MOTOROLA

PRO3150™

Portable Radio

Professional Radio

Detailed Service Manual

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Safety Information

Important information on safe and efficient operation is included in this manual. Read this information before using your radio.

SAFE AND EFFICIENT OPERATION OF MOTOROLA TWO-WAY RADIOS

This document provides information and instructions for the safe and efficient operation of Motorola Portable and Mobile Two-Way Radios.

The information provided in this document supersedes the general safety information contained in user guides published prior to January 1, 1998.

For information regarding radio use in hazardous areas, please refer to the Factory Mutual (FM) approval manual supplement or Instruction Card which is included with radio models that offer this capability

EXPOSURE TO RADIO FREQUENCY ENERGY

Your Motorola Two-Way Radio, which generates and radiates radio frequency (RF) electromagnetic energy (EME), is designed to comply with the following National and International Standards and Guidelines regarding exposure of human beings to radio frequency electromagnetic energy:

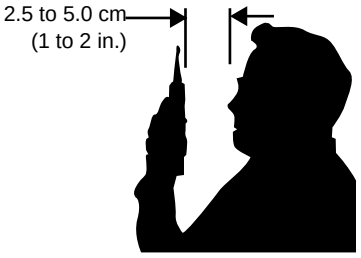
- Federal Communications Commission Report and Order No. FCC 96-326 (August 1996)
- American National Standards Institute (C95.1 - 1992)
- National Council on Radiation Protection and Measurements (NCRP-1986)
- International Commission on Non-Ionizing Radiation Protection (ICNRP- 1986)
- European Committee for Electrotechnical Standardization (CENELEC):

- ENV 50166-1 1995 E	Human exposure to electromagnetic fields Low frequency (0 Hz to 10 kHz)
- ENV 50166-2 1995 E	Human exposure to electromagnetic fields High frequency (10 kHz to 300 GHz)
- Proceedings of SC211/B 1996	“Safety Considerations for Human Exposure to EMFs from Mobile Telecommunication Equipment (MTE) in the Frequency Range 30MHz - 6 GHz.” (EMF - Electromagnetic Fields)

To assure optimal radio performance and to ensure that your exposure to radio frequency electromagnetic energy is within the guidelines in the above standards, always adhere to the following procedures:

PORTABLE RADIO OPERATION AND EME EXPOSURE

- When transmitting with a portable radio, hold radio in a vertical position with the microphone 2.5 to 5.0 centimeters (one to two inches) away from the mouth. Keep antenna at least 2.5 centimeters (one inch) from your head or body when transmitting.
- If you wear a portable Two-Way radio on your body, ensure that the antenna is at least 2.5 centimeters (one inch) from the body when transmitting.



ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY

NOTE Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed, or alternately configured for electromagnetic compatibility.

- To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospital or health facilities may be using equipment that is sensitive to external RF energy.
- When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with airline regulations or crew instructions.

OPERATIONAL WARNINGS

Vehicles with an Air Bag

WARNING: Do not place a portable radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of vehicle.

Potentially Explosive Atmospheres

WARNING: Turn off your Two-Way radio when you are in any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas (e.g. FM or Cenelec approved). Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

Batteries

WARNING: Do not replace or recharge batteries in a potentially explosive atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion.

Blasting Caps and Areas

WARNING: To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps. In a "*blasting area*" or in areas posted "*turn off two-way radio*", obey all signs and instructions.

NOTE The areas with potentially explosive atmospheres referred to above include fuelling areas such as: below decks on boats; fuel or chemical transfer or storage facilities; areas where the air contains chemicals or particles, such as grain, dust or metal powders; and any other area where you would normally be advised to turn off your vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

OPERATIONAL CAUTIONS

Damaged Antennas

CAUTION: Do not use any portable two-way radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries

CAUTION: All batteries can cause property damage and/or bodily injury such as burns if a conductive material such as jewelry, keys or beaded chains touch exposed terminals. The conductive material may complete an electrical circuit (short circuit) and become quite hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse or other container with metal objects.

Chapter 1

Introduction

1.1 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by a complete Manual revision or alternatively, as additions.

NOTE Before operating or testing these units, please read the Safety Information section in the front of this manual.

1.2 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any “return for exchange” or “return for repair” by an authorized Motorola Dealer must be accompanied by a Warranty claim form. Warranty claim forms are obtained by contacting customer service.

1.2.1 Warranty Period

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

1.2.2 Return Instructions

In instances where the product is covered under a “return for replacement” or “return for repair” warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

1.2.3 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

Firstly, Motorola's Accessories and Aftermarket Division (AAD) offers a repair service to both end users and dealers at competitive prices.

Secondly, Motorola’s service department supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

1.3 Related Documents

The following documents are directly related to the use and maintainability of this product.

Title	Part Number
Service Manual, Basic, Spanish	68P81093C27
Service Manual, Basic, Portuguese	68P81093C28
Service Manual, Basic, English	68P81093C22
Service Manual, Detailed, Spanish	68P81093C29
Service Manual, Detailed, Portuguese	68P81093C30

1.4 Technical Support

Technical support is available to assist the dealer/distributor and self-maintained customers in resolving any malfunction which may be encountered. Initial contact should be by telephone to customer resources wherever possible. When contacting Motorola technical support, be prepared to provide the product model number and the unit's serial number. The contact locations and telephone numbers are located in the Basic Service Manual listed under the Related Documents paragraph of this section.

1.4.1 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola's Accessories and Aftermarket Division (AAD). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All orders for parts/information should include the complete Motorola identification number. All part orders should be directed to your local AAD office. Please refer to your latest price pages.

Parts Order Entry
7:00 A. M. to 7:00 P. M. (Central Standard Time)
Monday through Friday (Chicago, U. S. A.)

To Order Parts in Latin America and the Caribbean:
(847) 538-8023
Motorola Parts
Accessories and Aftermarket Division
Latin America and Caribbean
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

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

1.5 Radio Model Chart and Specifications

The radio model charts and specifications are located in the Basic Service Manual listed under the Related Documents paragraph of this chapter.

1.6 Radio Model Information

The model number and serial number are located on a label attached to the back of your radio. You can determine the RF output power, frequency band, protocols, and physical packages from these numbers. The example below shows one portable radio model number and its specific characteristics.

Table 1-1 Radio Model Number (Example: LAH34KDC9AA1AN)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
LA = Motorola Internal Use	**H** = Portable	**34**	**K** VHF (136-174 MHz)	**D** 4-5W	**C** No Display	**9** Prog-ramma-ble	**AA** Conventional	**1** 4F	**A**	**N**
			R UHF R1 (403-470 MHz)		**H** 1-Line Display			**6** 16F		
			S UHF R2 (450-527)							

Notes

TABLE OF CONTENTS

Chapter 2

Theory of Operation

2.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 4 of this manual.

2.2 Radio Power Distribution

A block diagram of the DC power distribution throughout the radio board is shown in Figure 2-1. A 7.5V battery supplies the basic radio power (UNSWB) directly to the electronic on/off control, audio power amplifier, power amplifier automatic level control (ALC), and low battery detect circuit. When the radio on/off/volume control is turned on, the switched SWB+ is applied to the various radio power regulators, antenna switch, accessories jack, and keypad/option board, and transmit LED. The Vdda output from the 3.3V Vdda regulator supplies the microprocessor with operating power. Data is then sent to the controller ASFIC to turn on a DAC which takes over the momentary-on path within 12ms. The SWB+ signal supplies power until the radio is turned off. Jumpers for configuring the Vdda and Vddd regulators are shown in Figure 2-1 and described in Table 2-1.

The radio turns off when either of the following two conditions occur:

- Radio on/off/volume control is turned off.
- Low battery condition is detected.

If a low battery level is detected by the microprocessor through either of the above conditions, the radio personality data is stored to EEPROM prior to turning off.

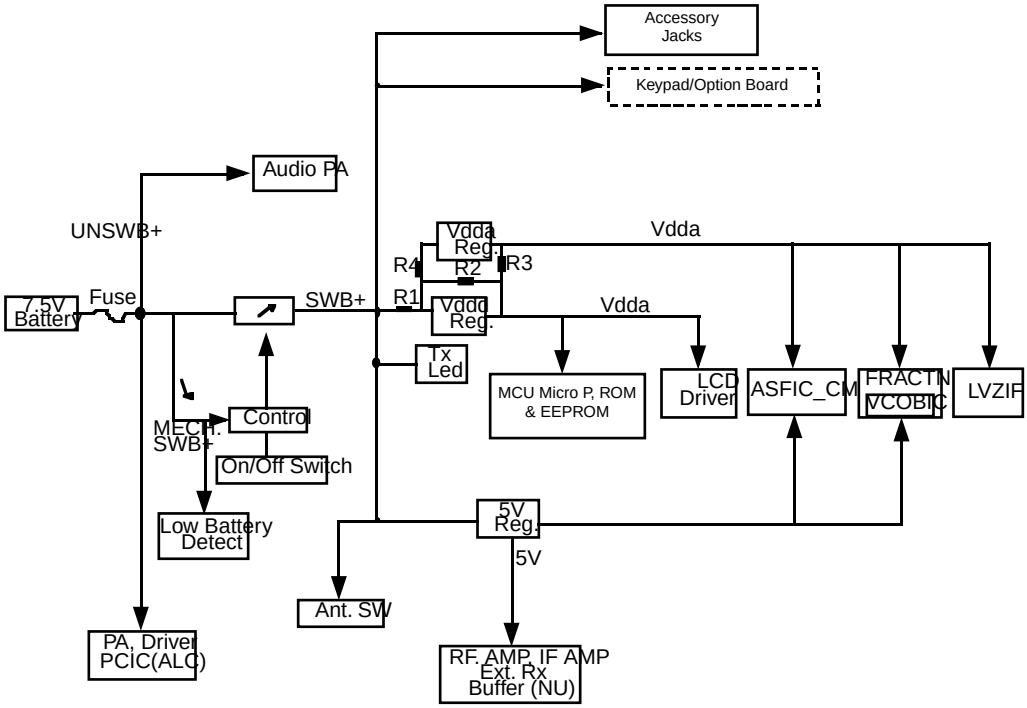


Figure 2-1. DC Power Distribution Block Diagram

Table 2-1 Radio Jumpers

Jumpers	Dual Vdd Regulator Scheme	Single Vdd Regulator Scheme
R1	Y	Y
R2	N	N
R3	N	Y
R4	Y	N

2.3 Keypad

The keypad block diagram is shown in Figure 2-2. The comparator compares the voltage when any one of the keypad row or keypad column keys is pressed. Pressing a key sends a message to the microprocessor through the output (KEY_INT) line signifying that a key has been pressed. The microprocessor then samples the Analog to Digital voltages at the keypad row and keypad column, and makes a comparison with a map table to identify the key pressed.

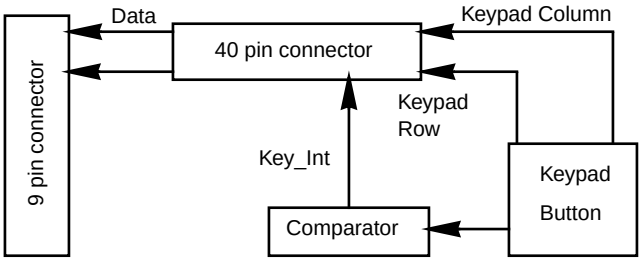


Figure 2-2. Keypad Block Diagram

2.4 Controller

The controller board is the central interface between the various subsystems of the radio. It is separated into MCU digital and audio/signalling functions as shown in Figure 2-3.

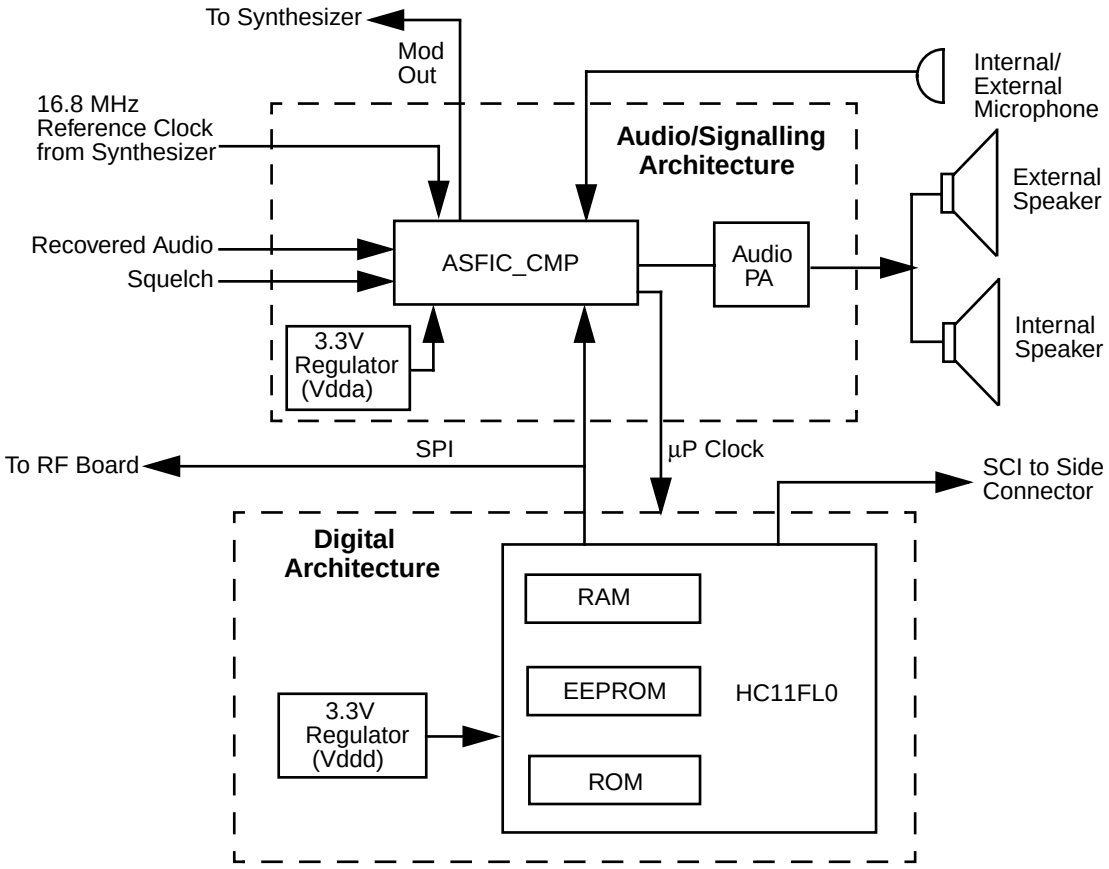


Figure 2-3. Controller Block Diagram

2.4.1 MCU Digital

An open architecture system, with the HC11FL0 as the processor, is used.

The digital portion of the controller consists of a micro controller and associated EEPROM, RAM, and ROM memories. Combinations of different size RAM and ROM are available to support various application software.

2.4.2 Audio/Signaling

The audio/signalling/filter/companding IC (ASFIC) and the audio power amplifier (Figure 2-3) form the main components of the audio/signalling section of the controller board. Inputs include a 16.8 MHz clock from the synthesizer, recovered audio and squelch, microprocessor, and external or internal microphones. Outputs include a microprocessor clock (CLK), modulator output to the synthesizer, and amplified audio signals to an internal or external speaker.

2.5 UHF Transmitter

The UHF transmitter consists of the following basic circuits as shown in Figure 2-4.

- Power amplifier (PA)
- Antenna switch/harmonic filter
- Antenna matching network
- Power control integrated circuit (PCIC)

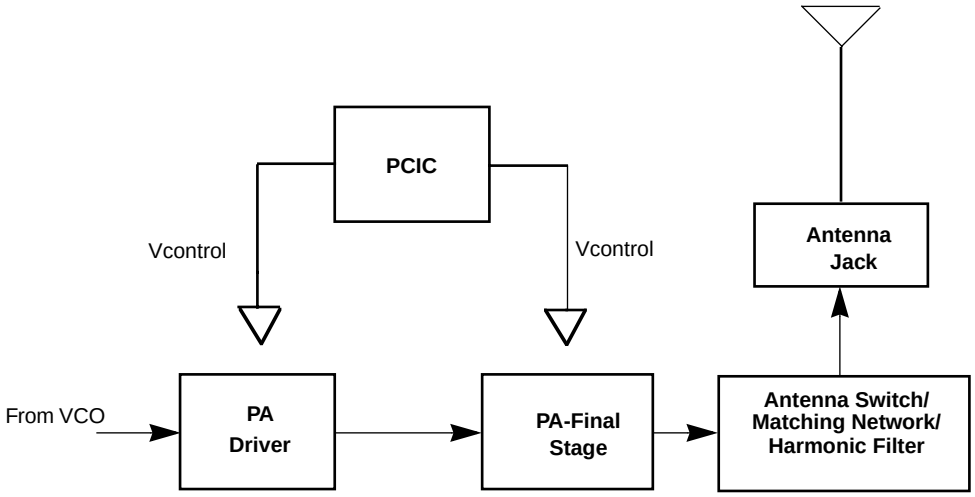


Figure 2-4. UHF Transmitter Block Diagram

2.5.1 Power Amplifier (PA)

The PA consists of two LDMOS devices:

1. PA driver, U101

2. PA final stage, Q110

The LDMOS driver (U101) provides 2-stage amplification using a supply voltage of 7.3V. The amplifier is capable of supplying an output power of 0.3W (U101-6 and -7) with an input signal of 2mW at 3dBm at U101-16. The current drain is typically 160mA while operating in the frequency range of 403-470MHz (Band 1) or 450-527 MHz (Band 2).

The LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain is typically 1300mA while operating in the frequency range of 403-470MHz. The power output can be varied by changing the bias voltage.

2.5.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C107, L104 and C106) and two current limiting resistors (R101 and R170). In the transmit mode, B+ at PCIC (U102) pin 23 goes low turning on Q111 which applies a B+ bias to the antenna switch circuit to bias the diodes “on”. The shunt diode (CR102) shorts out the receiver port and the pi network. This operates as a quarter wave transmission line to transform the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, creating a low attenuation path between the antenna and receiver ports.

2.5.3 Harmonic Filter

The harmonic filter consists of C104, L102, C143, C103, L101, C142 and C102. The harmonic filter for UHF is a modified Zolotarev design optimized for efficiency of the power module. This type of filter has the advantage that it can give a greater attenuation in the stop-band for a given ripple level. The harmonic filter insertion loss is typically less than 1.2dB.

2.5.4 Antenna Matching Network

The matching network (L116 and C141) matches the antenna's impedance with the harmonic filter to optimize the performance of the transmitter and receiver.

2.5.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the PCIC (U102) to regulate the power output of the radio. The current to the final stage of the power module is supplied through R102, which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to regulate the output power of the transmitter.

The PCIC contains internal digital to analog converters (DACs) that provide a programmable control loop reference voltage. The reference voltage level is programmable through the SPI line of the PCIC.

The PCIC internal resistors, integrators, and external capacitors (C133, C134 and C135) control the transmitter rise and fall times to reduce the power splatter into adjacent channels.

2.5.6 Temperature Cut Back Circuit

Diode CR105 and associated components are part of a temperature cut back circuit. This circuit senses the printed circuit board temperature around the transmitter circuits and outputs a DC voltage to the PCIC. If the DC voltage produced exceeds the set threshold in the PCIC, the transmitter output power decreases to reduce the transmitter temperature.

2.6 UHF Receiver

The UHF receiver consists of front end, back end, and automatic gain control circuits. A block diagram of the receiver is shown in Figure 2-5. Detailed descriptions of these stages are contained in the paragraphs that follow.

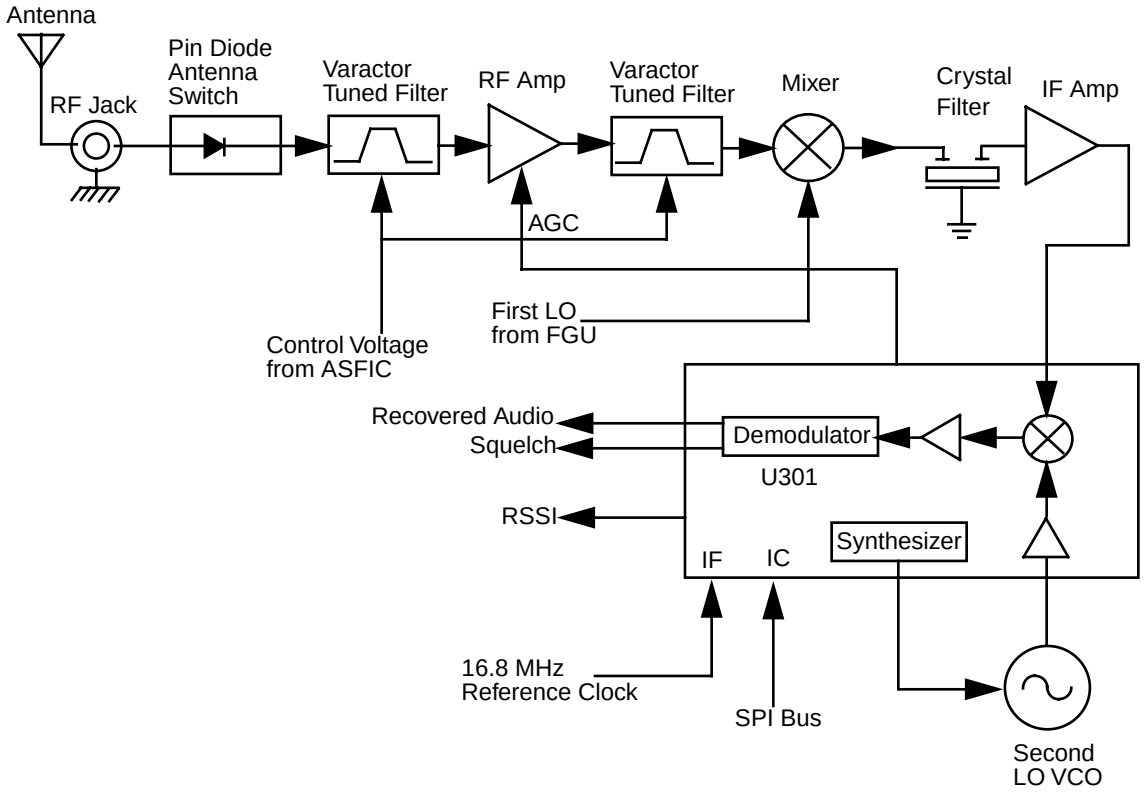


Figure 2-5. UHF Receiver Block Diagram

2.6.1 Receiver Front-End

The RF signal received by the antenna is applied to a low-pass filter. For UHF, the filter consists of components L101, L102, C102, C103, and C104. The filtered RF signal is passed through the antenna switch circuit consisting of two PIN diodes (CR101 and CR102) and a pi network (C106, L104, and C107). The signal is then applied to a varactor tuned filter bandpass.

The UHF bandpass filter consists of components L301, L302, C302, C303, C304, CR301, and CR302. The filter is electronically tuned by DACRx from IC 404 which supplies a control voltage to the varactor diodes (CR301 and CR302) in the filter, as determined by the microprocessor, depending on the carrier frequency. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

The output of the bandpass filter is coupled to the RF amplifier transistor Q301 via C307. After being amplified by the RF amplifier, the RF signal is further filtered by a second varactor tuned bandpass filter, consisting of L306, L307, C313, C317, CR304 and CR305.

Both the pre and post-RF amplifier varactor tuned filters have similar responses. The 3 dB bandwidth of the filter is approximately 50 MHz. This enables the filters to be electronically controlled by using a single control voltage from DACRx.

The output of the post-RF amplifier filter is connected to the passive double balanced mixer consisting of components T301, T302, and CR306. Matching of the filter to the mixer is provided by C381. After mixing with the first local oscillator (LO) signal from the voltage controlled oscillator (VCO) using low side injection, the RF signal is down-converted to a 45.1 MHz IF signal.

The IF signal coming out of the mixer is transferred to the crystal filter (FL301) through a resistor pad and a diplexer (C322 and L310). Matching to the input of the crystal filter is provided by C324 and L311. The crystal filter provides the necessary selectivity and intermodulation protection.

2.6.2 Receiver Back-End

The output of crystal filter FL301 is matched to the input of IF amplifier transistor Q302 by components R352 and C325. Voltage supply to the IF amplifier is taken from the receive 5 volts (R5). The IF amplifer provides a gain of about 7dB. The amplified IF signal is then coupled into U301, pin 3 via C330, C338 and L330 which provides the matching for the IF amplifier and U301.

The IF signal applied to pin 3 of U301 is amplified, down-converted, filtered, and demodulated, to produce the recovered audio at U301, pin 27. This IF IC (U301) is electronically programmable, and the amount of filtering (which is dependent on the radio channel spacing) is controlled by the microprocessor. Additional filtering, once externally provided by the conventional ceramic filters, is replaced by internal filters in the IF IC.

The IF IC uses a type of direct conversion process, whereby the externally generated second LO frequency is divided by two in U301 so that it is very close to the first IF frequency. The IF IC synthesizes the second LO and phase-locks the VCO to track the first IF frequency. The second LO is designed to oscillate at twice the first IF frequency because of the divide-by-two function in the IF IC.

In the absence of an IF signal, the VCO searches for a frequency, or its frequency will vary close to twice the IF frequency. When an IF signal is received, the VCO locks onto the IF signal. The second LO/VCO is a Colpitts oscillator built around transistor Q320. The VCO has a varactor diode, CR310, to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of C362, C363, C364, R320 and R321.

The IF IC also performs several other functions. It provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor, and used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

The demodulated signal on pin 27 of U301 is also used for squelch control. The signal is routed to U404 (ASFIC) where squelch signal shaping and detection takes place. The demodulated audio signal is also routed to U404 for processing before going to the audio amplifier for amplification.

2.6.3 Automatic Gain Control (AGC)

The front end automatic gain control circuit provides automatic reduction of gain for the front end RF amplifier via feedback. This prevents overloading of backend circuits by drawing some of the output power from the RF amplifier output. At high radio frequencies, capacitor C331 provides a low impedance path to ground for this purpose. CR308 is a PIN diode used for switching the path on or off. A certain amount of forward biasing current is needed to turn the PIN diode on. Transistor Q315 provides this current where, upon saturation, current will flow via R347, PIN diode, collector and emitter of Q315 and R319 before going to ground. Q315 is an NPN transistor used for switching. Maximum current flowing through the pin is limited mainly by the resistor R319.

The radio signal strength indicator (RSSI) voltage signal is used to drive Q315 to saturation, i.e., turned on. RSSI is produced by U301 and is proportional to the gain of the RF amplifier and the input power to the radio.

The resistor network at the input to the base of Q315 is scaled to turn on Q315, activating the AGC, at certain RSSI levels. To turn on Q315, the voltage across the transistor's base to ground must be greater or equal to the voltage across R319, plus the base-emitter voltage (Vbe) present at Q315. The resistor network with thermistor RT300 is capable of providing temperature compensation to the AGC

circuit, as RSSI generated by U301 is lower at cold temperatures compared to normal operation at room temperature. Resistor R300 and capacitor C397 form an R-C network used to dampen any transient instability while the AGC is turning on.

2.6.4 Frequency Generation Circuit

The frequency generation circuit, shown in Figure2-6, is composed of Fractional-N synthesizer U201 and VCO/Buffer IC U241. Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally require additional circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the schematic to locate reference designators.

The synthesizer is powered by regulated 5V and 3.3V, which are provided by ICs U247 and U248 respectively. The 5V signal goes to U201-13 and -30 while the 3.3V signal goes to U201-5, -20, -34 and -36. The synthesizer in turn generates a superfiltered 4.5V signal to power U241.

In addition to the VCO, the synthesizer also interfaces with the logic and ASFIC circuits. Programming for the synthesizer is accomplished through the data, clock and chip select lines from the microprocessor. A 3.3V dc signal from the synthesizer lock detect line indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFIC is supplied to U201, pin 10. Internally, the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going to the VCO.

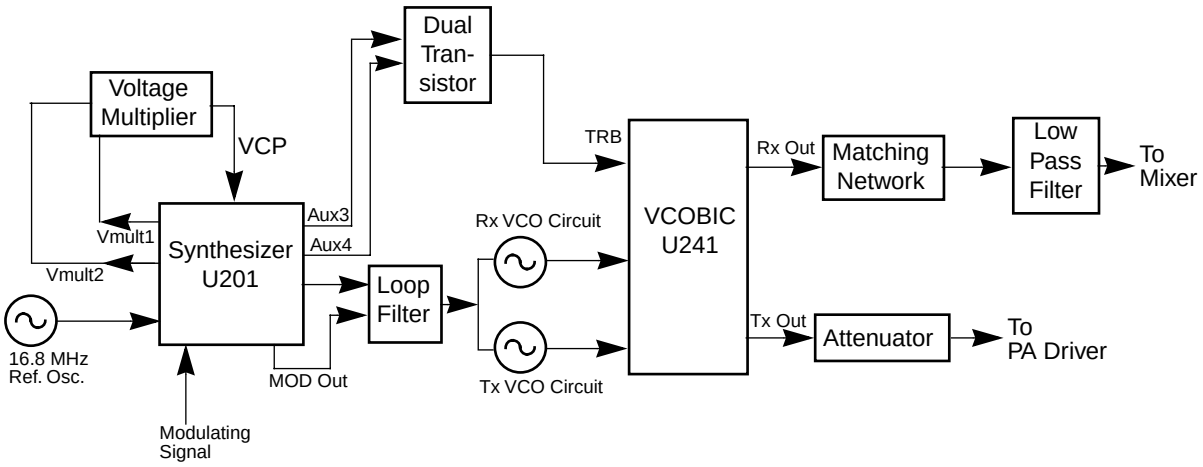


Figure 2-6. Frequency Generation Unit Block Diagram

2.7 Synthesizer

The Fractional-N Synthesizer, shown in Figure 2-7, uses a 16.8MHz crystal (FL201) to provide a reference for the system. The LVFractN IC (U201) further divides this to 2.1MHz, 2.225MHz, and 2.4MHz as reference frequencies. Together with C206, C207, C208, R204 and CR203, they build up the reference oscillator which is capable of 2.5ppm stability over temperatures of -30 to 85°C. It also provides 16.8MHz at pin 19 of U201 to be used by ASFIC and LVZIF.

The loop filter consists of C231, C232, C233, R231, R232 and R233. This filter provides the necessary dc steering voltage for the VCO and determines the amount of noise and spur passing through.

To achieve fast locking for the synthesizer, an internal adapt charge pump provides higher current at pin 45 of U201 to put the synthesizer within the lock range. The required frequency is then locked by normal mode charge pump at U201, pin 43.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C258, C259, C228, triple diode CR201 and level shifters U210 and U211. Two 3.3V square waves, 180 degrees out of phase, are first shifted to 5V, then along with regulated 5V, put through arrays of diodes and capacitors to build up 13.3V at U201-47.

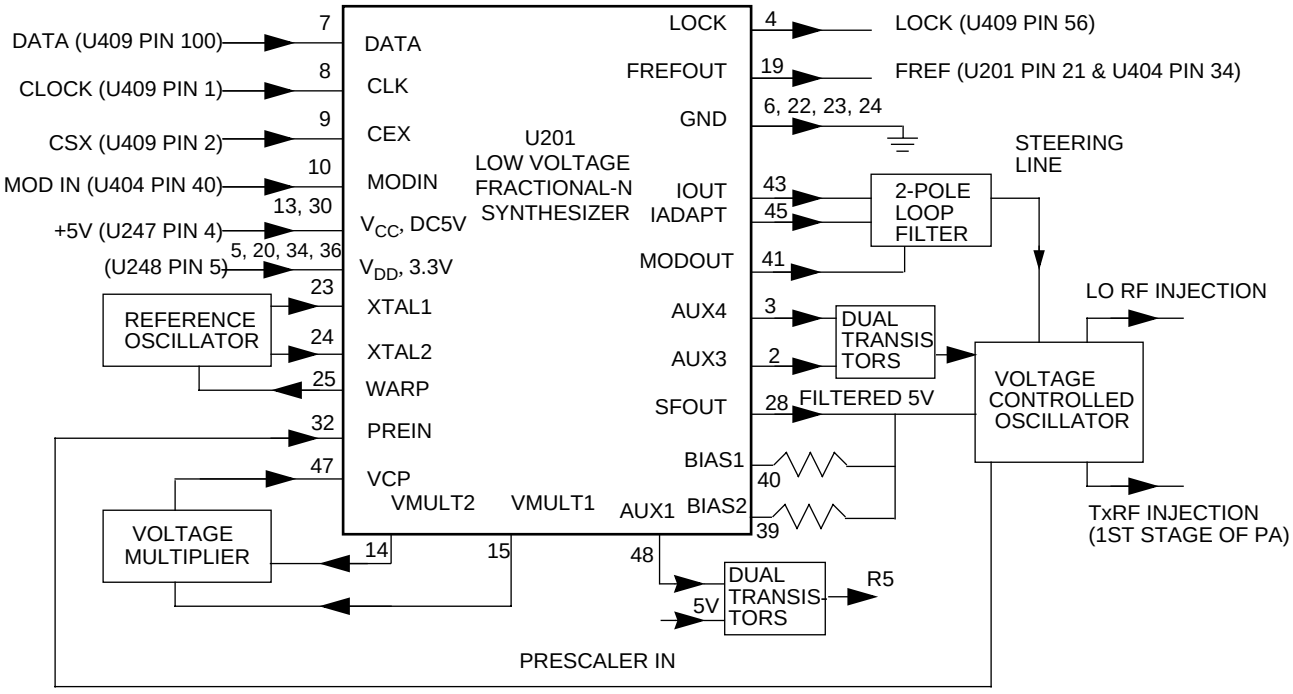


Figure 2-7. UHF Synthesizer Block Diagram

2.8 Voltage Controlled Oscillator (VCO)

The VCOB IC (U241), shown in Figure 2-8, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U241-19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U241-12, through a low pass filter, to the prescaler input (U201-32). After frequency comparison in the synthesizer, a resultant DC control voltage is received at the VCO. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 9.5V.

The VCOB IC (U241) is operated at 4.54 V (VSF) and Fractional-N synthesizer (U201) at 3.3V. This difference in operating voltage requires a level shifter consisting of Q260 and Q261 on the TRB line.

The operation logic is shown in Table 2-2.

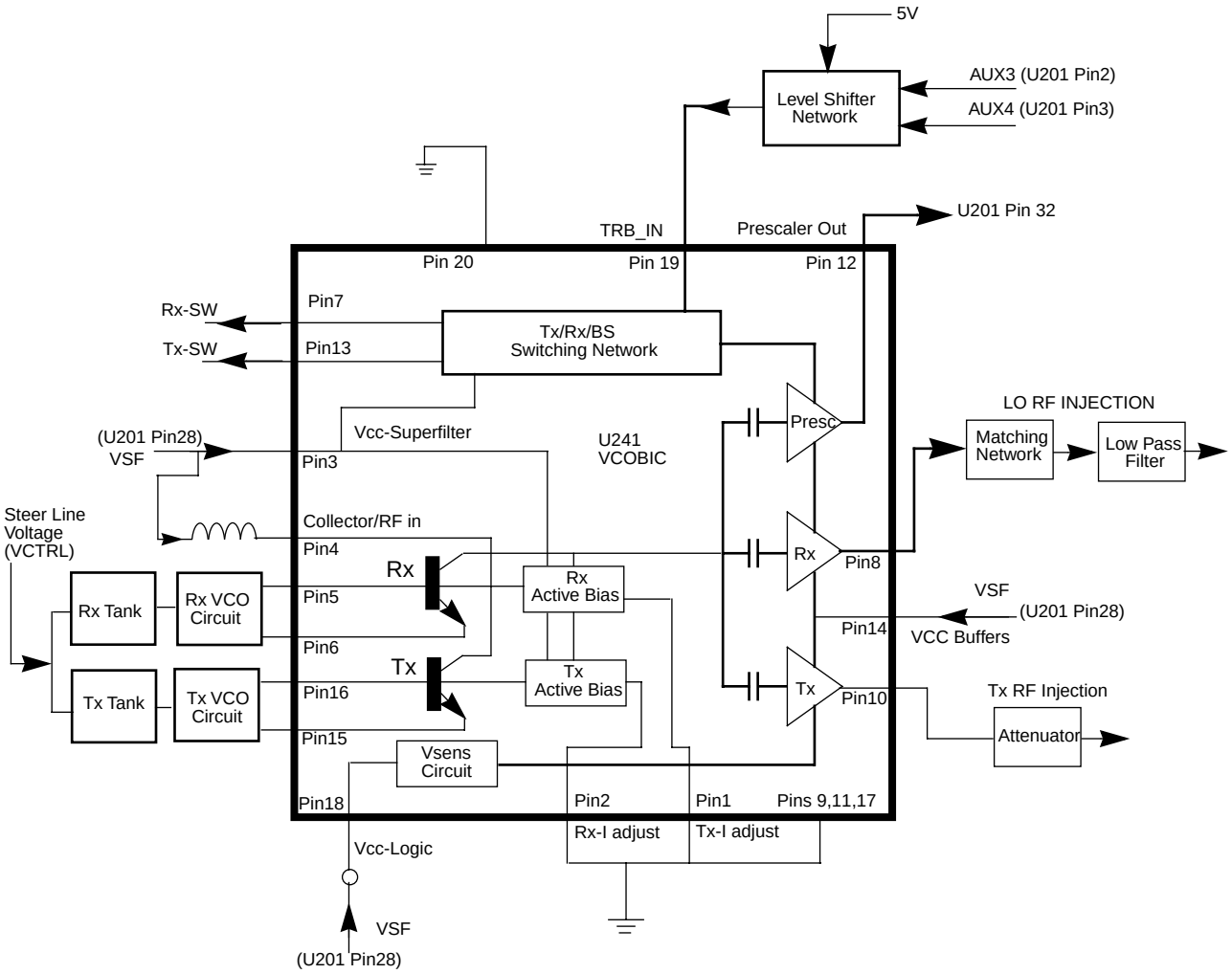


Figure 2-8. VCO Block Diagram

Table 2-2 Level Shifter Logic

Desired Mode	AUX 4	AUX 3	TRB
Tx	Low	High (@3.2V)	High (@4.8V)
Rx	High	Low	Low
Battery Saver	Low	Low	Hi-Z/Float (@2.5V)

In the receive mode, U241-19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U241. The RF signal at U241- 8 is run through a matching network. The resulting LO RF INJECTION RF signal is applied to the mixer at T302.

When PTT is pressed during the transmit condition, five volts is applied to U241-19. This activates the transmit VCO by enabling the U241 transmit oscillator and buffer. The TX RF INJECTION signal at

U241-10 is injected into the input of the PA module (U101-16). Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through U201-41.

When a high impedance is applied to U241-19, the VCO operates in battery saver mode. In this mode, both the receive and transmit oscillators, as well as the receive transmit and prescaler buffer, are turned off.

2.9 VHF Transmitter

The VHF transmitter consists of the following basic circuits as shown in Figure 2-9:

- Power amplifier.
- Antenna switch/harmonic filter.
- Antenna matching network.
- Power control integrated circuit (PCIC).

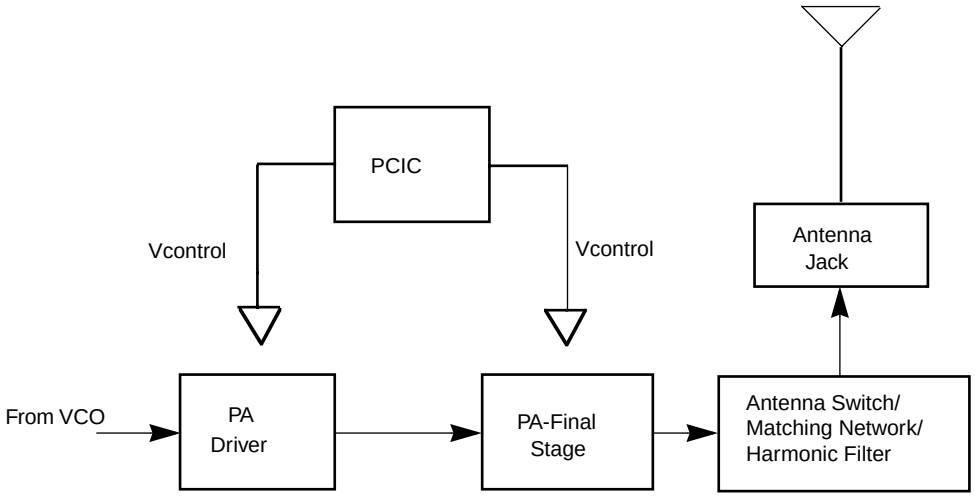


Figure 2-9. VHF Transmitter Block Diagram

2.9.1 Power Amplifier

The power amplifier consists of two devices:

- LDMOS driver IC (U3501) and
- LDMOS PA (Q3501)

The LDMOS driver IC contains a 2-stage amplification with a supply voltage of 7.3V.

This RF power amplifier is capable of supplying an output power of 0.3W (pins 6 and 7) with an input signal of 2mW (3dBm) (pin16). The current drain is typically around 130mA while operating in the frequency range of 136-174MHz.

The LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain is typically around 1800mA while operating in the frequency range of 136-174MHz. The power output can be varied by changing the bias voltage.

2.9.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (D3521 and D3551), a pi network (C3531, L3551 and C3550), and three current limiting resistors (R3571, R3572, R3573). In the transmit mode, B+ at PCIC (U3502) pin 23 will go low and turn on Q3561 where a B+ bias is applied to the antenna switch circuit to bias the diodes “on”. The shunt diode (D3551) shorts out the receiver port and the pi network (which operates as a quarter wave transmission line), and transforms the low impedance of

the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, creating a low attenuation path between the antenna and receiver ports.

2.9.3 Harmonic Filter

The harmonic filter consists of C3532 to C3536, L3531 and L3532. This network forms a low-pass filter to attenuate harmonic energy of the transmitter to specifications level. The harmonic filter insertion loss is typically less than 1.2dB.

2.9.4 Antenna Matching Network

A matching network made up of L3538, C3537 and C3539 is used to match the antenna's impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into an antenna.

2.9.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the PCIC (U3502) to control the power output of the radio by maintaining the radio current drain. The current to the final stage of the power module is supplied through R3519, which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to provide loop stability.

The PCIC also contains internal digital to analog converters (DACs) that provide the reference voltage of the control loop. The voltage level is controlled by the microprocessor through the data line of the PCIC.

The resistors and integrators within the PCIC, and the external capacitors (C3562, C3563 and C3565) control the transmitter rise and fall time and are necessary to reduce the power splatter into adjacent channels.

U3503 and its associated components act as a temperature cut back circuit. This provides the necessary voltage to the PCIC to cut the transmitter power if the radio temperature gets too high.

2.10 VHF Receiver

The VHF receiver consists of front end, back end, and automatic gain control circuits. A block diagram of the VHF receiver is shown in Figure 2-10. Detailed descriptions of these features are contained in the paragraphs that follow.

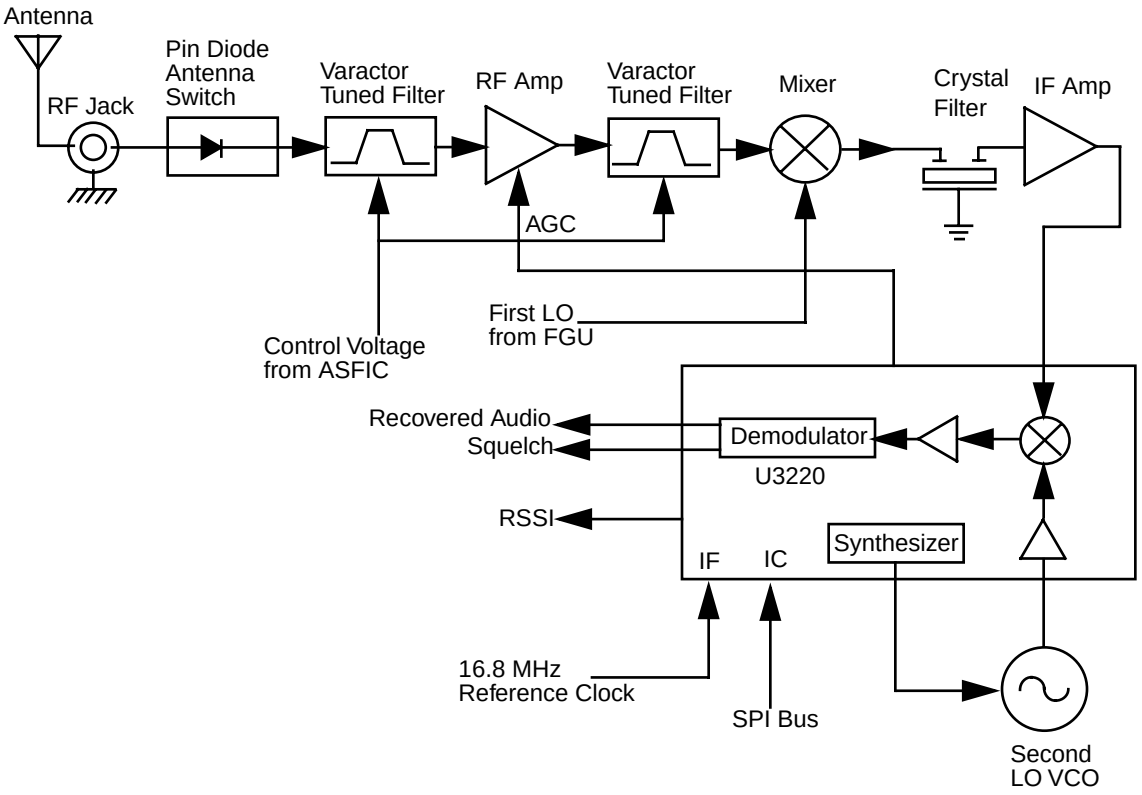


Figure 2-10. VHF Receiver Block Diagram

2.10.1 Receiver Front-End

The RF signal is received by the antenna and applied to a low-pass filter consisting of L3531, L3532, C3532 to C3536. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two PIN diodes (D3521 and D3551) and a pi network (C3531, L3551 and C3550).The RF signal is then applied to a varactor tuned bandpass filter which consists of L3301, L3303, C3301 to C3304 and D3301. The filter is tuned by applying a control voltage to the varactor diode (D3301) in the filter.

The bandpass filter is electronically tuned by the DACRx from IC U404 which is controlled by the microprocessor. Depending on the carrier frequency, the DACRx supplies the tuning voltage to the varactor diodes in the filter. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

The output of the bandpass filter is coupled to the RF amplifier transistor Q3302 via C3306. After being amplified by the RF amplifier, the RF signal is further filtered by a second varactor tuned bandpass filter, consisting of L3305, L3306, C3311 to C3314 and D3302.

Both the pre and post-RF amplifier varactor tuned filters have similar responses. The 3 dB bandwidth of the filter is about 12 MHz. This enables the filters to be electronically controlled by using a single control voltage which is DACRx.

The output of the post-RF amplifier filter is connected to the passive double balanced mixer which consists of T3301, T3302 and CR3301. Matching of the filter to the mixer is provided by C3317, C3318 and L3308. After mixing with the first LO signal from the voltage controlled oscillator (VCO) using high side injection, the RF signal is down-converted to the 45.1 MHz IF signal.

The IF signal coming out of the mixer is transferred to the crystal filter (Y3200) through a resistor pad (R3321 - R3323) and a diplexer (C3320 and L3309). Matching to the input of the crystal filter is provided by C3200 and L3200. The crystal filter provides the necessary selectivity and intermodulation protection.

2.10.2 Receiver Back-End

The output of crystal filter Y3200 is matched to the input of IF amplifier transistor Q3200 by capacitor C3203. Voltage supply to the IF amplifier is taken from the receiver 5 volts (R5). The controlled gain IF amplifer provides a maximum gain of about 10dB. The amplified IF signal is then coupled into U3220 pin 3 via L3202, C3207, and C3230 which provides impedance matching for the IF amplifier and U3220.

The IF signal applied to pin 3 of U3220 is amplified, down-converted, filtered, and then demodulated, to produce the recovered audio at pin 27 of U3220. This IF IC is electronically programmable, and the amount of filtering, which is dependent on the radio channel spacing, is controlled by the microprocessor. Additional filtering, once externally provided by the conventional ceramic filters, is replaced by internal filters in the IF module (U3220).

The IF IC uses a type of direct conversion process, whereby the externally generated second LO frequency is divided by two in U3220 so that it is very close to the first IF frequency. The IF IC (U3220) synthesizes the second LO and phase-locks the VCO to track the first IF frequency. The second LO is designed to oscillate at twice the first IF frequency because of the divide-by-two function in the IF IC.

In the absence of an IF signal, the VCO “searches” for a frequency, or its frequency will vary close to twice the IF frequency. When an IF signal is received, the VCO will lock onto the IF signal. The second LO/VCO is a Colpitts oscillator built around transistor Q3270. The VCO has a varactor diode, D3270, to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of C3278 to C3280, R3274 and R3275.

The IF IC (U3220) also provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor, and is used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

The demodulated signal on pin 27 of U3220 is also used for squelch control. The signal is routed to U404 (ASFIC) where squelch signal shaping and detection takes place. The demodulated audio signal is also routed to U404 for processing before going to the audio amplifier for amplification.

2.10.3 Automatic Gain Control (AGC)

The front end automatic gain control circuit provides automatic reduction of gain of the front end RF amplifier via feedback. This prevents overloading of backend circuits and is achieved by drawing some of the output power from the RF amplifier output. At high radio frequencies, capacitor C3327 provides the low impedance path to ground for this purpose. CR3302 is a PIN diode used for switching the path on or off. A certain amount of forward biasing current is needed to turn the PIN diode on. Transistor Q3301 provides this current.

Radio signal strength indicator, RSSI, a voltage signal, is used to drive Q3301 to saturation, i.e., turned on. RSSI is produced by U3220 and is proportional to the gain of the RF amplifier and the input power to the radio.

Resistors R3304 and R3305 make up a voltage divider designed to turn on Q3301 at certain RSSI levels. To turn on Q3301 the voltage across R3305 must be greater or equal to the voltage across R3324, plus the base-emitter voltage (Vbe) present at Q3301. Capacitor C3209 is used to dampen any instability while the AGC is turning on. The current flowing into the collector of Q3301, a high

current gain NPN transistor, is drawn through the PIN diode to turn it on. Maximum current flowing through the pin is limited by resistors R3316, R3313, R3306 and R3324. Feedback capacitor C3326 is used to provide some stability to this high gain stage.

An additional gain control circuit is formed by Q3201 and associated components. Resistors R3206 and R3207 are voltage dividers designed to turn on Q3201 at a significantly higher RSSI level than the level required to turn on PIN diode control transistor Q3301. In order to turn on Q3201 the voltage across R3207 must be greater or equal to the voltage across R3208 + Vbe. As current starts flowing into the collector of Q3201, it reduces the bias voltage at the base of IF amplifier transistor Q3200 and in turn, the gain of the IF amplifier. The gain is then controlled in a range of -30dB up to +10dB.

2.10.4 Frequency Generation Circuitry

The Frequency Generation Circuitry shown in Figure 2-11is composed of two main ICs, the Fractional-N synthesizer (U3701), and the VCO/Buffer IC (U3801). Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally would require additional circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the schematic for the reference designators.

The synthesizer is powered by regulated 5V and 3.3V which is provided from U3711 and U3201, respectively. The synthesizer, in turn, generates a superfiltered 4.5V which powers U3801.

In addition to the VCO, the synthesizer must interface with the logic and ASFIC circuitry. Programming for the synthesizer is accomplished through the data, clock and chip select lines from the microprocessor. A 3.3V dc signal from synthesizer lock detect line indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFIC is supplied to pin10 of U3701. Internally, the audio is digitized by the Fractional-N and applied to the loop divider to provide low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out to the VCO.

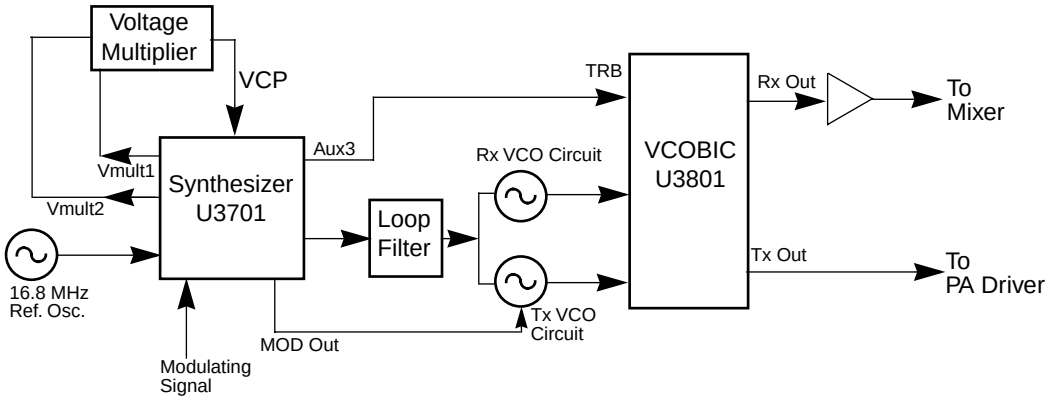


Figure 2-11. Frequency Generation Unit Block Diagram

2.11 Synthesizer

The Fractional-N Synthesizer shown in Figure 2-12 uses a 16.8MHz crystal (Y3761) to provide a reference for the system. The LVFractN IC (U3701) further divides this to 2.1MHz, 2.225MHz, and 2.4MHz as reference frequencies. Together with C3761, C3762, C3763, R3761 and D3761, they build up the reference oscillator that is capable of 2.5 ppm stability over temperatures of -30 to 85°C. A 16.8MHz signal at pin 19 of U3701 is also provided for use by ASFIC and LVZIF.

The loop filter which consists of C3721, C3722, R3721, R3722 and R3723 provides the necessary dc steering voltage for the VCO and determines the amount of noise and spur passing through.

In achieving fast locking for the synthesizer, an internal adapt charge pump provides higher current at pin 45 of U3701 to put the synthesizer within lock range. The required frequency is then locked by normal mode charge pump at pin 43.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C3701 to C3704 and triple diodes D3701and D3702. Two 3.3V square waves (180 degrees out of phase) are first multiplied by four and then shifted, along with regulated 5V, to build up 13.5V at pin 47 of U3701.

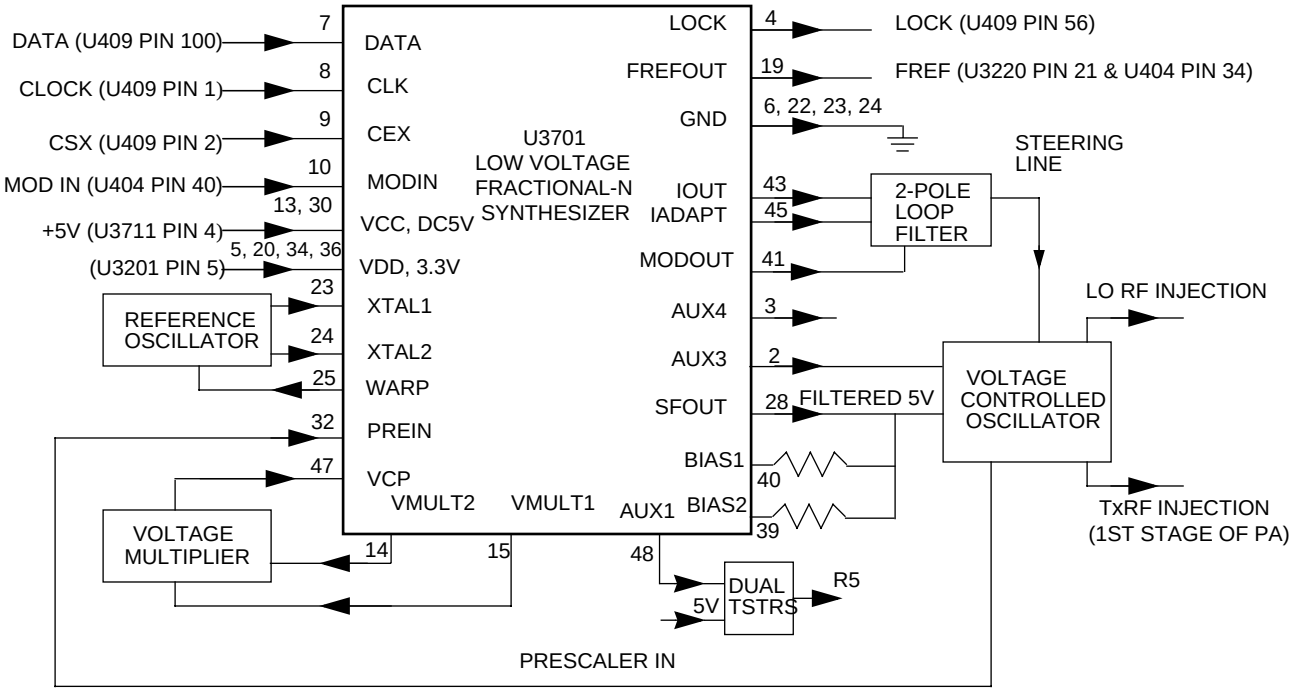


Figure 2-12. VHF Synthesizer Block Diagram

2.12 Voltage Control Oscillator (VCO)

The VCOB IC (U3801), shown in Figure 2-13, in conjunction with the Fractional-N synthesizer (U3701), generates RF in both the receive and the transmit modes of operation. The TRB line (U3801, pin 19) determines which oscillator and buffer will be enabled. A sample of the RF signal from the enabled oscillator is routed from U3801, pin 12, through a low pass filter, to the prescaler input (U3701, pin 32). After frequency comparison in the synthesizer, a resultant control voltage is received

at the VCO. This voltage is a DC voltage typically between 3.5V and 9.5V when the PLL is locked on frequency.

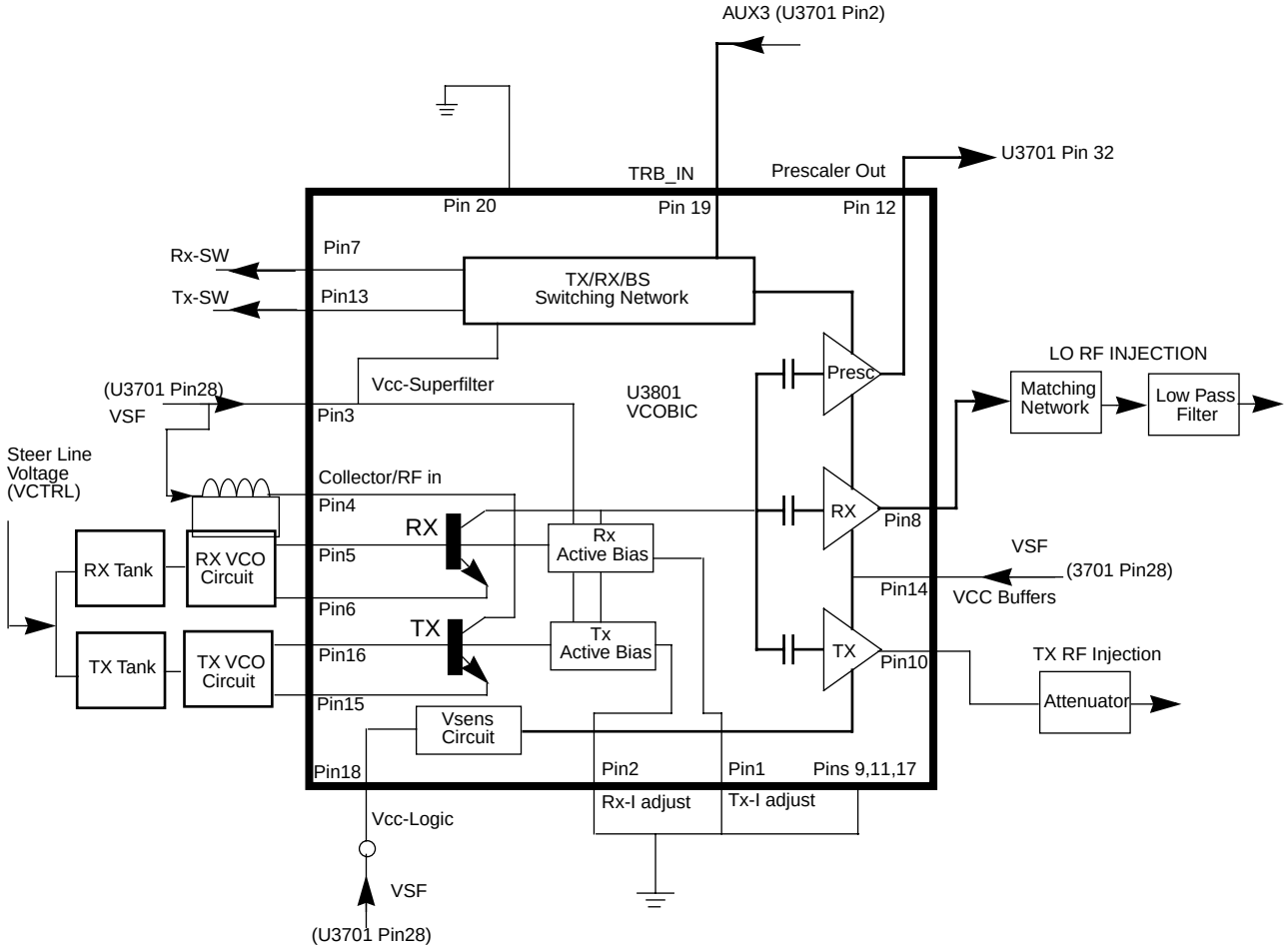


Figure 2-13. VCO Block Diagram

The RF section of the VCOB IC(U3801) is operated at 4.54 V (VSF), while the control section of the VCOBIC and Fractional-N synthesizer (U3701) is operated at 3.3V. The operation logic is shown in Table 2-3.

Table 2-3 VCO Control Logic

Desired Mode	AUX 4	AUX 3	TRB
Tx	Not Used	High (@3.2V)	High (@3.2V)
Rx	Not Used	Low	Low
Battery Saver	Not Used	Hi-Z/Float (@1.6V)	Hi-Z/Float (@1.6V)

In the receive mode, U3801, pin 19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U3801. The RF signal at U3801, pin 8 is run through a matching network. The resulting LO RF INJECTION signal is applied to the mixer at T3302.

During the transmit condition, when PTT is depressed, 3.2 volts is applied to U3801, pin 19. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U3801. The RF signal at U3801, pin 10 is injected into the input of the PA module (U3501, pin16). This RF signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through U3701, pin 41.

When a high impedance is applied to U3801, pin19, the VCO is operating in battery saver mode. In this case, both the receive and transmit oscillators, as well as the receive transmit and prescaler buffer, are turned off.

Chapter 3

Maintenance

3.1 Introduction

This section 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. CMOS 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 CMOS 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.

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

This 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.

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 from 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 tools recommended for working on 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
6680387A59 6680387A64 6680387A65 0180382A31	Extractor, 2-contact Heat controller with safety stand or Safety stand only Portable desoldering unit	Removal of discrete surface-mounted devices
6680375A74 0180386A81 0180386A78	0.025 replacement tip, 5/pk Miniature digital readout soldering station (incl. 1/64” micropoint tip) Illuminated magnifying glass with lens attachment.	For 0180382A31 portable desoldering unit.
0180386A82 6684253C72 6680384A98 1010041A86 1080370B43	Anti-static grounding kit probe Brush Solder (RMA type), 63/37, 0.020” diameter 1 lb. spool RMA liquid flux	Used during all radio assembly and disassembly procedures
R-1070A or, R-1319A	Shields and surface-mounted component - IC removal/rework station (order all heat-focus heads separately) Shields and surface-mounted component - IC removal/rework station SMD10000 M.A.P.E.	Removal and assembly of surface-mounted integrated circuits and shields Removal and assembly of surface-mounted integrated circuits and shields

Table 3-1 Recommended Test Tools

Motorola Part Number	Description	Application
6680334B49	0.410” x 0.410”	Heat-focus heads for R-1319A work station
6680334B50	0.430” x 0.430”	
6680334B51	0.492” x 0.492”	
6680334B52	0.572” x 0.572”	
6680334B53	0.670” x 0.790”	
6680370B51	0.475” x 0.475”	
6680370B54	0.710” x 0.710”	
6680370B57	0.245” x 0.245”	
6680370B58	0.340” x 0.340”	
6680371B15	0.460” x 0.560”	
6680371B74	0.470” x 0.570”	
6680332E45	0.591” x 0.315”	
6680332E46	0.862” x 0.350”	

3.6 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 Section 1 - Related Documents); then the circuit board must be separated from the radio chassis as described in the paragraphs that follow.

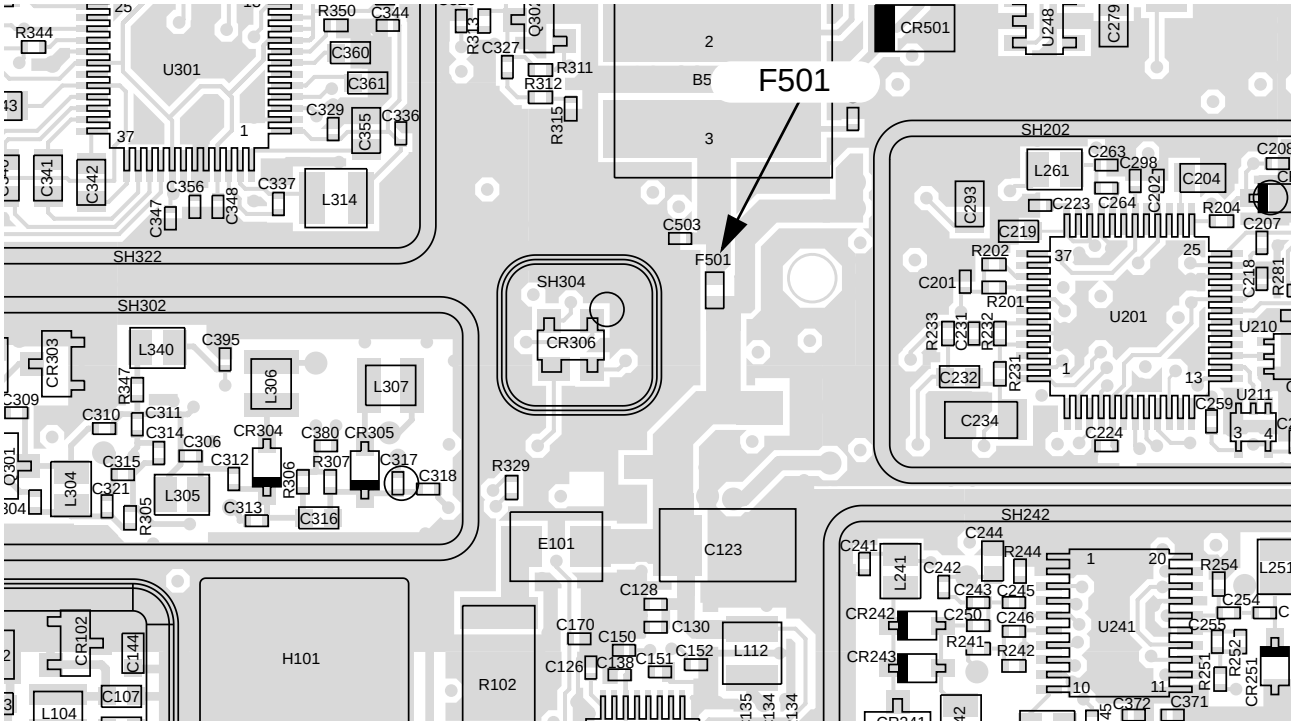


Figure 3-1. UHF/VHF Circuit Board Fuse Locations

3.7 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 Section 1 - Related Documents) for radio disassembly, then use a Torx driver and a T-6 bit to remove the four Torx screws shown in Figure 3-2.
2. Lift the circuit board out of the radio chassis, then remove and discard the thermal pad located between the circuit board and chassis.
3. After repairs, replace the thermal pad (Motorola P/N 7580556Z01) 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.

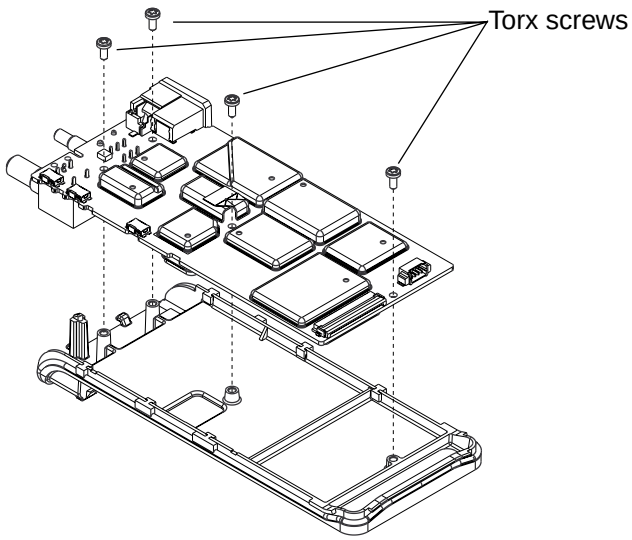


Figure 3-2. UHF/VHF Circuit Board Removal and Reinstallation

3.8 Power Up Self-Test Error Codes

Turning on the radio starts a self-test routine that checks the RAM, ROM checksum, EEPROM hardware and EEPROM checksum. If these checks are successful, the radio generates two high-pitched self-test pass tones. If the self-test is not successful, one low-pitched tone is heard. Radios with displays are able to display the error codes. The displayed error codes and related corrections are as follows:

- “RAM ERR” for <RAM Test Error>
- “ROM CS” for <ROM Checksum Error>
- “EPM ERR” for <EEPROM Hardware Test Error>
- “EPM CS” for <EEPROM Checksum Error>

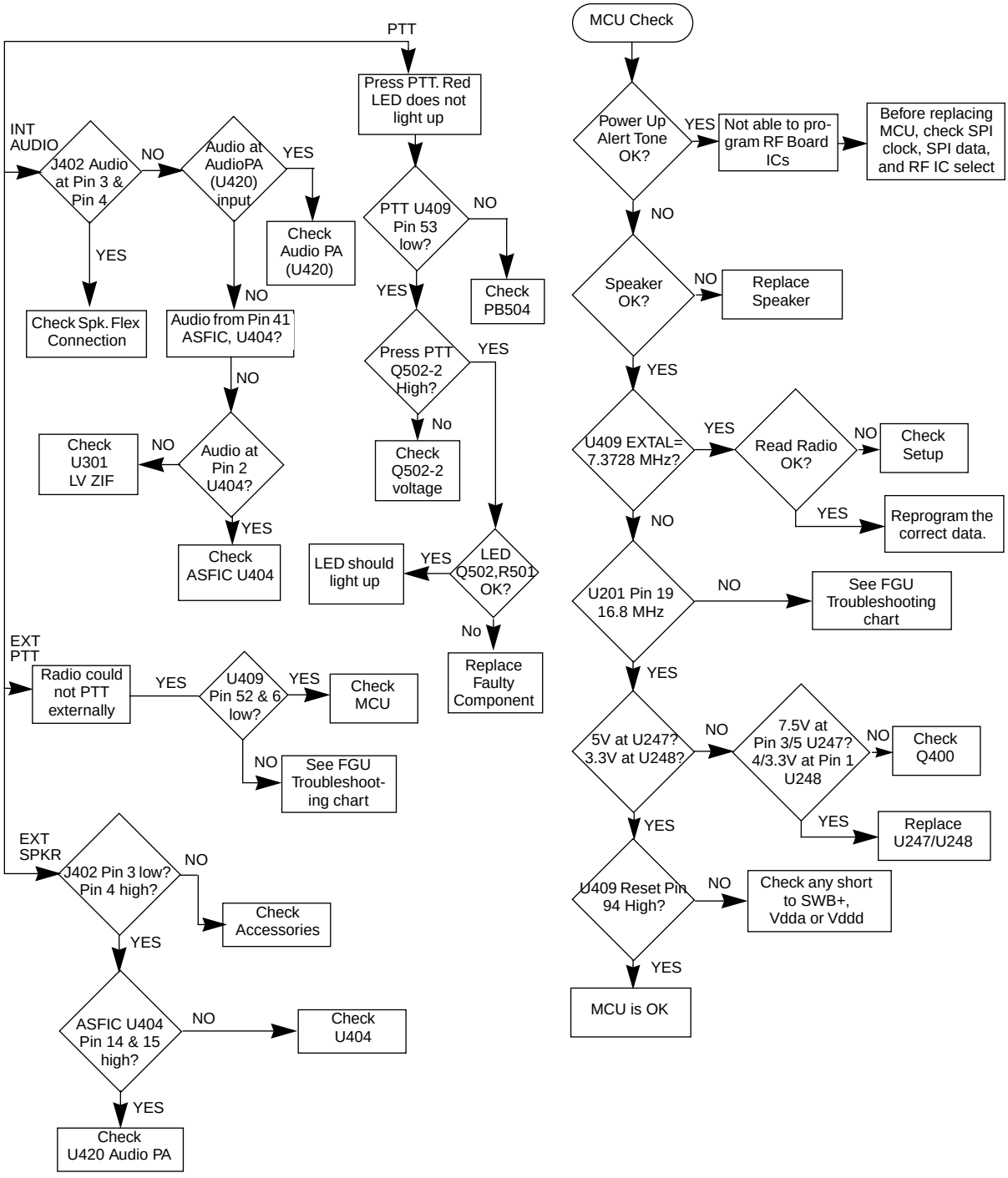
NOTE **Radio without display emits only “bonk” (300 Hz) tone if it fails the self-test.**

Table 3-2 Error Codes

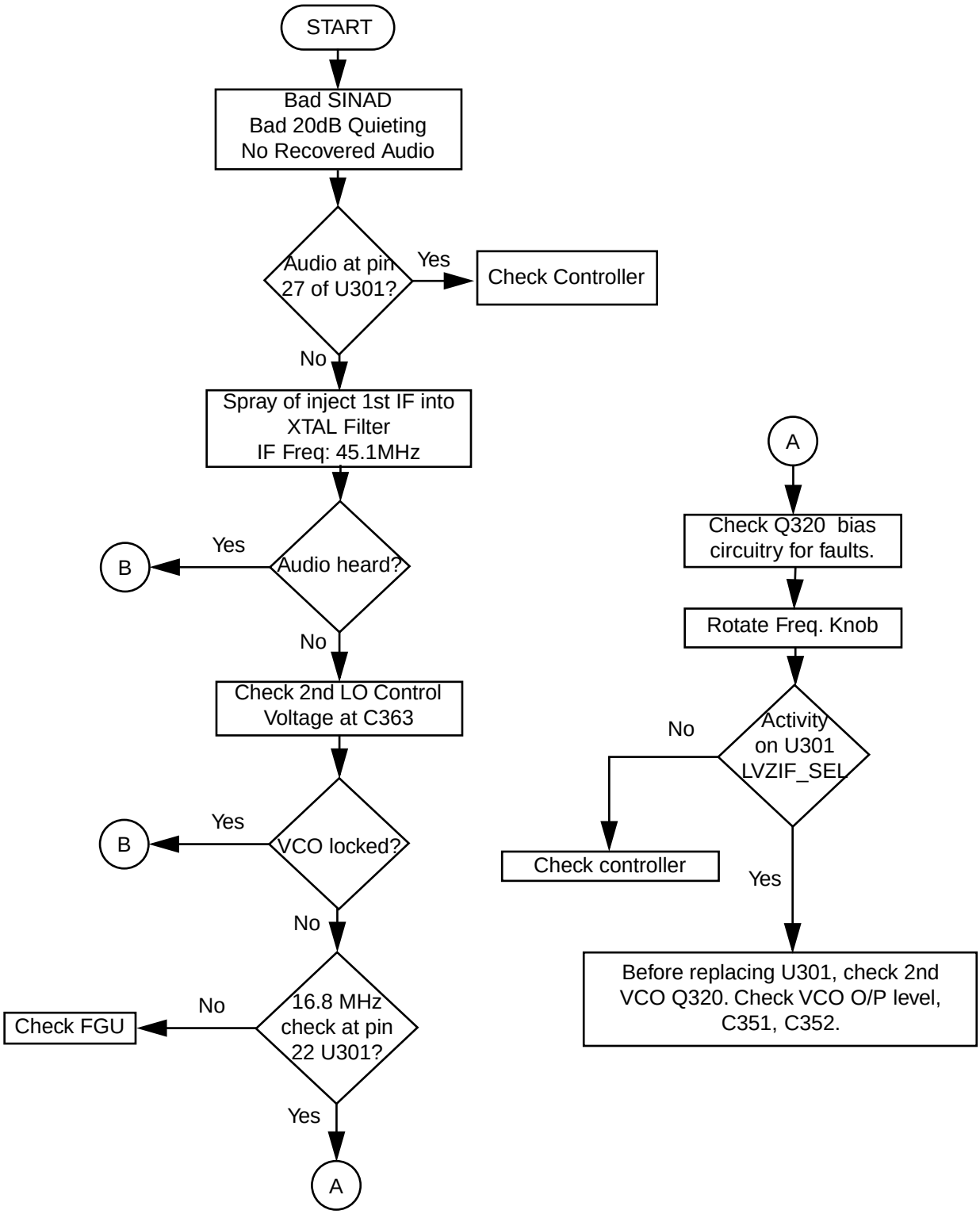
Error Code	Explanation	Corrective Action
“RAM ERR”	RAM Test Failure	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“ROM CS”	ROM Checksum is wrong.	Reprogram FLASH Memory, then retest. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“EPM ERR”	Codeplug structure mismatch, non existence of codeplug.	Reprogram codeplug with correct version and retest radio. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“EPM CS”	Codeplug checksum 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.

3.9 UHF Troubleshooting Charts

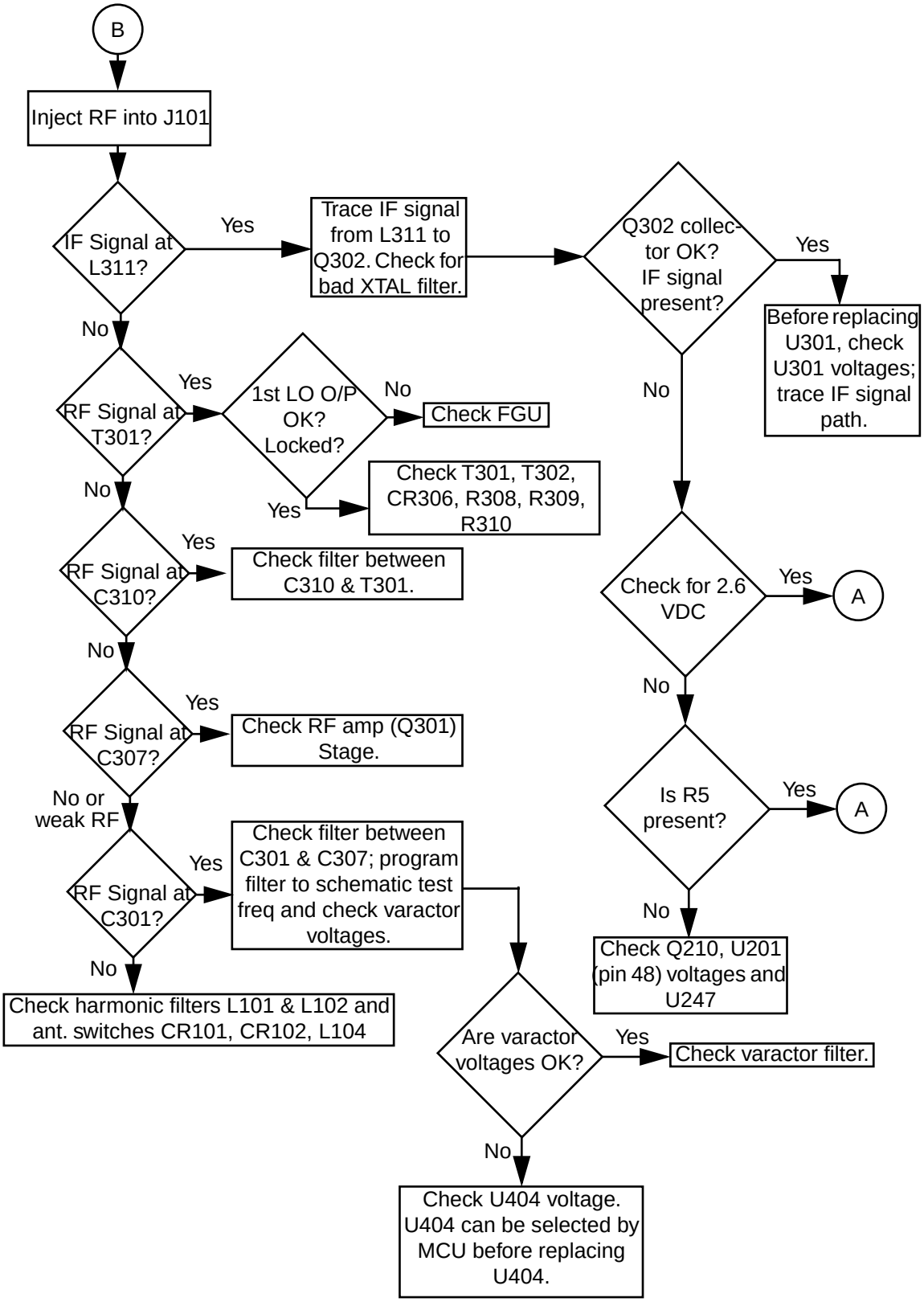
Troubleshooting Flow Chart for Controller



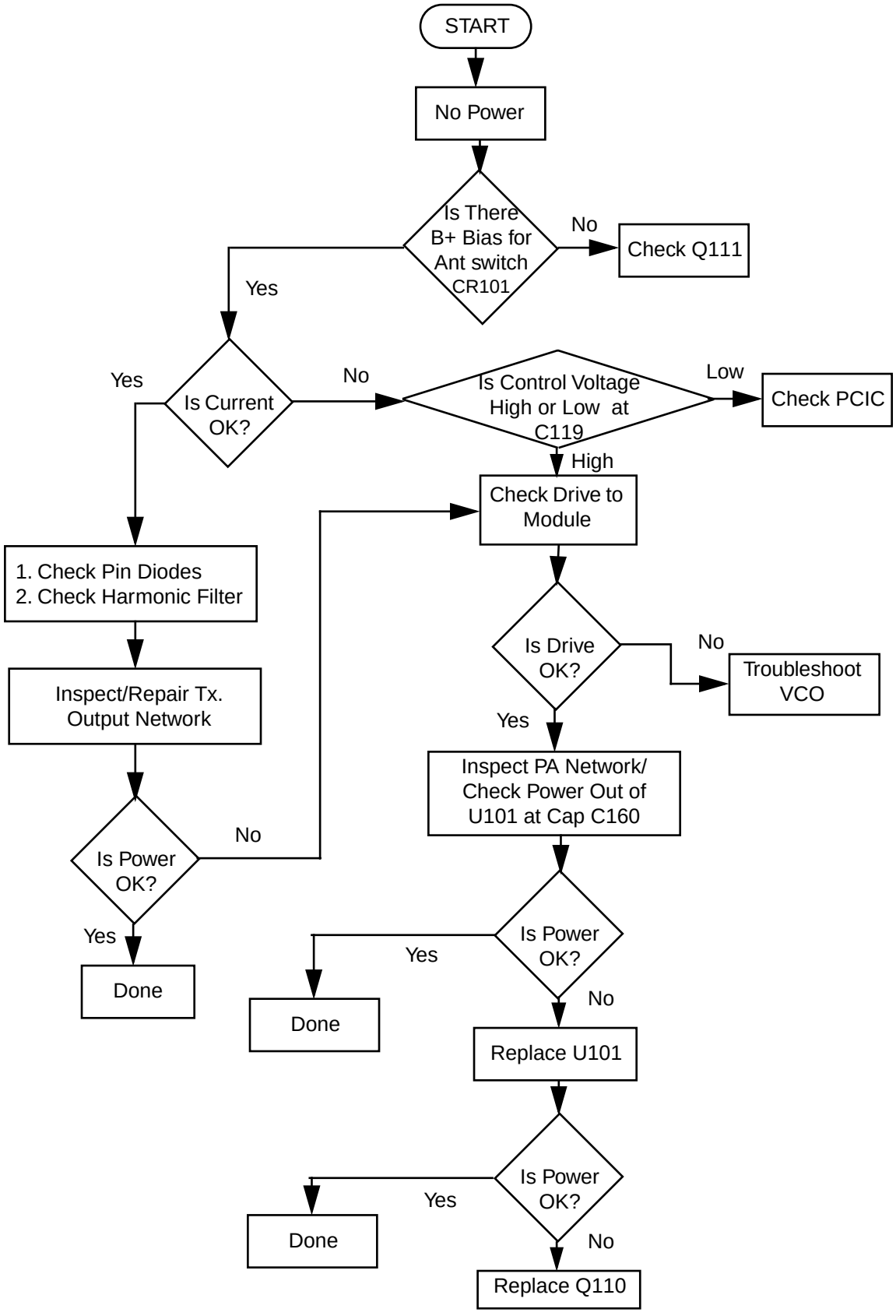
Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



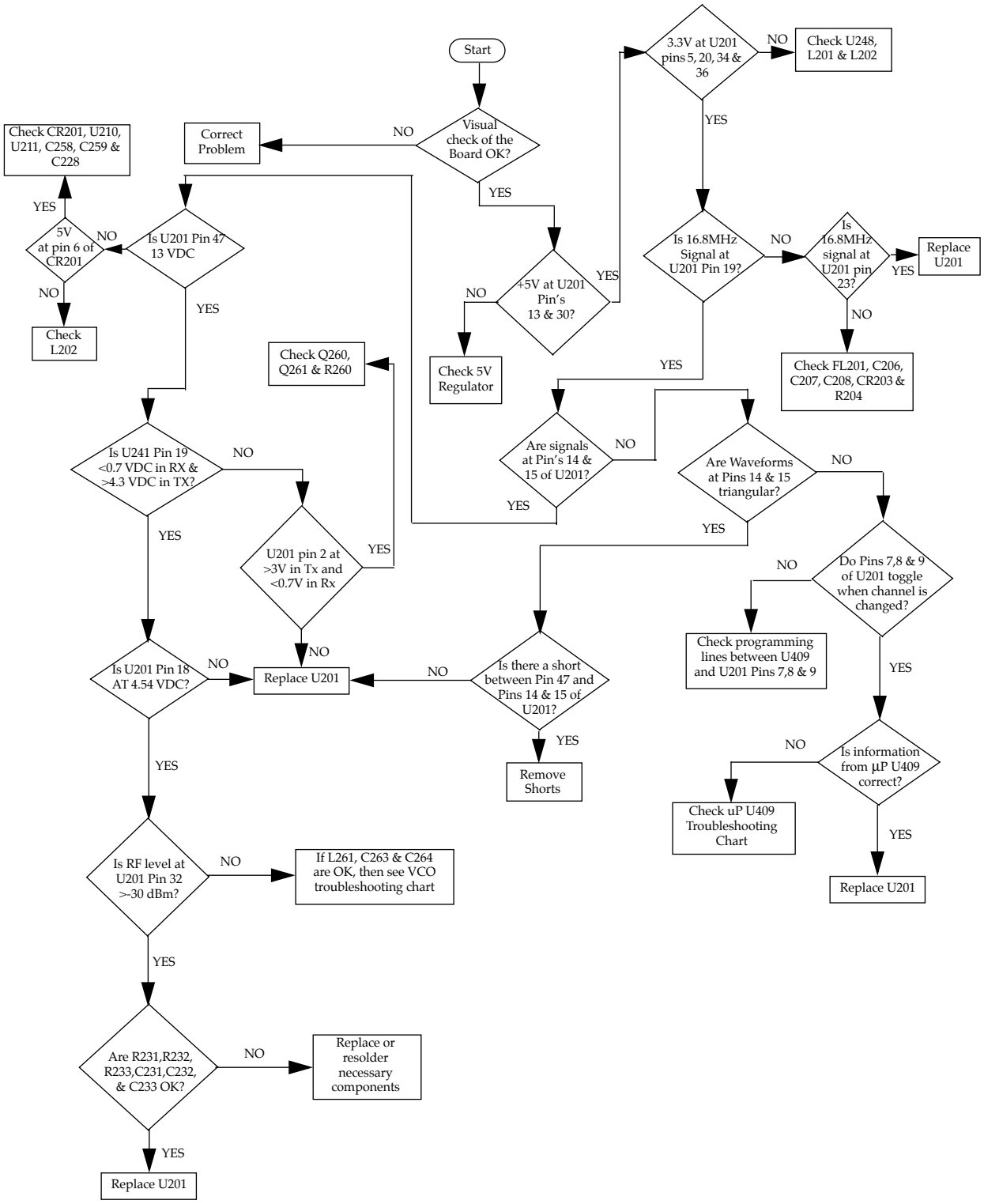
Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



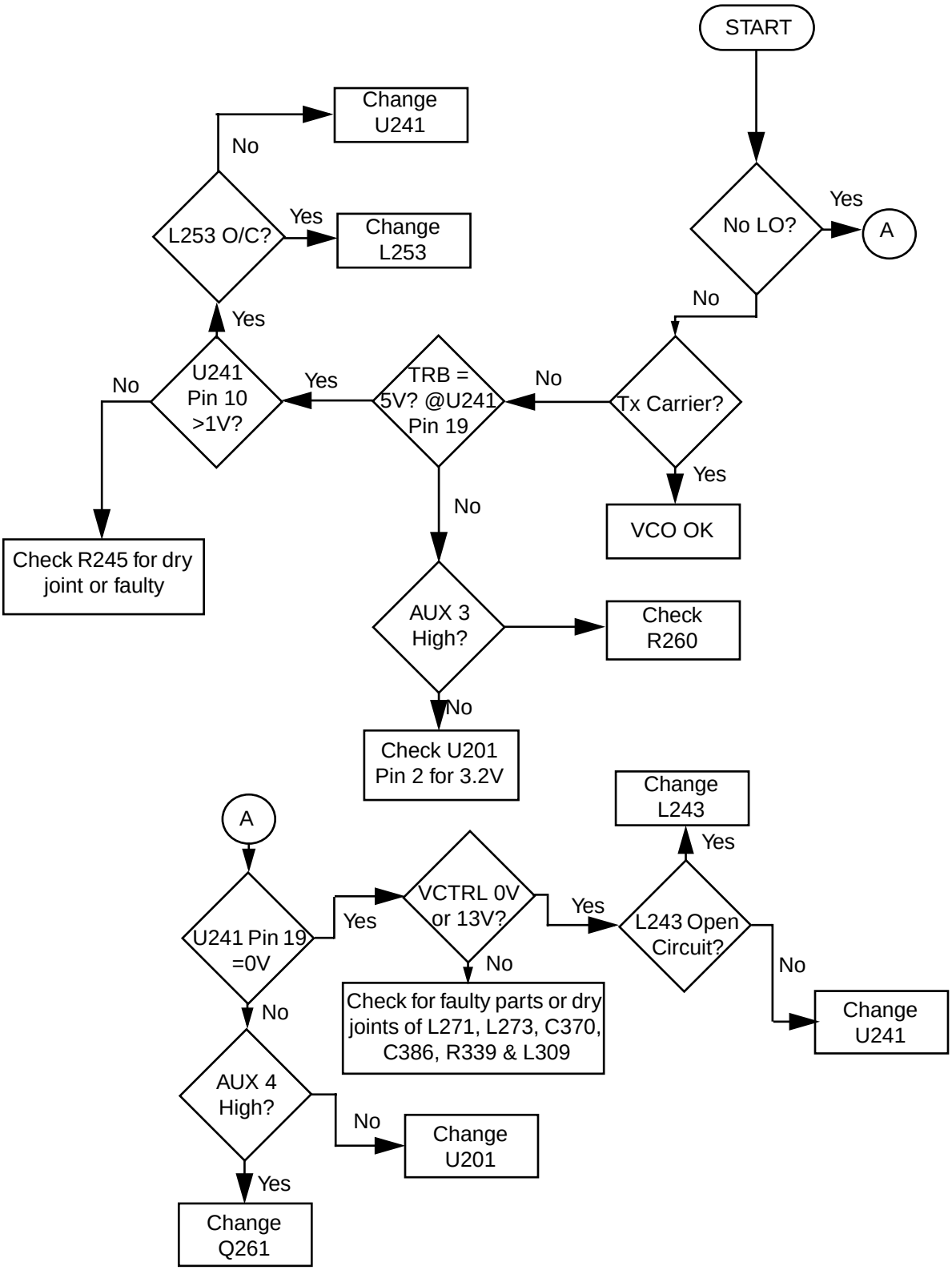
Troubleshooting Flow Chart for Transmitter



Troubleshooting Flow Chart for Synthesizer

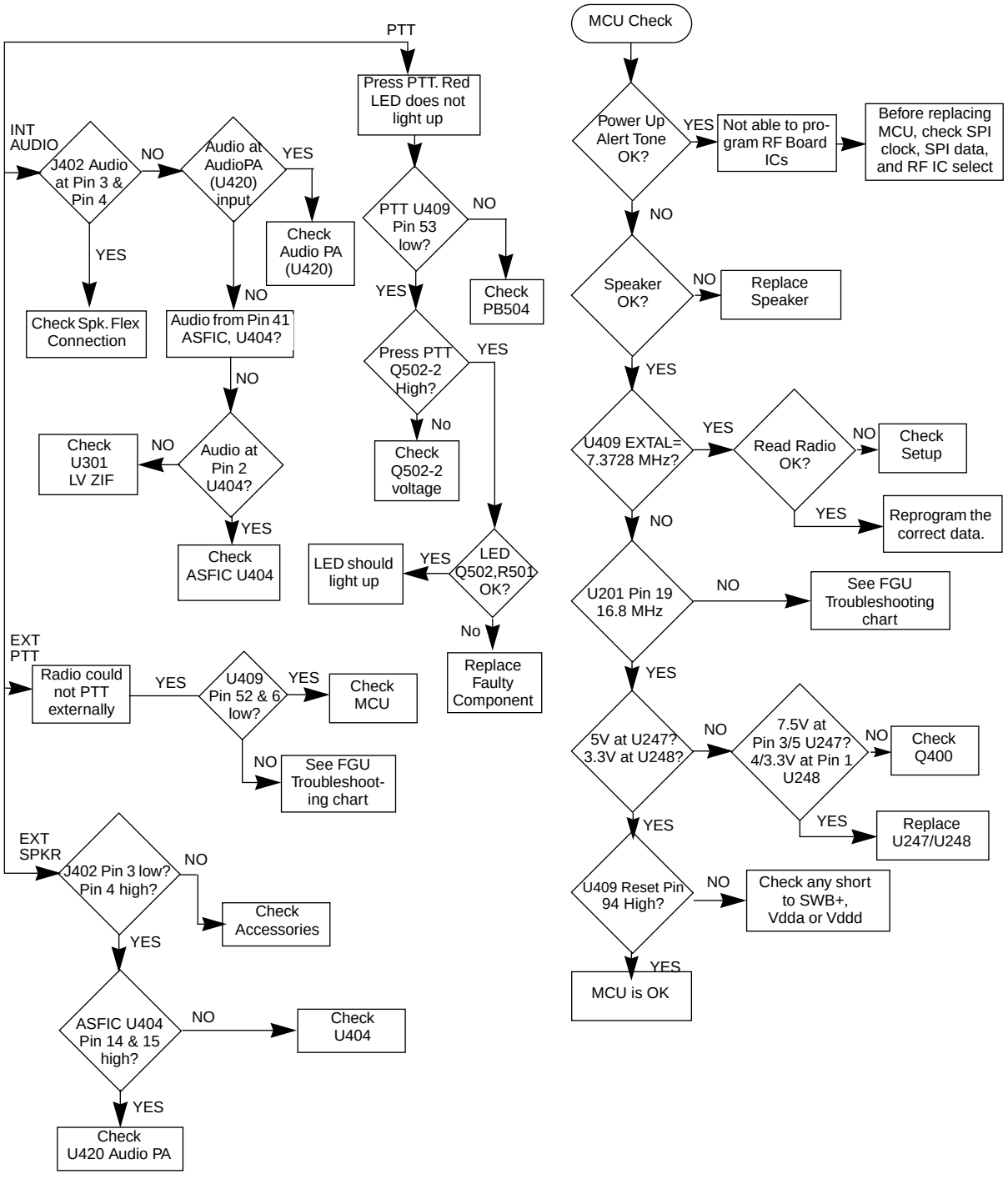


Troubleshooting Flow Chart for VCO

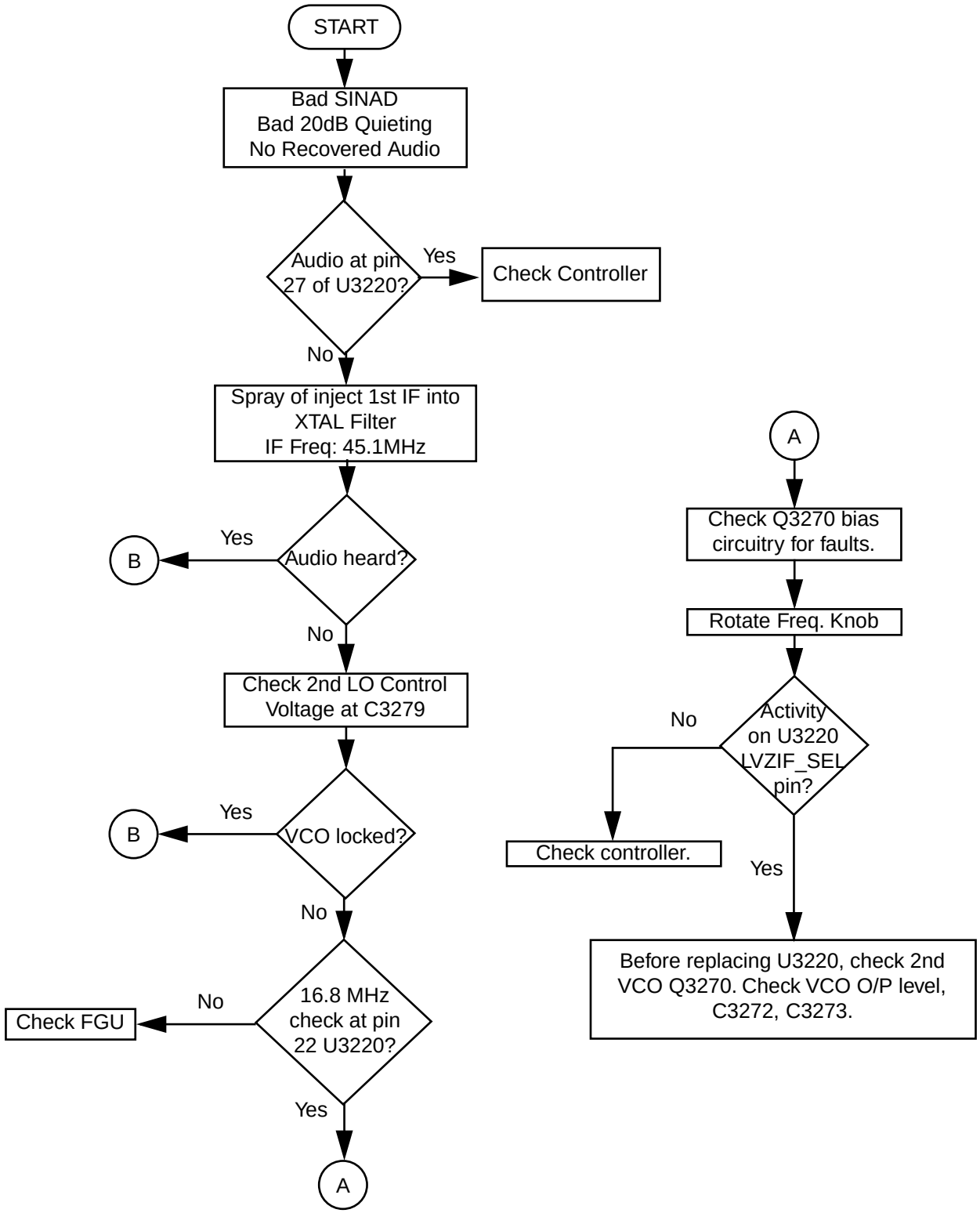


3.10 VHF Troubleshooting Charts

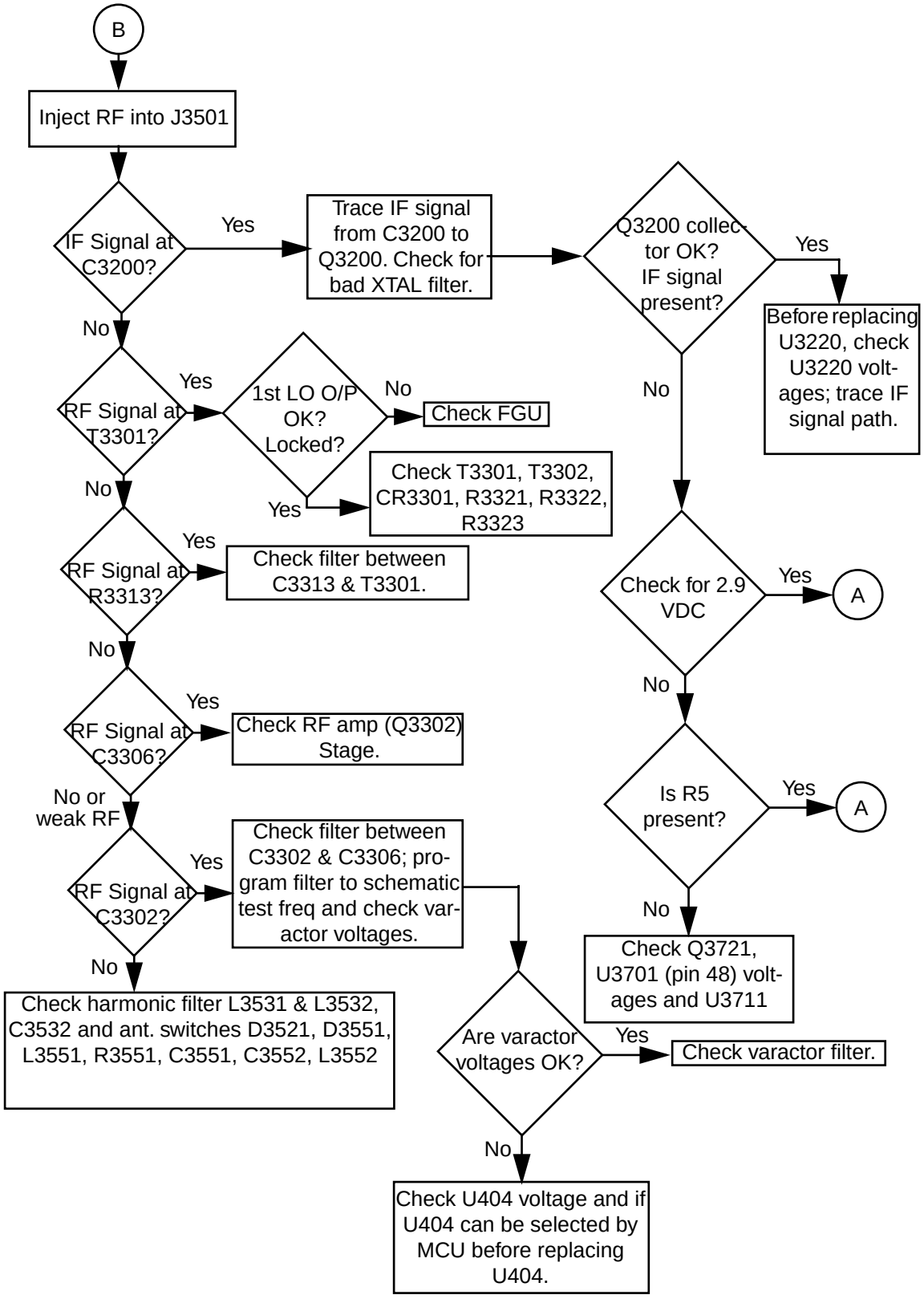
Troubleshooting Flow Chart for Controller

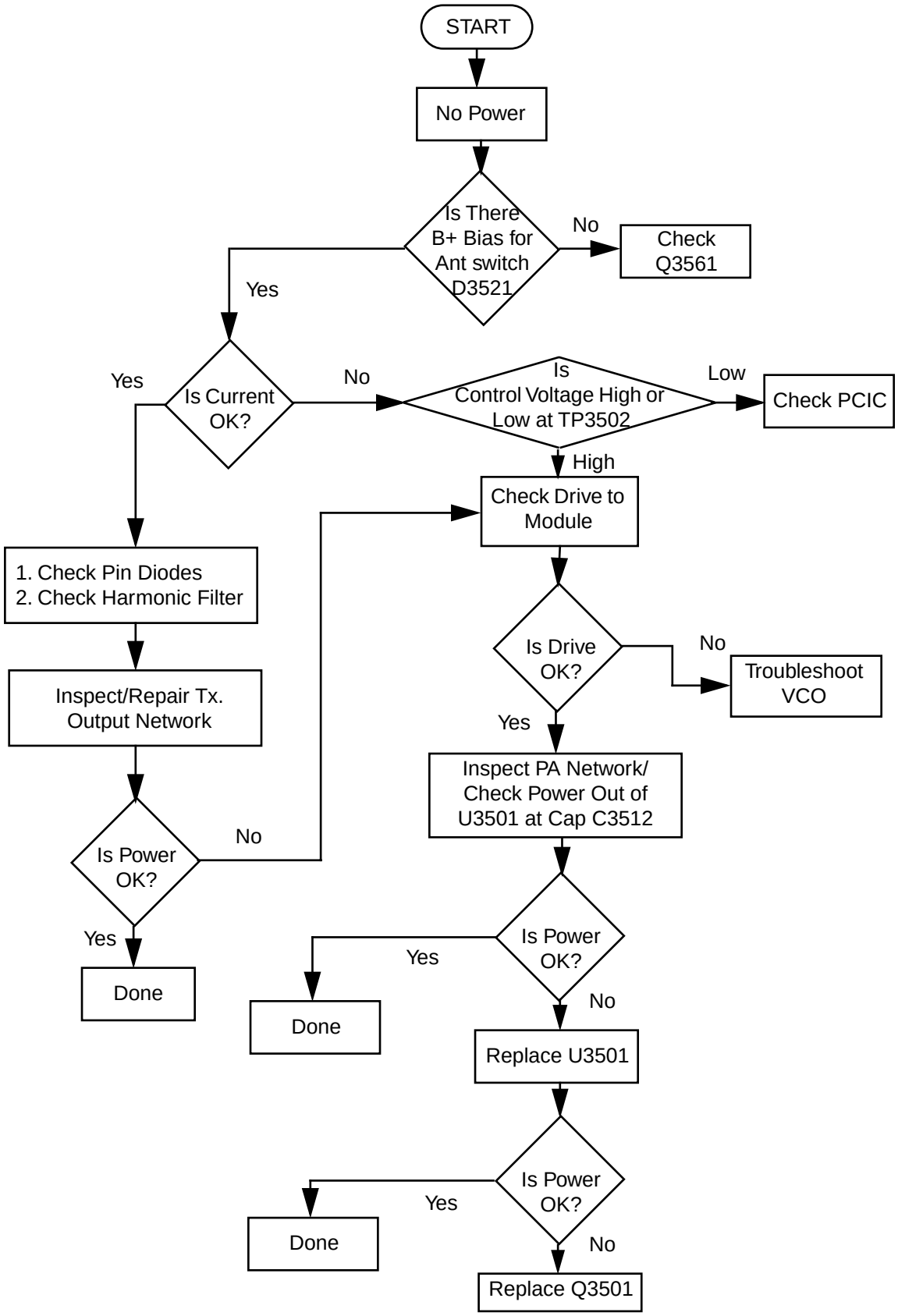


Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



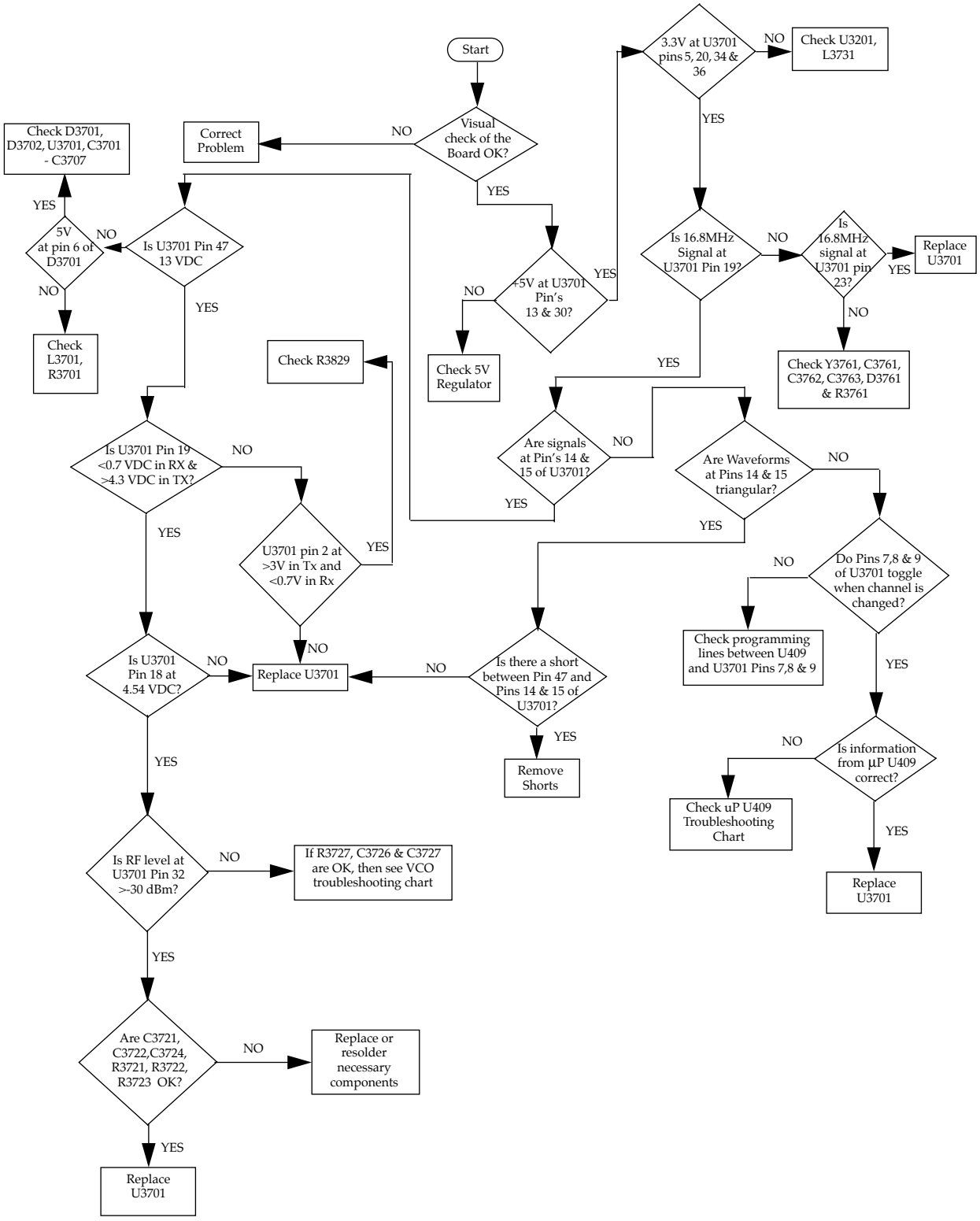
Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



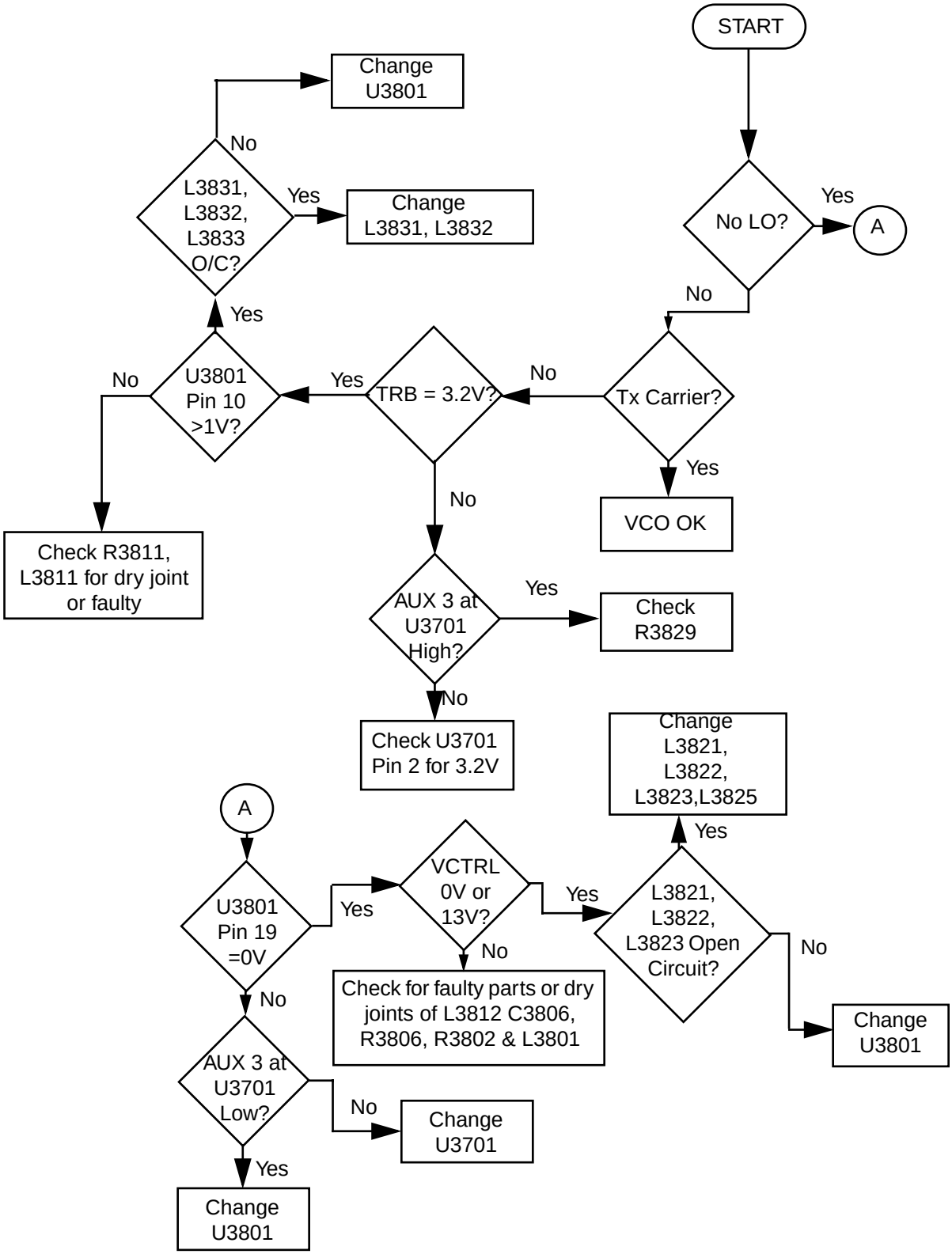


Troubleshooting Flow Chart for Transmitter

Troubleshooting Flow Chart for Synthesizer

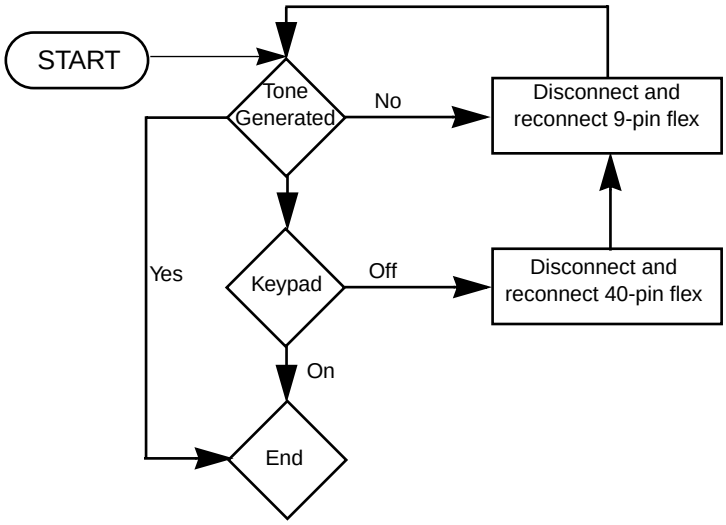


Troubleshooting Flow Chart for VCO



3.11 Keypad Troubleshooting Chart

Troubleshooting Flow Chart for Keypad



Chapter 4

Schematic Diagrams, Overlays, and Parts Lists

4.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

4.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistances are in Ohms (k = 1000), and capacitances are in picofarads (pF) or microfarads (µF).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. Transmitter measurements should be made with a 1.2 µH choke in series with the voltage probe to prevent circuit loading.
3. Reference Designators are assigned in the following manner:

400/500 Series	=	Controller
600 Series	=	Keypad Board
3200 Series	=	IF Circuitry
3300 Series	=	Receiver
3500 Series	=	Transmitter
3700 and 3800 Series	=	Frequency Generation

4. Interconnect Tie Point Legend:

UNSWB+	=	Unswitched Battery Voltage (7.5V)
SWB+	=	Switched Battery Voltage (7.5V)
R5	=	Receiver Five Volts
CLK	=	Clock
Vdda	=	Regulated 3.3 Volts (for analog)
Vddd	=	Regulated 3.3 Volts (for digital)
CSX	=	Chip Select Line (not for LVZIF)
SYN	=	Synthesizer
DACRX	=	Digital to Analog Voltage (For Receiver Front End Filter)
VSF	=	Voltage Super Filtered (5 volts)
VR	=	Voltage Regulator

4.1.2 Six Layer Circuit Board

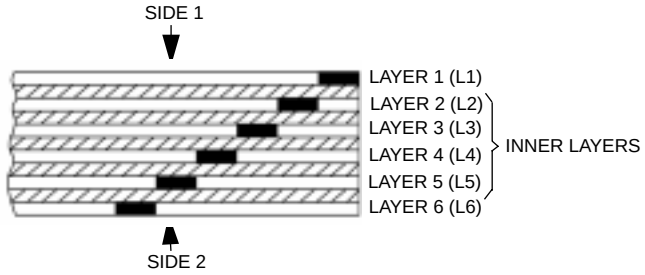


Figure 4-1. Six-Layer Circuit Board: Copper Steps in Layer Sequence

4.2 Flex Layout

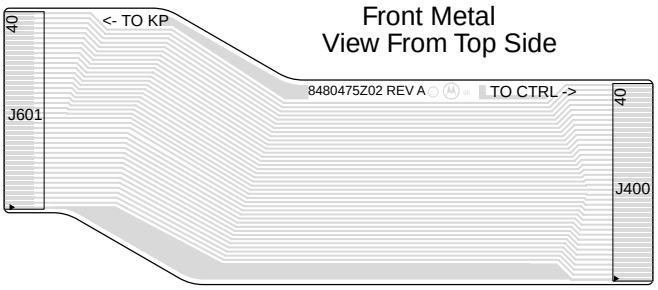


Figure 4-2. Keypad-Controller Interconnect Flex

4.3 Keypad-Controller Interconnect Flex Schematic

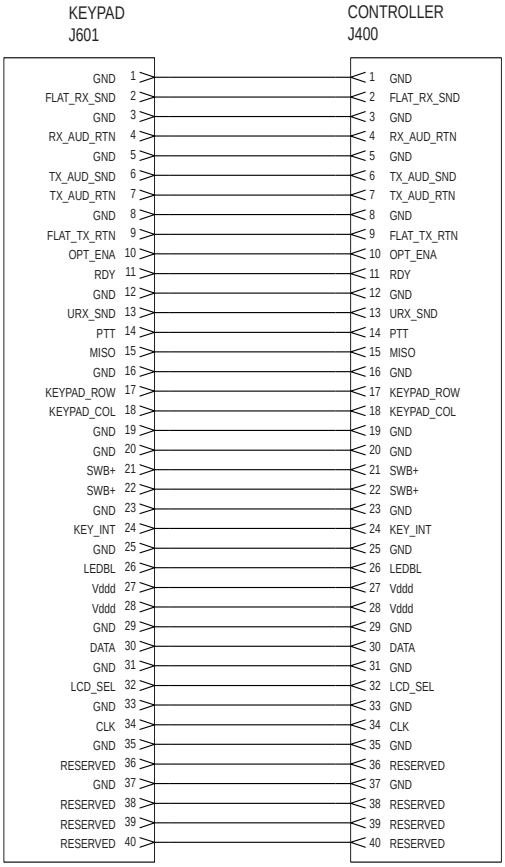


Figure 4-3. Keypad-Controller Interconnect Flex Schematic Diagram

4.3.1 Keypad Top and Bottom Overlays

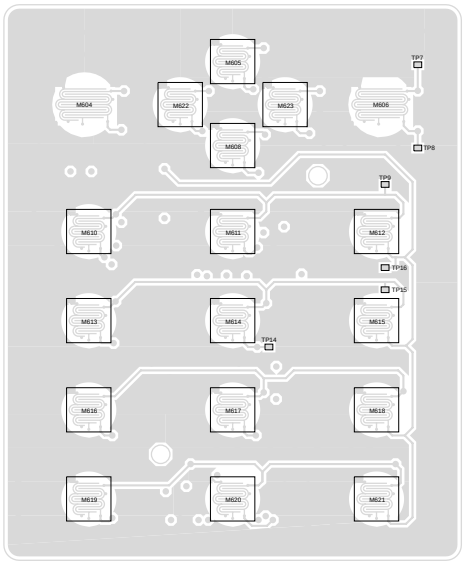


Figure 4-4. Keypad-Top Overlay

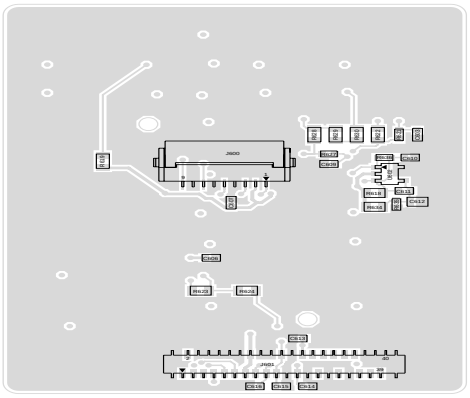


Figure 4-5. Keypad-Bottom Overlay

4.4 Speaker Microphone Schematic

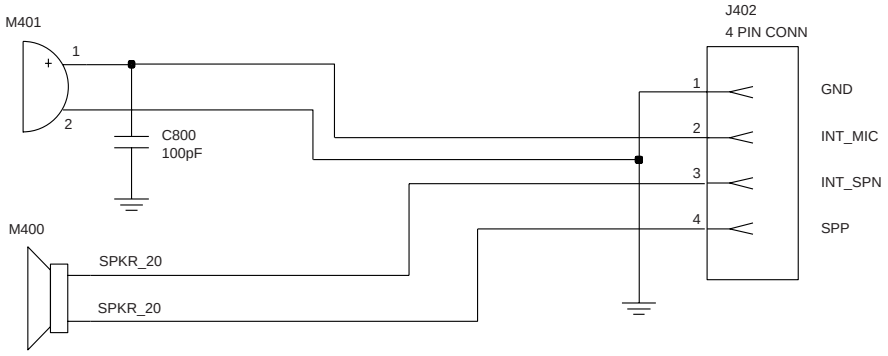


Figure 4-6. Speaker Microphone Schematic

4.4.1 Speaker Microphone Assembly

Table 4-1 Speaker Microphone Assembly Parts List

Reference Designator	Motorola Part No.	Description
C800	2113740A55	Capacitor, 100pF
M400	5085738Z02	Speaker
M401	5013920A04	Microphone, Mini Electret
	8485687Z01	Flex, Microphone
	09800727Z01	Connector, Wire

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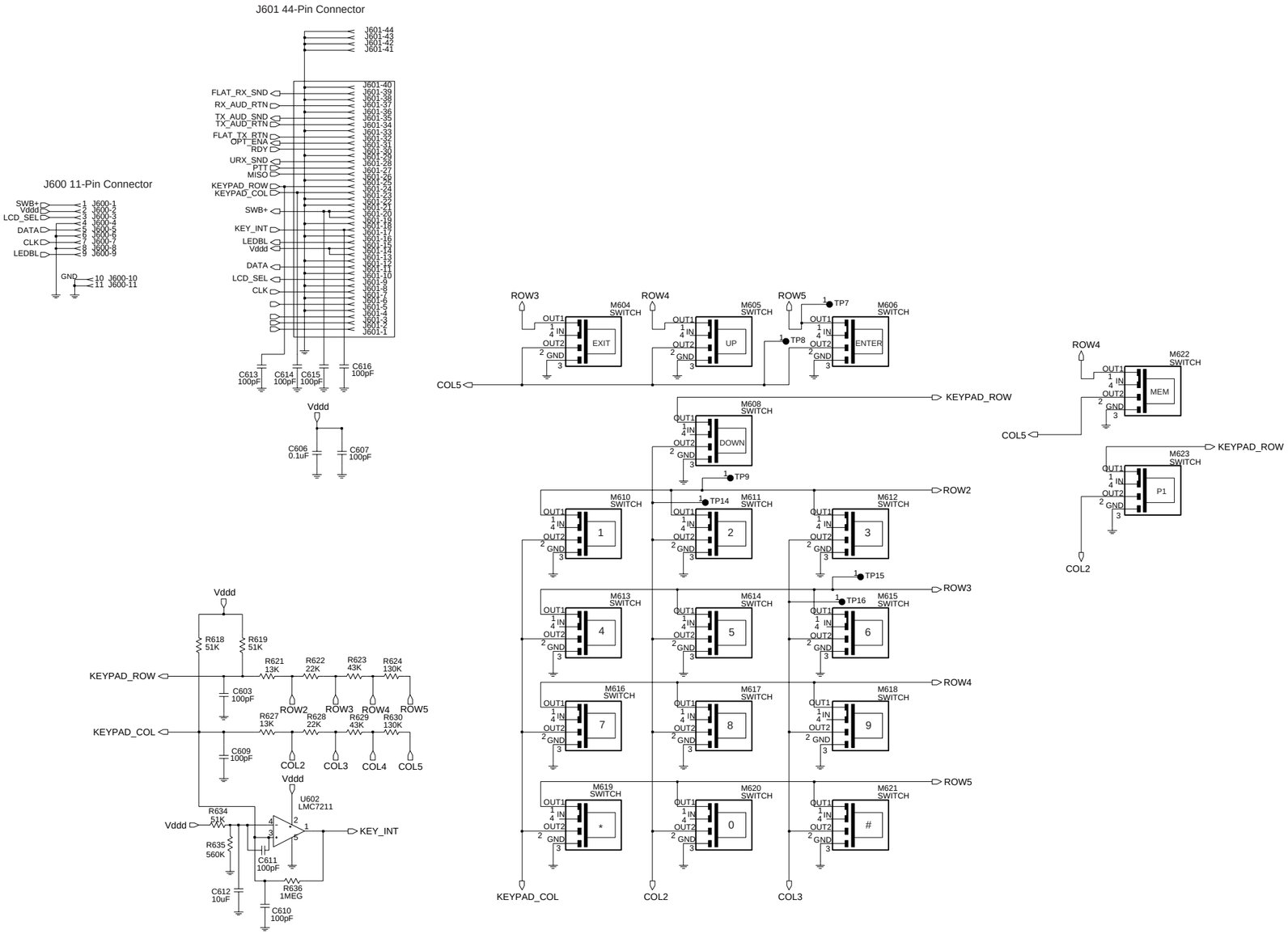


Figure 4-7. Keypad Board Schematic Diagram

Table 4-1 Keypad Board Parts List

Reference Designator	Motorola Part No.	Description
C603	2113740F51	100pF
C606	2113743E20	0.1uF
C607	2113740F51	100pF
C609	2113740F51	100pF
C610	2113740F51	100pF
C611	2113740F51	100pF
C612	2113928D08	10uF
C613	2113740F51	100pF
C614	2113740F51	100pF
C615	2113740F51	100pF
C616	2113740F51	100pF
J600	0985627Z01	11 pin connector
J601	0980521Z01	44 pin connector
R618	0660076E90	51K
R619	0660076E90	51K
R621	0662057P15	13K
R622	0660079J37	22K
R623	0660079J72	43K
R624	0662057G19	130K
R627	0662057P15	13K
R628	0660079J37	22K
R629	0660079J72	43K
R630	0662057G19	130K
R634	0660076E90	51K
R635	0662057B16	560K
R636	0662057B22	1Meg
U602	5102463J49	LMC7211 Comparator
	8485642Z01	PC Board

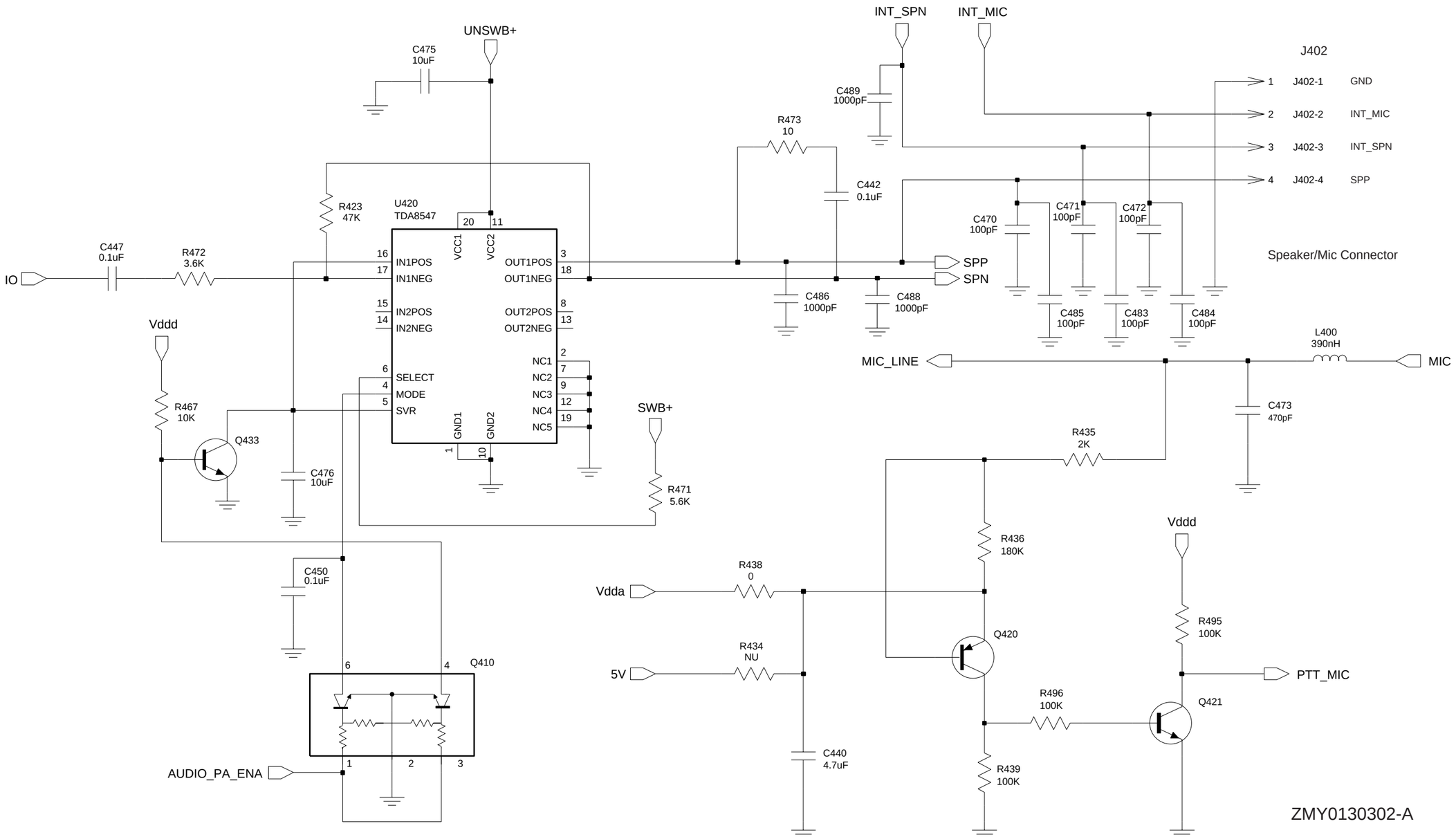


Figure 4-8. Complete Controller Schematic Diagram

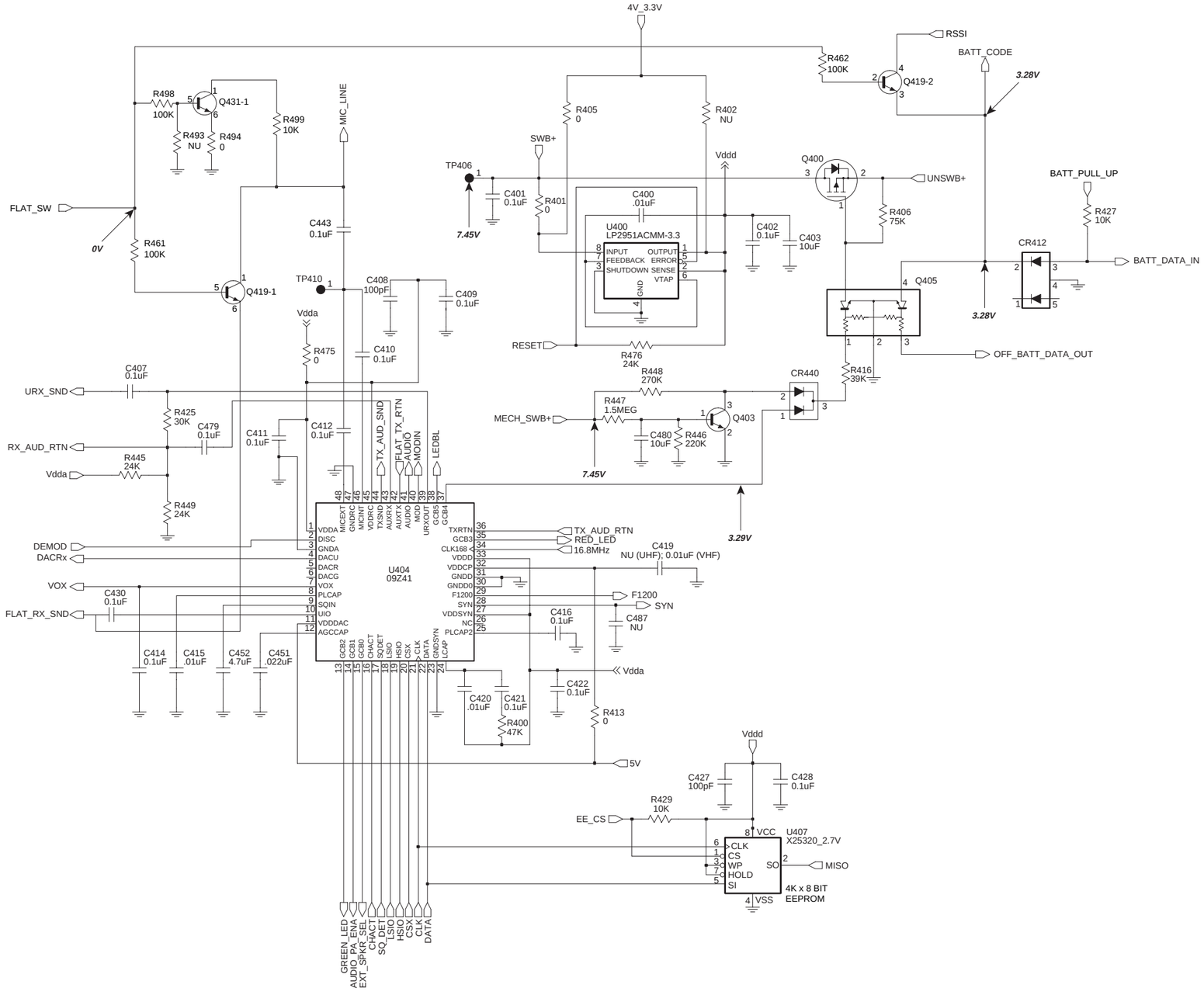


Figure 4-9. Controller ASFIC/ON_OFF Schematic Diagram

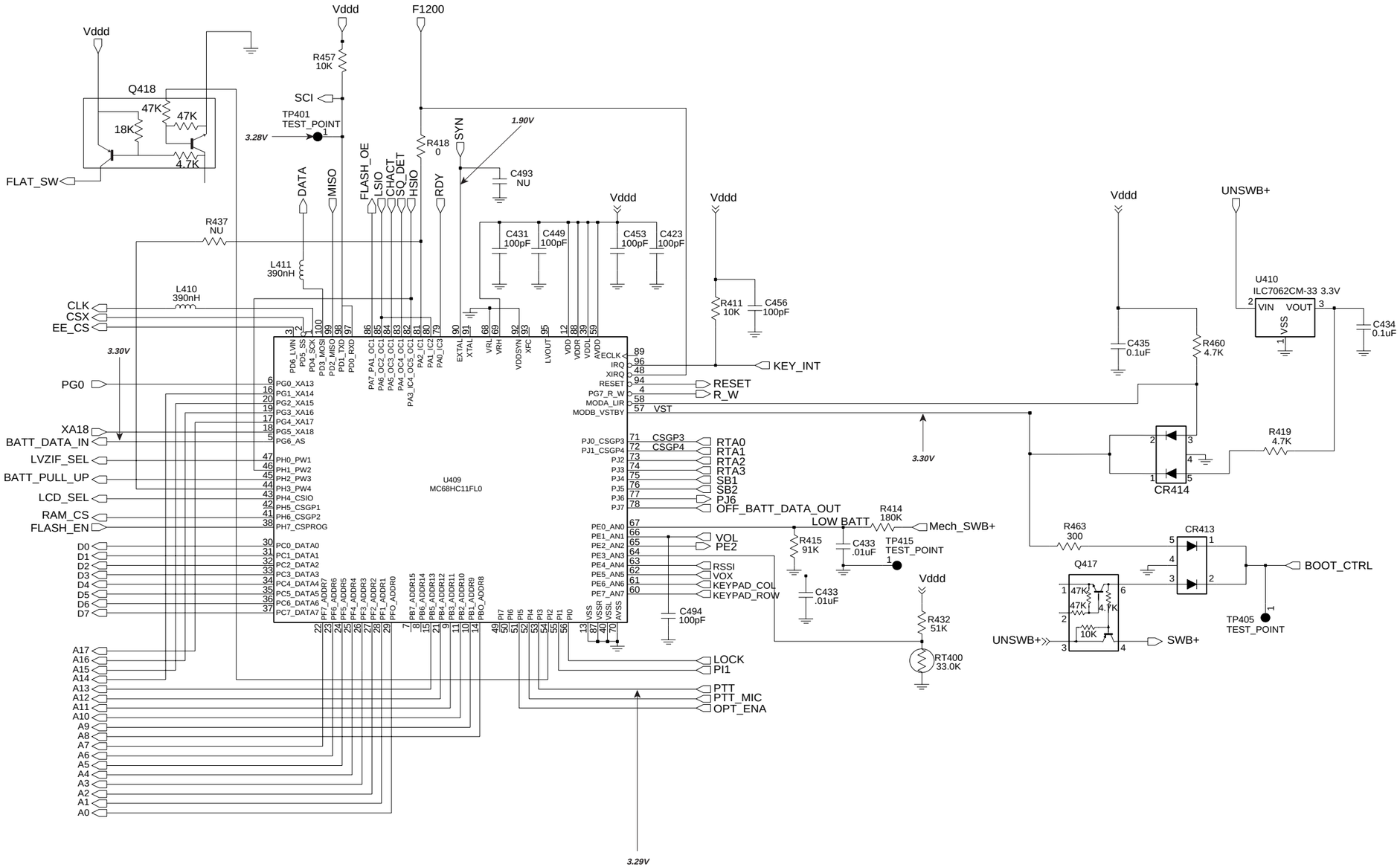


Figure 4-10. Controller Micro Processor Schematic Diagram

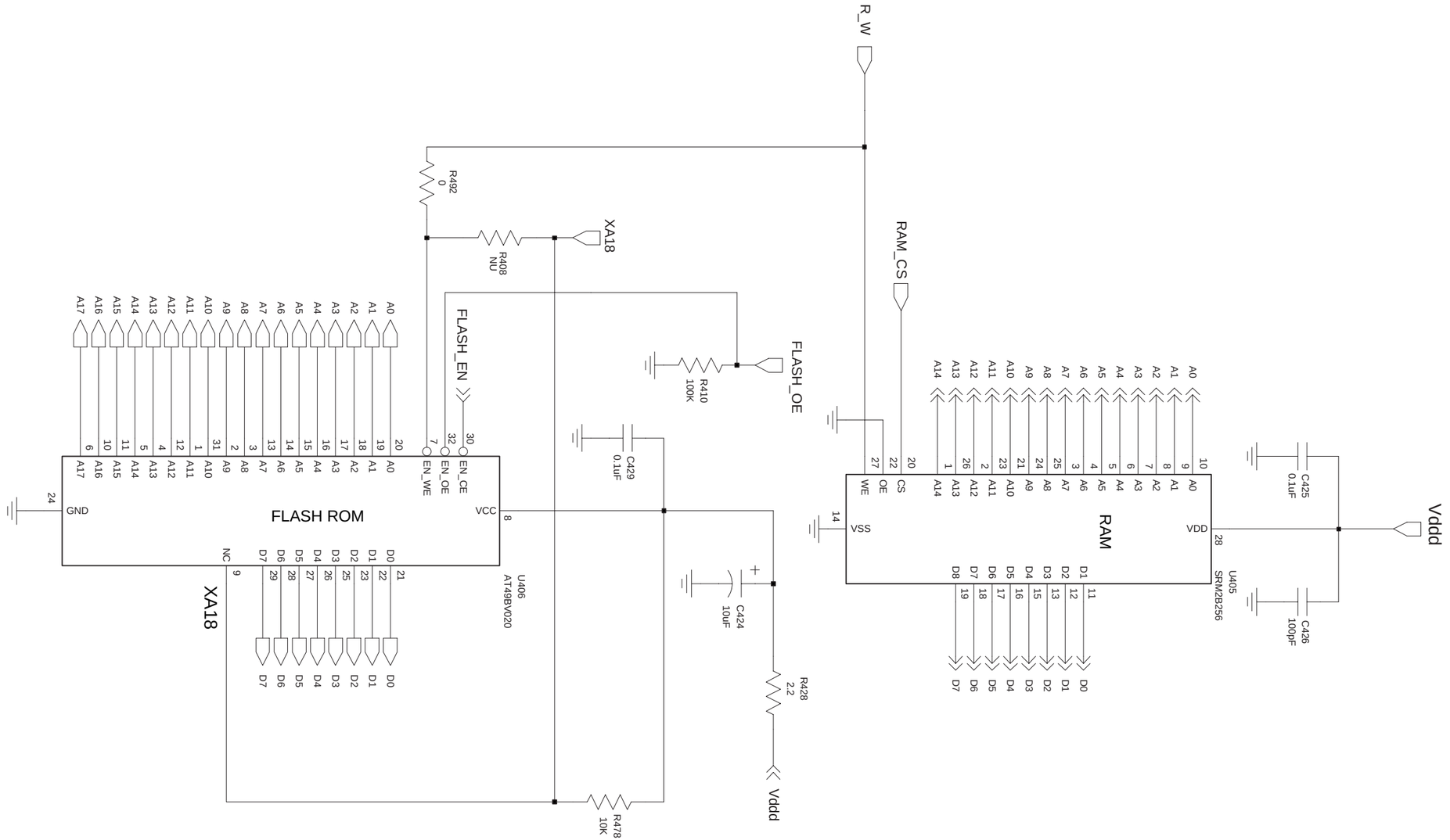


Figure 4-11. Controller Memory Schematic Diagram

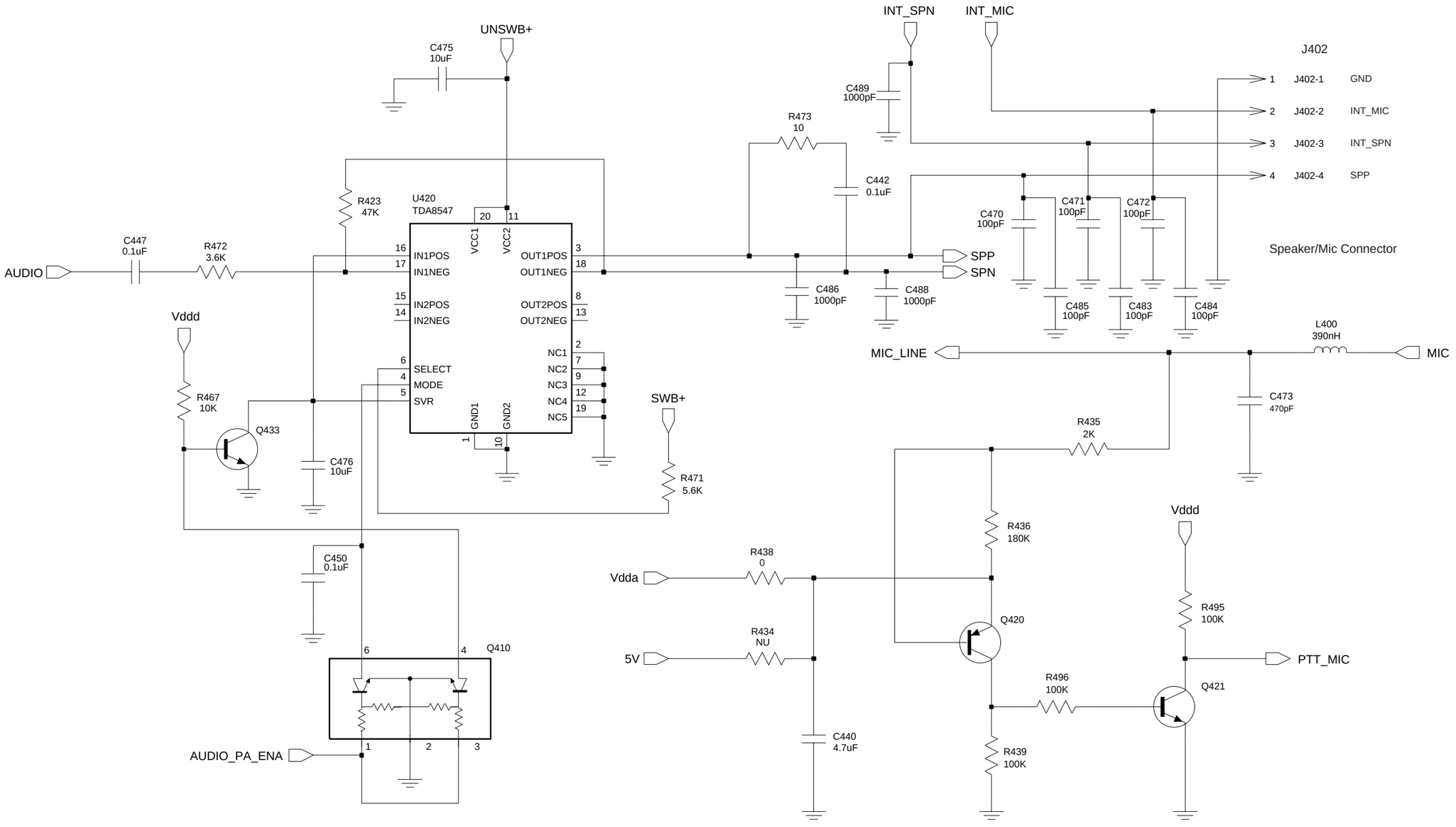


Figure 4-12. Controller Audio Power Amplifier Schematic Diagram

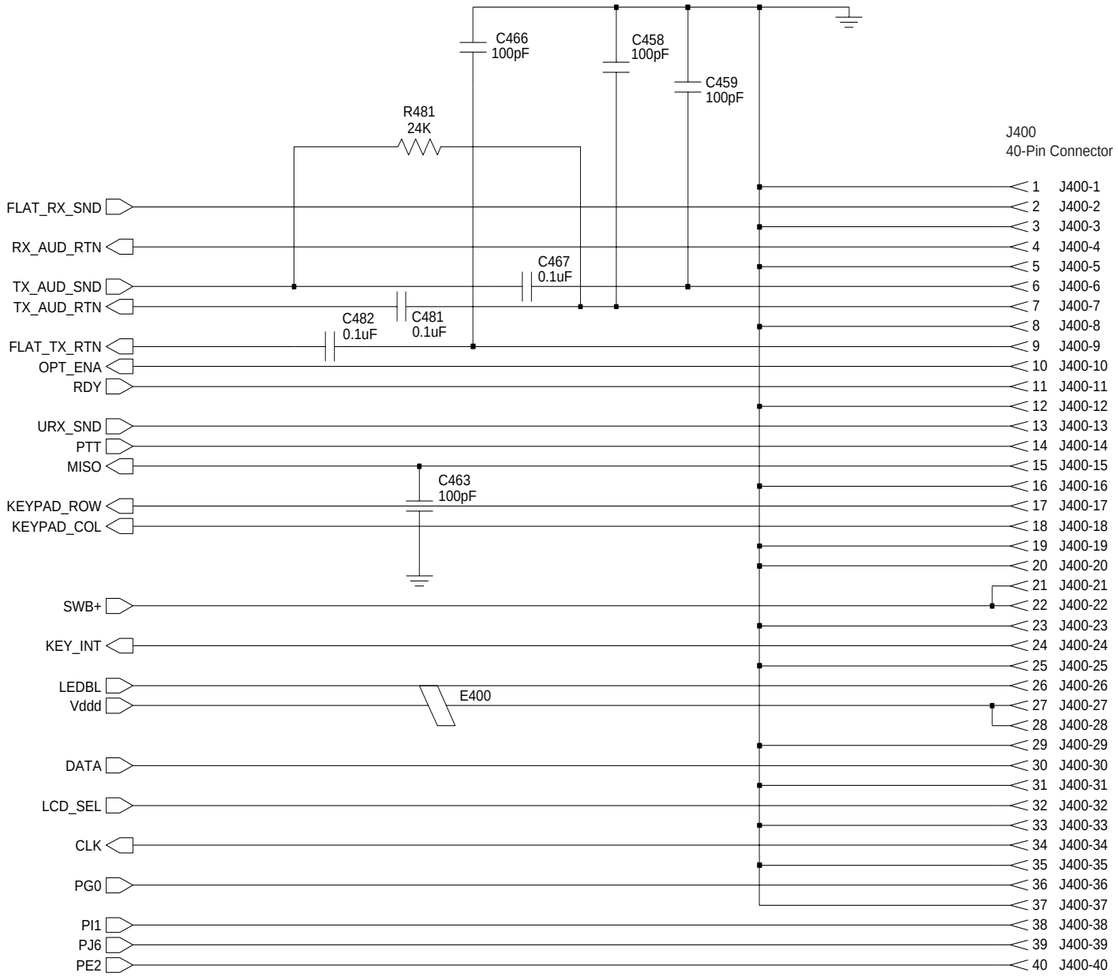


Figure 4-13. Controller Interface Schematic Diagram

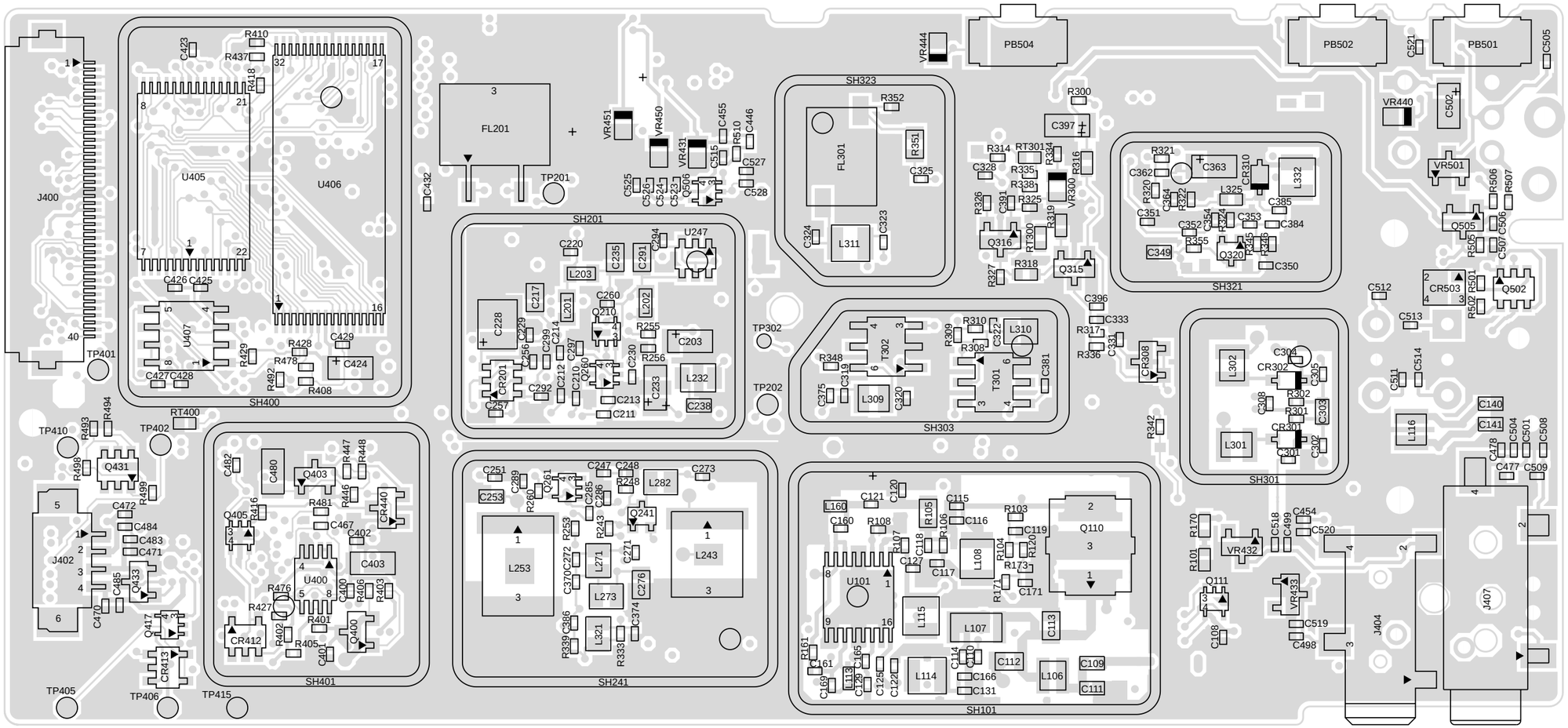


Figure 4-14. UHF (403-470MHz) Main Board Top Side PCB

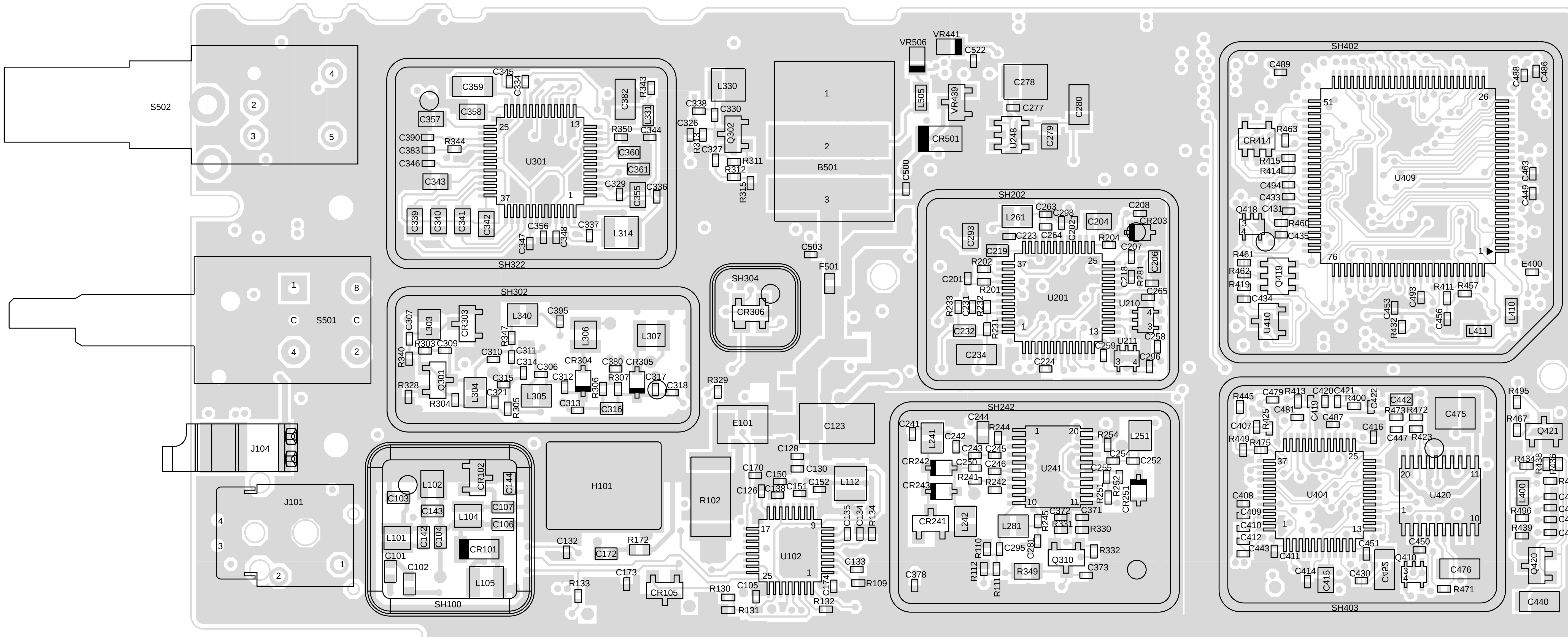


Figure 4-15. UHF (403-470MHz) Main Board Bottom Side PCB

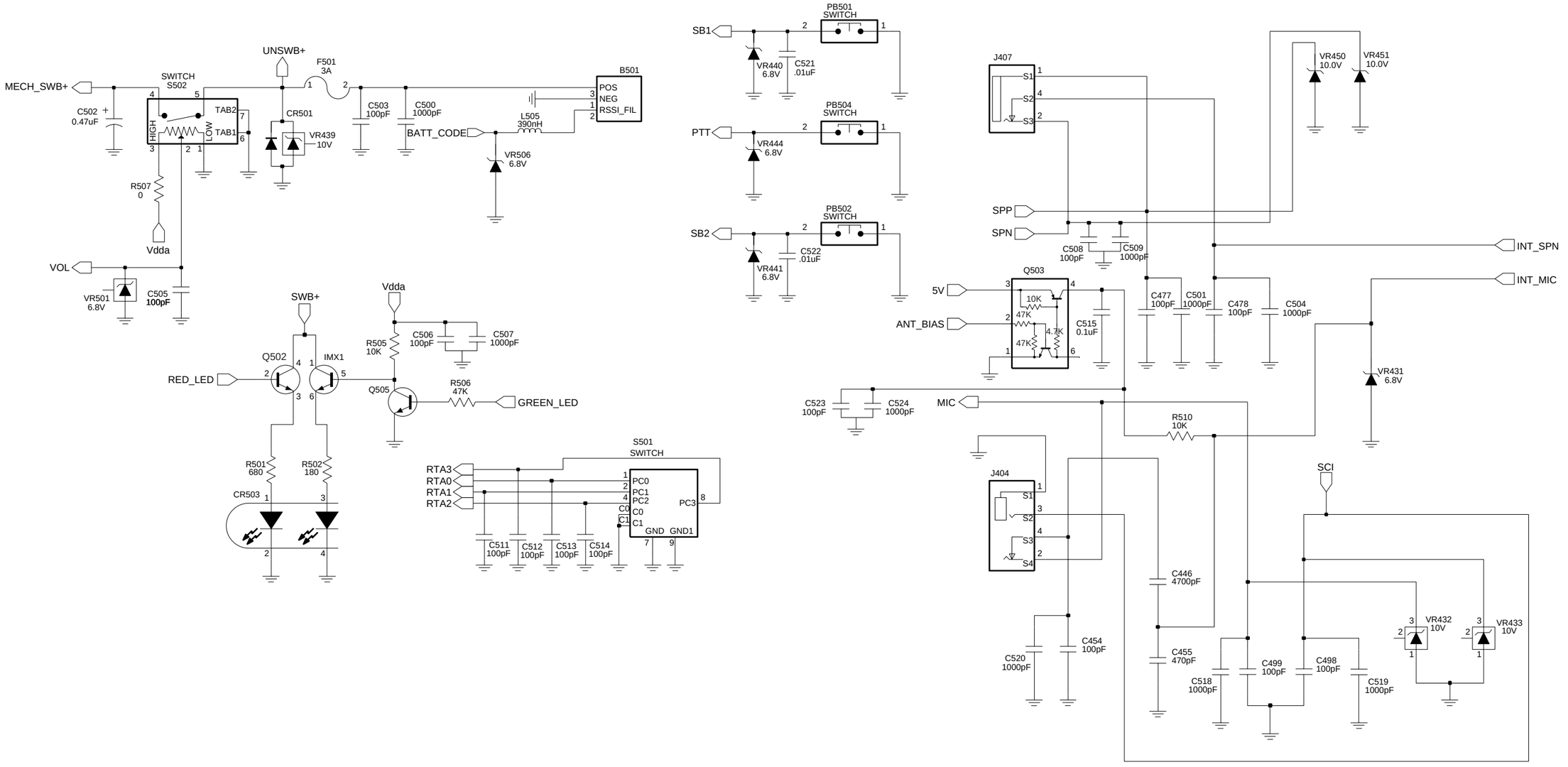


Figure 4-16. UHF (403-470MHz) Controls And Switches Schematic Diagram

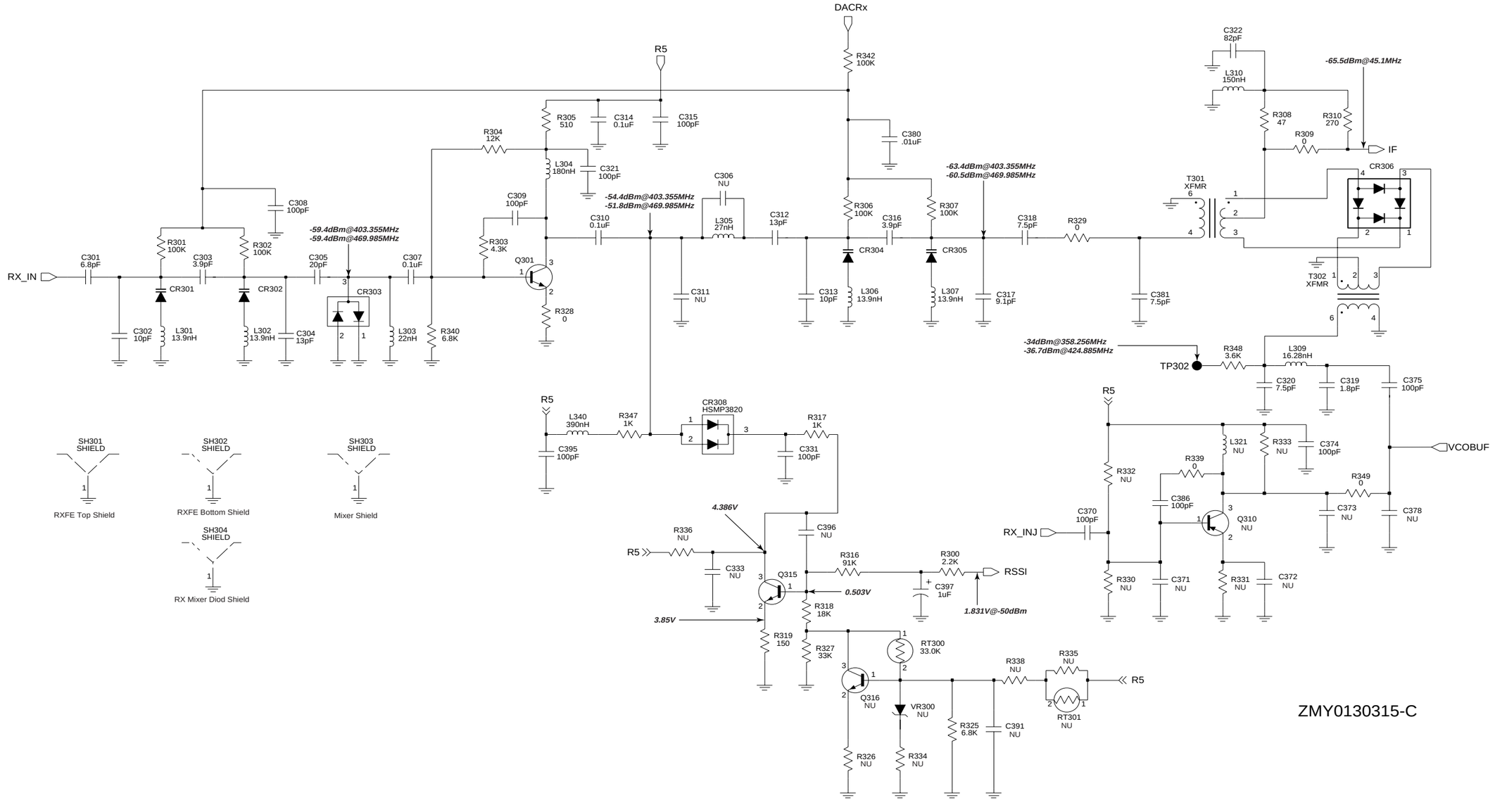


Figure 4-17. UHF (403-470MHz) Receiver Front End Schematic Diagram

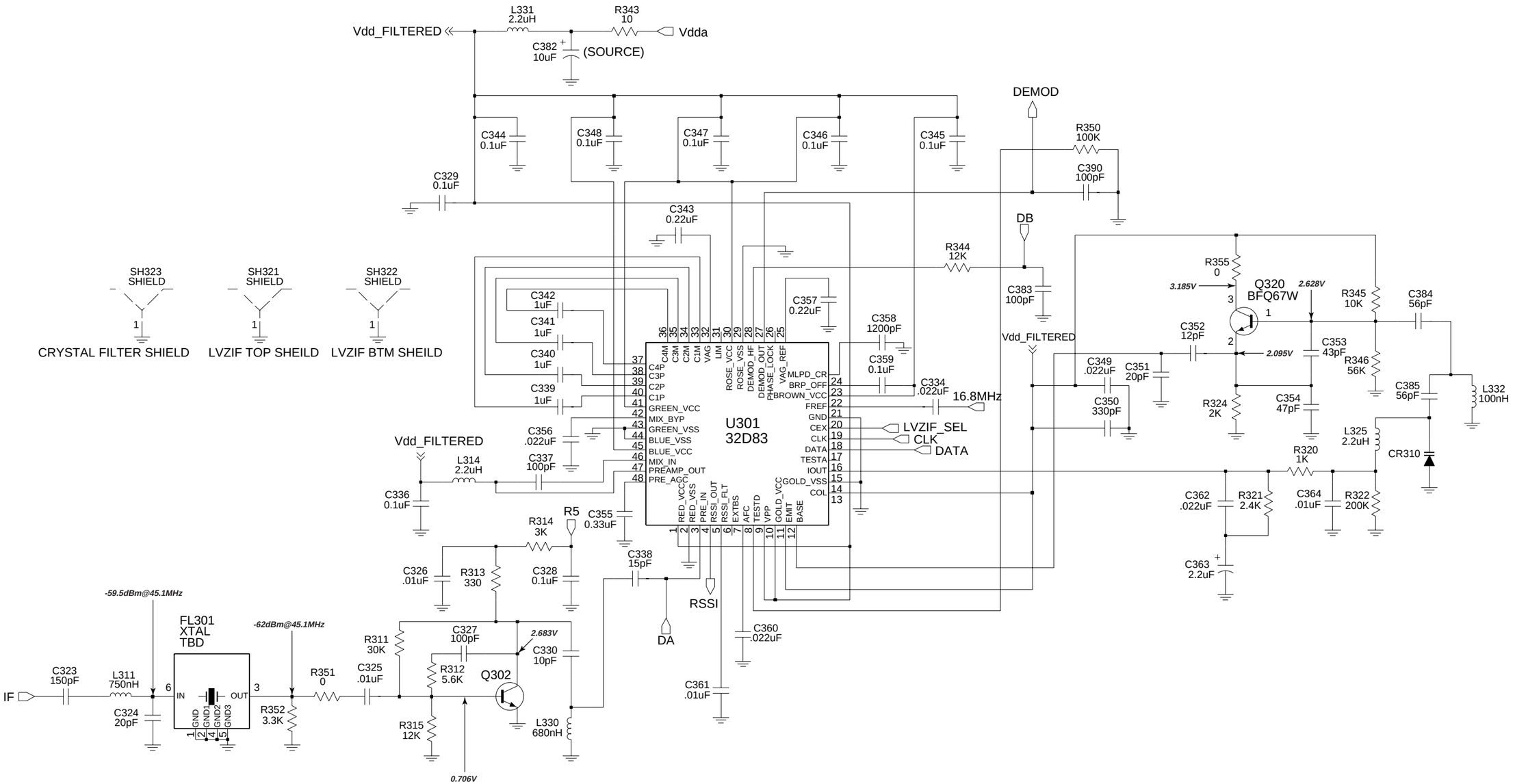


Figure 4-18. UHF (403-470MHz) Receiver Back End Schematic Diagram

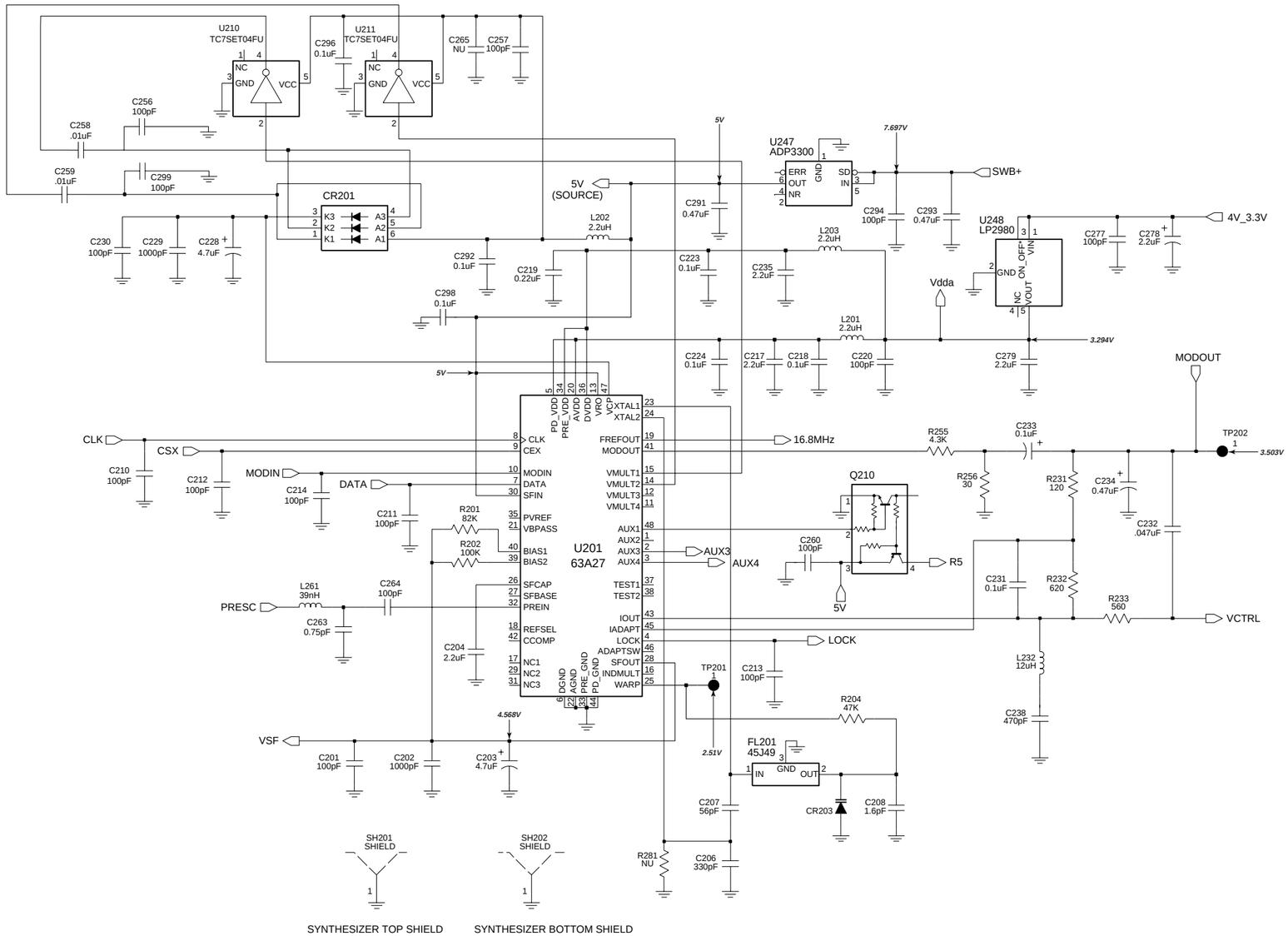


Figure 4-19. UHF (403-470MHz) Synthesizer Schematic Diagram

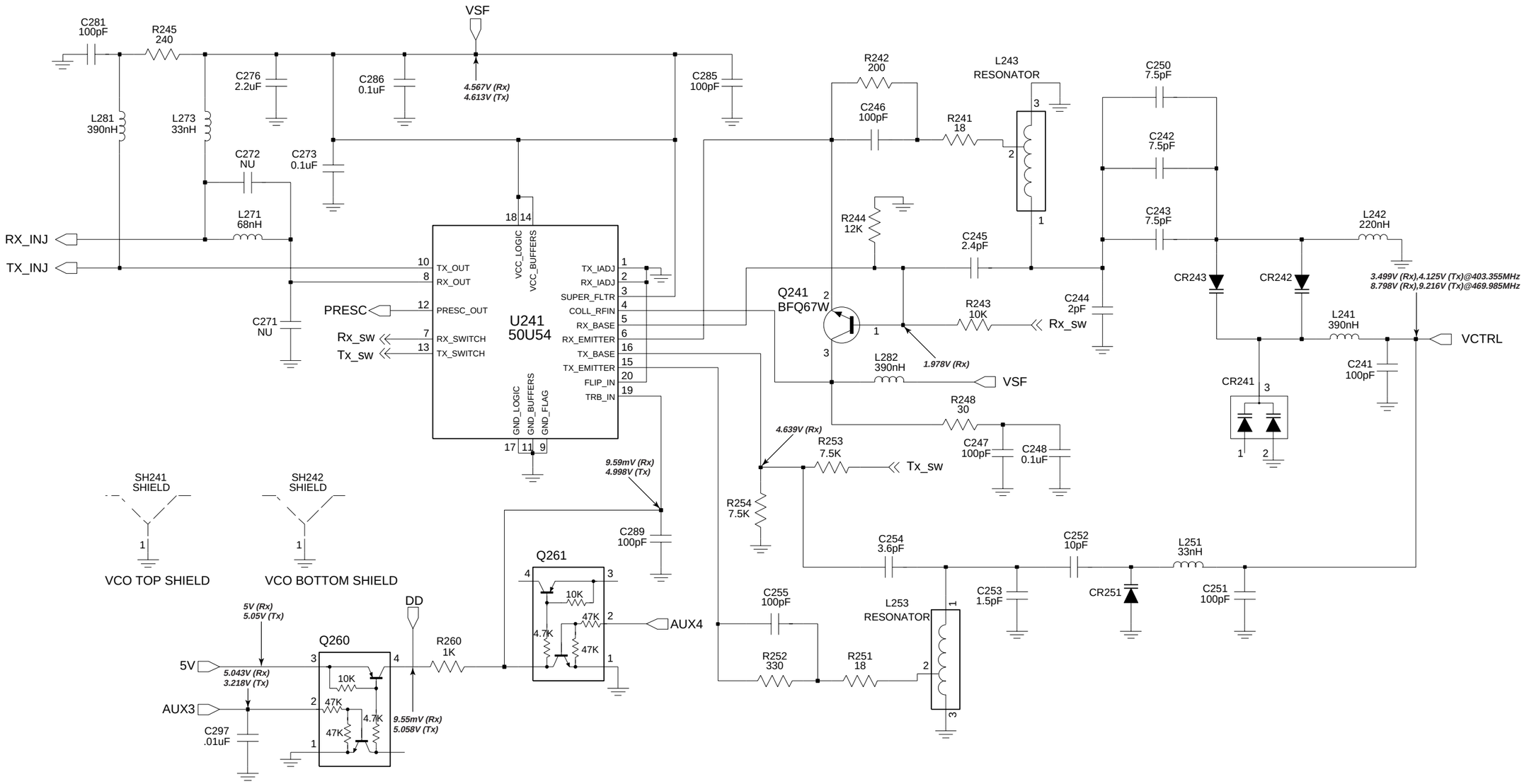
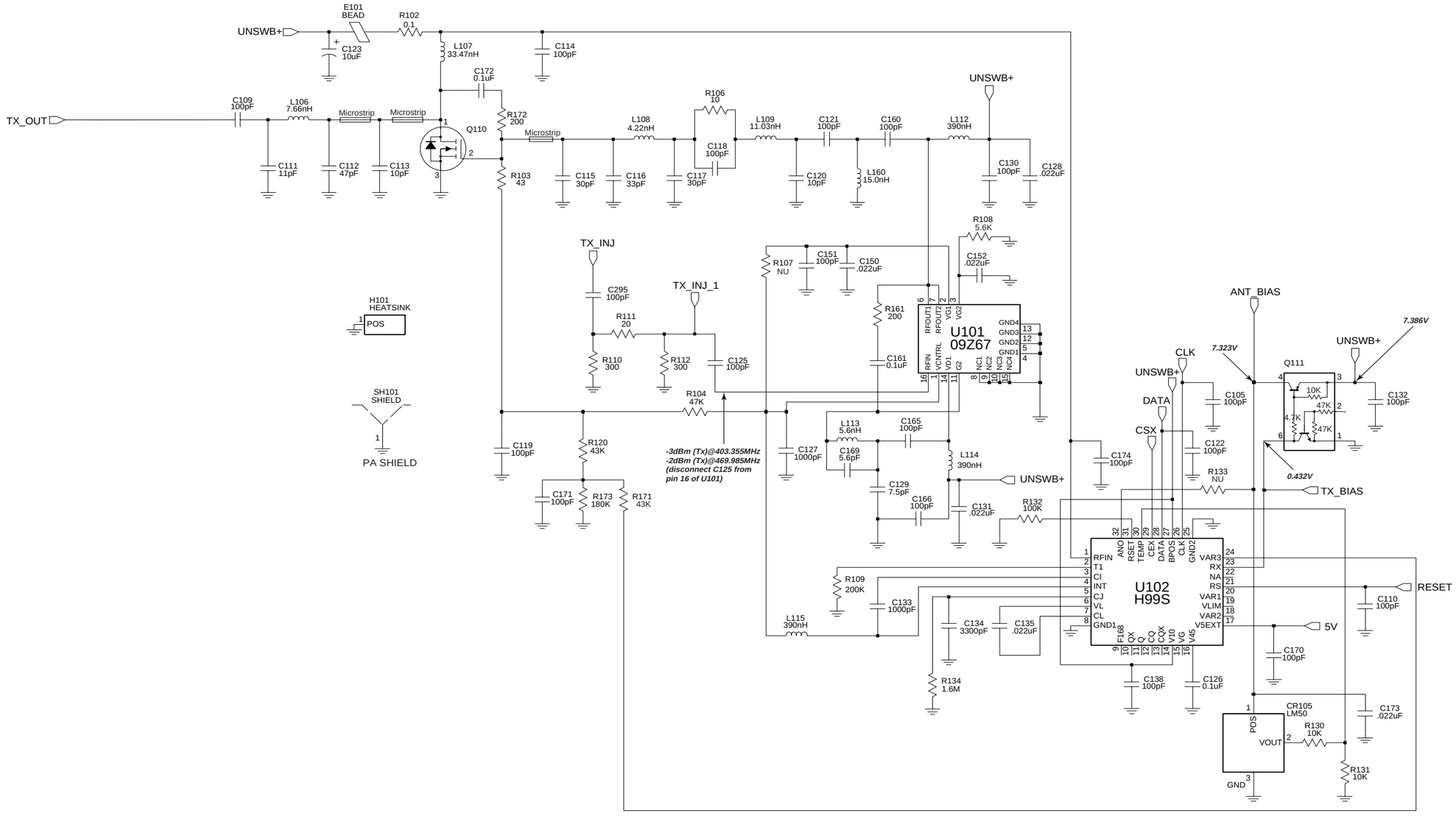


Figure 4-20. UHF (403-470MHz) Voltage Controlled Oscillator Schematic Diagram



ZMY0130317-B

Figure 4-21. UHF (403-470MHz) Transmitter Schematic Diagram

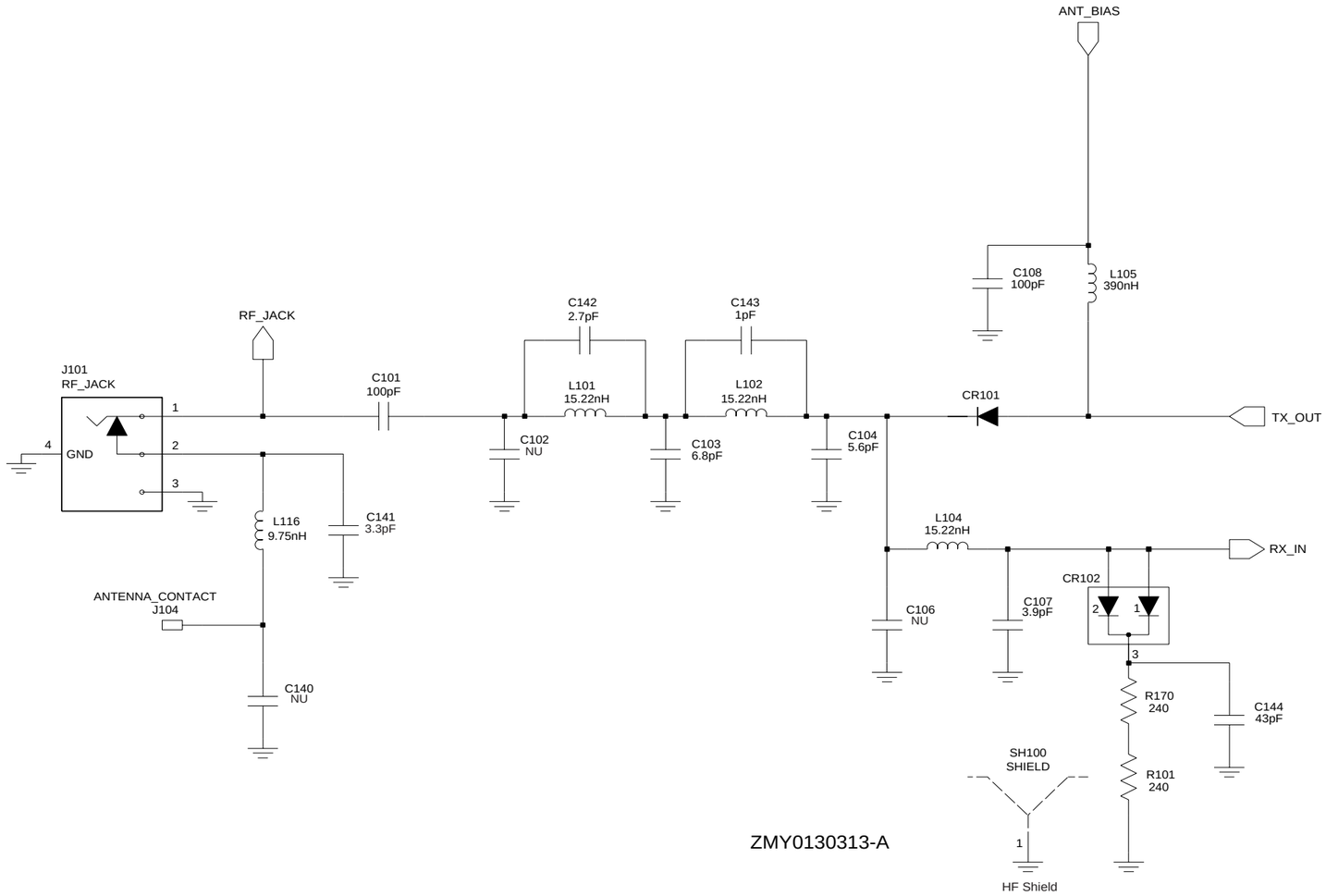


Figure 4-22. UHF (403-470 MHz) Harmonic Filter Schematic Diagram

Table 4-2: UHF Band 1Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A01	CONNECTOR, CONTACT BATTERY
C101	2113740F51	100pF
C102	Not Placed	
C103	2113740F23	6.8pF
C104	2113740F21	5.6pF
C105	2113743N50	100pF
C106	Not Placed	
C107	2113740F17	3.9pF
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2113740F30	13pF
C112	2180605Z32	47pF
C113	2180605Z16	10pF
C114	2113743N50	100pF
C115	2113743N26	10pF
C116	2113743N38	33.0pF
C117	Not Placed	
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	2113743N26	10pF
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF
C125	2113743N50	100pF
C126	2113743M24	0.1uF
C127	2113743L17	1000pF
C128	2113743M08	0.022uF
C129	2113743N23	7.5pF
C130	2113743N50	100pF
C131	2113743M08	0.022uF
C132	2113743N50	100pF
C133	2113743L17	1000pF
C134	2113743L29	3300pF
C135	2113743M08	0.022uF
C138	2113743N50	100pF
C142	2113740F13	2.7pF
C143	2113740F03	1pF
C144	2113740F42	43pF
C150	2113743M08	0.022uF
C151	2113743N50	100pF
C152	2113743M08	0.022uF
C160	2113743N50	100pF
C161	2113743M24	0.1uF
C165	2113743N50	100pF
C166	2113743N50	100pF
C169	2113743N20	5.6pF
C170	2113743N50	100pF
C171	2113743N50	100pF
C172	2113740F51	100pF
C173	2113743M08	0.022uF
C174	2113743N50	100pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7uF
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N44	56.0pF
C208	2113743N08	1.6pF
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	0.1uF
C219	2113743K16	0.220uF
C220	2113743N50	100pF
C223	2113743M24	0.1uF
C224	2113743M24	0.1uF
C228	2311049J11	4.7uF
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	0.1uF
C232	2113743E12	0.047uF
C233	2311049A01	0.1pF
C234	2311049A05	0.47pF
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N23	7.5pF
C243	2113743N23	7.5pF
C244	2113740F10	2.0pF
C245	2113743N11	2.4pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	0.1uF
C250	2113743N23	7.5pF
C251	2113743N50	100pF
C252	2113743N26	10pF
C253	2113740F09	1.8pF
C254	2113743N15	3.6pF
C255	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	0.01uF
C259	2113743L41	0.01uF
C260	2113743N50	100pF
C263	2113743N02	0.75pF
C264	2113743N50	100pF
C273	2113743M24	0.1uF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A09	2.2uF
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	0.1uF
C289	2113743N50	100pF
C291	2380737Z10	10.0uF
C292	2113743M24	0.1uF
C293	2113743A27	0.470uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	0.1uF
C297	2113743L41	0.01uF
C298	2113743M24	0.1uF
C299	2113743N50	100pF
C301	2113743N22	6.8pF
C302	2113743N26	10pF
C303	2113740L08	3.9pF
C304	2113743N26	10pF
C305	2113743N33	20.0pF
C307	2113743M24	0.1uF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	0.1uF
C312	2113743N25	9.1pF
C313	2113743N26	10pF
C314	2113743M24	0.1uF
C315	2113743N50	100pF
C316	2113740L08	3.9pF
C317	2113743N25	9.1pF
C318	2113743N23	7.5pF
C319	2113743N69	1.8pF
C320	2113743N23	7.5pF
C321	2113743N50	100pF
C322	2113743N48	82.0pF
C323	2113743N54	150pF
C324	2113743N33	20.0pF
C325	2113743L41	0.01uF
C326	2113743L41	0.01uF
C327	2113743N50	100pF
C328	2113743M24	0.1uF
C329	2113743M24	0.1uF
C330	2113743N26	10pF
C331	2113743N50	100pF
C334	2113743M08	0.022uF
C336	2113743M24	0.1uF
C337	2113743N50	100pF
C338	2113743N30	15.0pF
C339	2180478Z20	1.0uF
C340	2180478Z20	1.0uF
C341	2180478Z20	1.0uF
C342	2180478Z20	1.0uF
C343	2113743A23	0.220uF
C344	2113743M24	0.1uF
C345	2113743M24	0.1uF
C346	2113743M24	0.1uF
C347	2113743M24	0.1uF
C348	2113743M24	0.1uF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20.0pF
C352	2113743N28	12.0pF
C353	2113743N41	43.0pF
C354	2113743N42	47.0pF
C355	2113743A24	0.330uF
C356	2113743M08	0.022uF
C357	2113743A23	0.220uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF
C360	2113743E07	0.022uF
C361	2113741F49	10NF
C362	2113743M08	0.022uF
C363	2311049A40	2.2uF
C364	2113743L41	0.01uF
C370	2113743N50	100pF
C374	2113743N50	100pF
C375	2113743N50	100pF
C380	2113743L41	0.01uF
C381	2113743N23	7.5pF
C382	2311049A59	10uF
C383	2113743N50	100pF
C384	2113743N44	56.0pF
C385	2113743N44	56.0pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C395	2113743N50	100pF
C397	2311049A05	0.47pF
C400	2113743L41	0.01uF
C401	2113743M24	0.1uF
C402	2113743M24	0.1uF
C403	2113928D08	10.0uF
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	0.1uF
C410	2113928N01	0.1uF
C411	2113743M24	0.1uF
C412	2113928N01	0.1uF
C414	2113743M24	0.1uF
C415	2109720D01	0.01uF
C416	2113928N01	0.1uF

Circuit Ref	Motorola Part No.	Description
C420	2113743L41	0.01uF
C421	2113928N01	0.1uF
C422	2113743M24	0.1uF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	0.1uF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	0.1uF
C429	2113743M24	0.1uF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C433	2113743L41	0.01uF
C434	2113743M24	0.1uF
C435	2113743M24	0.1uF
C436	Not Placed	
C437	Not Placed	
C440	2113743G26	4.7uF
C441	Not Placed	
C442	2113743E20	0.10uF
C443	2113928N01	0.1uF
C444	Not Placed	
C445	Not Placed	
C446	2113743R33	4700pF, 5%
C447	2113743M08	0.022uF
C448	Not Placed	
C449	2113743N50	100pF
C450	Not Placed	
C451	2113743M08	0.022uF
C452	2113743G26	4.7uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	Not Placed	
C472	Not Placed	
C473	2113743L09	470pF
C475	2113743H14	10.0uF
C476	2113928D08	10.0uF
C477	2113743N50	100pF
C478	2113743N50	100pF
C479	2113928N01	0.1uF
C480	2113928D08	10.0uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C483	2113743L17	1000pF
C484	2113743L17	1000pF
C485	2113743L17	1000pF
C486	2113743L17	1000pF
C487	Not Placed	
C488	2113743L17	1000pF
C489	2113743L17	1000pF
C493	Not Placed	
C494	2113743N50	100pF
C498	2113743N50	100pF
C499	2113743N50	100pF
C500	2113743L17	1000pF
C501	2113743L17	1000pF
C502	2311049A05	0.47pF
C503	2113743N50	100pF
C504	2113743L17	1000pF
C505	2113743N50	100pF
C506	2113743N50	100pF
C507	2113743L17	1000pF
C508	2113743N50	100pF
C509	2113743L17	1000pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C515	2113743M24	0.1uF
C518	2113743L17	1000pF
C519	2113743L17	1000pF
C520	2113743L17	1000pF
C521	2113743L41	0.01uF
C522	2113743L41	0.01uF
C523	2113743N50	100pF
C524	2113743L17	1000pF
CR101	4880973Z02	PIN DIODE
CR102	4802245J41	PIN DIODES
CR105	5185963A15	TEMPERATURE SENSE
CR201	4802233J09	DIODE TRIPLE
CR203	4862824C03	VARACTOR
CR241	4805649Q13	DUAL VARACTOR
CR242	4862824C01	VARACTOR
CR243	4862824C01	VARACTOR
CR251	4802245J22	VARACTOR
CR301	4862824C01	VARACTOR
CR302	4862824C01	VARACTOR
CR303	4880154K03	DUAL COMMON ANODE-CATHODE
CR304	4862824C01	VARACTOR
CR305	4862824C01	VARACTOR
CR306	4802245J42	RING QUAD DIODE
CR308	4802245J41	PIN DIODES
CR310	4862824C01	VARACTOR
CR411	4802245J47	DIODE SCHOTTKY
CR412	4802245J47	DIODE SCHOTTKY
CR413	4802245J47	DIODE SCHOTTKY
CR440	4813833C02	DUAL DIODE COMMON CATHODE
CR501	4880107R01	RECTIFIER
CR503	4805729G49	LED RED/YEL
E101	2484657R01	FERRITE BEAD
E400	2480640Z01	FERRITE BEAD
F501	6580542Z01	FUSE 3A
FL201	4802245J49	CRYSTAL 16.8MHZ CLIP
FL301	4802245J43	XTAL FILTER 45.1MHZ
H101	2680499Z01	HEAT SPREADER
J101	0180117S05	RF JACK ASSEMBLY
J104	3980686Z01	ANTENNA CONTACT
J400	0905505Y04	40-PIN CONNECTOR
J402	2809926G02	4-PIN CONNECTOR
J404	0980689Z01	Connector (Stereo Jack 2.5mm)
J407	0980688Z01	Connector (Mono Jack 3.5mm)
L101	2460591B48	15.22nH, 10%
L102	2460591B48	15.22nH, 10%
L104	2460591B48	15.22nH, 10%
L105	2462587N22	390nH
L106	2479990A02	7.66nH
L107	2479990G01	33.47nH
L108	2479990A01	4.22nH
L112	2462587N45	22nH
L113	2413926H09	5.6nH
L114	2462587N22	390nH
L115	2462587N22	390nH
L116	2479990A03	9.75nH
L160	Not Placed	
L201	2462587Q20	2.2uH
L202	2462587Q20	2.2uH
L203	2462587Q20	2.2uH
L232	2462587P25	12uH
L241	2462587V41	390nH
L242	2462587V38	220nH
L243	2460593C01	TEFLON RESONATOR
L251	2462587V28	33nH
L253	2460593C02	TEFLON RESONATOR
L261	2462587V29	39nH
L271	2462587V32	68nH
L273	2462587V28	33nH
L281	2462587V41	390nH
L282	2462587V41	390nH
L301	2479990C01	13.9nH
L302	2479990C01	13.9nH
L303	2462587V26	22nH
L304	2462587V37	180nH
L305	2462587V26	22nH
L306	2479990C01	13.9nH
L307	2479990C01	13.9nH
L309	2479990C02	16.28nH
L310	2462587V36	150nH
L311	2462587N65	750nH
L314	2462587N72	2.2uH
L325	2480646Z20	2.20uH
L330	2462587N64	680nH
L331	2480646Z20	2.20uH
L332	2462587N53	100nH
L340	2462587V41	390nH
L400	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
PB501	4080523Z01	TACTILE PUSH BUTTON
PB502	4080523Z01	TACTILE PUSH BUTTON
PB503	4080523Z01	TACTILE PUSH BUTTON
Q110	4802245J55	RF POWER FET
Q111	4802245J50	DUAL NPN/PNP
Q210	4802245J50	DUAL NPN/PNP
Q241	4805218N63	NPN
Q260	4802245J50	DUAL NPN/PNP
Q261	4802245J50	DUAL NPN/PNP
Q301	4802245J44	NPN
Q302	4802245J44	NPN
Q315	4880214G02	NPN
Q320	4805218N63	NPN
Q400	4809579E18	MOSFET P-CHAN
Q403	4880214G02	NPN
Q405	4802245J54	DUAL NPN
Q410	4802245J54	DUAL NPN
Q417	4802245J50	DUAL NPN/PNP
Q418	4802245J50	DUAL NPN/PNP
Q419	5180159R01	DUAL NPN
Q420	4805128M67	SOT STR MMBT
Q421	4880214G02	NPN
Q431	5180159R01	DUAL NPN
Q502	5180159R01	DUAL NPN
Q503	4802245J50	Dual NPN/PNP
Q505	4880214G02	NPN
R101	0662057A34	240
R102	0680735Z01	0.075
R103	0662057M41	43
R104	0662057N15	47K
R105	0662057M01	0
R106	0662057M26	10
R108	0662057M92	5.6K
R109	0662057N30	200K
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300

Circuit Ref	Motorola Part No.	Description
R120	0662057N14	43K
R130	0662057M98	10K
R131	0662057N14	10K
R132	0662057N33	270K
R134	0662057N52	1.6M
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43K
R172	0662057A32	200
R173	0662057N29	180K
R201	0662057N21	82K
R202	0662057N23	100K
R204	0662057N15	47K
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M57	200
R243	0662057M98	10K
R244	0662057N01	12K
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M32	18
R252	0662057M62	330
R253	0662057M95	7.5K
R254	0662057M95	7.5K
R255	0662057M89	4.3K
R256	0662057M37	30
R260	0662057M74	1K
R281	Not Placed	
R300	0662057M82	2.2K
R301	0662057N23	100K
R302	0662057N23	100K
R303	0662057M89	4.3K
R304	0662057N01	12K
R305	0662057M67	510
R306	0662057N23	100K
R307	0662057N23	100K
R308	0662057M42	47
R309	0662057M01	0
R310	0662057M60	270
R311	0662057N10	30K
R312	0662057M92	5.6K
R313	0662057M62	330
R314	0662057M85	3K
R315	0662057N01	12K
R316	0662057A96	91K
R317	0662057M74	1K
R318	0662057A79	18K
R319	0662057A29	150
R320	0662057M74	1K

Circuit Ref	Motorola Part No.	Description
R321	0662057M83	2.4K
R322	0662057N30	200K
R324	0662057M81	2K
R325	0662057M94	6.8K
R327	0662057N11	33K
R328	0662057M01	0
R329	0662057M01	0
R339	0662057M01	0
R340	0662057M94	6.8K
R342	0662057N23	100K
R343	0662057M26	10
R344	0662057N01	12K
R345	0662057M98	10K
R346	0662057N17	56K
R347	0662057M74	1K
R348	0662057M87	3.6K
R349	0662057C01	0
R350	0662057N23	100K
R351	0662057C01	0
R352	0662057M86	3.3K
R355	0662057M01	0
R400	0662057N15	47K
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K
R415	0662057V26	91K
R416	0662057N13	39K
R418	0662057M01	0
R419	0662057M67	0
R423	0662057N39	470K
R425	0662057N10	30K
R427	0662057M98	10K
R428	0662057M10	2.2
R429	0662057M98	10K
R432	0662057N16	51K
R434	Not Placed	
R435	0662057M81	2K
R436	0662057N15	47K
R438	0662057M01	0
R445	0662057N08	24K
R446	0662057N31	220K
R447	0662057N51	1.5M
R448	0662057N33	270K
R449	0662057N08	24K
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057N23	100K

Circuit Ref	Motorola Part No.	Description
R462	0662057N23	100K
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057N12	36K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N08	24K
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R494	0662057M01	0
R495	0662057N23	100K
R496	0662057N23	100K
R498	0662057N23	100K
R499	0662057M98	10K
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10K
R506	0662057N15	47K
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	CHANNEL SWITCH
S502	1880619Z01	VOLUME SWITCH
SH100	2680687Z01	SHIELD, HARMONIC FILTER
SH101	2680510Z01	SHIELD, PA
SH201	2680511Z01	SYNTHESIZER TOP SHIELD
SH202	2680512Z01	SYNTHESIZER BOTTOM SHIELD
SH241	2680513Z01	SHIELD, VCO TOP
SH242	2680514Z01	SHIELD, VCO BOTTOM/ LVZIF
SH301	2680554Z01	RX PRE FILTER SHIELD
SH302	2680555Z01	RX POST FILTER/RX AMP
SH303	2680509Z01	SHIELD, MIXER
SH304	2680624Z01	SHIELD, MIXER DIODE
SH321	2680508Z01	SHIELD,LVZIF 2ND LO
SH322	2680517Z01	ZIF SHIELD
SH323	2680553Z01	SHIELD, CRYSTAL FILTER
SH400	2680505Z01	CONTROLLER MEMORY SHIELD
SH401	2680506Z01	ON/OFF CONTROLLER SHIELD
SH402	2680515Z01	MICROPROCESSOR CONTROLLED SHIELD
SH403	2680516Z01	ASFIC CMP/AUDIO PA CONTROLLER SHIELD
T301	2580541Z01	XFMR COIL
T302	2580541Z01	XFMR COIL
U101	5105109Z67	LDMOS DRIVER UHF IC
U102	5185765B01	POWER CONTROL IC

Circuit Ref	Motorola Part No.	Description
U201	5185963A27	LVFRACN
U210	5102463J61	INVERTER
U211	5102463J61	INVERTER
U241	5105750U54	VCO BuFFER
U247	5105739X05	REGULATOR LINEAR
U248	5102463J58	3.3V REGULATOR
U301	5109632D83	LVZIF 2.2
U400	5102463J40	3.3V REGULATOR
U404	5185963A53	ASFIC CMP
U405	5102463J36	STATIC_RAM_32KX8 I
U406	*5102463J59	FLASH ROM 128KX8
U407	*5102463J64	16K X 8 EEPROM
U409	5102226J56	UP HC11FLO
U410	5102463J57	REGULATOR 3.3V
U420	5102463J44	AUDIO PA
VR432	4805656W08	5.6V ZENER
VR433	4805656W08	5.6V ZENER
VR434	4802245J51	ZENER 6.8V
VR439	4880140L15	10V ZENER
VR440	4802245J51	ZENER 6.8V
VR441	4802245J51	ZENER 6.8V
VR442	4802245J51	ZENER 6.8V
VR443	4802245J51	ZENER 6.8V
VR444	4802245J51	ZENER 6.8V
VR445	4802245J53	ZENER_10V
VR446	4802245J53	ZENER_10V
VR447	4802245J53	ZENER_10V
VR448	4802245J53	ZENER_10V
VR449	4802245J53	ZENER_10V
VR450	4802245J53	ZENER_10V
VR501	4813830A18	6.8V ZENER
VR506	4802245J51	ZENER 6.8V
	7580671Z01	PAD (FLEXIBLE CIRCUIT)

* Motorola Depot Servicing only

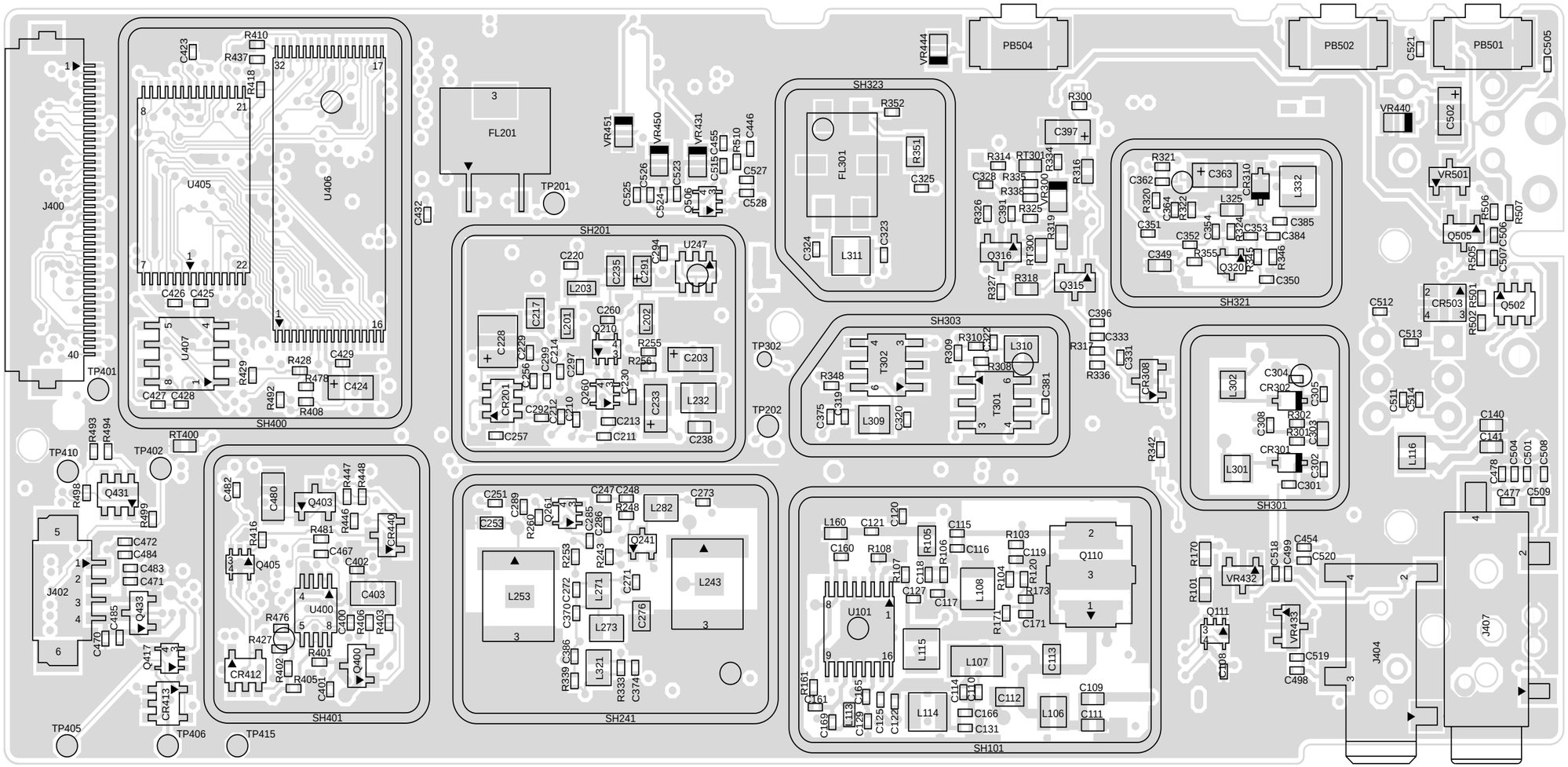


Figure 4-23. UHF (450-527 MHz) Main Board Top Side PCB

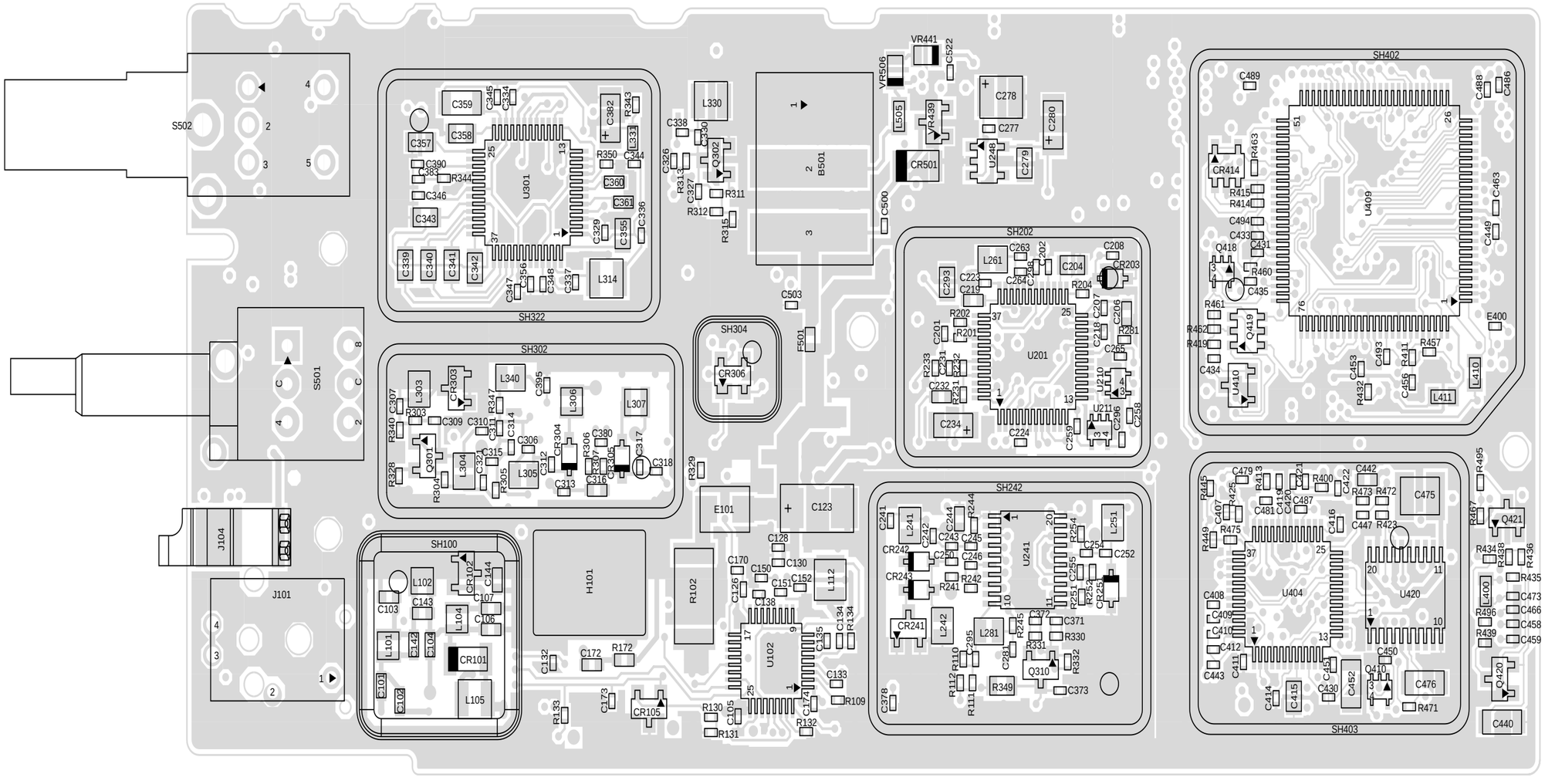


Figure 4-24. UHF (450-527 MHz) Main Board Bottom Side PCB

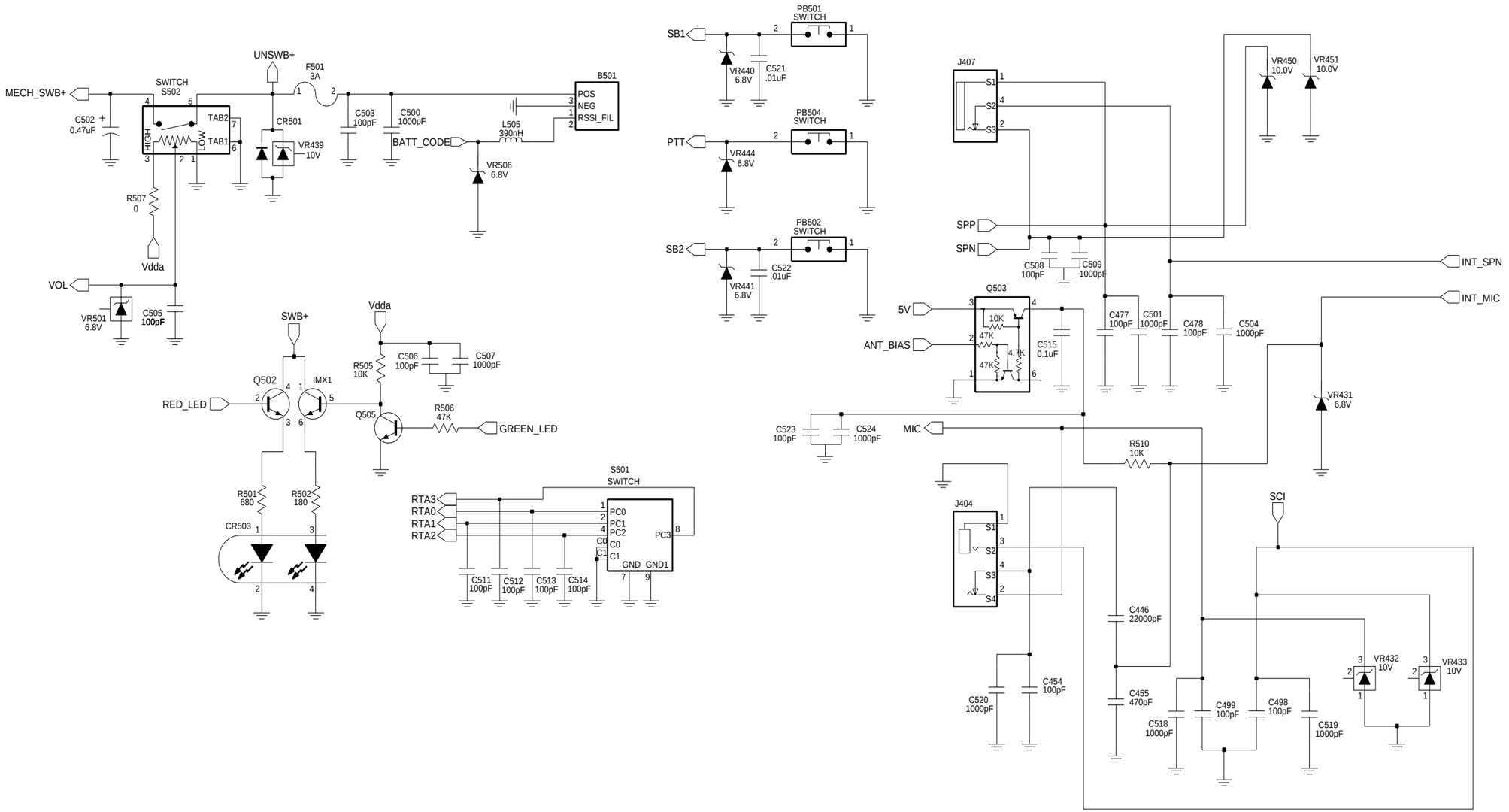


Figure 4-25. UHF (450-527 MHz) Controls And Switches Schematic Diagram

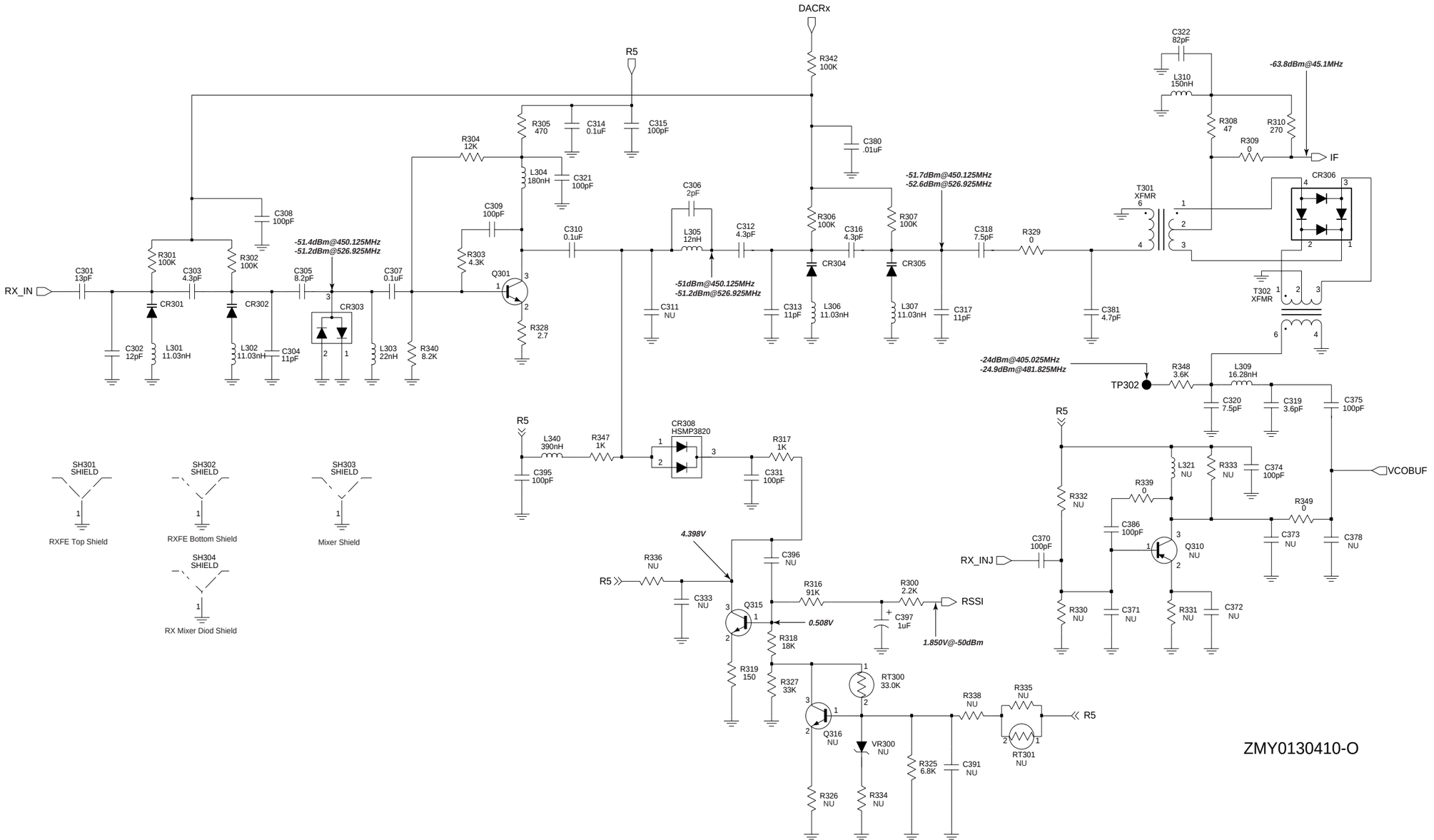


Figure 4-26. UHF (450-527 MHz) Receiver Front End Schematic Diagram

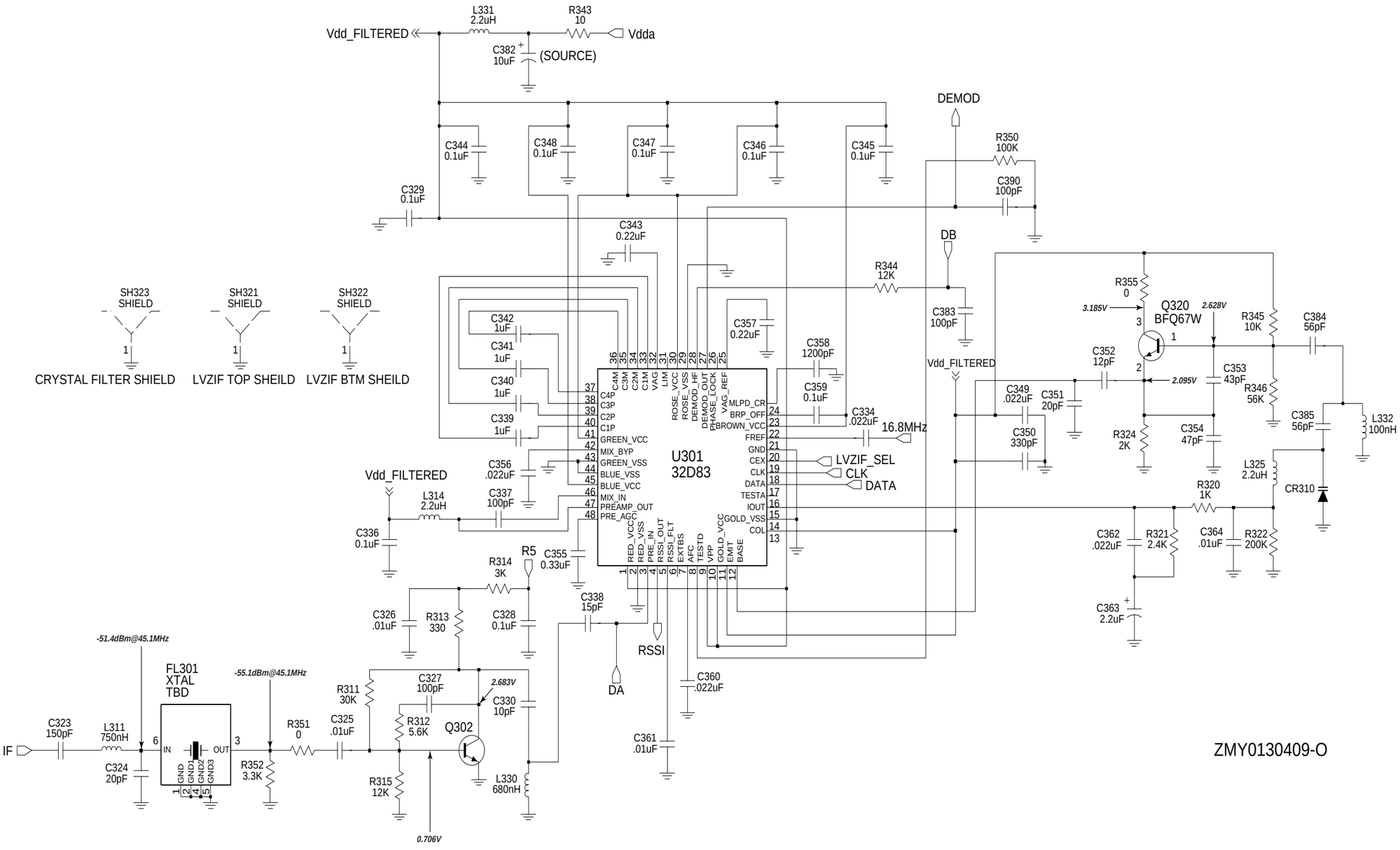


Figure 4-27. UHF (450-527 MHz) Receiver Back End Schematic Diagram

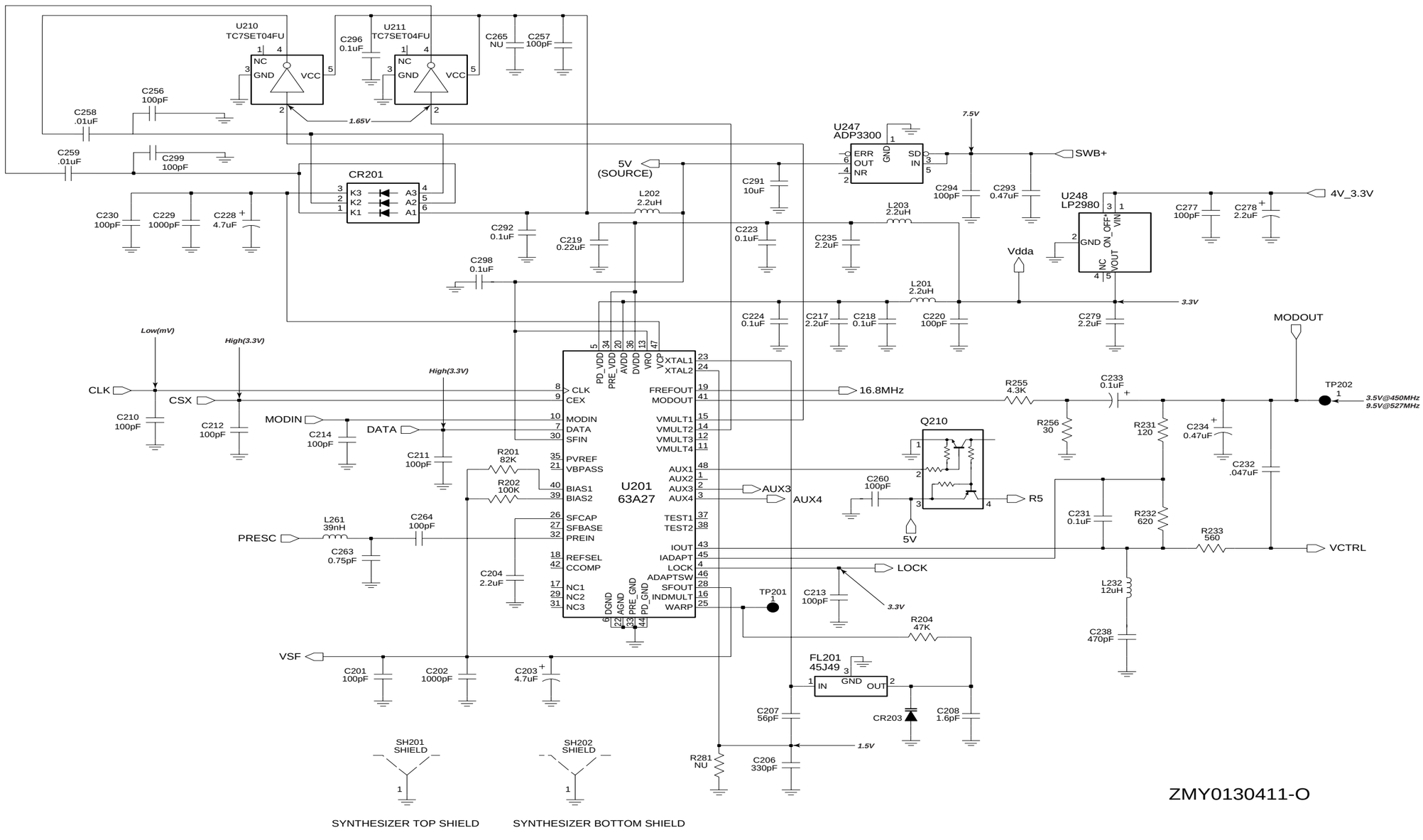


Figure 4-28. UHF (450-527 MHz) Synthesizer Schematic Diagram

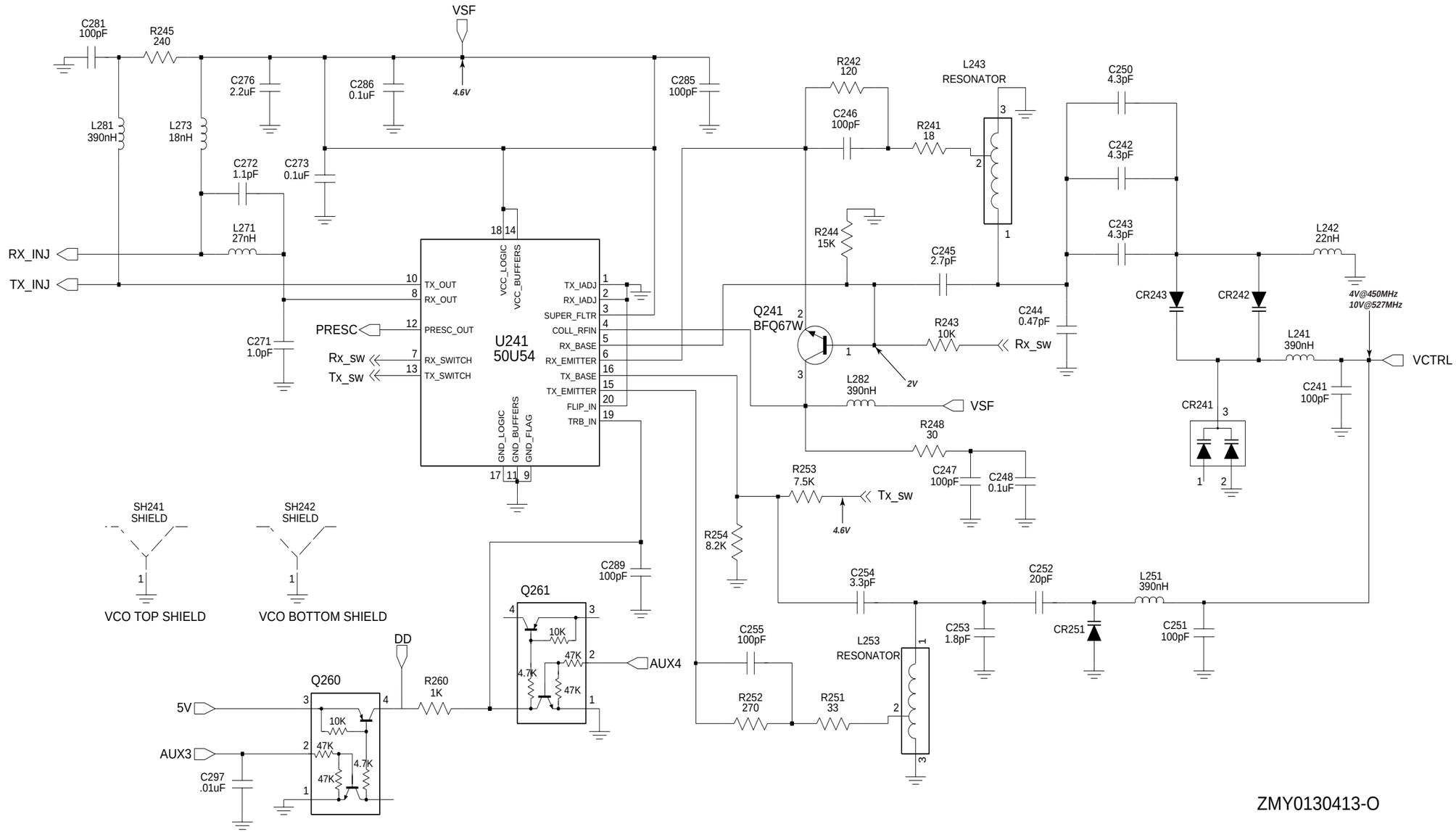


Figure 4-29. UHF (450-527 MHz) Voltage Controlled Oscillator Schematic Diagram

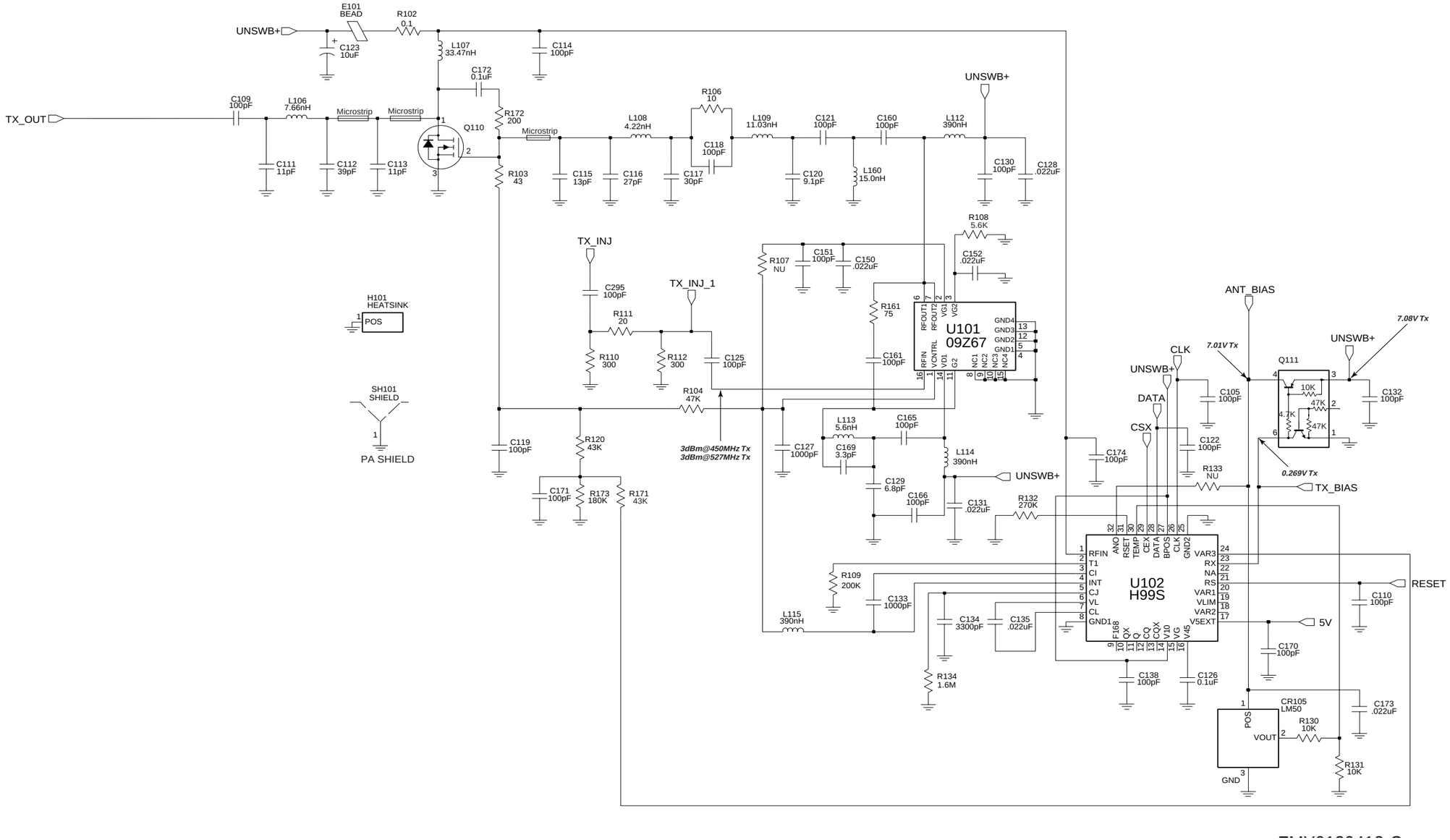


Figure 4-30. UHF (450-527 MHz) Transmitter Schematic Diagram

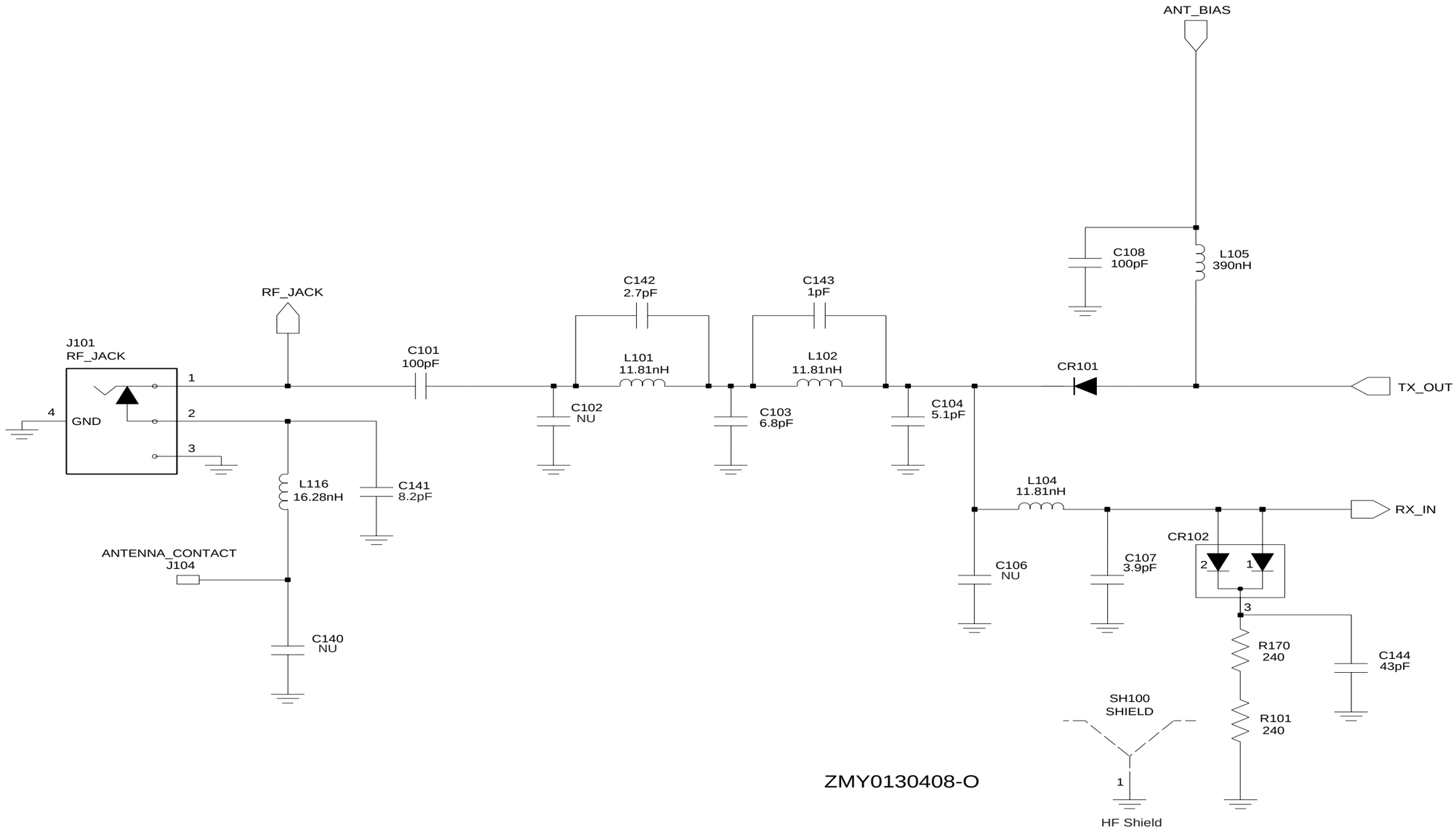


Figure 4-31. UHF (450-527 MHz) Harmonic Filter Schematic Diagram

Table 4-3 *UHF Band 2 Radio Parts List*

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Connector, Contact Battery
C101	2113740F51	100pF
C102	Not Placed	
C103	2113740L14	6.8pF
C104	2113740L11	5.1pF
C105	2113743N50	100pF
C106	Not Placed	
C107	2113740L08	3.9pF
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2113740F30	13pF
C112	2180605Z30	39pF
C113	2180605Z17	11pF
C114	2113743N50	100pF
C115	2113743N29	13pF
C116	2113743N36	27pF
C117	Not Placed	
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	2113743N25	9.1pF
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF
C125	2113743N50	100pF
C126	2113743M24	0.1uF
C127	2113743L17	1000pF
C128	2113743M08	0.022uF
C129	2113743N22	6.8pF
C130	2113743N50	100pF
C131	2113743M08	0.022uF
C132	2113743N50	100pF
C133	2113743L17	1000pF
C134	2113743L29	3300pF
C135	2113743M08	0.022uF
C138	2113743N50	100pF
C140	Not Placed	
C141	2113740F25	8.2pF
C142	2113740L04	2.7pF
C143	2113740F03	1 pF
C144	2113740F42	43pF
C150	2113743M08	0.022uF
C151	2113743N50	100pF
C152	2113743M08	0.022uF
C160	2113743N50	100pF
C161	2113743N50	100pF
C165	2113743N50	100pF
C166	2113743N50	100pF
C169	2113743N14	3.3pF
C170	2113743N50	100pF
C171	2113743N50	100pF
C172	2113740F51	100pF
C173	2113743M08	0.022uF
C174	2113743N50	100pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7pF
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N44	56.0pF
C208	2113743N08	1.6pF
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	0.1uF
C219	2113743K16	0.220uF
C220	2113743N50	100pF
C223	2113743M24	0.1uF
C224	2113743M24	0.1uF
C228	2311049J11	4.7uF
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	0.1uF
C232	2113743E12	0.047uF
C233	2311049A01	0.1pF
C234	2311049A05	0.47pF
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N17	4.3pF
C243	2113743N17	4.3pF
C244	2113740F14	0.47uF
C245	2113743N12	2.7pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	0.1uF
C250	2113743N17	4.3pF
C251	2113743N50	100pF
C252	2113743N33	20.0pF
C253	2113740F09	1.8pF
C254	2113743N14	3.3pF
C255	2113743N50	100pF
C256	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	0.01uF
C259	2113743L41	0.01uF
C260	2113743N50	100pF
C263	2113743N02	0.75pF
C264	2113743N50	100pF
C271	2113743N03	1.0pF
C272	2113743N04	1.1pF
C273	2113743M24	0.1uF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A09	2.2uF
C279	2104993J02	2.2uF
C280	2311049A40	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	0.1uF
C289	2113743N50	100pF
C291	2311049A69	10uF
C292	2113743M24	0.1uF
C293	2113743A27	0.470uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	0.1uF
C297	2113743L41	0.01uF
C298	2113743M24	0.1uF
C299	2113743N50	100pF
C301	2113743N29	13pF
C302	2113743N28	12pF
C303	2113740L09	4.3pF
C304	2113743N27	11pF
C305	2113743N24	8.2pF
C306	2113743N17	4.3pF
C307	2113743M24	0.1uF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	0.1uF
C312	2113743N23	7.5pF
C313	2113743N27	11pF
C314	2113743M24	0.1uF
C315	2113743N50	100pF
C316	2113740L09	4.3pF
C317	2113743N27	11pF
C318	2113743N23	7.5pF
C319	2113743N15	3.6pF
C320	2113743N23	7.5pF
C321	2113743N50	100pF
C322	2113743N48	82.0pF
C323	2113743N54	150pF
C324	2113743N33	20.0pF
C325	2113743L41	0.01uF
C326	2113743L41	0.01uF
C327	2113743N50	100pF
C328	2113743M24	0.1uF
C329	2113743M24	0.1uF
C330	2113743N26	10pF
C331	2113743N50	100pF
C334	2113743M08	0.022uF
C336	2113743M24	0.1uF
C337	2113743N50	100pF
C338	2113743N30	15.0pF
C339	2180478Z20	1.0uF
C340	2180478Z20	1.0uF
C341	2180478Z20	1.0uF
C342	2180478Z20	1.0uF
C343	2113743A23	0.220uF
C344	2113743M24	0.1uF
C345	2113743M24	0.1uF
C346	2113743M24	0.1uF
C347	2113743M24	0.1uF
C348	2113743M24	0.1uF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20.0pF
C352	2113743N28	12.0pF
C353	2113743N41	43.0pF
C354	2113743N42	47.0pF
C355	2113743A24	0.330uF
C356	2113743M08	0.022uF
C357	2113743A23	0.220uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF
C360	2113743E07	0.022uF
C361	2113741F49	10NF
C362	2113743M08	0.022uF
C363	2311049A40	2.2uF
C364	2113743L41	0.01uF
C370	2113743N50	100pF
C374	2113743N50	100pF
C375	2113743N50	100pF
C380	2113743L41	0.01uF
C381	2113743N18	4.7pF
C382	2311049A59	10uF
C383	2113743N50	100pF
C384	2113743N44	56.0pF
C385	2113743N44	56.0pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C395	2113743N50	100pF
C397	2311049A07	1.0uF
C400	2113743L41	0.01uF
C401	2113743M24	0.1uF
C402	2113743M24	0.1uF
C403	2113928D08	10.0uF
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	0.1uF

Circuit Ref	Motorola Part No.	Description
C410	2113928N01	0.1uF
C411	2113743M24	0.1uF
C412	2113928N01	0.1uF
C414	2113743M24	0.1uF
C415	2109720D01	0.01uF
C416	2113928N01	0.1uF
C420	2113743L41	0.01uF
C421	2113928N01	0.1uF
C422	2113743M24	0.1uF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	0.1uF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	0.1uF
C429	2113743M24	0.1uF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C433	2113743L41	0.01uF
C434	2113743M24	0.1uF
C435	2113743M24	0.1uF
C436	Not Placed	
C437	Not Placed	
C440	2113743G26	4.7uF
C441	Not Placed	
C442	2113743E20	10uF
C443	2113928N01	0.1uF
C444	Not Placed	
C445	Not Placed	
C446	2113743M08	0.022uF
C447	2113743N01	0.1uF
C448	Not Placed	
C449	2113743N50	100pF
C450	Not Placed	
C451	2113743M08	0.022uF
C452	2113743B29	1.0uF
C453	2113743N50	100pF
C454	2113743N50	100pF
C455	2113743L09	470pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C470	2113743N50	100pF
C471	2113743N50	100pF
C472	2113743N50	100pF
C473	2113743L09	470pF
C475	2113743H14	10.0uF
C476	2113928D08	10.0uF
C477	2113743N50	100pF
C478	2113743N50	100pF
C479	2113928N01	0.1uF
C480	2113928D08	10.0uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C483	2113743L17	1000pF
C484	2113743L17	1000pF
C485	2113743L17	1000pF
C486	Not Placed	
C487	Not Placed	
C488	Not Placed	
C489	Not Placed	
C493	Not Placed	
C494	2113743N50	100pF
C498	2113743N50	100pF
C499	2113743N50	100pF
C500	2113743L17	1000pF
C501	2113743L17	1000pF
C502	2311049A05	0.47pF
C503	2113743N50	100pF
C504	2113743L17	1000pF
C505	2113743N50	100pF
C506	2113743N50	100pF
C507	2113743L17	1000pF
C508	2113743N50	100pF
C509	2113743L17	1000pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C515	2113743M24	0.1uF
C518	2113743L17	1000pF
C519	2113743L17	1000pF
C520	2113743L17	1000pF
C521	2113743L41	0.01uF
C522	2113743L41	0.01uF
C523	2113743N50	100pF
C524	2113743L17	1000pF
C525	2113743N50	100pF
C526	2113743L17	1000pF
C527	2113743N50	100pF
C528	2113743L17	1000pF
CR101	4880973Z02	Pin Diode
CR102	4802245J41	Pin Diodes
CR105	5185963A15	Temperature Sense
CR201	4802233J09	Diode Triple
CR203	4862824C03	Varactor
CR241	4805649Q13	Dual Varactor
CR242	4862824C01	Varactor
CR243	4862824C01	Varactor
CR251	4862824C01	Varactor
CR252	Not Placed	
CR253	Not Placed	
CR254	Not Placed	
CR301	4862824C01	Varactor
CR302	4862824C01	Varactor
CR303	4880154K03	Dual Common Anode-cathode
CR304	4862824C01	Varactor
CR305	4862824C01	Varactor
CR306	4802245J42	Ring Quad Diode
CR308	4802245J41	Pin Diodes
CR310	4862824C01	Varactor
CR411	Not Placed	
CR412	4802245J47	Diode Schottky
CR413	4802245J47	Diode Schottky
CR414	4802245J47	Diode Schottky
CR440	4813833C02	Dual Diode Common Cathode
CR501	4880107R01	Rectifier
CR503	4805729G49	Led Red/yel
E101	2484657R01	Ferrite Bead
E400	2480640Z01	Ferrite Bead
F501	6580542Z01	Fuse 3A
FL201	4802245J49	Crystal 16.8MHz Clip
FL301	4802245J43	Xtal Filter 45.1MHz
H101	2680499Z01	Heat Spreader
J101	0985613Z01	RF Jack
J104	3980686Z01	Antenna Contact
J400	0905505Y04	40-Pin Connector
J402	2809926G02	4-PIn Connector
J404	0980689Z01	Connector (Stereo Jack 2.5m)
J407	0980688Z01	Connector (Mono Jack 3.5mm)
L101	2460591B08	11.81nH, 10%
L102	2460591B08	11.81nH, 10%
L104	2460591B08	11.81nH, 10%
L105	2462587N22	390nH
L106	2479990A02	7.66nH
L107	2479990G01	33.47nH
L109	Not Placed	
L108	2479990A01	4.22nH
L112	2462587N45	22nH
L113	2413926H09	5.6nH
L114	2462587N22	390nH
L115	2462587N22	390nH
L116	2479990C02	16.28nH
L160	Not Placed	
L201	2462587Q20	2.2uH
L202	2462587Q20	2.2uH
L203	2462587Q20	2.2uH
L232	2462587P25	12uH
L241	2462587V41	390nH
L242	2462587V26	22nH
L243	2485776Z02	Teflon Resonator
L251	2462587V41	390nH
L252	Not Placed	
L253	2460593C03	Teflon Resonator
L261	2462587V29	39nH
L271	2462587V27	27nH
L273	2462587V25	18nH
L281	2462587V41	390nH
L282	2462587V41	390nH
L301	2479990B01	11.03nH
L302	2479990B01	11.03nH
L303	2462587V26	22nH
L304	2462587V37	180nH
L305	2462587V22	8.2nH
L306	2479990B01	11.03nH
L307	2479990B01	11.03nH
L309	2479990C02	16.28nH
L310	2462587V36	150nH
L311	2462587N65	750nH
L314	2462587N72	2.2uH
L325	2480646Z20	2.20uH
L330	2462587N64	680nH
L331	2480646Z20	2.20uH
L332	2462587N53	100nH
L340	2462587V41	390nH
L400	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
PB501	4080523Z01	Tactile Push Button
PB502	4080523Z01	Tactile Push Button
PB503	4080523Z01	Tactile Push Button
Q110	4802245J55	RF Power FET
Q111	4802245J50	Dual NPN/PNP
Q210	4802245J50	Dual NPN/PNP
Q241	4805218N63	NPN
Q260	4802245J50	Dual NPN/PNP
Q261	4802245J50	Dual NPN/PNP
Q301	4802245J44	NPN
Q302	4802245J44	NPN
Q315	4880214G02	NPN
Q320	4805218N63	NPN
Q400	4809579E18	MOSFET P-Chan
Q403	4880214G02	NPN
Q405	4802245J54	Dual NPN
Q410	4802245J54	Dual NPN
Q417	4802245J50	Dual NPN/PNP
Q418	4802245J50	Dual NPN/PNP
Q419	5180159R01	Dual NPN
Q420	4805128M67	SOT STR MMBT

Circuit Ref	Motorola Part No.	Description
Q421	4880214G02	NPN
Q431	5180159R01	Dual NPN
Q433	4880214G02	NPN
Q502	5180159R01	DuaL NPN
Q505	4880214G02	NPN
R101	0662057A34	240
R102	0680735Z01	0.075
R103	0662057M41	43
R104	0662057N15	47K
R105	0662057C01	0
R106	0662057M26	10
R108	0662057M92	5.6K
R109	0662057N30	200K
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43K
R130	0662057M98	10K
R131	0662057N05	18K
R132	0662057N33	270K
R134	0662057N52	1.6M
R161	0662057M47	75
R170	0662057A34	240
R171	0662057N14	43K
R172	0662057A32	200
R173	0662057N29	180K
R201	0662057N21	82K
R202	0662057N23	100K
R204	0662057N15	47K
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M52	120
R243	0662057M98	10K
R244	0662057N03	15K
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M38	33
R252	0662057M60	270
R253	0662057M95	7.5K
R254	0662057M96	8.2K
R255	0662057M89	4.3K
R256	0662057M37	30
R260	0662057M74	1K
R281	Not Placed	
R300	0662057M82	2.2K
R301	0662057N23	100K
R302	0662057N23	100K
R303	0662057M89	4.3K
R304	0662057N01	12K
R305	0662057M66	470
R306	0662057N23	100K
R307	0662057N23	100K
R308	0662057M42	47
R309	0662057M01	0
R310	0662057M60	270
R311	0662057N10	30K
R312	0662057M92	5.6K
R313	0662057M62	330
R314	0662057M85	3K
R315	0662057N01	12K
R316	0662057A96	91K
R317	0662057M74	1K
R318	0662057A79	18K
R319	0662057A29	150
R320	0662057M74	1K
R321	0662057M83	2.4K
R322	0662057N30	200K
R324	0662057M81	2K
R325	0662057M94	6.8K
R327	0662057N11	33K
R328	0662057M12	2.7
R329	0662057M01	0
R339	0662057M01	0
R340	0662057M96	8.2K
R342	0662057N23	100K
R343	0662057M26	10
R344	0662057N01	12K
R345	0662057M98	10K
R346	0662057N17	56K
R347	0662057M74	1K
R348	0662057M87	3.6K
R349	0662057C01	0
R350	0662057N23	100K
R351	0662057C01	0
R352	0662057M86	3.3K
R355	0662057M01	0
R400	0662057N15	47K
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K
R415	0662057V26	91K
R416	0662057N13	39K
R418	0662057M01	0
R419	0662057M90	4.7K
R423	0662057N39	470K
R425	0662057N10	30K
R427	0662057M98	10K
R428	0662057M10	2.2
R429	0662057M98	10K
R432	0662057N16	51K
R434	Not Placed	
R435	0662057M81	2K
R436	0662057N15	47K
R438	0662057M01	0
R439	0662057N23	100K
R445	0662057N08	24K
R446	0662057N31	220K
R447	0662057N51	1.5M
R448	0662057N33	270K
R449	0662057N08	24K
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057N23	100K
R462	0662057N23	100K
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057N12	36K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N08	24K
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R494	0662057M01	0
R495	0662057N23	100K
R496	0662057N23	100K
R498	0662057N23	100K
R499	0662057M98	10K
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10K
R506	0662057N15	47K
R507	0662057M01	0
R510	0662057M98	10K
RT300	0680590Z01	Thermistor_33K
RT400	0680590Z01	Thermistor_33K
S501	4080710Z01	Channel Switch
S502	1880619Z01	Volume Switch
SH100	2680687Z01	Shield, Harmonic Filter
SH101	2680510Z01	Shield, PA
SH201	2680511Z01	Synthesizer Top Shield
SH202	2680511Z01	Synthesizer Bottom Shield
SH241	2680513Z01	Shield, VCO Top
SH242	2680514Z01	Shield, VCO Bottom/LVZIF
SH301	2680554Z01	RX Pre Filter Shield
SH302	2680555Z01	RX POST FILTER/RX AMP
SH303	2680509Z01	Shield, Mixer
SH304	2680624Z01	Shield, Mixer Diode
SH321	2680508Z01	SHield,LVZIF 2nd LO
SH322	2680514Z01	ZIF Shield
SH323	2680553Z01	Shield, Crystal Filter
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	On/Off Controller Shield
SH402	2680515Z01	Microprocessor Controlled Shield
SH403	2680516Z01	ASFIC Cmp/Audio PA Controller Shield
T301	2580541Z01	XFMR Coil
T302	2580541Z01	XFMR Coil
U101	5105109Z67	LDMOS Driver UHF IC
U102	5185765B01	Power Control IC
U201	5185963A27	LVFRACN
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO Buffer
U247	5105739X05	Regulator Linear
U248	5102463J58	3.3V Regulator
U301	5109632D83	LVZIF 2.2
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC CMP
U405	5102463J36	STATIC_RAM_32KX8 I
U406	*5102463J59	Flash ROM 128KX8
U407	*5102463J64	16K X 8 EEPROM
U409	5102226J56	UP HC11FLO
U410	5102463J57	Regulator 3.3V
U420	5102463J44	Audio PA
VR431	4802245J51	Zener 6.8V
VR432	4880140L15	10V Zener
VR433	4880140L15	10V Zener
VR434	Not Placed	
VR439	4880140L15	10V Zener
VR440	4802245J51	Zener 6.8V
VR441	4802245J51	Zener 6.8V
VR442	Not Placed	
VR443	Not Placed	
VR444	4802245J51	Zener 6.8V
VR445	Not Placed	
VR446	Not Placed	
VR447	Not Placed	
VR448	Not Placed	
VR449	Not Placed	
VR450	4802245J53	Zener_10V
VR451	4802245J53	Zener_10V
VR501	4813830A18	6.8V Zener
VR506	4802245J51	Zener_6.8V
	7580671Z01	Pad (Flexible Circuit)

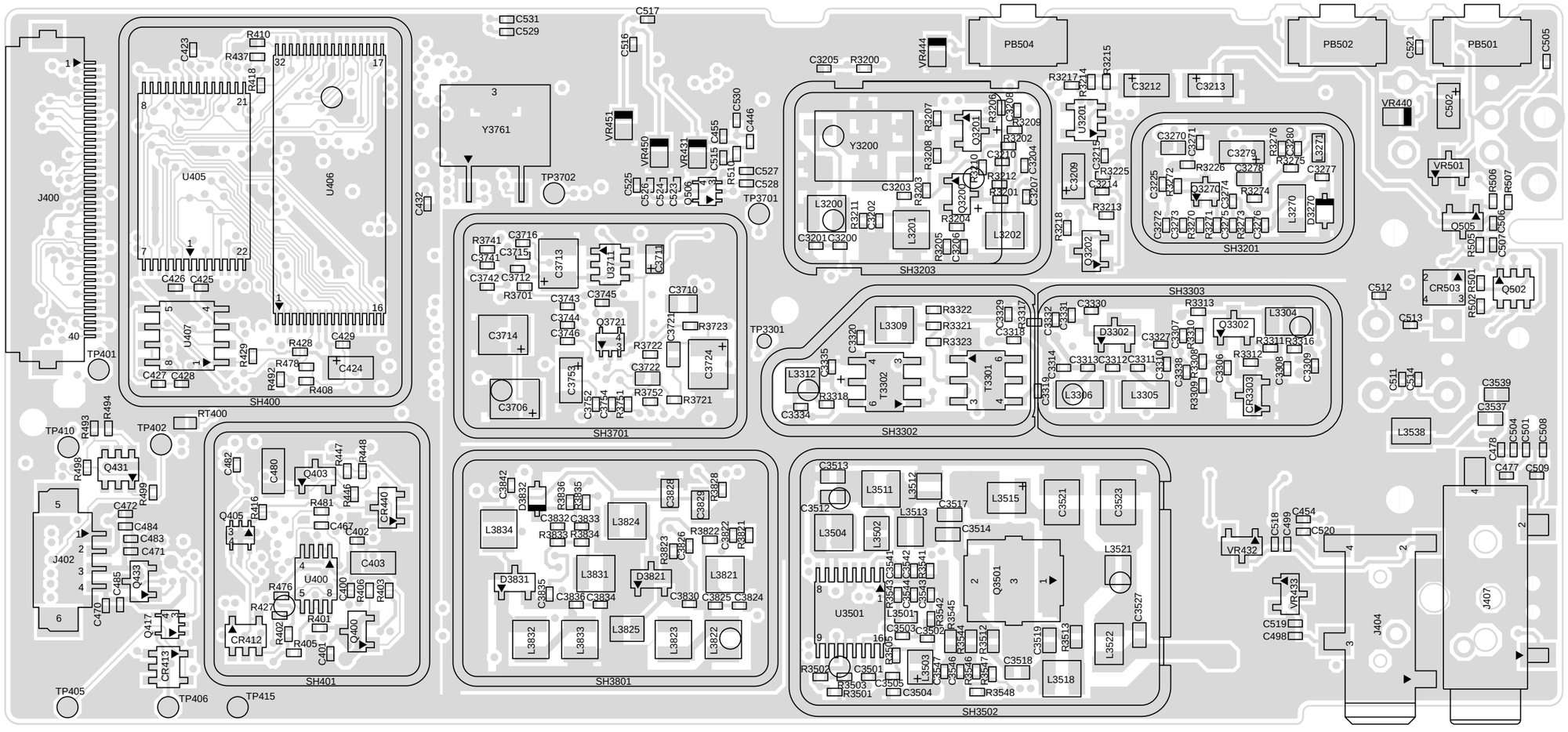


Figure 4-23. **VHF (136-174MHz) Main Board Top Side PCB**

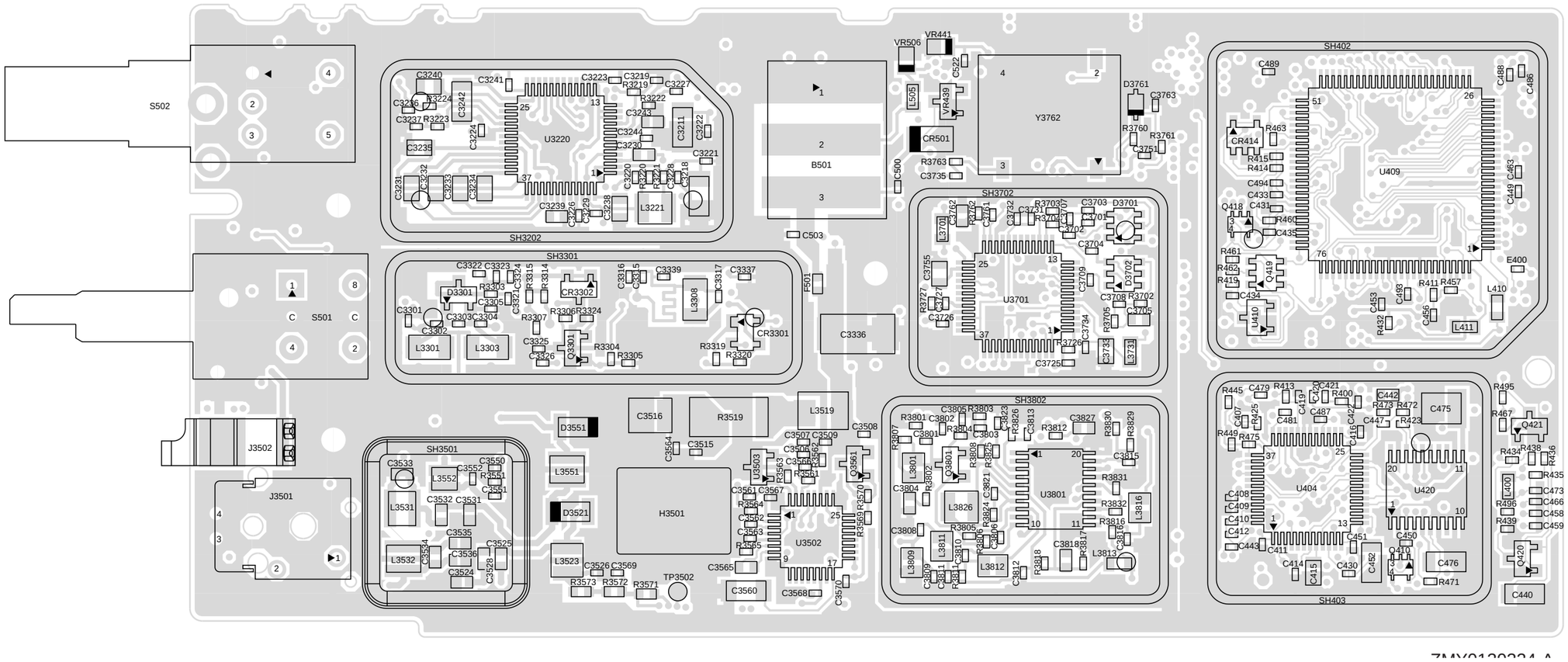


Figure 4-24. **VHF (136-174MHz) Main Board Bottom Side PCB**

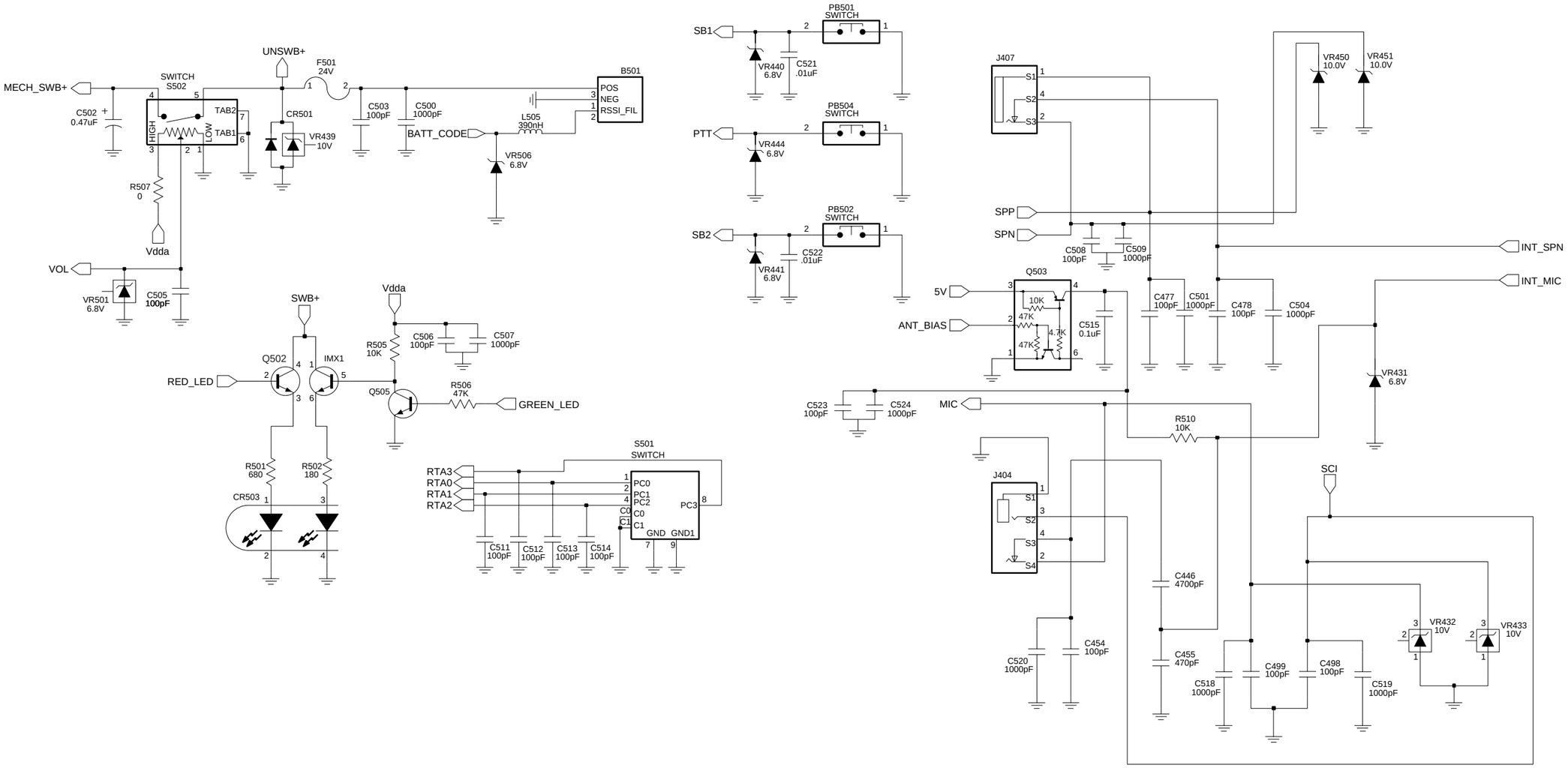


Figure 4-25. VHF (136-174MHz) Controls And Switches Schematic Diagram

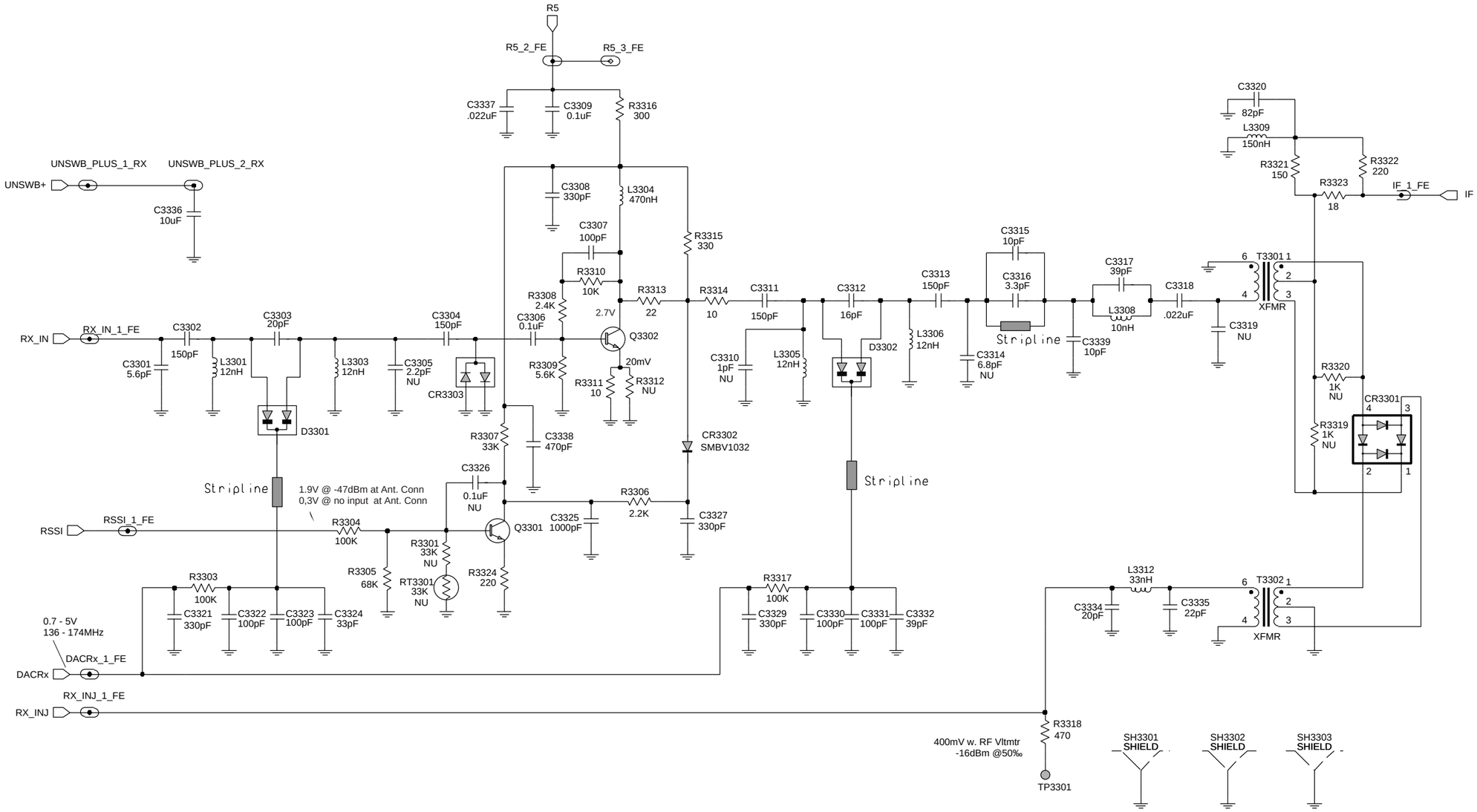


Figure 4-26. VHF (136-174MHz) Receiver Front End Schematic Diagram

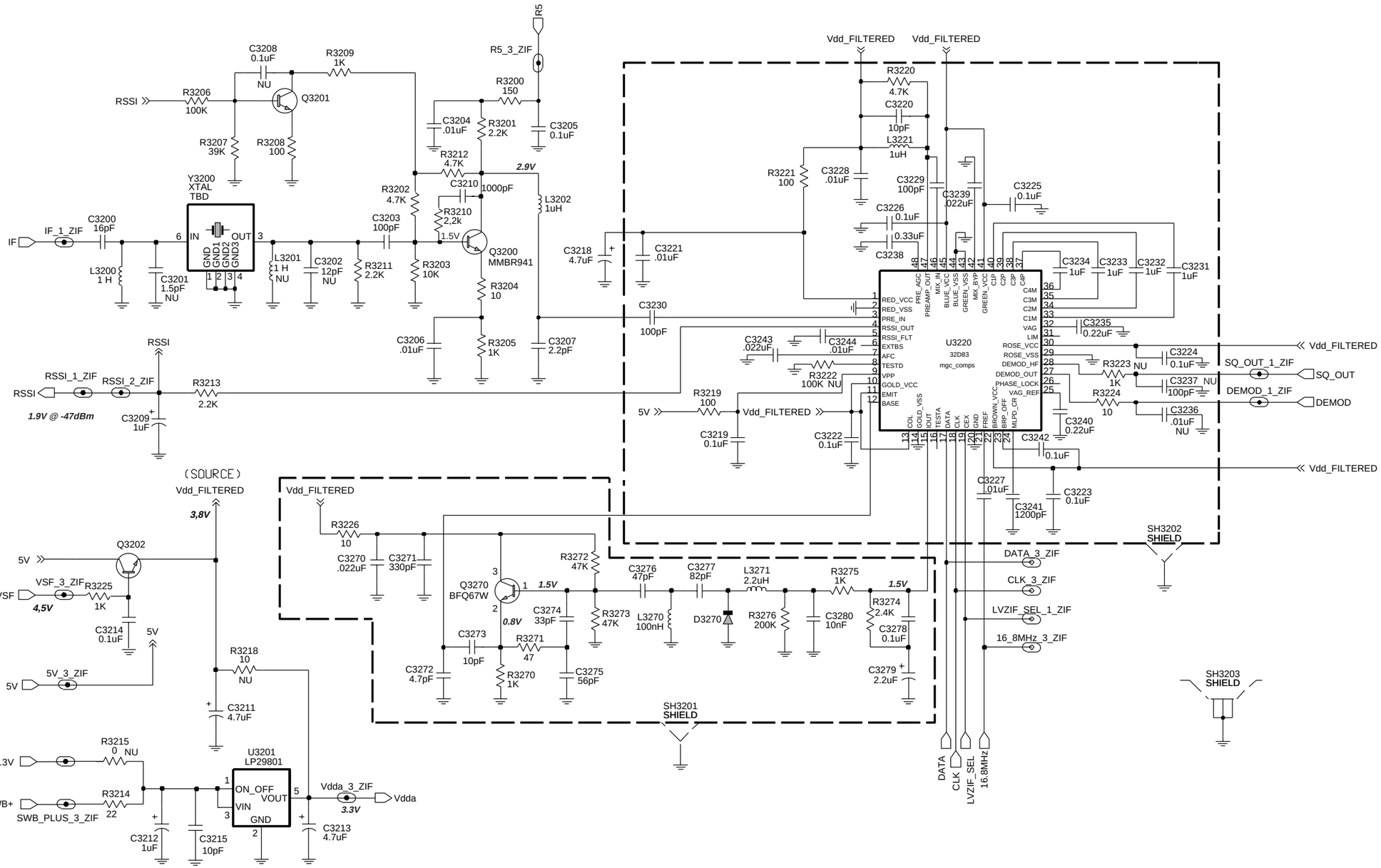


Figure 4-27. VHF (136-174MHz) Receiver Back End Schematic Diagram

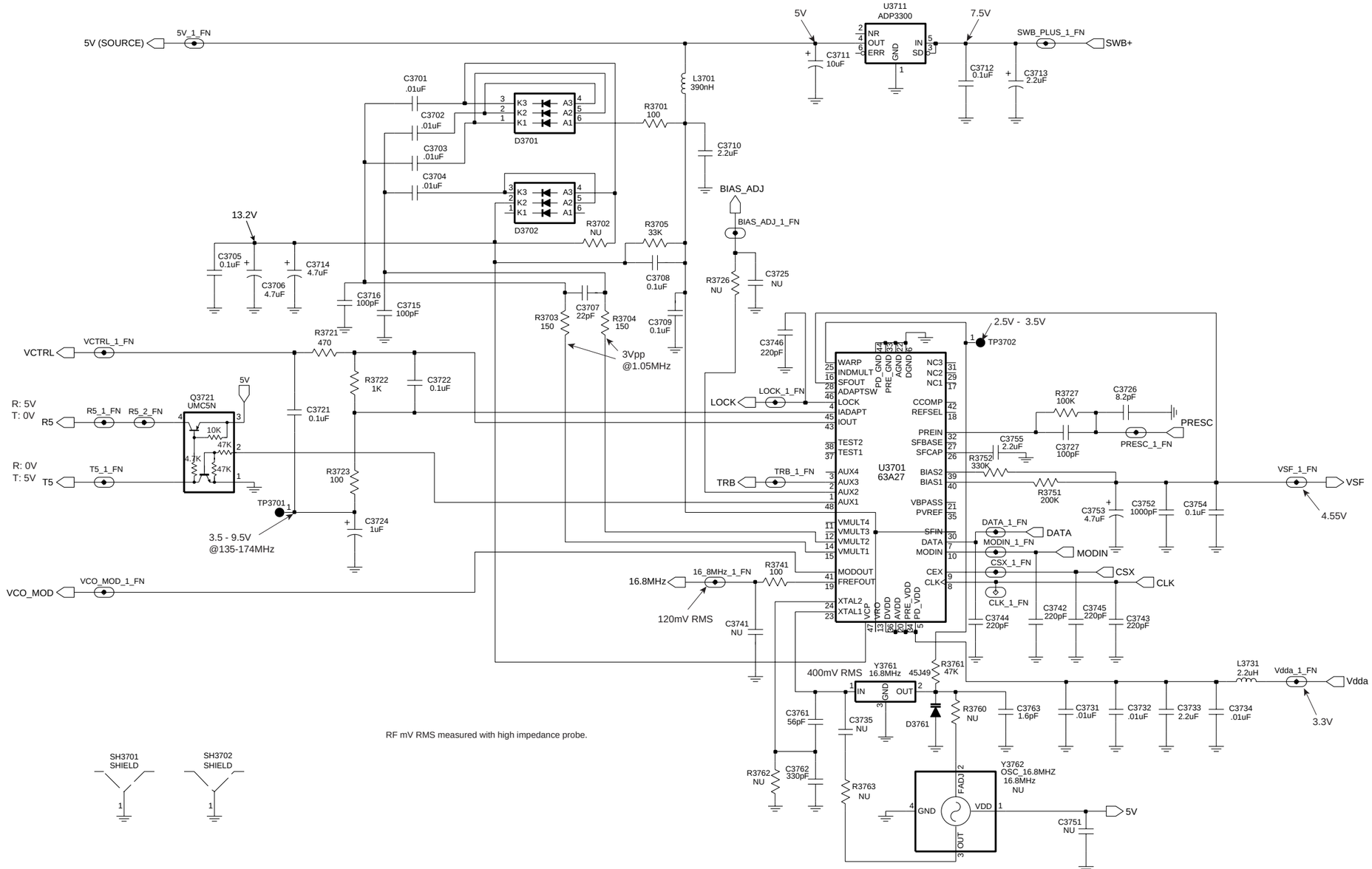
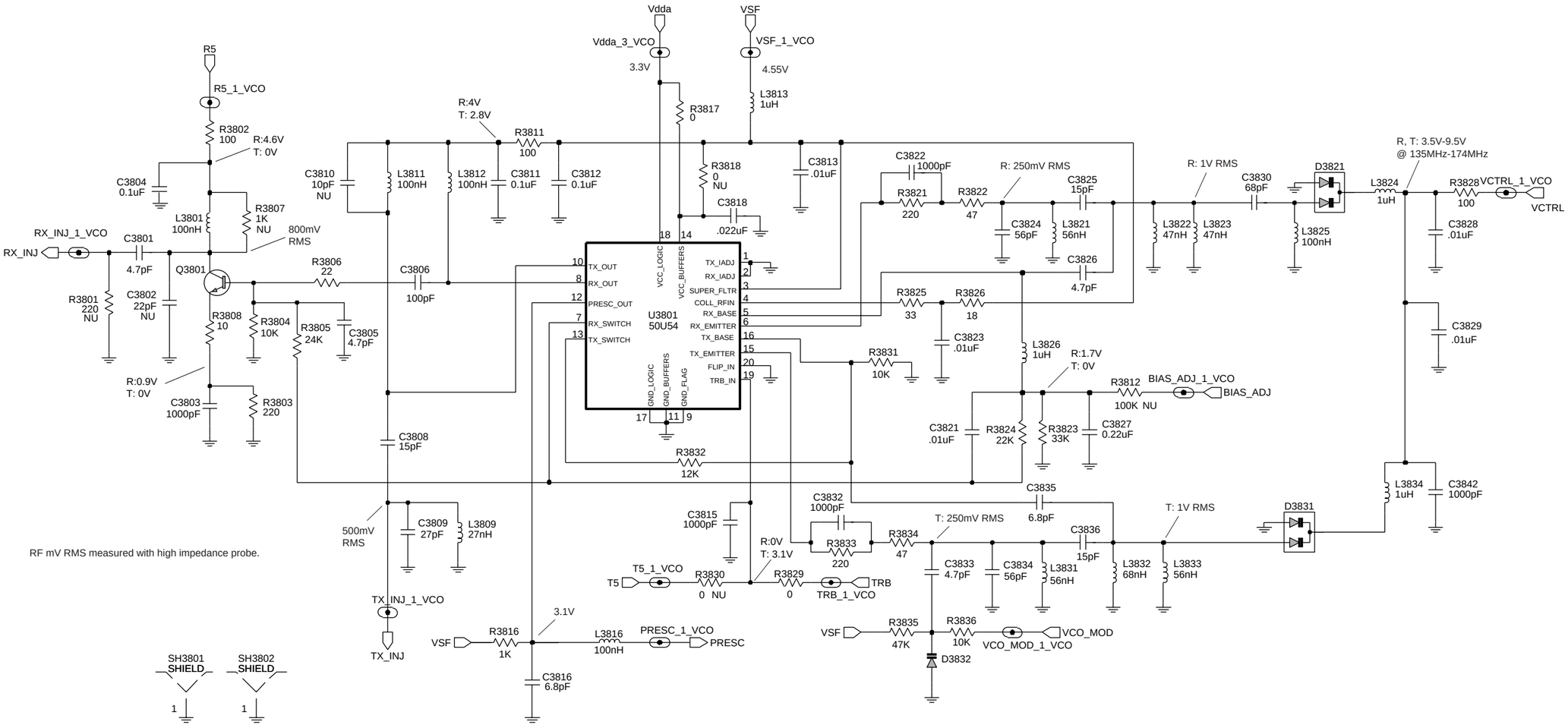


Figure 4-28. VHF (136-174MHz) Synthesizer Schematic Diagram



RF mV RMS measured with high impedance probe.

Figure 4-29. VHF (136-174MHz) Voltage Controlled Oscillator Schematic Diagram

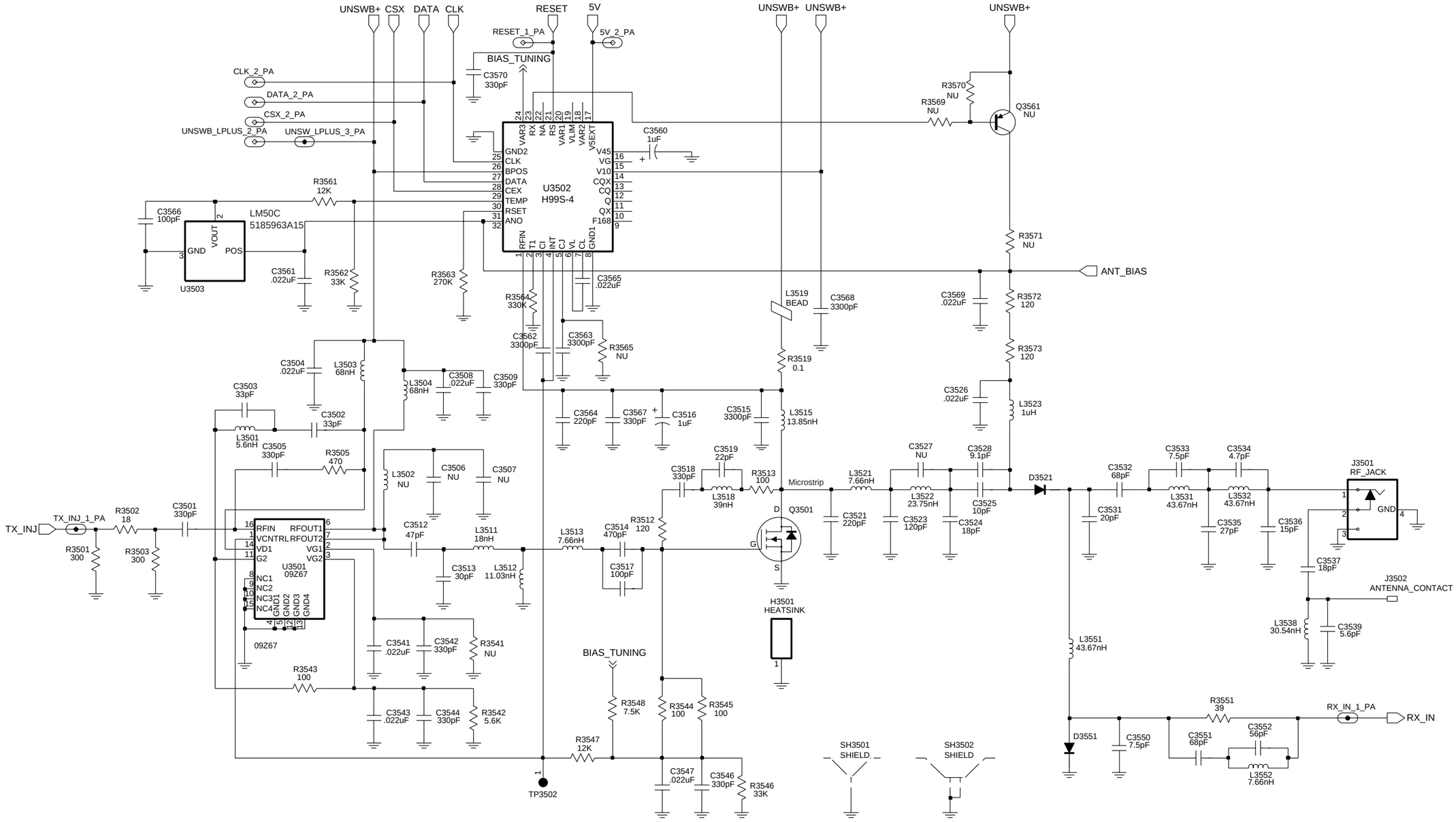


Figure 4-30. VHF (136-174MHz) Transmitter Schematic Diagram

Table 4-4: VHF Radio Parts List

Circuit Ref	Motorola Part No.	Description
B01	0986237A01	Connector, Battery Contact
C3200	2113743N31	16pF
C3203	2113743N50	100pF
C3204	2113743L41	.01uF
C3205	2113928N01	0.1uF
C3206	2113743L41	.01uF
C3207	2113743N10	2.2pF
C3209	2311049A07	1uF
C3210	2113743L17	1000pF
C3211	2311049A56	4.7uF
C3212	2311049A07	1uF
C3213	2311049A56	4.7uF
C3214	2113928N01	0.1uF
C3215	2113743N26	10pF
C3218	2311049A56	4.7uF
C3219	2113928N01	0.1uF
C3220	2113743N26	10pF
C3221	2113743L41	.01uF
C3222	2113928N01	0.1uF
C3223	2113928N01	0.1uF
C3224	2113928N01	0.1uF
C3225	2113928N01	0.1uF
C3226	2113928N01	0.1uF
C3227	2113743L41	.01uF
C3228	2113743L41	.01uF
C3229	2113743N50	100pF
C3230	2113740F51	100pF
C3231	2180478Z20	1uF
C3232	2180478Z20	1uF
C3233	2180478Z20	1uF
C3234	2180478Z20	1uF
C3235	2113743A23	0.22uF
C3238	2113743A21	0.15uF
C3239	2113743E07	.022uF
C3240	2113743A23	0.22uF
C3241	2113743L19	1200pF
C3242	2109720D14	0.1uF
C3243	2113743E07	.022uF
C3244	2113743L41	.01uF
C3270	2113743E07	.022uF
C3271	2113743L05	330pF
C3272	2113743N18	4.7pF
C3273	2113743N26	10pF
C3274	2113743N38	33pF
C3275	2113743N44	56pF
C3276	2113743N42	47pF
C3277	2113743N48	82pF
C3278	2113743E20	0.1uF
C3279	2311049A07	1uF
C3280	2113743L39	8200pF
C3301	2113743N29	13pF
C3302	2113743N54	150pF
C3303	2113743N33	20pF
C3304	2113743N54	150pF
C3306	2113928N01	0.1uF
C3307	2113743N50	100pF
C3308	2113743L05	330pF
C3309	2113928N01	0.1uF
C3311	2113743N54	150pF
C3312	2113743N31	16pF
C3313	2113743N54	150pF
C3315	2113743N26	10pF
C3316	2113743N33	20pF
C3317	2113743N40	39pF
C3318	2113743M08	.022uF
C3320	2113743N49	91pF
C3321	2113743L05	330pF
C3322	2113743N50	100pF
C3323	2113743N50	100pF
C3324	2113743N38	33pF
C3325	2113743L17	1000pF
C3326	Not Placed	
C3327	2113743L05	330pF
C3329	2113743L05	330pF
C3330	2113743N50	100pF
C3331	2113743N50	100pF
C3332	2113743N40	39pF
C3334	2113743N33	20pF
C3335	2113743N34	22pF
C3336	2311049A18	10uF
C3337	2113743M08	.022uF
C3338	2113743L09	470pF
C3339	2113743N26	10pF
C3501	2113743L05	330pF
C3502	2113743N38	33pF
C3503	2113743N38	33pF
C3504	2113743M08	.022uF
C3505	2113743L05	330pF
C3508	2113743M08	.022uF
C3509	2113743L05	330pF
C3512	2113740F43	47pF
C3513	2113740F38	30pF
C3514	2113740F67	470pF
C3515	2113743L29	3300pF
C3516	2311049A08	1uF
C3517	2113740F51	100pF
C3518	2113740F63	330pF
C3519	2113740F35	22pF
C3521	2111078B51	220pF
C3523	2111078B45	130pF
C3524	2113740F34	22pF
C3525	2113740F35	10pF
C3526	2113743M08	.022uF
C3528	2113740F26	9.1pF
C3531	2113740F29	12pF
C3532	2113740F38	68pF
C3533	2113740F26	7.5pF
C3534	2113740F27	10pF
C3535	2113740F36	24pF
C3536	2113740F31	15pF
C3537	2113740F33	18pF
C3539	2113740F21	5.6pF
C3541	2113743M08	.022uF
C3542	2113743L05	330pF
C3543	2113743M08	.022uF
C3544	2113743L05	330pF
C3546	2113743L05	330pF
C3547	2113743M08	.022uF
C3550	2113743N33	7.5pF
C3551	2113743N49	68pF
C3552	2113743N44	56pF
C3560	2311049A07	1uF
C3561	2113743M08	.022uF
C3562	2113743L29	3300pF
C3563	2113743L29	3300pF
C3564	2113743L01	220pF
C3565	2113743M08	.022uF
C3566	2113743N50	100pF
C3568	2113743L29	3300pF
C3569	2113743M08	.022uF
C3570	2113743L05	330pF
C3701	2113743L41	.01uF
C3702	2113743L41	.01uF
C3703	2113743L41	.01uF
C3704	2113743L41	.01uF
C3705	2113743E20	0.1uF
C3706	2311049J11	4.7uF
C3707	2113743N34	22pF
C3708	2113743M24	0.1uF
C3709	2113743M24	0.1uF
C3710	2104993J02	2.2uF
C3711	2380737Z10	2.2uF
C3712	2113743M24	0.1uF
C3713	2311049A09	2.2uF
C3714	2311049J11	4.7uF
C3715	2113743N50	100pF
C3716	2113743N50	100pF
C3721	2113743E20	0.1uF
C3722	2113743E20	0.1uF
C3724	2311049A08	1uF
C3726	2113743N24	8.2pF
C3727	2113743N50	100pF
C3731	2113743L41	.01uF
C3732	2113743L41	.01uF
C3733	2104993J02	2.2uF
C3734	2113743L41	.01uF
C3742	2113743L01	220pF
C3743	2113743L01	220pF
C3744	2113743L01	220pF
C3745	2113743L01	220pF
C3746	2113743L01	220pF
C3752	2113743L17	1000pF
C3753	2311049A56	4.7uF
C3754	2113743M24	0.1uF
C3755	2104993J02	2.2uF
C3761	2113743N44	56pF
C3762	2113740F63	330pF
C3763	2113743N08	1.6pF
C3801	2113743N18	4.7pF
C3803	2113743L17	1000pF
C3804	2113743E20	0.1uF
C3805	2113743N18	4.7pF
C3806	2113743N50	100pF
C3808	2113743N30	15pF
C3809	2113743N36	27pF
C3811	2113743M24	0.1uF
C3812	2113743M24	0.1uF
C3813	2113743L41	.01uF
C3815	2113743L17	1000pF
C3816	2113743N22	6.8pF
C3818	2113743E07	.022uF
C3821	2113743L41	.01uF
C3822	2113743L17	1000pF
C3823	2113743L41	.01uF
C3824	2113743N44	56pF
C3825	2113743N30	15pF
C3826	2113743N18	4.7pF
C3827	2113743E07	.022uF
C3828	2113741A45	.01uF
C3829	2113741A45	.01uF
C3830	2113743N46	68pF
C3832	2113743L17	1000pF
C3833	2113743N18	4.7pF
C3834	2113743N44	56pF
C3835	2113743N22	6.8pF
C3836	2113743N30	15pF
C3842	2113743L17	1000pF
C400	2113743L41	.01uF, 10%
C401	2113743M24	0.1uF, +80%/-20%
C402	2113743M24	0.1uF, +80%/-20%
C403	2113928D08	10uF, +80%/-20%
C407	2113928N01	0.1uF, 10%
C408	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C409	2113743M24	0.1uF, +80%/-20%
C410	2113928N01	0.1uF, 10%
C411	2113743M24	0.1uF, +80%/-20%
C412	2113928N01	0.1uF
C414	2113743M24	0.1uF, +80%/-20%
C415	2109720D01	.01uF, 10%
C416	2113928N01	0.1uF, 10%
C419	2113743L41	.01uF, 10%
C420	2113743L41	.01uF, 10%
C421	2113928N01	0.1uF, 10%
C422	2113743M24	0.1uF, +80%/-20%
C423	2113743N50	100pF
C424	2311049A59	10uF, 10%; 6V
C425	2113743M24	0.1uF, +80%/-20%
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	0.1uF, +80%/-20%
C429	2113743M24	0.1uF, +80%/-20%
C430	2113928N01	0.1uF, 10%
C431	2113743N50	100pF
C432	Not Placed	
C433	2113743L41	.01uF, 10%
C434	2113743M24	0.1uF, +80%/-20%
C435	2113743M24	0.1uF, +80%/-20%
C440	2113743G26	4.7uF, +80%/-20%
C442	2113743E20	0.1uF, 10%
C443	2113928N01	0.1uF, 10%
C446	2113743R33	4700pF
C447	2113928N01	0.1uF, 10%
C448	2113928N01	0.1uF, 10%
C449	2113743N50	100pF
C451	2113743M08	.022uF, +80%/-20%
C452	2113743G26	4.7uF, +80%/-20%
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF, 10%
C473	2113743L09	100pF
C475	2113743H14	10uF, +80%/-20%
C476	2113928D08	10uF, +80%/-20%
C477	2113743N50	100pF
C478	2113743N50	100pF
C479	2113928N01	0.1uF, 10%
C480	2113743G24	2.2uF
C481	2113928N01	0.1uF, 10%
C482	2113928N01	0.1uF, 10%
C483	2113743L17	1000pF
C484	2113743L17	1000pF

Circuit Ref	Motorola Part No.	Description
C485	2113743L17	1000pF
C486	2113743L17	1000pF
C487	Not Placed	
C488	2113743L17	1000pF
C489	2113743L17	1000pF
C493	Not Placed	
C494	2113743N50	100pF
C498	2113743N50	100pF
C499	2113743N50	100pF
C500	2113743L17	1000pF
C501	2113743L17	1000pF
C502	2311049A05	0.47uF, 10%; 25V
C503	2113743N50	100pF
C504	2113743L17	1000pF
C505	2113743N50	100pF
C506	2113743N50	100pF
C507	2113743L17	1000pF
C508	2113743N50	100pF
C509	2113743L17	1000pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C518	2113743L17	1000pF
C519	2113743L17	1000pF
C520	2113743L17	1000pF
C521	2113743L41	.01uF, 10%
C522	2113743L41	.01uF, 10%
C523	2113743N50	100pF
C524	2113743L17	1000pF
CR3301	4802245J42	Ring Quad Diode
CR3302	4805129M96	SMBV1032
CR3303	4880154K03	Dual Common Anode Cathode
CR414	4802245J47	Schottky Diode
CR412	4802245J47	Schottky Diode
CR413	4802245J47	Schottky Diode
CR440	4813833C02	Dual Diode Common Cathode
CR501	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yel
D3270	4862824C01	Varactor
D3301	4802081B58	Diode Dual
D3302	4802081B58	Diode Dual
D3521	4880973Z02	Pin Diode
D3551	4880973Z02	Pin Diode
D3701	4802233J09	Triple Diode
D3702	4802233J09	Triple Diode
D3761	4862824C03	Varactor
D3821	4805649Q13	Dual Varactor
D3831	4805649Q13	Dual Varactor
D3832	4862824C01	Varactor

Circuit Ref	Motorola Part No.	Description
E400	2480640Z01	Ferrite Bead
F501	6580542Z01	Fuse 3A
H3501	2680499Z01	Heatsink
J104	3980686Z01	Contact (Antenna)
J3501	0180117S05	RF_JACK
J3502	3980686Z01	Antenna Contact
J400	0905505Y04	40-pin Connector
J402	2809926G02	4-pin Connector
J404	0980689Z01	Stereo Jack (2.5mm)
J407	0980688Z01	Stereo Jack (3.5mm)
L3200	2462587N68	1uH
L3202	2462587N68	1uH
L3221	2462587N68	1uH
L3270	2462587T15	100nH
L3271	2462587Q20	2.2uH
L3301	2462587T35	12nH
L3303	2462587T35	12nH
L3304	2462587T23	470nH
L3305	2462587T35	12nH
L3306	2462587T35	12nH
L3308	2462587T34	10nH
L3309	2462587N55	150nH
L3312	2462587V28	33nH
L3501	2413926H09	5.6nH
L3503	2462587V32	68nH
L3504	2462587N51	68nH
L3511	2462587N44	18nH
L3512	2460591B04	11.03nH
L3513	2460591A11	7.66nH
L3515	2460591C23	13.85nH
L3518	2462587N48	39nH
L3519	2484657R01	Bead
L3521	2460591A11	7.66nH
L3522	2460591E24	23.75nH
L3523	2462587N68	1uH
L3531	2460591N28	34.14nH
L3532	2460591N28	34.14nH
L3538	2460591M36	30.54nH
L3551	2460591N36	43.67nH
L3552	2460591A11	7.66nH
L3701	2462587Q42	390nH
L3731	2462587Q20	2.2uH
L3801	2462587V34	100nH
L3809	2462587V27	27nH
L3811	2462587V34	100nH
L3812	2462587V34	100nH
L3813	2462587Q47	1uH
L3816	2462587V34	100nH
L3821	2462587N50	56nH
L3822	2462587N49	47nH
L3823	2462587N49	47nH

Circuit Ref	Motorola Part No.	Description
L3824	2462587N68	1uH
L3825	2462587V34	100nH
L3826	2462587N68	1uH
L3831	2462587N50	56nH
L3832	2462587N51	68nH
L3833	2462587N50	56nH
L3834	2462587N68	1uH
L400	2462587Q42	390nH, 10%
L401	2462587Q42	390nH, 10%
L410	2462587Q42	390nH, 10%
L411	2462587Q42	390nH, 10%
L505	2462587Q42	390nH, 10%
PB501	4080523Z01	Tactile, Pushbutton
PB502	4080523Z01	Tactile, Pushbutton
PB504	4080523Z01	Tactile, Pushbutton
Q3200	4813827A07	MMBR941
Q3201	4880214G02	NPN
Q3202	4880214G02	NPN
Q3270	4805218N63	BFQ67W
Q3301	4880214G02	NPN
Q3302	4813827A07	NPN
Q3501	4802245J55	RF Power FET
Q3721	4802245J50	UMC5N
Q3801	4813827A07	NPN
Q400	4809579E18	MOSFET P-Chan
Q403	4880214G02	NPN
Q405	4802245J54	Dual NPN
Q410	4802245J54	Dual NPN
Q417	4802245J50	Dual NPN/PNP
Q418	4802245J50	Dual NPN/PNP
Q419	5180159R01	Dual NPN5
Q420	4805128M67	MMBT3906
Q421	4880214G02	NPN
Q502	5180159R01	Dual NPN
Q505	4880214G02	NPN
R3200	0662057M54	150
R3201	0662057M82	2.2K
R3202	0662057M90	4.7K
R3203	0662057M98	10K
R3204	0662057M34	22
R3205	0662057M74	1K
R3206	0662057N23	100K
R3207	0662057N13	39K
R3208	0662057M50	100
R3209	0662057M74	1K
R3210	0662057M82	2.2K
R3211	0662057M82	2.2K
R3212	0662057M90	4.7K
R3213	0662057M82	2.2K
R3214	0662057M50	100
R3215	0662057M50	100

Circuit Ref	Motorola Part No.	Description
R3219	0662057M50	100
R3220	0662057M90	4.7K
R3221	0662057M50	100
R3224	0662057M26	10
R3225	0662057M74	1K
R3226	0662057M26	10
R3270	0662057M74	1K
R3271	0662057M42	47
R3272	0662057N15	47K
R3273	0662057N15	47K
R3274	0662057M74	1K
R3275	0662057M88	3.9K
R3276	0662057N30	200K
R3303	0662057N23	100K
R3304	0662057N23	100K
R3305	0662057N19	33K
R3306	0662057M82	2.2K
R3307	0662057N11	33K
R3308	0662057M86	2.4K
R3309	0662057M92	5.6K
R3310	0662057M98	10K
R3311	0662057M26	10
R3312	Not Placed	
R3313	0662057M34	22
R3314	0662057M26	10
R3315	0662057M62	330
R3316	0662057M61	300
R3317	0662057N23	100K
R3318	0662057M66	470
R3321	0662057M54	150
R3322	0662057M58	220
R3323	0662057M32	18
R3324	0662057M58	220
R3501	0662057M61	300
R3502	0662057M32	18
R3503	0662057M61	300
R3505	0662057M66	470
R3512	0662057A27	120
R3513	0662057A25	100
R3519	0680539Z01	0.1
R3542	0662057M92	5.6K
R3543	0662057M50	100
R3544	0662057A25	100
R3545	0662057A25	100
R3546	0662057N11	33K
R3547	0662057N01	12K
R3548	0662057M95	7.5K
R3551	0662057M40	39
R3561	0662057N01	12K
R3562	0662057N11	33K
R3563	0662057N33	270K
R3564	0662057N35	330K
R3572	0662057A27	120
R3573	0662057A27	120
R3701	0662057M50	100
R3702	Not Placed	
R3703	0662057M54	150
R3704	0662057M54	150
R3705	0662057N11	33K
R3721	0662057M66	470
R3722	0662057M74	1K
R3723	0662057M50	100
R3727	0662057N23	100K
R3741	0662057M50	100
R3751	0662057N30	200K
R3752	0662057N35	330K
R3760	Not Placed	
R3761	0662057N15	47K
R3802	0662057M50	100
R3803	0662057M58	220
R3804	0662057M98	10K
R3805	0662057N08	24K
R3806	0662057M34	22
R3808	0662057M26	10
R3811	0662057M50	100
R3816	0662057M74	1K
R3817	0662057M01	0
R3821	0662057M58	220
R3822	0662057M42	47
R3823	0662057N11	33K
R3824	0662057N07	22K
R3825	0662057M38	33
R3826	0662057M32	18
R3828	0662057M50	100
R3829	0662057M01	0
R3831	0662057M98	10K
R3832	0662057N01	12K
R3833	0662057M58	220
R3834	0662057M42	47
R3835	0662057N15	47K
R3836	0662057M98	10K
R400	0662057N15	47K
R401	0662057M01	0
R402	Not Placed	
R403	Not Placed	
R405	0662057M01	0
R406	0662057N20	75K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K, 1%
R415	0662057V26	91K, 1%
R416	0662057N13	39K
R418	0662057M01	0
R419	0662057M90	4700
R423	0662057N15	47K
R425	0662057N10	30K
R427	0662057M98	10K
R428	0662057M10	2.2K
R429	0662057M98	10K
R432	0662057N16	51K
R434	Not Placed	
R435	0662057M81	2K
R436	0662057N16	0
R437	Not Placed	
R438	0662057M01	0
R439	0662057N23	100K
R445	0662057N08	24K
R446	0662057N30	200K
R447	0662057N52	1.6M
R448	0662057N33	270K
R449	0662057N08	24K
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057N23	100K
R462	0662057N23	100K
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057N12	3.6K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N08	24K
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R494	0662057M01	0
R495	0662057N23	100K
R496	0662057N23	100K
R498	0662057N23	100K
R499	0662057M98	10K
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10K
R506	0662057N15	47K
R507	0662057M01	0
RT400	0680590Z01	Thermistor 33K
S501	4080502B03	Channel Switch
S502	1880619Z01	Volume Switch
SH3201	2602023X08	Shield
SH3202	2686081B02	Shield
SH3203	Not Placed	
SH3301	2686081B01	Shield
SH3302	2686081B05	Shield
SH3303	2686081B06	Shield
SH3501	2686081B03	Shield
SH3502	2686081B04	Shield
SH3702	2680511Z01	Shield
SH3801	2680513Z01	Shield
SH3802	2680514Z01	Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On/Off Shield
SH402	2680515Z01	Controller Microprocessor Shield
SH403	2680516Z01	Controller AsficCmp/Audio PA Shield
T3301	2580541Z01	XFMR Coil
T3302	2580541Z01	XFMR Coil
U3201	5102463J58	LP2980
U3220	5109632D83	LVZIF IC
U3501	5105109Z67	LDMOS Pre-driver
U3502	5185765B01	Power Control IC
U3503	5185963A15	Temperature Sense
U3701	5185963A27	LVFRACTN IC
U3711	5105739X05	Regulator, linear
U3801	5105750U54	VCO Buffer
U400	5102463J40	3.3V Reg
U404	5185963A53	AsficCmp
U405	Not Placed	
U406	*5102463J59	Flash ROM 256K
U407	*5102463J64	EEPROM 16Kx8
U409	5102226J55	up HC11FL0
U410	5102463J57	3.3V Reg
U420	5102463J44	Audio PA
VR431	4802245J51	6.8V Zener
VR432	4880140L15	10V Zener
VR433	4880140L15	10V Zener
VR439	4880140L15	10V Zener
VR440	4802245J51	6.8V Zener
VR441	4802245J51	6.8V Zener
VR444	4802245J51	6.8V Zener
VR450	4802245J53	10V Zener
VR451	4802245J53	10V Zener
VR501	4813830A18	6.8V Zener
VR506	4802245J51	6.8V Zener
Y3200	4802245J43	XTAL
Y3761	4802245J49	16.8MHz Crystal
	7580671Z01	pad (flexible circuit)

* Motorola Depot Servicing only

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