Chapter 3

MAINTENANCE

3.1 Introduction

This chapter of the manual describes:

- Preventive maintenance
- Safe handling of CMOS devices
- Repair procedures and techniques

3.2 Preventive Maintenance

The radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

3.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

3.2.2 Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly, and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE **Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.**

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).



CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

1. Cleaning External Plastic Surfaces
   The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lintless cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.
2. Cleaning Internal Circuit Boards and Components
   Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. Upon completion of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover..

NOTE **Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).**

3.3 Safe Handling of CMOS and LDMOS

Complementary metal-oxide semiconductor (CMOS) and lateral diffusion metal oxide semiconductor (LDMOS) devices are used in this family of radios. Their characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for the circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the basic manual (See Chapter 3).

3.4 General Repair Procedures and Techniques

1. Parts Replacement and Substitution
   When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications parts center listed in the “Piece Parts” section of this manual (See Chapter 1).
2. Rigid Circuit Boards
   The family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

   When soldering near the 20-pin and 40-pin connectors:

   - avoid accidentally getting solder in the connector.
   - be careful not to form solder bridges between the connector pins
   - closely examine your work for shorts due to solder bridges.
3. Flexible Circuits
   The flexible circuits are made from a different material than the rigid boards and different techniques must be used when soldering. Excessive prolonged heat on the flexible circuit can damage the material. Avoid excessive heat and excessive bending.

   For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600-700 degree tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat to be applied to the circuit.

   To replace a component on a flexible circuit:

   - grasp the edge of the flexible circuit with seizers (hemostats) near the part to be removed
   - pull gently
   - apply the tip of the soldering iron to the component connections while pulling with the seizers.
   - Do not attempt to puddle out components. Prolonged application of heat may damage the flexible circuit.
4. Chip Components
   Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700 degrees F. (370 degrees C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- **To remove a chip component:**
  - Use a hot-air hand piece and position the nozzle of the hand piece approximately 1/8” (0.3 cm) above the component to be removed.
  - Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers.
  - Using a solder wick and a soldering iron or a power desoldering station, remove the excess solder frLaufende K/F 2om the pads.
- **To replace a chip component using a soldering iron:**
  - Select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads.
  - Using a pair of tweezers, position the new chip component in place while heating the fresh solder.
  - Once solder wicks onto the new component, remove the heat from the solder.
  - Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- **To replace a chip component using hot air:**
  - Use the hot-air hand piece and reflow the solder on the solder pads to smooth it.
  - Apply a drop of solder paste flux to each pad.
  - Using a pair of tweezers, position the new component in place.
  - Position the hot-air hand piece approximately 1/8” (0.3 cm) above the component and begin applying heat.
  - Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

Shields
Removing and replacing shields will be done with the R-1070 station with the temperature control set to approximately 415°F (215°C) [445°F (230°C) maximum]

- **To remove the shield:**
  - Place the circuit board in the R-1070’s holder.
  - Select the proper heat focus head and attach it to the heater chimney.
  - Add solder paste flux around the base of the shield.
  - Position the shield under the heat-focus head.
  - Lower the vacuum tip and attach it to the shield by turning on the vacuum pump.
  - Lower the focus head until it is approximately 1/8” (0.3 cm) above the shield.
  - Turn on the heater and wait until the shield lifts off the circuit board.
  - Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump.
  - Remove the circuit board from the R-1070’s circuit board holder.
- **To replace the shield:**
  - Add solder to the shield if necessary, using a micro-tipped soldering iron.
  - Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board.
  - Place the circuit board back in the R1070’s circuit board holder.
  - Place the shield on the circuit board using a pair of tweezers.
  - Position the heat-focus head over the shield and lower it to approximately 1/8” (0.3 cm) above the shield.
  - Turn on the heater and wait for the solder to reflow.
  - Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool.
  - Remove the circuit board and inspect the repair. No cleaning should be necessary.

3.5 Recommended Test Tools

Table 3-1 lists the recommended tools used for maintaining this family of radios. These tools are also available from Motorola.

Table 3-1 Recommended Test Tools

Motorola Part Number	Description	Application
RSX4043	Torx Driver	Tighten and remove chassis screws
6680387A70	T-6 Torx Bit	Removable Torx driver bit
WADN4055A 6604008K01 6604008K02	Portable soldering station 0.4mmreplacement tip 0.8mmreplacement tip	Digitally controlled soldering Iron For WADN4055A soldering Iron For WADN4055A soldering Iron
0180386A78	Illuminated magnifying glass with lens attachment.	
0180386A82 6684253C72 6680384A98 1010041A86 0180303E45	Anti-static grounding kit Straight prober Brush Solder (RMA type), 63/37, 0.5mm diameter 1 lb. spool SMD tool kit	Used during all radio assembly and disassembly procedures
R1321A	Shields and surface-mounted component and IC removal/rework station (order all heat-focus heads separately)	Removal and assembly of surface-mounted integrated circuits and shields
6680332E82 6680332E84 6680332E85 6680332E90	Nozzle 20.3 x 20.3 mm Nozzle 12.7 x 12.7 mm Nozzle 12.7 x 24.1 mm Nozzle 24.1 x 24.1 mm	Heat-focus heads for R-1321A work station

Table 3-2 lists test equipment required to service the radio and other two-way radios.

Table 3-2 Recommended Test Equipment

Motorola Part Number	Description	Characteristics	Application
R2600_NT	Comms System Analyzer (non MPT)	This monitor will substitute for items with an asterisk*	Frequency/deviation meter and signal generator for widerange troubleshooting and alignment
R2680_NT	Comms System Analyzer (MPT1327) to be ordered with RLN1022_ (H/W) RLN1023_ (S/W)	This monitor will substitute for items with an asterisk*.	Frequency/deviation meter and signal generator for widerange troubleshooting and alignment
*R1072_	Digital Multimeter		AC/DC voltage and current measurements
*R-1377_	AC Voltmeter	100µV to 300V, 5Hz - 1MHz, 10Megohm input impedance	Audio voltage measurements
WADN133	Delay Oscilloscope	2 Channel 40MHz bandwidth, 5mV/cm - 20 V/cm	Waveform measurements
R1440_ 0180305F17 0180305F31 0180305F39 RLN4610 T1013_	Wattmeter, Plug-in Elements Plug-in Elements Plug-in Elements Carry case RF Dummy Load	Thruline 50-Ohm, ±5% accuracy 100W, 25 - 60MHz 25W, 100-250MHz 10W, 200-250MHz Wattmeter and 6 elements	Transmitter power output measurements
S1339_	RF Millivolt Meter	100mV to 3 VRF. 10kHz to 1.2GHz	RF level measurements
R1011_/220V	220V Power Supply	0 - 40V 0 - 40A	Programmable

3.6 Service Aids

Table 3-3 lists service aids recommended for working on the GP344/GP388 Radios. While all ofthese items are available from Motorola, most are standard shop equipment items, and anyequivalent item capable of the same performance may be substituted for the item listed.

Table 3-3 Service Aids

Motorola Part Number	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/ accessory jack. Allows switching for radio testing.
RKN4075_	Ribless Cable/Test Cable	Connects radio to Computer.
JMKN4123_	Programming Cable/Test Cable	Connects radio to RIB (RLN4008_).
RLN4008_	Radio Interface Box (RIB)	Enables communications between the radio and the computer's serial communications adapter.
HLN9756_	BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
HKN9743_	MAP27 Cable	Connects radio to computer for MAP27 applications in MPT requirements.
HLN9742_	Flash Upgrade Adapter	Provides connections to the computer or RIB programming /test cable.
0180305G54	Shop Battery Eliminator	Provides connections to the computer or RIB programming /test cable.
8180384F66	Bench Test Housing Eliminator for long housing.	Provides for troubleshooting of the radio when the housing is removed.
8180384M30	Bench Test Housing Eliminator for short housing.	Provides for troubleshooting of the radio when the housing is removed.
JMKN4125_	Battery Eliminator 7.5V	Interconnects radio to power supply.
EPN4040	Wall-Mounted Power Supply	Used to supply power to the RIB (UK).
EPN4041	Wall-Mounted Power Supply	Used to supply power to the RIB (Euro).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT. All other IBM models use B71. Connects the computer's serial communications adapter to the RIB. (RLN4008_).

3.7 Replacing the Circuit Board Fuse.

In cases where the radio fails to turn on when power is applied, the circuit board fuse should always be checked as a probable cause of the failure. The locations of the fuse for both the UHF and VHF boards are shown in Figure 3-1. The radio must be disassembled to replace the fuses as described in the Basic Service Manual (see Chapter 1 - Related Documents), then the circuit board separated from the radio chassis as described in the paragraphs that follow.

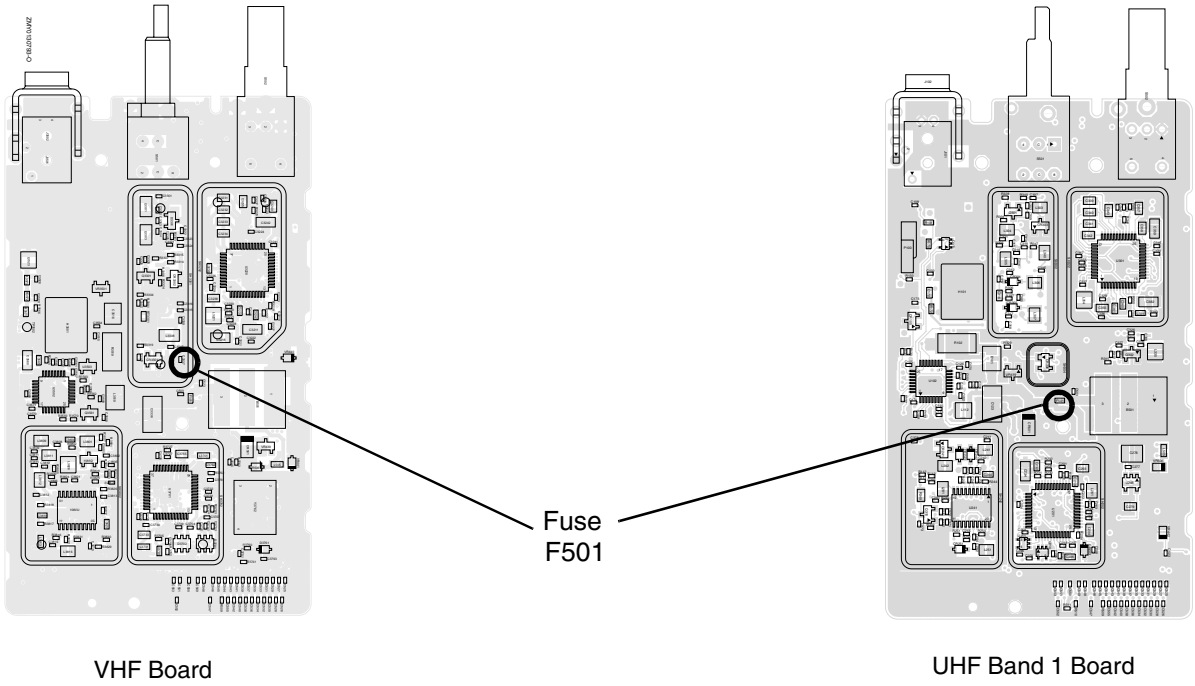


Figure 3-1. VHF, UHF Band 1, and UHF Band 2 Circuit Board Fuse Location

3.8 Removing and Reinstalling the Circuit Board

Both the UHF and VHF circuit boards are removed from the radio chassis in the following manner:

1. Refer to the Basic Service Manual (see Chapter 3- Related Documents) for radio disassembly, then use a philips screwdriver and to remove the four M2X4 screws shown in Figure 3-2.
2. Lift the circuit board out of the radio chassis, then remove and discard the O-rings located between the circuit board and chassis.
3. After repairs, replace the O-rings then reinstall the circuit board into the radio chassis.
4. Reinstall and tighten the four Torx screws to secure the circuit board to the chassis.
5. Refer to the Basic Service Manual to reassemble the radio.

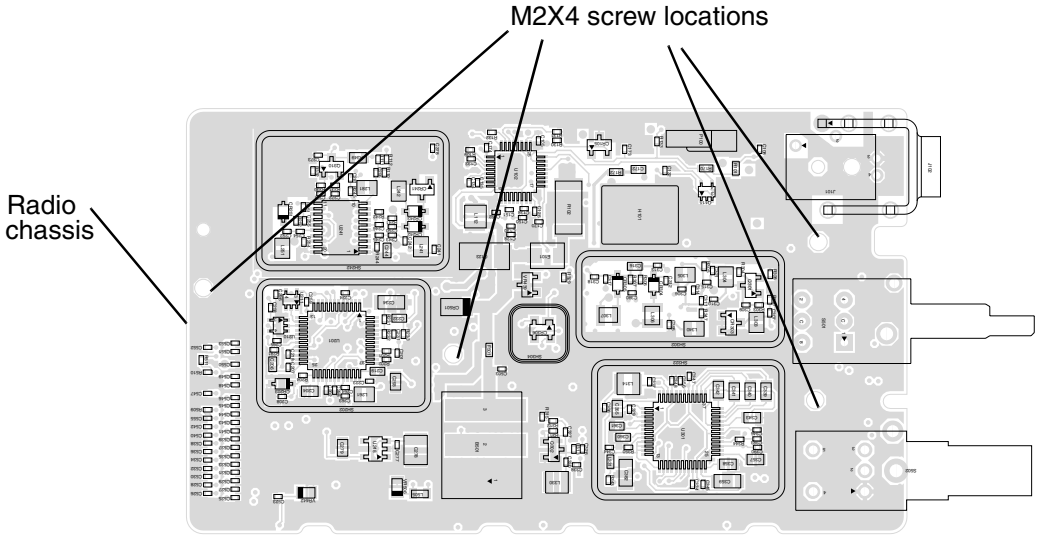


Figure 3-4. Circuit Board Removal and Reinstallation

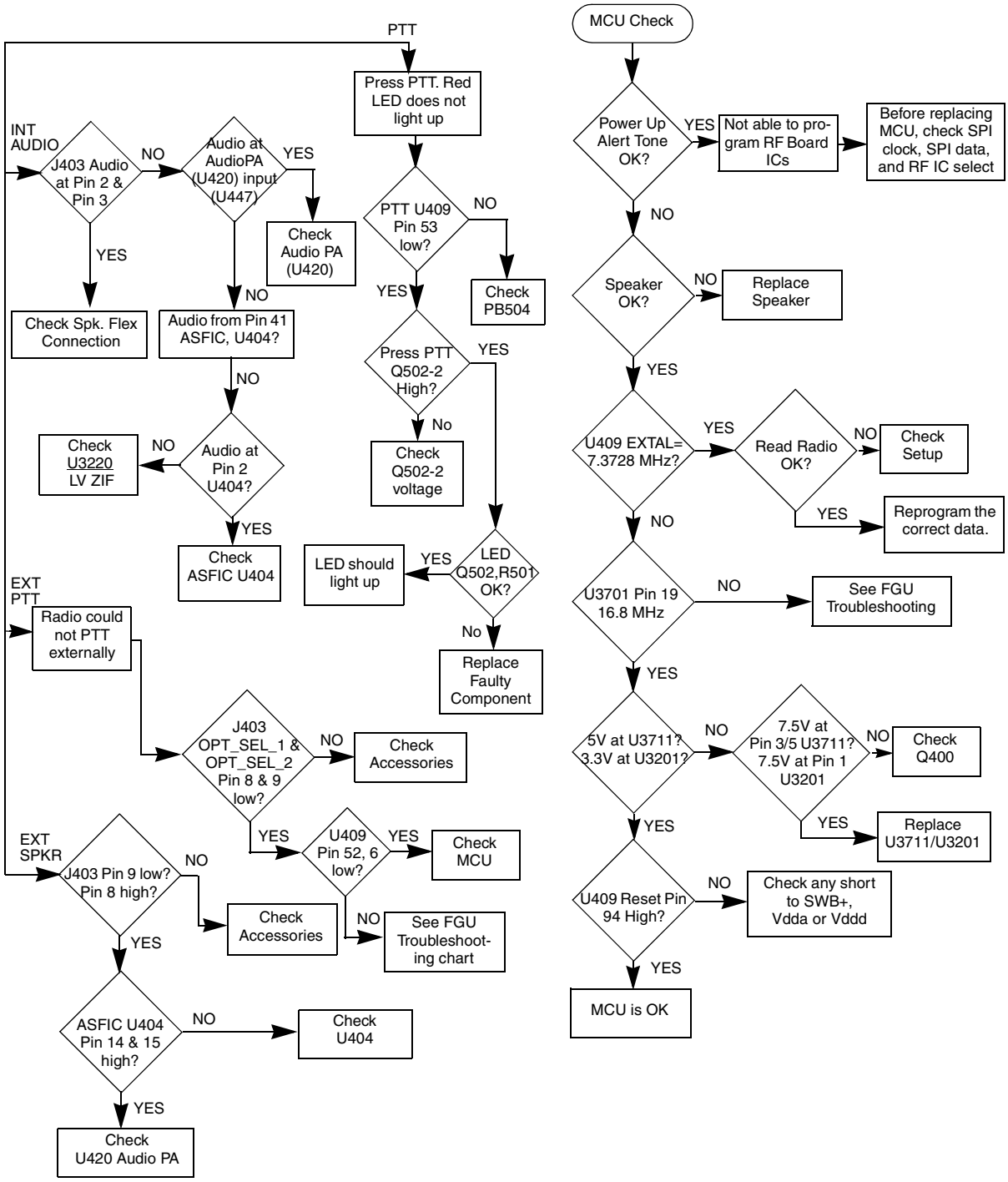
3.9 Error Codes

Turning on the radio using the ON/OFF volume control starts a self-test routine which checks the RAM, ROM checksum, EEPROM hardware and EEPROM checksum. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. Radio emits a low pitch tone if it fails the self-test.

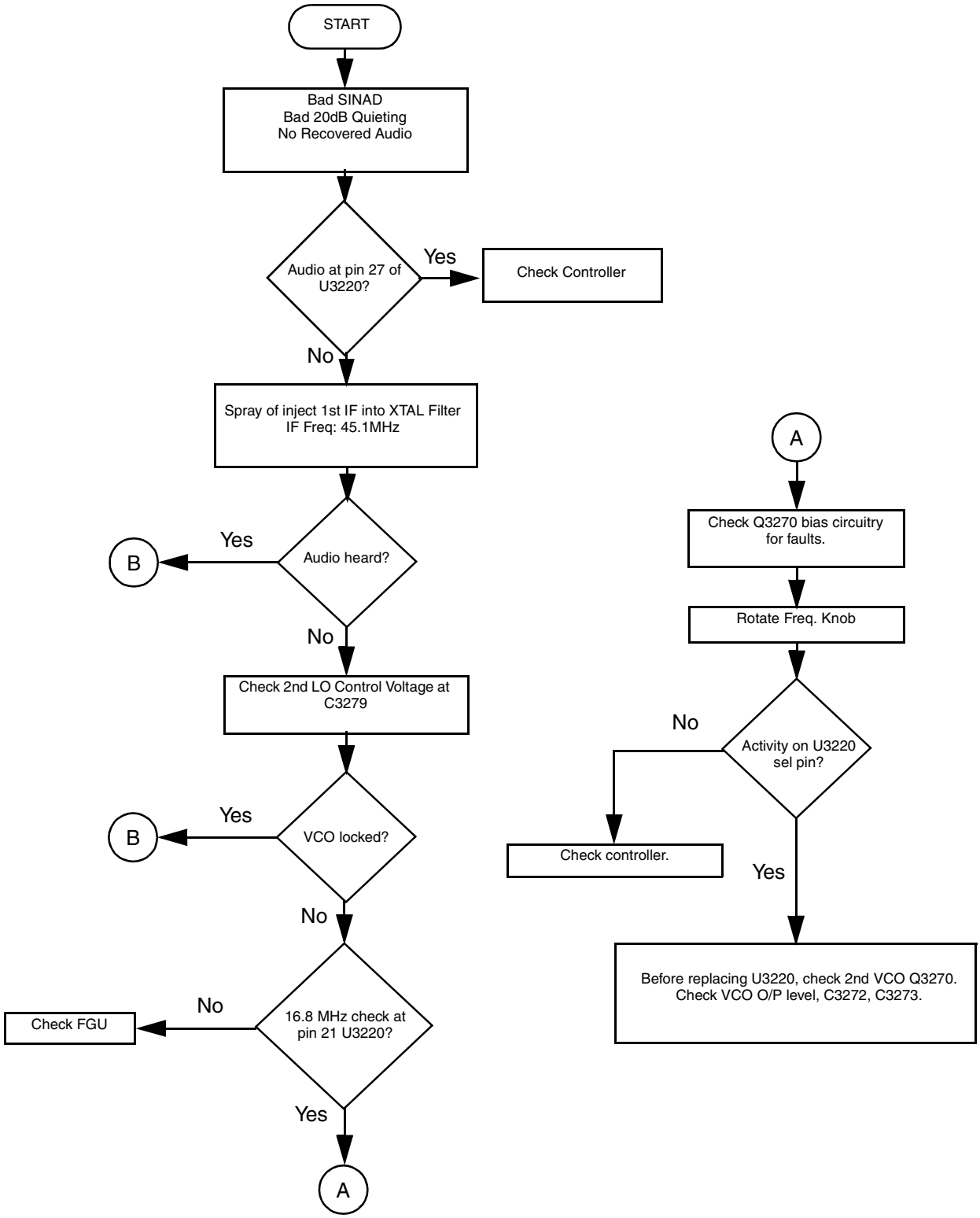
*Error Code	Explanation	Corrective Action
“RAM TST ERROR”	RAM Test Failure	Retest radio by turning it off and turning it on again. If message reoccurs, replace RAM (U405).
“ROM CS ERROR”	ROM Checksum is wrong.	Reprogram FLASH Memory, then retest. If message reoccurs, replace ROM (U406).
“EEPRM HW ERROR”	Codeplug structure mismatch, non existence of codeplug.	Reprogram codeplug with correct version and retest radio. If message reoccurs, replace EEPROM (U407).
“EEPRM CS ERROR”	Codeplug check-sum is wrong.	Reprogram codeplug.
No Display	Display module is not connected properly. Display module is damaged.	Check connection between main board and display module. Replace with new display module.

NOTE: *Error Codes are displayed on display radios only.

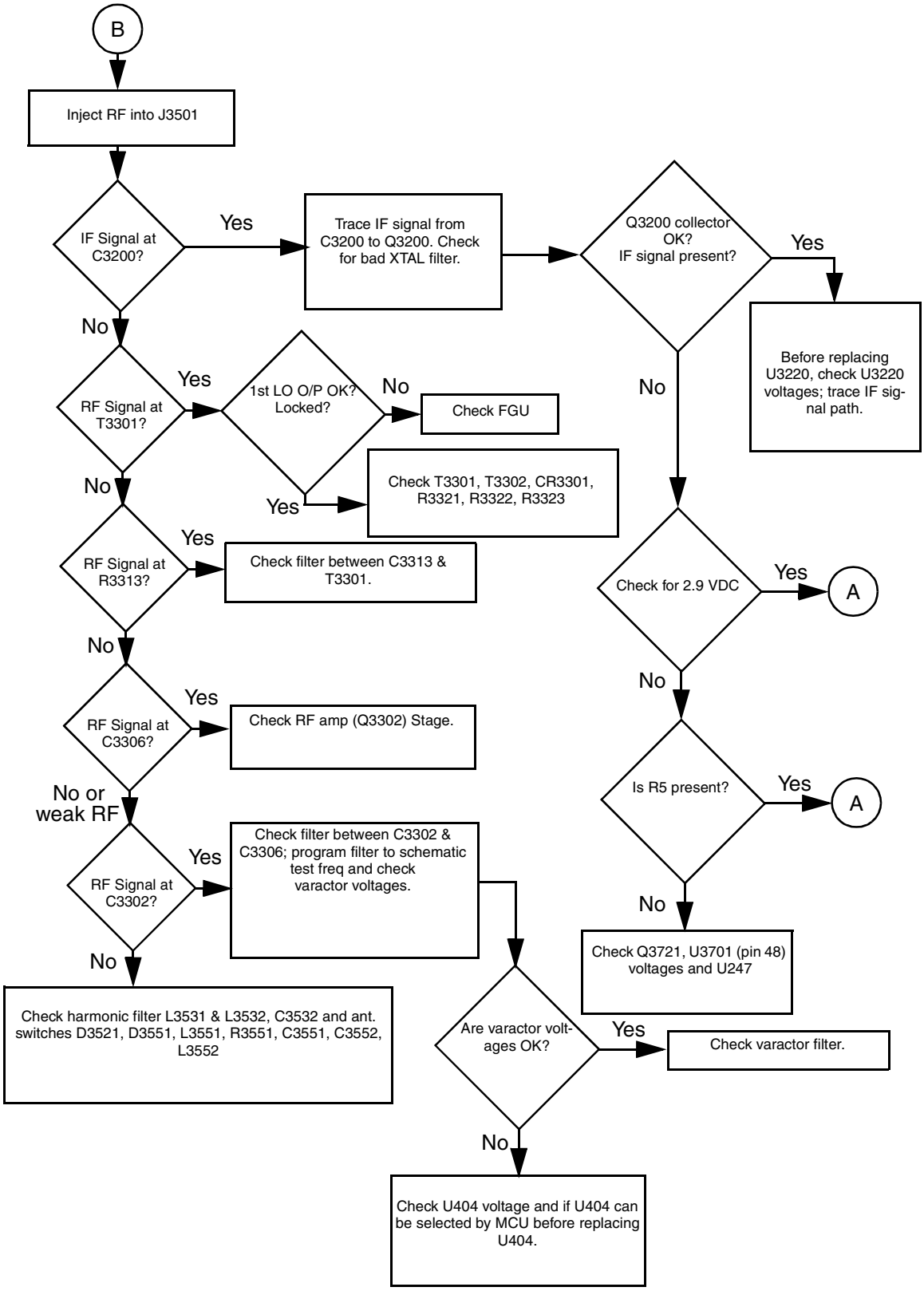
3.10 VHF Troubleshooting Charts



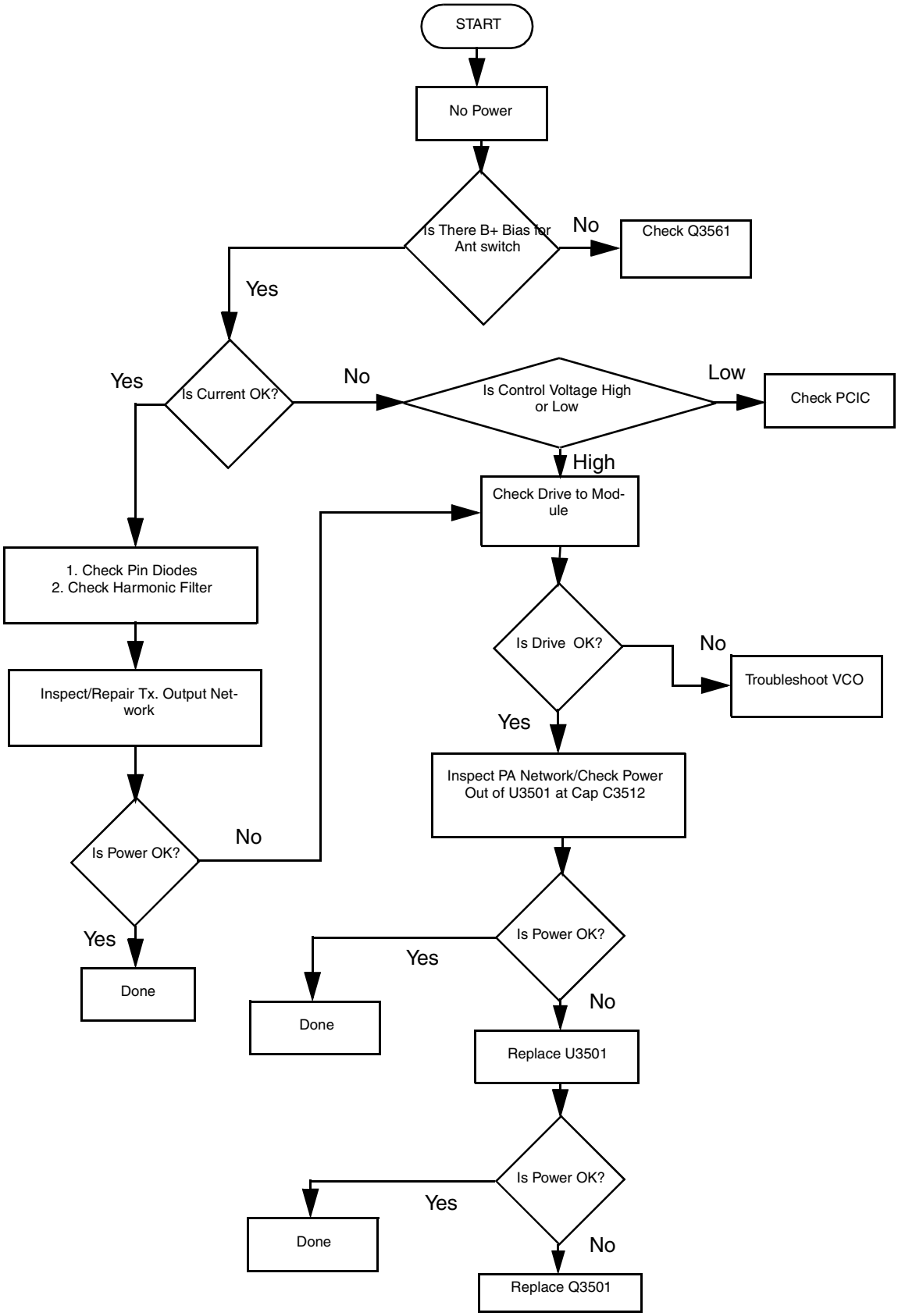
Troubleshooting Flow Chart for Controller



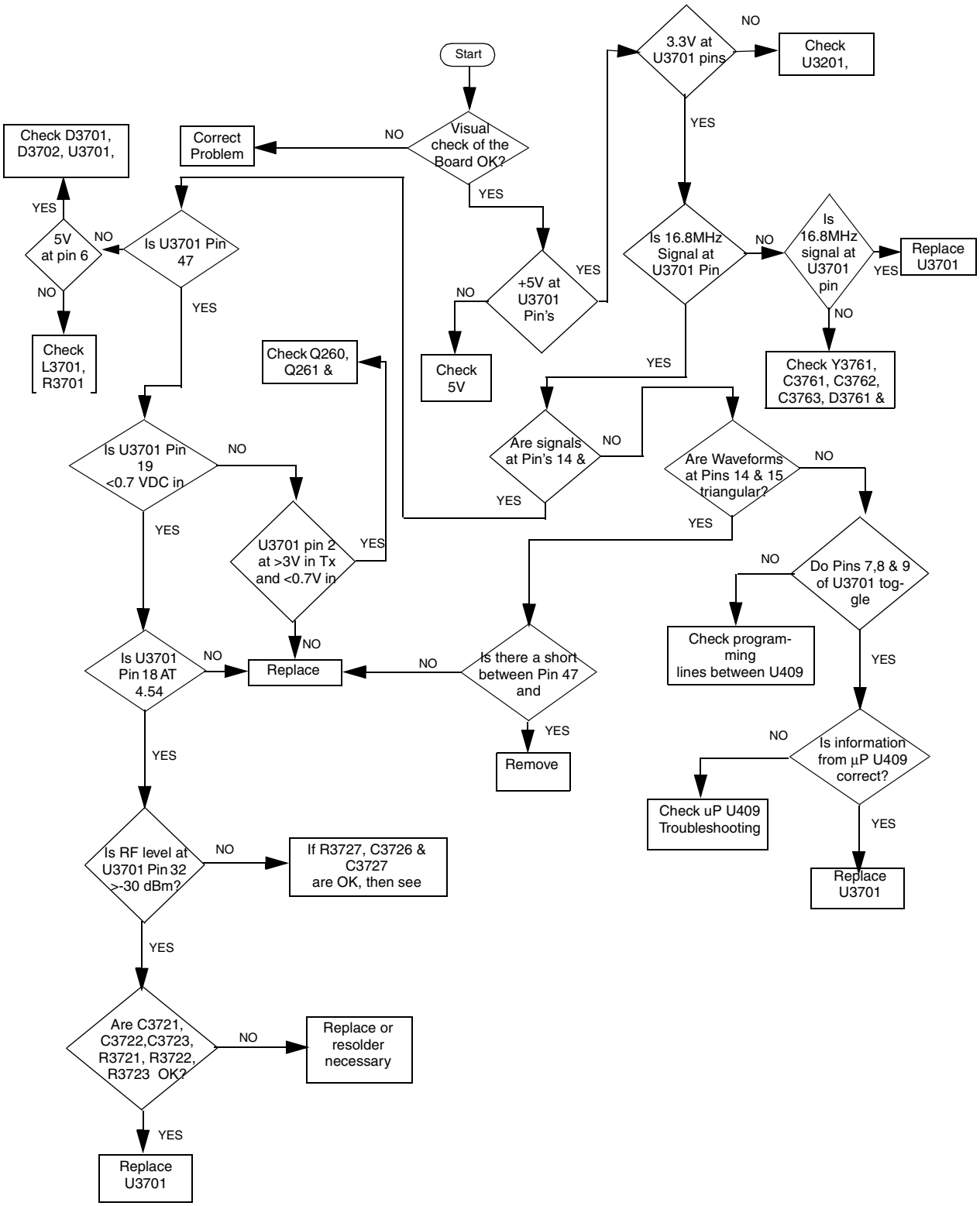
Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



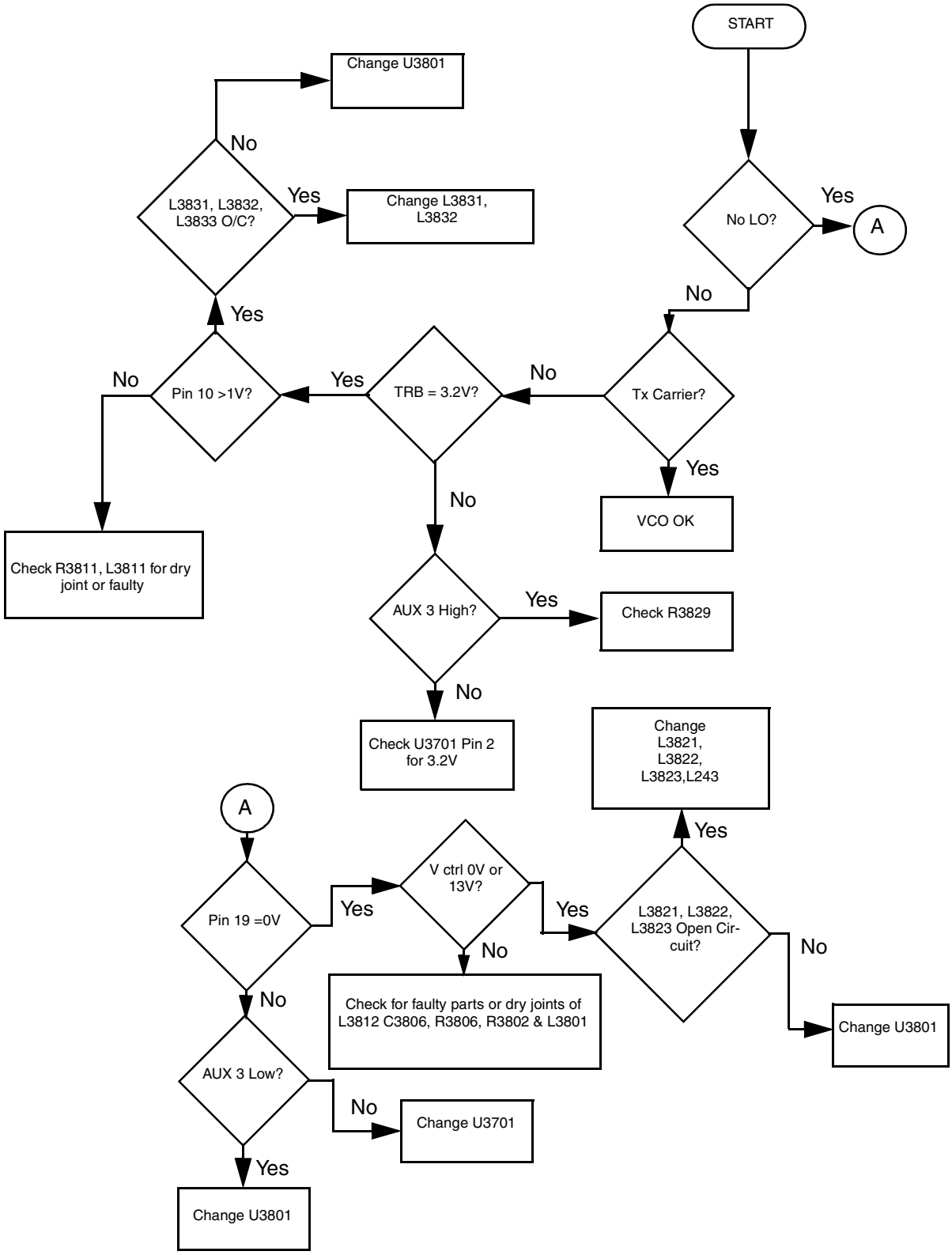
Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



Troubleshooting Flow Chart for Transmitter

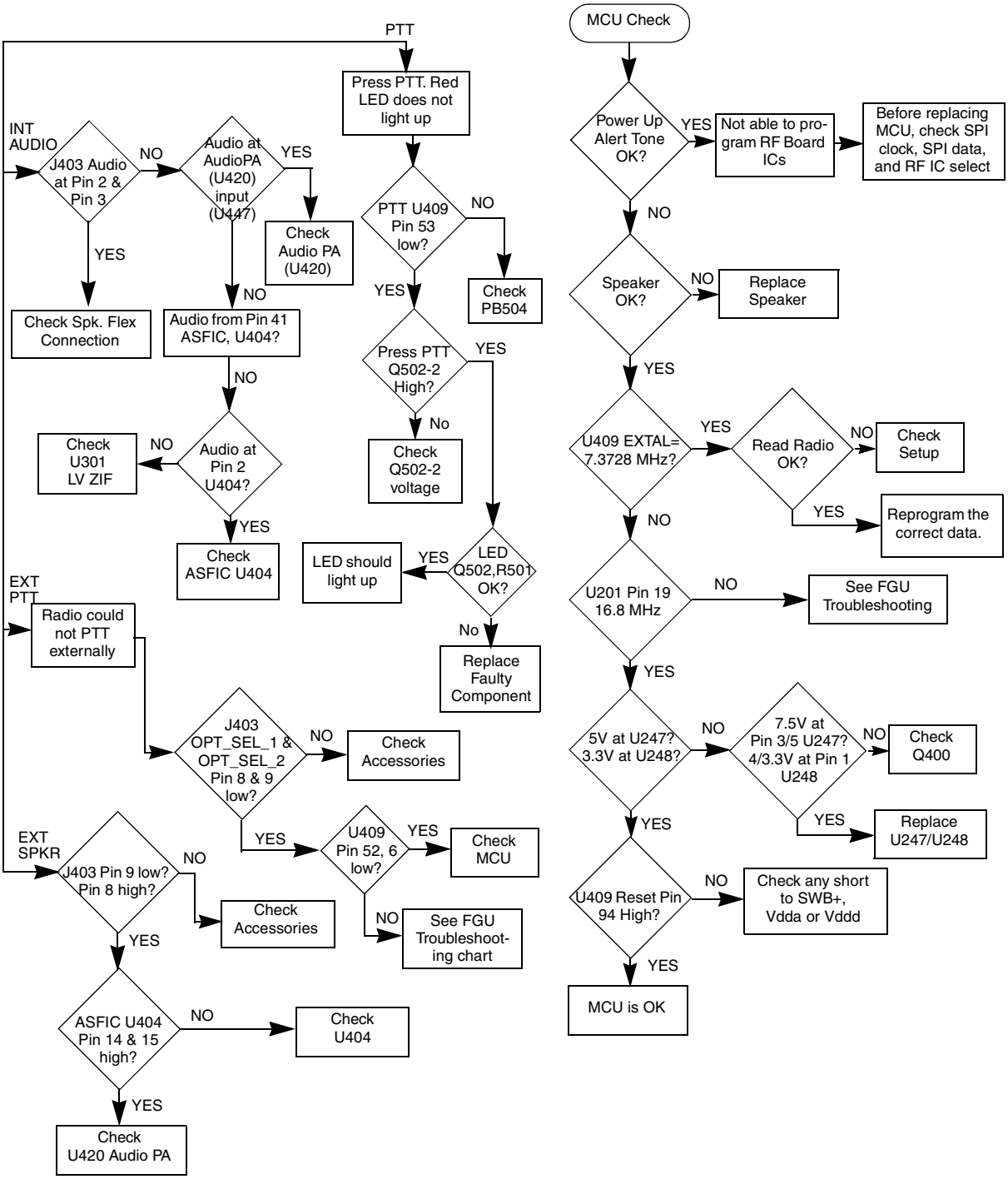


Troubleshooting Flow Chart for Synthesizer

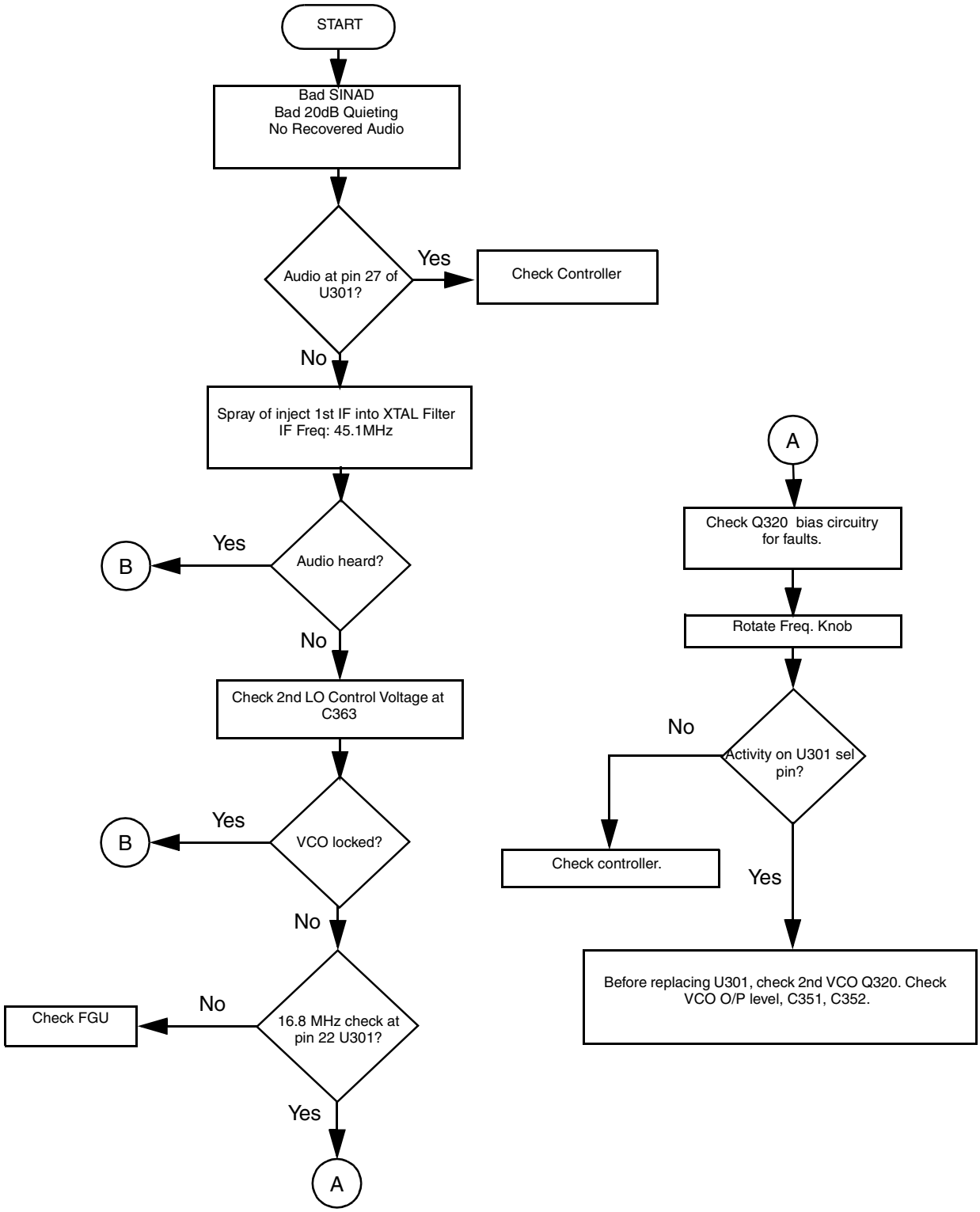


Troubleshooting Flow Chart for VCO

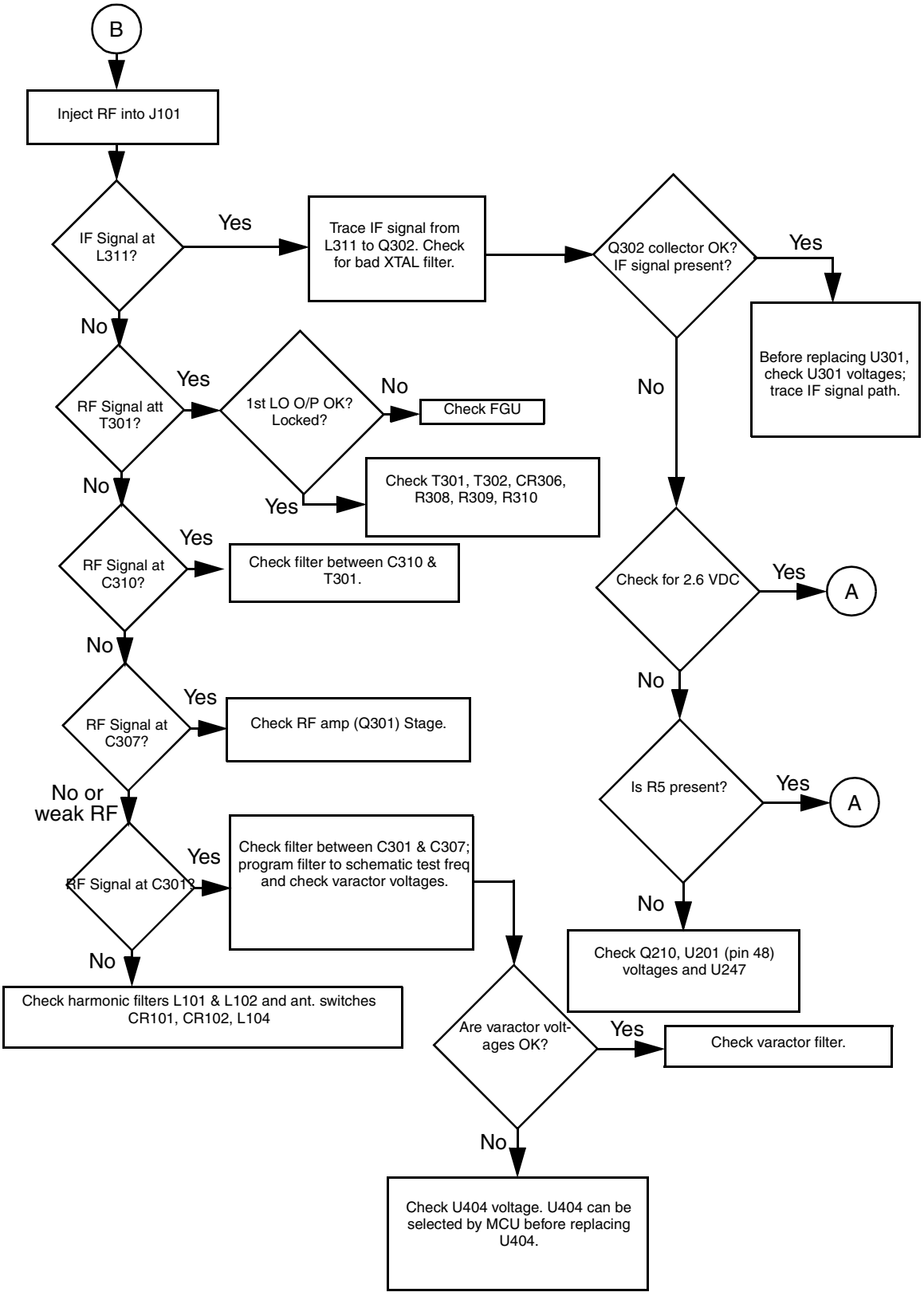
3.11 UHF (Band 1) Troubleshooting Charts



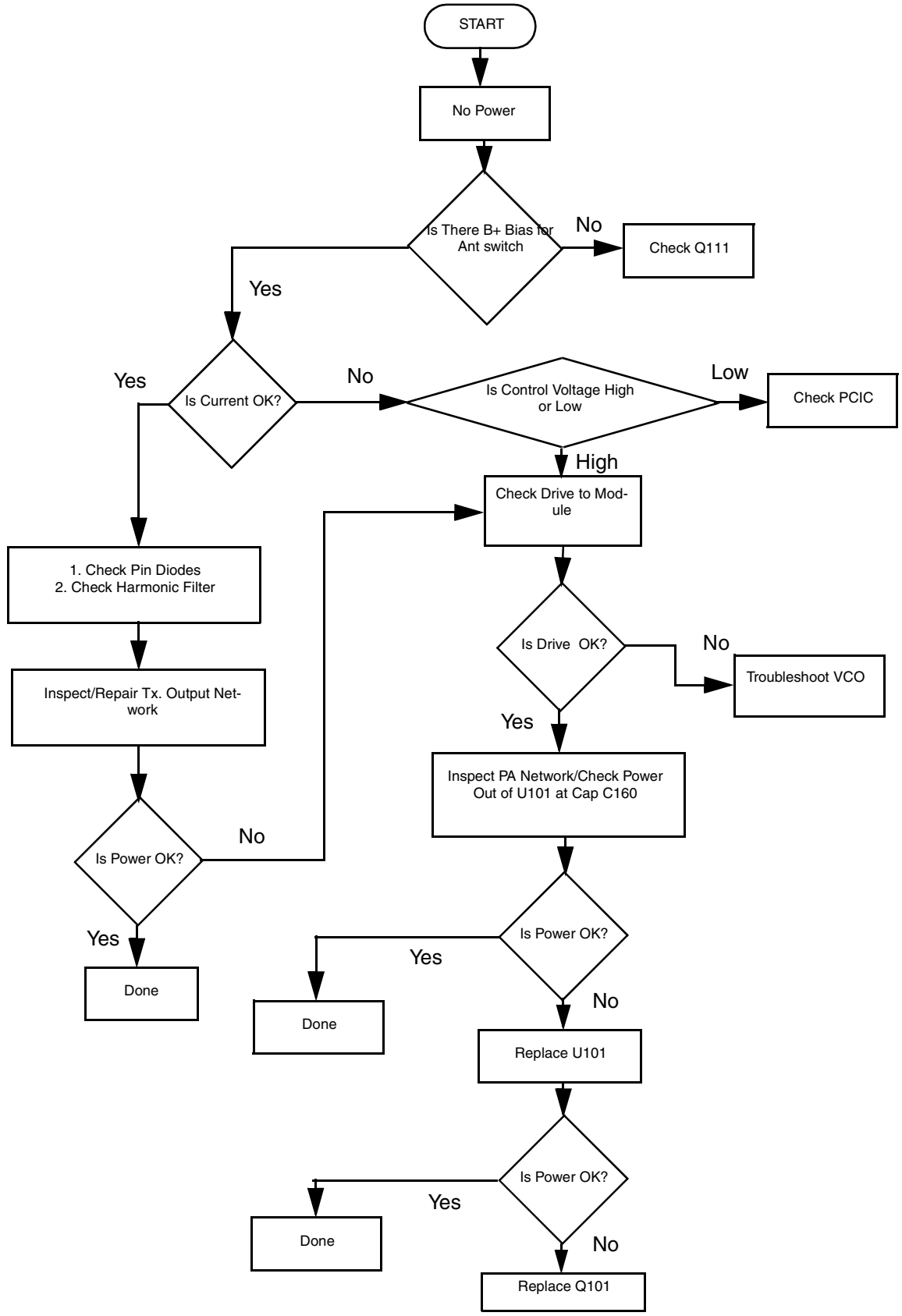
Troubleshooting Flow Chart for Controller



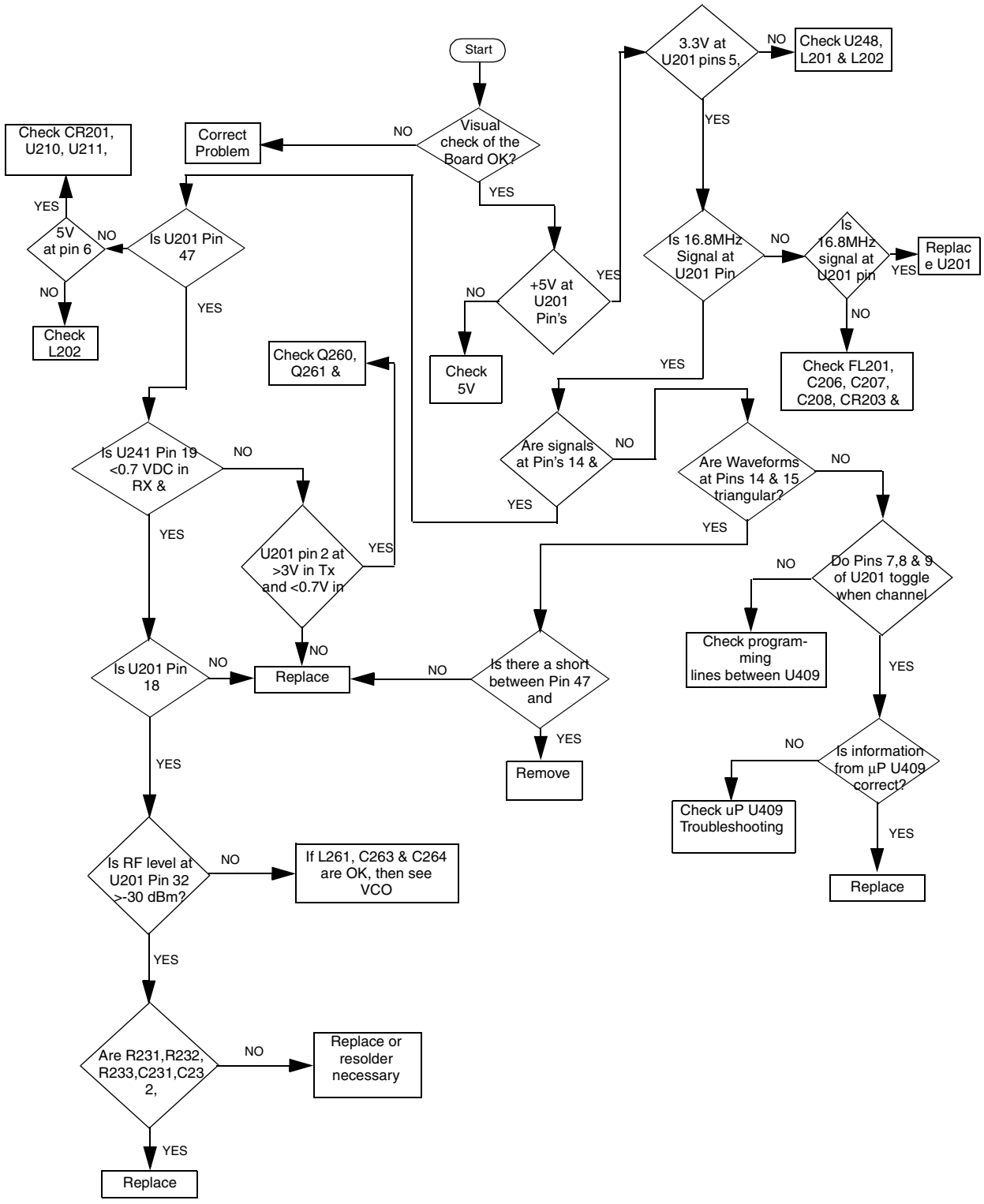
Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



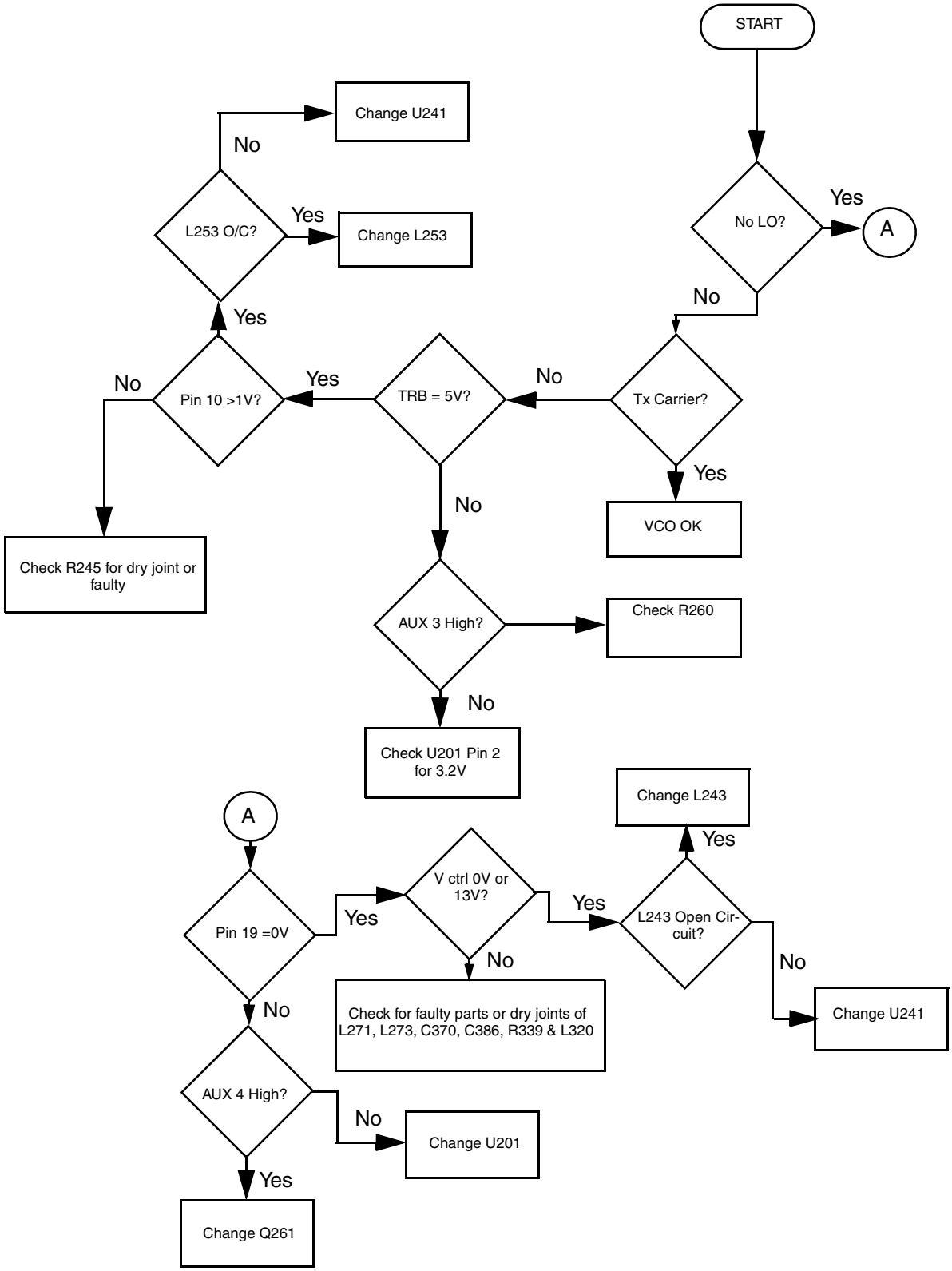
Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



Troubleshooting Flow Chart for Transmitter



Troubleshooting Flow Chart for Synthesizer



roubleshooting Flow Chart for VCO

3.12 Keypad Troubleshooting Chart

