

SP-200/SP-210

maxon[®]

A World of Communications

SERVICE MANUAL



SP-200/SP-210 SERVICE MANUAL

This manual is intended for use by qualified technicians and includes information pertaining to the SP-200/SP-210 circuit design and maintenance.

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Table of Contents

Table of Contents	i
About This Manual	v
Production Changes	v
Amendments	v
Safety Information	v
Electrostatic Discharge & Protection	vii
What is Electrostatic Discharge (ESD)?	vii
What is ESD damage?	vii
How do I protect against ESD damage?	vii
Prevent charges from forming	vii
Battery Charging & Care	1-9
General Information	1-1
Description	1-1
Features	1-1
Accessories/Options	1-1
Licensing Information	1-1
Unpacking	1-2
Technical Specifications	2-1
General	2-1
Temperature Range:	2-1
Transmitter	2-2
Receiver	2-4
Rx Tone Demodulation Characteristics	2-6
Environmental	2-7
Programmer	2-7
Operation	3-1
Description of Controls	3-1
Operation Mode	3-2
Power On Mode	3-2
Alerts and Alert messages	3-2
Features	3-4
Theory of Operation	4-1
Overview	4-1
Digital Circuit	4-1
Receiver	4-1
Rx Audio Circuit	4-2
Transmitter	4-3
Tx Audio Circuit	4-3
PLL Circuit	4-4
Link Option	4-5
Maintenance	5-1
Disassembly Procedure	5-1

Removing & Replacing the Belt Clip	5-1
Removing & Replacing the Battery	5-2
Removing & Replacing the Antenna & Control Knob	5-3
Removing & Replacing the Back Cover & RF Board	5-3
Removing & Replacing the RF Board from the Back Chassis	5-4
Removing & Replacing the Digital Board	5-5
Removing & Replacing the Daughter Boards	5-6
Removing & Replacing the Speaker	5-7
Component Replacement	5-8
Troubleshooting Guide	5-10
Voltage Charts	5-11
Alignment	6-1
Introduction	6-1
Required Test Equipment	6-1
Radio Configuration Setup	6-2
Alignment Procedure	6-3
Parts List	7-1
Component Pinout	7-9
Drawings	8-1
SP-200/SP-210 Wiring Diagram	8-1
SP-200/SP-210 Block Diagram	8-2
Module Schematics (UHF & LCD)	9-1
Module Schematics (VHF)	9-2
RF Board Schematic (VHF 148-174 MHz)	9-3
RF Board Schematic (UHF 440-470 MHz)	9-4
Digital Board Schematic (UHF & VHF)	9-5
RF Board PCB Assembly (VHF 148-174 MHz)	9-6
Digital Board PCB Assembly (VHF 148-174 MHz)	9-7
RF Board PCB Assembly (UHF 440-470 MHz)	9-8
Digital Board PCB Assembly (UHF 440-470 MHz)	9-9
SP-200/SP-210 Exploded View & Parts List	10-1

List of Figures & Tables

Figure 1-1 Unpacking	1-2
Figure 3-1 Description of Controls.	3-1
Figure 5-1. Belt Clip Removal	5-1
Figure 5-2. Belt Clip Installation	5-1
Figure 5-3. Battery Removal & Installation	5-2
Figure 5-4. Antenna & Knob Removal & Installation	5-3
Figure 5-5. Back Cover Removal & Installation	5-3
Figure 5-6. RF Board Removal	5-4
Figure 5-7. Digital Board Removal	5-5
Figure 5-8b. Digital Board Screws	5-5
Figure 5-9. Speaker Removal & Installation	5-7
Figure 6-1. Test Equipment Setup	6-1
Figure 6-2. Radio Configuration Setup	6-2
Figure 6-3. VCO Alignment Points	6-3
Table 7-1. UHF/VHF Chart	7-2

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About This Manual

This Maxon Service Manual is a comprehensive guide to the operation, programming, maintenance and field repair of the SP-200/SP-210 portable radio. The manual provides service technicians with testing, adjustment, alignment and parts replacement information. It covers all variants of the product and its accessories. Before using this manual or servicing the SP-200/SP-210 please read this page and the following chapters:

- **Electrostatic Discharge & Protection** (Page vii)
- **Battery Charging & Care** (Page ix)

Please observe the following symbols when servicing the radio:



- This symbol is used to identify a Warning or use of Caution. Use caution when following the outlined procedure.



- This symbol is used to identify a Electrostatic Discharge Sensitive (ESDS) device. Follow ESD protection guidelines when handling such devices.

Production Changes

Production or engineering changes may occur either after this manual is printed and before its next printing or before a Publication Change Notice can be provided.

Amendments



Amendments to this service manual will be issued in the form of a Publication Change Notice (PCN). A PCN will be made available at no charge and distributed via regular mail.

Safety Information

The Federal Communications Commission (FCC), with its action in General Docket 79-144, March 13, 1985, has adopted a safety standard for human exposure to Radio Frequency (RF) electromagnetic energy emitted by FCC regulated equipment. Maxon subscribes to the same safety standard for the use of its products. Proper operation of this radio will result in user exposure far below the Occupational Safety and Health Act (OSHA) and Federal Communications Commission limits.



WARNING



Do not hold the radio in such a manner that the antenna is next to, or touching, exposed parts of

the body, especially the face or eyes, while transmitting.



WARNING



Do not allow children to operate transmitter - equipped radio equipment.



WARNING



Do not operate a radio transmitter near unshielded electrical blasting caps or in other explosive environments unless it is specifically approved for such use.



CAUTION



Do not key the transmitter or press the PTT button without an appropriate load connected to the antenna connector. Do not allow unauthorized persons to operate any radio transmitting equipment.

Electrostatic Discharge & Protection

What is Electrostatic Discharge (ESD)?

Whenever static electricity on an object comes into contact with an earth ground object, discharge takes place, most often by way of a spark. This is similar to a miniature lightning strike. Objects sensitive to such Electrostatic discharge are Electrostatic Discharge Sensitive (**ESDS**).

Static electricity is generated by many different products and in many different ways. Handling plastic packaging, walking across a carpet, wearing clothing that retains static charges and working at a workbench that is not earth grounded are only a few ways static electricity is generated.

Your body can generate the largest static charge likely to come in contact with a **ESDS** component, so it is important that all necessary precautions are taken to prevent this contact from occurring.

What is ESD damage?

There are two types of damages or failures: **upset** and **catastrophic**.

Most ESD upset type damage will not normally show immediately. It may only show as a temporary loss of data but the next time everything passes the tests. Often the damage is so small that the damage to the component will not show up for some time, unlike damage caused by a short circuit which may cause a component to smoke, burn or explode. The component may not show any faults; however, at some point in time the component will fail, most likely at the most inconvenient time.

How do I protect against ESD damage?

There are several ways to protect electronic equipment from ESD damage. All of the following should be followed, but even following only one will help.

Prevent charges from forming.

1. Earth ground the workbench. Use an anti-static material on the surface of the workbench and make sure it is grounded. Do not use insulated underlays on the bench. Make sure the ground connections are secured.
2. Use an anti-static floor covering material. Wear anti-static shoes or heel straps. Your chair also must be anti-static.
3. Wear a wrist or heel strap connected to earth ground. Keep clean and tight. If your skin is dry, use lotion under the wrist strap. Check wrist or heel strap daily for proper grounding.
4. Keep non-anti-static plastic packaging and other plastic objects away from work area.
5. Use only anti-static plastic or foam material to protect components and boards. Place component or board **inside** anti-static bag, **not on top of it**.
6. Wear clothing that has been treated with a fabric softener during washing. This will not only reduce the risk of acquiring electrostatic charges but make your clothing more comfortable and stay cleaner longer.
7. Use earth grounded test equipment, soldering irons, etc. and hand tools without insulated handles.
8. Clean your workbench, chair, shoes, etc. with approved detergents and cleaning material only.
9. Observe ESD precautions when the ESDS label is present on components or units and/or in the product manuals.



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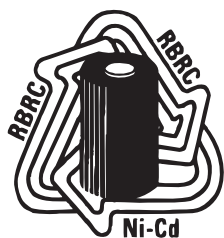
Battery Charging & Care



WARNING



- Do not dispose of the battery pack in fire - it may explode, causing injury or death.
- Do not replace the battery in hazardous atmosphere locations.
- Do not carry battery loose in your pocket or purse.
- Do not attempt to repair battery.



The U.S. Environmental Protection Agency (EPA) classifies used Ni-MH batteries as hazardous waste, unless certain exemptions apply.

The battery should be recycled at the end of its useful life. Under various state or local laws, such batteries must be recycled or disposed of properly and cannot be dumped in landfills or incinerators.

Maxon America fully endorses and encourages the recycling of Ni-MH batteries. A national program to collect and recycle used Ni-MH batteries is being implemented by the Rechargeable Battery Recycling Corporation (RBRC™). <http://www.rbrc.org/>. This program is being funded through the use of license fees paid by the battery and product manufacturers to place the RBRC™ Seal on the batteries.

The following is a list of facilities where the batteries can be shipped to be recycled. Contact these facilities for proper packaging and shipping guidelines.

Kinsbursky Brothers, Inc.

1314 N. Lemon Street, Anaheim, CA. 92801
TEL: (714) 738-8516 (800)-548-8797
FAX: (714) 441-0857

INMETCO <http://www.inmetco.com/>

245 Portersville Road, Ellwood City, PA 16117
TEL: (412) 758-2800 FAX: (412) 758-2842

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General Information

1

Description

Maxon's SP-200/SP-210 portable radios deliver up to 199 channels of communication with multiple scan modes to keep your access to information continuous and reliable.

Selectable 1 or 5 Watt output settings per channel allow you to keep in touch from buildings to staging areas to parking lots.

Operation and functions for Maxon's SP-200/SP-210 radios are described in this manual.

Features

- 199 Channel Capability
- 3-Digit Channel Display
- PC Programmable
- Scan List and Priority Channel Edit
- Priority Lookback Scan
- Deditcated Monitor Function with Nuisance Delete
- Dedicated Scan / Priority Button
- User Programmable Scan List of Group Channels

Accessories/Options

QPA-1350	1350 mAh Ni-MH Battery
ACC-100	UHF Antenna (440-470 MHz)
ACC-102	VHF Antenna (148-174 MHz)
ACC-400	Rapid rate charger
QPA-1411	Power supply, 110V AC (for use with ACC-400)
ACC-903	Programming software
ACC-2002	Programming cable
ACC-2003	Interface module
ACC-903A	Alignment software

Licensing Information

FCC Information

The SP-200/SP-210 complies with the Federal Communications Commission (FCC) requirements that regulate the Business Radio Service. The user must know and comply with all applicable parts of the FCC Rules and Regulations. Rules applicable to each service may be ordered from:

Federal Communications Commission

Branch License Division
Gettysburg, PA 17326
Tel: (717) 337-1212 <http://www.fcc.gov/>

- Note: A valid station license and call sign issued by the FCC is required before operating the transceiver. It is the users's responsibility to apply for and obtain this radio license.

Industry Canada Information

To obtain the Industry Canada license application, contact your nearest field office, or write:

Industry Canada

1241 Clyde AvenueOttawa
Ontario K2C 1Y3Canada
Tel: (613) 998-5968 <http://info.ic.gc.ca/>

Unpacking

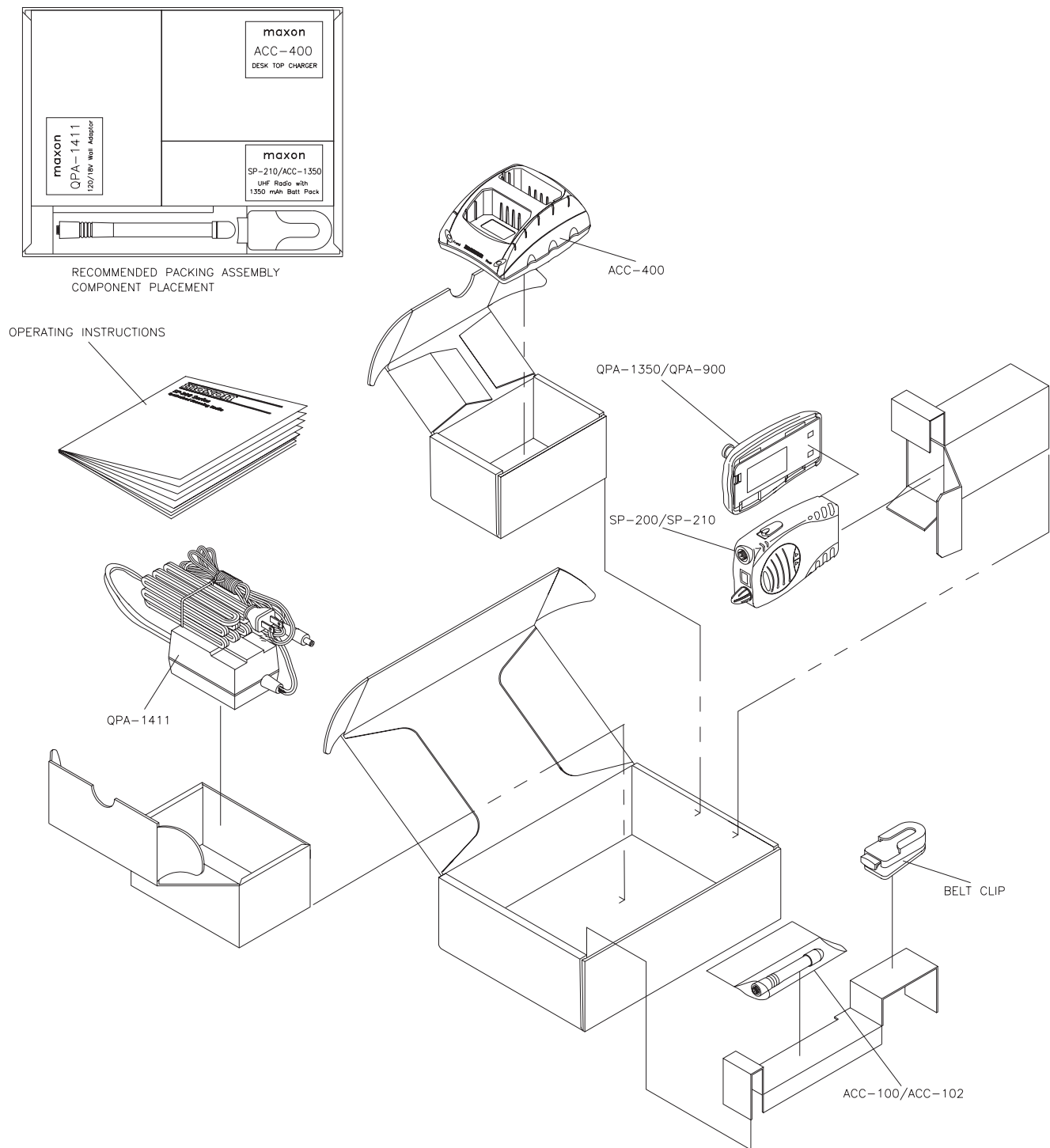


Figure 1-1 Unpacking

Technical Specifications

2

General

Model	SP-200/SP-210
Equipment Type	Handheld Portable
Performance Specifications	TIA/ EIA-603 & ETS 300-086
Band	UHF/VHF
Channel Spacings	12.5 kHz, 25 kHz programmable
RF Output Power	5 / 1 watt
Modulation Type	F3E
Audio Power	500 mW (Ext with 8 ohm) 1W (Int with 4 ohm)
Intermediate Frequency	45.1 MHz & 455 kHz
Number of Channels	199
Frequency Source	Synthesizer
Operation Rating	Intermittent 90 : 5 : 5 (Standby: Rx: Tx)
Power Supply	NiMH 7.5 VDC Nominal ±10 % VDC Extreme

Temperature Range:

Storage	from - 40° C to + 80° C
Operating	25° C ±10 NOM(Room Temp) from - 30° C to + 60° C
Current Consumption:	
Off	150 µA
Standby (Muted)	55 mA (Battery Save On 100mS, 400mS) 80 mA (Battery Save Off)
Unmuted, 100 % Max AF Power	400 mA
Transmit 5 Watt RF Power	2.4 A
Battery Life (5-5-90% duty cycle)	
1350 mAh	8 Hrs (Power Save On 100mS), (Power Save Off 400mS)

SP-200/SP-210
Technical Specifications

Frequency Bands:

	Rx	Tx
VHF: V1	136.000 - 162.000 MHz	136.000 - 162.000 MHz
V2	148.000 - 174.000	148.000 - 174.000
UHF: U2	440.000 - 470.000 MHz	440.000 - 470.000 MHz
U1	400.000 - 430.000	400.000 - 430.000
U5	420.000 - 450.000	420.000 - 450.000
U3	470.000 - 490.000	470.000 - 490.000
U4	490.000 - 512.000	490.000 - 512.000

Dimensions 406mm(H) x 58mm(W) x 38mm(D)

Weight 7.65oz. (217g) w/Battery, Belt Clip & Antenna

Transmitter

Carrier Power High 5.0W Max. 6.0W Min. 4.0W
Low 1.0W Max. 1.4W Min. 0.7W

Sustained Transmission Nominal conditions
Time: 5 10 30 S
Power: >90% >85% >80%

Frequency Error < 0.5 kHz Nominal condition for VHF
< 0.75 kHz Nominal condition for UHF
± 3 ppm Extreme condition UHF
± 5.0 ppm Extreme condition VHF

Audio Frequency Deviation:

Without subaudio tone modulation:

25 kHz Channel Spacing Nom. 3.0 Peak ±5.0 Min. ±3.8

12.5 kHz Nom. 1.5 Peak ±2.5 Min. ±1.8

With subaudio tone modulation @ 10 % peak deviation:

25 kHz Channel Spacing ±5.0 Peak @ Extreme condition
12.5 kHz ±2.5

Audio Frequency Response Within +1/-3dB of 6dB octave
@ 300 Hz to 2.55 kHz for 12.5 kHz C.S.
@ 300 Hz to 3.0 kHz for 25 kHz C.S.

Adjacent Channel Power

25 kHz < 70 dBc @ Nominal Condition
 < 65 dBc @ Extreme Condition

12.5 kHz < 60 dBc @ Nominal Condition
..... < 55 dBc @ Extreme Condition

Conducted Spurious Emission	Below 1 GHz	-36 dBm nominal
	Below 4 GHz	-30 dBm nominal

Modulation Sensitivity at Accessory/Mic Connector 15mV(Nom)>20mV(Min)>35mV(Max.) @ 60 %
Peak Dev.

Transmitter Audio Distortion (Without CTCSS) < 5% @ 1 kHz
< 10 % @ extreme condition

Hum & Noise:

12.5 kHz Channel Spacing > 40 dB (with PSOPH)

25 kHz Channel Spacing..... > 40 dB (with no PSOPH)

Modulation Symmetry < 10 % Peak Dev @ 1 kHz input for nominal dev +20dB

Load Stability..... No osc at $\pm 10:1$ VSWR all phase angles and suitable antenna No destroy at $\pm 20:1$ all phase angle

Peak Deviation Range Adjustment

@ 1 kHz, Nom. Dev +20dB	25 kHz Channel Spacing Min.>3.5, Max.<6.0
	20 kHz Channel Spacing Min.>2.8, Max.<5.0
	12.5 kHz Channel Spacing Min.>1.5, Max. <4.0

Tx TONE MODULATION CHARACTERISTICS

SUB AUDIO TONES-CTCSS

Tone Range 67 to 250.3 Hz @ 0.3% Accuracy

Tone Standard TIA/EIA-603

Non-Standard Tones	55 to 260 Hz @ 0.3% Accuracy
---------------------------------	------------------------------

Nominal Tone Deviation	15% (10%-20%) Peak System Deviation USA
	10% (8%-15%) Peak System Deviation UK

Deviation Range Adjustment 0% Min. Peak Deviation
 20% Max. Peak Deviation
 (using internal control @ nominal conditions)

Tone Deviation Variation vs. Tone Frequency Across

Switch Range <10% Peak Dev. @ 10% Peak system deviation

Tone Frequency vs. Deviation

Tone Distortion 5% THD @ 10% Peak system Deviation

SP-200/SP-210

Technical Specifications

Tx Audio Rejection- >25dB

(radio of peak dev. @ 300 Hz and peak dev. @ Highest) Standard tone frequency

Response Time <10mS (Peak level after Tx on and within 1% accuracy) (time to generate tone to 90%)

Hum and Noise..... >35dB with PSOPH (use any standard CTCSS Tone @ 10% Peak deviation {using 300 Hz HPF and 3 kHz LPF})

SUB AUDIO TONES- DCS

Tone Standard Normal and Inverted

Tone Deviation..... 15% \pm 5% Peak system deviation for MAI

Deviation Range Adjustment 0% Min. Dev. 25% Max. Dev.
(using internal control @ Nominal conditions)

Deviation Variation vs. DCS Code and Carrier Freq. 5% (DCS Code vs. deviation over switching range)

SUB AUDIO TONES-DEVIATION COMPARISON

Deviation Difference <10% Peak Dev. (Deviation with CTCSS minus Deviation with DCS code 346 @ single channel with No adjustment) (@ nominal and extreme condition)

Receiver

Performance without Sub Audio Modulation

Sensitivity (12dB Sinad)

@ Nom. Condition UHF: < -117 dBm, VHF: < -118 dBm

@ Extreme Condition UHF: < -115 dBm, VHF: < -116 dBm

Amplitude Characteristic < \pm 3 dB

Adjacent Channel Selectivity:

25 kHz Channel Spacing

@ Extreme Condition >60 dB @ Nom., >55 dB

12.5 kHz Channel Spacing

>50 dB @ Nom. >45 dB @ Extreme Condition

Spurious Response Rejection 70 dB (100 kHz - 4 GHz)

Image Response >70 dB

Others > 70 dB

±25 kHz / 50 kHz 65 dB

Conducted Spurious Emission

1 GHz - 4 GHz < -47 dBm

@ Nominal Conditions 9 kHz - 1 GHz < -57 dBm

1 GHz - 12.75 GHz < -47 dBm

Volume Control Adjustment Range..... < 10 mW Min.

> 600 mW Max. (8 ohm EXT)

AF Frequency Response (MOD Type F3) Within +1 / -3 dB of limit WRT 1 kHz
 (@ 300 Hz to 3 kHz for 25 kHz Channel
 Spacing)

25 kHz CP **< 40 dB No PSOPH**

12.5 kHz CP < 40 dB with PSOPH

Receiver Response Time < 16 mS

10dB Sinad @ normal condition

Power Save on Max. 16dB Sinad @ Nominal Condition
 Max. 18dB Sinad @ Extreme Condition

Hysteresis..... 0 - 6 dB Sinad @ Nominal Condition

SP-200/SP-210

Technical Specifications

Squelch Attack Time:

RF Level at Threshold < 40 mS

RF Level at Threshold + 20 dB < 30 mS

Squelch Decay Time 5 mS Min., 20 mS Max.

Antenna Socket Input Match > 10 dB Return Loss

L.O. Frequency Temperature Stability 1st < 5 ppm, 2nd < 15 ppm -30° to + 60° C

L.O. Frequency Aging Rate ±2 ppm/year

Rx Tone Demodulation Characteristics

SUBAUDIO TONES - CTCSS

Tone Range 67 Hz to 250.3 Hz

Tone Standard TIA/ EIA - 603 Standard

Non-Standard Tones 55 Hz to 260 Hz

Decoder Sensitivity:

Highest Tone ≤ 8dB Sinad

Mid Tone ≤ 8dB Sinad

Lowest Tone ≤ 8dB Sinad

Decoder + Squelch Attack Time:

Highest Tone < 200 mS

Mid Tone < 200 mS

Lowest Tone < 220 mS

Decoder Only Attack Time:

Highest Tone < 120 mS

Mid Tone < 130 mS

Lowest Tone < 150 mS

Decoder Decay Time < 75 mS Max.

Decoder Bandwidth Accept ±0.5% Tone Frequency
Reject ±3.0% Tone Frequency

Rx Audio Rejection > 25 dB

False Decoder Probability. < 1 False/ 5 Hours

Hum & Noise >40 dB PSOPH, >35 dB No PSOPH @ Highest
Tone Freq.

REFERENCE CRYSTAL

Frequency	12.8 MHz
Holder Type	HC-18
Temperature Characteristic	±5.0 ppm from -30° C to +60° C
Aging Rate	< 2 ppm/ year in 1st year < 1 ppm/ year thereafter
Lock Time	< 10 mS
Tx to Rx Same Frequency < 20 (No Power Saving)	
Rx to Tx Same Frequency <20	
Rx to Rx over « Switching Bandwidth	< 20 mS
Rx to Tx/ Tx to Rx over Switching Bandwidth	< 20 mS

Environmental

(PERFORMANCE WITHOUT DEGRADATION UNLESS STATED)

Temperature	deg C
Operating	-30° to +60° C Degradation Specified @ Extreme
Storage	-40° to +80° C
Recharging	-10° to +55° C
ESD	20 kV (C-MIC ³ 15 kV)
Vibration	MIL STD 810 C Procedures I, II, V and IEC68 26

Programmer

Programming Cable	ACC-2002
Programming Software	ACC-903

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Operation

3

Description of Controls

ITEM	DESCRIPTION
1. On / Off - Volume Control	Rotary switch, used to power on and off the radio and adjust volume
2. LCD Channel Display	LCD Display, used to indicate channel selection & alert modes
3. Busy / Tx Indicator	Multi-colored LED indicator
4. Antenna Receptacle	SMA Connector
5. Push-To-Talk (P-T-T) Bar	Push to talk, release to listen
6. Scan Button	When pressed the radio enters the scan mode
7. Monitor Button	When pressed the radio monitors the current channel for activity
8. Microphone	Used for sound transmission
9. Speaker	Used for sound reception
10. Channel Selector Buttons	Momentary buttons used to select one of 199 channels
11. Accessory Jack	Multi-purpose socket used to connect to a remote speaker/microphone or other accessory
12. Battery	Power Supply
13. Battery Charger Contacts	Contacts used for charging battery
14. UHF Antenna	Antenna
15. VHF Antenna	Antenna (Uncut)

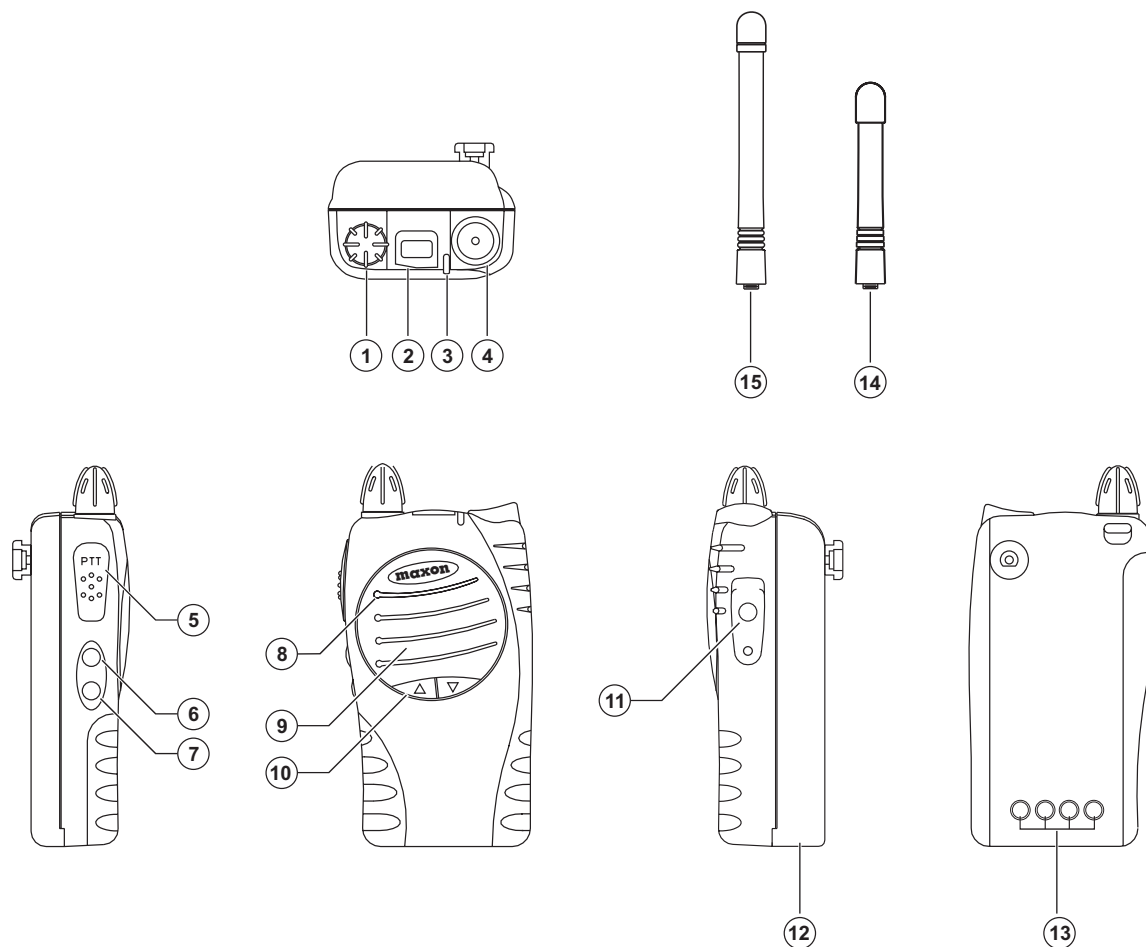


Figure 3-1 Description of Controls

1. Operation Mode

This section provides general descriptions of the operating modes of the SP-200/SP-210 Radio.

1.1. Power Off Mode

The SP-200/SP-210 enters the “Off” mode when the On/Off Volume knob is rotated to the most counter-clockwise position, beyond the detent. Upon entering Off mode, the radio stores its current channel (if Power On Channel function is disabled via PC programmer).

2. Power On Mode

The SP-200/SP-210 enters the “Power-On” mode when the On/Off Volume knob is rotated clockwise beyond the detent. Upon entry of the “Power-On” mode, the radio performs the power-on alert to indicate that it has been turned on. In the “Power-On” mode, the radio will restore the operational setting stored when it was last turned off (if Power On Channel function is disabled via PC programmer). The SP-200/SP-210 enters the LCD “All Display” mode by holding the PTT when the radio is powered on. In this mode, the radio will display all digits.

The SP-200/SP-210 enters the Programming or Cloning mode by holding Monitor button when the radio is powered up. In this mode, the radio will display program or clone messages. Refer to “3.15 Programming and Cloning”.

The SP-200/SP-210 enters the Edit mode by holding the Scan button when the radio is powered up. In this mode, the radio will display a “SE” or “PE” message. An “SE” message is the Scan List Edit. A “PE” message is the Priority Channel Edit. Refer to “4.12 Scan List Edit and Priority Channel Edit”.

2.1. Rx Mode

The SP-200/SP-210 enters the Rx mode when the user is not transmitting and the scan function is not active. In this mode, the receive function is performed. There are 4 conditions in this mode.

2.1.1. No Carrier Mode

In this mode, the LED is not lit and there is no audio present.

2.1.2. Un-muted Busy Mode

In this mode, the LED is lit yellow and there shall be audio present.

2.1.3. Muted Busy Mode

In this mode, the LED is lit yellow and there will not be audio present.

2.1.4. Correct Call Mode

In this mode, the LED is lit green and there is audio present. Any audio present is heard through the radio’s speaker.

2.2. Tx Mode

The SP-200/SP-210 enters the Tx mode, when the PTT (Push-To-Talk) button is pressed. In this mode, the radio transmits the audio on the selected channel. The speaker is muted and no alert tones are given. The radio exits this mode when the user releases the PTT button, the Time-Out-Timer expires, or the radio is turned off.

2.3. Scan Mode

The SP-200/SP-210 enters the scan mode when the Scan button is pressed and released.

2.4. Edit Mode

The SP-200/SP-210 enters the edit mode by holding the Scan button, when radio is powered up.

3. Alerts and Alert messages

This section describes the various audible alerts and LED/LCD alert messages the SP-200/SP-210 gives to the user for each condition.

- Note: All LED or audible alerts can be globally disabled via PC programming. All of the following descriptions assume both LED and audible alerts are enabled.

3.1. Power On

Upon power-on, the SP-200/SP-210 emits 50msec 800 Hz, 50msec 1100 Hz, 50msec 140 Hz, 50msec 160 Hz, 50msec 2000 Hz tones and displays all digits.

3.2. Button

The SP-200/SP-210 radio emits a 50msec 1000 Hz tone each time any button is pressed.

3.3. Busy

If a channel is busy, the LED will be lit yellow.

3.4. Correct call

If a channel has a sub tone option, the LED will be lit green for the duration of the correct call.

3.5. Transmit

While the PTT is pressed, the LED will be lit red for the duration of the transmission.

3.6. Scan

While the radio is scanning, the LED will flash green. The radio will display the current scanning group number on the LCD.

3.7. Scan Delete

If the monitor button is pressed in the scan mode, the radio will delete the scanned-channel in the scan list. The radio also emits a 1000 Hz tone for 250msec and displays the message “_d” on the LCD.

3.8. Scan All Delete

If all channels have been deleted in scan list while in the scan mode, the radio emits two 1000 Hz tones for 250msec. The radio also displays the message “Ad” on the LCD.

3.9. Time-Out-Timer

Five seconds prior the Time-Out-Timer time out, the radio emits a 1000 Hz 250msec tone to alert the user. Once the Time-Out-Timer expires, the radio emits the “Transmit Not Available” alert (a 1000 Hz 250msec tone). The radio also displays the message “to” on the LCD.

3.10. Tx Penalty

If the user attempts to transmit before the Tx Inhibit time expires, the radio will emit the “Penalty Alert” (three 1000 Hz 250msec tones). The radio also displays the message “Pt” on the LCD.

3.11. Tx Penalty End

The radio emits a 1000 Hz 250msec alert tone.

3.12. EEPROM Error

If an error is detected in the EEPROM, the radio will emit a 1000 Hz 250msec tone and display the “Er” message on the LCD.

3.13. PLL Unlock Error

When the PLL is out of lock, the radio emits two 1000 Hz 150msec tones and the radio displays the “UL” message on the LCD.

3.14. Low Battery

Upon detection of a low battery condition, the radio will emit three 1000 Hz 250msec tones and display the “LC” message on the LCD.

3.15. Programming and Cloning

When the programmer is reading programmed data from the radio, the radio displays the “r” message on the LCD and the LED will flash red.

When the programmer is writing data to the radio, the radio displays the “uu” message on the LCD and the LED flashes green.

When the radio is cloning programmed data as the master or slave, the radio displays the “m” or “S” message on the LCD.

3.16. Busy Lock Out

If the user attempts to transmit when the radio is busy or correct call, the radio will emit a 1000 Hz 250msec tone and the radio displays the “bL” message on the LCD (if the Busy Channel Lock Out function is enabled via PC programming).

3.17. Tx Inhibit / Receive Only

If the user attempts to transmit when the SCAN-Tx option is in Normal-scan Tx or Receive-Only/No-Tx, the radio emits two 1000 Hz 250msec tones and displays the “_h” or “rO” message on the LCD.

3.18. Auto Test

In the auto test mode, the radio displays the “A” message on the LCD.

4. Features

4.1. Software Version/Revision Display

Press and hold both of the Up and Down buttons. The radio will display the software version and revision number on the LCD. The first digit is the version number and the second digit is the revision number.

4.2. Channel Spacing

The radio is capable of programmable channel spacing. Each channel can be programmed via the PC programmer (ACC-903) to have 12.5 kHz, 20 kHz, or 25 kHz channel spacing.

4.3. Output Power

The radio is capable of programmable output power. Each channel can be programmed via PC programming to have either a high or low output power.

4.4. Power Save

The radio is capable of power save parameters. The power save parameters can be programmed via the PC programmer. The power save on time (Rx off time) can be programmed from 0.1 to 4.0 seconds in 0.1 second increments. The power save off time (Rx on time) can be programmed from 0.05 to 0.2 seconds in 0.01 second increments. The power save delay time (time before the power save begins or resumes) can be programmed from 1 to 8 seconds in 1 second increments.

4.5. Low Battery

Upon detection of a low battery condition, the radio will emit three beeps repeatedly, and display the message "LC" on the LCD. The radio continuously flashes the red LED in 200msec intervals to indicate a low battery condition.

When a low battery condition is detected, the radio transmits the audio. If transmission is attempted after releasing the PTT button, no transmissions are allowed and the low battery alert is given and the "LC" message is displayed on the LCD. After the message is displayed the radio will remain in receive mode.

4.6. Transmit Time-Out-Timer/Tx Penalty

The radio has a programmable transmit Time-Out-Timer (TOT). This timer prevents the user from transmitting for extended periods of time, which may damage the radio. The Time-Out-Timer period can be

programmed via PC programming from 10 to 990 second in 10 seconds increments. At five seconds before the Time-Out-Timer time-out, the radio emits a single 1000 Hz 250msec beep to alert the user. Once the Time-Out-Timer expires, the radio emits the "Transmit Not Available" alert and displays the "Pt" message on the LCD if PTT is pressed.

The Tx Inhibit feature may be used in conjunction with the Time-Out-Timer. The Tx Inhibit feature prevents the user from transmitting again for a period of time after the Time-Out-Timer expires. The Tx Inhibit time-out can be programmed via PC programming from 0 to 75 seconds in 5 seconds increments. If the user attempts to transmit before the Tx Inhibit time-out occurs, a "Transmit Not Available" alert is given and displayed the message "Pt" is displayed on the LCD.

4.7. Squelch Options

The radio supports three different squelch options: CTCSS, DCS, Squelch defeat (Monitor). Each channel has its squelch option set during dealer programming. For each transmit operation, the squelch option is implemented if the channel is deemed not busy.

4.7.1. CTCSS

The radio supports the 38 TIA/EIA standard CTCSS tones and non-standard CTCSS tones ranging from 55 Hz to 260 Hz in 0.1Hz increments. All tones are set up during dealer programming.

Tx operation: Upon pressing the PTT, the radio encodes the channel's programmed CTCSS tone and enters the Tx mode. The tone lasts for the duration of the transmission.

End of Tx operation: Upon leaving Tx mode, the radio may employ dealer programmable squelch tail elimination functions.

Rx operation: When the proper CTCSS tone is decoded, the radio will enter the correct call state from busy state. When the proper CTCSS tone is no longer being decoded, the radio will enter the busy state from the correct call state.

4.7.2. DCS

The Radio supports the encoding and decoding of 83 TIA/EIA normal and inverted DCS data.

Tx operation: Upon the pressing of PTT, the radio encodes the programmed DCS bit pattern for the selected channel and enters the Tx mode. The data lasts for the duration of the transmission.

End of Tx operation: Upon leaving the Tx mode, the radio may employ squelch tail elimination. This is accomplished by sending a turn off code.

Rx operation: The radio will decode the incoming data stream to determine if there is a match with the pre-programmed DCS data. If the DCS data is properly decoded, the radio will enter the correct call state from the busy state. When the proper DCS data is no longer being decoded, the radio will enter the busy state from the correct call state.

4.7.3. Squelch Defeat (Monitor) operation

If a Monitor button is dealer-programmed for Monitor operation, the Monitor button will function as push on/release off. By pressing the monitor button, the user will defeat the programmed squelch operation and enter the correct call status on the selected channel. When the user releases the monitor button, the radio will enter the busy state and resume programmed squelch operation.

4.8. Busy Channel Lockout/Marked Idle

These features shall be dealer-programmable on/off. These features shall not be defeated when scan is enabled.

Busy Channel Lockout On: Upon the PTT being pressed, if carrier is present, the radio will not exit the Rx mode to enter the Tx mode. The “Transmit Not Available” alert is given.

Busy Channel Lockout Off: Upon the PTT being pressed the radio will enter the Tx mode regardless of the presence of carrier.

Marked Idle On: If the Busy Channel Lockout is on and a carrier is detected, the radio will be permitted to enter the Tx mode if the Rx squelch option is valid.

4.9. Scan Function

During programming of the radio, there are two types of scan that can be selected, All Channel Scan & Group Scan.

All Channel Scan will put every channel in the scan list. Group scan enables the user to divide their scan lists into 13 groups. The user can then select what channels will be placed in each group. The user enters the scan mode by pressing the scan button on the side of the radio.

While the radio is scanning, the LED flashes green as the radio scans. Once the radio has enabled scan, the radio will traverse through the pre-programmed scan list. The time spent on receiving a channel in the scan list is referred to as the scan speed time. When an incoming call is detected and decoded, scanning ceases and the radio enters the “Un-muted Busy Mode” or “Correct Call Mode”. After the call has ended, the radio enters the receive mode and remains on the channel that the last call was received on. The radio will wait for the programmed delay time before resuming scan. If the radio receives a call from the same caller before the scan wait time expires, the radio will re-enter the “Un-muted Busy Mode” or “Correct Call Mode” and the scan wait time will be reset. If the user is permitted to respond to the caller, the scan wait time will be reset. When the scan wait time expires, the radio will resume scanning.

4.9.1. Rx Only/No Tx

No transmissions are allowed. If transmission is attempted, the “Transmit Not Available” alert is given.

4.9.2. Normal Scan Tx

When the radio receives a call on a scanned channel transmission is allowed. When the radio does not receive a call on a scanned channel, transmission is not be allowed.

4.9.3. Priority Scan Tx

When the radio receives a call on a scanned channel, transmission is allowed on that scanned channel. The user can only initiate a new transmission on the priority channel. If a priority channel isn't selected, transmissions are not allowed.

4.9.4. Priority Only Tx

The user can only transmit on the priority channel. If the priority channel isn't selected, transmissions are not allowed.

4.9.5. Scan Tx channel

When a priority channel is assigned to any channel, scan Tx can select either priority scan Tx or priority only Tx. When priority channel is not assigned, the user can select either normal scan Tx or receive only/No Tx.

4.10. Scan Delete Function

If a channel in the scan list is constantly being scanned to, the user can temporarily delete the channel from scan list by pressing the monitor button. This process can only be initiated when scan is active and the radio is in Un-muted Busy Mode or Correct Call Mode on the channel to be deleted.

4.11. Programming & Cloning**4.11.1. Programming**

The SP-200/SP-210 requires the ACC-2002 programming cable. With the 25 pin "D" type connector installed on the computer, take the other end of the programming cable and insert it in the receptacle located on the opposite side of the PTT on the radio.

Reading

1. Ensure that radio's On/Off Volume knob is in the "OFF" position.
2. Insert the ACC-2002 programming cable into the SPK/MIC jack.
3. Place the radio in the data read mode by holding the radio's monitor switch and then turning the On/Off Volume knob on the radio to the "ON" position. Release the monitor button upon the first LED flash. The radio will then display the "_r" message on the LCD.
4. Press & release the radio's monitor button once. The LED will glow red and programming will begin.
5. After programming, the radio will display the "-End-" message on the LCD.

Writing

1. Ensure that radio's On/Off Volume knob is in the "OFF" position.
2. Connect the programming cable through mic jack.
3. Place the radio in the data write mode by holding the radio's monitor button and then

turning radio's On/Off Volume knob to the "ON" position. Release the monitor button upon the second LED flash. The radio will then display the "_w" message on the LCD.

4. Press the radio's monitor button once. The LED will glow green and programming will begin.
5. After programming in complete, the radio will display the "-End-" message on the LCD.

4.11.2. Cloning

The SP-200/SP-210 requires a cloning cable, P/N: 920-015-0006. The frequencies and functions can be programmed from radio to radio by using this cable.

1. Ensure that the On/Off Volume knob is in the "OFF" position on both radios.
2. Place the master radio (the radio which already has desired program information in the EEPROM) in the data master mode by holding the radio's monitor button and then turning radio's On/Off Volume knob to the "ON" position. The yellow LED on the radio will flash. Release the monitor button on the fourth LED flash. The radio will then display the "_m" message on the LCD.
3. Place the slave radio (the radio which is not programmed, or has program information that will be revised) into data slave mode by holding the radio's monitor button and then turning the radio's On/Off Volume knob to the "ON" position. The yellow LED on the radio will flash. Release the monitor button on the third LED flash. The radio will then display the "_S" message on the LCD.
4. Insert the cloning cable into the SPK/MIC jack.
5. Press the slave radio's monitor button. The LED will then glow green.
6. Press the master radio's monitor button. The LED will then glow red and cloning will begin.
7. After cloning, the slave radio will display the "-End-" message, and the master radio will display the "_m" message. Press the monitor button once and the radio will repeat step 6.

8. For cloning other radios, repeat steps 3 through 7.

4.12. Scan List Edit and Priority Channel Edit

- Note: The radio must be programmed for Group Scan in order to edit the scan list. "SE" will not be displayed if All Channel Scan is programmed.

The radio will enter the Edit mode by holding the Scan button when the radio is powered up. The radio will display a toggled "SE" and "PE" message on the LCD every second while holding the Scan button. If you release the Scan button while "SE" is displayed, the radio will enter the Scan List Edit mode. If you release the Scan button while "PE" is displayed, the radio will enter the Priority Channel Edit mode.

In the Scan List Edit mode the radio will display "Cx" on the LCD. The x indicates the scan group number. To change the scan group, press and release the Up or Down button. The group number will be increase or decrease respectively.

Press and release the Scan button for Scan List Editing. The radio will display the first channel number for each scan group. To change the channel, press and release the Up or Down button. Each channel will be enabled for scan by pressing and releasing the Monitor button. The radio will display the blinking channel within scan list. The changed scan list will then be saved to EEPROM when the Scan button pressed.

In Priority Channel Edit mode the radio will display the blinking Priority Channel. To change the Priority Channel, press and release the Up or Down Button. To activate the channel as the Priority Channel, press and release the monitor button. The channel is saved to EEPROM as the Priority Channel and will display the new blinking Priority Channel.

4.13. Hardware Features

- On/Off & Volume Switch
- PTT Button
- Monitor Button
- External Accessory Jack
- 199 channels /with CTCSS and DCS
- 12.5 kHz /20 kHz/ 25 kHz Programmable
- 1 / 5 Watts Switchable

4.14. Main Functions

- Standard/Non-Standard CTCSS signaling
- Transmit Time-Out-timer/Tx Inhibit
- Low Battery Indication
- Memory Protect
- Battery save Circuitry
- 199 Channels

4.15. Marked Idle Enable

If this function is enabled, the unit will transmit, provided the correct programmed CTCSS tone has been decoded. This function is essential for repeater operation.

4.16. Standard/Non-Standard CTCSS

When programming a channel with CTCSS, any frequency from 55 to 260 Hz can be selected in 0.1 Hz increments. The radio is capable of encoding and decoding two non-standard CTCSS tones.

4.17. Transmit Time-Out-Timer (TOT)/Tx Inhibit

The time-out-timer is system programmable for 10 seconds to 990 seconds in 10 second increments and can also be selected as disabled. The default value is 10 seconds. The addition to this feature is a programmable lock-out-timer that inhibits the radio transmitter for a specified time after the time-out-timer expires.

When the time-out-timer function is enabled, and the Tx inhibit function is disabled, the radio will transmit after the time-out-timer has expired and the PTT button is released and again depressed. With the TOT and Tx enabled, the radio will not transmit after the time-out-timer has expired, even if the PTT is released and depressed again. Transmission will not be allowed until the Tx inhibit time has expired. Tx inhibit time is system programmable from 5 to 60 seconds in 5 second increments. The default value for the Tx inhibit is 5 seconds. The radio will beep one time, 5 seconds before the TOT time expires. This will indicate to the user that the transmitter is about to be locked out. If the PTT is released and depressed again anytime before the TOT has expired, the TOT time will be reset. If the beep tone enable/disable is set to disable, the one beep will not be issued. The radio will beep 4 times when the TOT time expires. After the Tx inhibit time passes, the radio will beep one final time.

4.18. VCO Lock Time

The Micro will allow more lock time for the VCO before the indication of out-of-lock beep.

4.19. Low Battery Indication

The Low Battery Indication does not inhibit Rx and will allow one transmission after low cell is indicated. Low cell will not be indicated during transmit mode. If the battery goes below specified limits during the Tx mode, low cell will be indicated immediately after releasing the PTT button.

After the low cell indication is issued, the transmitter can only be used one time. When the PTT is pushed again and then released, the transmitter is locked out until the unit is powered down and then powered back up.

4.20. Memory Protect

The software is such that if the radio is inadvertently put into program mode it will not lose the contents of the EEPROM memory. Data will only move in and out of the memory when the programmer is attached.

4.21. External Option Detect

An input to the Microprocessor is available which notifies the Microprocessor that an external option has been selected. An external option should be selected for each channel. If a channel is selected during programming for external option, this input should be active when the channel is selected during operation of the unit.

Theory of Operation

4

1. Overview

The SP-200/SP-210 radios are comprised of 2 PCB's. The Digital PCB contains the controls circuits. The RF PCB contains the transmitter and receiver circuits.

2. Digital Circuit

The digital circuit is in charge of controlling all of the signal paths and to set the frequencies and selecting the desired channel.

2.1 CTCSS Decode Circuit

Discriminator audio from Pin 9 of IC5 is fed into pin 13 of IC408 and associated parts, which acts as a LPF to pass everything below 3 kHz. The audio is then fed from pin 14 of IC408 to pin 3 of the ASIC (IC406). The audio is processed inside the ASIC to filter out all audio and noise and pass all frequencies below 300 Hz. This audio is then processed again through a squaring circuit inside the ASIC and sent through Pin 21 to the Micro (IC403) for decoding. If decoding is successful, a green light will be seen on the top panel of the radio. This is accomplished by logic 1 on Pin 14 of the Micro-processor. If decoding is unsuccessful, then an amber light will be seen on the top panel of the radio. This is accomplished by a logic 1 on Pin 14 and pin 15 of the Micro. This illuminates both the red and green LED's inside LED1.

2.2 CTCSS Encode Circuit

During Tx encode the tone squelch digital signal is produced as a square wave on pins 48, 49 and 50 of the Micro. The square wave signal is fed into pin 4 of IC406. The audio is then converted into a sine wave or DCS signal inside IC406. This audio is then fed from IC406 through pin 23 to IC407 pin 3. IC407 acts as a LPF to filter out any excess noise. The audio is then fed from pin 1 of IC407 back into pin 22 of IC406. This sub-audible signal is then combined with the voice audio signal inside IC406.

2.3 External Mic/PTT Control Circuit

The external microphone is connected via a 3.5mm stereo connector (J401) located opposite the PTT. The internal mic and speaker are disabled by J401.

2.4 Low Battery Indicator Circuit

When the battery voltage drops below 5.6 VDC, D403 and Q405 turn on. This turns on Q404, which sends a logic 0 to the Micro (IC403). The Micro then gives the low battery alert of 4 beeps and continuous flashing red light on the top panel of the radio.

2.5 EEPROM

Rx and Tx channel and RSSI detection level as well as other data from the programmer are stored in the EEPROM. The data stored is retained without power supplied. This is a non-volatile memory. The EEPROM may have information reprogrammed or erased.

3. Receiver

The receiver is comprised of:

1. Front End
2. First Mixer
3. Second Oscillator Mixer Limiter and FM Detector
4. Mute (Squelch) Circuit.

3.1 Front End

The receive signal is routed backward through the low pass filter, then onward to Pin 1 of the hybrid receiver Front End Module to a matching circuit consisting of C603 through C601, L602 through L601 is coupled to the base of Q601 which serves as an RF amplifier. Diode D601 serves as protection from static RF overload from nearby transmitters. The output of Q601 is then coupled to a bandpass filter consisting of C604 through C615 and L603 through L607. The output of Pin 6 is then coupled to the doubly balanced mixer D9. The receiver Front End Module is factory pre-tuned and requires no adjustment. Repair is effected by replacement of the entire module of the proper band. These are VHF 148 MHz to 174 MHz and UHF 440 MHz to 470 MHz. The receiver Front End Module signal pins are as follows:

1. RF Input
2. Input Ground
3. N/A
4. Receive +5V
5. Ground
6. Output

3.2 First Mixer

D9, T1 and T2 are doubly balanced mixers, which provide the 45.1 MHz intermediate frequency (IF) output. The filtered frequency from the Front End Module is coupled to T1. The 45.1 MHz IF output is matched to the input of the 2-pole monolithic filter by L14, L15, C93 and C92. The crystal filter provides a bandwidth of ± 7.2 kHz from the operating frequency providing a high degree of spurious and intermodulation protection. Additionally, a 90 MHz trap (XF1) is also placed at the filter output to provide additional attenuation of the second order IMD. The output of the filter is impedance matched by C90 and C43 to the base of the post of the filter IF amplifier Q25.

3.3 Second Oscillator Mixer Limiter and FM Detector

The output of the post filter amplifier, Q25, is coupled via C98 to the input of IC5 (MC3372). IC5 is a monolithic single conversion FM receiver, containing a mixer, the second local oscillator, limiter and quadrature discriminator. Crystal X1 44.645 MHz is used to provide resultant 455 kHz signal from the output of the second mixer. The mixer output is the routed to CF1 or CF2. These ceramic filters provide the adjacent channel selectivity of 25 kHz or 12.5 kHz bandwidth.

3.4 Mute (Squelch) Circuit

The mute circuit switches off the audio amplifier when no audio is present. The squelch circuit consists of IC5 and RV2 (RV4) and their associated components. The noise signal from pin 9 of IC5 is amplified by an internal amp of IC5 and then fed to RV2 or RV4 via L16, L17. RV2 or RV4 is used to adjust the squelch circuit sensitivity and is normally adjusted to produce a noise squelch opening sensitivity of 10dB to 12dB SINAD.

4. Rx Audio Circuit

The Rx Audio Circuit is comprised of:

1. ASIC
2. Audio Amp
3. Speaker/External Speaker
4. PL Tones

4.1 ASIC

Rx Audio from Pin 9 of IC 5 enters the ASIC at pin 30 (RxAUDIN).

A1 Buffer Amp that generates discriminator audio from Pin 30 to ASW1. Its gain is 1.

ASW1 ASW1 is a 2-way switch. It passes the Rx Audio from A1 to INTRIM.

INTRIM Compensates the deviation of the input signal sensitivity. The control range is +3.5/-4dB.

HPF Composed of the 8th order or more and the cut-off frequency is 300 Hz. The signal difference is over 30dB at the cut-off frequency and the first 250 Hz of attenuation.

ASW2 ASW2 is a 4-way switch. It passes the Rx signal from the HPF to the De-Emp.

De-Emp De-Emp has a characteristic curve of +6dB/oct. The gain for 1 kHz Analog signal is 1.

VOL POT Controls the magnitude of the input analog signal to pin 28.

4.2 Audio Amp

Rx audio is passed from pin 28 of IC406 through the volume control (VR5) and to pin 8 of IC402. IC402 is a 1 watt audio amplifier with audio mute. IC402 is enabled by a logic low applied to Q415 which in turn enables Q414, applying a ground to pin 2 of IC402. When enabled Rx audio is amplified and output on pin 5.

4.3 Speaker/External Speaker

When no external speaker is plugged into J401, the Rx audio is passed through to the internal speaker. When an external speaker is plugged into J401, the internal

speaker is cut-off from the rest of the circuit and Rx audio is passed through to the external speaker.

4.4 PL Tones

Discriminator audio is passed from pin 9 of IC5 to pin 13 of IC408. IC408 is a LPF that has a cut-off frequency of 300 Hz. The LPF will pass all PL tones and attenuate any voice audio. The PL tones are passed from pin 14 of IC408 to pin 3 of the ASIC. The PL tones are sent through a LPF that has a cut-off frequency of 300 Hz. The tones are then sent through SATTRIM2, which compensates for the deviation of the input signal. The tones are then sent out pin 23 to IC407 pin 3. IC407 acts as a LPF that will further attenuate any signals above 300 Hz. The audio is then passed from pin 1 of IC407 to pin 22 of the ASIC (IC406). This signal is then passed through COMP, which acts as a squaring circuit. This signal is output on pin 21 and sent to pin 80 of the Micro. The Micro then decodes the signal from there.

5. Transmitter

The transmitter is comprised of:

1. Buffer
2. Power AMP
3. Low Pass Filter
4. Antenna Switch
5. APC Circuits

5.1 Buffer

VCO output level is 0dBm and is amplified to +17dBm (UHF/VHF). The buffer consists of Q16, Q17 and Q3 for isolation and gain.

5.2 Power Amp

The PA module consists of a 2-stage amplifier and amplifies the Tx signal from +16dBm to +37dBm. The input and the output terminal of the PA Module are a matched 50 Ohms.

5.3 Low Pass Filter

L7, L8, L11, C72, C73, C74, C75 and C76 are the 7th order Chebyshev low pass filter. Unwanted harmonics are reduced by -65 dBc.

5.4 Antenna Switch

When transmitting, the diodes D5 and D6 are forward biased enabling RF passage to the antenna. D6 is shorted to ground inhibiting the RF signal to the front-end. In receive the diodes D5 and D6 are reversed biased passing the signal from the antenna through L13 and C83 to the front-end without signal loss.

5.5 Automatic Power Control Circuit

The Automatic Power Control Circuit (APC) consists of R109, variable resistor RV1, IC3 and transistors Q19, Q21 and Q22. The supply current is monitored by a difference of voltage across R109 (0.1 Ohm). If the current is varied by RF power output or other reasons, it produces some bias voltage by IC3A and Q19. The differential signal at the output of IC3 is passed to Q21 and Q22 that produces a constant power output to the antenna. RV1 is used to adjust the RF high power level and RV3 is for low power.

6. Tx Audio Circuit

The Tx Audio Circuit is comprised of:

1. Mic/External Mic circuit
2. Tx Audio Switch
3. High Pass Filter
4. ASIC
5. PL Tones

6.1 Mic/External Mic Circuit

The Tx audio enters the radio via the internal microphone or the external microphone jack. When using the internal microphone, the audio passes through the external jack then through to the rest of the circuit. When using the external jack, the audio from the internal mic is cut off from the rest of the circuit and the external mic audio is passed to the rest of the circuit.

6.2 Tx Audio Switch

The Tx Audio Switch (IC401) is used to disconnect mic audio from the rest of the circuit when not in Tx mode. Applying a 5V source to pin 13 of IC401 completes the circuit. This will close the connection between pin 1 and pin 2 of IC401, allowing Tx audio to pass through to the rest of the circuit.

6.3 High Pass Filter

A 2-pole HPF is used to block any audio above 3 kHz. This allows all voice audio to pass through to the rest of the circuit.

6.4 ASIC

The ASIC (IC406) is a MSIMXA Audio Processor. This microphone audio enters the ASIC at pin 29.

A2 The mic audio is passed through A2 which amplifies this signal by 10dB.

ASW1 The audio is then passed to a 2-way switch ASW1. When in Tx mode, ASW1 connects the transmit audio to INTRIM.

INTRIM INTRIM adjusts for the input signal sensitivity.

HPF Composed of the 8th order or more and the cut-off frequency is 300 Hz. As for the attenuation characteristics of the filter, the signal difference must be at least over 30dB at the cut-off frequency 300 Hz and the first 250 Hz of attenuation bandwidth.

ASW2 A 4 way switch. It receives the analog signal from the HPF and its output goes to Pre-Emp.

Pre-Emp Pre-Emphasis has a characteristic of +6dB/oct. The gain for 1 kHz analog signal, which is applied from ASW2 is 1.

AMP Gain Has a minimum gain of +20dB. Amplifies the signal from the Pre-Emphasis stage.

LIMITER Limits the signal at the definite magnitude for modulation. Limiter input must be limited at 0dB(2800mVp-p) and limiter output signal must be controlled at 4 stages from 0dB to -5.4dB.

VLPF A low pass filter of at least 6th order or more and its cut-off frequency must be selected to either 2.55 kHz or 3 kHz. Filter characteristics must be at least over 21dB/oct.

TxTRIM1 Compensates deviation for the magnitude of analog input signal, within the Gain range of +3.5 to -4dB, TxTRIM1 controls at 16 stages by 4 bit signal.

TxSUM Mixes the signal from TxTRIM1 with the PL tones which is applied to TDIN (pin4). When muting, attenuation factor must be over 50dB.

ATTN Attenuates the signal applied from TxSUM by 6dB.

TxTRIM2/3 Controls the deviation of the final output signal for modulation, within the range of +3.75 to -4dB.

A3/A4 The final output buffer amp of Tx analog signal and Gain is 0dB respectively. Output A3 sends the signal to the VCO and A4 sends the signal to the TCXO.

6.5 PL Tones

PL tones enter the ASIC at pin 4 directly from the Micro. The PL tones are sent through a LPF that has a cut-off frequency of 300 Hz. The tones are then sent through SATTRIM2, which compensates for the deviation of the input signal. The tones are then sent out pin 23 to IC407 pin 3. IC407 acts as a LPF that will further attenuate any signals above 300 Hz. The audio is then passed from pin 1 of IC407 to pin 22 of the ASIC (IC406). This signal is then passed through ATTN. ATTN attenuates the signal by 6dB. The tones are then sent into TxSUM where it is mixed with the Tx audio signal.

7. PLL Circuit

The PLL Circuit is comprised of:

1. 12.8 MHz TCXO
2. PLL IC Dual modulus Prescaler
3. Level Shifter & Charge Pump
4. DC to DC Converter
5. VCO

7.1 12.8 MHz TCXO

The TCXO contains a 2-stage thermistor network compensation and crystal oscillator and modulation ports. Compensation is ± 2.5 PPM or less from -30c to +60c.

7.2 PLL IC Dual Modulus Prescaler

The input frequency of 12.8 MHz is input to IC2 MC145191F pin 20. It is divided to 6.25 kHz or 5 kHz by the reference counter, and then supplied to the comparator. RF signal input from the VCO is divided to 1/64 by the prescaler in IC2, divided by A and N counters in IC2 to determine frequency steps, then

supplied to the comparator. PLL comparison frequency is 6.25/5 kHz so that minimum programmable frequency step is 5/6.25 kHz. The A and N counters are programmed to obtain the desired frequency by serial data in the CPU. In the comparator, the phase difference between the reference and the VCO signal is compared. When the phase of the reference frequency is leading, Fr is output, but when VCO frequency is leading, Fv is the output. When Fv=Fr, phase detector out is very small 0v pulses. 64/65 modulus prescaler is comprised in IC2, and has two output ports:

Port A pin 16: Tx enable 2

Port B pin 15: prescaler power save control

Pin 13 of the PLL IC labeled test2 allows the technician to see the output of the dual modules pre-scaler for trouble shooting purposes, no connection should be made to this pin.

7.3 Level Shifter & Charge Pump

The charge pump is used for changing output signals Fr, Fv at PLL IC from 0-5v to 0-12v necessary for controlling the VCO.

7.4 Reference Frequency LPF

The Loop Filter contains R12, C21 and C22. LPF settling time is 12mS with 1 kHz frequency. This also reduces the residual side-band noise for the best signal-to-noise ratio.

7.5 DC to DC Converter

The DC to DC converter converts the 5v to 14-16v to supply the necessary voltage for wide range frequency in VCO.

7.6 VCO

The VCO consist of one VCO. It is switched Tx/Rx by switching transistor Q203. It is configured as a colpits oscillator and connected to buffer as cascade bias in order to save power. The varicap diodes D201/D202 are low-resistance elements and produce a change in frequency with a change in reverse bias voltage (2-11v). L203/C220 are resonant coil and capacitor, which changes the control voltage by the tuning core and capacitor. D202 modulation diode modulates the audio signal. C204 compensates for the non-linearity of the VCO due to the modulation diode, and maintains a constant modulation regardless of frequency.

8. Link Option

Link 2 Open. See LK15

Link 3 Open. See LK8

Link 4 Closed. If opened PTT must pass through CON403 with input on pin 9 and output on pin 3. LK9 must be closed connecting the PTT out of the option board at pin 43 of the Micro.

Link 5 Open. When LK5 is closed, the option can request monitor from the Microprocessor on CON403 pin 10 for the option board to know that the monitor button has been pressed.

Link 6 Open. Closing LK6 will enable the option board to override the Microprocessor's AUD EN line.

Link 7 Closed. If opened, receive audio must pass through option CON403 pin 8 and out pin 14. (IE: Audio descrambling is one use.)

Link 8 Closed. R409 is a bypass and normally is installed, so that unprocessed receive audio is present at pin 8 of CON403. If LK8 is closed, LK3 must be open. If LK8 is open and LK3 is closed, the Micro can mute and receive audio at pin 8 of CON403.

Link 9 Open. Connects for Tx enable (PTT output) on CON403 pin 3. LK9 closed PTT connected in conjunction with LK4 closed.

Link10 Open. If an option that uses green call LED is installed. Closing LK10 will allow PTT and low battery indication to turn the green LED off, so that the tri-color LED is red for PTT or low battery indication. This is done even if installed option is turning green LED on.

Link 11 Closed. LK11 opened disables the monitor button.

Link 12 Open. LK12 closed with LK13 opened. The option has the ability to mute the mic path by pulling pin 5 of CON403 low, this is an open drain (collector) type output.

Link 13 Open. LK13 closed allows mic audio connection to option.

- Note: LK12 and LK13 should not be closed simultaneously.

SP-200/SP-210

Theory of Operation

Link 14 Open. LK14 closed CON403 pin 3 is now Tx enable.

- Note: LK9 and LK14 should not be closed simultaneously.

Link 15 Closed. LK15 opened (LK2 closed) both Microprocessor and pin 4 of CON403 are low to enable the TDA7233. At high, either one disables the TDA7233.

Link 16 Open. LK16 closed and LK17 opened connects alerts tones at the input of the volume control. If used, option must override the AUD EN. Note: see LK 6

Link 17 Open. LK17 closed connects side tones (IE. DTMF) to the internal speaker.

Link 18 150K resistor.

Link 22 Open. Pulls pin 20 of IC406 low when in receive mode and LK22 is closed.

Link 26 Closed. Allows PL tones from Micro to pass to IC406 pin 4.

Link 27 Closed. LK27(22K) Closed and LK28 Open makes beep tones variable.

Link 28 Open. LK28 Closed and LK27 open makes beep tones non-variable

Link 29 Closed. LK 29 and LK30 closed will bypass IC407A when receiving.

Link 30 Closed. LK 29 and LK30 closed will bypass IC407A when receiving.

Link 33 Closed. Connects Scan button to CON403 pin 11 when closed.

Link 34 Closed. Connects Scan button to pin 39 of the Micro when closed.

Link 35 Open. Connects Scan button to pin 36 of the Micro when closed.

Disassembly Procedure

Any repair or adjustment should only be made by or under the supervision of a qualified Radio Service Technician.

When removing or fitting, use the Exploded View and Parts List (Page 10-1) in conjunction with the following procedures.

Removing & Replacing the Belt Clip

Removing the belt clip:

1. Depress the release tab located on the top of the belt clip.
2. While depressing the release tab, push the belt clip downward.

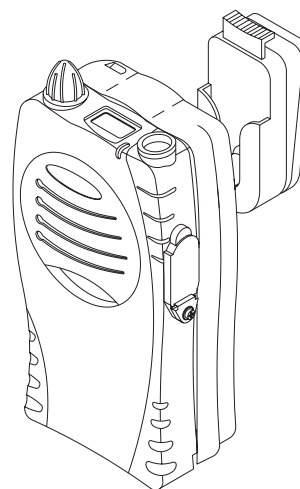


Figure 5-1. Belt Clip Removal

To replace the belt clip:

1. Locate the slot in the belt clip and align with the radio holder, located on the battery's upper left corner.
2. Push upward on the belt clip until a "click" is heard.

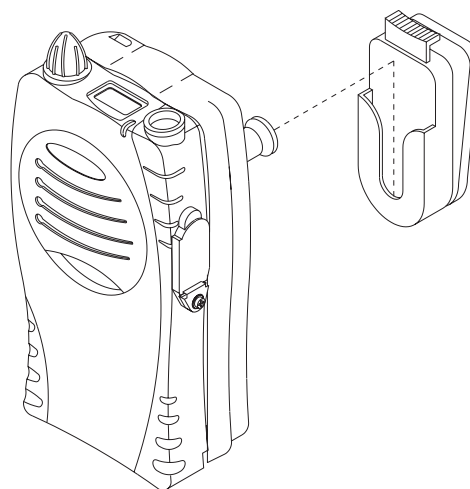


Figure 5-2. Belt Clip Installation

Removing & Replacing the Battery

To remove the battery:

1. Holding the radio chassis in one hand, press and hold the battery latch button (A) located on the top right side of the battery.
2. Using the other hand, slide the battery in a downward direction.
3. Remove the battery from the radio once it is free from the radio guide rails (B).

To replace the battery:

1. Position the battery in line with the radio battery guide rails (B).
2. Slide the battery into position until a “click” is heard.

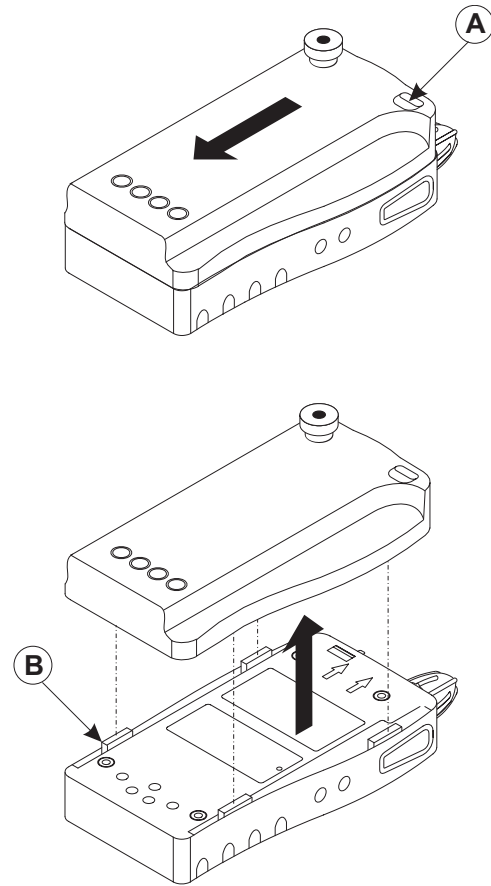


Figure 5-3. Battery Removal & Installation

Removing & Replacing the Antenna & Control Knob

To remove the Antenna:

1. Turn the Antenna counterclockwise and unscrew to remove.

To replace the Antenna:

1. Reverse the steps taken to remove the Antenna.

To remove the Control Knob:

1. Grip the control knob firmly between thumb and index finger and pull in a straight upward direction.

To replace the Control Knob:

1. Reverse the steps taken to remove the Control Knob.

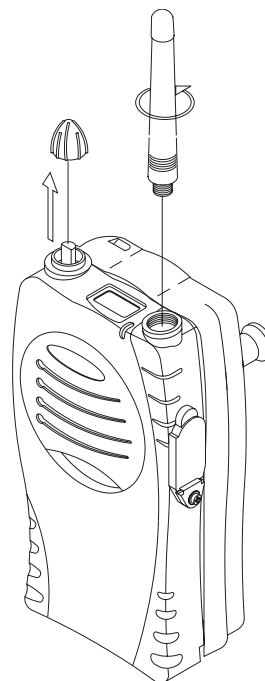


Figure 5-4. Antenna & Knob Removal & Installation

Removing & Replacing the Back Cover & RF Board

To remove the Back Cover & RF Board:

1. Remove battery.
2. Remove the Volume Control Knob.
3. Unscrew the four back cover mounting screws (A) located on the back cover of the radio. The rubber screw gaskets (B) should remain on the screw.
4. Grip the lower battery guide rails on the back cover (C) and pull outwards.
5. The RF board and back cover can now be removed by pulling the back cover away from the radio chassis (D).

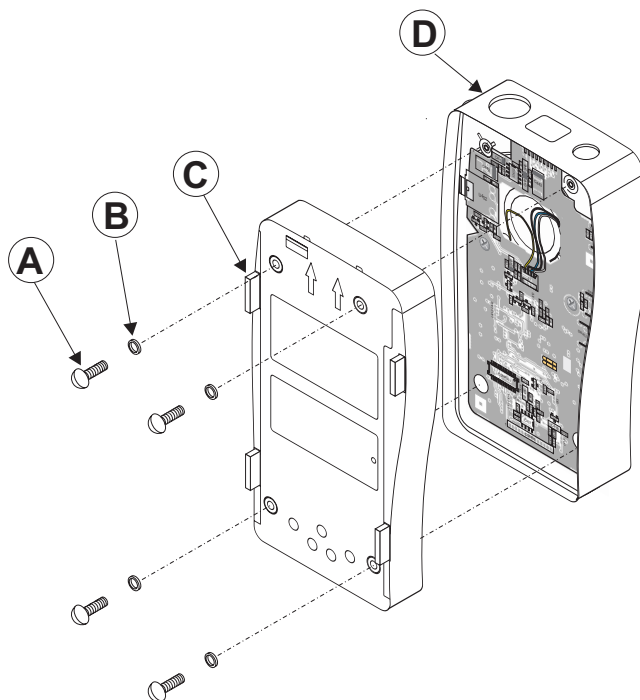


Figure 5-5. Back Cover Removal & Installation

To replace the Back Cover:

1. Reverse the steps taken to remove the back cover.

Removing & Replacing the RF Board from the Back Chassis

To remove the RF Board from the Back Chassis:

1. Remove the Ring Gasket (A) from the Back Chassis.
2. Remove the Nut (B) from the On/Off Volume switch.
3. Remove the two screws (C) that are securing the PA module to the Back Chassis.
4. Remove the screw (D), located just below the PA module, from the Back Chassis.
5. Unsolder the antenna wire (E) that connects the Antenna Connector to the RF PCB.
6. Lift the RF Board from the Back Chassis.

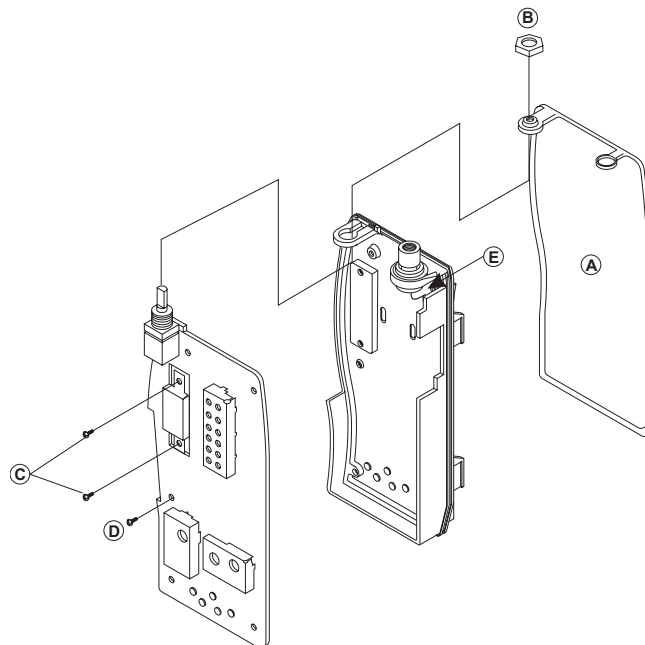
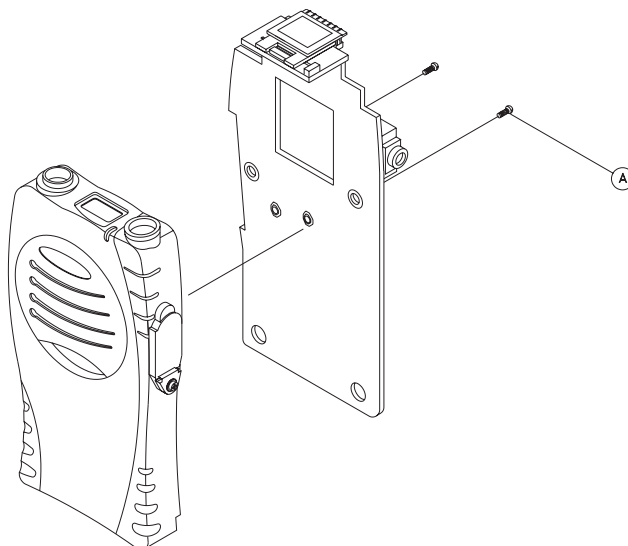


Figure 5-6. RF Board Removal

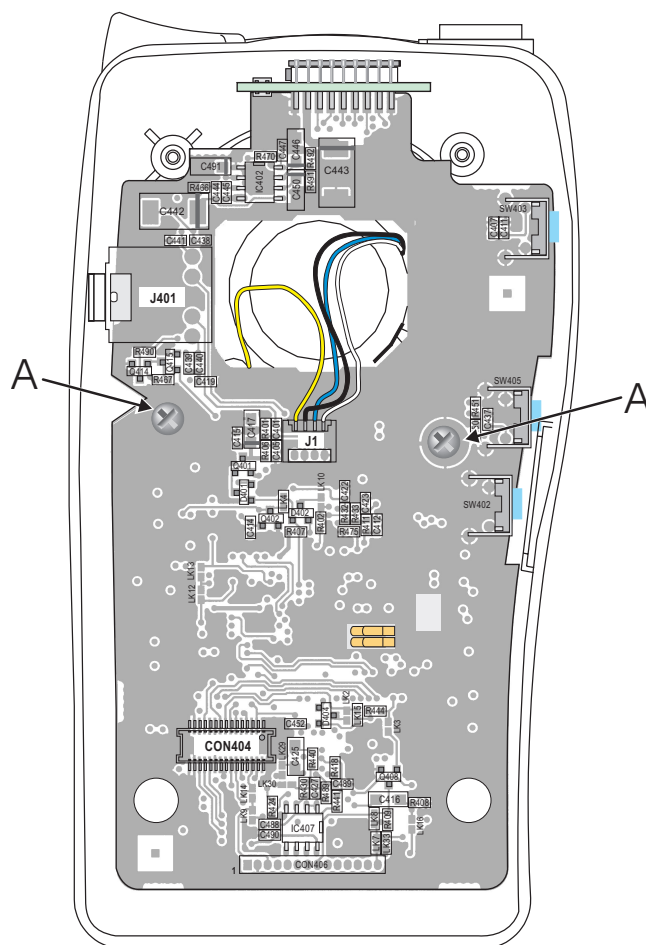
To replace the RF Board:

1. Reverse the steps taken to remove the back cover.

1. Pull out on the Speaker/Mic Dust Cap so that it is no longer inserted in the jack.
2. Remove the two screws (A) located near the middle of each side of the Digital Board.
3. Disconnect the Speaker/Mic wiring harness from the Digital Board at J1.
4. From inside the Front Cover, push out on the Front Cover at the Speaker/Mic Jack (J401). This will allow the Speaker/Mic Jack to clear the cover.
5. Simultaneously hold the front cover away from the speaker/mic jack and pull up on the Digital Board by gripping the connector CON404 and remove the Digital Board from the Front Cover.



1. Reverse the steps taken to remove the digital board.



Page 5-5
September 2000

Removing & Replacing the Daughter Boards

The Daughter Boards include the Front-End, VCO, TCXO and LCD PCB Assemblies which are soldered into the RF & Digital Board Assemblies.

1. Remove the RF Board.
2. Unsolder the appropriate Daughter Board from the RF Board Assembly.
3. To remove the LCD the Digital Board must be removed from the Front Cover.

To Replace a Daughter Board:

1. Ensure that the Main Board Assembly (RF or Digital) and Daughter Board are mechanically clean.
2. Insert the Daughter Board in the required position.
3. Ensure the Daughter Board is properly seated in the Main Board Assembly.
4. Solder the Daughter Board into position.



CAUTION



To avoid damage to a Main Board Assembly, soldering must be accomplished quickly. Refer to Component Replacement section of manual located on page 5-8.

If it becomes necessary to replace the VCO module it is recommended that the radio be sent to Customer Service.

Removing & Replacing the Speaker

To remove the speaker:

1. Remove the RF Board.
2. Disconnect the wiring harness from J1 on the Digital Board.
3. Remove the Digital Board.
4. Remove the Speaker (A) from the Front Cover.

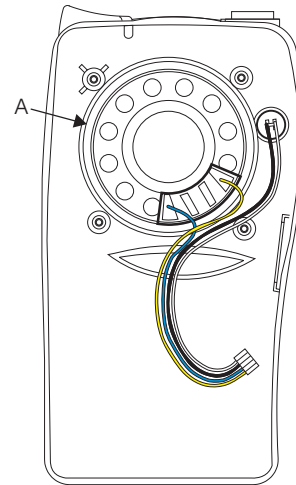


Figure 5-9. Speaker Removal & Installation

To replace the speaker

1. Reverse the steps taken to remove the speaker.

Component Replacement

Surface Mount Components

Surface mount components should always be replaced using a temperature controlled soldering system. The soldering tools may be either a temperature controlled soldering iron or a temperature controlled hot-air soldering station. A hot-air system is recommended for the removal of components on these boards. With either soldering system, a temperature of 700° F (371° C) should be maintained.

The following procedures outline the removal and replacement of surface mount components. If a hot-air soldering system is employed, see the manufacturer's operating instructions for detailed information on the use of your system.



CAUTION



Avoid applying heat to the body of any surface mount component using standard soldering methods. Heat should be applied only to the metalized terminals of the components. Hot-air systems do not damage the components since the heat is quickly and evenly distributed to the external surface of the component.



CAUTION



The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, service technicians should discharge themselves by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering equipment should have a known good earth ground.

Surface Mount Removal

1. Grip the component with tweezers or small needle nose pliers.
2. Alternately heat the metalized terminal ends of the surface mount component with the soldering iron. If a hot-air system is used, direct the heat to the terminals of the component. Use extreme care with the soldering equipment to prevent damage to the printed circuit board (PCB) and the surrounding components.

3. When the solder on all terminals is liquefied, gently remove the component. Excessive force may cause the PCB pads to separate from the board if all solder is not completely liquefied.
4. It may be necessary to remove excess solder using a vacuum de-soldering tool or Solder wick . Again, use great care when de-soldering or soldering on the printed circuit boards. It may also be necessary to remove the epoxy adhesive that was under the surface mount component and any flux on the printed circuit board.

Surface Mount Component Replacement

1. "Tin" one terminal end of the new component and the corresponding pad of the PCB. Use as little solder as possible.
2. Place the component on the PCB pads, observing proper polarity for capacitors, diodes, transistors, etc.
3. Simultaneously touch the "tinned" terminal end and the "tinned" pad with the soldering iron. Slightly press the component down on the board as the solder liquefies. Solder all terminals, allowing the component time to cool between each application of heat. Do not apply heat for an excessive length of time and do not use excessive solder.

With a hot-air system, apply hot air until all "tinned" areas are melted and the component is seated in place. It may be necessary to slightly press the component down on the board. Touch-up the soldered connections with a standard soldering iron if needed. Do not use excessive solder.



CAUTION



Some chemicals may damage the internal and external plastic parts of the radio.

4. Allow the component and the board to cool and then remove all flux from the area using alcohol or another approved flux remover.

Surface Mounted Integrated Circuit Replacement

Soldering and de-soldering techniques of the surface mounted IC's are similar to the above outlined procedures for the surface mounted chip components. Use extreme care and observe static precautions when removing or replacing the defective (or suspect) IC's. This will prevent any damage to the printed circuit board or the surrounding circuitry.

The hot-air soldering system is the best method of replacing surface mount IC's. The IC's can easily be removed and installed using the hot-air system. See the manufacturer's instructions for complete details on tip selection and other operating instructions unique to your system. If a hot-air system is not available, the service technician may wish to clip the pins near the body of the defective IC and remove it. The pins can then be removed from the PCB with a standard soldering iron and tweezers, and the new IC installed following the Surface Mount Component Replacement procedures. It may not be necessary to "tin" all (or any) of the IC pins before the installation process.

Troubleshooting Guide

SYMPTOMS	CAUSES	COUNTERMEASURES
Nothing happens when unit is turned on.	1. Complete discharge of battery (6 ±10%) 2. Fuse blown 3. 5V voltage source	1. Replace battery. 2. Replace fuse 3. IC5 (5v ±0.2V)
Warning Tone & Not Working	1. PLL error 2. Filtering error 3. EEPROM Fail 4. Low battery (<5.6V)	1. Check TCXO/VCO/PLL IC 2. Check LPF 3. Re-programming 4. Replace or charge battery
Bad Rx Sensitivity (-10 to -60dB)	1. Defective ANT sw 2. Defective Front-End 3. Defective DBM 4. IF IC 5. VCO level drop 6. Change of 1st local frequency	1. Check D5, D6 2. Check Q601 3. Check D4, T2, T3 4. Replace IC1 5. Rx VCO level >1.2 Vdc 6. Retune TCXO
Defective Rx	1. VCO frequency change or level drop 2. Defective voltage source	1. Defective IF IC (IC1) Repair VCO 2. IC5, Q1, Q3
PLL Error	1. Defective 12.8 MHz TCXO 2. Voltage source for RX VCO/TX VCO 3. Defective PLL IC	1. Replace TCXO. 2. Check Rx VCO / Tx VCO 3. Replace IC9
Low / No Tx Power	1. Tx Amp	1. Check Q6, Q7, Q9
No Modulation	1. SW IC & mic amp IC	1. Check IC2, IC8
No Programming	1. Short protector VCC	1. Defective programming lead

Voltage Charts

DIGITAL IC's UHF & VHF												
PIN	IC402			IC403B PINS 51 - 100 (1-25)					IC404		IC407	
	TX	SQ	UNSQ	LOWBAT	BCKLT ON	TX	SQ	UNSQ	TX	RX	TX	RX
1	GND			0	5	0	0	0	5	5	2.4	2.4
2	0.9	0.9	0.25	0	5	5	5	5	0.1	0.1	2.4	2.4
3	GND			0	0	0	0	0	5	5	2.4	2.4
4	7.5	7.5	7.5	0	0	0	0	4.65	GND		GND	
5	0.7	0.7	3.3	0	0	0	0	0	0	0	0.4	0.3
6	1.3	1.3	1.18	0	0	0	0	0	5	5	0.3	0.3
7	0.7	0.7	0.5	0	0	0	0	0	5	5	0	0
8	0	0	AF	0	0	0	0	0	5	5	5	5
9				0	0	0	0	0				
10				0	0	0	0	0				
11				0	0	0	0	0				
12				0	0	0	0	0				
13				0	0	0	0	0				
14				0	0	0	0	0				
15				0	0	0	0	0				
16				0	0	0	0	0				
17				0	0	0	0	0				
18				2.45	2.45	2.45	2.45	2.45				
19				2.45	2.45	2.45	2.45	2.45				
20				2.45	2.45	2.45	2.45	2.45				
21				2.45	2.45	2.45	2.45	2.45				
22				2.45	2.45	2.45	2.45	2.45				
23				2.45	2.45	2.45	2.45	2.45				
24				2.45	2.45	2.45	2.45	2.45				
25				2.45	2.45	2.45	2.45	2.45				
26				5	5	5	5	5				
27				5	5	5	5	5				
28				0	0	0	0	0				
29				0	0	0	0	0				
30				SIG	SIG	4.83	SIG	SIG				
31				0	0	0	0	0				
32				0	0	0	0	0				
33				0	0	0	0	0				
34				0	0	0	0	0				
35				5	5	5	5	5				
36				5	5	5	5	5				
37				5	5	5	5	5				
38				0.3	0.3	0.3	0.2	0.3				
39				5	5	5	5	5				
40				0.2	0.2	0.2	0.2	0.2				
41				0.2	0.2	0.2	0.2	0.2				
42				0.2	0.2	0.2	0.2	0.2				
43				0.2	0.2	0.2	0.2	0.2				
44				0.2	0.2	0.2	0.2	0.2				
45				0.2	0.2	0.2	0.2	0.2				
46				0.2	0.2	0.2	0.2	0.2				
47				0.2	0.2	0.2	0.2	0.2				
48				0.2	0.2	0.2	0.2	0.2				
49				0.2	0.2	0.2	0.2	0.2				
50				0.2	0.2	0.2	0.2	0.2				

---- UHF & VHF ----																					
PIN		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IC1	TX	GND			5	GND	8														
	RX	GND			5	GND	8														
IC2	TX	0	5	5	5	5	0.3	GND	0.2	4.7	2.6	2.6	5	3.8	4.9	0	4.9	4.9	CLK	0	12.8MHz
	RX	0	5	5	5	5	0.3	GND	0.2	4.7	2.6	2.6	5	3.8	4.9	0	0	4.9	CLK	0	12.8MHz
IC3	TX	1	3	3	GND	0.7	0.2	3.7	5												
	RX	0	3	3	GND	0	0	0	0												
	UNSQ	0	3	3	GND	0	0	0	0												
IC5	TX	0	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	GND	0				
	RX	4.3	3.7	3.5	4.4	3.4	3.4	3.4	3.4	AF	0.6	2.5	1.8	3.6	3.3	GND	1.7				
	UNSQ	4.3	3.7	3.45	4.4	3.4	3.4	3.4	3.4	AF	0.6	2.5	0	3.78	0	GND	1.7				
IC9	TX	0	3.7	7.5	0.4	GND															
	RX	0	0	7	0	GND															

DIGITAL IC's ----UHF----													
PIN	IC401				IC403 (1-50)								
	EXTTX	INTTX	SQ	UNSQ	SCAN	MON	KU	KD	NRW	LOPWR	HIPWR	SQ	UNSQ
1	2	5	5	5	GND								
2	2	5	0	0	GND								
3	2.34	2.34	2	2	GND								
4	2.34	2.34	2.4	2.4	0	0	0	0	0	0	0	0	0
5	5	5	0	0	5	5	5	5	5	5	5	5	5
6	0	0	0	0	GND								
7	GND				2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
8	0	0	0	0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
9	2	5	5	5	5	5	5	5	5	5	5	5	5
10	5	5	5	5	5	5	5	5	5	5	5	5	5
11	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	5	5	5	5	5	5	5	5	5
13	5	5	0	0	5	0	5	5	5	5	5	5	5
14	5	5	5	5	0	0	0	0	0	0	0	0	5
15					0	0	0	0	5	5	5	0	5
16					0	0	0	0	5	5	5	0	0
17					5	5	5	5	0	0	0	5	5
18					0	0	0	0	5	5	0	0	0
19					5	5	5	5	5	5	5	5	5
20					0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.4
21					0	0	0	0	0	0	0	0	0
22					0	0	0	0	0	0	0	0	0
23					0	0	0	0	0	0	0	0	0
24					0	0	0	0	0	0	0	0	0
25					5	5	5	5	5	0	0	0	0
26					5	5	5	5	0	5	5	5	5
27					0	0	0	0	0	0	0	0	0
28					1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
29					3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
30					5	5	5	5	5	5	5	5	5
31					5	5	5	5	5	5	5	5	5
32					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
33					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
34					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
35					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
36					5	5	5	5	5	5	5	5	5
37					5	5	5	5	5	5	5	5	5
38					5	5	5	5	5	5	5	5	5
39					0	5	5	5	5	5	5	5	5
40					5	5	5	0	5	5	5	5	5
41					5	5	0	5	5	5	5	5	5
42					5	0	5	5	5	5	5	5	5
43					5	5	5	5	0	0	0	5	5
44					5	5	5	5	5	5	5	5	5
45					5	5	5	5	5	5	5	5	5
46					5	5	5	5	5	5	5	5	5
47					5	5	5	5	5	5	5	5	5
48					5	5	5	5	5	5	0	5	5
49					5	5	5	5	5	5	2.4	5	5
50					0	0	0	0	0	0	2.4	0	0

DIGITAL IC's ----UHF----								
PIN	IC406				IC408			
	TX	SQ	UNSQ	NARROW	TX	SQ	UNSQ	
1	2.4	2.4	2.4	2.4	0	0	0	
2	4.9	4.9	4.9	4.9	0.3	0.3	0.3	
3	3.4	3.4	2.5	2.3	0.65	0.3	0.3	
4	2.4	2.4	2.4	2.4	5	5	5	
5	0.1	0.1	0.1	0.1	2.4	2.4	2.4	
6	0.1	0.1	0.1	0.1	2.5	2.5	2.5	
7	0.1	0.1	0.1	0.1	2.5	2.5	2.5	
8	5	5	5	5	2.5	2.5	2.5	
9	0.15	0.15	0.15	0.15	2.5	2.5	2.5	
10	0.15	0.15	0.15	0.15	2.4	2.4	2.4	
11	5	5	5	5	GND			
12	0	0	0	0	1.8	1.8	1.8	
13	5	5	5	5	1.8	1.8	1.8	
14	2.45	2.45	2.45	2.45	3.4	2.3	2.3	
15	5	5	5	5				
16	2	2	2	2				
17	1.6	1.6	1.6	1.6				
18	0	5	5	5				
19	GND							
20	0	2.4	2.4	2.4				
21	4.83	..	4.9	4.9				
22	2.34	2.4	2.4	2.4				
23	2.34	1.85	1.85	3				
24	GND							
25	2	2	2	2				
26	2.3	2.3	2.3	2.3				
27	2.4	2.4	2.4	2.4				
28	2.45	2.45	2.45	2.45				
29	2.4	2.4	2.4	2.45				
30	0	2.2	2.2	2.2				
31	2.4	2.4	2.4	2.45				
32	2.4	2.4	2.4	2.45				

DIGITAL IC's ----VHF----														
PIN	IC 401				IC403 PINS 1-50									
	EXTTX	INT TX	SQ	UNSQ	SCAN	MON	KU	KD	NRW	LOPWR	HIPWR	SQ	UNSQ	
1	2	5	5	5	GND									
2	2	5	0	0	GND									
3	2.6	2.6	2.4	2	GND									
4	2.6	2.6	2.4	2.4	0	0	0	0	0	0	0	0	0	
5	5	5	0	0	5	5	5	5	5	5	5	5	5	
6	0	0	0	0	GND									
7	GND				2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	
8	0	0	0	0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
9	2	5	5	5	5	5	5	5	5	5	5	5	5	
10	5	5	5	5	5	5	5	5	5	5	5	5	5	
11	0	1.18	3	0.2	0	0	0	0	0	0	0	0	0	
12	0	0	0	0	5	5	5	5	5	5	5	5	5	
13	5	5	0	0	5	0	5	5	5	5	5	5	0	
14	5	5	5	5	0	0	0	0	0	0	0	0	5	
15					0	0	0	0	5	5	5	0	5	
16					0	0	0	0	5	5	5	0	0	
17					5	5	5	5	0	0	0	5	5	
18					0	0	0	0	5	5	0	0	0	
19					5	5	5	5	5	5	5	5	5	
20					0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
21					0	0	0	0	0	0	0	0	0	
22					0	0	0	0	0	0	0	0	0	
23					0	0	0	0	0	0	0	0	0	
24					0	0	0	0	0	0	0	0	0	
25					5	5	5	5	5	0	0	0	0	
26					5	5	5	5	0	5	5	5	5	
27					0	0	0	0	0	0	0	0	0	
28					1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	
29					3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	
30					5	5	5	5	5	5	5	5	5	
31					5	5	5	5	5	5	5	5	5	
32					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
33					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
34					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
35					2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
36					5	5	5	5	5	5	5	5	5	
37					5	5	5	5	5	5	5	5	5	
38					5	5	5	5	5	5	5	5	5	
39					0	5	5	5	5	5	5	5	5	
40					5	5	5	0	5	5	5	5	5	
41					5	5	0	5	5	5	5	5	5	
42					5	0	5	5	5	5	5	5	5	
43					5	5	5	5	0	0	0	5	5	
44					5	5	5	5	5	5	5	5	5	
45					5	5	5	5	5	5	5	5	5	
46					5	5	5	5	5	5	5	5	5	
47					5	5	5	5	5	5	5	5	5	
48					5	5	5	5	5	5	5	5	5	
49					5	5	5	5	5	5	5	5	5	
50					0	0	0	0	0	0	0	0	0	

DIGITAL IC's ----VHF----							
PIN	IC406				IC408		
	TX	SQ	UNSQ	NARROW	TX	SQ	UNSQ
1	2.4	2.4	2.4	2.4	3.8	3.8	3.8
2	4.9	4.9	4.9	4.9	0.3	0.3	0.3
3	3.4	2.5	2.5	2.3	0.4	0.4	0.4
4	2.4	2.4	2.4	2.4	5	5	5
5	0.1	0.1	0.1	0.1	2.4	2.4	2.4
6	0.1	0.1	0.1	0.1	2.5	2.5	2.5
7	0.1	0.1	0.1	0.1	2.5	2.5	2.5
8	5	5	5	5	2.5	2.5	2.5
9	0.4	0.4	0.4	0.4	2.5	2.5	2.5
10	0.4	0.4	0.4	0.4	2.4	2.4	2.4
11	5	5	5	5	GND		
12	0	0	0	0	1.8	1.8	1.8
13	5	5	5	5	1.8	1.8	1.8
14	2.45	2.45	2.45	2.45	3.4	2.3	2.3
15	5	5	5	5			
16	2.1	2.1	2.1	2.1			
17	1.6	1.6	1.6	1.6			
18	0	0	0	0			
19	GND						
20	0	2.4	2.4	2.4			
21	4.83	SIG	4.9	4.9			
22	2.6	2.4	2.4	2.4			
23	2.6	2.4	2.1	3.25			
24	GND						
25	2	SIG	2	2			
26	2.4	3	3	3			
27	2.4	SIG	2.4	2.4			
28	2.45	2.45	2.45	2.45			
29	2.45	2.45	2.45	2.45			
30	2.2	SIG	2.2	2.2			
31	2.45	SIG	2.45	2.45			
32	2.45	2.45	2.45	2.45			

---- RF SECTION ----

VHF UHF	Hi Power			Low Power			RX		
	E	B	C	E	B	C	E	B	C
Q22	6.6	6	5.5	7	6.3	4.25	7.5	7.5	0
Q23	0	0	0.5	0	5	0	0	0	0

VHF UHF	TX			STANDARD RX			NARROW RX		
	E	B	C	E	B	C	E	B	C
Q1	0	0	0	4.4	0	4.4	4.5	5	4.5

VHF UHF	TRANSMIT			SQUELCHED			UNSQUELCHED		
	E	B	C	E	B	C	E	B	C
Q24	0	0	0	0	3.25	0	0	0	4.7
Q26	0	0	0	1.8	2.4	2.8	0.1	0.6	4.35
Q27	0	0	0	0	0.5	1.05	0	0.5	0.6

UHF	TX			RX		
	E	B	C	E	B	C
Q7	15	15	6.8	15	15	7.6
Q11	0	0	5	0	0	7.6
Q17	0	0.6	4.46	0	0	0

VHF	TX			RX		
	E	B	C	E	B	C
Q7	26.1	26.1	3.8	26.1	26.1	7.5
Q11	0	0	3.8	0	0	7.6
Q17	NOT INSTALLED					

VHF UHF	TX			RX		
	E	B	C	E	B	C
Q2	5	0	5	5	5	0
Q3	0	0.6	5.5	0	0	0
Q9	5	4	5	5	5	0
Q18	0	5	0	0	0	0
Q19	0.3	0.9	7.5	0	0	7.5
Q21	3.7	3	4.7	0	0	7.5
Q25	0	0	0	0	0.7	3.5
Q32	5	5	0	5	0	4.9

VHF UHF	ANY STATE		
	E	B	C
Q4	5	0	4.8
Q5	4.8	4.8	0
Q8	4.9	4.9	0
Q14	4.3	5	5

UHF	E	B	C
Q6	4.85	4.13	15
Q16	1.18	1.91	4.77
Q901	1.76	1.08	7.9
Q902	1.77	1.05	0
Q903	0	0.5	1.05
Q904	0	0.6	0.8
Q905	0	0.6	0.8

VHF	E	B	C
Q6	4.9	4.15	26.1
Q16	0.7	1.4	4.8
Q901	2.4	2	7.9
Q902	2.4	2	0
Q903	0	0.5	2
Q904	0	0.6	1.4
Q905	0	0.6	1.4

VHF UHF	NARROW			STANDARD		
	E	B	C	E	B	C
Q12	0	5	0	0	0	0
Q28	0	0	0	0	5	0
Q260	0	0	4.4	0	5	0

----DIGITAL SECTION----

VHF UHF	BACKLIGHT ON			BACKLIGHT OFF		
	E	B	C	E	B	C
Q409	0	5	2.75	0	0	5

VHF UHF	ANY STATE		
	E	B	C
Q406	0	0	5

VHF UHF	TX			RX		
	E	B	C	E	B	C
Q401	5	0.5	5	5	4.3	0
Q408	0	0	0.15	0	0	1
Q416	0	5	0	0	0	2.4

VHF UHF	INT TX			EXT TX			RX		
	E	B	C	E	B	C	E	B	C
Q402	0	0	0	0	5	0	0	0	5
Q403	5	5	0	5	2	5	5	5	0

VHF UHF	TRANSMIT			SQUELCHED			UNSQUELCHED		
	E	B	C	E	B	C	E	B	C
Q407	0	5	0	0	0	5	0	5	0
Q411	0	0	5	0	0	5	0.3	5	0.4
Q414	0	0	0.8	0	0	0.8	0	2.7	0
Q415	0	4.5	0	0	4.5	0	0	0	2.7

VHF UHF	LOW BATT			NOT LOW BATT		
	E	B	C	E	B	C
Q405	5	4.4	5	5	6	0
Q404	0	5	0	0	0	5

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Alignment

6

Introduction

Normally the radio will not require alignment. However, if alignment becomes necessary, the following procedures should be followed in conjunction with the "Test Equipment Setup" as shown in Figure 6-1 and the "Radio Configuration Setup" in Figure 6-2.

- Note: If it becomes necessary to align the Tone Deviation, Voice Deviation, Mic Sensitivity or Balance Tone, the ACC-2003 Alignment Kit (P/N: 480-030-0010) will be required. This kit includes the ACC-903A Alignment Software (P/N: 820-030-0045) and the ACC-2003 Interface Module (P/N: 510-050-0047).

Required Test Equipment

- Extender Card Kit (P/N: 480-030-0011)
- RF Signal Generator
- Watt Meter
- Modulation Meter
- Digital Volt Meter
- Oscilloscope
- Frequency Counter
- Audio Generator
- Distortion Meter
- Sinad Meter
- 20dB Dummy Load
- DC Power Supply
- Spectrum Analyzer (Optional)

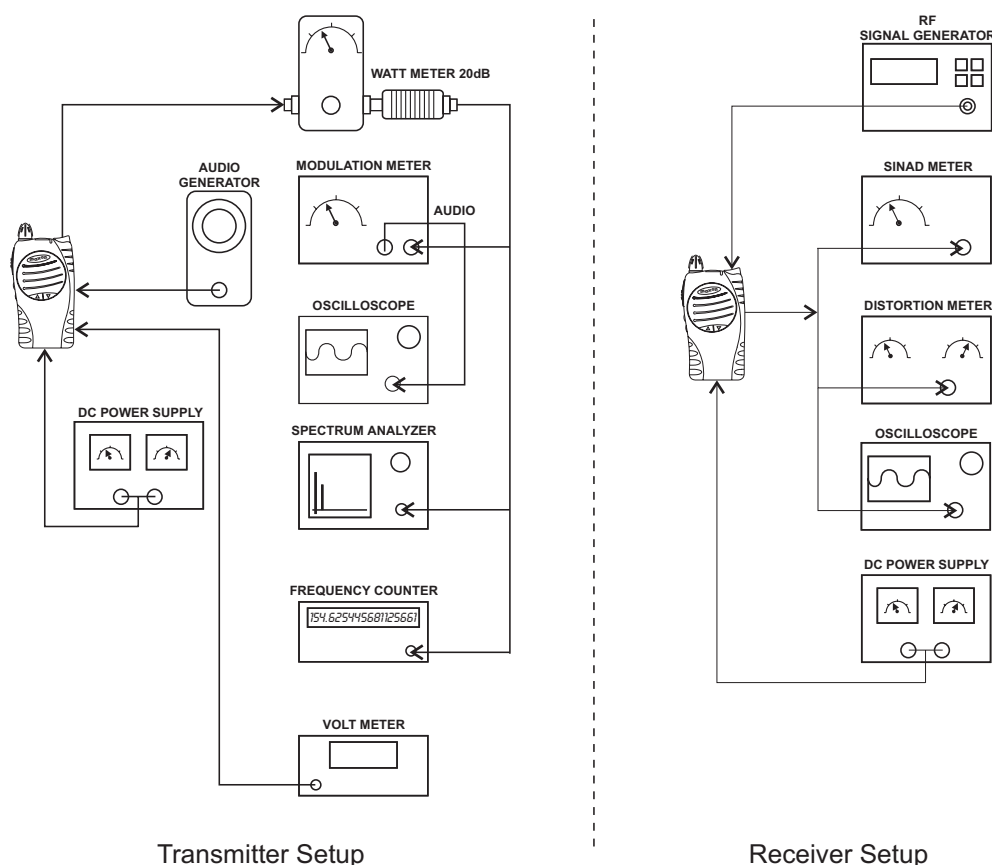


Figure 6-1. Test Equipment Setup

Radio Configuration Setup

The following Radio Configuration Setup must be accomplished using the Extender Card Kit (P/N: 480-030-0011) in order to reach all required alignment points and allow access to the PCB's for troubleshooting.

1. Disassemble the radio to the level shown in Fig. 6-2.
2. Install stand-offs (C), washer (G) and nuts (F).
3. Attach the Extender Card (D) on CON404 (A) and J3 (B).
4. Secure the Extender Card with screws (E).
5. Solder the center conductor of a BNC cable to the antenna input and the shield of the BNC to the ground plane on the radio PCB.
6. Solder an insulated wire to the power input terminal (I) to apply power to the radio.

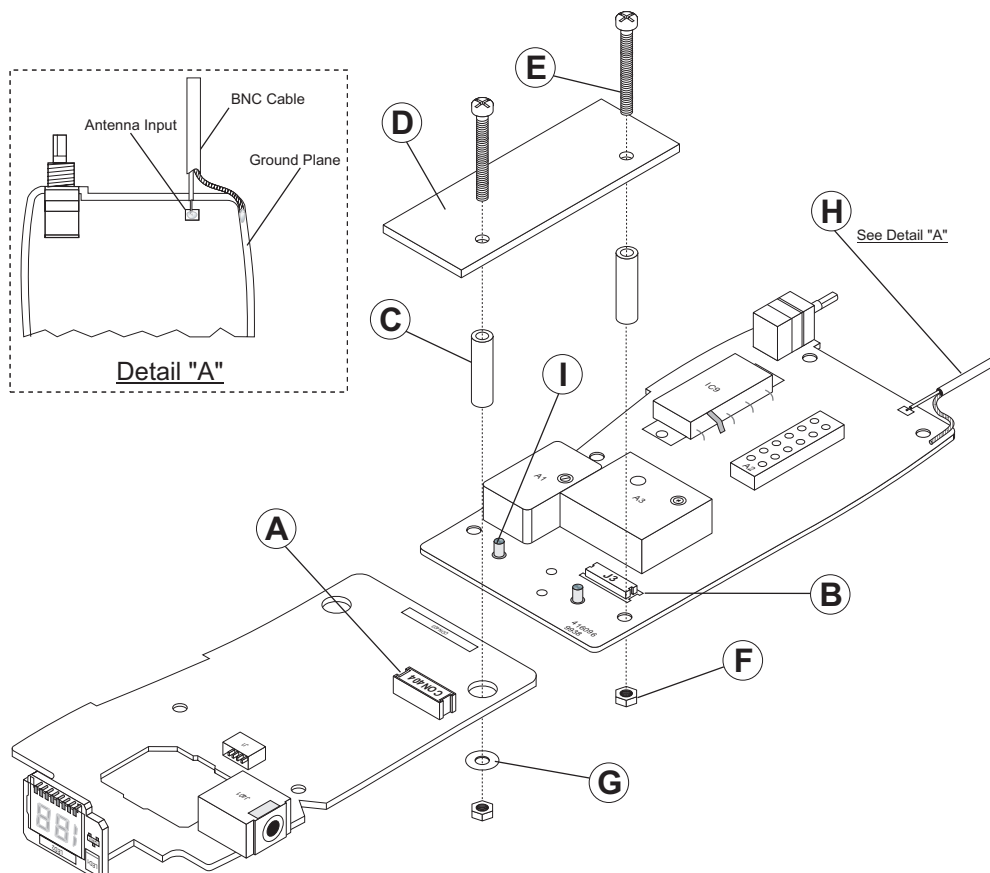


Figure 6-2. Radio Configuration Setup

Alignment Procedure

Squelch

1. Select a receiver channel that is programmed for narrow band (12.5kHz) operation.
2. Set the RF signal generator to the receiver frequency. Set the AF modulation signal to 1 kHz at 1.5K deviation.
3. Adjust the RF output level of the RF signal generator until the 1kHz signal is heard.
4. Adjust the RF signal to the level desired for squelch sensitivity as you monitor SINAD. This is usually 8dB to 12dB sinad.
5. On the Main board, adjust RV2 until the squelch is just unmuted (open).
6. Switch off the RF generator (squelch should close).
7. Switch on the RF generator, Squelch should open at the SINAD point where RV2 was adjusted.
8. Select a receiver channel that is programmed for wide band operation (25kHz).
9. Set the RF signal generator to the receiver frequency. Set the AF modulation signal to 1 kHz at 3K deviation.
10. Adjust the RF output level of the RF signal generator until the 1kHz signal is heard.
11. Adjust the RF signal to the level desired for squelch sensitivity as you monitor SINAD. This is usually 8dB to 12 dB SINAD.
12. On the Main board, adjust RV4 until the squelch is just unmuted (open).
13. Switch off the RF generator (squelch should close).
14. Switch on the RF generator, Squelch should open at the SINAD point where RV4 was adjusted.

VCO

- Note: Use TP1 to measure voltage.

1. Set the radio to the lowest transmitter frequency: **440 MHz (UHF)** or **148 MHz (VHF)** and while transmitting adjust the VCO L203 to **2.37V (UHF)** or **1.5V (VHF)**.
2. Set the radio to the highest transmitter frequency: **470 MHz (UHF)** or **174 MHz (VHF)** and while transmitting verify that the VCO voltage is **7.93V (UHF)** or **10.2~11.5V (VHF)**.
3. Set the radio to the lowest receiver frequency: **440 MHz (UHF)** or **148 MHz (VHF)** and while receiving adjust the VCO C208 to: **1.54V (UHF)** or **6~7V (VHF)**.
4. Set the radio to the highest receiver frequency: **470 MHz (UHF)** or **174 MHz (VHF)** and while receiving, verify that the VCO voltage is **9.4V (UHF)** or **11~12V (VHF)**.

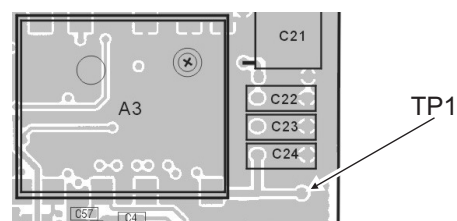


Figure 6-3. VCO Alignment Points

TCXO

1. Connect the radio to an RF signal generator.
2. Set the radio to the mid-range frequency: **455 MHz (UHF)** or **161 MHz (VHF)** and adjust the TCXO CT1 to within ± 200 Hz while transmitting.

APC (Automatic Power Control)

1. Connect the radio to an RF signal generator with the power meter set to the 5 Watt scale (or autorange).
2. Set the radio to a channel programmed for High Power (H).
3. While transmitting, adjust RV1 for High Power (5 Watts).
4. Set the radio to a channel programmed for Low Power (L).
5. While transmitting, adjust RV3 for Low Power (1 Watt).

Additional Alignments

If it becomes necessary to align the Tone Deviation, Voice Deviation, Mic Sensitivity or Balance Tone, the ACC-2003 Alignment Kit (P/N: 480-030-0010) will be required. This kit includes the ACC-903A Alignment Software (P/N: 820-030-0045) and the ACC-2003 Interface Module (P/N: 510-050-0047).

Computer System Requirements

- IBM® compatible (486 or faster)
- DOS 6.0 or later
- 8 MB of RAM (16 MB recommended)
- 1MB of hard disk space
- 1.44MB floppy disk drive
- Communications Port
- RS232 Serial Cable

Parts List

7

SP-200/SP-210 DIGITAL BOARD (650-010-0041/650-010-0043)

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
C187	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	C494	CAP, CER,0.015UF,10%,25V,X7R,0603,	100-611-1153
C401	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C495	CAP, CER,180PF,10%,50V,X7R,0603	100-621-1181
C402	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	CON404	CONN, RECPT,30P,DF15 SERIES,0.65MM	140-020-0064
C403	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	D401	DIODE, SW,KDS181S,SOT-23	220-010-0004
C404	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	D402	DIODE, SW,KDS181S,SOT-23	220-010-0004
C405	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	D403	DIODE, SW,KDS193,SOT-23	220-010-0003
C406	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	D404	DIODE, SW,KDS184S,SOT-23	220-010-0002
C407	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	E2	SW, DOME ASSY, 2DOMES,12MM,W/ADHB	830-110-0002
C408	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	IC401	IC, SW/MUX,MC14066BDR2,SO-14,A-SW	444-050-0001
C410	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	IC402	IC, AUDIO AMP,TDA7233D,SO-8	441-040-0013
C411	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	IC403	IC, CPU,MASK,HD6433837UX, QFP-100	443-203-0007
C412	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	IC404	IC, EEPROM, X25330S,SOIC-8	442-010-0019
C413	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	IC406	IC, AUDIO PROCESSOR,ASIC, MSIMXA	441-140-0003
C414	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	IC407	IC, OP AMP,LM358MX,SO-8,DUAL	441-030-0006
C415	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	IC408	IC, OP AMP,KIA324F,SO-14,QUAD	441-030-0002
C416	CAP, CER,1UF,+80-20%,16V,Y5V,1206	100-803-3089	J1	PIN, HDR,4P/SIP,R ANG,SHROUD,WAF	140-030-0043
C417	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	J401	JACK, EAR MIC,SLDR TYPE	140-080-0010
C418	CAP, CER,2200PF,5%,50V,X7R,0603	100-521-1222	L401	COIL CHIP,10UH,CYLNDRCL,+/-10%,1206	371-005-3103
C419	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	LK4	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C420	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	LK7	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C421	CAP, CER,0.022UF,10%,50V,X7R,0603	100-621-1223	LK8	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C422	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	LK11	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C423	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	LK15	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C424	CAP, CER,680PF,10%,50V,X7R,0603	100-621-1681	LK18	RES, TF,150K,5%,1/16W,+/-200,0603	741-102-1154
C425	CAP, CER,0.68UF,+80-20%,16V,Y5V,0805	100-803-2684	LK22	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C427	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	LK26	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C428	CAP, CER,15PF,5%,50V,COG,0603	100-520-1150	LK27	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223
C429	CAP, CER,15PF,5%,50V,COG,0603	100-520-1150	LK29	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C430	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	LK30	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C431	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	LK33	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C432	CAP, CER,0.0033UF,10%,50V,X7R,0603	100-621-1332	LK34	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
C433	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	Q401	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C434	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	Q402	TRANS, NPN,KRC101S,SOT-23,SW,(NA)	870-020-0002
C435	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	Q403	TRANS, PNP,BRT,KRA101S,SOT-23,SW,PA	870-010-0002
C436	CAP, CER,0.012UF,10%,25V,X7R,0603	100-611-1123	Q404	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C437	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	Q405	TRANS, PNP,KTA1504(Y),SOT-23,SW	870-100-0004
C438	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q406	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C439	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q408	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C440	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q414	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C441	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q415	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C442	CAP, TA,100UF,20%,6.3V,D	102-013-3107	Q416	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C443	CAP, TA,4.7UF,20%,20V,B,(3528,1411)	102-043-1475	R401	RES, TF,4.7K,5%,1/16W,+/-200,0603	741-102-1472
C444	CAP, CER,0.056UF,10%,16V,X7R,0603	100-601-1563	R402	RES, TF,560,5%,1/16W,+/-200,0603	741-102-1561
C445	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	R403	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103
C446	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	R404	RES, TF,220K,5%,1/16W,+/-200,0603	741-102-1224
C447	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	R405	RES, TF,120K,5%,1/16W,+/-200,0603	741-102-1124
C450	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	R406	RES, TF,6.8K, 5%, 1/16W,+/-200, 0603	741-102-1682
C451	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	R407	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473
C452	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	R408	RES, TF,1M,5%,1/16W,+/-200,0603	741-102-1105
C453	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	R409	RES, TF,100K,5%,1/16W,+/-200,0603	741-102-1104
C454	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	R410	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473
C486	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	R411	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473
C488	CAP, CER,0.0047UF,10%,50V,X7R,0603	100-621-1472	R412	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223
C489	CAP, CER,0.0047UF,10%,50V,X7R,0603	100-621-1472	R413	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103
C490	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	R415	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473
C491	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	R416	RES, TF,1.5K,5%,1/16W,+/-200,0603	741-102-1152
C492	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	R418	RES, TF,51K,5%,1/16W,+/-200,0603	741-102-1513
C493	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	R419	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473

SP-200/SP-210

Parts List

REF	DESCRIPTION	PART NO.
R420	SEE TABLE 7-1	
R421	SEE TABLE 7-1	
R422	SEE TABLE 7-1	
R423	SEE TABLE 7-1	
R424	RES, TF, 2.2K, 5%, 1/16W, +/-200,0603	741-102-1222
R425	RES, TF, 27K, 5%, 1/16W, +/-200,0603	741-102-1273
R426	RES, TF, 68K, 5%, 1/16W, +/-200, 0603	741-102-1683
R427	RES, TF, 27K, 5%, 1/16W, +/-200,0603	741-102-1273
R428	RES, TF, 120K, 5%, 1/16W, +/-200,0603	741-102-1124
R429	RES, TF, 27K, 5%, 1/16W, +/-200,0603	741-102-1273
R430	RES, TF, 10K, 5%, 1/16W, +/-200,0603	741-102-1103
R432	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R433	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R435	RES, TF, 2K, 5%, 1/16W, +/-200,0603	741-102-1202
R436	SEE TABLE 7-1	
R438	RES, TF, 200K, 5%, 1/16W, +/-200,0603	741-102-1204
R440	RES, TF, 10K, 5%, 1/16W, +/-200,0603	741-102-1103
R441	RES, TF, 120K, 5%, 1/16W, +/-200,0603	741-102-1124
R443	RES, TF, 4.7K, 5%, 1/16W, +/-200,0603	741-102-1472
R444	RES, TF, 4.7K, 5%, 1/16W, +/-200,0603	741-102-1472
R445	RES, TF, 1M, 5%, 1/16W, +/-200,0603	741-102-1105
R450	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R451	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R454	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R455	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R456	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R457	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R458	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R459	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R460	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R461	RES, TF, 100K, 5%, 1/16W, +/-200,0603	741-102-1104
R464	RES, TF, 220K, 5%, 1/16W, +/-200,0603	741-102-1224
R466	RES, TF, 10, 5%, 1/16W, +/-200,0603	741-102-1100
R467	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R470	RES, TF, 22K, 5%, 1/16W, +/-200,0603	741-102-1223
R471	RES, TF, 330K, 5%, 1/16W, +/-200,0603	741-102-1334
R472	SEE TABLE 7-1	
R473	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R474	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R475	RES, TF, 47K, 5%, 1/16W, +/-200,0603	741-102-1473
R477	RES, TF, 22, 5%, 1/16W, +/-200,0603	741-102-1220
R482	RES, TF, 22, 5%, 1/16W, +/-200,0603	741-102-1220
R483	RES, TF, 2.2K, 5%, 1/16W, +/-200,0603	741-102-1222
R484	RES, TF, 330, 5%, 1/16W, +/-200,0603	741-102-1331
R486	RES, TF, 120K, 5%, 1/16W, +/-200,0603	741-102-1124
R487	RES, TF, 7.5K, 5%, 1/16W, +/-200,0603	741-102-1752
R488	RES, TF, 330K, 5%, 1/16W, +/-200,0603	741-102-1334
R489	RES, TF, 51K, 5%, 1/16W, +/-200,0603	741-102-1513
R490	RES, TF, 1K, 5%, 1/16W, +/-200,0603	741-102-1102
R491	RES, TF, 20K, 5%, 1/16W, +/-200,0603	741-102-1203
R492	RES, TF, 20K, 5%, 1/16W, +/-200,0603	741-102-1203
R493	RES, TF, 82K, 5%, 1/16W, +/-200,0603	741-102-1823
SW402	SW, TACT,SKPT-1101VA, FLAT STEM,	830-070-0006
SW403	SW, TACT,SKPT-1101VA, FLAT STEM,	830-070-0006
SW405	SW, TACT,SKPT-1101VA, FLAT STEM,	830-070-0006
X401	XTAL, 3.579545MHZ, 12PF, 50PM, CP12A	162-000-0036

650-190-0006 (LCD DISPLAY)

REF	DESCRIPTION	PART NO.
E401	LCD, BKLIGHT, LIGHT PIPE, 13X9XT3.2, SI-RB	760-072-0005
LED1	LED, LAMP CHIP, RED/GRN, 3.0X2.5	240-030-0035
LED2	LCD, BKLIGHT, SLE0022M, SP-200	240-050-0006
Q407	TRANS, NPN, KRC104SND, SOT-23, SW	870-020-0001
Q409	TRANS, NPN, KRC104SND, SOT-23, SW	870-020-0001
Q411	TRANS, NPN, KRC104SND, SOT-23, SW	870-020-0001
R446	RES, TF, 470, 5%, 1/16W, +/-200,0603	741-102-1471
R447	RES, TF, 1.2K, 5%, 1/16W, +/-200,0603	741-102-1122
R448	RES, TF, 51, 5%, 1/16W, +/-200,0603	741-102-1510
R453	RES, TF, 33, 5%, 1/16W, +/-200,0603	741-102-1330
U401	LCD, DISPLAY, 3DIGIT, 15.25X10.9, 16PIN,	240-010-0022

650-010-0041 SP-200 VHF (148-174 MHz)

REF	DESCRIPTION	PART NO.
R420	RES, TF, 36K, 5%, 1/16W, ±200,0603	741-102-1363
R421	RES, TF, 15K, 5%, 1/16W, ±200,0603	741-102-1153
R422	RES, TF, 18K, 5%, 1/16W, ±200,0603	741-102-1183
R423	RES, TF, 75K, 5%, 1/16W, ±200,0603	741-102-1753
R436	RES, TF, 51K, 5%, 1/16W, ±200,0603	741-102-1513
R472	RES, TF, 39K, 5%, 1/16W, ±200,0603	741-102-1393

650-010-0043 SP-210 UHF (440-470 MHz)

REF	DESCRIPTION	PART NO.
R420	RES, TF, 100K, 5%, 1/16W, ±200,0603	741-102-1104
R421	RES, TF, 51K, 5%, 1/16W, ±200,0603	741-102-1513
R422	RES, TF, 20K, 5%, 1/16W, ±200,0603	741-102-1203
R423	RES, TF, 200K, 5%, 1/16W, ±200,0603	741-102-1204
R436	RES, TF, 120K, 5%, 1/16W, ±200,0603	741-102-1124
R472	RES, TF, 100K, 5%, 1/16W, ±200,0603	741-102-1104

Table 7-1. UHF/VHF Chart

SP-200 VHF (148-174 MHz) RF BOARD (650-020-0035)

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
REPLACEMENT MODULES			C68	CAP, CER,0.001UF,10%,50V,X7R,0805	100-621-2102
A1	ASSY, P/L,TCXO,"B",GMR5-21X	650-100-0007	C70	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
A2	ASSY, P/L,FRONT END,148-174MHZ,SP-200	650-110-0022	C72	CAP, CER,18PF,5%,50V,COG,0805	100-520-2180
A3	ASSY, P/L, PCB,VCO TX/RX,148-174MHZ	650-030-0033	C74	CAP, CER,43PF,5%,50V,COG,0805	100-520-2430
C1	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C75	CAP, CER,27PF,5%,50V,COG,0805	100-520-2270
C2	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	C77	CAP, CER,0.001UF,10%,50V,X7R,0805	100-621-2102
C3	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C78	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C4	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C79	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C6	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C80	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C7	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C81	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C8	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C82	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C9	CAP, CER,330PF,5%,50V,COG,0603	100-520-1331	C83	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120
C10	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120	C84	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C11	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C87	CAP, CER,22PF,5%,50V,COG,0603	100-520-1220
C12	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	C88	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104
C13	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C90	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120
C14	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C92	CAP, CER,14PF,5%,50V,COG,0603	100-520-1140
C15	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C93	CAP, CER,82PF,5%,50V,COG,0603	100-520-1820
C16	CAP, CER,6PF,0.5PF,50V,COG,0603	100-120-1060	C94	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
C17	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C95	CAP, TA,4.7UF,20%,10V,3216	102-023-0475
C18	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	C96	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C19	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C98	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C20	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C102	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C21	CAP, METAL POLY,0.68UF,10%,63V BOX	083-013-2684	C103	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C22	CAP, METAL POLY,0.022UF,10%,63V BOX	083-013-2223	C104	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C23	CAP, METAL POLY,0.01UF,10%,63V KBOX	083-014-2103	C105	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C24	CAP, METAL POLY,0.01UF,10%,63V KBOX	083-014-2103	C106	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C25	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C107	CAP, CER,10PF,0.5PF,50V,COG,0603	100-120-1100
C26	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C108	CAP, CER,0.0027UF,5%,50V,X7R,0603	100-521-1272
C27	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C111	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C28	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C112	CAP, CER,0.033UF,10%,16V,X7R,0603	100-601-1333
C29	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C113	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C30	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C114	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C31	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C115	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C32	CAP, CER,20PF,5%,50V,COG,0603	100-520-1200	C116	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C33	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C117	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C34	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C118	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330
C36	CAP, CER,14PF,5%,50V,COG,0805	100-520-2140	C121	CAP, CER,10PF,0.5PF,50V,COG,0603	100-120-1100
C37	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330	C122	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C38	CAP, CER,20PF,5%,50V,COG,0805	100-520-2200	C123	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C42	CAP, CER,51PF,5%,50V,COG,0805	100-520-2510	C124	CAP, CER,0.1UF,10%,50V,X7R,0603	100-621-1104
C43	CAP, CER,8PF,0.5PF,50V,COG,0603	100-120-1080	C126	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C45	CAP, CER,10PF,0.5PF,50V,COG,0603	100-120-1100	C127	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C46	CAP, CER,5PF,0.25PF,50V,COG,0603	100-020-1050	C128	CAP, TA,4.7UF,20%,10V,3216	102-023-0475
C47	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C129	CAP, ELE,10UF,16V,20%,3X5,5.0PT	081-032-3106
C48	CAP, CER,0.1UF,10%,50V,X7R,0603	100-621-1104	C131	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C51	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330	C145	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C52	CAP, CER,100PF,+/-5%,50V,COG,0603	100-520-1101	C146	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C53	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C163	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C54	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	C164	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C55	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C165	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C56	CAP, CER,6PF,0.5PF,50V,COG,0603	100-120-1060	C166	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C57	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C190	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C58	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C191	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C59	CAP, CER,0.47UF,+20-80%,16V,Y5V,0805	100-803-2474	C192	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
C60	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C194	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C61	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C195	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104
C62	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C303	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C63	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C304	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C65	CAP, TA,10UF,20%,10V,B,3528	102-023-1106	C307	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C66	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C308	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C67	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	C309	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
			C310	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221

SP-200/SP-210

Parts List

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
C311	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L11	COIL, SPRG, 3X0.55X5T:L SMD	350-000-0105
C314	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L13	COIL, SPRG,2.8X0.4X8T:L,SMD	350-000-0106
C316	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L14	COIL, CHIP,680NH,5%,25.2MHZ	371-313-3681
C318	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L15	COIL, CHIP,0.15UH,5%,NL252018T-R15J	371-004-3R15
C319	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L16	COIL, CHIP,1000UH,10%,300SS-102K	370-012-4102
C321	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L17	COIL, CHIP,1000UH,10%,300SS-102K	370-012-4102
C322	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L18	COIL, CHIP,1UH,5%,NL252018T-1R0J	371-017-3102
C323	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L19	COIL CHIP,10UH,CYLNDRCCL,+/-10%,1206	371-005-3103
C325	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	LK3	RES, TF, 0, 5%, 1/16W, +/-200,0603	741-102-1000
C326	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q1	TRANS, PNP,KRA104S,SOT-23,SW,(PD)	870-010-0005
C327	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q2	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C328	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q3	TRANS, 900MHZ AMP,MMBR951,SOT-23	870-200-0026
C908	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330	Q4	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C901	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q5	TRANS, PNP,KRA104S,SOT-23,SW,(PD)	870-010-0005
C902	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q6	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C903	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q7	TRANS, PNP,KTA1504(Y),SOT-23,SW	870-100-0004
C904	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q8	TRANS, PNP,KTA1504(Y),SOT-23,SW	870-100-0004
C905	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q9	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C906	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q11	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C907	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	Q12	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C910	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q14	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C911	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q16	TRANS, 900MHZ AMP,MMBR951,SOT-23	870-200-0026
C915	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q17	RES, TF, 0, 5%, 1/16W, +/-200,0603	741-102-1000
C916	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q18	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CF1	FILTER, CER,CFWM455F,455KHZ	310-010-0030	Q19	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
CF2	FILTER, CER,LTWM455HT,455KHZ	310-010-0025	Q21	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
CON1	TERM, CONTACT SPRING, GW9803302	140-060-0027	Q22	TRANS, PNP,KTA1663(Y),SOT-89	870-150-0002
CON2	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q23	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CON7	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q24	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CON8	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q25	TRANS, NPN,BFR92A,SOT-23	870-200-0020
CON9	TERM, CONTACT SPRING, GW9803302	140-060-0027	Q26	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
D2	DIODE, RECTIFIER,SM4004,400V,1A,SMD	220-030-0003	Q260	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
D5	DIODE, PIN,UPP9401,(T&R)50V,2.5W	220-020-0001	Q27	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
D6	DIODE, PIN,UPP9401,(T&R)50V,2.5W	220-020-0001	Q28	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
D8	DIODE, SW,KDS193,SOT-23	220-010-0003	Q32	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
D9	DIODE, SCHOTTKY,CHIP,HSMS-2817#L31	220-040-0009	Q901	TRANS, NPN,KTC4075,UMT3	870-200-0031
D13	DIODE, SW,KDS181S,SOT-23	220-010-0004	Q902	TRANS, PNP,KTA2014, USM	870-100-0018
D14	DIODE, SW,KDS181S,SOT-23	220-010-0004	Q903	TRANS, NPN,KTC4075,UMT3	870-200-0031
D16	DIODE, SW,KDS193,SOT-23	220-010-0003	Q904	TRANS, NPN,KTC4075,UMT3	870-200-0031
D21	DIODE, PIN,MMBV3401LT1,SOT-23	220-020-0002	Q905	TRANS, NPN,KTC4075,UMT3	870-200-0031
D25	DIODE, PIN,MMBV3401LT1,SOT-23	220-020-0002	R1	RES, TF,10K,5%, 1/16W,+/-200,0603	741-102-1103
D901	DIODE, SW,KDS226,SOT-23	220-010-0005	R2	RES, TF,100K,5%, 1/16W,+/-200,0603	741-102-1104
D902	DIODE, SW,KDS226,SOT-23	220-010-0005	R3	RES, TF,2.2K,5%, 1/16W,+/-200,0603	741-102-1222
D903	DIODE, SW,KDS226,SOT-23	220-010-0005	R4	RES, TF,1.8K,5%, 1/16W,+/-200,0603	741-102-1182
D903	RES, TF, 0, 5%, 1/16W, +/-200,0603	741-102-1000	R5	RES, TF,1.8K,5%, 1/16W,+/-200,0603	741-102-1182
E1	FNGR STRIP, 99-160-NT-80	560-140-0004	R6	RES, TF,2K,5%, 1/16W,+/-200,0603	741-102-1202
E2	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R7	RES, TF,1.8K,5%, 1/16W,+/-200,0603	741-102-1182
E3	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R8	RES, TF,910,5%, 1/16W,+/-200,0603	741-102-1911
E4	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R9	RES, TF,5.6K,5%, 1/16W,+/-200,0603	741-102-1562
E8	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R10	RES, TF,390,5%, 1/16W,+/-200,0603	741-102-1391
E9	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R11	RES, TF,100,5%, 1/16W,+/-200,0603	741-102-1101
E10	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R12	RES, TF,3.3K,5%, 1/16W,+/-200,0603	741-102-1332
FUSE1	FUSE, CER, F/B,60V,4A,5.7X2DIA,SMT	700-020-0002	R13	RES, TF,2.7K,5%, 1/16W,+/-200,0603	741-102-1272
IC1	IC, VREG,TK11450MTR,+5V,SOT-23L	441-010-0002	R14	RES, TF,2.7K,5%, 1/16W,+/-200,0603	741-102-1272
IC2	IC, PLL,MC145191FR2,SO-20,RS-440	440-050-0011	R15	RES, TF,100,5%, 1/16W,+/-200,0603	741-102-1101
IC3	IC, OP AMP,LM358MX,SO-8,DUAL	441-030-0006	R16	RES, TF,910,5%, 1/16W,+/-200,0603	741-102-1911
IC5	IC, FM IF,MC3372D,SO-16,LOW PWR	441-060-0005	R17	RES, TF,12K,5%, 1/16W,+/-200,0603	741-102-1123
IC9	IC, PWR MDL,RF,VHF,GNOK-M68776-E01	405-010-0009	R18	RES, TF,2.2K,5%, 1/16W,+/-200,0603	741-102-1222
J3	CONN, PLUG,30P,DF15 SERIES,0.65MM	140-030-0079	R19	RES, TF,51K,5%, 1/16W,+/-200,0603	741-102-1513
L1	COIL, CHIP,47NH,20%,LL2012-F47NM	371-010-5470	R20	RES, TF,5.1K,5%, 1/16W,+/-200,0603	741-102-1512
L2	COIL, CHIP,47NH,20%,LL2012-F47NM	371-010-5470	R21	RES, TF,120 5%, 1/16W,+/-200,0603	741-102-1121
L3	COIL, CHIP 0.1UH:NL252018T-R10J	371-804-3R10	R22	RES, TF,1.8K,5%, 1/16W,+/-200,0603	741-102-1182
L4	COIL, CHIP 0.1UH:NL252018T-R10J	371-804-3R10	R23	RES, TF,22.5%, 1/16W,+/-200,0603	741-102-1220
L6	COIL, CHIP,1UH,5%,NL252018T-1R0J	371-017-3102	R24	RES, TF,22.5%, 1/16W,+/-200,0603	741-102-1220
L7	COIL, SPRG,3X0.55X4T:L SMD	350-000-0104	R25	RES, TF,18.5%, 1/16W,+/-200,0603	741-102-1180
L8	COIL, SPRG, 3X0.55X5T:L SMD	350-000-0105	R26	RES, TF,100,5%, 1/16W,+/-200,0603	741-102-1101

SP-200/SP-210

Parts List

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
R27	RES, TF,4.7K,5%,1/16W,+/-200,0603	741-102-1472	R116	RES, TF,15K,5%,1/10W,TC250,0805	741-117-2153
R28	RES, TF,56,5%,1/16W,+/-200,0603	741-102-1560	R124	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
R29	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R130	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101
R30	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R135	RES, TF,4.7M,5%,1/16W,+/-200,0603	741-102-1475
R31	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R150	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
R32	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R151	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
R34	RES, TF,18,5%,1/16W,+/-200,0603	741-102-1180	R901	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
R35	RES, TF,8.2K,5%,1/16W,+/-200,0603	741-102-1822	R902	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
R37	RES, TF,1.2K,5%,1/16W, +/-200,0603	741-102-1122	R903	RES, TF,4.7K,5%,1/16W,+/-200,0603	741-102-1472
R41	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220	R904	RES, TF,7.5K,5%,1/16W,+/-200,0603	741-102-1752
R45	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223	R905	RES, TF,27K,5%,1/16W,+/-200,0603	741-102-1273
R46	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222	R906	RES, TF,7.5K,5%,1/16W,+/-200,0603	741-102-1752
R50	RES, TF,1M,5%,1/16W,+/-200,0603	741-102-1105	R907	RES, TF,27K,5%,1/16W,+/-200,0603	741-102-1273
R52	RES, TF,3.3K,5%,1/16W,+/-200,0603	741-102-1332	R908	RES, TF,10,5%,1/16W,+/-200,0603	741-102-1100
R53	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103	R909	RES, TF,470,5%,1/16W,+/-200,0603	741-102-1471
R54	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102	RV1	POT,VRES,10K,+/-25%,TOP ADJ,	901-120-0103
R55	RES, TF,1.2K,5%,1/16W, +/-200,0603	741-102-1122	RV2	POT,VRES,1K,3MM,+/-30%,TOP ADJ,	901-120-0102
R56	RES, TF,270,5%,1/16W,+/-200,0603	741-102-1271	RV3	POT,VRES,10K,+/-25%,TOP ADJ,	901-120-0103
R57	RES, TF,100K,1%,1/16W,0603	740-211-1003	RV4	POT,VRES,1K,3MM,+/-30%,TOP ADJ,	901-120-0102
R58	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474	T1	XFMR, B4F, FREQ.MIXER,617PT-1019,SMT	840-010-0002
R59	RES, TF,39,5%,1/16W,+/-200,0603	741-102-1390	T2	XFMR, B4F, FREQ.MIXER,617PT-1019,SMT	840-010-0002
R61	RES, TF,68K,1%,1/16W,+/-100,0603	740-211-1683	TH1	THERM, 33K, 3216, SMT	700-050-0002
R62	RES, TF,68K,1%,1/16W,+/-100,0603	740-211-1683	VR5	POT, ROTARY,20K,SPST,10MM,HORZ,5P	903-213-0203
R63	RES, TF,150,5%,1/16W,+/-200,0603	741-102-1151	X1	XTAL, 44.645M,-30,15PM,32PF,NR2D	162-000-0046
R64	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220	X2	FILTER, CER, DISCRIM,CDBC455CX16,455KHZ	315-012-0005
R65	RES, TF,51,5%,1/16W,+/-200,0603	741-102-1510	XF1	FILTER, XTAL,45Y15BN, 45.1MHZ	310-030-0019
R66	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R67	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R68	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R69	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R70	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R71	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R72	RES, TF,220K,5%,1/16W,+/-200,0603	741-102-1224			
R74	RES, TF,20K,5%,1/10W,TC250,0805	741-117-2203			
R75	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473			
R76	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R77	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R78	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R79	RES, TF,10,5%,1/16W,+/-200,0603	741-102-1100			
R81	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R82	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R83	RES, TF,18K,5%,1/16W,+/-200,0603	741-102-1183			
R84	RES, TF,18K,5%,1/16W,+/-200,0603	741-102-1183			
R85	RES, TF,39K,5%,1/16W,+/-200,0603	741-102-1393			
R86	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R87	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R88	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R89	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220			
R91	RES, TF,470,5%,1/16W,+/-200,0603	741-102-1471			
R92	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R94	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R95	RES, TF,3.3K,5%,1/16W,+/-200,0603	741-102-1332			
R96	RES, TF,1.5K,5%,1/16W,+/-200,0603	741-102-1152			
R97	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R98	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R99	RES, TF,100K,1%,1/16W,0603	740-211-1003			
R102	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R103	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R104	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R105	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R106	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R109	RES, TF,0.1,1%,1W, +/-100,1218	740-521-0R10			
R110	RES, TF,270,5%,1/16W,+/-200,0603	741-102-1271			
R111	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R112	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R115	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473			

SP-200/SP-210**Parts List****SP-210 UHF (440-470 MHz) RF BOARD (650-020-0032)**

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
REPLACEMENT MODULES					
A1	ASSY, P/L, TCXO, LOW COST,"A",	650-100-0008	C67	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
A2	ASSY, P/L, PCB,FRONT END,440-470MHZ	650-110-0021	C68	CAP, CER,0.001UF,10%,50V,X7R,0805	100-621-2102
A3	ASSY, P/L, PCB,VCO TX/RX,SP-210-U2	650-030-0031	C70	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
			C72	CAP, CER,2.2PF,0.5PF,50V,COG,0805	100-120-22R2
			C73	CAP, CER,8PF,0.5PF,50V,COG,0805	100-120-2080
C1	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C74	CAP, CER,10PF,0.25PF,COG,50V,0805	100-020-2100
C2	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	C75	CAP, CER,4.7PF,0.25PF,50V,COG,0805	100-120-24R7
C3	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C77	CAP, CER,470PF,5%,50V,COG,0805	100-520-2471
C4	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C78	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C6	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C79	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C7	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C80	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C8	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C81	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C9	CAP, CER,330PF,5%,50V,COG,0603	100-520-1331	C82	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C10	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120	C83	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120
C11	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C84	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C12	CAP, TA,10UF,20%,6.3V,3216,A	102-013-0106	C87	CAP, CER,22PF,5%,50V,COG,0603	100-520-1220
C13	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C88	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104
C14	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C90	CAP, CER,12PF,5%,50V,COG,0603	100-520-1120
C15	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C92	CAP, CER,14PF,5%,50V,COG,0603	100-520-1140
C16	CAP, CER,6PF,0.5PF,50V,COG,0603	100-120-1060	C93	CAP, CER,82PF,5%,50V,COG,0603	100-520-1820
C17	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C94	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
C18	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102	C95	CAP, TA,4.7UF,20%,10V,3216	102-023-0475
C19	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C96	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C20	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C98	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C21	CAP, METAL,POLY,0.33UF,63V BOX	083-013-2334	C102	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C22	CAP, METAL POLY,0.022UF,10%,63V BOX	083-013-2223	C103	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471
C23	CAP, METAL POLY,0.01UF,10%,63V KBOX	083-014-2103	C104	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C24	CAP, METAL POLY,0.01UF,10%,63V KBOX	083-014-2103	C105	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C25	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C106	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C26	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C107	CAP, CER,10PF,0.5PF,50V,COG,0603	100-120-1100
C27	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C108	CAP, CER,150PF,10%,50V,X7R,0603	100-621-1151
C28	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C111	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C29	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105	C112	CAP, CER,0.033UF,10%,16V,X7R,0603	100-601-1333
C30	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	C113	CAP, CER,0.1UF,10%,25V,X7R,0805	100-611-2104
C31	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C114	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C32	CAP, CER,4PF,0.25PF,50V,COG,0603	100-020-1040	C115	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C33	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C116	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C34	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C117	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C36	CAP, CER,7PF,0.5PF,50V,COG,0805	100-110-2070	C118	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330
C37	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C121	CAP, CER,10PF,0.5PF,50V,COG,0603	100-120-1100
C38	CAP, CER,15PF,5%,50V,COG,0805	100-520-2150	C122	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C41	CAP, CER,6PF,0.5PF,50V,COG,0805	100-120-2060	C123	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C42	CAP, CER,27PF,5%,50V,COG,0805	100-520-2270	C124	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104
C43	CAP, CER,8PF,0.5PF,50V,COG,0603	100-120-1080	C126	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C45	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C127	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C46	CAP, CER,5PF,0.25PF,50V,COG,0603	100-020-1050	C128	CAP, TA,4.7UF,20%,10V,3216	102-023-0475
C47	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C129	CAP, ELE,10UF,16V,20%,3X5,5.0PT	081-032-3106
C48	CAP, CER, 0.1UF,10%,50V,X7R,0603	100-621-1104	C131	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103
C51	CAP, CER,6PF,0.5PF,50V,COG,0603	100-120-1060	C145	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C52	CAP, CER,100PF,+/-5%,50V,COG,0603	100-520-1101	C146	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C53	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C163	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C54	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	C164	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C55	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C165	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C56	CAP, CER,6PF,0.5PF,50V,COG,0603	100-120-1060	C166	CAP, CER,47PF,5%,50V,COG,0603	100-520-1470
C57	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C190	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C58	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C191	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C59	CAP, CER,0.47UF,+20-80%,16V,Y5V,0805	100-803-2474	C192	CAP, CER,1UF,+80-20%,16V,Y5V,0805	100-803-2105
C60	CAP, TA,4.7UF,20%,10V,3216	102-023-0475	C194	CAP, CER,0.001UF,10%,50V,X7R,0603	100-621-1102
C61	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C195	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104
C62	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C303	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C63	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	C304	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C65	CAP, TA,10UF,20%,10V,B,3528	102-023-1106	C307	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221
C66	CAP, CER,470PF,10%,50V,X7R,0603	100-621-1471	C308	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221

SP-200/SP-210

Parts List

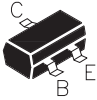
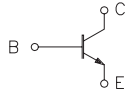
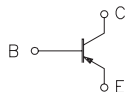
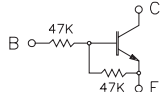
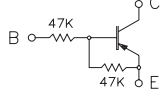
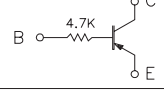
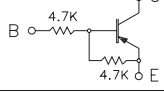
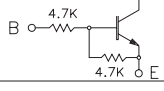






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C309	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L11	COIL, SPRG, 2X0.75X3T:L SMD	350-000-0103
C310	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L13	COIL, SPRG, 1.0X0.35X7T;R,SMD	350-000-0095
C311	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L14	COIL, CHIP,680NH,5%,25.2MHZ	371-313-3681
C314	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L15	COIL, CHIP,0.15UH,5%,NL252018T-R15J	371-004-3R15
C316	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L16	COIL, CHIP,1000UH,10%,300SS-102K	370-012-4102
C318	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L17	COIL, CHIP,1000UH,10%,300SS-102K	370-012-4102
C319	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L18	COIL, CHIP,1UH,5%,NL252018T-1R0J	371-017-3102
C321	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	L19	COIL CHIP,10UH,CYLNDRLCL,+/-10%,1206	371-005-3103
C322	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	LK3	RES, TF, 0, 5%, 1/16W, +/-200,0603	741-102-1000
C323	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q1	TRANS, PNP,KRA104S,SOT-23,SW,(PD)	870-010-0005
C325	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q2	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C326	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q3	TRANS, 900MHZ AMP,MMBR951,SOT-23	870-200-0026
C327	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q4	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C328	CAP, CER,220PF,5%,50V,COG,0603	100-520-1221	Q5	TRANS, PNP,KRA104S,SOT-23,SW,(PD)	870-010-0005
C901	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q6	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C902	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q7	TRANS, PNP,KTA1504(Y),SOT-23,SW	870-100-0004
C903	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q8	TRANS, PNP,KTA1504(Y),SOT-23,SW	870-100-0004
C904	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q9	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
C905	CAP, CER,18PF,5%,50V,COG,0603	100-520-1180	Q11	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C906	CAP, CER,18PF,5%,50V,COG,0603	100-520-1180	Q12	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
C907	CAP, CER,0.1UF,+80-20%,25V,Y5V,0603	100-813-1104	Q14	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
C908	CAP, CER,33PF,5%,50V,COG,0603	100-520-1330	Q16	TRANS, 900MHZ AMP,MMBR951,SOT-23	870-200-0026
C910	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q17	TRANS, NPN,BFR92A,SOT-23	870-200-0020
C911	CAP, CER,0.01UF,10%,25V,X7R,0603	100-611-1103	Q18	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CF1	FILTER, CER,CFWM455F,455KHZ	310-010-0030	Q19	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
CF2	FILTER, CER,LTWM455HT,455KHZ	310-010-0025	Q21	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
CON1	TERM, CONTACT SPRING, GW9803302	140-060-0027	Q22	TRANS, PNP,KTA1663(Y),SOT-89	870-150-0002
CON2	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q23	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CON7	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q24	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
CON8	TERM, ATE, &3.0X4.8, BSBM,AU PL,3U	560-110-2005	Q25	TRANS, NPN,BFR92A,SOT-23	870-200-0020
CON9	TERM, CONTACT SPRING, GW9803302	140-060-0027	Q26	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
D2	DIODE, RECTIFIER,SM4004,400V,1A,SMD	220-030-0003	Q27	TRANS, NPN,KTC3875(BL),SOT-23,	870-200-0006
D5	DIODE, PIN,UPP9401,(T&R)50V,2.5W	220-020-0001	Q28	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
D6	DIODE, PIN,UPP9401,(T&R)50V,2.5W	220-020-0001	Q32	TRANS, PNP,KRA110SPK,SOT-23,SW,PK	870-010-0010
D8	DIODE, SW,KDS193,SOT-23	220-010-0003	Q260	TRANS, NPN,KRC104SND,SOT-23,SW	870-020-0001
D9	DIODE, SCHOTTKY,CHIP,HSMS-2817#L31	220-040-0009	Q901	TRANS, NPN,KTC4075,UMT3	870-200-0031
D13	DIODE, SW,KDS181S,SOT-23	220-010-0004	Q902	TRANS, PNP,KTA2014, USM	870-100-0018
D14	DIODE, SW,KDS181S,SOT-23	220-010-0004	Q903	TRANS, NPN,KTC4075,UMT3	870-200-0031
D16	DIODE, SW,KDS193,SOT-23	220-010-0003	Q904	TRANS, NPN,KTC4075,UMT3	870-200-0031
D21	DIODE, PIN,MMBV3401LT1,SOT-23	220-020-0002	Q905	TRANS, NPN,KTC4075,UMT3	870-200-0031
D25	DIODE, PIN,MMBV3401LT1,SOT-23	220-020-0002	R1	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103
D901	DIODE, SW,KDS226,SOT-23	220-010-0005	R2	RES, TF,100K,5%,1/16W,+/-200,0603	741-102-1104
D902	DIODE, SW,KDS226,SOT-23	220-010-0005	R3	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
D903	RES, TF, 0, 5%, 1/16W, +/-200,0603	741-102-1000	R4	RES, TF,1.8K,5%,1/16W,+/-200,0603	741-102-1182
E1	FNGR STRIP, 99-160-NT-80	560-140-0004	R5	RES, TF,1.8K,5%,1/16W,+/-200,0603	741-102-1182
E2	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R6	RES, TF,2K,5%,1/16W,+/-200,0603	741-102-1202
E3	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R7	RES, TF,1.8K,5%,1/16W,+/-200,0603	741-102-1182
E4	INSU, SI/RB,XTAL,HS50,GRAY	390-010-0002	R8	RES, TF,910,5%,1/16W,+/-200,0603	741-102-1911
E8	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R9	RES, TF,5.6K,5%,1/16W,+/-200,0603	741-102-1562
E9	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R10	RES, TF,390,5%,1/16W,+/-200,0603	741-102-1391
E10	INSU, CAP,SI/RB,HS50,XTAL,GRAY	390-010-0006	R11	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101
FUSE1	FUSE, CER, F/B,60V,4A,5.7X2DIA,SMT	700-020-0002	R12	RES, TF,5.6K,5%,1/16W,+/-200,0603	741-102-1562
IC1	IC, VREG,TK11450MTR,+5V,SOT-23L	441-010-0002	R13	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
IC2	IC, PLL,MC145191FR2,SO-20,RS-440	440-050-0011	R14	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
IC3	IC, OP AMP,LM358MX,SO-8,DUAL	441-030-0006	R15	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101
IC5	IC, FM IF,MC3372D,SO-16,LOW PWR	441-060-0005	R16	RES, TF,910,5%,1/16W,+/-200,0603	741-102-1911
IC9	IC, PWR MDL,RF,GNOK-M68732H-E26	405-010-0008	R17	RES, TF,12K,5%,1/16W,+/-200,0603	741-102-1123
J3	CONN, PLUG,30P,DF15 SERIES,0.65MM	140-030-0079	R18	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
L1	COIL, CHIP,18NH,20%,LL2012-F18NM	371-010-5180	R19	RES, TF,51K,5%,1/16W,+/-200,0603	741-102-1513
L2	COIL, CHIP,18NH,20%,LL2012-F18NM	371-010-5180	R20	RES, TF,5.1K,5%,1/16W,+/-200,0603	741-102-1512
L3	COIL, CHIP,18NH,20%,LL2012-F18NM	371-010-5180	R22	RES, TF,1.8K,5%,1/16W,+/-200,0603	741-102-1182
L4	COIL, CHIP,18NH,20%,LL2012-F18NM	371-010-5180	R23	RES, TF,22.5%,1/16W,+/-200,0603	741-102-1220
L5	COIL, CHIP,18NH,20%,LL2012-F18NM	371-010-5180	R24	RES, TF,22.5%,1/16W,+/-200,0603	741-102-1220
L6	COIL, CHIP,0.82UH,NL252018T-R82J	371-804-3R82	R25	RES, TF,18.5%,1/16W,+/-200,0603	741-102-1180
L7	COIL, SPRG, 2X0.75X3T:L SMD	350-000-0103	R26	RES, TF,18.5%,1/16W,+/-200,0603	741-102-1180
L8	COIL, SPRG, 2X0.75X3T:L SMD	350-000-0103	R27	RES, TF,4.7K,5%,1/16W,+/-200,0603	741-102-1472

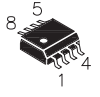
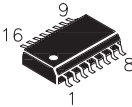
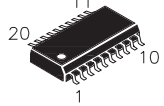
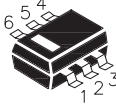
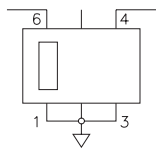
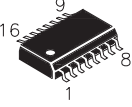
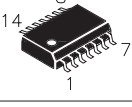

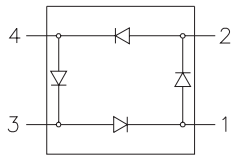

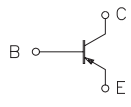



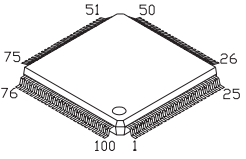
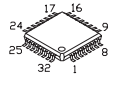
SP-200/SP-210

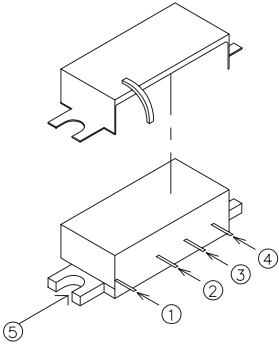
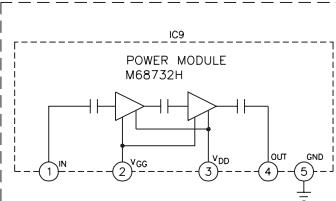
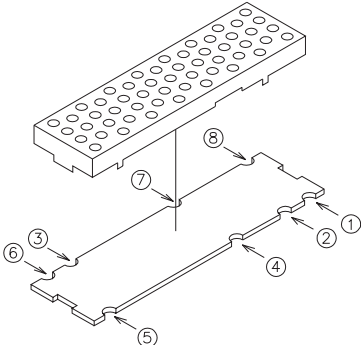
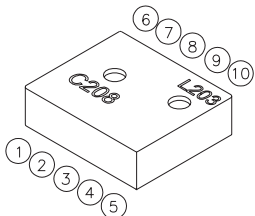
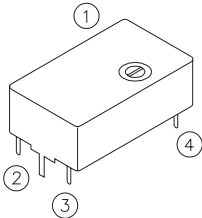
Parts List

REF	DESCRIPTION	PART NO.	REF	DESCRIPTION	PART NO.
R28	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101	R112	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223
R29	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R116	RES, TF,15K,5%,1/10W,TC250,0805	741-117-2153
R30	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R124	RES, TF, 0, 5%,1/16W, +/-200,0603	741-102-1000
R31	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R130	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101
R32	RES, TF,300,5%,1/16W,+/-200,0603	741-102-1301	R135	RES, TF,4.7M,5%,1/16W,+/-200,0603	741-102-1475
R33	RES, TF,6.8K, 5%, 1/16W,+/-200, 0603	741-102-1682	R150	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
R34	RES, TF,18,5%,1/16W,+/-200,0603	741-102-1180	R151	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272
R35	RES, TF,5.6K,5%,1/16W,+/-200,0603	741-102-1562	R901	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
R37	RES, TF,1.2K,5%,1/16W, +/-200,0603	741-102-1122	R902	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222
R41	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220	R903	RES, TF,4.7K,5%,1/16W,+/-200,0603	741-102-1472
R42	RES, TF,12K,5%,1/16W,+/-200,0603	741-102-1123	R904	RES, TF,7.5K,5%,1/16W,+/-200,0603	741-102-1752
R45	RES, TF,12K,5%,1/16W,+/-200,0603	741-102-1123	R905	RES, TF,27K,5%,1/16W,+/-200,0603	741-102-1273
R46	RES, TF,2.2K,5%,1/16W,+/-200,0603	741-102-1222	R906	RES, TF,7.5K,5%,1/16W,+/-200,0603	741-102-1752
R50	RES, TF,1M,5%,1/16W,+/-200,0603	741-102-1105	R907	RES, TF,27K,5%,1/16W,+/-200,0603	741-102-1273
R52	RES, TF,3.3K,5%,1/16W,+/-200,0603	741-102-1332	R908	RES, TF,10,5%,1/16W,+/-200,0603	741-102-1100
R53	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103	R909	RES, TF,470,5%,1/16W,+/-200,0603	741-102-1471
R54	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102	RV1	POT,VRES,10K,+/-25%,TOP ADJ,	901-120-0103
R55	RES, TF,1.2K,5%,1/16W, +/-200,0603	741-102-1122	RV2	POT,VRES,1K,3MM,+/-30%,TOP ADJ,	901-120-0102
R56	RES, TF,180,5%,1/16W,+/-200,0603	741-102-1181	RV3	POT,VRES,10K,+/-25%,TOP ADJ,	901-120-0103
R57	RES, TF,100K,1%,1/16W,0603	740-211-1003	RV4	POT,VRES,1K,3MM,+/-30%,TOP ADJ,	901-120-0102
R58	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474	T1	XFMR, B4F, FREQ.MIXER,617PT-1019,SMT	840-010-0002
R59	RES, TF,39,5%,1/16W,+/-200,0603	741-102-1390	T2	XFMR, B4F, FREQ.MIXER,617PT-1019,SMT	840-010-0002
R61	RES, TF,68K,1%,1/16W,+/-100,0603	740-211-1683	TH1	THERM, 33K, 3216, SMT	700-050-0002
R62	RES, TF,68K,1%,1/16W,+/-100,0603	740-211-1683	VR5	POT, ROTARY,20K,SPST,10MM,HORZ,5P	903-213-0203
R63	RES, TF,1.5K,5%,1/16W,+/-200,0603	741-102-1152	X1	XTAL, 44.645M,-30,15PM,32PF,NR2D	162-000-0046
R64	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220	X2	FILTER, CER, DISCRIM,CDBC455CX16,455KHZ	315-012-0005
R65	RES, TF,51,5%,1/16W,+/-200,0603	741-102-1510	XF1	FILTER, XTAL,45Y15BN, 45.1MHZ	310-030-0019
R66	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R67	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R68	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R69	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R70	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R71	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R72	RES, TF,220K,5%,1/16W,+/-200,0603	741-102-1224			
R74	RES, TF,24K,5%,1/10W,TC250,0805	741-117-2243			
R75	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473			
R76	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R77	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R78	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R79	RES, TF,10,5%,1/16W,+/-200,0603	741-102-1100			
R81	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R82	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R83	RES, TF,18K,5%,1/16W,+/-200,0603	741-102-1183			
R84	RES, TF,18K,5%,1/16W,+/-200,0603	741-102-1183			
R85	RES, TF,39K,5%,1/16W,+/-200,0603	741-102-1393			
R86	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R87	RES, TF,470K,5%,1/16W,+/-200,0603	741-102-1474			
R88	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R89	RES, TF,22,5%,1/16W,+/-200,0603	741-102-1220			
R91	RES, TF,470,5%,1/16W,+/-200,0603	741-102-1471			
R92	RES, TF,2.7K,5%,1/16W,+/-200,0603	741-102-1272			
R94	RES, TF,1K,5%,1/16W,+/-200,0603	741-102-1102			
R95	RES, TF,3.3K,5%,1/16W,+/-200,0603	741-102-1332			
R96	RES, TF,150,5%,1/16W,+/-200,0603	741-102-1151			
R97	RES, TF,100,5%,1/16W,+/-200,0603	741-102-1101			
R98	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R99	RES, TF,100K,1%,1/16W,0603	740-211-1003			
R100	RES, TF,47K,5%,1/16W,+/-200,0603	741-102-1473			
R102	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R103	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R104	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R105	RES, TF,22K,5%,1/16W,+/-200,0603	741-102-1223			
R106	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			
R109	RES, TF,0.1,1%,1W, +/-100,1218	740-521-0R10			
R110	RES, TF,270,5%,1/16W,+/-200,0603	741-102-1271			
R111	RES, TF,10K,5%,1/16W,+/-200,0603	741-102-1103			

Component Pinout

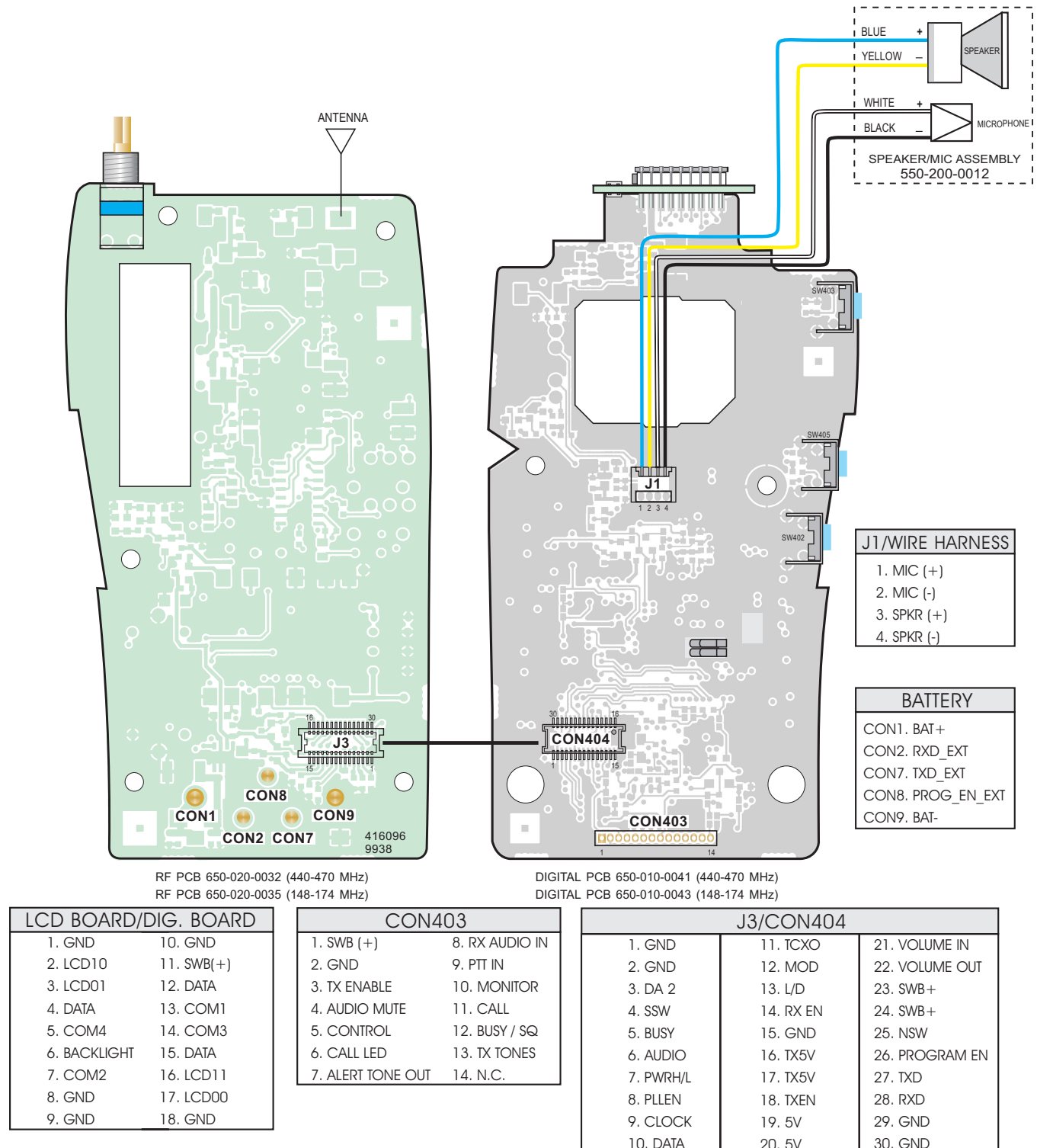
BASE DIAGRAM	MANUFACTURER'S PART NUMBER	REFERENCE NO.	SCHEMATIC
	MMBR951	Q3,16	
	BFR92A	Q25	
	KTC3875S (ALG)	Q6,11,14,19,21,26,27	
	KTA2014	Q902	
	KTA1504S (DTC144EK)	Q405	
	KRC104S (ND)	Q404,406,408,414,415,416	
	KRA104S (PD)	Q1,5	
	KRA110S (NK)	Q2,4,9,32,401	
	KRA101S (PA)	Q403	
	KRC101S (DTC-143EK)	Q402	
	KDS181 (A3)	D13,14,401,402	
	KDS193 (F3)	D8,16,403	
	KDS226 (C3)	D901,902,903	
	MMBV3401 (4D)	D21,25	
	KDS184 (B3)	D404	

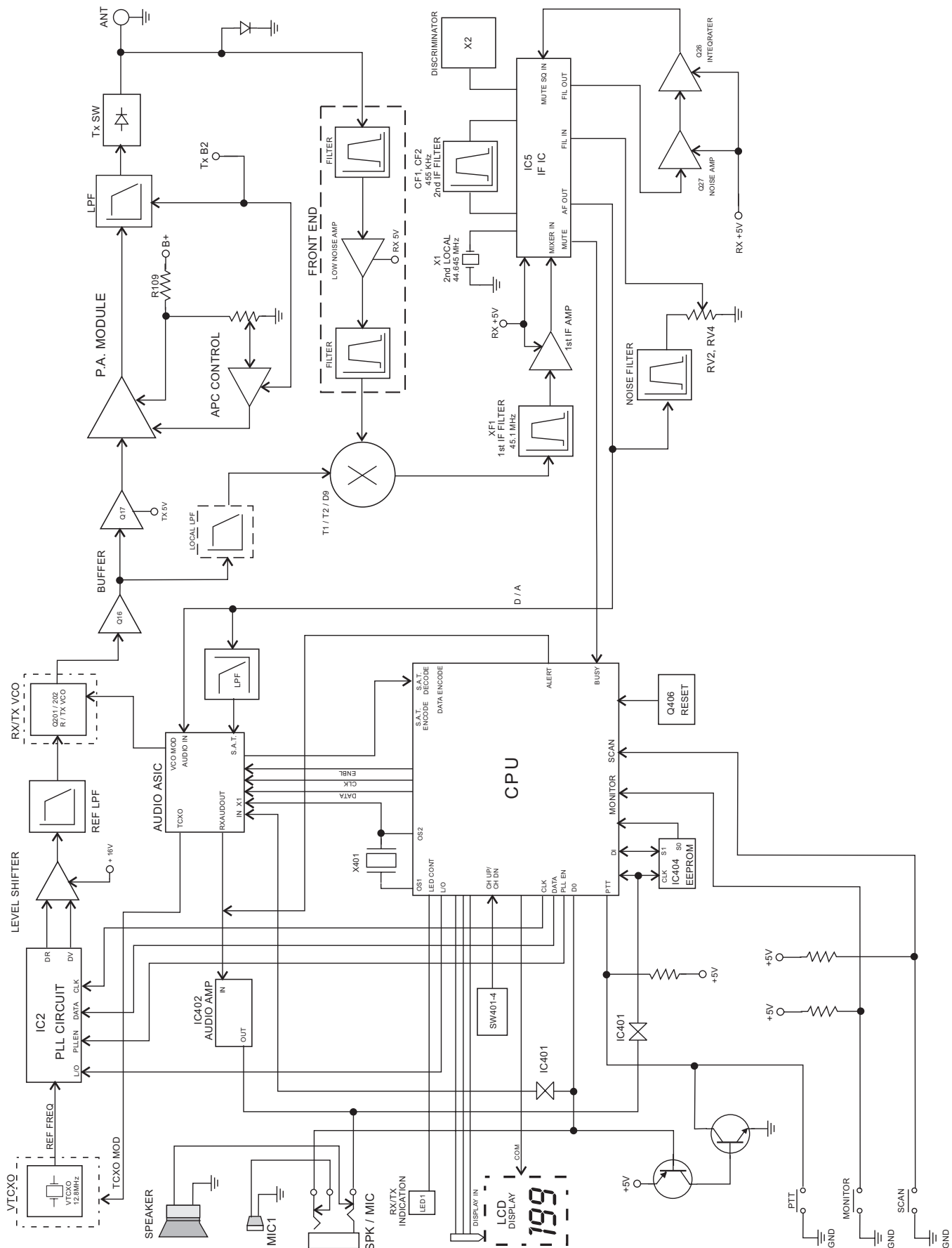
BASE DIAGRAM	MANUFACTURER'S PART NUMBER	REFERENCE NO.	SCHEMATIC
	TDA7233D	IC402	AUDIO AMPLIFIER
	X25330S	IC404	EEPROM
	LM358M	IC3, 407	DUAL LOW POWER OPAMP
	MC3372D	IC5	LOW POWER FM IF
	MC145191F	IC2	PLL IC
	TK11450	IC1	
	MC14066	IC401	
	KIA324F	IC408	
	HSMS2817	D9	
	KTA1663	Q22	
	UPP9401	D5,6	
	SM4004	D2	
	HD6433837UX	IC403	MICROPROCESSOR
	MSIMXA	IC406	AUDIO ASIC

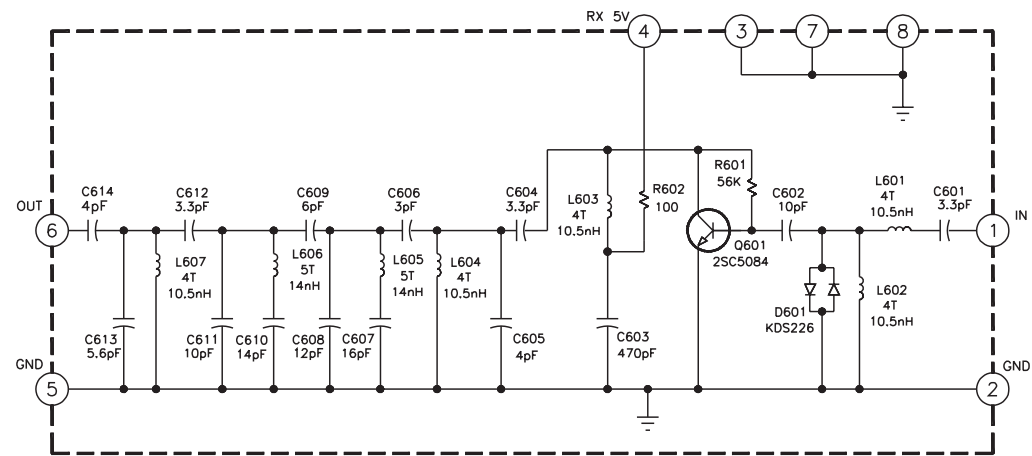
BASE DIAGRAM	PIN DESCRIPTION
	<p>RF POWER AMP (UHF) IC9 P/N: 405-010-0008 RF POWER AMP (VHF) IC9 P/N: 405-010-0009</p> <p><u>PIN DESCRIPTION</u></p> <p>① RF INPUT ② Vgg GATE BIAS SUPPLY ③ Vdd DRAIN BIAS SUPPLY ④ Po RF OUTPUT ⑤ GND FIN</p> 
	<p>RX FRONT-END (VHF) A2 P/N: 650-110-0022 RX FRONT-END (UHF) A2 P/N: 650-110-0021</p> <p><u>PIN DESCRIPTION</u></p> <p>① INPUT ⑤ GND ② GND ⑥ OUTPUT ③ GND ⑦ GND ④ B+ (5V) ⑧ GND</p>
	<p>VCO (VHF) A3 P/N: 650-030-0033 VCO (UHF) A3 P/N: 650-030-0031</p> <p><u>PIN DESCRIPTION</u></p> <p>① GND4 ⑥ 4.5V ② RX4.5V ⑦ FOUT ③ MOD ⑧ GND2 ④ GND1 ⑨ GND ⑤ VCON ⑩ GND3</p>
	<p>12.8 MHz TCXO (VHF) A1 P/N: 650-100-0007 12.8 MHz TCXO (UHF) A1 P/N: 650-100-0008</p> <p><u>PIN DESCRIPTION</u></p> <p>① Modulation ② GND ③ Out ④ Vcc (5V)</p>

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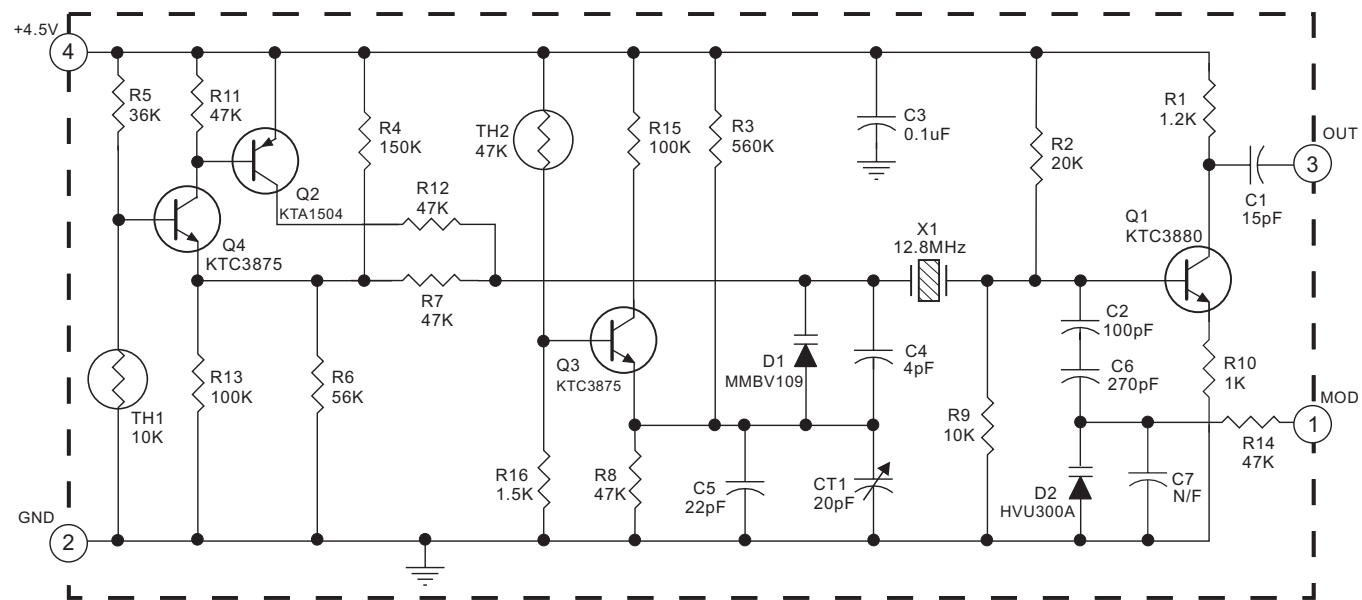
SP-200/SP-210 Wiring Diagram



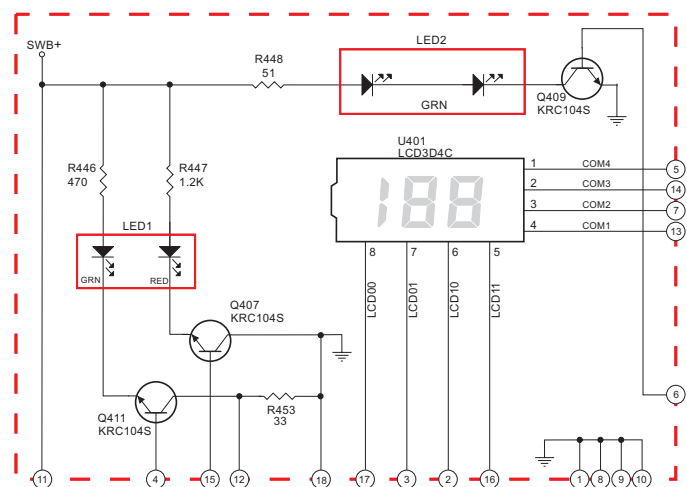
SP-200/SP-210 Block Diagram



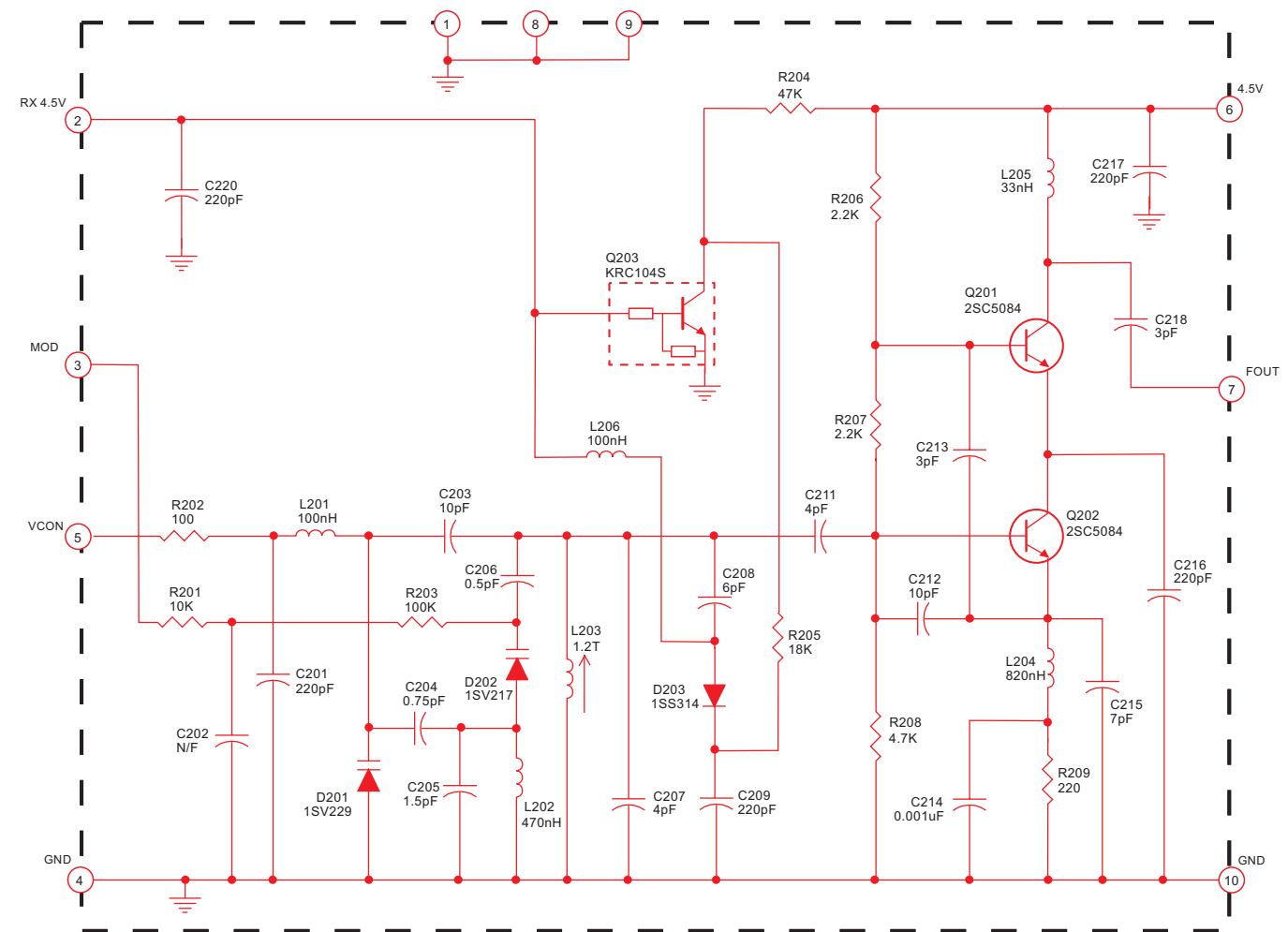
FRONT-END (UHF 440-470 MHz)
770-110-0021 Rev. A



TCXO (UHF 440-470 MHz)
770-100-0008 Rev. A



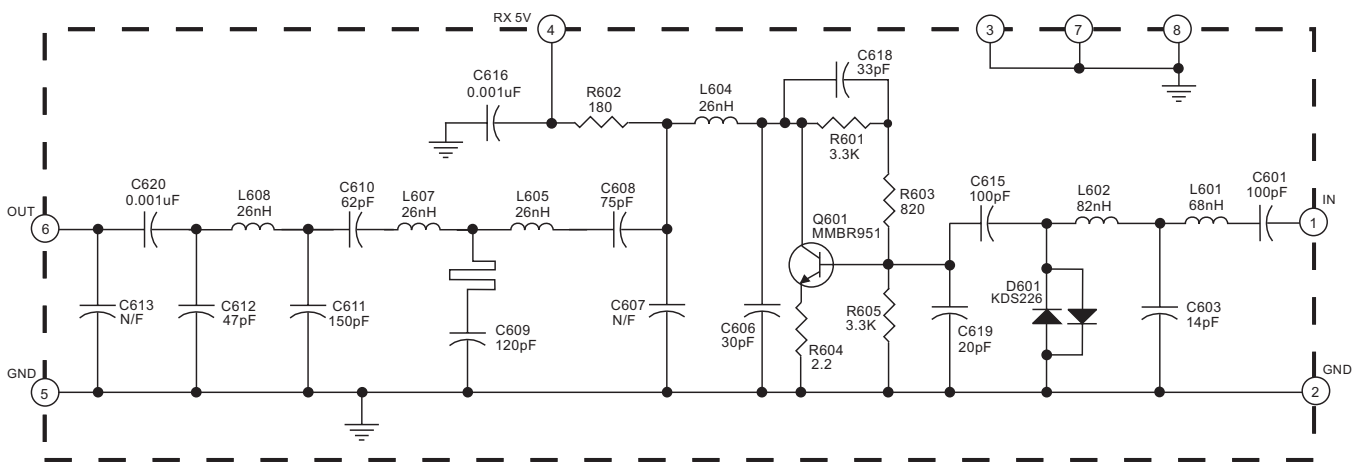
LCD (Common)
770-190-0006 Rev. A



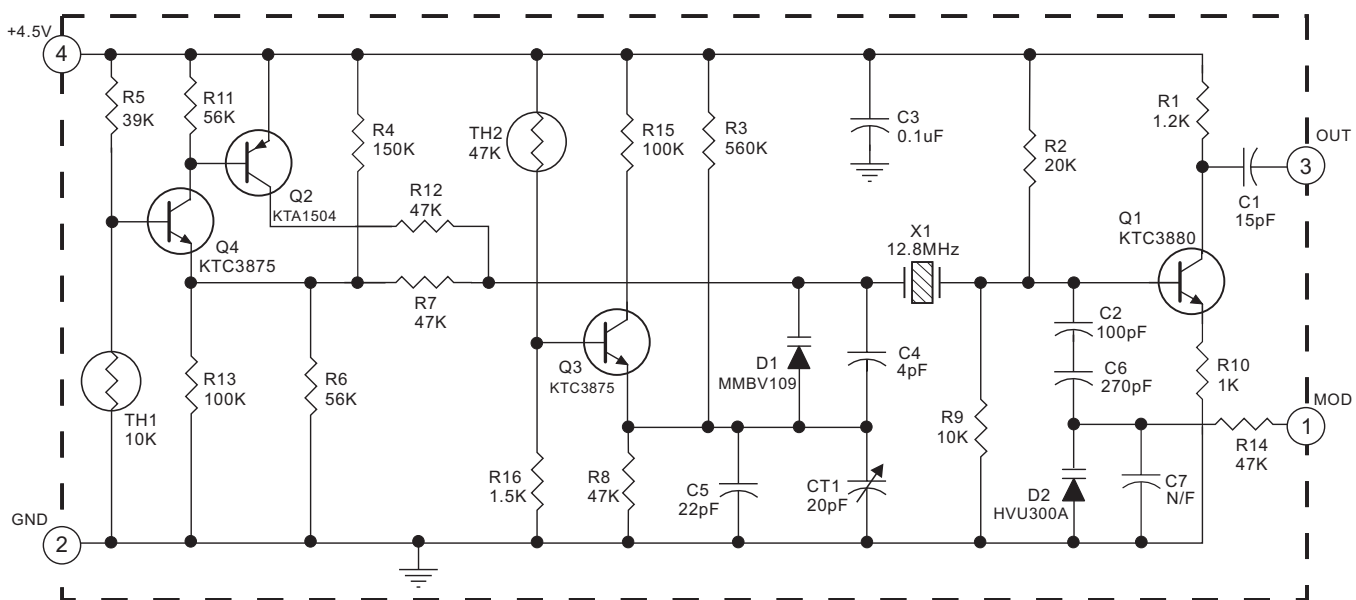
VCO (UHF 440-470 MHz)
770-030-0031 Rev. A

NOTES:

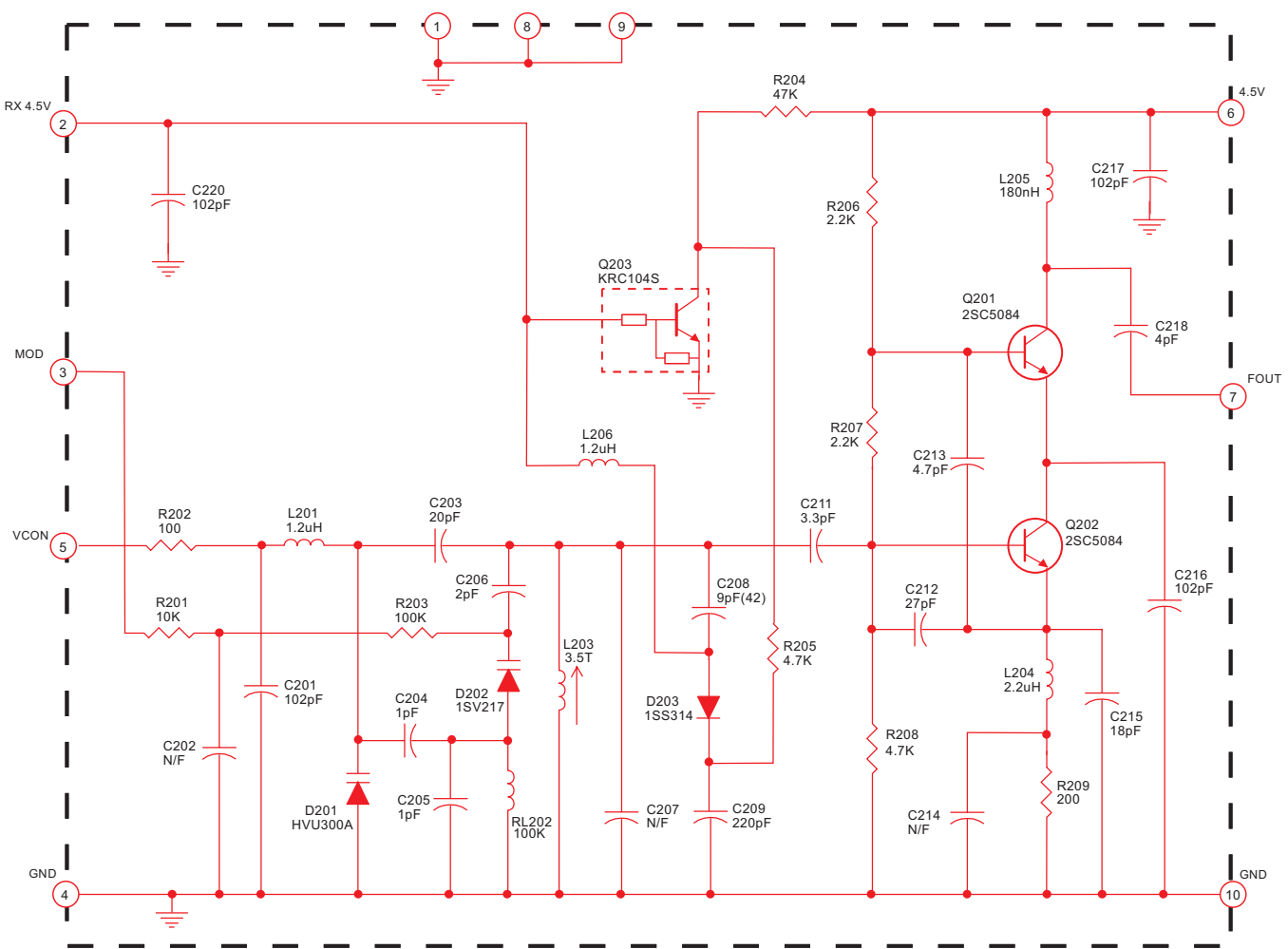
1. All values are in ohms, microhenries or microfarads unless otherwise specified.
2. All resistors are 1/10 W 5% unless otherwise specified.



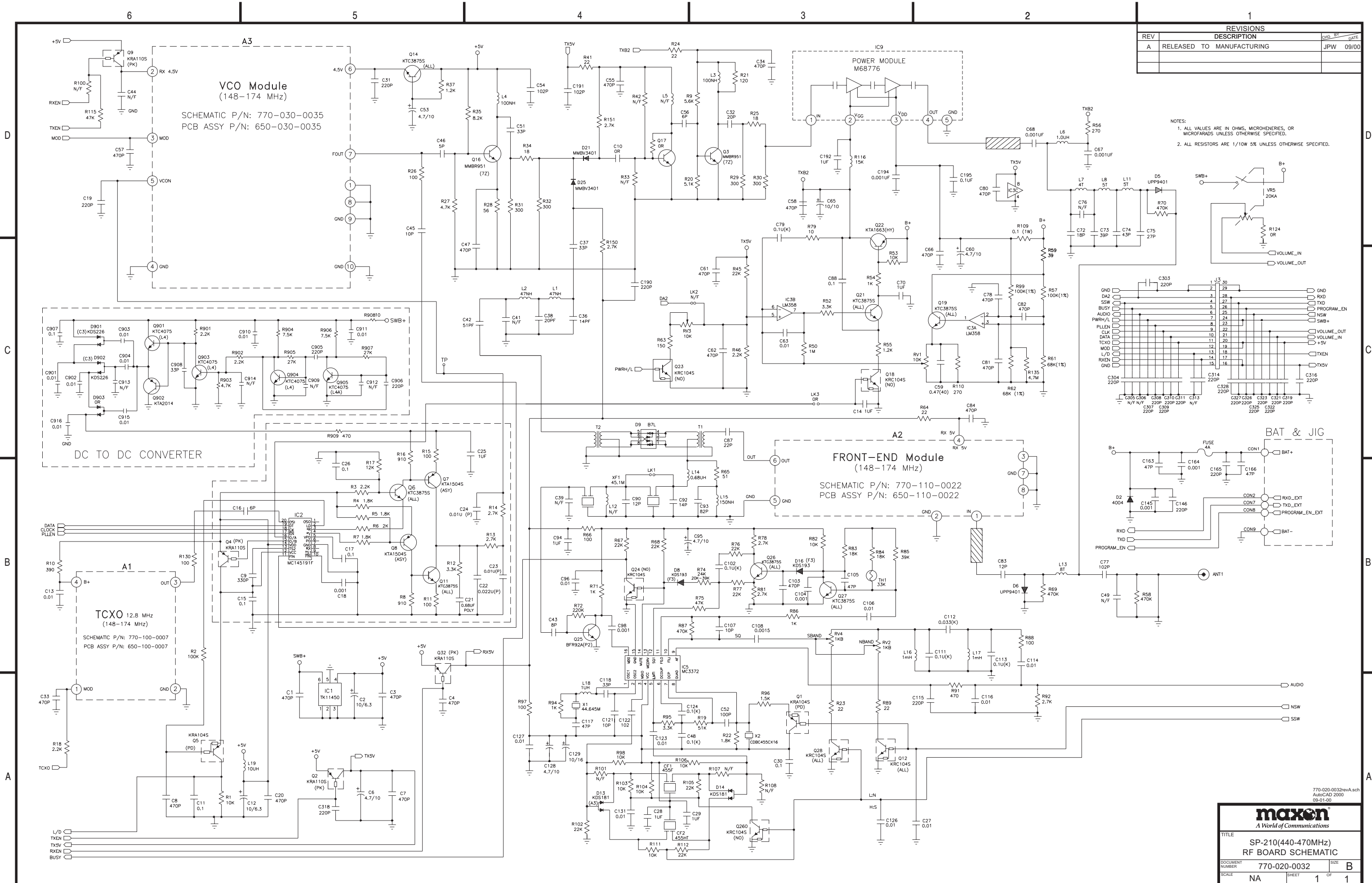
FRONT-END (VHF 148-174 MHz)
770-110-0022 Rev. A

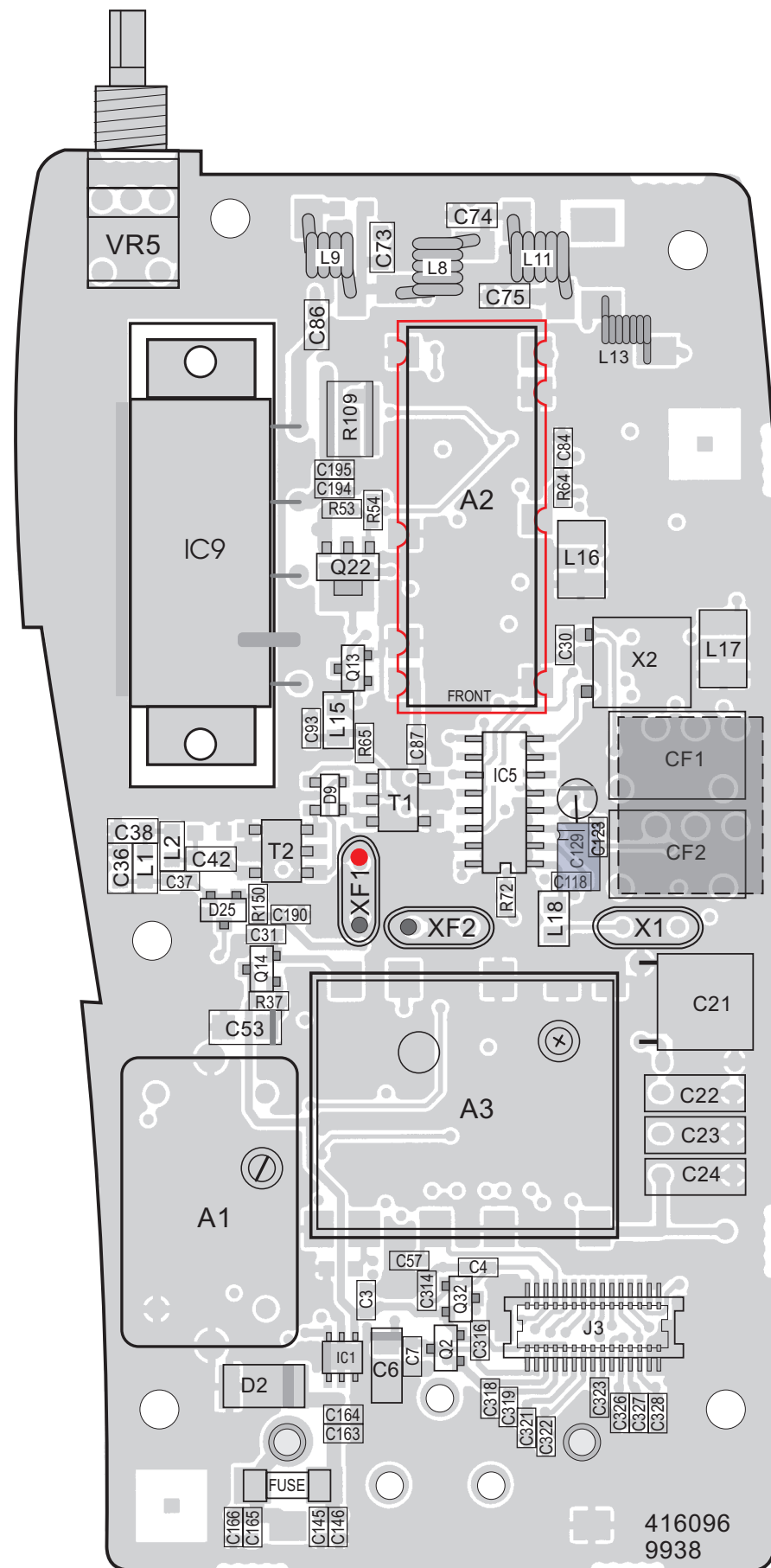


TCXO (VHF 148-174MHz)
770-100-0007 Rev. A

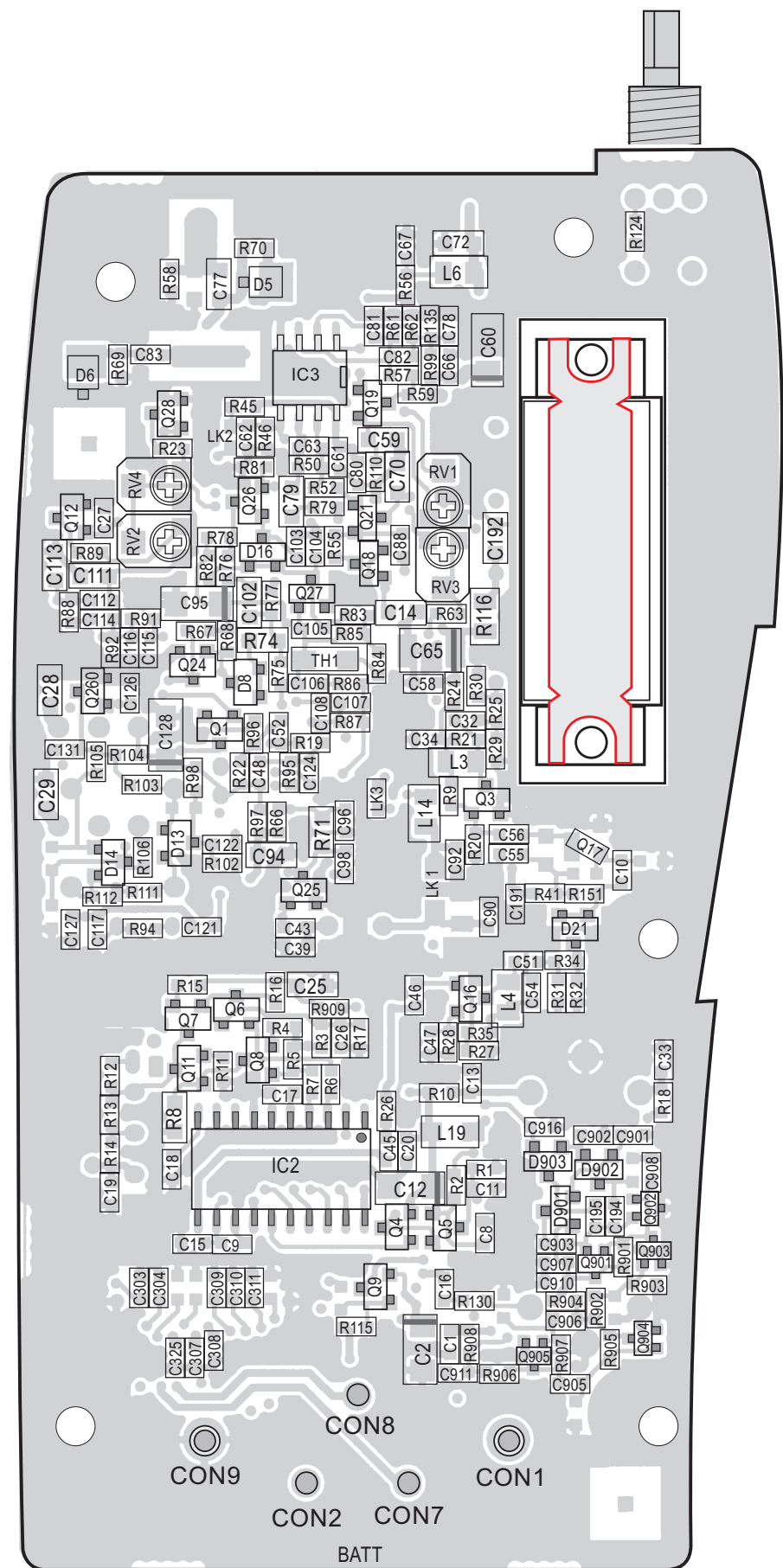


VCO (VHF 148-174 MHz)
770-030-0033 Rev. A



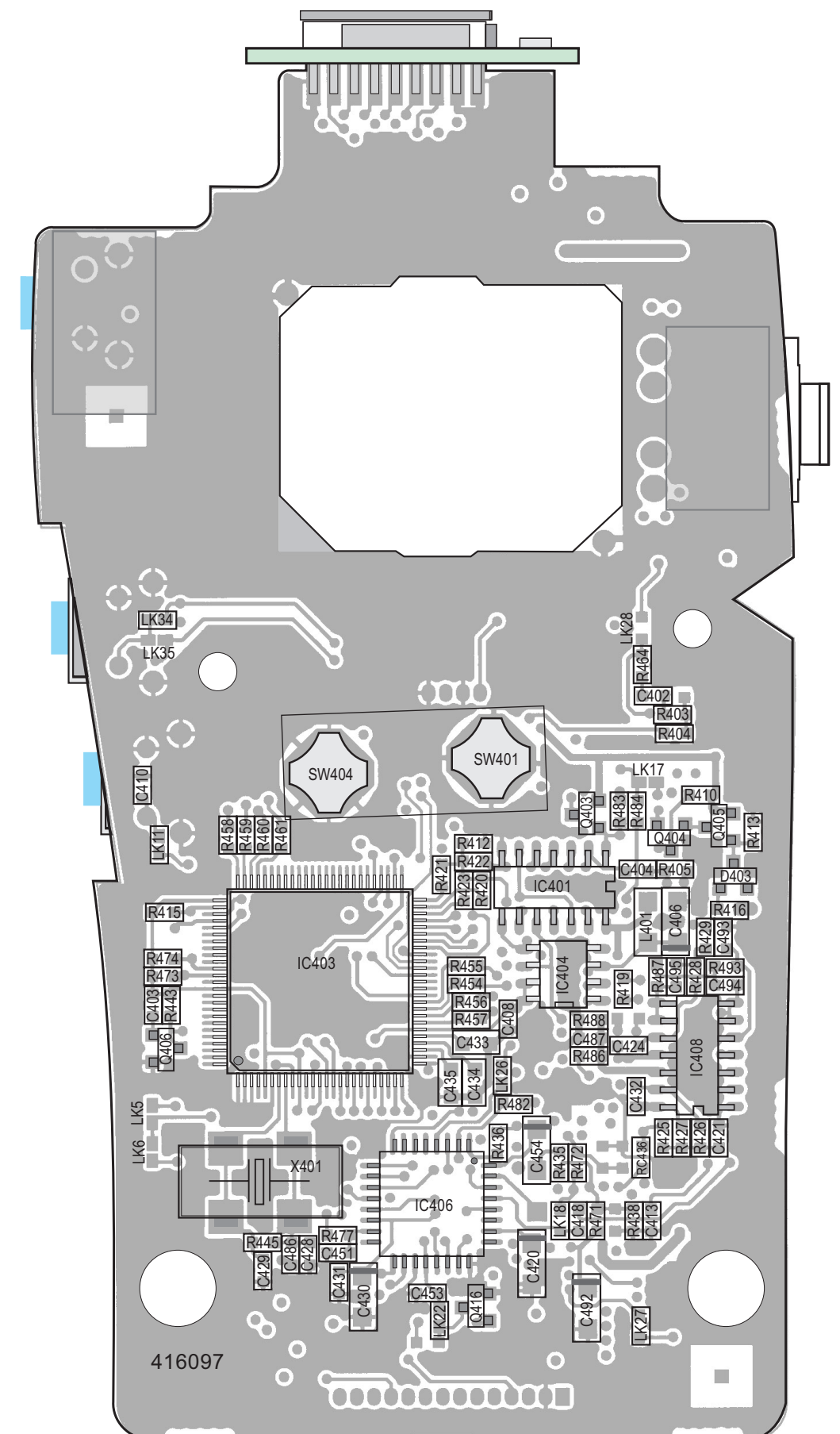
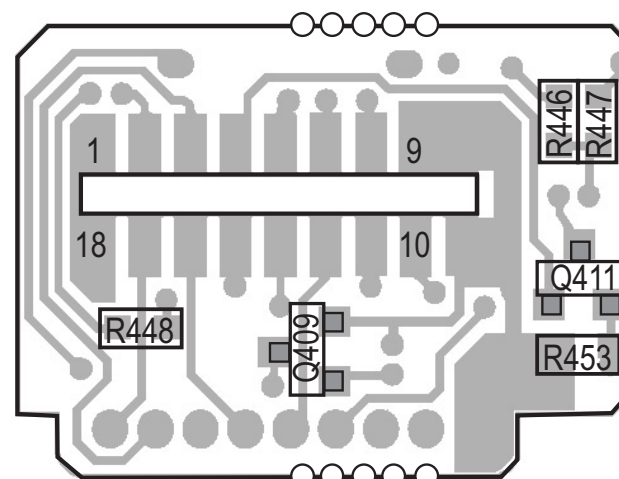
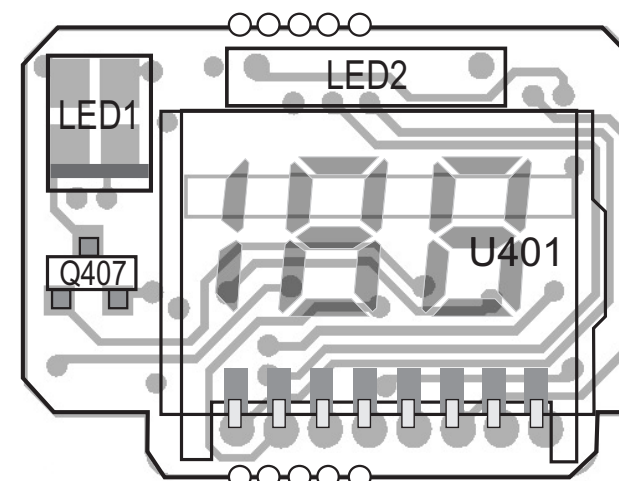
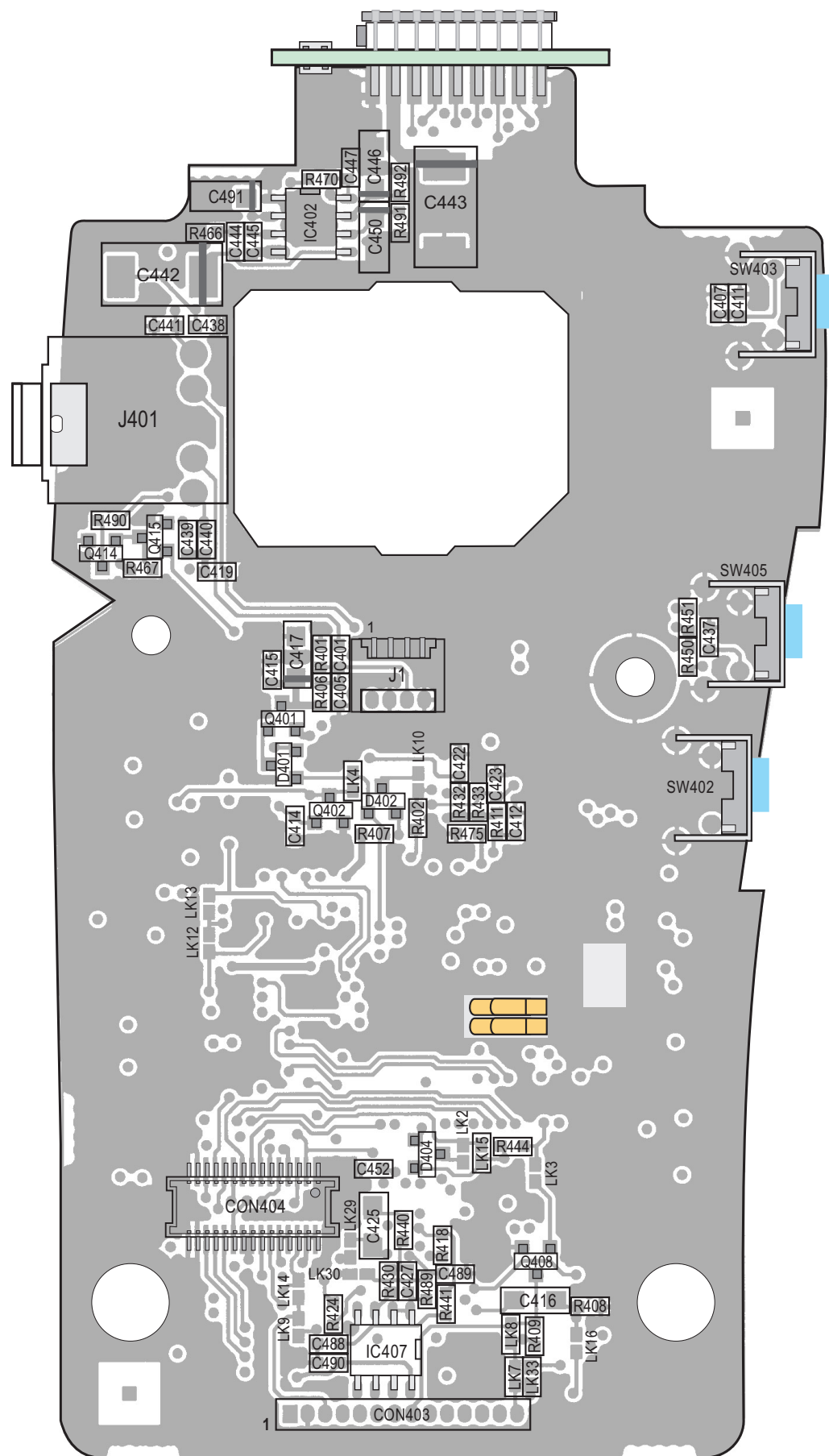


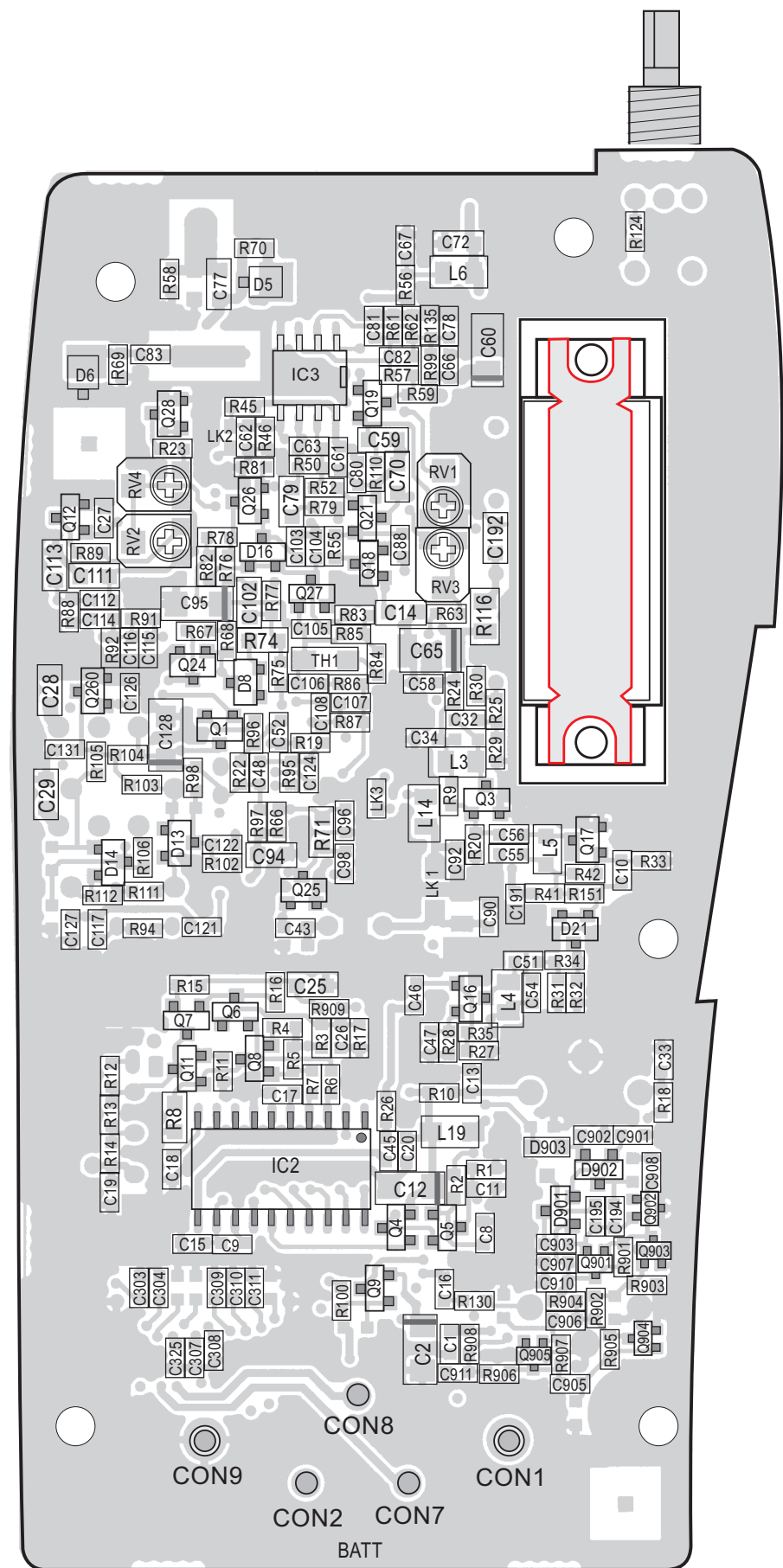
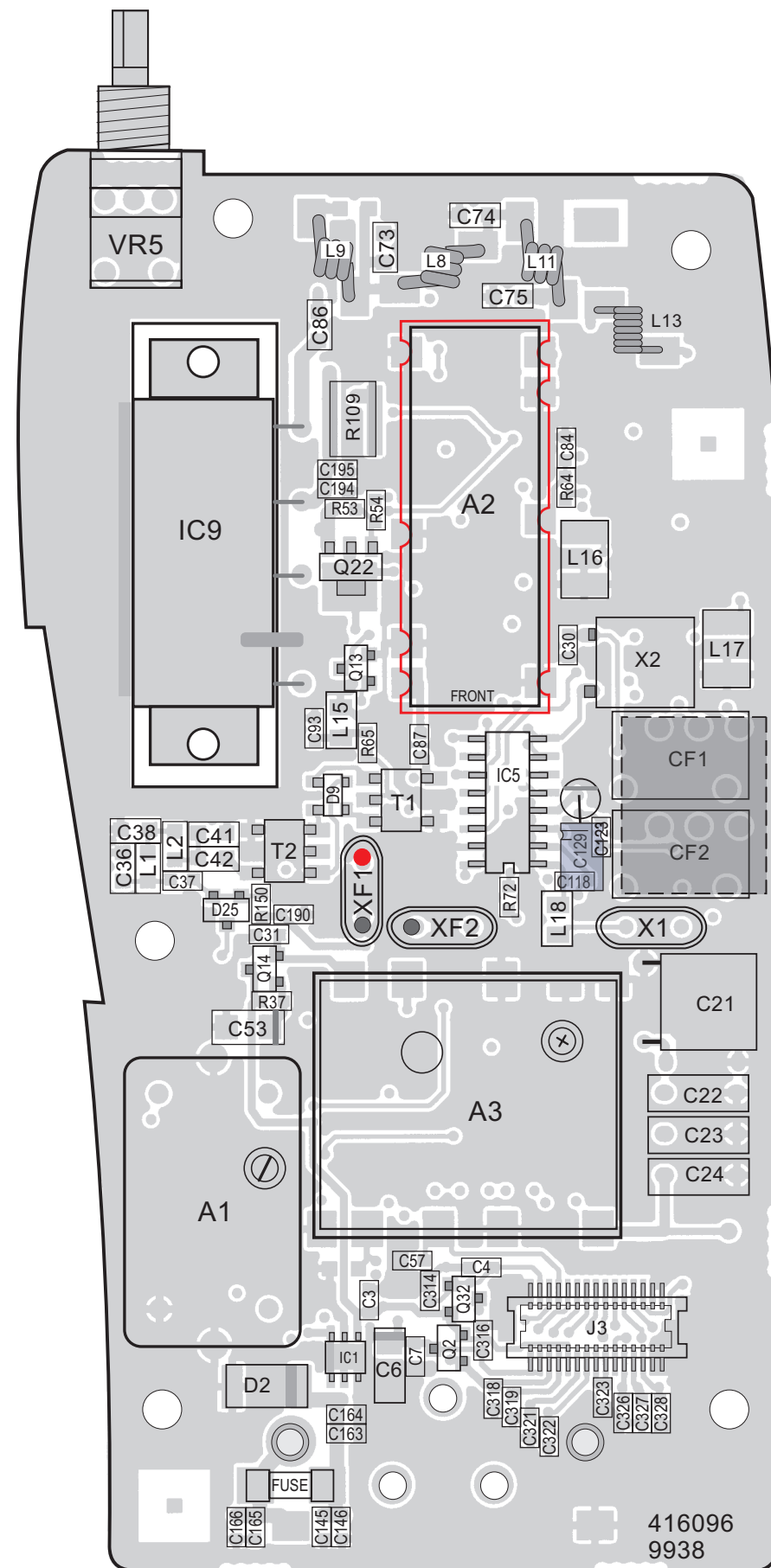
RF Board Assembly (VHF 148-174 MHz)
650-020-0035 Rev. A

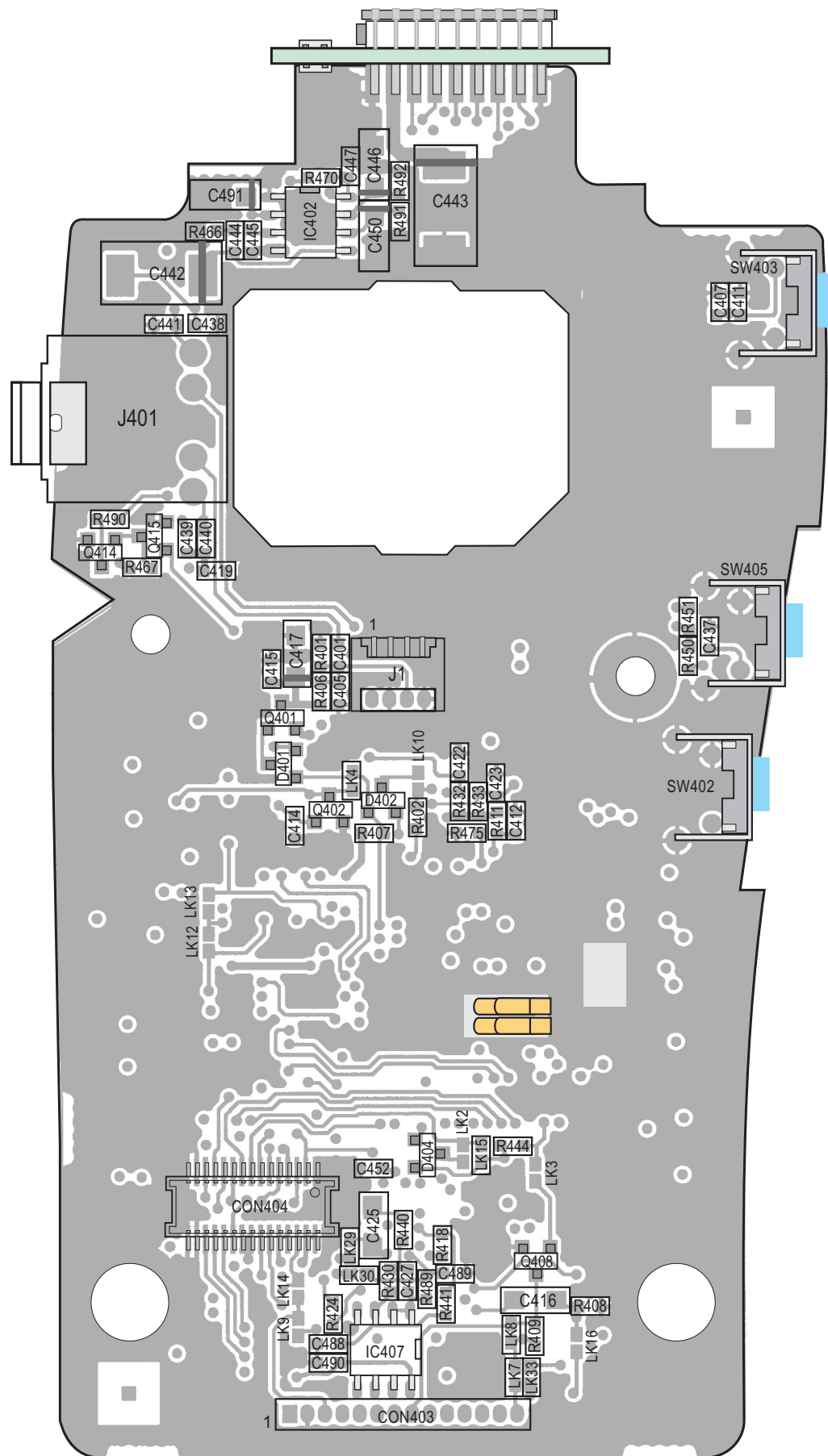


RF Board Assembly (VHF 148-174 MHz)
650-020-0035 Rev. A

RF Board PCB Assembly (VHF 148-174 MHz)



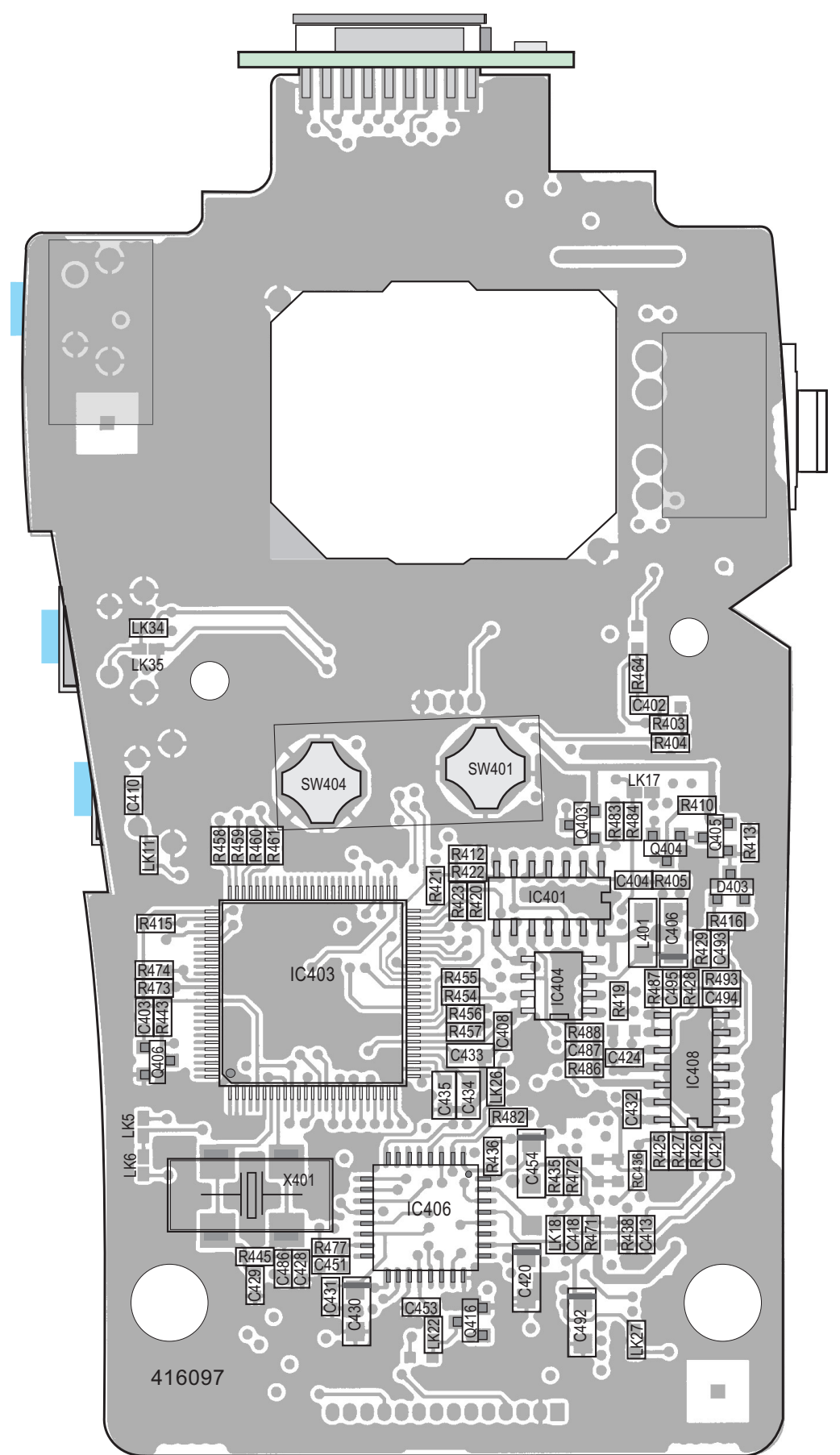




Digital Board Assembly (UHF 440-470 MHz)

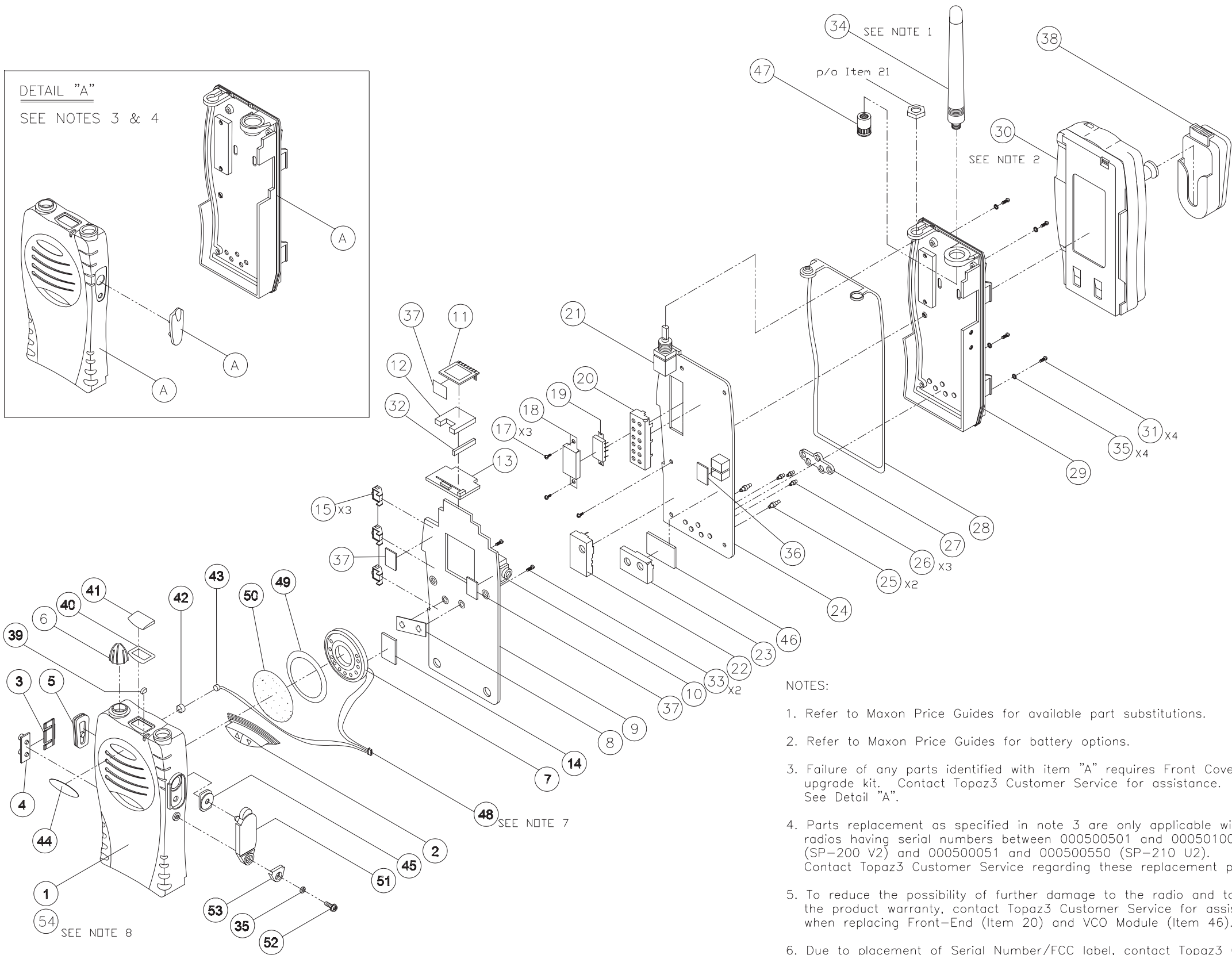
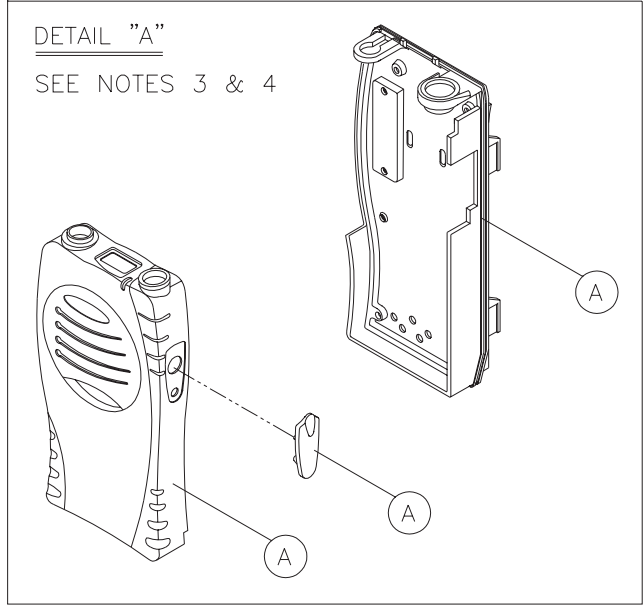
650-010-0041 Rev. A

Digital Board PCB Assembly (UHF 440-470 MHz)



Digital Board Assembly (UHF 440-470 MHz)

650-010-0041 Rev. A



NOTES:

1. Refer to Maxon Price Guides for available part substitutions.
2. Refer to Maxon Price Guides for battery options.
3. Failure of any parts identified with item "A" requires Front Cover upgrade kit. Contact Topaz3 Customer Service for assistance. See Detail "A".
4. Parts replacement as specified in note 3 are only applicable with radios having serial numbers between 000500501 and 000501000 (SP-200 V2) and 000500051 and 000500550 (SP-210 U2). Contact Topaz3 Customer Service regarding these replacement parts.
5. To reduce the possibility of further damage to the radio and to protect the product warranty, contact Topaz3 Customer Service for assistance when replacing Front-End (Item 20) and VCO Module (Item 46).
6. Due to placement of Serial Number/FCC label, contact Topaz3 Customer Service for repairs/replacement of Back Cover (Item 29).
7. Connect wire harness to J1 on Main Boad Assembly.
8. Items 1,2,3,4,5,7,14,35,39,40,41,42,43,44,45,48,49,50,51,52,53 can be ordered separately or included with Item 54 (Upper Cover Kit).

REPAIRABLE/REPLACEABLE PARTS LIST			
ITEM #	QTY	PART NUMBER	DESCRIPTION
1	1	550-021-0024	UPPER COVER
2	1	760-010-0032	KEYPAD
3	1	560-090-0078	BRACKET
4	1	760-010-0031	OPTION KEYPAD
5	1	760-040-0025	PTT PAD
6	1	660-090-0105	VOLUME KNOB
7	1	050-010-0030	SPEAKER
8	1	830-110-0002	DOME SWITCH ASSEMBLY
9	1	NOT AVAILABLE	DIGITAL BOARD ASSEMBLY
10	1	140-080-0050	ACCESSORY JACK, J401
11	1	240-010-0022	LCD
12	1	760-072-0005	BACK LIGHTER
13	1	NOT AVAILABLE	LCD BOARD ASSEMBLY
14	1	010-050-0034	MYLAR TAPE
15	3	830-070-0006	TACT SWITCH
16	1	NOT SHOWN	NOT SHOWN
17	3	330-110-0011	SCREW, M2X4
18	1	560-024-0006	SHIELD CAN
19	1	405-010-0009	POWER MODULE, (148-174 MHz)
19	1	405-010-0008	POWER MODULE, (440-470 MHz)
20	1	650-110-0022	FRONT-END MODULE, (148-174 MHz)
20	1	650-110-0021	FRONT-END MODULE, (440-470 MHz)
21	1	903-213-0203	VOLUME/POWER SWITCH (WITH NUT)
22	1	650-100-0007	TCXO ASSEMBLY, (148-174 MHz)
22	1	650-100-0008	TCXO ASSEMBLY, (440-470 MHz)
23	1	560-010-0016	VCO SHIELD CAN
24	1	NOT AVAILABLE	RF BOARD ASSEMBLY
25	2	140-060-0027	CONTACT TERMINAL SPRING
26	3	560-110-2005	TERMINAL
27	1	330-220-2003	TERMINAL GASKET
28	1	330-220-2002	RING GASKET
29	1	NOT AVAILABLE	BACK COVER (SEE NOTE 6)
30	1	QPA-1350	QPA-1350 BATTERY PACK
31	4	330-110-0151	SCREW, M6X5
32	2	330-200-0071	CUSHION, 10X2.5
33	2	330-090-0002	SCREW, M1.8X5
34	1	ACC-100	ANTENNA, UHF (440-470MHz)
34	1	ACC-102	ANTENNA, VHF (148-174MHz)
35	5	330-220-0037	GASKET RING
36	1	330-200-0073	CUSHION, 15X9
37	3	330-200-0072	CUSHION, 10X13
38	1	550-070-0018	BELT CLIP ASSEMBLY
39	1	760-072-0004	LED LENS
40	1	010-051-0015	DOUBLE SIDED TAPE
41	1	660-160-0059	LCD LENS
42	1	330-160-0008	MICROPHONE BUSHING
43	1	550-150-0035	MICROPHONE w/470pF CAP
44	1	490-070-0033	LOGO OVERLAY
45	1	330-220-0046	SPEAKER/MIC DUST CAP GROMET
46	1	650-030-0033	VCO ASSEMBLY, (148-174 MHz)
46	1	650-030-0031	VCO ASSEMBLY, (440-470 MHz)
47	1	140-080-0051	ANTENNA JACK, SMA
48	1	950-010-0038	4 PIN WIRE HARNESS
49	1	330-220-0047	SPEAKER GASKET
50	1	330-230-0061	SPEAKER FELT
51	1	760-020-0017	SPEAKER/MIC DUST CAP
52	1	330-110-0143	SCREW, M2X7
53	1	560-090-0082	BRACKET FOR DUST CAP
54	1	480-042-0025	UPPER COVER KIT
AVAILABLE TOOLS FOR SP-200/210			
	1	480-030-0011	EXTENDER CARD KIT