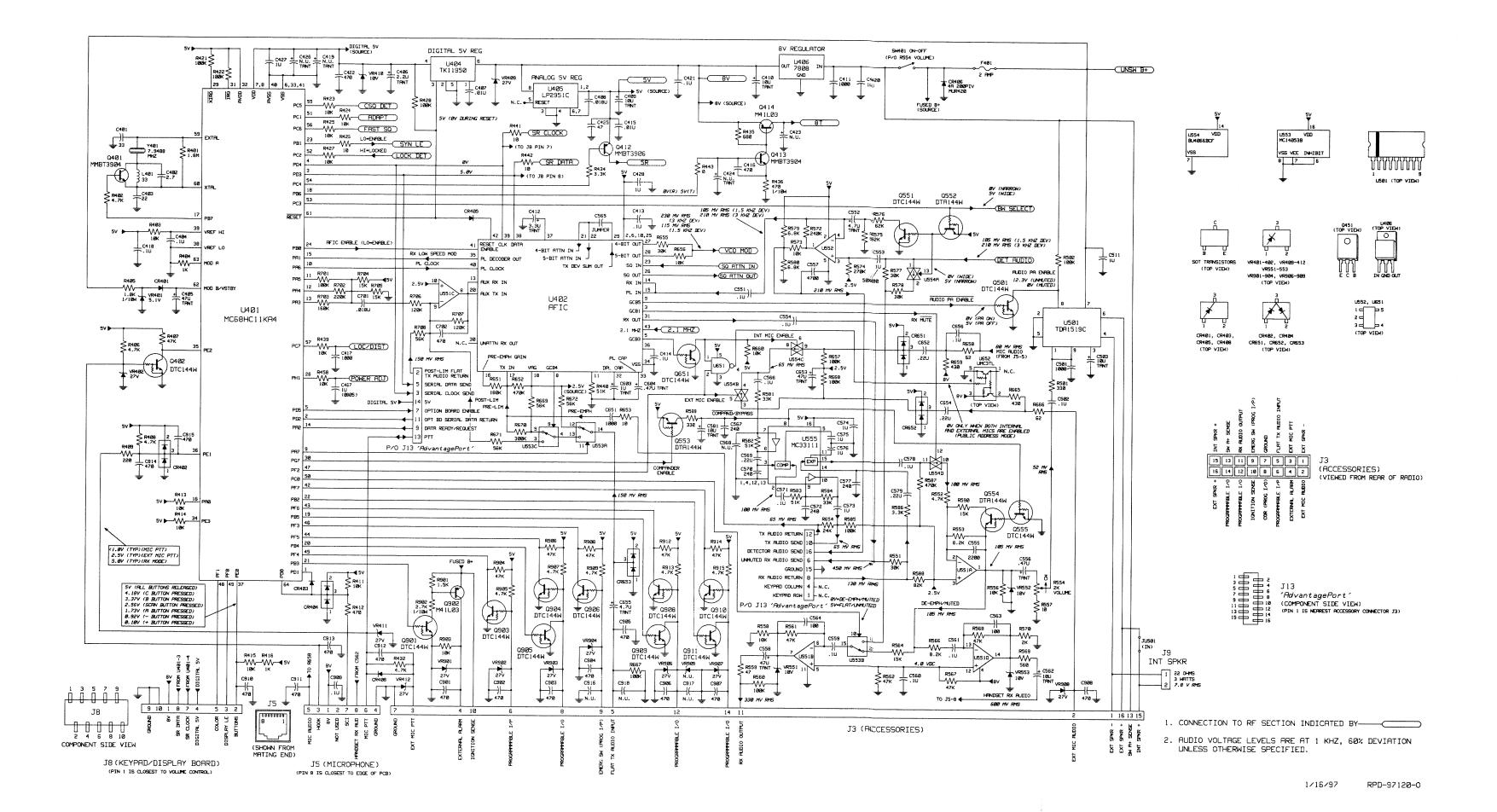


Schematic Diagram for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) (Sheet 1 of 2)

April, 1999

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Schematic Diagram for VHF Main Boards, 150-174 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUD3233C & HUD3251A Radios) (Sheet 2 of 2)

4

6880904Z96-A

April, 1999

Parts List

C12

C13

C15

C16

C18

C19

C26

C27

C28

C30

C55

C59

C65

C67

C68

C69

C70

C74

C75

C76

C79

C82, 83

C88, 89

C203

C214

C215

C216

C217

C218

C219

C221

C222

C223

C224

C225

C232

C233

C234

C237

C230, 231

C210, 21

C212, 213

C85 thru 8

C21, 22

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz,

SYMBOL PART NO.

150-174 MHz, 25-40 W REFERENCE MOTOROLA

21-13740F39

21-13740F52

21-13740F50

21-13740F38

21-13740F38

21-13740F50

21-13740F51

21-13740F41

21-13741F29

21-13740F41

21-13740F54

21-13740F43

21-13740F54

21-13741F29

21-13741F29

21-13740F12

21-13741F29

21-13740F37

21-13740F30

21-13741F29

21-13740F30

21-13740F49

21-13740F14

23-11049A05

21-13740F69

23-11049,111

23-11049.107

23-11049A57

21-13740F60

21-13740F59

23-11049J11

21-13741F49

23-11049J11

21-13741F29

21-13741F49

23-11049.111

23-11049.111

21-13743E05

21-13741F17

21-13740F29 12 pF

21-13740F39 33 pF

21-13740F36 24 pF

21-13740F19 4.7 ±0.25 pF

21-13740F10 2 ±0.25 pF

21-13741F29 1500 pF

21-13740F41 39 pF

21-13741F49 01 uF

21-13740F32 16 pF

21-13740F40 36 pF

21-13740F36 24 pF

21-13741F49 .01 uF

21-13741F17 470 pF

21-13741F29 1500 pt

21-13741E43 5600 pF

21-13741F25 1000 pF

21-13740F39 33 pF

21-13743E20 0.1 uF, 10%; 16 V

21-13928E01 1 uE 10%: 10V

21-13743E20 0.1 uE 10%: 16V

21-13743E20 0.1 uF, 10%; 16 V

23-11049A07 tantalum 1 uF, 10%; 16 V

23-11049J11 tantalum 4.7 uF, 10%; 16 V

21-13740L34 47 pF, 2%

21-13740L14 6.8 ±0.1 pF

21-13740F18 4.3 ±0.25 pF

21-13743E20 0.1 uF, 10%; 16V

21-13743E20 0.1 uF, 10%; 16 V

21-13743F20 0.1 uF 10%: 16V

21-13743E20 0.1 µE 10%: 16V

21-13743E20 0.1 uE 10%: 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13740F50 91 pF

21-13740F50 91 pF

21-13740F40 36 pF

21-13741F29 1500 pF

21-13740F20 5.1 ±0.25 pF

PL-971001-A

DESCRIPTION

capacitor, fixed: uF +/-5%; 50 V:

inless otherwise stated

33 pF

91 pF

39 pF

1500 p

39 pF

130 pl

1500 pl

21-13743E20 0.1 uF. 10%: 16 V

1500 pF

1500 pF

1500 p

3 ±0.25 pF

tantalum 0.47 uF. 10%; 25 V

tantalum 4.7 uF, 10%; 16 V

tantalum 3.3 uF 10%: 20 \

tantalum 10 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

tantalum 4.7 uF 10%: 16 V

tantalum 4.7 uF, 10%: 16 V

.018 uF, 10%; 16 V

2.4 ±0.25 pF

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz, 150-174 MHz, 25-40 W

21-13741F29

21-13740F03

21-13741F29

21-13740F10

21-13740L22

21-13740L16

21-13740L18

21-13741F29

21-13740F30

21-13741F25

21-13740F31

21-13741F29

21-13741F49

21-13741F49 .01 uF

21-13741F29 1500 pl

21-13741F49 .01 uF

21-13740F29 12 pF

21-13740F24 7.5 ±0.25 pF

21-13740F25 8.2 ±0.25 pF

21-13741F29 1500 pF

21-13741F29 1500 pF

21-13741F25 1000 pF

21-13741F29 1500 pF

21-13740F39 33 pF

21-13740F35 22 pF

21-13741F49 01 uF

21-13741F25 1000 pF

21-13741F17 470 pF

21-13741F25 1000 pF

21-13741F17 470 pF

21-13740F43 47 pF

21-13741F49

21-13743E20 0.1 uF. 10%: 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF. 10%: 16 V

21-13743E05 018 µE 10%: 16V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13741W01 1 uF, 10%; 25 V

21-13928E01 1 uF. 10%: 10 V

21-13743E20 0.1 uF. 10%: 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13740F20 5.1 ±0.25 pF

21-13740F20 5.1 ±0.25 pF

21-13928E01 1 uF, 10%; 10 V

21-13741F29 1500 pF

21-13741F29 1500 pF

21-13740F26 9.1 +0.25 pF

21-13741F29 1500 nF

21-13741F29 1500 pF

21-13743E20 0.1 uF, 10%; 16 V

Not Used

Not Used

21-13743K16 0.22 uF, +80/-20%; 16 V

21-13740F13 2.7 ±0.25 pF

21-13740F27 10 nF

21-13741F17 470 pF

21-13741F17 470 pF

21-13740L22 15 pF 2%

21-13740L19 11 pF. 2%

21-13740L16 8.2. ±0.1 pF

21-13740L18 10 pF. 2%

21-13740L26 22 pF, 2%

21-13740F04 1.1 ±0.25 pF

1500 pF

 $1 \pm 0.25 pf$

23-11049A03 tantalum 0.22 uF, 10%; 35 V

2 ±0.25 pF

15 pF. 2%

8.2 +0.1 p

10 pF. 2%

1500 pF

1000 pF

Not Used

23-11049A03 tantalum 0.22 uF, 10%; 35 V

Not Used

Not Used

Not Used

23-11049J43 tantalum 47 uF, 10%: 10 V

23-11049A40 tantalum 2.2 uF, 10%; 10 V

23-11049A57 tantalum 10 uF, 10%; 16 V

23-11049J07 tantalum 3.3 uF, 10%; 20 V

1500 pF

PART NO

REFERENCE MOTOROLA

SYMBOL

C239

C242

C243

C244

C245

C246 C247

C252

C255

C256

C261

C262 C263 C264 C265

C266 C267

C274

C276 C279 C281 C282 C283

C285 C286

C287 C288

C293 C294 C295

C296

C299 C401 C402 C403 C404

C405 C406

C409, 410

C413, 414

C412

C417

C421

C423, 424

C427, 428

C453, 454

C458, 459

C463, 464

C467

C465, 466

C455 thru 457

C271 thru 273

PL-971001-A

DESCRIPTION

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz, 150-174 MHz. 25-40 W

PART NO.

21-13741F25

23-11049J11

23-11049A05

23-11049A57

21-13740F51

06-62057B47

23-11049A05

21-13741F25

23-11049J43

23-11049J11

21-13743E05

21-13741F17 470 pF

21-13740A71 470 pF

21-13740A71 470 pF

21-13740A71 470 pF

21-13740A57 120 pF

21-13740A62 200 pF

21-13740A71 470 pF

21-13740A79 1000 pF

21-13740A40 30 pF

21-13741F17

21-13741F17

21-13740A71

21-13740A42

21-13740A71

21-13740A61

21-13740A52

21-13740B36

21-13740A55

21-11078B43

21-13740F33

21-13740F46

21-13740A71

21-13740A71 470 pF

21-13743E20 0.1 uF. 10%: 16 V

21-13743E20 0.1 uF. 10%: 16 V

21-13741W01 1 uF 10%: 25 V

21-13928E01 1 uF, 10%; 10 V

21-13741F33 2200 pF

21-13741F41 4700 pF

21-13740F60 240 pF

21-13740F60 240 nF

21-13740F60 240 pF

21-13740F60 240 pF

21-13743E20 0.1 uF. 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF. 10%: 16 V

21-13743E20 0.1 uF. 10%: 16 V

21-13743K16 0.22 µF. +80/-20%: 16 V

23-11049A57 tantalum 10 uF, 10%; 16 \

23-11049A07 tantalum 1 uF, 10%; 16 V

21-13743K16 0.22 uF, +80/-20%; 16 V

21-13743K16 0.22 uF, +80/-20%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743A19 0.1 uF, 10%; 16 V

470 n

36 pF

470 pF

180 pF

75 pF

100 pF

Not Used

110 pF: 100 V

30 pF

21-11032B15 0.22 uF. +80/-20%

21-11078B55 330 pF: 100 V

21-11078B53 270 pF: 100 V

21-11078B52 240 pF 100 V

21-11078B39 75 pF: 100 V

21-11078B39 75 pF: 100 V

21-80060M32 36 pF: 500 V

21-11078B59 470 pF: 100 V

21-11078B55 330 pF: 100 V

21-80060M24 16 pF; 500 V

470 pF

21-13741W01 1 uF. 10%: 25 V

Not Used

21-13743A19 0.1 uF, 10%; 16 V

21-13741W01 1 uF. 10%: 25 V

470 pF

Not Used

Not Used

21-13928E01 1 uF. 10%: 10 V

21-13743K16 0.22 uF, +80/-20%; 16 V

23-11049A57 tantalum 10 uF, 10%; 16 V

23-11049J43 tantalum 47 uF, 10%; 10 V

tantalum 4.7 uF, 10%; 16 \

tantalum 0.47 uF, 10%; 25 V

tantalum 10 uF, 10%: 16 \

tantalum 0.47 uF, 10%; 25 V

tantalum 47 uF, 10%; 10 V

tantalum 4.7 uF, 10%; 16 \

.018 uF, 10%; 16 V

REFERENCE MOTOROLA

SYMBOL

C501

C502

C503

C511 C551

C552

C553

C554

C555

C556 C557

C558

C566

C567

C568 C569 C570

C571

C577

C578

C579

C581

C603 C604

C651

C652

C653

C655

C701

C2410

C2411

C2412

C2416

C2417

C2418

C2425

C2426

C2427

C2428 C2429 C2430

C2431

C2433 C2434 C2435

C2436

C2437

C2438 C2439

C2440 C2441

C2442

C2445

C2449

C2451

C2452 C2453

C2454

C2456

C2450

C2446

C2443, 2444

C2447, 2448

C901 thru 908

C910 thru 915

C916 thru 918

C2413, 2414

C2419, 2420

C2422, 2423

C572 C573 thru 576

C559 thru 561

PL-971001-A

DESCRIPTION

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz, 150-174 MHz. 25-40 W REFERENCE MOTOROLA

PART NO.

C2480 thru 2483 21-13741F29 1500 pF

21-80060M25 18 pF: 500 V

21-11078B18 15 pF: 100 V

21-80060M34 43 pF: 500 V

21-80060M30 30 nF: 500 V

21-11078B18 15 pF: 100 V

21-13740A71 470 pF

C2485, 2486 21-80464E52 clamped mica 60 pF; 250 V

21-11078B59 470 pF: 100 V

21-13741W01 1 uF, 10%; 25 V

21-13743A19 0.1 uF, 10%; 16 V

48-80154K03 dual Schottky SOT

48-80154K03 dual Schottky SOT

48-05218N57 dual silicon SOT

48-05129M76 silicon SOT

48-80939T01 Schottky SOT

48-05129M76 silicon SOT

48-05129M76 silicon SOT

48-05129M76 silicon SO

CR651 thru 653 48-13833C07 dual silicon SOT MMBD7000

24-84657R01 ferrite bead

24-84657R01 ferrite bead

24-84657R01 ferrite bead

24-84657B01 ferrite head

24-84657R01 ferrite bead

65-05214E04 2 amp axial lead

91-80098D14 455 kHz 4F

91-80097D04 455 kHz 6F

91-80098D16 455 kHz 40

91-80097D16 455 kHz 6D

30-04510.101

28-04503J01

09-04426J01

09-04422.101

28-04423,101

09-80472U01

24-62587X55

06-62057B47 jumper

24-60591G24 9 turns

24-62587X69 chip 1.2 uH; 5%

24-62587X50 chip 56 nH; 5%

24-62587X69 chip 1.2 uH; 5%

24-62587X50 chip 56 nH; 5%

24-62587N72 chip 2.2 uH; 5%

24-62587X63 chip 0.62 uH; 5%

24-62587X68 chip 1 uH; 5%

24-62587X69 chip 1.2 uH; 5%

24-62587X69 chip 1.2 uH; 5%

24-62587X69 chip 1.2 uH: 5%

24-62587X49 chip 47 nH: 5%

24-62587X69 chip 1.2 uH; 5%

24-62587X51 chip 68 nH: 5%

24-62587X69 chip 1.2 uH; 5%

24-62587X53 chip 0.1 uH: 5%

24-62587V36 chip 0.15 uH; 5%

24-62587V37 chip 0.18 uH; 5%

09-80476U01 mini UHF coax

CR2450, 2451 48-02482J02 silicon PIN MA4P1250

48-80236E07 transient suppressor

Not Used

diode: (see note

48-80142L01 silicon PIN SOT MMBV3401

48-02245J22 silicon varactor SOT 1T363

48-13833C07 dual silicon SOT MMBD7000

48-62824C03 silicon varactor SOT 1SV232

48-13833C07 dual silicon SOT MMBD7000

48-13833C07 dual silicon SOT MMBD7000

48-82290T02 dual Schottky SOT HSMS-2802

connector, receptacle

16-pin, accessories

10 pin, display board

16-pin, option board

chip 0.15 uH: 5%

2-pin, internal speaker

power cable assembly (includes J2)

telephone type, 8 contact, microphone

48-62824C03 silicon varactor SOT 1SV232

SYMBOL

C2460

C2461

C2462

C2463

C2464

C2465 C2471

C2472

C2473

C2474

CR51

CR201

CR211

CR241

CR212

CR401 CR402

CR403

CR404

CR405

CR406

CR408

CR2480, 2481

E2420, 2421

E2470, 2471

E2430

F401

FL52

FL54

J13

JU501

L1 thru 7

L53, 54

L58, 59

L243, 244

L253 thru 255

L251

CR251, 252

PL-971001-A

DESCRIPTION

150-174 MHz, 25-40 W REFERENCE MOTOROLA

SYMBOL

L262

L283

L291

L401

L2410

L2413

L2420

L2424

L2431

L2432

L2433

L2443

L2451

L2463

Q51. 52

Q53, 54

Q271 Q281

Q401 Q402

Q412 Q413

Q414

Q551

Q901

Q2410

Q2420

Q2430

Q2440

R1.2

R68 thru 70

R201

Q451 Q452, 453

Q552 thru 554

Q903 thru 906

Q908 thru 911

L2422, 2423

L2441, 2442

HUD3233C & HUD3251A VHF Radio, 12.5/2/5 kHz. PL-971001-A PART NO. DESCRIPTION 24-62587X69 chip %.2 uH; 5% 24-62587X69 chip 1,2 uH; 5% 24-62587X69 chip 1: 2 uH: 5% 24-62587X52 chip \$2 nH: 5% 24-62587X49 chip 47 nH: 5% 24-62587X69 chip 1: 2 uH; 5% 24-62587X46 chip 27 nH: 5% 24-62587X69 chip % 2 uH; 5% 24-60578C43 chip 33 uH 24-60591H77 10 turns 24-62587N76 chip 4.7 uH; 5% 24-60591C73 5 turns Not Used 24-60591A49 3 turms 24-62587X45 chip 22 nH; 5% 24-60591F77 8 turns 24-60591F77 7 turrs 24-60591F77 7 turns 24-60591X01 3 turms 24-60591V77 12 turns 24-60591J77

11 turns

chip 2.2 uH

transilstor: (see note

NPN: type MMBR941

PNP; type MMBT3906

NPN; type MMBR941

PNP; type MMBT3906

PNP: type BCW68G

PNP: type 2SB1142S

NPN; type MMBT3904

PNP: type BCW68G

NPN: type BEG35

digital NPN; type DTC144W

digital NPN; type DTC144W

digital NPN; type DTC144W

digital NPN; type DTC144W

digital PNP; type DTA144W

digital NPN: type DTC144W

digital NPN: type DTC144W

digital NPN: type DTC144W

digital NPN: type DTC144W

resistor, fixed: +/-5%; 1/16 W:

unlesis otherwise stated

220; 1/10 watt

27k

120k

100

27k

3 3k

3 3k

digital NPN; type DTC144W

Not Uised

6 turres

48-13827A07 NPN; type MMBR941

48-13827A07 NPN; type MMBR941

48-80214G02 NPN; type MMBT3904

48-80214G02 NPN; type MMBT3904

48-02245J28 NPN; type BFQ43S

48-84411L04 NPN; type M1104

48-80225C18 NPN; type MRF2628

24-11087B30

24-60591S77

48-13827A07

48-13824A17

48-80947V01

48-13827A07

48-80947V01

48-13824A17

48-801411 03

48-02245J25

48-80947V01

48-80947V01

48-80494U01

48-80947V01

48-80947V01

48-80141L03

48-80947V01

48-80947V01

06-62057R47

06-62057458

06-62057480

06-62057A73

06-62057A13

06-62057A23

06-62057A47

06-62057A40

06-62057A18

06-62057A83

06-62057A75

06-62057A45

06-62057A25

06-62057A99

06-62057A76

06-62057A97

06-62057A81

06-62057A83

06-62057A91

06-62057A61

06-62057A47

06-62057A56

06-62057A73

06-62057461

06-62057A57

06-62057C59

48-02245J24

48-80947V01

48-80214G02

L2460 thru 2462 24-60591X04

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz, 150-174 MHz, 25-40 W

REFERENCE MOTOROLA PART NO SYMBOL DESCRIPTION 06-62057A89 47k R221 06-62057A49 R222 06-62057A18 R223 06-62057A57 2.2k R231 06-62057A49 R232 06-62057A57 R233 06-62057A82 R241 06-62057A65 R242 06-62057B06 220k R251 06-62057A73 R252 06-62057A55 1.8k R253 06-62057A33 220 06-62057A65 4.7k 06-62057A33 220 R271, 272 06-62057A75 12F R273 06-62057A23 82 R274 06-62057A56 2F R281 06-62057A56 R282 06-62057A59 2 7k R283 06-62057A15 39 R284 06-62057A33 220 R285 06-62057A15 39 R286 R287 06-62057A33 06-62057A92 62k R291 R292 06-62057A25 100 R293 06-62057A80 20k R294 06-62057A91 R401 06-62057B28 06-62057A65 4.7k R403 06-62057A73 10k 06-62057A49 1k R405 06-62057C81 1.8k; 1/10 watt 06-62057A65 4.7k R407 06-62057A89 47k 06-62057A65 4.7k 06-62057A33 220 06-62057A73 10k 06-62057A41 470 R413 thru 415 06-62057A73 10k 06-62057A49 R421, 422 06-62057A97 100k R423 thru 425 06-62057A73 10k R426 06-62057A01 R427 06-62057A73 10k R428 06-62057A97 100k B432 06-62057A65 4.7k R434 06-62057A61 3.3k R435 06-62057A45 06-62057C67 470; 1/10 watt R436 R439 06-62057A73 10k R440 06-62057A90 51k R441, 442 06-62057A01 06-62057B47 06-62057A45 680 R452 06-80195M37 330; 1/2 watt 06-62057A45 680 06-62057A49 1k R455 thru 458 06-62057A73 R459 06-62057A77 R460 06-62057A65 4.7k R461 06-62057A73 10k R462 R463 06-05621T02 thermistor 50k @ 25 degrees (06-62057A50 1 1k 06-62057A33 220 R464 R465 06-62057A25 R501 06-62057A37 330 R502 06-62057A97 100k R551 06-62057A84 30k R552 06-62057A65 R553 06-62057A71 8.2k R554 18-04405J02 variable 2k with switch R556 06-62057A73 R557 06-62057A01 R558 06-62057A73 06-62057A17

06-62057A97 100k

06-62057A89 47k

06-62057A71 8.2k

06-62057A89 47k

06-62057A43 560

06-62057A56 2k

06-62057A77

R561, 562

R567, 568

R570

R564

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz, 150-174 MHz, 25-40 W

DART NO

06-62057B07

06-62057A95

06-62057A92

06-62057A84

06-62057A69

06-62057A85

06-62057A97

06-62057A37

06-62057A77

06-62057A01

06-62057A73 10k

06-62057B08 270k

06-62057A90 51k

06-62057A85 33k

06-62057A61 3.3k

06-62057B14 470k

06-62057A95 82k

06-62057B04 180k

06-62057B14 470k

06-62057A82 24k

06-62057A84 30k

06-62057A73 10k

06-62057A97 100k

06-62057A20 62

06-62057A73 10k

06-62057A20 62

100k

160k

06-62057440

06-62057A40

06-62057A97

06-62057A91

06-62057B09

06-62057A91

06-62057A97

06-62057B06

06-62057B03

06-62057A73

06-62057A99 120k

06-62057A53 1.5k

06-62057C85 2 7k: 1/10 watt

06-62057A91 56k

06-62057A89 47k

06-62057A65 4.7k

06-62057A65 4.7k

06-62057A89 47k

06-62057A65 4.7k

06-62057A89 47k

06-62057A65 4.7k

06-62057A65 4.7k

06-62057C57 180: 1/10 watt

06-62057C59 220: 1/10 watt

06-62057C53 120; 1/10 watt

Not Used

Not Used

Not Used

82: 1 watt

Not Used

51-80505D05 double-balanced mixer

51-80605E02 receiver system

51-80604E01 audio filter

48-09939C04 dual transistor switch UMC3TL

51-05663U35 quad analog switch 4066B

VCO/buffe

51-80633C01 5 V regulator TK11950

51-05469E65 5 V regulator LP2951C

51-13816D03 8 V regulator MC7808B7

51-80932W01 dual op-amp LM2904 SOIC

51-80147R01 audio power amp TDA1519C

integrated circuit: (see note)

microcomputer MC68HC11KA4

10: 1/10 wat

06-62057C36 24; 1/10 watt

06-80195M25 100; 1/2 watt

06-62057A67 5.6k

06-62057A73 10k

06-62057A75 12k

06-62057A56 2k

51-05414S84

06-62057A89 47k

06-62057C27

06-80194M23

06-62057A89 47k

06-62057A77

REFERENCE MOTOROLA

SYMBOL

R573

R574

R575

R581

R584

R585

R586

R587

R588

R589

R590

R652

R653

R654

R655

R657

B658

R659

R660

R665

R667, 668

R671, 672

R704, 705

R706, 707

R701

R702

R703

R708

R901

R902

R903

R904

B905

R906

R907

R908

B909

R912

B913

R914

R915

R2410 R2411

R2412

R2420

R2440

R2451

R2483

R2484

B2485

R2486

U52, 53

U201*

U251

U401*

U402

U404

U405

U406 U451

U501

U551

U552

U1

R2413, 2414

R2430, 2431

R2481, 2482

R656

R651

R577, 578

R579, 580

R582, 583

PL-971001-A

PL-971001-A

DESCRIPTION

REFERENCE MOTOROLA SYMBOL PART NO. DESCRIPTION 51-84704M60 triple 2-channel switch 4053B U554 51-05663U35 quad analog switch 4066B U555 51-13811A35 compander MC33111 U651 51-05461G61 NAND gate TC7S00F U652 48-09939C04 dual transistor switch UMC3TL oitage regulator: (see note VR401 48-80140L06 zener diode 5.1 V SOT VR402 48-809481/01 zener diode 27 V SOT VR409 48-80948V01 zener diode 27 V SOT VR410 48-80140115 zener diode 10 V SO VR411 412 48-80948V01 zener diode 27 V SOT VR451 48-801401.05 zener diode 4.7 V SC VR551 thru 553 48-80140L15 zener diode 10 V SOT VR901 thru 904 48-80948V01 zener diode 27 V SO VR906 thru 909 48-80948V01 zener diode 27 V SOT Y51 91-80112R13 filter 44.85 MHz (includes Y51A and Y51B Y52 48-80606B07 44.395 MHz Y201* 48-80113R01 7.9488 MHz Y401 non-referenced items

HUD3233C & HUD3251A VHF Radio, 12.5/25 kHz,

PI -971001-A

150-174 MHz 25-40 W

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

26-04419J01 PA shield frame

26-80481U01 Tx buffer top shield

26-04420J01 PA shield cover

26-04400J01

14-05160A02 crystal insulator (for Y201)

26-04399J01 receiver mixer bottom shield

42-80281L01 ground clip (2 used for Q2640)

26-04398J01 VCO/synthesizer shield (4 used)

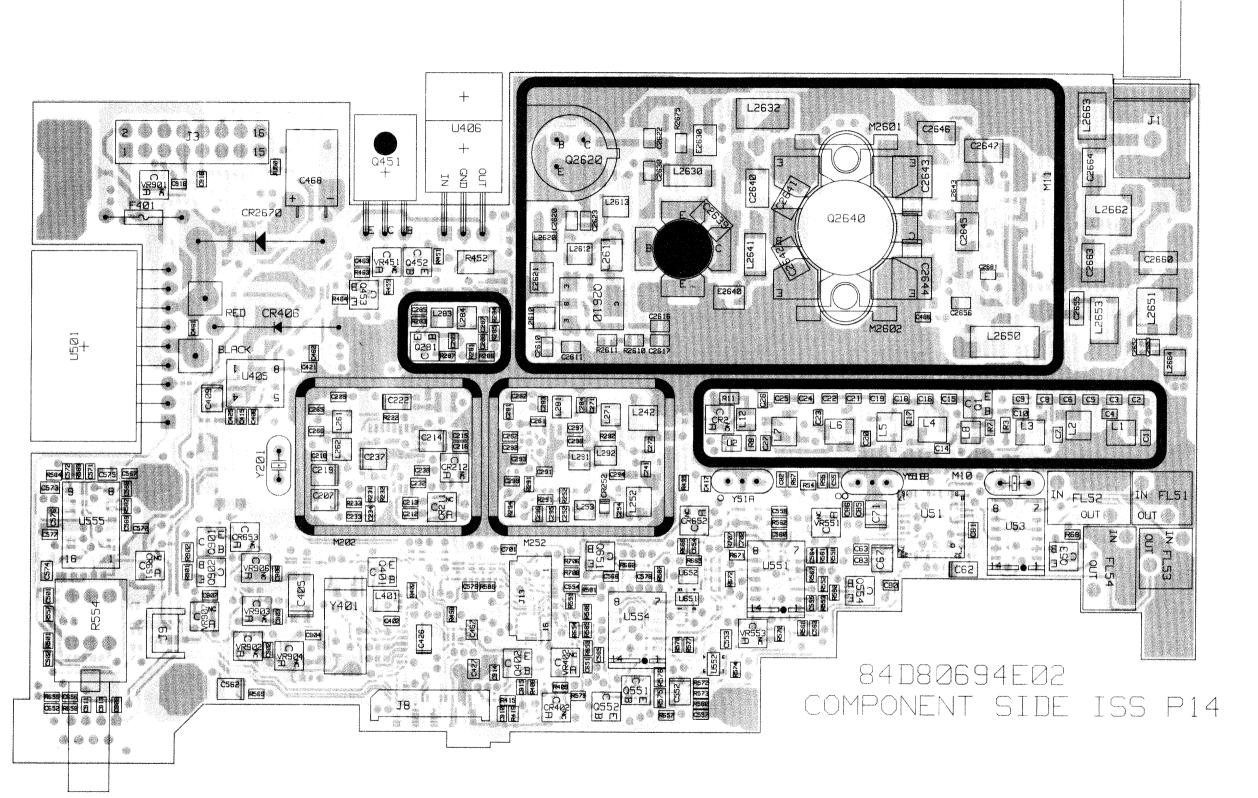
receiver front end top shield

Designators marked with an () denote parts which are not field serviceable. Recalibration of the radio using specialized factory equipment is mandatory when these components are replaced in order to guarantee the specified frequency stability of the radio at temperature extremes

Parts List for VHF Main Boards. 150-174 MHz, 12.5 & 25 kHz, 25-40 W 3251A Radios) April, 1999 6880904Z96-A

 51-62852A09	single opamp LMC7101	(Part of HUD3233C & HUD3
		-

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RCB-97107-O RCB-97110-O COMPONENT SIDE (GRAY) SOLDER SIDE (PINK) RCB-97111-O OVERLAY ----

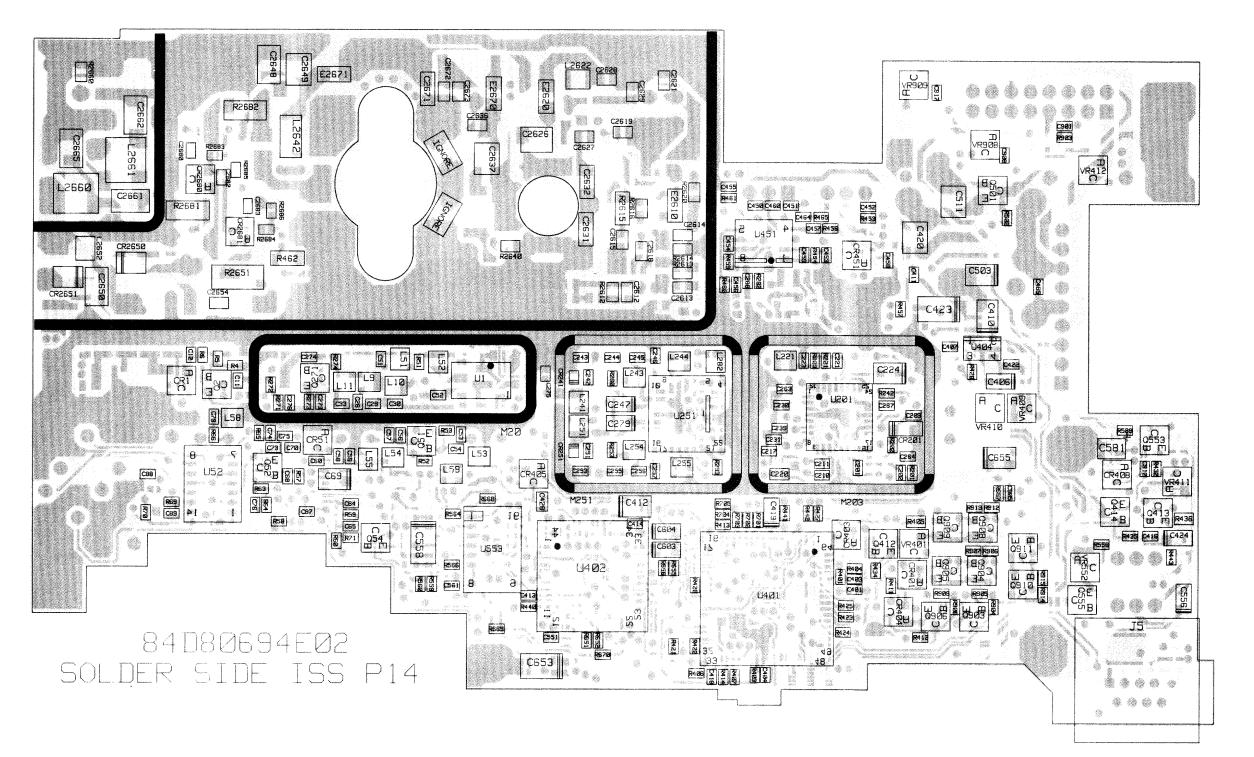
COMPONENT SIDE VIEW

COMPONENT SIDE INNER LAYER (GRAY) SOLDER SIDE INNER LAYER (PINK)
OVERLAY -----

RCB-97108-O RCB-97109-O RCB-97111-O

Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W (Part of HUE3873C, HUE3579A, HUE3580A & HUE3871A Radios)

COMPONENT SIDE VIEW

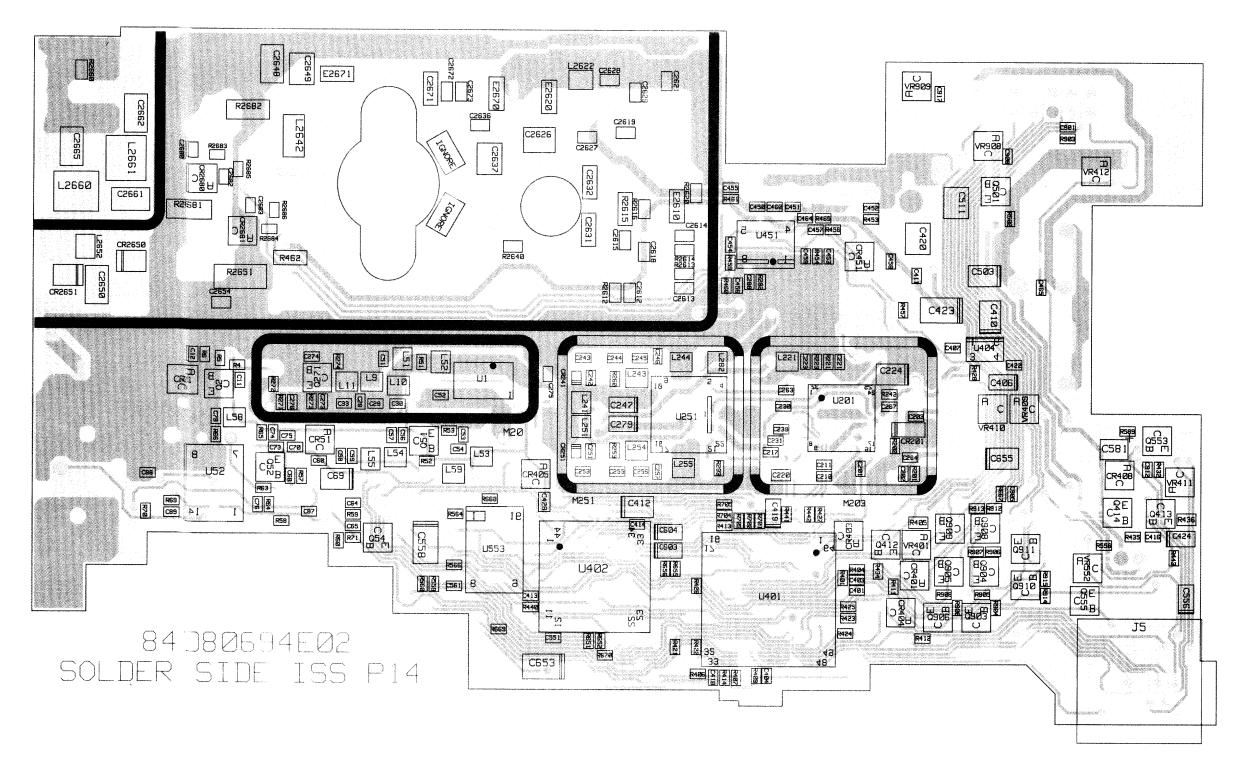


COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY -----

RCB-97107-O (REV) RCB-97110-O (REV) RCB-97112-O

Circuit Board Details for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W and 10-25 W (Part of HUE3873C, HUE3579A, HUE3580A & HUE3871A Radios)

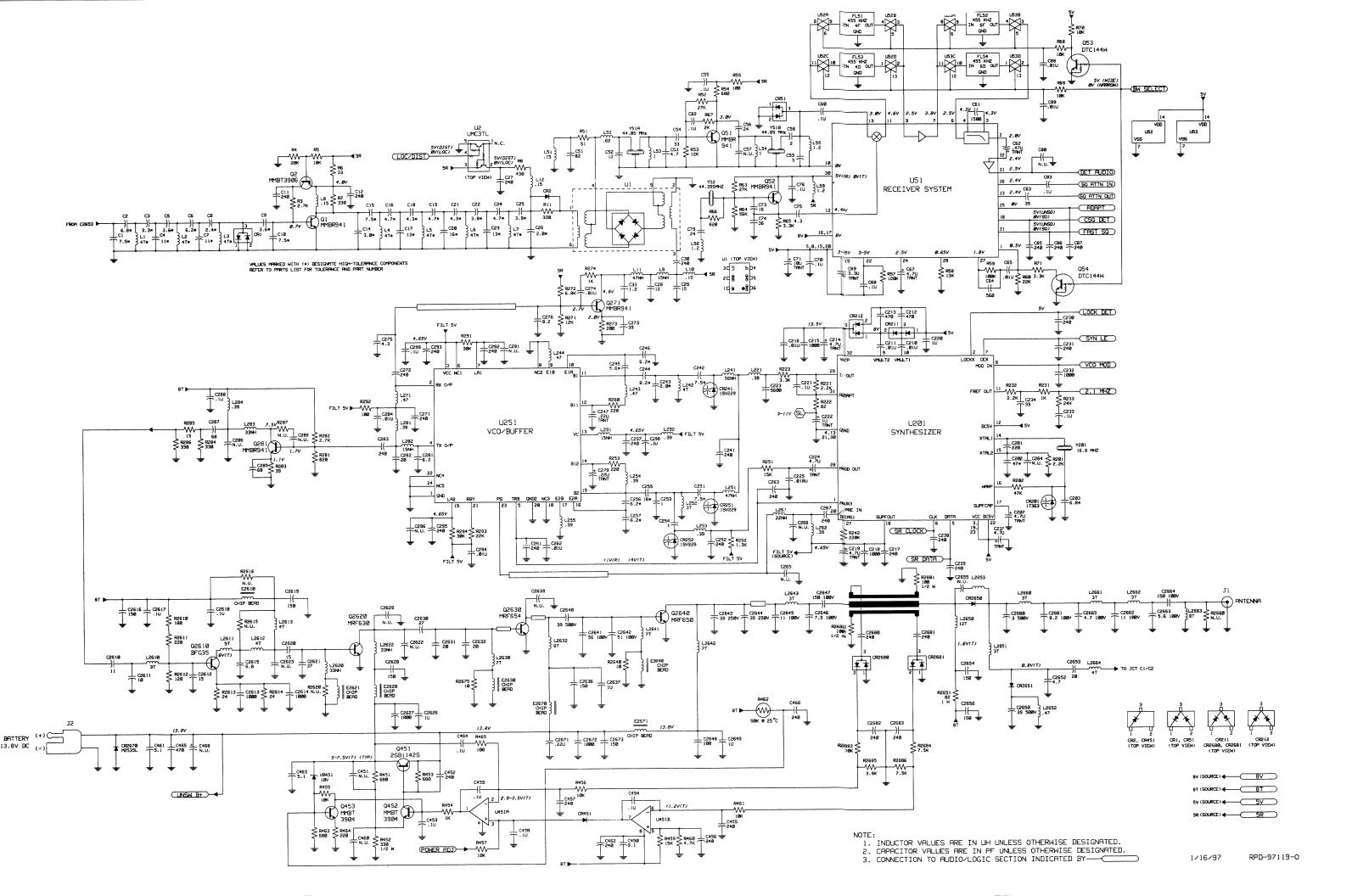
SOLDER SIDE VIEW



COMPONENT SIDE INNER LAYER (GRAY)
SOLDER SIDE INNER LAYER (PINK)
OVERLAY -----

RCB-97108-O (REV) RCB-97109-O (REV) RCB-97112-O

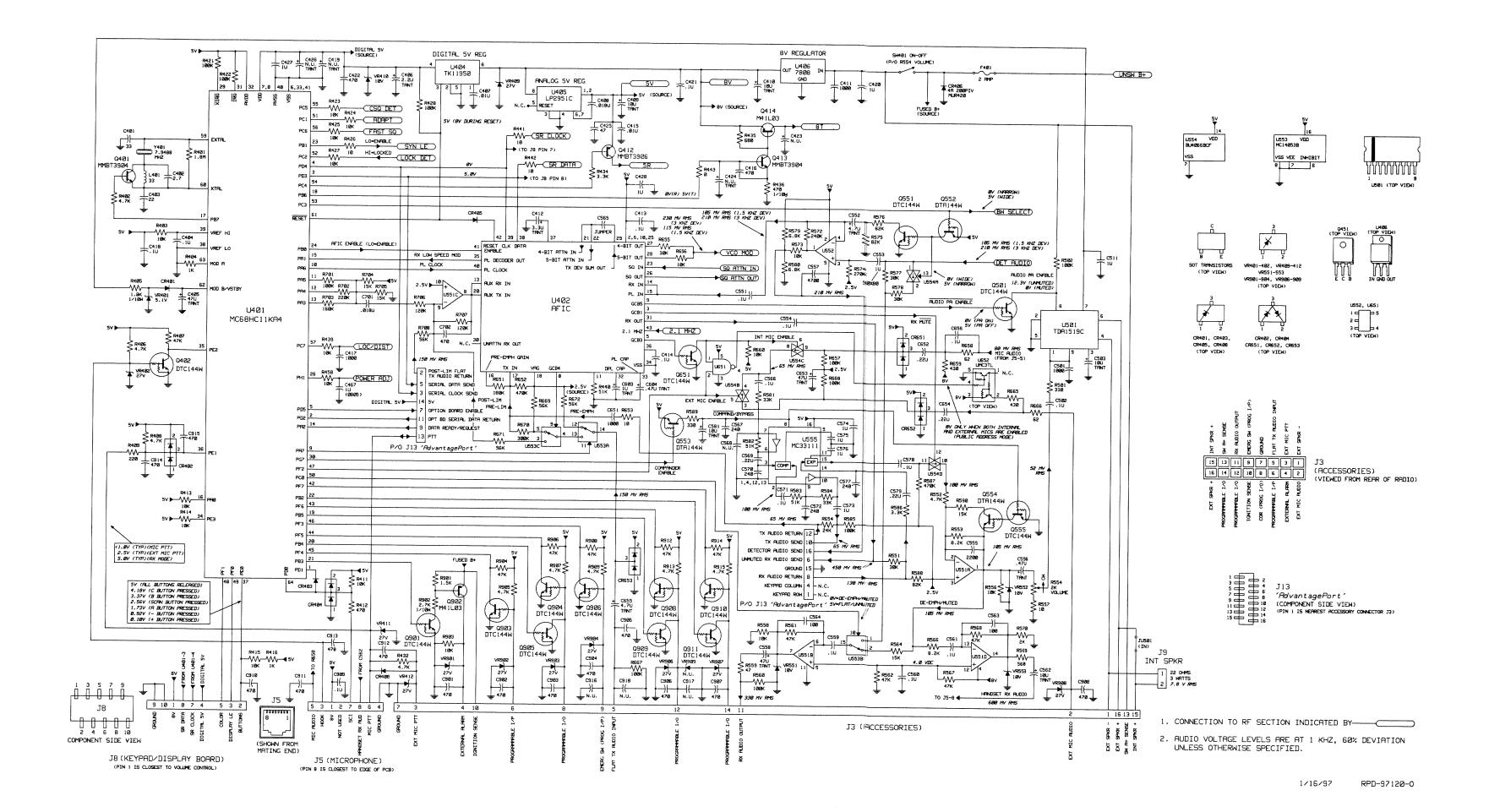
SOLDER SIDE VIEW



Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUE3873C & HUE3579A Radios) (Sheet 1 of 2)

April, 1999

6880904Z96-A



Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUE3873C & HUE3579A Radios) (Sheet 2 of 2)

6880904Z96-A

April, 1999

Parts List

C23

C26

C53

C55

C57

C58

C59

C60

C61

C62

C64

C67

C75

C76

C82 83

C88, 89

C202

C210, 21

C214

C215

C218

C219

C220

C221

C222 C223

C224

C225

C233

C230, 231

C212, 213

C85 thru 87

SYMBOL PART NO.

21-13740L15

21-13740L14

21-13740L06

21-13740L19

21-13740L13

21-13740[19

21-137401.03

21-13740L07

21-13740115

21-13740F60

21-13740L05

21-13740L15

21-13740L21

21-13740L09

21-13740L10

21-13740L23

21-13740L09

21-13740L08

21-13740L21

21-13740L10

21-13740L01

21-13740F60

21-13740F29

21-13740F31

21-13740F60

21-13740F05

21-13740F49

21-13740F29

21-13740F19

21-13740F39

21-13743E20

21-13740F36

21-13740F14

21-13741F29

23-11049A05

21-13740F69

21-13741F49

23-11049,111

23-11049.107

23-11049A57

21-13743E20

21-13740F36

21-13740F60

21-13741F49

23-11049J11

21-13741F49

21-13741F17

23-11049J11

21-13741F25

21-13741F49

21-13740F60

21-13741F25

23-11049J11

21-13928E01

21-13743E20

23-11049A07

21-13741F43

23-11049J11

21-13743E05

21-13740F60

21-13741F25

21-13740F39 33 pF

21-13740L10 4.7 ±0.1 pF

21-13740L08 3.9 ±0.1 pF

21-13740L07

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz 12.5/25 kHz, 25-40 W

REFERENCE MOTOROLA

6.8 ±0.1 pl

11 pF, 2%

3.6 ±0.1 pl

6.2 ±0.1 pF

11 pF. 2%

 $3.6 \pm 0.1 p$

 $7.5 \pm 0.1 pF$

3.0 +0.1 pF

 $7.5 \pm 0.1 p$

13 pF 2%

4.3 +0.1 pF

47+01 nF

16 pF, 2%

4.3 ±0.1 pf

3.9 ±0.1 pl

13 pF. 2%

2.0 ±0.1 pF

1.2 ±0.25 pF

4.7 ±0.25 pF

3 ±0.25 pF

0.1 uF, 10%; 16 V

tantalum 0.47 uF, 10%; 25 V

tantalum 4.7 uF, 10%; 16 V

tantalum 3.3 uF, 10%; 20 V

tantalum 10 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

tantalum 1 uF, 10%; 16 V

tantalum 4.7 uF, 10%; 16 V

1 uF, 10%; 10V

0.1 uF, 10%; 16V

.018 uF, 10%; 16 V

C458, 459

C463

C465 C466

C467

C468

C501

0.1 uF, 10%; 16 V

33 nF

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10% 16 V

21-13743E20 0.1 uF, 10%; 16 V

470 pF

1000 pF

5600 pF

240 pF

21-13743E20 0.1 uF, 10%; 16 V

1000 pF

21-13740F18 4.3 ±0.25 pF

21-13740F10 2 ±0.25 pF

21-13740F41 39 pF

21-13740F32 16 pF

21-13740F40 36 pF

21-13740F59 220 pF

21-13740L34 47 pF, 2%

21-13740L14 6.8 ±0.1 pF

DESCRIPTION

capacitor, fixed: uF +/-5%; 50 V:

unless otherwise stated

PL-971002-B REFERENCE MOTOROLA DESCRIPTION SYMBOL PART NO tantalum 4.7 uF, 10%; 16 V 21-13740F60 240 pF 21-13740L15 7.5 ±0.1 pF 21-13740L02 2.2 ±0.1 pF

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz 12.5/25 kHz, 25-40 W C238 thru 241 21-13740L16 8.2 ±0.1 pF 21-13740L12 5.6 ±0.1 pF C246 21-13740L13 6.2 ±0.1 pF tantalum 0.22 uF, 10%; 35 V C247 23-11049A03 21-13740L15 7.5 ±0.1 pF C251 21-13740F60 C253, 254 21-13740F03 1 ±0.25 pF 21-13740L24 C255 21-13740L13 C256, 257 21-13740F60 C261 C262 21-13741F49 21-13740F60 C263 C264 thru 266 21-13740F60 C267 21-13740F60 240 pF 21-13740F41 21-13741F49 21-13740F18 4.3 ±0.25 pF C275 21-13740F25 8.2 ±0.25 pF tantalum 0.22 uF, 10%; 35 V C279 23-11049A03 21-13740F22 6.2 ±0.25 pF 21-13740F34 C282 C283 C284 21-13740F60 21-13741F49 21-13740F47 C285 21-13740F47 68 pF C287 21-13743E20 0.1 uF, 10%; 16 V C289 Not Used Not Used 21-13740F60 C292, 293 240 pF 21-13741F49 21-13740F60 Not Used 21-13740F60 240 pF C298, 299 21-13743E20 0.1 uF, 10%; 16 V 21-13740F39 2.7 ±0.25 pF 21-13740F13 C403 21-13740F35 C404 C405 0.1 uF, 10%; 16V 21-13743E20 tantalum 47 uF, 10%; 10 V 23-11049J43 tantalum 2.2 uF, 10%; 10 V C406 C407 23-11049A40 21-13741F49 21-13743E05 .018 uF, 10%; 16 V C408 tantalum 10 uF, 10%; 16 V 23-11049A57 C409, 410 21-13741F25 1000 pF C411 tantalum 3.3 uF, 10%; 20 V 23-11049,J07 C413, 414 21-13743E20 0.1 uF, 10%; 16 V 21-13741F49 .01 uF 21-13741F17 470 pF 21-13741F25 1000 pF C418 21-13743E20 0.1 uF, 10%; 16 V C419 C420 21-13741W01 1 uF, 10%; 25 V C421 C422 21-13743E20 0.1 uF, 10%; 16 V 21-13741F17 470 pF C423 424 Not Used 21-13740F43 47 pF Not Used 21-13928E01 1 uF 10%: 10 V 21-13740F26 9.1 ±0.25 pF Not Used 21-13740F60 240 nF C453, 454 21-13743E20 0.1 uF, 10%; 16 V 21-13740F60 C455 thru 457

21-13743E20 0.1 uF, 10%; 16 V

21-13743E20 0.1 uF, 10%; 16 V

21-13928E01 1 uF, 10%; 10 V

21-13743F20 0.1 uE 10%: 16 V

5.1 ±0.25 pF

Not Used

23-11049A57 tantalum 10 uF, 10%; 16 V

21-13740F20 5.1 ±0.25 pF

21-13740F60 240 pF

21-13741F25 1000 pF

21-13740F60

21-13740F20

21-13741F17

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C511	21-13741W01	1 uF, 10%; 25 V
C551	21-13743E20	0.1 uF, 10%; 16 V
C552	23-11049J11	tantalum 4.7 uF, 10%; 16 V
C553	21-13928E01	1 uF, 10%; 10 V
C554	21-13743E20	0.1 uF, 10%; 16 V 2200 pF
C555 C556	21-13741F33 23-11049A05	tantalum 0.47 uF, 10%; 25 V
C557	21-13741F41	4700 pF
C558	23-11049J43	tantalum 47 uF, 10%; 10 V
C559 thru 561	21-13743E20	0.1 uF, 10%; 16 V
C562	23-11049A57	tantalum 10 uF, 10%; 16 V
C563, 564 C565	21-13740F51 06-62057B47	100 pF jumper
C566	21-13743E20	0.1 uF, 10%; 16 V
C567	21-13740F60	240 pF
C568		Not Used
C569	21-13743K16	0.22 uF, +80/-20%; 16 V 240 pF
C570 C571	21-13740F60 21-13743E20	0.1 uF, 10%; 16 V
C572	21-13740F60	240 pF
C573 thru 576	21-13928E01	1 uF, 10%; 10 V
C577	21-13740F60	240 pF
C578	21-13743E20	0.1 uF, 10%; 16 V
C579	21-13743K16 23-11049A57	0.22 uF, +80/-20%; 16 V tantalum 10 uF, 10%; 16 V
C581 C603	23-11049A07	tantalum 1 uF, 10%; 16 V
C604	23-11049A05	tantalum 0.47 uF, 10%; 25 V
C651	21-13741F25	1000 pF
C652	21-13743K16	0.22 uF, +80/-20%; 16 V
C653	23-11049J43	tantalum 47 uF, 10%; 10 V 0.22 uF, +80/-20%; 16 V
C654 C655	21-13743K16 23-11049J11	tantalum 4.7 uF, 10%; 16 V
C656	21-13743E20	0.1 uF, 10%; 16 V
C701	21-13743E05	.018 uF, 10%; 16 V
C702	21-13741F17	470 pF
C901 thru 908	21-13741F17	470 pF
C909 C910 thru 915	21-13743E20 21-13741F17	0.1 uF, 10%; 16 V 470 pF
C916 thru 918	21-107-411-17	Not Used
C2610	21-13740A30	11 pF
C2611	21-13740A29	10 pF
C2612	21-13740A33	15 pF
C2613 C2614	21-13740A79 21-13740A79	1000 pF 1000 pF
C2615	21-13740A24	6.8 ±0.25 pF
C2616	21-13740A59	150 pF
C2617, 2618	21-13743A19	0.1 uF, 10%; 16 V
C2619	21-13740A59	150 pF
C2620 C2621	21-13740A33 21-13740A39	15 pF 27 pF
C2622, 2623		Not Used
C2626	21-13741W01	1 uF, 10%; 25 V
C2627	21-13740A79	1000 pF
C2628	21-13740A59	150 pF
C2629 C2630	21-13740A39	Not Used 27 pF
C2631, 2632	21-13740B32	20 pF
C2636	21-13740A59	150 pF
C2637	21-13741W01	1 uF, 10%; 25 V
C2639	04 000001400	Not Used
C2640	21-80060M33	39 pF; 500 V 56 pF; 100 V
C2641 C2642	21-11078B36 21-11078B35	51 pF; 100 V
C2643, 2644	21-80964X35	clamped mica 39 pF; 250 V
C2645	21-11078B14	11 pF; 100 V
C2646	21-11078B10	7.5 ±0.25 pF; 100 V
C2647	21-80060M47	150 pF; 100 V
C2648 C2649	21-13740B49 21-13741W01	100 pF 1 uF, 10%; 25 V
C2650	21-80060M33	39 pF; 500 V
C2652	21-13740F19	4.7 ±0.25 pF
C2653	21-13740F34	20 pF
C2654	21-13740A59	150 pF
C2655	21-13740A59	Not Used 150 pF
C2656 C2660	21-80060M05	3 ±0.5 pF; 500 V
C2661	21-11078B11	8.2 ±0.25 pF; 100 V
C2662	21-11078B14	11 pF; 100 V
C2663	21-11078B07	5.6 ±0.25 pF; 100 V
C2664	21-80060M47	150 pF; 100 V

21-11078B05 4.7 ±0.25 pF; 100 V

21-11032B15 0.22 uF, +80/-20%

C2671

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz PL-971002-B 12.5/25 kHz, 25-40 W

12.5/25 kHz, 25-40 W REFERENCE MOTOROLA REFERENCE MOTOROLA DESCRIPTION SYMBOL SYMBOL PART NO L401 21-13740A79 C2672 L2610 21-13740A59 C2673 C2680 thru 2683 21-13740F60 L2611 240 pF L2612 diode: (see note) L2613 48-80154K03 dual Schottky SOT L2620 L2622 silicon PIN SOT MMBV3401 48-80142L01 48-80154K03 dual Schottky SOT L2632 48-02245J22 silicon varactor SOT 1T363 CR201 48-13833C07 dual silicon SOT MMBD7000 CR211 L2642 L2643 L2650 48-05218N57 dual silicon SOT 48-62824C01 silicon varactor SOT 1SV229 48-62824C01 silicon varactor SOT 1SV229 CR251, 252 L2651 48-05129M76 silicon SOT 48-13833C07 dual silicon SOT MMBD7000 L2652 CR402 CR403 48-80939T01 Schottky SOT L2660 thru 2662 24-60591X01 48-13833C07 dual silicon SOT MMBD7000 CR405 48-05129M76 silicon SOT L2664 48-05129M76 silicon SOT 48-05129M76 silicon SOT CR651 thru 653 48-13833C07 dual silicon SOT MMBD7000 silicon PIN MA4P1250 CR2650, 2651 48-02482J02 48-80236E07 transient suppressor Q51, 52 CR2670 Q53, 54 48-82290T02 dual Schottky SOT HSMS-2802 CR2680 2681 Q271 Q281 ferrite beads 24-84657R01 ferrite bead F2620, 2621 24-84657R01 ferrite bead Q412 24-84657R01 ferrite bead Q413 24-84657R01 ferrite bead Q414 E2670, 2671 24-84657R01 ferrite bead Q452, 453 65-05214E04 2 amp axial lead F401 91-80098D14 455 kHz 4F 91-80097D04 455 kHz 6F 91-80098D16 455 kHz 4D 91-80097D16 455 kHz 6D Q908 thru 911 connector, receptacle 09-80476U01 mini UHF coax Q2620 power cable assembly (includes J2) Q2630 16-pin, accessories telephone type, 8 contact, microphone Q2640 09-04422J01 10-pin, display board 28-04423J01 2-pin, internal speake 09-80472U01 16-pin, option board J13 06-62057B47 JU501 iumper 24-84562T11 4 turns airwound, 2% L1 thru 7 24-62587X55 chip 0.15 uH, 5% 24-62587X43 chip 15 nH, 5% 24-83411T63 0.15 uH, 5% shielded 24-62587X49 chip 47 nH, 5% 24-62587X55 chip 0.15 uH, 5% 24-62587X55 chip 0.15 uH, 5% 24-62587X63 chip 0.62 uH, 5% L53, 55 24-62587X68 chip 1 uH, 5% 24-62587X69 chip 1.2 uH, 5% L58, 59 24-62587X69 chip 1.2 uH, 5% 24-62587X60 chip 0.39 uH, 59 L221 L241 chip 56 nH, 5% 24-62587X50 1242 24-84562T11 4 turns airwound, 2% L243, 244 24-62587X61 chip 0.47 uH, 5% 24-62587X49 chip 47 nH, 5% R68 thru 70 24-84562T13 3 turns airwound, 2% L253 thru 255 24-62587X60 chip 0.39 uH, 5% chip 22 nH, 5% 24-62587X45 R202 L262 24-62587X60 chip 0.39 uH. 5% R221 R222 24-62587X61 chip 0.47 uH, 5% chip 0.39 uH, 5% 24-62587X60 R223 chip 15 nH, 5% 24-62587X43 R231 24-62587X47 chip 33 pH, 5% R232 R233 24-62587X60 chip 0.39 uH, 5% 24-62587X43 chip 15 nH, 5%

24-62587X60 chip 0.39 uH, 5%

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz PL-971002-B

DESCRIPTION

PART NO.

24-60578C43 chip 33 uH

24-62587T40 chip 33 nH 59

24-62587T40 chip 33 nH, 5%

24-60591A01 3 turns

24-60591C73 5 turns

24-60591B17 4 turns

24-60591B73 4 turns

24-60591E73 7 turns

24-60591A33 3 turns

24-60591V77 12 turns

24-60591X01 3 turns

24-60591R53 8 turns

chip: 0.47 uH

tramsistor: (see note)

NPN; type MMBR94

PNP; type MMBT3906

NPN; type MMBR941

NPIN: type MMBR941

NPIN: type MMBR941

NPN: type MMBT3904

PNP: type MMBT3906

PNP; type BCW68G

NPiN; type MMBT3904

digital NPN; type DTC144W

digital NPN; type DTC144W

digital PNP; type DTA144W

digital NPN; type DTC144W

digital NPN; type DTC144W

digital NPN; type DTC144W

digital NPN; type DTC144V

digital NPN; type DTC144V

resistor, fixed: +/-5%; 1/16 W:

unitess otherwise stated

330): 1/10 wat

NPIN; type BFG35

digital NPN: type DTC144W

digital NPN: type DTC144W

3 turns

48-80214G02 NPiN; type MMBT3904

48-02245J25 PNIP; type 2SB1142S

48-80225C09 NPIN; type MRF630

48-80225C19 NPIN: type MRF654

48-80225C24 NPIN; type MRF650

24-60591G73

24-60591E69

24-11087B22

24-60591B77

48-13827A07

48-13824A17

48-13827A07

48-80947V01

48-13827A07

48-13827A07

48-80214G02

48-80947V01

48-13824A17

48-80141L03

48-80214G02

48-80947V01

48-80947V01

48-80494U01

48-80947V01

48-80947V01

48-80141L03

48-80947V01

48-02245J24

06-62057A59

06-62057A80

06-62057A73

06-62057A37

06-62057A40

06-62057C63

06-62057A18

06-62057483

06-62057A75

06-62057445

06-62057A25

06-62057A99

06-62057A76

06-62057A97

06-62057A81

06-62057A83

06-62057A91

06-62057A61

06-62057A47

06-62057A56

06-62057A73

06-62057A61

06-62057A57

06-62057A89

06-62057A57

06-62057A23

06-62057A61

06-62057A49

06-62057A82

R242

06-62057A57 2.2k

06-62057B06 22:0k

06-62057A13

48-80947V01

48-80947V01

24-60591E73

06-62057B07

06-62057A73

06-62057B08

06-62057A95

06-62057A84

06-62057A85

06-62057A92 62k

06-62057A69 6.8k

R574

R576

R577, 578

R579, 580

HUF3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz 25 kHz 25-40 W FERENCE MOTOROLA

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	REFERENCE SYMBOL	
R251	06-62057A77	15k	R582, 583	
R252	06-62057A52	1.3k	R584	
R253	06-62057A33	220	R585	
R260	06-62057A33	220	R586	
R271	06-62057A75	12k	R587	
3272	06-62057A69	6.8k	R588	
R273	06-62057A32	200	R589	
3274	06-62057A49	1k	R590	
R281	06-62057A47	820	R651	
7282	06-62057A59	2.7k	R652	
R283	06-62057A15	39 330	R653	
R284 R285	06-62057A37 06-62057A05	15	R654 R655	
R286	06-62057A37	330	R656	
R287		Not Used	R657	
R291	06-62057A84	30k	R658	
R292	06-62057A25	100	R659	
R293	06-62057A81	22k	R660	
R294	06-62057A84	30k	R665	
R401	06-62057B28	1.8 meg	R666	
R402	06-62057A65	4.7k	R667, 668	
R403	06-62057A73	10k	R669	
R404	06-62057A49	1k	R670	
R405	06-62057C81	1.8k; 1/10 watt	R671, 672	
R406	06-62057A65	4.7k	R701	
R407	06-62057A89	47k	R702	
R408	06-62057A65	4.7k	R703	
R409	06-62057A33	220	R704, 705	
R411 R412	06-62057A73 06-62057A41	10k 470	R706, 707 R708	
R413 thru 415	06-62057A73	10k	R901	
R416	06-62057A49	1k	R902	
R421, 422	06-62057A97	100k	R903	
R423 thru 425	06-62057A73	10k	R904	
R426	06-62057A01	10	R905	
R427	06-62057A73	10k	R906	
R428	06-62057A97	100k	R907	
R432	06-62057A65	4.7k	R908	
R434	06-62057A61	3.3k	R909	
R435	06-62057A45	680	R912	
R436	06-62057C67	470; 1/10 watt	R913	
R439	06-62057A73	10k	R914	
R440	06-62057A90	51k	R915	
R441, 442	06-62057A01	10	R2610	
R443	06-62057B47	0	R2611	
R451	06-62057A45 06-80195M37	680 330; 1/2 watt	R2612	
R452 R453	06-80195M37 06-62057A45	680 watt	R2613, 614 R2615, 2616	
R454	06-62057A49	1k	R2620	
R455 thru 458	06-62057A49	10k	R2640	
R459	06-62057A77	15k	R2651	
R460	06-62057A65	4.7k	R2660	
R461	06-62057A73	10k	R2675	
R462	06-05621T02	thermistor 50k @ 25 degrees C	R2681, 2682	
R463	06-62057A45	680	R2683, 2684	
R464	06-62057A33	220	R2685, 2686	
R465	06-62057A25	100		
R501	06-62057A37	330	112	
R502	06-62057A97	100k	U1	
R551	06-62057A84	30k	U2	
R552	06-62057A65	4.7k	U51 U52	
R553	06-62057A71	8.2k variable 2k with switch	U53	
R554	18-04405J02		U201*	
R556	06-62057A73 06-62057A01	10k 10	U251	
R557	06-62057A01	10k	U401*	
R558 R559	06-62057A17	47	U402	
R560	06-62057A17	100k	U404	
R561, 562	06-62057A97	47k	U405	
R564	06-62057A77	15k	U406	
R566	06-62057A71	8.2k	U451	
R567, 568	06-62057A89	47k	U501	
R569	06-62057A43	560	U551	
R570	06-62057A56	2k	U552	
R572	06-62057B07	240k	U553	

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz

PART NO.

06-62057A90

06-62057A85

06-62057A97

06-62057A61

06-62057B14

06-62057A95

06-62057A37

06-62057A77

06-62057B04

06-62057B14

06-62057A01

06-62057A82

06-62057A84

06-62057473

06-62057497

06-62057A40

06-62057A73

06-62057A40

06-62057A20

06-62057A97

06-62057A91

06-62057B09

06-62057A91

06-62057A97

06-62057B06

06-62057B03

06-62057A77

06-62057A99

06-62057A53

06-62057C85

06-62057A73

06-62057A89

06-62057A65

06-62057A89

06-62057A65

06-62057A89

06-62057A65

06-62057A89

06-62057A65

06-62057A89

06-62057465

06-62057C57

06-62057C59

06-62057C53

06-62057C36

06-62057C27

06-80194M23

06-62057C27

06-80195M25

06-62057A73

06-62057A63

51-80505D05

48-09939C04

51-80605E02

51-05663U35

51-05663U35

51-05414S84

51-80604E01

51-80633C01

51-05469E65

51-13816D03

51-80932W0

51-80147R0

51-02198J28

51-62852A09

51-84704M60

51-05663U35

51-13811A35

51-05461G61

48-09939C04

U555

U652

VR401

U651

06-62057420

UHF Radio, 450-474 MHz PL-971002-B	HUE3873C, 12.5/25 kHz,
DESCRIPTION	REFEREN SYMBO
51k 33k 100k 3.3k 470k 82k 330 15k	VR402 VR409 VR410 VR411, 41 VR451 VR551 thru VR901 thru VR906 thru
470k 10	Y51
24k 30k 10k 100k	Y52 Y201* Y401
62 430 10k 430 62 100k 56k 300k	
56k 100k 220k	note: For on
160k 15k	must be ord
120k 56k 1.5k 2.7k; 1/10 watt	Designato Recalibrat when thes frequency
10k 47k 4.7k	
4.7k 4.7k 4.7k	
4.7k 47k 4.7k	
47k 4.7k 180; 1/10 watt 220; 1/10 watt	
120 ;1/10 watt 24; 1/10 watt Not Used Not Used	
10, 1/10 watt 82; 1 watt Not Used 10; 1/10 watt	
100; 1/2 watt 10k 3.9k	
integrated circuit: (see note) double-balanced mixer dual transistor switch UMC3TL receiver system quad analog switch 4066B	
quad analog switch 4066B synthesizer VCO/buffer microcomputer MC68HC11KA4	
audio filter 5 V regulator TK11950 5 V regulator LP2951C 8 V regulator MC7808BT dual op-amp LM2904 SOIC audio power amp TDA1519C	
quad op-amp LM2902D SOIC single opamp LMC7101 triple 2-channel switch 4053B quad analog switch 4066B compander MC33111 NAND gate TC7S00F dual transistor switch UMC3TL	
SECTION STREET	

HUE3873C, HUE3579A & HUE3545B UHF Radio, 450-474 MHz PL-971002-B . 25-40 W

NCE MOTOROLA PART NO. DESCRIPTION

48-80948V01 zener diode 27 V SOT

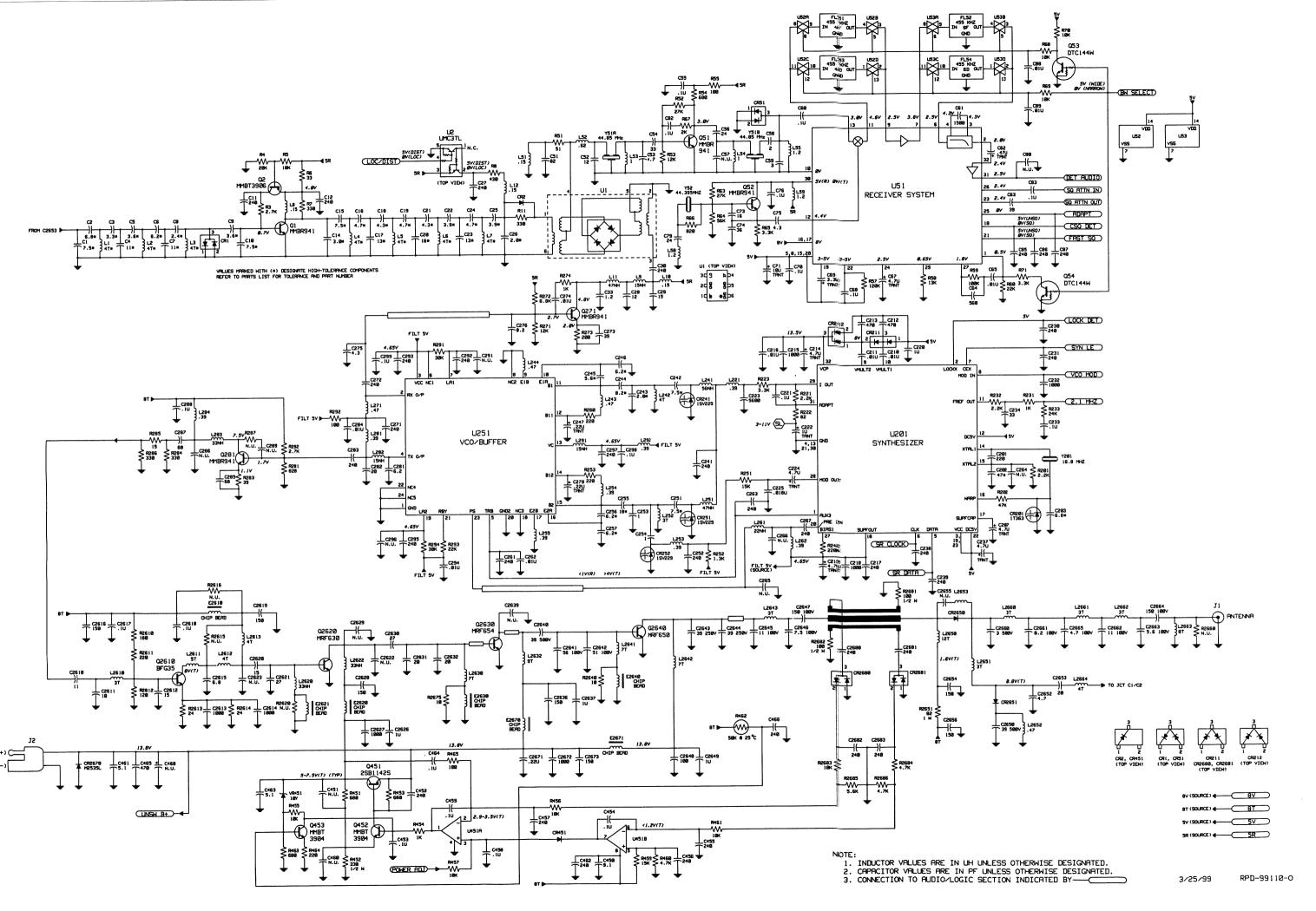
48-80948V01 zener diode 27 V SOT

V11403	40-003-010	2010 0000 27 4 001
VR410	48-80140L15	zener diode 10 V SOT
VR411, 412	48-80948V01	zener diode 27 V SOT
VR451	48-80140L15	zener diode 10 V SOT
VR551 thru 553	48-80140L15	zener diode 10 V SOT
VR901 thru 904	48-80948V01	zener diode 27 V SOT
VR906 thru 909	48-80948V01	zener diode 27 V SOT
		crystal: (see note)
Y51	91-80112R13	filter 44.85 MHz
		(includes Y51A and Y51B)
Y52	48-80606B07	44.395 MHz
Y201*		16.8 MHz
Y401	48-80113R01	7.9488 MHz
	non-refe	renced items
	14-05160A02	crystal insulator (for Y201)
	26-04398J01	VCO/synthesizer shield (4 used)
	26-04399J01	receiver mixer bottom shield
	26-04400J01	receiver front end top shield
	26-04419J01	PA shield frame
	26-04420J01	PA shield cover
	26-80481U01	TX buffer top shield
	42-80281L01	ground clip (2 used for Q2640)
ote: For optimum	performance, dio	des, transistors, and integrated circ
nust be ordered by		
Designators marl	ked with an (*) der	note parts which are not field service
Recalibration of t	he radio using spe	ecialized factory equipment is mand
when these comp	ponents are replac	ced in order to guarantee the specifi
frequency stabilit	y of the radio at te	emperature extremes.
	•	·

Parts List for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 25-40 W (Part of HUE3873C & HUE3579A Radios)

48-80140L06 zener diode 5.1 V SOT

voltage regulator: (see note)



Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios) (Sheet 1 of 2)

April, 1999

6880904Z96-A

13

8V REGULATOR SW401 ON-OFF (P/O R554 VOLUME) DIGITAL 5V DIGITAL 5V REG U404 TK11950 -CUNSW B+ M4 11 03 5V (AV DIRTNE RESET) R441 # (SR CLOCK) → (TO J8 PIN ?) R442 WW—SR DATA 5V C428 LISEL (TOP VIEW) → (TO JB PIN 8) C413 230 MV RHS 218 MV RHS (1.5 KHZ DEV)
(3 KHZ DEV)
(3 KHZ DEV)
(1.5 KHZ DEV)
(1.5 KHZ DEV) 3.3U DECET 23 2.6,10,25 8655 4-BIT OUT 27 W R656 50 IN 26 10K \$ R\$575 892K 105 MV RMS (1.5 KHZ DEV) 210 MV RMS (3 KHZ DEV) 41 RESET CLK DATA ENABLE AFIC ENABLE (LO-ENABLE) 4-BIT ATTN IN T C418 RX LOW SPEED MOD 35 PL DECODER OUT DET AUDIO \$ R502 \$ 1000K (SO ATTN IN) PL CLOCK TX DEV SUM OUT RUDIO PRI ENRIBLE 50 OUT 26 11 R701 R704 SV 12 100K R702 15K R705 13 R703 220K C701 15K → SQ ATTN OUT) PL IN 15 1.8K VR481 + C485 1/10H 5.1V 47U U4Ø2 AFIC GCR5 ** GCB1 3 RX OUT 3 MC68HC11KH4 2.1 MHZ 2.1 MHZ TD91519C CR482, CR484 CR651, CR652, CR653 (TOP VIEW) INT MIC EMABLE R458 POWER ADJ 2 POST-LIM FLAT TX AUDIO RETURN 8V 3 2 R665 (TOP VIEW) 430 5 SERIAL DATA SEND 3 SERIAL CLOCK SEND POST-LIM 7 OPTION BORRD ENRILE R671 - 3888K 11 OPT BD SERIAL DATA RETURN BY ONLY WHEN BOTH INTERNAL AND EXTERNAL MICS ARE ENABLED (PUBLIC ADDRESS MODE) 9 DATA READY/REQUEST 13 PTT P/O J13 'AdvantagePort' 15 13 11 9 7 5 3 I 16 14 12 10 8 6 4 2 COMPRINDE (ACCESSORIES) 52 MV A (VIEWED FROM REAR OF RADIO) Q554 R590 DTR144W 5v ► W 16 PI 7X PUDIO RETURN 12 24K 1990K 5V ► W 34 PE TX PUDIO SEND 10 47K (1.0V (TYP)(MIC PTT) 2.5V (TYP)(EXT MIC PTT) 5.0V (TYP)(RX MODE) DETECTOR PUDIO SEND 16 UNMUTED RX PUDIO SEND 6 R907 ≤ GROUND 15 450 MV RMS R9Ø9 4.7K R913 ≶ 7 F 8 RX RUDIO RETURN 8 J13 KEYPAD COLUMN 4 - N.C. 5V (ALL BUTTONS RELEASED)
4.18V (C BUTTON PRESSED)
3.3PV (B BUTTON PRESSED)
2.56V (SOAN BUTTON PRESSED)
1.73V (A BUTTON PRESSED)
8.92V (- BUTTON PRESSED)
6.18V (+ BUTTON PRESSED) 'AdvantagePort' KEYPAD ROW 1 - N.C. OV-DE-EMP-VMUITED
P/O J13 'AdvantagePort' 5V-FLAT/LINGUITED (COMPONENT SIDE VIEW)
(PIN 1 IS NEAREST ACCESSORY CONNECTOR J3) DE-EMPH/MUTED ₩ Q9Ø3 BTC144W ₩ 0904 DTC144W ₩ Q9Ø8 DTC144W Q910 DTC144W 27V C904 470 C916 C813 INT SPKR VR9Ø1
27V
C9Ø1
47Ø 12K 1K 1SV ____ C56Ø HANDSET RX AUDIO TO J5-8 **←**--9 10 1 8 7 4 5 3 2 J8 1. CONNECTION TO RF SECTION INDICATED BY-J3 (RICCESSORIES) AUDIO VOLTAGE LEVELS ARE AT 1 KHZ, 60% DEVIATION UNLESS OTHERWISE SPECIFIED. COMPONENT SIDE VIEW (SHOWN FROM J8(KEYPAD/DISPLAY BOARD) .TS (MTCROPHONE) (PIN 1 IS CLOSEST TO VOLUME CONTROL) (PIN B IS CLOSEST TO EDGE OF PCB)

Schematic Diagram for UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios) (Sheet 2 of 2)

14

6880904Z96-A

April, 1999

1/16/97 RPD-97120-0

Parts List

HUE3871A & HUE3580A UHF Radio, 450-474 MHz

REFERENCE	MOTOROLA	
SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-5%; 50 V:
C1	21-13740L15	unless otherwise stated 7.5 ±0.1 pF
C2	21-13740L13	6.8 ±0.1 pF
C3	21-13740L06	3.3 ±0.1 pF
C4	21-13740L19	11 pF, 2%
C5	21-13740L07	3.6 ±0.1 pF
C6	21-13740L13	6.2 ±0.1 pF
C7 C8	21-13740L19 21-13740L03	11 pF, 2% 2.4 ±0.1 pF
C9	21-13740L07	3.6 ±0.1 pF
C10	21-13740L15	7.5 ±0.1 pF
C11, 12	21-13740F60	240 pF
C14	21-13740L05	3.0 ±0.1 pF
C15 C16	21-13740L15 21-13740L10	7.5 ±0.1 pF 4.7 ±0.1 pF
C17	21-13740L21	13 pF, 2%
C18	21-13740L09	4.3 ±0.1 pF
C19	21-13740L10	4.7 ±0.1 pF
C20	21-13740L23	16 pF, 2%
C21 C22	21-13740L09	4.3 ±0.1 pF 3.9 ±0.1 pF
C22 C23	21-13740L08 21-13740L21	13 pF, 2%
C24	21-13740L10	4.7 ±0.1 pF
C25	21-13740L08	3.9 ±0.1 pF
C26	21-13740L01	2.0 ±0.1 pF
C27	21-13740F60	240 pF
C28 C29	21-13740F29 21-13740F31	12 pF 15 pF
C30	21-13740F60	240 pF
C33	21-13740F05	1.2 ±0.25 pF
C51	21-13740F49	82 pF
C52	21-13740F29	12 pF
C53 C54	21-13740F19 21-13740F39	4.7 ±0.25 pF 33 pF
C55	21-13743E20	0.1 uF, 10%; 16 V
C56	21-13740F36	24 pF
C57		Not Used_
C58	21-13740F10	2 ±0.25 pF
C59 C60	21-13740F14 21-13743E20	3 ±0.25 pF 0.1 uF, 10%; 16 V
C61	21-13741F29	1500 pF
C62	23-11049A05	tantalum 0.47 uF, 10%; 25 V
C63	21-13740F41	39 pF
C64	21-13740F69	560 pF
C65 C67	21-13741F49 23-11049J11	.01 uF tantalum 4.7 uF, 10%; 16 V
C68	21-13743E20	0.1 uF, 10%; 16 V
C69	23-11049J07	tantalum 3.3 uF, 10%; 20 V
C70	21-13743E20	0.1 uF, 10% 16 V
C71	23-11049A57	tantalum 10 uF, 10%; 16 V
C73	21-13740F32	16 pF
C74 C75	21-13740F40 21-13740F18	36 pF 4.3 ±0.25 pF
C76	21-13743E20	0.1 uF, 10%; 16 V
C79	21-13740F36	24 pF
C80		Not Used
C82, 83	21-13743E20	0.1 uF, 10%; 16 V
C85 thru 87 C88, 89	21-13740F60 21-13741F49	240 pF .01 uF
C201	21-13740F59	220 pF
C202	21-13740L34	47 pF, 2%
C203	21-13740L14	6.8 ±0.1 pF
C207	23-11049J11	tantalum 4.7 uF, 10%; 16 V
C210, 211 C212, 213	21-13741F49 21-13741F17	.01 uF 470 pF
C212, 213	23-11049J11	tantalum 4.7 uF, 10%; 16 V
C215	21-13741F25	1000 pF
C216	21-13741F49	.01 uF
C217	21-13740F60	240 pF
C218 C219	21-13741F25 23-11049J11	1000 pF tantalum 4.7 uF, 10%; 16 V
C219	21-13928E01	1 uF, 10%; 10V
C221	21-13743E20	0.1 uF, 10%; 16V
C222	23-11049A07	tantalum 1 uF, 10%; 16 V
C223	21-13741F43	5600 pF
C224	23-11049J11	tantalum 4.7 uF, 10%; 16 V
C225 C230, 231	21-13743E05 21-13740F60	.018 uF, 10%; 16 V 240 pF
C230, 231	21-13741F25	1000 pF
		<u>.</u>
C233	21-13743E20	0.1 uF, 10%; 16 V

HUE3871A & HUE3580A UHF Radio, 450-474 MHz 12.5/25 kHz, 10-25 W

23-11049A57 tantalum 10 uF, 10%; 16 V

PL-991005-O

HUE3871A & HUE3580A UHF Radio, 450-474 MHz 12 5/25 kHz 10-25 W

21-11032B15 0.22 uF. +80/-20%

PL-991005-O

HUE3871A & HUE3580A UHF Radio, 450-474 MHz 12.5/25 kHz, 10-25 W

PL-991005-O

HUE3871A & HUE3580A UHF Radio, 450-474 MHz 12 5/25 kHz, 10-25 W

06-62057B06 220k

PL-991005-O

12 5/25 kHz 10-25 W

HUE3871A & HUE3580A UHF Radio, 450-474 MHz

06-62057A85 33k

PL-991005-O

12 5/25 kHz 10-25 W

HUE3871A & HUE3580A UHF Radio, 450-474 MHz

PL-991005-O

HUE3871A & HUE3580A UHF Radio, 450-474 MHz 12 5/25 kHz 10-25 W

REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA REFERENCE MOTOROLA SYMBOL PART NO. DESCRIPTION DESCRIPTION DESCRIPTION DESCRIPTION SYMBOL SYMBOL DART NO SYMBOL DART NO DESCRIPTION SYMBOL PART NO DESCRIPTION SYMBOL 23-11049J11 C2672 R582, 583 21-13740A79 1000 pF 06-62057A90 chip 33 uH 21-13740F60 240 pF C238 thru 241 21-13743E20 0.1 uF, 10%; 16 V 21-13740A59 150 pF 24-60591A01 06-62057A52 06-62057A85 3 turns 21-13740L15 7.5 ±0.1 pF tantalum 4.7 uF, 10%; 16 V C2680 thru 2683 21-13740F60 240 pF 23-11049J11 24-60591C73 06-62057A33 06-62057A97 5 turns 21-13740L02 2.2 ±0.1 pl 1 uF, 10%; 10 V 21-13928F01 L2612 24-60591B17 R260 06-62057A33 B586 06-62057461 4 turns 3.3k 21-13740L16 8 2 +0 1 pl C244 21-13743E20 0.1 uF, 10%; 16 V diode: (see note) L2613 24-60591B73 R271 06-62057A75 4 turns 06-62057B14 C245 21-13740L12 5.6 ±0.1 nl C555 21-13741F33 48-80154K03 dual Schottky SOT R272 2200 pF 24-62587T40 06-62057A69 chip 33 nH, 5% 06-62057495 C246 21-13740L13 6.2 ±0.1 pF 48-80142L01 silicon PIN SOT MMBV3401 23-11049A05 tantalum 0.47 uF, 10%; 25 V 24-62587T40 L2622 06-62057A32 chip 33 nH, 5% R589 06-62057A37 tantalum 0.22 uF, 10%; 35 V C247 23-11049403 C557 CR51 dual Schottky SOT R274 21-13741F41 48-80154K03 1 2630 24-60591F73 06-62057449 06-62057A77 silicon varactor SOT 1T363 C251 21-13740L15 7.5 ±0.1 pF tantalum 47 uF, 10%; 10 V 23-11049,J43 L2632 24-60591G73 R281 06-62057A47 06-62057B04 C252 21-13740F60 240 pF 48-13833C07 dual silicon SOT MMBD7000 C559 thru 561 21-13743F20 0.1 uE 10%: 16 V 1 2641 24-60591F73 R282 06-62057459 06-62057B14 C253, 254 21-13740F03 1 ±0.25 pF 48-05218N57 dual silicon SOT 23-11049A57 tantalum 10 uF, 10%; 16 V L2642 R283 24-60591F69 06-62057415 R653 06-62057A01 21-13740L24 18 pF, 2% C563, 564 21-13740F51 48-62824C01 silicon varactor SOT 1SV229 R284 100 pF 24-60591A33 06-62057A37 06-62057A82 C256, 257 21-13740L13 6.2 ±0.1 pF CR251, 252 48-62824C01 silicon varactor SOT 1SV229 R285 R286 R287 C565 06-62057B47 L2650 24-60591V77 06-62057405 06-62057A84 21-13740F60 C261 C566 21-13743F20 0.1 uF 10% 16 V 48-05129M76 silicon SOT 24-60591X01 06-62057A37 06-62057A73 C262 21-13741F49 CR402 48-13833C07 dual silicon SOT MMBD7000 C567 21-13740F60 240 pF L2652 24-11087B22 chip 0.47 uH 06-62057A97 C263 21-13740F60 240 pF C568 48-80939T01 Schottky SQT 1.2653 R291 06-62057A84 B658 06-62057A20 C264 thru 266 48-13833C07 dual silicon SOT MMBD7000 CR404 C569 21-13743K16 0.22 uF, +80/-20%; 16 V L2660 thru 2662 24-60591X01 R292 06-62057A25 R659 06-62057A40 21-13740F60 240 pF C267 C570 21-13740F60 CR405 48-05129M76 silicon SOT 24-60591B53 R293 06-62057481 06-62057A73 C271, 272 21-13740F60 240 p C571 21-13743E20 0.1 uF, 10%; 16 V CB406 48-83553T02 4A 200 PIV MUB420 24-60591B77 R294 06-62057A84 06-62057A40 21-13740F41 39 nF C273 21-13740F60 CR408 48-05129M76 silicon SOT 06-62057B28 06-62057A20 C274 21-13741F49 C573 thru 5 21-13928E01 1 uF, 10%; 10 V 48-05129M76 silicon SOT R402 06-62057A65 06-62057A97 NPN; type MMBR941 C275 21-13740F18 4.3 ±0.25 pF CR651 thru 653 48-13833C07 dual silicon SOT MMBD7000 48-13827A07 06-62057A73 21-13740F60 06-62057A91 C276 21-13740F25 8.2 ±0.25 pF 0.1 uF. 10%; 16 V CR2650, 2651 48-02482J02 silicon PIN MA4P1250 R404 06-62057A49 21-13743E20 48-13824A17 PNP: type MMBT3906 06-62057B09 tantalum 0.22 uF, 10%; 35 V C279 06-62057C81 1.8k: 1/10 watt 21-13743K16 0.22 uF. +80/-20%; 16 V 48-80236E07 transient suppressor 48-13827A07 NPN; type MMBR94 R671, 672 06-62057A91 C281 48-82290T02 dual Schottky SOT HSMS-2802 21-13740F22 6.2 ±0.25 pF 23-11049A57 tantalum 10 uF, 10%; 16 V CR2680, 2681 48-80947V01 digital NPN; type DTC144W 06-62057A65 06-62057A97 C282 C283 21-13740F34 48-13827A07 06-62057A89 C603 23-11049A07 tantalum 1 uF 10%: 16 V NPN: type MMBR94 R702 06-62057B06 21-13740F60 C604 Q281 R408 06-62057A65 4.7k 240 p tantalum 0.47 uF, 10%; 25 V 48-13827A07 23-11049A05 ferrite beads NPN: type MMBR941 06-62057B03 C284 C285 24-84657R01 ferrite bead 21-13741F49 O1 uF C651 21-13741F25 48-80214G02 06-62057A33 220 1000 pF NPN: type MMRT3904 R704 705 06-62057477 C652 0.22 uF. +80/-20%: 16 V 24-84657R01 R411 68 nF 21-13743K16 E2620, 2621 06-62057A73 10k 21-13740F47 ferrite bead 48-80947V01 digital NPN: type DTC144W B706, 707 06-62057A99 C286 23-11049,J43 tantalum 47 uF, 10%: 10 V 24-84657R01 ferrite bead Q412 48-13824A17 PNP: type MMRT3906 06-62057A41 470 B708 06-62057A91 21-13740F47 68 pF C287 21-13743K16 0.22 uF. +80/-20%: 16 V 24-84657R01 ferrite bead Q413 48-80214G02 NPN; type MMBT3904 R413 thru 415 06-62057A73 10k R901 06-62057A53 C288 21-13743E20 0.1 uF, 10%; 16 V C655 23-11049.111 tantalum 4.7 uF 10%: 16 \ E2670, 2671 24-84657B01 ferrite bead Q414 48-801411 03 PNP; type BCW68G R416 06-62057449 06-62057C85 2.7k; 1/10 watt C289 C656 21-13743F20 0.1 uF. 10%: 16 V 48-02245J25 PNP; type 2SB1142S R421 422 06-62057497 100 Not Used 06-62057A73 C291 C701 21-13743E05 .018 uF, 10%; 16 V Q452, 453 48-80214G02 NPN; type MMBT3904 R423 thru 425 06-62057A73 06-62057A89 21-13740F60 F401 65-05214E04 2 amp axial lead C292, 293 240 pF 21-13741F17 48-80947V01 digital NPN; type DTC144W 06-62057A01 R905 06-62057A65 C294 21-13741F49 .01 uF C901 thru 908 21-13741F17 470 pF 48-80947V0 digital NPN; type DTC144W R427 06-62057A73 06-62057A89 C295 21-13743E20 0.1 uF, 10%; 16 V 21-13740F60 Q552 thru 554 48-80494U01 digital PNP; type DTA144W 06-62057A97 100 R907 06-62057A65 4.7k C296 C910 thru 915 21-13741F17 FL51 91-80098D14 455 kHz 4F 48-80947V01 digital NPN: type DTC144W 06-62057A65 4.7k R908 06-62057A89 47k 21-13740F60 C916 thru 918 FL52 91-80097D04 455 kHz 6F 48-80947V01 06-62057A61 3.3k digital NPN: type DTC144V Rana 06-62057A65 4.7k C298, 299 0.1 uF, 10%; 16 V 21-13740A30 11 pF FL53 91-80098D16 R435 21-13743E20 455 kHz 4D Q901 48-80947V01 06-62057A45 digital NPN: type DTC144W R912 06-62057A89 21-13740A29 21-13740F39 91-80097D16 C401 48-80141L03 06-62057C67 470: 1/10 wat Q902 PNP: type BCW68G 06-62057A65 4.7k C402 21-13740A33 21-13740F13 2.7 ±0.25 pF R439 Q903 thru 906 48-80947V01 digital NPN: type DTC144W 06-62057A73 R914 06-62057A89 C403 21-13740A79 21-13740F35 22 pF connector, receptacle Q908 thru 911 48-80947V01 digital NPN: type DTC144W 06-62057A90 06-62057A65 C404 21-13743E20 0.1 uF. 10%: 16V C2614 21-13740A79 09-80476U01 mini UHF coax 48-02245.124 NPN: type REG35 R441 442 06-62057401 06-62057C57 180: 1/10 watt C405 21-13740A24 6.8 ±0.25 pF 30-04510J01 23-11049J43 tantalum 47 uF, 10%: 10 V C2615 power cable assembly (includes J2) 48-80225C09 NPN: type MRF630 06-62057B47 R2611 06-62057C59 220; 1/10 watt 21-13740A59 28-04503J01 R451 C406 23-11049A40 tantalum 2.2 uF, 10%; 10 V 16-pin, accessories 48-80225C19 NPN: type MRF654 06-62057A45 680 R2612 06-62057C53 120 :1/10 watt C2617, 2618 21-13743A19 0.1 uF, 10%; 16 V 09-04426,101 telephone type, 8 contact, microphone Q2640 C407 21-13741F49 48-80225C24 NPN: type MRF650 06-80195M37 330: 1/2 watt R2613, 614 06-62057C36 24; 1/10 watt 21-13743E05 .018 uF, 10%; 16 V C2619 21-13740A59 150 pF 09-04422J01 10-pin, display board 06-62057445 680 R2615, 2616 Not Used 15 nF C409, 410 23-11049A57 tantalum 10 uF, 10%; 16 V C2620 21-13740A33 28-04423.101 2-pin, internal speaker resistor, fixed: +/-5%; 1/16 W: R454 06-62057A49 R2620 Not Used C411 21-13741F25 1000 pF 21-13740A39 27 pF 09-80472U01 16-pin, option board unless otherwise stated R455 thru 458 06-62057A73 06-62057C27 10; 1/10 watt R2640 06-62057459 C412 23-11049J07 tantalum 3.3 uF, 10%; 20 V C2622, 2623 06-62057A77 R2651 06-80194M23 82: 1 watt 21-13741W01 1 uF, 10%; 25 V C413, 414 21-13743E20 0.1 uF, 10%; 16 V 06-62057A80 06-62057A65 4.7k C2627 21-13740A79 1000 pF JU501 06-62057B47 06-62057A73 R461 06-62057A73 10k 21-13741F49 C415 R2675 06-62057C27 10; 1/10 watt C2628 21-13740A59 150 pF 06-62057A13 06-05621T02 thermistor 50k @ 25 degrees C C416 C417 21-13741F17 470 pF R2681, 2682 06-80195M25 100: 1/2 watt C2629 06-62057A37 R463 06-62057A45 21-13741F25 1000 nF 06-62057A73 4 turns airwound, 2% 21-13740A39 27 pF 24-84562T11 06-62057A40 06-62057A33 C418 21-13743E20 0.1 uF, 10%; 16 V 06-62057A65 C2631, 2632 21-13740B32 06-62057C63 R465 24-62587X55 chip 0.15 uH, 5% 330; 1/10 watt 06-62057A25 C419 R2685 06-62057A67 5.6k chip 15 nH, 5% 21-13740A59 24-62587X43 06-62057A18 06-62057A37 C420 21-13741W01 1 uF, 10%; 25 V R2686 06-62057A65 4.7k C2637 06-62057A83 R502 21-13741W01 1 uF, 10%; 25 V 24-83411T63 0.15 uH, 5% shielded 06-62057A97 C421 21-13743E20 0.1 uF, 10%; 16 V C2639 06-62057A75 24-62587X49 chip 47 nH, 5% 06-62057A84 21-13741F17 C2640 21-80060M33 39 pF; 500 V L12 06-62057A45 R552 integrated circuit: (see note 24-62587X55 chip 0.15 uH, 5% 06-62057A65 4.7k C423, 424 51-80505D05 double-balanced mixer 21-11078B36 56 pF: 100 V 06-62057A25 21-13740F43 47 pF 24-62587X55 chip 0.15 uH, 5% R553 06-62057A71 8.2k C425 48-09939C04 dual transistor switch UMC3TL **B57** R554 06-62057A99 21-11078B35 51 pF: 100 V 24-62587X63 chip 0.62 uH, 5% 18-04405.102 variable 2k with switch C426 51-80605E02 receiver system C427, 428 21-13928E01 1 uF. 10%; 10 V C2643, 2644 21-80964X35 clamped mica 39 pF: 250 V L53, 55 24-62587X68 chip 1 uH, 5% 06-62057A76 R556 06-62057A73 51-05663U35 quad analog switch 4066B C2645 21-11078B14 11 pF: 100 V 24-62587X69 chip 1.2 uH, 5% R59 06-62057A97 **R557** 06-62057401 21-13740F26 9.1 ±0.25 pF C450 51-05663U35 quad analog switch 4066B 7.5 ±0.25 pF: 100 V 06-62057A81 C2646 C2647 21-11078B10 L58, 59 24-62587X69 chip 1.2 uH, 5% R558 06-62057A73 Not Used 21-80060M47 150 pF; 100 V 24-62587X60 chip 0.39 uH, 5% 06-62057483 06-62057A17 21-13740F60 240 pF 51-05414S84 VCO/buffer 21-13740B49 100 pF L241 24-62587X50 chip 56 nH, 5% 06-62057A91 R560 06-62057A97 C453, 454 21-13743E20 0.1 uF. 10%; 16 V U401* microcomputer MC68HC11KA4 21-13741W01 1 uF, 10%; 25 V 06-62057A61 4 turns airwound, 2% 06-62057A89 C455 thru 457 21-13740F60 51-80604E01 U402 C2650 21-80060M33 39 pF; 500 V L243, 244 24-62587X61 06-62057A47 audio filter chip 0.47 uH, 5% 06-62057A77 C458, 459 21-13743E20 0.1 uF, 10%; 16 V 21-13740F19 4.7 ±0.25 pF 51-80633C01 5 V regulator TK11950 24-62587X49 chip 47 nH, 5% 06-62057A56 06-62057A71 C2653 C2654 21-13740F34 24-84562T13 3 turns airwound, 2% R68 thru 7 06-62057A73 R567, 568 06-62057A89 47I U405 51-05469F65 5 V regulator LP2951C 21-13740F20 5.1 ±0.25 pF 21-13740A59 L253 thru 255 24-62587X60 06-62057A61 11406 51-13816D03 8 V regulator MC7808BT 21-13740F60 chip 0.39 uH, 5% 06-62057A43 06-62057A57 51-80932W01 dual op-amp LM2904 SOIC 24-62587X45 chip 22 nH, 5% B570 06-62057456 21-13740F20 5.1 ±0.25 pF 21-13740A59 06-62057A89 audio power amp TDA1519C 24-62587X60 chip 0.39 uH, 5% 21-13743E20 0.1 uF, 10%; 16 V 06-62057B07 21-80060M05 06-62057A57 R573 51-02198J28 24-62587X61 chip 0.47 uH, 5% guad op-amp LM2902D SOIC 21-13741F17 06-62057A73 101 21-11078B11 8.2 ±0.25 pF; 100 V 06-62057A23 51-62852A09 24-62587X60 R574 chip 0.39 uH, 5% 06-62057B08 270k single opamp LMC7101 21-13740F60 240 pF R575 L282 U553 21-11078B14 R223 06-62057A61 24-62587X43 chip 15 nH, 5% 06-62057A95 821 51-84704M60 triple 2-channel switch 4053B C467 C468 21-13928E01 1 uF, 10%; 10 V 21-11078B07 5.6 ±0.25 pF; 100 V 06-62057A49 L283 24-62587X47 R231 B576 U554 U555 chip 33 nH, 5% 06-62057A92 62k 51-05663U35 guad analog switch 4066B Not Used R232 R233 L284 21-80060M47 150 pF: 100 V 06-62057A57 2.2k 24-62587X60 chip 0.39 uH, 5% B577, 578 06-62057A84 30k 51-13811A35 compander MC33111 21-13741F25 1000 pF 21-11078B05 4.7 +0.25 pF: 100 V R579, 580 U651 06-62057A82 24k 24-62587X43 chip 15 nH, 5% 06-62057A69 6.8k 51-05461G61 NAND gate TC7S00F 21-13743E20 0.1 uF, 10%; 16 V

24-62587X60 chip 0.39 uH, 5%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR401	48-80140L06	zener diode 5.1 V SOT
VR402	48-80948V01	zener diode 27 V SOT
VR409	48-80948V01	zener diode 27 V SOT
VR410	48-80140L15	zener diode 10 V SOT
VR411, 412	48-80948V01	zener diode 27 V SOT
VR451	48-80140L15	zener diode 10 V SOT
VR551 thru 553	48-80140L15	zener diode 10 V SOT
VR901 thru 904	48-80948V01	zener diode 27 V SOT
VR906 thru 909	48-80948V01	zener diode 27 V SOT
		crystal: (see note)
Y51	91-80112R13	filter 44.85 MHz
		(includes Y51A and Y51B)
Y52	48-80606B07	44.395 MHz
Y201*		16.8 MHz
Y401	48-80113R01	7.9488 MHz
	non-refe	renced items
	14-05160A02	crystal insulator (for Y201)
	26-04398J01	VCO/synthesizer shield (4 used
	26-04399J01	receiver mixer bottom shield
	26-04400J01	receiver front end top shield
	26-04419J01	PA shield frame
	26-04420J01	PA shield cover
	26-80481U01	TX buffer top shield
	42-80281L01	ground clip (2 used for Q2640)

PL-991005-O

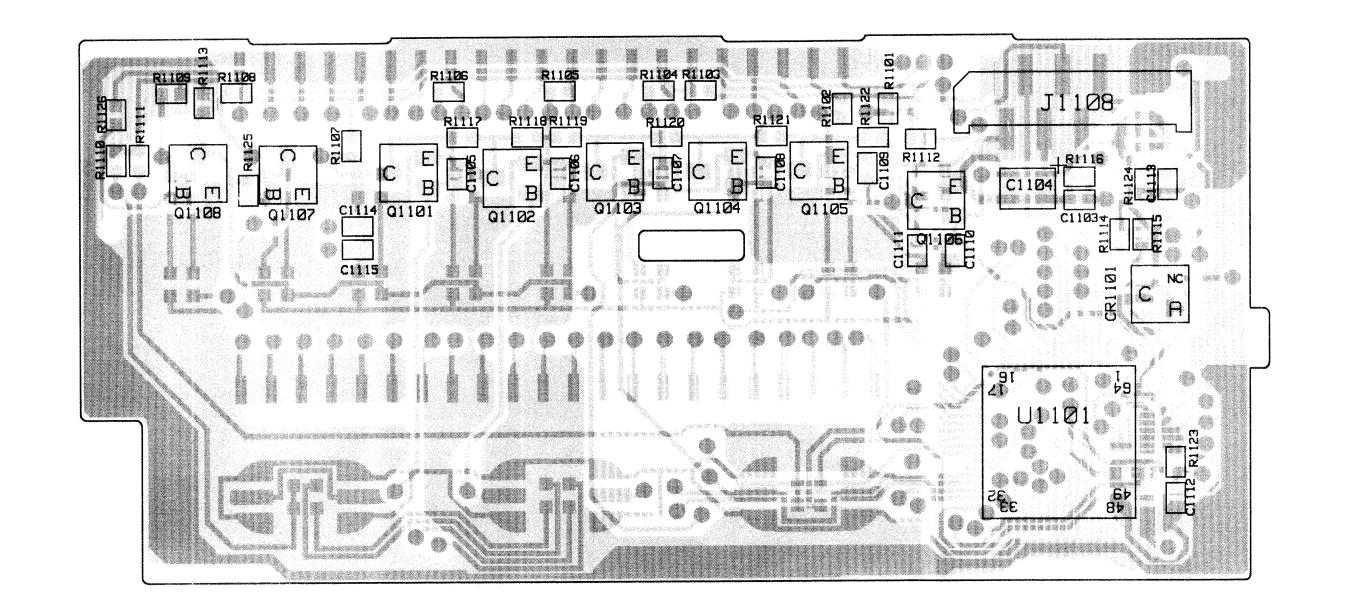
Designators marked with an (*) denote parts which are not field serviceable

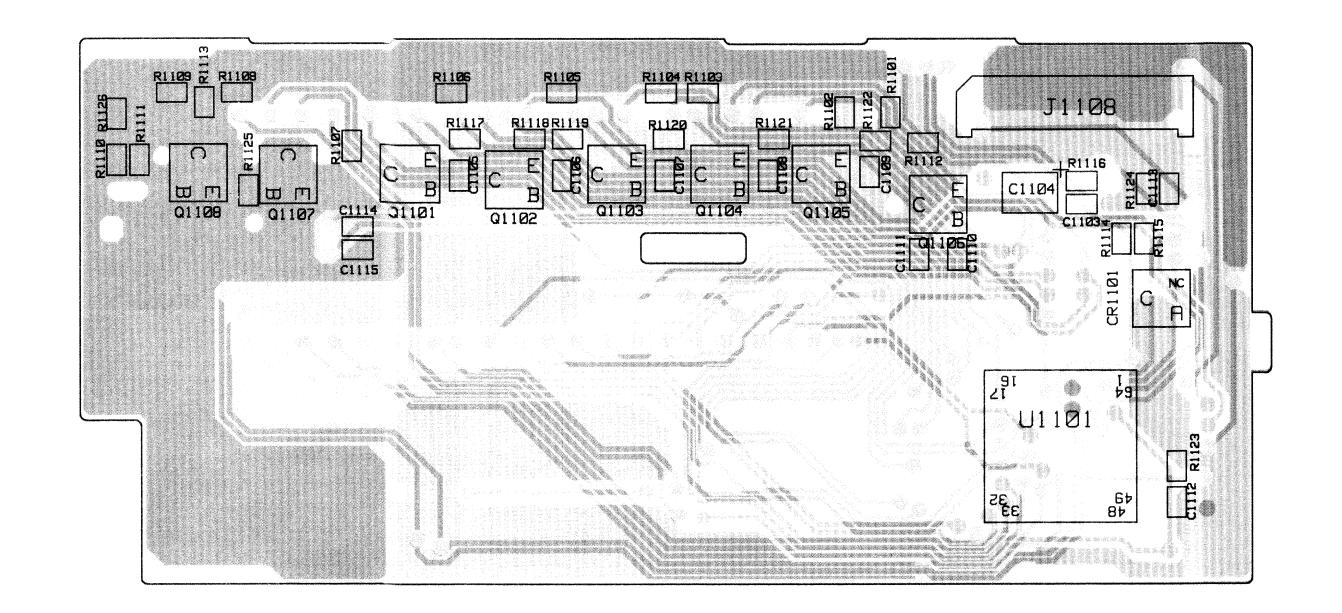
Recalibration of the radio using specialized factory equipment is mandatory when these components are replaced in order to guarantee the specified frequency stability of the radio at temperature extremes.

UHF Main Boards, 450-474 MHz, 12.5 & 25 kHz, 10-25 W (Part of HUE3871A & HUE3580A Radios)

(Page 16 is blank) 6880904Z96-A

48-09939C04 dual transistor switch UMC3TL





COMPONENT SIDE 84-80440U02 ISS P10

COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY -----

RCB-97113-O RCB-97116-O RCB-96117-O COMPONENT SIDE 84-80440U02 ISS P10

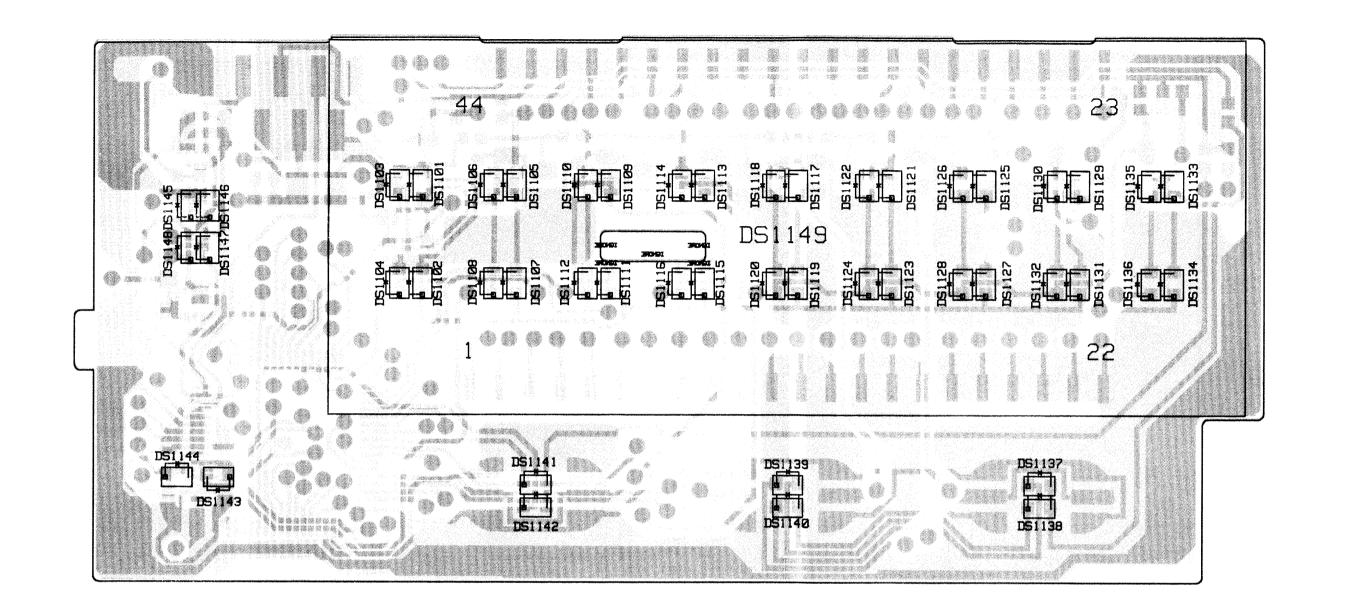
COMPONENT SIDE INNER LAYER (GRAY)
SOLDER SIDE INNER LAYER (PINK)
OVERLAY -----

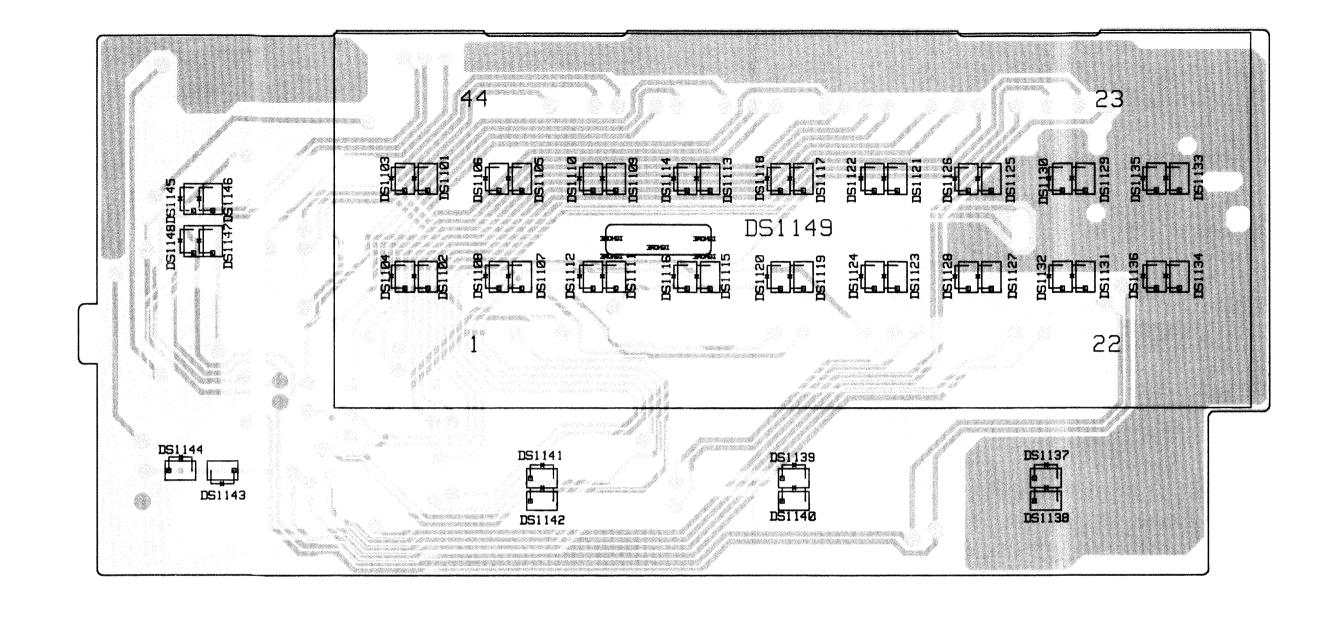
RCB-97114-O RCB-97115-O RCB-97117-O

Circuit Board Details for HLN9644A 8-Character Display Board, 20-Frequency

COMPONENT SIDE VIEW

COMPONENT SIDE VIEW





SOLDER SIDE 84-80440U02 ISS P10

> COMPONENT SIDE (GRAY) SOLDER SIDE (PINK) OVERLAY ----

RCB-97113-O (REV) RCB-97116-O (REV) RCB-97118-O

SOLDER SIDE VIEW

COMPONENT SIDE INNER LAYER (GRAY) SOLDER SIDE INNER LAYER (PINK) OVERLAY ----

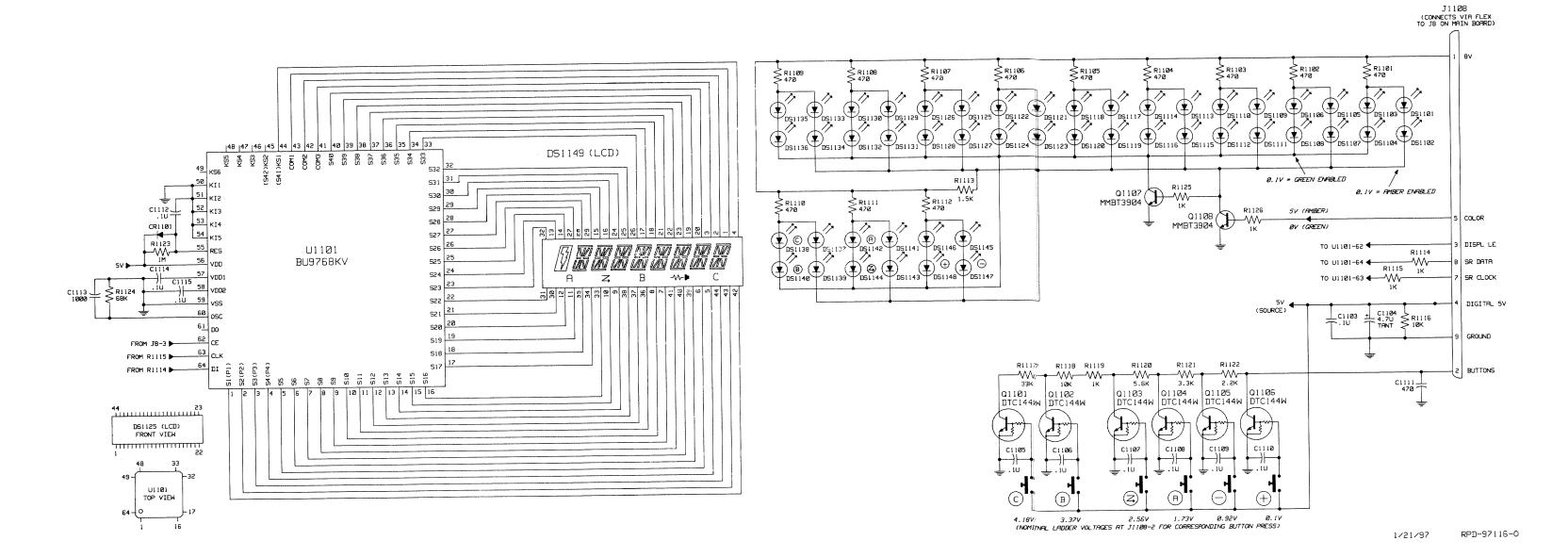
RCB-97114-O (REV) RCB-97115-O (REV) RCB-97118-O

SOLDER SIDE VIEW

SOLDER SIDE

84-80440U02 ISS P10

Circuit Board Details for HLN9644A 8-Character Display Board, 20-Frequency



Parts List

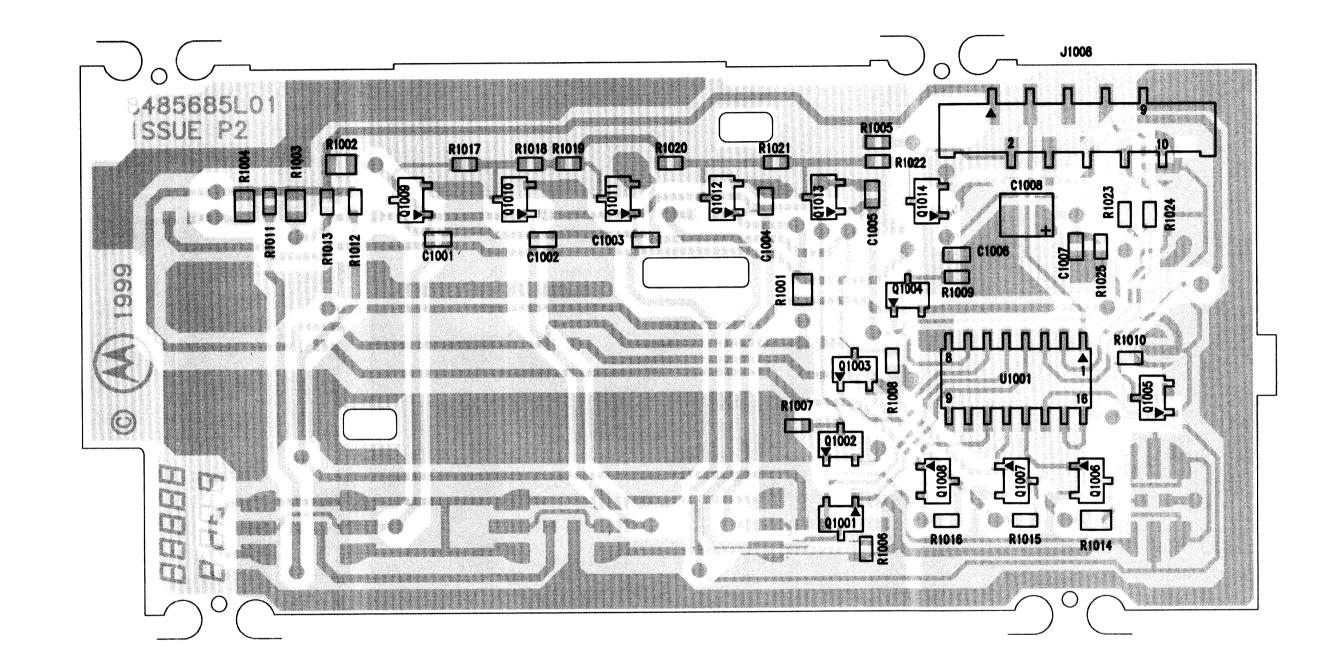
REFERENCE MOTOROLA

PL-971003-O M1225 Radio 8-Character Display Board

SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-5%; 50 V:
		unless otherwise stated
C1103	21-13743E20	0.1 uF, 10%; 16 V
C1104	23-11049A13	tantalum 4.7 uF, 10%; 10 V
C1105 thru 1110	21-13743E20	0.1 uF, 10%; 16 V 470 pF
C1111	21-13741F17	0.1 uF, 10%; 16 V
C1112	21-13743E20 21-13741F25	1000 pF
C1113 C1114, 1115	21-13743E20	0.1 uF, 10%; 16 V
51114, 1115	21 107 10220	
004404	40 00000T01	diode: (see note) Schottky SOT
CR1101	48-80939T01	•
		displays and indicators:
DS1101, 1102	48-80479U02	diode LED amber
DS1103, 1104	48-80479U01	diode LED green
DS1105	48-80479U02	diode LED amber
DS1106	48-80479U01	diode LED green diode LED amber
DS1107	48-80479U02 48-80479U01	diode LED green
DS1108	48-80479U02	diode LED green
DS1109	48-80479U01	diode LED green
DS1110	48-80479U02	diode LED amber
DS1111	48-80479U01	diode LED green
DS1112 DS1113	48-80479U02	diode LED amber
DS1114	48-80479U01	diode LED green
DS1115	48-80479U02	diode LED amber
DS1116	48-80479U01	diode LED green
DS1117	48-80479U02	diode LED amber
DS1118	48-80479U01	diode LED green
DS1119	48-80479U02	diode LED amber
DS1120	48-80479U01	diode LED green
DS1121	48-80479U02	diode LED amber
DS1122	48-80479U01	diode LED green
DS1123	48-80479U02	diode LED amber
DS1124	48-80479U01	diode LED green
DS1125	48-80479U02	diode LED amber
DS1126	48-80479U01	diode LED green
DS1127	48-80479U02	diode LED amber
DS1128	48-80479U01	diode LED green
DS1129	48-80479U02	diode LED amber
DS1130	48-80479U01	diode LED green
DS1131	48-80479U02	diode LED amber diode LED green
DS1132	48-80479U01	diode LED green
DS1133, 1134	48-80479U02 48-80479U01	diode LED green
DS1135, 1136 DS1137	48-80479U02	diode LED amber
DS1137	48-80479U01	diode LED green
DS1139	48-80479U02	diode LED amber
DS1140	48-80479U01	diode LED green
DS1141	48-80479U02	diode LED amber
DS1141	48-80479U01	diode LED green
DS1143	48-80479U02	diode LED amber
DS1144	48-80479U01	diode LED green
DS1145	48-80479U02	diode LED amber
DS1146	48-80479U01	diode LED green
DS1147	48-80479U02	diode LED amber
DS1148	48-80479U01	diode LED green
DS1149	72-80451U02	display, LCD
		connector, receptacle:
J1108	09-04422J01	10 pin, main board
F - 1 - 2		transistor: (see note)
Q1101 thru 110	6 48-80947V01	digital NPN; type DTC144W
Q1107, 1108	48-80214G02	NPN; type MMBT3904
Q1107, 1100	40 00E 1400E	
m.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0.000057411	resistor, fixed: +/-5%; 1/16 W:
R1101 thru 111.		470 1.5k
R1113	06-62057A53	1.5k
R1114, 1115	06-62057A49	1k 10k
R1116	06-62057A73	10k 33k
R1117	06-62057A85	
R1118	06-62057A73	
R1119	06-62057A49	
R1120	06-62057A67	5.6k 3.3k
R1121	06-62057A61	
R1122	06-62057A57	
R1123	06-62057B22	-
R1124	06-62057A93 06-62057A49	
	00-0203/A49	
R1125, 1126		
H1125, 1126	51-80449U01	integrated circuit: (see note) LCD driver BU9768KV

Schematic Diagram, and Parts List for HLN9644A 8-Character Display Board, 20-Frequency

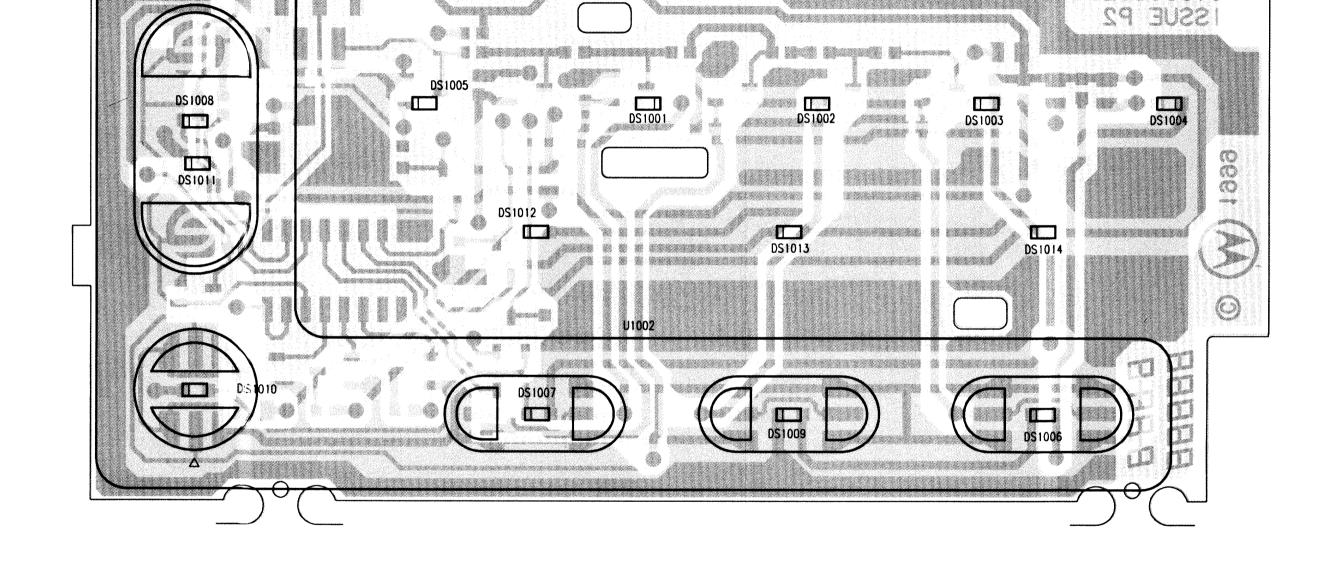
April, 1999 6880904Z96-A



COMPONENT SIDE (GRAY) SOLDER SIDE (PINK) OVERLAY -----

RCB-98132-O RCB-98133-O RCB-98134-O

COMPONENT SIDE VIEW



COMPONENT SIDE (GRAY) SOLDER SIDE (PINK)

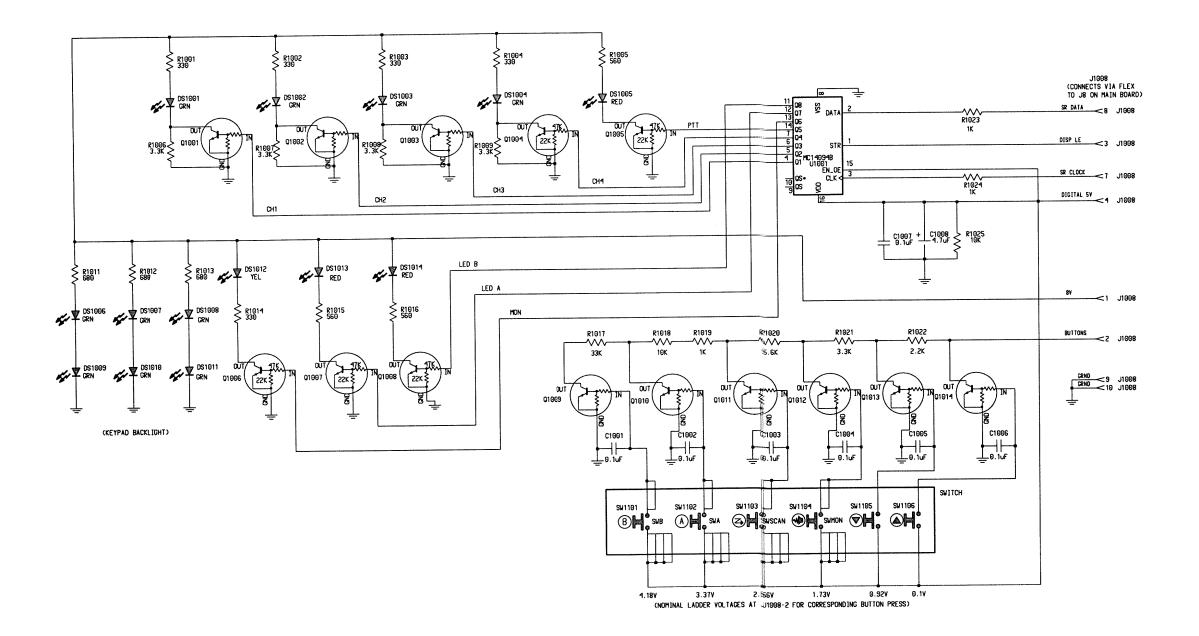
RCB-98132-O (REV) RCB-98133-O (REV)

485685L0

OVERLAY -----RCB-98135-O

SOLDER SIDE VIEW

Circuit Board Details for HLN9887A Display Board, 4-Frequency



RPD-99111-0

Parts List

M1225 Radio 4-Channel Display Board

21-991006-0

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-5%; 50 V: unless otherwise stated
C1001 thru 1007	21-13743E20	0.1 uF, 10%; 16 V
		displays and indicators:
DS1001 thru 1004		diode LED green
DS1005	48-80479U03	diode LED red
DS1006 thru 1011		diode LED green
DS1012	48-80479U05	
DS1013, 1014	48-80479U03	diode LED red
		connector, receptacle:
J1008	09-04422J01	10 pin, main board
		transistor: (see note)
Q1001 thru 11014	48-80947V01	digital NPN; type DTC144W
		resistor, fixed: +/-5%; 1/16 W:
R1001 thru 1004	06-60076A37	330
R1005	06-62057A43	560
R1006 thru 1009	06-62057A61	3.3k
R1010		Not Used
R1011 thru 1013	06-62057A45	680
R1014	06-60076A37	330
R11015, 1016	06-62057A43	
R1017	06-62057A85	
R1018	06-62057A73	
R1019	06-62057A49	
R1020	06-62057A67	
R1021	06-62057A61	3.3k
R1022	06-62057A57	
R1023, 1024	06-62057A49	
R1025	06-62057A73	10k
		integrated circuit: (see note)
U1001	51-13806A35	MC14094B
U1002	75-80450U01	Switch, keypad 28-pin

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

Schematic Diagram, and Parts List for HLN9887A Display Board, 4-Frequency

April, 1999

6880904Z96-A

21

Parts List

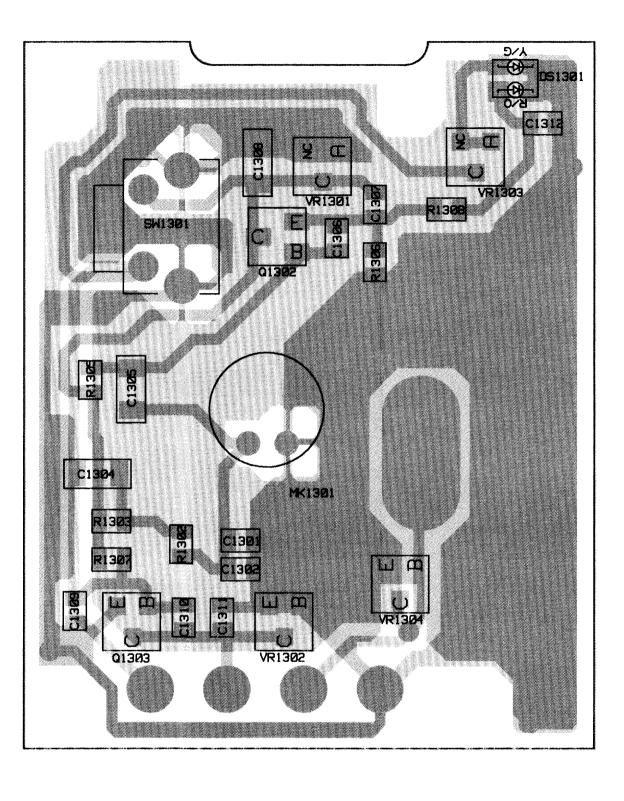
01-80446E01 Microphone Board with Cord

PL-971005-A

REFERENCE NUMBER	MOTOROLA PART NO.	DESCRIPTION
		capacitor, chip, uF +/-5%, 50 V;
		unless otherwise stated
C1301	21-13740A39	27 pF
C1302	21-13740A79	1000 pF
C1304	23-11049A59	tantalum 10 uF, ±10%; 6 V
C1305	21-13741A61	.047 uF
C1306	21-13740A59	150 pF
C1307	21-13740A79	1000 pF
C1308	21-11032B14	0.15 uF
C1309, 1310	21-13740A59	150 pF
C1311	21-13740A59	150 pF
C1312	21-13740A79	1000 pF
		display:
DS1301	48-05729G49	dual LED red/grn
		microphone:
MK1301	50-80258E04	cartridge electret
		transistor: see note
Q1302	48-80214G02	NPN; type MMBT3904
Q1303	48-05128M19	NPN Darlington; type MMBTA13
		resistor, chip: uF +/-5%, 1/10 W:
		unless otherwise stated
R1302	06-60076A57	2.2k
R1303	06-60076A49	1k
R1305	06-60076B01	100k
R1306	•••	Not Used
R1307	06-60076B01	100k
R1308	06-60076A09	22
		switch:
SW1301	40-80164S01	momentary pushbutton
		voltage regulator: see note
VR1301, 1302	48-80140L17	Zener diode SOT 12 V MMBZ5242L
VR1303	48-80140L06	Zener diode SOT 5.1 V MMBZ5231L
VR1304	48-80140L17	Zener diode SOT 12 V MMBZ5242L

30-80978Z03 coiled cord

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY -----

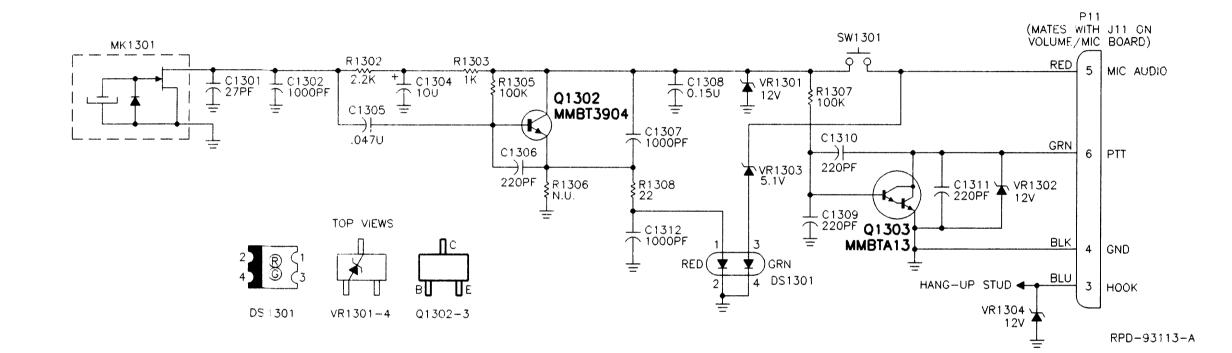
COMPONENT SIDE VIEW

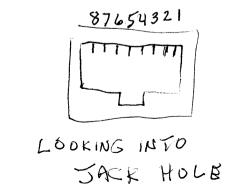
RCB-95101-O

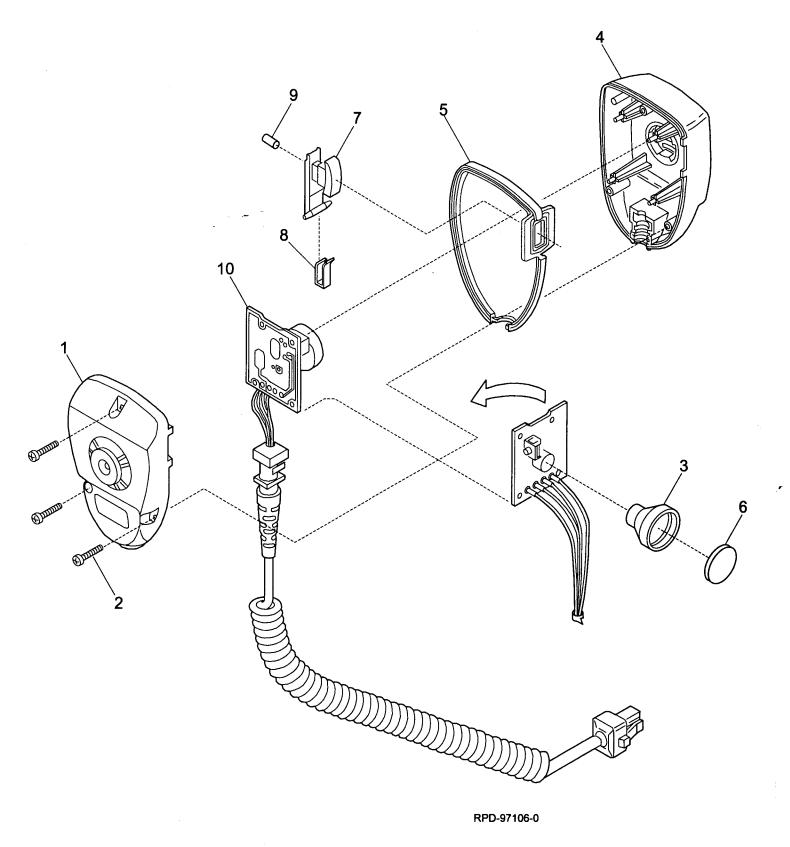
RCB-95102-O

RCB-95103-O

Circuit Board Details, Schematic Diagram, and Parts List for HMN3001/3008A Compact Microphone







Parts List
HMN3001A / 3008A Compact Microphone w/LED Indicator

	•		
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	
1	0180669D01	Assembly, HOUSING, rear	
2	0300139959	SCREW, 5-20 x 5/8; 3 used	
3	0580149R01	GROMMET, microphone	
4	1580443E03	¥ HOUSING, front	
5	3280565B01	GASKET, microphone	
6	3580132R01	BAFFLE, flet	
7	3880654D01	BUTTON, PTT	
8	4180658D01	SPRING, PTT	
9	7580983Z01	RUBBER SPACER, switch	
10		PC board	

Note: The front cover of the HMN3008A microphone has holes and a "Motorola" name. The HMN3174 mike is identical, except that the front cover has horizontal slots and a "Radius"

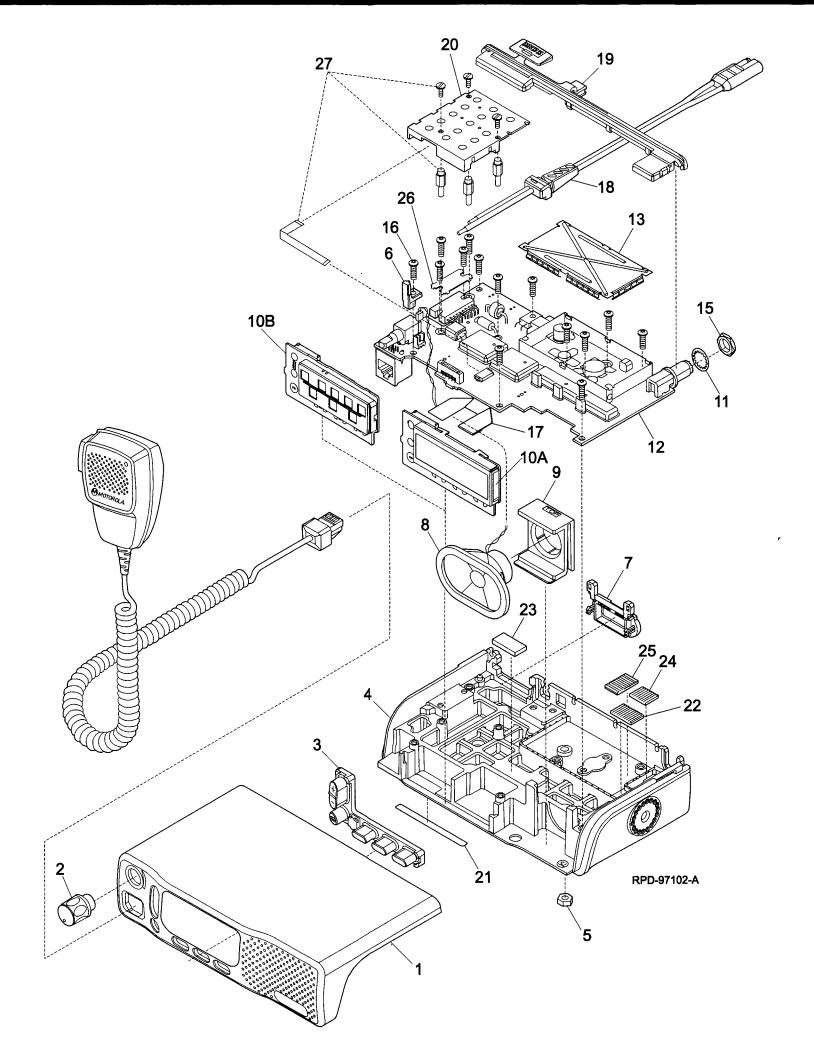
nameplate.

Exploded Mechanical View and Parts List for HMN3001/3008A Compact Microphone

Parts List M1225 Radio Exploded View, Mechanical

PL-971004-A

REFERENCE	MOTOROLA	
SYMBOL	PART NO.	DESCRIPTION
1	0180427U02	ASSY, HOUSING, 20-channel
	0180427U03	ASSY, HOUSING, 4-channel
2	3604414J01	KNOB, volume control
3	7580450U01	KEYPAD, 20-channel
	7580450U03	KEYPAD, 4-channel
4	2680448U01	HEATSINK
5	0280478U01	NUT, Mini-U
6	4380587U01	FLANGE, right angle, PC support
7	1504501J01	SHROUD, spacer, snap-on
8	5080442U01	SPEAKER, w/wire assembly
9	3204411J01	GROMMET, speaker retaining
10A	HLN9644	ASSY, front panel display, 20-channel
10B	HLN9887	ASSY, front panel display, 4-channel
11	400007698	WASHER, lock, Mini-U
12		Main Board
13	2604420J01	SHIELD, PA frame cover
14	0980476U01	CONNECTOR, antenna, Mini-U
15	0280477U01	NUT, Mini-U
16	0310943J11	SCREW, 3mm x 10; 14 used
17	2804431J01	CABLE, folded; 10 position
18	3080486U01	CABLE, power w/strain relief
19	3280484U01	GASKET, rear
20		Option Board
21	5404605J01	LABEL, warning
22	3204416J01	GASKET, thermal conductive pad
23	7504682J01	PAD, pullout VCO
24	3204416J01	GASKET, thermal conductive pad
		(Modified for UHF only)
25	3204416J01	GASKET, thermal conductive pad
		(Modified for VHF only)
26	0780443U01	SPANNER
27	HLN9345	Option Board Installation kit
:	non-refe	renced Items



M1225 Radio Exploded Mechanical View and Parts List