



MOTOROLA

Includes MMR-106, April 1996

SP50

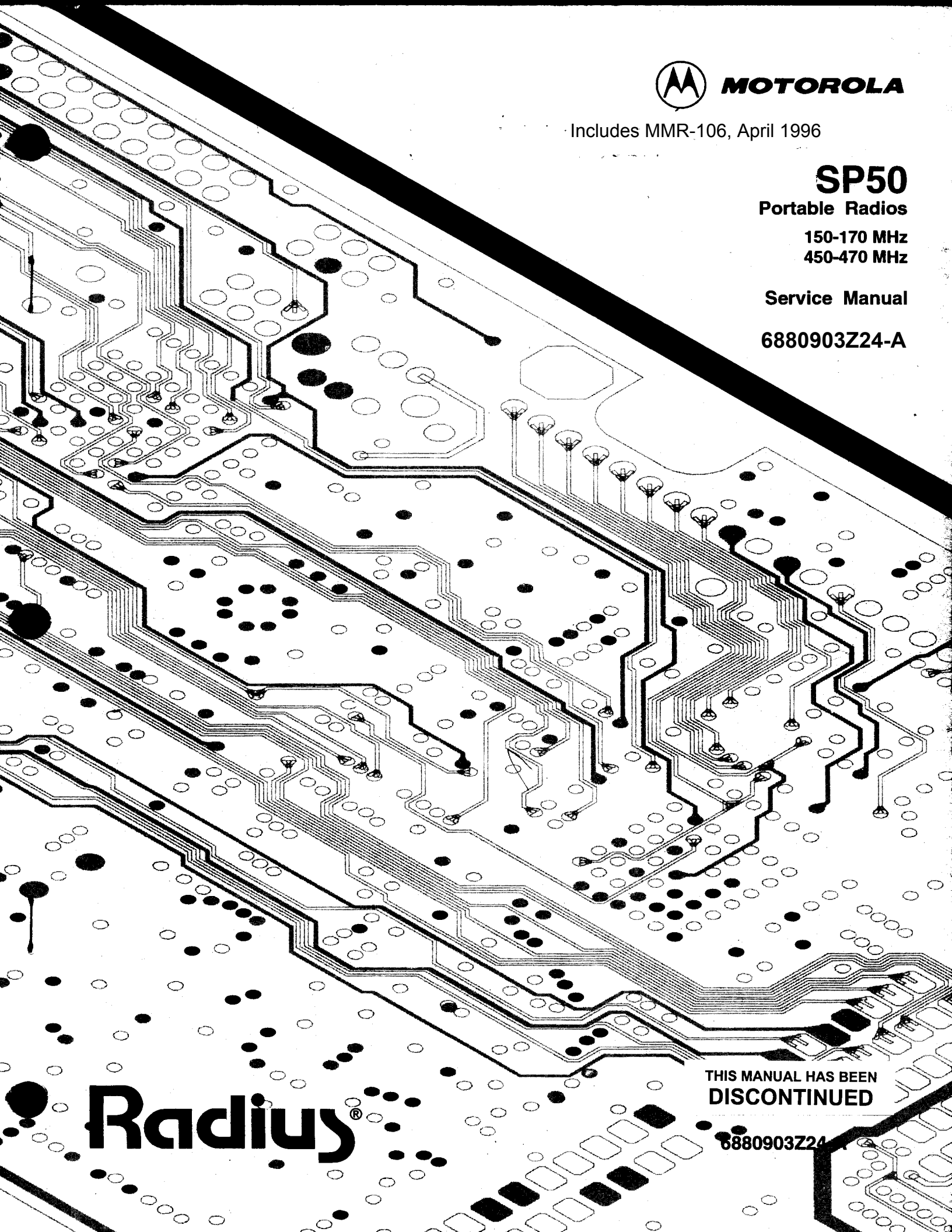
Portable Radios

150-170 MHz

450-470 MHz

Service Manual

6880903Z24-A



THIS MANUAL HAS BEEN
DISCONTINUED

6880903Z24-A

Radius®

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:

6880903Z24-A

SP50 Portable Radio Service Manual

REVISION DETAILS:

- N/A* 1. This supplement contains the new 2- and 10-Channel, 470-490 MHz radio models. Refer to the attached model chart.
- N/A* 2. In addition, a new circuit board detail, schematic, and parts list for the 470-490 MHz radio models, necessary for servicing these radios, have been supplied. Refer to the attached pages.
- N/A* 3. The following part numbers have been changed or added. Please note them in your manual.

Parts List for HLD9000A/HLD9044A and HLD9003A/HLD9045A VHF, 150-170 MHz Main Board

Ref. Symbol	Old Part Number	New Part Number	Description
C79T	2113740A48	2113740A42	36 pF
C147B	2113740A48	2113740G48	51 pF
C233T	2113740G19	2113740G08	1.6 pF
F301T	6580561D02	6505591Y01	4A
J403T	0180412D01	0180497E01	speaker/mic, external
R59T	0660076B03	0660076B08	200k
R257T	0660076A92	0660076B01	100k
R61B(N)	0660076A96	0660076B01	100k
R62B(W)	0660076A60	0660076A64	4.3k
SH51T	2680568D03	2680568D04	mixer
SH201T	2680686C03	2680686C04	synthesizer, top side
SH202B	2680686C03	2680686C04	synthesizer, bottom side
SH251T	2680588D03	2680588D04	VCO, top side
SH252B	2680588D03	2680588D04	VCO, bottom side

Parts List for HLD9008A/HLD9040A and HLD9009A/HLD9041A UHF 450-470 MHz Main Board

Ref. Symbol	Old Part Number	New Part Number	Description
C79T	2113740A48	2113740A42	36 pF
C233T	2113740G19	2113740G08	1.6 pF
C253T	2113740G39	2113740G41	33 pF
C254T	2113740G09	2113740G08	1.6 pF
C255T	2113740G25	2113740G28	9.1 pF
C263T	2113740G39	2113740G42	36 pF

Parts List for HLD9008A/HLD9040A and HLD9009A/HLD9041A UHF 450-470 MHz Main Board (Cont'd.)

Ref. Symbol	Old Part Number	New Part Number	Description
C264T	2113740G08	2113740G03	1 pF
C265T	2113740G28	2113740G32	13 pF
F301T	6580561D02	6505591Y01	4A
J403T	0180412D01	0180497E01	Speaker/Mic, external
JU303T	—	2113740A59	150
R59T	0660076B01	060076B08	200k
R61B(N)	0660076A96	0660076B01	100k
R257T	0660076A84	060076A82	24k
R62B(W)	0660076A60	0660076A64	4.3k
R62B(N)	0660076A73	0660076A80	20k
R306T	0660076A28	0660076A41	470
R307B	0660076A49	0660076M01	o ohms
SH51T	2680568D03	2680568D04	mixer
SH201T	2680686C03	2680686C04	Synthesizer, top side
SH202B	2680686C03	2680686C04	Synthesizer, bottom side
SH251T	2680588D03	2680588D04	VCO, top side
SH252B	2680588D03	2680588D04	VCO, bottom side

Parts List for SP50 Basic Exploded View, Standard & Compact

Ref. Symbol	Old Part Number	New Part Number	Description
7	7580604D01	7580604D02	Keypad
14	8480438D04	8480406E01	PCB, flex
27	2680537D01	2680537D02	Disc, speaker
28	0180620D01	0180620D02	Frame, battery, standard
34	3980514D02	3980514D03	Contact, rf ground

Parts List for SP50 DTMF Exploded View, Standard & Compact

Ref. Symbol	Old Part Number	New Part Number	Description
7	7580604D03	7580604D04	Keypad
27	2680537D01	2680537D02	Disc, speaker
28	0180620D01	018062D02	Frame, battery, standard
34	3980514D02	3980514D03	Contact, rf ground
	2690505E01	2680562E01	Tape, aluminum, standard UHF

Parts List for SP50 10 Hour (Standard) Battery Charger, Electrical

Ref. Symbol	Old Part Number	New Part Number	Description
Q202, Q204	4811056B02	4813824A22	PNP
VR204, VR205		4813830A31	18 V

ATTACHMENTS

Model Chart Page 3

Circuit Board Details for HLE9055A and HLE9056A UHF Main Boards, 470-490 MHz Pages 5, 6

Schematic Diagram for HLE9055A and HLE9056A UHF Main Boards, 470-490 MHz
(Sheet 1 of 2)..... Page 7

Schematic Diagram for HLE9055A and HLE9056A UHF Main Boards, 470-490 MHz
(Sheet 2 of 2)..... Page 8

Parts Lists for HLE9055A and HLE9056A UHF Main Boards, 470-490 MHz..... Page 9

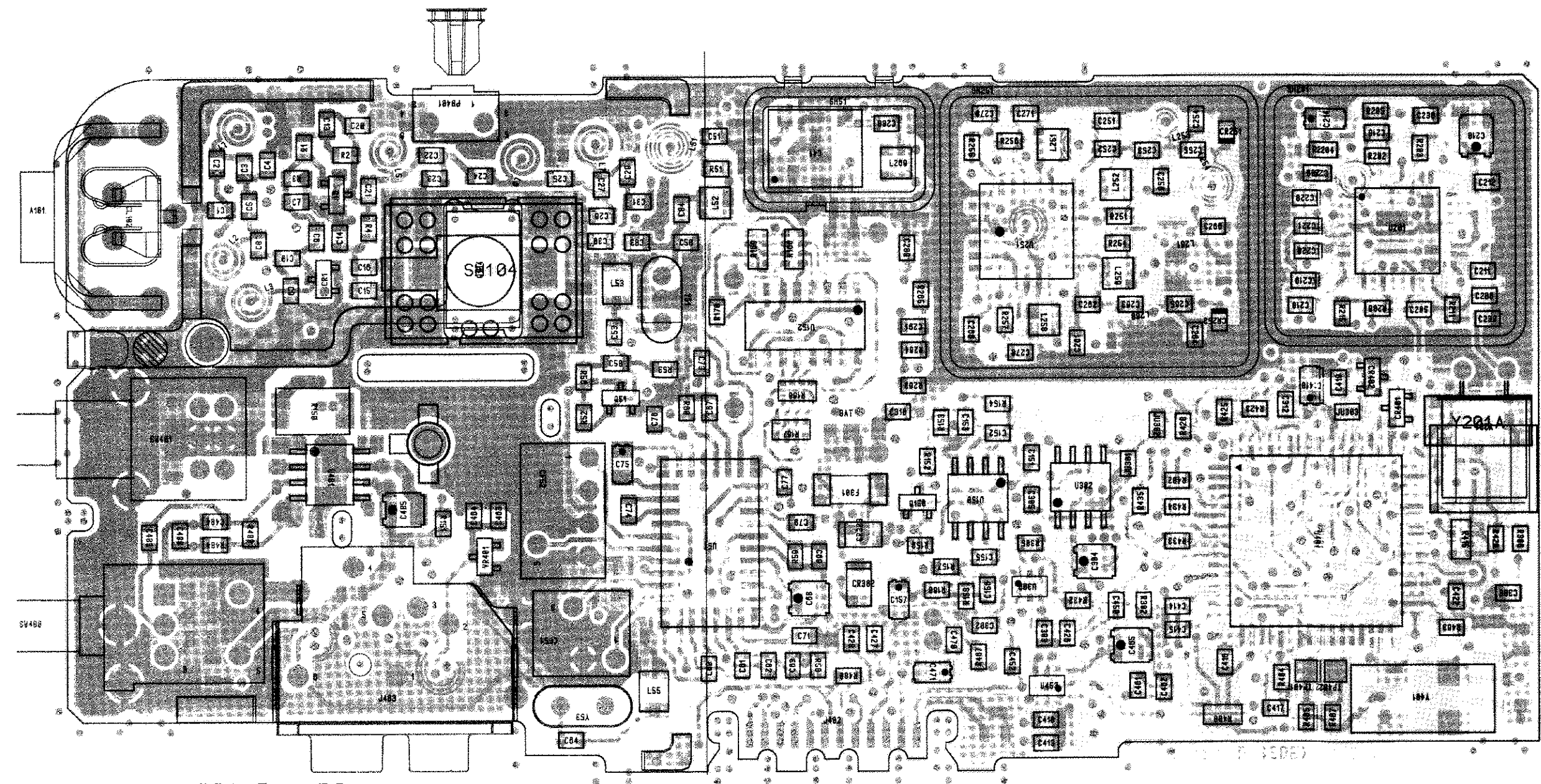
Model	Description
P94YQT00A2AA	2-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT00B2AA	6-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT00G2AA	10-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT20A2AA	2-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQT20B2AA	6-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQT20G2AA	10-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQS00A2AA	2-Channel, 450-470 MHz, 1-4 W, 12.5 kHz (Compact)
P94YQS00G2AA	10-Channel 450-470 MHz, 1-4 W, 12.5 kHz (Compact)*
P94YQS20A2AA	2-Channel, 450-470 MHz, 1-4 W, 20/25 kHz (Compact)
P94YQS20G2AA	10-Channel, 450-470 MHz, 1-4 W, 20/25 kHz (Compact)*
P94YQT00A3AA	2-Channel, 470-490 MHz, 1-4 W, 12.5 kHz
P94YQT00G3AA	10-Channel, 470-490 MHz, 1-4 W, 12.5 kHz
P94YQT20A3AA	2-Channel, 470-490 MHz, 1-4 W, 20/25 kHz
P94YQT20G3AA	10-Channel, 470-490 MHz, 1-4 W, 20/25 kHz

**SP50
UHF
450 - 470 MHz
470 - 490 MHz**

X = Indicates one of each required

											Item	Description	
X	X	X				X	X				HLE9008_/9040_	Main Board, 12.5 kHz	
			X	X	X			X	X		HLE9009_/9041_	Main Board, 20/25 kHz	
									X	X	HLE9055_	Main Board, 12.5 kHz	
										X	X	HLE9056_	Main Board, 20/25 kHz
X			X			X		X			HLN9173_	2-Channel Control Top Kit	
	X			X							HLN9174_	6-Channel Control Top Kit	
		X			X		X				HLN9175_	10-Channel Control Top Kit	
X	X	X	X	X	X						HHN9099_	Standard Housing	
						X	X	X	X		HHN9048_	Compact Housing	
X	X	X	X	X	X	X	X	X	X		NAE6483_	Antenna, Whip (403-520 MHz)	
X	X	X	X	X	X	X	X	X	X		6880903Z39	Worldwide User Training Guide (English, Spanish, French, Portuguese)	
X	X	X	X	X	X	X	X	X	X		6880903Z23	North America User Training Guide (English, Spanish, French)	
X	X	X	X	X	X	X	X	X	X		6880903Z32	Latin America User Training Guide (English, Spanish, Portuguese)	

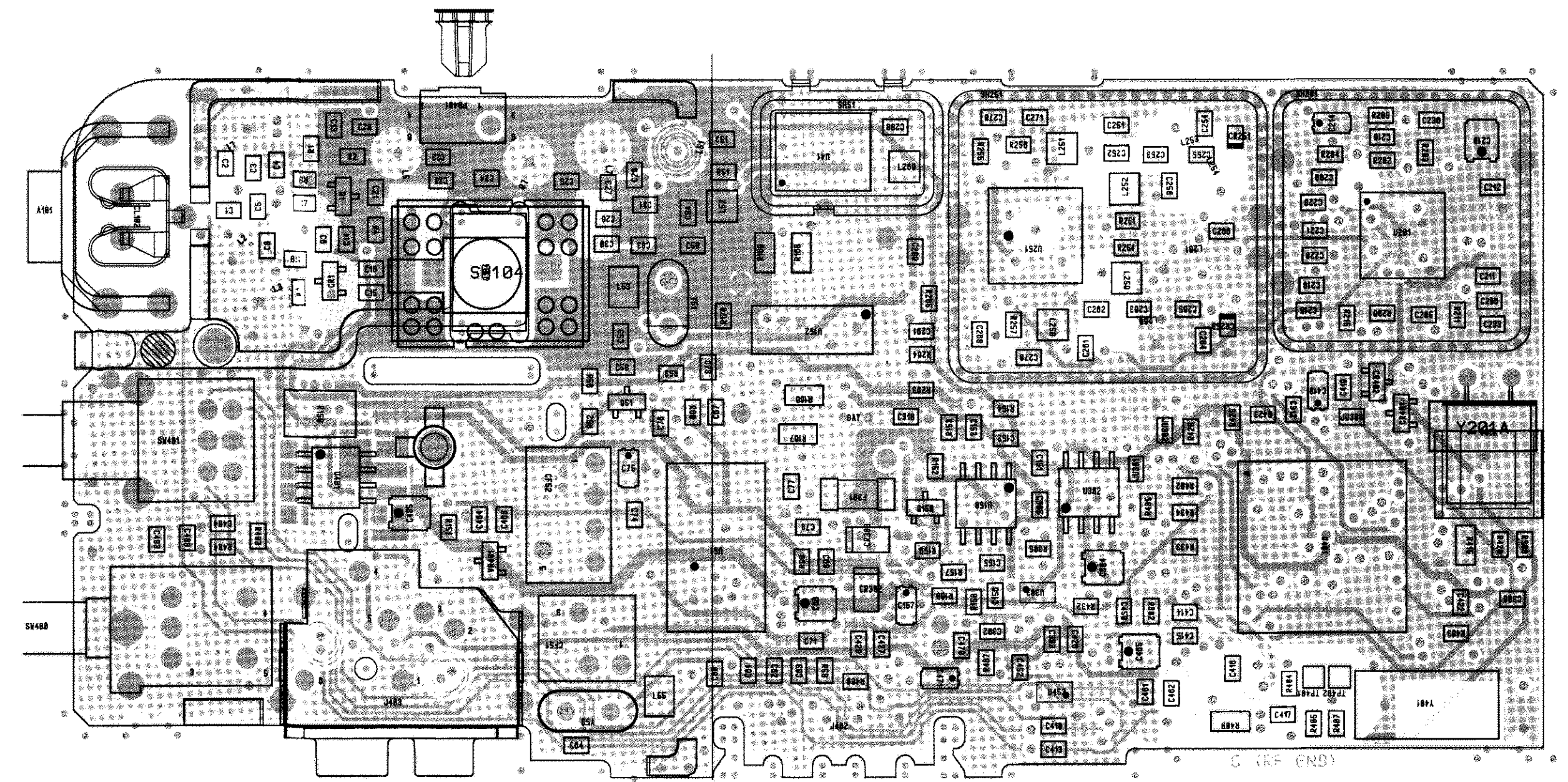
* = For International Use Only.



8480619E01 Rev-P2
 Plot Date: 02/08/96 09:36:55

COMPONENT SIDE (GRAY) RCB-96106-O
 SOLDER SIDE (PINK) RCB-96101-O
 OVERLAY ---- RCB-96107-O

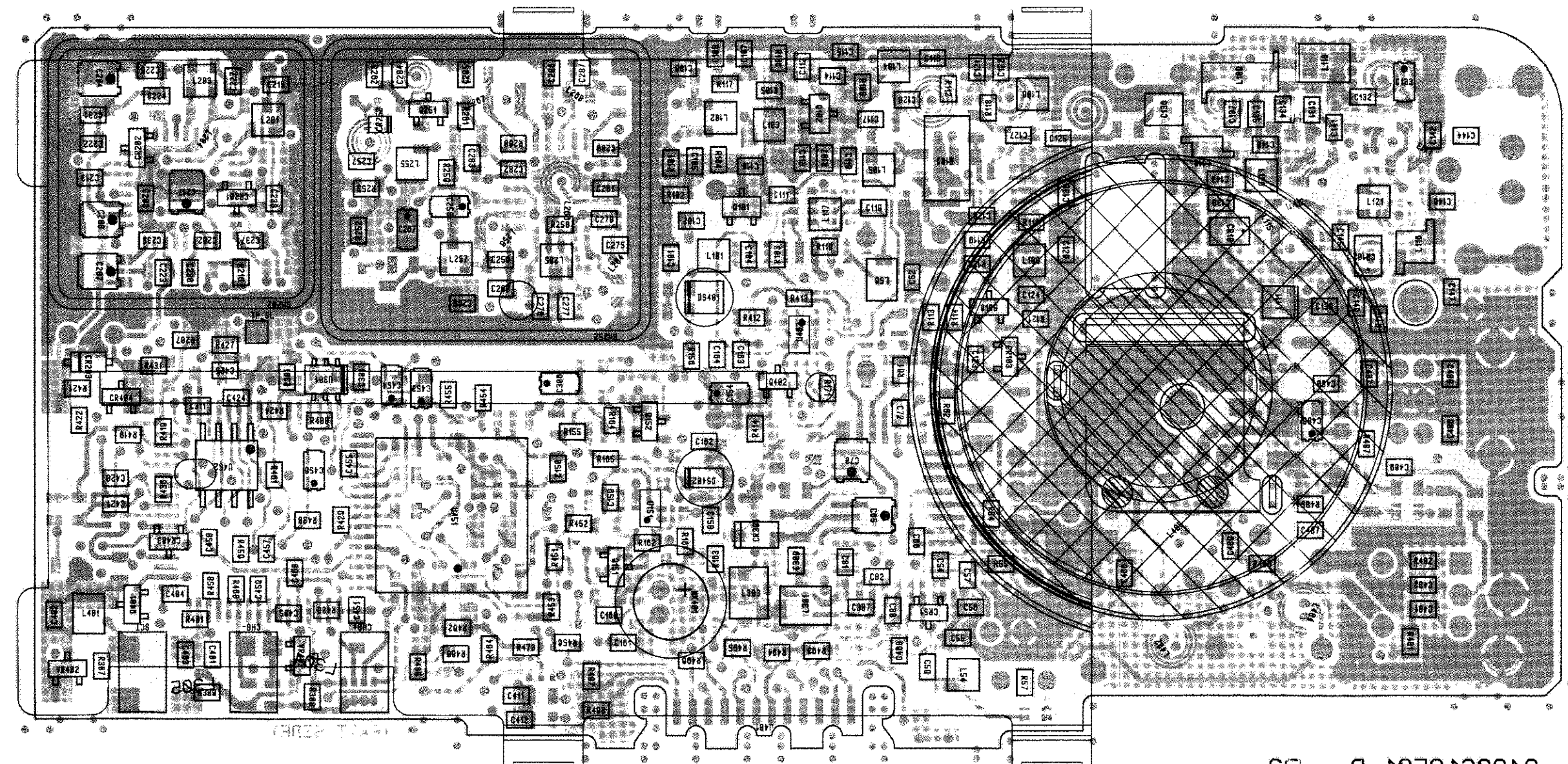
COMPONENT SIDE VIEW



8480619E01 Rev-P2
 Plot Date: 02/08/96 09:36:55

COMPONENT SIDE INNER LAYER (GRAY) RCB-96102-O
 SOLDER SIDE INNER LAYER (PINK) RCB-96105-O
 OVERLAY ---- RCB-96107-O

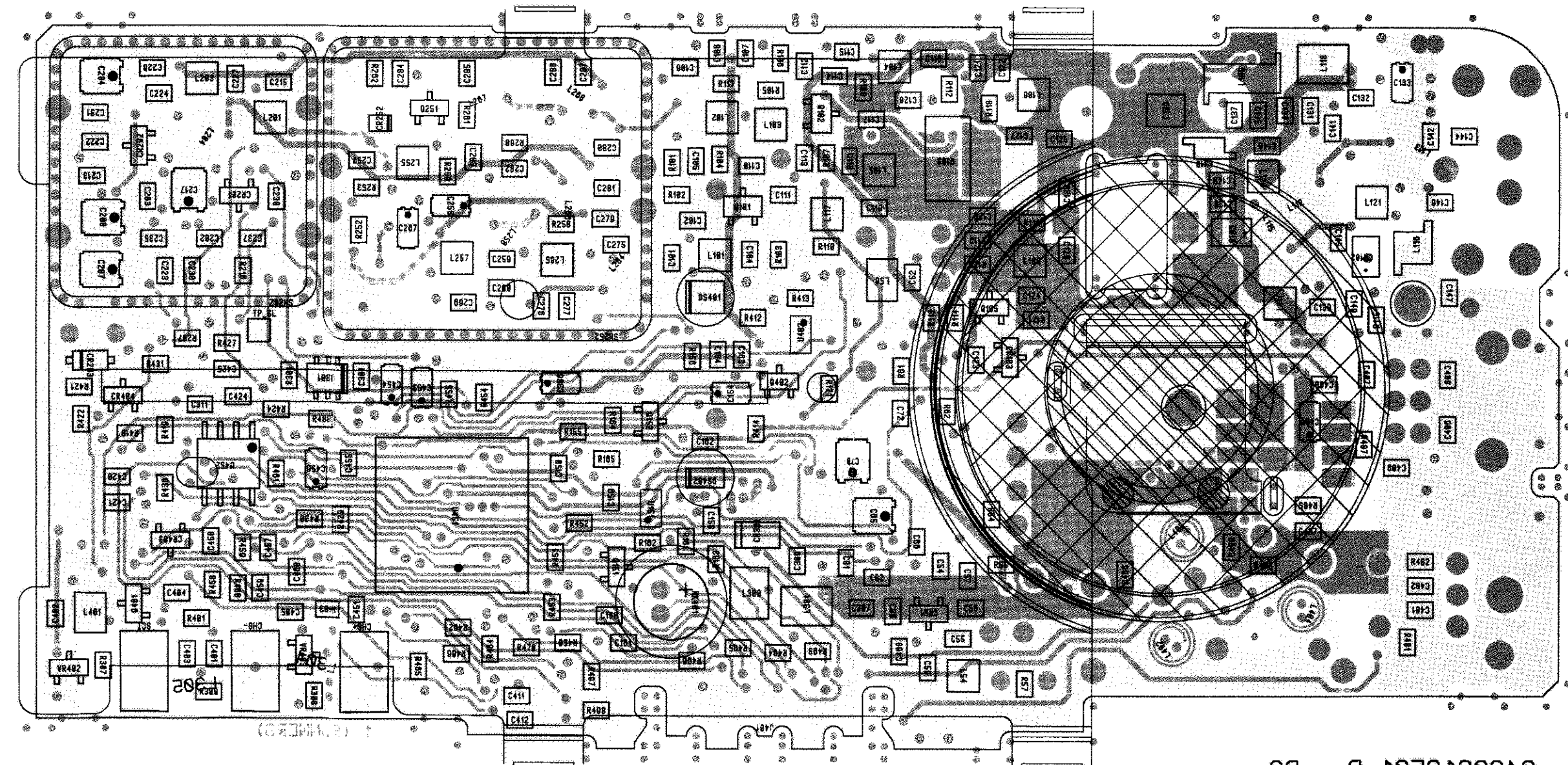
COMPONENT SIDE VIEW



Plot Date: 05/08/96 08:38:22
8480810E01 Rev-P5

COMPONENT SIDE (GRAY)
SOLDER SIDE (PINK)
OVERLAY -----
RCB-96106-O (REV)
RCB-96101-O (REV)
RCB-96108-O (REV)

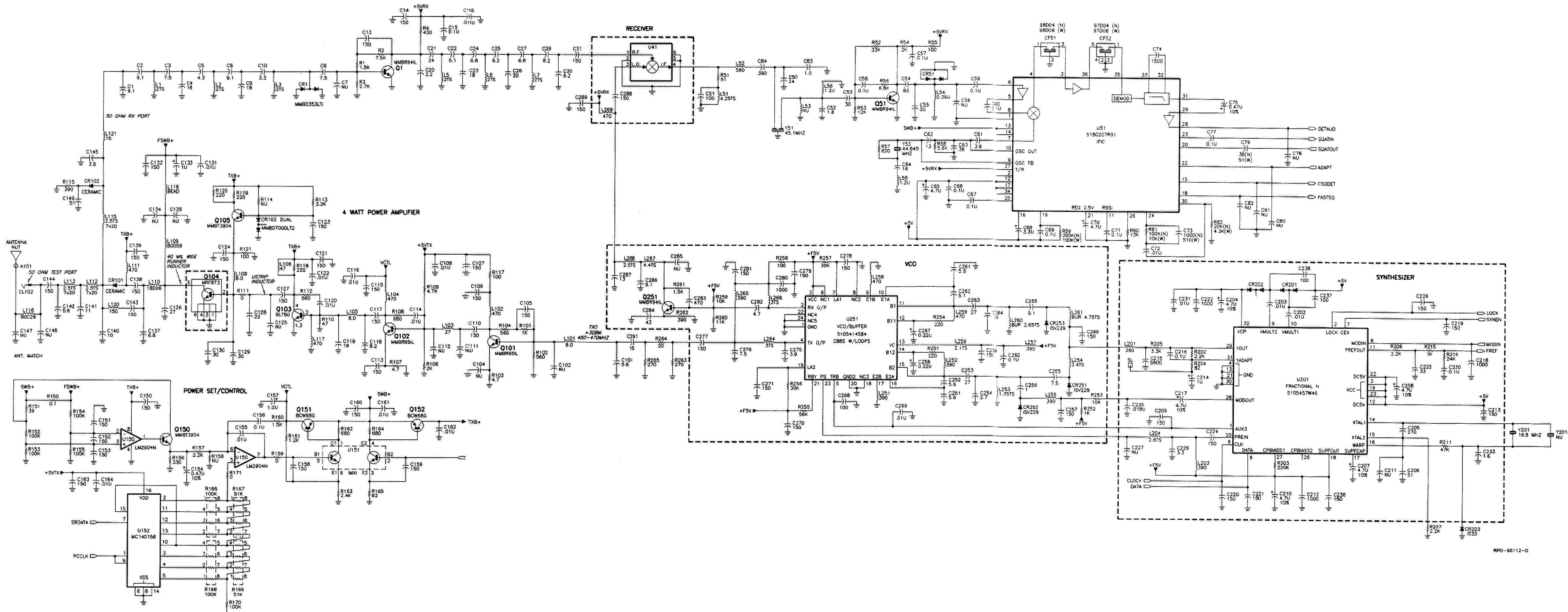
SOLDER SIDE VIEW



Plot Date: 05/08/96 08:38:22
8480810E01 Rev-P5

COMPONENT SIDE INNER LAYER (GRAY)
SOLDER SIDE INNER LAYER (PINK)
OVERLAY -----
RCB-96103-O (REV)
RCB-96104-O (REV)
RCB-96108-O (REV)

SOLDER SIDE VIEW

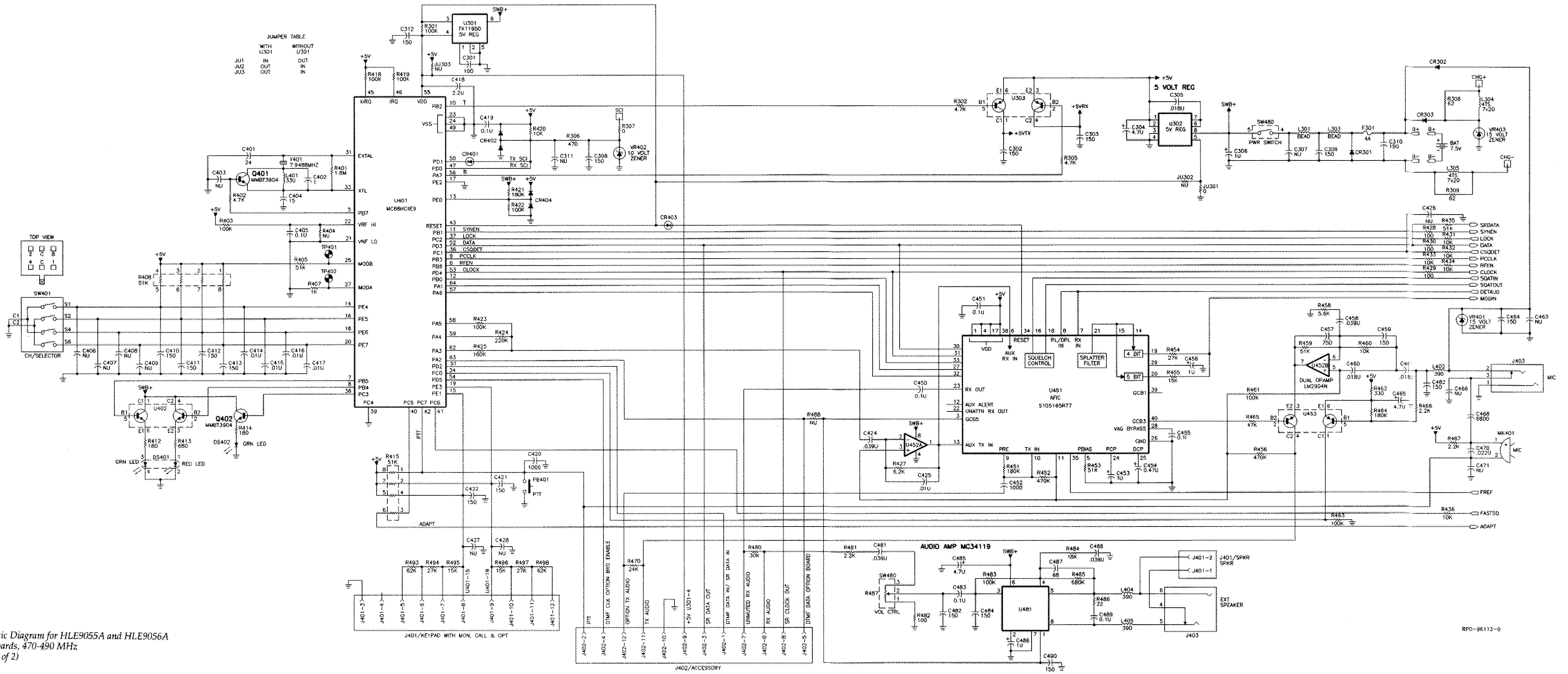


RPO-96112-D

Schematic Diagram for HLE9055A and HLE9056A
UHF Main Boards, 470-490 MHz
(Sheet 1 of 2)

JUMPER TABLE

	WITH U301	WITHOUT U301
JU1	IN	OUT
JU2	OUT	IN
JU3	OUT	IN



Schematic Diagram for HLE9055A and HLE9056A UHF Boards, 470-490 MHz (Sheet 2 of 2)

RPD-96113-0

Parts List

HLE9055A Main Board, 470-490 MHz, 4 W, 12.5 kHz (N)
 HLE9056A Main Board, 470-490 MHz, 4 W, 20/25 kHz (W) PL-961009-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF +/-5%; 50 V; unless otherwise stated
C1T	2113740G28	9.1
C2T	2113740G28	9.1
C3T	2113740G25	7.5
C4T	2113740G35	18
C5T	2113740G18	4.3
C6T	2113740G25	7.5
C7T	---	Not Used
C8T	2113740G28	9.1
C9T	2113740G35	18
C10T	2113740G15	3.3
C13, 14T	2113740A59	150
C15T	2113743A19	0.1 uF
C18T	2113741A45	.01 uF
C20T	2113740G11	2.2
C21T	2113740G38	2.4
C22T	2113740G20	5.1
C23T	2113740G35	18
C24T	2113740G24	6.8
C25T	2113740G23	6.2
C26T	2113740G36	2.0
C27T	2113740G24	6.8
C29T	2113740G27	8.2
C30T	2113740G23	6.2
C31T	2113740A59	150
C50T	2113740A38	24
C51T	2113740A55	100
C52B	2113740A09	1.8
C53T	2113740A40	30
C54B	2113740A53	82
C55B	2113740A36	20
C56B	---	Not Used
C57B	2113743A19	0.1 uF
C58T	2113743A19	0.1 uF
C59B	2113743A19	0.1 uF
C60T	2113743A19	0.1 uF
C61T	2113740A17	3.9
C62T	2113740A32	13
C63T	2113740A42	36
C64T	2113740A34	16
C65B	2311049J11	4.7 uF
C66B	2113743A19	0.1 uF
C67T	2113743A19	0.1 uF
C68T	2311049J07	3.3 uF
C69T	2113743A19	0.1 uF
C70B	2311049J11	4.7 uF
C71T	2113743A19	0.1 uF
C72B	2113741A45	.01 uF
C73(N)T	2113740A79	1000
C73(W)T	2113740A72	510
C74T	2113741A25	1500
C75T	2311049A05	.47 uF
C76T	---	Not Used
C77T	2113743A19	0.1 uF
C79(N)T	2113740A42	36
C79(W)T	2113740A48	51
C80 thru 82B	---	Not Used
C83T	2113740A03	1.0
C84T	2113740A69	390
C101B	2113740A21	5.6
C102B	---	Not Used
C104B	---	Not Used
C105 thru 107B	2113740A59	150
C108B	2113741A45	.01 uF
C110B	2113740A59	150
C111, 112B	---	Not Used
C113B	2113740A59	150
C114B	2113741A45	.01 uF
C115B	2113740A59	150
C116B	2113741A45	.01 uF
C117B	2113740A59	150
C118B	2113740A27	8.2
C119B	2113740A35	18
C120B	2113741A45	.01 uF
C121B	2113740A59	150
C122B	2113741A45	.01 uF
C129, 124B	2113740A59	150
C125B	---	Not Used
C127B	2113740A59	150
C128B	2113740A37	22
C129, 130B	2113740A40	30

HLE9055A Main Board, 470-490 MHz, 4 W, 12.5 kHz (N)
 HLE9056A Main Board, 470-490 MHz, 4 W, 20/25 kHz (W) PL-961009-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C131B	2113741A45	.01 uF
C132B	2113740A59	150
C133B	2311049A07	1 uF
C134, 135B	---	Not Used
C136B	2111078B25	27
C137B	2113740A24	6.8
C138B	2113740A59	150
C139B	2113740A59	150
C140B	2113740A29	10
C141B	2113740A30	11
C142B	2113740A21	5.6
C143, 144B	2113740A59	150
C145B	2113740A16	3.6
C146, 147B	---	Not Used
C149B	2113740A48	51
C150B	2113740A59	150
C151 thru 153T	2113740A59	150
C154B	2311049A05	0.47 uF
C155T	2113741A45	.01 uF
C156T	2113743A19	0.1 uF
C157T	2311049A07	1.0 uF
C158 thru 160B	2113740A59	150
C161, 162B	2113741A45	.01 uF
C163B	2113740A59	150
C164B	2113741A45	.01 uF
C202, 203B	2113741A45	.01 uF
C204B	2311049J11	4.7 uF
C205T	2113740A65	270
C206T	2113740A48	51
C207, 208B	2311049J11	4.7 uF
C209T	2113740A59	150
C210T	2311049J11	4.7 uF
C211T	---	Not Used
C212T	2113740A79	1000
C213B	2113740A59	150
C214T	2311049A07	1 uF
C215B	2113741A39	5600
C216T	2113743A19	0.1 uF
C217B	2311049J11	4.7 uF
C218T	2113740A79	1000
C219 thru 221T	2113740A59	150
C222B	2113740A79	1000
C223B	2113740A41	33
C224B	2113740A59	150
C225B	2113740A15	3.3
C227B	---	Not Used
C228T	2113740A59	150
C230B	2113743A19	0.1 uF
C231B	2113741A45	.01 uF
C233T	2113740G08	1.6
C235B	2113741A51	.018 uF
C236T	2113740A59	150
C237, 238B	2113740A55	100
C251, 252T	2113740G21	5.6
C253T	2113740G39	27
C255T	2113740G13	2.7
C256T	2113740G25	7.5
C256T	2113740A03	1
C257B	2113740A59	150
C258B	2311049A03	0.22 uF
C259B	2113740A59	150
C260B	2113743A19	0.1 uF
C261T	2113740G21	5.6
C262T	2113740G20	5.1
C263T	2113740G39	27
C264T	2113740G08	1.6
C265T	2113740G28	9.1
C266T	2113740A59	150
C267B	2311049A03	0.22 uF
C268T	2113740A35	100
C269B	2113741A45	.01 uF
C270, 271T	2113740A59	150
C275B	2113740A17	3.9
C276B	2113740A25	7.5
C277B	2113740A59	150
C278T	2113740A59	150
C279B	2113740A59	150
C280B	2113740A79	1000
C281B	2113740A59	150
C282B	2113740A19	4.7
C283B	2113740A71	470
C284B	2113740A44	43

HLE9055A Main Board, 470-490 MHz, 4 W, 12.5 kHz (N)
 HLE9056A Main Board, 470-490 MHz, 4 W, 20/25 kHz (W) PL-961009-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C285B	---	Not Used
C286B	2113740A28	9.1
C287B	2113740A32	13
C288, 289T	2113740A59	150
C291T	2113740A33	15
C301B	2113740A55	100
C302, 303T	2113740A59	150
C304T	2311049J11	4.7 uF
C305T	2113741A51	.018 uF
C306B	2311049A07	1 uF
C307B	---	Not Used
C308T	2113740A59	150
C309B	2113740A58	150
C310T	2113740A59	150
C311B	---	Not Used
C312T	2113740A59	150
C401B	2113740A38	24
C402B	2113740A03	1
C403B	---	Not Used
C404B	2113740A33	15
C405B	2113743A19	0.1 uF
C406 thru 409B	---	Not Used
C410T	2113740A59	150
C411, 412B	2113740A59	150
C413T	2113740A59	150
C414 thru 417T	2113741A45	.01 uF
C418T	2311049A40	2.2 uF
C419T	2113743A19	0.1 uF
C420, 421B	2113740A59	150
C422T	2113740A59	150
C424B	2113741A59	.039 uF
C425B	2113741A45	.01 uF
C426 thru 428T	---	Not Used
C450T	2113743A19	0.1 uF
C451B	2113743A19	0.1 uF
C452T	2113740A79	1000
C453B	2311049A07	1 uF
C454B	2311049A05	0.47 uF
C455B	2113743A19	0.1 uF
C456B	2311049A07	1 uF
C457B	2113740A76	750
C458B	2113741A59	.039 uF
C459B	2113740A59	150
C460B	2113741A51	.018 uF
C461T	2113741A51	.018 uF
C462T	2113740A59	150
C463T	---	Not Used
C464T	2113740A59	150
C465T	2311049J11	4.7 uF
C466B	---	Not Used
C468B	2113741A41	6800
C470T	2113741A53	.022 uF
C471T	---	Not Used
C481B	2113741A59	.039 uF
C482B	2113740A59	150
C483T	2113743A19	0.1 uF
C484T	2113740A59	150
C485T	2311049J11	4.7 uF
C486B	2311049A07	1 uF
C487B	2113740A51	68
C488T	2113741A59	.039 uF
C489B	2113743A19	0.1 uF
C490B	2113740A59	150
A101T	0280669C01	contacts: antenna nut
BATT	3980524D01	7.5 V, battery +/-
CHG+B	3980165S02	charge +
CHG-B	3980165S02	charge -
CL102T	3980532D01	50 ohm test port
SCI	3980165S02	serial comm interface
CF51(N)T	9180098D04	filter: 4-pole
CF51(W)T	9180098D06	4-pole
CF52(N)T	9180097D04	6-pole
CF52(W)T	9180097D06	6-pole
CR1T	4880154K03	diode: (see note)
CR51B	4880154K03	dual Schottky
CR101, 102B	4880973Z02	ceramic
CR103B	4813833C07	dual MMBD7000LT2

HLE9055A Main Board, 470-490 MHz, 4 W, 12.5 kHz (N)
 HLE9056A Main Board, 470-490 MHz, 4 W, 20/25 kHz (W) PL-961009-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR201, 202B	4813833C07	dual MMBD7000LT2
CR203B	4805649Q04	varactor
CR251T	4862824C01	varactor
CR252B	4862824C01	varactor
CR253T	4862824C01	varactor
CR301B	4880107R01	silicon
CR302, 303T	4880107R01	silicon
CR401T	4880939T01	diode
CR402T	4813833C07	dual 100 W
CR403B	4880939T01	diode
CR404B	4813833C07	dual
DS401B	4805729G49	light emitting diode: (see note)
DS402B	4805729G37	dual red/green red
F301T	6505591Y01	fuse: 4A, Slo-Blo
J403T	0180412D01	connector: accessory
JU301T	0660076M01	jumper: 0
JU302, 303T	---	Not Used
L52T	2462587X62	coil, rf: 560
L53T	---	Not Used
L54B	2462587X60	0.39 uF
L55T	2483411T74	1.2 uF
L56B	2463411T74	1.2 uF
L101B	2462587X40	8.0
L102B	2462587X61	470
L103B	2462567X46	27
L104B	2462587X61	470
L105B	2462587X40	8.0
L106B	2462587X49	47
L108B	2462587X40	8.0
L109B	2462580D59	80D59
L110B	2405318D06	18D06
L111B	2462587X61	470
L116B	2462580C29	80C29
L117B	2462587X61	470
L118B	2484657R01	ferrite bead
L120B	2462587X5	

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Section 1
Radio Disassembly/Assembly

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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 instruction manual revision. 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 SP50. 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 SP50 Portable Radios.

Table 1. Other Documentations

Information	Location
Basic Use of SP50	SP50 User Training Guide 6880903Z39 (Worldwide) 6880903Z23 (North America) 6880903Z32 (Latin America)
Programming	SP50 RSS Manual (6880903Z25) \$28.00

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.

Technical Support

Radius Product Services
Hwy. 34 West
Mt. Pleasant, IA 52641 USA
1-800-356-1520
319-385-5395 (International)

Radius 30-Day Warranty

Radius Repair Depot
Attention: Warranty Return
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA
1-800-356-1520
319-385-5395 (International)

Radius Major Component Repair

Radius Repair Depot
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA

Motorola Parts

Worldwide System and
Aftermarket Products Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Worldwide System and Aftermarket Products Division

Attention: International Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Customer Service


1-800-422-4210
1-708-538-8198 (FAX)

Parts Identification

1-708-538-0021
1-708-538-8194 (FAX)

Model Charts

Model	Description
P93YQT00A2AA	2-Channel, 150-170 MHz, 1-5 W, 12.5 kHz
P93YQT00B2AA	6-Channel, 150-170 MHz, 1-5 W, 12.5 kHz
P93YQT00G2AA	10-Channel, 150-170 MHz, 1-5 W, 12.5 kHz
P93YQT20A2AA	2-Channel, 150-170 MHz, 1-5 W, 20/25/30 kHz
P93YQT20B2AA	6-Channel, 150-170 MHz, 1-5 W, 20/25/30 kHz
P93YQT20G2AA	10-Channel, 150-170 MHz, 1-5 W, 20/25/30 kHz
P93YQS00A2AA	2-Channel, 150-170 MHz, 1-5 W, 12.5 kHz (Compact)
P93YQS00G2AA	10-Channel, 150-170 MHz, 1-5 W, 12.5 kHz (Compact)*
P93YQS20A2AA	2-Channel, 150-170 MHz, 1-5 W, 20/25/30 kHz (Compact)
P93YQS20G2AA	10-Channel, 150-170 MHz, 1-5 W, 20/25/30 kHz (Compact)*



SP50 VHF 150 - 170 MHz

X = Indicates one of each required

										Item	Description
X	X	X				X	X			HLD9000_/9044_	RF Board, 12.5KHz
			X	X	X			X	X	HLD9003_/9045_	RF Board, 20/25/30 KHz
X			X			X		X		HLN9173_	2-Channel Control Top Kit
	X			X						HLN9174_	6-Channel Control Top Kit
		X			X		X		X	HLN9175_	10-Channel Control Top Kit
X	X	X	X	X	X					HHN9050_	Standard Housing
						X	X	X	X	HHN9048_	Compact Housing
X	X	X	X	X	X	X	X	X	X	NAD6502_	Antenna, Heliflex (146-174 MHz)
X	X	X	X	X	X	X	X	X	X	6880903Z39	Worldwide User Training Guide (English, Spanish, French, Portuguese)
X	X	X	X	X	X	X	X	X	X	6880903Z23	North America User Training Guide (English, Spanish, French)
X	X	X	X	X	X	X	X	X	X	6880903Z32	Latin America User Training Guide (English, Spanish, Portuguese)

* = For International Use Only.

Model	Description
P94YQT00A2AA	2-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT00B2AA	6-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT00G2AA	10-Channel, 450-470 MHz, 1-4 W, 12.5 kHz
P94YQT20A2AA	2-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQT20B2AA	6-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQT20G2AA	10-Channel, 450-470 MHz, 1-4 W, 20/25 kHz
P94YQS00A2AA	2-Channel, 450-470 MHz, 1-4 W, 12.5 kHz (Compact)
P94YQS00G2AA	10-Channel 450-470 MHz, 1-4 W, 12.5 kHz (Compact)*
P94YQS20A2AA	2-Channel, 450-470 MHz, 1-4 W, 20/25 kHz (Compact)
P94YQS20G2AA	10-Channel, 450-470 MHz, 1-4 W, 20/25 kHz (Compact)*

SP50

UHF

450 - 470 MHz

X = Indicates one of each required

										Item	Description
X	X	X				X	X			HLE9008_/9040_	RF Board, 12.5KHz
			X	X	X			X	X	HLE9009_/9041_	RF Board, 20/25 KHz
X			X			X		X		HLN9173_ <i>NLA</i>	2-Channel Control Top Kit
	X			X						HLN9174_ <i>NLA</i>	6-Channel Control Top Kit
		X			X		X	X		HLN9175_ <i>NLA</i>	10-Channel Control Top Kit
X	X	X	X	X	X					HHN9099_	Standard Housing
						X	X	X	X	HHN9048_	Compact Housing
X	X	X	X	X	X	X	X	X	X	NAE6483_	Antenna, Whip (403-520 MHz)
X	X	X	X	X	X	X	X	X	X	6880903Z39	Worldwide User Training Guide (English, Spanish, French, Portuguese)
X	X	X	X	X	X	X	X	X	X	6880903Z23	North America User Training Guide (English, Spanish, French)
X	X	X	X	X	X	X	X	X	X	6880903Z32	Latin America User Training Guide (English, Spanish, Portuguese)

* = For International Use Only.



136-150.8 MHz, USE HAD9338 \$9.99

Accessories

Antennas:

NAD6502 AR	146-174 MHz VHF Heliflex Antenna, (standard antenna)	9.99
HAD9742	146-162 MHz VHF Stubby Antenna	
HAD9743	162-174 MHz VHF Stubby Antenna	
NAE6483	403-520 MHz UHF Whip Antenna, (standard antenna)	
NAE6522	438-470 MHz UHF Stubby Antenna	

HAD9728B ADD ANTENNA
136-174 9.56

Carrying Accessories:

HLN9122	Compact Leather Case with Beltloop	
HLN9127	Compact Nylon Carry Case with Beltloop	
HLN9126	Standard Nylon Carry Case with Beltloop	
HLN9125	Standard Hard Leather Carry Case with Beltloop	
HLN9128	Standard & Compact DTMF Leather Carry Case with Swivel	
HLN9129	Standard & Compact Leather Carry Case with Swivel	
HLN9724	Replacement 2-1/2" Belt Clip	2.55 (NO SPRING)
HLN8255	Spring Action Belt Clip 3"	← USE THIS ONE!
HLN9985	Waterproof Bag	
HLN9149	Swivel Beltloop Adapter	

Battery Chargers:

HTN9013	120V - 3 Hour Desktop Battery Charger	
HTN9014	120V - 10 Hour Desktop Battery Charger	
HTN8232	120V - Wall Charging Adapter - 10 Hour for Compact; 18-20 Hour for Standard	
HLN9090	120V - 6 Unit Charger Conversion Kit	
HTN9067	120V - 6 Unit Multi-unit Charger	
HTN9015	220V - 3 Hour Desktop Battery Charger with Euro Plug	
HTN9016	220V - 10 Hour Desktop Battery Charger with Euro Plug	
HTN9002	220V - Wall Charging Adapter with Euro Plug - 10 Hour for Compact; 18-20 Hour for Standard	
HLN9091	220V - 6 Unit Charger Conversion Kit	
HTN9068	220V - 6 Unit Multi-unit Charger	
HTN9059	240V - 3 Hour Desktop Battery Charger	
HTN9058	240V - 10 Hour Desktop Battery Charger	
HTN9057	240V - Wall Charging Adapter - 10 Hour for Compact; 18-20 Hour for Standard	
HLN9200	240V - 6 Unit Charger Conversion Kit	
HTN9070	240V - 6 Unit Multi-unit Charger	

Batteries:

HNN9044	650 mAH Compact Model Battery	
HNN9018	1200 mAH Standard Model Battery	\$45.

Audio/Signalling Accessories:

HMN9787/HMN9013	Light Weight Headset with Swivel Boom Microphone (without VOX)	
HLN9132	Earbud	
HMN9036	Earbud with Clip Microphone and PTT	
HMN9725/*HMN9140	Remote Speaker Microphone	
*HLN9133	VOX Adapter Kit	

Retrofit Kits/Service Aides:

HLN3047	DTMF Encode Compact 2 Channel Retrofit Kit	
HLN3048	DTMF Encode Compact 10 Channel Retrofit Kit	
HLN3024	DTMF Encode Standard 6 Channel Retrofit Kit	
HLN3046	DTMF Encode Standard 10 Channel Retrofit Kit	\$55
HLN3026	Quik-Call II Advantage™ Board	\$107
*HLN3042	SmarTrunk II™ Advantage Board	
HLN9087 A	External Antenna Adapter (BNC Connector)	7.95
HLN9102	Programming Stand	

Manuals/Videos:

6880903Z23	SP50 North America User Training Guide (English, Spanish, French)	
6880903Z32	SP50 Latin America User Training Guide (English, Spanish, Portuguese)	
6880903Z39	SP50 Worldwide User Training Guide (English, Spanish, French, Portuguese)	
HLN9178	English - SP50 User Training Video	
HLN9177	Spanish - SP50 User Training Video	

*Not Initially Available

Availability Subject To Change Without Notice

Performance Specifications

Performance Specifications

GENERAL

	VHF	UHF	
Model Series:	P93YQT/P93YQS	P94YQT/P94YQS	
Frequency:	150-170	450-470	
Channel Capacity:	2, 6, or 10 Channels		
Power Supply:	One (1) rechargeable Nickel-Cadmium battery		
Dimensions Standard: Compact:	6.2" x 2.5" x 1.28" (157.5mm x 63.5mm x 32.5mm) 5.2" x 2.5" x 1.28" (132.0mm x 63.5mm x 32.5mm)		
Weight Standard: Compact:	16.4 oz. (465g) 14.4 oz. (408g)		
Average Battery Life @ Continuous Standby Standard: Compact:	30 hrs. 15 hrs.		30 hrs. 15 hrs.
5-5-90 Duty Cycle Standard: Compact:	Low Power 12 hrs. 6 hrs.	High Power 8 hrs. 4 hrs.	Low Power 12 hrs. 6 hrs.
Sealing:	Passes rain testing per MIL-STD 810 C, D, E, & 1P54		
Shock & Vibration:	Impact resistance polycarbonate housing passes EIA RS-316B and MIL-STD 810 C, D, & E		
Dust & Humidity:	Weather resistant housing passes EIA RS-316B and MIL-STD 810 C, D, & E		

TRANSMITTER

	VHF		UHF	
	Low Power	High Power	Low Power	High Power
RF Output* Ni-Cad @ 7.5V:	1W	5W	1W	4W
Freq. Separation:	20 MHz		20 MHz	
Freq. Stability (-30°C to +60°C):	12.5 kHz ±.0003%	20/25/30 kHz ±.0005%	12.5 kHz ±.0003%	20/25 kHz ±.0005%
Spurs/Harmonics:	25 µW		25 µW	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000 Hz:	+1, -3 dB		+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<3%		<3%	
FM Noise:	-40 dB		-40 dB	
FCC Designation:	ABZ99FT3042		ABZ99FT4052	
FCC Modulation @ 20/25/30 kHz: @ 12.5 kHz:	16K0F1D 16K0F2D 16K0F3E 11K0F1D 11K0F2D 11K0F3E			

* Typical power setting.

MILITARY STANDARDS 810 C, D, & E

	810C		810D		810E	
Applicable MIL-STD	Methods	Procedures	Methods	Procedures	Methods	Procedures
Rain:	506.1	1, 2	506.2	1, 2	506.3	1, 2
Dust:	510.1	1	510.2	1	510.3	1
Vibration:	514.2	8, 10	514.3	1	514.4	1
Shock:	516.2	1, 2, 5	516.3	1, 4	516.4	1, 4

RECEIVER

	VHF		UHF	
Channel Spacing:	12.5 kHz	20/25/30 kHz	12.5 kHz	20/25 kHz
Freq Separation:	20 MHz		20 MHz	
Sensitivity* 12 dB EIA SINAD:	0.25 µV		0.25 µV	
Squelch*:	10 dB		10 dB	
Selectivity EIA:	-60 dB	-70 dB @ 30 kHz	-60 dB	-70 dB @ 25 kHz
Intermodulation EIA:	-55 dB	-60 dB	-55 dB	-60 dB
Freq. Stability (-30°C to +60°C):	±.0003%	±.0005%	±.0003%	±.0005%
Spur Rejection:	-60 dB		-60 dB	
Image Rejection:	-60 dB		-60 dB	
Rated Audio Output @ <3% dist.:	250 mW		250 mW	
Typical Audio Output @ <5% dist.:	500 mW		500 mW	
EIA Usable Bandwidth:	7.5 kHz		7.5 kHz	

*Typical specifications

All specifications subject to change without notice.

Service Aids

The following table lists service aids recommended for working on the SP50.

Motorola Part No.	Description	Application
HLN9214	Radio Interface Box <i>RLN4008B</i>	Enables communication between the radio and the computer's serial communications adapter.
HSN9412 <i>A</i>	RIB Power supply	Used to supply power to the RIB.
HKN9216 <i>A</i>	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.
HLN9102 <i>A</i>	Programming Stand	Connects radio to RIB.
HVN9012	Radio Service Software	Software on 3-1/2 in. and 5-1/4 in. floppy disc.
HKN9755 <i>A</i>	Cloning Cable	Allows the radio to be duplicated from a master radio by transferring programmed data from one radio to another.
RTX4005	Portable Test Set <i>RLN4460C</i>	Enables connection to the audio / accessory jack. Allows switching for radio testing.
RKN4034 <i>A</i>	Test Set cable	Connects radio to RTX4005B Test Box.

↓
200
25
52
112
185
375
38

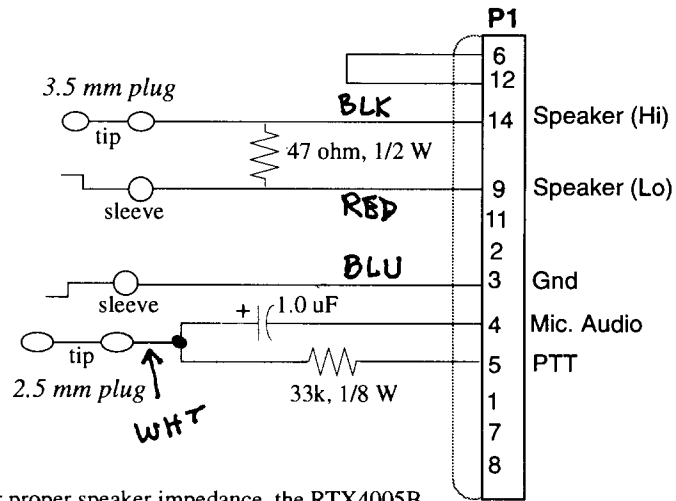
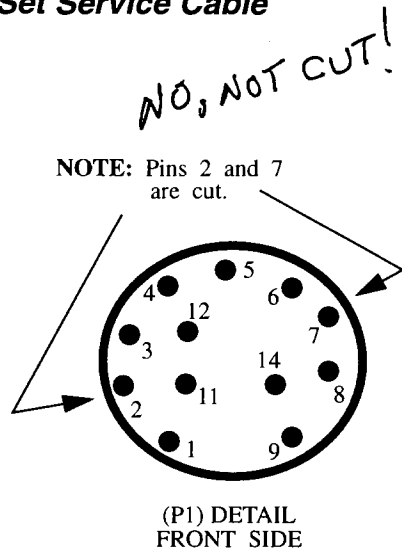
Test Equipment

The following table lists test equipment required to service the SP50 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 Elements (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

Radio Model Information

Test Set Service Cable



NOTE: For proper speaker impedance, the RTX4005B test set Audio out switch must be set to the "C" position

Figure 1. Service Cable (RKN4034A) for the Test Set (RTX4005B) **\$38**

Radio Model Information

The model number, serial number, and Motorola FCC designation number are all on a label attached to the back of your radio. From this model number, you can determine the RF output power, frequency band, type of squelch, and number of channels. The table below outlines one portable radio model number and its specific characteristics.

All SP50 radio models are synthesized, units that come standard with tone Private-Line (TPL) or Digital Private-Line (DPL) coded squelch, which may be enabled / disabled on a per channel basis. Programming changes can be made by a Radius dealer.

Radio Model Number (Example: P93YQS00G2AA)

Type of Unit	Tx Power	Freq.	Model Series	Channel Spacing	Channel Capability	Frequency Sub-band	Version	Unique Model Variation
P ↑	9 1-5 W VHF 1-4 W UHF	3 VHF	YQS Compact	00 12.5 kHz	A 2 Channels	1 Low Split	A	
		4 UHF	YQT Standard	20 20/25 kHz	G 6 Channels	2 High Split		A ↑
					G 10 Channels			A = Package Model with Battery, Antenna, etc.

P = Portable

✓ HVN9012

Radio Service Software Information

VERSION R02.00.00
02-JUN-95
AMERICAS SP50

To run the Radio Service Software, you will need the following equipment:

Required Equipment:

1. IBM XT, AT, Convertible, or System/2 Model 30/50™ with 512K RAM, Dual Floppy Disk Drives or on Floppy Disk and one Hard Disk.
2. PC DOS™ or MSDOS™ 3.0 or later.
3. Radio Interface Box (RIB) HLN9214. (RLN 4008B)
4. RIB to IBM AT cable HKN9216.
5. IBM AT cable to IBM XT computer adapter (optional) HLN9390.
6. Programming Stand HLN9102.
7. RIB power supply HSN9412 (110 VAC) or 0180358A56 (220 VAC).
8. Power Supply S1347/8 or equivalent.

HSN9412

RIB Power Supply.

Plug into 120 VAC outlet.

HKN9216

RIB to Computer Cable.

Plugs into RIB and computer.

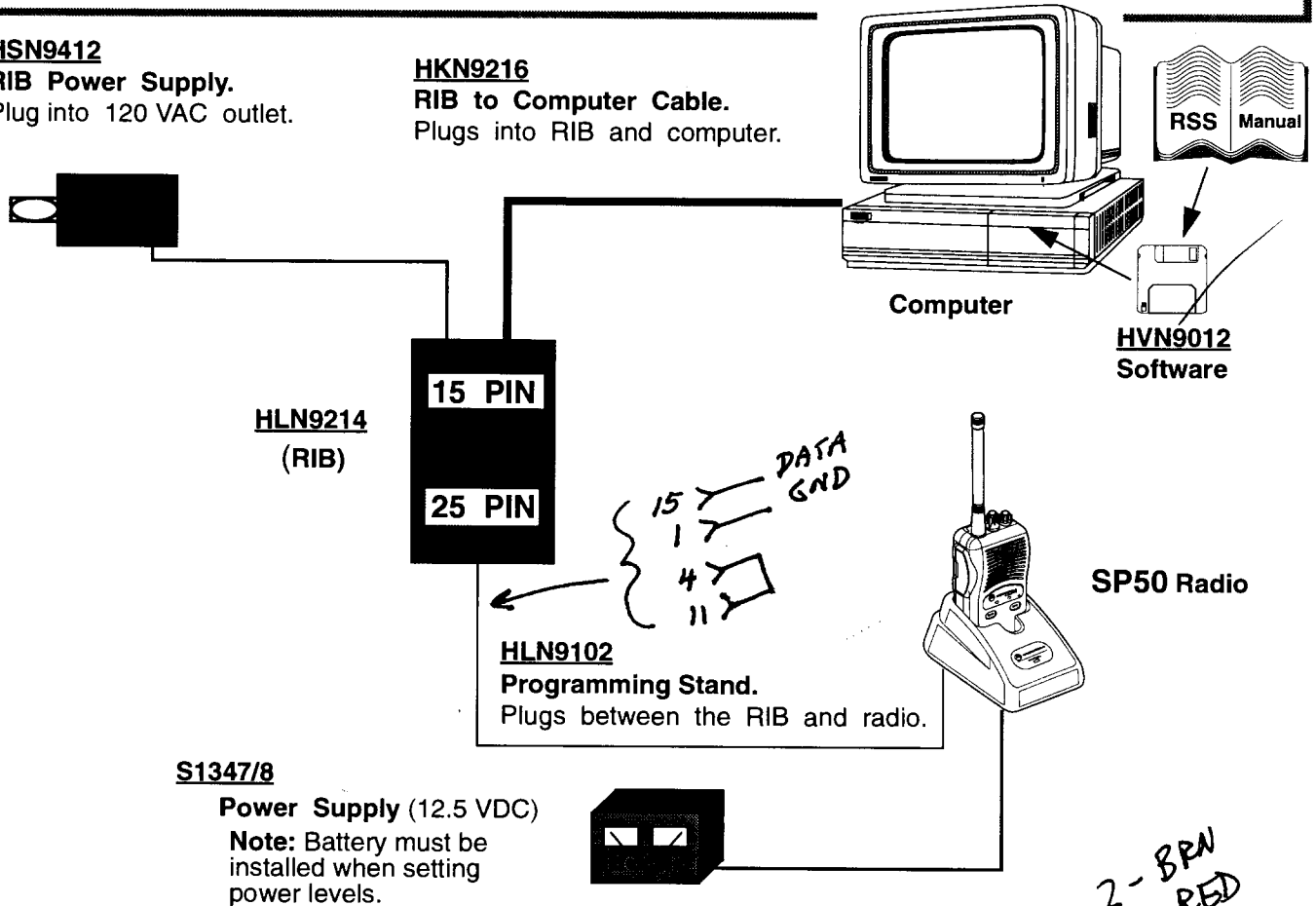


Figure 2. Equipment Setup

Configuring the RIB and Radio

1. Connect the RIB to the computer (Figure 2).
2. If your computer has an XT style communications port (25 pin connector), plug the HLN9390 adapter into the computer and plug the HKN9216 cable into the adapter. If you are unsure of which connection is on the back of your computer or the COM port, then please consult the computer manuals.
3. Plug the large 25 pin end of the HLN9102 programming stand into the RIB.
4. Plug HLN9102 programming stand into the power supply.
5. Plug the HSN9412 power supply into a wall outlet, and connect the other end to the RIB.
6. Place the radio into the programming stand and turn the volume control clockwise to turn it on.

2 - BRN
3 - RED
5 - YEL

Section 1

Radio Disassembly/Assembly

Overview

This section explains, step by step, how to disassemble and reassemble the SP50 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 Battery

The battery latch is located at the bottom center on the back side of the radio (Figure 1-1).

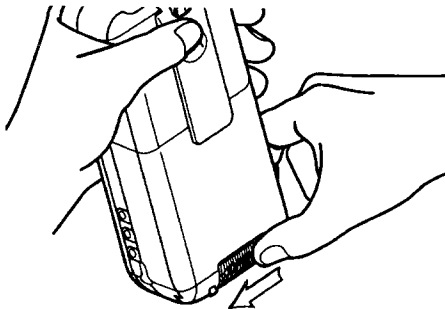


Figure 1-1. Slide Battery Latch

1. Slide latch from right to left to unlock battery compartment.
2. Slide battery cover down and away from radio to remove (Figure 1-2).

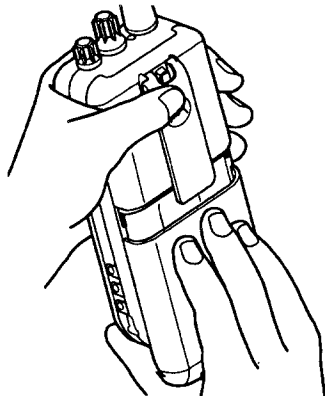


Figure 1-2. Slide Battery Cover

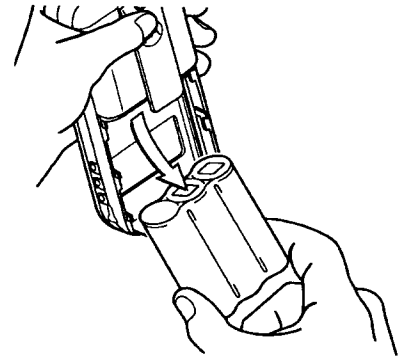


Figure 1-3. Remove Battery

3. To remove battery, lift from bottom end, and remove from radio housing (Figure 1-3).
4. Pry battery tray out using thumb nail or screw driver between bottom wall of battery tray and bottom wall of back cover.

Remove Back Cover

1. Unscrew the antenna counterclockwise and pull the controls knobs straight off with padded pliers to remove.
2. Fully insert a screwdriver between bottom wall of back cover and flexible wall of housing (Figure 1-4).
3. Tilt screwdriver towards body of radio until the back cover disengages from housing (Figure 1-4).

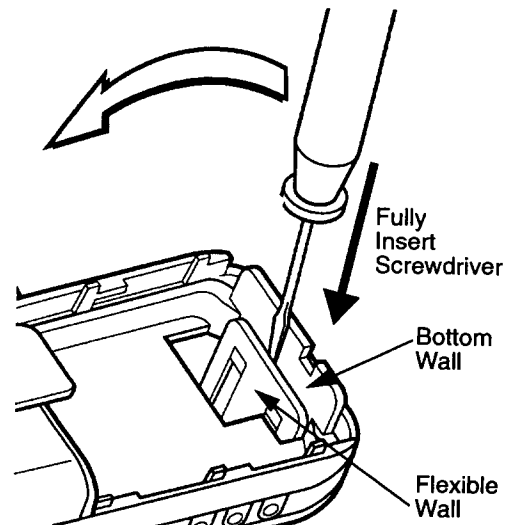


Figure 1-4. Remove Back Cover

Disassemble Radio

4. Grasp back cover, by bottom wall, and lift out of housing (Figure 1-5).

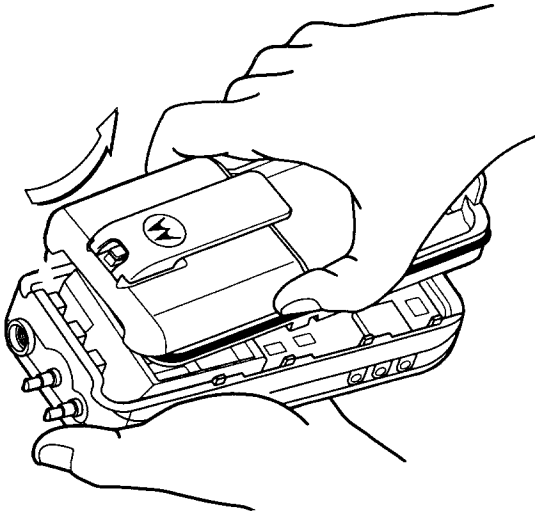


Figure 1-5. Remove Back Cover

Remove Main Board

- 1A. For **Compact** models carefully insert a screwdriver between opening of flexible wall of housing and mainboard and gently pry until main board lifts up (Figure 1-6).
- 1B. For **Standard** models, gently pry upwards using thumb.
2. Slide board out from housing until volume and channel shafts clear the control top openings.

NOTE

The flex cable will still be connected to the main board. Refer to the Disconnect Flex Cable section to remove.

3. Carefully lift main board from housing.

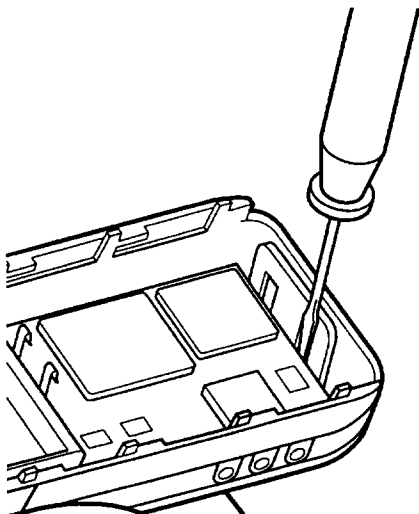


Figure 1-6. Remove Main Board

Disconnect Flex Cable

1. Place small screwdriver between flex clip tab and heatsink, making sure screwdriver does not extend past flex clip tab so as not to disturb any components on the board (Figure 1-7A).
2. Using the heatsink as leverage, pivot the screwdriver clockwise until the flex clip slides off the board (Figure 1-7B).

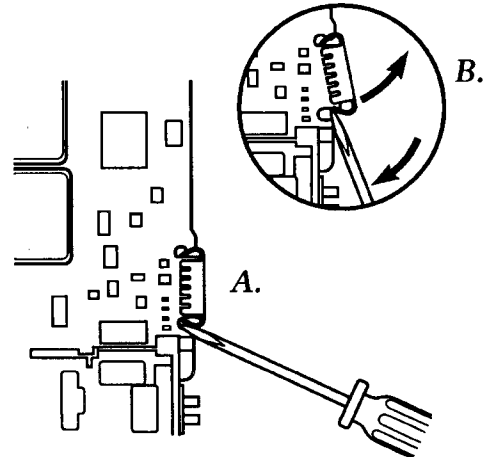


Figure 1-7. Remove Flex

Remove Heatsink

CAUTION

The clip on the heatsink is under extreme tension. When releasing the clip, the main board should rest on a flat surface while removing the heatsink.

1. Push clip over tab on heatsink with screw driver or needle nose pliers to release locking clip (Figure 1-8).
2. Carefully lift heatsink away from main board.

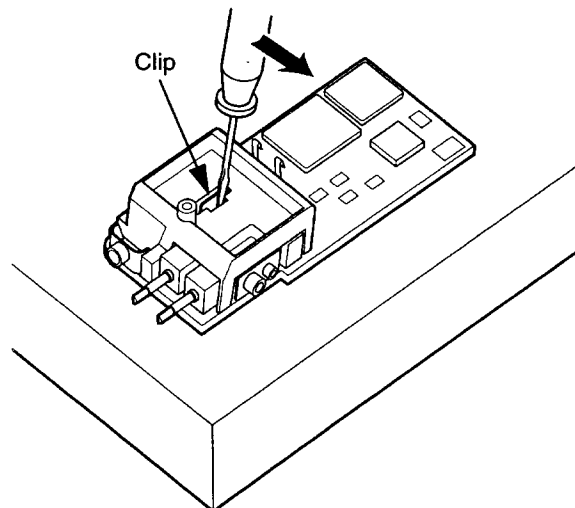


Figure 1-8. Remove Heat Sink

Reassemble Radio

Remove Speaker Assembly

1. Insert a screwdriver between one of the tabs on stiffner shield and slots on side of housing (Figure 1-9).

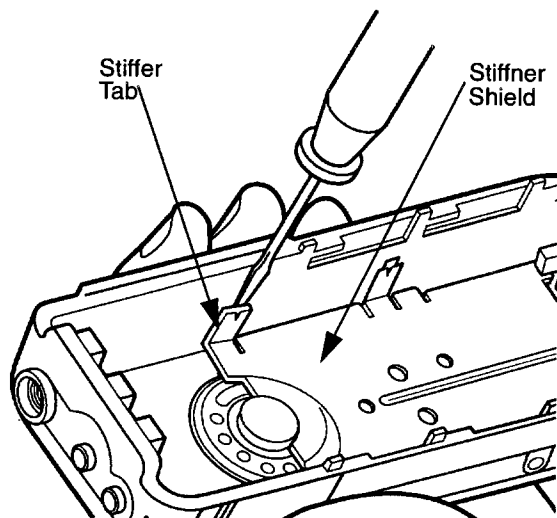


Figure 1-9. Remove Stiffner Shield

2. Gently pry tab until it disengages from housing.
3. Repeat steps 1 and 2 for the remaining three tabs.
4. Remove stiffner shield (Figure 1-10).
5. Remove flex cable (Figure 1-10).
6. Lift out speaker (Figure 1-10).

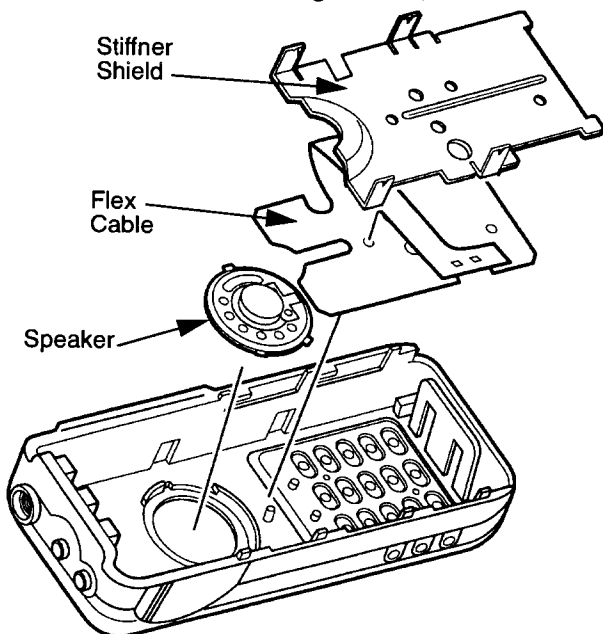


Figure 1-10. Speaker Assembly

Reassemble Radio

Replace Speaker Assembly

1. Align tabs on speaker with slots on housing and insert speaker (Figure 1-10).
2. Insert flex cable into housing and align pins (3) through holes on flex cable (Figure 1-10).
3. Insert stiffner shield into housing and align tabs with slots on side of housing (Figure 1-10).
4. Using a screwdriver press tabs until they snap into slots.

Replace Heatsink

1. Carefully align slot on heatsink with slot on main board.
2. While holding heatsink to main board, turn main board over to locate slot on back side of main board (Figure 1-11A).
3. Insert locking clip into slot as shown in Figure 1-11A.

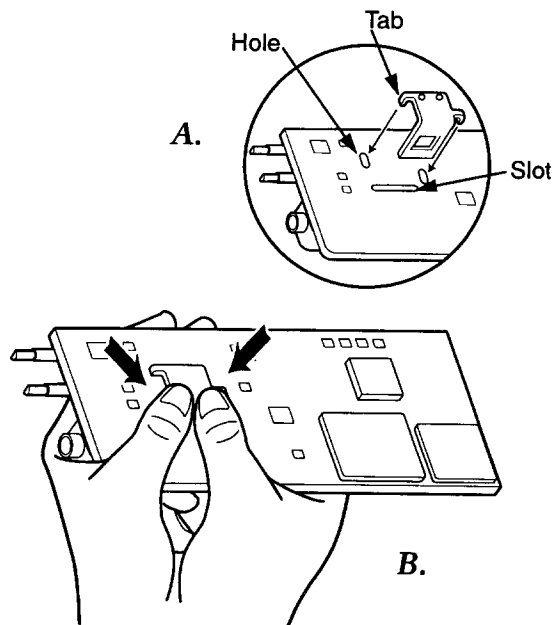


Figure 1-11. Replace Clip

4. Align tabs on locking clip with holes on main board (Figure 1-11A).
5. Using both thumbs press locking clip firmly until clip snaps into place on heatsink (Figure 1-11B).

Reassemble Radio

Reconnect Flex Cable

1. Pull flex clip off flex cable.
2. Place folded end of flex cable around connection on main board (Figure 1-12).
3. Insert tabs on connection through holes of flex cable (Figure 1-12). The exposed conductors on flex cable should touch contacts on main board.
4. Place flex clip into position on main board and push towards main board until flex clip snaps into place (Figure 1-12).

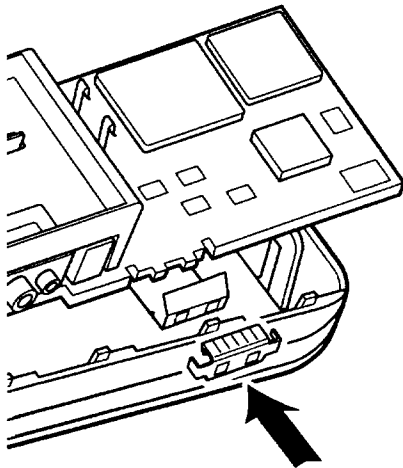


Figure 1-12. Reconnect Flex Cable

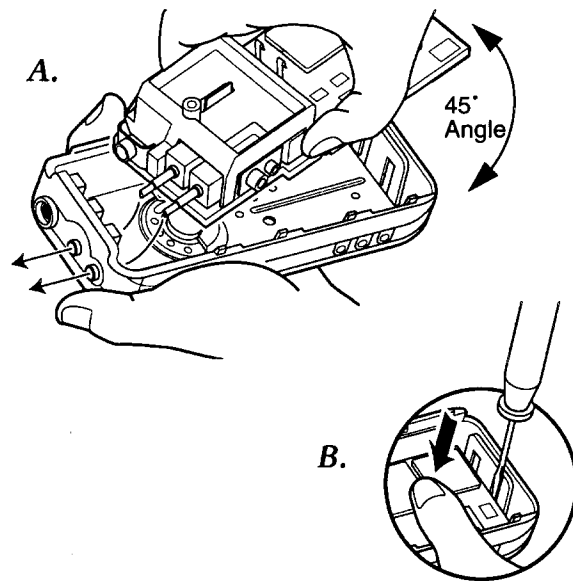


Figure 1-13. Replace Main Board

3. **For Standard models:** gently press down on board with thumb, making sure that board is fully seated inside the board stops.

Replace Back Cover**NOTE**

A gasket helps keep the radio free of unwanted dust, and water. It is recommended that a new lubricated gasket be used when the radio is re-assembled. Using an old gasket may impair the overall quality of the radio.

1. Align indentations of back cover to tabs on control top (Figure 1-14A).

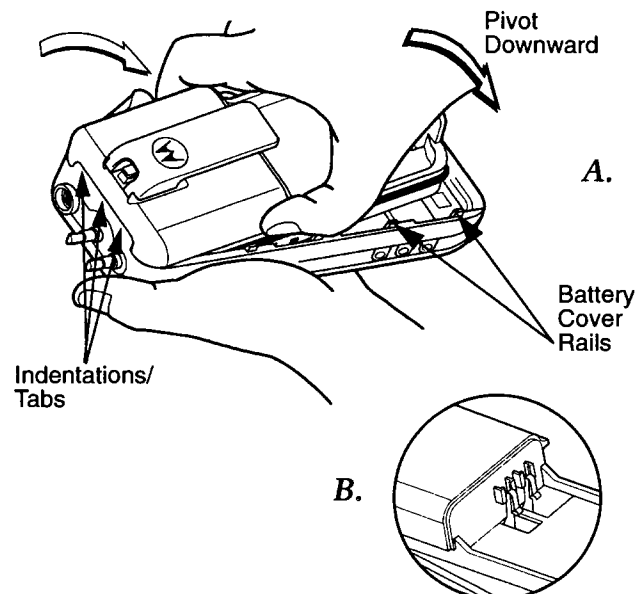


Figure 1-14. Replace Back Cover

Replace Main Board**NOTE**

Care should be taken that the flex cable does not cover the two LED openings on housing while replacing main board.

1. Carefully slide main board into housing at a 45 degree angle. Care should be taken as the volume and channel shafts are inserted into the openings of control top so as not to break off rubber seals (Figure 1-13A).
2. **For Compact models:** insert a screwdriver between main board and flexible wall of housing (Figure 1-13B).
- 2A. Tilt screwdriver towards body of radio while pushing main board down with thumb on rubber pad of shield (Figure 1-13B).
- 2B. Continue tilting screwdriver while pushing down on main board until main board clears both tabs along either side of flexible wall and is fully seated into front housing.

Reassemble Radio

2. Place battery contacts through slots on back cover (Figure 1-14B).
3. Firmly press the back cover towards control top until it is fully seated.
4. Continue to firmly press back cover towards control top while gently pivoting the back cover down into housing, making sure that o-ring gasket stays within housing battery cover rails (Figure 1-14A).

CAUTION

When replacing the back cover on Standard models, care should be taken not to catch the metal bar of the charging contact with the back cover

5. Hold radio in both hands with bottom side up.
6. Press both thumbs firmly down on bottom wall of back cover until back cover snaps into place.

Replace Battery Tray, Battery, Knobs, and Antenna

1. Replace battery tray by sliding in at 45 degree angle and pressing down on bottom wall of battery tray until it snaps into place.
2. Replace battery with label side face up.
3. Position battery cover over housing battery cover rails and press and slide upwards until battery cover snaps into place.
4. Slide battery latch from left to right to lock battery compartment.
5. Replace both control knobs and antenna.

Overview

This section provides a detailed theory of operation for the SP50 and its components: the microcontroller, the receiver, the transmitter, the frequency generation circuitry, the transmit/receive audio circuitry, and the option interface.

Microcontroller

The SP50 VHF and UHF radios use the Motorola 68HC11E9 microcontroller, U401, which utilizes:

- 7.9488 MHz clock rate
- Multiplexed 8-bit address/data lines
- 16-bit addressing
- Internal watchdog circuitry
- Analog to digital conversion input ports

The microcontroller's operating program is permanently written or "masked" within the microcontroller. Included in U401 is an EEPROM memory which stores channel, signalling, and scan list information.

Microcontroller Power-Up and Reset Routine

On power-up U401's reset line (pin 43) is held low by the AFIC (U451) until the synthesizer (U201) provides a stable 2.1 MHz output. When U451 releases its control, U401's hardware holds the reset line low until it verifies that clock Y401 is operational. When the reset line goes high, U401's hardware delays briefly to allow Y401 to stabilize, then the software begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 mS is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

U401's reset line can be controlled directly by the 5 V regulator (U301), the AFIC, and the microcontroller, and indirectly by the synthesizer. U301-3 drives the reset line low if it loses regulation. This prevents possible latch-up or overwriting of registers in the microcontroller because the reset line is higher in voltage than pin 55 of U401 (VDD).

U401 can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software

stuck in an infinite loop, unplanned hardware inputs, static zaps, etc.

The AFIC and synthesizer can control the reset line during power-up, as outlined above.

Receiver

The receiver of the SP50 radio consists of 3 major blocks: the front-end, the first mixer, and the IF/back-end.

Front-end

The VHF and UHF front-ends both have a pre-selector, an RF amplifier, and a post-selector filter. All filters are fixed-tuned designs to eliminate the need for factory tuning and to provide wide-band operation.

The VHF design uses both shunt and series coupled topology while the UHF design incorporates only shunt coupled topology. The UHF design is optimal for attenuating undesired signals on its lower side while the VHF design is more heavily attenuated on its upper side. The worst case image frequency for VHF is 90.2 MHz above 150 MHz, while the worst-case of UHF is 90.2 MHz below 470 MHz. Both bands use spiral inductors plated onto the PC board for all inductors within the front-ends.

The VHF pre-selector is a 2-pole, 0.1 dB Chebyshev bandpass design with shunt series coupled resonator topology. This topology provides fairly symmetrical attenuation around the center frequency of 160 MHz. The 3 dB bandwidth is approximately 35 MHz. Center of band insertion loss is about 1.5 dB. The input is matched to 50 ohms while the output is matched to the preceding RF amplifier.

The UHF pre-selector filter is also a 2-pole, 0.1 dB Chebyshev bandpass design but implemented in a shunt coupled resonator topology. The 3 dB bandwidth is approximately 30 MHz, centered at 460 MHz. The center of the band insertion loss is approximately 1.8 dB. The 2-pole filter is designed to operate with a 50 ohm input termination while the output termination is the input impedance of the RF amplifier that follows it.

The RF amplifier, Q1, is a Motorola MMBR541L NPN device biased in a common emitter configuration. The amp is stabilized by the shunt feedback resistor R1 with a gain of approximately 19 dB at VHF and 16 dB

Transmitter

at UHF. The noise figure is about 3.5 dB and 3.0 dB at VHF and UHF, respectively. The VHF amplifier draws 2.5 mA of current while the UHF amplifier draws 3.0 mA of current. Both are supplied by the receive 5 Volt supply (+5V Rx).

Terminating the RF amp is the post-selector filter. This filter is a 3-pole 0.1 dB Chebyshev design for both bands. The VHF design is series coupled topology while the UHF is shunt coupled. The 3 dB bandwidth is approximately 35 MHz centered at 160 MHz for VHF and 25 MHz centered at 460 MHz for UHF.

The insertion loss of this filter is approximately 2.0 dB for VHF and 2.7 dB for UHF. The filter is designed to be terminated with the RF amplifier output impedance on one side, and 50 ohms on the other.

The net gain from the receiver front-end is about 16.0 dB (VHF) and 10.8 dB (UHF) in the center of the band. The net noise figure is approximately 5.5 dB (VHF) and 5.2 dB (UHF). This is sufficient to achieve a typical center of the band sensitivity of 0.25 μ V for 12 dB SINAD.

First Mixer

The first mixer is a double balanced mixer (DBM) consisting of two baluns and a ring diode in a single package. The mixer operates with an LO level of about +5 dBm for both VHF and UHF. The conversion loss is approximately 6 dB. The double balanced type mixer provides excellent isolation between any two ports. Since a DBM can operate over a large bandwidth, the same mixer is used for both VHF and UHF radios. The DBM also provides excellent protection against receiver spurs due to non-linearities, such as IM and Half-IF. The purpose of the mixer is to translate the received signal down to the frequency of the first IF, 45.1 MHz, where it then enters the IF circuitry.

IF / Back-end

The IF/Back-end portion of the radio consists of several sections including, the high IF, the second LO, the second IF, and the IF IC chip. The first LO signal and the RF signal mix to the IF frequency of 45.1 MHz which then enters the high IF.

The signal enters the high IF, passes through a crystal filter, and is then amplified by the IF amp. The crystal filter provides selectivity, second image protection, and intermodulation protection. The amplifier provides approximately 10 dB of gain at VHF and 18 dB at UHF. The high IF has an approximate 3 dB bandwidth of 18 kHz for 20/25/30 kHz models and 13 kHz for 12.5 kHz models.

The filtered and amplified IF signal then mixes with the second local oscillator at 44.645 MHz. The second LO uses an amplifier internal to the IF IC, an external crystal and some external chip parts. The oscillator pre-

sents an approximate level of -15 dBm to the second IF mixer, internal to the IF IC.

The output of the mixed IF signal and second LO is at 455 kHz (second IF). This signal is then filtered by external ceramic filters and amplified. It is then passed back to the IF IC, sent to a phase-locked loop detector, and demodulated. The resulting detected audio output is then sent to the AFIC for further processing.

The IF IC also controls the squelch characteristics of the radio. With a few external parts, the squelch tail, hysteresis, attack, and delay can be optimized for the radio. The AFIC contains a 16 step programmable attenuator, which is used to adjust the squelch opening with the Radio Service Software (RSS).

Transmitter

The SP50 VHF and UHF transmitters contain five basic circuits: a power amplifier, an antenna switch, a harmonic filter, an antenna matching network, and a power control circuit. Refer to the block diagram and the schematic for more information.

Power Amplifier

The power amplifier (PA) of the VHF and UHF transmitters consists of four stages of amplification with the corresponding stages using the same transistors. The first two stages (Q101, Q102) of both PA line-ups utilize the MMBR951L transistor, while the third stage (Q103) uses a Phillips BLT50 transistor, and the last stage (Q104) uses the Motorola MRF873 transistor. The VHF PA line-up is capable of supplying 5 watts of output power at the antenna port, while the UHF PA line-up is capable of 4 watts. The power out of each line-up can be varied by changing the voltage (VCTL) on Q102.

Antenna Switch

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C145, L115, and part of C140), and a current limiting resistor (R115). The UHF circuit contains one additional capacitor (C149), which is used to tune out CR102's lead inductance. In the transmit mode, TxB+ is applied to the circuit to bias the diodes "on". To enable the Tx signal to go to the antenna rather than the input of the receiver, the shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off and there exists a low attenuation path between the antenna and receiver ports.

Harmonic Filter

The harmonic filter consists of C141, C142, L112, L113, and part of C140. The design of the harmonic filter for

Frequency Generation Circuitry

both VHF and UHF is based on a 5-pole, 0.1 dB ripple Chebyshev filter.

Antenna Match

To optimize the performance of the transmitter and receiver into an antenna, a network is used to match the antenna's impedance to the harmonic filter. The VHF network consists of C146, C147, and L116. The UHF network is made up of L116. Note that to measure the power out of the transmitter, one must remove the antenna and screw in its place a special BNC adapter, HLN9087A.

\$ 8.30 EACH

Power Control

The power control circuit consists of the networks associated with U150, Q150, Q151, U152, and part of U151. One half of Op Amp U150(A) and Q150, along with resistor R150, make up a current-to-voltage amplifier whose gain is mainly dependent upon the ratio of R156 to R151. The current to the final stage of the PA line-up is supplied through R150 (0.1 ohms), which provides a voltage proportional to the current drain at the inputs of U150A. The resistors at the input of U150A (R152, R153, R154, and R155) keep the voltages at these inputs below its maximum allowable. These resistors are 1% tolerance parts to minimize the error produced at the emitter of Q150 resulting from the voltage offset at the input of U150A. The signal at the emitter of Q150 is therefore proportional to the current drain of the final stage of the PA line-up and is applied to the input of U150B, which acts as a summing amplifier.

The voltage at the other input of the summing amp, U150B, is supplied from a network consisting of a 8-bit shift register and resistor arrays that are connected to approximate an R-2R ladder network. Hence, this network provides a very good approximation to an 8-bit Digital-to-Analog Converter (DAC). This DAC, which is under control of the microcontroller, provides a reference voltage to the control loop whose value can change depending upon the frequency of the channel of operation and upon whether the channel is to be a low or high power channel.

The error voltage at the input of U150B produces a voltage at its output, which is in turn applied to the series pass transistor, Q151, through its driver, U151A. The voltage at the collector of Q151 is applied to the controlled stage of the PA line-up. The feedback from the collector of Q151 to the emitter of U151A through R161 is provided to keep the two stages stable. Likewise, the feedback from the collector of Q151 to the minus input of the summing amp is to keep the whole control loop stable.

Frequency Generation Circuitry

The frequency generation circuitry is composed of two main IC's, the Fractional-N synthesizer (U201) and the VCO/Buffer IC (U251). Designed in conjunction to maximize compatibility, the two IC's provide many of the functions which normally would require additional circuitry. The block diagram illustrates the interconnect and support circuitry used in the design. Refer to the schematic for reference designator.

The supply for the synthesizer is from the regulated 5 V source which also serves the rest of the radio. The synthesizer in turn generates a superfiltered 5 V (actually 4.65 V) which powers U251.

In addition to the VCO, the synthesizer must interface with the logic and AFIC circuitry. Programming for the synthesizer is accomplished through the data, clock, and chip enable lines (pins 5, 6, and 7) which are driven by the microcontroller, U401. A serial stream of 98 bits is sent whenever the synthesizer is programmed. A 5 V dc signal from pin 2 of U201 indicates to the microcontroller that the synthesizer is locked while unlock is indicated by a low voltage on this pin. Transmit modulation from the AFIC is applied to pin 8 of U201. The audio is digitized and applied to the loop divider to provide the low-port modulation. The audio is also run through an internal attenuator for modulation balancing purposes before being outputted at pin 28 to the VCO. A 2.1 MHz clock is generated by U201 at pin 11. It is filtered and attenuated from 2.5 V to approximately 2 V and then routed to pin 35 of U451.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. The other reference oscillator components external to the IC are C205, C206, C211, R207, R211, C233, and CR203. The loop filter, comprised of R202, R204, R205, C214, C215, and C216, provides the necessary dc steering voltage for the VCO as well as filtering of spurious signals from the phase detector. For achieving fast locking of the synthesizer, an internal adapt charge pump provides higher current capability at pin 31 than when in the normal steady-state mode. Both the normal and adapt charge pumps receive their supply from the voltage multiplier which is made up of C202, C203, C204, C231, CR201, and CR202. By combining two 5 Volt square waves which are 180 out-of-phase along with Regulated 5 Volts, a supply of approximately 12.6 Volts is available at pin 32 for the charge pumps. The current for the normal mode charge pumps is set by R203. The pre-scaler for the loop is internal to U201 with the divider value determined by the frequency band of operation.

Transmit and Receive Audio Circuitry

VCO

The VCO (U251) in conjunction with the Fractional-N synthesizer (U201) generates rf in both the receive and the transmit modes of operation. The TRB line (U251-5) determines which oscillator and buffer will be enabled. A sample of the rf signal from the enabled oscillator is routed from U251-23, through a low pass filter, to the pre-scaler input (U201-20). After frequency comparison in the synthesizer, a resultant STEERING LINE VOLTAGE is received at the VCO. This voltage is a DC voltage between 3 and 11 V when the PLL is locked on frequency.

In the receive mode, U251-5 is grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U251. On VHF radios, the rf signal at U251-2 is run through a low pass filter. On UHF radios, the rf signal is run through a buffer amplifier before it is passed through the low pass filter. This is to provide additional isolation to the receive VCO from high level received rf signals. The rf signal after the low pass filter is the LO RF INJECTION and it is applied to the first mixer at U41-3.

During the transmit condition, PTT depressed, five volts is applied to U251-5. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U251. The rf signal at U251-4 is run through a low pass filter and an attenuator to give the correct drive level to the input of the PA. This rf signal is the Tx RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received by the transmit VCO modulation circuitry at MOD.

When a high impedance is applied to U251-5, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive, transmit, and pre-scaler buffer are turned off. In the synthesizer, the BATTERY SAVER mode places the A/D and the modulation attenuator in the off state. This mode is used to reduce current drain of the radio.

Transmit and Receive Audio Circuitry

SP50 receive (Rx) and transmit (Tx) audio circuits are common to both the VHF and UHF models. Most of the audio processing is accomplished in U451, the Audio Filter IC (AFIC). The AFIC performs the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter (Rx audio)
- Rx de-emphasis
- Tx pre-emphasis amplifier
- Tx audio limiter

- Post-limiter filter
- Programmable attenuators for:
 - Tx deviation
 - Microphone gain
 - Carrier squelch setting
- Microcontroller output port expansion
- 2.5 Vdc reference source

U451 parameters are programmed from U401 microcontroller via the serial CLOCK and DATA lines.

Tx Audio Path**Internal MIC Bias Switch and External PTT Sense Circuits**

The internal PTT (PB401) switch is connected in series with the internal microphone MK401. Pushing PB401 provides the ground path to bias MK401 and a logic zero which U401-42 recognizes as a PTT. The radio is also keyed when an external accessory draws current from J403-2. Pushing the PTT of a PTT equipped accessory (i.e. speaker mic) provides a current path from J403-2 through the closed external PTT and the microphone element. The current is sourced from the base of the external PTT sense transistor (U453-5), which saturates U453 and brings the collector (U453-1) to 5 V. U401-34 recognizes the 5 V as an external PTT.

MIC Amplifier

MIC audio from internal MIC MK401 is coupled through C468, J403, and L402 to the MIC amp circuit U452B. External MIC plug insertion mechanically disconnects the internal MIC. External MIC audio is coupled through L402 to the MIC amp input. Capacitors C458, C460 and C461, and resistors R458, R459 and R460 provide a low audio frequency roll off with a high-pass corner frequency of 1 kHz to improve transmit audio clarity. Crossover gain is 16 dB (at 1 kHz). Reference deviation is obtained with 8.5 mV rms input to the external MIC connector J403.

Tx Audio Mute Gate

Pins 2, 3, and 4 of dual PNP transistor U453 and resistors R465 and R456 comprise the Tx audio mute gate. The expanded output port, U451-40, controls U453. The mute function is enabled when modulating DTMF signalling.

Pre-emphasis Amp (Audio Filter IC)

The Audio Filter IC U451, contains a Tx audio pre-emphasis amp, with external gain setting resistor R451 and pre-emphasis elements R470 and C452. Connections are made at each end of resistor R470 to provide interconnection of option board Tx audio through connector J402. (See the Option Interface section.) Pre-

RadiusPort™ Option Interface

emphasis is 6 dB/octave with a corner frequency of 6600 Hz. Crossover gain is 0 dB at 1 kHz, with pass-band gain (head-room) of 17.5 dB.

Limiter/Post-Limiter Filter (Audio Filter IC)

The audio filter IC U451 contains the limiter circuit, which prevents over-deviation of the RF carrier by symmetrically clipping the peaks of the modulating voltage. Audio from the pre-emphasis amplifier circuit is coupled to the limiter. Gain of the limiter stage is adjustable in four 3 dB steps, from -3 dB, 0 dB, +3 dB, and +6 dB. Therefore, Tx audio path gain, or MIC gain, can be adjusted to compensate for different sound environments through the Radio Service Software. Clipped modulating voltage from the limiter output is coupled to the post-limiter filter. This filter attenuates the spurious products generated by the limiter.

Low Speed Encoder (CTCSS)

CTCSS (Private Line) is generated by the PL encoder circuit in the Audio Filter IC. Tone PL or Digital PL data is programmed for each mode from the Radio Service Software. On entering transmit mode, TPL or DPL data is programmed to U451 via the serial DATA and CLOCK lines. U401-57 microcontroller output strobes U451-32 PL CLOCK input at a constant rate during DPL encoding, or at a rate determined by the PL encoder algorithm in the microcontroller for TPL encoding corresponding to tone frequency. The encoded PL is summed with MIC audio at the post-limiter filter output. Digital attenuators are employed to adjust the balance of MIC audio and PL to prevent over deviation of the carrier. PL deviation is adjustable in three "coarse" steps of 500 Hz, 750 Hz, and 1 kHz, for 25 kHz models and with compensation of MIC audio level.

High Speed Encoder (DTMF)

Resistors R423, R424, R425, and R427, and summer U452A form the high speed encoder. U452A-1 is coupled to U451-13 Audio Filter IC auxiliary Tx modulation input.

DTMF encoded signals pass from this input to the post-limiter filter input. U452A-1 is also connected to U451-6 which is coupled into the Rx audio path to provide audio sidetones.

Deviation Attenuators (Audio Filter IC)

Carrier deviation is set by programming the digital deviation attenuators of the Audio Filter IC. Deviation data for each mode is entered through the Radio Service Software, and then programmed into U451 from microcontroller U401 upon entering transmit mode. U451-19 and U451-20 deviation attenuator outputs are combined through resistors R454 and R455 and dc-coupled to U201-8, the synthesizer modulation input.

Capacitor C218 provides a high frequency roll-off corner at 20 kHz to further attenuate spurious signals from U451. The dc voltage at the combined attenuator outputs sets the center frequency for the modulated carrier.

Rx Audio Path**Audio Processing (Audio Filter IC)**

The recovered Rx audio from the IF IC (U51) is applied to U451-7 and U451-8 on the Audio Filter IC. Rx audio at U451-7 is processed first by the PL rejection filter, which is characterized by a 2-pole, 300 Hz corner frequency high-pass response. Audio de-emphasis is a single pole low pass filter with a corner frequency of 231 Hz. Audio then passes through the digital volume attenuator and buffer amplifier output to U451-23. Audio is made available at J402 for use by an internally installed option board. (See Option Interface section.)

Low Speed Decoder (CTCSS)

Recovered Rx audio at U451-8, the PL/DPL decoder input, first passes through the Tone PL filter, or the Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then amplitude limited (U451-27) and coupled to the microcontroller U401-64 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.

Audio Power Amplifier

U481 is a low power amplifier IC capable of low voltage operation. The circuit provides a differential output (U481 pins 5 & 8) to the speaker (24 ohms) to maximize the available voltage swing at low voltages. Variable resistor R487 and R482 provide Rx audio volume adjustment. R482 will set the minimum volume level. The chip disable pin (U481-1) permits powering down the U481 IC for muting purposes and to conserve power.

RadiusPort™ Option Interface

The option interface provides the ability to interface Motorola designed and third party designed option boards to the radio. The following is a description of the signals available on the option interface.

NOTE

Not all logic functions are available on all models of the SP50.

J402-1

J402-1 interfaces with pin 51 of U401, the radio microcontroller. Pin 51 of the microcontroller is bi-directional

Option Interface

port D bit 2. In the SP50, this is decoder data into the radio. On a DTMF decoder board this would be the serial input for the 4-bits of tone data. On other option boards this input is used as the serial input for a multiple byte message.

J402-2

J402-2 interfaces with pin 42 of U401 and one end of PB401, the PTT switch. This is a wire-or connection with the internal PTT signal. It can either be used as an internal PTT sense or as a PTT input from the option board. This connection is pulled to 5 volts through a 51k ohm resistor. When this connection is shorted to ground the radio microcontroller processes an internal PTT request. This request normally keys the radio unless overridden by other enabled features.

J402-3

J402-3 interfaces with pin 52 of U401. Pin 52 of the microcontroller is bi-directional port D bit 3. In the SP50, this connection is for serial data out of the microcontroller. This controls loading of the various electrical subsystems internal to the radio in addition to data required by option boards installed into the radio. For option connector purposes this pin is used to shift multi-byte messages from the radio to an option board. When used for this purpose, pin J402-4 option board enable, is driven low by the radio microcontroller to enable a serial byte transfer to an option board.

J402-4

J402-4 interfaces with pin 54 of U401. Pin 54 of the microcontroller is bi-directional port D bit 4. In the SP50, this connection option board enables output from the microcontroller. This pin is used to enable option boards by mode or to enable a serial transfer in more complex option boards. When used as a simple option board enable the radio microcontroller sets the output either high or low on each channel change or power-up to reflect the programmed selection in the radio's per channel data. This is most typically used to enable an option board function by channel. When used in more complex option boards this line enables serial transfers between the radio microcontroller and the option board. Since the serial data out of the microcontroller is used for multiple internal devices, including an option board, this signal indicates when serial data is for option board use and not other electrical subsystems within the radio.

J402-5

J402-5 interfaces with pin 63 of U401. Pin 63 of the microcontroller is an input on port A bit 2 of the radio microcontroller. In the SP50, this connection is used for a variety of input signals from an option board. In a simple option board configuration, a falling edge on this pin connection signals that a selective call has been decoded by the option board. For DTMF decoder

boards or other simple BCD decoder boards, a falling edge on this pin indicates that a digit decode has been completed and is ready to be shifted into the microcontroller for concatenation and comparison to an ID string. In more complex option boards, a falling edge on this pin indicates that an option board requests a serial transfer on J402-1 and J402-3 or an acknowledgment of data received on J402-3 in a multiple byte transfer.

J402-6

This is the Rx audio output of the option board. This connection may be used for option boards that need to enable Rx audio on signaling decodes or to descramble audio as required by the option board descrambling technique. Option board Rx audio input is available at J402-6 with a sensitivity of 100 mV rms at less than 200 ohm output impedance from an option board. R480, a 30k ohm resistor between option board pins J402-6 and J402-7 requires design consideration on the part of any option board using Rx audio output. The Rx audio output level is controlled by the SP50 volume control before the audio amp.

J402-7

This option interface pin is connected to the Rx Out signal, pin 23 of the Audio Filter IC, U451 through coupling capacitor C450. In the SP50 radio, this signal de-emphasizes Rx audio and output is always unmuted audio in the radio. This pin may be used as the receive audio to a decoder option board such as DTMF, Two Tone Sequential, or MSK signalling decode. An audio scrambler option board may also use this input for receive audio in. Any option board requiring pre-emphasized audio would have to include the necessary filtering. The level of this de-emphasized audio is 450 mV rms at 15 ohm impedance.

J402-8

J402-8 interfaces with pin 53 of U401. Pin 53 of the microcontroller is bi-directional port PD5. In the SP50, this is the CLOCK output from the microcontroller for loading all internal subsystems as well as option boards that require synchronous serial transfers. Option boards requiring a multi-byte transfer may use this output as the CLOCK source for uploading internal option board registers on power-up, channel change, or for reading serial control requests.

J402-9

J402-9 is interfaced to pin 4 of voltage regulator U301. This is the microcontroller's 5 V source from the main board to the option board. Maximum current sourcing is 100 mA. Regulation is ± 0.2 Vdc.

Option Interface

J402-10

J402-10 is interfaced to the radio system ground. The heatsink chassis is also at ground, but is not recommended as the only source of ground for the option board.

J402-11

This is the audio from the internal or external microphone of the radio. J402-11 provides MIC audio output to an option board at a level of 65 mV rms and a 10k ohm input impedance. At this level the transmit deviation should be at 60%.

J402-12

Tx Audio input to the radio is available at J402-12 with a sensitivity of 60 mV rms pre-emphasized at a 6dB/octive, and less than 200 ohm output impedance (from the option board). If "flat" audio response is required, the audio output from the option board must be de-emphasized at a -6dB/octive rate, 300 Hz-3 kHz with 0 dB gain at 1 kHz. The low option board output impedance is required to achieve better than 40 dB isolation between main board input (J402-11) and output (J402-12) audio.

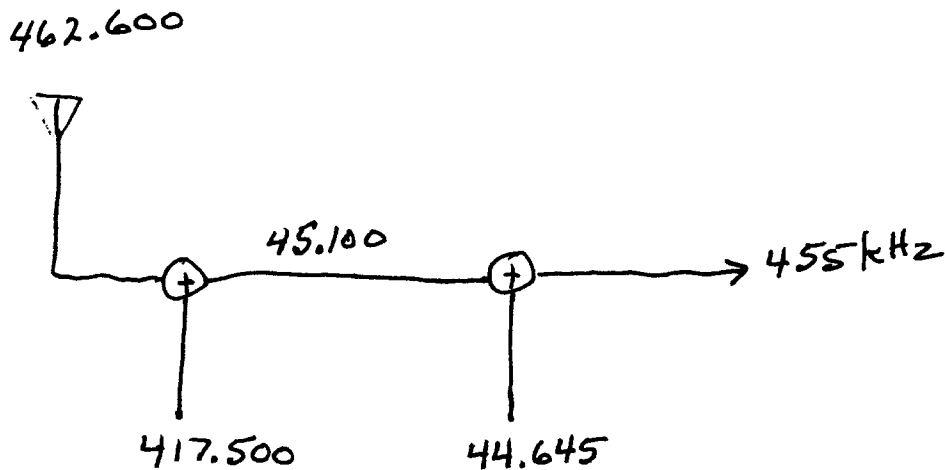
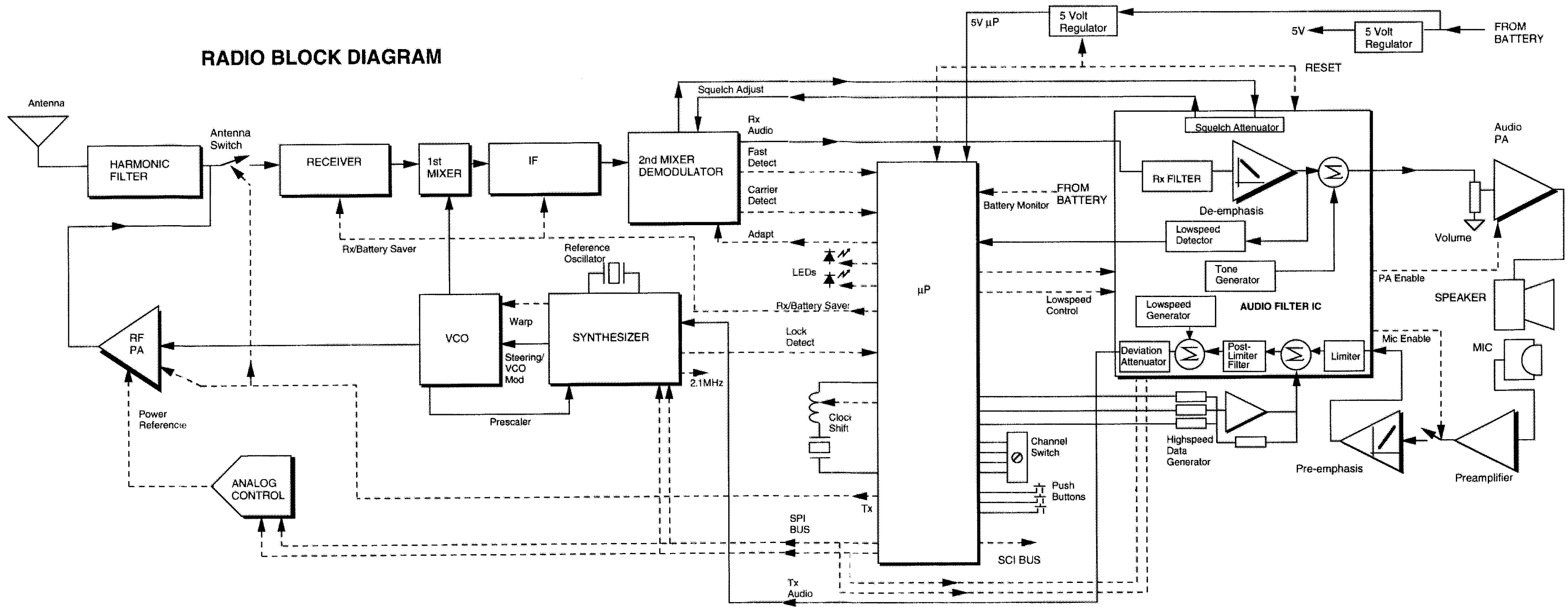


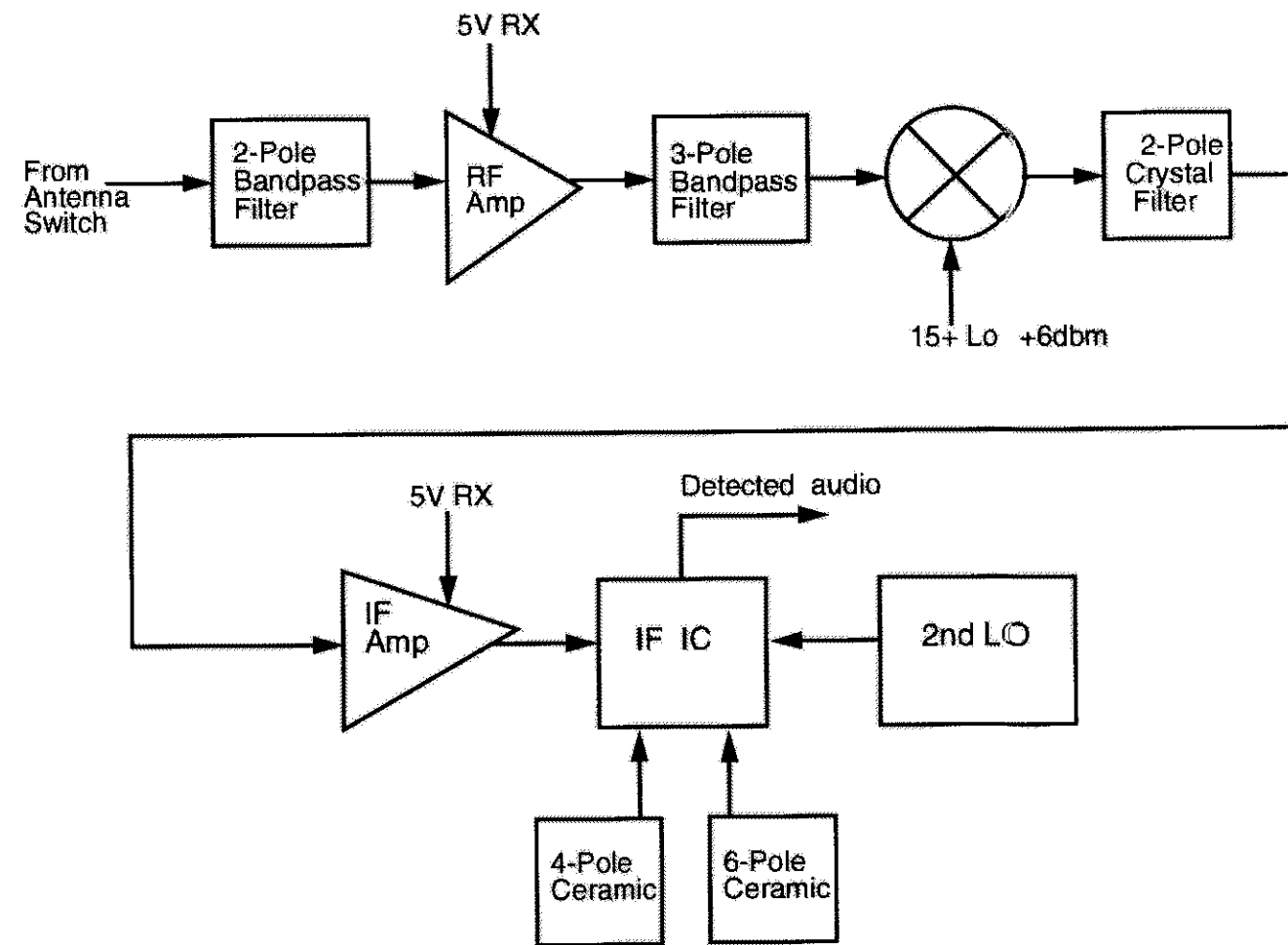
IMAGE: 372.400

$$\text{product } 148.030 \times 2 = 290.060$$

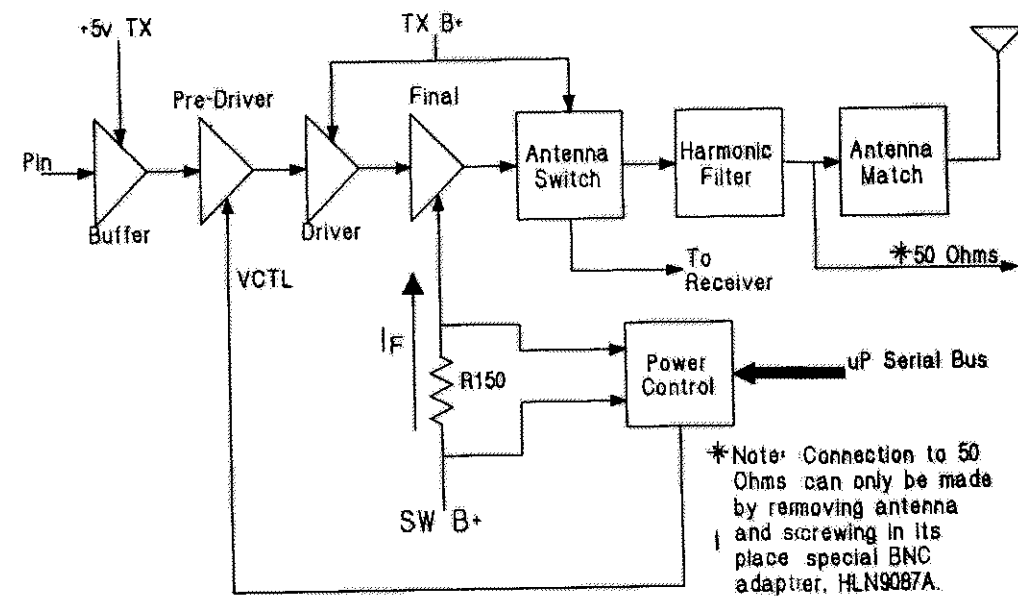
RADIO BLOCK DIAGRAM



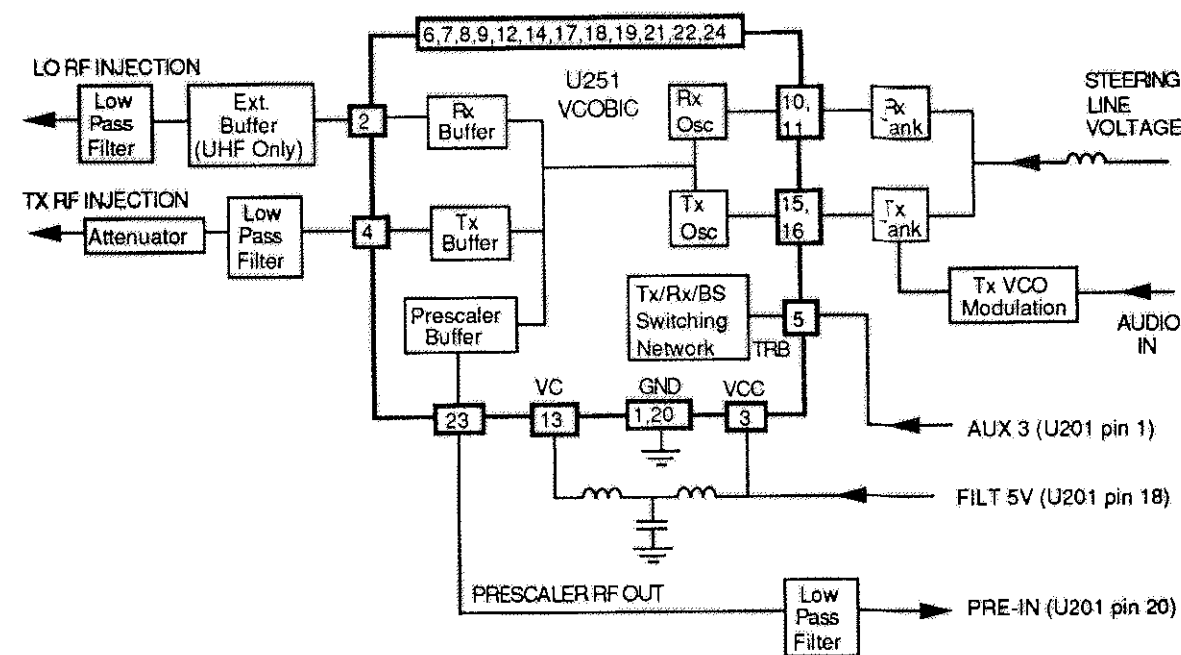
RECEIVER BLOCK DIAGRAM



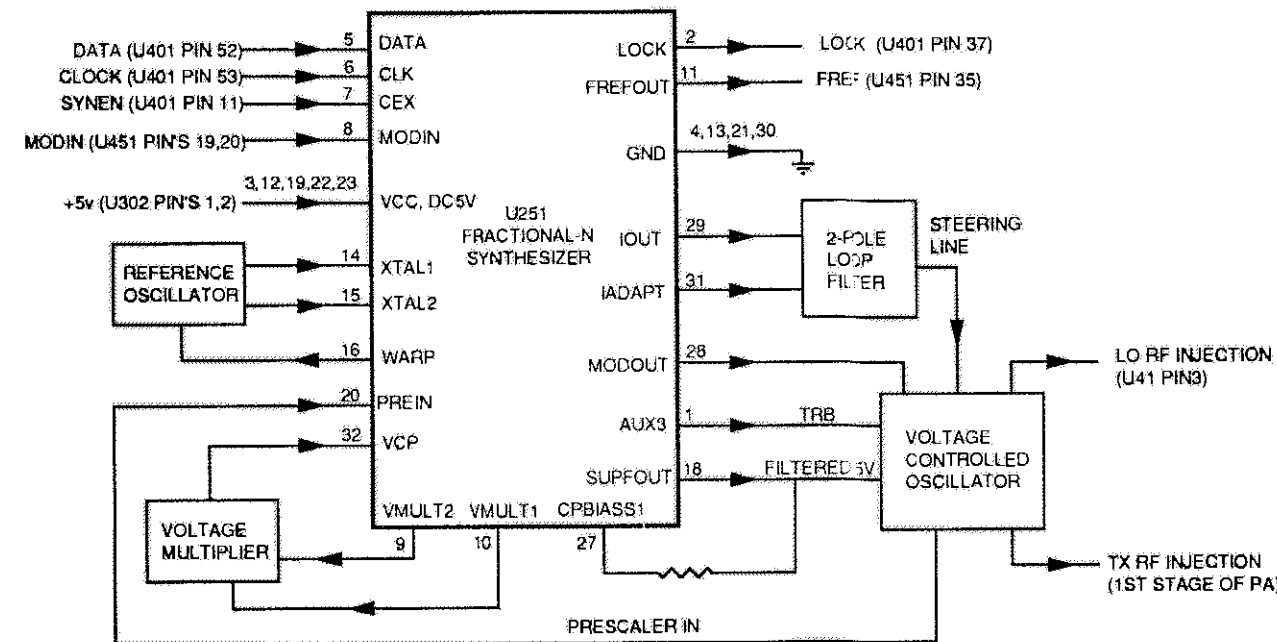
TRANSMITTER BLOCK DIAGRAM



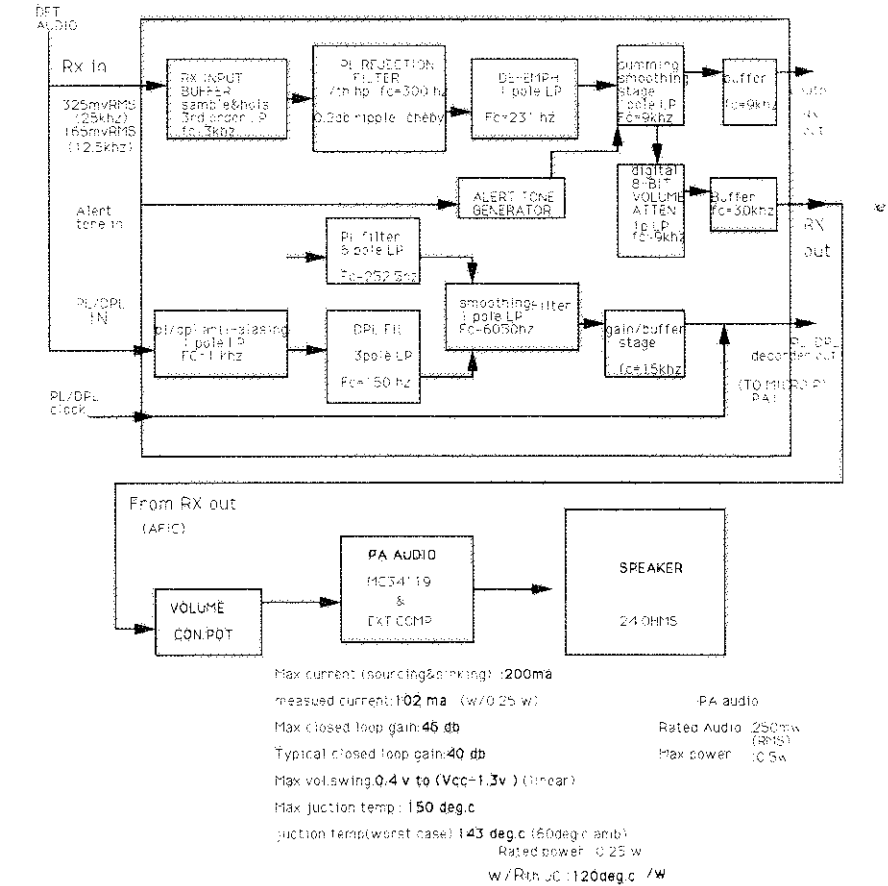
VCO BLOCK DIAGRAM



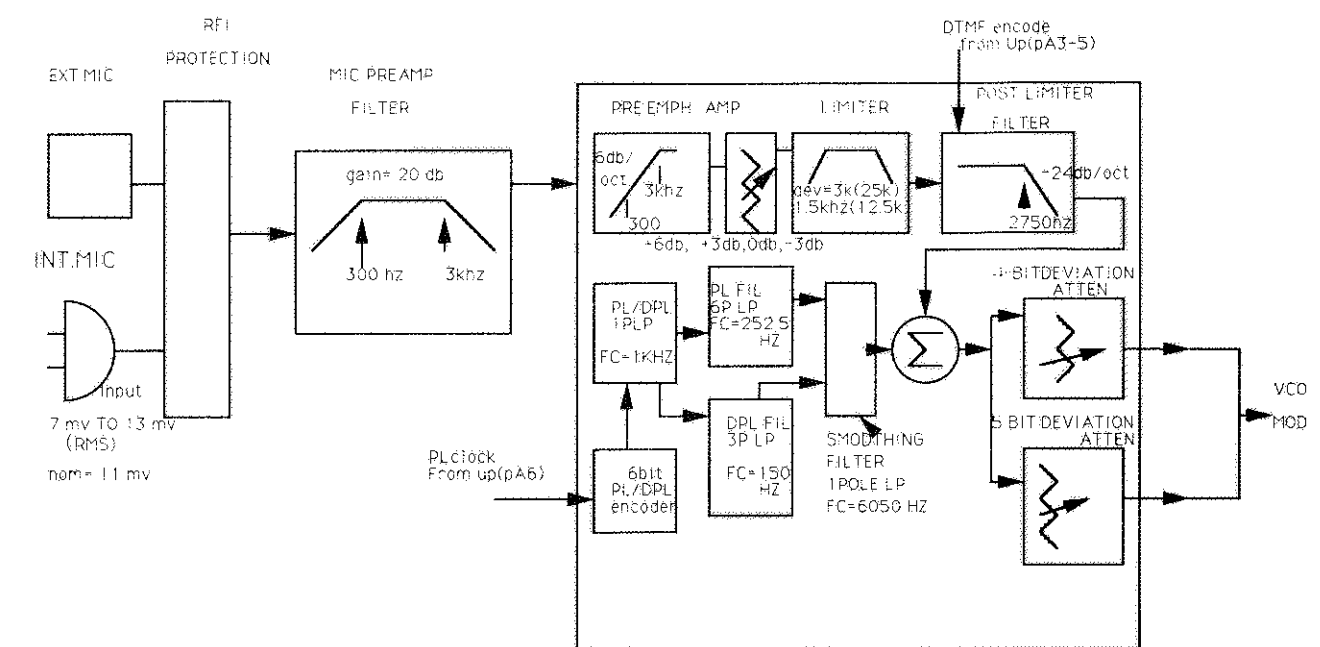
SYNTHESIZER BLOCK DIAGRAM



RX AUDIO AFIC BLOCK DIAGRAM



TX AUDIO AFIC BLOCK DIAGRAM



Overview

The remote speaker microphone is an accessory available with the SP50 portable radio. This section provides a general description of the remote speaker microphone and describes the operation, handling precautions, and maintenance of this accessory.

Description

The Model HMN9140A Remote Speaker Microphone includes a speaker, a microphone, a push-to-talk (PTT) switch and associated circuitry. A cable, terminated with a special plug, is provided for attaching to the accessory connector on the portable radio.

When the remote speaker microphone is attached to the radio, the speaker in the radio is disabled, and receiver audio is connected to the accessory speaker. Similarly, the accessory microphone is connected to the transmitter, and the accessory PTT switch can now control the PTT function in the radio. The radio microphone and PTT switch are still operational, but you can listen to the radio only through the accessory speaker.

IMPORTANT

Observe safety information in the radio operating instructions.

Operation

1. Attach the microphone's accessory connector to the accessory connector on top of the radio.
2. While listening to the accessory speaker, turn the radio on.
3. Operate radio according to operating instructions supplied with the radio.

NOTE

The microphone will perform best if it is worn as shown in Figure 3-1.

Handling Precautions

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

- Prior to and while servicing a remote speaker microphone, particularly after moving within

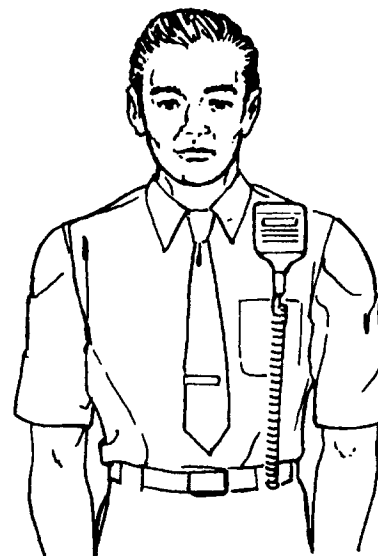


Figure 3-1. Ideal Microphone Position

the service area, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which may have accumulated on the person doing the service.

- Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

NOTE

Wearing a conductive wrist strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING

While wearing a conductive wrist strap, be careful near high voltage sources. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.

- When servicing a unit, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.
- All electrically powered test equipment should be grounded. Apply the ground lead from the

Maintenance

test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

- If the microphone cartridge is removed from the unit, place it on a conductive surface, such as a sheet of aluminum foil which is connected to ground through 100k ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

- When soldering, be sure the soldering iron is grounded
- Prior to replacing circuit components or touching the microphone cartridge, be sure to discharge any static buildup. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.
- Replacement microphone cartridges should be kept in conductive packaging until they are placed in unit.

Maintenance

Refer to the schematic diagram (shown in Figure 3-2), the exploded view (shown in Figure 3-3), and the parts lists. Every part in the microphone is identified and illustrated for assistance in removal and replacement.

If necessary, the external surfaces of the remote speaker microphone may be cleaned with a 0.5% solution of mild dishwashing detergent in water (one teaspoon of detergent in a gallon of water).

Parts List

HMN9140A Electrical Parts List

PL-951007-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-10%; 100 V: unless otherwise stated
C1	2113740A53	Chip, 82 pF, +/-5%, 50V
C2	2113740A67	Chip, 330 pF, +/-5%, 50 V
C3	2113741A53	Chip, .022 uF, +/-5%, 50V
C4	2113741B69	Chip, .1 uF, +/-5%, 50V
		coil, inductor:
L1 thru 4	2462575A02	Chip, 680 nH, +/-10%
		switch:
S1	3905834K06	Dome, PTT
		miscellaneous:
MK1	0180706Y83	Microphone assembly
LS1	5005910P05	Speaker

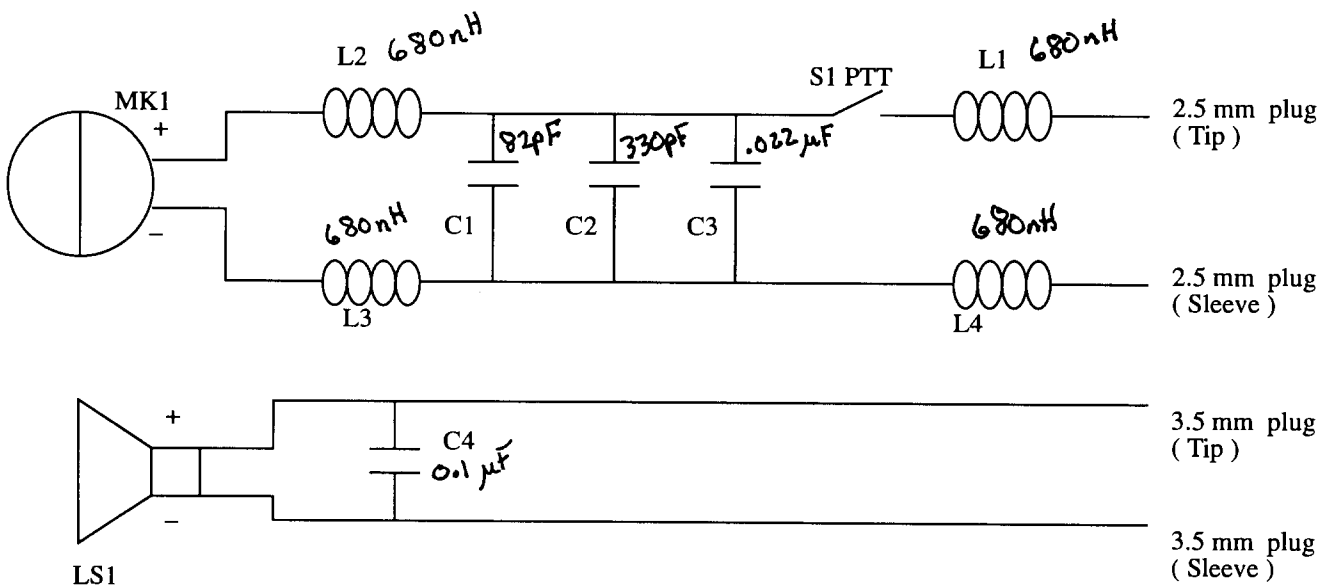


Figure 3-2. Schematic Diagram

Parts List

HMN9140A Remote Speaker Microphone

PL-951008-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	0105953N42	Front housing, items 1 thru 5
2	3305259Q01	Nameplate, Motorola
3	4505182Q01	Lever, PTT
4	3505152J01	Grille, cloth
5	1105461R01	Adhesive
6	3080417E08	Coil cord & connector
7	0180703Y67	PCB: includes electrical parts
8	3905834K06	Switch: dome. PTT (S1)
9	3205231Q01	Seal, dome
10	1405219Q01	Boot, microphone
11	0180706Y83	Microphone assembly
12	5005910P05	Speaker (LS1)
13	7505283Q02	Pad, speaker
14	3205690R01	Gasket
15	6405689R01	Plate, housing mounting
16	0300139982	Screw, Phillips, 2-56 x 5/32"; 3 used
17	1505172Q01	Housing, back
18	0484345A06	Washer, 3 used
19	0305137Q02	Screw, Phillips, 3 used
20	0105959N54	Belt clip assembly
21	0300139982	Screw, Phillips, 2-56 x 5/32"; 3 used

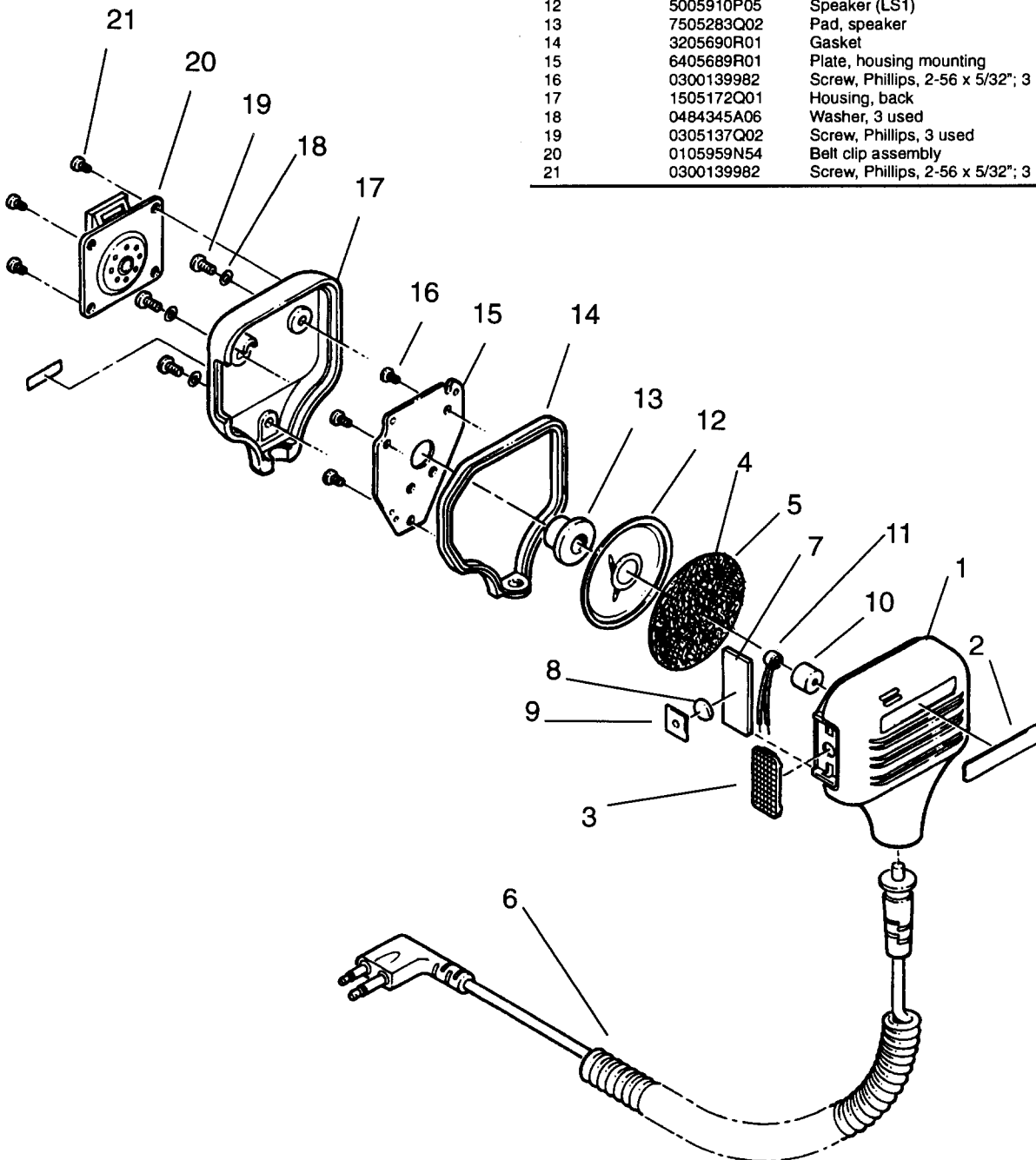


Figure 3-3. Exploded View

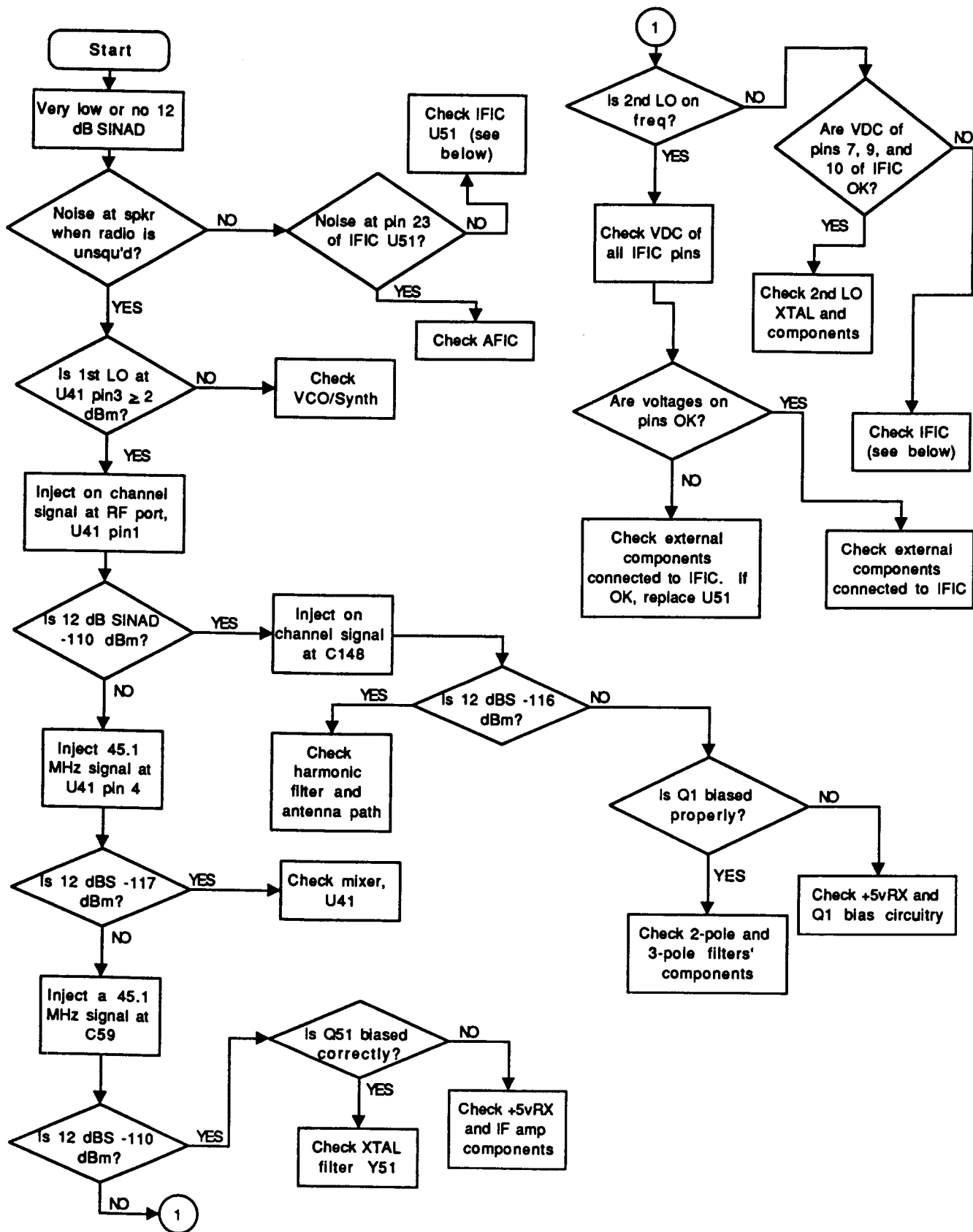
Overview

This section contains five troubleshooting tables for the following SP50 components:

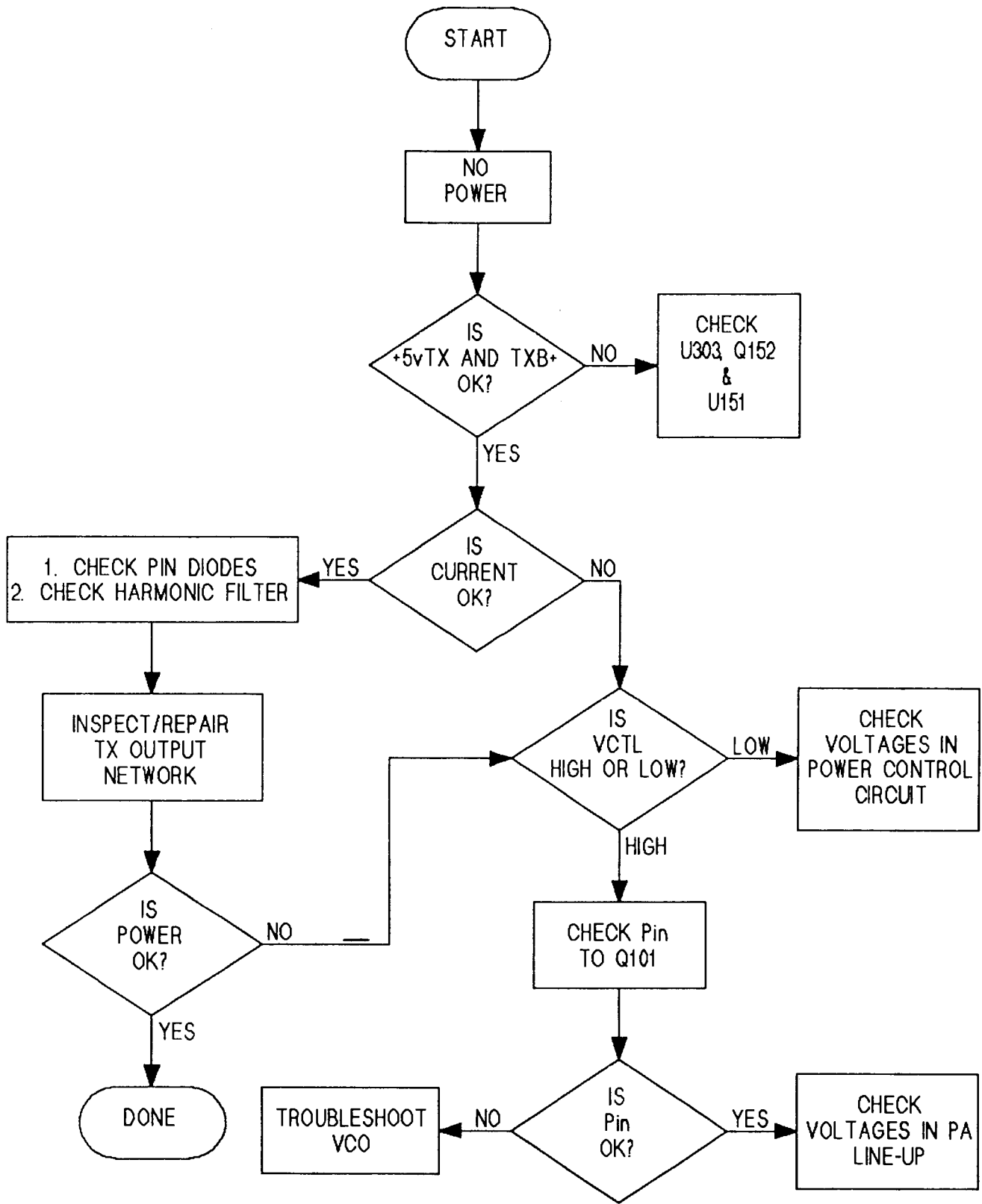
- Receiver
- Transmitter
- Synthesizer
- Microcontroller
- Voltage Controlled Oscillator (VCO)

Troubleshooting Charts

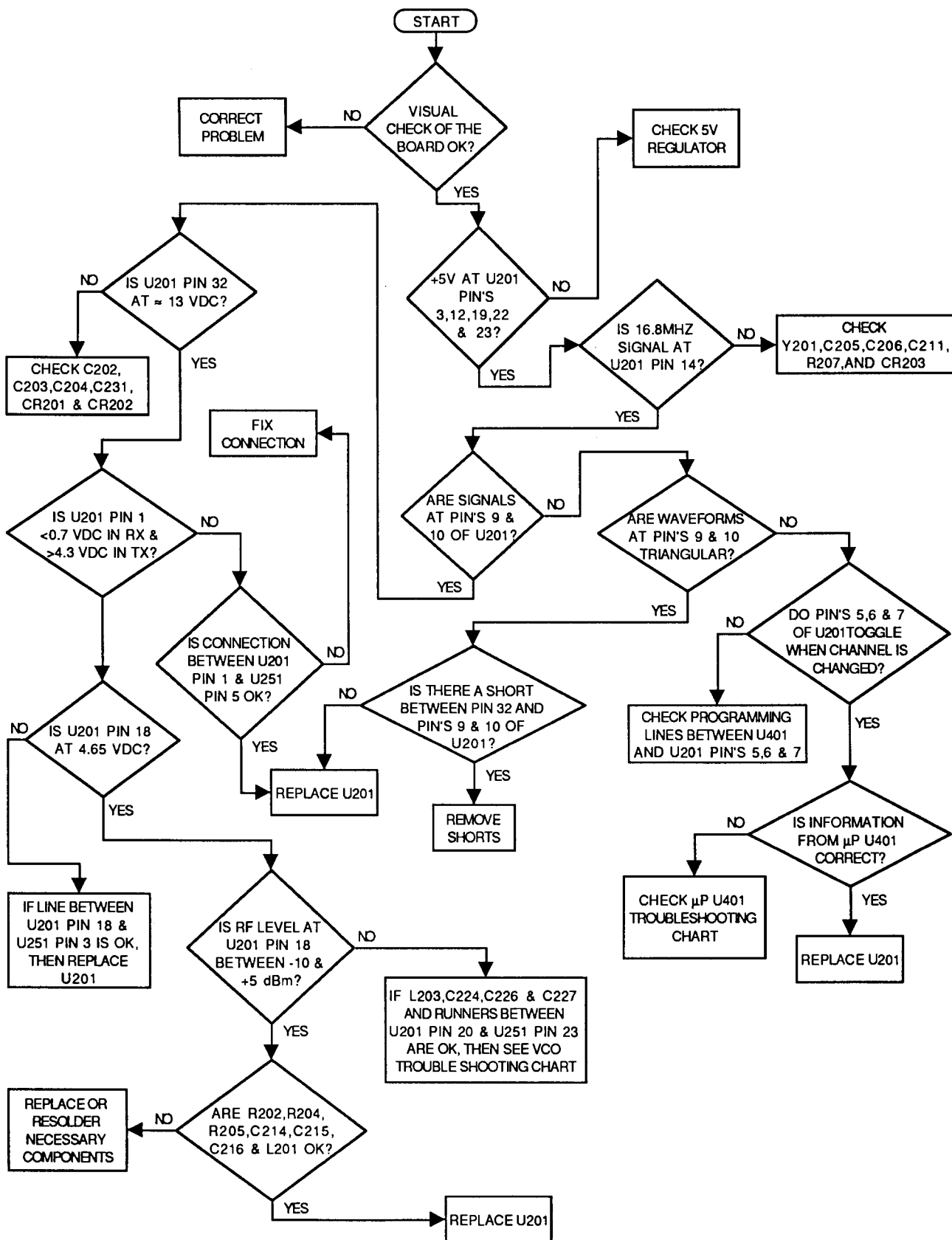
Refer to following pages.



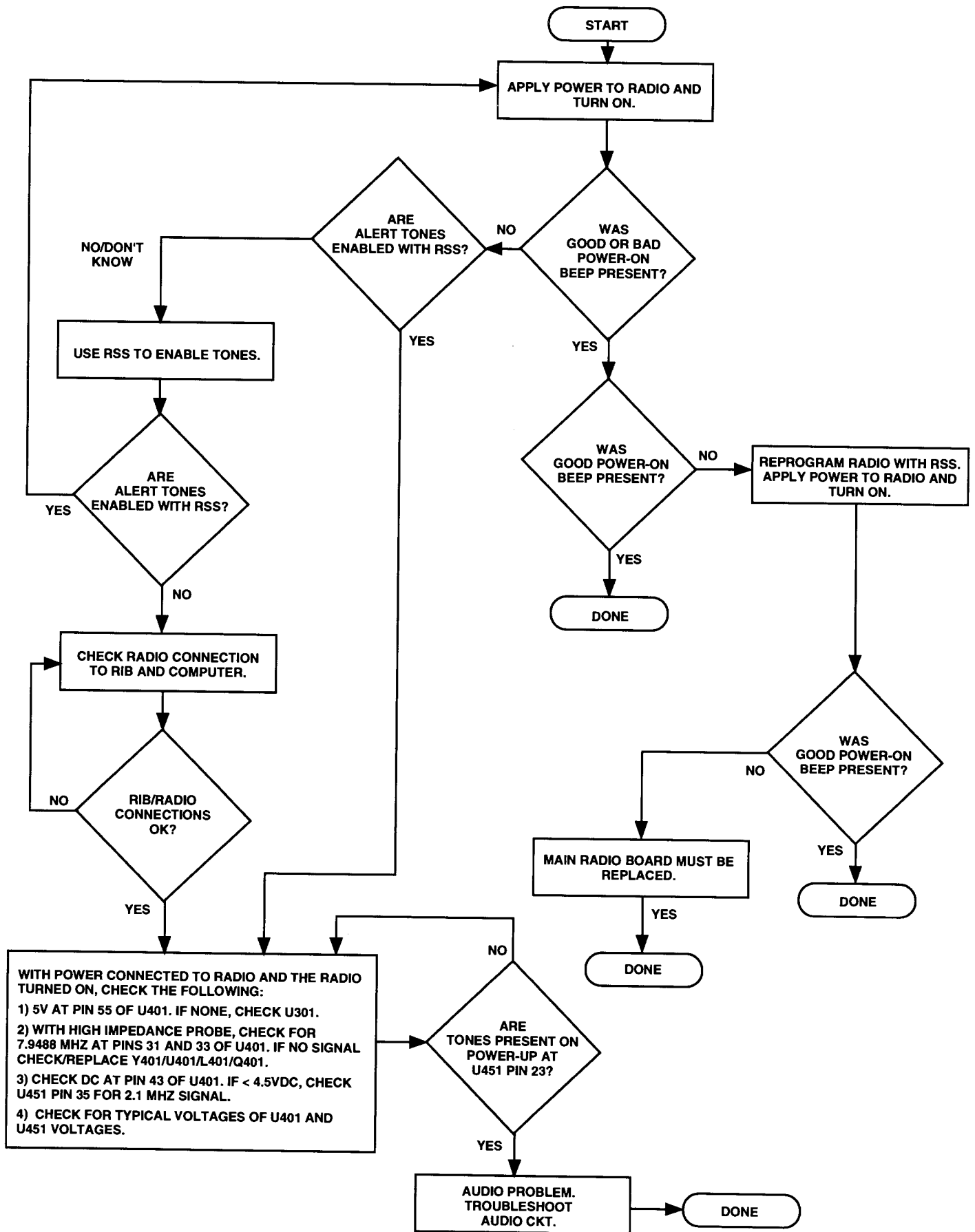
Troubleshooting Flow Chart for Receiver



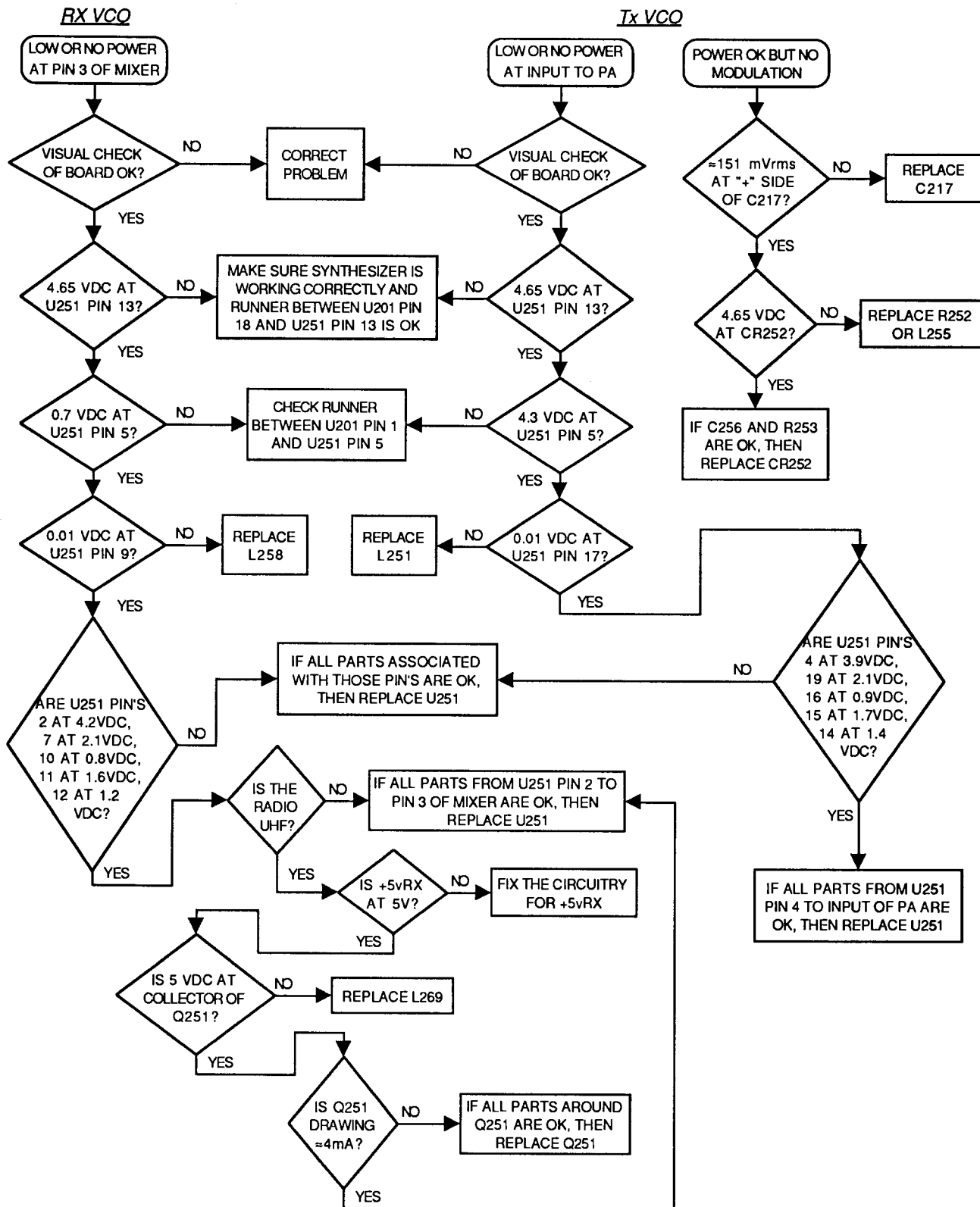
Troubleshooting Flow Chart for Transmitter



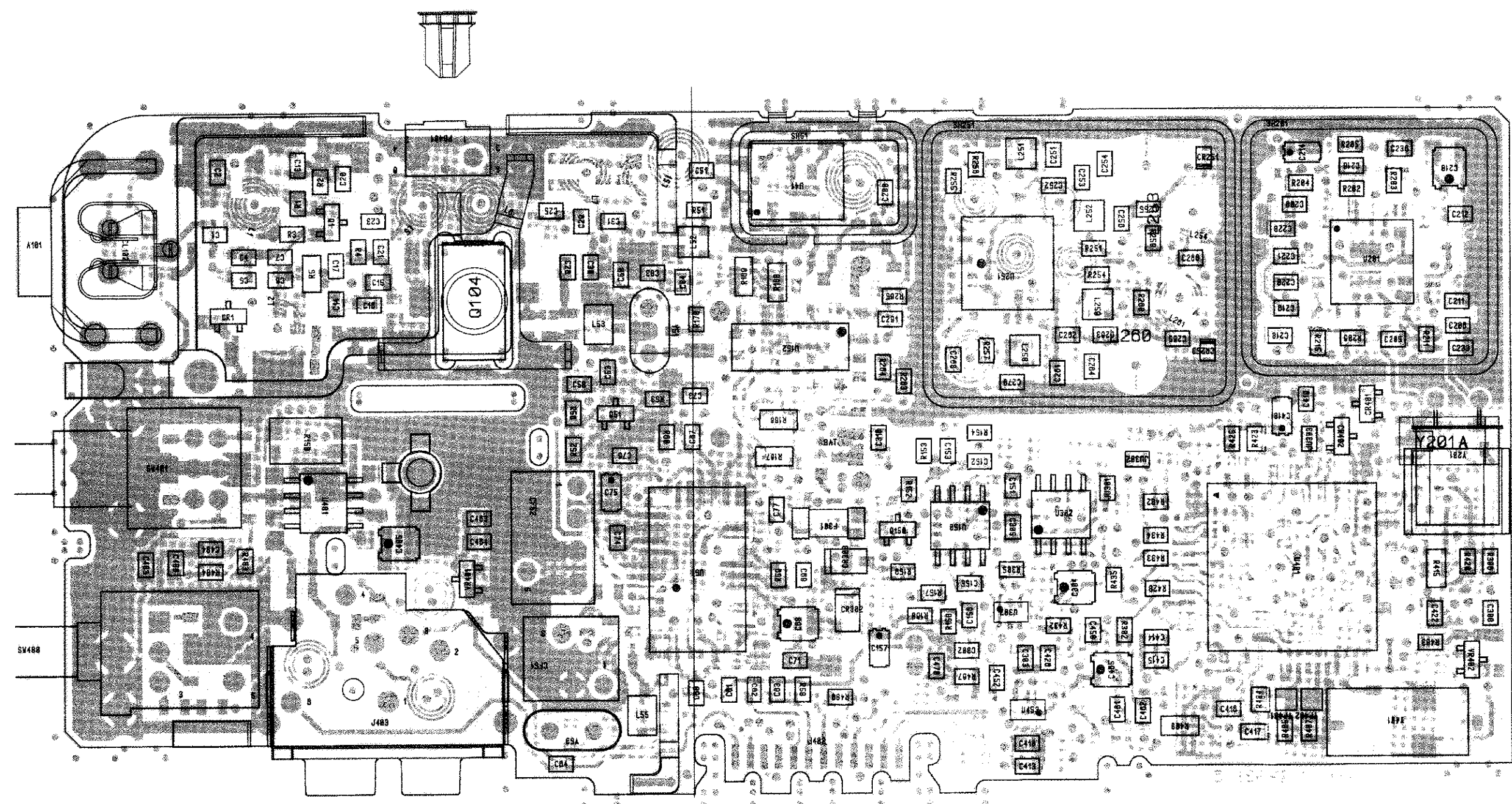
Troubleshooting Flow Chart for Synthesizer



Troubleshooting Flow Chart for Microcontroller



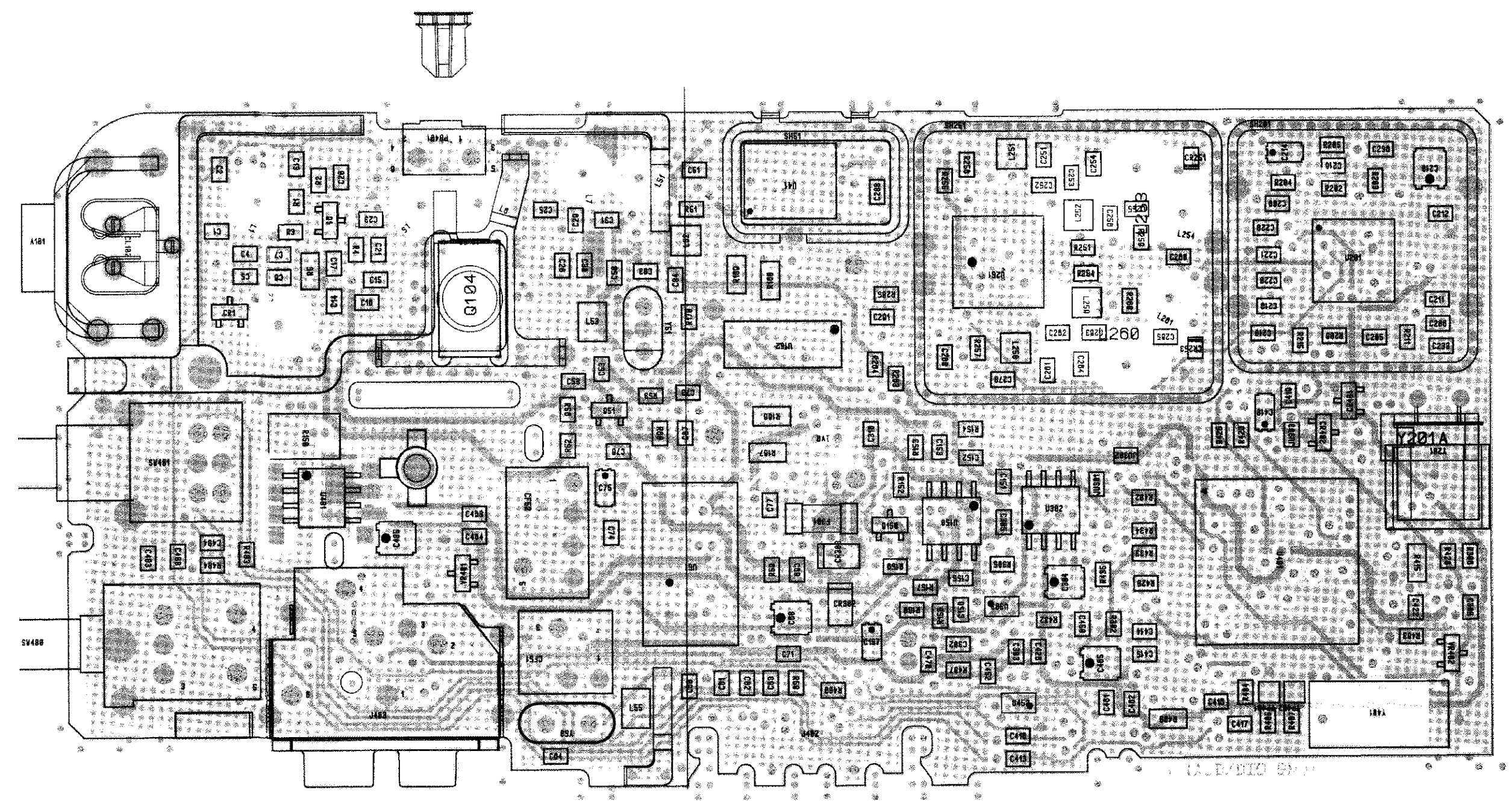
Troubleshooting Flow Chart for VCO



8480441D05 Rev-A
 Plot Date: 04/13/95 09:44:14

COMPONENT SIDE (GRAY) RCB-94137-A
 SOLDER SIDE (PINK) RCB-94142-A
 OVERLAY ----- RCB-94143-A

COMPONENT SIDE VIEW

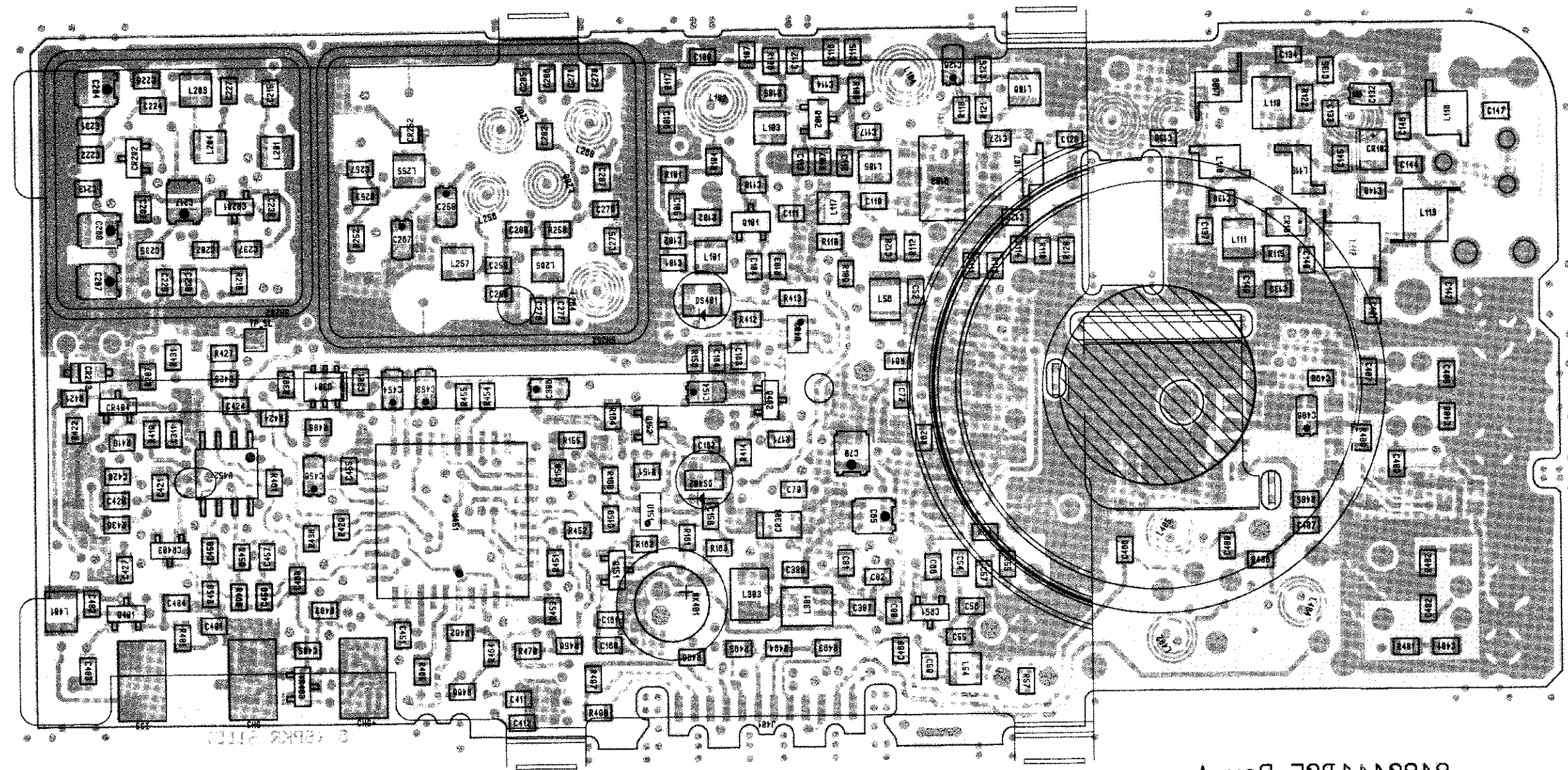


8480441D05 Rev-A
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COMPONENT SIDE INNER LAYER (GRAY) RCB-94138-A
 SOLDER SIDE INNER LAYER (PINK) RCB-94139-A
 OVERLAY ----- RCB-94143-A

COMPONENT SIDE VIEW

Circuit Board Details for HLD9000A/HLD9044A
 and HLD9003A/HLD9045A
 VHF Main Boards 150-170 MHz

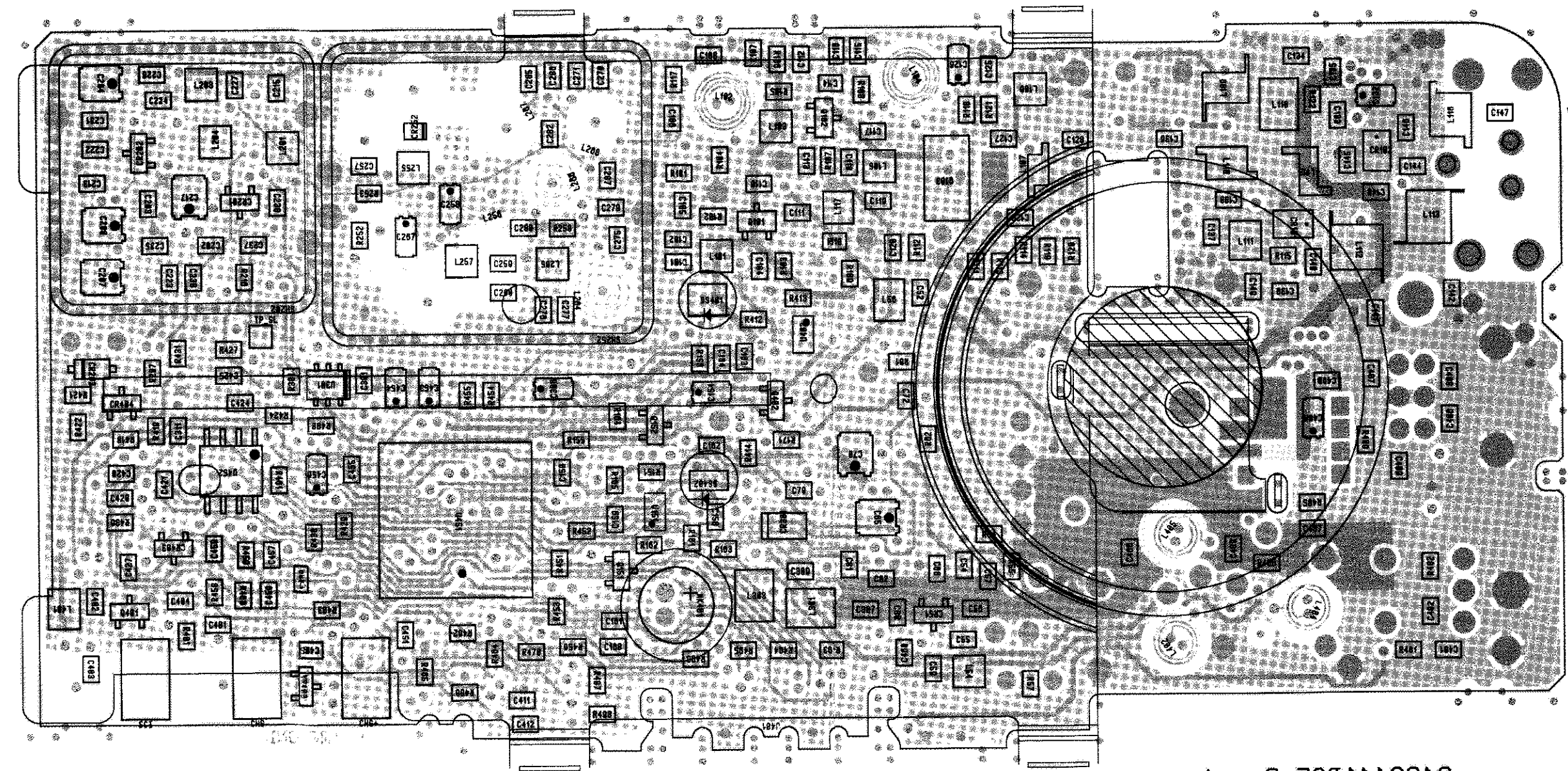


Plot Date: 04/13/92 08:44:14
8480441D02 Rev-A

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

RCB-94137-A (REV)
RCB-94142-A (REV)
RCB-94144-A (REV)

SOLDER SIDE VIEW

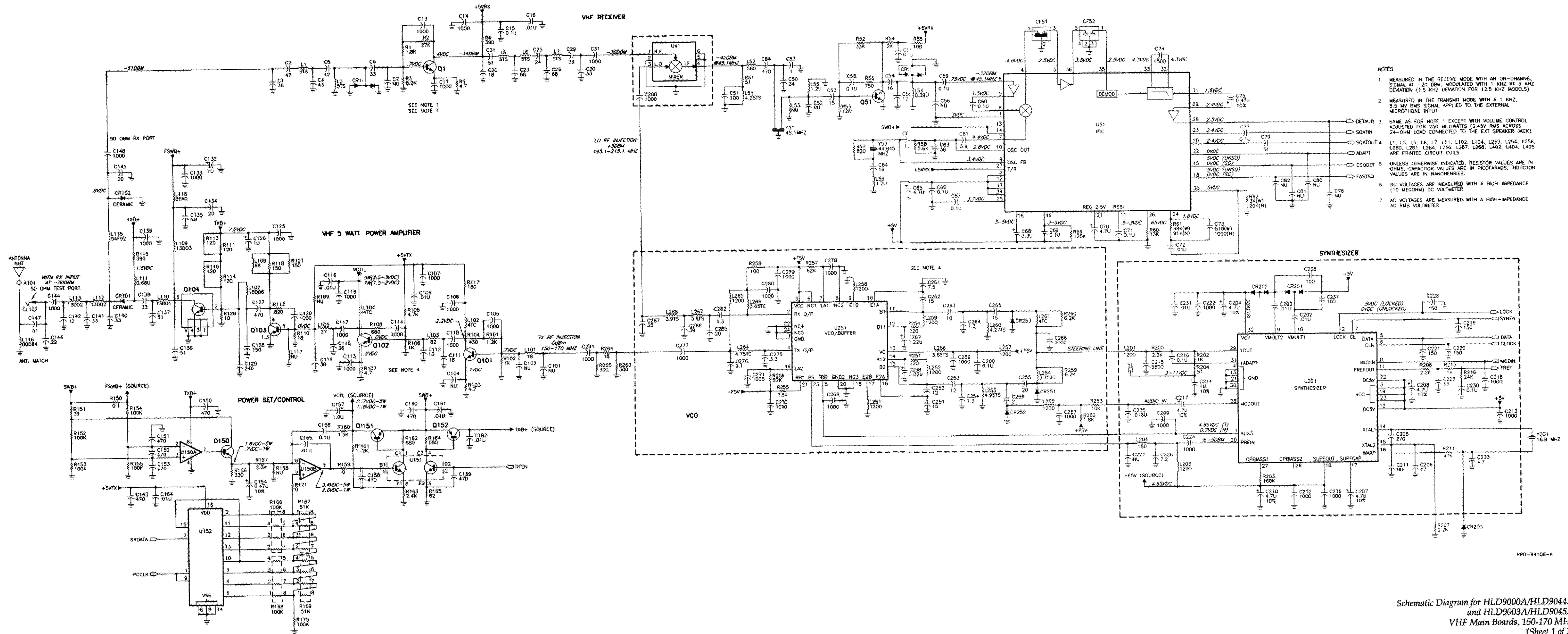


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8480441D02 Rev-A

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

RCB-94140-A (REV)
RCB-94141-A (REV)
RCB-94144-A (REV)

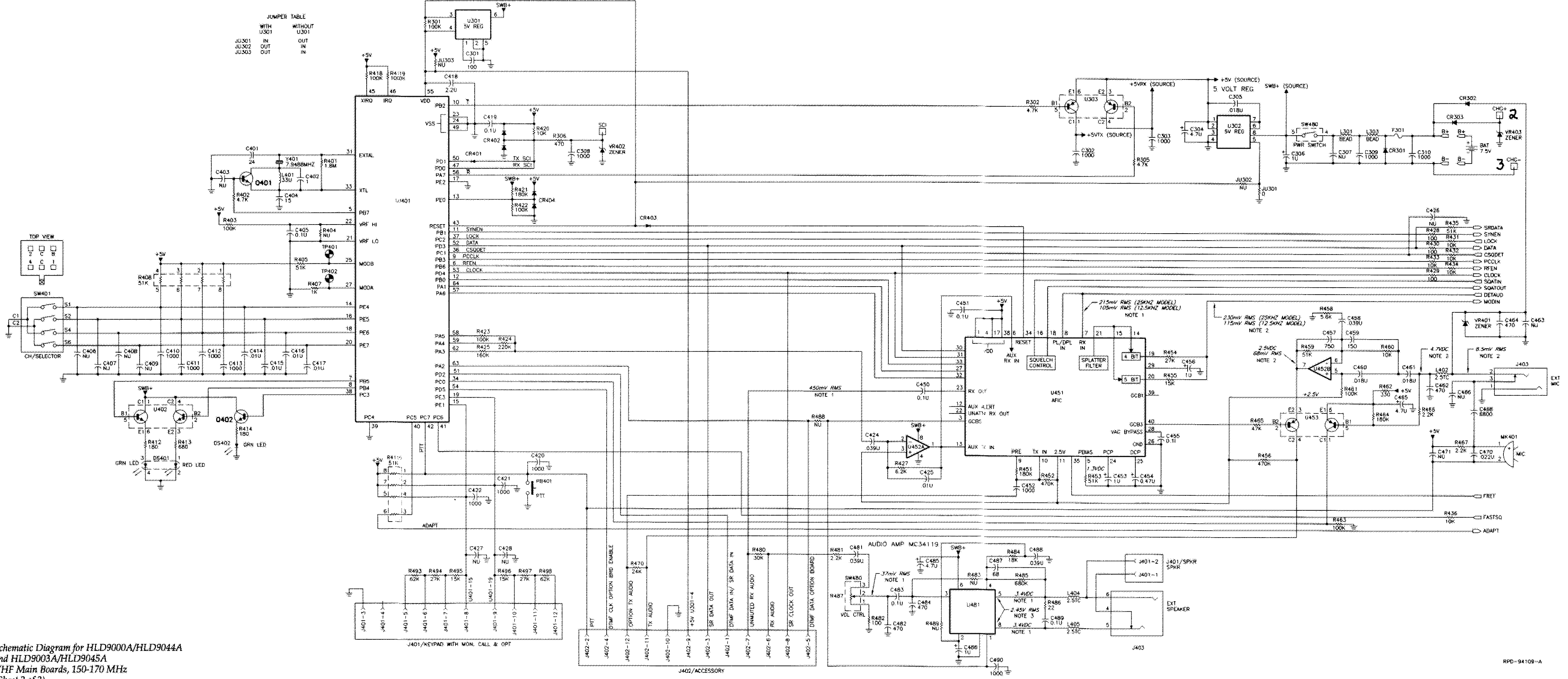
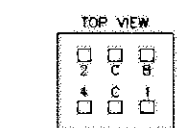
SOLDER SIDE VIEW



Schematic Diagram for HLD9000A/HLD9044A and HLD9003A/HLD9045A VHF Main Boards, 150-170 MHz (Sheet 1 of 2)

JUMPER TABLE

	WITH U301	WITHOUT U301
JU301	IN	OUT
JU302	OUT	IN
JU303	OUT	IN



Schematic Diagram for HLD9000A/HLD9044A
and HLD9003A/HLD9045A
VHF Main Boards, 150-170 MHz
(Sheet 2 of 2)

Parts List

HLD9000A/HLD9044A Main Board, 150-170 MHz, 5 W, 12.5 kHz (N)
 HLD9003A/HLD9045A Main Board, 150-170 MHz, 5 W, 20/25 kHz (W)
 PL-941006-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1T	2113740G42	capacitor, fixed: pF +/-5%; 50 V; unless otherwise stated
C2T	2113740G46	47, ±2%
C4T	2113740G44	43, ±2%
C5T	2113740G31	12, ±2%
C6T	2113740G41	33, ±1%
C7T	---	Not Used
C13T, 14T	2113740A79	1000
C15T	2113743A19	0.1 uF, ±10%; 16 V
C16T	2113741A45	.01 uF
C17T	2113740A79	1000
C20T	2113740G35	18, ±2%
C21T	2113740G48	51, ±2%
C23T	2113740G51	68, ±2%
C25T	2113740G38	24, ±2%
C26T	2113740A51	68
C29T	2113740G43	39, ±2%
C30T	2113740G41	33, ±1%
C31T	2113740A79	1000
C50T	2113740A38	24
C51T	2113740A55	100
C52B	---	Not Used
C53T	2113740A33	15
C54B	2113740A34	16
C55B	2113740A31	12
C56B	---	Not Used
C57B	2113743A19	0.1 uF, ±10%; 16 V
C58T	2113743A19	0.1 uF, ±10%; 16 V
C59B	2113743A19	0.1 uF, ±10%; 16 V
C60T	2113743A19	0.1 uF, ±10%; 16 V
C61T	2113740A17	3.9
C62T	2113740A32	13
C63T	2113740A42	36
C64T	2113740A34	16
C65B	2311049J11	4.7 uF, ±10%; 16 V
C66B	2113743A19	0.1 uF, ±10%; 16 V
C67T	2113743A19	0.1 uF, ±10%; 16 V
C68T	2311049J07	3.3 uF
C69T	2113743A19	0.1 uF, ±10%; 16 V
C70B	2311049J11	4.7 uF, ±10%; 16 V
C71T	2113743A19	0.1 uF, ±10%; 16 V
C72B	2113741A45	.01 uF
C73T(W)	2113740A72	510
C73T(N)	2113740A79	1000
C74T	2113741A25	1500
C75T	2311049A05	0.47 uF, ±10%; 25 V
C76T	---	Not Used
C77T	2113743A19	0.1 uF, ±10%; 16 V
C79T	2113740A48	51
C80B thru 82B	---	Not Used
C83T	2113740A03	1, ±0.25
C84T	2113740A65	270
C101B, 102B	---	Not Used
C104B	---	Not Used
C105B thru 107B	2113740A79	1000
C108B	2113741A45	.01 uF
C110B	2113740A79	1000
C111B	2113740A35	18
C112B	2113740A29	10
C113B thru 115B	2113740A79	1000
C116B	2113741A45	.01 uF
C117B	2113740A79	1000
C118B	2113740A42	36
C119B	2113740A40	30
C120B	2113740A79	1000
C125B	2113740A79	1000
C126B	2311049A07	1 uF, ±10%; 16 V
C127B	2113740A71	470
C128B	2113740A59	150
C129B	2113740A64	240
C132B	2311049A07	1 uF, ±10%; 16 V
C133B	2113740A79	1000
C134B	2113740A36	20
C135B	---	Not Used
C136B, 137B	2113740G48	51
C138B	2113740A41	33
C139B	2113740A79	1000
C140B, 141B	2113740A41	33
C142B	2113740A31	12
C144B	2113740A79	1000
C145B	2113740A36	20

HLD9000A/HLD9044A Main Board, 150-170 MHz, 5 W, 12.5 kHz (N)
 HLD9003A/HLD9045A Main Board, 150-170 MHz, 5 W, 20/25 kHz (W)
 PL-941006-A

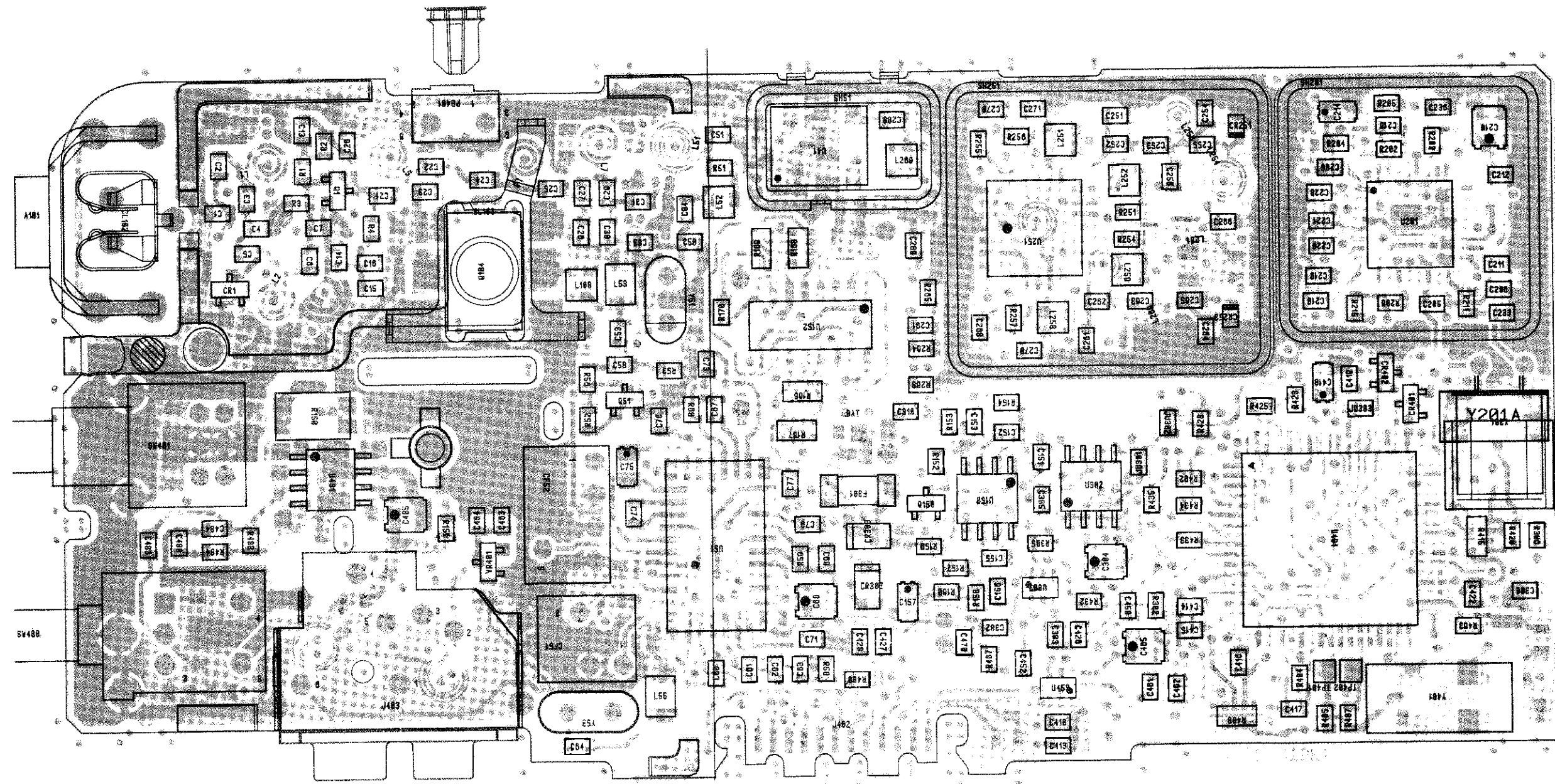
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C146B	2113740A37	22
C147B	2113740A48	51
C148B	2113740A79	1000
C150B	2113740A71	470
C151T thru 153T	2113740A71	470
C154B	2311049A05	0.47 uF, ±10%; 25 V
C155T	2113741A45	.01 uF
C156T	2113743A19	0.1 uF, ±10%; 16 V
C157T	2311049A07	1 uF, ±10%; 16 V
C158B thru 160B	2113740A71	470
C161B, 162B	2113741A45	.01 uF
C163B	2113740A71	470
C164B	2113741A45	.01 uF
C202B, 203B	2113741A45	.01 uF
C204B	2311049J11	4.7 uF, ±10%; 16 V
C205T	2113740A65	270
C206T	2113740A46	47
C207B, 208B	2311049J11	4.7 uF, ±10%; 16 V
C209T	2113740A79	1000
C210T	2311049J11	4.7 uF, ±10%; 16 V
C211T	---	Not Used
C212T	2113740A79	1000
C213B	2113740A79	1000
C214T	2311049A07	1 uF, ±10%; 16 V
C215B	2113741A45	5600
C218T	2113743A19	0.1 uF, ±10%; 16 V
C217B	2311049J11	4.7 uF, ±10%; 16 V
C218T	2113740A79	1000
C219T thru 221T	2113740A59	150
C222B	2113740A79	1000
C223B	2113740A41	33
C224B	2113740A79	1000
C226B	2113740A11	2.2, ±0.25
C227B	---	Not Used
C228T	2113740A59	150
C230B	2113743A19	0.1 uF, ±10%; 16 V
C231B	2113741A45	.01 uF
C233T	2113740G19	4.7, ±0.1
C235B	2113741A45	.018 uF
C236T	2113740A79	1000
C237B, 238B	2113740A55	100
C251T	2113740A33	15
C252T, 253T	2113740A31	12
C254T	2113740A06	1.3
C255T	2113740A36	20
C256T	2113740A10	2
C257B	2113740A79	1000
C258B	2311049A03	0.22 uF, ±10%; 35 V
C259B	2113740A79	1000
C260B	2113743A19	0.1 uF, ±10%; 16 V
C261T	2113740A25	7.5
C262T	2113740A33	15
C263T	2113740A29	10
C264T	2113740A06	1.3
C265T	2113740A33	15
C266T	2113740A79	1000
C267B	2311049A03	0.22 uF, ±10%; 35 V
C268T	2113740A79	1000
C270B, 271B	2113740A79	1000
C275B	2113740A15	3.3, ±0.25
C276B	2113740A28	9.1, ±0.25
C277B	2113740A79	1000
C278T	2113740A79	1000
C279B, 280B	2113740A79	1000
C282B	2113740A18	4.3, ±0.25
C285B	2113740A36	20
C286B	2113740A43	39
C287B	2113740A41	33
C288T	2113740A79	1000
C291T	2113740A79	1000
C301B	2113740A55	100
C302T, 303T	2113740A79	1000
C304T	2311049J11	4.7 uF, ±10%; 16 V
C305T	2113741A51	.018 uF
C306B	2311049A7	1 uF, ±10%; 16 V
C307B	---	Not Used
C308T	2113740A79	1000
C309B	2113740A79	1000
C310T	2113740A79	1000
C401B	2113740A38	24
C402B	2113740A03	1, ±0.25
C403B	---	Not Used

HLD9000A/HLD9044A Main Board, 150-170 MHz, 5 W, 12.5 kHz (N)
 HLD9003A/HLD9045A Main Board, 150-170 MHz, 5 W, 20/25 kHz (W)
 PL-941006-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C404B	2113740A33	15
C405B	2113743A19	0.1 uF, ±10%; 16 V
C406B thru 409B	---	Not Used
C410T	2113740A79	1000
C411B, 412B	2113740A79	1000
C413T	2113740A79	1000
C414T thru 417T	2113741A45	.01 uF
C418T	2311049A40	2.2 uF, ±10%; 10 V
C419T	2113743A19	0.1 uF, ±10%; 16 V
C420B, 421B	2113740A79	1000
C422T	2113740A79	1000
C424B	2113741A59	.039 uF
C425B	2113741A45	.01 uF
C426T	---	Not Used
C427B, 428B	---	Not Used
C450T	2113743A19	0.1 uF, ±10%; 16 V
C451B	2113743A19	0.1 uF, ±10%; 16 V
C452T	2113740A79	1000
C453B	2311049A07	1 uF, ±10%; 16 V
C454B	2311049A05	0.47 uF, ±10%; 25 V
C455B	2113743A19	0.1 uF, ±10%; 16 V
C456B	2311049A07	1 uF, ±10%; 16 V
C457B	2113740A76	750
C458B	2113741A59	.039 uF
C459B	2113740A59	150
C460B	2113741A51	.018 uF
C461T	2113741A51	.018 uF
C462T	2113740A71	470
C463T	---	Not Used
C464T	2113740A71	470
C465T	2311049J11	4.7 uF, ±10%; 16 V
C466B	---	Not Used
C468B	2113741A41	.022 uF
C470T	2113741A53	.039 uF
C481B	2113741A59	.022 uF
C482B	2113740A71	470
C483T	2113743A19	0.1 uF, ±10%; 16 V
C484T	2113740A71	470
C485T	2311049J11	4.7 uF, ±10%; 16 V
C486B	2311049A07	1 uF, ±10%; 16 V
C487B	2113740A51	68
C488T	2113741A59	.039 uF
C489B	2113743A19	0.1 uF, ±10%; 16 V
C490B	2113740A79	1000
CF51T(W)	9180098D06	filter, ceramic: 4-pole 455 kHz
CF51T(N)	9180098D04	4-pole 455 kHz
CF52T(W)	9180097D06	6-pole 455 kHz
CF52T(N)	9180097D04	6-pole 455 kHz
A101T	0280689C01	contacts: antenna nut
BATT	3980524D01	battery +/- charge +
CHG+B	3960165S02	charge +
CHG-B	3960185S02	charge -
CL101T	3980581D01	antenna ground
CL102T	3980532D01	50 ohm test port
CL103T	4280543D01	PA ground
CL104T	3980589D01	Tx ground
SCIB	3980165S02	serial comm interface
CR1T	4880154K03	dual Schottky
CR51B	4880154K03	dual Schottky
CR101B, 102	4880973Z02	pin
CR201B, 202	4813833C07	dual
CR203B	4805649Q04	varactor
CR210T	4862824C03	varactor
CR252B	4862824C03	varactor
CR253T	4862824C03	varactor
CR301B	4880107R01	silicon
CR302T, 303T	4880107R01	silicon
CR401T	4880939T01	diode
CR402T	4813833C07	dual 100 W
CR403B	4880939T01	diode
CR404B	4813833C07	dual
DS401B	4805729G49	light emitting diode: (see note) dual red/green
DS402B	4805729G37	red

HLD9000A/HLD9044A Main Board, 150-170 MHz, 5 W, 12.5 kHz (N)
 HLD9003A/HLD9045A Main Board, 150-170 MHz, 5 W, 20/25 kHz (W)
 PL-941006-A

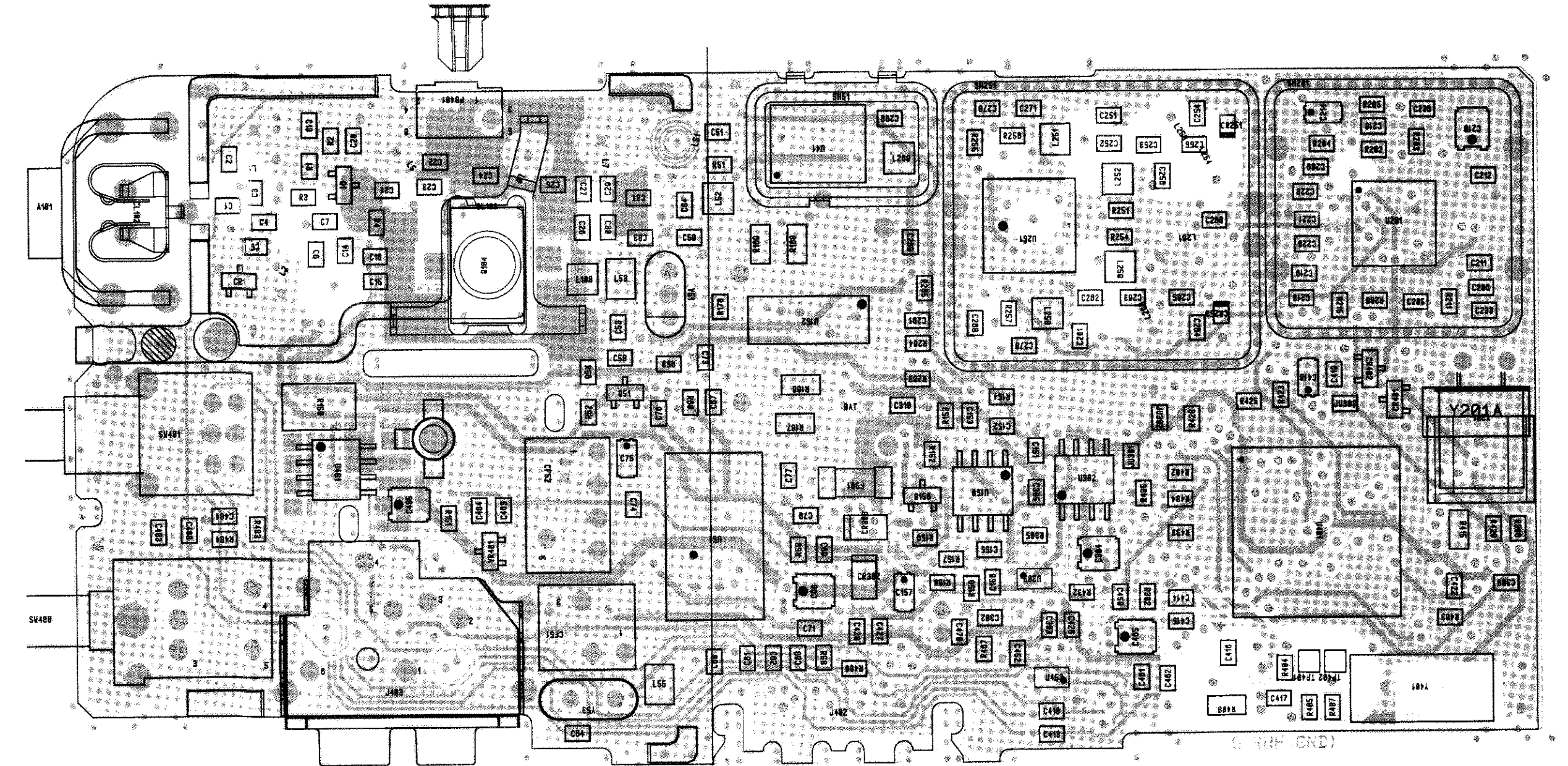
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
F301T	6580561D02	fuse: 4A
J403T	0180412D01	connector: speaker/mic, external
JU301T	0660076M01	0 ohms, ±0%; 1/8 W
JU302T	---	Not Used
JU303T	---	Not Used
L1T, 2T	---	coil, nH +/-5%: unless otherwise stated
L5T thru 7T	---	5TS spiral runner
L51T	---	4.25TS spiral runner
L52T	2462587N62	560
L53T	---	Not Used
L54B	2462587X60	390
L55T, 56T	2483411T74	1200
L101B	2462587N44	180
L102B	---	4TC spiral runner
L103B	2462587N52	82
L104B	---	4TC spiral runner
L105B	2462587N46	27
L106B	2462587N51	68
L107B	2405318D06	air wound, 2-turn
L109B	2480613D03	air wound, 5-turn
L110B	2480613D01	air wound, 3-turn
L111B	2411087B24	680
L112B, 113B	2480613D02	air wound, 7-turn
L115B	2405754F92	air wound, 6-turn
L116B	2462580D84	air wound, 5-turn
L117B	---	Not Used
L118B	2484657	



8480683C05 Rev-A
 Plot Date: 06/08/95 13:33:25

COMPONENT SIDE (GRAY) RCB-94145-A
 SOLDER SIDE (PINK) RCB-94150-A
 OVERLAY ----- RCB-94151-A

COMPONENT SIDE VIEW

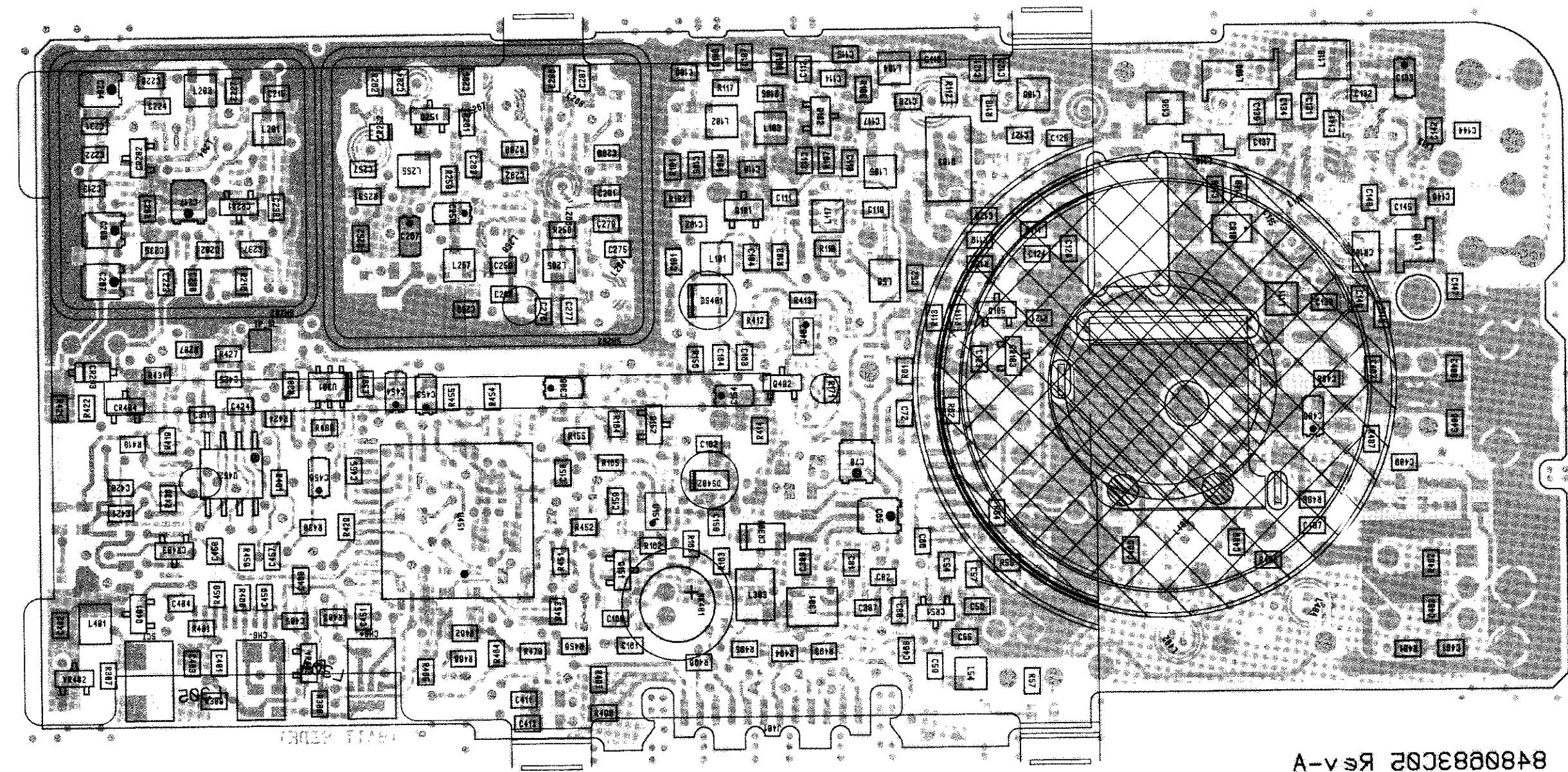


8480683C05 Rev-A
 Plot Date: 06/08/95 13:33:25

COMPONENT SIDE INNER LAYER (GRAY) RCB-94146-A
 SOLDER SIDE INNER LAYER (PINK) RCB-94147-A
 OVERLAY ----- RCB-94151-A

COMPONENT SIDE VIEW

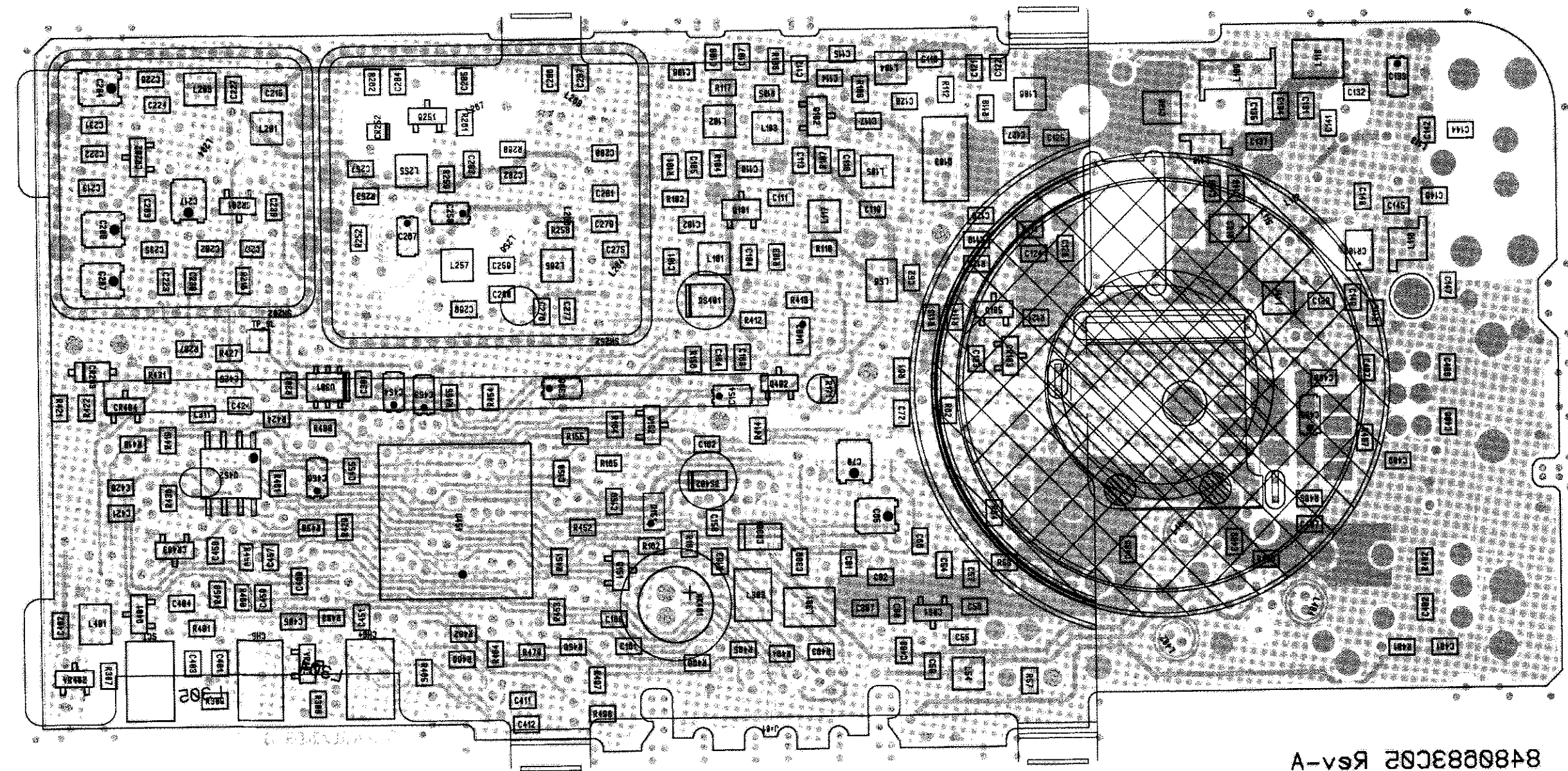
Circuit Board Details for HLE9008A/HLE9040A
 and HLE9009A/HLE9041A
 UHF Main Boards, 450-470 MHz



Plot Date: 06/08/92 13:33:52
848083C02 Rev-A

COMPONENT SIDE (GRAY) RCB-94145-A (REV)
SOLDER SIDE (PINK) RCB-94150-A (REV)
OVERLAY ----- RCB-94152-A (REV)

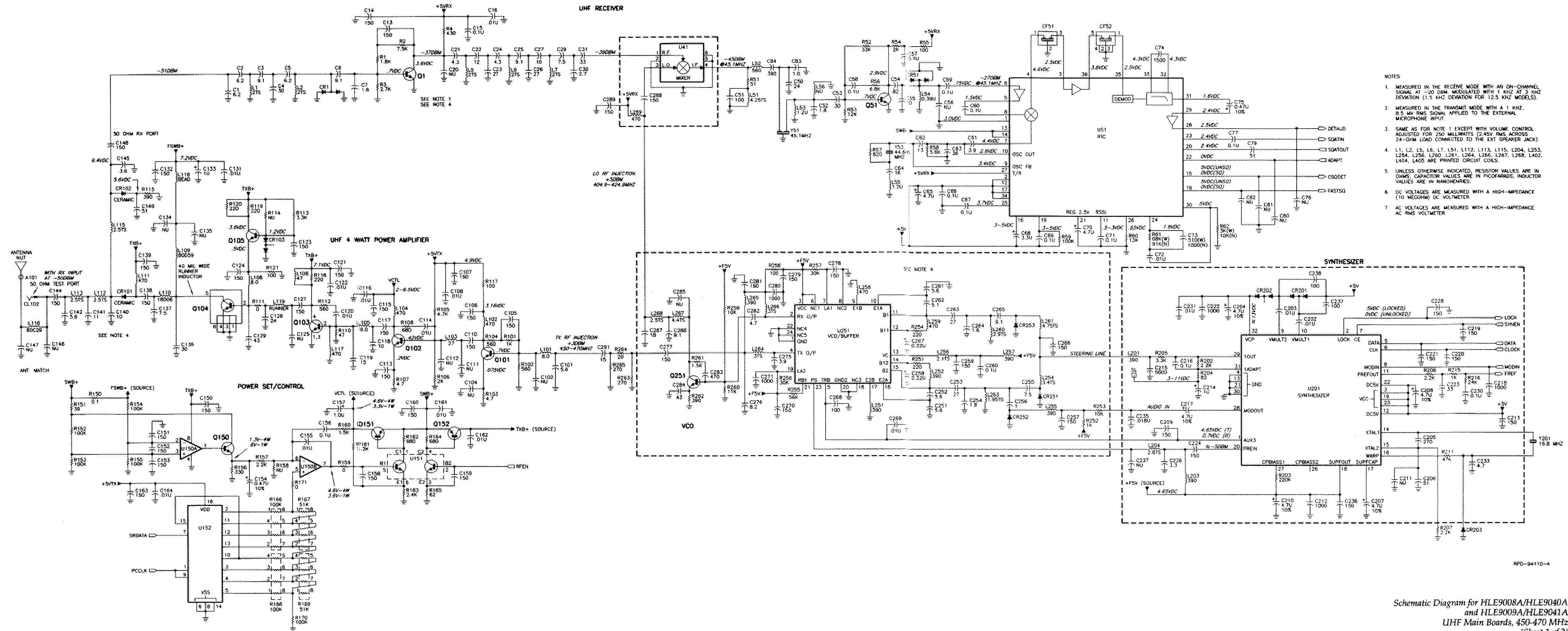
SOLDER SIDE VIEW



Plot Date: 06/08/92 13:33:52
848083C02 Rev-A

COMPONENT SIDE INNER LAYER (GRAY) RCB-94148-A (REV)
SOLDER SIDE INNER LAYER (PINK) RCB-94149-A (REV)
OVERLAY ----- RCB-94152-A (REV)

SOLDER SIDE VIEW

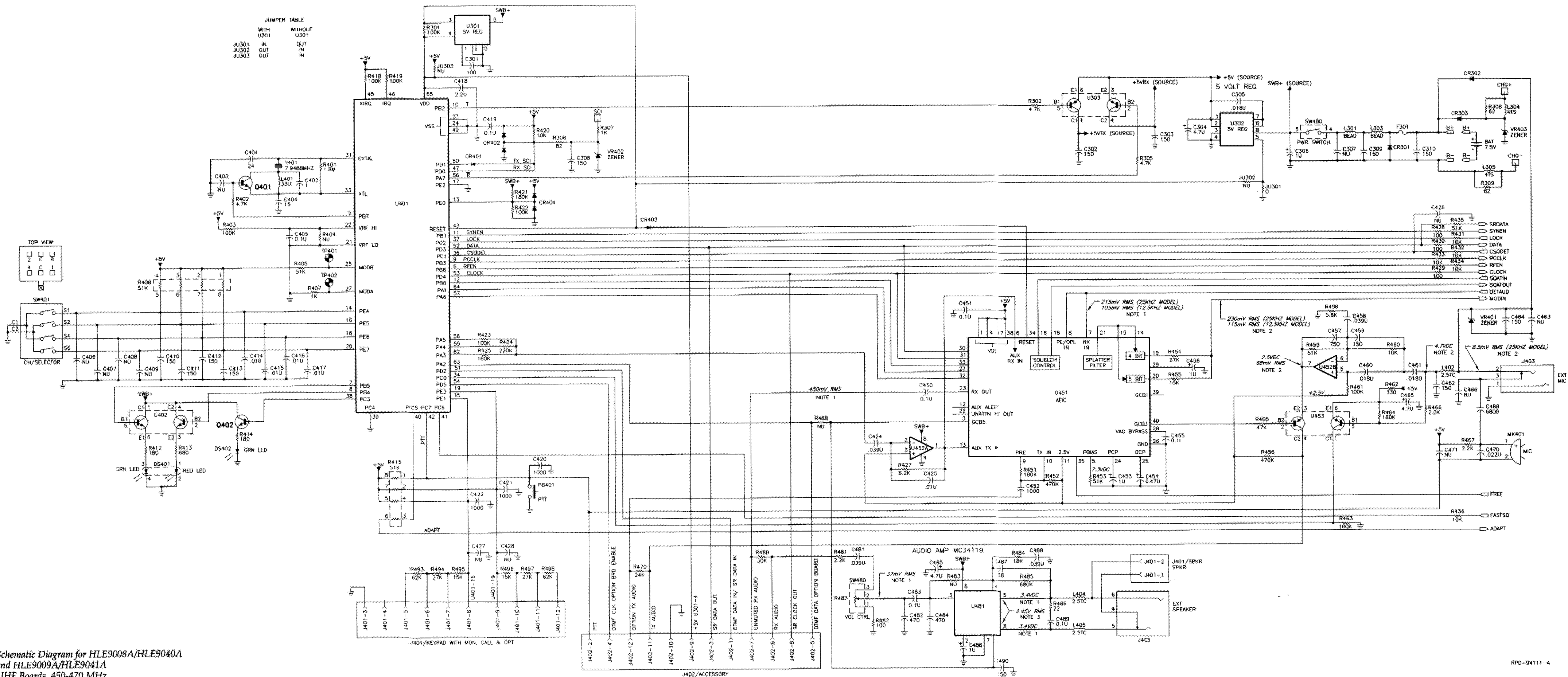


- NOTES
1. MEASURED IN THE RECEIVE MODE WITH AN ON-CHANNEL SIGNAL AT -20 DBM, MODULATED WITH 1 KHZ AT 3 KHZ DEVIATION (1.5 KHZ DEVIATION FOR 12.5 KHZ MODELS).
 2. MEASURED IN THE TRANSMIT MODE WITH A 1 KHZ, 8.5 MV RMS SIGNAL APPLIED TO THE EXTERNAL MICROPHONE INPUT.
 3. SAME AS FOR NOTE 1 EXCEPT WITH VOLUME CONTROL ADJUSTED FOR 250 MILLIWATTS (2.45V RMS ACROSS 24-OHM LOAD CONNECTED TO THE EXT SPEAKER JACK).
 4. L1, L2, L3, L6, L7, L51, L112, L113, L115, L204, L253, L254, L256, L261, L264, L266, L267, L268, L402, L404, L405 ARE PRINTED CIRCUIT COILS.
 5. UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN PICOFARADS, INDUCTOR VALUES ARE IN NANOHENRIES.
 6. DC VOLTAGES ARE MEASURED WITH A HIGH-IMPEDANCE (10 MEGOHM) DC VOLTMETER.
 7. AC VOLTAGES ARE MEASURED WITH A HIGH-IMPEDANCE AC RMS VOLTMETER.

Schematic Diagram for HLE9008A/HLE9040A and HLE9009A/HLE9041A UHF Main Boards, 450-470 MHz (Sheet 1 of 2)

JUMPER TABLE

	WITH U301	WITHOUT U301
JU301	IN	OUT
JU302	OUT	IN
JU303	OUT	IN



Schematic Diagram for HLE9008A/HLE9040A and HLE9009A/HLE9041A UHF Boards, 450-470 MHz (Sheet 2 of 2)

Parts List

HLE9008A/HLE9040A Main Board, 450-470 MHz, 4 W, 12.5 kHz (N)
 HLE9009A/HLE9041A Main Board, 450-470 MHz, 4 W, 20/25 kHz (W)
 PL-941007-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF +/-5%; 50 V: unless otherwise stated
C1T, 2T	2113740G23	6.2, ±0.1
C3T	2113740G28	9.1, ±0.1
C4T	2113740G40	30, ±2
C5T	2113740G23	6.2, ±0.1
C6T	2113740G28	9.1, ±0.1
C7T	2113740G08	1.6
C13T, 14T	2113740A59	150
C15T	2113743A19	0.1 uF
C16T	2113741A45	.01 uF
C20T	---	Not Used
C21T	2113740G18	4.3, ±0.1
C22T	2113740G31	12, ±2
C23T	2113740G39	27, ±2%
C24T	2113740G16	4.3, ±0.1
C25T	2113740G28	9.1, ±0.1
C26T	2113740G39	27, ±2%
C27T	2113740G29	10, ±0.1
C29T	2113740G25	7.5, ±0.1
C30T	2113740G13	2.7, ±0.1
C31T	2113740G41	33, ±1%
C50T	2113740A38	24
C51T	2113740A55	100
C52B	2113740A09	1.8, ±0.25
C53T	2113740A40	30
C54B	2113740A53	82
C55B	2113740A36	20
C56B	---	Not Used
C57B	2113743A19	0.1 uF, ±10%; 16 V
C58T	2113743A19	0.1 uF, ±10%; 16 V
C59B	2113743A19	0.1 uF, ±10%; 16 V
C60T	2113743A19	0.1 uF, ±10%; 16 V
C61T	2113740A17	3.9, ±0.25
C62T	2113740A32	13
C63T	2113740A42	36
C64T	2113740A34	16
C65B	2311049J11	4.7 uF, ±10%; 16 V
C66B	2113743A19	0.1 uF, ±10%; 16 V
C67T	2113743A19	0.1 uF, ±10%; 16 V
C68T	2311049J07	3.3 uF, ±10%; 20 V
C69T	2113743A19	0.1 uF, ±10%; 16 V
C70B	2311049J11	4.7 uF, ±10%; 16 V
C71T	2113743A19	0.1 uF, ±10%; 16 V
C72B	2113741A45	.01 uF
C73T(W)	2113740A72	510
C73T(N)	2113740A79	1000
C74T	2113741A25	1500
C75T	2311049A05	0.47 uF, ±10%; 25 V
C76T	---	Not Used
C77T	2113743A19	0.1 uF, ±10%; 16 V
C79T	---	Not Used
C80B thru 82B	---	Not Used
C83T	2113740A03	1, ±0.25
C84T	2113740A69	390
C101B	2113740A21	5.6, ±0.25
C102B	---	Not Used
C104B	---	Not Used
C105B thru 107B	2113740A59	150
C108B	2113741A45	.01 uF
C110B	2113740A59	150
C111B, 112B	---	Not Used
C113B	2113740A59	150
C114B	2113741A45	.01 uF
C115B	2113740A59	150
C116B	2113741A45	.01 uF
C117B	2113740A59	150
C118B	2113740A29	10
C119B	2113740A33	15
C120B	2113741A45	.01 uF
C121B	2113740A59	150
C122B	2113741A45	.01 uF
C123B, 124B	2113740A59	150
C125B	---	Not Used
C127B	2113740A59	150
C128B	2113740A38	24
C129B	2113740A44	.43
C131B	2113741A45	.01 uF
C132B	2113740A59	150
C133B	2311049A07	1 uF, ±10%; 16 V
C134B, 135B	---	Not Used
C136B	2111078B27	30, 100 V

HLE9008A/HLE9040A Main Board, 450-470 MHz, 4 W, 12.5 kHz (N)
 HLE9009A/HLE9041A Main Board, 450-470 MHz, 4 W, 20/25 kHz (W)
 PL-941007-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C137B	2113740A25	7.5, ±0.25
C138B, 139B	2113740A59	150
C140B	2113740A29	10
C141B	2113740A30	11
C142B	2113740A21	5.6, ±0.25
C144B	2113740A59	150
C145B	2113740A16	3.6, ±0.25
C146B, 147B	---	Not Used
C148B	2113740A59	150
C149B	2113740A48	51
C150B	2113740A59	150
C151T thru 153T	2113740A59	150
C154B	2311049A05	0.47 uF, ±10%; 25 V
C155T	2113741A45	.01 uF
C156T	2113743A19	0.1 uF, ±10%; 16 V
C157T	2311049A07	1.0 uF, ±10%; 16 V
C158B thru 160B	2113740A59	150
C161B, 162B	2113741A45	.01 uF
C163B	2113740A59	150
C164B	2113741A45	.01 uF
C202B, 203B	2113741A45	.01 uF
C204B	2311049J11	4.7 uF, ±10%; 16 V
C205T	2113740A59	270
C206T	2113740A48	51
C207B, 208B	2311049J11	4.7 uF, ±10%; 16 V
C209T	2113740A59	150
C210T	2311049J11	4.7 uF, ±10%; 16 V
C211T	---	Not Used
C212T	2113740A79	1000
C213B	2113740A59	150
C214T	2311049A07	1 uF, ±10%; 16 V
C215B	2113741A39	5600
C216T	2113743A19	0.1 uF, ±10%; 16 V
C217B	2311049J11	4.7 uF, ±10%; 16 V
C218T	2113740A79	1000
C219T thru 221T	2113740A59	150
C222B	2113740A79	1000
C223B	2113740A41	33
C224B	2113740A59	150
C226B	2113740A15	3.3, ±0.25
C227B	---	Not Used
C228T	2113740A59	150
C230B	2113743A19	0.1 uF, ±10%; 16 V
C231B	2113741A45	.01 uF
C235B	2113741A51	.018 uF
C236T	2113740A69	150
C237B, 238B	2113740A55	100
C251T, 252T	2113740G21	5.6, ±0.1
C253T	---	Not Used
C254T	---	Not Used
C255T	---	Not Used
C256T	2113740A03	1, ±0.1
C257B	2113740A59	150
C258B	2311049A03	0.22 uF, ±10%; 35 V
C259B	2113740A59	150
C260B	2113743A19	0.1 uF, ±10%; 16 V
C261T	2113740G21	5.6, ±0.1
C262T	2113740G20	5.1
C263T	---	Not Used
C264T	---	Not Used
C265T	---	Not Used
C266T	2113740A59	150
C267B	2311049A03	0.22 uF, ±10%; 35 V
C268T	2113740A55	100
C269B	2113741A45	.01 uF
C270T, 271T	2113740A59	150
C275B	2113740A17	3.9, ±0.25
C276B	2113740A27	8.2, ±0.25
C277B	2113740A59	150
C278T	2113740A59	150
C279B	2113740A59	150
C280B	2113740A79	1000
C281B	2113740A59	150
C282B	2113740A19	4.7, ±0.25
C283B	2113740A71	470
C284B	2113740A44	43
C285B	---	Not Used
C286B	2113740A28	9.1, ±0.25
C287B	2113740A35	18
C288T, 289T	2113740A59	150
C291T	2113740A33	15

HLE9008A/HLE9040A Main Board, 450-470 MHz, 4 W, 12.5 kHz (N)
 HLE9009A/HLE9041A Main Board, 450-470 MHz, 4 W, 20/25 kHz (W)
 PL-941007-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C301B	2113740A55	100
C302T, 303T	2113740A59	150
C304T	2311049J11	4.7 uF, ±10%; 16 V
C305T	2113741A51	.018 uF
C306B	2311049A07	1 uF, ±10%; 16 V
C307B	---	Not Used
C308T	2113740A59	150
C309B	2113740A59	150
C310T	2113740A59	150
C401B	2113740A38	24
C402B	2113740A03	1, ±0.25
C403B	---	Not Used
C404B	2113740A33	15
C405B	2113743A19	0.1 uF, ±10%; 16 V
C406B thru 409B	---	Not Used
C410T	2113740A59	150
C411B, 412B	2113740A59	150
C413T	2113740A59	150
C414T thru 417T	2113741A45	.01 uF
C418T	2311049A04	2.2 uF, ±10%; 10 V
C419T	2113743A19	0.1 uF, ±10%; 16 V
C420B, 421B	2113740A59	150
C422T	2113740A59	150
C424B	2113741A59	.039 uF
C425B	2113741A45	.01 uF
C426T thru 428T	---	Not Used
C450T	2113743A19	0.1 uF, ±10%; 16 V
C451B	2113743A19	0.1 uF, ±10%; 16 V
C452T	2113740A79	1000
C453B	2311049A07	1 uF, ±10%; 16 V
C454B	2311049A05	0.47 uF, ±10%; 25 V
C455B	2113743A19	0.1 uF, ±10%; 16 V
C456B	2113740A07	1 uF, ±10%; 16 V
C457B	2113740A76	750
C458B	2113741A59	.039 uF
C459B	2113740A59	150
C460B	2113741A51	.018 uF
C461T	2113741A51	.018 uF
C462T	2113740A59	150
C463T	---	Not Used
C464T	2113740A59	150
C465T	2311049J11	4.7 uF, ±10%; 16 V
C466B	---	Not Used
C468B	2113741A41	8900
C470T	2113741A53	.022 uF
C481B	2113741A59	.039 uF
C482B	2113740A59	150
C483T	2113743A19	0.1 uF, ±10%; 16 V
C484T	2113740A59	150
C485T	2311049J11	4.7 uF, ±10%; 16 V
C486B	2311049A07	1 uF, ±10%; 16 V
C487B	2113740A51	68
C488T	2113741A59	.039 uF
C489B	2113743A19	0.1 uF, ±10%; 16 V
C490B	2113740A59	150
CF51T(W)	9180098D06	4-Pole
CF51T(N)	9180098D04	4-Pole
CF52T(W)	9180097D06	6-Pole
CF52T(N)	9180097D04	6-Pole
A101T	0280689CD1	antenna nut
BATT	3980524D01	battery +/-
CHG+B	3980165S02	charge +
CHG-B	3980165S02	charge -
CL101T	3980581D01	antenna ground
CL102T	3980532D01	50 ohm test port
CL103T	4280543D01	PA ground
CL104T	3980589D01	Tx ground
SC1B	3980165S02	serial comm interface
CR1T	4880154K03	Dual Schottky Mixer
CR51B	4880154K03	Dual Schottky Mixer
CR101B, 102B	4880973Z02	pin
CR103B	4813833C07	Dual 100 W
CR201B, 202B	4813833C07	Dual 100 W
CR203B	4805649Q04	varactor
CR251T	4862824C01	varactor
CR252B	4862824C01	varactor

HLE9008A/HLE9040A Main Board, 450-470 MHz, 4 W, 12.5 kHz (N)
 HLE9009A/HLE9041A Main Board, 450-470 MHz, 4 W, 20/25 kHz (W)
 PL-941007-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR253T	4862824C01	varactor
CR301B	4880107R01	silicon
CR302T, 303T	4880107R01	silicon
CR401T	4880939T01	diode
CR402T	4813833C07	dual
CR403B	4880939T01	Schottky diode
CR404B	4813833C07	dual 100 W
DS401B	4805729G49	red/yellow
DS402B	4805729G37	green
F301T	---	fuse: 4A
J403T	---	connector: jumper:
JU251B	0611077A01	0 ohm, ±5%, 0 W
JU301T	0660076M01	0
JU302T, 303T	---	Not Used
L1T, 2T	---	2TS spiral runner
L5T thru 7T	---	2TS spiral runner
L51T	---	4.25TS spiral runner
L52T	2462587N62	560
L53T	---	Not Used
L54B	2462587X60	390
L55T	2483411T74	1200
L56B	2483411T74	1200
L101B	2462587X40	8.2
L102B	2462587X61	470
L103B	2462587X46	27
L104B		

Parts List

SP50 Basic Exploded View, Standard & Compact

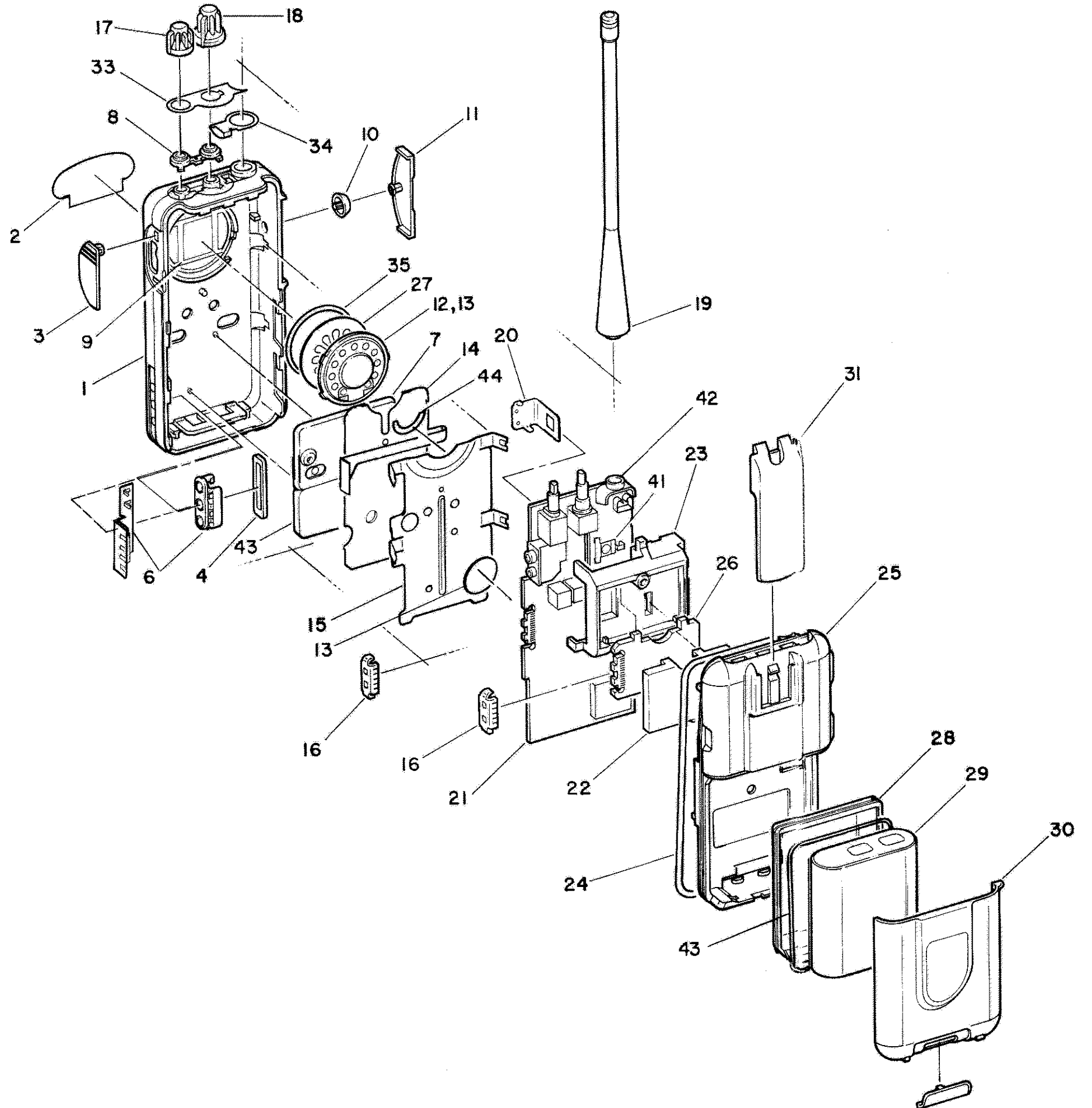
PL-941041-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1580421D03 1580423D03*	HOUSING, Compact HOUSING, Standard
2	1380416D03	ESCUTCHEON, nameplate
3	3880430D01	DUST CAP
4	0780414D01	SUPPORT, charging contacts, Compact
6	0180605D01 0180621D02	ASSY, charging contact, Compact ASSY, charging contact, Standard
7	7580511D01	KEYPAD
8	3280511D01	SEAL, control shaft
9	3580539D01	FELT, speaker
10	3880502C04	ACTUATOR, PTT
11	4580434D01	LEVER, PTT
12	5005256W01	SPEAKER
13	7580418D01	PAD, speaker; 3 used, Compact 4 used, Standard
14	0180100D01	PCB, flex
15	0780415D02	SUPPORT, flex/speaker
16	4280433D01	CLIP, flex connector
17	3680583B01	KNOB, volume 1.70
18	3680431D03 3680431D02 3680431D01	KNOB, frequency 10-channel 1.70 KNOB, frequency 6-channel 1.70 KNOB, frequency 2-channel 1.70
19	--	ANTENNA (see accessories)
20	4280578D01	CLIP, PA chassis
21	--	PCB, main board (see model charts)
22	--	SHIELD, option board
23	2780671D01	CHASSIS
24	3280545C01 3280545C02	O-RING, gasket, Compact O-RING, gasket, Standard
25	1580420D01 1580571D01	COVER, back, Compact COVER, back, Standard
26	--	PCB, option board
27	0080537D01	DISC, speaker
28	0180610B01 0180610D01	FRAME, battery, Compact FRAME, battery, Standard
29	--	BATTERY (see accessories)
30	0180415E03 0180415E04	ASSY, battery latch cover, Compact ASSY, battery latch cover, Standard
31	--	CLIP, belt (see accessories)
33	1380512D03 1380512D02 1380512D01	ESCUTCHEON, top plate, 10-channel .37 ESCUTCHEON, top plate, 6-channel .37 ESCUTCHEON, top plate, 2-channel .37
34	0080511D01	CONTACT, rt ground
35	7580538D01	RING, speaker
41	4280543D01	CLIP, PA ground (must be discarded & replaced when repairing Q104)
42	0280689C01	NUT, antenna
43	3280612D03 3205082E67	O-RING, battery frame, Compact O-RING, battery frame, Standard
44	1480541D01	PAD, speaker support

non-referenced items

2680505E01 TAPE, aluminum, Standard UHF

*If older standard housing (D01) is being replaced with D03, the D02 charging contact assembly must be used.



Standard and Compact Radio
Exploded Mechanical View
and Parts List
(Basic)

Parts List

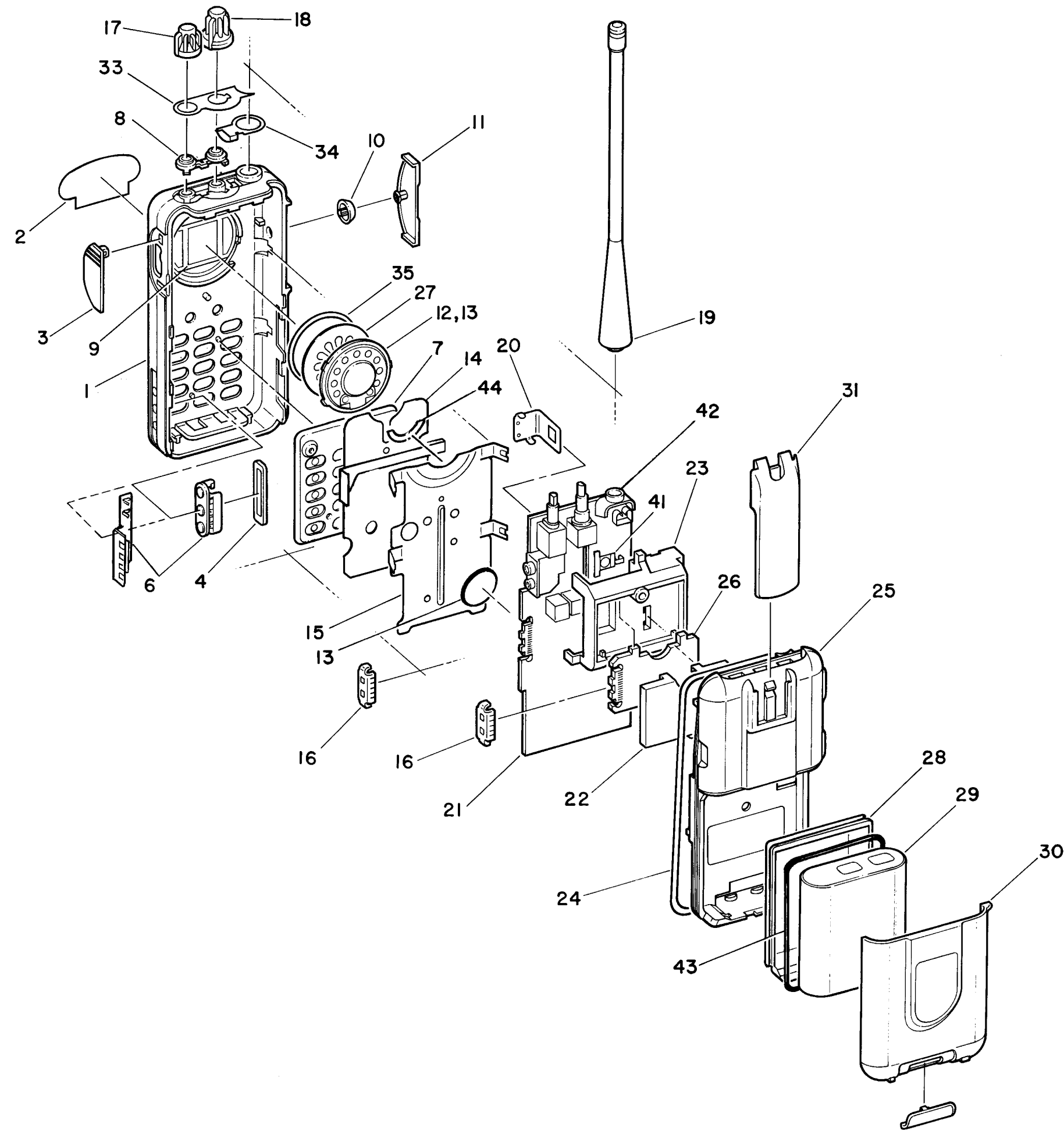
SP50 DTMF Encode Exploded View, Standard & Compact PL-941040-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1580421D04 1580423D04*	HOUSING, Compact HOUSING, Standard
2	1380416D03	ESCUTCHEON, nameplate
3	3880430D01	DUST CAP
4	0780414D01	SUPPORT, charging contacts, Compact
6	0180605D01 0180621D02	ASSY, charging contact, Compact ASSY, charging contact, Standard
7	7300407D00	KEYPAD
8	3280511D01	SEAL, control shaft
9	3580539D01	FELT, speaker
10	3880502C04	ACTUATOR, PTT
11	4580434D01	LEVER, PTT
12	5005256W01	SPEAKER
13	7580418D01	PAD, speaker; 3 used, Compact 4 used, Standard
14	8480438D04	PCB, flex
15	0780415D02	SUPPORT, flex/speaker
16	4280433D01	CLIP, flex connector
17	3680583B01	KNOB, volume
18	3680431D03 3680431D02 3680431D01	KNOB, frequency 10-channel KNOB, frequency 6-channel KNOB, frequency 2-channel
19	--	ANTENNA (see accessories)
20	4280578D01	CLIP, PA chassis
21	--	PCB, main board (see model charts)
22	--	SHIELD, option board
23	2780671D01	CHASSIS
24	3280545C01 3280545C02	O-RING, gasket, Compact O-RING, gasket, Standard
25	1580420D01 1580571D01	COVER, back, Compact COVER, back, Standard
26	--	PCB, option board
27	2000007D04	DISC, speaker
28	0180616D01	FRAME, battery, Compact
29	0180600D01	FRAME, battery, Standard
30	--	BATTERY (see accessories)
31	0180415E03 0180415E04	ASSY, battery latch cover, Compact ASSY, battery latch cover, Standard
33	1380512D03 1380512D02 1380512D01	CLIP, belt (see accessories) ESCUTCHEON, top plate, 10-channel ESCUTCHEON, top plate, 6-channel ESCUTCHEON, top plate, 2-channel
34	0000041D00	CONTACT, rf ground
35	7580538D01	RING, speaker
41	4280543D01	CLIP, PA ground (must be discarded & replaced when repairing Q104)
42	0280689C01	NUT, antenna
43	3280612D03 3205082E67	O-RING, battery frame, Compact O-RING, battery frame, Standard
44	1480541D01	PAD, speaker support

non-referenced items

~~2000000E04~~ TAPE, aluminum, Standard UHF

*If older standard housing (D02) is being replaced with D04, the D02 charging contact assembly must be used.



SP50+ HOUSING KIT HHN9208A
54.19

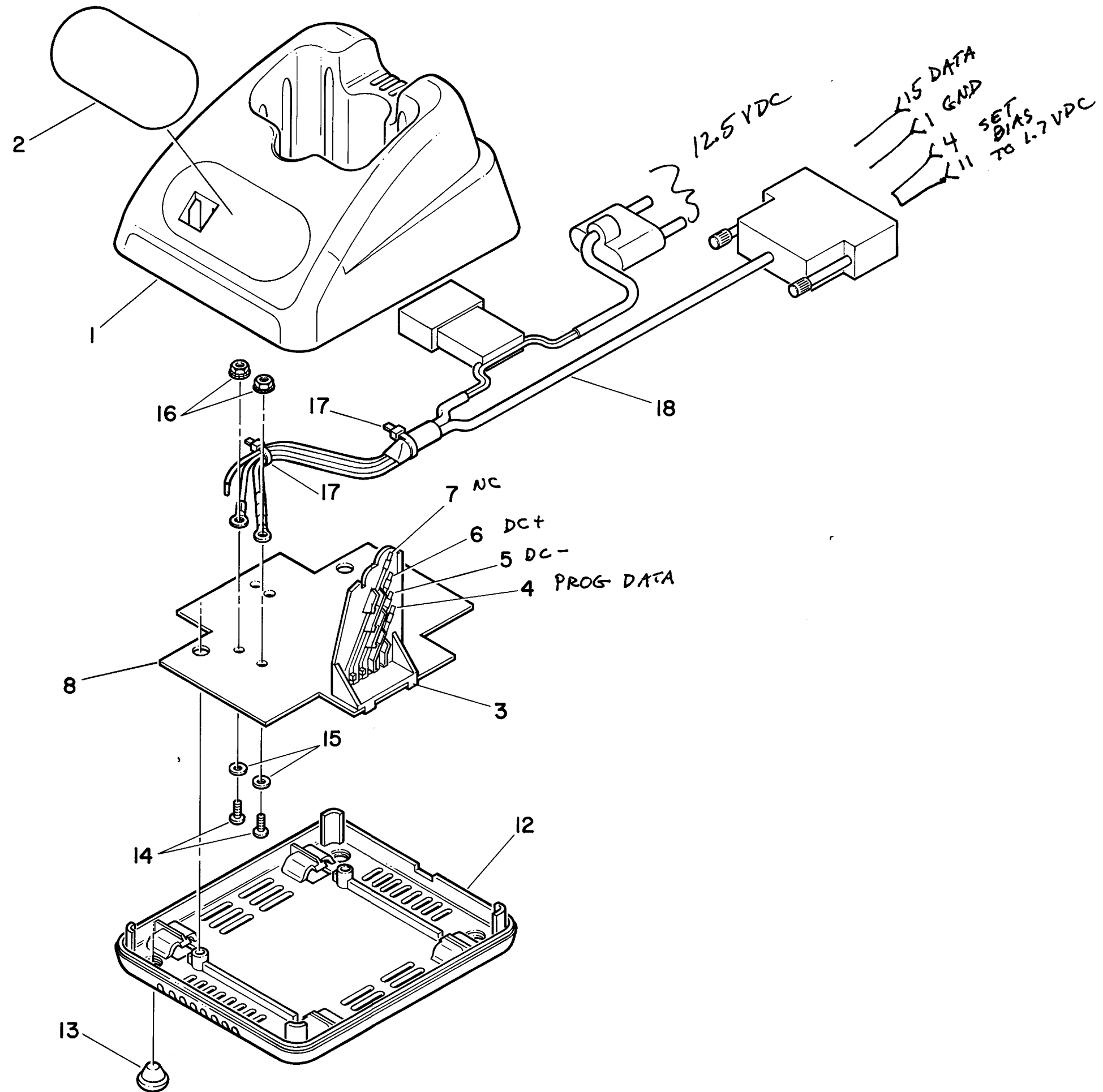
SP50/50+ TALL/SHORT NO DTMF
COSMETIC KIT REX4671A 37.84

Standard and Compact Radio
Exploded Mechanical View
and Parts List
(DTMF Encode)

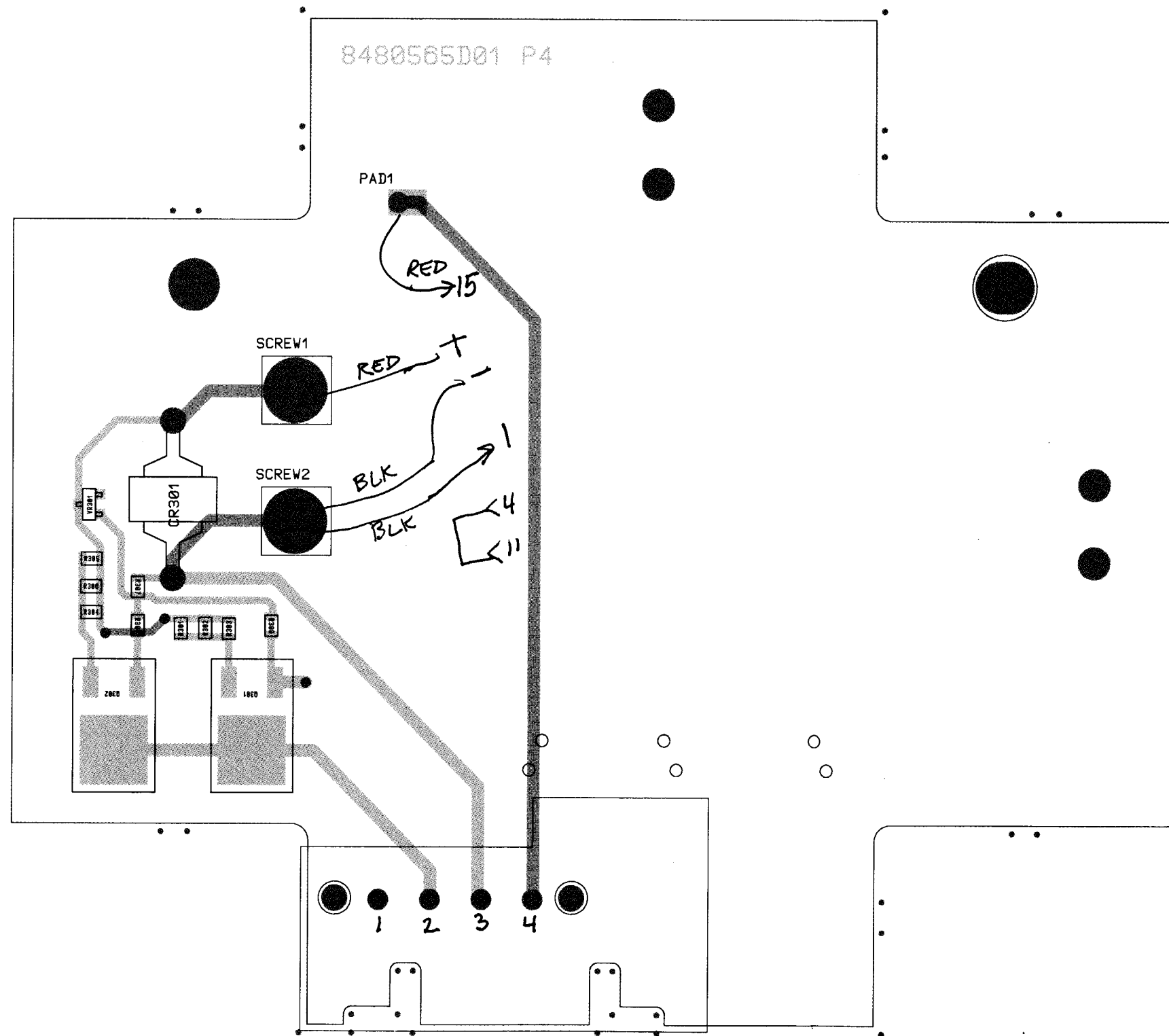
Parts List *HLN9102A*

SP50 Programming Stand, mechanical PL-941038-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1580551D02	HOUSING, programming stand
2	1380555D03	ESCUTCHEON, programming stand
3	3180554D01	HEADER, charger
4	3980553D04	CONTACT, radio position 4
5	3880553D03	CONTACT, radio position 3
6	3880553D02	CONTACT, radio position 2
7	3880553D01	CONTACT, radio position 1
8	0180707Y61	PCBA, programming stand
12	6480951Z01	BASE, charger
13	7580530C01	FEET, charger; 4 used
14	--	SCREW, 4-40 x 0.38, Phillips; 2 used
15	--	WASHER, flat #4; 2 used
16	--	NUT, kep, 4-40; 2 used
17	--	CABLE, tie 3"; 2 used
18	--	CABLE, assembly



Programming Stand
Exploded View and Parts List



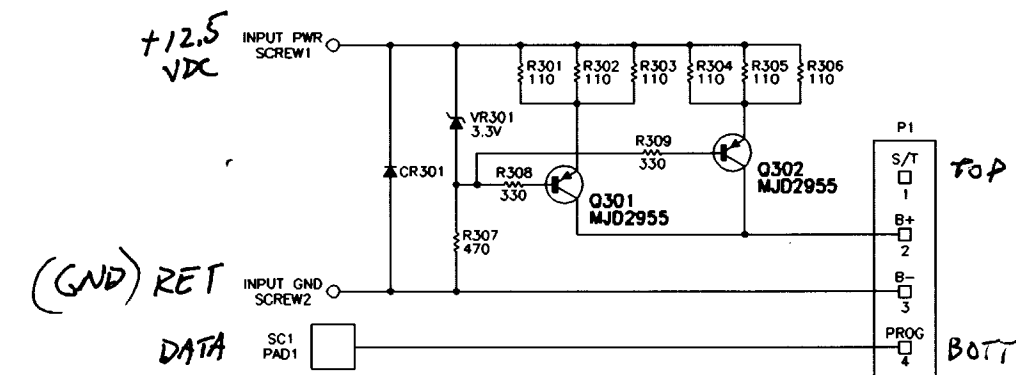
COMPONENT SIDE (GRAY) RCB-94128-O
 SOLDER SIDE (PINK) RCB-94129-O
 OVERLAY ----- RCB-94130-O

COMPONENT SIDE VIEW

Parts List HLN9102A

SP50 Programming Stand, Electrical PL-941037-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R301 thru 306	0660076A26	resistor, fixed: 110
R307	0660076A41	470
R308, 309	0660076A37	330
CR301	4880236E07	diode: Avalanche diode
Q301, 302	4813822A10	transistor: Power PNP
VR301	4813830A09	voltage regulator: Zener, 3.3 V



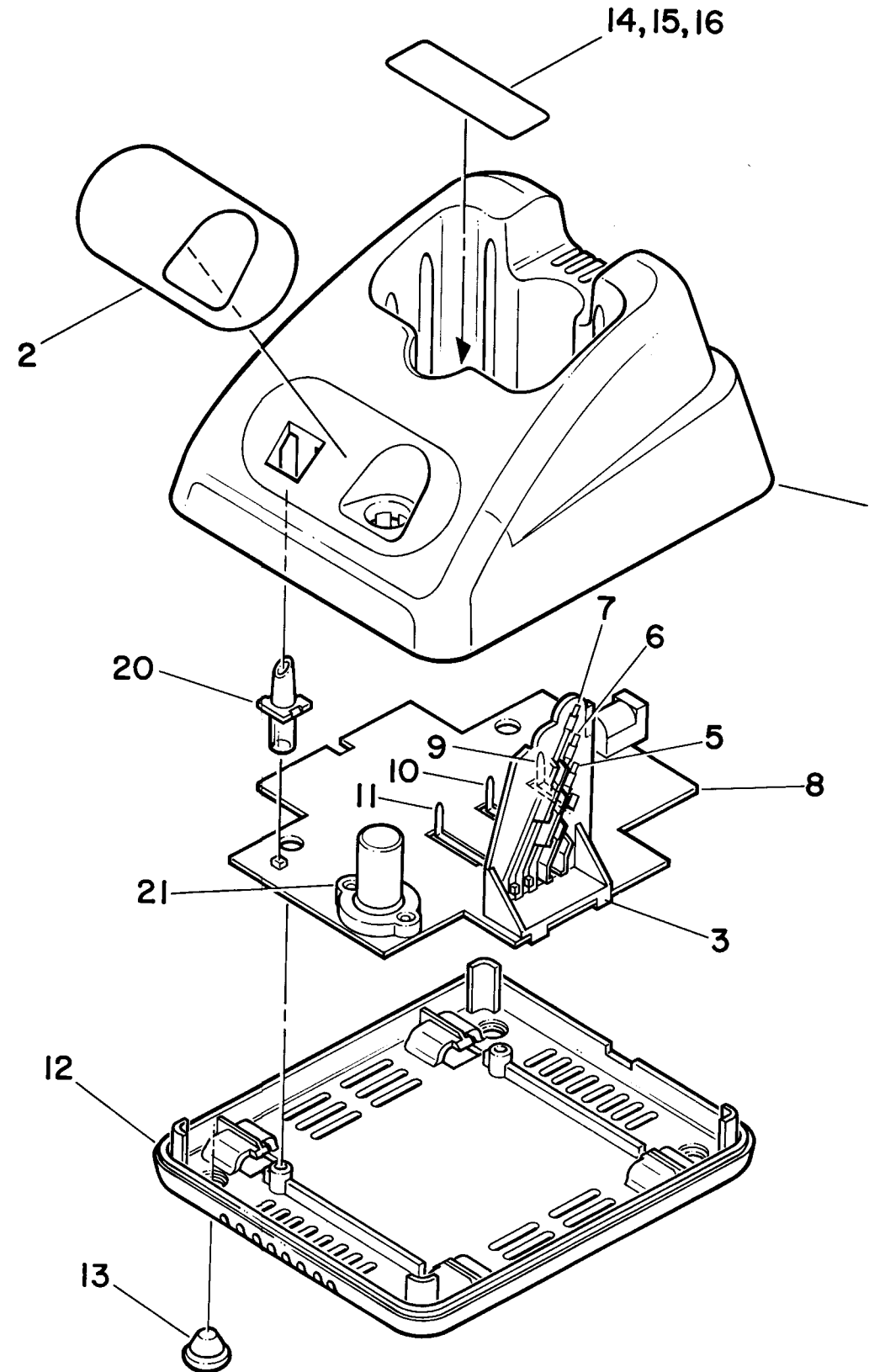
RPD-94126-0

Programming Stand
 Circuit Board, Schematic Diagram
 and Parts List

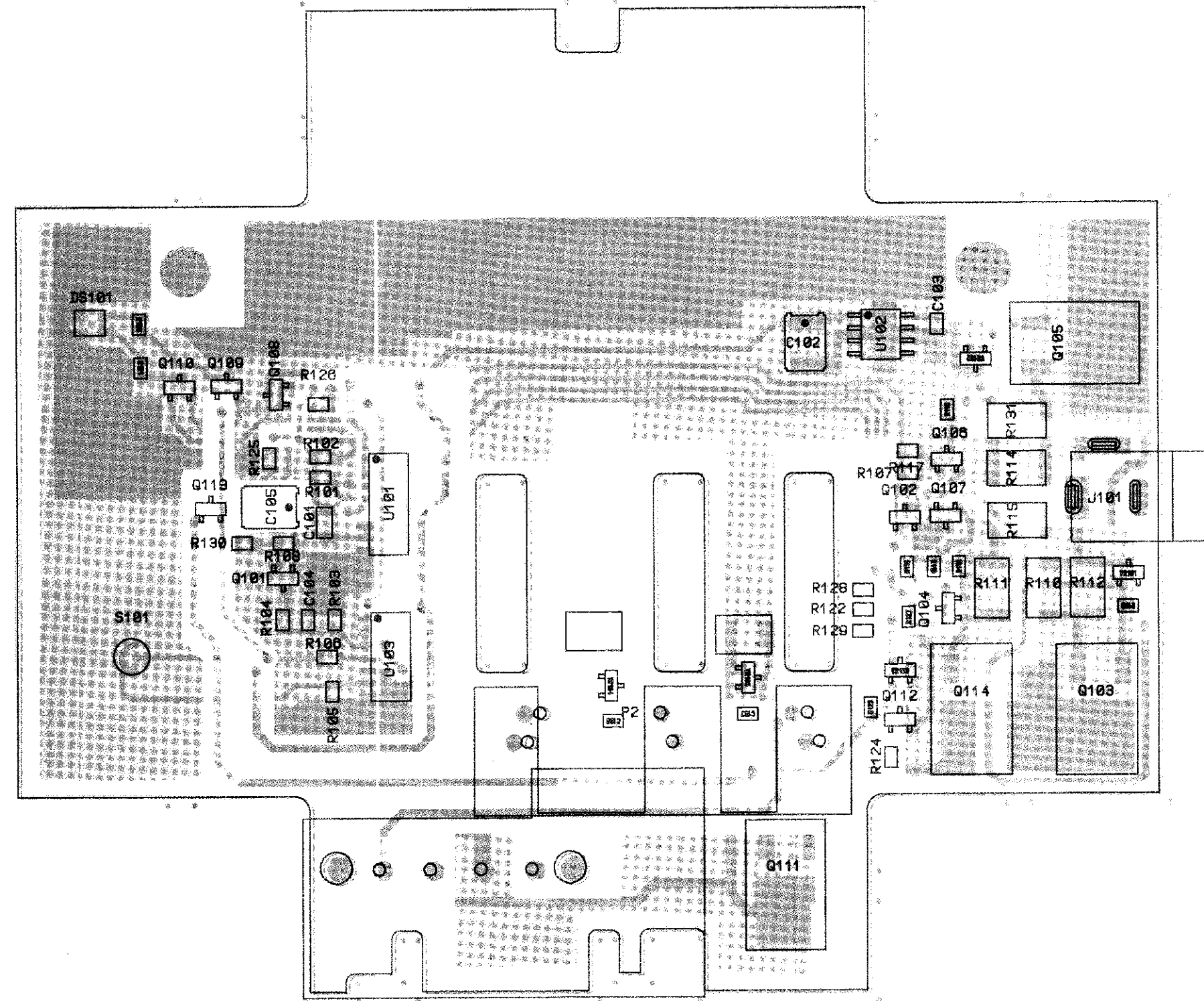
Parts List

SP50 3 Hour (Rapid Rate) Battery Charger, mechanical PL-941032-O

REFERENCE DESIGNATOR	MOTOROLA PART NO.	DESCRIPTION
1	1580551D01	HOUSING, rapid rate charger
2	1380555D02	ESCUTCHEON, rapid rate charger
3	3180554D01	HEADER, charger
5	3980553D03	CONTACT, radio position 3
6	3980553D02	CONTACT, radio position 2
7	3980553D01	CONTACT, radio position 1
8	0180707Y59	PCBA, rapid rate charger
9	3980552D03	CONTACT, battery position 3
10	3980552D02	CONTACT, battery position 2
11	3980552D01	CONTACT, battery position 1
12	6480951Z01	BASE, charger
13	7580530C01	FEET, charger; 4 used
14	3380609D04	LABEL, charger, 230 V
15	3380609D01	LABEL, charger, 120 V
16	3380609D06	LABEL, charger, 240 V
20	6180996Z01	LIGHT PIPE
21	3880556D01	PUSHBUTTON

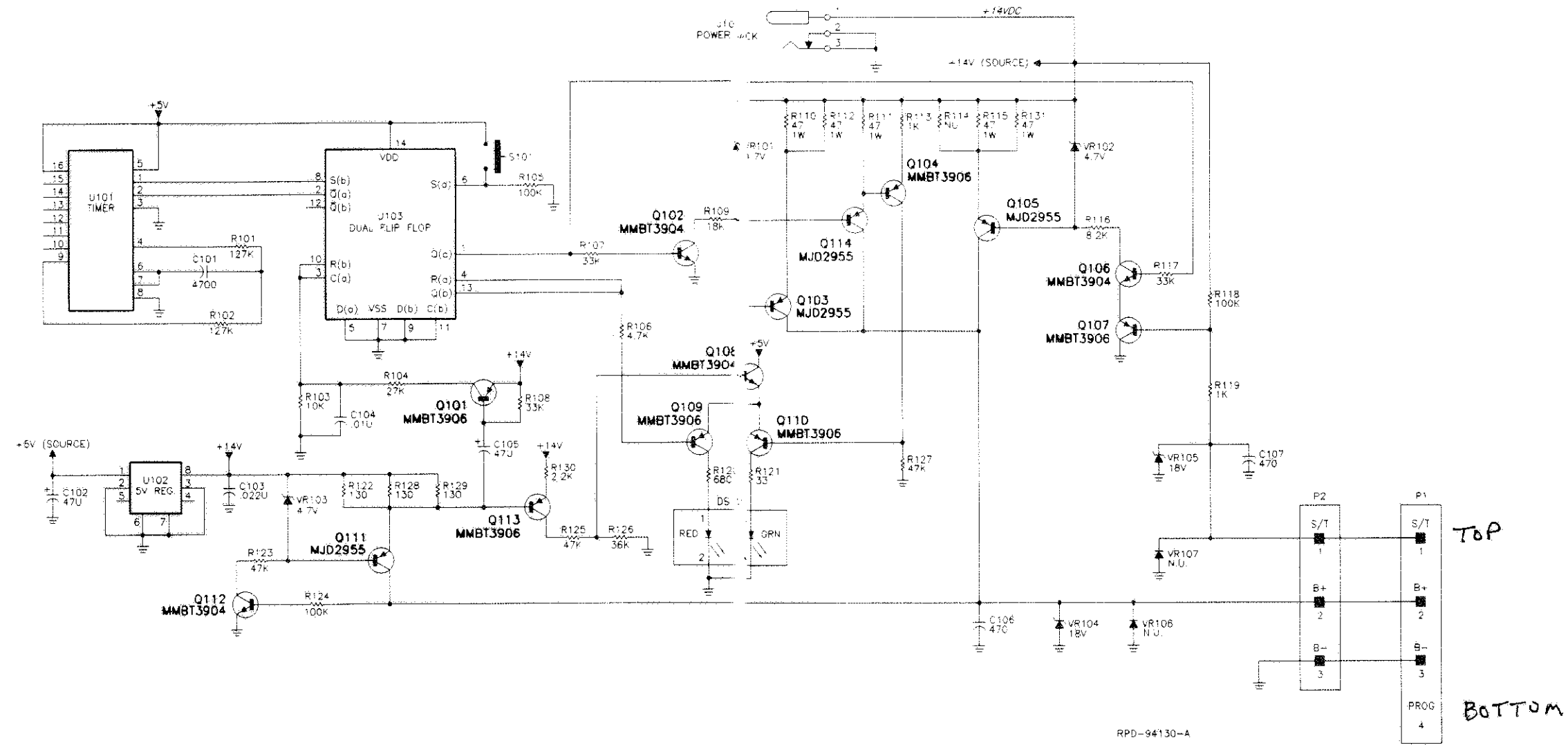


SP50 Chargers & Power Supplies		
Battery Charger	Rate/Voltage	Power Supply
HTN9013	3 Hour / 120 V	2580550D01
HTN9014	10 Hour / 120 V	2580955Z02
HTN9015	3 Hour / 230V	2580550D02 (European Plug)
HTN9016	10 Hour / 230 V	2580955Z03 (European Plug)
HTN9059	3 Hour / 240 V	2580550D03
HTN9058	10 Hour / 240 V	2580955Z04



COMPONENT SIDE (GRAY) RCB-94134-O
 SOLDER SIDE (PINK) RCB-94135-O
 OVERLAY ----- RCB-94136-O

COMPONENT SIDE VIEW



Parts List

SP50 3 Hour (Rapid Rate) Battery Charger, electrical PL-941039-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C101	2160520V17	capacitor, fixed: 4700
C102	2311049J44	47 uF
C103	2113741A53	022 uF
C104	2113741A45	.01 uF
C105	2311049J44	47 uF
C106, 107	2113740A71	470
DS101	4805729G49	light emitting diode: Dual, R/G
J101	0905706S05	connector, receptacle: power jack
R101, 102	0660079L12	resistor, fixed: 127k
R103	0660076A73	10k
R104	0660076A93	27k
R105	0660076B01	100k
R106	0660076A65	4.7k
R107, 108	0660076A85	33k
R109	0660076A79	18k
R110 thru 112	0683962T41	47 ohms
R113	060076A49	1k
R114	--	Not Used
R115	0683962T41	47 ohms
R116	0660076A71	8.2k
R117	0660076A85	33k
R118	0660076B01	100k
R119	0660076A49	1k
R120	0660076A45	680 ohms
R121	0660076A13	33 ohms
R122	0660076A28	130 ohms
R123	0660076A89	47k
R124	0660076B01	100k
R125	0660076A89	47k
R126	0660076A85	36k
R127	0660076A89	47k
R128, 129	0660076A28	130 ohms
R130	0660076A57	2.2k
R131	0683962T41	47 ohms
Q101	4805128M16	transistor: PNP
Q102	4880214G02	NPN
Q103	4813822A10	PNP
Q104	4805128M16	PNP
Q105	4813822A10	PNP
Q106	4880214G02	NPN
Q107	4805128M16	PNP
Q108	4880214G02	NPN
Q109, 110	4805128M16	PNP
Q111	4813822A10	PNP
Q112	4880214G02	NPN
Q113	4805128M16	PNP
Q114	4813822A10	PNP
VR101 thru 103	4880140L05	voltage regulator: 4.7 V
VR104, 105	4813830A31	18 V
VR106, 106	4813832A33	20 V
U101	5105461G48	integrated circuit: timer
U102	5105469E90	5 V regulator
U103	5184704M09	Dual flip flop
	8480564D01	board: PC board

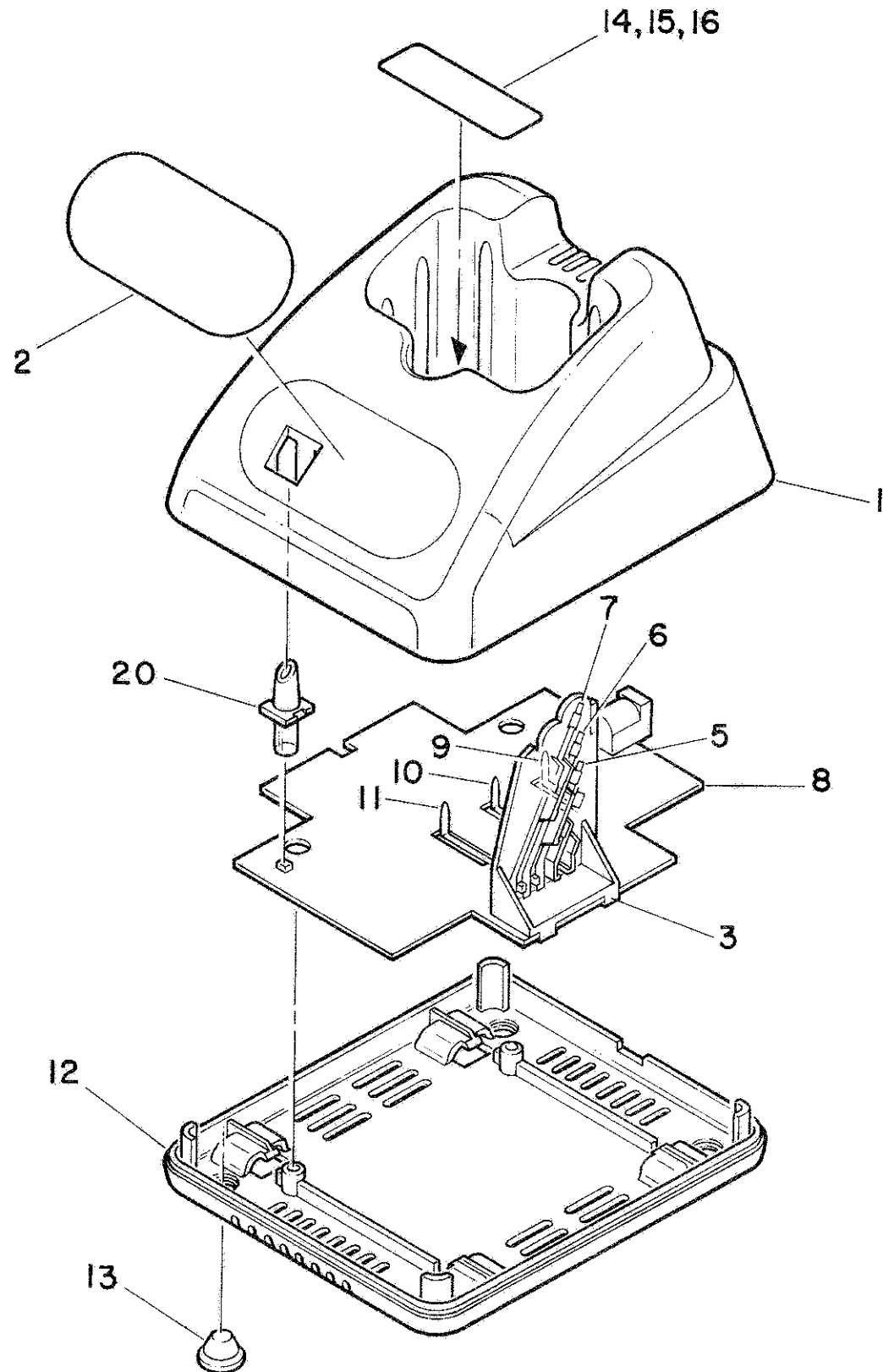
Battery Charger Rapid Rate (3 Hour) Circuit Board, Schematic Diagram and Parts List

Parts List

SP50 10 Hour (Standard) Battery Charger, mechanical

PL-941031-O

REFERENCE DESIGNATOR	MOTOROLA PART NO.	DESCRIPTION
1	1580551D02	HOUSING, standard charger
2	1380555D01	ESCUTCHEON, standard charger
3	3180554D01	HEADER, charger
5	3980553D03	CONTACT, radio position 3
6	3980553D02	CONTACT, radio position 2
7	3980553D01	CONTACT, radio position 1
8	0180707Y59	PCBA, standard charger
9	3980552D03	CONTACT, battery position 3
10	3980552D02	CONTACT, battery position 2
11	3980552D01	CONTACT, battery position 1
12	6480951Z01	BASE, charger
13	7580530C01	FEET, charger; 4 used
14	3380609D04	LABEL, charger, 230 V
15	3380609D01	LABEL, charger, 120 V
16	3380609D06	LABEL, charger, 240 V
20	6180996Z01	LIGHT PIPE



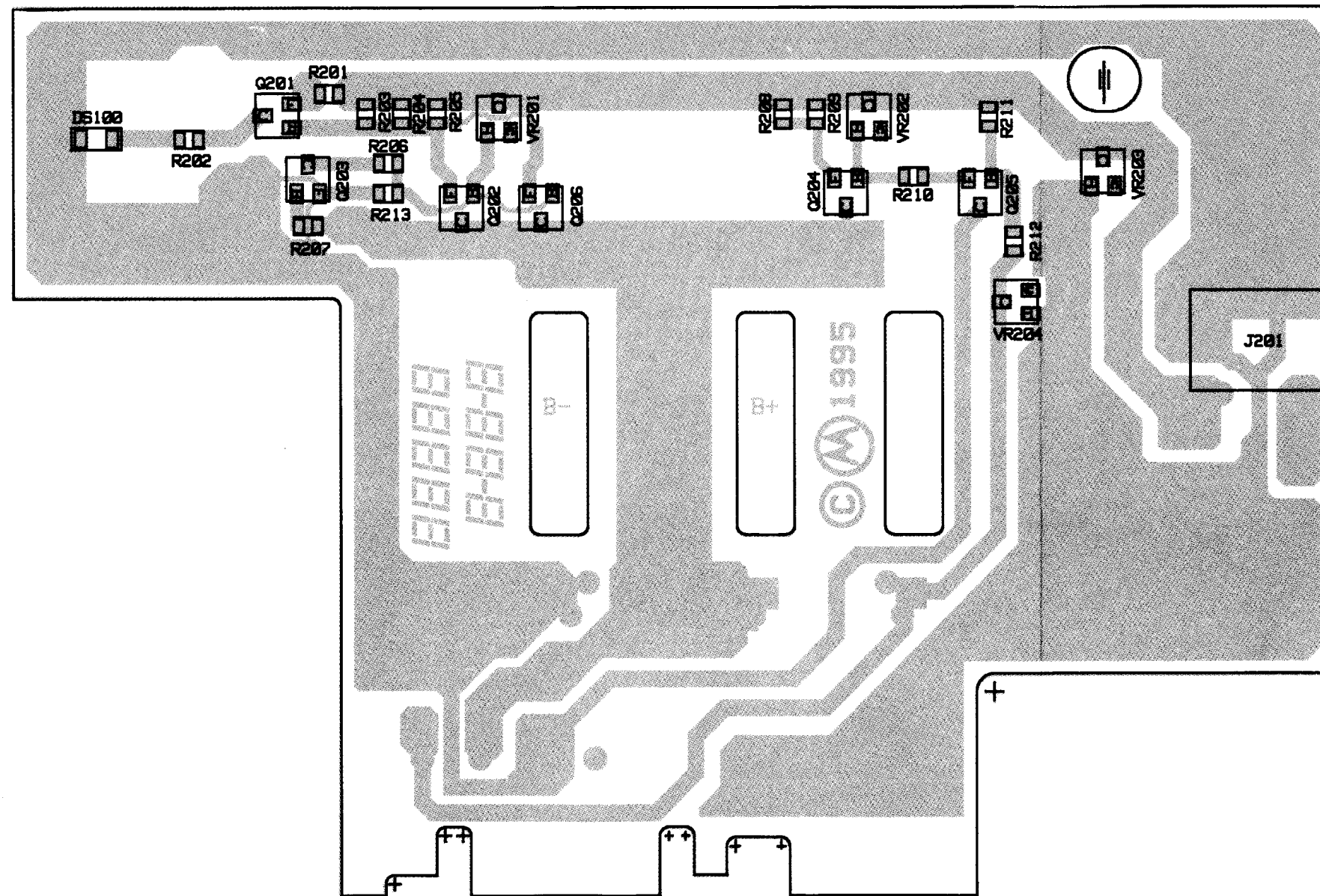
Battery Charger Standard Rate (10 Hour)
Exploded View and Parts List

Parts List

SP50 10 Hour (Standard) Battery Charger, Electrical PL-941036-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R201	0660076A23	resistor, fixed: 82
R202	0660076A57	2.2k 1K
R203 thru 205	0660076A32	200 240Ω
R206	---	Not Used
R207	---	Not Used
R208, 209	0660076A22	75
R210	0660076A89	47k
R211	0660076B01	100k
R212	0660076A42	510
R213	066076A71	8.2k
DS201	4805729G44	light emitting diode: red
J201	0980422B01	connector, receptacle: power jack
Q201	4805128M16	transistor: PNP
Q202	4811056B02	PNP
Q203	---	Not Used
Q204	4811056B02	Not Used
Q205	4805128M16	PNP
Q206	4811056B02	Not Used
VR201, 202	4880140L05	voltage regulator: 4.7 V
VR203	4811058B05	30 V

VR204, 4813830A31 18V
VR205

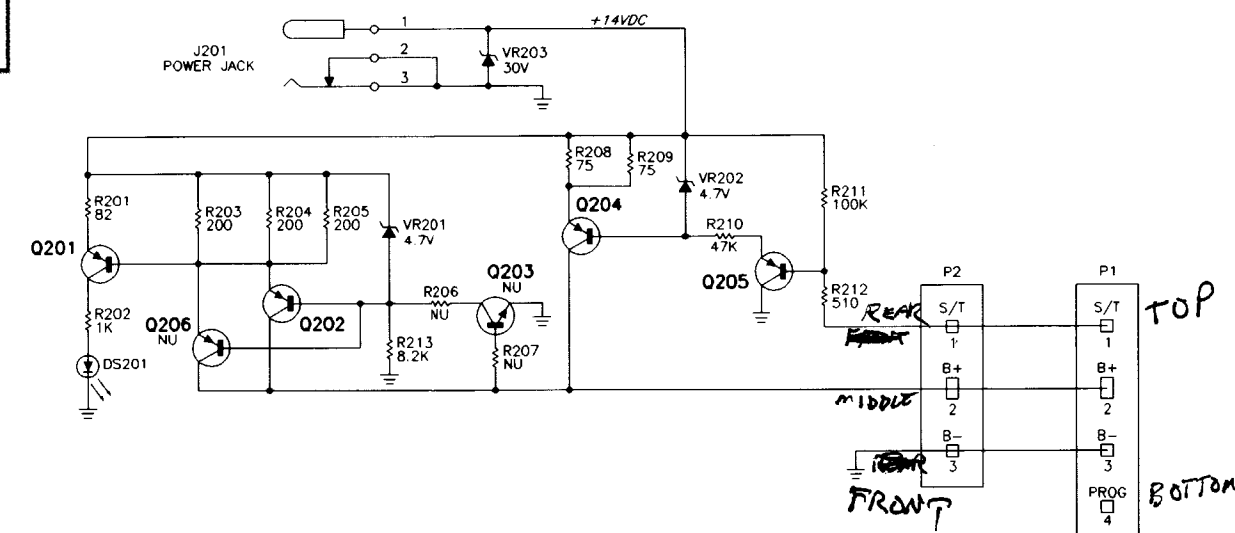


COMPONENT SIDE

COMPONENT SIDE LEGEND

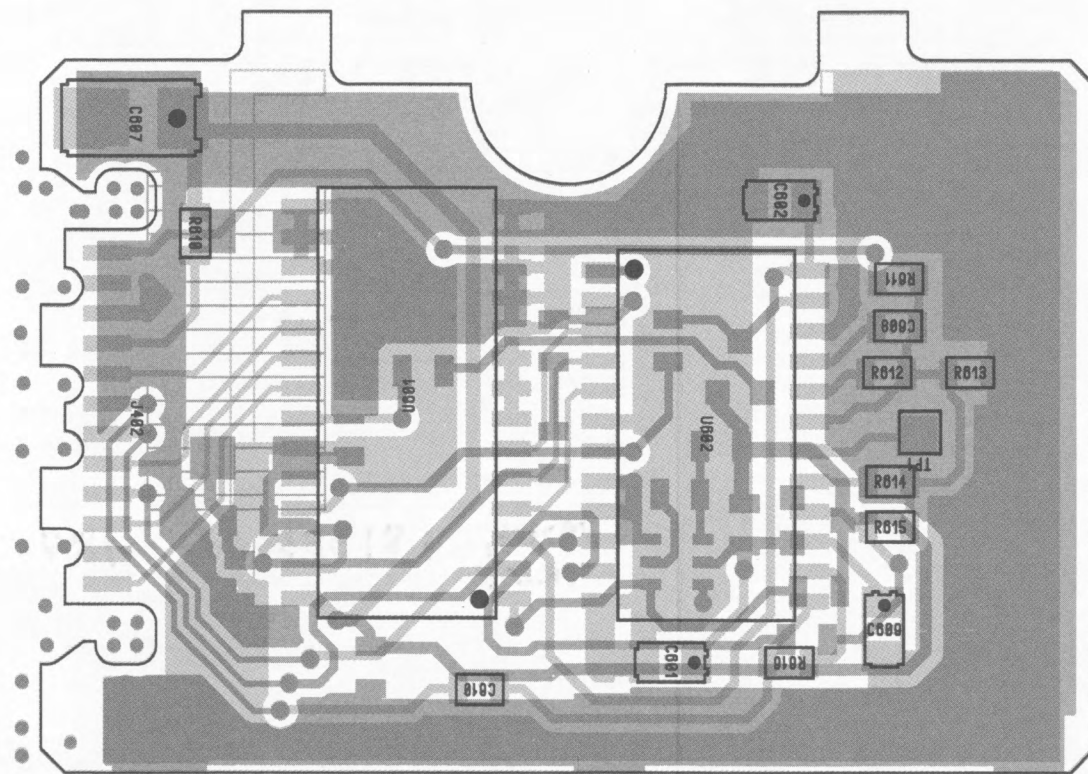
COMPONENT SIDE (GRAY) RCB-94131-A
OVERLAY ----- RCB-94133-A

COMPONENT SIDE VIEW



RPD-94127-A

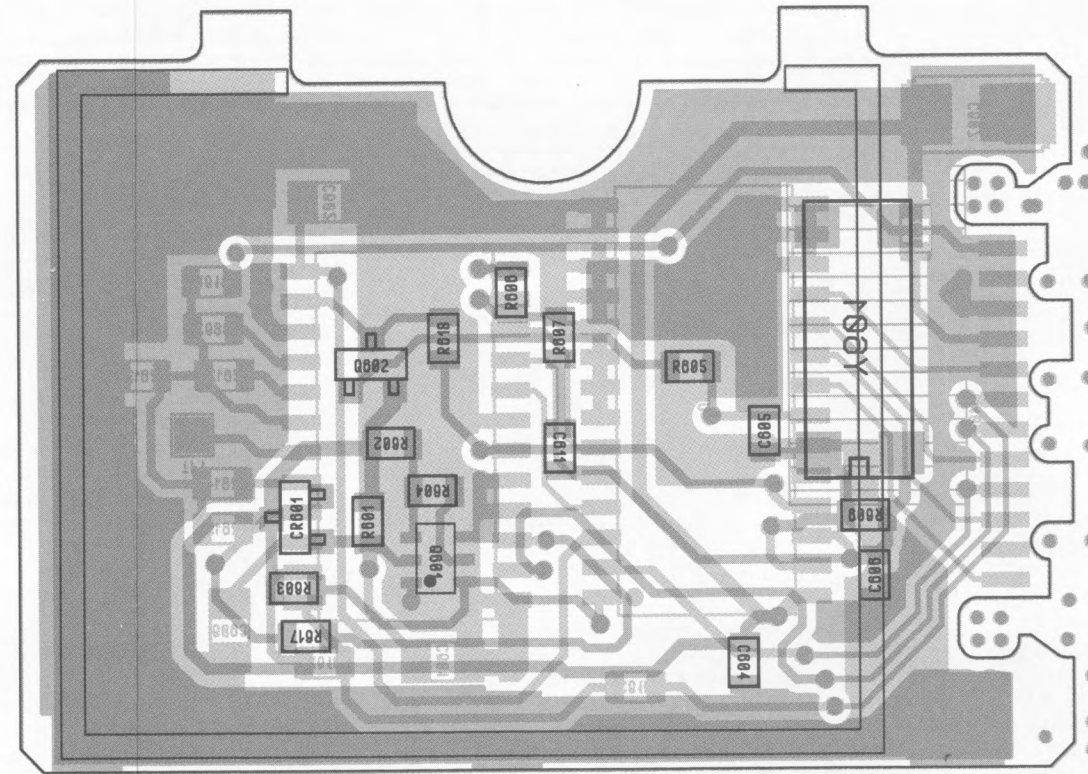
Battery Charger Standard Rate (10 Hour)
Circuit Board, Schematic Diagram
and Parts List



8480448E01 Rev-0
 Plot Date: 05/24/95 15:01:54

COMPONENT SIDE (GRAY) RCB-95149-O
 SOLDER SIDE (PINK) RCB-95150-O
 OVERLAY ----- RCB-95151-O

COMPONENT SIDE VIEW



8480448E01 Rev-0
 Plot Date: 05/24/95 12:01:24

COMPONENT SIDE (GRAY) RCB-95149-O (REV)
 SOLDER SIDE (PINK) RCB-95150-O (REV)
 OVERLAY ----- RCB-95152-O (REV)

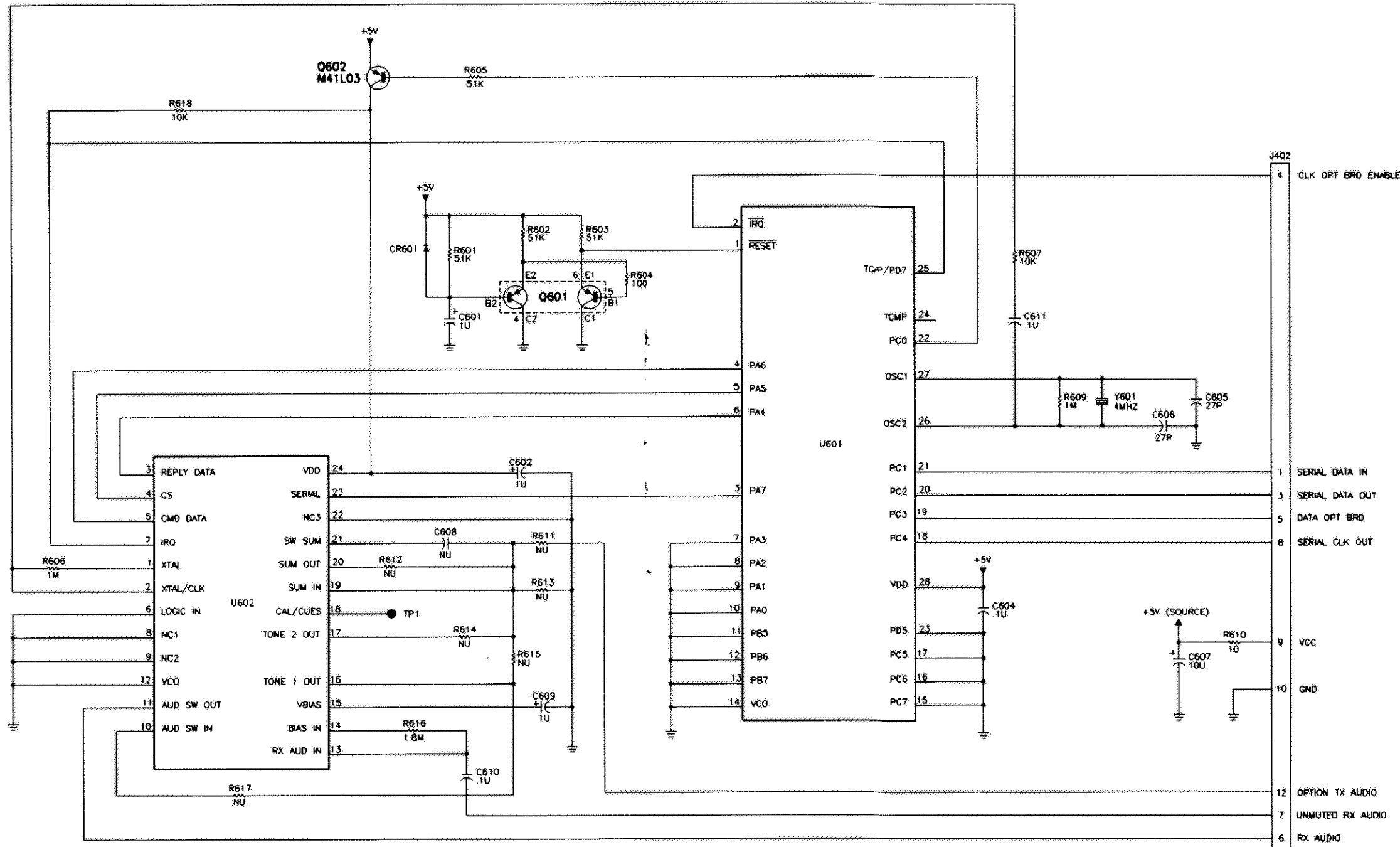
SOLDER SIDE VIEW

Parts List

HLN3026A SP50 QCII Option Board, Electrical PL-951003-O

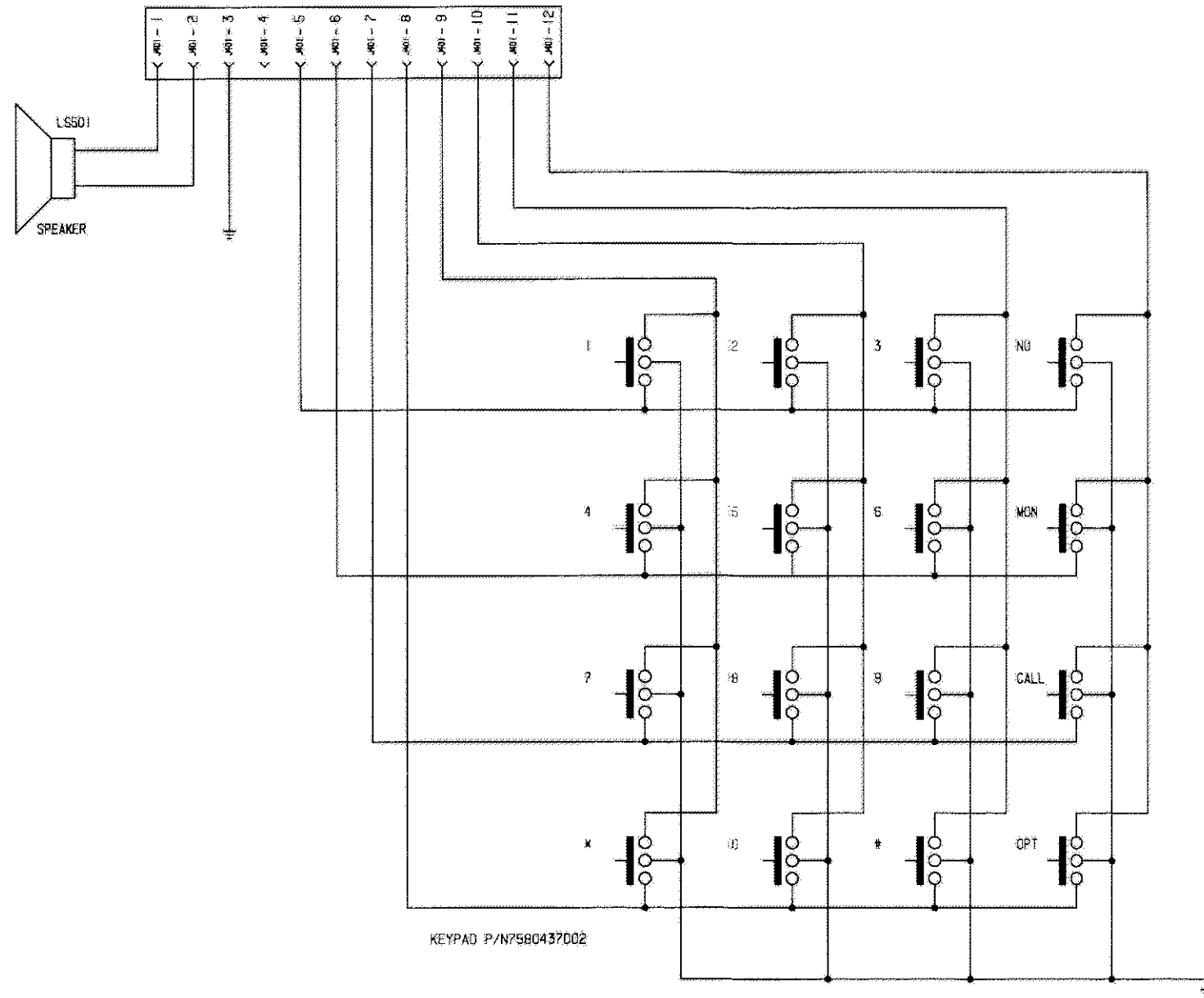
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C601, 602	2311049A07	capacitor, fixed: pF +/-10%; 100 V: unless otherwise stated
C604	2113743A19	0.1 uF
C605, 606	2113740A39	27
C607	2311049J26	10 uF
C608	---	Not Used
C609	2311049A07	1 uF
C610, 611	2113743A19	0.1 uF
CR601	4880939T01	diode: (see note) Schottky
Q601	5180159R03	transistor: (see note) PNP
Q602	4880141L03	PNP
R601 thru 603	0660076A90	resistor, fixed: +/-10%; 1/8 W: unless otherwise stated
R604	0660076A25	51k
R605	0660076A90	100
R606	0660076B25	51k
R607	0660076B25	1M
R609	0660076A73	10k
R610	0660076B25	1M
R611 thru 615	0660076A01	10
R616	---	Not Used
R617	0660076H31	1.8M
R618	---	Not Used
U601	5180492C01	integrated circuit: (see note) microprocessor
U601	5180442E01	MX-COM audio signal processor
Y601	4880113R10	crystal: (see note) 4 M

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

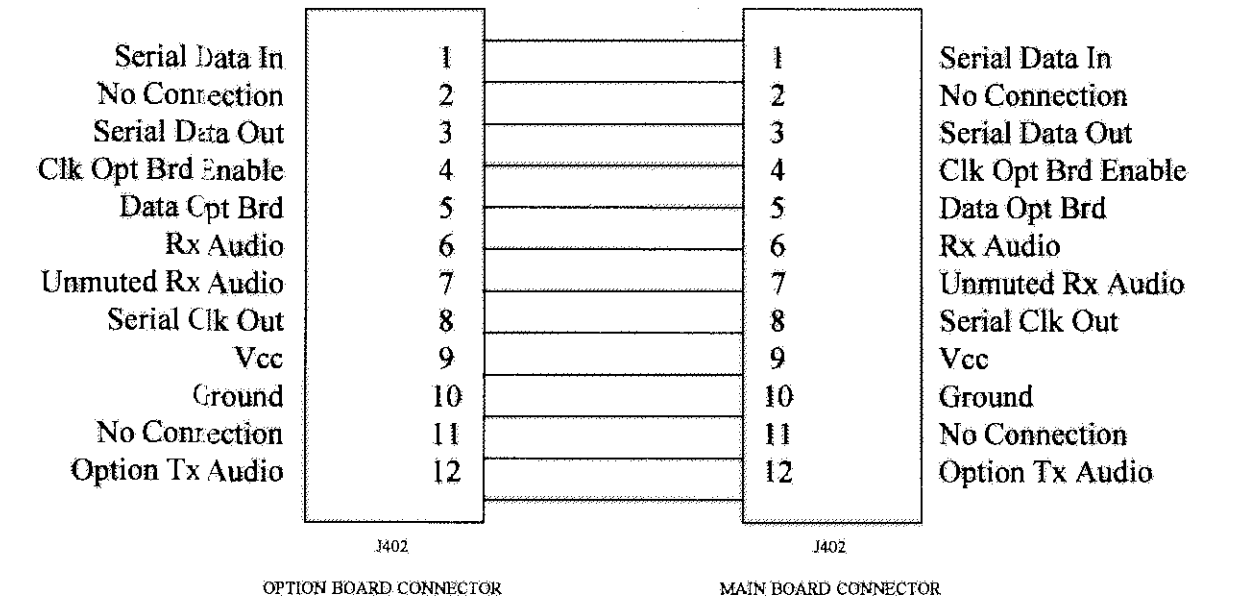


RPO-95118-0

Schematic Diagram and Parts List
for HLN3026A Quik-Call II Option Board



DTMF FLEX CABLE CONNECTIONS



OPTION BOARD FLEX CABLE CONNECTIONS